DATASHEET v1.0

nRF54LM20A and nRF54LM20B Wireless SoCs

nRF54LM20A and nRF54LM20B are part of the nRF54L Series of wireless System on Chips (SoCs). Every device in the series integrates an ultra-low power multiprotocol 2.4 GHz radio with MCU (Microcontroller Unit) functionality featuring a 128 MHz Arm® Cortex®-M33 processor. The nRF54LM20B variant includes an Axon Neural Processing Unit (NPU) – an edge AI accelerator. nRF54LM20A and nRF54LM20B feature an extended peripheral set including high-speed USB, increased memory size with 2036 KB NVM and 512 KB RAM, and up to 66 GPIO pins.

Nordic Semiconductor's proprietary technologies, such as low-leakage RAM and advanced multiprotocol radio design, enable ultra-low power consumption, reducing battery size or extending battery life.

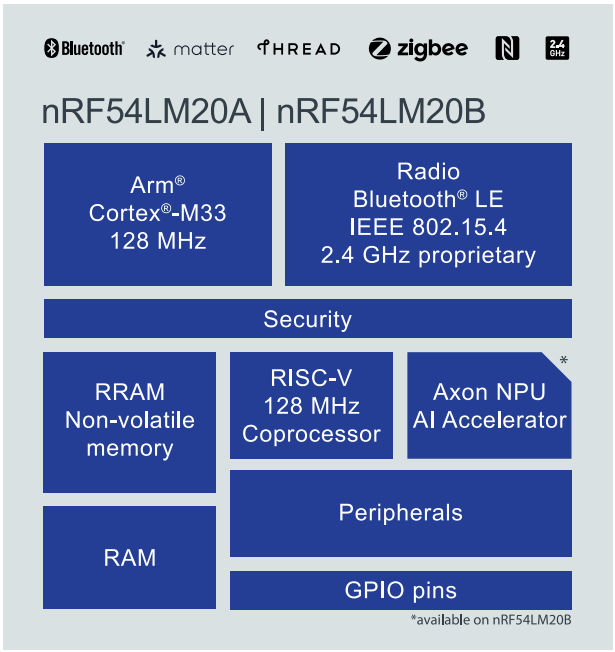
Designed with versatility in mind, the nRF54L Series SoCs enable a broad range of applications. The multiprotocol 2.4 GHz radio supports *Bluetooth*® LE with optional features including Channel Sounding introduced in *Bluetooth*® Core 6.0, as well as 802.15.4-2020 for standards such as Thread®, Matter, and Zigbee®, and a proprietary 2.4 GHz mode supporting up to 4 Mbps for higher throughput. The devices integrate the peripherals expected in a wireless microcontroller, enabling many products to be implemented with a single chip. An integrated RISC-V coprocessor further reduces the need for external ICs.

nRF54LM20A and nRF54LM20B enable demanding designs for *Bluetooth*® LE devices, as well as smart home and industrial applications, which require more memory, advanced features, and high GPIO counts.

The nRF54LM20B Axon NPU provides acceleration in edge AI applications such as health, biometric and activity tracking, voice control and audio classification, and low-fidelity vision.

Key features

- 128 MHz Arm® Cortex®-M33 processor
- 2036 KB NVM and 512 KB RAM
- Multiprotocol 2.4 GHz radio supporting *Bluetooth*® LE, 802.15.4-2020, and 2.4 GHz proprietary modes (up to 4 Mbps)
- Seven serial interfaces (SPI/TWI/UART) including high-speed support
- High-speed USB interface
- Extended set of interfaces, peripherals, and timers including Global RTC available in System OFF, ADC, TDM, PDM, NFC, PWM, and QDEC
- 128 MHz RISC-V coprocessor
- Optional Axon NPU
- Advanced security including TrustZone® isolation, tamper detection, and cryptographic engine with side-channel leakage protection
- Ultra-compact CSP and QFN packages



Power consumption highlights

Power mode	Current @ 3.0 V
Active with radio	
Bluetooth® LE TX 1 Mbps at 0 dBm	5.0 mA
Bluetooth® LE TX 1 Mbps at +4 dBm	7.1 mA
Bluetooth® LE TX 1 Mbps at +8 dBm	10.9 mA
Bluetooth® LE RX 1 Mbps	3.3 mA
Active with processing	
CPU CoreMark® from RRAM with cache	2.6 mA
Axon NPU running DS-CNN KWS	3.0 mA
Sleep	
System ON IDLE with GRTC (XOSC) and 512 KB RAM	4.3 µA
System OFF with GRTC wakeup	1.0 µA
System OFF	0.7 µA

Product variants

Part number	NVM	RAM	Axon NPU
nRF54LM20A	2036 KB	512 KB	No
nRF54LM20B	2036 KB	512 KB	Yes

Feature overview

Radio

- *Bluetooth*® LE
  - LE 2M, LE 1M, LE Coded
  - Channel Sounding
- IEEE 802.15.4-2020 – 250 kbps
  - Enables Matter, Thread®, Zigbee®
- 2.4 GHz proprietary GFSK
  - 4 Mbps, 2 Mbps, 1 Mbps
- Single-ended antenna output (on-chip balun)
- 128-bit AES/ECB/CCM/AAR coprocessor
- Configurable TX power with 1 dBm step size from -10 dBm to maximum

Processor

- 128MHz Arm® Cortex®-M33 CPU
  - FPU, DSP, MPU, TrustZone®
  - Debug – SWD, ETM, ITM, DWT, CTI, TPIU

Memory

- 2036 KB NVM (RRAM)
- 512 KB RAM

Edge AI accelerator

- nRF54LM20B only:
  - Axon NPU (AXONS)

Coprocessor/SoftPeripherals

- 128 MHz RISC-V coprocessor (VPR)
- sQSPI available as SoftPeripheral for VPR; see the software documentation for details

Peripherals

- Seven fully featured serial interfaces with EasyDMA, supporting I^2C, SPI controller/peripheral, and UART
  - One HS-SPI up to 32 MHz, six SPI up to 8 MHz (SPIM, SPIS)
  - Six TWI up to 400 kHz and I^2C compatible (TWIM, TWIS)
  - One HS-UART up to 4 Mbps, six UART up to 1 Mbps (UARTE)
- SAADC with eight programmable gain channels
  - 14-bit at 62.5 ksps (oversampled)
  - 12-bit at 125 ksps (oversampled)
  - 10-bit at up to 2 Msps
- High-speed USB interface (USBHS)
- Global RTC can run in System OFF mode and implement a shared system timer (GRTC)
- NFC-A listening device (NFCT)
- Pulse density modulation interface (PDM)
- Time division multiplexed sound interface, also configurable as I^2S interface (TDM)
- Three pulse width modulation four-channel units with autonomous waveform generation (PWM)
- Two quadrature decoders (QDEC)
- Two individual watchdog timers for secure and non-secure context (WDT)
- Seven 32-bit timers with counter mode (TIMER)
- Temperature sensor (TEMP)
- Comparator and low-power comparator with wake-up from System OFF mode (COMP, LPCOMP)

GPIO

- Up to 66 GPIO pins
- 64 MHz and 8 MHz ports

Power supply and clock

- Single-inductor DC/DC regulator
- Single 32 MHz crystal operation
- Optional 32.768 kHz crystal

Security

- Arm TrustZone, Root of Trust, secure boot, secure storage
- Security components – Cryptographic engine (CRACEN), Key management (KMU)
- Physical protection – Tamper detectors (TAMPC, GLITCHDET), Side-channel protection

Key specifications

- 8 dBm/7 dBm maximum TX power (CSP/QFN)
- -95.5 dBm RX sensitivity for 1 Mbps Bluetooth LE
- -101 dBm RX sensitivity for IEEE 802.15.4
- 503 CoreMark®, 3.93 CoreMark/MHz EEMBC CoreMark executing from non-volatile memory
- 1.7 V to 3.6 V supply and GPIO voltage
- -40°C to +85°C operating temperature

Packages for all variants

- CSP61 (CAAA) with 40 GPIO pins
  - 3.02x2.43 mm with 0.325 mm pitch
- CSP98 (PAAA) with 66 GPIO pins
  - 3.67x3.85 mm with 0.35 mm pitch
- QFN52 (QGAA) with 32 GPIO pins
  - 6x6 mm with 0.4 mm pitch

1 Revision history

Date	Version	Description
May 2026	1.0	First release

2 About this document

This document is organized into chapters that are based on the modules and peripherals available in the IC.

2.1 Document status

The document status reflects the level of maturity of the document.

Document name	Description
Preliminary Datasheet	Applies to document versions up to 1.0. This document contains target specifications for product development.
Datasheet	Applies to document versions 1.0 and higher. This document contains final product specifications. Nordic Semiconductor ASA reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.

Table 1: Defined document names

2.2 Peripheral chapters

The chapters describing peripherals include the following information:

- A description of the peripheral.
- The electrical specification tables, containing performance data which applies for the operating conditions described in Recommended operating conditions on page 1283.

2.2.1 Peripheral naming conventions

Every peripheral has a unique capitalized name or an abbreviation of its name, such as TIMER, that is used for identification and reference.

This name is used in chapter headings and references, and it will appear in the Arm Cortex Microcontroller Software Interface Standard (CMSIS) hardware abstraction layer to identify the peripheral.

When there is more than one instance of a peripheral in a power domain, a two digit number Dn is added as a suffix to the peripheral name when constructing the peripheral instance name. For example, a peripheral named PERI with instance name "PERI`Dn`" is located in power domain `D`, and is instance number `n` in that domain. For a list of power domains, see Power domains on page 11.

The following are additional examples of peripheral instance names:

- PPIB00 is in the MCU domain (0), and is the first PPIB instance in the MCU domain (0).
- SPIS21 is in the PERI domain (2), and is the second SPIS instance of the PERI domain (1).

The peripheral instance name is also used in the CMSIS to identify the peripheral instance.

The domain digits x are listed in the following table.

Domain digit	Power domain
0	MCU
1	RADIO
2	PERI
3	LP

Table 2: Domain digit overview

2.2.2.1 Peripheral instantiation

The peripherals have a set of security capabilities listed in Instantiation on page 232.

The following table describes the abbreviations used.

Abbreviation	Description
NS	TrustZone/security attribute is non-secure The peripheral is accessible as a non-secure peripheral
S	TrustZone/security attribute is secure The peripheral is accessible as a secure peripheral
US	TrustZone Map is user selectable The TrustZone/security attribute of the peripheral is configurable
HF	TrustZone Map is Hardware Fixed The TrustZone/security attribute of the peripheral cannot be changed
NA	Not Applicable – Peripheral has no DMA capability
NSA	NoSeparateAttribute – Peripheral with DMA and DMA transfer has the same security attribute as assigned to the peripheral
SA	SeparateAttribute – Peripheral with DMA and DMA transfers can have a different security attribute than the one assigned to the peripheral

Table 3: Instantiation table abbreviations

The Secure mapping column in the peripheral instantiation table defines configuration capabilities for the Arm TrustZone for Armv8-M secure attribute. The DMA security column describes the DMA capabilities of the peripheral.

The instantiation table has the following columns:

- Instance Column – Indicates the peripheral instance name followed by optional TrustZone attribute. A corresponding address is listed in the Base address column indicating the base address for secure and non-secure TrustZone attributes. This optional TrustZone attribute is separated by a colon (:).
- Trustzone Column – This has 3 sub-columns indicating the TrustZone map, TrustZone attribute and DMA capability. The options are as listed in Instantiation table abbreviations on page 5.

2.3 Register overview table

The register overview table shows a summary of all peripheral registers.

The following table explains the columns of the register overview table.

Field	Description
Register	Name of register
Offset	Offset address from peripheral base address
TZ	Security setting for split-security peripherals, blank for other peripherals
Description	Short summary of intended use

Table 4: Register overview table

2.4 Register tables

Individual registers are described using register tables. These tables are composed of two sections. The first three colored rows describe the position and size of the different fields in the register. The following rows describe the fields in more detail.

2.4.1 Fields and values

The ID row specifies the bits that belong to the different fields in the register. If a field has enumerated values, then every value will be identified with a unique value ID in the Value ID column.

A blank space means that the field is reserved and read as undefined. These fields must be written as `0` to secure forward compatibility. If a register is divided into more than one field, a unique field name is specified for each field in the Field column. The Value ID may be omitted in the single-bit bit fields when values can be substituted with a Boolean type enumerator range, such as true/false, disable(d)/enable(d), on/off, and so on.

Values are usually provided as decimal or hexadecimal. Hexadecimal values have a `0x` prefix; decimal values have no prefix.

The Value column can be populated in the following ways:

- Individual enumerated values, for example 1, 3, 9.
- Range of values, for example [0..4], indicating all values from 0 to 4.
- Implicit values. If no values are indicated in the Value column, all bit combinations are supported, or the field's translation and limitations are described in the text instead.

If two or more fields are closely related, the Value ID, Value, and Description may be omitted for all but the first field. Subsequent fields will indicate inheritance with '..'.

A feature marked Deprecated should not be used for new designs.

2.4.2 Permissions

Each register field can have different access permissions enforced by hardware. The access permission for each register field is documented in the Access column in the following ways:

Access	Description	Hardware behavior
R	Read only	Field can only be read. A write will be ignored.
W	Write only	Field can only be written. A read will return an undefined value.
RW	Read/write	Field can be read and written multiple times.
W1	Write once	Field can only be written once per reset. Any subsequent write will be ignored. A read will return an undefined value.
RW1	Read/write once	Field can be read multiple times, but only written once per reset. Any subsequent write will be ignored.
W0C	Write 0 to clear	Field can be read multiple times. A zero clears (set to zero) the corresponding bit in the register. Bits set to one are ignored.
W1C	Write 1 to clear	Field can be read multiple times. A one clears (set to zero) the corresponding bit in the register. Bits set to zero are ignored.
W1S	Write 1 to set	Field can be read multiple times. A one sets the corresponding bit in the register. Bits set to zero are ignored.
RME	Read Modify External	When read, a side effect occurs.

Table 5: Register field permission schemes

2.5 Registers

Register overview

Register	Offset	TZ	Description
DUMMY	0x514		Example of a register controlling a dummy feature

2.5.1 DUMMY

Address offset: 0x514

Example of a register controlling a dummy feature

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				J					I	H	G	F	E	D	D	D	C	C	C							B							A	A
Reset 0x00050002				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	FIELD0																																	
			Disabled	0																															
			NormalMode	1																															
			ExtendedMode	2																															
B	RW	FIELD1																																	
				This field is deprecated.																															
			Disabled	0																															
			Enabled	1																															
C	RW	FIELD2																																	
			ValidRange	[2..7]																															
D	RW	FIELD3																																	
E	R	FIELD4																																	
F	W	FIELD5																																	
G	RW W1C	FIELD6																																	
H	RW W0C	FIELD7																																	

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	J					I	H	G	F	E	D	D	D	C	C	C								B							A	A
Reset 0x00050002	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**

ID	R/W	Field	Value ID	Value	Description
I	RW	FIELD8			Example of a field that causes a side effect when read
	RME				
J	RW	PRIVATE			Example of a read-write field with "private" audience

3 Product overview

The device is an ultra-low power System on Chip (SoC) with advanced security features, a range of peripherals, and a multiprotocol 2.4 GHz transceiver.

It supports Bluetooth Low Energy, IEEE 802.15.4 for Thread and Zigbee protocols, and allows for the implementation of proprietary 2.4 GHz protocols.

The main processing unit is an Arm Cortex-M33 processor running at up to 128 MHz, supported by non-volatile RRAM and RAM memory.

The Arm Cortex-M33 has a full set of digital signal processing (DSP) instructions and a memory protection unit (MPU) for application security. The full-featured, single-precision floating-point unit (FPU) supports all single-precision instructions.

The peripheral set offers a variety of analog and digital functionality, enabling single-chip implementation of a wide range of applications.

Hardware isolation between the secure and non-secure resources, as defined by Arm TrustZone, is implemented in the device. The hardware peripherals can be configured as secure or non-secure.

A key management unit (KMU) provides key storage, that when combined with a cryptographic accelerator (CRACEN), ensures discretion of encryption keys even within the secure world. The cryptographic accelerator has protection against differential power analysis (DPA) attacks.

The device protects against physical security attacks through several security measures. It can detect and report fault injection attacks such as voltage glitching or electromagnetic fault injection. An external active shield I/O interface provides PCB or product level security for the detection of a product's encapsulation being opened, or product tampering.

The non-volatile memory on the device has a boot region that can be made immutable before the CPU starts up. Boot initiated from an immutable source allows subsequent boot steps to be performed by authenticated code.

The debug access port can be enabled or disabled to allow both non-intrusive and intrusive debugging, from secure- or non-secure worlds. The non-volatile memory can be protected against erasing, providing protection from unauthenticated repurposing. Authenticated debug access control, such as facilitating the Arm ADAC architecture, is supported through a hardware mailbox. The mailbox allows on-chip firmware to authenticate the debug host before enabling the device debug interface.

The device has a dedicated RISC-V CPU (VPR), which is a fast, lightweight peripheral processor (FLPR) dedicated for software defined peripherals.

3.1 Block diagram

The block diagram illustrates the overall system.

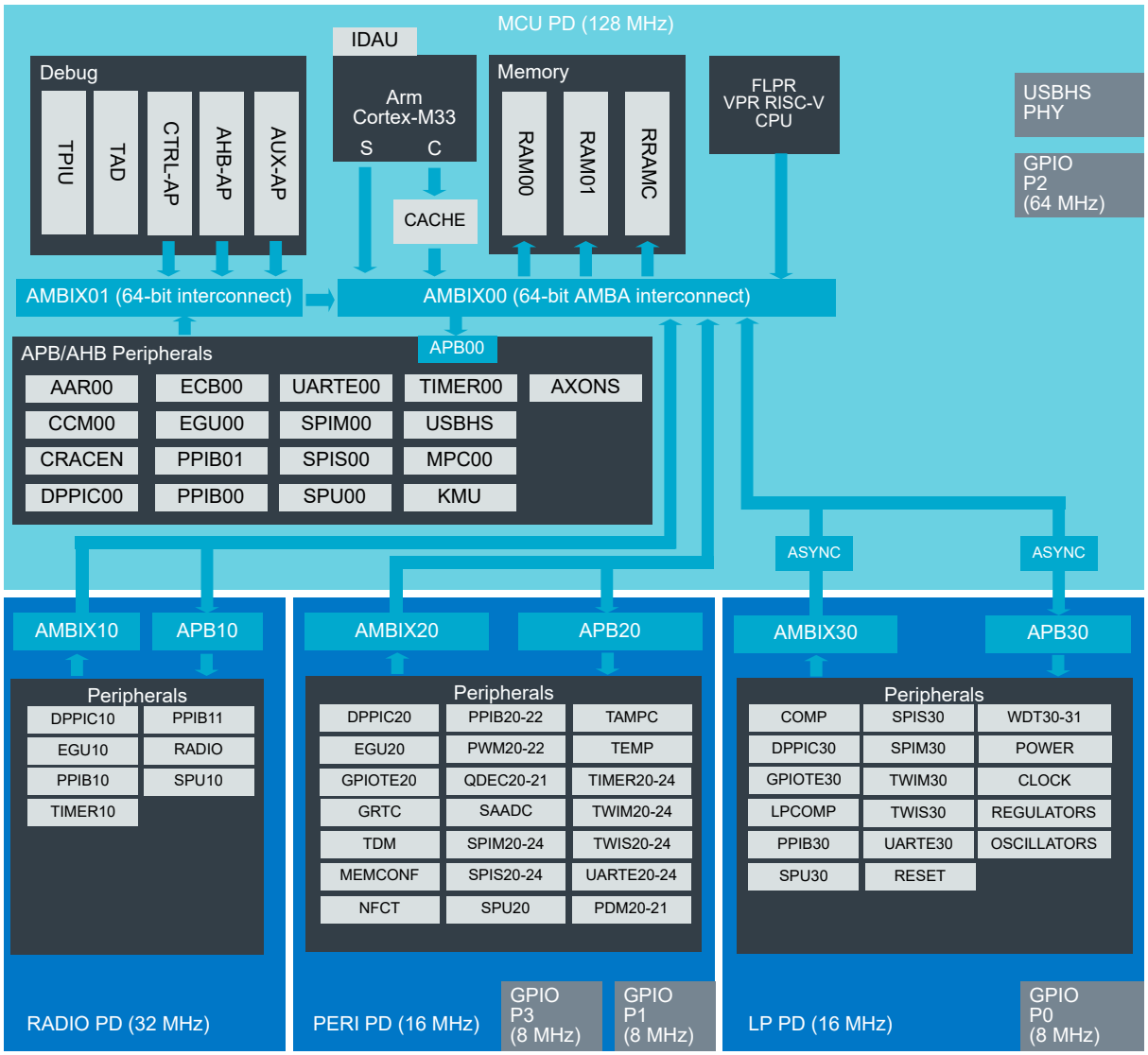


Figure 1: Block diagram

3.2 Memory and package overview

Memory	Device	
	nRF54LM20A	nRF54M20B
Non-volatile memory (RRAM)	2036 KB	2036 KB
Random access memory (RAM)	512 KB	512 KB
Axon NPU (Neural processing unit)	No	Yes

Table 6: Device memory and feature options

Feature		Package		
		QFN52	CSP61	CSP98
Pins	GPIO pins	32	40	66
	Wakeup-pins	26	34	55
	Analog input pins	8	8	8
Security	Active tamper shield pin pairs (in/out)	3	3	4
Debug	ITM parallel trace	No	No	Yes
Device	Package options			
	nRF54LM20A	Yes	Yes	Yes
	nRF54LM20B	Yes	Yes	Yes

Table 7: Package variants

3.3 Power domains

Multiple power domains ensure low-power operation.

The MCU domain contains an Arm Cortex-M33. The CPU is connected to a debug system that allows debug and ETM trace. The CPU executes program code from RRAM through an instruction cache. Data is stored in single-cycle RAM that is divided into multiple bus subordinates forming a continuous RAM space in the memory map. High-speed peripherals are also found in the MCU domain.

There are three additional domains that have peripherals allocated to them. They are the following:

- Radio domain – Contains the short-range radio and supporting peripherals used by the radio protocol stack. It runs at 32 MHz synchronously with the MCU domain.
- Peripheral domain – Contains most peripherals. It runs at 16 MHz synchronously with the MCU domain.
- Low-power domain – Contains peripherals for ultra-low power modes and can be used to wake the rest of the system, even when the peripheral domain is powered off. It runs at 16 MHz asynchronously to the MCU domain.

Each domain is mapped to one APB bus and can be powered independently. EasyDMA traffic from each domain is aggregated in a local AMBIX interconnect and can access RAM in the MCU domain.

Power domains have their own GPIO ports. GPIO pins can be used by peripherals in the same power domain. For exceptions, see GPIO — General purpose input/output on page 292 and pin assignments.

3.4 Address format

Addresses in the system memory map follow the address format described in the following tables.

Address bits	Description	Enumeration
[28:0]	Address space	
[31:29]	Address regions	0: Program memory 1: Data memory 2: Peripherals/APB space 7: CPU internal peripherals, like Arm Cortex private peripheral bus (PPB)

Table 8: Address regions format

The program and data memory address format is described in the following table.

Address bits	Description	Enumeration
[23:0]	Address space	
[28:24]	Reserved	Set to zero
[31:29]	Address regions	0: Program memory 1: Data memory

Table 9: Program memory and data memory address format

The peripheral address format is described in the following table.

Address bits	Description	Enumeration
[11:0]	Peripheral address space	
[17:12]	Peripheral subordinate index	Used for configuring the SPU — System protection unit on page 195, as the index *n* of register SPU.PERIPH[*n*].PERM.
[20:12]	Interrupt vector number	The index in the interrupt vector table
[23:18]	Peripheral APB bus number	1: APB peripherals in MCU power domain 2: APB peripherals in RADIO power domain 3: APB peripherals in PERI power domain 4: APB peripherals in LP power domain
[27:24]	Reserved	Set to zero
[28]	Security	0: Non-secure 1: Secure
[31:29]	Address regions	2: Peripherals on APB bus

Table 10: Peripheral address format

3.5 Memory

The CPU and peripherals with EasyDMA can access memory through the AMBIX interconnects. The same interconnect is used by the CPU to access peripheral registers. The following figure is a simplified interconnect diagram.

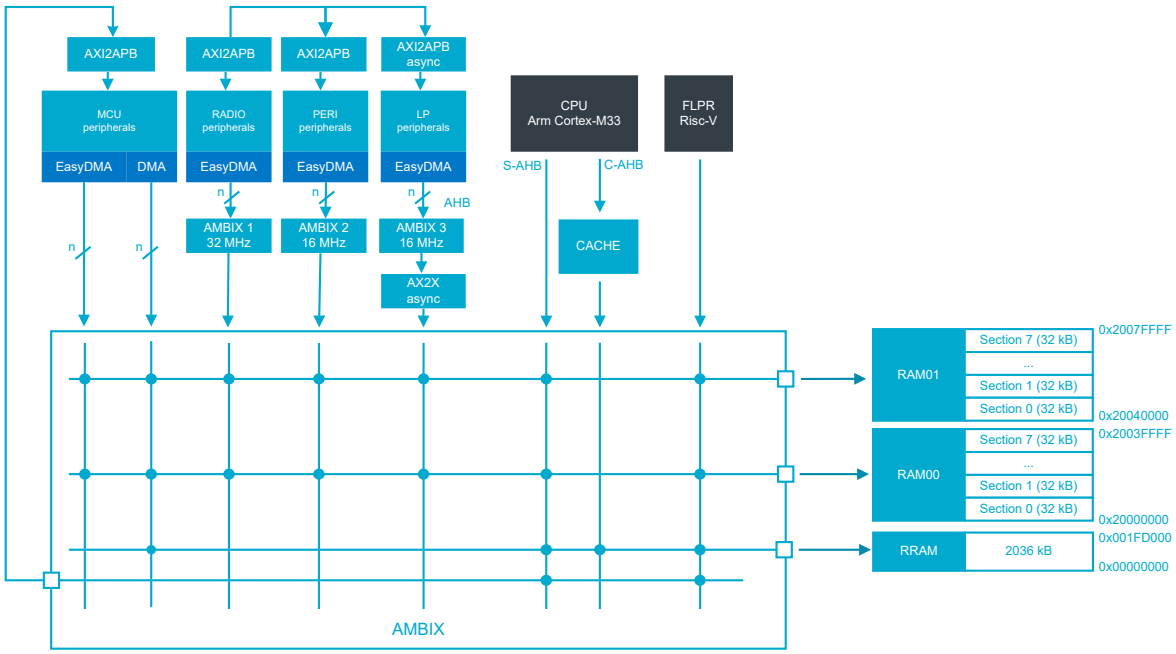


Figure 2: Memory layout

See Block diagram on page 9, AMBA interconnect (AMBIX) on page 28, and EasyDMA on page 29 for more information about the AMBIX interconnects and EasyDMA.

RAM and RRAM memory regions are protected with TrustZone security and are secure after reset. Memory regions can be configured to be non-secure by using MPC — Memory Privilege Controller on page 189.

3.5.1 RAM — Random access memory

The device RAM has sections arranged in one contiguous memory range, accessible from both the CPU and peripherals.

Each RAM sections has separate power control for System ON and System OFF mode. This preserves RAM contents in sleep modes or powers off RAM to save power. The sections are illustrated in Memory layout on page 13, and the register interface is described in MEMCONF — Memory configuration on page 46.

At the high end of the RAM address range are two dedicated areas:

- ProtectedRAM is used for secure key storage.
- VPR saved context is used by VPR to store and restore the context of the VPR during hibernation sleep.

For details, see Memory map on page 14.

3.5.2 NVM — Non-volatile memory

The CPU can read from non-volatile memory (RRAM) an unlimited number of times, but is restricted in how it writes to memory and the number of writes it can perform.

Writing to RRAM is managed by the RRAM controller (RRAMC), see RRAMC — Resistive random access memory controller on page 48.

The Arm Cortex-M33 CPU can access RRAM using the C-AHB (code) bus as shown in Memory layout on page 13. The code bus (C-AHB) interface is used for any instruction fetch or data access fetch to the code region of the Arm memory model. C-AHB bus access is cached, see CACHE — Instruction/data cache on page 31.

RRAM can also be accessed by FLPR. FLPR does not share the instruction cache with the Cortex-M33; it has its own built-in, dedicated cache that is only available to VPR. The regular CACHE — Instruction/data cache on page 31 is dedicated to the Cortex-M33 and is not available to FLPR.

3.5.3 Memory map

The complete memory map is shown in the following figure.

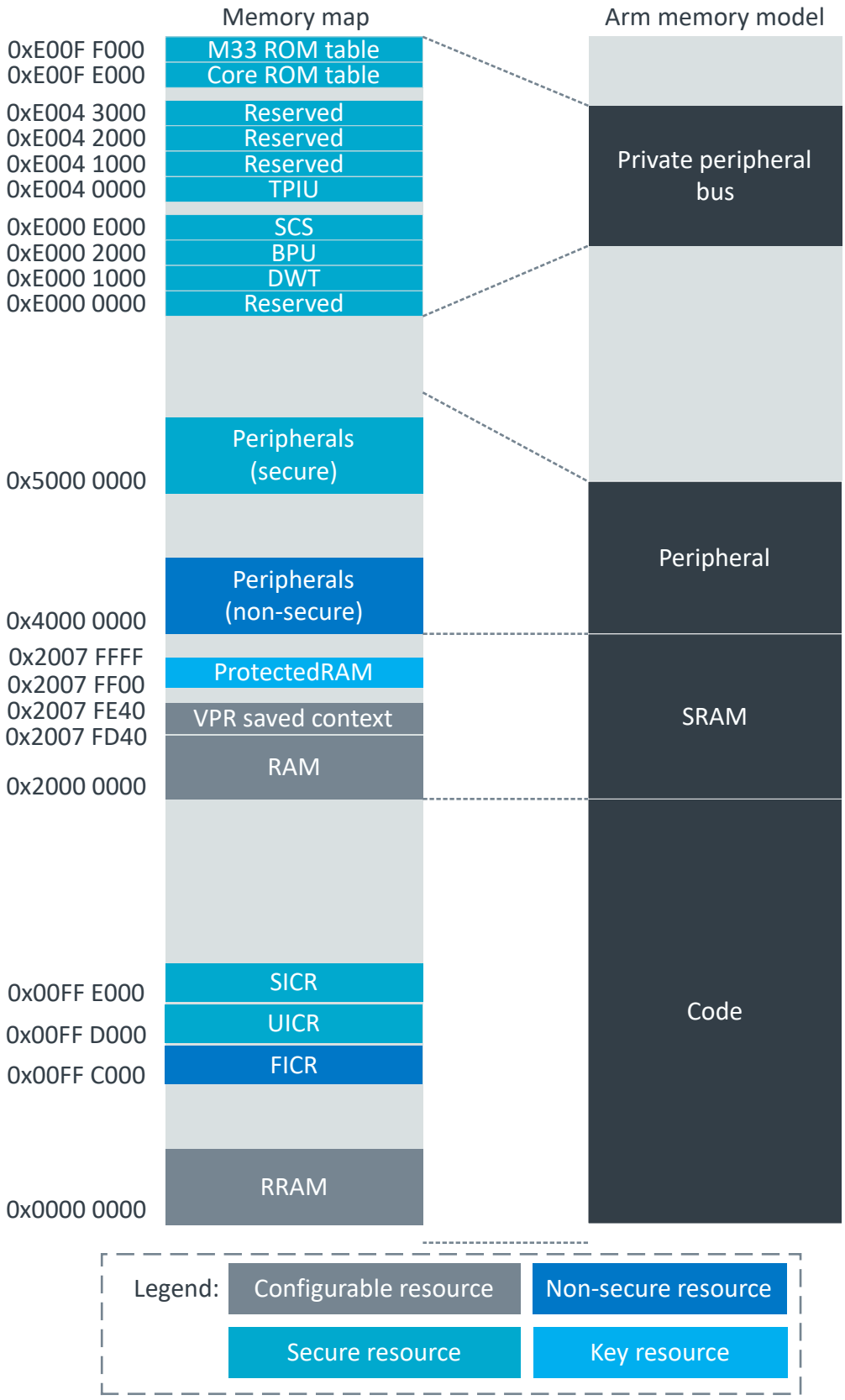


Figure 3: Memory map

3.5.4 Instantiation

ID	Base address	Instance	TrustZone			Split access	Description
			Map	Att	DMA		
32	0x50020000 0x40020000	USBHSCORE : S USBHSCORE : NS	US	S	SA	No	USBHSCORE
64	0x50040000	SPU00	HF	S	NA	No	System protection unit SPU00
65	0x50041000	MPC00	HF	S	NA	No	Memory privilege controller MPC00
66	0x50042000 0x40042000	DPPIC00 : S DPPIC00 : NS	US	S	NA	Yes	DPPI controller DPPIC00
68	0x50044000 0x40044000	PPIB00 : S PPIB00 : NS	US	S	NA	No	PPI bridge PPIB00
69	0x50045000 0x40045000	PPIB01 : S PPIB01 : NS	US	S	NA	No	PPI bridge PPIB01
73	0x50049000	KMU	HF	S	NSA	No	Key management unit
74	0x5004A000 0x4004A000	AAR00 : S AAR00 : NS	US	S	SA	No	Accelerated address resolver 00
74	0x5004A000 0x4004A000	CCM00 : S CCM00 : NS	US	S	SA	No	AES CCM mode encryption CCM00, running of HCLKCORE
75	0x5004B000 0x4004B000	ECB00 : S ECB00 : NS	US	S	SA	No	AES ECB mode encryption 00 When configuring this peripheral's DMA security using SPU configuration (DMASEC field of SPU->PERIPH[apb_slave_index]), use apb_slave_index 10 (same as AAR00 and CCM00)
76	0x5004C000 0x4004C000	VPR00 : S VPR00 : NS	US	NS	NA	No	FLPR - VPR peripheral registers
77	0x5004D000 0x4004D000	SPIM00 : S SPIM00 : NS	US	S	SA	No	SPI controller SPIM00
77	0x5004D000 0x4004D000	SPIS00 : S SPIS00 : NS	US	S	SA	No	SPI peripheral SPIS00
77	0x5004D000 0x4004D000	UARTE00 : S UARTE00 : NS	US	S	SA	No	Universal asynchronous receiver/transmitter UARTE00
78	0x5004E000	GLITCHDET	HF	S	NA	No	Glitch detectors
78	0x5004E000	RRAMC	HF	S	NA	No	RRAM Non-Volatile Memory Controller
80	0x50050400 0x40050400	GPIOHSPADCTRL : S GPIOHSPADCTRL : NS	US	S	NA	Yes	GPIO HS pad control GPIOHSPADCTRL
80	0x50050400 0x40050400	P2 : S P2 : NS	US	S	NA	Yes	General purpose input and output, port P2 Does not support pin sense mechanism, and DETECTMODE register has no effect. Supports extra high drive (DRIVE0=E0, DRIVE1=E1).
82	0x50052000 0x40052000	CTRLAP : S CTRLAP : NS	US	S	NSA	No	Control access port CPU side
83	0x50053000 0x40053000	TAD : S TAD : NS	US	S	NA	No	Trace and debug control
85	0x50055000 0x40055000	TIMER00 : S TIMER00 : NS	US	S	NA	No	Timer TIMER00
86	0x50056000 0x40056000	AXONS : S AXONS : NS	US	S	SA	No	Neural processing unit
88	0x50058000 0x40058000	EGU00 : S EGU00 : NS	US	S	NA	No	Event generator unit EGU00
89	0x50059000	CRACEN	HF	S	NSA	No	Crypto accelerator
90	0x5005A000 0x4005A000	USBHS : S USBHS : NS	US	S	SA	No	USBHS

ID	Base address	Instance	TrustZone			Split access	Description
			Map	Att	DMA		
128	0x50080000	SPU10	HF	S	NA	No	System protection unit SPU10
130	0x50082000 0x40082000	DPPIC10 : S DPPIC10 : NS	US	S	NA	Yes	DPPI controller DPPIC10
131	0x50083000 0x40083000	PPIB10 : S PPIB10 : NS	US	S	NA	No	PPI bridge PPIB10
132	0x50084000 0x40084000	PPIB11 : S PPIB11 : NS	US	S	NA	No	PPI bridge PPIB11
133	0x50085000 0x40085000	TIMER10 : S TIMER10 : NS	US	S	NA	No	Timer TIMER10
135	0x50087000 0x40087000	EGU10 : S EGU10 : NS	US	S	NA	No	Event generator unit EGU10
138	0x5008A000 0x4008A000	RADIO : S RADIO : NS	US	S	SA	No	2.4 GHz radio RADIO See pinout for GPIO options for DFE antenna switch control
192	0x500C0000	SPU20	HF	S	NA	No	System protection unit SPU20
194	0x500C2000 0x400C2000	DPPIC20 : S DPPIC20 : NS	US	S	NA	Yes	DPPI controller DPPIC20
195	0x500C3000 0x400C3000	PPIB20 : S PPIB20 : NS	US	S	NA	No	PPI bridge PPIB20
196	0x500C4000 0x400C4000	PPIB21 : S PPIB21 : NS	US	S	NA	No	PPI bridge PPIB21
197	0x500C5000 0x400C5000	PPIB22 : S PPIB22 : NS	US	S	NA	No	PPI bridge PPIB22
198	0x500C6000 0x400C6000	SPIM20 : S SPIM20 : NS	US	S	SA	No	SPI controller SPIM20
198	0x500C6000 0x400C6000	SPIS20 : S SPIS20 : NS	US	S	SA	No	SPI peripheral SPIS20
198	0x500C6000 0x400C6000	TWIM20 : S TWIM20 : NS	US	S	SA	No	Two-wire interface controller TWIM20
198	0x500C6000 0x400C6000	TWIS20 : S TWIS20 : NS	US	S	SA	No	Two-wire interface target TWIS20
198	0x500C6000 0x400C6000	UARTE20 : S UARTE20 : NS	US	S	SA	No	Universal asynchronous receiver/transmitter UARTE20
199	0x500C7000 0x400C7000	SPIM21 : S SPIM21 : NS	US	S	SA	No	SPI controller SPIM21
199	0x500C7000 0x400C7000	SPIS21 : S SPIS21 : NS	US	S	SA	No	SPI peripheral SPIS21
199	0x500C7000 0x400C7000	TWIM21 : S TWIM21 : NS	US	S	SA	No	Two-wire interface controller TWIM21
199	0x500C7000 0x400C7000	TWIS21 : S TWIS21 : NS	US	S	SA	No	Two-wire interface target TWIS21
199	0x500C7000 0x400C7000	UARTE21 : S UARTE21 : NS	US	S	SA	No	Universal asynchronous receiver/transmitter UARTE21
200	0x500C8000 0x400C8000	SPIM22 : S SPIM22 : NS	US	S	SA	No	SPI controller SPIM22
200	0x500C8000 0x400C8000	SPIS22 : S SPIS22 : NS	US	S	SA	No	SPI peripheral SPIS22
200	0x500C8000 0x400C8000	TWIM22 : S TWIM22 : NS	US	S	SA	No	Two-wire interface controller TWIM22
200	0x500C8000 0x400C8000	TWIS22 : S TWIS22 : NS	US	S	SA	No	Two-wire interface target TWIS22

ID	Base address	Instance	TrustZone			Split access	Description
			Map	Att	DMA		
200	0x500C8000 0x400C8000	UARTE22 : S UARTE22 : NS	US	S	SA	No	Universal asynchronous receiver/transmitter UARTE22
201	0x500C9000 0x400C9000	EGU20 : S EGU20 : NS	US	S	NA	No	Event generator unit EGU20
202	0x500CA000 0x400CA000	TIMER20 : S TIMER20 : NS	US	S	NA	No	Timer TIMER20
203	0x500CB000 0x400CB000	TIMER21 : S TIMER21 : NS	US	S	NA	No	Timer TIMER21
204	0x500CC000 0x400CC000	TIMER22 : S TIMER22 : NS	US	S	NA	No	Timer TIMER22
205	0x500CD000 0x400CD000	TIMER23 : S TIMER23 : NS	US	S	NA	No	Timer TIMER23
206	0x500CE000 0x400CE000	TIMER24 : S TIMER24 : NS	US	S	NA	No	Timer TIMER24
207	0x500CF000 0x400CF000	MEMCONF : S MEMCONF : NS	US	S	NA	No	Memory Configuration MEMCONF
208	0x500D0000 0x400D0000	PDM20 : S PDM20 : NS	US	S	SA	No	Pulse density modulation (digital microphone) interface PDM20
209	0x500D1000 0x400D1000	PDM21 : S PDM21 : NS	US	S	SA	No	Pulse density modulation (digital microphone) interface PDM21
210	0x500D2000 0x400D2000	PWM20 : S PWM20 : NS	US	S	SA	No	Pulse width modulation unit PWM20
211	0x500D3000 0x400D3000	PWM21 : S PWM21 : NS	US	S	SA	No	Pulse width modulation unit PWM21
212	0x500D4000 0x400D4000	PWM22 : S PWM22 : NS	US	S	SA	No	Pulse width modulation unit PWM22
213	0x500D5000 0x400D5000	SAADC : S SAADC : NS	US	S	SA	No	Successive approximation analog-to-digital converter SAADC
214	0x500D6000 0x400D6000	NFCT : S NFCT : NS	US	S	SA	No	Near field communication tag NFCT
215	0x500D7000 0x400D7000	TEMP : S TEMP : NS	US	S	NA	No	Temperature sensor TEMP
216	0x500D8200 0x400D8200	P1 : S P1 : NS	US	S	NA	Yes	General purpose input and output, port P1
216	0x500D8600 0x400D8600	P3 : S P3 : NS	US	S	NA	Yes	General purpose input and output, port P3
218	0x500DA000 0x400DA000	GPIOTE20 : S GPIOTE20 : NS	US	S	NA	Yes	8 channels and 2 interrupts for GPIO port P1 and P3 GPIO tasks and events GPIOTE20
224	0x500E0000 0x400E0000	QDEC20 : S QDEC20 : NS	US	S	NA	No	Quadrature decoder QDEC20
225	0x500E1000 0x400E1000	QDEC21 : S QDEC21 : NS	US	S	NA	No	Quadrature decoder QDEC21
226	0x500E2000 0x400E2000	GRTC : S GRTC : NS	US	S	NA	Yes	Global RTC GRTC
232	0x500E8000 0x400E8000	TDM : S TDM : NS	US	S	SA	No	Time division multiplexed audio interface TDM
237	0x500ED000 0x400ED000	SPIM23 : S SPIM23 : NS	US	S	SA	No	SPI controller SPIM23
237	0x500ED000 0x400ED000	SPIS23 : S SPIS23 : NS	US	S	SA	No	SPI peripheral SPIS23
237	0x500ED000 0x400ED000	TWIM23 : S TWIM23 : NS	US	S	SA	No	Two-wire interface controller TWIM23

ID	Base address	Instance	TrustZone			Split access	Description
			Map	Att	DMA		
237	0x500ED000 0x400ED000	TWIS23 : S TWIS23 : NS	US	S	SA	No	Two-wire interface target TWIS23
237	0x500ED000 0x400ED000	UARTE23 : S UARTE23 : NS	US	S	SA	No	Universal asynchronous receiver/transmitter UARTE23
238	0x500EE000 0x400EE000	SPIM24 : S SPIM24 : NS	US	S	SA	No	SPI controller SPIM24
238	0x500EE000 0x400EE000	SPIS24 : S SPIS24 : NS	US	S	SA	No	SPI peripheral SPIS24
238	0x500EE000 0x400EE000	TWIM24 : S TWIM24 : NS	US	S	SA	No	Two-wire interface controller TWIM24
238	0x500EE000 0x400EE000	TWIS24 : S TWIS24 : NS	US	S	SA	No	Two-wire interface target TWIS24
238	0x500EE000 0x400EE000	UARTE24 : S UARTE24 : NS	US	S	SA	No	Universal asynchronous receiver/transmitter UARTE24
239	0x500EF000	TAMPC	HF	S	NA	No	Tamper controller TAMPC
256	0x50100000	SPU30	HF	S	NA	No	System protection unit SPU30
258	0x50102000 0x40102000	DPPIC30 : S DPPIC30 : NS	US	S	NA	Yes	DPPI controller DPPIC30
259	0x50103000 0x40103000	PPIB30 : S PPIB30 : NS	US	S	NA	No	PPI bridge PPIB30
260	0x50104000 0x40104000	SPIM30 : S SPIM30 : NS	US	S	SA	No	SPI controller SPIM30
260	0x50104000 0x40104000	SPIS30 : S SPIS30 : NS	US	S	SA	No	SPI peripheral SPIS30
260	0x50104000 0x40104000	TWIM30 : S TWIM30 : NS	US	S	SA	No	Two-wire interface controller TWIM30
260	0x50104000 0x40104000	TWIS30 : S TWIS30 : NS	US	S	SA	No	Two-wire interface target TWIS30
260	0x50104000 0x40104000	UARTE30 : S UARTE30 : NS	US	S	SA	No	Universal asynchronous receiver/transmitter UARTE30
262	0x50106000 0x40106000	COMP : S COMP : NS	US	S	NA	No	Comparator COMP
262	0x50106000 0x40106000	LPCOMP : S LPCOMP : NS	US	S	NA	No	Low-power comparator LPCOMP
264	0x50108000	WDT30	HF	S	NA	No	Watchdog timer WDT30
265	0x50109000 0x40109000	WDT31 : S WDT31 : NS	US	S	NA	No	Watchdog timer WDT31
266	0x5010A000 0x4010A000	P0 : S P0 : NS	US	S	NA	Yes	General purpose input and output, port P0
268	0x5010C000 0x4010C000	GPIOTE30 : S GPIOTE30 : NS	US	S	NA	Yes	4 channels and 2 interrupts for GPIO port P0 GPIO tasks and events GPIOTE30
270	0x5010E000 0x4010E000	CLOCK : S CLOCK : NS	US	S	NA	No	Clock control
270	0x5010E000 0x4010E000	POWER : S POWER : NS	US	S	NA	No	Power control
270	0x5010E000 0x4010E000	RESET : S RESET : NS	US	S	NA	No	Reset status
288	0x50120000 0x40120000	OSCILLATORS : S OSCILLATORS : NS	US	S	NA	No	Oscillator control
288	0x50120000 0x40120000	REGULATORS : S REGULATORS : NS	US	S	NA	No	Regulator control

ID	Base address	Instance	TrustZone			Split access	Description
			Map	Att	DMA		
289	0x50121000 0x40121000	VREGUSB : S VREGUSB : NS	US	S	NA	No	USB regulator
N/A	0x00FFC000	FICR	HF	NS	NA	No	Factory information configuration
N/A	0x00FFD000	UICR	HF	S	NA	No	User information configuration
N/A	0x00FFE000	SICR	HF	S	NA	No	Secure information configuration region
N/A	0x50010000	CRACENCORE	HF	S	NSA	No	CRACEN core

Table 11: Instantiation table

4 Application core

4.1 Arm Cortex-M33 CPU

4.1.1 CPU

The Arm Cortex-M33 processor has a 32-bit instruction set (Thumb®-2 technology) that implements a super set of 16- and 32-bit instructions to maximize code density and performance.

This processor has the following features that enable energy-efficient arithmetic and high-performance signal processing:

- Digital signal processing (DSP) instructions:
  - Single-cycle multiply and accumulate (MAC) instructions
  - 8- and 16-bit single instruction multiple data (SIMD) instructions
- Hardware divide
- Single-precision floating-point unit (FPU)
- Memory Protection Unit (MPU)
- Arm TrustZone for Armv8-M
- Stack limit checking

The Arm Cortex Microcontroller Software Interface Standard (CMSIS) is implemented and available for the processor.

Real-time execution is highly deterministic in Thread mode, to and from sleep modes, and when handling events at configurable priority levels via the Nested Vectored Interrupt Controller (NVIC).

Instruction cache on the C-bus (code bus) of the Cortex-M33 CPU improves performance when fetching instructions (or data) from internal non-volatile memory. For more information on cache, see CACHE — Instruction/data cache on page 31. CPU performance parameters including wait states for configurations, CPU current consumption and efficiency, and processing power and efficiency based on the CoreMark benchmark can be found in CPU Electrical specification on page 1258.

4.1.1.1 Floating point interrupt

The floating point unit (FPU) may generate exceptions, for example, due to overflow or underflow. These exceptions may trigger interrupts when enabled in the FPU peripheral. For information on the FPU interrupts, see CPUC — CPU control on page 22.

4.1.1.2 CPU and support module configuration

The Arm Cortex-M33 processor has a number of CPU options and support modules implemented on the device.

Option	Description	Implemented
WIC	Wakeup Interrupt Controller	No
Endianness	Memory system endianness	Little endian
DWT	Data Watchpoint and Trace	Yes

Table 12: Core options

Module	Description	Implemented
MPU	Number of non-secure MPU regions	16
	Number of secure MPU regions	16
SAU	Number of SAU regions	4
FPU	Floating-point unit	Yes
DSP	Digital Signal Processing Extension	Yes
Arm TrustZone for Armv8-M	Armv8-M Security Extensions	Yes
CPIF	Coprocessor interface	No
ETM	Embedded Trace Macrocell	Yes
ITM	Instrumentation Trace Macrocell	Yes
MTB	Micro Trace Buffer	No
CTI	Cross Trigger Interface	No
BPU	Breakpoint Unit	Yes
INITSVTOR	Initial secure vector table offset	0x00000000
INITNSVTOR	Initial non-secure vector table offset	0x00000000

Table 13: Modules

4.1.2 CPUC — CPU control

CPUC controls elements of the Arm Cortex-M33 processor such as enabling floating-point exceptions. It is also able to lock certain features of the CPU and prevent them from being modified.

CPUC can generate events and CPU interupts for exceptions in the floating point unit (FPU), as shown in the following block diagram. Examples of such exceptions are divide-by-zero or floating-point overflow.

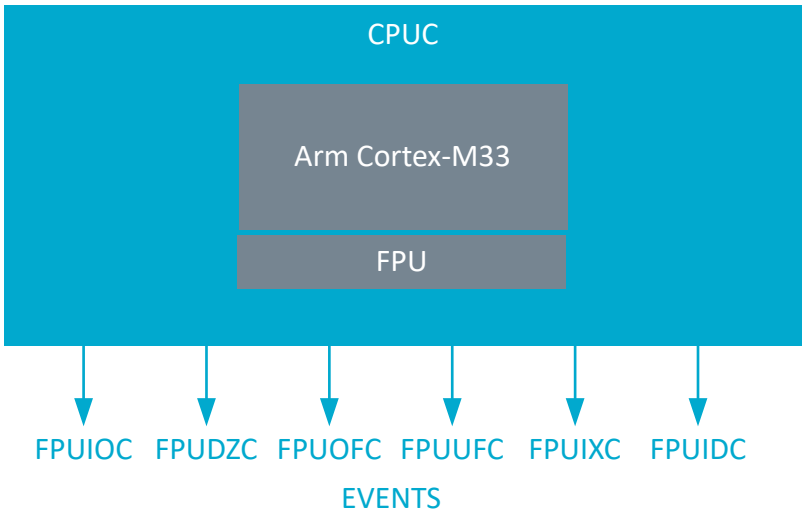


Figure 4: Block diagram

CPUC holds a CPU identifier CPUID, used in the system to uniquely identify the processing unit of a core.

In addition, CPUC holds a LOCK register, which is used to lock certain CPU features and prevent them from being modified. One example is the LOCK.LOCKSAU field. When set to `Locked`, this prevents further modifications to the SAU registers.

4.1.2.1 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
CPUC	APPLICATION	0xE0080000	HF	S	NA	No	Cortex-M33 configuration

Register overview

Register	Offset	TZ	Description
EVENTS_FPUIOC	0x100		An invalid operation exception has occurred in the FPU.
EVENTS_FPUDZC	0x104		A floating-point divide-by-zero exception has occurred in the FPU.
EVENTS_FPUOFC	0x108		A floating-point overflow exception has occurred in the FPU.
EVENTS_FPUUFC	0x10C		A floating-point underflow exception has occurred in the FPU.
EVENTS_FPUIXC	0x110		A floating-point inexact exception has occurred in the FPU.
EVENTS_FPUIDC	0x114		A floating-point input denormal exception has occurred in the FPU.
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
LOCK	0x500		Register to lock the certain parts of the CPU from being modified.
CPUID	0x504		The identifier for the CPU in this subsystem.

4.1.2.1.1 EVENTS_FPUIOC

Address offset: 0x100

An invalid operation exception has occurred in the FPU.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_FPUIOC			An invalid operation exception has occurred in the FPU.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

4.1.2.1.2 EVENTS_FPUDZC

Address offset: 0x104

A floating-point divide-by-zero exception has occurred in the FPU.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_FPUDZC			A floating-point divide-by-zero exception has occurred in the FPU.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

4.1.2.1.3 EVENTS_FPUOFC

Address offset: 0x108

A floating-point overflow exception has occurred in the FPU.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_FPUOFC			A floating-point overflow exception has occurred in the FPU.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

4.1.2.1.4 EVENTS_FPUUFC

Address offset: 0x10C

A floating-point underflow exception has occurred in the FPU.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_FPUUFC			A floating-point underflow exception has occurred in the FPU.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

4.1.2.1.5 EVENTS_FPUIXC

Address offset: 0x110

A floating-point inexact exception has occurred in the FPU.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_FPUIXC			A floating-point inexact exception has occurred in the FPU.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

4.1.2.1.6 EVENTS_FPUIDC

Address offset: 0x114

A floating-point input denormal exception has occurred in the FPU.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_FPUIDC			A floating-point input denormal exception has occurred in the FPU.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

4.1.2.1.7 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	FPUIOC			Enable or disable interrupt for event FPUIOC
			Disabled	0	Disable
			Enabled	1	Enable
B	RW	FPUDZC			Enable or disable interrupt for event FPUDZC
			Disabled	0	Disable
			Enabled	1	Enable
C	RW	FPUOFC			Enable or disable interrupt for event FPUOFC
			Disabled	0	Disable
			Enabled	1	Enable
D	RW	FPUUFC			Enable or disable interrupt for event FPUUFC
			Disabled	0	Disable
			Enabled	1	Enable
E	RW	FPUIXC			Enable or disable interrupt for event FPUIXC
			Disabled	0	Disable
			Enabled	1	Enable
F	RW	FPUIDC			Enable or disable interrupt for event FPUIDC
			Disabled	0	Disable
			Enabled	1	Enable

4.1.2.1.8 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1S	FPUIOC			Write '1' to enable interrupt for event FPUIOC
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	FPUDZC			Write '1' to enable interrupt for event FPUDZC
			Set	1	Enable

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1S	FPUOFC			Write '1' to enable interrupt for event FPUOFC
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1S	FPUUFC			Write '1' to enable interrupt for event FPUUFC
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1S	FPUIXC			Write '1' to enable interrupt for event FPUIXC
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1S	FPUIDC			Write '1' to enable interrupt for event FPUIDC
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

4.1.2.1.9 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	FPUIOC			Write '1' to disable interrupt for event FPUIOC
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	FPUDZC			Write '1' to disable interrupt for event FPUDZC
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	FPUOFC			Write '1' to disable interrupt for event FPUOFC
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1C	FPUUFC			Write '1' to disable interrupt for event FPUUFC

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1C	FPUIXC			Write '1' to disable interrupt for event FPUIXC
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1C	FPUIDC			Write '1' to disable interrupt for event FPUIDC
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

4.1.2.1.10 LOCK

Address offset: 0x500

Register to lock the certain parts of the CPU from being modified.

Each bit can only be written once and can only be changed from 0 to 1.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	LOCKVTORAIRCRS			Locks both the Vector table Offset Register (VTOR) and Application Interrupt and Reset Control Register (AIRCR) for secure mode.
			NotLocked	0	Both VTOR and AIRCR can be changed.
			Locked	1	Prevents changes to both VTOR and AIRCR.
B	RW	LOCKVTORNS			Locks the Vector table Offset Register (VTOR) for non-secure mode.
			NotLocked	0	VTOR can be changed.
			Locked	1	Prevents changes to VTOR.
C	RW	LOCKMPUS			Locks the Memory Protection Unit (MPU) for secure mode.
			NotLocked	0	MPU registers can be changed.
			Locked	1	Prevents changes to MPU registers.
D	RW	LOCKMPUNS			Locks the Memory Protection Unit (MPU) for non secure mode.
			NotLocked	0	MPU registers can be changed.
			Locked	1	Prevents changes to MPU registers.
E	RW	LOCKSAU			Locks the Security Attribution Unit (SAU)
			NotLocked	0	SAU registers can be changed.
			Locked	1	Prevents changes to SAU registers.

4.1.2.1.11 CPUID

Address offset: 0x504

The identifier for the CPU in this subsystem.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	CPUID			The CPU identifier.

4.1.3 Arm Cortex-M33 Peripherals

4.1.3.1 Instantiation

ID	Base address	Instance	TrustZone			Split access	Description
			Map	Att	DMA		
28	0x5001C000	SWI00	HF	S	NA	No	Software interrupt SWI00
29	0x5001D000	SWI01	HF	S	NA	No	Software interrupt SWI01
30	0x5001E000	SWI02	HF	S	NA	No	Software interrupt SWI02
31	0x5001F000	SWI03	HF	S	NA	No	Software interrupt SWI03
N/A	0x02F00000	ICACHEDATA	HF	S	NA	No	Instruction cache data
N/A	0x02F10000	ICACHEINFO	HF	S	NA	No	Instruction cache info
N/A	0xE0040000	TPIU	HF	NS	NA	No	Trace port interface unit (Trace and Debug)
N/A	0xE0041000	ETM	HF	NS	NA	No	Embedded trace macrocell
N/A	0xE0080000	CPUC	HF	S	NA	No	Cortex-M33 configuration
N/A	0xE0082000	ICACHE	HF	S	NA	No	Instruction cache

Table 14: Instantiation table

4.2 Core components

4.2.1 AMBA interconnect (AMBIX)

The AMBA interconnect (AMBIX) is a multilayer-capable bus interconnect that provides low latency access from Managers to Subordinates.

Manager and Subordinate connections are arranged in Manager and Subordinate pairs, allowing for a sparse bus matrix. The interconnect supports multiple concurrent transactions when targeting different Subordinates.

Some peripherals do not have the opportunity to pause incoming data. Being a low priority bus manager might cause loss of data for such peripherals upon bus contention. To avoid bus contention when using multiple bus managers, follow these guidelines:

- Avoid situations where more than one bus manager is accessing the same RAM subordinate.
- If more than one bus manager is accessing the same RAM subordinate, make sure that the bus bandwidth is not exhausted.

The interconnect enforces the TrustZone secure/non-secure attributes and is configured using MPC — Memory Privilege Controller on page 189.

4.2.1.1 AMBIX00 bus Managers and priority handling

The interconnect (AMBIX00) has a bus matrix that handles bus arbitration.

AMBIX00 uses a round robin bus manager arbitration algorithm.

4.2.1.2 AMBIX00 override configuration

The main interconnect (AMBIX00) has a configurable bus matrix.

The overrides are used to configure the secure and non-secure memory regions in the device. They are also used to prevent or grant access to read, write, or execute from the memory region. For more details, see MPC — Memory Privilege Controller on page 189.

4.2.2 EasyDMA

EasyDMA is a module implemented by some peripherals as a bus manager for direct access to RAM. Not all EasyDMA instances can access non-volatile memory.

A peripheral can implement multiple EasyDMA instances to provide dedicated channels. For example, a channel can be dedicated for reading and writing data between the peripheral and RAM. This concept is illustrated in the following example figure, where READER is reading data from RAMc, while WRITER is writing data to RAMa and RAMb (each RAM being separate bus subordinates).

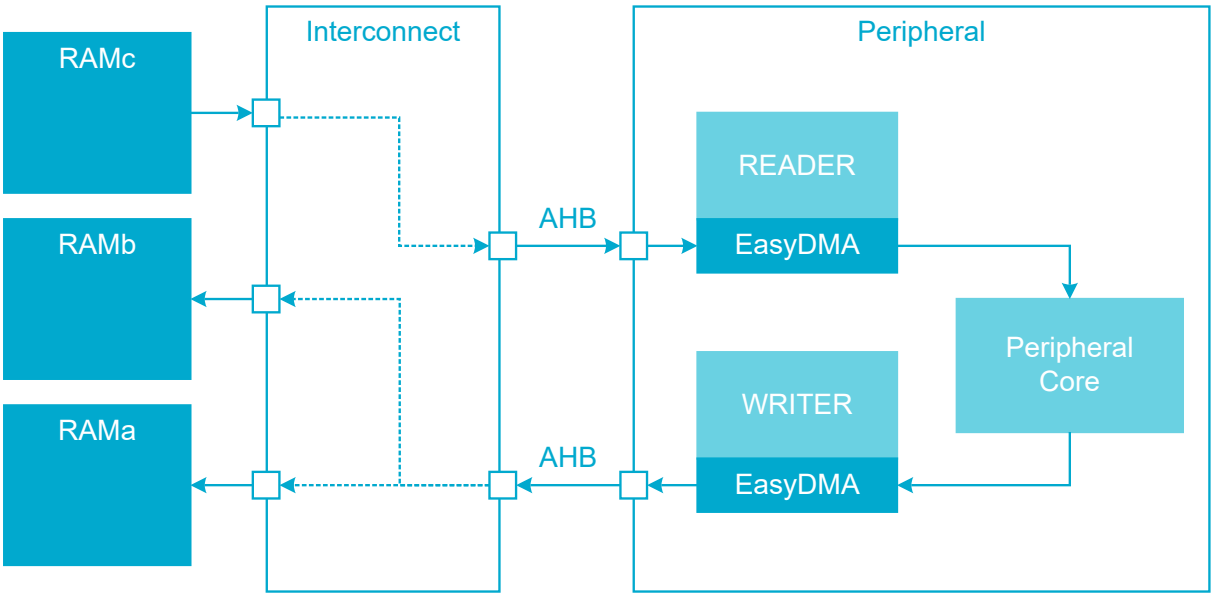


Figure 5: EasyDMA example

4.2.2.1 EasyDMA channel implementation

A typical EasyDMA channel is implemented in the following way.

```
READERBUFFER_SIZE 5
WRITERBUFFER_SIZE 6

uint8_t readerBuffer[READERBUFFER_SIZE]  __at__ 0x20000000;
uint8_t writerBuffer[WRITERBUFFER_SIZE]  __at__ 0x20000005;

// Configuring the READER channel
MYPERIPHERAL->READER.MAXCNT = READERBUFFER_SIZE;
MYPERIPHERAL->READER.PTR = &readerBuffer;

// Configure the WRITER channel
MYPERIPHERAL->WRITER.MAXCNT = WRITEERBUFFER_SIZE;
MYPERIPHERAL->WRITER.PTR = &writerBuffer;
```

This example shows a peripheral called MYPERIPHERAL that implements two EasyDMA channels. One channel is for reading called READER, and one for writing called WRITER. When the peripheral starts, it performs the following tasks.

1. Reads 5 B from the readerBuffer located in RAM at address 0x20000000.

2. Processes the data.
3. Writes up to 6 B back to the writerBuffer located in RAM at address 0x20000005.

The memory layout of these buffers is illustrated is shown in the following figure.

0x20000000	readerBuffer[0]	readerBuffer[1]	readerBuffer[2]	readerBuffer[3]
0x20000004	readerBuffer[4]	writerBuffer[0]	writerBuffer[1]	writerBuffer[2]
0x20000008	writerBuffer[3]	writerBuffer[4]	writerBuffer[5]	

Figure 6: EasyDMA memory layout

The specified size of the WRITER.MAXCNT register must not be larger than the actual size of the buffer (writerBuffer). This prevents the channel from overflowing the writerBuffer.

Once an EasyDMA transfer is complete, the CPU reads the AMOUNT register to see how many bytes were transferred. For example, the CPU can read the MYPERIPHERAL.WRITER.AMOUNT register to see how many bytes WRITER wrote to RAM.

Note: A READER or WRITER PTR register must point to a valid memory region before using EasyDMA. The reset value of a PTR register is not guaranteed to point to valid memory. See Memory on page 13 for more information about the memory regions and EasyDMA connectivity.

4.2.2.2 EasyDMA error handling

Errors can occur during DMA handling.

If READER.PTR or WRITER.PTR is not pointing to a valid memory region, an EasyDMA transfer could HardFault or cause RAM corruption. See Memory on page 13 for more information about the different memory regions.

An EasyDMA channel is an AHB bus Manager. If several AHB Managers try to access the same AHB Subordinate at the same time, AHB bus congestion can occur. Depending on the peripheral, the peripheral could either stall and wait for access to be granted, or lose data.

4.2.2.3 Array list

EasyDMA can operate in Array List mode.

The Array List mode is implemented in channels where the LIST register is available.

The array list is not able to specify where the next item in the list is located. Instead, it assumes that the list is organized as a linear array where items are located one after the other in RAM.

The EasyDMA array list is implemented with the data structure ArrayList_type. This is illustrated in the following code example using a READER EasyDMA channel as an example.

```
#define BUFFER_SIZE  4

typedef struct ArrayList
{
  uint8_t buffer[BUFFER_SIZE];
} ArrayList_type;

ArrayList_type ReaderList[3]  __at__ 0x20000000;

MYPERIPHERAL->READER.MAXCNT = BUFFER_SIZE;
MYPERIPHERAL->READER.PTR = &ReaderList;
MYPERIPHERAL->READER.LIST = MYPERIPHERAL_READER_LIST_ArrayList;
```

The data structure includes a buffer that is equal in size to the READER.MAXCNT register. EasyDMA uses the READER.MAXCNT register to determine when the buffer is full.

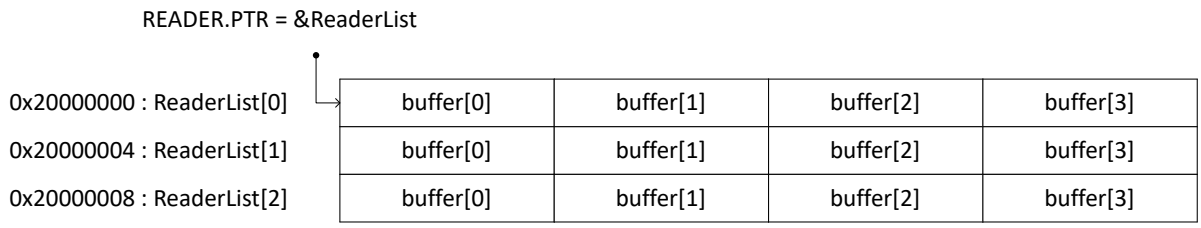


Figure 7: EasyDMA array list

4.2.3 CACHE — Instruction/data cache

The cache is two-way set associative with a least recently used (LRU) replacement policy. Both instruction and data accesses towards NVM memory are cached.

The cache has the following features:

- 4x64-bit cache line
- Ability to enable/disable cache at run-time
- Writes to cached memory are write-around and invalidate the cache line
- Manual invalidation and erase support
- Locking cache updates on cache misses
- Performance hit/miss counter registers for profiling CACHE operations
- Optional readable cache content for profiling
  - Data, tag, valid, and most recently used (MRU) bits
  - Can be disabled when not in use

The cache must be enabled by the ENABLE register. Upon enabling, the cache automatically invalidates the cache memory.

4.2.3.1 Architecture

The following figure shows the cache architecture.

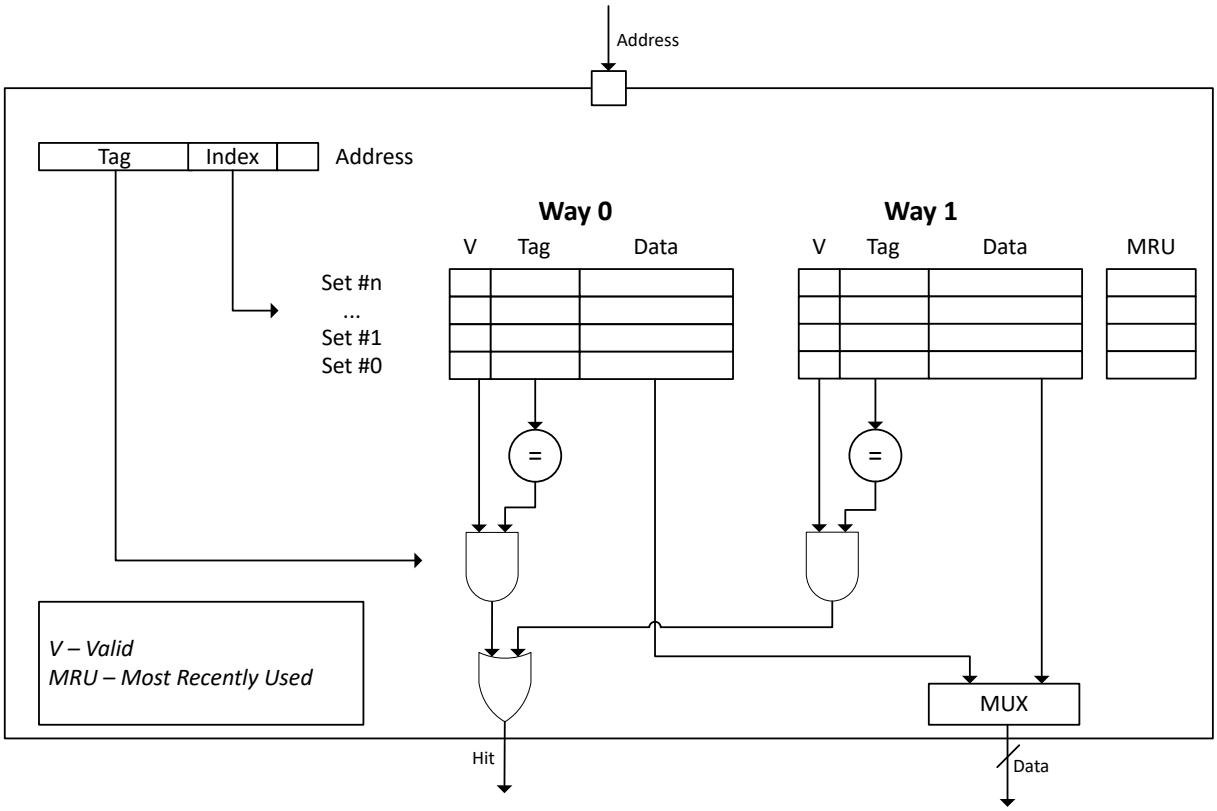


Figure 8: Cache overview

Bit	Name	Description
V	Valid	Indicates if a cache entry is valid. All V fields are cleared when enabling the cache, invalidating the cache, or when changing CACHE mode.
MRU	Most Recently Used	Updated on each fetch from the cache to indicate which Way was used most recently. Used to drive the cache replacement policy.

4.2.3.2 Profiling

The cache provides a scoreboard that tracks the hits and misses within the cache.

The results are available through a set of registers that can be used to indicate how well the cache is performing.

Profiling is enabled using PROFILING.ENABLE. All profiling counters can be cleared at any time using PROFILING.CLEAR. After being cleared, the counters will increment, according to the rules in the table below, at the next instruction- or data fetch.

Profiling counter	Description
HIT	Incremented on a cache hit
MISS	Incremented on a cache miss (not counting write misses)
LMISS	Incremented when accessing different line than was accessed last time
READS	Incremented on a CPU read
WRITES	Incremented on a CPU write

Table 15: Profiling counters

4.2.3.3 Debug

The CPU is able to read internal cache memories and tags for debug purposes.

The content of data and tag RAM's are accessible through registers SET[n].WAY[o].INFO (n=0..127) (o=0..1) on page 38 and SET[n].WAY[o].DU[p].DATA[q] (n=0..127) (o=0..1) (p=0..3) (q=0..1) on page 39.

Debug access is prevented by using register DEBUGLOCK on page 37.

4.2.3.4 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
ICACHE	APPLICATION	0xE0082000	HF	S	NA	No	Instruction cache

Configuration

Instance	Domain	Configuration
ICACHE	APPLICATION	Cache size: 8 KB. Sets: 128. Data unit: 64 bits. Line width = 4 data units.
		Supports line invalidation
		Supports cache erase
		Supports cache line maintain
		Supports extended profiling registers (LMISS / READS / WRITES)
		Supports debug lock
		Supports write lock
		Data bus width : 0..63

Register overview

Register	Offset	TZ	Description
TASKS_INVALIDATECACHE	0x008		Invalidate the cache.
TASKS_INVALIDATELINE	0x014		Invalidate the line.
TASKS_ERASE	0x020		Erase the cache.
STATUS	0x400		Status of the cache activities.
ENABLE	0x404		Enable cache.
LINEADDR	0x410		Memory address covered by the line to be maintained.
PROFILING.ENABLE	0x414		Enable the profiling counters.
PROFILING.CLEAR	0x418		Clear the profiling counters.
PROFILING.HIT	0x41C		The cache hit counter for cache region.
PROFILING.MISS	0x420		The cache miss counter for cache region.
PROFILING.LMISS	0x424		The cache line miss counter for cache region.
PROFILING.READS	0x428		Number of reads for cache region.
PROFILING.WRITES	0x42C		Number of writes for cache region.
DEBUGLOCK	0x430		Lock debug mode.
WRITELOCK	0x434		Lock cache updates.

4.2.3.4.1 TASKS_INVALIDATECACHE

Address offset: 0x008

Invalidate the cache.

The STATUS is updated for this task. This task can be triggered only when the STATUS is ready.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	W	TASKS_INVALIDATECACHE																																	
			Trigger	1																															

4.2.3.4.2 TASKS_INVALIDATELINE

Address offset: 0x014

Invalidate the line.

The STATUS is updated for this task. This task can be triggered only when the STATUS is ready.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	W	TASKS_INVALIDATELINE																																	
			Trigger	1																															

4.2.3.4.3 TASKS_ERASE

Address offset: 0x020

Erase the cache.

The STATUS is updated for this task. This task can be triggered only when the STATUS is ready.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	W	TASKS_ERASE																																	
			Trigger	1																															

4.2.3.4.4 STATUS

Address offset: 0x400

Status of the cache activities.

Indicates status of the activities initiated using respective tasks.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	READY			Ready status.
			Ready	0	Activity is done and ready for the next activity.
			Busy	1	Activity is in progress.

4.2.3.4.5 ENABLE

Address offset: 0x404

Enable cache.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			Enable cache
			Disabled	0	Disable cache
			Enabled	1	Enable cache

4.2.3.4.6 LINEADDR

Address offset: 0x410

Memory address covered by the line to be maintained.

The line maintain activities are line invalidate, line clean and line flush.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ADDR			Address.

4.2.3.4.7 PROFILING.ENABLE

Address offset: 0x414

Enable the profiling counters.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			Enable the profiling counters
			Disable	0	Disable profiling
			Enable	1	Enable profiling

4.2.3.4.8 PROFILING.CLEAR

Address offset: 0x418

Clear the profiling counters.

The profiling counters can be cleared at any time. When cleared, all profiling counters will be set to zero, and will increment at the next instruction- or data fetch.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value								Description																							
A	W	CLEAR										Clearing the profiling counters																							
			Clear	1								Clear the profiling counters																							

4.2.3.4.9 PROFILING.HIT

Address offset: 0x41C

The cache hit counter for cache region.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value								Description																							
A	R	HITS										Number of cache hits																							

4.2.3.4.10 PROFILING.MISS

Address offset: 0x420

The cache miss counter for cache region.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value								Description																							
A	R	MISSES										Number of cache misses																							

4.2.3.4.11 PROFILING.LMISS

Address offset: 0x424

The cache line miss counter for cache region.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value								Description																							
A	R	LMISSES										Number of cache line misses																							

4.2.3.4.12 PROFILING.READS

Address offset: 0x428

Number of reads for cache region.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	READS																																	
				Number of reads for cache region.																															

4.2.3.4.13 PROFILING.WRITES

Address offset: 0x42C

Number of writes for cache region.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	WRITES																																	
				Number of writes for cache region.																															

4.2.3.4.14 DEBUGLOCK

Address offset: 0x430

Lock debug mode.

Note: Debug mode can only be unlocked by a reset

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW1	DEBUGLOCK																																	
			Unlocked	0																															
			Locked	1																															
				Debug mode unlocked																															
				Debug mode locked. Ignores any other value written.																															

4.2.3.4.15 WRITELOCK

Address offset: 0x434

Lock cache updates.

Prevents updating of cache content on cache misses, but will continue to lookup instruction/data fetches in content already present in the cache. The write lock is applied to whole cache.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	WRITELOCK																																	
			Unlocked	0																															
			Locked	1																															
				Cache updates unlocked																															
				Cache updates locked																															

4.2.3.5 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
ICACHEINFO	APPLICATION	0x02F10000	HF	S	NA	No	Instruction cache info

Configuration

Instance	Domain	Configuration
ICACHEINFO	APPLICATION	Number of sets : 0..127 Number of ways : 0..1 Number of data units : 0..3 Data width of a data unit : 0..1 words TAG width : 0..19

Register overview

Register	Offset	TZ	Description
SET[n].WAY[o].INFO	0x0		Cache information for SET[n], WAY[o].

4.2.3.5.1 SET[n].WAY[o].INFO (n=0..127) (o=0..1)

Address offset: 0x0 + (n × 0x8) + (o × 0x4)

Cache information for SET[n], WAY[o].

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	G	F				E	D	C	B				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	TAG			Cache tag.
B-E	R	DUV[i] (i=0..3)			Data unit valid info. One info bit for each data unit in a line, LSB is the first data unit.
			Invalid	0	Invalid data unit
			Valid	1	Valid data unit
F	R	V			Line valid bit.
			Invalid	0	Invalid cache line
			Valid	1	Valid cache line
G	R	MRU			Most recently used way.
			Way0	0	Way0 was most recently used
			Way1	1	Way1 was most recently used

4.2.3.6 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
ICACHEDATA	APPLICATION	0x02F00000	HF	S	NA	No	Instruction cache data

Configuration

Instance	Domain	Configuration
ICACHEDATA	APPLICATION	Number of sets : 0..127 Number of ways : 0..1 Number of data units : 0..3 Data width of a data unit : 0..1 words

Register overview

Register	Offset	TZ	Description
SET[n].WAY[o].DU[p].DATA[q]	0x0		Cache data bits for DATA[q] in DU[p] (DataUnit) of SET[n], WAY[o].

4.2.3.6.1 SET[n].WAY[o].DU[p].DATA[q] (n=0..127) (o=0..1) (p=0..3) (q=0..1)

Address offset: 0x0 + (n × 0x40) + (o × 0x20) + (p × 0x8) + (q × 0x4)

Cache data bits for DATA[q] in DU[p] (DataUnit) of SET[n], WAY[o].

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	Data			Data

4.2.4 FICR — Factory information configuration registers

Factory information configuration registers (FICR) are pre-programmed in factory. These registers contain chip-specific information and configuration.

4.2.4.1 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
FICR	GLOBAL	0x00FFC000	HF	NS	NA	No	Factory information configuration

Register overview

Register	Offset	TZ	Description
INFO.CONFIGID	0x300		Configuration identifier
INFO.DEVICEID[n]	0x304		Device identifier
INFO.UUID[n]	0x30C		128-bit Universally Unique IDentifier (UUID).
INFO.PART	0x31C		Part code
INFO.VARIANT	0x320		Function variant code, Hardware version code, and Production configuration code encoded as ASCII.
INFO.PACKAGE	0x324		Package option
INFO.RAM	0x328		RAM size (KB)
INFO.RRAM	0x32C		RRAM size (KB)
ER[n]	0x380		Common encryption root key, word n
IR[n]	0x390		Common identity root key, word n
DEVICEADDRTYPE	0x3A0		Device address type
DEVICEADDR[n]	0x3A4		Device address n
TRIMCNF[n].ADDR	0x400		Address of the register which will be written
TRIMCNF[n].DATA	0x404		Data to be written into the register
NFC.TAGHEADER0	0x600		Default header for NFC Tag. Software can read these values to populate NFCID1_3RD_LAST, NFCID1_2ND_LAST and NFCID1_LAST.
NFC.TAGHEADER1	0x604		Default header for NFC Tag. Software can read these values to populate NFCID1_3RD_LAST, NFCID1_2ND_LAST and NFCID1_LAST.
NFC.TAGHEADER2	0x608		Default header for NFC Tag. Software can read these values to populate NFCID1_3RD_LAST, NFCID1_2ND_LAST and NFCID1_LAST.
NFC.TAGHEADER3	0x60C		Default header for NFC Tag. Software can read these values to populate NFCID1_3RD_LAST, NFCID1_2ND_LAST and NFCID1_LAST.
XOSC32MTRIM	0x620		XOSC32M capacitor selection trim values
XOSC32KTRIM	0x624		XOSC32K capacitor selection trim values

4.2.4.1.1 INFO

Device info

4.2.4.1.1.1 INFO.CONFIGID

Address offset: 0x300

Configuration identifier

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0xFFFFFFFF	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

ID	R/W	Field	Value ID	Value	Description
A	R	HWID			Identification number for the HW

4.2.4.1.1.2 INFO.DEVICEID[n] (n=0..1)

Address offset: 0x304 + (n × 0x4)

Device identifier

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	R	DEVICEID			64 bit unique device identifier DEVICEID[0] contains the least significant bits of the device identifier. DEVICEID[1] contains the most significant bits of the device identifier.

4.2.4.1.1.3 INFO.UUID[n] (n=0..3)

Address offset: 0x30C + (n × 0x4)

128-bit Universally Unique IDentifier (UUID).

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	R	UUID			Device UUID [n]. The DEVICE.UUID[0] contains the least significant bits of the device identifier.

4.2.4.1.1.4 INFO.PART

Address offset: 0x31C

Part code

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	R	PART			Part code
			N54LM20A	0x054BC20A	nRF54LM20A
			N54LM20B	0x054BC20B	nRF54LM20B
			Unspecified	0xFFFFFFFF	Unspecified

4.2.4.1.1.5 INFO.VARIANT

Address offset: 0x320

Function variant code, Hardware version code, and Production configuration code encoded as ASCII.

The VARIANT register is an ASCII encoded string of the form <VV> <H> <P>, where <VV> is the Function variant code, <H> is the Hardware version code, and <P> is the Production configuration code.

See the Ordering information chapter for more details on the function variant code, hardware version code, and production configuration code.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	R	VARIANT			Function variant code, Hardware version code, and Production configuration code encoded as ASCII
			AAB0	0x41414230	Example encoding for AAB0 - Function variant code AA, Hardware version code B, Production configuration code 0
			Unspecified	0xFFFFFFFF	Unspecified

4.2.4.1.1.6 INFO.PACKAGE

Address offset: 0x324

Package option

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	R	PACKAGE			Package option
			Unspecified	0xFFFFFFFF	Unspecified

4.2.4.1.1.7 INFO.RAM

Address offset: 0x328

RAM size (KB)

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	R	RAM			RAM size (KB)
			K512	0x200	512 kByte RAM
			Unspecified	0xFFFFFFFF	Unspecified

4.2.4.1.1.8 INFO.RRAM

Address offset: 0x32C

RRAM size (KB)

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	R	RRAM			RRAM size (KB)
			K2036	0x7F4	2036 KByte RRAM
			Unspecified	0xFFFFFFFF	Unspecified

4.2.4.1.2 ER[n] (n=0..3)

Address offset: 0x380 + (n × 0x4)

Common encryption root key, word n

Used to generate keys as recommended by the Bluetooth Core Specification

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	R	ER			Encryption Root, word n

4.2.4.1.3 IR[n] (n=0..3)

Address offset: 0x390 + (n × 0x4)

Common identity root key, word n

Used to generate keys as recommended by the Bluetooth Core Specification

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	R	IR			Identity Root, word n

4.2.4.1.4 DEVICEADDRTYPE

Address offset: 0x3A0

Device address type

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	R	DEVICEADDRTYPE			Device address type
			Public	0	Public address
			Random	1	Random address

4.2.4.1.5 DEVICEADDR[n] (n=0..1)

Address offset: 0x3A4 + (n × 0x4)

Device address n

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	R	DEVICEADDR			48 bit device address DEVICEADDR[0] contains the least significant bits of the device address. DEVICEADDR[1] contains the most significant bits of the device address. Only bits [15:0] of DEVICEADDR[1] are used.

4.2.4.1.6 TRIMCNF[n].ADDR (n=0..63)

Address offset: 0x400 + (n × 0x8)

Address of the register which will be written

Bit number																																
ID																																
Reset 0xFFFFFFFF																																
ID	R/W	Field																														
A	R	Address																														

Value ID	Value	Description
		Address

4.2.4.1.7 TRIMCNF[n].DATA (n=0..63)

Address offset: 0x404 + (n × 0x8)

Data to be written into the register

Bit number																																
ID																																
Reset 0xFFFFFFFF																																
ID	R/W	Field																														
A	R	Data																														

Value ID	Value	Description
		Data

4.2.4.1.8 NFC.TAGHEADER0

Address offset: 0x600

Default header for NFC Tag. Software can read these values to populate NFCID1_3RD_LAST, NFCID1_2ND_LAST and NFCID1_LAST.

Bit number																																
ID																																
Reset 0xFFFFFF5F																																
ID	R/W	Field																														
A	R	MFGID																														
B	R	UD1																														
C	R	UD2																														
D	R	UD3																														

Value ID	Value	Description
		Default Manufacturer ID: Nordic Semiconductor ASA has ICM 0x5F
		Unique identifier byte 1
		Unique identifier byte 2
		Unique identifier byte 3

4.2.4.1.9 NFC.TAGHEADER1

Address offset: 0x604

Default header for NFC Tag. Software can read these values to populate NFCID1_3RD_LAST, NFCID1_2ND_LAST and NFCID1_LAST.

Bit number																																
ID																																
Reset 0xFFFFFFFF																																
ID	R/W	Field																														
A-D	R	UD[i] (i=4..7)																														

Value ID	Value	Description
		Unique identifier byte i

4.2.4.1.10 NFC.TAGHEADER2

Address offset: 0x608

Default header for NFC Tag. Software can read these values to populate NFCID1_3RD_LAST, NFCID1_2ND_LAST and NFCID1_LAST.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				D	D	D	D	D	D	D	D	C	C	C	C	C	C	C	C	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A
Reset 0xFFFFFFFF				**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A-D	R	UD[i] (i=8..11)																																	

Unique identifier byte i

4.2.4.1.11 NFC.TAGHEADER3

Address offset: 0x60C

Default header for NFC Tag. Software can read these values to populate NFCID1_3RD_LAST, NFCID1_2ND_LAST and NFCID1_LAST.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				D	D	D	D	D	D	D	D	C	C	C	C	C	C	C	C	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A
Reset 0xFFFFFFFF				**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A-D	R	UD[i] (i=12..15)																																	

Unique identifier byte i

4.2.4.1.12 XOSC32MTRIM

Address offset: 0x620

XOSC32M capacitor selection trim values

Note: To enable the optional internal capacitors on XC1 and XC2 pins, see to the "Using internal capacitors" section of the OSCILLATORS chapter.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID										B	B	B	B	B	B	B	B	B								A	A	A	A	A	A	A	A	A	A
Reset 0xFFFFFFFF				**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	R	SLOPE																																	
				-256 = '1_0000_0000' and +255 = '0_1111_1111'																																	
B	R	OFFSET																																	

Slope trim factor on twos complement form

Offset trim factor on integer form

4.2.4.1.13 XOSC32KTRIM

Address offset: 0x624

XOSC32K capacitor selection trim values

Note: To enable the optional internal capacitors on XL1 and XL2 pins, see to the "Using internal capacitors" section of the OSCILLATORS chapter.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID										B	B	B	B	B	B	B	B	B								A	A	A	A	A	A	A	A	A	A
Reset 0xFFFFFFFF				**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	R	SLOPE																																	
B	R	OFFSET																																	

Slope trim factor on twos complement form

Offset trim factor on integer form

4.2.5 MEMCONF — Memory configuration

MEMCONF provides power control for RAM blocks.

Each RAM block can independently power up or power down in System ON and System OFF mode. RAM blocks can contain multiple RAM sections. For more information about System ON and System OFF modes, see Power and clock management on page 69. For an overview of available RAM blocks and RAM sections, see Memory on page 13.

MEMCONF registers are used for configuring the following:

- RAM sections to be retained during System OFF mode
- RAM sections to be retained and accessible during System ON mode

In System OFF mode, a RAM section is retained by configuring the corresponding MEM[i] field of the RET register.

In System ON mode, retention and accessibility for a RAM section is configured in the corresponding MEM[i] field of register POWER[n].CONTROL (n=0..1) on page 48.

A complete list of blocks (RET.MEM[i], RET2.MEM[i], and CONTROL.MEM[i]) are found in the following table.

Block number (index i in MEMCONF.POWER)	RAM section	RET reset value	CONTROL reset value
0	RAM00 section 0	1	1
1	RAM00 section 1	1	1
2	RAM00 section 2	1	1
3	RAM00 section 3	1	1
4	RAM00 section 4	1	1
5	RAM00 section 5	1	1
6	RAM00 section 6	1	1
7	RAM00 section 7	1	1
8	RAM01 section 0	1	1
9	RAM01 section 1	1	1
10	RAM01 section 2	1	1
11	RAM01 section 3	1	1
12	RAM01 section 4	1	1
13	RAM01 section 5	1	1
14	RAM01 section 6	1	1
15	RAM01 section 7	1	1
33	ICACHE tag + data 1:0	0	1
34	USBHS	0	1

Table 16: Memory block overview with MEMCONF.POWER configuration

A list of features that are retained using MEMCONF are found in the following table.

Block number (index i in MEMCONF.POWER)	Feature	RET reset value	Description
32	Restore VPR context at VPR reset	0	Enables VPR context restore from RAM after VPR reset, where the VPR reset maybe caused by a wakeup from hibernate. [1]

Table 17: Feature overview with MEMCONF.POWER.RET configuration

The following table summarizes the behavior of the CONTROL and RET fields when a power domain is powered on or off. The RAM section can be used to read and write data when it is powered. The RAM section is retained during System OFF.

Configuration			RAM section status	
Power mode	CONTROL	RET	Powered	Retained
System OFF	Any value	Off	No	No
System OFF	Off	On	No	No
System OFF	On	On	No	Yes
System ON IDLE	Off	Any value	No	No
System ON IDLE	On	Any value	No	Yes
System ON RUN	Any value	Any value	Yes	Yes

Table 18: RAM section configuration

The advantage of not retaining RAM content is reduced overall current consumption.

See chapter Memory on page 13 for more information on RAM sections.

Note: CACHE — Instruction/data cache on page 31 must be disabled when the ICACHE memory block is turned off, and only enabled after the ICACHE memory block is turned on.

4.2.5.1 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
MEMCONF : S MEMCONF : NS	GLOBAL	0x500CF000 0x400CF000	US	S	NA	No	Memory Configuration MEMCONF

[1] Must enable RAM retention using MEMCONF.POWER[0].RET.MEM[15] to restore the VPR context correctly.

Configuration

Instance	Domain	Configuration
MEMCONF : S MEMCONF : NS	GLOBAL	

Register overview

Register	Offset	TZ	Description
POWER[n].CONTROL	0x500		Control memory block power.
POWER[n].RET	0x508		RAM retention for RAM [n].

4.2.5.1.1 POWER[n].CONTROL (n=0..1)

Address offset: 0x500 + (n × 0x10)

Control memory block power.

Where n = 0 for memory blocks 0 to 31 and n = 1 for memory blocks 32 to 63.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				f	e	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0xFFFFFFFF				**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A-f	RW	MEM[i] (i=0..31)																																	
			Off	0																															
			On	1																															

4.2.5.1.2 POWER[n].RET (n=0..1)

Address offset: 0x508 + (n × 0x10)

RAM retention for RAM [n].

Where n = 0 for RAM blocks 0 to 31 and n = 1 for RAM blocks 32 to 63.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				f	e	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0xFFFFFFFF				**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A-f	RW	MEM[i] (i=0..31)																																	
			Off	0																															
			On	1																															

4.2.6 RRAMC — Resistive random access memory controller

The resistive random access memory controller (RRAMC) is used for writing the internal RRAM memory, the secure information configuration region (SICR), and the user information configuration registers (UICR).

The main features of RRAMC are:

- Write and overwrite without erasing
- 128-bit data unit with built in error correction code (ECC), detecting and correcting up to two bit errors per data unit
- Automatic standby or power-down modes
- One-time programmable (OTP) protection for user information configuration registers (UICR)
- Optional immutable boot region protection

4.2.6.1 Reading from RRAM

RRAM can be read using any natural alignment.

Read and execute operations are cachable through CACHE — Instruction/data cache on page 31. For execution performance figures, see CPU on page 21.

Low latency mode

The POWER.LOWPOWERCONFIG and POWER.STANDBYCONFIG registers allow trading off between latency and power consumption. To minimize wake-up latency from sleep mode, configure POWER.LOWPOWERCONFIG.MODE to be Standby. For further latency reduction, configure POWER.STANDBYCONFIG.MODE to also be Standby, which keeps RRAM in standby mode while the system is clocked.

When combined with Constant Latency sub-power mode, these settings provide the lowest possible RRAM access latency.

4.2.6.2 Writing to RRAM

When writing is enabled in register CONFIG.WEN, and CONFIG.WRITEBUFSIZE is set to `Unbuffered`, RRAM is written using any natural alignment (byte, half-word, 32-bit, or 64-bit).

RRAMC always writes full data units. When data is written to RRAM, the entire data unit is written and ECC is updated, even if only a single bit is changed. This has an effect on the endurance of the RRAM, as each write operation counts as a write to all bits in the data unit.

RRAMC is able to write both `0` and `1` to any bit in RRAM, even if that bit has been written before.

When writing with CONFIG.WRITEBUFSIZE set to `Unbuffered`, the written data (byte, half-word, 32-bit, or 64-bit) is committed to RRAM immediately.

4.2.6.2.1 Buffered RRAM write

RRAMC enables fast buffered writes for contiguous memory regions.

RRAMC has an internal write-buffer that can be configured using CONFIG.WRITEBUFSIZE.

When buffered writes are enabled, RRAMC will collect as much data as possible in the internal write-buffer, before bulk-committing the buffer to RRAM.

When committing to RRAM, the commit operation updates only the data in RRAM memory that has modified values. Values that have not been altered remain unchanged in RRAM.

To use buffered writes, perform the following operations:

1. Enable writing using CONFIG.WEN, and configure CONFIG.WRITEBUFSIZE.
2. Write to RRAM memory in incrementing address order.

RRAMC commits the write-buffer when either of the following occurs:

- The write-buffer is full
- The address written is outside the buffer area
- There is a read operation from a 128-bit data unit in the buffer that has already been written to

RRAMC stalls while the commit takes place, and additional wait-states can be observed for the bus access.

In addition to the automatic commit, a commit can also be triggered by the following:

- After a time-out waiting for a new write operation, configured in READYNEXTTIMEOUT
- When the COMMITWRITEBUF task is triggered

The manual triggers are useful in situations where it is crucial to ensure that the write buffer has been committed. Register BUFSTATUS.WRITEBUFEMPTY can be used to check if the write-buffer is empty, or if it contains uncommitted data.

Note: The internal write-buffer is volatile, and data loss may occur during a power failure or when entering System OFF mode with uncommitted data in the buffer. Ensure that the write-buffer is empty (see BUFSTATUS.WRITEBUFEMPTY on page 58) and that READY on page 58 is set before entering System OFF. When entering sleep in System ON mode, having uncommitted data in the internal write-buffer will keep the RRAM active, and thus increase power consumption.

4.2.6.3 Erasing RRAM

RRAMC provides a mechanism to erase the whole RRAM in one operation by using the ERASE.ERASEALL register.

When ERASEALL is triggered, RRAMC will write `0xFFFFFFFF` to the entire RRAM memory, including user information configuration registers (UICR) and the secure information configuration region (SICR) . ERASEALL will not erase the factory information configuration registers (FICR).

This functionality can be blocked by ERASE protection. For details, see CTRL-AP — Control access port on page 1181.

Note: Unlike the CTRL-AP ERASEALL operation that can be activated from a debugger, the RRAMC ERASEALL operation will not automatically grant access to the debug access port.

Note: The write-buffer must be committed before initiating an erase operation.

4.2.6.4 Region protection

The RRAM memory can be divided into several regions and these regions can be configured to restrict accesses.

Each region is configured using the REGION[n].ADDRESS and REGION[n].CONFIG registers.

When the region write-once feature is enabled, writes to a 32-bit words in the region are allowed only when the current data is `0xFFFFFFFF`, else the writes are ignored.

When the region configuration registers are writable, the region configuration registers can be updated until the lock bit is set to `Enabled`. However, the register fields Secure, Read, Write, and Execute can be written to `0`, even if the lock bit is set to `Enabled`.

After changing the region protection, CACHE must be invalidated to stay coherent with the updated RRAM configuration. Failure to do so will cause unpredictable results, such as being able to read cached content from a memory region that was just configured to be non-readable.

Note: The configuration registers for some of the regions are read-only and are reserved by the system configurations. See the register configuration table below for regions available for users.

4.2.6.5 Immutable boot region

RRAMC can make a part of the RRAM code memory immutable.

The immutable boot region has configurable permissions settings. Read, write, and execute permissions are configured individually. By making the region read-execute only, that memory range of the RRAM becomes immutable.

The region starts at address 0x00000000 and the size of the region is configurable. Note that the region does not add additional storage, but enforces permission settings on the memory range.

The size and permission settings of the immutable boot region is configured in UICR. If UICR.BOOTCONF is not configured, RRAMC will not enforce the protection.

Once the boot region protection is enabled, it can only be removed by ERASEALL. Erase protection can be enabled to prevent ERASEALL operation. For more information about erase protection, see CTRL-AP — Control access port on page 1181.

4.2.6.6 Power-failure protection

Power failure protection is possible by using the power-fail comparator (POF) that is monitoring power supply.

If the power-fail comparator is enabled, and the power supply voltage is below the POF threshold, the power-fail comparator will prevent RRAMC from performing write operations. For more information about POF, see Power-fail comparator on page 71.

If a power failure warning is present at the start of an RRAM write operation, RRAMC will block the operation and a bus error will be signaled.

If a power failure warning occurs during an ongoing RRAM write, RRAMC can be configured to handle this in two ways:

- If POWER.CONFIG.POF = `Abort`, then RRAMC will stop the commit process from the internal write-buffer as soon as the condition occurs. After a power-failure event, the write buffer must be cleared by using the CLRWRITEBUF task before writing more data to RRAM.
- If POWER.CONFIG.POF = `Wait`, then RRAMC will try to complete the on-going write despite the warning of the operating voltage becoming too low.

4.2.6.7 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
RRAMC	GLOBAL	0x5004E000	HF	S	NA	No	RRAM Non-Volatile Memory Controller

Configuration

Instance	Domain	Configuration
RRAMC	GLOBAL	RRAMC.REGION[4] is available for use, other regions are reserved for the system. RRAM data unit size : 128 bits per data unit Maximum write buffer size : 32

Register overview

Register	Offset	TZ	Description
TASKS_WAKEUP	0x000		Wakeup the RRAM from low power mode
TASKS_CLRWRITEBUF	0x004		Clear internal write-buffer
TASKS_COMMITWRITEBUF	0x008		Commits the data stored in internal write-buffer to RRAM
SUBSCRIBE_WAKEUP	0x080		Subscribe configuration for task WAKEUP

Register	Offset	TZ	Description
SUBSCRIBE_CLRWRITEBUF	0x084		Subscribe configuration for task CLRWRITEBUF
SUBSCRIBE_COMMITWRITEBUF	0x088		Subscribe configuration for task COMMITWRITEBUF
EVENTS_WOKENUP	0x100		RRAMC is woken up from low power mode
EVENTS_READY	0x104		RRAMC is ready
EVENTS_READYNEXT	0x108		Ready to accept a new write operation
EVENTS_ACCESSERROR	0x10C		RRAM access error
PUBLISH_WOKENUP	0x180		Publish configuration for event WOKENUP
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
INTPEND	0x30C		Pending interrupts
READY	0x400		RRAMC ready status
READYNEXT	0x404		Ready next flag
ACCESSERRORADDR	0x408		Address of the first access error
BUFSTATUS.WRITEBUFEMPTY	0x418		Internal write-buffer is empty
ECC.ERRORADDR	0x420		Address of the first ECC error that could not be corrected
CONFIG	0x500		Configuration register
READYNEXTTIMEOUT	0x50C		Configuration for ready next timeout counter, in units of AXI clock frequency
POWER.CONFIG	0x510		Power configuration
POWER.STANDBYCONFIG	0x514		Standby mode configuration
POWER.LOWPOWERCONFIG	0x518		Low power mode configuration
ERASE.ERASEALL	0x540		Erase RRAM, including UICR All information in SICR, including keys, are also erased
REGION[n].ADDRESS	0x550		Region address
REGION[n].CONFIG	0x554		Region configuration

4.2.6.7.1 TASKS_WAKEUP

Address offset: 0x000

Wakeup the RRAM from low power mode

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_WAKEUP			Wakeup the RRAM from low power mode
			Trigger	1	Trigger task

4.2.6.7.2 TASKS_CLRWRITEBUF

Address offset: 0x004

Clear internal write-buffer

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_CLRWRITEBUF			Clear internal write-buffer
			Trigger	1	Trigger task

4.2.6.7.3 TASKS_COMMITWRITEBUF

Address offset: 0x008

Commits the data stored in internal write-buffer to RRAM

READY status is updated during this operation

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_COMMITWRITEBUF			Commits the data stored in internal write-buffer to RRAM READY status is updated during this operation
			Trigger	1	Trigger task

4.2.6.7.4 SUBSCRIBE_WAKEUP

Address offset: 0x080

Subscribe configuration for task WAKEUP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task WAKEUP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

4.2.6.7.5 SUBSCRIBE_CLRWRITEBUF

Address offset: 0x084

Subscribe configuration for task CLRWRITEBUF

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task CLRWRITEBUF will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

4.2.6.7.6 SUBSCRIBE_COMMITWRITEBUF

Address offset: 0x088

Subscribe configuration for task COMMITWRITEBUF

READY status is updated during this operation

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task COMMITWRITEBUF will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

4.2.6.7.7 EVENTS_WOKENUP

Address offset: 0x100

RRAMC is woken up from low power mode

This event is triggered only if waken up by the WAKEUP task

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_WOKENUP			RRAMC is woken up from low power mode This event is triggered only if waken up by the WAKEUP task
			NotGenerated	0	Event not generated
			Generated	1	Event generated

4.2.6.7.8 EVENTS_READY

Address offset: 0x104

RRAMC is ready

This event is also generated when the CPU is waking up from sleep

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_READY			RRAMC is ready This event is also generated when the CPU is waking up from sleep
			NotGenerated	0	Event not generated
			Generated	1	Event generated

4.2.6.7.9 EVENTS_READYNEXT

Address offset: 0x108

Ready to accept a new write operation

This event is also generated when the CPU is waking up from sleep

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_READYNEXT			Ready to accept a new write operation
					This event is also generated when the CPU is waking up from sleep
			NotGenerated	0	Event not generated
			Generated	1	Event generated

4.2.6.7.10 EVENTS_ACCESSERROR

Address offset: 0x10C

RRAM access error

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_ACCESSERROR			RRAM access error
			NotGenerated	0	Event not generated
			Generated	1	Event generated

4.2.6.7.11 PUBLISH_WOKENUP

Address offset: 0x180

Publish configuration for event WOKENUP

This event is triggered only if waken up by the WAKEUP task

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event WOKENUP will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

4.2.6.7.12 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	WOKENUP			Enable or disable interrupt for event WOKENUP
					This event is triggered only if waken up by the WAKEUP task
			Disabled	0	Disable
			Enabled	1	Enable

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
B	RW	READY			Enable or disable interrupt for event READY
					This event is also generated when the CPU is waking up from sleep
			Disabled	0	Disable
			Enabled	1	Enable
C	RW	READYNEXT			Enable or disable interrupt for event READYNEXT
					This event is also generated when the CPU is waking up from sleep
			Disabled	0	Disable
			Enabled	1	Enable
D	RW	ACCESSERROR			Enable or disable interrupt for event ACCESSERROR
			Disabled	0	Disable
			Enabled	1	Enable

4.2.6.7.13 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1S	WOKENUP			Write '1' to enable interrupt for event WOKENUP
					This event is triggered only if waken up by the WAKEUP task
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	READY			Write '1' to enable interrupt for event READY
					This event is also generated when the CPU is waking up from sleep
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1S	READYNEXT			Write '1' to enable interrupt for event READYNEXT
					This event is also generated when the CPU is waking up from sleep
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1S	ACCESSERROR			Write '1' to enable interrupt for event ACCESSERROR
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

4.2.6.7.14 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	WOKENUP			Write '1' to disable interrupt for event WOKENUP This event is triggered only if waken up by the WAKEUP task
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	READY			Write '1' to disable interrupt for event READY This event is also generated when the CPU is waking up from sleep
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	READYNEXT			Write '1' to disable interrupt for event READYNEXT This event is also generated when the CPU is waking up from sleep
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1C	ACCESSERROR			Write '1' to disable interrupt for event ACCESSERROR
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

4.2.6.7.15 INTPEND

Address offset: 0x30C

Pending interrupts

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	WOKENUP			Read pending status of interrupt for event WOKENUP This event is triggered only if waken up by the WAKEUP task
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
B	R	READY			Read pending status of interrupt for event READY This event is also generated when the CPU is waking up from sleep
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
C	R	READYNEXT			Read pending status of interrupt for event READYNEXT This event is also generated when the CPU is waking up from sleep
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
D	R	ACCESSERROR			Read pending status of interrupt for event ACCESSERROR
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending

4.2.6.7.16 READY

Address offset: 0x400

RRAMC ready status

The event READY is generated when the status changes to Ready

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	READY																																	
			Busy	0																															
			Ready	1																															

4.2.6.7.17 READYNEXT

Address offset: 0x404

Ready next flag

The event READYNEXT is generated when the READYNEXT status changes to Ready

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	READYNEXT																																	
			Busy	0																															
			Ready	1																															

4.2.6.7.18 ACCESSERRORADDR

Address offset: 0x408

Address of the first access error

The event ACCESSERROR is generated on access error. When this event is cleared, this register is updated on the next access error

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00FFFFFF				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	R	ADDRESS																																	

4.2.6.7.19 BUFSTATUS.WRITEBUFEMPTY

Address offset: 0x418

Internal write-buffer is empty

The internal write-buffer has been committed to RRAM and is now empty

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	EMPTY			
			NotEmpty	0	The internal write-buffer has data that needs committing
			Empty	1	The internal write-buffer is empty and has no content that needs to be committed

4.2.6.7.20 ECC.ERRORADDR

Address offset: 0x420

Address of the first ECC error that could not be corrected

The event ECCERROR is generated on ECC error. When this event is cleared, this register is updated on the next ECC error

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00FFFFFF				**0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	R	ADDRESS			ECC error address The most significant 8 bits are set to zero always

4.2.6.7.21 CONFIG

Address offset: 0x500

Configuration register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B B B B B B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	WEN			Write enable
			Disabled	0	Write is disabled
			Enabled	1	Write is enabled
B	RW	WRITEBUFSIZE		0..32	Write-buffer size in number of data units
			Unbuffered	0	Disable buffering

4.2.6.7.22 READYNEXTTIMEOUT

Address offset: 0x50C

Configuration for ready next timeout counter, in units of AXI clock frequency

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A A A A A A A A A
Reset 0x00000080				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	VALUE		[0..4095]	Preload value for waiting for a next write
B	RW	EN			Enable ready next timeout
					The timeout value is number of RRAMC clock cycles. The timeout starts when the READYNEXT is set to ready
			Disable	0	Disable ready next timeout
			Enable	1	Enable ready next timeout

4.2.6.7.23 POWER.CONFIG

Address offset: 0x510

Power configuration

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A A A A A A A A A A
Reset 0x00000100				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ACCESSTIMEOUT			Access timeout, in 31.25 ns units, used for going into standby power mode or remain active on wake up
					The timeout counter counts down and is restarted on every RRAM access and on event WOKENUP
B	RW	POF			Power on failure warning handling configuration
			Wait	0	Wait until the current RRAM write finishes
			Abort	1	Abort the current RRAM write

4.2.6.7.24 POWER.STANDBYCONFIG

Address offset: 0x514

Standby mode configuration

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MODE			RRAM standby mode
			Normal	0	The RRAM automatically goes into idle mode while the RRAM is not being accessed
					The MCU power domain is turned off.
			PowerDown	2	The RRAM goes into power down mode when the access timeout counter is expired
					The penalty for RRAM access during wakeup from PowerDown mode is about 6us
			Standby	3	The RRAM remains active while the RRAM is not being accessed.
					Access to RRAM has the lowest latency when MCU PD is in RUN state, for example by using Constant Latency sub-power mode. ACCESSTIMEOUT has no effect in this mode.

4.2.6.7.25 POWER.LOWPOWERCONFIG

Address offset: 0x518

Low power mode configuration

The RRAMC low power mode is entered while the device goes into system on idle

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																		A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	MODE																																	
			PowerOff	0																															
			Standby	1																															

ID	R/W	Field	Value ID	Value	Description
A	RW	MODE			RRAM low power mode
			PowerOff	0	The RRAM is powered Off
			Standby	1	The RRAM automatically goes into standby mode while the RRAM is not being accessed This mode gives faster wake-ups, and is useful in combination with Constant Latency sub-power mode.

4.2.6.7.26 ERASE.ERASEALL

Address offset: 0x540

Erase RRAM, including UICR

All information in SICR, including keys, are also erased

The status in READY is updated during this operation

Writes to this register are ignored when erase protect is enabled

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	ERASE																																	
			NoOperation	0																															
			Erase	1																															

ID	R/W	Field	Value ID	Value	Description
A	RW	ERASE			Erase RRAM
			NoOperation	0	No operation
			Erase	1	Start erase of chip

4.2.6.7.27 REGION[n] (n=0..5)

RRAMC can apply access privileges to regions of the RRAM. Some regions are dedicated for system use and are not available for configuration - refer to the instantiation table for details.

4.2.6.7.27.1 REGION[n].ADDRESS (n=0..5)

Address offset: 0x550 + (n × 0x8)

Region address

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	STARTADDR																																	

ID	R/W	Field	Value ID	Value	Description
A	RW	STARTADDR			Start address of the region [n] Bits [31:24] and bit [9:0] are read-only and set to zero

4.2.6.7.27.2 REGION[n].CONFIG (n=0..5)

Address offset: 0x554 + (n × 0x8)

Region configuration

The register fields READ, WRITE and EXECUTE can can be written to 0, even when the LOCK field is set to Enabled.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID													G	G	G	G	G	G	G			F	E									D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	READ																																	
			NotAllowed	0																															
			Allowed	1																															
B	RW	WRITE																																	
			NotAllowed	0																															
			Allowed	1																															
C	RW	EXECUTE																																	
			NotAllowed	0																															
			Allowed	1																															
D	RW	SECURE																																	
			NonSecure	0																															
			Secure	1																															
E	RW	WRITEONCE																																	
			Disabled	0																															
			Enabled	1																															
F	RW	LOCK																																	
	W1S																																		
			Disabled	0																															
			Enabled	1																															
G	RW	SIZE																																	

4.2.7 SICR — Secure information configuration region

The secure information configuration region (SICR) is reserved for keys and device unique seed.

Access to SICR is managed by KMU — Key management unit on page 179. Bus transactions originating from CPU or other peripherals are blocked.

4.2.8 SWI — Software interrupts

A set of interrupts have been reserved for use as software interrupts.

These interrupts can be enabled and triggered by software by using the Arm Cortex-M33 NVIC registers, as described in the *Arm Cortex-M33 Processor Technical Reference Manual*.

4.2.8.1 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
SWI00	APPLICATION	0x5001C000	HF	S	NA	No	Software interrupt SWI00
SWI01	APPLICATION	0x5001D000	HF	S	NA	No	Software interrupt SWI01
SWI02	APPLICATION	0x5001E000	HF	S	NA	No	Software interrupt SWI02
SWI03	APPLICATION	0x5001F000	HF	S	NA	No	Software interrupt SWI03

4.2.9 UICR — User information configuration registers

The user information configuration registers (UICR) are non-volatile memory (NVM) registers that configure user specific settings and values for emulated one-time programmable (OTP).

All UICR registers have a write-once protection that allow them to be read multiple times, but written only once when UICR has been erased by the Erase All operation.

For information on writing registers, see RRAMC — Resistive random access memory controller on page 48 and Memory on page 13.

Notice that all access port protection registers are duplicated into PROTECT0/PROTECT1. For optimal security, set both registers set to "random" values different from the Unprotected value. For ERASEPROTECT, set both PROTECT0/PROTECT1 registers to the Protected value.

4.2.9.1 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
UICR	GLOBAL	0x00FFD000	HF	S	NA	No	User information configuration

Register overview

Register	Offset	TZ	Description
APPROTECT[n].PROTECT0	0x000		Access port protection
APPROTECT[n].PROTECT1	0x01C		Access port protection
SECUREAPPROTECT[n].PROTECT0	0x020		Access port protection
SECUREAPPROTECT[n].PROTECT1	0x03C		Access port protection register
AUXAPPROTECT[n].PROTECT0	0x040		Access port protection
AUXAPPROTECT[n].PROTECT1	0x05C		Access port protection register
ERASEPROTECT[n].PROTECT0	0x60		Erase protection
ERASEPROTECT[n].PROTECT1	0x7C		Erase protection
BOOTCONF	0x080		Immutable boot region configuration.
USER.ROT.PUBKEY[n].DIGEST[o]	0x200		First 256 bits of SHA2-512 digest over RoT public key generation [n].
USER.ROT.PUBKEY[n].REVOKE[o]	0x220		Revocation status for RoT public key generation [n].
USER.ROT.AUTHOPKEY[n].DIGEST[o]	0x2B0		First 256 bits of SHA2-512 digest over RoT authenticated operation public key generation [n].
USER.ROT.AUTHOPKEY[n].REVOKE[o]	0x2D0		Revocation status for RoT authenticated operation public key generation [n].
OTP[n]	0x500		One time programmable memory

4.2.9.1.1 APPROTECT[n] (n=0..0)

Access Port Protection Registers

4.2.9.1.1.1 APPROTECT[n].PROTECT0 (n=0..0)

Address offset: 0x000 + (n × 0x20)

Access port protection

Any other value than Unprotected will lock TAMPC PROTECT.DOMAIN signal protectors.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0xFFFFFFFF				**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW1	PALL																																	
			Unprotected	0xFFFFFFFF																															
				Leaves TAMPC PROTECT.DOMAIN DBGEN and NIDEN signal protectors unlocked and under CPU control.																															

4.2.9.1.1.2 APPROTECT[n].PROTECT1 (n=0..0)

Address offset: 0x01C + (n × 0x20)

Access port protection

Any other value than Unprotected will lock TAMPC PROTECT.DOMAIN signal protectors.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0xFFFFFFFF				**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW1	PALL																																	
			Unprotected	0xFFFFFFFF																															
				Leaves TAMPC PROTECT.DOMAIN DBGEN and NIDEN signal protectors unlocked and under CPU control.																															

4.2.9.1.2 SECUREAPPROTECT[n] (n=0..0)

Access Port Protection Registers

4.2.9.1.2.1 SECUREAPPROTECT[n].PROTECT0 (n=0..0)

Address offset: 0x020 + (n × 0x20)

Access port protection

Any other value than Unprotected will lock TAMPC PROTECT.DOMAIN signal protectors.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0xFFFFFFFF				**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW1	PALL																																	
			Unprotected	0xFFFFFFFF																															
				Leaves TAMPC PROTECT.DOMAIN SPIDEN and SPNIDEN signal protectors unlocked and under CPU control.																															

4.2.9.1.2.2 SECUREAPPROTECT[n].PROTECT1 (n=0..0)

Address offset: 0x03C + (n × 0x20)

Access port protection register

Any other value than Unprotected will lock TAMPC PROTECT.DOMAIN signal protectors.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0xFFFFFFFF				**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW1	PALL																																	
			Unprotected	0xFFFFFFFF																															

Leaves TAMPC PROTECT.DOMAIN SPIDEN and SPNIDEN signal protectors unlocked and under CPU control.

4.2.9.1.3 AUXAPPROTECT[n] (n=0..0)

Access Port Protection Registers

4.2.9.1.3.1 AUXAPPROTECT[n].PROTECT0 (n=0..0)

Address offset: 0x040 + (n × 0x20)

Access port protection

Any other value than Unprotected will lock TAMPC PROTECT.AP signal protectors.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0xFFFFFFFF				**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW1	PALL																																	
			Unprotected	0xFFFFFFFF																															

Leaves TAMPC PROTECT.AP DBGEN signal protector unlocked and under CPU control.

4.2.9.1.3.2 AUXAPPROTECT[n].PROTECT1 (n=0..0)

Address offset: 0x05C + (n × 0x20)

Access port protection register

Any other value than Unprotected will lock TAMPC PROTECT.AP signal protectors.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0xFFFFFFFF				**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW1	PALL																																	
			Unprotected	0xFFFFFFFF																															

Leaves TAMPC PROTECT.AP DBGEN signal protector unlocked and under CPU control.

4.2.9.1.4 ERASEPROTECT[n] (n=0..0)

Erase Protection Registers

4.2.9.1.4.1 ERASEPROTECT[n].PROTECT0 (n=0..0)

Address offset: 0x60 + (n × 0x20)

Erase protection

Any other value than `Protected` will leave the TAMPC PROTECT.ERASEPROTECT signal protector unlocked, so that CPU can control its value.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW1	PALL			
			Protected	0x50FA50FA	Erase protection is enabled and the signal protector is locked.

4.2.9.1.4.2 ERASEPROTECT[n].PROTECT1 (n=0..0)

Address offset: 0x7C + (n × 0x20)

Erase protection

Any other value than `Protected` will leave the TAMPC PROTECT.ERASEPROTECT signal protector unlocked, so that CPU can control its value.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW1	PALL			
			Protected	0x50FA50FA	Erase protection is enabled and the signal protector is locked.

4.2.9.1.5 BOOTCONF

Address offset: 0x080

Immutable boot region configuration.

If this register is not equal to 0xFFFFFFFF, RRAMC applies these settings at device reset, to form the immutable boot region.

For an immutable bootloader, recommended value is READ, EXECUTE, SECURE, WRITEONCE, LOCK, and SIZE. READ permission is needed for the CPU to read constants and instructions.

Unused bits (unused fields) must be set to zero.

> **Note:** After ERASEALL, a reset is required before the factory default settings are applied.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G G G G G G G F E D C B A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW1	READ			Read access. Must be enabled in order for the Arm Cortex CPU to start executing from RRAM.
			NotAllowed	0	Reading from the region is not allowed.
			Allowed	1	Reading from the region is allowed
B	RW1	WRITE			Write access
			NotAllowed	0	Writing to the region is not allowed
			Allowed	1	Writing to the region is allowed
C	RW1	EXECUTE			Execute access
			NotAllowed	0	Executing code from the region is not allowed
			Allowed	1	Executing code from the region is allowed

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G G G G G G G F E D C B A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
D	RW1	SECURE			Secure access
			NonSecure	0	Both secure and non-secure access to region is allowed
			Secure	1	Only secure access to region is allowed
E	RW1	WRITEONCE			Write-once
			Disabled	0	Write-once disabled
			Enabled	1	Write-once enabled Writes to a 32-bit word in the BOOTCONF region are is only when the current data is 0xFFFFFFFF, otherwise the writes are ignored
F	RW1	LOCK			Enable lock of configuration register
			Disabled	0	Lock is disabled, and the RRAMC region configuration registers for the immutable boot region are writable.
			Enabled	1	Lock is enabled, and the RRAMC configuration registers for the immutable boot region are read-only.
G	RW1	SIZE			Immutable boot region size Configures the region size in kB

4.2.9.1.6 USER.ROT

Assets installed to establish initial Root of Trust in the device.

User RoT key materials

4.2.9.1.6.1 USER.ROT.PUBKEY[n].DIGEST[o] (n=0..3) (o=0..7)

Address offset: 0x200 + (n × 0x2C) + (o × 0x4)

First 256 bits of SHA2-512 digest over RoT public key generation [n].

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW1	VALUE			Value for word [o] in the key digest [n].

4.2.9.1.6.2 USER.ROT.PUBKEY[n].REVOKE[o] (n=0..3) (o=0..2)

Address offset: 0x220 + (n × 0x2C) + (o × 0x4)

Revocation status for RoT public key generation [n].

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW1	STATUS			Revocation status.
			NotRevoked	0xFFFFFFFF	Key not revoked. Any other value says the key is revoked.

4.2.9.1.6.3 USER.ROT.AUTHOPKEY[n].DIGEST[o] (n=0..3) (o=0..7)

Address offset: 0x2B0 + (n × 0x2C) + (o × 0x4)

First 256 bits of SHA2-512 digest over RoT authenticated operation public key generation [n].

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW1	VALUE			Value for word [o] in the key digest [n].

4.2.9.1.6.4 USER.ROT.AUTHOPKEY[n].REVOKE[o] (n=0..3) (o=0..2)

Address offset: 0x2D0 + (n × 0x2C) + (o × 0x4)

Revocation status for RoT authenticated operation public key generation [n].

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW1	STATUS			Revocation status.
			NotRevoked	0xFFFFFFFF	Key not revoked.
					Any other value says the key is revoked.

4.2.9.1.7 OTP[n] (n=0..319)

Address offset: 0x500 + (n × 0x4)

One time programmable memory

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW1	OTP			OTP word
					Can only be written to a non 0xFFFFFFFF value once after Erase All operation.

5 Power and clock management

The power and clock management system is optimized for ultra-low power applications to provide maximum power efficiency.

The power and clock management system is shown in the following figure.

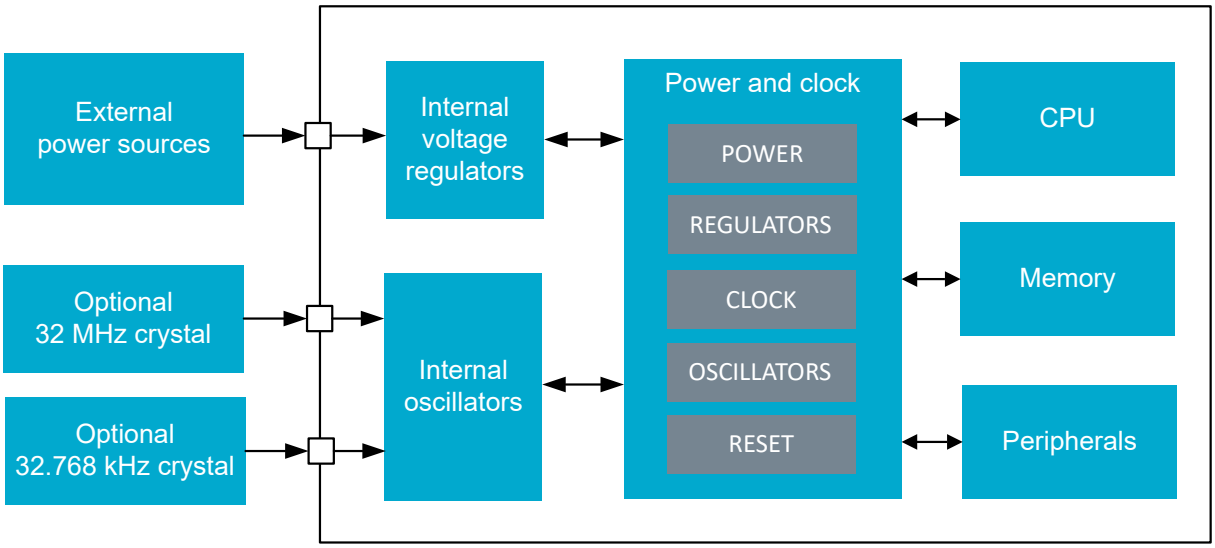


Figure 9: Power and clock management

The power and clock management system automatically tracks the power and clock resources requested by components in the system at any given time. To achieve the lowest power consumption possible, the system evaluates the requests, starts and stops clock sources, and chooses the most optimal regulator operation modes.

The device start-up sequence after reset is described in RESET — Reset control on page 109.

5.1 System ON mode

System ON is the default operation mode after power-on reset.

In System ON, all functional blocks, such as the CPU and peripherals, can be in an IDLE or RUN state depending on the configuration set by the software and the state of the executing application.

The power and clock management unit can switch the appropriate internal power domains on and off, depending on power requirements. A peripheral's power requirement is directly related to its activity level, which increases and decreases when specific tasks are triggered or events are generated.

5.1.1 Sub-power modes

In System ON mode, the system can reside in one of the two sub-power modes when the CPU and all peripherals are in an IDLE state.

The sub-power modes are the following:

- Constant Latency
- Low-power

In Constant Latency mode, the CPU wakeup latency and the PPI task response are constant and kept at a minimum. This is secured by forcing a set of basic resources to be turned on while in sleep mode. Constant

and predictable latency increases power consumption. Constant Latency mode is selected by triggering the task CONSTLAT.

In Low-power mode, the automatic power management system described in System ON mode ensures that the most efficient supply option is chosen to save power. The lowest possible power consumption comes at a cost of a varying CPU wakeup latency and PPI task response. Low-power mode is selected by triggering the task LOWPWR.

When the system enters System ON mode, it is in the sub-power mode Low-power by default.

5.2 System OFF mode

System OFF is the deepest power-saving mode the system can enter. In this mode, the system's core functionality is powered down and most ongoing tasks are stopped.

Register SYSTEMOFF on page 107 sets the device into System OFF mode. The following wakeup sources will initiate a wakeup from System OFF:

- The DETECT signal generated by the GPIO peripheral
- The ANADETECT signal generated by the LPCOMP peripheral
- The SENSE signal generated by the NFCT peripheral to wake-on-field
- The SYSCOUNTER compare event generated by the GRTC peripheral
- A valid USB voltage on the **VBUS** pin is detected, and again when the VBUS voltage falls below the valid range
- A debug session is started
- A pin reset

When the device wakes up from System OFF, a system reset is performed. For more details, see Reset behavior on page 111.

One or more RAM sections can be retained in System OFF depending on the RAM retention settings configured in MEMCONF — Memory configuration on page 46.

Before entering System OFF mode, the following conditions must be met.

- All on-going EasyDMA transactions must finish. See peripheral specific chapters for more information about how to get the status of EasyDMA transactions.
- The 32 MHz oscillator (HFXO) must be stopped. Stop HFXO with the XOSTOP task. The 32 kHz oscillator (LFXO) can be running.
- The register RESET.RESETREAS must be cleared. Failure to do so can make the system immediately wake up from System OFF mode.

5.2.1 Emulated System OFF mode

When the device is in Debug Interface mode, System OFF is emulated to ensure that all resources required for debugging are available during System OFF.

Resources required for debugging include the following key components:

- Debug Interface mode on page 1179
- CLOCK — Clock control on page 72
- POWER — Power control on page 100
- OSCILLATORS — Oscillator control on page 94
- REGULATORS — Regulator control on page 105
- RESET — Reset control on page 109
- CPU on page 21
- Memory on page 13

Because the CPU is kept on in an emulated System OFF mode, it is recommended to add an infinite loop directly after entering System OFF. This prevents the CPU from executing code that normally should not be executed. For more information, see Debug and trace on page 1174.

5.3 Power supply supervisors

The power supply supervisors monitor the connected power supply and provide the following functionality.

- Power-on reset (POR) — signals the circuit when a supply is connected
- Fixed brownout reset detector (BOR) — holds the system in reset when the voltage is too low for safe operation
- Optional power-fail comparator (POF) — signals the application when the supply voltage drops below a configured threshold

The power supply supervisors are illustrated in the following figure.

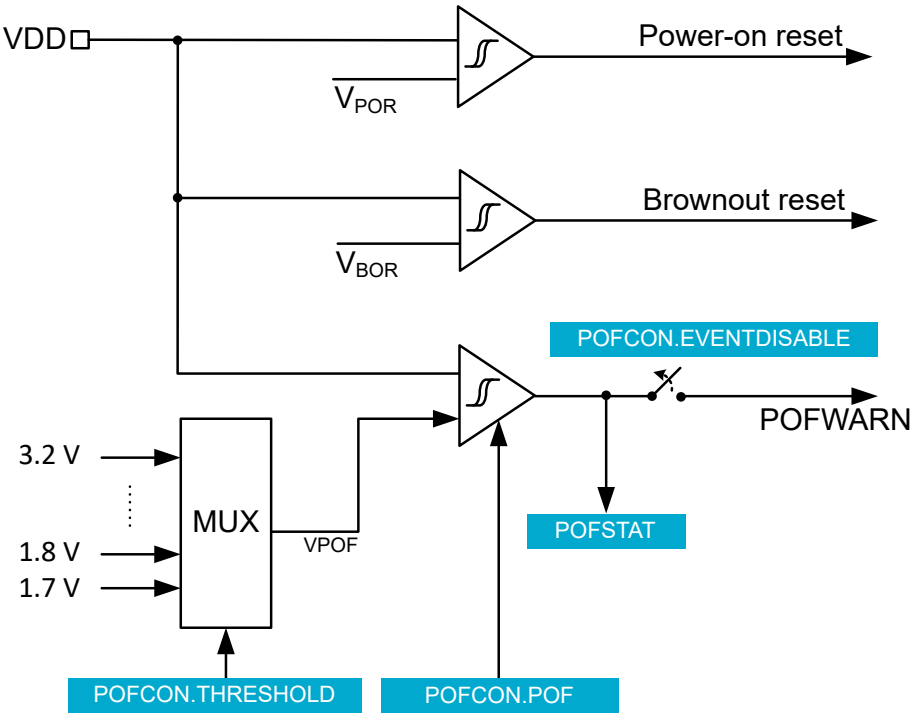


Figure 10: Power supply supervisors

5.3.1 Power-fail comparator

Using the power-fail comparator (POF) is optional. When enabled, it notifies the CPU of a potential power supply failure.

The POF can measure the voltage on **VDD** . To enable and configure the POF, see register POFCON on page 107.

When the supply voltage falls below the defined threshold, the POF generates an event POFWARN that can be used by an application to prepare for power failure. This event is also generated when the supply voltage is already below the threshold at the time the POF is enabled, or if the threshold is reconfigured to a level above the supply voltage. POFWARN is disabled using the EVENTDISABLE field of REGULATORS.POFCON. In addition to the event, the result of the POF is found using POFSTAT on page 108.

POFWARN prevents RRAMC from performing write operations to the non-volatile memory. See RRAMC — Resistive random access memory controller on page 48 for more information about non-volatile memory.

The POF features a hysteresis of V_{HYST}, as illustrated in the following figure.

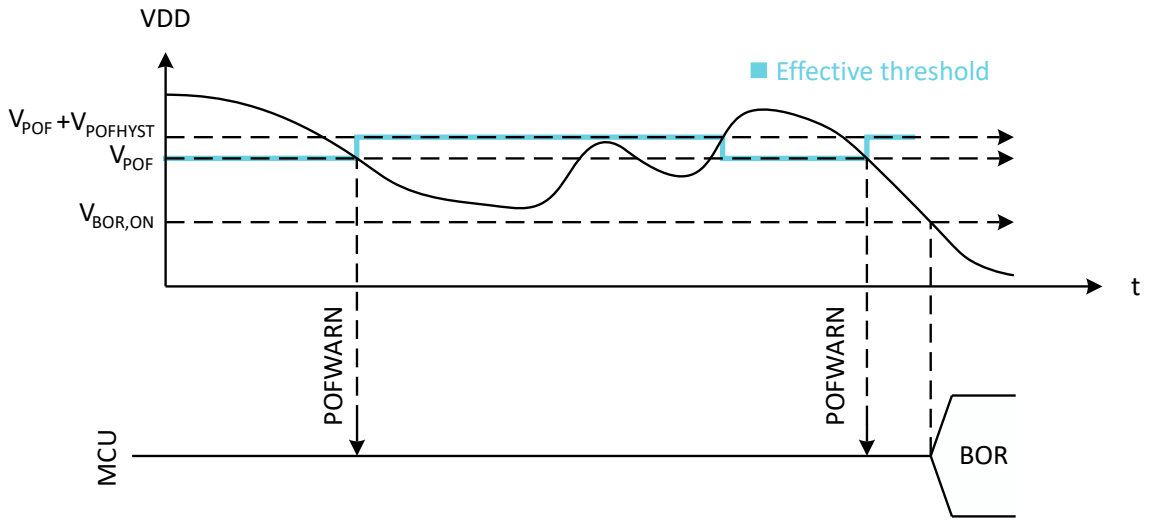


Figure 11: Power-fail comparator

To save power, the POF is not active in System ON when the HFCLK is not running, or in System OFF.

To measure the voltage, perform the following steps.

1. Disable POFWARN by writing `Disabled` to REGULATORS.POFCON.EVENTDISABLE.
2. Enable POF by writing `Enabled` to REGULATORS.POFCON.POF.
3. Loop over all threshold voltages by writing a threshold voltage into register REGULATORS.POFCON.THRESHOLD, starting at the lowest value enumerator until REGULATORS.POFSTAT toggles. This toggle indicates that the voltage has been found and can be read from register REGULATORS.POFCON.THRESHOLD.

5.4 CLOCK — Clock control

The clock control system sources the system clocks from internal or external high and low frequency oscillators. It distributes the clocks to modules based on their requirements. Clock distribution is automated and grouped independently by module to limit current consumption in unused branches of the clock tree.

The following are the main features for CLOCK:

- On-chip 128 MHz phase-locked loop (PLL) with internal oscillator
- 32 MHz crystal oscillator (when using the external 32 MHz crystal)
- 32.768 kHz RC oscillator
- 32.768 kHz crystal oscillator (when using the external 32.768 kHz crystal)
- Automatic clock control and distribution

The clock control system is responsible for requesting resources from the power and clock subsystem.

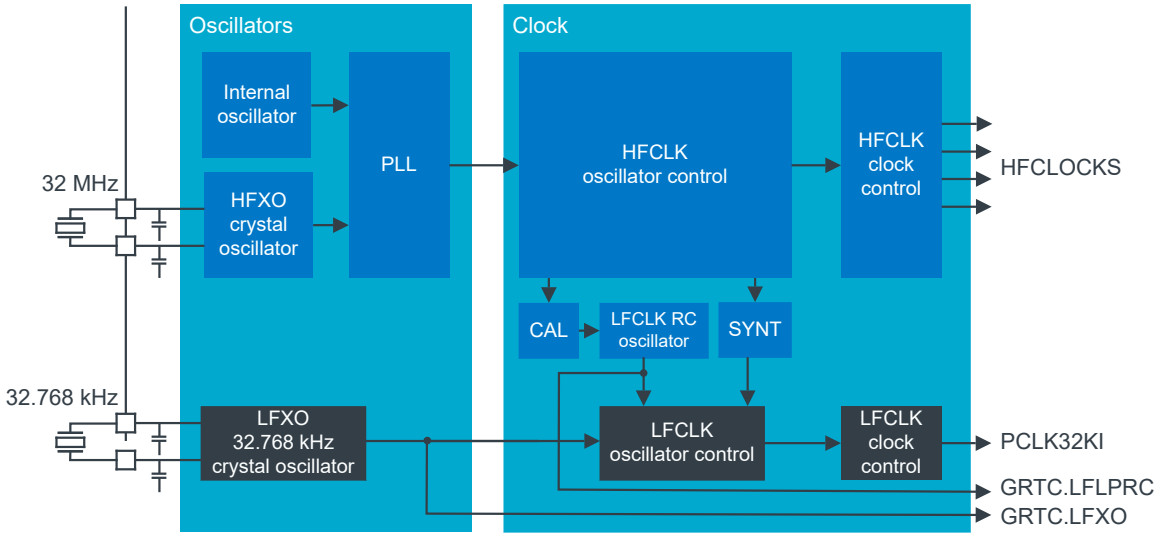


Figure 12: Clock control

5.4.1 HFCLK controller

The HFCLK clock controller provides the following clocks to the system.

Clock	Description
HCLKCORE	MCU power domain and CPU clock where 64 or 128 MHz can be selected.
PCLK32M	32 MHz peripheral clock for RADIO peripherals, PDM (PCLK) and TDM (PCLK).
PCLK24M	24 MHz peripheral clock for USB, PDM (ACLK), and TDM (ACLK). PCLK24M requires HFXO to be running. See the XO24MSTART task for details, in addition to PCLK24M and HFXO for more information.
PCLK16M	16 MHz peripheral clock.
PCLK1M	1 MHz peripheral clock.

Table 19: Clocks

Clock source	Description
HFINT	128 MHz internal oscillator
HFXO	32 MHz crystal oscillator

Table 20: Sources

The following HFCLK sources generate the HFCLK clocks:

- 128 MHz internal oscillator — PLL is operating in free running mode
- 32 MHz crystal oscillator — PLL is locked on a crystal (XOSC), optionally using built-in capacitors as described in OSCILLATORS — Oscillator control on page 94.

CPUs, peripherals, and other system components automatically request clocks. The HFCLK control passes the request to the power and clock subsystem. When the clocks are running, the HFCLK control distributes them to the components. The CPU clock frequency can be selected, as described in OSCILLATORS — Oscillator control on page 94.

When all HFCLK control requests end, the HFCLK control stops requesting CLOCK from the power and clock subsystem. For example, when the CPU enters sleep or when peripherals have completed their tasks, HFCLK stops CLOCK requests. If there are no requests for HFCLK or PCLK control, the power and clock subsystem automatically stops the clock.

When the system enters System ON mode and an HFCLK clock is requested, the PLL is automatically started. When clock requests stop, the PLL automatically stops.

HFCLK clocks are only available to the HFCLK controllers when the system is in System ON mode.

An HFCLK source can run before being started by the relevant clock request. This reduces start-up time but causes increased power consumption. An example of this would be to keep the PLL running during sleep by using the task PLLSTART.

HFXO must be started when crystal clock accuracy is required. The crystal is started by triggering the task XOSTART. When the crystal reaches the correct amplitude and frequency, the PLL automatically locks to the crystal and generates the event XOSTARTED. At the same time, the crystal oscillator is performing an XOTUNE. When that process finishes, the event XOTUNED is generated indicating the signal from the crystal oscillator is accurately tuned. The XOTUNED event is always generated after the XOSTARTED event. If the XOTUNE process fails, the event XOTUNEFAILED is generated. When that happens, the XOTUNE process must be started by triggering the task XOTUNE. The task XOSTOP will stop the crystal oscillator and the XOTUNE process (if it is running). The XOTUNE process will continue from where it left off, when the XOSTART task is triggered again.

If the crystal oscillator requires the XOTUNE process to be repeated, the device generates the event XOTUNEERROR. When that happens, the XOTUNE task must be triggered. This task does not request the crystal oscillator to start and it only takes effect if the crystal oscillator is already running. Do not trigger this task at the same time that RADIO is running (meaning RADIO must not be in the RX or TX states). A successful XOTUNE process is indicated by the event XOTUNED. If the procedure fails to complete, the XOTUNEFAILED event is generated. When a failure is detected, the XOTUNE process must be repeated. Repeated failures to complete the XOTUNED process indicates a faulty crystal or load capacitors.

Note: The crystal oscillator quality indicated by the XOSTARTED event is sufficient for all peripherals except RADIO and when calibrating the 32.768 kHz oscillator. Before using RADIO, ensure that the event XOTUNED has been generated. This ensures the highest quality crystal signal is available.

A new START task can be initiated after one has already been triggered, but before the corresponding STARTED event is generated. In this case, only one STARTED event will be generated, corresponding to the last triggered START task. Triggering a START task after the STARTED event from a previous triggered START tasks is generated, generates a new STARTED event.

The amount of time between a START task and its corresponding STARTED event may differ depending on whether the HFCLK source is already running or in the process of starting. The amount of time before a STARTED event may vary when a different HFCLK source is configured before triggering a new START task. Different crystal types also have different start-up times, see OSCILLATORS — Oscillator control on page 94 for details.

HFXO must be running to use RADIO, USBHS, NFCT, UARTE, or to calibrate the 32.768 kHz RC oscillator. Using HFXO will also improve SAADC performance by reducing clock jitter. When using serial communication peripherals such as SPIM, SPIS, TWIM, and TWIS, the HFXO must be running to achieve the highest accuracy for the bit rate. When using the internal RC oscillator (HFINT), the frequency accuracy of the serial interface is limited to the accuracy of HFINT, see High frequency clock source (HFCLK) on page 1257.

PCLK24M and HFXO

A 24 MHz PLL generates the PCLK24M clock and requires the 32 MHz crystal oscillator (HFXO) as a reference for locking. PCLK24M is started by triggering the task XO24MSTART, which requests HFXO as a reference source for the 24 MHz PLL.

When HFXO is requested through the XO24MSTART task, the crystal oscillator performs the XOTUNE process and generates the event XOTUNED when tuning completes successfully.

The XOTUNED event is generated only once when HFXO starts and completes tuning. If HFXO is already running and tuned, triggering either XO24MSTART or XOSTART will not generate a new XOTUNED event.

5.4.2 LFCLK controller

The system supports the following low frequency clock sources, as described in Clock control on page 73.

- 32.768 kHz RC oscillator (LFRC)
- 32.768 kHz crystal oscillator (LFXO)
- 32.768 kHz synthesized from HFCLK (LFSYNT)

LFXO can run in System OFF mode. The other clock sources only run in System ON mode.

The following LF clocks are available in the system.

Clock	Description
PCLK32KI	32.768 kHz peripheral low-frequency clock.
GRTC.LFLPRC	Direct path from 32.768 kHz internal oscillator (LFRC) to GRTC peripheral. Available only in System ON mode. If GRTC.LFLPRC is used, stop GRTC before entering System OFF mode.
GRTC.LFXO	Direct path from 32.768 kHz crystal oscillator (LFXO) to GRTC peripheral. Available in System ON or System OFF mode.

Table 21: Clocks

When a peripheral requires the PCLK32KI clock, the LFCLK control automatically requests the LFCLK clock for the power and clock subsystem. The default LFCLK source is the LFRC.

To use a different LFCLK source, select the preferred clock source in register LFCLK.SRC on page 92 and then trigger the LFCLKSTART task. If LFXO is selected as the clock source, LFCLK initially starts running from the 32.768 kHz LFRC then automatically switches to the crystal once available. The LFCLKSTARTED event is then generated.

When switching the LFCLK source, such as from LFRC to LFXO , up to one LFCLK cycle may be lost.

The LFCLKSTART task will request the clock to keep running until triggering the LFCLKSTOP task to stop the clock.

The LFCLK clock is stopped when there are no requests. For example, WDT is stopped, and the LFCLKSTOP task is triggered. Triggering the LFCLKSTOP task is required after the LFCLKSTART task has been triggered.

5.4.2.1 Calibrating the 32.768 kHz RC oscillator

The LFRC frequency is affected by temperature variation. LFRC can be calibrated to improve accuracy by using HFCLK as a reference oscillator during calibration.

The calibration must use the following sequence.

1. Start the LFCLK by triggering the LFCLKSTART task.

2. Start the HFCLK crystal oscillator HFXO by triggering the XOSTART task.
3. Wait for the LFCLKSTARTED and the HFXO XOTUNED events.
4. Trigger the CAL task to start the calibration process. The device automatically performs the calibration, adjusting the LFCLK frequency using HFCLK as reference. The DONE event is generated when calibration finishes.
5. Stop HFXO with the XOSTOP task.
6. Stop LFCLK with the LFCLKSTOP task.

LFCLK uses the calibrated value until the next calibration.

5.4.3 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
CLOCK : S CLOCK : NS	GLOBAL	0x5010E000 0x4010E000	US	S	NA	No	Clock control

Configuration

Instance	Domain	Configuration
CLOCK : S CLOCK : NS	GLOBAL	

Register overview

Register	Offset	TZ	Description
TASKS_XOSTART	0x000		Start crystal oscillator (HFXO)
TASKS_XOSTOP	0x004		Stop crystal oscillator (HFXO)
TASKS_PLLSTART	0x008		Start PLL and keep it running, regardless of the automatic clock requests
TASKS_PLLSTOP	0x00C		Stop PLL
TASKS_LFCLKSTART	0x010		Start LFCLK source as selected in LFCLK.SRC
TASKS_LFCLKSTOP	0x014		Stop LFCLK source
TASKS_CAL	0x018		Start calibration of LFRC oscillator
TASKS_XOTUNE	0x01C		Request tuning for HFXO
TASKS_XOTUNEABORT	0x020		Abort tuning for HFXO
TASKS_XO24MSTART	0x024		Request HFXO to provide a crystal clock for PCLK24M
TASKS_XO24MSTOP	0x028		Stop request HFXO for PCLK24M. When all requests for HFXO are stopped, HFXO will also stop.
SUBSCRIBE_XOSTART	0x080		Subscribe configuration for task XOSTART
SUBSCRIBE_XOSTOP	0x084		Subscribe configuration for task XOSTOP
SUBSCRIBE_PLLSTART	0x088		Subscribe configuration for task PLLSTART
SUBSCRIBE_PLLSTOP	0x08C		Subscribe configuration for task PLLSTOP
SUBSCRIBE_LFCLKSTART	0x090		Subscribe configuration for task LFCLKSTART
SUBSCRIBE_LFCLKSTOP	0x094		Subscribe configuration for task LFCLKSTOP
SUBSCRIBE_CAL	0x098		Subscribe configuration for task CAL
SUBSCRIBE_XOTUNE	0x09C		Subscribe configuration for task XOTUNE
SUBSCRIBE_XOTUNEABORT	0x0A0		Subscribe configuration for task XOTUNEABORT
SUBSCRIBE_XO24MSTART	0x0A4		Subscribe configuration for task XO24MSTART
SUBSCRIBE_XO24MSTOP	0x0A8		Subscribe configuration for task XO24MSTOP

Register	Offset	TZ	Description
EVENTS_XOSTARTED	0x100		Crystal oscillator has started
EVENTS_PLLSTARTED	0x104		PLL started
EVENTS_LFCLKSTARTED	0x108		LFCLK source started
EVENTS_DONE	0x10C		Calibration of LFRC oscillator complete event
EVENTS_XOTUNED	0x110		HFXO tuning is done. XOTUNED is generated after TASKS_XOSTART or after TASKS_XOTUNE has completed
EVENTS_XOTUNEERROR	0x114		HFXO quality issue detected, XOTUNE is needed
EVENTS_XOTUNEFAILED	0x118		HFXO tuning could not be completed
EVENTS_XO24MSTARTED	0x11C		XO24M started
PUBLISH_XOSTARTED	0x180		Publish configuration for event XOSTARTED
PUBLISH_PLLSTARTED	0x184		Publish configuration for event PLLSTARTED
PUBLISH_LFCLKSTARTED	0x188		Publish configuration for event LFCLKSTARTED
PUBLISH_DONE	0x18C		Publish configuration for event DONE
PUBLISH_XOTUNED	0x190		Publish configuration for event XOTUNED
PUBLISH_XOTUNEERROR	0x194		Publish configuration for event XOTUNEERROR
PUBLISH_XOTUNEFAILED	0x198		Publish configuration for event XOTUNEFAILED
PUBLISH_XO24MSTARTED	0x19C		Publish configuration for event XO24MSTARTED
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
INTPEND	0x30C		Pending interrupts
XO.RUN	0x408		Indicates that XOSTART task was triggered
XO.STAT	0x40C		XO status
PLL.RUN	0x428		Indicates that PLLSTART task was triggered
PLL.STAT	0x42C		Which PLL settings were selected when triggering START task
LFCLK.SRC	0x440		Clock source for LFCLK
LFCLK.RUN	0x448		Indicates that LFCLKSTART task was triggered
LFCLK.STAT	0x44C		Copy of LFCLK.SRCCOPY register, set when LFCLKSTARTED event is triggered.
LFCLK.SRCCOPY	0x450		Copy of LFCLK.SRC register, set when LFCLKSTART task is triggered
PLL24M.RUN	0x468		Indicates that XO24MSTART task was triggered
PLL24M.STAT	0x46C		Which PLL settings were selected when triggering START task

5.4.3.1 TASKS_XOSTART

Address offset: 0x000

Start crystal oscillator (HFXO)

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_XOSTART			Start crystal oscillator (HFXO)
			Trigger	1	Trigger task

5.4.3.2 TASKS_XOSTOP

Address offset: 0x004

Stop crystal oscillator (HFXO)

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_XOSTOP			Stop crystal oscillator (HFXO)
			Trigger	1	Trigger task

5.4.3.3 TASKS_PLLSTART

Address offset: 0x008

Start PLL and keep it running, regardless of the automatic clock requests

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_PLLSTART			Start PLL and keep it running, regardless of the automatic clock requests
			Trigger	1	Trigger task

5.4.3.4 TASKS_PLLSTOP

Address offset: 0x00C

Stop PLL

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_PLLSTOP			Stop PLL
			Trigger	1	Trigger task

5.4.3.5 TASKS_LFCLKSTART

Address offset: 0x010

Start LFCLK source as selected in LFCLK.SRC

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_LFCLKSTART			Start LFCLK source as selected in LFCLK.SRC
			Trigger	1	Trigger task

5.4.3.6 TASKS_LFCLKSTOP

Address offset: 0x014

Stop LFCLK source

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_LFCLKSTOP			Stop LFCLK source
			Trigger	1	Trigger task

5.4.3.7 TASKS_CAL

Address offset: 0x018

Start calibration of LFRC oscillator

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_CAL			Start calibration of LFRC oscillator
			Trigger	1	Trigger task

5.4.3.8 TASKS_XOTUNE

Address offset: 0x01C

Request tuning for HFXO

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_XOTUNE			Request tuning for HFXO
			Trigger	1	Trigger task

5.4.3.9 TASKS_XOTUNEABORT

Address offset: 0x020

Abort tuning for HFXO

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_XOTUNEABORT			Abort tuning for HFXO
			Trigger	1	Trigger task

5.4.3.10 TASKS_XO24MSTART

Address offset: 0x024

Request HFXO to provide a crystal clock for PCLK24M

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_XO24MSTART			Request HFXO to provide a crystal clock for PCLK24M
			Trigger	1	Trigger task

5.4.3.11 TASKS_XO24MSTOP

Address offset: 0x028

Stop request HFXO for PCLK24M. When all requests for HFXO are stopped, HFXO will also stop.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_XO24MSTOP			Stop request HFXO for PCLK24M. When all requests for HFXO are stopped, HFXO will also stop.
			Trigger	1	Trigger task

5.4.3.12 SUBSCRIBE_XOSTART

Address offset: 0x080

Subscribe configuration for task XOSTART

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task XOSTART will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

5.4.3.13 SUBSCRIBE_XOSTOP

Address offset: 0x084

Subscribe configuration for task XOSTOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task XOSTOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

5.4.3.14 SUBSCRIBE_PLLSTART

Address offset: 0x088

Subscribe configuration for task PLLSTART

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task PLLSTART will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

5.4.3.15 SUBSCRIBE_PLLSTOP

Address offset: 0x08C

Subscribe configuration for task PLLSTOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task PLLSTOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

5.4.3.16 SUBSCRIBE_LFCLKSTART

Address offset: 0x090

Subscribe configuration for task LFCLKSTART

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task LFCLKSTART will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

5.4.3.17 SUBSCRIBE_LFCLKSTOP

Address offset: 0x094

Subscribe configuration for task LFCLKSTOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task LFCLKSTOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

5.4.3.18 SUBSCRIBE_CAL

Address offset: 0x098

Subscribe configuration for task CAL

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task CAL will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

5.4.3.19 SUBSCRIBE_XOTUNE

Address offset: 0x09C

Subscribe configuration for task XOTUNE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task XOTUNE will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

5.4.3.20 SUBSCRIBE_XOTUNEABORT

Address offset: 0x0A0

Subscribe configuration for task XOTUNEABORT

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task XOTUNEABORT will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

5.4.3.21 SUBSCRIBE_XO24MSTART

Address offset: 0x0A4

Subscribe configuration for task XO24MSTART

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task XO24MSTART will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

5.4.3.22 SUBSCRIBE_XO24MSTOP

Address offset: 0x0A8

Subscribe configuration for task XO24MSTOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task XO24MSTOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

5.4.3.23 EVENTS_XOSTARTED

Address offset: 0x100

Crystal oscillator has started

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_XOSTARTED			Crystal oscillator has started
			NotGenerated	0	Event not generated
			Generated	1	Event generated

5.4.3.24 EVENTS_PLLSTARTED

Address offset: 0x104

PLL started

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_PLLSTARTED			PLL started
			NotGenerated	0	Event not generated
			Generated	1	Event generated

5.4.3.25 EVENTS_LFCLKSTARTED

Address offset: 0x108

LFCLK source started

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_LFCLKSTARTED			LFCLK source started
			NotGenerated	0	Event not generated
			Generated	1	Event generated

5.4.3.26 EVENTS_DONE

Address offset: 0x10C

Calibration of LFRC oscillator complete event

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_DONE			Calibration of LFRC oscillator complete event
			NotGenerated	0	Event not generated
			Generated	1	Event generated

5.4.3.27 EVENTS_XOTUNED

Address offset: 0x110

HFXO tuning is done. XOTUNED is generated after TASKS_XOSTART or after TASKS_XOTUNE has completed

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_XOTUNED			HFXO tuning is done. XOTUNED is generated after TASKS_XOSTART or after TASKS_XOTUNE has completed
			NotGenerated	0	Event not generated
			Generated	1	Event generated

5.4.3.28 EVENTS_XOTUNEERROR

Address offset: 0x114

HFXO quality issue detected, XOTUNE is needed

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_XOTUNEERROR			HFXO quality issue detected, XOTUNE is needed
			NotGenerated	0	Event not generated
			Generated	1	Event generated

5.4.3.29 EVENTS_XOTUNEFAILED

Address offset: 0x118

HFXO tuning could not be completed

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	EVENTS_XOTUNEFAILED																																	
			NotGenerated	0																															
			Generated	1																															

5.4.3.30 EVENTS_XO24MSTARTED

Address offset: 0x11C

XO24M started

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	EVENTS_XO24MSTARTED																																	
			NotGenerated	0																															
			Generated	1																															

5.4.3.31 PUBLISH_XOSTARTED

Address offset: 0x180

Publish configuration for event XOSTARTED

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				B																							A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	CHIDX		[0..255]																															
B	RW	EN																																	
			Disabled	0																															
			Enabled	1																															

5.4.3.32 PUBLISH_PLLSTARTED

Address offset: 0x184

Publish configuration for event PLLSTARTED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event PLLSTARTED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

5.4.3.33 PUBLISH_LFCLKSTARTED

Address offset: 0x188

Publish configuration for event LFCLKSTARTED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event LFCLKSTARTED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

5.4.3.34 PUBLISH_DONE

Address offset: 0x18C

Publish configuration for event DONE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event DONE will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

5.4.3.35 PUBLISH_XOTUNED

Address offset: 0x190

Publish configuration for event XOTUNED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event XOTUNED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

5.4.3.36 PUBLISH_XOTUNEERROR

Address offset: 0x194

Publish configuration for event XOTUNEERROR

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event XOTUNEERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

5.4.3.37 PUBLISH_XOTUNEFAILED

Address offset: 0x198

Publish configuration for event XOTUNEFAILED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event XOTUNEFAILED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

5.4.3.38 PUBLISH_XO24MSTARTED

Address offset: 0x19C

Publish configuration for event XO24MSTARTED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event XO24MSTARTED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

5.4.3.39 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XOSTARTED			Enable or disable interrupt for event XOSTARTED
			Disabled	0	Disable
			Enabled	1	Enable
B	RW	PLLSTARTED			Enable or disable interrupt for event PLLSTARTED
			Disabled	0	Disable
			Enabled	1	Enable
C	RW	LFCLKSTARTED			Enable or disable interrupt for event LFCLKSTARTED
			Disabled	0	Disable
			Enabled	1	Enable
D	RW	DONE			Enable or disable interrupt for event DONE
			Disabled	0	Disable
			Enabled	1	Enable
E	RW	XOTUNED			Enable or disable interrupt for event XOTUNED
			Disabled	0	Disable
			Enabled	1	Enable
F	RW	XOTUNEERROR			Enable or disable interrupt for event XOTUNEERROR
			Disabled	0	Disable
			Enabled	1	Enable
G	RW	XOTUNEFAILED			Enable or disable interrupt for event XOTUNEFAILED
			Disabled	0	Disable
			Enabled	1	Enable
H	RW	XO24MSTARTED			Enable or disable interrupt for event XO24MSTARTED
			Disabled	0	Disable
			Enabled	1	Enable

5.4.3.40 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1S	XOSTARTED			Write '1' to enable interrupt for event XOSTARTED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	PLLSTARTED			Write '1' to enable interrupt for event PLLSTARTED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1S	LFCLKSTARTED			Write '1' to enable interrupt for event LFCLKSTARTED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
D	RW W1S	DONE			Write '1' to enable interrupt for event DONE
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1S	XOTUNED			Write '1' to enable interrupt for event XOTUNED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1S	XOTUNEERROR			Write '1' to enable interrupt for event XOTUNEERROR
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1S	XOTUNEFAILED			Write '1' to enable interrupt for event XOTUNEFAILED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
H	RW W1S	XO24MSTARTED			Write '1' to enable interrupt for event XO24MSTARTED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

5.4.3.41 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	XOSTARTED			Write '1' to disable interrupt for event XOSTARTED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	PLLSTARTED			Write '1' to disable interrupt for event PLLSTARTED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	LFCLKSTARTED			Write '1' to disable interrupt for event LFCLKSTARTED
			Clear	1	Disable
			Disabled	0	Read: Disabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
			Enabled	1	Read: Enabled
D	RW W1C	DONE			Write '1' to disable interrupt for event DONE
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1C	XOTUNED			Write '1' to disable interrupt for event XOTUNED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1C	XOTUNEERROR			Write '1' to disable interrupt for event XOTUNEERROR
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1C	XOTUNEFAILED			Write '1' to disable interrupt for event XOTUNEFAILED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
H	RW W1C	XO24MSTARTED			Write '1' to disable interrupt for event XO24MSTARTED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

5.4.3.42 INTPEND

Address offset: 0x30C

Pending interrupts

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	XOSTARTED			Read pending status of interrupt for event XOSTARTED
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
B	R	PLLSTARTED			Read pending status of interrupt for event PLLSTARTED
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
C	R	LFCLKSTARTED			Read pending status of interrupt for event LFCLKSTARTED
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
D	R	DONE			Read pending status of interrupt for event DONE
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
E	R	XOTUNED			Read pending status of interrupt for event XOTUNED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
F	R	XOTUNEERROR			Read pending status of interrupt for event XOTUNEERROR
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
G	R	XOTUNEFAILED			Read pending status of interrupt for event XOTUNEFAILED
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
H	R	XO24MSTARTED			Read pending status of interrupt for event XO24MSTARTED
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending

5.4.3.43 XO.RUN

Address offset: 0x408

Indicates that XOSTART task was triggered

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	STATUS			XOSTART task triggered or not
			NotTriggered	0	Task not triggered
			Triggered	1	Task triggered

5.4.3.44 XO.STAT

Address offset: 0x40C

XO status

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	STATE			XO state (Running between START task and STOPPED event)
			NotRunning	0	XO is not running
			Running	1	XO is running

5.4.3.45 PLL.RUN

Address offset: 0x428

Indicates that PLLSTART task was triggered

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	STATUS			PLLSTART task triggered or not
			NotTriggered	0	Task not triggered
			Triggered	1	Task triggered

5.4.3.46 PLL.STAT

Address offset: 0x42C

Which PLL settings were selected when triggering START task

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	STATE			PLL state (Running between START task and STOPPED event)
			NotRunning	0	PLL is not running
			Running	1	PLL is running

5.4.3.47 LFCLK.SRC

Address offset: 0x440

Clock source for LFCLK

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	SRC			Select which LFCLK source is started by the LFCLKSTART task
			LFRC	0	32.768 kHz RC oscillator
			LFXO	1	32.768 kHz crystal oscillator
			LFSYNT	2	32.768 kHz synthesized from HFCLK

5.4.3.48 LFCLK.RUN

Address offset: 0x448

Indicates that LFCLKSTART task was triggered

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	STATUS			LFCLKSTART task triggered or not
			NotTriggered	0	Task not triggered
			Triggered	1	Task triggered

5.4.3.49 LFCLK.STAT

Address offset: 0x44C

Copy of LFCLK.SRCCOPY register, set when LFCLKSTARTED event is triggered.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	SRC			Value of LFCLK.SRCCOPY register when LFCLKSTARTED event was triggered
			LFRC	0	32.768 kHz RC oscillator
			LFXO	1	32.768 kHz crystal oscillator
			LFSYNT	2	32.768 kHz synthesized from HFCLK
B	R	STATE			LFCLK state (Running between START task and STOPPED event)
			NotRunning	0	LFCLK not running
			Running	1	LFCLK running

5.4.3.50 LFCLK.SRCCOPY

Address offset: 0x450

Copy of LFCLK.SRC register, set when LFCLKSTART task is triggered

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	SRC			Value of LFCLK.SRC register when LFCLKSTART task was triggered
			LFRC	0	32.768 kHz RC oscillator
			LFXO	1	32.768 kHz crystal oscillator
			LFSYNT	2	32.768 kHz synthesized from HFCLK

5.4.3.51 PLL24M.RUN

Address offset: 0x468

Indicates that XO24MSTART task was triggered

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	STATUS			XO24MSTART task triggered or not
			NotTriggered	0	Task not triggered
			Triggered	1	Task triggered

5.4.3.52 PLL24M.STAT

Address offset: 0x46C

Which PLL settings were selected when triggering START task

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	STATE			PLL state (Running between START task and STOPPED event)
			NotRunning	0	PLL24M is not running
			Running	1	PLL24M is running

5.5 OSCILLATORS — Oscillator control

The system oscillators are automatically controlled by the clock control system, see CLOCK — Clock control on page 72.

The system has the following crystal oscillators:

- High-frequency 32 MHz crystal oscillator (HFXO)
- Low-frequency 32.768 kHz crystal oscillator (LFXO)

The crystal oscillators can be configured to use either internal or external capacitors.

5.5.1 High-frequency (32 MHz) crystal oscillator (HFXO)

The high-frequency crystal oscillator (HFXO) is controlled by a 32 MHz external crystal.

The crystal oscillator is designed for use with an AT-cut quartz crystal in parallel resonant mode and is connected between pins **XC1** and **XC2**. For correct oscillation frequency, the load capacitance must match the specification in the crystal datasheet. The following figure shows how the 32 MHz crystal is connected to the high frequency crystal oscillator.

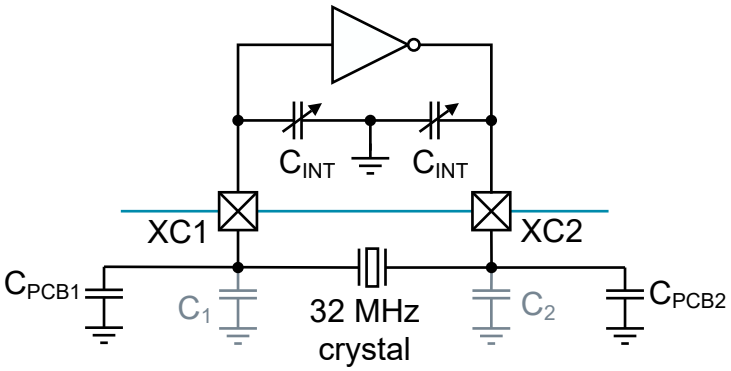


Figure 13: Circuit diagram of the high-frequency crystal oscillator

The device can be used with external capacitors C1 and C2 or the internal capacitors C_{INT}, which are configurable.

For reliable operation, the crystal load capacitance, shunt capacitance, equivalent series resistance, and drive level must comply with the specifications in table 32 MHz crystal oscillator (HFXO) on page 1261. It is recommended to use a crystal with lower than maximum load capacitance and/or shunt capacitance. A low load capacitance reduces both start up time and current consumption.

When using internal capacitors, the load capacitance (CL) is the total capacitance seen by the crystal across its terminals and is calculated by the following equation.

$$CL = \frac{(C1' \cdot C2')}{(C1' + C2')}$$

$$C1' = C_{INT} + C_{pcb1}$$
$$C2' = C_{INT} + C_{pcb2}$$

Figure 14: Load capacitance equation for internal capacitors

C_{INT} is the value of the internal capacitors. C_{pcb1} and C_{pcb2} are stray capacitance on the PCB.

The internal capacitor must be configured before starting the high-frequency crystal oscillator using the XOSTART task. To enable the internal capacitors, find the correct value for C_{INT} in the field OSCILLATORS.XOSC32M.CONFIG.INTCAP using the following equation.

```
INTCAP = (((CAPACITANCE-5.5)*(FICR->XOSC32MTRIM.SLOPE+791)) +
           FICR->XOSC32MTRIM.OFFSET*4)/256
```

The equation has the following variables:

- `CAPACITANCE` is the desired capacitor value of C_{INT} in pF, holding any value between 4.0 pF and 17.0 pF in 0.25 pF steps.
- `FICR->XOSC32MTRIM` are factory trim values which vary between devices.

After HFXO starts, the device uses the internal capacitor together with the external crystal after configuration.

5.5.1.1 Using external capacitors

It is possible to use external capacitors after disabling the internal capacitor.

When using external capacitors, the load capacitance (CL) is the total capacitance seen by the crystal across its terminals. It is calculated by the following equation.

$$CL = \frac{(C1' \cdot C2')}{(C1' + C2')}$$

$$C1' = C1 + C_{pcb1} + C_{pin}$$
$$C2' = C2 + C_{pcb2} + C_{pin}$$

Figure 15: Load capacitance equation for external capacitors

C1 and C2 are the external capacitors. C_{pcb1} and C_{pcb2} are stray capacitance on the PCB. C_{pin} is the pin input capacitance on pins **XC1** and **XC2**.

When using external capacitors, disable the internal capacitor by setting OSCILLATORS.XOSC32M.CONFIG.INTCAP to `0`.

5.5.1.2 Crystal selection

Several crystals are supported by the 32 MHz crystal oscillator.

The following figure shows a simple model of a crystal. It has R-L-C series components, called equivalent series resistance (ESR), motional capacitance ($C_{0=N}$), and motional inductance (L_M). The capacitor in parallel, C_0 , is called the shunt capacitance, and models the package capacitance.

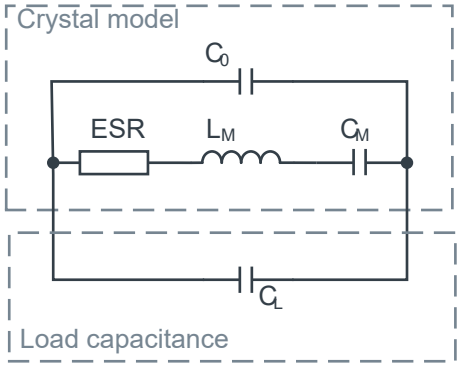


Figure 16: Simplified crystal model

The crystal needs to have parameters ESR, C_0 , and C_L selected to ensure the crystal oscillator is stable.

The following figure shows the maximum allowable combinations of ESR, C_0 and C_L for a given crystal. A crystal is supported if that crystal's parameters fall directly on the line or below it. Crystals that are above the line are not supported.

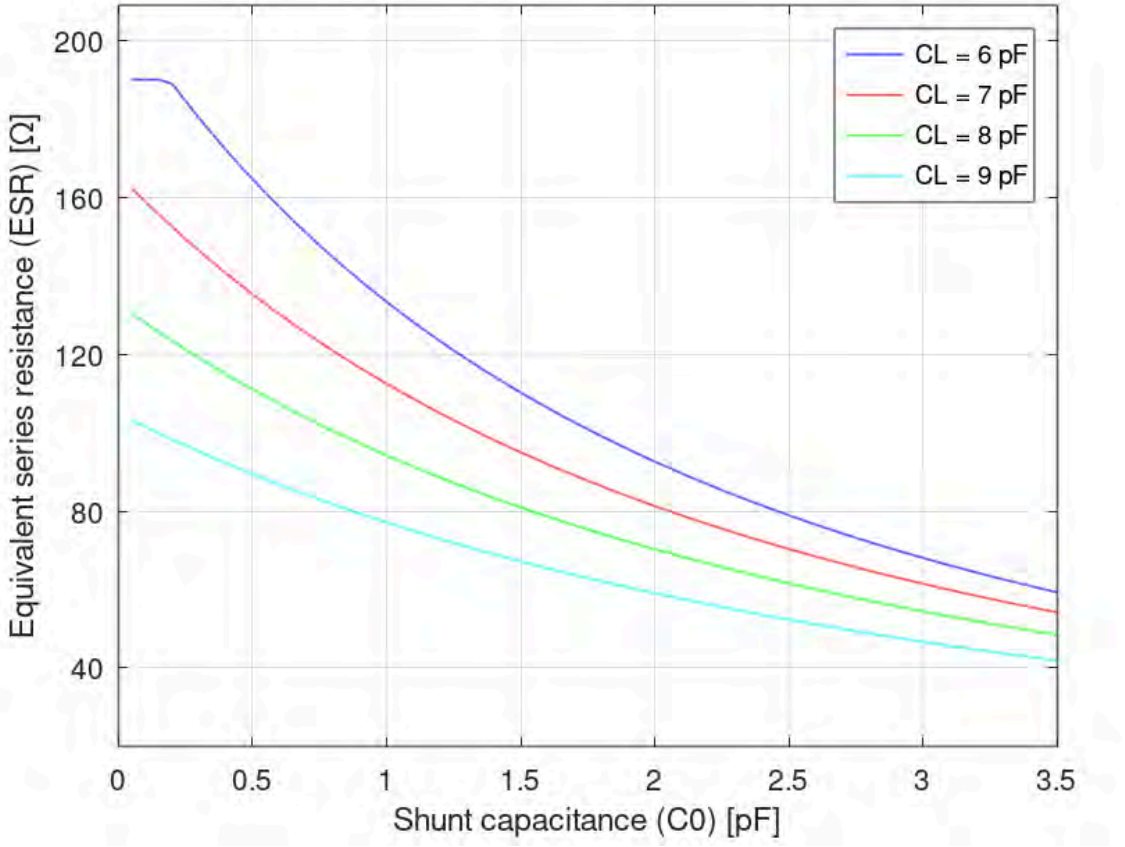


Figure 17: Maximum allowed combinations of ESR and C_0 for a given load capacitance C_L

5.5.2 Low-frequency (32.768 kHz) crystal oscillator (LFXO)

For clock accuracy higher than LFRC, the 32.768 kHz crystal oscillator (LFXO) must be used.

To use the LFXO, a 32.768 kHz crystal must be connected between the **XL1** and **XL2** pins, as shown in the following figure.

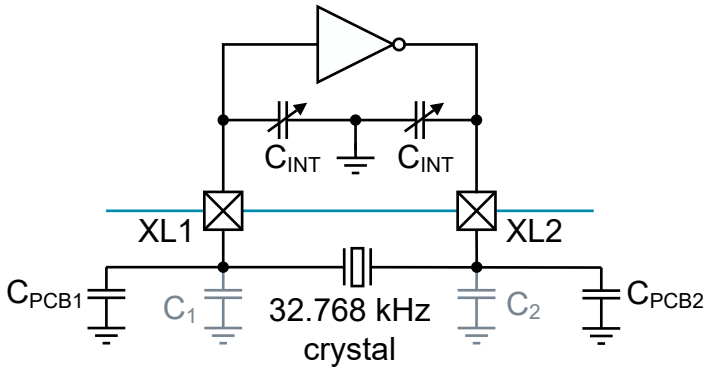


Figure 18: Circuit diagram of the low-frequency crystal oscillator

The device can be used with external capacitors C1 and C2 or the built-in configurable internal capacitors C_{INT}.

When using internal capacitors, the load capacitance (CL) is the total capacitance seen by the crystal across its terminals. It is calculated by the following equation.

$$CL = \frac{(C1' \cdot C2')}{(C1' + C2')}$$

$$C1' = C_{INT} + C_{pcb1}$$
$$C2' = C_{INT} + C_{pcb2}$$

Figure 19: Load capacitance equation for internal capacitors

C_{INT} is the value of the internal capacitors. C_{pcb1} and C_{pcb2} are stray capacitance on the PCB.

The internal capacitors must be configured before starting the low-frequency crystal oscillator (LFXO). To enable the internal capacitors, determine the correct field for OSCILLATORS.XOSC32KI.INTCAP using the following equation.

```
INTCAP = round( (2*CAPACITANCE - 12) * (FICR->XOSC32KTRIM.SLOPE + 0.765625 * 512)/512 +
 FICR->XOSC32KTRIM.OFFSET/64 )
```

The equation has the following variables:

- `CAPACITANCE` is the desired capacitor value in pF, holding any value between 3 pF and 18 pF in 0.65 pF steps.
- `FICR->XOSC32KTRIM` are factory trim values which are device specific.

When LFXO starts, it will use the internal capacitor together with the external crystal.

5.5.2.1 Using external capacitors

When using external capacitors, the load capacitance (CL) is the total capacitance seen by the crystal across its terminals. It is calculated by the following equation.

$$CL = \frac{(C1' \cdot C2')}{(C1' + C2')}$$

$$C1' = C1 + C_{pcb1} + C_{pin}$$
$$C2' = C2 + C_{pcb2} + C_{pin}$$

Figure 20: Load capacitance equation for external capacitors

C1 and C2 are ceramic SMD capacitors connected between each crystal terminal and ground. C_{pcb1} and C_{pcb2} are stray capacitance on the PCB. C_{pin} is the pin input capacitance on pins **XL1** and **XL2**. The load capacitors C1 and C2 must have the same value.

When using external capacitors, the internal capacitor is disabled by setting OSCILLATORS.XOSC32KI.INTCAP to `0`.

5.5.2.2 External source

The 32.768 kHz crystal oscillator (LFXO) is designed to work with external sources.

The device can use a rail-to-rail clock, where the signal should be applied to the **XL1** pin with the **XL2** pin left unconnected or connected to GND. To enable rail-to-rail clock, set XOSC32KI.BYPASS=`Enabled`.

Using an external source requires that CLOCK.LFCLK.SRC=`LFXO`.

5.5.3 CPU clock frequency selection

The CPU clock frequency is configurable on boot in the register PLL.FREQ (Retained) on page 98.

The device supports 64 or 128 MHz frequency.

The device starts at 64 MHz. For higher frequencies, it must be configured when the CPU starts and before any peripherals that use the high-frequency clock are enabled. Changing the frequency on a running system or to an unsupported value causes undefined system behavior and the device can malfunction.

5.5.4 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
OSCILLATORS : S OSCILLATORS : NS	GLOBAL	0x50120000 0x40120000	US	S	NA	No	Oscillator control

Register overview

Register	Offset	TZ	Description
XOSC32M.CONFIG.INTCAP	0x71C		Crystal load capacitor as seen by the crystal across its terminals, including pin capacitance but excluding PCB stray capacitance.
PLL.FREQ	0x800		Set speed of MCU power domain, including CPU This register is retained.
PLL.CURRENTFREQ	0x804		Current speed of MCU power domain, including CPU This register is retained.
XOSC32KI.BYPASS	0x900		Enable or disable bypass of LFCLK crystal oscillator with external clock source
XOSC32KI.INTCAP	0x904		Programmable capacitance of XL1 and XL2 This register is retained.
XOSC32KI.STATUS	0x914		Status information

5.5.4.1 XOSC32M

32 MHz oscillator control

5.5.4.1.1 XOSC32M.CONFIG.INTCAP

Address offset: 0x71C

Crystal load capacitor as seen by the crystal across its terminals, including pin capacitance but excluding PCB stray capacitance.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																											A	A	A	A	A	A
Reset 0x00000020	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	VAL			Crystal load capacitor value Use the provided equation in OSCILLATORS — Oscillator control on page 94 to calculate the register value.

5.5.4.2 PLL

Oscillator control

5.5.4.2.1 PLL.FREQ (Retained)

Address offset: 0x800

Set speed of MCU power domain, including CPU

This register is retained.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																		A	A
Reset 0x00000003				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW	FREQ																																	
			CK128M	1																															
			CK64M	3																															

5.5.4.2.2 PLL.CURRENTFREQ (Retained)

Address offset: 0x804

Current speed of MCU power domain, including CPU

This register is retained.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																		A	A
Reset 0x00000003				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	R	CURRENTFREQ																																	
			CK128M	1																															
			CK64M	3																															

5.5.4.3 XOSC32KI

32.768 kHz oscillator control

5.5.4.3.1 XOSC32KI.BYPASS

Address offset: 0x900

Enable or disable bypass of LFCLK crystal oscillator with external clock source

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	BYPASS																																	
			Disabled	0																															
			Enabled	1																															

5.5.4.3.2 XOSC32KI.INTCAP (Retained)

Address offset: 0x904

Programmable capacitance of XL1 and XL2

Use the provided equation in OSCILLATORS — Oscillator control on page 94 to calculate the register value.

This register is retained.

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	A A A A A
Reset 0x00000017	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 1 1**

ID	R/W	Field	Value ID	Value	Description
A	RW	VAL			Crystal load capacitor as seen by the crystal across its terminals, including pin capacitance but excluding PCB stray capacitance. Use the provided equation in "Using internal capacitors section" to calculate the register value.

5.5.4.3.3 XOSC32KI.STATUS

Address offset: 0x914

Status information

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	A
Reset 0x00000000	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	CLOCKRUNNING			Clock status
			NotRunning	0	Clock is not running.
			Running	1	Clock is running.

5.6 POWER — Power control

The POWER peripheral provides an interface for the power and clock subsystem for task, event, and interrupt related settings.

The POWER peripheral requests resources from the power and clock subsystem. The power and clock subsystem makes sure that the power mode with the proper latency settings is selected when requested. This means that the Constant Latency mode is prioritized over Low-power mode. For an overview of power modes, see Sub-power modes on page 69.

The event POFWARN is a system level event that enables the device to react quickly if there is a power failure. The power-fail comparator must be configured and enabled to receive the event, see Power-fail comparator on page 71 for more information.

Power control of the RAM blocks is controlled by the memory configuration peripheral (MEMCONF), see MEMCONF — Memory configuration on page 46.

> **Note:** Registers INTEN on page 104, INTENSET on page 104, and INTENCLR on page 104 are shared between the POWER and CLOCK peripherals.

5.6.1 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
POWER : S POWER : NS	GLOBAL	0x5010E000 0x4010E000	US	S	NA	No	Power control

Register overview

Register	Offset	TZ	Description
TASKS_CONSTLAT	0x30		Enable Constant Latency mode
TASKS_LOWPWR	0x34		Enable Low-power mode (variable latency)
SUBSCRIBE_CONSTLAT	0xB0		Subscribe configuration for task CONSTLAT
SUBSCRIBE_LOWPWR	0xB4		Subscribe configuration for task LOWPWR
EVENTS_POFWARN	0x130		Power failure warning
EVENTS_SLEEPENTER	0x134		CPU entered WFI/WFE sleep
EVENTS_SLEEPEXIT	0x138		CPU exited WFI/WFE sleep
PUBLISH_POFWARN	0x1B0		Publish configuration for event POFWARN
PUBLISH_SLEEPENTER	0x1B4		Publish configuration for event SLEEPENTER
PUBLISH_SLEEPEXIT	0x1B8		Publish configuration for event SLEEPEXIT
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
GPREGRET[n]	0x500		General purpose retention register This register is retained.
CONSTLATSTAT	0x520		Status of constant latency

5.6.1.1 TASKS_CONSTLAT

Address offset: 0x30

Enable Constant Latency mode

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_CONSTLAT			Enable Constant Latency mode
			Trigger	1	Trigger task

5.6.1.2 TASKS_LOWPWR

Address offset: 0x34

Enable Low-power mode (variable latency)

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_LOWPWR			Enable Low-power mode (variable latency)
			Trigger	1	Trigger task

5.6.1.3 SUBSCRIBE_CONSTLAT

Address offset: 0xB0

Subscribe configuration for task CONSTLAT

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task CONSTLAT will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

5.6.1.4 SUBSCRIBE_LOWPWR

Address offset: 0xB4

Subscribe configuration for task LOWPWR

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task LOWPWR will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

5.6.1.5 EVENTS_POFWARN

Address offset: 0x130

Power failure warning

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_POFWARN			Power failure warning
			NotGenerated	0	Event not generated
			Generated	1	Event generated

5.6.1.6 EVENTS_SLEEPENTER

Address offset: 0x134

CPU entered WFI/WFE sleep

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_SLEEPENTER			CPU entered WFI/WFE sleep
			NotGenerated	0	Event not generated
			Generated	1	Event generated

5.6.1.7 EVENTS_SLEEPEXIT

Address offset: 0x138

CPU exited WFI/WFE sleep

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_SLEEPEXIT			CPU exited WFI/WFE sleep
			NotGenerated	0	Event not generated
			Generated	1	Event generated

5.6.1.8 PUBLISH_POFWARN

Address offset: 0x1B0

Publish configuration for event POFWARN

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event POFWARN will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

5.6.1.9 PUBLISH_SLEEPENTER

Address offset: 0x1B4

Publish configuration for event SLEEPENTER

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event SLEEPENTER will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

5.6.1.10 PUBLISH_SLEEPEXIT

Address offset: 0x1B8

Publish configuration for event SLEEPEXIT

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event SLEEPEXIT will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

5.6.1.11 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	POFWARN			Enable or disable interrupt for event POFWARN
			Disabled	0	Disable
			Enabled	1	Enable
B	RW	SLEEPENTER			Enable or disable interrupt for event SLEEPENTER
			Disabled	0	Disable
			Enabled	1	Enable
C	RW	SLEEPEXIT			Enable or disable interrupt for event SLEEPEXIT
			Disabled	0	Disable
			Enabled	1	Enable

5.6.1.12 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1S	POFWARN			Write '1' to enable interrupt for event POFWARN
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	SLEEPENTER			Write '1' to enable interrupt for event SLEEPENTER
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1S	SLEEPEXIT			Write '1' to enable interrupt for event SLEEPEXIT
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

5.6.1.13 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	POFWARN			Write '1' to disable interrupt for event POFWARN
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	SLEEPENTER			Write '1' to disable interrupt for event SLEEPENTER
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	SLEEPEXIT			Write '1' to disable interrupt for event SLEEPEXIT
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

5.6.1.14 GPREGRET[n] (n=0..1) (Retained)

Address offset: 0x500 + (n × 0x4)

General purpose retention register

This register is retained.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	GPREGRET			General purpose retention register This register is retained

5.6.1.15 CONSTLATSTAT

Address offset: 0x520

Status of constant latency

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	STATUS			Status
			Disable	0	Constant latency disabled
			Enable	1	Constant latency enabled

5.7 REGULATORS — Regulator control

The power supply consists of a number of LDO and DC/DC regulators that maximize the system's power efficiency.

All system components are powered from the main on-chip voltage regulator VREGMAIN. The regulator converts the voltage supplied on **VDD** to internal voltage.

The device also has an USB regulator, which only powers the USB physical interface. It will not power the device. The USB regulator is documented in USBREG — USB regulator control on page 114.

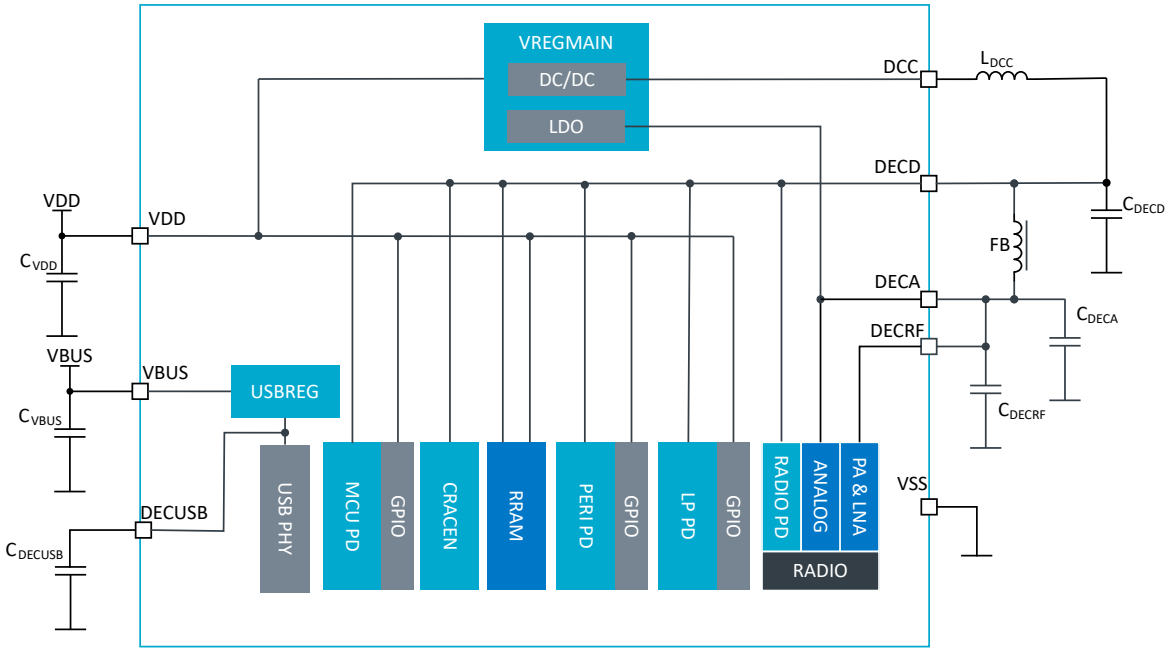


Figure 21: Regulator configuration

The main supply voltage is connected to the **VDD** pin.

5.7.1 VREGMAIN — Main regulator

VREGMAIN is the main regulator of the system.

The device only supports DC/DC mode, which needs external components. For details, see Reference circuitry on page 1246.

VREGMAIN starts up using a fall-back mode, and the DC/DC regulator must be enabled using register VREGMAIN.DCDCEN on page 108.

Inductor detection

The DC/DC regulator requires an external inductor connected to the **DCC** pin. If an inductor is not present, the regulator stays in fall-back mode to enable a soft shut-down of the system. Register VREGMAIN.INDUCTORDET on page 108 reports the inductor detection status and can be used to detect inductor failures that prevent DC/DC operation.

5.7.2 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
REGULATORS : S REGULATORS : NS	GLOBAL	0x50120000 0x40120000	US	S	NA	No	Regulator control

Register overview

Register	Offset	TZ	Description
SYSTEMOFF	0x500		System OFF register
POFCON	0x530		Power-fail comparator configuration
POFSTAT	0x534		Power-fail comparator status register
VREGMAIN.DCDCEN	0x600		Enable DC/DC converter
VREGMAIN.INDUCTORDET	0x604		VREGMAIN inductor detection

5.7.2.1 SYSTEMOFF

Address offset: 0x500

System OFF register

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	SYSTEMOFF			Enable System OFF mode
			Enter	1	Enable System OFF mode

5.7.2.2 POFCON

Address offset: 0x530

Power-fail comparator configuration

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																									C			B	B	B	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	POF			Enable or disable power-fail comparator
			Disabled	0	Disable
			Enabled	1	Enable
B	RW	THRESHOLD			Power-fail comparator threshold setting
			V17	0	Set threshold to 1.7 V for VDD
			V18	1	Set threshold to 1.8 V for VDD
			V19	2	Set threshold to 1.9 V for VDD
			V20	3	Set threshold to 2.0 V for VDD
			V21	4	Set threshold to 2.1 V for VDD
			V22	5	Set threshold to 2.2 V for VDD
			V23	6	Set threshold to 2.3 V for VDD
			V24	7	Set threshold to 2.4 V for VDD
			V25	8	Set threshold to 2.5 V for VDD
			V26	9	Set threshold to 2.6 V for VDD
			V27	10	Set threshold to 2.7 V for VDD
			V28	11	Set threshold to 2.8 V for VDD
			V29	12	Set threshold to 2.9 V for VDD
			V30	13	Set threshold to 3.0 V for VDD
			V31	14	Set threshold to 3.1 V for VDD
			V32	15	Set threshold to 3.2 V for VDD
C	RW	EVENTDISABLE			Disable the POFWARN power-fail warning event
			Enabled	0	POFWARN event is generated

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Disabled	1	POFWARN event is not generated

5.7.2.3 POFSTAT

Address offset: 0x534

Power-fail comparator status register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	COMPARATOR			Power-fail comparator status
			Above	0	Voltage detected above VPOF threshold
			Below	1	Voltage detected below VPOF threshold

5.7.2.4 VREGMAIN

Register interface for main voltage regulator.

5.7.2.4.1 VREGMAIN.DCDCEN

Address offset: 0x600

Enable DC/DC converter

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	VAL			Enable DC/DC buck converter
			Disabled	0	Disable DC/DC buck converter
			Enabled	1	Enable DC/DC converter If inductor is not present (see register VREGMAIN.INDUCTORDET), the DC/DC converter cannot operate

5.7.2.4.2 VREGMAIN.INDUCTORDET

Address offset: 0x604

VREGMAIN inductor detection

Ensure that an inductor is connected to the DCC pin. The detection can only take place before the DC/DC converter is enabled.

Note: The DC/DC converter cannot operate without an inductor.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	DETECTED			
			InductorNotDetected	0	VREGMAIN inductor not detected
			InductorDetected	1	VREGMAIN inductor detected

5.8 RESET — Reset control

A system-level reset is triggered by the following resets:

- Brownout
- Power-on
- CTRL-AP
- Watchdog
- Wakeup from System OFF
- Tamper detection
- Voltage glitch detection
- CPU Lockup
- Pin

The system reset sources are shown in the following figure.

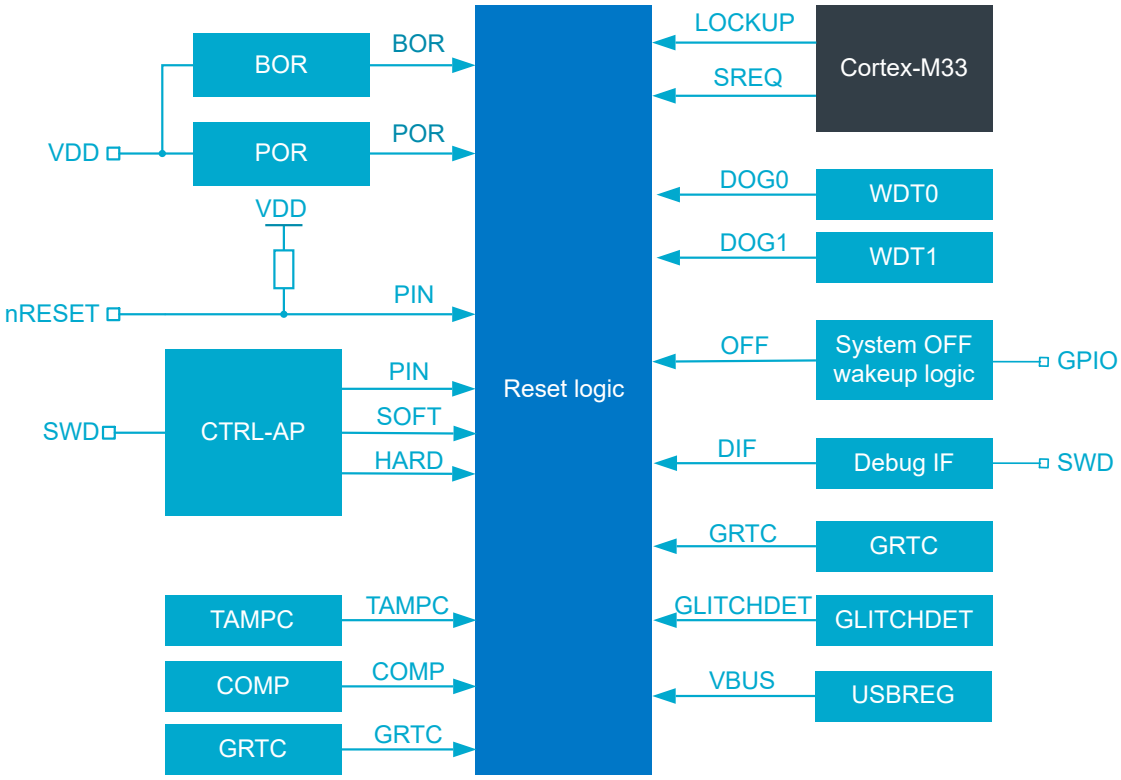


Figure 22: Reset sources

After a reset, the device automatically starts up. The register RESETREAS on page 112 can be read to determine which source generated the reset.

5.8.1 Power-on reset

The power-on reset (POR) generator initializes the system when the supply voltage is above the power-on threshold.

The system is held in a reset state until the supply reaches the minimum operating voltage and the internal voltage regulators start. After a power-on reset, the device starts up.

5.8.2 Pin reset

A pin reset is generated when the physical reset pin on the device is asserted.

Pin reset is available on the reset pin **nRESET**, see Pin assignments on page 1219. The device starts after **nRESET** is deasserted.

The reset pin has an internal pull-up resistor with the same resistance as GPIO pull-ups, see GPIO Electrical Specification on page 1259.

CTRL-AP can also reset a pin, see CTRL-AP resets on page 110.

5.8.3 Brownout reset

The brownout reset (BOR) generator puts the system in RESET state if the supply voltage drops below the brownout reset threshold.

Similar to a power-on reset, the device starts after BOR is deasserted.

5.8.4 Glitch detector

The glitch detector (GLITCHDET) sets the system to the RESET state when the supply voltage or the device internal digital voltage drops below safe thresholds.

Similar to a power-on reset and a brownout reset, the device starts after GLITCHDET is deasserted.

For more information about the glitch detector, see GLITCHDET — Voltage glitch detectors on page 178.

5.8.5 Wakeup from System OFF mode reset

The device is reset when it wakes up from System OFF mode.

Similar to a power-on reset (POR), the device is started after waking up from System OFF.

If the device is in Debug interface mode, the debug access port (DAP) is not reset after a wakeup from System OFF mode. For more information, see Debug and trace on page 1174.

For details on the System OFF mode, see System OFF mode on page 70.

5.8.6 Soft reset

A soft reset is generated when the SYSRESETREQ bit of the application interrupt and reset control register (AIRCR) in the Arm CPU is set. For more information, see Arm documentation.

A soft reset can also be generated using CTRL-AP, see CTRL-AP resets on page 110.

Similar to a power-on reset (POR), the device is restarted after a soft reset.

5.8.7 CTRL-AP resets

CTRL-AP can generate the following resets.

- Soft reset
- Pin reset
- Hard reset. This is used during an Erase ALL operation and is less intrusive than Pin reset. For more details, see Reset behavior on page 111.

Through the debugger interface, CTRL-AP can generate three resets using register RESET on page 1187. For more details, see CTRL-AP — Control access port on page 1181.

Similar to a power-on reset (POR), the device is restarted after a CTRL-AP reset.

5.8.8 Watchdog timer reset

A watchdog timer (WDT) reset is generated when the watchdog timer times out.

Similar to a power-on reset (POR), the device is started after a watchdog reset.

5.8.9 Retained registers

A retained register is one that will retain its value in System OFF mode and through a reset, depending on the reset source. See the individual peripheral chapters for information on which of their registers are retained.

5.8.10 Reset behavior

The reset source determines the behavior of the device after a reset.

In System OFF mode, the watchdog timer is not running and CPU lockup is not possible. RAM may be fully or partially retained, depending on RAM retention settings in MEMCONF — Memory configuration on page 46.

If the device is in Debug Interface mode, the debug components are not reset. Additionally, CPU lockup does not generate a reset. See Debug and trace on page 1174 for more information about the different debug components in the system.

An 'x' in the table means that the specific module or register is reset. The table also explicitly lists which reset sources are commonly referred to as 'cold boot'.

								Retained registers			
Reset source	**Cold boot**	**CM33**	**Peri-pher-als**	**De-bug**	**RAM**	**WDT**	**REGU-LATOR OSCI-LLA-TORS and CPU speed**	**RESET-REAS**	**POWE GP-RET-REG**	**GPIO**	**GRTC. SYS-COU-NTER**
CPU lockup		x	x							x[1]	x
Soft reset and CTRL-AP soft reset		x	x							x[1]	
Wakeup from System Off mode		x	x			x		x			
CTRL-AP hard reset		x	x	x	x	x	x			x	x
CTRL-AP pin reset		x	x	x	x	x	x			x	x
Watchdog timer reset		x	x	x	x	x	x			x	x
Pin reset		x	x	x	x	x	x			x	x
TAMPC reset		x	x	x	x	x	x			x	x
GLITCHDET reset	x	x	x	x	x	x	x	x	x	x	x
Brownout reset	x	x	x	x	x	x	x	x	x	x	x
Power-on reset	x	x	x	x	x	x	x	x	x	x	x

Table 22: Reset overview

[1]Except the CTRLSEL field.

For TAMPC reset sources, see TAMPC — Tamper controller on page 206.

5.8.11 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
RESET : S RESET : NS	GLOBAL	0x5010E000 0x4010E000	US	S	NA	No	Reset status

Register overview

Register	Offset	TZ	Description
RESETREAS	0x600		Reset reason

5.8.11.1 RESETREAS

Address offset: 0x600

Reset reason

Before entering System OFF mode, the RESETREAS register must be cleared.

Note: Unless cleared, the RESETREAS register will be cumulative. A field is cleared by writing 1 to it.

Note: When RESETREAS shows a pin reset (RESETPIN), ignore other reset reason bits.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	RESETPIN			Reset from pin reset detected CTRL-AP generating a pin reset has its own bit.
			NotDetected	0	Not detected
			Detected	1	Detected
B	RW	DOG0			Reset from watchdog timer 0 detected
			NotDetected	0	Not detected
			Detected	1	Detected
C	RW	DOG1			Reset from watchdog timer 1 detected
			NotDetected	0	Not detected
			Detected	1	Detected
D	RW	CTRLAPSOFT			Soft reset from CTRL-AP detected
			NotDetected	0	Not detected
			Detected	1	Detected
E	RW	CTRLAPHARD			Reset due to CTRL-AP hard reset
			NotDetected	0	Not detected
			Detected	1	Detected
F	RW	CTRLAPPIN			Reset due to CTRL-AP pin reset
			NotDetected	0	Not detected
			Detected	1	Detected
G	RW	SREQ			Reset from soft reset detected
			NotDetected	0	Not detected
			Detected	1	Detected
H	RW	LOCKUP			Reset from CPU lockup detected
			NotDetected	0	Not detected
			Detected	1	Detected
I	RW	OFF			Reset due to wakeup from System OFF mode when wakeup is triggered by DETECT signal from GPIO
			NotDetected	0	Not detected
			Detected	1	Detected
J	RW	LPCOMP			Reset due to wakeup from System OFF mode when wakeup is triggered by ANADETECT signal from LPCOMP
			NotDetected	0	Not detected
			Detected	1	Detected
K	RW	DIF			Reset triggered by Debug Interface
			NotDetected	0	Not detected
			Detected	1	Detected
L	RW	GRTC			Reset due to wakeup from GRTC
			NotDetected	0	Not detected
			Detected	1	Detected
M	RW	NFC			Reset after wakeup from System OFF mode due to NFC field being detected

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																					O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
			NotDetected	0																															
			Detected	1																															
N	RW	SECTAMPER																																	
			NotDetected	0																															
			Detected	1																															
O	RW	VBUS																																	
			NotDetected	0																															
			Detected	1																															

5.9 Power and clock components

5.9.1 USBREG — USB regulator control

A 5 V USB supply must power the VBUS pin when using the USB peripheral.

The device has a dedicated internal voltage regulator for converting the VBUS supply to 3.3 V for the USB signaling interface (D+ and D- lines, and pull-up on D+). The rest of the USB peripheral (USBHS) is supplied through the main supply like other on-chip features. As a consequence, both VBUS and VDD are required for USB peripheral operation. For details on the device voltage regulators, see REGULATORS — Regulator control on page 105.

5.9.1.1 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
VREGUSB : S VREGUSB : NS	GLOBAL	0x50121000 0x40121000	US	S	NA	No	USB regulator

Configuration

Instance	Domain	Configuration
VREGUSB : S VREGUSB : NS	GLOBAL	

Register overview

Register	Offset	TZ	Description
TASKS_START	0x000		Enable and start VREGUSB so that it can detect VBUS
TASKS_STOP	0x004		Stop and disable VREGUSB
EVENTS_VBUSDETECTED	0x104		VBUS detected
EVENTS_VBUSREMOVED	0x110		VBUS removed
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
INTPEND	0x30C		Pending interrupts

5.9.1.1.1 TASKS_START

Address offset: 0x000

Enable and start VREGUSB so that it can detect VBUS

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_START			Enable and start VREGUSB so that it can detect VBUS
			Trigger	1	Trigger task

5.9.1.1.2 TASKS_STOP

Address offset: 0x004

Stop and disable VREGUSB

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Stop and disable VREGUSB
			Trigger	1	Trigger task

5.9.1.1.3 EVENTS_VBUSDETECTED

Address offset: 0x104

VBUS detected

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_VBUSDETECTED			VBUS detected
			NotGenerated	0	Event not generated
			Generated	1	Event generated

5.9.1.1.4 EVENTS_VBUSREMOVED

Address offset: 0x110

VBUS removed

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_VBUSREMOVED			VBUS removed
			NotGenerated	0	Event not generated
			Generated	1	Event generated

5.9.1.1.5 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	VBUSDETECTED			Enable or disable interrupt for event VBUSDETECTED
			Disabled	0	Disable
			Enabled	1	Enable
B	RW	VBUSREMOVED			Enable or disable interrupt for event VBUSREMOVED
			Disabled	0	Disable
			Enabled	1	Enable

5.9.1.1.6 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1S	VBUSDETECTED			Write '1' to enable interrupt for event VBUSDETECTED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	VBUSREMOVED			Write '1' to enable interrupt for event VBUSREMOVED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

5.9.1.1.7 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	VBUSDETECTED			Write '1' to disable interrupt for event VBUSDETECTED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	VBUSREMOVED			Write '1' to disable interrupt for event VBUSREMOVED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

5.9.1.1.8 INTPEND

Address offset: 0x30C

Pending interrupts

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	VBUSDETECTED			Read pending status of interrupt for event VBUSDETECTED
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
B	R	VBUSREMOVED			Read pending status of interrupt for event VBUSREMOVED
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending

6 Event system

The distributed programmable peripheral interconnect (DPPI) system enables peripherals to interact autonomously with each other through tasks and events, without intervention from the CPU.

The DPPI channels are local to each power domain, but can be transferred between power domains using PPI bridges.

The following figure shows the power domains, the PPI controllers (DPPIC), and the PPI bridges (PPIB).

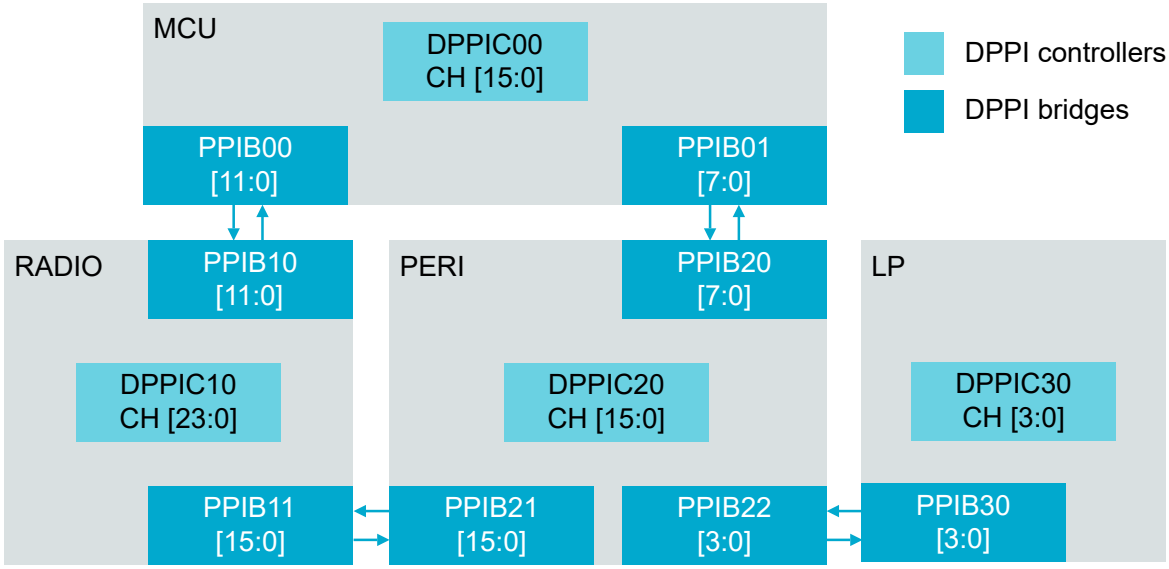


Figure 23: Power domains and PPI bridges

A subset of PPI channels from a power domain can be bridged across to a different power domain. For example, PPIB00 can bridge a set number of configurable DPPI channels to PPIB10. For more details on how to configure the PPI and bridge system, see DPPI — Distributed programmable peripheral interconnect on page 119 and PPIB — PPI Bridge on page 128.

6.1 DPPI latencies

DPPI task and event latency depends on the power domain of the source and destination peripherals.

DPPI signals operate on the HCLKCORE, PCLK32M, and PCLK16M clocks.

Power domain	Clock source
MCU	HCLKCORE (64 or 128 MHz)
RADIO	PCLK32M (32 MHz)
PERI	PCLK16M (16 MHz)
LP	PCLK16M (16 MHz)

Table 23: DPPI clock frequency

For peripherals in the same power domain, there is a two cycle delay from when an event is generated until a task subscribing to the same channel is triggered. Events that are generated while the system

is sleeping will have additional access latency, as the system needs to request and provide sufficient resources for PPI handling. Examples of such events are the following:

- A GPIO toggling and generating an event through GPIOTE
- Events generated by GRTC while all other clocks are stopped

To improve PPI latency, the Constant Latency mode can be used, see Sub-power modes on page 69.

For peripherals in different power domains, additional access latency will apply. Events that are generated while the generating or receiving power domains are sleeping will have additional access latency, as the system needs to request and provide sufficient resources for PPI handling.

6.2 DPPI — Distributed programmable peripheral interconnect

The distributed programmable peripheral interconnect (DPPI) enables peripherals to interact autonomously with each other through tasks and events, without CPU intervention. DPPI allows precise synchronization between peripherals when real-time application constraints exist, and eliminates the need for CPU involvement to implement behavior which can be predefined using the DPPI.

> **Note:** For more information on tasks, events, publish, subscribe, interrupts, and other concepts, see Peripheral interface on page 228.

The main features of DPPI are the following:

- Peripheral tasks can subscribe to channels
- Peripheral events can be published on channels
- Publish/subscribe pattern enabling multiple connection options that include the following:
  - One-to-one
  - One-to-many
  - Many-to-one
  - Many-to-many

The DPPI consists of several PPIBus modules. These modules are connected to a fixed number of DPPI channels and a DPPI controller (DPPIC).

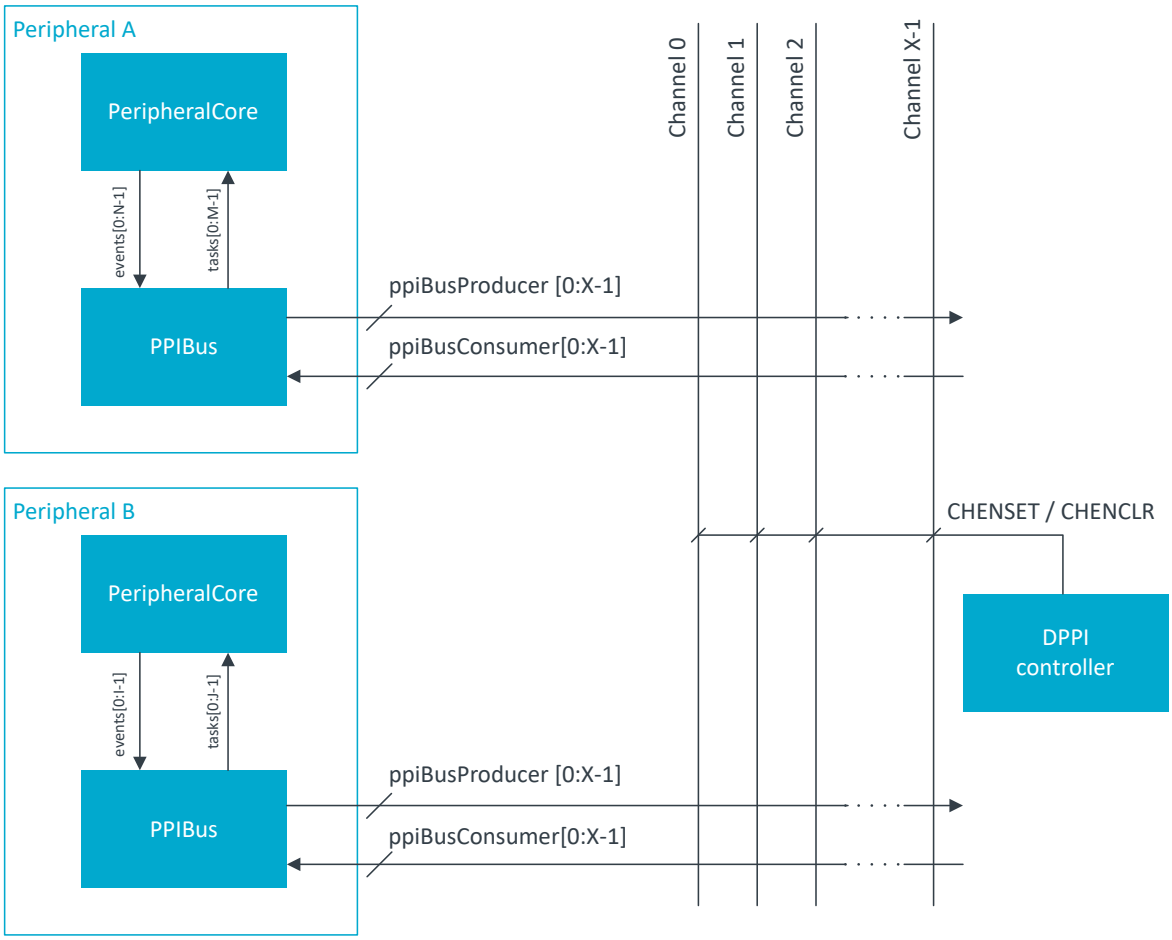


Figure 24: DPPI overview

6.2.1 Channel publish and subscribe

The DPPI system directs peripheral events to a channel (publishing) and converts events from a channel into peripheral tasks (subscribing).

All peripherals include the following:

- One publish register per event
- One subscribe register per task

The publish and subscribe registers have two fields. A channel index field (CHIDX) determines which channel an event is published to, or which channel a task is subscribed to. In addition there is an ENABLE field that must be set to `1` to activate the operation.

Writing non-existing channel index (CHIDX) numbers into a peripheral's publish or subscribe registers will yield unexpected results.

One event can trigger multiple tasks by subscribing different tasks to the same channel. Similarly, one task can be triggered by multiple events by publishing different events to the same channel. For advanced use cases, multiple events and multiple tasks can connect to the same channel forming a many-to-many connection. If multiple events are published on the same channel at the same time, the events are merged and only one event is routed through the DPPI.

The following figure shows how peripheral events are routed onto different channels based on publish registers.

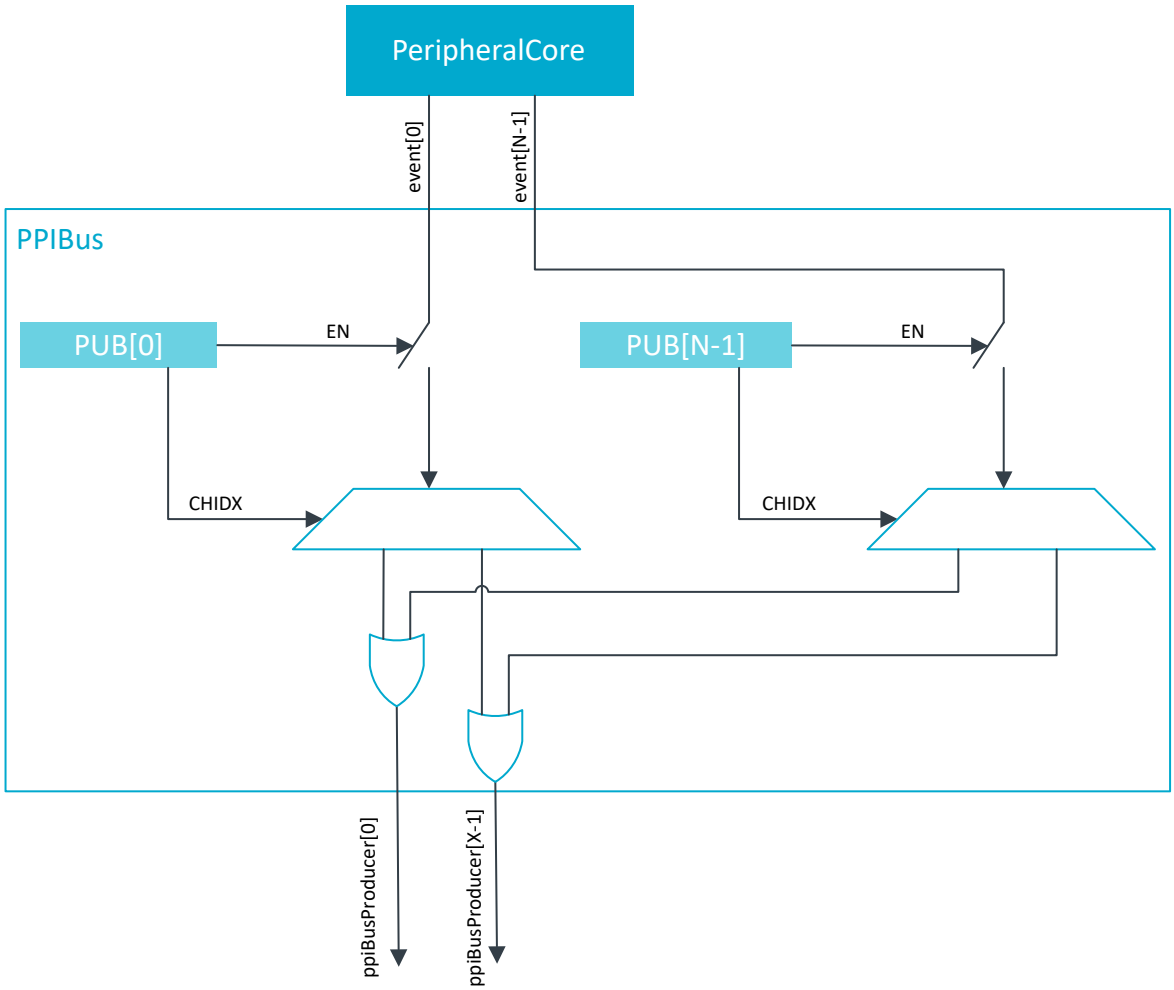


Figure 25: DPPI events flow

The following figure illustrates how peripheral tasks are triggered from different channels based on subscribe registers.

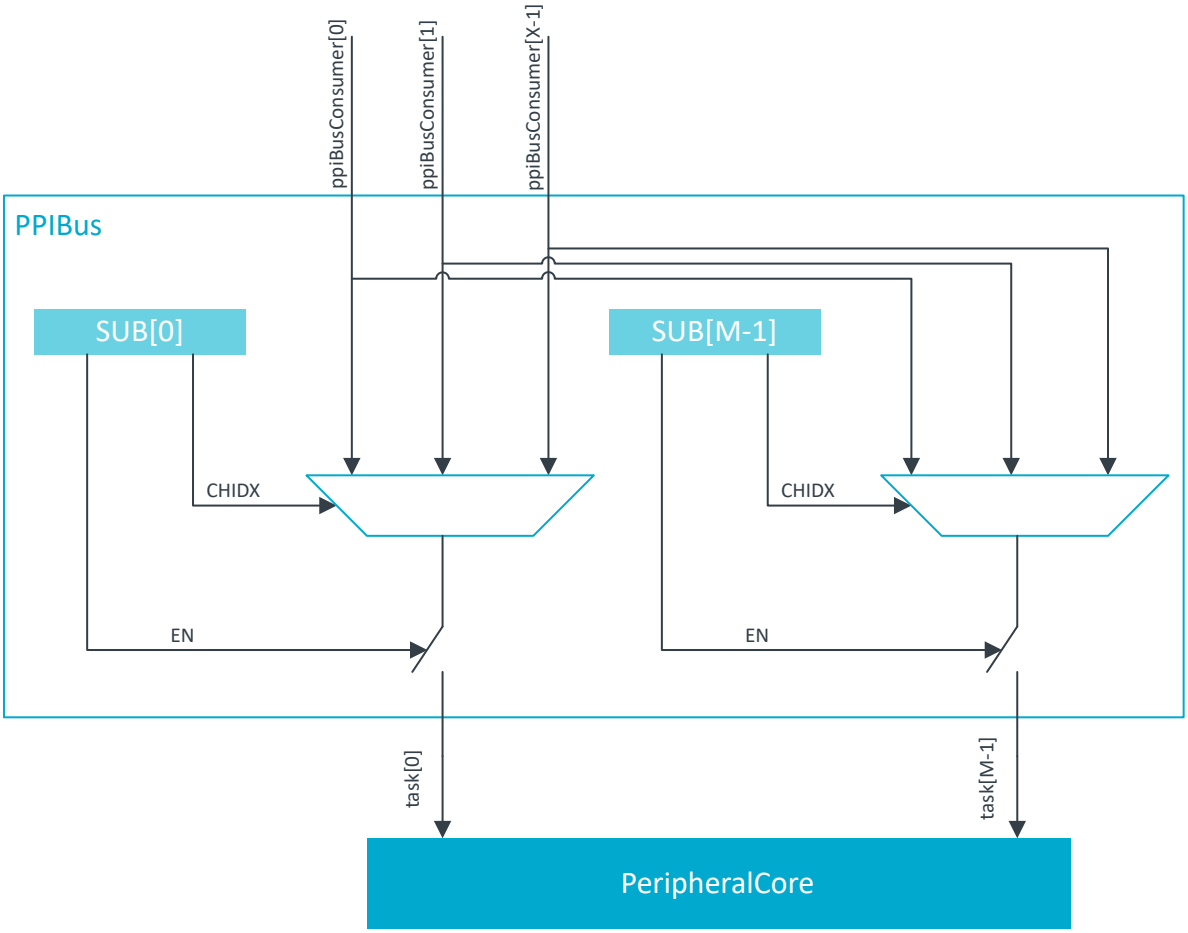


Figure 26: DPPI tasks flow

6.2.2 DPPI controller (DPPIC)

Enabling and disabling of DPPI channels is handled through DPPIC.

There are two ways of enabling or disabling a DPPI channel using DPPIC:

- Enable or disable channels individually using registers CHEN, CHENSET, and CHENCLR.
- Enable or disable channels in channel groups using the groups' tasks ENABLE and DISABLE. Channel groups should be defined via the CHG registers before these tasks are triggered.

> **Note:** ENABLE tasks are prioritized over DISABLE tasks, i.e. in case of a simultaneously occurring TASKS_CHG[m].EN and TASKS_CHG[n].DIS (m and n can be equal or different), the CHG[m].EN task will be prioritized if the same channel subscribed to both groups.

DPPIC tasks (for example CHG[0].EN) can be triggered through DPPI like any other task, which means they can be linked to a DPPI channel through the subscribe registers.

In order to write to CHG[n], the corresponding CHG[n].EN and CHG[n].DIS subscribe registers must be disabled. Writes to CHG[n] are ignored if any of the two subscribe registers are enabled.

6.2.3 Connection examples

Several connection options are available with DPPI. Examples are given for how to create one-to-one and many-to-many connections.

One-to-one connection

This example shows how to create a one-to-one connection between the TIMER compare register and the SAADC start task.

The channel configuration is set up first. TIMER will publish its COMPARE0 event on channel 0, and SAADC will subscribe its START task to events on the same channel. When this is finished, the channel is enabled through the DPPIC.

```
NRF_TIMER20->PUBLISH_COMPARE[0] = (0 << TIMER_PUBLISH_COMPARE_CHIDX_Pos) |
 TIMER_PUBLISH_COMPARE_EN_Msk;
NRF_SAADC->SUBSCRIBE_START = (0 << SAADC_SUBSCRIBE_START_CHIDX_Pos) |
 SAADC_SUBSCRIBE_START_EN_Msk;
NRF_DPPIC20->CHENSET = DPPIC_CHENSET_CH0_Msk;
```

Many-to-many connection

The following example shows how to create a many-to-many connection, showcasing the DPPIC's channel group functionality.

A channel group that includes only channel 0 is set up first. Then the GPIOTE and TIMER configure their IN0 and COMPARE0 events respectively to be published on channel 0, while the SAADC configures its START task to subscribe to events on channel 0. Through DPPIC, the CHG0 DISABLE task is configured to subscribe to events on channel 0. After an event is received on channel 0 it will be disabled. Finally, channel 0 is enabled using the DPPIC task to enable a channel group.

```
NRF_DPPIC20->CHG[0] = (DPPIC_CHG_CH0_Included << DPPIC_CHG_CH0_Pos);
NRF_GPIOTE20->PUBLISH_IN[0] = (0 << GPIOTE_PUBLISH_IN_CHIDX_Pos) |
 GPIOTE_PUBLISH_IN_EN_Msk;
NRF_TIMER20->PUBLISH_COMPARE[0] = (0 << TIMER_PUBLISH_COMPARE_CHIDX_Pos) |
 TIMER_PUBLISH_COMPARE_EN_Msk;
NRF_SAADC->SUBSCRIBE_START = (0 << SAADC_SUBSCRIBE_START_CHIDX_Pos) |
 SAADC_SUBSCRIBE_START_EN_Msk;
NRF_DPPIC20->SUBSCRIBE_CHG[0].DIS = DPPIC_CHENSET_CH0_Msk | DPPIC_SUBSCRIBE_CHG_DIS_EN_Msk;
NRF_DPPIC20->TASK_CHG[0].EN = 1;
```

6.2.4 Special considerations for a system implementing TrustZone for Cortex-M processors

DPPI is implemented with split security in order to handle both secure and non-secure accesses. In a system implementing the TrustZone for Cortex-M technology, DPPI channels can be defined as secure or non-secure using the SPU.

A peripheral configured as non-secure can only subscribe to or publish on non-secure DPPI channels. A peripheral configured as secure can access all DPPI channels. DPPI handles both secure and non-secure accesses, but behaves differently depending on the access type.

- A non-secure peripheral access can only configure and control the DPPI channels defined as non-secure in the SPU.DPPI.PERM[n] register
- A secure peripheral access can control all the DPPI channels, independently of the SPU.DPPI.PERM[n] register

Non-secure access to a DPPI register or bit field controlling a channel marked as secure in a SPU.DPPI[n].PERM register is ignored. Write access has no effect, and read access returns a zero value.

Exceptions are not triggered when non-secure accesses target a register or a bit field controlling a secure channel. For example, if the bit `i` is set in the SPU.DPPI[0].PERM register (declaring DPPI channel [i] as secure), then the following is true:

- Non-secure write access to registers CHEN, CHENSET, and CHENCLR cannot write bit `i` of these registers
- Non-secure write access to registers TASK_CHG[j].EN and TASK_CHG[j].DIS is ignored if the channel group `j` contains at least one channel defined as secure (it can be the channel [i] itself or any channel declared as secure)
- Non-secure read access to registers CHEN, CHENSET, and CHENCLR always read 0 for the bit at position `i`

For the channel configuration registers (CHG[]), access from non-secure code is only possible if the included channels are all non-secure, whether the channels are enabled or not. If register CHG[g] included one or more secure channels, then the group `g` is considered as secure, and only secure transfers can read to or write from CHG[g]. A non-secure write access is ignored, and a non-secure read access returns 0.

The DPPI can subscribe to secure and non-secure channels through the SUBSCRIBE_CHG[] registers in order to trigger the task for enabling or disabling channel groups. An event from a secure channel is ignored if the group subscribing to this channel is non-secure. A secure group can subscribe to a non-secure channel or a secure channel.

Channel group

Creating a channel group allows all channels in that group to be simultaneously enabled or disabled. The security attribute for a channel group (secure or non-secure) is defined as follows:

- If all channels (enabled or not) within a group are non-secure, then the group is considered non-secure
- If at least one of the channels (enabled or not) within the group is secure, then the group is considered secure

6.2.5 Split security

Individual DPPI channels and channel groups can have independent security attributes.

The split security of DPPI means it handles both secure and non-secure code access. DPPI channels and channel groups can be defined as secure or non-secure.

For more information on DPPI security, see DPPIC on page 141.

6.2.6 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
DPPIC00 : S DPPIC00 : NS	GLOBAL	0x50042000 0x40042000	US	S	NA	Yes	DPPI controller DPPIC00
DPPIC10 : S DPPIC10 : NS	GLOBAL	0x50082000 0x40082000	US	S	NA	Yes	DPPI controller DPPIC10
DPPIC20 : S DPPIC20 : NS	GLOBAL	0x500C2000 0x400C2000	US	S	NA	Yes	DPPI controller DPPIC20
DPPIC30 : S DPPIC30 : NS	GLOBAL	0x50102000 0x40102000	US	S	NA	Yes	DPPI controller DPPIC30

Configuration

Instance	Domain	Configuration
DPPIC00 : S DPPIC00 : NS	GLOBAL	16 DPPI channels 2 DPPI groups
DPPIC10 : S DPPIC10 : NS	GLOBAL	24 DPPI channels 6 DPPI groups
DPPIC20 : S DPPIC20 : NS	GLOBAL	16 DPPI channels 6 DPPI groups
DPPIC30 : S DPPIC30 : NS	GLOBAL	4 DPPI channels 2 DPPI groups

Register overview

Register	Offset	TZ	Description
TASKS_CHG[n].EN	0x000		Enable channel group n
TASKS_CHG[n].DIS	0x004		Disable channel group n
SUBSCRIBE_CHG[n].EN	0x080		Subscribe configuration for task CHG[n].EN
SUBSCRIBE_CHG[n].DIS	0x084		Subscribe configuration for task CHG[n].DIS
CHEN	0x500		Channel enable register
CHENSET	0x504		Channel enable set register
CHENCLR	0x508		Channel enable clear register
CHG[n]	0x800		Channel group n Note: Writes to this register are ignored if either SUBSCRIBE_CHG[n].EN or SUBSCRIBE_CHG[n].DIS is enabled

6.2.6.1 TASKS_CHG[n] (n=0..5)

Channel group tasks

6.2.6.1.1 TASKS_CHG[n].EN (n=0..5)

Address offset: 0x000 + (n × 0x8)

Enable channel group n

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	EN			Enable channel group n
			Trigger	1	Trigger task

6.2.6.1.2 TASKS_CHG[n].DIS (n=0..5)

Address offset: 0x004 + (n × 0x8)

Disable channel group n

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	DIS			Disable channel group n
			Trigger	1	Trigger task

6.2.6.2 SUBSCRIBE_CHG[n] (n=0..5)

Subscribe configuration for tasks

6.2.6.2.1 SUBSCRIBE_CHG[n].EN (n=0..5)

Address offset: 0x080 + (n × 0x8)

Subscribe configuration for task CHG[n].EN

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task CHG[n].EN will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

6.2.6.2.2 SUBSCRIBE_CHG[n].DIS (n=0..5)

Address offset: 0x084 + (n × 0x8)

Subscribe configuration for task CHG[n].DIS

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task CHG[n].DIS will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

6.2.6.3 CHEN

Address offset: 0x500

Channel enable register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				X W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-X	RW	CH[i] (i=0..23)			Enable or disable channel i
			Disabled	0	Disable channel
			Enabled	1	Enable channel

6.2.6.4 CHENSET

Address offset: 0x504

Channel enable set register

Note: Read: Reads value of CH[i] field in CHEN register

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID												X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID				Value				Description																							
A-X	RW W1S	CH[i] (i=0..23)										Channel i enable set register. Writing 0 has no effect.																						
			Disabled	0								Read: Channel disabled																						
			Enabled	1								Read: Channel enabled																						
			Set	1								Write: Enable channel																						

6.2.6.5 CHENCLR

Address offset: 0x508

Channel enable clear register

Note: Read: Reads value of CH[i] field in CHEN register

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID												X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID				Value				Description																							
A-X	RW W1C	CH[i] (i=0..23)										Channel i enable clear register. Writing 0 has no effect.																						
			Disabled	0								Read: Channel disabled																						
			Enabled	1								Read: Channel enabled																						
			Clear	1								Write: Disable channel																						

6.2.6.6 CHG[n] (n=0..5)

Address offset: 0x800 + (n × 0x4)

Channel group n

Note: Writes to this register are ignored if either SUBSCRIBE_CHG[n].EN or SUBSCRIBE_CHG[n].DIS is enabled

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID												X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID				Value				Description																							
A-X	RW	CH[i] (i=0..23)										Include or exclude channel i																						
			Excluded	0								Exclude																						
			Included	1								Include																						

6.3 PPIB — PPI Bridge

PPIB connects tasks and events of peripherals in two different PPI systems in different power-domains.

A PPI system contains a number of peripherals that can communicate with each other by using tasks and events. This functionality is enabled by the DPPI peripheral. In a PPI system, the peripherals and DPPI are instantiated in the same APB bus.

The following figure shows a PPI system including a PPIB:

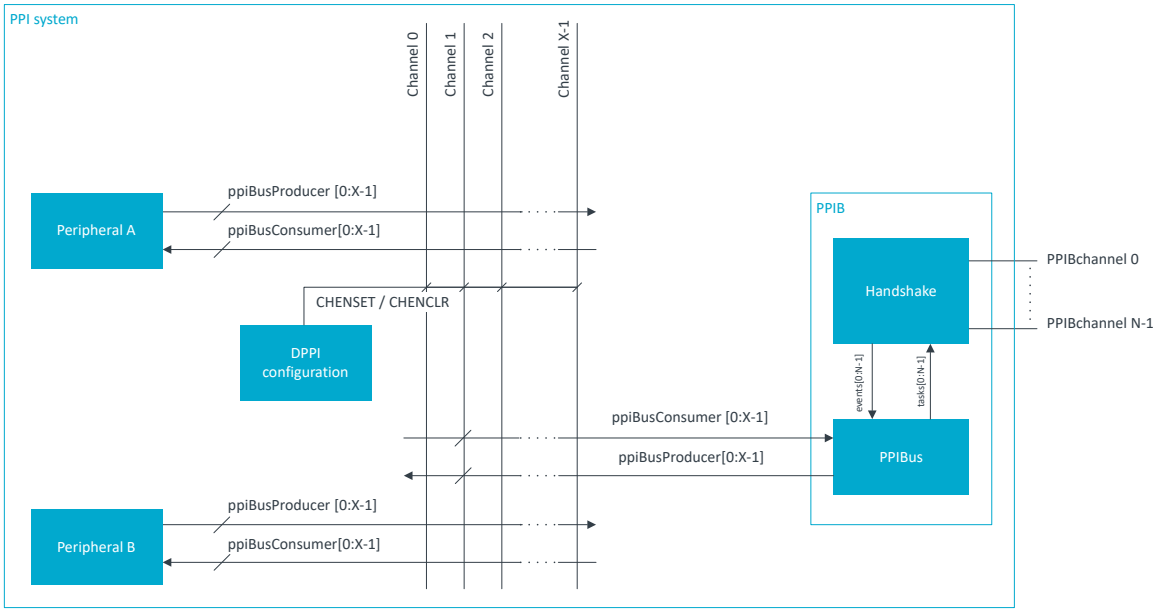


Figure 27: PPI system with PPIB

PPIB uses tasks and events like a standard peripheral, and connects to local DPPI channels via PPIBus. For more information on PPIBus module, see DPPI.

PPIB has a number of channels. Each PPIB channel connects to a single DPPI channel.

6.3.1 PPIB connections

A PPIB channel in one PPI system can be connected to a PPIB channel in another PPI system forming a PPIB connection.

A channel belonging to a PPIB instance in a PPI system is connected to a channel belonging to a PPIB instance in a different PPI system, creating a one-to-one PPIB connection between the two PPI systems. The connections are fixed and point-to-point, that is, a channel in a PPIB instance is connected only to a specific channel in another PPIB instance. For information on how the channels in the different PPIB instances are connected, see the Configuration table under the Registers section.

A PPIB channel can be configured as either source or sink. When configuring one side of the PPIB connection as source, the other side of the PPIB connection must be configured as sink, and viceversa. PPIB connections are unidirectional. Configuring both sides of a connection as source and sink at the same time will yield unexpected results.

On the source side of a PPIB connection, in order to send a (local) peripheral event to a different PPI system, the corresponding PPIB channel is configured as a consumer, subscribing to the same DPPI channel as the (local) peripheral publishes to, using the PPIB.SUBSCRIBE_SEND[n] register, with n the PPIB channel number.

On the sink side of a PPIB connection, for a (local) peripheral to be able to receive this event, the corresponding PPIB channel is configured as a producer, publishing to the same DPPI channel as the (local) peripheral subscribes to, using the PPIB.PUBLISH_RECEIVE[n] register, with n the PPIB channel number.

In a PPI system, several peripherals can publish to the same DPPI channel on the source side of a PPIB connection. Similarly, several peripherals can subscribe to the same DPPI channel on the sink side of a PPIB connection. This allows multiple connection options between peripherals in different PPI systems, same as DPPI allows in a local PPI system: one-to-one, one-to-many, many-to-one and many-to-many. However, when multiple peripherals can publish to the same DPPI channel on the source side of a PPIB connection, there is a risk of overflow. See Handshake and overflow on page 129.

6.3.2 Handshake and overflow

The two PPIB instances in a PPIB connection need a handshake to transfer a peripheral event.

This is handled by a Handshake module in the PPIB. If a handshake fails because an earlier event has not been processed completely, the new event won't be sent. Instead, bit `i` in OVERFLOW.SEND register on the source side will be set, with `i` the correspoding PPIB channel number.

6.3.3 Connection examples

This section contains examples on how two connect two PPI systems using PPIB.

The following example shows how to create a PPIB connection between the TIMER10 compare event in the RADIO PD and the SAADC start task in PERI PD. PPIB11 in RADIO PD is hardwired to PPIB21 in PERI PD, which allows the PPI systems in the two separate power domains to connect. DPPI channel 0 is used by both power domains. Note that it is only necessary to use the same DPPI channel within the power domain; different DPPI channels can be used across power domains. An example of this is given further down in this section.

```
   // RADIO PD
   NRF_TIMER10->PUBLISH_COMPARE[0] = (0<<TIMER_PUBLISH_COMPARE_CHIDX_Pos) |
TIMER_PUBLISH_COMPARE_EN_Msk;
   NRF_PPIB11->SUBSCRIBE_SEND[0] = (0<<PPIB_SUBSCRIBE_SEND_CHIDX_Pos) |
PPIB_SUBSCRIBE_SEND_EN_Msk;
   NRF_DPPIC10->CHENSET = DPPIC_CHENSET_CH0_Msk;

   // PERI PD
   NRF_SAADC->SUBSCRIBE_START = (0<<SAADC_SUBSCRIBE_START_CHIDX_Pos) |
SAADC_SUBSCRIBE_START_EN_Msk;
   NRF_PPIB21->PUBLISH_RECEIVE[0] = (0<<PPIB_PUBLISH_RECEIVE_CHIDX_Pos) |
PPIB_PUBLISH_RECEIVE_EN_Msk;
   NRF_DPPIC20->CHENSET = DPPIC_CHENSET_CH0_Msk;
```

The following example shows how to create a PPIB connection between the TIMER10 compare event in the RADIO PD and the GPIOTE SET task in LP PD. The two PPI systems must be connected through PPIB instances PPIB21 and PPIB22 in PERI PD. These PPIB instances are not connected to any peripheral, only to the PPIB instances in RADIO and LP power domains. PERI PD acts as a central system that connects the two systems by means of local PPIB and DPPIC instances. This allows scaling to larger PPI systems, since multiple PPI systems can be interconnected through a central PPI system. DPPI channel 0 is used for internal RADIO PD connections, channel 1 is used by LP PD, and channel 5 is used by PERI PD. It is

important that same DPPI channels are used within a power domain, but across domains the DPPI channel number does not matter.

```
   // RADIO PD
   NRF_TIMER10->PUBLISH_COMPARE[0] = (0<<TIMER_PUBLISH_COMPARE_CHIDX_Pos) |
TIMER_PUBLISH_COMPARE_EN_Msk;
   NRF_PPIB11->SUBSCRIBE_SEND[0] = (0<<PPIB_SUBSCRIBE_SEND_CHIDX_Pos) |
PPIB_SUBSCRIBE_SEND_EN_Msk;
   NRF_DPPIC10->CHENSET = DPPIC_CHENSET_CH0_Msk;

   // LP PD
   NRF_GPIOTE30->SUBSCRIBE_START = (1<<GPIOTE_SUBSCRIBE_SET_CHIDX_Pos) |
GPIOTE_SUBSCRIBE_SET_EN_Msk;
   NRF_PPIB30->PUBLISH_RECEIVE[0] = (1<<PPIB_PUBLISH_RECEIVE_CHIDX_Pos) |
PPIB_PUBLISH_RECEIVE_EN_Msk;
   NRF_DPPIC30->CHENSET = DPPIC_CHENSET_CH1_Msk;

   // PERI PD
   NRF_PPIB21->PUBLISH_RECEIVE[0] = (5<<PPIB_PUBLISH_RECEIVE_CHIDX_Pos) |
PPIB_PUBLISH_RECEIVE_EN_Msk;
   NRF_PPIB22->SUBSCRIBE_SEND[0] = (5<<PPIB_SUBSCRIBE_SEND_CHIDX_Pos) |
PPIB_SUBSCRIBE_SEND_EN_Msk;
   NRF_DPPIC20->CHENSET = DPPIC_CHENSET_CH5_Msk;
```

6.3.4.1 Security

The PPIB channels are security agnostic.

When configuring PPIB channels, consider whether the DPPI channel security settings need to match on both ends of the PPIB connection. While the PPIB channels themselves are security agnostic, maintaining consistent security configuration of the DPPI channels may be necessary.

6.3.5 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
PPIB00 : S PPIB00 : NS	GLOBAL	0x50044000 0x40044000	US	S	NA	No	PPI bridge PPIB00
PPIB01 : S PPIB01 : NS	GLOBAL	0x50045000 0x40045000	US	S	NA	No	PPI bridge PPIB01
PPIB10 : S PPIB10 : NS	GLOBAL	0x50083000 0x40083000	US	S	NA	No	PPI bridge PPIB10
PPIB11 : S PPIB11 : NS	GLOBAL	0x50084000 0x40084000	US	S	NA	No	PPI bridge PPIB11
PPIB20 : S PPIB20 : NS	GLOBAL	0x500C3000 0x400C3000	US	S	NA	No	PPI bridge PPIB20
PPIB21 : S PPIB21 : NS	GLOBAL	0x500C4000 0x400C4000	US	S	NA	No	PPI bridge PPIB21
PPIB22 : S PPIB22 : NS	GLOBAL	0x500C5000 0x400C5000	US	S	NA	No	PPI bridge PPIB22
PPIB30 : S PPIB30 : NS	GLOBAL	0x50103000 0x40103000	US	S	NA	No	PPI bridge PPIB30

Configuration

Instance	Domain	Configuration
PPIB00 : S PPIB00 : NS	GLOBAL	Bridges PPI channels 0-11 between PPIB_00 (MCU) and PPIB_10 (RADIO)
PPIB01 : S PPIB01 : NS	GLOBAL	Bridges PPI channels 0-7 between PPIB_01 (MCU) and PPIB_20 (PERI)
PPIB10 : S PPIB10 : NS	GLOBAL	Bridges PPI channels 0-11 between PPIB_10 (RADIO) and PPIB_00 (MCU)
PPIB11 : S PPIB11 : NS	GLOBAL	Bridges PPI channels 0-15 between PPIB_11 (RADIO) and PPIB_21 (PERI)
PPIB20 : S PPIB20 : NS	GLOBAL	Bridges PPI channels 0-7 between PPIB_20 (PERI) and PPIB_01 (MCU)
PPIB21 : S PPIB21 : NS	GLOBAL	Bridges PPI channels 0-15 between PPIB_21 (PERI) and PPIB_11 (RADIO)
PPIB22 : S PPIB22 : NS	GLOBAL	Bridges PPI channels 0-3 between PPIB_22 (PERI) and PPIB_30 (LP)
PPIB30 : S PPIB30 : NS	GLOBAL	Bridges PPI channels 0-3 between PPIB_30 (LP) and PPIB_22 (PERI)

Register overview

Register	Offset	TZ	Description
TASKS_SEND[n]	0x000		This task is unused, but the PPIB provides the SUBSCRIBE task to connect SEND [n] task.
SUBSCRIBE_SEND[n]	0x080		Subscribe configuration for task SEND[n]
EVENTS_RECEIVE[n]	0x100		This event is unused, but the PPIB provides the PUBLISH event to connect RECEIVE [n] event.
PUBLISH_RECEIVE[n]	0x180		Publish configuration for event RECEIVE[n]
OVERFLOW.SEND	0x400		The task overflow for SEND tasks using SUBSCRIBE_SEND. Write 0 to clear.

6.3.5.1 TASKS_SEND[n] (n=0..31)

Address offset: 0x000 + (n × 0x4)

This task is unused, but the PPIB provides the SUBSCRIBE task to connect SEND [n] task.

Writes to SEND [n] task are ignored.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_SEND			This task is unused, but the PPIB provides the SUBSCRIBE task to connect SEND [n] task. Writes to SEND [n] task are ignored.
			Trigger	1	Trigger task

6.3.5.2 SUBSCRIBE_SEND[n] (n=0..31)

Address offset: 0x080 + (n × 0x4)

Subscribe configuration for task SEND[n]

Writes to SEND [n] task are ignored.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID			B																						A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task SEND[n] will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

6.3.5.3 EVENTS_RECEIVE[n] (n=0..31)

Address offset: 0x100 + (n × 0x4)

This event is unused, but the PPIB provides the PUBLISH event to connect RECEIVE [n] event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_RECEIVE			This event is unused, but the PPIB provides the PUBLISH event to connect RECEIVE [n] event.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

6.3.5.4 PUBLISH_RECEIVE[n] (n=0..31)

Address offset: 0x180 + (n × 0x4)

Publish configuration for event RECEIVE[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event RECEIVE[n] will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

6.3.5.5 OVERFLOW.SEND

Address offset: 0x400

The task overflow for SEND tasks using SUBSCRIBE_SEND.

Write 0 to clear.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A-f	RW	SEND[i] (i=0..31)			The status for tasks overflow at SUBSCRIBE_SEND[i].
			Overflow	1	Task overflow is happened.
			NoOverflow	0	Task overflow is not happened.

7 Security

The device is designed with state-of-the-art security features that include the following.

- Arm TrustZone for memory, peripherals, GPIO pins, PPI channels, and interrupts
- Tamper controller to monitor and prevent physical attacks
  - Active driven tamper switches (active shield)
  - Signal protectors for critical configuration signals
  - Glitch detectors to guard against fault injection attacks
- Crypto accelerator with built-in self-check and countermeasures
  - Masking against simple and differential power analysis
  - Protection against timing attacks
- NIST SP 800-90B random number generator
- Non-volatile memory controller with built-in secure key storage (key management unit)
- Immutable boot region for establishing root of trust
- Authenticated debug to prevent unauthorized access to the debug port

7.1 Memory and peripheral access permissions

Access permissions are controlled by TrustZone, MPC, and SPU security peripherals.

The following figure shows the system security control modules for memory, peripherals, GPIO, and PPI.

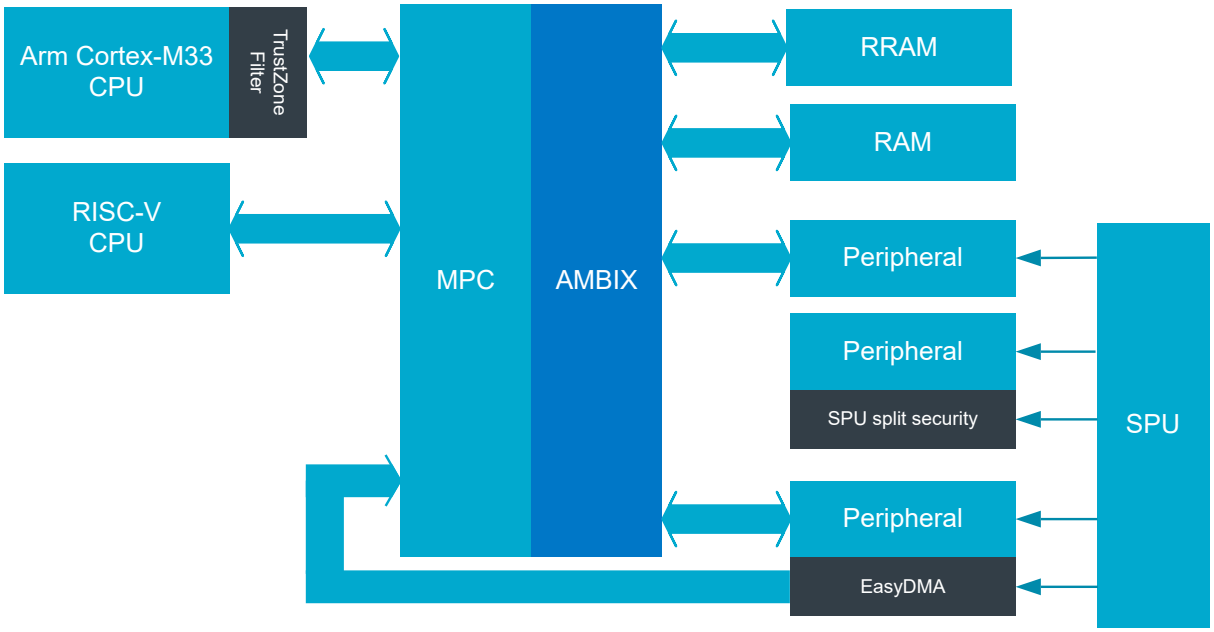


Figure 28: Modules filtering access permissions

The Arm Cortex-M33 CPU enforces TrustZone security internally, before issuing bus transactions. For security checks internal to the Arm Cortex-M33, see TrustZone security on page 136. After the internal CPU security check, the transaction is available on the bus.

Secure and non-secure memory has to be configured in the SAU and MPC.

The security attribution of a bus transaction from the Arm Cortex-M33 is determined by the CPU, SAU, and IDAU settings. See TrustZone security on page 136 for more information.

For RISC-V and peripherals, the attribution of the bus transaction is determined by the SPU settings.

The destination's security attribute is a combination of MPC and SPU configurations.

Abbreviation	Description
NS	Non-secure – TrustZone security attribute is non-secure
S	Secure – TrustZone security attribute is secure
NSC	Non-secure callable – TrustZone security attribute is non-secure callable
IDAU	Arm implementation defined attribution unit
SAU	Arm security attribution unit
SPU	Nordic system protection unit
MPC	Nordic memory privilege controller

Table 24: Abbreviations

Memory access overview

The following table lists the security attributes of the bus manager and their access to memory configured as secure and non-secure.

Bus manager security attribute	Destination memory security attribute	Access successful	MPC bus fault and error event
S	S	Yes	No
NS	S	No	Yes
S	NS	Yes	No
NS	NS	Yes	No

Table 25: Memory access overview

Peripheral access overview

Peripherals are moved in the memory map based on their security association. Non-secure peripherals can be accessed through addresses starting with 0x4 while secure peripherals are accessible in the memory region starting with 0x5.

The security association of each peripheral is controlled via the SPU. Only peripherals with programmable security association can be moved in the memory map.

Bus manager security attribute	Destination memory security attribute	Address region	Access successful	SPU bus fault and error event
S	S	0x5	Yes	No
S	S	0x4	No	Yes
NS	S	0x5	No	Yes
NS	S	0x4	No	Yes
S	NS	0x5	No	Yes
S	NS	0x4	Yes	No
NS	NS	0x5	No	Yes
NS	NS	0x4	Yes	No

Table 26: Peripheral access overview

In addition, the following also applies:

- For split security peripherals, bus faults are not generated for blocked split security bit accesses. Reads as 0, write is ignored.
- In a split peripheral, access is blocked to secure registers using the non-secure 0x4 memory region because it is through non-secure transactions. Make sure to use the secure memory region to access secure registers.

7.2 TrustZone security

The security architecture is based on Arm TrustZone.

The Arm Cortex-M based CPU supports Arm TrustZone for secure, non-secure, and non-secure callable memory regions.

The security attribution unit (SAU) and implementation defined attribution unit (IDAU) define the access permissions based on the security state.

The IDAU configuration divides system memory space into secure (S) and non-secure (NS) regions. The SAU provides configurable regions for the Arm Cortex-M CPU, and is used to define non-secure callable (NSC) regions.

IDAU preset configuration

IDAU configuration is preset in hardware and is not available for user configuration. The security attribution follows the address map, and the peripheral memory space is aliased for the secure and non-secure memory state, as defined in the following table.

Memory map name	Address map	IDAU TrustZone security attribute
Private peripheral bus	0xE0000000 – 0xFFFFFFFF	Not applicable
Device memory	0xA0000000 – 0xDFFFFFFF	NS
External memory	0x60000000 – 0xAFFFFFFF	NS
Peripheral (secure)	0x50000000 – 0x5FFFFFFF	S
Peripheral (non-secure)	0x40000000 – 0x4FFFFFFF	NS
Data memory	0x20000000 – 0x3FFFFFFF	NS
Program memory	0x00000000 – 0x1FFFFFFF	NS

Table 27: IDAU configuration

SAU configuration

The Arm Cortex-M33 CPU must configure its SAU regions when the CPU starts. The CPU assumes the memory map is secure before configuring the SAU regions.

SAU configuration registers are documented in the *Arm Cortex-M33 Technical Reference Manual*.

TrustZone security attributes

Based on IDAU and SAU configuration, the following table shows the TrustZone security attribute results.

IDAU security attribute	SAU security attribute	Security attribute result
S	NS, NSC, or S	S
NS, NSC, or S	S	S
NS	NS	NS
NS	NSC	NSC

Table 28: TrustZone security attributes

For the memory region that contains the secure gateway instruction branch veneers (entry points), the TrustZone security attribute seen by the Arm Cortex-M must be NSC for the secure functions that are callable from a non-secure program.

Example memory map

The following figure shows an example memory map using SAU regions to provide NS, S, and NSC regions. The figure also includes the required MPC override configuration to ensure correct secure/non-secure system partitioning.

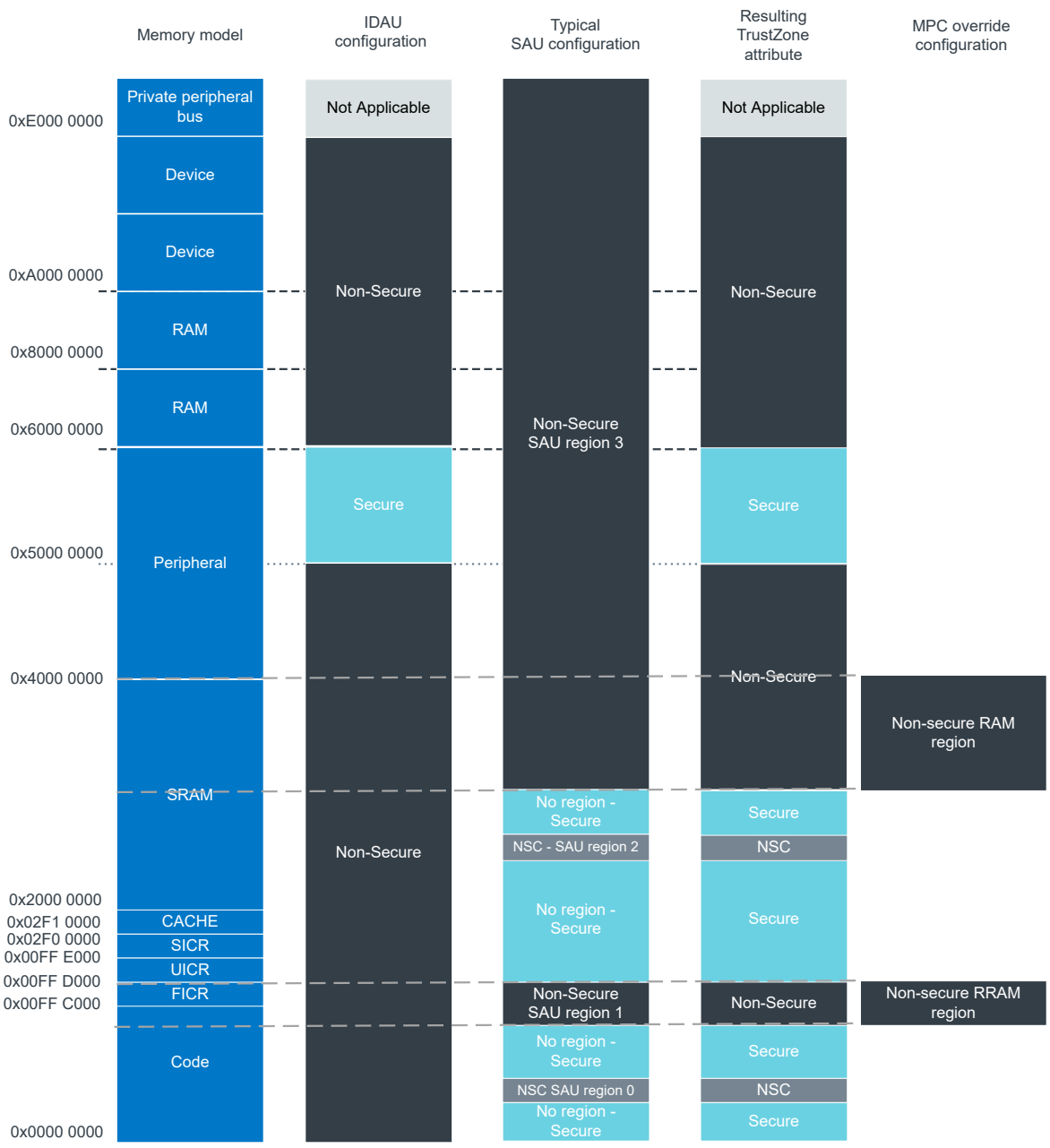


Figure 29: Example memory map security attribution

TrustZone security access

The Arm Cortex-M TrustZone security module generates a CPU SecureFault exception when access is not allowed. The following table shows combinations of TrustZone security attributes.

Arm Cortex-M TrustZone security attribute	Destination address security attribute	Secure fault	Access allowed
S	S	No	Yes
S	NS	No	Yes
NS	NS	No	Yes
NS	S	Yes	No

Table 29: TrustZone security access

The first two columns show the TrustZone security attribute from the TrustZone security attributes table.

The Arm Cortex-M TrustZone security attribute is the TrustZone security attribute seen by the Arm Cortex-M CPU while executing a program. This shows if the Arm Cortex-M CPU program is executed from S, NS, or NSC memory. The NSC for the Arm Cortex-M TrustZone security attribute behaves same as S in the table.

The destination address security attribute is the TrustZone security attribute of the destination address lookup from the SAU and IDAU. It is used by the Arm Cortex-M CPU on the bus transaction.

7.3 Immutable boot region

The device RRAM has a boot region that can be made immutable before the CPU starts up.

Boot initiated from an immutable source allows later boot steps to be performed by authenticated code.

The boot region starts at address `0x00000000`. This address contains the initial secure program counter (PC), the stack pointer (SP), and the interrupt vectors. The size and permissions of the region are configured using UICR register BOOTCONF on page 66.

After configuration, when there is a device reset, the hardware state-machine reads UICR fields and configures RRAMC. This enforces boot region protection before the Arm Cortex-M33 is released from reset.

For more information about the immutable boot region, see RRAMC — Resistive random access memory controller on page 48.

7.4 Security attributes

Bus access can have secure or non-secure attribution which follows the transaction through the system.

Non-secure peripherals use non-secure DMA bus transactions. Secure peripherals have configurable DMA security and can generate either secure or non-secure DMA bus transactions. The peripheral security is configured using SPU — System protection unit on page 195.

For Arm Cortex CPUs, see the Arm TrustZone architecture document for more details on security.

7.5 Security fault

Memory accesses that violate security permissions will generate a security fault.

If the Arm Cortex-M processor accesses RAM or NVM memory that violate security permissions, and the SAU regions match the device secure/non-secure memory map, the processor generates a SecureFault exception before the transaction enters the system busses.

At the system level, bus accesses are filtered by the Memory Protection Controller (MPC) and System Protection Unit (SPU) security components. These components trigger a BusFault using bus error response, not a SecureFault.

Access to a peripheral register that violates security permissions triggers the SPU event PERIPHACCERR. For more information about the SPU, see SPU — System protection unit on page 195. See also Peripherals with split security access on page 140.

If a peripheral DMA controller, or the the coprocessor, attempts to access a memory region that is not allowed by the MPC, the MPC will generate a bus error response that triggers a BusFault. The MPC also generates the MEMACCERR event. For more information, see MPC — Memory Privilege Controller on page 189.

7.6 Peripherals with split security access

Some peripherals have split security access, meaning they can handle both secure and non-secure access. A subset of the peripheral's functions can be secure, while another subset is non-secure. The security is configured using SPU registers.

The peripheral instantiation table in Instantiation on page 232 details the peripherals with split access.

Split security access is handled either on the register level or on the bit level, as explained in the following sections.

Register level split security access

For this group of peripherals, security is enforced at the register level. Split security settings apply for the entire register. Illegal access to the register will trigger a security fault. For example, if a register is configured as secure and the register is accessed from non-secure code, a security fault with a bus fault will be generated. A security fault due to an illegal access triggers the SPU event PERIPHACCERR.

Bit level split security access

For this group of peripherals, security is enforced at the register bit level. Split security settings are applied to individual bits of the register. The register supports access from both secure and non-secure code.

No exceptions are triggered for the access, however the following apply:

- Writing a secure bit from non-secure code will have no effect
- Reading a register from non-secure code will return `0` for all bits that are secure

For example, if bit `i` is configured as secure, then the following apply:

- Non-secure write access to the register will not change bit `i`
- Non-secure read access to the register will read `0` for the bit at position `i`

Interrupts

Some peripherals have split security interrupts. This means the interrupt can be configured with a security attribute.

An interrupt may be generated during secure or non-secure execution, and the interrupt handler is executed based on the interrupt's security attribute.

Interrupts implement split security at the register level. For instance, if interrupt 0 is configured as secure and there is a non-secure read/write access to registers INTEN0, INTENSET0, INTENCLR0, or INTPEND0, a security fault with a bus fault will be generated.

Interrupts are generated when enabled events are triggered. When an event for a split security interrupt is triggered, the following applies.

- If an interrupt is configured as secure, an event associated to either a secure or non-secure feature can trigger the interrupt.
- If an interrupt is configured as non-secure, only events associated with non-secure features can trigger the interrupt.

An attempt to enable an interrupt for an event that does not match the ownership and security settings of the interrupt will be ignored and a security fault is not generated.

A non-secure event can be enabled to trigger a secure interrupt.

7.6.1 CRACEN

CRACEN protects the Protected RAM and the SEED register from being accessed by the CPU.

Only KMU is able to push assets to the Protected RAM and the SEED register. The CPU does not have access to these. The hardware has built in protection that does not need configuration.

7.6.2 DPPIC

Individual DPPI channels and channel groups can have independent security attributes that are defined as either secure or non-secure. DPPI supports split security, handling both secure and non-secure access.

DPPI channels

A peripheral configured as non-secure can only subscribe to or publish on non-secure DPPI channels. A peripheral configured as secure can access all DPPI channels. An attempt by a non-secure peripheral to subscribe to or publish on a DPPI channel configured as secure is ignored, and a PPI event is not issued.

DPPI channels are enabled or disabled through individual bits in registers CHEN, CHENSET, and CHENCLR.

The security of a DPPI channel is configured using FEATURE.DPPIC.CH[n] (n=0..23) on page 202.

DPPI channel groups

Channels can be grouped, which allows them to be enabled or disabled collectively.

A channel group is either secure or non-secure.

- Secure channel group – includes both secure and non-secure DPPI channels
- Non-secure channel group – only includes non-secure DPPI channels

An attempt to include a secure DPPI channel in a non-secure DPPI channel group is ignored.

Registers CHG[n], TASKS_CHG[n].EN, TASKS_CHG[n].DIS, SUBSCRIBE_CHG[n].EN, and SUBSCRIBE_CHG[n].DIS configure the DPPI channel groups. A security fault is triggered when an illegal access is made to these registers.

DPPIC subscribe to DPPIC channels through the SUBSCRIBE_CHG[] registers to trigger the task for enabling or disabling channel groups. An event from a secure channel is ignored if the group subscribing to that channel is non-secure. A secure group can subscribe to a non-secure channel or a secure channel.

The security of a DPPIC channel group is configured using FEATURE.DPPIC.CHG[n] (n=0..7) on page 203.

7.6.3 GPIO

GPIO pins can be either secure or non-secure.

GPIO supports split security, meaning the GPIO pins and registers can be accessed from both secure and non-secure peripherals.

A peripheral configured as non-secure can only access non-secure pins. A peripheral configured as secure will be able to access all pins. An attempt to access a pin configured as secure by a non-secure peripheral is ignored.

GPIO pins can be read and written through individual bits in the GPIO port registers OUT, OUTSET, OUTCLR, and IN. GPIO pin direction is configured individually using bits in registers DIR, DIRSET, and DIRCLR. An attempt to access bits with a different security setting is ignored. Writing to these bits will have no effect, and read access returns a zero value.

The LATCH register has split security. Non-secure code can only read the state of the non-secure pins, while the secure pins read as zero. Secure code is able to read the state of all pins.

The DETECTMODE register applies to the entire port (both secure and non-secure pins), and determines if the latched or non-latched signals will generate the DETECT signal.

Pin security configuration

Access to device pins can be controlled by SPU. A pin can be set as secure so that only secure peripherals or secure code can access it. Pins set as non-secure can be accessed by both secure and non-secure peripherals or code.

The security attribute of each pin can be individually configured in FEATURE.GPIO[n].PIN[o] (n=0..3) (o=0..31) on page 204. When the secure attribute (SECATTR) is set for a pin, only peripherals that have the secure attribute set will be able to read the value of the pin or change it.

Peripherals can select the pins they need access to through their PSEL registers. If a peripheral has its attribute set to non-secure, but one of its PSEL registers selects a pin with the attribute set to secure, the SPU controlled logic will ensure that the pin selection is not propagated. In addition, the pin value will always be read as zero to prevent a non-secure peripheral from obtaining a value from a secure pin. Access to other pins with the attribute set as non-secure will not be blocked.

Pins can also be dedicated to peripherals by using the CTRLSEL field in the GPIO PIN_CNF[n] register. For pins controlled using CTRLSEL, the SPU PIN security setting is bypassed and pin access is controlled by the peripheral. This is illustrated in the following figure.

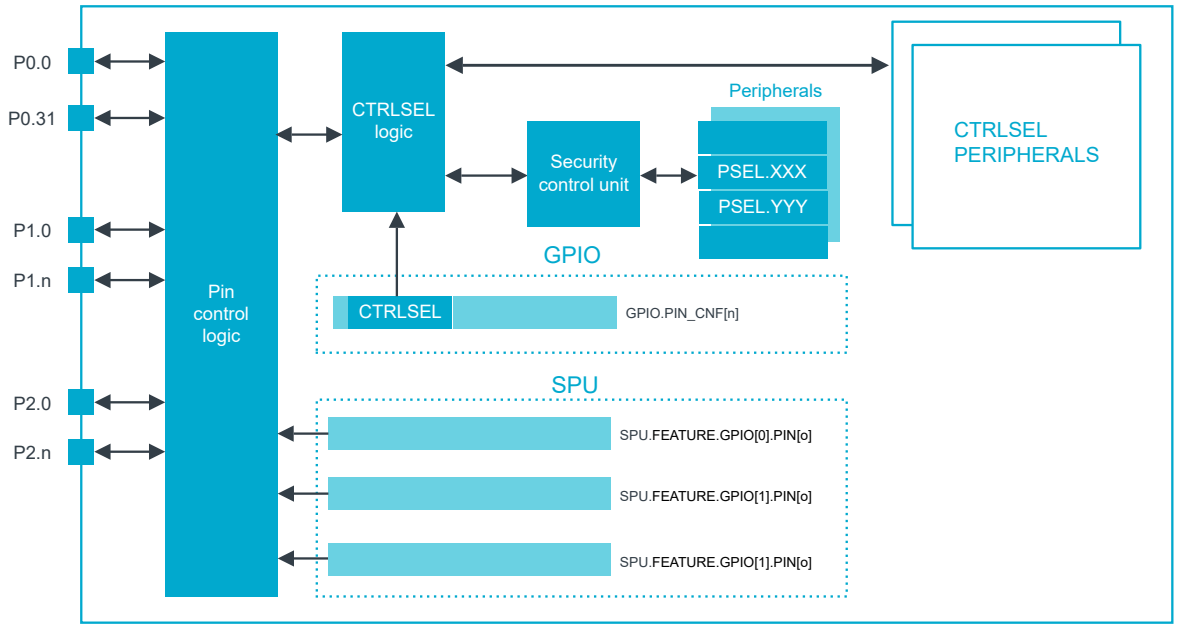


Figure 30: Pin access using CTRLSEL

7.6.4 GPIOTE

Individual GPIOTE channels and interrupts can have independent security settings and are defined as secure or non-secure.

GPIOTE channels

GPIOTE channel security is configured using FEATURE.GPIOTE[n].CH[o] (n=0..1) (o=0..7) on page 203.

A GPIOTE channel configured as secure can only be used by secure code to send tasks and receive events. A GPIOTE channel configured as non-secure can be used by both secure and non-secure code to send tasks and receive events.

GPIOTE channel tasks and events can be configured with a specific GPIO pin.

- A secure GPIOTE channel can be configured with both secure and non-secure GPIO pins
- A non-secure GPIOTE channel can only be configured with non-secure GPIO pins

See CONFIG[n].PSEL and CONFIG[n].PORT registers for more information.

GPIOTE channels that are not configured as described will not write to the pin when triggering the SET[n], CLR[n], and OUT[n] tasks, and will not generate the IN[n] event with changes in the pin polarity.

A GPIOTE channel `n` configured as secure has the following properties only during secure code execution:

- Trigger SET[n], CLR[n], and OUT[n] tasks
- Generate IN[n] events
- Access to the corresponding CONFIG[n] register

A GPIOTE channel `n` configured as non-secure has the following properties during both secure and non-secure code execution:

- Trigger SET[n], CLR[n], and OUT[n] tasks
- Generate IN[n] events
- Access to the corresponding CONFIG[n] register

A security fault is triggered when there is an access violation when accessing registers TASKS_SET[n], TASKS_CLR[n], TASKS_OUT[n], EVENTS_IN[n], or CONFIG[n].

GPIOTE channels can connect to PPI channels in order to send and receive events from other peripherals. GPIOTE channels can only publish or subscribe from DPPI channels that have the correct security attribute. An attempt to subscribe or publish on a DPPI channel configured as secure by a non-secure GPIOTE channel is ignored. A secure GPIOTE channel can subscribe or publish to both secure and non-secure DPPI channels.

GPIOTE interrupts

The security of the GPIOTE interrupt is configured using FEATURE.GPIOTE[n].INTERRUPT[o] (n=0..1) (o=0..7) on page 203.

A secure fault is triggered when non-secure code attempts to access registers INTENSET/INTENCLR on a secure GPIOTE interrupt.

GPIOTE interrupt `i` can only be generated by IN[j] event if interrupt `i` and channel `j` have the correct security attribute.

A secure GPIOTE interrupt can be triggered by an event generated by a secure and non-secure GPIOTE channel.

A non-secure GPIOTE interrupt can only be triggered by an event generated by non-secure GPIOTE channel.

7.6.5 GRTC

GRTC is implemented with split security, meaning it handles access from both secure and non-secure code. Individual GRTC SYSCOUNTER compare/capture channels and interrupts can have independent security settings that define them as secure or non-secure.

SYSCOUNTER compare/capture channels

The SYSCOUNTER compare/capture channels have the following security:

- Secure — The channel and its associated registers, trigger/subscribe tasks, and receive/publish events can only be accessed by secure code.
- Non-secure — The channel and its associated registers, trigger/subscribe tasks, and receive/publish events can be accessed by secure and non-secure code.

GRTC interrupts

GRTC interrupts can be defined as secure or non-secure.

A security fault is triggered when an invalid access targets registers INTEN/INTENSET/INTENCLR/INTPEND associated with an GRTC interrupt.

GRTC interrupt can only be generated by a COMPARE[j] event if the interrupt and channel have the correct security attribute.

A secure GRTC interrupt can be triggered by a secure or non-secure GRTC channel.

A non-secure GRTC interrupt can be triggered by an event generated by non-secure GRTC channel. An event generated by secure GRTC channel cannot trigger the interrupt.

7.7 Physical security

The device has countermeasures for physical attacks. It can detect and report fault injection attacks such as voltage glitching or electromagnetic fault injection.

The external active shield I/O interface is provided to facilitate PCB and product level security. It can detect if a product's encapsulation has been opened, or if the product has been tampered with. For more information, see TAMPC — Tamper controller on page 206.

The crypto accelerator (CRACEN) peripheral is protected against differential power analysis (DPA) attacks. The AES and public key acceleration engines all have countermeasures against DPA attacks and will report attack attempts. For more information, see CRACEN — Cryptographic accelerator engine on page 144.

7.8 Security components

7.8.1 CRACEN — Cryptographic accelerator engine

CRACEN (Cryptographic accelerator engine) is a dedicated hardware peripheral that provides a comprehensive set of cryptographic primitives and services to accelerate and harden cryptographic operations on the device.

CRACEN integrates symmetric ciphers, authenticated encryption, public-key arithmetic engines, and high-quality random number generation. It also includes an isolated key generator (IKG) to provision and hold keys securely, reducing exposure of sensitive material to the host CPU and software.

CRACEN is intended to offload compute-intensive and security-sensitive tasks from the main processor: encrypting and decrypting data, computing digests and message authentication codes, performing signature generation and verification, and carrying out key-exchange protocols such as Diffie-Hellman.

The main features of the CRACEN peripheral are the following:

- AES – supports 128- and 256- bit keys, but excludes multi-part operations . Up to 1 MB operation size for AES-CCM and AES-CTR.
- Chacha20-Poly1305, but without multi-part operations
- SHA – SHA1, SHA3, SHA-224, SHA-256, SHA-384, SHA-512
- Public key cryptographic engine (PKE)
  - Modular exponentiation – RSA with 4096-bit maximum operand size
  - Elliptic curve cryptography (ECC) with 640-bit maximum operand size
  - Digital signature algorithm (DSA) and Elliptic curve digital signature algorithm (ECDSA), with 4096-bit maximum operand size
  - Diffie-Hellman (D-H and ECD-H) key exchange
- Random number generators (RNG) – NDRNG, including TRNG
- Deterministic random bit generator (DRBG)
- Isolated key generator (IKG) – One asymmetric key and two symmetric (AES) keys
- Counter measures against side channel analysis for PKE and AES

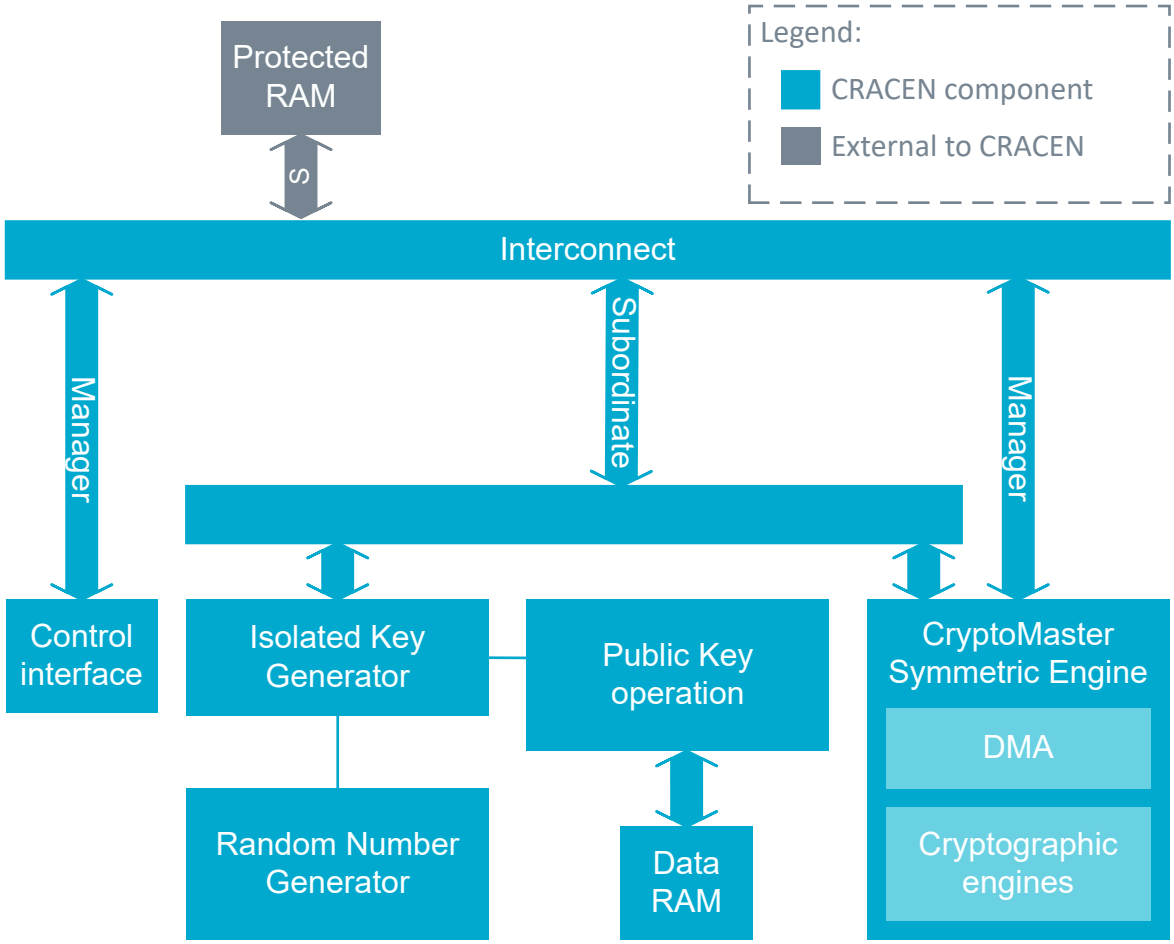


Figure 31: Cryptographic accelerator engine block diagram

7.8.1.1 Disclaimer

This section contains an important disclaimer about the CRACEN peripheral documentation.

CRACEN is recommended for use with the libraries in Nordic Semiconductor device SDKs. These libraries are tested and verified to work with the CRACEN hardware. The CRACEN subsystem documentation and register descriptions are for reference only and can be used for modifying the Nordic supplied SDK libraries or implementing new features.

Nordic Semiconductor ASA reserves the right to change the CRACEN documentation and register descriptions without further notice. Changes will not trigger erratas and will not be seen as changing form/fit/function of the device.

Please note that Nordic cannot support questions directly related to the register interface or modification of the source code implementation. Nordic provide support for the top-level API in the software library distributed as part of the device SDK.

7.8.1.2 Initialization

The CRACEN peripheral is a hardware and software solution where software is delivered as libraries in Nordic device SDKs. Recommended usage of the CRACEN subsystem is to use the SDK library implementation available for the device. The CRACEN subsystem is documented for reference purpose only, please see section Disclaimer on page 145 for more information.

Before the CRACEN peripheral can be used, it must be configured.

CRACEN is enabled using the ENABLE register. When CRACEN is enabled, it will erase the PKE data RAM by starting a zeroization process. When the PKBUSY field of the PK.STATUS is cleared, the zeroization operation is complete. The PKE engine is not available until the zeroization process has finished.

After CRACEN has been enabled, the CRACENCORE registers can be used.

Each hardware crypto operation category (module) must then be individually enabled. Note that ongoing crypto operations will complete even if the module is disabled during the operation.

7.8.1.3 PKE data RAM

The PKE data RAM is used by CRACEN as a store for intermediate values when doing cryptographic operations.

The PKE data RAM is divided into 15 different pages of size 4096 bits, where each page holds different data types for asymmetric cryptographic operations. After CRACEN IKG has been started, the PKE operate in what is referred to as CRACEN Secure Mode. In CRACEN Secure Mode, PKE RAM pages 0x8 - 0xC are accessible to the CPU, and will hold both the IAK public key components and the digest to be signed in addition to the signature components. The following table lists all pages and their availability from CPU access in CRACEN Secure Mode. To avoid information leakage, some of the pages are automatically zeroized when CRACEN is exiting Secure Mode.

Page number	Access	Zeroization
0-7	Blocked from CPU access	Yes
8-12	Accessible from the CPU	No
13-15	Blocked from CPU access	Yes

Table 30: PKE RAM page availbility in CRACEN Secure Mode

7.8.1.4 Protected RAM

Protected RAM regions can be retained and locked for storing symmetric keys. The CPU cannot access these regions.

After KMU has pushed keys into the protected RAM, PROTECTEDRAMLOCK must be set to `Enabled` before CRACEN can access and use the keys.

Register PROTECTEDRAMLOCK is a write-once register, and cannot be changed until the next device reset.

The address range of the Protected RAM memory range is defined in Memory on page 13.

7.8.1.5 Countermeasures

CRACEN contains security countermeasures to prevent malicious usage.

The following engines implement countermeasures:

- AES – Masking against Simple Power Analysis (SPA) and Differential Power Analysis (DPA)
- IKG/PKE – Protection against timing attacks and DPA

If CRACEN IKG/PKE is used maliciously, a TAMPC event will be generated and countermeasures executed according to the TAMPC configuration. The bits in TAMPC that control the countermeasures have lock bits, preventing further modification to the configuration.

7.8.1.6 Isolated Key Generator

The Isolated Key Generator (IKG) is a module that derives symmetric and asymmetric keys from the unique seed and optional personalization string.

After IKG has been enabled, CRACEN performs an IKG health test. The CTRDRBGBUSY field of the IKG.STATUS is cleared when the operation has completed. IKG is started by writing to the IKG.START register. The generated IKG keys are valid as long as CRACEN remains enabled. For details on enabling and disabling CRACEN, see ENABLE on page 151.

The IKG derives the following keys from seed upon request:

- One 256-bit ECC P-256 key
- Two 256-bit AES keys

> **Note:** The IKG generated keys are not directly accessible to the CPU but are used by the PKE and AES engines. The IKG generated AES keys are not the same as protected keys in protected RAM, but can be used by the same AES engine.

7.8.1.6.1 Loading seed to IKG

Before keys can be generated, KMU must push the key generation seed used by the IKG to the SEED register and marked as valid.

To create and derive a seed the following sequence of operations are needed.

Create device unique seed

1. Create three 128-bit random numbers using CRACEN RNG.
2. Provision the random numbers to KMU slots 0, 1, and 2 (128 bits in each slot).
   a. SRC.DEST=CRACEN.SEED[n], where n=0, 4, and 8
   b. SRC.VALUE=random[i], where i=0,1, and 2 (random number results from CRACEN.RND operation in step 1)

Load seed from KMU to CRACEN

1. Push the KMU slots where the seed is stored (KMU slots 0, 1, and 2).
2. Once all SEED registers have been pushed, CRACEN locks the SEED register and validates the seed for the IKG.

> **Note:** Any IKG key generations without valid seed (CRACEN.SEEDVALID) will fail.

7.8.1.7 Low power

To ensure lowest possible power consumption when the peripheral is not needed, disable CRACEN.

Make sure any operations are finished before disabling the peripheral in register ENABLE.

7.8.1.8 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
CRACEN	GLOBAL	0x50059000	HF	S	NSA	No	Crypto accelerator

Configuration

Instance	Domain	Configuration
CRACEN	GLOBAL	Access to CRACEN registers is blocked while KMU is performing a PUSH operation. CRACEN cannot write RRAM. CRACEN CRYPTOACCELERATOR specific configuration registers included PKE data (address 0x50018000) must be read and written using aligned access, i.e. using an operation where a word-aligned address is used for a word, or a halfword-aligned address is used for a halfword access. PKE code (address 0x5001C000) must be accessed using aligned access, i.e. using an operation where a word-aligned address is used for a word, or a halfword-aligned address is used for a halfword access.

Register overview

Register	Offset	TZ	Description
EVENTS_CRYPTOMASTER	0x100		Event indicating that interrupt triggered at Cryptomaster
EVENTS_RNG	0x104		Event indicating that interrupt triggered at RNG
EVENTS_PKEIKG	0x108		Event indicating that interrupt triggered at PKE or IKG
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
INTPEND	0x30C		Pending interrupts
ENABLE	0x400		Enable CRACEN peripheral modules.
SEEDVALID	0x404		Indicates the SEED register is valid. Writing this register has no effect.
SEED[n]	0x410		Seed word [n] for symmetric and asymmetric key generation. This register is only writable from KMU.
SEEDLOCK	0x440		Indicates the access to the SEED register is locked. Writing this register has no effect.
PROTECTEDRAMLOCK	0x444		Lock the access to the protected RAM.

7.8.1.8.1 EVENTS_CRYPTOMASTER

Address offset: 0x100

Event indicating that interrupt triggered at Cryptomaster

The interrupt source must be cleared at Cryptomaaster before clearing this event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_CRYPTOMASTER			Event indicating that interrupt triggered at Cryptomaster The interrupt source must be cleared at Cryptomaaster before clearing this event.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

7.8.1.8.2 EVENTS_RNG

Address offset: 0x104

Event indicating that interrupt triggered at RNG

The interrupt source must be cleared at RNG before clearing this event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_RNG			Event indicating that interrupt triggered at RNG The interrupt source must be cleared at RNG before clearing this event.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

7.8.1.8.3 EVENTS_PKEIKG

Address offset: 0x108

Event indicating that interrupt triggered at PKE or IKG

The interrupt source must be cleared at PKE or IKG before clearing this event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_PKEIKG			Event indicating that interrupt triggered at PKE or IKG The interrupt source must be cleared at PKE or IKG before clearing this event.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

7.8.1.8.4 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CRYPTOMASTER			Enable or disable interrupt for event CRYPTOMASTER The interrupt source must be cleared at Cryptomaaster before clearing this event.
			Disabled	0	Disable
			Enabled	1	Enable
B	RW	RNG			Enable or disable interrupt for event RNG The interrupt source must be cleared at RNG before clearing this event.
			Disabled	0	Disable
			Enabled	1	Enable
C	RW	PKEIKG			Enable or disable interrupt for event PKEIKG The interrupt source must be cleared at PKE or IKG before clearing this event.
			Disabled	0	Disable
			Enabled	1	Enable

7.8.1.8.5 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1S	CRYPTOMASTER			Write '1' to enable interrupt for event CRYPTOMASTER The interrupt source must be cleared at Cryptomaaster before clearing this event.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	RNG			Write '1' to enable interrupt for event RNG The interrupt source must be cleared at RNG before clearing this event.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1S	PKEIKG			Write '1' to enable interrupt for event PKEIKG The interrupt source must be cleared at PKE or IKG before clearing this event.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

7.8.1.8.6 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	CRYPTOMASTER			Write '1' to disable interrupt for event CRYPTOMASTER The interrupt source must be cleared at Cryptomaaster before clearing this event.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	RNG			Write '1' to disable interrupt for event RNG The interrupt source must be cleared at RNG before clearing this event.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	PKEIKG			Write '1' to disable interrupt for event PKEIKG The interrupt source must be cleared at PKE or IKG before clearing this event.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

7.8.1.8.7 INTPEND

Address offset: 0x30C

Pending interrupts

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	CRYPTOMASTER			Read pending status of interrupt for event CRYPTOMASTER The interrupt source must be cleared at Cryptomaaster before clearing this event.
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
B	R	RNG			Read pending status of interrupt for event RNG The interrupt source must be cleared at RNG before clearing this event.
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
C	R	PKEIKG			Read pending status of interrupt for event PKEIKG The interrupt source must be cleared at PKE or IKG before clearing this event.
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending

7.8.1.8.8 ENABLE

Address offset: 0x400

Enable CRACEN peripheral modules.

Each module of CRACEN can be enabled individually. When any of these modules are not in use, it can be disabled to save power. The module you want to use must first be enabled. Any ongoing crypto operations will be finished even if the module is disabled during the operation.

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					C B A
Reset 0x00000000					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CRYPTOMASTER			Enable cryptomaster
			Disabled	0	Cryptomaster disabled.
			Enabled	1	Cryptomaster enabled.
B	RW	RNG			Enable RNG
			Disabled	0	RNG disabled.
			Enabled	1	RNG enabled.
C	RW	PKEIKG			Enable PKE and IKG
			Disabled	0	PKE and IKG disabled.
			Enabled	1	PKE and IKG enabled.

7.8.1.8.9 SEEDVALID

Address offset: 0x404

Indicates the SEED register is valid. Writing this register has no effect.

This register is set when all SEED registers have been written, and the SEED is now valid.

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					A
Reset 0x00000000					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	VALID			Marks the SEED as valid
			Disabled	0	Valid disabled.
			Enabled	1	Valid enabled.

7.8.1.8.10 SEED[n] (n=0..11)

Address offset: 0x410 + (n × 0x4)

Seed word [n] for symmetric and asymmetric key generation.

This register is only writable from KMU.

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	VAL			Seed value

7.8.1.8.11 SEEDLOCK

Address offset: 0x440

Indicates the access to the SEED register is locked. Writing this register has no effect.

This register is set when all SEED registers have been written, and the SEED is now locked.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			Enable the lock Only possible to write a value 1.
			Disabled	0	Lock disabled.
			Enabled	1	Lock enabled.

7.8.1.8.12 PROTECTEDRAMLOCK

Address offset: 0x444

Lock the access to the protected RAM.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			Enable the lock Only possible to write a value 1.
			Disabled	0	Lock disabled.
			Enabled	1	Lock enabled.

7.8.1.9 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
CRACENCORE	GLOBAL	0x50010000	HF	S	NSA	No	CRACEN core

Configuration

Instance	Domain	Configuration
CRACENCORE	GLOBAL	Access to CRACENCORE registers is blocked while KMU is performing a PUSH operation. CRYPTMSTRDMA registers included CRYPTMSTRHW registers included RNGCONTROL registers included PK registers included IKG registers included RNGDATA registers included Apply reset values for registers in Lite Medium configuration Using CRACENCORE configuration reset values

Register overview

Register	Offset	TZ	Description
CRYPTMSTRDMA.FETCHADDRLSB	0x000		Fetch Address Least Significant Word
CRYPTMSTRDMA.FETCHADDRMSB	0x004		Fetch Address Most Significant Word
CRYPTMSTRDMA.FETCHLEN	0x008		Fetch DMA Length (only used in direct mode)
CRYPTMSTRDMA.FETCHTAG	0x00C		Fetch User Tag (only used in direct mode)
CRYPTMSTRDMA.PUSHADDRLSB	0x010		Push Address Least Significant Word
CRYPTMSTRDMA.PUSHADDRMSB	0x014		Push Address Most Significant Word
CRYPTMSTRDMA.PUSHLEN	0x018		Push Length (only used in direct mode)
CRYPTMSTRDMA.INTEN	0x01C		Interrupt Enable mask
CRYPTMSTRDMA.INTENSET	0x020		Interrupt Set
CRYPTMSTRDMA.INTENCLR	0x024		Interrupt Clear
CRYPTMSTRDMA.INTSTATRAW	0x028		Interrupt Status Raw
CRYPTMSTRDMA.INTSTAT	0x02C		Interrupt Status
CRYPTMSTRDMA.INTSTATCLR	0x030		Interrupt Status Clear
CRYPTMSTRDMA.CONFIG	0x034		Cryptomaster configuration
CRYPTMSTRDMA.START	0x038		Start
CRYPTMSTRDMA.STATUS	0x03C		Status
CRYPTMSTRHW.INCLIPSHWCFG	0x400		Incuded IPs Hardware configuration
CRYPTMSTRHW.BA411EAESHWCFG1	0x404		Generic g_AesModesPoss value.
CRYPTMSTRHW.BA411EAESHWCFG2	0x408		Generic g_CtrSize value.
CRYPTMSTRHW.BA413HASHHWCFG	0x40C		Generic g_Hash value
CRYPTMSTRHW.BA418SHA3HWCFG	0x410		Generic g_Sha3CtxtEn value.
CRYPTMSTRHW.BA419SM4HWCFG	0x414		Generic g_SM4ModesPoss value.
CRYPTMSTRHW.BA424ARIAHWCFG	0x418		Generic g_aria_modePoss value.
RNGCONTROL.CONTROL	0x1000		Control register
RNGCONTROL.FIFOLEVEL	0x1004		FIFO level register.
RNGCONTROL.FIFOTHRESHOLD	0x1008		FIFO threshold register.
RNGCONTROL.FIFODEPTH	0x100C		FIFO depth register.
RNGCONTROL.KEY[n]	0x1010		Key register.
RNGCONTROL.TESTDATA	0x1020		Test data register.
RNGCONTROL.REPEATTHRESHOLD	0x1024		Repetition test cut-off register.
RNGCONTROL.PROPTESTCUTOFF	0x1028		Proportion test cut-off register.
RNGCONTROL.LFSRSEED	0x102C		LFSR seed register.
RNGCONTROL.STATUS	0x1030		Status register.
RNGCONTROL.WARMUPPERIOD	0x1034		Number of clock cycles in warm-up sequence.
RNGCONTROL.DISABLEOSC	0x1038		DisableOsc register.
RNGCONTROL.SAMPLINGPERIOD	0x1044		Number of clock cycles between sampling moments.
RNGCONTROL.HWCONFIG	0x1058		Hardware configuration register.
RNGCONTROL.COOLDOWNPERIOD	0x105C		Number of clock cycles in cool-down sequence.
RNGCONTROL.AUTOCORRTESTCUTOFF0	0x1060		AutoCorrTestCutoff register 0
RNGCONTROL.AUTOCORRTESTCUTOFF1	0x1064		AutoCorrTestCutoff register 1
RNGCONTROL.CORRTESTCUTOFF0	0x1068		CorrTestCutoff register 0
RNGCONTROL.CORRTESTCUTOFF1	0x106C		CorrTestCutoff register 1
RNGCONTROL.AUTOCORRTESTFAILED	0x1070		Auto-correlation test failing ring(s).
RNGCONTROL.CORRTESTFAILED	0x1074		Correlation test failing ring.
RNGCONTROL.HWVERSION	0x107C		Fixed to 1 for this version.
RNGCONTROL.FIFO[n]	0x1080		FIFO data
PK.POINTERS	0x2000		Pointers register.
PK.COMMAND	0x2004		Command register.
PK.CONTROL	0x2008		Command register.
PK.STATUS	0x200C		Status register.
PK.TIMER	0x2014		Timer register.

Register	Offset	TZ	Description
PK.HWCONFIG	0x2018		Hardware configuration register.
PK.OPSIZE	0x201C		Operand size register.
PK.ECCERRORBITPOS	0x2040		ECC Error bit position register.
PK.ECCCONTROLSTATUSREG	0x2044		ECC Control and Status register.
PK.MICROCODEFORMAT	0x2078		Microcode Format register.
PK.HWVERSION	0x207C		Hardware Version register.
IKG.START	0x3000		Start register.
IKG.STATUS	0x3004		Status register.
IKG.INITDATA	0x3008		InitData register.
IKG.NONCE	0x300C		Nonce register.
IKG.PERSONALISATIONSTRING	0x3010		Personalisation String register.
IKG.RESEEDINTERVALLSB	0x3014		Reseed Interval LSB register.
IKG.RESEEDINTERVALMSB	0x3018		Reseed Interval MSB register.
IKG.PKECONTROL	0x301C		PKE Control register.
IKG.PKECOMMAND	0x3020		PKE Command register.
IKG.PKESTATUS	0x3024		PKE Status register.
IKG.SOFTRST	0x3028		SoftRst register.
IKG.HWCONFIG	0x302C		HwConfig register.

7.8.1.9.1 CRYPTMSTRDMA.FETCHADDRLSB

Address offset: 0x000

Fetch Address Least Significant Word

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	FETCHADDRLSB			Address In direct mode this register is written by SW with the address of the data block. In Scatter-gather mode this register is written by SW with the address of the first descriptor, and subsequently updated by the hardware after each processed descriptor.

7.8.1.9.2 CRYPTMSTRDMA.FETCHADDRMSB

Address offset: 0x004

Fetch Address Most Significant Word

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	FETCHADDRMSB			As the platform has 32bit addresses this register and ADDRMSB registers both give access to the same 32-bit register.

7.8.1.9.3 CRYPTMSTRDMA.FETCHLEN

Address offset: 0x008

Fetch DMA Length (only used in direct mode)

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					D	C	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	FETCHLEN																																	
B	RW	FETCHCSTADDR																																	
C	RW	FETCHREALIGN																																	
D	RW	FETCHZPADDING																																	

7.8.1.9.4 CRYPTMSTRDMA.FETCHTAG

Address offset: 0x00C

Fetch User Tag (only used in direct mode)

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	FETCHTAG																																	

7.8.1.9.5 CRYPTMSTRDMA.PUSHADDRLSB

Address offset: 0x010

Push Address Least Significant Word

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	PUSHADDRLSB																																	

Address

In direct mode this register is written by SW with the address of the data block. In Scatter-gather mode this register is written by SW with the address of the first descriptor, and subsequently updated by the hardware after each processed descriptor.

7.8.1.9.6 CRYPTMSTRDMA.PUSHADDRMSB

Address offset: 0x014

Push Address Most Significant Word

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	PUSHADDRMSB																																	

As the platform has 32bit addresses this register and ADDRMSB registers both give access to the same 32-bit register.

7.8.1.9.7 CRYPTMSTRDMA.PUSHLEN

Address offset: 0x018

Push Length (only used in direct mode)

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					D	C	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	PUSHLEN																																	
B	RW	PUSHCSTADDR																																	
C	RW	PUSHREALIGN																																	
D	RW	PUSHDISCARD																																	

7.8.1.9.8 CRYPTMSTRDMA.INTEN

Address offset: 0x01C

Interrupt Enable mask

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																														F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	FETCHERBLOCKEND																																	
B	RW	FETCHERSTOPPED																																	
C	RW	FETCHERERROR																																	
D	RW	PUSHERBLOCKEND																																	
E	RW	PUSHERSTOPPED																																	
F	RW	PUSHERERROR																																	

7.8.1.9.9 CRYPTMSTRDMA.INTENSET

Address offset: 0x020

Interrupt Set

Writing a 1 to a bit in this register enables the corresponding interrupt. Writing 0 has no effect.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																														F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	FETCHERBLOCKEND																																	
B	RW	FETCHERSTOPPED																																	
C	RW	FETCHERERROR																																	
D	RW	PUSHERBLOCKEND																																	
E	RW	PUSHERSTOPPED																																	
F	RW	PUSHERERROR																																	

7.8.1.9.10 CRYPTMSTRDMA.INTENCLR

Address offset: 0x024

Interrupt Clear

Writing a 1 to a bit in this register disables the corresponding interrupt. Writing 0 has no effect.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																														F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	FETCHERBLOCKEND																																	
				Fetcher DMA reached the end of a block (if enabled in the descriptor; scatter-gather only)																																	
B	RW	FETCHERSTOPPED																																	
				Fetcher DMA reached the end of a block with Stop=1, or end of direct transfer																																	
C	RW	FETCHERERROR																																	
				Bus error during fetcher DMA access																																	
D	RW	PUSHERBLOCKEND																																	
				Pusher DMA reached the end of a block (if enabled in the descriptor; scatter-gather only)																																	
E	RW	PUSHERSTOPPED																																	
				Pusher DMA reached the end of a block with Stop=1, or end of direct transfer																																	
F	RW	PUSHERERROR																																	
				Bus error during pusher DMA access																																	

7.8.1.9.11 CRYPTMSTRDMA.INTSTATRAW

Address offset: 0x028

Interrupt Status Raw

Interrupt status before bitmasking with INTEN.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																														F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	FETCHERBLOCKEND																																	
				Fetcher DMA reached the end of a block (if enabled in the descriptor; scatter-gather only)																																	
B	RW	FETCHERSTOPPED																																	
				Fetcher DMA reached the end of a block with Stop=1, or end of direct transfer																																	
C	RW	FETCHERERROR																																	
				Bus error during fetcher DMA access																																	
D	RW	PUSHERBLOCKEND																																	
				Pusher DMA reached the end of a block (if enabled in the descriptor; scatter-gather only)																																	
E	RW	PUSHERSTOPPED																																	
				Pusher DMA reached the end of a block with Stop=1, or end of direct transfer																																	
F	RW	PUSHERERROR																																	
				Bus error during pusher DMA access																																	

7.8.1.9.12 CRYPTMSTRDMA.INTSTAT

Address offset: 0x02C

Interrupt Status

Interrupt Status after bitmasking with INTEN. If any bit of this register is high, this sub-module interrupt line towards the CRACEN interrupt generation logic is high.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	FETCHERBLOCKEND			Fetcher DMA reached the end of a block (if enabled in the descriptor; scatter-gather only)
B	RW	FETCHERSTOPPED			Fetcher DMA reached the end of a block with Stop=1, or end of direct transfer
C	RW	FETCHERERROR			Bus error during fetcher DMA access
D	RW	PUSHERBLOCKEND			Pusher DMA reached the end of a block (if enabled in the descriptor; scatter-gather only)
E	RW	PUSHERSTOPPED			Pusher DMA reached the end of a block with Stop=1, or end of direct transfer
F	RW	PUSHERERROR			Bus error during pusher DMA access

7.8.1.9.13 CRYPTMSTRDMA.INTSTATCLR

Address offset: 0x030

Interrupt Status Clear

Writing a 1 to a bit in this register clears the corresponding interrupt. Writing 0 has no effect.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	FETCHERBLOCKEND			Fetcher DMA reached the end of a block (if enabled in the descriptor; scatter-gather only)
B	RW	FETCHERSTOPPED			Fetcher DMA reached the end of a block with Stop=1, or end of direct transfer
C	RW	FETCHERERROR			Bus error during fetcher DMA access
D	RW	PUSHERBLOCKEND			Pusher DMA reached the end of a block (if enabled in the descriptor; scatter-gather only)
E	RW	PUSHERSTOPPED			Pusher DMA reached the end of a block with Stop=1, or end of direct transfer
F	RW	PUSHERERROR			Bus error during pusher DMA access

7.8.1.9.14 CRYPTMSTRDMA.CONFIG

Address offset: 0x034

Cryptomaster configuration

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																												E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	FETCHCTRLINDIRECT			Fetcher scatter/gather. When this bit is zero, the fetcher runs in direct mode. When this bit is one, the fetcher runs in scatter-gather mode.
B	RW	PUSHCTRLINDIRECT			Pusher scatter/gather. When this bit is zero, the pusher runs in direct mode. When this bit is one, the pusher runs in scatter-gather mode.
C	RW	FETCHSTOP			Stop fetcher. When this bit is high, the fetcher will stop at the end of the current block (even if the STOP bit in the descriptor is low).
D	RW	PUSHSTOP			Stop pusher DMA. When this bit is high, the pusher will stop at the end of the current block (even if the STOP bit in the descriptor is low).
E	RW	SOFTRST			Soft reset the cryptomaster. When this bit is high, the software reset of the DMA modules, the FIFO's and the processing module will be activated. The bus is not affected (pending transfers will be completed). Set the bit to '1' for a duration of 300 ns before setting to zero again.

7.8.1.9.15 CRYPTMSTRDMA.START

Address offset: 0x038

Start

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																															B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	STARTFETCH			Writing a '1' starts the fetcher DMA. Writing a '0' has no effect.
B	W	STARTPUSH			Writing a '1' starts the pusher DMA. Writing a '0' has no effect.

7.8.1.9.16 CRYPTMSTRDMA.STATUS

Address offset: 0x03C

Status

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F									E	D	C			B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	FETCHBUSY			This bit is high as long as the fetcher DMA is busy.
B	R	PUSHBUSY			This bit is high as long as the pusher DMA is busy.
C	R	FETCHNOTEMPTY			Not empty flag for fetcher DMA input FIFO
D	R	PUSHWAITINGFIFO			Pusher DMA Waiting FIFO. This bit is high when the pusher is waiting for more data in output FIFO.
E	R	SOFTRSTBUSY			This bit is high when the soft reset is on going
F	R	PUSHNBDATA			Amount of data in the pusher DMA output FIFO

7.8.1.9.17 CRYPTMSTRHW.INCLIPSHWCFG

Address offset: 0x400

Incuded IPs Hardware configuration

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000671	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**1**

ID	R/W	Field	Value ID	Value	Description
A	R	BA411AESINCLUDED			Generic g_IncludeAES value. BA411E–AES IP included if set
B	R	BA415HPAESGCMINCLUDED			Generic g_IncludeAESGCM value. BA415–HP-AES-GCM IP included if set
C	R	BA416HPAESXTSINCLUDED			Generic g_IncludeAESXTS value. BA416–HP-AES-XTS IP included if set
D	R	BA412DESINCLUDED			Generic g_IncludeDES value. BA412–3DES IP included if set
E	R	BA413HASHINCLUDED			Generic g_IncludeHASH value. BA413–HASH IP included if set
F	R	BA417CHACHAPOLYINCLUDED			Generic g_IncludeChachaPoly value. BA417–ChaChaPoly IP included if set
G	R	BA418SHA3INCLUDED			Generic g_IncludeSHA3 value. BA418–SHA3 IP included if set
H	R	BA421ZUCINCLUDED			Generic g_IncludeZUC value. BA421–ZUC IP included if set
I	R	BA419SM4INCLUDED			Generic g_IncludeSM4 value. BA419–SM4 IP included if set
J	R	BA414EPPKEINCLUDED			Generic g_IncludePKE value. BA414EP-PKE IP included if set
K	R	BA431NDRNGINCLUDED			Generic g_IncludeNDRNG value. BA431–NDRNG IP included if set
L	R	BA420HPCHACHAPOLYINCLUDED			Generic g_IncludeHPChachaPoly value. BA420–HP-ChaChaPoly IP included if set
M	R	BA423SNOW3GINCLUDED			Generic g_IncludeSnow3G value. BA423–Snow3G IP included if set
N	R	BA422KASUMIINCLUDED			Generic g_IncludeKasumi value. BA422–Kasumi IP included if set
O	R	BA422ARIAINCLUDED			Generic g_IncludeAria value. BA424–Aria IP included if set

7.8.1.9.18 CRYPTMSTRHW.BA411EAESHWCFG1

Address offset: 0x404

Generic g_AesModesPoss value.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				F	E	D	D	D							C	B								A	A	A	A	A	A	A	A
Reset 0x1D020167	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**0**	**0**	**1**	**1**	**1**

ID	R/W	Field	Value ID	Value	Description
A	R	BA411EAESHWCFGMODE			Generic g_AesModesPoss value. BA411E-AES engine configuration.
B	R	BA411EAESHWCFGCS			Generic g_CS value. BA411E-AES engine configuration.
C	R	BA411EAESHWCFGMASKING			Generic g_UseMasking value. BA411E-AES engine configuration.
D	R	BA411EAESHWCFGKEYSIZE			Generic g_Keysize value. BA411E-AES engine configuration.
E	R	CONTEXTEN			Generic g_CxSwitch value. BA411E-AES engine configuration.
F	R	GLITCHPROT			Generic g_GlitchProtection value. BA411E-AES engine configuration.

7.8.1.9.19 CRYPTMSTRHW.BA411EAESHWCFG2

Address offset: 0x408

Generic g_CtrSize value.

BA411E-AES engine configuration.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					C	C	C	C	B	B	B	B					A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x02000010	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	BA411EAESHWCFG2			Maximum size in bits for the counter in CTR and CCM modes (g_CtrSize value). BA411E-AES engine configuration.
B	R	NBEXTAESKEYS			Generic g_Ext_nb_AES_keys value. BA411E-AES engine configuration.
C	R	NBIKGAESKEYS			Generic g_IKG_nb_AES_keys value. BA411E-AES engine configuration.

7.8.1.9.20 CRYPTMSTRHW.BA413HASHHWCFG

Address offset: 0x40C

Generic g_Hash value

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					F	F	F	E	E	E	E		D	C	B											A	A	A	A	A	A	A
Reset 0x0001003E	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	BA413HASHHWCFGMASK			Generic g_HashMaskFunc value. BA413-Hash engine configuration.
B	R	BA413HASHHWCFGPADDING			Generic g_HashPadding value. BA413-Hash engine configuration.
C	R	BA413HASHHWCFGHMAC			Generic g_HMAC_enabled value. BA413-Hash engine configuration.
D	R	BA413HASHHWCFGVERIFYDIGEST			Generic g_HashVerifyDigest value. BA413-Hash engine configuration.
E	R	NBEXTHASHKEYS			Generic g_Ext_nb_Hash_keys value. BA413-Hash number of Hash HW keys.
F	R	NBIKGHASHKEYS			Generic g_IKG_nb_Hash_keys value. BA413-Hash number of Hash IKG keys.

7.8.1.9.21 CRYPTMSTRHW.BA418SHA3HWCFG

Address offset: 0x410

Generic g_Sha3CtxtEn value.

BA418-SHA3 configuration.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					E	E	E	E	D	D	D	D		C	B																	A
Reset 0x00000001	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**

ID	R/W	Field	Value ID	Value	Description
A	R	BA418SHA3HWCFG			Generic g_Sha3CtxtEn value. BA418-SHA3 configuration.
B	R	HMAC			HMAC enabled. BA418-SHA3 configuration.
C	R	VERIFYDIGEST			Support to digest verification. BA418-SHA3 configuration.
D	R	NBEXTHASHKEYS			Number of SHA3 HW keys. BA418-SHA3 configuration.
E	R	NBIKGHASHKEYS			Number of SHA3 IKG keys. BA418-SHA3 configuration.

7.8.1.9.22 CRYPTMSTRHW.BA419SM4HWCFG

Address offset: 0x414

Generic g_SM4ModesPoss value.

BA419-SM4 engine configuration.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	BA419SM4HWCFG			Generic g_SM4ModesPoss value. BA419-SM4 engine configuration.
B	R	USEMASKING			Generic g_sm4UseMasking value. BA419-SM4 engine configuration.

7.8.1.9.23 CRYPTMSTRHW.BA424ARIAHWCFG

Address offset: 0x418

Generic g_aria_modePoss value.

BA424-Aria engine configuration.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	BA424ARIAHWCFG			Generic g_aria_modePoss value. BA424-Aria engine configuration.

7.8.1.9.24 RNGCONTROL.CONTROL

Address offset: 0x1000

Control register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P P O O O N N M L K J J J J I H G F E D C B A
Reset 0x00040000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	ENABLE			Start the NDRNG. Self-clearing bit.
B	RW	LFSREN			Select between the NDRNG with asynchronous free running oscillators (when 0) and the Pseudo-Random generator with synchronous oscillators for simulation purpose (when 1).
C	RW	TESTEN			Select input for conditioning function and continuous tests:
			NORMAL	0	Noise source (normal mode).
			TEST	1	Test data register (test mode).
D	RW	CONDBYPASS			Conditioning function bypass.
			NORMAL	0	the conditioning function is used (normal mode).
			BYPASS	1	the conditioning function is bypassed (to observe entropy source directly).
E	RW	INTENREP			Enable interrupt if any of the health test fails.
F	RW	INTENFULL			Enable interrupt if FIFO is full.
G	RW	SOFTRST			Datapath content flush and control FSM
H	RW	FORCEACTIVEROS			Force oscillators to run when FIFO is full.
I	RW	IGNOREHEALTHTESTSFAILFORFSM			Results of the health tests during start-up and online test do not affect the control FSM state. It also bypass control FSM StartUp phase.
J	RW	NB128BITBLOCKS			Number of 128 bit blocks used in conditioning (AES-CBC-MAC) post-processing. Zero value is not allowed.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				P	P	O	O	O			N	N	M	L	K	J	J	J	J				I	H			G	F			E	D	C	B	A
Reset 0x00040000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
K	RW	FIFOWRITESTARTUP																																	
				Enable write of the samples in the FIFO during start-up.																																	
L	RW	DISREPETTESTS																																	
				All repetition tests (each share) are disabled via this single bit.																																	
M	RW	DISPROPTESTS																																	
				All proportion tests (each share) are disabled via this single bit.																																	
N	RW	DISAUTOCORRTESTS																																	
				Disable specific delay(s) check in auto-correlation test - same RO: x1: vs. the following sample of the same RO -> (0) delay check 1x: vs. the later sample of the same RO -> (+1) delay check																																	
O	RW	DISCORRTESTS																																	
				Disable specific delay(s) check in correlation test - different ROs: xx1: vs. the same sample of the other RO -> (0) delay check x1x: vs. the preceding sample of the other RO -> (-1) delay check 1xx: vs. the next sample of the other RO -> (+1) delay check																																	
P	RW	BLENDINGMETHOD																																	
				Select blending method																																	
			CONCATENATION	0																																	
				Concatenation																																	
			XORLEVEL1	1																																	
				XOR level 1																																	
			XORLEVEL2	2																																	
				XOR level 2																																	
			VONNEUMANN	3																																	
				VON-NEUMANN debiasing																																	

7.8.1.9.25 RNGCONTROL.FIFOLEVEL

Address offset: 0x1004

FIFO level register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	FIFOLEVEL																																	
				Number of 32 bits words of random values available in the FIFO. Any write to this register clears the FULLINT flag in the STATUS register, but does not affect this register content. Note that if the FIFO is still full when writing this register, the status flag and interrupt will be set back up right away																																	

7.8.1.9.26 RNGCONTROL.FIFOTHRESHOLD

Address offset: 0x1008

FIFO threshold register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																	A	A	A
Reset 0x00000003				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW	FIFOTHRESHOLD																																	
				FIFO level threshold below which the module leaves the idle state to refill the FIFO. Expressed in number of 128bit blocks. After a FIFO read, the RNG will start refilling the FIFO if FIFOLEVEL is smaller than (FIFOTHRESHOLD + 1) * 4																																	

7.8.1.9.27 RNGCONTROL.FIFODEPTH

Address offset: 0x100C

FIFO depth register.

Bit number																																
ID																																
Reset 0x00000010																																
ID	R/W	Field	Value ID	Value	Description																											
A	R	FIFODEPTH			Maximum number of 32 bits words that can be stored in the FIFO.																											

7.8.1.9.28 RNGCONTROL.KEY[n] (n=0..3)

Address offset: 0x1010 + (n × 0x4)

Key register.

Bit number																																
ID																																
Reset 0x00000000																																
ID	R/W	Field	Value ID	Value	Description																											
A	RW	KEY			Key register. Key0 is byte 0-3, Key1 is byte 4-7, Key2 is byte 8-11 and Key3 is byte 12-15.																											

7.8.1.9.29 RNGCONTROL.TESTDATA

Address offset: 0x1020

Test data register.

This register is used to feed known data to the conditioning function or to the continuous tests. When one word is written into this register, the 32-bit are sent to those modules. Since some time is needed for processing, there is one busy flag (TESTDATABUSY in the STATUS register) going high as soon as data is written, and going low when the next word can be written. Write access to this register is ignored when CONTROL.TESTEN is 0. Test data written through this interface is expected to be a multiple of 128 bits.

Bit number																																
ID																																
Reset 0x00000000																																
ID	R/W	Field	Value ID	Value	Description																											
A	W	TESTDATA			Test data register.																											

7.8.1.9.30 RNGCONTROL.REPEATTHRESHOLD

Address offset: 0x1024

Repetition test cut-off register.

Bit number																																
ID																																
Reset 0x00000004																																
ID	R/W	Field	Value ID	Value	Description																											
A	RW	REPEATTHRESHOLD			Repetition Test cut-off value.																											

7.8.1.9.31 RNGCONTROL.PROPTESTCUTOFF

Address offset: 0x1028

Proportion test cut-off register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																											A	A	A	A	A	A	A	A	A
Reset 0x0000000D				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW	PROPTESTCUTOFF																																	
																											Proportion test cut-off value.								

7.8.1.9.32 RNGCONTROL.LFSRSEED

Address offset: 0x102C

LFSR seed register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID										B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00FFFFFF				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW	LFSRSEED																																	
																											LFSR initialization value.								
B	W	LFSRSSELECTION																																	
																											Share index for which initialization value should be used.								

7.8.1.9.33 RNGCONTROL.STATUS

Address offset: 0x1030

Status register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID															J	I	I	I	I	H	H	H	H		G			F	E	D	C	B	B	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	TESTDATABUSY																																	
																											High when data written to TestData register is being processed.								
B	R	STATE																																	
																											State of the control FSM:								
			RESET	0																							Reset								
			STARTUP	1																							Startup								
			IDLERON	2																							Idle / FIFO full								
			FILLFIFO	4																							Fill FIFO								
			ERROR	5																							Error								
C	R	REPFAIL																																	
																											NIST repetition test(s) failure.								
D	R	PROPFAIL																																	
																											NIST proportion test(s) failure.								
E	RW	ANYHEALTHTESTFAIL																																	
	W0C																										Any of the enabled health tests is failing.								
F	R	FULLINT																																	
																											FIFO full status.								
G	RW	STARTUPFAIL																																	
	W0C																										Start-up test(s) failure.								
H	R	REPTESTFAILPERSHARE																																	
																											NIST Repetition test failure per share.								
I	R	PROPTESTFAILPERSHARE																																	
																											NIST Proportion test failure per share.								
J	RW	CONDITIONINGISTOOSLOW																																	
	W0C																										Conditioning consumes data slower than they are provided to it. This can happen for SAMPLINGPERIOD < 15, BLENDINGMETHOD = CONCATENATION, or four shares.								

7.8.1.9.34 RNGCONTROL.WARMUPPERIOD

Address offset: 0x1034

Number of clock cycles in warm-up sequence.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																								A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000200				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	WARMUPPERIOD																																	
				Number of clock cycles in warm-up sequence.																																	

7.8.1.9.35 RNGCONTROL.DISABLEOSC

Address offset: 0x1038

DisableOsc register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	DISABLEOSC																																	
				Disable oscillator rings. Oscillators are grouped in shares. Each group of 8 bits controls one share: bits [7:0] disable oscillators from the first share, bits [15:8] disable oscillators from the second share, bits [23:16] disable oscillators from the third share, and bits [31:24] disable oscillators from the fourth share.																																		

7.8.1.9.36 RNGCONTROL.SAMPLINGPERIOD

Address offset: 0x1044

Number of clock cycles between sampling moments.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																								A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000FFF				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW	SAMPLINGPERIOD																																	
				Number of clock cycles between sampling moments.																																	

7.8.1.9.37 RNGCONTROL.HWCONFIG

Address offset: 0x1058

Hardware configuration register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		D	D	C	C	C	C	B	B	B	A	A	A	A	A	A	A	A
Reset 0x0002410F				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	R	NBOFINV																																	
				Generic g_NbOfInverters value.																																	
B	R	LOG2NBOFAUTOCORRTESTSPERSHARE																																	
				Generic g_Log2NbOfAutoCorrTestsPerShare value.																																	
C	R	LOG2FIFODEPTH																																	
				Generic g_Log2FifoDepth value.																																	
D	R	LOG2NBOFSHARES																																	
				Generic g_Log2NbOfShares value.																																	

7.8.1.9.38 RNGCONTROL.COOLDOWNPERIOD

Address offset: 0x105C

Number of clock cycles in cool-down sequence.

Bit number																															
ID																						A	A	A	A	A	A	A	A	A	A
Reset 0x00000000																						**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID					Value													Description									
A	RW	COOLDOWNPERIOD																				Number of clock cycles in cool-down sequence.									

7.8.1.9.39 RNGCONTROL.AUTOCORRTESTCUTOFF0

Address offset: 0x1060

AutoCorrTestCutoff register 0

Bit number																															
ID																															
Reset 0x007F007F																															
ID	R/W	Field		Value ID					Value													Description									
A	RW	DLYZEROCUTOFF																				Auto-correlation test cut-off value for delay of 0 samples.									
B	RW	DLYONECUTOFF																				Auto-correlation test cut-off value for delay of +1 sample.									

7.8.1.9.40 RNGCONTROL.AUTOCORRTESTCUTOFF1

Address offset: 0x1064

AutoCorrTestCutoff register 1

Bit number																															
ID																															
Reset 0x007F007F																															
ID	R/W	Field		Value ID					Value													Description									
A	RW	DLYTWOCUTOFF																				Auto-correlation test cut-off value for delay of +2 samples.									
B	RW	DLYTHREECUTOFF																				Auto-correlation test cut-off value for delay of +3 samples.									

7.8.1.9.41 RNGCONTROL.CORRTESTCUTOFF0

Address offset: 0x1068

CorrTestCutoff register 0

Bit number																															
ID																															
Reset 0x007F007F																															
ID	R/W	Field		Value ID					Value													Description									
A	RW	DLYZEROCUTOFF																				Correlation test cut-off value for delay of 0 samples.									
B	RW	DLYONECUTOFF																				Correlation test cut-off value for delay of +/-1 sample.									

7.8.1.9.42 RNGCONTROL.CORRTESTCUTOFF1

Address offset: 0x106C

CorrTestCutoff register 1

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x007F007F				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW	DLYTWOCUTOFF																																	
B	RW	DLYTHREECUTOFF																																	

Correlation test cut-off value for delay of +/- 2 samples.

Correlation test cut-off value for delay of +/- 3 samples.

7.8.1.9.43 RNGCONTROL.AUTOCORRTESTFAILED

Address offset: 0x1070

Auto-correlation test failing ring(s).

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	AUTOCORRTESTFAILED																																	

Auto-correlation test failing ring(s).

7.8.1.9.44 RNGCONTROL.CORRTESTFAILED

Address offset: 0x1074

Correlation test failing ring.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	CORRTESTFAILED																																	

Correlation test failing ring.

7.8.1.9.45 RNGCONTROL.HWVERSION

Address offset: 0x107C

Fixed to 1 for this version.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000001				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
ID	R/W	Field	Value ID	Value																															
A	R	HWVERSION																																	

Fixed to 1 for this version.

7.8.1.9.46 RNGCONTROL.FIFO[n] (n=0..31)

Address offset: 0x1080 + (n × 0x4)

FIFO data

The FIFO contains the RNG output data.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	DATA																																	

FIFO data

7.8.1.9.47 PK.POINTERS

Address offset: 0x2000

Pointers register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID								D	D	D	D					C	C	C	C					B	B	B	B					A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	OPPTRA																																	
				When executing primitive arithmetic operations, this pointer defines where operand A is located in memory (location 0x0 to 0xF).																																	
B	RW	OPPTRB																																	
				When executing primitive arithmetic operations, this pointer defines where operand B is located in memory (location 0x0 to 0xF).																																	
C	RW	OPPTRC																																	
				When executing primitive arithmetic operations, this pointer defines the location (0x0 to 0xF) where the result will be stored in memory.																																	
D	RW	OPPTRN																																	
				When executing primitive arithmetic operations, this pointer defines the location where the modulus is located in memory (location 0x0 to 0xF).																																	

7.8.1.9.48 PK.COMMAND

Address offset: 0x2004

Command register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				L	K	J	I		H	G	F		E	E	E	D		C	C	C	C	C	C	C	C	C	B	A	A	A	A	A	A	A
Reset 0x0000000F				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW	OPEADDR																																	
				This field defines the operation to be performed. See documentation for more details.																																	
B	RW	FIELDF																																	
				0: Field is GF(p) 1: Field is GF(2**m)																																	
C	RW	OPBYTESM1																																	
				This field defines the size (= number of bytes minus one) of the operands for the current operation. Possible values are limited by the maximum supported operand size. Examples: - 0x014 - ECC on curve K-163 - 0x01F - ECC on curve P-256 - 0x02F - ECC on curve P-384 - 0x033 - ECC on curve K-409 - 0x041 - ECC on curve P-521 - 0x07F - 1024-bit RSA - 0x09F - 1280-bit RSA - 0x1FF - 4096-bit RSA - 0x3FF - 8192-bit RSA																																	
D	RW	RANDMOD																																	
				Enable randomization of modulus (counter-measure).																																	
E	RW	SELCURVE																																	
				Enable accelerator for specific curve modulus: This field has no effect when the optional acceleration hardware is not included.																																	
			NOACCEL	0x0																																	
				No acceleration (default)																																	
			P256	0x1																																	
				P256																																	
			P384	0x2																																	
				P384																																	
			P521	0x3																																	
				P521																																	
			P192	0x4																																	
				P192																																	
			CURVE25519	0x5																																	
				Curve25519																																	
			ED25519	0x6																																	
				Ed25519.																																	
F	RW	RANDKE																																	
				Enable randomization of exponent/scalar (counter-measure).																																	
G	RW	RANDPROJ																																	
				Enable randomization of projective coordinates (counter-measure).																																	
H	RW	EDWARDS																																	
				Enable Edwards curve.																																	

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E E E D C C C C C C C C C B A A A A A A A
Reset 0x0000000F				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
I	RW	SWAPBYTES			Swap the bytes on AHB interface: This bit must be programmed before writing/reading any data in data memory.
			NATIVE	0	Native format (little endian).
			SWAPPED	1	Byte swapped (big endian).
J	RW	FLAGA			Flag A.
K	RW	FLAGB			Flag B.
L	RW	CALCR2			This bit indicates if the IP has to calculate R**2 mod N for the next operation. This bit must be set to 1 when a new prime number has been programmed. This bit is used for primitive operations and ignored for the other operations.
			NRECALCULATE	0	don't recalculate R^2 mod N
			RECALCULATE	1	re-calculate R^2 mod N

7.8.1.9.49 PK.CONTROL

Address offset: 0x2008

Command register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	START			Writing a 1 starts the processing.
B	W	CLEARIRQ			Writing a 1 clears the IRQ output.

7.8.1.9.50 PK.STATUS

Address offset: 0x200C

Status register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D C B A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	ERRORFLAGS			These bits indicate an error condition. They are updated at the end of the operation. They are cleared when starting a new operation.
B	R	PKBUSY			This bit reflects the BUSY output value. It is set when the operation starts and it is cleared when the operation is finished.
C	R	INTRPTSTATUS			This bit reflects the IRQ output value. It is set when the operation is finished. It is cleared when the CPU writes the bit 1 of Control Register.
D	R	FAILPTR			These bits indicate which data location generated the error flag. They are not available for all error flags.

7.8.1.9.51 PK.TIMER

Address offset: 0x2014

Timer register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	TIMER																																	
				Number of clock cycles (as the number of core cycles is always even, register bit 0 is tied to zero).																																	

7.8.1.9.52 PK.HWCONFIG

Address offset: 0x2018

Hardware configuration register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				P	O	N			M	L	K	J	I	H	G	F	E	D	C	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x01F30200				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	MAXOPSIZE																																	
				Maximum operand size (number of bytes).																																	
B	R	NBMULT																																	
				Number of multipliers:																																	
			MULT1	0																															
				1 multiplier																																	
			MULT4	1																															
				4 multipliers																																	
			MULT16	2																															
				16 multipliers																																	
			MULT64	4																															
				64 multipliers																																	
			MULT256	8																															
				256 multipliers																																	
C	R	PRIMEFIELD																																	
				Support prime field.																																	
D	R	BINARYFIELD																																	
				Support binary field.																																	
E	R	DATAMEMECC																																	
				Support data memory error correction.																																	
F	R	CODEMEMECC																																	
				Support code memory error correction.																																	
G	R	P256																																	
				Support ECC P256 acceleration.																																	
H	R	P384																																	
				Support ECC P384 acceleration.																																	
I	R	P521																																	
				Support ECC P521 acceleration.																																	
J	R	P192																																	
				Support ECC P192 acceleration.																																	
K	R	X25519																																	
				Support Curve25519/Ed25519 acceleration.																																	
L	R	AHBMASTER																																	
				Memory access																																	
			SLAVE	0																															
				Memory access through AHB Slave and internally in the PKE.																																	
			MASTER	1																															
				Memory access through AHB Master, outside the PKE.																																	
M	R	CODERAM																																	
				Code memory																																	
			ROM	0																															
				Code memory is a ROM.																																	
			RAM	1																															
				Code memory is a RAM.																																	
N	R	DISABLESMX																																	
				State of DisableSMx input (high when SM2/SM9 operations are disabled).																																	
O	R	DISABLECLRMEM																																	
				State of DisableClrMem input (high when automatic clear of the RAM after reset is disabled).																																	
P	R	DISABLECM																																	
				State of DisableCM input (high when counter-measures are disabled).																																	

7.8.1.9.53 PK.OPSIZE

Address offset: 0x201C

Operand size register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A
Reset 0x00001000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	OPSIZE			Operand size (number of bytes): This register is used when the memory is accessed via AHB Master
			OPSIZE256	0x0100	256 bytes.
			OPSIZE521	0x0209	521 bytes.
			OPSIZE2048	0x0800	2048 bytes.
			OPSIZE4096	0x1000	4096 bytes.

7.8.1.9.54 PK.ECCERRORBITPOS

Address offset: 0x2040

ECC Error bit position register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B B B B B B B B B B A A A A A A A A A A
Reset 0x03FF03FF				**0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	ERRORBITPOS1			Position of error bit 1
B	RW	ERRORBITPOS2			Position of error bit 2

7.8.1.9.55 PK.ECCCONTROLSTATUSREG

Address offset: 0x2044

ECC Control and Status register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	DATAMEMCORRECTION			Data Memory Correction flag, clear on write
B	RW W1C	DATAMEMFAILURE			Data Memory Failure flag, clear on write
C	RW W1C	CODEMEMCORRECTION			Code Memory Correction flag, clear on write
D	RW W1C	CODEMEMFAILURE			Code Memory Failure flag, clear on write

7.8.1.9.56 PK.MICROCODEFORMAT

Address offset: 0x2078

Microcode Format register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0xD4B79DDA				**1 1 0 1 0 1 0 0 1 0 1 1 0 1 1 1 1 0 0 1 1 1 0 1 1 1 0 1 1 0 1 0**
ID	R/W	Field	Value ID	Value	Description
A	R	MICROCODEFORMAT			Microcode format number.

7.8.1.9.57 PK.HWVERSION

Address offset: 0x207C

Hardware Version register.

Bit number																																
ID																																
Reset 0x00010001																																
ID	R/W	Field	Value ID	Value	Description																											
A	R	MINOR			Minor version number.																											
B	R	MAJOR			Major version number.																											

7.8.1.9.58 IKG.START

Address offset: 0x3000

Start register.

Bit number																																
ID																																
Reset 0x00000000																																
ID	R/W	Field	Value ID	Value	Description																											
A	W	START			Start the Isolated Key Generation.																											

7.8.1.9.59 IKG.STATUS

Address offset: 0x3004

Status register.

Bit number																																
ID																																
Reset 0x00000000																																
ID	R/W	Field	Value ID	Value	Description																											
A	R	SEEDERROR			Seed Error during Isolated Key Generation. When the IKG module is in error state, a reset is required to restart the module.																											
B	R	ENTROPYERROR			Entropy Error during Isolated Key Generation. When the IKG module is in error state, a reset is required to restart the module.																											
C	R	OKAY			Isolated Key Generation is okay.																											
D	R	CTRDRBGBUSY			CTR_DRBG health test is busy (only when g_hw_health_test = true).																											
E	R	CATASTROPHICERROR			Catastrophic error during CTR_DRBG health test (only when g_hw_health_test = true). When the IKG module is in error state, a reset is required to restart the module.																											
F	R	SYMKEYSTORED			Symmetric Keys are stored.																											
G	R	PRIVKEYSTORED			Private Keys are stored.																											

7.8.1.9.60 IKG.INITDATA

Address offset: 0x3008

InitData register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	W	INITDATA																																	
				Writing a 1 initialise Nonce and Personalisation_String registers counters, i.e. start writing from the 32 LSB.																																	

7.8.1.9.61 IKG.NONCE

Address offset: 0x300C

Nonce register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	NONCE																																	
				Nonce (write/read value 32-bit by 32-bit).																																	

7.8.1.9.62 IKG.PERSONALISATIONSTRING

Address offset: 0x3010

Personalisation String register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	PERSONALISATIONSTRING																																	
				Personalisation String (write/read value 32-bit by 32-bit). If this register is not accessed, then Personalisation String is considered null.																																	

7.8.1.9.63 IKG.RESEEDINTERVALLSB

Address offset: 0x3014

Reseed Interval LSB register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x80000000				**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	RESEEDINTERVALLSB																																	
				Reseed Interval LSB.																																	

7.8.1.9.64 IKG.RESEEDINTERVALMSB

Address offset: 0x3018

Reseed Interval MSB register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	RESEEDINTERVALMSB																																	
				Reseed Interval MSB.																																	

7.8.1.9.65 IKG.PKECONTROL

Address offset: 0x301C

PKE Control register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																		B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	W	PKESTART																																	Start the PKE operation or trigger for Secure mode exit.
B	W	CLEARIRQ																																	Clear the IRQ output.

7.8.1.9.66 IKG.PKECOMMAND

Address offset: 0x3020

PKE Command register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																										C	C	B	B	B	B			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	SECUREMODE																																	Secure mode. It is activated as soon as it is set to 1.It is deactivated when it is set to 0 and PKE_Start is set to 1.
			DEACTIVATED	0																															
			ACTIVATED	1																															
B	RW	SELECTEDKEY																																	Select Generated Private Key for PKE operation. This Key Index should be between 0 and g_nb_priv_keys-1.
C	RW	OPSEL																																	Select PKE operation with Isolated Key Note: Value 3 is reserved.
			PUBKEY	0																															Public Key Generation
			ECDSA	1																															ECDSA Signature
			PTMUL	2																															Point Multiplication

7.8.1.9.67 IKG.PKESTATUS

Address offset: 0x3024

PKE Status register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	E	D	C															B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	ERROR																																	Error because either Private Keys are not stored or the operation is not defined.
B	R	STARTERROR																																	Error because a new operation is started while the previous one is still busy.
C	R	IKGPKBUSY																																	Busy, set when the operation starts and cleared when the operation is finished.
D	R	IRQSTATUS																																	IRQ, set when the operation is finished and cleared when the CPU writes the bit 1 of PKE_Control Register or a new operation is started.
E	R	ERASEBUSY																																	The PKE Data RAM is being erased.

7.8.1.9.68 IKG.SOFTRST

Address offset: 0x3028

SoftRst register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	SOFTRST																																	
			NORMAL	0																															
			KEY	1																															

7.8.1.9.69 IKG.HWCONFIG

Address offset: 0x302C

HwConfig register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				K	K	K	K	J	J	J	J	I	I	I	I	H	H	H	H	G	G	G	F	E	E	D	C	B	B	B	B	A	A	A	A
Reset 0xCC4C8312				**1**	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	NBSYMKEYS																																	
B	R	NBPRIVKEYS																																	
C	R	IKGCM																																	
D	R	HWHEALTHTEST																																	
E	R	CURVE																																	
			P256	0																															
			P384	1																															
			P521	2																															
F	R	DF																																	
G	R	KEYSIZE																																	
			AES128	1																															
			AES192	2																															
			AES256	4																															
H	R	ENTROPYINPUTLENGTH																																	
I	R	NONCELENGTH																																	
J	R	PERSONALIZATIONSTRINGLENGTH																																	
K	R	ADDITIONALINPUTLENGTH																																	

7.8.2 GLITCHDET — Voltage glitch detectors

The system has voltage glitch detectors.

The voltage glitch detectors are automatically enabled after reset. To save power, the glitch detectors must be disabled when not in use.

7.8.2.1 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
GLITCHDET	GLOBAL	0x5004E000	HF	S	NA	No	Glitch detectors

Register overview

Register	Offset	TZ	Description
CONFIG	0x5A0		Configuration for glitch detector

7.8.2.1.1 CONFIG

Address offset: 0x5A0

Configuration for glitch detector

Bit number																															
ID																														B	A
Reset 0x00000001									**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
ID	R/W	Field		Value ID		Value																									
A	RW	ENABLE																													
				Disable		0																									
				Enable		1																									
B	RW	MODE																													
				HighPassFilter		0																									
				CapDiv		1																									

7.8.3 KMU — Key management unit

The key management unit (KMU) provides secure key storage functions by storing data in a dedicated region of RRAM.

The secure information configuration region, SICR, is the RRAM region that holds keys seeds, and metadata. Access to KMU and the key slots in SICR is only allowed from secure mode. KMU has exclusive access to SICR, meaning the rest of the system does not have access. The KMU stores data in key slots that hold one 128-bit value together with an access policy and a destination address for the key value. Multiple key slots can be combined to hold key sizes larger than 128 bits. How and when a key value can be used is determined by the access policy. When requested by the CPU, the destination address, which is part of the key slot, determines the memory map location for the key value that is pushed by KMU.

Key slots can be configured to be pushed directly into write-only key registers or RAM of cryptographic accelerators like CRACEN, without revealing the key value to the CPU. This enables the CPU to use the key values stored inside the key slots for cryptographic operations without knowing the key value.

KMU can also store other secrets, like the CRACEN SEED register, using multiple key slots.

A good design practice is to overwrite previously pushed secrets when they are no longer in use. KMU can be used for this, by pushing key slots with previously generated random data to the key RAM.

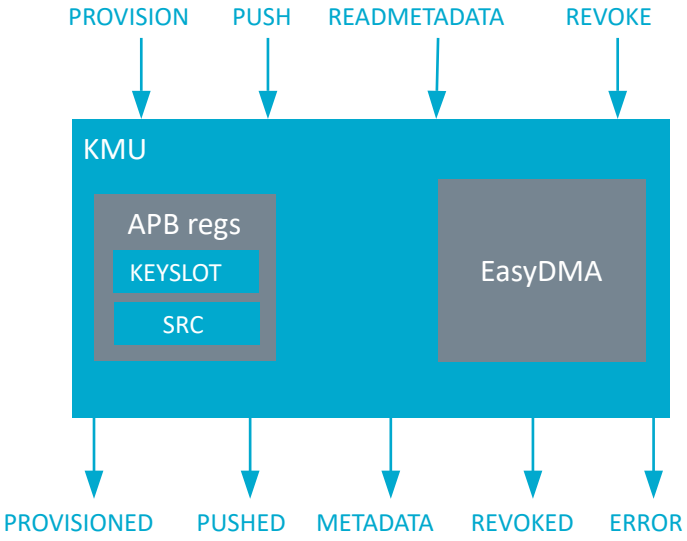


Figure 32: Block diagram

7.8.3.1 Key slot

A key slot stores secure assets and up to 32 bits of additional metadata. Assets greater than 128 bits must be divided and distributed over multiple key slot instances.

The following table summarizes what can be stored in a key slot.

Field	Size [bits]	Description
METADATA	32	A text field that can be used for any purpose. This field can be read by secure code using the READMETADATA task.
DEST	32	The destination address used for the push, and used by the PUSH operation.
VALUE	128	The secure asset. This field cannot be read, only pushed to its destination address using the PUSH task.
RPOLICY	2	The revocation policy for the key slot. See Provisioning on page 181 for a detailed definition of this field.

Table 31: Key slot contents

7.8.3.1.1 Key slot states

KMU maintains the key slot state.

The following figure shows the key slot states and how they transition through the device life cycle.

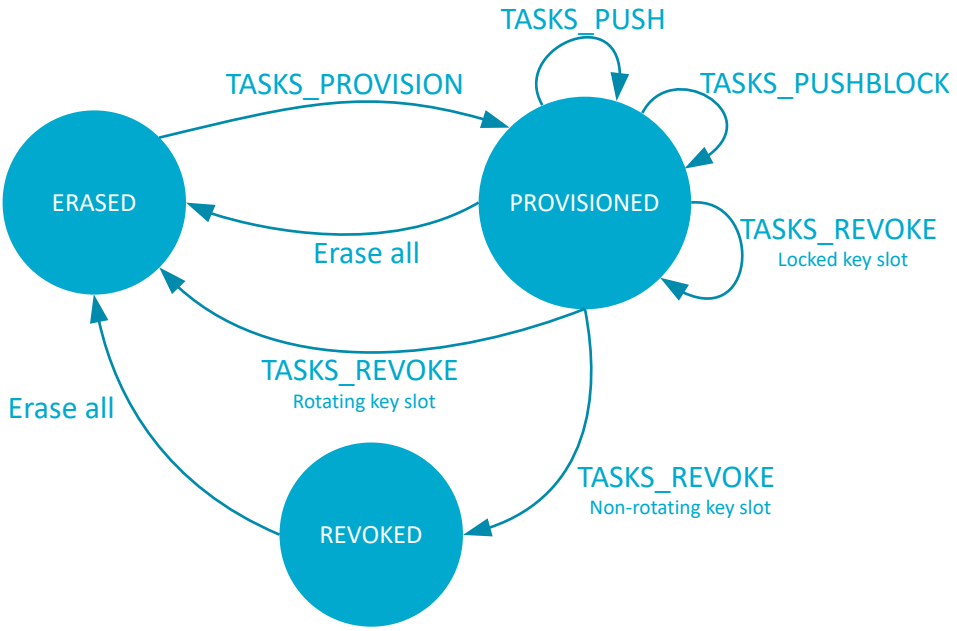


Figure 33: Key slot states

7.8.3.2 Operations

KMU has operations to store, use, and remove assets.

Operation	Description
Provision	Store assets in SICR
Push	Retrieve assets from SICR and push to write-only registers or memory for use
Read metadata	Read key slot metadata from SICR
Revoke	Remove an asset from SICR
Block	Block a keyslot from being pushed, provisioned, or revoked until next reset
Push block	Block a key slot by preventing a push until next reset

Table 32: KMU operations

KMU allows a single operation to run at a time. Once a TASK is triggered to start an operation, KMU ignores any subsequent TASK requests until the initial operation is complete.

7.8.3.2.1 Provisioning

Provisioning is the storage of an asset in SICR. During provisioning, KMU copies data and revocation policy from RAM to SICR.

Provisioning a key slot is possible when the key slot is in the ERASED state.

To provision an asset, perform the following steps:

1. Populate the SRC data struct as an array in RAM.
2. Write the SRC register to the address of the SRC data in RAM. See the following table for SRC data details.
3. Configure the key slot ID in the KEY SLOT register.

4. Using the RRAM controller, enable unbuffered RRAM write using register RRAMC.CONFIG. For more details on RRAMC, see RRAMC — Resistive random access memory controller on page 48.
5. Trigger the PROVISION task. KMU writes data to SICR.

   If copying of data was successful, KMU generates the PROVISIONED event, otherwise KMU generates the ERROR event.
6. Disable the RRAM write operation. For details, see RRAMC — Resistive random access memory controller on page 48.

If a power failure occurs during provisioning, KMU will not write key slot data to RRAM and the key slot is not provisioned.

For more details on how to detect power failures, see Power-fail comparator on page 71.

The following lists the SRC data used for provisioning.

Field	Byte offset	Size [bytes]	Description
METADATA	24	4	32 bits of any cleartext metadata that belongs with the key slot. This metadata can later be read using the READMETADATA task (for details, see Read metadata on page 183).
DEST	20	4	32-bit destination address. Note that DEST cannot point to SICR. DEST must be on a 128-bit boundary.
RPOLICY	16	4	Revocation policy (same definition as the key slot RPOLICY field). Only two LSB's of the field are used, unused bits shall be set to zero. • '11' REVOKED: When TASKS_REVOKE is triggered, key slot ends up in the Revoked state "forever" (until Erase all). • '01' ROTATING: Key Slot can be reused, and when TASKS_REVOKE is triggered, the key slot ends up in the Erased state and can be reused. • '10' LOCKED: Key Slot can not be revoked (until Erase all). When TASKS_REVOKE is triggerd, EVENTS_ERROR is generated. • '00' RESERVED: Reserved for future use. The revocation policy affects how the key slot transitions through it states, see Key slot states on page 180.
VALUE[3:0]	0	16	Asset contents/value. This value can later be used by the PUSH task (for details, see Push on page 182).

Table 33: SRC data

7.8.3.2.2 Push

Retrieving an asset from SICR is called a push. During a push, KMU copies data from SICR to the destination address that was determined during provisioning.

A key slot can be pushed only when it is in the PROVISIONED state and if it is not push-blocked. For more details on push-block, see Push block on page 183.

To push a key slot, perform the following steps:

1. Configure the key slot ID in the KEYSLOT register.
2. Trigger the PUSH task.

KMU copies data from SICR.

If the push is successful, KMU generates the PUSHED event. If the keyslot is in the REVOKED state, KMU generates the REVOKED event. If unsuccessful, KMU generates the ERROR event.

Note: Some push operations generate the PUSHED event when data is not successfully copied to the destination. For example, when the CRACEN SEEDLOCK register is set to enabled, write operations to the CRACEN SEED register are ignored.

7.8.3.2.3 Read metadata

Each key slot has a 32-bit metadata field that can be read.

The metadata field is the same 32-bit fields that is provisioned, see Provisioning on page 181.

When reading the metadata, KMU copies the key slot metadata from SICR to the METADATA register.

Key slot metadata can be read when the key slot is in the PROVISIONED state.

Perform the following steps to read key slot metadata.

1. Configure the key slot ID in the KEYSLOT register.
2. Trigger the READMETADATA task.

   If the key slot is revoked, KMU generates the REVOKED event and ends the operation.

   If the key slot has not been provisioned, KMU generates the ERROR event and ends the operation.

KMU copies data from SICR into the METADATA register. If copying of data was successful, KMU generates the METADATAREAD event. If unsuccessful, KMU generates the ERROR event.

7.8.3.2.4 Revoke

A key slot which is revoked can no longer be pushed.

A key slot can be revoked when it is in the PROVISIONED state or when its revocation policy is not LOCKED.

To revoke a key slot, perform the following steps:

1. Configure the key slot ID in the KEYSLOT register.
2. Enable RRAM write operation in Normal write mode. For details, see RRAMC — Resistive random access memory controller on page 48.
3. Trigger the REVOKE task.

   KMU erases the asset from SICR. If revoking the key slot is successful, KMU generates the REVOKED event. If unsuccessful, or the key slot is already in the REVOKED state, KMU generates the ERROR event.
4. Disable RRAM write operation. For details, see RRAMC — Resistive random access memory controller on page 48.

Rotating key slots are available after a successful revocation. Non-rotating key slots remain in a REVOKED state and can not be used again until SICR is erased.

SICR can only be erased using the Erase All functions of CTRL-AP — Control access port on page 1181 and RRAMC — Resistive random access memory controller on page 48.

7.8.3.2.5 Push block

Push block prevents a key slot from being pushed until the next device reset.

A key slot must be in the PROVISIONED state for a push block to take effect.

To block a key slot from the push operation, perform the following steps:

1. Configure the key slot ID in the KEYSLOT register.

2. Trigger the PUSHBLOCK task.

   When the push block has been applied, KMU generates the PUSHBLOCKED event.

7.8.3.2.6 Block

Block prevents a key slot from being provisioned, pushed, or revoked until the next device reset.

To block a key slot, perform the following steps:

1. Configure the key slot ID in the KEYSLOT register.
2. Trigger the BLOCK task.

   When the block has been applied, KMU generates the BLOCKED event.

7.8.3.2.7 Error handling

Errors during KMU operations generate the ERROR event. Further information about the cause of the error can be found in the ERRORSTATUS register.

The ERRORSTATUS field indicates the error cause for the last attempted KMU operation, or indicates no error if the KMU operation was succesful. The ERRORSTATUS value is cleared upon initiating a new KMU operation.

Certain types of errors will cause the KMU to enter lockup state. When the KMU is in lockup state, no further operations are possible, and all tasks are ignored. The KMU can only be returned to operational state by performing a device reset. An error causing lockup will generate the ERROR event, and information about the cause of the lockup error can be read in the LOCKUPSTATUS field. This field reads as zero when the KMU is not in lockup state.

7.8.3.3 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
KMU	GLOBAL	0x50049000	HF	S	NSA	No	Key management unit

Configuration

Instance	Domain	Configuration
KMU	GLOBAL	Number of keyslots is 250 Number of bits per keyslot is 128

Register overview

Register	Offset	TZ	Description
TASKS_PROVISION	0x0000		Provision key slot
TASKS_PUSH	0x0004		Push key slot
TASKS_REVOKE	0x0008		Revoke key slot
TASKS_READMETADATA	0x000C		Read key slot metadata into METADATA register
TASKS_PUSHBLOCK	0x0010		Block only the PUSH operation of a key slot, preventing the key slot from being PUSHED until next reset. The task is kept for backwards compatibility.
TASKS_BLOCK	0x0014		Block the PROVISION, PUSH, and REVOKE operations of a key slot, preventing the key slot from being PROVISIONED, PUSHED, or REVOKED until next reset
EVENTS_PROVISIONED	0x100		Key slot successfully provisioned

Register	Offset	TZ	Description
EVENTS_PUSHED	0x104		Key slot successfully pushed
EVENTS_REVOKED	0x108		Key slot has been revoked and can no longer be used
EVENTS_ERROR	0x10C		Error generated during PROVISION, PUSH, READMETADATA or REVOKE operations. Triggering the PROVISION, PUSH and REVOKE tasks on a BLOCKED keyslot will also generate this event.
EVENTS_METADATAREAD	0x110		Key slot metadata has been read into METADATA register
EVENTS_PUSHBLOCKED	0x114		The PUSHBLOCK operation was successful. The event is kept for backwards compatibility.
EVENTS_BLOCKED	0x118		The BLOCK operation was successful
STATUS	0x400		KMU status register
KEYSLOT	0x500		Select key slot to operate on
SRC	0x504		Source address for provisioning
METADATA	0x508		Key slot metadata as read by TASKS_READMETADATA.

7.8.3.3.1 TASKS_PROVISION

Address offset: 0x0000

Provision key slot

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_PROVISION			Provision key slot
			Trigger	1	Trigger task

7.8.3.3.2 TASKS_PUSH

Address offset: 0x0004

Push key slot

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_PUSH			Push key slot
			Trigger	1	Trigger task

7.8.3.3.3 TASKS_REVOKE

Address offset: 0x0008

Revoke key slot

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_REVOKE			Revoke key slot
			Trigger	1	Trigger task

7.8.3.3.4 TASKS_READMETADATA

Address offset: 0x000C

Read key slot metadata into METADATA register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_READMETADATA			Read key slot metadata into METADATA register
			Trigger	1	Trigger task

7.8.3.3.5 TASKS_PUSHBLOCK

Address offset: 0x0010

Block only the PUSH operation of a key slot, preventing the key slot from being PUSHED until next reset. The task is kept for backwards compatibility.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_PUSHBLOCK			Block only the PUSH operation of a key slot, preventing the key slot from being PUSHED until next reset. The task is kept for backwards compatibility.
			Trigger	1	Trigger task

7.8.3.3.6 TASKS_BLOCK

Address offset: 0x0014

Block the PROVISION, PUSH, and REVOKE operations of a key slot, preventing the key slot from being PROVISIONED, PUSHED, or REVOKED until next reset

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_BLOCK			Block the PROVISION, PUSH, and REVOKE operations of a key slot, preventing the key slot from being PROVISIONED, PUSHED, or REVOKED until next reset
			Trigger	1	Trigger task

7.8.3.3.7 EVENTS_PROVISIONED

Address offset: 0x100

Key slot successfully provisioned

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_PROVISIONED			Key slot successfully provisioned
			NotGenerated	0	Event not generated
			Generated	1	Event generated

7.8.3.3.8 EVENTS_PUSHED

Address offset: 0x104

Key slot successfully pushed

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_PUSHED			Key slot successfully pushed
			NotGenerated	0	Event not generated
			Generated	1	Event generated

7.8.3.3.9 EVENTS_REVOKED

Address offset: 0x108

Key slot has been revoked and can no longer be used

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_REVOKED			Key slot has been revoked and can no longer be used
			NotGenerated	0	Event not generated
			Generated	1	Event generated

7.8.3.3.10 EVENTS_ERROR

Address offset: 0x10C

Error generated during PROVISION, PUSH, READMETADATA or REVOKE operations. Triggering the PROVISION, PUSH and REVOKE tasks on a BLOCKED keyslot will also generate this event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_ERROR			Error generated during PROVISION, PUSH, READMETADATA or REVOKE operations. Triggering the PROVISION, PUSH and REVOKE tasks on a BLOCKED keyslot will also generate this event.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

7.8.3.3.11 EVENTS_METADATAREAD

Address offset: 0x110

Key slot metadata has been read into METADATA register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_METADATAREAD			Key slot metadata has been read into METADATA register
			NotGenerated	0	Event not generated
			Generated	1	Event generated

7.8.3.3.12 EVENTS_PUSHBLOCKED

Address offset: 0x114

The PUSHBLOCK operation was successful. The event is kept for backwards compatibility.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_PUSHBLOCKED			The PUSHBLOCK operation was successful. The event is kept for backwards compatibility.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

7.8.3.3.13 EVENTS_BLOCKED

Address offset: 0x118

The BLOCK operation was successful

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_BLOCKED			The BLOCK operation was successful
			NotGenerated	0	Event not generated
			Generated	1	Event generated

7.8.3.3.14 STATUS

Address offset: 0x400

KMU status register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	STATUS			KMU status
			Ready	0	KMU is ready for new operation
			Busy	1	KMU is busy, an operation is in progress

7.8.3.3.15 KEYSLOT

Address offset: 0x500

Select key slot to operate on

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																									A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	ID		0..249	Select key slot ID to provision, push, read METADATA, revoke or block when the corresponding task is triggered.

7.8.3.3.16 SRC

Address offset: 0x504

Source address for provisioning

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	SRC			Source address for TASKS_PROVISION.

7.8.3.3.17 METADATA

Address offset: 0x508

Key slot metadata as read by TASKS_READMETADATA.

When EVENTS_METADATAREAD has been generated, this register holds the key slot metadata. The register can be written to zero to clear its contents.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	METADATA			Read metadata.

7.8.4 MPC — Memory Privilege Controller

The MPC peripheral is an address decoder with built-in security functions.

MPC enforces security for system memory access. It is used to divide the address space into smaller regions and assign permissions to these regions.

The main features of MPC are the following:

- Address decoding
- Configurable access permissions
- Error reporting

7.8.4.1 Override configuration

The MPC overrides are used to divide the address space into smaller regions and assign permissions to these regions.

When the device is reset, the memory in RAM and the non-volatile memory (NVM) is secure. Only secure CPUs and peripherals can read, write, or execute from secure memory.

To configure permission settings in a memory region, perform the following steps.

1. Define the memory region by configuring STARTADDR and ENDADDR. The values must be multiples of the override region granularity, which is 4096.

2. Use PERMMASK to define which of the access permissions in PERM to apply.
3. Enable and lock the override using the CONFIG register.

To prevent unintended reconfiguration of MPC, all overrides should be safeguarded by using the LOCK bit in the CONFIG register.

Note: For overlapping regions, MPC will perform a logical OR between the permission bits. The logical OR applies to both PERMMASK and PERM registers. Because of this, it is not possible to retract the READ, WRITE or EXECUTE permissions. For PERM.SECURE, the OR operation between Secure (1) and NonSecure (0) will result in a Secure overlap region.

Access blocking

Dedicated override regions can be used to block access to a memory region. See the MPC configuration table for which overrides are capable of access blocking.

To configure an override to block access, perform the following steps.

1. Define the memory region by configuring STARTADDR and ENDADDR. The values must be multiples of the override region granularity, which is 4096.
2. Enable and lock the override using the CONFIG register.

After applying the configuration, the memory region is blocked from access. The CPU will receive a bus fault when trying to access the region.

7.8.4.2 MPC error reporting

MPC reports an error when an access violation is detected.

MPC generates an EVENTS_MEMACCERR event when an erroneous transaction is detected. The following errors can be detected.

- The address cannot be decoded or the bus Manager does not have permissions to access the Subordinate. When this happens, the MEMACCERR.ADDRESS will capture the failing address issued by the bus Manager port and MEMACCERR.INFO will capture additional access information for the attempted transaction.
- If a transaction is routed to a Subordinate, but the Subordinate responds with an error.

The MEMACCERR registers will not be updated when EVENTS_MEMACCERR is set.

7.8.4.3 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
MPC00	GLOBAL	0x50041000	HF	S	NA	No	Memory privilege controller MPC00

Configuration

Instance	Domain	Configuration
MPC00	GLOBAL	The override region granularity is 4096 bytes Overrides 0 through 6 are available for override configuration. Override 7 can be configured for access blocking. Overrides 8 through 11 are reserved by the system and cannot be configured.

Register overview

Register	Offset	TZ	Description
EVENTS_MEMACCERR	0x100		Memory Access Error event
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
MEMACCERR.ADDRESS	0x400		Target Address of Memory Access Error. Register content will not be changed as long as MEMACCERR event is active.
MEMACCERR.INFO	0x404		Access information for the transaction that triggered a memory access error. Register content will not be changed as long as MEMACCERR event is active.
OVERRIDE[n].CONFIG	0x800		Override region n Configuration register
OVERRIDE[n].STARTADDR	0x804		Override region n Start Address
OVERRIDE[n].ENDADDR	0x808		Override region n End Address
OVERRIDE[n].PERM	0x810		Permission settings for override region n
OVERRIDE[n].PERMMASK	0x814		Masks permission setting fields from register OVERRIDE.PERM

7.8.4.3.1 EVENTS_MEMACCERR

Address offset: 0x100

Memory Access Error event

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	EVENTS_MEMACCERR																																	
			NotGenerated	0																															
			Generated	1																															

7.8.4.3.2 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	MEMACCERR																																	
			Disabled	0																															
			Enabled	1																															

7.8.4.3.3 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1S	MEMACCERR			Write '1' to enable interrupt for event MEMACCERR
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

7.8.4.3.4 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	MEMACCERR			Write '1' to disable interrupt for event MEMACCERR
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

7.8.4.3.5 MEMACCERR

Memory Access Error status registers

7.8.4.3.5.1 MEMACCERR.ADDRESS

Address offset: 0x400

Target Address of Memory Access Error. Register content will not be changed as long as MEMACCERR event is active.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	ADDRESS			Target address for erroneous access

7.8.4.3.5.2 MEMACCERR.INFO

Address offset: 0x404

Access information for the transaction that triggered a memory access error. Register content will not be changed as long as MEMACCERR event is active.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	READ			Read bit of bus access
			Set	1	Read access bit was set

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			NotSet	0	Read access bit was not set
B	R	WRITE			Write bit of bus access
			Set	1	Write access bit was set
			NotSet	0	Write access bit was not set
C	R	EXECUTE			Execute bit of bus access
			Set	1	Execute access bit was set
			NotSet	0	Execute access bit was not set
D	R	SECURE			Secure bit of bus access
			Set	1	Secure access bit was set
			NotSet	0	Secure access bit was not set
E	R	ERRORSOURCE			Source of memory access error
			MPC	1	Error was triggered by MPC module
			Slave	0	Error was triggered by a Subordinate

7.8.4.3.6 OVERRIDE[n] (n=0..11)

Special privilege tables

7.8.4.3.6.1 OVERRIDE[n].CONFIG (n=0..11)

Address offset: 0x800 + (n × 0x20)

Override region n Configuration register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW1	LOCK			Lock Override region n
			Unlocked	0	Override region n settings can be updated
			Locked	1	Override region n settings can not be updated until next reset
B	RW	ENABLE			Enable Override region n
			Disabled	0	Override region n is not used
			Enabled	1	Override region n is used

7.8.4.3.6.2 OVERRIDE[n].STARTADDR (n=0..11)

Address offset: 0x804 + (n × 0x20)

Override region n Start Address

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	STARTADDR			Start address for override region n Address must be aligned to override region granularity, see the instance configuration table above for the override region granularity. The least significant bits of this register field are ignored based on the override region granularity and read as zero.

7.8.4.3.6.3 OVERRIDE[n].ENDADDR (n=0..11)

Address offset: 0x808 + (n × 0x20)

Override region n End Address

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENDADDR			End address for override region n Address must be aligned to override region granularity, see the instance configuration table above for the override region granularity. The least significant bits of this register field are ignored based on the override region granularity and read as zero.

7.8.4.3.6.4 OVERRIDE[n].PERM (n=0..11)

Address offset: 0x810 + (n × 0x20)

Permission settings for override region n

See section *Validate an access* above.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	READ			Read access
			NotAllowed	0	Read access to override region n is not allowed
			Allowed	1	Read access to override region n is allowed
B	RW	WRITE			Write access
			NotAllowed	0	Write access to override region n is not allowed
			Allowed	1	Write access to override region n is allowed
C	RW	EXECUTE			Software execute
			NotAllowed	0	Software execution from override region n is not allowed
			Allowed	1	Software execution from override region n is allowed
D	RW	SECATTR			Security mapping
			Secure	1	Override region n is mapped in secure memory address space
			NonSecure	0	Override region n is mapped in non-secure memory address space

7.8.4.3.6.5 OVERRIDE[n].PERMMASK (n=0..11)

Address offset: 0x814 + (n × 0x20)

Masks permission setting fields from register OVERRIDE.PERM

See section *Validate an access* above.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	READ			Read mask
			Masked	0	Permission setting READ in OVERRIDE register will not be applied
			UnMasked	1	Permission setting READ in OVERRIDE register will be applied

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
B	RW	WRITE			Write mask
			Masked	0	Permission setting WRITE in OVERRIDE register will not be applied
			UnMasked	1	Permission setting WRITE in OVERRIDE register will be applied
C	RW	EXECUTE			Execute mask
			Masked	0	Permission setting EXECUTE in OVERRIDE register will not be applied
			UnMasked	1	Permission setting EXECUTE in OVERRIDE register will be applied
D	RW	SECATTR			Security mapping mask
			Masked	0	Permission setting SECATTR in OVERRIDE register will not be applied
			UnMasked	1	Permission setting SECATTR in OVERRIDE register will be applied

7.8.5 SPU — System protection unit

SPU configures the access privileges for a peripheral.

SPU allows configuring access controls individually for each peripheral, and for some peripheral features. For example, a DPPI channel can be configured with different access controls than the peripheral.

SPU controls access according to TrustZone security attributes. If a peripheral or feature is configured as secure, only TrustZone secure accesses are allowed. If a peripheral or feature is configured as non-secure, then accesses are allowed both from secure and non-secure masters.

For some peripherals, the peripheral's DMA has a separate security configuration. If the peripheral is configured as secure, the peripheral's DMA can be configured to perform either secure or non-secure accesses. If the peripheral is configured as non-secure, the peripheral's DMA will always perform non-secure accesses.

7.8.5.1 General concepts

The SPU provides the register interface to configure and enforce the access privileges per peripheral, and where applicable, individual features of the peripheral such as GPIO pins, DPPI channels, etc.

Any accesses to a peripheral or a peripheral feature are validated against the SPU configuration for the security attributes.

Security attributes of a peripheral normally applies to all registers of the peripheral. However, some peripherals have split security to individual features within the peripheral, such as individual pins or DPPI channels. For these split feature peripherals, access is granted on a per-bit or per-register level. Unless mentioned otherwise, the term peripheral is used in the remainder of this section to refer to both a peripheral and an individual peripheral feature.

Each APB bus has its own SPU instance that controls the resource of that bus. The SPU must be configured for security attributes of the peripherals. The SPU is always a secure peripheral.

- See Instantiation on page 232 to find the SPU instance used by the peripheral.
- The APB bus number can be extracted from the peripheral address. See Address format on page 11 to find the APB bus number for a peripheral.
- See Block diagram on page 9 for an overview over APB buses, the peripherals on that bus, and their controlling SPU instance.

See Address format on page 11 for information on extracting the Peripheral slave index from a peripheral address.

The following example shows which SPU instance to use for SAADC peripheral to configure the peripheral permissions using PERIPH[*n*].PERM:

```
#define SPU_CORTEX_ADDRESS_REGION    (0x50000000)

uint32_t perip_addr = NRF_SAADC_S_BASE;


uint32_t apb_bus_number = (perip_addr & 0x00FC0000);
uint32_t apb_slave_index = (perip_addr & 0x0003F000) >> 12;

// Get the address to the SPU instance
NRF_SPU_Type *p_spu = (NRF_SPU_Type*)(SPU_CORTEX_ADDRESS_REGION |
apb_bus_number);

// Configure PERIPH[n].PERM.SECATTR to secure for SAADC
p_spu->PERIPH[apb_slave_index].PERM =
(p_spu->PERIPH[apb_slave_index].PERM &
~SPU_PERIPH_PERM_SECATTR_Msk) |
(SPU_PERIPH_PERM_SECATTR_Secure <<
SPU_PERIPH_PERM_SECATTR_Pos)
```

See Instantiation on page 232 to find the value of SLAVE_BITS for each SPU instance.

SPU supports secure and non-secure accesses based on TrustZone. On each access to a peripheral address, the security state of the master initiating the transaction is verified against the SPU security attribute configuration of the peripheral. The following figure shows a simplified view of the SPU registers controlling several internal modules.

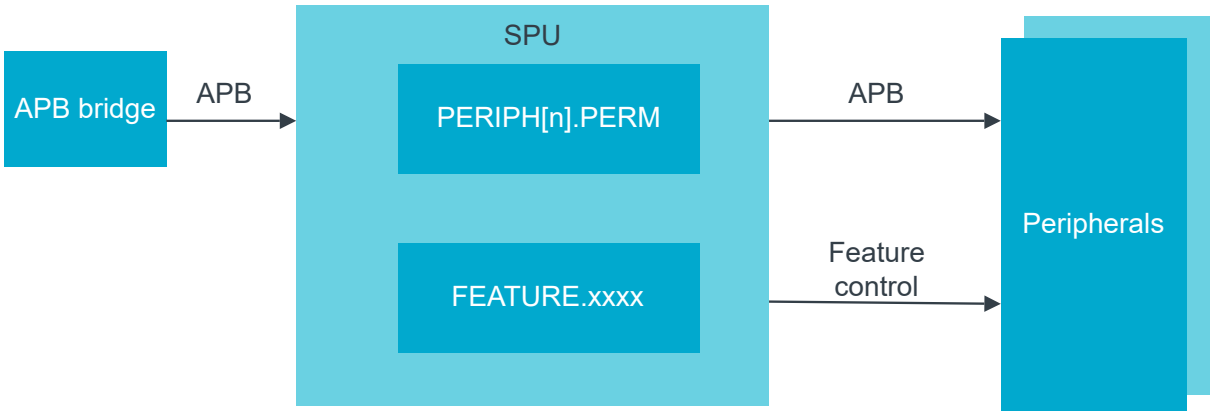


Figure 34: Simplified view of peripherals and peripheral features using SPU

The protection logic implements a read-as-zero/write-ignore (RAZ/WI) policy:

- A read operation that is not allowed by the SPU will always return a zero value on the bus, preventing information leak.
- A write operation that is not allowed by the SPU will be ignored.

An access error on peripherals managed by an SPU result in the PERIPHACCERR event on the SPU.

7.8.5.2 Peripheral access control

Peripheral access control depends on the security attributes.

Peripheral security attributes are defined in the *Peripheral Instantiation* table as one of the following:

Always Secure (HF S)
Access to the peripheral is always restricted to secure code.

Always Non-secure (HF NS)
Access to the peripheral is always allowed from both secure and non-secure code.

User selectable (US)
The security attribute can be configured for secure or non-secure access.

The full list of peripherals and their corresponding security attributes can be found in the *Instantiation* table in *Memory* section. For each peripheral with ID *n*, the register PERIPH[*n*].PERM.SECUREMAPPING will show whether the security attribute for this peripheral is user selectable or not.

The security attribute can be configured using the register PERIPH[*n*].PERM.SECATTR, if user selectable.

The DMA security attribute is determined as follows:

- If PERIPH[n].PERM.DMA is set to NoSeparateAttribute, then PERIPH[n].PERM.DMASEC cannot be configured, it has the same value as PERIPH[n].PERM.SECATTR.
- If PERIPH[n].PERM.DMA is set to SeparateAttribute and PERIPH[n].PERM.SECATTR is set to secure, then PERIPH[n].PERM.DMASEC is configurable. It is by default set to secure.

Secure code can access both secure peripherals and non-secure peripherals.

The DMA Privilege attribute is determined as follows:

- If PERIPH[n].PERM.DMA is set to NoSeparateAttribute, then PERIPH[n].PERM.DMAPRIVL cannot be configured, it has the same value as PERIPH[n].PERM.PRIVLATTR.
- If PERIPH[n].PERM.DMA is set to SeparateAttribute and PERIPH[n].PERM.PRIVLATTR is set to Privileged, then PERIPH[n].PERM.DMAPRIVL is configurable. It is by default set to Privileged.

7.8.5.2.1 Peripherals with split security

Peripherals with split security allow more detailed configuration.

When peripherals have split security, then the security of each feature in the peripheral can be configured individually using register FEATURE.

Each SPU instance can have different numbers of features. See the instantiation table for an overview of features supported by the split security peripherals.

7.8.5.2.2 Peripheral address mapping

Peripherals that have non-secure security mapping have their address starting with 0x4XXX_XXXX.
Peripherals that have secure security mapping have their address starting with 0x5XXX_XXXX.

Peripherals with a user-selectable security mapping are available at an address starting with:

- 0x4XXX_XXXX, if the peripheral security attribute is set to non-secure
- 0x5XXX_XXXX, if the peripheral security attribute is set to secure

> **Note:** Accesses to the 0x4XXX_XXXX address range from secure or non-secure code for a peripheral marked as secure will result in a bus-error.
>
> Secure code accessing the 0x5XXX_XXXX address range of a peripheral marked as non-secure will also result in a bus-error.

Peripherals with a split security mapping are available at an address starting with:

- 0x4XXX_XXXX for non-secure access and 0x5XXX_XXXX for secure access, if the peripheral security attribute is set to non-secure

  - Secure registers in the 0x4XXX_XXXX range are not visible for secure or non-secure code, and an attempt to access such a register will generate a peripheral access error, and result in write-ignore, read as zero behavior.
  - Secure code can access both non-secure and secure registers in the 0x5XXX_XXXX range
- 0x5XXX_XXXX, if the peripheral security attribute is set to secure

Note: An access to an address that is within the address range of an APB interconnect, but is not within the address range of a peripheral, will generate a peripheral acccess error, and result in write-ignore, read as zero behavior.

7.8.5.2.3 Special considerations for peripherals with DMA master

Peripherals containing a DMA master can be configured so the security attribute of the DMA transfers is different from the security attribute of the peripheral itself. This allows a secure peripheral to do non-secure data transfers to or from the system memories.

If the following conditions are met:

- The DMA field of PERIPH[n].PERM.DMA is "SeparateAttribute"
- The peripheral itself is secure (PERIPH[n].PERM.SECATTR == 1)

Then it is possible to select the security attribute of the DMA transfers using the field DMASEC (PERIPH[n].PERM.DMASEC == Secure and PERIPH[n].PERM.DMASEC == NonSecure) in PERIPH[n].PERM.

7.8.5.2.4 Peripheral access error reporting

The SPU generates a peripheral access error event once access violation is detected.

The following will happen if the logic controlled by the SPU detects an access violation on one of the peripherals:

- The faulty transfer will be blocked
- In case of a read transfer, the data will read as zero
- If supported by the master, feedback is sent to the master through specific bus error signals. If the master is a processor supporting Arm TrustZone for Cortex-M, a SecureFault exception will be generated for security related errors.
- The PERIPHACCERR event will be triggered.

7.8.5.3 Feature access control

Access to the features can be restricted. A feature can be declared as secure so that only secure peripherals can access it.

The security attribute of a feature is configured by using corresponding SPU's feature register. When the secure attribute is set for a feature, only secure peripherals and code will be able to access that feature. For example, register FEATURE.GRTC.CC[n] is used to configure security for the capture-and-compare functionality of the GRTC peripheral. When the secure attribute is set, only secure code can access and use the corresponding capture-and-compare registers, tasks, and events.

See the SPU configuration to find the features supported by each SPU instance.

7.8.5.5 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
SPU00	GLOBAL	0x50040000	HF	S	NA	No	System protection unit SPU00
SPU10	GLOBAL	0x50080000	HF	S	NA	No	System protection unit SPU10
SPU20	GLOBAL	0x500C0000	HF	S	NA	No	System protection unit SPU20
SPU30	GLOBAL	0x50100000	HF	S	NA	No	System protection unit SPU30

Configuration

Instance	Domain	Configuration
SPU00	GLOBAL	Supports FEATURE.DPPIC[n] Supports FEATURE.GPIO[n] SLAVE_BITS=4 (number of address bits required to represent the peripheral slave index)
SPU10	GLOBAL	Supports FEATURE.DPPIC[n] SLAVE_BITS=4 (number of address bits required to represent the peripheral slave index)
SPU20	GLOBAL	Supports FEATURE.DPPIC[n] Supports FEATURE.GPIOTE[n] Supports FEATURE.GRTC[n] Supports FEATURE.GPIO[n] SLAVE_BITS=4 (number of address bits required to represent the peripheral slave index)
SPU30	GLOBAL	Supports FEATURE.DPPIC[n] Supports FEATURE.GPIOTE[n] Supports FEATURE.GPIO[n] SLAVE_BITS=4 (number of address bits required to represent the peripheral slave index)

Register overview

Register	Offset	TZ	Description
EVENTS_PERIPHACCERR	0x100		A security violation has been detected on one or several peripherals
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
INTPEND	0x30C		Pending interrupts
PERIPHACCERR.ADDRESS	0x404		Address of the transaction that caused first error.
PERIPH[n].PERM	0x500		Get and set the applicable access permissions for the peripheral slave index n
FEATURE.DPPIC.CH[n]	0x680		Security configuration for channel n of DPPIC
FEATURE.DPPIC.CHG[n]	0x6E0		Security configuration for channel group n of DPPIC
FEATURE.GPIOTE[n].CH[o]	0x700		Security configuration for channel o of GPIOTE[n]
FEATURE.GPIOTE[n].INTERRUPT[o]	0x720		Security configuration for interrupt o of GPIOTE[n]
FEATURE.GPIO[n].PIN[o]	0x800		Security configuration for GPIO[n] PIN[o]

Register	Offset	TZ	Description
FEATURE.GRTC.CC[n]	0xD00		Security configuration for CC n of GRTC
FEATURE.GRTC.PWMCONFIG	0xD74		Security Configuration for PWMCONFIG of GRTC
FEATURE.GRTC.CLK	0xD78		Security configuration for CLKOUT/CLKCFG of GRTC
FEATURE.GRTC.SYSCOUNTER	0xD7C		Security configuration for SYSCOUNTERL/SYSCOUNTERH of GRTC
FEATURE.GRTC.INTERRUPT[n]	0xD80		Security configuration for interrupt n of GRTC

7.8.5.5.1 EVENTS_PERIPHACCERR

Address offset: 0x100

A security violation has been detected on one or several peripherals

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	A
Reset 0x00000000	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_PERIPHACCERR			A security violation has been detected on one or several peripherals
			NotGenerated	0	Event not generated
			Generated	1	Event generated

7.8.5.5.2 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	A
Reset 0x00000000	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PERIPHACCERR			Enable or disable interrupt for event PERIPHACCERR
			Disabled	0	Disable
			Enabled	1	Enable

7.8.5.5.3 INTENSET

Address offset: 0x304

Enable interrupt

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	A
Reset 0x00000000	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PERIPHACCERR			Write '1' to enable interrupt for event PERIPHACCERR
	W1S				
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

7.8.5.5.4 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	PERIPHACCERR			Write '1' to disable interrupt for event PERIPHACCERR
	W1C				
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

7.8.5.5.5 INTPEND

Address offset: 0x30C

Pending interrupts

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	PERIPHACCERR			Read pending status of interrupt for event PERIPHACCERR
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending

7.8.5.5.6 PERIPHACCERR.ADDRESS

Address offset: 0x404

Address of the transaction that caused first error.

The event PERIPHACCERR must be cleared to clear this register.

Note: Only the lower 16 bits of the address are captured into the register. The upper 16 bits correspond to the upper 16 bits of the SPU's base address.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	ADDRESS			Address

7.8.5.5.7 PERIPH[n].PERM (n=0..63)

Address offset: 0x500 + (n × 0x4)

Get and set the applicable access permissions for the peripheral slave index n

Note: Reset values are unique per peripheral instantiation. Please refer to the peripheral instantiation table. Entries not listed in the instantiation table are undefined.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				F E D C B B A A
Reset 0x8000002A				**1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 1 0**
ID	R/W	Field	Value ID	Value	Description
A	R	SECUREMAPPING			Read capabilities for TrustZone Cortex-M secure attribute

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	F																							E			D	C	B	B	A	A
Reset 0x8000002A	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**1**	**0**

ID	R/W	Field	Value ID	Value	Description
			NonSecure	0	This peripheral is always accessible as a non-secure peripheral
			Secure	1	This peripheral is always accessible as a secure peripheral
			UserSelectable	2	Non-secure or secure attribute for this peripheral is defined by the PERIPH[n].PERM register
			Split	3	This peripheral implements the split security mechanism.
B	R	DMA			Read the peripheral DMA capabilities
			NoDMA	0	Peripheral has no DMA capability
			NoSeparateAttribute	1	Peripheral has DMA and DMA transfers always have the same security attribute as assigned to the peripheral
			SeparateAttribute	2	Peripheral has DMA and DMA transfers can have a different security attribute than the one assigned to the peripheral
C	RW	SECATTR			Peripheral security mapping This bit has effect only if PERIPH[n].PERM.SECUREMAPPING is UserSelectable or Split
			Secure	1	Peripheral is mapped in secure peripheral address space
			NonSecure	0	If SECUREMAPPING == UserSelectable: Peripheral is mapped in non-secure peripheral address space. If SECUREMAPPING == Split: Peripheral is mapped in non-secure and secure peripheral address space.
D	RW	DMASEC			Security attribution for the DMA transfer This bit has effect only if PERIPH[n].PERM.SECATTR is set to secure and PERIPH[n].PERM.DMA is set to SeparateAttribute.
			Secure	1	DMA transfers initiated by this peripheral have the secure attribute set
			NonSecure	0	DMA transfers initiated by this peripheral have the non-secure attribute set
E	RW W1S	LOCK			Register lock
			Unlocked	0	This register can be updated
			Locked	1	The content of this register can not be changed until the next reset When Locked, it remains Locked until the next reset cycle.
F	R	PRESENT			Indicates if a peripheral is present with peripheral slave index n
			NotPresent	0	Peripheral is not present
			IsPresent	1	Peripheral is present

7.8.5.5.8 FEATURE.DPPIC.CH[n] (n=0..23)

Address offset: 0x680 + (n × 0x4)

Security configuration for channel n of DPPIC

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00100010				**0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	SECATTR			SECATTR feature
			NonSecure	0	Feature is available for non-secure usage
			Secure	1	Feature is reserved for secure usage
B	RW	LOCK			LOCK feature
	W1S				
			Unlocked	0	Feature permissions can be updated
			Locked	1	Feature permissions can not be changed until the next reset When Locked, it remains Locked until the next reset cycle.

7.8.5.5.9 FEATURE.DPPIC.CHG[n] (n=0..7)

Address offset: 0x6E0 + (n × 0x4)

Security configuration for channel group n of DPPIC

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00100010				**0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	SECATTR			SECATTR feature
			NonSecure	0	Feature is available for non-secure usage
			Secure	1	Feature is reserved for secure usage
B	RW	LOCK			LOCK feature
	W1S				
			Unlocked	0	Feature permissions can be updated
			Locked	1	Feature permissions can not be changed until the next reset When Locked, it remains Locked until the next reset cycle.

7.8.5.5.10 FEATURE.GPIOTE[n].CH[o] (n=0..1) (o=0..7)

Address offset: 0x700 + (n × 0x40) + (o × 0x4)

Security configuration for channel o of GPIOTE[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00100010				**0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	SECATTR			SECATTR feature
			NonSecure	0	Feature is available for non-secure usage
			Secure	1	Feature is reserved for secure usage
B	RW	LOCK			LOCK feature
	W1S				
			Unlocked	0	Feature permissions can be updated
			Locked	1	Feature permissions can not be changed until the next reset When Locked, it remains Locked until the next reset cycle.

7.8.5.5.11 FEATURE.GPIOTE[n].INTERRUPT[o] (n=0..1) (o=0..7)

Address offset: 0x720 + (n × 0x40) + (o × 0x4)

Security configuration for interrupt o of GPIOTE[n]

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																											B					A			
Reset 0x00100010				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	SECATTR																																	
			NonSecure	0																															
			Secure	1																															
B	RW	LOCK																																	
	W1S																																		
			Unlocked	0																															
			Locked	1																															

7.8.5.5.12 FEATURE.GPIO[n].PIN[o] (n=0..3) (o=0..31)

Address offset: 0x800 + (n × 0x80) + (o × 0x4)

Security configuration for GPIO[n] PIN[o]

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																											B					A			
Reset 0x00100010				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	SECATTR																																	
			NonSecure	0																															
			Secure	1																															
B	RW	LOCK																																	
	W1S																																		
			Unlocked	0																															
			Locked	1																															

7.8.5.5.13 FEATURE.GRTC.CC[n] (n=0..23)

Address offset: 0xD00 + (n × 0x4)

Security configuration for CC n of GRTC

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																											B					A			
Reset 0x00100010				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	SECATTR																																	
			NonSecure	0																															
			Secure	1																															
B	RW	LOCK																																	
	W1S																																		
			Unlocked	0																															
			Locked	1																															

7.8.5.5.14 FEATURE.GRTC.PWMCONFIG

Address offset: 0xD74

Security Configuration for PWMCONFIG of GRTC

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																											B					A			
Reset 0x00100010				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	SECATTR																																	
			NonSecure	0																															
			Secure	1																															
B	RW	LOCK																																	
	W1S																																		
			Unlocked	0																															
			Locked	1																															

7.8.5.5.15 FEATURE.GRTC.CLK

Address offset: 0xD78

Security configuration for CLKOUT/CLKCFG of GRTC

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																											B					A			
Reset 0x00100010				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	SECATTR																																	
			NonSecure	0																															
			Secure	1																															
B	RW	LOCK																																	
	W1S																																		
			Unlocked	0																															
			Locked	1																															

7.8.5.5.16 FEATURE.GRTC.SYSCOUNTER

Address offset: 0xD7C

Security configuration for SYSCOUNTERL/SYSCOUNTERH of GRTC

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																											B					A			
Reset 0x00100010				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	SECATTR																																	
			NonSecure	0																															
			Secure	1																															
B	RW	LOCK																																	
	W1S																																		
			Unlocked	0																															
			Locked	1																															

7.8.5.5.17 FEATURE.GRTC.INTERRUPT[n] (n=0..15)

Address offset: 0xD80 + (n × 0x4)

Security configuration for interrupt n of GRTC

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																											B					A			
Reset 0x00100010				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	SECATTR																																	
			NonSecure	0																															
			Secure	1																															
B	RW	LOCK																																	
	W1S																																		
			Unlocked	0																															
			Locked	1																															

7.8.6 TAMPC — Tamper controller

The tamper controller peripheral handles input from internal and external physical attack detectors and controls the device response.

The following figure shows an overview of the TAMPC detectors, input, and output.

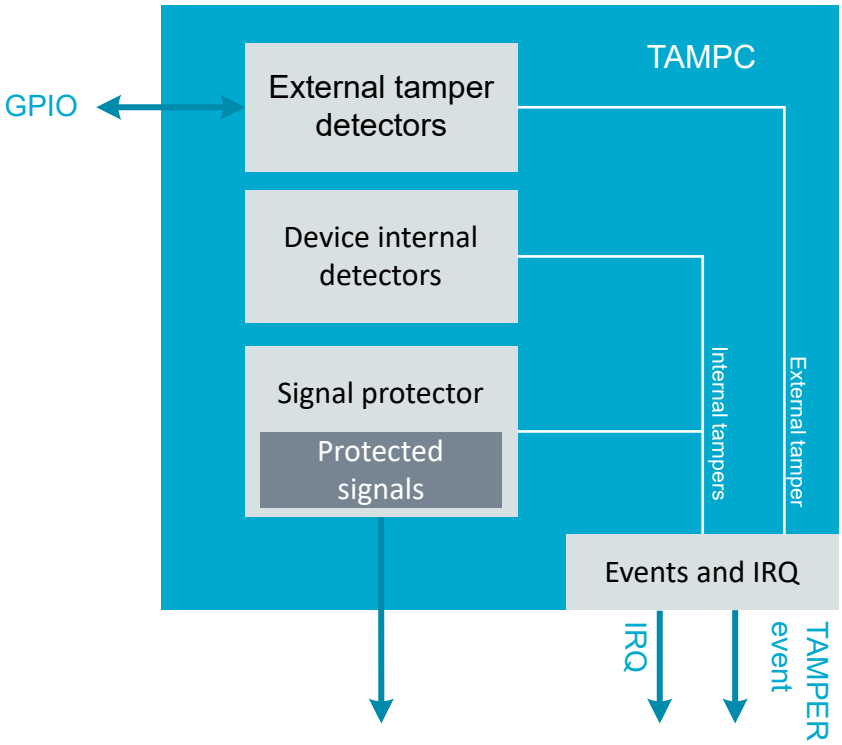


Figure 35: TAMPC overview

TAMPC implements the following physical security features:

- Detection of external tampering attacks
  - Detector supporting an active driven shield mounted on a PCB that is on top of a device
- Detection of fault injection attacks (voltage glitching, electromagnetic fault injection, etc.)
  - Signal protector to guard critical configuration signals
  - Glitch detectors to protect internal logic
  - Built-in self-check for correctness inside the CRACEN

The tamper detectors are divided into two categories: external and internal. The external detectors rely on external stimuli through dedicated GPIO pins, and the internal detectors rely on internal signals not exposed outside the device package.

External tamper detectors

A tamper attack detected by any of the external tamper detectors indicates that a break-in attack is ongoing. This could include breaking the product encapsulation. This is detected through the external active shield detectors.

Internal tamper detectors

A tamper attack detected by an internal tamper detector indicates that the device's internal logic could be affected by the attack, the system state could be compromised, and thus not to be trusted. Recommended operation is to utilize the TAMPC automatic system wide reset feature, see PROTECT.INTRESETEN.CTRL on page 225. This ensures the device is operating in a safe and known state after an attack has been detected. The automatic reset from TAMPC triggers `SECTAMPER` to be set in the reset reason register. The device should on the following reset check for `SECTAMPER` in the reset reason register and take necessary action.

7.8.6.1 Active shield

TAMPC supports an active shield to protect against physical access to the device and its connections on the PCB level.

The active shield detector is enabled using the register PROTECT.ACTIVESHIELD.CTRL on page 220. The active shield detector has a number of channels. Depending on its configuration, TAMPC will react when a channel in the active shield is broken, meaning there is a mismatch between the input and output signal of an enabled channel in the active shield. A broken channel detected in the active shield causes one of the following to occur:

- A TAMPC event is generated.
- A chip reset is triggered and the `SECTAMPER` value in the reset reason register indicates what happened, depending on the status of the register PROTECT.EXTRESETEN.CTRL on page 224.

A channel in the active shield detector consists of a signal propagating from an output pin to an input pin. The channels are enabled using the CH[i] fields in the register ACTIVESHIELD.CHEN on page 215. The GPIO pins reserved for the active shield detector channels must be configured before the channels are ready for use. Pin direction and CTRLSEL must be set according to the register interface in the GPIO peripheral. For more information about reserved active shield detector pins, see Pin assignments on page 1219. Pins reserved for the active shield detector can be used as generic GPIO pins when the channel is unused.

The active shield detector contains a Pseudo-Random Bit Sequence (PRBS) generator. A PRBS signal is generated on an output pin at each rising edge of the 32 KHz clock. The signal is routed through an external shield to an input pin. The signal on the input pin is sampled on the falling edge of the 32KHz clock. If the sampled signal does not match the transmitted signal, a channel in the external shield is assumed broken and a tamper event is generated.

7.8.6.2 CRACEN tamper detector

The cryptographic accelerator engine (CRACEN) implements a separate tamper detector mechanism. This tamper detector is always enabled.

CRACEN has security countermeasures and notifies TAMPC if tampering is detected during its operations. TAMPC will react according to the register setting in PROTECT.CRACENTAMP.CTRL and one of the following will occur:

- A TAMPC event is generated.
- A chip reset is triggered and the `SECTAMPER` value in the reset reason register indicates what happened, depending on the status of the register PROTECT.INTRESETEN.CTRL on page 225.

The internal tamper reset enable signal INTRESETEN is enabled from reset.

For more information about CRACEN countermeasures, see CRACEN — Cryptographic accelerator engine on page 144.

7.8.6.3 Glitch detector

The device implements glitch detectors to protect against fault injection attacks.

Detectors are strategically placed to detect fault injection attacks. The detectors are designed and tuned to trigger before logic fails enabling the digital logic to react before an injected fault is propagated through the system.

The glitch detectors are enabled from reset and can be disabled for debugging using

- PROTECT.GLITCHSLOWDOMAIN.CTRL on page 222
- PROTECT.GLITCHFASTDOMAIN.CTRL on page 223

When an internal tamper event is detected, one of the following will occur:

- A TAMPC EVENT is generated.

- A chip reset is triggered and the SECTAMPER value in the reset reason register indicates what happened, depending on the status of the register PROTECT.INTRESETEN.CTRL on page 225.

7.8.6.4 Signal protector

The device implements detectors to protect selected signals that control critical device features.

The signal protector implements one detector per protected signal to detect unintentional value changes in that signal. The detector notifies TAMPC if a protected signal changes value caused by tampering. The detectors are enabled from reset and can be disabled using the register , which is for debugging purposes only. A detected unintentional value change in any of the protected signals leads to an internal tamper event where one of the following occur:

- A TAMPC event is generated.
- A chip reset is triggered and the SECTAMPER value in the reset reason register indicates what happened, depending on the status of the register PROTECT.INTRESETEN.CTRL on page 225.

The INTRESETEN register is enabled from reset. The PROTECT.<component>.STATUS registers indicate which protected signal had an unintentional value change when the register INTENRESETEN is disabled.

The signal protector implements a two stage write cycle to change the value of a protected signal, in addition to a required write key which must be included for all register writes. The two stages are the following:

1. Initial register write to clear the write protection.
2. Register write to change the signal's value.

Write Clear to the WRITEPROTECTION field in the PROTECT.<component>.CTRL register to clear the write protection in the first register write. Then write to the VALUE and LOCK fields in the next register write operation.

> **Note:** It is required to clear the WRITEPROTECTION field before any updates to the VALUE and LOCK fields are accepted by the register.

The write protection is automatically re-enabled after the subsequent write to change the VALUE field when the register write does not include the Clear value in the WRITEPROTECTION field.

The LOCK field controls a lock feature which prevents further updates to the VALUE and LOCK fields until a reset with the required reset source for the specific signal is issued.

A WRITEERROR event is generated for any of the following conditions:

- Register write does not have the correct write key
- Write protection is active and the write operation does not contain the value to clear the write protection
- The lock is enabled

The sequence to change the VALUE or LOCK fields in the PROTECT.<component>.CTRL registers is as follows:

1. Write Clear to the WRITEPROTECTION field and KEY to the KEY field.
2. Write Disabled to the WRITEPROTECTION field, KEY to the KEY field, and KEY to the desired LOCK and VALUE fields.

7.8.6.4.1 Debugger signals

TAMPC provides protection for the following Arm CoreSight™ debugger signals.

Signal	Name	Notes
NIDEN	Non-Invasive Debug Enable	ETM/ITM trace and other non-halting debug methods
DBGEN	Invasive Debug Enable	The debugger may halt the CPU for debug purposes
SPNIDEN	Secure Privileged Non-Invasive Debug Enable	Same as NIDEN with a secure TrustZone security attribute
SPIDEN	Secure Privileged Debug Enable	Same as DBGEN with a secure TrustZone security attribute

Table 34: TAMPC protected debugger signals

See the appropriate*Arm CoreSight Technical Reference manual* for details on these signals.

For more information about using the protected debugger signals, see Debug and trace on page 1174.

7.8.6.5 TAMPC reset behavior

TAMPC registers are reset by different sources.

Protected signals in TAMPC are divided into the following reset source categories.

- Category 1 – Brownout reset, power-on reset
- Category 2 – Pin reset and TAMPC reset
- Category 3 – Watchdog timer reset, CPU lockup reset, System reset request, and Wake-up from System OFF reset

For more information about reset sources, see RESET — Reset control on page 109.

			Reset source		
Register	**Function**	**Reset value**	**Cat 1**	**Cat 2**	**Cat 3**
PROTECT.DOMAIN[0].DBGEN	Allow invasive debugging in non-secure mode of Arm Cortex-M33.	0	x	x	
PROTECT.DOMAIN[0].NIDEN	Allow non-invasive debugging in non-secure mode of Arm Cortex-M33.	0	x	x	
PROTECT.DOMAIN[0].SPIDEN	Allow invasive debugging in secure mode of Arm Cortex-M33.	0	x	x	
PROTECT.DOMAIN[0].SPNIDEN	Allow non-invasive debugging in secure mode of Arm Cortex-M33.	0	x	x	
PROTECT.AP[0].DBGEN	Allow debugging of FLPR RISC-V CPU.	0	x	x	
PROTECT.ACTIVESHIELD	Enable active shield detector.	0	x	x	x
PROTECT.CRACENTAMP	Enable CRACEN tamper detector.	1	x	x	x
PROTECT.GLITCHSLOWDOMAIN	Enable slow domain glitch detector.	1	x	x	x
PROTECT.GLITCHFASTDOMAIN	Enable fast domain glitch detector.	1	x	x	x
PROTECT.EXTRESETEN	Enable automatic reset from external tamper detectors events.	0	x	x	x
PROTECT.INTRESETEN	Enable automatic reset from internal tamper detector events.	1	x	x	x
PROTECT.ERASEPROTECT	Allow device erase using CTRL-AP and RRAMC.	0	x	x	x

Table 35: TAMPC protected signals

7.8.6.6 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
TAMPC	GLOBAL	0x500EF000	HF	S	NA	No	Tamper controller TAMPC

Configuration

Instance	Domain	Configuration
TAMPC	GLOBAL	For the active shield function, use dedicated pins on P1 Reset value of field VALUE in register PROTECT.INTRESETEN.CTRL: 1

Register overview

Register	Offset	TZ	Description
EVENTS_TAMPER	0x100		Tamper controller detected an error.
EVENTS_WRITEERROR	0x104		Attempt to write a VALUE in PROTECT registers without clearing the WRITEPROTECT.

Register	Offset	TZ	Description
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
INTPEND	0x30C		Pending interrupts
STATUS	0x400		The tamper controller status.
ACTIVESHIELD.CHEN	0x404		Active shield detector channel enable register.
PROTECT.DOMAIN[n].DBGEN.CTRL	0x500		Control register for invasive (halting) debug enable for the local debug components within domain n.
PROTECT.DOMAIN[n].DBGEN.STATUS	0x504		Status register for invasive (halting) debug enable for domain n.
PROTECT.DOMAIN[n].NIDEN.CTRL	0x508		Control register for non-invasive debug enable for the local debug components within domain n.
PROTECT.DOMAIN[n].NIDEN.STATUS	0x50C		Status register for non-invasive debug enable for domain n.
PROTECT.DOMAIN[n].SPIDEN.CTRL	0x510		Control register for secure priviliged invasive (halting) debug enable for the local debug components within domain n.
PROTECT.DOMAIN[n].SPIDEN.STATUS	0x514		Status register for secure priviliged invasive (halting) debug enable for domain n.
PROTECT.DOMAIN[n].SPNIDEN.CTRL	0x518		Control register for secure priviliged non-invasive debug enable for the local debug components within domain n.
PROTECT.DOMAIN[n].SPNIDEN.STATUS	0x51C		Status register for secure priviliged non-invasive debug enable for domain n.
PROTECT.AP[n].DBGEN.CTRL	0x700		Control register to enable invasive (halting) debug in domain ns access port.
PROTECT.AP[n].DBGEN.STATUS	0x704		Status register for invasive (halting) debug enable for domain ns access port.
PROTECT.ACTIVESHIELD.CTRL	0x900		Control register for active shield detector enable signal.
PROTECT.ACTIVESHIELD.STATUS	0x904		Status register for active shield detector enable signal.
PROTECT.CRACENTAMP.CTRL	0x938		Control register for CRACEN tamper detector enable signal.
PROTECT.CRACENTAMP.STATUS	0x93C		Status register for CRACEN tamper detector enable signal.
PROTECT.GLITCHSLOWDOMAIN.CTRL	0x940		Control register for slow domain glitch detectors enable signal.
PROTECT.GLITCHSLOWDOMAIN.STATUS	0x944		Status register for slow domain glitch detectors enable signal.
PROTECT.GLITCHFASTDOMAIN.CTRL	0x948		Control register for fast domain glitch detectors enable signal.
PROTECT.GLITCHFASTDOMAIN.STATUS	0x94C		Status register for fast domain glitch detectors enable signal.
PROTECT.EXTRESETEN.CTRL	0x970		Control register for external tamper reset enable signal.
PROTECT.EXTRESETEN.STATUS	0x974		Status register for external tamper reset enable signal.
PROTECT.INTRESETEN.CTRL	0x978		Control register for internal tamper reset enable signal.
PROTECT.INTRESETEN.STATUS	0x97C		Status register for internal tamper reset enable signal.
PROTECT.ERASEPROTECT.CTRL	0x980		Control register for erase protection.
PROTECT.ERASEPROTECT.STATUS	0x984		Status register for eraseprotect.

7.8.6.6.1 EVENTS_TAMPER

Address offset: 0x100

Tamper controller detected an error.

Bit number																															
ID																															A
Reset 0x00000000																															
ID	R/W	Field	Value ID	Value	Description																										
A	RW	EVENTS_TAMPER			Tamper controller detected an error.																										
			NotGenerated	0	Event not generated																										
			Generated	1	Event generated																										

7.8.6.6.2 EVENTS_WRITEERROR

Address offset: 0x104

Attempt to write a VALUE in PROTECT registers without clearing the WRITEPROTECT.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_WRITEERROR			Attempt to write a VALUE in PROTECT registers without clearing the WRITEPROTECT.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

7.8.6.6.3 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	TAMPER			Enable or disable interrupt for event TAMPER
			Disabled	0	Disable
			Enabled	1	Enable
B	RW	WRITEERROR			Enable or disable interrupt for event WRITEERROR
			Disabled	0	Disable
			Enabled	1	Enable

7.8.6.6.4 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1S	TAMPER			Write '1' to enable interrupt for event TAMPER
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	WRITEERROR			Write '1' to enable interrupt for event WRITEERROR
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

7.8.6.6.5 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	TAMPER			Write '1' to disable interrupt for event TAMPER
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	WRITEERROR			Write '1' to disable interrupt for event WRITEERROR
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

7.8.6.6.6 INTPEND

Address offset: 0x30C

Pending interrupts

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	TAMPER			Read pending status of interrupt for event TAMPER
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
B	R	WRITEERROR			Read pending status of interrupt for event WRITEERROR
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending

7.8.6.6.7 STATUS

Address offset: 0x400

The tamper controller status.

Note: Unless cleared, the STATUS register will be cumulative. A field is cleared by writing '1' to it.

Note: The glitch detectors must be reset using their CTRL registers before the STATUS register bits for glitch detectors can be cleared. The glitch detector continuously drives its output status signal to the STATUS register, hence clearing only the STATUS register is not sufficient.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	ACTIVESHIELD			Active shield detector detected an error.
			NotDetected	0	Not detected.
			Detected	1	Detected.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
B	RW W1C	PROTECT			Error detected for the protected signals.
			NotDetected	0	Not detected.
			Detected	1	Detected.
C	RW W1C	CRACENTAMP			CRACEN detected an error.
			NotDetected	0	Not detected.
			Detected	1	Detected.
D	RW W1C	GLITCHSLOWDOMAIN[i] (i=0..0)			Slow domain glitch detector i detected an error.
			NotDetected	0	Not detected.
			Detected	1	Detected.
E-H	RW W1C	GLITCHFASTDOMAIN[i] (i=0..3)			Fast domain glitch detector i detected an error.
			NotDetected	0	Not detected.
			Detected	1	Detected.

7.8.6.6.8 ACTIVESHIELD.CHEN

Address offset: 0x404

Active shield detector channel enable register.

Pins reserved for the active shield channels must be configured before the channels can be used. Pins reserved for unused channels can be used as GPIO.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-D	RW	CH[i] (i=0..3)			Enable or disable active shield channel i.
			Disabled	0	Disable channel.
			Enabled	1	Enable channel.

7.8.6.6.9 PROTECT.DOMAIN[n].DBGEN.CTRL (n=0..0)

Address offset: 0x500 + (n × 0x20)

Control register for invasive (halting) debug enable for the local debug components within domain n.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000010				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	VALUE			Set value of dbgen signal.
			Low	0	Signal is logic 0, indicating that invasive debug is disabled.
			High	1	Signal is logic 1, indicating that invasive debug is enabled.
B	W1 W1S	LOCK			Lock this register to prevent changes to the VALUE field until next reset.
			Disabled	0	Lock disabled.
			Enabled	1	Lock enabled.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D									C	C	C	C			B	A
Reset 0x00000010				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
C	RW	WRITEPROTECTION																																	
			Disabled	0x0																															
			Enabled	0x1																															
			Clear	0xF																															
D	W	KEY																																	
			KEY	0x50FA																															

7.8.6.6.10 PROTECT.DOMAIN[n].DBGEN.STATUS (n=0..0)

Address offset: 0x504 + (n × 0x20)

Status register for invasive (halting) debug enable for domain n.

Note: Unless cleared, the STATUS register will be cumulative. A field is cleared by writing '1' to it.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	ERROR																																	
	W1C																																		
			NoError	0																															
			Error	1																															

7.8.6.6.11 PROTECT.DOMAIN[n].NIDEN.CTRL (n=0..0)

Address offset: 0x508 + (n × 0x20)

Control register for non-invasive debug enable for the local debug components within domain n.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D									C	C	C	C			B	A
Reset 0x00000010				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	VALUE																																	
			Low	0																															
			High	1																															
B	W1	LOCK																																	
	W1S																																		
			Disabled	0																															
			Enabled	1																															

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000010				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
C	RW	WRITEPROTECTION			The write protection must be cleared to allow updates to the VALUE field. The write protection is cleared by writing CLEAR in a separate write operation prior to updating the VALUE and LOCK fields. The write protection is automatically enabled after the corresponding change to the VALUE field.
			Disabled	0x0	Read: Write protection is disabled.
			Enabled	0x1	Read: Write protection is enabled.
			Clear	0xF	Write: Value to clear write protection.
D	W	KEY			Required write key for upper 16 bits. Must be included in all register write operations.
			KEY	0x50FA	Write key value.

7.8.6.6.12 PROTECT.DOMAIN[n].NIDEN.STATUS (n=0..0)

Address offset: 0x50C + (n × 0x20)

Status register for non-invasive debug enable for domain n.

Note: Unless cleared, the STATUS register will be cumulative. A field is cleared by writing '1' to it.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	ERROR			Error detection status.
			NoError	0	No error detected.
			Error	1	Error detected.

7.8.6.6.13 PROTECT.DOMAIN[n].SPIDEN.CTRL (n=0..0)

Address offset: 0x510 + (n × 0x20)

Control register for secure priviliged invasive (halting) debug enable for the local debug components within domain n.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000010				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	VALUE			Set value of spiden signal.
			Low	0	Signal is logic 0, indicating that secure priviliged invasive debug is disabled.
			High	1	Signal is logic 1, indicating that secure priviliged invasive debug is enabled.
B	W1 W1S	LOCK			Lock this register to prevent changes to the VALUE field until next reset.
			Disabled	0	Lock disabled.
			Enabled	1	Lock enabled.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000010				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
C	RW	WRITEPROTECTION			The write protection must be cleared to allow updates to the VALUE field. The write protection is cleared by writing CLEAR in a separate write operation prior to updating the VALUE and LOCK fields. The write protection is automatically enabled after the corresponding change to the VALUE field.
			Disabled	0x0	Read: Write protection is disabled.
			Enabled	0x1	Read: Write protection is enabled.
			Clear	0xF	Write: Value to clear write protection.
D	W	KEY			Required write key for upper 16 bits. Must be included in all register write operations.
			KEY	0x50FA	Write key value.

7.8.6.6.14 PROTECT.DOMAIN[n].SPIDEN.STATUS (n=0..0)

Address offset: 0x514 + (n × 0x20)

Status register for secure priviliged invasive (halting) debug enable for domain n.

Note: Unless cleared, the STATUS register will be cumulative. A field is cleared by writing '1' to it.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	ERROR			Error detection status.
			NoError	0	No error detected.
			Error	1	Error detected.

7.8.6.6.15 PROTECT.DOMAIN[n].SPNIDEN.CTRL (n=0..0)

Address offset: 0x518 + (n × 0x20)

Control register for secure priviliged non-invasive debug enable for the local debug components within domain n.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000010				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	VALUE			Set value of spniden signal.
			Low	0	Signal is logic 0, indicating that secure priviliged non-invasive debug is disabled.
			High	1	Signal is logic 1, indicating that secure priviliged non-invasive debug is enabled.
B	W1 W1S	LOCK			Lock this register to prevent changes to the VALUE field until next reset.
			Disabled	0	Lock disabled.
			Enabled	1	Lock enabled.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000010				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
C	RW	WRITEPROTECTION			The write protection must be cleared to allow updates to the VALUE field. The write protection is cleared by writing CLEAR in a separate write operation prior to updating the VALUE and LOCK fields. The write protection is automatically enabled after the corresponding change to the VALUE field.
			Disabled	0x0	Read: Write protection is disabled.
			Enabled	0x1	Read: Write protection is enabled.
			Clear	0xF	Write: Value to clear write protection.
D	W	KEY			Required write key for upper 16 bits. Must be included in all register write operations.
			KEY	0x50FA	Write key value.

7.8.6.6.16 PROTECT.DOMAIN[n].SPNIDEN.STATUS (n=0..0)

Address offset: 0x51C + (n × 0x20)

Status register for secure priviliged non-invasive debug enable for domain n.

Note: Unless cleared, the STATUS register will be cumulative. A field is cleared by writing '1' to it.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	ERROR			Error detection status.
			NoError	0	No error detected.
			Error	1	Error detected.

7.8.6.6.17 PROTECT.AP[n].DBGEN.CTRL (n=0..0)

Address offset: 0x700 + (n × 0x10)

Control register to enable invasive (halting) debug in domain ns access port.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000010				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	VALUE			Set value of dbgen signal.
			Low	0	Signal is logic 0, indicating that invasive debug is disabled.
			High	1	Signal is logic 1, indicating that invasive debug is enabled.
B	W1 W1S	LOCK			Lock this register to prevent changes to the VALUE field until next reset.
			Disabled	0	Lock disabled.
			Enabled	1	Lock enabled.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000010				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
C	RW	WRITEPROTECTION			The write protection must be cleared to allow updates to the VALUE field. The write protection is cleared by writing CLEAR in a separate write operation prior to updating the VALUE and LOCK fields. The write protection is automatically enabled after the corresponding change to the VALUE field.
			Disabled	0x0	Read: Write protection is disabled.
			Enabled	0x1	Read: Write protection is enabled.
			Clear	0xF	Write: Value to clear write protection.
D	W	KEY			Required write key for upper 16 bits. Must be included in all register write operations.
			KEY	0x50FA	Write key value.

7.8.6.6.18 PROTECT.AP[n].DBGEN.STATUS (n=0..0)

Address offset: 0x704 + (n × 0x10)

Status register for invasive (halting) debug enable for domain ns access port.

Note: Unless cleared, the STATUS register will be cumulative. A field is cleared by writing '1' to it.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	ERROR			Error detection status.
			NoError	0	No error detected.
			Error	1	Error detected.

7.8.6.6.19 PROTECT.ACTIVESHIELD

Enable active shield detector.

The active shield pins are dedicated GPIO pins that must be configured as inputs and outputs before use. Each active shield channel has one GPIO for output and one GPIO for input.

7.8.6.6.19.1 PROTECT.ACTIVESHIELD.CTRL

Address offset: 0x900

Control register for active shield detector enable signal.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000010				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	VALUE			Set value of active shield enable signal.
			Low	0	Signal is logic 0.
			High	1	Signal is logic 1.
B	W1 W1S	LOCK			Lock this register to prevent changes to the VALUE field until next reset.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000010				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Disabled	0	Lock disabled.
			Enabled	1	Lock enabled.
C	RW	WRITEPROTECTION			The write protection must be cleared to allow updates to the VALUE field. The write protection is cleared by writing CLEAR in a separate write operation prior to updating the VALUE and LOCK fields. The write protection is automatically enabled after the corresponding change to the VALUE field.
			Disabled	0x0	Read: Write protection is disabled.
			Enabled	0x1	Read: Write protection is enabled.
			Clear	0xF	Write: Value to clear write protection.
D	W	KEY			Required write key for upper 16 bits. Must be included in all register write operations.
			KEY	0x50FA	Write key value.

7.8.6.6.19.2 PROTECT.ACTIVESHIELD.STATUS

Address offset: 0x904

Status register for active shield detector enable signal.

Note: Unless cleared, the STATUS register will be cumulative. A field is cleared by writing '1' to it.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	ERROR			Error detection status.
			NoError	0	No error detected.
			Error	1	Error detected.

7.8.6.6.20 PROTECT.CRACENTAMP

Enable tamper detector from CRACEN.

Note: Disabling this bit only disables the TAMPC handling of the CRACENTAMP event, it does not disable the CRACEN from generating the CRACENTAMP event.

7.8.6.6.20.1 PROTECT.CRACENTAMP.CTRL

Address offset: 0x938

Control register for CRACEN tamper detector enable signal.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000011				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	VALUE			Set value of CRACEN tamper detector enable signal.
			Low	0	Signal is logic 0.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000011				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
			High	1	Signal is logic 1.
B	W1 W1S	LOCK			Lock this register to prevent changes to the VALUE field until next reset.
			Disabled	0	Lock disabled.
			Enabled	1	Lock enabled.
C	RW	WRITEPROTECTION			The write protection must be cleared to allow updates to the VALUE field. The write protection is cleared by writing CLEAR in a separate write operation prior to updating the VALUE and LOCK fields. The write protection is automatically enabled after the corresponding change to the VALUE field.
			Disabled	0x0	Read: Write protection is disabled.
			Enabled	0x1	Read: Write protection is enabled.
			Clear	0xF	Write: Value to clear write protection.
D	W	KEY			Required write key for upper 16 bits. Must be included in all register write operations.
			KEY	0x50FA	Write key value.

7.8.6.6.20.2 PROTECT.CRACENTAMP.STATUS

Address offset: 0x93C

Status register for CRACEN tamper detector enable signal.

Note: Unless cleared, the STATUS register will be cumulative. A field is cleared by writing '1' to it.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	ERROR			Error detection status.
			NoError	0	No error detected.
			Error	1	Error detected.

7.8.6.6.21 PROTECT.GLITCHSLOWDOMAIN

Enable slow domain glitch detectors.

7.8.6.6.21.1 PROTECT.GLITCHSLOWDOMAIN.CTRL

Address offset: 0x940

Control register for slow domain glitch detectors enable signal.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000011				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	VALUE			Set value of slow domain glitch detectors enable signal.
			Low	0	Signal is logic 0.
			High	1	Signal is logic 1.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000011				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
B	W1 W1S	LOCK			Lock this register to prevent changes to the VALUE field until next reset.
			Disabled	0	Lock disabled.
			Enabled	1	Lock enabled.
C	RW	WRITEPROTECTION			The write protection must be cleared to allow updates to the VALUE field. The write protection is cleared by writing CLEAR in a separate write operation prior to updating the VALUE and LOCK fields. The write protection is automatically enabled after the corresponding change to the VALUE field.
			Disabled	0x0	Read: Write protection is disabled.
			Enabled	0x1	Read: Write protection is enabled.
			Clear	0xF	Write: Value to clear write protection.
D	W	KEY			Required write key for upper 16 bits. Must be included in all register write operations.
			KEY	0x50FA	Write key value.

7.8.6.6.21.2 PROTECT.GLITCHSLOWDOMAIN.STATUS

Address offset: 0x944

Status register for slow domain glitch detectors enable signal.

Note: Unless cleared, the STATUS register will be cumulative. A field is cleared by writing '1' to it.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	ERROR			Error detection status.
			NoError	0	No error detected.
			Error	1	Error detected.

7.8.6.6.22 PROTECT.GLITCHFASTDOMAIN

Enable fast domain glitch detectors.

7.8.6.6.22.1 PROTECT.GLITCHFASTDOMAIN.CTRL

Address offset: 0x948

Control register for fast domain glitch detectors enable signal.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000011				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	VALUE			Set value of fast domain glitch detector's enable signal.
			Low	0	Signal is logic 0.
			High	1	Signal is logic 1.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000011				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
B	W1 W1S	LOCK			Lock this register to prevent changes to the VALUE field until next reset.
			Disabled	0	Lock disabled.
			Enabled	1	Lock enabled.
C	RW	WRITEPROTECTION			The write protection must be cleared to allow updates to the VALUE field. The write protection is cleared by writing CLEAR in a separate write operation prior to updating the VALUE and LOCK fields. The write protection is automatically enabled after the corresponding change to the VALUE field.
			Disabled	0x0	Read: Write protection is disabled.
			Enabled	0x1	Read: Write protection is enabled.
			Clear	0xF	Write: Value to clear write protection.
D	W	KEY			Required write key for upper 16 bits. Must be included in all register write operations.
			KEY	0x50FA	Write key value.

7.8.6.6.22.2 PROTECT.GLITCHFASTDOMAIN.STATUS

Address offset: 0x94C

Status register for fast domain glitch detectors enable signal.

Note: Unless cleared, the STATUS register will be cumulative. A field is cleared by writing '1' to it.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	ERROR			Error detection status.
			NoError	0	No error detected.
			Error	1	Error detected.

7.8.6.6.23 PROTECT.EXTRESETEN

Trigger a reset when tamper is detected by the external tamper detectors.

This reset gives reset reason *SECTAMPER*

7.8.6.6.23.1 PROTECT.EXTRESETEN.CTRL

Address offset: 0x970

Control register for external tamper reset enable signal.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000010				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	VALUE			Set value of external tamper reset enable signal.
			Low	0	Signal is logic 0.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000010				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			High	1	Signal is logic 1.
B	W1 W1S	LOCK			Lock this register to prevent changes to the VALUE field until next reset.
			Disabled	0	Lock disabled.
			Enabled	1	Lock enabled.
C	RW	WRITEPROTECTION			The write protection must be cleared to allow updates to the VALUE field. The write protection is cleared by writing CLEAR in a separate write operation prior to updating the VALUE and LOCK fields. The write protection is automatically enabled after the corresponding change to the VALUE field.
			Disabled	0x0	Read: Write protection is disabled.
			Enabled	0x1	Read: Write protection is enabled.
			Clear	0xF	Write: Value to clear write protection.
D	W	KEY			Required write key for upper 16 bits. Must be included in all register write operations.
			KEY	0x50FA	Write key value.

7.8.6.6.23.2 PROTECT.EXTRESETEN.STATUS

Address offset: 0x974

Status register for external tamper reset enable signal.

Note: Unless cleared, the STATUS register will be cumulative. A field is cleared by writing '1' to it.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	ERROR			Error detection status.
			NoError	0	No error detected.
			Error	1	Error detected.

7.8.6.6.24 PROTECT.INTRESETEN

Trigger a reset when tamper is detected by the glitch detectors, signal protector or CRACEN tamper detector.

This reset gives reset reason *SECTAMPER*

7.8.6.6.24.1 PROTECT.INTRESETEN.CTRL

Address offset: 0x978

Control register for internal tamper reset enable signal.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000011				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	VALUE			Set value of internal tamper reset enable signal.
			Low	0	Signal is logic 0.
			High	1	Signal is logic 1.
B	W1 W1S	LOCK			Lock this register to prevent changes to the VALUE field until next reset.
			Disabled	0	Lock disabled.
			Enabled	1	Lock enabled.
C	RW	WRITEPROTECTION			The write protection must be cleared to allow updates to the VALUE field. The write protection is cleared by writing CLEAR in a separate write operation prior to updating the VALUE and LOCK fields. The write protection is automatically enabled after the corresponding change to the VALUE field.
			Disabled	0x0	Read: Write protection is disabled.
			Enabled	0x1	Read: Write protection is enabled.
			Clear	0xF	Write: Value to clear write protection.
D	W	KEY			Required write key for upper 16 bits. Must be included in all register write operations.
			KEY	0x50FA	Write key value.

7.8.6.6.24.2 PROTECT.INTRESETEN.STATUS

Address offset: 0x97C

Status register for internal tamper reset enable signal.

Note: Unless cleared, the STATUS register will be cumulative. A field is cleared by writing '1' to it.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	ERROR			Error detection status.
			NoError	0	No error detected.
			Error	1	Error detected.

7.8.6.6.25 PROTECT.ERASEPROTECT

Device erase protection.

7.8.6.6.25.1 PROTECT.ERASEPROTECT.CTRL

Address offset: 0x980

Control register for erase protection.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D D D D D D C C C C B A
Reset 0x00000010				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	VALUE			Set value of eraseprotect signal.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D									C	C	C	C			B	A
Reset 0x00000010				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
			Low	0																															
			High	1																															
B	W1	LOCK																																	
	W1S																																		
			Disabled	0																															
			Enabled	1																															
C	RW	WRITEPROTECTION																																	
			Disabled	0x0																															
			Enabled	0x1																															
			Clear	0xF																															
D	W	KEY																																	
			KEY	0x50FA																															

7.8.6.6.25.2 PROTECT.ERASEPROTECT.STATUS

Address offset: 0x984

Status register for eraseprotect.

Note: Unless cleared, the STATUS register will be cumulative. A field is cleared by writing '1' to it.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	ERROR																																	
	W1C																																		
			NoError	0																															
			Error	1																															

8 Peripherals

The device features a rich set of peripherals. The following sections describe the peripherals and how they are used.

8.1 Peripheral interface

Peripherals are controlled by the CPU through configuration, task, and event registers. Task registers are inputs, enabling the CPU and other peripherals to initiate a functionality. Event registers are outputs, enabling a peripheral to trigger tasks in other peripherals or the CPU by tying events to CPU interrupts.

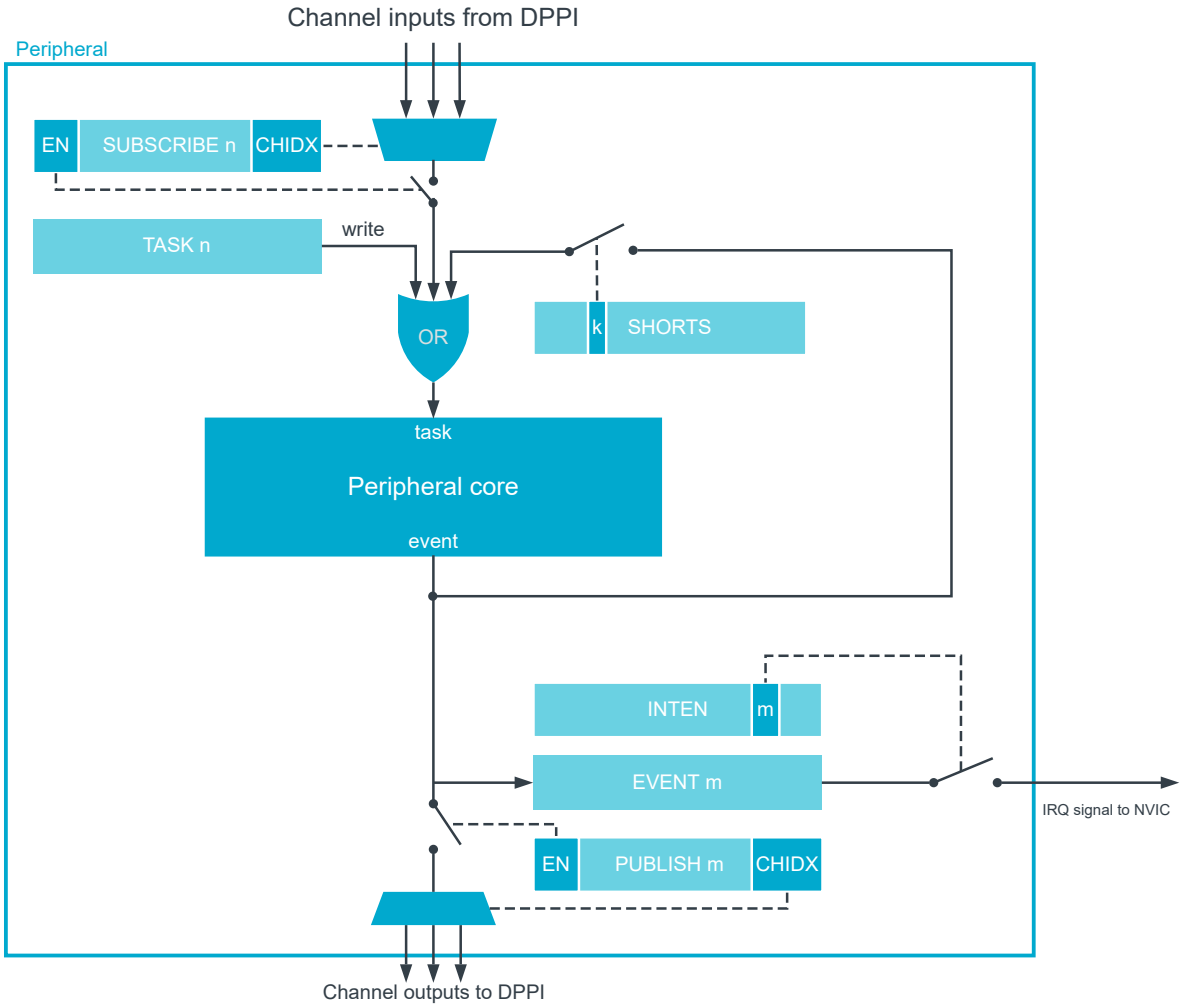


Figure 36: Peripheral interface

The distributed programmable peripheral interconnect (DPPI) feature enables peripherals to connect events to tasks without CPU intervention. For more information on DPPI and the DPPI channels, see DPPI — Distributed programmable peripheral interconnect on page 119.

8.1.2 Peripheral ID

Each peripheral is assigned a fixed block of address space that is minimum 4 KB in size and has at least 1024 registers of 32 bits.

For more information on available peripherals and their location in the address map, see Instantiation on page 232.

There is a direct relationship between peripheral ID and base address:

```
base_address = 0x40000000 + 0x1000 * ID
```

Example peripheral base addresses:

- 0x40000000 is assigned ID=0
- 0x40001000 is assigned ID=1
- 0x4001F000 is assigned ID=31

Peripherals can share the same ID, which has the following limitations:

- Shared registers or common resources
- Limited availability due to mutually exclusive operation; only one peripheral in use at a time
- Enforced peripheral behavior when switching between peripherals (disable the first peripheral before enabling the second)

8.1.3 Peripherals with shared ID

Peripherals sharing ID [1...n] and a base address may not be used simultaneously. Only one peripheral can be enabled at a given ID.

When switching between two peripherals sharing an ID, perform the following to prevent unwanted behavior.

1. Disable the previously used peripheral.
2. Disable any publish/subscribe connection to the DPPI system for the peripheral that is being disabled.
3. Clear all bits in the INTEN register (INTENCLR = 0xFFFFFFFF).
4. Configure the peripheral being enabled. Do not rely on the inherited configuration from the disabled peripheral.
5. Enable the peripheral.

For a list of peripherals that share an ID, see Instantiation on page 232.

8.1.4 Peripheral registers

Most peripherals have an ENABLE register. Unless otherwise specified, the peripheral registers must be configured before enabling the peripheral.

PSEL registers must be set before a peripheral is enabled or started. Updating PSEL registers while the peripheral is running can cause undefined behavior. To connect a peripheral to a different GPIO, the following must be performed:

1. Disable the peripheral.
2. Update the PSEL register.
3. Re-enable the peripheral.

> **Note:** The peripheral must be enabled before tasks and events can be used.

Most of the register values are not retained during System OFF or when a reset is triggered. Some registers will retain their values in System OFF or for some specific reset sources. These registers are marked as

retained in the register description for a given peripheral. For more information on their behavior, see chapter RESET — Reset control on page 109.

8.1.5 Bit set and clear

Registers with multiple single-bit fields can implement the set-and-clear bit pattern. This bit pattern enables firmware to set and clear individual bits in a register without having to perform a read-modify-write operation to the main register.

This bit pattern is implemented using three consecutive addresses in the register map, where the main register is followed by dedicated SET and CLR registers (in that exact order).

In the main register, the SET register sets individual bits and the CLR register clears them. Writing `1` to a bit in the SET or CLR register will set or clear the same bit in the main register. Writing `0` to a bit in the SET or CLR register has no effect. Reading the SET or CLR register returns the value of the main register.

Note: The main register may not be visible, and therefore not directly accessible in all cases.

8.1.6 Tasks

Tasks trigger actions in a peripheral, such as to start a particular behavior. A peripheral can implement multiple tasks, with each task having a separate register in that peripheral's task register group.

A task is triggered when firmware writes `1` to the task register, or when the peripheral itself or another peripheral toggles the corresponding task signal. See the figure Peripheral interface on page 228.

8.1.7 Events

Events notify peripherals and the CPU about events that have happened, such as a state change in a peripheral. A peripheral may generate multiple events, where each event has a separate register in that peripheral's event register group.

An event is generated when the peripheral toggles the corresponding event signal and updates the event register to show an event has been generated, see figure Peripheral interface on page 228. An event register is cleared when firmware writes a `0` to that register. A peripheral can continually generate events when the event register is `1`.

8.1.8 Publish and subscribe

Events and tasks from different peripherals can be connected together through the DPPI system using the PUBLISH and SUBSCRIBE registers in each peripheral. See Peripheral interface on page 228.

An event can be published onto a DPPI channel by configuring the event's PUBLISH register. Similarly, a task can subscribe to a DPPI channel by configuring the task's SUBSCRIBE register.

See DPPI — Distributed programmable peripheral interconnect on page 119 for details.

8.1.9 Shortcuts

A shortcut is a direct connection between an event and a task within the same peripheral. If a shortcut is enabled, the associated task is automatically triggered when its associated event is generated.

Using shortcuts is the same as connecting a task and event outside the peripheral through the DPPI. The propagation delay for a shortcut is usually shorter than the propagation delay through the DPPI.

Shortcuts are predefined, which means that their connections cannot be configured by firmware. Each shortcut can be individually enabled or disabled through the shortcut register, one bit per shortcut, giving a maximum of 32 shortcuts for each peripheral.

8.1.10 Interrupts

All peripherals support interrupts generated by events.

Events generated by a peripheral can be configured to generate interrupts using registers INTEN, INTENSET, and INTENCLR. Multiple events can be enabled to generate interrupts simultaneously. Event registers in the peripheral register event group indicate the source.

Some peripherals implement only INTENSET and INTENCLR registers. The INTEN register is not available on those peripherals. See the individual peripheral chapters for details. In all cases, reading back the INTENSET or INTENCLR register returns the same information as INTEN.

The INTPEND register contains the interrupt pending status of events generated by a peripheral. This is a read-only register. To clear bits from INTPEND, clear the corresponding event register.

Each event implemented in the peripheral is associated with a specific bit position in the INTEN, INTENSET, and INTENCLR registers.

To ensure the lowest possible power consumption while in sleep, perform either of the following steps on any pending interrupts:

- Clear the pending interrupt by writing `0` to the corresponding EVENT register
- Disable the interrupt by using the INTEN or INTENCLR registers

This has to be done even if the peripheral is disabled in its ENABLE or POWER register.

The relationship between tasks, events, shortcuts, and interrupts is illustrated in Peripheral interface on page 228.

A peripheral can occupy single or multiple interrupts. For single interrupts, the interrupt number follows the peripheral ID. For example, the peripheral with ID=4 is connected to interrupt number 4 in the nested vectored interrupt controller (NVIC). In this case, only single INTEN registers are available.

Peripherals implementing multiple interrupts have several INTEN registers that follow the convention of INTENn, where n is the interrupt number from the peripheral. This also applies to corresponding INTPEND, INTENSET, and INTENCLR registers. This feature enables any event to generate an interrupt from the peripheral.

Peripherals implementing more than 32 events have access to multiple INTEN registers that follow the convention of INTENn, where n is the event group number. The 32 lowest events in the peripheral make event group 0. The next 32 events in the peripheral make event group 1, and so on. This convention is also applicable for corresponding INTPEND, INTENSET, and INTENCLR registers.

Peripherals implementing both multiple interrupts and more than 32 events have multiple INTEN registers. In this case, registers follow the convention of INTENnm, where n is interrupt number from the peripheral and m is event group number. This convention is also applicable for corresponding INTPEND, INTENSET, and INTENCLR registers.

8.1.10.1 Interrupt clearing and disabling

Interrupts must be cleared by writing `0` to the corresponding EVENT register.

Interrupts are immediately re-triggered until cleared. Routines for software interrupt services continue to execute, even if a new event has not been received.

8.2 Instantiation

ID	Base address	Instance	TrustZone			Split access	Description
			Map	Att	DMA		
32	0x50020000 0x40020000	USBHSCORE : S USBHSCORE : NS	US	S	SA	No	USBHSCORE
64	0x50040000	SPU00	HF	S	NA	No	System protection unit SPU00
65	0x50041000	MPC00	HF	S	NA	No	Memory privilege controller MPC00
66	0x50042000 0x40042000	DPPIC00 : S DPPIC00 : NS	US	S	NA	Yes	DPPI controller DPPIC00
68	0x50044000 0x40044000	PPIB00 : S PPIB00 : NS	US	S	NA	No	PPI bridge PPIB00
69	0x50045000 0x40045000	PPIB01 : S PPIB01 : NS	US	S	NA	No	PPI bridge PPIB01
73	0x50049000	KMU	HF	S	NSA	No	Key management unit
74	0x5004A000 0x4004A000	AAR00 : S AAR00 : NS	US	S	SA	No	Accelerated address resolver 00
74	0x5004A000 0x4004A000	CCM00 : S CCM00 : NS	US	S	SA	No	AES CCM mode encryption CCM00, running of HCLKCORE
75	0x5004B000 0x4004B000	ECB00 : S ECB00 : NS	US	S	SA	No	AES ECB mode encryption 00 When configuring this peripheral's DMA security using SPU configuration (DMASEC field of SPU->PERIPH[apb_slave_index]), use apb_slave_index 10 (same as AAR00 and CCM00)
76	0x5004C000 0x4004C000	VPR00 : S VPR00 : NS	US	NS	NA	No	FLPR - VPR peripheral registers
77	0x5004D000 0x4004D000	SPIM00 : S SPIM00 : NS	US	S	SA	No	SPI controller SPIM00
77	0x5004D000 0x4004D000	SPIS00 : S SPIS00 : NS	US	S	SA	No	SPI peripheral SPIS00
77	0x5004D000 0x4004D000	UARTE00 : S UARTE00 : NS	US	S	SA	No	Universal asynchronous receiver/transmitter UARTE00
78	0x5004E000	GLITCHDET	HF	S	NA	No	Glitch detectors
78	0x5004E000	RRAMC	HF	S	NA	No	RRAM Non-Volatile Memory Controller
80	0x50050400 0x40050400	GPIOHSPADCTRL : S GPIOHSPADCTRL : NS	US	S	NA	Yes	GPIO HS pad control GPIOHSPADCTRL
80	0x50050400 0x40050400	P2 : S P2 : NS	US	S	NA	Yes	General purpose input and output, port P2 Does not support pin sense mechanism, and DETECTMODE register has no effect. Supports extra high drive (DRIVE0=E0, DRIVE1=E1).
82	0x50052000 0x40052000	CTRLAP : S CTRLAP : NS	US	S	NSA	No	Control access port CPU side
83	0x50053000 0x40053000	TAD : S TAD : NS	US	S	NA	No	Trace and debug control
85	0x50055000 0x40055000	TIMER00 : S TIMER00 : NS	US	S	NA	No	Timer TIMER00
86	0x50056000 0x40056000	AXONS : S AXONS : NS	US	S	SA	No	Neural processing unit
88	0x50058000 0x40058000	EGU00 : S EGU00 : NS	US	S	NA	No	Event generator unit EGU00
89	0x50059000	CRACEN	HF	S	NSA	No	Crypto accelerator

ID	Base address	Instance	TrustZone			Split access	Description
			Map	Att	DMA		
90	0x5005A000 0x4005A000	USBHS : S USBHS : NS	US	S	SA	No	USBHS
128	0x50080000	SPU10	HF	S	NA	No	System protection unit SPU10
130	0x50082000 0x40082000	DPPIC10 : S DPPIC10 : NS	US	S	NA	Yes	DPPI controller DPPIC10
131	0x50083000 0x40083000	PPIB10 : S PPIB10 : NS	US	S	NA	No	PPI bridge PPIB10
132	0x50084000 0x40084000	PPIB11 : S PPIB11 : NS	US	S	NA	No	PPI bridge PPIB11
133	0x50085000 0x40085000	TIMER10 : S TIMER10 : NS	US	S	NA	No	Timer TIMER10
135	0x50087000 0x40087000	EGU10 : S EGU10 : NS	US	S	NA	No	Event generator unit EGU10
138	0x5008A000 0x4008A000	RADIO : S RADIO : NS	US	S	SA	No	2.4 GHz radio RADIO See pinout for GPIO options for DFE antenna switch control
192	0x500C0000	SPU20	HF	S	NA	No	System protection unit SPU20
194	0x500C2000 0x400C2000	DPPIC20 : S DPPIC20 : NS	US	S	NA	Yes	DPPI controller DPPIC20
195	0x500C3000 0x400C3000	PPIB20 : S PPIB20 : NS	US	S	NA	No	PPI bridge PPIB20
196	0x500C4000 0x400C4000	PPIB21 : S PPIB21 : NS	US	S	NA	No	PPI bridge PPIB21
197	0x500C5000 0x400C5000	PPIB22 : S PPIB22 : NS	US	S	NA	No	PPI bridge PPIB22
198	0x500C6000 0x400C6000	SPIM20 : S SPIM20 : NS	US	S	SA	No	SPI controller SPIM20
198	0x500C6000 0x400C6000	SPIS20 : S SPIS20 : NS	US	S	SA	No	SPI peripheral SPIS20
198	0x500C6000 0x400C6000	TWIM20 : S TWIM20 : NS	US	S	SA	No	Two-wire interface controller TWIM20
198	0x500C6000 0x400C6000	TWIS20 : S TWIS20 : NS	US	S	SA	No	Two-wire interface target TWIS20
198	0x500C6000 0x400C6000	UARTE20 : S UARTE20 : NS	US	S	SA	No	Universal asynchronous receiver/transmitter UARTE20
199	0x500C7000 0x400C7000	SPIM21 : S SPIM21 : NS	US	S	SA	No	SPI controller SPIM21
199	0x500C7000 0x400C7000	SPIS21 : S SPIS21 : NS	US	S	SA	No	SPI peripheral SPIS21
199	0x500C7000 0x400C7000	TWIM21 : S TWIM21 : NS	US	S	SA	No	Two-wire interface controller TWIM21
199	0x500C7000 0x400C7000	TWIS21 : S TWIS21 : NS	US	S	SA	No	Two-wire interface target TWIS21
199	0x500C7000 0x400C7000	UARTE21 : S UARTE21 : NS	US	S	SA	No	Universal asynchronous receiver/transmitter UARTE21
200	0x500C8000 0x400C8000	SPIM22 : S SPIM22 : NS	US	S	SA	No	SPI controller SPIM22
200	0x500C8000 0x400C8000	SPIS22 : S SPIS22 : NS	US	S	SA	No	SPI peripheral SPIS22
200	0x500C8000 0x400C8000	TWIM22 : S TWIM22 : NS	US	S	SA	No	Two-wire interface controller TWIM22

ID	Base address	Instance	TrustZone			Split access	Description
			Map	Att	DMA		
200	0x500C8000 0x400C8000	TWIS22 : S TWIS22 : NS	US	S	SA	No	Two-wire interface target TWIS22
200	0x500C8000 0x400C8000	UARTE22 : S UARTE22 : NS	US	S	SA	No	Universal asynchronous receiver/transmitter UARTE22
201	0x500C9000 0x400C9000	EGU20 : S EGU20 : NS	US	S	NA	No	Event generator unit EGU20
202	0x500CA000 0x400CA000	TIMER20 : S TIMER20 : NS	US	S	NA	No	Timer TIMER20
203	0x500CB000 0x400CB000	TIMER21 : S TIMER21 : NS	US	S	NA	No	Timer TIMER21
204	0x500CC000 0x400CC000	TIMER22 : S TIMER22 : NS	US	S	NA	No	Timer TIMER22
205	0x500CD000 0x400CD000	TIMER23 : S TIMER23 : NS	US	S	NA	No	Timer TIMER23
206	0x500CE000 0x400CE000	TIMER24 : S TIMER24 : NS	US	S	NA	No	Timer TIMER24
207	0x500CF000 0x400CF000	MEMCONF : S MEMCONF : NS	US	S	NA	No	Memory Configuration MEMCONF
208	0x500D0000 0x400D0000	PDM20 : S PDM20 : NS	US	S	SA	No	Pulse density modulation (digital microphone) interface PDM20
209	0x500D1000 0x400D1000	PDM21 : S PDM21 : NS	US	S	SA	No	Pulse density modulation (digital microphone) interface PDM21
210	0x500D2000 0x400D2000	PWM20 : S PWM20 : NS	US	S	SA	No	Pulse width modulation unit PWM20
211	0x500D3000 0x400D3000	PWM21 : S PWM21 : NS	US	S	SA	No	Pulse width modulation unit PWM21
212	0x500D4000 0x400D4000	PWM22 : S PWM22 : NS	US	S	SA	No	Pulse width modulation unit PWM22
213	0x500D5000 0x400D5000	SAADC : S SAADC : NS	US	S	SA	No	Successive approximation analog-to-digital converter SAADC
214	0x500D6000 0x400D6000	NFCT : S NFCT : NS	US	S	SA	No	Near field communication tag NFCT
215	0x500D7000 0x400D7000	TEMP : S TEMP : NS	US	S	NA	No	Temperature sensor TEMP
216	0x500D8200 0x400D8200	P1 : S P1 : NS	US	S	NA	Yes	General purpose input and output, port P1
216	0x500D8600 0x400D8600	P3 : S P3 : NS	US	S	NA	Yes	General purpose input and output, port P3
218	0x500DA000 0x400DA000	GPIOTE20 : S GPIOTE20 : NS	US	S	NA	Yes	8 channels and 2 interrupts for GPIO port P1 and P3 GPIO tasks and events GPIOTE20
224	0x500E0000 0x400E0000	QDEC20 : S QDEC20 : NS	US	S	NA	No	Quadrature decoder QDEC20
225	0x500E1000 0x400E1000	QDEC21 : S QDEC21 : NS	US	S	NA	No	Quadrature decoder QDEC21
226	0x500E2000 0x400E2000	GRTC : S GRTC : NS	US	S	NA	Yes	Global RTC GRTC
232	0x500E8000 0x400E8000	TDM : S TDM : NS	US	S	SA	No	Time division multiplexed audio interface TDM
237	0x500ED000 0x400ED000	SPIM23 : S SPIM23 : NS	US	S	SA	No	SPI controller SPIM23
237	0x500ED000 0x400ED000	SPIS23 : S SPIS23 : NS	US	S	SA	No	SPI peripheral SPIS23

ID	Base address	Instance	TrustZone			Split access	Description
			Map	Att	DMA		
237	0x500ED000 0x400ED000	TWIM23 : S TWIM23 : NS	US	S	SA	No	Two-wire interface controller TWIM23
237	0x500ED000 0x400ED000	TWIS23 : S TWIS23 : NS	US	S	SA	No	Two-wire interface target TWIS23
237	0x500ED000 0x400ED000	UARTE23 : S UARTE23 : NS	US	S	SA	No	Universal asynchronous receiver/transmitter UARTE23
238	0x500EE000 0x400EE000	SPIM24 : S SPIM24 : NS	US	S	SA	No	SPI controller SPIM24
238	0x500EE000 0x400EE000	SPIS24 : S SPIS24 : NS	US	S	SA	No	SPI peripheral SPIS24
238	0x500EE000 0x400EE000	TWIM24 : S TWIM24 : NS	US	S	SA	No	Two-wire interface controller TWIM24
238	0x500EE000 0x400EE000	TWIS24 : S TWIS24 : NS	US	S	SA	No	Two-wire interface target TWIS24
238	0x500EE000 0x400EE000	UARTE24 : S UARTE24 : NS	US	S	SA	No	Universal asynchronous receiver/transmitter UARTE24
239	0x500EF000	TAMPC	HF	S	NA	No	Tamper controller TAMPC
256	0x50100000	SPU30	HF	S	NA	No	System protection unit SPU30
258	0x50102000 0x40102000	DPPIC30 : S DPPIC30 : NS	US	S	NA	Yes	DPPI controller DPPIC30
259	0x50103000 0x40103000	PPIB30 : S PPIB30 : NS	US	S	NA	No	PPI bridge PPIB30
260	0x50104000 0x40104000	SPIM30 : S SPIM30 : NS	US	S	SA	No	SPI controller SPIM30
260	0x50104000 0x40104000	SPIS30 : S SPIS30 : NS	US	S	SA	No	SPI peripheral SPIS30
260	0x50104000 0x40104000	TWIM30 : S TWIM30 : NS	US	S	SA	No	Two-wire interface controller TWIM30
260	0x50104000 0x40104000	TWIS30 : S TWIS30 : NS	US	S	SA	No	Two-wire interface target TWIS30
260	0x50104000 0x40104000	UARTE30 : S UARTE30 : NS	US	S	SA	No	Universal asynchronous receiver/transmitter UARTE30
262	0x50106000 0x40106000	COMP : S COMP : NS	US	S	NA	No	Comparator COMP
262	0x50106000 0x40106000	LPCOMP : S LPCOMP : NS	US	S	NA	No	Low-power comparator LPCOMP
264	0x50108000	WDT30	HF	S	NA	No	Watchdog timer WDT30
265	0x50109000 0x40109000	WDT31 : S WDT31 : NS	US	S	NA	No	Watchdog timer WDT31
266	0x5010A000 0x4010A000	P0 : S P0 : NS	US	S	NA	Yes	General purpose input and output, port P0
268	0x5010C000 0x4010C000	GPIOTE30 : S GPIOTE30 : NS	US	S	NA	Yes	4 channels and 2 interrupts for GPIO port P0 GPIO tasks and events GPIOTE30
270	0x5010E000 0x4010E000	CLOCK : S CLOCK : NS	US	S	NA	No	Clock control
270	0x5010E000 0x4010E000	POWER : S POWER : NS	US	S	NA	No	Power control
270	0x5010E000 0x4010E000	RESET : S RESET : NS	US	S	NA	No	Reset status
288	0x50120000 0x40120000	OSCILLATORS : S OSCILLATORS : NS	US	S	NA	No	Oscillator control

ID	Base address	Instance	TrustZone			Split access	Description
			Map	Att	DMA		
288	0x50120000 0x40120000	REGULATORS : S REGULATORS : NS	US	S	NA	No	Regulator control
289	0x50121000 0x40121000	VREGUSB : S VREGUSB : NS	US	S	NA	No	USB regulator
N/A	0x00FFC000	FICR	HF	NS	NA	No	Factory information configuration
N/A	0x00FFD000	UICR	HF	S	NA	No	User information configuration
N/A	0x00FFE000	SICR	HF	S	NA	No	Secure information configuration region
N/A	0x50010000	CRACENCORE	HF	S	NSA	No	CRACEN core

Table 36: Instantiation table

8.3 AAR — Accelerated address resolver

Accelerated address resolver is a cryptographic support function for implementing the Resolvable Private Address Resolution Procedure described in the *Bluetooth Core specification*.

The main features of AAR are:

- Memory-to-memory operations using Scatter/Gather DMA
- Real-time address resolution on incoming packets
- Multiple IRK resolution

The procedure allows two devices that share a secret key to generate and resolve a hash based on their device address. AAR enables real-time address resolution on incoming packets when configured as described in this chapter. This allows real-time packet filtering (whitelisting) using a list of known shared keys (Identity Resolving Keys (IRK) in *Bluetooth*).

The inputs and outputs of AAR are illustrated in the following figure.

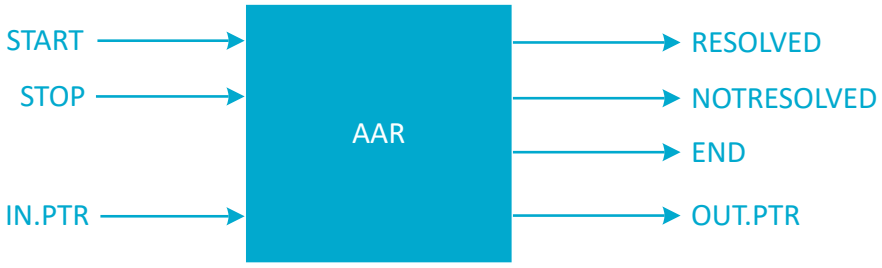


Figure 37: AAR block diagram

8.3.1 Shared resources

AAR shares the same AES module as the ECB and CCM peripherals. ECB will always have the lowest priority. If there is a sharing conflict during encryption, ECB operation will be aborted and an ERRORECB event will be generated by ECB.

Additionally, AAR shares registers and other resources with the peripherals that have the same ID as AAR. See Peripherals with shared ID on page 229 for more information.

8.3.2 Resolving a resolvable address

As per *Bluetooth* specification, a private resolvable address is composed of six bytes.

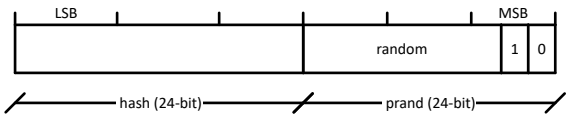


Figure 38: Resolvable address

To resolve an address, IN.PTR must point to a job list describing both the Hash and Prand parts of the private resolvable address (DEVICEADDR) field from the Bluetooth packet, as well as a number of Identity Resolving Keys (IRK). This is illustrated in the examples below. How many IRKs are used is determined by the number of IRKs in the job list. See EasyDMA on page 239 for an introduction to EasyDMA job lists.

The resolver is started by triggering the START task. A RESOLVED event is generated if AAR manages to resolve the address using one of the Identity Resolving Keys (IRK). AAR will generate a NOTRESOLVED event if it is not able to resolve the address using the specified list of IRKs. If there are no IRKs in the joblist, the NOTRESOLVED event is generated.

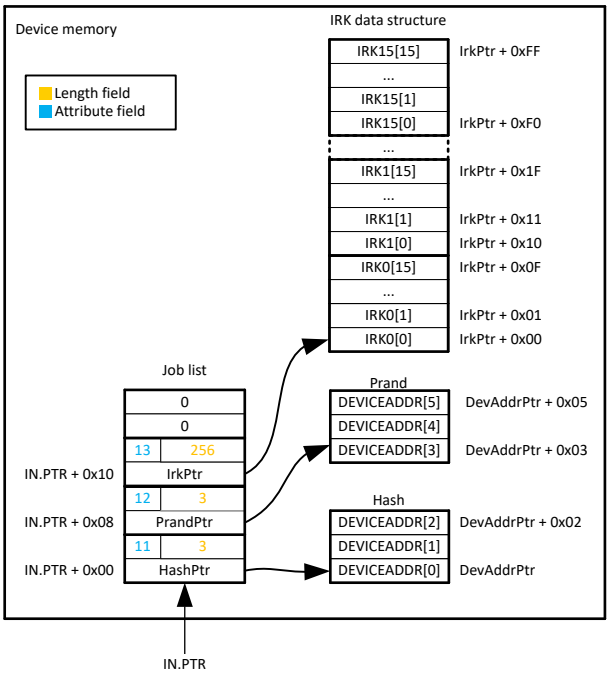


Figure 39: Address resolution with 16 IRKs and DEVICEADDR preloaded into RAM

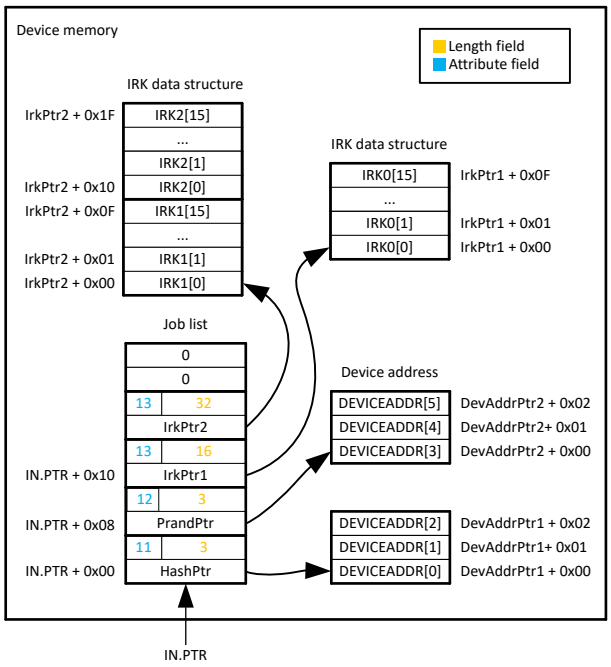


Figure 40: Address resolution with packet device address preloaded into multiple RAM locations, and three IRK keys

AAR will go through the list of available IRKs in the job list, and for each IRK try to resolve the address according to the Resolvable Private Address Resolution Procedure described in the *Bluetooth* Specification[2]. The time it takes to resolve an address may vary depending on where in the list the resolvable address is located. The resolution time will also be affected by RAM accesses performed by other peripherals and the CPU. See the Electrical specifications for more information about resolution time.

Note: Maximum number of IRKs supported in a job list is 4096.

AAR only compares the received address to those programmed in the module without checking the address type.

AAR will stop when it has managed to resolve the maximum number allowed, specified in the MAXRESOLVED register. Each time AAR resolves an IRK, the index of the corresponding IRK is written to memory through the output job list in OUT.PTR. For each IRK found, OUT.AMOUNT is updated accordingly.

The output job list must define a memory region large enough to hold list of resolved IRK indices. This is calculated from the MAXRESOLVED register, where each IRK index occupies two bytes in memory. In the example below, the `n` indicates the number of bytes (size) in the resolved IRK index array. The value of `n` must be exactly 2 times the value of MAXRESOLVED.

[2] *Bluetooth* Specification Version 4.0 [Vol 3] chapter 10.8.2.3.

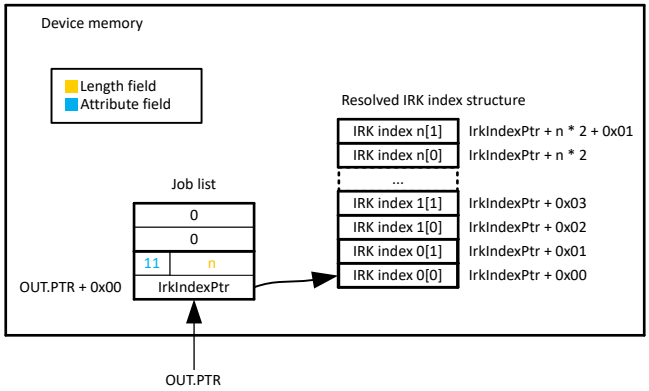


Figure 41: Resolved IRK index structure at RAM

At the end of the operation, AAR will generate the END event.

Triggering the STOP task will stop AAR. If AAR is stopped before the operation has completed, the END, RESOLVED, and NOTRESOLVED events are not generated. However, if STOP is triggered close to the end of the operation the events can be generated.

8.3.3 EasyDMA

This peripheral implements EasyDMA with scatter-gather functionality for reading from memory without CPU involvement.

The scatter-gather functionality allows EasyDMA to collect data from multiple memory regions, instead of one contiguous block. The memory regions are described by a job list, called input job list. The job list consists of one or more job entries that consist of a 32-bit address field, 8-bit attribute field, and 24-bit length field. A job list ends with a zero filled job entry.

The input job list must have separate entries for the following entries:

1. The three first bytes of the resolvable private address (the 24-bit hash)
2. The three following bytes of the resolvable private address (the 24-bit prand)
3. The IRKs

The attribute field of each of these entries identify the input job and must be set according to the following table.

Attribute	Value
Hash	11
Prand	12
Irk	13

Table 37: Attribute field for input job list

If the IN.PTR register or the entries in the input job list are not pointing to memory connected to the DMA bus, an EasyDMA transfer may result in a HardFault or memory corruption. See Memory on page 13 for more information about the different memory regions and DMA connectivity.

The EasyDMA will have finished accessing the RAM when the END, RESOLVED, or NOTRESOLVED events are generated.

For instances supporting DMA error detection, the ERRORSTATUS register will report if a bus error has occurred during DMA access. To see if DMA error detection is supported, see the the instance's configuration in Instantiation on page 232.

The list of the resolved IRK indices are stored in memory using the output job list, configured by OUT.PTR.

Attribute	Value
Resolved Irk index	11

Table 38: Attribute field for output job list

Example

The figure below shows an example of a job list with three job entries. Each of the entries point to a memory address, and the length field describes how many bytes of data is stored at that address. There are three blocks of memory in use

- Hash, an array of length 3
- Prand, an array of length 3
- Irk, an array of at least length 16

The data pointed to from the job list is what is fed into the module and processed according to the peripheral's operation. The entries of the job list comprises pointers to the individual arrays, as well as their sizes. Job entries with length greater than one are processed in little endian order.

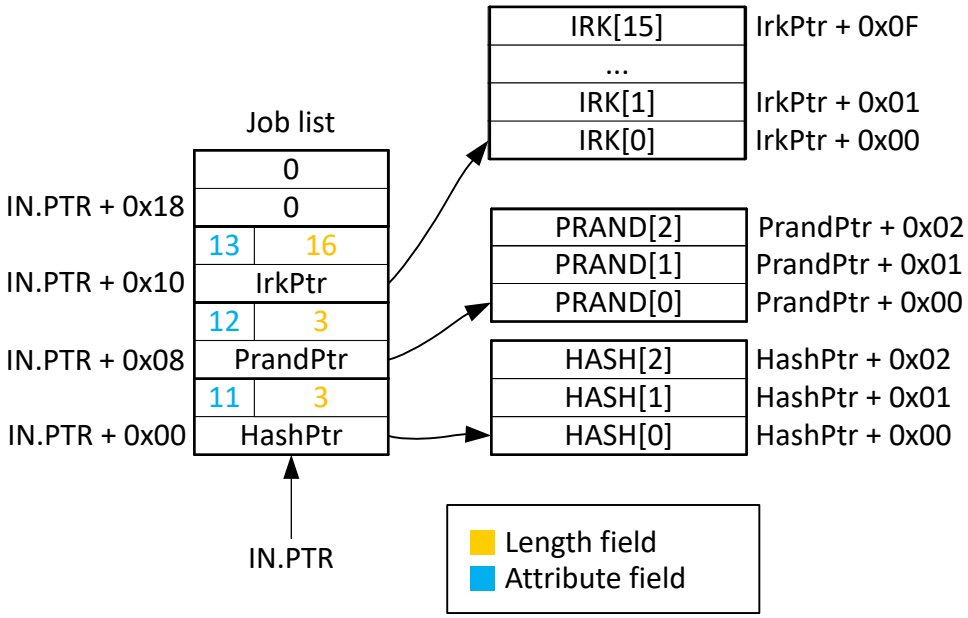


Figure 42: EasyDMA Scatter-Gather job list example

8.3.4 Use case example for chaining RADIO packet reception with address resolution using AAR

AAR may be started as soon as the 6 bytes required by AAR have been received by RADIO and stored in RAM. The Hash and Prand part of the job list must point to the part of the packet containing the device address.

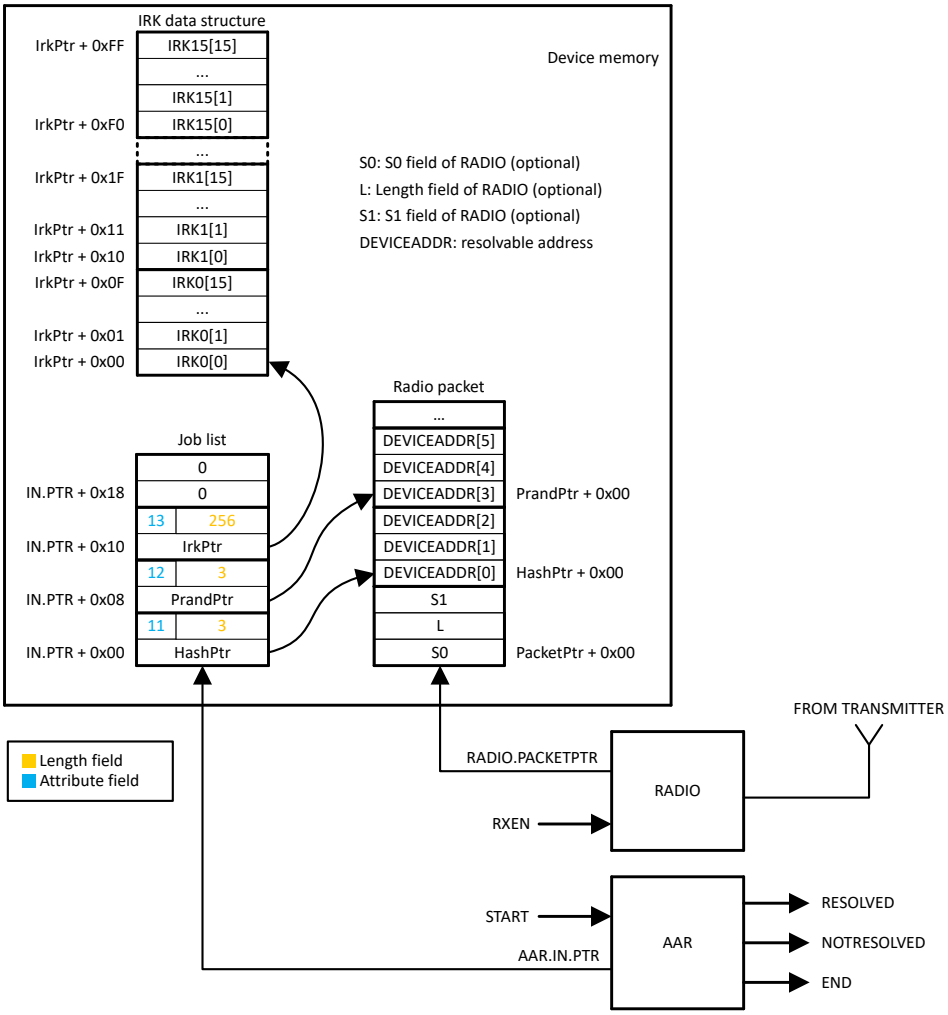


Figure 43: Address resolution with packet loaded into RAM by RADIO

8.3.5 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
AAR00 : S AAR00 : NS	GLOBAL	0x5004A000 0x4004A000	US	S	SA	No	Accelerated address resolver 00

Register overview

Register	Offset	TZ	Description
TASKS_START	0x000		Start resolving addresses based on IRKs specified in the IRK data structure
TASKS_STOP	0x004		Stop resolving addresses
SUBSCRIBE_START	0x080		Subscribe configuration for task START
SUBSCRIBE_STOP	0x084		Subscribe configuration for task STOP
EVENTS_END	0x100		Address resolution procedure complete or ended due to an error
EVENTS_RESOLVED	0x104		Address resolved
EVENTS_NOTRESOLVED	0x108		Address not resolved

Register	Offset	TZ	Description
EVENTS_ERROR	0x10C		Operation aborted because of a STOP task or due to an error
PUBLISH_END	0x180		Publish configuration for event END
PUBLISH_RESOLVED	0x184		Publish configuration for event RESOLVED
PUBLISH_NOTRESOLVED	0x188		Publish configuration for event NOTRESOLVED
PUBLISH_ERROR	0x18C		Publish configuration for event ERROR
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
ERRORSTATUS	0x404		Error status
ENABLE	0x500		Enable AAR
MAXRESOLVED	0x508		Maximum number of IRKs to resolve
IN.PTR	0x530		Input pointer
OUT.PTR	0x538		Output pointer
OUT.AMOUNT	0x53C		Number of bytes transferred in the last transaction

8.3.5.1 TASKS_START

Address offset: 0x000

Start resolving addresses based on IRKs specified in the IRK data structure

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_START			Start resolving addresses based on IRKs specified in the IRK data structure
			Trigger	1	Trigger task

8.3.5.2 TASKS_STOP

Address offset: 0x004

Stop resolving addresses

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Stop resolving addresses
			Trigger	1	Trigger task

8.3.5.3 SUBSCRIBE_START

Address offset: 0x080

Subscribe configuration for task START

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																									A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task START will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.3.5.4 SUBSCRIBE_STOP

Address offset: 0x084

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.3.5.5 EVENTS_END

Address offset: 0x100

Address resolution procedure complete or ended due to an error

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_END			Address resolution procedure complete or ended due to an error
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.3.5.6 EVENTS_RESOLVED

Address offset: 0x104

Address resolved

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_RESOLVED			Address resolved
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.3.5.7 EVENTS_NOTRESOLVED

Address offset: 0x108

Address not resolved

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_NOTRESOLVED			Address not resolved
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.3.5.8 EVENTS_ERROR

Address offset: 0x10C

Operation aborted because of a STOP task or due to an error

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_ERROR			Operation aborted because of a STOP task or due to an error
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.3.5.9 PUBLISH_END

Address offset: 0x180

Publish configuration for event END

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event END will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.3.5.10 PUBLISH_RESOLVED

Address offset: 0x184

Publish configuration for event RESOLVED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event RESOLVED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.3.5.11 PUBLISH_NOTRESOLVED

Address offset: 0x188

Publish configuration for event NOTRESOLVED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event NOTRESOLVED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.3.5.12 PUBLISH_ERROR

Address offset: 0x18C

Publish configuration for event ERROR

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event ERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.3.5.13 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1S	END			Write '1' to enable interrupt for event END
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	RESOLVED			Write '1' to enable interrupt for event RESOLVED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1S	NOTRESOLVED			Write '1' to enable interrupt for event NOTRESOLVED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1S	ERROR			Write '1' to enable interrupt for event ERROR
			Set	1	Enable

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.3.5.14 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	END			Write '1' to disable interrupt for event END
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	RESOLVED			Write '1' to disable interrupt for event RESOLVED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	NOTRESOLVED			Write '1' to disable interrupt for event NOTRESOLVED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1C	ERROR			Write '1' to disable interrupt for event ERROR
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.3.5.15 ERRORSTATUS

Address offset: 0x404

Error status

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	ERRORSTATUS			Error status when the ERROR event is generated
			NoError	0	No errors have occurred
			PrematureInptrEnd	1	End of INPTR job list before data structure was read.
			PrematureOutptrEnd	2	End of OUTPTR job list before data structure was read.
			DmaError	4	Bus error during DMA access.

8.3.5.16 ENABLE

Address offset: 0x500

Enable AAR

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																		A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	ENABLE																																	
			Disabled	0																															
			Enabled	3																															

8.3.5.17 MAXRESOLVED

Address offset: 0x508

Maximum number of IRKs to resolve

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																								A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000001				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW	MAXRESOLVED		1..4095																															
				After MAXRESOLVED number of IRKs have been resolved, AAR will stop processing and generate the END event																															

8.3.5.18 IN

IN EasyDMA channel

8.3.5.18.1 IN.PTR

Address offset: 0x530

Input pointer

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	PTR																																	

8.3.5.19 OUT

OUT EasyDMA channel

8.3.5.19.1 OUT.PTR

Address offset: 0x538

Output pointer

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			Output pointer

8.3.5.19.2 OUT.AMOUNT

Address offset: 0x53C

Number of bytes transferred in the last transaction

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																									A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT		[1..255]	Number of bytes written to memory after triggering the START task. Each resolved IRK index uses two bytes.

8.4 AXONS — Neural processing unit

Axon NPU is an ultra-low power neural network accelerator built for artificial intelligence (AI) and machine learning (ML) applications. It enables real-time processing while keeping power consumption to a minimum, making it perfect for IoT edge computing where battery life is critical.

> **Note:** Axon NPU is only available in selected device variants. For more information on Axon NPU device availability, see Product overview on page 9.

The main features of Axon NPU are the following:

- Fast and power efficient execution of neural network operators
- End-to-end execution with little to no CPU intervention for most operators
- Support for quantized int8 models.
- Flexible DMA and execution pipeline that can support many functions beyond traditional neural network operators
- Compatible with a software tool chain and driver that stay up to date with growing Axon NPU functionality
- Acceleration of int24 DSP vector operations square root, natural log, exponent, and FFT

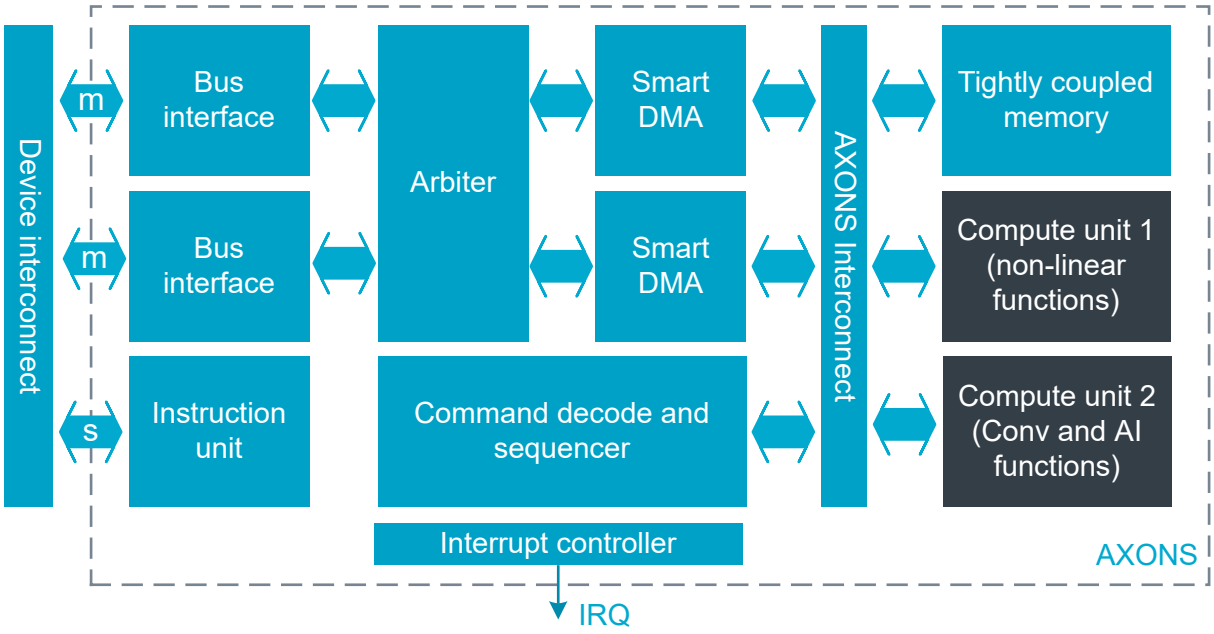


Figure 44: Block diagram

Optimized for battery-powered devices, Axon NPU is a high-performance yet energy-efficient solution for wearables, security systems, health monitoring, and other IoT applications. By reducing power usage, it extends system battery life without compromising processing speed, ensuring reliable performance even in resource-limited environments.

Axon NPU is intended for use with the libraries in Nordic Semiconductor device SDKs. Base operations include convolution (1D and 2D), Fully Connected, Add, Multiply, and Pooling (average and max). See the Axon NPU toolchain documentation for a complete list of limits and currently supported functionality.

8.4.1 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
AXONS : S AXONS : NS	GLOBAL	0x50056000 0x40056000	US	S	SA	No	Neural processing unit

Configuration

Instance	Domain	Configuration
AXONS : S AXONS : NS	GLOBAL	

Register overview

Register	Offset	TZ	Description
ENABLE	0x400		Enable AXONS.
STATUS	0x404		Status

8.4.1.1 ENABLE

Address offset: 0x400

Enable AXONS.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	EN																																	
			Disabled	0																															
			Enabled	1																															

ID	R/W	Field	Value ID	Value	Description
A	RW	EN			Enable
			Disabled	0	AXONS disabled (powered off).
			Enabled	1	AXONS enabled.

8.4.1.2 STATUS

Address offset: 0x404

Status

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	READY																																	
			NotReady	0																															
			Ready	1																															

ID	R/W	Field	Value ID	Value	Description
A	R	READY			AXONS ready
			NotReady	0	AXONS is not yet accessible
			Ready	1	AXONS is accessible

8.5 CCM — AES CCM mode encryption

Counter with cipher block chaining - message authentication code (CCM) mode is an authenticated encryption algorithm designed to provide both authentication and confidentiality (encryption/decryption) during data transfer.

The main features of CCM are:

- Memory-to-memory packet encryption and decryption operations using Scatter/Gather DMA
- Support for Bluetooth requirements and algorithm as defined in IETF RFC3610
- Support for IEEE 802.15.4
- Concurrent operation with RADIO

AES CCM combines counter (CTR) mode encryption and cipher block chaining - message authentication code (CBC-MAC) authentication. The CCM terminology message authentication code (MAC) is called message integrity check (MIC) in *Bluetooth* terminology, and also in this document.



Figure 45: CCM Overview

CCM generates an encrypted keystream that is applied to input data using the XOR operation and generates an M byte MAC field in one operation. CCM and RADIO can be configured to work

synchronously. CCM will encrypt in time for transmission and decrypt after receiving bytes into memory from the radio. All operations can complete within the packet RX or TX time. CCM on this device is implemented to support the Bluetooth requirements and the algorithm as defined in IETF RFC3610, and depends on the AES-128 block cipher. A description of the CCM algorithm can also be found in NIST Special Publication 800-38C. The Bluetooth specification describes the configuration of counter mode blocks and encryption blocks to implement compliant encryption for Bluetooth Low Energy.

CCM uses EasyDMA to read/write additional authenticated data, plain text and cipher text.

Two operations are supported:

- Packet encryption
- Packet decryption

All operations are done in compliance with the *Bluetooth Core Specification*, as well as IEEE 802.15.4.

8.5.1 Shared resources

The CCM shares the same AES module as the AAR and ECB peripherals. The ECB will always have the lowest priority. If an operation is aborted due to a conflict among the shared resources, an ERROR event will be generated.

Additionally, the CCM shares registers and other resources with the peripherals that have the same ID as the CCM. See Peripherals with shared ID on page 229 for more information.

8.5.2 Encryption and decryption

CCM supports both packet encryption and decryption.

The following table shows the different CCM input/output and parameters supported by the CCM module for encryption and decryption:

Parameter	Valid input	Description
M	0, 4, 6, 8, 10, 12, 14, 16	Number of bytes in the authentication field
L	2 (fixed)	Number of bytes in the length field
l(a)	0-65279	Number of bytes in additional authenticated data
l(m)	0-(65535 - M)	Number of bytes in the message to authenticate and encrypt
l(c)	0-65535	Number of bytes in the encrypted message; l(m) + M bytes
a	l(a) number of bytes	Additional authenticated data
m	l(m) number of bytes	Message to authenticate and encrypt
c	l(c) number of bytes	Encrypted message

Table 39: CCM Parameters

In addition to the parameters listed above, the CCM requires two sets of data: a 128-bit key and a 128-bit nonce. These are supplied via dedicated register interfaces: KEY.VALUE registers for the 128-bit key, and NONCE.VALUE registers for the 128-bit nonce. The 128-bit key in the KEY.VALUE registers is stored in reverse byte order relative to the payload. For example, using the sample session key from the Bluetooth Core Specification v5.4, Volume 6, Part C, chapter 1.2:

- Session Key (SK): 99AD1B5226A37E3E058E3B8E27C2C666

The KEY.VALUE registers are populated as follows:

- KEY.VALUE[0] = `0x27C2C666`
- KEY.VALUE[1] = `0x058E3B8E`
- KEY.VALUE[2] = `0x26A37E3E`
- KEY.VALUE[3] = `0x99AD1B52`

The same reverse byte order is used for the NONCE.VALUE registers. For the packet example "3. Data packet1" with the following values:

- IV: DEAFBABEBADCAB24
- Direction Bit: 1
- Packet Counter: 1

The NONCE.VALUE registers are populated as follows:

- NONCE.VALUE[0] = `0xBEBAAFDE`
- NONCE.VALUE[1] = `0x24ABDCBA`
- NONCE.VALUE[2] = `0x00000080`
- NONCE.VALUE[3] = `0x00000001`

Note: Although the NONCE in the example above is 13 bytes, it must be written as a 16-byte value with the first 3 bytes zero-padded.

Note: The KEY and NONCE byte order is reversed compared to the NRF52 and NRF53 series devices.

8.5.2.1 Encryption

During packet encryption, CCM will read the unencrypted packet located in memory at the address specified in register IN.PTR, encrypt the packet and append an M byte long message authentication code (MAC) field to the packet.

The message to authenticate and encrypt (m) and additional authenticated data (a) are included in the MAC generation. The first byte in the packet header can be masked by configuring the ADATAMASK register. This is useful for Bluetooth header masking. For protocols other than Bluetooth, the ADATAMASK register must be set to 0xFF for correct CCM operation; the reset value is configured to support Bluetooth.

Encryption is started by triggering the START task with the MODE register set to `Encryption`. The END event will be generated when packet encryption is completed.

The AES CCM will modify the l(c) output field of the packet to adjust for the appended MAC field, that is, add MODE.MACLEN bytes to l(m), and store the resulting packet back into memory at the locations specified in the OUT.PTR list, as illustrated in the following figure. The maximum length of l(m) plus MODE.MACLEN cannot exceed 65535 bytes.

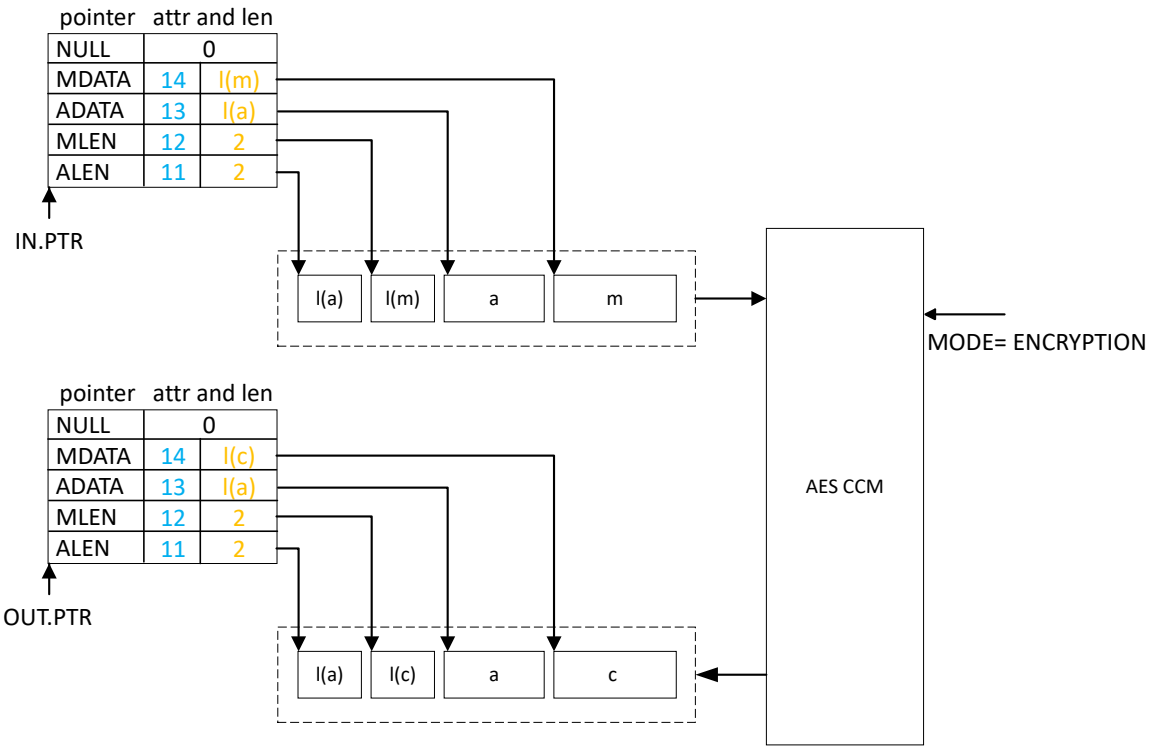


Figure 46: Encryption

If the following occurs, the ERROR event is generated, the CCM stops, and the ERRORSTATUS register will report the type of error that triggered the ERROR event:

- The IN.PTR job list ends before reading out the complete CCM data structure
- The OUT.PTR job list ends before writing out the complete encrypted CCM data structure
- The CCM is not able to operate fast enough to run concurrently with the RADIO as the RADIO transmits the encrypted packet.
- The EasyDMA engine encounters an error, see EasyDMA and ERROR event on page 257

Any values of l(m) and l(a) are allowed. If encrypting empty packets, i.e. l(m) = l(a) = 0, no encryption will take place; the END event is generated, and CCM operation is stopped.

For Bluetooth (MODE.PROTOCOL=`Ble`), valid packets with 0 payload (l(a) is larger than 0 but l(m) is 0) will not be authenticated but instead moved unmodified through the AES CCM peripheral, and thus no MAC will be generated.

For IEEE 802.15.4 (MODE.PROTOCOL=`Ieee802154`), valid packets with 0 payload (l(a) is larger than 0 but l(m) is 0) will be authenticated, and thus a MAC will be generated as part of the output data.

8.5.2.2 Decryption

During packet decryption, CCM will read the encrypted packet located in memory at the address specified in the IN.PTR pointer, decrypt the packet, authenticate the packet's MAC field and generate the appropriate MAC status.

The encrypted message in (c), is decrypted and authenticated together with additional authenticated data (a) and then matched against the decrypted MAC value. The decrypted MAC value is part of (c). Bits in the first byte of the data can be masked away before calculating the MAC value by configuring the ADATAMASK register. This is useful for Bluetooth header masking. For protocols other than Bluetooth, the ADATAMASK register must be set to 0xFF for correct CCM operation; the reset value is configured to support Bluetooth.

Decryption is started by triggering the START task with the MODE register set to `FastDecryption`.

CCM will write the l(m) value of the decrypted packet to the location provided in OUT.PTR, and then store the decrypted packet into memory at the locations given by the OUT.PTR list as illustrated in the following figure.

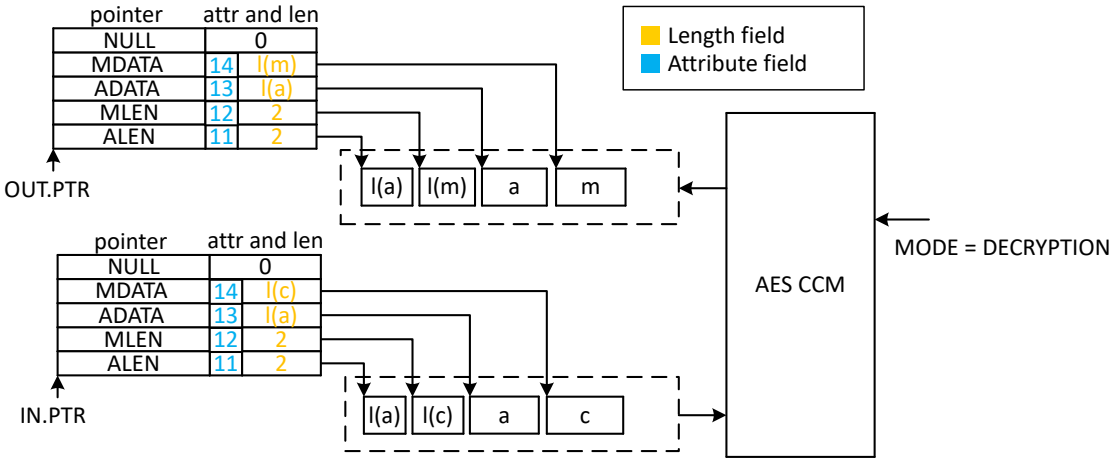


Figure 47: Decryption

For Bluetooth (MODE.PROTOCOL=`Ble`), CCM is only able to authenticate messages where l(c) is at least MACLEN+1 bytes long. If l(c) is less than MACLEN+1, CCM will generate an END event and clear the MACSTATUS (indicating MAC check failure). Furthermore, empty packets (l(c)=0) will be moved unmodified through the AES CCM peripheral even though ERROR event shall be generated. In any other case that leads to a failed MACSTATUS or an ERROR event, the contents of the job addresses given in OUT.PTR are undefined.

For IEEE 802.15.4 (MODE.PROTOCOL=`Ieee802154`), CCM will also perform authentication on messages where only ADATA is present (i.e. l(m)=0 and l(a)>0). In this case MACSTATUS reflects the result of the authentication. If l(c)<MACLEN, then the ERROR event is generated, and the contents of the locations given in OUT.PTR are undefined.

If the following occurs, the ERROR event is generated, and CCM is stopped.

- The IN.PTR job list ends before reading out the complete CCM data structure
- The OUT.PTR job list ends before writing out the complete decrypted CCM data structure
- The EasyDMA engine encounters an error, see EasyDMA and ERROR event on page 257

If the IN.PTR or OUT.PTR job lists do not end before the complete encrypted/decrypted CCM data structures are read, the END event is generated and CCM operation is stopped.

8.5.3 Encrypting packets in radio transmit mode

When the AES CCM is encrypting a packet at the same time as the radio is transmitting it, the radio must read the encrypted packet from the same memory location as the AES CCM is writing to.

The OUT.PTR pointer in the AES CCM must therefore point to the same memory location as the PACKETPTR pointer in the radio, see Example configuration of encryption during radio transmission on page 255.

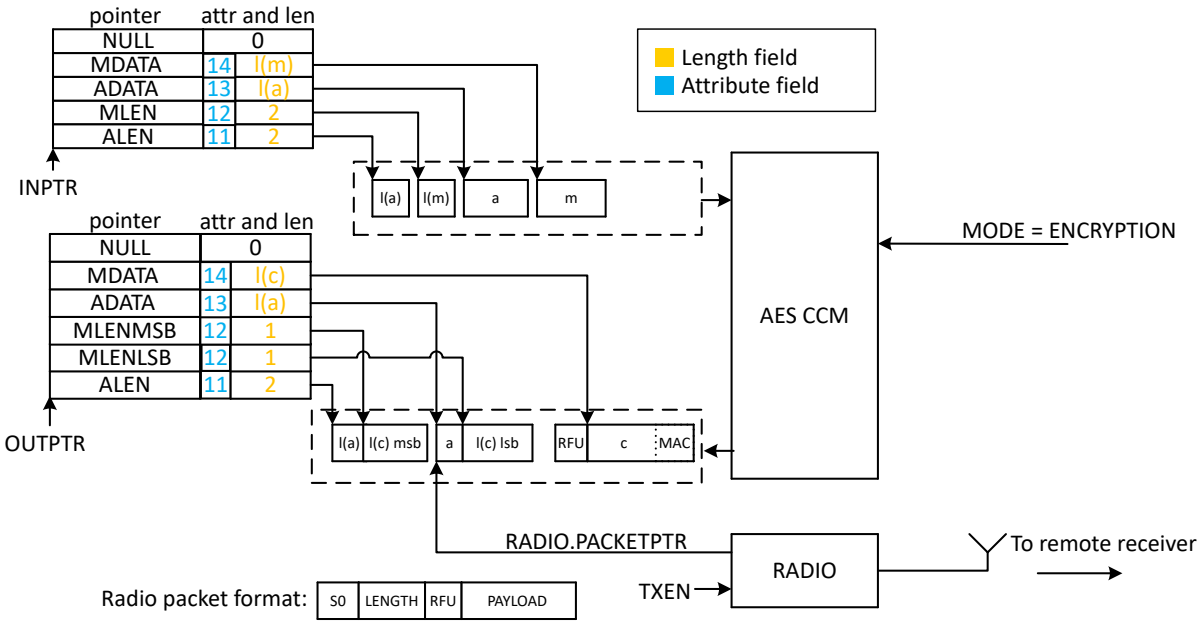


Figure 48: Example configuration of encryption during radio transmission

The START task must be triggered by RADIO READY event to ensure that the payload is encrypted in time for radio transmission. This is illustrated in the following figure, using a PPI connection between RADIO.EVENTS_READY and CCM.TASKS_START.

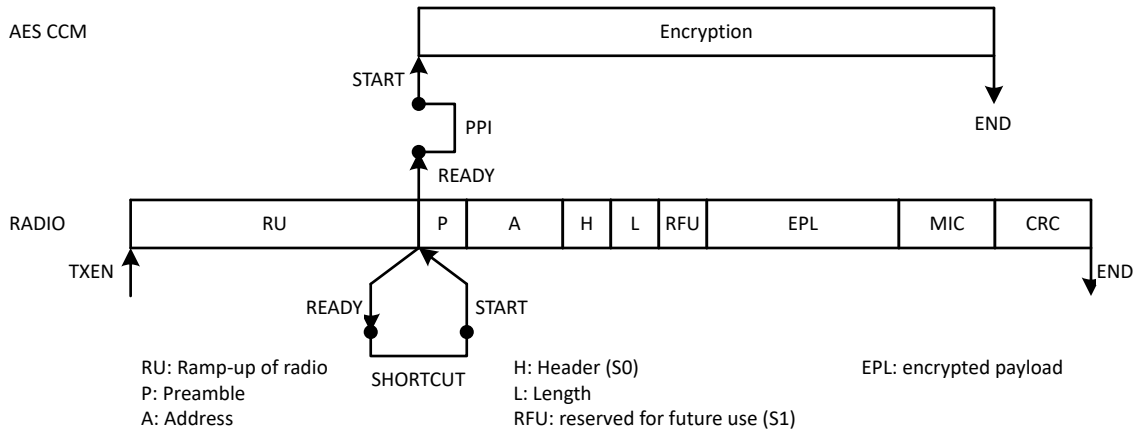


Figure 49: Radio transmission with encryption using a PPI connection

8.5.4 Decrypting packets received by the radio

To decrypt a packet received by the radio immediately upon its reception, CCM can be started when the RADIO PAYLOAD event is generated. The packet is decrypted when the CCM.END event is generated. Typically, CCM will decrypt the packet before or during the reception of the CRC. However, if the packet is large and the bitrate is high, CCM will not finish before the PHYEND event, but shortly afterward. After the CCM.END event is generated; the MACSTATUS can be checked.

AES CCM must therefore operate on the same memory location as RADIO, as illustrated in the following figure.

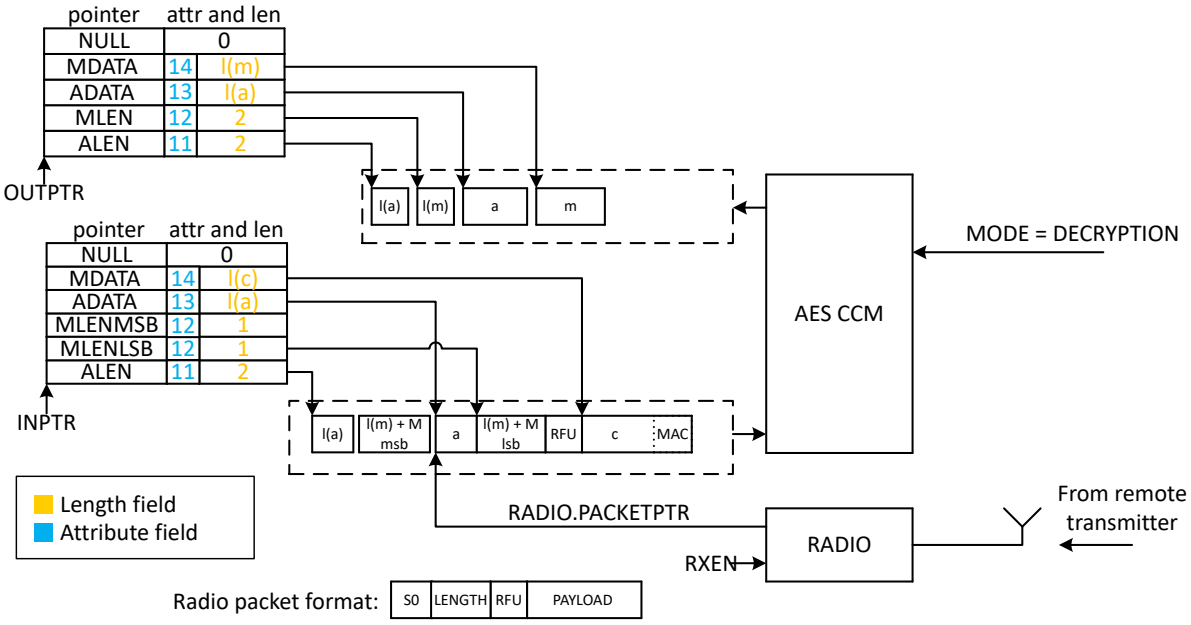


Figure 50: Example configuration of CCM for decrypting a packet as it is received by the RADIO

8.5.5 CCM data structure

The input and output data structures are located in memory specified by IN.PTR and OUT.PTR on page 264 respectively.

Both IN.PTR and OUT.PTR point to a scatter/gather job list. This job list must contain all the fields listed in the attribute field table. Each job list must be terminated with a 0 filled job entry. If either of the IN.PTR or OUT.PTR job list is not terminated, then the behavior of CCM is undefined.

The job list consists of one or more job entries each containing a 32-bit address field, an 8-bit attribute field, and a 24-bit length field. A job list ends with a zero-filled job entry. The EasyDMA job list example below illustrates a job list that points to three different memory sections with varying lengths. The data pointed to by the job list is fed into the module to be processed according to the CCM operation. Job entries with a length greater than one byte are processed in little endian order.

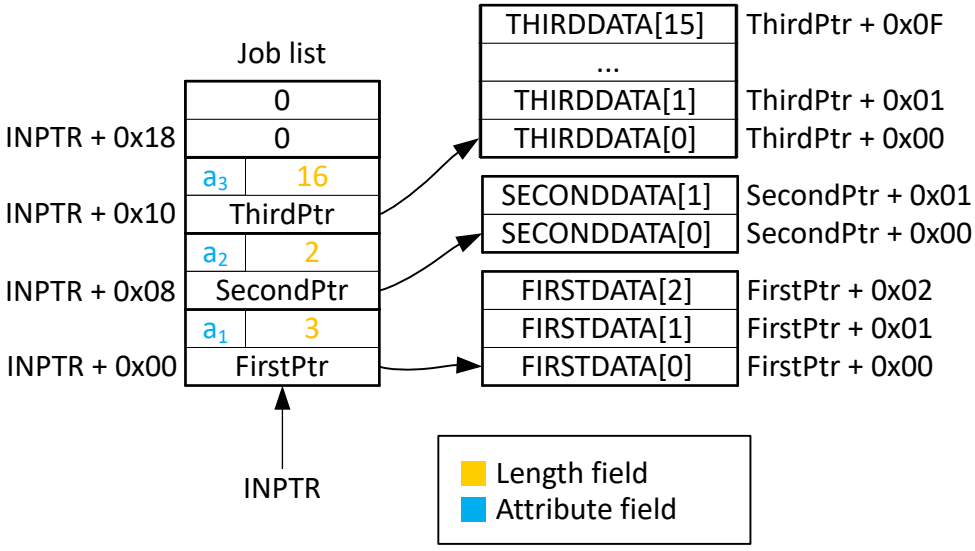


Figure 51: EasyDMA job list example

The attribute field identifies the job and must be set according to the following table.

Attribute	Value
Alen	11
Mlen	12
Adata	13
Mdata	14

Table 40: Attribute field

8.5.6 EasyDMA and ERROR event

The CCM implements an EasyDMA with scatter/gather mechanism for reading and writing to memory.

In cases where the CPU and other EasyDMA enabled peripherals are accessing the same RAM block at the same time, a high level of bus collisions may cause too slow operation for correct on the fly encryption. In this case the ERROR event will be generated.

EasyDMA will have finished accessing the memory when the END event is generated.

If the IN.PTR and the OUT.PTR are not pointing to memory with DMA connectivity, an EasyDMA transfer may result in a HardFault or memory corruption. See Memory on page 13 for more information about the different memory regions.

For instances supporting DMA error detection, the ERRORSTATUS register will report if a bus error has occurred during DMA access.

8.5.7 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
CCM00 : S CCM00 : NS	GLOBAL	0x5004A000 0x4004A000	US	S	SA	No	AES CCM mode encryption CCM00, running of HCLKCORE

Configuration

Instance	Domain	Configuration
CCM00 : S CCM00 : NS	GLOBAL	Does not support on-the-fly decryption.

Register overview

Register	Offset	TZ	Description
TASKS_START	0x000		Start encryption/decryption. This operation will stop by itself when completed.
TASKS_STOP	0x004		Stop encryption/decryption
TASKS_RATEOVERRIDE	0x008		Override DATARATE setting in MODE register with the contents of the RATEOVERRIDE register for any ongoing encryption/decryption
SUBSCRIBE_START	0x080		Subscribe configuration for task START
SUBSCRIBE_STOP	0x084		Subscribe configuration for task STOP
SUBSCRIBE_RATEOVERRIDE	0x088		Subscribe configuration for task RATEOVERRIDE
EVENTS_END	0x104		Encrypt/decrypt complete or ended because of an error

Register	Offset	TZ	Description
EVENTS_ERROR	0x108		CCM error event
PUBLISH_END	0x184		Publish configuration for event END
PUBLISH_ERROR	0x188		Publish configuration for event ERROR
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
MACSTATUS	0x400		MAC check result
ERRORSTATUS	0x404		Error status
ENABLE	0x500		Enable
MODE	0x504		Operation mode
KEY.VALUE[n]	0x510		128-bit AES key
NONCE.VALUE[n]	0x520		13-byte NONCE vector Only the lower 13 bytes are used
IN.PTR	0x530		Input pointer Points to a job list containing unencrypted CCM data structure in Encryption mode Points to a job list containing encrypted CCM data structure in Decryption mode
OUT.PTR	0x538		Output pointer Points to a job list containing encrypted CCM data structure in Encryption mode Points to a job list containing decrypted CCM data structure in Decryption mode
RATEOVERRIDE	0x544		Data rate override setting.
ADATAMASK	0x548		CCM adata mask.

8.5.7.1 TASKS_START

Address offset: 0x000

Start encryption/decryption. This operation will stop by itself when completed.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_START			Start encryption/decryption. This operation will stop by itself when completed.
			Trigger	1	Trigger task

8.5.7.2 TASKS_STOP

Address offset: 0x004

Stop encryption/decryption

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Stop encryption/decryption
			Trigger	1	Trigger task

8.5.7.3 TASKS_RATEOVERRIDE

Address offset: 0x008

Override DATARATE setting in MODE register with the contents of the RATEOVERRIDE register for any ongoing encryption/decryption

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_RATEOVERRIDE			Override DATARATE setting in MODE register with the contents of the RATEOVERRIDE register for any ongoing encryption/decryption
			Trigger	1	Trigger task

8.5.7.4 SUBSCRIBE_START

Address offset: 0x080

Subscribe configuration for task START

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task START will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.5.7.5 SUBSCRIBE_STOP

Address offset: 0x084

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.5.7.6 SUBSCRIBE_RATEOVERRIDE

Address offset: 0x088

Subscribe configuration for task RATEOVERRIDE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task RATEOVERRIDE will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.5.7.7 EVENTS_END

Address offset: 0x104

Encrypt/decrypt complete or ended because of an error

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_END			Encrypt/decrypt complete or ended because of an error
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.5.7.8 EVENTS_ERROR

Address offset: 0x108

CCM error event

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_ERROR			CCM error event
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.5.7.9 PUBLISH_END

Address offset: 0x184

Publish configuration for event END

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event END will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.5.7.10 PUBLISH_ERROR

Address offset: 0x188

Publish configuration for event ERROR

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event ERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.5.7.11 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	END			Write '1' to enable interrupt for event END
	W1S				
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW	ERROR			Write '1' to enable interrupt for event ERROR
	W1S				
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.5.7.12 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	END			Write '1' to disable interrupt for event END
	W1C				
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW	ERROR			Write '1' to disable interrupt for event ERROR
	W1C				
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.5.7.13 MACSTATUS

Address offset: 0x400

MAC check result

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	MACSTATUS																																	
			CheckFailed	0																															
			CheckPassed	1																															

8.5.7.14 ERRORSTATUS

Address offset: 0x404

Error status

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	ERRORSTATUS																																	
			NoError	0																															
			PrematureInptrEnd	1																															
			PrematureOutptrEnd	2																															
			EncryptionTooSlow	3																															
			DmaError	4																															

8.5.7.15 ENABLE

Address offset: 0x500

Enable

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																		A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	ENABLE																																	
			Disabled	0																															
			Enabled	2																															

8.5.7.16 MODE

Address offset: 0x504

Operation mode

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D C C C B B A A
Reset 0x00000001				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	MODE			The mode of operation to be used. The settings in this register apply when the CRYPT task is triggered.
			Encryption	0	AES CCM packet encryption mode
			Decryption	1	This mode will run CCM decryption in the speed of the DATARATE field. This enumerator is deprecated.
			FastDecryption	2	AES CCM decryption mode.
				3	
B	RW	PROTOCOL			Protocol and packet format selection
			Ble	0	Bluetooth Low Energy packet format
			Ieee802154	1	802.15.4 packet format
				2	
				3	
C	RW	DATARATE			Radio data rate that the CCM shall run synchronous with
			125Kbit	0	125 Kbps
			250Kbit	1	250 Kbps
			500Kbit	2	500 Kbps
			1Mbit	3	1 Mbps
			2Mbit	4	2 Mbps
			4Mbit	5	4 Mbps
D	RW	MACLEN			CCM MAC length (bytes)
			M0	0	M = 0 This is a special case for CCM* where encryption is required but not authentication
			M4	1	M = 4
			M6	2	M = 6
			M8	3	M = 8
			M10	4	M = 10
			M12	5	M = 12
			M14	6	M = 14
			M16	7	M = 16

8.5.7.17 KEY.VALUE[n] (n=0..3)

Address offset: 0x510 + (n × 0x4)

128-bit AES key

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	VALUE			AES 128-bit key value, bits (32*(i+1))-1 : (32*i)

8.5.7.18 NONCE.VALUE[n] (n=0..3)

Address offset: 0x520 + (n × 0x4)

13-byte NONCE vector

Only the lower 13 bytes are used

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	VALUE			NONCE value, bits (32*(n+1))-1 : (32*n)

8.5.7.19 IN

IN EasyDMA channel

8.5.7.19.1 IN.PTR

Address offset: 0x530

Input pointer

Points to a job list containing unencrypted CCM data structure in Encryption mode

Points to a job list containing encrypted CCM data structure in Decryption mode

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			Input pointer

8.5.7.20 OUT

OUT EasyDMA channel

8.5.7.20.1 OUT.PTR

Address offset: 0x538

Output pointer

Points to a job list containing encrypted CCM data structure in Encryption mode

Points to a job list containing decrypted CCM data structure in Decryption mode

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			Output pointer

8.5.7.21 RATEOVERRIDE

Address offset: 0x544

Data rate override setting.

Override value to be used instead of the setting of MODE.DATARATE. This override value applies when the RATEOVERRIDE task is triggered.

Note: The override is only applied when operating in BLE Long Range mode.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																	A	A	A
Reset 0x00000002				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	RATEOVERRIDE																																	
			125Kbit	0																															
			500Kbit	2																															
			1Mbit	3																															
			2Mbit	4																															
			4Mbit	5																															

8.5.7.22 ADATAMASK

Address offset: 0x548

CCM adata mask.

Bitmask for the first adata byte. The masking is done before MAC generation/authentication.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																												A	A	A	A	A	A	A	A
Reset 0x000000E3				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW	ADATAMASK																																	

8.6 COMP — Comparator

The comparator peripheral (COMP) compares one input voltage (VIN+) against another input voltage (VIN-). VIN+ can be derived from an analog input pin (**AIN0** to **AIN7**). VIN- can be derived from multiple sources depending on the operation mode of the comparator.

The main features of COMP are the following:

- Input range from 0 V to VDD
- Single-ended mode
  - Fully flexible hysteresis using a 64-level reference ladder
- Differential mode
  - Configurable hysteresis
- Reference inputs (VREF)
  - External reference from **AIN0** to **AIN7** (between 0 V and VDD)
  - Internal VDD reference
  - 1.2 V internal reference
- Two speed/power consumption modes, low-power and high-speed
- Single-pin capacitive sensor support
- Event generation on output changes
  - UP event when VIN+ rises above VIN- (VIN+ > VIN-)
  - DOWN event when VIN+ falls below VIN- (VIN+ < VIN-)
  - CROSS event on VIN+ and VIN- crossing
  - READY event on core and internal reference (if used) ready

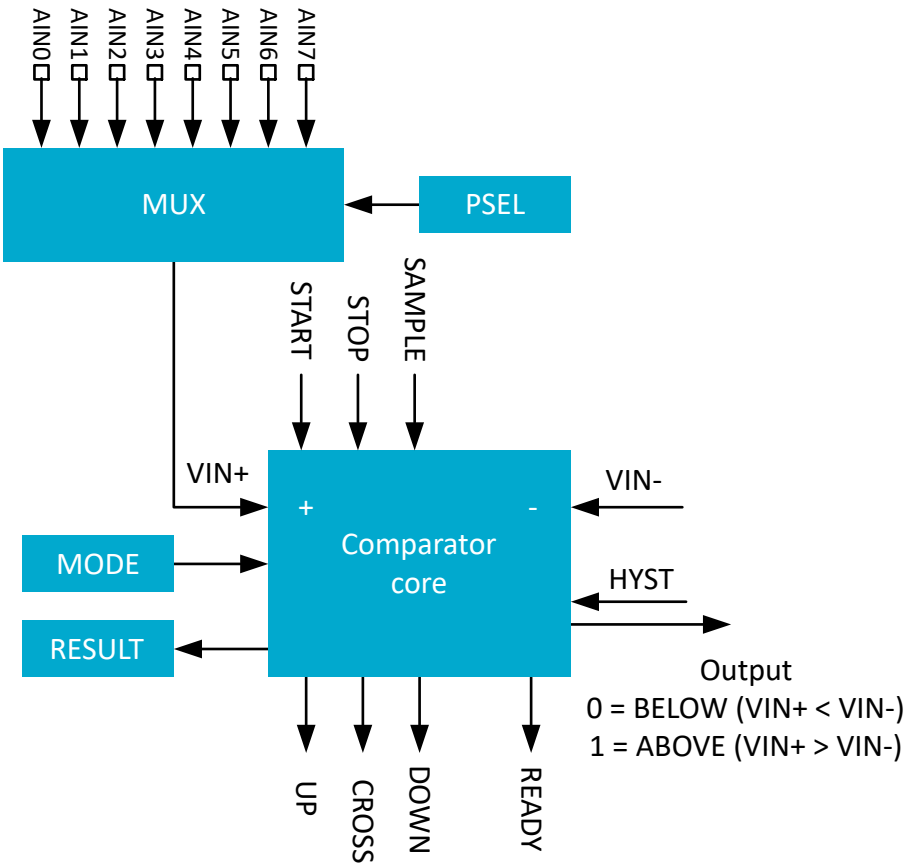


Figure 52: COMP overview

8.6.1 START and STOP tasks

Once enabled through register ENABLE, COMP is started by triggering the START task and stopped by triggering the STOP task. COMP will generate a READY event to indicate when it is ready for use and the output is correct. The delay between START and READY is $t_{INT\_REF,START}$ when an internal reference is selected, or $t_{COMP,START}$ if an external reference is used. When the COMP peripheral is started, events will be generated every time VIN+ crosses VIN-.

8.6.2 Operation modes

COMP can be configured to operate in the two main operation modes, differential mode and single-ended mode. See register MODE for more information. In both operation modes, COMP can operate in different speed and power consumption modes (low-power to high-speed). High-speed mode will consume more power compared to low-power mode. Low-power mode will result in a slower response time compared to high-speed mode.

Use register PSEL to select any of the **AIN[0..7]** pins as the VIN+ input. The COMP operation mode does not matter. The source of VIN- depends on which operation mode is used.

- Differential mode – Derived directly from pins **AIN[0..7]**.
- Single-ended mode – Derived from VREF. VREF can be derived from VDD, **AIN[0..7]**, or internal 1.2 V reference.

The selected analog pins will be acquired by the comparator once it is enabled.

An optional hysteresis on VIN+ and VIN- can be enabled when the module is used in differential mode through the register HYST. In single-ended mode, VUP and VDOWN thresholds can be set to implement

a hysteresis using the reference ladder (see Comparator in single-ended mode on page 269). This hysteresis is in the order of magnitude of $V_{DIFFHYST}$, and prevents noise on the signal to create unwanted events. See Hysteresis example where VIN+ starts below VUP on page 270 for an illustration of the effect of an active hysteresis on a noisy input signal.

An upward crossing will generate an UP event and a downward crossing will generate a DOWN event. The CROSS event will be generated every time there is a crossing, independent of direction.

The immediate value of the comparator can be sampled to register RESULT by triggering the SAMPLE task.

8.6.3 Current source on analog input

A selectable current can be applied through register ISOURCE on the selected AIN[n] line. Enabling the block creates a feedback path around the comparator, forming a relaxation oscillator. The circuit will sink current from VIN+ when the comparator output is high, and source current into VIN+ when the comparator output is low. The frequency of the oscillator is dependent on the capacitance at the analog input pin, the reference voltages, and the value of the current source. In this mode, only a capacitive sensor needs to be attached between the analog input pin and ground. With a selected current of 10 µA, VUP-VDOWN equal to 1 V, and an external capacity of typically 10 pF, the resulting oscillation frequency is around 500 kHz.

The frequency of the oscillator can be calculated as follows:

```
f_OSC = I_SOURCE / (2C·(VUP-VDOWN) )
```

8.6.4 Shared resources

The COMP shares analog resources with other analog peripherals.

Additionally, COMP shares registers and other resources with other peripherals that have the same ID as the COMP. See Peripherals with shared ID on page 229 for more information.

The COMP peripheral shall not be disabled (by writing to the ENABLE register) before the peripheral has been stopped. Failing to do so may result in unpredictable behavior.

8.6.5 Differential mode

In differential mode, the reference input VIN- is derived directly from one of the AINx pins.

Before enabling the comparator via the ENABLE register, the following registers must be configured for the differential mode:

- PSEL
- MODE
- EXTREFSEL

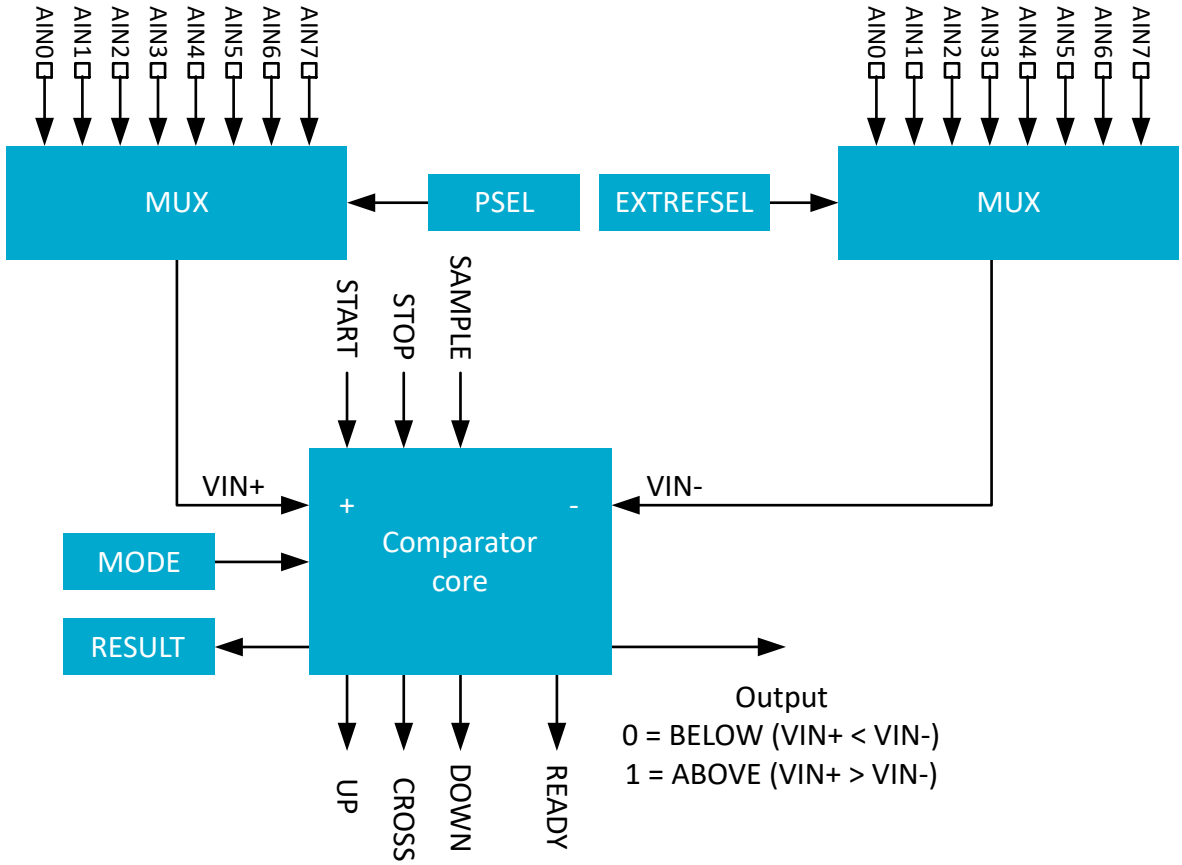


Figure 53: Comparator in differential mode

Note: Depending on the device, not all the analog inputs may be available for each MUX. See definitions for PSEL and EXTREFSEL for more information about which analog pins are available on a particular device.

When HYST register is turned on while in this mode, the output of the comparator (and associated events) will change from ABOVE to BELOW whenever VIN+ becomes lower than VIN- - ($V_{DIFFHYST}$ / 2). It will also change from BELOW to ABOVE whenever VIN+ becomes higher than VIN- + ($V_{DIFFHYST}$ / 2). This behavior is illustrated in Hysteresis enabled in differential mode on page 268.

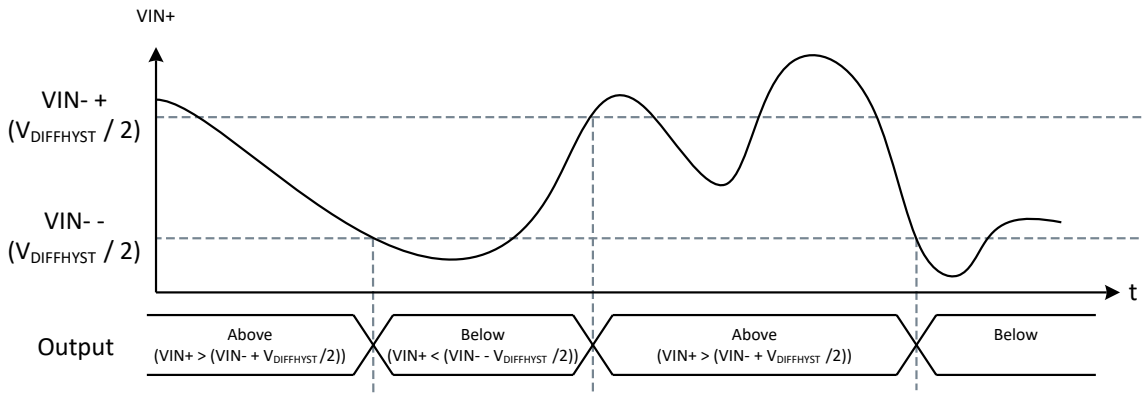


Figure 54: Hysteresis enabled in differential mode

8.6.6 Single-ended mode

In single-ended mode, VIN- is derived from the reference ladder.

Before enabling the comparator via the ENABLE register, the following registers must be configured for the single-ended mode:

- PSEL
- MODE
- REFSEL
- EXTREFSEL
- TH

The reference ladder uses the reference voltage (VREF) to derive two new voltage references, VUP and VDOWN. VUP and VDOWN are configured using THUP and THDOWN respectively in the TH register. VREF can be derived from any of the available reference sources, configured using the EXTREFSEL and REFSEL registers as illustrated in Comparator in single-ended mode on page 269. When AREF is selected in the REFSEL register, the EXTREFSEL register is used to select one of the AIN0-AIN7 analog input pins as reference input. The selected analog pins will be acquired by the comparator once it is enabled.

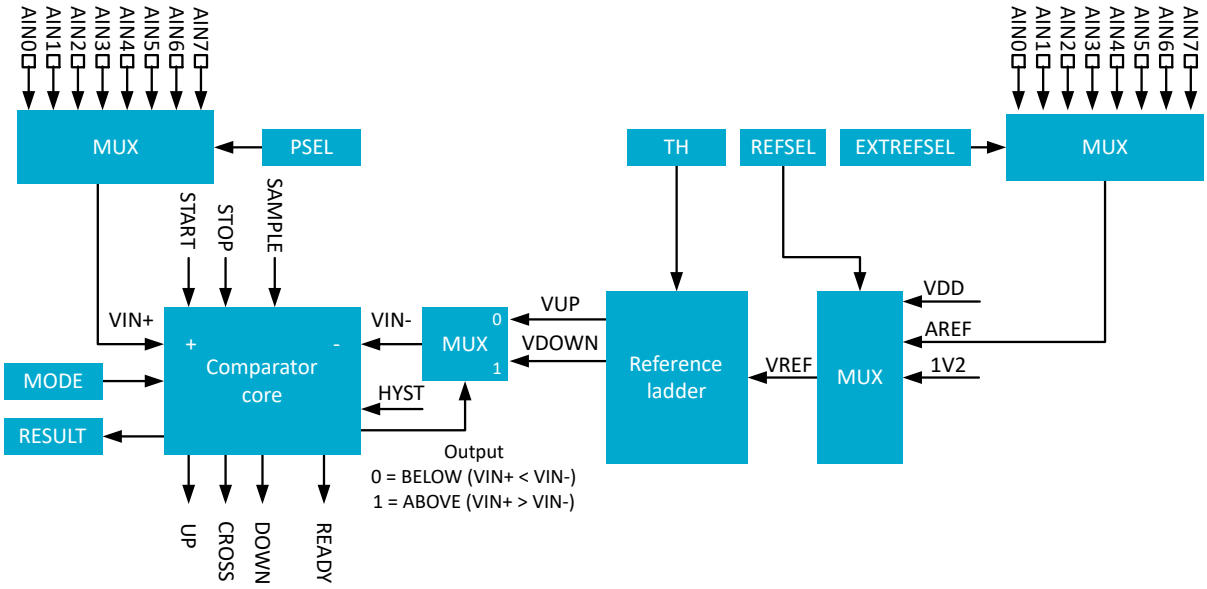


Figure 55: Comparator in single-ended mode

Note: Depending on the device, not all the analog inputs may be available for each MUX. See definitions for PSEL and EXTREFSEL for more information about which analog pins are available on a particular device.

When the comparator core detects that VIN+ > VIN-, i.e. ABOVE as per the RESULT register, VIN- will switch to VDOWN. When VIN+ falls below VIN- again, VIN- will be switched back to VUP. By specifying VUP larger than VDOWN, a hysteresis can be generated as illustrated in Hysteresis example where VIN+ starts below VUP on page 270 and Hysteresis example where VIN+ starts above VUP on page 270.

Writing to HYST has no effect in single-ended mode, and the content of this register is ignored.

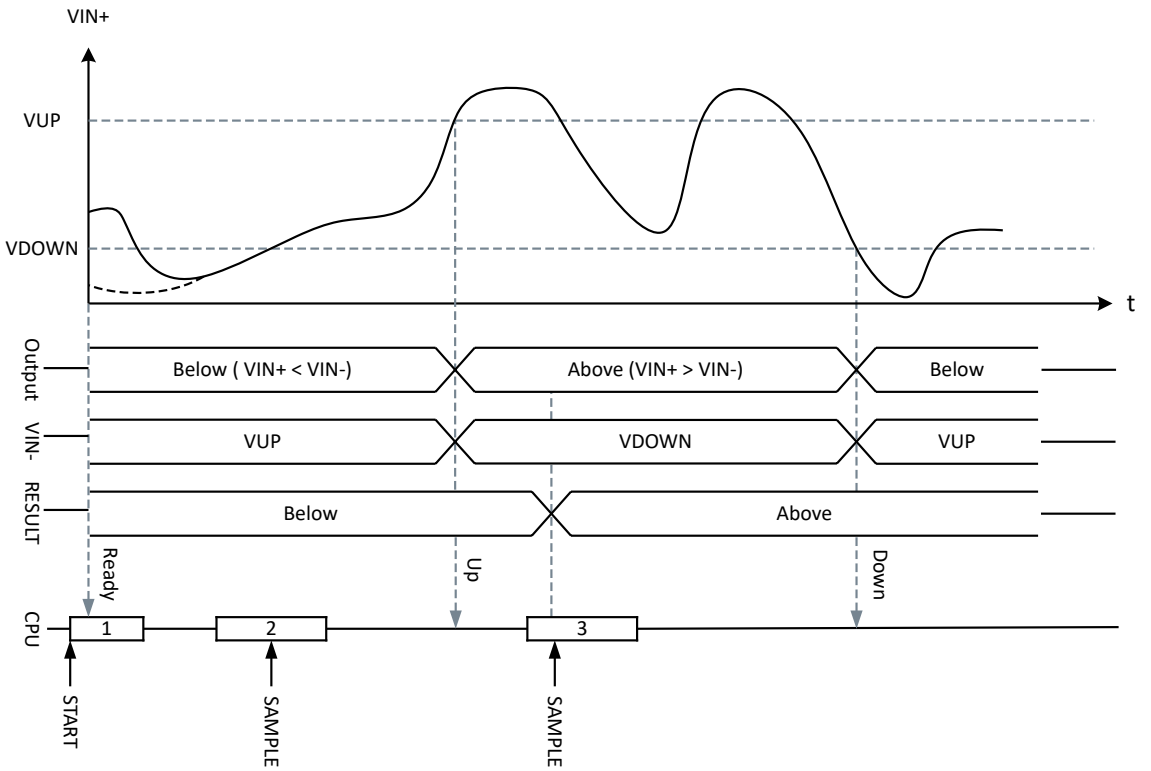


Figure 56: Hysteresis example where VIN+ starts below VUP

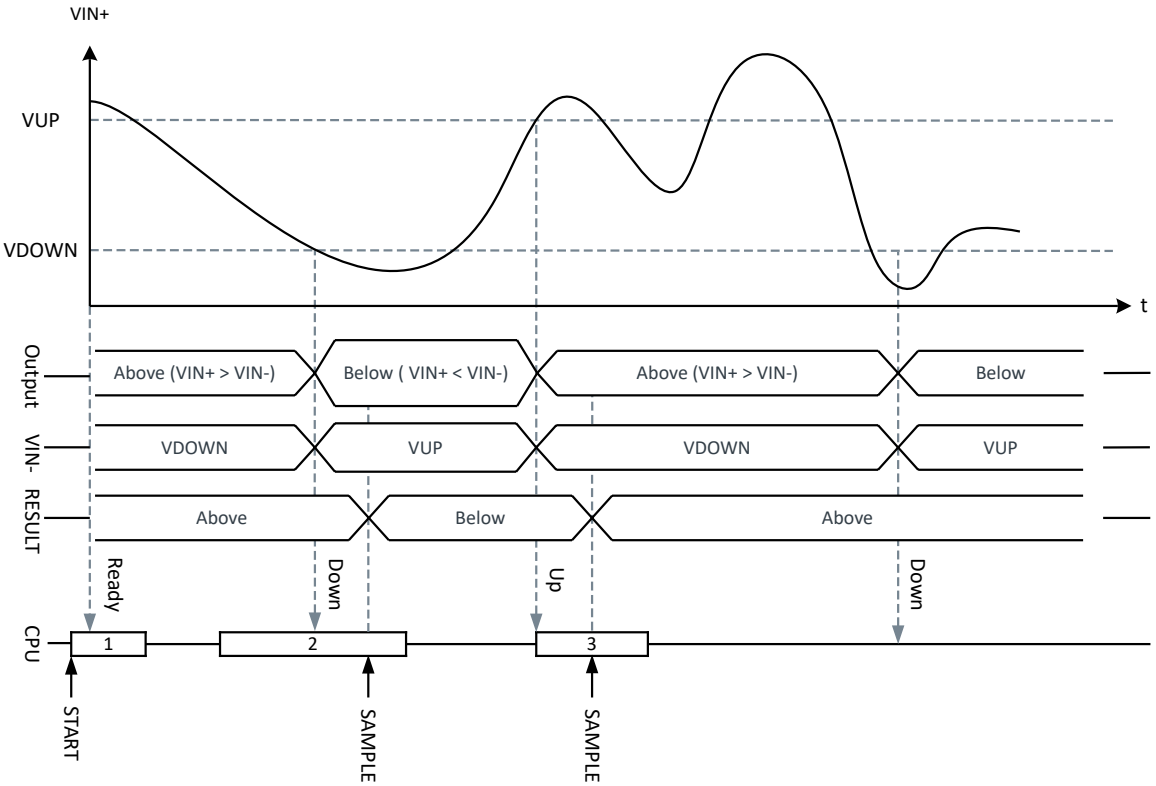


Figure 57: Hysteresis example where VIN+ starts above VUP

8.6.7 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
COMP : S COMP : NS	GLOBAL	0x50106000 0x40106000	US	S	NA	No	Comparator COMP

Register overview

Register	Offset	TZ	Description
TASKS_START	0x000		Start comparator
TASKS_STOP	0x004		Stop comparator
TASKS_SAMPLE	0x008		Sample comparator value. This task requires that COMP has been started by the START Task.
SUBSCRIBE_START	0x080		Subscribe configuration for task START
SUBSCRIBE_STOP	0x084		Subscribe configuration for task STOP
SUBSCRIBE_SAMPLE	0x088		Subscribe configuration for task SAMPLE
EVENTS_READY	0x100		COMP is ready and output is valid
EVENTS_DOWN	0x104		Downward crossing
EVENTS_UP	0x108		Upward crossing
EVENTS_CROSS	0x10C		Downward or upward crossing
PUBLISH_READY	0x180		Publish configuration for event READY
PUBLISH_DOWN	0x184		Publish configuration for event DOWN
PUBLISH_UP	0x188		Publish configuration for event UP
PUBLISH_CROSS	0x18C		Publish configuration for event CROSS
SHORTS	0x200		Shortcuts between local events and tasks
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
INTPEND	0x30C		Pending interrupts
RESULT	0x400		Compare result
ENABLE	0x500		COMP enable
PSEL	0x504		Pin select
REFSEL	0x508		Reference source select for single-ended mode
EXTREFSEL	0x50C		External reference select
TH	0x530		Threshold configuration for hysteresis unit
MODE	0x534		Mode configuration
HYST	0x538		Comparator hysteresis enable
ISOURCE	0x53C		Current source select on analog input

8.6.7.1 TASKS_START

Address offset: 0x000

Start comparator

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_START			Start comparator
			Trigger	1	Trigger task

8.6.7.2 TASKS_STOP

Address offset: 0x004

Stop comparator

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Stop comparator
			Trigger	1	Trigger task

8.6.7.3 TASKS_SAMPLE

Address offset: 0x008

Sample comparator value. This task requires that COMP has been started by the START Task.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_SAMPLE			Sample comparator value. This task requires that COMP has been started by the START Task.
			Trigger	1	Trigger task

8.6.7.4 SUBSCRIBE_START

Address offset: 0x080

Subscribe configuration for task START

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task START will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.6.7.5 SUBSCRIBE_STOP

Address offset: 0x084

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.6.7.6 SUBSCRIBE_SAMPLE

Address offset: 0x088

Subscribe configuration for task SAMPLE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task SAMPLE will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.6.7.7 EVENTS_READY

Address offset: 0x100

COMP is ready and output is valid

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_READY			COMP is ready and output is valid
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.6.7.8 EVENTS_DOWN

Address offset: 0x104

Downward crossing

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_DOWN			Downward crossing
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.6.7.9 EVENTS_UP

Address offset: 0x108

Upward crossing

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	EVENTS_UP																																	
			NotGenerated	0																															
			Generated	1																															

8.6.7.10 EVENTS_CROSS

Address offset: 0x10C

Downward or upward crossing

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	EVENTS_CROSS																																	
			NotGenerated	0																															
			Generated	1																															

8.6.7.11 PUBLISH_READY

Address offset: 0x180

Publish configuration for event READY

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				B																							A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	CHIDX		[0..255]																															
B	RW	EN																																	
			Disabled	0																															
			Enabled	1																															

8.6.7.12 PUBLISH_DOWN

Address offset: 0x184

Publish configuration for event DOWN

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				B																							A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	CHIDX		[0..255]																															
B	RW	EN																																	
			Disabled	0																															
			Enabled	1																															

8.6.7.13 PUBLISH_UP

Address offset: 0x188

Publish configuration for event UP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event UP will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.6.7.14 PUBLISH_CROSS

Address offset: 0x18C

Publish configuration for event CROSS

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event CROSS will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.6.7.15 SHORTS

Address offset: 0x200

Shortcuts between local events and tasks

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	READY_SAMPLE			Shortcut between event READY and task SAMPLE
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
B	RW	READY_STOP			Shortcut between event READY and task STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
C	RW	DOWN_STOP			Shortcut between event DOWN and task STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
D	RW	UP_STOP			Shortcut between event UP and task STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
E	RW	CROSS_STOP			Shortcut between event CROSS and task STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut

8.6.7.16 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	READY			Enable or disable interrupt for event READY
			Disabled	0	Disable
			Enabled	1	Enable
B	RW	DOWN			Enable or disable interrupt for event DOWN
			Disabled	0	Disable
			Enabled	1	Enable
C	RW	UP			Enable or disable interrupt for event UP
			Disabled	0	Disable
			Enabled	1	Enable
D	RW	CROSS			Enable or disable interrupt for event CROSS
			Disabled	0	Disable
			Enabled	1	Enable

8.6.7.17 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1S	READY			Write '1' to enable interrupt for event READY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	DOWN			Write '1' to enable interrupt for event DOWN
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1S	UP			Write '1' to enable interrupt for event UP
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1S	CROSS			Write '1' to enable interrupt for event CROSS
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.6.7.18 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	READY			Write '1' to disable interrupt for event READY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	DOWN			Write '1' to disable interrupt for event DOWN
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	UP			Write '1' to disable interrupt for event UP
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1C	CROSS			Write '1' to disable interrupt for event CROSS
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.6.7.19 INTPEND

Address offset: 0x30C

Pending interrupts

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	READY			Read pending status of interrupt for event READY
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
B	R	DOWN			Read pending status of interrupt for event DOWN
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
C	R	UP			Read pending status of interrupt for event UP
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
D	R	CROSS			Read pending status of interrupt for event CROSS
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending

8.6.7.20 RESULT

Address offset: 0x400

Compare result

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	RESULT			Result of last compare. Decision point SAMPLE task.
			Below	0	Input voltage is below the threshold (VIN+ < VIN-)
			Above	1	Input voltage is above the threshold (VIN+ > VIN-)

8.6.7.21 ENABLE

Address offset: 0x500

COMP enable

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			Enable or disable COMP
			Disabled	0	Disable
			Enabled	2	Enable

8.6.7.22 PSEL

Address offset: 0x504

Pin select

The pin is selected based on PSEL.PORT

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B B B B A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PIN			Analog pin select
B	RW	PORT			GPIO Port selection

8.6.7.23 REFSEL

Address offset: 0x508

Reference source select for single-ended mode

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A
Reset 0x00000004				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	REFSEL			Reference select
			Int1V2	0	VREF = internal 1.2 V reference
			VDD	4	VREF = VDD
			ARef	5	VREF = AREF

8.6.7.24 EXTREFSEL

Address offset: 0x50C

External reference select

The external reference pin is selected based on EXTREFSEL.PORT

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B B B B A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN			External analog reference pin select
B	RW	PORT			GPIO Port selection

8.6.7.25 TH

Address offset: 0x530

Threshold configuration for hysteresis unit

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B B B B B B A A A A A A
Reset 0x00002020				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	THDOWN		[63:0]	VDOWN = (THDOWN+1)/64*VREF
B	RW	THUP		[63:0]	VUP = (THUP+1)/64*VREF

8.6.7.26 MODE

Address offset: 0x534

Mode configuration

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	SP			Speed and power modes
			Low	0	Low-power mode
			Normal	1	Normal mode
			High	2	High-speed mode
B	RW	MAIN			Main operation modes
			SE	0	Single-ended mode
			Diff	1	Differential mode

8.6.7.27 HYST

Address offset: 0x538

Comparator hysteresis enable

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	HYST			Comparator hysteresis
			NoHyst	0	Comparator hysteresis disabled
			Hyst40mV	1	Comparator hysteresis enabled

8.6.7.28 ISOURCE

Address offset: 0x53C

Current source select on analog input

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ISOURCE			Current source select on analog input
			Off	0	Current source disabled
			Ien2uA5	1	Current source enabled (+/- 2.5 uA)
			Ien5uA	2	Current source enabled (+/- 5 uA)
			Ien10uA	3	Current source enabled (+/- 10 uA)

8.7 ECB — AES electronic codebook mode encryption

The AES electronic codebook mode encryption (ECB) can be used for a range of cryptographic functions like hash generation, digital signatures, and keystream generation for data encryption/decryption. The ECB encryption block supports 128 bit AES encryption (encryption only, not decryption).

The main features of ECB are:

- 128-bit AES encryption
- Supports standard AES ECB block encryption
- Memory-to-memory operations using Scatter/Gather DMA

The inputs and outputs of the ECB are illustrated below.

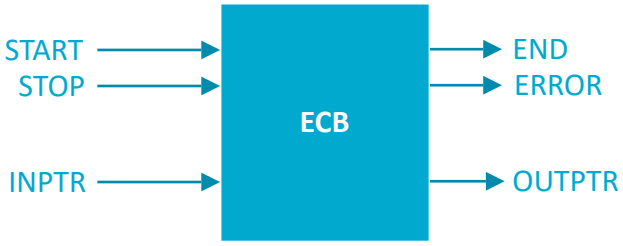


Figure 58: ECB block diagram

AES ECB uses EasyDMA with scatter-gather to access to memory for in-place operations on cleartext and ciphertext during encryption. ECB uses the same AES core as the CCM and AAR blocks and is an asynchronous operation which may not complete if the AES core is busy.

AES ECB performs a 128 bit AES block encrypt. At the START task, cleartext is loaded into the ECB from memory described by the scatter/gather job list pointed to by INPTR and the ciphertext is written into memory described by the job list pointed to by OUTPTR. When the last cleartext byte has been encrypted and written to OUTPTR, the END event is triggered.

The following figure illustrates how the input and output job lists can be configured. For more details of the joblists, see EasyDMA on page 282.

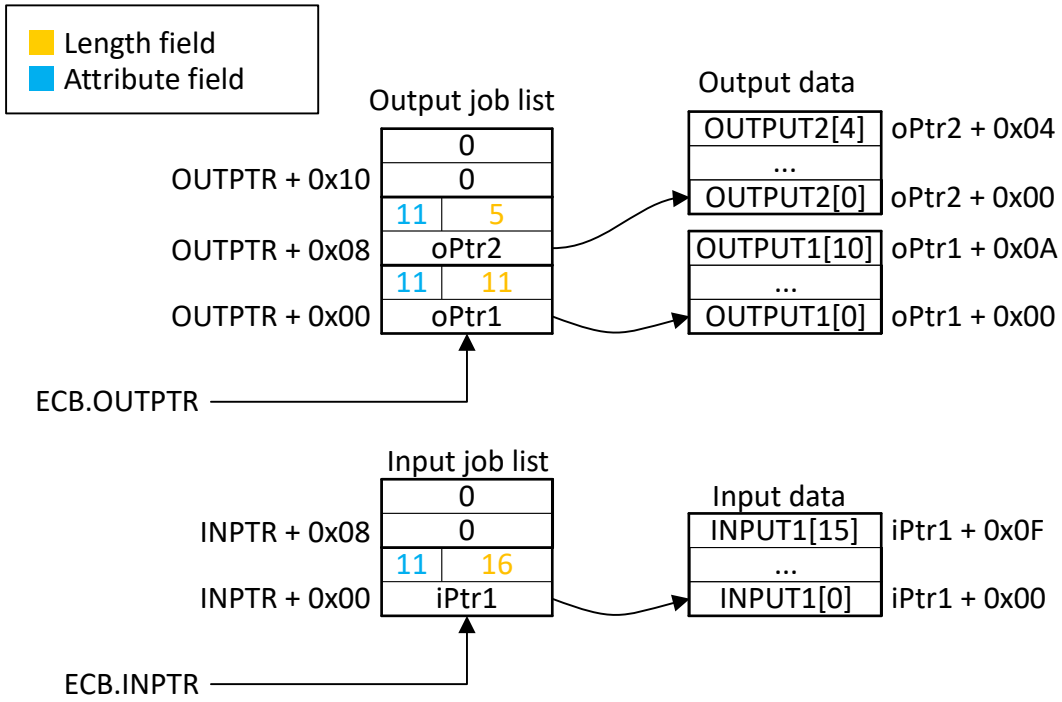


Figure 59: Example job lists for ECB operation

The AES key is set by writing the KEY.VALUE key registers. The same key can be used to encrypt multiple blocks by triggering the START task multiple times.

AES ECB can be stopped by triggering the STOP task.

ECB only supports a single 16-byte block. For different job list sizes the following rules apply:

- If less than 16 bytes is supplied as input, then a PrematureInptrEnd error is triggered. The EVENTS_ERROR will also be set.
- If more than 16 bytes is supplied as input, then only the first 16 bytes are used.
- For an output job, only the number of bytes specified in the job list are copied to memory.

The 128-bit key in the KEY.VALUE registers is stored in reverse byte order relative to the payload. For example, using the sample calculation from the Bluetooth Core Specification v5.4, Volume 6, Part C, chapter 1.1, with the following data:

- Key: 4C68384139F574D836BCF34E9DFB01BF
- Plaintext: 0213243546576879acbdcedfe0f10213
- Expected Encrypted Output: 99ad1b5226a37e3e058e3b8e27c2c666

The KEY.VALUE registers are populated as follows:

- KEY.VALUE[0] = `0x9DFB01BF`
- KEY.VALUE[1] = `0x36BCF34E`

- KEY.VALUE[2] = 0x39F574D8
- KEY.VALUE[3] = 0x4C683841

The IN.PTR points to a job that contains the following 16-byte input data array:

```
{0x02, 0x13, 0x24, 0x35, 0x46, 0x57, 0x68, 0x79, 0xAC, 0xBD, 0xCE, 0xDF, 0xE0,
0xF1, 0x02, 0x13}
```

Once the encryption is complete, the output buffer referenced by the output job will be filled with the following 16-byte array:

```
{0x99, 0xAD, 0x1B, 0x52, 0x26, 0xA3, 0x7E, 0x3E, 0x05, 0x8E, 0x3B, 0x8E, 0x27,
0xC2, 0xC6, 0x66}
```

Note: The KEY byte order is reversed compared to the NRF52 and NRF53 series devices.

8.7.1 Shared resources

The ECB shares the same AES module as the AAR and CCM peripherals. The ECB will always have lowest priority. If there is a sharing conflict during encryption, the ECB operation will be aborted and an ERROR event will be generated.

8.7.2 EasyDMA

This peripheral implements EasyDMA with scatter-gather functionality for reading from and writing to memory without CPU involvement.

The scatter-gather functionality allows EasyDMA to collect data from multiple memory regions, instead of one contigous block. The memory regions are described by a job list. The job list consists of one or more job entries that consist of a 32-bit address field, 8-bit attribute field, and 24-bit length field. A job list ends with a zero filled job entry. The attribute field must be set to 11.

If INPTR or OUTPTR pointers or the entries in the job lists are not pointing to memory connected to the DMA bus, an EasyDMA transfer may result in a HardFault or memory corruption. See Memory on page 13 for more information about the different memory regions and DMA connectivity.

The EasyDMA will have finished accessing the RAM when the END or ERROR events are generated.

For instances supporting DMA error detection, the ERRORSTATUS register will report if a bus error has occurred during DMA access. To see if DMA error detection is supported, see the the instance's configuration in Instantiation on page 232.

Example

The figure below shows an example of a job list with three job entries. Each of the entries point to a memory address, and the length field describes how many bytes of data is stored at that address. There are three blocks of memory in use

- FIRSTDATA, an array of length 3
- SECONDDATA, an array of length 2
- THIRDDATA, an array of length 11

The data pointed to from the job list is what is fed into the module and processed according to the peripheral's operation. The entries of the job list comprises pointers to the individual arrays, as well as their sizes. Job entries with length greater than one are processed in little endian order.

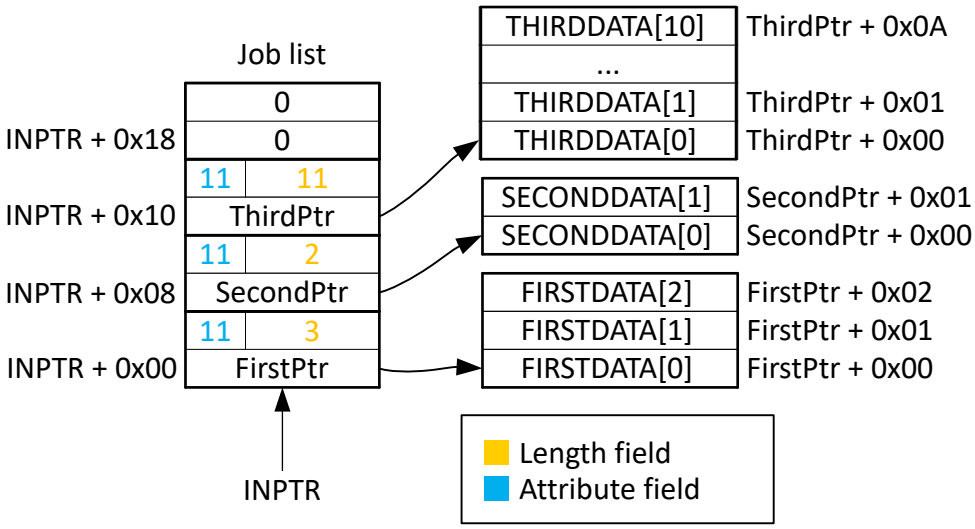


Figure 60: EasyDMA Scatter-Gather job list example

8.7.3 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
ECB00 : S ECB00 : NS	GLOBAL	0x5004B000 0x4004B000	US	S	SA	No	AES ECB mode encryption 00 When configuring this peripheral's DMA security using SPU configuration (DMASEC field of SPU->PERIPH[apb_slave_index]), use apb_slave_index 10 (same as AAR00 and CCM00)

Configuration

Instance	Domain	Configuration
ECB00 : S ECB00 : NS	GLOBAL	

Register overview

Register	Offset	TZ	Description
TASKS_START	0x000		Start ECB block encrypt
TASKS_STOP	0x004		Abort a possible executing ECB operation
SUBSCRIBE_START	0x080		Subscribe configuration for task START
SUBSCRIBE_STOP	0x084		Subscribe configuration for task STOP
EVENTS_END	0x100		ECB block encrypt complete
EVENTS_ERROR	0x104		ECB block encrypt aborted because of a STOP task or due to an error
PUBLISH_END	0x180		Publish configuration for event END

Register	Offset	TZ	Description
PUBLISH_ERROR	0x184		Publish configuration for event ERROR
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
ERRORSTATUS	0x400		Error status
KEY.VALUE[n]	0x510		128-bit AES key
IN.PTR	0x530		Input pointer
OUT.PTR	0x538		Output pointer Points to a job list containing encrypted ECB data structure
CSAA.REFLECTOR	0x53C		Selected Channel Sounding Access Address used in the CS SYNC from Reflector to Initiator
CSAA.INITIATOR	0x540		Selected Channel Sounding Access Address used in the CS SYNC from Initiator to Reflector
CSAA.MODE	0x544		Operation modes

8.7.3.1 TASKS_START

Address offset: 0x000

Start ECB block encrypt

If a crypto operation is already running in the AES core, the START task will not start a new encryption and an ERROR event will be triggered

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_START			Start ECB block encrypt If a crypto operation is already running in the AES core, the START task will not start a new encryption and an ERROR event will be triggered
			Trigger	1	Trigger task

8.7.3.2 TASKS_STOP

Address offset: 0x004

Abort a possible executing ECB operation

If a running ECB operation is aborted by STOP, the ERROR event is triggered.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Abort a possible executing ECB operation If a running ECB operation is aborted by STOP, the ERROR event is triggered.
			Trigger	1	Trigger task

8.7.3.3 SUBSCRIBE_START

Address offset: 0x080

Subscribe configuration for task START

If a crypto operation is already running in the AES core, the START task will not start a new encryption and an ERROR event will be triggered

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task START will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.7.3.4 SUBSCRIBE_STOP

Address offset: 0x084

Subscribe configuration for task STOP

If a running ECB operation is aborted by STOP, the ERROR event is triggered.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.7.3.5 EVENTS_END

Address offset: 0x100

ECB block encrypt complete

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_END			ECB block encrypt complete
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.7.3.6 EVENTS_ERROR

Address offset: 0x104

ECB block encrypt aborted because of a STOP task or due to an error

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_ERROR			ECB block encrypt aborted because of a STOP task or due to an error
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.7.3.7 PUBLISH_END

Address offset: 0x180

Publish configuration for event END

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event END will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.7.3.8 PUBLISH_ERROR

Address offset: 0x184

Publish configuration for event ERROR

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event ERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.7.3.9 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	END			Write '1' to enable interrupt for event END
	W1S				
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW	ERROR			Write '1' to enable interrupt for event ERROR
	W1S				
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.7.3.10 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	END			Write '1' to disable interrupt for event END
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	ERROR			Write '1' to disable interrupt for event ERROR
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.7.3.11 ERRORSTATUS

Address offset: 0x400

Error status

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	ERRORSTATUS			Error status when the ERROR event is generated
			NoError	0	No errors have occurred
			PrematureInptrEnd	1	End of INPTR job list before data structure was read.
			PrematureOutptrEnd	2	End of OUTPTR job list before data structure was read.
			EncryptionTooSlow	3	Encryption aborted due to higher priority peripheral requesting or using the AES module. This enumerator is deprecated.
			Aborted	3	Encryption aborted due to higher priority peripheral requesting or using the AES module.
			DmaError	4	Bus error during DMA access.

8.7.3.12 KEY.VALUE[n] (n=0..3)

Address offset: 0x510 + (n × 0x4)

128-bit AES key

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	W	VALUE			AES 128-bit key value, bits (32*(n+1))-1 : (32*n)

8.7.3.13 IN

IN EasyDMA channel

8.7.3.13.1 IN.PTR

Address offset: 0x530

Input pointer

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			Points to a job list containing unencrypted ECB data structure

8.7.3.14 OUT

OUT EasyDMA channel

8.7.3.14.1 OUT.PTR

Address offset: 0x538

Output pointer

Points to a job list containing encrypted ECB data structure

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			Output pointer

8.7.3.15 CSAA

Channel sounding access address scoring algorithm

8.7.3.15.1 CSAA.REFLECTOR

Address offset: 0x53C

Selected Channel Sounding Access Address used in the CS SYNC from Reflector to Initiator

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	PN			

8.7.3.15.2 CSAA.INITIATOR

Address offset: 0x540

Selected Channel Sounding Access Address used in the CS SYNC from Initiator to Reflector

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	PN			

8.7.3.15.3 CSAA.MODE

Address offset: 0x544

Operation modes

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	BITREVERSE																																	
			Default	0																															
			Reversed	1																															

Reverse the endianness on bit level for the ECB output, INITIATOR, and REFLECTOR registers

Enable bit reversal on each byte.

Default endianness

Reversed endianness

8.8 EGU — Event generator unit

Event generator unit (EGU) provides support for interlayer signaling. This means providing support for atomic triggering of both CPU execution and hardware tasks, from both firmware (by CPU) and hardware (by PPI). This feature can be used for triggering CPU execution at a lower priority execution from a higher priority execution, or to handle a peripheral's interrupt service routine (ISR) execution at a lower priority for some of its events. However, triggering any priority from any priority is possible.

Listed here are the main EGU features:

- Software-enabled interrupt triggering
- Separate interrupt vectors for every EGU instance
- Up to 16 separate event flags per interrupt for multiplexing

Each instance of EGU implements a set of tasks which can individually be triggered to generate the corresponding event. For example, the corresponding event for TASKS_TRIGGER[n] is EVENTS_TRIGGERED[n]. See Instances on page 289 for a list of EGU instances.

8.8.1 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
EGU00 : S EGU00 : NS	GLOBAL	0x50058000 0x40058000	US	S	NA	No	Event generator unit EGU00
EGU10 : S EGU10 : NS	GLOBAL	0x50087000 0x40087000	US	S	NA	No	Event generator unit EGU10
EGU20 : S EGU20 : NS	GLOBAL	0x500C9000 0x400C9000	US	S	NA	No	Event generator unit EGU20

Configuration

Instance	Domain	Configuration
EGU00 : S EGU00 : NS	GLOBAL	6 events
EGU10 : S EGU10 : NS	GLOBAL	16 events
EGU20 : S EGU20 : NS	GLOBAL	6 events

Register overview

Register	Offset	TZ	Description
TASKS_TRIGGER[n]	0x000		Trigger n for triggering the corresponding TRIGGERED[n] event
SUBSCRIBE_TRIGGER[n]	0x080		Subscribe configuration for task TRIGGER[n]
EVENTS_TRIGGERED[n]	0x100		Event number n generated by triggering the corresponding TRIGGER[n] task
PUBLISH_TRIGGERED[n]	0x180		Publish configuration for event TRIGGERED[n]
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt

8.8.1.1 TASKS_TRIGGER[n] (n=0..15)

Address offset: 0x000 + (n × 0x4)

Trigger n for triggering the corresponding TRIGGERED[n] event

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_TRIGGER			Trigger n for triggering the corresponding TRIGGERED[n] event
			Trigger	1	Trigger task

8.8.1.2 SUBSCRIBE_TRIGGER[n] (n=0..15)

Address offset: 0x080 + (n × 0x4)

Subscribe configuration for task TRIGGER[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task TRIGGER[n] will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.8.1.3 EVENTS_TRIGGERED[n] (n=0..15)

Address offset: 0x100 + (n × 0x4)

Event number n generated by triggering the corresponding TRIGGER[n] task

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_TRIGGERED			Event number n generated by triggering the corresponding TRIGGER[n] task
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.8.1.4 PUBLISH_TRIGGERED[n] (n=0..15)

Address offset: 0x180 + (n × 0x4)

Publish configuration for event TRIGGERED[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event TRIGGERED[n] will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.8.1.5 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A-P	RW	TRIGGERED[i] (i=0..15)			Enable or disable interrupt for event TRIGGERED[i]
			Disabled	0	Disable
			Enabled	1	Enable

8.8.1.6 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A-P	RW W1S	TRIGGERED[i] (i=0..15)			Write '1' to enable interrupt for event TRIGGERED[i]
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.8.1.7 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number																															
																				P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000																				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID		Value		Description																							
A-P	RW	TRIGGERED[i] (i=0..15)						Write '1' to disable interrupt for event TRIGGERED[i]																							
	W1C																														
				Clear		1		Disable																							
				Disabled		0		Read: Disabled																							
				Enabled		1		Read: Enabled																							

8.9 GPIO — General purpose input/output

The general purpose input/output (GPIO) pins are grouped as one or more ports, with each port having up to 32 GPIO pins.

The number of ports and GPIO pins per port varies with product variant and package. Refer to Registers on page 298 and Pin assignments on page 1219 for more information about the number of GPIO pins that are supported.

GPIO has the following user-configurable features:

- Configurable output drive strength
- Internal pull-up and pull-down resistors
- Wake-up from high or low level triggers on all pins in PERI and LP power domains
- Trigger interrupt on state changes on any pin on selected ports, see the wakeup source capability in Port capabilities on page 295
- One or more GPIO outputs can be controlled through PPI and GPIOTE channels
- All pins can be individually mapped to interface blocks for layout flexibility
- GPIO state changes captured on SENSE signal can be stored by LATCH register
- Support for secure and non-secure attributes for pins in conjunction with the system protection unit (SPU)

The following figure illustrates the GPIO port containing 32 individual pins, where `PIN0` is illustrated in more detail as a reference. All signals on the left side in the illustration are used by other peripherals in the system and therefore not directly available to the CPU.

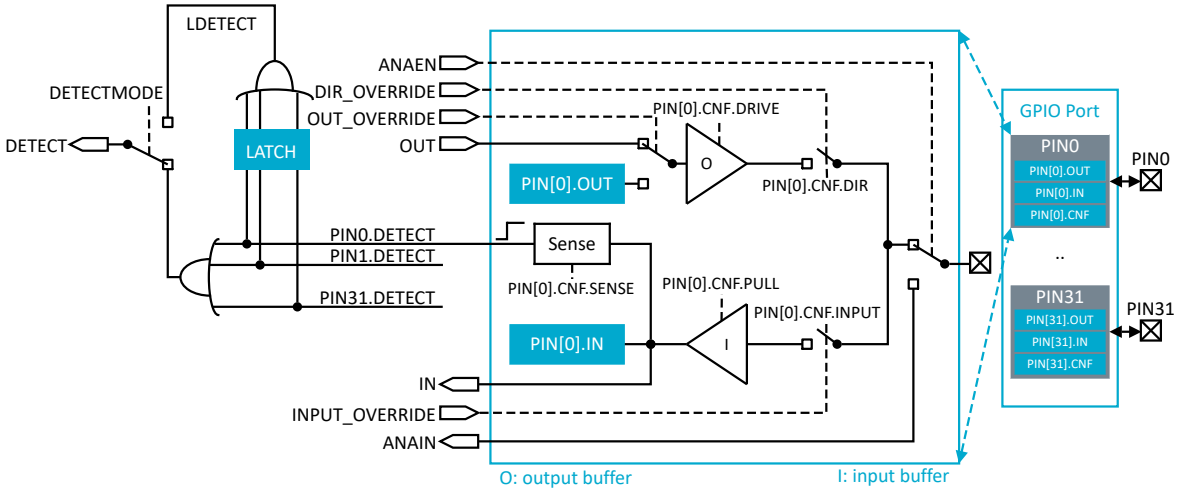


Figure 61: GPIO port and the GPIO pin details

8.9.1 Pin configuration

The GPIO port peripheral implements up to 32 pins, `PIN[n]` (n = 0..31), that can be individually configured in the PIN_CNF[n] registers (n=0..31).

The following parameters can be enabled or configured in these registers:

- Direction
- Drive strength
- Pull-up and pull-down resistors
- Pin sensing
- Input buffer disconnect
- Analog input (for selected pins)

All write-capable registers are retained registers. See POWER — Power control on page 100 for more information.

When not used as an input, disconnect the input buffer of the GPIO pin to save power. An input must be connected to get a valid value in the IN register and for the sense mechanism to have access to the pin.

Other peripherals in the system can connect to GPIO pins to override their output value, override their configuration, or read their analog or digital input value.

Selected pins also support analog input signals (ANAIN). The assignment of the analog pins can be found in Pin assignments on page 1219.

GPIO drive strength is configured using the DRIVE0 and DRIVE1 fields of register PIN_CNF[n] (n=0..31) (Retained) on page 302. Some pins may not support every drive configuration, see Pin assignments on page 1219 for more information.

When a pin is configured as digital input, it is important to minimize increased current consumption when the input voltage is between V_{IL} and V_{IH}. It is a good practice to ensure that the external circuitry does not drive the pin to levels between V_{IL} and V_{IH} for a long period of time.

For more information on pin assignment and the corresponding effect of read and write operations of GPIO registers, see Peripheral and subsystem assignment on page 296.

Note: NFCT uses two pins to connect to the antenna, which are shared with GPIOs. NFC pins are enabled from reset. To use them as GPIO pins, NFC use must be disabled using register PADCONFIG on page 391. For more details, see NFCT — Near field communication tag on page 352.

8.9.2 Pin sense mechanism

Pin sensitivity can be individually configured through the SENSE field in the PIN_CNF[n] register to detect a high level or a low level on their input. When the correct level is detected, the sense mechanism will set the DETECT signal `high`. Each pin has a separate DETECT signal.

The default behavior for the DETECT signal is defined by the register DETECTMODE. By default, the DETECT signals from all pins in the GPIO port are combined into one common DETECT signal that is routed throughout the system, and can be utilized by other peripherals. This mechanism is functional in both System ON and System OFF modes.The DETECTMODE applies to both secure and non-secure pins.

Pins must be in a level that cannot trigger the sense mechanism before enabling it. When the sense mechanism is enabled, the DETECT signal will immediately go high if the SENSE condition configured in the PIN_CNF registers is met. This will trigger a PORT event if the DETECT signal was low before enabling the sense mechanism.

The DETECT signal is used by the power and clock management system to exit from System OFF mode, and by the GPIOTE peripheral to allow pins to generate events and interrupts.

When a pin's PINx.DETECT signal goes high, a flag will be set in the register LATCH. For example, when the PIN0.DETECT signal goes high, bit 0 in the register LATCH will be set to `1`. If the CPU performs a clear operation on a bit in the register LATCH when the associated PINx.DETECT signal is high, the bit in the register LATCH will not be cleared. The register LATCH will only be cleared if the CPU explicitly clears it by writing a `1` to the bit to be cleared. This means the register LATCH will not be affected by a PINx.DETECT signal being set low.

The LATCH register has split security. Non-secure code can only read the state of the non-secure pins, while the secure pins read as `0`. Secure code is able to read the state of all pins.

The LDETECT signal will be set high when one or more bits in the register LATCH `1`. The LDETECT signal will be set low when all bits in the register LATCH are successfully cleared to `0`.

If one or more bits in the register LATCH are `1` after the CPU has performed a clear operation, a rising edge will be generated on the LDETECT signal. This is illustrated in DETECT signal behavior on page 295.

> **Note:** The CPU can read the register LATCH at any time to check if a SENSE condition has been met on one or more of the GPIO pins. This is true even if that condition is no longer met at the time the CPU queries the register LATCH. This mechanism will work even if the LDETECT signal is not used as the DETECT signal.

LDETECT is enabled using the DETECTMODE register. See GPIO port and the GPIO pin details on page 293.

The following figure illustrates the DETECT signal behavior for these two alternatives.

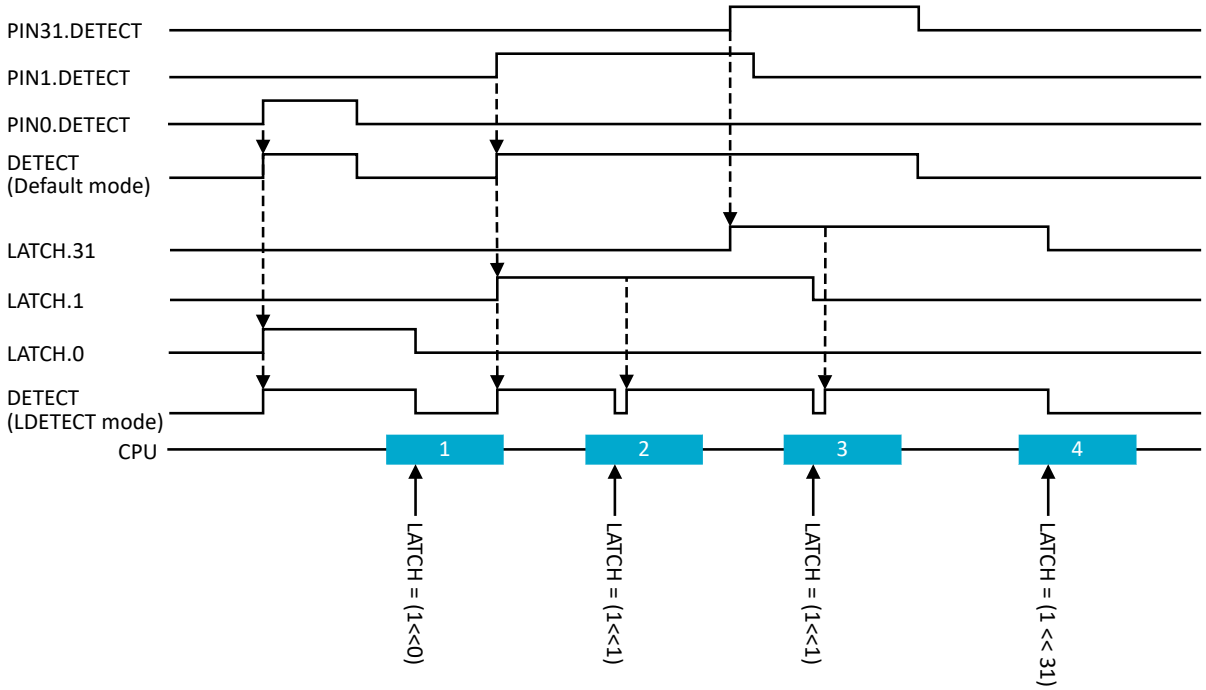


Figure 62: DETECT signal behavior

8.9.3 Port capabilities

The device power domains have their own GPIO ports with different capabilities.

The following is a list of all GPIO ports (P[n]) in the system.

- P0 low-power domain – These I/O pins can wake the system up from System OFF or System ON sleep, and can be accessed by all peripherals in the low-power domain.
- P1 and P3 peripheral domain – These I/O pins can wake the system up from System OFF or System ON sleep, and can be accessed by all peripherals in the peripheral domain.
- P2 MCU domain – These I/O pins are faster and can be used for high-speed signals such as trace or fast serial peripheral communication. GPIO P2 cannot wake the system from sleep. P2 does not have the GPIO SENSE or DETECT mechanism, or GPIOTE.

Peripherals cannot mix pins from different ports. All pins must be on the same port.

The following table lists the port special functions and characteristics.

Port	Wakeup source	Extra high drive strength (E0E1)	Pin sense/ detect	GPIOTE	Maximum speed [MHz]
P0	Yes	No	Yes	Yes	8
P1	Yes	No	Yes	Yes	8
P2	No	Yes	No	No	64
P3	Yes	No	Yes	Yes	8

Table 41: Port capabilities

Please note that certain peripherals can operate the GPIOs at higher frequencies than those specified in the table above. In addition to the capabilities of the port, some specific pins have additional functions. These are listed in Pin assignments on page 1219.

8.9.4 Peripheral and subsystem assignment

System GPIO pins can be allocated to peripherals with dedicated pins or subsystems such as trace and debug.

The pins of the system are listed in Pin assignments on page 1219.

A pin can be assigned to any of the following:

- GPIO or peripheral with PSEL registers
- Peripheral with dedicated pins (VPR and GRTC)
- Trace and debug (TND) subsystem

By default, all pins are assigned to GPIO or peripherals with PSEL registers. This is the default value of the CTRLSEL value in register PIN_CNF[n] (n=0..31) (Retained) on page 302.

To allocate a pin to a peripheral or subsystem with dedicated pins, such as GRTC or TND, change the CTRLSEL value in register PIN_CNF[n] (n=0..31) (Retained) on page 302 for that pin. This will connect the pin to the subsystem or peripheral.

Only the peripheral or subsystem where the pin was allocated can observe and control that pin's state. Reading a pin that is not allocated to the current subsystem will return zero, and writes will be ignored. If a pin is allocated to a subsystem that cannot access it, the pin stays under control of the GPIO peripheral.

When CTRLSEL is used to allocate a peripheral or subsystem, reading the GPIO peripheral registers will not reveal the state of the pins.

The following figure illustrates how to assign a pin to a peripheral that has dedicated pins, or a subsystem such as trace and debug.

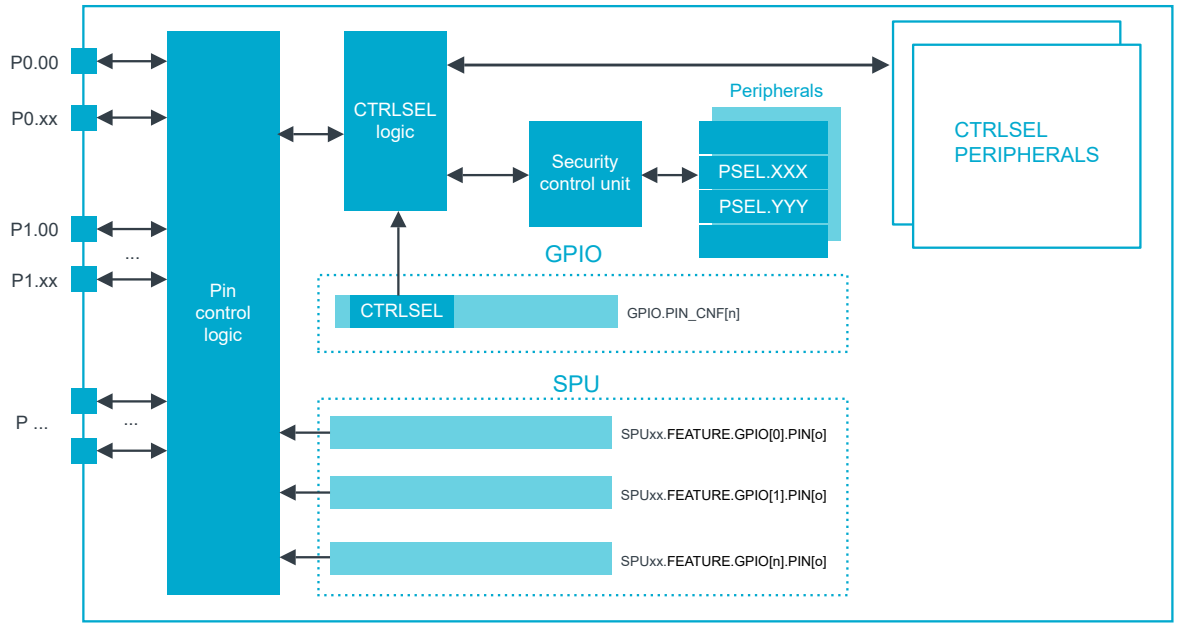


Figure 63: Pin access using CTRLSEL

For details on pin security, see Security on page 134.

Note: CTRLSEL must be configured before any pins are used, otherwise glitches on the GPIO pins of the corresponding port can occur.

8.9.5 Clock pins

The device has dedicated clock pins. Some peripherals, such as SPI, TWI, and TRACE, have clock signals.

The dedicated clock pins are optimized to ensure correct timing between the clock and data signals for these peripherals. All peripherals that have clock signals must use these pins. See Pin assignments on page 1219 for the full list.

The data signal associated with the peripheral must use pins close to the clock pin. This ensures that the internal paths from the peripheral to the pin have the same delay, so that the data and clock signals reach the pins at the same time.

For high-speed signals, the printed circuit board (PCB) layout must use short PCB traces of identical length. This reduces delays and ensures the same delay on the clock and data path.

8.9.6 Fast port control

GPIOHSPADCTRL.BIAS.HSBIAS configures the slew rate of the GPIO pins on P2 in the E0 and E1 drive mode.

A higher slew rate is mandatory for fast signal switching and timing accuracy, helping to maintain correct data transfer at higher speeds. A lower slew rate helps minimize EMI, signal overshoot, and noise.

The recommended setting is to always use the highest slew rate.

8.9.6.1 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
GPIOHSPADCTRL : S GPIOHSPADCTRL : NS	GLOBAL	0x50050400 0x40050400	US	S	NA	Yes	GPIO HS pad control GPIOHSPADCTRL

Register overview

Register	Offset	TZ	Description
BIAS	0x30		Bias control
CTRL	0x38		Input sampling and buffering control (used by the VPR coprocessor for emulating a QSPI peripheral)

8.9.6.1.1 BIAS

Address offset: 0x30

Bias control

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																														B	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	HSBIAS		[0..3]	Slew setting for high-speed pad (Use highest/fastest value)
B	RW	REPLICABIAS		[0..1]	Slew setting for replica clock (used by the VPR coprocessor for emulating a QSPI peripheral)

8.9.6.1.2 CTRL

Address offset: 0x38

Input sampling and buffering control (used by the VPR coprocessor for emulating a QSPI peripheral)

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E E E E D C B A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	RXDELAY			Delay selection
B	RW	SCKEN			Enable SCK
			Disabled	0	Delay chain is reset and delayed sampling is disabled
			Enabled	1	Delay chain and delayed sampling is active
C	RW	SCKPHASE			SCK phase
			Inverted	0	Invert SCK phase
			NonInverted	1	Non-inverted SCK phase
D	RW	CSNEN			Enable CSN synchronization of sampling
			Enabled	0	Delay chain is reset on active edge of CSN
			Disabled	1	Delay chain is not reset on active edge of CSN
E	RW	DATAENABLE			Enable delayed sampling
			Disabled	0	Delayed sampling is disabled
			Enabled	0xF	Delayed sampling is enabled

8.9.7 Reset behavior

While the **nRESET** pin is asserted (falling edge and held low), GPIO pins will enter one of two states:

- Retain their current configuration (e.g., outputs remain outputs, inputs remain inputs)
- Switch to high impedance, which is the default state upon device startup

Once **nRESET** is deasserted (rising edge), all GPIOs transition to the high impedance state until device firmware configures them.

When GPIO pins are in a high-impedance state for a prolonged period, external circuits that depend on a clearly defined logic level (either high or low) might require the use of external pull-up or pull-down resistors to ensure reliable operation. However, in most cases this is not required, as the duration of the high-impedance state during the reset cycle is typically very short.

8.9.8 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
P2 : S P2 : NS	GLOBAL	0x50050400 0x40050400	US	S	NA	Yes	General purpose input and output, port P2 Does not support pin sense mechanism, and DETECTMODE register has no effect. Supports extra high drive (DRIVE0=E0, DRIVE1=E1).
P1 : S P1 : NS	GLOBAL	0x500D8200 0x400D8200	US	S	NA	Yes	General purpose input and output, port P1
P3 : S P3 : NS	GLOBAL	0x500D8600 0x400D8600	US	S	NA	Yes	General purpose input and output, port P3
P0 : S P0 : NS	GLOBAL	0x5010A000 0x4010A000	US	S	NA	Yes	General purpose input and output, port P0

Configuration

Instance	Domain	Configuration
P2 : S P2 : NS	GLOBAL	P2 has 11 pins, P2.00 through P2.10.
P1 : S P1 : NS	GLOBAL	I/O pins on this port have pin sense mechanism P1 has 32 pins, P1.00 through P1.31.
P3 : S P3 : NS	GLOBAL	I/O pins on this port have pin sense mechanism P3 has 13 pins, P3.00 through P3.12.
P0 : S P0 : NS	GLOBAL	I/O pins on this port have pin sense mechanism P0 has 10 pins, P0.00 through P0.09.

Register overview

Register	Offset	TZ	Description
OUT	0x000		Write GPIO port This register is retained.
OUTSET	0x004		Set individual bits in GPIO port
OUTCLR	0x008		Clear individual bits in GPIO port
IN	0x00C		Read GPIO port
DIR	0x010		Direction of GPIO pins This register is retained.
DIRSET	0x014		DIR set register
DIRCLR	0x018		DIR clear register
LATCH	0x020		Latch register indicating what GPIO pins that have met the criteria set in the PIN_CNF[n].SENSE registers This register is retained.
DETECTMODE	0x024	S	Select between default DETECT signal behavior and LDETECT mode This register is retained.
PIN_CNF[n]	0x080		Pin n configuration of GPIO pin This register is retained.

8.9.8.1 OUT (Retained)

Address offset: 0x000

Write GPIO port

This register is retained.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				f	e	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value	Description																														
A-f	RW	PIN[i] (i=0..31)			Pin i																														
			Low	0	Pin driver is low																														
			High	1	Pin driver is high																														

8.9.8.2 OUTSET

Address offset: 0x004

Set individual bits in GPIO port

Note: Read: reads value of OUT register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				f	e	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A-f	RW	PIN[i] (i=0..31)																																	
	W1S																																		
			Low	0																															
			High	1																															
			Set	1																															

				Description
				Pin i
				Read: pin driver is low
				Read: pin driver is high
				Write: writing a '1' sets the pin high; writing a '0' has no effect

8.9.8.3 OUTCLR

Address offset: 0x008

Clear individual bits in GPIO port

Note: Read: reads value of OUT register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				f	e	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A-f	RW	PIN[i] (i=0..31)																																	
	W1C																																		
			Low	0																															
			High	1																															
			Clear	1																															

				Description
				Pin i
				Read: pin driver is low
				Read: pin driver is high
				Write: writing a '1' sets the pin low; writing a '0' has no effect

8.9.8.4 IN

Address offset: 0x00C

Read GPIO port

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				f	e	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A-f	R	PIN[i] (i=0..31)																																	
			Low	0																															
			High	1																															

				Description
				Pin i
				Pin input is low
				Pin input is high

8.9.8.5 DIR (Retained)

Address offset: 0x010

Direction of GPIO pins

This register is retained.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				f	e	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A-f	RW	PIN[i] (i=0..31)																																	
			Input	0																															
			Output	1																															

8.9.8.6 DIRSET

Address offset: 0x014

DIR set register

Note: Read: reads value of DIR register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				f	e	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A-f	RW	PIN[i] (i=0..31)																																	
	W1S																																		
			Input	0																															
			Output	1																															
			Set	1																															

8.9.8.7 DIRCLR

Address offset: 0x018

DIR clear register

Note: Read: reads value of DIR register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				f	e	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A-f	RW	PIN[i] (i=0..31)																																	
	W1C																																		
			Input	0																															
			Output	1																															
			Clear	1																															

8.9.8.8 LATCH (Retained)

Address offset: 0x020

Latch register indicating what GPIO pins that have met the criteria set in the PIN_CNF[n].SENSE registers

This register is retained.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-f	RW	PIN[i] (i=0..31)			Status on whether PINi has met criteria set in PIN_CNF[i].SENSE register.
					Write '1' to clear.
			NotLatched	0	Criteria has not been met
			Latched	1	Criteria has been met

8.9.8.9 DETECTMODE (Retained)

Address offset: 0x024

Select between default DETECT signal behavior and LDETECT mode

DETECTMODE applies to both secure (DETECT_SEC) and non-secure pins (DETECT_NONSEC)

This register is retained.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	DETECTMODE			Select between default DETECT signal behavior and LDETECT mode
			Default	0	DETECT directly connected to PIN DETECT signals
			LDETECT	1	Use the latched LDETECT behavior

8.9.8.10 PIN_CNF[n] (n=0..31) (Retained)

Address offset: 0x080 + (n × 0x4)

Pin n configuration of GPIO pin

This register is retained.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G G G F F E E D D C C B A
Reset 0x00000002				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	DIR			Pin direction. Same physical register as DIR register
			Input	0	Configure pin as an input pin
			Output	1	Configure pin as an output pin
B	RW	INPUT			Connect or disconnect input buffer
			Connect	0	Connect input buffer
			Disconnect	1	Disconnect input buffer
C	RW	PULL			Pull configuration
			Disabled	0	No pull
			Pulldown	1	Pull-down on pin
			Pullup	3	Pull-up on pin
D	RW	DRIVE0			Drive configuration for '0'
			S0	0	Standard '0'
			H0	1	High drive '0'
			D0	2	Disconnect '0'(normally used for wired-or connections)
			E0	3	Extra high drive '0'
					Note: The DRIVE1 must be E1 as well to work properly.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					G	G	G											F	F					E	E	D	D					C	C	B	A
Reset 0x00000002				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**
ID	R/W	Field	Value ID	Value																															
E	RW	DRIVE1																																	
			S1	0																															
			H1	1																															
			D1	2																															
			E1	3																															
F	RW	SENSE																																	
			Disabled	0																															
			High	2																															
			Low	3																															
G	RW	CTRLSEL																																	
			GPIO	0x0																															
			VPR	0x1																															
			GRTC	0x4																															

Pin configuration for '1'

Description

Drive configuration for '1'

Standard '1'

High drive '1'

Disconnect '1'(normally used for wired-or connections)

Extra high drive '1'

Note: The DRIVE0 must be E0 as well to work properly.

Pin sensing mechanism

Disabled

Sense for high level

Sense for low level

Select which module has direct control over this pin

Note: this field is only accessible from secure code

GPIO or peripherals with PSEL registers

VPR processor

GRTC peripheral

8.10 GPIOTE — GPIO tasks and events

The GPIO tasks and events (GPIOTE) peripheral provides functionality for accessing GPIO pins using tasks and events. Each GPIOTE channel can be assigned to one pin.

The main features of GPIOTE are the following:

- GPIO pin state change by triggering tasks
- Event generation on GPIO pin state change
- PORT event generation on GPIO DETECT signal
- Support for split security on individual GPIOTE channels

A GPIOTE block enables GPIOs to generate events on pin state change which can be used to carry out tasks through the PPI system. A GPIO can also be driven to change state on system events using the PPI system. See Peripheral interface on page 228 for additional information on tasks and events. GPIO is described in more detail in GPIO — General purpose input/output on page 292.

Detection of pin state changes when in low power mode is possible when in System ON or System OFF.

GPIOTE supports split-security. Each channel is assigned a security state (S/NS).

Up to three tasks can be used in each GPIOTE channel for performing write operations to a pin. Tasks SET and CLR are fixed. OUT can be configured to perform following operations:

- Set
- Clear
- Toggle

An event can be generated in each GPIOTE channel from one of the following input conditions:

- Rising edge
- Falling edge
- Any change

8.10.1 Pin events and tasks

The GPIOTE module has a number of tasks and events that can be configured to operate on individual GPIO pins.

The tasks SET[n], CLR[n], and OUT[n] can write to individual pins, and events IN[n] can be generated from input changes of individual pins.

The SET task will set the pin selected in CONFIG[n].PSEL to high. The CLR task will set the pin low.

The effect of the OUT task on the pin is configurable in CONFIG[n].POLARITY. It can set the pin high, set it low, or toggle it.

Tasks and events are configured using the CONFIG[n] registers. One CONFIG[n] register is associated with a set of SET[n], CLR[n], and OUT[n] tasks and IN[n] events.

As long as a SET[n], CLR[n], and OUT[n] task or an IN[n] event is configured to control pin **n**, the pin's output value will only be updated by the GPIOTE module. The pin's output value, as specified in the GPIO, will therefore be ignored as long as the pin is controlled by GPIOTE. Attempting to write to the pin as a normal GPIO pin will have no effect. When the GPIOTE is disconnected from a pin, the associated pin gets the output and configuration values specified in the GPIO module, see MODE field in CONFIG[n] register.

When conflicting tasks are triggered simultaneously (i.e. during the same clock cycle) in one channel, the priority of the tasks is as described in the following table.

Priority	Task
1	OUT
2	CLR
3	SET

Table 42: Task priorities

When setting the CONFIG[n] registers, MODE=Disabled does not have the same effect as MODE=Task and POLARITY=None. In the latter case, a CLR or SET task occurring at the exact same time as OUT will end up with no change on the pin, based on the priorities described in the table above.

When a GPIOTE channel is configured to operate on a pin as a task, the initial value of that pin is configured in the OUTINIT field of CONFIG[n].

8.10.2 Port event

PORT is an event that can be generated from multiple input pins using the GPIO DETECT signal.

The event will be generated on the rising edge of the DETECT signal. See GPIO — General purpose input/output on page 292 for more information about the DETECT signal.

There are two DETECT signals that come from the GPIO peripheral , the secure DETECT_SEC for pins marked as secure and the non-secure DETECT_NONSEC. Each signal has a corresponding port event, EVENTS_PORT[n].SECURE and EVENTS_PORT[n].NONSECURE. Secure events are not accessible from the non-secure side.

The GPIO DETECT signal will not wake the system up again if the system is put into System ON IDLE while the DETECT signal is high. Make sure to clear all DETECT sources before entering sleep. If the LATCH register is used as a source, a new rising edge will be generated on DETECT if any bit in LATCH is still high after clearing all or part of the register. This could occur if one of the PINx.DETECT signals is still high, for example. See Pin sense mechanism on page 294 for more information.

Setting the system to System OFF while DETECT is high will cause a wakeup from System OFF reset.

This feature can be used to wake up the CPU from a WFI or WFE type sleep in System ON when all peripherals and the CPU are idle, meaning the lowest power consumption in System ON mode.

In order to prevent spurious interrupts from the PORT event while configuring the sources, the following must be performed:

1. Disable interrupts on the PORT event (through INTENCLR.PORT).
2. Configure the sources (PIN_CNF[n].SENSE in GPIO).
3. Clear any potential event that could have occurred during configuration (write '0' to EVENTS_PORT).
4. Enable interrupts (through INTENSET.PORT).

8.10.3 Tasks and events pin configuration

Each GPIOTE channel is associated with one physical GPIO pin through the CONFIG.PSEL field.

When Event mode is selected in CONFIG.MODE, the pin specified by CONFIG.PSEL will be configured as an input, overriding the DIR setting in GPIO. Similarly, when Task mode is selected in CONFIG.MODE, the pin specified by CONFIG.PSEL will be configured as an output overriding the DIR setting and OUT value in GPIO. When Disabled is selected in CONFIG.MODE, the pin specified by CONFIG.PSEL will use its configuration from the PIN[n].CNF registers in GPIO.

For the range of possible CONFIG.PORT values in the product, see Instances on page 305. Writing other values may lead to undefined behavior.

Note: A pin can only be assigned to one GPIOTE channel at a time. Failing to do so may result in unpredictable behavior.

8.10.4 Split security attribute

Individual GPIOTE channels and interrupts can have independent security attributes.

GPIOTE is implemented with split security, meaning it handles accesses from both secure and non-secure code. GPIOTE channels and interrupts can be defined as secure or non-secure.

For more information on GPIOTE security attributes, see GPIOTE on page 143.

8.10.5 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
GPIOTE20 : S GPIOTE20 : NS	GLOBAL	0x500DA000 0x400DA000	US	S	NA	Yes	8 channels and 2 interrupts for GPIO port P1 and P3 GPIO tasks and events GPIOTE20
GPIOTE30 : S GPIOTE30 : NS	GLOBAL	0x5010C000 0x4010C000	US	S	NA	Yes	4 channels and 2 interrupts for GPIO port P0 GPIO tasks and events GPIOTE30

Configuration

Instance	Domain	Configuration
GPIOTE20 : S GPIOTE20 : NS	GLOBAL	Number of GPIOTE channels: 0..7 Number of GPIOTE port events: 0..0 Number of GPIOTE interrupts: 0..1
GPIOTE30 : S GPIOTE30 : NS	GLOBAL	Number of GPIOTE channels: 0..3 Number of GPIOTE port events: 0..0 Number of GPIOTE interrupts: 0..1

Register overview

Register	Offset	TZ	Description
TASKS_OUT[n]	0x000		Task for writing to pin specified in CONFIG[n].PSEL. Action on pin is configured in CONFIG[n].POLARITY.
TASKS_SET[n]	0x030		Task for writing to pin specified in CONFIG[n].PSEL. Action on pin is to set it high.
TASKS_CLR[n]	0x060		Task for writing to pin specified in CONFIG[n].PSEL. Action on pin is to set it low.
SUBSCRIBE_OUT[n]	0x080		Subscribe configuration for task OUT[n]
SUBSCRIBE_SET[n]	0x0B0		Subscribe configuration for task SET[n]
SUBSCRIBE_CLR[n]	0x0E0		Subscribe configuration for task CLR[n]
EVENTS_IN[n]	0x100		Event from pin specified in CONFIG[n].PSEL
EVENTS_PORT[n].NONSECURE	0x140	NS	Non-secure port event
EVENTS_PORT[n].SECURE	0x144	S	Secure port event
PUBLISH_IN[n]	0x180		Publish configuration for event IN[n]
PUBLISH_PORT[n].NONSECURE	0x1C0	NS	Publish configuration for event PORT[n].NONSECURE
PUBLISH_PORT[n].SECURE	0x1C4	S	Publish configuration for event PORT[n].SECURE
INTENSET0	0x304		Enable interrupt
INTENCLR0	0x308		Disable interrupt
INTENSET1	0x314		Enable interrupt
INTENCLR1	0x318		Disable interrupt
CONFIG[n]	0x510		Configuration for OUT[n], SET[n], and CLR[n] tasks and IN[n] event

8.10.5.1 TASKS_OUT[n] (n=0..7)

Address offset: 0x000 + (n × 0x4)

Task for writing to pin specified in CONFIG[n].PSEL. Action on pin is configured in CONFIG[n].POLARITY.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_OUT			Task for writing to pin specified in CONFIG[n].PSEL. Action on pin is configured in CONFIG[n].POLARITY.
			Trigger	1	Trigger task

8.10.5.2 TASKS_SET[n] (n=0..7)

Address offset: 0x030 + (n × 0x4)

Task for writing to pin specified in CONFIG[n].PSEL. Action on pin is to set it high.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_SET			Task for writing to pin specified in CONFIG[n].PSEL. Action on pin is to set it high.
			Trigger	1	Trigger task

8.10.5.3 TASKS_CLR[n] (n=0..7)

Address offset: 0x060 + (n × 0x4)

Task for writing to pin specified in CONFIG[n].PSEL. Action on pin is to set it low.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_CLR			Task for writing to pin specified in CONFIG[n].PSEL. Action on pin is to set it low.
			Trigger	1	Trigger task

8.10.5.4 SUBSCRIBE_OUT[n] (n=0..7)

Address offset: 0x080 + (n × 0x4)

Subscribe configuration for task OUT[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task OUT[n] will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.10.5.5 SUBSCRIBE_SET[n] (n=0..7)

Address offset: 0x0B0 + (n × 0x4)

Subscribe configuration for task SET[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task SET[n] will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.10.5.6 SUBSCRIBE_CLR[n] (n=0..7)

Address offset: 0x0E0 + (n × 0x4)

Subscribe configuration for task CLR[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task CLR[n] will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.10.5.7 EVENTS_IN[n] (n=0..7)

Address offset: 0x100 + (n × 0x4)

Event from pin specified in CONFIG[n].PSEL

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_IN			Event from pin specified in CONFIG[n].PSEL
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.10.5.8 EVENTS_PORT[n] (n=0..0)

Peripheral events.

8.10.5.8.1 EVENTS_PORT[n].NONSECURE (n=0..0)

Address offset: 0x140 + (n × 0x8)

Non-secure port event

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					A
Reset 0x00000000					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	TZ	Field	Value ID	Value	Description
A	RW	NS	NONSECURE			Non-secure port event
				NotGenerated	0	Event not generated
				Generated	1	Event generated

8.10.5.8.2 EVENTS_PORT[n].SECURE (n=0..0)

Address offset: 0x144 + (n × 0x8)

Secure port event

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					A
Reset 0x00000000					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	TZ	Field	Value ID	Value	Description
A	RW	S	SECURE			Secure port event
				NotGenerated	0	Event not generated
				Generated	1	Event generated

8.10.5.9 PUBLISH_IN[n] (n=0..7)

Address offset: 0x180 + (n × 0x4)

Publish configuration for event IN[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event IN[n] will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.10.5.10 PUBLISH_PORT[n] (n=0..0)

Publish configuration for events

8.10.5.10.1 PUBLISH_PORT[n].NONSECURE (n=0..0)

Address offset: 0x1C0 + (n × 0x8)

Publish configuration for event PORT[n].NONSECURE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event PORT[n].NONSECURE will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.10.5.10.2 PUBLISH_PORT[n].SECURE (n=0..0)

Address offset: 0x1C4 + (n × 0x8)

Publish configuration for event PORT[n].SECURE

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	B A A A A A A A
Reset 0x00000000	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event PORT[n].SECURE will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.10.5.11 INTENSET0

Address offset: 0x304

Enable interrupt

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	J I H G F E D C B A
Reset 0x00000000	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	TZ	Field	Value ID	Value	Description
A-H	RW W1S		IN[i] (i=0..7)			Write '1' to enable interrupt for event IN[i]
				Set	1	Enable
				Disabled	0	Read: Disabled
				Enabled	1	Read: Enabled
I	RW W1S	NS	PORT0NONSECURE			Write '1' to enable interrupt for event PORT0NONSECURE
				Set	1	Enable
				Disabled	0	Read: Disabled
				Enabled	1	Read: Enabled
J	RW W1S	S	PORT0SECURE			Write '1' to enable interrupt for event PORT0SECURE
				Set	1	Enable
				Disabled	0	Read: Disabled
				Enabled	1	Read: Enabled

8.10.5.12 INTENCLR0

Address offset: 0x308

Disable interrupt

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	J I H G F E D C B A
Reset 0x00000000	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	TZ	Field	Value ID	Value	Description
A-H	RW W1C		IN[i] (i=0..7)			Write '1' to disable interrupt for event IN[i]
				Clear	1	Disable
				Disabled	0	Read: Disabled
				Enabled	1	Read: Enabled
I	RW W1C	NS	PORT0NONSECURE			Write '1' to disable interrupt for event PORT0NONSECURE
				Clear	1	Disable
				Disabled	0	Read: Disabled
				Enabled	1	Read: Enabled

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					J I H G F E D C B A
Reset 0x00000000					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	TZ	Field	Value ID	Value	Description
J	RW W1C	S	PORT0SECURE			Write '1' to disable interrupt for event PORT0SECURE
				Clear	1	Disable
				Disabled	0	Read: Disabled
				Enabled	1	Read: Enabled

8.10.5.13 INTENSET1

Address offset: 0x314

Enable interrupt

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					J I H G F E D C B A
Reset 0x00000000					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	TZ	Field	Value ID	Value	Description
A-H	RW W1S		IN[i] (i=0..7)			Write '1' to enable interrupt for event IN[i]
				Set	1	Enable
				Disabled	0	Read: Disabled
				Enabled	1	Read: Enabled
I	RW W1S	NS	PORT0NONSECURE			Write '1' to enable interrupt for event PORT0NONSECURE
				Set	1	Enable
				Disabled	0	Read: Disabled
				Enabled	1	Read: Enabled
J	RW W1S	S	PORT0SECURE			Write '1' to enable interrupt for event PORT0SECURE
				Set	1	Enable
				Disabled	0	Read: Disabled
				Enabled	1	Read: Enabled

8.10.5.14 INTENCLR1

Address offset: 0x318

Disable interrupt

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					J I H G F E D C B A
Reset 0x00000000					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	TZ	Field	Value ID	Value	Description
A-H	RW W1C		IN[i] (i=0..7)			Write '1' to disable interrupt for event IN[i]
				Clear	1	Disable
				Disabled	0	Read: Disabled
				Enabled	1	Read: Enabled
I	RW W1C	NS	PORT0NONSECURE			Write '1' to disable interrupt for event PORT0NONSECURE
				Clear	1	Disable
				Disabled	0	Read: Disabled

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					J I H G F E D C B A
Reset 0x00000000					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	TZ	Field	Value ID	Value	Description
				Enabled	1	Read: Enabled
J	RW W1C	S	PORT0SECURE			Write '1' to disable interrupt for event PORT0SECURE
				Clear	1	Disable
				Disabled	0	Read: Disabled
				Enabled	1	Read: Enabled

8.10.5.15 CONFIG[n] (n=0..7)

Address offset: 0x510 + (n × 0x4)

Configuration for OUT[n], SET[n], and CLR[n] tasks and IN[n] event

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					E D D C C C C B B B B B A A
Reset 0x00000000					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MODE			Mode
			Disabled	0	Disabled. Pin specified by PSEL will not be acquired by the GPIOTE module.
			Event	1	Event mode The pin specified by PSEL will be configured as an input and the IN[n] event will be generated if operation specified in POLARITY occurs on the pin.
			Task	3	Task mode The GPIO specified by PSEL will be configured as an output and triggering the SET[n], CLR[n] or OUT[n] task will perform the operation specified by POLARITY on the pin. When enabled as a task the GPIOTE module will acquire the pin and the pin can no longer be written as a regular output pin from the GPIO module.
B	RW	PSEL		[0..31]	GPIO number associated with SET[n], CLR[n], and OUT[n] tasks and IN[n] event
C	RW	PORT		[0..15]	Port number
D	RW	POLARITY			When In task mode: Operation to be performed on output when OUT[n] task is triggered. When In event mode: Operation on input that shall trigger IN[n] event.
			None	0	Task mode: No effect on pin from OUT[n] task. Event mode: no IN[n] event generated on pin activity.
			LoToHi	1	Task mode: Set pin from OUT[n] task. Event mode: Generate IN[n] event when rising edge on pin.
			HiToLo	2	Task mode: Clear pin from OUT[n] task. Event mode: Generate IN[n] event when falling edge on pin.
			Toggle	3	Task mode: Toggle pin from OUT[n]. Event mode: Generate IN[n] when any change on pin.
E	RW	OUTINIT			When in task mode: Initial value of the output when the GPIOTE channel is configured. When in event mode: No effect.
			Low	0	Task mode: Initial value of pin before task triggering is low
			High	1	Task mode: Initial value of pin before task triggering is high

8.11 GRTC — Global real-time counter

The global real-time counter peripheral (GRTC) is an ultra-low power shared system timer. GRTC implements a high-resolution system timer that is available in all power modes, including System OFF.

The system timer has a 1 µs resolution and is 52 bits wide. This provides a run time of 142 years after initial power-on until the counter wraps around. It uses the 16 MHz clock when the high-speed clock is active, but automatically switches to 32.768 kHz in the other power modes. It will continue to be updated in all power modes. Due to the combination of clock sources, it has a 1 µs resolution and an accuracy equal to the 32.768 kHz clock.

The main features of GRTC are the following:

- System timer – SYSCOUNTER
  - 1 µs resolution
  - Multiple compare/capture channels on SYSCOUNTER
  - PPI connection
  - Periodic interval generation for one compare event
  - Wake up from System OFF mode
  - Supports split security for GRTC features
- Pulse Width Modulation (PWM)
  - Single channel PWM
  - Operates in System OFF mode
- Clock output on pin
  - LFCLK
  - Configurable divided fast clock output

The system timer is a high resolution timer which can be accessed by all processors in the system. It allows the same system counter to be shared among all users. GRTC can operate in System OFF mode.

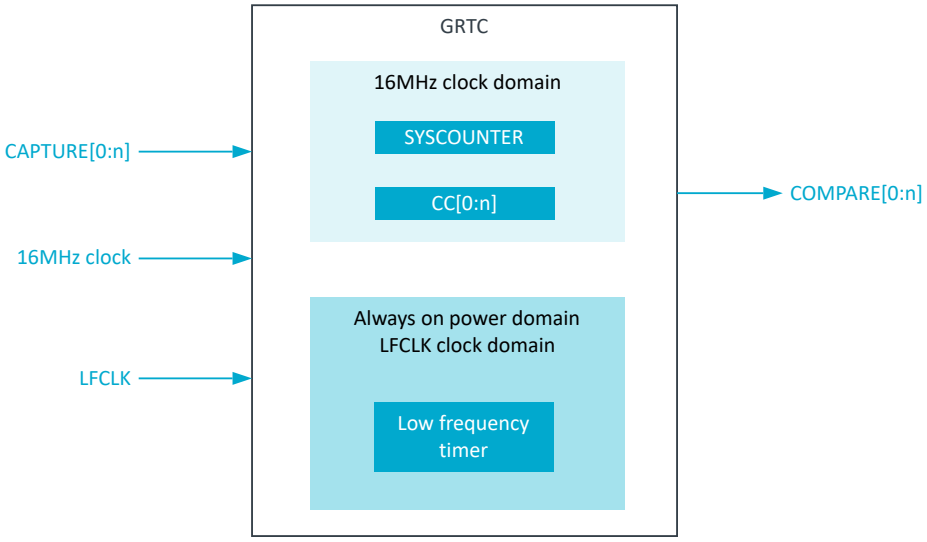


Figure 64: GRTC block diagram

The internal low-frequency timer can run while in System OFF mode.

All GRTC registers are reset during wakeup from System OFF mode. However, the SYSCOUNTER[m].SYSCOUNTERL and SYSCOUNTER[m].SYSCOUNTERH registers are restored automatically on wakeup from System OFF mode and after soft reset.

8.11.1 GRTC clock sources

The low frequency timer in GRTC will run off the LFCLK.

When the low frequency timer is started, the GRTC peripheral will automatically request the LFCLK source if the LFCLK is not already running.

The GRTC low frequency timer clock source can be selected using register CLKCFG.CLKSEL. The clock source cannot be changed after GRTC is started.

The clock source selection at GRTC is retained internally during System OFF mode, even though the CLKCFG.CLKSEL is reset on wakeup.

The SYSCOUNTER runs off the fast clock (16MHz clock), but uses only LFCLK while SYSCOUNTER is in sleep state.

See CLOCK for more information about clock sources.

8.11.2 SYSCOUNTER

The internal counter at SYSCOUNTER increments every 1 µs.

SYSCOUNTER is a 52-bit counter and is enabled using MODE.SYSCOUNTEREN register. The internal low frequency timer must be started for the proper operation of the SYSCOUNTER while SYSCOUNTER goes into sleep mode. It can be started by the TASKS_START task and can be stopped by the TASKS_STOP task when SYSCOUNTER is no more in use.

There are [m] registers SYSCOUNTER[m] providing access to SYSCOUNTER for each security attribute.

The current value of SYSCOUNTER can be read using corresponding SYSCOUNTER[m].SYSCOUNTERL and SYSCOUNTER[m].SYSCOUNTERH. But, the SYSCOUNTER[m].SYSCOUNTERL must be read before corresponding SYSCOUNTER[m].SYSCOUNTERH. The SYSCOUNTER[m].SYSCOUNTERH.OVERFLOW indicates if the SYSCOUNTER[m].SYSCOUNTERL is overflown after reading it.

Sample code for reading the SYSCOUNTER value:

```
     uint32_t syscounterl_value, syscounterh_value, syscounterh;
     uint64_t syscounter;

     do
     {
       syscounterl_value = GRTC.SYSCOUNTER[m].SYSCOUNTERL;
       syscounterh = GRTC.SYSCOUNTER[m].SYSCOUNTERH;

       syscounterh_value = ((syscounterh & GRTC_SYSCOUNTER_SYSCOUNTERH_VALUE_Msk) >>
GRTC_SYSCOUNTER_SYSCOUNTERH_VALUE_Pos);

       if (((syscounterh & GRTC_SYSCOUNTER_SYSCOUNTERH_OVERFLOW_Msk) >>
GRTC_SYSCOUNTER_SYSCOUNTERH_OVERFLOW_Pos) ==
GRTC_SYSCOUNTER_SYSCOUNTERH_OVERFLOW_Overflow)
       {
         syscounterh = syscounterh_value - 1;
       }

     } while (((syscounterh & GRTC_SYSCOUNTER_SYSCOUNTERH_BUSY_Msk) >>
GRTC_SYSCOUNTER_SYSCOUNTERH_BUSY_Pos) != GRTC_SYSCOUNTER_SYSCOUNTERH_BUSY_Ready);

     syscounter = (syscounterh_value << 32) + syscounterl_value;
```

Compare and Capture (CC)

The CC[n] is a group of registers interfacing the compare and capture channels of SYSCOUNTER, where *n* is the number of compare and capture channels specified in the GRTC instance configuration table below. Each CC[n] has an associated TASKS_CAPTURE[n] task and EVENTS_COMPARE[n] event. Each channel compare functionality can be enabled/disabled with CC[n].CCEN.ACTIVE, and its current active state read from this same register.

The EVENTS_COMPARE[n] event can be generated by writing the compare values to the corresponding CC[n].CCL and CC[n].CCH registers. When a channel compare functionality is enabled and SYSCOUNTER is equal or greater than that CC value EVENTS_COMPARE[n] will be generated. Writes to CC[n].CCL disable the corresponding compare channel and writes to CC[n].CCH enable it. So CC[n].CCL must be written first.

Each channel compare functionality, except for the first channel when operating in periodic mode, operates in one-shot mode. When operating in one-shot mode, CC[n].CCEN.ACTIVE is cleared automatically following a compare event.

Moreover, a compare channel is automatically disabled when triggering TASKS_CAPTURE[n].

The EVENTS_COMPARE[n] event is generated immediately if the configured compare value at CC[n] is less than the current SYSCOUNTER value. The status CC[n].CCEN.PASTCC indicates this condition.

Every time the TASKS_CAPTURE[n] task is triggered, the current SYSCOUNTER is copied into the corresponding CC[n].CCL and CC[n].CCH registers. The CC[n].CCL and CC[n].CCH registers can be read in any order. The TASKS_CAPTURE[n] task will not generate EVENTS_COMPARE[n] event.

The TASKS_CAPTURE[n] tasks and EVENTS_COMPARE[n] events can be connected with the PPI. However, the TASKS_CAPTURE[n] is functional only when the SYSCOUNTER is in active state. The GRTC can be forced into active state by setting any SYSCOUNTER[n].ACTIVE register.

The compare value for CC[n] can also be updated by adding a fixed value provided at CC[n].CCADD.VALUE. Based on the CC[n].CCADD.REFERENCE configuration, either the current CC value or the current SYSCOUNTER value is added to the CC[n].CCADD.VALUE to configure the new compare value. Writing to CC[n].CCADD enables the corresponding compare channel.

Writes to CC[n].CCADD are ignored when the SYSCOUNTER is in sleep state.

Periodic interval

In addition to one-shot mode, the CC[0] can produce periodic EVENTS_COMPARE[0] event without any software interaction. The interval between these events can be programmed using INTERVAL register and non-zero interval enables this periodic interval feature. On every EVENTS_COMPARE[0] event, CC[0] becomes CC[0] + INTERVAL.

SYSCOUNTER sleep mode

SYSCOUNTER supports the following power modes:

- SYSCOUNTER is in active state
- SYSCOUNTER is in sleep state - This is the GRTC ultra-low power sleep mode

To save power, SYSCOUNTER automatically goes into sleep state when there is no activity.

Before SYSCOUNTER goes into sleep state, the GRTC configures the internal low frequency timer compare match based on the next expected SYSCOUNTER compare match using CC[n] configuration. An internal event on low frequency timer is generated when the compare match happens.

The internal counter at SYSCOUNTER is not ticking when SYSCOUNTER is in sleep state, the internal low frequency timer is configured as described above.

SYSCOUNTER returns to active state when any one of the following condition is met,

- Any of SYSCOUNTER[n].ACTIVE register is set to Active
- SYSCOUNTER counter value is read
- Any of the following registers are written:
  - MODE
  - CC[n]
  - INTENn/INTENSETn/INTENCLRn/INTENPENDn
  - Write to tasks TASKS_START, TASKS_STOP and TASKS_CLEAR
  - When internal low frequency timer compare match happens
- Any CPU is not sleeping, if MODE.AUTOEN is set

SYSCOUNTER goes back into sleep state when none of the above conditions met. However, the SYSCOUNTER active state can be extended by configuring the number of LFCLK cycles at TIMEOUT register.

On wake up to active state, SYSCOUNTER is updated based on the internal low frequency timer compare match. The status SYSCOUNTER[m].SYSCOUNTERH.BUSY indicates SYSCOUNTER is synchronized and valid after the SYSCOUNTER is woken up.

The status SYSCOUNTER[m].SYSCOUNTERH.LOADED indicates SYSCOUNTER is loaded after wake up, but not synchomized to the low frequency clock yet. This gives early indication of the SYSCOUNTER value, whcih may vary approximately one low frequency clcok cycle.

The SYSCOUNTER status can be summerized as below:

- SYSCOUNTER[m].SYSCOUNTERH.BUSY = 1 and SYSCOUNTER[m].SYSCOUNTERH.LOADED = 0 : SYSCCOUNTER is in sleep and SYSCOUNTER[m].SYSCOUNTER value is invalid

- SYSCOUNTER[m].SYSCOUNTERH.BUSY = 1 and SYSCOUNTER[m].SYSCOUNTERH.LOADED = 1 : SYSCCOUNTER is in woken up and SYSCOUNTER[m].SYSCOUNTER value is updated but not synchronized to low frequency clock yet
- SYSCOUNTER[m].SYSCOUNTERH.BUSY = 0 and SYSCOUNTER[m].SYSCOUNTERH.LOADED = 1 : SYSCOUNTER[m].SYSCOUNTER value is valid

Before handling next scheduled EVENTS_COMPARE[n] event, GRTC must wake up from the low power state. The WAKETIME register configures the number of LFCLK cycles that GRTC will wake up before the compare event. This duration allows the device sufficient time to power up, initialize, and activate the necessary clocks to accurately generate and handle events from the GRTC SYSCOUNTER. A longer system wake-up time requires a larger WAKETIME value to ensure reliable event processing. When the device is in System OFF, the WAKETIME must cover the system wakeup time from System OFF mode and in addition the required time the system uses to configure GRTC and enable the event.

All GRTC registers must be restored at wakeup from system OFF before the next scheduled COMPARE[n] event is generated. The TIMEOUT register must be configured to a value higher than WAKETIME (TIMEOUT > WAKETIME + guard_time). This makes sure that GRTC is not entering sleep again if the next event is nearer than TIMEOUT LFCLK cycles. The minimum guard time is 1 LFCLK cycle.

Recommendation on reading SYSCOUNTER

The following steps are recommended while reading SYSCOUNTER:

1. Set the corresponding SYSCOUNTER[m].ACTIVE to Active
2. Wait until the corresponding status SYSCOUNTER[m].SYSCOUNTERH.BUSY is cleared
3. Read the corresponding SYSCOUNTER[m].SYSCOUNTERL/H values
4. Clear the SYSCOUNTER[m].ACTIVE set above

Entering System OFF mode

The following steps are recommended before entering System OFF mode:

1. Set the SYSCOUNTER in active state, either
   - Set MODE.AUTOEN
   - Set corresponding SYSCOUNTER[m].ACTIVE to Active
2. If GRTC is wakeup source, then set the corresponding CC[n] value to expected wakeup time
3. Set WAKETIME for the boot latency
4. Set the SYSCOUNTER in sleep state, by clearing the configuration set at step 1 above
5. Wait for either of EVENTS_RTCOMPARESYNC or any EVENTS_COMPARE[n]
   - If any EVENTS_COMPARE[n] triggered,
     a. Allow CPUs to wakeup on interrupts
     b. Do not enter System OFF mode
   - Else,
     a. Enter System OFF by using the SYSTEMOFF register

8.11.3 Pulse Width Modulation (PWM)

The GRTC peripheral has a built-in PWM that can drive one output pin as an 8-bit non-inverted pulse-width modulated output.

The PWM is based on the internal low frequency timer of the GRTC and the PWM has a period of 256 LFCLK clock cycles, resulting frequency is 128Hz.

The PWM can be started by the TASKS_PWMSTART task and can be stopped by the TASKS_PWMSTOP task. The PWM starts/stops on next time when the lower 8 bits of internal low frequency timer becomes to zero. It takes up to 256 LFCLK clock cycles to take these tasks to go into effect.

The STATUS.PWM.READY indicates busy while handling the tasks TASKS_PWMSTART and TASKS_PWMSTOP. These PWM tasks must be triggered only when the STATUS.PWM.READY status indicates ready. The EVENTS_PWMREADY event is generated when the STATUS.PWM.READY status changes from busy to ready.

The PWM compare value is configured using PWMCONFIG and the copied to the internal PWM compare register when the lower 8 bits of internal low frequency timer is 0.

The PWM output goes high when the the lower 8 bits of internal low frequency timer goes to zero and the PWM output goes low when the lower 8 bits of internal low frequency timer matches the PWM compare value. The EVENTS_PWMPERIODEND event is generated on the rising edge of the PWM output.

To optimize the GRTC power consumption, the EVENTS_PWMPERIODEND can be disabled using EVTEN/EVTENSET/EVTENCLR registers to prevent clock from being requested when those events are triggered.

The PWM is operating even while the device is in system OFF.

For the PWM output pin mapping, see Pin assignments on page 1219. GRTC uses standard output drive strength for PWM output.

8.11.4 Clock output

The GRTC can be configured to output the clock on a pin.

The following clocks can be configured to be output on pins:

- LFCLK (32 KHz clock) output
- Divided 16M Hz clock (fast clock) output

The clock outputs can be enabled or disabled using CLKOUT.

The 16 MHz clock is divided before it is output on a pin. The divisor can be configured in CLKCFG, where clock output is (fast clock) / (CLKCFG.CLKFASTDIV * 2). The CLKCFG.CLKFASTDIV should be changed only when CLKOUT.CLKOUTFAST is disabled.

When updating the configuration registers CLKCFG and CLKOUT, a delay of a few LFCLK cycles may occur before the configuration takes effect. The STATUS.CLKOUT.READY register indicates whether the GRTC is busy updating the configuration:

- Busy: Configuration is in progress.
- Ready: Safe to update configuration.

Always check STATUS.CLKOUT.READY before making changes to CLKCFG or CLKOUT. The EVENTS_CLKOUTREADY event is generated when the STATUS.CLKOUT.READY status changes from busy to ready.

The LFCLK clock is output also when the device is in System OFF mode.

For the clock output pin mapping, see Pin assignments on page 1219. GRTC uses standard output drive strength for clock output.

8.11.5 Split Security

The GRTC peripheral supports split security, where the split security features can have different security attributes than the GRTC peripheral.

Split security settings are configured in SPU.

The following GRTC features have split security attributes:

- Each compare/capture channel at CC[n] register group - The same security attribute applies to the corresponding channels for,
  - TASKS_CAPTURE[n]
  - SUBSCRIBE_CAPTURE[n]
  - EVENTS_COMPARE[n]
  - PUBLISH_COMPARE[n]
- Each INTENm/INTENSETm/INTENCLRm/INTENPENDm - The same security attribute applies to the following registers
  - SYSCOUNTER[m]
- Registers, tasks, and events associated with the PWM function have configurable security attribute.
  - PWMCONFIG
  - TASKS_PWMSTART
  - TASKS_PWMSTOP
  - EVENTS_PWMPERIODEND
  - EVENTS_PWMREADY
  - PUBLISH_PWMREADY
  - STATUS.PWM
- Registers, tasks, and events associated with the CLKOUT and CLKCFG functions have configurable security attribute.
  - CLKOUT
  - CLKCFG
  - EVENTS_CLKOUTREADY
  - PUBLISH_CLKOUTREADY
  - STATUS.CLKOUT

INTERVAL has same security attribute as the CC[0] register group.

For more information on GRTC split ownership and security attributes, see Split Security on page 318.

Interrupts

GRTC provides multiple interrupts. Each interrupt is associated with its own set of INTENm/INTENSETm/INTENCLRm/INTENPENDm register. All events are routed to each of INTENm/INTENSETm/INTENCLRm/INTENPENDm registers, however only those events matching the security attributes can be accessible using the INTENm/INTENSETm/INTENCLRm/INTENPENDm registers.

8.11.6 Task priority

If the START task and the STOP task are triggered at the same time, meaning within the same period of LFCLK, the STOP task is prioritized.

If one or more of the CAPTURE tasks and the CLEAR task are triggered at the same time, that is, within the same period of LFCLP, the CAPTURE tasks are prioritized. This means that the CC registers will capture the counter value before the CLEAR tasks are triggered.

The STATUS.LFTIMER.READY indicates busy while handling the tasks TASKS_START, TASKS_STOP and TASKS_CLEAR. These tasks must be triggered only when the STATUS.LFTIMER.READY status indicates ready.

8.11.7 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
GRTC : S GRTC : NS	GLOBAL	0x500E2000 0x400E2000	US	S	NA	Yes	Global RTC GRTC

Configuration

Instance	Domain	Configuration
GRTC : S GRTC : NS	GLOBAL	Local CPUs connected to MODE.AUTO.EN.CpuActive : Application core Arm Cortex-M33. CLKSEL settings XO and LFLPRC must be used for lowest possible power consumption in sleep modes. Width of the RTCOUNTERH, RTCOMPAREH and RTCOMPARESYNCH registers : 0..14 Number of compare/capture registers : 0..11 Width of the TIMEOUT register : 0..15 Number of GRTC interrupts : 0..3 The PWM registers are available. The CLKOUT register is available. The CLKCFG.CLKSEL register is available. The CLKCFG.CLKSEL register supports LFLPRC. The CC[n].CCADD register has write access only. The ready status and events are available. SYSCOUNTER[n].SYSCOUNTERH.LOADED status is available CC[n].CCEN.PASTCC status is available 4 interrupts with interrupt remapping 12 capture compare channels implemented

Register overview

Register	Offset	TZ	Description
TASKS_CAPTURE[n]	0x000		Capture the counter value to CC[n] register
TASKS_START	0x060		Start the counter
TASKS_STOP	0x064		Stop the counter
TASKS_CLEAR	0x068		Clear the counter
TASKS_PWMSTART	0x06C		Start the PWM
TASKS_PWMSTOP	0x070		Stop the PWM
SUBSCRIBE_CAPTURE[n]	0x080		Subscribe configuration for task CAPTURE[n]
EVENTS_COMPARE[n]	0x100		Compare event on CC[n] match
EVENTS_RTCOMPARESYNC	0x164		The GRTC low frequency timer is synchronized with the SYSCOUNTER
EVENTS_PWMPERIODEND	0x16C		Event on end of each PWM period
EVENTS_PWMREADY	0x174		Event on STATUS.PWM.READY status changed to ready

Register	Offset	TZ	Description
EVENTS_CLKOUTREADY	0x178		Event on STATUS.CLKOUT.READY status changed to ready
PUBLISH_COMPARE[n]	0x180		Publish configuration for event COMPARE[n]
PUBLISH_PWMREADY	0x1F4		Publish configuration for event PWMREADY
PUBLISH_CLKOUTREADY	0x1F8		Publish configuration for event CLKOUTREADY
SHORTS	0x200		Shortcuts between local events and tasks
INTEN0	0x300		Enable or disable interrupt
INTENSET0	0x304		Enable interrupt
INTENCLR0	0x308		Disable interrupt
INTPEND0	0x30C		Pending interrupts
INTEN1	0x310		Enable or disable interrupt
INTENSET1	0x314		Enable interrupt
INTENCLR1	0x318		Disable interrupt
INTPEND1	0x31C		Pending interrupts
INTEN2	0x320		Enable or disable interrupt
INTENSET2	0x324		Enable interrupt
INTENCLR2	0x328		Disable interrupt
INTPEND2	0x32C		Pending interrupts
INTEN3	0x330		Enable or disable interrupt
INTENSET3	0x334		Enable interrupt
INTENCLR3	0x338		Disable interrupt
INTPEND3	0x33C		Pending interrupts
EVTEN	0x400		Enable or disable event routing
EVTENSET	0x404		Enable event routing
EVTENCLR	0x408		Disable event routing
MODE	0x510		Counter mode selection
CC[n].CCL	0x520		The lower 32-bits of Capture/Compare register CC[n]
CC[n].CCH	0x524		The higher 32-bits of Capture/Compare register CC[n]
CC[n].CCADD	0x528		Count to add to CC[n] when this register is written.
CC[n].CCEN	0x52C		Configure Capture/Compare register CC[n]
TIMEOUT	0x6A4		Timeout after all CPUs gone into sleep state to stop the SYSCOUNTER
INTERVAL	0x6A8		Count to add to CC[0] when the event EVENTS_COMPARE[0] triggers.
WAKETIME	0x6AC		GRTC wake up time.
STATUS.LFTIMER	0x6B0		Low frequency timer status.
STATUS.PWM	0x6B4		PWM status.
STATUS.CLKOUT	0x6B8		CLKOUT configuration status.
PWMCONFIG	0x710		PWM configuration.
CLKOUT	0x714		Configuration of clock output
CLKCFG	0x718		Clock Configuration
SYSCOUNTER[n].SYSCOUNTERL	0x720		The lower 32-bits of the SYSCOUNTER for index [n]
SYSCOUNTER[n].SYSCOUNTERH	0x724		The higher 20-bits of the SYSCOUNTER for index [n]
SYSCOUNTER[n].ACTIVE	0x728		Request to keep the SYSCOUNTER in the active state and prevent going to sleep for index [n]

8.11.7.1 TASKS_CAPTURE[n] (n=0..11)

Address offset: 0x000 + (n × 0x4)

Capture the counter value to CC[n] register

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_CAPTURE			Capture the counter value to CC[n] register
			Trigger	1	Trigger task

8.11.7.2 TASKS_START

Address offset: 0x060

Start the counter

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_START			Start the counter
			Trigger	1	Trigger task

8.11.7.3 TASKS_STOP

Address offset: 0x064

Stop the counter

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Stop the counter
			Trigger	1	Trigger task

8.11.7.4 TASKS_CLEAR

Address offset: 0x068

Clear the counter

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_CLEAR			Clear the counter
			Trigger	1	Trigger task

8.11.7.5 TASKS_PWMSTART

Address offset: 0x06C

Start the PWM

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_PWMSTART			Start the PWM
			Trigger	1	Trigger task

8.11.7.6 TASKS_PWMSTOP

Address offset: 0x070

Stop the PWM

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_PWMSTOP			Stop the PWM
			Trigger	1	Trigger task

8.11.7.7 SUBSCRIBE_CAPTURE[n] (n=0..11)

Address offset: 0x080 + (n × 0x4)

Subscribe configuration for task CAPTURE[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task CAPTURE[n] will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.11.7.8 EVENTS_COMPARE[n] (n=0..11)

Address offset: 0x100 + (n × 0x4)

Compare event on CC[n] match

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_COMPARE			Compare event on CC[n] match
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.11.7.9 EVENTS_RTCOMPARESYNC

Address offset: 0x164

The GRTC low frequency timer is synchronized with the SYSCOUNTER

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_RTCOMPARESYNC			The GRTC low frequency timer is synchronized with the SYSCOUNTER
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.11.7.10 EVENTS_PWMPERIODEND

Address offset: 0x16C

Event on end of each PWM period

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_PWMPERIODEND			Event on end of each PWM period
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.11.7.11 EVENTS_PWMREADY

Address offset: 0x174

Event on STATUS.PWM.READY status changed to ready

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_PWMREADY			Event on STATUS.PWM.READY status changed to ready
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.11.7.12 EVENTS_CLKOUTREADY

Address offset: 0x178

Event on STATUS.CLKOUT.READY status changed to ready

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_CLKOUTREADY			Event on STATUS.CLKOUT.READY status changed to ready
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.11.7.13 PUBLISH_COMPARE[n] (n=0..11)

Address offset: 0x180 + (n × 0x4)

Publish configuration for event COMPARE[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event COMPARE[n] will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.11.7.14 PUBLISH_PWMREADY

Address offset: 0x1F4

Publish configuration for event PWMREADY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event PWMREADY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.11.7.15 PUBLISH_CLKOUTREADY

Address offset: 0x1F8

Publish configuration for event CLKOUTREADY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event CLKOUTREADY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.11.7.16 SHORTS

Address offset: 0x200

Shortcuts between local events and tasks

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	RTCOMPARE_CLEAR			Shortcut between event RTCOMPARE and task CLEAR
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut

8.11.7.17 INTEN0

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A-L	RW	COMPARE[i] (i=0..11)			Enable or disable interrupt for event COMPARE[i]

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					P	O		N		M														L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
			Disabled	0																															
			Enabled	1																															
M	RW	RTCOMPARESYNC																																	
			Disabled	0																															
			Enabled	1																															
N	RW	PWMPERIODEND																																	
			Disabled	0																															
			Enabled	1																															
O	RW	PWMREADY																																	
			Disabled	0																															
			Enabled	1																															
P	RW	CLKOUTREADY																																	
			Disabled	0																															
			Enabled	1																															

8.11.7.18 INTENSET0

Address offset: 0x304

Enable interrupt

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					P	O		N		M														L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A-L	RW W1S	COMPARE[i] (i=0..11)																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
M	RW W1S	RTCOMPARESYNC																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
N	RW W1S	PWMPERIODEND																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
O	RW W1S	PWMREADY																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
P	RW W1S	CLKOUTREADY																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															

8.11.7.19 INTENCLR0

Address offset: 0x308

Disable interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		P	O		N		M														L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A-L	RW W1C	COMPARE[i] (i=0..11)			Write '1' to disable interrupt for event COMPARE[i]
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1C	RTCOMPARESYNC			Write '1' to disable interrupt for event RTCOMPARESYNC
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
N	RW W1C	PWMPERIODEND			Write '1' to disable interrupt for event PWMPERIODEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
O	RW W1C	PWMREADY			Write '1' to disable interrupt for event PWMREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
P	RW W1C	CLKOUTREADY			Write '1' to disable interrupt for event CLKOUTREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.11.7.20 INTPEND0

Address offset: 0x30C

Pending interrupts

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		P	O		N		M														L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A-L	R	COMPARE[i] (i=0..11)			Read pending status of interrupt for event COMPARE[i]
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
M	R	RTCOMPARESYNC			Read pending status of interrupt for event RTCOMPARESYNC
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
N	R	PWMPERIODEND			Read pending status of interrupt for event PWMPERIODEND
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
O	R	PWMREADY			Read pending status of interrupt for event PWMREADY
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
P	R	CLKOUTREADY			Read pending status of interrupt for event CLKOUTREADY
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending

8.11.7.21 INTEN1

Address offset: 0x310

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A-L	RW	COMPARE[i] (i=0..11)			Enable or disable interrupt for event COMPARE[i]
			Disabled	0	Disable
			Enabled	1	Enable
M	RW	RTCOMPARESYNC			Enable or disable interrupt for event RTCOMPARESYNC
			Disabled	0	Disable
			Enabled	1	Enable
N	RW	PWMPERIODEND			Enable or disable interrupt for event PWMPERIODEND
			Disabled	0	Disable
			Enabled	1	Enable
O	RW	PWMREADY			Enable or disable interrupt for event PWMREADY
			Disabled	0	Disable
			Enabled	1	Enable
P	RW	CLKOUTREADY			Enable or disable interrupt for event CLKOUTREADY
			Disabled	0	Disable
			Enabled	1	Enable

8.11.7.22 INTENSET1

Address offset: 0x314

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A-L	RW W1S	COMPARE[i] (i=0..11)			Write '1' to enable interrupt for event COMPARE[i]
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1S	RTCOMPARESYNC			Write '1' to enable interrupt for event RTCOMPARESYNC
			Set	1	Enable

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
N	RW W1S	PWMPERIODEND			Write '1' to enable interrupt for event PWMPERIODEND
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
O	RW W1S	PWMREADY			Write '1' to enable interrupt for event PWMREADY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
P	RW W1S	CLKOUTREADY			Write '1' to enable interrupt for event CLKOUTREADY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.11.7.23 INTENCLR1

Address offset: 0x318

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-L	RW W1C	COMPARE[i] (i=0..11)			Write '1' to disable interrupt for event COMPARE[i]
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1C	RTCOMPARESYNC			Write '1' to disable interrupt for event RTCOMPARESYNC
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
N	RW W1C	PWMPERIODEND			Write '1' to disable interrupt for event PWMPERIODEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
O	RW W1C	PWMREADY			Write '1' to disable interrupt for event PWMREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
P	RW W1C	CLKOUTREADY			Write '1' to disable interrupt for event CLKOUTREADY

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					P	O		N		M														L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
			Clear	1																															
			Disabled	0																															
			Enabled	1																															

8.11.7.24 INTPEND1

Address offset: 0x31C

Pending interrupts

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					P	O		N		M														L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A-L	R	COMPARE[i] (i=0..11)																																	
			NotPending	0																															
			Pending	1																															
M	R	RTCOMPARESYNC																																	
			NotPending	0																															
			Pending	1																															
N	R	PWMPERIODEND																																	
			NotPending	0																															
			Pending	1																															
O	R	PWMREADY																																	
			NotPending	0																															
			Pending	1																															
P	R	CLKOUTREADY																																	
			NotPending	0																															
			Pending	1																															

8.11.7.25 INTEN2

Address offset: 0x320

Enable or disable interrupt

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					P	O		N		M														L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A-L	RW	COMPARE[i] (i=0..11)																																	
			Disabled	0																															
			Enabled	1																															
M	RW	RTCOMPARESYNC																																	
			Disabled	0																															
			Enabled	1																															
N	RW	PWMPERIODEND																																	
			Disabled	0																															
			Enabled	1																															
O	RW	PWMREADY																																	
			Disabled	0																															

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					P	O		N		M														L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
			Enabled	1																															
P	RW	CLKOUTREADY																																	
			Disabled	0																															
			Enabled	1																															

8.11.7.26 INTENSET2

Address offset: 0x324

Enable interrupt

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					P	O		N		M														L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A-L	RW W1S	COMPARE[i] (i=0..11)																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
M	RW W1S	RTCOMPARESYNC																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
N	RW W1S	PWMPERIODEND																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
O	RW W1S	PWMREADY																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
P	RW W1S	CLKOUTREADY																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															

8.11.7.27 INTENCLR2

Address offset: 0x328

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-L	RW W1C	COMPARE[i] (i=0..11)			Write '1' to disable interrupt for event COMPARE[i]
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1C	RTCOMPARESYNC			Write '1' to disable interrupt for event RTCOMPARESYNC
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
N	RW W1C	PWMPERIODEND			Write '1' to disable interrupt for event PWMPERIODEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
O	RW W1C	PWMREADY			Write '1' to disable interrupt for event PWMREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
P	RW W1C	CLKOUTREADY			Write '1' to disable interrupt for event CLKOUTREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.11.7.28 INTPEND2

Address offset: 0x32C

Pending interrupts

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-L	R	COMPARE[i] (i=0..11)			Read pending status of interrupt for event COMPARE[i]
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
M	R	RTCOMPARESYNC			Read pending status of interrupt for event RTCOMPARESYNC
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
N	R	PWMPERIODEND			Read pending status of interrupt for event PWMPERIODEND
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
O	R	PWMREADY			Read pending status of interrupt for event PWMREADY
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
P	R	CLKOUTREADY			Read pending status of interrupt for event CLKOUTREADY
			NotPending	0	Read: Not pending

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		P	O		N		M														L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
			Pending	1	Read: Pending

8.11.7.29 INTEN3

Address offset: 0x330

Enable or disable interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		P	O		N		M														L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A-L	RW	COMPARE[i] (i=0..11)			Enable or disable interrupt for event COMPARE[i]
			Disabled	0	Disable
			Enabled	1	Enable
M	RW	RTCOMPARESYNC			Enable or disable interrupt for event RTCOMPARESYNC
			Disabled	0	Disable
			Enabled	1	Enable
N	RW	PWMPERIODEND			Enable or disable interrupt for event PWMPERIODEND
			Disabled	0	Disable
			Enabled	1	Enable
O	RW	PWMREADY			Enable or disable interrupt for event PWMREADY
			Disabled	0	Disable
			Enabled	1	Enable
P	RW	CLKOUTREADY			Enable or disable interrupt for event CLKOUTREADY
			Disabled	0	Disable
			Enabled	1	Enable

8.11.7.30 INTENSET3

Address offset: 0x334

Enable interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		P	O		N		M														L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A-L	RW W1S	COMPARE[i] (i=0..11)			Write '1' to enable interrupt for event COMPARE[i]
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1S	RTCOMPARESYNC			Write '1' to enable interrupt for event RTCOMPARESYNC
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
N	RW W1S	PWMPERIODEND			Write '1' to enable interrupt for event PWMPERIODEND
			Set	1	Enable

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
O	RW W1S	PWMREADY			Write '1' to enable interrupt for event PWMREADY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
P	RW W1S	CLKOUTREADY			Write '1' to enable interrupt for event CLKOUTREADY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.11.7.31 INTENCLR3

Address offset: 0x338

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-L	RW W1C	COMPARE[i] (i=0..11)			Write '1' to disable interrupt for event COMPARE[i]
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1C	RTCOMPARESYNC			Write '1' to disable interrupt for event RTCOMPARESYNC
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
N	RW W1C	PWMPERIODEND			Write '1' to disable interrupt for event PWMPERIODEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
O	RW W1C	PWMREADY			Write '1' to disable interrupt for event PWMREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
P	RW W1C	CLKOUTREADY			Write '1' to disable interrupt for event CLKOUTREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.11.7.32 INTPEND3

Address offset: 0x33C

Pending interrupts

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					P	O		N		M														L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A-L	R	COMPARE[i] (i=0..11)																																	
			NotPending	0																															
			Pending	1																															
M	R	RTCOMPARESYNC																																	
			NotPending	0																															
			Pending	1																															
N	R	PWMPERIODEND																																	
			NotPending	0																															
			Pending	1																															
O	R	PWMREADY																																	
			NotPending	0																															
			Pending	1																															
P	R	CLKOUTREADY																																	
			NotPending	0																															
			Pending	1																															

8.11.7.33 EVTEN

Address offset: 0x400

Enable or disable event routing

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID								A																											
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	PWMPERIODEND																																	
			Disabled	0																															
			Enabled	1																															

8.11.7.34 EVTENSET

Address offset: 0x404

Enable event routing

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID								A																											
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	PWMPERIODEND																																	
			Disabled	0																															
			Enabled	1																															
			Set	1																															

8.11.7.35 EVTENCLR

Address offset: 0x408

Disable event routing

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID								A																											
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	PWMPERIODEND																																	
			Disabled	0																															
			Enabled	1																															
			Clear	1																															

8.11.7.36 MODE

Address offset: 0x510

Counter mode selection

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																		B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	AUTOEN																																	
			Default	0																															
			CpuActive	1																															
B	RW	SYSCOUNTEREN																																	
			Disabled	0																															
			Enabled	1																															

8.11.7.37 CC[n].CCL (n=0..11)

Address offset: 0x520 + (n × 0x10)

The lower 32-bits of Capture/Compare register CC[n]

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	CCL																																	

8.11.7.38 CC[n].CCH (n=0..11)

Address offset: 0x524 + (n × 0x10)

The higher 32-bits of Capture/Compare register CC[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CCH			Capture/Compare high value in 1 µs

8.11.7.39 CC[n].CCADD (n=0..11)

Address offset: 0x528 + (n × 0x10)

Count to add to CC[n] when this register is written.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	VALUE			Count to add to CC[n]
B	W	REFERENCE			Configure the Capture/Compare register
			SYSCOUNTER	0	Adds SYSCOUNTER value. CC[n] becomes CCADD[n].VALUE + SYSCOUNTER when this register is written.
			CC	1	Adds CC value. CC[n] becomes CCADD[n].VALUE + CC[n] when this register is written.

8.11.7.40 CC[n].CCEN (n=0..11)

Address offset: 0x52C + (n × 0x10)

Configure Capture/Compare register CC[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ACTIVE			Configure the Capture/Compare register
			Disable	0	Capture/Compare register CC[n] Disabled.
			Enable	1	Capture/Compare register CC[n] enabled.
B	RW	PASTCC			Status of event EVENTS_COMPARE[n] caused by the configured CC value is in past
			Inactive	0	Inactive
			Active	1	Active

8.11.7.41 TIMEOUT

Address offset: 0x6A4

Timeout after all CPUs gone into sleep state to stop the SYSCOUNTER

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	VALUE			Number of 32Ki cycles

8.11.7.42 INTERVAL

Address offset: 0x6A8

Count to add to CC[0] when the event EVENTS_COMPARE[0] triggers.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID				Value												Description															
A	RW	VALUE																		Count to add to CC[0]															

8.11.7.43 WAKETIME

Address offset: 0x6AC

GRTC wake up time.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																												A	A	A	A	A	A	A	A
Reset 0x00000001				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
ID	R/W	Field		Value ID				Value												Description															
A	RW	VALUE																		Number of LFCLK clock cycles to wake up before the next scheduled EVENTS_COMPARE event															

8.11.7.44 STATUS.LFTIMER

Address offset: 0x6B0

Low frequency timer status.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000001				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
ID	R/W	Field		Value ID				Value												Description															
A	R	READY																		Low frequency timer is ready or busy.															
				Busy				0												Busy															
				Ready				1												Ready															

8.11.7.45 STATUS.PWM

Address offset: 0x6B4

PWM status.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000001				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
ID	R/W	Field		Value ID				Value												Description															
A	R	READY																		PWM is ready or busy.															
				Busy				0												Busy															
				Ready				1												Ready															

8.11.7.46 STATUS.CLKOUT

Address offset: 0x6B8

CLKOUT configuration status.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000001				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
ID	R/W	Field	Value ID	Value																															
A	R	READY																																	
			Busy	0																															
			Ready	1																															

8.11.7.47 PWMCONFIG

Address offset: 0x710

PWM configuration.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																												A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	COMPAREVALUE		1..255																															

8.11.7.48 CLKOUT

Address offset: 0x714

Configuration of clock output

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																		B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	CLKOUT32K																																	
			Disabled	0																															
			Enabled	1																															
B	RW	CLKOUTFAST																																	
			Disabled	0																															
			Enabled	1																															

8.11.7.49 CLKCFG

Address offset: 0x718

Clock Configuration

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B B A A A A A A A A
Reset 0x00010001				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	CLKFASTDIV		1..255	Fast clock divisor value of clock output Fast clock divisor value 0 behaves same as 1.
B	W	CLKSEL			GRTC LFCLK clock source selection
			LFXO	0	GRTC LFCLK clock source is LFXO
			SystemLFCLK	1	GRTC LFCLK clock source is system LFCLK
			LFLPRC	2	GRTC LFCLK clock source is LFLPRC

8.11.7.50 SYSCOUNTER[n].SYSCOUNTERL (n=0..3)

Address offset: 0x720 + (n × 0x10)

The lower 32-bits of the SYSCOUNTER for index [n]

The SYSCOUNTERL must be read before SYSCOUNTERH.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	VALUE			The lower 32-bits of the SYSCOUNTER value.

8.11.7.51 SYSCOUNTER[n].SYSCOUNTERH (n=0..3)

Address offset: 0x724 + (n × 0x10)

The higher 20-bits of the SYSCOUNTER for index [n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x60000000				**0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	VALUE			The higher 20-bits of the SYSCOUNTER value.
B	R	LOADED			SYSCOUNTER loaded status
			NotLoaded	0	SYSCOUNTER is not loaded
			Loaded	1	SYSCOUNTER is loaded
C	R	BUSY			SYSCOUNTER busy status
			Ready	0	SYSCOUNTER is ready for read
			Busy	1	SYSCOUNTER is busy, so not ready for read (value returned in the VALUE field of this register is not valid)
D	R	OVERFLOW			The SYSCOUNTERL overflow indication after reading it.
			NoOverflow	0	SYSCOUNTERL is not overflown
			Overflow	1	SYSCOUNTERL overflown

8.11.7.52 SYSCOUNTER[n].ACTIVE (n=0..3)

Address offset: 0x728 + (n × 0x10)

Request to keep the SYSCOUNTER in the active state and prevent going to sleep for index [n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	ACTIVE			Keep SYSCOUNTER in active state
			NotActive	0	Allow SYSCOUNTER to go to sleep
			Active	1	Keep SYSCOUNTER active

8.12 LPCOMP — Low-power comparator

The low-power comparator (LPCOMP) peripheral compares an input voltage against a reference voltage.

The main features of LPCOMP are the following:

- Input range of 0 to VDD
- Ultra-low power
- Eight input options (**AIN0** to **AIN7**)
- Two reference voltage options:
  - Two external analog reference inputs
  - 15-level internal reference ladder (VDD/16)
- Optional hysteresis enable on input
- Wakeup source from System OFF or System ON IDLE

In System ON, LPCOMP can generate separate events on rising and falling edges of a signal, or sample the current state of the pin to determine if it is above or below the selected reference. The block is configurable to use any of the analog inputs on the device. Additionally, LPCOMP can be used as an analog wakeup source from System ON IDLE or System OFF. The comparator threshold is programmable to a range of supply voltage fractions.

Note: LPCOMP cannot be used (STARTed) at the same time as COMP. Only one comparator can be used at a time.

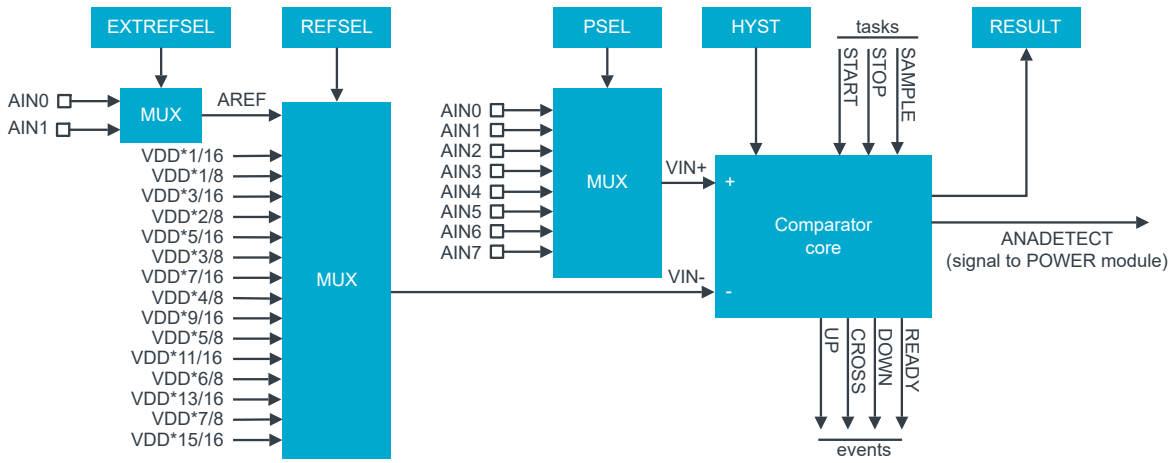


Figure 65: LPCOMP block diagram

8.12.1 Operation

The LPCOMP peripheral compares an input voltage (VIN+) from an analog input pin selected via the PSEL register, against a reference voltage (VIN-) selected via registers REFSEL on page 351 and EXTREFSEL.

The PSEL, REFSEL, and EXTREFSEL registers must be configured before LPCOMP is enabled through the ENABLE register.

The HYST register allows enabling an optional hysteresis in the comparator core. This hysteresis prevents noise on the signal, which would create unwanted events. The following figure illustrates the effect of an active hysteresis on a noisy input signal. It is disabled by default, and must be configured before enabling LPCOMP.

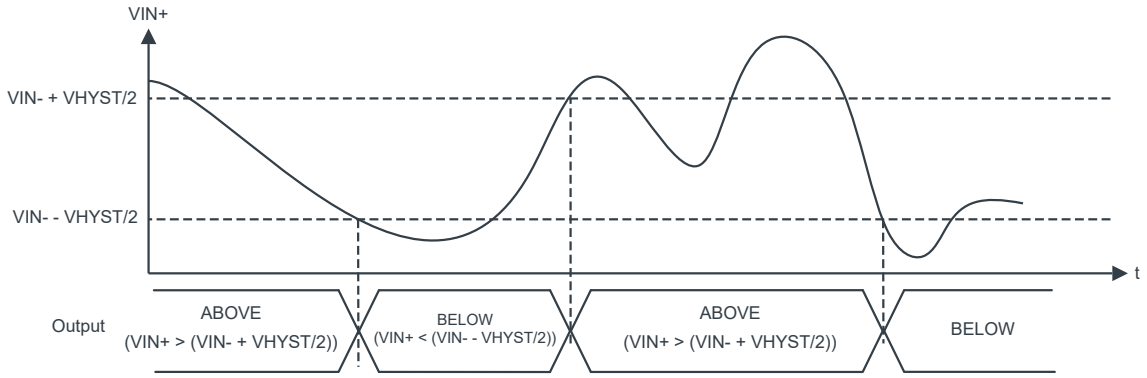


Figure 66: Effect of hysteresis on a noisy input signal

LPCOMP is started by triggering the START task. After a startup time of $t_{LPCOMP,STARTUP}$, LPCOMP generates a READY event to indicate that the comparator is ready to use and the output of LPCOMP is correct. LPCOMP generates events every time VIN+ crosses VIN-. More specifically, every time VIN+ rises above VIN- (upward crossing), an UP event and CROSS event are generated. Every time VIN+ falls below VIN- (downward crossing), a DOWN event and CROSS event are generated. When hysteresis is enabled, the upward crossing level becomes $VIN- + VHYST/2$, and the downward crossing level becomes $VIN- - VHYST/2$.

LPCOMP is stopped by triggering the STOP task.

LPCOMP is operational in both System ON and System OFF mode when enabled through the ENABLE register. See POWER — Power control on page 100 for more information about power modes. Entering System OFF is not allowed when a READY event is pending to be generated.

All LPCOMP registers, including ENABLE, are classified as retained registers when the LPCOMP is enabled. However, when the device wakes up from System OFF, all LPCOMP registers are reset.

LPCOMP can wake up the system from System OFF by asserting the ANADETECT signal. The ANADETECT signal can be derived from any of the event sources that generate UP, DOWN, and CROSS events. If wakeup from System OFF occurs, only the ANADETECT signal is generated. See the ANADETECT register (ANADETECT on page 351) for more information on configuring the ANADETECT signal.

The immediate value of the LPCOMP can be sampled to RESULT on page 350 by triggering the SAMPLE task.

See RESETREAS on page 112 for more information on how to detect a wakeup from LPCOMP.

8.12.2 Shared resources

LPCOMP shares analog resources with SAADC. While it is possible to use the SAADC at the same time as the LPCOMP, selecting the same analog input pin for both modules is not supported.

Additionally, LPCOMP shares registers and other resources with other peripherals that have the same ID as the LPCOMP. See Peripherals with shared ID on page 229 for more information.

The LPCOMP peripheral should not be disabled (by writing to the ENABLE register) before the peripheral has stopped. Failing to do so may result in unpredictable behavior.

8.12.3 Pin configuration

The LPCOMP.PSEL register is used to select an analog input pin for LPCOMP. The pins available are **AIN0** through **AIN7**.

See GPIO — General purpose input/output on page 292 for more information about the pins. Similarly, you can use EXTREFSEL on page 351 to select one of the analog reference input pins, **AIN0** and **AIN1**, as input for AREF if it is selected in EXTREFSEL on page 351. The selected analog pins are acquired by LPCOMP when it is enabled through ENABLE on page 350.

8.12.4 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
LPCOMP : S LPCOMP : NS	GLOBAL	0x50106000 0x40106000	US	S	NA	No	Low-power comparator LPCOMP

Register overview

Register	Offset	TZ	Description
TASKS_START	0x000		Start comparator
TASKS_STOP	0x004		Stop comparator
TASKS_SAMPLE	0x008		Sample comparator value. This task requires that LPCOMP has been started by the START task.
SUBSCRIBE_START	0x080		Subscribe configuration for task START
SUBSCRIBE_STOP	0x084		Subscribe configuration for task STOP
SUBSCRIBE_SAMPLE	0x088		Subscribe configuration for task SAMPLE
EVENTS_READY	0x100		LPCOMP is ready and output is valid
EVENTS_DOWN	0x104		Downward crossing
EVENTS_UP	0x108		Upward crossing
EVENTS_CROSS	0x10C		Downward or upward crossing
PUBLISH_READY	0x180		Publish configuration for event READY
PUBLISH_DOWN	0x184		Publish configuration for event DOWN
PUBLISH_UP	0x188		Publish configuration for event UP
PUBLISH_CROSS	0x18C		Publish configuration for event CROSS
SHORTS	0x200		Shortcuts between local events and tasks
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
INTPEND	0x30C		Pending interrupts
RESULT	0x400		Compare result
ENABLE	0x500		Enable LPCOMP
PSEL	0x504		Input pin select
REFSEL	0x508		Reference select
EXTREFSEL	0x50C		External reference select
ANADETECT	0x520		Analog detect configuration
HYST	0x538		Comparator hysteresis enable

8.12.4.1 TASKS_START

Address offset: 0x000

Start comparator

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_START			Start comparator
			Trigger	1	Trigger task

8.12.4.2 TASKS_STOP

Address offset: 0x004

Stop comparator

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Stop comparator
			Trigger	1	Trigger task

8.12.4.3 TASKS_SAMPLE

Address offset: 0x008

Sample comparator value. This task requires that LPCOMP has been started by the START task.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_SAMPLE			Sample comparator value. This task requires that LPCOMP has been started by the START task.
			Trigger	1	Trigger task

8.12.4.4 SUBSCRIBE_START

Address offset: 0x080

Subscribe configuration for task START

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task START will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.12.4.5 SUBSCRIBE_STOP

Address offset: 0x084

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.12.4.6 SUBSCRIBE_SAMPLE

Address offset: 0x088

Subscribe configuration for task SAMPLE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task SAMPLE will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.12.4.7 EVENTS_READY

Address offset: 0x100

LPCOMP is ready and output is valid

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_READY			LPCOMP is ready and output is valid
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.12.4.8 EVENTS_DOWN

Address offset: 0x104

Downward crossing

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_DOWN			Downward crossing
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.12.4.9 EVENTS_UP

Address offset: 0x108

Upward crossing

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_UP			Upward crossing
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.12.4.10 EVENTS_CROSS

Address offset: 0x10C

Downward or upward crossing

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_CROSS			Downward or upward crossing
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.12.4.11 PUBLISH_READY

Address offset: 0x180

Publish configuration for event READY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event READY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.12.4.12 PUBLISH_DOWN

Address offset: 0x184

Publish configuration for event DOWN

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event DOWN will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.12.4.13 PUBLISH_UP

Address offset: 0x188

Publish configuration for event UP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event UP will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.12.4.14 PUBLISH_CROSS

Address offset: 0x18C

Publish configuration for event CROSS

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event CROSS will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.12.4.15 SHORTS

Address offset: 0x200

Shortcuts between local events and tasks

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	READY_SAMPLE			Shortcut between event READY and task SAMPLE
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
B	RW	READY_STOP			Shortcut between event READY and task STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
C	RW	DOWN_STOP			Shortcut between event DOWN and task STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
D	RW	UP_STOP			Shortcut between event UP and task STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
E	RW	CROSS_STOP			Shortcut between event CROSS and task STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut

8.12.4.16 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	READY			Enable or disable interrupt for event READY
			Disabled	0	Disable
			Enabled	1	Enable
B	RW	DOWN			Enable or disable interrupt for event DOWN
			Disabled	0	Disable
			Enabled	1	Enable
C	RW	UP			Enable or disable interrupt for event UP
			Disabled	0	Disable
			Enabled	1	Enable
D	RW	CROSS			Enable or disable interrupt for event CROSS
			Disabled	0	Disable
			Enabled	1	Enable

8.12.4.17 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	READY			Write '1' to enable interrupt for event READY
	W1S				
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW	DOWN			Write '1' to enable interrupt for event DOWN
	W1S				
			Set	1	Enable

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1S	UP			Write '1' to enable interrupt for event UP
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1S	CROSS			Write '1' to enable interrupt for event CROSS
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.12.4.18 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	READY			Write '1' to disable interrupt for event READY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	DOWN			Write '1' to disable interrupt for event DOWN
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	UP			Write '1' to disable interrupt for event UP
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1C	CROSS			Write '1' to disable interrupt for event CROSS
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.12.4.19 INTPEND

Address offset: 0x30C

Pending interrupts

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	READY			Read pending status of interrupt for event READY
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
B	R	DOWN			Read pending status of interrupt for event DOWN
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
C	R	UP			Read pending status of interrupt for event UP
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
D	R	CROSS			Read pending status of interrupt for event CROSS
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending

8.12.4.20 RESULT

Address offset: 0x400

Compare result

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	RESULT			Result of last compare. Decision point SAMPLE task.
			Below	0	Input voltage is below the reference threshold (VIN+ < VIN-)
			Above	1	Input voltage is above the reference threshold (VIN+ > VIN-)

8.12.4.21 ENABLE

Address offset: 0x500

Enable LPCOMP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			Enable or disable LPCOMP
			Disabled	0	Disable
			Enabled	1	Enable

8.12.4.22 PSEL

Address offset: 0x504

Input pin select

The pin is selected based on PSEL.PORT

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	B B B B A A A A A
Reset 0x00000000	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PIN			Analog pin select
B	RW	PORT			GPIO Port selection

8.12.4.23 REFSEL

Address offset: 0x508

Reference select

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	A A A A
Reset 0x00000004	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	REFSEL			Reference select
			Ref1_8Vdd	0	VDD * 1/8 selected as reference
			Ref2_8Vdd	1	VDD * 2/8 selected as reference
			Ref3_8Vdd	2	VDD * 3/8 selected as reference
			Ref4_8Vdd	3	VDD * 4/8 selected as reference
			Ref5_8Vdd	4	VDD * 5/8 selected as reference
			Ref6_8Vdd	5	VDD * 6/8 selected as reference
			Ref7_8Vdd	6	VDD * 7/8 selected as reference
			ARef	7	External analog reference selected
			Ref1_16Vdd	8	VDD * 1/16 selected as reference
			Ref3_16Vdd	9	VDD * 3/16 selected as reference
			Ref5_16Vdd	10	VDD * 5/16 selected as reference
			Ref7_16Vdd	11	VDD * 7/16 selected as reference
			Ref9_16Vdd	12	VDD * 9/16 selected as reference
			Ref11_16Vdd	13	VDD * 11/16 selected as reference
			Ref13_16Vdd	14	VDD * 13/16 selected as reference
			Ref15_16Vdd	15	VDD * 15/16 selected as reference

8.12.4.24 EXTREFSEL

Address offset: 0x50C

External reference select

The external reference pin is selected based on EXTREFSEL.PORT

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	B B B B A A A A A
Reset 0x00000000	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PIN			External analog reference pin select
B	RW	PORT			GPIO Port selection

8.12.4.25 ANADETECT

Address offset: 0x520

Analog detect configuration

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	ANADETECT			Analog detect configuration
			Cross	0	Generate ANADETECT on crossing, both upward crossing and downward crossing
			Up	1	Generate ANADETECT on upward crossing only
			Down	2	Generate ANADETECT on downward crossing only

8.12.4.26 HYST

Address offset: 0x538

Comparator hysteresis enable

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	HYST			Comparator hysteresis enable
			Disabled	0	Comparator hysteresis disabled
			Enabled	1	Comparator hysteresis enabled

8.13 NFCT — Near field communication tag

The NFCT peripheral is an implementation of an NFC Forum compliant listening device NFC-A.

The main features of NFCT are the following:

- NFC-A listen mode operation:
  - 13.56 MHz input frequency
  - Bit rate 106 kbps
- Wake-on-field low power field detection (SENSE) mode
- Frame assemble and disassemble for the NFC-A frames specified by the NFC Forum
- Programmable frame timing controller
- Integrated automatic collision resolution, cyclic redundancy check (CRC), and parity functions

With appropriate software, the NFCT peripheral can be used as the listening device NFC-A as specified by the NFC Forum.

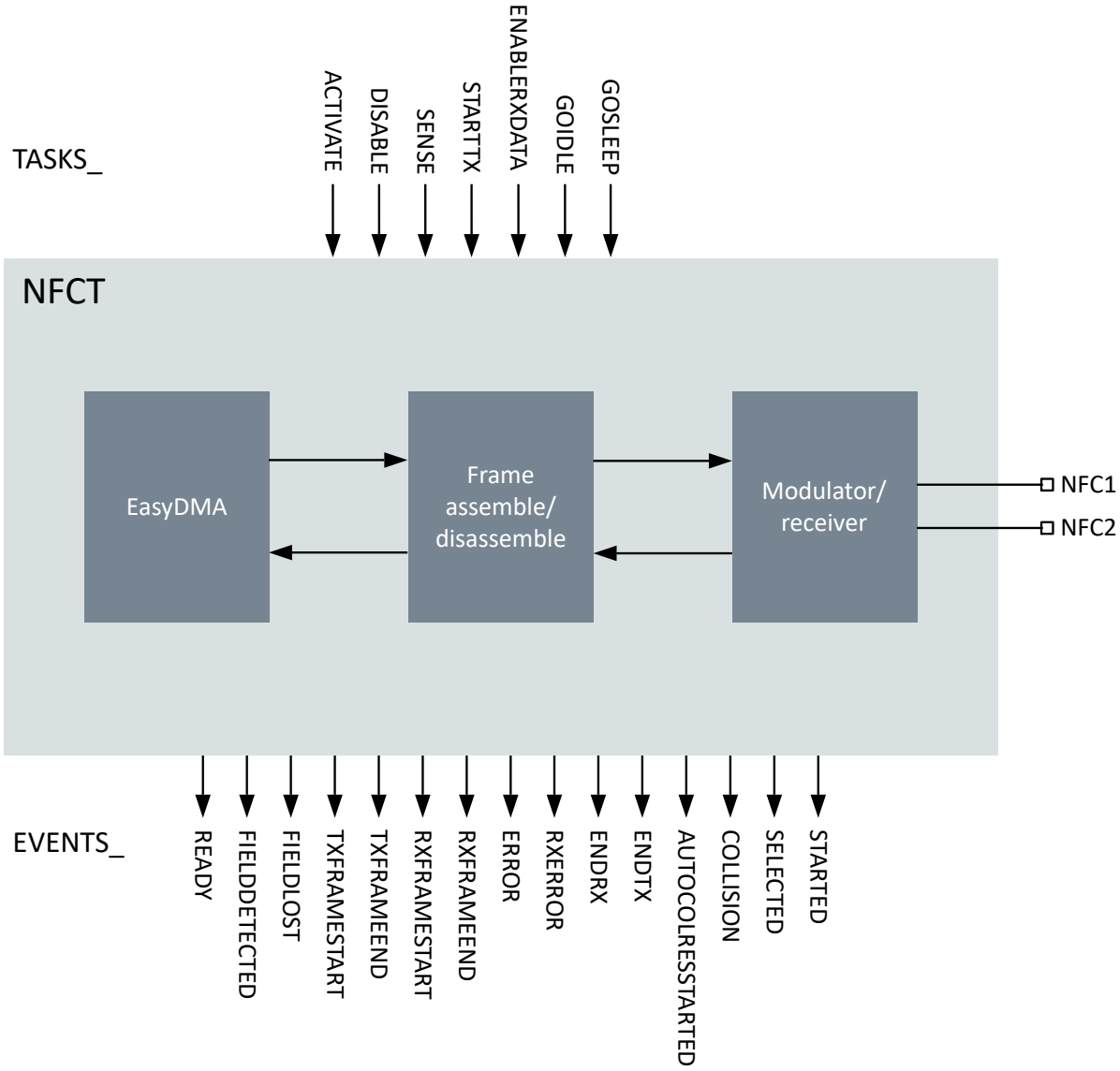


Figure 67: NFCT block diagram

8.13.1 Overview

The NFCT peripheral contains a 13.56 MHz AM receiver and a 13.56 MHz load modulator with 106 kbps data rate as defined by the NFC Forum.

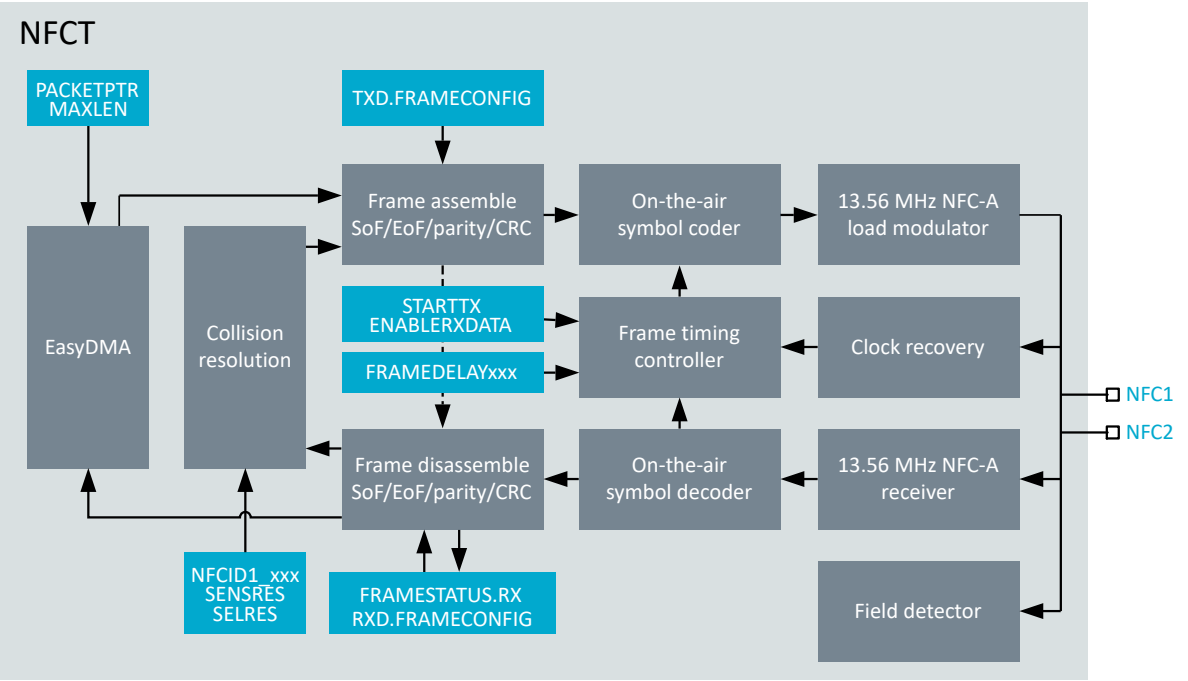


Figure 68: NFCT overview

When transmitting, the frame data will be transferred directly from RAM and transmitted with configurable frame type and delay timing. The system will be notified by an event whenever a complete frame is received or sent. The received frames will be automatically disassembled and the data part of the frame transferred to RAM.

The NFCT peripheral also supports the collision detection and resolution ("anticollision") as defined by the NFC Forum.

Wake-on-field is supported in SENSE mode while the device is either in System OFF or System ON mode. When the antenna enters an NFC field, an event will be triggered notifying the system to activate the NFCT functionality for incoming frames. In System ON, if the energy detected at the antenna increases beyond a threshold value, the module will generate a FIELDDETECTED event. When the strength of the field no longer supports NFC communication, the module will generate a FIELDLOST event. For the Low Power Field Detect threshold values, refer to NFCT Electrical Specification on page 1260.

In System OFF, the NFCT Low Power Field Detect function can wake the system up through a reset. See RESETREAS on page 112 for more information on how to detect a wakeup from NFCT.

If the system is put into System OFF mode while a field is already present, the NFCT Low Power Field Detect function will wake the system up right away and generate a reset.

> **Note:** As a consequence of a reset, NFCT is disabled, and therefore the reset handler will have to activate NFCT again and set it up properly.

The HFXO must be running before the NFCT peripheral goes into ACTIVATED state. Note that the NFCT peripheral calibration is automatically done on ACTIVATE task. The HFXO can be turned off when the NFCT peripheral goes into SENSE mode. The shortcut FIELDDETECTED_ACTIVATE can be used when the HFXO is already running while in SENSE mode.

Outgoing data will be collected from RAM with the EasyDMA function and assembled according to the TXD.FRAMECONFIG register. Incoming data will be disassembled according to the RXD.FRAMECONFIG register and the data section in the frame will be written to RAM via the EasyDMA function.

The NFCT peripheral includes a frame timing controller that can be used to accurately control the inter-frame delay between the incoming frame and a corresponding outgoing frame. It also includes optional CRC functionality.

8.13.2 Operating states

Tasks and events are used to control the operating state of the peripheral. The module can change state by triggering a task, or when specific operations are finalized. Events and tasks allow software to keep track of and change the current state.

See NFCT block diagram on page 353 and NFCT state diagram, automatic collision resolution enabled on page 355 for more information. See *NFC Forum, NFC Activity Technical Specification* for description on NFCT operating states.

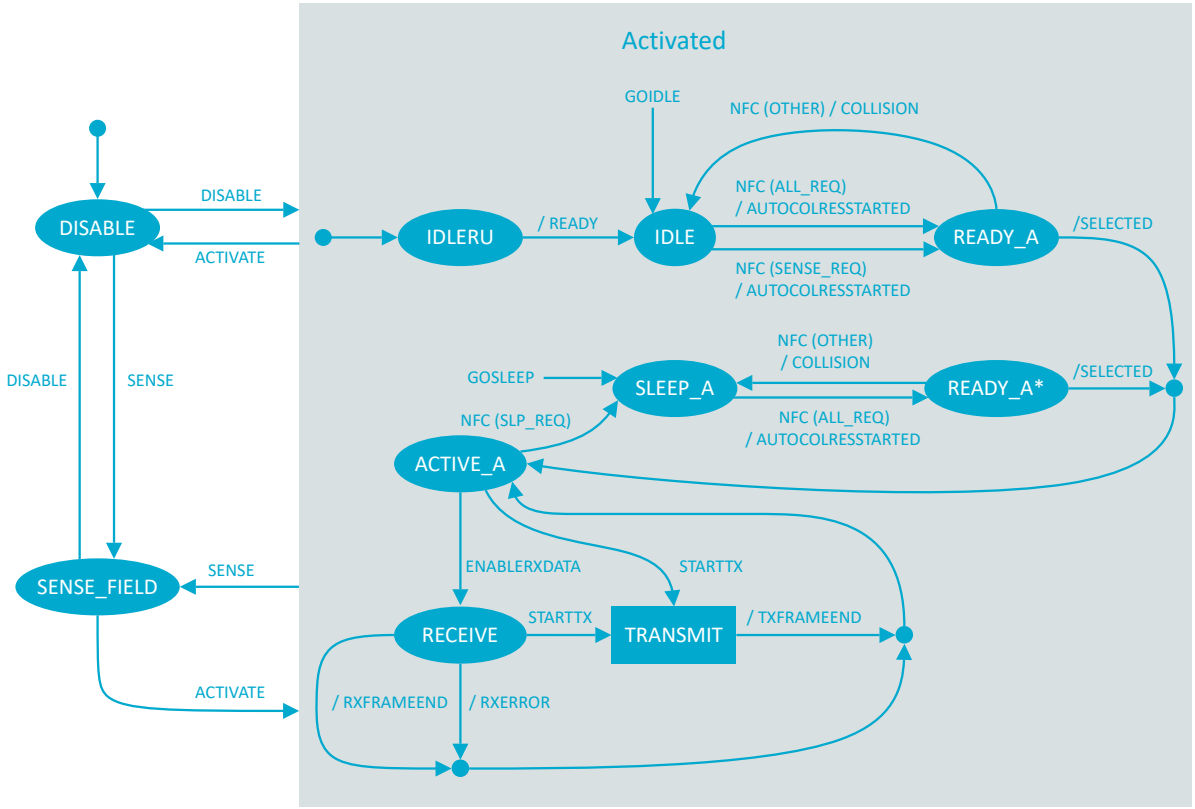


Figure 69: NFCT state diagram, automatic collision resolution enabled

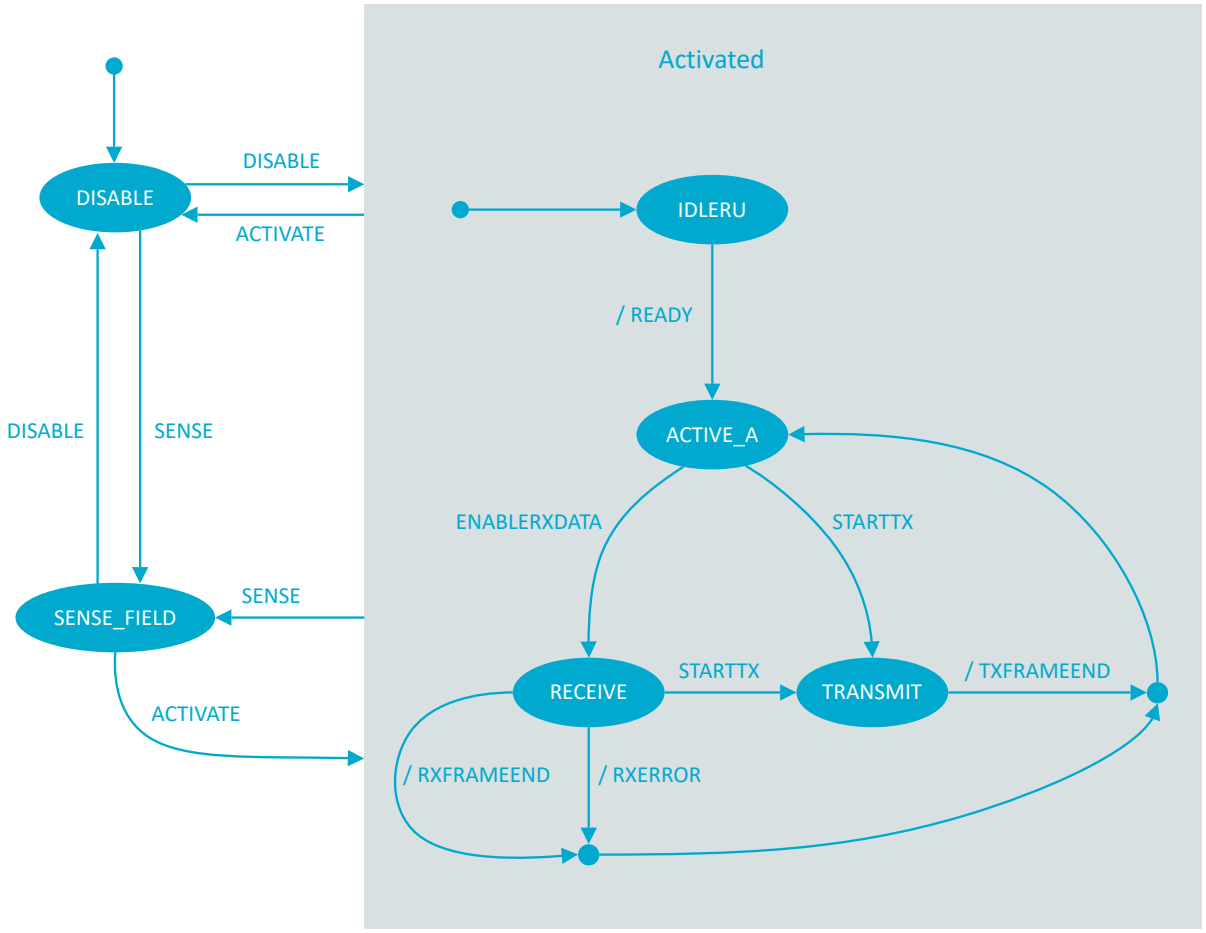


Figure 70: NFCT state diagram, automatic collision resolution disabled

Important:

- FIELDLOST event is not generated in SENSE mode.
- Sending SENSE task while field is still present does not generate FIELDDETECTED event.
- If the FIELDDETECTED event is cleared before sending the ACTIVATE task, then the FIELDDETECTED event shows up again after sending the ACTIVATE task. The shortcut FIELDDETECTED_ACTIVATE can be used to avoid this condition.

8.13.3 Pin configuration

NFCT uses two pins to connect the antenna and these pins are shared with GPIOs.

The ENABLE field in register PADCONFIG on page 391 defines the usage of these pins and their protection level against excessive voltages. See Pin assignments on page 1219 for the pins used by the NFCT peripheral.

When PADCONFIG.ENABLE=`Enabled`, a protection circuit will be enabled on the dedicated pins, preventing the chip from being damaged in the presence of a strong NFC field. The protection circuit will short the two pins together if the voltage difference exceeds approximately 2V. The GPIO function on those pins will also be disabled.

When PADCONFIG.ENABLE=`Disabled`, the device will not be protected against strong NFC field damages caught by a connected NFCT antenna, and the NFCT peripheral will not operate as expected, as it will never leave the DISABLE state.

The pins dedicated to the NFCT antenna function will have some limitation when the pins are configured for normal GPIO operation. The pin capacitance will be higher on those pins (refer to C_{PAD_NFC} in the

Electrical Specification of GPIO — General purpose input/output on page 292), and some increased leakage current between the two pins is to be expected if they are used in GPIO mode, and are driven to different logical values. To save power, the two pins should always be set to the same logical value whenever entering one of the device power saving modes. For details, refer to I_{NFC_LEAK} in the Electrical Specification of GPIO — General purpose input/output on page 292.

8.13.4 EasyDMA

The NFCT peripheral implements EasyDMA for reading and writing of data packets from and to the Data RAM.

The NFCT EasyDMA utilizes a pointer called PACKETPTR on page 386 for receiving and transmitting packets.

The NFCT peripheral uses EasyDMA to read or write RAM, but not both at the same time. The event RXFRAMESTART indicates that the EasyDMA has started writing to the RAM for a receive frame and the event RXFRAMEND indicates that the EasyDMA has completed writing to the RAM. Similarly, the event TXFRAMESTART indicates that the EasyDMA has started reading from the RAM for a transmit frame and the event TXFRAMEND indicates that the EasyDMA has completed reading from the RAM. If a transmit and a receive operation is issued at the same time, the transmit operation would be prioritized.

Starting a transmit operation while the EasyDMA is writing a receive frame to the RAM will result in unpredictable behavior. Starting an EasyDMA operation when there is an ongoing EasyDMA operation may result in unpredictable behavior. It is recommended to wait for the TXFRAMEEND or RXFRAMEEND event for the ongoing transmit or receive before starting a new receive or transmit operation.

The MAXLEN on page 386 register determines the maximum number of bytes that can be read from or written to the RAM. This feature can be used to ensure that the NFCT peripheral does not overwrite, or read beyond, the RAM assigned to a packet. Note that if the RXD.AMOUNT or TXD.AMOUNT register indicates longer data packets than set in MAXLEN, the frames sent to or received from the physical layer will be incomplete. If that situation occurs in RX mode, the OVERRUN bit in the FRAMESTATUS.RX register will be set and an RXERROR event will be triggered.

Important: The RXD.AMOUNT and TXD.AMOUNT define a frame length in bytes and bits excluding start of frame (SoF), end of frame (EoF), and parity, but including CRC for RXD.AMOUNT only. Make sure to take potential additional bits into account when setting MAXLEN.

Only sending task ENABLERXDATA ensures that a new value in PACKETPTR pointing to the RX buffer in Data RAM is taken into account.

If PACKETPTR is not pointing to the Data RAM region, an EasyDMA transfer may result in a hard fault or RAM corruption. For more information about the different memory regions, see Chapter Memory on page 13.

The NFCT peripherals normally do alternative receive and transmit frames. Therefore, to prepare for the next frame, the PACKETPTR, MAXLEN, TXD.FRAMECONFIG and TXD.AMOUNT can be updated while the receive is in progress, and, similarly, the PACKETPTR, MAXLEN and RXD.FRAMECONFIG can be updated while the transmit is in progress. They can be updated and prepared for the next NFC frame immediately after the STARTED event of the current frame has been received. Updating the TXD.FRAMECONFIG and TXD.AMOUNT during the current transmit frame or updating RXD.FRAMECONFIG during current receive frame may cause unpredictable behaviour.

In accordance with *NFC Forum, NFC Digital Protocol Technical Specification*, the least significant bit (LSB) from the least significant byte (LSByte) is sent on air first. The bytes are stored in increasing order, starting at the lowest address in the EasyDMA buffer in RAM.

8.13.5 Frame assembler

The NFCT peripheral implements a frame assembler in hardware.

When the NFCT peripheral is in the ACTIVE_A state, the software can decide to enter RX or TX mode. For RX mode, see Frame disassembler on page 359. For TX mode, the software must indicate the address of the source buffer in Data RAM and its size through programming the PACKETPTR and MAXLEN registers respectively, then issuing a STARTTX task.

MAXLEN must be set so that it matches the size of the frame to be sent.

The STARTED event indicates that the PACKETPTR and MAXLEN registers have been captured by the frame assembler EasyDMA.

When asserting the STARTTX task, the frame assembler module will start reading TXD.AMOUNT.TXDATABYTES bytes (plus one additional byte if TXD.AMOUNT.TXDATABITS > 0) from the RAM position set by the PACKETPTR.

The NFCT peripheral transmits the data as read from RAM, adding framing and the CRC calculated on the fly if set in TXD.FRAMECONFIG. The NFCT peripheral will take (8*TXD.AMOUNT.TXDATABYTES + TXD.AMOUNT.TXDATABITS) bits and assemble a frame according to the settings in TXD.FRAMECONFIG. Both short frames, standard frames, and bit-oriented SDD frames as specified in the *NFC Forum, NFC Digital Protocol Technical Specification* can be assembled by the correct setting of the TXD.FRAMECONFIG register.

The bytes will be transmitted on air in the same order as they are read from RAM with a rising bit order within each byte, least significant bit (LSB) first. That is, the least significant bit (b0) will be transmitted on air before the second bit (b1), and so on. The bits read from RAM will be coded into symbols as defined in the *NFC Forum, NFC Digital Protocol Technical Specification*.

Note: Some NFC Forum documents, such as *NFC Forum, NFC Digital Protocol Technical Specification*, define bit numbering in a byte from b1 (LSB) to b8 (most significant bit (MSB)), while most other technical documents from the NFC Forum, and also the Nordic Semiconductor documentation, traditionally number them from b0 to b7. The present document uses the b0–b7 numbering scheme. Be aware of this when comparing the *NFC Forum, NFC Digital Protocol Technical Specification* to others.

The frame assembler can be configured in TXD.FRAMECONFIG to add SoF symbol, calculate and add parity bits, and calculate and add CRC to the data read from RAM when assembling the frame. The total frame will then be longer than what is defined by TXD.AMOUNT.TXDATABYTES. TXDATABITS. DISCARDMODE will select if the first bits in the first byte read from RAM or the last bits in the last byte read from RAM will be discarded if TXD.AMOUNT.TXDATABITS are not equal to zero. Note that if TXD.FRAMECONFIG.PARITY = Parity and TXD.FRAMECONFIG.DISCARDMODE=DiscardStart, a parity bit will be included after the non-complete first byte. No parity will be added after a non-complete last byte.

The frame assemble operation for different settings in TXD.FRAMECONFIG is illustrated in the following table. All shaded bit fields are added by the frame assembler. Some of these bits are optional and appearances are configured in TXD.FRAMECONFIG. Note that the frames illustrated do not necessarily comply with the NFC specification. The figure only illustrates the behavior of the NFCT peripheral.

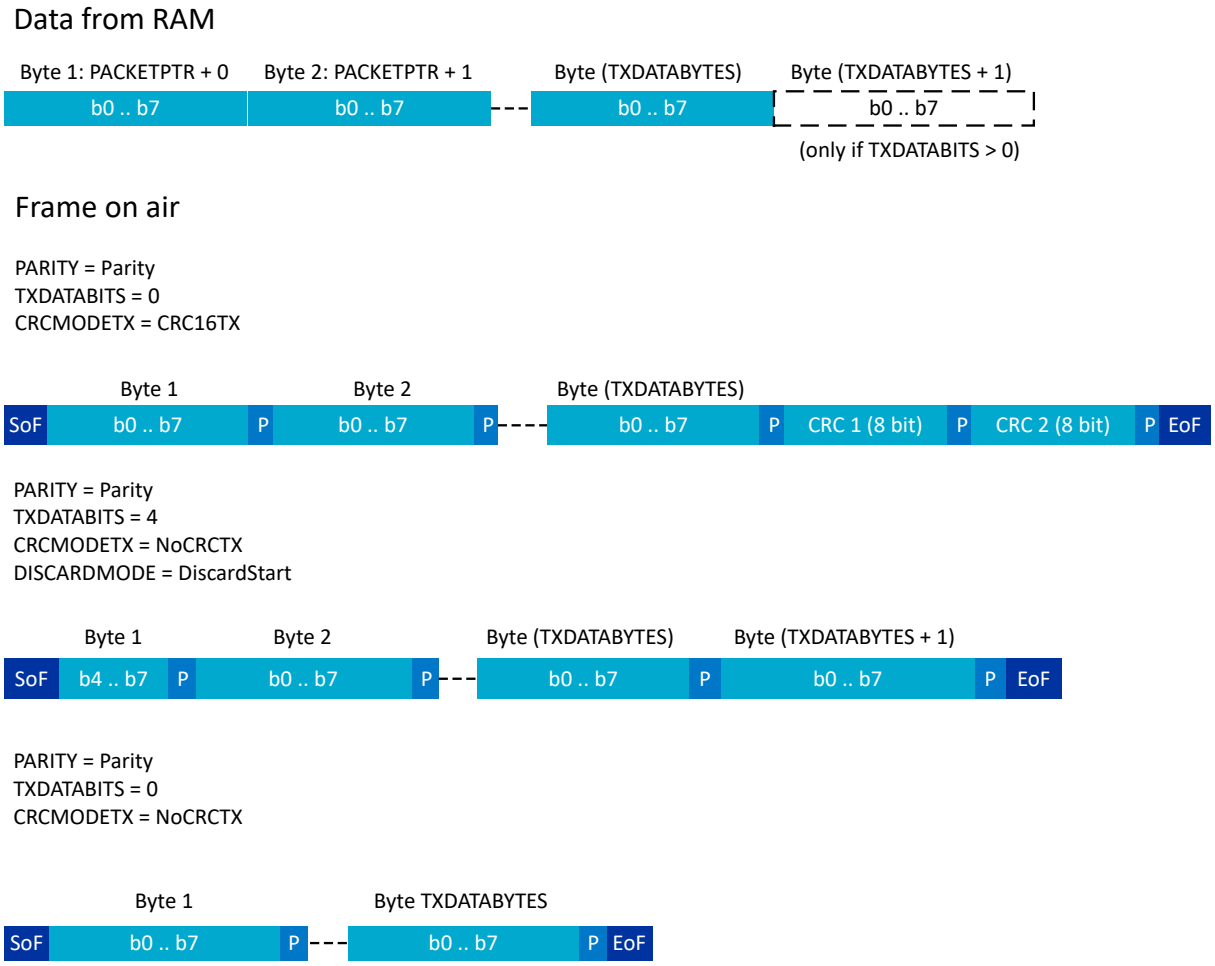


Figure 71: Frame assemble illustration

The accurate timing for transmitting the frame on air is set using the frame timing controller settings.

8.13.6 Frame disassembler

The NFCT peripheral implements a frame disassembler in hardware.

When the NFCT peripheral is in the ACTIVE_A state, the software can decide to enter RX or TX mode. For TX mode, see Frame assembler on page 357. For RX mode, the software must indicate the address and size of the destination buffer in Data RAM through programming the PACKETPTR and MAXLEN registers before issuing an ENABLERXDATA task.

The STARTED event indicates that the PACKETPTR and MAXLEN registers have been captured by the frame disassembler EasyDMA.

When an incoming frame starts, the RXFRAMESTART event will get issued and data will be written to the buffer in Data RAM. The frame disassembler will verify and remove any parity bits, start of frame (SoF) and end of frame (EoF) symbols on the fly based on RXD.FRAMECONFIG register configuration. It will, however, verify and transfer the CRC bytes into RAM, if the CRC is enabled through RXD.FRAMECONFIG.

When an EoF symbol is detected, the NFCT peripheral will assert the RXFRAMEEND event and write the RXD.AMOUNT register to indicate numbers of received bytes and bits in the data packet. The module does not interpret the content of the data received from the remote NFC device, except for SoF, EoF, parity, and CRC checking, as described above. The frame disassemble operation is illustrated in the following figure.

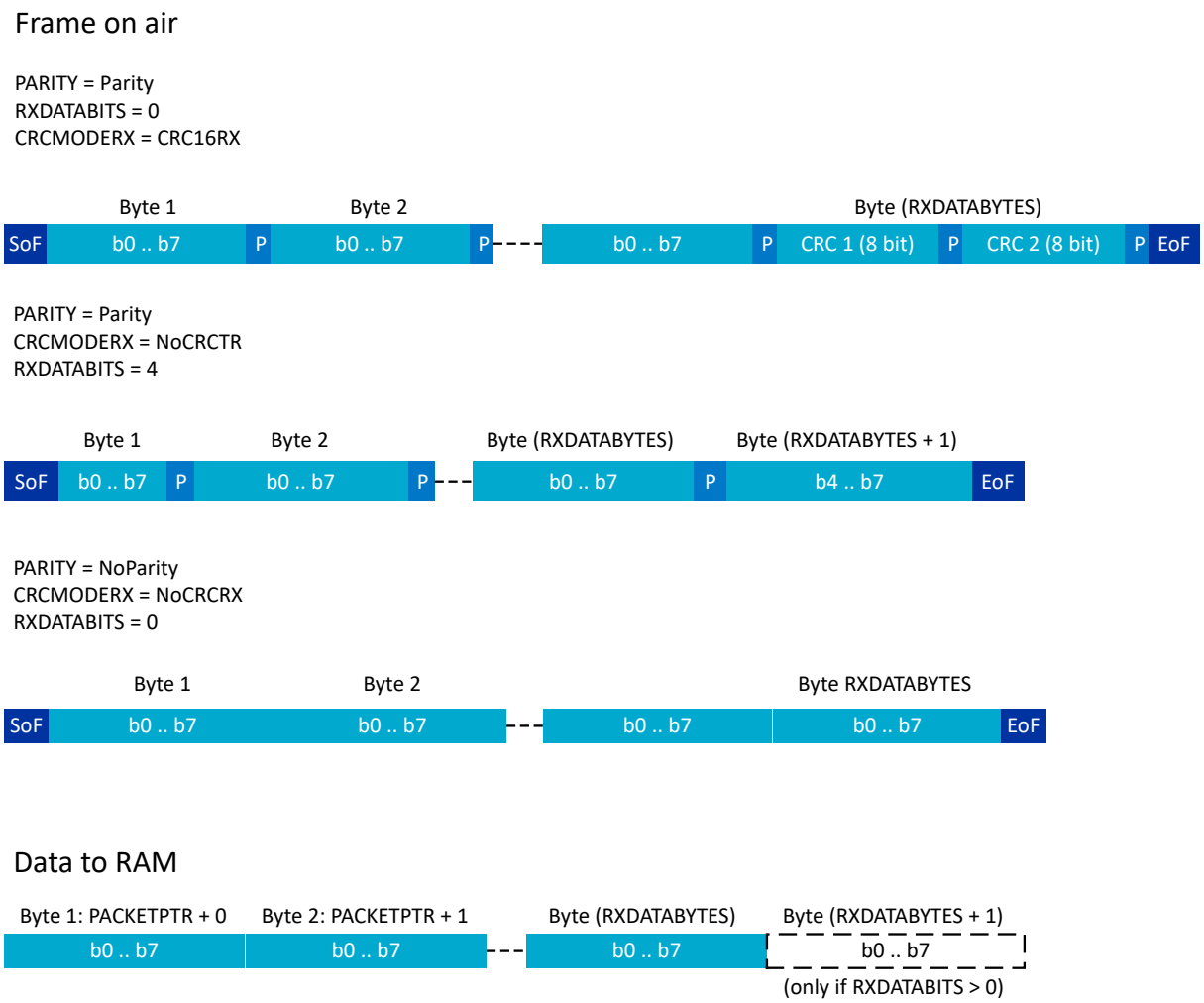


Figure 72: Frame disassemble illustration

Per NFC specification, the time between EoF to the next SoF can be as short as 86 µs, and thefore care must be taken that PACKETPTR and MAXLEN are ready and ENABLERXDATA is issued on time after the end of previous frame. The use of a PPI shortcut from TXFRAMEEND to ENABLERXDATA is recommended.

8.13.7 Frame timing controller

The NFCT peripheral includes a frame timing controller that continuously keeps track of the number of the 13.56 MHz RF carrier clock periods since the end of the EoF of the last received frame.

The NFCT peripheral can be programmed to send a responding frame within a time window or at an exact count of RF carrier periods. In case of FRAMEDELAYMODE = Window, a STARTTX task triggered before the frame timing controller counter is equal to FRAMEDELAYMIN will force the transmission to halt until the counter is equal to FRAMEDELAYMIN. If the counter is within FRAMEDELAYMIN and FRAMEDELAYMAX when the STARTTX task is triggered, the NFCT peripheral will start the transmission straight away. In case of FRAMEDELAYMODE = ExactVal, a STARTTX task triggered before the frame delay counter is equal to FRAMEDELAYMAX will halt the actual transmission start until the counter is equal to FRAMEDELAYMAX.

In case of FRAMEDELAYMODE = WindowGrid, the behaviour is similar to the FRAMEDELAYMODE = Window, but the actual transmission between FRAMEDELAYMIN and FRAMEDELAYMAX starts on a bit grid as defined for NFC-A Listen frames (slot duration of 128 RF carrier periods).

An ERROR event (with FRAMEDELAYTIMEOUT cause in ERRORSTATUS) will be asserted if the frame timing controller counter reaches FRAMEDELAYMAX without any STARTTX task triggered. This may happen even when the response is not required as per *NFC Forum, NFC Digital Protocol Technical Specification*. Any commands handled by the automatic collision resolution that don't involve a response being

generated may also result in an ERROR event (with FRAMEDELAYTIMEOUT cause in ERRORSTATUS). The FRAMEDELAYMIN and FRAMEDELAYMAX values shall only be updated before the STARTTX task is triggered. Failing to do so may cause unpredictable behaviour.

The frame timing controller operation is illustrated in the following figure. The frame timing controller automatically adjusts the frame timing counter based on the last received data bit according to NFC-A technology in the *NFC Forum, NFC Digital Protocol Technical Specification*.

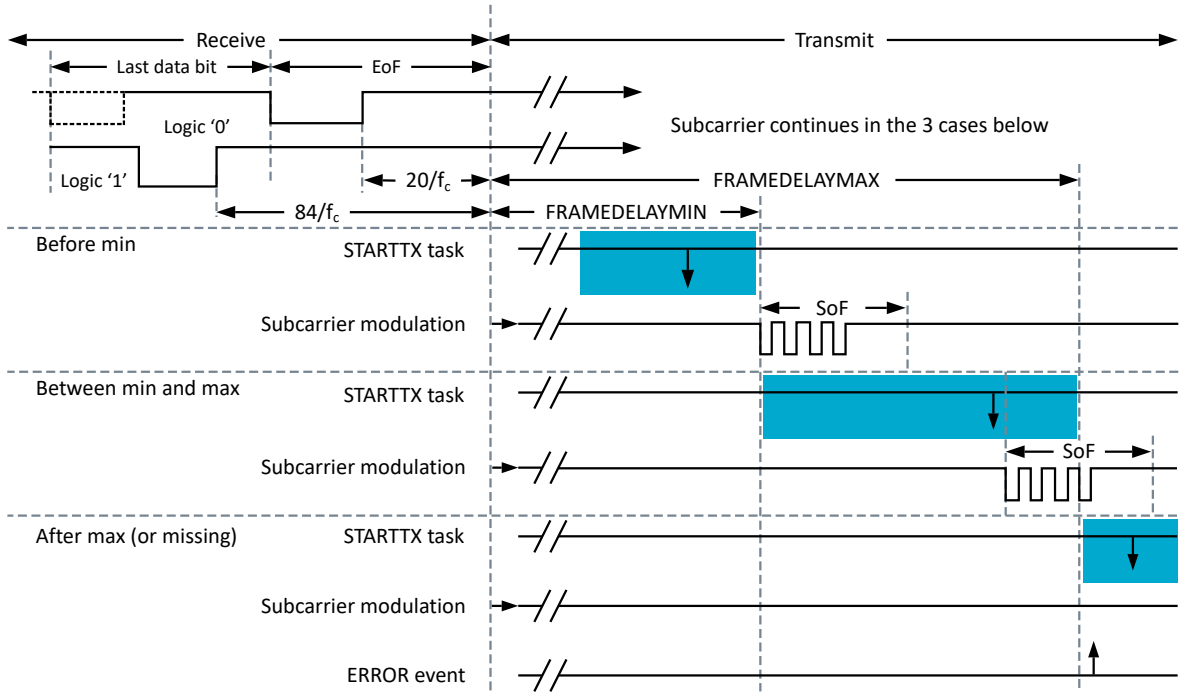


Figure 73: Frame timing controller (FRAMEDELAYMODE=Window)

8.13.8 Collision resolution

The NFCT peripheral implements an automatic collision resolution function as defined by the NFC Forum.

Automatic collision resolution is enabled by default, and it is recommended that the feature is used since it is power efficient and reduces the complexity of software handling the collision resolution sequence. This feature can be disabled through the MODE field in the AUTOCOLRESCONFIG register. When the automatic collision resolution is disabled, all commands will be sent over EasyDMA as defined in frame disassembler.

The SENSRES and SELRES registers need to be programmed upfront in order for the collision resolution to behave correctly. Depending on the NFCIDSIZE field in SENSRES, the following registers also need to be programmed upfront:

- NFCID1_LAST if NFCID1SIZE=NFCID1Single (ID = 4 bytes);
- NFCID1_2ND_LAST and NFCID1_LAST if NFCID1SIZE=NFCID1Double (ID = 7 bytes);
- NFCID1_3RD_LAST, NFCID1_2ND_LAST and NFCID1_LAST if NFCID1SIZE=NFCID1Triple (ID = 10 bytes);

A pre-defined set of registers, NFC.TAGHEADER0..3, containing a valid NFCID1 value, is available in FICR and can be used by software to populate the NFCID1_3RD_LAST, NFCID1_2ND_LAST, and NFCID1_LAST registers.

NFCID1 byte allocation (top sent first on air) on page 362 explains the position of the ID bytes in NFCID1_3RD_LAST, NFCID1_2ND_LAST, and NFCID1_LAST, depending on the ID size, and as compared to the definition used in the *NFC Forum, NFC Digital Protocol Technical Specification*.

	ID = 4 bytes	ID = 7 bytes	ID = 10 bytes
NFCID1.Q			$nfcid1_0$
NFCID1.R			$nfcid1_1$
NFCID1.S			$nfcid1_2$
NFCID1.T		$nfcid1_0$	$nfcid1_3$
NFCID1.U		$nfcid1_1$	$nfcid1_4$
NFCID1.V		$nfcid1_2$	$nfcid1_5$
NFCID1.W	$nfcid1_0$	$nfcid1_3$	$nfcid1_6$
NFCID1.X	$nfcid1_1$	$nfcid1_4$	$nfcid1_7$
NFCID1.Y	$nfcid1_2$	$nfcid1_5$	$nfcid1_8$
NFCID1.Z	$nfcid1_3$	$nfcid1_6$	$nfcid1_9$

Table 43: NFCID1 byte allocation (top sent first on air)

The hardware implementation can handle the states from IDLE to ACTIVE_A automatically as defined in the *NFC Forum, NFC Activity Technical Specification*, and the other states are to be handled by software. The software keeps track of the state through events. The collision resolution will trigger an AUTOCOLRESSTARTED event when it has started. Reaching the ACTIVE_A state is indicated by the SELECTED event.

If collision resolution fails, a COLLISION event is triggered. Note that errors occurring during automatic collision resolution may also cause ERROR and/or RXERROR events to be generated. Other events may also get generated. It is recommended that the software ignores any event except COLLISION, SELECTED and FIELDLOST during automatic collision resolution. Software shall also make sure that any unwanted SHORT or PPI shortcut is disabled during automatic collision resolution.

The automatic collision resolution will be restarted, if the packets are received with CRC or parity errors while in ACTIVE_A state. The automatic collision resolution feature can be disabled while in ACTIVE_A state to avoid this.

The SLP_REQ is automatically handled by the NFCT peripheral when the automatic collision resolution is enabled. However, this results in an ERROR event (with FRAMEDELAYTIMEOUT cause in ERRORSTATUS) since the SLP_REQ has no response. This error must be ignored until the SELECTED event is triggered and this error should be cleared by the software when the SELECTED event is triggered.

8.13.9 Antenna interface

In ACTIVATED state, an amplitude regulator will adjust the voltage swing on the antenna pins to a value that is within the V_{swing} limit.

Refer to NFCT Electrical Specification on page 1260.

8.13.10 NFCT antenna recommendations

The NFCT antenna coil must be connected differential between `NFC1` and `NFC2` pins of the device.

Two external capacitors should be used to tune the resonance of the antenna circuit to 13.56 MHz.

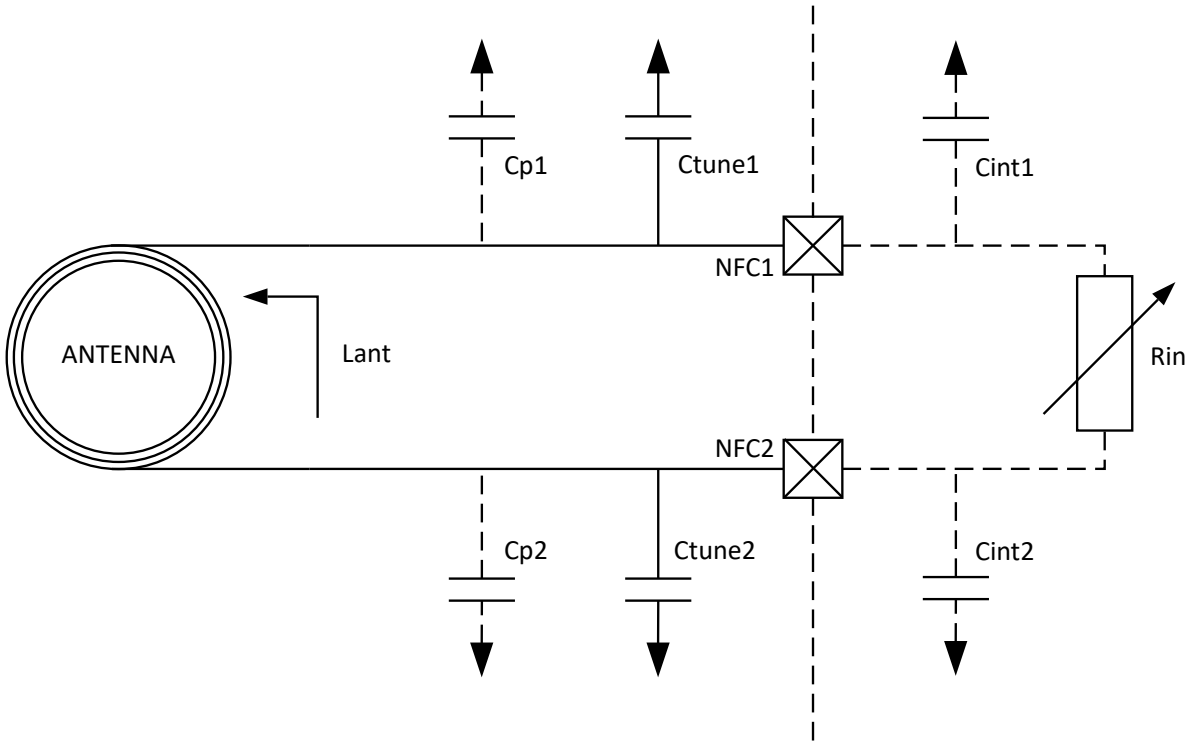


Figure 74: NFCT antenna recommendations

The required tuning capacitor value is given by the below equations:

$$C'_{tune} = \frac{1}{(2\pi \cdot 13.56\ MHz)^2 \cdot L_{ant}} \quad where\ C'_{tune} = \frac{1}{2} \cdot (C_p + C_{\text{int}} + C_{tune})$$

$$and\ C_{tune1} = C_{tune2} = C_{tune} \qquad C_{p1} = C_{p2} = C_p \qquad C_{\text{int1}} = C_{\text{int2}} = C_{\text{int}}$$

$$C_{tune} = \frac{2}{(2\pi \cdot 13.56\ MHz)^2 \cdot L_{ant}} - C_p - C_{\text{int}}$$

An antenna inductance of L_{ant} = 2 µH will give tuning capacitors in the range of 130 pF on each pin. The total capacitance on **NFC1** and **NFC2** must be matched.

8.13.11 Battery protection

If the antenna is exposed to a strong NFC field, current may flow in the opposite direction on the supply due to parasitic diodes and ESD structures.

If the battery used does not tolerate return current, a series diode must be placed between the battery and the device in order to protect the battery.

8.13.12 Digital Modulation Signal

Support for external analog frontends or antenna architectures is possible by optionally outputting the digital modulation signal to a GPIO.

The NFCT peripheral is designed to connect directly to a loop antenna, receive a modulated signal from an NFC Reader with its internal analog frontend and transmit data back by changing the input resistance that is then seen as modulated load by the NFC Reader.

In addition, the peripheral has an option to output the digital modulation signal to a GPIO. Reception still occurs through the internal analog frontend, whereas transmission can be done by one of the following:

- The internal analog frontend through the loop antenna (default)
- An external frontend using the digital modulation signal
- The combination of both above

There are two registers that allow configuration of the modulation signal (i.e. of the response from NFCT to the NFC Reader), MODULATIONCTRL and MODULATIONPSEL. The registers need to be programmed before NFCT sends a response to a request from a reader. Ideally, this configuration is performed during startup and whenever the NFCT peripheral is powered up.

The selected GPIO needs to be configured as output in the corresponding GPIO configuration register. It is recommended to set an output value in the corresponding GPIO.OUT register – this value will be driven whenever the NFCT peripheral is disabled.

NFCT drives the pin low when there is no modulation, and drives it with On-Off Keying (OOK) modulation of an 847 kHz subcarrier (derived from the carrier frequency) when it responds to commands from an NFC Reader.

8.13.13 References

NFC Forum, NFC Analog Specification version 2.1, www.nfc-forum.org

NFC Forum, NFC Digital Protocol Technical Specification version 2.2, www.nfc-forum.org

NFC Forum, NFC Activity Technical Specification version 2.1, www.nfc-forum.org

8.13.14 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
NFCT : S NFCT : NS	GLOBAL	0x500D6000 0x400D6000	US	S	SA	No	Near field communication tag NFCT

Configuration

Instance	Domain	Configuration
NFCT : S NFCT : NS	GLOBAL	Reset value of register NFCTFIELDDETCFG: 1

Register overview

Register	Offset	TZ	Description
TASKS_ACTIVATE	0x000		Activate NFCT peripheral for incoming and outgoing frames, change state to activated
TASKS_DISABLE	0x004		Disable NFCT peripheral
TASKS_SENSE	0x008		Enable NFC sense field mode, change state to sense mode
TASKS_STARTTX	0x00C		Start transmission of an outgoing frame, change state to transmit
TASKS_STOPTX	0x010		Stops an issued transmission of a frame
TASKS_ENABLERXDATA	0x01C		Initializes the EasyDMA for receive.
TASKS_GOIDLE	0x024		Force state machine to IDLE state
TASKS_GOSLEEP	0x028		Force state machine to SLEEP_A state

Register	Offset	TZ	Description
SUBSCRIBE_ACTIVATE	0x080		Subscribe configuration for task ACTIVATE
SUBSCRIBE_DISABLE	0x084		Subscribe configuration for task DISABLE
SUBSCRIBE_SENSE	0x088		Subscribe configuration for task SENSE
SUBSCRIBE_STARTTX	0x08C		Subscribe configuration for task STARTTX
SUBSCRIBE_STOPTX	0x090		Subscribe configuration for task STOPTX
SUBSCRIBE_ENABLERXDATA	0x09C		Subscribe configuration for task ENABLERXDATA
SUBSCRIBE_GOIDLE	0x0A4		Subscribe configuration for task GOIDLE
SUBSCRIBE_GOSLEEP	0x0A8		Subscribe configuration for task GOSLEEP
EVENTS_READY	0x100		The NFCT peripheral is ready to receive and send frames
EVENTS_FIELDDETECTED	0x104		Remote NFC field detected
EVENTS_FIELDLOST	0x108		Remote NFC field lost
EVENTS_TXFRAMESTART	0x10C		Marks the start of the first symbol of a transmitted frame
EVENTS_TXFRAMEEND	0x110		Marks the end of the last transmitted on-air symbol of a frame
EVENTS_RXFRAMESTART	0x114		Marks the end of the first symbol of a received frame
EVENTS_RXFRAMEEND	0x118		Received data has been checked (CRC, parity) and transferred to RAM, and EasyDMA has ended accessing the RX buffer
EVENTS_ERROR	0x11C		NFC error reported. The ERRORSTATUS register contains details on the source of the error.
EVENTS_RXERROR	0x128		NFC RX frame error reported. The FRAMESTATUS.RX register contains details on the source of the error.
EVENTS_ENDRX	0x12C		RX buffer (as defined by PACKETPTR and MAXLEN) in Data RAM full.
EVENTS_ENDTX	0x130		Transmission of data in RAM has ended, and EasyDMA has ended accessing the TX buffer
EVENTS_AUTOCOLRESSTARTED	0x138		Auto collision resolution process has started
EVENTS_COLLISION	0x148		NFC auto collision resolution error reported.
EVENTS_SELECTED	0x14C		NFC auto collision resolution successfully completed
EVENTS_STARTED	0x150		EasyDMA is ready to receive or send frames.
PUBLISH_READY	0x180		Publish configuration for event READY
PUBLISH_FIELDDETECTED	0x184		Publish configuration for event FIELDDETECTED
PUBLISH_FIELDLOST	0x188		Publish configuration for event FIELDLOST
PUBLISH_TXFRAMESTART	0x18C		Publish configuration for event TXFRAMESTART
PUBLISH_TXFRAMEEND	0x190		Publish configuration for event TXFRAMEEND
PUBLISH_RXFRAMESTART	0x194		Publish configuration for event RXFRAMESTART
PUBLISH_RXFRAMEEND	0x198		Publish configuration for event RXFRAMEEND
PUBLISH_ERROR	0x19C		Publish configuration for event ERROR
PUBLISH_RXERROR	0x1A8		Publish configuration for event RXERROR
PUBLISH_ENDRX	0x1AC		Publish configuration for event ENDRX
PUBLISH_ENDTX	0x1B0		Publish configuration for event ENDTX
PUBLISH_AUTOCOLRESSTARTED	0x1B8		Publish configuration for event AUTOCOLRESSTARTED
PUBLISH_COLLISION	0x1C8		Publish configuration for event COLLISION
PUBLISH_SELECTED	0x1CC		Publish configuration for event SELECTED
PUBLISH_STARTED	0x1D0		Publish configuration for event STARTED
SHORTS	0x200		Shortcuts between local events and tasks
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
ERRORSTATUS	0x404		NFC Error Status register
FRAMESTATUS.RX	0x40C		Result of last incoming frame
NFCTAGSTATE	0x410		Current operating state of NFC tag
SLEEPSTATE	0x420		Sleep state during automatic collision resolution
FIELDPRESENT	0x43C		Indicates the presence or not of a valid field
FRAMEDELAYMIN	0x504		Minimum frame delay
FRAMEDELAYMAX	0x508		Maximum frame delay
FRAMEDELAYMODE	0x50C		Configuration register for the Frame Delay Timer
PACKETPTR	0x510		Packet pointer for TXD and RXD data storage in Data RAM

Register	Offset	TZ	Description
MAXLEN	0x514		Size of the RAM buffer allocated to TXD and RXD data storage each
TXD.FRAMECONFIG	0x518		Configuration of outgoing frames
TXD.AMOUNT	0x51C		Size of outgoing frame
RXD.FRAMECONFIG	0x520		Configuration of incoming frames
RXD.AMOUNT	0x524		Size of last incoming frame
MODULATIONCTRL	0x52C		Enables the modulation output to a GPIO pin which can be connected to a second external antenna.
MODULATIONPSEL	0x538		Pin select for Modulation control
MODE	0x550		Configure EasyDMA mode
NFCID1.LAST	0x590		Last NFCID1 part (4, 7 or 10 bytes ID)
NFCID1.SECONDLAST	0x594		Second last NFCID1 part (7 or 10 bytes ID)
NFCID1.THIRDLAST	0x598		Third last NFCID1 part (10 bytes ID)
AUTOCOLRESCONFIG	0x59C		Controls the auto collision resolution function. This setting must be done before the NFCT peripheral is activated.
SENSRES	0x5A0		NFC-A SENS_RES auto-response settings
SELRES	0x5A4		NFC-A SEL_RES auto-response settings
PADCONFIG	0x6D4		NFC pad configuration

8.13.14.1 TASKS_ACTIVATE

Address offset: 0x000

Activate NFCT peripheral for incoming and outgoing frames, change state to activated

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_ACTIVATE			Activate NFCT peripheral for incoming and outgoing frames, change state to activated
			Trigger	1	Trigger task

8.13.14.2 TASKS_DISABLE

Address offset: 0x004

Disable NFCT peripheral

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_DISABLE			Disable NFCT peripheral
			Trigger	1	Trigger task

8.13.14.3 TASKS_SENSE

Address offset: 0x008

Enable NFC sense field mode, change state to sense mode

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_SENSE			Enable NFC sense field mode, change state to sense mode
			Trigger	1	Trigger task

8.13.14.4 TASKS_STARTTX

Address offset: 0x00C

Start transmission of an outgoing frame, change state to transmit

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STARTTX			Start transmission of an outgoing frame, change state to transmit
			Trigger	1	Trigger task

8.13.14.5 TASKS_STOPTX

Address offset: 0x010

Stops an issued transmission of a frame

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOPTX			Stops an issued transmission of a frame
			Trigger	1	Trigger task

8.13.14.6 TASKS_ENABLERXDATA

Address offset: 0x01C

Initializes the EasyDMA for receive.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_ENABLERXDATA			Initializes the EasyDMA for receive.
			Trigger	1	Trigger task

8.13.14.7 TASKS_GOIDLE

Address offset: 0x024

Force state machine to IDLE state

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_GOIDLE			Force state machine to IDLE state
			Trigger	1	Trigger task

8.13.14.8 TASKS_GOSLEEP

Address offset: 0x028

Force state machine to SLEEP_A state

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_GOSLEEP			Force state machine to SLEEP_A state
			Trigger	1	Trigger task

8.13.14.9 SUBSCRIBE_ACTIVATE

Address offset: 0x080

Subscribe configuration for task ACTIVATE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task ACTIVATE will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.13.14.10 SUBSCRIBE_DISABLE

Address offset: 0x084

Subscribe configuration for task DISABLE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task DISABLE will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.13.14.11 SUBSCRIBE_SENSE

Address offset: 0x088

Subscribe configuration for task SENSE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task SENSE will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.13.14.12 SUBSCRIBE_STARTTX

Address offset: 0x08C

Subscribe configuration for task STARTTX

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STARTTX will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.13.14.13 SUBSCRIBE_STOPTX

Address offset: 0x090

Subscribe configuration for task STOPTX

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOPTX will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.13.14.14 SUBSCRIBE_ENABLERXDATA

Address offset: 0x09C

Subscribe configuration for task ENABLERXDATA

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task ENABLERXDATA will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.13.14.15 SUBSCRIBE_GOIDLE

Address offset: 0x0A4

Subscribe configuration for task GOIDLE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task GOIDLE will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.13.14.16 SUBSCRIBE_GOSLEEP

Address offset: 0x0A8

Subscribe configuration for task GOSLEEP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task GOSLEEP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.13.14.17 EVENTS_READY

Address offset: 0x100

The NFCT peripheral is ready to receive and send frames

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_READY			The NFCT peripheral is ready to receive and send frames
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.13.14.18 EVENTS_FIELDDETECTED

Address offset: 0x104

Remote NFC field detected

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_FIELDDETECTED			Remote NFC field detected
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.13.14.19 EVENTS_FIELDLOST

Address offset: 0x108

Remote NFC field lost

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_FIELDLOST			Remote NFC field lost
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.13.14.20 EVENTS_TXFRAMESTART

Address offset: 0x10C

Marks the start of the first symbol of a transmitted frame

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_TXFRAMESTART			Marks the start of the first symbol of a transmitted frame
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.13.14.21 EVENTS_TXFRAMEEND

Address offset: 0x110

Marks the end of the last transmitted on-air symbol of a frame

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_TXFRAMEEND			Marks the end of the last transmitted on-air symbol of a frame
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.13.14.22 EVENTS_RXFRAMESTART

Address offset: 0x114

Marks the end of the first symbol of a received frame

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_RXFRAMESTART			Marks the end of the first symbol of a received frame
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.13.14.23 EVENTS_RXFRAMEEND

Address offset: 0x118

Received data has been checked (CRC, parity) and transferred to RAM, and EasyDMA has ended accessing the RX buffer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_RXFRAMEEND			Received data has been checked (CRC, parity) and transferred to RAM, and EasyDMA has ended accessing the RX buffer
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.13.14.24 EVENTS_ERROR

Address offset: 0x11C

NFC error reported. The ERRORSTATUS register contains details on the source of the error.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_ERROR			NFC error reported. The ERRORSTATUS register contains details on the source of the error.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.13.14.25 EVENTS_RXERROR

Address offset: 0x128

NFC RX frame error reported. The FRAMESTATUS.RX register contains details on the source of the error.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_RXERROR			NFC RX frame error reported. The FRAMESTATUS.RX register contains details on the source of the error.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.13.14.26 EVENTS_ENDRX

Address offset: 0x12C

RX buffer (as defined by PACKETPTR and MAXLEN) in Data RAM full.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_ENDRX			RX buffer (as defined by PACKETPTR and MAXLEN) in Data RAM full.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.13.14.27 EVENTS_ENDTX

Address offset: 0x130

Transmission of data in RAM has ended, and EasyDMA has ended accessing the TX buffer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_ENDTX			Transmission of data in RAM has ended, and EasyDMA has ended accessing the TX buffer
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.13.14.28 EVENTS_AUTOCOLRESSTARTED

Address offset: 0x138

Auto collision resolution process has started

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_AUTOCOLRESSTARTED			Auto collision resolution process has started
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.13.14.29 EVENTS_COLLISION

Address offset: 0x148

NFC auto collision resolution error reported.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_COLLISION			NFC auto collision resolution error reported.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.13.14.30 EVENTS_SELECTED

Address offset: 0x14C

NFC auto collision resolution successfully completed

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_SELECTED			NFC auto collision resolution successfully completed
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.13.14.31 EVENTS_STARTED

Address offset: 0x150

EasyDMA is ready to receive or send frames.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_STARTED			EasyDMA is ready to receive or send frames.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.13.14.32 PUBLISH_READY

Address offset: 0x180

Publish configuration for event READY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event READY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.13.14.33 PUBLISH_FIELDDETECTED

Address offset: 0x184

Publish configuration for event FIELDDETECTED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event FIELDDETECTED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.13.14.34 PUBLISH_FIELDLOST

Address offset: 0x188

Publish configuration for event FIELDLOST

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event FIELDLOST will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.13.14.35 PUBLISH_TXFRAMESTART

Address offset: 0x18C

Publish configuration for event TXFRAMESTART

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event TXFRAMESTART will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.13.14.36 PUBLISH_TXFRAMEEND

Address offset: 0x190

Publish configuration for event TXFRAMEEND

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event TXFRAMEEND will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.13.14.37 PUBLISH_RXFRAMESTART

Address offset: 0x194

Publish configuration for event RXFRAMESTART

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event RXFRAMESTART will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.13.14.38 PUBLISH_RXFRAMEEND

Address offset: 0x198

Publish configuration for event RXFRAMEEND

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event RXFRAMEEND will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.13.14.39 PUBLISH_ERROR

Address offset: 0x19C

Publish configuration for event ERROR

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event ERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.13.14.40 PUBLISH_RXERROR

Address offset: 0x1A8

Publish configuration for event RXERROR

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event RXERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.13.14.41 PUBLISH_ENDRX

Address offset: 0x1AC

Publish configuration for event ENDRX

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event ENDRX will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.13.14.42 PUBLISH_ENDTX

Address offset: 0x1B0

Publish configuration for event ENDTX

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event ENDTX will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.13.14.43 PUBLISH_AUTOCOLRESSTARTED

Address offset: 0x1B8

Publish configuration for event AUTOCOLRESSTARTED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event AUTOCOLRESSTARTED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.13.14.44 PUBLISH_COLLISION

Address offset: 0x1C8

Publish configuration for event COLLISION

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event COLLISION will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.13.14.45 PUBLISH_SELECTED

Address offset: 0x1CC

Publish configuration for event SELECTED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event SELECTED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.13.14.46 PUBLISH_STARTED

Address offset: 0x1D0

Publish configuration for event STARTED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event STARTED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.13.14.47 SHORTS

Address offset: 0x200

Shortcuts between local events and tasks

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	FIELDDETECTED_ACTIVATE			Shortcut between event FIELDDETECTED and task ACTIVATE
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
B	RW	FIELDLOST_SENSE			Shortcut between event FIELDLOST and task SENSE
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
C	RW	TXFRAMEEND_ENABLERXDATA			Shortcut between event TXFRAMEEND and task ENABLERXDATA
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut

8.13.14.48 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	READY			Enable or disable interrupt for event READY
			Disabled	0	Disable
			Enabled	1	Enable
B	RW	FIELDDETECTED			Enable or disable interrupt for event FIELDDETECTED
			Disabled	0	Disable
			Enabled	1	Enable
C	RW	FIELDLOST			Enable or disable interrupt for event FIELDLOST
			Disabled	0	Disable
			Enabled	1	Enable
D	RW	TXFRAMESTART			Enable or disable interrupt for event TXFRAMESTART
			Disabled	0	Disable
			Enabled	1	Enable
E	RW	TXFRAMEEND			Enable or disable interrupt for event TXFRAMEEND
			Disabled	0	Disable
			Enabled	1	Enable
F	RW	RXFRAMESTART			Enable or disable interrupt for event RXFRAMESTART
			Disabled	0	Disable
			Enabled	1	Enable
G	RW	RXFRAMEEND			Enable or disable interrupt for event RXFRAMEEND
			Disabled	0	Disable
			Enabled	1	Enable
H	RW	ERROR			Enable or disable interrupt for event ERROR
			Disabled	0	Disable
			Enabled	1	Enable
I	RW	RXERROR			Enable or disable interrupt for event RXERROR
			Disabled	0	Disable
			Enabled	1	Enable
J	RW	ENDRX			Enable or disable interrupt for event ENDRX
			Disabled	0	Disable
			Enabled	1	Enable

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
K	RW	ENDTX			Enable or disable interrupt for event ENDTX
			Disabled	0	Disable
			Enabled	1	Enable
L	RW	AUTOCOLRESSTARTED			Enable or disable interrupt for event AUTOCOLRESSTARTED
			Disabled	0	Disable
			Enabled	1	Enable
M	RW	COLLISION			Enable or disable interrupt for event COLLISION
			Disabled	0	Disable
			Enabled	1	Enable
N	RW	SELECTED			Enable or disable interrupt for event SELECTED
			Disabled	0	Disable
			Enabled	1	Enable
O	RW	STARTED			Enable or disable interrupt for event STARTED
			Disabled	0	Disable
			Enabled	1	Enable

8.13.14.49 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1S	READY			Write '1' to enable interrupt for event READY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	FIELDDETECTED			Write '1' to enable interrupt for event FIELDDETECTED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1S	FIELDLOST			Write '1' to enable interrupt for event FIELDLOST
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1S	TXFRAMESTART			Write '1' to enable interrupt for event TXFRAMESTART
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1S	TXFRAMEEND			Write '1' to enable interrupt for event TXFRAMEEND
			Set	1	Enable
			Disabled	0	Read: Disabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
			Enabled	1	Read: Enabled
F	RW W1S	RXFRAMESTART			Write '1' to enable interrupt for event RXFRAMESTART
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1S	RXFRAMEEND			Write '1' to enable interrupt for event RXFRAMEEND
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
H	RW W1S	ERROR			Write '1' to enable interrupt for event ERROR
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
I	RW W1S	RXERROR			Write '1' to enable interrupt for event RXERROR
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
J	RW W1S	ENDRX			Write '1' to enable interrupt for event ENDRX
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
K	RW W1S	ENDTX			Write '1' to enable interrupt for event ENDTX
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
L	RW W1S	AUTOCOLRESSTARTED			Write '1' to enable interrupt for event AUTOCOLRESSTARTED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1S	COLLISION			Write '1' to enable interrupt for event COLLISION
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
N	RW W1S	SELECTED			Write '1' to enable interrupt for event SELECTED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
O	RW W1S	STARTED			Write '1' to enable interrupt for event STARTED
			Set	1	Enable
			Disabled	0	Read: Disabled

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID												O	N	M				L		K	J	I			H	G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
			Enabled	1	Read: Enabled

8.13.14.50 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID												O	N	M				L		K	J	I			H	G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	READY			Write '1' to disable interrupt for event READY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	FIELDDETECTED			Write '1' to disable interrupt for event FIELDDETECTED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	FIELDLOST			Write '1' to disable interrupt for event FIELDLOST
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1C	TXFRAMESTART			Write '1' to disable interrupt for event TXFRAMESTART
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1C	TXFRAMEEND			Write '1' to disable interrupt for event TXFRAMEEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1C	RXFRAMESTART			Write '1' to disable interrupt for event RXFRAMESTART
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1C	RXFRAMEEND			Write '1' to disable interrupt for event RXFRAMEEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
H	RW W1C	ERROR			Write '1' to disable interrupt for event ERROR
			Clear	1	Disable

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID												O	N	M				L		K	J	I			H	G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
I	RW W1C	RXERROR			Write '1' to disable interrupt for event RXERROR
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
J	RW W1C	ENDRX			Write '1' to disable interrupt for event ENDRX
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
K	RW W1C	ENDTX			Write '1' to disable interrupt for event ENDTX
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
L	RW W1C	AUTOCOLRESSTARTED			Write '1' to disable interrupt for event AUTOCOLRESSTARTED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1C	COLLISION			Write '1' to disable interrupt for event COLLISION
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
N	RW W1C	SELECTED			Write '1' to disable interrupt for event SELECTED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
O	RW W1C	STARTED			Write '1' to disable interrupt for event STARTED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.13.14.51 ERRORSTATUS

Address offset: 0x404

NFC Error Status register

Note: Write a bit to `1` to clear it. Writing `0` has no effect.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	FRAMEDELAYTIMEOUT			No STARTTX task triggered before expiration of the time set in FRAMEDELAYMAX

8.13.14.52 FRAMESTATUS.RX

Address offset: 0x40C

Result of last incoming frame

Note: Write a bit to 1 to clear it. Writing 0 has no effect.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	CRCERROR			No valid end of frame (EoF) detected
			CRCCorrect	0	Valid CRC detected
			CRCError	1	CRC received does not match local check
B	RW W1C	PARITYSTATUS			Parity status of received frame
			ParityOK	0	Frame received with parity OK
			ParityError	1	Frame received with parity error
C	RW W1C	OVERRUN			Overrun detected
			NoOverrun	0	No overrun detected
			Overrun	1	Overrun error

8.13.14.53 NFCTAGSTATE

Address offset: 0x410

Current operating state of NFC tag

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	NFCTAGSTATE			NfcTag state
			Disabled	0	Disabled or sense
			RampUp	2	RampUp
			Idle	3	Idle
			Receive	4	Receive
			FrameDelay	5	FrameDelay
			Transmit	6	Transmit

8.13.14.54 SLEEPSTATE

Address offset: 0x420

Sleep state during automatic collision resolution

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	SLEEPSTATE			Reflects the sleep state during automatic collision resolution. Set to IDLE by a GOIDLE task. Set to SLEEP_A when a valid SLEEP_REQ frame is received or by a GOSLEEP task.
			Idle	0	State is IDLE.
			SleepA	1	State is SLEEP_A.

8.13.14.55 FIELDPRESENT

Address offset: 0x43C

Indicates the presence or not of a valid field

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	FIELDPRESENT			Indicates if a valid field is present. Available only in the activated state.
			NoField	0	No valid field detected
			FieldPresent	1	Valid field detected
B	R	LOCKDETECT			Indicates if the low level has locked to the field
			NotLocked	0	Not locked to field
			Locked	1	Locked to field

8.13.14.56 FRAMEDELAYMIN

Address offset: 0x504

Minimum frame delay

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000480				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	FRAMEDELAYMIN			Minimum frame delay in number of 13.56 MHz clock cycles

8.13.14.57 FRAMEDELAYMAX

Address offset: 0x508

Maximum frame delay

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00001000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	FRAMEDELAYMAX			Maximum frame delay in number of 13.56 MHz clock cycles

8.13.14.58 FRAMEDELAYMODE

Address offset: 0x50C

Configuration register for the Frame Delay Timer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000001				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1**

ID	R/W	Field	Value ID	Value	Description
A	RW	FRAMEDELAYMODE			Configuration register for the Frame Delay Timer
			FreeRun	0	Transmission is independent of frame timer and will start when the STARTTX task is triggered. No timeout.
			Window	1	Frame is transmitted between FRAMEDELAYMIN and FRAMEDELAYMAX
			ExactVal	2	Frame is transmitted exactly at FRAMEDELAYMAX
			WindowGrid	3	Frame is transmitted on a bit grid between FRAMEDELAYMIN and FRAMEDELAYMAX

8.13.14.59 PACKETPTR

Address offset: 0x510

Packet pointer for TXD and RXD data storage in Data RAM

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			Packet pointer for TXD and RXD data storage in Data RAM. This address is a byte-aligned RAM address.

Note: See the memory chapter for details about which memories are available for EasyDMA.

8.13.14.60 MAXLEN

Address offset: 0x514

Size of the RAM buffer allocated to TXD and RXD data storage each

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MAXLEN		[0..257]	Size of the RAM buffer allocated to TXD and RXD data storage each

8.13.14.61 TXD.FRAMECONFIG

Address offset: 0x518

Configuration of outgoing frames

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000017				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 1 1**

ID	R/W	Field	Value ID	Value	Description
A	RW	PARITY			Indicates if parity is added to the frame
			NoParity	0	Parity is not added to TX frames
			Parity	1	Parity is added to TX frames
B	RW	DISCARDMODE			Discarding unused bits at start or end of a frame

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000017				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 1 1**
ID	R/W	Field	Value ID	Value	Description
			DiscardEnd	0	Unused bits are discarded at end of frame (EoF)
			DiscardStart	1	Unused bits are discarded at start of frame (SoF)
C	RW	SOF			Adding SoF or not in TX frames
			NoSoF	0	SoF symbol not added
			SoF	1	SoF symbol added
D	RW	CRCMODETX			CRC mode for outgoing frames
			NoCRCTX	0	CRC is not added to the frame
			CRC16TX	1	16 bit CRC added to the frame based on all the data read from RAM that is used in the frame

8.13.14.62 TXD.AMOUNT

Address offset: 0x51C

Size of outgoing frame

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B B B B B B B B A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	TXDATABITS		[0..7]	Number of bits in the last or first byte read from RAM that shall be included in the frame (excluding parity bit). The DISCARDMODE field in FRAMECONFIG.TX selects if unused bits is discarded at the start or at the end of a frame. A value of 0 data bytes and 0 data bits is invalid.
B	RW	TXDATABYTES		[0..257]	Number of complete bytes that shall be included in the frame, excluding CRC, parity, and framing.

8.13.14.63 RXD.FRAMECONFIG

Address offset: 0x520

Configuration of incoming frames

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B A
Reset 0x00000015				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PARITY			Indicates if parity expected in RX frame
			NoParity	0	Parity is not expected in RX frames
			Parity	1	Parity is expected in RX frames
B	RW	SOF			SoF expected or not in RX frames
			NoSoF	0	SoF symbol is not expected in RX frames
			SoF	1	SoF symbol is expected in RX frames
C	RW	CRCMODERX			CRC mode for incoming frames
			NoCRCRX	0	CRC is not expected in RX frames
			CRC16RX	1	Last 16 bits in RX frame is CRC, CRC is checked and CRCSTATUS updated

8.13.14.64 RXD.AMOUNT

Address offset: 0x524

Size of last incoming frame

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B B B B B B B B A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	RXDATABITS			Number of bits in the last byte in the frame, if less than 8 (including CRC, but excluding parity and SoF/EoF framing). Frames with 0 data bytes and less than 7 data bits are invalid and are not received properly.
B	R	RXDATABYTES			Number of complete bytes received in the frame (including CRC, but excluding parity and SoF/EoF framing)

8.13.14.65 MODULATIONCTRL

Address offset: 0x52C

Enables the modulation output to a GPIO pin which can be connected to a second external antenna.

See MODULATIONPSEL for GPIO configuration.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000001				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	MODULATIONCTRL			Configuration of modulation control.
			Invalid	0x0	Invalid, defaults to same behaviour as for Internal
			Internal	0x1	Use internal modulator only
			ModToGpio	0x2	Output digital modulation signal to a GPIO pin.
			InternalAndModToGpio	0x3	Use internal modulator and output digital modulation signal to a GPIO pin.

8.13.14.66 MODULATIONPSEL

Address offset: 0x538

Pin select for Modulation control

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..3]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.13.14.67 MODE

Address offset: 0x550

Configure EasyDMA mode

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000001				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	LPOP			Enable low-power operation, or use low-latency
			LowLat	0	Low-latency operation
			LowPower	1	Low-power operation
			FullLowPower	3	Full Low-power operation

8.13.14.68 NFCID1.LAST

Address offset: 0x590

Last NFCID1 part (4, 7 or 10 bytes ID)

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D C C C C C C C C B B B B B B B B A A A A A A A A
Reset 0x00006363				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 1 1 0 1 1 0 0 0 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	Z			NFCID1 byte Z (very last byte sent)
B	RW	Y			NFCID1 byte Y
C	RW	X			NFCID1 byte X
D	RW	W			NFCID1 byte W

8.13.14.69 NFCID1.SECONDLAST

Address offset: 0x594

Second last NFCID1 part (7 or 10 bytes ID)

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C C C C C C C B B B B B B B B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	V			NFCID1 byte V
B	RW	U			NFCID1 byte U
C	RW	T			NFCID1 byte T

8.13.14.70 NFCID1.THIRDLAST

Address offset: 0x598

Third last NFCID1 part (10 bytes ID)

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C C C C C C C B B B B B B B B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	S			NFCID1 byte S
B	RW	R			NFCID1 byte R
C	RW	Q			NFCID1 byte Q

8.13.14.71 AUTOCOLRESCONFIG

Address offset: 0x59C

Controls the auto collision resolution function. This setting must be done before the NFCT peripheral is activated.

Note: When modifiying this register, bit `1` must be written to `1`.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000002				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MODE			Enables/disables auto collision resolution
			Enabled	0	Auto collision resolution enabled
			Disabled	1	Auto collision resolution disabled

8.13.14.72 SENSRES

Address offset: 0x5A0

NFC-A SENS_RES auto-response settings

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E E E E D D D D C C B A A A A A
Reset 0x00000001				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	BITFRAMESDD			Bit frame SDD as defined by the b5:b1 of byte 1 in SENS_RES response in the NFC Forum, NFC Digital Protocol Technical Specification
			SDD00000	0	SDD pattern 00000
			SDD00001	1	SDD pattern 00001
			SDD00010	2	SDD pattern 00010
			SDD00100	4	SDD pattern 00100
			SDD01000	8	SDD pattern 01000
			SDD10000	16	SDD pattern 10000
B	RW	RFU5			Reserved for future use. Shall be 0.
C	RW	NFCIDSIZE			NFCID1 size. This value is used by the auto collision resolution engine.
			NFCID1Single	0	NFCID1 size: single (4 bytes)
			NFCID1Double	1	NFCID1 size: double (7 bytes)
			NFCID1Triple	2	NFCID1 size: triple (10 bytes)
D	RW	PLATFCONFIG			Tag platform configuration as defined by the b4:b1 of byte 2 in SENS_RES response in the NFC Forum, NFC Digital Protocol Technical Specification
E	RW	RFU74			Reserved for future use. Shall be 0.

8.13.14.73 SELRES

Address offset: 0x5A4

NFC-A SEL_RES auto-response settings

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E D D C C B A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	RFU10			Reserved for future use. Shall be 0.
B	RW	CASCADE			Cascade as defined by the b3 of SEL_RES response in the NFC Forum, NFC Digital Protocol Technical Specification (controlled by hardware, shall be 0)
C	RW	RFU43			Reserved for future use. Shall be 0.
D	RW	PROTOCOL			Protocol as defined by the b7:b6 of SEL_RES response in the NFC Forum, NFC Digital Protocol Technical Specification
E	RW	RFU7			Reserved for future use. Shall be 0.

8.13.14.74 PADCONFIG

Address offset: 0x6D4

NFC pad configuration

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000001				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			Enable NFC pads See GPIO port mapping section to find NFC pads.
			Disabled	0	NFC pads are used as GPIO pins
			Enabled	1	The NFC pads are configured as NFC antenna pins Also enables the protection for NFC pads.

8.14 PDM — Pulse density modulation interface

The pulse density modulation (PDM) peripheral enables input of pulse density modulated signals from external audio interfaces, such as digital microphones. PDM generates the PDM clock and supports single-channel or dual-channel (left and right) data input. Data is transferred directly to RAM buffers using EasyDMA.

The main features of PDM are the following:

- Up to two PDM microphones configured as a left/right pair using the same data input
- 8 kHz, 16 kHz, 32 kHz, or 48k Hz output sample rate, 16-bit samples
- Supports digital microphone clocks at 768 kHz, 800 kHz, 1.024 MHz , 1.536 MHz, 2.048 MHz , 3.072 MHz , 1.28 MHz, and 2.56 MHz
- Selectable sample rate ratio of 48, 50, 64, 80, 96, 150,192, or custom even values up to 256 between PDM_CLK and output sample rate
- Hardware decimation filters
- EasyDMA support for sample buffering

The following figure shows the interaction between the PDM interface and up to two digital microphones. EasyDMA reduces the real-time requirements for controlling the PDM target from a low priority CPU execution context. PDM has the necessary digital filter elements to produce pulse code modulation (PCM) samples and allows continuous audio streaming.

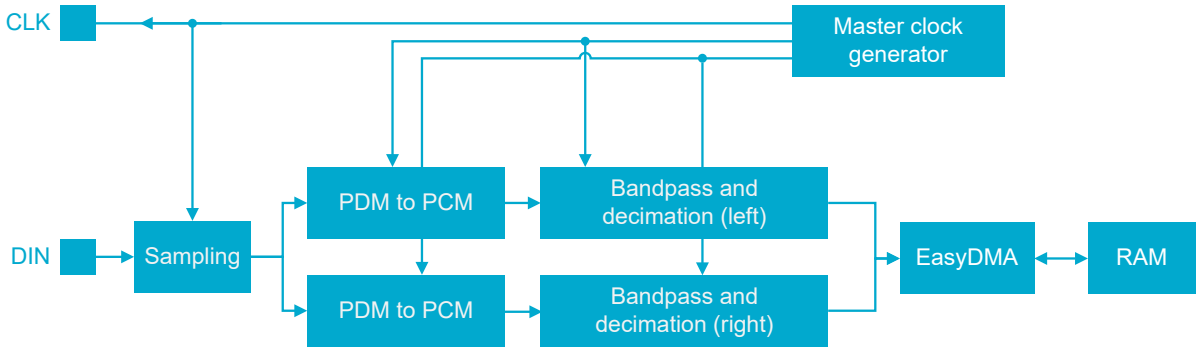


Figure 75: PDM module

8.14.1 Master clock generator

The PDM clock frequency is adjusted through the PRESCALER register in the master clock. The master clock generator does not add jitter to the selected HFCLK source. It is recommended (but not mandatory) to use the crystal as HFCLK source.

The PDM frequency can be adjusted by using the PRESCALER register, even while the clock generator is running. To select the correct value for PRESCALER, use the following equation:

- CLK=PCLK32M/PRESCALER when using PCLK32M
- CLK=ACLK/PRESCALER when using a second CLK source

Note: Depending on the product, ACLK can be connected to different clock sources. For example, ACKL can be connected to a PLL generating a 24 MHz clock.

Requested PDM frequency f_{pdm} [Hz]	f_{source} [Hz]	RATIO	PRESCALER	Actual PDM frequency f_{actual} [Hz]	Sample frequency [Hz]	Error [%]
1024000	32000000 (PCLK32M)	64	31	1032258	16129	0.8
1280000	32000000 (PCLK32M)	80	25	1280000	16000	0
800000	32000000 (PCLK32M)	50	40	800000	16000	0.0
1024000	24000000 (ACLK)	64	23	1043478	16304	1.9
1280000	24000000 (ACLK)	80	19	1263157	15789	-1.31
800000	24000000 (ACLK)	50	30	800000	16000	0.0

Table 44: Configuration examples

8.14.2 Module operation

By default, bits from the left PDM microphone are sampled on PDM_CLK falling edge, and bits for the right are sampled on the rising edge of PDM_CLK, resulting in two bitstreams. Each bitstream is fed into a digital

filter which converts the PDM stream into 16-bit PCM samples, then filters and down-samples them to reach the appropriate sample rate.

The EDGE field in the MODE register allows swapping left and right channels, so that left will be sampled on rising edge, and right on falling.

The PDM module uses EasyDMA to store the samples coming out from the filters into one buffer in RAM. Depending on the mode chosen in the OPERATION field in the MODE register, memory either contains alternating left and right 16-bit samples (Stereo), or only a left (or only right, depending on the value of the EDGE field) 16-bit samples (Mono). To ensure continuous PDM sampling, it is up to the application to update the EasyDMA destination address pointer as the previous buffer is filled.

The continuous transfer can be started or stopped by sending the START and STOP tasks. STOP becomes effective after the current frame has finished transferring, which will generate the STOPPED event. The STOPPED event indicates that all activity in the module is finished, and that the data is available in RAM (EasyDMA has finished transferring as well). Attempting to restart before receiving the STOPPED event may result in unpredictable behavior.

Soft Gain/Mute

A short description of the Gain, Mute, and Soft Gain/Mute functionality is provided below.

Gain

The gain is configurable in the range [-20, 20] dB, using the following registers:

- GAINL – left channel, in 0.5 dB steps
- GAINR – right channel, in 0.5 dB steps
- FILTER.CTRL.GAINADD0P25 – additional gain, one optional +0.25 dB step that applies to both channels

Custom oversampling rates and CIC filter gain compensation

PDM supports gain compensation, for the selected decimation/oversamling ratio (OSR).

The decimation ratio is set in RATIO, as either one of the listed ratios, or the special value `Custom`. When RATIO=`Custom`, the actual decimation rate is configured using the register FILTER.CTRL.DECRATIO. When using custom decimation ratios, configure register FILTER.CTRL.CICFILTERMSBCUSTOM to match FILTER.CTRL.DECRATIO.

PDM uses partial gain compensation towards the closest upper power of 2. For the fixed OSR ratios, compensation gain is fixed and pre-calculated in the design. However, when using custom oversampling ratios, the gain compensation must be calculated and configured.

To calculate the additional compensated gain for Custom OSR ratios, please follow the steps below:

1. Calculate the CIC filter gain:

   $gainCIC = OSR^5$

   where OSR is the oversampling ratio and the CIC filter order is 5.
2. Determine the closest upper power of 2:

   $closePow2 = floor(log2(gainCIC)) + 1$
3. Calculate the required gain compensation:

   $gainComp = -20 \times log10(gainCIC / 2^{closePow2})$ dB
4. Configure the compensation registers:
   - FILTER.CTRL.MINORSTEP050CUSTOM – Set the number of +0.5 dB steps
   - FILTER.CTRL.MINORSTEP025CUSTOM – To add an additional +0.25 dB step

Note: These registers are only active when RATIO = `Custom` (Custom decimation ratio mode).

Mute

The Mute function is a specific case of the Gain function, where the gain coefficient is set to 0.

This function is controlled using the FILTER.SOFTMUTE register.

Soft Gain/Mute

The Soft Gain/Mute provides the possibility to gradually change the gain setting, to avoid a sudden gain change which may lead to audible clicks.

The Soft Gain/Mute function is controlled using the registers FILTER.SOFTCYCLES (the number of soft cycles at the baseband frequency). If FILTER.SOFTCYCLES is set to `Custom`, then the actual number of softcycles used is configured using the register FILTER.CTRL.SOFTCYCLES (using a multiplication factor of 32).

Gain Range

The desired gain range is [-20, 20]dB with 0.5 dB steps, with the option to improve gain resolution to 0.25 dB steps.

8.14.3 Decimation filter

In order to convert the incoming data stream into PCM audio samples, a decimation filter is included in the PDM peripheral.

The filter input is a two-channel PDM serial stream (with left channel on clock high, right channel on clock low). Output consists of two 16-bit PCM samples at a sample rate lower than the PDM clock rate and a ratio defined by the RATIO register.

A digital volume control is implemented within the filter stage of each channel. It can attenuate or amplify the output samples in a range of ±20 dB of the default (reset) setting and is defined by $G_{PDM,default}$ = 0 dB. The gain is controlled by the GAINL and GAINR registers. As shown in #unique_1019/unique_1019_Connect_42_section_vqt_d1g_xcc, depending on OSR value, internal compensation is added for fixed predefined OSR values and a programmable one is available for custom OSR values.

8.14.4 EasyDMA

Samples are written directly to RAM, meaning EasyDMA must be configured appropriately.

The address pointer for the EasyDMA channel is set in the SAMPLE.PTR register. If the destination address set in SAMPLE.PTR is not pointing to the Data RAM region, an EasyDMA transfer may result in a HardFault or RAM corruption. See Memory on page 13 for more information about memory regions.

Note: The value programmed in SAMPLE.PTR register must be 32-bit aligned.

DMA transfer supports Stereo (left and right 16-bit samples) and Mono (left only) data transfer as configured in the OPERATION field of the MODE register. The samples are stored as little endian.

MODE.OPERATIC	Bits per sample	Result stored per RAM word	Physical RAM allocated (32-bit words)	Result boundary indexes in RAM	Note
Stereo	32 (2x16)	L+R	ceil(SAMPLE.MAXCNT/2)	R0=[31:16] L0=[15:0]	Default
Mono	16	2xL	ceil(SAMPLE.MA)	L1=[31:16] L0=[15:0]	

Table 45: DMA sample storage

The destination buffer in RAM consists of one block, where the size of the block is set in the SAMPLE.MAXCNT register. The sample format is number of bytes used by the samples that will be stored in the memory. The physical RAM allocated is always the following:

```
(RAM allocation, in bytes)=SAMPLE.MAXCNT * 2;
```

Sample mapping depends on MODE.OPERATION.

If OPERATION=Stereo, RAM will contain a succession of left and right samples.

If OPERATION=Mono, RAM will contain a succession of left only samples.

For a given value of SAMPLE.MAXCNT, the buffer in RAM can contain half the stereo sampling time as compared to the mono sampling time.

The PDM acquisition can be started by the START task, after the SAMPLE.PTR and SAMPLE.MAXCNT registers have been written. When PDM starts, it will take some time ($t_{PDM,DATA}$) for the filters to generate valid data. Transients from the PDM microphone itself may also occur. The first few samples (typically around 50) can contain invalid values or transients. It is advised to discard the first few samples after a PDM start.

As soon as the STARTED event is received, the firmware can write the next SAMPLE.PTR value (this register is double-buffered), to ensure continuous operation.

When the buffer in RAM is full of samples, an END event is triggered. The firmware can start processing the data in the buffer. At the same time, PDM starts acquiring data into the new buffer pointed to by SAMPLE.PTR. It sends a new STARTED event, so that the firmware can update SAMPLE.PTR to the next buffer address.

8.14.5 Hardware example

PDM can be configured with a single microphone (mono), or with two microphones.

When a single microphone is used, connect the microphone clock to CLK, and data to DIN. The following figures show a single PDM microphone wired as left.

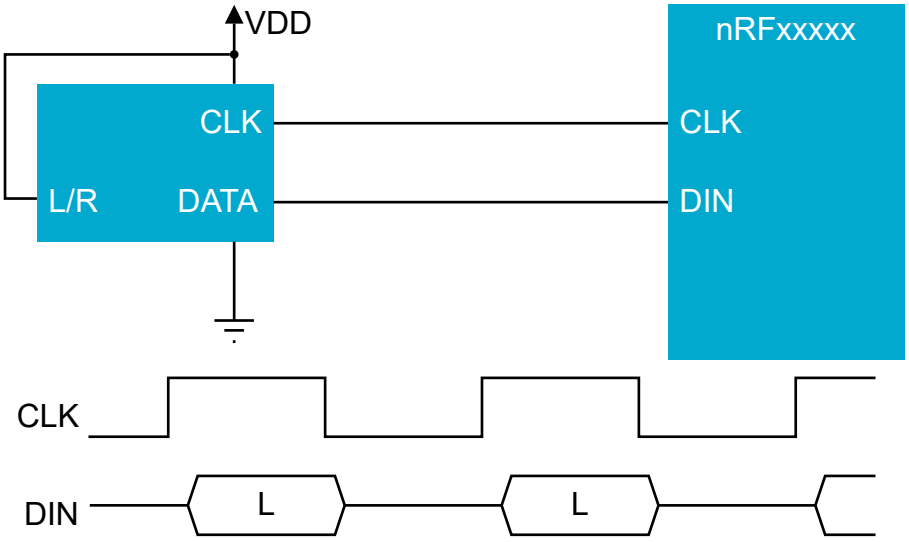


Figure 76: Left wired microphone

The following figures show a single PDM microphone wired as right.

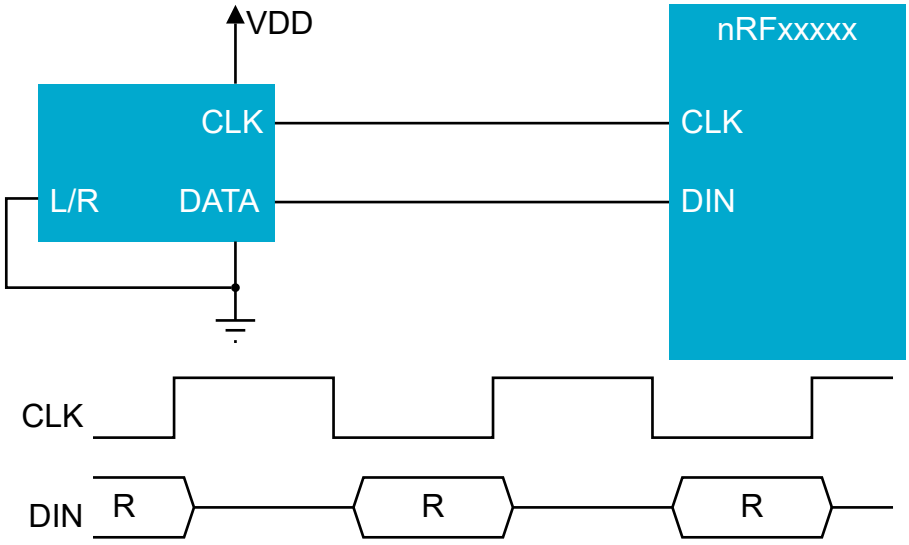


Figure 77: Right wired microphone

A single microphone (mono) configuration, depending on the microphone's implementation, either the left or the right channel (sampled at falling or rising CLK edge respectively) will contain reliable data.

If two microphones are used, one of them has to be set as left, the other as right (L/R pin tied high or to GND on the respective microphone). It is strongly recommended to use two identical microphones so their timing in left and right operations match.

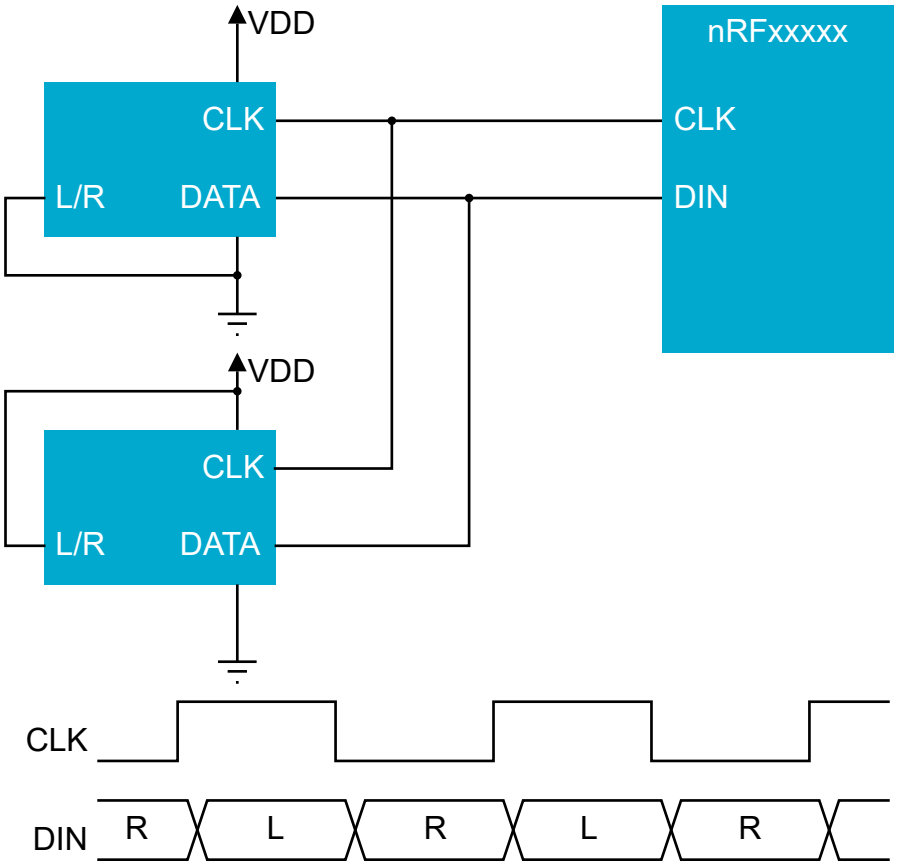


Figure 78: Example of two PDM microphones

8.14.6 Pin configuration

The CLK and DIN signals assigned to the PDM peripheral are mapped to physical pins according to the configuration specified in the PSEL.CLK and PSEL.DIN registers respectively. If the CONNECT field in any PSEL register is set to `Disconnected`, the associated PDM signal will not be connected to the required physical pins and will not operate properly.

The PSEL.CLK and PSEL.DIN registers and their configurations are only used when PDM is enabled, and retained while the device is in System ON mode. See POWER — Power control on page 100 for more information about power modes. When the peripheral is disabled, the pins behave as regular GPIOs, and use the configuration in their respective OUT bit field and PIN_CNF[n] register.

To ensure correct behavior in the PDM module, the pins used by the PDM module must be configured in the GPIO peripheral as described in GPIO configuration before enabling peripheral on page 398 before enabling the PDM module. This is to ensure that the pins used by the PDM module are driven correctly if the PDM module itself is temporarily disabled or the device temporarily enters System OFF. This configuration must be retained in the GPIO for the selected I/Os as long as the PDM module is supposed to be connected to an external PDM circuit.

Only one peripheral can be assigned to drive a particular GPIO pin at a time. Failing to do so may result in unpredictable behavior.

PDM signal	PDM pin	Direction	Output value	Comment
CLK	As specified in PSEL.CLK	Output	0	
DIN	As specified in PSEL.DIN	Input	Not applicable	

Table 46: GPIO configuration before enabling peripheral

8.14.7 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
PDM20 : S PDM20 : NS	GLOBAL	0x500D0000 0x400D0000	US	S	SA	No	Pulse density modulation (digital microphone) interface PDM20
PDM21 : S PDM21 : NS	GLOBAL	0x500D1000 0x400D1000	US	S	SA	No	Pulse density modulation (digital microphone) interface PDM21

Configuration

Instance	Domain	Configuration
PDM20 : S PDM20 : NS	GLOBAL	Use GPIO port P1 or P3 ACLK is the fixed 24 MHz clock PCLK24M PCLK is the fixed 32 MHz clock PCLK32M Supports 8, 16, 32, 48 kHz sample rate. CURRENTAMOUNT register included.
PDM21 : S PDM21 : NS	GLOBAL	Use GPIO port P1 or P3 ACLK is the fixed 24 MHz clock PCLK24M PCLK is the fixed 32 MHz clock PCLK32M Supports 8, 16, 32, 48 kHz sample rate. CURRENTAMOUNT register included.

Register overview

Register	Offset	TZ	Description
TASKS_START	0x000		Starts continuous PDM transfer
TASKS_STOP	0x004		Stops PDM transfer
SUBSCRIBE_START	0x080		Subscribe configuration for task START
SUBSCRIBE_STOP	0x084		Subscribe configuration for task STOP
EVENTS_STARTED	0x100		PDM transfer has started
EVENTS_STOPPED	0x104		PDM transfer has finished
EVENTS_END	0x108		The PDM has written the last sample specified by SAMPLE.MAXCNT (or the last sample after a STOP task has been received) to Data RAM
EVENTS_DMA.BUSERROR	0x110		This event is generated if an error occurs during the bus transfer.
PUBLISH_STARTED	0x180		Publish configuration for event STARTED
PUBLISH_STOPPED	0x184		Publish configuration for event STOPPED

Register	Offset	TZ	Description
PUBLISH_END	0x188		Publish configuration for event END
PUBLISH_DMA.BUSERROR	0x190		Publish configuration for event DMA.BUSERROR
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
INTPEND	0x30C		Pending interrupts
ENABLE	0x500		PDM module enable register
MODE	0x508		Defines the routing of the connected PDM microphone signals
GAINL	0x518		Left output gain adjustment
GAINR	0x51C		Right output gain adjustment
RATIO	0x520		Selects the decimation ratio between PDM_CLK and output sample rate. When RATIO is selected to be "custom", the decimation rate should be set using the FILTER.CTRL field before setting the RATIO to 7 Change PRESCALER.DIVISOR accordingly.
FILTER.CTRL	0x524		Aditional PDM configurability
FILTER.HPPOLE	0x528		Settings for the high-pass filter
FILTER.HPDISABLE	0x52C		High pass filter disable
FILTER.SOFTMUTE	0x530		Soft mute function
FILTER.SOFTCYCLES	0x534		Soft mute settings
FILTER.SAMPLEDELAY	0x538		Input Data Sampling with Number of ckFilterL (double frequency of PDM_CLK) Clock Cycle Delay. Optionally,input sample point can be delayed independently on left and right channels using FILTER:CTRL[20:19] bits
PSEL.CLK	0x540		Pin number configuration for PDM CLK signal
PSEL.DIN	0x544		Pin number configuration for PDM DIN signal
CLKSELECT	0x54C		Master clock generator configuration
SAMPLE.PTR	0x560		RAM address pointer to write samples to with EasyDMA
SAMPLE.MAXCNT	0x564		Number of bytes to allocate memory for in EasyDMA mode
PRESCALER	0x580		The prescaler is used to set the PDM frequency
DMA.TERMINATEONBUSERROR	0x700		Terminate the transaction if a BUSERROR event is detected.
DMA.BUSERRORADDRESS	0x704		Address of transaction that generated the last BUSERROR event.

8.14.7.1 TASKS_START

Address offset: 0x000

Starts continuous PDM transfer

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_START			Starts continuous PDM transfer
			Trigger	1	Trigger task

8.14.7.2 TASKS_STOP

Address offset: 0x004

Stops PDM transfer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Stops PDM transfer
			Trigger	1	Trigger task

8.14.7.3 SUBSCRIBE_START

Address offset: 0x080

Subscribe configuration for task START

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task START will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.14.7.4 SUBSCRIBE_STOP

Address offset: 0x084

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.14.7.5 EVENTS_STARTED

Address offset: 0x100

PDM transfer has started

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_STARTED			PDM transfer has started
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.14.7.6 EVENTS_STOPPED

Address offset: 0x104

PDM transfer has finished

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_STOPPED			PDM transfer has finished
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.14.7.7 EVENTS_END

Address offset: 0x108

The PDM has written the last sample specified by SAMPLE.MAXCNT (or the last sample after a STOP task has been received) to Data RAM

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_END			The PDM has written the last sample specified by SAMPLE.MAXCNT (or the last sample after a STOP task has been received) to Data RAM
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.14.7.8 EVENTS_DMA

Peripheral events.

8.14.7.8.1 EVENTS_DMA.BUSERROR

Address offset: 0x110

This event is generated if an error occurs during the bus transfer.

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Errors occurring while the EVENTS_BUSERROR register is set are ignored.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	BUSERROR			This event is generated if an error occurs during the bus transfer. When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register. Errors occurring while the EVENTS_BUSERROR register is set are ignored.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.14.7.9 PUBLISH_STARTED

Address offset: 0x180

Publish configuration for event STARTED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event STARTED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.14.7.10 PUBLISH_STOPPED

Address offset: 0x184

Publish configuration for event STOPPED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event STOPPED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.14.7.11 PUBLISH_END

Address offset: 0x188

Publish configuration for event END

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event END will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.14.7.12 PUBLISH_DMA

Publish configuration for events

8.14.7.12.1 PUBLISH_DMA.BUSERROR

Address offset: 0x190

Publish configuration for event DMA.BUSERROR

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Errors occurring while the EVENTS_BUSERROR register is set are ignored.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event DMA.BUSERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.14.7.13 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	STARTED			Enable or disable interrupt for event STARTED
			Disabled	0	Disable
			Enabled	1	Enable
B	RW	STOPPED			Enable or disable interrupt for event STOPPED
			Disabled	0	Disable
			Enabled	1	Enable
C	RW	END			Enable or disable interrupt for event END
			Disabled	0	Disable
			Enabled	1	Enable
D	RW	DMABUSERROR			Enable or disable interrupt for event DMABUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register. Errors occurring while the EVENTS_BUSERROR register is set are ignored.
			Disabled	0	Disable
			Enabled	1	Enable

8.14.7.14 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1S	STARTED			Write '1' to enable interrupt for event STARTED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	STOPPED			Write '1' to enable interrupt for event STOPPED
			Set	1	Enable
			Disabled	0	Read: Disabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
			Enabled	1	Read: Enabled
C	RW W1S	END			Write '1' to enable interrupt for event END
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1S	DMABUSERROR			Write '1' to enable interrupt for event DMABUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register. Errors occurring while the EVENTS_BUSERROR register is set are ignored.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.14.7.15 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	STARTED			Write '1' to disable interrupt for event STARTED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	STOPPED			Write '1' to disable interrupt for event STOPPED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	END			Write '1' to disable interrupt for event END
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1C	DMABUSERROR			Write '1' to disable interrupt for event DMABUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register. Errors occurring while the EVENTS_BUSERROR register is set are ignored.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.14.7.16 INTPEND

Address offset: 0x30C

Pending interrupts

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	STARTED			Read pending status of interrupt for event STARTED
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
B	R	STOPPED			Read pending status of interrupt for event STOPPED
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
C	R	END			Read pending status of interrupt for event END
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
D	R	DMABUSERROR			Read pending status of interrupt for event DMABUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register. Errors occurring while the EVENTS_BUSERROR register is set are ignored.
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending

8.14.7.17 ENABLE

Address offset: 0x500

PDM module enable register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			Enable or disable PDM module
			Disabled	0	Disable
			Enabled	1	Enable

8.14.7.18 MODE

Address offset: 0x508

Defines the routing of the connected PDM microphone signals

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	OPERATION			Mono or stereo operation
			Stereo	0	Sample and store one pair (left + right) of 16-bit samples per RAM word R=[31:16]; L=[15:0]
			Mono	1	Sample and store two successive left samples (16 bits each) per RAM word L1=[31:16]; L0=[15:0]
B	RW	EDGE			Defines on which PDM_CLK edge left (or mono) is sampled. The right channel is sampled on the opposide edge of the left channel. When EDGE is set to 1 (LeftRising) and stereo input is used the right and left channels are swapped relative to EDGE set to 0 (LeftFalling).
			LeftFalling	0	Left (or mono) is sampled on falling edge of PDM_CLK
			LeftRising	1	Left (or mono) is sampled on rising edge of PDM_CLK

8.14.7.19 GAINL

Address offset: 0x518

Left output gain adjustment

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A
Reset 0x00000028				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	GAINL			Left output gain adjustment, in 0.5 dB steps, around the default module gain (see electrical parameters) 0x00 -20 dB gain adjust 0x01 -19.5 dB gain adjust (...) 0x27 -0.5 dB gain adjust 0x28 0 dB gain adjust 0x29 +0.5 dB gain adjust (...) 0x4F +19.5 dB gain adjust 0x50 +20 dB gain adjust
			MinGain	0x00	-20 dB gain adjustment (minimum)
			DefaultGain	0x28	0 dB gain adjustment
			MaxGain	0x50	+20 dB gain adjustment (maximum)

8.14.7.20 GAINR

Address offset: 0x51C

Right output gain adjustment

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A
Reset 0x00000028				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	GAINR			Right output gain adjustment, in 0.5 dB steps, around the default module gain (see electrical parameters)
			MinGain	0x00	-20 dB gain adjustment (minimum)
			DefaultGain	0x28	0 dB gain adjustment
			MaxGain	0x50	+20 dB gain adjustment (maximum)

8.14.7.21 RATIO

Address offset: 0x520

Selects the decimation ratio between PDM_CLK and output sample rate. When RATIO is selected to be "custom", the decimation rate should be set using the FILTER.CTRL field before setting the RATIO to 7

Change PRESCALER.DIVISOR accordingly.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A
Reset 0x00000002				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	RATIO			Selects the decimation ratio between PDM_CLK and output sample rate
			Ratio48	0	Ratio of 48
			Ratio50	1	Ratio of 50
			Ratio64	2	Ratio of 64
			Ratio80	3	Ratio of 80
			Ratio96	4	Ratio of 96
			Ratio150	5	Ratio of 150
			Ratio192	6	Ratio of 192
			Custom	7	Custom. The decimation rate can be changed using the FILTER.CTRL[31:25] bits

8.14.7.22 FILTER.CTRL

Address offset: 0x524

Aditional PDM configurability

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				I I I I I I I H H H H G G F F F F E E E E D C B A
Reset 0x4EE0D200				**0 1 0 0 1 1 1 0 1 1 1 0 0 0 0 0 1 1 0 1 0 0 1 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	OVERRIDERIGHTSOFTMUTE			Override soft mute enable for right channel Available only in Stereo mode
			Disable	0	No action
			Enable	1	override and disable soft mute
B	RW	OVERRIDELEFTSOFTMUTE			Override soft mute enable for left channel Available only in Stereo mode
			Disable	0	No action
			Enable	1	override and disable soft mute
C	RW	GAINADD0P25			Add +0.25dB to the gain stage Option to add 0.25dB to the gain stage

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				I	I	I	I	I	I	I	H	H	H	H	G	G		F	F	F	F	E	E	E	E	D	C	B	A						
Reset 0x4EE0D200				**0**	**1**	**0**	**0**	**1**	**1**	**1**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
			Disable	0																															
			Enable	1																															
D	RW	MINORSTEP025CUSTOM																																	
				Compensates Gain with +0.25dB Applicable when custon decimation ratio us used (RATIO=Custom)																															
			Disable	0																															
			Enable	1																															
E	RW	MINORSTEP050CUSTOM		[0..12]																															
				Compensates Gain with +0.5dB steps Applicable when custon decimation ratio us used (RATIO=Custom)																															
F	RW	SOFTCYCLES		[0..15]																															
				Custom number of cycles for soft gain/mute function 32*(Multiplication+1) steps The steps represent one clock cycle at baseband signal frequency; applicable when FILTER.SOFTCYCLES=Custom																															
G	RW	DATASAMPLEDELAY																																	
				Input data sampling point delay in PDM_CLK cycels Can be used to configure sample delay independently on left and right channel																															
			NoDelay	0																															
			DelayOnLeft	1																															
			DelayOnRight	2																															
			DelayOnBoth	3																															
H	RW	CICFILTERMSBCUSTOM																																	
				Defines MSB for CIC fliter when RATIO is set to "Custom" The value of MSB is 20 + value configured in this field																															
			Range0	0																															
			Range1	1																															
			Range2	2																															
			Range3	3																															
			Range4	4																															
			Range5	5																															
			Range6	6																															
			Range7	7																															
			Range8	8																															
			Range9	9																															
			Range10	10																															
			Range11	11																															
			Range12	12																															
			Range13	13																															
			Range14	14																															
			Range15	15																															
I	RW	DECRATIO		[2..127]																															
				Configures decimation ratio to any even number between 6 and 256 Decimation rate is 2x(DECRATIO+1)																															

8.14.7.23 FILTER.HPPOLE

Address offset: 0x528

Settings for the high-pass filter

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A
Reset 0x00000005				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	HPPOLE			Settings for the high-pass filter -3dB gain pole, assuming filter source clock of 16KHz
			p0p16	15	0.16 Hz
			p0p32	14	0.32 Hz
			p0p64	13	0.64 Hz
			p1p25	12	1.25 Hz
			p2p5	11	2.5 Hz
			p5	10	5 Hz
			p10	9	10 Hz
			p20	8	20 Hz
			p40	7	40 Hz
			p79	6	79 Hz
			p157	5	157 Hz
			p310	4	310 Hz
			p603	3	603 Hz
			p1152	2	1152 Hz
			p2110	1	2110 Hz

8.14.7.24 FILTER.HPDISABLE

Address offset: 0x52C

High pass filter disable

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000001				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	DISABLE			High pass filter disable
			Enable	0	High pass filter enabled
			Disable	1	High pass filter disabled

8.14.7.25 FILTER.SOFTMUTE

Address offset: 0x530

Soft mute function

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			Soft mute function
			Disabled	0	Disable soft mute function
			Enabled	1	Enable soft mute function

8.14.7.26 FILTER.SOFTCYCLES

Address offset: 0x534

Soft mute settings

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A
Reset 0x00000002				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	DISABLE			Soft mute settings: amount of cycles for transition
			s2	0	2 filter source clock cycles
			s8	1	8 filter source clock cycles
			s32	2	32 filter source clock cycles
			s64	3	64 filter source clock cycles
			s128	4	128 filter source clock cycles
			s256	5	256 filter source clock cycles
			s512	6	512 filter source clock cycles
			Custom	7	The number of cycles can be set using FILTER.CTRL[17:14] bits
			custom	7	See the Custom enumerator This enumerator is deprecated.

8.14.7.27 FILTER.SAMPLEDELAY

Address offset: 0x538

Input Data Sampling with Number of ckFilterL (double frequency of PDM_CLK) Clock Cycle Delay. Optionally,input sample point can be delayed independently on left and right channels using FILTER:CTRL[20:19] bits

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	DELAY			Input Data Sampling with Number of ckFilterL (double frequency of PDM_CLK) Clock Cycle Delay
			NoDelay	0	No delay
			Delay1Ck	1	1 Cycle

8.14.7.28 PSEL.CLK

Address offset: 0x540

Pin number configuration for PDM CLK signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.14.7.29 PSEL.DIN

Address offset: 0x544

Pin number configuration for PDM DIN signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.14.7.30 CLKSELECT

Address offset: 0x54C

Master clock generator configuration

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	SRC			Master clock source selection
			PCLK32M	0	32 MHz peripheral clock
			ACLK	1	24 MHz peripheral clock

8.14.7.31 SAMPLE.PTR

Address offset: 0x560

RAM address pointer to write samples to with EasyDMA

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	SAMPLEPTR			Address to write PCM samples to over DMA

Note: See the memory chapter for details about which memories are available for EasyDMA.

8.14.7.32 SAMPLE.MAXCNT

Address offset: 0x564

Number of bytes to allocate memory for in EasyDMA mode

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	BUFFSIZE		[0..32767]	Length of DMA RAM allocation in number of bytes

8.14.7.33 PRESCALER

Address offset: 0x580

The prescaler is used to set the PDM frequency

The prescaler divides the clock by DIVISOR to make the PDM clock. The resulting frequency is given by the frequency of the 'core clock' divided by DIVISOR.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A
Reset 0x00000004				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	DIVISOR		4..126	Core clock to PDM divisor

8.14.7.34 DMA.TERMINATEONBUSERROR

Address offset: 0x700

Terminate the transaction if a BUSERROR event is detected.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			
			Disabled	0	Disable
			Enabled	1	Enable

8.14.7.35 DMA.BUSERRORADDRESS

Address offset: 0x704

Address of transaction that generated the last BUSERROR event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	ADDRESS			

8.15 PWM — Pulse width modulation

The pulse width modulation peripheral (PWM) enables the generation of pulse width modulated signals on GPIO. The peripheral implements a counter with up-count mode and up-and-down-count mode, consisting of four PWM channels that can drive assigned GPIO pins.

The main features of PWM are the following:

- Programmable PWM frequency
- Up to four PWM channels with individual polarity and duty cycle values
- Edge or center-aligned pulses across PWM channels
- Multiple duty cycle arrays (sequences) defined in RAM
- Autonomous and glitch-free update of duty cycle values directly from memory through EasyDMA (no CPU involvement)
- Change of polarity, duty cycle, and base frequency on every PWM period
- RAM sequences can be repeated or connected into loops

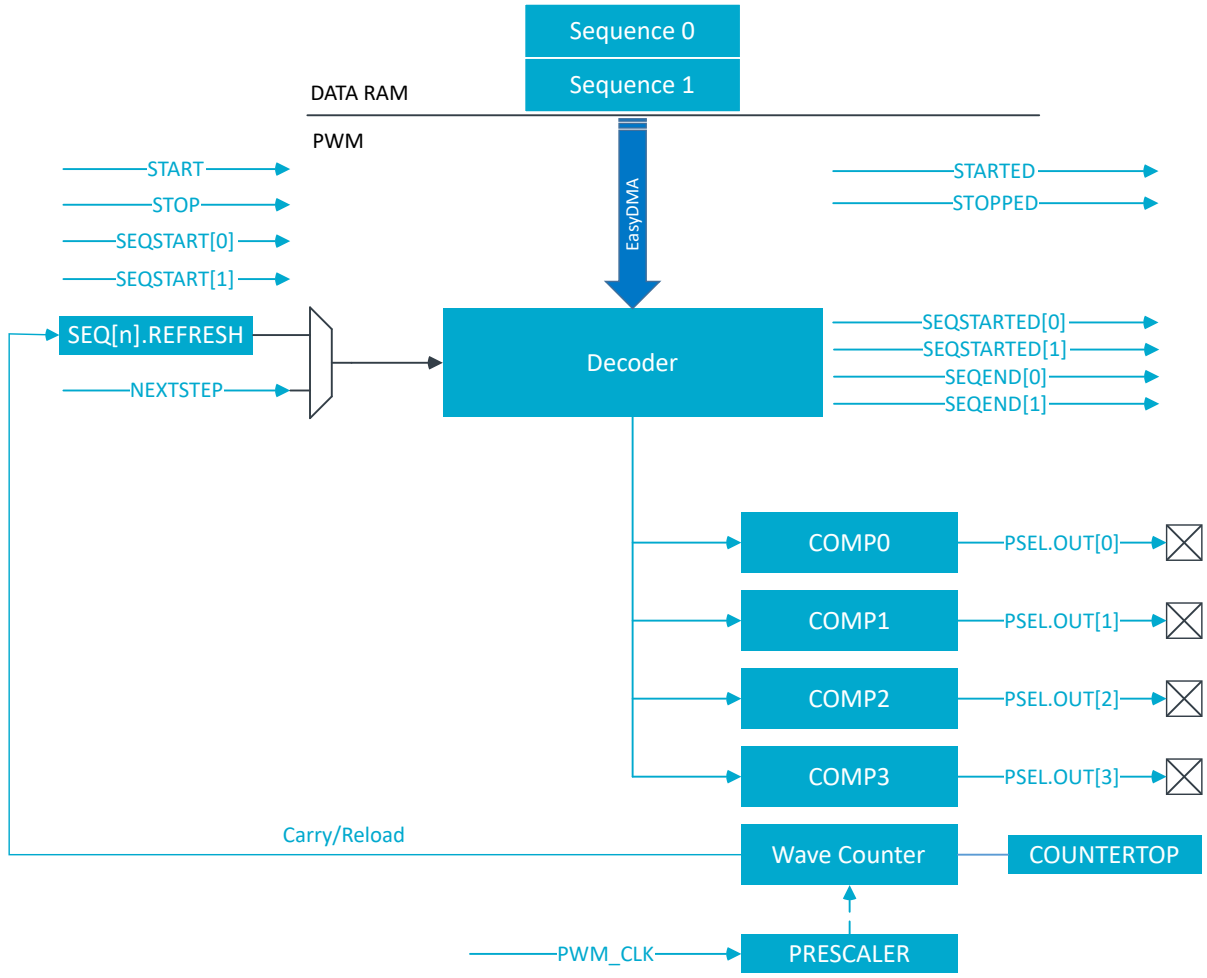


Figure 79: PWM module

8.15.1 Wave counter

The wave counter is responsible for generating the pulses at a duty cycle that depends on the compare values, and at a frequency that depends on COUNTERTOP.

There is one common 15-bit counter with four compare channels. Thus, all four channels will share the same period (PWM frequency), but can have individual duty cycle and polarity. The polarity is set by the most significant bit (MSB) of the value read from RAM (see figure Decoder memory access modes on page 416). When the MSB bit is high (FallingEdge polarity), OUT[n] starts high to become low during the given PWM cycle, whereas the inverse occurs for RisingEdge polarity. Whether the counter counts up, or up and down, is controlled by the MODE register.

The timer top value is controlled by the COUNTERTOP register. This register value, in conjunction with the selected PRESCALER of the PWM_CLK, will result in a given PWM period. A COUNTERTOP value smaller than the compare setting will result in a state where no PWM edges are generated. OUT[n] is held high, given that the polarity is set to FallingEdge. All compare registers are internal and can only be configured through decoder presented later. COUNTERTOP can be safely written at any time.

Sampling follows the START task. If DECODER.LOAD=WaveForm, the register value is ignored and taken from RAM instead (see section Decoder with EasyDMA on page 416 for more details). If DECODER.LOAD is anything else than the WaveForm, it is sampled following a STARTSEQ[n] task and when loading a new value from RAM during a sequence playback.

The following figure shows the counter operating in up mode (MODE=PWM_MODE_Up), with two PWM channels with the same frequency but different duty cycle:

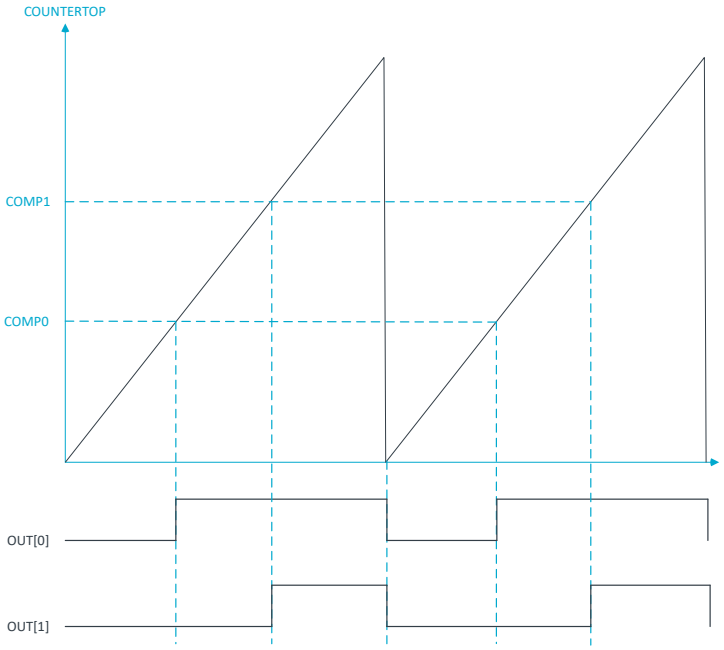


Figure 80: PWM counter in up mode example - RisingEdge polarity

The counter is automatically reset to zero when COUNTERTOP is reached and OUT[n] will invert. OUT[n] is held low if the compare value is 0 and held high if set to COUNTERTOP, given that the polarity is set to FallingEdge. Counter running in up mode results in pulse widths that are edge-aligned. The following is the code for the counter in up mode example:

```
uint16_t pwm_seq[4] = {PWM_CH0_DUTY, PWM_CH1_DUTY, PWM_CH2_DUTY, PWM_CH3_DUTY};
NRF_PWM0->PSEL.OUT[0] = (first_port << PWM_PSEL_OUT_PORT_Pos) |
                        (first_pin << PWM_PSEL_OUT_PIN_Pos) |
                        (PWM_PSEL_OUT_CONNECT_Connected <<
                                                PWM_PSEL_OUT_CONNECT_Pos);
NRF_PWM0->PSEL.OUT[1] = (second_port << PWM_PSEL_OUT_PORT_Pos) |
                        (second_pin << PWM_PSEL_OUT_PIN_Pos) |
                        (PWM_PSEL_OUT_CONNECT_Connected <<
                                                PWM_PSEL_OUT_CONNECT_Pos);
NRF_PWM0->ENABLE      = (PWM_ENABLE_ENABLE_Enabled << PWM_ENABLE_ENABLE_Pos);
NRF_PWM0->MODE        = (PWM_MODE_UPDOWN_Up << PWM_MODE_UPDOWN_Pos);
NRF_PWM0->PRESCALER   = (PWM_PRESCALER_PRESCALER_DIV_1 <<
                                                PWM_PRESCALER_PRESCALER_Pos);
NRF_PWM0->COUNTERTOP  = (16000 << PWM_COUNTERTOP_COUNTERTOP_Pos); //1 msec
NRF_PWM0->LOOP        = (PWM_LOOP_CNT_Disabled << PWM_LOOP_CNT_Pos);
NRF_PWM0->DECODER   = (PWM_DECODER_LOAD_Individual << PWM_DECODER_LOAD_Pos) |
                      (PWM_DECODER_MODE_RefreshCount << PWM_DECODER_MODE_Pos);
NRF_PWM0->DMA.SEQ[0].PTR    = ((uint32_t)(pwm_seq) << PWM_DMA_SEQ_PTR_PTR_Pos);
NRF_PWM0->DMA.SEQ[0].MAXCNT = (sizeof(pwm_seq) << PWM_DMA_SEQ_MAXCNT_MAXCNT_Pos);
NRF_PWM0->SEQ[0].REFRESH  = 0;
NRF_PWM0->SEQ[0].ENDDELAY = 0;
NRF_PWM0->TASKS_DMA.SEQ[0].START = 1;
```

When the counter is running in up mode, the following formula can be used to compute the PWM period and the step size:

PWM period: $T_{PWM(Up)} = T_{PWM\_CLK} * COUNTERTOP$

Step width/Resolution: $T_{steps} = T_{PWM\_CLK}$

The following figure shows the counter operating in up-and-down mode (MODE=PWM_MODE_UpAndDown), with two PWM channels with the same frequency but different duty cycle and output polarity:

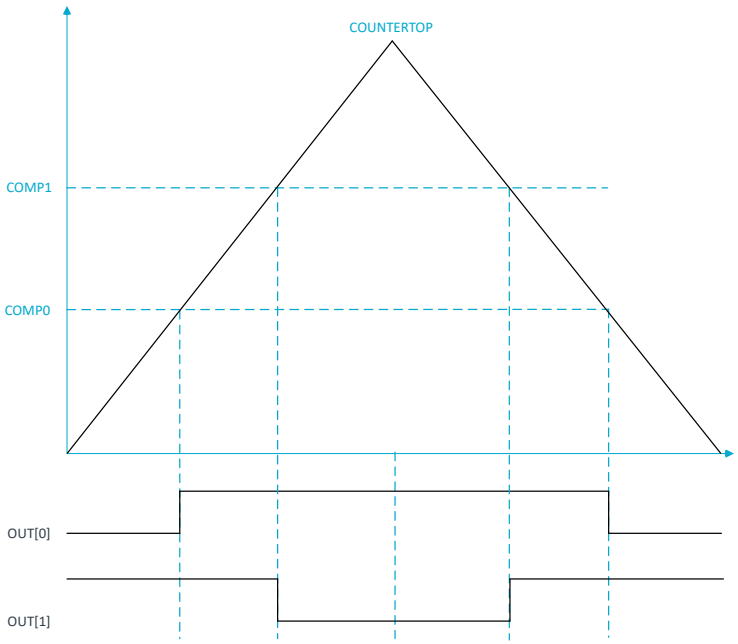


Figure 81: PWM counter in up-and-down mode example

The counter starts decrementing to zero when COUNTERTOP is reached and will invert the OUT[n] when compare value is hit for the second time. This results in a set of pulses that are center-aligned. The following is the code for the counter in up-and-down mode example:

```
uint16_t pwm_seq[4] = {PWM_CH0_DUTY, PWM_CH1_DUTY, PWM_CH2_DUTY, PWM_CH3_DUTY};
NRF_PWM0->PSEL.OUT[0] = (first_port << PWM_PSEL_OUT_PORT_Pos) |
                        (first_pin << PWM_PSEL_OUT_PIN_Pos) |
                        (PWM_PSEL_OUT_CONNECT_Connected <<
                                                PWM_PSEL_OUT_CONNECT_Pos);
NRF_PWM0->PSEL.OUT[1] = (second_pin << PWM_PSEL_OUT_PIN_Pos) |
                        (PWM_PSEL_OUT_CONNECT_Connected <<
                                                PWM_PSEL_OUT_CONNECT_Pos);
NRF_PWM0->ENABLE      = (PWM_ENABLE_ENABLE_Enabled << PWM_ENABLE_ENABLE_Pos);
NRF_PWM0->MODE        = (PWM_MODE_UPDOWN_UpAndDown << PWM_MODE_UPDOWN_Pos);
NRF_PWM0->PRESCALER   = (PWM_PRESCALER_PRESCALER_DIV_1 <<
                                                PWM_PRESCALER_PRESCALER_Pos);
NRF_PWM0->COUNTERTOP  = (16000 << PWM_COUNTERTOP_COUNTERTOP_Pos); //1 msec
NRF_PWM0->LOOP        = (PWM_LOOP_CNT_Disabled << PWM_LOOP_CNT_Pos);
NRF_PWM0->DECODER   = (PWM_DECODER_LOAD_Individual << PWM_DECODER_LOAD_Pos) |
                      (PWM_DECODER_MODE_RefreshCount << PWM_DECODER_MODE_Pos);
NRF_PWM0->DMA.SEQ[0].PTR    = ((uint32_t)(pwm_seq) << PWM_DMA_SEQ_PTR_PTR_Pos);
NRF_PWM0->DMA.SEQ[0].MAXCNT = (sizeof(pwm_seq) << PWM_DMA_SEQ_MAXCNT_MAXCNT_Pos);
NRF_PWM0->SEQ[0].REFRESH  = 0;
NRF_PWM0->SEQ[0].ENDDELAY = 0;
NRF_PWM0->TASKS_DMA.SEQ[0].START = 1;
```

When the counter is running in up-and-down mode, the following formula can be used to compute the PWM period and the step size:

$T_{PWM(Up\ And\ Down)} = T_{PWM\_CLK} * 2 * COUNTERTOP$

Step width/Resolution: $T_{steps} = T_{PWM\_CLK} * 2$

8.15.2 Decoder with EasyDMA

The decoder uses EasyDMA to take PWM parameters stored in RAM and update the internal compare registers of the wave counter, based on the mode of operation.

PWM parameters are organized into a sequence containing at least one half word (16 bit). Its most significant bit[15] denotes the polarity of the OUT[n] while bit[14:0] is the 15-bit compare value.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Id				B A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
Id	RW	Field	Value Id	Value	Description
A	RW	COMPARE			Duty cycle setting - value loaded to internal compare register
B	RW	POLARITY			Edge polarity of GPIO.
			RisingEdge	0	First edge within the PWM period is rising
			FallingEdge	1	First edge within the PWM period is falling

The DECODER register controls how the RAM content is interpreted and loaded into the internal compare registers. The LOAD field controls if the RAM values are loaded to all compare channels, or to update a group or all channels with individual values. The following figure illustrates how parameters stored in RAM are organized and routed to various compare channels in different modes:

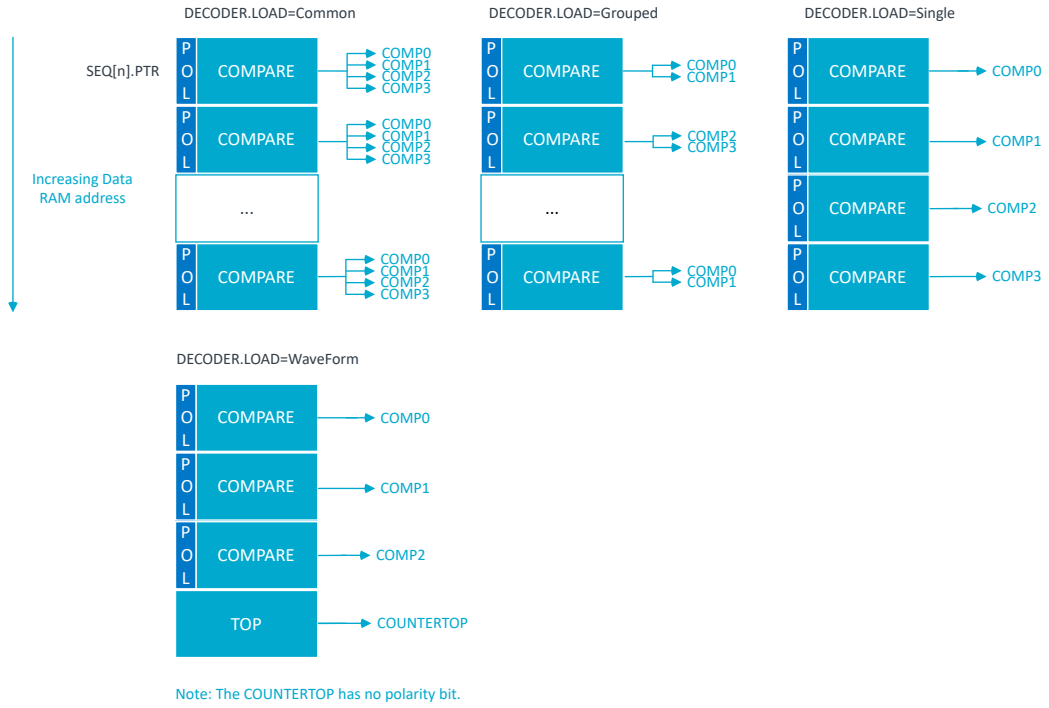


Figure 82: Decoder memory access modes

A special mode of operation is available when DECODER.LOAD is set to WaveForm. In WaveForm mode, up to three PWM channels can be enabled - OUT[0] to OUT[2]. In RAM, four values are loaded at a time: the first, second and third location are used to load the values, and the fourth RAM location is used to load the COUNTERTOP register. This way one can have up to three PWM channels with a frequency base that changes on a per PWM period basis. This mode of operation is useful for arbitrary wave form generation in applications, such as LED lighting.

The register SEQ[n].REFRESH=N (one per sequence n=0 or 1) will instruct a new RAM stored pulse width value on every $(N+1)^{th}$ PWM period. Setting the register to zero will result in a new duty cycle update every PWM period, as long as the minimum PWM period is observed.

Note that registers SEQ[n].REFRESH and SEQ[n].ENDDELAY are ignored when DECODER.MODE=NextStep. The next value is loaded upon every received NEXTSTEP task.

SEQ[n].PTR is the pointer used to fetch COMPARE values from RAM. If the SEQ[n].PTR is not pointing to a RAM region, an EasyDMA transfer may result in a HardFault or RAM corruption. See Memory on page 13 for more information about the different memory regions. After the SEQ[n].PTR is set to the desired RAM location, the SEQ[n].MAXCNT register must be set to the number of bytes in the sequence. It is important to observe that the Grouped mode requires one half word per group, while the Single mode requires one half word per channel, thus increasing the RAM size occupation. If PWM generation is not running when the DMA.SEQ[n].START task is triggered, the task will load the first value from RAM and then start the PWM generation. A SEQSTARTED[n] event is generated as soon as the EasyDMA has read the first PWM parameter from RAM and the wave counter has started executing it. When LOOP.MAXCNT=0, sequence n=0 or 1 is played back once. After the last value in the sequence has been loaded and started executing, a SEQEND[n] event is generated. The PWM generation will then continue with the output defined in the IDLEOUT register. The following figure illustrates an example of a simple playback.

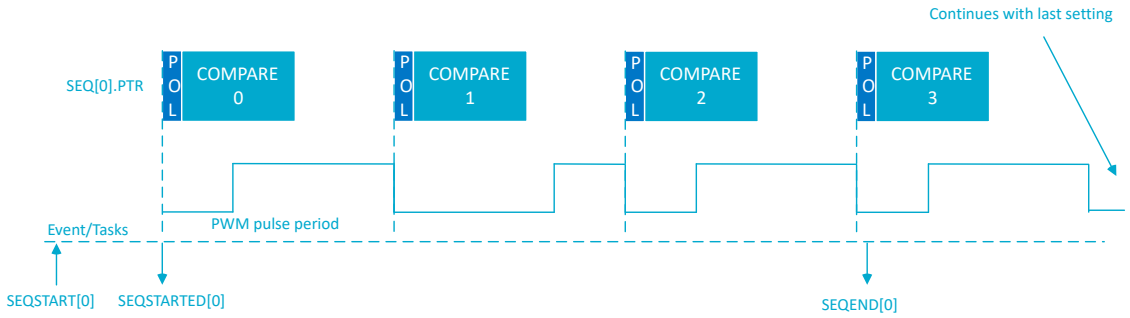


Figure 83: Simple sequence example

The following source code is used for configuration and timing details in a sequence where only sequence 0 is used and only run once with a new PWM duty cycle for each period.

```
NRF_PWM0->PSEL.OUT[0] = (first_port << PWM_PSEL_OUT_PORT_Pos) |
                        (first_pin << PWM_PSEL_OUT_PIN_Pos) |
                        (PWM_PSEL_OUT_CONNECT_Connected <<
                                                PWM_PSEL_OUT_CONNECT_Pos);
NRF_PWM0->ENABLE      = (PWM_ENABLE_ENABLE_Enabled << PWM_ENABLE_ENABLE_Pos);
NRF_PWM0->MODE        = (PWM_MODE_UPDOWN_Up << PWM_MODE_UPDOWN_Pos);
NRF_PWM0->PRESCALER   = (PWM_PRESCALER_PRESCALER_DIV_1 <<
                                                PWM_PRESCALER_PRESCALER_Pos);
NRF_PWM0->COUNTERTOP  = (16000 << PWM_COUNTERTOP_COUNTERTOP_Pos); //1 msec
NRF_PWM0->LOOP        = (PWM_LOOP_CNT_Disabled << PWM_LOOP_CNT_Pos);
NRF_PWM0->DECODER   = (PWM_DECODER_LOAD_Common << PWM_DECODER_LOAD_Pos) |
                      (PWM_DECODER_MODE_RefreshCount << PWM_DECODER_MODE_Pos);
NRF_PWM0->DMA.SEQ[0].PTR  = ((uint32_t)(seq0_ram) << PWM_DMA_SEQ_PTR_PTR_Pos);
NRF_PWM0->DMA.SEQ[0].MAXCNT  = (sizeof(seq0_ram) << PWM_DMA_SEQ_MAXCNT_MAXCNT_Pos);
NRF_PWM0->SEQ[0].REFRESH  = 0;
NRF_PWM0->SEQ[0].ENDDELAY = 0;
NRF_PWM0->TASKS_DMA.SEQ[0].START = 1;
```

To completely stop the PWM generation and force the associated pins to a defined state, a STOP task can be triggered at any time. A STOPPED event is generated when the PWM generation has stopped at the end of the currently running PWM period, and the pins go into their idle state as defined by the IDLEOUT register. PWM generation can then only be restarted through a DMA.SEQ[n].START task. DMA.SEQ[n].START will resume PWM generation after having loaded the first value from the RAM buffer defined in the SEQ[n].PTR register.

The following table indicates when specific registers get sampled by the hardware. Care should be taken when updating these registers to avoid that values are applied earlier than expected.

Register	Taken into account by hardware	Recommended (safe) update
SEQ[n].PTR	When sending the DMA.SEQ[n].START task	After having received the SEQSTARTED[n] event
SEQ[n].MAXCNT	When sending the DMA.SEQ[n].START task	After having received the SEQSTARTED[n] event
SEQ[0].ENDDELAY	When sending the SEQSTART[0] task Every time a new value from sequence [0] has been loaded from RAM and gets applied to the Wave Counter (indicated by the PWMPERIODEND event)	Before starting sequence [0] through a SEQSTART[0] task When no more value from sequence [0] gets loaded from RAM (indicated by the SEQEND[0] event) At any time during sequence [1] (which starts when the SEQSTARTED[1] event is generated)
SEQ[1].ENDDELAY	When sending the SEQSTART[1] task Every time a new value from sequence [1] has been loaded from RAM and gets applied to the Wave Counter (indicated by the PWMPERIODEND event)	Before starting sequence [1] through a SEQSTART[1] task When no more value from sequence [1] gets loaded from RAM (indicated by the SEQEND[1] event) At any time during sequence [0] (which starts when the SEQSTARTED[0] event is generated)
SEQ[0].REFRESH	When sending the SEQSTART[0] task Every time a new value from sequence [0] has been loaded from RAM and gets applied to the Wave Counter (indicated by the PWMPERIODEND event)	Before starting sequence [0] through a SEQSTART[0] task At any time during sequence [1] (which starts when the SEQSTARTED[1] event is generated)
SEQ[1].REFRESH	When sending the SEQSTART[1] task Every time a new value from sequence [1] has been loaded from RAM and gets applied to the Wave Counter (indicated by the PWMPERIODEND event)	Before starting sequence [1] through a SEQSTART[1] task At any time during sequence [0] (which starts when the SEQSTARTED[0] event is generated)
COUNTERTOP	In DECODER.LOAD=WaveForm: this register is ignored. In all other LOAD modes: at the end of current PWM period (indicated by the PWMPERIODEND event)	Before starting PWM generation through a DMA.SEQ[n].START task After a STOP task has been triggered, and the STOPPED event has been received.
MODE	Immediately	Before starting PWM generation through a DMA.SEQ[n].START task After a STOP task has been triggered, and the STOPPED event has been received.
DECODER	Immediately	Before starting PWM generation through a DMA.SEQ[n].START task After a STOP task has been triggered, and the STOPPED event has been received.
PRESCALER	Immediately	Before starting PWM generation through a DMA.SEQ[n].START task After a STOP task has been triggered, and the STOPPED event has been received.
LOOP	Immediately	Before starting PWM generation through a DMA.SEQ[n].START task After a STOP task has been triggered, and the STOPPED event has been received.
PSEL.OUT[n]	Immediately	Before enabling the PWM instance through the ENABLE register

Table 47: When to safely update PWM registers

Note: SEQ[n].REFRESH and SEQ[n].ENDDELAY are ignored at the end of a complex sequence, indicated by a LOOPSDONE event. The reason for this is that the last value loaded from RAM is maintained until further action from software (restarting a new sequence, or stopping PWM generation).

The following figure shows a more complex example using the register LOOP on page 441.

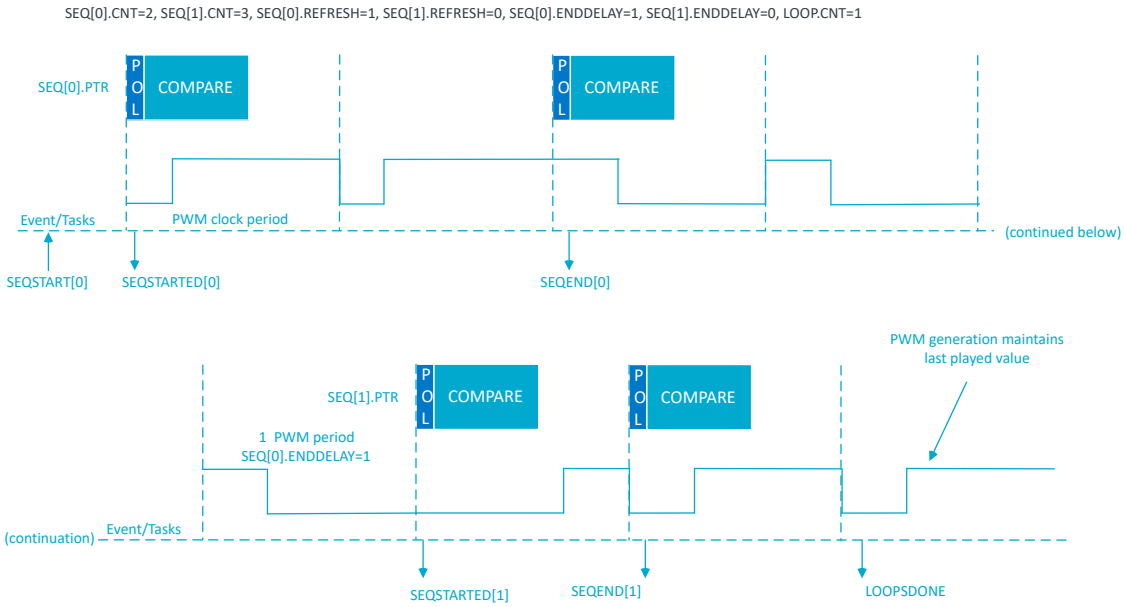


Figure 84: Example using two sequences

In this case, an automated playback takes place, consisting of SEQ[0], delay 0, SEQ[1], delay 1, then again SEQ[0], etc. The user can choose to start a complex playback with SEQ[0] or SEQ[1] through sending the SEQSTART[0] or SEQSTART[1] task. The complex playback always ends with delay 1.

The two sequences 0 and 1 are defined by the addresses of value tables in RAM (pointed to by SEQ[n].PTR) and the buffer size (SEQ[n].MAXCNT). The rate at which a new value is loaded is defined individually for each sequence by SEQ[n].REFRESH. The chaining of sequence 1 following the sequence 0 is implicit, the LOOP.CNT register allows the chaining of sequence 1 to sequence 0 for a determined number of times. In other words, it allows to repeat a complex sequence a number of times in a fully automated way.

In the following code example, sequence 0 is defined with SEQ[0].REFRESH set to 1, meaning that a new PWM duty cycle is pushed every second PWM period. This complex sequence is started with the SEQSTART[0] task, so SEQ[0] is played first. Since SEQ[0].ENDDELAY=1 there will be one PWM period delay between last period on sequence 0 and the first period on sequence 1. Since SEQ[1].ENDDELAY=0 there is no delay 1, so SEQ[0] would be started immediately after the end of SEQ[1]. However, as LOOP.CNT is

1, the playback stops after having played SEQ[1] only once, and both SEQEND[1] and LOOPSDONE are generated (their order is not guaranteed in this case).

```
NRF_PWM0->PSEL.OUT[0] = (first_port << PWM_PSEL_OUT_PORT_Pos) |
                        (first_pin << PWM_PSEL_OUT_PIN_Pos) |
                        (PWM_PSEL_OUT_CONNECT_Connected <<
                                                  PWM_PSEL_OUT_CONNECT_Pos);
NRF_PWM0->ENABLE      = (PWM_ENABLE_ENABLE_Enabled << PWM_ENABLE_ENABLE_Pos);
NRF_PWM0->MODE        = (PWM_MODE_UPDOWN_Up << PWM_MODE_UPDOWN_Pos);
NRF_PWM0->PRESCALER   = (PWM_PRESCALER_PRESCALER_DIV_1 <<
                                                   PWM_PRESCALER_PRESCALER_Pos);
NRF_PWM0->COUNTERTOP  = (16000 << PWM_COUNTERTOP_COUNTERTOP_Pos); //1 msec
NRF_PWM0->LOOP        = (1 << PWM_LOOP_CNT_Pos);
NRF_PWM0->DECODER   = (PWM_DECODER_LOAD_Common << PWM_DECODER_LOAD_Pos) |
                      (PWM_DECODER_MODE_RefreshCount << PWM_DECODER_MODE_Pos);
NRF_PWM0->DMA.SEQ[0].PTR   = ((uint32_t)(seq0_ram) << PWM_DMA_SEQ_PTR_PTR_Pos);
NRF_PWM0->DMA.SEQ[0].MAXCNT  = (sizeof(seq0_ram) << PWM_DMA_SEQ_MAXCNT_MAXCNT_Pos);
NRF_PWM0->SEQ[0].REFRESH  = 1;
NRF_PWM0->SEQ[0].ENDDELAY = 1;
NRF_PWM0->DMA.SEQ[1].PTR   = ((uint32_t)(seq1_ram) << PWM_DMA_SEQ_PTR_PTR_Pos);
NRF_PWM0->DMA.SEQ[1].MAXCNT  = (sizeof(seq1_ram) << PWM_DMA_SEQ_MAXCNT_MAXCNT_Pos);
NRF_PWM0->SEQ[1].REFRESH  = 0;
NRF_PWM0->SEQ[1].ENDDELAY = 0;
NRF_PWM0->TASKS_DMA.SEQ[0].START = 1;
```

The decoder can also be configured to asynchronously load new PWM duty cycle. If the DECODER.MODE register is set to NextStep, then the NEXTSTEP task will cause an update of internal compare registers on the next PWM period.

The following figures provide an overview of each part of an arbitrary sequence, in various modes (LOOP.CNT=0 and LOOP.CNT>0). In particular, the following are represented:

- Initial and final duty cycle on the PWM output(s)
- Chaining of SEQ[0] and SEQ[1] if LOOP.CNT>0
- Influence of registers on the sequence
- Events generated during a sequence
- DMA activity (loading of next value and applying it to the output(s))

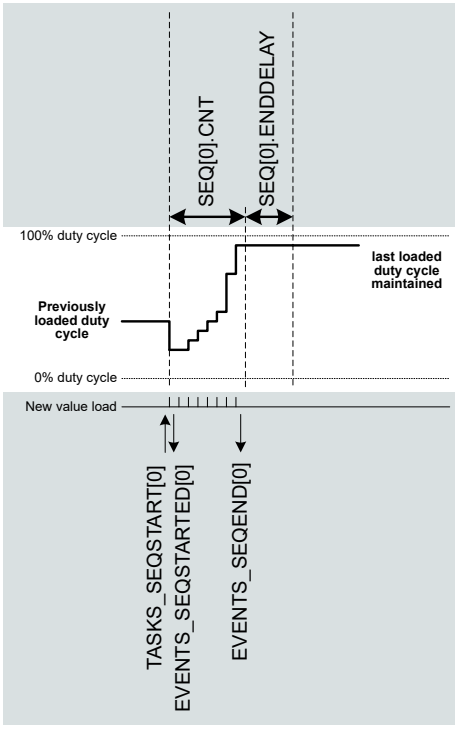


Figure 85: Single shot (LOOP.CNT=0)

Note: The single-shot example also applies to SEQ[1]. Only SEQ[0] is represented for simplicity.

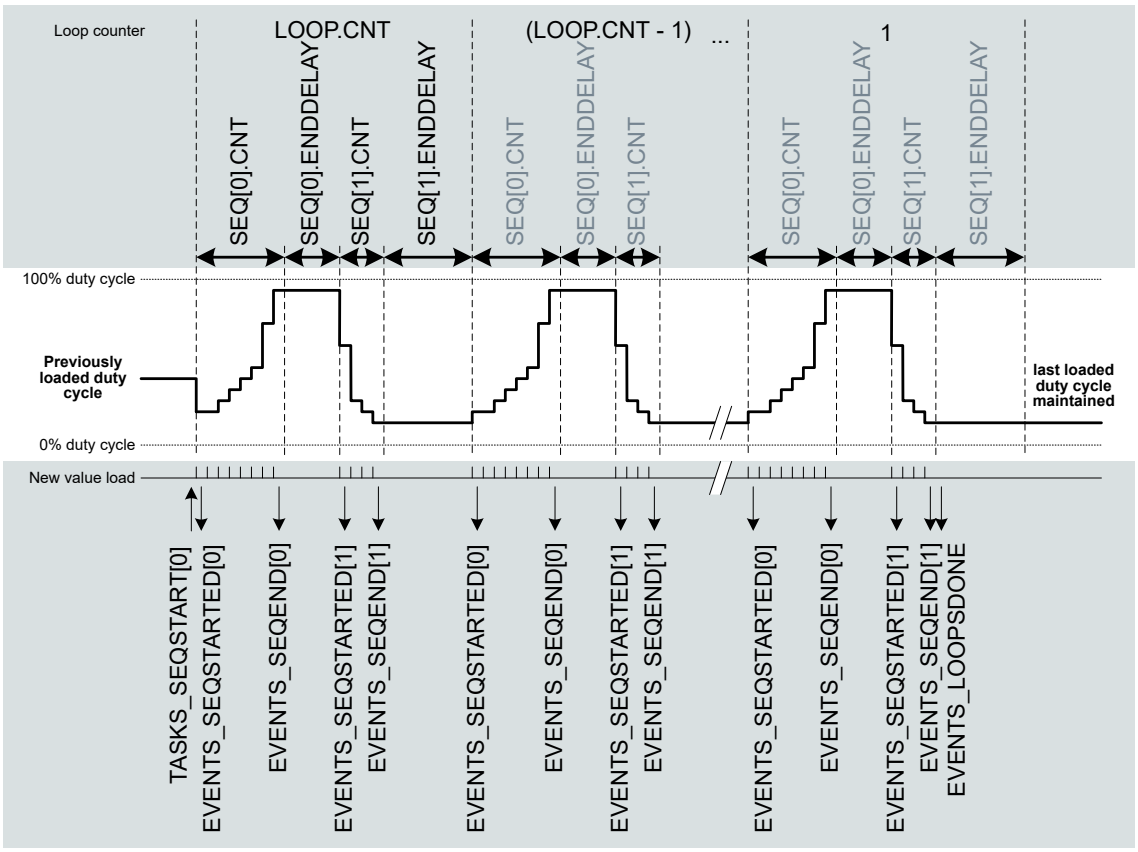


Figure 86: Complex sequence (LOOP.CNT>0) starting with SEQ[0]

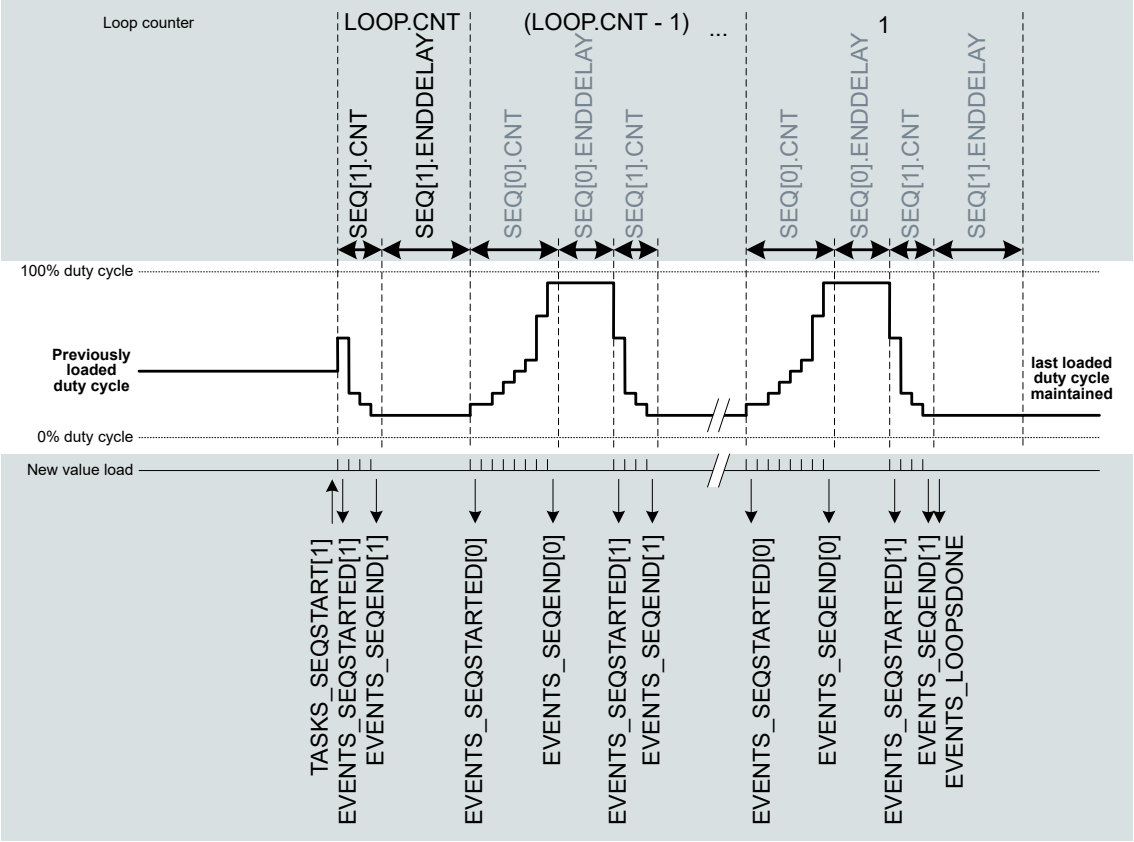


Figure 87: Complex sequence (LOOP.CNT>0) starting with SEQ[1]

Note: If a sequence is in use in a simple or complex sequence, it must have a length of SEQ[n].MAXCNT > 0.

This example shows how the PWM module can be configured to repeat a single sequence until stopped.

```
NRF_PWM0->PSEL.OUT[0] = (first_port << PWM_PSEL_OUT_PORT_Pos) |
                        (first_pin << PWM_PSEL_OUT_PIN_Pos) |
                        (PWM_PSEL_OUT_CONNECT_Connected <<
                                                PWM_PSEL_OUT_CONNECT_Pos);
NRF_PWM0->ENABLE      = (PWM_ENABLE_ENABLE_Enabled << PWM_ENABLE_ENABLE_Pos);
NRF_PWM0->MODE        = (PWM_MODE_UPDOWN_Up << PWM_MODE_UPDOWN_Pos);
NRF_PWM0->PRESCALER   = (PWM_PRESCALER_PRESCALER_DIV_1 <<
                                                PWM_PRESCALER_PRESCALER_Pos);
NRF_PWM0->COUNTERTOP  = (16000 << PWM_COUNTERTOP_COUNTERTOP_Pos); //1 msec
// Enable the shortcut from LOOPSDONE event to DMA.SEQ1.START task for infinite loop
NRF_PWM0->SHORTS      = (PWM_SHORTS_LOOPSDONE_DMA_SEQ1_START_Enabled <<
                                        PWM_SHORTS_LOOPSDONE_DMA_SEQ1_START_Pos);
// LOOP_CNT must be greater than 0 for the LOOPSDONE event to trigger and enable looping
NRF_PWM0->LOOP        = (1 << PWM_LOOP_CNT_Pos);
NRF_PWM0->DECODER     = (PWM_DECODER_LOAD_Common << PWM_DECODER_LOAD_Pos) |
                    (PWM_DECODER_MODE_RefreshCount << PWM_DECODER_MODE_Pos);
// To repeat a single sequence until stopped, it must be configured in SEQ[1]
NRF_PWM0->DMA.SEQ[1].PTR  = ((uint32_t)(seq0_ram)) << PWM_DMA_SEQ_PTR_PTR_Pos;
NRF_PWM0->DMA.SEQ[1].MAXCNT  =(sizeof(seq0_ram) << PWM_DMA_SEQ_MAXCNT_MAXCNT_Pos);
NRF_PWM0->SEQ[1].REFRESH  = 0;
NRF_PWM0->SEQ[1].ENDDELAY = 0;
NRF_PWM0->TASKS_DMA.SEQ[1].START = 1;
```

8.15.3 Limitations

The previous compare value is repeated if the PWM period is shorter than the time it takes for the EasyDMA to retrieve from RAM and update the internal compare registers. This is to ensure a glitch-free operation even for very short PWM periods.

Only SEQ[1] can trigger the LOOPSDONE event upon completion, not SEQ[0]. This requires looping to be enabled (LOOP > 0) and SEQ[1].MAXCNT > 0 when sequence playback starts.

8.15.4 Pin configuration

The OUT[n] (n=0..3) signals associated with each PWM channel are mapped to physical pins according to the configuration of PSEL.OUT[n] registers. If PSEL.OUT[n].CONNECT is set to Disconnected, the associated PWM module signal will not be connected to any physical pins.

Once PWM has been enabled, the PSEL.OUT[n] registers take effect and PWM generation starts from the IDLEOUT register. PWM can then be started and sequences generated.

To ensure correct behavior in the PWM module, the pins that are used must be configured in the GPIO peripheral in the following way before the PWM module is enabled:

PWM signal	PWM pin	Direction	Output value	Comment
OUT[n]	As specified in PSEL.OUT[n] (n=0..3)	Output	0	Idle state defined in GPIO OUT register and the IDLEOUT register

Table 48: Recommended GPIO configuration before starting PWM generation

The idle state of a pin is defined by the OUT register in the GPIO module and the IDLEOUT register, to ensure that the pins used by the PWM module are driven correctly. Both OUT register in the GPIO module and the IDLEOUT register should be set with same value for each PWM channel before enabling the PWM module . When PWM is disabled using the ENABLE register the PWM module stops controlling the GPIO pins, and the corresponding pins are then controlled by the GPIO peripheral.

Only one peripheral can be assigned to drive a particular GPIO pin at a time. Failing to do so may result in unpredictable behavior.

8.15.5 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
PWM20 : S PWM20 : NS	GLOBAL	0x500D2000 0x400D2000	US	S	SA	No	Pulse width modulation unit PWM20
PWM21 : S PWM21 : NS	GLOBAL	0x500D3000 0x400D3000	US	S	SA	No	Pulse width modulation unit PWM21
PWM22 : S PWM22 : NS	GLOBAL	0x500D4000 0x400D4000	US	S	SA	No	Pulse width modulation unit PWM22

Configuration

Instance	Domain	Configuration
PWM20 : S PWM20 : NS	GLOBAL	Use GPIO port P1 or P3 IDLEOUT register is available. EVENTS_COMPAREMATCH events are available. CURRENTAMOUNT register included.
PWM21 : S PWM21 : NS	GLOBAL	Use GPIO port P1 or P3 IDLEOUT register is available. EVENTS_COMPAREMATCH events are available. CURRENTAMOUNT register included.
PWM22 : S PWM22 : NS	GLOBAL	Use GPIO port P1 or P3 IDLEOUT register is available. EVENTS_COMPAREMATCH events are available. CURRENTAMOUNT register included.

Register overview

Register	Offset	TZ	Description
TASKS_STOP	0x004		Stops PWM pulse generation on all channels at the end of current PWM period, and stops sequence playback
TASKS_NEXTSTEP	0x008		Steps by one value in the current sequence on all enabled channels if DECODER.MODE=NextStep. Does not cause PWM generation to start if not running.
TASKS_DMA.SEQ[n].START	0x010		Starts operation using easyDMA to load the values. See peripheral description for operation using easyDMA.
SUBSCRIBE_STOP	0x084		Subscribe configuration for task STOP
SUBSCRIBE_NEXTSTEP	0x088		Subscribe configuration for task NEXTSTEP
SUBSCRIBE_DMA.SEQ[n].START	0x090		Subscribe configuration for task START
EVENTS_STOPPED	0x104		Response to STOP task, emitted when PWM pulses are no longer generated
EVENTS_SEQSTARTED[n]	0x108		First PWM period started on sequence n
EVENTS_SEQEND[n]	0x110		Emitted at end of every sequence n, when last value from RAM has been applied to wave counter
EVENTS_PWMPERIODEND	0x118		Emitted at the end of each PWM period
EVENTS_LOOPSDONE	0x11C		Concatenated sequences have been played the amount of times defined in LOOP.CNT
EVENTS_RAMUNDERFLOW	0x120		Emitted when retrieving from RAM does not complete in time for the PWM module
EVENTS_DMA.SEQ[n].END	0x124		Generated after all MAXCNT bytes have been transferred
EVENTS_DMA.SEQ[n].READY	0x128		Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
EVENTS_DMA.SEQ[n].BUSERROR	0x12C		An error occured during the bus transfer.
EVENTS_COMPAREMATCH[n]	0x13C		This event is generated when the compare matches for the compare channel [n].
PUBLISH_STOPPED	0x184		Publish configuration for event STOPPED
PUBLISH_SEQSTARTED[n]	0x188		Publish configuration for event SEQSTARTED[n]
PUBLISH_SEQEND[n]	0x190		Publish configuration for event SEQEND[n]
PUBLISH_PWMPERIODEND	0x198		Publish configuration for event PWMPERIODEND
PUBLISH_LOOPSDONE	0x19C		Publish configuration for event LOOPSDONE
PUBLISH_RAMUNDERFLOW	0x1A0		Publish configuration for event RAMUNDERFLOW
PUBLISH_DMA.SEQ[n].END	0x1A4		Publish configuration for event END
PUBLISH_DMA.SEQ[n].READY	0x1A8		Publish configuration for event READY
PUBLISH_DMA.SEQ[n].BUSERROR	0x1AC		Publish configuration for event BUSERROR
PUBLISH_COMPAREMATCH[n]	0x1BC		Publish configuration for event COMPAREMATCH[n]

Register	Offset	TZ	Description
SHORTS	0x200		Shortcuts between local events and tasks
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
INTPEND	0x30C		Pending interrupts
ENABLE	0x500		PWM module enable register
MODE	0x504		Selects operating mode of the wave counter
COUNTERTOP	0x508		Value up to which the pulse generator counter counts
PRESCALER	0x50C		Configuration for PWM_CLK
DECODER	0x510		Configuration of the decoder
LOOP	0x514		Number of playbacks of a loop
IDLEOUT	0x518		Configure the output value on the PWM channel during idle
SEQ[n].REFRESH	0x528		Number of additional PWM periods between samples loaded into compare register
SEQ[n].ENDDELAY	0x52C		Time added after the sequence
PSEL.OUT[n]	0x560		Output pin select for PWM channel n
DMA.SEQ[n].PTR	0x704		RAM buffer start address
DMA.SEQ[n].MAXCNT	0x708		Maximum number of bytes in channel buffer
DMA.SEQ[n].AMOUNT	0x70C		Number of bytes transferred in the last transaction, updated after the END event.
DMA.SEQ[n].CURRENTAMOUNT	0x710		Number of bytes transferred in the current transaction
DMA.SEQ[n].TERMINATEONBUSERROR	0x71C		Terminate the transaction if a BUSERROR event is detected.
DMA.SEQ[n].BUSERRORADDRESS	0x720		Address of transaction that generated the last BUSERROR event.

8.15.5.1 TASKS_STOP

Address offset: 0x004

Stops PWM pulse generation on all channels at the end of current PWM period, and stops sequence playback

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Stops PWM pulse generation on all channels at the end of current PWM period, and stops sequence playback
			Trigger	1	Trigger task

8.15.5.2 TASKS_NEXTSTEP

Address offset: 0x008

Steps by one value in the current sequence on all enabled channels if DECODER.MODE=NextStep. Does not cause PWM generation to start if not running.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_NEXTSTEP			Steps by one value in the current sequence on all enabled channels if DECODER.MODE=NextStep. Does not cause PWM generation to start if not running.
			Trigger	1	Trigger task

8.15.5.3 TASKS_DMA

Peripheral tasks.

8.15.5.3.1 TASKS_DMA.SEQ[n] (n=0..1)

Peripheral tasks.

8.15.5.3.1.1 TASKS_DMA.SEQ[n].START (n=0..1)

Address offset: 0x010 + (n × 0x8)

Starts operation using easyDMA to load the values. See peripheral description for operation using easyDMA.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	START			Starts operation using easyDMA to load the values. See peripheral description for operation using easyDMA.
			Trigger	1	Trigger task

8.15.5.4 SUBSCRIBE_STOP

Address offset: 0x084

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.15.5.5 SUBSCRIBE_NEXTSTEP

Address offset: 0x088

Subscribe configuration for task NEXTSTEP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task NEXTSTEP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.15.5.6 SUBSCRIBE_DMA

Subscribe configuration for tasks

8.15.5.6.1 SUBSCRIBE_DMA.SEQ[n] (n=0..1)

Subscribe configuration for tasks

8.15.5.6.1.1 SUBSCRIBE_DMA.SEQ[n].START (n=0..1)

Address offset: 0x090 + (n × 0x8)

Subscribe configuration for task START

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task START will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.15.5.7 EVENTS_STOPPED

Address offset: 0x104

Response to STOP task, emitted when PWM pulses are no longer generated

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_STOPPED			Response to STOP task, emitted when PWM pulses are no longer generated
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.15.5.8 EVENTS_SEQSTARTED[n] (n=0..1)

Address offset: 0x108 + (n × 0x4)

First PWM period started on sequence n

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_SEQSTARTED			First PWM period started on sequence n
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.15.5.9 EVENTS_SEQEND[n] (n=0..1)

Address offset: 0x110 + (n × 0x4)

Emitted at end of every sequence n, when last value from RAM has been applied to wave counter

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_SEQEND			Emitted at end of every sequence n, when last value from RAM has been applied to wave counter
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.15.5.10 EVENTS_PWMPERIODEND

Address offset: 0x118

Emitted at the end of each PWM period

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_PWMPERIODEND			Emitted at the end of each PWM period
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.15.5.11 EVENTS_LOOPSDONE

Address offset: 0x11C

Concatenated sequences have been played the amount of times defined in LOOP.CNT

This event triggers after the last SEQ[1] completion of the loop, and only if looping was enabled (LOOP > 0) when the sequence playback was started.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_LOOPSDONE			Concatenated sequences have been played the amount of times defined in LOOP.CNT This event triggers after the last SEQ[1] completion of the loop, and only if looping was enabled (LOOP > 0) when the sequence playback was started.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.15.5.12 EVENTS_RAMUNDERFLOW

Address offset: 0x120

Emitted when retrieving from RAM does not complete in time for the PWM module

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_RAMUNDERFLOW			Emitted when retrieving from RAM does not complete in time for the PWM module
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.15.5.13 EVENTS_DMA

Peripheral events.

8.15.5.13.1 EVENTS_DMA.SEQ[n] (n=0..1)

Peripheral events.

8.15.5.13.1.1 EVENTS_DMA.SEQ[n].END (n=0..1)

Address offset: 0x124 + (n × 0xC)

Generated after all MAXCNT bytes have been transferred

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	END			Generated after all MAXCNT bytes have been transferred
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.15.5.13.1.2 EVENTS_DMA.SEQ[n].READY (n=0..1)

Address offset: 0x128 + (n × 0xC)

Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	READY			Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.15.5.13.1.3 EVENTS_DMA.SEQ[n].BUSERROR (n=0..1)

Address offset: 0x12C + (n × 0xC)

An error occured during the bus transfer.

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	BUSERROR			An error occured during the bus transfer. When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.15.5.14 EVENTS_COMPAREMATCH[n] (n=0..3)

Address offset: 0x13C + (n × 0x4)

This event is generated when the compare matches for the compare channel [n].

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_COMPAREMATCH			This event is generated when the compare matches for the compare channel [n].
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.15.5.15 PUBLISH_STOPPED

Address offset: 0x184

Publish configuration for event STOPPED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event STOPPED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.15.5.16 PUBLISH_SEQSTARTED[n] (n=0..1)

Address offset: 0x188 + (n × 0x4)

Publish configuration for event SEQSTARTED[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event SEQSTARTED[n] will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.15.5.17 PUBLISH_SEQEND[n] (n=0..1)

Address offset: 0x190 + (n × 0x4)

Publish configuration for event SEQEND[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event SEQEND[n] will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.15.5.18 PUBLISH_PWMPERIODEND

Address offset: 0x198

Publish configuration for event PWMPERIODEND

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event PWMPERIODEND will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.15.5.19 PUBLISH_LOOPSDONE

Address offset: 0x19C

Publish configuration for event LOOPSDONE

This event triggers after the last SEQ[1] completion of the loop, and only if looping was enabled (LOOP > 0) when the sequence playback was started.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event LOOPSDONE will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.15.5.20 PUBLISH_RAMUNDERFLOW

Address offset: 0x1A0

Publish configuration for event RAMUNDERFLOW

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event RAMUNDERFLOW will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.15.5.21 PUBLISH_DMA

Publish configuration for events

8.15.5.21.1 PUBLISH_DMA.SEQ[n] (n=0..1)

Publish configuration for events

8.15.5.21.1.1 PUBLISH_DMA.SEQ[n].END (n=0..1)

Address offset: 0x1A4 + (n × 0xC)

Publish configuration for event END

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event END will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.15.5.21.1.2 PUBLISH_DMA.SEQ[n].READY (n=0..1)

Address offset: 0x1A8 + (n × 0xC)

Publish configuration for event READY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event READY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.15.5.21.1.3 PUBLISH_DMA.SEQ[n].BUSERROR (n=0..1)

Address offset: 0x1AC + (n × 0xC)

Publish configuration for event BUSERROR

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event BUSERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.15.5.22 PUBLISH_COMPAREMATCH[n] (n=0..3)

Address offset: 0x1BC + (n × 0x4)

Publish configuration for event COMPAREMATCH[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event COMPAREMATCH[n] will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.15.5.23 SHORTS

Address offset: 0x200

Shortcuts between local events and tasks

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-B	RW	SEQEND[i]_STOP (i=0..1)			Shortcut between event SEQEND[n] and task STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
C-D	RW	LOOPSDONE_DMA_SEQ[i]_START (i=0..1)			Shortcut between event LOOPSDONE and task DMA.SEQ[n].START
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
E	RW	LOOPSDONE_STOP			Shortcut between event LOOPSDONE and task STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
F	RW	RAMUNDERFLOW_STOP			Shortcut between event RAMUNDERFLOW and task STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
G-H	RW	DMA_SEQ[i]_BUSERROR_STOP (i=0..1)			Shortcut between event DMA.SEQ[n].BUSERROR and task STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut

8.15.5.24 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	STOPPED			Enable or disable interrupt for event STOPPED
			Disabled	0	Disable
			Enabled	1	Enable
B-C	RW	SEQSTARTED[i] (i=0..1)			Enable or disable interrupt for event SEQSTARTED[i]
			Disabled	0	Disable
			Enabled	1	Enable
D-E	RW	SEQEND[i] (i=0..1)			Enable or disable interrupt for event SEQEND[i]
			Disabled	0	Disable
			Enabled	1	Enable
F	RW	PWMPERIODEND			Enable or disable interrupt for event PWMPERIODEND
			Disabled	0	Disable
			Enabled	1	Enable
G	RW	LOOPSDONE			Enable or disable interrupt for event LOOPSDONE This event triggers after the last SEQ[1] completion of the loop, and only if looping was enabled (LOOP > 0) when the sequence playback was started.
			Disabled	0	Disable
			Enabled	1	Enable
H	RW	RAMUNDERFLOW			Enable or disable interrupt for event RAMUNDERFLOW
			Disabled	0	Disable
			Enabled	1	Enable
I	RW	DMASEQ0END			Enable or disable interrupt for event DMASEQ0END
			Disabled	0	Disable
			Enabled	1	Enable
J	RW	DMASEQ0READY			Enable or disable interrupt for event DMASEQ0READY
			Disabled	0	Disable
			Enabled	1	Enable
K	RW	DMASEQ0BUSERROR			Enable or disable interrupt for event DMASEQ0BUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Disabled	0	Disable
			Enabled	1	Enable
L	RW	DMASEQ1END			Enable or disable interrupt for event DMASEQ1END
			Disabled	0	Disable
			Enabled	1	Enable
M	RW	DMASEQ1READY			Enable or disable interrupt for event DMASEQ1READY
			Disabled	0	Disable
			Enabled	1	Enable
N	RW	DMASEQ1BUSERROR			Enable or disable interrupt for event DMASEQ1BUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Disabled	0	Disable
			Enabled	1	Enable
O-R	RW	COMPAREMATCH[i] (i=0..3)			Enable or disable interrupt for event COMPAREMATCH[i]
			Disabled	0	Disable
			Enabled	1	Enable

8.15.5.25 INTENSET

Address offset: 0x304

Enable interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID														R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A	
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1S	STOPPED			Write '1' to enable interrupt for event STOPPED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B-C	RW W1S	SEQSTARTED[i] (i=0..1)			Write '1' to enable interrupt for event SEQSTARTED[i]
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D-E	RW W1S	SEQEND[i] (i=0..1)			Write '1' to enable interrupt for event SEQEND[i]
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1S	PWMPERIODEND			Write '1' to enable interrupt for event PWMPERIODEND
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1S	LOOPSDONE			Write '1' to enable interrupt for event LOOPSDONE This event triggers after the last SEQ[1] completion of the loop, and only if looping was enabled (LOOP > 0) when the sequence playback was started.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
H	RW W1S	RAMUNDERFLOW			Write '1' to enable interrupt for event RAMUNDERFLOW
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
I	RW W1S	DMASEQ0END			Write '1' to enable interrupt for event DMASEQ0END
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
J	RW W1S	DMASEQ0READY			Write '1' to enable interrupt for event DMASEQ0READY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
K	RW W1S	DMASEQ0BUSERROR			Write '1' to enable interrupt for event DMASEQ0BUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
L	RW W1S	DMASEQ1END			Write '1' to enable interrupt for event DMASEQ1END
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1S	DMASEQ1READY			Write '1' to enable interrupt for event DMASEQ1READY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
N	RW W1S	DMASEQ1BUSERROR			Write '1' to enable interrupt for event DMASEQ1BUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
O-R	RW W1S	COMPAREMATCH[i] (i=0..3)			Write '1' to enable interrupt for event COMPAREMATCH[i]
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.15.5.26 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	STOPPED			Write '1' to disable interrupt for event STOPPED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B-C	RW W1C	SEQSTARTED[i] (i=0..1)			Write '1' to disable interrupt for event SEQSTARTED[i]
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D-E	RW W1C	SEQEND[i] (i=0..1)			Write '1' to disable interrupt for event SEQEND[i]
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1C	PWMPERIODEND			Write '1' to disable interrupt for event PWMPERIODEND
			Clear	1	Disable

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1C	LOOPSDONE			Write '1' to disable interrupt for event LOOPSDONE This event triggers after the last SEQ[1] completion of the loop, and only if looping was enabled (LOOP > 0) when the sequence playback was started.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
H	RW W1C	RAMUNDERFLOW			Write '1' to disable interrupt for event RAMUNDERFLOW
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
I	RW W1C	DMASEQ0END			Write '1' to disable interrupt for event DMASEQ0END
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
J	RW W1C	DMASEQ0READY			Write '1' to disable interrupt for event DMASEQ0READY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
K	RW W1C	DMASEQ0BUSERROR			Write '1' to disable interrupt for event DMASEQ0BUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
L	RW W1C	DMASEQ1END			Write '1' to disable interrupt for event DMASEQ1END
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1C	DMASEQ1READY			Write '1' to disable interrupt for event DMASEQ1READY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
N	RW W1C	DMASEQ1BUSERROR			Write '1' to disable interrupt for event DMASEQ1BUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
O-R	RW W1C	COMPAREMATCH[i] (i=0..3)			Write '1' to disable interrupt for event COMPAREMATCH[i]
			Clear	1	Disable
			Disabled	0	Read: Disabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
			Enabled	1	Read: Enabled

8.15.5.27 INTPEND

Address offset: 0x30C

Pending interrupts

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	STOPPED			Read pending status of interrupt for event STOPPED
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
B-C	R	SEQSTARTED[i] (i=0..1)			Read pending status of interrupt for event SEQSTARTED[i]
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
D-E	R	SEQEND[i] (i=0..1)			Read pending status of interrupt for event SEQEND[i]
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
F	R	PWMPERIODEND			Read pending status of interrupt for event PWMPERIODEND
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
G	R	LOOPSDONE			Read pending status of interrupt for event LOOPSDONE This event triggers after the last SEQ[1] completion of the loop, and only if looping was enabled (LOOP > 0) when the sequence playback was started.
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
H	R	RAMUNDERFLOW			Read pending status of interrupt for event RAMUNDERFLOW
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
I	R	DMASEQ0END			Read pending status of interrupt for event DMASEQ0END
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
J	R	DMASEQ0READY			Read pending status of interrupt for event DMASEQ0READY
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
K	R	DMASEQ0BUSERROR			Read pending status of interrupt for event DMASEQ0BUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
L	R	DMASEQ1END			Read pending status of interrupt for event DMASEQ1END
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
M	R	DMASEQ1READY			Read pending status of interrupt for event DMASEQ1READY
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
N	R	DMASEQ1BUSERROR			Read pending status of interrupt for event DMASEQ1BUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
O-R	R	COMPAREMATCH[i] (i=0..3)			Read pending status of interrupt for event COMPAREMATCH[i]
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending

8.15.5.28 ENABLE

Address offset: 0x500

PWM module enable register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			Enable or disable PWM module
			Disabled	0	Disabled
			Enabled	1	Enable

8.15.5.29 MODE

Address offset: 0x504

Selects operating mode of the wave counter

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	UPDOWN			Selects up mode or up-and-down mode for the counter
			Up	0	Up counter, edge-aligned PWM duty cycle
			UpAndDown	1	Up and down counter, center-aligned PWM duty cycle

8.15.5.30 COUNTERTOP

Address offset: 0x508

Value up to which the pulse generator counter counts

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x000003FF				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1**

ID	R/W	Field	Value ID	Value	Description
A	RW	COUNTERTOP		[3..32767]	Value up to which the pulse generator counter counts. This register is ignored when DECODER.MODE=WaveForm and only values from RAM are used.

8.15.5.31 PRESCALER

Address offset: 0x50C

Configuration for PWM_CLK

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PRESCALER			Prescaler of PWM_CLK
			DIV_1	0	Divide by 1 (16 MHz)
			DIV_2	1	Divide by 2 (8 MHz)
			DIV_4	2	Divide by 4 (4 MHz)
			DIV_8	3	Divide by 8 (2 MHz)
			DIV_16	4	Divide by 16 (1 MHz)
			DIV_32	5	Divide by 32 (500 kHz)
			DIV_64	6	Divide by 64 (250 kHz)
			DIV_128	7	Divide by 128 (125 kHz)

8.15.5.32 DECODER

Address offset: 0x510

Configuration of the decoder

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	LOAD			How a sequence is read from RAM and spread to the compare register
			Common	0	1st half word (16-bit) used in all PWM channels 0..3
			Grouped	1	1st half word (16-bit) used in channel 0..1; 2nd word in channel 2..3
			Individual	2	1st half word (16-bit) in ch.0; 2nd in ch.1; ...; 4th in ch.3
			WaveForm	3	1st half word (16-bit) in ch.0; 2nd in ch.1; ...; 4th in COUNTERTOP
B	RW	MODE			Selects source for advancing the active sequence
			RefreshCount	0	SEQ[n].REFRESH is used to determine loading internal compare registers
			NextStep	1	NEXTSTEP task causes a new value to be loaded to internal compare registers

8.15.5.33 LOOP

Address offset: 0x514

Number of playbacks of a loop

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CNT			Number of playbacks of pattern cycles
			Disabled	0	Looping disabled (stop at the end of the sequence)

8.15.5.34 IDLEOUT

Address offset: 0x518

Configure the output value on the PWM channel during idle

Writes to this register are ignored when the PWM is enabled.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-D	RW	VAL[i] (i=0..3)			Idle output value for PWM channel [i]

8.15.5.35 SEQ[n].REFRESH (n=0..1)

Address offset: 0x528 + (n × 0x20)

Number of additional PWM periods between samples loaded into compare register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000001				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	CNT			Number of additional PWM periods between samples loaded into compare register (load every REFRESH.CNT+1 PWM periods)
			Continuous	0	Update every PWM period

8.15.5.36 SEQ[n].ENDDELAY (n=0..1)

Address offset: 0x52C + (n × 0x20)

Time added after the sequence

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CNT			Time added after the sequence in PWM periods

8.15.5.37 PSEL.OUT[n] (n=0..3)

Address offset: 0x560 + (n × 0x4)

Output pin select for PWM channel n

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.15.5.38 DMA.SEQ[n].PTR (n=0..1)

Address offset: 0x704 + (n × 0x24)

RAM buffer start address

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			RAM buffer start address for this EasyDMA channel. This address is a word aligned Data RAM address.

Note: See the memory chapter for details about which memories are available for EasyDMA.

8.15.5.39 DMA.SEQ[n].MAXCNT (n=0..1)

Address offset: 0x708 + (n × 0x24)

Maximum number of bytes in channel buffer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MAXCNT		[1..0x7fff]	Maximum number of bytes in channel buffer

8.15.5.40 DMA.SEQ[n].AMOUNT (n=0..1)

Address offset: 0x70C + (n × 0x24)

Number of bytes transferred in the last transaction, updated after the END event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT		[1..0x7fff]	Number of bytes transferred in the last transaction. In case of NACK error, includes the NACK'ed byte.

8.15.5.41 DMA.SEQ[n].CURRENTAMOUNT (n=0..1)

Address offset: 0x710 + (n × 0x24)

Number of bytes transferred in the current transaction

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT		[1..0x7fff]	Number of bytes transferred in the current transaction. Continuously updated.

8.15.5.42 DMA.SEQ[n].TERMINATEONBUSERROR (n=0..1)

Address offset: 0x71C + (n × 0x24)

Terminate the transaction if a BUSERROR event is detected.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value								Description																							
A	RW	ENABLE																																	
			Disabled	0								Disable																							
			Enabled	1								Enable																							

8.15.5.43 DMA.SEQ[n].BUSERRORADDRESS (n=0..1)

Address offset: 0x720 + (n × 0x24)

Address of transaction that generated the last BUSERROR event.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value								Description																							
A	R	ADDRESS																																	

8.16 QDEC — Quadrature decoder

The quadrature decoder peripheral (QDEC) provides buffered decoding of quadrature-encoded sensor signals. It is suitable for mechanical and optical sensors.

The main features of QDEC are the following:

- Digital waveform decoding from off-chip quadrature encoder
- Sample accumulation eliminating hard real-time requirements to be enforced on application
- Configurable sample period and accumulation to match application requirements
- Optional input debounce filters
- Optional LED output signal for optical encoders

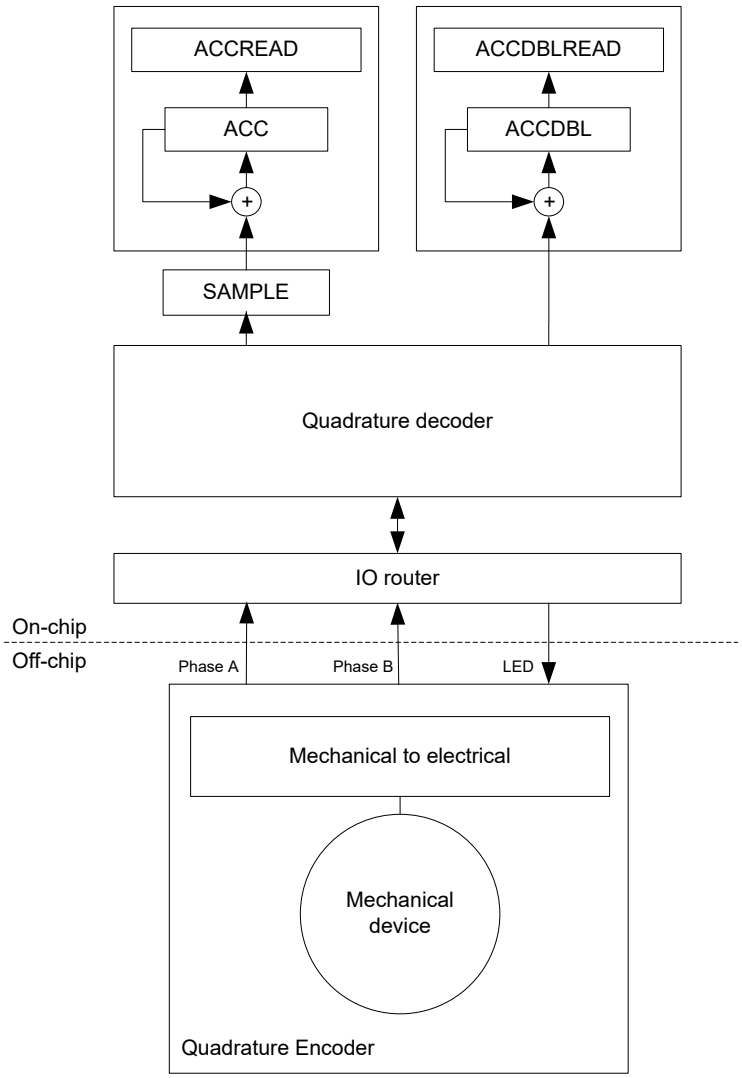


Figure 88: Quadrature decoder configuration

8.16.1 Sampling and decoding

The QDEC decodes the output from an incremental motion encoder by sampling the QDEC phase input pins (A and B).

The off-chip quadrature encoder is an incremental motion encoder outputting two waveforms, phase A and phase B. The two output waveforms are always 90 degrees out of phase, meaning that one always changes level before the other. The direction of movement is indicated by the waveform that changes level first. Invalid transitions may occur, meaning the two waveforms simultaneously switch. This may occur if the wheel rotates too fast relative to the sample rate set for the decoder.

The QDEC decodes the output from the off-chip encoder by sampling the QDEC phase input pins (A and B) at a fixed rate as specified in the SAMPLEPER register.

If the SAMPLEPER value needs to be changed, the QDEC shall be stopped using the STOP task. SAMPLEPER can be then changed upon receiving the STOPPED event, and QDEC can be restarted using the START task. Failing to do so may result in unpredictable behavior.

It is good practice to only change registers LEDPOL, REPORTPER, DBFEN, and LEDPRE when the QDEC is stopped.

When started, the decoder continuously samples the two input waveforms and decodes these by comparing the current sample pair (n) with the previous sample pair (n-1).

The decoding of the sample pairs is described in the table below.

Previous sample pair(n - 1)		Current samples pair(n)		SAMPLE register	ACC operation	ACCDBL operation	Description
A	B	A	B				
0	0	0	0	0	No change	No change	No movement
0	0	0	1	1	Increment	No change	Movement in positive direction
0	0	1	0	-1	Decrement	No change	Movement in negative direction
0	0	1	1	2	No change	Increment	Error: Double transition
0	1	0	0	-1	Decrement	No change	Movement in negative direction
0	1	0	1	0	No change	No change	No movement
0	1	1	0	2	No change	Increment	Error: Double transition
0	1	1	1	1	Increment	No change	Movement in positive direction
1	0	0	0	1	Increment	No change	Movement in positive direction
1	0	0	1	2	No change	Increment	Error: Double transition
1	0	1	0	0	No change	No change	No movement
1	0	1	1	-1	Decrement	No change	Movement in negative direction
1	1	0	0	2	No change	Increment	Error: Double transition
1	1	0	1	-1	Decrement	No change	Movement in negative direction
1	1	1	0	1	Increment	No change	Movement in positive direction
1	1	1	1	0	No change	No change	No movement

Table 49: Sampled value encoding

8.16.2 LED output

The LED output follows the sample period. The LED is switched on for a set period before sampling and then switched off immediately after. The period the LED is switched on before sampling is given in the LEDPRE register.

The LED output pin polarity is specified in the LEDPOL register.

When using off-chip mechanical encoders not requiring an LED, the LED output can be disabled by writing value 'Disconnected' to the CONNECT field of the PSEL.LED register. In this case, the QDEC will not acquire access to a pin for the LED output.

8.16.3 Debounce filters

Each of the two-phase inputs have digital debounce filters.

When enabled through the DBFEN register, the filter inputs are sampled at a fixed 1 MHz frequency during the entire sample period (which is specified in the SAMPLEPER register). The filters require all of the samples within this sample period to equal before the input signal is accepted and transferred to the output of the filter.

As a result, only input signal with a steady state longer than twice the period specified in SAMPLEPER are guaranteed to pass through the filter. Any signal with a steady state shorter than SAMPLEPER will always be suppressed by the filter. It is assumed that the frequency during the debounce period never exceeds 500 kHz (as required by the Nyquist theorem when using a 1 MHz sample frequency).

The LED will always be ON when the debounce filters are enabled, as the inputs in this case will be sampled continuously.

When the debounce filters are enabled, displacements reported by the QDEC peripheral are delayed by one SAMPLEPER period.

8.16.4 Accumulators

The quadrature decoder contains two accumulator registers, ACC and ACCDBL. These registers accumulate valid motion sample values and the number of detected invalid samples (double transitions), respectively.

The ACC register accumulates all valid values (1/-1) written to the SAMPLE register. This can be useful for preventing hard real-time requirements from being enforced on the application. When using the ACC register, the application can fetch data when necessary instead of reading all SAMPLE register output. The ACC register holds the relative movement of the external mechanical device from the previous clearing of the ACC register. Sample values indicating a double transition (2) will not be accumulated in the ACC register.

An ACCOF event is generated if the ACC receives a SAMPLE value that would cause the register to overflow or underflow. Any SAMPLE value that would cause an ACC overflow or underflow will be discarded, but any samples that do not cause the ACC to overflow or underflow will still be accepted.

The accumulator ACCDBL accumulates the number of detected double transitions since the previous clearing of the ACCDBL register.

The ACC and ACCDBL registers can be cleared by the READCLRACC and subsequently read using the ACCREAD and ACCDBLREAD registers.

The ACC register can be separately cleared by the RDCLRACC and subsequently read using the ACCREAD registers.

The ACCDBL register can be separately cleared by the RDCLRDBL and subsequently read using the ACCDBLREAD registers.

The REPORTPER register allows automated capture of multiple samples before sending an event. When a non-null displacement is captured and accumulated, a REPORTRDY event is sent. When one or more double-displacements are captured and accumulated, a DBLRDY event is sent. The REPORTPER field in this register determines how many samples must be accumulated before the contents are evaluated and a REPORTRDY or DBLRDY event is sent.

Using the RDCLRACC task (manually sent upon receiving the event, or using the DBLRDY_RDCLRACC shortcut), ACCREAD can then be read.

When a double transition has been captured and accumulated, a DBLRDY event is sent. Using the RDCLRDBL task (manually sent upon receiving the event, or using the DBLRDY_RDCLRDBL shortcut), ACCDBLREAD can then be read.

8.16.5 Output/input pins

The QDEC uses a three-pin interface to the off-chip quadrature encoder.

These pins are acquired when the QDEC is enabled in the ENABLE register. The pins acquired by the QDEC cannot be written by the CPU, but they can still be read by the CPU.

The pin numbers used for the QDEC are selected using the PSEL.n registers.

8.16.6 Pin configuration

The Phase A, Phase B, and LED signals are mapped to physical pins according to the configuration specified in the PSEL.A, PSEL.B, and PSEL.LED registers respectively.

If the CONNECT field value 'Disconnected' is specified in any of these registers, the associated signal will not be connected to any physical pin. The PSEL.A, PSEL.B, and PSEL.LED registers and their configurations are only used as long as the QDEC is enabled, and retained only as long as the device is in ON mode. When the peripheral is disabled, the pins will behave as regular GPIOs, and use the configuration in their respective OUT bit field and PIN_CNF[n] register.

To secure correct behavior in the QDEC, the pins used by the QDEC must be configured in the GPIO peripheral as described in GPIO configuration before enabling peripheral on page 448 before enabling the QDEC. This configuration must be retained in the GPIO for the selected I/Os as long as the QDEC is enabled.

Only one peripheral can be assigned to drive a particular GPIO pin at a time. Failing to do so may result in unpredictable behavior.

QDEC signal	QDEC pin	Direction	Output value	Comment
Phase A	As specified in PSEL.A	Input	Not applicable	
Phase B	As specified in PSEL.B	Input	Not applicable	
LED	As specified in PSEL.LED	Input	Not applicable	

Table 50: GPIO configuration before enabling peripheral

8.16.7 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
QDEC20 : S QDEC20 : NS	GLOBAL	0x500E0000 0x400E0000	US	S	NA	No	Quadrature decoder QDEC20
QDEC21 : S QDEC21 : NS	GLOBAL	0x500E1000 0x400E1000	US	S	NA	No	Quadrature decoder QDEC21

Configuration

Instance	Domain	Configuration
QDEC20 : S QDEC20 : NS	GLOBAL	Use GPIO port P1 or P3
QDEC21 : S QDEC21 : NS	GLOBAL	Use GPIO port P1 or P3

Register overview

Register	Offset	TZ	Description
TASKS_START	0x000		Task starting the quadrature decoder
TASKS_STOP	0x004		Task stopping the quadrature decoder
TASKS_READCLRACC	0x008		Read and clear ACC and ACCDBL
TASKS_RDCLRACC	0x00C		Read and clear ACC
TASKS_RDCLRDBL	0x010		Read and clear ACCDBL
SUBSCRIBE_START	0x080		Subscribe configuration for task START
SUBSCRIBE_STOP	0x084		Subscribe configuration for task STOP
SUBSCRIBE_READCLRACC	0x088		Subscribe configuration for task READCLRACC
SUBSCRIBE_RDCLRACC	0x08C		Subscribe configuration for task RDCLRACC
SUBSCRIBE_RDCLRDBL	0x090		Subscribe configuration for task RDCLRDBL
EVENTS_SAMPLERDY	0x100		Event being generated for every new sample value written to the SAMPLE register
EVENTS_REPORTRDY	0x104		Non-null report ready
EVENTS_ACCOF	0x108		ACC or ACCDBL register overflow
EVENTS_DBLRDY	0x10C		Double displacement(s) detected

Register	Offset	TZ	Description
EVENTS_STOPPED	0x110		QDEC has been stopped
PUBLISH_SAMPLERDY	0x180		Publish configuration for event SAMPLERDY
PUBLISH_REPORTRDY	0x184		Publish configuration for event REPORTRDY
PUBLISH_ACCOF	0x188		Publish configuration for event ACCOF
PUBLISH_DBLRDY	0x18C		Publish configuration for event DBLRDY
PUBLISH_STOPPED	0x190		Publish configuration for event STOPPED
SHORTS	0x200		Shortcuts between local events and tasks
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
ENABLE	0x500		Enable the quadrature decoder
LEDPOL	0x504		LED output pin polarity
SAMPLEPER	0x508		Sample period
SAMPLE	0x50C		Motion sample value
REPORTPER	0x510		Number of samples to be taken before REPORTRDY and DBLRDY events can be generated
ACC	0x514		Register accumulating the valid transitions
ACCREAD	0x518		Snapshot of the ACC register, updated by the READCLRACC or RDCLRACC task
PSEL.LED	0x51C		Pin select for LED signal
PSEL.A	0x520		Pin select for A signal
PSEL.B	0x524		Pin select for B signal
DBFEN	0x528		Enable input debounce filters
LEDPRE	0x540		Time period the LED is switched ON prior to sampling
ACCDBL	0x544		Register accumulating the number of detected double transitions
ACCDBLREAD	0x548		Snapshot of the ACCDBL, updated by the READCLRACC or RDCLRDBL task

8.16.7.1 TASKS_START

Address offset: 0x000

Task starting the quadrature decoder

When started, the SAMPLE register will be continuously updated at the rate given in the SAMPLEPER register.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_START			Task starting the quadrature decoder When started, the SAMPLE register will be continuously updated at the rate given in the SAMPLEPER register.
			Trigger	1	Trigger task

8.16.7.2 TASKS_STOP

Address offset: 0x004

Task stopping the quadrature decoder

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Task stopping the quadrature decoder
			Trigger	1	Trigger task

8.16.7.3 TASKS_READCLRACC

Address offset: 0x008

Read and clear ACC and ACCDBL

Task transferring the content of ACC to ACCREAD and the content of ACCDBL to ACCDBLREAD, and then clearing the ACC and ACCDBL registers. These read-and-clear operations will be done atomically.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_READCLRACC			Read and clear ACC and ACCDBL
					Task transferring the content of ACC to ACCREAD and the content of ACCDBL to ACCDBLREAD, and then clearing the ACC and ACCDBL registers. These read-and-clear operations will be done atomically.
			Trigger	1	Trigger task

8.16.7.4 TASKS_RDCLRACC

Address offset: 0x00C

Read and clear ACC

Task transferring the content of ACC to ACCREAD, and then clearing the ACC register. This read-and-clear operation will be done atomically.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_RDCLRACC			Read and clear ACC
					Task transferring the content of ACC to ACCREAD, and then clearing the ACC register. This read-and-clear operation will be done atomically.
			Trigger	1	Trigger task

8.16.7.5 TASKS_RDCLRDBL

Address offset: 0x010

Read and clear ACCDBL

Task transferring the content of ACCDBL to ACCDBLREAD, and then clearing the ACCDBL register. This read-and-clear operation will be done atomically.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_RDCLRDBL			Read and clear ACCDBL
					Task transferring the content of ACCDBL to ACCDBLREAD, and then clearing the ACCDBL register. This read-and-clear operation will be done atomically.
			Trigger	1	Trigger task

8.16.7.6 SUBSCRIBE_START

Address offset: 0x080

Subscribe configuration for task START

When started, the SAMPLE register will be continuously updated at the rate given in the SAMPLEPER register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task START will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.16.7.7 SUBSCRIBE_STOP

Address offset: 0x084

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.16.7.8 SUBSCRIBE_READCLRACC

Address offset: 0x088

Subscribe configuration for task READCLRACC

Task transferring the content of ACC to ACCREAD and the content of ACCDBL to ACCDBLREAD, and then clearing the ACC and ACCDBL registers. These read-and-clear operations will be done atomically.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task READCLRACC will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.16.7.9 SUBSCRIBE_RDCLRACC

Address offset: 0x08C

Subscribe configuration for task RDCLRACC

Task transferring the content of ACC to ACCREAD, and then clearing the ACC register. This read-and-clear operation will be done atomically.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task RDCLRACC will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.16.7.10 SUBSCRIBE_RDCLRDBL

Address offset: 0x090

Subscribe configuration for task RDCLRDBL

Task transferring the content of ACCDBL to ACCDBLREAD, and then clearing the ACCDBL register. This read-and-clear operation will be done atomically.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task RDCLRDBL will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.16.7.11 EVENTS_SAMPLERDY

Address offset: 0x100

Event being generated for every new sample value written to the SAMPLE register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_SAMPLERDY			Event being generated for every new sample value written to the SAMPLE register
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.16.7.12 EVENTS_REPORTRDY

Address offset: 0x104

Non-null report ready

Event generated when REPORTPER number of samples has been accumulated in the ACC register and the content of the ACC register is not equal to 0. (Thus, this event is only generated if a motion is detected since the previous clearing of the ACC register).

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_REPORTRDY			Non-null report ready Event generated when REPORTPER number of samples has been accumulated in the ACC register and the content of the ACC register is not equal to 0. (Thus, this event is only generated if a motion is detected since the previous clearing of the ACC register).
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.16.7.13 EVENTS_ACCOF

Address offset: 0x108

ACC or ACCDBL register overflow

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_ACCOF			ACC or ACCDBL register overflow
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.16.7.14 EVENTS_DBLRDY

Address offset: 0x10C

Double displacement(s) detected

Event generated when REPORTPER number of samples has been accumulated and the content of the ACCDBL register is not equal to 0. (Thus, this event is only generated if a double transition is detected since the previous clearing of the ACCDBL register).

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_DBLRDY			Double displacement(s) detected
					Event generated when REPORTPER number of samples has been accumulated and the content of the ACCDBL register is not equal to 0. (Thus, this event is only generated if a double transition is detected since the previous clearing of the ACCDBL register).
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.16.7.15 EVENTS_STOPPED

Address offset: 0x110

QDEC has been stopped

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_STOPPED			QDEC has been stopped
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.16.7.16 PUBLISH_SAMPLERDY

Address offset: 0x180

Publish configuration for event SAMPLERDY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event SAMPLERDY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.16.7.17 PUBLISH_REPORTRDY

Address offset: 0x184

Publish configuration for event REPORTRDY

Event generated when REPORTPER number of samples has been accumulated in the ACC register and the content of the ACC register is not equal to 0. (Thus, this event is only generated if a motion is detected since the previous clearing of the ACC register).

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event REPORTRDY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.16.7.18 PUBLISH_ACCOF

Address offset: 0x188

Publish configuration for event ACCOF

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event ACCOF will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.16.7.19 PUBLISH_DBLRDY

Address offset: 0x18C

Publish configuration for event DBLRDY

Event generated when REPORTPER number of samples has been accumulated and the content of the ACCDBL register is not equal to 0. (Thus, this event is only generated if a double transition is detected since the previous clearing of the ACCDBL register).

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event DBLRDY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.16.7.20 PUBLISH_STOPPED

Address offset: 0x190

Publish configuration for event STOPPED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event STOPPED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.16.7.21 SHORTS

Address offset: 0x200

Shortcuts between local events and tasks

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	REPORTRDY_READCLRACC			Shortcut between event REPORTRDY and task READCLRACC
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
B	RW	SAMPLERDY_STOP			Shortcut between event SAMPLERDY and task STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
C	RW	REPORTRDY_RDCLRACC			Shortcut between event REPORTRDY and task RDCLRACC
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
D	RW	REPORTRDY_STOP			Shortcut between event REPORTRDY and task STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
E	RW	DBLRDY_RDCLRDBL			Shortcut between event DBLRDY and task RDCLRDBL
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
F	RW	DBLRDY_STOP			Shortcut between event DBLRDY and task STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
G	RW	SAMPLERDY_READCLRACC			Shortcut between event SAMPLERDY and task READCLRACC
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut

8.16.7.22 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	SAMPLERDY			Enable or disable interrupt for event SAMPLERDY
			Disabled	0	Disable
			Enabled	1	Enable

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
B	RW	REPORTRDY			Enable or disable interrupt for event REPORTRDY Event generated when REPORTPER number of samples has been accumulated in the ACC register and the content of the ACC register is not equal to 0. (Thus, this event is only generated if a motion is detected since the previous clearing of the ACC register).
			Disabled	0	Disable
			Enabled	1	Enable
C	RW	ACCOF			Enable or disable interrupt for event ACCOF
			Disabled	0	Disable
			Enabled	1	Enable
D	RW	DBLRDY			Enable or disable interrupt for event DBLRDY Event generated when REPORTPER number of samples has been accumulated and the content of the ACCDBL register is not equal to 0. (Thus, this event is only generated if a double transition is detected since the previous clearing of the ACCDBL register).
			Disabled	0	Disable
			Enabled	1	Enable
E	RW	STOPPED			Enable or disable interrupt for event STOPPED
			Disabled	0	Disable
			Enabled	1	Enable

8.16.7.23 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1S	SAMPLERDY			Write '1' to enable interrupt for event SAMPLERDY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	REPORTRDY			Write '1' to enable interrupt for event REPORTRDY Event generated when REPORTPER number of samples has been accumulated in the ACC register and the content of the ACC register is not equal to 0. (Thus, this event is only generated if a motion is detected since the previous clearing of the ACC register).
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1S	ACCOF			Write '1' to enable interrupt for event ACCOF
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
D	RW W1S	DBLRDY			Write '1' to enable interrupt for event DBLRDY Event generated when REPORTPER number of samples has been accumulated and the content of the ACCDBL register is not equal to 0. (Thus, this event is only generated if a double transition is detected since the previous clearing of the ACCDBL register).
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1S	STOPPED			Write '1' to enable interrupt for event STOPPED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.16.7.24 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	SAMPLERDY			Write '1' to disable interrupt for event SAMPLERDY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	REPORTRDY			Write '1' to disable interrupt for event REPORTRDY Event generated when REPORTPER number of samples has been accumulated in the ACC register and the content of the ACC register is not equal to 0. (Thus, this event is only generated if a motion is detected since the previous clearing of the ACC register).
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	ACCOF			Write '1' to disable interrupt for event ACCOF
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1C	DBLRDY			Write '1' to disable interrupt for event DBLRDY Event generated when REPORTPER number of samples has been accumulated and the content of the ACCDBL register is not equal to 0. (Thus, this event is only generated if a double transition is detected since the previous clearing of the ACCDBL register).
			Clear	1	Disable
			Disabled	0	Read: Disabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
			Enabled	1	Read: Enabled
E	RW W1C	STOPPED			Write '1' to disable interrupt for event STOPPED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.16.7.25 ENABLE

Address offset: 0x500

Enable the quadrature decoder

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A-	RW	ENABLE			Enable or disable the quadrature decoder When enabled the decoder pins will be active. When disabled the quadrature decoder pins are not active and can be used as GPIO .
			Disabled	0	Disable
			Enabled	1	Enable

8.16.7.26 LEDPOL

Address offset: 0x504

LED output pin polarity

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	LEDPOL			LED output pin polarity
			ActiveLow	0	Led active on output pin low
			ActiveHigh	1	Led active on output pin high

8.16.7.27 SAMPLEPER

Address offset: 0x508

Sample period

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	SAMPLEPER			Sample period. The SAMPLE register will be updated for every new sample
			128us	0	128 µs
			256us	1	256 µs

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			512us	2	512 µs
			1024us	3	1024 µs
			2048us	4	2048 µs
			4096us	5	4096 µs
			8192us	6	8192 µs
			16384us	7	16384 µs
			32ms	8	32768 µs
			65ms	9	65536 µs
			131ms	10	131072 µs

8.16.7.28 SAMPLE

Address offset: 0x50C

Motion sample value

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	SAMPLE		[-1..2]	Last motion sample The value is a 2's complement value, and the sign gives the direction of the motion. The value '2' indicates a double transition.

8.16.7.29 REPORTPER

Address offset: 0x510

Number of samples to be taken before REPORTRDY and DBLRDY events can be generated

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	REPORTPER			Specifies the number of samples to be accumulated in the ACC register before the REPORTRDY and DBLRDY events can be generated. The report period in [µs] is given as: RPUS = SP * RP, where RPUS is the report period in [µs/report], SP is the sample period in [µs/sample] specified in SAMPLEPER, and RP is the report period in [samples/report] specified in REPORTPER .
			10Smpl	0	10 samples/report
			40Smpl	1	40 samples/report
			80Smpl	2	80 samples/report
			120Smpl	3	120 samples/report
			160Smpl	4	160 samples/report
			200Smpl	5	200 samples/report
			240Smpl	6	240 samples/report
			280Smpl	7	280 samples/report
			1Smpl	8	1 sample/report

8.16.7.30 ACC

Address offset: 0x514

Register accumulating the valid transitions

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	ACC		[-1024..1023]	Register accumulating all valid samples (not double transition) read from the SAMPLE register. Double transitions (SAMPLE = 2) will not be accumulated in this register. The value is a 32 bit 2's complement value. If a sample that would cause this register to overflow or underflow is received, the sample will be ignored and an overflow event (ACCOF) will be generated. The ACC register is cleared by triggering the READCLRACC or the RDCLRACC task.

8.16.7.31 ACCREAD

Address offset: 0x518

Snapshot of the ACC register, updated by the READCLRACC or RDCLRACC task

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	ACCREAD		[-1024..1023]	Snapshot of the ACC register. The ACCREAD register is updated when the READCLRACC or RDCLRACC task is triggered.

8.16.7.32 PSEL.LED

Address offset: 0x51C

Pin select for LED signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.16.7.33 PSEL.A

Address offset: 0x520

Pin select for A signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.16.7.34 PSEL.B

Address offset: 0x524

Pin select for B signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.16.7.35 DBFEN

Address offset: 0x528

Enable input debounce filters

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	DBFEN			Enable input debounce filters
			Disabled	0	Debounce input filters disabled
			Enabled	1	Debounce input filters enabled

8.16.7.36 LEDPRE

Address offset: 0x540

Time period the LED is switched ON prior to sampling

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A
Reset 0x00000010				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	LEDPRE		[1..511]	Period in µs the LED is switched on prior to sampling

8.16.7.37 ACCDBL

Address offset: 0x544

Register accumulating the number of detected double transitions

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	ACCDBL		[0..15]																															
				Register accumulating the number of detected double or illegal transitions. (SAMPLE = 2).																																
				When this register has reached its maximum value, the accumulation of double/illegal transitions will stop. An overflow event (ACCOF) will be generated if any double or illegal transitions are detected after the maximum value was reached. This field is cleared by triggering the READCLRACC or RDCLRDBL task.																																

8.16.7.38 ACCDBLREAD

Address offset: 0x548

Snapshot of the ACCDBL, updated by the READCLRACC or RDCLRDBL task

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	ACCDBLREAD		[0..15]																															
				Snapshot of the ACCDBL register. This field is updated when the READCLRACC or RDCLRDBL task is triggered.																																

8.17 RADIO — 2.4 GHz radio

The 2.4 GHz radio transceiver is compatible with multiple radio standards such as Bluetooth Low Energy, IEEE 802.15.4, and Nordic's proprietary protocols.

The main features of the RADIO peripheral are the following:

- Multidomain 2.4 GHz radio transceiver, with
  - Bluetooth Low Energy 1 Mbps and 2 Mbps modes
  - Bluetooth Low Energy Long Range (125 kbps and 500 kbps) modes
  - IEEE 802.15.4 250 kbps mode
  - 1 Mbps, 2 Mbps and 4 Mbps Nordic proprietary modes
- Best in class link budget and low power operation
- Efficient data interface with EasyDMA support
- Automatic address filtering and pattern matching
- Automated packet assembler/disassembler
- Automated CRC generator and checker

EasyDMA, in combination with an automated packet assembler, packet disassembler, automated CRC generator and CRC checker, makes it easy to configure and use RADIO. See the following figure for details.

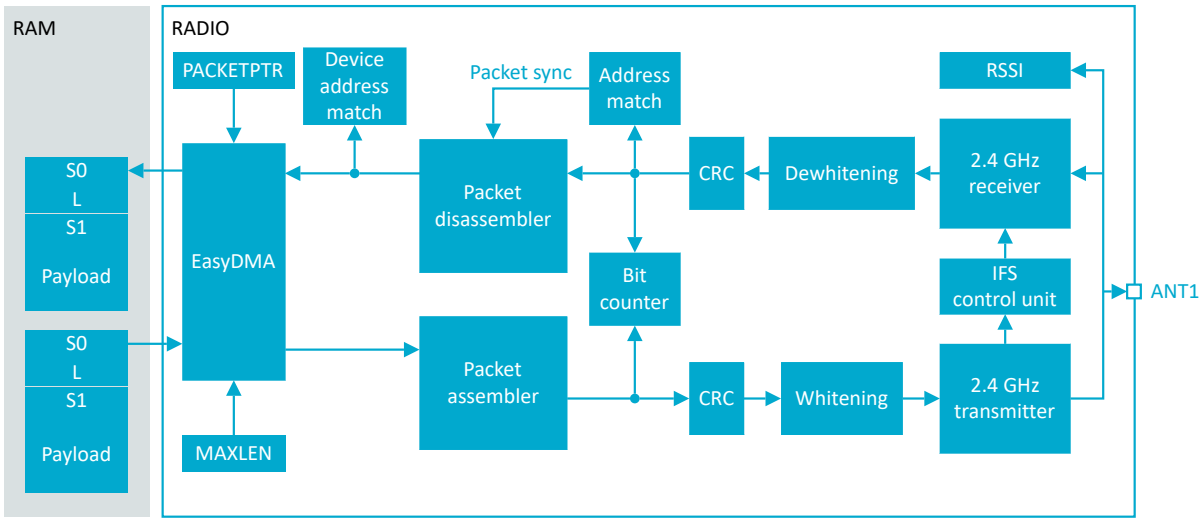


Figure 89: RADIO block diagram

RADIO includes a device address match unit and an interframe spacing control unit that can be utilized to simplify device filtering and interframe spacing respectively in Bluetooth Low Energy and similar applications.

RADIO also includes a received signal strength indicator (RSSI) and a bit counter. The bit counter generates events when a preconfigured number of bits are sent or received by RADIO.

8.17.1 Packet configuration

A RADIO packet contains the fields PREAMBLE, ADDRESS, S0, LENGTH, S1, PAYLOAD, and CRC. For Long Range (125 kbps and 500 kbps) Bluetooth Low Energy modes, fields CI, TERM1, and TERM2 are also included.

The content of a RADIO packet is illustrated in the following figures. RADIO sends the fields in the packet according to the sequence shown in the figures, starting on the left.

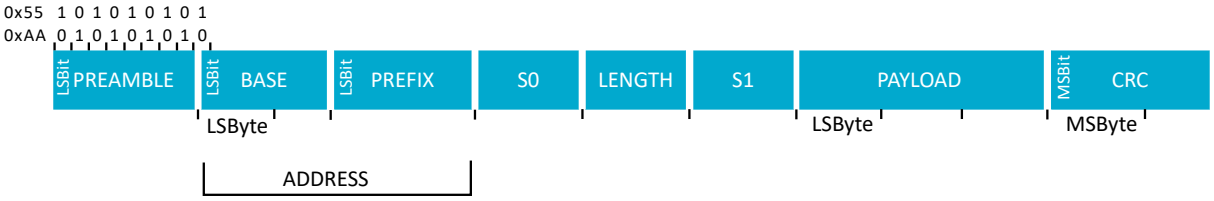


Figure 90: On-air packet layout



Figure 91: On-air packet layout for Long Range (125 kbps and 500 kbps) Bluetooth Low Energy modes

Not shown in the figures is the static payload add-on (the length of which is defined in PCNF1.STATLEN, and which is 0 bytes in a standard BLE packet). The static payload add-on is sent between PAYLOAD and CRC fields. RADIO sends the different fields in the packet in the order they are illustrated above, from left to right.

PREAMBLE is sent with least significant bit first on air. The size of the PREAMBLE depends on the mode selected in the MODE register, and is configured using PCNF0.PLEN.

		Preamble	
MODE	Preamble size (octets)	When first bit of ADDRESS is 0	When first bit of ADDRESS is 1
Ble_1Mbit	1	0xAA	0x55
Nrf_1Mbit	1	0xAA	0x55
Nrf_2Mbit	1	0xAA	0x55
Ble_2Mbit	2	0xAAAA	0x5555
Nrf_4Mbit_0BT4	2	0xAAAA	0x5555
Nrf_4Mbit_0BT6	2	0xAAAA	0x5555
Ble_LR125Kbit	Any	10 repetitions of 0x3C	
Ble_LR500Kbit	Any	10 repetitions of 0x3C	
Ieee802154_250Kbit	Any	4 repetitions of 0x00	

Table 51: Preamble size according to mode

Radio packets are stored in memory inside instances of a RADIO packet data structure as shown in the following figure. The PREAMBLE, ADDRESS, CI, TERM1, TERM2, and CRC fields are omitted in this data structure. Fields S0, LENGTH, and S1 are optional.



Figure 92: Representation of a RADIO packet in RAM

The byte ordering on air is always least significant byte first for the ADDRESS and PAYLOAD fields, and most significant byte first for the CRC field. The ADDRESS fields are always transmitted and received least significant bit first. The CRC field is always transmitted and received most significant bit first. The endianness, meaning the order in which the bits are sent and received, of the S0, LENGTH, S1, and PAYLOAD fields can be configured via PCNF1.ENDIAN.

The sizes of the S0, LENGTH, and S1 fields can be individually configured via S0LEN, LFLEN, and S1LEN in PCNF0, respectively. If any of these fields are configured to be less than 8 bits, the least significant bits of the fields are used.

If S0, LENGTH, or S1 are specified with zero length, their fields will be omitted in memory. Otherwise, each field will be represented as a separate byte, regardless of the number of bits in their on-air counterpart.

Independent of the configuration of PCNF1.MAXLEN, the combined length of S0, LENGTH, S1, and PAYLOAD cannot exceed 258 bytes.

8.17.2 Address configuration

The on-air radio ADDRESS field is composed of two parts, the base address field and the address prefix field.

The size of the base address field is configurable via the PCNF1.BALEN register. The base address is truncated from the least significant byte if PCNF1.BALEN is less than 4. See Definition of logical addresses on page 466.

The on-air addresses are defined in the BASE0/BASE1 registers and PREFIX0/PREFIX1 registers. It is only when writing these registers that the user must relate to the actual on-air addresses. For other

radio address registers, such as the TXADDRESS, RXADDRESSES, and RXMATCH registers, logical radio addresses ranging from 0 to 7 are used. The relationship between the on-air radio addresses and the logical addresses is described in the following table.

Logical address	Base address	Prefix byte
0	BASE0	PREFIX0.AP0
1	BASE1	PREFIX0.AP1
2	BASE1	PREFIX0.AP2
3	BASE1	PREFIX0.AP3
4	BASE1	PREFIX1.AP4
5	BASE1	PREFIX1.AP5
6	BASE1	PREFIX1.AP6
7	BASE1	PREFIX1.AP7

Table 52: Definition of logical addresses

8.17.3 Data whitening

Packet whitening and de-whitening is possible with RADIO and is enabled in PCNF1.WHITEEN. When enabled, whitening and de-whitening will be handled by RADIO automatically as packets are sent and received.

The data whitening is done by means of a configurable linear feedback shift register in a one-to-many topology, as illustrated in the following figure. Bit 0 is used to exclusive OR (XOR) the data packet that is to be whitened or de-whitened. The linear feedback shift register is configured and initialized using the DATAWHITE register. The reset value for the DATAWHITE.POLY field is compatible with Bluetooth Low Energy. The initial vector is configured in DATAWHITE.IV.

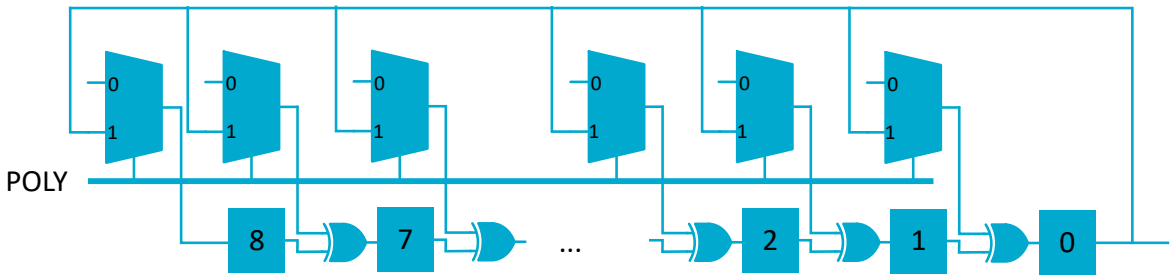


Figure 93: Data whitening and de-whitening

Whitening and de-whitening will be performed over the whole packet except for the preamble and the address fields.

Including the address field in CRC check (CRCCNF.SKIPADDR = Include) is not supported for whitened packets.

8.17.4 CRC

The cyclic redundancy check (CRC) generator in RADIO calculates the CRC over the whole packet excluding the preamble.

The device also supports excluding the address field from the CRC calculation, see the CRCCNF.SKIPADDR register for more information.

The CRC polynomial is configurable as illustrated in the following figure, where bit 0 in the register CRCPOLY corresponds to X^0 and bit n corresponds to X^n. See CRCPOLY on page 545 for more information.

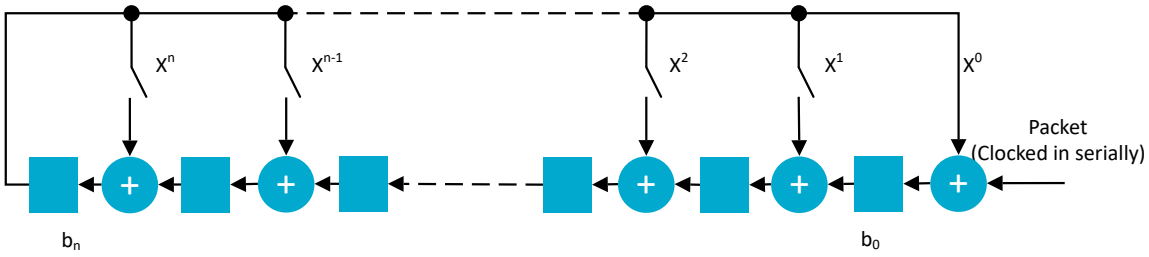


Figure 94: n bit CRC generation

The figure shows that the CRC is calculated by feeding the packet serially through the CRC generator. Before the packet is clocked through the CRC generator, the CRC generator's latches $b_{[0..n]}$ will be initialized with a predefined value specified in the register CRCINIT. After the whole packet has been clocked through the CRC generator, $b_{[0..n]}$ will hold the resulting CRC. This value will be used by RADIO during both transmission and reception. The CPU cannont read latches $b_{[0..n]}$ at any time. However, a received CRC can be read by the CPU via the register RXCRC.

The length (n) of the CRC is configurable, see CRCCNF for more information.

When the entire packet including the CRC has been received, and no errors were detected, RADIO generates the event CRCOK. If CRC errors were detected, the event CRCERROR is generated.

The CRC check status can be read from the register CRCSTATUS after a packet has been received.

8.17.5 Radio states

Tasks and events are used to control the operating state of RADIO when in RX mode or TX mode.

RADIO can enter the states described in the following table.

State	Description
DISABLED	No operations are going on inside RADIO and the power consumption is at a minimum
RXRU	RADIO is ramping up and preparing for reception
RXIDLE	RADIO is ready for reception to start
RX	Reception has been started and the addresses enabled in the RXADDRESSES register are being monitored
RXDISABLE	RADIO is disabling the receiver
SETTLE	RADIO is waiting for the PLL to settle
PLL	The PLL has settled
TXRU	RADIO is ramping up and preparing for transmission
TXIDLE	RADIO is ready for transmission to start
TX	RADIO is transmitting a packet
TXDISABLE	RADIO is disabling the transmitter

Table 53: RADIO state diagram

A simplified state diagram without the optional states SETTLE and PLL is shown in the following figure.

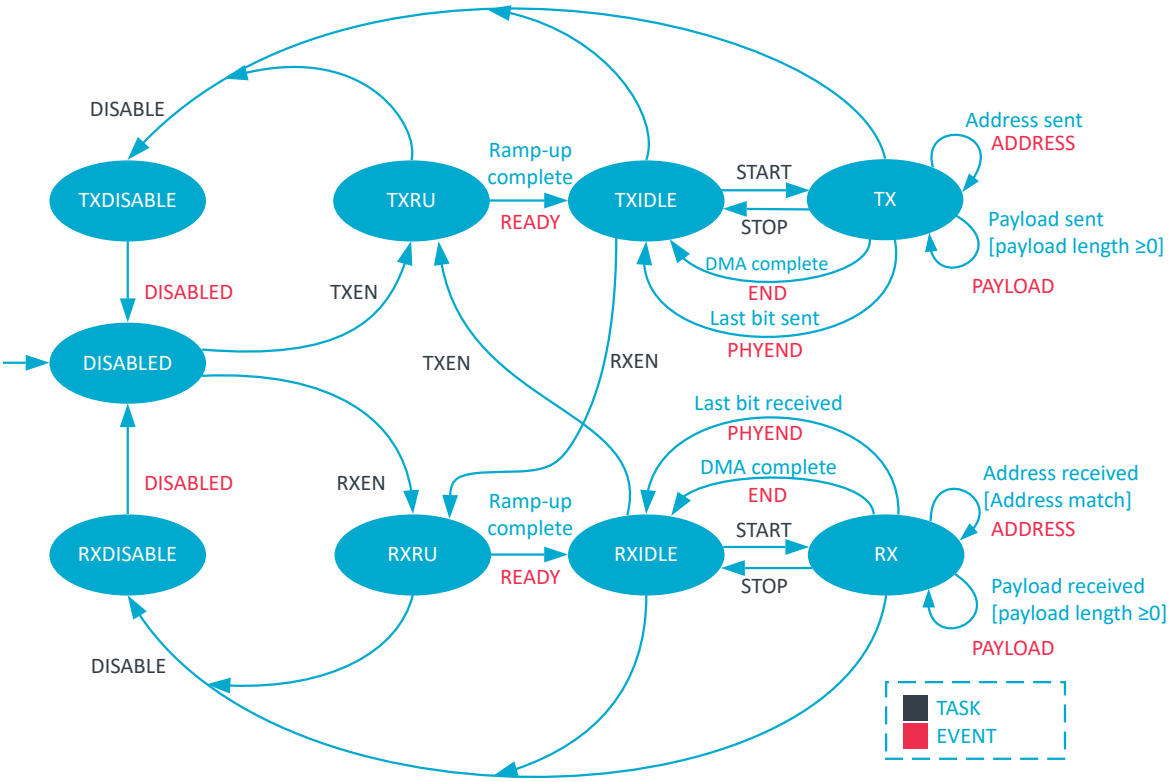


Figure 95: Radio states without PLL

A second state diagram is shown in the following figure. This diagram only contains the specific transitions involving SETTLE and PLL. This way of operating the RADIO enables keeping the PLL on and locked without enabling RX or TX.

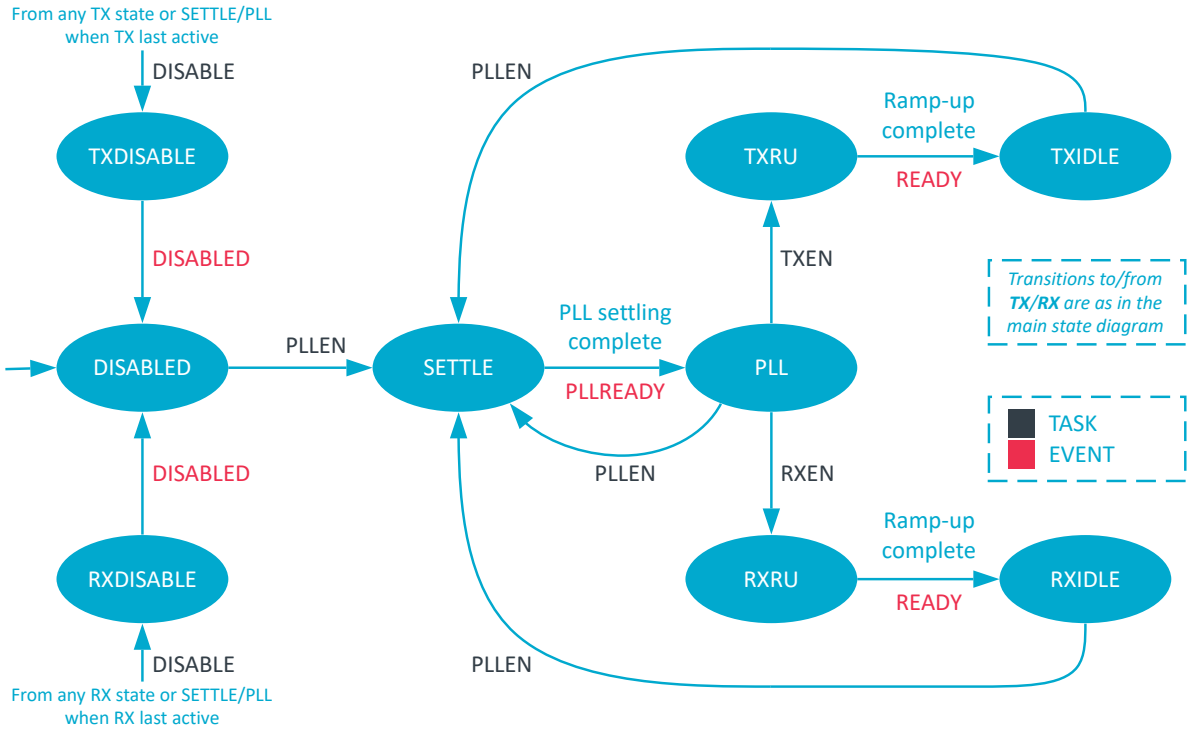


Figure 96: Radio states, PLL only

This figure shows how the tasks and events relate to the RADIO peripheral's operation. RADIO does not prevent a task from being triggered from the wrong state. For example, if the RXEN task is triggered from

the RXDISABLE state, this may lead to unpredictable behavior. The PAYLOAD event is always generated, even if the payload is zero.

The END to START shortcut should not be used with IEEE 802.15.4 250 kbps mode. Use the PHYEND to START shortcut instead.

The END to START shortcut should not be used with Long Range (125 kbps and 500 kbps) Bluetooth Low Energy modes. Use the PHYEND to START shortcut instead.

8.17.6 Transmit sequence

Before RADIO can transmit a packet, it must first ramp-up in TX mode. See TXRU in Radio states without PLL on page 468 and Transmit sequence on page 469. A TXRU ramp-up sequence is initiated when the TXEN task is triggered. After RADIO has successfully ramped up, it will generate the READY event indicating that a packet transmission can be initiated. A packet transmission is initiated by triggering the START task. The START task can first be triggered after RADIO has entered into the TXIDLE state.

The following figure illustrates a single packet transmission where the CPU manually triggers the different tasks needed to control the flow of RADIO, meaning no shortcuts are used. If shortcuts are not used, a certain amount of delay caused by CPU execution is expected between READY and START, and between PHYEND and DISABLE. As illustrated in the following figure, RADIO will by default transmit an unmodulated carrier between READY and START, and between PHYEND and DISABLED.

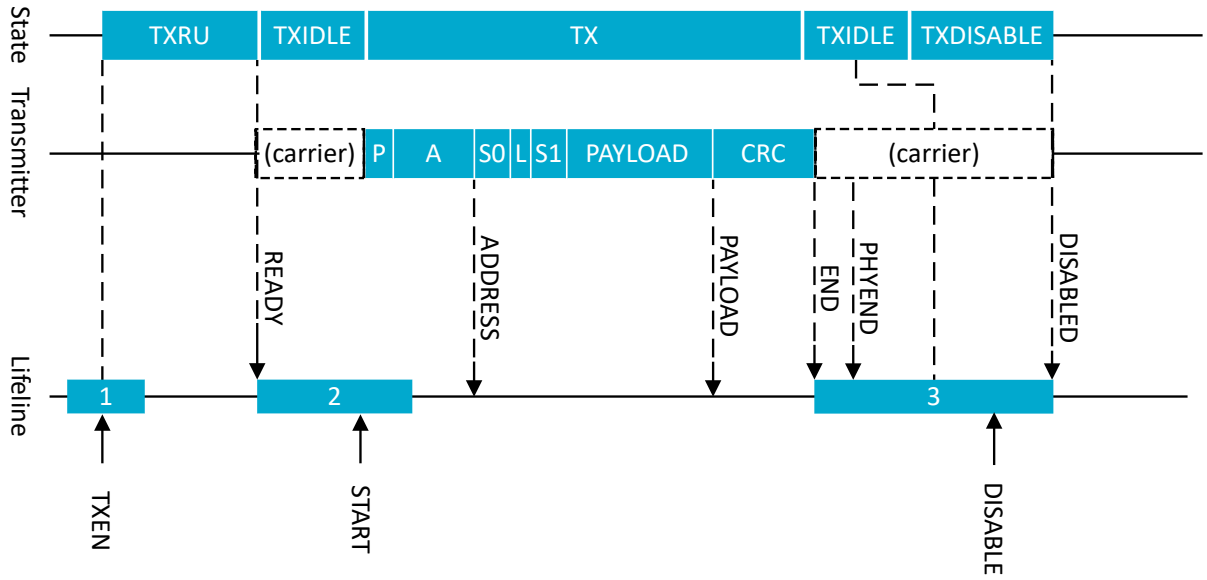


Figure 97: Transmit sequence

The following figure shows a transmit sequence where no delay is introduced. RADIO is configured to use shortcuts between READY and START, and between PHYEND and DISABLE.

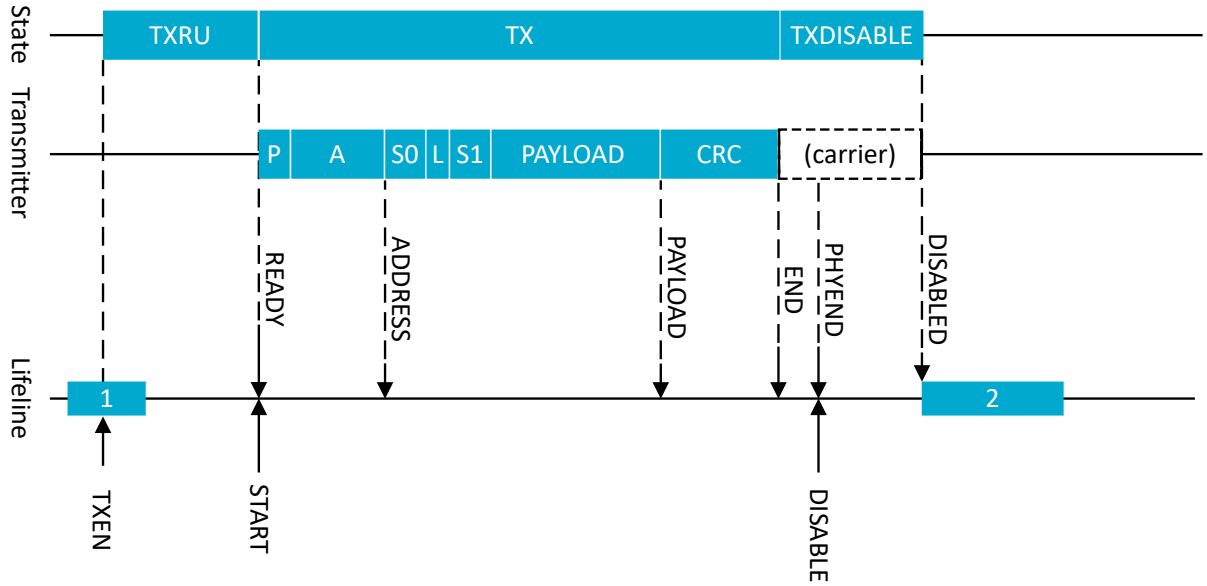


Figure 98: Transmit sequence using shortcuts to avoid delays

RADIO is able to send multiple packets one after the other without having to disable and re-enable RADIO between packets, as illustrated in the following figure.

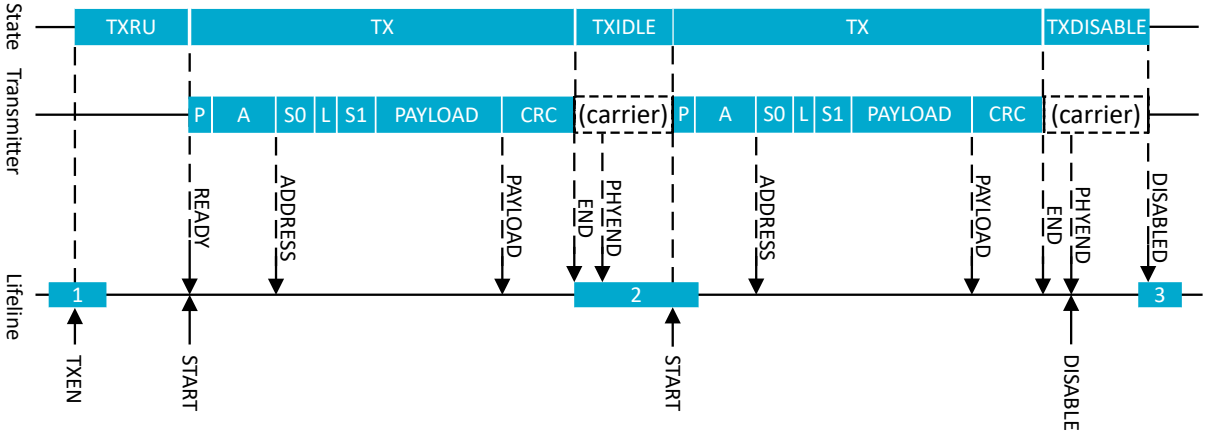


Figure 99: Transmission of multiple packets

8.17.7 Receive sequence

Before RADIO is able to receive a packet, it must first ramp up in RX mode. See RXRU in Radio states without PLL on page 468 and Receive sequence on page 471 for more information.

An RXRU ramp-up sequence is initiated when the RXEN task is triggered. After RADIO has successfully ramped up, it will generate the READY event indicating that a packet reception can be initiated. A packet reception is initiated by triggering the START task. As illustrated in Radio states without PLL on page 468, the START task can first be triggered after RADIO has entered the RXIDLE state.

The following figure shows a single packet reception where the CPU manually triggers the tasks needed to control the flow of RADIO, meaning no shortcuts are used. If shortcuts are not used, a certain amount of delay caused by CPU execution is expected between READY and START, and between PHYEND and DISABLE. RADIO will be listening and possibly receiving undefined data, represented with an **X**, from START and until a packet with valid preamble (P) is received.

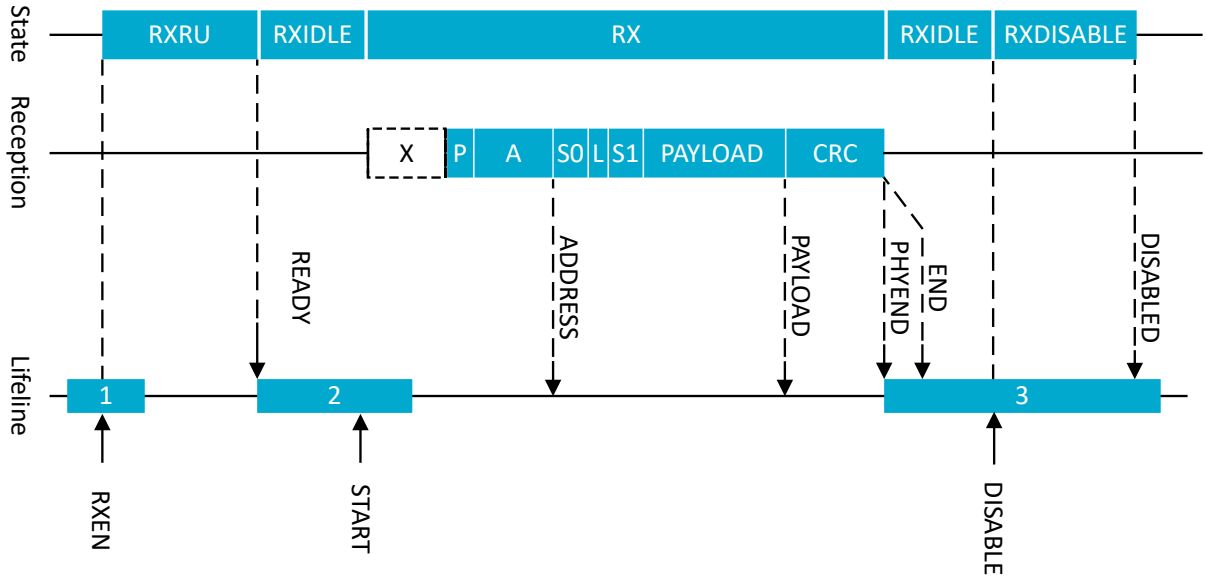


Figure 100: Receive sequence

The following figure shows a receive sequence where no delay is introduced. RADIO is configured to use shortcuts between READY and START, and between PHYEND and DISABLE.

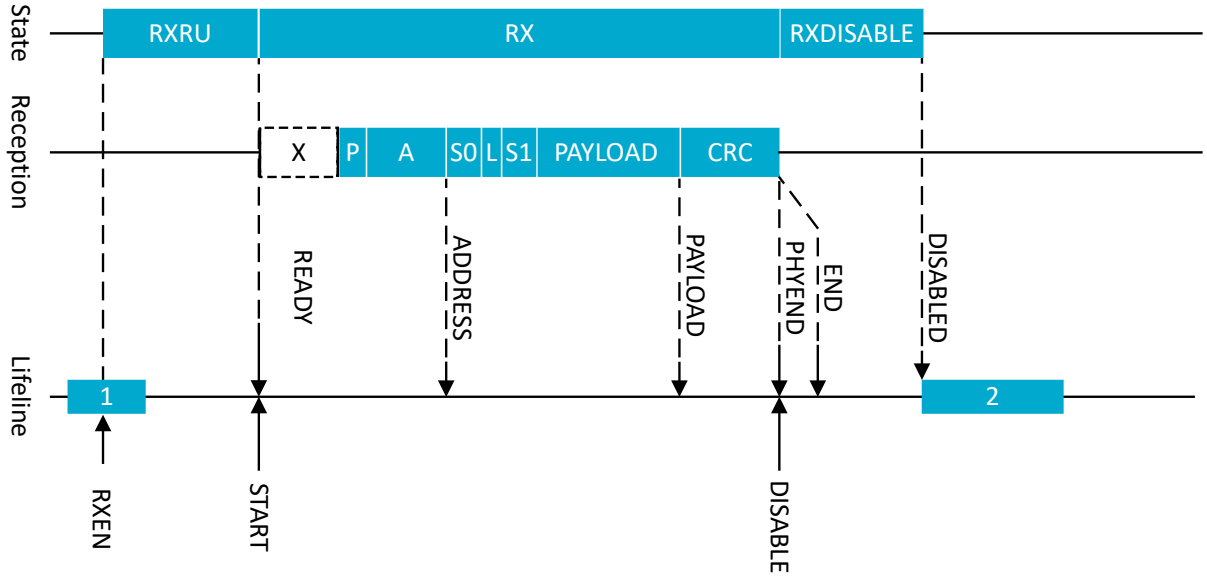


Figure 101: Receive sequence using shortcuts to avoid delays

RADIO can receive consecutive packets without having to disable and re-enable RADIO between packets, as illustrated in the following figure.

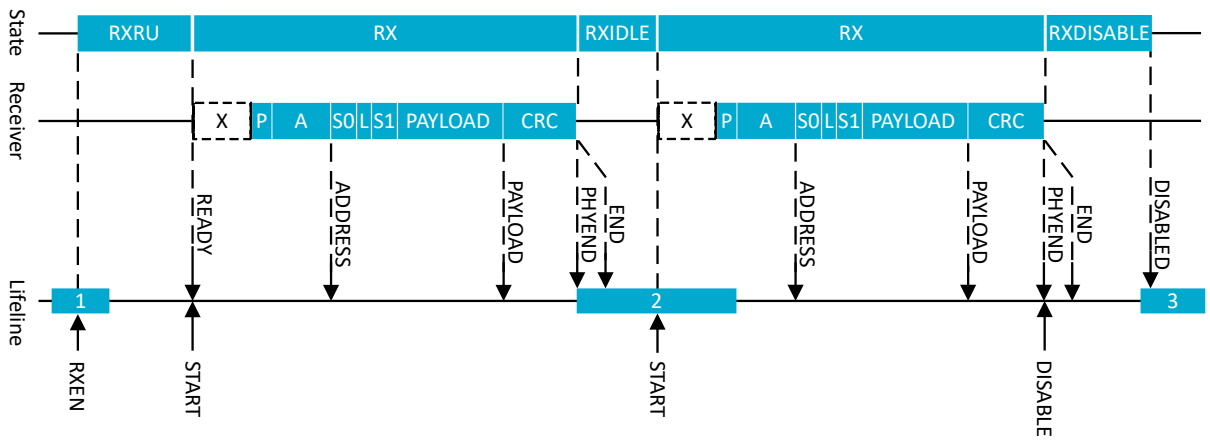


Figure 102: Reception of multiple packets

8.17.8 Received signal strength indicator (RSSI)

RADIO implements a mechanism for measuring the power in the received signal. This feature is called received signal strength indicator (RSSI).

The RSSI is continuously measured and the value filtered using a single-pole IIR filter. After a signal level change, the RSSI will settle after approximately $RSSI_{SETTLE}$.

Sampling the received signal strength is started by using the RSSISTART task. The sample can be read from the RSSISAMPLE register.

The sample period of the RSSI is defined by $RSSI_{PERIOD}$. The RSSISAMPLE will hold the filtered received signal strength after this sample period.

For the RSSI sample to be valid, RADIO has to be enabled in RX mode by triggering the RXEN task and the reception has to be started with the READY event followed by START task.

8.17.9 Interframe spacing (IFS)

Interframe spacing (IFS) is defined as the time in microseconds between two consecutive packets, starting from when the end of the last bit of the previous packet is received, to the beginning of the first bit of the subsequent packet that is transmitted.

RADIO can enforce this interval, as specified in the TIFS register, as long as the TIFS register is not specified to be shorter than the RADIO peripheral's turnaround time (meaning the time needed to switch off the receiver and then switch on the transmitter). The TIFS register can be written any time before the last bit on air is received.

This timing is illustrated in the following figure.

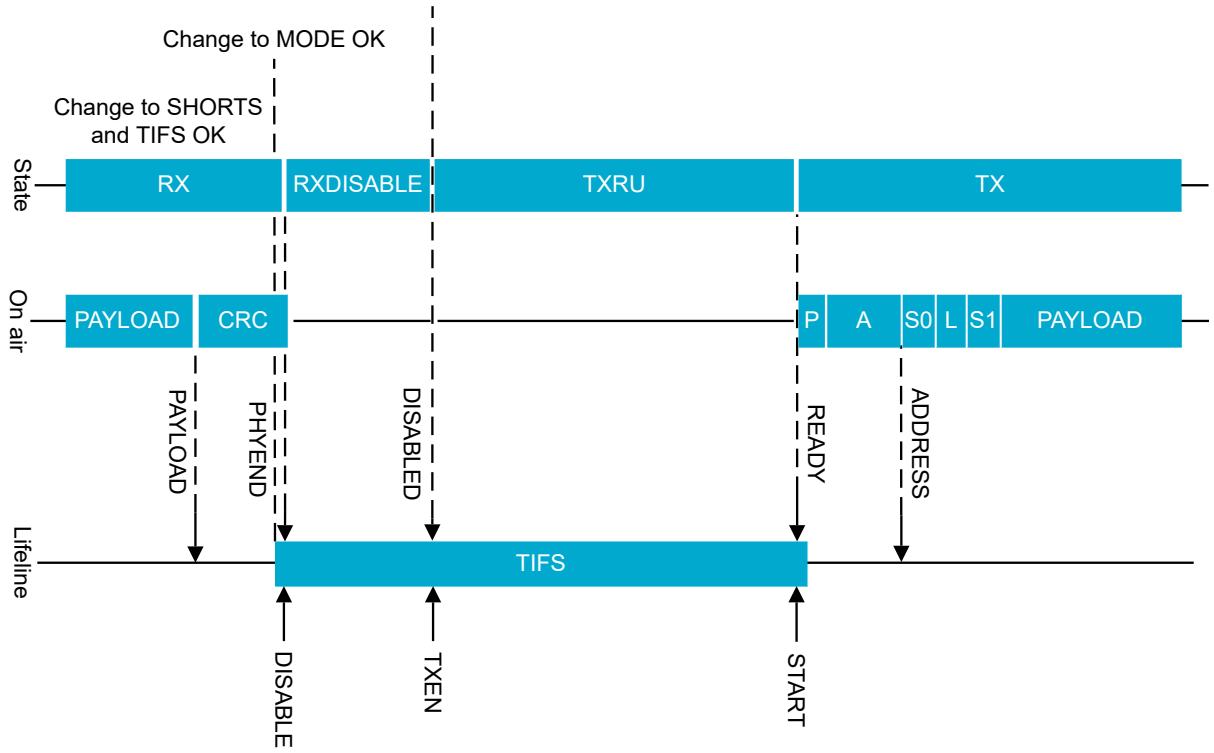


Figure 103: IFS timing detail

The TIFS duration starts after the last bit on air (at the PHYEND event), and elapses with the first bit being transmitted on air (just after READY event).

TIFS is only enforced if the shortcuts PHYEND to DISABLE and DISABLED to TXEN or PHYEND to DISABLE and DISABLED to RXEN are enabled. The short READY to START must also be enabled. In these configurations, TXEN or RXEN is automatically delayed to achieve the configured interframe spacing.

TIFS is qualified for use in IEEE 802.15.4 250kbps mode, Bluetooth Low Energy Long Range (125 kbps and 500 kbps) modes, and Bluetooth Low Energy 1 Mbps and 2 Mbps modes, using the Legacy ramp-up mode.

SHORTS and TIFS registers are not double-buffered and can be updated at any point before the last bit on air is received.

8.17.10 Device address match

The device address match feature is tailored for device filtering in Bluetooth Low Energy and similar implementations.

This feature enables on-the-fly device address matching while receiving a packet over-the-air. This feature only works in RX mode and when RADIO is configured for little endian, see PCNF1.ENDIAN for more information.

The device address match unit assumes that the first 48 bits of the payload are the device address and that bit number 6 in S0 is the TxAdd bit. See the *Bluetooth Core Specification* for more information about device addresses, TxAdd, and the device filtering procedure.

RADIO is able to listen for eight different device addresses at the same time. These addresses are specified in a DAB/DAP register pair, one pair per address, in addition to a TxAdd bit configured in the DACNF register. The DAB register specifies the 32 least significant bits of the device address, while the DAP register specifies the 16 most significant bits of the device address.

Each of the device addresses can be individually included or excluded from the matching mechanism. This is configured in the DACNF register.

8.17.11 Bit counter

RADIO implements a simple counter that can be configured to generate an event after a specific number of bits has been transmitted or received.

By using shortcuts, this counter can be started from different events generated by RADIO and count relative to these events.

The bit counter is started by triggering the BCSTART task, and stopped by triggering the BCSTOP task. A BCMATCH event will be generated when the bit counter has counted the bits specified in register BCC. The bit counter will continue to count bits until the DISABLED event is generated or until the BCSTOP task is triggered. After the BCMATCH event, the CPU can reconfigure the value BCC for new BCMATCH events within the same packet.

The bit counter can only be started after RADIO has received the ADDRESS event.

The bit counter will stop and reset for the tasks BCSTOP, STOP, or DISABLE, or the event END.

The following figure shows how the bit counter can be used to generate the BCMATCH event in the beginning of the packet payload, and again generate a second BCMATCH event after sending 2 bytes (16 bits) of the payload.

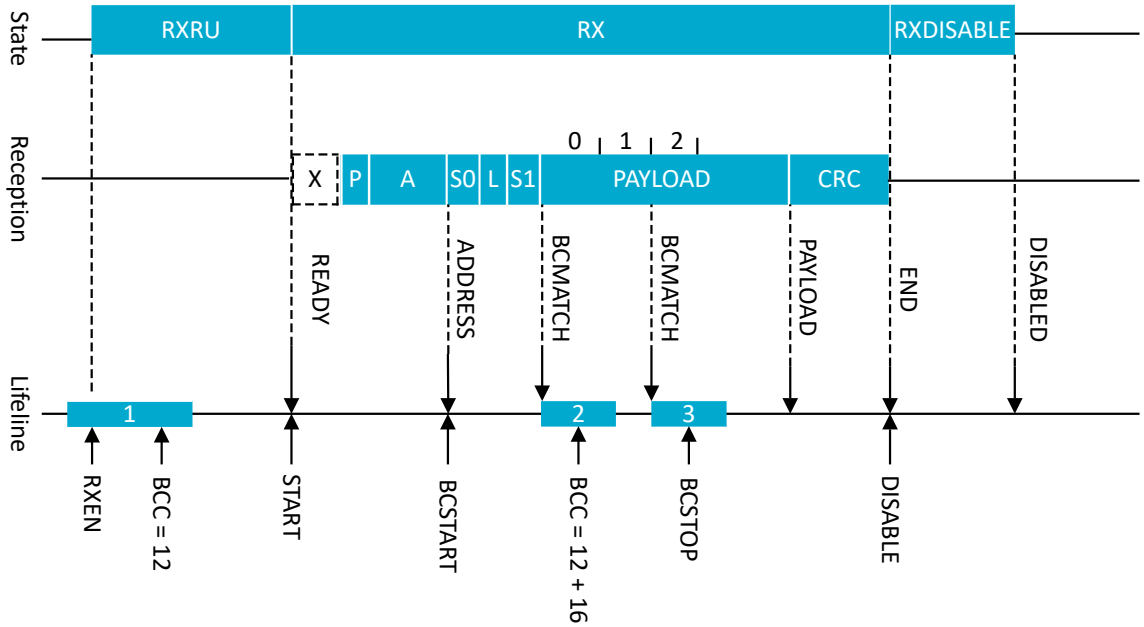


Figure 104: Bit counter example

RXRU assumes that the total combined length of S0, L, and S1 is 12 bits.

8.17.12 IEEE 802.15.4 operation

The IEEE standard 802.15.4 differs from the Nordic proprietary and Bluetooth Low Energy modes. Differences include modulation scheme, channel structure, packet structure, security, and medium access control.

The following are the main features of the IEEE 802.15.4 mode:

- Ultra-low power 250 kbps, 2450 MHz, IEEE 802.15.4-2020 compliant link
- Clear channel assessment (CCA)
- Energy detection (ED) scan
- CRC generation

To enable RADIO to comply with the IEEE 802.15.4-2020 standard, set MODE = Ieee802154_250kbit.

8.17.12.1 Packet structure

IEEE 802.15.4 defines an on-the-air frame/packet that is different from what is used in Bluetooth Low Energy.

The following figure provides an overview of the physical frame structure and its timing.

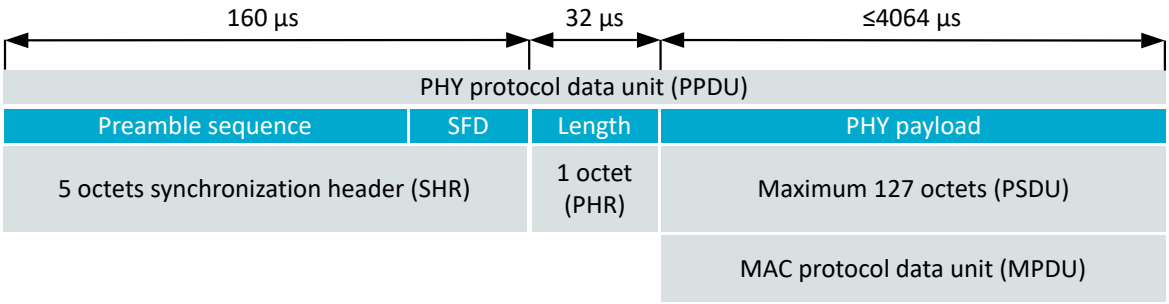


Figure 105: IEEE 802.15.4 frame format (PPDU)

The standard uses the term octet for an 8-bit storage unit within the PPDU. For timing, the value `symbol` is used, and it has a duration of 16 µs.

The total usable payload (PSDU) is 127 octets, but when CRC is in use, this is reduced to 125 octets of usable payload.

The preamble sequence consists of four octets that are all `0` and are used for synchronizing the RADIO peripheral's receiver. Following the preamble is the single octet start of frame delimiter (SFD), with a fixed value of `0xA7`. An alternate SFD can be programmed through the SFD register, providing an initial level of frame filtering when non-standard compliance is chosen. It is a valuable feature when operating in a congested or private network. The preamble sequence and the SFD are generated by RADIO and are not programmed by the user into the frame buffer.

Following the five octet synchronization header (SHR) is the single octet PHY header (PHR). The least significant seven bits of PHR denote the frame length of the following PSDU. The most significant bit is reserved and is set to `0` for frames that are standard compliant. RADIO reports all eight bits which can be used to carry additional information. The PHR is the first byte written to the frame data memory pointed to by PACKETPTR. Frames with zero length are discarded, and the FRAMESTART event is not generated in this case.

The next N octets carry the data of the PHY packet, where N equals the value of the PHR. For an implementation also using the IEEE 802.15.4 medium access control (MAC) layer, the PHY data is a MAC frame of N-2 octets, because two octets occupy a CRC field.

An IEEE 802.15.4 MAC layer frame consists of the following:

- A header, which is composed of the following:
  - The frame control field (FCF)
  - The sequence number
  - Addressing fields
- A payload
- The 16-bit frame control sequence (FCS)

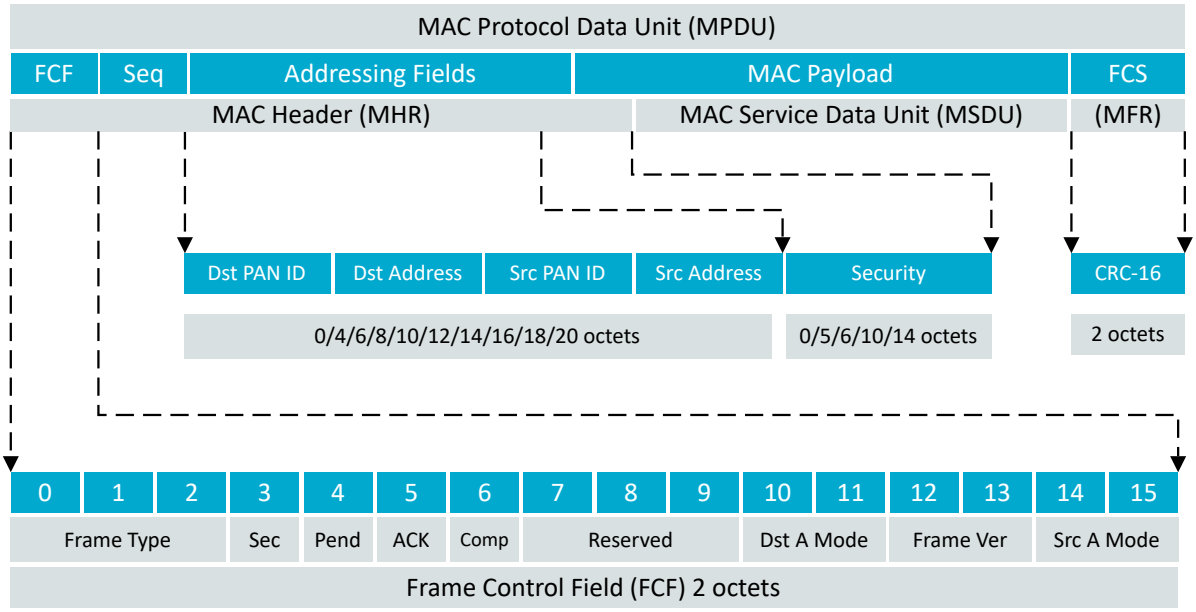


Figure 106: IEEE 802.15.4 frame format (MPDU)

The two FCF octets contain information about the frame type, addressing, and other control flags. This field is decoded when using the assisted operating modes offered by RADIO.

The sequence number is a single octet in size and is unique for a frame. It is used in the associated acknowledgement frame sent upon successful frame reception.

The addressing field can be zero (acknowledgement frame) or up to 20 octets in size. The field is used to direct packets to the correct recipient and denote its origin. IEEE 802.15.4 bases its addressing on networks being organized in PANs with 16-bit identifier and nodes having a 16-bit or 64-bit address. In the assisted receive mode, these parameters are analyzed for address matching and acknowledgement.

The MAC payload carries the data of the next higher layer, or in the case of a MAC command frame, information used by the MAC layer itself.

The two last octets contain the 16-bit ITU-T CRC. The FCS is calculated over the MAC header (MHR) and MAC payload (MSDU) parts of the frame. This field is calculated automatically when sending a frame, or indicated in the CRCSTATUS register when a frame is received. If configured, this feature is maintained autonomously by the CRC module.

8.17.12.2 Operating frequencies

IEEE 802.15.4 defines 16 channels in the 2450 MHz frequency band. The channels are numbered from 11 to 26, each with a width of 5 MHz.

To choose the correct channel center frequency, the FREQUENCY register must be programmed according to the following table.

IEEE 802.15.4 channel	Center frequency (MHz)	FREQUENCY setting
Channel 11	2405	5
Channel 12	2410	10
Channel 13	2415	15
Channel 14	2420	20
Channel 15	2425	25
Channel 16	2430	30
Channel 17	2435	35
Channel 18	2440	40
Channel 19	2445	45
Channel 20	2450	50
Channel 21	2455	55
Channel 22	2460	60
Channel 23	2465	65
Channel 24	2470	70
Channel 25	2475	75
Channel 26	2480	80

Table 54: IEEE 802.15.4 center frequency definition

8.17.12.3 Energy detection (ED)

In order to determine the presence of activity, IEEE 802.15.4 requires that the received signal power within the channel bandwidth can be sampled.

To prevent the channel signal from being decoded, the shortcut between the READY event and the START task should be disabled before putting RADIO in RX mode. The energy detection (ED) measurement time, where RSSI samples are averaged, is 8 symbol periods, corresponding to 128 µs. The standard further specifies the measurement to be a number between 0 and 255, where 0 indicates received power less than 10 dB above the selected receiver sensitivity. The power range of the ED values must be at least a 40 dB linear mapping with accuracy of ±6 dB. See section *6.9.7 Receiver ED* in IEEE 802.15.4 for further details.

The following example shows how to perform a single energy detection measurement and convert to IEEE 802.15.4 scale.

IEEE 802.15.4 ED measurement example

```
#define ED_RSSISCALE 4 // From electrical specifications
uint8_t sample_ed(void)
{
    int val;
    NRF_RADIO->TASKS_EDSTART = 1; // Start
    while (NRF_RADIO->EVENTS_EDEND != 1) {
        // CPU can sleep here or do something else
        // Use of interrupts are encouraged
        }
    val = NRF_RADIO->EDSAMPLE * ED_RSSISCALE; // Read level
    return (uint8_t)(val>255 ? 255 : val);    // Convert to IEEE 802.15.4 scale
}
```

For scaling between hardware value and dBm, see Clear channel assessment (CCA) on page 478.

The `mlme-scan.req`primitive of the MAC layer uses the ED measurement to detect channels where there might be wireless activity. To assist this primitive, a tailored mode of operation is available where the ED measurement runs for a defined number of iterations keeping track of the maximum ED level. This is engaged by writing the EDCNT field of the EDCTRL register to a value different from `0`, where it will run the specified number of iterations and report the maximum energy measurement in the EDSAMPLE register. The scan is started with the EDSTART task and the end indicated with the EDEND event. This significantly reduces the interrupt frequency and therefore power consumption. The following figure shows how the ED measurement will operate depending on the EDCNT and EDPERIOD fields of the EDCTRL register.

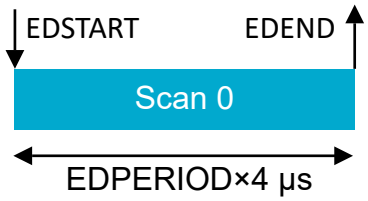


Figure 107: Energy detection measurement for a single iteration (EDCNT = 0)

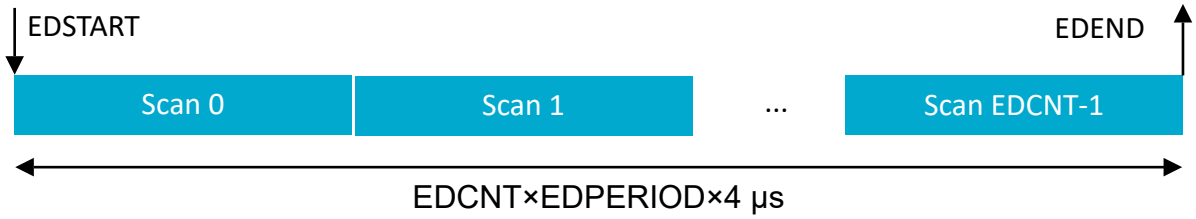


Figure 108: Energy detection measurement example with multiple iterations

The scan is stopped by writing the EDSTOP task. It is followed by the EDSTOPPED event when the module has terminated.

8.17.12.4 Clear channel assessment (CCA)

IEEE 802.15.4 implements a listen-before-talk channel access method to avoid collisions when transmitting. This is known as carrier sense multiple access with collision avoidance (CSMA-CA). The key part of this method is measuring if the wireless medium is busy or not.

The following clear channel assessment modes are supported:

- CCA Mode 1 (energy above threshold) – The medium is reported busy upon detecting any energy above the ED threshold.

- CCA Mode 2 (carrier sense only) – The medium is reported busy upon detection of a signal compliant with IEEE 802.15.4 with the same modulation and spreading characteristics.
- CCA Mode 3 (carrier sense with energy above threshold) – The medium is reported busy using a logical combination (AND/OR) between the results from CCA Mode 1 and CCA Mode 2.

The clear channel assessment should survey a period equal to 8 symbols or 128 µs.

RADIO must be in RX mode and be able to receive correct packets when performing the CCA. The shortcut between READY and START must be disabled if baseband processing is not to be performed while the measurement is running.

Register EDSAMPLE on page 531 is updated at the end of the clear channel assessment and can be used to read the energy level measured during the procedure. For CCACTRL.CCAMODE = EdModeEdModeTest1, EDSAMPLE holds the first ED measurement. For the other CCA modes, EDSAMPLE holds the average ED value.

CCA Mode 1

CCA Mode 1 is enabled by first configuring the field CCACTRL.CCAMODE = EdMode and writing the CCACTRL.CCAEDTHRES field to a chosen value. Once the CCASTART task is written, RADIO will perform an ED measurement for 8 symbols and compare the measured level with that found in the CCACTRL.CCAEDTHRES field. If the measured value is higher than or equal to this threshold, the CCABUSY event is generated. If the measured level is less than the threshold, the CCAIDLE event is generated.

CCA Mode 2

CCA Mode 2 is enabled by configuring the field CCACTRL.CCAMODE = CarrierMode. RADIO will sample to see if a valid SFD is found during the 8 symbols. If a valid SFD is detected, the CCABUSY event is generated and the device should not send any data. The CCABUSY event is also generated if the scan was performed during an ongoing frame reception. If the measurement period completes with no SFD detection, the CCAIDLE event is generated. When CCACTRL.CCACORRCNT is not zero, the algorithm will look at the correlator output in addition to the SFD detection signal. If an SFD is reported during the scan period, it will terminate immediately indicating busy medium. Similarly, if the number of peaks above CCACTRL.CCACORRTHRES crosses the CCACTRL.CCACORRCNT, the CCACTRL.CCABUSY event is generated. If less than CCACORRCOUNT crossings are found and no SFD is reported, the CCAIDLE event will be generated and the device can send data.

CCA Mode 3

CCA Mode 3 is enabled by configuring CCACTRL.CCAMODE = CarrierAndEdMode or CCACTRL.CCAMODE = CarrierOrEdMode and performing the required logical combination of the result from CCA Mode 1 and CCA Mode 2. The CCABUSY or CCAIDLE events are generated by ANDing or ORing the energy above threshold and carrier detection scans.

Shortcuts

An ongoing CCA can be stopped by issuing the CCASTOP task. This will trigger the associated CCASTOPPED event.

For CCA mode automation, the following shortcuts are available:

- To automatically switch between RX mode (when performing the CCA) and to TX mode where the packet is sent, the shortcut between CCAIDLE and TXEN, in conjunction with the short between CCAIDLE and STOP, must be used.
- To automatically disable RADIO whenever the CCA reports a busy medium, the shortcut between CCABUSY and DISABLE can be used.

- To immediately start a CCA after ramping up into RX mode, the shortcut between RXREADY and CCASTART can be used.

Conversion

The conversion from a CCAEDTHRES, LQI, or EDSAMPLE value to dBm can be done with the following equation, where $VAL_{HARDWARE}$ is either CCAEDTHRES, LQI, or EDSAMPLE. LQI and EDSAMPLE are hardware-reported values, while CCAEDTHRES is set by software. Constants ED_RSSISCALE and ED_RSSIOFFS are from the electrical specifications.

$$P_{RF}[dBm] = ED\_RSSIOFFS + VAL_{HARDWARE}$$

The ED_RSSISCALE constant is used to calculate power in 802.15.4 units (0-255), using the following formula:

$$P_{RF}[802.15.4\ units] = MIN(\ ED\_RSSISCALE \times VAL_{HARDWARE},\ 255\ )$$

8.17.12.5 Cyclic redundancy check (CRC)

IEEE 802.15.4 uses a 16-bit ITU-T cyclic redundancy check (CRC) calculated over the MAC header (MHR) and MAC service data unit (MSDU).

The standard defines the following generator polynomial:

$G(x) = x^{16} + x^{12} + x^5 + 1$

In RX mode, RADIO will trigger the CRC module when the first octet after the frame length (PHR) is received. The CRC will then update on each consecutive octet received. When a complete frame is received, the CRCSTATUS register will be updated accordingly and the CRCOK or CRCERROR events will be generated. When the CRC module is enabled, it will not write the two last octets (CRC) to the frame RAM. When transmitting, the CRC will be computed on the fly, starting with the first octet after PHR, and inserted as the two last octets in the frame. The EasyDMA will fetch the frame length minus 2 octets from RAM and insert the CRC octets at their correct positions in the frame.

The following code shows how to configure the CRC module for correct operation when in IEEE 802.15.4 mode. The CRCCNF is written to 16-bit CRC and the CRCPOLY is written to `0x11021`. The start value used by IEEE 802.15.4 is `0` and CRCINIT is configured to reflect this.

```
/* 16-bit CRC with ITU-T polynomial with 0 as start condition*/
NRF_RADIO->CRCCNF = ((RADIO_CRCCNF_SKIPADDR_Ieee802154 << RADIO_CRCCNF_SKIPADDR_Pos) |
                     (RADIO_CRCCNF_LEN_Two << RADIO_CRCCNF_LEN_Pos));
NRF_RADIO->CRCPOLY = 0x11021;
NRF_RADIO->CRCINIT = 0;
```

The ENDIANESS subregister must be set to little-endian since the FCS field is transmitted from the left bit to the right bit.

8.17.12.6 Transmit sequence

The transmission is started by first putting RADIO in RX mode and triggering the RXEN task .

An outline of the IEEE 802.15.4 transmission is illustrated in the following figure.

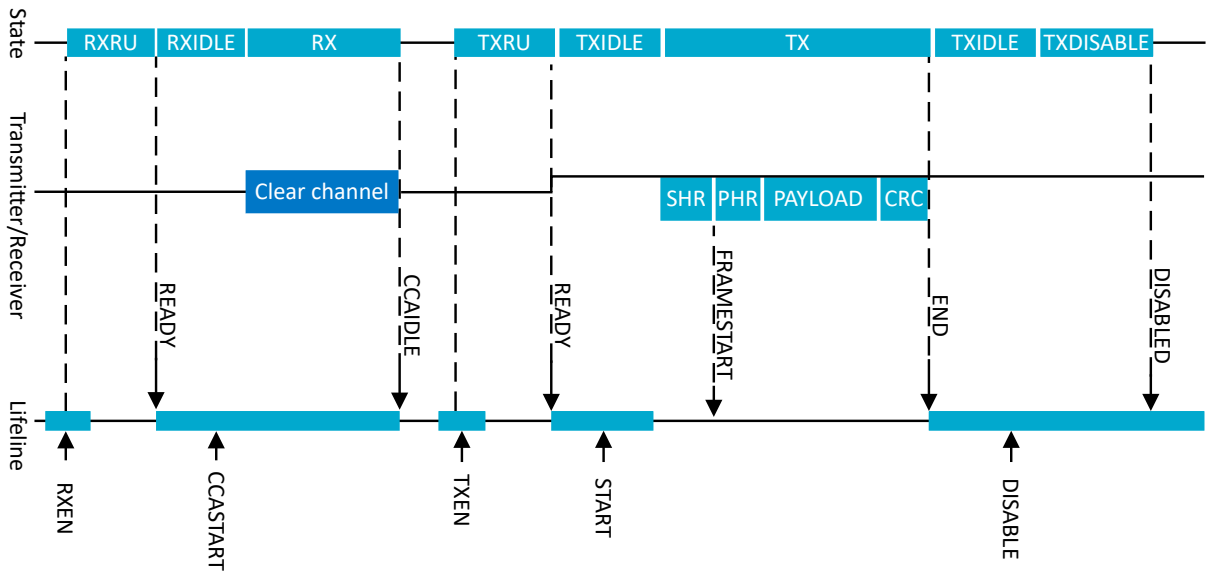


Figure 109: IEEE 802.15.4 transmit sequence

The receiver will ramp up and enter the RXIDLE state where the READY event is generated. Upon receiving the READY event, the CCA is started by triggering the CCASTART task. The chosen mode of assessment (register CCACTRL.CCAMODE) will be performed and signal the CCAIDLE event or CCABUSY event 128 µs later. If the event CCABUSY is received, RADIO will have to retry the CCA after a specific back-off period. This is outlined in the *IEEE 802.15.4 standard, Figure 69 in section 7.5.1.4 The CSMA-CA algorithm*.

If the event CCAIDLE is generated, a write to the task register TXEN enters RADIO in TXRU state. The READY event will be generated when RADIO is in the TXIDLE state and ready to transmit. With the PACKETPTR pointing to the length (PHR) field of the frame, the START task can be written. RADIO will send the four octet preamble sequence followed by the start of frame delimiter (register SFD). The first byte read from RAM is the length field (PHR) followed by the transmission of the number of bytes indicated as the frame length. If the CRC module is configured, it will run for PHR-2 octets. The last two octets will be substituted with the results from running the CRC. The necessary CRC parameters are sampled on the START task. The FCS field of the frame is little endian.

In addition to the available shortcuts, one is provided between the READY event and the CCASTART task so that a CCA can automatically start when the receiver is ready. A second shortcut has been added between the CCAIDLE event and the TXEN task, when a clear channel is detected, RADIO can immediately enter TX mode.

8.17.12.7 Receive sequence

RADIO must be in RX mode before the receive sequence can begin. After writing to the RXEN task, RADIO will start ramping up and enter the RXRU state.

When the READY event is generated, RADIO enters the RXIDLE mode. For the baseband processing to be enabled, the START task must be written. An outline of the IEEE 802.15.4 receive sequence can be found in the following figure.

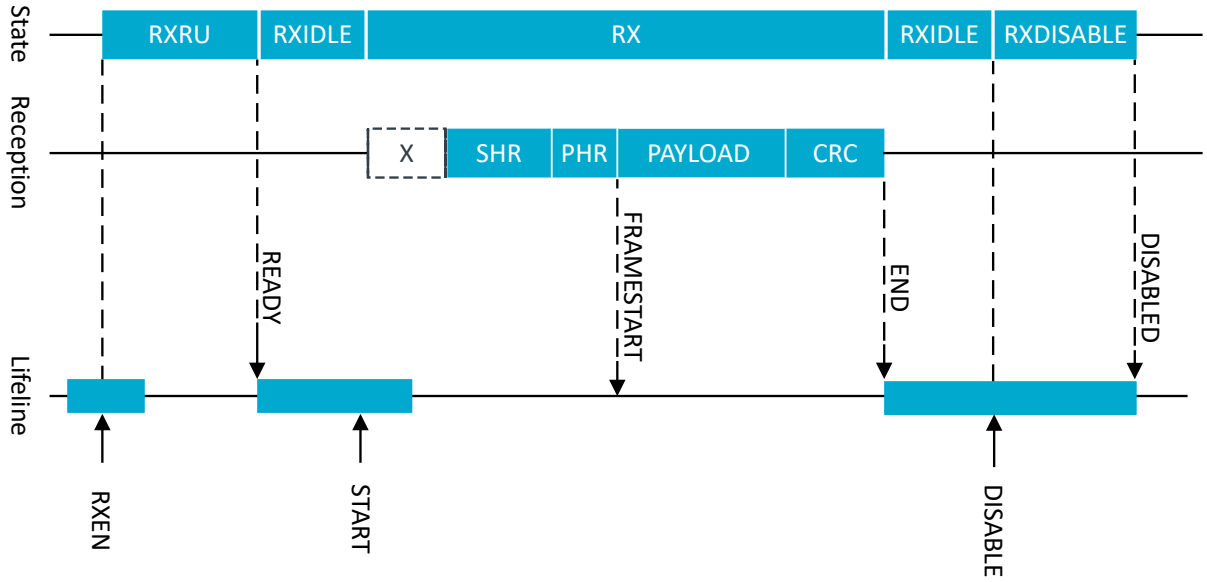


Figure 110: IEEE 802.15.4 receive sequence

When a valid SHR is received, RADIO will start storing future octets (starting with PHR) to the data memory pointed to by PACKETPTR. After the SFD octet is received, the FRAMESTART event is generated. If the CRC module is enabled, it will start updating with the second byte received (first byte in payload) and run for the full frame length. The two last bytes in the frame are not written to RAM when CRC is configured. However, if the result of the CRC is zero after running the full frame, the CRCOK event will be generated. The END event is generated when the last octet has been received and is available in data memory.

When a packet is received, a link quality indicator (LQI) is generated and appended immediately after the last received octet. When using an IEEE 802.15.4 compliant frame, this will be just after the MSDU since the FCS is not reported. In the case of a non-compliant frame, it will be appended after the full frame. The LQI reported by the hardware must be converted to the IEEE 802.15.4 range by an 8-bit saturating multiplication of 4, as shown in IEEE 802.15.4 ED measurement example on page 478. The LQI is only valid for frames equal to, or longer than, three octets. When receiving a frame, the RSSI (reported as negative dB) will be measured at three points during the reception. These three values will be sorted with the middle value selected (median 3) to be remapped within the LQI range. The following figure illustrates the LQI measurement and how the data is arranged in data memory.

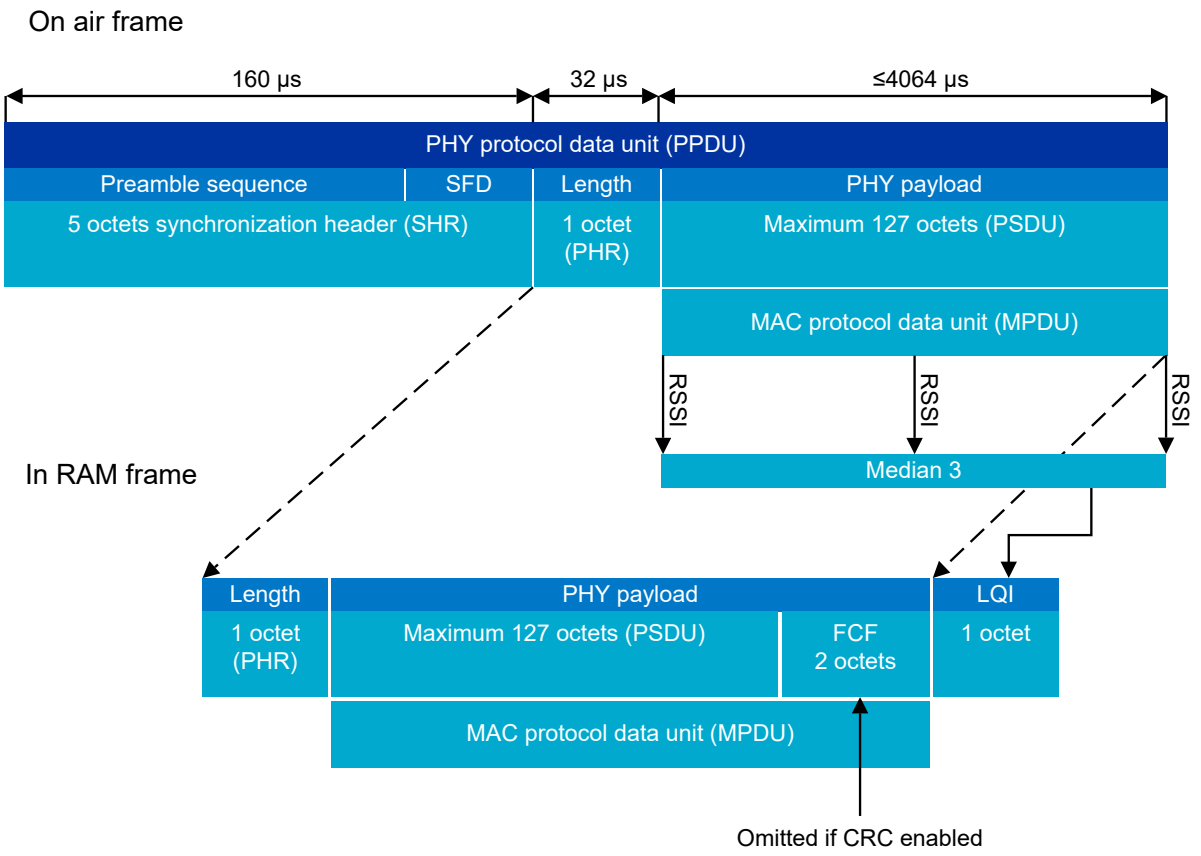


Figure 111: IEEE 802.15.4 frame in data memory

A shortcut has been added between the FRAMESTART event and the BCSTART task. This can be used to trigger a BCMATCH event after N bits, such as when inspecting the MAC addressing fields.

8.17.12.8 Interframe spacing (IFS)

IEEE 802.15.4 defines a specific time that is allotted for the MAC sublayer to process received data. The interframe spacing (IFS) is used to prevent two frames from being transmitted too close together. If the transmission is requesting an acknowledgement, the space before the second frame must be at least one IFS period.

IFS is determined to be one of the following:

- IFS = macMinSIFSPeriod (12 symbols) if MPDU ≤ aMaxSIFSFrameSize (18 octets) octets
- IFS = macMinLIFSPeriod (40 symbols) if MPDU > aMaxSIFSFrameSize

Using the efficient assisted modes in RADIO, the TIFS will be programmed with the correct value based on the frame being transmitted. If the assisted modes are not in use, the TIFS register must be updated manually. The following figure shows what IFS period is valid in both acknowledged and unacknowledged transmissions.

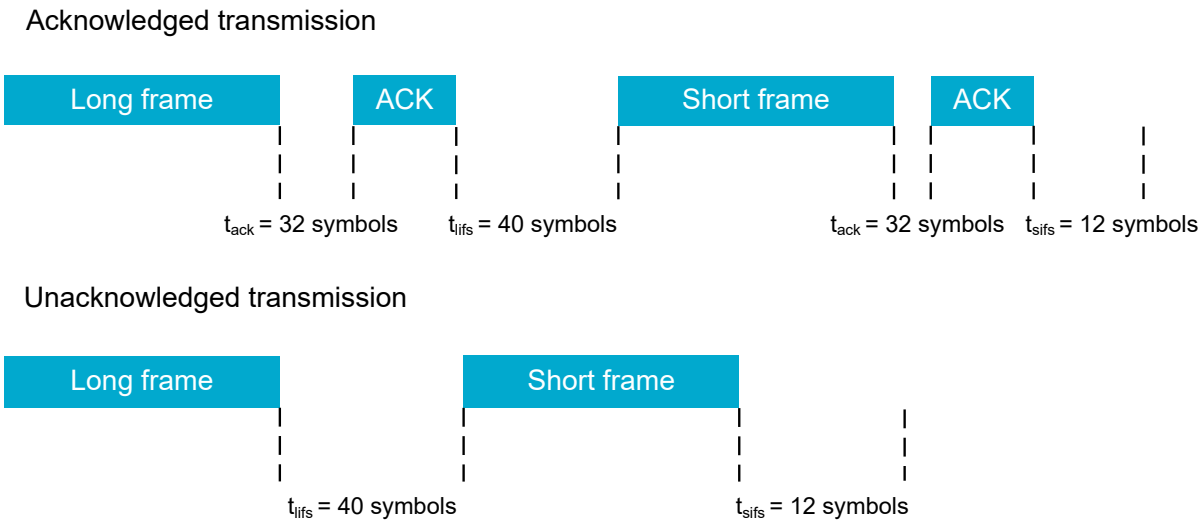


Figure 112: Interframe spacing examples

8.17.13 EasyDMA

RADIO uses EasyDMA to read and write packets to RAM without CPU involvement.

As illustrated in RADIO block diagram on page 464, the RADIO peripheral's EasyDMA utilizes the same PACKETPTR for receiving and transmitting packets. This pointer should be reconfigured by the CPU each time before RADIO is started by the START task. The PACKETPTR register is double-buffered, meaning that it can be updated and prepared for the next transmission.

The END event indicates that the last bit has been processed by RADIO. The DISABLED event is issued to acknowledge that the DISABLE task is done.

The structure of a packet is described in detail in Packet configuration on page 464. The data that is stored in Data RAM and transported by EasyDMA consists of the following fields:

- S0
- LENGTH
- S1
- PAYLOAD

In addition, a static add-on is sent immediately after the payload.

The size of each of the listed fields in the frame is configurable (see Packet configuration on page 464), and the space occupied in RAM depends on these settings. The size of the field can be zero, as long as the resulting frame complies with the chosen RF protocol.

All fields are extended in size to align with a byte boundary in RAM. For instance, a 3-bit long field on-air will occupy 1 byte in RAM while a 9-bit long field will be extended to 2 bytes.

The packet's elements can be configured as follows:

- CI, TERM1, and TERM2 fields are only present in Bluetooth Low Energy Long Range mode
- S0 is configured through the field PCNF0.S0LEN
- LENGTH is configured through the field PCNF0.LFLEN
- S1 is configured through the field PCNF0.S1LEN
- Payload size is configured through the value in RAM corresponding to the LENGTH field
- Static add-on size is configured through the field PCNF1.STATLEN

The PCNF1.MAXLEN field configures the maximum packet payload plus add-on size in number of bytes that can be transmitted or received by RADIO. This feature can be used to ensure that RADIO does not overwrite or read beyond the RAM assigned to the packet payload. This means that if the LENGTH

field of the packet payload exceeds PCNF1.STATLEN, and the LENGTH field in the packet specifies a packet larger than configured in PCNF1.MAXLEN, the payload will be truncated to the length specified in PCNF1.MAXLEN.

> **Note:** The PCNF1.MAXLEN field includes the payload and the add-on, but excludes the size occupied by the S0, LENGTH, and S1 fields. This has to be taken into account when allocating RAM.

If the payload and add-on length is specified larger than PCNF1.MAXLEN, RADIO will transmit or receive in the same way as before, except the payload is now truncated to PCNF1.MAXLEN. The packet's LENGTH field will not be altered when the payload is truncated. RADIO will calculate CRC as if the packet length is equal to PCNF1.MAXLEN.

> **Note:** If PACKETPTR is not pointing to the RAM region, an EasyDMA transfer may result in a HardFault or RAM corruption. See Memory on page 13 for more information about the different memory regions.

The END event indicates that the last bit has been processed by RADIO. The DISABLED event is issued to acknowledge that the DISABLE task is done.

8.17.14 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
RADIO : S RADIO : NS	GLOBAL	0x5008A000 0x4008A000	US	S	SA	No	2.4 GHz radio RADIO See pinout for GPIO options for DFE antenna switch control

Configuration

Instance	Domain	Configuration
RADIO : S RADIO : NS	GLOBAL	For the PSEL registers, use only dedicated pins on port P1

Register overview

Register	Offset	TZ	Description
TASKS_TXEN	0x000		Enable RADIO in TX mode
TASKS_RXEN	0x004		Enable RADIO in RX mode
TASKS_START	0x008		Start RADIO
TASKS_STOP	0x00C		Stop RADIO
TASKS_DISABLE	0x010		Disable RADIO
TASKS_RSSISTART	0x014		Start the RSSI and take one single sample of the receive signal strength
TASKS_BCSTART	0x018		Start the bit counter
TASKS_BCSTOP	0x01C		Stop the bit counter
TASKS_EDSTART	0x020		Start the energy detect measurement used in IEEE 802.15.4 mode
TASKS_EDSTOP	0x024		Stop the energy detect measurement
TASKS_CCASTART	0x028		Start the clear channel assessment used in IEEE 802.15.4 mode
TASKS_CCASTOP	0x02C		Stop the clear channel assessment
TASKS_AUXDATADMASTART	0x038		Start DMA transaction of acquisition

Register	Offset	TZ	Description
TASKS_AUXDATADMASTOP	0x03C		Stop ongoing DMA transaction of acquisition
TASKS_PLLEN	0x06C		Enable RADIO in PLL mode (standby for either TX or RX)
TASKS_CSTONESSTART	0x0A0		Start tone processing for channel sounding
TASKS_SOFTRESET	0x0A4		Reset all public registers, but with these exceptions: DMA registers and EVENT/INTEN/ SUBSCRIBE/PUBLISH registers. Only to be used in DISABLED state.
SUBSCRIBE_TXEN	0x100		Subscribe configuration for task TXEN
SUBSCRIBE_RXEN	0x104		Subscribe configuration for task RXEN
SUBSCRIBE_START	0x108		Subscribe configuration for task START
SUBSCRIBE_STOP	0x10C		Subscribe configuration for task STOP
SUBSCRIBE_DISABLE	0x110		Subscribe configuration for task DISABLE
SUBSCRIBE_RSSISTART	0x114		Subscribe configuration for task RSSISTART
SUBSCRIBE_BCSTART	0x118		Subscribe configuration for task BCSTART
SUBSCRIBE_BCSTOP	0x11C		Subscribe configuration for task BCSTOP
SUBSCRIBE_EDSTART	0x120		Subscribe configuration for task EDSTART
SUBSCRIBE_EDSTOP	0x124		Subscribe configuration for task EDSTOP
SUBSCRIBE_CCASTART	0x128		Subscribe configuration for task CCASTART
SUBSCRIBE_CCASTOP	0x12C		Subscribe configuration for task CCASTOP
SUBSCRIBE_AUXDATADMASTART	0x138		Subscribe configuration for task AUXDATADMASTART
SUBSCRIBE_AUXDATADMASTOP	0x13C		Subscribe configuration for task AUXDATADMASTOP
SUBSCRIBE_PLLEN	0x16C		Subscribe configuration for task PLLEN
SUBSCRIBE_CSTONESSTART	0x1A0		Subscribe configuration for task CSTONESSTART
SUBSCRIBE_SOFTRESET	0x1A4		Subscribe configuration for task SOFTRESET
EVENTS_READY	0x200		RADIO has ramped up and is ready to be started
EVENTS_TXREADY	0x204		RADIO has ramped up and is ready to be started TX path
EVENTS_RXREADY	0x208		RADIO has ramped up and is ready to be started RX path
EVENTS_ADDRESS	0x20C		Address sent or received
EVENTS_FRAMESTART	0x210		IEEE 802.15.4 length field received
EVENTS_PAYLOAD	0x214		Packet payload sent or received
EVENTS_END	0x218		Memory access for packet data has been completed
EVENTS_PHYEND	0x21C		The last bit is sent on air or last bit is received
EVENTS_DISABLED	0x220		RADIO has been disabled
EVENTS_DEVMATCH	0x224		A device address match occurred on the last received packet
EVENTS_DEVMISS	0x228		No device address match occurred on the last received packet
EVENTS_CRCOK	0x22C		Packet received with CRC ok
EVENTS_CRCERROR	0x230		Packet received with CRC error
EVENTS_BCMATCH	0x238		Bit counter reached bit count value
EVENTS_EDEND	0x23C		Sampling of energy detection complete (a new ED sample is ready for readout from the RADIO.EDSAMPLE register)
EVENTS_EDSTOPPED	0x240		The sampling of energy detection has stopped
EVENTS_CCAIDLE	0x244		Wireless medium in idle - clear to send
EVENTS_CCABUSY	0x248		Wireless medium busy - do not send
EVENTS_CCASTOPPED	0x24C		The CCA has stopped
EVENTS_RATEBOOST	0x250		Ble_LR CI field received, receive mode is changed from Ble_LR125Kbit to Ble_LR500Kbit
EVENTS_MHRMATCH	0x254		MAC header match found
EVENTS_SYNC	0x258		Initial sync detected
EVENTS_CTEPRESENT	0x25C		CTEInfo byte is received
EVENTS_PLLREADY	0x2B0		PLL has settled and RADIO is ready to be enabled in either TX or RX mode
EVENTS_RXADDRESS	0x2BC		Address received
EVENTS_AUXDATADMAEND	0x2C0		AUXDATA DMA end
EVENTS_CSTONESEND	0x2C8		The channel sounding tone processing is complete
PUBLISH_READY	0x300		Publish configuration for event READY
PUBLISH_TXREADY	0x304		Publish configuration for event TXREADY
PUBLISH_RXREADY	0x308		Publish configuration for event RXREADY

Register	Offset	TZ	Description
PUBLISH_ADDRESS	0x30C		Publish configuration for event ADDRESS
PUBLISH_FRAMESTART	0x310		Publish configuration for event FRAMESTART
PUBLISH_PAYLOAD	0x314		Publish configuration for event PAYLOAD
PUBLISH_END	0x318		Publish configuration for event END
PUBLISH_PHYEND	0x31C		Publish configuration for event PHYEND
PUBLISH_DISABLED	0x320		Publish configuration for event DISABLED
PUBLISH_DEVMATCH	0x324		Publish configuration for event DEVMATCH
PUBLISH_DEVMISS	0x328		Publish configuration for event DEVMISS
PUBLISH_CRCOK	0x32C		Publish configuration for event CRCOK
PUBLISH_CRCERROR	0x330		Publish configuration for event CRCERROR
PUBLISH_BCMATCH	0x338		Publish configuration for event BCMATCH
PUBLISH_EDEND	0x33C		Publish configuration for event EDEND
PUBLISH_EDSTOPPED	0x340		Publish configuration for event EDSTOPPED
PUBLISH_CCAIDLE	0x344		Publish configuration for event CCAIDLE
PUBLISH_CCABUSY	0x348		Publish configuration for event CCABUSY
PUBLISH_CCASTOPPED	0x34C		Publish configuration for event CCASTOPPED
PUBLISH_RATEBOOST	0x350		Publish configuration for event RATEBOOST
PUBLISH_MHRMATCH	0x354		Publish configuration for event MHRMATCH
PUBLISH_SYNC	0x358		Publish configuration for event SYNC
PUBLISH_CTEPRESENT	0x35C		Publish configuration for event CTEPRESENT
PUBLISH_PLLREADY	0x3B0		Publish configuration for event PLLREADY
PUBLISH_RXADDRESS	0x3BC		Publish configuration for event RXADDRESS
PUBLISH_AUXDATADMAEND	0x3C0		Publish configuration for event AUXDATADMAEND
PUBLISH_CSTONESEND	0x3C8		Publish configuration for event CSTONESEND
SHORTS	0x400		Shortcuts between local events and tasks
INTENSET00	0x488		Enable interrupt
INTENSET01	0x48C		Enable interrupt
INTENCLR00	0x490		Disable interrupt
INTENCLR01	0x494		Disable interrupt
INTENSET10	0x4A8		Enable interrupt
INTENSET11	0x4AC		Enable interrupt
INTENCLR10	0x4B0		Disable interrupt
INTENCLR11	0x4B4		Disable interrupt
MODE	0x500		Data rate and modulation
PHYENDTXDELAY	0x518		Configurable delay of PHYEND event for TX
STATE	0x520		Current radio state
EDCTRL	0x530		IEEE 802.15.4 energy detect control
EDSAMPLE	0x534		IEEE 802.15.4 energy detect level
CCACTRL	0x538		IEEE 802.15.4 clear channel assessment control
DATAWHITE	0x540		Data whitening configuration
AUXDATA.CNF[n]	0x548		AUXDATA configuration
AUXDATADMA[n].ENABLE	0x550		Enable or disable data acquisition
AUXDATADMA[n].PTR	0x554		DMA pointer
AUXDATADMA[n].MAXCNT	0x558		Maximum number of 32-bit words to transfer
AUXDATADMA[n].AMOUNT	0x55C		Number of 32-bit words transferred in the last transaction
TIMING	0x704		Timing
FREQUENCY	0x708		Frequency
TXPOWER	0x710		Output power
TIFS	0x714		Interframe spacing in µs
RSSISAMPLE	0x718		RSSI sample
RXGAIN.CONFIG	0x7D4		Override configuration of receiver gain control loop
FREQFINETUNE	0x0804		Fine tuning of the RF frequency
FECONFIG	0x908		Config register

Register	Offset	TZ	Description
CFO_STAT	0xB00		Carrier freq. offset estimate
DBCCORR	0xB40		Correlator thresholds
DFEMODE	0xD00		Whether to use Angle-of-Arrival (AOA) or Angle-of-Departure (AOD)
DFESTATUS	0xD04		DFE status information
DFECTRL1	0xD10		Various configuration for Direction finding
DFECTRL2	0xD14		Start offset for Direction finding
SWITCHPATTERN	0xD28		GPIO patterns to be used for each antenna
CLEARPATTERN	0xD2C		Clear the GPIO pattern array for antenna control
PSEL.DFEGPIO[n]	0xD30		Pin select for DFE pin n
DFEPACKET.PTR	0xD50		Data pointer
DFEPACKET.MAXCNT	0xD54		Maximum number of bytes to transfer
DFEPACKET.AMOUNT	0xD58		Number of bytes transferred in the last transaction
DFEPACKET.CURRENTAMOUNT	0xD5C		Number of bytes transferred in the current transaction
CRCSTATUS	0xE0C		CRC status
RXMATCH	0xE10		Received address
RXCRC	0xE14		CRC field of previously received packet
DAI	0xE18		Device address match index
PDUSTAT	0xE1C		Payload status
PCNF0	0xE20		Packet configuration register 0
PCNF1	0xE28		Packet configuration register 1
BASE0	0xE2C		Base address 0
BASE1	0xE30		Base address 1
PREFIX0	0xE34		Prefixes bytes for logical addresses 0-3
PREFIX1	0xE38		Prefixes bytes for logical addresses 4-7
TXADDRESS	0xE3C		Transmit address select
RXADDRESSES	0xE40		Receive address select
CRCCNF	0xE44		CRC configuration
CRCPOLY	0xE48		CRC polynomial
CRCINIT	0xE4C		CRC initial value
DAB[n]	0xE50		Device address base segment n
DAP[n]	0xE70		Device address prefix n
DACNF	0xE90		Device address match configuration
BCC	0xE94		Bit counter compare
CTESTATUS	0xEA4		CTEInfo parsed from received packet
MHRMATCHCONF	0xEB4		Search pattern configuration
MHRMATCHMASK	0xEB8		Pattern mask
SFD	0xEBC		IEEE 802.15.4 start of frame delimiter
CTEINLINECONF	0xEC0		Configuration for CTE inline mode
PACKETPTR	0xED0		Packet pointer
CSTONES.MODE	0x1000		Selects the mode(s) that are activated on the start signal
CSTONES.NUMSAMPLES	0x1004		Number of input samples at 2MHz sample rate
CSTONES.NEXTFREQUENCY	0x1008		The value of FREQUENCY that will be used in the next step
CSTONES.FAEPEER	0x1014		FAEPEER (Frequency Actuation Error) of peer if known. Used during Mode 0 steps.
CSTONES.PHASESHIFT	0x1018		Parameter used in TPM, provided by software
CSTONES.NUMSAMPLESCOEFF	0x101C		Parameter used in TPM, provided by software
CSTONES.PCT16	0x1020		Mean magnitude and mean phase converted to IQ
CSTONES.MAGPHASEMEAN	0x1024		Mean magnitude and phase of the signal before it is converted to PCT16
CSTONES.IQRAWMEAN	0x1028		Mean of IQ values
CSTONES.MAGSTD	0x102C		Magnitude standard deviation approximation
CSTONES.FFOEST	0x1034		FFO estimate
CSTONES.DOWNSAMPLE	0x1038		Turn on/off down sample of input IQ-signals
CSTONES.FREQOFFSET	0x1044		Frequency offset estimate
RTT.CONFIG	0x1050		RTT Config.

Register	Offset	TZ	Description
RTT.SEGMENT01	0x1054		RTT segments 0 and 1
RTT.SEGMENT23	0x1058		RTT segments 2 and 3
RTT.SEGMENT45	0x105C		RTT segments 4 and 5
RTT.SEGMENT67	0x1060		RTT segments 6 and 7

8.17.14.1 TASKS_TXEN

Address offset: 0x000

Enable RADIO in TX mode

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_TXEN			Enable RADIO in TX mode
			Trigger	1	Trigger task

8.17.14.2 TASKS_RXEN

Address offset: 0x004

Enable RADIO in RX mode

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_RXEN			Enable RADIO in RX mode
			Trigger	1	Trigger task

8.17.14.3 TASKS_START

Address offset: 0x008

Start RADIO

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_START			Start RADIO
			Trigger	1	Trigger task

8.17.14.4 TASKS_STOP

Address offset: 0x00C

Stop RADIO

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Stop RADIO
			Trigger	1	Trigger task

8.17.14.5 TASKS_DISABLE

Address offset: 0x010

Disable RADIO

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_DISABLE			Disable RADIO
			Trigger	1	Trigger task

8.17.14.6 TASKS_RSSISTART

Address offset: 0x014

Start the RSSI and take one single sample of the receive signal strength

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_RSSISTART			Start the RSSI and take one single sample of the receive signal strength
			Trigger	1	Trigger task

8.17.14.7 TASKS_BCSTART

Address offset: 0x018

Start the bit counter

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_BCSTART			Start the bit counter
			Trigger	1	Trigger task

8.17.14.8 TASKS_BCSTOP

Address offset: 0x01C

Stop the bit counter

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_BCSTOP			Stop the bit counter
			Trigger	1	Trigger task

8.17.14.9 TASKS_EDSTART

Address offset: 0x020

Start the energy detect measurement used in IEEE 802.15.4 mode

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_EDSTART			Start the energy detect measurement used in IEEE 802.15.4 mode
			Trigger	1	Trigger task

8.17.14.10 TASKS_EDSTOP

Address offset: 0x024

Stop the energy detect measurement

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_EDSTOP			Stop the energy detect measurement
			Trigger	1	Trigger task

8.17.14.11 TASKS_CCASTART

Address offset: 0x028

Start the clear channel assessment used in IEEE 802.15.4 mode

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_CCASTART			Start the clear channel assessment used in IEEE 802.15.4 mode
			Trigger	1	Trigger task

8.17.14.12 TASKS_CCASTOP

Address offset: 0x02C

Stop the clear channel assessment

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_CCASTOP			Stop the clear channel assessment
			Trigger	1	Trigger task

8.17.14.13 TASKS_AUXDATADMASTART

Address offset: 0x038

Start DMA transaction of acquisition

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_AUXDATADMASTART			Start DMA transaction of acquisition
			Trigger	1	Trigger task

8.17.14.14 TASKS_AUXDATADMASTOP

Address offset: 0x03C

Stop ongoing DMA transaction of acquisition

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_AUXDATADMASTOP			Stop ongoing DMA transaction of acquisition
			Trigger	1	Trigger task

8.17.14.15 TASKS_PLLEN

Address offset: 0x06C

Enable RADIO in PLL mode (standby for either TX or RX)

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_PLLEN			Enable RADIO in PLL mode (standby for either TX or RX)
			Trigger	1	Trigger task

8.17.14.16 TASKS_CSTONESSTART

Address offset: 0x0A0

Start tone processing for channel sounding

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_CSTONESSTART			Start tone processing for channel sounding
			Trigger	1	Trigger task

8.17.14.17 TASKS_SOFTRESET

Address offset: 0x0A4

Reset all public registers, but with these exceptions: DMA registers and EVENT/INTEN/SUBSCRIBE/PUBLISH registers. Only to be used in DISABLED state.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_SOFTRESET			Reset all public registers, but with these exceptions: DMA registers and EVENT/INTEN/SUBSCRIBE/PUBLISH registers. Only to be used in DISABLED state.
			Trigger	1	Trigger task

8.17.14.18 SUBSCRIBE_TXEN

Address offset: 0x100

Subscribe configuration for task TXEN

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task TXEN will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.17.14.19 SUBSCRIBE_RXEN

Address offset: 0x104

Subscribe configuration for task RXEN

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task RXEN will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.17.14.20 SUBSCRIBE_START

Address offset: 0x108

Subscribe configuration for task START

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task START will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.17.14.21 SUBSCRIBE_STOP

Address offset: 0x10C

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.17.14.22 SUBSCRIBE_DISABLE

Address offset: 0x110

Subscribe configuration for task DISABLE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task DISABLE will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.17.14.23 SUBSCRIBE_RSSISTART

Address offset: 0x114

Subscribe configuration for task RSSISTART

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task RSSISTART will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.17.14.24 SUBSCRIBE_BCSTART

Address offset: 0x118

Subscribe configuration for task BCSTART

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task BCSTART will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.17.14.25 SUBSCRIBE_BCSTOP

Address offset: 0x11C

Subscribe configuration for task BCSTOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task BCSTOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.17.14.26 SUBSCRIBE_EDSTART

Address offset: 0x120

Subscribe configuration for task EDSTART

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task EDSTART will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.17.14.27 SUBSCRIBE_EDSTOP

Address offset: 0x124

Subscribe configuration for task EDSTOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task EDSTOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.17.14.28 SUBSCRIBE_CCASTART

Address offset: 0x128

Subscribe configuration for task CCASTART

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task CCASTART will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.17.14.29 SUBSCRIBE_CCASTOP

Address offset: 0x12C

Subscribe configuration for task CCASTOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task CCASTOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.17.14.30 SUBSCRIBE_AUXDATADMASTART

Address offset: 0x138

Subscribe configuration for task AUXDATADMASTART

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task AUXDATADMASTART will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.17.14.31 SUBSCRIBE_AUXDATADMASTOP

Address offset: 0x13C

Subscribe configuration for task AUXDATADMASTOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task AUXDATADMASTOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.17.14.32 SUBSCRIBE_PLLEN

Address offset: 0x16C

Subscribe configuration for task PLLEN

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task PLLEN will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.17.14.33 SUBSCRIBE_CSTONESSTART

Address offset: 0x1A0

Subscribe configuration for task CSTONESSTART

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task CSTONESSTART will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.17.14.34 SUBSCRIBE_SOFTRESET

Address offset: 0x1A4

Subscribe configuration for task SOFTRESET

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task SOFTRESET will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.17.14.35 EVENTS_READY

Address offset: 0x200

RADIO has ramped up and is ready to be started

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_READY			RADIO has ramped up and is ready to be started
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.36 EVENTS_TXREADY

Address offset: 0x204

RADIO has ramped up and is ready to be started TX path

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_TXREADY			RADIO has ramped up and is ready to be started TX path
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.37 EVENTS_RXREADY

Address offset: 0x208

RADIO has ramped up and is ready to be started RX path

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_RXREADY			RADIO has ramped up and is ready to be started RX path
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.38 EVENTS_ADDRESS

Address offset: 0x20C

Address sent or received

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_ADDRESS			Address sent or received
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.39 EVENTS_FRAMESTART

Address offset: 0x210

IEEE 802.15.4 length field received

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_FRAMESTART			IEEE 802.15.4 length field received
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.40 EVENTS_PAYLOAD

Address offset: 0x214

Packet payload sent or received

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_PAYLOAD			Packet payload sent or received
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.41 EVENTS_END

Address offset: 0x218

Memory access for packet data has been completed

In TX: Last byte to be transmitted has been fetched from RAM

In RX: Last byte received on air has been stored to RAM

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_END			Memory access for packet data has been completed In TX: Last byte to be transmitted has been fetched from RAM In RX: Last byte received on air has been stored to RAM
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.42 EVENTS_PHYEND

Address offset: 0x21C

The last bit is sent on air or last bit is received

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_PHYEND			The last bit is sent on air or last bit is received
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.43 EVENTS_DISABLED

Address offset: 0x220

RADIO has been disabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_DISABLED			RADIO has been disabled
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.44 EVENTS_DEVMATCH

Address offset: 0x224

A device address match occurred on the last received packet

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_DEVMATCH			A device address match occurred on the last received packet
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.45 EVENTS_DEVMISS

Address offset: 0x228

No device address match occurred on the last received packet

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_DEVMISS			No device address match occurred on the last received packet
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.46 EVENTS_CRCOK

Address offset: 0x22C

Packet received with CRC ok

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_CRCOK			Packet received with CRC ok
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.47 EVENTS_CRCERROR

Address offset: 0x230

Packet received with CRC error

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_CRCERROR			Packet received with CRC error
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.48 EVENTS_BCMATCH

Address offset: 0x238

Bit counter reached bit count value

Bit counter value is specified in the RADIO.BCC register

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					A
Reset 0x00000000					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_BCMATCH			Bit counter reached bit count value
					Bit counter value is specified in the RADIO.BCC register
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.49 EVENTS_EDEND

Address offset: 0x23C

Sampling of energy detection complete (a new ED sample is ready for readout from the RADIO.EDSAMPLE register)

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					A
Reset 0x00000000					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_EDEND			Sampling of energy detection complete (a new ED sample is ready for readout from the RADIO.EDSAMPLE register)
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.50 EVENTS_EDSTOPPED

Address offset: 0x240

The sampling of energy detection has stopped

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					A
Reset 0x00000000					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_EDSTOPPED			The sampling of energy detection has stopped
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.51 EVENTS_CCAIDLE

Address offset: 0x244

Wireless medium in idle - clear to send

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					A
Reset 0x00000000					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_CCAIDLE			Wireless medium in idle - clear to send
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.52 EVENTS_CCABUSY

Address offset: 0x248

Wireless medium busy - do not send

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_CCABUSY			Wireless medium busy - do not send
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.53 EVENTS_CCASTOPPED

Address offset: 0x24C

The CCA has stopped

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_CCASTOPPED			The CCA has stopped
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.54 EVENTS_RATEBOOST

Address offset: 0x250

Ble_LR CI field received, receive mode is changed from Ble_LR125Kbit to Ble_LR500Kbit

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_RATEBOOST			Ble_LR CI field received, receive mode is changed from Ble_LR125Kbit to Ble_LR500Kbit
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.55 EVENTS_MHRMATCH

Address offset: 0x254

MAC header match found

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_MHRMATCH			MAC header match found
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.56 EVENTS_SYNC

Address offset: 0x258

Initial sync detected

For MODE=Ieee802154_250Kbit: A possible preamble has been received. However, due to the sporadic reception of noise, this event can be falsely triggered.

For MODE=Ble_LR125Kbit, Ble_LR500Kbit: A possible preamble has been received. However, due to the sporadic reception of noise, this event can be falsely triggered.

For MODE=Nrf_1Mbit, Nrf_2Mbit, Ble_1Mbit, or Ble_2Mbit: A possible preamble and the first two bytes of the address field has been received. The event can be generated falsely also in this mode.

It is also possible that the event is not generated, or not generated before the ADDRESS event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_SYNC			Initial sync detected For MODE=Ieee802154_250Kbit: A possible preamble has been received. However, due to the sporadic reception of noise, this event can be falsely triggered. For MODE=Ble_LR125Kbit, Ble_LR500Kbit: A possible preamble has been received. However, due to the sporadic reception of noise, this event can be falsely triggered. For MODE=Nrf_1Mbit, Nrf_2Mbit, Ble_1Mbit, or Ble_2Mbit: A possible preamble and the first two bytes of the address field has been received. The event can be generated falsely also in this mode. It is also possible that the event is not generated, or not generated before the ADDRESS event.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.57 EVENTS_CTEPRESENT

Address offset: 0x25C

CTEInfo byte is received

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_CTEPRESENT			CTEInfo byte is received
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.58 EVENTS_PLLREADY

Address offset: 0x2B0

PLL has settled and RADIO is ready to be enabled in either TX or RX mode

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_PLLREADY			PLL has settled and RADIO is ready to be enabled in either TX or RX mode
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.59 EVENTS_RXADDRESS

Address offset: 0x2BC

Address received

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_RXADDRESS			Address received
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.60 EVENTS_AUXDATADMAEND

Address offset: 0x2C0

AUXDATA DMA end

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_AUXDATADMAEND			AUXDATA DMA end
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.61 EVENTS_CSTONESEND

Address offset: 0x2C8

The channel sounding tone processing is complete

The results are available in the CSTONES registers

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_CSTONESEND			The channel sounding tone processing is complete The results are available in the CSTONES registers
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.17.14.62 PUBLISH_READY

Address offset: 0x300

Publish configuration for event READY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event READY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.63 PUBLISH_TXREADY

Address offset: 0x304

Publish configuration for event TXREADY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event TXREADY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.64 PUBLISH_RXREADY

Address offset: 0x308

Publish configuration for event RXREADY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event RXREADY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.65 PUBLISH_ADDRESS

Address offset: 0x30C

Publish configuration for event ADDRESS

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event ADDRESS will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.66 PUBLISH_FRAMESTART

Address offset: 0x310

Publish configuration for event FRAMESTART

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event FRAMESTART will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.67 PUBLISH_PAYLOAD

Address offset: 0x314

Publish configuration for event PAYLOAD

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event PAYLOAD will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.68 PUBLISH_END

Address offset: 0x318

Publish configuration for event END

In TX: Last byte to be transmitted has been fetched from RAM

In RX: Last byte received on air has been stored to RAM

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event END will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.69 PUBLISH_PHYEND

Address offset: 0x31C

Publish configuration for event PHYEND

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event PHYEND will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.70 PUBLISH_DISABLED

Address offset: 0x320

Publish configuration for event DISABLED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event DISABLED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.71 PUBLISH_DEVMATCH

Address offset: 0x324

Publish configuration for event DEVMATCH

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event DEVMATCH will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.72 PUBLISH_DEVMISS

Address offset: 0x328

Publish configuration for event DEVMISS

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event DEVMISS will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.73 PUBLISH_CRCOK

Address offset: 0x32C

Publish configuration for event CRCOK

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event CRCOK will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.74 PUBLISH_CRCERROR

Address offset: 0x330

Publish configuration for event CRCERROR

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event CRCERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.75 PUBLISH_BCMATCH

Address offset: 0x338

Publish configuration for event BCMATCH

Bit counter value is specified in the RADIO.BCC register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event BCMATCH will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.76 PUBLISH_EDEND

Address offset: 0x33C

Publish configuration for event EDEND

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event EDEND will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.77 PUBLISH_EDSTOPPED

Address offset: 0x340

Publish configuration for event EDSTOPPED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event EDSTOPPED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.78 PUBLISH_CCAIDLE

Address offset: 0x344

Publish configuration for event CCAIDLE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event CCAIDLE will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.79 PUBLISH_CCABUSY

Address offset: 0x348

Publish configuration for event CCABUSY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event CCABUSY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.80 PUBLISH_CCASTOPPED

Address offset: 0x34C

Publish configuration for event CCASTOPPED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event CCASTOPPED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.81 PUBLISH_RATEBOOST

Address offset: 0x350

Publish configuration for event RATEBOOST

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event RATEBOOST will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.82 PUBLISH_MHRMATCH

Address offset: 0x354

Publish configuration for event MHRMATCH

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event MHRMATCH will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.83 PUBLISH_SYNC

Address offset: 0x358

Publish configuration for event SYNC

For MODE=Ieee802154_250Kbit: A possible preamble has been received. However, due to the sporadic reception of noise, this event can be falsely triggered.

For MODE=Ble_LR125Kbit, Ble_LR500Kbit: A possible preamble has been received. However, due to the sporadic reception of noise, this event can be falsely triggered.

For MODE=Nrf_1Mbit, Nrf_2Mbit, Ble_1Mbit, or Ble_2Mbit: A possible preamble and the first two bytes of the address field has been received. The event can be generated falsely also in this mode.

It is also possible that the event is not generated, or not generated before the ADDRESS event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event SYNC will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.84 PUBLISH_CTEPRESENT

Address offset: 0x35C

Publish configuration for event CTEPRESENT

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event CTEPRESENT will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.85 PUBLISH_PLLREADY

Address offset: 0x3B0

Publish configuration for event PLLREADY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event PLLREADY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.86 PUBLISH_RXADDRESS

Address offset: 0x3BC

Publish configuration for event RXADDRESS

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event RXADDRESS will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.87 PUBLISH_AUXDATADMAEND

Address offset: 0x3C0

Publish configuration for event AUXDATADMAEND

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event AUXDATADMAEND will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.88 PUBLISH_CSTONESEND

Address offset: 0x3C8

Publish configuration for event CSTONESEND

The results are available in the CSTONES registers

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event CSTONESEND will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.17.14.89 SHORTS

Address offset: 0x400

Shortcuts between local events and tasks

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	READY_START			Shortcut between event READY and task START
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
B	RW	DISABLED_TXEN			Shortcut between event DISABLED and task TXEN
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
C	RW	DISABLED_RXEN			Shortcut between event DISABLED and task RXEN
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
D	RW	ADDRESS_RSSISTART			Shortcut between event ADDRESS and task RSSISTART
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
E	RW	END_START			Shortcut between event END and task START
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
F	RW	ADDRESS_BCSTART			Shortcut between event ADDRESS and task BCSTART
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
G	RW	PHYEND_PLLEN			Shortcut between event PHYEND and task PLLEN
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
H	RW	RXREADY_CCASTART			Shortcut between event RXREADY and task CCASTART
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
I	RW	CCAIDLE_TXEN			Shortcut between event CCAIDLE and task TXEN
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
J	RW	CCABUSY_DISABLE			Shortcut between event CCABUSY and task DISABLE
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
K	RW	FRAMESTART_BCSTART			Shortcut between event FRAMESTART and task BCSTART
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
L	RW	READY_EDSTART			Shortcut between event READY and task EDSTART
			Disabled	0	Disable shortcut

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Enabled	1	Enable shortcut
M	RW	EDEND_DISABLE			Shortcut between event EDEND and task DISABLE
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
N	RW	CCAIDLE_STOP			Shortcut between event CCAIDLE and task STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
O	RW	TXREADY_START			Shortcut between event TXREADY and task START
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
P	RW	RXREADY_START			Shortcut between event RXREADY and task START
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
Q	RW	PHYEND_DISABLE			Shortcut between event PHYEND and task DISABLE
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
R	RW	PHYEND_START			Shortcut between event PHYEND and task START
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
S	RW	PLLREADY_TXEN			Shortcut between event PLLREADY and task TXEN
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
T	RW	PLLREADY_RXEN			Shortcut between event PLLREADY and task RXEN
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut

8.17.14.90 INTENSET00

Address offset: 0x488

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1S	READY			Write '1' to enable interrupt for event READY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	TXREADY			Write '1' to enable interrupt for event TXREADY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1S	RXREADY			Write '1' to enable interrupt for event RXREADY
			Set	1	Enable
			Disabled	0	Read: Disabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Enabled	1	Read: Enabled
D	RW W1S	ADDRESS			Write '1' to enable interrupt for event ADDRESS
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1S	FRAMESTART			Write '1' to enable interrupt for event FRAMESTART
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1S	PAYLOAD			Write '1' to enable interrupt for event PAYLOAD
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1S	END			Write '1' to enable interrupt for event END In TX: Last byte to be transmitted has been fetched from RAM In RX: Last byte received on air has been stored to RAM
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
H	RW W1S	PHYEND			Write '1' to enable interrupt for event PHYEND
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
I	RW W1S	DISABLED			Write '1' to enable interrupt for event DISABLED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
J	RW W1S	DEVMATCH			Write '1' to enable interrupt for event DEVMATCH
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
K	RW W1S	DEVMISS			Write '1' to enable interrupt for event DEVMISS
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
L	RW W1S	CRCOK			Write '1' to enable interrupt for event CRCOK
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1S	CRCERROR			Write '1' to enable interrupt for event CRCERROR
			Set	1	Enable

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID												W	V	U	T	S	R	Q	P	O	N		M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
			Disabled	0																															
			Enabled	1																															
N	RW W1S	BCMATCH																																	
				Bit counter value is specified in the RADIO.BCC register																																
			Set	1																															
			Disabled	0																															
			Enabled	1																															
O	RW W1S	EDEND																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
P	RW W1S	EDSTOPPED																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
Q	RW W1S	CCAIDLE																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
R	RW W1S	CCABUSY																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
S	RW W1S	CCASTOPPED																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
T	RW W1S	RATEBOOST																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
U	RW W1S	MHRMATCH																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
V	RW W1S	SYNC			Write '1' to enable interrupt for event SYNC For MODE=Ieee802154_250Kbit: A possible preamble has been received. However, due to the sporadic reception of noise, this event can be falsely triggered. For MODE=Ble_LR125Kbit, Ble_LR500Kbit: A possible preamble has been received. However, due to the sporadic reception of noise, this event can be falsely triggered. For MODE=Nrf_1Mbit, Nrf_2Mbit, Ble_1Mbit, or Ble_2Mbit: A possible preamble and the first two bytes of the address field has been received. The event can be generated falsely also in this mode. It is also possible that the event is not generated, or not generated before the ADDRESS event.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
W	RW W1S	CTEPRESENT			Write '1' to enable interrupt for event CTEPRESENT
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.17.14.91 INTENSET01

Address offset: 0x48C

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1S	PLLREADY			Write '1' to enable interrupt for event PLLREADY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	RXADDRESS			Write '1' to enable interrupt for event RXADDRESS
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1S	AUXDATADMAEND			Write '1' to enable interrupt for event AUXDATADMAEND
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1S	CSTONESEND			Write '1' to enable interrupt for event CSTONESEND The results are available in the CSTONES registers
			Set	1	Enable

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	D C B A
Reset 0x00000000	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.17.14.92 INTENCLR00

Address offset: 0x490

Disable interrupt

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	READY			Write '1' to disable interrupt for event READY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	TXREADY			Write '1' to disable interrupt for event TXREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	RXREADY			Write '1' to disable interrupt for event RXREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1C	ADDRESS			Write '1' to disable interrupt for event ADDRESS
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1C	FRAMESTART			Write '1' to disable interrupt for event FRAMESTART
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1C	PAYLOAD			Write '1' to disable interrupt for event PAYLOAD
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1C	END			Write '1' to disable interrupt for event END In TX: Last byte to be transmitted has been fetched from RAM In RX: Last byte received on air has been stored to RAM
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
H	RW W1C	PHYEND			Write '1' to disable interrupt for event PHYEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
I	RW W1C	DISABLED			Write '1' to disable interrupt for event DISABLED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
J	RW W1C	DEVMATCH			Write '1' to disable interrupt for event DEVMATCH
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
K	RW W1C	DEVMISS			Write '1' to disable interrupt for event DEVMISS
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
L	RW W1C	CRCOK			Write '1' to disable interrupt for event CRCOK
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1C	CRCERROR			Write '1' to disable interrupt for event CRCERROR
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
N	RW W1C	BCMATCH			Write '1' to disable interrupt for event BCMATCH Bit counter value is specified in the RADIO.BCC register
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
O	RW W1C	EDEND			Write '1' to disable interrupt for event EDEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
P	RW W1C	EDSTOPPED			Write '1' to disable interrupt for event EDSTOPPED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
Q	RW W1C	CCAIDLE			Write '1' to disable interrupt for event CCAIDLE
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
R	RW W1C	CCABUSY			Write '1' to disable interrupt for event CCABUSY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
S	RW W1C	CCASTOPPED			Write '1' to disable interrupt for event CCASTOPPED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
T	RW W1C	RATEBOOST			Write '1' to disable interrupt for event RATEBOOST
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
U	RW W1C	MHRMATCH			Write '1' to disable interrupt for event MHRMATCH
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
V	RW W1C	SYNC			Write '1' to disable interrupt for event SYNC For MODE=Ieee802154_250Kbit: A possible preamble has been received. However, due to the sporadic reception of noise, this event can be falsely triggered. For MODE=Ble_LR125Kbit, Ble_LR500Kbit: A possible preamble has been received. However, due to the sporadic reception of noise, this event can be falsely triggered. For MODE=Nrf_1Mbit, Nrf_2Mbit, Ble_1Mbit, or Ble_2Mbit: A possible preamble and the first two bytes of the address field has been received. The event can be generated falsely also in this mode. It is also possible that the event is not generated, or not generated before the ADDRESS event.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
W	RW W1C	CTEPRESENT			Write '1' to disable interrupt for event CTEPRESENT
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.17.14.93 INTENCLR01

Address offset: 0x494

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	PLLREADY			Write '1' to disable interrupt for event PLLREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	RXADDRESS			Write '1' to disable interrupt for event RXADDRESS
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	AUXDATADMAEND			Write '1' to disable interrupt for event AUXDATADMAEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1C	CSTONESEND			Write '1' to disable interrupt for event CSTONESEND The results are available in the CSTONES registers
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.17.14.94 INTENSET10

Address offset: 0x4A8

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1S	READY			Write '1' to enable interrupt for event READY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	TXREADY			Write '1' to enable interrupt for event TXREADY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1S	RXREADY			Write '1' to enable interrupt for event RXREADY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1S	ADDRESS			Write '1' to enable interrupt for event ADDRESS
			Set	1	Enable
			Disabled	0	Read: Disabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Enabled	1	Read: Enabled
E	RW W1S	FRAMESTART			Write '1' to enable interrupt for event FRAMESTART
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1S	PAYLOAD			Write '1' to enable interrupt for event PAYLOAD
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1S	END			Write '1' to enable interrupt for event END In TX: Last byte to be transmitted has been fetched from RAM In RX: Last byte received on air has been stored to RAM
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
H	RW W1S	PHYEND			Write '1' to enable interrupt for event PHYEND
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
I	RW W1S	DISABLED			Write '1' to enable interrupt for event DISABLED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
J	RW W1S	DEVMATCH			Write '1' to enable interrupt for event DEVMATCH
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
K	RW W1S	DEVMISS			Write '1' to enable interrupt for event DEVMISS
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
L	RW W1S	CRCOK			Write '1' to enable interrupt for event CRCOK
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1S	CRCERROR			Write '1' to enable interrupt for event CRCERROR
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
N	RW W1S	BCMATCH			Write '1' to enable interrupt for event BCMATCH Bit counter value is specified in the RADIO.BCC register

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID												W	V	U	T	S	R	Q	P	O	N		M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
			Set	1																															
			Disabled	0																															
			Enabled	1																															
O	RW W1S	EDEND																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
P	RW W1S	EDSTOPPED																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
Q	RW W1S	CCAIDLE																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
R	RW W1S	CCABUSY																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
S	RW W1S	CCASTOPPED																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
T	RW W1S	RATEBOOST																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
U	RW W1S	MHRMATCH																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
V	RW W1S	SYNC			Write '1' to enable interrupt for event SYNC For MODE=Ieee802154_250Kbit: A possible preamble has been received. However, due to the sporadic reception of noise, this event can be falsely triggered. For MODE=Ble_LR125Kbit, Ble_LR500Kbit: A possible preamble has been received. However, due to the sporadic reception of noise, this event can be falsely triggered. For MODE=Nrf_1Mbit, Nrf_2Mbit, Ble_1Mbit, or Ble_2Mbit: A possible preamble and the first two bytes of the address field has been received. The event can be generated falsely also in this mode. It is also possible that the event is not generated, or not generated before the ADDRESS event.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
W	RW W1S	CTEPRESENT			Write '1' to enable interrupt for event CTEPRESENT
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.17.14.95 INTENSET11

Address offset: 0x4AC

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1S	PLLREADY			Write '1' to enable interrupt for event PLLREADY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	RXADDRESS			Write '1' to enable interrupt for event RXADDRESS
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1S	AUXDATADMAEND			Write '1' to enable interrupt for event AUXDATADMAEND
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1S	CSTONESEND			Write '1' to enable interrupt for event CSTONESEND The results are available in the CSTONES registers
			Set	1	Enable

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	D C B A
Reset 0x00000000	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.17.14.96 INTENCLR10

Address offset: 0x4B0

Disable interrupt

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	READY			Write '1' to disable interrupt for event READY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	TXREADY			Write '1' to disable interrupt for event TXREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	RXREADY			Write '1' to disable interrupt for event RXREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1C	ADDRESS			Write '1' to disable interrupt for event ADDRESS
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1C	FRAMESTART			Write '1' to disable interrupt for event FRAMESTART
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1C	PAYLOAD			Write '1' to disable interrupt for event PAYLOAD
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1C	END			Write '1' to disable interrupt for event END In TX: Last byte to be transmitted has been fetched from RAM In RX: Last byte received on air has been stored to RAM
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID									W	V	U	T	S	R	Q	P	O	N		M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
H	RW W1C	PHYEND			Write '1' to disable interrupt for event PHYEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
I	RW W1C	DISABLED			Write '1' to disable interrupt for event DISABLED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
J	RW W1C	DEVMATCH			Write '1' to disable interrupt for event DEVMATCH
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
K	RW W1C	DEVMISS			Write '1' to disable interrupt for event DEVMISS
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
L	RW W1C	CRCOK			Write '1' to disable interrupt for event CRCOK
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1C	CRCERROR			Write '1' to disable interrupt for event CRCERROR
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
N	RW W1C	BCMATCH			Write '1' to disable interrupt for event BCMATCH Bit counter value is specified in the RADIO.BCC register
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
O	RW W1C	EDEND			Write '1' to disable interrupt for event EDEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
P	RW W1C	EDSTOPPED			Write '1' to disable interrupt for event EDSTOPPED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
Q	RW W1C	CCAIDLE			Write '1' to disable interrupt for event CCAIDLE
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
R	RW W1C	CCABUSY			Write '1' to disable interrupt for event CCABUSY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
S	RW W1C	CCASTOPPED			Write '1' to disable interrupt for event CCASTOPPED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
T	RW W1C	RATEBOOST			Write '1' to disable interrupt for event RATEBOOST
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
U	RW W1C	MHRMATCH			Write '1' to disable interrupt for event MHRMATCH
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
V	RW W1C	SYNC			Write '1' to disable interrupt for event SYNC For MODE=Ieee802154_250Kbit: A possible preamble has been received. However, due to the sporadic reception of noise, this event can be falsely triggered. For MODE=Ble_LR125Kbit, Ble_LR500Kbit: A possible preamble has been received. However, due to the sporadic reception of noise, this event can be falsely triggered. For MODE=Nrf_1Mbit, Nrf_2Mbit, Ble_1Mbit, or Ble_2Mbit: A possible preamble and the first two bytes of the address field has been received. The event can be generated falsely also in this mode. It is also possible that the event is not generated, or not generated before the ADDRESS event.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
W	RW W1C	CTEPRESENT			Write '1' to disable interrupt for event CTEPRESENT
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.17.14.97 INTENCLR11

Address offset: 0x4B4

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	PLLREADY			Write '1' to disable interrupt for event PLLREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	RXADDRESS			Write '1' to disable interrupt for event RXADDRESS
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	AUXDATADMAEND			Write '1' to disable interrupt for event AUXDATADMAEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1C	CSTONESEND			Write '1' to disable interrupt for event CSTONESEND The results are available in the CSTONES registers
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.17.14.98 MODE

Address offset: 0x500

Data rate and modulation

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MODE			Radio data rate and modulation setting. The radio supports frequency-shift keying (FSK) modulation.
			Nrf_1Mbit	0	1 Mbps Nordic proprietary radio mode
			Nrf_2Mbit	1	2 Mbps Nordic proprietary radio mode
			Ble_1Mbit	3	1 Mbps BLE
			Ble_2Mbit	4	2 Mbps BLE
			Ble_LR125Kbit	5	Long range 125 kbps TX, 125 kbps and 500 kbps RX
			Ble_LR500Kbit	6	Long range 500 kbps TX, 125 kbps and 500 kbps RX
			Nrf_4Mbit_0BT6	9	4 Mbps Nordic proprietary radio mode (BT=0.6/h=0.5)
			Nrf_4Mbit_0BT4	10	4 Mbps Nordic proprietary radio mode (BT=0.4/h=0.5)
			Ieee802154_250Kbit	15	IEEE 802.15.4-2006 250 kbps

8.17.14.99 PHYENDTXDELAY

Address offset: 0x518

Configurable delay of PHYEND event for TX

There are separate values for each on-air bit rate. The maximum supported value is 3.5 us (unit is 0.5 us)

This register will not be reset by the SOFTRESET task

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																					D	D	D		C	C	C		B	B	B		A	A	A
Reset 0x00000421				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW	RATE4M																																	
				For modes with 4 Mbps on-air bit rate, unit is 2 bit periods (Nrf_4Mbit0_5 and Nrf_4Mbit0_25 modes)																																	
				Default 1 (0.5 us = 2 on-air bit periods)																																	
B	RW	RATE2M																																	
				For modes with 2 Mbps on-air bit rate, unit is 1 bit period (Nrf_2Mbit, Ble_2Mbit, and Ieee802154_250Kbit modes)																																	
				Default 2 (1 us = 2 on-air bit periods)																																	
C	RW	RATE1M																																	
				For modes with 1 Mbps on-air bit rate, unit is 1/2 bit period (Nrf_1Mbit and Ble_1Mbit modes)																																	
				Also used for Coded phy (Ble_LR125Kbit and Ble_LR500Kbit modes)																																	
				Default 4 (2 us = 2 on-air bit periods)																																	
D	RW	RATE250K																																	
				For modes with 250 kbps on-air bit rate, unit is 1/8 bit period (Nrf_250Kbit mode)																																	
				Default 0																																	

8.17.14.100 STATE

Address offset: 0x520

Current radio state

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	STATE																																	
				Current radio state																																	
			Disabled	0																																	
				RADIO is in the DISABLED state																																	
			RxRu	1																																	
				RADIO is in the RXRU state																																	
			RxIdle	2																																	
				RADIO is in the RXIDLE state																																	
			Rx	3																																	
				RADIO is in the RX state																																	
			RxDisable	4																																	
				RADIO is in the RXDISABLE state																																	
			Settle	5																																	
				RADIO is in the SETTLE state																																	
			Pll	6																																	
				RADIO is in the PLL state																																	
			TxRu	9																																	
				RADIO is in the TXRU state																																	
			TxIdle	10																																	
				RADIO is in the TXIDLE state																																	
			Tx	11																																	
				RADIO is in the TX state																																	
			TxDisable	12																																	
				RADIO is in the TXDISABLE state																																	

8.17.14.101 EDCTRL

Address offset: 0x530

IEEE 802.15.4 energy detect control

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID						B	B	B	B	B	B				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x20000000				**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	EDCNT																																	
				IEEE 802.15.4 energy detect loop count Number of iterations to perform an ED scan. If set to 0 one scan is performed, otherwise the specified number + 1 of ED scans will be performed and the max ED value tracked in EDSAMPLE.																																
B	RW	EDPERIOD																																	
				IEEE 802.15.4 energy detect period, 4us resolution, no averaging except the IEEE 802.15.4 ED range 128us (32) EDPERIOD value other than Default is not supported.																																
			Default	32																															

8.17.14.102 EDSAMPLE

Address offset: 0x534

IEEE 802.15.4 energy detect level

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																												A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	EDLVL		[0..127]																															
				IEEE 802.15.4 energy detect level Register value must be converted to IEEE 802.15.4 range by an 8-bit saturating multiplication by factor ED_RSSISCALE, as shown in the code example for ED sampling																																

8.17.14.103 CCACTRL

Address offset: 0x538

IEEE 802.15.4 clear channel assessment control

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D C C C C C C C C B B B B B B B B A A A
Reset 0x052D0000				**0 0 0 0 0 1 0 1 0 0 1 0 1 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CCAMODE			CCA mode of operation
			EdMode	0	Energy above threshold Will report busy whenever energy is detected above CCAEDTHRES
			CarrierMode	1	Carrier seen Will report busy whenever compliant IEEE 802.15.4 signal is seen
			CarrierAndEdMode	2	Energy above threshold AND carrier seen
			CarrierOrEdMode	3	Energy above threshold OR carrier seen
			EdModeTest1	4	Energy above threshold test mode that will abort when first ED measurement over threshold is seen. No averaging.
B	RW	CCAEDTHRES			CCA energy busy threshold. Used in all the CCA modes except CarrierMode. Must be converted from IEEE 802.15.4 range by dividing by factor ED_RSSISCALE - similar to EDSAMPLE register
C	RW	CCACORRTHRES			CCA correlator busy threshold. Only relevant to CarrierMode, CarrierAndEdMode, and CarrierOrEdMode.
D	RW	CCACORRCNT			Limit for occurances above CCACORRTHRES. When not equal to zero the corrolator based signal detect is enabled.

8.17.14.104 DATAWHITE

Address offset: 0x540

Data whitening configuration

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B B B B B B B B A A A A A A A A
Reset 0x00890040				**0 0 0 0 0 0 0 0 1 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	IV			Whitening initial value Data whitening initial value.
B	RW	POLY			Whitening polynomial Data whitening polynomial. Bit 0 is always interpreted as 1.

8.17.14.105 AUXDATA.CNF[n] (n=0..0)

Address offset: 0x548 + (n × 0x4)

AUXDATA configuration

This register will not be reset by the SOFTRESET task

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ACQMODE			Acquisition mode
			Rtt	7	Baseband Channel Sounding RTT Data

8.17.14.106 AUXDATADMA[n].ENABLE (n=0..0)

Address offset: 0x550 + (n × 0x10)

Enable or disable data acquisition

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			Enable or disable data acquisition
			Disabled	0	Data acquisition is disabled
			Enabled	1	Data acquisition is enabled

8.17.14.107 AUXDATADMA[n].PTR (n=0..0)

Address offset: 0x554 + (n × 0x10)

DMA pointer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			Data pointer See the memory chapter for details about which memories are available for EasyDMA.

8.17.14.108 AUXDATADMA[n].MAXCNT (n=0..0)

Address offset: 0x558 + (n × 0x10)

Maximum number of 32-bit words to transfer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000040				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MAXCNT			Maximum number of 32-bit words to transfer

8.17.14.109 AUXDATADMA[n].AMOUNT (n=0..0)

Address offset: 0x55C + (n × 0x10)

Number of 32-bit words transferred in the last transaction

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT			Number of 32-bit words transferred in the last transaction

8.17.14.110 TIMING

Address offset: 0x704

Timing

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000001				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	RU			Ramp-up time
			Legacy	0	Legacy ramp-up time
			Fast	1	Fast ramp-up (default)

8.17.14.111 FREQUENCY

Address offset: 0x708

Frequency

Note: This register is double-buffered, and will only take effect on the next TXEN/RXEN/PLLEN task trigger

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000002				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	FREQUENCY			Radio channel frequency. Frequency = 2400 + FREQUENCY (MHz).
B	RW	MAP			Channel map selection. 0: Channel map between 2400 MHZ to 2500 MHz, Frequency = 2400 + FREQUENCY (MHz). 1: Channel map between 2360 MHZ to 2460 MHz, Frequency = 2360 + FREQUENCY (MHz).

8.17.14.112 TXPOWER

Address offset: 0x710

Output power

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A
Reset 0x00000013				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	TXPOWER			RADIO output power Output power, see value mapping to dBm below. **Note:** This register is double-buffered, and will only take effect on the next TXEN/RXEN/PLLEN task trigger
			MaxdBm	0x3F	+8 dBm
			Pos8dBm	0x3F	+8 dBm
			Pos7dBm	0x39	+7 dBm
			Pos6dBm	0x33	+6 dBm
			Pos5dBm	0x2D	+5 dBm
			Pos4dBm	0x28	+4 dBm
			Pos3dBm	0x23	+3 dBm
			Pos2dBm	0x1F	+2 dBm
			Pos1dBm	0x1B	+1 dBm
			0dBm	0x18	0 dBm
			Neg1dBm	0x15	-1 dBm
			Neg2dBm	0x13	-2 dBm
			Neg3dBm	0x11	-3 dBm

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	A A A A A A A A A A
Reset 0x00000013	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 1**

ID	R/W	Field	Value ID	Value	Description
			Neg4dBm	0xF	-4 dBm
			Neg5dBm	0xD	-5 dBm
			Neg6dBm	0xB	-6 dBm
			Neg7dBm	0xA	-7 dBm
			Neg8dBm	0x9	-8 dBm
			Neg9dBm	0x8	-9 dBm
			Neg10dBm	0x7	-10 dBm
			Neg12dBm	0x6	-12 dBm
			Neg14dBm	0x5	-14 dBm
			Neg16dBm	0x4	-16 dBm
			Neg18dBm	0x3	-18 dBm
			Neg20dBm	0x2	-20 dBm
			Neg22dBm	0x2	-22 dBm
			Neg28dBm	0x1	-28 dBm
			Neg40dBm	0x130	-40 dBm
			Neg46dBm	0x110	-46 dBm
			MindBm	0x0	Minimum output power

8.17.14.113 TIFS

Address offset: 0x714

Interframe spacing in µs

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	A A A A A A A A A A
Reset 0x00000000	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	TIFS			Interframe spacing in us. Interframe space is the time interval between two consecutive packets. It is defined as the time, in microseconds, from the end of the last bit of the previous packet to the start of the first bit of the subsequent packet.

8.17.14.114 RSSISAMPLE

Address offset: 0x718

RSSI sample

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	A A A A A A A
Reset 0x0000007F	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1**

ID	R/W	Field	Value ID	Value	Description
A	R	RSSISAMPLE			RSSI sample result. The value of this register is read as a positive value while the actual received signal strength is a negative value. Actual received signal strength is therefore as follows: received signal strength = -A dBm.

8.17.14.115 RXGAIN.CONFIG

Address offset: 0x7D4

Override configuration of receiver gain control loop

Overriding the default values can result in unpredictable behavior

This register will not be reset by the SOFTRESET task

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID							D					C	C	B	A	A	A	A																	
Reset 0x801230C3				**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW	AGCAAFOVERRIDE																																	
B	RW	AGCMIXOVERRIDE																																	
C	RW	AGCLNAOVERRIDE																																	
D	RW	AGCOVERRIDEGAIN																																	
			NoOverride	0																															
			Override	1																															

8.17.14.116 FREQFINETUNE

Address offset: 0x0804

Fine tuning of the RF frequency

Receiver sensitivity may be degraded when operating on 2414, 2415, 2430, 2431, 2446, 2447, 2462, 2463, 2478 or 2479 MHz with a small but non-zero FREQFINETUNE value

This register will not be reset by the SOFTRESET task

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																							A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	FREQFINETUNE																																	

Twos-complement number for fine-tuning the frequency. The step size is 488.28125 Hz, giving a range from -1 MHz to (one step short of) +1 MHz.

8.17.14.117 FECONFIG

Address offset: 0x908

Config register

This register will not be reset by the SOFTRESET task

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID															A																					
Reset 0x10800005				**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW	SCALERMODE																																	
			Disabled	0																															
			Enabled	1																															

Mode for narrow scaling output.

Classic log based scaling mode.

LUT based scaling mode.

8.17.14.118 CFO_STAT

Address offset: 0xB00

Carrier freq. offset estimate

This register will not be reset by the SOFTRESET task

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	SYNCOK			SYNC ok
			SyncNotOK	0	
			SyncOk	1	

8.17.14.119 DBCCORR

Address offset: 0xB40

Correlator thresholds

This register will not be reset by the SOFTRESET task

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A
Reset 0x1FFFFF90				**0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 1 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	TH			Correlation threshold

8.17.14.120 DFEMODE

Address offset: 0xD00

Whether to use Angle-of-Arrival (AOA) or Angle-of-Departure (AOD)

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	DFEOPMODE			Direction finding operation mode
			Disabled	0	Direction finding mode disabled
			AoD	2	Direction finding mode set to AoD
			AoA	3	Direction finding mode set to AoA

8.17.14.121 DFESTATUS

Address offset: 0xD04

DFE status information

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	SWITCHINGSTATE			Internal state of switching state machine
			Idle	0	Switching state Idle
			Offset	1	Switching state Offset
			Guard	2	Switching state Guard
			Ref	3	Switching state Ref
			Switching	4	Switching state Switching
			Ending	5	Switching state Ending
B	R	SAMPLINGSTATE			Internal state of sampling state machine
			Idle	0	Sampling state Idle
			Sampling	1	Sampling state Sampling

8.17.14.122 DFECTRL1

Address offset: 0xD10

Various configuration for Direction finding

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H H H H G G G G F F F E D D D C C C B A A A A A A
Reset 0x00023282				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 1 0 0 1 0 1 0 0 0 0 1 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	NUMBEROF8US			Length of the AoA/AoD procedure in number of 8 us units Always used in TX mode, but in RX mode only when CTEINLINECTRLEN is 0
B	RW	DFEINEXTENSION			Add CTE extension and do antenna switching/sampling in this extension
			CRC	1	AoA/AoD procedure triggered at end of CRC
			Payload	0	Antenna switching/sampling is done in the packet payload
C	RW	TSWITCHSPACING			Interval between every time the antenna is changed in the SWITCHING state
			4us	1	4us
			2us	2	2us
			1us	3	1us
D	RW	TSAMPLESPACINGREF			Interval between samples in the REFERENCE period
			4us	1	4us
			2us	2	2us
			1us	3	1us
			500ns	4	0.5us
			250ns	5	0.25us
			125ns	6	0.125us
E	RW	SAMPLETYPE			Whether to sample I/Q or magnitude/phase
			IQ	0	Complex samples in I and Q
			MagPhase	1	Complex samples as magnitude and phase
F	RW	TSAMPLESPACING			Interval between samples in the SWITCHING period when CTEINLINECTRLEN is 0 **Note:** Not used when CTEINLINECTRLEN is set. Then either CTEINLINERXMODE1US or CTEINLINERXMODE2US are used.
			4us	1	4us
			2us	2	2us
			1us	3	1us
			500ns	4	0.5us
			250ns	5	0.25us

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID								H	H	H	H	G	G	G	G		F	F	F	E	D	D	D		C	C	C	B		A	A	A	A	A	A
Reset 0x00023282				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**
ID	R/W	Field	Value ID	Value																															
			125ns	6																									0.125us						
G	RW	REPEATPATTERN																											Repeat every antenna pattern N times.						
			NoRepeat	0																									Do not repeat (1 time in total)						
H	RW	AGCBACKOFFGAIN																											Gain will be lowered by the specified number of gain steps at the start of CTE **Note:** First LNAGAIN gain drops, then MIXGAIN, then AAFGAIN						

8.17.14.123 DFECTRL2

Address offset: 0xD14

Start offset for Direction finding

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID								B	B	B	B	B	B	B	B	B	B	B	B				A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	TSWITCHOFFSET																											Signed value offset after the end of the CRC before starting switching in number of 16M cycles						
B	RW	TSAMPLEOFFSET																											Signed value offset before starting sampling in number of 16M cycles relative to the beginning of the REFERENCE state - 12 us after switching start						

8.17.14.124 SWITCHPATTERN

Address offset: 0xD28

GPIO patterns to be used for each antenna

Maximum 8 GPIOs can be controlled. To secure correct signal levels on the pins, the pins must be configured in the GPIO peripheral as described in Pin configuration.

If the total number of antenna slots is bigger than the number of patterns, we loop back to the pattern used after the reference pattern.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																												A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	SWITCHPATTERN																											Fill array of GPIO patterns for antenna control The GPIO pattern array size is 40 entries. When written, bit n corresponds to the GPIO configured in PSEL.DFEGPIO[n]. When read, returns the number of GPIO patterns written since the last time the array was cleared. Use CLEARPATTERN to clear the array.						

8.17.14.125 CLEARPATTERN

Address offset: 0xD2C

Clear the GPIO pattern array for antenna control

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	CLEARPATTERN			Clear the GPIO pattern array for antenna control Behaves as a task register, but does not have PPI nor IRQ

8.17.14.126 PSEL.DFEGPIO[n] (n=0..6)

Address offset: 0xD30 + (n × 0x4)

Pin select for DFE pin n

Note: Must be set before enabling the radio

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID									C															B	B	B	B	A	A	A	A	A
Reset 0xFFFFFFFF	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[15:0]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.17.14.127 DFEPACKET

DFE packet EasyDMA channel

8.17.14.127.1 DFEPACKET.PTR

Address offset: 0xD50

Data pointer

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			Data pointer See the memory chapter for details about which memories are available for EasyDMA.

8.17.14.127.2 DFEPACKET.MAXCNT

Address offset: 0xD54

Maximum number of bytes to transfer

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00004000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MAXCNT			Maximum number of bytes to transfer

8.17.14.127.3 DFEPACKET.AMOUNT

Address offset: 0xD58

Number of bytes transferred in the last transaction

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT			Number of bytes transferred in the last transaction

8.17.14.127.4 DFEPACKET.CURRENTAMOUNT

Address offset: 0xD5C

Number of bytes transferred in the current transaction

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT			Number of bytes transferred in the current transaction. Continuously updated.

8.17.14.128 CRCSTATUS

Address offset: 0xE0C

CRC status

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	CRCSTATUS			CRC status of packet received
			CRCError	0	Packet received with CRC error
			CRCOk	1	Packet received with CRC ok

8.17.14.129 RXMATCH

Address offset: 0xE10

Received address

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																															A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	RXMATCH			Received address
					Logical address of which previous packet was received

8.17.14.130 RXCRC

Address offset: 0xE14

CRC field of previously received packet

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	RXCRC			CRC field of previously received packet
					CRC field of previously received packet

8.17.14.131 DAI

Address offset: 0xE18

Device address match index

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	DAI			Device address match index
					Index (n) of device address, see DAB[n] and DAP[n], that got an address match

8.17.14.132 PDUSTAT

Address offset: 0xE1C

Payload status

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	PDUSTAT			Status on payload length vs. PCNF1.MAXLEN
			LessThan	0	Payload less than PCNF1.MAXLEN
			GreaterThan	1	Payload greater than PCNF1.MAXLEN
B	R	CISTAT			Status on what rate packet is received with in Long Range
			LR125kbit	0	Frame is received at 125 kbps
			LR500kbit	1	Frame is received at 500 kbps

8.17.14.133 PCNF0

Address offset: 0xE20

Packet configuration register 0

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H H G F F E E D D C C C C B A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	LFLEN			Length on air of LENGTH field in number of bits.
B	RW	S0LEN			Length on air of S0 field in number of bytes.
C	RW	S1LEN			Length on air of S1 field in number of bits.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H H G F F E E D D C C C C B A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
D	RW	S1INCL			Include or exclude S1 field in RAM
			Automatic	0	Include S1 field in RAM only if S1LEN > 0
			Include	1	Always include S1 field in RAM independent of S1LEN
E	RW	CILEN			Length of code indicator - long range
F	RW	PLEN			Length of preamble on air. Decision point: TASKS_START task
			8bit	0	8-bit preamble
			16bit	1	16-bit preamble
			32bitZero	2	32-bit zero preamble - used for IEEE 802.15.4
			LongRange	3	Preamble - used for BLE long range
G	RW	CRCINC			Indicates if LENGTH field contains CRC or not
			Exclude	0	LENGTH does not contain CRC
			Include	1	LENGTH includes CRC
H	RW	TERMLEN			Length of TERM field in Long Range operation

8.17.14.134 PCNF1

Address offset: 0xE28

Packet configuration register 1

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				F E D C C C B B B B B B B B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MAXLEN		[0..255]	Maximum length of packet payload. If the packet payload is larger than MAXLEN, the radio will truncate the payload to MAXLEN.
B	RW	STATLEN		[0..255]	Static length in number of bytes The static length parameter is added to the total length of the payload when sending and receiving packets, e.g. if the static length is set to N the radio will receive or send N bytes more than what is defined in the LENGTH field of the packet.
C	RW	BALEN		[2..4]	Base address length in number of bytes The address field is composed of the base address and the one byte long address prefix, e.g. set BALEN=2 to get a total address of 3 bytes.
D	RW	ENDIAN			On-air endianness of packet, this applies to the S0, LENGTH, S1, and the PAYLOAD fields.
			Little	0	Least significant bit on air first
			Big	1	Most significant bit on air first
E	RW	WHITEEN			Enable or disable packet whitening Including the address field to CRC check is not supported for whitened packets.
			Disabled	0	Disable
			Enabled	1	Enable
F	RW	WHITEOFFSET			If whitening is enabled S0 can be configured to be excluded from whitening
			Include	0	S0 included in whitening
			Exclude	1	S0 excluded from whitening

8.17.14.135 BASE0

Address offset: 0xE2C

Base address 0

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	BASE0			Base address 0

8.17.14.136 BASE1

Address offset: 0xE30

Base address 1

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	BASE1			Base address 1

8.17.14.137 PREFIX0

Address offset: 0xE34

Prefixes bytes for logical addresses 0-3

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	D	D	D	D	D	D	D	D	C	C	C	C	C	C	C	C	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A-D	RW	AP[i] (i=0..3)			Address prefix i

8.17.14.138 PREFIX1

Address offset: 0xE38

Prefixes bytes for logical addresses 4-7

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	D	D	D	D	D	D	D	D	C	C	C	C	C	C	C	C	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A-D	RW	AP[i] (i=4..7)			Address prefix i

8.17.14.139 TXADDRESS

Address offset: 0xE3C

Transmit address select

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	TXADDRESS			Transmit address select Logical address to be used when transmitting a packet

8.17.14.140 RXADDRESSES

Address offset: 0xE40

Receive address select

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-H	RW	ADDR[i] (i=0..7)			Enable or disable reception on logical address i
			Disabled	0	Disable
			Enabled	1	Enable

8.17.14.141 CRCCNF

Address offset: 0xE44

CRC configuration

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B B B A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	LEN			CRC length in number of bytes. **Note:** For MODE Ble_LR125Kbit and Ble_LR500Kbit, only LEN set to 3 is supported
			Disabled	0	CRC length is zero and CRC calculation is disabled
			One	1	CRC length is one byte and CRC calculation is enabled
			Two	2	CRC length is two bytes and CRC calculation is enabled
			Three	3	CRC length is three bytes and CRC calculation is enabled
B	RW	SKIPADDR			Control whether CRC calculation skips the address field. Other fields can also be skipped.
			Include	0	CRC calculation includes address field
			Skip	1	CRC calculation starting at first byte after address field.
			Ieee802154	2	CRC calculation starting at first byte after length field (as per 802.15.4 standard).
			SkipS0	3	CRC calculation starting at first byte after S0 field.
			SkipS1	4	CRC calculation starting at first byte after S1 field.

8.17.14.142 CRCPOLY

Address offset: 0xE48

CRC polynomial

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID									A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CRCPOLY			CRC polynomial Each term in the CRC polynomial is mapped to a bit in this register which index corresponds to the term's exponent. The least significant term/ bit is hardwired internally to 1, and bit number 0 of the register content is ignored by the hardware. The following example is for an 8 bit CRC polynomial: x8 + x7 + x3 + x2 + 1 = 1 1000 1101 .

8.17.14.143 CRCINIT

Address offset: 0xE4C

CRC initial value

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID									A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CRCINIT			CRC initial value Initial value for CRC calculation

8.17.14.144 DAB[n] (n=0..7)

Address offset: 0xE50 + (n × 0x4)

Device address base segment n

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DAB			Device address base segment n

8.17.14.145 DAP[n] (n=0..7)

Address offset: 0xE70 + (n × 0x4)

Device address prefix n

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DAP			Device address prefix n

8.17.14.146 DACNF

Address offset: 0xE90

Device address match configuration

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-H	RW	ENA[i] (i=0..7)			Enable or disable device address matching using device address i
			Disabled	0	Disabled
			Enabled	1	Enabled
I-P	RW	TXADD[i] (i=0..7)			TxAdd for device address i

8.17.14.147 BCC

Address offset: 0xE94

Bit counter compare

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	BCC			Bit counter compare Bit counter compare register

8.17.14.148 CTESTATUS

Address offset: 0xEA4

CTEInfo parsed from received packet

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C B A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	CTETIME			CTETime parsed from packet
B	R	RFU			RFU parsed from packet
C	R	CTETYPE			CTEType parsed from packet

8.17.14.149 MHRMATCHCONF

Address offset: 0xEB4

Search pattern configuration

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MHRMATCHCONF			Search pattern configuration

8.17.14.150 MHRMATCHMASK

Address offset: 0xEB8

Pattern mask

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	MHRMATCHMASK																																	
				Pattern mask																															

8.17.14.151 SFD

Address offset: 0xEBC

IEEE 802.15.4 start of frame delimiter

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																												A	A	A	A	A	A	A	A
Reset 0x000000A7				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW	SFD																																	
				IEEE 802.15.4 start of frame delimiter. Note: the least significant 4 bits of the SFD cannot all be zeros.																																	

8.17.14.152 CTEINLINECONF

Address offset: 0xEC0

Configuration for CTE inline mode

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				H	H	H	H	H	H	H	H	G	G	G	G	G	G	G	F	F	F	E	E	E				D	D		C	B			A
Reset 0x00002800				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	CTEINLINECTRLEN																																	
				Enable parsing of CTEInfo from received packet in BLE modes																																	
			Enabled	1																															
				Parsing of CTEInfo is enabled																															
			Disabled	0																															
				Parsing of CTEInfo is disabled																															
B	RW	CTEINFOINS1																																	
				CTEInfo is S1 byte or not																															
			InS1	1																															
				CTEInfo is in S1 byte (data PDU)																															
			NotInS1	0																															
				CTEInfo is NOT in S1 byte (advertising PDU)																															
C	RW	CTEERRORHANDLING																																	
				Sampling/switching if CRC is not OK																															
			Yes	1																															
				Sampling and antenna switching also when CRC is not OK																															
			No	0																															
				No sampling and antenna switching when CRC is not OK																															
D	RW	CTETIMEVALIDRANGE																																	
				Max range of CTETime **Note:** Valid range is 2-20 in BLE core spec. If larger than 20, it can be an indication of an error in the received packet.																															
			20	0																															
				20 in 8us unit (default) Set to 20 if parsed CTETime is larger han 20																															
			31	1																															
				31 in 8us unit																															
			63	2																															
				63 in 8us unit																															
E	RW	CTEINLINERXMODE1US																																	
				Spacing between samples for the samples in the SWITCHING period when CTEINLINEMODE is set When the device is in AoD mode, this is used when the received CTEType is "AoD 1 us". When in AoA mode, this is used when TSWITCHSPACING is 2 us.																															
			4us	1																															
				4us																															
			2us	2																															
				2us																															
			1us	3																															
				1us																															
			500ns	4																															
				0.5us																															

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H H H H H H H H G G G G G G G G F F F E E E D D C B A
Reset 0x00002800				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			250ns	5	0.25us
			125ns	6	0.125us
F	RW	CTEINLINERXMODE2US			Spacing between samples for the samples in the SWITCHING period when CTEINLINEMODE is set When the device is in AoD mode, this is used when the received CTEType is "AoD 2 us". When in AoA mode, this is used when TSWITCHSPACING is 4 us.
			4us	1	4us
			2us	2	2us
			1us	3	1us
			500ns	4	0.5us
			250ns	5	0.25us
			125ns	6	0.125us
G	RW	S0CONF			S0 bit pattern to match The least significant bit always corresponds to the first bit of S0 received
H	RW	S0MASK			S0 bit mask to set which bit to match The least significant bit always corresponds to the first bit of S0 received

8.17.14.153 PACKETPTR

Address offset: 0xED0

Packet pointer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			Data pointer See the memory chapter for details about which memories are available for EasyDMA.

8.17.14.154 CSTONES.MODE

Address offset: 0x1000

Selects the mode(s) that are activated on the start signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000003				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	TPM			Enable or disable TPM
			Disabled	0	TPM is disabled
			Enabled	1	TPM is enabled
B	RW	TFM			Enable or disable TFM
			Disabled	0	TFM is disabled
			Enabled	1	TFM is enabled

8.17.14.155 CSTONES.NUMSAMPLES

Address offset: 0x1004

Number of input samples at 2MHz sample rate

Bit number																																
ID																										A	A	A	A	A	A	A	A
Reset 0x000000A0																										**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field																								Value ID				Value			Description
A	RW	NUMSAMPLES																															Maximum value supported is 160

8.17.14.156 CSTONES.NEXTFREQUENCY

Address offset: 0x1008

The value of FREQUENCY that will be used in the next step

Bit number																																
ID																																
Reset 0x00000000																																
ID	R/W	Field																								Value ID				Value			Description
A	RW	NEXTFREQUENCY																															Frequency = 2400 + FREQUENCY (MHz)

8.17.14.157 CSTONES.FAEPEER

Address offset: 0x1014

FAEPEER (Frequency Actuation Error) of peer if known. Used during Mode 0 steps.

This register will not be reset by the SOFTRESET task

Bit number																																
ID																																
Reset 0x00000000																																
ID	R/W	Field																								Value ID				Value			Description
A	RW	FAEPEER																															Units 31.25 ppb.

8.17.14.158 CSTONES.PHASESHIFT

Address offset: 0x1018

Parameter used in TPM, provided by software

Bit number																																
ID																																
Reset 0x00000000																																
ID	R/W	Field																								Value ID				Value			Description
A	RW	PHASESHIFT																															Phase shift used in TPM calculation

8.17.14.159 CSTONES.NUMSAMPLESCOEFF

Address offset: 0x101C

Parameter used in TPM, provided by software

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x0000199A				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 1 1 0 0 1 1 0 1 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	NUMSAMPLESCOEFF			Coefficient 2**16/(numSamples/16) in Q1.15 format (Default numsamples value is 160)

8.17.14.160 CSTONES.PCT16

Address offset: 0x1020

Mean magnitude and mean phase converted to IQ

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B B B B B B B B B B B B B B B B A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	PCT16I			Inphase
B	R	PCT16Q			Quadrature

8.17.14.161 CSTONES.MAGPHASEMEAN

Address offset: 0x1024

Mean magnitude and phase of the signal before it is converted to PCT16

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B B B B B B B B B B B B B B B B A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	PHASE			Mean phase
B	R	MAG			Mean magnitude

8.17.14.162 CSTONES.IQRAWMEAN

Address offset: 0x1028

Mean of IQ values

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B B B B B B B B B B B B B B B B A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	IQRAWMEANI			Inphase
B	R	IQRAWMEANQ			Quadrature

8.17.14.163 CSTONES.MAGSTD

Address offset: 0x102C

Magnitude standard deviation approximation

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	MAGSTD			Magnitude standard deviation approximation

8.17.14.164 CSTONES.FFOEST

Address offset: 0x1034

FFO estimate

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	FFOEST			Units 62.5 ppb. Max range +/-100 ppm plus margin.

8.17.14.165 CSTONES.DOWNSAMPLE

Address offset: 0x1038

Turn on/off down sample of input IQ-signals

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLEFILTER			Turn on/off down sample of input IQ-signals
			OFF	0	Disable filter
			ON	1	Enable filter
B	RW	RATE			Indicating if BLE1M or BLE2M is used
			BLE1M	0	Radio mode BLE1M is used
			BLE2m	1	Radio mode BLE2M is used This enumerator is deprecated.
			BLE2M	1	Radio mode BLE2M is used

8.17.14.166 CSTONES.FREQOFFSET

Address offset: 0x1044

Frequency offset estimate

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	FREQOFFSET			

8.17.14.167 RTT.CONFIG

Address offset: 0x1050

RTT Config.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E E E E E E E E D D D D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EN			Enable RTT functionality. Only valid for BLE 1MBPS and 2MBPS mode
			Disabled	0	Disable RTT Block
			Enabled	1	Enable RTT Block
B	RW	ENFULLAA			Enabling/Disable ping over the entire access address.
			Disabled	0	Disable ping over the entire access address, i.e., enable only over the first 16-bit access address
			Enabled	1	Enable ping over the entire access address
C	RW	ROLE			Role as a Initiator or Reflector.
			Initiator	0	Initiator
			Reflector	1	Reflector
D	RW	NUMSEGMENTS			Number of 16bit payload segments available for ToA detection. Allowed values are 0, 2, 4, 6 and 8.
E	RW	EFSDELAY			Early Frame Sync Delay, i.e., number of cycles to wait for access address to anchor correctly. For Ble_2Mbit, the EFSDELAY value is 64 (2us) and for Ble_1Mbit, it can be 256 (8us).

8.17.14.168 RTT.SEGMENT01

Address offset: 0x1054

RTT segments 0 and 1

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	DATA			Data Bits 31 - 0

8.17.14.169 RTT.SEGMENT23

Address offset: 0x1058

RTT segments 2 and 3

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	DATA			Data Bits 63 - 32

8.17.14.170 RTT.SEGMENT45

Address offset: 0x105C

RTT segments 4 and 5

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	DATA			Data Bits 95 - 64

8.17.14.171 RTT.SEGMENT67

Address offset: 0x1060

RTT segments 6 and 7

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DATA			Data Bits 127 - 96

8.18 SAADC — Successive approximation analog-to-digital converter

The SAADC peripheral is a differential successive approximation register (SAR) analog-to-digital converter (ADC).

The main features of SAADC are the following:

- Four accuracy modes
  - 10-bit mode with a maximum sample rate of 2 Msps
  - 12-bit mode with a sample rate of 125 ksps
  - 14-bit mode with a sample rate of 62.5 ksps
  - Oversampling mode with configurable sample rate
- 10-bit arithmetic resolution in single-ended mode, 11-bit arithmetic resolution in differential mode, and 12/14-bit resolution with oversampling
- Full bandwidth up to 1 MHz (Nyquist) for all inputs
- Multiple analog inputs
  - GPIO pins with analog function (input range 0 to VDD)
  - VDD (divided down to a valid range using the programmable gain stage)
- Up to eight configurable gain input channels
  - One input per single-ended channel and two inputs per differential channel
  - Scan mode can be configured with both single-ended inputs and differential inputs
  - Each channel can be configured to select analog inputs
- Sampling triggered by a TASK from software or a DPPI channel for full flexibility on sample frequency source from low-power 32.768 kHz RTC or more accurate 1/16 MHz timers
- One-shot conversion mode to sample a single channel
- Scan mode to sample a series of channels in sequence with configurable sample delay
- Support for direct sample transfer to RAM using EasyDMA
- Interrupts on single sample and full buffer events
- Samples stored as 16-bit two's complement values for differential and single-ended sampling
- Continuous sampling without the need of an external timer
- On-the-fly limit checking

8.18.1 Shared resources

The SAADC peripheral can coexist with COMP and other peripherals using one of **`AIN[0..7]`** , provided these are assigned to different pins.

It is not recommended to select the same analog input pin for both peripherals.

8.18.2 Overview

The SAADC peripheral supports up to eight external analog inputs. It can be operated in one-shot mode with sampling under software control, or continuous mode with a programmable sampling rate.

The analog inputs can be configured as eight single-ended inputs, four differential inputs, or a combination of these. Each channel can be configured to select the following:

- GPIO pins with names starting with **AIN** which have analog input function, see Pin assignments on page 1219. Input range is 0 V to VDD.
- **VDD** (divided down to a valid range using the programmable gain stage)
- **DVDD**
- **AVDD**

Channels can be sampled individually in one-shot or continuous sampling modes, or multiple channels can be sampled in sequence using scan mode. To improve noise performance, channels can be oversampled.

Oversampling can be done with either noise shaping or by accumulation and averaging.

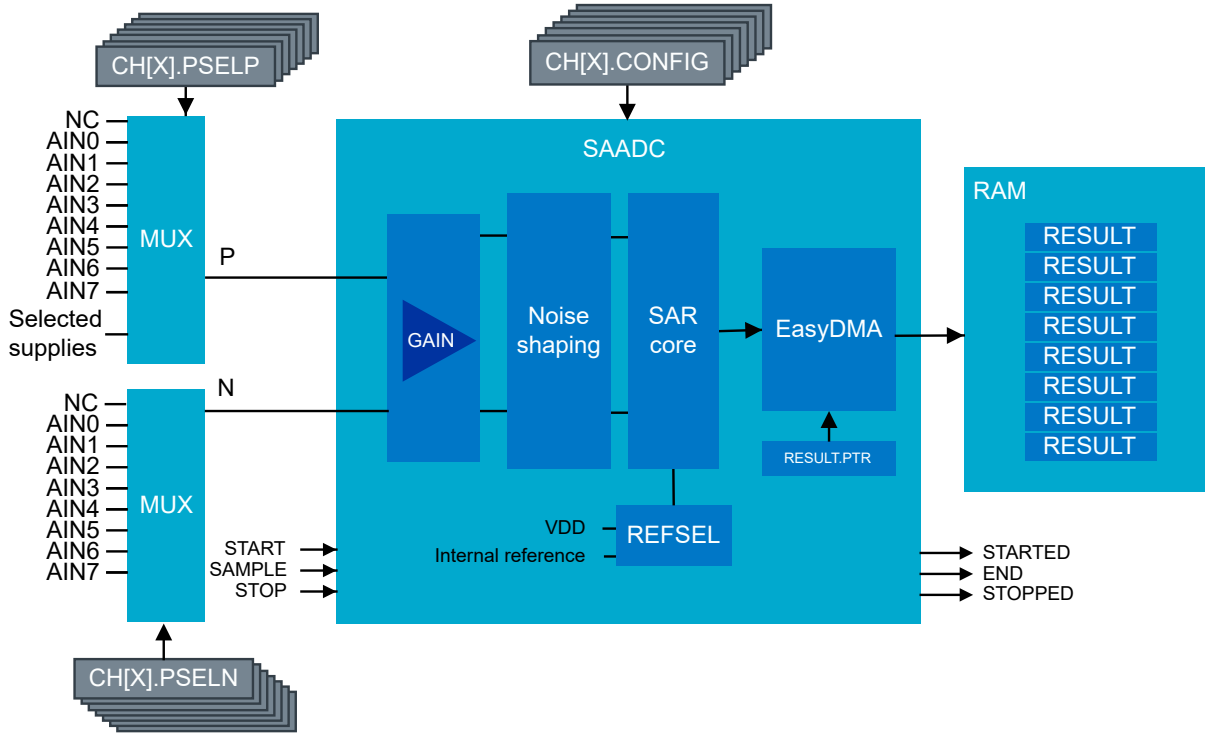


Figure 113: Simplified ADC block diagram

Internally, the ADC is always a differential analog-to-digital converter. By default, it is configured with single-ended input in the register CH[n].CONFIG using the MODE field. In single-ended mode, the negative input will be shorted to ground internally.

In single-ended mode, the ADC internal ground is the same as the external ground that is used for measuring the reference voltage. Because of this, the ADC is sensitive to ground bounce on the PCB in single-ended mode. Differential measurement is recommended if this is of concern.

8.18.3 Digital output

ADC output depends on the settings in the registers CH[n].CONFIG and RESOLUTION registers as follows:

```
RESULT=[V(P) – V(N) ] * GAIN/REFERENCE * 2(RESOLUTION - m)
```

```
V(P) = voltage at input P,
V(N) = voltage at input N,
GAIN = the selected gain setting
m = the mode setting (use m=0 if CONFIG.MODE=SE, or m=1 if CONFIG.MODE=Diff)
REFERENCE = selected reference voltage
```

The result generated by the ADC will deviate from what is expected due to DC errors like offset, gain, differential non-linearity (DNL), and integral non-linearity (INL). See Electrical specification for details on these parameters. The result can also vary due to AC errors like non-linearities in the GAIN block, settling errors due to high source impedance and sampling jitter. For battery measurement, the DC errors are most noticeable.

The ADC has a wide selection of gains controlled in the GAIN field of the register CH[n].CONFIG. If CH[n].CONFIG.REFSEL=0, the input range of the ADC core is nominally ±0.9 V differentially, and the input must be scaled accordingly with proper gain setting.

The ADC has a temperature dependent offset. If the ADC is to operate over a large temperature range, it is recommended to run CALIBRATEOFFSET at regular intervals. The CALIBRATEDONE event will be generated when the calibration has been completed. The DONE and RESULTDONE events will also be generated.

8.18.4 Analog inputs and channels

Up to eight analog input channels, CH[n](n=0..7), can be configured.

See Shared resources on page 554 for shared input with comparators.

For the SAADC peripheral to operate in one-shot mode, any available channel can be enabled. If more than one CH[n] is configured, SAADC enters scan mode.

An analog input is selected as a positive converter input and enabled by setting register CH[n].PSELP.

An analog input is selected as a negative converter input if register CH[n].PSELN is set. The register CH[n].PSELN will have no effect unless differential mode is enabled and CH[n].PSELP is set, see MODE field in register CH[n].CONFIG.

> **Note:** It is not recommended to use the same analog input pin for multiple analog peripheral functions. See Shared resources on page 554.

8.18.5 Operation modes

The SAADC input configuration supports several modes of sampling.

- One-shot, one channel
- One-shot, scan (one sample for each channel)
- Continuous, one channel
- Continuous, scan

> **Note:** Scan mode and oversampling should not be combined without burst.

Perform the following steps to sample ADC. At least one channel must be enabled in the register CH[n].CONFIG.

1. Enable ADC with register ENABLE.

2. Start ADC using the START task.
3. Trigger the SAMPLE task to sample ADC.

ADC indicates a single ongoing conversion via the register STATUS. Multiple conversions occur in the ADC during oversampling, noise shaping, scan mode, or continuous modes. As a result, the value in register STATUS will toggle at the end of each single conversion.

8.18.5.1 One-shot mode

One-shot mode is configured by enabling only one of the available channels defined in registers CH[n].PSELP, CH[n].PSELN, and CH[n].CONFIG.

After receiving a SAMPLE task, ADC powers up and starts to sample the input voltage. The CH[n].CONFIG.TACQ controls the acquisition time.

The time it takes to perform the first sample is given by the following equation:

$$t_{PWRUP} + t_{ACQ} + t_{CONV}$$

t_{ACQ} = the acquisition time
t_{CONV} = the conversion time
t_{PWRUP} = the time it takes to power up ADC

If multiple samples are taken, some combinations of t_{ACQ} and t_{CONV} will allow ADC to pipeline sampling and conversion. When this happens, the actual sampling time is t_{CONV}.

A DONE event signals that one sample has been taken.

In this mode, the RESULTDONE event has the same meaning as DONE when no oversampling takes place. Both events may occur before the actual value has been transferred into RAM by EasyDMA. For more information, see EasyDMA on page 559.

8.18.5.2 Continuous mode

Continuous sampling is achieved by using the internal timer in the ADC, or triggering the SAMPLE task from one of the general purpose timers through the PPI system.

The sample rate must meet the following criteria, depending on how many channels are active:

$$t_{SAMPLE} > t_{ACQ} + t_{CONV}$$

SAADC will use pipelining to increase sampling speed when the following are true:

tACQ=0
tCONV=0

In this case, the time for the first sample to arrive is given by the following equation:

$$t_{SAMPLE}=t_{PWRUP} + t_{ACQ} + t_{CONV}$$

Subsequent samples are given by the following equation:

$$f_{SAMPLE}=1/(t_{CONV})$$

The register SAMPLERATE can be used as a local timer instead of triggering individual SAMPLE tasks. When SAMPLERATE.MODE is set to Timers, it is sufficient to trigger SAMPLE task only once in order to start the SAADC peripheral. Triggering the STOP task will stop sampling. The SAMPLERATE.CC field controls the sample rate.

A DONE event signals that one sample has been taken.

In this mode, the RESULTDONE event has the same meaning as DONE when no oversampling takes place. Both events may occur before the value has been transferred into RAM by EasyDMA.

8.18.5.3 Improving sampling accuracy

SAADC has multiple options to improve sample accuracy. Noise shaping modes provide the highest performance by enabling a delta-sigma configuration with analog filtering, oversampling, and digital filtering. Pure oversampling is also supported.

Noise shaping

Noise shaping is implemented using the ADC peripheral within a first-order delta-sigma loop. The output is decimated and subsequently filtered with FIR filters. The sampling rate is 1 Msps in noise shaping modes and high-resolution settings (RESOLUTION ≥ 12) are recommended. Enable noise shaping by configuring the register NOISESHAPE. Depending on the selected mode, the input signal must be bandwidth limited. See Electrical specification parameters $f_{BW,NS}$ for details.

Noise shaping modes are configured using the register NOISESHAPE.

Mode	Description
0	Noise shaping is disabled.
NS1	Noise shaping and decimation by 8, giving a sample rate of 125 ksps.
NS2	Noise shaping and decimation by 32, giving a sample rate of 31.25 ksps. Recommended resolution setting is 14 bits.
NS3	Noise shaping with oversampling set by the register OVERSAMPLE.

Table 55: Noise shaping modes

Oversampling

Oversampling can improve the signal-to-noise ratio (SNR) by approximately 10log(OSR), where OSR is the oversampling ratio. Each oversampled result is the combination of the $2^{OVERSAMPLE}$ samples that have gone through an accumulate-and-average filter.

Oversampling and scanning can only be combined when burst mode is enabled. Without burst mode, oversampling and scanning will average across multiple input channels.

The register OVERSAMPLE controls the accumulator. The $2^{OVERSAMPLE}$ samples must be taken before the result is written to RAM. This can be achieved by either of the following:

- Use the built-in SAADC local timer and the register SAMPLERATE to perform sampling.
- Use the TIMER peripheral and DPPI to trigger the SAADC SAMPLE task to sample $2^{OVERSAMPLE}$ times at a fixed rate.
- Trigger the SAMPLE task $2^{OVERSAMPLE}$ times from software.
- Enable burst mode and trigger the SAMPLE task once.

Burst mode can be enabled to avoid manually triggering the SAMPLE task $2^{OVERSAMPLE}$ times. When burst is enabled, ADC automatically samples the input $2^{OVERSAMPLE}$ times consecutively, with an approximate timing of $(t_{ACQ} + t_{CONV}) \times 2^{OVERSAMPLE}$. Besides extending the conversion time, it behaves like one-shot mode.

A DONE event indicates that a single sample has been acquired, while a RESULTDONE event indicates that enough samples have been gathered to transfer an oversampled result to RAM.

Chopping

Chopping is a technique used to cancel offset voltages and other low frequency errors, and is enabled in the register CH[n].CONFIG.CHOPPING. When chopping is enabled, the input to ADC is alternately inverted (chopped) at the input mux, and a conversion is performed for each phase of chop. Chopping is combined with oversampling and ADC output is passed through the accumulate and average filter used in oversampling mode.

8.18.5.4 Scan mode

A channel is considered enabled if CH[n].PSELP is set. If more than one channel is enabled, SAADC enters scan mode.

In scan mode, one SAMPLE task will trigger one conversion per enabled channel. The time it takes to sample all channels is calculated by the following:

```
Total time < Sum(CH[x].t_ACQ+t_CONV), x=0..enabled channels
```

A DONE event signals that one channel has been sampled.

In this mode, the RESULTDONE event is generated after each sample, once for each channel.

8.18.6 EasyDMA

After configuring RESULT.PTR and RESULT.MAXCNT, SAADC resources are started by triggering the START task. SAADC uses EasyDMA to store results in a Result buffer in RAM.

The Result buffer is located at the address specified in the RESULT.PTR register. The RESULT.PTR register is double-buffered and can be updated and prepared for the next START task immediately after the STARTED event is generated. The size of the Result buffer (in bytes) is specified in the RESULT.MAXCNT register, and SAADC will generate an END event when the Result buffer is full, see SAADC on page 560. Results are stored in little-endian byte order in Data RAM. Every sample will be sign extended to 16 bits before stored in the Result buffer.

SAADC is stopped by triggering the STOP task. The STOP task will terminate an ongoing sampling. SAADC will generate a STOPPED event when it has stopped. If SAADC has already stopped when the STOP task is triggered, the STOPPED event is still generated.

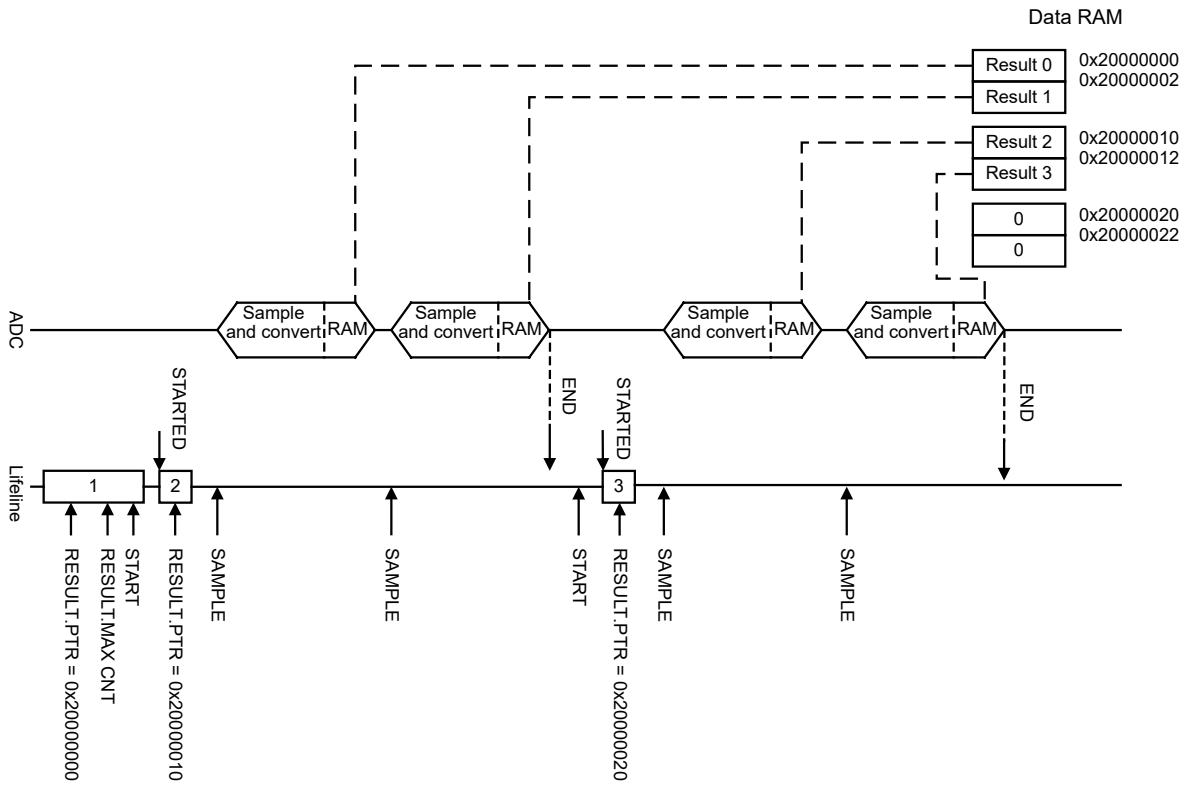


Figure 114: SAADC

If the RESULT.PTR is not pointing to a RAM region accessible from the peripheral, an EasyDMA transfer may result in a HardFault, memory corruption, or both. See Memory on page 13 for more information about the memory regions.

The EasyDMA will have finished accessing the RAM when the END or STOPPED event has been generated.

The RESULT.AMOUNT register can be read following an END event or a STOPPED event to see how many bytes have been transferred to the Result buffer in RAM from when the START task was triggered.

In scan mode, SAMPLE tasks can be triggered once the START task is triggered. The END event is generated when the number of samples transferred to memory reaches the value specified by RESULT.MAXCNT. After an END event, the START task needs to be triggered again before new samples can be taken. For more information about the scan mode, see Scan mode on page 559.

Note: Ensure the Result buffer can hold at least one result for each enabled channel by setting RESULT.MAXCNT ≥ 2 × (number of enabled channels). Each sample requires two bytes. Insufficient space leads to undefined behavior.

8.18.7 Reference

SAADC can use different reference voltages (VREF), controlled in the REFSEL field of the register CH[n].CONFIG.

The accepted VREF voltages are the following:

- Internal reference, VREF=0.9 V
- External reference, VREF provided by the EXTREF pin

Note: The external reference voltage should be close (±5%) to the internal reference voltage VREF. Using a lower reference voltage will lead to increased leakage and can lead to undefined behavior.

ADC is preceded by a gain stage which has a programmable gain. The voltage range seen at the input of the gain stage is the following:

```
VRangeDifferential=±VREF/GAIN
```

```
VRangeSingleEnded=±0.5*VREF/GAIN
```

The **AIN[0..7]** inputs cannot exceed VDD, or be lower than VSS. The input ranges are also limited by the REFERENCE and GAIN used.

The following condition must always hold true for valid measurements, otherwise the ADC will saturate and report the max value determined by the RESOLUTION.

```
[V(P) - V(N) ] * GAIN/REFERENCE ≤ 1
```

8.18.8 Acquisition time

To sample the input voltage, the SAADC peripheral connects a capacitor to the input.

The acquisition time indicates how long the capacitor is connected, see the TACQ field in the register CH[n].CONFIG. The required acquisition time depends on the source (R_{source}) resistance. For high source resistance, the acquisition time should be increased, see Acquisition time on page 561.

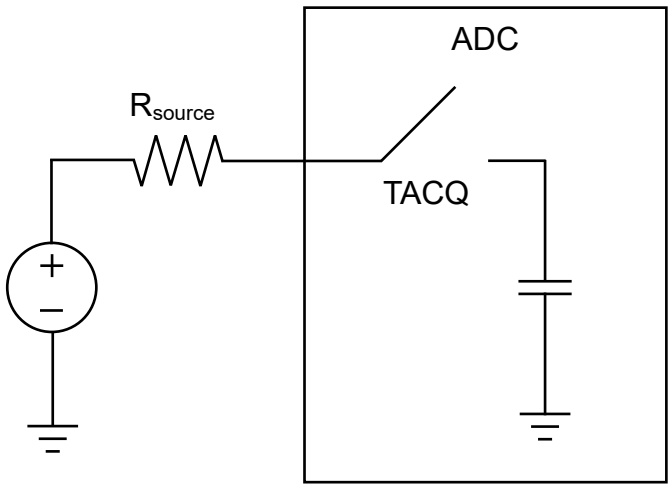


Figure 115: Simplified SAADC sample network

TACQ	Maximum source resistance [kΩ]
≤1	<1
3	10
5	40
10	100
15	200
20	400
40	800

Table 56: Acquisition time

8.18.9 Limits event monitoring

Monitoring a channel with an event can be set up by configuring limit register CH[n].LIMIT.

If the conversion result is higher than the defined high limit, or lower than the defined low limit, the appropriate event will be generated. Limit comparison happens automatically and does not need to be enabled.

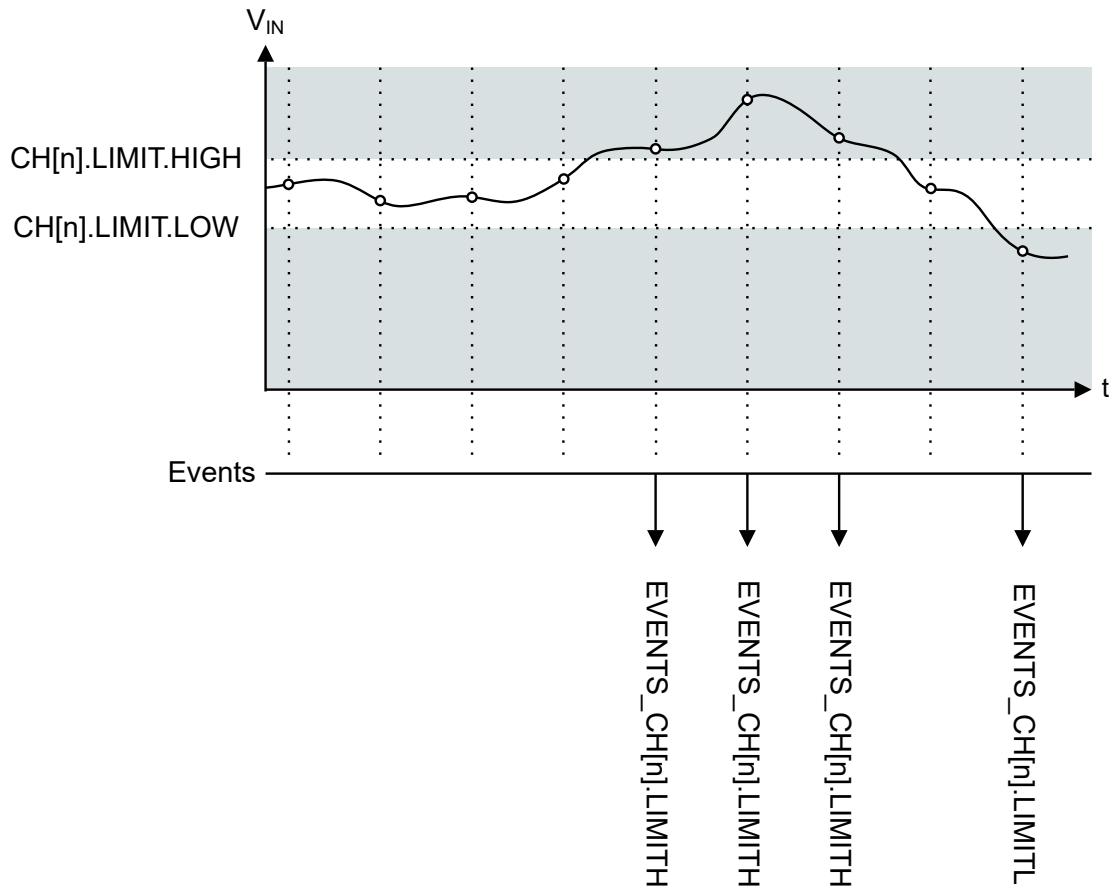


Figure 116: Example of limits monitoring on channel [n]

When setting the channel limits, CH[n].LIMIT.HIGH must be higher than, or equal to, CH[n].LIMIT.LOW. In other words, an event can only be generated when the input signal has been sampled outside of the defined limits. It is not possible to generate an event when the input signal is inside a defined range by switching high and low limits.

If a channel does not require comparison, software ignores the related events. In that situation, the value of the limits registers is irrelevant, so it does not matter if CH[n].LIMIT.LOW is lower than CH[n].LIMIT.HIGH or not.

8.18.10 Performance factors

Clock jitter can affect sample timing accuracy and circuit noise can affect ADC performance.

Jitter can be between START tasks or from START task to acquisition. START timer accuracy and regulator start up times and references will contribute to variability. Sources of circuit noise may include CPU activity and the DC/DC regulator. Best ADC performance is achieved using START timing based on the TIMER module, HFXO clock source, and Constant Latency mode.

8.18.11 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
SAADC : S SAADC : NS	GLOBAL	0x500D5000 0x400D5000	US	S	SA	No	Successive approximation analog-to-digital converter SAADC

Configuration

Instance	Domain	Configuration
SAADC : S SAADC : NS	GLOBAL	CURRENTAMOUNT register included.

Register overview

Register	Offset	TZ	Description
TASKS_START	0x000		Start the ADC and prepare the result buffer in RAM
TASKS_SAMPLE	0x004		Take one ADC sample, if scan is enabled all channels are sampled. This task requires that SAADC has started, i.e. EVENTS_STARTED was set and EVENTS_STOPPED was not.
TASKS_STOP	0x008		Stop the ADC and terminate any on-going conversion
TASKS_CALIBRATEOFFSET	0x00C		Starts offset auto-calibration
SUBSCRIBE_START	0x080		Subscribe configuration for task START
SUBSCRIBE_SAMPLE	0x084		Subscribe configuration for task SAMPLE
SUBSCRIBE_STOP	0x088		Subscribe configuration for task STOP
SUBSCRIBE_CALIBRATEOFFSET	0x08C		Subscribe configuration for task CALIBRATEOFFSET
EVENTS_STARTED	0x100		The ADC DMA has started
EVENTS_END	0x104		The ADC has filled up the Result buffer
EVENTS_DONE	0x108		A conversion task has been completed. Depending on the mode, multiple conversions might be needed for a result to be transferred to RAM.
EVENTS_RESULTDONE	0x10C		A result is ready to get transferred to RAM.
EVENTS_CALIBRATEDONE	0x110		Calibration is complete
EVENTS_STOPPED	0x114		The ADC DMA has stopped
EVENTS_CH[n].LIMITH	0x118		Last results is above CH[n].LIMIT.HIGH
EVENTS_CH[n].LIMITL	0x11C		Last results is below CH[n].LIMIT.LOW
PUBLISH_STARTED	0x180		Publish configuration for event STARTED
PUBLISH_END	0x184		Publish configuration for event END
PUBLISH_DONE	0x188		Publish configuration for event DONE
PUBLISH_RESULTDONE	0x18C		Publish configuration for event RESULTDONE
PUBLISH_CALIBRATEDONE	0x190		Publish configuration for event CALIBRATEDONE
PUBLISH_STOPPED	0x194		Publish configuration for event STOPPED
PUBLISH_CH[n].LIMITH	0x198		Publish configuration for event CH[n].LIMITH
PUBLISH_CH[n].LIMITL	0x19C		Publish configuration for event CH[n].LIMITL
SHORTS	0x200		Shortcuts between local events and tasks
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
STATUS	0x400		Status
TRIM.LINCALCOEFF[n]	0x440		Linearity calibration coefficient
ENABLE	0x500		Enable or disable ADC

Register	Offset	TZ	Description
CH[n].PSELP	0x510		Input positive pin selection for CH[n]
CH[n].PSELN	0x514		Input negative pin selection for CH[n]
CH[n].CONFIG	0x518		Input configuration for CH[n]
CH[n].LIMIT	0x51C		High/low limits for event monitoring a channel
BURST	0x5E8		Enable burst mode
RESOLUTION	0x5F0		Resolution configuration
OVERSAMPLE	0x5F4		Oversampling configuration. OVERSAMPLE should not be combined with SCAN unless burst is enabled. The RESOLUTION is applied before averaging, thus for high OVERSAMPLE a higher RESOLUTION should be used.
SAMPLERATE	0x5F8		Configures the sampling rate for either task-triggered or continuous operation using a local timer
RESULT.PTR	0x62C		Data pointer
RESULT.MAXCNT	0x630		Maximum number of buffer bytes to transfer. Note that one sample is two bytes.
RESULT.AMOUNT	0x634		Number of buffer bytes transferred since last START, updated after the END or STOPPED events
RESULT.CURRENTAMOUNT	0x638		Number of buffer bytes transferred since last START, continuously updated
NOISESHAPE	0x654		SAADC provides two operational noise shaping modes (one that prioritizes higher bandwith, while the other prioritizes higher accuracy) that allow trade-offs between ADC resolution, power consumption, and signal bandwidth.

8.18.11.1 TASKS_START

Address offset: 0x000

Start the ADC and prepare the result buffer in RAM

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_START			Start the ADC and prepare the result buffer in RAM
			Trigger	1	Trigger task

8.18.11.2 TASKS_SAMPLE

Address offset: 0x004

Take one ADC sample, if scan is enabled all channels are sampled. This task requires that SAADC has started, i.e. EVENTS_STARTED was set and EVENTS_STOPPED was not.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_SAMPLE			Take one ADC sample, if scan is enabled all channels are sampled. This task requires that SAADC has started, i.e. EVENTS_STARTED was set and EVENTS_STOPPED was not.
			Trigger	1	Trigger task

8.18.11.3 TASKS_STOP

Address offset: 0x008

Stop the ADC and terminate any on-going conversion

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Stop the ADC and terminate any on-going conversion
			Trigger	1	Trigger task

8.18.11.4 TASKS_CALIBRATEOFFSET

Address offset: 0x00C

Starts offset auto-calibration

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_CALIBRATEOFFSET			Starts offset auto-calibration
			Trigger	1	Trigger task

8.18.11.5 SUBSCRIBE_START

Address offset: 0x080

Subscribe configuration for task START

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task START will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.18.11.6 SUBSCRIBE_SAMPLE

Address offset: 0x084

Subscribe configuration for task SAMPLE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task SAMPLE will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.18.11.7 SUBSCRIBE_STOP

Address offset: 0x088

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.18.11.8 SUBSCRIBE_CALIBRATEOFFSET

Address offset: 0x08C

Subscribe configuration for task CALIBRATEOFFSET

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task CALIBRATEOFFSET will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.18.11.9 EVENTS_STARTED

Address offset: 0x100

The ADC DMA has started

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_STARTED			The ADC DMA has started
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.18.11.10 EVENTS_END

Address offset: 0x104

The ADC has filled up the Result buffer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_END			The ADC has filled up the Result buffer
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.18.11.11 EVENTS_DONE

Address offset: 0x108

A conversion task has been completed. Depending on the mode, multiple conversions might be needed for a result to be transferred to RAM.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_DONE			A conversion task has been completed. Depending on the mode, multiple conversions might be needed for a result to be transferred to RAM.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.18.11.12 EVENTS_RESULTDONE

Address offset: 0x10C

A result is ready to get transferred to RAM.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_RESULTDONE			A result is ready to get transferred to RAM.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.18.11.13 EVENTS_CALIBRATEDONE

Address offset: 0x110

Calibration is complete

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_CALIBRATEDONE			Calibration is complete
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.18.11.14 EVENTS_STOPPED

Address offset: 0x114

The ADC DMA has stopped

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_STOPPED			The ADC DMA has stopped
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.18.11.15 EVENTS_CH[n] (n=0..7)

Peripheral events.

8.18.11.15.1 EVENTS_CH[n].LIMITH (n=0..7)

Address offset: 0x118 + (n × 0x8)

Last results is above CH[n].LIMIT.HIGH

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	LIMITH			Last results is above CH[n].LIMIT.HIGH
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.18.11.15.2 EVENTS_CH[n].LIMITL (n=0..7)

Address offset: 0x11C + (n × 0x8)

Last results is below CH[n].LIMIT.LOW

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	LIMITL			Last results is below CH[n].LIMIT.LOW
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.18.11.16 PUBLISH_STARTED

Address offset: 0x180

Publish configuration for event STARTED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event STARTED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.18.11.17 PUBLISH_END

Address offset: 0x184

Publish configuration for event END

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event END will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.18.11.18 PUBLISH_DONE

Address offset: 0x188

Publish configuration for event DONE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event DONE will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.18.11.19 PUBLISH_RESULTDONE

Address offset: 0x18C

Publish configuration for event RESULTDONE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event RESULTDONE will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.18.11.20 PUBLISH_CALIBRATEDONE

Address offset: 0x190

Publish configuration for event CALIBRATEDONE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event CALIBRATEDONE will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.18.11.21 PUBLISH_STOPPED

Address offset: 0x194

Publish configuration for event STOPPED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event STOPPED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.18.11.22 PUBLISH_CH[n] (n=0..7)

Publish configuration for events

8.18.11.22.1 PUBLISH_CH[n].LIMITH (n=0..7)

Address offset: 0x198 + (n × 0x8)

Publish configuration for event CH[n].LIMITH

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event CH[n].LIMITH will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.18.11.22.2 PUBLISH_CH[n].LIMITL (n=0..7)

Address offset: 0x19C + (n × 0x8)

Publish configuration for event CH[n].LIMITL

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event CH[n].LIMITL will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.18.11.23 SHORTS

Address offset: 0x200

Shortcuts between local events and tasks

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DONE_SAMPLE			Shortcut between event DONE and task SAMPLE
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
B	RW	END_START			Shortcut between event END and task START
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut

8.18.11.24 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	STARTED			Enable or disable interrupt for event STARTED
			Disabled	0	Disable
			Enabled	1	Enable
B	RW	END			Enable or disable interrupt for event END
			Disabled	0	Disable
			Enabled	1	Enable
C	RW	DONE			Enable or disable interrupt for event DONE
			Disabled	0	Disable
			Enabled	1	Enable
D	RW	RESULTDONE			Enable or disable interrupt for event RESULTDONE
			Disabled	0	Disable
			Enabled	1	Enable
E	RW	CALIBRATEDONE			Enable or disable interrupt for event CALIBRATEDONE
			Disabled	0	Disable
			Enabled	1	Enable
F	RW	STOPPED			Enable or disable interrupt for event STOPPED
			Disabled	0	Disable
			Enabled	1	Enable
G	RW	CH0LIMITH			Enable or disable interrupt for event CH0LIMITH
			Disabled	0	Disable
			Enabled	1	Enable
H	RW	CH0LIMITL			Enable or disable interrupt for event CH0LIMITL
			Disabled	0	Disable
			Enabled	1	Enable
I	RW	CH1LIMITH			Enable or disable interrupt for event CH1LIMITH
			Disabled	0	Disable
			Enabled	1	Enable
J	RW	CH1LIMITL			Enable or disable interrupt for event CH1LIMITL
			Disabled	0	Disable
			Enabled	1	Enable
K	RW	CH2LIMITH			Enable or disable interrupt for event CH2LIMITH
			Disabled	0	Disable
			Enabled	1	Enable

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
L	RW	CH2LIMITL			Enable or disable interrupt for event CH2LIMITL
			Disabled	0	Disable
			Enabled	1	Enable
M	RW	CH3LIMITH			Enable or disable interrupt for event CH3LIMITH
			Disabled	0	Disable
			Enabled	1	Enable
N	RW	CH3LIMITL			Enable or disable interrupt for event CH3LIMITL
			Disabled	0	Disable
			Enabled	1	Enable
O	RW	CH4LIMITH			Enable or disable interrupt for event CH4LIMITH
			Disabled	0	Disable
			Enabled	1	Enable
P	RW	CH4LIMITL			Enable or disable interrupt for event CH4LIMITL
			Disabled	0	Disable
			Enabled	1	Enable
Q	RW	CH5LIMITH			Enable or disable interrupt for event CH5LIMITH
			Disabled	0	Disable
			Enabled	1	Enable
R	RW	CH5LIMITL			Enable or disable interrupt for event CH5LIMITL
			Disabled	0	Disable
			Enabled	1	Enable
S	RW	CH6LIMITH			Enable or disable interrupt for event CH6LIMITH
			Disabled	0	Disable
			Enabled	1	Enable
T	RW	CH6LIMITL			Enable or disable interrupt for event CH6LIMITL
			Disabled	0	Disable
			Enabled	1	Enable
U	RW	CH7LIMITH			Enable or disable interrupt for event CH7LIMITH
			Disabled	0	Disable
			Enabled	1	Enable
V	RW	CH7LIMITL			Enable or disable interrupt for event CH7LIMITL
			Disabled	0	Disable
			Enabled	1	Enable

8.18.11.25 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1S	STARTED			Write '1' to enable interrupt for event STARTED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
B	RW W1S	END			Write '1' to enable interrupt for event END
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1S	DONE			Write '1' to enable interrupt for event DONE
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1S	RESULTDONE			Write '1' to enable interrupt for event RESULTDONE
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1S	CALIBRATEDONE			Write '1' to enable interrupt for event CALIBRATEDONE
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1S	STOPPED			Write '1' to enable interrupt for event STOPPED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1S	CH0LIMITH			Write '1' to enable interrupt for event CH0LIMITH
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
H	RW W1S	CH0LIMITL			Write '1' to enable interrupt for event CH0LIMITL
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
I	RW W1S	CH1LIMITH			Write '1' to enable interrupt for event CH1LIMITH
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
J	RW W1S	CH1LIMITL			Write '1' to enable interrupt for event CH1LIMITL
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
K	RW W1S	CH2LIMITH			Write '1' to enable interrupt for event CH2LIMITH
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID														V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
L	RW W1S	CH2LIMITL												Write '1' to enable interrupt for event CH2LIMITL																					
			Set	1										Enable																					
			Disabled	0										Read: Disabled																					
			Enabled	1										Read: Enabled																					
M	RW W1S	CH3LIMITH												Write '1' to enable interrupt for event CH3LIMITH																					
			Set	1										Enable																					
			Disabled	0										Read: Disabled																					
			Enabled	1										Read: Enabled																					
N	RW W1S	CH3LIMITL												Write '1' to enable interrupt for event CH3LIMITL																					
			Set	1										Enable																					
			Disabled	0										Read: Disabled																					
			Enabled	1										Read: Enabled																					
O	RW W1S	CH4LIMITH												Write '1' to enable interrupt for event CH4LIMITH																					
			Set	1										Enable																					
			Disabled	0										Read: Disabled																					
			Enabled	1										Read: Enabled																					
P	RW W1S	CH4LIMITL												Write '1' to enable interrupt for event CH4LIMITL																					
			Set	1										Enable																					
			Disabled	0										Read: Disabled																					
			Enabled	1										Read: Enabled																					
Q	RW W1S	CH5LIMITH												Write '1' to enable interrupt for event CH5LIMITH																					
			Set	1										Enable																					
			Disabled	0										Read: Disabled																					
			Enabled	1										Read: Enabled																					
R	RW W1S	CH5LIMITL												Write '1' to enable interrupt for event CH5LIMITL																					
			Set	1										Enable																					
			Disabled	0										Read: Disabled																					
			Enabled	1										Read: Enabled																					
S	RW W1S	CH6LIMITH												Write '1' to enable interrupt for event CH6LIMITH																					
			Set	1										Enable																					
			Disabled	0										Read: Disabled																					
			Enabled	1										Read: Enabled																					
T	RW W1S	CH6LIMITL												Write '1' to enable interrupt for event CH6LIMITL																					
			Set	1										Enable																					
			Disabled	0										Read: Disabled																					
			Enabled	1										Read: Enabled																					
U	RW W1S	CH7LIMITH												Write '1' to enable interrupt for event CH7LIMITH																					
			Set	1										Enable																					
			Disabled	0										Read: Disabled																					
			Enabled	1										Read: Enabled																					

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
V	RW W1S	CH7LIMITL			Write '1' to enable interrupt for event CH7LIMITL
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.18.11.26 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	STARTED			Write '1' to disable interrupt for event STARTED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	END			Write '1' to disable interrupt for event END
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	DONE			Write '1' to disable interrupt for event DONE
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1C	RESULTDONE			Write '1' to disable interrupt for event RESULTDONE
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1C	CALIBRATEDONE			Write '1' to disable interrupt for event CALIBRATEDONE
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1C	STOPPED			Write '1' to disable interrupt for event STOPPED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1C	CH0LIMITH			Write '1' to disable interrupt for event CH0LIMITH
			Clear	1	Disable
			Disabled	0	Read: Disabled

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID														V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
			Enabled	1	Read: Enabled																														
H	RW W1C	CH0LIMITL			Write '1' to disable interrupt for event CH0LIMITL																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
I	RW W1C	CH1LIMITH			Write '1' to disable interrupt for event CH1LIMITH																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
J	RW W1C	CH1LIMITL			Write '1' to disable interrupt for event CH1LIMITL																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
K	RW W1C	CH2LIMITH			Write '1' to disable interrupt for event CH2LIMITH																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
L	RW W1C	CH2LIMITL			Write '1' to disable interrupt for event CH2LIMITL																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
M	RW W1C	CH3LIMITH			Write '1' to disable interrupt for event CH3LIMITH																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
N	RW W1C	CH3LIMITL			Write '1' to disable interrupt for event CH3LIMITL																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
O	RW W1C	CH4LIMITH			Write '1' to disable interrupt for event CH4LIMITH																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
P	RW W1C	CH4LIMITL			Write '1' to disable interrupt for event CH4LIMITL																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
Q	RW W1C	CH5LIMITH			Write '1' to disable interrupt for event CH5LIMITH																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Enabled	1	Read: Enabled
R	RW W1C	CH5LIMITL			Write '1' to disable interrupt for event CH5LIMITL
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
S	RW W1C	CH6LIMITH			Write '1' to disable interrupt for event CH6LIMITH
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
T	RW W1C	CH6LIMITL			Write '1' to disable interrupt for event CH6LIMITL
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
U	RW W1C	CH7LIMITH			Write '1' to disable interrupt for event CH7LIMITH
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
V	RW W1C	CH7LIMITL			Write '1' to disable interrupt for event CH7LIMITL
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.18.11.27 STATUS

Address offset: 0x400

Status

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	STATUS			Status
			Ready	0	ADC is ready. No on-going conversion.
			Busy	1	ADC is busy. Conversion is in progress.

8.18.11.28 TRIM.LINCALCOEFF[n] (n=0..5)

Address offset: 0x440 + (n × 0x4)

Linearity calibration coefficient

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	VAL		0..65535	value

8.18.11.29 ENABLE

Address offset: 0x500

Enable or disable ADC

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			Enable or disable ADC
			Disabled	0	Disable ADC
			Enabled	1	Enable ADC When enabled, the ADC will acquire access to the GPIO pins specified in the CH[n].PSELP and CH[n].PSELN registers.

8.18.11.30 CH[n].PSELP (n=0..7)

Address offset: 0x510 + (n × 0x10)

Input positive pin selection for CH[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D C C B B B A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN			GPIO pin selection.
B	RW	PORT			GPIO port selection
C	RW	INTERNAL			Internal input selection for analog positive input when CH[n].PSELP.CONNECT = Internal
			Avdd	0	Connected to the internal 0.9V analog supply rail
			Dvdd	1	Connected to the internal 0.9V digital supply rail
			Vdd	2	Connected to VDD
D	RW	CONNECT			Connection
			NC	0	Not connected
			AnalogInput	1	Select analog input The analog input is connected based on CH[n].PSELP.PIN and CH[n].PSELP.PORT
			Internal	2	Selects internal inputs. The analog input is connected based on CH[n].PSELP.INTERNAL

8.18.11.31 CH[n].PSELN (n=0..7)

Address offset: 0x514 + (n × 0x10)

Input negative pin selection for CH[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D C C B B B B A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN			GPIO pin selection.
B	RW	PORT			GPIO Port selection
C	RW	INTERNAL			Internal input selection for analog negative input when CH[n].PSELN.CONNECT = Internal
			Avdd	0	Connected to the internal 0.9V analog supply rail
			Dvdd	1	Connected to the internal 0.9V digital supply rail
			Vdd	2	Connected to VDD
D	RW	CONNECT			Connection
			NC	0	Not connected
			AnalogInput	1	Select analog input The analog input is connected based on CH[n].PSELN.PIN and CH[n].PSELN.PORT
			Internal	2	Selects internal inputs. The actual analog input is CH[n].PSELN.INTERNAL

8.18.11.32 CH[n].CONFIG (n=0..7)

Address offset: 0x518 + (n × 0x10)

Input configuration for CH[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				F F F E E E E E E E E D C B B B A
Reset 0x00020000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHOPPING			Enable chopping
			Disabled	0	Chopping is disabled
			Enabled	1	Chopping is enabled
B	RW	GAIN			Gain control
			Gain2	0	2
			Gain1	1	1
			Gain2_3	2	2/3
			Gain2_4	3	2/4
			Gain2_5	4	2/5
			Gain2_6	5	2/6
			Gain2_7	6	2/7
			Gain2_8	7	2/8
C-	RW	REFSEL			Reference control
			Internal	0	Internal reference (0.9 V)
			External	1	External reference voltage
D	RW	MODE			Enable differential mode
			SE	0	Single ended, PSELN will be ignored, negative input to ADC shorted to GND
			Diff	1	Differential
E	RW	TACQ		[1..319]	Acquisition time, the time the ADC uses to sample the input voltage. Resulting acquistion time is ((TACQ+1) x 125 ns)
F	RW	TCONV		[1..7]	Conversion time. Resulting conversion time is ((TCONV+1) x 250 ns)

8.18.11.33 CH[n].LIMIT (n=0..7)

Address offset: 0x51C + (n × 0x10)

High/low limits for event monitoring a channel

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x7FFF8000				**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	LOW		[-32768 to +32767]																															
B	RW	HIGH		[-32768 to +32767]																															

8.18.11.34 BURST

Address offset: 0x5E8

Enable burst mode

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	BURST																																	
			Disabled	0																															
			Enabled	1																															

8.18.11.35 RESOLUTION

Address offset: 0x5F0

Resolution configuration

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																	A	A	A
Reset 0x00000001				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW	VAL																																	
			8bit	0																															
			10bit	1																															
			12bit	2																															
			14bit	3																															

8.18.11.36 OVERSAMPLE

Address offset: 0x5F4

Oversampling configuration. OVERSAMPLE should not be combined with SCAN unless burst is enabled. The RESOLUTION is applied before averaging, thus for high OVERSAMPLE a higher RESOLUTION should be used.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	OVERSAMPLE			Oversample control
			Bypass	0	Bypass oversampling
			Over2x	1	Oversample 2x
			Over4x	2	Oversample 4x
			Over8x	3	Oversample 8x
			Over16x	4	Oversample 16x
			Over32x	5	Oversample 32x
			Over64x	6	Oversample 64x
			Over128x	7	Oversample 128x
			Over256x	8	Oversample 256x

8.18.11.37 SAMPLERATE

Address offset: 0x5F8

Configures the sampling rate for either task-triggered or continuous operation using a local timer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CC		[8..2047]	Capture and compare value. Sample rate is 16 MHz/CC
B	RW	MODE			Select mode for sample rate control
			Task	0	Rate is controlled from SAMPLE task
			Timers	1	Rate is controlled from local timer (use CC to control the rate)

8.18.11.38 RESULT

RESULT EasyDMA channel

8.18.11.38.1 RESULT.PTR

Address offset: 0x62C

Data pointer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x20000000				**0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			Data pointer

Note: See the memory chapter for details about which memories are available for EasyDMA.

8.18.11.38.2 RESULT.MAXCNT

Address offset: 0x630

Maximum number of buffer bytes to transfer. Note that one sample is two bytes.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MAXCNT			Maximum number of buffer bytes to transfer. Note that one sample is two bytes.

8.18.11.38.3 RESULT.AMOUNT

Address offset: 0x634

Number of buffer bytes transferred since last START, updated after the END or STOPPED events

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT			Number of buffer bytes transferred since last START, updated after the END or STOPPED events.

8.18.11.38.4 RESULT.CURRENTAMOUNT

Address offset: 0x638

Number of buffer bytes transferred since last START, continuously updated

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT			Number of buffer bytes transferred since last START, continuously updated.

8.18.11.39 NOISESHAPE

Address offset: 0x654

SAADC provides two operational noise shaping modes (one that prioritizes higher bandwith, while the other prioritizes higher accuracy) that allow trade-offs between ADC resolution, power consumption, and signal bandwidth.

Note: When using noise shaping, the first RESULTREADY event will take longer to arrive as the filters need to be filled with valid data.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																		A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	NOISESHAPE																																	
			Disable	0																															
			NS1	1																															
			NS2	2																															
			NS3	3																															
			Audio	1																															
			Accuracy	2																															

Use enumerator NS1 for future compatibility.

This enumerator is deprecated.

Use enumerator NS2 for future compatibility.

This enumerator is deprecated.

8.19 SPIM — Serial peripheral interface controller with EasyDMA

The SPI controller peripheral (SPIM) with EasyDMA provides a full duplex, 4-wire synchronous serial communication interface.

The main features of SPIM are the following:

- EasyDMA direct transfer to and from RAM
- SPI mode [0..3]
- Individual selection of I/O pins
- Optional D/CX output line for distinguishing between command and data bytes
- Optional hardware controlled chip select (CSN)

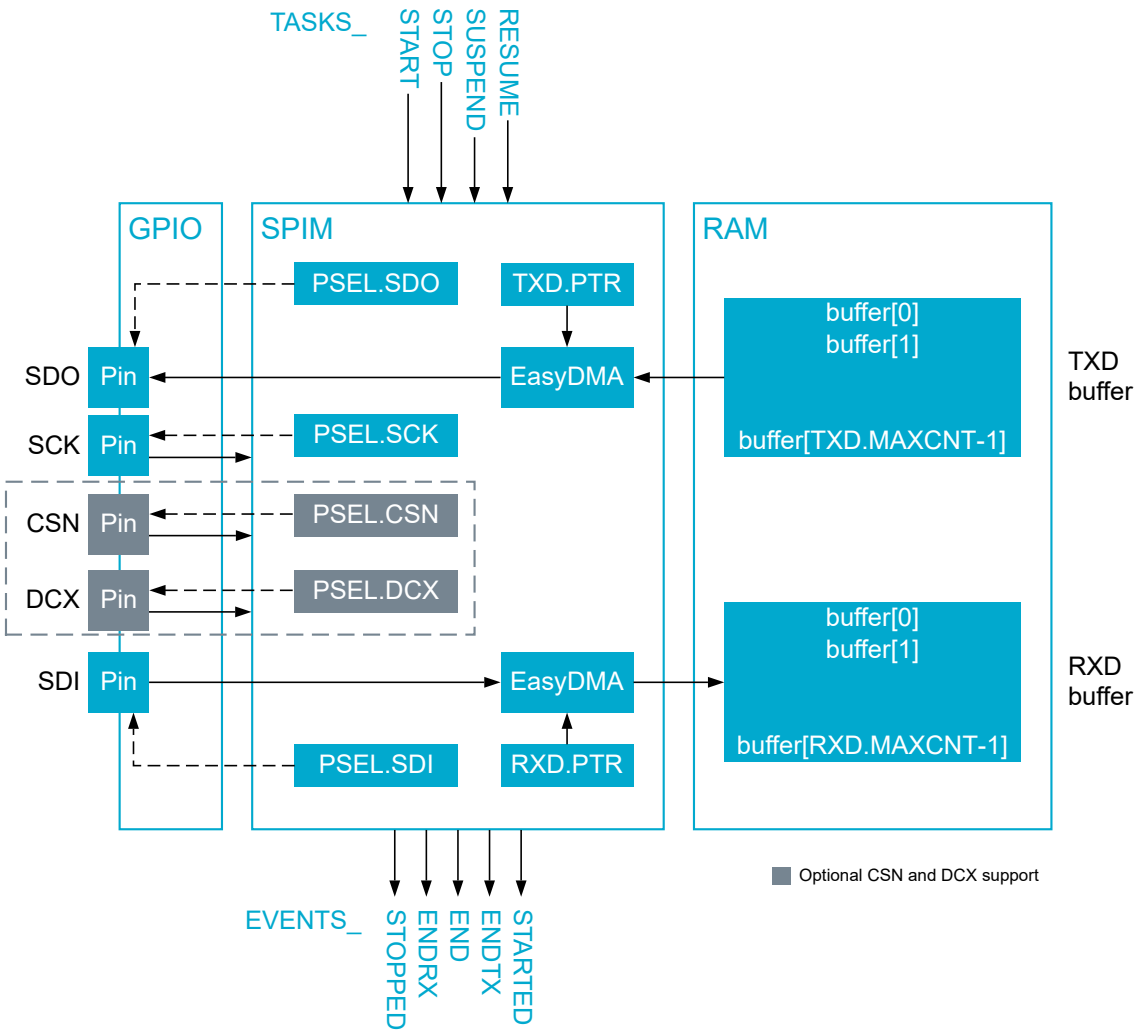


Figure 117: SPIM with EasyDMA

8.19.1 SPIM transaction sequence

An SPIM transaction is started by triggering the START task. This initiates a number of bytes to be transmitted/received on SDO/SDI.

The following figure illustrates an SPIM transaction.

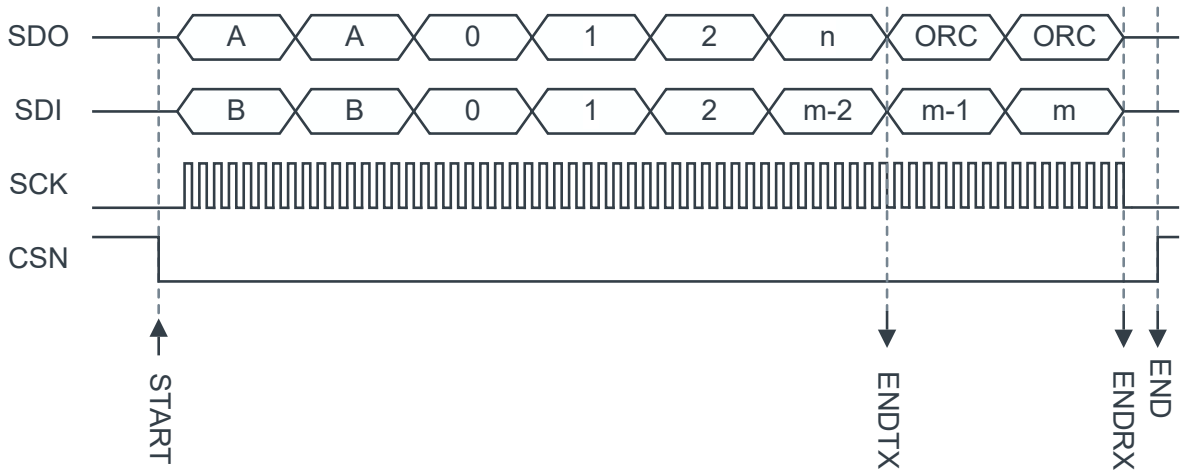


Figure 118: SPIM transaction

The ENDTX event is generated when all bytes in buffer DMA.TX.PTR on page 610 are transmitted. The number of bytes in the transmit buffer is specified in register DMA.TX.MAXCNT on page 610. The ENDRX event is generated when buffer DMA.RX.PTR on page 607 is full; that is when the number of bytes specified in register DMA.RX.MAXCNT on page 608 have been received. The transaction stops automatically after all bytes are transmitted or received. When the maximum number of bytes in the receive buffer is larger than the number of bytes in the transmit buffer, the contents of register ORC on page 606 will be transmitted after the last byte in the transmit buffer has been transmitted.

The END event is generated after both the ENDRX and ENDTX events have been generated.

SPIM is stopped by triggering the STOP task. If the STOP task is triggered during an ongoing transaction, SPIM completes the process for the current byte before stopping, and a STOPPED event is generated. The STOPPED event is only generated when the SPIM has an ongoing transaction at the time the STOP task is triggered.

If the ENDTX event has not been generated when the SPIM peripheral stops, the ENDTX event will be generated, even if all bytes in the buffer have not been transmitted.

If the ENDRX event has not been generated when the SPIM stops, the ENDRX event will be generated even if the buffer DMA.RX.PTR on page 607 is not full.

A transaction can be suspended and resumed using the SUSPEND and RESUME tasks, respectively. When the SUSPEND task is triggered, SPIM completes transmitting and receiving the current byte before it is suspended.

8.19.2 D/CX functionality

Some SPI targets, such as display drivers, require an additional signal from the SPIM to distinguish between command and data bytes. This line is called D/CX.

SPIM supports additional signals such as a D/CX output line. The D/CX line is set low for transmitting command bytes and high for transmitting data bytes.

The D/CX pin number is selected using PSEL.DCX on page 607. The number of command bytes that precede the data bytes is configured using DCXCNT on page 605. Writing to DCXCNT on page 605 during an ongoing transmission is not allowed.

The following figure shows D/CX in use, where SPIM.DCXCNT=`1`.

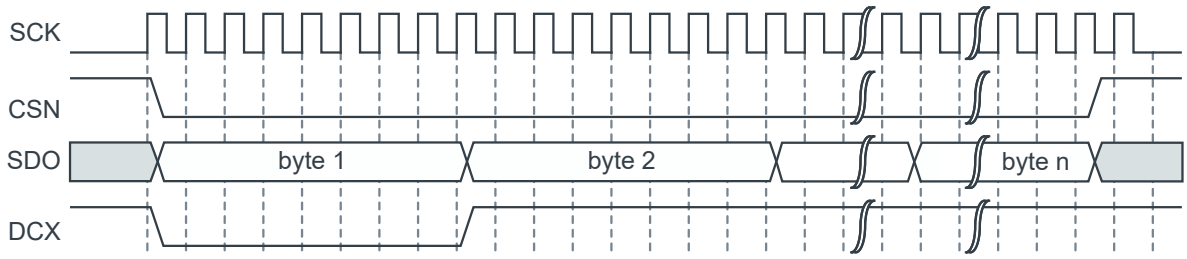


Figure 119: D/CX example

8.19.3 Chip select hardware control

To use CSN hardware control, set register PSEL.CSN on page 607 according to the Pin configuration on page 586.

Hardware-controlled CSN is suited when there is a single slave on the bus. When multiple slaves are attached to the bus, CSN must be controlled using GPIO.

When enabled, CSN is asserted automatically after TASKS_START on page 591 is triggered, and deasserted after EVENTS_END on page 595. The value in register IFTIMING.CSNDUR on page 605 sets the time between the falling edge of CSN and the first SCK edge. The same delay is used between the last SCK edge and the rising edge of CSN at the end of a transfer. It is also used between two transfers as the

minimum CSN inactive time when the END_START short is enabled. The IFTIMING.CSNDUR is expressed in number of SPIM core clock periods.

The following figure shows a timing diagram with two SPI transmissions where the delay is controlled by IFTIMING.CSNDUR and is represented by t_{CSNDUR}.

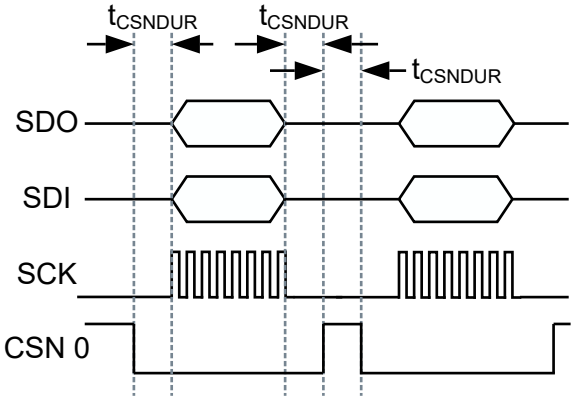


Figure 120: CSNDUR example

The following figure shows the timing delay for the combinations of polarity and phase settings. The register CSNPOL on page 605 determines the active polarity of the signal.

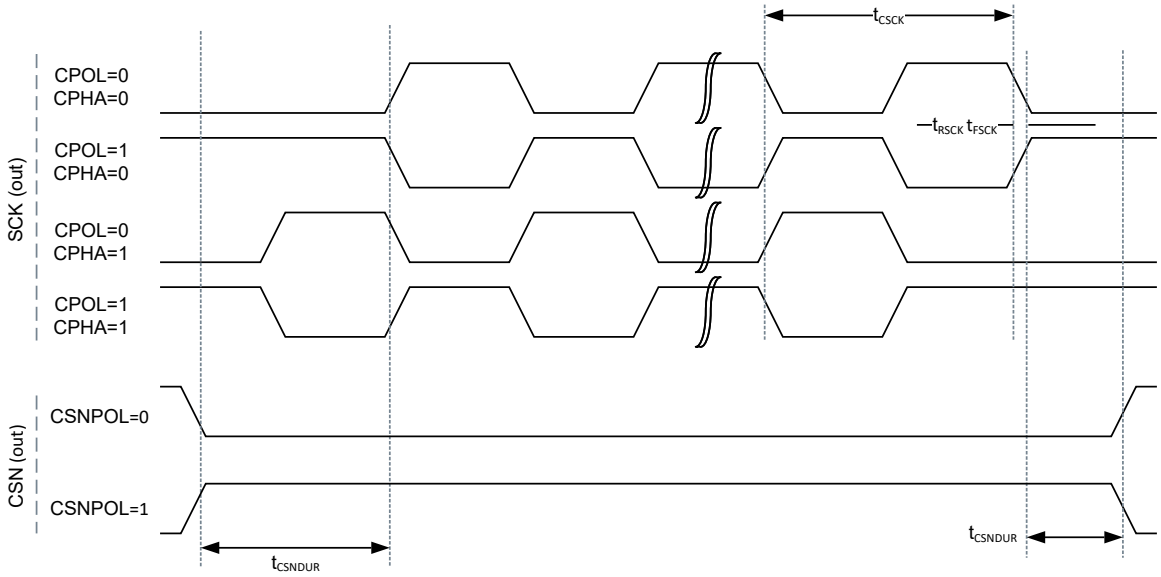


Figure 121: Polarity settings timing delay

8.19.4 Pin configuration

To configure pins for SPIM use, see the corresponding PSEL.n registers.

The contents of registers PSEL.SCK, PSEL.CSN, PSEL.DCX, PSEL.MOSI, and PSEL.MISO are only used when SPIM is enabled, and retained while the device is in System ON mode. The PSEL.n registers can be configured only when SPIM is disabled in register ENABLE on page 603.

To ensure correct behavior, the pins used by SPIM must be configured in the GPIO peripheral as described in GPIO configuration on page 587 before SPIM is enabled.

Only one peripheral can be assigned to drive a GPIO pin at a time. If more than one peripheral is assigned to a GPIO pin, it could result in unpredictable behavior.

SPIM signal	SPIM pin	Direction	Output value
SCK	As specified in PSEL.SCK on page 606	Output	Same as CONFIG.CPOL
CSN	As specified in PSEL.CSN on page 607	Output	Same as CONFIG.CPOL
DCX	As specified in PSEL.DCX on page 607	Output	1
SDO	As specified in PSEL.MOSI on page 606	Output	0
SDI	As specified in PSEL.MISO on page 607	Input	Not applicable

Table 57: GPIO configuration

SPIM supports SPI modes [0..3]. The clock polarity (CPOL) and the clock phase (CPHA) are configured in register CONFIG on page 604.

Mode	Clock polarity (CPOL)	Clock phase (CPHA)
SPI_MODE0	0 (Active `High`)	0 (Leading)
SPI_MODE1	0 (Active `High`)	1 (Trailing)
SPI_MODE2	1 (Active `Low`)	0 (Leading)
SPI_MODE3	1 (Active `Low`)	1 (Trailing)

Table 58: SPI modes

8.19.5 Shared resources

The SPIM peripheral shares registers and other resources with peripherals that have the same ID as SPIM. Before SPIM can be configured and used, all peripherals that have the same ID as SPIM must be disabled.

Disabling a peripheral with the same ID as SPIM will not reset any shared SPIM registers. Configure all SPIM registers to ensure they operate correctly.

See the Instantiation table in Instantiation on page 232 for details on peripherals and their IDs.

8.19.6 EasyDMA

SPIM uses EasyDMA to fetch data to transmit from RAM or store received data in RAM.

SPIM implements the following EasyDMA channels.

Channel	Type	Register Cluster
TXD	READER	DMA.TX.PTR on page 610
RXD	WRITER	DMA.RX.PTR on page 607

Table 59: SPIM EasyDMA channels

The .PTR and .MAXCNT registers are double-buffered. After receiving the STARTED event, the registers can be written to before the next transmission.

SPIM automatically stops transmitting after TXD.MAXCNT bytes have been transmitted and RXD.MAXCNT bytes have been received. If RXD.MAXCNT is larger than TXD.MAXCNT, the remaining transmitted bytes

will contain the value defined in the ORC register. If TXD.MAXCNT is larger than RXD.MAXCNT, the additional received bytes will be discarded.

The RX.END and TX.END events indicate that EasyDMA has finished accessing buffers in RAM. Both RX and TX must be finished before the END event is generated.

If several AHB bus masters try to access the same AHB slave at the same time, AHB bus congestion can occur. In this case, the EasyDMA channel behavior will depend on the SPIM instance. Refer to Instances on page 588 for information about what behavior is expected in each instance.

See EasyDMA for more detailed information.

8.19.7 Low power

When the peripheral is not needed, stop and disable SPIM to ensure lowest possible power consumption.

If a transaction is ongoing, the software must trigger the STOP task and wait for the STOPPED event before disabling the peripheral through the ENABLE register. If no transaction is ongoing, the peripheral can be disabled directly without triggering the STOP task.

8.19.8 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
SPIM00 : S SPIM00 : NS	GLOBAL	0x5004D000 0x4004D000	US	S	SA	No	SPI controller SPIM00
SPIM20 : S SPIM20 : NS	GLOBAL	0x500C6000 0x400C6000	US	S	SA	No	SPI controller SPIM20
SPIM21 : S SPIM21 : NS	GLOBAL	0x500C7000 0x400C7000	US	S	SA	No	SPI controller SPIM21
SPIM22 : S SPIM22 : NS	GLOBAL	0x500C8000 0x400C8000	US	S	SA	No	SPI controller SPIM22
SPIM23 : S SPIM23 : NS	GLOBAL	0x500ED000 0x400ED000	US	S	SA	No	SPI controller SPIM23
SPIM24 : S SPIM24 : NS	GLOBAL	0x500EE000 0x400EE000	US	S	SA	No	SPI controller SPIM24
SPIM30 : S SPIM30 : NS	GLOBAL	0x50104000 0x40104000	US	S	SA	No	SPI controller SPIM30

Configuration

Instance	Domain	Configuration
SPIM00 : S SPIM00 : NS	GLOBAL	Use dedicated pins on GPIO port P2 CSN functionality is supported. DCX functionality is supported. Peripheral core frequency is 128 MHz. Prescaler divisor range is 4..126
SPIM20 : S SPIM20 : NS	GLOBAL	Use GPIO port P1 or P3 CSN functionality is supported. DCX functionality is supported. Peripheral core frequency is 16 MHz. Prescaler divisor range is 2..126
SPIM21 : S SPIM21 : NS	GLOBAL	Use GPIO port P1 or P3 CSN functionality is supported. DCX functionality is supported. Peripheral core frequency is 16 MHz. Prescaler divisor range is 2..126
SPIM22 : S SPIM22 : NS	GLOBAL	Use GPIO port P1 or P3 CSN functionality is supported. DCX functionality is supported. Peripheral core frequency is 16 MHz. Prescaler divisor range is 2..126
SPIM23 : S SPIM23 : NS	GLOBAL	Use GPIO port P1 or P3 CSN functionality is supported. DCX functionality is supported. Peripheral core frequency is 16 MHz. Prescaler divisor range is 2..126
SPIM24 : S SPIM24 : NS	GLOBAL	Use GPIO port P1 or P3 CSN functionality is supported. DCX functionality is supported. Peripheral core frequency is 16 MHz. Prescaler divisor range is 2..126
SPIM30 : S SPIM30 : NS	GLOBAL	Use GPIO port P0 CSN functionality is supported. DCX functionality is supported. Peripheral core frequency is 16 MHz. Prescaler divisor range is 2..126

Register overview

Register	Offset	TZ	Description
TASKS_START	0x000		Start SPI transaction
TASKS_STOP	0x004		Stop SPI transaction

Register	Offset	TZ	Description
TASKS_SUSPEND	0x00C		Suspend SPI transaction
TASKS_RESUME	0x010		Resume SPI transaction
TASKS_DMA.RX.ENABLEMATCH[n]	0x030		Enables the MATCH[n] event by setting the ENABLE[n] bit in the CONFIG register.
TASKS_DMA.RX.DISABLEMATCH[n]	0x040		Disables the MATCH[n] event by clearing the ENABLE[n] bit in the CONFIG register.
SUBSCRIBE_START	0x080		Subscribe configuration for task START
SUBSCRIBE_STOP	0x084		Subscribe configuration for task STOP
SUBSCRIBE_SUSPEND	0x08C		Subscribe configuration for task SUSPEND
SUBSCRIBE_RESUME	0x090		Subscribe configuration for task RESUME
SUBSCRIBE_DMA.RX.ENABLEMATCH[n]	0x0B0		Subscribe configuration for task ENABLEMATCH[n]
SUBSCRIBE_DMA.RX.DISABLEMATCH[n]	0x0C0		Subscribe configuration for task DISABLEMATCH[n]
EVENTS_STARTED	0x100		SPI transaction has started
EVENTS_STOPPED	0x104		SPI transaction has stopped
EVENTS_END	0x108		End of RXD buffer and TXD buffer reached
EVENTS_DMA.RX.END	0x14C		Generated after EasyDMA has completed its operation.
EVENTS_DMA.RX.READY	0x150		Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
EVENTS_DMA.RX.BUSERROR	0x154		An error occured during the bus transfer.
EVENTS_DMA.RX.MATCH[n]	0x158		Pattern match is detected on the DMA data bus.
EVENTS_DMA.TX.END	0x168		Generated after EasyDMA has completed its operation.
EVENTS_DMA.TX.READY	0x16C		Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
EVENTS_DMA.TX.BUSERROR	0x170		An error occured during the bus transfer.
PUBLISH_STARTED	0x180		Publish configuration for event STARTED
PUBLISH_STOPPED	0x184		Publish configuration for event STOPPED
PUBLISH_END	0x188		Publish configuration for event END
PUBLISH_DMA.RX.END	0x1CC		Publish configuration for event END
PUBLISH_DMA.RX.READY	0x1D0		Publish configuration for event READY
PUBLISH_DMA.RX.BUSERROR	0x1D4		Publish configuration for event BUSERROR
PUBLISH_DMA.RX.MATCH[n]	0x1D8		Publish configuration for event MATCH[n]
PUBLISH_DMA.TX.END	0x1E8		Publish configuration for event END
PUBLISH_DMA.TX.READY	0x1EC		Publish configuration for event READY
PUBLISH_DMA.TX.BUSERROR	0x1F0		Publish configuration for event BUSERROR
SHORTS	0x200		Shortcuts between local events and tasks
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
ENABLE	0x500		Enable SPIM
PRESCALER	0x52C		The prescaler is used to set the SPI frequency.
CONFIG	0x554		Configuration register
IFTIMING.RXDELAY	0x5AC		Sample delay for input serial data on SDI
IFTIMING.CSNDUR	0x5B0		Minimum duration between edge of CSN and edge of SCK. When SHORTS.END_START is used, this is also the minimum duration CSN must stay high between transactions.
DCXCNT	0x5B4		DCX configuration
CSNPOL	0x5B8		Polarity of CSN output
ORC	0x5C0		Byte transmitted after TXD.MAXCNT bytes have been transmitted in the case when RXD.MAXCNT is greater than TXD.MAXCNT
PSEL.SCK	0x600		Pin select for SCK
PSEL.MOSI	0x604		Pin select for SDO signal
PSEL.MISO	0x608		Pin select for SDI signal
PSEL.DCX	0x60C		Pin select for DCX signal
PSEL.CSN	0x610		Pin select for CSN
DMA.RX.PTR	0x704		RAM buffer start address
DMA.RX.MAXCNT	0x708		Maximum number of bytes in channel buffer

Register	Offset	TZ	Description
DMA.RX.AMOUNT	0x70C		Number of bytes transferred in the last transaction, updated after the END event. For channels that supports the compare match filter, this register is also updated after each MATCH event.
DMA.RX.LIST	0x714		EasyDMA list type
DMA.RX.TERMINATEONBUSERROR	0x71C		Terminate the transaction if a BUSERROR event is detected.
DMA.RX.BUSERRORADDRESS	0x720		Address of transaction that generated the last BUSERROR event.
DMA.RX.MATCH.CONFIG	0x724		Configure individual match events
DMA.RX.MATCH.CANDIDATE[n]	0x728		The data to look for - any match will trigger the MATCH[n] event, if enabled.
DMA.TX.PTR	0x73C		RAM buffer start address
DMA.TX.MAXCNT	0x740		Maximum number of bytes in channel buffer
DMA.TX.AMOUNT	0x744		Number of bytes transferred in the last transaction, updated after the END event. For channels that supports the compare match filter, this register is also updated after each MATCH event.
DMA.TX.LIST	0x74C		EasyDMA list type
DMA.TX.TERMINATEONBUSERROR	0x754		Terminate the transaction if a BUSERROR event is detected.
DMA.TX.BUSERRORADDRESS	0x758		Address of transaction that generated the last BUSERROR event.

8.19.8.1 TASKS_START

Address offset: 0x000

Start SPI transaction

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_START			Start SPI transaction
			Trigger	1	Trigger task

8.19.8.2 TASKS_STOP

Address offset: 0x004

Stop SPI transaction

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Stop SPI transaction
			Trigger	1	Trigger task

8.19.8.3 TASKS_SUSPEND

Address offset: 0x00C

Suspend SPI transaction

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_SUSPEND			Suspend SPI transaction
			Trigger	1	Trigger task

8.19.8.4 TASKS_RESUME

Address offset: 0x010

Resume SPI transaction

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_RESUME			Resume SPI transaction
			Trigger	1	Trigger task

8.19.8.5 TASKS_DMA

Peripheral tasks.

8.19.8.5.1 TASKS_DMA.RX

Peripheral tasks.

8.19.8.5.1.1 TASKS_DMA.RX.ENABLEMATCH[n] (n=0..3)

Address offset: 0x030 + (n × 0x4)

Enables the MATCH[n] event by setting the ENABLE[n] bit in the CONFIG register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	ENABLEMATCH			Enables the MATCH[n] event by setting the ENABLE[n] bit in the CONFIG register.
			Trigger	1	Trigger task

8.19.8.5.1.2 TASKS_DMA.RX.DISABLEMATCH[n] (n=0..3)

Address offset: 0x040 + (n × 0x4)

Disables the MATCH[n] event by clearing the ENABLE[n] bit in the CONFIG register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	DISABLEMATCH			Disables the MATCH[n] event by clearing the ENABLE[n] bit in the CONFIG register.
			Trigger	1	Trigger task

8.19.8.6 SUBSCRIBE_START

Address offset: 0x080

Subscribe configuration for task START

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task START will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.19.8.7 SUBSCRIBE_STOP

Address offset: 0x084

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.19.8.8 SUBSCRIBE_SUSPEND

Address offset: 0x08C

Subscribe configuration for task SUSPEND

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task SUSPEND will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.19.8.9 SUBSCRIBE_RESUME

Address offset: 0x090

Subscribe configuration for task RESUME

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task RESUME will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.19.8.10 SUBSCRIBE_DMA

Subscribe configuration for tasks

8.19.8.10.1 SUBSCRIBE_DMA.RX

Subscribe configuration for tasks

8.19.8.10.1.1 SUBSCRIBE_DMA.RX.ENABLEMATCH[n] (n=0..3)

Address offset: 0x0B0 + (n × 0x4)

Subscribe configuration for task ENABLEMATCH[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task ENABLEMATCH[n] will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.19.8.10.1.2 SUBSCRIBE_DMA.RX.DISABLEMATCH[n] (n=0..3)

Address offset: 0x0C0 + (n × 0x4)

Subscribe configuration for task DISABLEMATCH[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task DISABLEMATCH[n] will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.19.8.11 EVENTS_STARTED

Address offset: 0x100

SPI transaction has started

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_STARTED			SPI transaction has started
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.19.8.12 EVENTS_STOPPED

Address offset: 0x104

SPI transaction has stopped

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_STOPPED			SPI transaction has stopped
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.19.8.13 EVENTS_END

Address offset: 0x108

End of RXD buffer and TXD buffer reached

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_END			End of RXD buffer and TXD buffer reached
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.19.8.14 EVENTS_DMA

Peripheral events.

8.19.8.14.1 EVENTS_DMA.RX

Peripheral events.

8.19.8.14.1.1 EVENTS_DMA.RX.END

Address offset: 0x14C

Generated after EasyDMA has completed its operation.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	END			Generated after EasyDMA has completed its operation.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.19.8.14.1.2 EVENTS_DMA.RX.READY

Address offset: 0x150

Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	READY			Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.19.8.14.1.3 EVENTS_DMA.RX.BUSERROR

Address offset: 0x154

An error occured during the bus transfer.

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	BUSERROR			An error occured during the bus transfer. When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.19.8.14.1.4 EVENTS_DMA.RX.MATCH[n] (n=0..3)

Address offset: 0x158 + (n × 0x4)

Pattern match is detected on the DMA data bus.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MATCH			Pattern match is detected on the DMA data bus.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.19.8.14.2 EVENTS_DMA.TX

Peripheral events.

8.19.8.14.2.1 EVENTS_DMA.TX.END

Address offset: 0x168

Generated after EasyDMA has completed its operation.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	END			Generated after EasyDMA has completed its operation.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.19.8.14.2.2 EVENTS_DMA.TX.READY

Address offset: 0x16C

Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	READY			Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.19.8.14.2.3 EVENTS_DMA.TX.BUSERROR

Address offset: 0x170

An error occured during the bus transfer.

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	BUSERROR			An error occured during the bus transfer. When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.19.8.15 PUBLISH_STARTED

Address offset: 0x180

Publish configuration for event STARTED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event STARTED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.19.8.16 PUBLISH_STOPPED

Address offset: 0x184

Publish configuration for event STOPPED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event STOPPED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.19.8.17 PUBLISH_END

Address offset: 0x188

Publish configuration for event END

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event END will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.19.8.18 PUBLISH_DMA

Publish configuration for events

8.19.8.18.1 PUBLISH_DMA.RX

Publish configuration for events

8.19.8.18.1.1 PUBLISH_DMA.RX.END

Address offset: 0x1CC

Publish configuration for event END

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event END will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.19.8.18.1.2 PUBLISH_DMA.RX.READY

Address offset: 0x1D0

Publish configuration for event READY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event READY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.19.8.18.1.3 PUBLISH_DMA.RX.BUSERROR

Address offset: 0x1D4

Publish configuration for event BUSERROR

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event BUSERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.19.8.18.1.4 PUBLISH_DMA.RX.MATCH[n] (n=0..3)

Address offset: 0x1D8 + (n × 0x4)

Publish configuration for event MATCH[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event MATCH[n] will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.19.8.18.2 PUBLISH_DMA.TX

Publish configuration for events

8.19.8.18.2.1 PUBLISH_DMA.TX.END

Address offset: 0x1E8

Publish configuration for event END

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event END will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.19.8.18.2.2 PUBLISH_DMA.TX.READY

Address offset: 0x1EC

Publish configuration for event READY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event READY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.19.8.18.2.3 PUBLISH_DMA.TX.BUSERROR

Address offset: 0x1F0

Publish configuration for event BUSERROR

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event BUSERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.19.8.19 SHORTS

Address offset: 0x200

Shortcuts between local events and tasks

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	END_START			Shortcut between event END and task START
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
B-E	RW	DMA_RX_MATCH[i]_DMA_RX_ENABLEMA +1)%4] (i=0..3)			Shortcut between event DMA.RX.MATCH[n] and task DMA.RX.ENABLEMATCH[(i+1)%4] Allows daisy-chaining match events.
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
F-I	RW	DMA_RX_MATCH[i]_DMA_RX_DISABLEMATCH[i] (i=0..3)			Shortcut between event DMA.RX.MATCH[i] and task DMA.RX.DISABLEMATCH[i]
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut

8.19.8.20 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1S	STARTED			Write '1' to enable interrupt for event STARTED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	STOPPED			Write '1' to enable interrupt for event STOPPED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1S	END			Write '1' to enable interrupt for event END
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1S	DMARXEND			Write '1' to enable interrupt for event DMARXEND
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1S	DMARXREADY			Write '1' to enable interrupt for event DMARXREADY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
F	RW W1S	DMARXBUSERROR			Write '1' to enable interrupt for event DMARXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G-J	RW W1S	DMARXMATCH[i] (i=0..3)			Write '1' to enable interrupt for event DMARXMATCH[i]
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
K	RW W1S	DMATXEND			Write '1' to enable interrupt for event DMATXEND
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
L	RW W1S	DMATXREADY			Write '1' to enable interrupt for event DMATXREADY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1S	DMATXBUSERROR			Write '1' to enable interrupt for event DMATXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.19.8.21 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	STARTED			Write '1' to disable interrupt for event STARTED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	STOPPED			Write '1' to disable interrupt for event STOPPED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	END			Write '1' to disable interrupt for event END

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1C	DMARXEND			Write '1' to disable interrupt for event DMARXEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1C	DMARXREADY			Write '1' to disable interrupt for event DMARXREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1C	DMARXBUSERROR			Write '1' to disable interrupt for event DMARXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G-J	RW W1C	DMARXMATCH[i] (i=0..3)			Write '1' to disable interrupt for event DMARXMATCH[i]
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
K	RW W1C	DMATXEND			Write '1' to disable interrupt for event DMATXEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
L	RW W1C	DMATXREADY			Write '1' to disable interrupt for event DMATXREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1C	DMATXBUSERROR			Write '1' to disable interrupt for event DMATXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.19.8.22 ENABLE

Address offset: 0x500

Enable SPIM

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			Enable or disable SPIM
			Disabled	0	Disable SPIM
			Enabled	7	Enable SPIM

8.19.8.23 PRESCALER

Address offset: 0x52C

The prescaler is used to set the SPI frequency.

The prescaler divides the core clock by the divisor to make the SPI clock. The resulting frequency is given by 'core clock' / DIVISOR. Different instances of the SPIM might have different core clocks. The SPIM core clock and divisor limits is given in the instance table in Instances on page 588.

Note that a low prescaler setting may require changing the default RXDELAY value to ensure correct sampling.

Only even numbers is allowed for the divisor.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A
Reset 0x00000040				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DIVISOR		2..126	Core clock to SCK divisor

8.19.8.24 CONFIG

Address offset: 0x554

Configuration register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	ORDER			Bit order
			MsbFirst	0	Most significant bit shifted out first
			LsbFirst	1	Least significant bit shifted out first
B	RW	CPHA			Serial clock (SCK) phase
			Leading	0	Sample on leading edge of clock, shift serial data on trailing edge
			Trailing	1	Sample on trailing edge of clock, shift serial data on leading edge
C	RW	CPOL			Serial clock (SCK) polarity
			ActiveHigh	0	Active high
			ActiveLow	1	Active low

8.19.8.25 IFTIMING.RXDELAY

Address offset: 0x5AC

Sample delay for input serial data on SDI

If the value is written larger than the maximum value, the maximum value will be used.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A
Reset 0x00000002				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	RXDELAY		[7..0]	Sample delay for input serial data on SDI. The value specifies the number of SPIM core clock cycles delay from the the sampling edge of SCK (leading edge for CONFIG.CPHA = 0, trailing edge for CONFIG.CPHA = 1) until the input serial data is sampled. As en example, if RXDELAY = 0 and CONFIG.CPHA = 0, the input serial data is sampled on the rising edge of SCK.

8.19.8.26 IFTIMING.CSNDUR

Address offset: 0x5B0

Minimum duration between edge of CSN and edge of SCK. When SHORTS.END_START is used, this is also the minimum duration CSN must stay high between transactions.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A
Reset 0x00000002				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CSNDUR		[0xFF..0]	Minimum duration between edge of CSN and edge of SCK. When SHORTS.END_START is used, this is the minimum duration CSN must stay high between transactions. The value is specified in number of SPIM core clock cycles. Note that for low values of CSNDUR, the system turnaround time will dominate the actual time between transactions.

8.19.8.27 DCXCNT

Address offset: 0x5B4

DCX configuration

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	DCXCNT		0x0..0xF	This register specifies the number of command bytes preceding the data bytes. The PSEL.DCX line will be low during transmission of command bytes and high during transmission of data bytes. Value 0xF indicates that all bytes are command bytes.

8.19.8.28 CSNPOL

Address offset: 0x5B8

Polarity of CSN output

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CSNPOL[i] (i=0..0)			Polarity of CSN output
			LOW	0	Active low (idle state high)
			HIGH	1	Active high (idle state low)

8.19.8.29 ORC

Address offset: 0x5C0

Byte transmitted after TXD.MAXCNT bytes have been transmitted in the case when RXD.MAXCNT is greater than TXD.MAXCNT

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	ORC			Byte transmitted after TXD.MAXCNT bytes have been transmitted in the case when RXD.MAXCNT is greater than TXD.MAXCNT.

8.19.8.30 PSEL.SCK

Address offset: 0x600

Pin select for SCK

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**

ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.19.8.31 PSEL.MOSI

Address offset: 0x604

Pin select for SDO signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**

ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.19.8.32 PSEL.MISO

Address offset: 0x608

Pin select for SDI signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.19.8.33 PSEL.DCX

Address offset: 0x60C

Pin select for DCX signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.19.8.34 PSEL.CSN

Address offset: 0x610

Pin select for CSN

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.19.8.35 DMA.RX.PTR

Address offset: 0x704

RAM buffer start address

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x20000000	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			RAM buffer start address for this EasyDMA channel. This address is a word aligned Data RAM address.

Note: See the memory chapter for details about which memories are available for EasyDMA.

8.19.8.36 DMA.RX.MAXCNT

Address offset: 0x708

Maximum number of bytes in channel buffer

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MAXCNT		[1..0xffff]	Maximum number of bytes in channel buffer

8.19.8.37 DMA.RX.AMOUNT

Address offset: 0x70C

Number of bytes transferred in the last transaction, updated after the END event.

For channels that supports the compare match filter, this register is also updated after each MATCH event.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT		[1..0xffff]	Number of bytes transferred in the last transaction. In case of NACK error, includes the NACK'ed byte.

8.19.8.38 DMA.RX.LIST

Address offset: 0x714

EasyDMA list type

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																															A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	TYPE			List type
			Disabled	0	Disable EasyDMA list
			ArrayList	1	Use array list

8.19.8.39 DMA.RX.TERMINATEONBUSERROR

Address offset: 0x71C

Terminate the transaction if a BUSERROR event is detected.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			
			Disabled	0	Disable
			Enabled	1	Enable

8.19.8.40 DMA.RX.BUSERRORADDRESS

Address offset: 0x720

Address of transaction that generated the last BUSERROR event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	ADDRESS			

8.19.8.41 DMA.RX.MATCH

Registers to control the behavior of the pattern matcher engine

8.19.8.41.1 DMA.RX.MATCH.CONFIG

Address offset: 0x724

Configure individual match events

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-D	RW	ENABLE[i] (i=0..3)			Enable match filter i
			Disabled	0	Match filter disabled
			Enabled	1	Match filter enabled
E-H	RW	ONESHOT[i] (i=0..3)			Configure match filter i as one-shot or continous One-shot operation will disable the filter on a match, while Continous operation will keep it enabled until explicitly disabled.
			Continuous	0	Match filter stays enabled until disabled by task
			Oneshot	1	Match filter stays enabled until next data word is received

8.19.8.41.2 DMA.RX.MATCH.CANDIDATE[n] (n=0..3)

Address offset: 0x728 + (n × 0x4)

The data to look for - any match will trigger the MATCH[n] event, if enabled.

Note: This register can be updated while a transfer is in progress, but the new value will not take effect until either the DMA is restarted or the match event is generated. That makes it possible to write a new set of match words which will be searched for immediately after the event triggers.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																									A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DATA			Data to look for

8.19.8.42 DMA.TX.PTR

Address offset: 0x73C

RAM buffer start address

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x20000000	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			RAM buffer start address for this EasyDMA channel. This address is a word aligned Data RAM address.

Note: See the memory chapter for details about which memories are available for EasyDMA.

8.19.8.43 DMA.TX.MAXCNT

Address offset: 0x740

Maximum number of bytes in channel buffer

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MAXCNT		[1..0xffff]	Maximum number of bytes in channel buffer

8.19.8.44 DMA.TX.AMOUNT

Address offset: 0x744

Number of bytes transferred in the last transaction, updated after the END event.

For channels that supports the compare match filter, this register is also updated after each MATCH event.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT		[1..0xffff]	Number of bytes transferred in the last transaction. In case of NACK error, includes the NACK'ed byte.

8.19.8.45 DMA.TX.LIST

Address offset: 0x74C

EasyDMA list type

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	TYPE			List type
			Disabled	0	Disable EasyDMA list
			ArrayList	1	Use array list

8.19.8.46 DMA.TX.TERMINATEONBUSERROR

Address offset: 0x754

Terminate the transaction if a BUSERROR event is detected.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			
			Disabled	0	Disable
			Enabled	1	Enable

8.19.8.47 DMA.TX.BUSERRORADDRESS

Address offset: 0x758

Address of transaction that generated the last BUSERROR event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	ADDRESS			

8.20 SPIS — Serial peripheral interface target with EasyDMA

The SPI target peripheral (SPIS) with EasyDMA provides a full duplex, 4-wire synchronous serial communication interface.

The main features of SPIS are the following:

- EasyDMA direct transfer to and from RAM
- SPI mode [0..3]
- Individual selection of I/O pins
- Hardware-based semaphore mechanisms for synchronizing access to data buffers by SPIS and CPU

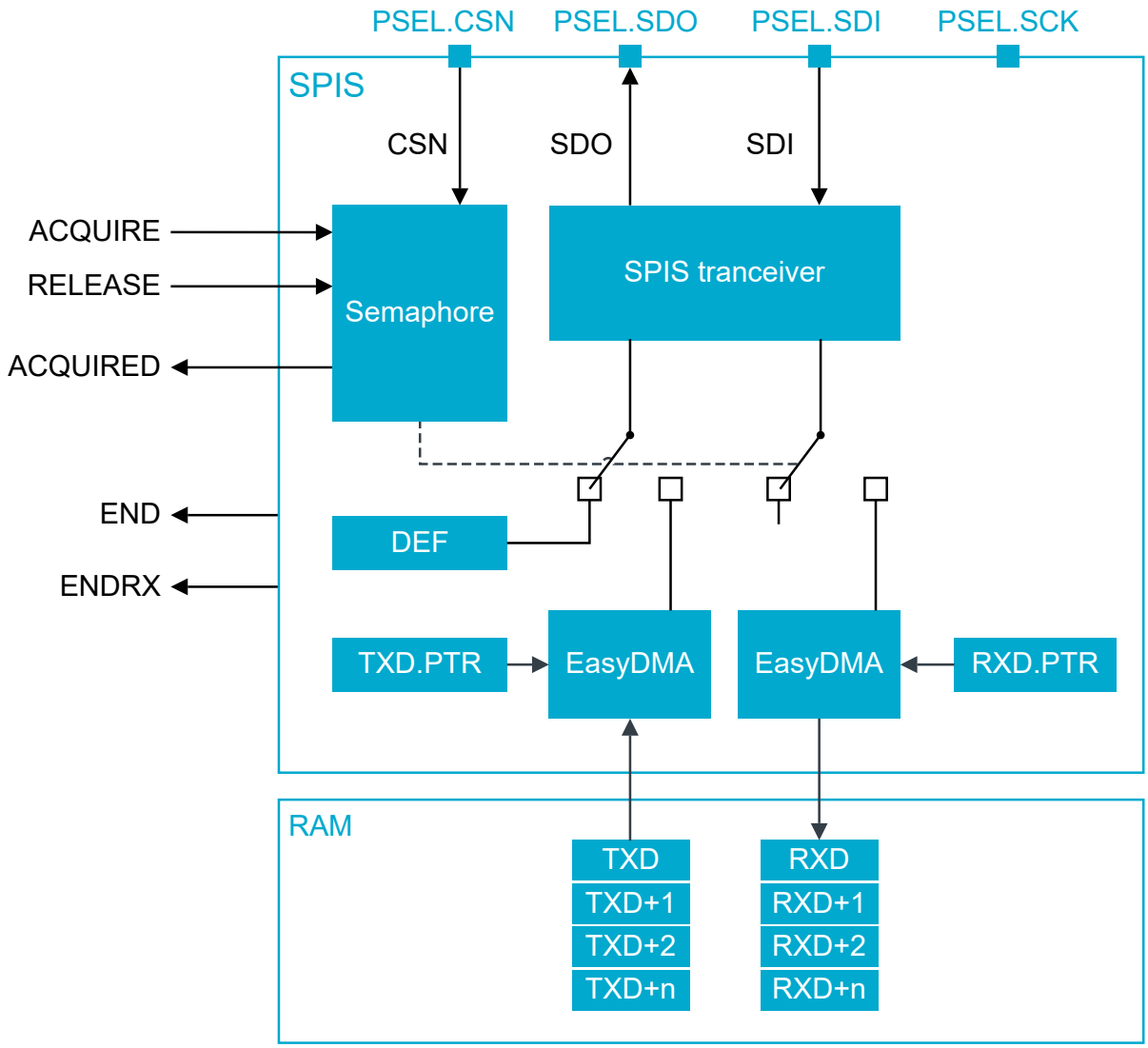


Figure 122: SPIS

8.20.1 SPI modes

SPIS supports SPI modes [0..3]. Modes CPOL and CPHA are set in the CONFIG register.

Mode	Clock polarity (CPOL)	Clock phase (CPHA)
SPI_MODE0	0 (Active `High`)	0 (Sample on Leading)
SPI_MODE1	0 (Active `High`)	1 (Sample on Trailing)
SPI_MODE2	1 (Active `Low`)	0 (Sample on Leading)
SPI_MODE3	1 (Active `Low`)	1 (Sample on Trailing)

Table 60: SPI modes

8.20.2 Shared resources

The SPIS peripheral shares registers and other resources with peripherals that have the same ID as SPIS. Before SPIS can be configured and used, all peripherals that have the same ID as SPIS must be disabled.

Disabling a peripheral with the same ID as SPIS will not reset any shared SPIS registers. Configure all SPIS registers to ensure they operate correctly.

See the Instantiation table in Instantiation on page 232 for details on peripherals and their IDs.

8.20.3 EasyDMA

SPIS implements EasyDMA for accessing RAM without CPU involvement.

SPIS implements the EasyDMA channels found in the following table.

Channel	Type	Register Cluster
TXD	READER	TXD
RXD	WRITER	RXD

Table 61: SPIS EasyDMA Channels

For detailed information regarding the use of EasyDMA, see EasyDMA on page 29.

If RXD.MAXCNT is greater than TXD.MAXCNT, the remaining transmitted bytes will contain the value defined in the ORC register.

The END event indicates that EasyDMA is finished accessing the RAM buffer.

8.20.4 SPIS operation

SPIS uses two memory pointers. RXD.PTR points to the RXD buffer (receive buffer) and TXD.PTR points to the TXD buffer (transmit buffer). Because these buffers are located in RAM, which can be accessed by both SPIS and the CPU, a hardware based semaphore mechanism is implemented to enable safe sharing.

The CPU must acquire the SPI semaphore before it can safely update the RXD.PTR and TXD.PTR pointers. The ACQUIRE task must be triggered for the CPU to receive the ACQUIRED event and have access to the semaphore. When the CPU has updated the RXD.PTR and TXD.PTR pointers, the CPU must release the semaphore before SPIS can acquire it.

The CPU releases the semaphore by triggering the RELEASE task, as illustrated in the following figure. Triggering the RELEASE task when the CPU does not have access to the semaphore will have no effect. See Semaphore operation on page 615 for more information.

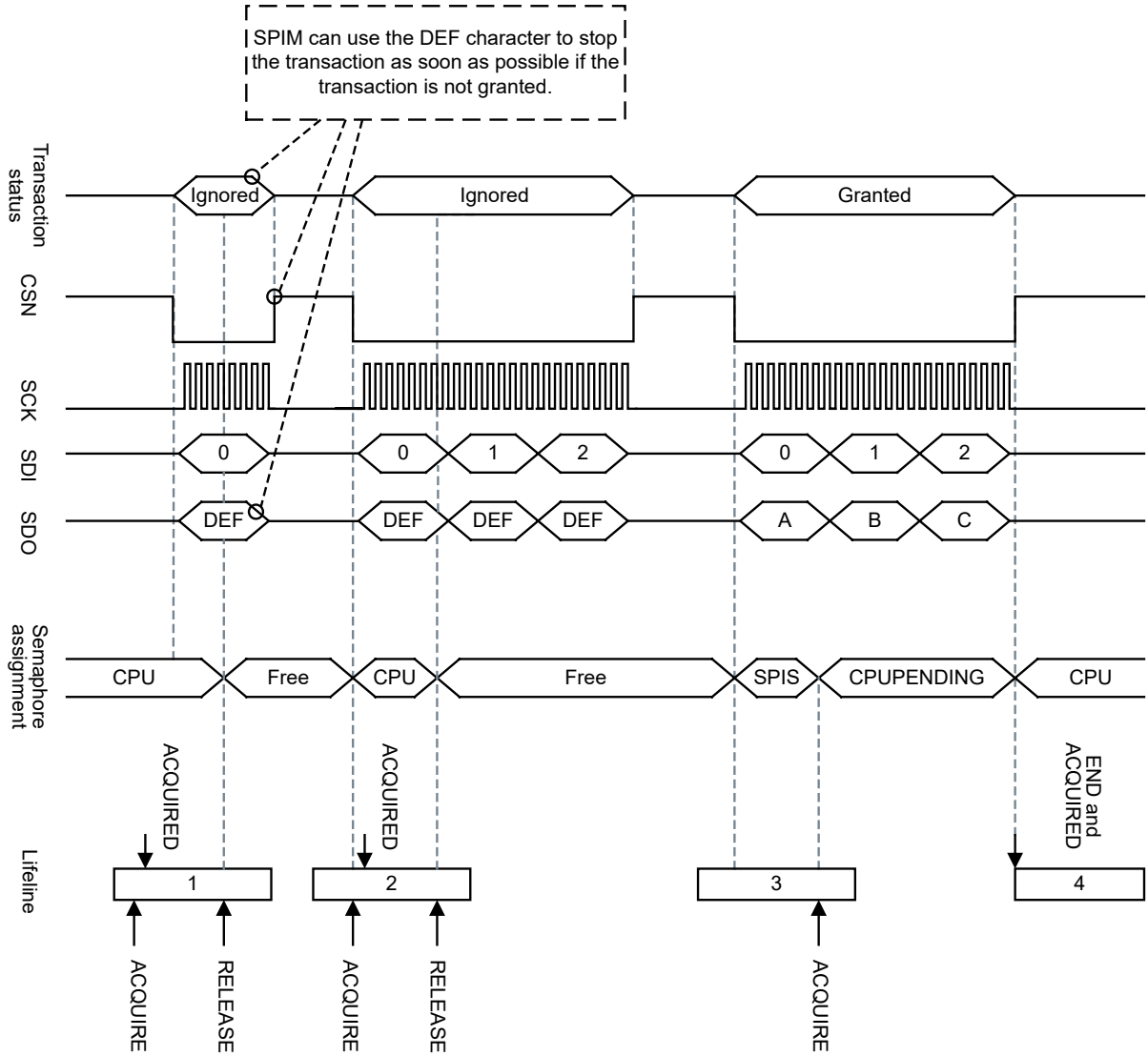


Figure 123: SPI transaction when shortcut between END and ACQUIRE is enabled

If the CPU is not able to reconfigure TXD.PTR and RXD.PTR between granted transactions, the same TX data will be clocked out and the RX buffers will be overwritten. To prevent this from happening, the END_ACQUIRE shortcut can be used. With this shortcut enabled, the semaphore will be handed over to the CPU automatically after the granted transaction has completed. This enables the CPU to update the TXPTR and RXPTR between every granted transaction.

The ENDRX event is generated when the RX buffer has been filled.

The RXD.MAXCNT register specifies the maximum number of bytes SPIS can receive in one granted transaction. If SPIS receives more than RXD.MAXCNT number of bytes, an OVERFLOW will be indicated in the STATUS register and the incoming bytes will be discarded.

The TXD.MAXCNT parameter specifies the maximum number of bytes SPIS can transmit in one granted transaction. If SPIS is forced to transmit more than TXD.MAXCNT number of bytes, an OVERREAD will be indicated in the STATUS register and the ORC character will be clocked out.

The RXD.AMOUNT and TXD.AMOUNT registers are updated when a granted transaction is complete. The TXD.AMOUNT register indicates how many bytes were read from the TX buffer in the last transaction. ORC (over-read) characters are not included in this number. Similarly, the RXD.AMOUNT register indicates how many bytes were written into the RX buffer in the last transaction.

8.20.5 Semaphore operation

The semaphore is a mechanism implemented inside the SPIS peripheral that prevents SPIS and CPU from accessing data buffers simultaneously.

By default, the semaphore is assigned to the CPU after the SPIS peripheral is enabled. An ACQUIRED event will not be generated for this initial semaphore handover. If the ACQUIRE task is triggered while the semaphore is assigned to the CPU, an ACQUIRED event will be generated immediately. The following figure illustrates the transitions between states in the semaphore based on the relevant tasks and events.

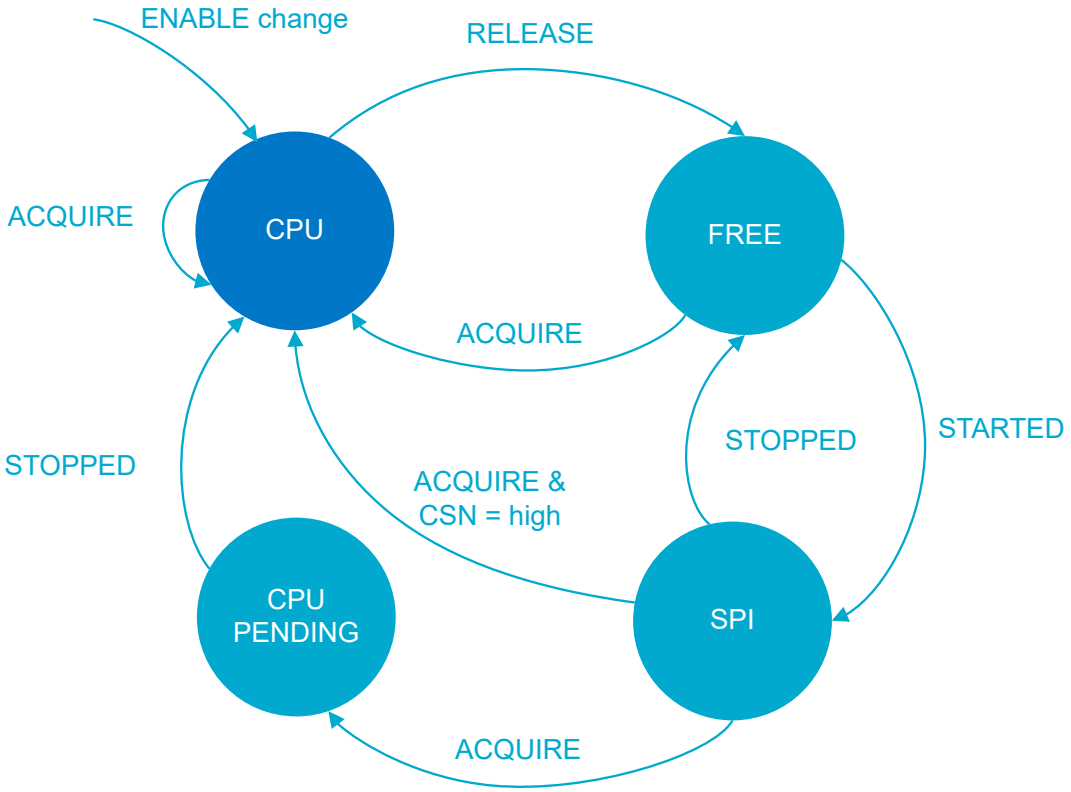


Figure 124: SPI semaphore FSM

Note: The semaphore mechanism does not prevent the CPU from performing read or write access to the RXD.PTR register, TXD.PTR registers, or RAM that these pointers are pointing to. The semaphore is only telling when these can be updated by the CPU so that safe sharing is achieved.

SPIS will try to acquire the semaphore when the STARTED event is detected. If SPIS does not obtain the semaphore, the transaction will be ignored and the semaphore is retained by the CPU. All incoming data on SDI will be discarded and the DEF (default) character will be clocked out on the SDO line throughout the transaction. This is also true if the semaphore is released by the CPU during the transaction. If a race condition occurs where the CPU and SPIS try to acquire the semaphore at the same time, as illustrated in lifeline item 2 in figure SPI transaction when shortcut between END and ACQUIRE is enabled on page 614, the CPU is given the semaphore.

If SPIS acquires the semaphore, the transaction will be granted. The incoming data on SDI will be stored in the RXD buffer and the data in the TXD buffer will be clocked out on SDO.

When a transaction is complete and CSN goes `HIGH`, SPIS will automatically release the semaphore and generate the END event.

SPIS can be granted multiple transactions in a row as long as the semaphore is available.

If the CPU tries to acquire the semaphore while it is assigned to SPIS, an immediate handover will not be granted. After the granted transaction is complete, SPIS releases the semaphore to the CPU. If the END_ACQUIRE shortcut is enabled and the CPU has triggered the ACQUIRE task during a granted transaction, only one ACQUIRE request will be served following the END event.

8.20.6 Pin configuration

The CSN, SCK, SDI, and SDO signals associated with SPIS are mapped to physical pins according to the configuration specified in the PSEL.CSN, PSEL.SCK, PSEL.MOSI, and PSEL.MISO registers, respectively. If the CONNECT field is set to `Disconnected`, the associated SPIS signal will not be connected to any physical pins.

These registers and their configurations are only used when SPIS is enabled, and retained as long as the device is in System ON mode. See POWER — Power control on page 100 for more information about power modes. When the peripheral is disabled, the pins behave as regular GPIOs, and use the configuration in their respective OUT bit field and PIN_CNF[n] register. Only configure PSEL.CSN, PSEL.SCK, PSEL.MOSI, and PSEL.MISO when SPIS is disabled.

Before enabling SPIS, the pins used by SPIS must be configured in the GPIO peripheral as described in GPIO configuration before enabling peripheral on page 616. This ensures that the pins are driven correctly if SPIS becomes temporarily disabled, or if the device enters System OFF mode. This configuration must be retained in the GPIO for the selected pins to be recognized by an external SPI controller.

The SDO line is set as an input, with input buffer connected, as long as SPIS is not selected with CSN. This can cause additional current consumption if the SDO line is left floating. To avoid this, it is recommended to connect a pull-up or pull-down resistor on the SDO line when it is not driven by an external SPI controller.

Only one peripheral can be assigned to drive a particular GPIO pin at a time. Failing to do so may result in unpredictable behavior.

SPI signal	SPI pin	Direction	Output value	Comment
CSN	As specified in PSEL.CSN	Input	Not applicable	
SCK	As specified in PSEL.SCK	Input	Not applicable	
SDI	As specified in PSEL.MOSI	Input	Not applicable	
SDO	As specified in PSEL.MISO	Input	Not applicable	Emulates that SPIS is not selected.

Table 62: GPIO configuration before enabling peripheral

8.20.7 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
SPIS00 : S SPIS00 : NS	GLOBAL	0x5004D000 0x4004D000	US	S	SA	No	SPI peripheral SPIS00
SPIS20 : S SPIS20 : NS	GLOBAL	0x500C6000 0x400C6000	US	S	SA	No	SPI peripheral SPIS20
SPIS21 : S SPIS21 : NS	GLOBAL	0x500C7000 0x400C7000	US	S	SA	No	SPI peripheral SPIS21
SPIS22 : S SPIS22 : NS	GLOBAL	0x500C8000 0x400C8000	US	S	SA	No	SPI peripheral SPIS22
SPIS23 : S SPIS23 : NS	GLOBAL	0x500ED000 0x400ED000	US	S	SA	No	SPI peripheral SPIS23
SPIS24 : S SPIS24 : NS	GLOBAL	0x500EE000 0x400EE000	US	S	SA	No	SPI peripheral SPIS24
SPIS30 : S SPIS30 : NS	GLOBAL	0x50104000 0x40104000	US	S	SA	No	SPI peripheral SPIS30

Configuration

Instance	Domain	Configuration
SPIS00 : S SPIS00 : NS	GLOBAL	Use dedicated pins on GPIO port P2
SPIS20 : S SPIS20 : NS	GLOBAL	Use GPIO port P1 or P3
SPIS21 : S SPIS21 : NS	GLOBAL	Use GPIO port P1 or P3
SPIS22 : S SPIS22 : NS	GLOBAL	Use GPIO port P1 or P3
SPIS23 : S SPIS23 : NS	GLOBAL	Use GPIO port P1 or P3
SPIS24 : S SPIS24 : NS	GLOBAL	Use GPIO port P1 or P3
SPIS30 : S SPIS30 : NS	GLOBAL	Use GPIO port P0

Register overview

Register	Offset	TZ	Description
TASKS_ACQUIRE	0x014		Acquire SPI semaphore
TASKS_RELEASE	0x018		Release SPI semaphore, enabling the SPI slave to acquire it
TASKS_DMA.RX.ENABLEMATCH[n]	0x030		Enables the MATCH[n] event by setting the ENABLE[n] bit in the CONFIG register.
TASKS_DMA.RX.DISABLEMATCH[n]	0x040		Disables the MATCH[n] event by clearing the ENABLE[n] bit in the CONFIG register.
SUBSCRIBE_ACQUIRE	0x094		Subscribe configuration for task ACQUIRE
SUBSCRIBE_RELEASE	0x098		Subscribe configuration for task RELEASE
SUBSCRIBE_DMA.RX.ENABLEMATCH[n]	0x0B0		Subscribe configuration for task ENABLEMATCH[n]
SUBSCRIBE_DMA.RX.DISABLEMATCH[n]	0x0C0		Subscribe configuration for task DISABLEMATCH[n]
EVENTS_END	0x104		Granted transaction completed

Register	Offset	TZ	Description
EVENTS_ACQUIRED	0x118		Semaphore acquired
EVENTS_DMA.RX.END	0x14C		Generated after all MAXCNT bytes have been transferred
EVENTS_DMA.RX.READY	0x150		Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
EVENTS_DMA.RX.BUSERROR	0x154		An error occured during the bus transfer.
EVENTS_DMA.RX.MATCH[n]	0x158		Pattern match is detected on the DMA data bus.
EVENTS_DMA.TX.END	0x168		Generated after all MAXCNT bytes have been transferred
EVENTS_DMA.TX.READY	0x16C		Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
EVENTS_DMA.TX.BUSERROR	0x170		An error occured during the bus transfer.
PUBLISH_END	0x184		Publish configuration for event END
PUBLISH_ACQUIRED	0x198		Publish configuration for event ACQUIRED
PUBLISH_DMA.RX.END	0x1CC		Publish configuration for event END
PUBLISH_DMA.RX.READY	0x1D0		Publish configuration for event READY
PUBLISH_DMA.RX.BUSERROR	0x1D4		Publish configuration for event BUSERROR
PUBLISH_DMA.RX.MATCH[n]	0x1D8		Publish configuration for event MATCH[n]
PUBLISH_DMA.TX.END	0x1E8		Publish configuration for event END
PUBLISH_DMA.TX.READY	0x1EC		Publish configuration for event READY
PUBLISH_DMA.TX.BUSERROR	0x1F0		Publish configuration for event BUSERROR
SHORTS	0x200		Shortcuts between local events and tasks
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
SEMSTAT	0x400		Semaphore status register
STATUS	0x440		Status from last transaction
ENABLE	0x500		Enable SPI slave
CONFIG	0x554		Configuration register
DEF	0x55C		Default character. Character clocked out in case of an ignored transaction.
ORC	0x5C0		Over-read character
PSEL.SCK	0x600		Pin select for SCK
PSEL.MISO	0x604		Pin select for SDO signal
PSEL.MOSI	0x608		Pin select for SDI signal
PSEL.CSN	0x610		Pin select for CSN signal
DMA.RX.PTR	0x704		RAM buffer start address
DMA.RX.MAXCNT	0x708		Maximum number of bytes in channel buffer
DMA.RX.AMOUNT	0x70C		Number of bytes transferred in the last transaction, updated after the END event. Also updated after each MATCH event.
DMA.RX.LIST	0x714		EasyDMA list type
DMA.RX.TERMINATEONBUSERROR	0x71C		Terminate the transaction if a BUSERROR event is detected.
DMA.RX.BUSERRORADDRESS	0x720		Address of transaction that generated the last BUSERROR event.
DMA.RX.MATCH.CONFIG	0x724		Configure individual match events
DMA.RX.MATCH.CANDIDATE[n]	0x728		The data to look for - any match will trigger the MATCH[n] event, if enabled.
DMA.TX.PTR	0x73C		RAM buffer start address
DMA.TX.MAXCNT	0x740		Maximum number of bytes in channel buffer
DMA.TX.AMOUNT	0x744		Number of bytes transferred in the last transaction, updated after the END event. Also updated after each MATCH event.
DMA.TX.LIST	0x74C		EasyDMA list type
DMA.TX.TERMINATEONBUSERROR	0x754		Terminate the transaction if a BUSERROR event is detected.
DMA.TX.BUSERRORADDRESS	0x758		Address of transaction that generated the last BUSERROR event.

8.20.7.1 TASKS_ACQUIRE

Address offset: 0x014

Acquire SPI semaphore

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_ACQUIRE			Acquire SPI semaphore
			Trigger	1	Trigger task

8.20.7.2 TASKS_RELEASE

Address offset: 0x018

Release SPI semaphore, enabling the SPI slave to acquire it

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_RELEASE			Release SPI semaphore, enabling the SPI slave to acquire it
			Trigger	1	Trigger task

8.20.7.3 TASKS_DMA

Peripheral tasks.

8.20.7.3.1 TASKS_DMA.RX

Peripheral tasks.

8.20.7.3.1.1 TASKS_DMA.RX.ENABLEMATCH[n] (n=0..3)

Address offset: 0x030 + (n × 0x4)

Enables the MATCH[n] event by setting the ENABLE[n] bit in the CONFIG register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	ENABLEMATCH			Enables the MATCH[n] event by setting the ENABLE[n] bit in the CONFIG register.
			Trigger	1	Trigger task

8.20.7.3.1.2 TASKS_DMA.RX.DISABLEMATCH[n] (n=0..3)

Address offset: 0x040 + (n × 0x4)

Disables the MATCH[n] event by clearing the ENABLE[n] bit in the CONFIG register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	DISABLEMATCH			Disables the MATCH[n] event by clearing the ENABLE[n] bit in the CONFIG register.
			Trigger	1	Trigger task

8.20.7.4 SUBSCRIBE_ACQUIRE

Address offset: 0x094

Subscribe configuration for task ACQUIRE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task ACQUIRE will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.20.7.5 SUBSCRIBE_RELEASE

Address offset: 0x098

Subscribe configuration for task RELEASE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task RELEASE will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.20.7.6 SUBSCRIBE_DMA

Subscribe configuration for tasks

8.20.7.6.1 SUBSCRIBE_DMA.RX

Subscribe configuration for tasks

8.20.7.6.1.1 SUBSCRIBE_DMA.RX.ENABLEMATCH[n] (n=0..3)

Address offset: 0x0B0 + (n × 0x4)

Subscribe configuration for task ENABLEMATCH[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task ENABLEMATCH[n] will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.20.7.6.1.2 SUBSCRIBE_DMA.RX.DISABLEMATCH[n] (n=0..3)

Address offset: 0x0C0 + (n × 0x4)

Subscribe configuration for task DISABLEMATCH[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task DISABLEMATCH[n] will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.20.7.7 EVENTS_END

Address offset: 0x104

Granted transaction completed

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_END			Granted transaction completed
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.20.7.8 EVENTS_ACQUIRED

Address offset: 0x118

Semaphore acquired

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_ACQUIRED			Semaphore acquired
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.20.7.9 EVENTS_DMA

Peripheral events.

8.20.7.9.1 EVENTS_DMA.RX

Peripheral events.

8.20.7.9.1.1 EVENTS_DMA.RX.END

Address offset: 0x14C

Generated after all MAXCNT bytes have been transferred

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	END			Generated after all MAXCNT bytes have been transferred
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.20.7.9.1.2 EVENTS_DMA.RX.READY

Address offset: 0x150

Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	READY			Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.20.7.9.1.3 EVENTS_DMA.RX.BUSERROR

Address offset: 0x154

An error occured during the bus transfer.

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	BUSERROR			An error occured during the bus transfer. When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.20.7.9.1.4 EVENTS_DMA.RX.MATCH[n] (n=0..3)

Address offset: 0x158 + (n × 0x4)

Pattern match is detected on the DMA data bus.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MATCH			Pattern match is detected on the DMA data bus.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.20.7.9.2 EVENTS_DMA.TX

Peripheral events.

8.20.7.9.2.1 EVENTS_DMA.TX.END

Address offset: 0x168

Generated after all MAXCNT bytes have been transferred

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	END			Generated after all MAXCNT bytes have been transferred
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.20.7.9.2.2 EVENTS_DMA.TX.READY

Address offset: 0x16C

Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	READY			Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.20.7.9.2.3 EVENTS_DMA.TX.BUSERROR

Address offset: 0x170

An error occured during the bus transfer.

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	BUSERROR			An error occured during the bus transfer. When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.20.7.10 PUBLISH_END

Address offset: 0x184

Publish configuration for event END

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event END will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.20.7.11 PUBLISH_ACQUIRED

Address offset: 0x198

Publish configuration for event ACQUIRED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event ACQUIRED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.20.7.12 PUBLISH_DMA

Publish configuration for events

8.20.7.12.1 PUBLISH_DMA.RX

Publish configuration for events

8.20.7.12.1.1 PUBLISH_DMA.RX.END

Address offset: 0x1CC

Publish configuration for event END

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event END will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.20.7.12.1.2 PUBLISH_DMA.RX.READY

Address offset: 0x1D0

Publish configuration for event READY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event READY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.20.7.12.1.3 PUBLISH_DMA.RX.BUSERROR

Address offset: 0x1D4

Publish configuration for event BUSERROR

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event BUSERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.20.7.12.1.4 PUBLISH_DMA.RX.MATCH[n] (n=0..3)

Address offset: 0x1D8 + (n × 0x4)

Publish configuration for event MATCH[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event MATCH[n] will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.20.7.12.2 PUBLISH_DMA.TX

Publish configuration for events

8.20.7.12.2.1 PUBLISH_DMA.TX.END

Address offset: 0x1E8

Publish configuration for event END

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event END will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.20.7.12.2.2 PUBLISH_DMA.TX.READY

Address offset: 0x1EC

Publish configuration for event READY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event READY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.20.7.12.2.3 PUBLISH_DMA.TX.BUSERROR

Address offset: 0x1F0

Publish configuration for event BUSERROR

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event BUSERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.20.7.13 SHORTS

Address offset: 0x200

Shortcuts between local events and tasks

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	END_ACQUIRE			Shortcut between event END and task ACQUIRE
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
B-E	RW	DMA_RX_MATCH[i]_DMA_RX_ENABLEMA +1)%4] (i=0..3)			Shortcut between event DMA.RX.MATCH[n] and task DMA.RX.ENABLEMATCH[(i+1)%4] Allows daisy-chaining match events.
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
F-I	RW	DMA_RX_MATCH[i]_DMA_RX_DISABLEMATCH[i] (i=0..3)			Shortcut between event DMA.RX.MATCH[n] and task DMA.RX.DISABLEMATCH[n]
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut

8.20.7.14 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1S	END			Write '1' to enable interrupt for event END
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	ACQUIRED			Write '1' to enable interrupt for event ACQUIRED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1S	DMARXEND			Write '1' to enable interrupt for event DMARXEND
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1S	DMARXREADY			Write '1' to enable interrupt for event DMARXREADY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1S	DMARXBUSERROR			Write '1' to enable interrupt for event DMARXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
F-I	RW W1S	DMARXMATCH[i] (i=0..3)			Write '1' to enable interrupt for event DMARXMATCH[i]
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
J	RW W1S	DMATXEND			Write '1' to enable interrupt for event DMATXEND
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
K	RW W1S	DMATXREADY			Write '1' to enable interrupt for event DMATXREADY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
L	RW W1S	DMATXBUSERROR			Write '1' to enable interrupt for event DMATXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.20.7.15 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	END			Write '1' to disable interrupt for event END
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	ACQUIRED			Write '1' to disable interrupt for event ACQUIRED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	DMARXEND			Write '1' to disable interrupt for event DMARXEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1C	DMARXREADY			Write '1' to disable interrupt for event DMARXREADY
			Clear	1	Disable

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1C	DMARXBUSERROR			Write '1' to disable interrupt for event DMARXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F-I	RW W1C	DMARXMATCH[i] (i=0..3)			Write '1' to disable interrupt for event DMARXMATCH[i]
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
J	RW W1C	DMATXEND			Write '1' to disable interrupt for event DMATXEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
K	RW W1C	DMATXREADY			Write '1' to disable interrupt for event DMATXREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
L	RW W1C	DMATXBUSERROR			Write '1' to disable interrupt for event DMATXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.20.7.16 SEMSTAT

Address offset: 0x400

Semaphore status register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000001				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1**

ID	R/W	Field	Value ID	Value	Description
A	R	SEMSTAT			Semaphore status
			Free	0	Semaphore is free
			CPU	1	Semaphore is assigned to CPU
			SPIS	2	Semaphore is assigned to SPI slave
			CPUPending	3	Semaphore is assigned to SPI but a handover to the CPU is pending

8.20.7.17 STATUS

Address offset: 0x440

Status from last transaction

Individual bits are cleared by writing a '1' to the bits that shall be cleared.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	OVERREAD			TX buffer over-read detected, and prevented
			NotPresent	0	Read: error not present
			Present	1	Read: error present
			Clear	1	Write: clear error on writing '1'
B	RW	OVERFLOW			RX buffer overflow detected, and prevented
			NotPresent	0	Read: error not present
			Present	1	Read: error present
			Clear	1	Write: clear error on writing '1'

8.20.7.18 ENABLE

Address offset: 0x500

Enable SPI slave

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			Enable or disable SPI slave
			Disabled	0	Disable SPI slave
			Enabled	2	Enable SPI slave

8.20.7.19 CONFIG

Address offset: 0x554

Configuration register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	ORDER			Bit order
			MsbFirst	0	Most significant bit shifted out first
			LsbFirst	1	Least significant bit shifted out first
B	RW	CPHA			Serial clock (SCK) phase
			Leading	0	Sample on leading edge of clock, shift serial data on trailing edge
			Trailing	1	Sample on trailing edge of clock, shift serial data on leading edge
C	RW	CPOL			Serial clock (SCK) polarity
			ActiveHigh	0	Active high
			ActiveLow	1	Active low

8.20.7.20 DEF

Address offset: 0x55C

Default character. Character clocked out in case of an ignored transaction.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	DEF			Default character. Character clocked out in case of an ignored transaction.

8.20.7.21 ORC

Address offset: 0x5C0

Over-read character

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ORC			Over-read character. Character clocked out after an over-read of the transmit buffer.

8.20.7.22 PSEL.SCK

Address offset: 0x600

Pin select for SCK

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.20.7.23 PSEL.MISO

Address offset: 0x604

Pin select for SDO signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.20.7.24 PSEL.MOSI

Address offset: 0x608

Pin select for SDI signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.20.7.25 PSEL.CSN

Address offset: 0x610

Pin select for CSN signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.20.7.26 DMA.RX.PTR

Address offset: 0x704

RAM buffer start address

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x20000000				**0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			RAM buffer start address for this EasyDMA channel. This address is a word aligned Data RAM address.

Note: See the memory chapter for details about which memories are available for EasyDMA.

8.20.7.27 DMA.RX.MAXCNT

Address offset: 0x708

Maximum number of bytes in channel buffer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MAXCNT		[1..0xffff]	Maximum number of bytes in channel buffer

8.20.7.28 DMA.RX.AMOUNT

Address offset: 0x70C

Number of bytes transferred in the last transaction, updated after the END event.

Also updated after each MATCH event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT		[1..0xffff]	Number of bytes transferred in the last transaction. In case of NACK error, includes the NACK'ed byte.

8.20.7.29 DMA.RX.LIST

Address offset: 0x714

EasyDMA list type

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	TYPE			List type
			Disabled	0	Disable EasyDMA list
			ArrayList	1	Use array list

8.20.7.30 DMA.RX.TERMINATEONBUSERROR

Address offset: 0x71C

Terminate the transaction if a BUSERROR event is detected.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			
			Disabled	0	Disable
			Enabled	1	Enable

8.20.7.31 DMA.RX.BUSERRORADDRESS

Address offset: 0x720

Address of transaction that generated the last BUSERROR event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	ADDRESS			

8.20.7.32 DMA.RX.MATCH

Registers to control the behavior of the pattern matcher engine

8.20.7.32.1 DMA.RX.MATCH.CONFIG

Address offset: 0x724

Configure individual match events

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A-D	RW	ENABLE[i] (i=0..3)			Enable match filter i
			Disabled	0	Match filter disabled
			Enabled	1	Match filter enabled
E-H	RW	ONESHOT[i] (i=0..3)			Configure match filter i as one-shot or sticky One-shot match filters can be used together with shortcuts to check for continuous data sequences by disabling the filter if the next data is not a match. **Note:** The presence of these shorts depends on the configuration of the peripheral integrating this EasyDMA.
			Continuous	0	Match filter stays enabled until disabled by task
			Oneshot	1	Match filter stays enabled until next data word is received

8.20.7.32.2 DMA.RX.MATCH.CANDIDATE[n] (n=0..3)

Address offset: 0x728 + (n × 0x4)

The data to look for - any match will trigger the MATCH[n] event, if enabled.

Note: This register can be updated while a transfer is in progress, but the new value will not take effect until a match has been found or the transfer is done. That makes it possible to write a new set of match words which will be searched for immediately after the event triggers.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DATA			Data to look for

8.20.7.33 DMA.TX.PTR

Address offset: 0x73C

RAM buffer start address

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x20000000	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			RAM buffer start address for this EasyDMA channel. This address is a word aligned Data RAM address.

Note: See the memory chapter for details about which memories are available for EasyDMA.

8.20.7.34 DMA.TX.MAXCNT

Address offset: 0x740

Maximum number of bytes in channel buffer

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MAXCNT		[1..0xffff]	Maximum number of bytes in channel buffer

8.20.7.35 DMA.TX.AMOUNT

Address offset: 0x744

Number of bytes transferred in the last transaction, updated after the END event.

Also updated after each MATCH event.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT		[1..0xffff]	Number of bytes transferred in the last transaction. In case of NACK error, includes the NACK'ed byte.

8.20.7.36 DMA.TX.LIST

Address offset: 0x74C

EasyDMA list type

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																															A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	TYPE			List type
			Disabled	0	Disable EasyDMA list
			ArrayList	1	Use array list

8.20.7.37 DMA.TX.TERMINATEONBUSERROR

Address offset: 0x754

Terminate the transaction if a BUSERROR event is detected.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID				Value												Description															
A	RW	ENABLE																																	
				Disabled				0												Disable															
				Enabled				1												Enable															

8.20.7.38 DMA.TX.BUSERRORADDRESS

Address offset: 0x758

Address of transaction that generated the last BUSERROR event.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID				Value												Description															
A	R	ADDRESS																																	

8.21 TDM — Time division multiplexed audio interface

The time division multiplexed peripheral (TDM) is a multi-channel time division multiplexed audio interface that supports transferring up to eight channels within a sample frame. TDM can also be configured to support I^2S in mono or stereo. It implements EasyDMA for sample transfer directly to and from RAM without CPU intervention.

The main features of TDM are the following:

- Controller and target clock mode
- Simultaneous bidirectional (TX and RX) audio streaming
- Up to eight output and input channels, in either left-aligned or right-aligned formats
- Supports mono or stereo I^2S
- 8, 16, 24, and 32-bit sample widths
- Separate sample and word widths
- Serial clock (SCK) generator supporting a wide range of sample rates
- Separate controller clock (MCK) generator

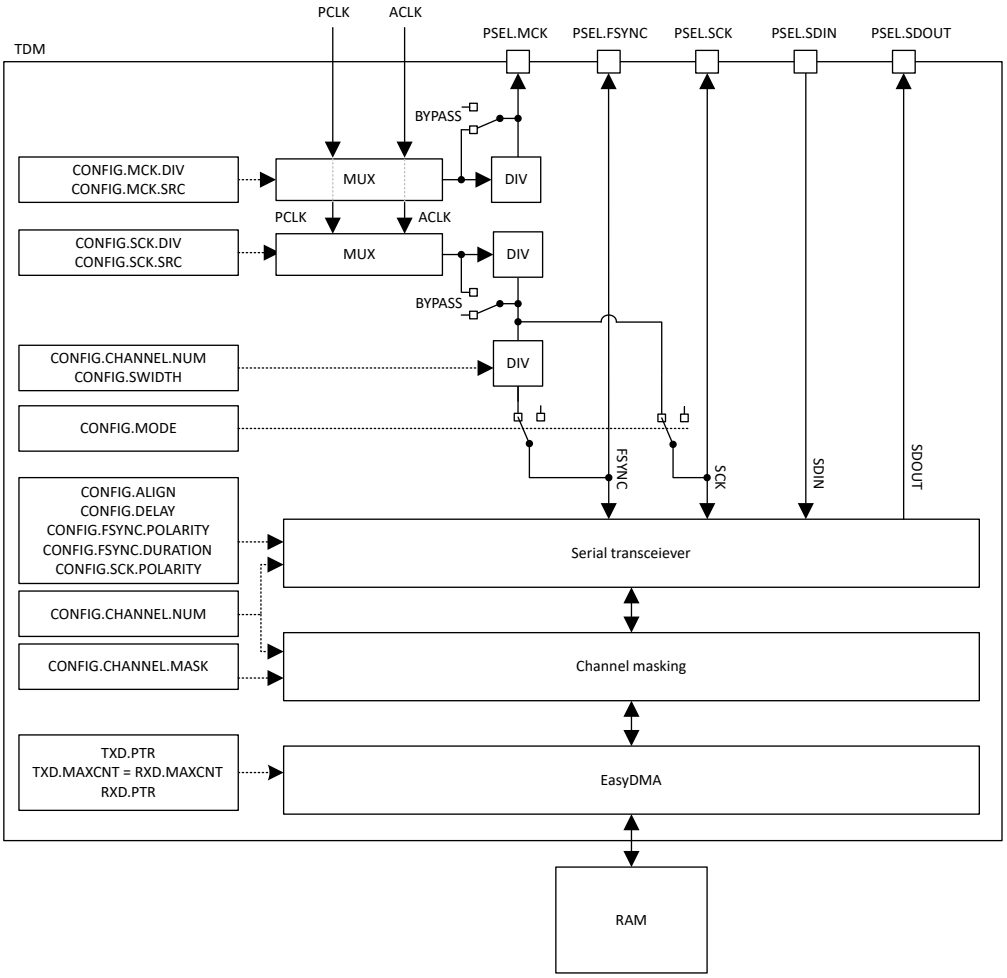


Figure 125: Block diagram

8.21.1 Overview

The TDM interface is comprised of a frame synchronization pulse (FSYNC), a serial clock (SCLK), and the serial audio data (SDIN or SDOUT).

The Master always supplies the clock signals FSYNC and SCK to the Slave. Serial data can be received on the input data pin **SDIN**, or transmitted on the output data pin **SDOUT**.

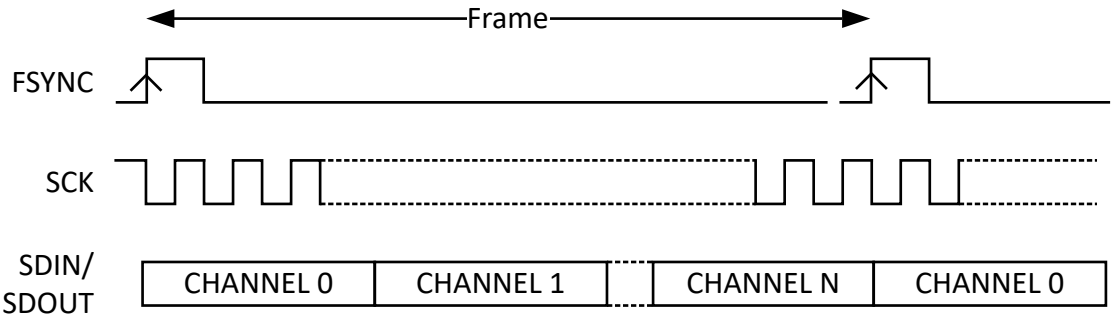


Figure 126: TDM overview

8.21.2 Transmitting and receiving

TDM supports both transmission (TX) and reception (RX) of serial data. In both cases the serial data is shifted synchronously to the SCK clock signal.

TX data is written to the SDOUT pin on the falling edge of SCK, and RX data is read from the SDIN pin on the rising edge of SCK. To change the active edge of SCK, use register CONFIG.SCK.POLARITY on page 663.

The most significant bit (MSB) is always transmitted first.

TX and RX are available in both Master and Slave modes and can be enabled/disabled independently in CONFIG.RXTXEN on page 661.

Transmission and/or reception is started by triggering the START task. When transmission is enabled in CONFIG.TXEN), the TXPTRUPD event will be generated for every number of transmitted data words given by TXD.MAXCNT on page 670. Each data word contains one or more samples. The TXPTRUPD event is generated just before MAXCNT number of bytes have been transmitted. Similarly, when reception is enabled in CONFIG.RXTXEN, the RXPTRUPD event is generated just after MAXCNT number of bytes have been received.

The CONFIG.ORS register stores extra samples used to align frames.

- When transmitting and receiving, if the receive size (RXD.MAXCNT) exceeds the transmit size (TXD.MAXCNT), additional bytes are sent after TXD.MAXCNT bytes have been transmitted. These extra bytes are being sent while RXD.MAXCNT bytes are received and continue until the frame is completed.
- When only transmitting, extra samples are sent after TXD.MAXCNT bytes have been transmitted to complete the frame.

If transmitting more samples than receiving (TXD.MAXCNT is larger than RXD.MAXCNT), the additional received samples will be discarded.

During receive-only operation, once RXD.MAXCNT bytes have been received, any further samples are discarded.

CONFIG.ORS follows the layout of a 32-bit memory word and can contain four 8-bit samples, two 16-bit samples, one right-aligned 24-bit sample sign-extended to 32 bit, or one 32-bit sample. The size of the samples is dependent on CONFIG.SWIDTH. For details on the memory word layout, see Channel mask and EasyDMA on page 643.

The MAXCNT event is generated synchronously to the active FSYNC edge at the beginning of a frame after transmitting RXD.MAXCNT bytes. The initial MAXCNT event is generated at the first active edge of FSYNC after the START task has been triggered. The MAXCNT event is generated once all data has been transmitted and/or received. The data will be available in RAM upon completion of the EasyDMA operation.

Transmission can be aborted by using the ABORT task. This will abort TDM transfer possibly without completing MAXCNT words, and will cause the ABORTED event to be generated.

The following figure shows an example of transmitting and receiving aligned data using the following TDM configuration.

- CONFIG.FSYNC.DURATION = `Channel`
- CONFIG.FSYNC.CPOLARITY = `PosEdge`
- CONFIG.SWIDTH = `8Bit`
- CONFIG.CHANNEL.NUM = `Tdm2Ch`
- CONFIG.CHANNEL.DELAY = `Delay0Ck`
- TXD.MAXCNT = `1`

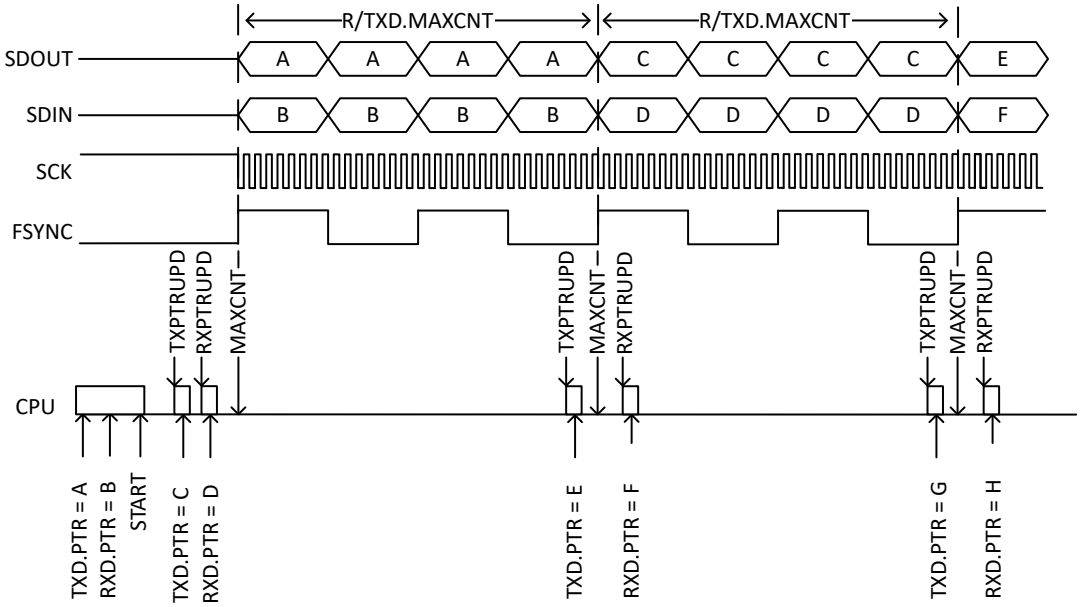


Figure 127: Transmitting and receiving data

8.21.3 Clocks

In addition to the frame sync (FSYNC) pulse, TDM has two clock signals. The master clock MCK and the sample data bit clock SCK.

MCK and SCK are independent and can be configured individually.

The serial clock (SCK), often referred to as the serial bit clock, pulses once for each data bit being transferred on the serial data lines SDIN and SDOUT.

The polarity of SCK is configured in CONFIG.SCK.POLARITY.

When operating in Master mode, SCK clock source and frequency and is configured in CONFIG.SCK.SRC and CONFIG.SCK.DIV respectively. For CONFIG.SCK.DIV value, see Clock divider equations on page 641.

When operating in Slave mode, SCK is an input signal provided by the external master.

The optional master clock (MCK) is independent from SCK and FSYNC.

The master clock generator is enabled/disabled using CONFIG.MCK.EN on page 661, and the generator is started or stopped by the START or STOP tasks respectively.

8.21.3.1 Frame synchronization pulse (FSYNC)

FSYNC defines the start of the frame in the serial bit streams sent and received on SDOUT and SDIN, respectively. It is often referred to as "word clock", "sample clock", "word select", "frame clock", or "left/right clock".

In master mode, FSYNC duration is configured in CONFIG.FSYNC.DURATION on page 666. The duration can either be one SCK period, or one channel. This is illustrated in the following figure.

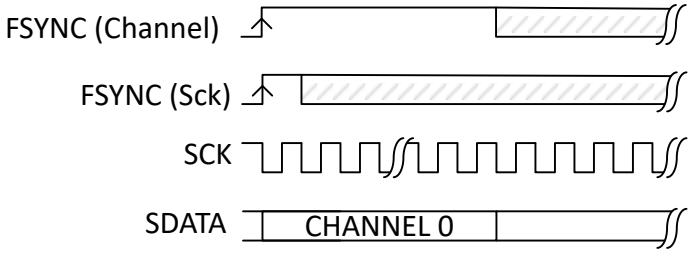


Figure 128: Configuration of FSYNC duration in Master mode

Regardless of FSYNC duration, the frequency of FSYNC is equivalent to the audio sample rate.

If is possible to configure the sample size to only use a fraction of a channel, see Width and alignment on page 641. Also in this configuration FSYNC duration is the channel width (not the audio sample size), as illustrated in the following figure.

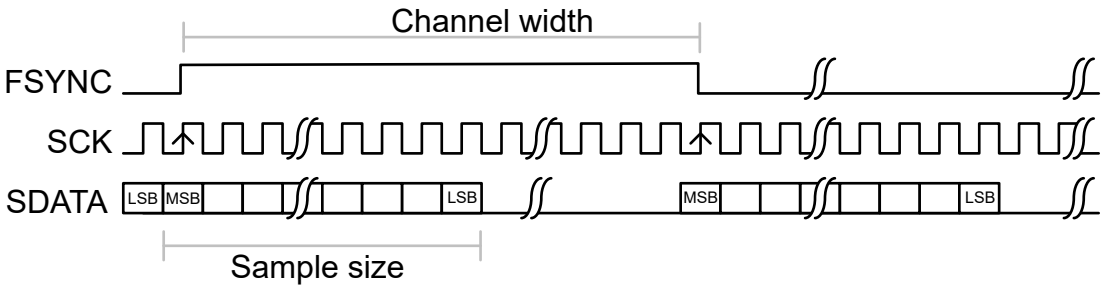


Figure 129: FSYNC duration when sample size is less than channel width

The alignment of the frame with the active edge of FSYNC can be adjusted using the register CONFIG.CHANNEL.DELAY on page 665. This allows the data to be delayed one or more periods of the serial clock following the active edge of FSYNC, as illustrated in the following figure.

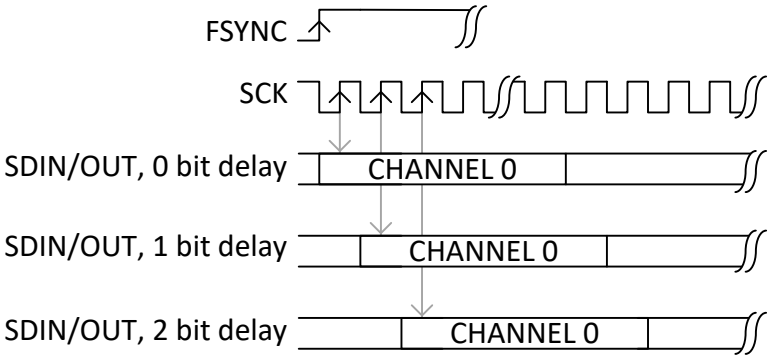


Figure 130: Configuration of delay

When TDM is configured for the I^2S mode, each frame contains one left and right sample pair, with the left sample being transferred during the low half period of FSYNC followed by the right sample being transferred during the high half period of FSYNC. There is a single SCK clock pulse delay between FSYNC edge and the first bit of the sample.

With the Aligned format, each frame contains one left and right sample pair, with the left sample being transferred during the high half period of FSYNC followed by the right sample being transferred during the low half period of FSYNC. There is no delay between FSYNC edge and the first bit of the sample.

For TDM, the active edge of FSYNC defines the beginning of a frame. The words within the frame are transferred continously, with no transitions of FSYNC.

FSYNC configuration details described above is summarised the following table.

Format	CONFIG.FSYNC.DURATION	CONFIG.FSYNC.POLARITY	CONFIG.CHANNEL.DELAY
I2S	`Channel`	Left=`NegEdge`	`Delay1Ck`
Aligned	`Channel`	Left=`PosEdge`	`Delay0Ck`
TDM	`Channel` or `Sck`	`PosEdge`	`Delay0Ck`, `Delay1Ck`, or `Delay2Ck`

Table 63: FSYNC configuration overview

8.21.3.2 Clock source selection

The clock source for SCK and MCK is selectable in registers CONFIG.MCK.SRC on page 662 and CONFIG.SCK.SRC on page 663 respectively.

The following clocks can be selected as the clock source.

- Peripheral clock (PCLK)
- Additional clock (ACLK)

To improve the clock accuracy and jitter performance, it is recommended (but not mandatory) that the PCLK source used is running off the external crystal. The ACLK source requires the use of a crystal. See CLOCK — Clock control on page 72 for more information about clock sources.

The clock generator can be bypassed so that MCK or SCK is derived directly from the input source. This can be configured in the BYPASS field of their respective registers CONFIG.SCK.SRC and CONFIG.SCK.SRC.

8.21.3.3 Clock frequency selection

MCK and SCK frequency can be adjusted on-the-fly by using CONFIG.MCK.DIV or CONFIG.SCK.DIV.

8.21.3.3.1 Clock divider equations

The following equations are used to select SCK and MCK frequencies.

In the following equations, the following notation is used:

- f_{CK} is the SCK or MCK frequency in Hz.
- f_{source} is the frequency of the selected clock source, either ACLK or PCLK.
- DIV is the CONFIG.SCK.DIV or CONFIG.MCK.DIV register value.

The first equation is used to calculate the value of CONFIG.MCK.DIV or CONFIG.SCK.DIV for a given source, and MCK or SCK frequency.

$$DIV = 4096 \cdot \left\lfloor \frac{f_{CK} \cdot 1048576}{f_{source} + \frac{f_{CK}}{2}} \right\rfloor$$

Figure 131: MCK and SCK clock frequency equation

Because of rounding errors, an accurate MCK clock may not be achievable. The equation does not take into account the maximum register values of CONFIG.MCK.DIV or CONFIG.SCK.DIV.

The actual MCK or SCK frequency can be calculated using the equation below.

$$f_{actual} = \frac{f_{source}}{\left\lfloor \frac{1048576 \cdot 4096}{DIV} \right\rfloor}$$

Figure 132: Actual MCK and SCK clock frequency

The clock error can be calculated using the equation below. The error *e* is the percentage difference from the requested f_{MCK} or f_{SCK} frequency.

$$e = 100 \cdot \frac{f_{actual} - f_{CK}}{f_{CK}} = 100 \cdot \frac{\frac{f_{source}}{\left\lfloor \frac{1048576 \cdot 4096}{DIV} \right\rfloor} - f_{CK}}{f_{CK}}$$

Figure 133: MCK and SCK frequency error equation

8.21.4 Width and alignment

Each audio data sample is followed by sufficient number of zero data bits to complete an M-bit word. The CONFIG.SWIDTH on page 664 register defines the sample width of the data read and written to memory, as well as the number of SCK clock cycles per word. The M-bit word is sometimes referred to as a *channel block*.

The following figure illustrates a configuration with identical sample and channel/word widths. The number of SCK pulses matches the number of sample bits.

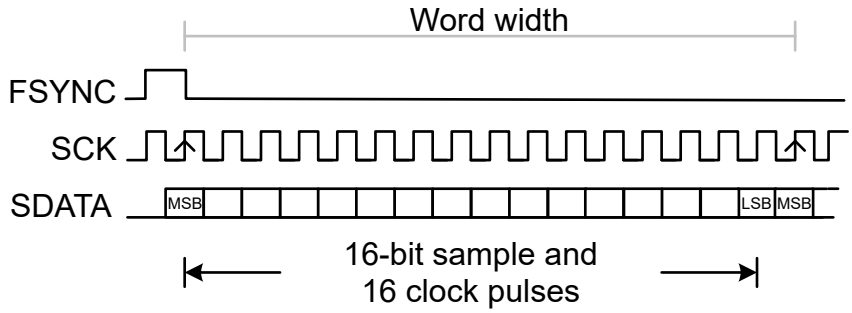


Figure 134: Aligned format, with CONFIG.SWIDTH configured to 16 bit samples in a 16 bit word

The next figure illustrates a configuration with greater word width than sample width. The number of SCK pulses are greater than the number of sample bits, with the sample being left-aligned in the word.

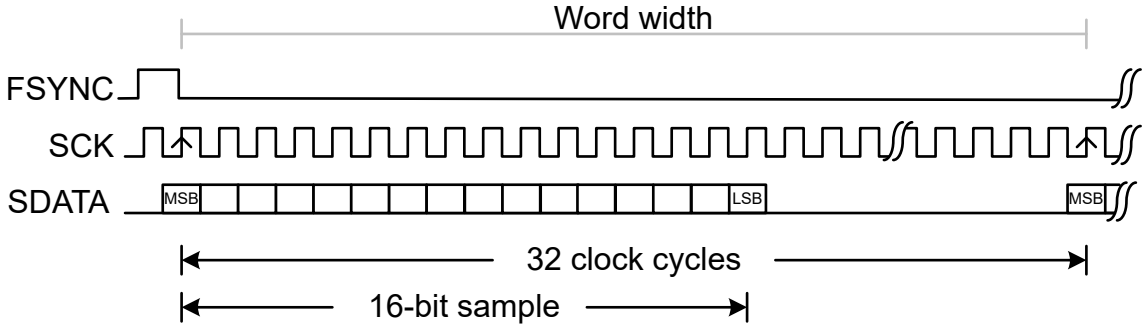


Figure 135: Aligned format, with CONFIG.SWIDTH configured to 16-bit samples in a 32-bit word

Alignment of samples

If the word width differs from the sample width, the sample value can be either right or left-aligned inside a word, as specified in CONFIG.ALIGN on page 664.

When using left-alignment, each word starts with the MSB of the sample value, as illustrated in the following figure.

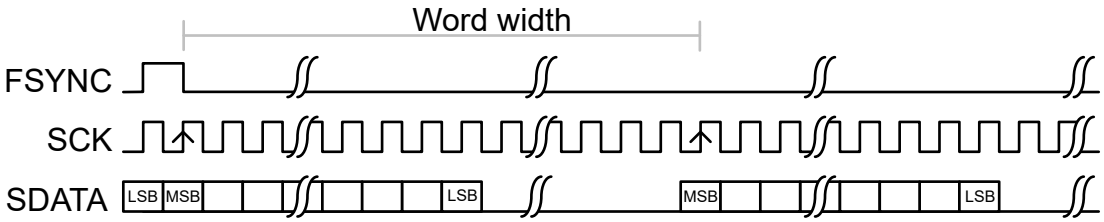


Figure 136: CONFIG.ALIGN set to left justified

When using right-alignment, each word ends with the LSB of the sample value. This is illustrated in the following figure.

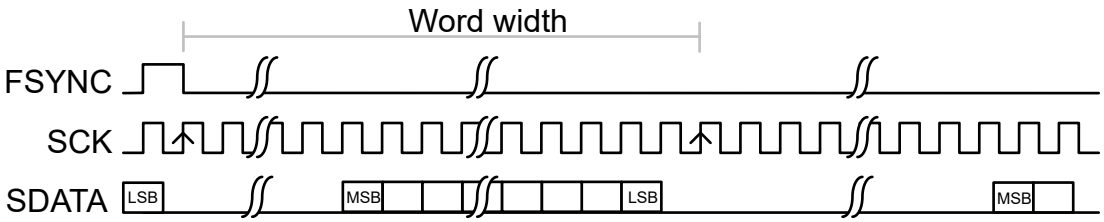


Figure 137: CONFIG.ALIGN set to right justified

8.21.5 Channel mask and EasyDMA

TDM implements EasyDMA for accessing RAM without CPU intervention.

EasyDMA

The source and destination pointers for the TX and RX data are configured in TXD.PTR on page 669 and RXD.PTR on page 668. The memory pointed to by these pointers will only be read or written when TX or RX are enabled in and .

The addresses written to the pointer registers TXD.PTR on page 669 and RXD.PTR on page 668 are double-buffered in hardware, and these double buffers are updated for every TXD.MAXCNT/RXD.MAXCNT words (containing one or more samples) read/written from/to memory. The events TXPTRUPD and RXPTRUPD are generated whenever the TXD.PTR and RXD.PTR are transferred to these double buffers.

If TXD.PTR on page 669 is not pointing to the Data RAM region when transmission is enabled, or RXD.PTR on page 668 is not pointing to the Data RAM region when reception is enabled, an EasyDMA transfer may result in a HardFault and/or memory corruption. See Memory on page 13 for more information about the different memory regions.

The size of the RXD and TXD memory buffers are independent, but the number of transmitted bytes always equals the number of received bytes. With RXD.MAXCNT and TXD.MAXCNT being independent, data is either discarded or padded as described in Transmitting and receiving on page 637. The size of the buffers is specified in a number of bytes, however the memory is organized in 32-bit words that either contain four 8-bit samples, two 16-bit samples, one right-aligned 24-bit sample sign extended to 32 bit, or one 32-bit sample.

Channel masking

Channel masking takes place between the transceiver and the EasyDMA access to memory as illustrated in the following figure.

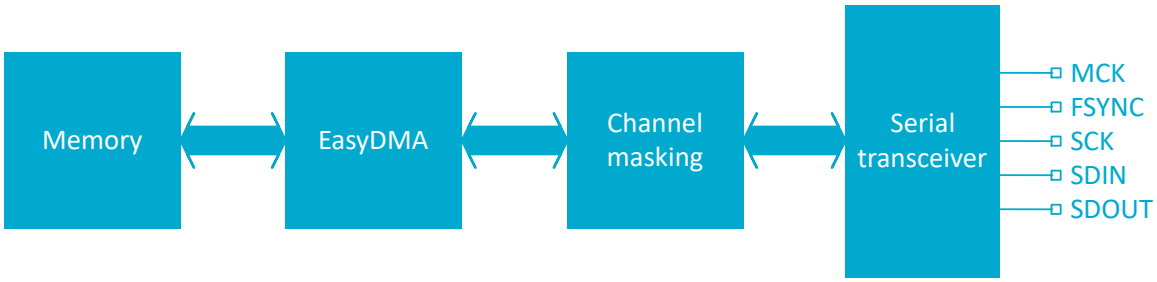


Figure 138: Channel masking block diagram

Which of the samples transferred over the data lines are accessed by EasyDMA, is selected by the register CONFIG.CHANNEL.MASK on page 664. In this register, channels are enabled or disabled from the memory transfers. Disabled channels are ignored - transmitted bits are zero, and received data is discarded. Enabled channels will have their data stored to, or received from, memory.

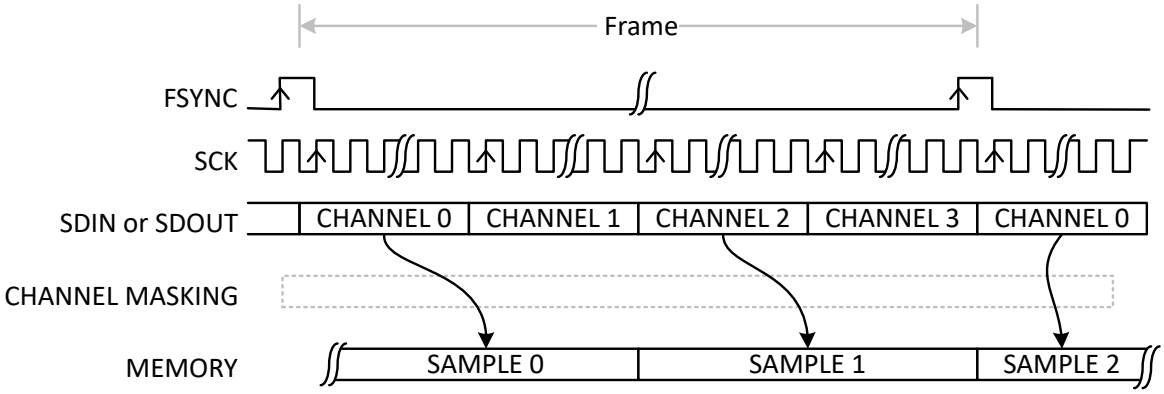


Figure 139: Channel masking example. Four channel audio input, storing only two channels to memory

Memory map for single channel (mono)

When the resulting data after channel masking is a single channel, the following figures show how this channel's samples are mapped to memory. The mapping is valid for both RX and TX.

	31 24	23 16	15 8	7 0
x.PTR	Left sample 3	Left sample 2	Left sample 1	Left sample 0
x.PTR + 4	Left sample 7	Left sample 6	Left sample 5	Left sample 4
x.PTR + n - 4	Left sample n-1	Left sample n-2	Left sample n-3	Left sample n-4

Figure 140: Memory mapping for 8 bit mono. CONFIG.SWIDTH = 8Bit, CONFIG.CHANNEL.NUM = 2 and CONFIG.CHANNEL.MASK = 0x00010001

	31 16	15 0
x.PTR	Left sample 1	Left sample 0
x.PTR + 4	Left sample 3	Left sample 2
x.PTR + (n*2) - 4	Left sample n - 1	Left sample n - 2

Figure 141: Memory mapping for 16 bit mono, left channel only. CONFIG.SWIDTH = 16Bit, CONFIG.CHANNEL.NUM = 2 and CONFIG.CHANNEL.MASK = 0x00010001

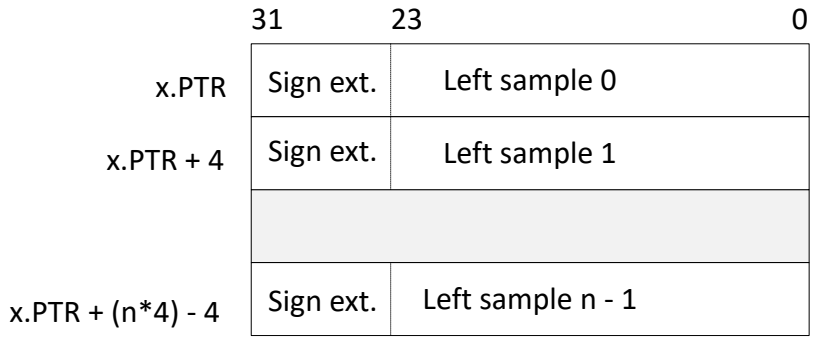


Figure 142: Memory mapping for 24 bit mono, left channel only. CONFIG.SWIDTH = 24Bit, CONFIG.CHANNEL.NUM = 2 and CONFIG.CHANNEL.MASK = 0x00010001

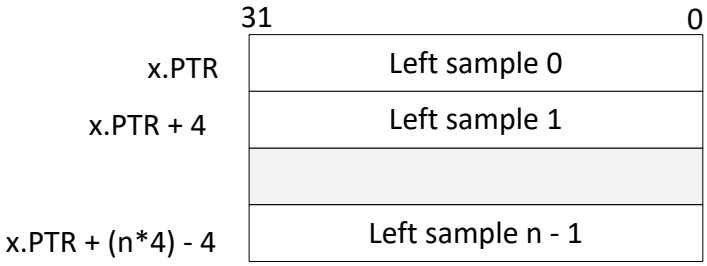


Figure 143: Memory mapping for 32 bit mono, left channel only. CONFIG.SWIDTH = 32Bit, CONFIG.CHANNEL.NUM = 2 and CONFIG.CHANNEL.MASK = 0x00010001

Memory map for two channels (stereo)

When the resulting data after channel masking is two channels (stereo), the following figures show how this channel's samples are mapped to memory. The mapping is valid for both RX and TX.

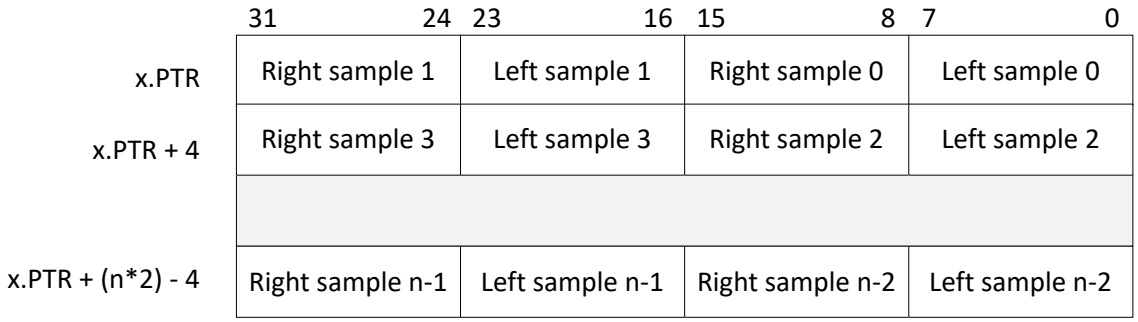


Figure 144: Memory mapping for 8 bit stereo. CONFIG.SWIDTH = 8Bit, CONFIG.CHANNEL.NUM = 2 and CONFIG.CHANNEL.MASK = 0x00030003

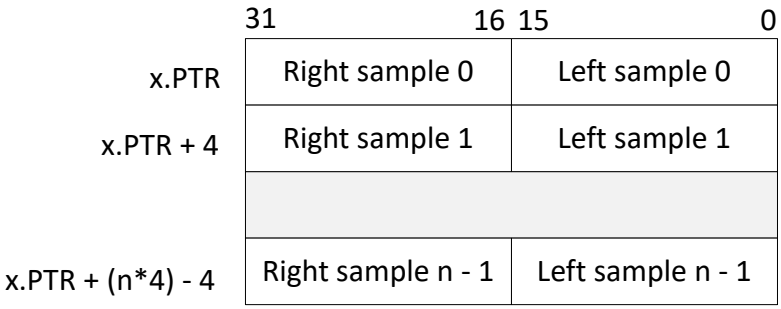


Figure 145: Memory mapping for 16 bit stereo. CONFIG.SWIDTH = 16Bit, CONFIG.CHANNEL.NUM = 2 and CONFIG.CHANNEL.MASK = 0x00030003

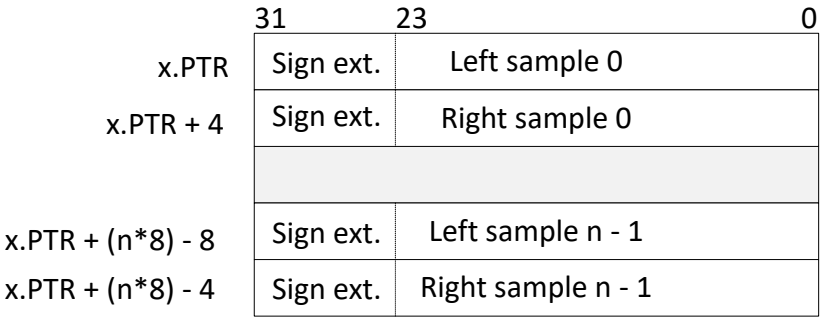


Figure 146: Memory mapping for 24 bit stereo. CONFIG.SWIDTH = 24Bit, CONFIG.CHANNEL.NUM = 2 and CONFIG.CHANNEL.MASK = 0x00030003

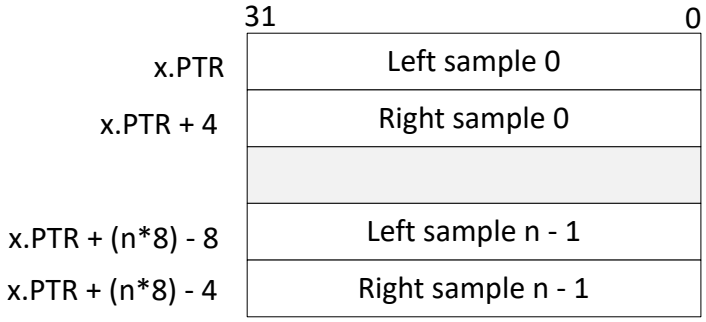


Figure 147: Memory mapping for 32 bit stereo. CONFIG.SWIDTH = 32Bit, CONFIG.CHANNEL.NUM = 2 and CONFIG.CHANNEL.MASK = 0x00030003

Memory map for multi-channel (three or more)

The following equation can be used to calculate the address of the word storing a multi-channel sample. The equation is valid for both RX and TX. The following notation is used.

- S is the number of data bits in a sample
- N total number of channels per sample
- n is the channel number of the current sample
- m is the sample number

$$x.PTR + \left\lfloor \frac{m \times N + n}{\left\lfloor \frac{32}{S} \right\rfloor} \right\rfloor \times 4$$

Figure 148: The equation for calculating the 32-bit aligned address of a multi-channel sample.

When the resulting data after channel masking is three or more the samples are stored sequentially in memory, similar to stereo. The following figures show how the samples are mapped to memory. The mapping is valid for both RX and TX.

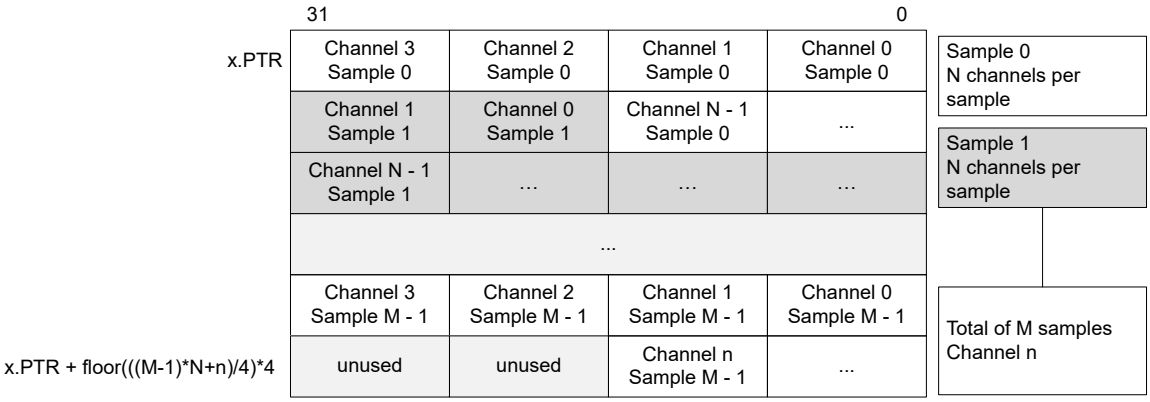


Figure 149: Memory mapping for 8 bit TDM. CONFIG.SWIDTH = 8Bit, CONFIG.CHANNEL.NUM = n and all channels enabled in CONFIG.CHANNEL.MASK

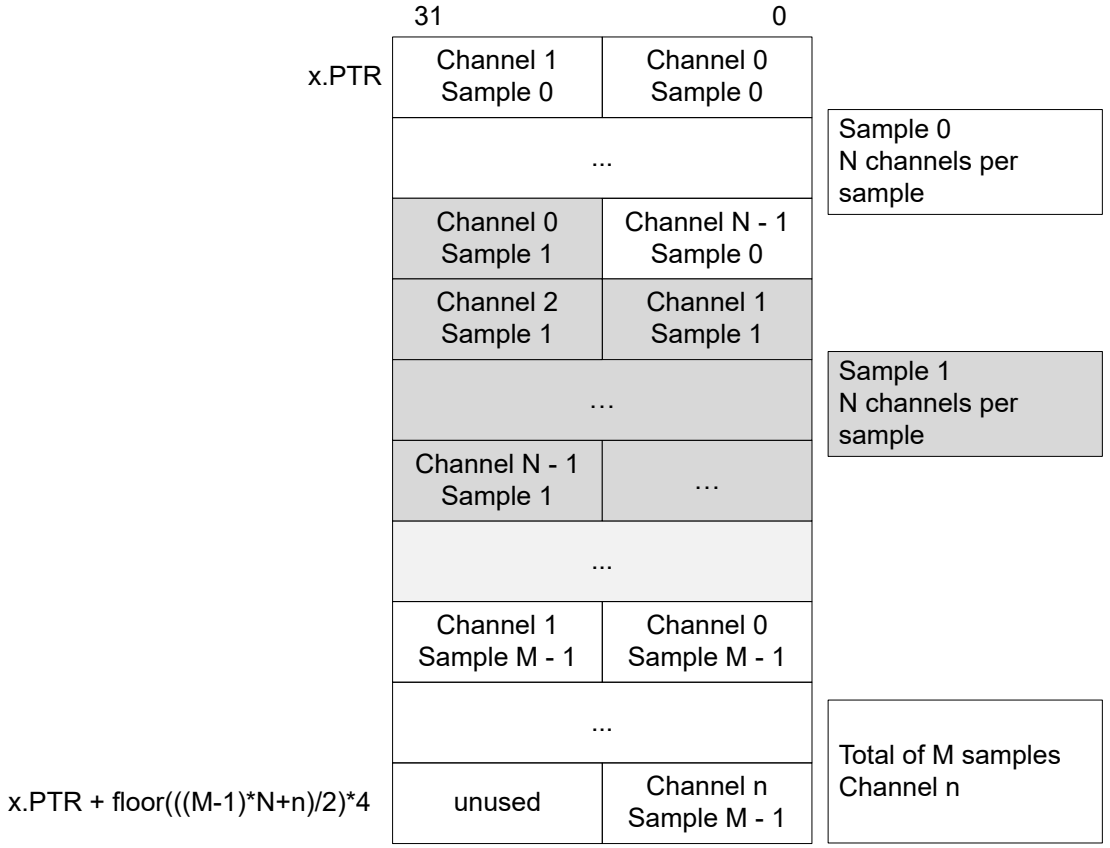


Figure 150: Memory mapping for 16 bit TDM. CONFIG.SWIDTH = 16Bit, CONFIG.CHANNEL.NUM = n and all channels enabled in CONFIG.CHANNEL.MASK

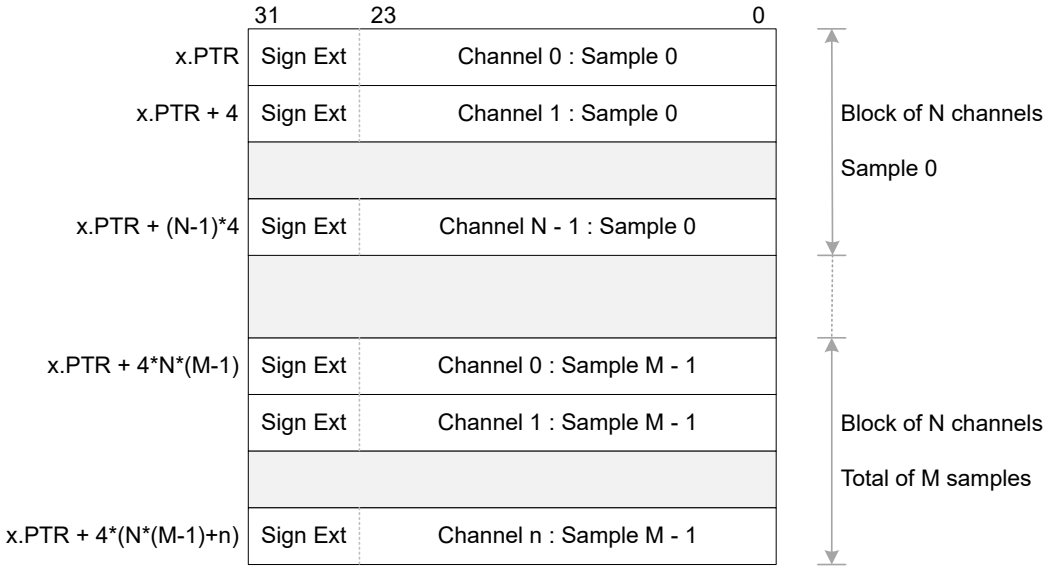


Figure 151: Memory mapping for 24 bit TDM. CONFIG.SWIDTH = 24Bit, CONFIG.CHANNEL.NUM = n and all channels enabled in CONFIG.CHANNEL.MASK

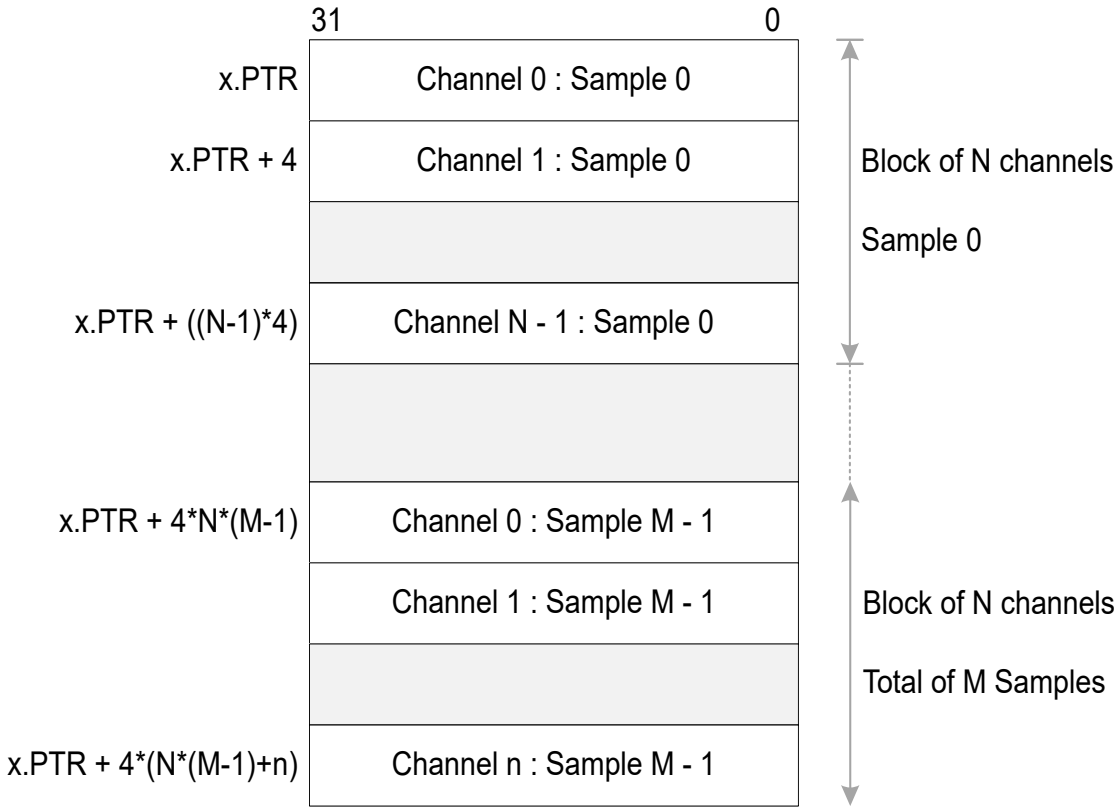


Figure 152: Memory mapping for 32 bit TDM. CONFIG.SWIDTH = 32Bit, CONFIG.CHANNEL.NUM = n and all channels enabled in CONFIG.CHANNEL.MASK

8.21.6 Pin configuration

The MCK, SCK, FSYNC, SDIN and SDOUT signals associated with TDM are mapped to physical pins according to the pin numbers specified in the PSEL.x registers.

These pins are acquired whenever TDM is enabled through the register ENABLE on page 660.

When a pin is acquired by TDM, the direction of the pin (input or output) will be configured automatically, and any pin direction setting done in the GPIO module will be overridden. The directions for the various TDM pins are shown in the following tables.

To secure correct signal levels on the pins in System OFF mode, and when TDM is disabled, these pins must be configured in the GPIO peripheral directly.

TDM signal	TDM pin	Direction	Output value	Comment
MCK	As specified in PSEL.MCK	Output	0	
FSYNC	As specified in PSEL.FSYNC	Output	0	
SCK	As specified in PSEL.SCK	Output	0	
SDIN	As specified in PSEL.SDIN	Input	Not applicable	
SDOUT	As specified in PSEL.SDOUT	Output	0	

Table 64: GPIO configuration before enabling peripheral (Master mode)

TDM signal	TDM pin	Direction	Output value	Comment
MCK	As specified in PSEL.MCK	Output	0	
FSYNC	As specified in PSEL.FSYNC	Input	Not applicable	
SCK	As specified in PSEL.SCK	Input	Not applicable	
SDIN	As specified in PSEL.SDIN	Input	Not applicable	
SDOUT	As specified in PSEL.SDOUT	Output	0	

Table 65: GPIO configuration before enabling peripheral (Slave mode)

8.21.7 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
TDM : S TDM : NS	GLOBAL	0x500E8000 0x400E8000	US	S	SA	No	Time division multiplexed audio interface TDM

Configuration

Instance	Domain	Configuration
TDM : S TDM : NS	GLOBAL	Use GPIO port P1 or P3 ACLK is the fixed 24 MHz clock PCLK24M PCLK is the fixed 32 MHz clock PCLK32M CURRENTAMOUNT register included.

Register overview

Register	Offset	TZ	Description
TASKS_START	0x000		Starts continuous TDM transfer. Also starts MCK when this is enabled
TASKS_STOP	0x004		Stops TDM transfer after the completion of MAXCNT bytes. Triggering this task will cause the STOPPED event to be generated.
TASKS_ABORT	0x008		Abort TDM transfer without completing MAXCNT bytes. Triggering this task will cause the ABORTED event to be generated.

Register	Offset	TZ	Description
SUBSCRIBE_START	0x080		Subscribe configuration for task START
SUBSCRIBE_STOP	0x084		Subscribe configuration for task STOP
SUBSCRIBE_ABORT	0x088		Subscribe configuration for task ABORT
EVENTS_RXPTRUPD	0x104		The RXD.PTR register has been copied to internal double-buffers. When TDM is started and RX is enabled, this event will be generated for every RXTXD.MAXCNT bytes received on the SDIN pin.
EVENTS_STOPPED	0x108		Transfer stopped.
EVENTS_ABORTED	0x10C		Transfer aborted.
EVENTS_TXPTRUPD	0x118		The TDX.PTR register has been copied to internal double-buffers. When TDM is started and TX is enabled, this event will be generated for every RXTXD.MAXCNT bytes that are sent on the SDOUT pin.
EVENTS_MAXCNT	0x120		Generated on the active edge of FSYNC, after both RX and TX DMA transfers have completed. An initial MAXCNT event is also triggered on the first active edge of FSYNC after the START task is issued.
EVENTS_BUSERROR_RX	0x124		This event is generated if an error occurs during the bus transfer.
EVENTS_BUSERROR_TX	0x128		This event is generated if an error occurs during the bus transfer.
PUBLISH_RXPTRUPD	0x184		Publish configuration for event RXPTRUPD
PUBLISH_STOPPED	0x188		Publish configuration for event STOPPED
PUBLISH_ABORTED	0x18C		Publish configuration for event ABORTED
PUBLISH_TXPTRUPD	0x198		Publish configuration for event TXPTRUPD
PUBLISH_MAXCNT	0x1A0		Publish configuration for event MAXCNT
PUBLISH_BUSERROR_RX	0x1A4		Publish configuration for event BUSERROR_RX
PUBLISH_BUSERROR_TX	0x1A8		Publish configuration for event BUSERROR_TX
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
INTPEND	0x30C		Pending interrupts
ENABLE	0x500		Enable TDM
CONFIG.MODE	0x504		Mode configuration
CONFIG.RXTXEN	0x508		Reception (RX) and transmission (TX) enable.
CONFIG.MCK.EN	0x50C		Master clock generator enable.
CONFIG.MCK.DIV	0x510		MCK divider.
CONFIG.MCK.SRC	0x514		MCK clock source selection
CONFIG.SCK.DIV	0x518		SCK divider.
CONFIG.SCK.SRC	0x51C		SCK clock source selection
CONFIG.SCK.POLARITY	0x520		Set SCK Polarity.
CONFIG.SWIDTH	0x524		Sample and word width configuration.
CONFIG.ALIGN	0x528		Alignment of sample within the audio data word.
CONFIG.CHANNEL.MASK	0x52C		Select which channels are to be used.
CONFIG.CHANNEL.NUM	0x530		Select number of channels.
CONFIG.CHANNEL.DELAY	0x534		Set channel delay.
CONFIG.FSYNC.POLARITY	0x538		Set FSYNC Polarity.
CONFIG.FSYNC.DURATION	0x53C		Set FSYNC duration.
CONFIG.ORS	0x540		Over-read sample: Extra sample(s) to be transmitted after TXD.MAXCNT bytes have been transmitted.
PSEL.MCK	0x570		Pin select for MCK signal
PSEL.SCK	0x574		Pin select for SCK signal
PSEL.FSYNC	0x578		Pin select for FSYNC signal
PSEL.SDIN	0x57C		Pin select for SDIN signal
PSEL.SDOUT	0x580		Pin select for SDOUT signal
RXD.PTR	0x704		RAM buffer start address
RXD.MAXCNT	0x708		Maximum number of bytes in channel buffer
RXD.AMOUNT	0x70C		Number of bytes transferred in the last transaction, updated after the END event.

Register	Offset	TZ	Description
RXD.CURRENTAMOUNT	0x710		Number of bytes transferred in the current transaction
RXD.MODE	0x718		Configure EasyDMA mode
RXD.TERMINATEONBUSERROR	0x71C		Terminate the transaction if a BUSERROR event is detected.
RXD.BUSERRORADDRESS	0x720		Address of transaction that generated the last BUSERROR event.
TXD.PTR	0x744		RAM buffer start address
TXD.MAXCNT	0x748		Maximum number of bytes in channel buffer
TXD.AMOUNT	0x74C		Number of bytes transferred in the last transaction, updated after the END event.
TXD.CURRENTAMOUNT	0x750		Number of bytes transferred in the current transaction
TXD.MODE	0x758		Configure EasyDMA mode
TXD.TERMINATEONBUSERROR	0x75C		Terminate the transaction if a BUSERROR event is detected.
TXD.BUSERRORADDRESS	0x760		Address of transaction that generated the last BUSERROR event.

8.21.7.1 TASKS_START

Address offset: 0x000

Starts continuous TDM transfer. Also starts MCK when this is enabled

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_START			Starts continuous TDM transfer. Also starts MCK when this is enabled
			Trigger	1	Trigger task

8.21.7.2 TASKS_STOP

Address offset: 0x004

Stops TDM transfer after the completion of MAXCNT bytes. Triggering this task will cause the STOPPED event to be generated.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Stops TDM transfer after the completion of MAXCNT bytes. Triggering this task will cause the STOPPED event to be generated.
			Trigger	1	Trigger task

8.21.7.3 TASKS_ABORT

Address offset: 0x008

Abort TDM transfer without completing MAXCNT bytes. Triggering this task will cause the ABORTED event to be generated.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_ABORT			Abort TDM transfer without completing MAXCNT bytes. Triggering this task will cause the ABORTED event to be generated.
			Trigger	1	Trigger task

8.21.7.4 SUBSCRIBE_START

Address offset: 0x080

Subscribe configuration for task START

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task START will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.21.7.5 SUBSCRIBE_STOP

Address offset: 0x084

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.21.7.6 SUBSCRIBE_ABORT

Address offset: 0x088

Subscribe configuration for task ABORT

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task ABORT will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.21.7.7 EVENTS_RXPTRUPD

Address offset: 0x104

The RXD.PTR register has been copied to internal double-buffers. When TDM is started and RX is enabled, this event will be generated for every RXTXD.MAXCNT bytes received on the SDIN pin.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_RXPTRUPD			The RXD.PTR register has been copied to internal double-buffers. When TDM is started and RX is enabled, this event will be generated for every RXTXD.MAXCNT bytes received on the SDIN pin.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.21.7.8 EVENTS_STOPPED

Address offset: 0x108

Transfer stopped.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_STOPPED			Transfer stopped.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.21.7.9 EVENTS_ABORTED

Address offset: 0x10C

Transfer aborted.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_ABORTED			Transfer aborted.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.21.7.10 EVENTS_TXPTRUPD

Address offset: 0x118

The TDX.PTR register has been copied to internal double-buffers. When TDM is started and TX is enabled, this event will be generated for every RXTXD.MAXCNT bytes that are sent on the SDOUT pin.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_TXPTRUPD			The TDX.PTR register has been copied to internal double-buffers. When TDM is started and TX is enabled, this event will be generated for every RXTXD.MAXCNT bytes that are sent on the SDOUT pin.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.21.7.11 EVENTS_MAXCNT

Address offset: 0x120

Generated on the active edge of FSYNC, after both RX and TX DMA transfers have completed. An initial MAXCNT event is also triggered on the first active edge of FSYNC after the START task is issued.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_MAXCNT			Generated on the active edge of FSYNC, after both RX and TX DMA transfers have completed. An initial MAXCNT event is also triggered on the first active edge of FSYNC after the START task is issued.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.21.7.12 EVENTS_BUSERROR_RX

Address offset: 0x124

This event is generated if an error occurs during the bus transfer.

When this event is generated, the address which caused the error can be read from the RXD.BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_BUSERROR_RX			This event is generated if an error occurs during the bus transfer. When this event is generated, the address which caused the error can be read from the RXD.BUSERRORADDRESS register.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.21.7.13 EVENTS_BUSERROR_TX

Address offset: 0x128

This event is generated if an error occurs during the bus transfer.

When this event is generated, the address which caused the error can be read from the TXD.BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_BUSERROR_TX			This event is generated if an error occurs during the bus transfer. When this event is generated, the address which caused the error can be read from the TXD.BUSERRORADDRESS register.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.21.7.14 PUBLISH_RXPTRUPD

Address offset: 0x184

Publish configuration for event RXPTRUPD

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event RXPTRUPD will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.21.7.15 PUBLISH_STOPPED

Address offset: 0x188

Publish configuration for event STOPPED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event STOPPED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.21.7.16 PUBLISH_ABORTED

Address offset: 0x18C

Publish configuration for event ABORTED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event ABORTED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.21.7.17 PUBLISH_TXPTRUPD

Address offset: 0x198

Publish configuration for event TXPTRUPD

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event TXPTRUPD will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.21.7.18 PUBLISH_MAXCNT

Address offset: 0x1A0

Publish configuration for event MAXCNT

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event MAXCNT will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.21.7.19 PUBLISH_BUSERROR_RX

Address offset: 0x1A4

Publish configuration for event BUSERROR_RX

When this event is generated, the address which caused the error can be read from the RXD.BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event BUSERROR_RX will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.21.7.20 PUBLISH_BUSERROR_TX

Address offset: 0x1A8

Publish configuration for event BUSERROR_TX

When this event is generated, the address which caused the error can be read from the TXD.BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event BUSERROR_TX will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.21.7.21 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	RXPTRUPD			Enable or disable interrupt for event RXPTRUPD
			Disabled	0	Disable
			Enabled	1	Enable
B	RW	STOPPED			Enable or disable interrupt for event STOPPED
			Disabled	0	Disable
			Enabled	1	Enable
C	RW	ABORTED			Enable or disable interrupt for event ABORTED
			Disabled	0	Disable
			Enabled	1	Enable
D	RW	TXPTRUPD			Enable or disable interrupt for event TXPTRUPD
			Disabled	0	Disable
			Enabled	1	Enable
E	RW	MAXCNT			Enable or disable interrupt for event MAXCNT
			Disabled	0	Disable
			Enabled	1	Enable
F	RW	BUSERROR_RX			Enable or disable interrupt for event BUSERROR_RX When this event is generated, the address which caused the error can be read from the RXD.BUSERRORADDRESS register.
			Disabled	0	Disable
			Enabled	1	Enable
G	RW	BUSERROR_TX			Enable or disable interrupt for event BUSERROR_TX When this event is generated, the address which caused the error can be read from the TXD.BUSERRORADDRESS register.
			Disabled	0	Disable
			Enabled	1	Enable

8.21.7.22 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1S	RXPTRUPD			Write '1' to enable interrupt for event RXPTRUPD
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	STOPPED			Write '1' to enable interrupt for event STOPPED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1S	ABORTED			Write '1' to enable interrupt for event ABORTED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1S	TXPTRUPD			Write '1' to enable interrupt for event TXPTRUPD
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1S	MAXCNT			Write '1' to enable interrupt for event MAXCNT
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1S	BUSERROR_RX			Write '1' to enable interrupt for event BUSERROR_RX When this event is generated, the address which caused the error can be read from the RXD.BUSERRORADDRESS register.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1S	BUSERROR_TX			Write '1' to enable interrupt for event BUSERROR_TX When this event is generated, the address which caused the error can be read from the TXD.BUSERRORADDRESS register.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.21.7.23 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	RXPTRUPD			Write '1' to disable interrupt for event RXPTRUPD

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	STOPPED			Write '1' to disable interrupt for event STOPPED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	ABORTED			Write '1' to disable interrupt for event ABORTED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1C	TXPTRUPD			Write '1' to disable interrupt for event TXPTRUPD
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1C	MAXCNT			Write '1' to disable interrupt for event MAXCNT
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1C	BUSERROR_RX			Write '1' to disable interrupt for event BUSERROR_RX When this event is generated, the address which caused the error can be read from the RXD.BUSERRORADDRESS register.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1C	BUSERROR_TX			Write '1' to disable interrupt for event BUSERROR_TX When this event is generated, the address which caused the error can be read from the TXD.BUSERRORADDRESS register.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.21.7.24 INTPEND

Address offset: 0x30C

Pending interrupts

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	RXPTRUPD			Read pending status of interrupt for event RXPTRUPD
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
B	R	STOPPED			Read pending status of interrupt for event STOPPED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
C	R	ABORTED			Read pending status of interrupt for event ABORTED
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
D	R	TXPTRUPD			Read pending status of interrupt for event TXPTRUPD
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
E	R	MAXCNT			Read pending status of interrupt for event MAXCNT
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
F	R	BUSERROR_RX			Read pending status of interrupt for event BUSERROR_RX When this event is generated, the address which caused the error can be read from the RXD.BUSERRORADDRESS register.
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
G	R	BUSERROR_TX			Read pending status of interrupt for event BUSERROR_TX When this event is generated, the address which caused the error can be read from the TXD.BUSERRORADDRESS register.
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending

8.21.7.25 ENABLE

Address offset: 0x500

Enable TDM

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			Enable TDM
			Disabled	0	Disable
			Enabled	1	Enable

8.21.7.26 CONFIG

Configuration registers.

These registers must be configured before triggering the START tasks.

8.21.7.26.1 CONFIG.MODE

Address offset: 0x504

Mode configuration

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MODE			Mode configuration
			Master	0	Master mode. SCK and FSYNC are created internally and output on PSEL.SCK and PSEL.FSYNC.
			Slave	1	Slave mode. SCK and FSYNC are received on PSEL.SCK and PSEL.FSYNC.

8.21.7.26.2 CONFIG.RXTXEN

Address offset: 0x508

Reception (RX) and transmission (TX) enable.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	RXTXEN			Enable reception or transmission.
			Duplex	0	Enable both reception and transmission. Data will be written to the RXD.PTR address and data transmitted from the TXD.PTR address.
			Rx	1	Enable reception, disable transmission. Data will be written to the RXD.PTR address.
			Tx	2	Enable transmission, disable reception. Data will be transmitted from the TXD.PTR address.
				3	Reserved for future use.

8.21.7.26.3 CONFIG.MCK.EN

Address offset: 0x50C

Master clock generator enable.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MCKEN			Master clock generator enable.
			Disabled	0	Master clock generator disabled.
			Enabled	1	Master clock generator enabled.

8.21.7.26.4 CONFIG.MCK.DIV

Address offset: 0x510

MCK divider.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	DIV																																	
			CKDIV2	0x80000000																															
			CKDIV3	0x50000000																															
			CKDIV4	0x40000000																															
			CKDIV5	0x30000000																															
			CKDIV6	0x28000000																															
			CKDIV8	0x20000000																															
			CKDIV10	0x18000000																															
			CKDIV11	0x16000000																															
			CKDIV15	0x11000000																															
			CKDIV16	0x10000000																															
			CKDIV21	0x0C000000																															
			CKDIV23	0x0B000000																															
			CKDIV30	0x08800000																															
			CKDIV31	0x08400000																															
			CKDIV32	0x08000000																															
			CKDIV42	0x06000000																															
			CKDIV63	0x04100000																															
			CKDIV125	0x020C0000																															

8.21.7.26.5 CONFIG.MCK.SRC

Address offset: 0x514

MCK clock source selection

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																											B								A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	CLKSRC																																	
			PCLK	0																															
			PCLK32M	0																															
			ACLK	1																															
B	RW	BYPASS																																	
			Disable	0																															
			Enable	1																															

8.21.7.26.6 CONFIG.SCK.DIV

Address offset: 0x518

SCK divider.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	SCKDIV																																	
			CKDIV2	0x80000000																															
			CKDIV3	0x50000000																															
			CKDIV4	0x40000000																															
			CKDIV5	0x30000000																															
			CKDIV6	0x28000000																															
			CKDIV8	0x20000000																															
			CKDIV10	0x18000000																															
			CKDIV11	0x16000000																															
			CKDIV15	0x11000000																															
			CKDIV16	0x10000000																															
			CKDIV21	0x0C000000																															
			CKDIV23	0x0B000000																															
			CKDIV30	0x08800000																															
			CKDIV31	0x08400000																															
			CKDIV32	0x08000000																															
			CKDIV42	0x06000000																															
			CKDIV63	0x04100000																															
			CKDIV125	0x020C0000																															

8.21.7.26.7 CONFIG.SCK.SRC

Address offset: 0x51C

SCK clock source selection

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																											B								A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	CLKSRC																																	
			PCLK	0																															
			ACLK	1																															
B	RW	BYPASS																																	
			Disable	0																															
			Enable	1																															

8.21.7.26.8 CONFIG.SCK.POLARITY

Address offset: 0x520

Set SCK Polarity.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	SCKPOLARITY																																	Set the polarity of the active SCK edge.
			PosEdge	0																															TX data is written to the SDOUT pin on the falling edge of SCK, ready to be received on the rising edge of SCK.
			NegEdge	1																															TX data is written to the SDOUT pin on the rising edge of SCK, ready to be received on the falling edge of SCK.

8.21.7.26.9 CONFIG.SWIDTH

Address offset: 0x524

Sample and word width configuration.

Configures how many bits are used for each sample, and how many SCK clock cycles are used when transferring the sample on SDIN/SDOUT pins

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																	A	A	A
Reset 0x00000001				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW	SWIDTH																																	Sample and word width
			8Bit	0																															8 bit sample in an 8-bit word.
			16Bit	1																															16 bit sample in a 16-bit word.
			24Bit	2																															24 bit sample in a 24-bit word.
			32Bit	3																															32 bit sample in a 32-bit word.
			8BitIn16	4																															8 bit sample in a 16-bit word.
			8BitIn32	5																															8 bit sample in a 32-bit word.
			16BitIn32	6																															16 bit sample in a 32-bit word.
			24BitIn32	7																															24 bit sample in a 32-bit word.

8.21.7.26.10 CONFIG.ALIGN

Address offset: 0x528

Alignment of sample within the audio data word.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	ALIGN																																	Alignment of sample within the audio data word.
			Left	0																															Left-aligned.
			Right	1																															Right-aligned.

8.21.7.26.11 CONFIG.CHANNEL.MASK

Address offset: 0x52C

Select which channels are to be used.

Received and transmitted samples for enabled channels will be transferred between peripheral and memory using EasyDMA.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00FF00FF				**0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A-H	RW	Rx[i]Enable (i=0..7)			
			Disable	0	Disable Rx channel data.
			Enable	1	Enable Rx channel data.
I-P	RW	Tx[i]Enable (i=0..7)			
			Disable	0	Disable Tx channel data.
			Enable	1	Enable Tx channel data.

8.21.7.26.12 CONFIG.CHANNEL.NUM

Address offset: 0x530

Select number of channels.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A
Reset 0x00000001				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	NUM			Select number of channels.
			Tdm1Ch	0	1-channel audio (mono).
			Tdm2Ch	1	2-channel audio (stereo).
			Tdm3Ch	2	3-channel audio.
			Tdm4Ch	3	4-channel audio.
			Tdm5Ch	4	5-channel audio.
			Tdm6Ch	5	6-channel audio.
			Tdm7Ch	6	7-channel audio.
			Tdm8Ch	7	8-channel audio.

8.21.7.26.13 CONFIG.CHANNEL.DELAY

Address offset: 0x534

Set channel delay.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000001				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	DELAY			Configure number of inactive SCK periods from edge of FSYNC until start of first data bit.
			Delay0Ck	0	No delay. Used with I2S DSP/Aligned format.
			Delay1Ck	1	One clock pulse delay. Used with Original I2S format.
			Delay2Ck	2	Two clock pulses delay.

8.21.7.26.14 CONFIG.FSYNC.POLARITY

Address offset: 0x538

Set FSYNC Polarity.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	POLARITY			Set the polarity of the active period of FSYNC.
			NegEdge	0	Frame starts at falling edge of FSYNC.
			PosEdge	1	Frame starts at rising edge of FSYNC.

8.21.7.26.15 CONFIG.FSYNC.DURATION

Address offset: 0x53C

Set FSYNC duration.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000001				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	DURATION			Set the duration of the active period of FSYNC in Master mode.
			Sck	0	FSYNC is active for the duration of one SCK period
			Channel	1	FSYNC is active for the duration of channel

8.21.7.26.16 CONFIG.ORS

Address offset: 0x540

Over-read sample: Extra sample(s) to be transmitted after TXD.MAXCNT bytes have been transmitted.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ORS			Data to transmit after TXD.MAXCNT bytes have been transmitted.

8.21.7.27 PSEL.MCK

Address offset: 0x570

Pin select for MCK signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[1,3]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.21.7.28 PSEL.SCK

Address offset: 0x574

Pin select for SCK signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[1,3]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.21.7.29 PSEL.FSYNC

Address offset: 0x578

Pin select for FSYNC signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[1,3]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.21.7.30 PSEL.SDIN

Address offset: 0x57C

Pin select for SDIN signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[1,3]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.21.7.31 PSEL.SDOUT

Address offset: 0x580

Pin select for SDOUT signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[1,3]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.21.7.32 RXD.PTR

Address offset: 0x704

RAM buffer start address

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x20000000				**0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			RAM buffer start address for this EasyDMA channel. This address is a word aligned Data RAM address.

Note: See the memory chapter for details about which memories are available for EasyDMA.

8.21.7.33 RXD.MAXCNT

Address offset: 0x708

Maximum number of bytes in channel buffer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MAXCNT		[1..0x3fff]	Maximum number of bytes in channel buffer

8.21.7.34 RXD.AMOUNT

Address offset: 0x70C

Number of bytes transferred in the last transaction, updated after the END event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT		[1..0x3fff]	Number of bytes transferred in the last transaction. In case of NACK error, includes the NACK'ed byte.

8.21.7.35 RXD.CURRENTAMOUNT

Address offset: 0x710

Number of bytes transferred in the current transaction

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT		[1..0x3fff]	Number of bytes transferred in the current transaction. Continuously updated.

8.21.7.36 RXD.MODE

Address offset: 0x718

Configure EasyDMA mode

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000001				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	LPOP			Enable low-power operation, or use low-latency
			LowLat	0	Low-latency operation
			LowPower	1	Low-power operation

8.21.7.37 RXD.TERMINATEONBUSERROR

Address offset: 0x71C

Terminate the transaction if a BUSERROR event is detected.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			
			Disabled	0	Disable
			Enabled	1	Enable

8.21.7.38 RXD.BUSERRORADDRESS

Address offset: 0x720

Address of transaction that generated the last BUSERROR event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	ADDRESS			

8.21.7.39 TXD.PTR

Address offset: 0x744

RAM buffer start address

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x20000000	**0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			RAM buffer start address for this EasyDMA channel. This address is a word aligned Data RAM address.

Note: See the memory chapter for details about which memories are available for EasyDMA.

8.21.7.40 TXD.MAXCNT

Address offset: 0x748

Maximum number of bytes in channel buffer

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	A A A A A A A A A A A A A A A
Reset 0x00000000	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MAXCNT		[1..0x3fff]	Maximum number of bytes in channel buffer

8.21.7.41 TXD.AMOUNT

Address offset: 0x74C

Number of bytes transferred in the last transaction, updated after the END event.

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	A A A A A A A A A A A A A A A
Reset 0x00000000	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT		[1..0x3fff]	Number of bytes transferred in the last transaction. In case of NACK error, includes the NACK'ed byte.

8.21.7.42 TXD.CURRENTAMOUNT

Address offset: 0x750

Number of bytes transferred in the current transaction

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	A A A A A A A A A A A A A A A
Reset 0x00000000	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT		[1..0x3fff]	Number of bytes transferred in the current transaction. Continuously updated.

8.21.7.43 TXD.MODE

Address offset: 0x758

Configure EasyDMA mode

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000001				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	LPOP			Enable low-power operation, or use low-latency
			LowLat	0	Low-latency operation
			LowPower	1	Low-power operation

8.21.7.44 TXD.TERMINATEONBUSERROR

Address offset: 0x75C

Terminate the transaction if a BUSERROR event is detected.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			
			Disabled	0	Disable
			Enabled	1	Enable

8.21.7.45 TXD.BUSERRORADDRESS

Address offset: 0x760

Address of transaction that generated the last BUSERROR event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	ADDRESS			

8.22 TEMP — Temperature sensor

The temperature sensor peripheral (TEMP) measures die temperature over the temperature range of the device. Linearity compensation can be implemented if required by the application.

The main features of TEMP are the following:

- Temperature range is greater than or equal to operating temperature of the device
- Resolution is 0.25 degrees
- TEMP analog electronics power down after temperature measurement is completed

To achieve the measurement accuracy stated in the electrical specification, the crystal oscillator must be selected as the HFCLK source, see CLOCK — Clock control on page 72 for more information.

8.22.1 Operation

TEMP is started by triggering the START task.

When the temperature measurement is finished, a DATARDY event will be generated and the measurement result can be read from the TEMP register.

When the temperature measurement is finished, TEMP analog electronics power-down to save power.

TEMP only supports one-shot operation, meaning that every TEMP measurement has to be explicitly started using the START task.

8.22.2 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
TEMP : S TEMP : NS	GLOBAL	0x500D7000 0x400D7000	US	S	NA	No	Temperature sensor TEMP

Register overview

Register	Offset	TZ	Description
TASKS_START	0x000		Start temperature measurement
TASKS_STOP	0x004		Stop temperature measurement
SUBSCRIBE_START	0x080		Subscribe configuration for task START
SUBSCRIBE_STOP	0x084		Subscribe configuration for task STOP
EVENTS_DATARDY	0x100		Temperature measurement complete, data ready
PUBLISH_DATARDY	0x180		Publish configuration for event DATARDY
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
TEMP	0x508		Temperature in °C (0.25° steps)
A0	0x520		Slope of 1st piece wise linear function
A1	0x524		Slope of 2nd piece wise linear function
A2	0x528		Slope of 3rd piece wise linear function
A3	0x52C		Slope of 4th piece wise linear function
A4	0x530		Slope of 5th piece wise linear function
A5	0x534		Slope of 6th piece wise linear function
A6	0x538		Slope of 7th piece wise linear function
B0	0x540		y-intercept of 1st piece wise linear function
B1	0x544		y-intercept of 2nd piece wise linear function
B2	0x548		y-intercept of 3rd piece wise linear function
B3	0x54C		y-intercept of 4th piece wise linear function
B4	0x550		y-intercept of 5th piece wise linear function
B5	0x554		y-intercept of 6th piece wise linear function
B6	0x558		y-intercept of 7th piece wise linear function
T0	0x560		End point of 1st piece wise linear function
T1	0x564		End point of 2nd piece wise linear function
T2	0x568		End point of 3rd piece wise linear function
T3	0x56C		End point of 4th piece wise linear function
T4	0x570		End point of 5th piece wise linear function
T5	0x574		End point of 6th piece wise linear function

8.22.2.1 TASKS_START

Address offset: 0x000

Start temperature measurement

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_START			Start temperature measurement
			Trigger	1	Trigger task

8.22.2.2 TASKS_STOP

Address offset: 0x004

Stop temperature measurement

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Stop temperature measurement
			Trigger	1	Trigger task

8.22.2.3 SUBSCRIBE_START

Address offset: 0x080

Subscribe configuration for task START

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task START will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.22.2.4 SUBSCRIBE_STOP

Address offset: 0x084

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.22.2.5 EVENTS_DATARDY

Address offset: 0x100

Temperature measurement complete, data ready

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_DATARDY			Temperature measurement complete, data ready
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.22.2.6 PUBLISH_DATARDY

Address offset: 0x180

Publish configuration for event DATARDY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event DATARDY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.22.2.7 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DATARDY			Write '1' to enable interrupt for event DATARDY
	W1S				
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.22.2.8 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DATARDY			Write '1' to disable interrupt for event DATARDY
	W1C				
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.22.2.9 TEMP

Address offset: 0x508

Temperature in °C (0.25° steps)

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000					**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID					Value																Description											
A	R	TEMP																							Temperature in °C (0.25° steps) Result of temperature measurement. Die temperature in °C, 2's complement format, 0.25 °C steps 11 bits sign extended to 32 bits, with 2 LSBs as fractional bits. Decision point: DATARDY											

8.22.2.10 A0

Address offset: 0x520

Slope of 1st piece wise linear function

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																									A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x0000038C					**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**1**	**0**	**0**
ID	R/W	Field		Value ID					Value																Description											
A	RW	A0																							Slope of 1st piece wise linear function										

8.22.2.11 A1

Address offset: 0x524

Slope of 2nd piece wise linear function

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																									A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x000003B3					**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**1**	**1**	**0**	**0**	**1**	**1**
ID	R/W	Field		Value ID					Value																Description											
A	RW	A1																							Slope of 2nd piece wise linear function										

8.22.2.12 A2

Address offset: 0x528

Slope of 3rd piece wise linear function

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																									A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x000003FA					**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**0**
ID	R/W	Field		Value ID					Value																Description											
A	RW	A2																							Slope of 3rd piece wise linear function										

8.22.2.13 A3

Address offset: 0x52C

Slope of 4th piece wise linear function

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																					A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000451	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**1**

ID	R/W	Field	Value ID	Value	Description
A	RW	A3			Slope of 4th piece wise linear function

8.22.2.14 A4

Address offset: 0x530

Slope of 5th piece wise linear function

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																					A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x000004AA	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**0**	**1**	**0**	**1**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	A4			Slope of 5th piece wise linear function

8.22.2.15 A5

Address offset: 0x534

Slope of 6th piece wise linear function

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																					A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000539	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**1**

ID	R/W	Field	Value ID	Value	Description
A	RW	A5			Slope of 6th piece wise linear function

8.22.2.16 A6

Address offset: 0x538

Slope of 7th piece wise linear function

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																					A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000578	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**1**	**1**	**1**	**1**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	A6			Slope of 7th piece wise linear function

8.22.2.17 B0

Address offset: 0x540

y-intercept of 1st piece wise linear function

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A
Reset 0x00000037				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	B0			y-intercept of 1st piece wise linear function

8.22.2.18 B1

Address offset: 0x544

y-intercept of 2nd piece wise linear function

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A
Reset 0x00000011				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	B1			y-intercept of 2nd piece wise linear function

8.22.2.19 B2

Address offset: 0x548

y-intercept of 3rd piece wise linear function

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A
Reset 0x00000005				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	B2			y-intercept of 3rd piece wise linear function

8.22.2.20 B3

Address offset: 0x54C

y-intercept of 4th piece wise linear function

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A
Reset 0x0000002B				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	B3			y-intercept of 4th piece wise linear function

8.22.2.21 B4

Address offset: 0x550

y-intercept of 5th piece wise linear function

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A
Reset 0x0000008F				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	B4			y-intercept of 5th piece wise linear function

8.22.2.22 B5

Address offset: 0x554

y-intercept of 6th piece wise linear function

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																					A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x0000015D	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**1**	**1**	**1**	**0**	**1**

ID	R/W	Field	Value ID	Value	Description
A	RW	B5			y-intercept of 6th piece wise linear function

8.22.2.23 B6

Address offset: 0x558

y-intercept of 7th piece wise linear function

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																					A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x000001C0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	B6			y-intercept of 7th piece wise linear function

8.22.2.24 T0

Address offset: 0x560

End point of 1st piece wise linear function

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																									A	A	A	A	A	A	A	A
Reset 0x000000E5	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**1**	**0**	**1**

ID	R/W	Field	Value ID	Value	Description
A	RW	T0			End point of 1st piece wise linear function

8.22.2.25 T1

Address offset: 0x564

End point of 2nd piece wise linear function

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																									A	A	A	A	A	A	A	A
Reset 0x000000FB	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**1**

ID	R/W	Field	Value ID	Value	Description
A	RW	T1			End point of 2nd piece wise linear function

8.22.2.26 T2

Address offset: 0x568

End point of 3rd piece wise linear function

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	A A A A A A A A
Reset 0x00000010	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	T2			End point of 3rd piece wise linear function

8.22.2.27 T3

Address offset: 0x56C

End point of 4th piece wise linear function

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	A A A A A A A A
Reset 0x0000002B	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 1 1**

ID	R/W	Field	Value ID	Value	Description
A	RW	T3			End point of 4th piece wise linear function

8.22.2.28 T4

Address offset: 0x570

End point of 5th piece wise linear function

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	A A A A A A A A
Reset 0x00000041	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1**

ID	R/W	Field	Value ID	Value	Description
A	RW	T4			End point of 5th piece wise linear function

8.22.2.29 T5

Address offset: 0x574

End point of 6th piece wise linear function

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	A A A A A A A A
Reset 0x00000050	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	T5			End point of 6th piece wise linear function

8.23 TIMER — Timer/counter

The TIMER peripheral is a general purpose timer allowing user defined time intervals.

The main features of TIMER are the following:

- Two modes of operation: Timer mode and Counter mode
- Multiple capture/compare registers
- Compare event for every capture/compare register
- 4-bit (1/2X) prescaler
- Configurable number of bits including 8, 16, 24 or 32 bits
- TIMER runs on the high-frequency clock source (HFCLK)

TIMER runs on the high-frequency clock source (HFCLK) and includes a four-bit (1/2X) prescaler that can divide the timer input clock (PCLK) from the HFCLK controller. The TIMER base frequency is always given as PCLK divided by the prescaler value.

The PPI system allows a TIMER event to trigger a task on another system peripheral on the device. The PPI system also enables the TIMER task/event feature to generate periodic output and PWM signals to any GPIO. The number of GPIO pins used at the same time is limited by the number of GPIOTE channels.

8.23.1 TIMER modes

TIMER can operate in two modes: Timer mode and Counter mode. In both modes, TIMER is started by triggering the START task, and stopped by triggering the STOP task. After TIMER stops, it can resume timing/counting by triggering the START task again. When timing/counting resumes, TIMER continues from the value it was on prior to stopping.

In Timer mode, TIMER's internal COUNTER register is incremented by one for every tick of the timer frequency f_{TIMER}, as shown in the following figure. The timer frequency is derived from PCLK as shown in the following example, using the values specified in the PRESCALER register.

$$f_{TIMER} = PCLK / (2^{PRESCALER})$$

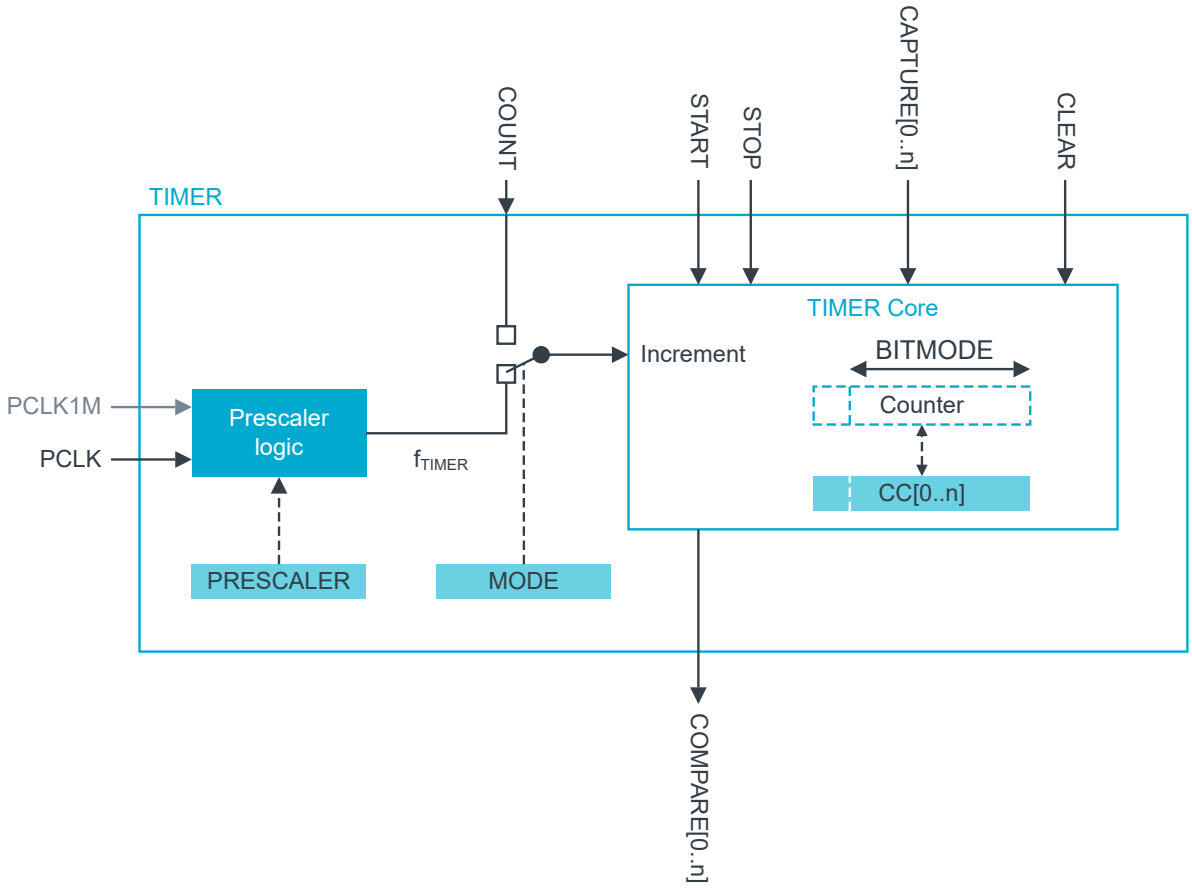


Figure 153: Timer/counter operation

For timers using PCLK16M as PCLK, when $f_{TIMER} \leq 1$ MHz, TIMER uses PCLK1M instead of PCLK for reduced power consumption. Clock source selection between PCLK and PCLK1M is automatic according to the TIMER base frequency set by the prescaler.

In Counter mode, the TIMER's internal COUNTER register is incremented by one each time the COUNT task is triggered, meaning the timer frequency and the prescaler are not used in Counter mode. Similarly, the COUNT task has no effect in Timer mode.

The maximum value of TIMER is configured by changing the bit-width of the timer in register BITMODE on page 688.

PRESCALER on page 688 and BITMODE on page 688 must only be updated when TIMER is stopped. If these registers are updated while TIMER is started, unpredictable behavior may occur.

When TIMER is incremented beyond its maximum value, the Counter register will overflow and TIMER will automatically start over from zero.

The Counter register can be cleared by triggering the CLEAR task. This will explicitly set the internal value to zero.

TIMER implements multiple capture/compare registers.

Independent of prescaler settings, the accuracy of TIMER is equivalent to one tick of the timer frequency f_{TIMER} as shown in Timer/counter operation on page 680.

8.23.2 Capture

TIMER implements one capture task for every available capture/compare register.

Every time the CAPTURE[n] task is triggered, the counter value is copied to the CC[n] register.

8.23.3 Compare

TIMER implements one COMPARE event for every available capture/compare register.

When the counter value becomes equal to the value specified in a capture compare register CC[n], the corresponding compare event COMPARE[n] is generated.

BITMODE on page 688 specifies how many Counter and capture/compare register bits are used when the comparison is performed. Other bits are ignored.

The COMPARE event can be configured to operate in one-shot mode by configuring the corresponding ONESHOTEN[n] register. After writing CC[n], a COMPARE[n] event is generated the first time the Counter matches CC[n].

8.23.4 Task delays

After TIMER is started, the CLEAR, COUNT, and STOP tasks are guaranteed to take effect within one clock cycle of the PCLK.

8.23.5 Task priority

If the START task and the STOP task are triggered at the same time, meaning within the same period of PCLK, the STOP task is prioritized.

If one or more of the CAPTURE tasks and the CLEAR task are triggered at the same time, that is, within the same period of PCLK, the CAPTURE tasks are prioritized. This means that the CC registers will capture the counter value before the CLEAR tasks are triggered.

8.23.6 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
TIMER00 : S TIMER00 : NS	GLOBAL	0x50055000 0x40055000	US	S	NA	No	Timer TIMER00
TIMER10 : S TIMER10 : NS	GLOBAL	0x50085000 0x40085000	US	S	NA	No	Timer TIMER10
TIMER20 : S TIMER20 : NS	GLOBAL	0x500CA000 0x400CA000	US	S	NA	No	Timer TIMER20
TIMER21 : S TIMER21 : NS	GLOBAL	0x500CB000 0x400CB000	US	S	NA	No	Timer TIMER21
TIMER22 : S TIMER22 : NS	GLOBAL	0x500CC000 0x400CC000	US	S	NA	No	Timer TIMER22
TIMER23 : S TIMER23 : NS	GLOBAL	0x500CD000 0x400CD000	US	S	NA	No	Timer TIMER23
TIMER24 : S TIMER24 : NS	GLOBAL	0x500CE000 0x400CE000	US	S	NA	No	Timer TIMER24

Configuration

Instance	Domain	Configuration
TIMER00 : S TIMER00 : NS	GLOBAL	Peripheral clock frequency (PCLK) is 128 MHz The system is able to configure the TIMER peripheral input clock frequency (PCLK) before it reaches TIMER, and calculations of PRESCALER value must take the actual PCLK frequency into account 6 capture compare channels implemented
TIMER10 : S TIMER10 : NS	GLOBAL	Peripheral clock frequency (PCLK) is 32 MHz 8 capture compare channels implemented
TIMER20 : S TIMER20 : NS	GLOBAL	Peripheral clock frequency (PCLK) is 16 MHz 6 capture compare channels implemented
TIMER21 : S TIMER21 : NS	GLOBAL	Peripheral clock frequency (PCLK) is 16 MHz 6 capture compare channels implemented
TIMER22 : S TIMER22 : NS	GLOBAL	Peripheral clock frequency (PCLK) is 16 MHz 6 capture compare channels implemented
TIMER23 : S TIMER23 : NS	GLOBAL	Peripheral clock frequency (PCLK) is 16 MHz 6 capture compare channels implemented
TIMER24 : S TIMER24 : NS	GLOBAL	Peripheral clock frequency (PCLK) is 16 MHz 6 capture compare channels implemented

Register overview

Register	Offset	TZ	Description
TASKS_START	0x000		Start Timer
TASKS_STOP	0x004		Stop Timer
TASKS_COUNT	0x008		Increment Timer (Counter mode only)

Register	Offset	TZ	Description
TASKS_CLEAR	0x00C		Clear time
TASKS_CAPTURE[n]	0x040		Capture Timer value to CC[n] register
SUBSCRIBE_START	0x080		Subscribe configuration for task START
SUBSCRIBE_STOP	0x084		Subscribe configuration for task STOP
SUBSCRIBE_COUNT	0x088		Subscribe configuration for task COUNT
SUBSCRIBE_CLEAR	0x08C		Subscribe configuration for task CLEAR
SUBSCRIBE_CAPTURE[n]	0x0C0		Subscribe configuration for task CAPTURE[n]
EVENTS_COMPARE[n]	0x140		Compare event on CC[n] match
PUBLISH_COMPARE[n]	0x1C0		Publish configuration for event COMPARE[n]
SHORTS	0x200		Shortcuts between local events and tasks
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
INTPEND	0x30C		Pending interrupts
MODE	0x504		Timer mode selection
BITMODE	0x508		Configure the number of bits used by the TIMER
PRESCALER	0x510		Timer prescaler register
CC[n]	0x540		Capture/Compare register n
ONESHOTEN[n]	0x580		Enable one-shot operation for Capture/Compare channel n

8.23.6.1 TASKS_START

Address offset: 0x000

Start Timer

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_START			Start Timer
			Trigger	1	Trigger task

8.23.6.2 TASKS_STOP

Address offset: 0x004

Stop Timer

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Stop Timer
			Trigger	1	Trigger task

8.23.6.3 TASKS_COUNT

Address offset: 0x008

Increment Timer (Counter mode only)

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_COUNT			Increment Timer (Counter mode only)
			Trigger	1	Trigger task

8.23.6.4 TASKS_CLEAR

Address offset: 0x00C

Clear time

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_CLEAR			Clear time
			Trigger	1	Trigger task

8.23.6.5 TASKS_CAPTURE[n] (n=0..7)

Address offset: 0x040 + (n × 0x4)

Capture Timer value to CC[n] register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_CAPTURE			Capture Timer value to CC[n] register
			Trigger	1	Trigger task

8.23.6.6 SUBSCRIBE_START

Address offset: 0x080

Subscribe configuration for task START

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task START will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.23.6.7 SUBSCRIBE_STOP

Address offset: 0x084

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.23.6.8 SUBSCRIBE_COUNT

Address offset: 0x088

Subscribe configuration for task COUNT

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task COUNT will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.23.6.9 SUBSCRIBE_CLEAR

Address offset: 0x08C

Subscribe configuration for task CLEAR

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task CLEAR will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.23.6.10 SUBSCRIBE_CAPTURE[n] (n=0..7)

Address offset: 0x0C0 + (n × 0x4)

Subscribe configuration for task CAPTURE[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task CAPTURE[n] will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.23.6.11 EVENTS_COMPARE[n] (n=0..7)

Address offset: 0x140 + (n × 0x4)

Compare event on CC[n] match

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_COMPARE			Compare event on CC[n] match
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.23.6.12 PUBLISH_COMPARE[n] (n=0..7)

Address offset: 0x1C0 + (n × 0x4)

Publish configuration for event COMPARE[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event COMPARE[n] will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.23.6.13 SHORTS

Address offset: 0x200

Shortcuts between local events and tasks

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-H	RW	COMPARE[i]_CLEAR (i=0..7)			Shortcut between event COMPARE[i] and task CLEAR
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
I-P	RW	COMPARE[i]_STOP (i=0..7)			Shortcut between event COMPARE[i] and task STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut

8.23.6.14 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-H	RW	COMPARE[i] (i=0..7)			Enable or disable interrupt for event COMPARE[i]
			Disabled	0	Disable
			Enabled	1	Enable

8.23.6.15 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-H	RW W1S	COMPARE[i] (i=0..7)			Write '1' to enable interrupt for event COMPARE[i]
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.23.6.16 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-H	RW W1C	COMPARE[i] (i=0..7)			Write '1' to disable interrupt for event COMPARE[i]
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.23.6.17 INTPEND

Address offset: 0x30C

Pending interrupts

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-H	R	COMPARE[i] (i=0..7)			Read pending status of interrupt for event COMPARE[i]
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending

8.23.6.18 MODE

Address offset: 0x504

Timer mode selection

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																		A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	MODE																																	
			Timer	0																															
			Counter	1																															
				This enumerator is deprecated.																															
			LowPowerCounter	2																															

8.23.6.19 BITMODE

Address offset: 0x508

Configure the number of bits used by the TIMER

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																		A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	BITMODE																																	
			16Bit	0																															
			08Bit	1																															
			24Bit	2																															
			32Bit	3																															

8.23.6.20 PRESCALER

Address offset: 0x510

Timer prescaler register

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																															A	A	A	A
Reset 0x00000004				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	PRESCALER		[0..9]																															

8.23.6.21 CC[n] (n=0..7)

Address offset: 0x540 + (n × 0x4)

Capture/Compare register n

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	CC																																	

Capture/Compare value

Only the number of bits indicated by BITMODE will be used by the TIMER.

8.23.6.22 ONESHOTEN[n] (n=0..7)

Address offset: 0x580 + (n × 0x4)

Enable one-shot operation for Capture/Compare channel n

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	ONESHOTEN																																	
			Disable	0																															
			Enable	1																															

Configures the corresponding compare-channel for one-shot operation

Disable one-shot operation

Compare event is generated every time the Counter matches CC[n]

Enable one-shot operation

Compare event is generated the first time the Counter matches CC[n] after CC[n] has been written

8.24 TWIM — I²C compatible two-wire interface controller with EasyDMA

The TWI controller peripheral (TWIM) with EasyDMA provides a half duplex, two-wire synchronous serial communication interface which supports multiple targets in the same bus.

The main features of TWIM are the following:

- I²C compatible for 100 kbps and 400 kbps
- 1000 kbps bit rate support for selected pull-up resistor/bus capacitance combinations
- Supported baud rates:
  - 100 kbps
  - 400 kbps
  - 1000 kbps
- EasyDMA direct transfer to and from RAM
- Individual selection of I/O pins
- Support for clock stretching
- Transmissions can be suspended and resumed

The two-wire interface can communicate with a bidirectional wired-AND bus with two lines (SCL, SDA). The interface enables interconnecting up to 127 individually addressable devices. TWIM is not compatible with CBUS.

Selecting GPIO pins individually ensures flexibility in device pinout and efficient use of board space and signal routing.

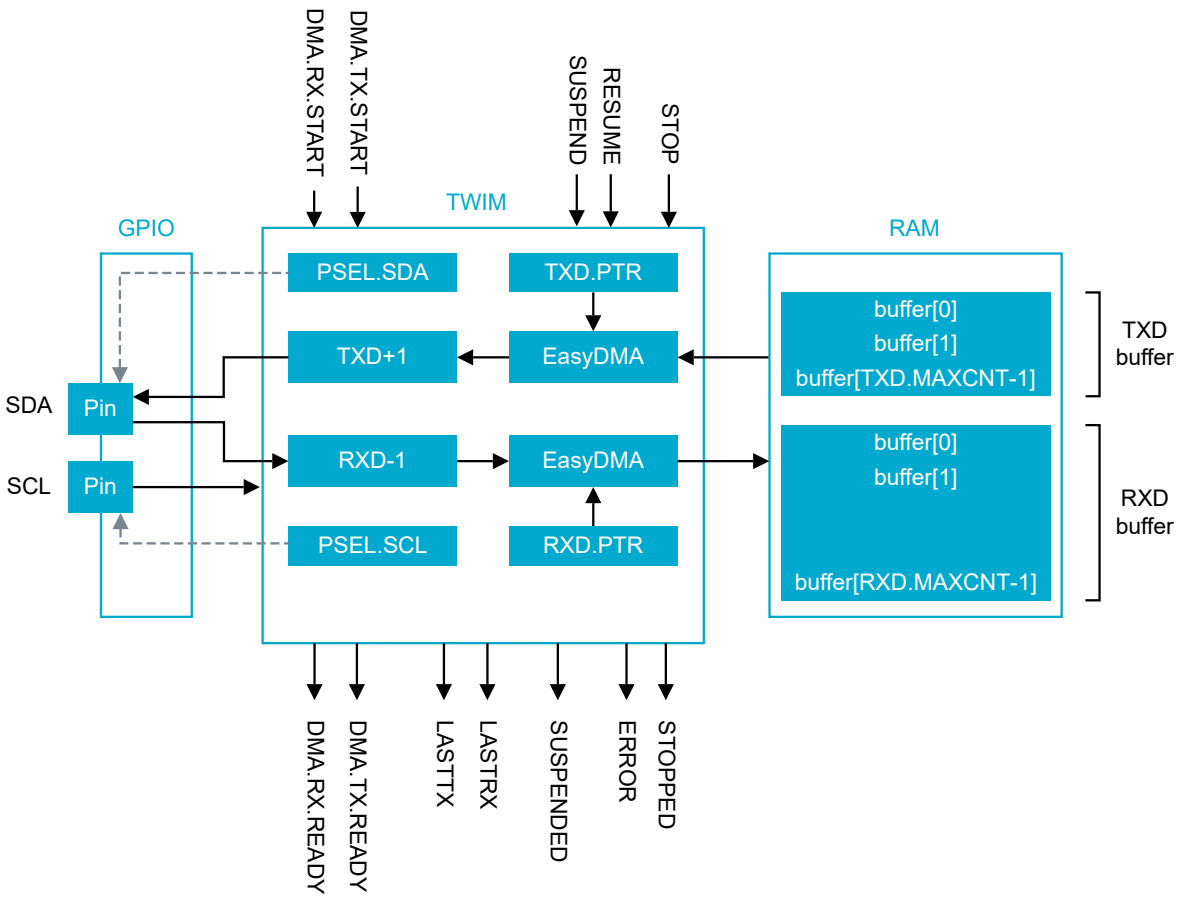


Figure 154: TWIM with EasyDMA

A typical TWIM setup consists of one controller and one or more targets, as illustrated in the following figure. TWIM can only operate as a single controller on the TWI bus. A bus configuration with multiple controllers is not supported.

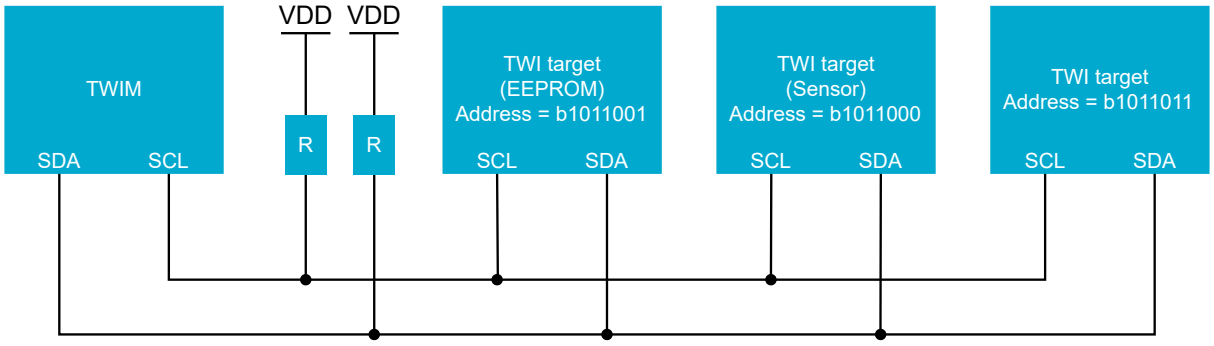


Figure 155: A typical TWIM setup with one controller and three targets

TWIM supports clock stretching performed by the targets.

8.24.1 TWIM operation

The FREQUENCY register defines the speed at which data is transmitted over the interface. Enumerators for common frequencies, such as `K100` or `K400`, are provided.

The following formula can be used to calculate arbitrary frequencies. Due to the finite resolution of the clock generator, the actual SCL frequency may vary slightly from the calculated value.

Note: The frequency calculation equation is applicable only within the following SCL frequency ranges:

- Fast-mode: 90 kHz to 500 kHz
- Fast-mode plus: 900 kHz to 1100 kHz

Outside of these frequency intervals, the accuracy is not guaranteed.

$$\text{FREQUENCY} = 2^{12} \times \left\lfloor \frac{2^{20}}{\text{round}\left(\frac{\text{f\_PCLK}}{\text{desired\_frequency}}\right)} \right\rfloor$$

Figure 156: TWIM frequency

- FREQUENCY is the value to be used in the TWIM FREQUENCY register.
- f_PCLK is the peripheral clock frequency for the TWIM instance, as defined in Instances on page 696.
- desired_frequency is the desired frequency in hertz, such as 100000 or 400000.

TWIM is started by triggering the DMA.TX.START or DMA.RX.START tasks, and stopped by triggering the STOP task. If TWIM is running when the STOP task is triggered, it stops and generates a STOPPED event.

After TWIM starts, the DMA.TX.START and DMA.RX.START tasks must not be triggered again until TWIM has issued a LASTRX, LASTTX, or STOPPED event.

TWIM can be suspended using the SUSPEND task, which is useful when using TWIM in a low priority interrupt context. When TWIM enters the SUSPEND state, it will automatically issue a SUSPENDED event while performing a continuous clock stretching. This continues until a RESUME task is received. TWIM cannot be stopped while it is suspended. The STOP task must be issued after TWIM resumes operation.

Note: Any ongoing byte transfer is allowed to complete before suspend is enforced. A SUSPEND task has no effect unless TWIM is actively involved in a transfer.

If a NACK is clocked in from the target, TWIM generates an ERROR event.

8.24.2 Shared resources

The TWIM peripheral shares registers and other resources with peripherals that have the same ID as TWIM. Therefore, all peripherals that have the same ID as TWIM must be disabled before TWIM can be configured and used.

Disabling shared peripherals will not reset any of the registers that are shared with TWIM. Configure all relevant TWIM registers to ensure they operate correctly.

See the Instantiation table in Instantiation on page 232 for details on peripherals and their IDs.

8.24.3 EasyDMA

EasyDMA is implemented by TWIM in order to access RAM without the CPU.

TWIM implements the following EasyDMA channels.

Channel	Type	Register Cluster
TXD	READER	TXD
RXD	WRITER	RXD

Table 66: TWIM EasyDMA channels

The RXD.PTR, TXD.PTR, RXD.MAXCNT, and TXD.MAXCNT registers are double-buffered. They are ready for the next transmission immediately after receiving the EVENTS_DMA.RX.READY or EVENTS_DMA.TX.READY event.

The STOPPED event indicates that EasyDMA is finished accessing the buffer in RAM.

See EasyDMA on page 29 for more detailed information.

8.24.4 TWIM write sequence

A TWIM write sequence is started by triggering the DMA.TX.START task. After the DMA.TX.START task has been triggered, TWIM generates a start condition on the TWI bus. This is followed by clocking out the address and the READ/WRITE bit set to `0` (WRITE = `0`, READ = `1`).

The target device address the controller wants to write to must match the clocked address. The READ/WRITE bit is followed by an ACK/NACK bit (ACK = `0` or NACK = `1`) generated by the target.

After receiving the ACK bit, TWIM clocks out the data bytes found in the transmit buffer located in RAM at the address specified in the TXD.PTR register. Each byte clocked out from TWIM is followed by an ACK/NACK bit clocked in from the target.

A typical TWIM write sequence including clock stretching performed by TWIM following a SUSPEND task is shown in the following figure.

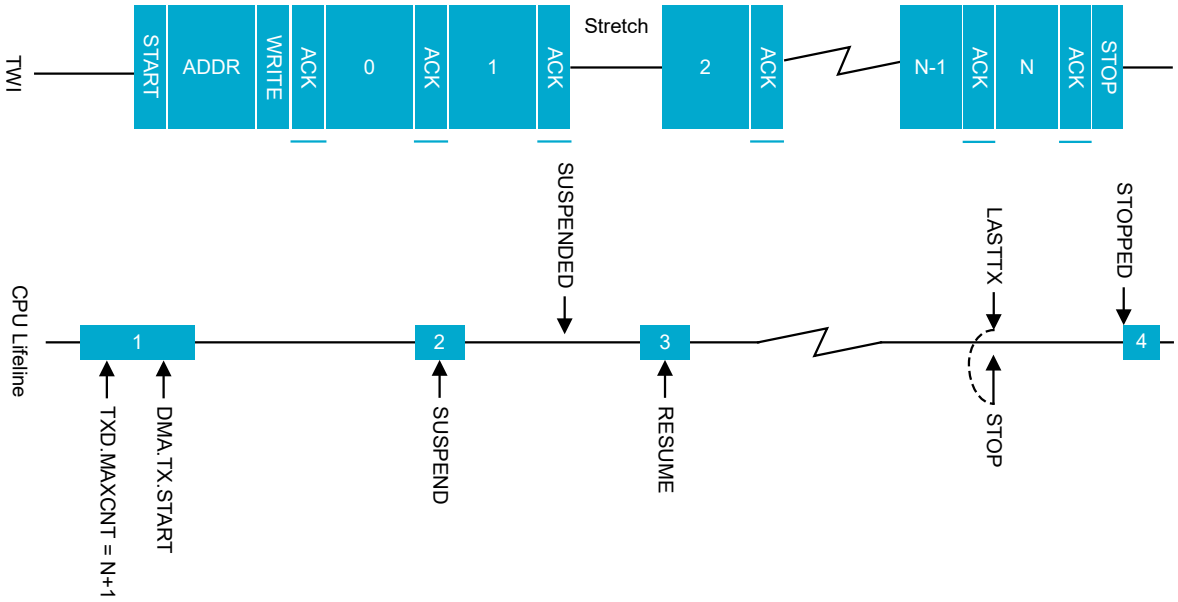


Figure 157: TWIM writing data to a target

A SUSPENDED event indicates that the SUSPEND task has taken effect.

TWIM will generate a LASTTX event when it starts to transmit the last byte.

TWIM is stopped by triggering the STOP task. To stop TWIM as fast as possible, trigger the task during the transmission of the last byte. The shortcut between LASTTX and STOP can also be used to accomplish this.

TWIM does not stop on its own when the entire RAM buffer has been sent or when an error occurs. The STOP task must be issued, either through the local or PPI shortcut, or in software as part of the error handler.

8.24.5 TWIM read sequence

A TWIM read sequence is started by triggering the DMA.RX.START task. After the DMA.RX.START task has been triggered, TWIM generates a start condition on the TWI bus. This is followed by clocking out the address and the READ/WRITE bit set to 1 (WRITE = 0, READ = 1). The address must match the address of the target device that the controller wants to read from. The READ/WRITE bit is followed by an ACK/NACK bit (ACK = 0 or NACK = 1) generated by the target.

After sending the ACK bit, the TWI target sends data to the controller using the clock generated by TWIM.

Data received will be stored in RAM at the address specified in the RXD.PTR register. TWIM will generate an ACK before the last byte is received from the target. TWIM generates a NACK after the last byte received to indicate that the read sequence will stop.

A typical TWIM read sequence is illustrated in the following figure, including clock stretching performed by TWIM following a SUSPEND task.

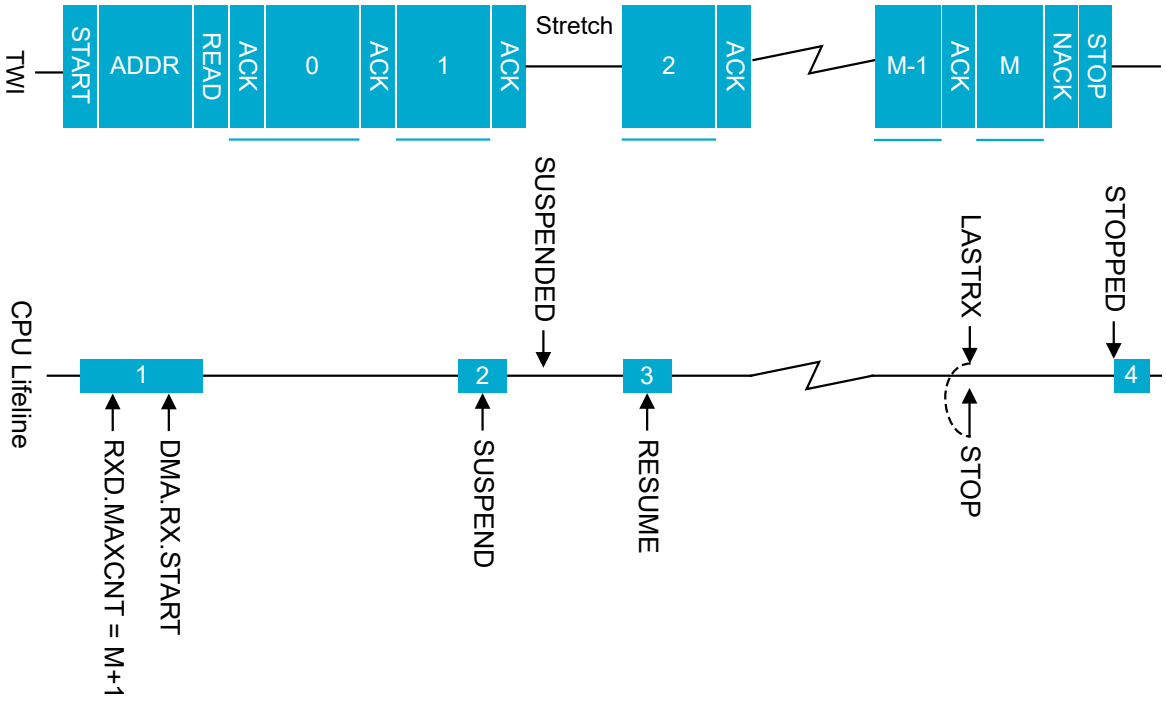


Figure 158: TWIM reading data from a target

A SUSPENDED event indicates that the SUSPEND task has taken effect. This event can be used to synchronize the software.

TWIM generates a LASTRX event when it is ready to receive the last byte. If RXD.MAXCNT > 1, the LASTRX event is generated after sending the ACK of the previously received byte. If RXD.MAXCNT = 1, the LASTRX event is generated after receiving the ACK following the address and READ bit.

TWIM is stopped by triggering the STOP task. This task must be triggered before the NACK bit begins transmission. The STOP task can be triggered at any time during the reception of the last byte. It is recommended to use the shortcut between LASTRX and STOP.

TWIM does not stop on its own when the RAM buffer is full or when an error occurs. The STOP task must be issued, either through a local or PPI shortcut, or in software as part of the error handler.

TWIM cannot be stopped while suspended. The STOP task must be issued after TWIM has been resumed.

8.24.6 TWIM repeated start sequence

A typical repeated start sequence is when TWIM writes two bytes to the target followed by reading four bytes from the target. This example uses shortcuts to perform a simple repeated start sequence, with one write followed by one read. The same approach can be used to perform a repeated start sequence where the sequence is read followed by a write.

The following figure shows an example of a repeated start sequence where TWIM writes two bytes followed by reading four bytes from the target.

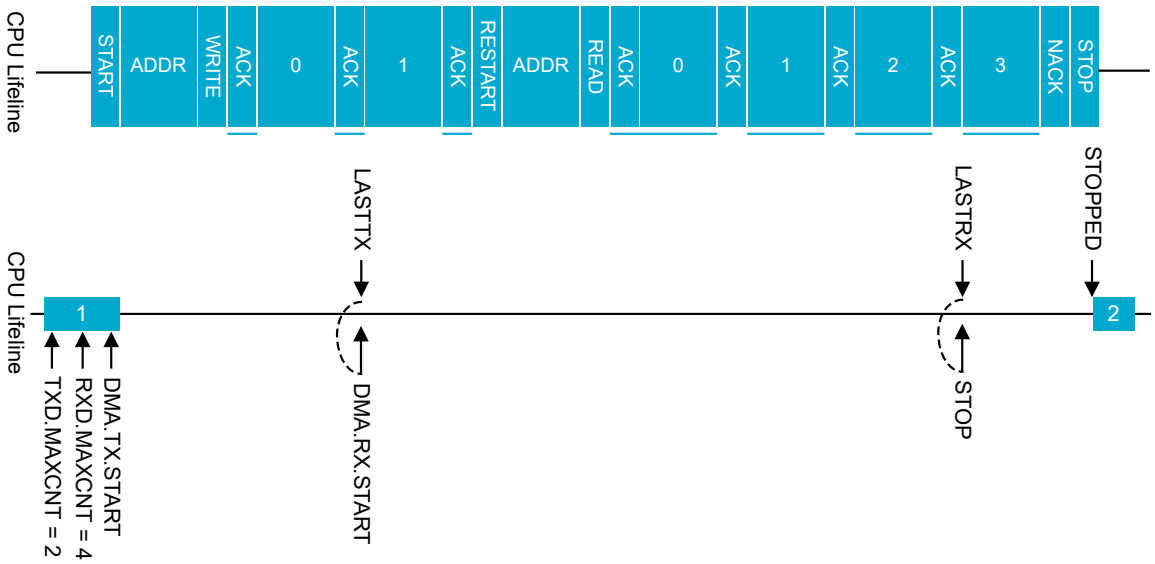


Figure 159: Controller repeated start sequence

If a more complex repeated start sequence is needed, and the TWI firmware drive is serviced in a low priority interrupt, use the SUSPEND task and SUSPENDED event to ensure that the correct tasks are generated at the correct time. A double repeated start sequence using the SUSPEND task to secure safe operation in low priority interrupts is shown in the following figure.

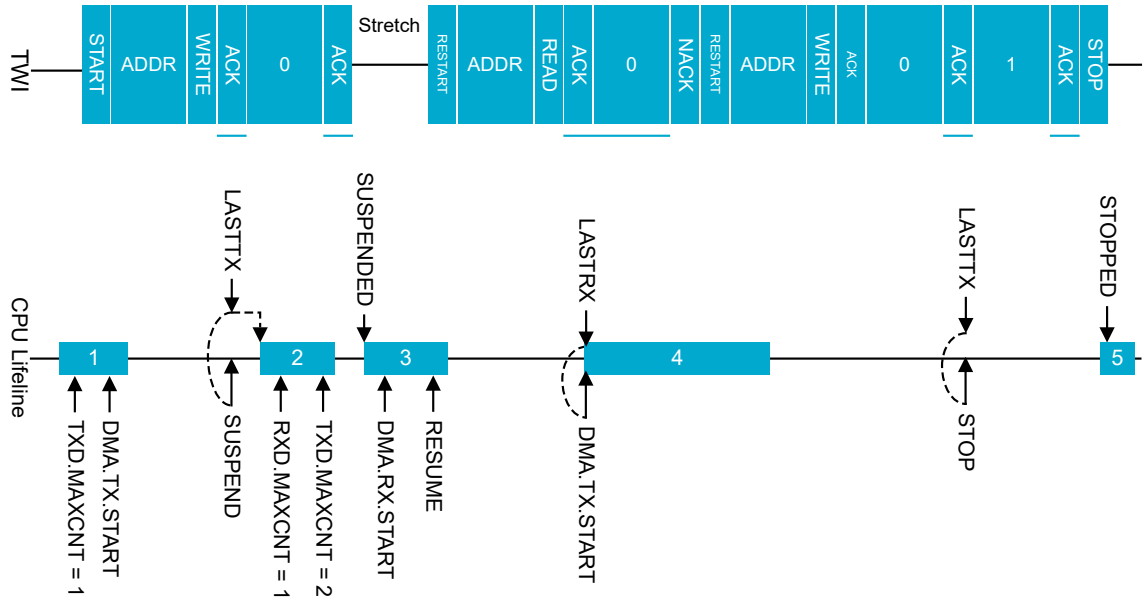


Figure 160: Double repeated start sequence

8.24.7 Low power

When the peripheral is not needed, stop and disable TWIM for lowest possible power consumption.

When the STOP task is sent, the software must wait until the STOPPED event is received before disabling the peripheral through the ENABLE register. If the peripheral is already stopped, the STOP task is not needed.

8.24.8 TWIM pin configuration

The SCL and SDA signals are mapped to physical pins using the PSEL.SCL and PSEL.SDA registers.

These registers and their configurations are only used when TWIM is enabled, and retained while the device is in System ON mode. When the peripheral is disabled, the pins behave as regular GPIOs and are configured according to their respective OUT bit field and PIN_CNF[n] register. Configure registers PSEL.SCL and PSEL.SDA when TWIM is disabled.

Only one peripheral can be assigned to drive a GPIO pin at a time. If more than one peripheral is assigned to a GPIO pin, it could result in unpredictable behavior.

When TWIM is in System OFF mode or disabled, the pins using TWIM must be configured by the GPIO peripheral according to the following table to ensure correct pin behavior.

TWIM signal	TWIM pin	Drive strength	Direction	Output value
SCL	As specified in PSEL.SCL	S0D1	Input	Not applicable
SDA	As specified in PSEL.SDA	S0D1	Input	Not applicable

Table 67: GPIO configuration before enabling peripheral

8.24.9 Pull-up resistor

1000 kbps bit rate is supported when using H0D1 drive strength, 1 kΩ pull-up resistor, and maximum 50 pF bus capacitance. For other bit rates, see the following figure.

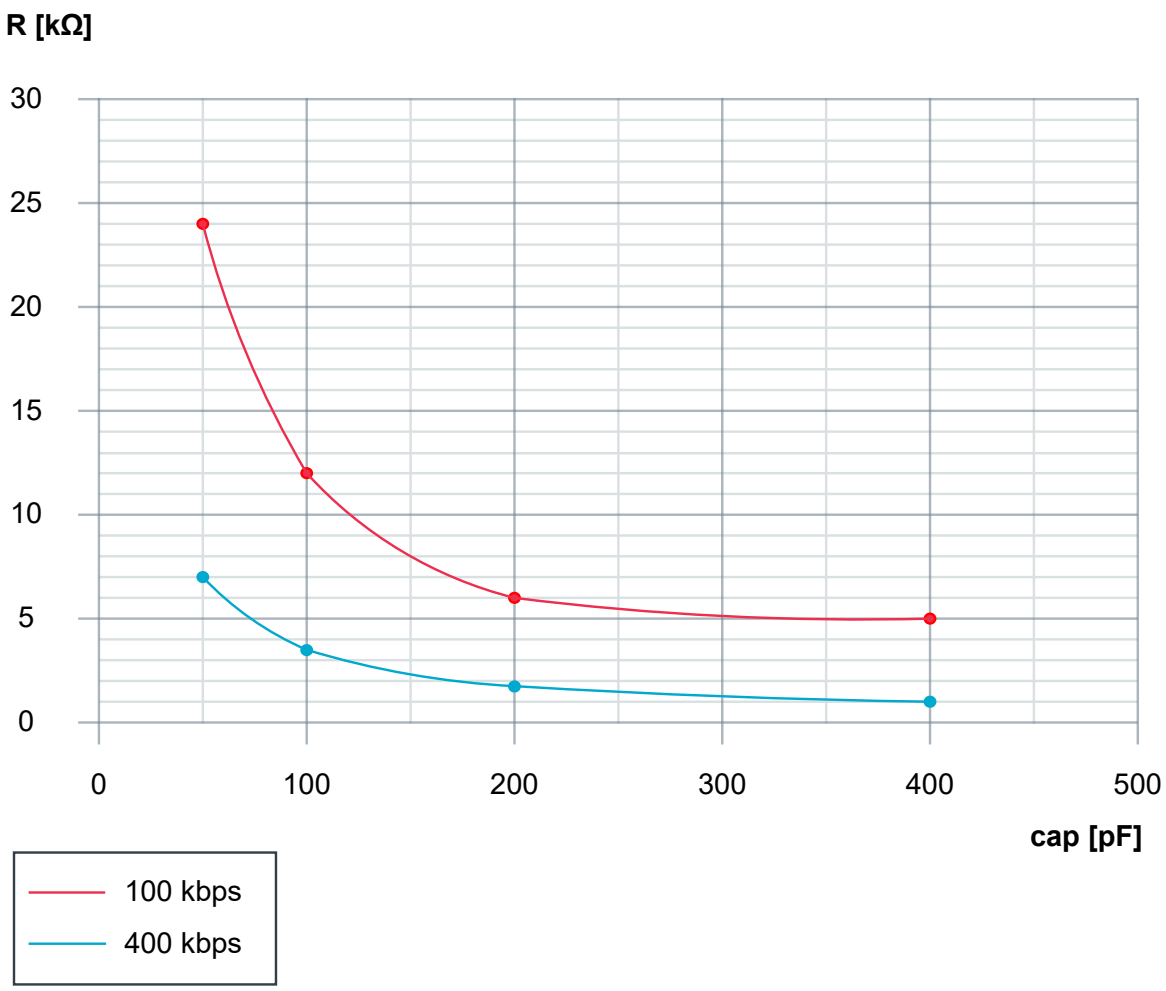


Figure 161: Recommended TWIM pull-up value vs. line capacitance

- The *I^2C bus specification* allows a maximum line capacitance of 400 pF.
- The value of internal pull-up resistor (R_{PU}) for nRF54LM20A and nRF54LM20B can be found in GPIO Electrical Specification on page 1259.

8.24.10 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
TWIM20 : S TWIM20 : NS	GLOBAL	0x500C6000 0x400C6000	US	S	SA	No	Two-wire interface controller TWIM20
TWIM21 : S TWIM21 : NS	GLOBAL	0x500C7000 0x400C7000	US	S	SA	No	Two-wire interface controller TWIM21
TWIM22 : S TWIM22 : NS	GLOBAL	0x500C8000 0x400C8000	US	S	SA	No	Two-wire interface controller TWIM22
TWIM23 : S TWIM23 : NS	GLOBAL	0x500ED000 0x400ED000	US	S	SA	No	Two-wire interface controller TWIM23
TWIM24 : S TWIM24 : NS	GLOBAL	0x500EE000 0x400EE000	US	S	SA	No	Two-wire interface controller TWIM24
TWIM30 : S TWIM30 : NS	GLOBAL	0x50104000 0x40104000	US	S	SA	No	Two-wire interface controller TWIM30

Configuration

Instance	Domain	Configuration
TWIM20 : S TWIM20 : NS	GLOBAL	Use GPIO port P1 or P3 Peripheral clock frequency is 16 MHz.
TWIM21 : S TWIM21 : NS	GLOBAL	Use GPIO port P1 or P3 Peripheral clock frequency is 16 MHz.
TWIM22 : S TWIM22 : NS	GLOBAL	Use GPIO port P1 or P3 Peripheral clock frequency is 16 MHz.
TWIM23 : S TWIM23 : NS	GLOBAL	Use GPIO port P1 or P3 Peripheral clock frequency is 16 MHz.
TWIM24 : S TWIM24 : NS	GLOBAL	Use GPIO port P1 or P3 Peripheral clock frequency is 16 MHz.
TWIM30 : S TWIM30 : NS	GLOBAL	Use GPIO port P0 Peripheral clock frequency is 16 MHz.

Register overview

Register	Offset	TZ	Description
TASKS_STOP	0x004		Stop TWI transaction. Must be issued while the TWI master is not suspended.
TASKS_SUSPEND	0x00C		Suspend TWI transaction
TASKS_RESUME	0x010		Resume TWI transaction
TASKS_DMA.RX.START	0x028		Starts operation using easyDMA to load the values. See peripheral description for operation using easyDMA.
TASKS_DMA.RX.STOP	0x02C		Stops operation using easyDMA. This does not trigger an END event.
TASKS_DMA.RX.ENABLEMATCH[n]	0x030		Enables the MATCH[n] event by setting the ENABLE[n] bit in the CONFIG register.
TASKS_DMA.RX.DISABLEMATCH[n]	0x040		Disables the MATCH[n] event by clearing the ENABLE[n] bit in the CONFIG register.
TASKS_DMA.TX.START	0x050		Starts operation using easyDMA to load the values. See peripheral description for operation using easyDMA.
TASKS_DMA.TX.STOP	0x054		Stops operation using easyDMA. This does not trigger an END event.
SUBSCRIBE_STOP	0x084		Subscribe configuration for task STOP
SUBSCRIBE_SUSPEND	0x08C		Subscribe configuration for task SUSPEND
SUBSCRIBE_RESUME	0x090		Subscribe configuration for task RESUME
SUBSCRIBE_DMA.RX.START	0x0A8		Subscribe configuration for task START
SUBSCRIBE_DMA.RX.STOP	0x0AC		Subscribe configuration for task STOP
SUBSCRIBE_DMA.RX.ENABLEMATCH[n]	0x0B0		Subscribe configuration for task ENABLEMATCH[n]
SUBSCRIBE_DMA.RX.DISABLEMATCH[n]	0x0C0		Subscribe configuration for task DISABLEMATCH[n]
SUBSCRIBE_DMA.TX.START	0x0D0		Subscribe configuration for task START
SUBSCRIBE_DMA.TX.STOP	0x0D4		Subscribe configuration for task STOP
EVENTS_STOPPED	0x104		TWI stopped
EVENTS_ERROR	0x114		TWI error
EVENTS_SUSPENDED	0x128		SUSPEND task has been issued, TWI traffic is now suspended.
EVENTS_LASTRX	0x134		Byte boundary, starting to receive the last byte
EVENTS_LASTTX	0x138		Byte boundary, starting to transmit the last byte
EVENTS_DMA.RX.END	0x14C		Indicates that the transfer of MAXCNT bytes between memory and the peripheral has been fully completed.
EVENTS_DMA.RX.READY	0x150		Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
EVENTS_DMA.RX.BUSERROR	0x154		An error occured during the bus transfer.
EVENTS_DMA.RX.MATCH[n]	0x158		Pattern match is detected on the DMA data bus.

Register	Offset	TZ	Description
EVENTS_DMA.TX.END	0x168		Indicates that the transfer of MAXCNT bytes between memory and the peripheral has been fully completed.
EVENTS_DMA.TX.READY	0x16C		Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
EVENTS_DMA.TX.BUSERROR	0x170		An error occured during the bus transfer.
PUBLISH_STOPPED	0x184		Publish configuration for event STOPPED
PUBLISH_ERROR	0x194		Publish configuration for event ERROR
PUBLISH_SUSPENDED	0x1A8		Publish configuration for event SUSPENDED
PUBLISH_LASTRX	0x1B4		Publish configuration for event LASTRX
PUBLISH_LASTTX	0x1B8		Publish configuration for event LASTTX
PUBLISH_DMA.RX.END	0x1CC		Publish configuration for event END
PUBLISH_DMA.RX.READY	0x1D0		Publish configuration for event READY
PUBLISH_DMA.RX.BUSERROR	0x1D4		Publish configuration for event BUSERROR
PUBLISH_DMA.RX.MATCH[n]	0x1D8		Publish configuration for event MATCH[n]
PUBLISH_DMA.TX.END	0x1E8		Publish configuration for event END
PUBLISH_DMA.TX.READY	0x1EC		Publish configuration for event READY
PUBLISH_DMA.TX.BUSERROR	0x1F0		Publish configuration for event BUSERROR
SHORTS	0x200		Shortcuts between local events and tasks
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
ERRORSRC	0x4C4		Error source
ENABLE	0x500		Enable TWIM
FREQUENCY	0x524		TWI frequency. Accuracy depends on the HFCLK source selected.
ADDRESS	0x588		Address used in the TWI transfer
PSEL.SCL	0x600		Pin select for SCL signal
PSEL.SDA	0x604		Pin select for SDA signal
DMA.RX.PTR	0x704		RAM buffer start address
DMA.RX.MAXCNT	0x708		Maximum number of bytes in channel buffer
DMA.RX.AMOUNT	0x70C		Number of bytes transferred in the last transaction, updated after the END event. Also updated after each MATCH event.
DMA.RX.LIST	0x714		EasyDMA list type
DMA.RX.TERMINATEONBUSERROR	0x71C		Terminate the transaction if a BUSERROR event is detected.
DMA.RX.BUSERRORADDRESS	0x720		Address of transaction that generated the last BUSERROR event.
DMA.RX.MATCH.CONFIG	0x724		Configure individual match events
DMA.RX.MATCH.CANDIDATE[n]	0x728		The data to look for - any match will trigger the MATCH[n] event, if enabled.
DMA.TX.PTR	0x73C		RAM buffer start address
DMA.TX.MAXCNT	0x740		Maximum number of bytes in channel buffer
DMA.TX.AMOUNT	0x744		Number of bytes transferred in the last transaction, updated after the END event. Also updated after each MATCH event.
DMA.TX.LIST	0x74C		EasyDMA list type
DMA.TX.TERMINATEONBUSERROR	0x754		Terminate the transaction if a BUSERROR event is detected.
DMA.TX.BUSERRORADDRESS	0x758		Address of transaction that generated the last BUSERROR event.

8.24.10.1 TASKS_STOP

Address offset: 0x004

Stop TWI transaction. Must be issued while the TWI master is not suspended.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Stop TWI transaction. Must be issued while the TWI master is not suspended.
			Trigger	1	Trigger task

8.24.10.2 TASKS_SUSPEND

Address offset: 0x00C

Suspend TWI transaction

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_SUSPEND			Suspend TWI transaction
			Trigger	1	Trigger task

8.24.10.3 TASKS_RESUME

Address offset: 0x010

Resume TWI transaction

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_RESUME			Resume TWI transaction
			Trigger	1	Trigger task

8.24.10.4 TASKS_DMA

Peripheral tasks.

8.24.10.4.1 TASKS_DMA.RX

Peripheral tasks.

8.24.10.4.1.1 TASKS_DMA.RX.START

Address offset: 0x028

Starts operation using easyDMA to load the values. See peripheral description for operation using easyDMA.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	START			Starts operation using easyDMA to load the values. See peripheral description for operation using easyDMA.
			Trigger	1	Trigger task

8.24.10.4.1.2 TASKS_DMA.RX.STOP

Address offset: 0x02C

Stops operation using easyDMA. This does not trigger an END event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	STOP			Stops operation using easyDMA. This does not trigger an END event.
			Trigger	1	Trigger task

8.24.10.4.1.3 TASKS_DMA.RX.ENABLEMATCH[n] (n=0..3)

Address offset: 0x030 + (n × 0x4)

Enables the MATCH[n] event by setting the ENABLE[n] bit in the CONFIG register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	ENABLEMATCH			Enables the MATCH[n] event by setting the ENABLE[n] bit in the CONFIG register.
			Trigger	1	Trigger task

8.24.10.4.1.4 TASKS_DMA.RX.DISABLEMATCH[n] (n=0..3)

Address offset: 0x040 + (n × 0x4)

Disables the MATCH[n] event by clearing the ENABLE[n] bit in the CONFIG register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	DISABLEMATCH			Disables the MATCH[n] event by clearing the ENABLE[n] bit in the CONFIG register.
			Trigger	1	Trigger task

8.24.10.4.2 TASKS_DMA.TX

Peripheral tasks.

8.24.10.4.2.1 TASKS_DMA.TX.START

Address offset: 0x050

Starts operation using easyDMA to load the values. See peripheral description for operation using easyDMA.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	W	START			Starts operation using easyDMA to load the values. See peripheral description for operation using easyDMA.
			Trigger	1	Trigger task

8.24.10.4.2.2 TASKS_DMA.TX.STOP

Address offset: 0x054

Stops operation using easyDMA. This does not trigger an END event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	W	STOP			Stops operation using easyDMA. This does not trigger an END event.
			Trigger	1	Trigger task

8.24.10.5 SUBSCRIBE_STOP

Address offset: 0x084

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.24.10.6 SUBSCRIBE_SUSPEND

Address offset: 0x08C

Subscribe configuration for task SUSPEND

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task SUSPEND will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.24.10.7 SUBSCRIBE_RESUME

Address offset: 0x090

Subscribe configuration for task RESUME

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task RESUME will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.24.10.8 SUBSCRIBE_DMA

Subscribe configuration for tasks

8.24.10.8.1 SUBSCRIBE_DMA.RX

Subscribe configuration for tasks

8.24.10.8.1.1 SUBSCRIBE_DMA.RX.START

Address offset: 0x0A8

Subscribe configuration for task START

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task START will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.24.10.8.1.2 SUBSCRIBE_DMA.RX.STOP

Address offset: 0x0AC

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.24.10.8.1.3 SUBSCRIBE_DMA.RX.ENABLEMATCH[n] (n=0..3)

Address offset: 0x0B0 + (n × 0x4)

Subscribe configuration for task ENABLEMATCH[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task ENABLEMATCH[n] will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.24.10.8.1.4 SUBSCRIBE_DMA.RX.DISABLEMATCH[n] (n=0..3)

Address offset: 0x0C0 + (n × 0x4)

Subscribe configuration for task DISABLEMATCH[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task DISABLEMATCH[n] will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.24.10.8.2 SUBSCRIBE_DMA.TX

Subscribe configuration for tasks

8.24.10.8.2.1 SUBSCRIBE_DMA.TX.START

Address offset: 0x0D0

Subscribe configuration for task START

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task START will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.24.10.8.2.2 SUBSCRIBE_DMA.TX.STOP

Address offset: 0x0D4

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.24.10.9 EVENTS_STOPPED

Address offset: 0x104

TWI stopped

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_STOPPED			TWI stopped
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.24.10.10 EVENTS_ERROR

Address offset: 0x114

TWI error

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_ERROR			TWI error
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.24.10.11 EVENTS_SUSPENDED

Address offset: 0x128

SUSPEND task has been issued, TWI traffic is now suspended.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_SUSPENDED			SUSPEND task has been issued, TWI traffic is now suspended.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.24.10.12 EVENTS_LASTRX

Address offset: 0x134

Byte boundary, starting to receive the last byte

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_LASTRX			Byte boundary, starting to receive the last byte
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.24.10.13 EVENTS_LASTTX

Address offset: 0x138

Byte boundary, starting to transmit the last byte

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_LASTTX			Byte boundary, starting to transmit the last byte
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.24.10.14 EVENTS_DMA

Peripheral events.

8.24.10.14.1 EVENTS_DMA.RX

Peripheral events.

8.24.10.14.1.1 EVENTS_DMA.RX.END

Address offset: 0x14C

Indicates that the transfer of MAXCNT bytes between memory and the peripheral has been fully completed.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	END			Indicates that the transfer of MAXCNT bytes between memory and the peripheral has been fully completed.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.24.10.14.1.2 EVENTS_DMA.RX.READY

Address offset: 0x150

Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	READY			Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.24.10.14.1.3 EVENTS_DMA.RX.BUSERROR

Address offset: 0x154

An error occured during the bus transfer.

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	BUSERROR			An error occured during the bus transfer. When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.24.10.14.1.4 EVENTS_DMA.RX.MATCH[n] (n=0..3)

Address offset: 0x158 + (n × 0x4)

Pattern match is detected on the DMA data bus.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MATCH			Pattern match is detected on the DMA data bus.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.24.10.14.2 EVENTS_DMA.TX

Peripheral events.

8.24.10.14.2.1 EVENTS_DMA.TX.END

Address offset: 0x168

Indicates that the transfer of MAXCNT bytes between memory and the peripheral has been fully completed.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	END			Indicates that the transfer of MAXCNT bytes between memory and the peripheral has been fully completed.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.24.10.14.2.2 EVENTS_DMA.TX.READY

Address offset: 0x16C

Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	READY			Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.24.10.14.2.3 EVENTS_DMA.TX.BUSERROR

Address offset: 0x170

An error occured during the bus transfer.

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	BUSERROR			An error occured during the bus transfer. When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.24.10.15 PUBLISH_STOPPED

Address offset: 0x184

Publish configuration for event STOPPED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event STOPPED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.24.10.16 PUBLISH_ERROR

Address offset: 0x194

Publish configuration for event ERROR

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event ERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.24.10.17 PUBLISH_SUSPENDED

Address offset: 0x1A8

Publish configuration for event SUSPENDED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event SUSPENDED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.24.10.18 PUBLISH_LASTRX

Address offset: 0x1B4

Publish configuration for event LASTRX

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event LASTRX will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.24.10.19 PUBLISH_LASTTX

Address offset: 0x1B8

Publish configuration for event LASTTX

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event LASTTX will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.24.10.20 PUBLISH_DMA

Publish configuration for events

8.24.10.20.1 PUBLISH_DMA.RX

Publish configuration for events

8.24.10.20.1.1 PUBLISH_DMA.RX.END

Address offset: 0x1CC

Publish configuration for event END

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event END will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.24.10.20.1.2 PUBLISH_DMA.RX.READY

Address offset: 0x1D0

Publish configuration for event READY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event READY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.24.10.20.1.3 PUBLISH_DMA.RX.BUSERROR

Address offset: 0x1D4

Publish configuration for event BUSERROR

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event BUSERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.24.10.20.1.4 PUBLISH_DMA.RX.MATCH[n] (n=0..3)

Address offset: 0x1D8 + (n × 0x4)

Publish configuration for event MATCH[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event MATCH[n] will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.24.10.20.2 PUBLISH_DMA.TX

Publish configuration for events

8.24.10.20.2.1 PUBLISH_DMA.TX.END

Address offset: 0x1E8

Publish configuration for event END

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event END will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.24.10.20.2.2 PUBLISH_DMA.TX.READY

Address offset: 0x1EC

Publish configuration for event READY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event READY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.24.10.20.2.3 PUBLISH_DMA.TX.BUSERROR

Address offset: 0x1F0

Publish configuration for event BUSERROR

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event BUSERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.24.10.21 SHORTS

Address offset: 0x200

Shortcuts between local events and tasks

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	LASTTX_DMA_RX_START			Shortcut between event LASTTX and task DMA.RX.START
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
B	RW	LASTTX_SUSPEND			Shortcut between event LASTTX and task SUSPEND
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
C	RW	LASTTX_STOP			Shortcut between event LASTTX and task STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
D	RW	LASTRX_DMA_TX_START			Shortcut between event LASTRX and task DMA.TX.START
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
E	RW	LASTRX_STOP			Shortcut between event LASTRX and task STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
F-I	RW	DMA_RX_MATCH[i]_DMA_RX_ENABLEMA			Shortcut between event DMA.RX.MATCH[n] and task
		+1)%4] (i=0..3)			DMA.RX.ENABLEMATCH[(i+1)%4]
					Allows daisy-chaining match events.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
J-M	RW	DMA_RX_MATCH[i]_DMA_RX_DISABLEMATCH[i] (i=0..3)			Shortcut between event DMA.RX.MATCH[n] and task DMA.RX.DISABLEMATCH[n]
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut

8.24.10.22 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	STOPPED			Enable or disable interrupt for event STOPPED
			Disabled	0	Disable
			Enabled	1	Enable
B	RW	ERROR			Enable or disable interrupt for event ERROR
			Disabled	0	Disable
			Enabled	1	Enable
C	RW	SUSPENDED			Enable or disable interrupt for event SUSPENDED
			Disabled	0	Disable
			Enabled	1	Enable
D	RW	LASTRX			Enable or disable interrupt for event LASTRX
			Disabled	0	Disable
			Enabled	1	Enable
E	RW	LASTTX			Enable or disable interrupt for event LASTTX
			Disabled	0	Disable
			Enabled	1	Enable
F	RW	DMARXEND			Enable or disable interrupt for event DMARXEND
			Disabled	0	Disable
			Enabled	1	Enable
G	RW	DMARXREADY			Enable or disable interrupt for event DMARXREADY
			Disabled	0	Disable
			Enabled	1	Enable
H	RW	DMARXBUSERROR			Enable or disable interrupt for event DMARXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Disabled	0	Disable
			Enabled	1	Enable
I-L	RW	DMARXMATCH[i] (i=0..3)			Enable or disable interrupt for event DMARXMATCH[i]
			Disabled	0	Disable
			Enabled	1	Enable
M	RW	DMATXEND			Enable or disable interrupt for event DMATXEND
			Disabled	0	Disable
			Enabled	1	Enable
N	RW	DMATXREADY			Enable or disable interrupt for event DMATXREADY

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				O	N	M	L	K	J	I	H	G	F					E	D			C					B				A	
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
			Disabled	0	Disable
			Enabled	1	Enable
O	RW	DMATXBUSERROR			Enable or disable interrupt for event DMATXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Disabled	0	Disable
			Enabled	1	Enable

8.24.10.23 INTENSET

Address offset: 0x304

Enable interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				O	N	M	L	K	J	I	H	G	F					E	D			C					B				A	
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1S	STOPPED			Write '1' to enable interrupt for event STOPPED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	ERROR			Write '1' to enable interrupt for event ERROR
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1S	SUSPENDED			Write '1' to enable interrupt for event SUSPENDED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1S	LASTRX			Write '1' to enable interrupt for event LASTRX
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1S	LASTTX			Write '1' to enable interrupt for event LASTTX
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1S	DMARXEND			Write '1' to enable interrupt for event DMARXEND
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1S	DMARXREADY			Write '1' to enable interrupt for event DMARXREADY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
H	RW W1S	DMARXBUSERROR			Write '1' to enable interrupt for event DMARXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
I-L	RW W1S	DMARXMATCH[i] (i=0..3)			Write '1' to enable interrupt for event DMARXMATCH[i]
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1S	DMATXEND			Write '1' to enable interrupt for event DMATXEND
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
N	RW W1S	DMATXREADY			Write '1' to enable interrupt for event DMATXREADY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
O	RW W1S	DMATXBUSERROR			Write '1' to enable interrupt for event DMATXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.24.10.24 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	STOPPED			Write '1' to disable interrupt for event STOPPED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	ERROR			Write '1' to disable interrupt for event ERROR
			Clear	1	Disable
			Disabled	0	Read: Disabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
			Enabled	1	Read: Enabled
C	RW W1C	SUSPENDED			Write '1' to disable interrupt for event SUSPENDED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1C	LASTRX			Write '1' to disable interrupt for event LASTRX
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1C	LASTTX			Write '1' to disable interrupt for event LASTTX
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1C	DMARXEND			Write '1' to disable interrupt for event DMARXEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1C	DMARXREADY			Write '1' to disable interrupt for event DMARXREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
H	RW W1C	DMARXBUSERROR			Write '1' to disable interrupt for event DMARXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
I-L	RW W1C	DMARXMATCH[i] (i=0..3)			Write '1' to disable interrupt for event DMARXMATCH[i]
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1C	DMATXEND			Write '1' to disable interrupt for event DMATXEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
N	RW W1C	DMATXREADY			Write '1' to disable interrupt for event DMATXREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
O	RW W1C	DMATXBUSERROR			Write '1' to disable interrupt for event DMATXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.24.10.25 ERRORSRC

Address offset: 0x4C4

Error source

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	OVERRUN			Overrun error A new byte was received before previous byte got transferred into RXD buffer. (Previous data is lost)
			NotReceived	0	Error did not occur
			Received	1	Error occurred
B	RW W1C	ANACK			NACK received after sending the address (write '1' to clear)
			NotReceived	0	Error did not occur
			Received	1	Error occurred
C	RW W1C	DNACK			NACK received after sending a data byte (write '1' to clear)
			NotReceived	0	Error did not occur
			Received	1	Error occurred

8.24.10.26 ENABLE

Address offset: 0x500

Enable TWIM

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			Enable or disable TWIM
			Disabled	0	Disable TWIM
			Enabled	6	Enable TWIM

8.24.10.27 FREQUENCY

Address offset: 0x524

TWI frequency. Accuracy depends on the HFCLK source selected.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x04000000				**0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	FREQUENCY			TWI master clock frequency
			K100	0x01980000	100 kbps
			K250	0x04000000	250 kbps
			K400	0x06400000	400 kbps
			K1000	0x0FF00000	1000 kbps

8.24.10.28 ADDRESS

Address offset: 0x588

Address used in the TWI transfer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ADDRESS			Address used in the TWI transfer

8.24.10.29 PSEL.SCL

Address offset: 0x600

Pin select for SCL signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.24.10.30 PSEL.SDA

Address offset: 0x604

Pin select for SDA signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.24.10.31 DMA.RX.PTR

Address offset: 0x704

RAM buffer start address

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x20000000	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			RAM buffer start address for this EasyDMA channel. This address is a word aligned Data RAM address.

Note: See the memory chapter for details about which memories are available for EasyDMA.

8.24.10.32 DMA.RX.MAXCNT

Address offset: 0x708

Maximum number of bytes in channel buffer

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MAXCNT		[1..0xFFFF]	Maximum number of bytes in channel buffer

8.24.10.33 DMA.RX.AMOUNT

Address offset: 0x70C

Number of bytes transferred in the last transaction, updated after the END event.

Also updated after each MATCH event.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT		[1..0xFFFF]	Number of bytes transferred in the last transaction. In case of NACK error, includes the NACK'ed byte.

8.24.10.34 DMA.RX.LIST

Address offset: 0x714

EasyDMA list type

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	TYPE			List type
			Disabled	0	Disable EasyDMA list
			ArrayList	1	Use array list

8.24.10.35 DMA.RX.TERMINATEONBUSERROR

Address offset: 0x71C

Terminate the transaction if a BUSERROR event is detected.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			
			Disabled	0	Disable
			Enabled	1	Enable

8.24.10.36 DMA.RX.BUSERRORADDRESS

Address offset: 0x720

Address of transaction that generated the last BUSERROR event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	ADDRESS			

8.24.10.37 DMA.RX.MATCH

Registers to control the behavior of the pattern matcher engine

8.24.10.37.1 DMA.RX.MATCH.CONFIG

Address offset: 0x724

Configure individual match events

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-D	RW	ENABLE[i] (i=0..3)			Enable match filter i
			Disabled	0	Match filter disabled
			Enabled	1	Match filter enabled
E-H	RW	ONESHOT[i] (i=0..3)			Configure match filter i as one-shot or continous One-shot operation will disable the filter on a match, while Continous operation will keep it enabled until explicitly disabled.
			Continuous	0	Match filter stays enabled until disabled by task
			Oneshot	1	Match filter stays enabled until next data word is received

8.24.10.37.2 DMA.RX.MATCH.CANDIDATE[n] (n=0..3)

Address offset: 0x728 + (n × 0x4)

The data to look for - any match will trigger the MATCH[n] event, if enabled.

Note: This register can be updated while a transfer is in progress, but the new value will not take effect until either the DMA is restarted or the match event is generated. That makes it possible to write a new set of match words which will be searched for immediately after the event triggers.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	DATA			Data to look for

8.24.10.38 DMA.TX.PTR

Address offset: 0x73C

RAM buffer start address

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x20000000				**0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			RAM buffer start address for this EasyDMA channel. This address is a word aligned Data RAM address. **Note:** See the memory chapter for details about which memories are available for EasyDMA.

8.24.10.39 DMA.TX.MAXCNT

Address offset: 0x740

Maximum number of bytes in channel buffer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MAXCNT		[1..0xFFFF]	Maximum number of bytes in channel buffer

8.24.10.40 DMA.TX.AMOUNT

Address offset: 0x744

Number of bytes transferred in the last transaction, updated after the END event.

Also updated after each MATCH event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT		[1..0xFFFF]	Number of bytes transferred in the last transaction. In case of NACK error, includes the NACK'ed byte.

8.24.10.41 DMA.TX.LIST

Address offset: 0x74C

EasyDMA list type

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	TYPE			List type
			Disabled	0	Disable EasyDMA list
			ArrayList	1	Use array list

8.24.10.42 DMA.TX.TERMINATEONBUSERROR

Address offset: 0x754

Terminate the transaction if a BUSERROR event is detected.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			
			Disabled	0	Disable
			Enabled	1	Enable

8.24.10.43 DMA.TX.BUSERRORADDRESS

Address offset: 0x758

Address of transaction that generated the last BUSERROR event.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	ADDRESS			

8.25 TWIS — I²C compatible two-wire interface target with EasyDMA

The TWI target peripheral (TWIS) with EasyDMA provides a half duplex, two-wire synchronous serial communication interface.

The main features of TWIS are the following:

- I²C compatible
- Supports 100 kbps and 400 kbps bit rate
- EasyDMA direct transfer to and from RAM
- Individual selection of I/O pins
- Support for clock stretching

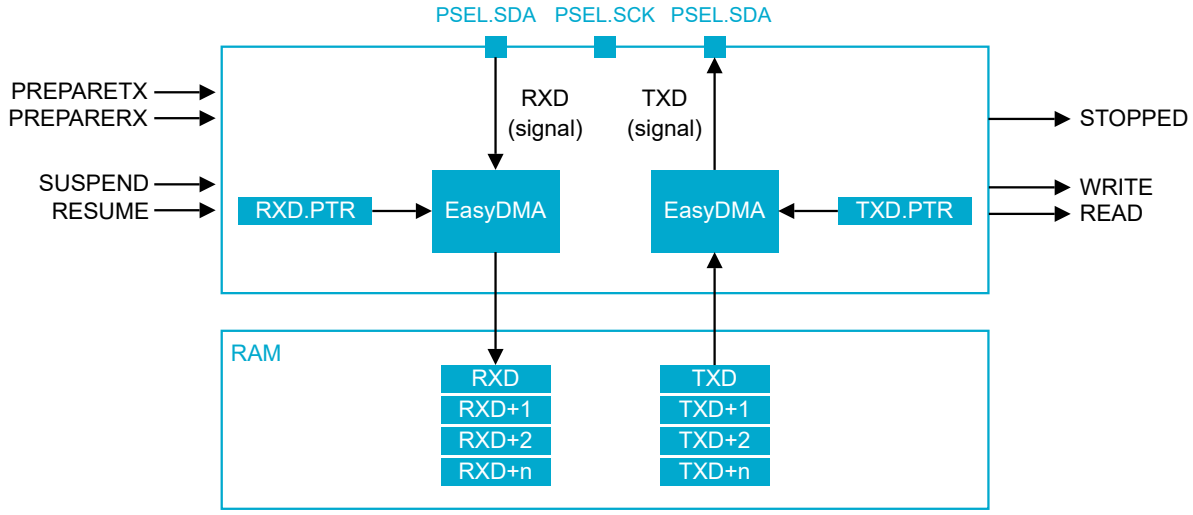


Figure 162: TWIS with EasyDMA

A typical TWI setup consists of one controller and one or more targets, as seen in the following figure. Only a single controller can be used on the TWI bus.

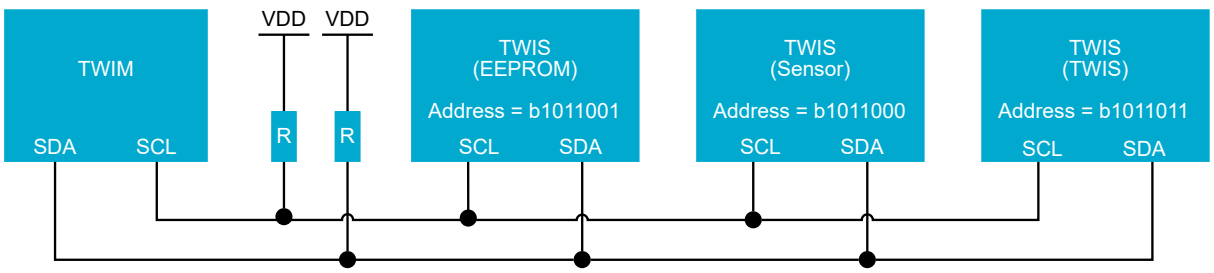


Figure 163: Typical TWI setup with one controller and three targets

8.25.1 State machine

The following figure shows the TWIS state machine.

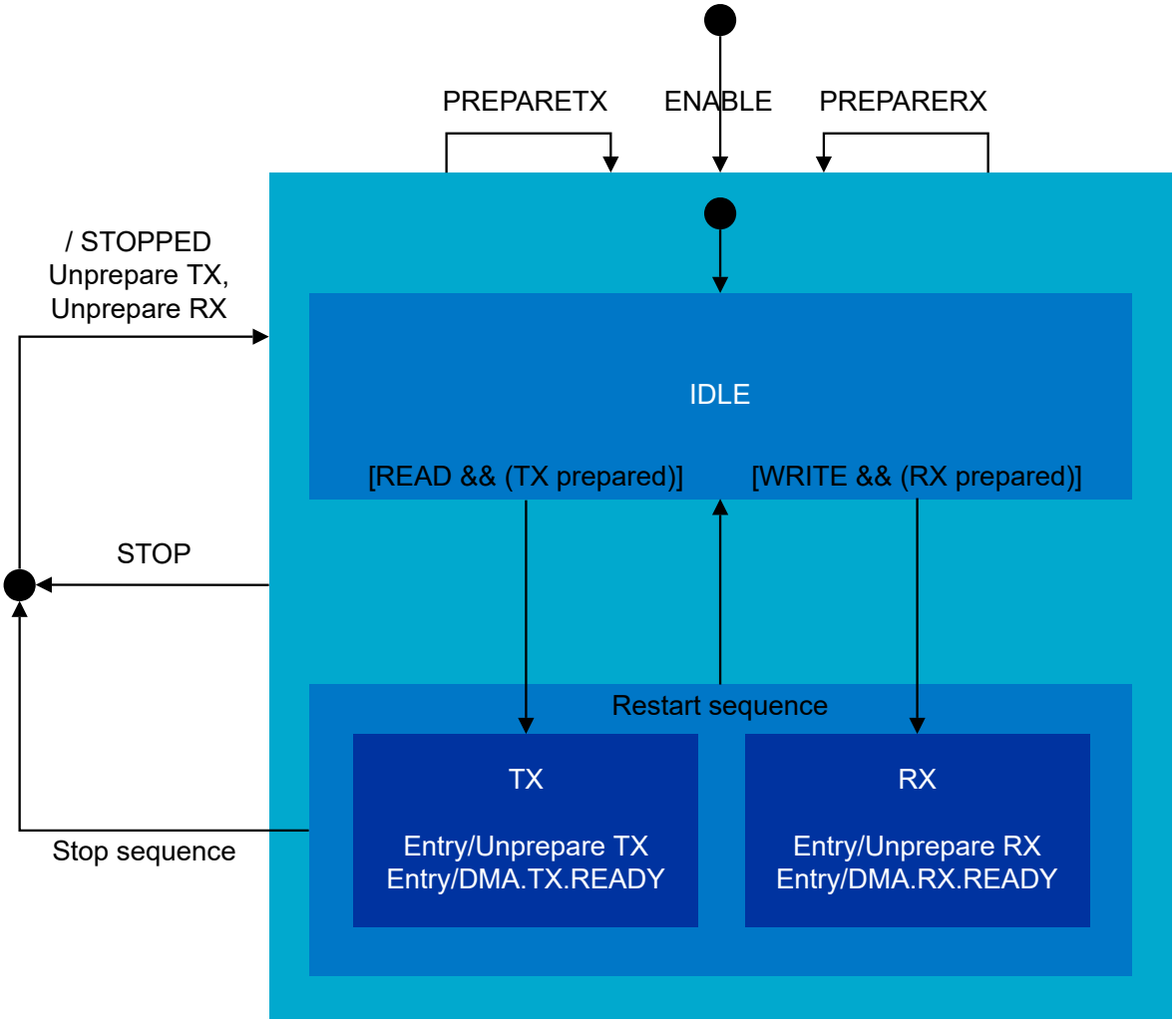


Figure 164: TWIS state machine

The following table contains descriptions of the symbols used in the state machine.

Symbol	Type	Description
ENABLE	Register	TWIS enabled via the ENABLE register.
PREPARETX	Task	The TASKS_PREPARETX task was triggered.
STOP	Task	The TASKS_STOP task was triggered.
PREPARERX	Task	The TASKS_PREPARERX task was triggered.
STOPPED	Event	The EVENTS_STOPPED event was generated.
DMA.RX.READY	Event	The EVENTS_DMA.RX.READY event was generated.
DMA.TX.READY	Event	The EVENTS_DMA.TX.READY event was generated.
TX prepared	Internal	Internal flag indicating that a TASKS_PREPARETX task was triggered.
RX prepared	Internal	Internal flag indicating that a TASKS_PREPARERX task was triggered.
Unprepare TX	Internal	Clears the TX prepared flag until the next TASKS_PREPARETX task.
Unprepare RX	Internal	Clears the RX prepared flag until the next TASKS_PREPARERX task.
Stop condition	TWI protocol	A TWI stop condition was detected.
Restart condition	TWI protocol	A TWI restart condition was detected.

Table 68: TWI slave state machine symbols

TWIS supports clock stretching. In order to use this feature, the controller must also support clock stretching for the feature to execute properly. TWIS operates in a low-power mode while waiting for the TWI controller to initiate a transfer. As long as TWIS is not addressed, it will remain in this mode.

For TWIS to run correctly, PSEL.SCL, PSEL.SDA, CONFIG, and the ADDRESS[n] registers must be configured, the SCL and SDA lines must both be high, before enabling TWIS through the ENABLE register. Similarly, changing these settings must be performed while TWIS is disabled. Failing to do so may result in unpredictable behavior.

8.25.2 Shared resources

The TWIS peripheral shares registers and other resources with peripherals that have the same ID as TWIS. Before TWIS can be configured and used, all peripherals that have the same ID as TWIS must be disabled.

Disabling a peripheral with the same ID as TWIS will not reset any shared TWIS registers. Configure all TWIS registers to ensure they operate correctly.

See the Instantiation table in Instantiation on page 232 for details on peripherals and their IDs.

8.25.3 EasyDMA

TWIS implements EasyDMA for accessing RAM without CPU involvement.

TWIS implements the EasyDMA channels found in the following table.

Channel	Type	Register Cluster
TXD	READER	TXD
RXD	WRITER	RXD

Table 69: TWIS EasyDMA Channels

For detailed information regarding the use of EasyDMA, see EasyDMA on page 29.

The STOPPED event indicates that EasyDMA is finished accessing the buffer in RAM.

8.25.4 Read command response

Before TWIS can respond to a read command, it must be configured and enabled in the ENABLE register. When enabled, TWIS is in the IDLE state.

A read command is started when TWIM generates a start condition on the TWI bus. This is followed by clocking out the address and setting the READ/WRITE bit to `1` (READ=1, WRITE=0). The READ/WRITE bit is followed by an ACK/NACK bit (ACK = 0, NACK = 1) response from the TWIS.

TWIS can listen for two addresses at a time. This is configured in the ADDRESS registers and the CONFIG register.

TWIS only acknowledges (ACK) the read command if the address presented by the controller matches one of the addresses the target is configured to listen for. TWIS will generate a READ event when it acknowledges the read command.

TWIS only detects a read command from the IDLE state.

TWIS will set an internal **`TX prepared`** flag when the PREPARETX task is triggered.

When the read command is received, TWIS will enter the TX state if the internal **`TX prepared`** flag is set.

If the internal **`TX prepared`** flag is not set when the read command is received, TWIS will stretch the controller's clock until the PREPARETX task is triggered and the internal **`TX prepared`** flag is set.

TWIS will generate the EVENTS_DMA.TX.READY event and clear the **`TX prepared`** flag when it enters the TX state. In this state, TWIS will send the data bytes found in the transmit buffer to the controller using the controller's clock.

TWIS returns to the IDLE state if the TWIS receives a restart command when it is in the TX state.

TWIS is stopped when it receives the stop condition from TWIM. A STOPPED event will be generated when the transaction has stopped. TWIS will clear the **`TX prepared`** flag and go back to the IDLE state when it has stopped.

The transmit buffer is located in RAM at the address specified in the TXD.PTR register. TWIS will only be able to send TXD.MAXCNT bytes from the transmit buffer for each transaction. If TWIM forces TWIS to send more than TXD.MAXCNT bytes, the target will send the byte specified in the ORC register to the controller instead. If this happens, an ERROR event will be generated.

The EasyDMA configuration registers RXD.PTR, TXD.PTR, RXD.AMOUNT, and TXD.AMOUNT, are latched when the EVENTS_DMA.TX.READY event is generated.

TWIS can be forced to stop by triggering the STOP task. A STOPPED event will be generated when TWIS has stopped. TWIS will clear the **`TX prepared`** flag and return to the IDLE state when it has stopped, see Terminate an ongoing TWI transaction on page 728.

Each byte sent from TWIS will be followed by an ACK/NACK bit sent from the controller. TWIM will generate a NACK following the last byte that it wants to receive to tell the target to release the bus allowing TWIM to generate the stop condition. The TXD.AMOUNT register can be queried after a transaction to see how many bytes were sent.

A typical TWIS read command response is illustrated in the following figure, including clock stretching following a SUSPEND task.

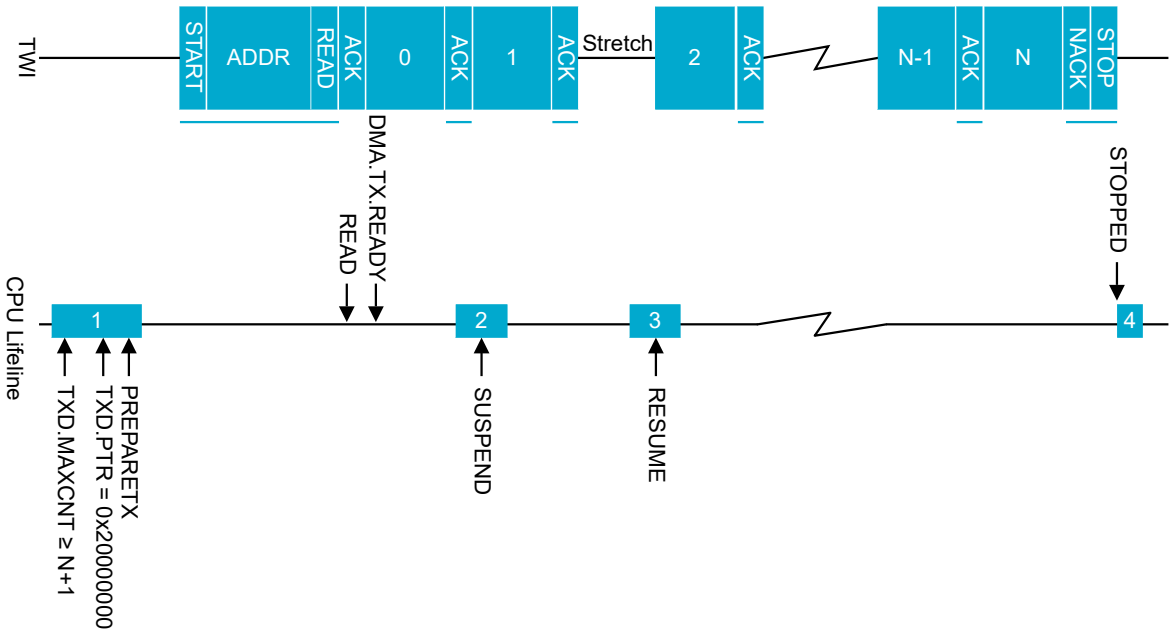


Figure 165: TWIS responding to a read command

8.25.5 Write command response

Before TWIS can respond to a write command, TWIS must be configured and enabled in the ENABLE register. When enabled, TWIS is in the IDLE state.

A write command is started when TWIM generates a start condition on the TWI bus. This is followed by clocking out the address and setting the READ/WRITE bit to 0 (READ = 1, WRITE = 0). The READ/WRITE bit is followed by an ACK/NACK bit (ACK = 0, NACK = 1) response from the TWIS.

TWIS can listen for two addresses at a time. This is configured in the ADDRESS registers and the CONFIG register.

TWIS only acknowledges (ACK) the write command if the address presented by the controller matches one of the addresses the target is configured to listen for. TWIS will generate a WRITE event when it acknowledges the write command.

TWIS only detects a write command from the IDLE state.

TWIS will set an internal **RX prepared** flag when the PREPARERX task is triggered.

When the write command is received, TWIS will enter the RX state if the internal **RX prepared** flag is set.

If the internal **RX prepared** flag is not set when the write command is received, TWIS will start stretching the master's clock after the first data byte, not allowing the master to send the stop condition. Clock is stretched until the PREPARERX task is triggered and the internal **RX prepared** flag is set.

TWIS will generate the EVENTS_DMA.RX.READY event and clear the internal **RX prepared** flag when it enters the RX state. In this state, TWIS will be able to receive the bytes sent by the TWIM.

TWIS returns to the IDLE state if TWIS receives a restart command when it is in the RX state.

TWIS is stopped when it receives the stop condition from TWIM. A STOPPED event will be generated when the transaction has stopped. TWIS will clear the internal **RX prepared** flag and go back to the IDLE state when it has stopped.

The receive buffer is located in RAM at the address specified in the RXD.PTR register. TWIS can only receive as many bytes as specified in the RXD.MAXCNT register. If TWIM tries to send more bytes to TWIS than it

can receive, the extra bytes are discarded and NACKed by the target. If this happens, an ERROR event will be generated.

The EasyDMA configuration registers, RXD.PTR, TXD.PTR, RXD.AMOUNT, and TXD.AMOUNT, are latched when the EVENTS_DMA.RX.READY event is generated.

TWIS can be forced to stop by triggering the STOP task. A STOPPED event will be generated when TWIS has stopped. TWIS will clear the internal **`RX prepared`** flag and return to the IDLE state when it has stopped, see Terminate an ongoing TWI transaction on page 728.

TWIS will generate an ACK after every byte received from the controller. The RXD.AMOUNT register can be queried after a transaction to see how many bytes were received.

A typical TWIS write command response is illustrated in the following figure, including clock stretching following a SUSPEND task.

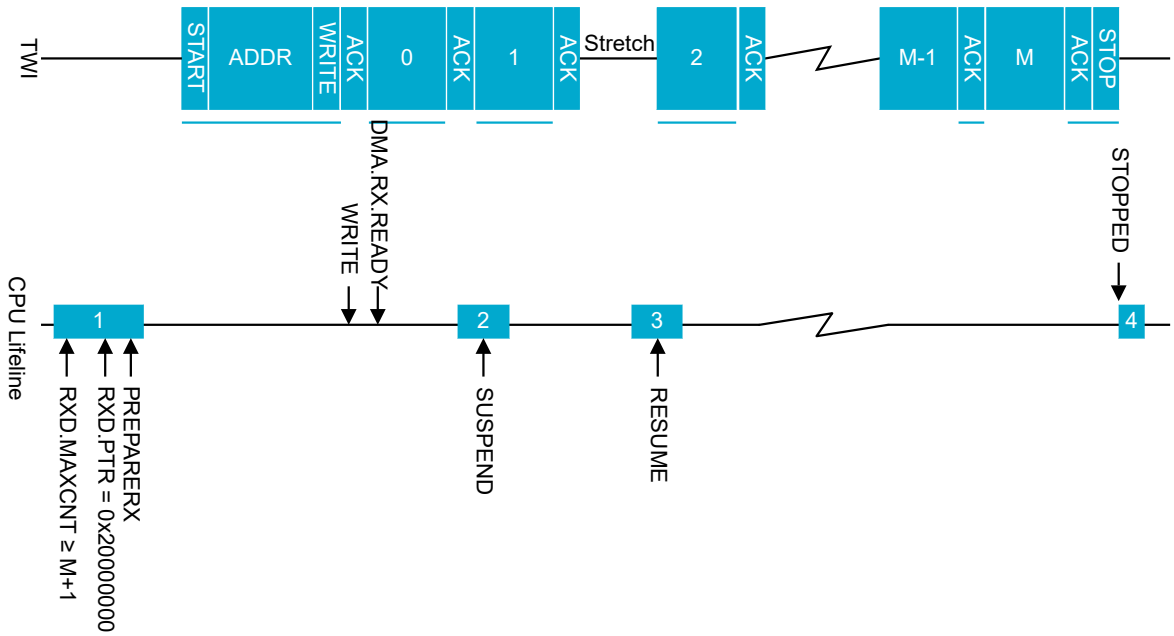


Figure 166: TWIS responding to a write command

8.25.6 TWI controller repeated start sequence

A repeated start sequence is where the TWI controller writes two bytes to TWIS, followed by reading four bytes from the target. This is shown in the following figure.

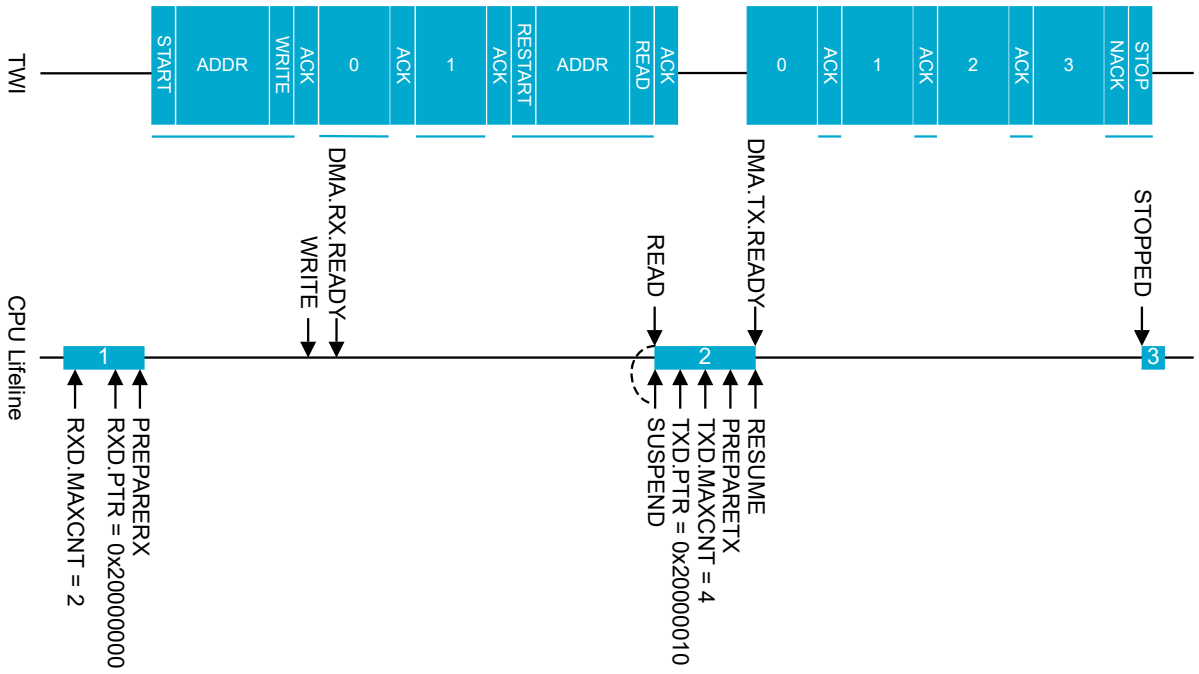


Figure 167: Repeated start sequence

In this example, the receiver does not know in advance what the controller wants to read. This information is in the first two received bytes of the write in the repeated start sequence. For the CPU to process the received data before TWIS replies to the read command, the SUSPEND task is triggered. This is enabled through a shortcut from the READ event generated when the read command is received. When the CPU has processed the incoming data and prepared the correct data response, the CPU will resume the transaction by triggering the RESUME task.

8.25.7 Terminate an ongoing TWI transaction

In some situations, an ongoing transaction must be terminated. This can happen when the external TWI controller is not responding correctly, for example.

To stop an ongoing transaction, trigger the STOP task. A STOPPED event will be generated when TWIS stops. It is not dependent on the STOP condition being generated on the TWI bus. TWIS will release the bus when it has stopped and returns to its IDLE state.

8.25.8 Low power

When the peripheral is not needed, stop and disable TWIS for lowest possible power consumption.

When the STOP task is sent, the software must wait until the STOPPED event is received before disabling the peripheral through the ENABLE register. If the peripheral is already stopped, the STOP task is not needed.

8.25.9 Target mode pin configuration

The SCL and SDA signals are mapped to physical pins using the PSEL.SCL and PSEL.SDA registers.

The PSEL.SCL and PSEL.SDA registers and their configurations are only used when TWIS is enabled, and retained while the device is in System ON mode. When the peripheral is disabled, the pins function as regular GPIOs, and use the configuration in their respective OUT bit field and PIN_CNF[n] register. Only configure PSEL.SCL and PSEL.SDA when TWIS is disabled.

When in System OFF mode or when TWIS is disabled, the TWIS pins must be configured in the GPIO peripheral as described in the following table to secure correct signal levels.

Only one peripheral can be assigned to drive a GPIO pin at a time. Failing to do so may result in unpredictable behavior.

TWIS signal	TWIS pin	Direction	Output value	Drive strength
SCL	As specified in PSEL.SCL	Input	Not applicable	S0D1
SDA	As specified in PSEL.SDA	Input	Not applicable	S0D1

Table 70: GPIO configuration before enabling peripheral

8.25.10 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
TWIS20 : S TWIS20 : NS	GLOBAL	0x500C6000 0x400C6000	US	S	SA	No	Two-wire interface target TWIS20
TWIS21 : S TWIS21 : NS	GLOBAL	0x500C7000 0x400C7000	US	S	SA	No	Two-wire interface target TWIS21
TWIS22 : S TWIS22 : NS	GLOBAL	0x500C8000 0x400C8000	US	S	SA	No	Two-wire interface target TWIS22
TWIS23 : S TWIS23 : NS	GLOBAL	0x500ED000 0x400ED000	US	S	SA	No	Two-wire interface target TWIS23
TWIS24 : S TWIS24 : NS	GLOBAL	0x500EE000 0x400EE000	US	S	SA	No	Two-wire interface target TWIS24
TWIS30 : S TWIS30 : NS	GLOBAL	0x50104000 0x40104000	US	S	SA	No	Two-wire interface target TWIS30

Configuration

Instance	Domain	Configuration
TWIS20 : S TWIS20 : NS	GLOBAL	Use GPIO port P1 or P3
TWIS21 : S TWIS21 : NS	GLOBAL	Use GPIO port P1 or P3
TWIS22 : S TWIS22 : NS	GLOBAL	Use GPIO port P1 or P3
TWIS23 : S TWIS23 : NS	GLOBAL	Use GPIO port P1 or P3
TWIS24 : S TWIS24 : NS	GLOBAL	Use GPIO port P1 or P3
TWIS30 : S TWIS30 : NS	GLOBAL	Use GPIO port P0

Register overview

Register	Offset	TZ	Description
TASKS_STOP	0x004		Stop TWI transaction
TASKS_SUSPEND	0x00C		Suspend TWI transaction
TASKS_RESUME	0x010		Resume TWI transaction
TASKS_PREPARERX	0x020		Prepare the TWI slave to respond to a write command
TASKS_PREPARETX	0x024		Prepare the TWI slave to respond to a read command
TASKS_DMA.RX.ENABLEMATCH[n]	0x030		Enables the MATCH[n] event by setting the ENABLE[n] bit in the CONFIG register.
TASKS_DMA.RX.DISABLEMATCH[n]	0x040		Disables the MATCH[n] event by clearing the ENABLE[n] bit in the CONFIG register.
SUBSCRIBE_STOP	0x084		Subscribe configuration for task STOP
SUBSCRIBE_SUSPEND	0x08C		Subscribe configuration for task SUSPEND
SUBSCRIBE_RESUME	0x090		Subscribe configuration for task RESUME
SUBSCRIBE_PREPARERX	0x0A0		Subscribe configuration for task PREPARERX
SUBSCRIBE_PREPARETX	0x0A4		Subscribe configuration for task PREPARETX
SUBSCRIBE_DMA.RX.ENABLEMATCH[n]	0x0B0		Subscribe configuration for task ENABLEMATCH[n]
SUBSCRIBE_DMA.RX.DISABLEMATCH[n]	0x0C0		Subscribe configuration for task DISABLEMATCH[n]
EVENTS_STOPPED	0x104		TWI stopped
EVENTS_ERROR	0x114		TWI error
EVENTS_WRITE	0x13C		Write command received
EVENTS_READ	0x140		Read command received
EVENTS_DMA.RX.END	0x14C		Generated after EasyDMA has completed its operation.
EVENTS_DMA.RX.READY	0x150		Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
EVENTS_DMA.RX.BUSERROR	0x154		An error occured during the bus transfer.
EVENTS_DMA.RX.MATCH[n]	0x158		Pattern match is detected on the DMA data bus.
EVENTS_DMA.TX.END	0x168		Generated after EasyDMA has completed its operation.
EVENTS_DMA.TX.READY	0x16C		Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
EVENTS_DMA.TX.BUSERROR	0x170		An error occured during the bus transfer.
PUBLISH_STOPPED	0x184		Publish configuration for event STOPPED
PUBLISH_ERROR	0x194		Publish configuration for event ERROR
PUBLISH_WRITE	0x1BC		Publish configuration for event WRITE
PUBLISH_READ	0x1C0		Publish configuration for event READ
PUBLISH_DMA.RX.END	0x1CC		Publish configuration for event END
PUBLISH_DMA.RX.READY	0x1D0		Publish configuration for event READY
PUBLISH_DMA.RX.BUSERROR	0x1D4		Publish configuration for event BUSERROR
PUBLISH_DMA.RX.MATCH[n]	0x1D8		Publish configuration for event MATCH[n]
PUBLISH_DMA.TX.END	0x1E8		Publish configuration for event END
PUBLISH_DMA.TX.READY	0x1EC		Publish configuration for event READY
PUBLISH_DMA.TX.BUSERROR	0x1F0		Publish configuration for event BUSERROR
SHORTS	0x200		Shortcuts between local events and tasks
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
ERRORSRC	0x4D0		Error source
MATCH	0x4D4		Status register indicating which address had a match
ENABLE	0x500		Enable TWIS
ADDRESS[n]	0x588		TWI slave address n
CONFIG	0x594		Configuration register for the address match mechanism
ORC	0x5C0		Over-read character. Character sent out in case of an over-read of the transmit buffer.
PSEL.SCL	0x600		Pin select for SCL signal
PSEL.SDA	0x604		Pin select for SDA signal
DMA.RX.PTR	0x704		RAM buffer start address

Register	Offset	TZ	Description
DMA.RX.MAXCNT	0x708		Maximum number of bytes in channel buffer
DMA.RX.AMOUNT	0x70C		Number of bytes transferred in the last transaction, updated after the END event. For channels that supports the compare match filter, this register is also updated after each MATCH event.
DMA.RX.LIST	0x714		EasyDMA list type
DMA.RX.TERMINATEONBUSERROR	0x71C		Terminate the transaction if a BUSERROR event is detected.
DMA.RX.BUSERRORADDRESS	0x720		Address of transaction that generated the last BUSERROR event.
DMA.RX.MATCH.CONFIG	0x724		Configure individual match events
DMA.RX.MATCH.CANDIDATE[n]	0x728		The data to look for - any match will trigger the MATCH[n] event, if enabled.
DMA.TX.PTR	0x73C		RAM buffer start address
DMA.TX.MAXCNT	0x740		Maximum number of bytes in channel buffer
DMA.TX.AMOUNT	0x744		Number of bytes transferred in the last transaction, updated after the END event. For channels that supports the compare match filter, this register is also updated after each MATCH event.
DMA.TX.LIST	0x74C		EasyDMA list type
DMA.TX.TERMINATEONBUSERROR	0x754		Terminate the transaction if a BUSERROR event is detected.
DMA.TX.BUSERRORADDRESS	0x758		Address of transaction that generated the last BUSERROR event.

8.25.10.1 TASKS_STOP

Address offset: 0x004

Stop TWI transaction

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Stop TWI transaction
			Trigger	1	Trigger task

8.25.10.2 TASKS_SUSPEND

Address offset: 0x00C

Suspend TWI transaction

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_SUSPEND			Suspend TWI transaction
			Trigger	1	Trigger task

8.25.10.3 TASKS_RESUME

Address offset: 0x010

Resume TWI transaction

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_RESUME			Resume TWI transaction
			Trigger	1	Trigger task

8.25.10.4 TASKS_PREPARERX

Address offset: 0x020

Prepare the TWI slave to respond to a write command

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_PREPARERX			Prepare the TWI slave to respond to a write command
			Trigger	1	Trigger task

8.25.10.5 TASKS_PREPARETX

Address offset: 0x024

Prepare the TWI slave to respond to a read command

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_PREPARETX			Prepare the TWI slave to respond to a read command
			Trigger	1	Trigger task

8.25.10.6 TASKS_DMA

Peripheral tasks.

8.25.10.6.1 TASKS_DMA.RX

Peripheral tasks.

8.25.10.6.1.1 TASKS_DMA.RX.ENABLEMATCH[n] (n=0..3)

Address offset: 0x030 + (n × 0x4)

Enables the MATCH[n] event by setting the ENABLE[n] bit in the CONFIG register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	ENABLEMATCH			Enables the MATCH[n] event by setting the ENABLE[n] bit in the CONFIG register.
			Trigger	1	Trigger task

8.25.10.6.1.2 TASKS_DMA.RX.DISABLEMATCH[n] (n=0..3)

Address offset: 0x040 + (n × 0x4)

Disables the MATCH[n] event by clearing the ENABLE[n] bit in the CONFIG register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	DISABLEMATCH			Disables the MATCH[n] event by clearing the ENABLE[n] bit in the CONFIG register.
			Trigger	1	Trigger task

8.25.10.7 SUBSCRIBE_STOP

Address offset: 0x084

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.25.10.8 SUBSCRIBE_SUSPEND

Address offset: 0x08C

Subscribe configuration for task SUSPEND

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task SUSPEND will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.25.10.9 SUBSCRIBE_RESUME

Address offset: 0x090

Subscribe configuration for task RESUME

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task RESUME will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.25.10.10 SUBSCRIBE_PREPARERX

Address offset: 0x0A0

Subscribe configuration for task PREPARERX

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task PREPARERX will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.25.10.11 SUBSCRIBE_PREPARETX

Address offset: 0x0A4

Subscribe configuration for task PREPARETX

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task PREPARETX will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.25.10.12 SUBSCRIBE_DMA

Subscribe configuration for tasks

8.25.10.12.1 SUBSCRIBE_DMA.RX

Subscribe configuration for tasks

8.25.10.12.1.1 SUBSCRIBE_DMA.RX.ENABLEMATCH[n] (n=0..3)

Address offset: 0x0B0 + (n × 0x4)

Subscribe configuration for task ENABLEMATCH[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task ENABLEMATCH[n] will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.25.10.12.1.2 SUBSCRIBE_DMA.RX.DISABLEMATCH[n] (n=0..3)

Address offset: 0x0C0 + (n × 0x4)

Subscribe configuration for task DISABLEMATCH[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task DISABLEMATCH[n] will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.25.10.13 EVENTS_STOPPED

Address offset: 0x104

TWI stopped

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_STOPPED			TWI stopped
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.25.10.14 EVENTS_ERROR

Address offset: 0x114

TWI error

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_ERROR			TWI error
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.25.10.15 EVENTS_WRITE

Address offset: 0x13C

Write command received

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_WRITE			Write command received
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.25.10.16 EVENTS_READ

Address offset: 0x140

Read command received

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_READ			Read command received
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.25.10.17 EVENTS_DMA

Peripheral events.

8.25.10.17.1 EVENTS_DMA.RX

Peripheral events.

8.25.10.17.1.1 EVENTS_DMA.RX.END

Address offset: 0x14C

Generated after EasyDMA has completed its operation.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	END			Generated after EasyDMA has completed its operation.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.25.10.17.1.2 EVENTS_DMA.RX.READY

Address offset: 0x150

Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	READY			Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.25.10.17.1.3 EVENTS_DMA.RX.BUSERROR

Address offset: 0x154

An error occured during the bus transfer.

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	BUSERROR			An error occured during the bus transfer. When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.25.10.17.1.4 EVENTS_DMA.RX.MATCH[n] (n=0..3)

Address offset: 0x158 + (n × 0x4)

Pattern match is detected on the DMA data bus.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MATCH			Pattern match is detected on the DMA data bus.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.25.10.17.2 EVENTS_DMA.TX

Peripheral events.

8.25.10.17.2.1 EVENTS_DMA.TX.END

Address offset: 0x168

Generated after EasyDMA has completed its operation.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	END			Generated after EasyDMA has completed its operation.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.25.10.17.2.2 EVENTS_DMA.TX.READY

Address offset: 0x16C

Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	READY			Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.25.10.17.2.3 EVENTS_DMA.TX.BUSERROR

Address offset: 0x170

An error occured during the bus transfer.

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	BUSERROR			An error occured during the bus transfer. When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.25.10.18 PUBLISH_STOPPED

Address offset: 0x184

Publish configuration for event STOPPED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event STOPPED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.25.10.19 PUBLISH_ERROR

Address offset: 0x194

Publish configuration for event ERROR

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event ERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.25.10.20 PUBLISH_WRITE

Address offset: 0x1BC

Publish configuration for event WRITE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event WRITE will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.25.10.21 PUBLISH_READ

Address offset: 0x1C0

Publish configuration for event READ

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event READ will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.25.10.22 PUBLISH_DMA

Publish configuration for events

8.25.10.22.1 PUBLISH_DMA.RX

Publish configuration for events

8.25.10.22.1.1 PUBLISH_DMA.RX.END

Address offset: 0x1CC

Publish configuration for event END

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event END will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.25.10.22.1.2 PUBLISH_DMA.RX.READY

Address offset: 0x1D0

Publish configuration for event READY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event READY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.25.10.22.1.3 PUBLISH_DMA.RX.BUSERROR

Address offset: 0x1D4

Publish configuration for event BUSERROR

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event BUSERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.25.10.22.1.4 PUBLISH_DMA.RX.MATCH[n] (n=0..3)

Address offset: 0x1D8 + (n × 0x4)

Publish configuration for event MATCH[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event MATCH[n] will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.25.10.22.2 PUBLISH_DMA.TX

Publish configuration for events

8.25.10.22.2.1 PUBLISH_DMA.TX.END

Address offset: 0x1E8

Publish configuration for event END

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event END will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.25.10.22.2.2 PUBLISH_DMA.TX.READY

Address offset: 0x1EC

Publish configuration for event READY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event READY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.25.10.22.2.3 PUBLISH_DMA.TX.BUSERROR

Address offset: 0x1F0

Publish configuration for event BUSERROR

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event BUSERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.25.10.23 SHORTS

Address offset: 0x200

Shortcuts between local events and tasks

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	WRITE_SUSPEND			Shortcut between event WRITE and task SUSPEND
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
B	RW	READ_SUSPEND			Shortcut between event READ and task SUSPEND
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
C-F	RW	DMA_RX_MATCH[i]_DMA_RX_ENABLEMATCH[(i+1)%4] (i=0..3)			Shortcut between event DMA.RX.MATCH[n] and task DMA.RX.ENABLEMATCH[(i+1)%4] Allows daisy-chaining match events.
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
G-J	RW	DMA_RX_MATCH[i]_DMA_RX_DISABLEMA (i=0..3)			Shortcut between event DMA.RX.MATCH[n] and task DMA.RX.DISABLEMATCH[n]
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut

8.25.10.24 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	STOPPED			Enable or disable interrupt for event STOPPED
			Disabled	0	Disable
			Enabled	1	Enable
B	RW	ERROR			Enable or disable interrupt for event ERROR
			Disabled	0	Disable
			Enabled	1	Enable
C	RW	WRITE			Enable or disable interrupt for event WRITE
			Disabled	0	Disable
			Enabled	1	Enable

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
D	RW	READ			Enable or disable interrupt for event READ
			Disabled	0	Disable
			Enabled	1	Enable
E	RW	DMARXEND			Enable or disable interrupt for event DMARXEND
			Disabled	0	Disable
			Enabled	1	Enable
F	RW	DMARXREADY			Enable or disable interrupt for event DMARXREADY
			Disabled	0	Disable
			Enabled	1	Enable
G	RW	DMARXBUSERROR			Enable or disable interrupt for event DMARXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Disabled	0	Disable
			Enabled	1	Enable
H-K	RW	DMARXMATCH[i] (i=0..3)			Enable or disable interrupt for event DMARXMATCH[i]
			Disabled	0	Disable
			Enabled	1	Enable
L	RW	DMATXEND			Enable or disable interrupt for event DMATXEND
			Disabled	0	Disable
			Enabled	1	Enable
M	RW	DMATXREADY			Enable or disable interrupt for event DMATXREADY
			Disabled	0	Disable
			Enabled	1	Enable
N	RW	DMATXBUSERROR			Enable or disable interrupt for event DMATXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Disabled	0	Disable
			Enabled	1	Enable

8.25.10.25 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1S	STOPPED			Write '1' to enable interrupt for event STOPPED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	ERROR			Write '1' to enable interrupt for event ERROR
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
C	RW W1S	WRITE			Write '1' to enable interrupt for event WRITE
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1S	READ			Write '1' to enable interrupt for event READ
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1S	DMARXEND			Write '1' to enable interrupt for event DMARXEND
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1S	DMARXREADY			Write '1' to enable interrupt for event DMARXREADY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1S	DMARXBUSERROR			Write '1' to enable interrupt for event DMARXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
H-K	RW W1S	DMARXMATCH[i] (i=0..3)			Write '1' to enable interrupt for event DMARXMATCH[i]
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
L	RW W1S	DMATXEND			Write '1' to enable interrupt for event DMATXEND
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1S	DMATXREADY			Write '1' to enable interrupt for event DMATXREADY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
N	RW W1S	DMATXBUSERROR			Write '1' to enable interrupt for event DMATXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.25.10.26 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				N	M	L	K	J	I	H	G	F	E			D	C										B				A	
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	STOPPED			Write '1' to disable interrupt for event STOPPED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	ERROR			Write '1' to disable interrupt for event ERROR
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	WRITE			Write '1' to disable interrupt for event WRITE
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1C	READ			Write '1' to disable interrupt for event READ
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1C	DMARXEND			Write '1' to disable interrupt for event DMARXEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1C	DMARXREADY			Write '1' to disable interrupt for event DMARXREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1C	DMARXBUSERROR			Write '1' to disable interrupt for event DMARXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
H-K	RW W1C	DMARXMATCH[i] (i=0..3)			Write '1' to disable interrupt for event DMARXMATCH[i]
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
L	RW W1C	DMATXEND			Write '1' to disable interrupt for event DMATXEND
			Clear	1	Disable

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
M	RW W1C	DMATXREADY			Write '1' to disable interrupt for event DMATXREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
N	RW W1C	DMATXBUSERROR			Write '1' to disable interrupt for event DMATXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.25.10.27 ERRORSRC

Address offset: 0x4D0

Error source

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	OVERFLOW			RX buffer overflow detected, and prevented
			NotDetected	0	Error did not occur
			Detected	1	Error occurred
B	RW W1C	DNACK			NACK sent after receiving a data byte
			NotReceived	0	Error did not occur
			Received	1	Error occurred
C	RW W1C	OVERREAD			TX buffer over-read detected, and prevented
			NotDetected	0	Error did not occur
			Detected	1	Error occurred

8.25.10.28 MATCH

Address offset: 0x4D4

Status register indicating which address had a match

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	MATCH		[0..1]	Indication of which address in ADDRESS that matched the incoming address

8.25.10.29 ENABLE

Address offset: 0x500

Enable TWIS

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			Enable or disable TWIS
			Disabled	0	Disable TWIS
			Enabled	9	Enable TWIS

8.25.10.30 ADDRESS[n] (n=0..1)

Address offset: 0x588 + (n × 0x4)

TWI slave address n

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	ADDRESS			TWI slave address

8.25.10.31 CONFIG

Address offset: 0x594

Configuration register for the address match mechanism

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000001				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1**

ID	R/W	Field	Value ID	Value	Description
A-B	RW	ADDRESS[i] (i=0..1)			Enable or disable address matching on ADDRESS[i]
			Disabled	0	Disabled
			Enabled	1	Enabled

8.25.10.32 ORC

Address offset: 0x5C0

Over-read character. Character sent out in case of an over-read of the transmit buffer.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	ORC			Over-read character. Character sent out in case of an over-read of the transmit buffer.

8.25.10.33 PSEL.SCL

Address offset: 0x600

Pin select for SCL signal

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				C																								B	B	B	A	A	A	A	A
Reset 0xFFFFFFFF				**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																								Description							
A	RW	PIN		[0..31]																								Pin number							
B	RW	PORT		[0..7]																								Port number							
C	RW	CONNECT																										Connection							
			Disconnected	1																								Disconnect							
			Connected	0																								Connect							

8.25.10.34 PSEL.SDA

Address offset: 0x604

Pin select for SDA signal

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				C																								B	B	B	A	A	A	A	A
Reset 0xFFFFFFFF				**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																								Description							
A	RW	PIN		[0..31]																								Pin number							
B	RW	PORT		[0..7]																								Port number							
C	RW	CONNECT																										Connection							
			Disconnected	1																								Disconnect							
			Connected	0																								Connect							

8.25.10.35 DMA.RX.PTR

Address offset: 0x704

RAM buffer start address

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x20000000				**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																								Description							
A	RW	PTR																										RAM buffer start address for this EasyDMA channel. This address is a word aligned Data RAM address.							

Note: See the memory chapter for details about which memories are available for EasyDMA.

8.25.10.36 DMA.RX.MAXCNT

Address offset: 0x708

Maximum number of bytes in channel buffer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MAXCNT		[1..0xFFFF]	Maximum number of bytes in channel buffer

8.25.10.37 DMA.RX.AMOUNT

Address offset: 0x70C

Number of bytes transferred in the last transaction, updated after the END event.

For channels that supports the compare match filter, this register is also updated after each MATCH event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT		[1..0xFFFF]	Number of bytes transferred in the last transaction. In case of NACK error, includes the NACK'ed byte.

8.25.10.38 DMA.RX.LIST

Address offset: 0x714

EasyDMA list type

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	TYPE			List type
			Disabled	0	Disable EasyDMA list
			ArrayList	1	Use array list

8.25.10.39 DMA.RX.TERMINATEONBUSERROR

Address offset: 0x71C

Terminate the transaction if a BUSERROR event is detected.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			
			Disabled	0	Disable
			Enabled	1	Enable

8.25.10.40 DMA.RX.BUSERRORADDRESS

Address offset: 0x720

Address of transaction that generated the last BUSERROR event.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	ADDRESS			

8.25.10.41 DMA.RX.MATCH

Registers to control the behavior of the pattern matcher engine

8.25.10.41.1 DMA.RX.MATCH.CONFIG

Address offset: 0x724

Configure individual match events

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID													H	G	F	E													D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A-D	RW	ENABLE[i] (i=0..3)			Enable match filter i
			Disabled	0	Match filter disabled
			Enabled	1	Match filter enabled
E-H	RW	ONESHOT[i] (i=0..3)			Configure match filter i as one-shot or continous One-shot operation will disable the filter on a match, while Continous operation will keep it enabled until explicitly disabled.
			Continuous	0	Match filter stays enabled until disabled by task
			Oneshot	1	Match filter stays enabled until next data word is received

8.25.10.41.2 DMA.RX.MATCH.CANDIDATE[n] (n=0..3)

Address offset: 0x728 + (n × 0x4)

The data to look for - any match will trigger the MATCH[n] event, if enabled.

Note: This register can be updated while a transfer is in progress, but the new value will not take effect until either the DMA is restarted or the match event is generated. That makes it possible to write a new set of match words which will be searched for immediately after the event triggers.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																									A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DATA			Data to look for

8.25.10.42 DMA.TX.PTR

Address offset: 0x73C

RAM buffer start address

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x20000000	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			RAM buffer start address for this EasyDMA channel. This address is a word aligned Data RAM address.

Note: See the memory chapter for details about which memories are available for EasyDMA.

8.25.10.43 DMA.TX.MAXCNT

Address offset: 0x740

Maximum number of bytes in channel buffer

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MAXCNT		[1..0xFFFF]	Maximum number of bytes in channel buffer

8.25.10.44 DMA.TX.AMOUNT

Address offset: 0x744

Number of bytes transferred in the last transaction, updated after the END event.

For channels that supports the compare match filter, this register is also updated after each MATCH event.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT		[1..0xFFFF]	Number of bytes transferred in the last transaction. In case of NACK error, includes the NACK'ed byte.

8.25.10.45 DMA.TX.LIST

Address offset: 0x74C

EasyDMA list type

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																															A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	TYPE			List type
			Disabled	0	Disable EasyDMA list
			ArrayList	1	Use array list

8.25.10.46 DMA.TX.TERMINATEONBUSERROR

Address offset: 0x754

Terminate the transaction if a BUSERROR event is detected.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID				Value																		Description									
A	RW	ENABLE																																	
				Disabled				0																		Disable									
				Enabled				1																		Enable									

8.25.10.47 DMA.TX.BUSERRORADDRESS

Address offset: 0x758

Address of transaction that generated the last BUSERROR event.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID				Value																		Description									
A	R	ADDRESS																																	

8.26 UARTE — Universal asynchronous receiver/transmitter with EasyDMA

The Universal asynchronous receiver/transmitter with EasyDMA peripheral (UARTE) provides a full-duplex, asynchronous serial communication interface with hardware flow control.

The main features of UARTE are the following:

- Full-duplex operation
- EasyDMA direct transfer to and from RAM
- Individual selection of I/O pins
- Optional even and odd parity bit checking and generation
- One or two stop bits
- Configurable data frame size: 4 bit to 9 bit
- 9-bit mode support with address matching in RX
- Automatic hardware flow control
- Supports return to the IDLE state between transactions (when using HW flow control)
- Interrupt generation after programmable timeout
- Compare match filter for generating events or interrupts

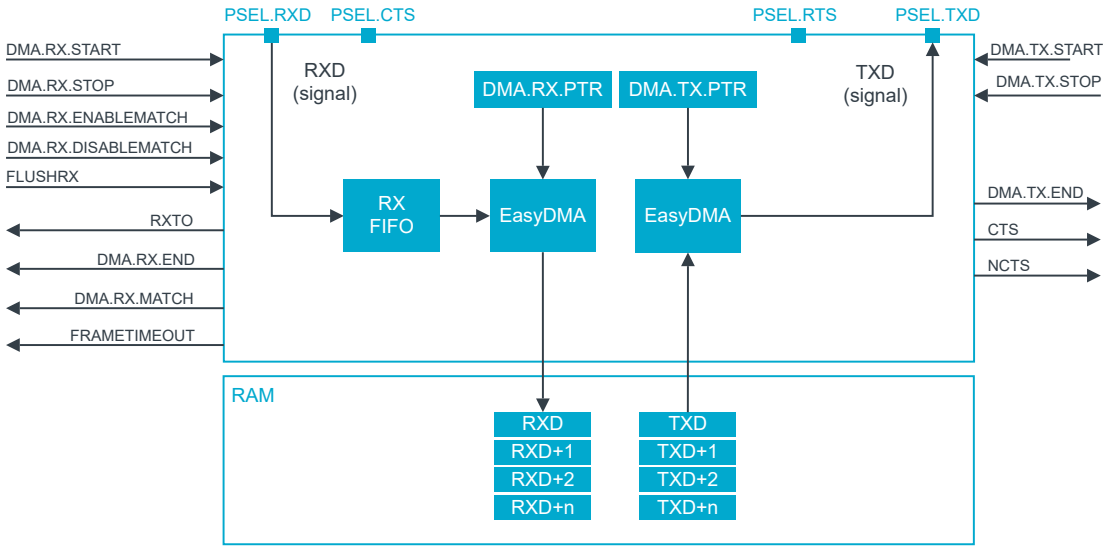


Figure 168: UARTE configuration

Note: The external crystal oscillator must be enabled to obtain sufficient clock accuracy for stable communication. See CLOCK — Clock control on page 72 for more information.

8.26.1 Baudrate

The UART baudrate defines the speed at which data is transmitted over the UART interface, measured in bits per second (bps).

The BAUDRATE register lists a set of precalculated values for the most common baudrates and 16 MHz PCLK. For the high speed instances (PCLK > 16 MHz), the baudrate is calculated as follows:

$$\mathrm{BAUDRATE} = 2^{12} \times \left\lfloor \frac{2^{20}}{\mathrm{round}\left(\frac{\mathrm{f\_PCLK}}{\mathrm{desired\_baudrate}}\right)} \right\rfloor$$

Figure 169: UARTE baudrate

- BAUDRATE is the value to be used in the UARTE BAUDRATE register.
- f_PCLK is the peripheral clock frequency for the UARTE instance, as defined in Instances on page 760.
- desired_baudrate is the desired baudrate in bits per second, such as 9600 or 115200.

8.26.2 EasyDMA

UARTE implements EasyDMA for reading and writing to and from RAM.

If the DMA.TX.PTR and the DMA.RX.PTR are not pointing to the RAM region, an EasyDMA transfer may result in a HardFault or RAM corruption. See Memory on page 13 for more information about each memory region.

The DMA.RX.PTR, DMA.TX.PTR, DMA.RX.MAXCNT, and DMA.TX.MAXCNT registers are double-buffered. They can be updated and prepared for the next reception or transmission immediately after having received the DMA.RX.READY or DMA.TX.READY events.

The DMA.RX.END and DMA.TX.END events indicate that the EasyDMA is finished accessing the RX or TX buffer in RAM.

For detailed information regarding the use of EasyDMA, see EasyDMA on page 29.

8.26.3 Transmission

The first step of a DMA transmission is storing bytes in the transmit buffer and configuring EasyDMA. This is achieved by writing the initial address pointer to DMA.TX.PTR, and the number of bytes to transmit from the RAM buffer to DMA.TX.MAXCNT. The UARTE transmission is started by triggering the DMA.TX.START task.

After each byte has been sent over the TXD line, a TXDRDY event is generated.

When then bytes have been transmitted, the DMA.TX.END event is generated.

A UARTE transmission sequence is stopped by triggering the DMA.TX.STOP task. A TXSTOPPED event will be generated when the UARTE transmitter has stopped.

If the DMA.TX.END event has not been generated when the UARTE transmitter stops, UARTE will generate the DMA.TX.END event explicitly even though all bytes specified in the DMA.TX.MAXCNT register have not been transmitted.

If flow control is enabled in the HWFC field in the CONFIG register, a transmission will be automatically suspended when CTS is deactivated, and resumed when CTS is activated again, as shown in the following figure. A byte that is in transmission when CTS is deactivated will finish transmitting before the transmission is suspended.

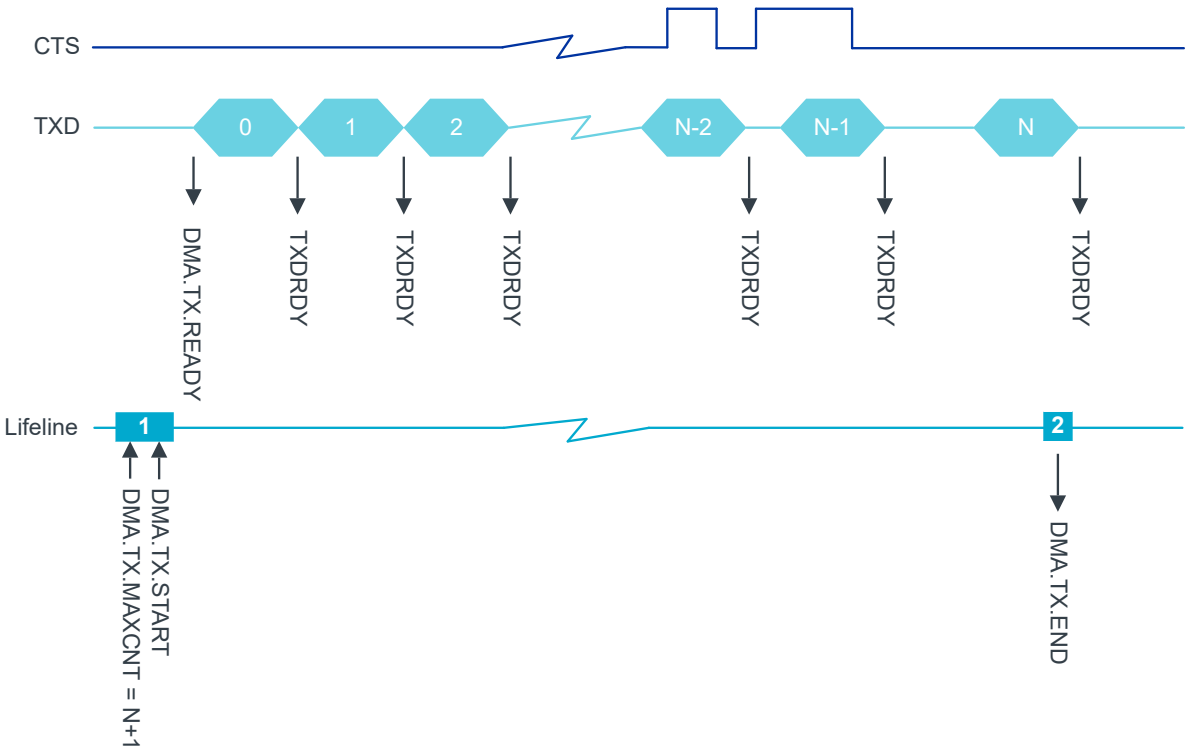


Figure 170: UARTE transmission

The UARTE transmitter is least active when it is stopped, consuming the least amount of energy. This is before it is started via DMA.TX.START, or after it has been stopped via DMA.TX.STOP and the TXSTOPPED event has been generated. See POWER — Power control on page 100 for more information about power modes.

8.26.4 Reception

The UARTE receiver is started by triggering the DMA.RX.START task. The UARTE receiver uses EasyDMA to store incoming data in an RX buffer in RAM.

The RX buffer is located at the address specified in the DMA.RX.PTR register. The DMA.RX.PTR register is double-buffered and can be updated and prepared for the next DMA.RX.START task immediately after the EVENTS_DMA.RX.READY event is generated. The size of the RX buffer is specified in the DMA.RX.MAXCNT register. UARTE generates an DMA.RX.END event when it has filled up the RX buffer, as seen in the following figure.

For each byte received over the RXD line, an RXDRDY event is generated. This event is likely to occur before the corresponding data has been transferred to RAM.

The DMA.RX.AMOUNT register can be queried following an DMA.RX.END event to see how many new bytes have been transferred to the RX buffer in RAM since the previous DMA.RX.END event.

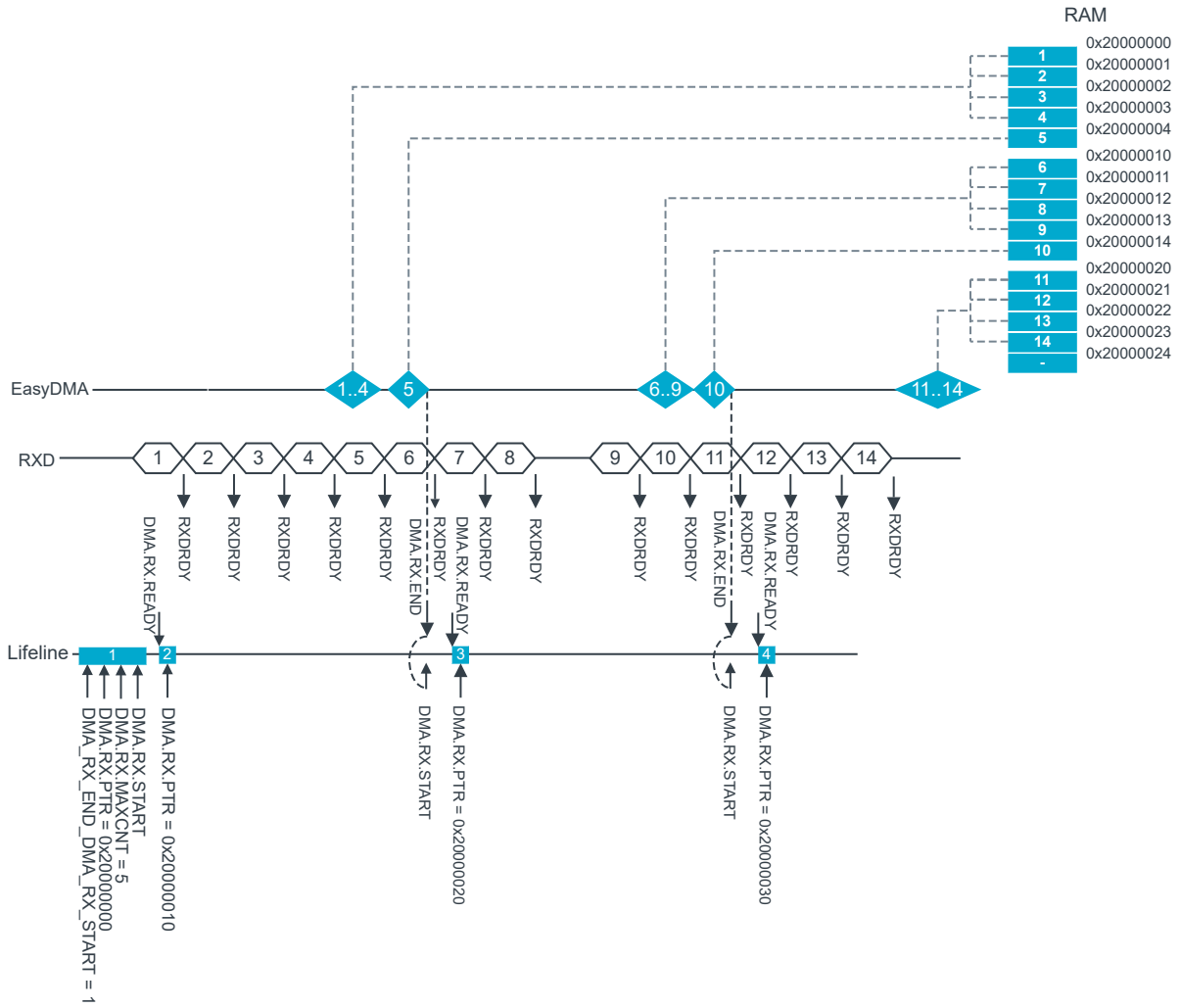


Figure 171: UARTE reception

The UARTE receiver is stopped by triggering the DMA.RX.STOP task. The RXTO and DMA.RX.END events are generated when UARTE has stopped.

Stopping the UARTE with a RX buffer that is empty or not completely filled up will also cause the DMA.RX.END event to be generated.

The number of bytes stored in the RX buffer can be found by reading the DMA.RX.AMOUNT register following the DMA.RX.END event.

To stop UARTE, trigger the DMA.RX.STOP task. After the STOP task is triggered, UARTE can receive up to four bytes during the timeout period. The data received during the timeout period will be written to DMA.RX.PTR, and limited by DMA.RX.MAXCNT registers. MAXCNT should be set to at least four bytes to

allow for this, while following the DMA.RX.END event, the DMA.RX.AMOUNT register will indicate the actual number of bytes received.

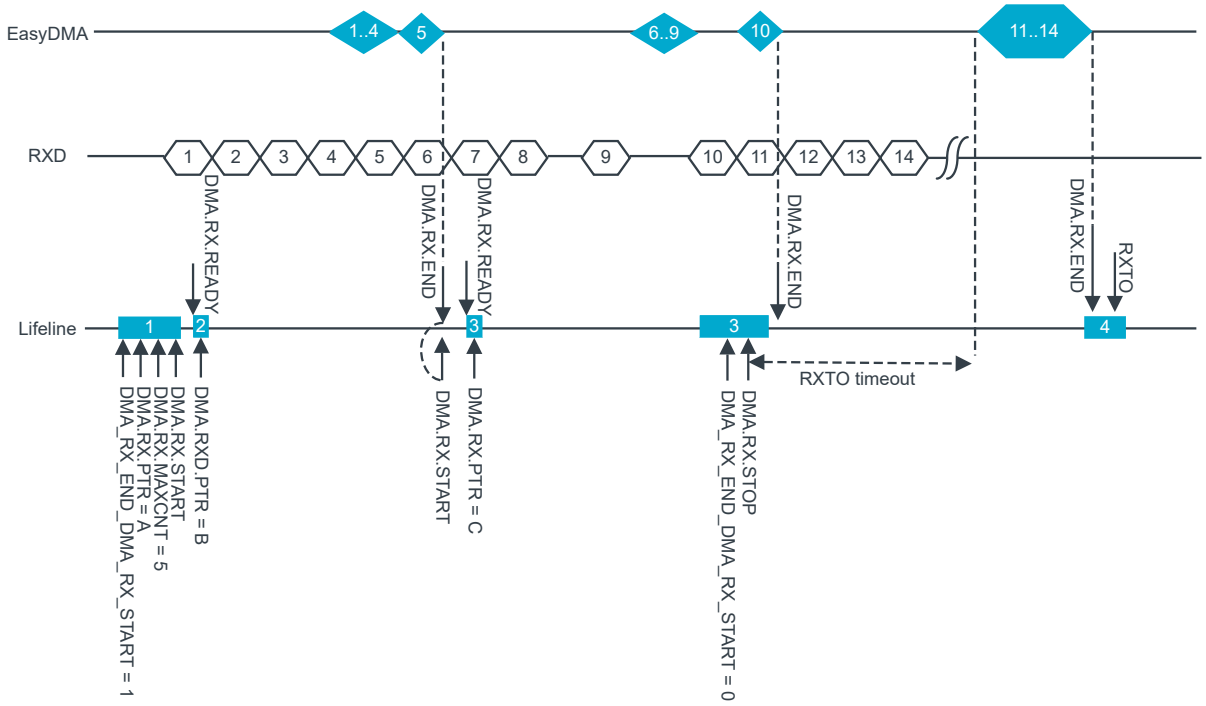


Figure 172: UARTE reception with forced stop through DMA.RX.STOP

If hardware flow control is enabled in the HWFC field in the CONFIG register, the RTS signal will be deactivated when the receiver is stopped via the DMA.RX.STOP task, or when UARTE can only receive three more bytes in its internal RX FIFO.

With flow control disabled, the UARTE will function in the same way as when the flow control is enabled, except that the RTS line will not be used. This means that no signal will be generated when UARTE is only able to receive three additional bytes in its internal RX FIFO. Data received when the internal RX FIFO is full, will be lost.

The UARTE receiver is least active when it is stopped, consuming the least amount of energy. This is before it is started via DMA.RX.START, or after it has been stopped via DMA.RX.STOP and the RXTO event has been generated. See POWER — Power control on page 100 for more information about power modes.

8.26.5 Data frame size

UARTE implements a configurable data frame size of 4 bits to 9 bits and is set in the register CONFIG on page 783. If a value greater than 9 or less than 4 is written to this register, the frame size will be set to 8 bits and the register will read back a value of 8.

When UARTE is used with the 9 bit frame size, a 9th bit is added after the MSB of the 8 bit data frame, and before the parity and stop bits, as shown in the following figure. This bit indicates if the 8 bit data is an address or data. If the 9th bit is `1`, the 8 bit data is interpreted as an address. If the 9th bit is `0`, the 8 bit data is interpreted as data.

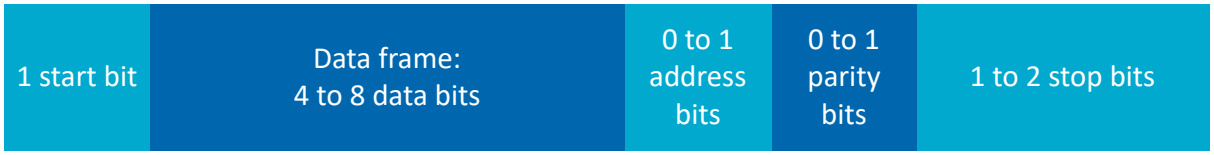


Figure 173: UARTE frame

When UART is in RX configured with a 9 bit frame size, all frames are ignored until a frame with the address bit set is received, and the 8 remaining bits of the data frame matches the address set in the register ADDRESS on page 784. The frames following the matching address are received as an 8 bit data frame until the next frame where the address bit set is received, the address bit is not stored. If the address does not match ADDRESS, the following frames are ignored.

If the parity bit is enabled, the address bit is not included in the parity calculation.

When UART TX is started, the first byte in the buffer read by EasyDMA is treated as an address, and transmitted with the address bit set to `1`. The next bits in the buffer are treated as data and transmitted with the address bit set to `0`.

When UARTE uses a data frame size less than an 8 bits, the data is trimmed from an 8 bit frame size in the RAM buffer for TX, and padded before being stored in the RAM buffer for RX. The ENDIAN field in the register CONFIG defines if the data is trimmed from MSB or LSB of the 8 bit buffer frame.

8.26.6 Frame timeout interrupt

UARTE can generate an event after a programmable timeout.

If enabled with the FRAMETIMEOUT field in register CONFIG on page 783, a counter starts at the start flag, and counts the number of bit periods given in register FRAMETIMEOUT on page 784. The period time of the counter is equal to the period of one bit on the UART TX line given by the BAUDRATE register. When the timeout expires, the event EVENTS_FRAMETIMEOUT is generated. The STOP task also stops the timeout counter. UARTE reception can be stopped on timeout by setting the short from the FRAMETIMEOUT event to the DMA.RX.STOP task in register SHORTS on page 776.

This feature can be used to support variable length UART transmission with no end of transmission tag. After the last UART frames are received within the configured timeout, an interrupt is generated and the data can be processed.

The following figure shows an example where the UART receives a transmission that times out after byte 12.

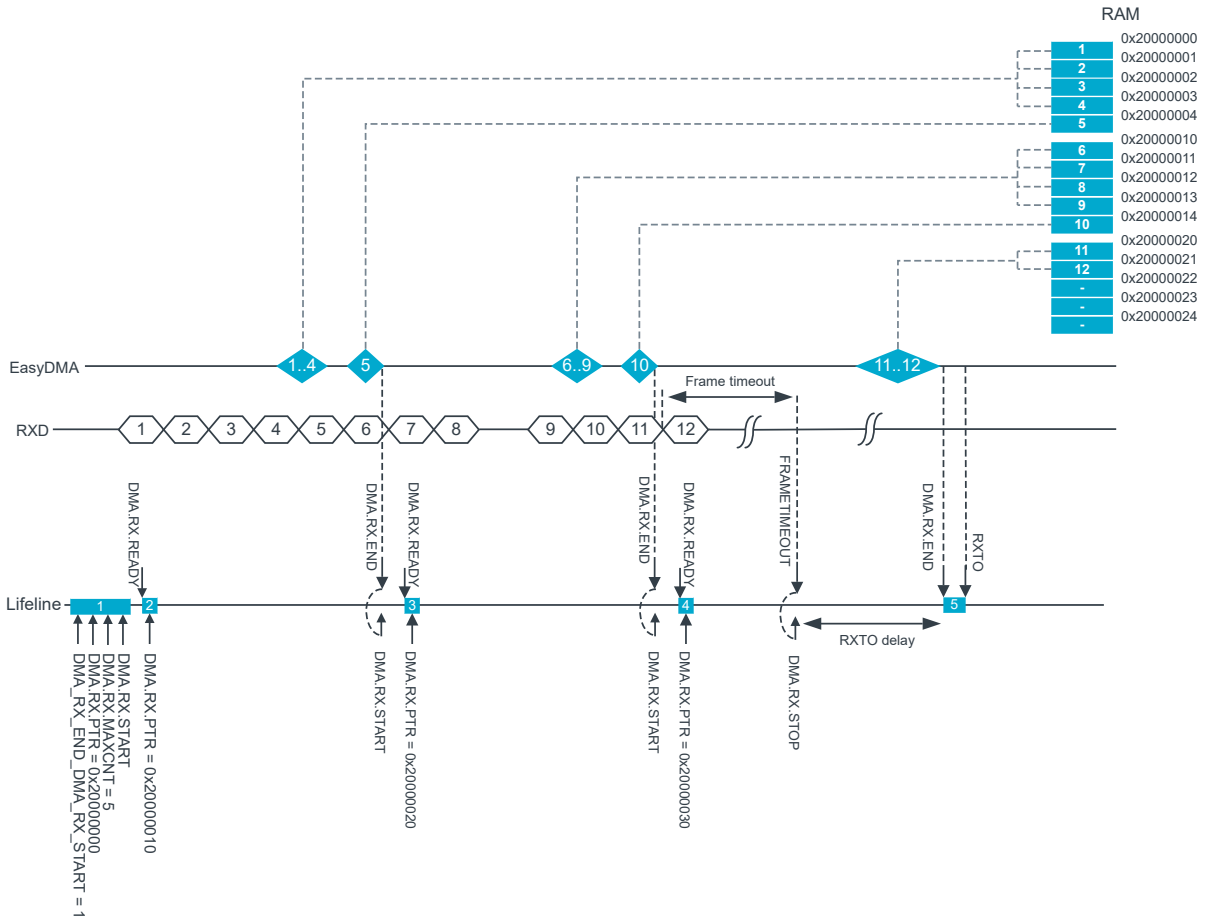


Figure 174: UARTE reception frame timeout

The minimum value of the FRAMETIMEOUT register must be set to a value larger than the configured UART frame length.

Note: Frames received after the RXTO event are discarded and not stored in memory. Reception will commence when DMA.RX.START is triggered.

8.26.7 Error conditions

An ERROR event, in the form of a framing error, will be generated if a valid stop bit is not detected in a frame. Another ERROR event, in the form of a break condition, will be generated if the RXD line is held active low for longer than the length of a data frame. A framing error is always generated before a break condition occurs.

An ERROR event will not stop reception. If the error was a parity error, the received byte is still transferred into RAM along with any following bytes. If a framing error occurs (wrong stop bit), that byte will not be stored in RAM but the next incoming bytes will.

8.26.8 Using the UARTE without flow control

If flow control is not enabled, the interface will behave as if the CTS and RTS lines are held active.

8.26.9 Parity and stop bit configuration

Automatic even parity generation for both transmission and reception can be configured using the register CONFIG on page 783. If odd parity is required, it can be configured using the register CONFIG on page 783. See the register description for details.

The amount of stop bits can be configured in the register CONFIG on page 783.

8.26.10 Compare match filter

UARTE has a compare match filter that can watch for a specific sequence of data. This feature is implemented in EasyDMA on the RX channel.

UARTE can generate events or interrupts when the specific data sequence is received. The event EVENTS_DMA.RX.MATCH[n] (n=0..3) on page 770 is generated when there is a match in the data stream being received. The number of MATCH can be different for each instance. See Registers on page 760 for how many MATCH events are implemented per instance.

Register DMA.RX.MATCH.CANDIDATE[n] (n=0..3) on page 788 configures the pattern for comparison. The filter is enabled with the corresponding ENABLE bit in register DMA.RX.MATCH.CONFIG on page 787. The DMA.RX.ENABLEMATCH task can be used to set that bit, and the DMA.RX.DISABLEMATCH task will clear that bit. If the ONESHOT[i] field in the CONFIG register is set, the corresponding ENABLE[i] bit will be cleared on a successful match.

For detailed information regarding the use of pattern matching in the EasyDMA engine, see EasyDMA on page 29.

8.26.11 Low power

To ensure lowest possible power consumption when the peripheral is not needed, stop and disable UARTE.

The DMA.TX.STOP and DMA.RX.STOP tasks are not always needed (the peripheral might already be stopped). If DMA.TX.STOP or DMA.RX.STOP is sent, software waits until the TXSTOPPED or RXTO event is received before disabling the peripheral through the ENABLE register.

8.26.12 Pin configuration

The RXD, CTS (Clear To Send, active low), RTS (Request To Send, active low), and TXD signals associated with UARTE are mapped to physical pins according to the configuration specified in the PSEL.n registers.

These registers and their configurations are only used when UARTE is enabled, and retained while the device is in System ON mode. The PSEL.n registers can be configured only when UARTE is disabled.

To ensure correct behavior when in System OFF mode, the pins must be configured in the GPIO peripheral as described in the following table.

Only one peripheral can be assigned to drive a particular GPIO pin at a time. Failing to do so may result in unpredictable behavior.

UARTE signal	UARTE pin	Direction	Output value
RXD	As specified in PSEL.RXD	Input	Not applicable
CTS	As specified in PSEL.CTS	Input	Not applicable
RTS	As specified in PSEL.RTS	Output	1
TXD	As specified in PSEL.TXD	Output	1

Table 71: GPIO configuration before enabling peripheral

8.26.13 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
UARTE00 : S UARTE00 : NS	GLOBAL	0x5004D000 0x4004D000	US	S	SA	No	Universal asynchronous receiver/ transmitter UARTE00
UARTE20 : S UARTE20 : NS	GLOBAL	0x500C6000 0x400C6000	US	S	SA	No	Universal asynchronous receiver/ transmitter UARTE20
UARTE21 : S UARTE21 : NS	GLOBAL	0x500C7000 0x400C7000	US	S	SA	No	Universal asynchronous receiver/ transmitter UARTE21
UARTE22 : S UARTE22 : NS	GLOBAL	0x500C8000 0x400C8000	US	S	SA	No	Universal asynchronous receiver/ transmitter UARTE22
UARTE23 : S UARTE23 : NS	GLOBAL	0x500ED000 0x400ED000	US	S	SA	No	Universal asynchronous receiver/ transmitter UARTE23
UARTE24 : S UARTE24 : NS	GLOBAL	0x500EE000 0x400EE000	US	S	SA	No	Universal asynchronous receiver/ transmitter UARTE24
UARTE30 : S UARTE30 : NS	GLOBAL	0x50104000 0x40104000	US	S	SA	No	Universal asynchronous receiver/ transmitter UARTE30

Configuration

Instance	Domain	Configuration
UARTE00 : S UARTE00 : NS	GLOBAL	Use dedicated pins on GPIO port P2 The core frequency scales with the CPU frequency, see PLL.FREQ (Retained) on page 98 Supports up to 4 Mbps Timeout interrupt is included. Supports data frame sizes 4, 5, 6, 7, 8, and 9 bits. Peripheral clock frequency is 128 MHz.
UARTE20 : S UARTE20 : NS	GLOBAL	Use GPIO port P1 or P3 Supports up to 1 Mbps Timeout interrupt is included. Supports data frame sizes 4, 5, 6, 7, 8, and 9 bits. Peripheral clock frequency is 16 MHz.
UARTE21 : S UARTE21 : NS	GLOBAL	Use GPIO port P1 or P3 Supports up to 1 Mbps Timeout interrupt is included. Supports data frame sizes 4, 5, 6, 7, 8, and 9 bits. Peripheral clock frequency is 16 MHz.
UARTE22 : S UARTE22 : NS	GLOBAL	Use GPIO port P1 or P3 Supports up to 1 Mbps Timeout interrupt is included. Supports data frame sizes 4, 5, 6, 7, 8, and 9 bits. Peripheral clock frequency is 16 MHz.
UARTE23 : S UARTE23 : NS	GLOBAL	Use GPIO port P1 or P3 Supports up to 1 Mbps Timeout interrupt is included. Supports data frame sizes 4, 5, 6, 7, 8, and 9 bits. Peripheral clock frequency is 16 MHz.
UARTE24 : S UARTE24 : NS	GLOBAL	Use GPIO port P1 or P3 Supports up to 1 Mbps Timeout interrupt is included. Supports data frame sizes 4, 5, 6, 7, 8, and 9 bits. Peripheral clock frequency is 16 MHz.
UARTE30 : S UARTE30 : NS	GLOBAL	Use GPIO port P0 Supports up to 1 Mbps Timeout interrupt is included. Supports data frame sizes 4, 5, 6, 7, 8, and 9 bits. Peripheral clock frequency is 16 MHz.

Register overview

Register	Offset	TZ	Description
TASKS_FLUSHRX	0x01C		Flush RX FIFO into RX buffer
TASKS_DMA.RX.START	0x028		Starts operation using easyDMA to load the values. See peripheral description for operation using easyDMA.
TASKS_DMA.RX.STOP	0x02C		Stops operation using easyDMA. This does not trigger an END event.
TASKS_DMA.RX.ENABLEMATCH[n]	0x030		Enables the MATCH[n] event by setting the ENABLE[n] bit in the CONFIG register.
TASKS_DMA.RX.DISABLEMATCH[n]	0x040		Disables the MATCH[n] event by clearing the ENABLE[n] bit in the CONFIG register.
TASKS_DMA.TX.START	0x050		Starts operation using easyDMA to load the values. See peripheral description for operation using easyDMA.
TASKS_DMA.TX.STOP	0x054		Stops operation using easyDMA. This does not trigger an END event.
SUBSCRIBE_FLUSHRX	0x09C		Subscribe configuration for task FLUSHRX
SUBSCRIBE_DMA.RX.START	0x0A8		Subscribe configuration for task START
SUBSCRIBE_DMA.RX.STOP	0x0AC		Subscribe configuration for task STOP
SUBSCRIBE_DMA.RX.ENABLEMATCH[n]	0x0B0		Subscribe configuration for task ENABLEMATCH[n]
SUBSCRIBE_DMA.RX.DISABLEMATCH[n]	0x0C0		Subscribe configuration for task DISABLEMATCH[n]
SUBSCRIBE_DMA.TX.START	0x0D0		Subscribe configuration for task START
SUBSCRIBE_DMA.TX.STOP	0x0D4		Subscribe configuration for task STOP
EVENTS_CTS	0x100		CTS is activated (set low). Clear To Send.
EVENTS_NCTS	0x104		CTS is deactivated (set high). Not Clear To Send.
EVENTS_TXDRDY	0x10C		Data sent from TXD
EVENTS_RXDRDY	0x110		Data received in RXD (but potentially not yet transferred to Data RAM)
EVENTS_ERROR	0x114		Error detected
EVENTS_RXTO	0x124		Receiver timeout
EVENTS_TXSTOPPED	0x130		Transmitter stopped
EVENTS_DMA.RX.END	0x14C		Generated after EasyDMA has completed its operation.
EVENTS_DMA.RX.READY	0x150		Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
EVENTS_DMA.RX.BUSERROR	0x154		An error occured during the bus transfer.
EVENTS_DMA.RX.MATCH[n]	0x158		Pattern match is detected on the DMA data bus.
EVENTS_DMA.TX.END	0x168		Generated after EasyDMA has completed its operation.
EVENTS_DMA.TX.READY	0x16C		Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
EVENTS_DMA.TX.BUSERROR	0x170		An error occured during the bus transfer.
EVENTS_FRAMETIMEOUT	0x174		Timed out due to bus being idle while receiving data.
PUBLISH_CTS	0x180		Publish configuration for event CTS
PUBLISH_NCTS	0x184		Publish configuration for event NCTS
PUBLISH_TXDRDY	0x18C		Publish configuration for event TXDRDY
PUBLISH_RXDRDY	0x190		Publish configuration for event RXDRDY
PUBLISH_ERROR	0x194		Publish configuration for event ERROR
PUBLISH_RXTO	0x1A4		Publish configuration for event RXTO
PUBLISH_TXSTOPPED	0x1B0		Publish configuration for event TXSTOPPED
PUBLISH_DMA.RX.END	0x1CC		Publish configuration for event END
PUBLISH_DMA.RX.READY	0x1D0		Publish configuration for event READY
PUBLISH_DMA.RX.BUSERROR	0x1D4		Publish configuration for event BUSERROR
PUBLISH_DMA.RX.MATCH[n]	0x1D8		Publish configuration for event MATCH[n]
PUBLISH_DMA.TX.END	0x1E8		Publish configuration for event END
PUBLISH_DMA.TX.READY	0x1EC		Publish configuration for event READY
PUBLISH_DMA.TX.BUSERROR	0x1F0		Publish configuration for event BUSERROR
PUBLISH_FRAMETIMEOUT	0x1F4		Publish configuration for event FRAMETIMEOUT
SHORTS	0x200		Shortcuts between local events and tasks
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt

Register	Offset	TZ	Description
INTENCLR	0x308		Disable interrupt
ERRORSRC	0x480		Error source
ENABLE	0x500		Enable UART
BAUDRATE	0x524		Baud rate. Accuracy depends on the HFCLK source selected.
CONFIG	0x56C		Configuration of parity, hardware flow control, framesize, and packet timeout.
ADDRESS	0x574		Set the address of the UARTE for RX when used in 9 bit data frame mode.
FRAMETIMEOUT	0x578		Set the number of UARTE bits to count before triggering packet timeout.
PSEL.TXD	0x604		Pin select for TXD signal
PSEL.CTS	0x608		Pin select for CTS signal
PSEL.RXD	0x60C		Pin select for RXD signal
PSEL.RTS	0x610		Pin select for RTS signal
DMA.RX.PTR	0x704		RAM buffer start address
DMA.RX.MAXCNT	0x708		Maximum number of bytes in channel buffer
DMA.RX.AMOUNT	0x70C		Number of bytes transferred in the last transaction, updated after the END event. For channels that supports the compare match filter, this register is also updated after each MATCH event.
DMA.RX.LIST	0x714		EasyDMA list type
DMA.RX.TERMINATEONBUSERROR	0x71C		Terminate the transaction if a BUSERROR event is detected.
DMA.RX.BUSERRORADDRESS	0x720		Address of transaction that generated the last BUSERROR event.
DMA.RX.MATCH.CONFIG	0x724		Configure individual match events
DMA.RX.MATCH.CANDIDATE[n]	0x728		The data to look for - any match will trigger the MATCH[n] event, if enabled.
DMA.TX.PTR	0x73C		RAM buffer start address
DMA.TX.MAXCNT	0x740		Maximum number of bytes in channel buffer
DMA.TX.AMOUNT	0x744		Number of bytes transferred in the last transaction, updated after the END event. For channels that supports the compare match filter, this register is also updated after each MATCH event.
DMA.TX.LIST	0x74C		EasyDMA list type
DMA.TX.TERMINATEONBUSERROR	0x754		Terminate the transaction if a BUSERROR event is detected.
DMA.TX.BUSERRORADDRESS	0x758		Address of transaction that generated the last BUSERROR event.

8.26.13.1 TASKS_FLUSHRX

Address offset: 0x01C

Flush RX FIFO into RX buffer

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_FLUSHRX			Flush RX FIFO into RX buffer
			Trigger	1	Trigger task

8.26.13.2 TASKS_DMA

Peripheral tasks.

8.26.13.2.1 TASKS_DMA.RX

Peripheral tasks.

8.26.13.2.1.1 TASKS_DMA.RX.START

Address offset: 0x028

Starts operation using easyDMA to load the values. See peripheral description for operation using easyDMA.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	START			Starts operation using easyDMA to load the values. See peripheral description for operation using easyDMA.
			Trigger	1	Trigger task

8.26.13.2.1.2 TASKS_DMA.RX.STOP

Address offset: 0x02C

Stops operation using easyDMA. This does not trigger an END event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	STOP			Stops operation using easyDMA. This does not trigger an END event.
			Trigger	1	Trigger task

8.26.13.2.1.3 TASKS_DMA.RX.ENABLEMATCH[n] (n=0..3)

Address offset: 0x030 + (n × 0x4)

Enables the MATCH[n] event by setting the ENABLE[n] bit in the CONFIG register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	ENABLEMATCH			Enables the MATCH[n] event by setting the ENABLE[n] bit in the CONFIG register.
			Trigger	1	Trigger task

8.26.13.2.1.4 TASKS_DMA.RX.DISABLEMATCH[n] (n=0..3)

Address offset: 0x040 + (n × 0x4)

Disables the MATCH[n] event by clearing the ENABLE[n] bit in the CONFIG register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	DISABLEMATCH			Disables the MATCH[n] event by clearing the ENABLE[n] bit in the CONFIG register.
			Trigger	1	Trigger task

8.26.13.2.2 TASKS_DMA.TX

Peripheral tasks.

8.26.13.2.2.1 TASKS_DMA.TX.START

Address offset: 0x050

Starts operation using easyDMA to load the values. See peripheral description for operation using easyDMA.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	START			Starts operation using easyDMA to load the values. See peripheral description for operation using easyDMA.
			Trigger	1	Trigger task

8.26.13.2.2.2 TASKS_DMA.TX.STOP

Address offset: 0x054

Stops operation using easyDMA. This does not trigger an END event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	STOP			Stops operation using easyDMA. This does not trigger an END event.
			Trigger	1	Trigger task

8.26.13.3 SUBSCRIBE_FLUSHRX

Address offset: 0x09C

Subscribe configuration for task FLUSHRX

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task FLUSHRX will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.26.13.4 SUBSCRIBE_DMA

Subscribe configuration for tasks

8.26.13.4.1 SUBSCRIBE_DMA.RX

Subscribe configuration for tasks

8.26.13.4.1.1 SUBSCRIBE_DMA.RX.START

Address offset: 0x0A8

Subscribe configuration for task START

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task START will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.26.13.4.1.2 SUBSCRIBE_DMA.RX.STOP

Address offset: 0x0AC

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.26.13.4.1.3 SUBSCRIBE_DMA.RX.ENABLEMATCH[n] (n=0..3)

Address offset: 0x0B0 + (n × 0x4)

Subscribe configuration for task ENABLEMATCH[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task ENABLEMATCH[n] will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.26.13.4.1.4 SUBSCRIBE_DMA.RX.DISABLEMATCH[n] (n=0..3)

Address offset: 0x0C0 + (n × 0x4)

Subscribe configuration for task DISABLEMATCH[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task DISABLEMATCH[n] will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.26.13.4.2 SUBSCRIBE_DMA.TX

Subscribe configuration for tasks

8.26.13.4.2.1 SUBSCRIBE_DMA.TX.START

Address offset: 0x0D0

Subscribe configuration for task START

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task START will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.26.13.4.2.2 SUBSCRIBE_DMA.TX.STOP

Address offset: 0x0D4

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.26.13.5 EVENTS_CTS

Address offset: 0x100

CTS is activated (set low). Clear To Send.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_CTS			CTS is activated (set low). Clear To Send.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.26.13.6 EVENTS_NCTS

Address offset: 0x104

CTS is deactivated (set high). Not Clear To Send.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_NCTS			CTS is deactivated (set high). Not Clear To Send.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.26.13.7 EVENTS_TXDRDY

Address offset: 0x10C

Data sent from TXD

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_TXDRDY			Data sent from TXD
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.26.13.8 EVENTS_RXDRDY

Address offset: 0x110

Data received in RXD (but potentially not yet transferred to Data RAM)

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_RXDRDY			Data received in RXD (but potentially not yet transferred to Data RAM)
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.26.13.9 EVENTS_ERROR

Address offset: 0x114

Error detected

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_ERROR			Error detected
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.26.13.10 EVENTS_RXTO

Address offset: 0x124

Receiver timeout

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_RXTO			Receiver timeout
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.26.13.11 EVENTS_TXSTOPPED

Address offset: 0x130

Transmitter stopped

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_TXSTOPPED			Transmitter stopped
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.26.13.12 EVENTS_DMA

Peripheral events.

8.26.13.12.1 EVENTS_DMA.RX

Peripheral events.

8.26.13.12.1.1 EVENTS_DMA.RX.END

Address offset: 0x14C

Generated after EasyDMA has completed its operation.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	END			Generated after EasyDMA has completed its operation.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.26.13.12.1.2 EVENTS_DMA.RX.READY

Address offset: 0x150

Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	READY			Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.26.13.12.1.3 EVENTS_DMA.RX.BUSERROR

Address offset: 0x154

An error occured during the bus transfer.

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	BUSERROR			An error occured during the bus transfer. When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.26.13.12.1.4 EVENTS_DMA.RX.MATCH[n] (n=0..3)

Address offset: 0x158 + (n × 0x4)

Pattern match is detected on the DMA data bus.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MATCH			Pattern match is detected on the DMA data bus.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.26.13.12.2 EVENTS_DMA.TX

Peripheral events.

8.26.13.12.2.1 EVENTS_DMA.TX.END

Address offset: 0x168

Generated after EasyDMA has completed its operation.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	END			Generated after EasyDMA has completed its operation.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.26.13.12.2.2 EVENTS_DMA.TX.READY

Address offset: 0x16C

Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	READY			Generated when EasyDMA has buffered the .PTR and .MAXCNT registers for the channel, allowing them to be written to prepare for the next sequence.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.26.13.12.2.3 EVENTS_DMA.TX.BUSERROR

Address offset: 0x170

An error occured during the bus transfer.

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	BUSERROR			An error occured during the bus transfer. When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.26.13.13 EVENTS_FRAMETIMEOUT

Address offset: 0x174

Timed out due to bus being idle while receiving data.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_FRAMETIMEOUT			Timed out due to bus being idle while receiving data.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.26.13.14 PUBLISH_CTS

Address offset: 0x180

Publish configuration for event CTS

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event CTS will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.26.13.15 PUBLISH_NCTS

Address offset: 0x184

Publish configuration for event NCTS

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event NCTS will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.26.13.16 PUBLISH_TXDRDY

Address offset: 0x18C

Publish configuration for event TXDRDY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event TXDRDY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.26.13.17 PUBLISH_RXDRDY

Address offset: 0x190

Publish configuration for event RXDRDY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event RXDRDY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.26.13.18 PUBLISH_ERROR

Address offset: 0x194

Publish configuration for event ERROR

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event ERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.26.13.19 PUBLISH_RXTO

Address offset: 0x1A4

Publish configuration for event RXTO

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event RXTO will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.26.13.20 PUBLISH_TXSTOPPED

Address offset: 0x1B0

Publish configuration for event TXSTOPPED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event TXSTOPPED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.26.13.21 PUBLISH_DMA

Publish configuration for events

8.26.13.21.1 PUBLISH_DMA.RX

Publish configuration for events

8.26.13.21.1.1 PUBLISH_DMA.RX.END

Address offset: 0x1CC

Publish configuration for event END

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event END will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.26.13.21.1.2 PUBLISH_DMA.RX.READY

Address offset: 0x1D0

Publish configuration for event READY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event READY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.26.13.21.1.3 PUBLISH_DMA.RX.BUSERROR

Address offset: 0x1D4

Publish configuration for event BUSERROR

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event BUSERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.26.13.21.1.4 PUBLISH_DMA.RX.MATCH[n] (n=0..3)

Address offset: 0x1D8 + (n × 0x4)

Publish configuration for event MATCH[n]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event MATCH[n] will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.26.13.21.2 PUBLISH_DMA.TX

Publish configuration for events

8.26.13.21.2.1 PUBLISH_DMA.TX.END

Address offset: 0x1E8

Publish configuration for event END

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event END will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.26.13.21.2.2 PUBLISH_DMA.TX.READY

Address offset: 0x1EC

Publish configuration for event READY

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event READY will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.26.13.21.2.3 PUBLISH_DMA.TX.BUSERROR

Address offset: 0x1F0

Publish configuration for event BUSERROR

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event BUSERROR will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.26.13.22 PUBLISH_FRAMETIMEOUT

Address offset: 0x1F4

Publish configuration for event FRAMETIMEOUT

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event FRAMETIMEOUT will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.26.13.23 SHORTS

Address offset: 0x200

Shortcuts between local events and tasks

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	DMA_RX_END_DMA_RX_START			Shortcut between event DMA.RX.END and task DMA.RX.START
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
B	RW	DMA_RX_END_DMA_RX_STOP			Shortcut between event DMA.RX.END and task DMA.RX.STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
C	RW	DMA_TX_END_DMA_TX_STOP			Shortcut between event DMA.TX.END and task DMA.TX.STOP
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
D-G	RW	DMA_RX_MATCH[i]_DMA_RX_ENABLEMA +1)%4] (i=0..3)			Shortcut between event DMA.RX.MATCH[n] and task DMA.RX.ENABLEMATCH[(i+1)%4] Allows daisy-chaining match events.
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
H-K	RW	DMA_RX_MATCH[i]_DMA_RX_DISABLEMATCH[i] (i=0..3)			Shortcut between event DMA.RX.MATCH[n] and task DMA.RX.DISABLEMATCH[n]
			Disabled	0	Disable shortcut
			Enabled	1	Enable shortcut
L	RW	FRAMETIMEOUT_DMA_RX_STOP			Shortcut between event FRAMETIMEOUT and task DMA.RX.STOP
			Disabled	0	Disable shortcut

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID			L	K	J	I	H	G	F	E	D			C												B	A					
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
			Enabled	1	Enable shortcut

8.26.13.24 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID			R	Q	P	O	N	M	L	K	J	I	H							G			F				E	D	C		B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CTS			Enable or disable interrupt for event CTS
			Disabled	0	Disable
			Enabled	1	Enable
B	RW	NCTS			Enable or disable interrupt for event NCTS
			Disabled	0	Disable
			Enabled	1	Enable
C	RW	TXDRDY			Enable or disable interrupt for event TXDRDY
			Disabled	0	Disable
			Enabled	1	Enable
D	RW	RXDRDY			Enable or disable interrupt for event RXDRDY
			Disabled	0	Disable
			Enabled	1	Enable
E	RW	ERROR			Enable or disable interrupt for event ERROR
			Disabled	0	Disable
			Enabled	1	Enable
F	RW	RXTO			Enable or disable interrupt for event RXTO
			Disabled	0	Disable
			Enabled	1	Enable
G	RW	TXSTOPPED			Enable or disable interrupt for event TXSTOPPED
			Disabled	0	Disable
			Enabled	1	Enable
H	RW	DMARXEND			Enable or disable interrupt for event DMARXEND
			Disabled	0	Disable
			Enabled	1	Enable
I	RW	DMARXREADY			Enable or disable interrupt for event DMARXREADY
			Disabled	0	Disable
			Enabled	1	Enable
J	RW	DMARXBUSERROR			Enable or disable interrupt for event DMARXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Disabled	0	Disable
			Enabled	1	Enable
K-N	RW	DMARXMATCH[i] (i=0..3)			Enable or disable interrupt for event DMARXMATCH[i]
			Disabled	0	Disable
			Enabled	1	Enable
O	RW	DMATXEND			Enable or disable interrupt for event DMATXEND
			Disabled	0	Disable
			Enabled	1	Enable

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID						R	Q	P	O	N	M	L	K	J	I	H							G			F				E	D	C		B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
P	RW	DMATXREADY																																	
			Disabled	0																															
			Enabled	1																															
Q	RW	DMATXBUSERROR																																	
			Disabled	0																															
			Enabled	1																															
R	RW	FRAMETIMEOUT																																	
			Disabled	0																															
			Enabled	1																															

Description

Enable or disable interrupt for event DMATXREADY

Disable

Enable

Enable or disable interrupt for event DMATXBUSERROR

When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.

Disable

Enable

Enable or disable interrupt for event FRAMETIMEOUT

Disable

Enable

8.26.13.25 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID						R	Q	P	O	N	M	L	K	J	I	H							G			F				E	D	C		B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW W1S	CTS																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
B	RW W1S	NCTS																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
C	RW W1S	TXDRDY																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
D	RW W1S	RXDRDY																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
E	RW W1S	ERROR																																	
			Set	1																															
			Disabled	0																															
			Enabled	1																															
F	RW W1S	RXTO																																	
			Set	1																															

Description

Write '1' to enable interrupt for event CTS

Enable

Read: Disabled

Read: Enabled

Write '1' to enable interrupt for event NCTS

Enable

Read: Disabled

Read: Enabled

Write '1' to enable interrupt for event TXDRDY

Enable

Read: Disabled

Read: Enabled

Write '1' to enable interrupt for event RXDRDY

Enable

Read: Disabled

Read: Enabled

Write '1' to enable interrupt for event ERROR

Enable

Read: Disabled

Read: Enabled

Write '1' to enable interrupt for event RXTO

Enable

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID			R	Q	P	O	N	M	L	K	J	I	H							G			F				E	D	C		B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1S	TXSTOPPED			Write '1' to enable interrupt for event TXSTOPPED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
H	RW W1S	DMARXEND			Write '1' to enable interrupt for event DMARXEND
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
I	RW W1S	DMARXREADY			Write '1' to enable interrupt for event DMARXREADY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
J	RW W1S	DMARXBUSERROR			Write '1' to enable interrupt for event DMARXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
K-N	RW W1S	DMARXMATCH[i] (i=0..3)			Write '1' to enable interrupt for event DMARXMATCH[i]
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
O	RW W1S	DMATXEND			Write '1' to enable interrupt for event DMATXEND
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
P	RW W1S	DMATXREADY			Write '1' to enable interrupt for event DMATXREADY
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
Q	RW W1S	DMATXBUSERROR			Write '1' to enable interrupt for event DMATXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
R	RW W1S	FRAMETIMEOUT			Write '1' to enable interrupt for event FRAMETIMEOUT
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.26.13.26 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID			R	Q	P	O	N	M	L	K	J	I	H							G			F				E	D	C		B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	CTS			Write '1' to disable interrupt for event CTS
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	NCTS			Write '1' to disable interrupt for event NCTS
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
C	RW W1C	TXDRDY			Write '1' to disable interrupt for event TXDRDY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
D	RW W1C	RXDRDY			Write '1' to disable interrupt for event RXDRDY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
E	RW W1C	ERROR			Write '1' to disable interrupt for event ERROR
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
F	RW W1C	RXTO			Write '1' to disable interrupt for event RXTO
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
G	RW W1C	TXSTOPPED			Write '1' to disable interrupt for event TXSTOPPED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
H	RW W1C	DMARXEND			Write '1' to disable interrupt for event DMARXEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
I	RW W1C	DMARXREADY			Write '1' to disable interrupt for event DMARXREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
			Enabled	1	Read: Enabled
J	RW W1C	DMARXBUSERROR			Write '1' to disable interrupt for event DMARXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
K-N	RW W1C	DMARXMATCH[i] (i=0..3)			Write '1' to disable interrupt for event DMARXMATCH[i]
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
O	RW W1C	DMATXEND			Write '1' to disable interrupt for event DMATXEND
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
P	RW W1C	DMATXREADY			Write '1' to disable interrupt for event DMATXREADY
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
Q	RW W1C	DMATXBUSERROR			Write '1' to disable interrupt for event DMATXBUSERROR When this event is generated, the address which caused the error can be read from the BUSERRORADDRESS register.
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
R	RW W1C	FRAMETIMEOUT			Write '1' to disable interrupt for event FRAMETIMEOUT
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.26.13.27 ERRORSRC

Address offset: 0x480

Error source

This register is read/write one to clear.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	OVERRUN			Overrun error A start bit is received while the previous data still lies in RXD. (Previous data is lost.)
			NotPresent	0	Read: error not present

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Present	1	Read: error present
B	RW W1C	PARITY			Parity error A character with bad parity is received, if HW parity check is enabled.
			NotPresent	0	Read: error not present
			Present	1	Read: error present
C	RW W1C	FRAMING			Framing error occurred A valid stop bit is not detected on the serial data input after all bits in a character have been received.
			NotPresent	0	Read: error not present
			Present	1	Read: error present
D	RW W1C	BREAK			Break condition The serial data input is '0' for longer than the length of a data frame. (The data frame length is 10 bits without parity bit and 11 bits with parity bit.)
			NotPresent	0	Read: error not present
			Present	1	Read: error present

8.26.13.28 ENABLE

Address offset: 0x500

Enable UART

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			Enable or disable UARTE
			Disabled	0	Disable UARTE
			Enabled	8	Enable UARTE

8.26.13.29 BAUDRATE

Address offset: 0x524

Baud rate. Accuracy depends on the HFCLK source selected.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x04000000				**0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	BAUDRATE			Baud rate
			Baud1200	0x0004F000	1200 baud (actual rate: 1205) when UARTE has 16 MHz peripheral clock frequency
			Baud2400	0x0009D000	2400 baud (actual rate: 2396) when UARTE has 16 MHz peripheral clock frequency
			Baud4800	0x0013B000	4800 baud (actual rate: 4808) when UARTE has 16 MHz peripheral clock frequency
			Baud9600	0x00275000	9600 baud (actual rate: 9598) when UARTE has 16 MHz peripheral clock frequency

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x04000000				**0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Baud14400	0x003AF000	14400 baud (actual rate: 14401) when UARTE has 16 MHz peripheral clock frequency
			Baud19200	0x004EA000	19200 baud (actual rate: 19208) when UARTE has 16 MHz peripheral clock frequency
			Baud28800	0x0075C000	28800 baud (actual rate: 28777) when UARTE has 16 MHz peripheral clock frequency
			Baud31250	0x00800000	31250 baud when UARTE has 16 MHz peripheral clock frequency
			Baud38400	0x009D0000	38400 baud (actual rate: 38369) when UARTE has 16 MHz peripheral clock frequency
			Baud56000	0x00E50000	56000 baud (actual rate: 55944) when UARTE has 16 MHz peripheral clock frequency
			Baud57600	0x00EB0000	57600 baud (actual rate: 57554) when UARTE has 16 MHz peripheral clock frequency
			Baud76800	0x013A9000	76800 baud (actual rate: 76923) when UARTE has 16 MHz peripheral clock frequency
			Baud115200	0x01D60000	115200 baud (actual rate: 115108) when UARTE has 16 MHz peripheral clock frequency
			Baud230400	0x03B00000	230400 baud (actual rate: 231884) when UARTE has 16 MHz peripheral clock frequency
			Baud250000	0x04000000	250000 baud when UARTE has 16 MHz peripheral clock frequency
			Baud460800	0x07400000	460800 baud (actual rate: 457143) when UARTE has 16 MHz peripheral clock frequency
			Baud921600	0x0F000000	921600 baud (actual rate: 941176) when UARTE has 16 MHz peripheral clock frequency
			Baud1M	0x10000000	1 megabaud when UARTE has 16 MHz peripheral clock frequency

8.26.13.30 CONFIG

Address offset: 0x56C

Configuration of parity, hardware flow control, framesize, and packet timeout.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E E E E D C B B B A
Reset 0x00001000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	HWFC			Hardware flow control
			Disabled	0	Disabled
			Enabled	1	Enabled
B	RW	PARITY			Parity
			Excluded	0x0	Exclude parity bit
			Included	0x7	Include parity bit
C	RW	STOP			Stop bits
			One	0	One stop bit
			Two	1	Two stop bits
D	RW	PARITYTYPE			Even or odd parity type
			Even	0	Even parity
			Odd	1	Odd parity
E	RW	FRAMESIZE			Set the data frame size
			9bit	9	9 bit data frame size. 9th bit is treated as address bit.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E E E E D C B B B A
Reset 0x00001000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			8bit	8	8 bit data frame size.
			7bit	7	7 bit data frame size.
			6bit	6	6 bit data frame size.
			5bit	5	5 bit data frame size.
			4bit	4	4 bit data frame size.
F	RW	ENDIAN			Select if data is trimmed from MSB or LSB end when the data frame size is less than 8.
			MSB	0	Data is trimmed from MSB end.
			LSB	1	Data is trimmed from LSB end.
G	RW	FRAMETIMEOUT			Enable packet timeout.
			DISABLED	0	Packet timeout is disabled.
			ENABLED	1	Packet timeout is enabled.
			Disabled	0	Packet timeout is disabled.
			Enabled	1	Packet timeout is enabled.

8.26.13.31 ADDRESS

Address offset: 0x574

Set the address of the UARTE for RX when used in 9 bit data frame mode.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ADDRESS			Set address

8.26.13.32 FRAMETIMEOUT

Address offset: 0x578

Set the number of UARTE bits to count before triggering packet timeout.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A
Reset 0x00000010				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	COUNTERTOP			Number of UARTE bits before timeout.

8.26.13.33 PSEL.TXD

Address offset: 0x604

Pin select for TXD signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.26.13.34 PSEL.CTS

Address offset: 0x608

Pin select for CTS signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.26.13.35 PSEL.RXD

Address offset: 0x60C

Pin select for RXD signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.26.13.36 PSEL.RTS

Address offset: 0x610

Pin select for RTS signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B B B A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	PIN		[0..31]	Pin number
B	RW	PORT		[0..7]	Port number
C	RW	CONNECT			Connection
			Disconnected	1	Disconnect
			Connected	0	Connect

8.26.13.37 DMA.RX.PTR

Address offset: 0x704

RAM buffer start address

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x20000000				**0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			RAM buffer start address for this EasyDMA channel. This address is a word aligned Data RAM address.

Note: See the memory chapter for details about which memories are available for EasyDMA.

8.26.13.38 DMA.RX.MAXCNT

Address offset: 0x708

Maximum number of bytes in channel buffer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MAXCNT		[1..0xffff]	Maximum number of bytes in channel buffer

8.26.13.39 DMA.RX.AMOUNT

Address offset: 0x70C

Number of bytes transferred in the last transaction, updated after the END event.

For channels that supports the compare match filter, this register is also updated after each MATCH event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT		[1..0xffff]	Number of bytes transferred in the last transaction. In case of NACK error, includes the NACK'ed byte.

8.26.13.40 DMA.RX.LIST

Address offset: 0x714

EasyDMA list type

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																		A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	TYPE																																	
			Disabled	0																															
			ArrayList	1																															

8.26.13.41 DMA.RX.TERMINATEONBUSERROR

Address offset: 0x71C

Terminate the transaction if a BUSERROR event is detected.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	ENABLE																																	
			Disabled	0																															
			Enabled	1																															

8.26.13.42 DMA.RX.BUSERRORADDRESS

Address offset: 0x720

Address of transaction that generated the last BUSERROR event.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	ADDRESS																																	

8.26.13.43 DMA.RX.MATCH

Registers to control the behavior of the pattern matcher engine

8.26.13.43.1 DMA.RX.MATCH.CONFIG

Address offset: 0x724

Configure individual match events

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-D	RW	ENABLE[i] (i=0..3)			Enable match filter i
			Disabled	0	Match filter disabled
			Enabled	1	Match filter enabled
E-H	RW	ONESHOT[i] (i=0..3)			Configure match filter i as one-shot or continous One-shot operation will disable the filter on a match, while Continous operation will keep it enabled until explicitly disabled.
			Continuous	0	Match filter stays enabled until disabled by task
			Oneshot	1	Match filter stays enabled until next data word is received

8.26.13.43.2 DMA.RX.MATCH.CANDIDATE[n] (n=0..3)

Address offset: 0x728 + (n × 0x4)

The data to look for - any match will trigger the MATCH[n] event, if enabled.

Note: This register can be updated while a transfer is in progress, but the new value will not take effect until either the DMA is restarted or the match event is generated. That makes it possible to write a new set of match words which will be searched for immediately after the event triggers.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	DATA			Data to look for

8.26.13.44 DMA.TX.PTR

Address offset: 0x73C

RAM buffer start address

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x20000000				**0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	PTR			RAM buffer start address for this EasyDMA channel. This address is a word aligned Data RAM address. **Note:** See the memory chapter for details about which memories are available for EasyDMA.

8.26.13.45 DMA.TX.MAXCNT

Address offset: 0x740

Maximum number of bytes in channel buffer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MAXCNT		[1..0xffff]	Maximum number of bytes in channel buffer

8.26.13.46 DMA.TX.AMOUNT

Address offset: 0x744

Number of bytes transferred in the last transaction, updated after the END event.

For channels that supports the compare match filter, this register is also updated after each MATCH event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	AMOUNT		[1..0xffff]	Number of bytes transferred in the last transaction. In case of NACK error, includes the NACK'ed byte.

8.26.13.47 DMA.TX.LIST

Address offset: 0x74C

EasyDMA list type

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	TYPE			List type
			Disabled	0	Disable EasyDMA list
			ArrayList	1	Use array list

8.26.13.48 DMA.TX.TERMINATEONBUSERROR

Address offset: 0x754

Terminate the transaction if a BUSERROR event is detected.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			
			Disabled	0	Disable
			Enabled	1	Enable

8.26.13.49 DMA.TX.BUSERRORADDRESS

Address offset: 0x758

Address of transaction that generated the last BUSERROR event.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	ADDRESS			

8.27 USBHS — Universal Serial Bus High Speed

The USBHS (USB high speed) peripheral is a USB 2.0 device that supports USB 2.0 and is backward compatible with the USB 1.1 Specification.

The following are main features of USBHS:

- Multiple DMA/non-DMA mode access support for the application
- Supports up to 16 bidirectional endpoints, including control endpoint 0
- Supports the following modes:
  - High-speed (HS) 480 Mbps
  - Full-speed (FS) 12 Mbps
  - Low-speed (LS) 1.5 Mbps
  - Configurable device mode
- Includes automatic ping capabilities
- Supports keep-alive in low-speed mode and SOFs in high- and full-speed modes
- Provides on-chip PLL to reduce clock noise and eliminate the need for an external clock generator
- Supports battery charging, enabling a device to draw current in excess of the USB 2.0 specification for charging or powering up from dedicated charging ports or charging downstream ports
- Does not support On-The-Go (OTG)

8.27.1 USB pins

The USBHS peripheral features a number of dedicated pins which can be grouped into two categories: signal and power.

Signal pins connect to the USB device and consist of the **D+** and **D−** pins. These are dedicated pins and not available as standard GPIO pins. The data line does not need serial resistors. **TXRTUNE** connects to a tuning resistor on the PCB. The USBHS does not have an **ID** pin. The USBHS peripheral is implemented according to the USB Specification v2.0, *5V Short Circuit Withstand ECN Requirement Change*, meaning these pins are not 5 V tolerant.

See Reference circuitry on page 1246 for the reference circuit diagram.

The signal pins are operational when the following are true:

- The device is powered
- **VBUS** is in the valid voltage range
- USBHS is enabled by the software driver

Note: The **D+** and **D−** pins are impedance controlled signals and must be routed on the PCB according to the USB standard. See the development kit user guide for a routing example.

TXRTUNE resistor

An external resistor with 200 Ω resistance and 1% tolerance must be connected from the **TXRTUNE** pin to the **VSS** pin to calibrate a 45 Ω source impedance for the **D+** and **D−** pins. Using a constant current output from the **TXRTUNE** pin and measuring the voltage over the external resistor, the nominal voltage over the resistor will be 400 mV.

VBUS detection

The **VBUS** pin has a voltage detector for both rising and falling voltage. This means it will detect the USB cable being connected and disconnected. The voltage detector generates events that are picked up by the USBHS software driver, which can be used as wakeup-sources for the device.

For pin assignments, see Pin assignments on page 1219.

8.27.2 Interrupt sharing

USBHS and USBHSCORE share the same interrupt, and interrupts are generated through USBHS.

The interrupts are enabled and disabled using the mechanisms available in USBHSCORE, using registers such as USBHSCORE.GINTSTS and USBHSCORE.GINTMSK.

8.27.3 USBHS not in use

If USBHS is not used in an application, the following applies.

All USBHS pins can be left floating (not connected). See USB pins on page 790 for the list of USBHS pins.

Do not enable USBHS or the USB regulator.

8.27.4 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
USBHS : S USBHS : NS	GLOBAL	0x5005A000 0x4005A000	US	S	SA	No	USBHS

Configuration

Instance	Domain	Configuration
USBHS : S USBHS : NS	GLOBAL	Has Start of Frame (SOF) event. RTUNE method for calibrating DP and DM 45Ohm source impedance without external TXRTUNE resistor available. Includes STATUS register

Register overview

Register	Offset	TZ	Description
TASKS_START	0x000		Start the USB peripheral.
TASKS_STOP	0x004		Stop the USB peripheral
PUBLISH_SOF	0x180		Publish configuration for SOF event.
ENABLE	0x400		Enable USB peripheral.
STATUS	0x408		This register contains status bits for the USBHS
PHY.CONFIG	0x440		USB PHY parameter overrides
PHY.CLOCK	0x444		USB PHY clock configurations
PHY.BATTCHRG	0x448		Battery Charging Configuration
PHY.BATTCHRGSTATUS	0x44C		Battery charger input signals
PHY.INPUTOVERRIDE	0x458		Enables overriding of individual signals to the PHY, the override values are set in PHY.OVERRIDEVALUES

Register	Offset	TZ	Description
PHY.OVERRIDEVALUES	0x45C		Values that are used to override the input signals to the PHY.
PHY.RTUNE	0x464		The RTUNE mode is an alternative method for calibrating the DP and DM 45-Ohm source impedance.

8.27.4.1 TASKS_START

Address offset: 0x000

Start the USB peripheral.

To start USB peripheral, it needs to be enabled using the ENABLE register first.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_START			Start the USB peripheral. To start USB peripheral, it needs to be enabled using the ENABLE register first.
			Trigger	1	Trigger task

8.27.4.2 TASKS_STOP

Address offset: 0x004

Stop the USB peripheral

This bit can be cleared to disable the clock to the USB core. By default the clock is enabled when ENABLE.CORE is set. To enable the clock again run the START task.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Stop the USB peripheral This bit can be cleared to disable the clock to the USB core. By default the clock is enabled when ENABLE.CORE is set. To enable the clock again run the START task.
			Trigger	1	Trigger task

8.27.4.3 PUBLISH_SOF

Address offset: 0x180

Publish configuration for SOF event.

In Host mode, this event triggers every time a Start Of Frame (SOF) is generated in the USB controller.
In Device mode, this signal triggers every time a SOF token is received from the USB host or when a SOF token is missed at the start of frame.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel to publish to
B	RW	EN			Enable publishing of SOF event
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.27.4.4 ENABLE

Address offset: 0x400

Enable USB peripheral.

To enable USB peripheral, both USB Controller and USB PHY need to be enabled

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CORE			Enable USB Controller
			Disabled	0	USB Controller disabled.
			Enabled	1	USB Controller enabled.
B	RW	PHY			Enable USB PHY
			Disabled	0	USB PHY disabled.
			Enabled	1	USB PHY enabled.

8.27.4.5 STATUS

Address offset: 0x408

This register contains status bits for the USBHS

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	CORE			Indicates wether the USBHS core is ready after a START task
			NotReady	0	The USBHS core is not ready, and register access to the USBHSCORE registers is not possible. Access to USBHSCORE.PCGCCTL is possible even when NotReady.
			Ready	1	The USBHS core is ready, and register access to the USBHS.CORE registers is possible

8.27.4.6 PHY.CONFIG

Address offset: 0x440

USB PHY parameter overrides

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K K J J I I H H H H G G G G F F E E D D D C C C B B B B A A
Reset 0x5533D6F0				**0 1 0 1 0 1 0 1 0 0 1 1 0 0 1 1 1 1 0 1 0 1 1 0 1 1 1 1 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	PLLITUNE		[0x0..0x3]	PLL Integral Path Tune
B	RW	PLLPTUNE		[0x0..0xf]	PLL Proportional Path Tune
C	RW	COMPDISTUNE0		[0x0..0x7]	Disconnect Threshold Adjustment
D	RW	SQRXTUNE0		[0x0..0x3]	Squelch Threshold Adjustment
E	RW	VDATREFTUNE0		[0x0..0x3]	Data Detect Voltage Adjustment
F	RW	TXHSXVTUNE0		[0x0..0x2]	Transmitter High-Speed Crossover Adjustment
G	RW	TXFSLSTUNE0		[0x0..0x7]	FS/LS Source Impedance Adjustment
H	RW	TXVREFTUNE0		[0x0..0x7]	HS DC Voltage Level Adjustment
I	RW	TXRISETUNE0		[0x0..0x2]	HS Transmitter Rise/Fall Time Adjustment
J	RW	TXRESTUNE0		[0x0..0x2]	USB Source Impedance Adjustment
K	RW	TXPREEMPAMPTUNE0		[0x0..0x2]	HS Transmitter Pre-Emphasis Current Control
L	RW	TXPREEMPPULSETUNE0		[0x0..0x1]	HS Transmitter Pre-Emphasis Duration Control

8.27.4.7 PHY.CLOCK

Address offset: 0x444

USB PHY clock configurations

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B A A A
Reset 0x0000001A				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 1 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	FSEL			Select reference clock frequency
			Clock19200KHz	0	Reference clock is 19.2MHz. The PLLBTUNE must be set to 1.
			Clock20000KHz	1	Reference clock is 20MHz. The PLLBTUNE must be set to 1.
			Clock24000KHz	2	Reference clock is 24MHz. The PLLBTUNE must be set to 1.
			Clock50000KHz	7	Reference clock is 50MHz. The PLLBTUNE must be set to 0.
B	RW	PLLBTUNE			PLL bandwidth adjustment
			Disabled	0	PLL bandwidth adjustment disabled.
			Enabled	1	PLL bandwidth adjustment enabled.
C	RW	COMMONONN			Common block power down control
			POWERED	0	The REFCLOCK_LOGIC,bias and PLL blocks are powered in sleep or suspend mode.
			SUSPEND	1	The REFCLOCK_LOGIC, bias and PLL blocks are powered down in suspend mode and bias and PLL blocks are powered down in sleep mode.

8.27.4.8 PHY.BATTCHRG

Address offset: 0x448

Battery Charging Configuration

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHRGSEL0			Battery charging source select
			SourceDP0SinkDM0	0	Data source voltage (VDAT_SRC) is sourced onto DP0 and sunk from DM0
			SourceDM0SinkDP0	1	Data source voltage (VDAT_SRC) is sourced onto DM0 and sunk from DP0
B	RW	VDATENB0			Attach/Connect Detection Enable
			Disabled	0	Data detect voltage (CHG_DET) is disabled
			Enabled	1	Data detect voltage (CHG_DET) is enabled
C	RW	VDATSRCENB0			Battery Charging Source Select
			Disabled	0	Data source voltage (VDAT_SRC) is disabled
			Enabled	1	Data source voltage (VDAT_SRC) is enabled

8.27.4.9 PHY.BATTCHRGSTATUS

Address offset: 0x44C

Battery charger input signals

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	CHGDET			
B	R	FSVPLUS			
C	R	FSVMINUS			

8.27.4.10 PHY.INPUTOVERRIDE

Address offset: 0x458

Enables overriding of individual signals to the PHY, the override values are set in PHY.OVERRIDEVALUES

The override values are set in the OVERRIDEVALUES register. When INPUTOVERRIDE is enabled for a signal the input signals to the PHY is driven by the OVERRIDEVALUES register, when INPUTOVERRIDE is disabled the input signals to the PHY is driven by the USB controller for normal operation.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E D C B B A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	OPMODE0			
			Disabled	0	Overrides are disabled
			Enabled	3	Overrides are enabled
B	RW	XCVRSEL0			
			Disabled	0	Overrides are disabled
			Enabled	3	Overrides are enabled
C	RW	DPPULLDOWN			
D	RW	DMPULLDOWN			
E	RW	SUSPENDM0			
F	RW	VBUSVALID			
G	RW	ID			Overrides OTG ID pin signal

8.27.4.11 PHY.OVERRIDEVALUES

Address offset: 0x45C

Values that are used to override the input signals to the PHY.

These values defines the values of the input signals to the PHY when the INPUTOVERRIDE is enabled.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				G	F					E	D	C		B	B	A	A																		
Reset 0x02000000				**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	OPMODE0																																	
B	RW	XCVRSEL0																																	
C	RW	DPPULLDOWN																																	
			Enable	1																															
			Disable	0																															
D	RW	DMPULLDOWN																																	
			Enable	1																															
			Disable	0																															
E	RW	SUSPENDM0																																	
F	RW	VBUSVALID																																	
			Valid	1																															
			NotValid	0																															
G	RW	ID																																	
			Device	1																															
			Host	0																															

8.27.4.12 PHY.RTUNE

Address offset: 0x464

The RTUNE mode is an alternative method for calibrating the DP and DM 45-Ohm source impedance.

When this method is used, the USBHS REXT resistor does not need to be connected and can be left floating. This RTUNE mode is selected by setting RTUNESEL to 0, and the tune calibration value is set by the RCALCODE input bus.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																															B	B	B	B	A
Reset 0x0000000F				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW	RTUNESEL																																	
			TXRTUNE	1																															
			RTUNE	0																															
B	RW	RCALCODE																																	

8.27.5 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
USBHSCORE : S USBHSCORE : NS	GLOBAL	0x50020000 0x40020000	US	S	SA	No	USBHSCORE

Register overview

Register	Offset	TZ	Description
GOTGCTL	0x000		Control and Status Register
GOTGINT	0x004		Interrupt Register
GAHBCFG	0x008		AHB Configuration Register
GUSBCFG	0x00C		USB Configuration Register
GRSTCTL	0x010		Reset Register
GINTSTS	0x014		Interrupt STATUS Register
GINTMSK	0x018		Interrupt Mask Register
GRXSTSR	0x01C		Receive Status Debug Read Register
GRXSTSP	0x020		Receive Status Read/Pop Register
GRXFSIZ	0x024		Receive FIFO Size Register
GNPTXFSIZ	0x028		Non-periodic Transmit FIFO Size Register
GNPTXSTS	0x02C		Non-periodic Transmit FIFO/Queue Status Register
GGPIO	0x038		General Purpose Input/Output Register
GUID	0x03C		User ID Register
GSNPSID	0x040		Synopsys ID Register
GHWCFG1	0x044		User Hardware Configuration 1 Register
GHWCFG2	0x048		User Hardware Configuration 2 Register
GHWCFG3	0x04C		User Hardware Configuration 3 Register
GHWCFG4	0x050		User Hardware Configuration 4 Register
GLPMCFG	0x054		LPM Config Register
GPWRDN	0x058		Global Power Down Register
GDFIFOCFG	0x05C		Global DFIFO Configuration Register
GINTMSK2	0x068		Interrupt Mask Register 2
GINTSTS2	0x06C		Interrupt Register 2
HPTXFSIZ	0x100		Host Periodic Transmit FIFO Size Register
DIEPTXF[n]	0x104		Device IN Endpoint Transmit FIFO 1 Size Register
HCFG	0x400		Host Configuration Register
HFIR	0x404		Host Frame Interval Register
HFNUM	0x408		Host Frame Number/Frame Time Remaining Register
HPTXSTS	0x410		Host Periodic Transmit FIFO/Queue Status Register
HAINT	0x414		Host All Channels Interrupt Register
HAINTMSK	0x418		Host All Channels Interrupt Mask Register
HPRT	0x440		Host Port Control and Status Register
HC[n].CHAR	0x500		Host Channel Characteristics Register 0
HC[n].SPLT	0x504		Host Channel Split Control Register 0
HC[n].INT	0x508		Host Channel Interrupt Register 0
HC[n].INTMSK	0x50C		Host Channel Interrupt Mask Register 0
HC[n].TSIZ	0x510		Host Channel Transfer Size Register 0
HC[n].DMA	0x514		Host Channel DMA Address Register 0
DCFG	0x800		Device Configuration Register

Register	Offset	TZ	Description
DCTL	0x804		Device Control Register
DSTS	0x808		Device Status Register
DIEPMSK	0x810		Device IN Endpoint Common Interrupt Mask Register
DOEPMSK	0x814		Device OUT Endpoint Common Interrupt Mask Register
DAINT	0x818		Device All Endpoints Interrupt Register
DAINTMSK	0x81C		Device All Endpoints Interrupt Mask Register
DVBUSDIS	0x828		Device VBUS Discharge Time Register
DVBUSPULSE	0x82C		Device VBUS Pulsing Time Register
DTHRCTL	0x830		Device Threshold Control Register
DIEPEMPMSK	0x834		Device IN Endpoint FIFO Empty Interrupt Mask Register
DIEPCTL0	0x900		Device Control IN Endpoint 0 Control Register
DIEPINT0	0x908		Device IN Endpoint 0 Interrupt Register
DIEPTSIZ0	0x910		Device IN Endpoint 0 Transfer Size Register
DIEPDMA0	0x914		Device IN Endpoint 0 DMA Address Register
DTXFSTS0	0x918		Device IN Endpoint Transmit FIFO Status Register 0
DIEPCTL1	0x920		Device Control IN Endpoint Control Register 1
DIEPINT1	0x928		Device IN Endpoint Interrupt Register 1
DIEPTSIZ1	0x930		Device IN Endpoint Transfer Size Register 1
DIEPDMA1	0x934		Device IN Endpoint DMA Address Register 1
DTXFSTS1	0x938		Device IN Endpoint Transmit FIFO Status Register 1
DIEPCTL2	0x940		Device Control IN Endpoint Control Register 2
DIEPINT2	0x948		Device IN Endpoint Interrupt Register 2
DIEPTSIZ2	0x950		Device IN Endpoint Transfer Size Register 2
DIEPDMA2	0x954		Device IN Endpoint DMA Address Register 2
DTXFSTS2	0x958		Device IN Endpoint Transmit FIFO Status Register 2
DIEPCTL3	0x960		Device Control IN Endpoint Control Register 3
DIEPINT3	0x968		Device IN Endpoint Interrupt Register 3
DIEPTSIZ3	0x970		Device IN Endpoint Transfer Size Register 3
DIEPDMA3	0x974		Device IN Endpoint DMA Address Register 3
DTXFSTS3	0x978		Device IN Endpoint Transmit FIFO Status Register 3
DIEPCTL4	0x980		Device Control IN Endpoint Control Register 4
DIEPINT4	0x988		Device IN Endpoint Interrupt Register 4
DIEPTSIZ4	0x990		Device IN Endpoint Transfer Size Register 4
DIEPDMA4	0x994		Device IN Endpoint DMA Address Register 4
DTXFSTS4	0x998		Device IN Endpoint Transmit FIFO Status Register 4
DIEPCTL5	0x9A0		Device Control IN Endpoint Control Register 5
DIEPINT5	0x9A8		Device IN Endpoint Interrupt Register 5
DIEPTSIZ5	0x9B0		Device IN Endpoint Transfer Size Register 5
DIEPDMA5	0x9B4		Device IN Endpoint DMA Address Register 5
DTXFSTS5	0x9B8		Device IN Endpoint Transmit FIFO Status Register 5
DIEPCTL6	0x9C0		Device Control IN Endpoint Control Register 6
DIEPINT6	0x9C8		Device IN Endpoint Interrupt Register 6
DIEPTSIZ6	0x9D0		Device IN Endpoint Transfer Size Register 6
DIEPDMA6	0x9D4		Device IN Endpoint DMA Address Register 6
DTXFSTS6	0x9D8		Device IN Endpoint Transmit FIFO Status Register 6
DIEPCTL7	0x9E0		Device Control IN Endpoint Control Register 7
DIEPINT7	0x9E8		Device IN Endpoint Interrupt Register 7
DIEPTSIZ7	0x9F0		Device IN Endpoint Transfer Size Register 7
DIEPDMA7	0x9F4		Device IN Endpoint DMA Address Register 7
DTXFSTS7	0x9F8		Device IN Endpoint Transmit FIFO Status Register 7
DIEPCTL8	0xA00		Device Control IN Endpoint Control Register 8
DIEPINT8	0xA08		Device IN Endpoint Interrupt Register 8
DIEPTSIZ8	0xA10		Device IN Endpoint Transfer Size Register 8

Register	Offset	TZ	Description
DIEPDMA8	0xA14		Device IN Endpoint DMA Address Register 8
DTXFSTS8	0xA18		Device IN Endpoint Transmit FIFO Status Register 8
DIEPCTL9	0xA20		Device Control IN Endpoint Control Register 9
DIEPINT9	0xA28		Device IN Endpoint Interrupt Register 9
DIEPTSIZ9	0xA30		Device IN Endpoint Transfer Size Register 9
DIEPDMA9	0xA34		Device IN Endpoint DMA Address Register 9
DTXFSTS9	0xA38		Device IN Endpoint Transmit FIFO Status Register 9
DIEPCTL10	0xA40		Device Control IN Endpoint Control Register 10
DIEPINT10	0xA48		Device IN Endpoint Interrupt Register 10
DIEPTSIZ10	0xA50		Device IN Endpoint Transfer Size Register 10
DIEPDMA10	0xA54		Device IN Endpoint DMA Address Register 10
DTXFSTS10	0xA58		Device IN Endpoint Transmit FIFO Status Register 10
DIEPCTL11	0xA60		Device Control IN Endpoint Control Register 11
DIEPINT11	0xA68		Device IN Endpoint Interrupt Register 11
DIEPTSIZ11	0xA70		Device IN Endpoint Transfer Size Register 11
DIEPDMA11	0xA74		Device IN Endpoint DMA Address Register 11
DTXFSTS11	0xA78		Device IN Endpoint Transmit FIFO Status Register 11
DIEPCTL12	0xA80		Device Control IN Endpoint Control Register 12
DIEPINT12	0xA88		Device IN Endpoint Interrupt Register 12
DIEPTSIZ12	0xA90		Device IN Endpoint Transfer Size Register 12
DIEPDMA12	0xA94		Device IN Endpoint DMA Address Register 12
DTXFSTS12	0xA98		Device IN Endpoint Transmit FIFO Status Register 12
DIEPCTL13	0xAA0		Device Control IN Endpoint Control Register 13
DIEPINT13	0xAA8		Device IN Endpoint Interrupt Register 13
DIEPTSIZ13	0xAB0		Device IN Endpoint Transfer Size Register 13
DIEPDMA13	0xAB4		Device IN Endpoint DMA Address Register 13
DTXFSTS13	0xAB8		Device IN Endpoint Transmit FIFO Status Register 13
DIEPCTL14	0xAC0		Device Control IN Endpoint Control Register 14
DIEPINT14	0xAC8		Device IN Endpoint Interrupt Register 14
DIEPTSIZ14	0xAD0		Device IN Endpoint Transfer Size Register 14
DIEPDMA14	0xAD4		Device IN Endpoint DMA Address Register 14
DTXFSTS14	0xAD8		Device IN Endpoint Transmit FIFO Status Register 14
DIEPCTL15	0xAE0		Device Control IN Endpoint Control Register 15
DIEPINT15	0xAE8		Device IN Endpoint Interrupt Register 15
DIEPTSIZ15	0xAF0		Device IN Endpoint Transfer Size Register 15
DIEPDMA15	0xAF4		Device IN Endpoint DMA Address Register 15
DTXFSTS15	0xAF8		Device IN Endpoint Transmit FIFO Status Register 15
DOEPCTL0	0xB00		Device Control OUT Endpoint 0 Control Register
DOEPINT0	0xB08		Device OUT Endpoint 0 Interrupt Register
DOEPTSIZ0	0xB10		Device OUT Endpoint 0 Transfer Size Register
DOEPDMA0	0xB14		Device OUT Endpoint 0 DMA Address Register
DOEPCTL1	0xB20		Device Control OUT Endpoint Control Register 1
DOEPINT1	0xB28		Device OUT Endpoint Interrupt Register 1
DOEPTSIZ1	0xB30		Device OUT Endpoint Transfer Size Register 1
DOEPDMA1	0xB34		Device OUT Endpoint DMA Address Register 1
DOEPCTL2	0xB40		Device Control OUT Endpoint Control Register 2
DOEPINT2	0xB48		Device OUT Endpoint Interrupt Register 2
DOEPTSIZ2	0xB50		Device OUT Endpoint Transfer Size Register 2
DOEPDMA2	0xB54		Device OUT Endpoint DMA Address Register 2
DOEPCTL3	0xB60		Device Control OUT Endpoint Control Register 3
DOEPINT3	0xB68		Device OUT Endpoint Interrupt Register 3
DOEPTSIZ3	0xB70		Device OUT Endpoint Transfer Size Register 3
DOEPDMA3	0xB74		Device OUT Endpoint DMA Address Register 3

Register	Offset	TZ	Description
DOEPCTL4	0xB80		Device Control OUT Endpoint Control Register 4
DOEPINT4	0xB88		Device OUT Endpoint Interrupt Register 4
DOEPTSIZ4	0xB90		Device OUT Endpoint Transfer Size Register 4
DOEPDMA4	0xB94		Device OUT Endpoint DMA Address Register 4
DOEPCTL5	0xBA0		Device Control OUT Endpoint Control Register 5
DOEPINT5	0xBA8		Device OUT Endpoint Interrupt Register 5
DOEPTSIZ5	0xBB0		Device OUT Endpoint Transfer Size Register 5
DOEPDMA5	0xBB4		Device OUT Endpoint DMA Address Register 5
DOEPCTL6	0xBC0		Device Control OUT Endpoint Control Register 6
DOEPINT6	0xBC8		Device OUT Endpoint Interrupt Register 6
DOEPTSIZ6	0xBD0		Device OUT Endpoint Transfer Size Register 6
DOEPDMA6	0xBD4		Device OUT Endpoint DMA Address Register 6
DOEPCTL7	0xBE0		Device Control OUT Endpoint Control Register 7
DOEPINT7	0xBE8		Device OUT Endpoint Interrupt Register 7
DOEPTSIZ7	0xBF0		Device OUT Endpoint Transfer Size Register 7
DOEPDMA7	0xBF4		Device OUT Endpoint DMA Address Register 7
DOEPCTL8	0xC00		Device Control OUT Endpoint Control Register 8
DOEPINT8	0xC08		Device OUT Endpoint Interrupt Register 8
DOEPTSIZ8	0xC10		Device OUT Endpoint Transfer Size Register 8
DOEPDMA8	0xC14		Device OUT Endpoint DMA Address Register 8
DOEPCTL9	0xC20		Device Control OUT Endpoint Control Register 9
DOEPINT9	0xC28		Device OUT Endpoint Interrupt Register 9
DOEPTSIZ9	0xC30		Device OUT Endpoint Transfer Size Register 9
DOEPDMA9	0xC34		Device OUT Endpoint DMA Address Register 9
DOEPCTL10	0xC40		Device Control OUT Endpoint Control Register 10
DOEPINT10	0xC48		Device OUT Endpoint Interrupt Register 10
DOEPTSIZ10	0xC50		Device OUT Endpoint Transfer Size Register 10
DOEPDMA10	0xC54		Device OUT Endpoint DMA Address Register 10
DOEPCTL11	0xC60		Device Control OUT Endpoint Control Register 11
DOEPINT11	0xC68		Device OUT Endpoint Interrupt Register 11
DOEPTSIZ11	0xC70		Device OUT Endpoint Transfer Size Register 11
DOEPDMA11	0xC74		Device OUT Endpoint DMA Address Register 11
DOEPCTL12	0xC80		Device Control OUT Endpoint Control Register 12
DOEPINT12	0xC88		Device OUT Endpoint Interrupt Register 12
DOEPTSIZ12	0xC90		Device OUT Endpoint Transfer Size Register 12
DOEPDMA12	0xC94		Device OUT Endpoint DMA Address Register 12
DOEPCTL13	0xCA0		Device Control OUT Endpoint Control Register 13
DOEPINT13	0xCA8		Device OUT Endpoint Interrupt Register 13
DOEPTSIZ13	0xCB0		Device OUT Endpoint Transfer Size Register 13
DOEPDMA13	0xCB4		Device OUT Endpoint DMA Address Register 13
DOEPCTL14	0xCC0		Device Control OUT Endpoint Control Register 14
DOEPINT14	0xCC8		Device OUT Endpoint Interrupt Register 14
DOEPTSIZ14	0xCD0		Device OUT Endpoint Transfer Size Register 14
DOEPDMA14	0xCD4		Device OUT Endpoint DMA Address Register 14
DOEPCTL15	0xCE0		Device Control OUT Endpoint Control Register 15
DOEPINT15	0xCE8		Device OUT Endpoint Interrupt Register 15
DOEPTSIZ15	0xCF0		Device OUT Endpoint Transfer Size Register 15
DOEPDMA15	0xCF4		Device OUT Endpoint DMA Address Register 15
PCGCCTL	0xE00		Power and Clock Gating Control Register
GSTARFXDIS	0xF00		Global STAR Fix Disable Register
DWCOTGDFIFO[n].DATA[o]	0x1000		Data FIFO Access Register Map 0
DWCOTGDFIFODIRECTACCESS.DATA[n]	0x11000		Data FIFO Direct Access Register Map

8.27.5.1 GOTGCTL

Address offset: 0x000

Control and Status Register

The OTG Control and Status register controls the behavior and reflects the status of the OTG function of the controller.

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID								P	O	N	N	N	N	M	L	K	J	I	H	G								F	E	D	C	B	A		
Reset 0x000D0000					**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value	Description																														
A	RW	VBVALIDOVEN			Mode: Host only. VBUS Valid Override Enable (VbvalidOvEn) This bit is used to enable/disable the software to override the Bvalid signal using the GOTGCTL.VbvalidOvVal.																																
			DISABLED	0	Override is disabled and bvalid signal from the respective PHY selected is used internally by the controller																																
			ENABLED	1	The vbus-valid signal received from the PHY is overridden with GOTGCTL.VbvalidOvVal																																
B	RW	VBVALIDOVVAL			Mode: Host only. VBUS Valid OverrideValue (VbvalidOvVal) This bit is used to set Override value for vbusvalid signal when GOTGCTL.VbvalidOvEn is set.																																
			SET0	0	vbusvalid value when GOTGCTL.VbvalidOvEn = 1																																
			SET1	1	vbusvalid value when GOTGCTL.VbvalidOvEn is 1																																
C	RW	AVALIDOVEN			Mode: Host only. A-Peripheral Session Valid Override Enable (AvalidOvEn) This bit is used to enable/disable the software to override the Avalid signal using the GOTGCTL.AvalidOvVal.																																
			DISABLED	0	Derive AValid from PHY																																
			ENABLED	1	Derive Avalid from GOTGCTL.AvalidOvVal																																
D	RW	AVALIDOVVAL			Mode: Host only. A-Peripheral Session Valid OverrideValue (AvalidOvVal) This bit is used to set Override value for Avalid signal when GOTGCTL.AvalidOvEn is set.																																
			VALUE0	0	Avalid value is 1'b0 when GOTGCTL.AvalidOvEn =1																																
			VALUE1	1	Avalid value is 1'b1 when GOTGCTL.AvalidOvEn =1																																
E	RW	BVALIDOVEN			Mode: Device only. B-Peripheral Session Valid Override Value (BvalidOvEn) This bit is used to enable/disable the software to override the Bvalid signal using the GOTGCTL.BvalidOvVal.																																
			DISABLED	0	Override is disabled and bvalid signal from the respective PHY selected is used internally by the core																																
			ENABLED	1	Internally Bvalid received from the PHY is overridden with GOTGCTL.BvalidOvVal																																
F	RW	BVALIDOVVAL			Mode: Device only. B-Peripheral Session Valid OverrideValue (BvalidOvVal) This bit is used to set Override value for Bvalid signal when GOTGCTL.BvalidOvEn is set.																																
			VALUE0	0	Bvalid value when GOTGCTL.BvalidOvEn =1																																
			VALUE1	1	Bvalid value when GOTGCTL.BvalidOvEn =1																																
G	RW	DBNCEFLTRBYPASS			Mode: Host and Device. Debounce Filter Bypass Bypass Debounce filters for avalid, bvalid, vbusvalid, sessend, iddig signals when enabled. Note: This register bit is valid only when debounce filters are present in core.																																
			DISABLED	0	Debounce Filter Bypass is disabled.																																
			ENABLED	1	Debounce Filter Bypass is enabled.																																

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N N N N M L K J I H G F E D C B A
Reset 0x000D0000				**0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
H	R	CONIDSTS			Mode: Host and Device. Connector ID Status (ConIDSts) Indicates the connector ID status on a connect event. Note: The reset value of this register field can be read only after the PHY clock is stable, or if IDDIG_FILTER is enabled, wait for the filter timer to expire to read the correct reset value which ever event is later. Reset: - 1'b0: in host only mode (OTG_MODE = 5 or 6) - 1'b1: in all other configurations
			MODEA	0	The core is in A-Device mode.
			MODEB	1	The core is in B-Device mode.
I	R	DBNCTIME			Mode: Host only. Long/Short Debounce Time (DbncTime) Indicates the debounce time of a detected connection.
			LONG	0	Long debounce time, used for physical connections (100 ms + 2.5 micro-sec)
			SHORT	1	Short debounce time, used for soft connections (2.5 micro-sec)
J	R	ASESVLD			Mode: Host only. A-Session Valid (ASesVld) Indicates the Host mode transceiver status. Note: If you do not enabled OTG features (such as SRP and HNP), the read reset value will be 1. The vbus assigns the values internally for non-SRP or non-HNP configurations. In case of OTG_MODE=0, the reset value of this bit is 1'b0.
			NOTVALID	0	A-session is not valid.
			VALID	1	A-session is valid.
K	R	BSESVLD			Mode: Device only. B-Session Valid (BSesVld) Indicates the Device mode transceiver status. In OTG mode, you can use this bit to determine if the device is connected or disconnected. Note: - If you do not enable OTG features (such as SRP and HNP), the read reset value will be 1.The vbus assigns the values internally for non- SRP or non-HNP configurations. - In case of OTG_MODE=0, the reset value of this bit is 1'b0. - The reset value of this register field can be read only after the PHY clock is stable, or if IDDIG_FILTER is enabled, wait for the filter timer to expire to read the correct reset value which ever event is later.
			NOTVALID	0	B-session is not valid.
			VALID	1	B-session is valid.
L	RW	OTGVER			OTG Version (OTGVer) Indicates the OTG revision.
			VER13	0	Supports OTG Version 1.3
			VER20	1	Supports OTG Version 2.0
M	R	CURMOD			Current Mode of Operation (CurMod) Mode: Host and Device Indicates the current mode. Reset: Note: The reset value of this register field can be read only after the PHY clock is stable, or if IDDIG_FILTER is enabled, wait for the filter timer to expire to read the correct reset value which ever event is later.
			DEVICEMODE	0	Current mode is device mode.
			HOSTMODE	1	Current mode is host mode.
N	R	MULTVALIDBC			Mode: Host and Device. Multi Valued ID pin (MultValIdBC) Battery Charger ACA inputs in the following order:
			RIDC	1	B-Device connected to ACA. VBUS is on.
			RIDB	2	B-Device connected to ACA. VBUS is off.
			RIDA	4	A-Device connected to ACA
			RIDGND	8	A-Device not connected to ACA
			RIDFLOAT	16	B-Device not connected to ACA

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N N N N N M L K J I H G F E D C B A
Reset 0x000D0000				**0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
O	RW	CHIRPEN			Mode: Device Only. This bit when programmed to 1'b1 results in the core asserting chirp_on before sending an actual Chirp "K" signal on USB. This bit is present only if OTG_BC_SUPPORT = 1.If OTG_BC_SUPPORT!=1, this bit is a reserved bit. Do not set this bit when core is operating in HSIC mode because HSIC always operates at High Speed and High speed chirp is not used
			CHIRPDISABLE	0	The controller does not assert chirp_on before sending an actual Chirp "K" signal on USB.
			CHIRPENABLE	1	The controller asserts chirp_on before sending an actual Chirp "K" signal on USB.
P	RW	EUSB2PHYDISCSUPP			This field is only applicable to Device mode and must be set to 1'b1 if eUSB2 PHY is used.
			DISABLED	0	Device disconnect detection using GINTSTS.USBRst interrupt when not in hibernation and GPWRDN.ResetDetected when in hibernation
			ENABLED	1	Device disconnect detection using GOTGINT.SesEEndDet interrupt when not in hibernation and GPWRDN.StsChngInt when in hibernation

8.27.5.2 GOTGINT

Address offset: 0x004

Interrupt Register

The application reads this register whenever there is an OTG interrupt and clears the bits in this register to clear the OTG interrupt.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	SESENDDET			Mode: Host and Device. Session End Detected (SesEndDet) The controller sets this bit when the utmiotg_bvalid signal is deasserted. This bit can be set only by the core and the application must write 1 to clear it.
			INACTIVE	0	Session is Active
			ACTIVE	1	SessionEnd utmiotg_bvalid signal is deasserted
B	RW	SESREQSUCSTSCHNG			Mode: Host and Device. Session Request Success Status Change (SesReqSucStsChng) The core sets this bit on the success or failure of a session request. The application must read the Session Request Success bit in the OTG Control and Status register (GOTGCTL.SesReqScs) to check for success or failure. This bit can be set only by the core and the application must write 1 to clear it.
			INACTIVE	0	No Change in Session Request Status
			ACTIVE	1	Session Request Status has changed

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID												G	F	E	D								C	B						A		
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	RW	HSTNEGSUCSTSCHNG			Mode: Host and Device. Host Negotiation Success Status Change (HstNegSucStsChng) The core sets this bit on the success or failure of a USB host negotiation request. The application must read the Host Negotiation Success bit of the OTG Control and Status register (GOTGCTL.HstNegScs) to check for success or failure. This bit can be set only by the core and the application must write 1 to clear it.
			INACTIVE	0	No Change
			ACTIVE	1	Host Negotiation Status Change
D	RW	HSTNEGDET			Mode:Host and Device. Host Negotiation Detected (HstNegDet) The core sets this bit when it detects a host negotiation request on the USB. This bit can be set only by the core and the application must write 1 to clear it.
			INACTIVE	0	No Active HNP Request
			ACTIVE	1	Active HNP request detected
E	RW	ADEVTOUTCHG			Mode: Host and Device. A-Device Timeout Change (ADevTOUTChg) The core sets this bit to indicate that the A-device has timed out while waiting for the B-device to connect.This bit can be set only by the core and the application must write 1 to clear it.
			INACTIVE	0	No A-Device Timeout
			ACTIVE	1	A-Device Timeout
F	RW	DBNCEDONE			Mode: Host only. Debounce Done (DbnceDone) The core sets this bit when the debounce is completed after the device connect. The application can start driving USB reset after seeing this interrupt. This bit is only valid when the HNP Capable or SRP Capable bit is SET in the Core USB Configuration register (GUSBCFG.HNPCap or GUSBCFG.SRPCap, respectively). This bit can be set only by the core and the application must write 1 to clear it.
			INACTIVE	0	After Connect waiting for Debounce to complete
			ACTIVE	1	Debounce completed
G	RW	MULTVALIPCHNG			This bit when set indicates that there is a change in the value of at least one ACA pin value. This bit is present only if OTG_BC_SUPPORT=1, otherwise it is reserved.
			NOACAPINCHANGE	0	Indicates there is no change in ACA pin value
			ACAPINCHANGE	1	Indicates there is a change in ACA pin value

8.27.5.3 GAHBCFG

Address offset: 0x008

AHB Configuration Register

This register can be used to configure the core after power-on or a change in mode. This register mainly contains AHB system-related configuration parameters. Do not change this register after the initial programming. The application must program this register before starting any transactions on either the AHB or the USB.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID							J	J	I	I		H	G	F													E	D		C	B	B	B	B	A
Reset 0x0A000000				**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
				Description																															
A	RW	GLBLINTRMSK																																	
				Mode: Host and device. Global Interrupt Mask (GlblIntrMsk)																																	
				The application uses this bit to mask or unmask the interrupt line assertion to itself. Irrespective of this bit's setting, the interrupt status registers are updated by the controller.																																	
			MASK	0																																	
				Mask the interrupt assertion to the application																																	
			NOMASK	1																																	
				Unmask the interrupt assertion to the application.																																	
B	RW	HBSTLEN																																	
				Mode: Host and device. Burst Length/Type (HBstLen)																																	
				This field is used in both External and Internal DMA modes. In External DMA mode, these bits appear on dma_burst[3:0] ports, which can be used by an external wrapper to interface the External DMA Controller interface to Synopsys DW_ahb_dmac or ARM PrimeCell. External DMA Mode defines the DMA burst length in terms of 32-bit words: Internal DMA Mode AHB Requester burst type:																																	
			WORD1ORSINGLE	0																																	
				1 word or single																																	
			WORD4ORINCR	1																																	
				4 words or INCR																																	
			WORD8	2																																	
				8 words																																	
			WORD16ORINCR4	3																																	
				16 words or INCR4																																	
			WORD32	4																																	
				32 words																																	
			WORD64ORINCR8	5																																	
				64 words or INCR8																																	
			WORD128	6																																	
				128 words																																	
			WORD256ORINCR16	7																																	
				256 words or INCR16																																	
			WORDX	8																																	
				Others reserved																																	
C	RW	DMAEN																																	
				Mode: Host and device. DMA Enable (DMAEn)																																	
				This bit is always 0 when Completer-Only mode has been selected.																																	
			COMPLETERMODE	0																																	
				Core operates in Completer mode																																	
			DMAMODE	1																																	
				Core operates in a DMA mode																																	
D	RW	NPTXFEMPLVL																																	
				Mode: Host and device. Non-Periodic TxFIFO Empty Level (NPTxFEmpLvl)																																	
				This bit is used only in Completer mode. In host mode and with Shared FIFO with device mode, this bit indicates when the Non-Periodic TxFIFO Empty Interrupt bit in the Core Interrupt register (GINTSTS.NPTxFEmp) is triggered. With dedicated FIFO in device mode, this bit indicates when IN endpoint Transmit FIFO empty interrupt (DIEPINTn.TxFEmp) is triggered. Host mode and with Shared FIFO with device mode: Dedicated FIFO in device mode:																																	
			HALFEMPTY	0																																	
				DIEPINTn.TxFEmp interrupt indicates that the Non-Periodic TxFIFO is half empty or that the IN Endpoint TxFIFO is half empty.																																	
			EMPTY	1																																	
				GINTSTS.NPTxFEmp interrupt indicates that the Non-Periodic TxFIFO is completely empty or that the IN Endpoint TxFIFO is completely empty.																																	
E	RW	PTXFEMPLVL																																	
				Mode: Host only. Periodic TxFIFO Empty Level (PTxFEmpLvl)																																	
				Indicates when the Periodic TxFIFO Empty Interrupt bit in the Core Interrupt register (GINTSTS.PTxFEmp) is triggered. This bit is used only in Completer mode.																																	
			HALFEMPTY	0																																	
				GINTSTS.PTxFEmp interrupt indicates that the Periodic TxFIFO is half empty.																																	
			EMPTY	1																																	
				GINTSTS.PTxFEmp interrupt indicates that the Periodic TxFIFO is completely empty.																																	

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				J	J	I	I		H	G	F													E	D		C	B	B	B	B	A
Reset 0x0A000000	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	REMMEMSUPP			Mode: Host and Device. Remote Memory Support (RemMemSupp) This bit is programmed to enable the functionality to wait for the system DMA Done Signal for the DMA Write Transfers. - GAHBCFG.RemMemSupp=1 The int_dma_req output signal is asserted when the DMA starts write transfer to the external memory. When the core is done with the Transfers it asserts int_dma_done signal to flag the completion of DMA writes from the controller. The core then waits for sys_dma_done signal from the system to proceed further and complete the Data Transfer corresponding to a particular Channel/Endpoint. - GAHBCFG.RemMemSupp=0 The int_dma_req and int_dma_done signals are not asserted and the core proceeds with the assertion of the XferComp interrupt as soon as the DMA write transfer is done at the Core Boundary and it does not wait for the sys_dma_done signal to complete the DATA transfers.
			DISABLED	0	Remote Memory Support Feature disabled
			ENABLED	1	Remote Memory Support Feature enabled
G	RW	NOTIALLDMAWRIT			Mode: Host and Device. Notify All DMA Write Transactions (NotiAllDmaWrit) This bit is programmed to enable the System DMA Done functionality for all the DMA write Transactions corresponding to the Channel/ Endpoint. This bit is valid only when GAHBCFG.RemMemSupp is set to 1. - GAHBCFG.NotiAllDmaWrit = 1 The core asserts int_dma_req for all the DMA write transactions on the AHB interface along with int_dma_done, chep_last_transact and chep_number signal informations. The core waits for sys_dma_done signal for all the DMA write transactions in order to complete the transfer of a particular Channel/Endpoint. - GAHBCFG.NotiAllDmaWrit = 0 The core asserts int_dma_req signal only for the last transaction of DMA write transfer corresponding to a particular Channel/Endpoint. Similarly, the core waits for sys_dma_done signal only for that transaction of DMA write to complete the transfer of a particular Channel/Endpoint.
			LASTTRANS	0	
			ALLTRANS	1	The core asserts int_dma_req for all the DMA write transactions on the AHB interface along with int_dma_done, chep_last_transact and chep_number signal informations. The core waits for sys_dma_done signal for all the DMA write transactions in order to complete the transfer of a particular Channel/ Endpoint
H	RW	AHBSINGLE			Mode: Host and Device. AHB Single Support (AHBSingle) This bit when programmed supports Single transfers for the remaining data in a transfer when the core is operating in DMA mode. Note: If this feature is enabled, the AHB RETRY and SPLIT transfers still have INCR burst type. Enable this feature when the AHB Completer connected to the core does not support INCR burst (and when Split, and Retry transactions are not being used in the bus).
			INCRBURST	0	The remaining data in the transfer is sent using INCR burst size
			SINGLEBURST	1	The remaining data in the transfer is sent using Single burst size

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID							J	J	I	I		H	G	F													E	D		C	B	B	B	B	A
Reset 0x0A000000				**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value								Description																							
I	RW	LOAEOPCHECKCLKSBYTE										Mode: Host. Number of clock cycles to check for EOP SE0 for LOA logic Note: - This field only affects USB2.0 FS operation in UTMI 8bit mode. The mac_prt logic checks for the programmed number of clocks of SE0 to validate an EOP for a packet. - The actual number of clocks checked will be the value programmed plus 1. So a value 1 results in checking for 2 clocks of SE0. Value of 3 checks 4 clocks of SE0 and so on. - The default value is 1, which results in 2 clocks of SE0 check.																					
			ONE	1								Check for 2 clocks of EOP SE0																							
			TWO	2								Check for 3 clocks of EOP SE0																							
J	RW	LOAEOPCHECKCLKSWORD										Mode: Host. Number of clock cycles to check for EOP SE0 for LOA logic Note: - This field only affects USB2.0 FS operation in UTMI 16bit mode. The mac_prt logic checks for the programmed number of clocks of SE0 to validate an EOP for a packet. - The actual number of clocks checked will be the value programmed plus 1. So a value 1 results in checking for 2 clocks of SE0. Value of 3 checks 4 clocks of SE0 and so on. - The default value is 1, which results in 2 clocks of SE0 check.																					
			ONE	1								Check for 2 clocks of EOP SE0																							
			TWO	2								Check for 3 clocks of EOP SE0																							

8.27.5.4 GUSBCFG

Address offset: 0x00C

USB Configuration Register

This register can be used to configure the core after power-on or when changing to Host mode or Device mode. It contains USB and USB-PHY related configuration parameters. The application must program this register before starting any transactions on either the AHB or the USB. If you are using the HSIC interface, HSIC PHY must be in reset while programming this register. Do not make changes to this register after the initial programming.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				M	L	K	J		I				H							G		F	F	F	F				E	D	C	B	A	A	A
Reset 0x10001400				**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value								Description																							
A	RW	TOUTCAL										Mode: Host and Device. HS/FS Timeout Calibration (TOutCal) The number of PHY clocks that the application programs in this field is added to the high-speed/full-speed interpacket timeout duration in the core to account for any additional delays introduced by the PHY. This can be required, because the delay introduced by the PHY in generating the linestate condition can vary from one PHY to another. The USB standard timeout value for high-speed operation is 736 to 816 (inclusive) bit times. The USB standard timeout value for full-speed operation is 16 to 18 (inclusive) bit times. The application must program this field based on the speed of enumeration. The number of bit times added per PHY clock are as follows: High-speed operation: - One 30-MHz PHY clock = 16 bit times - One 60-MHz PHY clock = 8 bit times Full-speed operation: - One 30-MHz PHY clock = 0.4 bit times - One 60-MHz PHY clock = 0.2 bit times - One 48-MHz PHY clock = 0.25 bit times																					
			ZERO	0								Add 0 PHY clocks																							

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				M	L	K	J		I				H							G		F	F	F	F				E	D	C	B	A	A	A
Reset 0x10001400				**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
			ONE	1																															
			TWO	2																															
			THREE	3																															
			FOUR	4																															
			FIVE	5																															
			SIX	6																															
			SEVEN	7																															
B	RW	PHYIF																																	
				The application uses this bit to configure the core to support a UTMI+ PHY with an 8- or 16-bit interface. When a ULPI PHY is chosen, this must be Set to 8-bit mode. This bit is writable only If UTMI+ and ULPI were selected. Otherwise, this bit returns the value for the power-on interface selected during configuration.																																
			BITS8	0																															
			BITS16	1																															
C	R	ULPIUTMISEL																																	
				The application uses this bit to select either a UTMI+ interface or ULPI Interface.																																	
			UTMI	0																															
			ULPI	1																															
D	R	FSINTF																																	
				The application uses this bit to select either a unidirectional or bidirectional USB 1.1 full-speed serial transceiver interface. If a USB 1.1 Full-Speed Serial Transceiver interface was not selected, this bit is always 0, with Write Only access. If a USB 1.1 FS interface was selected, Then the application can Set this bit to select between the 3- and 6-pin interfaces, and access is Read and Write. Note: For supporting the new 4-pin bi-directional interface, you need to select 6-pin unidirectional FS serial mode, and add an external control to convert it to a 4-pin interface.																																
			FS6PIN	0																															
			FS3PIN	1																															
E	R	PHYSEL																																	
				Mode: Host and Device USB 2.0 High-Speed PHY or USB 1.1 Full-Speed Serial Transceiver Select (PHYSel) The application uses this bit to select either a high-speed UTMI+ or ULPI PHY, or a full-speed transceiver. If a USB 1.1 Full-Speed Serial Transceiver interface was not selected in, this bit is always 0, with Write Only access. If a high-speed PHY interface was not selected in, this bit is always 1, with Write Only access. If both interface types were selected (parameters have non-zero values), the application uses this bit to select which interface is active, and access is Read and Write.																																
			USB20	0																															
			USB11	1																															

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J		I				H							G		F	F	F	F				E	D	C	B	A	A	A
Reset 0x10001400	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	USBTRDTIM			Mode: Device only. USB Turnaround Time (USBTrdTim) Sets the turnaround time in PHY clocks. Specifies the response time for a MAC request to the Packet FIFO Controller (PFC) to fetch data from the DFIFO (SPRAM). This must be programmed to Note:Refer to Programming Guide Section "Choosing the Value of GUSBCFG.USBTrdTim" for the turnaround time calculation. During the AHB Clock Frequency selection, it is recommended to consider mis-sampling into account for USBTrdTim. USB turnaround time is critical for certification where long cables and 5-Hubs are used. If you need the AHB to run at less than 30 MHz (or less than 42MHz when operating in 16-bit UTMI mode in HS speed), and if USB turnaround time is not critical, these bits can be programmed to a larger value.
			TURNTIME16BIT	5	MAC interface is 16-bit UTMI+.
			TURNTIME8BIT	9	MAC interface is 8-bit UTMI+.
G	RW	PHYLPWRCLKSEL			PHY Low-Power Clock Select (PhyLPwrClkSel) Mode: Host and Device Selects either 480-MHz or 48-MHz (low-power) PHY mode. In FS and LS modes, the PHY can usually operate on a 48-MHz clock to save power. In 480 MHz mode, the UTMI interface operates at either 60 or 30-MHz, depending upon whether 8- or 16-bit data width is selected. In 48-MHz mode, the UTMI interface operates at 48 MHz in FS mode and at either 48 or 6 MHz in LS mode (depending on the PHY vendor). This bit drives the utmi_fsls_low_power core output signal, and is valid only for UTMI+ PHYs.
			INTPLLCLK	0	480-MHz Internal PLL clock
			EXTCLK	1	48-MHz External Clock
H	RW	TERMSELDLPULSE			Mode: Device only. TermSel DLine Pulsing Selection (TermSelDLPulse) This bit selects utmi_termselect to drive data line pulse during SRP.
			TXVALID	0	Data line pulsing using utmi_txvalid
			TERMSEL	1	Data line pulsing using utmi_termsel
I	R	ICUSBCAP			Mode: Host and Device. IC_USB-Capable (IC_USBCap) The application uses this bit to control the core's IC_USB capabilities. This bit is writable only if OTG_ENABLE_IC_USB=1 and OTG_FSPHY_INTERFACE!=0. The reset value depends on the configuration parameter OTG_SELECT_IC_USB when OTG_ENABLE_IC_USB = 1. In all other cases, this bit is set to 1'b0 and the bit is read only.
			NOTSELECTED	0	IC_USB PHY Interface is not selected
			SELECTED	1	IC_USB PHY Interface is selected
J	RW	TXENDDELAY			Mode: Device only. Tx End Delay (TxEndDelay) Setting this bit to 1'b1 enables the controller to follow the TxEndDelay timings as per UTMI+ specification 1.05 section 4.1.5 for opmode signal during remote wakeup. The default value of this field is 1'b1 and it is not recommended to program it to 1'b0. The option to set it to 1'b0 (Normal Mode) is present only for debug purpose.
			DISABLED	0	Normal Mode
			ENABLED	1	Tx End delay

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				M	L	K	J		I				H							G		F	F	F	F			E	D	C	B	A	A	A
Reset 0x10001400				**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
K	RW	FORCEHSTMODE																																	
			DISABLED	0																															
			ENABLED	1																															
L	RW	FORCEDEVMODE																																	
			DISABLED	0																															
			ENABLED	1																															
M	W	CORRUPTTXPKT																																	
			Disabled	0																															
			Enabled	1																															

8.27.5.5 GRSTCTL

Address offset: 0x010

Reset Register

The application uses this register to reset various hardware features inside the controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	J	I	H																G	G	G	F	F	F	F	F	E	D		C	B	A
Reset 0x80000000	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CSFTRST			Mode: Host and Device. Core Soft Reset (CSftRst) Resets the hclk and phy_clock domains as follows: - Clears the interrupts and all the CSR registers except the following register bits: -- PCGCCTL.RstPdwnModule -- PCGCCTL.GateHclk -- PCGCCTL.PwrClmp -- PCGCCTL.StopPPhyLPwrClkSelclk -- GUSBCFG.ForceDevMode -- GUSBCFG.ForceHstMode -- GUSBCFG.PhyLPwrClkSel -- GUSBCFG.DDRSel -- GUSBCFG.PHYSel -- GUSBCFG.FSIntf -- GUSBCFG.ULPI_UTMI_Sel -- GUSBCFG.PHYIf -- GUSBCFG.TxEndDelay -- GUSBCFG.TermSelDLPulse -- GUSBCFG.ULPIClkSusM -- GUSBCFG.ULPIAutoRes -- GUSBCFG.ULPIFsLs -- GGPIO -- GPWRDN -- GADPCTL -- HCFG.FSLSPclkSel -- DCFG.DevSpd -- DCTL.SftDiscon - All module state machines - All module state machines (except the AHB Completer Unit) are reset to the IDLE state, and all the transmit FIFOs and the receive FIFO are flushed. - Any transactions on the AHB Requester are terminated as soon as possible, after gracefully completing the last data phase of an AHB transfer. Any transactions on the USB are terminated immediately. - When Hibernation or ADP feature is enabled, the PMU module is not reset by the Core Soft Reset. The application can write to this bit any time it wants to reset the core. The application must clear this bit after checking the bit 29 of this register (Core Soft Reset Done). Software must also must check that bit 31 of this register is 1 (AHB Requester is IDLE) before starting any operation. Typically software reset is used during software development and also when you dynamically change the PHY selection bits in the USB configuration registers listed above. When you change the PHY, the corresponding clock for the PHY is selected and used in the PHY domain. Once a new clock is selected, the PHY domain has to be reset for proper operation.
			NOTACTIVE	0	No reset
			ACTIVE	1	Resets hclk and phy_clock domains
B	RW	PIUFSSFTRST			Mode: Host and Device. PIU FS Dedicated Controller Soft Reset (PIUFSSftRst) Resets the PIU FS Dedicated Controller All module state machines in FS Dedicated Controller of PIU are reset to the IDLE state. Used to reset the FS Dedicated controller in PIU in case of any PHY Errors like Loss of activity or Babble Error resulting in the PHY remaining in RX state for more than one frame boundary. This is a self clearing bit and core clears this bit after all the necessary logic is reset in the core.
			RESETINACTIVE	0	No Reset
			RESETACTIVE	1	PIU FS Dedicated Controller Soft Reset
C	RW	FRMCNTRRST			Mode: Host only. Host Frame Counter Reset (FrmCntrRst) The application writes this bit to reset the (micro)Frame number counter inside the core. When the (micro)Frame counter is reset, the subsequent SOF sent out by the core has a (micro)Frame number of 0. When application writes 1 to the bit, it might not be able to read back the value as it gets cleared by the core in a few clock cycles.
			NOTACTIVE	0	No reset
			ACTIVE	1	Host Frame Counter Reset

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	J	I	H																G	G	G	F	F	F	F	E	D		C	B	A
Reset 0x80000000	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
D	RW	RXFFLSH			Mode: Host and Device. RxFIFO Flush (RxFFlsh) The application can flush the entire RxFIFO using this bit, but must first ensure that the core is not in the middle of a transaction. The application must only write to this bit after checking that the controller is neither reading from the RxFIFO nor writing to the RxFIFO. The application must wait until the bit is cleared before performing any other operations. This bit requires eight clocks (slowest of PHY or AHB clock) to clear.
			INACTIVE	0	Does not flush the entire RxFIFO
			ACTIVE	1	Flushes the entire RxFIFO
E	RW	TXFFLSH			Mode: Host and Device. TxFIFO Flush (TxFFlsh) This bit selectively flushes a single or all transmit FIFOs, but cannot do so If the core is in the midst of a transaction. The application must write this bit only after checking that the core is neither writing to the TxFIFO nor reading from the TxFIFO. Verify using these registers: - ReadNAK Effective Interrupt ensures the core is not reading from the FIFO - WriteGRSTCTL.AHBIdle ensures the core is not writing anything to the FIFO. Flushing is normally recommended when FIFOs are reconfigured or when switching between Shared FIFO and Dedicated Transmit FIFO operation. FIFO flushing is also recommended during device endpoint disable. The application must wait until the core clears this bit before performing any operations. This bit takes eight clocks to clear, using the slower clock of phy_clk or hclk.
			INACTIVE	0	No Flush
			ACTIVE	1	Selectively flushes a single or all transmit FIFOs
F	RW	TXFNUM			Mode: Host and Device. TxFIFO Number (TxFNum) This is the FIFO number that must be flushed using the TxFIFO Flush bit. This field must not be changed until the core clears the TxFIFO Flush bit. -- Non-periodic TxFIFO flush in Host mode -- Non-periodic TxFIFO flush in device mode when in shared FIFO operation -- Tx FIFO 0 flush in device mode when in dedicated FIFO mode -- Periodic TxFIFO flush in Host mode -- Periodic TxFIFO 1 flush in Device mode when in shared FIFO operation -- TXFIFO 1 flush in device mode when in dedicated FIFO mode -- Periodic TxFIFO 2 flush in Device mode when in shared FIFO operation -- TXFIFO 2 flush in device mode when in dedicated FIFO mode ... -- Periodic TxFIFO 15 flush in Device mode when in shared FIFO operation -- TXFIFO 15 flush in device mode when in dedicated FIFO mode
			TXF0	0	-Periodic TxFIFO flush in host mode -Periodic TxFIFO 0 flush in device mode when in shared FIFO operation -TXFIFO 0 flush in device mode when in dedicated FIFO mode
			TXF1	1	-Periodic TxFIFO flush in host mode -Periodic TxFIFO 1 flush in device mode when in shared FIFO operation -TXFIFO 1 flush in device mode when in dedicated FIFO mode
			TXF2	2	-Periodic TxFIFO 2 flush in device mode when in shared FIFO operation -TXFIFO 2 flush in device mode when in dedicated FIFO mode
			TXF3	3	-Periodic TxFIFO 3 flush in device mode when in shared FIFO operation -TXFIFO 3 flush in device mode when in dedicated FIFO mode
			TXF4	4	-Periodic TxFIFO 4 flush in device mode when in shared FIFO operation -TXFIFO 4 flush in device mode when in dedicated FIFO mode
			TXF5	5	-Periodic TxFIFO 5 flush in device mode when in shared FIFO operation -TXFIFO 5 flush in device mode when in dedicated FIFO mode

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	J	I	H																G	G	G	F	F	F	F	E	D		C	B	A
Reset 0x80000000	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
			TXF6	6	-Periodic TxFIFO 6 flush in device mode when in shared FIFO operation - TXFIFO 6 flush in device mode when in dedicated FIFO mode
			TXF7	7	-Periodic TxFIFO 7 flush in device mode when in shared FIFO operation - TXFIFO 7 flush in device mode when in dedicated FIFO mode
			TXF8	8	-Periodic TxFIFO 8 flush in device mode when in shared FIFO operation - TXFIFO 8 flush in device mode when in dedicated FIFO mode
			TXF9	9	-Periodic TxFIFO 9 flush in device mode when in shared FIFO operation - TXFIFO 9 flush in device mode when in dedicated FIFO mode
			TXF10	10	-Periodic TxFIFO 10 flush in device mode when in shared FIFO operation - TXFIFO 10 flush in device mode when in dedicated FIFO mode
			TXF11	11	-Periodic TxFIFO 11 flush in device mode when in shared FIFO operation - TXFIFO 11 flush in device mode when in dedicated FIFO mode
			TXF12	12	-Periodic TxFIFO 12 flush in device mode when in shared FIFO operation - TXFIFO 12 flush in device mode when in dedicated FIFO mode
			TXF13	13	-Periodic TxFIFO 13 flush in Device mode when in shared FIFO operation - TXFIFO 13 flush in device mode when in dedicated FIFO mode
			TXF14	14	-Periodic TxFIFO 14 flush in Device mode when in shared FIFO operation - TXFIFO 14 flush in device mode when in dedicated FIFO mode
			TXF15	15	-Periodic TxFIFO 15 flush in Device mode when in shared FIFO operation - TXFIFO 15 flush in device mode when in dedicated FIFO mode
			TXF16	16	Flush all the transmit FIFOs in device or host mode
G	RW	CLOCKSWITCHTIMER			This field is applicable if the controller is configured with multiple PHY interfaces. It must be programmed before programming the required PHY interface in GUSBCFG register. Host Mode: Set this field to 3'b111 if: - The clock from the previous PHY is OFF before switching to the new PHY. Set this field to 3'b010 if all the below conditions are satisfied: - (OTG_FSPHY_INTERFACE != 0 && OTG_HSPHY_INTERFACE !=0) - USB1.1 FS Serial PHY will be used (i.e., GUSBCFG.PHYSel = 1'b1). - Clock from previous PHY is not OFF before switching to the new PHY. This field need not be programmed in other cases. Device Mode: Set this field to 3'b111 if: - The clock from the previous PHY is off before switching to the new PHY. Set this field to 3'b010 if all the below conditions are satisfied: - (OTG_FSPHY_INTERFACE != 0 && OTG_HSPHY_INTERFACE !=0) - USB1.1 FS Serial PHY will be used (i.e., GUSBCFG.PHYSel = 1'b1) - DCFG.DevSpd = 2'b10. - Clock from previous PHY is not OFF before switching to the new PHY. This field need not be programmed in other cases. Note: This field is not required to be programmed if Shared PHY interface is not configured.
			TIMERVALUE19	0	timer value set to 19
			TIMERVALUE15	1	timer value set to 15
			TIMERVALUE147	2	timer value set to 147
			TIMERVALUE50	3	timer value set to 50
			TIMERVALUE100	4	timer value set to 100
			TIMERVALUE125	5	timer value set to 125
			TIMERVALUE200	6	timer value set to 200
			TIMERDISABLED	7	timer is disabled
H	RW	CSFTRSTDONE			Mode: Host and Device. Core Soft Reset Done (CSftRstDone) The core sets this bit when all the necessary logic is reset in the core.This bit is cleared by the application along with GRSTCTL.CSftRst (bit 0)
			INACTIVE	0	No reset

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				J I H G G G F F F F E D C B A
Reset 0x80000000				**1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			ACTIVE	1	Core Soft Reset is done
I	R	DMAREQ			Mode: Host and Device. DMA Request Signal (DMAReq) Indicates that the DMA request is in progress. Used for debug.
			INACTIVE	0	No DMA request
			ACTIVE	1	DMA request is in progress
J	R	AHBIDLE			Mode: Host and Device. AHB Requester Idle (AHBIdle) Indicates that the AHB Requester State Machine is in the IDLE condition.
			INACTIVE	0	Not Idle
			ACTIVE	1	AHB Requester Idle

8.27.5.6 GINTSTS

Address offset: 0x014

Interrupt STATUS Register

This register interrupts the application for system-level events in the current mode (Device mode or Host mode). Some of the bits in this register are valid only in Host mode, while others are valid in Device mode only. This register also indicates the current mode. To clear the interrupt status bits of type R_SS_WC, the application must write 1'b1 to the bit. The FIFO status interrupts are read only; once software reads from or writes to the FIFO while servicing these interrupts, FIFO interrupt conditions are cleared automatically. The application must clear the GINTSTS register at initialization before unmasking the interrupt bit to avoid any interrupts generated prior to initialization. Note: Read the reset value of GINTSTS.CurMod only after the following conditions: - If IDDIG_FILTER is disabled, read only after PHY clock is stable. - If IDDIG_FILTER is enabled, read only after the filter timer expires.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x04000020				**0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	CURMOD			Mode: Host and Device. Current Mode of Operation (CurMod) Indicates the current mode. Note: The reset value of this register field can be read only after the PHY clock is stable, or if IDDIG_FILTER is enabled, wait for the filter timer to expire to read the correct reset value which ever event is later.
			DEVICE	0	Device mode
			HOST	1	Host mode
B	RW	MODEMIS			Mode: Host and Device. Mode Mismatch Interrupt (ModeMis) The core sets this bit when the application is trying to access: - A Host mode register, when the controller is operating in Device mode - A Device mode register, when the controller is operating in Host mode The register access is completed on the AHB with an OKAY response, but is ignored by the controller internally and does not affect the operation of the controller. This bit can be set only by the core and the application must write 1 to clear it.
			INACTIVE	0	No Mode Mismatch Interrupt
			ACTIVE	1	Mode Mismatch Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I			H	G	F	E	D	C	B	A
Reset 0x04000020	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	R	OTGINT			Mode: Host and Device. OTG Interrupt (OTGInt) The controller sets this bit to indicate an OTG protocol event. The application must read the OTG Interrupt Status (GOTGINT) register to determine the exact event that caused this interrupt. The application must clear the appropriate status bit in the GOTGINT register to clear this bit.
			INACTIVE	0	No Interrupt
			ACTIVE	1	OTG Interrupt
D	RW	SOF			Mode: Host and Device. Start of (micro)Frame (Sof) In Host mode, the core sets this bit to indicate that an SOF (FS), micro-SOF (HS), or Keep-Alive (LS) is transmitted on the USB. The application must write a 1 to this bit to clear the interrupt. In Device mode, the controller sets this bit to indicate that an SOF token has been received on the USB. The application can read the Device Status register to get the current (micro)Frame number. This interrupt is seen only when the core is operating at either HS or FS. This bit can be set only by the core and the application must write 1 to clear it. Note: This register may return 1'b1 if read immediately after power-on reset. If the register bit reads 1'b1 immediately after power-on reset, it does not indicate that an SOF has been sent (in case of host mode) or SOF has been received (in case of device mode). The read value of this interrupt is valid only after a valid connection between host and device is established. If the bit is set after power on reset the application can clear the bit.
			INACTIVE	0	No Start of Frame
			ACTIVE	1	Start of Frame
E	R	RXFLVL			Mode: Host and Device. RxFIFO Non-Empty (RxFLvl) Indicates that there is at least one packet pending to be read from the RxFIFO.
			INACTIVE	0	Rx Fifo is empty
			ACTIVE	1	Rx Fifo is not empty
F	R	NPTXFEMP			Mode: Host and Device. Non-periodic TxFIFO Empty (NPTxFEmp) This interrupt is asserted when the Non-periodic TxFIFO is either half or completely empty, and there is space for at least one Entry to be written to the Non-periodic Transmit Request Queue. The half or completely empty status is determined by the Non-periodic TxFIFO Empty Level bit in the Core AHB Configuration register (GAHBCFG.NPTxFEmpLvl). In host mode, the application can use GINTSTS.NPTxFEmp with the OTG_EN_DED_TX_FIFO parameter set to either 1 or 0. In device mode, the application uses GINTSTS.NPTxFEmp when OTG_EN_DED_TX_FIFO=0. When OTG_EN_DED_TX_FIFO=1, the application uses DIEPINTn.TxFEmp.
			INACTIVE	0	Non-periodic TxFIFO is not empty
			ACTIVE	1	Non-periodic TxFIFO is empty
G	R	GINNAKEFF			Mode: Device only. Global IN Non-periodic NAK Effective (GINNakEff) Indicates that the Set Global Non-periodic IN NAK bit in the Device Control register (DCTL.SGNPInNak) set by the application, has taken effect in the core. That is, the core has sampled the Global IN NAK bit Set by the application. This bit can be cleared by clearing the Clear Global Non-periodic IN NAK bit in the Device Control register (DCTL.CGNPInNak). This interrupt does not necessarily mean that a NAK handshake is sent out on the USB. The STALL bit takes precedence over the NAK bit.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I			H	G	F	E	D	C	B	A
Reset 0x04000020				**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
			INACTIVE	0	Global Non-periodic IN NAK not active
			ACTIVE	1	Set Global Non-periodic IN NAK bit
H	R	GOUTNAKEFF			Mode: Device only. Global OUT NAK Effective (GOUTNakEff) Indicates that the Set Global OUT NAK bit in the Device Control register (DCTL.SGOUTNak), Set by the application, has taken effect in the core. This bit can be cleared by writing the Clear Global OUT NAK bit in the Device Control register (DCTL.CGOUTNak).
			INACTIVE	0	Not Active
			ACTIVE	1	Global OUT NAK Effective
I	RW	ERLYSUSP			Mode: Device only. Early Suspend (ErlySusp) The controller sets this bit to indicate that an Idle state has been detected on the USB for 3 ms.
			INACTIVE	0	No Idle state detected
			ACTIVE	1	3ms of Idle state detected
J	RW	USBSUSP			Mode: Device only. USB Suspend (USBSusp) The controller sets this bit to indicate that a suspend was detected on the USB. The controller enters the Suspended state when there is no activity on the linestate signal for an extended period of time.
			INACTIVE	0	Not Active
			ACTIVE	1	USB Suspend
K	RW	USBRST			Mode: Device only. USB Reset (USBRst) The controller sets this bit to indicate that a reset is detected on the USB.
			INACTIVE	0	Not active
			ACTIVE	1	USB Reset
L	RW	ENUMDONE			Mode: Device only. Enumeration Done (EnumDone) The core sets this bit to indicate that speed enumeration is complete. The application must read the Device Status (DSTS) register to obtain the enumerated speed.
			INACTIVE	0	Not active
			ACTIVE	1	Enumeration Done
M	RW	ISOOUTDROP			Mode: Device only. Isochronous OUT Packet Dropped Interrupt (ISOOutDrop) The controller sets this bit when it fails to write an isochronous OUT packet into the RxFIFO because the RxFIFO does not have enough space to accommodate a maximum packet size packet for the isochronous OUT endpoint.
			INACTIVE	0	Not active
			ACTIVE	1	Isochronous OUT Packet Dropped Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I			H	G	F	E	D	C	B	A
Reset 0x04000020	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
N	RW	EOPF			Mode: Device only. End of Periodic Frame Interrupt (EOPF) Indicates that the period specified in the Periodic Frame Interval field of the Device Configuration register (DCFG.PerFrInt) has been reached in the current microframe. In case of Non-Ignore Frame Number Scatter/Gather (Descriptor DMA) mode, the controller internally handles the following scenarios based on EOPF: Read Flush: At the EOPF, the controller checks if there are any pending packets in the FIFO corresponding to the current (micro)Frame. - If there are any pending packets, then the controller initiates read flush, due to which the read pointer is updated to the starting location of the next micro-frame packet. - If there are no pending packets corresponding to the current (micro)Frame, the controller does not take any action. Write Flush: At the EOPF, if the controller is still fetching the current micro-frame data, then the controller stops pushing data into the TXFIFO but keeps fetching the complete packet from the System Memory. After completing the scheduled packet size fetch, the controller updates the Status Quadlet Fields (Transmit Status to BUFFLUSH) and closes the Descriptor. During the descriptor close, the controller initiates write flush, due to which the write pointer is updated to the starting location of the next micro-frame packet. Because the controller stops pushing the packet to the TxFIFO after EOPF, to bring the write pointer to the starting location of the next micro-frame, write flush is done.
			INACTIVE	0	Not active
			ACTIVE	1	End of Periodic Frame Interrupt
O	RW	RSTRDONEINT			Mode: Device only. Restore Done Interrupt (RstrDoneInt) The controller sets this bit to indicate that the restore command after Hibernation was completed by the core. The controller continues from Suspended state into the mode dictated by PCGCCTL.RestoreMode field.
			INACTIVE	0	Not active
			ACTIVE	1	Restore Done Interrupt
P	RW	EPMIS			Mode: Device only. Endpoint Mismatch Interrupt (EPMis) Note: This interrupt is valid only in shared FIFO operation. Indicates that an IN token has been received for a non-periodic endpoint, but the data for another endpoint is present in the top of the Non-periodic Transmit FIFO and the IN endpoint mismatch count programmed by the application has expired.
			INACTIVE	0	Not active
			ACTIVE	1	Endpoint Mismatch Interrupt
Q	R	IEPINT			Mode: Device only. IN Endpoints Interrupt (IEPInt) The core sets this bit to indicate that an interrupt is pending on one of the IN endpoints of the core (in Device mode). The application must read the Device All Endpoints Interrupt (DAINT) register to determine the exact number of the IN endpoint on Device IN Endpoint-n Interrupt (DIEPINTn) register to determine the exact cause of the interrupt. The application must clear the appropriate status bit in the corresponding DIEPINTn register to clear this bit.
			INACTIVE	0	Not active
			ACTIVE	1	IN Endpoints Interrupt

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I			H	G	F	E	D	C	B	A
Reset 0x04000020				**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
R	R	OEPINT			Mode: Device only. OUT Endpoints Interrupt (OEPInt) The controller sets this bit to indicate that an interrupt is pending on one of the OUT endpoints of the core (in Device mode). The application must read the Device All Endpoints Interrupt (DAINT) register to determine the exact number of the OUT endpoint on which the interrupt occurred, and then read the corresponding Device OUT Endpoint-n Interrupt (DOEPINTn) register to determine the exact cause of the interrupt. The application must clear the appropriate status bit in the corresponding DOEPINTn register to clear this bit.
			INACTIVE	0	Not active
			ACTIVE	1	OUT Endpoints Interrupt
S	RW	INCOMPISOIN			Mode: Device only. Incomplete Isochronous IN Transfer (incompISOIN) The core sets this interrupt to indicate that there is at least one isochronous IN endpoint on which the transfer is not completed in the current microframe. This interrupt is asserted along with the End of Periodic Frame Interrupt (EOPF) bit in this register. Note: This interrupt is not asserted in Scatter/Gather DMA mode.
			INACTIVE	0	Not active
			ACTIVE	1	Incomplete Isochronous IN Transfer
T	RW	INCOMPLP			Incomplete Periodic Transfer (incomplP) Mode: Host only In Host mode, the core sets this interrupt bit when there are incomplete periodic transactions still pending which are scheduled for the current microframe. Incomplete Isochronous OUT Transfer (incompISOOUT) Mode: Device only The Device mode, the core sets this interrupt to indicate that there is at least one isochronous OUT endpoint on which the transfer is not completed in the current microframe. This interrupt is asserted along with the End of Periodic Frame Interrupt (EOPF) bit in this register.
			INACTIVE	0	Not active
			ACTIVE	1	Incomplete Periodic Transfer
U	RW	FETSUSP			Mode: Device only. Data Fetch Suspended (FetSusp) This interrupt is valid only in DMA mode. This interrupt indicates that the core has stopped fetching data. For IN endpoints due to the unavailability of TxFIFO space or Request Queue space. This interrupt is used by the application for an endpoint mismatch algorithm. For example, after detecting an endpoint mismatch, the application: - Sets a Global non-periodic IN NAK handshake - Disables IN endpoints - Flushes the FIFO - Determines the token sequence from the IN Token Sequence Learning Queue - Re-enables the endpoints - Clears the Global non-periodic IN NAK handshake If the Global non-periodic IN NAK is cleared, the core has not yet fetched data for the IN endpoint, and the IN token is received. The core generates an 'IN token received when FIFO empty' interrupt. It then sends the host a NAK response. To avoid this scenario, the application can check the GINTSTS.FetSusp interrupt, which ensures that the FIFO is full before clearing a Global NAK handshake. Alternatively, the application can mask the IN token received when FIFO empty interrupt when clearing a Global IN NAK handshake.
			INACTIVE	0	Not active
			ACTIVE	1	Data Fetch Suspended

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I			H	G	F	E	D	C	B	A
Reset 0x04000020	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
V	RW	RESETDET			Mode: Device only. Reset detected Interrupt (ResetDet) In Device mode, this interrupt is asserted when a reset is detected on the USB in partial power-down mode when the device is in Suspend. In Host mode, this interrupt is not asserted.
			INACTIVE	0	Not active
			ACTIVE	1	Reset detected Interrupt
W	R	PRTINT			Mode: Host only. Host Port Interrupt (PrtInt) The core sets this bit to indicate a change in port status of one of the controller ports in Host mode. The application must read the Host Port Control and Status (HPRT) register to determine the exact event that caused this interrupt. The application must clear the appropriate status bit in the Host Port Control and Status register to clear this bit.
			INACTIVE	0	Not active
			ACTIVE	1	Host Port Interrupt
X	R	HCHINT			Mode: Host only. Host Channels Interrupt (HChInt) The core sets this bit to indicate that an interrupt is pending on one of the channels of the core (in Host mode). The application must read the Host All Channels Interrupt (HAINT) register to determine the exact number of the channel on which the interrupt occurred, and Then read the corresponding Host Channel-n Interrupt (HCINTn) register to determine the exact cause of the interrupt. The application must clear the appropriate status bit in the HCINTn register to clear this bit.
			INACTIVE	0	Not active
			ACTIVE	1	Host Channels Interrupt
Y	R	PTXFEMP			Mode: Host only. Periodic TxFIFO Empty (PTxFEmp) This interrupt is asserted when the Periodic Transmit FIFO is either half or completely empty and there is space for at least one entry to be written in the Periodic Request Queue. The half or completely empty status is determined by the Periodic TxFIFO Empty Level bit in the Core AHB Configuration register (GAHBCFG.PTxFEmpLvl).
			INACTIVE	0	Not active
			ACTIVE	1	Periodic TxFIFO Empty
Z	RW	LPMINT			Mode: Host and Device. LPM Transaction Received Interrupt (LPM_Int). - Device Mode: This interrupt is asserted when the device receives an LPM transaction and responds with a non-ERRORed response. - Host Mode: This interrupt is asserted when the device responds to an LPM transaction with a non-ERRORed response or when the host core has completed LPM transactions for the programmed number of times (GLPMCFG.RetryCnt).
			INACTIVE	0	Not Active
			ACTIVE	1	LPM Transaction Received Interrupt
a	RW	CONIDSTSCHNG			Mode: Host and Device. Connector ID Status Change (ConIDStsChng) The core sets this bit when there is a change in connector ID status.
			INACTIVE	0	Not Active
			ACTIVE	1	Connector ID Status Change
b	RW	DISCONNINT			Mode: Host only. Disconnect Detected Interrupt (DisconnInt) Asserted when a device disconnect is detected.
			INACTIVE	0	Not active
			ACTIVE	1	Disconnect Detected Interrupt

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I			H	G	F	E	D	C	B	A
Reset 0x04000020				**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
c	RW	SESSREQINT																																	
			INACTIVE	0																															
			ACTIVE	1																															
d	RW	WKUPINT																																	
			INACTIVE	0																															
			ACTIVE	1																															

8.27.5.7 GINTMSK

Address offset: 0x018

Interrupt Mask Register

This register works with the Interrupt Register (GINTSTS) to interrupt the application. When an interrupt bit is masked, the interrupt associated with that bit is not generated. However, the GINTSTS register bit corresponding to that interrupt is still set. Note: The fields of this register change depending on host or device mode.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				b	a	Z	Y	X	W	V	U	T	S	R		Q	P	O	N	M	L	K	J	I	H			G	F	E	D	C	B	A	
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	MODEMISMSK																																	
			MASK	0																															
			NOMASK	1																															
B	RW	OTGINTMSK																																	
			MASK	0																															
			NOMASK	1																															
C	RW	SOFMSK																																	
			MASK	0																															
			NOMASK	1																															

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				b	a	Z	Y	X	W	V	U	T	S	R		Q	P	O	N	M	L	K	J	I	H			G	F	E	D	C	B	A	
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
				Description																															
D	RW	RXFLVLMSK																																	
				Mode: Host and Device. Receive FIFO Non-Empty Mask (RxFLvlMsk)																																	
			MASK	0																																	
				Receive FIFO Non-Empty Mask																																	
			NOMASK	1																																	
				No Receive FIFO Non-Empty Mask																																	
E	RW	NPTXFEMPMSK																																	
				Mode: Host and Device. Non-periodic TxFIFO Empty Mask (NPTxFEmpMsk)																																	
			MASK	0																																	
				Non-periodic TxFIFO Empty Mask																																	
			NOMASK	1																																	
				No Non-periodic TxFIFO Empty Mask																																	
F	RW	GINNAKEFFMSK																																	
				Mode: Device only,. Global Non-periodic IN NAK Effective Mask (GINNakEffMsk)																																	
			MASK	0																																	
				Global Non-periodic IN NAK Effective Mask																																	
			NOMASK	1																																	
				No Global Non-periodic IN NAK Effective Mask																																	
G	RW	GOUTNAKEFFMSK																																	
				Mode: Device only. Global OUT NAK Effective Mask (GOUTNakEffMsk)																																	
			MASK	0																																	
				Global OUT NAK Effective Mask																																	
			NOMASK	1																																	
				No Global OUT NAK Effective Mask																																	
H	RW	ERLYSUSPMSK																																	
				Mode: Device only. Early Suspend Mask (ErlySuspMsk)																																	
			MASK	0																																	
				Early Suspend Mask																																	
			NOMASK	1																																	
				No Early Suspend Mask																																	
I	RW	USBSUSPMSK																																	
				Mode: Device only. USB Suspend Mask (USBSuspMsk)																																	
			MASK	0																																	
				USB Suspend Mask																																	
			NOMASK	1																																	
				No USB Suspend Mask																																	
J	RW	USBRSTMSK																																	
				Mode: Device only. USB Reset Mask (USBRstMsk)																																	
			MASK	0																																	
				USB Reset Mask																																	
			NOMASK	1																																	
				No USB Reset Mask																																	
K	RW	ENUMDONEMSK																																	
				Mode: Device only. Enumeration Done Mask (EnumDoneMsk)																																	
			MASK	0																																	
				Enumeration Done Mask																																	
			NOMASK	1																																	
				No Enumeration Done Mask																																	
L	RW	ISOOUTDROPMSK																																	
				Mode: Device only. Isochronous OUT Packet Dropped Interrupt Mask (ISOOutDropMsk)																																	
			MASK	0																																	
				Isochronous OUT Packet Dropped Interrupt Mask																																	
			NOMASK	1																																	
				No Isochronous OUT Packet Dropped Interrupt Mask																																	
M	RW	EOPFMSK																																	
				Mode: Device only. End of Periodic Frame Interrupt Mask (EOPFMsk)																																	
			MASK	0																																	
				End of Periodic Frame Interrupt Mask																																	
			NOMASK	1																																	
				No End of Periodic Frame Interrupt Mask																																	
N	RW	RSTRDONEINTMSK																																	
				Mode: Host and Device. Restore Done Interrupt Mask (RstrDoneIntMsk)																																	
			MASK	0																																	
				Restore Done Interrupt Mask																																	
			NOMASK	1																																	
				No Restore Done Interrupt Mask																																	
O	RW	EPMISMSK																																	
				Mode: Device only. Endpoint Mismatch Interrupt Mask (EPMisMsk)																																	
			MASK	0																																	
				Endpoint Mismatch Interrupt Mask																																	
			NOMASK	1																																	
				No Endpoint Mismatch Interrupt Mask																																	
P	RW	IEPINTMSK																																	
				Mode: Device only. IN Endpoints Interrupt Mask (IEPIntMsk)																																	
			MASK	0																																	
				IN Endpoints Interrupt Mask																																	
			NOMASK	1																																	
				No IN Endpoints Interrupt Mask																																	
Q	RW	OEPINTMSK																																	
				Mode: Device only. OUT Endpoints Interrupt Mask (OEPIntMsk)																																	
			MASK	0																																	
				OUT Endpoints Interrupt Mask																																	
			NOMASK	1																																	
				No OUT Endpoints Interrupt Mask																																	
R	RW	INCOMPLPMSK																																	
				Incomplete Periodic Transfer Mask (incomplPMsk) Mode: Host only Incomplete Isochronous OUT Transfer Interrupt Mask (incompISOOUTMsk) Mode: Device only																																	
			MASK	0																																	
				Host mode: Incomplete Periodic Transfer MaskDevice mode: Incomplete Isochronous OUT Transfer Mask																																	

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				b	a	Z	Y	X	W	V	U	T	S	R		Q	P	O	N	M	L	K	J	I	H			G	F	E	D	C	B	A	
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
			NOMASK	1																															
				Host mode: No Incomplete Periodic Transfer MaskDevice mode: No Incomplete Isochronous OUT Transfer Mask																																
S	RW	FETSUSPMSK																																	
				Mode: Device only. Data Fetch Suspended Mask (FetSuspMsk)																																
			MASK	0																															
				Data Fetch Suspended Mask																																
			NOMASK	1																															
				No Data Fetch Suspended Mask																																
T	RW	RESETDETMSK																																	
				Mode: Device only. Reset detected Interrupt Mask (ResetDetMsk)																																
			MASK	0																															
				Reset detected Interrupt Mask																																
			NOMASK	1																															
				No Reset detected Interrupt Mask																																
U	RW	PRTINTMSK																																	
				Mode: Host only. Host Port Interrupt Mask (PrtIntMsk)																																
			MASK	0																															
				Host Port Interrupt Mask																																
			NOMASK	1																															
				No Host Port Interrupt Mask																																
V	RW	HCHINTMSK																																	
				Mode: Host only. Host Channels Interrupt Mask (HChIntMsk)																																
			MASK	0																															
				Host Channels Interrupt Mask																																
			NOMASK	1																															
				No Host Channels Interrupt Mask																																
W	RW	PTXFEMPMSK																																	
				Mode: Host only. Periodic TxFIFO Empty Mask (PTxFEmpMsk)																																
			MASK	0																															
				Periodic TxFIFO Empty Mask																																
			NOMASK	1																															
				No Periodic TxFIFO Empty Mask																																
X	RW	LPMINTMSK																																	
				Mode: Host and Device. LPM Transaction Received Interrupt (LPM_Int)																																
				LPM Transaction received interrupt Mask																																
			MASK	0																															
				LPM Transaction received interrupt Mask																																
			NOMASK	1																															
				No LPM Transaction received interrupt Mask																																
Y	RW	CONIDSTSCHNGMSK																																	
				Mode: Host and Device. Connector ID Status Change Mask (ConIDStsChngMsk)																																
			MASK	0																															
				Connector ID Status Change Mask																																
			NOMASK	1																															
				No Connector ID Status Change Mask																																
Z	RW	DISCONNINTMSK																																	
				Mode: Host and Device. Disconnect Detected Interrupt Mask (DisconnIntMsk)																																
			MASK	0																															
				Disconnect Detected Interrupt Mask																																
			NOMASK	1																															
				No Disconnect Detected Interrupt Mask																																
a	RW	SESSREQINTMSK																																	
				Mode: Host and Device. Session Request/New Session Detected Interrupt Mask (SessReqIntMsk)																																
			MASK	0																															
				Session Request or New Session Detected Interrupt Mask																																
			NOMASK	1																															
				No Session Request or New Session Detected Interrupt Mask																																
b	RW	WKUPINTMSK																																	
				Mode: Host and Device. Resume/Remote Wakeup Detected Interrupt Mask (WkUpIntMsk) The WakeUp bit is used for LPM state wake up in a way similar to that of wake up in suspend state.																																
			MASK	0																															
				Resume or Remote Wakeup Detected Interrupt Mask																																
			NOMASK	1																															
				Unmask Resume Remote Wakeup Detected Interrupt																																

8.27.5.8 GRXSTSR

Address offset: 0x01C

Receive Status Debug Read Register

A read to the Receive Status Debug Read register returns the contents of the top of the Receive FIFO. The receive status contents must be interpreted differently in Host and Device modes. The core ignores the receive status read when the receive FIFO is empty and returns a value of 32'h0000_0000. Note: - Use of these fields vary based on whether the core is functioning as a host or a device. - Do not read this register's reset value before configuring the core because the read value is 'X' in the simulation.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID								E	E	E	E	D	D	D	D	C	C	B	B	B	B	B	B	B	B	B	B	B	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	CHNUM			Channel Number (ChNum) Mode: Host only Indicates the channel number to which the current received packet belongs. Endpoint Number (EPNum) Mode: Device only Indicates the endpoint number to which the current received packet belongs.
			CHEP0	0	Channel or EndPoint 0
			CHEP1	1	Channel or EndPoint 1
			CHEP2	2	Channel or EndPoint 2
			CHEP3	3	Channel or EndPoint 3
			CHEP4	4	Channel or EndPoint 4
			CHEP5	5	Channel or EndPoint 5
			CHEP6	6	Channel or EndPoint 6
			CHEP7	7	Channel or EndPoint 7
			CHEP8	8	Channel or EndPoint 8
			CHEP9	9	Channel or EndPoint 9
			CHEP10	10	Channel or EndPoint 10
			CHEP11	11	Channel or EndPoint 11
			CHEP12	12	Channel or EndPoint 12
			CHEP13	13	Channel or EndPoint 13
			CHEP14	14	Channel or EndPoint 14
			CHEP15	15	Channel or EndPoint 15
B	R	BCNT			Byte Count (BCnt) In host mode, indicates the byte count of the received IN data packet. In device mode, indicates the byte count of the received data packet.
C	R	DPID			Data PID (DPID) In host mode, indicates the Data PID of the received packet. In device mode, indicates the Data PID of the received OUT data packet.
			DATA0	0	DATA0
			DATA2	1	DATA2
			DATA1	2	DATA1
			MDATA	3	MDATA
D	R	PKTSTS			Packet Status (PktSts) indicates the status of the received packet. In host mode, In device mode,
			OUTNAK	1	Global OUT NAK in device mode (triggers an interrupt)
			INOUTDPRX	2	IN data packet received in host mode and OUT data packet received in device mode
			INOUTTRCOM	3	IN or OUT transfer completed in both host and device mode (triggers an interrupt)
			DSETUPCOM	4	SETUP transaction completed in device mode (triggers an interrupt)
			DTTOG	5	Data toggle error (triggers an interrupt) in host mode
			DSETUPRX	6	SETUP data packet received in device mode
			CHHALT	7	Channel halted in host mode (triggers an interrupt)
E	R	FN			Mode: Device only. Frame Number (FN) This is the least significant 4 bits of the (micro)Frame number in which the packet is received on the USB. This field is supported only when isochronous OUT endpoints are supported.

8.27.5.9 GRXSTSP

Address offset: 0x020

Receive Status Read/Pop Register

A read to the Receive Status Read and Pop register returns the contents of the top of the Receive FIFO and additionally pops the top data entry out of the RxFIFO. The receive status contents must be interpreted differently in Host and Device modes. The core ignores the receive status pop/read when the receive FIFO is empty and returns a value of 32'h0000_0000. The application must only pop the Receive Status FIFO when the Receive FIFO Non-Empty bit of the Core Interrupt register (GINTSTS.RxFLvl) is asserted. Note: - Use of these fields vary based on whether the core is functioning as a host or a device. - Do not read this register's reset value before configuring the core because the read value is 'X' in the simulation.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E E E E D D D D C C B B B B B B B B B B B B A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	CHNUM			Channel Number (ChNum) Mode: Host only Indicates the channel number to which the current received packet belongs. Endpoint Number (EPNum) Mode: Device only Indicates the endpoint number to which the current received packet belongs.
			CHEP0	0	Channel or EndPoint 0
			CHEP1	1	Channel or EndPoint 1
			CHEP2	2	Channel or EndPoint 2
			CHEP3	3	Channel or EndPoint 3
			CHEP4	4	Channel or EndPoint 4
			CHEP5	5	Channel or EndPoint 5
			CHEP6	6	Channel or EndPoint 6
			CHEP7	7	Channel or EndPoint 7
			CHEP8	8	Channel or EndPoint 8
			CHEP9	9	Channel or EndPoint 9
			CHEP10	10	Channel or EndPoint 10
			CHEP11	11	Channel or EndPoint 11
			CHEP12	12	Channel or EndPoint 12
			CHEP13	13	Channel or EndPoint 13
			CHEP14	14	Channel or EndPoint 14
			CHEP15	15	Channel or EndPoint 15
B	R	BCNT			Byte Count (BCnt) In host mode, indicates the byte count of the received IN data packet. In device mode, indicates the byte count of the received data packet.
C	R	DPID			Data PID (DPID) In host mode, indicates the Data PID of the received packet. In device mode, indicates the Data PID of the received OUT data packet.
			DATA0	0	DATA0
			DATA2	1	DATA2
			DATA1	2	DATA1
			MDATA	3	MDATA
D	R	PKTSTS			Packet Status (PktSts) indicates the status of the received packet. In host mode, In device mode,
			OUTNAK	1	Global OUT NAK in device mode (triggers an interrupt)
			INOUTDPRX	2	IN data packet received in host mode and OUT data packet received in device mode

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E E E E D D D D C C B B B B B B B B B B A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			INOUTTRCOM	3	IN or OUT transfer completed in both host and device mode (triggers an interrupt)
			DSETUPCOM	4	SETUP transaction completed in device mode (triggers an interrupt)
			DTTOG	5	Data toggle error (triggers an interrupt) in host mode
E	R	FN			Mode: Device only. Frame Number (FN) This is the least significant 4 bits of the (micro)Frame number in which the packet is received on the USB. This field is supported only when isochronous OUT endpoints are supported.

8.27.5.10 GRXFSIZ

Address offset: 0x024

Receive FIFO Size Register

The application can program the RAM size that must be allocated to the RxFIFO.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000C00				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	RXFDEP			Mode: Host and Device. RxFIFO Depth (RxFDep) This value is in terms of 32-bit words. - Minimum value is 16 - Maximum value is 32,768 The power-on reset value of this register is specified as the Largest Rx Data FIFO Depth during configuration. If Enable Dynamic FIFO Sizing is selected in coreConsultant, these flops are optimized, and reads return the power-on value. If Enable Dynamic FIFO Sizing is selected in coreConsultant, you can write a new value in this field. Programmed values must not exceed the power-on value.

8.27.5.11 GNPTXFSIZ

Address offset: 0x028

Non-periodic Transmit FIFO Size Register

The application can program the RAM size and the memory start address for the Non-periodic TxFIFO
Note: The fields of this register change depending on host or device mode.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					B	B	B	B	B	B	B	B	B	B	B	B					A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x0C000C00	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	NPTXFSTADDR			Non-periodic Transmit RAM Start Address (NPTxFStAddr) For host mode, this field is always valid. This field contains the memory start address for Non-periodic Transmit FIFO RAM. - This field is determined during coreConsultant configuration by "Enable Dynamic FIFO Sizing?" (OTG_DFIFO_DYNAMIC):OTG_DFIFO_DYNAMIC = 0 These flops are optimized, and reads return the power-on value. - OTG_DFIFO_DYNAMIC = 1 The application can write a new value in this field. Programmed values must not exceed the power-on value set in coreConsultant. Programmed values must not exceed the power-on value set in coreConsultant. The power-on reset value of this field is specified during coreConsultant configuration by Largest Rx Data FIFO Depth (parameter OTG_RX_DFIFO_DEPTH).
B	RW	NPTXFDEP			Mode: Host only. Non-periodic TxFIFO Depth (NPTxFDep) For host mode, this field is always valid. For device mode, this field is valid only when OTG_EN_DED_TX_FIFO=0. This value is in terms of 32-bit words. - Minimum value is 16 - Maximum value is 32,768 This attribute of field is determined during coreConsultant configuration by "Enable Dynamic FIFO Sizing?" (OTG_DFIFO_DYNAMIC): - OTG_DFIFO_DYNAMIC = 0: These flops are optimized, and reads return the power-on value. - OTG_DFIFO_DYNAMIC = 1: The application can write a new value in this field. Programmed values must not exceed the power-on value set in coreConsultant. The power-on reset value of this field is specified during coreConsultant configuration as Largest IN Endpoint FIFO 0 Depth (parameter OTG_TX_DINEP_DFIFO_DEPTH_0).

8.27.5.12 GNPTXSTS

Address offset: 0x02C

Non-periodic Transmit FIFO/Queue Status Register

In Device mode, this register is valid only in Shared FIFO operation. This read-only register contains the free space information for the Non-periodic TxFIFO and the Non-periodic Transmit Request Queue.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		C	C	C	C	C	C	C	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00080C00	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	NPTXFSPCAVAIL			Non-periodic TxFIFO Space Avail (NPTxFSpcAvail) Indicates the amount of free space available in the Non-periodic TxFIFO. Values are in terms of 32-bit words. Reset: Configurable
B	R	NPTXQSPCAVAIL			Non-periodic Transmit Request Queue Space Available (NPTxQSpcAvail) Indicates the amount of free space available in the Non-periodic Transmit Request Queue. This queue holds both IN and OUT requests in Host mode. Device mode has only IN requests. - n: n locations available (0 <= n <= 8) Reset: Configurable
			FULL	0	Non-periodic Transmit Request Queue is full
			QUE1	1	1 location available
			QUE2	2	2 locations available
			QUE3	3	3 locations available

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C C C C C C B B B B B B B A A A A A A A A A A A A A A
Reset 0x00080C00				**0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			QUE4	4	4 locations available
			QUE5	5	5 locations available
			QUE6	6	6 locations available
			QUE7	7	7 locations available
			QUE8	8	8 locations available
C	R	NPTXQTOP			Top of the Non-periodic Transmit Request Queue (NPTxQTop) Entry in the Non-periodic Tx Request Queue that is currently being processed by the MAC.
			INOUTTK	0	IN/OUT token
			ZEROTX	1	Zero-length transmit packet (device IN/host OUT)
			PINGCSPLIT	2	PING/CSPLIT token
			CHNHALT	3	Channel halt command

8.27.5.13 GGPIO

Address offset: 0x038

General Purpose Input/Output Register

The application can use this register for general purpose input/output ports or for debugging.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B B B B B B B B B B B B B B B B A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	GPI			General Purpose Input (GPI) This field's read value reflects the gp_i[15:0] core input value.
B	RW	GPO			General Purpose Output (GPO) This field is driven as an output from the core, gp_o[15:0]. The application can program this field to determine the corresponding value on the gp_o[15:0] output.

8.27.5.14 GUID

Address offset: 0x03C

User ID Register

This is a read/write register containing the User ID. It is implemented only if Remove Optional Features? was deselected during coreConsultant configuration (parameter OTG_RM_OPT_FEATURES = 0). The power-on value for this register is specified as the Power-on Value of User ID Register User Identification Register during coreConsultant configuration (parameter OTG_USERID). This register can be used in the following ways: - To store the version or revision of your system - To store hardware configurations that are outside the DWC_otg core - As a scratch register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	GUID			User ID (UserID) Application-programmable ID field. Reset value is configurable.

8.27.5.15 GSNPSID

Address offset: 0x040

Synopsys ID Register

This read-only register contains the release number of the core being used.

Bit number																																
ID																																
Reset 0x4F54500B																																
ID	R/W	Field	Value ID	Value	Description																											
A	R	SYNOPSYSID			Release number of the controller being used currently. Bits [31:16]: - 0x4f54: ASCII Value for OT Bits [15:0]: Current Release Number. For example, 0x400a corresponds to v4.00a Release number.																									

8.27.5.16 GHWCFG1

Address offset: 0x044

User Hardware Configuration 1 Register

This register contains the logical endpoint direction(s) selected using coreConsultant.

Bit number																																
ID																																
Reset 0x00000000																																
ID	R/W	Field	Value ID	Value	Description																											
A	R	EPDIR			This 32-bit field uses two bits per endpoint to determine the endpoint direction. Endpoint ... Direction Note: This field is configured using the OTG_EP_DIR_1(n) parameter.																									

8.27.5.17 GHWCFG2

Address offset: 0x048

User Hardware Configuration 2 Register

This register contains configuration options selected using coreConsultant.

Bit number																																
ID							M	M	M	M	M	L	L	K	K		J	I	H	G	G	G	G	F	F	F	F	E	E	D	D	C	B	B	A	A	A
Reset 0x228FFC52							**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**0**
ID	R/W	Field	Value ID	Value	Description																																	
A	R	OTGMODE			Mode of Operation (OtgMode) - 3'b000: HNP- and SRP-Capable OTG (Host & Device) Note: This field is configured using the OTG_MODE parameter.																															
			HNPSRP	0	HNP- and SRP-Capable OTG (Host and Device)																															
			SRPOTG	1	SRP-Capable OTG (Host and Device)																															
			NHNPNSRP	2	Non-HNP and Non-SRP Capable OTG (Host and Device)																															
			SRPCAPD	3	SRP-Capable Device																															
			NONOTGD	4	Non-OTG Device																															
			SRPCAPH	5	SRP-Capable Host																															
			NONOTGH	6	Non-OTG Host																															

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					M	M	M	M	M	L	L	K	K		J	I	H	G	G	G	F	F	F	F	E	E	D	D	C	B	B	A	A	A
Reset 0x228FFC52				**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**0**
ID	R/W	Field	Value ID	Value																															
B	R	OTGARCH																																	
			COMPLETERMODE	0																															
			EXTERNALDMA	1																															
			INTERNALDMA	2																															
C	R	SINGPNT																																	
			MULTIPOINT	0																															
			SINGLEPOINT	1																															
D	R	HSPHYTYPE																																	
			NOHS	0																															
			UTMIPLUS	1																															
			ULPI	2																															
			UTMIPUSULPI	3																															
E	R	FSPHYTYPE																																	
			NOFS	0																															
			FS	1																															
			FSPLUSUTMI	2																															
			FSPLUSULPI	3																															
F	R	NUMDEVEPS																																	
			ENDPT0	0																															
			ENDPT1	1																															
			ENDPT2	2																															
			ENDPT3	3																															
			ENDPT4	4																															
			ENDPT5	5																															
			ENDPT6	6																															
			ENDPT7	7																															
			ENDPT8	8																															
			ENDPT9	9																															
			ENDPT10	10																															
			ENDPT11	11																															
			ENDPT12	12																															
			ENDPT13	13																															
			ENDPT14	14																															
			ENDPT15	15																															

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		M	M	M	M	M	L	L	K	K		J	I	H	G	G	G	G	F	F	F	F	E	E	D	D	C	B	B	A	A	A
Reset 0x228FFC52	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**0**

ID	R/W	Field	Value ID	Value	Description
G	R	NUMHSTCHNL			Number of Host Channels (NumHstChnl) Indicates the number of host channels supported by the core in Host mode. The range of this field is 0-15: 0 specifies 1 channel, 15 specifies 16 channels. Note: This field is configured using the OTG_NUM_HOST_CHAN parameter.
			HOSTCH0	0	Host Channel 1
			HOSTCH1	1	Host Channel 2
			HOSTCH2	2	Host Channel 3
			HOSTCH3	3	Host Channel 4
			HOSTCH4	4	Host Channel 5
			HOSTCH5	5	Host Channel 6
			HOSTCH6	6	Host Channel 7
			HOSTCH7	7	Host Channel 8
			HOSTCH8	8	Host Channel 9
			HOSTCH9	9	Host Channel 10
			HOSTCH10	10	Host Channel 11
			HOSTCH11	11	Host Channel 12
			HOSTCH12	12	Host Channel 13
			HOSTCH13	13	Host Channel 14
			HOSTCH14	14	Host Channel 15
			HOSTCH15	15	Host Channel 16
H	R	PERIOSUPPORT			Periodic OUT Channels Supported in Host Mode (PerioSupport) - 1'b0: No Note: This field is configured using the OTG_EN_PERIO_HOST parameter.
			DISABLED	0	Periodic OUT Channels is not supported in Host Mode
			ENABLED	1	Periodic OUT Channels Supported in Host Mode Supported
I	R	DYNFIFOSIZING			Dynamic FIFO Sizing Enabled (DynFifoSizing) - 1'b0: No Note: This field is configured using the OTG_DFIFO_DYNAMIC parameter.
			DISABLED	0	Dynamic FIFO Sizing Disabled
			ENABLED	1	Dynamic FIFO Sizing Enabled
J	R	MULTIPROCINTRPT			Multi Processor Interrupt Enabled (MultiProcIntrpt) - 1'b0: No Note: This field is configured using the OTG_MULTI_PROC_INTRPT parameter.
			DISABLED	0	No Multi Processor Interrupt Enabled
			ENABLED	1	Multi Processor Interrupt Enabled
K	R	NPTXQDEPTH			Non-periodic Request Queue Depth (NPTxQDepth) - 2'b00: 2 Note: This field is configured using the OTG_NPERIO_TX_QUEUE_DEPTH parameter.
			TWO	0	Queue size 2
			FOUR	1	Queue size 4
			EIGHT	2	Queue size 8
L	R	PTXQDEPTH			Host Mode Periodic Request Queue Depth (PTxQDepth) - 2'b00: 2 Note: This field is configured using the OTG_PERIO_TX_QUEUE_DEPTH parameter.
			QUE2	0	Queue Depth 2
			QUE4	1	Queue Depth 4
			QUE8	2	Queue Depth 8

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				M M M M M L L K K J I H G G G G F F F F E E D D C B B A A A
Reset 0x228FFC52				**0 0 1 0 0 0 1 0 1 0 0 0 1 1 1 1 1 1 1 1 1 1 0 0 0 1 0 1 0 0 1 0**
ID	R/W	Field	Value ID	Value	Description
			QUE16	3	Queue Depth 16
M	R	TKNQDEPTH			Device Mode IN Token Sequence Learning Queue Depth (TknQDepth) Range: 0-30 Note: This field is configured using the OTG_TOKEN_QUEUE_DEPTH parameter.

8.27.5.18 GHWCFG3

Address offset: 0x04C

User Hardware Configuration 3 Register

This register contains configuration options selected using coreConsultant.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L L L L L L L L L L L L L L L K J I H G F E D C B B B A A A A
Reset 0x0BE0C0E8				**0 0 0 0 1 0 1 1 1 1 1 0 0 0 0 0 1 1 0 0 0 0 0 0 1 1 1 0 1 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	XFERSIZEWIDTH			Width of Transfer Size Counters (XferSizeWidth) - 4'b0000: 11 bits ... Note: This field is configured using the OTG_PACKET_COUNT_WIDTH parameter.
			WIDTH11	0	Width of Transfer Size Counter 11 bits
			WIDTH12	1	Width of Transfer Size Counter 12 bits
			WIDTH13	2	Width of Transfer Size Counter 13 bits
			WIDTH14	3	Width of Transfer Size Counter 14 bits
			WIDTH15	4	Width of Transfer Size Counter 15 bits
			WIDTH16	5	Width of Transfer Size Counter 16 bits
			WIDTH17	6	Width of Transfer Size Counter 17 bits
			WIDTH18	7	Width of Transfer Size Counter 18 bits
			WIDTH19	8	Width of Transfer Size Counter 19 bits
B	R	PKTSIZEWIDTH			Width of Packet Size Counters (PktSizeWidth) - 3'b000: 4 bits Note: This field is configured using the OTG_PACKET_COUNT_WIDTH parameter.
			BITS4	0	Width of Packet Size Counter 4
			BITS5	1	Width of Packet Size Counter 5
			BITS6	2	Width of Packet Size Counter 6
			BITS7	3	Width of Packet Size Counter 7
			BITS8	4	Width of Packet Size Counter 8
			BITS9	5	Width of Packet Size Counter 9
			BITS10	6	Width of Packet Size Counter 10
C	R	OTGEN			OTG Function Enabled (OtgEn) The application uses this bit to indicate the OTG capabilities of the controller . Note: This field is configured using the OTG_MODE parameter.
			DISABLED	0	Not OTG Capable
			ENABLED	1	OTG Capable
D	R	I2CINTSEL			I2C Selection (I2CIntSel) - 1'b0: I2C Interface is not available on the controller. Note: This field is configured using the OTG_I2C_INTERFACE parameter.
			DISABLED	0	I2C Interface is not available
			ENABLED	1	I2C Interface is available

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L L L L L L L L L L L L L L L L K J I H G F E D C B B B A A A A
Reset 0x0BE0C0E8				**0 0 0 0 1 0 1 1 1 1 1 0 0 0 0 0 1 1 0 0 0 0 0 0 1 1 1 0 1 0 0 0**
ID	R/W	Field	Value ID	Value	Description
E	R	VNDCTLSUPT			Vendor Control Interface Support (VndctlSupt) - 1'b0: Vendor Control Interface is not available on the core. Note: This field is configured using the OTG_VENDOR_CTL_INTERFACE parameter.
			DISABLED	0	Vendor Control Interface is not available.
			ENABLED	1	Vendor Control Interface is available.
F	R	OPTFEATURE			Optional Features Removed (OptFeature) Indicates whether the User ID register, GPIO interface ports, and SOF toggle and counter ports were removed for gate count optimization by enabling Remove Optional Features. Note: This field is configured using the OTG_RM_OPT_FEATURES parameter.
			DISABLED	0	Optional features were not Removed
			ENABLED	1	Optional Features have been Removed
G	R	RSTTYPE			Reset Style for Clocked always Blocks in RTL (RstType) - 1'b0: Asynchronous reset is used in the controller Note: This field is configured using the OTG_SYNC_RESET_TYPE parameter.
			ASYNCRST	0	Asynchronous reset is used in the core
			SYNCRST	1	Synchronous reset is used in the core
H	R	ADPSUPPORT			This bit indicates whether ADP logic is present within or external to the controller - 0: No ADP logic present with the controller - 1: ADP logic is present along with the controller.
			DISABLED	0	ADP logic is not present along with the controller
			ENABLED	1	ADP logic is present along with the controller
I	R	HSICMODE			HSIC mode specified for Mode of Operation Value Range: 0 - 1 - 1: HSIC-capable with shared UTMI PHY interface - 0: Non-HSIC-capable
			DISABLED	0	No HSIC capability
			ENABLED	1	HSIC-capable with shared UTMI PHY interface
J	R	BCSUPPORT			This bit indicates the controller support for Battery Charger. - 0 - No Battery Charger Support
			DISABLED	0	No Battery Charger Support
			ENABLED	1	Battery Charger Support present
K	R	LPMMODE			LPM mode specified for Mode of Operation.
			DISABLED	0	LPM disabled
			ENABLED	1	LPM enabled
L	R	DFIFODEPTH			DFIFO Depth (DfifoDepth - EP_LOC_CNT) This value is in terms of 32-bit words. - Minimum value is 32 - Maximum value is 32,768 Note: This field is configured using the OTG_DFIFO_DEPTH parameter. For more information on EP_LOC_CNT, see the "Endpoint Information Controller (EPINFO_CTL)" section.

8.27.5.19 GHWCFG4

Address offset: 0x050

User Hardware Configuration 4 Register

This register contains configuration options selected using coreConsultant. Note: Bit [31] is available only when Scatter/Gather DMA mode is enabled. When Scatter/Gather DMA mode is disabled, this field is reserved.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				U	T	S	S	S	S	R	Q	P	O	N	M	L	L	L	L	K	K	J	I	H	G	F		E	D	C	B	A	A	A	A
Reset 0x3E10AA60				**0**	**0**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	NUMDEVPERIOEPS			Number of Device Mode Periodic IN Endpoints (NumDevPerioEps) Range: 0-15																																
			VALUE0	0	Number of Periodic IN EPs is 0																														
			VALUE1	1	Number of Periodic IN EPs is 1																														
			VALUE2	2	Number of Periodic IN EPs is 2																														
			VALUE3	3	Number of Periodic IN EPs is 3																														
			VALUE4	4	Number of Periodic IN EPs is 4																														
			VALUE5	5	Number of Periodic IN EPs is 5																														
			VALUE6	6	Number of Periodic IN EPs is 6																														
			VALUE7	7	Number of Periodic IN EPs is 7																														
			VALUE8	8	Number of Periodic IN EPs is 8																														
			VALUE9	9	Number of Periodic IN EPs is 9																														
			VALUE10	10	Number of Periodic IN EPs is 10																														
			VALUE11	11	Number of Periodic IN EPs is 11																														
			VALUE12	12	Number of Periodic IN EPs is 12																														
			VALUE13	13	Number of Periodic IN EPs is 13																														
			VALUE14	14	Number of Periodic IN EPs is 14																														
			VALUE15	15	Number of Periodic IN EPs is 15																														
B	R	PARTIALPWRDN			Enable Partial Power Down (PartialPwrDn) - 1'b0: Partial Power Down Not Enabled																														
			DISABLED	0	Partial Power Down disabled																														
			ENABLED	1	Partial Power Down enabled																														
C	R	AHBFREQ			Minimum AHB Frequency Less Than 60 MHz (AhbFreq) - 1'b0: No																														
			DISABLED	0	Minimum AHB Frequency More Than 60 MHz																														
			ENABLED	1	Minimum AHB Frequency Less Than 60 MHz																														
D	R	HIBERNATION			Enable Hibernation (Hibernation) - 1'b0: Hibernation feature not enabled																														
			DISABLED	0	Hibernation feature disabled																														
			ENABLED	1	Hibernation feature enabled																														
E	R	EXTENDEDHIBERNATION			Enable Hibernation - 1'b0: Extended Hibernation feature not enabled																														
			DISABLED	0	Extended Hibernation feature not enabled																														
			ENABLED	1	Extended Hibernation feature enabled																														
F	R	ENHANCEDLPMSUPT1			Enhanced LPM Support1 (EnhancedLPMSupt1) - This bit indicates that the controller supports L1 entry based on FIFO status. - Accept L1 Request even if Bulk/Interrupt TxFIFO is not empty.																														
			DISABLED	0	Reject L1 Request even if Non-Periodic (Bulk/Interrupt) TxFIFO is not empty.																														
			ENABLED	1	Accept L1 Request even if Non-Periodic (Bulk/Interrupt) TxFIFO is not empty																														
G	R	SERVINTFLOW			Service Interval Flow This bit indicates that the controller supports Service-Interval based scheduling flow for ISOC IN EPs.																														
			DISABLED	0	Service Interval Flow not supported																														

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				U	T	S	S	S	S	R	Q	P	O	N	M	L	L	L	L	K	K	J	I	H	G	F		E	D	C	B	A	A	A	A
Reset 0x3E10AA60				**0**	**0**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
			ENABLED	1																															
H	R	IPGISOCSUPT																																	
				This bit indicates that the controller supports the worst-case scenario of Rx followed by Rx Inter Packet Gap (IPG) (32-bit times) as per the UTMI Specification for any token following an ISOC OUT token. Without this support, when any token follows an ISOC OUT token with the worst-case IPG, the controller does not detect the followed token. The worst-case IPG of the controller without this support depends on the AHB and PHY clock frequency.By default IPG Support is enabled.																																
			DISABLED	0																															
			ENABLED	1																															
I	R	ACGSUPT																																	
				This bit indicates that the controller supports the Dynamic (Switching) Power Reduction during periods when there is no USB and AHB Traffic.																																
			DISABLED	0																															
			ENABLED	1																															
J	R	ENHANCEDLPMSUPT																																	
				This bit indicates that the controller supports the following behavior: L1 Entry Behavior based on FIFO Status - TX FIFO - Accept L1 Request even if ISOC IN TX FIFO is not empty. - Reject L1 Request if Non-Periodic TX FIFO is not empty. - Ensure application can flush the TX FIFO while the Controller is in L1. - RX FIFO - Accept L1 Request even if RX FIFO (common to Periodic and Non-Periodic) is not empty. - Accept L1 Request but delay SLEEPM assertion until RX SINK Buffer is empty. Prevent L1 Entry if a Control Transfer is in progress on any Control Endpoint. Ability to Flush TxFIFO even if PHY Clock is gated.																																		
			ENABLED	1																															
K	R	PHYDATAWIDTH																																	
				(PhyDataWidth)<vr>When a ULPI PHY is used, an internal wrapper converts ULPI to UTMI+.																																
			WIDTH1	0																															
			WIDTH2	1																															
			WIDTH3	2																															
L	R	NUMCTLEPS																																	
				Endpoint 0 (NumCtlEps) Range: 0-15																																
			ENDPT0	0																															
			ENDPT1	1																															
			ENDPT2	2																															
			ENDPT3	3																															
			ENDPT4	4																															
			ENDPT5	5																															
			ENDPT6	6																															
			ENDPT7	7																															
			ENDPT8	8																															
			ENDPT9	9																															
			ENDPT10	10																															
			ENDPT11	11																															
			ENDPT12	12																															
			ENDPT13	13																															

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				U	T	S	S	S	S	R	Q	P	O	N	M	L	L	L	L	K	K	J	I	H	G	F		E	D	C	B	A	A	A	A
Reset 0x3E10AA60				**0**	**0**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
			ENDPT14	14																															
			ENDPT15	15																															
M	R	IDDGFLTR																																	
				- 1'b0: No filter																															
			DISABLED	0																															
			ENABLED	1																															
N	R	VBUSVALIDFLTR																																	
				- 1'b0: No filter																															
			DISABLED	0																															
			ENABLED	1																															
O	R	AVALIDFLTR																																	
				- 1'b0: No filter																															
			DISABLED	0																															
			ENABLED	1																															
P	R	BVALIDFLTR																																	
				- 1'b0: No filter																															
			DISABLED	0																															
			ENABLED	1																															
Q	R	SESSENDFLTR																																	
				- 1'b0: No filter																															
			DISABLED	0																															
			ENABLED	1																															
R	R	DEDFIFOMODE																																	
				(DedFifoMode)																															
			DISABLED	0																															
			ENABLED	1																															
S	R	INEPS																																	
				- 0: 1 IN Endpoint - 1: 2 IN Endpoints .... - 15: 16 IN Endpoints																															
			ENDPT1	0																															
			ENDPT2	1																															
			ENDPT3	2																															
			ENDPT4	3																															
			ENDPT5	4																															
			ENDPT6	5																															
			ENDPT7	6																															
			ENDPT8	7																															
			ENDPT9	8																															
			ENDPT10	9																															
			ENDPT11	10																															
			ENDPT12	11																															
			ENDPT13	12																															
			ENDPT14	13																															
			ENDPT15	14																															
			ENDPT16	15																															
T	R	DESCDMAENABLED																																	
				- 1'b0: Non-Scatter/Gather DMA configuration																															
			DISABLE	0																															
			ENABLE	1																															

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				U	T	S	S	S	S	R	Q	P	O	N	M	L	L	L	L	K	K	J	I	H	G	F		E	D	C	B	A	A	A	A
Reset 0x3E10AA60				**0**	**0**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
U	R	DESCDMA																																	
				- 1'b0: Non Dynamic configuration Note: This field is configured using the OTG_EN_DESC_DMA parameter.																																	
			CONFIG1	0																																	Non Dynamic configuration
			CONFIG2	1																																	Dynamic configuration

8.27.5.20 GLPMCFG

Address offset: 0x054

LPM Config Register

Register to control the LPM functionality of the controller.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID						O	N	M	M	M	L	K	K	K	J	J	J	I	H	G	G	F	F	F	F	E	D	C	C	C	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	LPMCAP																																	
				The application uses this bit to control the controller LPM capabilities. If the core operates as a non-LPM-capable host, it cannot request the connected device/hub to activate LPM mode. If the core operates as a non-LPM-capable device, it cannot respond to any LPM transactions. If GLPMCFG.LPMCap is 1'b0, the software must not set any of the remaining fields in the GLPMCFG register and these fields must hold their Reset values.																																	
			DISABLED	0																																	LPM capability is not enabled
			ENABLED	1																																	LPM capability is enabled
B	RW	APPL1RES																																	
				Handshake response to LPM token pre-programmed by device application software. The response depends on GLPMCFG.LPMCap. If GLPMCFG.LPMCap is 1'b0, the core operates as a non-LPM-capable Device and does not respond to any LPM transactions. If GLPMCFG.LPMCap is 1'b1, the core responds as follows: - 1: ACK Even though an ACK is pre-programmed, the core responds with an ACK only on a successful LPM transaction. The LPM transaction is successful if: -- There are no PID/CRC5 errors in both the EXT token and the LPM token (else ERROR) -- A valid bLinkState = 0001B (L1) is received in the LPM transaction (else STALL) -- No data is pending in the Transmit queue (else NYET) - 0: NYET The pre-programmed software bit is overridden for response to LPM token when: -- The received bLinkState is not L1 (STALL response) -- An error is detected in either of the LPM token packets due to corruption (ERROR response).																																	
			NYETRESP	0																																	The core responds with a NYET when an error is detected in either of the LPM token packets due to corruption
			ACKRESP	1																																	The core responds with an ACK only on a successful LPM transaction

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID			O	N	M	M	M	L	K	K	K	J	J	J	J	I	H	G	G	F	F	F	F	F	E	D	C	C	C	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	RW	HIRD			Host-Initiated Resume Duration (HIRD) EnBESL = 1'b0 Host Initiated Resume Duration. - Host Mode: The value of HIRD to be sent in an LPM transaction. This value is also used to initiate resume for a duration TL1HubDrvResume1 for host-initiated resume. - Device Mode: This field is read only and is updated with the Received LPM Token HIRD bmAttribute when an ACK/NYET/STALL response is sent to an LPM transaction. If HIRD[3:0], EnBESL = 1'b1 Best Effort Service Latency (BESL). - Host Mode: The value of BESL to be sent in an LPM transaction. This value is also used to initiate resume for a duration TL1HubDrvResume1 for host-initiated resume. - Device Mode: This field is updated with the Received LPM Token BESL bmAttribute when an ACK/NYET/STALL response is sent to an LPM transaction. If BESL[3:0],
D	RW	BREMOTEWAKE			RemoteWakeEnable (bRemoteWake) Mode: Host and Device Host Mode: The value of remote wake up to be sent in wIndex field of LPM transaction. Device Mode: This field is read only. It is updated with the Received LPM Token bRemoteWake bmAttribute when an ACK/NYET/STALL response is sent to an LPM transaction.
			DISABLED	0	Remote Wakeup is disabled
			ENABLED	1	In Host or device mode, this field takes the value of remote wake up
E	RW	ENBLSLPM			Enable utmi_sleep_n (EnblSlpM) Mode: Host and Device For ULPI interface: The application uses this bit to control the utmi_sleep_n assertion to the PHY when in L1 state. For the host, this bit is valid only in Local Device mode. Note: - When a ULPI interface is configured, enabling this bit results in a write to Bit 7 of the ULPI Function Control register. The Synopsys ULPI PHY supports writing to this bit, and in the L1 state asserts SleepM when utmi_l1_suspend_n cannot be asserted. - When a ULPI/UTMI PHY associated with the controller (Host or device) does not support the LPM sleep feature clock gating, it is recommended to keep the EnblSlpM bit in disabled state (= 1'b0). This ensures the ULPI wrapper is in enabled mode and detects any wakeup events. For all other interfaces: The application uses this bit to control utmi_sleep_n assertion to the PHY in the L1 state. For the host, this bit is valid only in Local Device mode.
			DISABLED	0	utmi_sleep_n assertion from the core is not transferred to the external PHY
			ENABLED	1	utmi_sleep_n assertion from the core is transferred to the external PHY when utmi_l1_suspend_n cannot be asserted

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID			O	N	M	M	M	L	K	K	K	J	J	J	J	I	H	G	G	F	F	F	F	F	E	D	C	C	C	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	HIRDTHRES			BESL/HIRD Threshold (HIRD_Thres) Device Mode: Note: When a ULPI/UTMI PHY associated with the controller (Host or device) does not support the LPM sleep feature clock gating, it is recommended to keep the HIRD_Thres[12] bit in disabled state (= 1'b0). This ensures the ULPI wrapper is in enabled mode and detects any wakeup events. - EnBESL = 1'b0: The core puts the PHY into deep low power mode in L1 (by core asserting L1SuspendM) when HIRD value is greater than or equal to the value defined in this field HIRD_Thres[3:0] and HIRD_Thres[4] is set to 1b1. - EnBESL = 1'b1: The core puts the PHY into deep low power mode in L1 (by core asserting L1SuspendM) when BESL value is greater than or equal to the value defined in this field BESL_Thres[3:0] and BESL_Thres [4] is set to 1'b1. - DCTL.DeepSleepBESLReject = 1'b1: In device initiated resume, the core expects the Host to resume service to the device within the BESL value corresponding to L1 exit time specified in HIRD_Thres[3:0]. The Device sends a NYET response when the received HIRD in LPM token is greater than HIRD threshold. Host Mode: The core puts the PHY into deep low power mode in L1 (by core asserting L1SuspendM) when HIRD_Thres[4] is set to 1'b1. HIRD_Thres[3:0] specifies the time for which resume signaling is to be reflected by host (TL1HubDrvResume2) on the USB bus when it detects device initiated resume. To differentiate between Deep Sleep and Shallow Sleep, HIRD greater than or equal to HIRD threshold comparison is done. For differentiating between NYET or ACK response for LPM token HIRD greater than HIRD Threshold comparison is used. - When EnBESL = 1'b0, HIRD_Thres must not be programmed with a value greater than 4'b1100 in host mode since this exceeds maximum TL1HubDrvResume2. - When EnBESL = 1'b1, HIRD_Thres must not be programmed with a value greater than 4'b0110 in host mode since this exceeds maximum TL1HubDrvResume2. For additional details, see the "Additional Details on GLPMCFG.HIRD_Thres Register Field" section in the databook.
G	R	COREL1RES			LPM Response (CoreL1Res) Device Mode: The response of the core to LPM transaction received is reflected in these two bits. Host Mode: Handshake response received from local device for LPM transaction
			LPMRESP1	0	ERROR : No handshake response
			LPMRESP2	1	STALL response
			LPMRESP3	2	NYET response
			LPMRESP4	3	ACK response

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID			O	N	M	M	M	L	K	K	K	J	J	J	J	I	H	G	G	F	F	F	F	F	E	D	C	C	C	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
H	R	SLPSTS			Port Sleep Status (SlpSts) Device Mode: This bit is set as long as a Sleep condition is present on the USB bus. The core enters the Sleep state when an ACK response is sent to an LPM transaction and the TL1TokenRetry timer has expired. To stop the PHY clock, the application must set the Port Clock Stop bit, which asserts the PHY Suspend input signal. The application must rely on SlpSts and not ACK in CoreL1Res to confirm transition into sleep. The core comes out of sleep: - When there is any activity on the USB line_state - When the application writes to the Remote Wakeup Signaling bit in the Device Control register (DCTL.RmtWkUpSig) or when the application resets or soft-disconnects the device. Host Mode: The host transitions to Sleep (L1) state as a side-effect of a successful LPM transaction by the core to the local port with ACK response from the device. The read value of this bit reflects the current Sleep status of the port. The core clears this bit after: - The core detects a remote L1 Wakeup signal; - The application sets the Port Reset bit or the Port L1Resume bit in the HPRT register; or - The application sets the L1Resume/ Remote Wakeup Detected Interrupt bit or Disconnect Detected Interrupt bit in the Core Interrupt register (GINTSTS.L1WkUpInt or GINTSTS.DisconnInt, respectively).
			CORENOTINL1	0	In Host or Device mode, this bit indicates core is not in L1
			COREINL1	1	In Host mode, this bit indicates the core transitions to Sleep state as a successful LPM transaction. In Device mode, the core enters the Sleep state when an ACK response is sent to an LPM transaction
I	R	L1RESUMEOK			Sleep State Resume OK (L1ResumeOK) Device and Host Mode: Indicates that the application or host can start resume from Sleep state. This bit is valid in LPM sleep (L1) state. It is set in sleep mode after a delay of 50 micro sec (TL1Residency). The bit is reset when SlpSts is 0.
			NOTOK	0	The application/core cannot start Resume from Sleep state
			OK	1	The application/core can start Resume from Sleep state
J	RW	LPMCHNLINDX			LPM Channel Index Host Mode: The channel number on which the LPM transaction has to be applied while sending an LPM transaction to the local device. Based on the LPM channel index, the core automatically inserts the device address and end point number programmed in the corresponding channel into the LPM transaction. Device Mode: LPM Accept Control (LPM_Accept_Ctrl) LPM_Accept_Ctrl[0] (LPM_Chnl_Indx[3]): The application can use this bit to accept an LPM token even if data is present in the INTR endpoint TxFIFO. This bit is applicable only for Dedicated TX FIFO configurations (OTG_EN_DED_TX_FIFO=1).
			CH0	0	Channel 0
			CH1	1	Channel 1
			CH2	2	Channel 2
			CH3	3	Channel 3
			CH4	4	Channel 4
			CH5	5	Channel 5
			CH6	6	Channel 6
			CH7	7	Channel 7
			CH8	8	Channel 8

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID						O	N	M	M	M	L	K	K	K	J	J	J	J	I	H	G	G	F	F	F	F	F	E	D	C	C	C	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
			CH9	9																															
			CH10	10																															
			CH11	11																															
			CH12	12																															
			CH13	13																															
			CH14	14																															
			CH15	15																															
K	RW	LPMRETRYCNT																																	
				Host Mode: Number of additional LPM retries that the HOST would perform if the Device Response was an ERROR until a valid device response is received (STALL/NYET/ACK). Device Mode: LPM Accept Control (LPM_Accept_Ctrl) LPM_Accept_Ctrl[1]: The application can use this bit to reject an LPM token (NYET) between multiple stages of a single control transfer LPM_Accept_Ctrl[2]: The application can use this bit to accept an LPM token even if data is present in the ISOC endpoint TxFIFO. This bit is applicable only for Dedicated TxFIFO configurations (OTG_EN_DED_TX_FIFO=1). LPM_Accept_Ctrl[3]: The application can use this bit to accept an LPM token even if data is present in the BULK endpoint TxFIFO. This bit is applicable only for Dedicated TxFIFO configurations (OTG_EN_DED_TX_FIFO=1).																																		
			RETRY0	0																															
			RETRY1	1																															
			RETRY2	2																															
			RETRY3	3																															
			RETRY4	4																															
			RETRY5	5																															
			RETRY6	6																															
			RETRY7	7																															
L	RW	SNDLPM																																	
				Host Mode: When set by application software, an LPM transaction containing two tokens, EXT & LPM is sent. Cleared by the hardware once a valid response (STALL./NYET/ACK) is received from the Device or the core had finished transmitting the programmed number of LPM retries. Note that this bit must be set only when the host is connected to local port.																																
			DISABLED	0																															
			ENABLED	1																															
M	R	LPMRETRYCNTSTS																																	
				Host Mode: Number of LPM Host Retries still remaining to be transmitted for the current LPM sequence.																															
			RETRYREM0	0																															
			RETRYREM1	1																															
			RETRYREM2	2																															
			RETRYREM3	3																															
			RETRYREM4	4																															
			RETRYREM5	5																															
			RETRYREM6	6																															
			RETRYREM7	7																															

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				O N M M L K K K J J J J I H G G F F F F E D C C C C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
N	RW	LPMENBESL			LPM Enable BESL (LPM_EnBESL) This bit enables the BESL feature as defined in LPM Errata
			DISABLED	0	BESL is disabled
			ENABLED	1	BESL is enabled as defined in LPM Errata
O	RW	LPMRESTORESLPSTS			LPM Restore Sleep Status (LPM_RestoreSlpSts) When the application power gates the core (Partial Power Down / Hibernation) the application needs to program this bit to restore the LPM status in the core. The application needs to program this bit, during restore process, based on whether it decides to go into Shallow Sleep (Clock Gating Only) or Deep Sleep (Power Gating) based on the BESL value received from the Host
			DISABLED	0	Puts the core in Shallow Sleep mode based on the BESL value from the Host
			ENABLED	1	Puts the core in Deep Sleep mode based on the BESL value from the Host

8.27.5.21 GPWRDN

Address offset: 0x058

Global Power Down Register

This is the Hibernation control register. This register is active only during hibernation and ADP. The application can get the status of the wakeup_logic and control it through this register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				W W W W W V U T T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000010				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	PMUINTSEL			PMU Interrupt Select (PMUIntSel) A write to this bit with 1'b1 enables the PMU to generate interrupts to the application. During this state all interrupts from the DWC_otg_core module are blocked to the application. Note: This bit must be set to 1'b1 before the core is put into hibernation. Note: This bit must not be written to during normal mode of operation.
			DISABLE	0	Internal DWC_otg_core interrupt is selected
			ENABLE	1	External DWC_otg_pmu interrupt is selected
B	RW	PMUACTV			PMU Active (PMUActv) This is bit is to enable or disable the PMU logic. Note: This bit must not be written to during normal mode of operation.
			DISABLE	0	Disable PMU module
			ENABLE	1	Enable PMU module
C	RW	RESTORE			Restore The application must program this bit to enable or disable restore mode from the PMU module. Note: This bit must not be written to during normal mode of operation.
			DISABLE	0	The controller in normal mode of operation
			ENABLE	1	The controller in Restore mode

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				W	W	W	W	W		V	U	T	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000010	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
D	RW	PWRDNCLMP			Power Down Clamp (PwrDnClmp) The application must program this bit to enable or disable the clamps to all the outputs of the core module to prevent the corruption of other active logic.
			DISABLE	0	Disable PMU power clamp
			ENABLE	1	Enable PMU power clamp
E	RW	PWRDNRSTN			Power Down ResetN (PwrDnRst_n) The application must program this bit to reset the core during the Hibernation exit process or during ADP when powering up the core (in case the core was powered off during ADP process). Note: This bit must not be written to during normal mode of operation.
			DISABLE	0	Reset the controller
			ENABLE	1	The controller is in normal operation
F	RW	PWRDNSWTCH			Power Down Switch (PwrDnSwtch) This bit indicates to the controller whether the VDD switch is in ON/ OFF state. Note: This bit must not be written to during normal mode of operation.
			ON	0	The controller is in ON state
			OFF	1	The controller is in OFF state
G	RW	DISABLEVBUS			DisableVBUS Host Mode: The application must program this bit if HPRT0.PrtPwr was programmed to 0 before entering Hibernation. This is to indicate PMU whether session was ended before entering Hibernation. Device Mode: The application must program this bit to inform the PMU whether the bvalid valid signal is high (session valid) or low (session end) whenever the core is switched off. This bit is valid only when GPWRDN.PMUActv is 1.
			DISABLED	0	Host mode:HPRT0.PrtPwr was not programmed to 0, and in Device mode:Session Valid
			ENABLED	1	Host mode:HPRT0.PrtPwr was programmed to 0 and in Device mode:Session End
H	RW	LNSTSCHNG			Line State Change (LnStsChng) This interrupt is asserted when there is a Linestate Change detected by the PMU. The application must read GPWRDN.Linestate to determine the current linestate on USB. This bit is valid only when GPWRDN.PMUActv is 1.
			DISABLED	0	No LineState change on USB
			ENABLED	1	LineState change on USB
I	RW	LINESTAGECHANGEMSK			LineStageChangeMsk Mask for LineStateChange interrupt.
			MASK	0	Mask for LineStateChange Interrupt
			NOMASK	1	No LineStateChange Interrupt Mask
J	RW	RESETDETECTED			ResetDetected This field indicates that Reset has been detected by the PMU module. This field generates an interrupt.
			DISABLED	0	Reset not detected
			ENABLED	1	Reset detected
K	RW	RESETDETMSK			ResetDetMsk Mask for ResetDetected interrupt
			MASK	0	Mask for ResetDetect Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				W	W	W	W	W		V	U	T	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000010	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
			NOMASK	1	No ResetDetect Interrupt Mask
L	RW	DISCONNECTDETECT			DisconnectDetect This field indicates that Disconnect has been detected by the PMU. This field generates an interrupt. After detecting disconnect during hibernation the application must not restore the core, but instead start the initialization process.
			DISABLED	0	Disconnect not detected
			ENABLED	1	Disconnect detected
M	RW	DISCONNECTDETECTMSK			DisconnectDetectMsk Mask For DisconnectDetect Interrupt
			MASK	0	Mask for DisconnectDetect Interrupt
			NOMASK	1	No DisconnectDetect Interrupt Mask
N	RW	CONNECTDET			ConnectDet This field indicates that a new connect has been detected
			DISABLED	0	Connect not detected
			ENABLED	1	Connect detected
O	RW	CONNDETMSK			ConnDetMsk Mask for ConnectDet interrupt
			NOMASK	0	No ConnectDet Interrupt Mask
			MASK	1	Mask for ConnectDet Interrupt
P	RW	SRPDETECT			SRPDetect This field indicates that SRP has been detected by the PMU. This field generates an interrupt. After detecting SRP during hibernation the application must not restore the core. The application must get into the initialization process.
			DISABLED	0	SRP not detected
			ENABLED	1	SRP detected
Q	RW	SRPDETECTMSK			SRPDetectMsk Mask for SRPDetect Interrupt
			NOMASK	0	No SRPDetect Interrupt Mask
			MASK	1	Mask for SRPDetect Interrupt
R	RW	STSCHNGINT			Status Change Interrupt (StsChngInt) This field indicates a status change in either the IDDIG or BSessVld signal. After receiving this interrupt the application must read the GPWRDN register and interpret the change in IDDIG or BSesVld with respect to the previous value stored by the application. Note: When Battery Charger is enabled and the ULPI interface is used, if StsChngInt is received and the application reads GPWRDN register and determines that it is because of a change in the value of IDDIG, then StsChngInt may be generated once again within the next few clock cycles. This occurs because of an ambiguity in the implementation of Battery Charger Support over the ULPI interface. After receiving the StsChngInt for the second time the application can once again read the GPWRDN register. However, this time the valueIDDIG (or BSesVld) would not have changed. The application then processes the second interrupt but no further action will be required as a result.
			DISABLED	0	No Status change
			ENABLED	1	Status change detected

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID							W	W	W	W	W		V	U	T	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000010				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
S	RW	STSCHNGINTMSK																																	
			MASK	0																															
			NOMASK	1																															
T	R	LINESTATE																																	
			LS1	0																															
			LS2	1																															
			LS3	2																															
			LS4	3																															
U	R	IDDIG																																	
			DISABLED	0																															
			ENABLED	1																															
V	R	BSESSVLD																																	
			NOTVALID	0																															
			VALID	1																															
W	R	MULTVALIDBC																																	
			RID0	0																															
			RIDC	1																															
			RIDB	2																															
			RIDA	4																															
			RIDGND	8																															
			RIDARIDGND	12																															
			RIDFLOAT	16																															
			RIDCRIDFLOAT	17																															
			RIDBRIDFLOAT	18																															
			RID1	31																															

8.27.5.22 GDFIFOCFG

Address offset: 0x05C

Global DFIFO Configuration Register

Register to configure the DFIFOs for the controller.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x0BE00C00				**0**	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	GDFIFOCFG																																	
				GDFIFOCfg This field is for dynamic programming of the DFIFO Size. This value takes effect only when the application programs a non zero value to this register. The value programmed must conform to the guidelines described in 'FIFO RAM Allocation'. The core does not have any corrective logic if the FIFO sizes are programmed incorrectly.																														
B	RW	EPINFOBASEADDR		This field provides the start address of the EP info controller. The EP info controller manages the stored values in the last few locations of the SPRAM as listed below. - Host Buffer DMA mode: One location per channel is used in SPRAM to store the HCDMAn value. - Host Scatter/Gather DMA mode: Four locations per channel are used in SPRAM to store the Base Descriptor address, Current Descriptor address, Current Buffer Pointer, and the Status Quadlet. - Device Buffer DMA mode: One location per endpoint direction is used in SPRAM to store the DIEPDMA and DOEPDMA value. - Device Scatter/Gather DMA mode: Four locations per endpoint direction are used in SPRAM to store the Base Descriptor address, Current Descriptor address, Current Buffer Pointer and the Status Quadlet.																																		

8.27.5.23 GINTMSK2

Address offset: 0x068

Interrupt Mask Register 2

This register works with the Interrupt Register (GINTSTS2) to interrupt the application. When an interrupt bit is masked, the interrupt associated with that bit is not generated. However, the GINTSTS2 register bit corresponding to that interrupt is still set. Note: The fields of this register change depending on host or device mode.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	GINTMSK2																																	

8.27.5.24 GINTSTS2

Address offset: 0x06C

Interrupt Register 2

This register interrupts the application for system-level events in the current mode (Device mode or Host mode). Some of the bits in this register are valid only in Host mode, while others are valid in Device mode only. This register also indicates the current mode. To clear the interrupt status bits of type R_SS_WC, the application must write 1'b1 to the bit. The application must clear the GINTSTS2 register at initialization before unmasking the interrupt bit to avoid any interrupts generated prior to initialization.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	GINTSTS2			

8.27.5.25 HPTXFSIZ

Address offset: 0x100

Host Periodic Transmit FIFO Size Register

This register holds the size and the memory start address of the Periodic TxFIFO. Note: Read the reset value of this register only after the following conditions: - If IDDIG_FILTER is disabled, read only after PHY clock is stable. - If IDDIG_FILTER is enabled, read only after the filter timer expires.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					B	B	B	B	B	B	B	B	B	B	B	B				A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x0C001800	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PTXFSTADDR			Host Periodic TxFIFO Start Address (PTxFStAddr) The power-on reset value of this register is the sum of the Largest Rx Data FIFO Depth and Largest Non-periodic Tx Data FIFO Depth.These parameters are: In shared FIFO operation: - OTG_RX_DFIFO_DEPTH + OTG_TX_NPERIO_DFIFO_DEPTH In dedicated FIFO mode: - OTG_RX_DFIFO_DEPTH + OTG_TX_HNPERIO_DFIFO_DEPTH If Enable Dynamic FIFO Sizing? was deselected in coreConsultant (parameter OTG_DFIFO_DYNAMIC = 0), these flops are optimized, and reads return the power-on value. If Enable Dynamic FIFO Sizing? was selected in coreConsultant (parameter OTG_DFIFO_DYNAMIC = 1), you can write a new value in this field. Programmed values must not exceed the power-on value set in coreConsultant.
B	RW	PTXFSIZE			Host Periodic TxFIFO Depth (PTxFSize) This value is in terms of 32-bit words. - Minimum value is 16 - Maximum value is 32,768 The power-on reset value of this register is specified as the Largest Host Mode Periodic Tx Data FIFO Depth. - If Enable Dynamic FIFO Sizing? was deselected in coreConsultant (parameter OTG_DFIFO_DYNAMIC = 0), these flops are optimized, and reads return the power-on value. - If Enable Dynamic FIFO Sizing? was selected in coreConsultant (parameter OTG_DFIFO_DYNAMIC = 1), you can write a new value in this field. Programmed values must not exceed the power-on value set in coreConsultant.

8.27.5.26 DIEPTXF[n] (n=1..15)

Address offset: 0x104 + (n × 0x4)

Device IN Endpoint Transmit FIFO 1 Size Register

This register is valid only in dedicated FIFO mode (OTG_EN_DED_TX_FIFO=1). It holds the size and memory start address of IN endpoint TxFIFOs implemented in Device mode. Each FIFO holds the data for one IN endpoint. This register is repeated for instantiated IN endpoint FIFOs 1 to 15. For IN endpoint FIFO 0, use GNPTXFSIZ register for programming the size and memory start address.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					B	B	B	B	B	B	B	B	B	B	B	B				A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x0C001800	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	INEPNTXFSTADDR			IN Endpoint FIFOn Transmit RAM Start Address (INEPnTxFStAddr) This field contains the memory start address for the IN endpoint Transmit FIFO that this register corresponds to. The power-on reset value of this register is calculated according to the following formula: OTG_RX_DFIFO_DEPTH + SUM of OTG_TX_DINEP_DFIFO_DEPTH_'n', where n = 0 to (FIFO number-1). For example, Start address of INEP FIFO 1 (DIEPTXF1) is OTG_RX_DFIFO_DEPTH + OTG_TX_DINEP_DFIFO_DEPTH_0, start address of INEP FIFO 2 (DIEPTXF2) is OTG_RX_DFIFO_DEPTH + OTG_TX_DINEP_DFIFO_DEPTH_0 + OTG_TX_DINEP_DFIFO_DEPTH_1, and so on. If at POR the calculated value (C) exceeds 65535, then the Reset value becomes Reset Value(A) = (C-65536). - If Enable Dynamic FIFO Sizing is deselected in coreConsultant (OTG_DFIFO_DYNAMIC = 0), this field is read-only and read value is the power-on reset value. - If Enable Dynamic FIFO Sizing is selected in coreConsultant (OTG_DFIFO_DYNAMIC = 1), and you have calculated or programmed a new value for RxFIFO depth or TX FIFO depths, you can program their values according to the above formula. Programmed values must not exceed the power-on value set in coreConsultant.
B	RW	INEPNTXFDEP			IN Endpoint TxFIFO Depth (INEPnTxFDep) This value is in terms of 32-bit words. - Minimum value is 16 - Maximum value is 32,768 The power-on reset value of this register is specified as the Largest IN Endpoint FIFO number Depth (parameter OTG_TX_DINEP_DFIFO_DEPTH_i) set during coreConsultant configuration, where i is the FIFO number this register corresponds to. - If "Enable Dynamic FIFO Sizing?" was deselected in coreConsultant (parameter OTG_DFIFO_DYNAMIC = 0), these flops are optimized, and reads return the power-on value. - If "Enable Dynamic FIFO Sizing?" was selected in coreConsultant (parameter OTG_DFIFO_DYNAMIC = 1), you can write a new value in this field. Programmed values must not exceed the power-on value.

8.27.5.27 HCFG

Address offset: 0x400

Host Configuration Register

This register is used to configure the controller in Host mode.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	E																D	D	D	D	D	D	D	D	C					B	A	A
Reset 0x00000200	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	FSLSPCLKSEL			FS/LS PHY Clock Select (FSLSPclkSel) When the core is in FS Host mode When the core is in LS Host mode Notes: - When Core in FS mode, the internal and external clocks have the same frequency. - When Core in LS mode, -- If FSLSPclkSel = 2'b00: Internal and external clocks have the same frequency -- If FSLSPclkSel = 2'b10: Internal clock is the divided by eight version of external 48 MHz clock
			CLK3060	0	PHY clock is running at 30/60 MHz
			CLK48	1	PHY clock is running at 48 MHz

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E D D D D D D D C B A A
Reset 0x00000200				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
			CLK6	2	PHY clock is running at 6 MHz
B	RW	FSLSSUPP			FS- and LS-Only Support (FSLSSupp) The application uses this bit to control the core's enumeration speed. Using this bit, the application can make the core enumerate as a FS host, even If the connected device supports HS traffic. Do not make changes to this field after initial programming.
			HSFSLS	0	HS/FS/LS, based on the maximum speed supported by the connected device
			FSLS	1	FS/LS-only, even if the connected device can support HS
C	RW	ENA32KHZS			Enable 32 KHz Suspend mode (Ena32KHzS) This bit can be set only in FS PHY interface is selected. Else, this bit needs to be set to zero. When FS PHY interface is chosen and this bit is set, the core expects that the PHY clock during Suspend is switched from 48 MHz to 32 KHz.
			DISABLED	0	32 KHz Suspend mode disabled
			ENABLED	1	32 KHz Suspend mode enabled
D	RW	RESVALID			Resume Validation Period (ResValid) This field is effective only when HCFG.Ena32KHzS is set. It controls the resume period when the core resumes from suspend. The core counts for 'ResValid' number of clock cycles to detect a valid resume when this is set.
E	RW	MODECHTIMEN			Mode Change Ready Timer Enable (ModeChTimEn) This bit is used to enable/disable the Host core to wait 200 PHY clock cycles at the end of Resume to change the opmode signal to the PHY to 00 after Suspend or LPM.
			ENABLED	0	The Host core waits for either 200 PHY clock cycles or a linestate of SE0 at the end of resume to change the opmode from 0x2 to 0x0
			DISABLED	1	The Host core waits only for a linestate of SE0 at the end of resume to change the opmode from 0x2 to 0x0

8.27.5.28 HFIR

Address offset: 0x404

Host Frame Interval Register

This register is used to control the interval between two consecutive SOFs.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x0000EA60	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	FRINT			Frame Interval (FrInt) The value that the application programs to this field specifies the interval between two consecutive SOFs (FS) or micro- SOFs (HS) or Keep-Alive tokens (HS). This field contains the number of PHY clocks that constitute the required frame interval. The Default value set in this field is for FS operation when the PHY clock frequency is 60 MHz. The application can write a value to this register only after the Port Enable bit of the Host Port Control and Status register (HPRT.PrtEnaPort) has been Set. If no value is programmed, the core calculates the value based on the PHY clock specified in the FS/LS PHY Clock Select field of the Host Configuration register (HCFG.FSLSPclkSel). Do not change the value of this field after the initial configuration. - 125 us * (PHY clock frequency for HS) - 1 ms * (PHY clock frequency for FS/LS)
B	RW	HFIRRLDCTRL			Reload Control (HFIRRldCtrl) This bit allows dynamic reloading of the HFIR register during run time. This bit needs to be programmed during initial configuration and its value must not be changed during runtime.
			DISABLED	0	The HFIR cannot be reloaded dynamically
			ENABLED	1	The HFIR can be dynamically reloaded during runtime

8.27.5.29 HFNUM

Address offset: 0x408

Host Frame Number/Frame Time Remaining Register

This register indicates the current frame number. It also indicates the time remaining (in terms of the number of PHY clocks) in the current (micro)frame. Note: Read the reset value of this register only after the following conditions: - If IDDIG_FILTER is disabled, read only when the PHY clock is stable. - If IDDIG_FILTER is enabled, read only after the filter timer expires.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00003FFF	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

ID	R/W	Field	Value ID	Value	Description
A	R	FRNUM			Frame Number (FrNum) This field increments when a new SOF is transmitted on the USB, and is reset to 0 when it reaches 16'h3FFF.
			INACTIVE	0	No SOF is transmitted
			ACTIVE	1	SOF is transmitted
B	R	FRREM			Frame Time Remaining (FrRem) Indicates the amount of time remaining in the current microframe (HS) or Frame (FS/LS), in terms of PHY clocks. This field decrements on each PHY clock. When it reaches zero, this field is reloaded with the value in the Frame Interval register and a new SOF is transmitted on the USB.

8.27.5.30 HPTXSTS

Address offset: 0x410

Host Periodic Transmit FIFO/Queue Status Register

This register contains information about the Periodic Transmit Queue in the Host controller.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				C	C	C	C	C	C	C	C	C	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00080C00				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	PTXFSPCAVAIL			Periodic Transmit Data FIFO Space Available (PTxFSpcAvail) Indicates the number of free locations available to be written to in the Periodic TxFIFO. Values are in terms of 32-bit words - Others : Reserved																																
B	R	PTXQSPCAVAIL			Periodic Transmit Request Queue Space Available (PTxQSpcAvail) Indicates the number of free locations available to be written in the Periodic Transmit Request Queue. This queue holds both IN and OUT requests. - n: n locations available (0 <= n <= 16)																																
			FULL	0	Periodic Transmit Request Queue is full																																
			FREE1	1	1 location available																																
			FREE2	2	2 locations available																																
			FREE3	3	3 locations available																																
			FREE4	4	4 locations available																																
			FREE5	5	5 locations available																																
			FREE6	6	6 locations available																																
			FREE7	7	7 locations available																																
			FREE8	8	8 locations available																																
			FREE9	9	9 locations available																																
			FREE10	10	10 locations available																																
			FREE11	11	11 locations available																																
			FREE12	12	12 locations available																																
			FREE13	13	13 locations available																																
			FREE14	14	14 locations available																																
			FREE15	15	15 locations available																																
C	R	PTXQTOP			Top of the Periodic Transmit Request Queue (PTxQTop) This indicates the Entry in the Periodic Tx Request Queue that is currently being processed by the MAC. This register is used for debugging.																																

8.27.5.31 HAINT

Address offset: 0x414

Host All Channels Interrupt Register

When a significant event occurs on a channel, the Host All Channels Interrupt register interrupts the application using the Host Channels Interrupt bit of the Core Interrupt register (GINTSTS.HChInt). This is shown in the "Interrupt Hierarchy" figure in the databook. There is one interrupt bit per channel, up to a maximum of 16 bits. Bits in this register are set and cleared when the application sets and clears bits in the corresponding Host Channel-n Interrupt register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	HAINT			Channel Interrupt for channel no.																																
			INACTIVE	0	Not active																																
			ACTIVE	1	Host Channel Interrupt																																

8.27.5.32 HAINTMSK

Address offset: 0x418

Host All Channels Interrupt Mask Register

The Host All Channel Interrupt Mask register works with the Host All Channel Interrupt register to interrupt the application when an event occurs on a channel. There is one interrupt mask bit per channel, up to a maximum of 16 bits.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	HAINTMSK			Channel Interrupt Mask (HAINTMsk) One bit per channel: Bit 0 for channel 0, bit 15 for channel 15
			MASK	0	Mask Channel interrupt
			UNMASK	1	UnMask Channel interrupt

8.27.5.33 HPRT

Address offset: 0x440

Host Port Control and Status Register

This register is available only in Host mode. Currently, the OTG Host supports only one port. A single register holds USB port-related information such as USB reset, enable, suspend, resume, connect status, and test mode for each port. It is shown in the "Interrupt Hierarchy" figure in the databook. The R_SS_WC bits in this register can trigger an interrupt to the application through the Host Port Interrupt bit of the Core Interrupt register (GINTSTS.PrtInt). On a Port Interrupt, the application must read this register and clear the bit that caused the interrupt. For the R_SS_WC bits, the application must write a 1 to the bit to clear the interrupt.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				M M L L L L K J J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	PRTCONNSTS			Port Connect Status (PrtConnSts) - 0: No device is attached to the port. - 1: A device is attached to the port.
			NOTATTACHED	0	No device is attached to the port
			ATTACHED	1	A device is attached to the port
B	RW	PRTCONNDET			Port Connect Detected (PrtConnDet) The core sets this bit when a device connection is detected to trigger an interrupt to the application using the Host Port Interrupt bit of the Core Interrupt register (GINTSTS.PrtInt).This bit can be set only by the core and the application must write 1 to clear it.The application must write a 1 to this bit to clear the interrupt.
			INACTIVE	0	No device connection detected
			ACTIVE	1	Device connection detected

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID														M	M	L	L	L	L	K	J	J		I	H	G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	RW	PRTENA			Port Enable (PrtEna) A port is enabled only by the core after a reset sequence, and is disabled by an overcurrent condition, a disconnect condition, or by the application clearing this bit. The application cannot Set this bit by a register write. It can only clear it to disable the port by writing 1. This bit does not trigger any interrupt to the application.
			DISABLED	0	Port disabled
			ENABLED	1	Port enabled
D	RW	PRTENCHNG			Port Enable/Disable Change (PrtEnChng) The core sets this bit when the status of the Port Enable bit [2] of this register changes.This bit can be set only by the core and the application must write 1 to clear it.
			INACTIVE	0	Port Enable bit 2 has not changed
			ACTIVE	1	Port Enable bit 2 changed
E	R	PRTOVRCURRACT			Port Overcurrent Active (PrtOvrCurrAct) Indicates the overcurrent condition of the port.
			INACTIVE	0	No overcurrent condition
			ACTIVE	1	Overcurrent condition
F	RW	PRTOVRCURRCHNG			Port Overcurrent Change (PrtOvrCurrChng) The core sets this bit when the status of the Port Overcurrent Active bit (bit 4) in this register changes.This bit can be set only by the core and the application must write 1 to clear it
			INACTIVE	0	Status of port overcurrent status is not changed
			ACTIVE	1	Status of port overcurrent changed
G	RW	PRTRES			Port Resume (PrtRes) The application sets this bit to drive resume signaling on the port. The core continues to drive the resume signal until the application clears this bit. If the core detects a USB remote wakeup sequence, as indicated by the Port Resume/Remote Wakeup Detected Interrupt bit of the Core Interrupt register (GINTSTS.WkUpInt), the core starts driving resume signaling without application intervention and clears this bit when it detects a disconnect condition. The read value of this bit indicates whether the core is currently driving resume signaling. When LPM is enabled, In L1 state the behavior of this bit is as follows: The application sets this bit to drive resume signaling on the port. The core continues to drive the resume signal until a pre-determined time specified in GLPMCFG.HIRD_Thres[3:0] field. If the core detects a USB remote wakeup sequence, as indicated by the Port L1Resume/Remote L1Wakeup Detected Interrupt bit of the Core Interrupt register (GINTSTS.L1WkUpInt), the core starts driving resume signaling without application intervention and clears this bit at the end of resume.This bit can be set by both core or application and also cleared by core or application. This bit is cleared by the core even if there is no device connected to the Host.
			NORESUME	0	No resume driven
			RESUME	1	Resume driven

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID														M	M	L	L	L	L	K	J	J		I	H	G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
H	RW	PRTSUSP			Port Suspend (PrtSusp) The application sets this bit to put this port in Suspend mode. The core only stops sending SOFs when this is Set. To stop the PHY clock, the application must Set the Port Clock Stop bit, which asserts the suspend input pin of the PHY. The read value of this bit reflects the current suspend status of the port. This bit is cleared by the core after a remote wakeup signal is detected or the application sets the Port Reset bit or Port Resume bit in this register or the Resume/Remote Wakeup Detected Interrupt bit or Disconnect Detected Interrupt bit in the Core Interrupt register (GINTSTS.WkUpInt or GINTSTS.DisconnInt, respectively).This bit is cleared by the core even if there is no device connected to the Host.
			INACTIVE	0	Port not in Suspend mode
			ACTIVE	1	Port in Suspend mode
I	RW	PRTRST			Port Reset (PrtRst) When the application sets this bit, a reset sequence is started on this port. The application must time the reset period and clear this bit after the reset sequence is complete. The application must leave this bit set for at least a minimum duration mentioned below to start a reset on the port. The application can leave it set for another 10 ms in addition to the required minimum duration, before clearing the bit, even though there is no maximum limit Set by the USB standard.This bit is cleared by the core even if there is no device connected to the Host. - High speed: 50 ms - Full speed/ Low speed: 10 ms
			DISABLED	0	Port not in reset
			ENABLED	1	Port in reset
J	R	PRTLNSTS			Port Line Status (PrtLnSts) Indicates the current logic level USB data lines
			PLUSD	1	Logic level of D+
			MINUSD	2	Logic level of D-
K	RW	PRTPWR			Port Power (PrtPwr) The application uses this field to control power to this port (write 1'b1 to set to 1'b1 and write 1'b0 to set to 1'b0), and the core can clear this bit on an over current condition. Note: This bit is interface independent. The application needs to program this bit for all interfaces as described in the host programming flow in the Programming Guide.
			OFF	0	Power off
			ON	1	Power on
L	RW	PRTTSTCTL			Port Test Control (PrtTstCtl) The application writes a nonzero value to this field to put the port into a Test mode, and the corresponding pattern is signaled on the port. To move the DWC_otg controller to test mode, you must set this field. Complete the following steps to move the DWC_otg core to test mode: - 1. Power on the core. - 2. Load the DWC_otg driver. - 3. Connect an HS device and enumerate to HS mode. - 4. Access the HPRT register to send test packets. - 5. Remove the device and connect to fixture (OPT) port. The DWC_otg host core continues sending out test packets. - 6. Test the eye diagram.
			DISABLED	0	Test mode disabled
			TESTJ	1	Test_J mode
			TESTK	2	Test_K mode

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	M	M	L	L	L	L	K	J	J		I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
			TESTSN	3																															
			TESTPM	4																															
			TESTFENB	5																															
M	R	PRTSPD																																	
				Indicates the speed of the device attached to this port.																															
			HIGHSPD	0																															
			FULLSPD	1																															
			LOWSPD	2																															
			PRTSPDRSVD3	3																															

8.27.5.34 HC[n].CHAR (n=0..15)

Address offset: 0x500 + (n × 0x18)

Host Channel Characteristics Register 0

This register contains the characteristics of the Host Channel.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				J	I	H	G	G	G	G	G	G	G	F	F	E	E	D		C	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	MPS																																	
				Indicates the maximum packet size of the associated endpoint.																															
B	RW	EPNUM																																	
				Indicates the endpoint number on the device serving as the data source or sink.																															
			ENDPT0	0																															
			ENDPT1	1																															
			ENDPT2	2																															
			ENDPT3	3																															
			ENDPT4	4																															
			ENDPT5	5																															
			ENDPT6	6																															
			ENDPT7	7																															
			ENDPT8	8																															
			ENDPT9	9																															
			ENDPT10	10																															
			ENDPT11	11																															
			ENDPT12	12																															
			ENDPT13	13																															
			ENDPT14	14																															
			ENDPT15	15																															
C	RW	EPDIR																																	
				Indicates whether the transaction is IN or OUT.																															
			OUT	0																															
			IN	1																															

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	J	I	H	G	G	G	G	G	G	G	F	F	E	E	D		C	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
D	RW	LSPDDEV			Low-Speed Device (LSpdDev) This field is Set by the application to indicate that this channel is communicating to a low-speed device. The application must program this bit when a low speed device is connected to the host through an FS HUB. The DWC_otg Host core uses this field to drive the XCVR_SELECT signal to 2'b11 while communicating to the LS Device through the FS hub. Note: In a peer to peer setup, the DWC_otg Host core ignores this bit even if it is set by the application software.
			DISABLED	0	Not Communicating with low speed device
			ENABLED	1	Communicating with low speed device
E	RW	EPTYPE			Endpoint Type (EPType) Indicates the transfer type selected.
			CTRL	0	Control
			ISOC	1	Isochronous
			BULK	2	Bulk
			INTERR	3	Interrupt
F	RW	EC			Multi Count (MC) / Error Count (EC) When the Split Enable bit of the Host Channel-n Split Control register (HCSPLTn.SpltEna) is reset (1'b0), this field indicates to the host the number of transactions that must be executed per microframe for this periodic endpoint. For non periodic transfers, this field is used only in DMA mode, and specifies the number packets to be fetched for this channel before the internal DMA engine changes arbitration. When HCSPLTn.SpltEna is Set (1'b1), this field indicates the number of immediate retries to be performed for a periodic split transactions on transaction errors. This field must be Set to at least 2'b01.
			ECRSVD0	0	Reserved. This field yields undefined result
			TRANSONE	1	1 transaction
			TRANSTWO	2	2 transactions to be issued for this endpoint per microframe
			TRANSTHREE	3	3 transactions to be issued for this endpoint per microframe
G	RW	DEVADDR			Device Address (DevAddr) This field selects the specific device serving as the data source or sink.
H	RW	ODDFRM			Odd Frame (OddFrm) This field is set (reset) by the application to indicate that the OTG host must perform a transfer in an odd (micro)Frame. This field is applicable for only periodic (isochronous and interrupt) transactions.
			EFRAME	0	Even Frame Transfer
			OFRAME	1	Odd Frame Transfer
I	RW	CHDIS			Channel Disable (ChDis) The application sets this bit to stop transmitting/receiving data on a channel, even before the transfer for that channel is complete. The application must wait for the Channel Disabled interrupt before treating the channel as disabled.
			INACTIVE	0	Transmit/Recieve normal
			ACTIVE	1	Stop transmitting/receiving data on channel
J	RW	CHENA			Channel Enable (ChEna) When Scatter/Gather mode is enabled When Scatter/Gather mode is disabled This field is set by the application and cleared by the OTG host.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				J	I	H	G	G	G	G	G	G	G	F	F	E	E	D		C	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
			DISABLED	0																															
			ENABLED	1																															

8.27.5.35 HC[n].SPLT (n=0..15)

Address offset: 0x504 + (n × 0x18)

Host Channel Split Control Register 0

This register contains the Split characteristics of the Host Channel.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				E															D	C	C	B	B	B	B	B	B	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	PRTADDR																																	
				Port Address (PrtAddr) This field is the port number of the recipient transaction translator.																																	
B	RW	HUBADDR																																	
				Hub Address (HubAddr) This field holds the device address of the transaction translator's hub.																																	
C	RW	XACTPOS																																	
				Transaction Position (XactPos) This field is used to determine whether to send all, first, middle, or last payloads with each OUT transaction.																																	
			MIDDLE	0																															
				Mid. This is the middle payload of this transaction (which is larger than 188 bytes)																																	
			END	1																															
				End. This is the last payload of this transaction (which is larger than 188 bytes)																																	
			BEGIN	2																															
				Begin. This is the first data payload of this transaction (which is larger than 188 bytes)																																	
			ALL	3																															
				All. This is the entire data payload of this transaction (which is less than or equal to 188 bytes)																																	
D	RW	COMPSPLT																																	
				Do Complete Split (CompSplt) The application sets this field to request the OTG host to perform a complete split transaction.																																	
			NOSPLIT	0																															
				No complete split transaction																																	
			SPLIT	1																															
				Complete Split transaction																																	
E	RW	SPLTENA																																	
				Split Enable (SpltEna) The application sets this field to indicate that this channel is enabled to perform split transactions.																																	
			DISABLED	0																															
				Split not enabled																																	
			ENABLED	1																															
				Split enabled																																	

8.27.5.36 HC[n].INT (n=0..15)

Address offset: 0x508 + (n × 0x18)

Host Channel Interrupt Register 0

This register indicates the status of a channel with respect to USB- and AHB-related events. It is shown in the "Interrupt Hierarchy" figure in the databook. The application must read this register when the Host Channels Interrupt bit of the Core Interrupt register (GINTSTS.HChInt) is set. Before the application can read this register, it must first read the Host All Channels Interrupt (HAINT) register to get the exact channel number for the Host Channel-n Interrupt register. The application must clear the appropriate bit in this register to clear the corresponding bits in the HAINT and GINTSTS registers.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																						K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed (XferCompl) Transfer completed normally without any errors.This bit can be set only by the core and the application must write 1 to clear it. - For Scatter/Gather DMA mode, it indicates that current descriptor processing got completed with IOC bit set in its descriptor. - In non Scatter/Gather DMA mode, it indicates that Transfer completed normally without any errors.
			INACTIVE	0	Transfer in progress or No Active Transfer
			ACTIVE	1	Transfer completed normally without any errors
B	RW	CHHLTD			Channel Halted (ChHltd) In non Scatter/Gather DMA mode, it indicates the transfer completed abnormally either because of any USB transaction error or in response to disable request by the application or because of a completed transfer. In Scatter/gather DMA mode, this indicates that transfer completed due to any of the following - EOL being set in descriptor - AHB error - Excessive transaction errors - Babble - Stall
			INACTIVE	0	Channel not halted
			ACTIVE	1	Channel Halted
C	RW	AHBERR			AHB Error (AHBErr) This is generated only in Internal DMA mode when there is an AHB error during AHB read/write. The application can read the corresponding channel's DMA address register to get the error address. For details, see "AHB Error Handling" in the Programming Guide.
			INACTIVE	0	No AHB error
			ACTIVE	1	AHB error during AHB read/write
D	RW	STALL			STALL Response Received Interrupt (STALL) In Scatter/Gather DMA mode, the interrupt due to this bit is masked in the core.This bit can be set only by the core and the application must write 1 to clear it.
			INACTIVE	0	No Stall Response Received Interrupt
			ACTIVE	1	Stall Response Received Interrupt
E	RW	NAK			NAK Response Received Interrupt (NAK) In Scatter/Gather DMA mode, the interrupt due to this bit is masked in the core.This bit can be set only by the core and the application must write 1 to clear it.
			INACTIVE	0	No NAK Response Received Interrupt
			ACTIVE	1	NAK Response Received Interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
F	RW	ACK			ACK Response Received/Transmitted Interrupt (ACK) In Scatter/Gather DMA mode, the interrupt due to this bit is masked in the core.This bit can be set only by the core and the application must write 1 to clear it.
			INACTIVE	0	No ACK Response Received or Transmitted Interrupt
			ACTIVE	1	ACK Response Received or Transmitted Interrup
G	RW	NYET			NYET Response Received Interrupt (NYET) In Scatter/Gather DMA mode, the interrupt due to this bit is masked in the core.This bit can be set only by the core and the application must write 1 to clear it.
			INACTIVE	0	No NYET Response Received Interrupt
			ACTIVE	1	NYET Response Received Interrupt
H	RW	XACTERR			Transaction Error (XactErr) Indicates one of the following errors occurred on the USB. - CRC check failure - Timeout - Bit stuff error - False EOP In Scatter/Gather DMA mode, the interrupt due to this bit is masked in the core.This bit can be set only by the core and the application must write 1 to clear it.
			INACTIVE	0	No Transaction Error
			ACTIVE	1	Transaction Error
I	RW	BBLERR			Babble Error (BblErr) In Scatter/Gather DMA mode, the interrupt due to this bit is masked in the core. This bit can be set only by the core and the application must write 1 to clear it.
			INACTIVE	0	No Babble Error
			ACTIVE	1	Babble Error
J	RW	FRMOVRUN			Frame Overrun (FrmOvrun). In Scatter/Gather DMA mode, the interrupt due to this bit is masked in the core. This bit can be set only by the core and the application must write 1 to clear it.
			INACTIVE	0	No Frame Overrun
			ACTIVE	1	Frame Overrun
K	RW	DATATGLERR			Data Toggle Error (DataTglErr).This bit can be set only by the core and the application must write 1 to clear it.In Scatter/Gather DMA mode, the interrupt due to this bit is masked in the core.
			INACTIVE	0	No Data Toggle Error
			ACTIVE	1	Data Toggle Error

8.27.5.37 HC[n].INTMSK (n=0..15)

Address offset: 0x50C + (n × 0x18)

Host Channel Interrupt Mask Register 0

This register reflects the mask for each channel status described in the previous section.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPLMSK			Transfer Completed Mask (XferComplMsk)
			MASK	0	Transfer Completed Mask
			NOMASK	1	No Transfer Completed Mask
B	RW	CHHLTDMSK			Channel Halted Mask (ChHltdMsk)
			MASK	0	Channel Halted Mask
			NOMASK	1	No Channel Halted Mask
C	RW	AHBERRMSK			AHB Error Mask (AHBErrMsk) In scatter/gather DMA mode for host, interrupts are not generated due to the corresponding bits set in HCINTn.
			MASK	0	AHB Error Mask
			NOMASK	1	No AHB Error Mask
D	RW	STALLMSK			STALL Response Received Interrupt Mask (StallMsk) In scatter/gather DMA mode for host, interrupts are not generated due to the corresponding bits set in HCINTn.
			MASK	0	Mask STALL Response Received Interrupt
			NOMASK	1	No STALL Response Received Interrupt Mask
E	RW	NAKMSK			NAK Response Received Interrupt Mask (NakMsk) In scatter/gather DMA mode for host, interrupts are not generated due to the corresponding bits set in HCINTn.
			MASK	0	Mask NAK Response Received Interrupt
			NOMASK	1	No NAK Response Received Interrupt Mask
F	RW	ACKMSK			ACK Response Received/Transmitted Interrupt Mask (AckMsk) In scatter/gather DMA mode for host, interrupts are not generated due to the corresponding bits set in HCINTn.
			MASK	0	Mask ACK Response Received/Transmitted Interrupt
			NOMASK	1	No ACK Response Received/Transmitted Interrupt Mask
G	RW	NYETMSK			NYET Response Received Interrupt Mask (NyetMsk) In scatter/gather DMA mode for host, interrupts are not generated due to the corresponding bits set in HCINTn.
			MASK	0	Mask NYET Response Received Interrupt
			NOMASK	1	No NYET Response Received Interrupt Mask
H	RW	XACTERRMSK			Transaction Error Mask (XactErrMsk) In scatter/gather DMA mode for host, interrupts are not generated due to the corresponding bits set in HCINTn.
			MASK	0	Mask Transaction Error
			NOMASK	1	No Transaction Error Mask
I	RW	BBLERRMSK			Babble Error Mask (BblErrMsk) In scatter/gather DMA mode for host, interrupts are not generated due to the corresponding bits set in HCINTn.
			MASK	0	Mask Babble Error
			NOMASK	1	No Babble Error Mask
J	RW	FRMOVRUNMSK			Frame Overrun Mask (FrmOvrunMsk) In scatter/gather DMA mode for host, interrupts are not generated due to the corresponding bits set in HCINTn.
			MASK	0	Mask Overrun Mask
			NOMASK	1	No Frame Overrun Mask
K	RW	DATATGLERRMSK			Data Toggle Error Mask (DataTglErrMsk) In scatter/gather DMA mode for host, interrupts are not generated due to the corresponding bits set in HCINTn.
			MASK	0	Mask Data Toggle Error
			NOMASK	1	No Data Toggle Error Mask

8.27.5.38 HC[n].TSIZ (n=0..15)

Address offset: 0x510 + (n × 0x18)

Host Channel Transfer Size Register 0

This register reflects the transfer size for the Host Channel.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	D	C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Non-Scatter/Gather DMA Mode: Transfer Size (XferSize) For an OUT, this field is the number of data bytes the host sends during the transfer. For an IN, this field is the buffer size that the application has Reserved for the transfer. The application is expected to program this field as an integer multiple of the maximum packet size for IN transactions (periodic and non-periodic). The width of this counter is specified as Width of Transfer Size Counters during coreConsultant configuration (parameter OTG_TRANS_COUNT_WIDTH). Scatter/Gather DMA Mode: [18:16]: Reserved [15:8]: NTD (Number of Transfer Descriptors) (Non Isochronous) This value is in terms of number of descriptors. Maximum number of descriptor that can be present in the list is 64. The values can be from 0 to 63. - 0: 1 descriptor - 63: 64 descriptors This field indicates the total number of descriptors present in that list. The core wraps around after servicing NTD number of descriptors for that list. (Isochronous) This field indicates the number of descriptors present in that list microframe. The possible values for FS are - 1: 2 descriptors - 3: 4 descriptors - 7: 8 descriptors - 15: 16 descriptors - 31: 32 descriptors - 63: 64 descriptors The possible values for HS are - 7: 8 descriptors - 15: 16 descriptors - 31: 32 descriptors - 63: 64 descriptors - 127: 128 descriptors - 255: 256 descriptors [7:0]: SCHED_INFO (Schedule information) Every bit in this 8 bit register indicates scheduling for that microframe. Bit 0 indicates scheduling for 1st microframe and bit 7 indicates scheduling for 8th microframe in that frame. A value of 8'b11111111 indicates that the corresponding interrupt channel is scheduled to issue a token every microframe in that frame. A value of 8'b10101010 indicates that the corresponding interrupt channel is scheduled to issue a token every alternate microframe starting with second microframe. Note that this field is applicable only for periodic (Isochronous and Interrupt) channels.
B	RW	PKTCNT			Non-Scatter/Gather DMA Mode: Packet Count (PktCnt) This field is programmed by the application with the expected number of packets to be transmitted (OUT) or received (IN). The host decrements this count on every successful transmission or reception of an OUT/IN packet. Once this count reaches zero, the application is interrupted to indicate normal completion. The width of this counter is specified as Width of Packet Counters during coreConsultant configuration (parameter OTG_PACKET_COUNT_WIDTH). Scatter/Gather DMA Mode: [28:19]: Reserved
C	RW	PID			PID (Pid) The application programs this field with the type of PID to use for the initial transaction. The host maintains this field for the rest of the transfer.
			DATA0	0	DATA0
			DATA2	1	DATA2
			DATA1	2	DATA1
			MDATA	3	MDATA (non-control)/SETUP (control)
D	RW	DOPNG			Do Ping (DoPng) This bit is used only for OUT transfers. Setting this field to 1 directs the host to do PING protocol. Note: Do not set this bit for IN transfers. If this bit is set for IN transfers it disables the channel.
			NOPING	0	No ping protocol

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				D	C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID			Value																			Description									
				PING			1																			Ping protocol									

8.27.5.39 HC[n].DMA (n=0..15)

Address offset: 0x514 + (n × 0x18)

Host Channel DMA Address Register 0

This register is used by the OTG host in the internal DMA mode to maintain the current buffer pointer for IN/OUT transactions. The starting DMA address must be DWORD-aligned.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID			Value																			Description									
A	RW	DMAADDR																								In Buffer DMA Mode: [31:0]: DMA Address (DMAAddr) This field holds the start address in the external memory from which the data for the endpoint must be fetched or to which it must be stored. This register is incremented on every AHB transaction. Reset: X if not programmed as the register is in SPRAM. In Scatter-Gather DMA (DescDMA) Mode for Non-Isochronous: [31:9]: DMA Address (DMAAddr) The start address must be 512-bytes aligned. This field holds the start address of the 512 bytes page. The first descriptor in the list must be located in this address. The first descriptor may be or may not be ready. The core starts processing the list from the CTD value. [8:3]: Current Transfer Desc(CTD) This value is in terms of number of descriptors. The values can be from 0 to 63. This field indicates the current descriptor processed in the list. This field is updated both by application and the core. For example, if the application enables the channel after programming CTD=5, then the core starts processing the sixth descriptor. The address is obtained by adding a value of (8bytes*5=) 40(decimal) to DMAAddr. [2:0]: Reserved In Scatter-Gather DMA (DescDMA) Mode for Isochronous: [31:N]: DMA Address (DMAAddr) The start address must be 512-bytes aligned. This field holds the address of the 2*(nTD+1) bytes of locations in which the isochronous descriptors are present where N is based on nTD as follows: - [31:N]: Base Address - [N-1:3]: Offset - [2:0]: 000 For HS ISOC, if nTD is, - 7, N=6 - 15, N=7 - 31, N=8 - 63, N=9 - 127, N=10 - 255, N=11 For FS ISOC, if nTD is, - 1, N=4 - 3, N=5 - 7, N=6 - 15, N=7 - 31, N=8 - 63, N=9 [N-1:3]: Current Transfer Desc(CTD) CTD for isochronous is based on the current frame/ (micro)frame value. Need to be set to zero by application. Reset: (N+1:3)'h0 [2:0]: Reserved

8.27.5.40 DCFG

Address offset: 0x800

Device Configuration Register

This register configures the core in Device mode after power-on or after certain control commands or enumeration. Do not make changes to this register after initial programming.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	J	J	J	J	J	J	I	I							H		G	F		E	E	D	D	D	D	D	D	C	B	A	A
Reset 0x08020000	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DEVSPD			Device Speed (DevSpd) Indicates the speed at which the application requires the core to enumerate, or the maximum speed the application can support. However, the actual bus speed is determined only after the connect sequence is completed, and is based on the speed of the USB host to which the core is connected.
			USBHS20	0	High speed USB 2.0 PHY clock is 30 MHz or 60 MHz
			USBFS20	1	Full speed USB 2.0 PHY clock is 30 MHz or 60 MHz
			USBLS116	2	Low speed USB 1.1 transceiver clock is 6 MHz
			USBFS1148	3	Full speed USB 1.1 transceiver clock is 48 MHz
B	RW	NZSTSOUTHSHK			Non-Zero-Length Status OUT Handshake (NZStsOUTHShk) The application can use this field to select the handshake the core sends on receiving a nonzero-length data packet during the OUT transaction of a control transfer's Status stage.
			SENDOUT	0	Send the received OUT packet to the application (zero-length or non-zero length) and send a handshake based on NAK and STALL bits for the endpoint in the Devce Endpoint Control Register
			SENDSTALL	1	Send a STALL handshake on a nonzero-length status OUT transaction and do not send the received OUT packet to the application
C	RW	ENA32KHZSUSP			Enable 32 KHz Suspend mode (Ena32KHzSusp) This bit can be set only if FS PHY interface is selected. Otherwise, this bit needs to be set to zero. If FS PHY interface is chosen and this bit is set, the PHY clock during Suspend must be switched from 48 MHz to 32 KHz.
			DISABLED	0	USB 1.1 Full-Speed Serial Transceiver not selected
			ENABLED	1	USB 1.1 Full-Speed Serial Transceiver Interface selected
D	RW	DEVADDR			Device Address (DevAddr) The application must program this field after every SetAddress control command.
E	RW	PERFRINT			Periodic Frame Interval (PerFrInt) Indicates the time within a (micro)Frame at which the application must be notified using the End Of Periodic Frame Interrupt. This can be used to determine If all the isochronous traffic for that (micro)Frame is complete.
			EOPF80	0	80% of the (micro)Frame interval
			EOPF85	1	85% of the (micro)Frame interval
			EOPF90	2	90% of the (micro)Frame interval
			EOPF95	3	95% of the (micro)Frame interval
F	RW	XCVRDLY			XCVRDLY Enables or disables delay between xcvr_sel and txvalid during device chirp
			DISABLE	0	No delay between xcvr_sel and txvalid during Device chirp
			ENABLE	1	Enable delay between xcvr_sel and txvalid during Device chirp
G	RW	ERRATICINTMSK			Erratic Error Interrupt Mask
			NOMASK	0	Early suspend interrupt is generated on erratic error
			MASK	1	Mask early suspend interrupt on erratic error

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	J	J	J	J	J	J	I	I							H		G	F		E	E	D	D	D	D	D	D	C	B	A	A
Reset 0x08020000	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
H	RW	IPGISOCSUPT			Worst-Case Inter-Packet Gap ISOC OUT Support (ipgisocSupt) This bit indicates that the controller supports the worst-case scenario of Rx followed by Rx Inter-Packet Gap (IPG) (32 bit times) as per the UTMI Specification for any token following an ISOC OUT token. Without this support, when any token follows an ISOC OUT token with the worst-case IPG, the controller does not detect the followed token. The worst-case IPG of the controller without this support depends on the AHB and PHY clock frequency.
			DISABLED	0	Worst-Case Inter-Packet Gap ISOC OUT Support is disabled
			ENABLED	1	Worst-Case Inter-Packet Gap ISOC OUT Support is enabled
I	RW	PERSCHINTVL			Periodic Scheduling Interval (PerSchIntvl) PerSchIntvl must be programmed for Scatter/Gather DMA mode. This field specifies the amount of time the Internal DMA engine must allocate for fetching periodic IN endpoint data. Based on the number of periodic endpoints, this value must be specified as 25,50 or 75% of (micro)Frame. - When any periodic endpoints are active, the internal DMA engine allocates the specified amount of time in fetching periodic IN endpoint data . - When no periodic endpoints are active, Then the internal DMA engine services non-periodic endpoints, ignoring this field. - After the specified time within a (micro)Frame, the DMA switches to fetching for non-periodic endpoints.
			MF25	0	25% of (micro)Frame
			MF50	1	50% of (micro)Frame
			MF75	2	75% of (micro)Frame
			PERSCHINTVLRSVD3	3	
J	RW	RESVALID			Resume Validation Period (ResValid) This field is effective only when DCFG.Ena32KHzSusp is set. It controls the resume period when the core resumes from suspend. The core counts for ResValid number of clock cycles to detect a valid resume when this bit is set

8.27.5.41 DCTL

Address offset: 0x804

Device Control Register

This register is used to control the characteristics of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID													N	M		L	K				J	I	H	G	F	E	E	E	D	C	B	A
Reset 0x00000002	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	RMTWKUPSIG			Remote Wakeup Signaling (RmtWkUpSig) When the application sets this bit, the core initiates remote signaling to wake up the USB host. The application must Set this bit to instruct the core to exit the Suspend state. As specified in the USB 2.0 specification, the application must clear this bit 1-15 ms after setting it. If LPM is enabled and the core is in the L1 (Sleep) state, when the application sets this bit, the core initiates L1 remote signaling to wake up the USB host. The application must set this bit to instruct the core to exit the Sleep state. As specified in the LPM specification, the hardware automatically clears this bit 50 microseconds (TL1DevDrvResume) after being set by the application. The application must not set this bit when GLPMCFG bRemoteWake from the previous LPM transaction is zero.
			DISABLEDRMWKUP	0	Core does not send Remote Wakeup Signaling
			ENABLERMWKUP	1	Core sends Remote Wakeup Signaling
B	RW	SFTDISCON			Soft Disconnect (SftDiscon) The application uses this bit to signal the controller to do a soft disconnect. As long as this bit is set, the host does not see that the device is connected, and the device does not receive signals on the USB. The core stays in the disconnected state until the application clears this bit. UTMI+ to 2'b00, which generates a device connect event to the USB host. When the device is reconnected, the USB host restarts device enumeration. The following is the minimum duration under various conditions for which this bit must be set for the USB host to detect a device disconnect. To accommodate clock jitter, it is recommended that the application adds some extra delay to the specified minimum duration. For high speed, if the device state is, - Suspended, the minimum duration is 1ms + 2.5us - Idle, the minimum duration is 3ms + 2.5us - Not Idle or Suspended (performing transactions), the minimum duration 125 us For full speed/low speed, if the device state is, - Suspended, the minimum duration is 1ms + 2.5us - Idle, the minimum duration is 2.5us - Not Idle or Suspended (performing transactions), the minimum duration 125 us Note: - This bit can be also used for ULPI/FS Serial interfaces. - This bit is not impacted by a soft reset.
			NODISCONNECT	0	The core drives the phy_opmode_o signal on the UTMI+ to 2'b00, which generates a device connect event to the USB host
			DISCONNECT	1	The core drives the phy_opmode_o signal on the UTMI+ to 2'b01, which generates a device disconnect event to the USB host
C	R	GNPINNAKSTS			Global Non-periodic IN NAK Status (GNPINNakSts) - 1'b0: A handshake is sent out based on the data availability in the transmit FIFO.
			INACTIVE	0	A handshake is sent out based on the data availability in the transmit FIFO
			ACTIVE	1	A NAK handshake is sent out on all non-periodic IN endpoints, irrespective of the data availability in the transmit FIFO.
D	R	GOUTNAKSTS			Global OUT NAK Status (GOUTNakSts) - 1'b0: A handshake is sent based on the FIFO Status and the NAK and STALL bit settings.
			INACTIVE	0	A handshake is sent based on the FIFO Status and the NAK and STALL bit settings.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	O												N	M		L	K				J	I	H	G	F	E	E	E	D	C	B	A
Reset 0x00000002	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**

ID	R/W	Field	Value ID	Value	Description
			ACTIVE	1	No data is written to the RxFIFO, irrespective of space availability. Sends a NAK handshake on all packets, except on SETUP transactions. All isochronous OUT packets are dropped.
E	RW	TSTCTL			Test Control (TstCtl) - 3'b000: Test mode disabled
			DISABLED	0	Test mode disabled
			TESTJ	1	Test_J mode
			TESTK	2	Test_K mode
			TESTSN	3	Test_SE0_NAK mode
			TESTPM	4	Test_Packet mode
			TESTFE	5	Test_force_Enable
F	W	SGNPINNAK			Set Global Non-periodic IN NAK (SGNPInNak) A write to this field sets the Global Non-periodic IN NAK.The application uses this bit to send a NAK handshake on all non-periodic IN endpoints. The core can also Set this bit when a timeout condition is detected on a non-periodic endpoint in shared FIFO operation. The application must Set this bit only after making sure that the Global IN NAK Effective bit in the Core Interrupt Register (GINTSTS.GINNakEff) is cleared
			DISABLE	0	Disable Global Non-periodic IN NAK
			ENABLE	1	Set Global Non-periodic IN NAK
G	W	CGNPINNAK			Clear Global Non-periodic IN NAK (CGNPInNak) A write to this field clears the Global Non-periodic IN NAK.
			DISABLE	0	Disable Global Non-periodic IN NAK
			ENABLE	1	Clear Global Non-periodic IN NAK
H	W	SGOUTNAK			Set Global OUT NAK (SGOUTNak) A write to this field sets the Global OUT NAK. The application uses this bit to send a NAK handshake on all OUT endpoints. The application must set the this bit only after making sure that the Global OUT NAK Effective bit in the Core Interrupt Register (GINTSTS.GOUTNakEff) is cleared.
			DISABLED	0	Disable Global OUT NAK
			ENABLED	1	Set Global OUT NAK
I	W	CGOUTNAK			Clear Global OUT NAK (CGOUTNak) A write to this field clears the Global OUT NAK.
			DISABLED	0	Disable Clear Global OUT NAK
			ENABLED	1	Clear Global OUT NAK
J	RW	PWRONPRGDONE			Power-On Programming Done (PWROnPrgDone) The application uses this bit to indicate that register programming is completed after a wake-up from Power Down mode.
			NOTDONE	0	Power-On Programming not done
			DONE	1	Power-On Programming Done

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID													N	M		L	K				J	I	H	G	F	E	E	E	D	C	B	A
Reset 0x00000002	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**

ID	R/W	Field	Value ID	Value	Description
K	RW	IGNRFRMNUM			Ignore Frame Number Feature for Isochronous Endpoints (IgnrFrmNum) This field is also used to control the Periodic Transfer Interrupt (PTI) feature. Note: Do not program IgnrFrmNum bit to 1'b1 when the core is operating in threshold mode. Completer Mode (GAHBCFG.DMAEn=0): This bit is not valid in Completer mode and must not be programmed to 1. Scatter/ Gather DMA Mode (GAHBCFG.DMAEn=1,DCFG.DescDMA=1): Note: When Scatter/Gather DMA mode is enabled this feature is not applicable to High Speed, High bandwidth transfers. When this bit is enabled, there must be only one packet per descriptor. - 0: The core transmits the packets only in the frame number in which they are intended to be transmitted. - 1: The core ignores the frame number, sending packets immediately as the packets are ready. In Scatter/Gather DMA mode, if this bit is enabled, the packets are not flushed when a ISOC IN token is received for an elapsed frame. Non-Scatter/Gather DMA Mode, that is, Buffer DMA Mode (GAHBCFG.DMAEn=1,DCFG.DescDMA=0): When Scatter/Gather DMA mode is disabled, this field is used by the application to enable Periodic Transfer Interrupt (PTI) Mode. The application can program Periodic Endpoint transfers for multiple (micro)Frames. - 0: Periodic Transfer Interrupt feature is disabled, application needs to program transfers for periodic endpoints every (micro)Frame - 1: Periodic Transfer Interrupt feature is enabled, application can program transfers for multiple (micro)Frames for periodic endpoints. In the PTI mode, the application receives Transfer Complete Interrupt after transfers for multiple (micro)Frames are completed.
			DISABLED	0	Scatter/Gather DMA Mode: The core transmits the packets only in the frame number in which they are intended to be transmitted.Non-Scatter/ Gather DMA Mode: Periodic Transfer Interrupt feature is disabled.
			ENABLED	1	Scatter/Gather DMA Mode: The core ignores the frame number, sending packets immediately as the packets are ready.Non-Scatter/Gather DMA Mode: Periodic Transfer Interrupt feature is enabled.
L	RW	NAKONBBLE			NAK on Babble Error (NakOnBble) Set NAK automatically on babble (NakOnBble). The core sets NAK automatically for the endpoint on which babble is received.
			DISABLED	0	Disable NAK on Babble Error
			ENABLED	1	NAK on Babble Error
M	RW	DEEPSLEEPBESLREJECT			DeepSleepBESLReject - 1: Deep Sleep BESL Reject feature is enabled - 0: Deep Sleep BESL Reject feature is disabled Core rejects LPM request with HIRD value greater than HIRD threshold programmed. NYET response is sent for LPM tokens with HIRD value greater than HIRD threshold. By default, the Deep Sleep BESL Reject feature is disabled.
			DISABLED	0	Deep Sleep BESL Reject feature is disabled
			ENABLED	1	Deep Sleep BESL Reject feature is enabled

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				O												N	M		L	K				J	I	H	G	F	E	E	E	D	C	B	A
Reset 0x00000002				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**
ID	R/W	Field	Value ID	Value																															
N	RW	SERVINT																																	
			DISABLED	0																															
			ENABLED	1																															
O	RW	UTMITERMSELCORRDIS																																	
			DISABLED	0																															
			ENABLED	1																															

8.27.5.42 DSTS

Address offset: 0x808

Device Status Register

This register indicates the status of the core with respect to USB-related events. It must be read on interrupts from Device All Interrupts (DAINT) register.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID												E	E	D	D	D	D	D	D	D	D	D	D	D	D	D	D					C	B	B	A
Reset 0x00000002				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	SUSPSTS																																	
			INACTIVE	0																															
			ACTIVE	1																															

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E E D D D D D D D D D D D D D D D D D C B B A
Reset 0x00000002				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0**
ID	R/W	Field	Value ID	Value	Description
B	R	ENUMSPD			Enumerated Speed (EnumSpd) Indicates the speed at which the controller has come up after speed detection through a connect or reset sequence. Low speed is not supported for devices using a UTMI+ PHY.
			HS3060	0	High speed (PHY clock is running at 30 or 60 MHz)
			FS3060	1	Full speed (PHY clock is running at 30 or 60 MHz)
			LS6	2	Low speed (PHY clock is running at 6 MHz)
			FS48	3	Full speed (PHY clock is running at 48 MHz)
C	R	ERRTICERR			Erratic Error (ErrticErr) The core sets this bit to report any erratic errors (phy_rxvalid_i/phy_rxvldh_i or phy_rxactive_i is asserted for at least 2 ms, due to PHY error) seen on the UTMI+. Due to erratic errors, the core goes into Suspended state and an interrupt is generated to the application with Early Suspend bit of the Core Interrupt register (GINTSTS.ErlySusp). If the early suspend is asserted due to an erratic error, the application must perform a PHY reset followed by a soft reset to controller.
			INACTIVE	0	No Erratic Error
			ACTIVE	1	Erratic Error
D	R	SOFFN			Frame or Microframe Number of the Received SOF (SOFFN) When the core is operating at high speed, this field contains a microframe number. When the core is operating at full or low speed, this field contains a Frame number. Note: This register may return a non-zero value if read immediately after power-on reset. In case the register bit reads non-zero immediately after power-on reset, it does not indicate that SOF has been received from the host. The read value of this interrupt is valid only after a valid connection between host and device is established.
E	R	DEVLNSTS			Device Line Status (DevLnSts) Indicates the current logic level USB data lines - DevLnSts[1]: Logic level of D- - DevLnSts[0]: Logic level of D+

8.27.5.43 DIEPMSK

Address offset: 0x810

Device IN Endpoint Common Interrupt Mask Register

This register works with each of the Device IN Endpoint Interrupt (DIEPINTn) registers for all endpoints to generate an interrupt per IN endpoint. The IN endpoint interrupt for a specific status in the DIEPINTn register can be masked by writing to the corresponding bit in this register. Status bits are masked by default.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPLMSK			Transfer Completed Interrupt Mask (XferComplMsk)
			MASK	0	Mask Transfer Completed Interrupt
			NOMASK	1	No Transfer Completed Interrupt Mask
B	RW	EPDISBLDMSK			Endpoint Disabled Interrupt Mask (EPDisbldMsk)
			MASK	0	Mask Endpoint Disabled Interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			NOMASK	1	No Endpoint Disabled Interrupt Mask
C	RW	AHBERRMSK			AHB Error Mask (AHBErrMsk)
			MASK	0	Mask AHB Error Interrupt
			NOMASK	1	No AHB Error Interrupt Mask
D	RW	TIMEOUTMSK			Timeout Condition Mask (TimeOUTMsk) (Non-isochronous endpoints)
			MASK	0	Mask Timeout Condition Interrupt
			NOMASK	1	No Timeout Condition Interrupt Mask
E	RW	INTKNTXFEMPMSK			IN Token Received When TxFIFO Empty Mask (INTknTXFEmpMsk)
			MASK	0	Mask IN Token Received When TxFIFO Empty Interrupt
			NOMASK	1	No IN Token Received When TxFIFO Empty Interrupt
F	RW	INTKNEPMISMSK			IN Token received with EP Mismatch Mask (INTknEPMisMsk)
			MASK	0	Mask IN Token received with EP Mismatch Interrupt
			NOMASK	1	No Mask IN Token received with EP Mismatch Interrupt
G	RW	INEPNAKEFFMSK			IN Endpoint NAK Effective Mask (INEPNakEffMsk)
			MASK	0	Mask IN Endpoint NAK Effective Interrupt
			NOMASK	1	No IN Endpoint NAK Effective Interrupt Mask
H	RW	TXFIFOUNDRNMSK			Fifo Underrun Mask (TxfifoUndrnMsk)
			MASK	0	Mask Fifo Underrun Interrupt
			NOMASK	1	No Fifo Underrun Interrupt Mask
I	RW	NAKMSK			NAK interrupt Mask (NAKMsk)
			MASK	0	Mask NAK Interrupt
			NOMASK	1	No Mask NAK Interrupt

8.27.5.44 DOEPMSK

Address offset: 0x814

Device OUT Endpoint Common Interrupt Mask Register

This register works with each of the Device OUT Endpoint Interrupt (DOEPINTn) registers for all endpoints to generate an interrupt per OUT endpoint. The OUT endpoint interrupt for a specific status in the DOEPINTn register can be masked by writing into the corresponding bit in this register. Status bits are masked by default.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPLMSK			Transfer Completed Interrupt Mask (XferComplMsk)
			MASK	0	Mask Transfer Completed Interrupt
			NOMASK	1	No Transfer Completed Interrupt Mask
B	RW	EPDISBLDMSK			Endpoint Disabled Interrupt Mask (EPDisbldMsk)
			MASK	0	Mask Endpoint Disabled Interrupt
			NOMASK	1	No Endpoint Disabled Interrupt Mask
C	RW	AHBERRMSK			AHB Error (AHBErrMsk)
			MASK	0	Mask AHB Error Interrupt
			NOMASK	1	No AHB Error Interrupt Mask
D	RW	SETUPMSK			SETUP Phase Done Mask (SetUPMsk) Applies to control endpoints only.
			MASK	0	Mask SETUP Phase Done Interrupt
			NOMASK	1	No SETUP Phase Done Interrupt Mask

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
E	RW	OUTTKNEPDISMSK			OUT Token Received when Endpoint Disabled Mask (OUTTknEPdisMsk) Applies to control OUT endpoints only.
			MASK	0	Mask OUT Token Received when Endpoint Disabled Interrupt
			NOMASK	1	No OUT Token Received when Endpoint Disabled Interrupt Mask
F	RW	STSPHSERCVDMSK			Status Phase Received Mask (StsPhseRcvdMsk) Applies to control OUT endpoints only.
			MASK	0	Status Phase Received Mask
			NOMASK	1	No Status Phase Received Mask
G	RW	BACK2BACKSETUP			Back-to-Back SETUP Packets Received Mask (Back2BackSETup) Applies to control OUT endpoints only.
			MASK	0	Mask Back-to-Back SETUP Packets Received Interrupt
			NOMASK	1	No Back-to-Back SETUP Packets Received Interrupt Mask
H	RW	OUTPKTERRMSK			OUT Packet Error Mask (OutPktErrMsk)
			MASK	0	Mask OUT Packet Error Interrupt
			NOMASK	1	No OUT Packet Error Interrupt Mask
I	RW	BBLEERRMSK			Babble Error interrupt Mask (BbleErrMsk)
			MASK	0	Mask Babble Error Interrupt
			NOMASK	1	No Babble Error Interrupt Mask
J	RW	NAKMSK			NAK interrupt Mask (NAKMsk)
			MASK	0	Mask NAK Interrupt
			NOMASK	1	No NAK Interrupt Mask
K	RW	NYETMSK			NYET interrupt Mask (NYETMsk)
			MASK	0	Mask NYET Interrupt
			NOMASK	1	No NYET Interrupt Mask

8.27.5.45 DAINT

Address offset: 0x818

Device All Endpoints Interrupt Register

When a significant event occurs on an endpoint, a Device All Endpoints Interrupt register interrupts the application using the Device OUT Endpoints Interrupt bit or Device IN Endpoints Interrupt bit of the Core Interrupt register (GINTSTS.OEPInt or GINTSTS.IEPInt, respectively). This is shown in Figure 5-2. There is one interrupt bit per endpoint, up to a maximum of 16 bits for OUT endpoints and 16 bits for IN endpoints. For a bidirectional endpoint, the corresponding IN and OUT interrupt bits are used. Bits in this register are set and cleared when the application sets and clears bits in the corresponding Device Endpoint-n Interrupt register (DIEPINTn/DOEPINTn).

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	INEPINT0			IN Endpoint 0 Interrupt Bit
			INACTIVE	0	No Interrupt
			ACTIVE	1	Interrupt is active for IN EP0
B	R	INEPINT1			IN Endpoint 1 Interrupt Bit
			INACTIVE	0	No Interrupt
			ACTIVE	1	Interrupt is active for the IN EP
C	R	INEPINT2			IN Endpoint 2 Interrupt Bit

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				f	e	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
			INACTIVE	0																															
			ACTIVE	1																															
D	R	INEPINT3																																	
			INACTIVE	0																															
			ACTIVE	1																															
E	R	INEPINT4																																	
			INACTIVE	0																															
			ACTIVE	1																															
F	R	INEPINT5																																	
			INACTIVE	0																															
			ACTIVE	1																															
G	R	INEPINT6																																	
			INACTIVE	0																															
			ACTIVE	1																															
H	R	INEPINT7																																	
			INACTIVE	0																															
			ACTIVE	1																															
I	R	INEPINT8																																	
			INACTIVE	0																															
			ACTIVE	1																															
J	R	INEPINT9																																	
			INACTIVE	0																															
			ACTIVE	1																															
K	R	INEPINT10																																	
			INACTIVE	0																															
			ACTIVE	1																															
L	R	INEPINT11																																	
			INACTIVE	0																															
			ACTIVE	1																															
M	R	INEPINT12																																	
			INACTIVE	0																															
			ACTIVE	1																															
N	R	INEPINT13																																	
			INACTIVE	0																															
			ACTIVE	1																															
O	R	INEPINT14																																	
			INACTIVE	0																															
			ACTIVE	1																															
P	R	INEPINT15																																	
			INACTIVE	0																															
			ACTIVE	1																															
Q	R	OUTEPINT0																																	
			INACTIVE	0																															
			ACTIVE	1																															
R	R	OUTEPINT1																																	
			INACTIVE	0																															
			ACTIVE	1																															
S	R	OUTEPINT2																																	
			INACTIVE	0																															
			ACTIVE	1																															

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				f	e	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
T	R	OUTEPINT3																																	
			INACTIVE	0																															
			ACTIVE	1																															
U	R	OUTEPINT4																																	
			INACTIVE	0																															
			ACTIVE	1																															
V	R	OUTEPINT5																																	
			INACTIVE	0																															
			ACTIVE	1																															
W	R	OUTEPINT6																																	
			INACTIVE	0																															
			ACTIVE	1																															
X	R	OUTEPINT7																																	
			INACTIVE	0																															
			ACTIVE	1																															
Y	R	OUTEPINT8																																	
			INACTIVE	0																															
			ACTIVE	1																															
Z	R	OUTEPINT9																																	
			INACTIVE	0																															
			ACTIVE	1																															
a	R	OUTEPINT10																																	
			INACTIVE	0																															
			ACTIVE	1																															
b	R	OUTEPINT11																																	
			INACTIVE	0																															
			ACTIVE	1																															
c	R	OUTEPINT12																																	
			INACTIVE	0																															
			ACTIVE	1																															
d	R	OUTEPINT13																																	
			INACTIVE	0																															
			ACTIVE	1																															
e	R	OUTEPINT14																																	
			INACTIVE	0																															
			ACTIVE	1																															
f	R	OUTEPINT15																																	
			INACTIVE	0																															
			ACTIVE	1																															

8.27.5.46 DAINTMSK

Address offset: 0x81C

Device All Endpoints Interrupt Mask Register

The Device Endpoint Interrupt Mask register works with the Device Endpoint Interrupt register to interrupt the application when an event occurs on a device endpoint. However, the Device All Endpoints Interrupt (DAINT) register bit corresponding to that interrupt is still set.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	f	e	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	INEPMSK0			IN Endpoint 0 Interrupt mask Bit
			MASK	0	Mask IN Endpoint 0 Interrupt
			NOMASK	1	No Interrupt mask
B	RW	INEPMSK1			IN Endpoint 1 Interrupt mask Bit
			MASK	0	Mask IN Endpoint Interrupt
			NOMASK	1	No Interrupt mask
C	RW	INEPMSK2			IN Endpoint 2 Interrupt mask Bit
			MASK	0	Mask IN Endpoint Interrupt
			NOMASK	1	No Interrupt mask
D	RW	INEPMSK3			IN Endpoint 3 Interrupt mask Bit
			MASK	0	Mask IN Endpoint Interrupt
			NOMASK	1	No Interrupt mask
E	RW	INEPMSK4			IN Endpoint 4 Interrupt mask Bit
			MASK	0	Mask IN Endpoint Interrupt
			NOMASK	1	No Interrupt mask
F	RW	INEPMSK5			IN Endpoint 5 Interrupt mask Bit
			MASK	0	Mask IN Endpoint Interrupt
			NOMASK	1	No Interrupt mask
G	RW	INEPMSK6			IN Endpoint 6 Interrupt mask Bit
			MASK	0	Mask IN Endpoint Interrupt
			NOMASK	1	No Interrupt mask
H	RW	INEPMSK7			IN Endpoint 7 Interrupt mask Bit
			MASK	0	Mask IN Endpoint Interrupt
			NOMASK	1	No Interrupt mask
I	RW	INEPMSK8			IN Endpoint 8 Interrupt mask Bit
			MASK	0	Mask IN Endpoint Interrupt
			NOMASK	1	No Interrupt mask
J	RW	INEPMSK9			IN Endpoint 9 Interrupt mask Bit
			MASK	0	Mask IN Endpoint Interrupt
			NOMASK	1	No Interrupt mask
K	RW	INEPMSK10			IN Endpoint 10 Interrupt mask Bit
			MASK	0	Mask IN Endpoint Interrupt
			NOMASK	1	No Interrupt mask
L	RW	INEPMSK11			IN Endpoint 11 Interrupt mask Bit
			MASK	0	Mask IN Endpoint Interrupt
			NOMASK	1	No Interrupt mask
M	RW	INEPMSK12			IN Endpoint 12 Interrupt mask Bit
			MASK	0	Mask IN Endpoint Interrupt
			NOMASK	1	No Interrupt mask
N	RW	INEPMSK13			IN Endpoint 13 Interrupt mask Bit
			MASK	0	Mask IN Endpoint Interrupt
			NOMASK	1	No Interrupt mask
O	RW	INEPMSK14			IN Endpoint 14 Interrupt mask Bit
			MASK	0	Mask IN Endpoint Interrupt
			NOMASK	1	No Interrupt mask
P	RW	INEPMSK15			IN Endpoint 15 Interrupt mask Bit
			MASK	0	Mask IN Endpoint Interrupt
			NOMASK	1	No Interrupt mask
Q	RW	OUTEPMSK0			OUT Endpoint 0 Interrupt mask Bit
			MASK	0	Mask OUT Endpoint 0 Interrupt

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				f	e	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
			NOMASK	1																															
R	RW	OUTEPMSK1																																	
			MASK	0																															
			NOMASK	1																															
S	RW	OUTEPMSK2																																	
			MASK	0																															
			NOMASK	1																															
T	RW	OUTEPMSK3																																	
			MASK	0																															
			NOMASK	1																															
U	RW	OUTEPMSK4																																	
			MASK	0																															
			NOMASK	1																															
V	RW	OUTEPMSK5																																	
			MASK	0																															
			NOMASK	1																															
W	RW	OUTEPMSK6																																	
			MASK	0																															
			NOMASK	1																															
X	RW	OUTEPMSK7																																	
			MASK	0																															
			NOMASK	1																															
Y	RW	OUTEPMSK8																																	
			MASK	0																															
			NOMASK	1																															
Z	RW	OUTEPMSK9																																	
			MASK	0																															
			NOMASK	1																															
a	RW	OUTEPMSK10																																	
			MASK	0																															
			NOMASK	1																															
b	RW	OUTEPMSK11																																	
			MASK	0																															
			NOMASK	1																															
c	RW	OUTEPMSK12																																	
			MASK	0																															
			NOMASK	1																															
d	RW	OUTEPMSK13																																	
			MASK	0																															
			NOMASK	1																															
e	RW	OUTEPMSK14																																	
			MASK	0																															
			NOMASK	1																															
f	RW	OUTEPMSK15																																	
			MASK	0																															
			NOMASK	1																															

8.27.5.47 DVBUSDIS

Address offset: 0x828

Device VBUS Discharge Time Register

This register specifies the VBUS discharge time after VBUS pulsing during SRP.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x000017D7				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**0**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW	DVBUSDIS																																	
				Device VBUS Discharge Time (DVBUSDis)																																	
				Specifies the VBUS discharge time after VBUS pulsing during SRP. This value equals (VBUS discharge time in PHY clocks) / 1, 024. The value you use depends whether the PHY is operating at 30MHz (16-bit data width) or 60 MHz (8-bit data width). Depending on your VBUS load, this value can need adjustment.																														

8.27.5.48 DVBUSPULSE

Address offset: 0x82C

Device VBUS Pulsing Time Register

This register contains the VBUS pulsing time during SRP.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																								A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x000005B8				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**0**	**1**	**1**	**1**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	DVBUSPULSE																																	
				Device VBUS Pulsing Time (DVBUSPulse)																																	
				Specifies the VBUS pulsing time during SRP. This value equals (VBUS pulsing time in PHY clocks) / 1, 024 The value you use depends whether the PHY is operating at 30MHz (16-bit data width) or 60 MHz (8-bit data width).																														

8.27.5.49 DTHRCTL

Address offset: 0x830

Device Threshold Control Register

This register contains the Receive and Transmit Threshold characteristics of the Device controller.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID								G		F	F	F	F	F	F	F	F	E				D	D	C	C	C	C	C	C	C	C	B	A
Reset 0x08100020				**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	NONISOTHREN																																	
				Non-ISO IN Endpoints Threshold Enable. (NonISOThrEn)																																	
				When this bit is Set, the core enables thresholding for Non Isochronous IN endpoints.																																	
			DISABLED	0																																	
				No thresholding																																	
			ENABLED	1																																	
				Enable thresholding for non-isochronous IN endpoints																																	
B	RW	ISOTHREN																																	
				ISO IN Endpoints Threshold Enable. (ISOThrEn) When this bit is Set, the core enables thresholding for isochronous IN endpoints.																																	
			DISABLED	0																																	
				No thresholding																																	
			ENABLED	1																																	
				Enables thresholding for isochronous IN endpoints																																	

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					G		F	F	F	F	F	F	F	F	F	E				D	D	C	C	C	C	C	C	C	C	B	A
Reset 0x08100020	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	RW	TXTHRLEN			Transmit Threshold Length (TxThrLen) This field specifies Transmit thresholding size in DWORDS. This also forms the MAC threshold and specifies the amount of data in bytes to be in the corresponding endpoint transmit FIFO, before the core can start transmit on the USB. The threshold length has to be at least eight DWORDS when the value of AHBThrRatio is 2'h00. In case the AHBThrRatio is non zero the application needs to ensure that the AHB Threshold value does not go below the recommended eight DWORD. This field controls both isochronous and non-isochronous IN endpoint thresholds. The recommended value for ThrLen is to be the same as the programmed AHB Burst Length (GAHBCFG.HBstLen). Note: - When OTG_ARCHITECTURE=0, the reset value of this register field is 0. - When OTG_ARCHITECTURE=2, the reset value of this register field is 8.
D	RW	AHBTHRRATIO			AHB Threshold Ratio (AHBThrRatio) These bits define the ratio between the AHB threshold and the MAC threshold for the transmit path only. The AHB threshold always remains less than or equal to the USB threshold, because this does not increase overhead. Both the AHB and the MAC threshold must be DWORD-aligned. The application needs to program TxThrLen and the AHBThrRatio to make the AHB Threshold value DWORD aligned. If the AHB threshold value is not DWORD aligned, the core might not behave correctly. When programming the TxThrLen and AHBThrRatio, the application must ensure that the minimum AHB threshold value does not go below 8 DWORDS to meet the USB turnaround time requirements.
			THRESZERO	0	AHB threshold = MAC threshold
			THRESONE	1	AHB threshold = MAC threshold /2
			THRESTWO	2	AHB threshold = MAC threshold /4
			THRESTHREE	3	AHB threshold = MAC threshold /8
E	RW	RXTHREN			Receive Threshold Enable (RxThrEn) When this bit is set, the core enables thresholding in the receive direction. Note: We recommends that you do not enable RxThrEn, because it may cause issues in the RxFIFO especially during error conditions such as RxError and Babble.
			DISABLED	0	Disable thresholding
			ENABLED	1	Enable thresholding in the receive direction
F	RW	RXTHRLEN			Receive Threshold Length (RxThrLen) This field specifies Receive thresholding size in DWORDS. This field also specifies the amount of data received on the USB before the core can start transmitting on the AHB. The threshold length has to be at least eight DWORDS. The recommended value for ThrLen is to be the same as the programmed AHB Burst Length (GAHBCFG.HBstLen).
G	RW	ARBPRKEN			Arbiter Parking Enable (ArbPrkEn) This bit controls internal DMA arbiter parking for IN endpoints. If thresholding is enabled and this bit is set to one, then the arbiter parks on the IN endpoint for which there is a token received on the USB. This is done to avoid getting into underrun conditions. By default, arbiter parking is enabled.
			DISABLED	0	Disable DMA arbiter parking
			ENABLED	1	Enable DMA arbiter parking for IN endpoints

8.27.5.50 DIEPEMPMSK

Address offset: 0x834

Device IN Endpoint FIFO Empty Interrupt Mask Register

This register is valid only in Dedicated FIFO operation (OTG_EN_DED_TX_FIFO = 1). This register is used to control the IN endpoint FIFO empty interrupt generation (DIEPINTn.TxfEmp).

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					A A A A A A A A A A A A A A A A
Reset 0x00000000					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	INEPTXFEMPMSK			IN EP Tx FIFO Empty Interrupt Mask Bits (InEpTxfEmpMsk) These bits acts as mask bits for DIEPINTn.TxFEmp interrupt, one bit per IN Endpoint: Bit 0 for IN EP 0, bit 15 for IN EP 15
			EP0MASK	1	Mask IN EP0 Tx FIFO Empty Interrupt
			EP1MASK	2	Mask IN EP1 Tx FIFO Empty Interrupt
			EP2MASK	4	Mask IN EP2 Tx FIFO Empty Interrupt
			EP3MASK	8	Mask IN EP3 Tx FIFO Empty Interrupt
			EP4MASK	16	Mask IN EP4 Tx FIFO Empty Interrupt
			EP5MASK	32	Mask IN EP5 Tx FIFO Empty Interrupt
			EP6MASK	64	Mask IN EP6 Tx FIFO Empty Interrupt
			EP7MASK	128	Mask IN EP7 Tx FIFO Empty Interrupt
			EP8MASK	256	Mask IN EP8 Tx FIFO Empty Interrupt
			EP9MASK	512	Mask IN EP9 Tx FIFO Empty Interrupt
			EP10MASK	1024	Mask IN EP10 Tx FIFO Empty Interrupt
			EP11MASK	2048	Mask IN EP11 Tx FIFO Empty Interrupt
			EP12MASK	4096	Mask IN EP12 Tx FIFO Empty Interrupt
			EP13MASK	8192	Mask IN EP13 Tx FIFO Empty Interrupt
			EP14MASK	16384	Mask IN EP14 Tx FIFO Empty Interrupt
			EP15MASK	32768	Mask IN EP15 Tx FIFO Empty Interrupt

8.27.5.51 DIEPCTL0

Address offset: 0x900

Device Control IN Endpoint 0 Control Register

This register is used to control the characteristics of the IN Endpoint 0 of the Device controller.

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					J I H G F F F F E D D C B A A
Reset 0x00008000					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) Applies to IN and OUT endpoints. The application must program this field with the maximum packet size for the current logical endpoint.
			BYTES64	0	64 bytes
			BYTES32	1	32 bytes
			BYTES16	2	16 bytes
			BYTES8	3	8 bytes
B	R	USBACTEP			USB Active Endpoint (USBActEP) This bit is always SET to 1, indicating that control endpoint 0 is always active in all configurations and interfaces.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	J	I			H	G	F	F	F	F	E		D	D	C		B														A	A
Reset 0x00008000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
			ACTIVE0	1	Control endpoint is always active
C	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When this bit is set, either by the application or core, the core stops transmitting data, even If there is data available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	The core is transmitting non-NAK handshakes based on the FIFO status
			ACTIVE	1	The core is transmitting NAK handshakes on this endpoint
D	R	EPTYPE			Endpoint Type (EPType) Hardcoded to 00 for control.
			ACTIVE	0	Endpoint Control 0
E	RW	STALL			STALL Handshake (Stall) The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Nonperiodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority.
			INACTIVE	0	No Stall
			ACTIVE	1	Stall Handshake
F	RW	TXFNUM			TxFIFO Number (TxFNum) - For Shared FIFO operation, this value is always set to 0, indicating that control IN endpoint 0 data is always written in the Non-Periodic Transmit FIFO. - For Dedicated FIFO operation, this value is set to the FIFO number that is assigned to IN Endpoint.
			TXFIFO0	0	Tx FIFO 0
			TXFIFO1	1	Tx FIFO 1
			TXFIFO2	2	Tx FIFO 2
			TXFIFO3	3	Tx FIFO 3
			TXFIFO4	4	Tx FIFO 4
			TXFIFO5	5	Tx FIFO 5
			TXFIFO6	6	Tx FIFO 6
			TXFIFO7	7	Tx FIFO 7
			TXFIFO8	8	Tx FIFO 8
			TXFIFO9	9	Tx FIFO 9
			TXFIFO10	10	Tx FIFO 10
			TXFIFO11	11	Tx FIFO 11
			TXFIFO12	12	Tx FIFO 12
			TXFIFO13	13	Tx FIFO 13
			TXFIFO14	14	Tx FIFO 14
			TXFIFO15	15	Tx FIFO 15
G	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			NOCLEAR	0	No action
			CLEAR	1	Clear NAK
H	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also set this bit for an endpoint after a SETUP packet is received on that endpoint.
			NOSET	0	No action
			SET	1	Set NAK

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				J	I			H	G	F	F	F	F	E		D	D	C		B													A	A
Reset 0x00008000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
I	RW	EPDIS																																	
			INACTIVE	0																															
			ACTIVE	1																															
J	RW	EPENA																																	
			INACTIVE	0																															
			ACTIVE	1																															

8.27.5.52 DIEPINT0

Address offset: 0x908

Device IN Endpoint 0 Interrupt Register

This register indicates the status of an endpoint with respect to USB- and AHB-related events. It is shown in the "Interrupt Hierarchy" figure in the databook. The application must read this register when the OUT Endpoints Interrupt bit or IN Endpoints Interrupt bit of the Core Interrupt register (GINTSTS.OEPInt or GINTSTS.IEPInt, respectively) is set. Before the application can read this register, it must first read the Device All Endpoints Interrupt (DAINT) register to get the exact endpoint number for the Device Endpoint-n Interrupt register. The application must clear the appropriate bit in this register to clear the corresponding bits in the DAINT and GINTSTS registers

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																					N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	XFERCOMPL																																	
			INACTIVE	0																															
			ACTIVE	1																															

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000080				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	TIMEOUT			Timeout Condition (TimeOUT) - In shared TX FIFO mode, applies to non-isochronous IN endpoints only. - In dedicated FIFO mode, applies only to Control IN endpoints. - In Scatter/Gather DMA mode, the TimeOUT interrupt is not asserted. Indicates that the core has detected a timeout condition on the USB for the last IN token on this endpoint.
			INACTIVE	0	No Timeout interrupt
			ACTIVE	1	Timeout interrupt
E	RW	INTKNTXFEMP			IN Token Received When TxFIFO is Empty (INTknTXFEmp) Applies to non-periodic IN endpoints only. Indicates that an IN token was received when the associated TxFIFO (periodic/non-periodic) was empty. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received when TxFIFO Empty interrupt
			ACTIVE	1	IN Token Received when TxFIFO Empty Interrupt
F	RW	INTKNEPMIS			IN Token Received with EP Mismatch (INTknEPMis) Applies to non-periodic IN endpoints only. Indicates that the data in the top of the non-periodic TxFIFO belongs to an endpoint other than the one for which the IN token was received. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received with EP Mismatch interrupt
			ACTIVE	1	IN Token Received with EP Mismatch interrupt
G	RW	INEPNAKEFF			IN Endpoint NAK Effective (INEPNakEff) Applies to periodic IN endpoints only. This bit can be cleared when the application clears the IN endpoint NAK by writing to DIEPCTLn.CNAK. This interrupt indicates that the core has sampled the NAK bit Set (either by the application or by the core). The interrupt indicates that the IN endpoint NAK bit Set by the application has taken effect in the core. This interrupt does not guarantee that a NAK handshake is sent on the USB. A STALL bit takes priority over a NAK bit.
			INACTIVE	0	No IN Endpoint NAK Effective interrupt
			ACTIVE	1	IN Endpoint NAK Effective interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
H	R	TXFEMP			Transmit FIFO Empty (TxFEmp) This bit is valid only for IN Endpoints This interrupt is asserted when the TxFIFO for this endpoint is either half or completely empty. The half or completely empty status is determined by the TxFIFO Empty Level bit in the Core AHB Configuration register (GAHBCFG.NPTxFEmpLvl)).
			INACTIVE	0	No Transmit FIFO Empty interrupt
			ACTIVE	1	Transmit FIFO Empty interrupt
I	RW	TXFIFOUNDRN			Fifo Underrun (TxfifoUndrn) Applies to IN endpoints only. The core generates this interrupt when it detects a transmit FIFO underrun condition in threshold mode for this endpoint.
			INACTIVE	0	No Fifo Underrun interrupt
			ACTIVE	1	Fifo Underrun interrupt
J	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done.
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
K	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status
L	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No interrupt
			ACTIVE	1	BbleErr interrupt
M	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. <brIn case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No interrupt
			ACTIVE	1	NAK Interrupt
N	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No interrupt
			ACTIVE	1	NYET Interrupt

8.27.5.53 DIEPTSIZ0

Address offset: 0x910

Device IN Endpoint 0 Transfer Size Register

The application must modify this register before enabling endpoint 0. Once endpoint 0 is enabled using Endpoint Enable bit of the Device Control Endpoint 0 Control registers (DIEPCTL0.EPEna/ DOEPCTL0.EPEna), the core modifies this register. The application can only read this register once the core has cleared the Endpoint Enable bit. Nonzero endpoints use the registers for endpoints 115. When Scatter/Gather DMA mode is enabled, this register must not be programmed by the application. If the application reads this register when Scatter/Gather DMA mode is enabled, the core returns all zeros.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID												B	B													A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) This field contains the transfer size in bytes for the current endpoint. The transfer size (XferSize) = Sum of buffer sizes across all descriptors in the list for the endpoint. In Buffer DMA, the core only interrupts the application after it has exhausted the transfer size amount of data. The transfer size can be set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. - IN Endpoints: The core decrements this field every time a packet from the external memory is written to the TxFIFO. - OUT Endpoints: The core decrements this field every time a packet is read from the RxFIFO and written to the external memory.
B	RW	PKTCNT			Packet Count (PktCnt) Indicates the total number of USB packets that constitute the Transfer Size amount of data for endpoint 0. - IN Endpoints : This field is decremented every time a packet (maximum size or short packet) is read from the TxFIFO. - OUT Endpoints: This field is decremented every time a packet (maximum size or short packet) is written to the RxFIFO.

8.27.5.54 DIEPDMA0

Address offset: 0x914

Device IN Endpoint 0 DMA Address Register

This register contains the DMA Address for the IN Endpoint 0 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			DMAAddr This field holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.55 DTXFSTS0

Address offset: 0x918

Device IN Endpoint Transmit FIFO Status Register 0

This register contains information about the IN Endpoint Transmit FIFO of the Device controller.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000C00				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	INEPTXFSPCAVAIL																																	
				IN Endpoint TxFIFO Space Avail (INEPTxFSpcAvail) Indicates the amount of free space available in the Endpoint TxFIFO. Values are in terms of 32-bit words. In DRD configurations (OTG_MODE = 0, 1, or 2) with dynamic FIFO sizing feature enabled (OTG_DFIFO_DYNAMIC = 1), the value of this field is, - the maximum value of (OTG_TX_HNPERIO_DFIFO_DEPTH, OTG_TX_DINEP_DFIFO_DEPTH_0) during reset, and - OTG_TX_DINEP_DFIFO_DEPTH_0, immediately after reset deassertion																																		

8.27.5.56 DIEPCTL1

Address offset: 0x920

Device Control IN Endpoint Control Register 1

This register is used to control the characteristics of Endpoint 1. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	MPS																																	
				Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.																																	
B	RW	USBACTEP																																	
				USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.																																	
			DISABLED	0																																	
				Not Active																																	
			ENABLED	1																																	
				USB Active Endpoint																																	

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: Applies to isochronous IN and OUT endpoints only. Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			DATA0EVENFRM	0	DATA0 or Even Frame
			DATA1ODDFRM	1	DATA1 or Odd Frame
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUP	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
G	RW	TXFNUM			TxFIFO Number (TxFNum) Shared FIFO Operation non-periodic endpoints must set this bit to zero. Periodic endpoints must map this to the corresponding Periodic TxFIFO number. - Others: Specified Periodic TxFIFO.number Note: An interrupt IN endpoint can be configured as a non-periodic endpoint for applications such as mass storage. The core treats an IN endpoint as a non-periodic endpoint if the TxFNum field is set to 0. Otherwise, a separate periodic FIFO must be allocated for an interrupt IN endpoint, and the number of this FIFO must be programmed into the TxFNum field. Configuring an interrupt IN endpoint as a non-periodic endpoint saves the extra periodic FIFO area. Dedicated FIFO Operation: These bits specify the FIFO number associated with this endpoint. Each active IN endpoint must be programmed to a separate FIFO number. This field is valid only for IN endpoints.
			TXFIFO0	0	Tx FIFO 0
			TXFIFO1	1	Tx FIFO 1
			TXFIFO2	2	Tx FIFO 2
			TXFIFO3	3	Tx FIFO 3
			TXFIFO4	4	Tx FIFO 4
			TXFIFO5	5	Tx FIFO 5
			TXFIFO6	6	Tx FIFO 6
			TXFIFO7	7	Tx FIFO 7
			TXFIFO8	8	Tx FIFO 8
			TXFIFO9	9	Tx FIFO 9
			TXFIFO10	10	Tx FIFO 10
			TXFIFO11	11	Tx FIFO 11
			TXFIFO12	12	Tx FIFO 12
			TXFIFO13	13	Tx FIFO 13
			TXFIFO14	14	Tx FIFO 14
			TXFIFO15	15	Tx FIFO 15
H	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
I	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also Set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
J	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to Even (micro)Frame
K	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to Odd (micro)Frame
L	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint
M	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled, -- For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. -- For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. - When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: -- For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. -- For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. - The core clears this bit before setting any of the following interrupts on this endpoint: -- SETUP Phase Done -- Endpoint Disabled -- Transfer Completed Note: For control endpoints in DMA mode, this bit must be set to be able to transfer SETUP data packets in memory.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.57 DIEPINT1

Address offset: 0x928

Device IN Endpoint Interrupt Register 1

This register contains the interrupts for the IN Endpoint 1 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																						N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080					**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID			Value																													
A	RW	XFERCOMPL																																		
				INACTIVE			0																													
				ACTIVE			1																													
B	RW	EPDISBLD																																		
				INACTIVE			0																													
				ACTIVE			1																													
C	RW	AHBERR																																		
				INACTIVE			0																													
				ACTIVE			1																													
D	RW	TIMEOUT																																		
				INACTIVE			0																													
				ACTIVE			1																													
E	RW	INTKNTXFEMP																																		
				INACTIVE			0																													
				ACTIVE			1																													

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	INTKNEPMIS			IN Token Received with EP Mismatch (INTknEPMis) Applies to non-periodic IN endpoints only. Indicates that the data in the top of the non-periodic TxFIFO belongs to an endpoint other than the one for which the IN token was received. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received with EP Mismatch interrupt
			ACTIVE	1	IN Token Received with EP Mismatch interrupt
G	RW	INEPNAKEFF			IN Endpoint NAK Effective (INEPNakEff) Applies to periodic IN endpoints only. This bit can be cleared when the application clears the IN endpoint NAK by writing to DIEPCTLn.CNAK. This interrupt indicates that the core has sampled the NAK bit Set (either by the application or by the core). The interrupt indicates that the IN endpoint NAK bit Set by the application has taken effect in the core. This interrupt does not guarantee that a NAK handshake is sent on the USB. A STALL bit takes priority over a NAK bit.
			INACTIVE	0	No Endpoint NAK Effective interrupt
			ACTIVE	1	IN Endpoint NAK Effective interrupt
H	R	TXFEMP			Transmit FIFO Empty (TxFEmp) This bit is valid only for IN endpoints This interrupt is asserted when the TxFIFO for this endpoint is either half or completely empty. The half or completely empty status is determined by the TxFIFO Empty Level bit in the Core AHB Configuration register (GAHBCFG.NPTxFEmpLvl)).
			INACTIVE	0	No Transmit FIFO Empty interrupt
			ACTIVE	1	Transmit FIFO Empty interrupt
I	RW	TXFIFOUNDRN			Fifo Underrun (TxfifoUndrn) Applies to IN endpoints Only This bit is valid only If thresholding is enabled. The core generates this interrupt when it detects a transmit FIFO underrun condition for this endpoint.
			INACTIVE	0	No Tx FIFO Underrun interrupt
			ACTIVE	1	TxFIFO Underrun interrupt
J	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done.
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
K	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
L	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No interrupt
			ACTIVE	1	BbleErr interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000080				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
M	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
N	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

8.27.5.58 DIEPTSIZ1

Address offset: 0x930

Device IN Endpoint Transfer Size Register 1

This register reflects the Transfer Size of the IN Endpoint 1 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C B B B B B B B B B B A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet from the external memory is written to the TxFIFO.
B	RW	PKTCNT			Packet Count (PktCnt) Indicates the total number of USB packets that constitute the Transfer Size amount of data for endpoint 0. This field is decremented every time a packet (maximum size or short packet) is read from the TxFIFO.
C	RW	MC			MC Applies to IN endpoints only. For periodic IN endpoints, this field indicates the number of packets that must be transmitted per microframe on the USB. The core uses this field to calculate the data PID for isochronous IN endpoints. For non-periodic IN endpoints, this field is valid only in Internal DMA mode. It specifies the number of packets the core must fetchfor an IN endpoint before it switches to the endpoint pointed to by the Next Endpoint field of the Device Endpoint-n Control register (DIEPCTLn.NextEp)
			PACKETONE	1	1 packet
			PACKETTWO	2	2 packets
			PACKETTHREE	3	3 packets

8.27.5.59 DIEPDMA1

Address offset: 0x934

Device IN Endpoint DMA Address Register 1

This register contains the DMA Address for the IN Endpoint 1 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.60 DTXFSTS1

Address offset: 0x938

Device IN Endpoint Transmit FIFO Status Register 1

This register reflects the status of the IN Endpoint Transmit FIFO Status Register 1 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000C00	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	INEPTXFSPCAVAIL			IN Endpoint TxFIFO Space Avail (INEPTxFSpcAvail) Indicates the amount of free space available in the Endpoint TxFIFO. Values are in terms of 32-bit words. In DRD configurations (OTG_MODE = 0, 1, or 2) with dynamic FIFO sizing feature enabled (OTG_DFIFO_DYNAMIC = 1), the value of this field (before DIEPCTLi.TxFNum is programmed) is - the maximum value of (OTG_TX_HNPERIO_DFIFO_DEPTH, OTG_TX_DINEP_DFIFO_DEPTH_0) during reset, and - OTG_TX_DINEP_DFIFO_DEPTH_0, immediately after reset deassertion After DIEPCTLi.TxFNum is programmed, the value of this field will return OTG_TX_DINEP_DFIFO_DEPTH_i

8.27.5.61 DIEPCTL2

Address offset: 0x940

Device Control IN Endpoint Control Register 2

This register is used to control the characteristics of Endpoint 2. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: Applies to isochronous IN and OUT endpoints only. Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			DATA0EVENFRM	0	DATA0 or Even Frame
			DATA1ODDFRM	1	DATA1 or Odd Frame
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUP	3	Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens
G	RW	TXFNUM			TxFIFO Number (TxFNum) Shared FIFO Operation non-periodic endpoints must set this bit to zero. Periodic endpoints must map this to the corresponding Periodic TxFIFO number. - Others: Specified Periodic TxFIFO.number Note: An interrupt IN endpoint can be configured as a non-periodic endpoint for applications such as mass storage. The core treats an IN endpoint as a non-periodic endpoint if the TxFNum field is set to 0. Otherwise, a separate periodic FIFO must be allocated for an interrupt IN endpoint, and the number of this FIFO must be programmed into the TxFNum field. Configuring an interrupt IN endpoint as a non-periodic endpoint saves the extra periodic FIFO area. Dedicated FIFO Operation: These bits specify the FIFO number associated with this endpoint. Each active IN endpoint must be programmed to a separate FIFO number. This field is valid only for IN endpoints.
			TXFIFO0	0	Tx FIFO 0
			TXFIFO1	1	Tx FIFO 1
			TXFIFO2	2	Tx FIFO 2
			TXFIFO3	3	Tx FIFO 3
			TXFIFO4	4	Tx FIFO 4
			TXFIFO5	5	Tx FIFO 5
			TXFIFO6	6	Tx FIFO 6
			TXFIFO7	7	Tx FIFO 7
			TXFIFO8	8	Tx FIFO 8
			TXFIFO9	9	Tx FIFO 9
			TXFIFO10	10	Tx FIFO 10
			TXFIFO11	11	Tx FIFO 11
			TXFIFO12	12	Tx FIFO 12
			TXFIFO13	13	Tx FIFO 13
			TXFIFO14	14	Tx FIFO 14
			TXFIFO15	15	Tx FIFO 15
H	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
I	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also Set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
J	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to Even (micro)Frame
K	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to Odd (micro)Frame
L	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
M	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled, -- For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. -- For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. - When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: -- For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. -- For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. - The core clears this bit before setting any of the following interrupts on this endpoint: -- SETUP Phase Done -- Endpoint Disabled -- Transfer Completed Note: For control endpoints in DMA mode, this bit must be set to be able to transfer SETUP data packets in memory.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.62 DIEPINT2

Address offset: 0x948

Device IN Endpoint Interrupt Register 2

This register contains the interrupts for the IN Endpoint 2 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	TIMEOUT			Timeout Condition (TimeOUT) - In shared TX FIFO mode, applies to non-isochronous IN endpoints only. - In dedicated FIFO mode, applies only to Control IN endpoints. - In Scatter/ Gather DMA mode, the TimeOUT interrupt is not asserted. Indicates that the core has detected a timeout condition on the USB for the last IN token on this endpoint.
			INACTIVE	0	No Timeout interrupt
			ACTIVE	1	Timeout interrupt
E	RW	INTKNTXFEMP			IN Token Received When TxFIFO is Empty (INTknTXFEmp) Applies to non-periodic IN endpoints only. Indicates that an IN token was received when the associated TxFIFO (periodic/non-periodic) was empty. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received interrupt
			ACTIVE	1	IN Token Received Interrupt
F	RW	INTKNEPMIS			IN Token Received with EP Mismatch (INTknEPMis) Applies to non-periodic IN endpoints only. Indicates that the data in the top of the non-periodic TxFIFO belongs to an endpoint other than the one for which the IN token was received. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received with EP Mismatch interrupt
			ACTIVE	1	IN Token Received with EP Mismatch interrupt
G	RW	INEPNAKEFF			IN Endpoint NAK Effective (INEPNakEff) Applies to periodic IN endpoints only. This bit can be cleared when the application clears the IN endpoint NAK by writing to DIEPCTLn.CNAK. This interrupt indicates that the core has sampled the NAK bit Set (either by the application or by the core). The interrupt indicates that the IN endpoint NAK bit Set by the application has taken effect in the core. This interrupt does not guarantee that a NAK handshake is sent on the USB. A STALL bit takes priority over a NAK bit.
			INACTIVE	0	No Endpoint NAK Effective interrupt
			ACTIVE	1	IN Endpoint NAK Effective interrupt
H	R	TXFEMP			Transmit FIFO Empty (TxFEmp) This bit is valid only for IN endpoints This interrupt is asserted when the TxFIFO for this endpoint is either half or completely empty. The half or completely empty status is determined by the TxFIFO Empty Level bit in the Core AHB Configuration register (GAHBCFG.NPTxFEmpLvl)).
			INACTIVE	0	No Transmit FIFO Empty interrupt
			ACTIVE	1	Transmit FIFO Empty interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000080				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
I	RW	TXFIFOUNDRN			Fifo Underrun (TxfifoUndrn) Applies to IN endpoints Only This bit is valid only If thresholding is enabled. The core generates this interrupt when it detects a transmit FIFO underrun condition for this endpoint.
			INACTIVE	0	No Tx FIFO Underrun interrupt
			ACTIVE	1	TxFIFO Underrun interrupt
J	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done.
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
K	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
L	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No interrupt
			ACTIVE	1	BbleErr interrupt
M	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
N	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

8.27.5.63 DIEPTSIZ2

Address offset: 0x950

Device IN Endpoint Transfer Size Register 2

This register reflects the Transfer Size of the IN Endpoint 2 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet from the external memory is written to the TxFIFO.
B	RW	PKTCNT			Packet Count (PktCnt) Indicates the total number of USB packets that constitute the Transfer Size amount of data for endpoint 0. This field is decremented every time a packet (maximum size or short packet) is read from the TxFIFO.
C	RW	MC			MC Applies to IN endpoints only. For periodic IN endpoints, this field indicates the number of packets that must be transmitted per microframe on the USB. The core uses this field to calculate the data PID for isochronous IN endpoints. For non-periodic IN endpoints, this field is valid only in Internal DMA mode. It specifies the number of packets the core must fetchfor an IN endpoint before it switches to the endpoint pointed to by the Next Endpoint field of the Device Endpoint-n Control register (DIEPCTLn.NextEp)
			PACKETONE	1	1 packet
			PACKETTWO	2	2 packets
			PACKETTHREE	3	3 packets

8.27.5.64 DIEPDMA2

Address offset: 0x954

Device IN Endpoint DMA Address Register 2

This register contains the DMA Address for the IN Endpoint 2 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.65 DTXFSTS2

Address offset: 0x958

Device IN Endpoint Transmit FIFO Status Register 2

This register reflects the status of the IN Endpoint Transmit FIFO Status Register 2 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000C00				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	INEPTXFSPCAVAIL																																	
				IN Endpoint TxFIFO Space Avail (INEPTxFSpcAvail) Indicates the amount of free space available in the Endpoint TxFIFO. Values are in terms of 32-bit words. In DRD configurations (OTG_MODE = 0, 1, or 2) with dynamic FIFO sizing feature enabled (OTG_DFIFO_DYNAMIC = 1), the value of this field (before DIEPCTLi.TxFNum is programmed) is - the maximum value of (OTG_TX_HNPERIO_DFIFO_DEPTH, OTG_TX_DINEP_DFIFO_DEPTH_0) during reset, and - OTG_TX_DINEP_DFIFO_DEPTH_0, immediately after reset deassertion After DIEPCTLi.TxFNum is programmed, the value of this field will return OTG_TX_DINEP_DFIFO_DEPTH_i																																		

8.27.5.66 DIEPCTL3

Address offset: 0x960

Device Control IN Endpoint Control Register 3

This register is used to control the characteristics of Endpoint 3. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	MPS																																	
				Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.																																	
B	RW	USBACTEP																																	
				USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.																																	
			DISABLED	0																																	
				Not Active																																	
			ENABLED	1																																	
				USB Active Endpoint																																	

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: Applies to isochronous IN and OUT endpoints only. Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			DATA0EVENFRM	0	DATA0 or Even Frame
			DATA1ODDFRM	1	DATA1 or Odd Frame
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUP	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
G	RW	TXFNUM			TxFIFO Number (TxFNum) Shared FIFO Operation non-periodic endpoints must set this bit to zero. Periodic endpoints must map this to the corresponding Periodic TxFIFO number. - Others: Specified Periodic TxFIFO.number Note: An interrupt IN endpoint can be configured as a non-periodic endpoint for applications such as mass storage. The core treats an IN endpoint as a non-periodic endpoint if the TxFNum field is set to 0. Otherwise, a separate periodic FIFO must be allocated for an interrupt IN endpoint, and the number of this FIFO must be programmed into the TxFNum field. Configuring an interrupt IN endpoint as a non-periodic endpoint saves the extra periodic FIFO area. Dedicated FIFO Operation: These bits specify the FIFO number associated with this endpoint. Each active IN endpoint must be programmed to a separate FIFO number. This field is valid only for IN endpoints.
			TXFIFO0	0	Tx FIFO 0
			TXFIFO1	1	Tx FIFO 1
			TXFIFO2	2	Tx FIFO 2
			TXFIFO3	3	Tx FIFO 3
			TXFIFO4	4	Tx FIFO 4
			TXFIFO5	5	Tx FIFO 5
			TXFIFO6	6	Tx FIFO 6
			TXFIFO7	7	Tx FIFO 7
			TXFIFO8	8	Tx FIFO 8
			TXFIFO9	9	Tx FIFO 9
			TXFIFO10	10	Tx FIFO 10
			TXFIFO11	11	Tx FIFO 11
			TXFIFO12	12	Tx FIFO 12
			TXFIFO13	13	Tx FIFO 13
			TXFIFO14	14	Tx FIFO 14
			TXFIFO15	15	Tx FIFO 15
H	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
I	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also Set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
J	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to Even (micro)Frame
K	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to Odd (micro)Frame
L	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint
M	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled, -- For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. -- For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. - When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: -- For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. -- For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. - The core clears this bit before setting any of the following interrupts on this endpoint: -- SETUP Phase Done -- Endpoint Disabled -- Transfer Completed Note: For control endpoints in DMA mode, this bit must be set to be able to transfer SETUP data packets in memory.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.67 DIEPINT3

Address offset: 0x968

Device IN Endpoint Interrupt Register 3

This register contains the interrupts for the IN Endpoint 3 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl)
					Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld)
					Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt
C	RW	AHBERR			AHB Error (AHBErr)
					Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	TIMEOUT			Timeout Condition (TimeOUT)
					- In shared TX FIFO mode, applies to non-isochronous IN endpoints only. - In dedicated FIFO mode, applies only to Control IN endpoints. - In Scatter/Gather DMA mode, the TimeOUT interrupt is not asserted. Indicates that the core has detected a timeout condition on the USB for the last IN token on this endpoint.
			INACTIVE	0	No Timeout interrupt
			ACTIVE	1	Timeout interrupt
E	RW	INTKNTXFEMP			IN Token Received When TxFIFO is Empty (INTknTXFEmp)
					Applies to non-periodic IN endpoints only. Indicates that an IN token was received when the associated TxFIFO (periodic/non-periodic) was empty. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received interrupt
			ACTIVE	1	IN Token Received Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	INTKNEPMIS			IN Token Received with EP Mismatch (INTknEPMis) Applies to non-periodic IN endpoints only. Indicates that the data in the top of the non-periodic TxFIFO belongs to an endpoint other than the one for which the IN token was received. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received with EP Mismatch interrupt
			ACTIVE	1	IN Token Received with EP Mismatch interrupt
G	RW	INEPNAKEFF			IN Endpoint NAK Effective (INEPNakEff) Applies to periodic IN endpoints only. This bit can be cleared when the application clears the IN endpoint NAK by writing to DIEPCTLn.CNAK. This interrupt indicates that the core has sampled the NAK bit Set (either by the application or by the core). The interrupt indicates that the IN endpoint NAK bit Set by the application has taken effect in the core. This interrupt does not guarantee that a NAK handshake is sent on the USB. A STALL bit takes priority over a NAK bit.
			INACTIVE	0	No Endpoint NAK Effective interrupt
			ACTIVE	1	IN Endpoint NAK Effective interrupt
H	R	TXFEMP			Transmit FIFO Empty (TxFEmp) This bit is valid only for IN endpoints This interrupt is asserted when the TxFIFO for this endpoint is either half or completely empty. The half or completely empty status is determined by the TxFIFO Empty Level bit in the Core AHB Configuration register (GAHBCFG.NPTxFEmpLvl)).
			INACTIVE	0	No Transmit FIFO Empty interrupt
			ACTIVE	1	Transmit FIFO Empty interrupt
I	RW	TXFIFOUNDRN			Fifo Underrun (TxfifoUndrn) Applies to IN endpoints Only This bit is valid only If thresholding is enabled. The core generates this interrupt when it detects a transmit FIFO underrun condition for this endpoint.
			INACTIVE	0	No Tx FIFO Underrun interrupt
			ACTIVE	1	TxFIFO Underrun interrupt
J	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done.
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
K	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
L	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No interrupt
			ACTIVE	1	BbleErr interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000080				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
M	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
N	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

8.27.5.68 DIEPTSIZ3

Address offset: 0x970

Device IN Endpoint Transfer Size Register 3

This register reflects the Transfer Size of the IN Endpoint 3 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C B B B B B B B B B B A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet from the external memory is written to the TxFIFO.
B	RW	PKTCNT			Packet Count (PktCnt) Indicates the total number of USB packets that constitute the Transfer Size amount of data for endpoint 0. This field is decremented every time a packet (maximum size or short packet) is read from the TxFIFO.
C	RW	MC			MC Applies to IN endpoints only. For periodic IN endpoints, this field indicates the number of packets that must be transmitted per microframe on the USB. The core uses this field to calculate the data PID for isochronous IN endpoints. For non-periodic IN endpoints, this field is valid only in Internal DMA mode. It specifies the number of packets the core must fetchfor an IN endpoint before it switches to the endpoint pointed to by the Next Endpoint field of the Device Endpoint-n Control register (DIEPCTLn.NextEp)
			PACKETONE	1	1 packet
			PACKETTWO	2	2 packets
			PACKETTHREE	3	3 packets

8.27.5.69 DIEPDMA3

Address offset: 0x974

Device IN Endpoint DMA Address Register 3

This register contains the DMA Address for the IN Endpoint 3 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.70 DTXFSTS3

Address offset: 0x978

Device IN Endpoint Transmit FIFO Status Register 3

This register reflects the status of the IN Endpoint Transmit FIFO Status Register 3 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000C00	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	INEPTXFSPCAVAIL			IN Endpoint TxFIFO Space Avail (INEPTxFSpcAvail) Indicates the amount of free space available in the Endpoint TxFIFO. Values are in terms of 32-bit words. In DRD configurations (OTG_MODE = 0, 1, or 2) with dynamic FIFO sizing feature enabled (OTG_DFIFO_DYNAMIC = 1), the value of this field (before DIEPCTLi.TxFNum is programmed) is - the maximum value of (OTG_TX_HNPERIO_DFIFO_DEPTH, OTG_TX_DINEP_DFIFO_DEPTH_0) during reset, and - OTG_TX_DINEP_DFIFO_DEPTH_0, immediately after reset deassertion After DIEPCTLi.TxFNum is programmed, the value of this field will return OTG_TX_DINEP_DFIFO_DEPTH_i

8.27.5.71 DIEPCTL4

Address offset: 0x980

Device Control IN Endpoint Control Register 4

This register is used to control the characteristics of Endpoint 4. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: Applies to isochronous IN and OUT endpoints only. Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			DATA0EVENFRM	0	DATA0 or Even Frame
			DATA1ODDFRM	1	DATA1 or Odd Frame
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUP	3	Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens
G	RW	TXFNUM			TxFIFO Number (TxFNum) Shared FIFO Operation non-periodic endpoints must set this bit to zero. Periodic endpoints must map this to the corresponding Periodic TxFIFO number. - Others: Specified Periodic TxFIFO.number Note: An interrupt IN endpoint can be configured as a non-periodic endpoint for applications such as mass storage. The core treats an IN endpoint as a non-periodic endpoint if the TxFNum field is set to 0. Otherwise, a separate periodic FIFO must be allocated for an interrupt IN endpoint, and the number of this FIFO must be programmed into the TxFNum field. Configuring an interrupt IN endpoint as a non-periodic endpoint saves the extra periodic FIFO area. Dedicated FIFO Operation: These bits specify the FIFO number associated with this endpoint. Each active IN endpoint must be programmed to a separate FIFO number. This field is valid only for IN endpoints.
			TXFIFO0	0	Tx FIFO 0
			TXFIFO1	1	Tx FIFO 1
			TXFIFO2	2	Tx FIFO 2
			TXFIFO3	3	Tx FIFO 3
			TXFIFO4	4	Tx FIFO 4
			TXFIFO5	5	Tx FIFO 5
			TXFIFO6	6	Tx FIFO 6
			TXFIFO7	7	Tx FIFO 7
			TXFIFO8	8	Tx FIFO 8
			TXFIFO9	9	Tx FIFO 9
			TXFIFO10	10	Tx FIFO 10
			TXFIFO11	11	Tx FIFO 11
			TXFIFO12	12	Tx FIFO 12
			TXFIFO13	13	Tx FIFO 13
			TXFIFO14	14	Tx FIFO 14
			TXFIFO15	15	Tx FIFO 15
H	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
I	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also Set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
J	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to Even (micro)Frame
K	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to Odd (micro)Frame
L	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
M	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled, -- For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. -- For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. - When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: -- For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. -- For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. - The core clears this bit before setting any of the following interrupts on this endpoint: -- SETUP Phase Done -- Endpoint Disabled -- Transfer Completed Note: For control endpoints in DMA mode, this bit must be set to be able to transfer SETUP data packets in memory.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.72 DIEPINT4

Address offset: 0x988

Device IN Endpoint Interrupt Register 4

This register contains the interrupts for the IN Endpoint 4 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	TIMEOUT			Timeout Condition (TimeOUT) - In shared TX FIFO mode, applies to non-isochronous IN endpoints only. - In dedicated FIFO mode, applies only to Control IN endpoints. - In Scatter/Gather DMA mode, the TimeOUT interrupt is not asserted. Indicates that the core has detected a timeout condition on the USB for the last IN token on this endpoint.
			INACTIVE	0	No Timeout interrupt
			ACTIVE	1	Timeout interrupt
E	RW	INTKNTXFEMP			IN Token Received When TxFIFO is Empty (INTknTXFEmp) Applies to non-periodic IN endpoints only. Indicates that an IN token was received when the associated TxFIFO (periodic/non-periodic) was empty. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received interrupt
			ACTIVE	1	IN Token Received Interrupt
F	RW	INTKNEPMIS			IN Token Received with EP Mismatch (INTknEPMis) Applies to non-periodic IN endpoints only. Indicates that the data in the top of the non-periodic TxFIFO belongs to an endpoint other than the one for which the IN token was received. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received with EP Mismatch interrupt
			ACTIVE	1	IN Token Received with EP Mismatch interrupt
G	RW	INEPNAKEFF			IN Endpoint NAK Effective (INEPNakEff) Applies to periodic IN endpoints only. This bit can be cleared when the application clears the IN endpoint NAK by writing to DIEPCTLn.CNAK. This interrupt indicates that the core has sampled the NAK bit Set (either by the application or by the core). The interrupt indicates that the IN endpoint NAK bit Set by the application has taken effect in the core. This interrupt does not guarantee that a NAK handshake is sent on the USB. A STALL bit takes priority over a NAK bit.
			INACTIVE	0	No Endpoint NAK Effective interrupt
			ACTIVE	1	IN Endpoint NAK Effective interrupt
H	R	TXFEMP			Transmit FIFO Empty (TxFEmp) This bit is valid only for IN endpoints This interrupt is asserted when the TxFIFO for this endpoint is either half or completely empty. The half or completely empty status is determined by the TxFIFO Empty Level bit in the Core AHB Configuration register (GAHBCFG.NPTxFEmpLvl)).
			INACTIVE	0	No Transmit FIFO Empty interrupt
			ACTIVE	1	Transmit FIFO Empty interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000080				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
I	RW	TXFIFOUNDRN			Fifo Underrun (TxfifoUndrn) Applies to IN endpoints Only This bit is valid only If thresholding is enabled. The core generates this interrupt when it detects a transmit FIFO underrun condition for this endpoint.
			INACTIVE	0	No Tx FIFO Underrun interrupt
			ACTIVE	1	TxFIFO Underrun interrupt
J	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done.
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
K	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
L	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No interrupt
			ACTIVE	1	BbleErr interrupt
M	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
N	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

8.27.5.73 DIEPTSIZ4

Address offset: 0x990

Device IN Endpoint Transfer Size Register 4

This register reflects the Transfer Size of the IN Endpoint 4 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet from the external memory is written to the TxFIFO.
B	RW	PKTCNT			Packet Count (PktCnt) Indicates the total number of USB packets that constitute the Transfer Size amount of data for endpoint 0. This field is decremented every time a packet (maximum size or short packet) is read from the TxFIFO.
C	RW	MC			MC Applies to IN endpoints only. For periodic IN endpoints, this field indicates the number of packets that must be transmitted per microframe on the USB. The core uses this field to calculate the data PID for isochronous IN endpoints. For non-periodic IN endpoints, this field is valid only in Internal DMA mode. It specifies the number of packets the core must fetchfor an IN endpoint before it switches to the endpoint pointed to by the Next Endpoint field of the Device Endpoint-n Control register (DIEPCTLn.NextEp)
			PACKETONE	1	1 packet
			PACKETTWO	2	2 packets
			PACKETTHREE	3	3 packets

8.27.5.74 DIEPDMA4

Address offset: 0x994

Device IN Endpoint DMA Address Register 4

This register contains the DMA Address for the IN Endpoint 4 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.75 DTXFSTS4

Address offset: 0x998

Device IN Endpoint Transmit FIFO Status Register 4

This register reflects the status of the IN Endpoint Transmit FIFO Status Register 4 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000C00				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	INEPTXFSPCAVAIL																																	
				IN Endpoint TxFIFO Space Avail (INEPTxFSpcAvail) Indicates the amount of free space available in the Endpoint TxFIFO. Values are in terms of 32-bit words. In DRD configurations (OTG_MODE = 0, 1, or 2) with dynamic FIFO sizing feature enabled (OTG_DFIFO_DYNAMIC = 1), the value of this field (before DIEPCTLi.TxFNum is programmed) is - the maximum value of (OTG_TX_HNPERIO_DFIFO_DEPTH, OTG_TX_DINEP_DFIFO_DEPTH_0) during reset, and - OTG_TX_DINEP_DFIFO_DEPTH_0, immediately after reset deassertion After DIEPCTLi.TxFNum is programmed, the value of this field will return OTG_TX_DINEP_DFIFO_DEPTH_i																																		

8.27.5.76 DIEPCTL5

Address offset: 0x9A0

Device Control IN Endpoint Control Register 5

This register is used to control the characteristics of Endpoint 5. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	MPS																																	
				Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.																																	
B	RW	USBACTEP																																	
				USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.																																	
			DISABLED	0																																	
				Not Active																																	
			ENABLED	1																																	
				USB Active Endpoint																																	

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: Applies to isochronous IN and OUT endpoints only. Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			DATA0EVENFRM	0	DATA0 or Even Frame
			DATA1ODDFRM	1	DATA1 or Odd Frame
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUP	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
G	RW	TXFNUM			TxFIFO Number (TxFNum) Shared FIFO Operation non-periodic endpoints must set this bit to zero. Periodic endpoints must map this to the corresponding Periodic TxFIFO number. - Others: Specified Periodic TxFIFO.number Note: An interrupt IN endpoint can be configured as a non-periodic endpoint for applications such as mass storage. The core treats an IN endpoint as a non-periodic endpoint if the TxFNum field is set to 0. Otherwise, a separate periodic FIFO must be allocated for an interrupt IN endpoint, and the number of this FIFO must be programmed into the TxFNum field. Configuring an interrupt IN endpoint as a non-periodic endpoint saves the extra periodic FIFO area. Dedicated FIFO Operation: These bits specify the FIFO number associated with this endpoint. Each active IN endpoint must be programmed to a separate FIFO number. This field is valid only for IN endpoints.
			TXFIFO0	0	Tx FIFO 0
			TXFIFO1	1	Tx FIFO 1
			TXFIFO2	2	Tx FIFO 2
			TXFIFO3	3	Tx FIFO 3
			TXFIFO4	4	Tx FIFO 4
			TXFIFO5	5	Tx FIFO 5
			TXFIFO6	6	Tx FIFO 6
			TXFIFO7	7	Tx FIFO 7
			TXFIFO8	8	Tx FIFO 8
			TXFIFO9	9	Tx FIFO 9
			TXFIFO10	10	Tx FIFO 10
			TXFIFO11	11	Tx FIFO 11
			TXFIFO12	12	Tx FIFO 12
			TXFIFO13	13	Tx FIFO 13
			TXFIFO14	14	Tx FIFO 14
			TXFIFO15	15	Tx FIFO 15
H	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
I	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also Set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
J	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to Even (micro)Frame
K	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to Odd (micro)Frame
L	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint
M	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled, -- For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. -- For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. - When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: -- For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. -- For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. - The core clears this bit before setting any of the following interrupts on this endpoint: -- SETUP Phase Done -- Endpoint Disabled -- Transfer Completed Note: For control endpoints in DMA mode, this bit must be set to be able to transfer SETUP data packets in memory.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.77 DIEPINT5

Address offset: 0x9A8

Device IN Endpoint Interrupt Register 5

This register contains the interrupts for the IN Endpoint 5 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																			N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	TIMEOUT			Timeout Condition (TimeOUT) - In shared TX FIFO mode, applies to non-isochronous IN endpoints only. - In dedicated FIFO mode, applies only to Control IN endpoints. - In Scatter/ Gather DMA mode, the TimeOUT interrupt is not asserted. Indicates that the core has detected a timeout condition on the USB for the last IN token on this endpoint.
			INACTIVE	0	No Timeout interrupt
			ACTIVE	1	Timeout interrupt
E	RW	INTKNTXFEMP			IN Token Received When TxFIFO is Empty (INTknTXFEmp) Applies to non-periodic IN endpoints only. Indicates that an IN token was received when the associated TxFIFO (periodic/non-periodic) was empty. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received interrupt
			ACTIVE	1	IN Token Received Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	INTKNEPMIS			IN Token Received with EP Mismatch (INTknEPMis) Applies to non-periodic IN endpoints only. Indicates that the data in the top of the non-periodic TxFIFO belongs to an endpoint other than the one for which the IN token was received. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received with EP Mismatch interrupt
			ACTIVE	1	IN Token Received with EP Mismatch interrupt
G	RW	INEPNAKEFF			IN Endpoint NAK Effective (INEPNakEff) Applies to periodic IN endpoints only. This bit can be cleared when the application clears the IN endpoint NAK by writing to DIEPCTLn.CNAK. This interrupt indicates that the core has sampled the NAK bit Set (either by the application or by the core). The interrupt indicates that the IN endpoint NAK bit Set by the application has taken effect in the core. This interrupt does not guarantee that a NAK handshake is sent on the USB. A STALL bit takes priority over a NAK bit.
			INACTIVE	0	No Endpoint NAK Effective interrupt
			ACTIVE	1	IN Endpoint NAK Effective interrupt
H	R	TXFEMP			Transmit FIFO Empty (TxFEmp) This bit is valid only for IN endpoints This interrupt is asserted when the TxFIFO for this endpoint is either half or completely empty. The half or completely empty status is determined by the TxFIFO Empty Level bit in the Core AHB Configuration register (GAHBCFG.NPTxFEmpLvl)).
			INACTIVE	0	No Transmit FIFO Empty interrupt
			ACTIVE	1	Transmit FIFO Empty interrupt
I	RW	TXFIFOUNDRN			Fifo Underrun (TxfifoUndrn) Applies to IN endpoints Only This bit is valid only If thresholding is enabled. The core generates this interrupt when it detects a transmit FIFO underrun condition for this endpoint.
			INACTIVE	0	No Tx FIFO Underrun interrupt
			ACTIVE	1	TxFIFO Underrun interrupt
J	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done.
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
K	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
L	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No interrupt
			ACTIVE	1	BbleErr interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000080				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
M	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
N	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

8.27.5.78 DIEPTSIZ5

Address offset: 0x9B0

Device IN Endpoint Transfer Size Register 5

This register reflects the Transfer Size of the IN Endpoint 5 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C B B B B B B B B B B A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet from the external memory is written to the TxFIFO.
B	RW	PKTCNT			Packet Count (PktCnt) Indicates the total number of USB packets that constitute the Transfer Size amount of data for endpoint 0. This field is decremented every time a packet (maximum size or short packet) is read from the TxFIFO.
C	RW	MC			MC Applies to IN endpoints only. For periodic IN endpoints, this field indicates the number of packets that must be transmitted per microframe on the USB. The core uses this field to calculate the data PID for isochronous IN endpoints. For non-periodic IN endpoints, this field is valid only in Internal DMA mode. It specifies the number of packets the core must fetchfor an IN endpoint before it switches to the endpoint pointed to by the Next Endpoint field of the Device Endpoint-n Control register (DIEPCTLn.NextEp)
			PACKETONE	1	1 packet
			PACKETTWO	2	2 packets
			PACKETTHREE	3	3 packets

8.27.5.79 DIEPDMA5

Address offset: 0x9B4

Device IN Endpoint DMA Address Register 5

This register contains the DMA Address for the IN Endpoint 5 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.80 DTXFSTS5

Address offset: 0x9B8

Device IN Endpoint Transmit FIFO Status Register 5

This register reflects the status of the IN Endpoint Transmit FIFO Status Register 5 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000C00	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	INEPTXFSPCAVAIL			IN Endpoint TxFIFO Space Avail (INEPTxFSpcAvail) Indicates the amount of free space available in the Endpoint TxFIFO. Values are in terms of 32-bit words. In DRD configurations (OTG_MODE = 0, 1, or 2) with dynamic FIFO sizing feature enabled (OTG_DFIFO_DYNAMIC = 1), the value of this field (before DIEPCTLi.TxFNum is programmed) is - the maximum value of (OTG_TX_HNPERIO_DFIFO_DEPTH, OTG_TX_DINEP_DFIFO_DEPTH_0) during reset, and - OTG_TX_DINEP_DFIFO_DEPTH_0, immediately after reset deassertion After DIEPCTLi.TxFNum is programmed, the value of this field will return OTG_TX_DINEP_DFIFO_DEPTH_i

8.27.5.81 DIEPCTL6

Address offset: 0x9C0

Device Control IN Endpoint Control Register 6

This register is used to control the characteristics of Endpoint 6. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: Applies to isochronous IN and OUT endpoints only. Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			DATA0EVENFRM	0	DATA0 or Even Frame
			DATA1ODDFRM	1	DATA1 or Odd Frame
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUP	3	Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens
G	RW	TXFNUM			TxFIFO Number (TxFNum) Shared FIFO Operation non-periodic endpoints must set this bit to zero. Periodic endpoints must map this to the corresponding Periodic TxFIFO number. - Others: Specified Periodic TxFIFO.number Note: An interrupt IN endpoint can be configured as a non-periodic endpoint for applications such as mass storage. The core treats an IN endpoint as a non-periodic endpoint if the TxFNum field is set to 0. Otherwise, a separate periodic FIFO must be allocated for an interrupt IN endpoint, and the number of this FIFO must be programmed into the TxFNum field. Configuring an interrupt IN endpoint as a non-periodic endpoint saves the extra periodic FIFO area. Dedicated FIFO Operation: These bits specify the FIFO number associated with this endpoint. Each active IN endpoint must be programmed to a separate FIFO number. This field is valid only for IN endpoints.
			TXFIFO0	0	Tx FIFO 0
			TXFIFO1	1	Tx FIFO 1
			TXFIFO2	2	Tx FIFO 2
			TXFIFO3	3	Tx FIFO 3
			TXFIFO4	4	Tx FIFO 4
			TXFIFO5	5	Tx FIFO 5
			TXFIFO6	6	Tx FIFO 6
			TXFIFO7	7	Tx FIFO 7
			TXFIFO8	8	Tx FIFO 8
			TXFIFO9	9	Tx FIFO 9
			TXFIFO10	10	Tx FIFO 10
			TXFIFO11	11	Tx FIFO 11
			TXFIFO12	12	Tx FIFO 12
			TXFIFO13	13	Tx FIFO 13
			TXFIFO14	14	Tx FIFO 14
			TXFIFO15	15	Tx FIFO 15
H	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
I	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also Set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
J	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to Even (micro)Frame
K	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to Odd (micro)Frame
L	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
M	RW	EPENA																																	
			INACTIVE	0																															
			ACTIVE	1																															

8.27.5.82 DIEPINT6

Address offset: 0x9C8

Device IN Endpoint Interrupt Register 6

This register contains the interrupts for the IN Endpoint 6 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																					N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	XFERCOMPL																																	
			INACTIVE	0																															
			ACTIVE	1																															
B	RW	EPDISBLD																																	
			INACTIVE	0																															
			ACTIVE	1																															

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	TIMEOUT			Timeout Condition (TimeOUT) - In shared TX FIFO mode, applies to non-isochronous IN endpoints only. - In dedicated FIFO mode, applies only to Control IN endpoints. - In Scatter/Gather DMA mode, the TimeOUT interrupt is not asserted. Indicates that the core has detected a timeout condition on the USB for the last IN token on this endpoint.
			INACTIVE	0	No Timeout interrupt
			ACTIVE	1	Timeout interrupt
E	RW	INTKNTXFEMP			IN Token Received When TxFIFO is Empty (INTknTXFEmp) Applies to non-periodic IN endpoints only. Indicates that an IN token was received when the associated TxFIFO (periodic/non-periodic) was empty. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received interrupt
			ACTIVE	1	IN Token Received Interrupt
F	RW	INTKNEPMIS			IN Token Received with EP Mismatch (INTknEPMis) Applies to non-periodic IN endpoints only. Indicates that the data in the top of the non-periodic TxFIFO belongs to an endpoint other than the one for which the IN token was received. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received with EP Mismatch interrupt
			ACTIVE	1	IN Token Received with EP Mismatch interrupt
G	RW	INEPNAKEFF			IN Endpoint NAK Effective (INEPNakEff) Applies to periodic IN endpoints only. This bit can be cleared when the application clears the IN endpoint NAK by writing to DIEPCTLn.CNAK. This interrupt indicates that the core has sampled the NAK bit Set (either by the application or by the core). The interrupt indicates that the IN endpoint NAK bit Set by the application has taken effect in the core. This interrupt does not guarantee that a NAK handshake is sent on the USB. A STALL bit takes priority over a NAK bit.
			INACTIVE	0	No Endpoint NAK Effective interrupt
			ACTIVE	1	IN Endpoint NAK Effective interrupt
H	R	TXFEMP			Transmit FIFO Empty (TxFEmp) This bit is valid only for IN endpoints This interrupt is asserted when the TxFIFO for this endpoint is either half or completely empty. The half or completely empty status is determined by the TxFIFO Empty Level bit in the Core AHB Configuration register (GAHBCFG.NPTxFEmpLvl)).
			INACTIVE	0	No Transmit FIFO Empty interrupt
			ACTIVE	1	Transmit FIFO Empty interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000080				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
I	RW	TXFIFOUNDRN			Fifo Underrun (TxfifoUndrn) Applies to IN endpoints Only This bit is valid only If thresholding is enabled. The core generates this interrupt when it detects a transmit FIFO underrun condition for this endpoint.
			INACTIVE	0	No Tx FIFO Underrun interrupt
			ACTIVE	1	TxFIFO Underrun interrupt
J	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done.
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
K	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
L	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No interrupt
			ACTIVE	1	BbleErr interrupt
M	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
N	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

8.27.5.83 DIEPTSIZ6

Address offset: 0x9D0

Device IN Endpoint Transfer Size Register 6

This register reflects the Transfer Size of the IN Endpoint 6 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet from the external memory is written to the TxFIFO.
B	RW	PKTCNT			Packet Count (PktCnt) Indicates the total number of USB packets that constitute the Transfer Size amount of data for endpoint 0. This field is decremented every time a packet (maximum size or short packet) is read from the TxFIFO.
C	RW	MC			MC Applies to IN endpoints only. For periodic IN endpoints, this field indicates the number of packets that must be transmitted per microframe on the USB. The core uses this field to calculate the data PID for isochronous IN endpoints. For non-periodic IN endpoints, this field is valid only in Internal DMA mode. It specifies the number of packets the core must fetchfor an IN endpoint before it switches to the endpoint pointed to by the Next Endpoint field of the Device Endpoint-n Control register (DIEPCTLn.NextEp)
			PACKETONE	1	1 packet
			PACKETTWO	2	2 packets
			PACKETTHREE	3	3 packets

8.27.5.84 DIEPDMA6

Address offset: 0x9D4

Device IN Endpoint DMA Address Register 6

This register contains the DMA Address for the IN Endpoint 6 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.85 DTXFSTS6

Address offset: 0x9D8

Device IN Endpoint Transmit FIFO Status Register 6

This register reflects the status of the IN Endpoint Transmit FIFO Status Register 6 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000C00				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	INEPTXFSPCAVAIL			IN Endpoint TxFIFO Space Avail (INEPTxFSpcAvail) Indicates the amount of free space available in the Endpoint TxFIFO. Values are in terms of 32-bit words. In DRD configurations (OTG_MODE = 0, 1, or 2) with dynamic FIFO sizing feature enabled (OTG_DFIFO_DYNAMIC = 1), the value of this field (before DIEPCTLi.TxFNum is programmed) is - the maximum value of (OTG_TX_HNPERIO_DFIFO_DEPTH, OTG_TX_DINEP_DFIFO_DEPTH_0) during reset, and - OTG_TX_DINEP_DFIFO_DEPTH_0, immediately after reset deassertion After DIEPCTLi.TxFNum is programmed, the value of this field will return OTG_TX_DINEP_DFIFO_DEPTH_i

8.27.5.86 DIEPCTL7

Address offset: 0x9E0

Device Control IN Endpoint Control Register 7

This register is used to control the characteristics of Endpoint 7. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				M L K J I H G G G G F E E D C B A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: Applies to isochronous IN and OUT endpoints only. Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			DATA0EVENFRM	0	DATA0 or Even Frame
			DATA1ODDFRM	1	DATA1 or Odd Frame
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUP	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
G	RW	TXFNUM			TxFIFO Number (TxFNum) Shared FIFO Operation non-periodic endpoints must set this bit to zero. Periodic endpoints must map this to the corresponding Periodic TxFIFO number. - Others: Specified Periodic TxFIFO.number Note: An interrupt IN endpoint can be configured as a non-periodic endpoint for applications such as mass storage. The core treats an IN endpoint as a non-periodic endpoint if the TxFNum field is set to 0. Otherwise, a separate periodic FIFO must be allocated for an interrupt IN endpoint, and the number of this FIFO must be programmed into the TxFNum field. Configuring an interrupt IN endpoint as a non-periodic endpoint saves the extra periodic FIFO area. Dedicated FIFO Operation: These bits specify the FIFO number associated with this endpoint. Each active IN endpoint must be programmed to a separate FIFO number. This field is valid only for IN endpoints.
			TXFIFO0	0	Tx FIFO 0
			TXFIFO1	1	Tx FIFO 1
			TXFIFO2	2	Tx FIFO 2
			TXFIFO3	3	Tx FIFO 3
			TXFIFO4	4	Tx FIFO 4
			TXFIFO5	5	Tx FIFO 5
			TXFIFO6	6	Tx FIFO 6
			TXFIFO7	7	Tx FIFO 7
			TXFIFO8	8	Tx FIFO 8
			TXFIFO9	9	Tx FIFO 9
			TXFIFO10	10	Tx FIFO 10
			TXFIFO11	11	Tx FIFO 11
			TXFIFO12	12	Tx FIFO 12
			TXFIFO13	13	Tx FIFO 13
			TXFIFO14	14	Tx FIFO 14
			TXFIFO15	15	Tx FIFO 15
H	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
I	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also Set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
J	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to Even (micro)Frame
K	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to Odd (micro)Frame
L	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint
M	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled, -- For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. -- For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. - When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: -- For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. -- For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. - The core clears this bit before setting any of the following interrupts on this endpoint: -- SETUP Phase Done -- Endpoint Disabled -- Transfer Completed Note: For control endpoints in DMA mode, this bit must be set to be able to transfer SETUP data packets in memory.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.87 DIEPINT7

Address offset: 0x9E8

Device IN Endpoint Interrupt Register 7

This register contains the interrupts for the IN Endpoint 7 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	TIMEOUT			Timeout Condition (TimeOUT) - In shared TX FIFO mode, applies to non-isochronous IN endpoints only. - In dedicated FIFO mode, applies only to Control IN endpoints. - In Scatter/Gather DMA mode, the TimeOUT interrupt is not asserted. Indicates that the core has detected a timeout condition on the USB for the last IN token on this endpoint.
			INACTIVE	0	No Timeout interrupt
			ACTIVE	1	Timeout interrupt
E	RW	INTKNTXFEMP			IN Token Received When TxFIFO is Empty (INTknTXFEmp) Applies to non-periodic IN endpoints only. Indicates that an IN token was received when the associated TxFIFO (periodic/non-periodic) was empty. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received interrupt
			ACTIVE	1	IN Token Received Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	INTKNEPMIS			IN Token Received with EP Mismatch (INTknEPMis) Applies to non-periodic IN endpoints only. Indicates that the data in the top of the non-periodic TxFIFO belongs to an endpoint other than the one for which the IN token was received. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received with EP Mismatch interrupt
			ACTIVE	1	IN Token Received with EP Mismatch interrupt
G	RW	INEPNAKEFF			IN Endpoint NAK Effective (INEPNakEff) Applies to periodic IN endpoints only. This bit can be cleared when the application clears the IN endpoint NAK by writing to DIEPCTLn.CNAK. This interrupt indicates that the core has sampled the NAK bit Set (either by the application or by the core). The interrupt indicates that the IN endpoint NAK bit Set by the application has taken effect in the core. This interrupt does not guarantee that a NAK handshake is sent on the USB. A STALL bit takes priority over a NAK bit.
			INACTIVE	0	No Endpoint NAK Effective interrupt
			ACTIVE	1	IN Endpoint NAK Effective interrupt
H	R	TXFEMP			Transmit FIFO Empty (TxFEmp) This bit is valid only for IN endpoints This interrupt is asserted when the TxFIFO for this endpoint is either half or completely empty. The half or completely empty status is determined by the TxFIFO Empty Level bit in the Core AHB Configuration register (GAHBCFG.NPTxFEmpLvl)).
			INACTIVE	0	No Transmit FIFO Empty interrupt
			ACTIVE	1	Transmit FIFO Empty interrupt
I	RW	TXFIFOUNDRN			Fifo Underrun (TxfifoUndrn) Applies to IN endpoints Only This bit is valid only If thresholding is enabled. The core generates this interrupt when it detects a transmit FIFO underrun condition for this endpoint.
			INACTIVE	0	No Tx FIFO Underrun interrupt
			ACTIVE	1	TxFIFO Underrun interrupt
J	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done.
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
K	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
L	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No interrupt
			ACTIVE	1	BbleErr interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000080				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
M	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
N	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

8.27.5.88 DIEPTSIZ7

Address offset: 0x9F0

Device IN Endpoint Transfer Size Register 7

This register reflects the Transfer Size of the IN Endpoint 7 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C B B B B B B B B B B A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet from the external memory is written to the TxFIFO.
B	RW	PKTCNT			Packet Count (PktCnt) Indicates the total number of USB packets that constitute the Transfer Size amount of data for endpoint 0. This field is decremented every time a packet (maximum size or short packet) is read from the TxFIFO.
C	RW	MC			MC Applies to IN endpoints only. For periodic IN endpoints, this field indicates the number of packets that must be transmitted per microframe on the USB. The core uses this field to calculate the data PID for isochronous IN endpoints. For non-periodic IN endpoints, this field is valid only in Internal DMA mode. It specifies the number of packets the core must fetchfor an IN endpoint before it switches to the endpoint pointed to by the Next Endpoint field of the Device Endpoint-n Control register (DIEPCTLn.NextEp)
			PACKETONE	1	1 packet
			PACKETTWO	2	2 packets
			PACKETTHREE	3	3 packets

8.27.5.89 DIEPDMA7

Address offset: 0x9F4

Device IN Endpoint DMA Address Register 7

This register contains the DMA Address for the IN Endpoint 7 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.90 DTXFSTS7

Address offset: 0x9F8

Device IN Endpoint Transmit FIFO Status Register 7

This register reflects the status of the IN Endpoint Transmit FIFO Status Register 7 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000C00	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	INEPTXFSPCAVAIL			IN Endpoint TxFIFO Space Avail (INEPTxFSpcAvail) Indicates the amount of free space available in the Endpoint TxFIFO. Values are in terms of 32-bit words. In DRD configurations (OTG_MODE = 0, 1, or 2) with dynamic FIFO sizing feature enabled (OTG_DFIFO_DYNAMIC = 1), the value of this field (before DIEPCTLi.TxFNum is programmed) is - the maximum value of (OTG_TX_HNPERIO_DFIFO_DEPTH, OTG_TX_DINEP_DFIFO_DEPTH_0) during reset, and - OTG_TX_DINEP_DFIFO_DEPTH_0, immediately after reset deassertion After DIEPCTLi.TxFNum is programmed, the value of this field will return OTG_TX_DINEP_DFIFO_DEPTH_i

8.27.5.91 DIEPCTL8

Address offset: 0xA00

Device Control IN Endpoint Control Register 8

This register is used to control the characteristics of Endpoint 8. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: Applies to isochronous IN and OUT endpoints only. Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			DATA0EVENFRM	0	DATA0 or Even Frame
			DATA1ODDFRM	1	DATA1 or Odd Frame
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUP	3	Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens
G	RW	TXFNUM			TxFIFO Number (TxFNum) Shared FIFO Operation non-periodic endpoints must set this bit to zero. Periodic endpoints must map this to the corresponding Periodic TxFIFO number. - Others: Specified Periodic TxFIFO.number Note: An interrupt IN endpoint can be configured as a non-periodic endpoint for applications such as mass storage. The core treats an IN endpoint as a non-periodic endpoint if the TxFNum field is set to 0. Otherwise, a separate periodic FIFO must be allocated for an interrupt IN endpoint, and the number of this FIFO must be programmed into the TxFNum field. Configuring an interrupt IN endpoint as a non-periodic endpoint saves the extra periodic FIFO area. Dedicated FIFO Operation: These bits specify the FIFO number associated with this endpoint. Each active IN endpoint must be programmed to a separate FIFO number. This field is valid only for IN endpoints.
			TXFIFO0	0	Tx FIFO 0
			TXFIFO1	1	Tx FIFO 1
			TXFIFO2	2	Tx FIFO 2
			TXFIFO3	3	Tx FIFO 3
			TXFIFO4	4	Tx FIFO 4
			TXFIFO5	5	Tx FIFO 5
			TXFIFO6	6	Tx FIFO 6
			TXFIFO7	7	Tx FIFO 7
			TXFIFO8	8	Tx FIFO 8
			TXFIFO9	9	Tx FIFO 9
			TXFIFO10	10	Tx FIFO 10
			TXFIFO11	11	Tx FIFO 11
			TXFIFO12	12	Tx FIFO 12
			TXFIFO13	13	Tx FIFO 13
			TXFIFO14	14	Tx FIFO 14
			TXFIFO15	15	Tx FIFO 15
H	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
I	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also Set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
J	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to Even (micro)Frame
K	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to Odd (micro)Frame
L	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
M	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled, -- For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. -- For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. - When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: -- For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. -- For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. - The core clears this bit before setting any of the following interrupts on this endpoint: -- SETUP Phase Done -- Endpoint Disabled -- Transfer Completed Note: For control endpoints in DMA mode, this bit must be set to be able to transfer SETUP data packets in memory.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.92 DIEPINT8

Address offset: 0xA08

Device IN Endpoint Interrupt Register 8

This register contains the interrupts for the IN Endpoint 8 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	TIMEOUT			Timeout Condition (TimeOUT) - In shared TX FIFO mode, applies to non-isochronous IN endpoints only. - In dedicated FIFO mode, applies only to Control IN endpoints. - In Scatter/Gather DMA mode, the TimeOUT interrupt is not asserted. Indicates that the core has detected a timeout condition on the USB for the last IN token on this endpoint.
			INACTIVE	0	No Timeout interrupt
			ACTIVE	1	Timeout interrupt
E	RW	INTKNTXFEMP			IN Token Received When TxFIFO is Empty (INTknTXFEmp) Applies to non-periodic IN endpoints only. Indicates that an IN token was received when the associated TxFIFO (periodic/non-periodic) was empty. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received interrupt
			ACTIVE	1	IN Token Received Interrupt
F	RW	INTKNEPMIS			IN Token Received with EP Mismatch (INTknEPMis) Applies to non-periodic IN endpoints only. Indicates that the data in the top of the non-periodic TxFIFO belongs to an endpoint other than the one for which the IN token was received. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received with EP Mismatch interrupt
			ACTIVE	1	IN Token Received with EP Mismatch interrupt
G	RW	INEPNAKEFF			IN Endpoint NAK Effective (INEPNakEff) Applies to periodic IN endpoints only. This bit can be cleared when the application clears the IN endpoint NAK by writing to DIEPCTLn.CNAK. This interrupt indicates that the core has sampled the NAK bit Set (either by the application or by the core). The interrupt indicates that the IN endpoint NAK bit Set by the application has taken effect in the core. This interrupt does not guarantee that a NAK handshake is sent on the USB. A STALL bit takes priority over a NAK bit.
			INACTIVE	0	No Endpoint NAK Effective interrupt
			ACTIVE	1	IN Endpoint NAK Effective interrupt
H	R	TXFEMP			Transmit FIFO Empty (TxFEmp) This bit is valid only for IN endpoints This interrupt is asserted when the TxFIFO for this endpoint is either half or completely empty. The half or completely empty status is determined by the TxFIFO Empty Level bit in the Core AHB Configuration register (GAHBCFG.NPTxFEmpLvl)).
			INACTIVE	0	No Transmit FIFO Empty interrupt
			ACTIVE	1	Transmit FIFO Empty interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000080				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
I	RW	TXFIFOUNDRN			Fifo Underrun (TxfifoUndrn) Applies to IN endpoints Only This bit is valid only If thresholding is enabled. The core generates this interrupt when it detects a transmit FIFO underrun condition for this endpoint.
			INACTIVE	0	No Tx FIFO Underrun interrupt
			ACTIVE	1	TxFIFO Underrun interrupt
J	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done.
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
K	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
L	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No interrupt
			ACTIVE	1	BbleErr interrupt
M	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
N	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

8.27.5.93 DIEPTSIZ8

Address offset: 0xA10

Device IN Endpoint Transfer Size Register 8

This register reflects the Transfer Size of the IN Endpoint 8 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet from the external memory is written to the TxFIFO.
B	RW	PKTCNT			Packet Count (PktCnt) Indicates the total number of USB packets that constitute the Transfer Size amount of data for endpoint 0. This field is decremented every time a packet (maximum size or short packet) is read from the TxFIFO.
C	RW	MC			MC Applies to IN endpoints only. For periodic IN endpoints, this field indicates the number of packets that must be transmitted per microframe on the USB. The core uses this field to calculate the data PID for isochronous IN endpoints. For non-periodic IN endpoints, this field is valid only in Internal DMA mode. It specifies the number of packets the core must fetchfor an IN endpoint before it switches to the endpoint pointed to by the Next Endpoint field of the Device Endpoint-n Control register (DIEPCTLn.NextEp)
			PACKETONE	1	1 packet
			PACKETTWO	2	2 packets
			PACKETTHREE	3	3 packets

8.27.5.94 DIEPDMA8

Address offset: 0xA14

Device IN Endpoint DMA Address Register 8

This register contains the DMA Address for the IN Endpoint 8 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.95 DTXFSTS8

Address offset: 0xA18

Device IN Endpoint Transmit FIFO Status Register 8

This register reflects the status of the IN Endpoint Transmit FIFO Status Register 8 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000C00				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	INEPTXFSPCAVAIL			IN Endpoint TxFIFO Space Avail (INEPTxFSpcAvail) Indicates the amount of free space available in the Endpoint TxFIFO. Values are in terms of 32-bit words. In DRD configurations (OTG_MODE = 0, 1, or 2) with dynamic FIFO sizing feature enabled (OTG_DFIFO_DYNAMIC = 1), the value of this field (before DIEPCTLi.TxFNum is programmed) is - the maximum value of (OTG_TX_HNPERIO_DFIFO_DEPTH, OTG_TX_DINEP_DFIFO_DEPTH_0) during reset, and - OTG_TX_DINEP_DFIFO_DEPTH_0, immediately after reset deassertion After DIEPCTLi.TxFNum is programmed, the value of this field will return OTG_TX_DINEP_DFIFO_DEPTH_i

8.27.5.96 DIEPCTL9

Address offset: 0xA20

Device Control IN Endpoint Control Register 9

This register is used to control the characteristics of Endpoint 9. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				M L K J I H G G G G F E E D C B A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: Applies to isochronous IN and OUT endpoints only. Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			DATA0EVENFRM	0	DATA0 or Even Frame
			DATA1ODDFRM	1	DATA1 or Odd Frame
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUP	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
G	RW	TXFNUM			TxFIFO Number (TxFNum) Shared FIFO Operation non-periodic endpoints must set this bit to zero. Periodic endpoints must map this to the corresponding Periodic TxFIFO number. - Others: Specified Periodic TxFIFO.number Note: An interrupt IN endpoint can be configured as a non-periodic endpoint for applications such as mass storage. The core treats an IN endpoint as a non-periodic endpoint if the TxFNum field is set to 0. Otherwise, a separate periodic FIFO must be allocated for an interrupt IN endpoint, and the number of this FIFO must be programmed into the TxFNum field. Configuring an interrupt IN endpoint as a non-periodic endpoint saves the extra periodic FIFO area. Dedicated FIFO Operation: These bits specify the FIFO number associated with this endpoint. Each active IN endpoint must be programmed to a separate FIFO number. This field is valid only for IN endpoints.
			TXFIFO0	0	Tx FIFO 0
			TXFIFO1	1	Tx FIFO 1
			TXFIFO2	2	Tx FIFO 2
			TXFIFO3	3	Tx FIFO 3
			TXFIFO4	4	Tx FIFO 4
			TXFIFO5	5	Tx FIFO 5
			TXFIFO6	6	Tx FIFO 6
			TXFIFO7	7	Tx FIFO 7
			TXFIFO8	8	Tx FIFO 8
			TXFIFO9	9	Tx FIFO 9
			TXFIFO10	10	Tx FIFO 10
			TXFIFO11	11	Tx FIFO 11
			TXFIFO12	12	Tx FIFO 12
			TXFIFO13	13	Tx FIFO 13
			TXFIFO14	14	Tx FIFO 14
			TXFIFO15	15	Tx FIFO 15
H	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
I	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also Set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
J	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to Even (micro)Frame
K	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to Odd (micro)Frame
L	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint
M	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled, -- For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. -- For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. - When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: -- For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. -- For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. - The core clears this bit before setting any of the following interrupts on this endpoint: -- SETUP Phase Done -- Endpoint Disabled -- Transfer Completed Note: For control endpoints in DMA mode, this bit must be set to be able to transfer SETUP data packets in memory.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.97 DIEPINT9

Address offset: 0xA28

Device IN Endpoint Interrupt Register 9

This register contains the interrupts for the IN Endpoint 9 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																					N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.																																		
			INACTIVE	0	No Transfer Complete Interrupt																																
			ACTIVE	1	Transfer Complete Interrupt																																
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.																																		
			INACTIVE	0	No Endpoint Disabled Interrupt																																
			ACTIVE	1	Endpoint Disabled Interrupt																																
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" in the Programming Guide.																																		
			INACTIVE	0	No AHB Error Interrupt																																
			ACTIVE	1	AHB Error interrupt																																
D	RW	TIMEOUT			Timeout Condition (TimeOUT) - In shared TX FIFO mode, applies to non-isochronous IN endpoints only. - In dedicated FIFO mode, applies only to Control IN endpoints. - In Scatter/Gather DMA mode, the TimeOUT interrupt is not asserted. Indicates that the core has detected a timeout condition on the USB for the last IN token on this endpoint.																																		
			INACTIVE	0	No Timeout interrupt																																
			ACTIVE	1	Timeout interrupt																																
E	RW	INTKNTXFEMP			IN Token Received When TxFIFO is Empty (INTknTXFEmp) Applies to non-periodic IN endpoints only. Indicates that an IN token was received when the associated TxFIFO (periodic/non-periodic) was empty. This interrupt is asserted on the endpoint for which the IN token was received.																																		
			INACTIVE	0	No IN Token Received interrupt																																
			ACTIVE	1	IN Token Received Interrupt																																

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	INTKNEPMIS			IN Token Received with EP Mismatch (INTknEPMis) Applies to non-periodic IN endpoints only. Indicates that the data in the top of the non-periodic TxFIFO belongs to an endpoint other than the one for which the IN token was received. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received with EP Mismatch interrupt
			ACTIVE	1	IN Token Received with EP Mismatch interrupt
G	RW	INEPNAKEFF			IN Endpoint NAK Effective (INEPNakEff) Applies to periodic IN endpoints only. This bit can be cleared when the application clears the IN endpoint NAK by writing to DIEPCTLn.CNAK. This interrupt indicates that the core has sampled the NAK bit Set (either by the application or by the core). The interrupt indicates that the IN endpoint NAK bit Set by the application has taken effect in the core. This interrupt does not guarantee that a NAK handshake is sent on the USB. A STALL bit takes priority over a NAK bit.
			INACTIVE	0	No Endpoint NAK Effective interrupt
			ACTIVE	1	IN Endpoint NAK Effective interrupt
H	R	TXFEMP			Transmit FIFO Empty (TxFEmp) This bit is valid only for IN endpoints This interrupt is asserted when the TxFIFO for this endpoint is either half or completely empty. The half or completely empty status is determined by the TxFIFO Empty Level bit in the Core AHB Configuration register (GAHBCFG.NPTxFEmpLvl)).
			INACTIVE	0	No Transmit FIFO Empty interrupt
			ACTIVE	1	Transmit FIFO Empty interrupt
I	RW	TXFIFOUNDRN			Fifo Underrun (TxfifoUndrn) Applies to IN endpoints Only This bit is valid only If thresholding is enabled. The core generates this interrupt when it detects a transmit FIFO underrun condition for this endpoint.
			INACTIVE	0	No Tx FIFO Underrun interrupt
			ACTIVE	1	TxFIFO Underrun interrupt
J	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done.
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
K	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
L	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No interrupt
			ACTIVE	1	BbleErr interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000080				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
M	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
N	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

8.27.5.98 DIEPTSIZ9

Address offset: 0xA30

Device IN Endpoint Transfer Size Register 9

This register reflects the Transfer Size of the IN Endpoint 9 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C B B B B B B B B B B A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet from the external memory is written to the TxFIFO.
B	RW	PKTCNT			Packet Count (PktCnt) Indicates the total number of USB packets that constitute the Transfer Size amount of data for endpoint 0. This field is decremented every time a packet (maximum size or short packet) is read from the TxFIFO.
C	RW	MC			MC Applies to IN endpoints only. For periodic IN endpoints, this field indicates the number of packets that must be transmitted per microframe on the USB. The core uses this field to calculate the data PID for isochronous IN endpoints. For non-periodic IN endpoints, this field is valid only in Internal DMA mode. It specifies the number of packets the core must fetchfor an IN endpoint before it switches to the endpoint pointed to by the Next Endpoint field of the Device Endpoint-n Control register (DIEPCTLn.NextEp)
			PACKETONE	1	1 packet
			PACKETTWO	2	2 packets
			PACKETTHREE	3	3 packets

8.27.5.99 DIEPDMA9

Address offset: 0xA34

Device IN Endpoint DMA Address Register 9

This register contains the DMA Address for the IN Endpoint 9 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.100 DTXFSTS9

Address offset: 0xA38

Device IN Endpoint Transmit FIFO Status Register 9

This register reflects the status of the IN Endpoint Transmit FIFO Status Register 9 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000C00	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	INEPTXFSPCAVAIL			IN Endpoint TxFIFO Space Avail (INEPTxFSpcAvail) Indicates the amount of free space available in the Endpoint TxFIFO. Values are in terms of 32-bit words. In DRD configurations (OTG_MODE = 0, 1, or 2) with dynamic FIFO sizing feature enabled (OTG_DFIFO_DYNAMIC = 1), the value of this field (before DIEPCTLi.TxFNum is programmed) is - the maximum value of (OTG_TX_HNPERIO_DFIFO_DEPTH, OTG_TX_DINEP_DFIFO_DEPTH_0) during reset, and - OTG_TX_DINEP_DFIFO_DEPTH_0, immediately after reset deassertion After DIEPCTLi.TxFNum is programmed, the value of this field will return OTG_TX_DINEP_DFIFO_DEPTH_i

8.27.5.101 DIEPCTL10

Address offset: 0xA40

Device Control IN Endpoint Control Register 10

This register is used to control the characteristics of Endpoint 10. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: Applies to isochronous IN and OUT endpoints only. Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			DATA0EVENFRM	0	DATA0 or Even Frame
			DATA1ODDFRM	1	DATA1 or Odd Frame
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUP	3	Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens
G	RW	TXFNUM			TxFIFO Number (TxFNum) Shared FIFO Operation non-periodic endpoints must set this bit to zero. Periodic endpoints must map this to the corresponding Periodic TxFIFO number. - Others: Specified Periodic TxFIFO.number Note: An interrupt IN endpoint can be configured as a non-periodic endpoint for applications such as mass storage. The core treats an IN endpoint as a non-periodic endpoint if the TxFNum field is set to 0. Otherwise, a separate periodic FIFO must be allocated for an interrupt IN endpoint, and the number of this FIFO must be programmed into the TxFNum field. Configuring an interrupt IN endpoint as a non-periodic endpoint saves the extra periodic FIFO area. Dedicated FIFO Operation: These bits specify the FIFO number associated with this endpoint. Each active IN endpoint must be programmed to a separate FIFO number. This field is valid only for IN endpoints.
			TXFIFO0	0	Tx FIFO 0
			TXFIFO1	1	Tx FIFO 1
			TXFIFO2	2	Tx FIFO 2
			TXFIFO3	3	Tx FIFO 3
			TXFIFO4	4	Tx FIFO 4
			TXFIFO5	5	Tx FIFO 5
			TXFIFO6	6	Tx FIFO 6
			TXFIFO7	7	Tx FIFO 7
			TXFIFO8	8	Tx FIFO 8
			TXFIFO9	9	Tx FIFO 9
			TXFIFO10	10	Tx FIFO 10
			TXFIFO11	11	Tx FIFO 11
			TXFIFO12	12	Tx FIFO 12
			TXFIFO13	13	Tx FIFO 13
			TXFIFO14	14	Tx FIFO 14
			TXFIFO15	15	Tx FIFO 15
H	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
I	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also Set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
J	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to Even (micro)Frame
K	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to Odd (micro)Frame
L	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
M	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled, -- For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. -- For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. - When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: -- For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. -- For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. - The core clears this bit before setting any of the following interrupts on this endpoint: -- SETUP Phase Done -- Endpoint Disabled -- Transfer Completed Note: For control endpoints in DMA mode, this bit must be set to be able to transfer SETUP data packets in memory.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.102 DIEPINT10

Address offset: 0xA48

Device IN Endpoint Interrupt Register 10

This register contains the interrupts for the IN Endpoint 10 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	TIMEOUT			Timeout Condition (TimeOUT) - In shared TX FIFO mode, applies to non-isochronous IN endpoints only. - In dedicated FIFO mode, applies only to Control IN endpoints. - In Scatter/Gather DMA mode, the TimeOUT interrupt is not asserted. Indicates that the core has detected a timeout condition on the USB for the last IN token on this endpoint.
			INACTIVE	0	No Timeout interrupt
			ACTIVE	1	Timeout interrupt
E	RW	INTKNTXFEMP			IN Token Received When TxFIFO is Empty (INTknTXFEmp) Applies to non-periodic IN endpoints only. Indicates that an IN token was received when the associated TxFIFO (periodic/non-periodic) was empty. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received interrupt
			ACTIVE	1	IN Token Received Interrupt
F	RW	INTKNEPMIS			IN Token Received with EP Mismatch (INTknEPMis) Applies to non-periodic IN endpoints only. Indicates that the data in the top of the non-periodic TxFIFO belongs to an endpoint other than the one for which the IN token was received. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received with EP Mismatch interrupt
			ACTIVE	1	IN Token Received with EP Mismatch interrupt
G	RW	INEPNAKEFF			IN Endpoint NAK Effective (INEPNakEff) Applies to periodic IN endpoints only. This bit can be cleared when the application clears the IN endpoint NAK by writing to DIEPCTLn.CNAK. This interrupt indicates that the core has sampled the NAK bit Set (either by the application or by the core). The interrupt indicates that the IN endpoint NAK bit Set by the application has taken effect in the core. This interrupt does not guarantee that a NAK handshake is sent on the USB. A STALL bit takes priority over a NAK bit.
			INACTIVE	0	No Endpoint NAK Effective interrupt
			ACTIVE	1	IN Endpoint NAK Effective interrupt
H	R	TXFEMP			Transmit FIFO Empty (TxFEmp) This bit is valid only for IN endpoints This interrupt is asserted when the TxFIFO for this endpoint is either half or completely empty. The half or completely empty status is determined by the TxFIFO Empty Level bit in the Core AHB Configuration register (GAHBCFG.NPTxFEmpLvl)).
			INACTIVE	0	No Transmit FIFO Empty interrupt
			ACTIVE	1	Transmit FIFO Empty interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000080				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
I	RW	TXFIFOUNDRN			Fifo Underrun (TxfifoUndrn) Applies to IN endpoints Only This bit is valid only If thresholding is enabled. The core generates this interrupt when it detects a transmit FIFO underrun condition for this endpoint.
			INACTIVE	0	No Tx FIFO Underrun interrupt
			ACTIVE	1	TxFIFO Underrun interrupt
J	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done.
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
K	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
L	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No interrupt
			ACTIVE	1	BbleErr interrupt
M	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
N	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

8.27.5.103 DIEPTSIZ10

Address offset: 0xA50

Device IN Endpoint Transfer Size Register 10

This register reflects the Transfer Size of the IN Endpoint 10 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet from the external memory is written to the TxFIFO.
B	RW	PKTCNT			Packet Count (PktCnt) Indicates the total number of USB packets that constitute the Transfer Size amount of data for endpoint 0. This field is decremented every time a packet (maximum size or short packet) is read from the TxFIFO.
C	RW	MC			MC Applies to IN endpoints only. For periodic IN endpoints, this field indicates the number of packets that must be transmitted per microframe on the USB. The core uses this field to calculate the data PID for isochronous IN endpoints. For non-periodic IN endpoints, this field is valid only in Internal DMA mode. It specifies the number of packets the core must fetchfor an IN endpoint before it switches to the endpoint pointed to by the Next Endpoint field of the Device Endpoint-n Control register (DIEPCTLn.NextEp)
			PACKETONE	1	1 packet
			PACKETTWO	2	2 packets
			PACKETTHREE	3	3 packets

8.27.5.104 DIEPDMA10

Address offset: 0xA54

Device IN Endpoint DMA Address Register 10

This register contains the DMA Address for the IN Endpoint 10 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.105 DTXFSTS10

Address offset: 0xA58

Device IN Endpoint Transmit FIFO Status Register 10

This register reflects the status of the IN Endpoint Transmit FIFO Status Register 10 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																					A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000C00					**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID					Value																			Description									
A	R	INEPTXFSPCAVAIL																										IN Endpoint TxFIFO Space Avail (INEPTxFSpcAvail) Indicates the amount of free space available in the Endpoint TxFIFO. Values are in terms of 32-bit words. In DRD configurations (OTG_MODE = 0, 1, or 2) with dynamic FIFO sizing feature enabled (OTG_DFIFO_DYNAMIC = 1), the value of this field (before DIEPCTLi.TxFNum is programmed) is - the maximum value of (OTG_TX_HNPERIO_DFIFO_DEPTH, OTG_TX_DINEP_DFIFO_DEPTH_0) during reset, and - OTG_TX_DINEP_DFIFO_DEPTH_0, immediately after reset deassertion After DIEPCTLi.TxFNum is programmed, the value of this field will return OTG_TX_DINEP_DFIFO_DEPTH_i									

8.27.5.106 DIEPCTL11

Address offset: 0xA60

Device Control IN Endpoint Control Register 11

This register is used to control the characteristics of Endpoint 11. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000					**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID					Value																			Description									
A	RW	MPS																										Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.									
B	RW	USBACTEP																										USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.									
				DISABLED					0																			Not Active									
				ENABLED					1																			USB Active Endpoint									

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: Applies to isochronous IN and OUT endpoints only. Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			DATA0EVENFRM	0	DATA0 or Even Frame
			DATA1ODDFRM	1	DATA1 or Odd Frame
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUP	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
G	RW	TXFNUM			TxFIFO Number (TxFNum) Shared FIFO Operation non-periodic endpoints must set this bit to zero. Periodic endpoints must map this to the corresponding Periodic TxFIFO number. - Others: Specified Periodic TxFIFO.number Note: An interrupt IN endpoint can be configured as a non-periodic endpoint for applications such as mass storage. The core treats an IN endpoint as a non-periodic endpoint if the TxFNum field is set to 0. Otherwise, a separate periodic FIFO must be allocated for an interrupt IN endpoint, and the number of this FIFO must be programmed into the TxFNum field. Configuring an interrupt IN endpoint as a non-periodic endpoint saves the extra periodic FIFO area. Dedicated FIFO Operation: These bits specify the FIFO number associated with this endpoint. Each active IN endpoint must be programmed to a separate FIFO number. This field is valid only for IN endpoints.
			TXFIFO0	0	Tx FIFO 0
			TXFIFO1	1	Tx FIFO 1
			TXFIFO2	2	Tx FIFO 2
			TXFIFO3	3	Tx FIFO 3
			TXFIFO4	4	Tx FIFO 4
			TXFIFO5	5	Tx FIFO 5
			TXFIFO6	6	Tx FIFO 6
			TXFIFO7	7	Tx FIFO 7
			TXFIFO8	8	Tx FIFO 8
			TXFIFO9	9	Tx FIFO 9
			TXFIFO10	10	Tx FIFO 10
			TXFIFO11	11	Tx FIFO 11
			TXFIFO12	12	Tx FIFO 12
			TXFIFO13	13	Tx FIFO 13
			TXFIFO14	14	Tx FIFO 14
			TXFIFO15	15	Tx FIFO 15
H	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
I	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also Set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
J	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to Even (micro)Frame
K	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to Odd (micro)Frame
L	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint
M	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled, -- For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. -- For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. - When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: -- For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. -- For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. - The core clears this bit before setting any of the following interrupts on this endpoint: -- SETUP Phase Done -- Endpoint Disabled -- Transfer Completed Note: For control endpoints in DMA mode, this bit must be set to be able to transfer SETUP data packets in memory.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.107 DIEPINT11

Address offset: 0xA68

Device IN Endpoint Interrupt Register 11

This register contains the interrupts for the IN Endpoint 11 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																						N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080					**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID			Value																						Description							
A	RW	XFERCOMPL																											Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.							
				INACTIVE			0																						No Transfer Complete Interrupt							
				ACTIVE			1																						Transfer Complete Interrupt							
B	RW	EPDISBLD																											Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.							
				INACTIVE			0																						No Endpoint Disabled Interrupt							
				ACTIVE			1																						Endpoint Disabled Interrupt							
C	RW	AHBERR																											AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" in the Programming Guide.							
				INACTIVE			0																						No AHB Error Interrupt							
				ACTIVE			1																						AHB Error interrupt							
D	RW	TIMEOUT																											Timeout Condition (TimeOUT) - In shared TX FIFO mode, applies to non-isochronous IN endpoints only. - In dedicated FIFO mode, applies only to Control IN endpoints. - In Scatter/Gather DMA mode, the TimeOUT interrupt is not asserted. Indicates that the core has detected a timeout condition on the USB for the last IN token on this endpoint.							
				INACTIVE			0																						No Timeout interrupt							
				ACTIVE			1																						Timeout interrupt							
E	RW	INTKNTXFEMP																											IN Token Received When TxFIFO is Empty (INTknTXFEmp) Applies to non-periodic IN endpoints only. Indicates that an IN token was received when the associated TxFIFO (periodic/non-periodic) was empty. This interrupt is asserted on the endpoint for which the IN token was received.							
				INACTIVE			0																						No IN Token Received interrupt							
				ACTIVE			1																						IN Token Received Interrupt							

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	N M L K J I H G F E D C B A
Reset 0x00000080	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
F	RW	INTKNEPMIS			IN Token Received with EP Mismatch (INTknEPMis) Applies to non-periodic IN endpoints only. Indicates that the data in the top of the non-periodic TxFIFO belongs to an endpoint other than the one for which the IN token was received. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received with EP Mismatch interrupt
			ACTIVE	1	IN Token Received with EP Mismatch interrupt
G	RW	INEPNAKEFF			IN Endpoint NAK Effective (INEPNakEff) Applies to periodic IN endpoints only. This bit can be cleared when the application clears the IN endpoint NAK by writing to DIEPCTLn.CNAK. This interrupt indicates that the core has sampled the NAK bit Set (either by the application or by the core). The interrupt indicates that the IN endpoint NAK bit Set by the application has taken effect in the core. This interrupt does not guarantee that a NAK handshake is sent on the USB. A STALL bit takes priority over a NAK bit.
			INACTIVE	0	No Endpoint NAK Effective interrupt
			ACTIVE	1	IN Endpoint NAK Effective interrupt
H	R	TXFEMP			Transmit FIFO Empty (TxFEmp) This bit is valid only for IN endpoints This interrupt is asserted when the TxFIFO for this endpoint is either half or completely empty. The half or completely empty status is determined by the TxFIFO Empty Level bit in the Core AHB Configuration register (GAHBCFG.NPTxFEmpLvl)).
			INACTIVE	0	No Transmit FIFO Empty interrupt
			ACTIVE	1	Transmit FIFO Empty interrupt
I	RW	TXFIFOUNDRN			Fifo Underrun (TxfifoUndrn) Applies to IN endpoints Only This bit is valid only If thresholding is enabled. The core generates this interrupt when it detects a transmit FIFO underrun condition for this endpoint.
			INACTIVE	0	No Tx FIFO Underrun interrupt
			ACTIVE	1	TxFIFO Underrun interrupt
J	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done.
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
K	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
L	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No interrupt
			ACTIVE	1	BbleErr interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000080				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
M	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
N	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

8.27.5.108 DIEPTSIZ11

Address offset: 0xA70

Device IN Endpoint Transfer Size Register 11

This register reflects the Transfer Size of the IN Endpoint 11 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C B B B B B B B B B B A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet from the external memory is written to the TxFIFO.
B	RW	PKTCNT			Packet Count (PktCnt) Indicates the total number of USB packets that constitute the Transfer Size amount of data for endpoint 0. This field is decremented every time a packet (maximum size or short packet) is read from the TxFIFO.
C	RW	MC			MC Applies to IN endpoints only. For periodic IN endpoints, this field indicates the number of packets that must be transmitted per microframe on the USB. The core uses this field to calculate the data PID for isochronous IN endpoints. For non-periodic IN endpoints, this field is valid only in Internal DMA mode. It specifies the number of packets the core must fetchfor an IN endpoint before it switches to the endpoint pointed to by the Next Endpoint field of the Device Endpoint-n Control register (DIEPCTLn.NextEp)
			PACKETONE	1	1 packet
			PACKETTWO	2	2 packets
			PACKETTHREE	3	3 packets

8.27.5.109 DIEPDMA11

Address offset: 0xA74

Device IN Endpoint DMA Address Register 11

This register contains the DMA Address for the IN Endpoint 11 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.110 DTXFSTS11

Address offset: 0xA78

Device IN Endpoint Transmit FIFO Status Register 11

This register reflects the status of the IN Endpoint Transmit FIFO Status Register 11 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000C00	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	INEPTXFSPCAVAIL			IN Endpoint TxFIFO Space Avail (INEPTxFSpcAvail) Indicates the amount of free space available in the Endpoint TxFIFO. Values are in terms of 32-bit words. In DRD configurations (OTG_MODE = 0, 1, or 2) with dynamic FIFO sizing feature enabled (OTG_DFIFO_DYNAMIC = 1), the value of this field (before DIEPCTLi.TxFNum is programmed) is - the maximum value of (OTG_TX_HNPERIO_DFIFO_DEPTH, OTG_TX_DINEP_DFIFO_DEPTH_0) during reset, and - OTG_TX_DINEP_DFIFO_DEPTH_0, immediately after reset deassertion After DIEPCTLi.TxFNum is programmed, the value of this field will return OTG_TX_DINEP_DFIFO_DEPTH_i

8.27.5.111 DIEPCTL12

Address offset: 0xA80

Device Control IN Endpoint Control Register 12

This register is used to control the characteristics of Endpoint 12. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A
Reset 0x00000000					**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: Applies to isochronous IN and OUT endpoints only. Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			DATA0EVENFRM	0	DATA0 or Even Frame
			DATA1ODDFRM	1	DATA1 or Odd Frame
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
			INTERRUP	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens
G	RW	TXFNUM			TxFIFO Number (TxFNum) Shared FIFO Operation non-periodic endpoints must set this bit to zero. Periodic endpoints must map this to the corresponding Periodic TxFIFO number. - Others: Specified Periodic TxFIFO.number Note: An interrupt IN endpoint can be configured as a non-periodic endpoint for applications such as mass storage. The core treats an IN endpoint as a non-periodic endpoint if the TxFNum field is set to 0. Otherwise, a separate periodic FIFO must be allocated for an interrupt IN endpoint, and the number of this FIFO must be programmed into the TxFNum field. Configuring an interrupt IN endpoint as a non-periodic endpoint saves the extra periodic FIFO area. Dedicated FIFO Operation: These bits specify the FIFO number associated with this endpoint. Each active IN endpoint must be programmed to a separate FIFO number. This field is valid only for IN endpoints.
			TXFIFO0	0	Tx FIFO 0
			TXFIFO1	1	Tx FIFO 1
			TXFIFO2	2	Tx FIFO 2
			TXFIFO3	3	Tx FIFO 3
			TXFIFO4	4	Tx FIFO 4
			TXFIFO5	5	Tx FIFO 5
			TXFIFO6	6	Tx FIFO 6
			TXFIFO7	7	Tx FIFO 7
			TXFIFO8	8	Tx FIFO 8
			TXFIFO9	9	Tx FIFO 9
			TXFIFO10	10	Tx FIFO 10
			TXFIFO11	11	Tx FIFO 11
			TXFIFO12	12	Tx FIFO 12
			TXFIFO13	13	Tx FIFO 13
			TXFIFO14	14	Tx FIFO 14
			TXFIFO15	15	Tx FIFO 15
H	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
I	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also Set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
J	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to Even (micro)Frame
K	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to Odd (micro)Frame
L	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
M	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled, -- For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. -- For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. - When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: -- For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. -- For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. - The core clears this bit before setting any of the following interrupts on this endpoint: -- SETUP Phase Done -- Endpoint Disabled -- Transfer Completed Note: For control endpoints in DMA mode, this bit must be set to be able to transfer SETUP data packets in memory.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.112 DIEPINT12

Address offset: 0xA88

Device IN Endpoint Interrupt Register 12

This register contains the interrupts for the IN Endpoint 12 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	TIMEOUT			Timeout Condition (TimeOUT) - In shared TX FIFO mode, applies to non-isochronous IN endpoints only. - In dedicated FIFO mode, applies only to Control IN endpoints. - In Scatter/Gather DMA mode, the TimeOUT interrupt is not asserted. Indicates that the core has detected a timeout condition on the USB for the last IN token on this endpoint.
			INACTIVE	0	No Timeout interrupt
			ACTIVE	1	Timeout interrupt
E	RW	INTKNTXFEMP			IN Token Received When TxFIFO is Empty (INTknTXFEmp) Applies to non-periodic IN endpoints only. Indicates that an IN token was received when the associated TxFIFO (periodic/non-periodic) was empty. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received interrupt
			ACTIVE	1	IN Token Received Interrupt
F	RW	INTKNEPMIS			IN Token Received with EP Mismatch (INTknEPMis) Applies to non-periodic IN endpoints only. Indicates that the data in the top of the non-periodic TxFIFO belongs to an endpoint other than the one for which the IN token was received. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received with EP Mismatch interrupt
			ACTIVE	1	IN Token Received with EP Mismatch interrupt
G	RW	INEPNAKEFF			IN Endpoint NAK Effective (INEPNakEff) Applies to periodic IN endpoints only. This bit can be cleared when the application clears the IN endpoint NAK by writing to DIEPCTLn.CNAK. This interrupt indicates that the core has sampled the NAK bit Set (either by the application or by the core). The interrupt indicates that the IN endpoint NAK bit Set by the application has taken effect in the core. This interrupt does not guarantee that a NAK handshake is sent on the USB. A STALL bit takes priority over a NAK bit.
			INACTIVE	0	No Endpoint NAK Effective interrupt
			ACTIVE	1	IN Endpoint NAK Effective interrupt
H	R	TXFEMP			Transmit FIFO Empty (TxFEmp) This bit is valid only for IN endpoints This interrupt is asserted when the TxFIFO for this endpoint is either half or completely empty. The half or completely empty status is determined by the TxFIFO Empty Level bit in the Core AHB Configuration register (GAHBCFG.NPTxFEmpLvl)).
			INACTIVE	0	No Transmit FIFO Empty interrupt
			ACTIVE	1	Transmit FIFO Empty interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000080				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
I	RW	TXFIFOUNDRN			Fifo Underrun (TxfifoUndrn) Applies to IN endpoints Only This bit is valid only If thresholding is enabled. The core generates this interrupt when it detects a transmit FIFO underrun condition for this endpoint.
			INACTIVE	0	No Tx FIFO Underrun interrupt
			ACTIVE	1	TxFIFO Underrun interrupt
J	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done.
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
K	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
L	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No interrupt
			ACTIVE	1	BbleErr interrupt
M	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
N	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

8.27.5.113 DIEPTSIZ12

Address offset: 0xA90

Device IN Endpoint Transfer Size Register 12

This register reflects the Transfer Size of the IN Endpoint 12 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet from the external memory is written to the TxFIFO.
B	RW	PKTCNT			Packet Count (PktCnt) Indicates the total number of USB packets that constitute the Transfer Size amount of data for endpoint 0. This field is decremented every time a packet (maximum size or short packet) is read from the TxFIFO.
C	RW	MC			MC Applies to IN endpoints only. For periodic IN endpoints, this field indicates the number of packets that must be transmitted per microframe on the USB. The core uses this field to calculate the data PID for isochronous IN endpoints. For non-periodic IN endpoints, this field is valid only in Internal DMA mode. It specifies the number of packets the core must fetchfor an IN endpoint before it switches to the endpoint pointed to by the Next Endpoint field of the Device Endpoint-n Control register (DIEPCTLn.NextEp)
			PACKETONE	1	1 packet
			PACKETTWO	2	2 packets
			PACKETTHREE	3	3 packets

8.27.5.114 DIEPDMA12

Address offset: 0xA94

Device IN Endpoint DMA Address Register 12

This register contains the DMA Address for the IN Endpoint 12 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.115 DTXFSTS12

Address offset: 0xA98

Device IN Endpoint Transmit FIFO Status Register 12

This register reflects the status of the IN Endpoint Transmit FIFO Status Register 12 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																					A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000C00					**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID					Value																			Description									
A	R	INEPTXFSPCAVAIL																										IN Endpoint TxFIFO Space Avail (INEPTxFSpcAvail) Indicates the amount of free space available in the Endpoint TxFIFO. Values are in terms of 32-bit words. In DRD configurations (OTG_MODE = 0, 1, or 2) with dynamic FIFO sizing feature enabled (OTG_DFIFO_DYNAMIC = 1), the value of this field (before DIEPCTLi.TxFNum is programmed) is - the maximum value of (OTG_TX_HNPERIO_DFIFO_DEPTH, OTG_TX_DINEP_DFIFO_DEPTH_0) during reset, and - OTG_TX_DINEP_DFIFO_DEPTH_0, immediately after reset deassertion After DIEPCTLi.TxFNum is programmed, the value of this field will return OTG_TX_DINEP_DFIFO_DEPTH_i									

8.27.5.116 DIEPCTL13

Address offset: 0xAA0

Device Control IN Endpoint Control Register 13

This register is used to control the characteristics of Endpoint 13. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000					**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID					Value																			Description									
A	RW	MPS																										Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.									
B	RW	USBACTEP																										USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.									
				DISABLED					0																			Not Active									
				ENABLED					1																			USB Active Endpoint									

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: Applies to isochronous IN and OUT endpoints only. Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			DATA0EVENFRM	0	DATA0 or Even Frame
			DATA1ODDFRM	1	DATA1 or Odd Frame
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUP	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
G	RW	TXFNUM			TxFIFO Number (TxFNum) Shared FIFO Operation non-periodic endpoints must set this bit to zero. Periodic endpoints must map this to the corresponding Periodic TxFIFO number. - Others: Specified Periodic TxFIFO.number Note: An interrupt IN endpoint can be configured as a non-periodic endpoint for applications such as mass storage. The core treats an IN endpoint as a non-periodic endpoint if the TxFNum field is set to 0. Otherwise, a separate periodic FIFO must be allocated for an interrupt IN endpoint, and the number of this FIFO must be programmed into the TxFNum field. Configuring an interrupt IN endpoint as a non-periodic endpoint saves the extra periodic FIFO area. Dedicated FIFO Operation: These bits specify the FIFO number associated with this endpoint. Each active IN endpoint must be programmed to a separate FIFO number. This field is valid only for IN endpoints.
			TXFIFO0	0	Tx FIFO 0
			TXFIFO1	1	Tx FIFO 1
			TXFIFO2	2	Tx FIFO 2
			TXFIFO3	3	Tx FIFO 3
			TXFIFO4	4	Tx FIFO 4
			TXFIFO5	5	Tx FIFO 5
			TXFIFO6	6	Tx FIFO 6
			TXFIFO7	7	Tx FIFO 7
			TXFIFO8	8	Tx FIFO 8
			TXFIFO9	9	Tx FIFO 9
			TXFIFO10	10	Tx FIFO 10
			TXFIFO11	11	Tx FIFO 11
			TXFIFO12	12	Tx FIFO 12
			TXFIFO13	13	Tx FIFO 13
			TXFIFO14	14	Tx FIFO 14
			TXFIFO15	15	Tx FIFO 15
H	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
I	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also Set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
J	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to Even (micro)Frame
K	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to Odd (micro)Frame
L	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint
M	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled, -- For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. -- For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. - When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: -- For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. -- For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. - The core clears this bit before setting any of the following interrupts on this endpoint: -- SETUP Phase Done -- Endpoint Disabled -- Transfer Completed Note: For control endpoints in DMA mode, this bit must be set to be able to transfer SETUP data packets in memory.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.117 DIEPINT13

Address offset: 0xAA8

Device IN Endpoint Interrupt Register 13

This register contains the interrupts for the IN Endpoint 13 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																						N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080					**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID			Value																													
A	RW	XFERCOMPL																																		
				INACTIVE			0																													
				ACTIVE			1																													
B	RW	EPDISBLD																																		
				INACTIVE			0																													
				ACTIVE			1																													
C	RW	AHBERR																																		
				INACTIVE			0																													
				ACTIVE			1																													
D	RW	TIMEOUT																																		
				INACTIVE			0																													
				ACTIVE			1																													
E	RW	INTKNTXFEMP																																		
				INACTIVE			0																													
				ACTIVE			1																													

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	INTKNEPMIS			IN Token Received with EP Mismatch (INTknEPMis) Applies to non-periodic IN endpoints only. Indicates that the data in the top of the non-periodic TxFIFO belongs to an endpoint other than the one for which the IN token was received. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received with EP Mismatch interrupt
			ACTIVE	1	IN Token Received with EP Mismatch interrupt
G	RW	INEPNAKEFF			IN Endpoint NAK Effective (INEPNakEff) Applies to periodic IN endpoints only. This bit can be cleared when the application clears the IN endpoint NAK by writing to DIEPCTLn.CNAK. This interrupt indicates that the core has sampled the NAK bit Set (either by the application or by the core). The interrupt indicates that the IN endpoint NAK bit Set by the application has taken effect in the core. This interrupt does not guarantee that a NAK handshake is sent on the USB. A STALL bit takes priority over a NAK bit.
			INACTIVE	0	No Endpoint NAK Effective interrupt
			ACTIVE	1	IN Endpoint NAK Effective interrupt
H	R	TXFEMP			Transmit FIFO Empty (TxFEmp) This bit is valid only for IN endpoints This interrupt is asserted when the TxFIFO for this endpoint is either half or completely empty. The half or completely empty status is determined by the TxFIFO Empty Level bit in the Core AHB Configuration register (GAHBCFG.NPTxFEmpLvl)).
			INACTIVE	0	No Transmit FIFO Empty interrupt
			ACTIVE	1	Transmit FIFO Empty interrupt
I	RW	TXFIFOUNDRN			Fifo Underrun (TxfifoUndrn) Applies to IN endpoints Only This bit is valid only If thresholding is enabled. The core generates this interrupt when it detects a transmit FIFO underrun condition for this endpoint.
			INACTIVE	0	No Tx FIFO Underrun interrupt
			ACTIVE	1	TxFIFO Underrun interrupt
J	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done.
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
K	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
L	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No interrupt
			ACTIVE	1	BbleErr interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000080				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
M	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
N	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

8.27.5.118 DIEPTSIZ13

Address offset: 0xAB0

Device IN Endpoint Transfer Size Register 13

This register reflects the Transfer Size of the IN Endpoint 13 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C B B B B B B B B B B A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet from the external memory is written to the TxFIFO.
B	RW	PKTCNT			Packet Count (PktCnt) Indicates the total number of USB packets that constitute the Transfer Size amount of data for endpoint 0. This field is decremented every time a packet (maximum size or short packet) is read from the TxFIFO.
C	RW	MC			MC Applies to IN endpoints only. For periodic IN endpoints, this field indicates the number of packets that must be transmitted per microframe on the USB. The core uses this field to calculate the data PID for isochronous IN endpoints. For non-periodic IN endpoints, this field is valid only in Internal DMA mode. It specifies the number of packets the core must fetchfor an IN endpoint before it switches to the endpoint pointed to by the Next Endpoint field of the Device Endpoint-n Control register (DIEPCTLn.NextEp)
			PACKETONE	1	1 packet
			PACKETTWO	2	2 packets
			PACKETTHREE	3	3 packets

8.27.5.119 DIEPDMA13

Address offset: 0xAB4

Device IN Endpoint DMA Address Register 13

This register contains the DMA Address for the IN Endpoint 13 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.120 DTXFSTS13

Address offset: 0xAB8

Device IN Endpoint Transmit FIFO Status Register 13

This register reflects the status of the IN Endpoint Transmit FIFO Status Register 13 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000C00	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	INEPTXFSPCAVAIL			IN Endpoint TxFIFO Space Avail (INEPTxFSpcAvail) Indicates the amount of free space available in the Endpoint TxFIFO. Values are in terms of 32-bit words. In DRD configurations (OTG_MODE = 0, 1, or 2) with dynamic FIFO sizing feature enabled (OTG_DFIFO_DYNAMIC = 1), the value of this field (before DIEPCTLi.TxFNum is programmed) is - the maximum value of (OTG_TX_HNPERIO_DFIFO_DEPTH, OTG_TX_DINEP_DFIFO_DEPTH_0) during reset, and - OTG_TX_DINEP_DFIFO_DEPTH_0, immediately after reset deassertion After DIEPCTLi.TxFNum is programmed, the value of this field will return OTG_TX_DINEP_DFIFO_DEPTH_i

8.27.5.121 DIEPCTL14

Address offset: 0xAC0

Device Control IN Endpoint Control Register 14

This register is used to control the characteristics of Endpoint 14. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A
Reset 0x00000000					**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: Applies to isochronous IN and OUT endpoints only. Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			DATA0EVENFRM	0	DATA0 or Even Frame
			DATA1ODDFRM	1	DATA1 or Odd Frame
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
			INTERRUP	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens
G	RW	TXFNUM			TxFIFO Number (TxFNum) Shared FIFO Operation non-periodic endpoints must set this bit to zero. Periodic endpoints must map this to the corresponding Periodic TxFIFO number. - Others: Specified Periodic TxFIFO.number Note: An interrupt IN endpoint can be configured as a non-periodic endpoint for applications such as mass storage. The core treats an IN endpoint as a non-periodic endpoint if the TxFNum field is set to 0. Otherwise, a separate periodic FIFO must be allocated for an interrupt IN endpoint, and the number of this FIFO must be programmed into the TxFNum field. Configuring an interrupt IN endpoint as a non-periodic endpoint saves the extra periodic FIFO area. Dedicated FIFO Operation: These bits specify the FIFO number associated with this endpoint. Each active IN endpoint must be programmed to a separate FIFO number. This field is valid only for IN endpoints.
			TXFIFO0	0	Tx FIFO 0
			TXFIFO1	1	Tx FIFO 1
			TXFIFO2	2	Tx FIFO 2
			TXFIFO3	3	Tx FIFO 3
			TXFIFO4	4	Tx FIFO 4
			TXFIFO5	5	Tx FIFO 5
			TXFIFO6	6	Tx FIFO 6
			TXFIFO7	7	Tx FIFO 7
			TXFIFO8	8	Tx FIFO 8
			TXFIFO9	9	Tx FIFO 9
			TXFIFO10	10	Tx FIFO 10
			TXFIFO11	11	Tx FIFO 11
			TXFIFO12	12	Tx FIFO 12
			TXFIFO13	13	Tx FIFO 13
			TXFIFO14	14	Tx FIFO 14
			TXFIFO15	15	Tx FIFO 15
H	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
I	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also Set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
J	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to Even (micro)Frame
K	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to Odd (micro)Frame
L	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
M	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled, -- For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. -- For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. - When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: -- For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. -- For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. - The core clears this bit before setting any of the following interrupts on this endpoint: -- SETUP Phase Done -- Endpoint Disabled -- Transfer Completed Note: For control endpoints in DMA mode, this bit must be set to be able to transfer SETUP data packets in memory.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.122 DIEPINT14

Address offset: 0xAC8

Device IN Endpoint Interrupt Register 14

This register contains the interrupts for the IN Endpoint 14 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	TIMEOUT			Timeout Condition (TimeOUT) - In shared TX FIFO mode, applies to non-isochronous IN endpoints only. - In dedicated FIFO mode, applies only to Control IN endpoints. - In Scatter/Gather DMA mode, the TimeOUT interrupt is not asserted. Indicates that the core has detected a timeout condition on the USB for the last IN token on this endpoint.
			INACTIVE	0	No Timeout interrupt
			ACTIVE	1	Timeout interrupt
E	RW	INTKNTXFEMP			IN Token Received When TxFIFO is Empty (INTknTXFEmp) Applies to non-periodic IN endpoints only. Indicates that an IN token was received when the associated TxFIFO (periodic/non-periodic) was empty. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received interrupt
			ACTIVE	1	IN Token Received Interrupt
F	RW	INTKNEPMIS			IN Token Received with EP Mismatch (INTknEPMis) Applies to non-periodic IN endpoints only. Indicates that the data in the top of the non-periodic TxFIFO belongs to an endpoint other than the one for which the IN token was received. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received with EP Mismatch interrupt
			ACTIVE	1	IN Token Received with EP Mismatch interrupt
G	RW	INEPNAKEFF			IN Endpoint NAK Effective (INEPNakEff) Applies to periodic IN endpoints only. This bit can be cleared when the application clears the IN endpoint NAK by writing to DIEPCTLn.CNAK. This interrupt indicates that the core has sampled the NAK bit Set (either by the application or by the core). The interrupt indicates that the IN endpoint NAK bit Set by the application has taken effect in the core. This interrupt does not guarantee that a NAK handshake is sent on the USB. A STALL bit takes priority over a NAK bit.
			INACTIVE	0	No Endpoint NAK Effective interrupt
			ACTIVE	1	IN Endpoint NAK Effective interrupt
H	R	TXFEMP			Transmit FIFO Empty (TxFEmp) This bit is valid only for IN endpoints This interrupt is asserted when the TxFIFO for this endpoint is either half or completely empty. The half or completely empty status is determined by the TxFIFO Empty Level bit in the Core AHB Configuration register (GAHBCFG.NPTxFEmpLvl)).
			INACTIVE	0	No Transmit FIFO Empty interrupt
			ACTIVE	1	Transmit FIFO Empty interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000080				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
I	RW	TXFIFOUNDRN			Fifo Underrun (TxfifoUndrn) Applies to IN endpoints Only This bit is valid only If thresholding is enabled. The core generates this interrupt when it detects a transmit FIFO underrun condition for this endpoint.
			INACTIVE	0	No Tx FIFO Underrun interrupt
			ACTIVE	1	TxFIFO Underrun interrupt
J	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done.
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
K	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
L	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No interrupt
			ACTIVE	1	BbleErr interrupt
M	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
N	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

8.27.5.123 DIEPTSIZ14

Address offset: 0xAD0

Device IN Endpoint Transfer Size Register 14

This register reflects the Transfer Size of the IN Endpoint 14 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet from the external memory is written to the TxFIFO.
B	RW	PKTCNT			Packet Count (PktCnt) Indicates the total number of USB packets that constitute the Transfer Size amount of data for endpoint 0. This field is decremented every time a packet (maximum size or short packet) is read from the TxFIFO.
C	RW	MC			MC Applies to IN endpoints only. For periodic IN endpoints, this field indicates the number of packets that must be transmitted per microframe on the USB. The core uses this field to calculate the data PID for isochronous IN endpoints. For non-periodic IN endpoints, this field is valid only in Internal DMA mode. It specifies the number of packets the core must fetchfor an IN endpoint before it switches to the endpoint pointed to by the Next Endpoint field of the Device Endpoint-n Control register (DIEPCTLn.NextEp)
			PACKETONE	1	1 packet
			PACKETTWO	2	2 packets
			PACKETTHREE	3	3 packets

8.27.5.124 DIEPDMA14

Address offset: 0xAD4

Device IN Endpoint DMA Address Register 14

This register contains the DMA Address for the IN Endpoint 14 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.125 DTXFSTS14

Address offset: 0xAD8

Device IN Endpoint Transmit FIFO Status Register 14

This register reflects the status of the IN Endpoint Transmit FIFO Status Register 14 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000C00				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	INEPTXFSPCAVAIL																																	
				IN Endpoint TxFIFO Space Avail (INEPTxFSpcAvail) Indicates the amount of free space available in the Endpoint TxFIFO. Values are in terms of 32-bit words. In DRD configurations (OTG_MODE = 0, 1, or 2) with dynamic FIFO sizing feature enabled (OTG_DFIFO_DYNAMIC = 1), the value of this field (before DIEPCTLi.TxFNum is programmed) is - the maximum value of (OTG_TX_HNPERIO_DFIFO_DEPTH, OTG_TX_DINEP_DFIFO_DEPTH_0) during reset, and - OTG_TX_DINEP_DFIFO_DEPTH_0, immediately after reset deassertion After DIEPCTLi.TxFNum is programmed, the value of this field will return OTG_TX_DINEP_DFIFO_DEPTH_i																																		

8.27.5.126 DIEPCTL15

Address offset: 0xAE0

Device Control IN Endpoint Control Register 15

This register is used to control the characteristics of Endpoint 15. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	MPS																																	
				Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.																																
B	RW	USBACTEP																																	
				USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.																																
			DISABLED	0																																
				Not Active																																
			ENABLED	1																																
				USB Active Endpoint																																

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: Applies to isochronous IN and OUT endpoints only. Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			DATA0EVENFRM	0	DATA0 or Even Frame
			DATA1ODDFRM	1	DATA1 or Odd Frame
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUP	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
G	RW	TXFNUM			TxFIFO Number (TxFNum) Shared FIFO Operation non-periodic endpoints must set this bit to zero. Periodic endpoints must map this to the corresponding Periodic TxFIFO number. - Others: Specified Periodic TxFIFO.number Note: An interrupt IN endpoint can be configured as a non-periodic endpoint for applications such as mass storage. The core treats an IN endpoint as a non-periodic endpoint if the TxFNum field is set to 0. Otherwise, a separate periodic FIFO must be allocated for an interrupt IN endpoint, and the number of this FIFO must be programmed into the TxFNum field. Configuring an interrupt IN endpoint as a non-periodic endpoint saves the extra periodic FIFO area. Dedicated FIFO Operation: These bits specify the FIFO number associated with this endpoint. Each active IN endpoint must be programmed to a separate FIFO number. This field is valid only for IN endpoints.
			TXFIFO0	0	Tx FIFO 0
			TXFIFO1	1	Tx FIFO 1
			TXFIFO2	2	Tx FIFO 2
			TXFIFO3	3	Tx FIFO 3
			TXFIFO4	4	Tx FIFO 4
			TXFIFO5	5	Tx FIFO 5
			TXFIFO6	6	Tx FIFO 6
			TXFIFO7	7	Tx FIFO 7
			TXFIFO8	8	Tx FIFO 8
			TXFIFO9	9	Tx FIFO 9
			TXFIFO10	10	Tx FIFO 10
			TXFIFO11	11	Tx FIFO 11
			TXFIFO12	12	Tx FIFO 12
			TXFIFO13	13	Tx FIFO 13
			TXFIFO14	14	Tx FIFO 14
			TXFIFO15	15	Tx FIFO 15
H	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
I	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also Set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	M	L	K	J	I	H	G	G	G	G	F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
J	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to Even (micro)Frame
K	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd (micro)Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to Odd (micro)Frame
L	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint
M	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled, -- For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. -- For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. - When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: -- For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. -- For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. - The core clears this bit before setting any of the following interrupts on this endpoint: -- SETUP Phase Done -- Endpoint Disabled -- Transfer Completed Note: For control endpoints in DMA mode, this bit must be set to be able to transfer SETUP data packets in memory.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.127 DIEPINT15

Address offset: 0xAE8

Device IN Endpoint Interrupt Register 15

This register contains the interrupts for the IN Endpoint 15 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																			N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	TIMEOUT			Timeout Condition (TimeOUT) - In shared TX FIFO mode, applies to non-isochronous IN endpoints only. - In dedicated FIFO mode, applies only to Control IN endpoints. - In Scatter/Gather DMA mode, the TimeOUT interrupt is not asserted. Indicates that the core has detected a timeout condition on the USB for the last IN token on this endpoint.
			INACTIVE	0	No Timeout interrupt
			ACTIVE	1	Timeout interrupt
E	RW	INTKNTXFEMP			IN Token Received When TxFIFO is Empty (INTknTXFEmp) Applies to non-periodic IN endpoints only. Indicates that an IN token was received when the associated TxFIFO (periodic/non-periodic) was empty. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received interrupt
			ACTIVE	1	IN Token Received Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																		N	M	L	K		J	I	H	G	F	E	D	C	B	A
Reset 0x00000080	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	INTKNEPMIS			IN Token Received with EP Mismatch (INTknEPMis) Applies to non-periodic IN endpoints only. Indicates that the data in the top of the non-periodic TxFIFO belongs to an endpoint other than the one for which the IN token was received. This interrupt is asserted on the endpoint for which the IN token was received.
			INACTIVE	0	No IN Token Received with EP Mismatch interrupt
			ACTIVE	1	IN Token Received with EP Mismatch interrupt
G	RW	INEPNAKEFF			IN Endpoint NAK Effective (INEPNakEff) Applies to periodic IN endpoints only. This bit can be cleared when the application clears the IN endpoint NAK by writing to DIEPCTLn.CNAK. This interrupt indicates that the core has sampled the NAK bit Set (either by the application or by the core). The interrupt indicates that the IN endpoint NAK bit Set by the application has taken effect in the core. This interrupt does not guarantee that a NAK handshake is sent on the USB. A STALL bit takes priority over a NAK bit.
			INACTIVE	0	No Endpoint NAK Effective interrupt
			ACTIVE	1	IN Endpoint NAK Effective interrupt
H	R	TXFEMP			Transmit FIFO Empty (TxFEmp) This bit is valid only for IN endpoints This interrupt is asserted when the TxFIFO for this endpoint is either half or completely empty. The half or completely empty status is determined by the TxFIFO Empty Level bit in the Core AHB Configuration register (GAHBCFG.NPTxFEmpLvl)).
			INACTIVE	0	No Transmit FIFO Empty interrupt
			ACTIVE	1	Transmit FIFO Empty interrupt
I	RW	TXFIFOUNDRN			Fifo Underrun (TxfifoUndrn) Applies to IN endpoints Only This bit is valid only If thresholding is enabled. The core generates this interrupt when it detects a transmit FIFO underrun condition for this endpoint.
			INACTIVE	0	No Tx FIFO Underrun interrupt
			ACTIVE	1	TxFIFO Underrun interrupt
J	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done.
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
K	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
L	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No interrupt
			ACTIVE	1	BbleErr interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000080				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
M	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
N	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

8.27.5.128 DIEPTSIZ15

Address offset: 0xAF0

Device IN Endpoint Transfer Size Register 15

This register reflects the Transfer Size of the IN Endpoint 15 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C B B B B B B B B B B A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet from the external memory is written to the TxFIFO.
B	RW	PKTCNT			Packet Count (PktCnt) Indicates the total number of USB packets that constitute the Transfer Size amount of data for endpoint 0. This field is decremented every time a packet (maximum size or short packet) is read from the TxFIFO.
C	RW	MC			MC Applies to IN endpoints only. For periodic IN endpoints, this field indicates the number of packets that must be transmitted per microframe on the USB. The core uses this field to calculate the data PID for isochronous IN endpoints. For non-periodic IN endpoints, this field is valid only in Internal DMA mode. It specifies the number of packets the core must fetchfor an IN endpoint before it switches to the endpoint pointed to by the Next Endpoint field of the Device Endpoint-n Control register (DIEPCTLn.NextEp)
			PACKETONE	1	1 packet
			PACKETTWO	2	2 packets
			PACKETTHREE	3	3 packets

8.27.5.129 DIEPDMA15

Address offset: 0xAF4

Device IN Endpoint DMA Address Register 15

This register contains the DMA Address for the IN Endpoint 15 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.130 DTXFSTS15

Address offset: 0xAF8

Device IN Endpoint Transmit FIFO Status Register 15

This register reflects the status of the IN Endpoint Transmit FIFO Status Register 15 of the Device controller. Note: This register exists for an endpoint i if the OTG_EP_DIR_i parameter is 0 or 1 for that endpoint.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000C00	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	INEPTXFSPCAVAIL			IN Endpoint TxFIFO Space Avail (INEPTxFSpcAvail) Indicates the amount of free space available in the Endpoint TxFIFO. Values are in terms of 32-bit words. In DRD configurations (OTG_MODE = 0, 1, or 2) with dynamic FIFO sizing feature enabled (OTG_DFIFO_DYNAMIC = 1), the value of this field (before DIEPCTLi.TxFNum is programmed) is - the maximum value of (OTG_TX_HNPERIO_DFIFO_DEPTH, OTG_TX_DINEP_DFIFO_DEPTH_0) during reset, and - OTG_TX_DINEP_DFIFO_DEPTH_0, immediately after reset deassertion After DIEPCTLi.TxFNum is programmed, the value of this field will return OTG_TX_DINEP_DFIFO_DEPTH_i

8.27.5.131 DOEPCTL0

Address offset: 0xB00

Device Control OUT Endpoint 0 Control Register

This register is used to control the characteristics of the OUT Endpoint 0 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	I	H			G	F					E		D	D	C		B														A	A
Reset 0x00008000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	MPS			Maximum Packet Size (MPS) The maximum packet size for control OUT endpoint 0 is the same as what is programmed in control IN Endpoint 0.
			BYTE64	0	64 bytes
			BYTE32	1	32 bytes
			BYTE16	2	16 bytes
			BYTE8	3	8 bytes
B	R	USBACTEP			USB Active Endpoint (USBActEP) This bit is always set to 1, indicating that a control endpoint 0 is always active in all configurations and interfaces.
			ACTIVE	1	USB Active Endpoint 0
C	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit, the core stops receiving data, even If there is space in the RxFIFO to accommodate the incoming packet. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	The core is transmitting non-NAK handshakes based on the FIFO status
			ACTIVE	1	The core is transmitting NAK handshakes on this endpoint
D	R	EPTYPE			Endpoint Type (EPType) Hardcoded to 2'b00 for control.
			ACTIVE	0	Endpoint Control 0
E	RW	STALL			STALL Handshake (Stall) The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit or Global OUT NAK is Set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	No Stall
			ACTIVE	1	Stall Handshake
F	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			NOCLEAR	0	No action
			CLEAR	1	Clear NAK
G	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also set bit on a Transfer Completed interrupt, or after a SETUP is received on the endpoint.
			NOSET	0	No action
			SET	1	Set NAK
H	R	EPDIS			Endpoint Disable (EPDis) The application cannot disable control OUT endpoint 0.
			INACTIVE	0	No Endpoint disable

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	I	H			G	F					E		D	D	C		B														A	A
Reset 0x00008000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
I	RW	EPENA			Endpoint Enable (EPEna) - When Scatter/Gather DMA mode is enabled, for OUT endpoints this bit indicates that the descriptor structure and data buffer to receive data is setup. - When Scatter/Gather DMA mode is disabled (such as for buffer-pointer based DMA mode)this bit indicates that the application has allocated the memory to start receiving data from the USB. - The core clears this bit before setting any of the following interrupts on this endpoint: -- SETUP Phase Done -- Endpoint Disabled -- Transfer Completed Note: In DMA mode, this bit must be set for the core to transfer SETUP data packets into memory and it is not cleared on Transfer Completed interrupt of SETUP packet.
			INACTIVE	0	No action
			ACTIVE	1	Enable Endpoint

8.27.5.132 DOEPINT0

Address offset: 0xB08

Device OUT Endpoint 0 Interrupt Register

This register contains the interrupts for the OUT Endpoint 0 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. When Scatter/Gather DMA mode is enabled - For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. - For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is Set. Note: In DMA mode, this bit must be set for the core to transfer SETUP data packets into memory. When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" section in the Programming Guide.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	SETUP			SETUP Phase Done (SetUp) Applies to control OUT endpoints only. Indicates that the SETUP phase for the control endpoint is complete and no more back-to-back SETUP packets were received for the current control transfer. On this interrupt, the application can decode the received SETUP data packet.
			INACTIVE	0	No SETUP Phase Done
			ACTIVE	1	SETUP Phase Done
E	RW	OUTTKNEPDIS			OUT Token Received When Endpoint Disabled (OUTTknEPdis) Applies only to control OUT endpoints. Indicates that an OUT token was received when the endpoint was not yet enabled. This interrupt is asserted on the endpoint for which the OUT token was received.
			INACTIVE	0	No OUT Token Received When Endpoint Disabled
			ACTIVE	1	OUT Token Received When Endpoint Disabled
F	RW	STSPHSERCVD			Status Phase Received for Control Write (StsPhseRcvd) This interrupt is valid only for Control OUT endpoints. This interrupt is generated only after the core has transferred all the data that the host has sent during the data phase of a control write transfer, to the system memory buffer. The interrupt indicates to the application that the host has switched from data phase to the status phase of a Control Write transfer. The application can use this interrupt to ACK or STALL the Status phase, after it has decoded the data phase.
			INACTIVE	0	No Status Phase Received for Control Write
			ACTIVE	1	Status Phase Received for Control Write
G	RW	BACK2BACKSETUP			Back-to-Back SETUP Packets Received (Back2BackSETup) Applies to Control OUT endpoints only. This bit indicates that the core has received more than three back-to-back SETUP packets for this particular endpoint. For information about handling this interrupt, refer to Programming guide section "Handling More Than Three Back-to-Back SETUP Packets". This bit is not valid in Completer mode.
			INACTIVE	0	No Back-to-Back SETUP Packets Received
			ACTIVE	1	Back-to-Back SETUP Packets Received
H	RW	OUTPKTERR			OUT Packet Error (OutPktErr) Applies to OUT endpoints Only This interrupt is valid only when thresholding is enabled. This interrupt is asserted when the core detects an overflow or a CRC error for non-Isochronous OUT packet.
			INACTIVE	0	No OUT Packet Error
			ACTIVE	1	OUT Packet Error
I	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the core to process, such as Host busy or DMA done.
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
J	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts)
					This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
K	RW	BBLEERR			NAK Interrupt (BbleErr)
					The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No BbleErr interrupt
			ACTIVE	1	BbleErr interrupt
L	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt)
					The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
M	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt)
					The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt
N	RW	STUPPKTRCVD			Setup Packet Received
					Applicable for Control OUT Endpoints in only in the Buffer DMA Mode Set by the controller, this bit indicates that this buffer holds 8 bytes of setup data. There is only one Setup packet per buffer. On receiving a Setup packet, the controller closes the buffer and disables the corresponding endpoint. The application has to re-enable the endpoint to receive any OUT data for the Control Transfer and reprogram the buffer start address. Note: Because of the above behavior, the controller can receive any number of back to back setup packets and one buffer for every setup packet is used.
			NOTRCVD	0	No Setup packet received
			RCVD	1	Setup packet received

8.27.5.133 DOEPTSIZ0

Address offset: 0xB10

Device OUT Endpoint 0 Transfer Size Register

This register contains the Transfer Size for the OUT Endpoint 0 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID			C	C									B													A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for endpoint 0. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet is read from the RxFIFO and written to the external memory.
B	RW	PKTCNT			Packet Count (PktCnt) This field is decremented to zero after a packet is written into the RxFIFO.
C	RW	SUPCNT			SETUP Packet Count (SUPCnt) This field specifies the number of back-to-back SETUP data packets the endpoint can receive.
			ONEPACKET	1	1 packet
			TWOPACKET	2	2 packets
			THREEPACKET	3	3 packets

8.27.5.134 DOEPDMA0

Address offset: 0xB14

Device OUT Endpoint 0 DMA Address Register

This register contains the DMA Address for the OUT Endpoint 0 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.135 DOEPCTL1

Address offset: 0xB20

Device Control OUT Endpoint Control Register 1

This register is used to control the characteristics of OUT Endpoint 1 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable for both Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: - Applies to isochronous IN and OUT endpoints only. - Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			INACTIVE	0	Endpoint Data PID not active
			ACTIVE	1	Endpoint Data PID active
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUPT	3	Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens
G	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
H	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
I	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to odd (micro)Frame
J	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to odd (micro)Frame

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E E D C B A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
K	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint
L	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. When Scatter/Gather DMA mode is enabled, - For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. - For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: - For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. - For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. The core clears this bit before setting any of the following interrupts on this endpoint: - SETUP Phase Done - Endpoint Disabled - Transfer Completed Note: For control endpoints in DMA mode, this bit must be set for the controller to transfer SETUP data packets to the memory. This bit is not cleared on Transfer Completed interrupt of the SETUP packet.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.136 DOEPINT1

Address offset: 0xB28

Device OUT Endpoint Interrupt Register 1

This register contains the interrupts for the OUT Endpoint 1 of the Device controller.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is Set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" section in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	SETUP			SETUP Phase Done (SetUp) Applies to control OUT endpoints only. Indicates that the SETUP phase for the control endpoint is complete and no more back-to-back SETUP packets were received for the current control transfer. On this interrupt, the application can decode the received SETUP data packet.
			INACTIVE	0	No SETUP Phase Done
			ACTIVE	1	SETUP Phase Done
E	RW	OUTTKNEPDIS			OUT Token Received When Endpoint Disabled (OUTTknEPdis) Applies only to control OUT endpoints. Indicates that an OUT token was received when the endpoint was not yet enabled. This interrupt is asserted on the endpoint for which the OUT token was received.
			INACTIVE	0	No OUT Token Received When Endpoint Disabled
			ACTIVE	1	OUT Token Received When Endpoint Disabled
F	RW	STSPHSERCVD			Status Phase Received for Control Write (StsPhseRcvd) This interrupt is valid only for Control OUT endpoints. This interrupt is generated only after the core has transferred all the data that the host has sent during the data phase of a control write transfer, to the system memory buffer. The interrupt indicates to the application that the host has switched from data phase to the status phase of a Control Write transfer. The application can use this interrupt to ACK or STALL the Status phase, after it has decoded the data phase.
			INACTIVE	0	No Status Phase Received for Control Write
			ACTIVE	1	Status Phase Received for Control Write
G	RW	BACK2BACKSETUP			Back-to-Back SETUP Packets Received (Back2BackSETup) Applies to Control OUT endpoints only. This bit indicates that the core has received more than three back-to-back SETUP packets for this particular endpoint. For information about handling this interrupt, refer to Programming guide section "Handling More Than Three Back-to-Back SETUP Packets". This bit is not valid in Completer mode.
			INACTIVE	0	No Back-to-Back SETUP Packets Received
			ACTIVE	1	Back-to-Back SETUP Packets Received

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
H	RW	OUTPKTERR			OUT Packet Error (OutPktErr) Applies to OUT endpoints Only This interrupt is valid only when thresholding is enabled. This interrupt is asserted when the core detects an overflow or a CRC error for non-Isochronous OUT packet.
			INACTIVE	0	No OUT Packet Error
			ACTIVE	1	OUT Packet Error
I	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
J	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
K	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No BbleErr interrupt
			ACTIVE	1	BbleErr interrupt
L	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
M	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt
N	RW	STUPPKTRCVD			Setup Packet Received Applicable for Control OUT Endpoints in only in the Buffer DMA Mode Set by the controller, this bit indicates that this buffer holds 8 bytes of setup data. There is only one Setup packet per buffer. On receiving a Setup packet, the controller closes the buffer and disables the corresponding endpoint. The application has to re-enable the endpoint to receive any OUT data for the Control Transfer and reprogram the buffer start address. Note: Because of the above behavior, the controller can receive any number of back to back setup packets and one buffer for every setup packet is used.
			NOTRCVD	0	No Setup packet received
			RCVD	1	Setup packet received

8.27.5.137 DOEPTSIZ1

Address offset: 0xB30

Device OUT Endpoint Transfer Size Register 1

This register contains the Transfer Size for the OUT Endpoint 1 of the Device controller.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	XFERSIZE																																	
B	RW	PKTCNT																																	
C	R	RXDPID																																	
			DATA0	0																															
			DATA2PACKET1	1																															
			DATA1PACKET2	2																															
			MDATAPACKET3	3																															

8.27.5.138 DOEPDMA1

Address offset: 0xB34

Device OUT Endpoint DMA Address Register 1

This register contains the DMA Address for the OUT Endpoint 1 of the Device controller.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	DMAADDR																																	

8.27.5.139 DOEPCTL2

Address offset: 0xB40

Device Control OUT Endpoint Control Register 2

This register is used to control the characteristics of OUT Endpoint 2 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable for both Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: - Applies to isochronous IN and OUT endpoints only. - Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			INACTIVE	0	Endpoint Data PID not active
			ACTIVE	1	Endpoint Data PID active
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUPT	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens
G	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
H	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
I	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to odd (micro)Frame

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E E D C B A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
J	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to odd (micro)Frame
K	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint
L	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. When Scatter/Gather DMA mode is enabled, - For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. - For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: - For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. - For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. The core clears this bit before setting any of the following interrupts on this endpoint: - SETUP Phase Done - Endpoint Disabled - Transfer Completed Note: For control endpoints in DMA mode, this bit must be set for the controller to transfer SETUP data packets to the memory. This bit is not cleared on Transfer Completed interrupt of the SETUP packet.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.140 DOEPINT2

Address offset: 0xB48

Device OUT Endpoint Interrupt Register 2

This register contains the interrupts for the OUT Endpoint 2 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is Set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" section in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	SETUP			SETUP Phase Done (SetUp) Applies to control OUT endpoints only. Indicates that the SETUP phase for the control endpoint is complete and no more back-to-back SETUP packets were received for the current control transfer. On this interrupt, the application can decode the received SETUP data packet.
			INACTIVE	0	No SETUP Phase Done
			ACTIVE	1	SETUP Phase Done
E	RW	OUTTKNEPDIS			OUT Token Received When Endpoint Disabled (OUTTknEPdis) Applies only to control OUT endpoints. Indicates that an OUT token was received when the endpoint was not yet enabled. This interrupt is asserted on the endpoint for which the OUT token was received.
			INACTIVE	0	No OUT Token Received When Endpoint Disabled
			ACTIVE	1	OUT Token Received When Endpoint Disabled
F	RW	STSPHSERCVD			Status Phase Received for Control Write (StsPhseRcvd) This interrupt is valid only for Control OUT endpoints. This interrupt is generated only after the core has transferred all the data that the host has sent during the data phase of a control write transfer, to the system memory buffer. The interrupt indicates to the application that the host has switched from data phase to the status phase of a Control Write transfer. The application can use this interrupt to ACK or STALL the Status phase, after it has decoded the data phase.
			INACTIVE	0	No Status Phase Received for Control Write
			ACTIVE	1	Status Phase Received for Control Write

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
G	RW	BACK2BACKSETUP			Back-to-Back SETUP Packets Received (Back2BackSETup) Applies to Control OUT endpoints only. This bit indicates that the core has received more than three back-to-back SETUP packets for this particular endpoint. For information about handling this interrupt, refer to Programming guide section "Handling More Than Three Back-to-Back SETUP Packets". This bit is not valid in Completer mode.
			INACTIVE	0	No Back-to-Back SETUP Packets Received
			ACTIVE	1	Back-to-Back SETUP Packets Received
H	RW	OUTPKTERR			OUT Packet Error (OutPktErr) Applies to OUT endpoints Only This interrupt is valid only when thresholding is enabled. This interrupt is asserted when the core detects an overflow or a CRC error for non-Isochronous OUT packet.
			INACTIVE	0	No OUT Packet Error
			ACTIVE	1	OUT Packet Error
I	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
J	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
K	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No BbleErr interrupt
			ACTIVE	1	BbleErr interrupt
L	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
M	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
N	RW	STUPPKTRCVD			Setup Packet Received Applicable for Control OUT Endpoints in only in the Buffer DMA Mode Set by the controller, this bit indicates that this buffer holds 8 bytes of setup data. There is only one Setup packet per buffer. On receiving a Setup packet, the controller closes the buffer and disables the corresponding endpoint. The application has to re-enable the endpoint to receive any OUT data for the Control Transfer and reprogram the buffer start address. Note: Because of the above behavior, the controller can receive any number of back to back setup packets and one buffer for every setup packet is used.
			NOTRCVD	0	No Setup packet received
			RCVD	1	Setup packet received

8.27.5.141 DOEPTSIZ2

Address offset: 0xB50

Device OUT Endpoint Transfer Size Register 2

This register contains the Transfer Size for the OUT Endpoint 2 of the Device controller.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C B B B B B B B B B B A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet is read from the RxFIFO and written to the external memory.
B	RW	PKTCNT			Packet Count (PktCnt) This field is decremented to zero after a packet is written into the RxFIFO.
C	R	RXDPID			RxDPID Applies to isochronous OUT endpoints only. This is the data PID received in the last packet for this endpoint. SETUP Packet Count (SUPCnt) Applies to control OUT Endpoints only. This field specifies the number of back-to-back SETUP data packets the endpoint can receive.
			DATA0	0	DATA0
			DATA2PACKET1	1	DATA2 or 1 packet
			DATA1PACKET2	2	DATA1 or 2 packets
			MDATAPACKET3	3	MDATA or 3 packets

8.27.5.142 DOEPDMA2

Address offset: 0xB54

Device OUT Endpoint DMA Address Register 2

This register contains the DMA Address for the OUT Endpoint 2 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.143 DOEPCTL3

Address offset: 0xB60

Device Control OUT Endpoint Control Register 3

This register is used to control the characteristics of OUT Endpoint 3 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable for both Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: - Applies to isochronous IN and OUT endpoints only. - Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			INACTIVE	0	Endpoint Data PID not active
			ACTIVE	1	Endpoint Data PID active
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUPT	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
G	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
H	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
I	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to odd (micro)Frame
J	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to odd (micro)Frame
K	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E E D C B A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
L	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. When Scatter/Gather DMA mode is enabled, - For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. - For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: - For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. - For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. The core clears this bit before setting any of the following interrupts on this endpoint: - SETUP Phase Done - Endpoint Disabled - Transfer Completed Note: For control endpoints in DMA mode, this bit must be set for the controller to transfer SETUP data packets to the memory. This bit is not cleared on Transfer Completed interrupt of the SETUP packet.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.144 DOEPINT3

Address offset: 0xB68

Device OUT Endpoint Interrupt Register 3

This register contains the interrupts for the OUT Endpoint 3 of the Device controller.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is Set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" section in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	SETUP			SETUP Phase Done (SetUp) Applies to control OUT endpoints only. Indicates that the SETUP phase for the control endpoint is complete and no more back-to-back SETUP packets were received for the current control transfer. On this interrupt, the application can decode the received SETUP data packet.
			INACTIVE	0	No SETUP Phase Done
			ACTIVE	1	SETUP Phase Done
E	RW	OUTTKNEPDIS			OUT Token Received When Endpoint Disabled (OUTTknEPdis) Applies only to control OUT endpoints. Indicates that an OUT token was received when the endpoint was not yet enabled. This interrupt is asserted on the endpoint for which the OUT token was received.
			INACTIVE	0	No OUT Token Received When Endpoint Disabled
			ACTIVE	1	OUT Token Received When Endpoint Disabled
F	RW	STSPHSERCVD			Status Phase Received for Control Write (StsPhseRcvd) This interrupt is valid only for Control OUT endpoints. This interrupt is generated only after the core has transferred all the data that the host has sent during the data phase of a control write transfer, to the system memory buffer. The interrupt indicates to the application that the host has switched from data phase to the status phase of a Control Write transfer. The application can use this interrupt to ACK or STALL the Status phase, after it has decoded the data phase.
			INACTIVE	0	No Status Phase Received for Control Write
			ACTIVE	1	Status Phase Received for Control Write
G	RW	BACK2BACKSETUP			Back-to-Back SETUP Packets Received (Back2BackSETup) Applies to Control OUT endpoints only. This bit indicates that the core has received more than three back-to-back SETUP packets for this particular endpoint. For information about handling this interrupt, refer to Programming guide section "Handling More Than Three Back-to-Back SETUP Packets". This bit is not valid in Completer mode.
			INACTIVE	0	No Back-to-Back SETUP Packets Received
			ACTIVE	1	Back-to-Back SETUP Packets Received
H	RW	OUTPKTERR			OUT Packet Error (OutPktErr) Applies to OUT endpoints Only This interrupt is valid only when thresholding is enabled. This interrupt is asserted when the core detects an overflow or a CRC error for non-Isochronous OUT packet.
			INACTIVE	0	No OUT Packet Error
			ACTIVE	1	OUT Packet Error

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	N M L K J I H G F E D C B A
Reset 0x00000000	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
I	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
J	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
K	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No BbleErr interrupt
			ACTIVE	1	BbleErr interrupt
L	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
M	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt
N	RW	STUPPKTRCVD			Setup Packet Received Applicable for Control OUT Endpoints in only in the Buffer DMA Mode Set by the controller, this bit indicates that this buffer holds 8 bytes of setup data. There is only one Setup packet per buffer. On receiving a Setup packet, the controller closes the buffer and disables the corresponding endpoint. The application has to re-enable the endpoint to receive any OUT data for the Control Transfer and reprogram the buffer start address. Note: Because of the above behavior, the controller can receive any number of back to back setup packets and one buffer for every setup packet is used.
			NOTRCVD	0	No Setup packet received
			RCVD	1	Setup packet received

8.27.5.145 DOEPTSIZ3

Address offset: 0xB70

Device OUT Endpoint Transfer Size Register 3

This register contains the Transfer Size for the OUT Endpoint 3 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet is read from the RxFIFO and written to the external memory.
B	RW	PKTCNT			Packet Count (PktCnt) This field is decremented to zero after a packet is written into the RxFIFO.
C	R	RXDPID			RxDPID Applies to isochronous OUT endpoints only. This is the data PID received in the last packet for this endpoint. SETUP Packet Count (SUPCnt) Applies to control OUT Endpoints only. This field specifies the number of back-to-back SETUP data packets the endpoint can receive.
			DATA0	0	DATA0
			DATA2PACKET1	1	DATA2 or 1 packet
			DATA1PACKET2	2	DATA1 or 2 packets
			MDATAPACKET3	3	MDATA or 3 packets

8.27.5.146 DOEPDMA3

Address offset: 0xB74

Device OUT Endpoint DMA Address Register 3

This register contains the DMA Address for the OUT Endpoint 3 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.147 DOEPCTL4

Address offset: 0xB80

Device Control OUT Endpoint Control Register 4

This register is used to control the characteristics of OUT Endpoint 4 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable for both Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: - Applies to isochronous IN and OUT endpoints only. - Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			INACTIVE	0	Endpoint Data PID not active
			ACTIVE	1	Endpoint Data PID active
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUPT	3	Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens
G	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
H	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
I	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to odd (micro)Frame
J	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to odd (micro)Frame

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E E D C B A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
K	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint
L	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. When Scatter/Gather DMA mode is enabled, - For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. - For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: - For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. - For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. The core clears this bit before setting any of the following interrupts on this endpoint: - SETUP Phase Done - Endpoint Disabled - Transfer Completed Note: For control endpoints in DMA mode, this bit must be set for the controller to transfer SETUP data packets to the memory. This bit is not cleared on Transfer Completed interrupt of the SETUP packet.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.148 DOEPINT4

Address offset: 0xB88

Device OUT Endpoint Interrupt Register 4

This register contains the interrupts for the OUT Endpoint 4 of the Device controller.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is Set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" section in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	SETUP			SETUP Phase Done (SetUp) Applies to control OUT endpoints only. Indicates that the SETUP phase for the control endpoint is complete and no more back-to-back SETUP packets were received for the current control transfer. On this interrupt, the application can decode the received SETUP data packet.
			INACTIVE	0	No SETUP Phase Done
			ACTIVE	1	SETUP Phase Done
E	RW	OUTTKNEPDIS			OUT Token Received When Endpoint Disabled (OUTTknEPdis) Applies only to control OUT endpoints. Indicates that an OUT token was received when the endpoint was not yet enabled. This interrupt is asserted on the endpoint for which the OUT token was received.
			INACTIVE	0	No OUT Token Received When Endpoint Disabled
			ACTIVE	1	OUT Token Received When Endpoint Disabled
F	RW	STSPHSERCVD			Status Phase Received for Control Write (StsPhseRcvd) This interrupt is valid only for Control OUT endpoints. This interrupt is generated only after the core has transferred all the data that the host has sent during the data phase of a control write transfer, to the system memory buffer. The interrupt indicates to the application that the host has switched from data phase to the status phase of a Control Write transfer. The application can use this interrupt to ACK or STALL the Status phase, after it has decoded the data phase.
			INACTIVE	0	No Status Phase Received for Control Write
			ACTIVE	1	Status Phase Received for Control Write
G	RW	BACK2BACKSETUP			Back-to-Back SETUP Packets Received (Back2BackSETup) Applies to Control OUT endpoints only. This bit indicates that the core has received more than three back-to-back SETUP packets for this particular endpoint. For information about handling this interrupt, refer to Programming guide section "Handling More Than Three Back-to-Back SETUP Packets". This bit is not valid in Completer mode.
			INACTIVE	0	No Back-to-Back SETUP Packets Received
			ACTIVE	1	Back-to-Back SETUP Packets Received

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
H	RW	OUTPKTERR			OUT Packet Error (OutPktErr) Applies to OUT endpoints Only This interrupt is valid only when thresholding is enabled. This interrupt is asserted when the core detects an overflow or a CRC error for non-Isochronous OUT packet.
			INACTIVE	0	No OUT Packet Error
			ACTIVE	1	OUT Packet Error
I	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
J	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
K	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No BbleErr interrupt
			ACTIVE	1	BbleErr interrupt
L	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
M	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt
N	RW	STUPPKTRCVD			Setup Packet Received Applicable for Control OUT Endpoints in only in the Buffer DMA Mode Set by the controller, this bit indicates that this buffer holds 8 bytes of setup data. There is only one Setup packet per buffer. On receiving a Setup packet, the controller closes the buffer and disables the corresponding endpoint. The application has to re-enable the endpoint to receive any OUT data for the Control Transfer and reprogram the buffer start address. Note: Because of the above behavior, the controller can receive any number of back to back setup packets and one buffer for every setup packet is used.
			NOTRCVD	0	No Setup packet received
			RCVD	1	Setup packet received

8.27.5.149 DOEPTSIZ4

Address offset: 0xB90

Device OUT Endpoint Transfer Size Register 4

This register contains the Transfer Size for the OUT Endpoint 4 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet is read from the RxFIFO and written to the external memory.
B	RW	PKTCNT			Packet Count (PktCnt) This field is decremented to zero after a packet is written into the RxFIFO.
C	R	RXDPID			RxDPID Applies to isochronous OUT endpoints only. This is the data PID received in the last packet for this endpoint. SETUP Packet Count (SUPCnt) Applies to control OUT Endpoints only. This field specifies the number of back-to-back SETUP data packets the endpoint can receive.
			DATA0	0	DATA0
			DATA2PACKET1	1	DATA2 or 1 packet
			DATA1PACKET2	2	DATA1 or 2 packets
			MDATAPACKET3	3	MDATA or 3 packets

8.27.5.150 DOEPDMA4

Address offset: 0xB94

Device OUT Endpoint DMA Address Register 4

This register contains the DMA Address for the OUT Endpoint 4 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.151 DOEPCTL5

Address offset: 0xBA0

Device Control OUT Endpoint Control Register 5

This register is used to control the characteristics of OUT Endpoint 5 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable for both Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: - Applies to isochronous IN and OUT endpoints only. - Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			INACTIVE	0	Endpoint Data PID not active
			ACTIVE	1	Endpoint Data PID active
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUPT	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens
G	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
H	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
I	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to odd (micro)Frame

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E E D C B A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
J	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to odd (micro)Frame
K	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint
L	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. When Scatter/Gather DMA mode is enabled, - For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. - For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: - For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. - For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. The core clears this bit before setting any of the following interrupts on this endpoint: - SETUP Phase Done - Endpoint Disabled - Transfer Completed Note: For control endpoints in DMA mode, this bit must be set for the controller to transfer SETUP data packets to the memory. This bit is not cleared on Transfer Completed interrupt of the SETUP packet.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.152 DOEPINT5

Address offset: 0xBA8

Device OUT Endpoint Interrupt Register 5

This register contains the interrupts for the OUT Endpoint 5 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is Set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" section in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	SETUP			SETUP Phase Done (SetUp) Applies to control OUT endpoints only. Indicates that the SETUP phase for the control endpoint is complete and no more back-to-back SETUP packets were received for the current control transfer. On this interrupt, the application can decode the received SETUP data packet.
			INACTIVE	0	No SETUP Phase Done
			ACTIVE	1	SETUP Phase Done
E	RW	OUTTKNEPDIS			OUT Token Received When Endpoint Disabled (OUTTknEPdis) Applies only to control OUT endpoints. Indicates that an OUT token was received when the endpoint was not yet enabled. This interrupt is asserted on the endpoint for which the OUT token was received.
			INACTIVE	0	No OUT Token Received When Endpoint Disabled
			ACTIVE	1	OUT Token Received When Endpoint Disabled
F	RW	STSPHSERCVD			Status Phase Received for Control Write (StsPhseRcvd) This interrupt is valid only for Control OUT endpoints. This interrupt is generated only after the core has transferred all the data that the host has sent during the data phase of a control write transfer, to the system memory buffer. The interrupt indicates to the application that the host has switched from data phase to the status phase of a Control Write transfer. The application can use this interrupt to ACK or STALL the Status phase, after it has decoded the data phase.
			INACTIVE	0	No Status Phase Received for Control Write
			ACTIVE	1	Status Phase Received for Control Write

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
G	RW	BACK2BACKSETUP			Back-to-Back SETUP Packets Received (Back2BackSETup) Applies to Control OUT endpoints only. This bit indicates that the core has received more than three back-to-back SETUP packets for this particular endpoint. For information about handling this interrupt, refer to Programming guide section "Handling More Than Three Back-to-Back SETUP Packets". This bit is not valid in Completer mode.
			INACTIVE	0	No Back-to-Back SETUP Packets Received
			ACTIVE	1	Back-to-Back SETUP Packets Received
H	RW	OUTPKTERR			OUT Packet Error (OutPktErr) Applies to OUT endpoints Only This interrupt is valid only when thresholding is enabled. This interrupt is asserted when the core detects an overflow or a CRC error for non-Isochronous OUT packet.
			INACTIVE	0	No OUT Packet Error
			ACTIVE	1	OUT Packet Error
I	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
J	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
K	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No BbleErr interrupt
			ACTIVE	1	BbleErr interrupt
L	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
M	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																				N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
N	RW	STUPPKTRCVD																																	
			NOTRCVD	0																															
			RCVD	1																															

8.27.5.153 DOEPTSIZ5

Address offset: 0xBB0

Device OUT Endpoint Transfer Size Register 5

This register contains the Transfer Size for the OUT Endpoint 5 of the Device controller.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	XFERSIZE																																	
B	RW	PKTCNT																																	
C	R	RXDPID																																	
			DATA0	0																															
			DATA2PACKET1	1																															
			DATA1PACKET2	2																															
			MDATAPACKET3	3																															

8.27.5.154 DOEPDMA5

Address offset: 0xBB4

Device OUT Endpoint DMA Address Register 5

This register contains the DMA Address for the OUT Endpoint 5 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.155 DOEPCTL6

Address offset: 0xBC0

Device Control OUT Endpoint Control Register 6

This register is used to control the characteristics of OUT Endpoint 6 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable for both Scatter/Gather DMA mode and non-Scatter/ Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/ Gather DMA mode: - Applies to isochronous IN and OUT endpoints only. - Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			INACTIVE	0	Endpoint Data PID not active
			ACTIVE	1	Endpoint Data PID active
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUPT	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
G	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
H	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
I	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to odd (micro)Frame
J	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to odd (micro)Frame
K	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E E D C B A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
L	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. When Scatter/Gather DMA mode is enabled, - For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. - For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: - For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. - For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. The core clears this bit before setting any of the following interrupts on this endpoint: - SETUP Phase Done - Endpoint Disabled - Transfer Completed Note: For control endpoints in DMA mode, this bit must be set for the controller to transfer SETUP data packets to the memory. This bit is not cleared on Transfer Completed interrupt of the SETUP packet.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.156 DOEPINT6

Address offset: 0xBC8

Device OUT Endpoint Interrupt Register 6

This register contains the interrupts for the OUT Endpoint 6 of the Device controller.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is Set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" section in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	SETUP			SETUP Phase Done (SetUp) Applies to control OUT endpoints only. Indicates that the SETUP phase for the control endpoint is complete and no more back-to-back SETUP packets were received for the current control transfer. On this interrupt, the application can decode the received SETUP data packet.
			INACTIVE	0	No SETUP Phase Done
			ACTIVE	1	SETUP Phase Done
E	RW	OUTTKNEPDIS			OUT Token Received When Endpoint Disabled (OUTTknEPdis) Applies only to control OUT endpoints. Indicates that an OUT token was received when the endpoint was not yet enabled. This interrupt is asserted on the endpoint for which the OUT token was received.
			INACTIVE	0	No OUT Token Received When Endpoint Disabled
			ACTIVE	1	OUT Token Received When Endpoint Disabled
F	RW	STSPHSERCVD			Status Phase Received for Control Write (StsPhseRcvd) This interrupt is valid only for Control OUT endpoints. This interrupt is generated only after the core has transferred all the data that the host has sent during the data phase of a control write transfer, to the system memory buffer. The interrupt indicates to the application that the host has switched from data phase to the status phase of a Control Write transfer. The application can use this interrupt to ACK or STALL the Status phase, after it has decoded the data phase.
			INACTIVE	0	No Status Phase Received for Control Write
			ACTIVE	1	Status Phase Received for Control Write
G	RW	BACK2BACKSETUP			Back-to-Back SETUP Packets Received (Back2BackSETup) Applies to Control OUT endpoints only. This bit indicates that the core has received more than three back-to-back SETUP packets for this particular endpoint. For information about handling this interrupt, refer to Programming guide section "Handling More Than Three Back-to-Back SETUP Packets". This bit is not valid in Completer mode.
			INACTIVE	0	No Back-to-Back SETUP Packets Received
			ACTIVE	1	Back-to-Back SETUP Packets Received
H	RW	OUTPKTERR			OUT Packet Error (OutPktErr) Applies to OUT endpoints Only This interrupt is valid only when thresholding is enabled. This interrupt is asserted when the core detects an overflow or a CRC error for non-Isochronous OUT packet.
			INACTIVE	0	No OUT Packet Error
			ACTIVE	1	OUT Packet Error

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
I	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
J	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
K	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No BbleErr interrupt
			ACTIVE	1	BbleErr interrupt
L	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
M	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt
N	RW	STUPPKTRCVD			Setup Packet Received Applicable for Control OUT Endpoints in only in the Buffer DMA Mode Set by the controller, this bit indicates that this buffer holds 8 bytes of setup data. There is only one Setup packet per buffer. On receiving a Setup packet, the controller closes the buffer and disables the corresponding endpoint. The application has to re-enable the endpoint to receive any OUT data for the Control Transfer and reprogram the buffer start address. Note: Because of the above behavior, the controller can receive any number of back to back setup packets and one buffer for every setup packet is used.
			NOTRCVD	0	No Setup packet received
			RCVD	1	Setup packet received

8.27.5.157 DOEPTSIZ6

Address offset: 0xBD0

Device OUT Endpoint Transfer Size Register 6

This register contains the Transfer Size for the OUT Endpoint 6 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet is read from the RxFIFO and written to the external memory.
B	RW	PKTCNT			Packet Count (PktCnt) This field is decremented to zero after a packet is written into the RxFIFO.
C	R	RXDPID			RxDPID Applies to isochronous OUT endpoints only. This is the data PID received in the last packet for this endpoint. SETUP Packet Count (SUPCnt) Applies to control OUT Endpoints only. This field specifies the number of back-to-back SETUP data packets the endpoint can receive.
			DATA0	0	DATA0
			DATA2PACKET1	1	DATA2 or 1 packet
			DATA1PACKET2	2	DATA1 or 2 packets
			MDATAPACKET3	3	MDATA or 3 packets

8.27.5.158 DOEPDMA6

Address offset: 0xBD4

Device OUT Endpoint DMA Address Register 6

This register contains the DMA Address for the OUT Endpoint 6 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.159 DOEPCTL7

Address offset: 0xBE0

Device Control OUT Endpoint Control Register 7

This register is used to control the characteristics of OUT Endpoint 7 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable for both Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: - Applies to isochronous IN and OUT endpoints only. - Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			INACTIVE	0	Endpoint Data PID not active
			ACTIVE	1	Endpoint Data PID active
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUPT	3	Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens
G	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
H	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
I	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to odd (micro)Frame
J	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to odd (micro)Frame

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E E D C B A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
K	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint
L	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. When Scatter/Gather DMA mode is enabled, - For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. - For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: - For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. - For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. The core clears this bit before setting any of the following interrupts on this endpoint: - SETUP Phase Done - Endpoint Disabled - Transfer Completed Note: For control endpoints in DMA mode, this bit must be set for the controller to transfer SETUP data packets to the memory. This bit is not cleared on Transfer Completed interrupt of the SETUP packet.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.160 DOEPINT7

Address offset: 0xBE8

Device OUT Endpoint Interrupt Register 7

This register contains the interrupts for the OUT Endpoint 7 of the Device controller.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is Set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" section in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	SETUP			SETUP Phase Done (SetUp) Applies to control OUT endpoints only. Indicates that the SETUP phase for the control endpoint is complete and no more back-to-back SETUP packets were received for the current control transfer. On this interrupt, the application can decode the received SETUP data packet.
			INACTIVE	0	No SETUP Phase Done
			ACTIVE	1	SETUP Phase Done
E	RW	OUTTKNEPDIS			OUT Token Received When Endpoint Disabled (OUTTknEPdis) Applies only to control OUT endpoints. Indicates that an OUT token was received when the endpoint was not yet enabled. This interrupt is asserted on the endpoint for which the OUT token was received.
			INACTIVE	0	No OUT Token Received When Endpoint Disabled
			ACTIVE	1	OUT Token Received When Endpoint Disabled
F	RW	STSPHSERCVD			Status Phase Received for Control Write (StsPhseRcvd) This interrupt is valid only for Control OUT endpoints. This interrupt is generated only after the core has transferred all the data that the host has sent during the data phase of a control write transfer, to the system memory buffer. The interrupt indicates to the application that the host has switched from data phase to the status phase of a Control Write transfer. The application can use this interrupt to ACK or STALL the Status phase, after it has decoded the data phase.
			INACTIVE	0	No Status Phase Received for Control Write
			ACTIVE	1	Status Phase Received for Control Write
G	RW	BACK2BACKSETUP			Back-to-Back SETUP Packets Received (Back2BackSETup) Applies to Control OUT endpoints only. This bit indicates that the core has received more than three back-to-back SETUP packets for this particular endpoint. For information about handling this interrupt, refer to Programming guide section "Handling More Than Three Back-to-Back SETUP Packets". This bit is not valid in Completer mode.
			INACTIVE	0	No Back-to-Back SETUP Packets Received
			ACTIVE	1	Back-to-Back SETUP Packets Received

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
H	RW	OUTPKTERR			OUT Packet Error (OutPktErr) Applies to OUT endpoints Only This interrupt is valid only when thresholding is enabled. This interrupt is asserted when the core detects an overflow or a CRC error for non-Isochronous OUT packet.
			INACTIVE	0	No OUT Packet Error
			ACTIVE	1	OUT Packet Error
I	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
J	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
K	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No BbleErr interrupt
			ACTIVE	1	BbleErr interrupt
L	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
M	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt
N	RW	STUPPKTRCVD			Setup Packet Received Applicable for Control OUT Endpoints in only in the Buffer DMA Mode Set by the controller, this bit indicates that this buffer holds 8 bytes of setup data. There is only one Setup packet per buffer. On receiving a Setup packet, the controller closes the buffer and disables the corresponding endpoint. The application has to re-enable the endpoint to receive any OUT data for the Control Transfer and reprogram the buffer start address. Note: Because of the above behavior, the controller can receive any number of back to back setup packets and one buffer for every setup packet is used.
			NOTRCVD	0	No Setup packet received
			RCVD	1	Setup packet received

8.27.5.161 DOEPTSIZ7

Address offset: 0xBF0

Device OUT Endpoint Transfer Size Register 7

This register contains the Transfer Size for the OUT Endpoint 7 of the Device controller.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	XFERSIZE																																	
B	RW	PKTCNT																																	
C	R	RXDPID																																	
			DATA0	0																															
			DATA2PACKET1	1																															
			DATA1PACKET2	2																															
			MDATAPACKET3	3																															

8.27.5.162 DOEPDMA7

Address offset: 0xBF4

Device OUT Endpoint DMA Address Register 7

This register contains the DMA Address for the OUT Endpoint 7 of the Device controller.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	DMAADDR																																	

8.27.5.163 DOEPCTL8

Address offset: 0xC00

Device Control OUT Endpoint Control Register 8

This register is used to control the characteristics of OUT Endpoint 8 of the Device controller.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.																																
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.																														
			DISABLED	0	Not Active																																
			ENABLED	1	USB Active Endpoint																																
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable for both Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: - Applies to isochronous IN and OUT endpoints only. - Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.																																		
			INACTIVE	0	Endpoint Data PID not active																																
			ACTIVE	1	Endpoint Data PID active																																
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.																																		
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status																																
			NAK	1	The core is transmitting NAK handshakes on this endpoint																																

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUPT	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens
G	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
H	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
I	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to odd (micro)Frame

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E E D C B A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
J	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to odd (micro)Frame
K	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint
L	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. When Scatter/Gather DMA mode is enabled, - For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. - For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: - For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. - For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. The core clears this bit before setting any of the following interrupts on this endpoint: - SETUP Phase Done - Endpoint Disabled - Transfer Completed Note: For control endpoints in DMA mode, this bit must be set for the controller to transfer SETUP data packets to the memory. This bit is not cleared on Transfer Completed interrupt of the SETUP packet.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.164 DOEPINT8

Address offset: 0xC08

Device OUT Endpoint Interrupt Register 8

This register contains the interrupts for the OUT Endpoint 8 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is Set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" section in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	SETUP			SETUP Phase Done (SetUp) Applies to control OUT endpoints only. Indicates that the SETUP phase for the control endpoint is complete and no more back-to-back SETUP packets were received for the current control transfer. On this interrupt, the application can decode the received SETUP data packet.
			INACTIVE	0	No SETUP Phase Done
			ACTIVE	1	SETUP Phase Done
E	RW	OUTTKNEPDIS			OUT Token Received When Endpoint Disabled (OUTTknEPdis) Applies only to control OUT endpoints. Indicates that an OUT token was received when the endpoint was not yet enabled. This interrupt is asserted on the endpoint for which the OUT token was received.
			INACTIVE	0	No OUT Token Received When Endpoint Disabled
			ACTIVE	1	OUT Token Received When Endpoint Disabled
F	RW	STSPHSERCVD			Status Phase Received for Control Write (StsPhseRcvd) This interrupt is valid only for Control OUT endpoints. This interrupt is generated only after the core has transferred all the data that the host has sent during the data phase of a control write transfer, to the system memory buffer. The interrupt indicates to the application that the host has switched from data phase to the status phase of a Control Write transfer. The application can use this interrupt to ACK or STALL the Status phase, after it has decoded the data phase.
			INACTIVE	0	No Status Phase Received for Control Write
			ACTIVE	1	Status Phase Received for Control Write

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
G	RW	BACK2BACKSETUP			Back-to-Back SETUP Packets Received (Back2BackSETup) Applies to Control OUT endpoints only. This bit indicates that the core has received more than three back-to-back SETUP packets for this particular endpoint. For information about handling this interrupt, refer to Programming guide section "Handling More Than Three Back-to-Back SETUP Packets". This bit is not valid in Completer mode.
			INACTIVE	0	No Back-to-Back SETUP Packets Received
			ACTIVE	1	Back-to-Back SETUP Packets Received
H	RW	OUTPKTERR			OUT Packet Error (OutPktErr) Applies to OUT endpoints Only This interrupt is valid only when thresholding is enabled. This interrupt is asserted when the core detects an overflow or a CRC error for non-Isochronous OUT packet.
			INACTIVE	0	No OUT Packet Error
			ACTIVE	1	OUT Packet Error
I	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
J	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
K	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No BbleErr interrupt
			ACTIVE	1	BbleErr interrupt
L	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
M	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																				N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
N	RW	STUPPKTRCVD																																	
			NOTRCVD	0																															
			RCVD	1																															

8.27.5.165 DOEPTSIZ8

Address offset: 0xC10

Device OUT Endpoint Transfer Size Register 8

This register contains the Transfer Size for the OUT Endpoint 8 of the Device controller.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	XFERSIZE																																	
B	RW	PKTCNT																																	
C	R	RXDPID																																	
			DATA0	0																															
			DATA2PACKET1	1																															
			DATA1PACKET2	2																															
			MDATAPACKET3	3																															

8.27.5.166 DOEPDMA8

Address offset: 0xC14

Device OUT Endpoint DMA Address Register 8

This register contains the DMA Address for the OUT Endpoint 8 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.167 DOEPCTL9

Address offset: 0xC20

Device Control OUT Endpoint Control Register 9

This register is used to control the characteristics of OUT Endpoint 9 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable for both Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: - Applies to isochronous IN and OUT endpoints only. - Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			INACTIVE	0	Endpoint Data PID not active
			ACTIVE	1	Endpoint Data PID active
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUPT	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
G	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
H	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
I	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to odd (micro)Frame
J	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to odd (micro)Frame
K	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E E D C B A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
L	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. When Scatter/Gather DMA mode is enabled, - For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. - For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: - For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. - For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. The core clears this bit before setting any of the following interrupts on this endpoint: - SETUP Phase Done - Endpoint Disabled - Transfer Completed Note: For control endpoints in DMA mode, this bit must be set for the controller to transfer SETUP data packets to the memory. This bit is not cleared on Transfer Completed interrupt of the SETUP packet.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.168 DOEPINT9

Address offset: 0xC28

Device OUT Endpoint Interrupt Register 9

This register contains the interrupts for the OUT Endpoint 9 of the Device controller.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is Set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" section in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	SETUP			SETUP Phase Done (SetUp) Applies to control OUT endpoints only. Indicates that the SETUP phase for the control endpoint is complete and no more back-to-back SETUP packets were received for the current control transfer. On this interrupt, the application can decode the received SETUP data packet.
			INACTIVE	0	No SETUP Phase Done
			ACTIVE	1	SETUP Phase Done
E	RW	OUTTKNEPDIS			OUT Token Received When Endpoint Disabled (OUTTknEPdis) Applies only to control OUT endpoints. Indicates that an OUT token was received when the endpoint was not yet enabled. This interrupt is asserted on the endpoint for which the OUT token was received.
			INACTIVE	0	No OUT Token Received When Endpoint Disabled
			ACTIVE	1	OUT Token Received When Endpoint Disabled
F	RW	STSPHSERCVD			Status Phase Received for Control Write (StsPhseRcvd) This interrupt is valid only for Control OUT endpoints. This interrupt is generated only after the core has transferred all the data that the host has sent during the data phase of a control write transfer, to the system memory buffer. The interrupt indicates to the application that the host has switched from data phase to the status phase of a Control Write transfer. The application can use this interrupt to ACK or STALL the Status phase, after it has decoded the data phase.
			INACTIVE	0	No Status Phase Received for Control Write
			ACTIVE	1	Status Phase Received for Control Write
G	RW	BACK2BACKSETUP			Back-to-Back SETUP Packets Received (Back2BackSETup) Applies to Control OUT endpoints only. This bit indicates that the core has received more than three back-to-back SETUP packets for this particular endpoint. For information about handling this interrupt, refer to Programming guide section "Handling More Than Three Back-to-Back SETUP Packets". This bit is not valid in Completer mode.
			INACTIVE	0	No Back-to-Back SETUP Packets Received
			ACTIVE	1	Back-to-Back SETUP Packets Received
H	RW	OUTPKTERR			OUT Packet Error (OutPktErr) Applies to OUT endpoints Only This interrupt is valid only when thresholding is enabled. This interrupt is asserted when the core detects an overflow or a CRC error for non-Isochronous OUT packet.
			INACTIVE	0	No OUT Packet Error
			ACTIVE	1	OUT Packet Error

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID	N M L K J I H G F E D C B A
Reset 0x00000000	**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
I	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
J	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
K	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No BbleErr interrupt
			ACTIVE	1	BbleErr interrupt
L	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
M	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt
N	RW	STUPPKTRCVD			Setup Packet Received Applicable for Control OUT Endpoints in only in the Buffer DMA Mode Set by the controller, this bit indicates that this buffer holds 8 bytes of setup data. There is only one Setup packet per buffer. On receiving a Setup packet, the controller closes the buffer and disables the corresponding endpoint. The application has to re-enable the endpoint to receive any OUT data for the Control Transfer and reprogram the buffer start address. Note: Because of the above behavior, the controller can receive any number of back to back setup packets and one buffer for every setup packet is used.
			NOTRCVD	0	No Setup packet received
			RCVD	1	Setup packet received

8.27.5.169 DOEPTSIZ9

Address offset: 0xC30

Device OUT Endpoint Transfer Size Register 9

This register contains the Transfer Size for the OUT Endpoint 9 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet is read from the RxFIFO and written to the external memory.
B	RW	PKTCNT			Packet Count (PktCnt) This field is decremented to zero after a packet is written into the RxFIFO.
C	R	RXDPID			RxDPID Applies to isochronous OUT endpoints only. This is the data PID received in the last packet for this endpoint. SETUP Packet Count (SUPCnt) Applies to control OUT Endpoints only. This field specifies the number of back-to-back SETUP data packets the endpoint can receive.
			DATA0	0	DATA0
			DATA2PACKET1	1	DATA2 or 1 packet
			DATA1PACKET2	2	DATA1 or 2 packets
			MDATAPACKET3	3	MDATA or 3 packets

8.27.5.170 DOEPDMA9

Address offset: 0xC34

Device OUT Endpoint DMA Address Register 9

This register contains the DMA Address for the OUT Endpoint 9 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.171 DOEPCTL10

Address offset: 0xC40

Device Control OUT Endpoint Control Register 10

This register is used to control the characteristics of OUT Endpoint 10 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable for both Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: - Applies to isochronous IN and OUT endpoints only. - Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			INACTIVE	0	Endpoint Data PID not active
			ACTIVE	1	Endpoint Data PID active
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUPT	3	Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens
G	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
H	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
I	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to odd (micro)Frame
J	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to odd (micro)Frame

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID			L	K	J	I	H	G				F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
K	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint
L	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. When Scatter/Gather DMA mode is enabled, - For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. - For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: - For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. - For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. The core clears this bit before setting any of the following interrupts on this endpoint: - SETUP Phase Done - Endpoint Disabled - Transfer Completed Note: For control endpoints in DMA mode, this bit must be set for the controller to transfer SETUP data packets to the memory. This bit is not cleared on Transfer Completed interrupt of the SETUP packet.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.172 DOEPINT10

Address offset: 0xC48

Device OUT Endpoint Interrupt Register 10

This register contains the interrupts for the OUT Endpoint 10 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is Set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" section in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	SETUP			SETUP Phase Done (SetUp) Applies to control OUT endpoints only. Indicates that the SETUP phase for the control endpoint is complete and no more back-to-back SETUP packets were received for the current control transfer. On this interrupt, the application can decode the received SETUP data packet.
			INACTIVE	0	No SETUP Phase Done
			ACTIVE	1	SETUP Phase Done
E	RW	OUTTKNEPDIS			OUT Token Received When Endpoint Disabled (OUTTknEPdis) Applies only to control OUT endpoints. Indicates that an OUT token was received when the endpoint was not yet enabled. This interrupt is asserted on the endpoint for which the OUT token was received.
			INACTIVE	0	No OUT Token Received When Endpoint Disabled
			ACTIVE	1	OUT Token Received When Endpoint Disabled
F	RW	STSPHSERCVD			Status Phase Received for Control Write (StsPhseRcvd) This interrupt is valid only for Control OUT endpoints. This interrupt is generated only after the core has transferred all the data that the host has sent during the data phase of a control write transfer, to the system memory buffer. The interrupt indicates to the application that the host has switched from data phase to the status phase of a Control Write transfer. The application can use this interrupt to ACK or STALL the Status phase, after it has decoded the data phase.
			INACTIVE	0	No Status Phase Received for Control Write
			ACTIVE	1	Status Phase Received for Control Write
G	RW	BACK2BACKSETUP			Back-to-Back SETUP Packets Received (Back2BackSETup) Applies to Control OUT endpoints only. This bit indicates that the core has received more than three back-to-back SETUP packets for this particular endpoint. For information about handling this interrupt, refer to Programming guide section "Handling More Than Three Back-to-Back SETUP Packets". This bit is not valid in Completer mode.
			INACTIVE	0	No Back-to-Back SETUP Packets Received
			ACTIVE	1	Back-to-Back SETUP Packets Received

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
H	RW	OUTPKTERR			OUT Packet Error (OutPktErr) Applies to OUT endpoints Only This interrupt is valid only when thresholding is enabled. This interrupt is asserted when the core detects an overflow or a CRC error for non-Isochronous OUT packet.
			INACTIVE	0	No OUT Packet Error
			ACTIVE	1	OUT Packet Error
I	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
J	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
K	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No BbleErr interrupt
			ACTIVE	1	BbleErr interrupt
L	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
M	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt
N	RW	STUPPKTRCVD			Setup Packet Received Applicable for Control OUT Endpoints in only in the Buffer DMA Mode Set by the controller, this bit indicates that this buffer holds 8 bytes of setup data. There is only one Setup packet per buffer. On receiving a Setup packet, the controller closes the buffer and disables the corresponding endpoint. The application has to re-enable the endpoint to receive any OUT data for the Control Transfer and reprogram the buffer start address. Note: Because of the above behavior, the controller can receive any number of back to back setup packets and one buffer for every setup packet is used.
			NOTRCVD	0	No Setup packet received
			RCVD	1	Setup packet received

8.27.5.173 DOEPTSIZ10

Address offset: 0xC50

Device OUT Endpoint Transfer Size Register 10

This register contains the Transfer Size for the OUT Endpoint 10 of the Device controller.

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID						C	C	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000					**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet is read from the RxFIFO and written to the external memory.
B	RW	PKTCNT			Packet Count (PktCnt) This field is decremented to zero after a packet is written into the RxFIFO.
C	R	RXDPID			RxDPID Applies to isochronous OUT endpoints only. This is the data PID received in the last packet for this endpoint. SETUP Packet Count (SUPCnt) Applies to control OUT Endpoints only. This field specifies the number of back-to-back SETUP data packets the endpoint can receive.
			DATA0	0	DATA0
			DATA2PACKET1	1	DATA2 or 1 packet
			DATA1PACKET2	2	DATA1 or 2 packets
			MDATAPACKET3	3	MDATA or 3 packets

8.27.5.174 DOEPDMA10

Address offset: 0xC54

Device OUT Endpoint DMA Address Register 10

This register contains the DMA Address for the OUT Endpoint 10 of the Device controller.

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000					**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.175 DOEPCTL11

Address offset: 0xC60

Device Control OUT Endpoint Control Register 11

This register is used to control the characteristics of OUT Endpoint 11 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable for both Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: - Applies to isochronous IN and OUT endpoints only. - Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			INACTIVE	0	Endpoint Data PID not active
			ACTIVE	1	Endpoint Data PID active
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUPT	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens
G	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
H	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
I	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to odd (micro)Frame

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
J	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to odd (micro)Frame
K	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint
L	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. When Scatter/Gather DMA mode is enabled, - For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. - For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: - For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. - For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. The core clears this bit before setting any of the following interrupts on this endpoint: - SETUP Phase Done - Endpoint Disabled - Transfer Completed Note: For control endpoints in DMA mode, this bit must be set for the controller to transfer SETUP data packets to the memory. This bit is not cleared on Transfer Completed interrupt of the SETUP packet.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.176 DOEPINT11

Address offset: 0xC68

Device OUT Endpoint Interrupt Register 11

This register contains the interrupts for the OUT Endpoint 11 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is Set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" section in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	SETUP			SETUP Phase Done (SetUp) Applies to control OUT endpoints only. Indicates that the SETUP phase for the control endpoint is complete and no more back-to-back SETUP packets were received for the current control transfer. On this interrupt, the application can decode the received SETUP data packet.
			INACTIVE	0	No SETUP Phase Done
			ACTIVE	1	SETUP Phase Done
E	RW	OUTTKNEPDIS			OUT Token Received When Endpoint Disabled (OUTTknEPdis) Applies only to control OUT endpoints. Indicates that an OUT token was received when the endpoint was not yet enabled. This interrupt is asserted on the endpoint for which the OUT token was received.
			INACTIVE	0	No OUT Token Received When Endpoint Disabled
			ACTIVE	1	OUT Token Received When Endpoint Disabled
F	RW	STSPHSERCVD			Status Phase Received for Control Write (StsPhseRcvd) This interrupt is valid only for Control OUT endpoints. This interrupt is generated only after the core has transferred all the data that the host has sent during the data phase of a control write transfer, to the system memory buffer. The interrupt indicates to the application that the host has switched from data phase to the status phase of a Control Write transfer. The application can use this interrupt to ACK or STALL the Status phase, after it has decoded the data phase.
			INACTIVE	0	No Status Phase Received for Control Write
			ACTIVE	1	Status Phase Received for Control Write

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
G	RW	BACK2BACKSETUP			Back-to-Back SETUP Packets Received (Back2BackSETup) Applies to Control OUT endpoints only. This bit indicates that the core has received more than three back-to-back SETUP packets for this particular endpoint. For information about handling this interrupt, refer to Programming guide section "Handling More Than Three Back-to-Back SETUP Packets". This bit is not valid in Completer mode.
			INACTIVE	0	No Back-to-Back SETUP Packets Received
			ACTIVE	1	Back-to-Back SETUP Packets Received
H	RW	OUTPKTERR			OUT Packet Error (OutPktErr) Applies to OUT endpoints Only This interrupt is valid only when thresholding is enabled. This interrupt is asserted when the core detects an overflow or a CRC error for non-Isochronous OUT packet.
			INACTIVE	0	No OUT Packet Error
			ACTIVE	1	OUT Packet Error
I	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
J	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
K	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No BbleErr interrupt
			ACTIVE	1	BbleErr interrupt
L	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
M	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
N	RW	STUPPKTRCVD			Setup Packet Received Applicable for Control OUT Endpoints in only in the Buffer DMA Mode Set by the controller, this bit indicates that this buffer holds 8 bytes of setup data. There is only one Setup packet per buffer. On receiving a Setup packet, the controller closes the buffer and disables the corresponding endpoint. The application has to re-enable the endpoint to receive any OUT data for the Control Transfer and reprogram the buffer start address. Note: Because of the above behavior, the controller can receive any number of back to back setup packets and one buffer for every setup packet is used.
			NOTRCVD	0	No Setup packet received
			RCVD	1	Setup packet received

8.27.5.177 DOEPTSIZ11

Address offset: 0xC70

Device OUT Endpoint Transfer Size Register 11

This register contains the Transfer Size for the OUT Endpoint 11 of the Device controller.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C B B B B B B B B B B A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet is read from the RxFIFO and written to the external memory.
B	RW	PKTCNT			Packet Count (PktCnt) This field is decremented to zero after a packet is written into the RxFIFO.
C	R	RXDPID			RxDPID Applies to isochronous OUT endpoints only. This is the data PID received in the last packet for this endpoint. SETUP Packet Count (SUPCnt) Applies to control OUT Endpoints only. This field specifies the number of back-to-back SETUP data packets the endpoint can receive.
			DATA0	0	DATA0
			DATA2PACKET1	1	DATA2 or 1 packet
			DATA1PACKET2	2	DATA1 or 2 packets
			MDATAPACKET3	3	MDATA or 3 packets

8.27.5.178 DOEPDMA11

Address offset: 0xC74

Device OUT Endpoint DMA Address Register 11

This register contains the DMA Address for the OUT Endpoint 11 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.179 DOEPCTL12

Address offset: 0xC80

Device Control OUT Endpoint Control Register 12

This register is used to control the characteristics of OUT Endpoint 12 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable for both Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: - Applies to isochronous IN and OUT endpoints only. - Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			INACTIVE	0	Endpoint Data PID not active
			ACTIVE	1	Endpoint Data PID active
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUPT	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
G	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
H	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
I	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to odd (micro)Frame
J	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to odd (micro)Frame
K	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E E D C B A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
L	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. When Scatter/Gather DMA mode is enabled, - For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. - For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: - For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. - For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. The core clears this bit before setting any of the following interrupts on this endpoint: - SETUP Phase Done - Endpoint Disabled - Transfer Completed Note: For control endpoints in DMA mode, this bit must be set for the controller to transfer SETUP data packets to the memory. This bit is not cleared on Transfer Completed interrupt of the SETUP packet.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.180 DOEPINT12

Address offset: 0xC88

Device OUT Endpoint Interrupt Register 12

This register contains the interrupts for the OUT Endpoint 12 of the Device controller.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is Set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" section in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	SETUP			SETUP Phase Done (SetUp) Applies to control OUT endpoints only. Indicates that the SETUP phase for the control endpoint is complete and no more back-to-back SETUP packets were received for the current control transfer. On this interrupt, the application can decode the received SETUP data packet.
			INACTIVE	0	No SETUP Phase Done
			ACTIVE	1	SETUP Phase Done
E	RW	OUTTKNEPDIS			OUT Token Received When Endpoint Disabled (OUTTknEPdis) Applies only to control OUT endpoints. Indicates that an OUT token was received when the endpoint was not yet enabled. This interrupt is asserted on the endpoint for which the OUT token was received.
			INACTIVE	0	No OUT Token Received When Endpoint Disabled
			ACTIVE	1	OUT Token Received When Endpoint Disabled
F	RW	STSPHSERCVD			Status Phase Received for Control Write (StsPhseRcvd) This interrupt is valid only for Control OUT endpoints. This interrupt is generated only after the core has transferred all the data that the host has sent during the data phase of a control write transfer, to the system memory buffer. The interrupt indicates to the application that the host has switched from data phase to the status phase of a Control Write transfer. The application can use this interrupt to ACK or STALL the Status phase, after it has decoded the data phase.
			INACTIVE	0	No Status Phase Received for Control Write
			ACTIVE	1	Status Phase Received for Control Write
G	RW	BACK2BACKSETUP			Back-to-Back SETUP Packets Received (Back2BackSETup) Applies to Control OUT endpoints only. This bit indicates that the core has received more than three back-to-back SETUP packets for this particular endpoint. For information about handling this interrupt, refer to Programming guide section "Handling More Than Three Back-to-Back SETUP Packets". This bit is not valid in Completer mode.
			INACTIVE	0	No Back-to-Back SETUP Packets Received
			ACTIVE	1	Back-to-Back SETUP Packets Received
H	RW	OUTPKTERR			OUT Packet Error (OutPktErr) Applies to OUT endpoints Only This interrupt is valid only when thresholding is enabled. This interrupt is asserted when the core detects an overflow or a CRC error for non-Isochronous OUT packet.
			INACTIVE	0	No OUT Packet Error
			ACTIVE	1	OUT Packet Error

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
I	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
J	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
K	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No BbleErr interrupt
			ACTIVE	1	BbleErr interrupt
L	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
M	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt
N	RW	STUPPKTRCVD			Setup Packet Received Applicable for Control OUT Endpoints in only in the Buffer DMA Mode Set by the controller, this bit indicates that this buffer holds 8 bytes of setup data. There is only one Setup packet per buffer. On receiving a Setup packet, the controller closes the buffer and disables the corresponding endpoint. The application has to re-enable the endpoint to receive any OUT data for the Control Transfer and reprogram the buffer start address. Note: Because of the above behavior, the controller can receive any number of back to back setup packets and one buffer for every setup packet is used.
			NOTRCVD	0	No Setup packet received
			RCVD	1	Setup packet received

8.27.5.181 DOEPTSIZ12

Address offset: 0xC90

Device OUT Endpoint Transfer Size Register 12

This register contains the Transfer Size for the OUT Endpoint 12 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet is read from the RxFIFO and written to the external memory.
B	RW	PKTCNT			Packet Count (PktCnt) This field is decremented to zero after a packet is written into the RxFIFO.
C	R	RXDPID			RxDPID Applies to isochronous OUT endpoints only. This is the data PID received in the last packet for this endpoint. SETUP Packet Count (SUPCnt) Applies to control OUT Endpoints only. This field specifies the number of back-to-back SETUP data packets the endpoint can receive.
			DATA0	0	DATA0
			DATA2PACKET1	1	DATA2 or 1 packet
			DATA1PACKET2	2	DATA1 or 2 packets
			MDATAPACKET3	3	MDATA or 3 packets

8.27.5.182 DOEPDMA12

Address offset: 0xC94

Device OUT Endpoint DMA Address Register 12

This register contains the DMA Address for the OUT Endpoint 12 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.183 DOEPCTL13

Address offset: 0xCA0

Device Control OUT Endpoint Control Register 13

This register is used to control the characteristics of OUT Endpoint 13 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable for both Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: - Applies to isochronous IN and OUT endpoints only. - Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			INACTIVE	0	Endpoint Data PID not active
			ACTIVE	1	Endpoint Data PID active
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUPT	3	Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens
G	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
H	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
I	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to odd (micro)Frame
J	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to odd (micro)Frame

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID			L	K	J	I	H	G				F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
K	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint
L	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. When Scatter/Gather DMA mode is enabled, - For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. - For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: - For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. - For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. The core clears this bit before setting any of the following interrupts on this endpoint: - SETUP Phase Done - Endpoint Disabled - Transfer Completed Note: For control endpoints in DMA mode, this bit must be set for the controller to transfer SETUP data packets to the memory. This bit is not cleared on Transfer Completed interrupt of the SETUP packet.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.184 DOEPINT13

Address offset: 0xCA8

Device OUT Endpoint Interrupt Register 13

This register contains the interrupts for the OUT Endpoint 13 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is Set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" section in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	SETUP			SETUP Phase Done (SetUp) Applies to control OUT endpoints only. Indicates that the SETUP phase for the control endpoint is complete and no more back-to-back SETUP packets were received for the current control transfer. On this interrupt, the application can decode the received SETUP data packet.
			INACTIVE	0	No SETUP Phase Done
			ACTIVE	1	SETUP Phase Done
E	RW	OUTTKNEPDIS			OUT Token Received When Endpoint Disabled (OUTTknEPdis) Applies only to control OUT endpoints. Indicates that an OUT token was received when the endpoint was not yet enabled. This interrupt is asserted on the endpoint for which the OUT token was received.
			INACTIVE	0	No OUT Token Received When Endpoint Disabled
			ACTIVE	1	OUT Token Received When Endpoint Disabled
F	RW	STSPHSERCVD			Status Phase Received for Control Write (StsPhseRcvd) This interrupt is valid only for Control OUT endpoints. This interrupt is generated only after the core has transferred all the data that the host has sent during the data phase of a control write transfer, to the system memory buffer. The interrupt indicates to the application that the host has switched from data phase to the status phase of a Control Write transfer. The application can use this interrupt to ACK or STALL the Status phase, after it has decoded the data phase.
			INACTIVE	0	No Status Phase Received for Control Write
			ACTIVE	1	Status Phase Received for Control Write
G	RW	BACK2BACKSETUP			Back-to-Back SETUP Packets Received (Back2BackSETup) Applies to Control OUT endpoints only. This bit indicates that the core has received more than three back-to-back SETUP packets for this particular endpoint. For information about handling this interrupt, refer to Programming guide section "Handling More Than Three Back-to-Back SETUP Packets". This bit is not valid in Completer mode.
			INACTIVE	0	No Back-to-Back SETUP Packets Received
			ACTIVE	1	Back-to-Back SETUP Packets Received

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
H	RW	OUTPKTERR			OUT Packet Error (OutPktErr) Applies to OUT endpoints Only This interrupt is valid only when thresholding is enabled. This interrupt is asserted when the core detects an overflow or a CRC error for non-Isochronous OUT packet.
			INACTIVE	0	No OUT Packet Error
			ACTIVE	1	OUT Packet Error
I	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
J	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
K	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No BbleErr interrupt
			ACTIVE	1	BbleErr interrupt
L	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
M	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt
N	RW	STUPPKTRCVD			Setup Packet Received Applicable for Control OUT Endpoints in only in the Buffer DMA Mode Set by the controller, this bit indicates that this buffer holds 8 bytes of setup data. There is only one Setup packet per buffer. On receiving a Setup packet, the controller closes the buffer and disables the corresponding endpoint. The application has to re-enable the endpoint to receive any OUT data for the Control Transfer and reprogram the buffer start address. Note: Because of the above behavior, the controller can receive any number of back to back setup packets and one buffer for every setup packet is used.
			NOTRCVD	0	No Setup packet received
			RCVD	1	Setup packet received

8.27.5.185 DOEPTSIZ13

Address offset: 0xCB0

Device OUT Endpoint Transfer Size Register 13

This register contains the Transfer Size for the OUT Endpoint 13 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet is read from the RxFIFO and written to the external memory.
B	RW	PKTCNT			Packet Count (PktCnt) This field is decremented to zero after a packet is written into the RxFIFO.
C	R	RXDPID			RxDPID Applies to isochronous OUT endpoints only. This is the data PID received in the last packet for this endpoint. SETUP Packet Count (SUPCnt) Applies to control OUT Endpoints only. This field specifies the number of back-to-back SETUP data packets the endpoint can receive.
			DATA0	0	DATA0
			DATA2PACKET1	1	DATA2 or 1 packet
			DATA1PACKET2	2	DATA1 or 2 packets
			MDATAPACKET3	3	MDATA or 3 packets

8.27.5.186 DOEPDMA13

Address offset: 0xCB4

Device OUT Endpoint DMA Address Register 13

This register contains the DMA Address for the OUT Endpoint 13 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.187 DOEPCTL14

Address offset: 0xCC0

Device Control OUT Endpoint Control Register 14

This register is used to control the characteristics of OUT Endpoint 14 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	MPS			Maximum Packet Size (MPS) The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.
B	RW	USBACTEP			USB Active Endpoint (USBActEP) Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable for both Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: - Applies to isochronous IN and OUT endpoints only. - Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			INACTIVE	0	Endpoint Data PID not active
			ACTIVE	1	Endpoint Data PID active
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUPT	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens
G	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
H	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
I	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to odd (micro)Frame

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E E D C B A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
J	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to odd (micro)Frame
K	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint
L	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. When Scatter/Gather DMA mode is enabled, - For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. - For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: - For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. - For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. The core clears this bit before setting any of the following interrupts on this endpoint: - SETUP Phase Done - Endpoint Disabled - Transfer Completed Note: For control endpoints in DMA mode, this bit must be set for the controller to transfer SETUP data packets to the memory. This bit is not cleared on Transfer Completed interrupt of the SETUP packet.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.188 DOEPINT14

Address offset: 0xCC8

Device OUT Endpoint Interrupt Register 14

This register contains the interrupts for the OUT Endpoint 14 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is Set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" section in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	SETUP			SETUP Phase Done (SetUp) Applies to control OUT endpoints only. Indicates that the SETUP phase for the control endpoint is complete and no more back-to-back SETUP packets were received for the current control transfer. On this interrupt, the application can decode the received SETUP data packet.
			INACTIVE	0	No SETUP Phase Done
			ACTIVE	1	SETUP Phase Done
E	RW	OUTTKNEPDIS			OUT Token Received When Endpoint Disabled (OUTTknEPdis) Applies only to control OUT endpoints. Indicates that an OUT token was received when the endpoint was not yet enabled. This interrupt is asserted on the endpoint for which the OUT token was received.
			INACTIVE	0	No OUT Token Received When Endpoint Disabled
			ACTIVE	1	OUT Token Received When Endpoint Disabled
F	RW	STSPHSERCVD			Status Phase Received for Control Write (StsPhseRcvd) This interrupt is valid only for Control OUT endpoints. This interrupt is generated only after the core has transferred all the data that the host has sent during the data phase of a control write transfer, to the system memory buffer. The interrupt indicates to the application that the host has switched from data phase to the status phase of a Control Write transfer. The application can use this interrupt to ACK or STALL the Status phase, after it has decoded the data phase.
			INACTIVE	0	No Status Phase Received for Control Write
			ACTIVE	1	Status Phase Received for Control Write

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
G	RW	BACK2BACKSETUP			Back-to-Back SETUP Packets Received (Back2BackSETup) Applies to Control OUT endpoints only. This bit indicates that the core has received more than three back-to-back SETUP packets for this particular endpoint. For information about handling this interrupt, refer to Programming guide section "Handling More Than Three Back-to-Back SETUP Packets". This bit is not valid in Completer mode.
			INACTIVE	0	No Back-to-Back SETUP Packets Received
			ACTIVE	1	Back-to-Back SETUP Packets Received
H	RW	OUTPKTERR			OUT Packet Error (OutPktErr) Applies to OUT endpoints Only This interrupt is valid only when thresholding is enabled. This interrupt is asserted when the core detects an overflow or a CRC error for non-Isochronous OUT packet.
			INACTIVE	0	No OUT Packet Error
			ACTIVE	1	OUT Packet Error
I	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
J	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
K	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No BbleErr interrupt
			ACTIVE	1	BbleErr interrupt
L	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
M	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
N	RW	STUPPKTRCVD			Setup Packet Received Applicable for Control OUT Endpoints in only in the Buffer DMA Mode Set by the controller, this bit indicates that this buffer holds 8 bytes of setup data. There is only one Setup packet per buffer. On receiving a Setup packet, the controller closes the buffer and disables the corresponding endpoint. The application has to re-enable the endpoint to receive any OUT data for the Control Transfer and reprogram the buffer start address. Note: Because of the above behavior, the controller can receive any number of back to back setup packets and one buffer for every setup packet is used.
			NOTRCVD	0	No Setup packet received
			RCVD	1	Setup packet received

8.27.5.189 DOEPTSIZ14

Address offset: 0xCD0

Device OUT Endpoint Transfer Size Register 14

This register contains the Transfer Size for the OUT Endpoint 14 of the Device controller.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C B B B B B B B B B B A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet is read from the RxFIFO and written to the external memory.
B	RW	PKTCNT			Packet Count (PktCnt) This field is decremented to zero after a packet is written into the RxFIFO.
C	R	RXDPID			RxDPID Applies to isochronous OUT endpoints only. This is the data PID received in the last packet for this endpoint. SETUP Packet Count (SUPCnt) Applies to control OUT Endpoints only. This field specifies the number of back-to-back SETUP data packets the endpoint can receive.
			DATA0	0	DATA0
			DATA2PACKET1	1	DATA2 or 1 packet
			DATA1PACKET2	2	DATA1 or 2 packets
			MDATAPACKET3	3	MDATA or 3 packets

8.27.5.190 DOEPDMA14

Address offset: 0xCD4

Device OUT Endpoint DMA Address Register 14

This register contains the DMA Address for the OUT Endpoint 14 of the Device controller.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	DMAADDR																																	

Holds the start address of the external memory for storing or fetching endpoint

data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.191 DOEPCTL15

Address offset: 0xCE0

Device Control OUT Endpoint Control Register 15

This register is used to control the characteristics of OUT Endpoint 15 of the Device controller.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	MPS																																	

Maximum Packet Size (MPS)

The application must program this field with the maximum packet size for the current logical endpoint. This value is in bytes.

B	RW	USBACTEP			USB Active Endpoint (USBActEP)
					Indicates whether this endpoint is active in the current configuration and interface. The core clears this bit for all endpoints (other than EP 0) after detecting a USB reset. After receiving the SetConfiguration and SetInterface commands, the application must program endpoint registers accordingly and set this bit.
			DISABLED	0	Not Active
			ENABLED	1	USB Active Endpoint

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	R	DPID			Endpoint Data PID (DPID) Applies to interrupt/bulk IN and OUT endpoints only. Contains the PID of the packet to be received or transmitted on this endpoint. The application must program the PID of the first packet to be received or transmitted on this endpoint, after the endpoint is activated. The applications use the SetD1PID and SetD0PID fields of this register to program either DATA0 or DATA1 PID. This field is applicable for both Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. Even/Odd (Micro)Frame (EO_FrNum) In non-Scatter/Gather DMA mode: - Applies to isochronous IN and OUT endpoints only. - Indicates the (micro)frame number in which the core transmits/receives isochronous data for this endpoint. The application must program the even/odd (micro)frame number in which it intends to transmit/receive isochronous data for this endpoint using the SetEvnFr and SetOddFr fields in this register. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is provided in the transmit descriptor structure. The frame in which data is received is updated in receive descriptor structure.
			INACTIVE	0	Endpoint Data PID not active
			ACTIVE	1	Endpoint Data PID active
D	R	NAKSTS			NAK Status (NAKSts) Indicates the following: When either the application or the core sets this bit: - The core stops receiving any data on an OUT endpoint, even if there is space in the RxFIFO to accommodate the incoming packet. - For non-isochronous IN endpoints: The core stops transmitting any data on an IN endpoint, even if there data is available in the TxFIFO. - For isochronous IN endpoints: The core sends out a zero-length data packet, even if there data is available in the TxFIFO. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			NONNAK	0	The core is transmitting non-NAK handshakes based on the FIFO status
			NAK	1	The core is transmitting NAK handshakes on this endpoint
E	RW	EPTYPE			Endpoint Type (EPType) This is the transfer type supported by this logical endpoint.
			CONTROL	0	Control
			ISOCHRONOUS	1	Isochronous
			BULK	2	Bulk
			INTERRUPT	3	Interrupt
F	RW	STALL			STALL Handshake (Stall) Applies to non-control, non-isochronous IN and OUT endpoints only. The application sets this bit to stall all tokens from the USB host to this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Only the application can clear this bit, never the core. Applies to control endpoints only. The application can only set this bit, and the core clears it, when a SETUP token is received for this endpoint. If a NAK bit, Global Non-periodic IN NAK, or Global OUT NAK is set along with this bit, the STALL bit takes priority. Irrespective of this bit's setting, the core always responds to SETUP data packets with an ACK handshake.
			INACTIVE	0	STALL All non-active tokens
			ACTIVE	1	STALL All Active Tokens

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	L	K	J	I	H	G					F		E	E	D	C	B					A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
G	W	CNAK			Clear NAK (CNAK) A write to this bit clears the NAK bit for the endpoint.
			INACTIVE	0	No Clear NAK
			ACTIVE	1	Clear NAK
H	W	SNAK			Set NAK (SNAK) A write to this bit sets the NAK bit for the endpoint. Using this bit, the application can control the transmission of NAK handshakes on an endpoint. The core can also set this bit for an endpoint after a SETUP packet is received on that endpoint.
			INACTIVE	0	No Set NAK
			ACTIVE	1	Set NAK
I	W	SETD0PID			Set DATA0 PID (SetD0PID) - Applies to interrupt/bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA0. - This field is applicable both for Scatter/Gather DMA mode and non-Scatter/Gather DMA mode. In non-Scatter/Gather DMA mode: Set Even (micro)frame (SetEvenFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the Even/Odd (micro)frame (EO_FrNum) field to even (micro)frame. - When Scatter/Gather DMA mode is enabled, this field is reserved. The frame number in which to send data is in the transmit descriptor structure. The frame in which to receive data is updated in receive descriptor structure.
			DISABLED	0	Disables Set DATA0 PID or Do not force Even Frame
			ENABLED	1	Set Endpoint Data PID to DATA0 or Sets EO_FrNum field to odd (micro)Frame
J	W	SETD1PID			Set DATA1 PID (SetD1PID) - Applies to interrupt and bulk IN and OUT endpoints only. - Writing to this field sets the Endpoint Data PID (DPID) field in this register to DATA1. - This field is applicable both for scatter-gather DMA mode and non scatter-gather DMA mode. Set Odd (micro)frame (SetOddFr) - Applies to isochronous IN and OUT endpoints only. - Writing to this field sets the even and odd (micro)frame (EO_FrNum) field to odd (micro)frame.
			DISABLED	0	Disables Set DATA1 PID or Do not force Odd Frame
			ENABLED	1	Set Endpoint Data PID to DATA1 or Sets EO_FrNum field to odd (micro)Frame
K	RW	EPDIS			Endpoint Disable (EPDis) Applies to IN and OUT endpoints. The application sets this bit to stop transmitting/receiving data on an endpoint, even before the transfer for that endpoint is complete. The application must wait for the Endpoint Disabled interrupt before treating the endpoint as disabled. The core clears this bit before setting the Endpoint Disabled interrupt. The application must set this bit only if Endpoint Enable is already set for this endpoint.
			INACTIVE	0	No Action
			ACTIVE	1	Disable Endpoint

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E E D C B A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
L	RW	EPENA			Endpoint Enable (EPEna) Applies to IN and OUT endpoints. When Scatter/Gather DMA mode is enabled, - For IN endpoints this bit indicates that the descriptor structure and data buffer with data ready to transmit is setup. - For OUT endpoint it indicates that the descriptor structure and data buffer to receive data is setup. When Scatter/Gather DMA mode is enabled such as for buffer-pointer based DMA mode: - For IN endpoints, this bit indicates that data is ready to be transmitted on the endpoint. - For OUT endpoints, this bit indicates that the application has allocated the memory to start receiving data from the USB. The core clears this bit before setting any of the following interrupts on this endpoint: - SETUP Phase Done - Endpoint Disabled - Transfer Completed Note: For control endpoints in DMA mode, this bit must be set for the controller to transfer SETUP data packets to the memory. This bit is not cleared on Transfer Completed interrupt of the SETUP packet.
			INACTIVE	0	No Action
			ACTIVE	1	Enable Endpoint

8.27.5.192 DOEPINT15

Address offset: 0xCE8

Device OUT Endpoint Interrupt Register 15

This register contains the interrupts for the OUT Endpoint 15 of the Device controller.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	XFERCOMPL			Transfer Completed Interrupt (XferCompl) Applies to IN and OUT endpoints. - When Scatter/Gather DMA mode is enabled -- For IN endpoint this field indicates that the requested data from the descriptor is moved from external system memory to internal FIFO. -- For OUT endpoint this field indicates that the requested data from the internal FIFO is moved to external system memory. This interrupt is generated only when the corresponding endpoint descriptor is closed, and the IOC bit for the corresponding descriptor is Set. - When Scatter/Gather DMA mode is disabled, this field indicates that the programmed transfer is complete on the AHB as well as on the USB, for this endpoint.
			INACTIVE	0	No Transfer Complete Interrupt
			ACTIVE	1	Transfer Complete Interrupt
B	RW	EPDISBLD			Endpoint Disabled Interrupt (EPDisbld) Applies to IN and OUT endpoints. This bit indicates that the endpoint is disabled per the application's request.
			INACTIVE	0	No Endpoint Disabled Interrupt
			ACTIVE	1	Endpoint Disabled Interrupt

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	N	M	L	K	J		I	H		G	F	E	D	C	B	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	RW	AHBERR			AHB Error (AHBErr) Applies to IN and OUT endpoints. This is generated only in Internal DMA mode when there is an AHB error during an AHB read/write. The application can read the corresponding endpoint DMA address register to get the error address. For details, see "AHB Error Handling" section in the Programming Guide.
			INACTIVE	0	No AHB Error Interrupt
			ACTIVE	1	AHB Error interrupt
D	RW	SETUP			SETUP Phase Done (SetUp) Applies to control OUT endpoints only. Indicates that the SETUP phase for the control endpoint is complete and no more back-to-back SETUP packets were received for the current control transfer. On this interrupt, the application can decode the received SETUP data packet.
			INACTIVE	0	No SETUP Phase Done
			ACTIVE	1	SETUP Phase Done
E	RW	OUTTKNEPDIS			OUT Token Received When Endpoint Disabled (OUTTknEPdis) Applies only to control OUT endpoints. Indicates that an OUT token was received when the endpoint was not yet enabled. This interrupt is asserted on the endpoint for which the OUT token was received.
			INACTIVE	0	No OUT Token Received When Endpoint Disabled
			ACTIVE	1	OUT Token Received When Endpoint Disabled
F	RW	STSPHSERCVD			Status Phase Received for Control Write (StsPhseRcvd) This interrupt is valid only for Control OUT endpoints. This interrupt is generated only after the core has transferred all the data that the host has sent during the data phase of a control write transfer, to the system memory buffer. The interrupt indicates to the application that the host has switched from data phase to the status phase of a Control Write transfer. The application can use this interrupt to ACK or STALL the Status phase, after it has decoded the data phase.
			INACTIVE	0	No Status Phase Received for Control Write
			ACTIVE	1	Status Phase Received for Control Write
G	RW	BACK2BACKSETUP			Back-to-Back SETUP Packets Received (Back2BackSETup) Applies to Control OUT endpoints only. This bit indicates that the core has received more than three back-to-back SETUP packets for this particular endpoint. For information about handling this interrupt, refer to Programming guide section "Handling More Than Three Back-to-Back SETUP Packets". This bit is not valid in Completer mode.
			INACTIVE	0	No Back-to-Back SETUP Packets Received
			ACTIVE	1	Back-to-Back SETUP Packets Received
H	RW	OUTPKTERR			OUT Packet Error (OutPktErr) Applies to OUT endpoints Only This interrupt is valid only when thresholding is enabled. This interrupt is asserted when the core detects an overflow or a CRC error for non-Isochronous OUT packet.
			INACTIVE	0	No OUT Packet Error
			ACTIVE	1	OUT Packet Error

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
I	RW	BNAINTR			BNA (Buffer Not Available) Interrupt (BNAIntr) This bit is valid only when Scatter/Gather DMA mode is enabled. The core generates this interrupt when the descriptor accessed is not ready for the Core to process, such as Host busy or DMA done
			INACTIVE	0	No BNA interrupt
			ACTIVE	1	BNA interrupt
J	RW	PKTDRPSTS			Packet Drop Status (PktDrpSts) This bit indicates to the application that an ISOC OUT packet has been dropped. This bit does not have an associated mask bit and does not generate an interrupt. Dependency: This bit is valid in non Scatter/Gather DMA mode when periodic transfer interrupt feature is selected.
			INACTIVE	0	No interrupt
			ACTIVE	1	Packet Drop Status interrupt
K	RW	BBLEERR			NAK Interrupt (BbleErr) The core generates this interrupt when babble is received for the endpoint.
			INACTIVE	0	No BbleErr interrupt
			ACTIVE	1	BbleErr interrupt
L	RW	NAKINTRPT			NAK Interrupt (NAKInterrupt) The core generates this interrupt when a NAK is transmitted or received by the device. In case of isochronous IN endpoints the interrupt gets generated when a zero length packet is transmitted due to un-availability of data in the TXFifo.
			INACTIVE	0	No NAK interrupt
			ACTIVE	1	NAK Interrupt
M	RW	NYETINTRPT			NYET Interrupt (NYETIntrpt) The core generates this interrupt when a NYET response is transmitted for a non isochronous OUT endpoint.
			INACTIVE	0	No NYET interrupt
			ACTIVE	1	NYET Interrupt
N	RW	STUPPKTRCVD			Setup Packet Received Applicable for Control OUT Endpoints in only in the Buffer DMA Mode Set by the controller, this bit indicates that this buffer holds 8 bytes of setup data. There is only one Setup packet per buffer. On receiving a Setup packet, the controller closes the buffer and disables the corresponding endpoint. The application has to re-enable the endpoint to receive any OUT data for the Control Transfer and reprogram the buffer start address. Note: Because of the above behavior, the controller can receive any number of back to back setup packets and one buffer for every setup packet is used.
			NOTRCVD	0	No Setup packet received
			RCVD	1	Setup packet received

8.27.5.193 DOEPTSIZ15

Address offset: 0xCF0

Device OUT Endpoint Transfer Size Register 15

This register contains the Transfer Size for the OUT Endpoint 15 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID		C	C	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	XFERSIZE			Transfer Size (XferSize) Indicates the transfer size in bytes for the endpoint. The core interrupts the application only after it has exhausted the transfer size amount of data. The transfer size can be Set to the maximum packet size of the endpoint, to be interrupted at the end of each packet. The core decrements this field every time a packet is read from the RxFIFO and written to the external memory.
B	RW	PKTCNT			Packet Count (PktCnt) This field is decremented to zero after a packet is written into the RxFIFO.
C	R	RXDPID			RxDPID Applies to isochronous OUT endpoints only. This is the data PID received in the last packet for this endpoint. SETUP Packet Count (SUPCnt) Applies to control OUT Endpoints only. This field specifies the number of back-to-back SETUP data packets the endpoint can receive.
			DATA0	0	DATA0
			DATA2PACKET1	1	DATA2 or 1 packet
			DATA1PACKET2	2	DATA1 or 2 packets
			MDATAPACKET3	3	MDATA or 3 packets

8.27.5.194 DOEPDMA15

Address offset: 0xCF4

Device OUT Endpoint DMA Address Register 15

This register contains the DMA Address for the OUT Endpoint 15 of the Device controller.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DMAADDR			Holds the start address of the external memory for storing or fetching endpoint data. Note: For control endpoints, this field stores control OUT data packets as well as SETUP transaction data packets. When more than three SETUP packets are received back-to-back, the SETUP data packet in the memory is overwritten. This register is incremented on every AHB transaction. The application can give only a DWORD-aligned address. - When Scatter/Gather DMA mode is not enabled, the application programs the start address value in this field. - When Scatter/Gather DMA mode is enabled, this field indicates the base pointer for the descriptor list.

8.27.5.195 PCGCCTL

Address offset: 0xE00

Power and Clock Gating Control Register

This register is used to control the Power and Clock Gating characteristics of the controller.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	H				G		F	E	D		C		B	A
Reset 0x880A0000				**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	STOPPCLK			Stop Pclk (StopPclk) - The application sets this bit to stop the PHY clock (phy_clk) when the USB is suspended, the session is not valid, or the device is disconnected. - The application clears this bit when the USB is resumed or a new session starts.
			DISABLED	0	Disable Stop Pclk
			ENABLED	1	Enable Stop Pclk
B	RW	GATEHCLK			Gate Hclk (GateHclk) - The application sets this bit to gate hclk to modules other than the AHB Completer and Requester and wakeup logic when the USB is suspended or the session is not valid. - The application clears this bit when the USB is resumed or a new session starts.
			DISABLED	0	Clears this bit when the USB is resumed or a new session starts
			ENABLED	1	Sets this bit to gate hclk to modules when the USB is suspended or the session is not valid
C	RW	RSTPDWNMODULE			Reset Power-Down Modules (RstPdwnModule) This bit is valid only in Partial Power-Down mode. - The application sets this bit when the power is turned off. - The application clears this bit after the power is turned on and the PHY clock is up. Note: The R/W of all core registers are possible only when this bit is set to 1b0.
			ON	0	Power is turned on
			OFF	1	Power is turned off
D	RW	ENBLL1GATING			Enable Sleep Clock Gating If this bit is set, core internal clock gating is enabled sleep state if utmi_l1_suspend_n cannot be asserted by the core. The PHY clock is not gated in sleep state if Enbl_L1Gating is not set.
			DISABLED	0	The PHY clock is not gated in Sleep state
			ENABLED	1	The Core internal clock gating is enabled in Sleep state
E	R	PHYSLEEP			PHY In Sleep Indicates that the PHY is in Sleep State.
			INACTIVE	0	Phy not in Sleep state
			ACTIVE	1	Phy in Sleep state
F	R	L1SUSPENDED			L1 Deep Sleep Indicates that the PHY is in deep sleep when in L1 state.
			INACTIVE	0	Non Deep Sleep
			ACTIVE	1	Deep Sleep
G	RW	RESTOREMODE			Restore Mode (RestoreMode) The application must program this bit to specify the restore mode during RESTORE POINT before programming PCGCCTL.EssRegRest bit is set. - Host Mode: - Device Mode:
			DISABLED	0	In Host mode,this bit indicates Host-initiated Resume and Reset. In Device mode, this bit indicates Device-initiated Remote Wakeup
			ENABLED	1	In Host mode,this bit indicates Device-initiated Remote Wakeup. In Device mode, this bit indicates Host-initiated Resume and Reset
H	W	ESSREGRESTORED			Essential Register Values Restored (EssRegRestored) A write of one into this field indicates that register values of essential registers have been restored. For definition of essential registers, refer programming flow section for Hibernation.
			NOTRESTORED	0	Register values of essential registers are not restored

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	H				G		F	E	D		C		B	A
Reset 0x880A0000	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
			RESTORED	1	Register values of essential registers have been restored
I	RW	RESTOREVALUE			Restore Value (RestoreValue) When Hibernation mode is enabled, the RestoreValue needs to be read at SAVE_POINT to store in non-volatile memory and at RESTORE_POINT restored before PCGCCTL.EssRegRestored field is set. - [31] if_dev_mode -- 1: Device mode, core restored as device -- 0: Host mode, core restored as host - [30:29] p2hd_prt_spd (PRT speed) -- 00: HS -- 01: FS -- 10: LS -- 11: Reserved - [28:27] p2hd_dev_enum_spd (Device enumerated speed) -- 00: HS -- 01: FS (30/60 MHz clk) -- 10: LS -- 11: FS (48 MHz clk) - [26:20] mac_dev_addr (MAC device address) Device address - [19] mac_termselect (Termination selection) -- 0: HS_TERM (Program for High Speed) -- 1: FS_TERM (Program for Full Speed) - [18:17] mac_xcvrselect (Transceiver select) -- 00: HS_XCVR (High Speed) -- 01: FS_XCVR (Full Speed) -- 10: LS_XCVR (Low Speed) -- 11: LFS_XCVR (Reserved) - [16] sh2pl_prt_ctl[0] -- 1: prt_power enabled -- 0: prt_power disabled - [15:14] prt_clk_sel (Refer prt_clk_sel table) Defines port clock select for different speeds.

8.27.5.196 GSTARFXDIS

Address offset: 0xF00

Global STAR Fix Disable Register

This register is used to disable STAR fixes added in the controller. The application can set the register fields to operate with the functionality before the fix was done.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	a	Z	Y		X	W	V	U	T	S	R		Q	P	O	N			M	L	K	J		I	H	G	F	E	D	C	B	A
Reset 0x00002200	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	HOSTIGNORESRMTWKUPDIS			Disable the STAR fix added for Device controller to go back to low power mode when Host ignores Remote wakeup The application programs Host_Ignores_RmtWkup_dis=1 to disable the device controller from going back to low power mode (SUSPENDED state) when the host ignores the remote wakeup signalling from the device and does not respond back with resume. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Device controller goes back into SUSPENDED state when host ignores Remote Wakeup
			DISABLEFIX	1	Device controller waits indefinitely without entering SUSPENDED state when host ignores the Remote Wakeup
B	RW	RESUMEFRMCHKBUSDIS			Disable the STAR fix added for Device controller to detect lineK and move to RESUMING state after the 50us pull-up delay ends The application programs Resume_frm_CHK_BUS_dis=1 to disable the device controller from detecting line K and transitioning to RESUMING state in the scenario where Host resume starts immediately after the 50us pull-up delay timer expires. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Device controller detects line K and resumes
			DISABLEFIX	1	Device controller does not detect line K and resume

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	a	Z	Y		X	W	V	U	T	S	R		Q	P	O	N			M	L	K	J		I	H	G	F	E	D	C	B	A
Reset 0x00002200	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
C	RW	IGNORECTLOUTDATA0DIS			Disable the STAR fix added for Device controller to reject DATA0 for the first Control OUT Data Phase and Control Status OUT Phase The application programs Ignore_CtlOUT_DATA0_dis=1 to disable the device controller from reporting transaction error when DATA0 PID is received from host for the first Control OUT Data Phase and Control Status OUT phase. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Transaction Error reported when host sends DATA0 PID
			DISABLEFIX	1	Transaction Error not reported when host sends DATA0 PID
D	RW	SSPLITSTALLNYETERRDIS			Disable the STAR fix added for Host controller to flag error for SSPLIT STALL/NYET The application programs SSPLIT_STALLNYET_Err_dis=1 to disable the host controller from reporting transaction error for STALL/NYET received from device for SSPLIT transfer. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Transaction Error reported when device sends STALL/NYET for SSPLIT
			DISABLEFIX	1	Transaction Error not reported when device sends STALL/NYET for SSPLIT
E	RW	ACCEPTISOCSPLITDATA1DIS			Disable the STAR fix added for Host controller to accept DATA1 PID from device for ISOC Split transfers The application programs Accept_Isoc_split_DATA1_dis=1 to disable the host controller from accepting DATA1 PID from device for ISOC Split transfers. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Transaction Error not reported when device sends DATA1 PID for ISOC Split
			DISABLEFIX	1	Transaction Error reported when device sends DATA1 PID for ISOC Split
F	RW	HANDLEFAULTYCABLEDIS			Disable the STAR fix added for Host controller to handle Faulty cable scenarios The application programs HandleFaultyCable_dis=1 to disable the host controller from reporting Port Babble error when the linestate is stuck at 1 (in FS mode) or 2 (in LS mode) due to a Faulty cable. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Fix for handling faulty cable enabled
			DISABLEFIX	1	Fix for handling faulty cable disabled
G	RW	LSIPGINCRDIS			Disable the STAR fix added for Host controller LS mode IPG increment from 2 LS bit times to 3 LS bit times The application programs LS_IPG_incr_dis=1 to disable the IPG increment from 2 to 3 LS bit times when host controller is operating in LS mode. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Host LS mode IPG is 3 LS bit times
			DISABLEFIX	1	Host LS mode IPG is 2 LS bit times
H	RW	FSDISCIDLEDIS			Disable the STAR fix added for Device controller to transition to IDLE state during FS device disconnect The application programs FSDisc_Idle_dis=1 to disable the Transmit/Receive state machine from moving to IDLE state when FS device disconnect happens. This bit must be programmed during the initial configuration of the controller and must not be modified later.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	a	Z	Y		X	W	V	U	T	S	R		Q	P	O	N			M	L	K	J		I	H	G	F	E	D	C	B	A
Reset 0x00002200	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
			ENABLEFIX	0	Device controller transitions to IDLE state during FS device disconnect
			DISABLEFIX	1	Device controller does not transition to IDLE state during FS device disconnect
I	RW	CONCURRENTRMTWKUPUSBRESUMEDIS			Disable the STAR fix added for Device controller to not start Remote Wakeup signalling when USB resume has already started The application programs Concurrent_Rmtwkup_USBResume_dis=1 to allow the controller to do remote wakeup signalling when USB resume has already started from the Host. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Device controller does not start remote wakeup signalling when host resume has already started
			DISABLEFIX	1	Device controller is allowed to start remote wakeup signalling when host resume has already started
J	RW	LSIPGCHKAFTERNAKSTALLFORINDIS			Disable the STAR fix added for Host controller to wait for IPG duration to send next token after receiving NAK/STALL for previous IN token with FS/LS device The application programs LS_IPG_chk_after_NAK_STALL_for_IN_dis=1 to allow the controller to send the next token without waiting for the interpacket gap duration after receiving a NAK/STALL from device for the previous IN token. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Host controller checks IPG after NAK/STALL for IN token
			DISABLEFIX	1	Host controller does not check IPG after NAK/STALL for IN token
K	RW	PHYIOPXCVRSELTXVLDCORRDIS			Disable the STAR fix added for Host controller to increase the gap between utmi_xcvrselect switching and utmi_txvalid assertion in LS/FS mode The application programs PHY_IOp_xcvrsel_txvld_corr_dis=1 to allow the controller to assert utmi_txvalid 1 cycle after the utmi_xcvrselect switching. This can cause interop issues with SNPS PHY which requires at least 2 cycles of gap between the utmi_xcvrselect switch and the utmi_txvalid assertion. Hence it is recommended to program PHY_IOp_xcvrsel_txvld_corr_dis=0. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Host controller asserts utmi_txvalid at least 2 utmi_clk cycles after utmi_xcvrselect switching
			DISABLEFIX	1	Host controller can assert utmi_txvalid after 1 utmi_clk cycle of utmi_xcvrselect switching

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	a	Z	Y		X	W	V	U	T	S	R		Q	P	O	N			M	L	K	J		I	H	G	F	E	D	C	B	A
Reset 0x00002200	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
L	RW	ULPIXCVRSELSWITCHCORRDIS			Disable the STAR fix added for Host controller to increase the preamble transceiver select switch delay to accommodate time taken for ULPI function control write The application programs ULPI_xcvrsel_switch_corr_dis=1 to allow the controller to do back to back transceiver select switching within the duration required for a single ULPI function control write (around 5-6 ulpi_clk cycles). This can cause a corrupted packet to go on the bus since the ULPI wrapper may not be able to do the second ULPI functional update (register write) correctly. Hence it is recommended to program ULPI_xcvrsel_switch_corr_dis=0. With ULPI_xcvrsel_switch_corr_dis=0, the delay between transceiver select switch and txvalid assertion has also been increased for FS/LS mode to resolve PHY interop issues. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Host controller waits for previous functional register update to complete before switching the transceiver select again or asserting txvalid
			DISABLEFIX	1	Host controller does not wait for the previous functional register update to complete before switching the transceiver select again or asserting txvalid
M	RW	XACTERRDATA0CTRLSTSINDIS			Disable the STAR fix added for Host controller to report transaction error when DATA0 PID is received for CTRL STATUS IN transfer in DMA mode The application programs XactErr_DATA0_CTRL_STS_IN_dis=1 to allow the controller to respond with ACK for the incorrect DATA0 PID and then retry the control STATUS IN transfer until DATA1 PID is received. With XactErr_DATA0_CTRL_STS_IN_dis=0, the controller generates Transaction Error interrupt when the incorrect PID is received. This STAR fix is applicable only for Buffer DMA and Descriptor DMA modes. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Host controller reports transaction error when DATA0 PID is received for CTRL STATUS IN transfer in DMA mode
			DISABLEFIX	1	Host controller retries the transfer when DATA0 PID is received for CTRL STATUS IN transfer in DMA mode
N	RW	HOSTUTMITXVLDCORRDIS			Disable the correction to OpMode/XcvrSel/TermSel on UTMI Interface in Host mode. When HPRT.PrtRst is set by the application, the Host controller can change the Opmode, XcvrSel and TermSel while TxValid is still high (1'b1) during SOF transmission in 8-bit UTMI mode. This behavior of the controller has been corrected to handle port reset during SOF transmission. With the fix, the controller waits for Txvalid to go low (1'b0) and then changes the OpMode, XcvrSel and TermSel. The application can set this register bit to 1'b1 to fall back to the original behavior of the controller. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Opmode, XcvrSel, TermSel are changed by the Host Controller after TxValid goes LOW (1'b0)
			DISABLEFIX	1	Opmode, XcvrSel, TermSel are changed by the Host Controller without waiting for TxValid to go LOW (1'b0) during SOF transmission

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	a	Z	Y		X	W	V	U	T	S	R		Q	P	O	N			M	L	K	J		I	H	G	F	E	D	C	B	A
Reset 0x00002200	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
O	RW	OPMODEXCVRSELCHIRPENCORRDIS			Disable the STAR fix added for correcting Opmode and XcvrSel on UTMI Interface when reset is detected in suspend state. In configurations with Battery charger support enabled (and GOTGCTL.ChirpEn programmed to 1), the RTL has been updated to wait for 1ms and then change the opmode and xcvrselect when reset is detected in the suspend state. The application can set this register bit to 1'b1 to fall back to the original behavior of the controller and change Opmode and XcvrSel without waiting for 1ms after reset detection. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Valid Combination of Opmode and XcvrSel is driven when reset is detected in suspend state
			DISABLEFIX	1	Invalid Combination of Opmode and XcvrSel is driven when reset is detected in suspend state
P	RW	TXVALIDDEASSERTIONCORRDIS			Disable the STAR fix added for correcting Txvalid deassertion on UTMI Interface when soft disconnect is done. The RTL has been updated to wait for utmi_txready and then de-assert the utmi_txvalid being driven by MAC DSSR when soft disconnect is done. The application can set this register bit to 1'b1 to fall back to the original behavior of the controller and change Txvalid without waiting for Txready. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Txvalid is deasserted during soft disconnect after receiving Txready from the PHY
			DISABLEFIX	1	Txvalid is deasserted during soft disconnect without waiting for Txready from the PHY
Q	RW	HOSTNOXFERAFTERPRTDISFIXDIS			Disable the STAR fix added for correcting Host behavior when port is disabled. The RTL has been updated to not assert utmi_txvalid when the port is disabled. The application can set this register bit to 1'b1 to fall back to the original behavior of the controller. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Txvalid is not asserted when port is disabled
			DISABLEFIX	1	Txvalid can be asserted when port is disabled
R	RW	LINESTATESE0FILTERFOREOPDIS			Disable the STAR fix added for filtering SE0 from the linestate during EOP detection.. The RTL has been updated to filter glitches occurred in the linestate. The application can set this register bit to 1'b1 to fall back to the original behavior of the controller. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Filter for linestate is enabled
			DISABLEFIX	1	Filter for linestate is not enabled

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	a	Z	Y		X	W	V	U	T	S	R		Q	P	O	N			M	L	K	J		I	H	G	F	E	D	C	B	A
Reset 0x00002200	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
S	RW	DMPULLDOWNUPDATEINOTGFORHIBANDPP			Disable the STAR fix added for utmiotg_dmpulldown update in Hibernation and Partial power down modes. The RTL has been updated for OTG mode to remove the glitch in utmiotg_dmpulldown signal while controller is exiting from Hibernation or Partial power down. The application can set this register bit to 1'b1 to fall back to the original behavior of the controller. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	utmiotg_dmpulldown logic for hiberabtion and partial power down is enabled
			DISABLEFIX	1	utmiotg_dmpulldown logic for hiberabtion and partial power down is not enabled
T	RW	CHIRPDETECTIONUPDTHSTDIS			Disable the Chirp detection logic change in host mode. The RTL has been updated in Host mode to avoid the unexpected chirp detection when there is no chirp K from device. After the RTL fix chirp detection logic depends on the delayed WAIT_CHIRP state. The application can set this register bit to 1'b1 to fall back to the original behavior of the controller. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Chirp detection logic in MAC PRT module depends on the delayed WAIT_CHIRP state and only valid chirp K from device is detected
			DISABLEFIX	1	Chirp detection logic depends on the WAIT_CHIRP state and controller might detect false chirp K from device
U	RW	PROGRAMMABLESE0DURATIONTODETECTEOP			Disable the STAR fix added for programmable se0 duration to detect EOP in Host mode . The RTL Enhancement has been done to reduce the EOP SE0 detection time for USB2 SOF,transmitted by the core to work with longer cables and/ or devices with longer delays. The application can set this register bit to 1'b1 to fall back to the original behavior of the controller. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Programmable se0 duration to detect EOP in Host mode is enabled
			DISABLEFIX	1	Programmable se0 duration to detect EOP in Host mode is disabled
V	RW	ENABLELEVELSYNCHRONISERFORH2PDTXF			Disable the STAR fix added for h2pd_txf_0len_pkt signal which is passing through a level synchronizer. Dummy synchronizer of h2pd_txf_0len_pkt signal has been replaced with Level synchronizer. The application can set this register bit to 1'b1 to fall back to the original behavior of the controller. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	level synchroniser for h2pd_txf_0len_pkt is enabled and disabled dummy synchronizer
			DISABLEFIX	1	level synchroniser for h2pd_txf_0len_pkt is disabled and connected through dummy synchronizer

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	a	Z	Y		X	W	V	U	T	S	R		Q	P	O	N			M	L	K	J		I	H	G	F	E	D	C	B	A
Reset 0x00002200	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
W	RW	EUSB2TERMINATERESUMEONDISCDIS			Disable fix for Terminating Resume if UTMI HostDisconnect is detected. The RTL has been updated in Host mode to terminate Resume if UTMI HostDisconnect is asserted, this is to avoid the controller and PHY from being out of sync if HostDisconnect coincides with the beginning of Resume transmission. The application can set this register bit to 1'b1 to fall back to the original behavior of the controller. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Host controller terminates Resume if HostDisconnect is asserted
			DISABLEFIX	1	Host controller does not terminate Resume if HostDisconnect is asserted
X	RW	EUSB2FSLSDISCDETECTIONDIS			Disable fix for FS/LS disconnect detection using UTMI HostDisconnect in MAC PRT. The RTL has been updated in Host mode to detect disconnect using the utmi_hostdisconnect signal instead of monitoring 2.5us of SE0 on DP/DM. The application can set this register bit to 1'b1 to fall back to the original behavior of the controller. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Host controller detects FS/LS disconnect using utmi_hostdisconnect signal
			DISABLEFIX	1	Host controller detects disconnect by monitoring 2.5us of SE0 on DP/DM
Y	RW	HOSTFLUSHEXCESSTKNFIXDIS			Disable fix for recovering the Host controller when sufficient time is not available in the current uF for an overscheduled ISOC OUT or INTR IN transfer. The application can set this register bit to 1'b1 to fall back to the original behavior of the controller. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	Host controller functionality is as expected if there is an overscheduled ISOC OUT or INTR IN transfer
			DISABLEFIX	1	Host controller functionality cannot be determined if there is an overscheduled ISOC OUT or INTR IN transfer
Z	RW	TITRANSDONETGLDURINGISOCEOPFDISAB			Disable the fix added to not toggle ti_trans_done in SEND_EOP state when the ISOC in tokens responds with zero length packets after end of periodic frame till next start of frame. The fix is added when operating in descriptor dma device mode. The application can set this register bit to 1'b1 to fall back to the original behavior of the controller. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	ti_transdone is not toggled after eopf during ISOC IN transfer till next SOF
			DISABLEFIX	1	ti_transdone is toggled after eopf during ISOC IN transfer till next SOF
a	RW	CLEARSOFREFCLKTIMERDURINGDISC			Disable the STAR fix added to clear the SOF refclk timer during disconnect detection. The STAR fix is added when using both UTMI and eUSB2 PHY. The application can set this register bit to 1'b1 to fall back to the original behavior of the controller. This bit must be programmed during the initial configuration of the controller and must not be modified later.
			ENABLEFIX	0	SOF refclk timer is cleared immediately after device disconnect is detected.
			DISABLEFIX	1	SOF refclk timer is not cleared immediately after device disconnect is detected.

8.27.5.197 DWCOTGDFIFO[n].DATA[o] (n=0..15) (o=0..1023)

Address offset: 0x1000 + (n × 0x1000) + (o × 0x4)

Data FIFO Access Register Map 0

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description

8.27.5.198 DWCOTGDFIFODIRECTACCESS.DATA[n] (n=0..3071)

Address offset: 0x11000 + (n × 0x4)

Data FIFO Direct Access Register Map

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description

8.28 VPR — RISC-V CPU

VPR is a small, efficient CPU developed by Nordic Semiconductor.

The VPR implementation is the Fast Lightweight Peripheral Processor (FLPR), optimized to implement coprocessor functions, and operating at the same frequency as the application processor.

VPR is compatible with the RISC-V instruction set and implements the following extensions:

- E – Integer instruction set with 16 registers
- M – Multiply and divide extension
- C – Compressed extension (compressed instructions)

VPR implements the machine mode CPU mode as well as the RISC-V CLIC specification for the interrupt controller.

VPR does not start on its own, but must be started by the application core processor by performing the following steps:

1. Configure VPR program counter (PC) to point to the peripheral binary image by using register INITPC on page 1123.
2. Start VPR by using register CPURUN on page 1122.

8.28.1 VPR registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
VPR00 : S VPR00 : NS	GLOBAL	0x5004C000 0x4004C000	US	NS	NA	No	FLPR - VPR peripheral registers

Configuration

Instance	Domain	Configuration
VPR00 : S VPR00 : NS	GLOBAL	VEVIF indexes 16 through 19 maps onto DPPI channels 0 through 4 Supports RV32E (Base Integer Instruction Set embedded) Supports M extension (Integer Multiplication and Division) Supports C extension (compressed instructions) Supports Zba extension (Bit Manipulation - Address generation instructions) Supports Zbb extension (Bit Manipulation - Basic bit manipulation) Supports Zbc extension (Bit Manipulation - Carry-less multiplication) Supports Zbs extension (Bit Manipulation - Single bit instructions) Supports Zcb extension (code-size saving instructions) Does not support FENCE.I instruction (use FENCE instruction instead) Supports CSR (Control and Status Register) instructions Does not support CNTR (base counter) instructions Supports M-mode CLIC (interrupt controller) Supports MCLICCFG register Supports external debugger Debugger supports triggers (breakpoints) Boot vector (INIT_PC_RESET_VALUE): 0x00000000 Self-booting (VPR_START_RESET_VALUE): 0 VPR RAM base address (RAM_BASE_ADDR): 0x20000000 VPR RAM size (RAM_SZ): 20 (Value in bytes is computed as 2^(RAM size)) Retain registers in Deep Sleep mode: 0 Restore VPR context at VPR reset using register [NRF_MEMCONF->POWER1.RET].MEM[0] VPR context save address: 0x2007FD40 VPR context save size: 512 bytes VPR remap address: 0x00000000 VEVIF tasks: 16..22 Mask of supported VEVIF tasks: 0x007F0000 VEVIF DPPI indices: 16..19 Mask of supported VEVIF DPPI channels: 0x000F0000 VEVIF events: 16..22 Mask of supported VEVIF events: 0x00100000 Debugger interface register offset: 0x5004C400 New RTP features

Register overview

Register	Offset	TZ	Description
TASKS_TRIGGER[n]	0x000		VPR task [n] register

Register	Offset	TZ	Description
SUBSCRIBE_TRIGGER[n]	0x080		Subscribe configuration for task TASKS_TRIGGER[n]
EVENTS_TRIGGERED[n]	0x100		VPR event [n] register
PUBLISH_TRIGGERED[n]	0x180		Publish configuration for event EVENTS_TRIGGERED[n]
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
INTPEND	0x30C		Pending interrupts
DEBUGIF.DATA0	0x410		Abstract Data 0. Read/write data for argument 0
DEBUGIF.DATA1	0x414		Abstract Data 1. Read/write data for argument 1
DEBUGIF.DMCONTROL	0x440		Debug Module Control
DEBUGIF.DMSTATUS	0x444		Debug Module Status
DEBUGIF.HARTINFO	0x448		Hart Information
DEBUGIF.HALTSUM1	0x44C		Halt Summary 1
DEBUGIF.HAWINDOWSEL	0x450		Hart Array Window Select
DEBUGIF.HAWINDOW	0x454		Hart Array Window
DEBUGIF.ABSTRACTCS	0x458		Abstract Control and Status
DEBUGIF.ABSTRACTCMD	0x45C		Abstract command
DEBUGIF.ABSTRACTAUTO	0x460		Abstract Command Autoexec
DEBUGIF.CONFSTRPTR[n]	0x464		Configuration String Pointer [n]
DEBUGIF.NEXTDM	0x474		Next Debug Module
DEBUGIF.PROGBUF[n]	0x480		Program Buffer [n]
DEBUGIF.AUTHDATA	0x4C0		Authentication Data
DEBUGIF.HALTSUM2	0x4D0		Halt Summary 2
DEBUGIF.HALTSUM3	0x4D4		Halt Summary 3
DEBUGIF.SBADDRESS3	0x4DC		System Bus Addres 127:96
DEBUGIF.SBCS	0x4E0		System Bus Access Control and Status
DEBUGIF.SBADDRESS0	0x4E4		System Bus Addres 31:0
DEBUGIF.SBADDRESS1	0x4E8		System Bus Addres 63:32
DEBUGIF.SBADDRESS2	0x4EC		System Bus Addres 95:64
DEBUGIF.SBDATA0	0x4F0		System Bus Data 31:0
DEBUGIF.SBDATA1	0x4F4		System Bus Data 63:32
DEBUGIF.SBDATA2	0x4F8		System Bus Data 95:64
DEBUGIF.SBDATA3	0x4FC		System Bus Data 127:96
DEBUGIF.HALTSUM0	0x500		Halt summary 0
CPURUN	0x800		State of the CPU after a core reset
VPRSTATUS	0x804		VPR state information.
INITPC	0x808		Initial value of the PC at CPU start.

8.28.1.1 TASKS_TRIGGER[n] (n=16..22)

Address offset: 0x000 + (n × 0x4)

VPR task [n] register

If RTPs are not enabled: writes to registers 15..0 are ignored, other read/write accesses operate normally

If RTPs are enabled: reads or writes to these registers will be stalled if there is a simultaneous VPR CSR write access to any of the VEVIF CSR registers (except VEVENTSB and VEVENTSBS).

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_TRIGGER			VPR task [n] register If RTPs are not enabled: writes to registers 15..0 are ignored, other read/write accesses operate normally If RTPs are enabled: reads or writes to these registers will be stalled if there is a simultaneous VPR CSR write access to any of the VEVIF CSR registers (except VEVENTSB and VEVENTSBS).
			Trigger	1	Trigger task

8.28.1.2 SUBSCRIBE_TRIGGER[n] (n=16..19)

Address offset: 0x080 + (n × 0x4)

Subscribe configuration for task TASKS_TRIGGER[n]

If RTPs are not enabled: writes to registers 15..0 are ignored, other read/write accesses operate normally

If RTPs are enabled: reads or writes to these registers will be stalled if there is a simultaneous VPR CSR write access to any of the VEVIF CSR registers (except VEVENTSB and VEVENTSBS).

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	CHIDX			DPPI channel that task TASKS_TRIGGER[n] will subscribe to
B	RW	EN			Subscription enable bit
			Disabled	0x0	Disable subscription
			Enabled	0x1	Enable subscription

8.28.1.3 EVENTS_TRIGGERED[n] (n=16..22)

Address offset: 0x100 + (n × 0x4)

VPR event [n] register

If RTPs are not enabled: writes to registers 15..0 are ignored, other read/write accesses operate normally

If RTPs are enabled: reads or writes to these registers will be stalled if there is a simultaneous VPR CSR write access to any of the VEVIF CSR registers (except VEVENTSB and VEVENTSBS).

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_TRIGGERED			VPR event [n] register If RTPs are not enabled: writes to registers 15..0 are ignored, other read/write accesses operate normally If RTPs are enabled: reads or writes to these registers will be stalled if there is a simultaneous VPR CSR write access to any of the VEVIF CSR registers (except VEVENTSB and VEVENTSBS).
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.28.1.4 PUBLISH_TRIGGERED[n] (n=16..19)

Address offset: 0x180 + (n × 0x4)

Publish configuration for event EVENTS_TRIGGERED[n]

If RTPs are not enabled: writes to registers 15..0 are ignored, other read/write accesses operate normally

If RTPs are enabled: reads or writes to these registers will be stalled if there is a simultaneous VPR CSR write access to any of the VEVIF CSR registers (except VEVENTSB and VEVENTSBS).

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	CHIDX			DPPI channel that event EVENTS_TRIGGERED[n] will publish to
B	RW	EN			Publication enable bit
			Disabled	0x0	Disable publishing
			Enabled	0x1	Enable publishing

8.28.1.5 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
	RW	TRIGGERED[i] (i=16..22)			Enable or disable interrupt for event TRIGGERED[i] If RTPs are not enabled: writes to registers 15..0 are ignored, other read/write accesses operate normally If RTPs are enabled: reads or writes to these registers will be stalled if there is a simultaneous VPR CSR write access to any of the VEVIF CSR registers (except VEVENTSB and VEVENTSBS).
			Disabled	0	Disable
			Enabled	1	Enable

8.28.1.6 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
	RW W1S	TRIGGERED[i] (i=16..22)			Write '1' to enable interrupt for event TRIGGERED[i] If RTPs are not enabled: writes to registers 15..0 are ignored, other read/ write accesses operate normally If RTPs are enabled: reads or writes to these registers will be stalled if there is a simultaneous VPR CSR write access to any of the VEVIF CSR registers (except VEVENTSB and VEVENTSBS).
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.28.1.7 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
	RW W1C	TRIGGERED[i] (i=16..22)			Write '1' to disable interrupt for event TRIGGERED[i] If RTPs are not enabled: writes to registers 15..0 are ignored, other read/ write accesses operate normally If RTPs are enabled: reads or writes to these registers will be stalled if there is a simultaneous VPR CSR write access to any of the VEVIF CSR registers (except VEVENTSB and VEVENTSBS).
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.28.1.8 INTPEND

Address offset: 0x30C

Pending interrupts

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
	R	TRIGGERED[i] (i=16..22)			Read pending status of interrupt for event TRIGGERED[i] If RTPs are not enabled: writes to registers 15..0 are ignored, other read/ write accesses operate normally If RTPs are enabled: reads or writes to these registers will be stalled if there is a simultaneous VPR CSR write access to any of the VEVIF CSR registers (except VEVENTSB and VEVENTSBS).
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending

8.28.1.9 DEBUGIF.DATA0

Address offset: 0x410

Abstract Data 0. Read/write data for argument 0

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	DATA0																																	
																																			Abstract Data 0

8.28.1.10 DEBUGIF.DATA1

Address offset: 0x414

Abstract Data 1. Read/write data for argument 1

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	DATA1																																	
																																			Abstract Data 1

8.28.1.11 DEBUGIF.DMCONTROL

Address offset: 0x440

Debug Module Control

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				K	J	I	H		G	F	F	F	F	F	F	F	F	F	E	E	E	E	E	E	E	E	E	E			D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	DMACTIVE																																	Reset signal for the debug module.
			Disabled	0																															Reset the debug module itself
			Enabled	1																															Normal operation
B	RW	NDMRESET																																	Reset signal output from the debug module to the system.
			Inactive	0																															Reset inactive
			Active	1																															Reset active
C	W	CLRRESETHALTREQ																																	Clear the halt on reset request.
			NoOperation	0																															No operation when written 0.
			Clear	1																															Clears the halt on reset request
D	W	SETRESETHALTREQ																																	Set the halt on reset request.
			NoOperation	0																															No operation when written 0.
			Set	1																															Sets the halt on reset request
E	W	HARTSELHI																																	The high 10 bits of hartsel.
F	W	HARTSELLO																																	The low 10 bits of hartsel.
G	W	HASEL																																	Definition of currently selected harts.
			Single	0																															Single hart selected.
			Multiple	1																															Multiple harts selected
H	W	ACKHAVERESET																																	Clear the havereset.
			NoOperation	0																															No operation when written 0.
			Clear	1																															Clears the havereset for selected harts.
I	RW	HARTRESET																																	Reset harts.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				K J I H G F F F F F F F F F E E E E E E E E E E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Deasserted	0	Reset de-asserted.
			Asserted	1	Reset asserted.
J	W	RESUMEREQ			Resume currently selected harts.
			NoOperation	0	No operation when written 0.
			Resumed	1	Currently selected harts resumed.
K	W	HALTREQ			Halt currently selected harts.
			Clear	0	Clears halt request bit for all currently selected harts.
			Halt	1	Currently selected harts halted.

8.28.1.12 DEBUGIF.DMSTATUS

Address offset: 0x444

Debug Module Status

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				R Q P O N M L K J I H G F E D C B A A A A
Reset 0x00400082				**0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0**
ID	R/W	Field	Value ID	Value	Description
A	R	VERSION			Version of the debug module.
			NotPresent	0	Debug module not present.
			V011	1	There is a Debug Module and it conforms to version 0.11 of this specifcation.
			V013	2	There is a Debug Module and it conforms to version 0.13 of this specifcation.
			NonConform	15	There is a Debug Module but it does not conform to any available version of the spec.
B	R	CONFSTRPTRVALID			Configuration string.
			NotRelevant	0	The confstrptr0..confstrptr3 holds information which is not relevant to the configuration string.
			Address	1	The confstrptr0..confstrptr3 holds the address of the configuration string.
C	R	HASRESETHALTREQ			Halt-on-reset support status.
			No	0	Halt-on-reset is supported.
			Yes	1	Halt-on-reset is not supported.
D	R	AUTHBUSY			Authentication busy status.
			No	0	The authentication module is ready.
			Yes	1	The authentication module is busy.
E	R	AUTHENTICATED			Authentication status.
			No	0	Authentication required before using the debug module.
			Yes	1	Authentication passed.
F	R	ANYHALTED			Any currently selected harts halted status.
			No	0	None of the currently selected harts halted.
			Yes	1	Any of the currently selected harts halted.
G	R	ALLHALTED			All currently selected harts halted status.
			No	0	Not all of the currently selected harts halted.
			Yes	1	All of the currently selected harts halted.
H	R	ANYRUNNING			Any currently selected harts running status.
			No	0	None of the currently selected harts running.
			Yes	1	Any of the currently selected harts running.
I	R	ALLRUNNING			All currently selected harts running status.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID													R			Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A	A	A	A
Reset 0x00400082				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**
ID	R/W	Field	Value ID	Value																															
			No	0																															
			Yes	1																															
J	R	ANYUNAVAIL																																	
			No	0																															
			Yes	1																															
K	R	ALLUNAVAIL																																	
			No	0																															
			Yes	1																															
L	R	ANYNONEXISTENT																																	
			No	0																															
			Yes	1																															
M	R	ALLNONEXISTENT																																	
			No	0																															
			Yes	1																															
N	R	ANYRESUMEACK																																	
			No	0																															
			Yes	1																															
O	R	ALLRESUMEACK																																	
			No	0																															
			Yes	1																															
P	R	ANYHAVERESET																																	
			No	0																															
			Yes	1																															
Q	R	ALLHAVERESET																																	
			No	0																															
			Yes	1																															
R	R	IMPEBREAK																																	
			No	0																															
			Yes	1																															

8.28.1.13 DEBUGIF.HARTINFO

Address offset: 0x448

Hart Information

This register gives information about the hart currently selected by hartsel. This register is optional. If it is not present it should read all-zero. If this register is included, the debugger can do more with the Program Buffer by writing programs which explicitly access the data and/or dscratch registers

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D C B B B B A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	DATAADDR		-2048 .. 2047	Data Address If dataaccess is 0: The number of the first CSR dedicated to shadowing the data registers. If dataaccess is 1: Address of RAM where the data registers are shadowed. This address is sign extended and easily addressed with a load or store using x0 as the address register.
B	R	DATASIZE		0 .. 12	Data Size If dataaccess is 0: Number of CSRs dedicated to shadowing the data registers. If dataaccess is 1: Number of 32-bit words in the memory map dedicated to shadowing the data registers. Since there are at most 12 data registers, the value in this register must be 12 or smaller
C	R	DATAACCESS			Data Access
			No	0	The data registers are shadowed in the hart by CSRs. Each CSR is DXLEN bits in size, and corresponds to a single argument.
			Yes	1	The data registers are shadowed in the hart's memory map. Each register takes up 4 bytes in the memory map.
D	R	NSCRATCH			Number of dscratch registers Number of dscratch registers available for the debugger to use during program buffer execution, starting from dscratch0. The debugger can make no assumptions about the contents of these registers between commands.

8.28.1.14 DEBUGIF.HALTSUM1

Address offset: 0x44C

Halt Summary 1

Each bit in this read-only register indicates whether any of a group of harts is halted or not. Unavailable/ nonexistent harts are not considered to be halted. This register might not be present if fewer than 33 harts are connected to this DM. The LSB reflects the halt status of harts hartsel[19:10] 0x0 through 0x1f. The MSB reflects the halt status of harts hartsel[19:10] 0x3e0 through 0x3ff.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	HALTSUM1			Halt Summary 1

8.28.1.15 DEBUGIF.HAWINDOWSEL

Address offset: 0x450

Hart Array Window Select

This register selects which of the 32-bit portion of the hart array mask register is accessible in hawindow

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	HAWINDOWSEL			The high bits of this field may be tied to 0, depending on how large the array mask register is. E.g. on a system with 48 harts only bit 0 of this field may actually be writable.

8.28.1.16 DEBUGIF.HAWINDOW

Address offset: 0x454

Hart Array Window

This register provides R/W access to a 32-bit portion of the hart array mask register. The position of the window is determined by hawindowsel. I.e. bit 0 refers to hart hawindowsel x 32, while bit 31 refers to hart hawindowsel x 32 + 31. Since some bits in the hart array mask register may be constant 0, some bits in this register may be constant 0, depending on the current value of hawindowsel.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MASKDATA			Mask data.

8.28.1.17 DEBUGIF.ABSTRACTCS

Address offset: 0x458

Abstract Control and Status

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D C B B B A A A A
Reset 0x01000002				**0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0**
ID	R/W	Field	Value ID	Value	Description
A	R	DATACOUNT			Number of data registers that are implemented as part of the abstract command interface. Valid sizes are 1..12.
B	RW	CMDERR			Command error when the abstract command fails.
			NoError	0	No error.
			Busy	1	An abstract command was executing while command, abstractcs, or abstractauto was written, or when one of the data or progbuf registers was read or written. This status is only written if cmderr contains 0
			NotSupported	2	The requested command is notsupported, regardless of whether the hart is running or not.
			Exception	3	An exception occurred while executing the command (e.g. while executing theProgram Buffer).
			HaltResume	4	The abstract command couldn't execute because the hart wasn't in the required state (running/halted). or unavailable.
			Bus	5	The abstract command failed due to abus error (e.g. alignment, access size, or timeout).
			Other	7	The command failed for another reason.
C	R	BUSY			Abstract command execution status.
			NotBusy	0	Not busy.
			Busy	1	An abstract command is currently being executed. This bit is set as soon as command is written, and is not cleared until that command has completed.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID							D	D	D	D	D												C		B	B	B					A	A	A	A
Reset 0x01000002				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**
ID	R/W	Field	Value ID	Value			Description																												
D	R	PROGBUFSIZE					Size of the Program Buffer, in 32-bit words. Valid sizes are 0 - 1.																														

8.28.1.18 DEBUGIF.ABSTRACTCMD

Address offset: 0x45C

Abstract command

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value			Description																												
A	W	CONTROL					This Field is interpreted in a command specific manner, described for each abstract command.																														
B	W	CMDTYPE					The type determines the overall functionality of this abstract command.																														
			REGACCESS	0			Register Access Command																														
			MEMACCESS	2			Memory Access Command																														

8.28.1.19 DEBUGIF.ABSTRACTAUTO

Address offset: 0x460

Abstract Command Autoexec

This register is optional. Including it allows more efficient burst accesses. A debugger can detect whether it is support by setting bits and reading them back. Writing this register while an abstract command is executing causes cmderr to become 1 (busy) once the command completes (busy becomes 0).

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B					A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value			Description																												
A	R	AUTOEXECDATA					When a bit in this field is 1, read or write accesses to the corresponding data word cause the command in command to be executed again.																														
B	R	AUTOEXECPROGBUF					When a bit in this field is 1, read or write accesses to the corresponding progbuf word cause the command in command to be executed again.																														

8.28.1.20 DEBUGIF.CONFSTRPTR[n] (n=0..3)

Address offset: 0x464 + (n × 0x4)

Configuration String Pointer [n]

When confstrptrvalid is set, reading this register returns bits 31:0 of the configuration string pointer. Reading the other confstrptr registers returns the upper bits of the address. When system bus mastering is implemented, this must be an address that can be used with the System Bus Access module. Otherwise, this must be an address that can be used to access the configuration string from the hart with ID 0.32 RISC-V External Debug Support Version 0.13.2 If confstrptrvalid is 0, then the confstrptr registers hold identifier information.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	ADDR			Address

8.28.1.21 DEBUGIF.NEXTDM

Address offset: 0x474

Next Debug Module

If there is more than one DM accessible on this DMI, this register contains the base address of the next one in the chain, or 0 if this is the last one in the chain.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	ADDR			Address

8.28.1.22 DEBUGIF.PROGBUF[n] (n=0..15)

Address offset: 0x480 + (n × 0x4)

Program Buffer [n]

progbuf0 through progbuf15 provide read/write access to the optional program buffer. progbufsize indicates how many of them are implemented starting at progbuf0, counting up. Accessing these registers while an abstract command is executing causes cmderr to be set to 1 (busy) if it is 0. Attempts to write them while busy is set does not change their value. The values in these registers may not be preserved after an abstract command is executed. The only guarantees on their contents are the ones offered by the command in question. If the command fails, no assumptions can be made about the contents of these registers.

Note: The VPR implements a single progbuf, all others (beyond progbuf0) are hardwired 0

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	DATA			Data

8.28.1.23 DEBUGIF.AUTHDATA

Address offset: 0x4C0

Authentication Data

This register serves as a 32-bit serial port to/from the authentication module. When authbusy is clear, the debugger can communicate with the authentication module by reading or writing this register. There is no separate mechanism to signal overflow/underflow.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	DATA			Data

8.28.1.24 DEBUGIF.HALTSUM2

Address offset: 0x4D0

Halt Summary 2

Each bit in this read-only register indicates whether any of a group of harts is halted or not. Unavailable/ nonexistent harts are not considered to be halted. This register might not be present if fewer than 1025 harts are connected to this DM. The LSB reflects the halt status of harts hartsel[19:15] 0x0 through hartsel[19:15] 0x3ff. The MSB reflects the halt status of harts hartsel[19:15] 0x7c00 through hartsel[19:15] 0x7fff

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	HALTSUM2			Halt Summary 2

8.28.1.25 DEBUGIF.HALTSUM3

Address offset: 0x4D4

Halt Summary 3

Each bit in this read-only register indicates whether any of a group of harts is halted or not. Unavailable/ nonexistent harts are not considered to be halted. This register might not be present if fewer than 32769 harts are connected to this DM. The LSB reflects the halt status of harts 0x0 through 0x7fff. The MSB reflects the halt status of harts 0xf8000 through 0xfffff

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	HALTSUM3			Halt Summary 3

8.28.1.26 DEBUGIF.SBADDRESS3

Address offset: 0x4DC

System Bus Addres 127:96

If sbasize is less than 97, then this register is not present. When the system bus master is busy, writes to this register will set sbbusyerror and don't do anything else.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	ADDRESS			Accesses bits 127:96 of the physical address in sbaddress (if the system address bus is that wide).

8.28.1.27 DEBUGIF.SBCS

Address offset: 0x4E0

System Bus Access Control and Status

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	N	N	N							M	L	K	J	J	J	I	H	G	G	G	F	F	F	F	F	F	E	D	C	B	A
Reset 0x20000000	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	SBACCESS8			8-bit system bus accesses are supported.
B	R	SBACCESS16			16-bit system bus accesses are supported.
C	R	SBACCESS32			32-bit system bus accesses are supported.
D	R	SBACCESS64			64-bit system bus accesses are supported.
E	R	SBACCESS128			128-bit system bus accesses are supported.
F	R	SBASIZE			Width of system bus addresses in bits. (0 indicates there is no bus access support.)
G	R	SBERROR			When the Debug Module's system bus master encounters an error, this field gets set. The bits in this field remain set until they are cleared by writing 1 to them. While this field is non-zero, no more system bus accesses can be initiated by the Debug Module. An implementation may report Other error (7) for any error condition.
			Normal	0	There was no bus error.
			Timeout	1	There was a timeout.
			Address	2	A bad address was accessed.
			Alignment	3	There was an alignment error.
			Size	4	An access of unsupported size was requested.
			Other	7	Other.
H	R	SBREADONDATA			
			sbreadondata	1	Every read from sbdata0 automatically triggers a system bus read at the (possibly autoincremented) address.
I	R	SBAUTOINCREMENT			
			sbautoincrement	1	sbaddress is incremented by the access size (in bytes) selected in sbaccess after every system bus access.
J	R	SBACCESS			Select the access size to use for system bus accesses. If sbaccess has an unsupported value when the DM starts a bus access, the access is not performed and sberror is set to 4.
			size8	0	8-bit.
			size16	1	16-bit.
			size32	2	32-bit.
			size64	3	64-bit.
			size128	4	128-bit.
K	R	SBREADONADDR			
			sbreadonaddr	1	Every write to sbaddress0 automatically triggers a system bus read at the new address.
L	R	SBBUSY			(Whether the system bus itself is busy is related, but not the same thing.) This bit goes high immediately when a read or write is requested for any reason, and does not go low until the access is fully completed. Writes to sbcs while sbbusy is high result in undefined behavior. A debugger must not write to sbcs until it reads sbbusy as 0.
			notbusy	0	System bus master is not busy.
			busy	1	System bus master is busy.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				N N N M L K J J J I H G G G F F F F F F E D C B A
Reset 0x20000000				**0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
M	R	SBBUSYERROR			Set when the debugger attempts to read data while a read is in progress, or when the debugger initiates a new access while one is already in progress (while sbbusy is set). It remains set until it's explicitly cleared by the debugger. While this field is set, no more system bus accesses can be initiated by the Debug Module.
			noerror	0	No error.
			error	1	Debugger access attempted while one in progress.
N	R	SBVERSION			
			version0	0	The System Bus interface conforms to mainline drafts of thia RISC-V External Debug Support spec older than 1 January, 2018.
			version1	1	The System Bus interface conforms to RISC-V External Debug Support version 0.13.2. Other values are reserved for future versions.

8.28.1.28 DEBUGIF.SBADDRESS0

Address offset: 0x4E4

System Bus Addres 31:0

If sbasize is 0, then this register is not present. When the system bus master is busy, writes to this register will set sbbusyerror and don't do anything else. If sberror is 0, sbbusyerror is 0, and sbreadonaddr is set then writes to this register start the following: 1. Set sbbusy. 2. Perform a bus read from the new value of sbaddress. 3. If the read succeeded and sbautoincrement is set, increment sbaddress. 4. Clear sbbusy.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	ADDRESS			Accesses bits 31:0 of the physical address in sbaddress.

8.28.1.29 DEBUGIF.SBADDRESS1

Address offset: 0x4E8

System Bus Addres 63:32

If sbasize is less than 33, then this register is not present. When the system bus master is busy, writes to this register will set sbbusyerror and don't do anything else.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	ADDRESS			Accesses bits 63:32 of the physical address in sbaddress (if the system address bus is that wide).

8.28.1.30 DEBUGIF.SBADDRESS2

Address offset: 0x4EC

System Bus Addres 95:64

If sbasize is less than 65, then this register is not present. When the system bus master is busy, writes to this register will set sbbusyerror and don't do anything else.

Bit number																																
ID																																
Reset 0x00000000																																
ID	R/W	Field	Value ID	Value	Description																											
A	R	ADDRESS			Accesses bits 95:64 of the physical address in sbaddress (if the system address bus is that wide).																											

8.28.1.31 DEBUGIF.SBDATA0

Address offset: 0x4F0

System Bus Data 31:0

If all of the sbaccess bits in sbcs are 0, then this register is not present. Any successful system bus read updates sbdata. If the width of the read access is less than the width of sbdata, the contents of the remaining high bits may take on any value. If either sberror or sbbusyerror isn't 0 then accesses do nothing. If the bus master is busy then accesses set sbbusyerror, and don't do anything else. Writes to this register start the following: 1. Set sbbusy. 2. Perform a bus write of the new value of sbdata to sbaddress. 3. If the write succeeded and sbautoincrement is set, increment sbaddress. 4. Clear sbbusy. Reads from this register start the following: 1. "Return" the data. 2. Set sbbusy. 3. If sbreadondata is set: (a) Perform a system bus read from the address contained in sbaddress, placing the result in sbdata. (b) If sbautoincrement is set and the read was successful, increment sbaddress. 4. Clear sbbusy. Only sbdata0 has this behavior. The other sbdata registers have no side effects. On systems that have buses wider than 32 bits, a debugger should access sbdata0 after accessing the other sbdata registers

Bit number																																
ID																																
Reset 0x00000000																																
ID	R/W	Field	Value ID	Value	Description																											
A	R	DATA			Accesses bits 31:0 of sbdata																											

8.28.1.32 DEBUGIF.SBDATA1

Address offset: 0x4F4

System Bus Data 63:32

If sbaccess64 and sbaccess128 are 0, then this register is not present. If the bus master is busy then accesses set sbbusyerror, and don't do anything else.

Bit number																																
ID																																
Reset 0x00000000																																
ID	R/W	Field	Value ID	Value	Description																											
A	R	DATA			Accesses bits 63:32 of sbdata (if the system bus is that wide).																											

8.28.1.33 DEBUGIF.SBDATA2

Address offset: 0x4F8

System Bus Data 95:64

This register only exists if sbaccess128 is 1. If the bus master is busy then accesses set sbbusyerror, and don't do anything else

Bit number																																
ID																																
Reset 0x00000000																																
ID	R/W	Field																														
A	R	DATA																														

Value ID	Value	Description
		Accesses bits 95:64 of sbdata (if the system bus is that wide).

8.28.1.34 DEBUGIF.SBDATA3

Address offset: 0x4FC

System Bus Data 127:96

This register only exists if sbaccess128 is 1. If the bus master is busy then accesses set sbbusyerror, and don't do anything else

Bit number																																
ID																																
Reset 0x00000000																																
ID	R/W	Field																														
A	R	DATA																														

Value ID	Value	Description
		Accesses bits 127:96 of sbdata (if the system bus is that wide).

8.28.1.35 DEBUGIF.HALTSUM0

Address offset: 0x500

Halt summary 0

Each bit in this read-only register indicates whether one specific hart is halted or not. Unavailable/ nonexistent harts are not considered to be halted. This register might not be present if fewer than 2 harts are connected to this DM. The LSB reflects the halt status of hart hartsel[19:5] 0x0, and the MSB reflects halt status of hart hartsel[19:5] 0xf

Bit number																																
ID																																
Reset 0x00000000																																
ID	R/W	Field																														
A	R	HALTSUM0																														

Value ID	Value	Description
		Halt summary 0

8.28.1.36 CPURUN

Address offset: 0x800

State of the CPU after a core reset

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EN			Controls CPU running state after a core reset.
			Stopped	0	CPU stopped. If this is the CPU state after a core reset, setting this bit will change the CPU state to CPU running.
			Running	1	CPU running. If this is the CPU state after a core reset, clearing this bit will change the CPU state to CPU stopped after a core reset.

8.28.1.37 VPRSTATUS

Address offset: 0x804

VPR state information.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	CPUSTATUS			Enumerates one of several possible states for the VPR:
			WAITING	0x0	WAITING (not yet started)
			RUNNING	0x1	RUNNING
			SLEEPING	0x2	SLEEPING
			INTERRUPT	0x3	INTERRUPT (in handler)
			EXCEPTION_TRAP	0x4	EXCEPTION/TRAP (in handler)
			ONGOING_RESET	0x5	ONGOING_RESET
			HALTED	0x6	HALTED
			ERROR	0xE	ERROR (lockup, needs debugging or reset)
B	R	RTPENABLED			Mirrors the ENABLERTPERIPH bit in the NORDIC.VPRNORDICCTRL CSR When this bit is cleared, it will override the APB read value of the INTEN register to 0.
			Disabled	0	Real-time peripherals disabled
			Enabled	1	Real-time peripherals enabled
C	R	RTPSTALL			Stalled waiting for real-time peripheral blocking CSR access, for example WAIT, OUTB with dirty status
			NotStalled	0	CPU not stalled on blocing CSR access.
			Stalled	1	CPU stalled on blocing CSR access.

8.28.1.38 INITPC

Address offset: 0x808

Initial value of the PC at CPU start.

Note: This address must be 64 bit aligned

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	INITPC			Initial value of the PC at CPU start. This value should be set before setting CPURUN.EN. After setting CPURUN.EN, this register can be reconfigured to prepare the CPU to start from a new initial PC upon receiving a reset request **Note:** This value is used directly, so take care if changing it after VPR has started. Temporarily disabling interrupts is recommended if you need to update it. The bottom 2 bits are ignored.

8.28.2 VPR CLIC registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
VPRCLIC	FLPR	0xF0000000	HF	NS	NA	No	VPR CLIC registers

Configuration

Instance	Domain	Configuration
VPRCLIC	FLPR	Supported interrupts (IRQNUM): 0..270 VEVIF tasks: 0..31 Mask of supported VEVIF tasks: 0xFFFFFFFF VPR counter (CNT0) interrupt handler number (COUNTER_IRQ_NUM): 31 CLIC supports 2 level bits

Register overview

Register	Offset	TZ	Description
CLIC.CLICCFG	0x0000		CLIC configuration.
CLIC.CLICINFO	0x0004		CLIC information.
CLIC.CLICINT[n]	0x1000		Interrupt control register for IRQ number [n].

8.28.2.1 CLIC.CLICCFG

Address offset: 0x0000

CLIC configuration.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C B B B B A
Reset 0x00000011				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A	R	NVBITS			Selective interrupt hardware vectoring.
			Implemented	1	Selective interrupt hardware vectoring is implemented
B	R	NLBITS			Interrupt level encoding. Indicates how many upper bits are assigned to encode the interrupt level in CLICINT[n].PRIORITY
			Eight	8	8 bits = interrupt levels encoded in eight bits
C	R	NMBITS			Interrupt privilege mode. Indicates how many bits represent privilege mode
			ModeM	0	All interrupts are M-mode only

8.28.2.2 CLIC.CLICINFO

Address offset: 0x0004

CLIC information.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C C C C C B B B B B B B B A A A A A A A A A A A A
Reset 0x00401FFF				**0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	R	NUMINTERRUPTS			Maximum number of interrupts supported.
B	R	VERSION			Version
C	R	NUMTRIGGER			Number of maximum interrupt triggers supported

8.28.2.3 CLIC.CLICINT[n] (n=0..270)

Address offset: 0x1000 + (n × 0x4)

Interrupt control register for IRQ number [n].

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H H H H H H H H G G F F E D D D D D D C B B B B B B B A
Reset 0x3FC30000				**0 0 1 1 1 1 1 1 1 1 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	IP			Interrupt Pending bit.
			NotPending	0	Interrupt not pending
			Pending	1	Interrupt pending
B	R	READ1			Read as 0, write ignored.
C	RW	IE			Interrupt enable bit.
			Disabled	0	Interrupt disabled
			Enabled	1	Interrupt enabled
D	R	READ2			Read as 0, write ignored.
E	R	SHV			Selective Hardware Vectoring.
			Vectored	1	Hardware vectored
F	R	TRIG			Trigger type and polarity for each interrupt input.
			EdgeTriggered	1	Interrupts are edge-triggered
G	R	MODE			Privilege mode.
			MachineMode	3	Machine mode
H	RW	PRIORITY			Interrupt priority level
			PRIO3F	0x3F	Priority level 0x3F

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	H	H	H	H	H	H	H	H	G	G				F	F	E	D	D	D	D	D	D	D	C	B	B	B	B	B	B	B	A
Reset 0x3FC30000	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
			PRIO7F	0x7F	Priority level 0x7F
			PRIOBF	0xBF	Priority level 0xBF
			PRIOFF	0xFF	Priority level 0xFF
			PRIOLEVEL0	0x3F	Priority level 0 This enumerator is deprecated.
			PRIOLEVEL1	0x7F	Priority level 1 This enumerator is deprecated.
			PRIOLEVEL2	0xBF	Priority level 2 This enumerator is deprecated.
			PRIOLEVEL3	0xFF	Priority level 3 This enumerator is deprecated.

8.28.3 VPR Control Status Registers (CSRs)

Instances

Instance	Domain	Base address	Description
VPRCSR	FLPR		VPR CSR registers

Configuration

Instance	Domain	Configuration
VPRCSR	FLPR	VEVIF indexes 16 through 19 maps onto DPPI channels 0 through 4 Use GPIO port P2 HARTNUM: 14 MCLICBASE: 0xF0000000 HIBERNATE: 1 DBG: 1 Number of HW breakpoints: 1 VPR cannot be retained CSR VIOPINS value: 0x000007FF VEVIF tasks: 0..31 Mask of supported VEVIF tasks: 0xFFFFFFFF VEVIF DPPI indices: 16..19 VEVIF events: 0..31 CACHE available OUTMODE for shifting functionality available VPR does not support peripheral blocking access New RTP features CLIC supports 2 level bits

Register overview

Register	Offset	Description
MSTATUS	0x300	Machine Status
MISA	0x301	Machine ISA
MTVEC	0x305	Machine Trap-Vector
MTVT	0x307	Machine Trap Vector Table
MCOUNTINHIBIT	0x320	Machine Counter-Inhibit
MSCRATCH	0x340	Machine Scratch
MEPC	0x341	Machine Exception Program Counter
MCAUSE	0x342	Machine Cause
MTVAL	0x343	Machine Trap Value
MINTSTATUS	0x346	M-mode Interrupt Status
MINTTHRESH	0x347	M-mode Interrupt-level Threshold
MCLICBASE	0x350	Machine CLIC Base
TSELECT	0x7A0	Trigger Select
TDATA1	0x7A1	Trigger Data 1
TDATA2	0x7A2	Trigger Data 2
TDATA3	0x7A3	Trigger Data 3
TINFO	0x7A4	Trigger Info
TCONTROL	0x7A5	Trigger Control
DCSR	0x7B0	Debug Control and Status
DPC	0x7B1	Debug PC
MCYCLE	0xB00	Machine Cycle Counter
MINSTRET	0xB02	Machine Instruction Counter
MCYCLEH	0xB80	Machine Cycle Counter (Upper part)
MINSTRETH	0xB82	Machine Instruction Counter (Upper part)
UCYCLE	0xC00	User Cycle Counter
UINSTRET	0xC02	User Instruction Counter
UCYCLEH	0xC80	User Cycle Counter (Upper part)
UINSTRETH	0xC82	User Instruction Counter (Upper part)
MVENDORID	0xF11	Machine Vendor ID
MARCHID	0xF12	Machine Architecture ID
MIMPID	0xF13	Machine Implementation ID
MHARTID	0xF14	Machine Hart ID
NORDIC.VPRNORDICCTRL	0x7C0	Nordic Core Control
NORDIC.VPRNORDICSLEEPCTRL	0x7C1	Nordic Sleep Control
NORDIC.VPRNORDICFEATURESDISABLE	0x7C2	Contains disable bits for certain features in the core
NORDIC.VIOPINS	0x7C3	VPR pins used for Real Time Peripherals VIO
NORDIC.EXTPARAMS	0x7C4	Reads values of external configuration parameters
NORDIC.AXCACHE	0x7C5	Memory type encoding
NORDIC.CACHE.CTRL	0x7C8	Cache control
NORDIC.CACHE.CFG	0x7C9	Cache configuration
NORDIC.CACHE.DATATAGADDR	0x7CA	Cache tag base address
NORDIC.CACHE.DATABASEADDR	0x7CB	Cache data base address
NORDIC.RTPERIPHCTRL	0x7CC	RT peripheral control
NORDIC.RTPERIPHSTATUS	0x7CD	Real-Time Peripheral Status
NORDIC.CNTMODE0	0x7D0	CNT0 Mode
NORDIC.CNTMODE1	0x7D1	CNT1 Mode
NORDIC.CNT	0x7D2	32-bit Counter
NORDIC.CNTTOP	0x7D3	Counter Top
NORDIC.CNTADD	0x7D4	CNT Add
NORDIC.CNT0	0x7D5	16-bit Counter 0
NORDIC.CNTADD0	0x7D6	CNT0 Add

Register	Offset	Description
NORDIC.CNT1	0x7D7	16-bit Counter 1
NORDIC.CNTADD1	0x7D8	CNT1 Add
NORDIC.WAIT0	0x7DA	Wait 0
NORDIC.WAIT1	0x7DB	Wait 1
NORDIC.WAIT	0x7DC	Wait
NORDIC.TASKS	0x7E0	DPPI Tasks
NORDIC.SUBSCRIBE	0x7E1	Enable Task Subscription
NORDIC.EVENTS	0x7E2	DPPI Events
NORDIC.PUBLISH	0x7E3	Enable Event Publication
NORDIC.INTEN	0x7E4	DPPI Event Interrupt Enable
NORDIC.EVENTSB	0x7E5	Buffered DPPI Events
NORDIC.EVENTSBS	0x7E6	EVENTSB Dirty Status
NORDIC.OUT	0xBC0	GPIO Output value. Real Time Peripherals VIO.
NORDIC.DIR	0xBC1	GPIO pin Direction. Real Time Peripherals VIO.
NORDIC.IN	0xBC2	GPIO Input. Real Time Peripherals VIO.
NORDIC.INMODE	0xBC3	Input Mode
NORDIC.OUTB	0xBC4	Buffered GPIO Output
NORDIC.DIRB	0xBC5	Buffered GPIO pin Direction
NORDIC.DIROUT	0xBC6	DIR and OUT concatenation
NORDIC.DIROUTB	0xBC7	Concatenation of DIRB and OUTB
NORDIC.OUTBRB	0xBC8	Byte reversed register OUTB
NORDIC.OUTBRW	0xBC9	Word reversed register OUTB
NORDIC.INBRB	0xBCA	Byte reversed register INB
NORDIC.SHIFTCTRLB	0xBCB	Buffered IO shift control
NORDIC.SHIFTCNTIN	0xBCD	Number of frames to be shifted from INB before new data is required
NORDIC.SHIFTCNTOUT	0xBCE	Number of frames to be shifted to OUTB before new data is required
NORDIC.SHIFTCNTB	0xBCF	Buffered SHIFTCNTOUT and SHIFTCNTIN register
NORDIC.OUTTGL	0xBD0	GPIO Output Toggle
NORDIC.DIRTGL	0xBD1	GPIO pin Direction Toggle
NORDIC.OUTBTGL	0xBD2	Buffered GPIO Output Toggle
NORDIC.DIRBTGL	0xBD3	Buffered GPIO pin Direction Toggle
NORDIC.DIROUTTGL	0xBD4	DIROUT Toggle
NORDIC.DIROUTBTGL	0xBD5	DIROUTB Toggle
NORDIC.OUTUBTGL	0xBD6	Buffered GPIO Unshifted Output Toggle
NORDIC.OUTBS	0xBD8	Buffered GPIO Output Dirty Status
NORDIC.DIRBS	0xBD9	Buffered GPIO pin Direction Dirty Status
NORDIC.DIROUTBS	0xBDA	Combination of DIRB and OUTB Dirty Status
NORDIC.OUTUBS	0xBDB	Buffered GPIO Unshifted Output Dirty Status
NORDIC.OUTMODE	0xBE3	Serial output mode
NORDIC.OUTMODEB	0xBE4	Buffered OUTMODE register
NORDIC.INMODEB	0xBE5	Buffered INMODE register
NORDIC.INB	0xBE6	Buffered GPIO input
NORDIC.OUTUB	0xBE7	Buffered write to Unshifted parts of OUT
NORDIC.SHIFTCNTCOMP	0xBE8	SHIFTCNTIN/OUT compare values
NORDIC.WAITEVENT	0xBE9	Wait for internal event
NORDIC.WAITINPUT	0xBEA	Wait input
NORDIC.RTPINTEN	0xBEB	Interrupt enable
NORDIC.OUTUBTRIG	0xBEC	OUTUB trigger select

8.28.3.1 MSTATUS

Address offset: 0x300

Machine Status

Keeps track of and controls the hart current operating state. In VPR it only contains/controls information of machine privileged mode interrupts, see MIE and MPIE

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C B A
Reset 0x00001800				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MIE			Global interrupt enable for machine privilege mode
			Disabled	0	
			Enabled	1	
B	RW	MPIE			Exists to support nested traps. Value of the interrupt-enable bit active prior to the trap for machine privilege mode
			Disabled	0	
			Enabled	1	
C	R	MPP			Exists to support nested traps. Value of the privlege mode prior to the trap for machine privilege mode

8.28.3.2 MISA

Address offset: 0x301

Machine ISA

Reports the ISA supported by the hart

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				I I H G F E D C B A
Reset 0x40001016				**0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 1 1 0**
ID	R/W	Field	Value ID	Value	Description
A	R	A			Atomic extension Indicates presence of standard A extension
			Disabled	0	
			Enabled	1	
B	R	B			Bit-Manipulation extension Indicates presence of standard B extension
			Disabled	0	
			Enabled	1	
C	R	C			Compressed extension Indicates presence of standard C extension
			Disabled	0	
			Enabled	1	
D	R	E			RV32E/RV64E base ISA Indicates presence of standard E extension
			Disabled	0	
			Enabled	1	
E	R	I			RV32I/64I/128I base ISA Indicates presence of standard I extension
			Disabled	0	
			Enabled	1	
F	R	M			Integer Multiply/Divide extension Indicates presence of standard M extension
			Disabled	0	

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				I	I							H										G	F				E				D		C	B	A
Reset 0x40001016				**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**0**
ID	R/W	Field	Value ID	Value																															
			Enabled	1																															
G	R	N																																	
				Indicates presence of standard N extension																																	
			Disabled	0																															
			Enabled	1																															
H	R	X																																	
				Non-standard extensions present																																	
				Indicates presence of standard non-standard extensions																																	
			NotPresent	0																															
			Present	1																															
I	R	MXL																																	
				Machine XLEN																																	
				Encodes the native base integer ISA width. The MXL field may be writable in implementations that support multiple base ISA widths. The effective XLEN in M-mode, MXLEN, is given by the setting of MXL, or has a fixed value if misa is zero. The MXL field is always set to the widest supported ISA variant at reset																																	
			XLEN32	1																																	
			XLEN64	2																																	
			XLEN128	3																																	

8.28.3.3 MTVEC

Address offset: 0x305

Machine Trap-Vector

Holds trap vector configuration, consisting of a vector base address (BASE) and a vector mode (MODE)

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A
Reset 0x00000003				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
A	R	MODE																																	
				Mode																																	
			CLIC	3																																	
				Core Local Interrupt Controller (CLIC) interrupt handling mode																																	
B	RW	BASE																																	
				Vector base address																																	
				The BASE field value must align on an 8-byte boundary																																	

8.28.3.4 MTVT

Address offset: 0x307

Machine Trap Vector Table

Holds the base address of the trap vector table, aligned on a 64-byte or greater power-of-two boundary. The actual alignment can be determined by writing ones to the low-order bits then reading them back.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A				
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	VAL																																	
				Machine Trap Vector Table base address value for CLIC vectored interrupts																																	

8.28.3.5 MCOUNTINHIBIT

Address offset: 0x320

Machine Counter-Inhibit

Register that controls which of the hardware performance-monitoring counters increment.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																	B		A
Reset 0x00000005				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW	CY																																	
			INCREMENT	0x0																															
			INHIBIT	0x1																															
B	RW	IR																																	
			INCREMENT	0x0																															
			INHIBIT	0x1																															

8.28.3.6 MSCRATCH

Address offset: 0x340

Machine Scratch

Register dedicated for use by machine mode. Typically, it is used to hold a pointer to a machine-mode hart-local context space and swapped with a user register upon entry to an M-mode trap handler.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	VAL																																	

Machine Scratch value

8.28.3.7 MEPC

Address offset: 0x341

Machine Exception Program Counter

When a trap is taken into M-mode, mepc is written with the virtual address of the instruction that was interrupted or that encountered the exception. Otherwise, mepc is never written by the implementation, though it may be explicitly written by software

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	VAL																																	

Machine Exception Program Counter value

8.28.3.8 MCAUSE

Address offset: 0x342

Machine Cause

When a trap is taken into M-mode, mcause is written with a code indicating the event that caused the trap. Otherwise, mcause is never written by the implementation, though it may be explicitly written by software.

Note: Writing this register can have side effects, so care needs to be taken when initializing this for a new thread context. To be safe, initialize this to the reset value when creating a new thread.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				F	E	D	D	C				B	B	B	B	B	B	B	B					A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x30000000				**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	EXCEPTIONCODE																																	
				See RISC-V Instruction Set Manual Volume II: Privileged Architecture for details on the exception codes. Exception codes listed here only apply if the trap is not caused by an interrupt (Interrupt bitfield set to 0)																																		
			INSTADDRMISALIGN	0x0																																	
			INSTACCESSFAULT	0x1																																	
			ILLEGALINST	0x2																																	
			BKPT	0x3																																	
			LOADADDRMISALIGN	0x4																																	
			LOADACCESSFAULT	0x5																																	
			STOREADDRMISALIGN	0x6																																	
			STOREACCESSFAULT	0x7																																	
			ECALLMMODE	0xB																																	
			MISALIGNSTACKING	0x18																																	
			BUSFAULTSTACKING	0x19																																	
			INTVECTORFAULT	0x1A																																	
			MISALIGNUNSTACKING	0x1B																																	
			BUSFAULTUNSTACKING	0x1C																																	
			STORETIMEOUTFAULT	0x1D																																	
			LOADTIMEOUTFAULT	0x1E																																	
			STACKINGEXCFAULT	0x1F																																	
B	RW	MPIL																																	
				Previous interrupt level																																	
C	RW	MPIE																																	
				Previous interrupt enable, same as MSTATUS.MPIE																																	
D	R	MPP																																	
				Previous privilege mode, same as MSTATUS.MPP																																	
E	RW	MINHV																																	
				In hardware vectoring																																	
				Set by hardware at start of hardware vectoring, cleared by hardware at end of successful hardware vectoring																																	
F	RW	INTERRUPT																																	
				Interrupt bit																																	
				Set if the trap was caused by an interrupt																																	
			EXCEPTION	0																																	
			INTERRUPT	1																																	

8.28.3.9 MTVAL

Address offset: 0x343

Machine Trap Value

When a trap is taken into M-mode, MTVAL is either set to zero or written with exception-specific information to assist software in handling the trap. In VPR this register is ignored by exceptions and set to zero permanently

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	VAL			Machine Trap Value

8.28.3.10 MINTSTATUS

Address offset: 0x346

M-mode Interrupt Status

Holds the active interrupt level for M-mode

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A																								
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	MIL			M-Mode interrupt level

8.28.3.11 MINTTHRESH

Address offset: 0x347

M-mode Interrupt-level Threshold

Holds an 8-bit field for the threshold level of M-mode. Typical use is to implement critical sections. The current hart's effective interrupt level would then be: effective_level = max(MINTSTATUS.MIL, MINTTHRESH.TH)

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																									A	A	A	A	A	A	A	A
Reset 0x0000001F	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**

ID	R/W	Field	Value ID	Value	Description
A	RW	TH			M-Mode Interrupt-level Threshold
			DISABLED	0x0	Threshold disabled **Note:** This can always be used to reset the threshold to the lowest supported level and let all interrupt levels through, even though it will not read back as this value afterwards.
			THRESH1F	0x1F	Threshold level 0x1F **Note:** This is the reset level, threshold disabled.
			THRESH3F	0x3F	Threshold level 0x3F
			THRESH7F	0x7F	Threshold level 0x7F
			THRESHBF	0xBF	Threshold level 0xBF
			THRESHFF	0xFF	Threshold level 0xFF
			THRESHLEVEL0	0x3F	Threshold level 0 This enumerator is deprecated.
			THRESHLEVEL1	0x7F	Threshold level 1 This enumerator is deprecated.
			THRESHLEVEL2	0xBF	Threshold level 2 This enumerator is deprecated.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																												A	A	A	A	A	A	A	A
Reset 0x0000001F				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
			THRESHLEVEL3	0xFF																															
				Threshold level 3 This enumerator is deprecated.																																

8.28.3.12 MCLICBASE

Address offset: 0x350

Machine CLIC Base

Provides the base address of CLIC memory mapped registers. Its value should be configured or set up at the platform level to indicate the starting address of CLIC memory mapped registers. Since the CLIC memory map must be aligned at a 4KiB boundary, the mclicbase CSR has its 12 least-significant bits hardwired to zero. It is used to inform software about the location of CLIC memory mappped registers.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0xF0000000				**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	VAL																																	
				CLIC base address value																															

8.28.3.13 TSELECT

Address offset: 0x7A0

Trigger Select

This register determines which trigger is accessible through the other trigger registers. The set of accessible triggers must start at 0, and be contiguous

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	VAL																																	
				Trigger Select value																															

8.28.3.14 TDATA1

Address offset: 0x7A1

Trigger Data 1

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C C C B A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	DATA			Trigger Specific Data, refer to the RISC-V Debug Specification for more details.
B	RW	DMODE			Debug Mode This bit is only writable from Debug Mode
			BOTH	0	Both Debug and M-mode can write the tdata registers at the selected tselect.
			ONLYDEBUG	1	Only Debug Mode can write the tdata registers at the selected tselect. Writes from other modes are ignored.
C	RW	TYPE			Type
			NOTRIGGER	0x0	There is no trigger at this tselect
			MATCH	0x2	The trigger is an address match trigger. The remaining bits in this register act as described in mcontrol

8.28.3.15 TDATA2

Address offset: 0x7A2

Trigger Data 2

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	DATA			Trigger Specific Data

8.28.3.16 TDATA3

Address offset: 0x7A3

Trigger Data 3

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	DATA			Trigger Specific Data

8.28.3.17 TINFO

Address offset: 0x7A4

Trigger Info

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000004	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	INFO			Trigger Info value One bit for each possible type enumerated in tdata1. Bit N corresponds to type N. If the bit is set, then that type is supported by the currently selected trigger. If the currently selected trigger doesn't exist, this field contains 1. If type is not writable, this register may be unimplemented, in which case reading it causes an illegal instruction exception. In this case the debugger can read the only supported type from tdata1.

8.28.3.18 TCONTROL

Address offset: 0x7A5

Trigger Control

This optional register is one solution to a problem regarding triggers with action=0 firing in M-mode trap handlers

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																									B				A			
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	MTE			Mode Trigger Enable
			DONTMATCH	0	Triggers with action=0 do not match/fire while the hart is in M-mode
			MATCH	1	Triggers do match/fire while the hart is in M-mode. When a trap into M-mode is taken, mte is set to 0. When mret is executed, mte is set to the value of mpte
B	R	MPTE			Mode Previous Trigger Enable When a trap into M-mode is taken, mpte is set to the value of mte

8.28.3.19 DCSR

Address offset: 0x7B0

Debug Control and Status

This register is only accesible from debug mode

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	F	F	F	F													E				D			C	C	C				B	A	A
Reset 0x40000003	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**

ID	R/W	Field	Value ID	Value	Description
A	R	PRV			Privilege level Contains the privilege level the hart was operating in when Debug Mode was entered. VPR only supports Machine Privilege Level.
			MACHINE	3	

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				F	F	F	F													E				D			C	C	C				B	A	A
Reset 0x40000003				**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**
ID	R/W	Field	Value ID	Value																															
B	RW	STEP																																	
C	R	CAUSE																																	
			EBREAK	1																															
			TRIGGER	2																															
			HALTREQ	3																															
			STEP	4																															
			RESETHALTREQ	5																															
D	RW	STEPIE																																	
			Disabled	0																															
			Enabled	1																															
E	RW	EBREAKM																																	
			SPEC	0																															
			ENTERDBG	1																															
F	R	XDEBUGVER																																	
			STDDBG	4																															

8.28.3.20 DPC

Address offset: 0x7B1

Debug PC

Upon entry to debug mode, dpc is updated with the virtual address of the next instruction to be executed. When resuming, the hart's PC is updated to the virtual address stored in dpc. A debugger may write dpc to change where the hart resumes

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	VAL																																	

8.28.3.21 MCYCLE

Address offset: 0xB00

Machine Cycle Counter

Counts the number of clock cycles executed by the processor core on which the hart is running

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	VAL			Machine Cycle Counter value

8.28.3.22 MINSTRET

Address offset: 0xB02

Machine Instruction Counter

Counts the number of instructions the hart has retired

In this context retired means a successfully executed instruction

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	VAL			Machine Instruction Counter value

8.28.3.23 MCYCLEH

Address offset: 0xB80

Machine Cycle Counter (Upper part)

Counts the number of clock cycles executed by the processor core on which the hart is running

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	VAL			Machine Cycle Counter value

8.28.3.24 MINSTRETH

Address offset: 0xB82

Machine Instruction Counter (Upper part)

Counts the number of instructions the hart has retired

In this context retired means a successfully executed instruction

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	VAL			Machine Instruction Counter (Upper part) value

8.28.3.25 UCYCLE

Address offset: 0xC00

User Cycle Counter

Counts the number of clock cycles executed by the processor core on which the hart is running. This register is a read-only copy of MCYCLE

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	VAL			User Cycle Counter value

8.28.3.26 UINSTRET

Address offset: 0xC02

User Instruction Counter

Counts the number of instructions the hart has retired. This register is a read-only copy of MINSTRET

In this context retired means a successfully executed instruction

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	VAL			User Instruction Counter value

8.28.3.27 UCYCLEH

Address offset: 0xC80

User Cycle Counter (Upper part)

Counts the number of clock cycles executed by the processor core on which the hart is running. This register is a read-only copy of MCYCLEH

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	VAL			User Cycle Counter value

8.28.3.28 UINSTRETH

Address offset: 0xC82

User Instruction Counter (Upper part)

Counts the number of instructions the hart has retired. This register is a read-only copy of MINSTRETH

In this context retired means a successfully executed instruction

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	VAL			User Instruction Counter (Upper part) value

8.28.3.29 MVENDORID

Address offset: 0xF11

Machine Vendor ID

32-bit read-only register providing the JEDEC manufacturer ID of the provider of the core.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A
Reset 0x00000144				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	OFFSET																																	
				MVENDORID encodes the final byte in the Offset field, discarding the parity bit																																	
B	R	BANK																																	
				MVENDORID encodes the number of one-byte continuation codes in the Bank field																																	

8.28.3.30 MARCHID

Address offset: 0xF12

Machine Architecture ID

32-bit read-only register encoding the base microarchitecture of the hart

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				H																		G	G	G	F	E	E	E	E	D		C	B	A	A
Reset 0x8000006E				**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	MULDIV																																	
				Indicates the MULDIV parameter option																																	
B	R	HIBERNATE																																	
				Indicates the POWEROFFSLEEP parameter option																																	
C	R	DBG																																	
				Indicates the DBG parameter option																																	
D	R	BUSWIDTH																																	
				Indicates the BUS_WIDTH parameter option																																	
E	R	BKPT																																	
				Indicates the BKPT parameter option																																	
F	R	CACHE																																	
				Indicates that the CACHE is present																																	
G	R	CACHEEXTRATAGBUF																																	
				Indicates the number of extra TAG buffers in CACHE																																	
H	R	IMPLEM																																	
				Indicates a non-open implementation																																	

8.28.3.31 MIMPID

Address offset: 0xF13

Machine Implementation ID

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID												C	C	C	C	C	C	C	C	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A
Reset 0x00010300				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	PATCHREV																																	
				Indicates the number of the patch revision																																	
B	R	MINORREV																																	
				Indicates the number of the minor revision																																	
C	R	MAJORREV																																	
				Indicates the number of the major revison																																	

8.28.3.32 MHARTID

Address offset: 0xF14

Machine Hart ID

Contains the integer ID of the hardware thread running the code. Hart ID is unique for every VPR instance and this register's reset value is set to it

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x0000000E	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	HARTNUM			Machine Hart ID value

8.28.3.33 NORDIC.VPRNORDICCTRL

Address offset: 0x7C0

Nordic Core Control

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D									C	B						A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLERTPERIPH			Control bit to enable Real-Time Peripherals When this bit is cleared, it will override the APB read value of the INTEN register to 0.
			Disabled	0	
			Enabled	1	
B	RW	CNTIRQENABLE			Enables the generation of IRQ number COUNTER_IRQ_NUM
			Disabled	0x0	
			Enabled	0x1	
C	RW	VPRBUSPRI			Arbitration priority on bus Setting high priority will give VPR maximum priority and can cause starvation for other bus masters trying to access the same memory. It should only be used in limited sections of code and care must be taken to avoid continuous memory accesses to ensure other bus masters can perform interleaved accesses.
			LowPriority	0x0	Low priority for VPR RAM transactions on bus
			HighPriority	0x1	High priority for VPR RAM transactions on bus
D	W	NORDICKEY			Used in order to protect the write to this register
			Enabled	0x507D	Write enabled

8.28.3.34 NORDIC.VPRNORDICSLEEPCTRL

Address offset: 0x7C1

Nordic Sleep Control

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID															C	B													A	A	A	A
Reset 0x00000002	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	SLEEPSTATE			Sleep State
			WAIT	0x0	Sleep is not turning off the clock
			RESET	0x2	Sleep state default reset value. Going to sleep with sleep state = RESET has the same effect as going to sleep with sleep state = WAIT
			SLEEP	0x5	Sleep is turning the clock off

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C B A A A A
Reset 0x00000002				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0**
ID	R/W	Field	Value ID	Value	Description
			DEEPSLEEP	0x7	Sleep is turning the clock off, equivalent to SLEEP This enumerator is deprecated.
			HIBERNATE	0xF	Sleep is turning the clock off and all the registers are saved automatically, restart by a reset
B	RW	RETURNTOSLEEP			Return to Sleep Forces the CPU to return to sleep when it returns in a non handler program
			Disabled	0x0	
			Enabled	0x1	
C	RW	STACKONSLEEP			Stack on Sleep Force CPU to stack the context before going to sleep : this is used in order to have a fast wake up
			Disabled	0x0	
			Enabled	0x1	

8.28.3.35 NORDIC.VPRNORDICFEATURESDISABLE

Address offset: 0x7C2

Contains disable bits for certain features in the core

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C C C C C C C C C C C C C C C B A
Reset 0x00000010				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	DISABLECLICROUNDROBIN			Disable CLIC Round Robin Disable Round Robin arbitration in CLIC for interrupt requests
			Enabled	0	
			Disabled	1	
B	RW	UNRECOVRETURN			Unrecoverable Return Force unrecoverable return from exception
			Disabled	0	
			Enabled	1	
C	W	NORDICKEY			Used in order to protect the write to this register
			Enabled	0x507D	Write enabled

8.28.3.36 NORDIC.VIOPINS

Address offset: 0x7C3

VPR pins used for Real Time Peripherals VIO

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x000007FF				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	R	VAL			VPR pins used for Real Time Peripherals VIO

8.28.3.37 NORDIC.EXTPARAMS

Address offset: 0x7C4

Reads values of external configuration parameters

External configuration parameters are unique for every VPR instance and this register's reset value depends on them

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					C C C C B A A
Reset 0x0000000E					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 0**
ID	R/W	Field	Value ID	Value	Description
A	R	MULDIV			value of MULDIV
B	R	DBG			value of DBG
C	R	BKPT			value of BKPT

8.28.3.38 NORDIC.AXCACHE

Address offset: 0x7C5

Memory type encoding

AXI4 protocol memory type encoding

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					C C C C B B B B A A A A
Reset 0x00000EEE					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 0 1 1 1 0 1 1 1 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	AWCACHE			Memory type for data stores
			DEVNONBUFF	0x0	Device Non-Bufferable
			DEVBUFF	0x1	Device Bufferable
			NNONCACHENONBUFF	0x2	Normal Non-cacheable Non-bufferable
			NNONCACHEBUFF	0x3	Normal Non-cacheable Bufferable
			WRITETHNALLOC	0x6	Write-through No-allocate
			WRITETHRALLOC	0x6	Write-through Read-allocate
			WRITETHWALLOC	0xE	Write-through Write-allocate
			WRITETHRWALLOC	0xE	Write-through Read and Write-allocate
			WRITEBACKNALLOC	0x7	Write-back No-allocate
			WRITEBACKRALLOC	0x7	Write-back Read-allocate
			WRITEBACKWALLOC	0xF	Write-back Write-allocate
			WRITEBACKRWALLOC	0xF	Write-back Read and Write-allocate
B	RW	IARCACHE			Memory type for instruction loads
			DEVNONBUFF	0x0	Device Non-Bufferable
			DEVBUFF	0x1	Device Bufferable
			NNONCACHENONBU	0x2	Normal Non-cacheable Non-bufferable
			NNONCACHEBUFF	0x3	Normal Non-cacheable Bufferable
			WRITETHNALLOC	0xA	Write-through No-allocate
			WRITETHRALLOC	0xE	Write-through Read-allocate
			WRITETHWALLOC	0xA	Write-through Write-allocate
			WRITETHRWALLOC	0xE	Write-through Read and Write-allocate
			WRITEBACKNALLOC	0xB	Write-back No-allocate
			WRITEBACKRALLOC	0xF	Write-back Read-allocate
			WRITEBACKWALLOC	0xB	Write-back Write-allocate
			WRITEBACKRWALLO	0xF	Write-back Read and Write-allocate
C	RW	DARCACHE			Memory type for data loads

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C C C B B B B A A A A
Reset 0x00000EEE				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 0 1 1 1 0 1 1 1 0**
ID	R/W	Field	Value ID	Value	Description
			DEVNONBUFF	0x0	Device Non-Bufferable
			DEVBUFF	0x1	Device Bufferable
			NNONCACHENONBUFF	0x2	Normal Non-cacheable Non-bufferable
			NNONCACHEBUFF	0x3	Normal Non-cacheable Bufferable
			WRITETHNALLOC	0xA	Write-through No-allocate
			WRITETHRALLOC	0xE	Write-through Read-allocate
			WRITETHWALLOC	0xA	Write-through Write-allocate
			WRITETHRWALLOC	0xE	Write-through Read and Write-allocate
			WRITEBACKNALLOC	0xB	Write-back No-allocate
			WRITEBACKRALLOC	0xF	Write-back Read-allocate
			WRITEBACKWALLOC	0xB	Write-back Write-allocate
			WRITEBACKRWALLOC	0xF	Write-back Read and Write-allocate

8.28.3.39 NORDIC.CACHE.CTRL

Address offset: 0x7C8

Cache control

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	ENABLE			Enable cache
			Disabled	0	Cache disabled
			Enabled	1	Cache enabled
B	RW W1S	CACHECLR			Cache clear Writing this bit writes the tag cache region to 0. This should be done before enabling the cache. The CPU stalls until the operation is complete. Interrupts must be disabled when performing the cache clear operation.
			NoOperation	0	No Operation
			Clear	1	Cache clear

8.28.3.40 NORDIC.CACHE.CFG

Address offset: 0x7C9

Cache configuration

Configures the cache region size and line size

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CACHESIZE		0..15	Cache size is 2^CACHESIZE or (1 << CACHESIZE) KB, with a maximum size of 32KB (CACHESIZE = 5) To prevent RAM corruption or undefined behavior this field should only be modified when the cache is disabled
B	RW	CACHELINESIZE			Cache line size To prevent RAM corruption or undefined behavior this field should only be modified when the cache is disabled
			CachelineSize32B	0	Cache line size is 32 bytes (4 data units)
			CachelineSize64B	1	Cache line size is 64 bytes (8 data units)

8.28.3.41 NORDIC.CACHE.DATATAGADDR

Address offset: 0x7CA

Cache tag base address

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	VAL		0x0..0xFFFFFFFC	Cache tag base address value Defines where the tag cache region starts. The tag base address must be aligned with the tag cache region size. The lower 2 bits are write ignored / read as zero, so the value must be rounded to a power of 2.

8.28.3.42 NORDIC.CACHE.DATABASEADDR

Address offset: 0x7CB

Cache data base address

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	VAL		0x0..0xFFFFFFFC	Cache data base address value Defines where the data cache region starts. The data base address must be aligned with the data cache region size. The lower 2 bits are write ignored / read as zero, so the value must be rounded to a power of 2.

8.28.3.43 NORDIC.RTPERIPHCTRL

Address offset: 0x7CC

RT peripheral control

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				F E E D D D D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CLOCKPOLARITY			Clock polarity This field is applicable only when OUTMODE.MODE = OutBBufToggleClk
			Low	0x0	Clock polarity is low
			High	0x1	Clock polarity is High
B	RW	STOPCOUNTERS			Stop counters CNT0 and CNT1 on OUTB under-run, or on INB Overflow if OUTMODE2 and INMODE2 This feature is used for clock stretching during OUTB under-run
			NoStop	0	Counters do not stop on OUTB under-run
			Stop	1	Counters stop on OUTB under-run Resume the counters when OUTB is written
C	RW	INSEL			Input pin selection
			SamePin	0x0	Sample on same OUT pin
			SeparatePin	0x1	Sample on separate pin (OUT+1)
D	RW	EVPINSEL			Event pin select Event pin select: VIO 0-15
E	RW	EVEDGE			Event pin edge
			AnyEdge	0x0	Any edge
			RisingEdge	0x1	Rising edge
			FallingEdge	0x2	Falling edge
F	RW	EVSAMPLE			Event pin sampling
			Continuous	0x0	Sample continuously
			Event	0x1	Sample on CNT1 event

8.28.3.44 NORDIC.RTPERIPHSTATUS

Address offset: 0x7CD

Real-Time Peripheral Status

Reads Real-Time Peripheral Status. Write to clear status

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	OUTBUNDERRUN			Set if OUTB value is not written in time for the next shift out event, which means OUT data is not valid. Can only be cleared by SW by writing a 1 to the bit.
B	RW W1C	INBOVERRUN			Set if INB value is not read in time for the next shift in event, which means IN data is lost. Can only be cleared by SW by writing a 1 to the bit.

8.28.3.45 NORDIC.CNTMODE0

Address offset: 0x7D0

CNT0 Mode

Real Time Peripherals VTIM

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CNTMODE0			CNT0 Mode
			STOP	0x0	CNT0 stops at 0
			WRAP	0x1	When CNT0 reaches 0 it will continue counting from 0xFFFF
			RELOAD	0x2	When CNT0 reaches 0 it will continue counting from the value in CNTTOP
			TRIGCOMB	0x3	When CNT0 reaches 0 it is reloaded from CNTTOP and stops. Counting will restart when a VIO event happens
			TRIGWRAP	0x5	When the counter reaches 0 it wraps to MAX and stops. Counting will restart when a VIO event happens

8.28.3.46 NORDIC.CNTMODE1

Address offset: 0x7D1

CNT1 Mode

Real Time Peripherals VTIM

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CNTMODE1			CNT1 Mode
			STOP	0x0	CNT1 stops at 0
			WRAP	0x1	When CNT1 reaches 0 it will continue counting from 0xFFFF
			RELOAD	0x2	When CNT1 reches 0 it will continue counting from the value in CNTTOP
			TRIGCOMB	0x3	In combine mode mode CNT1 acts as an extension of CNT0 (16 most significant bits of the 32-bit CNT)
			TRIGRELOAD	0x4	When CNT1 reaches 0 it is reloaded from CNTTOP and stops. Counting will restart when a VIO event happens
			TRIGWRAP	0x5	When CNT1 reaches 0 it wraps to MAX and stops. Counting will restart when a VIO event happens

8.28.3.47 NORDIC.CNT

Address offset: 0x7D2

32-bit Counter

Addresses CNT0 and CNT1 in the same operation. Real Time Peripherals VTIM

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B B B B B B B B B B B B B B B B A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CNT0			16-bit Counter 0
B	RW	CNT1			16-bit Counter 1

8.28.3.48 NORDIC.CNTTOP

Address offset: 0x7D3

Counter Top

This register value is used when reload mode is active. Entire 32-bit value is used when CNT1 is in combined mode. Real Time Peripherals VTIM

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CNT0RELOAD			Reload value for CNT0
B	RW	CNT1RELOAD			Reload value for CNT1

8.28.3.49 NORDIC.CNTADD

Address offset: 0x7D4

CNT Add

Adds a value to 32-bit counter CNT. Real Time Peripherals VTIM

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	VAL			Value added to CNT

8.28.3.50 NORDIC.CNT0

Address offset: 0x7D5

16-bit Counter 0

Real Time Peripherals VTIM

Read-only when the counters are in COMBINE mode.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	VAL			CNT0 value

8.28.3.51 NORDIC.CNTADD0

Address offset: 0x7D6

CNT0 Add

Adds a value to CNT0. Real Time Peripherals VTIM

Has no effect when the counters are in COMBINE mode.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	VAL			Value added to CNT0

8.28.3.52 NORDIC.CNT1

Address offset: 0x7D7

16-bit Counter 1

Real Time Peripherals VTIM

Read-only when the counters are in COMBINE mode.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	VAL			CNT1 value

8.28.3.53 NORDIC.CNTADD1

Address offset: 0x7D8

CNT1 Add

Adds a value to CNT1. Real Time Peripherals VTIM

Has no effect when the counters are in COMBINE mode.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	VAL			Value added to CNT1

8.28.3.54 NORDIC.WAIT0

Address offset: 0x7DA

Wait 0

Writing to this register will stall the CPU until CNT0 reaches 0

Note: This should not be used when counters are in combined mode

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	DATA			Value to write to CNT0
B	W	WRITEDATA			
			WAIT	0x0	Wait until CNT0 reaches 0
			WRITE	0x1	Write DATA to CNT0 and then wait until CNT0 reaches 0

8.28.3.55 NORDIC.WAIT1

Address offset: 0x7DB

Wait 1

Writing to this register will stall the CPU until CNT1 reaches 0

Note: This should not be used when counters are in combined mode

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	DATA			Value to write to CNT1
B	W	WRITEDATA			
			WAIT	0x0	Wait until CNT1 reaches 0
			WRITE	0x1	Write DATA to CNT1 and then wait until CNT1 reaches 0

8.28.3.56 NORDIC.WAIT

Address offset: 0x7DC

Wait

Writing any value to register will stall the CPU until CNT reaches 0 in TRIGCOMB mode

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	VAL			

8.28.3.57 NORDIC.TASKS

Address offset: 0x7E0

DPPI Tasks

CSR view of TASKS_TRIGGER[31:0] APB registers. Real Time Peripherals VEVIF

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-f	RW	TASKS[i] (i=0..31)			
			Disabled	0x0	TASKS[i] diabled
			Enabled	0x1	TASKS[i] enabled

8.28.3.58 NORDIC.SUBSCRIBE

Address offset: 0x7E1

Enable Task Subscription

CSR view of SUBSCRIBE_TRIGGER[31:0] APB registers (Enable bits). Real Time Peripherals VEVIF

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
	RW	SUBSCRIBE[i] (i=16..19)			
			Disabled	0x0	Subscribe disabled for TASK[i]
			Enabled	0x1	Subscribe enabled for TASK[i]

8.28.3.59 NORDIC.EVENTS

Address offset: 0x7E2

DPPI Events

CSR view of EVENTS_TRIGGERED[31:0]APB registers. Real Time Peripherals VEVIF

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-f	RW	EVENTS[i] (i=0..31)			
			Disabled	0x0	EVENTS[i] disabled
			Enabled	0x1	EVENTS[i] enabled

8.28.3.60 NORDIC.PUBLISH

Address offset: 0x7E3

Enable Event Publication

CSR view of PUBLISH_TRIGGERED[31:0] APB registers (Enable bits). Real Time Peripherals VEVIF

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
	RW	PUBLISH[i] (i=16..19)			
			Disabled	0x0	Publish disabled for EVENTS[i]
			Enabled	0x1	Publish enabled for EVENTS[i]

8.28.3.61 NORDIC.INTEN

Address offset: 0x7E4

DPPI Event Interrupt Enable

CSR view of the INTEN APB register (also modified through INTENSET and INTENCLR). Every bit enables interrupt generation sourced by the corresponding event. Real Time Peripherals VEVIF

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-f	RW	INTEN[i] (i=0..31)			
			Disabled	0x0	Interrupt disabled for EVENTS[i]
			Enabled	0x1	Interrupt enabled for EVENTS[i]

8.28.3.62 NORDIC.EVENTSB

Address offset: 0x7E5

Buffered DPPI Events

The value in this register is passed to EVENTS on a Counter0 event (write sets dirty status). Real Time Peripherals VEVIF

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				f	e	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A-f	W	EVENTSB[i] (i=0..31)																																	
			Disabled	0x0																															
			Enabled	0x1																															

8.28.3.63 NORDIC.EVENTSBS

Address offset: 0x7E6

EVENTSB Dirty Status

Reads EVENTSB dirty status. Writes EVENTSB (sets dirty status)

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	W	EVENTSB																																	
A	R	DIRTYBIT																																	
			CLEAN	0x0																															
			DIRTY	0x1																															

8.28.3.64 NORDIC.OUT

Address offset: 0xBC0

GPIO Output value. Real Time Peripherals VIO.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																				P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A-P	RW	PIN[i] (i=0..15)																																	
			LOW	0x0																															
			HIGH	0x1																															

8.28.3.65 NORDIC.DIR

Address offset: 0xBC1

GPIO pin Direction. Real Time Peripherals VIO.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-P	RW	PIN[i] (i=0..15)			
			INPUT	0x0	Pin is set as input
			OUTPUT	0x1	Pin is set as output

8.28.3.66 NORDIC.IN

Address offset: 0xBC2

GPIO Input. Real Time Peripherals VIO.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-P	R	PIN[i] (i=0..15)			
			LOW	0x0	Pin is Low
			HIGH	0x1	Pin is High

8.28.3.67 NORDIC.INMODE

Address offset: 0xBC3

Input Mode

Sets the sampling mode for values read through IN. Real Time Peripherals VIO

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MODE			Input Mode
			CONTINUOUS	0x0	Continuous sampling (if CPU is not sleeping)
			EVENT	0x1	Sampling on Counter1 event
			SHIFT	0x2	Sampling and shifting on Counter1 event synchronized with OUT
			SHIFTA	0x3	Sampling and shifting on Counter1 event, independent of OUT

8.28.3.68 NORDIC.OUTB

Address offset: 0xBC4

Buffered GPIO Output

Bits 15:0 in this register are passed to OUT on a Counter0 event (write sets dirty status). Real Time Peripherals VIO

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-f	RW	PIN[i] (i=0..31)			
			LOW	0x0	Pin driver is low
			HIGH	0x1	Pin driver is high

8.28.3.69 NORDIC.DIRB

Address offset: 0xBC5

Buffered GPIO pin Direction

The value in this register is passed to DIR on a Counter0 event (write sets dirty status). Real Time Peripherals VIO.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-P	RW	PIN[i] (i=0..15)			
			INPUT	0x0	Pin is set as input
			OUTPUT	0x1	Pin is set as output

8.28.3.70 NORDIC.DIROUT

Address offset: 0xBC6

DIR and OUT concatenation

Addresses DIR[15:0] and OUT[15:0] in the same operation. Real Time Peripherals VIO

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				Q P O N M L K J I H G F E D C B A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	OUT			GPIO Output
B-Q	RW	DIR[i] (i=0..15)			GPIO pin Direction

8.28.3.71 NORDIC.DIROUTB

Address offset: 0xBC7

Concatenation of DIRB and OUTB

Addresses DIRB[15:0] and OUTB[15:0] in the same operation. The value in this register is passed to DIROUT on a Counter0 event (write sets dirty status of both buffers). Real Time Peripherals VIO

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				Q P O N M L K J I H G F E D C B A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	OUTB			Buffered GPIO Output
B-Q	RW	DIRB[i] (i=0..15)			Buffered GPIO pin Direction

8.28.3.72 NORDIC.OUTBRB

Address offset: 0xBC8

Byte reversed register OUTB

This register is shadow to register OUTB and holds frames in reversed order for each byte of OUTB

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	VAL		0x0..0xFFFFFFFF	

8.28.3.73 NORDIC.OUTBRW

Address offset: 0xBC9

Word reversed register OUTB

This register is shadow to register OUTB and holds frame reversed in the whole word of OUTB

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	VAL		0x0..0xFFFFFFFF	

8.28.3.74 NORDIC.INBRB

Address offset: 0xBCA

Byte reversed register INB

This register is shadow to register INB and holds frame reversed in each byte of OUTB

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	R	VAL		0x0..0xFFFFFFFF	

8.28.3.75 NORDIC.SHIFTCTRLB

Address offset: 0xBCB

Buffered IO shift control

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					B_C	B_C	B_C	B_C			C_A	C_A				B_B	B_B	B_B	B_B	B_B		B_A	B_A	B_A			A_A	A_A	A_A	A_A	A_A	A_A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	SHIFTCNTB			
A_A	RW	SHIFTCNTB.VALUE		0..63	Alias to SHIFTCNTB.VALUE register
B	RW	OUTMODEB			
B_A	RW	OUTMODEB.MODE			Alias to OUTMODEB.MODE register
			NoShifting	0x0	No shifting
			OutBBuf	0x2	Only OUTB used for buffering
			OutBBufToggleClk	0x4	Only OUTB used for buffering, auto-toggle clock line
B_B	RW	OUTMODEB.FRAMEWIDTH		0..16	Alias to OUTMODEB.FRAMEWIDTH register
B_C	RW	OUTMODEB.SEL		0..15	Alias to OUTMODEB.SEL register
C	RW	INMODEB			
C_A	RW	INMODEB.MODE			Alias to INMODEB.MODE register
			CONTINUOUS	0x0	Continuous sampling (if CPU is not sleeping)

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID					B_C	B_C	B_C	B_C			C_A	C_A				B_B	B_B	B_B	B_B	B_B		B_A	B_A	B_A			A_A	A_A	A_A	A_A	A_A	A_A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
			EVENT	0x1	Sampling on Counter1 event
			SHIFT	0x2	Sampling and shifting on Counter1 event
			SHIFTA	0x3	Sampling and shifting on Counter1 event, independent from output

8.28.3.76 NORDIC.SHIFTCNTIN

Address offset: 0xBCD

Number of frames to be shifted from INB before new data is required

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																											A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	VALUE		0..63	Value

8.28.3.77 NORDIC.SHIFTCNTOUT

Address offset: 0xBCE

Number of frames to be shifted to OUTB before new data is required

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																											A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	VALUE		0..63	Value

8.28.3.78 NORDIC.SHIFTCNTB

Address offset: 0xBCF

Buffered SHIFTCNTOUT and SHIFTCNTIN register

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																											A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	VALUE		0..63	Value

8.28.3.79 NORDIC.OUTTGL

Address offset: 0xBD0

GPIO Output Toggle

Toggles bits in OUT. Real Time Peripherals VIO

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-P	W	PIN[i] (i=0..15)			
			UNCHANGED	0x0	Pin remains unchanged
			TOGGLE	0x1	Pin is toggled

8.28.3.80 NORDIC.DIRTGL

Address offset: 0xBD1

GPIO pin Direction Toggle

Toggles bits in DIR. Real Time Peripherals VIO

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-P	W	PIN[i] (i=0..15)			
			UNCHANGED	0x0	Pin remains unchanged
			TOGGLE	0x1	Pin is toggled

8.28.3.81 NORDIC.OUTBTGL

Address offset: 0xBD2

Buffered GPIO Output Toggle

Toggles bits in OUTB (sets dirty status). Real Time Peripherals VIO

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-f	W	PIN[i] (i=0..31)			
			UNCHANGED	0x0	Pin remains unchanged
			TOGGLE	0x1	Pin is toggled

8.28.3.82 NORDIC.DIRBTGL

Address offset: 0xBD3

Buffered GPIO pin Direction Toggle

Toggles bits in DIRB (sets dirty status). Real Time Peripherals VIO

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-P	W	PIN[i] (i=0..15)			
			UNCHANGED	0x0	Pin remains unchanged
			TOGGLE	0x1	Pin is toggled

8.28.3.83 NORDIC.DIROUTTGL

Address offset: 0xBD4

DIROUT Toggle

Toggles bits in DIR[15:0] and OUT[15:0] in the same operation. Real Time Peripherals VIO

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				f	e	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A-P	W	OUT[i] (i=0..15)																																	
			UNCHANGED	0x0																															
			TOGGLE	0x1																															
Q-f	W	DIR[i] (i=0..15)																																	
			UNCHANGED	0x0																															
			TOGGLE	0x1																															

8.28.3.84 NORDIC.DIROUTBTGL

Address offset: 0xBD5

DIROUTB Toggle

Toggles bits in DIRB[15:0] and OUTB[15:0] in the same operation (sets dirty status). Real Time Peripherals VIO

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				f	e	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A-P	W	OUTB[i] (i=0..15)																																	
			UNCHANGED	0x0																															
			TOGGLE	0x1																															
Q-f	W	DIRB[i] (i=0..15)																																	
			UNCHANGED	0x0																															
			TOGGLE	0x1																															

8.28.3.85 NORDIC.OUTUBTGL

Address offset: 0xBD6

Buffered GPIO Unshifted Output Toggle

Toggles bits in OUTUB[15:0] (sets dirty status). Real Time Peripherals VIO

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																				P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A-P	W	PIN[i] (i=0..15)																																	
			UNCHANGED	0x0																															
			TOGGLE	0x1																															

8.28.3.86 NORDIC.OUTBS

Address offset: 0xBD8

Buffered GPIO Output Dirty Status

Reads OUTB dirty status. Writes OUTB value (and sets dirty status) if it's not already dirty. Real Time Peripherals VIO

Note: This register does not stall on writes when already dirty, and as such can be used to implement non-blocking update-when-ready writes to the buffered outputs

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	OUTB			Write to OUTB (if not dirty)
A	R	DIRTYBIT			Read Buffer Dirty status
			CLEAN	0x0	Buffer is clean
			DIRTY	0x1	Buffer is dirty

8.28.3.87 NORDIC.DIRBS

Address offset: 0xBD9

Buffered GPIO pin Direction Dirty Status

Reads DIRB dirty status. Writes DIRB value (sets dirty status). Real Time Peripherals VIO

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	DIRB			Write to DIRB (if not dirty)
A	R	DIRTYBIT			Read Buffer Dirty status
			CLEAN	0x0	Buffer is clean
			DIRTY	0x1	Buffer is dirty

8.28.3.88 NORDIC.DIROUTBS

Address offset: 0xBDA

Combination of DIRB and OUTB Dirty Status

Reads combination (OR) of DIRB and OUTB dirty status. Writes DIRB and OUTB[15:0] in the same operation (sets dirty status of both buffers). Real Time Peripherals VIO

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID					A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000					**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	DIROUTB			Write to DIROUTB (if not dirty)
A	R	DIRTYBIT			Read Combination (OR) of DIRB and OUTB Dirty status
			CLEAN	0x0	Buffer is clean
			DIRTY	0x1	Buffer is dirty

8.28.3.89 NORDIC.OUTUBS

Address offset: 0xBDB

Buffered GPIO Unshifted Output Dirty Status

Reads OUTUB dirty status. Writes OUTUB[15:0] value (sets dirty status). Real Time Peripherals VIO

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	W	OUTUB																																	
				Write to OUTUB (if not dirty)																															
A	R	DIRTYBIT																																	
				Read Buffer Dirty status																															
			CLEAN	0x0																															
				Buffer is clean																															
			DIRTY	0x1																															
				Buffer is dirty																															

8.28.3.90 NORDIC.OUTMODE

Address offset: 0xBE3

Serial output mode

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID								C	C	C	C				B	B	B	B	B													A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	MODE																																	
				Mode																															
			NoShifting	0x0																															
				No shifting																															
			OutBBuf	0x2																															
				Only OUTB used for buffering																															
			OutBBufToggleClk	0x4																															
				Only OUTB used for buffering, auto-toggle clock line																															
B	RW	FRAMEWIDTH		0..16																															
				Output frame width MODE=0x2: BITS=FRAMEWIDTH. Legal values: 1, 2, 3, 4, 5, 6, 7, 8, 16 (9-15 are not legal) MODE=0x4: BITS=FRAMEWIDTH. Legal values: 1, 2, 3, 4, 5, 6, 7, 8																															
C	RW	SEL		0..15																															
				Start index of VIO used for shifting from OUTB and to INB. For OUTB, the number of left shifts is given by (MODE is OUTMODE.MODE): if (MODE < 2) then SHIFTS = 0; else if ((MODE==4) & (SEL==0)) then SHIFTS = 1; else SHIFTS = SEL; For INB, the number of left shifts is given by (MODE is INMODE.MODE): if (MODE < 2) then SHIFTS = 0; else if ((MODE==2) & (INSEL==1) & (FRAMEWIDTH==1)) then SHIFTS = 2; else if (SEL==0) then SHIFTS = 1; else SHIFTS = SEL;																															

8.28.3.91 NORDIC.OUTMODEB

Address offset: 0xBE4

Buffered OUTMODE register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				C C C C B B B B B A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MODE			Mode
			NoShifting	0x0	No shifting
			OutBBuf	0x2	Only OUTB used for buffering
			OutBBufToggleClk	0x4	Only OUTB used for buffering, auto-toggle clock line
B	RW	FRAMEWIDTH		0..16	Frame width in bits

C	RW	SEL		0..15	Start index of VIO used for shifting from OUTB and to INB.
					For OUTB, the number of left shifts is given by (MODE is OUTMODE.MODE):
					if (MODE < 2) then SHIFTS = 0;
					else if ((MODE==4) & (SEL==0)) then SHIFTS = 1;
					else SHIFTS = SEL;
					For INB, the number of left shifts is given by (MODE is INMODE.MODE):
					if (MODE < 2) then SHIFTS = 0;
					else if ((MODE==2) & (INSEL==1) & (FRAMEWIDTH==1)) then SHIFTS = 2;
					else if (SEL==0) then SHIFTS = 1;
					else SHIFTS = SEL;

8.28.3.92 NORDIC.INMODEB

Address offset: 0xBE5

Buffered INMODE register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	MODE			Input Mode
			CONTINUOUS	0x0	Continuous sampling (if CPU is not sleeping)
			EVENT	0x1	Sampling on Counter1 event
			SHIFT	0x2	Sampling and shifting on Counter1 event
			SHIFTA	0x3	Sampling and shifting on Counter1 event, independent from output

8.28.3.93 NORDIC.INB

Address offset: 0xBE6

Buffered GPIO input

GPIO Input. Real Time Peripherals VIO.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-f	R	PIN[i] (i=0..31)			
			LOW	0x0	Pin is Low
			HIGH	0x1	Pin is High

8.28.3.94 NORDIC.OUTUB

Address offset: 0xBE7

Buffered write to Unshifted parts of OUT

Buffered write to OUT bits that are not driven by OUTB shifting (OUT[OUTMODE.FRAMEWIDTH +SHIFTS-1:SHIFTS] is not affected, refer to OUTMODE.SEL for the definition of SHIFTS). OUTUB is transferred to OUT on a selectable internal event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	OUT			Written to OUT MSBs that are not driven by OUTB shifting.

8.28.3.95 NORDIC.SHIFTCNTCOMP

Address offset: 0xBE8

SHIFTCNTIN/OUT compare values

Can trigger events and interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B B B B B B A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	OUTCOMPVAL			Compare value for SHIFTCNTOUT
B	RW	INCOMPVAL			Compare value for SHIFTCNTIN

8.28.3.96 NORDIC.WAITEVENT

Address offset: 0xBE9

Wait for internal event

Write value: mask which bits to wait for

Read value: the new value when unstalled. If a read-while-write operation is performed, the read value is AND'ed with the write value

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	IEVENTCNT0			CNT0's event
B	RW	IEVENTCNT1			CNT1's event
C	RW	IEVENTVIO			Event generated by a specific VIO pin
D	RW	IEVENTVIOANY			Event generated by a change in any VIO pin
E	RW	IEVENTVTASKSANY			Event when any TASK is triggered
F	RW	IEVENTSHIFTCNTOUT			Event for SHIFTCNTOUT when reaching a compare value defined in SHIFTCNTCOMP
G	RW	IEVENTSHIFTCNTIN			Event for SHIFTCNTIN when reaching a compare value defined in SHIFTCNTCOMP

8.28.3.97 NORDIC.WAITINPUT

Address offset: 0xBEA

Wait input

Each bit waits until either the corresponding VTASK is high or there is a change in the corresponding VIO pin. Whether a given bit is mapped to VEVIF or VIO is defined by CSR VIOPINS, which can be different for each VPR instance.

Write value: mask which bits to wait for

Read value: bits that contribute to unstalling will read as 1, other bits will read as 0. If a read-while-write operation is performed, the read value is AND'ed with the write value

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	VTASKSVIO																																	
																																			VTASKS or VIO pins

8.28.3.98 NORDIC.RTPINTEN

Address offset: 0xBEB

Interrupt enable

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																												G	F	E	D	C	B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	CNT0																																	
																																			Interrupt enable for IEVENTCNT0, alias of VPRNORDICCTRL.CNTIRQENABLE
B	RW	CNT1																																	Interrupt enable for IEVENTCNT1
C	RW	VIO																																	Interrupt enable for IEVENTVIO
D	RW	VIOANY																																	Interrupt enable for IEVENTVIOANY
E	RW	VTASKSANY																																	Interrupt enable for IEVENTVTASKSANY
F	RW	SHIFTCNTOUT																																	Interrupt enable for IEVENTSHIFTCNTOUT
G	RW	SHIFTCNTIN																																	Interrupt enable for IEVENTSHIFTCNTIN

8.28.3.99 NORDIC.OUTUBTRIG

Address offset: 0xBEC

OUTUB trigger select

Selects an internal event as the trigger condition for transferring OUTUB to OUT

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																														A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	SEL			OUTUBTRIG select
			IEVENTSHIFTCNTIN	6	
			IEVENTSHIFTCNTOUT	5	
			IEVENTVTASKSANY	4	
			IEVENTVIOANY	3	
			IEVENTVIO	2	
			IEVENTCNT1	1	
			IEVENTCNT0	0	

8.29 WDT — Watchdog timer

The countdown watchdog timer (WDT) uses the low-frequency clock source (LFCLK) and offers configurable and robust protection against application lock-up.

The main features of WDT are:

- Generates watchdog reset
- Optional pause of WDT when the CPU is sleeping or when it is stopped by the debugger
- Optional generation of non-maskable interrupt (NMI)
- Runs off the low-frequency clock source (LFCLK)

WDT must be configured before it is started. After configuration, WDT is started by triggering the START task.

When WDT is running, its configuration registers (CRV, RREN, and CONFIG) are blocked for further configuration.

WDT can be paused while the CPU is sleeping, or when the debugger has halted the CPU. WDT is implemented as a down-counter that generates a TIMEOUT event when it wraps over after counting down to 0. When WDT is started by the START task, the watchdog counter is loaded with the value specified in the CRV register. This counter is also reloaded with the value specified in the CRV register when a reload request is granted.

The timeout period for the watchdog is given by the following equation:

```
timeout [s] = ( CRV + 1 ) / 32768
```

When started, WDT will make the 32.768 kHz RC oscillator start if no other 32.768 kHz clock source is running and generating the 32.768 kHz system clock, see chapter CLOCK — Clock control on page 72.

8.29.1 Reload criteria

WDT has eight separate reload request registers. These registers are used to request WDT to reload its counter with the value specified in the CRV register. To reload the watchdog counter, write `0x6E524635` to all enabled reload registers.

One or more RR registers can be individually enabled through the RREN register.

8.29.2 Temporarily pausing the watchdog

By default, the watchdog will be active counting down the down-counter while the CPU is sleeping. It is possible to configure the watchdog to automatically pause when the CPU is sleeping or when it is stopped by the debugger.

Entering System OFF mode will stop and disable the watchdog.

8.29.3 Watchdog reset

A TIMEOUT event automatically leads to a watchdog reset.

If the watchdog is configured to generate an interrupt on the TIMEOUT event, the watchdog reset is postponed by two 32.768 kHz clock cycles after the TIMEOUT event is generated. Once the TIMEOUT event is generated, and unless the watchdog is stopped, the impending watchdog reset will occur.

The watchdog can be reset from several reset sources, see Reset behavior on page 111. After a reset, the watchdog configuration registers are available for configuration.

See RESET — Reset control on page 109 for more information about reset sources.

The TIMEOUT event will also generate NMI interrupt, when NMI interrupt is supported. See the the instance's configuration in Instantiation on page 232 to see if NMI is supported.

8.29.4 Stopping the watchdog

By default, the watchdog cannot be stopped. It is possible to configure the watchdog to allow the STOP task.

To stop the watchdog, perform the following steps.

1. Set the CONFIG register's STOPEN field to `Enable` during watchdog configuration.
2. Write the special value 0x6E524635 to the TSEN register.
3. Invoke the STOP task.

When these conditions are met, the watchdog is stopped and a STOPPED event is issued.

When the watchdog is stopped, its configuration registers CRV, RREN, and CONFIG are no longer blocked.

> **Note:** It is recommended to write zeros to TSEN on page 1172 after the watchdog has stopped, to avoid runaway code triggering the STOP task.

8.29.5 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
WDT30	GLOBAL	0x50108000	HF	S	NA	No	Watchdog timer WDT30
WDT31 : S WDT31 : NS	GLOBAL	0x50109000 0x40109000	US	S	NA	No	Watchdog timer WDT31

Configuration

Instance	Domain	Configuration
WDT30	GLOBAL	Supports non-maskable interrupts (NMI).
WDT31 : S WDT31 : NS	GLOBAL	Does not generate non-maskable interrupts.

Register overview

Register	Offset	TZ	Description
TASKS_START	0x000		Start WDT
TASKS_STOP	0x004		Stop WDT
SUBSCRIBE_START	0x080		Subscribe configuration for task START
SUBSCRIBE_STOP	0x084		Subscribe configuration for task STOP
EVENTS_TIMEOUT	0x100		Watchdog timeout
EVENTS_STOPPED	0x104		Watchdog stopped
PUBLISH_TIMEOUT	0x180		Publish configuration for event TIMEOUT
PUBLISH_STOPPED	0x184		Publish configuration for event STOPPED
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
INTPEND	0x30C		Pending interrupts
NMIEN	0x320		Enable or disable interrupt
NMIENSET	0x324		Enable interrupt
NMIENCLR	0x328		Disable interrupt
RUNSTATUS	0x400		Run status
REQSTATUS	0x404		Request status
CRV	0x504		Counter reload value
RREN	0x508		Enable register for reload request registers
CONFIG	0x50C		Configuration register
TSEN	0x520		Task stop enable
RR[n]	0x600		Reload request n

8.29.5.1 TASKS_START

Address offset: 0x000

Start WDT

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_START			Start WDT
			Trigger	1	Trigger task

8.29.5.2 TASKS_STOP

Address offset: 0x004

Stop WDT

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	W	TASKS_STOP			Stop WDT
			Trigger	1	Trigger task

8.29.5.3 SUBSCRIBE_START

Address offset: 0x080

Subscribe configuration for task START

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task START will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.29.5.4 SUBSCRIBE_STOP

Address offset: 0x084

Subscribe configuration for task STOP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that task STOP will subscribe to
B	RW	EN			
			Disabled	0	Disable subscription
			Enabled	1	Enable subscription

8.29.5.5 EVENTS_TIMEOUT

Address offset: 0x100

Watchdog timeout

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_TIMEOUT			Watchdog timeout
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.29.5.6 EVENTS_STOPPED

Address offset: 0x104

Watchdog stopped

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_STOPPED			Watchdog stopped
			NotGenerated	0	Event not generated
			Generated	1	Event generated

8.29.5.7 PUBLISH_TIMEOUT

Address offset: 0x180

Publish configuration for event TIMEOUT

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event TIMEOUT will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.29.5.8 PUBLISH_STOPPED

Address offset: 0x184

Publish configuration for event STOPPED

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	CHIDX		[0..255]	DPPI channel that event STOPPED will publish to
B	RW	EN			
			Disabled	0	Disable publishing
			Enabled	1	Enable publishing

8.29.5.9 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	TIMEOUT			Enable or disable interrupt for event TIMEOUT
			Disabled	0	Disable
			Enabled	1	Enable
B	RW	STOPPED			Enable or disable interrupt for event STOPPED
			Disabled	0	Disable
			Enabled	1	Enable

8.29.5.10 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1S	TIMEOUT			Write '1' to enable interrupt for event TIMEOUT
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	STOPPED			Write '1' to enable interrupt for event STOPPED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.29.5.11 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1C	TIMEOUT			Write '1' to disable interrupt for event TIMEOUT
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	STOPPED			Write '1' to disable interrupt for event STOPPED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.29.5.12 INTPEND

Address offset: 0x30C

Pending interrupts

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	R	TIMEOUT			Read pending status of interrupt for event TIMEOUT
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending
B	R	STOPPED			Read pending status of interrupt for event STOPPED
			NotPending	0	Read: Not pending
			Pending	1	Read: Pending

8.29.5.13 NMIEN

Address offset: 0x320

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	TIMEOUT			Enable or disable interrupt for event TIMEOUT
			Disabled	0	Disable
			Enabled	1	Enable
B	RW	STOPPED			Enable or disable interrupt for event STOPPED
			Disabled	0	Disable
			Enabled	1	Enable

8.29.5.14 NMIENSET

Address offset: 0x324

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1S	TIMEOUT			Write '1' to enable interrupt for event TIMEOUT
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	STOPPED			Write '1' to enable interrupt for event STOPPED
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.29.5.15 NMIENCLR

Address offset: 0x328

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW W1C	TIMEOUT			Write '1' to disable interrupt for event TIMEOUT
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1C	STOPPED			Write '1' to disable interrupt for event STOPPED
			Clear	1	Disable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

8.29.5.16 RUNSTATUS

Address offset: 0x400

Run status

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	RUNSTATUSWDT			Indicates whether or not WDT is running
			NotRunning	0	Watchdog is not running
			Running	1	Watchdog is running

8.29.5.17 REQSTATUS

Address offset: 0x404

Request status

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000001				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1**
ID	R/W	Field	Value ID	Value	Description
A-H	R	RR[i] (i=0..7)			Request status for RR[i] register
			DisabledOrRequested	0	RR[i] register is not enabled, or are already requesting reload
			EnabledAndUnrequested	1	RR[i] register is enabled, and are not yet requesting reload

8.29.5.18 CRV

Address offset: 0x504

Counter reload value

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0xFFFFFFFF				**1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**
ID	R/W	Field	Value ID	Value	Description
A	RW	CRV		[0xF..0xFFFFFFFF]	Counter reload value in number of cycles of the 32.768 kHz clock

8.29.5.19 RREN

Address offset: 0x508

Enable register for reload request registers

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																												H	G	F	E	D	C	B	A
Reset 0x00000001				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
ID	R/W	Field	Value ID	Value																															
A-H	RW	RR[i] (i=0..7)																																	
			Disabled	0																															
			Enabled	1																															

8.29.5.20 CONFIG

Address offset: 0x50C

Configuration register

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																													C			B			A
Reset 0x00000001				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
ID	R/W	Field	Value ID	Value																															
A	RW	SLEEP																																	
			Pause	0																															
			Run	1																															
B	RW	HALT																																	
			Pause	0																															
			Run	1																															
C	RW	STOPEN																																	
			Disable	0																															
			Enable	1																															

8.29.5.21 TSEN

Address offset: 0x520

Task stop enable

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	W	TSEN																																	
			Enable	0x6E524635																															

8.29.5.22 RR[n] (n=0..7)

Address offset: 0x600 + (n × 0x4)

Reload request n

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	W	RR			Reload request register
			Reload	0x6E524635	Value to request a reload of the watchdog timer

9 Debug and trace

The debug and trace system is a flexible and powerful mechanism for non-intrusive debugging.

The main features of the debugand trace system are the following:

- Access port connection for Arm Cortex-M33
  - Eight breakpoints
  - Four watchpoint comparators
  - Instrumentation trace macrocell (ITM)
  - Embedded trace macrocell (ETM)
  - Access protection through APPROTECT, SECUREAPPROTECT, and ERASEPROTECT
- Serial wire debug (SWD) interface, protocol version 2 with multidrop support
- Control-access port (CTRL-AP) that enables device control when other debug access ports (DAP) have been disabled by the access port protection
- Trace port interface unit (TPIU)
  - 4-bit parallel trace of ITM and ETM trace data
  - Serial wire output (SWO) trace of ITM data

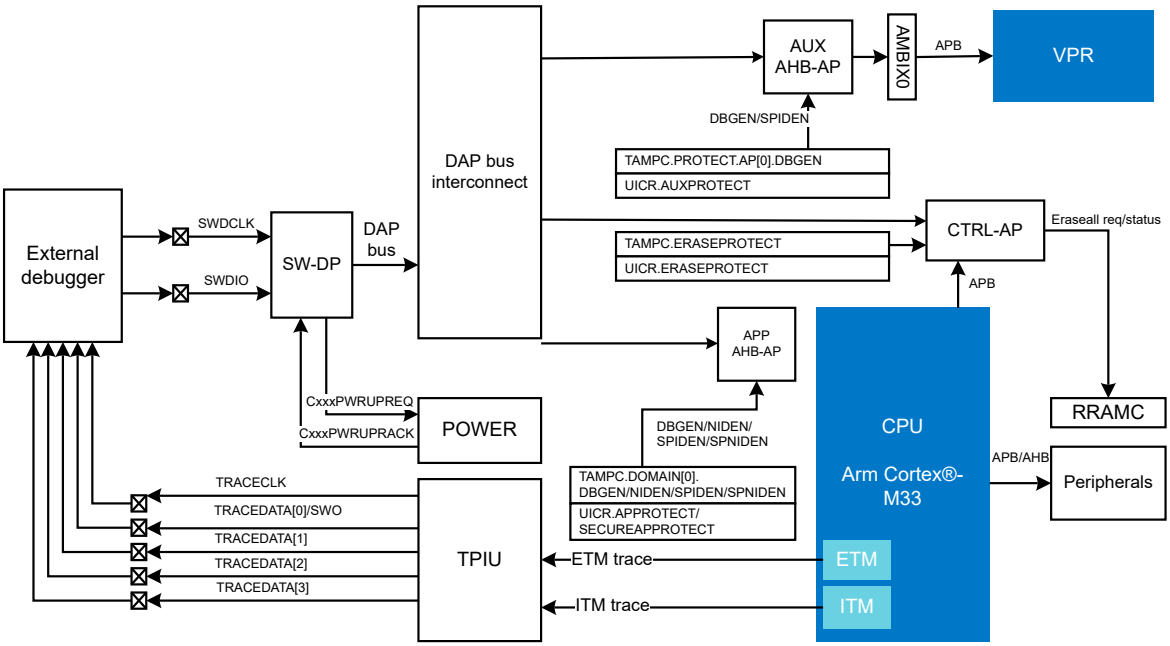


Figure 175: Debug and trace overview

9.1 Debug access port

An external debugger can access the device through the debug access port (DAP).

The DAP implements a standard serial wire debug (SWD) Arm CoreSight protocol with a two-pin serial interface (**SWDCLK** and **SWDIO**).

The **SWDIO** pin has an internal pull-up resistor. The **SWDCLK** pin has an internal pull-down resistor.

There are several access ports for connecting to different parts of the system, as shown in the following table.

AP ID	Type	Description
0	AHB-AP	CM33 access port
1	AHB-AP	AUX access port
2	CTRL-AP	Control access port

Table 72: Access port overview

The AHB-AP is a standard Arm component. See the *ArmCoreSight SoC-400 Technical Reference Manual* for more information. The control access port (CTRL-AP) is proprietary and described in more detail in CTRL-AP — Control access port on page 1181.

9.1.1 Debug access port registers

Register overview

Register	Offset	TZ	Description
TARGETID	0x024		The TARGETID register provides information about the target when the host is connected to a single device. The TARGETID register is accessed by a read of DP register 0x4 when the DPBANKSEL bit in the SELECT register is set to 0x2.
DLPIDR	0x034		The DLPIDR register provides information about the serial wire debug protocol version. Accessed by a read of DP register 0x4 when the DPBANKSEL bit in the SELECT register is set to 0x3.

9.1.1.1 TARGETID

Address offset: 0x024

The TARGETID register provides information about the target when the host is connected to a single device.

The TARGETID register is accessed by a read of DP register 0x4 when the DPBANKSEL bit in the SELECT register is set to 0x2.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				C	C	C	C	B	B	B	B	B	B	B	B	B	B	B	B					A	A	A	A	A	A	A	A	A	A	A	
Reset 0x00000289				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**
ID	R/W	Field	Value ID	Value																															
A	R	TDESIGNER																																	
				An 11-bit code JEDEC JEP106 continuation code and identity code. The ID identifies the designer of the part.																																	
			NordicSemi	0x144																																	
				Nordic Semiconductor ASA.																																	
B	R	TPARTNO																																	
				Part number.																																	
C	R	TREVISION																																	
				Target revision.																																	

9.1.1.2 DLPIDR

Address offset: 0x034

The DLPIDR register provides information about the serial wire debug protocol version.

Accessed by a read of DP register 0x4 when the DPBANKSEL bit in the SELECT register is set to 0x3.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID	B	B	B	B																									A	A	A	A
Reset 0x00000001	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**

ID	R/W	Field	Value ID	Value	Description
A	R	PROTVSN			Protocol version.
			SWDPv2	1	SW protocol version 2.
B	R	TINSTANCE			Target instance.

9.2 Access port protection

The access ports can be protected to secure the internal assets and resources of the device. While the control access port (CTRL-AP) is always accessible from an external debugger, the system applies various protection mechanisms to control and restrict access to the individual AHB access ports. These mechanisms ensure both secure and non-secure access can be selectively managed and protected.

Protection is controlled by specific registers, which enable or disable debug access at different levels. These registers are part of UICR and TAMPC. The access port is normally protected. The hardware and software configurations of these registers control the access protection policies as shown in the following table.

Registers	Description
UICR.APPROTECT	Hardware control of non-secure debug access. A device reset is required for this configuration to take effect. `Unprotected` – CPU controls DBGEN/NIDEN, locks disabled. Other values – DBGEN/NIDEN disabled and locked.
TAMPC.PROTECT.DOMAIN[0].DBGEN TAMPC.PROTECT.DOMAIN[0].NIDEN	CPU control of non-secure debug access. The registers can be locked.

Table 73: Non-secure Arm Cortex-M33 AHB-AP debug access

Registers	Description
UICR.SECUREAPPROTECT	Hardware control of secure debug access. A device reset is required for this configuration to take effect. `Unprotected` – CPU controls SPIDEN/SPNIDEN, locks disabled. Other values – SPIDEN/SPNIDEN disabled and locked.
TAMPC.PROTECT.DOMAIN[0].SPIDEN TAMPC.PROTECT.DOMAIN[0].SPNIDEN	CPU control of secure debug access. The registers can be locked. Non-secure invasive debug access must be enabled for secure debug access to be enabled.

Table 74: Secure Arm Cortex-M33 AHB-AP debug access

Registers	Description
UICR.AUXAPPROTECT	Hardware control of AUX-AP debug access. A device reset is required for this configuration to take effect. `Unprotected` – CPU controls AUX-AP DBGEN, lock disabled. Other values – AUX-AP DBGEN disabled and locked.
TAMPC.PROTECT.AP[0].DBGEN	Software control of AUX-AP debug access. The registers can be locked.

Table 75: VPR AUX-AP debug access

The access port protection is illustrated in the following figures.

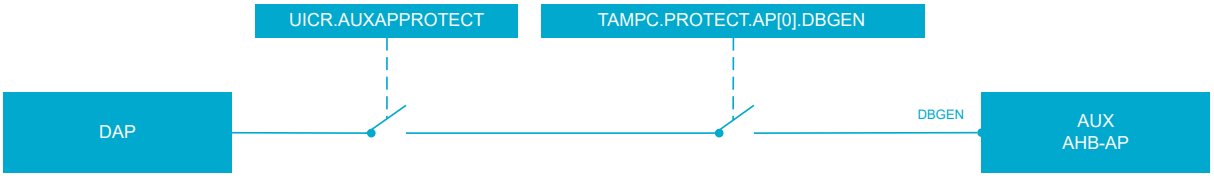


Figure 176: AUX access port protection overview

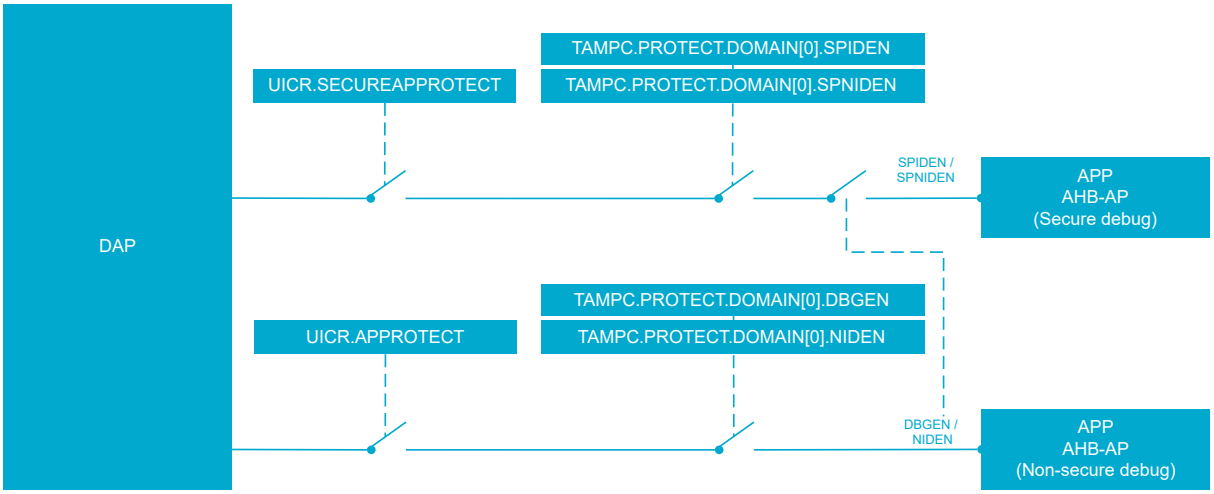


Figure 177: Arm Cortex-M33 AHB-AP access port protection overview

Registers	Description
UICR.APPROTECT UICR.SECUREAPPROTECT	Hardware control of RRAMC ERASEALL protection in addition to access ports. A device reset is required for this configuration to take effect. Any value other than `Unprotected` disables RRAMC ERASEALL.
UICR.ERASEPROTECT	Hardware control of RRAMC ERASEALL and CTRL-AP ERASEALL protection. A device reset is required for this configuration to take effect. Any value other than `Unprotected` disables the erase all operations.
TAMPC.PROTECT.ERASEPROTECT	Software control of RRAMC ERASEALL and CTRL-AP ERASEALL protection. The register can be locked.

Table 76: Erase protection

The ERASEALL protection is illustrated in the following figure:

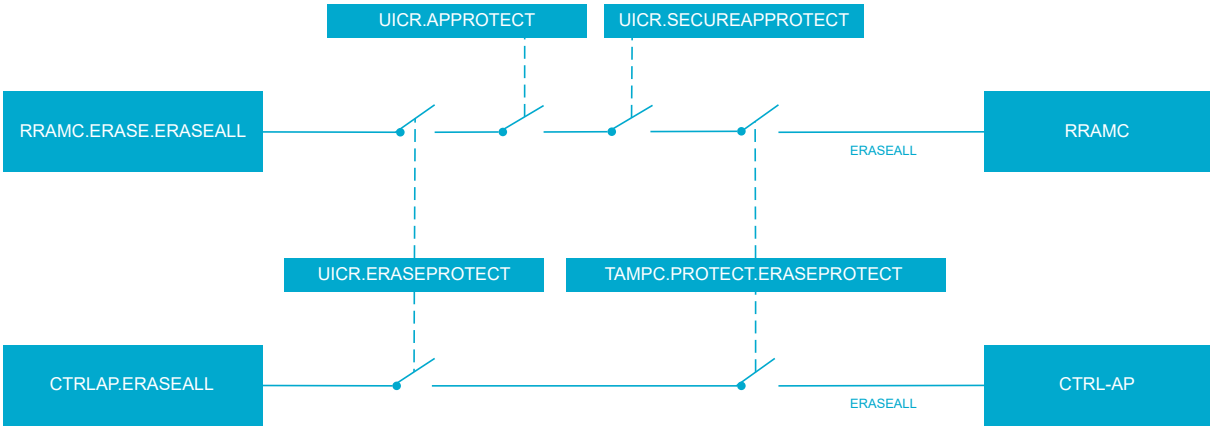


Figure 178: ERASEALL protection overview

The reset behavior of the TAMPC access port and ERASEALL protection is defined in Signal protector on page 209. On-chip software must write to the TAMPC registers before a debug access port is opened.

The access port remains open after the completion of the CTRL-AP.ERASEALL operation. CTRL-AP temporarily removes the access port protection until certain conditions are met, after which the protection will be reinstated. The AHB-AP will be protected when one of the following conditions are met:

- Power-on reset
- Brownout reset
- Watchdog timer reset
- Pin reset

The following figure shows how a device with access port protection enabled can be erased, programmed, and configured to allow debugging. The access port state is determined by operations sent from the debugger and registers written by firmware. Reset in the following figure refers to any of the conditions previously listed for AHB-AP protection. When writing to the TAMPC, the software must first disable write protection, then write the new values. For more details, see TAMPC — Tamper controller on page 206.

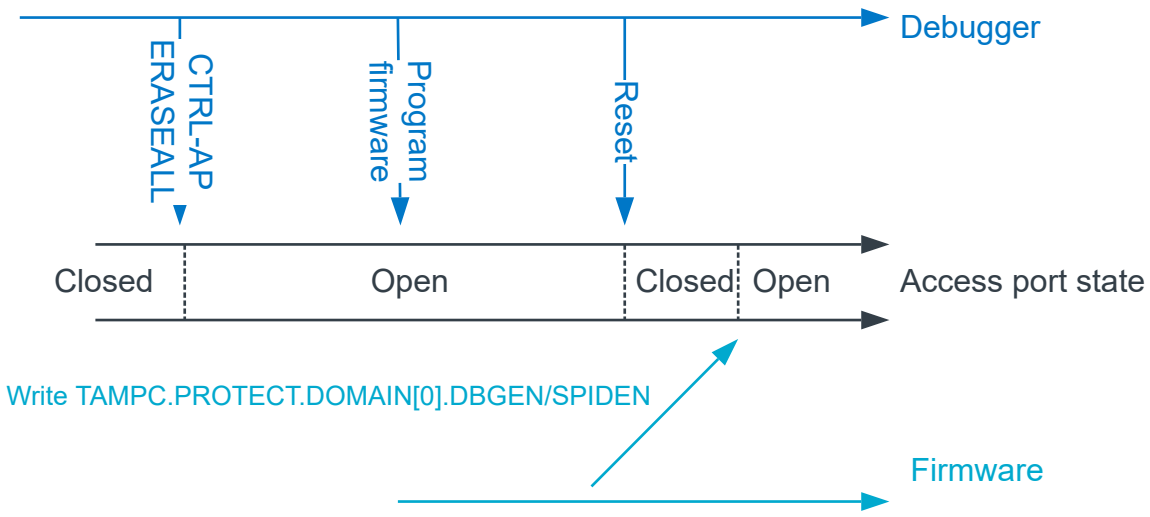


Figure 179: Access port unlocking

The debugger can read the access port protection status in the core's AHB-AP, using the Arm AHB-AP Control/Status Word register (CSW), defined in the *Arm CoreSight SoC-400 Technical Reference Manual*. The DbgStatus field indicates that the AHB-AP can perform AHB transfers, while the SPIStatus field indicates if secure AHB transfers are permitted. For a list of all debug access ports, see Debug access port on page 1174.

9.3 Debug Interface mode

Before the external debugger can connect to an access port, the debugger must first request the device to power up through the debug access port (SWJ-DP).

The device remains in Debug Interface mode when the debugger requests power through CxxxPWRUPREQ. CxxxPWRUPREQ refers to either CSYSPWRUPREQ or CDBGPWRUPREQ, and is further documented in the Arm debug interface architecture specification.

When not in Debug Interface mode, the device is in normal mode. When a debug session is over, the device must be set to normal mode by the external debugger, followed by a pin reset. This reduces overall power consumption.

Some peripherals behave differently in Debug Interface mode compared to normal mode. These differences are described in more detail in the corresponding peripheral chapter.

For details on how to use the debug capabilities, read the debug documentation of your IDE.

If the device is in System OFF when power is requested from CxxxPWRUPREQ, the system wakes up and the DIF flag in RESETREAS on page 112 is set.

9.4 Real-time debug

The device supports real-time debugging. This allows interrupts to execute to completion in real time when breakpoints are set in Thread mode or lower priority interrupts.

Real-time debugging enables setting a breakpoint for single-stepping through code. This prevents real-time event-driven threads from running at a higher priority. For example, this enables the device to continue to service high-priority interrupts of an external controller or sensor, without failure or loss of state synchronization, while stepping through code in a low-priority thread.

9.5 Multidrop serial wire debug

Multidrop serial wire debug (SWD) allows simultaneous access to an unlimited number of devices through a single connection. This is useful for connectivity-constrained products that have several chips with multidrop support.

To select a target in a multidrop capable product, the debugger must write the correct TPARTNO, and TDESIGNER fields into the SW-DP TARGETSEL register. Values for these fields are located in DLPIDR on page 1175.

For more information about multidrop SWD, see the *Arm Debug Interface Architecture Specification*, ADIv5.0 to ADIv5.2.

9.6 Trace

The device supports ETM and ITM trace.

Trace data from the ETM and ITM is sent to an external debugger through a 4-bit wide parallel trace port (TPIU), as illustrated in Access port unlocking.

In addition to parallel trace mode, the TPIU supports serial trace mode through the serial wire output (SWO) trace protocol. Parallel and serial trace modes cannot be used at the same time. ETM trace is only supported in parallel trace mode. ITM trace is supported in both parallel and serial trace mode. See the debug documentation of the IDE for more information.

TPIU trace pins are multiplexed with GPIO pins. The **SWO** and **TRACEDATA[0]** pins can use the same GPIO. See Pin assignments on page 1219 for more information.

Trace speed is configured in the register TRACEPORTSPEED. Trace pin speed is determined by the GPIO drive setting of the multiplexed pins. See GPIO — General purpose input/output on page 292 for information on drive settings.

The trace speed must be configured according to the maximum speed of the GPIO pins used for trace. For information about GPIO speed, see GPIO — General purpose input/output on page 292.

9.6.1 Enabling the trace port

A specific sequence of operations must be performed to enable the trace port.

1. Enable trace and debug using the following code.

```
NRF_TAD_S->ENABLE = TAD_ENABLE_ENABLE_Msk;
```

2. Set drive strength to the highest possible value to ensure fast operation. Do this for all trace pins that will be used.

```
#define TRACE_PIN_CONFIG    ((GPIO_PIN_CNF_DRIVE0_E0 << GPIO_PIN_CNF_DRIVE0_Pos) \
                           | (GPIO_PIN_CNF_DRIVE1_E1 << GPIO_PIN_CNF_DRIVE1_Pos))
#define NRF_Px_S NRF_P2_S // From pin assignments
```

```
#define TRACE_PIN_CLEAR     (~(GPIO_PIN_CNF_CTRLSEL_Msk | GPIO_PIN_CNF_DRIVE0_Msk \
                           | GPIO_PIN_CNF_DRIVE1_Msk))

// Clear the bitfields before configuring to make sure the correct value is written.
NRF_Px_S->PIN_CNF[TRACE_TRACECLK_PIN] &= TRACE_PIN_CLEAR;
NRF_Px_S->PIN_CNF[TRACE_TRACEDATA0_PIN] &= TRACE_PIN_CLEAR;
NRF_Px_S->PIN_CNF[TRACE_TRACEDATA1_PIN] &= TRACE_PIN_CLEAR;
NRF_Px_S->PIN_CNF[TRACE_TRACEDATA2_PIN] &= TRACE_PIN_CLEAR;
NRF_Px_S->PIN_CNF[TRACE_TRACEDATA3_PIN] &= TRACE_PIN_CLEAR;

NRF_Px_S->PIN_CNF[TRACE_TRACECLK_PIN] |= TRACE_PIN_CONFIG;
NRF_Px_S->PIN_CNF[TRACE_TRACEDATA0_PIN] |= TRACE_PIN_CONFIG;
NRF_Px_S->PIN_CNF[TRACE_TRACEDATA1_PIN] |= TRACE_PIN_CONFIG;
NRF_Px_S->PIN_CNF[TRACE_TRACEDATA2_PIN] |= TRACE_PIN_CONFIG;
NRF_Px_S->PIN_CNF[TRACE_TRACEDATA3_PIN] |= TRACE_PIN_CONFIG;
```

3. Trace port speed is configured as a prescaled version of the CPU frequency and must be at least half the CPU frequency to avoid dropping trace packets. The trace speed must also be within the maximum speed of the GPIO pins used for trace. For information about GPIO speed, see GPIO — General purpose input/output on page 292.

```
NRF_TAD_S->TRACEPORTSPEED = TAD_TRACEPORTSPEED_TRACEPORTSPEED_DIV2;
```

4. Configure Arm CoreSight components. See documentation for Arm CoreSight for more information.

9.7 CTRL-AP — Control access port

The control access port (CTRL-AP) is a custom access port that enables control of the device when other access ports (AP) have been disabled by the access port protection.

For an overview of the other debug access ports, see DAP.

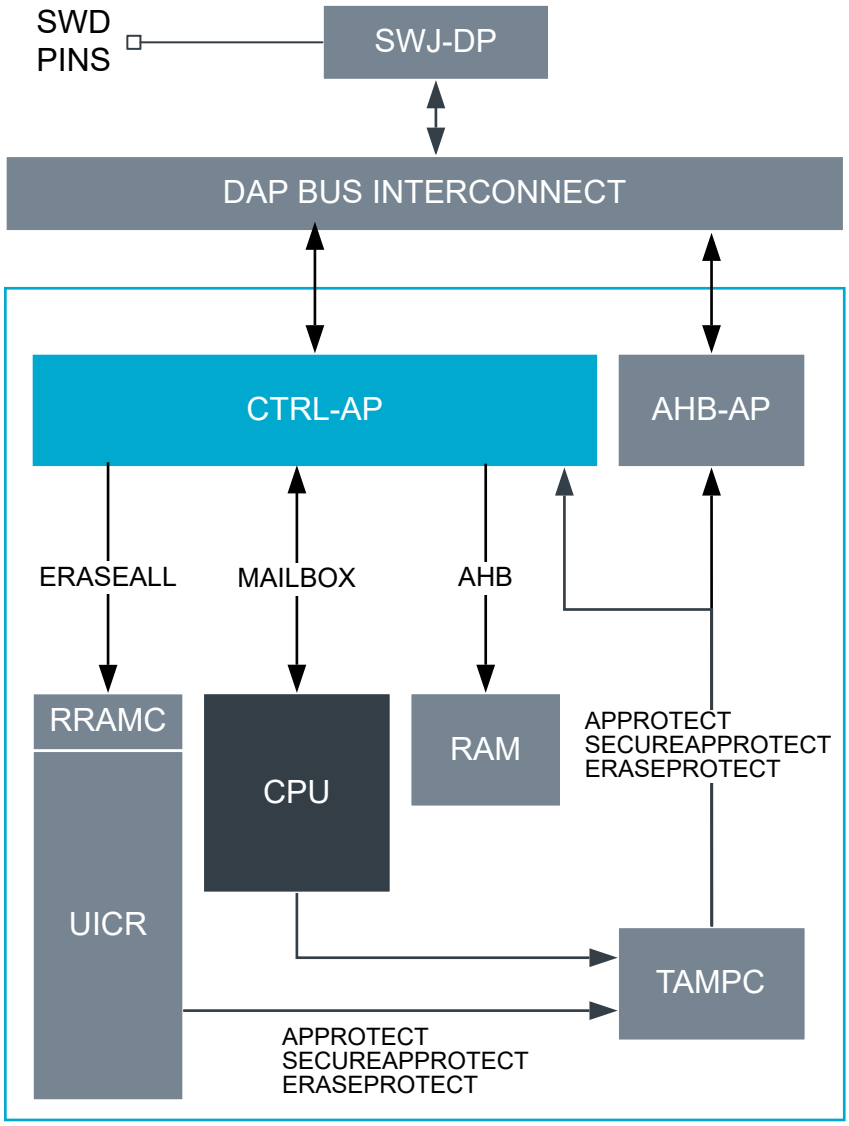


Figure 180: Control access port details

Access port protection (APPROTECT) blocks the debugger from accessing the AHB-AP and prevents read and write access to all CPU registers and memory-mapped addresses. To enable access port protection for both secure and non-secure modes, use the registers UICR.SECUREAPPROTECT and UICR.APPROTECT.

Erase protection (ERASEPROTECT) protects the entire non-volatile memory, SICR, and UICR from being erased. Erase protection is enabled through UICR and disabled through cooperation between the firmware and debugger. For more information about disabling erase protection, see Erase protection on page 1185.

CTRL-AP has the following features:

- Reset the device
- Erase all
- Mailbox interface
- INFO.PARTNO and INFO.HWREVISION registers

The CTRL-AP peripheral has the following types of registers:

- Peripheral registers – Accessed by a CPU using the APB interface
- Debugger registers – Accessed by an external debugger using the CTRL-AP interface

9.7.1 Reset request

The debugger can request the device to perform a reset.

The register RESET is used to request the reset. Once the reset is performed, the reset reason is accessible through the RESETREAS register. For more information about reset, see RESET — Reset control on page 109.

9.7.2 Erase all

The erase all function lets the debugger trigger an erase of non-volatile memory, user information configuration registers (UICR), secure information configuration region (SICR), RAM, all peripheral settings, and also temporarily removes the access port protection.

To trigger an erase all function, follow the sequence in the following flowchart. After the sequence has completed, the access port protection is removed until the next pin reset, power-on reset, brownout reset, or watchdog timer reset.

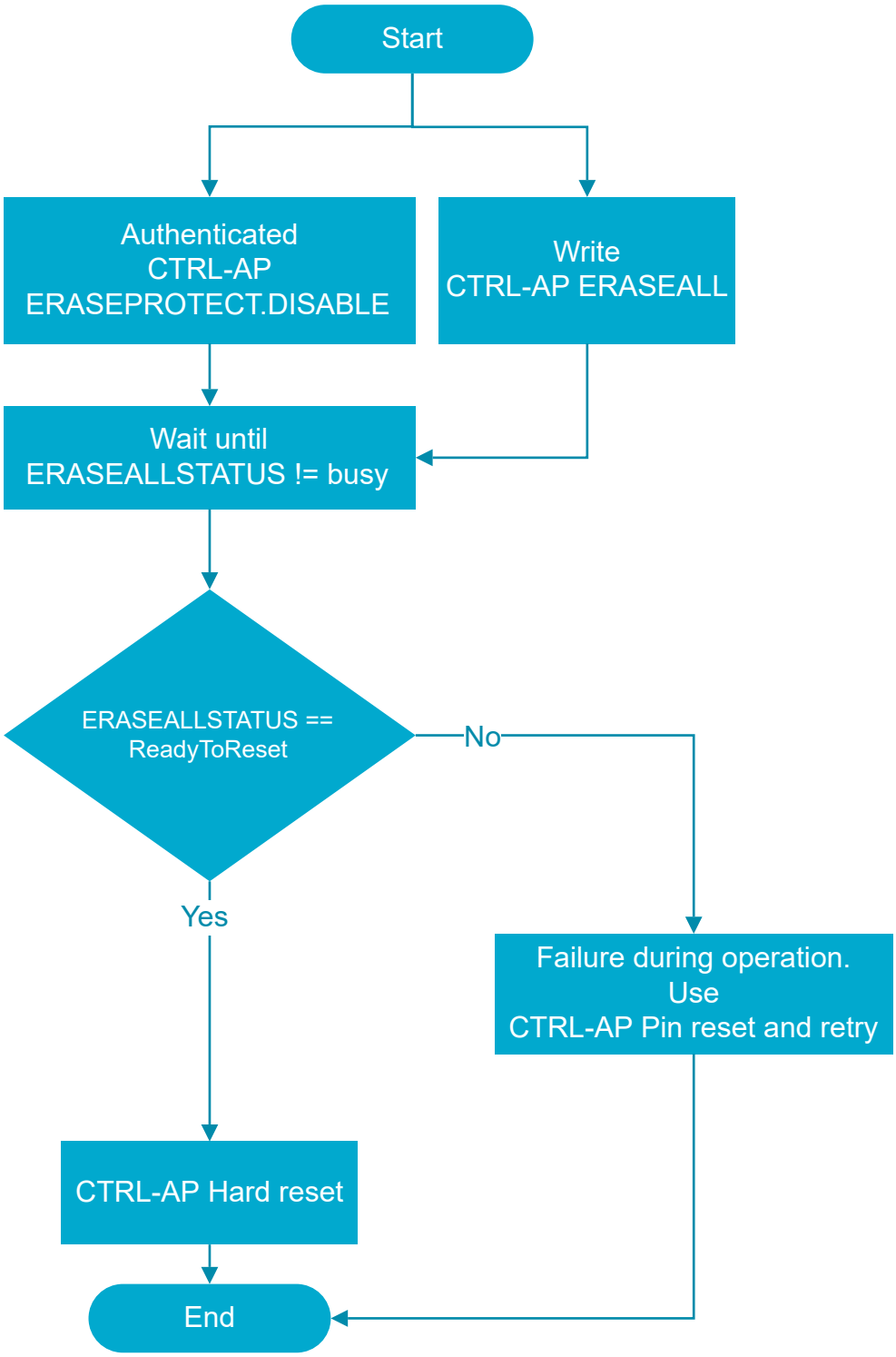


Figure 181: Erase all states

Erase all protection

It is possible to prevent the debugger from performing an erase all operation by using either the TAMPC TAMPC.PROTECT.ERASEPROTECT register, or the UICR.ERASEPROTECT register followed by a device reset.

Once this has been configured, the CTRL-AP ERASEALL operation is disabled.

The register ERASEPROTECT.STATUS on page 1188 holds the status for erase protection.

9.7.2.1 Erase protection

Erase protection can be used to prevent a device from being erased.

A device ERASEALL operation can be initiated either by the non-volatile memory controller, or through the control access port. The following table describes the protection of the CTRL-AP ERASEALL operation. For more information, see Access port protection on page 1176

Access port protection state		ERASEALL operation
UICR.ERASEPROTECT	TAMPC.PROTECT.ERASEPROTECT	ERASEALL
Unprotected	Unprotected	Allowed
Protected	-	Disabled
-	Protected	Disabled

Table 77: Erase all protection

The debugger can read the erase protection status in the register ERASEPROTECT.STATUS on page 1188.

When erase protection is enabled, both the debugger and on-board firmware are required to disable it. The same non-zero 32-bit KEY value must be written to the debugger register ERASEPROTECT.DISABLE and CPU register ERASEPROTECT.DISABLE to disable erase protection. When both registers have been written with the same non-zero 32-bit KEY value, the device is automatically erased as described in Erase all on page 1183. The access ports will be re-enabled on the next reset once the secure erase sequence has completed.

Write to the write-once register ERASEPROTECT.LOCK on page 1194 as early as possible in the start-up sequence, preferably as soon as the on-chip firmware has determined it does not need to communicate with a debugger over the CTRL-AP mailbox interface. Once written, it will not be possible to remove the erase protection until the next pin reset, power-on reset, brownout reset, or watchdog timer reset, and therefore ERASEPROTECT.DISABLE is also disabled.

9.7.3 Mailbox interface

CTRL-AP implements a mailbox interface which enables the CPU to communicate with a debugger over the SWD interface.

The mailbox interface consists of a transmit register MAILBOX.TXDATA on page 1189 with its corresponding status register MAILBOX.TXSTATUS on page 1189, and a receive register MAILBOX.RXDATA on page 1189 with its corresponding status register MAILBOX.RXSTATUS on page 1189. Status bits in registers TXSTATUS/RXSTATUS will be set and cleared automatically when registers TXDATA/RXDATA are written to and read from, independently of the direction.

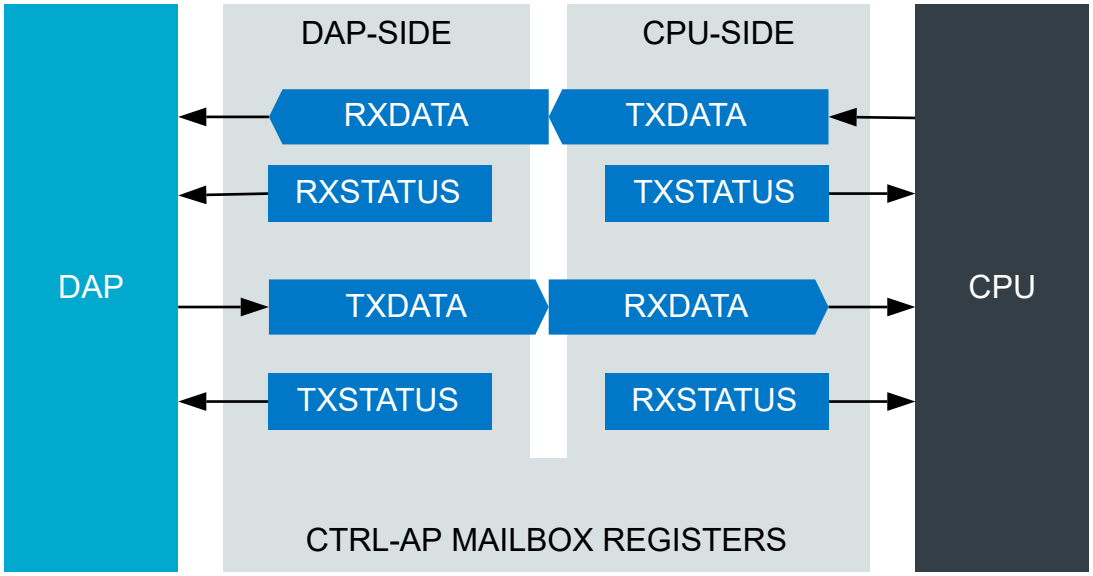


Figure 182: Mailbox register interface

Mailbox transfer sequence

1. Sender writes TXDATA
2. CTRL-AP sets sender's TXSTATUS to `DataPending`
3. CTRL-AP sets receiver's RXSTATUS to `DataPending`
4. Receiver reads RXDATA
5. CTRL-AP sets receiver's RXSTATUS to `NoDataPending`
6. CTRL-AP sets sender's TXSTATUS to `NoDataPending`

Events

EVENTS_RXREADY is generated when MAILBOX.RXSTATUS changes to `DataPending`. This indicates that a debugger has written new data to MAILBOX.RXDATA.

EVENTS_TXDONE is generated when the MAILBOX.TXSTATUS changes to `NoDataPending`. This indicates that a debugger has read the data from MAILBOX.TXDATA.

9.7.4 Device information

Device information, such as part number and hardware revision, can be read using CTRL-AP.

CTRL-AP provides the following information about the device:

- CTRL-AP identification register, IDR, see IDR
- Part number, see INFO.PARTNO
- Hardware revision, see INFO.HWREVISION

The information is available even for protected devices.

9.7.5 Debugger registers

CTRL-AP has a set of registers that can only be accessed from the debugger through the SWD interface. These are not accessible from the CPU.

9.7.5.1 Debug side registers

Register overview

Register	Offset	TZ	Description
RESET	0x000		System reset request and status
ERASEALL	0x004		Perform a secure erase of the device, where flash, SRAM, and UICR will be erased in sequence. The device will be returned to factory default settings upon next reset.
ERASEALLSTATUS	0x008		This is the status register for the ERASEALL operation.
ERASEPROTECT.STATUS	0x00C		Erase protection status.
ERASEPROTECT.DISABLE	0x010		This register disables ERASEPROTECT and performs Erase all.
APPROTECT.STATUS	0x014		This is the status register for the access port protection.
MAILBOX.TXDATA	0x020		Data sent from the debugger to the device.
MAILBOX.TXSTATUS	0x024		Status to indicate if data sent from the debugger to the device has been read.
MAILBOX.RXDATA	0x028		Data sent from the device to the debugger.
MAILBOX.RXSTATUS	0x02C		Status to indicate if data sent from the device to the debugger has been read.
INFO.PARTNO	0x030		Part number of the device
INFO.HWREVISION	0x034		Hardware Revision of the device
IDR	0x0FC		CTRL-AP Identification Register, IDR

9.7.5.1.1 RESET

Address offset: 0x000

System reset request and status

Only the enumerated values are supported, writing other values has unpredictable effect.

The Erase all operation cannot be interrupted by this reset request. Once the Erase all operation has started, CTRL-AP reset requests are ignored.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID				Value																											
A	W	RESET																																	
				NoReset				0																											
				SoftReset				1																											
				HardReset				2																											
				PinReset				4																											

9.7.5.1.2 ERASEALL

Address offset: 0x004

Perform a secure erase of the device, where flash, SRAM, and UICR will be erased in sequence. The device will be returned to factory default settings upon next reset.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	W	ERASEALL			Return device to factory default settings
			NoOperation	0	No operation
			Erase	1	Erase flash, SRAM, and UICR in sequence

9.7.5.1.3 ERASEALLSTATUS

Address offset: 0x008

This is the status register for the ERASEALL operation.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	ERASEALLSTATUS			Status bits for the ERASEALL operation
			Ready	0	ERASEALL is ready
			ReadyToReset	1	Device is ready to be reset
			Busy	2	ERASEALL is busy (on-going)
			Error	3	Error during ERASEALL

9.7.5.1.4 ERASEPROTECT.STATUS

Address offset: 0x00C

Erase protection status.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	PALL			Erase protection status.
			Enabled	1	Erase protection is enabled.
			Disabled	0	Erase protection is not enabled and ERASEALL can be performed.

9.7.5.1.5 ERASEPROTECT.DISABLE

Address offset: 0x010

This register disables ERASEPROTECT and performs Erase all.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	KEY			The Erase all sequence will be initiated if value of the KEY fields are non-zero and the KEY fields match on both the CPU and debugger sides.

9.7.5.1.6 APPROTECT.STATUS

Address offset: 0x014

This is the status register for the access port protection.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																		B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	APPROTECT																																	
			Enabled	1																															
			Disabled	0																															
B	R	SECUREAPPROTECT																																	
			Enabled	1																															
			Disabled	0																															

9.7.5.1.7 MAILBOX.TXDATA

Address offset: 0x020

Data sent from the debugger to the device.

Writing to this register will automatically set field DataPending in register TXSTATUS.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	Data																																	

9.7.5.1.8 MAILBOX.TXSTATUS

Address offset: 0x024

Status to indicate if data sent from the debugger to the device has been read.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	Status																																	
			NoDataPending	0																															
			DataPending	1																															

9.7.5.1.9 MAILBOX.RXDATA

Address offset: 0x028

Data sent from the device to the debugger.

Reading from this register will automatically set field NoDataPending in register RXSTATUS.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	Data																																	

9.7.5.1.10 MAILBOX.RXSTATUS

Address offset: 0x02C

Status to indicate if data sent from the device to the debugger has been read.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	Status			Status of register DATA
			NoDataPending	0	No data pending in register RXDATA
			DataPending	1	Data pending in register RXDATA

9.7.5.1.11 INFO.PARTNO

Address offset: 0x030

Part number of the device

This register is retained on system on idle.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	PARTNO			Part number

9.7.5.1.12 INFO.HWREVISION

Address offset: 0x034

Hardware Revision of the device

This register is retained on system on idle.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	ID			Part Variant

9.7.5.1.13 IDR

Address offset: 0x0FC

CTRL-AP Identification Register, IDR

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E E E E D D D D C C C C C C C B B B B A A A A A A A A
Reset 0x32880000				**0 0 1 1 0 0 1 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	APID			AP Identification
B	R	CLASS			Access Port (AP) class
			NotDefined	0x0	No defined class
			MEMAP	0x8	Memory Access Port
C	R	JEP106ID			JEDEC JEP106 identity code
D	R	JEP106CONT			JEDEC JEP106 continuation code
E	R	REVISION			Revision

9.7.6 Peripheral registers

CTRL-AP has a set of registers that can be accessed by the CPU.

9.7.6.1 CPU side registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
CTRLAP : S CTRLAP : NS	GLOBAL	0x50052000 0x40052000	US	S	NSA	No	Control access port CPU side

Register overview

Register	Offset	TZ	Description
EVENTS_RXREADY	0x100		RXSTATUS is changed to DataPending.
EVENTS_TXDONE	0x104		TXSTATUS is changed to NoDataPending.
INTEN	0x300		Enable or disable interrupt
INTENSET	0x304		Enable interrupt
INTENCLR	0x308		Disable interrupt
INTPEND	0x30C		Pending interrupts
MAILBOX.RXDATA	0x400		Data sent from the debugger to the CPU.
MAILBOX.RXSTATUS	0x404		Status to indicate if data sent from the debugger to the CPU has been read.
MAILBOX.TXDATA	0x480		Data sent from the CPU to the debugger.
MAILBOX.TXSTATUS	0x484		Status to indicate if data sent from the CPU to the debugger has been read.
ERASEPROTECT.LOCK	0x500		This register locks the ERASEPROTECT.DISABLE register from being written until next reset.
ERASEPROTECT.DISABLE	0x504		This register disables the ERASEPROTECT register and performs an ERASEALL operation.
RESET	0x520		System reset request.

9.7.6.1.1 EVENTS_RXREADY

Address offset: 0x100

RXSTATUS is changed to DataPending.

New data is available in MAILBOX.RXDATA.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field		Value ID				Value																		Description									
A	RW	EVENTS_RXREADY																								RXSTATUS is changed to DataPending. New data is available in MAILBOX.RXDATA.									
				NotGenerated				0																		Event not generated									
				Generated				1																		Event generated									

9.7.6.1.2 EVENTS_TXDONE

Address offset: 0x104

TXSTATUS is changed to NoDataPending.

MAILBOX.TXDATA has been read.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EVENTS_TXDONE			TXSTATUS is changed to NoDataPending. MAILBOX.TXDATA has been read.
			NotGenerated	0	Event not generated
			Generated	1	Event generated

9.7.6.1.3 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	RXREADY			Enable or disable interrupt for event RXREADY New data is available in MAILBOX.RXDATA.
			Disabled	0	Disable
			Enabled	1	Enable
B	RW	TXDONE			Enable or disable interrupt for event TXDONE MAILBOX.TXDATA has been read.
			Disabled	0	Disable
			Enabled	1	Enable

9.7.6.1.4 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW W1S	RXREADY			Write '1' to enable interrupt for event RXREADY New data is available in MAILBOX.RXDATA.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled
B	RW W1S	TXDONE			Write '1' to enable interrupt for event TXDONE MAILBOX.TXDATA has been read.
			Set	1	Enable
			Disabled	0	Read: Disabled
			Enabled	1	Read: Enabled

9.7.6.1.5 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																		B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW W1C	RXREADY																																	
			Clear	1																															
			Disabled	0																															
			Enabled	1																															
B	RW W1C	TXDONE																																	
			Clear	1																															
			Disabled	0																															
			Enabled	1																															

9.7.6.1.6 INTPEND

Address offset: 0x30C

Pending interrupts

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																		B	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	RXREADY																																	
			NotPending	0																															
			Pending	1																															
B	R	TXDONE																																	
			NotPending	0																															
			Pending	1																															

9.7.6.1.7 MAILBOX.RXDATA

Address offset: 0x400

Data sent from the debugger to the CPU.

Reading from this register will automatically set field NoDataPending in register RXSTATUS.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	R	RXDATA																																	

Data received from debugger.

9.7.6.1.8 MAILBOX.RXSTATUS

Address offset: 0x404

Status to indicate if data sent from the debugger to the CPU has been read.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	RXSTATUS			Status of data in register RXDATA.
			NoDataPending	0	No data is pending in register RXDATA.
			DataPending	1	Data is pending in register RXDATA.

9.7.6.1.9 MAILBOX.TXDATA

Address offset: 0x480

Data sent from the CPU to the debugger.

Writing to this register will automatically set field DataPending in register TXSTATUS.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	TXDATA			Data sent to debugger.

9.7.6.1.10 MAILBOX.TXSTATUS

Address offset: 0x484

Status to indicate if data sent from the CPU to the debugger has been read.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	TXSTATUS			Status of data in register TXDATA.
			NoDataPending	0	No data is pending in register TXDATA.
			DataPending	1	Data is pending in register TXDATA.

9.7.6.1.11 ERASEPROTECT.LOCK

Address offset: 0x500

This register locks the ERASEPROTECT.DISABLE register from being written until next reset.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW1	LOCK			Writing any value will lock the ERASEPROTECT.DISABLE register from being written until next reset.
			Locked	1	Register ERASEPROTECT.DISABLE is read-only.

9.7.6.1.12 ERASEPROTECT.DISABLE

Address offset: 0x504

This register disables the ERASEPROTECT register and performs an ERASEALL operation.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	W1	KEY																																	
																																			The ERASEALL sequence is initiated if the value of the KEY fields are non-zero and the KEY fields match on both the CPU and debugger sides.

9.7.6.1.13 RESET

Address offset: 0x520

System reset request.

Only the enumerated values are supported, writing other values has unpredictable effect.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																	A	A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	W	RESET																																	Reset request
			NoReset	0																															No reset is generated
			SoftReset	1																															Perform a device soft reset
			HardReset	2																															Perform a device hard reset
			PinReset	4																															Perform a device pin reset

9.8 TAD — Trace and debug control

Configuration interface for trace and debug.

Please refer to the Trace section for more information about how to configure the trace and debug interface.

Note: When the trace port is enabled, all pins assigned to the trace port are acquired by the TAD peripheral and cannot be used for GPIO or other functions. This applies even when using the serial trace mode (SWO). See Pin assignment chapter for more information.

9.8.1 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
TAD : S TAD : NS	GLOBAL	0x50053000 0x40053000	US	S	NA	No	Trace and debug control

Register overview

Register	Offset	TZ	Description
SYSPWRUPREQ	0x400		System power-up request
DBGPWRUPREQ	0x404		Debug power-up request
ENABLE	0x500		Enable debug domain and acquire selected GPIOs
TRACEPORTSPEED	0x518		Trace port speed This register is retained.

9.8.1.1 SYSPWRUPREQ

Address offset: 0x400

System power-up request

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	ACTIVE																																	
			NotActive	0																															
			Active	1																															

9.8.1.2 DBGPWRUPREQ

Address offset: 0x404

Debug power-up request

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	ACTIVE																																	
			NotActive	0																															
			Active	1																															

9.8.1.3 ENABLE

Address offset: 0x500

Enable debug domain and acquire selected GPIOs

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																			A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	ENABLE																																	
			DISABLED	0																															
			ENABLED	1																															

9.8.1.4 TRACEPORTSPEED (Retained)

Address offset: 0x518

Trace port speed

This register is retained.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																		A	A
Reset 0x00000000				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ID	R/W	Field	Value ID	Value																															
A	RW	TRACEPORTSPEED																																	
			DIV1	0																															
			DIV2	1																															
			DIV4	2																															
			DIV32	3																															

9.9 ETM — Embedded trace macrocell

The ARM embedded trace macrocell implements instruction, data and event tracing.

This document only provides a register-level description of this ARM component. See the Arm® Embedded Trace Macrocell Architecture Specification for more details

9.9.1 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
ETM	APPLICATION	0xE0041000	HF	NS	NA	No	Embedded trace macrocell

Register overview

Register	Offset	TZ	Description
TRCPRGCTLR	0x004		Enables the trace unit.
TRCPROCSELR	0x008		Controls which PE to trace. Might ignore writes when the trace unit is enabled or not idle. Before writing to this register, ensure that TRCSTATR.IDLE == 1 so that the trace unit can synchronize with the chosen PE. Implemented if TRCIDR3.NUMPROC is greater than zero.
TRCSTATR	0x00C		Idle status bit
TRCCONFIGR	0x010		Controls the tracing options This register must always be programmed as part of trace unit initialization. Might ignore writes when the trace unit is enabled or not idle.
TRCEVENTCTL0R	0x20		Controls the tracing of arbitrary events. If the selected event occurs a trace element is generated in the trace stream according to the settings in TRCEVENTCTL1R.DATAEN and TRCEVENTCTL1R.INSTEN.
TRCEVENTCTL1R	0x24		Controls the behavior of the events that TRCEVENTCTL0R selects. This register must always be programmed as part of trace unit initialization. Might ignore writes when the trace unit is enabled or not idle.

Register	Offset	TZ	Description
TRCSTALLCTLR	0x2C		Enables trace unit functionality that prevents trace unit buffer overflows. Might ignore writes when the trace unit is enabled or not idle. Must be programmed if TRCIDR3.STALLCTL == 1.
TRCTSCTLR	0x30		Controls the insertion of global timestamps in the trace streams. When the selected event is triggered, the trace unit inserts a global timestamp into the trace streams. Might ignore writes when the trace unit is enabled or not idle. Must be programmed if TRCCONFIGR.TS == 1.
TRCSYNCPR	0x34		Controls how often trace synchronization requests occur. Might ignore writes when the trace unit is enabled or not idle. If writes are permitted then the register must be programmed.
TRCCCCTLR	0x38		Sets the threshold value for cycle counting. Might ignore writes when the trace unit is enabled or not idle. Must be programmed if TRCCONFIGR.CCI==1.
TRCBBCTLR	0x3C		Controls which regions in the memory map are enabled to use branch broadcasting. Might ignore writes when the trace unit is enabled or not idle. Must be programmed if TRCCONFIGR.BB == 1.
TRCTRACEIDR	0x40		Sets the trace ID for instruction trace. If data trace is enabled then it also sets the trace ID for data trace, to (trace ID for instruction trace) + 1. This register must always be programmed as part of trace unit initialization. Might ignore writes when the trace unit is enabled or not idle.
TRCQCTLR	0x44		Controls when Q elements are enabled. Might ignore writes when the trace unit is enabled or not idle. This register must be programmed if it is implemented and TRCCONFIGR.QE is set to any value other than 0b00.
TRCVICTLR	0x080		Controls instruction trace filtering. Might ignore writes when the trace unit is enabled or not idle. Only returns stable data when TRCSTATR.PMSTABLE == 1. Must be programmed, particularly to set the value of the SSSTATUS bit, which sets the state of the start/stop logic.
TRCVIIECTLR	0x084		ViewInst exclude control. Might ignore writes when the trace unit is enabled or not idle. This register must be programmed when one or more address comparators are implemented.
TRCVISSCTLR	0x088		Use this to set, or read, the single address comparators that control the ViewInst start/stop logic. The start/stop logic is active for an instruction which causes a start and remains active up to and including an instruction which causes a stop, and then the start/stop logic becomes inactive. Might ignore writes when the trace unit is enabled or not idle. If implemented then this register must be programmed.
TRCVIPCSSCTLR	0x08C		Use this to set, or read, which PE comparator inputs can control the ViewInst start/stop logic. Might ignore writes when the trace unit is enabled or not idle. If implemented then this register must be programmed.

Register	Offset	TZ	Description
TRCVDCTLR	0x0A0		Controls data trace filtering. Might ignore writes when the trace unit is enabled or not idle. This register must be programmed when data tracing is enabled, that is, when either TRCCONFIGR.DA == 1 or TRCCONFIGR.DV == 1.
TRCVDSACCTLR	0x0A4		ViewData include / exclude control. Might ignore writes when the trace unit is enabled or not idle. This register must be programmed when one or more address comparators are implemented.
TRCVDARCCTLR	0x0A8		ViewData include / exclude control. Might ignore writes when the trace unit is enabled or not idle. This register must be programmed when one or more address comparators are implemented.
TRCSEQEVR[n]	0x100		Moves the sequencer state according to programmed events. Might ignore writes when the trace unit is enabled or not idle. When the sequencer is used, all sequencer state transitions must be programmed with a valid event.
TRCSEQRSTEVR	0x118		Moves the sequencer to state 0 when a programmed event occurs. Might ignore writes when the trace unit is enabled or not idle. When the sequencer is used, all sequencer state transitions must be programmed with a valid event.
TRCSEQSTR	0x11C		Use this to set, or read, the sequencer state. Might ignore writes when the trace unit is enabled or not idle. Only returns stable data when TRCSTATR.PMSTABLE == 1. When the sequencer is used, all sequencer state transitions must be programmed with a valid event.
TRCEXTINSELR	0x120		Use this to set, or read, which external inputs are resources to the trace unit. Might ignore writes when the trace unit is enabled or not idle. Only returns stable data when TRCSTATR.PMSTABLE == 1. When the sequencer is used, all sequencer state transitions must be programmed with a valid event.
TRCCNTRLDVR[n]	0x140		This sets or returns the reload count value for counter n. Might ignore writes when the trace unit is enabled or not idle.
TRCCNTCTLR[n]	0x150		Controls the operation of counter n. Might ignore writes when the trace unit is enabled or not idle.
TRCCNTVR[n]	0x160		This sets or returns the value of counter n. The count value is only stable when TRCSTATR.PMSTABLE == 1. If software uses counter n then it must write to this register to set the initial counter value. Might ignore writes when the trace unit is enabled or not idle.
TRCRSCTLR[n]	0x200		Controls the selection of the resources in the trace unit. Might ignore writes when the trace unit is enabled or not idle. If software selects a non-implemented resource then CONSTRAINED UNPREDICTABLE behavior of the resource selector occurs, so the resource selector might fire unexpectedly or might not fire. Reads of the TRCRSCTLRn might return UNKNOWN.
TRCSSCCR0	0x280		Controls the single-shot comparator.
TRCSSCSR0	0x2A0		Indicates the status of the single-shot comparators. TRCSSCSR0 is sensitive toinstruction addresses.
TRCSSPCICR0	0x2C0		Selects the processor comparator inputs for Single-shot control.
TRCPDCR	0x310		Controls the single-shot comparator.

Register	Offset	TZ	Description
TRCPDSR	0x314		Indicates the power down status of the ETM.
TRCITATBIDR	0xEE4		Sets the state of output pins.
TRCITIATBINR	0xEF4		Reads the state of the input pins.
TRCITIATBOUTR	0xEFC		Sets the state of the output pins.
TRCITCTRL	0xF00		Enables topology detection or integration testing, by putting ETM-M33 into integration mode.
TRCCLAIMSET	0xFA0		Sets bits in the claim tag and determines the number of claim tag bits implemented.
TRCCLAIMCLR	0xFA4		Clears bits in the claim tag and determines the current value of the claim tag.
TRCAUTHSTATUS	0xFB8		Indicates the current level of tracing permitted by the system
TRCDEVARCH	0xFBC		The TRCDEVARCH identifies ETM-M33 as an ETMv4.2 component
TRCDEVTYPE	0xFCC		Controls the single-shot comparator.
TRCPIDR[n]	0xFD0		Coresight peripheral identification registers.
TRCCIDR[n]	0xFF0		Coresight component identification registers.

9.9.1.1 TRCPRGCTLR

Address offset: 0x004

Enables the trace unit.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	EN			Trace unit enable bit
			Disabled	0	The trace unit is disabled. All trace resources are inactive and no trace is generated.
			Enabled	1	The trace unit is enabled.

9.9.1.2 TRCPROCSELR

Address offset: 0x008

Controls which PE to trace.

Might ignore writes when the trace unit is enabled or not idle.

Before writing to this register, ensure that TRCSTATR.IDLE == 1 so that the trace unit can synchronize with the chosen PE.

Implemented if TRCIDR3.NUMPROC is greater than zero.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																												A	A	A	A	A
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PROCSEL			PE select bits that select the PE to trace.

9.9.1.3 TRCSTATR

Address offset: 0x00C

Idle status bit

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	IDLE			Trace unit enable bit
			NotIdle	0	The trace unit is not idle.
			Idle	1	The trace unit is idle.
B	RW	PMSTABLE			Programmers' model stable bit
			NotStable	0	The programmers' model is not stable.
			Stable	1	The programmers' model is stable.

9.9.1.4 TRCCONFIGR

Address offset: 0x010

Controls the tracing options

This register must always be programmed as part of trace unit initialization.

Might ignore writes when the trace unit is enabled or not idle.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				M L K J J I H G G G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	LOADASP0INST			Instruction P0 load field. This field controls whether load instructions are traced as P0 instructions.
			No	0	Do not trace load instructions as P0 instructions.
			Yes	1	Trace load instructions as P0 instructions.
B	RW	STOREASP0INST			Instruction P0 field. This field controls whether store instructions are traced as P0 instructions.
			No	0	Do not trace store instructions as P0 instructions.
			Yes	1	Trace store instructions as P0 instructions.
C	RW	BB			Branch broadcast mode bit.
			Disabled	0	Branch broadcast mode is disabled.
			Enabled	1	Branch broadcast mode is enabled.
D	RW	CCI			Cycle counting instruction trace bit.
			Disabled	0	Cycle counting in the instruction trace is disabled.
			Enabled	1	Cycle counting in the instruction trace is enabled.
E	RW	CID			Context ID tracing bit.
			Disabled	0	Context ID tracing is disabled.
			Enabled	1	Context ID tracing is enabled.
F	RW	VMID			Virtual context identifier tracing bit.
			Disabled	0	Virtual context identifier tracing is disabled.
			Enabled	1	Virtual context identifier tracing is enabled.
G	RW	COND			Conditional instruction tracing bit.
			Disabled	0	Conditional instruction tracing is disabled.
			LoadOnly	1	Conditional load instructions are traced.
			StoreOnly	2	Conditional store instructions are traced.
			LoadAndStore	3	Conditional load and store instructions are traced.
			All	7	All conditional instructions are traced.
H	RW	TS			Global timestamp tracing bit.
			Disabled	0	Global timestamp tracing is disabled.
			Enabled	1	Global timestamp tracing is enabled.
I	RW	RS			Return stack enable bit.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				M L K J J I H G G G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Disabled	0	Return stack is disabled.
			Enabled	1	Return stack is enabled.
J	RW	QE			Q element enable field.
			Disabled	0	Q elements are disabled.
			OnlyWithoutInstCou	1	Q elements with instruction counts are enabled. Q elements without instruction counts are disabled.
			Enabled	3	Q elements with and without instruction counts are enabled.
K	RW	VMIDOPT			Control bit to select the Virtual context identifier value used by the trace unit, both for trace generation and in the Virtual context identifier comparators.
			VTTBR_EL2	0	VTTBR_EL2.VMID is used. If the trace unit supports a Virtual context identifier larger than the VTTBR_EL2.VMID, the upper unused bits are always zero. If the trace unit supports a Virtual context identifier larger than 8 bits and if the VTCR_EL2.VS bit forces use of an 8-bit Virtual context identifier, bits [15:8] of the trace unit Virtual context identifier are always zero.
			CONTEXTIDR_EL2	1	CONTEXTIDR_EL2 is used.
L	RW	DA			Data address tracing bit.
			Disabled	0	Data address tracing is disabled.
			Enabled	1	Data address tracing is enabled.
M	RW	DV			Data value tracing bit.
			Disabled	0	Data value tracing is disabled.
			Enabled	1	Data value tracing is enabled.

9.9.1.5 TRCEVENTCTL0R

Address offset: 0x20

Controls the tracing of arbitrary events.

If the selected event occurs a trace element is generated in the trace stream according to the settings in TRCEVENTCTL1R.DATAEN and TRCEVENTCTL1R.INSTEN.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENT		[0:255]	Select which event should generate trace elements.

9.9.1.6 TRCEVENTCTL1R

Address offset: 0x24

Controls the behavior of the events that TRCEVENTCTL0R selects.

This register must always be programmed as part of trace unit initialization.

Might ignore writes when the trace unit is enabled or not idle.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-D	RW	INSTEN[i] (i=0..3)			Instruction event enable field.
			Disabled	0	The trace unit does not generate an Event element.
			Enabled	1	The trace unit generates an Event element for event i, in the instruction trace stream.
E	RW	DATAEN			Data event enable bit.
			Disabled	0	The trace unit does not generate an Event element if event 0 occurs.
			Enabled	1	The trace unit generates an Event element in the data trace stream if event 0 occurs.
F	RW	ATB			AMBA Trace Bus (ATB) trigger enable bit.
			Disabled	0	ATB trigger is disabled.
			Enabled	1	ATB trigger is enabled. If a CoreSight ATB interface is implemented then when event 0 occurs the trace unit generates an ATB event.
G	RW	LPOVERRIDE			Low-power state behavior override bit. Controls how a trace unit behaves in low-power state.
			Disabled	0	Trace unit low-power state behavior is not affected. That is, the trace unit is enabled to enter low-power state.
			Enabled	1	Trace unit low-power state behavior is overridden. That is, entry to a low-power state does not affect the trace unit resources or trace generation.

9.9.1.7 TRCSTALLCTLR

Address offset: 0x2C

Enables trace unit functionality that prevents trace unit buffer overflows.

Might ignore writes when the trace unit is enabled or not idle.

Must be programmed if TRCIDR3.STALLCTL == 1.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E D C B A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	LEVEL		[15:0]	Threshold level field. If LEVEL is nonzero then a trace unit might suppress the generation of: Global timestamps in the instruction trace stream and the data trace stream. Cycle counting in the instruction trace stream, although the cumulative cycle count remains correct.
			Min	0	Zero invasion. This setting has a greater risk of a FIFO overflow
			Max	15	Maximum invasion occurs but there is less risk of a FIFO overflow.
B	RW	ISTALL			Instruction stall bit. Controls if a trace unit can stall the PE when the instruction trace buffer space is less than LEVEL.
			Disabled	0	The trace unit must not stall the PE.
			Enabled	1	The trace unit can stall the PE.
C	RW	DSTALL			Data stall bit. Controls if a trace unit can stall the PE when the data trace buffer space is less than LEVEL.
			Disabled	0	The trace unit must not stall the PE.
			Enabled	1	The trace unit can stall the PE.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E D C B A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
D	RW	INSTPRIORITY			Prioritize instruction trace bit. Controls if a trace unit can prioritize instruction trace when the instruction trace buffer space is less than LEVEL.
			Disabled	0	The trace unit must not prioritize instruction trace.
			Enabled	1	The trace unit can prioritize instruction trace. A trace unit might prioritize instruction trace by preventing output of data trace, or other means which ensure that the instruction trace has a higher priority than the data trace.
E	RW	DATADISCARDLOAD			Data discard field. Controls if a trace unit can discard data trace elements on a load when the data trace buffer space is less than LEVEL.
			Disabled	0	The trace unit must not discard any data trace elements.
			Enabled	1	The trace unit can discard P1 and P2 elements associated with data loads.
F	RW	DATADISCARDSTORE			Data discard field. Controls if a trace unit can discard data trace elements on a store when the data trace buffer space is less than LEVEL.
			Disabled	0	The trace unit must not discard any data trace elements.
			Enabled	1	The trace unit can discard P1 and P2 elements associated with data stores.
G	RW	NOOVERFLOW			Trace overflow prevention bit.
			Disabled	0	Trace overflow prevention is disabled.
			Enabled	1	Trace overflow prevention is enabled. This might cause a significant performance impact.

9.9.1.8 TRCTSCTLR

Address offset: 0x30

Controls the insertion of global timestamps in the trace streams.

When the selected event is triggered, the trace unit inserts a global timestamp into the trace streams.

Might ignore writes when the trace unit is enabled or not idle.

Must be programmed if TRCCONFIGR.TS == 1.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENT		[0:255]	Select which event should generate time stamps.

9.9.1.9 TRCSYNCPR

Address offset: 0x34

Controls how often trace synchronization requests occur.

Might ignore writes when the trace unit is enabled or not idle.

If writes are permitted then the register must be programmed.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	PERIOD		[31:0]	Controls how many bytes of trace, the sum of instruction and data, that a trace unit can generate before a trace synchronization request occurs. The number of bytes is always a power of two, calculated by 2^PERIOD
			Disabled	0	Trace synchronization requests are disabled. This setting does not disable other types of trace synchronization request.

9.9.1.10 TRCCCCTLR

Address offset: 0x38

Sets the threshold value for cycle counting.

Might ignore writes when the trace unit is enabled or not idle.

Must be programmed if TRCCONFIGR.CCI==1.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	THRESHOLD		[2047:0]	Sets the threshold value for instruction trace cycle counting.

9.9.1.11 TRCBBCTLR

Address offset: 0x3C

Controls which regions in the memory map are enabled to use branch broadcasting.

Might ignore writes when the trace unit is enabled or not idle.

Must be programmed if TRCCONFIGR.BB == 1.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-H	RW	RANGE[i] (i=0..7)			Address range field. Selects which address range comparator pairs are in use with branch broadcasting. Each field represents an address range comparator pair, so field[i] controls the selection of address range comparator pair i.
			Disabled	0	The address range that address range comparator pair i defines, is not selected.
			Enabled	1	The address range that address range comparator pair n defines, is selected.

9.9.1.12 TRCTRACEIDR

Address offset: 0x40

Sets the trace ID for instruction trace. If data trace is enabled then it also sets the trace ID for data trace, to (trace ID for instruction trace) + 1.

This register must always be programmed as part of trace unit initialization.

Might ignore writes when the trace unit is enabled or not idle.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	TRACEID			Trace ID field. Sets the trace ID value for instruction trace. Bit[0] must be zero if data trace is enabled. If data trace is enabled then a trace unit sets the trace ID for data trace, to TRACEID+1.

9.9.1.13 TRCQCTLR

Address offset: 0x44

Controls when Q elements are enabled.

Might ignore writes when the trace unit is enabled or not idle.

This register must be programmed if it is implemented and TRCCONFIGR.QE is set to any value other than 0b00.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-H	RW	RANGE[i] (i=0..7)			Specifies the address range comparators to be used for controlling Q elements.
			Disabled	0	Address range comparator i is disabled.
			Enabled	1	Address range comparator i is selected for use.
I	RW	MODE			Selects whether the address range comparators selected by the RANGE field indicate address ranges where the trace unit is permitted to generate Q elements or address ranges where the trace unit is not permitted to generate Q elements:
			Exclude	0	Exclude mode. The address range comparators selected by the RANGE field indicate address ranges where the trace unit cannot generate Q elements. If no ranges are selected, Q elements are permitted across the entire memory map.
			Include	1	Include mode. The address range comparators selected by the RANGE field indicate address ranges where the trace unit can generate Q elements. If all the implemented bits in RANGE are set to 0 then Q elements are disabled.

9.9.1.14 TRCVICTLR

Address offset: 0x080

Controls instruction trace filtering.

Might ignore writes when the trace unit is enabled or not idle.

Only returns stable data when TRCSTATR.PMSTABLE == 1.

Must be programmed, particularly to set the value of the SSSTATUS bit, which sets the state of the start/stop logic.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E D C B A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENT_SEL			Select which resource number should be filtered.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I H G F E D C B A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			Disabled	0	This event is not filtered.
			Enabled	1	This event is filtered.
B	RW	SSSTATUS			When TRCIDR4.NUMACPAIRS > 0 or TRCIDR4.NUMPC > 0, this bit returns the status of the start/stop logic.
			Stopped	0	The start/stop logic is in the stopped state.
			Started	1	The start/stop logic is in the started state.
C	RW	TRCRESET			Controls whether a trace unit must trace a Reset exception.
			Disabled	0	The trace unit does not trace a Reset exception unless it traces the exception or instruction immediately prior to the Reset exception.
			Enabled	1	The trace unit always traces a Reset exception.
D	RW	TRCERR			When TRCIDR3.TRCERR==1, this bit controls whether a trace unit must trace a System error exception.
			Disabled	0	The trace unit does not trace a System error exception unless it traces the exception or instruction immediately prior to the System error exception.
			Enabled	1	The trace unit always traces a System error exception, regardless of the value of ViewInst.
E-H	RW	EXLEVEL[i]_S (i=0..3)			In Secure state, each bit controls whether instruction tracing is enabled for the corresponding Exception level i.
			Disabled	1	The trace unit does not generate instruction trace, in Secure state, for Exception level i.
			Enabled	0	The trace unit generates instruction trace, in Secure state, for Exception level i.
I-L	RW	EXLEVEL[i]_NS (i=0..3)			In Non-secure state, each bit controls whether instruction tracing is enabled for the corresponding Exception level i.
			Disabled	1	The trace unit does not generate instruction trace, in Non-secure state, for Exception level i.
			Enabled	0	The trace unit generates instruction trace, in Non-secure state, for Exception level i.

9.9.1.15 TRCVIIECTLR

Address offset: 0x084

ViewInst exclude control.

Might ignore writes when the trace unit is enabled or not idle.

This register must be programmed when one or more address comparators are implemented.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-H	RW	INCLUDE[i] (i=0..7)			Include range field. Selects which address range comparator pairs are in use with ViewInst include control.
			Disabled	0	The address range that address range comparator pair i defines, is not selected for ViewInst include control.
			Enabled	1	The address range that address range comparator pair i defines, is selected for ViewInst include control.
I-P	RW	EXCLUDE[i] (i=0..7)			Exclude range field. Selects which address range comparator pairs are in use with ViewInst exclude control.
			Disabled	0	The address range that address range comparator pair i defines, is not selected for ViewInst exclude control.
			Enabled	1	The address range that address range comparator pair i defines, is selected for ViewInst exclude control.

9.9.1.16 TRCVISSCTLR

Address offset: 0x088

Use this to set, or read, the single address comparators that control the ViewInst start/stop logic. The start/stop logic is active for an instruction which causes a start and remains active up to and including an instruction which causes a stop, and then the start/stop logic becomes inactive.

Might ignore writes when the trace unit is enabled or not idle.

If implemented then this register must be programmed.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-H	RW	START[i] (i=0..7)			Selects which single address comparators are in use with ViewInst start/stop control, for the purpose of starting trace.
			Disabled	0	The single address comparator i, is not selected as a start resource.
			Enabled	1	The single address comparator i, is selected as a start resource.
I-P	RW	STOP[i] (i=0..7)			Selects which single address comparators are in use with ViewInst start/stop control, for the purpose of stopping trace
			Disabled	0	The single address comparator i, is not selected as a stop resource.
			Enabled	1	The single address comparator i, is selected as a stop resource.

9.9.1.17 TRCVIPCSSCTLR

Address offset: 0x08C

Use this to set, or read, which PE comparator inputs can control the ViewInst start/stop logic.

Might ignore writes when the trace unit is enabled or not idle.

If implemented then this register must be programmed.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-H	RW	START[i] (i=0..7)			Selects which PE comparator inputs are in use with ViewInst start/stop control, for the purpose of starting trace
			Disabled	0	The single PE comparator input i, is not selected as a start resource.
			Enabled	1	The single PE comparator input i, is selected as a start resource.
I-P	RW	STOP[i] (i=0..7)			Selects which PE comparator inputs are in use with ViewInst start/stop control, for the purpose of stopping trace.
			Disabled	0	The single PE comparator input i, is not selected as a stop resource.
			Enabled	1	The single PE comparator input i, is selected as a stop resource.

9.9.1.18 TRCVDCTLR

Address offset: 0x0A0

Controls data trace filtering.

Might ignore writes when the trace unit is enabled or not idle.

This register must be programmed when data tracing is enabled, that is, when either TRCCONFIGR.DA == 1 or TRCCONFIGR.DV == 1.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				L K J I I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-H	RW	EVENT[i] (i=0..7)			Event unit enable bit.
			Disabled	0	The trace event is not selected for trace filtering.
			Enabled	1	The trace event is selected for trace filtering.
I	RW	SPREL			Controls whether a trace unit traces data for transfers that are relative to the Stack Pointer (SP).
			Enabled	0	The trace unit does not affect the tracing of SP-relative transfers.
			DataOnly	2	The trace unit does not trace the address portion of SP-relative transfers. If data value tracing is enabled then the trace unit generates a P1 data address element.
			Disabled	3	The trace unit does not trace the address or value portions of SP-relative transfers.
J	RW	PCREL			Controls whether a trace unit traces data for transfers that are relative to the Program Counter (PC).
			Enabled	0	The trace unit does not affect the tracing of PC-relative transfers.
			Disabled	1	The trace unit does not trace the address or value portions of PC-relative transfers.
K	RW	TBI			Controls which information a trace unit populates in bits[63:56] of the data address.
			SignExtend	0	The trace unit assigns bits[63:56] to have the same value as bit[55] of the data address, that is, it sign-extends the value.
			Copy	1	The trace unit assigns bits[63:56] to have the same value as bits[63:56] of the data address.
L	RW	TRCEXDATA			Controls the tracing of data transfers for exceptions and exception returns on Armv6-M, Armv7-M, and Armv8-M PEs.
			Disabled	0	Exception and exception return data transfers are not traced.
			Enabled	1	Exception and exception return data transfers are traced if the other aspects of ViewData indicate that the data transfers must be traced.

9.9.1.19 TRCVDSACCTLR

Address offset: 0x0A4

ViewData include / exclude control.

Might ignore writes when the trace unit is enabled or not idle.

This register must be programmed when one or more address comparators are implemented.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-H	RW	INCLUDE[i] (i=0..7)			Selects which single address comparators are in use with ViewData include control.
			Disabled	0	The single address comparator i, is not selected for ViewData include control.
			Enabled	1	The single address comparator i, is selected for ViewData include control.
I-P	RW	EXCLUDE[i] (i=0..7)			Selects which single address comparators are in use with ViewData exclude control.
			Disabled	0	The single address comparator i, is not selected for ViewData exclude control.
			Enabled	1	The single address comparator i, s selected for ViewData exclude control.

9.9.1.20 TRCVDARCCTLR

Address offset: 0x0A8

ViewData include / exclude control.

Might ignore writes when the trace unit is enabled or not idle.

This register must be programmed when one or more address comparators are implemented.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-H	RW	INCLUDE[i] (i=0..7)			Include range field. Selects which address range comparator pairs are in use with ViewData include control.
			Disabled	0	The address range that address range comparator i defines, is not selected for ViewData include control.
			Enabled	1	The address range that address range comparator i defines, is selected for ViewData include control.
I-P	RW	EXCLUDE[i] (i=0..7)			Exclude range field. Selects which address range comparator pairs are in use with ViewData exclude control.
			Disabled	0	The address range that address range comparator i defines, is not selected for ViewData exclude control.
			Enabled	1	The address range that address range comparator i defines, s selected for ViewData exclude control.

9.9.1.21 TRCSEQEVR[n] (n=0..2)

Address offset: 0x100 + (n × 0x4)

Moves the sequencer state according to programmed events.

Might ignore writes when the trace unit is enabled or not idle.

When the sequencer is used, all sequencer state transitions must be programmed with a valid event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				P O N M L K J I H G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-H	RW	F[i] (i=0..7)			Forward field.
			Disabled	0	The trace event does not affect the sequencer.
			Enabled	1	When the event occurs then the sequencer state moves from state n to state n+1.
I-P	RW	B[i] (i=0..7)			Backward field.
			Disabled	0	The trace event does not affect the sequencer.
			Enabled	1	When the event occurs then the sequencer state moves from state n+1 to state n.

9.9.1.22 TRCSEQRSTEVR

Address offset: 0x118

Moves the sequencer to state 0 when a programmed event occurs.

Might ignore writes when the trace unit is enabled or not idle.

When the sequencer is used, all sequencer state transitions must be programmed with a valid event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EVENT		[0:255]	Select which event should reset the sequencer.

9.9.1.23 TRCSEQSTR

Address offset: 0x11C

Use this to set, or read, the sequencer state.

Might ignore writes when the trace unit is enabled or not idle.

Only returns stable data when TRCSTATR.PMSTABLE == 1.

When the sequencer is used, all sequencer state transitions must be programmed with a valid event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	STATE			Sets or returns the state of the sequencer.
			State0	0	The sequencer is in state 0.
			State1	1	The sequencer is in state 1.
			State2	2	The sequencer is in state 2.
			State3	3	The sequencer is in state 3.

9.9.1.24 TRCEXTINSELR

Address offset: 0x120

Use this to set, or read, which external inputs are resources to the trace unit.

Might ignore writes when the trace unit is enabled or not idle.

Only returns stable data when TRCSTATR.PMSTABLE == 1.

When the sequencer is used, all sequencer state transitions must be programmed with a valid event.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D C C C C C C C C B B B B B B B B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A-D	RW	SEL[i] (i=0..3)		[0:255]	Each field in this collection selects an external input as a resource for the trace unit.

9.9.1.25 TRCCNTRLDVR[n] (n=0..3)

Address offset: 0x140 + (n × 0x4)

This sets or returns the reload count value for counter n.

Might ignore writes when the trace unit is enabled or not idle.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	VALUE		[0:65535]	Contains the reload value for counter n. When a reload event occurs for counter n then the trace unit copies the VALUEn field into counter n.

9.9.1.26 TRCCNTCTLR[n] (n=0..3)

Address offset: 0x150 + (n × 0x4)

Controls the operation of counter n.

Might ignore writes when the trace unit is enabled or not idle.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B B B B B B B B A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	CNTEVENT		[0:255]	Selects an event, that when it occurs causes counter n to decrement.
B	RW	RLDEVENT		[0:255]	Selects an event, that when it occurs causes a reload event for counter n.
C	RW	RLDSELF			Controls whether a reload event occurs for counter n, when counter n reaches zero.
			Disabled	0	The counter is in Normal mode.
			Enabled	1	The counter is in Self-reload mode.
D	RW	CNTCHAIN			For TRCCNTCTLR3 and TRCCNTCTLR1, this bit controls whether counter n decrements when a reload event occurs for counter n-1.
			Disabled	0	Counter n does not decrement when a reload event for counter n-1 occurs.
			Enabled	1	Counter n decrements when a reload event for counter n-1 occurs. This concatenates counter n and counter n-1, to provide a larger count value.

9.9.1.27 TRCCNTVR[n] (n=0..3)

Address offset: 0x160 + (n × 0x4)

This sets or returns the value of counter n.

The count value is only stable when TRCSTATR.PMSTABLE == 1.

If software uses counter n then it must write to this register to set the initial counter value.

Might ignore writes when the trace unit is enabled or not idle.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	VALUE		[0:65535]	Contains the count value of counter n.

9.9.1.28 TRCRSCTLR[n] (n=2..31)

Address offset: 0x200 + (n × 0x4)

Controls the selection of the resources in the trace unit.

Might ignore writes when the trace unit is enabled or not idle.

If software selects a non-implemented resource then CONSTRAINED UNPREDICTABLE behavior of the resource selector occurs, so the resource selector might fire unexpectedly or might not fire. Reads of the TRCRSCTLRn might return UNKNOWN.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	EN			Trace unit enable bit
			Disabled	0	The trace unit is disabled. All trace resources are inactive and no trace is generated.
			Enabled	1	The trace unit is enabled.

9.9.1.29 TRCSSCCR0

Address offset: 0x280

Controls the single-shot comparator.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	RW	RST			Enables the single-shot comparator resource to be reset when it occurs, to enable another comparator match to be detected
			Disabled	0	Multiple matches can not be detected.
			Enabled	1	Multiple matches can occur.

9.9.1.30 TRCSSCSR0

Address offset: 0x2A0

Indicates the status of the single-shot comparators. TRCSSCSR0 is sensitive toinstruction addresses.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	INST			Instruction address comparator support
			False	0	Single-shot instruction address comparisons not supported.
			True	1	Single-shot instruction address comparisons supported.
B	RW	DA			Data address comparator support
			False	0	Data address comparisons not supported.
			True	1	Data address comparisons supported.
C	RW	DV			Data value comparator support
			False	0	Data value comparisons not supported.
			True	1	Data value comparisons supported.
D	RW	PC			Process counter value comparator support
			False	0	Process counter value comparisons not supported.
			True	1	Process counter value comparisons supported.
E	RW	STATUS			Single-shot status. This indicates whether any of the selected comparators have matched.
			NoMatch	0	Match has not occurred.
			Match	1	Match has occurred at least once.

9.9.1.31 TRCSSPCICR0

Address offset: 0x2C0

Selects the processor comparator inputs for Single-shot control.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A-D	RW	PC[i] (i=0..3)			Selects processor comparator i inputs for Single-shot control
			Disabled	0	Processor comparator i is not selected for Single-shot control.
			Enabled	1	Processor comparator i is selected for Single-shot control.

9.9.1.32 TRCPDCR

Address offset: 0x310

Controls the single-shot comparator.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	PU			Power up request, to request that power to ETM and access to the trace registers is maintained.
			Disabled	0	Power not requested.
			Enabled	1	Power requested.

9.9.1.33 TRCPDSR

Address offset: 0x314

Indicates the power down status of the ETM.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	POWER			Indicates ETM is powered up
			NotPoweredUp	0	ETM is not powered up. All registers are not accessible.
			PoweredUp	1	ETM is powered up. All registers are accessible.
B	RW	STICKYPD			Sticky power down state. This bit is set to 1 when power to the ETM registers is removed, to indicate that programming state has been lost. It is cleared after a read of the TRCPDSR
			NotPoweredDown	0	Trace register power has not been removed since the TRCPDSR was last read.
			PoweredDown	1	Trace register power has been removed since the TRCPDSR was last read.

9.9.1.34 TRCITATBIDR

Address offset: 0xEE4

Sets the state of output pins.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				G F E D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A-G	RW	ID[i] (i=0..6)			Drives the ATIDMI[i] output pin.

9.9.1.35 TRCITIATBINR

Address offset: 0xEF4

Reads the state of the input pins.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	ATVALID			Returns the value of the ATVALIDMI input pin.
B	RW	AFREADY			Returns the value of the AFREADYMI input pin.

9.9.1.36 TRCITIATBOUTR

Address offset: 0xEFC

Sets the state of the output pins.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	ATVALID			Drives the ATVALIDMI output pin.
B	RW	AFREADY			Drives the AFREADYMI output pin.

9.9.1.37 TRCITCTRL

Address offset: 0xF00

Enables topology detection or integration testing, by putting ETM-M33 into integration mode.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	IME			Integration mode enable
			Disabled	0	ETM is not in integration mode.
			Enabled	1	ETM is in integration mode.

9.9.1.38 TRCCLAIMSET

Address offset: 0xFA0

Sets bits in the claim tag and determines the number of claim tag bits implemented.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A-D	RW	SET[i] (i=0..3)			Claim tag set register
			NotSet	0	Claim tag i is not set.
			Set	1	Claim tag i is set.
			Claim	1	Set claim tag i.

9.9.1.39 TRCCLAIMCLR

Address offset: 0xFA4

Clears bits in the claim tag and determines the current value of the claim tag.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D C B A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A-D	RW	CLR[i] (i=0..3)			Claim tag clear register
			NotSet	0	Claim tag i is not set.
			Set	1	Claim tag i is set.
			Clear	1	Clear claim tag i.

9.9.1.40 TRCAUTHSTATUS

Address offset: 0xFB8

Indicates the current level of tracing permitted by the system

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D C C B B A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

ID	R/W	Field	Value ID	Value	Description
A	RW	NSID			Non-secure Invasive Debug

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D C C B B A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
			NotImplemented	0	The feature is not implemented.
			Implemented	1	The feature is implemented.
B	RW	NSNID			Non-secure Non-Invasive Debug
			NotImplemented	0	The feature is not implemented.
			Implemented	1	The feature is implemented.
C	RW	SID			Secure Invasive Debug
			NotImplemented	0	The feature is not implemented.
			Implemented	1	The feature is implemented.
D	RW	SNID			Secure Non-Invasive Debug
			NotImplemented	0	The feature is not implemented.
			Implemented	1	The feature is implemented.

9.9.1.41 TRCDEVARCH

Address offset: 0xFBC

The TRCDEVARCH identifies ETM-M33 as an ETMv4.2 component

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				D D D D D D D D D D D C B B B A A A A A A A A A A A A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	ARCHID			Architecture ID
			ETMv42	0x4A13	Component is an ETMv4 component
B	R	REVISION			Architecture revision
			v2	2	Component is part of architecture 4.2
C	R	PRESENT			This register is implemented
			Absent	0	The register is not implemented.
			Present	1	The register is implemented.
D	R	ARCHITECT			Defines the architect of the component
			Arm	0x23B	This peripheral was architected by Arm.

9.9.1.42 TRCDEVTYPE

Address offset: 0xFCC

Controls the single-shot comparator.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
ID				B B B B A A A A
Reset 0x00000000				**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**
ID	R/W	Field	Value ID	Value	Description
A	R	MAJOR			The main type of the component
			TraceSource	3	Peripheral is a trace source.
B	R	SUB			The sub-type of the component
			ProcessorTrace	1	Peripheral is a processor trace source.

9.9.1.43 TRCPIDR[n] (n=0..7)

Address offset: 0xFD0 + (n × 0x4)

Coresight peripheral identification registers.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description

9.9.1.44 TRCCIDR[n] (n=0..3)

Address offset: 0xFF0 + (n × 0x4)

Coresight component identification registers.

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ID																																
Reset 0x00000000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ID	R/W	Field	Value ID	Value	Description

9.10 TPIU — Trace port interface unit

The Arm Cortex-M33 TPIU bridges the on-chip trace data from the ETM and the ITM, with separate IDs, to a data stream.

The Arm Cortex-M33 TPIU encapsulates IDs where required, and an external Trace Port Analyzer (TPA) captures the data stream. See the Arm Cortex-M33 Processor Technical Reference Manual for more details.

9.10.1 Registers

Instances

Instance	Domain	Base address	TrustZone			Split access	Description
			Map	Att	DMA		
TPIU	APPLICATION	0xE0040000	HF	NS	NA	No	Trace port interface unit (Trace and Debug)

10 Hardware and layout

10.1 Pin assignments

The pin assignment figures and tables describe the pinouts for the product variants of the device.

The nRF54LM20A and nRF54LM20B device provides flexibility regarding GPIO pin routing and configuration. Some pins have limitations or recommendations on how the pin should be configured or what it should be used for.

As a general rule, peripherals must use GPIO pins in their own domain, and can be used for all peripheral functions when selected in the peripheral's PSEL register. Serial peripherals must use pins from the same port. Note the dedicated clock pin requirements. The dedicated clock pin requirements are described in Clock pins on page 1219. Some device functions must use specific pins, as listed in Pin assignments on page 1219.

The block diagram shows which peripheral and port belong together, see Block diagram on page 9.

The different GPIO ports have different properties. For details, see GPIO — General purpose input/output on page 292.

10.1.1 Dedicated pins

The device has some pins dedicated for specific purposes. GPIO pin routing and configuration is flexible. Some pins have limitations or recommendations for configuration and use.

Peripheral	Description
TRACE	Has dedicated pins that must be configured using extra high drive E0/E1 configuration in the DRIVE0/1 fields of the PIN_CNF GPIO register.
GRTC	Has dedicated pins for clock and PWM output.
TAMPC	Has dedicated pins for active shield input and output.
FLPR	Uses dedicated pins on P2 for emulated peripherals such as QSPI.
RADIO	Uses dedicated pins on P1 for antenna switch control (DFEGPIO for direction finding).
NFC	Uses dedicated pins as listed in the pin assignments table for the selected device. These pins are configured as NFC antenna pins from reset. To use the pins for Digital I/O, NFC function must be disabled in the NFCT — Near field communication tag on page 352 peripheral.

Table 78: Dedicated pin functions

10.1.2 Clock pins

The device has dedicated clock pins.

Some peripherals have clock signals. Dedicated clock pins have been optimized to ensure correct timing relationship between clock and data signals for these peripherals. See the following table for which peripheral signals must use clock pins. The pin assignment table identifies clock pins.

Clock pins can also be used as regular I/O data pins.

The peripheral data signal must be configured to use pins close to the clock pin. This ensures that the internal paths from the peripheral to the pin have the same delay, so that the data and clock signals reach the pins at the same time.

For high-speed signals, the printed circuit board (PCB) layout must use short PCB traces of identical length. This makes sure any delays are kept to a minimum, with close to identical delay on the clock and data path.

The following table shows which peripheral signals must use clock pins.

Peripheral	Signal	Clock pin required
SPIM/SPIS	SDO	
	SDI	
	SCK	Yes
	CSN	
	DCX	
TWIM/TWIS	SCL	Yes
PDM	DIN	
	CLK	Yes
TDM	MCK	Yes
	FSYNC	
	SCK	Yes
	SDIN	
	SDOUT	
TRACE	TRACEDATA[]	
	TRACECLK	Yes (dedicated pin)
GRTC	CLKOUT32K	Yes (dedicated pin)
	PWMOUT	Yes (dedicated pin)
	CLKOUTFAST	Yes (dedicated pin)

Table 79: List of peripheral signals and clock pin requirement

10.1.3 CSP61 (CAAA) package pin assignments

The CSP61 pin assignment figure and table describe the pinouts for this variant of the device.

Pins that can be used as clock signals are shown in as red in the figure. For more information about clock pins, see Clock pins on page 1219.

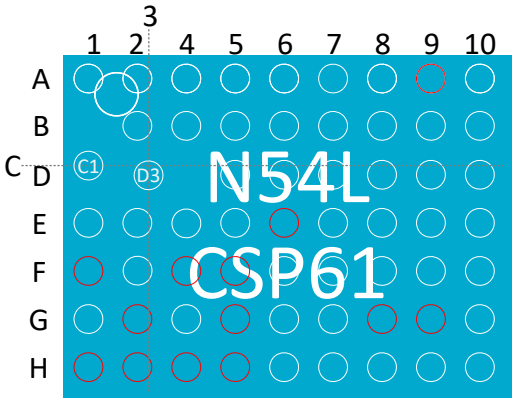


Figure 183: CSP61 pin assignments, top view

Pin	Clock pin	Name	Function	Description	Dedicated function
A1		XC2	Analog input	Connection for 32 MHz crystal	
A2		XC1	Analog input	Connection for 32 MHz crystal	
A4		VDD	Power	VDD for DC/DC	
A5		DCC	Power	DC/DC Regulator output	
A6		DECD	Power	0.9 V regulator supply decoupling	
A7		VSS	Power	Ground	
A8		DECA	Power	0.9 V regulator supply decoupling	
A9	Yes	P2.01 FLPR.0 QSPI.SCK SPIM00.SCK SPIS00.SCK	Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O	General Purpose I/O General Purpose I/O QSPI SCK SPIM00 SCK SPIS00 SCK	 FLPR FLPR (QSPI) SPIM00 SPIS00
A10		P2.00 FLPR.4 QSPI.D3 SPIM00.DCX UARTE00.RXD	Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O	General Purpose I/O General Purpose I/O QSPI D3 SPIM00 DCX UARTE00 RXD	 FLPR FLPR(QSPI) SPIM00 UARTE00
B2		DECRF	Power	0.9 V regulator supply decoupling for radio	Must be connected to DECA
B4		P1.15 ASO[2] RADIO[0]	Digital I/O Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 2 output Radio DFE GPIO	 TAMPC Radio
B5		P1.16 ASI[2] RADIO[1]	Digital I/O Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 2 input Radio DFE GPIO	 TAMPC Radio
B6		P1.20 RADIO[5]	Digital I/O Digital I/O	General Purpose I/O Radio DFE GPIO	 Radio

Pin	Clock pin	Name	Function	Description	Dedicated function
		XL1	Analog input	Connection for 32.768 kHz crystal	
B7		**P1.21** **RADIO[6]** **XL2**	Digital I/O Digital I/O Analog input	General Purpose I/O Radio DFE GPIO Connection for 32.768 kHz crystal	Radio
B8		**P1.26** **ASI[3]**	Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 3 input	TAMPC
B9		**P2.03** **FLPR.3** **QSPI.D2**	Digital I/O Digital I/O Digital I/O	General Purpose I/O QSPI D2	FLPR FLPR (QSPI)
B10		**P2.02** **FLPR.1** **QSPI.D0** **SPIM00.SDO** **SPIS00.SDO** **UARTE00.TXD**	Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O	General Purpose I/O General Purpose I/O QSPI D0 SPIM00 SDO SPIS00 SDO UARTE00 TXD	FLPR FLPR(QSPI) SPIM00 SPIS00 UARTE00
C1		**ANT**	RF	Single ended radio antenna connection	
D3		**VSS**	Power	Ground	
D5		**SWDCLK**	Digital I/O	Serial wire clock; input with pull-down	
D6		**P1.22**	Digital I/O	General Purpose I/O	
D7		**P1.25** **ASO[3]**	Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 3 output	TAMPC
D8		**P1.28**	Digital I/O	General Purpose I/O	
D9		**P2.05** **FLPR.5** **QSPI.CSN** **SPIM00.CSN**	Digital I/O Digital I/O Digital I/O Digital I/O	General Purpose I/O General Purpose I/O QSPI CSN SPIM00 CSN	FLPR FLPR(QSPI) SPIM00

Pin	Clock pin	Name	Function	Description	Dedicated function
		SPIS00.CSN	Digital I/O	SPIS00 CSN	SPIS00
		UARTE00.RTS	Digital I/O	UARTE00 RTS	UARTE00
D10		P2.04	Digital I/O	General Purpose I/O	
		FLPR.2	Digital I/O	General Purpose I/O	FLPR
		QSPI.D1	Digital I/O	QSPI D1	FLPR(QSPI)
		SPIM00.SDI	Digital I/O	SPIM00 SDI	SPIM00
		SPIS00.SDI	Digital I/O	SPIS00 SDI	SPIS00
		UARTE00.CTS	Digital I/O	UARTE00 CTS	UARTE00
E1		VSS_PA	Power	Ground (Radio supply)	
E2		nRESET	Reset	Chip nReset input with pull-up	
E4		SWDIO	Digital I/O	Serial wire data; bidirectional with high-drive and pull-up	
E5		P1.19	Digital I/O	General Purpose I/O	
		RADIO[4]	Digital I/O	Radio DFE GPIO	Radio
E6	Yes	P1.24	Digital I/O	General Purpose I/O	
E7		P1.27	Digital I/O	General Purpose I/O	
E8		P1.01	Digital I/O	General Purpose I/O	
		NFC1	NFC input	NFC antenna pin 1	NFC
E9		P1.29	Digital I/O	General Purpose I/O	
		AIN3	Analog input	Analog input	
E10		VDD	Power	1.7 V to 3.6 V, short to package/ PCB VDD pin	
F1	Yes	P1.13	Digital I/O	General Purpose I/O	
F2		P1.11	Digital I/O	General Purpose I/O	
F4	Yes	P1.14	Digital I/O	General Purpose I/O	
F5	Yes	P3.03	Digital I/O	General Purpose I/O	
F6		P3.01	Digital I/O	General Purpose I/O	
F7		P1.05	Digital I/O	General Purpose I/O	
		AIN5	Analog input	Analog input	TAMPC

Pin	Clock pin	Name	Function	Description	Dedicated function
		ASO[0]	Digital I/O	TAMPC active shield 0 output	
F8		**P1.02** **NFC2**	Digital I/O NFC input	General Purpose I/O NFC antenna pin 2	NFC
F9		**P1.30** **AIN2**	Digital I/O Analog input	General Purpose I/O Analog input	
F10		**VSS**	Power	Ground	
G1		**P0.08**	Digital I/O	General Purpose I/O	
G2	Yes	**P0.07**	Digital I/O	General Purpose I/O	
G4		**P3.05**	Digital I/O	General Purpose I/O	
G5	Yes	**P3.04**	Digital I/O	General Purpose I/O	
G6		**TXRTUNE**	Analog I/O	USB TXRTUNE line	USB
G7		**P1.06** **AIN4** **ASI[0]**	Digital I/O Analog input Digital I/O	General Purpose I/O Analog input TAMPC active shield 0 input	TAMPC
G8	Yes	**P1.04** **AIN6**	Digital I/O Analog input	General Purpose I/O Analog input	
G9	Yes	**P1.03** **AIN7**	Digital I/O Analog input	General Purpose I/O Analog input	
G10		**P1.31** **AIN1**	Digital I/O Analog input	General Purpose I/O Analog input	
H1	Yes	**P0.06**	Digital I/O	General Purpose I/O	
H2	Yes	**P0.04**	Digital I/O Digital I/O	General Purpose I/O GRTC CLKOUT32K	GRTC
H4	Yes	**P0.03**	Digital I/O Digital I/O	General Purpose I/O GRTC PWM	GRTC
H5	Yes	**P1.07** **EXTREF**	Digital I/O Digital I/O Analog input	General Purpose I/O GRTC CLKOUTFAST ADC external reference	GRTC

Pin	Clock pin	Name	Function	Description	Dedicated function
H6		D-	Analog I/O	USB D- line	USB
H7		D+	Analog I/O	USB D+ line	USB
H8		DECUSB	Power	USB regulator decoupling	USB
H9		VBUS	Power	USB 5 V supply	USB
H10		P1.00 AIN0	Digital I/O Analog input	General Purpose I/O Analog input	

Table 80: CSP61 pin assignments

10.1.4 CSP98 (PAAA) package pin assignments

The CSP98 pin assignment figure and table describe the pinouts for this variant of the device.

Pins that can be used as clock signals are shown in as red in the figure. For more information about clock pins, see Clock pins on page 1219.

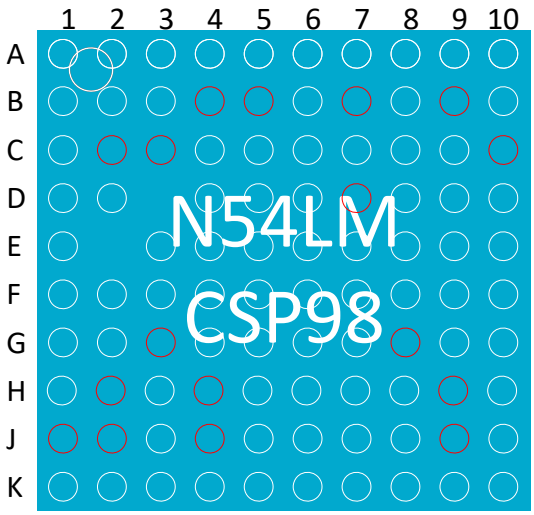


Figure 184: CSP98 pin assignments, top view

Pin	Clock pin	Name	Function	Description	Dedicated function
A1		VSS	Power	Ground	
A2		XC1	Analog input	Connection for 32 MHz crystal	
A3		VDD	Power	1.7 V to 3.6 V, short to package/ PCB VDD pin	
A4		VDD	Power	VDD for DC/DC	
A5		DCC	Power	DC/DC Regulator output	
A6		DECD	Power	0.9 V regulator supply decoupling	
A7		VSS	Power	Ground	
A8		DECA	Power	0.9 V regulator supply decoupling	
A9		VDD	Power	1.7 V to 3.6 V, short to package/ PCB VDD pin	
A10		VSS	Power	Ground	
B1		XC2	Analog input	Connection for 32 MHz crystal	
B2		P1.15 ASO[2] RADIO[0]	Digital I/O Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 2 output Radio DFE GPIO	 TAMPC Radio
B3		P1.16 ASI[2] RADIO[1]	Digital I/O Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 2 input Radio DFE GPIO	 TAMPC Radio
B4	Yes	P1.17 RADIO[2]	Digital I/O Digital I/O	General Purpose I/O Radio DFE GPIO	 Radio
B5	Yes	P1.18 RADIO[3]	Digital I/O Digital I/O	General Purpose I/O Radio DFE GPIO	 Radio
B6		P1.19 RADIO[4]	Digital I/O Digital I/O	General Purpose I/O Radio DFE GPIO	 Radio
B7	Yes	P1.23	Digital I/O	General Purpose I/O	

Pin	Clock pin	Name	Function	Description	Dedicated function
B8		P1.26 ASI[3]	Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 3 input	 TAMPC
B9	Yes	P2.06 FLPR.6 TRACECLK SPIM00.SCK SPIS00.SCK	Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O	General Purpose I/O General Purpose I/O Trace clock SPIM00 SCK SPIS00 SCK	 FLPR TRACE SPIM00 SPIS00
B10		P2.00 FLPR.4 QSPI.D3 SPIM00.DCX UARTE00.RXD	Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O	General Purpose I/O General Purpose I/O QSPI D3 SPIM00 DCX UARTE00 RXD	 FLPR FLPR(QSPI) SPIM00 UARTE00
C1		DECRF	Power	0.9 V regulator supply decoupling for radio	Must be connected to DECA
C2	Yes	P1.14	Digital I/O	General Purpose I/O	
C3	Yes	P1.13	Digital I/O	General Purpose I/O	
C4		P1.12	Digital I/O	General Purpose I/O	
C5		P1.11	Digital I/O	General Purpose I/O	
C6		P1.20 RADIO[5] XL1	Digital I/O Digital I/O Analog input	General Purpose I/O Radio DFE GPIO Connection for 32.768 kHz crystal	 Radio
C7		P1.21 RADIO[6] XL2	Digital I/O Digital I/O Analog input	General Purpose I/O Radio DFE GPIO Connection for 32.768 kHz crystal	 Radio
C8		P1.27	Digital I/O	General Purpose I/O	
C9		P2.07 FLPR.7 TRACEDATA[0]	Digital I/O Digital I/O Digital I/O	General Purpose I/O General Purpose I/O Trace data	 FLPR TRACE

Pin	Clock pin	Name	Function	Description	Dedicated function
		SWO	Digital I/O	Serial wire output (SWO)	
		SPIM00.DCX	Digital I/O	SPIM00 DCX	SPIM00
		UARTE00.RXD	Digital I/O	UARTE00 RXD	UARTE00
C10	Yes	P2.01	Digital I/O	General Purpose I/O	
		FLPR.0	Digital I/O	General Purpose I/O	FLPR
		QSPI.SCK	Digital I/O	QSPI SCK	FLPR (QSPI)
		SPIM00.SCK	Digital I/O	SPIM00 SCK	SPIM00
		SPIS00.SCK	Digital I/O	SPIS00 SCK	SPIS00
D1		VSS	Power	Ground	
D2		VSS	Power	Ground	
D4		P3.12	Digital I/O	General Purpose I/O	
D5		P1.10	Digital I/O	General Purpose I/O	
D6		P1.22	Digital I/O	General Purpose I/O	
D7	Yes	P1.24	Digital I/O	General Purpose I/O	
D8		P1.28	Digital I/O	General Purpose I/O	
D9		P2.08	Digital I/O	General Purpose I/O	
		FLPR.8	Digital I/O	General Purpose I/O	FLPR
		TRACEDATA[1]	Digital I/O	Trace data	TRACE
		SPIM00.SDO	Digital I/O	SPIM00 SDO	SPIM00
		SPIS00.SDO	Digital I/O	SPIS00 SDO	SPIS00
		UARTE00.TXD	Digital I/O	UARTE00 TXD	UARTE00
D10		P2.02	Digital I/O	General Purpose I/O	
		FLPR.1	Digital I/O	General Purpose I/O	FLPR
		QSPI.D0	Digital I/O	QSPI D0	FLPR(QSPI)
		SPIM00.SDO	Digital I/O	SPIM00 SDO	SPIM00
		SPIS00.SDO	Digital I/O	SPIS00 SDO	SPIS00
		UARTE00.TXD	Digital I/O	UARTE00 TXD	UARTE00
E1		ANT	RF	Single ended radio antenna connection	
E3		P0.09	Digital I/O	General Purpose I/O	

Pin	Clock pin	Name	Function	Description	Dedicated function
E4		P3.11	Digital I/O	General Purpose I/O	
E5		VSS	Power	Ground	NC, but connect to VSS on PCB
E6		VSS	Power	Ground	NC, but connect to VSS on PCB
E7		P1.25 ASO[3]	Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 3 output	TAMPC
E8		P1.09 ASI[1]	Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 1 input	TAMPC
E9		P2.09 FLPR.9 TRACEDATA[2] SPIM00.SDI SPIS00.SDI UARTE00.CTS	Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O	General Purpose I/O General Purpose I/O Trace data SPIM00 SDI SPIS00 SDI UARTE00 CTS	 FLPR TRACE SPIM00 SPIS00 UARTE00
E10		P2.03 FLPR.3 QSPI.D2	Digital I/O Digital I/O Digital I/O	General Purpose I/O QSPI D2	 FLPR FLPR (QSPI)
F1		VSS	Power	Ground	
F2		nRESET	Reset	Chip nReset input with pull-up	
F3		P0.08	Digital I/O	General Purpose I/O	
F4		P3.10	Digital I/O	General Purpose I/O	
F5		VSS	Power	Ground	NC, but connect to VSS on PCB

Pin	Clock pin	Name	Function	Description	Dedicated function
F6		VSS	Power	Ground	NC, but connect to VSS on PCB
F7		P3.09	Digital I/O	General Purpose I/O	
F8		P1.08 ASO[1]	Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 1 output	 TAMPC
F9		P2.10 FLPR.10 TRACEDATA[3] SPIM00.CSN SPIS00.CSN UARTE00.RTS	Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O	General Purpose I/O General Purpose I/O Trace data SPIM00 CSN SPIS00 CSN UARTE00 RTS	 FLPR TRACE SPIM00 SPIS00 UARTE00
F10		P2.04 FLPR.2 QSPI.D1 SPIM00.SDI SPIS00.SDI UARTE00.CTS	Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O	General Purpose I/O General Purpose I/O QSPI D1 SPIM00 SDI SPIS00 SDI UARTE00 CTS	 FLPR FLPR(QSPI) SPIM00 SPIS00 UARTE00
G1		SWDCLK	Digital I/O	Serial wire clock; input with pull-down	
G2		SWDIO	Digital I/O	Serial wire data; bidirectional with high-drive and pull-up	
G3	Yes	P0.07	Digital I/O	General Purpose I/O	
G4		P3.08	Digital I/O	General Purpose I/O	
G5		P3.07	Digital I/O	General Purpose I/O	
G6		P3.06	Digital I/O	General Purpose I/O	
G7		P3.05	Digital I/O	General Purpose I/O	
G8	Yes	P1.07 EXTREF	Digital I/O Digital I/O Analog input	General Purpose I/O GRTC CLKOUTFAST ADC external reference	 GRTC

Pin	Clock pin	Name	Function	Description	Dedicated function
G9		**P2.05** **FLPR.5** **QSPI.CSN** **SPIM00.CSN** **SPIS00.CSN** **UARTE00.RTS**	Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O	General Purpose I/O General Purpose I/O QSPI CSN SPIM00 CSN SPIS00 CSN UARTE00 RTS	 FLPR FLPR(QSPI) SPIM00 SPIS00 UARTE00
G10		**VDD**	Power	1.7 V to 3.6 V, short to package/ PCB VDD pin	
H1		**VDD**	Power	Power supply	
H2	Yes	**P0.06**	Digital I/O	General Purpose I/O	
H3		**P0.05**	Digital I/O	General Purpose I/O	
H4	Yes	**P3.03**	Digital I/O	General Purpose I/O	
H5		**P3.02**	Digital I/O	General Purpose I/O	
H6		**P3.01**	Digital I/O	General Purpose I/O	
H7		**P3.00**	Digital I/O	General Purpose I/O	
H8		**P1.05** **AIN5** **ASO[0]**	Digital I/O Analog input Digital I/O	General Purpose I/O Analog input TAMPC active shield 0 output	 TAMPC
H9	Yes	**P1.03** **AIN7**	Digital I/O Analog input	General Purpose I/O Analog input	
H10		**P1.29** **AIN3**	Digital I/O Analog input	General Purpose I/O Analog input	
J1	Yes	**P0.04**	Digital I/O Digital I/O	General Purpose I/O GRTC CLKOUT32K	 GRTC
J2	Yes	**P0.03**	Digital I/O Digital I/O	General Purpose I/O GRTC PWM	 GRTC
J3		**P0.02**	Digital I/O	General Purpose I/O	

Pin	Clock pin	Name	Function	Description	Dedicated function
J4	Yes	**P3.04**	Digital I/O	General Purpose I/O	
J5		**TXRTUNE**	Analog I/O	USB TXRTUNE line	USB
J6		**P1.01** **NFC1**	Digital I/O NFC input	General Purpose I/O NFC antenna pin 1	NFC
J7		**P1.02** **NFC2**	Digital I/O NFC input	General Purpose I/O NFC antenna pin 2	NFC
J8		**P1.06** **AIN4** **ASI[0]**	Digital I/O Analog input Digital I/O	General Purpose I/O Analog input TAMPC active shield 0 input	TAMPC
J9	Yes	**P1.04** **AIN6**	Digital I/O Analog input	General Purpose I/O Analog input	
J10		**P1.30** **AIN2**	Digital I/O Analog input	General Purpose I/O Analog input	
K1		**VSS**	Power	Ground	
K2		**P0.01**	Digital I/O	General Purpose I/O	
K3		**P0.00**	Digital I/O	General Purpose I/O	
K4		**D-**	Analog I/O	USB D- line	USB
K5		**D+**	Analog I/O	USB D+ line	USB
K6		**DECUSB**	Power	USB regulator decoupling	USB
K7		**VBUS**	Power	USB 5 V supply	USB
K8		**P1.00** **AIN0**	Digital I/O Analog input	General Purpose I/O Analog input	
K9		**P1.31** **AIN1**	Digital I/O Analog input	General Purpose I/O Analog input	
K10		**VSS**	Power	Ground	

Table 81: CSP98 pin assignments

10.1.5 QFN52 (QGAA) package pin assignments

The QFN52 pin assignment figure and table describe the pinouts for this variant of the device.

Pins that can be used as clock signals are shown in as red in the figure. For more information about clock pins, see Clock pins on page 1219.

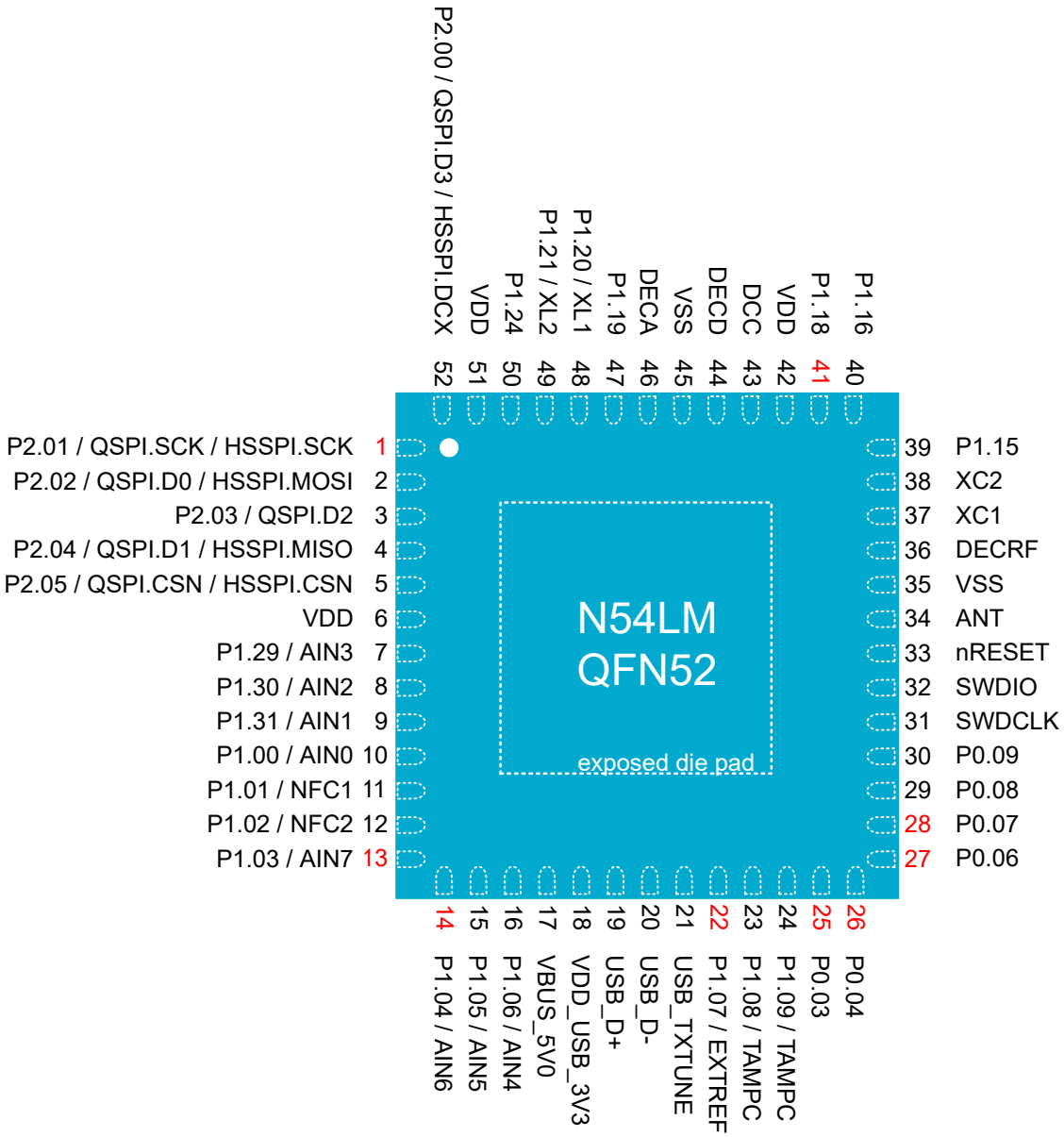


Figure 185: QFN52 pin assignments, top view

Pin	Clock pin	Name	Function	Description	Dedicated function
1	Yes	P2.01 FLPR.0 QSPI.SCK SPIM00.SCK SPIS00.SCK	Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O	General Purpose I/O General Purpose I/O QSPI SCK SPIM00 SCK SPIS00 SCK	 FLPR FLPR (QSPI) SPIM00 SPIS00
2		P2.02 FLPR.1 QSPI.D0 SPIM00.SDO SPIS00.SDO UARTE00.TXD	Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O	General Purpose I/O General Purpose I/O QSPI D0 SPIM00 SDO SPIS00 SDO UARTE00 TXD	 FLPR FLPR(QSPI) SPIM00 SPIS00 UARTE00
3		P2.03 FLPR.3 QSPI.D2	Digital I/O Digital I/O Digital I/O	General Purpose I/O QSPI D2	 FLPR FLPR (QSPI)
4		P2.04 FLPR.2 QSPI.D1 SPIM00.SDI SPIS00.SDI UARTE00.CTS	Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O	General Purpose I/O General Purpose I/O QSPI D1 SPIM00 SDI SPIS00 SDI UARTE00 CTS	 FLPR FLPR(QSPI) SPIM00 SPIS00 UARTE00
5		P2.05 FLPR.5 QSPI.CSN SPIM00.CSN SPIS00.CSN UARTE00.RTS	Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O	General Purpose I/O General Purpose I/O QSPI CSN SPIM00 CSN SPIS00 CSN UARTE00 RTS	 FLPR FLPR(QSPI) SPIM00 SPIS00 UARTE00
6		VDD	Power	1.7 V to 3.6 V, short to package/ PCB VDD pin	
7		P1.29 AIN3	Digital I/O Analog input	General Purpose I/O Analog input	
8		P1.30 AIN2	Digital I/O Analog input	General Purpose I/O Analog input	

Pin	Clock pin	Name	Function	Description	Dedicated function
9		P1.31 AIN1	Digital I/O Analog input	General Purpose I/O Analog input	
10		P1.00 AIN0	Digital I/O Analog input	General Purpose I/O Analog input	
11		P1.01 NFC1	Digital I/O NFC input	General Purpose I/O NFC antenna pin 1	NFC
12		P1.02 NFC2	Digital I/O NFC input	General Purpose I/O NFC antenna pin 2	NFC
13	Yes	P1.03 AIN7	Digital I/O Analog input	General Purpose I/O Analog input	
14	Yes	P1.04 AIN6	Digital I/O Analog input	General Purpose I/O Analog input	
15		P1.05 AIN5 ASO[0]	Digital I/O Analog input Digital I/O	General Purpose I/O Analog input TAMPC active shield 0 output	TAMPC
16		P1.06 AIN4 ASI[0]	Digital I/O Analog input Digital I/O	General Purpose I/O Analog input TAMPC active shield 0 input	TAMPC
17		VBUS	Power	USB 5 V supply	USB
18		DECUSB	Power	USB regulator decoupling	USB
19		D+	Analog I/O	USB D+ line	USB
20		D-	Analog I/O	USB D- line	USB
21		TXRTUNE	Analog I/O	USB TXRTUNE line	USB
22	Yes	P1.07 EXTREF	Digital I/O Digital I/O Analog input	General Purpose I/O GRTC CLKOUTFAST ADC external reference	GRTC

Pin	Clock pin	Name	Function	Description	Dedicated function
23		**P1.08** **ASO[1]**	Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 1 output	 TAMPC
24		**P1.09** **ASI[1]**	Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 1 input	 TAMPC
25	Yes	**P0.03**	Digital I/O Digital I/O	General Purpose I/O GRTC PWM	 GRTC
26	Yes	**P0.04**	Digital I/O Digital I/O	General Purpose I/O GRTC CLKOUT32K	 GRTC
27	Yes	**P0.06**	Digital I/O	General Purpose I/O	
28	Yes	**P0.07**	Digital I/O	General Purpose I/O	
29		**P0.08**	Digital I/O	General Purpose I/O	
30		**P0.09**	Digital I/O	General Purpose I/O	
31		**SWDCLK**	Digital I/O	Serial wire clock; input with pull-down	
32		**SWDIO**	Digital I/O	Serial wire data; bidirectional with high-drive and pull-up	
33		**nRESET**	Reset	Chip nReset input with pull-up	
34		**ANT**	RF	Single ended radio antenna connection	
35		**VSS**	Power	Ground	
36		**DECRF**	Power	0.9 V regulator supply decoupling for radio	Must be connected to DECA
37		**XC1**	Analog input	Connection for 32 MHz crystal	
38		**XC2**	Analog input	Connection for 32 MHz crystal	
39		**P1.15** **ASO[2]** **RADIO[0]**	Digital I/O Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 2 output Radio DFE GPIO	 TAMPC Radio

Pin	Clock pin	Name	Function	Description	Dedicated function
40		P1.16 ASI[2] RADIO[1]	Digital I/O Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 2 input Radio DFE GPIO	 TAMPC Radio
41	Yes	P1.18 RADIO[3]	Digital I/O Digital I/O	General Purpose I/O Radio DFE GPIO	 Radio
42		VDD	Power	VDD for DC/DC	
43		DCC	Power	DC/DC Regulator output	
44		DECD	Power	0.9 V regulator supply decoupling	
45		VSS	Power	Ground	
46		DECA	Power	0.9 V regulator supply decoupling	
47		P1.19 RADIO[4]	Digital I/O Digital I/O	General Purpose I/O Radio DFE GPIO	 Radio
48		P1.20 RADIO[5] XL1	Digital I/O Digital I/O Analog input	General Purpose I/O Radio DFE GPIO Connection for 32.768 kHz crystal	 Radio
49		P1.21 RADIO[6] XL2	Digital I/O Digital I/O Analog input	General Purpose I/O Radio DFE GPIO Connection for 32.768 kHz crystal	 Radio
50	Yes	P1.24	Digital I/O	General Purpose I/O	
51		VDD	Power	1.7 V to 3.6 V, short to package/ PCB VDD pin	
52		P2.00 FLPR.4 QSPI.D3 SPIM00.DCX	Digital I/O Digital I/O Digital I/O Digital I/O	General Purpose I/O General Purpose I/O QSPI D3 SPIM00 DCX	 FLPR FLPR(QSPI) SPIM00

Pin	Clock pin	Name	Function	Description	Dedicated function
		UARTE00.RXD	Digital I/O	UARTE00 RXD	UARTE00
53		**VSS**	Power	Ground	

Table 82: QFN52 pin assignments

10.1.6 Pin function availability by package

The following table is an overview of all pin functions, and their availability on the different package options.

Name	Function	Description	Dedicated function	Clock pin	CSP61 Pin	CSP98 Pin	QFN52 Pin
ANT	RF	Single ended radio antenna connection			C1	E1	34
D+	Analog I/O	USB D+ line	USB		H7	K5	19
D-	Analog I/O	USB D- line	USB		H6	K4	20
P0.00	Digital I/O	General Purpose I/O				K3	
P0.01	Digital I/O	General Purpose I/O				K2	
P0.02	Digital I/O	General Purpose I/O				J3	
P0.03	Digital I/O Digital I/O	General Purpose I/O GRTC PWM	 GRTC	Yes	H4	J2	25
P0.04	Digital I/O Digital I/O	General Purpose I/O GRTC CLKOUT32K	 GRTC	Yes	H2	J1	26
P0.05	Digital I/O	General Purpose I/O				H3	
P0.06	Digital I/O	General Purpose I/O		Yes	H1	H2	27
P0.07	Digital I/O	General Purpose I/O		Yes	G2	G3	28
P0.08	Digital I/O	General Purpose I/O			G1	F3	29
P0.09	Digital I/O	General Purpose I/O				E3	30
P1.00 AIN0	Digital I/O Analog input	General Purpose I/O Analog input			H10	K8	10
P1.01 NFC1	Digital I/O NFC input	General Purpose I/O NFC antenna pin 1	 NFC		E8	J6	11
P1.02 NFC2	Digital I/O NFC input	General Purpose I/O NFC antenna pin 2	 NFC		F8	J7	12
P1.03 AIN7	Digital I/O Analog input	General Purpose I/O Analog input		Yes	G9	H9	13
P1.04 AIN6	Digital I/O Analog input	General Purpose I/O Analog input		Yes	G8	J9	14
P1.05 AIN5 ASO[0]	Digital I/O Analog input Digital I/O	General Purpose I/O Analog input TAMPC active shield 0 output	 TAMPC		F7	H8	15
P1.06 AIN4 ASI[0]	Digital I/O Analog input Digital I/O	General Purpose I/O Analog input TAMPC active shield 0 input	 TAMPC		G7	J8	16
P1.07 EXTREF	Digital I/O Digital I/O Analog input	General Purpose I/O GRTC CLKOUTFAST ADC external reference	 GRTC	Yes	H5	G8	22
P1.08 ASO[1]	Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 1 output	 TAMPC			F8	23
P1.09 ASI[1]	Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 1 input	 TAMPC			E8	24
P1.10	Digital I/O	General Purpose I/O				D5	

Name	Function	Description	Dedicated function	Clock pin	CSP61 Pin	CSP98 Pin	QFN52 Pin
P1.11	Digital I/O	General Purpose I/O			F2	C5	
P1.12	Digital I/O	General Purpose I/O				C4	
P1.13	Digital I/O	General Purpose I/O		Yes	F1	C3	
P1.14	Digital I/O	General Purpose I/O		Yes	F4	C2	
P1.15 ASO[2] RADIO[0]	Digital I/O Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 2 output Radio DFE GPIO	 TAMPC Radio		B4	B2	39
P1.16 ASI[2] RADIO[1]	Digital I/O Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 2 input Radio DFE GPIO	 TAMPC Radio		B5	B3	40
P1.17 RADIO[2]	Digital I/O Digital I/O	General Purpose I/O Radio DFE GPIO	 Radio	Yes		B4	
P1.18 RADIO[3]	Digital I/O Digital I/O	General Purpose I/O Radio DFE GPIO	 Radio	Yes		B5	41
P1.19 RADIO[4]	Digital I/O Digital I/O	General Purpose I/O Radio DFE GPIO	 Radio		E5	B6	47
P1.20 RADIO[5] XL1	Digital I/O Digital I/O Analog input	General Purpose I/O Radio DFE GPIO Connection for 32.768 kHz crystal	 Radio		B6	C6	48
P1.21 RADIO[6] XL2	Digital I/O Digital I/O Analog input	General Purpose I/O Radio DFE GPIO Connection for 32.768 kHz crystal	 Radio		B7	C7	49
P1.22	Digital I/O	General Purpose I/O			D6	D6	
P1.23	Digital I/O	General Purpose I/O		Yes		B7	
P1.24	Digital I/O	General Purpose I/O		Yes	E6	D7	50
P1.25 ASO[3]	Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 3 output	 TAMPC		D7	E7	
P1.26 ASI[3]	Digital I/O Digital I/O	General Purpose I/O TAMPC active shield 3 input	 TAMPC		B8	B8	
P1.27	Digital I/O	General Purpose I/O			E7	C8	
P1.28	Digital I/O	General Purpose I/O			D8	D8	
P1.29 AIN3	Digital I/O Analog input	General Purpose I/O Analog input	 		E9	H10	7
P1.30 AIN2	Digital I/O Analog input	General Purpose I/O Analog input	 		F9	J10	8
P1.31 AIN1	Digital I/O Analog input	General Purpose I/O Analog input	 		G10	K9	9
P2.00 FLPR.4	Digital I/O Digital I/O	General Purpose I/O General Purpose I/O	 FLPR		A10	B10	52

Name	Function	Description	Dedicated function	Clock pin	CSP61 Pin	CSP98 Pin	QFN52 Pin
QSPI.D3	Digital I/O	QSPI D3	FLPR(QSPI)				
SPIM00.DCX	Digital I/O	SPIM00 DCX	SPIM00				
UARTE00.RXD	Digital I/O	UARTE00 RXD	UARTE00				
P2.01	Digital I/O	General Purpose I/O					
FLPR.0	Digital I/O	General Purpose I/O	FLPR				
QSPI.SCK	Digital I/O	QSPI SCK	FLPR (QSPI)	Yes	A9	C10	1
SPIM00.SCK	Digital I/O	SPIM00 SCK	SPIM00				
SPIS00.SCK	Digital I/O	SPIS00 SCK	SPIS00				
P2.02	Digital I/O	General Purpose I/O					
FLPR.1	Digital I/O	General Purpose I/O	FLPR				
QSPI.D0	Digital I/O	QSPI D0	FLPR(QSPI)		B10	D10	2
SPIM00.SDO	Digital I/O	SPIM00 SDO	SPIM00				
SPIS00.SDO	Digital I/O	SPIS00 SDO	SPIS00				
UARTE00.TXD	Digital I/O	UARTE00 TXD	UARTE00				
P2.03	Digital I/O	General Purpose I/O					
FLPR.3	Digital I/O	QSPI D2	FLPR		B9	E10	3
QSPI.D2	Digital I/O		FLPR (QSPI)				
P2.04	Digital I/O	General Purpose I/O					
FLPR.2	Digital I/O	General Purpose I/O	FLPR				
QSPI.D1	Digital I/O	QSPI D1	FLPR(QSPI)		D10	F10	4
SPIM00.SDI	Digital I/O	SPIM00 SDI	SPIM00				
SPIS00.SDI	Digital I/O	SPIS00 SDI	SPIS00				
UARTE00.CTS	Digital I/O	UARTE00 CTS	UARTE00				
P2.05	Digital I/O	General Purpose I/O					
FLPR.5	Digital I/O	General Purpose I/O	FLPR				
QSPI.CSN	Digital I/O	QSPI CSN	FLPR(QSPI)		D9	G9	5
SPIM00.CSN	Digital I/O	SPIM00 CSN	SPIM00				
SPIS00.CSN	Digital I/O	SPIS00 CSN	SPIS00				
UARTE00.RTS	Digital I/O	UARTE00 RTS	UARTE00				
P2.06	Digital I/O	General Purpose I/O					
FLPR.6	Digital I/O	General Purpose I/O	FLPR				
TRACECLK	Digital I/O	Trace clock	TRACE	Yes		B9	
SPIM00.SCK	Digital I/O	SPIM00 SCK	SPIM00				
SPIS00.SCK	Digital I/O	SPIS00 SCK	SPIS00				
P2.07	Digital I/O	General Purpose I/O					
FLPR.7	Digital I/O	General Purpose I/O	FLPR				
TRACEDATA[0]	Digital I/O	Trace data	TRACE			C9	
SWO	Digital I/O	Serial wire output (SWO)					
SPIM00.DCX	Digital I/O	SPIM00 DCX	SPIM00				
UARTE00.RXD	Digital I/O	UARTE00 RXD	UARTE00				
P2.08	Digital I/O	General Purpose I/O				D9	

Name	Function	Description	Dedicated function	Clock pin	CSP61 Pin	CSP98 Pin	QFN52 Pin
FLPR.8	Digital I/O	General Purpose I/O	FLPR				
TRACEDATA[1	Digital I/O	Trace data	TRACE				
SPIM00.SDO	Digital I/O	SPIM00 SDO	SPIM00				
SPIS00.SDO	Digital I/O	SPIS00 SDO	SPIS00				
UARTE00.TXD	Digital I/O	UARTE00 TXD	UARTE00				
P2.09	Digital I/O	General Purpose I/O				E9	
FLPR.9	Digital I/O	General Purpose I/O	FLPR				
TRACEDATA[2]	Digital I/O	Trace data	TRACE				
SPIM00.SDI	Digital I/O	SPIM00 SDI	SPIM00				
SPIS00.SDI	Digital I/O	SPIS00 SDI	SPIS00				
UARTE00.CTS	Digital I/O	UARTE00 CTS	UARTE00				
P2.10	Digital I/O	General Purpose I/O				F9	
FLPR.10	Digital I/O	General Purpose I/O	FLPR				
TRACEDATA[3	Digital I/O	Trace data	TRACE				
SPIM00.CSN	Digital I/O	SPIM00 CSN	SPIM00				
SPIS00.CSN	Digital I/O	SPIS00 CSN	SPIS00				
UARTE00.RTS	Digital I/O	UARTE00 RTS	UARTE00				
P3.00	Digital I/O	General Purpose I/O				H7	
P3.01	Digital I/O	General Purpose I/O			F6	H6	
P3.02	Digital I/O	General Purpose I/O				H5	
P3.03	Digital I/O	General Purpose I/O		Yes	F5	H4	
P3.04	Digital I/O	General Purpose I/O		Yes	G5	J4	
P3.05	Digital I/O	General Purpose I/O			G4	G7	
P3.06	Digital I/O	General Purpose I/O				G6	
P3.07	Digital I/O	General Purpose I/O				G5	
P3.08	Digital I/O	General Purpose I/O				G4	
P3.09	Digital I/O	General Purpose I/O				F7	
P3.10	Digital I/O	General Purpose I/O				F4	
P3.11	Digital I/O	General Purpose I/O				E4	
P3.12	Digital I/O	General Purpose I/O				D4	
SWDCLK	Digital I/O	Serial wire clock; input with pull-down			D5	G1	31
SWDIO	Digital I/O	Serial wire data; bidirectional with high-drive and pull-up			E4	G2	32
XC1	Analog input	Connection for 32 MHz crystal			A2	A2	37
XC2	Analog input	Connection for 32 MHz crystal			A1	B1	38
nRESET	Reset	Chip nReset input with pull-up			E2	F2	33

Table 83: Package pin assignment summary

10.2 Mechanical specifications

The mechanical specifications for the packages show the dimensions in millimeters.

10.2.1 CSP61 (CAAA) package

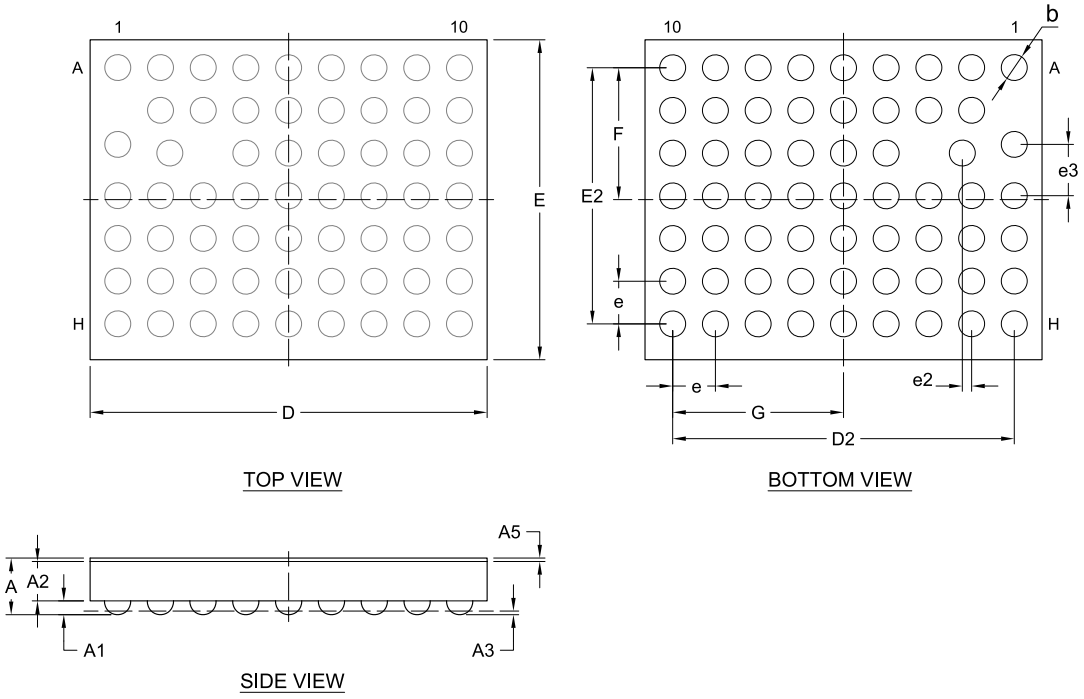


Figure 186: Package dimensions

	A	A1	A2	A3	A5	D	E	D2	E2	b	e	e2	e3	F	G
Min.	0.3886	0.0916	0.275		0.022	2.987	2.4013	2.585	1.935	0.185	0.310				
Nom.	0.4316		0.3	0.03	0.025	3.017	2.4313	2.600	1.950		0.325	0.07	0.39	1.005	1.3
Max.	0.4746	0.1216	0.325		0.028	3.047	2.4613	2.615	1.965	0.215	0.340				

Table 84: Package dimensions in millimeters

This CSP package uses WLCSP (Wafer Level Chip Scale Package) package technology.

10.2.2 CSP98 (PAAA) package

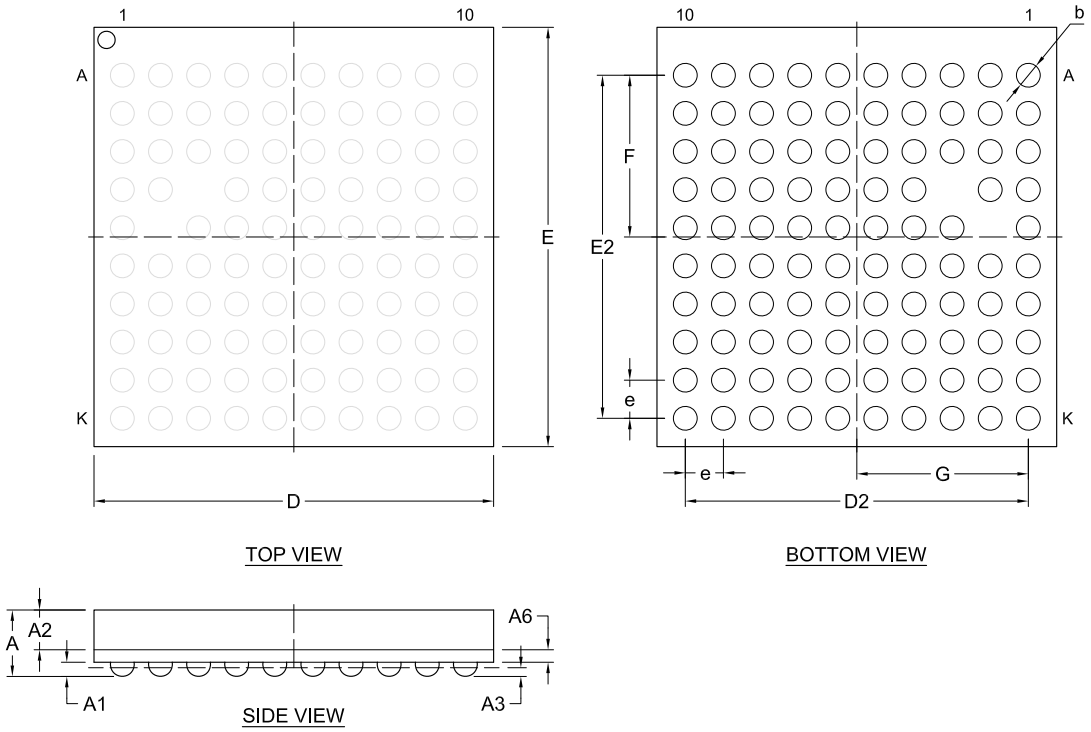


Figure 187: Package dimensions

	A	A1	A2	A3	A6	D	E	D2	E2	b	e	F	G
Min.	0.539	0.08				3.57	3.75	3.07	3.07	0.17	0.27		
Nom.	0.61	0.13	0.365	0.08	0.115	3.67	3.85	3.15	3.15	0.22	0.35	1.485	1.575
Max.	0.681	0.18				3.77	3.95	3.23	3.23	0.27	0.43		

Table 85: Package dimensions in millimeters

The CSP package uses FCCSP (Flip-Chip Chip Scale Package) package technology.

10.2.3 QFN52 (QGAA) package

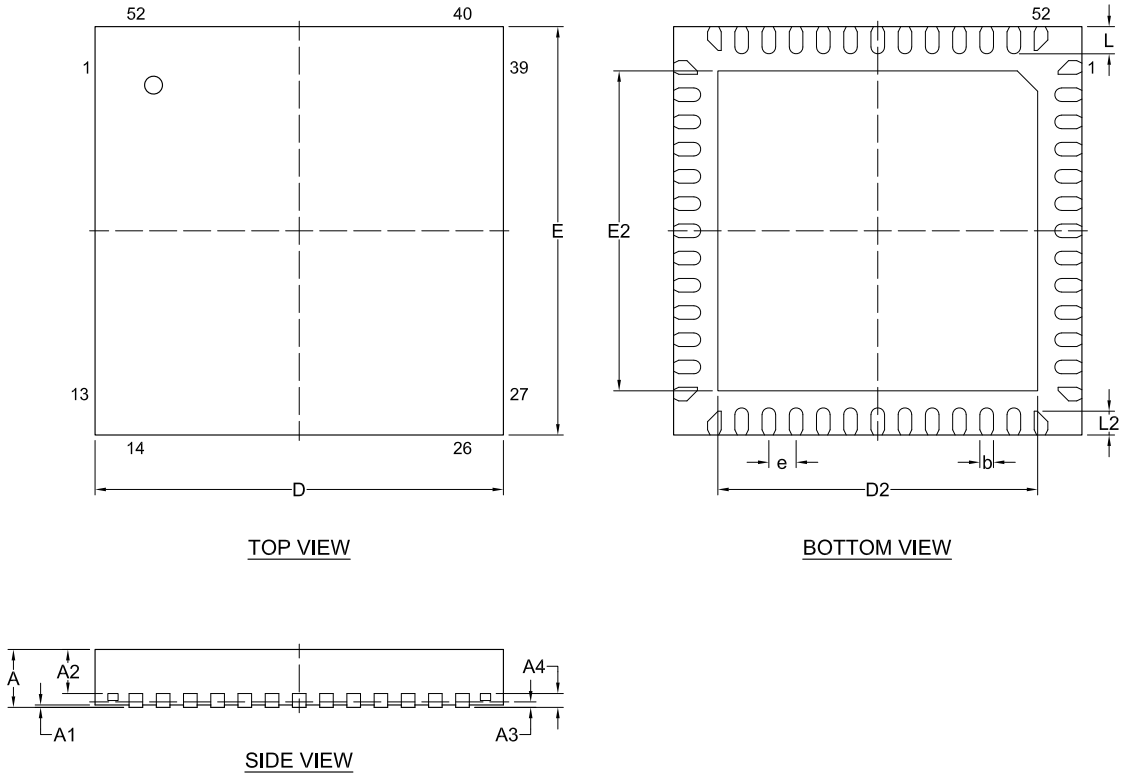


Figure 188: Package dimensions

	A	A1	A2	A3	A4	b	D, E	D2, E2	e	L2	L
Min.	0.80	0.00				0.15		4.60		0.25	0.30
Nom.	0.85	0.035	0.65	0.08	0.203	0.20	6.00	4.70	0.40	0.35	0.40
Max.	0.90	0.05				0.25		4.80		0.45	0.50

Table 86: Package dimensions in millimeters

10.3 Reference circuitry

To ensure good RF performance when designing PCBs, it is highly recommended to use the PCB layouts and component values provided by Nordic Semiconductor.

Documentation for the different package reference circuits, including Altium Designer files, PCB layout files, and PCB production files can be downloaded from www.nordicsemi.com.

In this section, there are reference circuits for all product variants, showing the components and component values to support on-chip features in a design.

10.3.1 Circuit configuration 1 for CSP98 (PAAA)

Config no.	Supply configuration	Enabled features	
	VDD	USB	NFC
Config. 1	DCDC: supplied by battery or external supply	Yes	No

Table 87: Configuration summary for circuit configuration no. 1

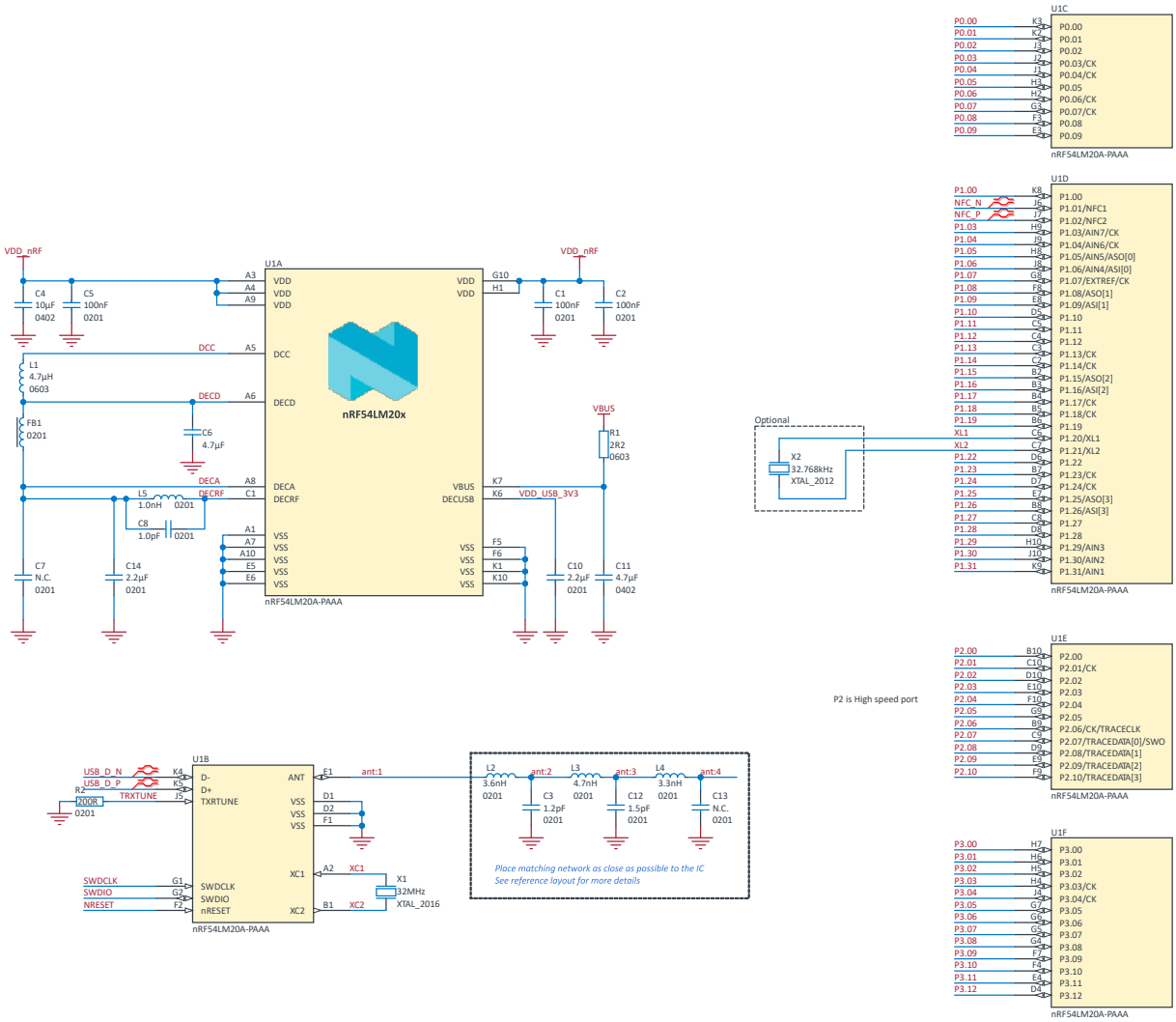


Figure 189: Circuit configuration no. 1 schematic

The reference schematic shows the USB supply path, including the on-chip USB regulator and the decoupling and tuning components required at the USB pins (VBUS, DECUSB, D+, D-, and TXRTUNE). ESD and overvoltage protection components on the USB interface are not shown in this schematic. For a USB connector that may be exposed to ESD or overvoltage, the design must add appropriate protection on the VBUS and data lines in addition to the components shown here.

Note: For PCB reference layouts, see the product page for the nRF54LM20A and nRF54LM20B on www.nordicsemi.com.

Designator	Value	Description	Footprint
C1, C2, C5	100 nF	Capacitor, X7R, ±10%	0201
C3	1.2 pF	Capacitor, NP0, 50 V, ±0.05pF	0201
C4	10 µF	Capacitor, X6S, 6.3 V, ±20%	0402
C6	4.7 µF	Capacitor, X5R, 6.3 V, ±20%	0201
C7, C13	NC	Not mounted	0201
C8	1.0 pF	Capacitor, C0G/NP0, 25 V	0201
C10, C14	2.2 µF	Capacitor, X6T, 2.5 V, ±20 %	0201
C11	4.7 µF	Capacitor, X5R, 10 V	0402
C12	1.5 pF	Capacitor, NP0, ±0.05 pF, 25V, High Q	0201
FB1	120 Ω	Ferrite bead, 120 Ω at 100 MHz, 200 mA, 500 mΩ max	0201
L1	4.7 µH	Inductor, 120 mA, ±20%, 0.65 Ω	0603
L2	3.6 nH	Inductor, 500 mA, ±0.1 nH, 170 mΩ	0201
L3	4.7 nH	Inductor, 300 mA, ±3%, 250 mΩ	0201
L4	3.3 nH	Inductor, 500 mA, ±0.1 nH, 170 mΩ	0201
L5	1.0 nH	Inductor, 750 mA, ±0.2 nH	0201
R1	2.2 Ω	Resistor, ±1%, 0.05 W	0201
R2	200 Ω	Resistor, ±1%, 0.05 W	0201
U1	nRF54LM20A-PAAA	Multiprotocol Bluetooth Low Energy, IEEE 802.15.4, and 2.4GHz proprietary System on Chip	CSP98
X1	32 MHz	Crystal SMD 2016, 32 MHz, Cl = 8 pF, Total Tol: ±40 ppm. For frequency tolerance requirements, see 32 MHz crystal oscillator (HFXO) on page 1261.	XTAL_2016
X2	32.768 kHz	Crystal SMD 2012, 32.768 kHz, Cl = 9 pF, Total tol: ±20 ppm	XTAL_2012

Table 88: Bill of material for circuit configuration no. 1

10.3.2 PCB layout example

The PCB layout in the following figure is a reference layout for Circuit configuration 1 for CSP98 (PAAA).

For all available reference layouts, see the product pages for nRF54LM20A and nRF54LM20B on www.nordicsemi.com.

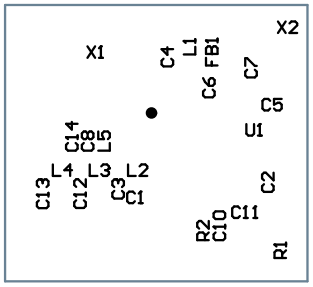


Figure 190: Top silk layer

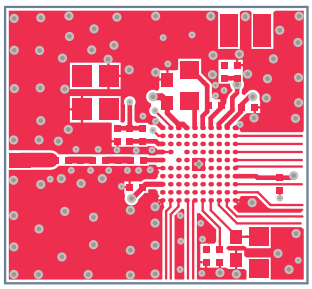


Figure 191: Top layer

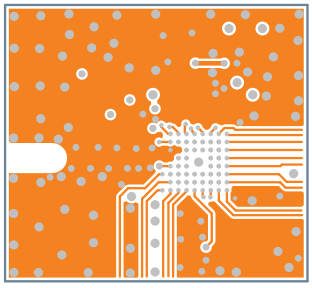


Figure 192: Mid layer 1

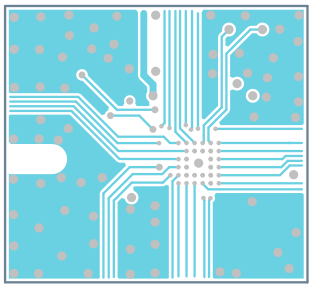


Figure 193: Mid layer 2

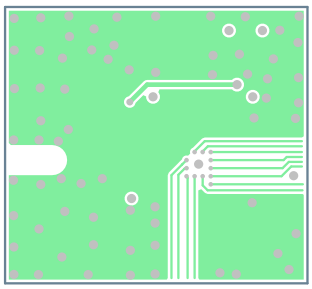


Figure 194: Mid layer 3

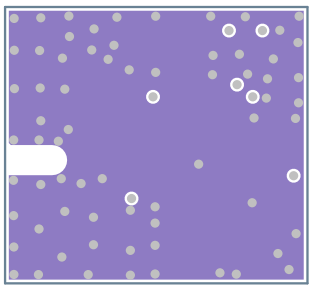


Figure 195: Mid layer 4

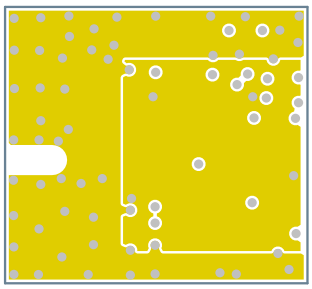


Figure 196: Mid layer 5

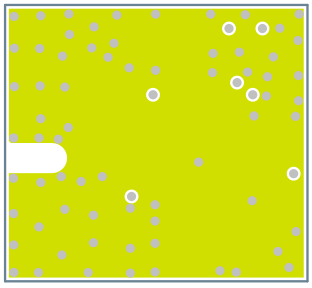


Figure 197: Mid layer 6

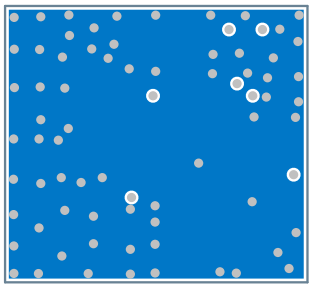


Figure 198: Bottom layer

10.3.3 PMIC support

The nRF54L Series is comprehensively supported by Nordic Semiconductor's own range of PMICs (Power Management Integrated Circuits). These PMICs are meticulously designed to enhance the performance and efficiency of the nRF54L Series devices. This integration ensures the longest battery life and the highest reliability for the end application. The synergy between the nRF54L Series and the Nordic PMICs highlights Nordic Semiconductor's commitment to providing a complete and cohesive solution for their customers' needs in wireless technology applications.

10.4 Package thermal characteristics

A summary of the thermal characteristics for the different packages available for the device can be found below.

Symbol	Package	Typ.	Unit
$\theta_{JA,CSP}$	CSP98	34.94	°C/W
$\theta_{JC,CSP}$	CSP98	8.16	°C/W

Table 89: Package thermal characteristics

Values for θ_{JA} are obtained by simulation following the EIA/JESD51-2 for still air condition using JEDEC PCB.

Values for θ_{JC} are obtained by simulation. A cold plate and the grease between package and cold plate are modeled.

11 Electrical specifications

11.1 Conditions

The following table shows a set of common conditions used in all scenarios, unless otherwise stated.

Condition	Value	Note
Supply	3 V on VDD	
Temperature	25°C	
CPU	WFI (wait for interrupt)/WFE (wait for event) sleep	
Peripherals	All IDLE	
Clock	HFCLK = HFINT running at 128 MHz LFCLK = Not running	
Regulator	DC/DC	
GPIO	Port 2 HSBIAS=3 (fastest slew rate)	Applies for timing specifications for GPIO port P2 using Extra high drive strength
RAM	32 kB	In System ON, RAM value refers to the amount of RAM that is powered. The remaining RAM is powered off and not retained. In System OFF, RAM value refers to amount of RAM that is retained.
External components	As reference circuitry	See Reference circuitry on page 1246 for details.
Cache enabled	Yes	Only applies when the CPU is running from non-volatile memory.
Compiler version	GCC version 10.3.1 20210621	
Compiler flags	`-O0 -fno-strict-aliasing -fno-delete-null-pointer-checks -fomit-frame-pointer -ffunction-sections -fmax-errors=1 -mcpu=cortex-m33 -mthumb -falign-functions=16 -mfloat-abi=soft -msoft-float`	

Table 90: Current consumption scenarios, common conditions

11.2 Current consumption

Because the power and clock management system is constantly adjusting power and clock sources, it is difficult to estimate an application's current consumption. To facilitate the estimation process, a set of current consumption scenarios is provided to show the typical current drawn from the supply pins.

Each scenario specifies a set of operations and conditions applying to the given scenario. All scenarios are listed in the following sections.

11.2.1 CURRENT Electrical specification

11.2.1.1 Sleep

Symbol	Description	Min.	Typ.	Max.	Units
I_{OFF0}	System OFF, Wake on pin, 0 KB RAM retained		0.7		µA
I_{OFF1}	System OFF, Wake on pin + GRTC, LFXO, 0 KB RAM retained		1.0		µA
$I_{ONIDLE0}$	System ON, Wake on pin, 32 KB RAM retained		1.1		µA
$I_{ONIDLE1}$	System ON, Wake on pin, 512 KB RAM retained		4.0		µA
$I_{ONIDLE2}$	System ON, Wake on pin + GRTC, LFXO, 512 KB RAM retained		4.3		µA

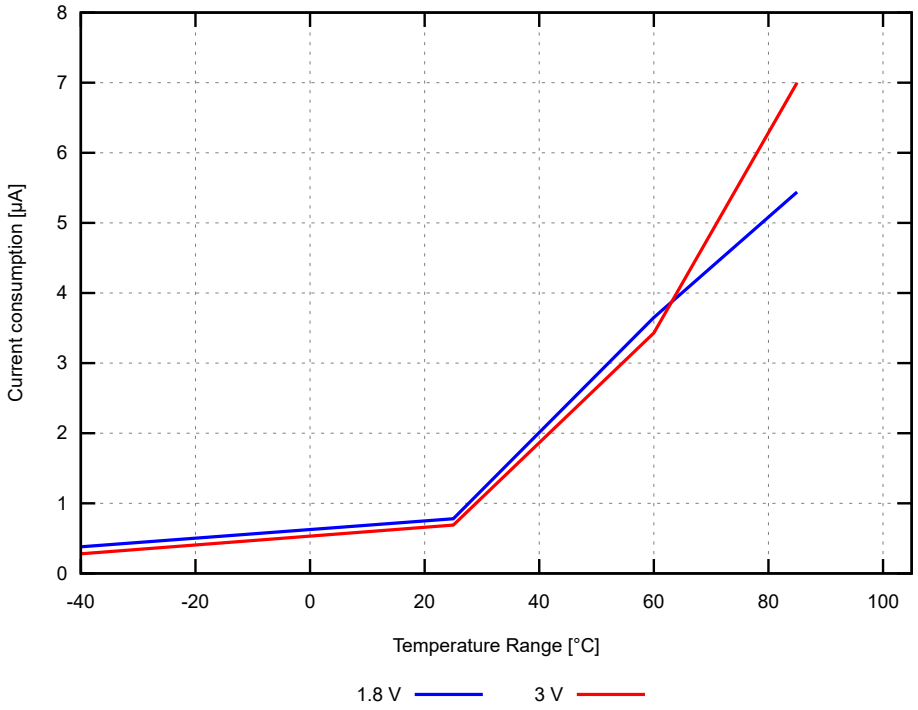


Figure 199: System OFF, Wake on pin, 0 KB RAM retained (typical values)

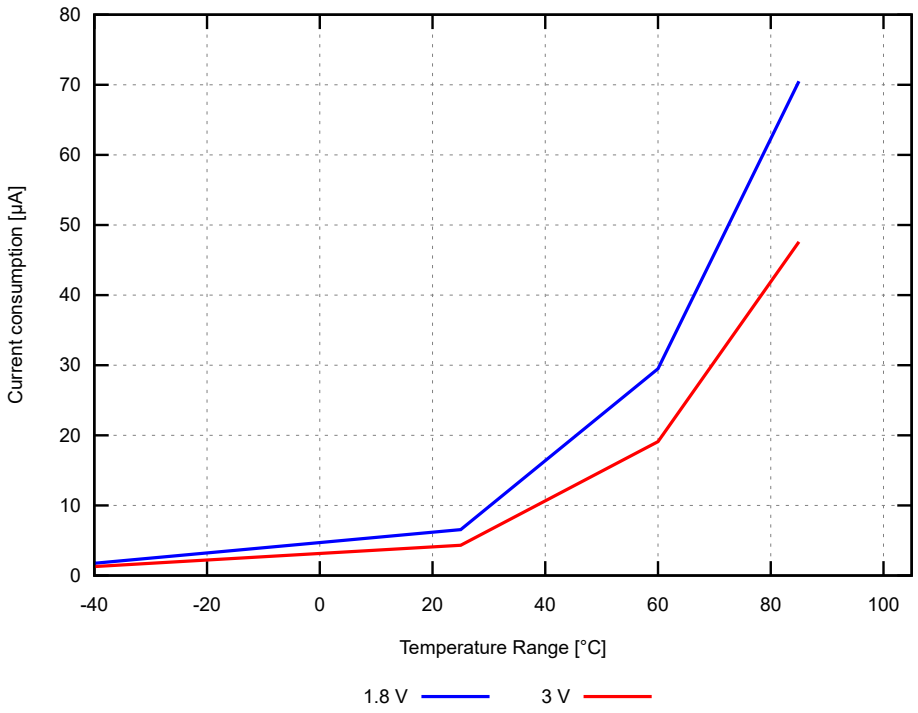


Figure 200: System ON, Wake on pin + GRTC, LFXO, 512 KB RAM retained (typical values)

11.2.1.2 Axon NPU running

The following table summarizes the typical performance of Axon NPU.

Symbol	Description	Min.	Typ.	Max.	Units
I_{AXONS0}	DS-CNN keyword spotting (KWS)		3.0		mA
I_{AXONS1}	Autoencoder (dense, AD)		3.5		mA
I_{AXONS2}	MobileNetV1 (VWW)		2.8		mA
I_{AXONS3}	ResNet (IC)		2.7		mA

11.2.1.3 COMP active

Symbol	Description	Min.	Typ.	Max.	Units
I_{COMP0}	COMP enabled in Low-power mode		42		µA
I_{COMP1}	COMP enabled in Normal mode		44		µA
I_{COMP2}	COMP enabled in High-speed mode		48		µA

11.2.1.4 CPU running

The CPU running parameters are obtained using the following compiler version:

Compiler: Arm version 6.16 (armclang)

Compiler flags:

```
--target=arm-arm-none-eabi -c -g -masm=auto -Wno-unused-value -mcpu=cortex-m33 -mfloat-abi=hard -mfpu=fpv5-sp-d16 -flto -Omax
```

Linker flags:

```
--lto --remove
```

Symbol	Description	Min.	Typ.	Max.	Units
$I_{APPCPU0}$	CPU running Coremark at 128 MHz from NVM, Cache enabled		2.4		mA

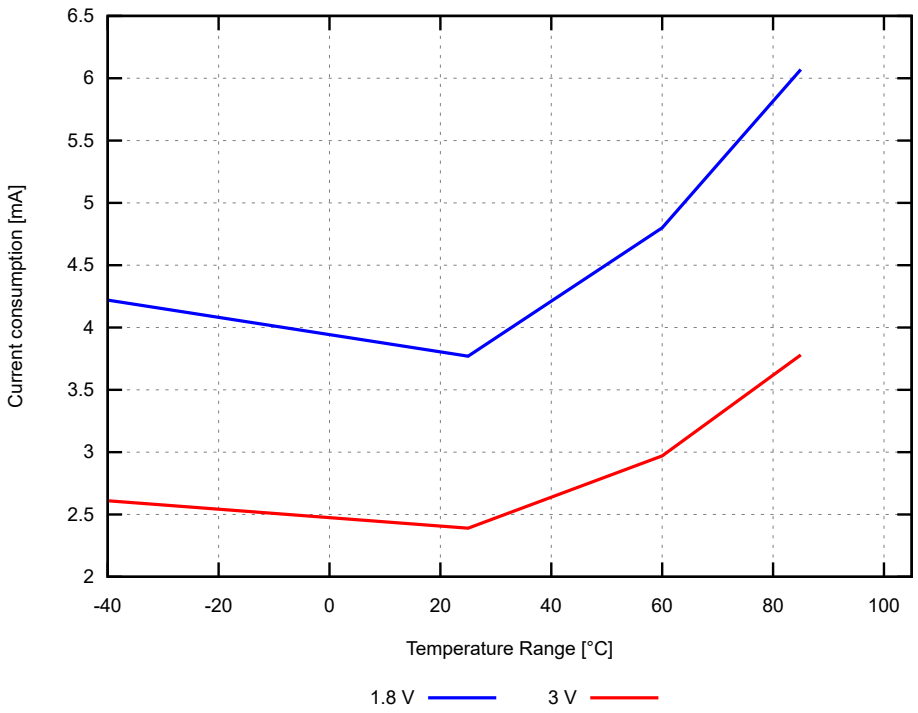


Figure 201: CPU running Coremark at 128 MHz from NVM, Cache enabled (typical values)

11.2.1.5 QDEC active

Symbol	Description	Min.	Typ.	Max.	Units
I_{QDEC0}	QDEC enabled but not running		94		µA
I_{QDEC1}	QDEC running, 131 ms sample period		135		µA

11.2.1.6 RADIO transmitting/receiving

Symbol	Description	Min.	Typ.	Max.	Units
I_{RADIO_RX0}	Radio RX, 1 Mbps, HFXO		3.3		mA
I_{RADIO_TX0}	Radio TX, 0 dBm, HFXO		5.0		mA
I_{RADIO_TX1}	Radio TX, 4 dBm, HFXO		7.1		mA
I_{RADIO_TX2}	Radio TX, 8 dBm, HFXO		10.9		mA

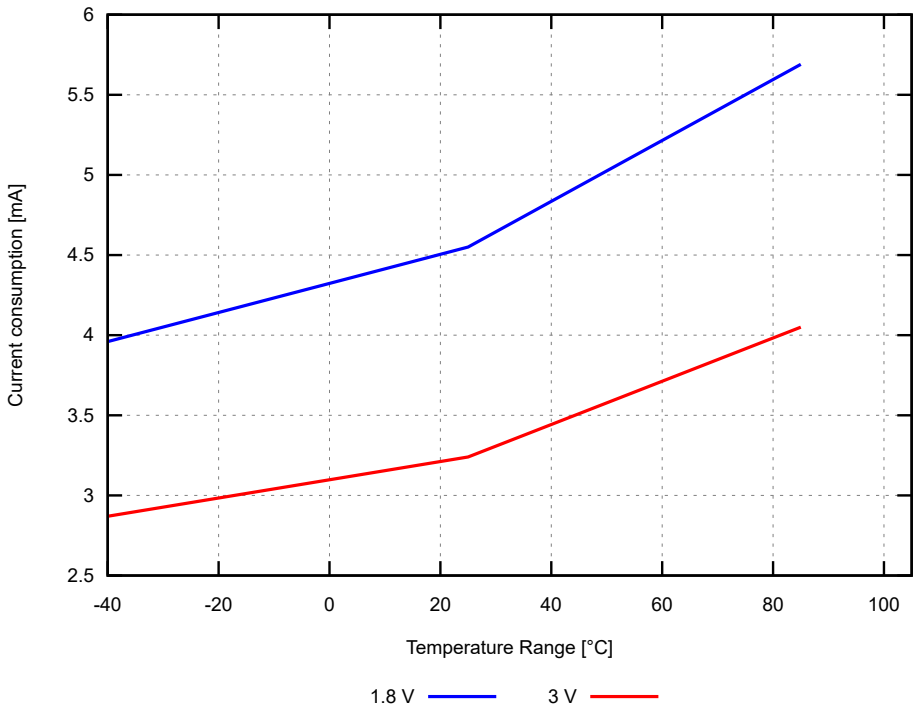


Figure 202: Radio RX, 1 Mbps, HFXO (typical values)

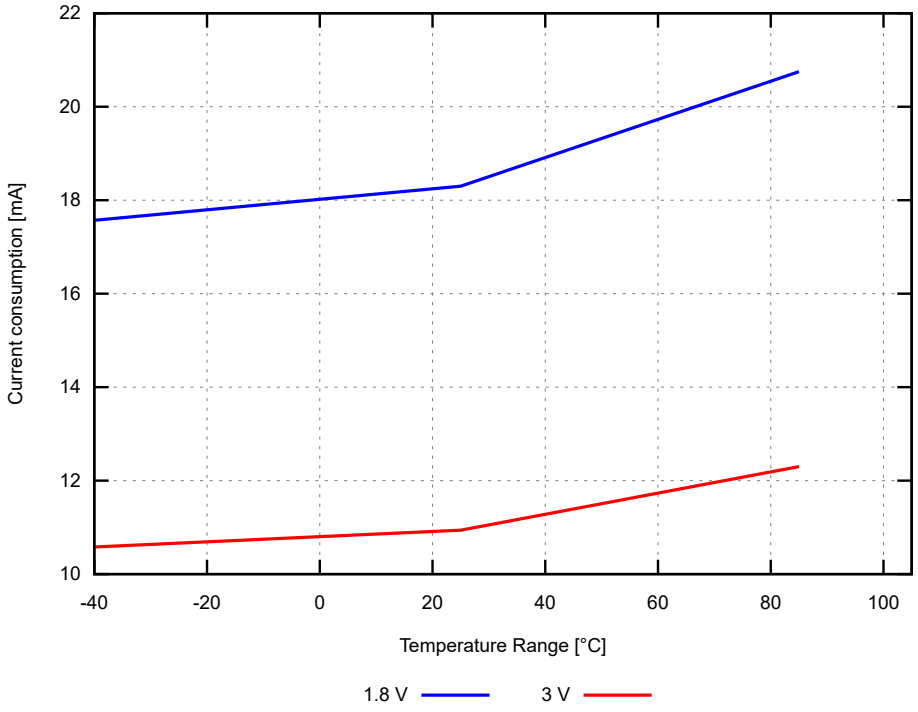


Figure 203: Radio TX, 8 dBm, HFXO (typical values)

11.2.1.7 RNG active

Symbol	Description	Min.	Typ.	Max.	Units
I_{RNG0}	CRACEN running RNG, 512 KB RAM retained		1.9		mA

11.2.1.8 SAADC active

Symbol	Description	Min.	Typ.	Max.	Units
I_{SAADC0}	SAADC, 2 Msps, HFXO, 512 KB RAM retained		1.3		mA

11.2.1.9 TEMP active

Symbol	Description	Min.	Typ.	Max.	Units
I_{TEMP0}	TEMP continously sampling via DPPI connections		0.31		mA

11.2.1.10 TIMER active

Symbol	Description	Min.	Typ.	Max.	Units
I_{TIMER0}	TIMER00 running at 128 MHz		480		µA
I_{TIMER1}	TIMER20 running at 16 MHz		171		µA
I_{TIMER2}	TIMER20 running at 1 MHz		139		µA
I_{TIMER3}	TIMER10 running at 32MHz, HFXO		198		µA

11.2.1.11 WDT active

Symbol	Description	Min.	Typ.	Max.	Units
I_{WDT0}	WDT active		3.6		µA
I_{WDT1}	WDT active, LFXO		3.2		µA

11.2.1.12 RRAM active

Symbol	Description	Min.	Typ.	Max.	Units
I_{RRAM0}	System ON, CPU running @ 128 MHz, writing in unbuffered mode 32-bit words to RRAM, 512 KB RAM retained		3.5		mA

11.3 AXONS Electrical specification

11.3.1 Timing specifications

Symbol	Description	Min.	Typ.	Max.	Units
t_{KWS}	Time to run DS-CNN keyword spotting (KWS) model		4.5		ms
t_{AD}	Time to run Autoencoder (dense, AD) model		1.3		ms
t_{VWW}	Time to run MobileNetV1 (VWW) model		14.4		ms
t_{IC}	Time to run ResNet (IC) model		17.9		ms

11.4 CLOCK Electrical specification

11.4.1 High frequency clock source (HFCLK)

Symbol	Description	Min.	Typ.	Max.	Units
f_{NOM}	Nominal output frequency		64/128		MHz
f_{TOL_HFINT}	Frequency tolerance when running from internal oscillator	-10		6	%
t_{START_HFINT}	Startup time for internal RC oscillator			6	µs

11.4.2 32.768 kHz clock source (LFCLK)

Symbol	Description	Min.	Typ.	Max.	Units
f_{NOM_LFCLK}	Nominal output frequency		32.768		kHz
t_{START_LFXO}	Startup time for 32.768 kHz crystal oscillator		0.43		s
f_{TOL_LFRC}	Frequency tolerance, uncalibrated			±4.5	%
$f_{TOL\_CAL\_LFRC}$	Frequency tolerance after calibration. Constant temperature within ±0.5 °C, calibration performed at least every 8 seconds, averaging interval > 7.5 ms, defined as 3 sigma.			±250	ppm
t_{START_LFRC}	Startup time for internal RC oscillator		1000		µs

11.5 COMP Electrical specification

11.5.1 COMP Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
$t_{PROPDLY,LP}$	Propagation delay, low-power mode[3]		0.5		µs
$t_{PROPDLY,HS}$	Propagation delay, high-speed mode[3]		0.1		µs
I_{SOURCE}	Configurable input current provided by the output driven current source.				µA
$I_{SOURCE,A}$	Current when register ISOURCE=Ien2uA5	1.4	2.2	3.6	µA
$I_{SOURCE,B}$	Current when register ISOURCE=Ien5uA	3.3	4.5	6.1	µA
$I_{SOURCE,C}$	Current when register ISOURCE=Ien10uA	6.7	8.9	11.3	µA
$V_{DIFFHYST}$	Optional hysteresis applied to differential input	40	60	80	mV
$t_{INT\_REF,START}$	Startup time for the internal bandgap reference		1.5	2.2	µs
E_{INT_REF}	Internal bandgap reference error	-4.7	0	4.0	%
$V_{INPUTOFFSET}$	Input offset	-15	0	15	mV
$t_{COMP,START}$	Startup time for the comparator core		3		µs

11.6 CPU Electrical specification

11.6.1 CPU performance

The CPU performance metrics are derived from benchmarks executed on highly optimized firmware. The firmware is compiled using the specified compiler version and settings to ensure accurate and reliable performance data.

Compiler: Arm version 6.16 (armclang)

Compiler flags:

```
--target=arm-arm-none-eabi -c -g -masm=auto -Wno-unused-value -mcpu=cortex-m33 -mfloat-abi=hard -mfpu=fpv5-sp-d16 -flto -Omax
```

[3] Propagation delay is with 10 mV overdrive.

Linker flags:

```
--lto --remove
```

Symbol	Description	Min.	Typ.	Max.	Units
$CM_{RRAMCACHE128}$	CPU running CoreMark at 128 MHz from RRAM, cache enabled		503		CoreMark
$CM_{rram128/MHz}$	CoreMark per MHz, running from RRAM, cache enabled, HFXO128M		3.93		CoreMark/MHz
CM_{RAM128}	CPU running CoreMark at 128 MHz from RAM		464		CoreMark

11.6.2 CPU wakeup times

Symbol	Description	Min.	Typ.	Max.	Units
t_{R2ON}	Time from pin reset to CPU executes the first instruction		44		µs
t_{OFF2ON}	Time from wake-up from System OFF mode to CPU executes the first instruction		37		µs
$t_{IDLE2CPU,POWEROFF}$	Wakeup time from CPU sleep (WFI,WFE) to CPU executes the next instruction, RRAMC LOWPOWERCONFIG is using PowerOff mode. CACHE is disabled.		18		µs
$t_{IDLE2CPU,CONSTLAT,POWEROFF}$	Wakeup time from CPU sleep (WFI,WFE) to CPU executes the next instruction in constant latency sub-mode, RRAMC LOWPOWERCONFIG is using PowerOff mode. CACHE is disabled.		17		µs
$t_{IDLE2CPU,CACHE}$	Wakeup time from CPU sleep (WFI,WFE) to CPU executes the next instruction. CACHE is enabled.		2		µs
$t_{IDLE2CPU,STANDBY}$	Wakeup time from CPU sleep (WFI,WFE) to CPU executes the next instruction, RRAMC LOWPOWERCONFIG is using Standby mode. CACHE is disabled.		0.5		µs
$t_{IDLE2CPU,CACHE,CONSTLAT}$	Wakeup time from CPU sleep (WFI,WFE) to CPU executes the next instruction in constant latency sub-mode, CACHE enabled.		0.3		µs

11.7 GPIO Electrical specification

11.7.1 GPIO Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
V_{IH}	Input high voltage	0.7 x VDD		VDD	V
V_{IL}	Input low voltage	VSS		0.3 x VDD	V
$V_{OH,SD}$	Output high voltage, standard drive, 0.5 mA, VDD ≥1.7	VDD - 0.4		VDD	V
$V_{OH,HDH}$	Output high voltage, high drive, 5 mA, VDD ≥ 2.7 V	VDD - 0.4		VDD	V
$V_{OH,HDL}$	Output high voltage, high drive, 3 mA, VDD ≥ 1.7 V	VDD - 0.4		VDD	V
$V_{OL,SD}$	Output low voltage, standard drive, 0.5 mA, VDD ≥1.7	VSS		VSS + 0.4	V
$I_{OL,SD}$	Current at VSS+0.4 V, output set low, standard drive, VDD ≥1.7	1	3	4	mA
$I_{OL,HDL}$	Current at VSS+0.4 V, output set low, high drive, VDD >= 1.7 V	3			mA
$I_{OL,ED}$	Current at VSS+0.4 V, output set low, extra drive, VDD >= 1.7 V	16			mA
$I_{OH,SD}$	Current at VDD-0.4 V, output set high, standard drive, VDD ≥1.7	1	3	4	mA
$I_{OH,HDL}$	Current at VDD-0.4 V, output set high, high drive, VDD >= 1.7 V	4			mA
$I_{OH,ED}$	Current at VDD-0.4 V, output set high, extra drive, VDD >= 1.7 V	14			mA
$I_{GPIO,TOTAL}$	Recommended maximum sustained current drawn by all GPIOs			15	mA
$t_{RF,15pF}$	Rise/fall time, standard drive mode, 10-90%, 15 pF load[1]		8		ns

[1] Rise and fall times based on simulations

Symbol	Description	Min.	Typ.	Max.	Units
$t_{RF,25pF}$	Rise/fall time, standard drive mode, 10-90%, 25 pF load[1]		12		ns
$t_{RF,50pF}$	Rise/fall time, standard drive mode, 10-90%, 50 pF load[1]		21		ns
$t_{HRF,12pF}$	Rise/Fall time, high drive mode, 20-80%, 12 pF load[1]		4		ns
$t_{ERF,12pF}$	Rise/Fall time, extra drive mode, 20-80%, 12 pF load[1]		0.9		ns
R_{PU}	Pull-up resistance	12	14	16	kΩ
R_{PD}	Pull-down resistance	12	14	18	kΩ
$t_{OE,ED}$	Output enable delay in extra drive mode			855	ns
C_{PAD}	Pad capacitance		1		pF
C_{PAD_NFC}	Pad capacitance on NFC pads		5		pF

11.8 LPCOMP Electrical specification

11.8.1 LPCOMP Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
$t_{LPCANADET}$	Time from VIN crossing (≥ 50 mV above threshold) to ANADETECT signal generated		1.5		µs
$V_{INPOFFSET}$	Input offset including reference ladder error	-18		18	mV
V_{HYST}	Optional hysteresis		43		mV
$t_{STARTUP}$	Startup time for LPCOMP	10	32	62	µs

11.9 NFCT Electrical specification

11.9.1 NFCT Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
f_c	Frequency of operation	12.55	13.56	13.57	MHz
C_{MI}	Carrier modulation index	95			%
DR	Data Rate		106		kbps
V_{sense}	Peak differential field detect threshold level on NFC1-NFC2, with input being high impedance in sense mode		1.3		Vp
I_{max}	Maximum input current on NFCT pins		80	130	mA

11.9.2 NFCT Timing Parameters

Symbol	Description	Min.	Typ.	Max.	Units
$t_{activate}$	Time from task_ACTIVATE in SENSE or DISABLE state to ACTIVATE_A or IDLE state, excluding voltage supply and oscillator startup times			625	µs
t_{sense}	Time from remote field is present in SENSE mode to FIELDDETECTED event is asserted		7.2		µs

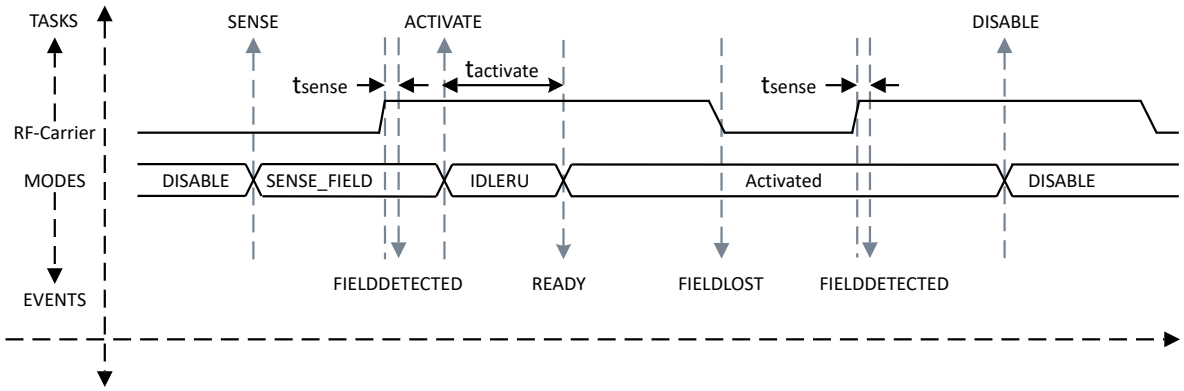


Figure 204: NFCT timing parameters (Shortcuts for FIELDDETECTED and FIELDLOST are disabled)

11.10 OSCILLATORS Electrical specification

11.10.1 32 MHz crystal oscillator (HFXO)

Symbol	Description	Min.	Typ.	Max.	Units
f_{HFXO}	External crystal frequency		32		MHz
f_{TOL_HFXO}	Frequency tolerance requirement for 2.4 GHz proprietary radio applications			±60	ppm
$f_{TOL\_HFXO\_BLE}$	Frequency tolerance requirement, Bluetooth Low Energy applications			±40	ppm
C_{L_HFXO}	Load capacitance	6		9	pF
P_{D_HFXO}	Drive level			100	µW
C_{PIN_HFXO}	Input capacitance on XC1 and XC2 pins with internal capacitor disabled (INTCAP=0)		3.1		pF
$I_{STBY\_X32M\_X2}$	Core standby current for a given 2.0x1.6 mm crystal: CL_HFXO=8 pF C0_HFXO=0.74 pF LM_HFXO=9.4 mH RS_HFXO=35 Ω		34		µA
$I_{START\_X32M\_X2}$	Average startup current during first 1ms for a given 2.0x1.6 mm crystal		0.36		mA
$t_{POWERUP\_X32M\_X2}$	Power-up time for a given 2.0x1.6 mm crystal, generating XOSTARTED event		200		µs
$t_{POWERUP\_X32M\_TUNED\_X2}$	Power-up time for a given 2.0x1.6 mm crystal, generating XOTUNED event		300		µs
$I_{STBY\_X32M\_X3}$	Core standby current for a given 1.2x1.0 mm crystal: CL_HFXO=8 pF C0_HFXO=0.42 pF LM_HFXO=22.7 mH RS_HFXO=100 Ω		63		µA
$I_{START\_X32M\_X3}$	Average startup current during first 1ms for a given 1.2x1.0 mm crystal		0.38		mA
$t_{POWERUP\_X32M\_X3}$	Power-up time for a given 1.2x1.0 mm crystal, generating XOSTARTED event		415		µs
$t_{POWERUP\_X32M\_TUNED\_X3}$	Power-up time for a given 1.2x1.0 mm crystal, generating XOTUNED event		700		µs

11.10.2 32.768 kHz crystal oscillator (LFXO)

Symbol	Description	Min.	Typ.	Max.	Units
f_{LFXO}	External crystal frequency		32.768		kHz
$f_{TOL\_LFXO\_BLE}$	Frequency tolerance requirement, Bluetooth Low Energy applications			±500	ppm
$f_{TOL\_LFXO\_ANT}$	Frequency tolerance requirement for ANT applications			±50	ppm
C_{L_LFXO}	Load capacitance	6		9	pF
C_{0_LFXO}	Shunt capacitance		1.0	2.0	pF
R_{S_LFXO}	Equivalent series resistance			100	kΩ
P_{D_LFXO}	Drive level			0.5	µW
C_{pin}	Input capacitance on XL1 and XL2 pins with internal capacitor disabled (INTCAP=0)		3		pF
$V_{AMP,IN,XO,LOW}$	Peak-to-peak amplitude for external low swing clock. Input signal must not swing outside supply rails.	100		500	mV

11.11 PPI Electrical specification

11.11.1 Typical PPI latencies

Symbol	Description	Min.	Typ.	Max.	Units
t_{PPI}	PPI latency between same power-domain peripherals in RUN state (i.e. PCLK's are running)		2		cycles

11.12 PDM Electrical specification

11.12.1 PDM Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
$f_{PDM,CLK,64}$	PDM clock speed. PDMCLKCTRL = Default (Setting needed for 16 kHz sample frequency @ RATIO = Ratio64)		1.032		MHz
$f_{PDM,CLK,80}$	PDM clock speed. PDMCLKCTRL = 1280K (Setting needed for 16 kHz sample frequency @ RATIO = Ratio80)		1.280		MHz
$t_{PDM,JITTER}$	Jitter in PDM clock output				ns
$T_{dPDM,CLK}$	PDM clock duty cycle	40	50	60	%
$t_{PDM,DATA}$	Decimation filter delay			5	ms
$t_{PDM,s}$	Data setup time	35			ns
$t_{PDM,h}$	Data hold time	0			ns
$G_{PDM,default}$	Default (reset) absolute gain of the PDM module		0		dB

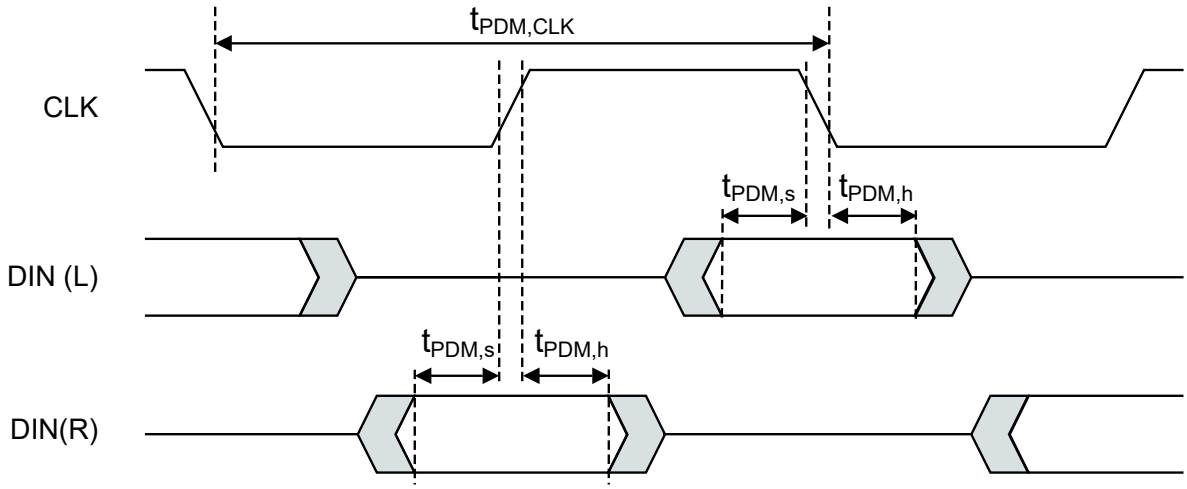


Figure 205: PDM timing diagram

11.13 QDEC Electrical specification

11.13.1 QDEC Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
t_{SAMPLE}	Time between sampling signals from quadrature decoder	128		131072	µs
t_{LED}	Time from LED is turned on to signals are sampled	0		511	µs

11.14 RADIO Electrical specification

11.14.1 General radio characteristics

Symbol	Description	Min.	Typ.	Max.	Units
f_{OP}	Operating frequencies	2400		2500	MHz
$f_{CH,SP}$	Channel spacing		1.0		MHz
$f_{DELTA,BLE,1M}$	Frequency deviation @ Bluetooth LE 1 Mbps		±250		kHz
$f_{DELTA,BLE,2M}$	Frequency deviation @ Bluetooth LE 2 Mbps		±500		kHz
$f_{DELTA,4M}$	Frequency deviation @ 4 Mbps		±1000		kHz
fsk_{BPS}	On-the-air data rate	125		4000	kbps
$f_{chip,\ IEEE\ 802.15.4}$	Chip rate in IEEE 802.15.4 mode		2000		kchip/s

11.14.2 Radio current consumption (transmitter)

Symbol	Description	Min.	Typ.	Max.	Units
$I_{TX,MaxdBm,CSP}$	TX only run current for CSP package, P_{RF} at maximum power setting		9.7		mA
$I_{TX,0dBM}$	TX only run current, P_{RF} = 0 dBm		3.9		mA
$I_{TX,MINUS26dBM}$	TX only run current P_{RF} = -26 dBm		1.5		mA

11.14.3 Radio current consumption (Receiver)

Symbol	Description	Min.	Typ.	Max.	Units
$I_{RX,1M}$	RX only run current, 1 Mbps/1 Mbps Bluetooth LE mode		2.1		mA

11.14.4 Transmitter specification

Symbol	Description	Min.	Typ.	Max.	Units
$P_{RF,CSP}$	Maximum output power for CSP package		8		dBm
P_{RFCR}	RF power accuracy	-1		1	dB
$P_{RF1,BLE1M,2MHZ}$	Adjacent Channel Transmit Power 2 MHz (1 Mbps Bluetooth LE mode)		-48		dBc
$P_{RF1,BLE1M,3MHZ}$	Adjacent Channel Transmit Power 3 MHz (1 Mbps Bluetooth LE mode)		-54		dBc
$P_{RF1,BLE2M,4MHZ}$	Adjacent Channel Transmit Power 4 MHz (2 Mbps Bluetooth LE mode)		-51		dBc
$P_{RF1,BLE2M,6MHZ}$	Adjacent Channel Transmit Power 6 MHz (2 Mbps Bluetooth LE mode)		-56		dBc
$P_{harm2nd,\ IEEE\ 802.15.4}$	2nd harmonics in IEEE 802.15.4 mode		-56		dBm
$P_{harm3rd,\ IEEE\ 802.15.4}$	3rd harmonics in IEEE 802.15.4 mode		-67		dBm

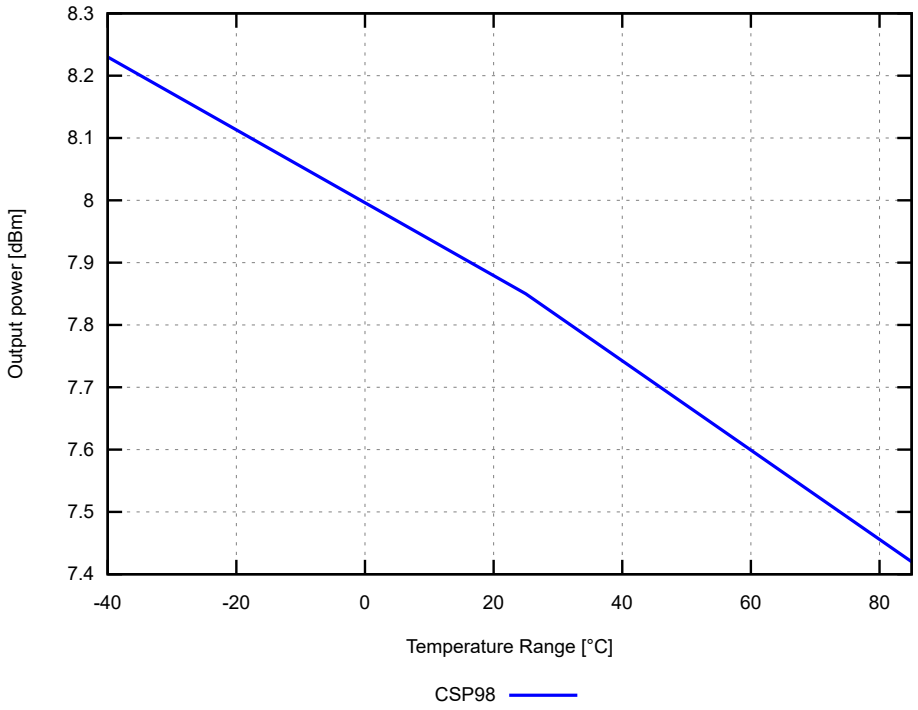


Figure 206: Output power, 1 Mbps Bluetooth low energy mode, at maximum TXPOWER setting (typical values)

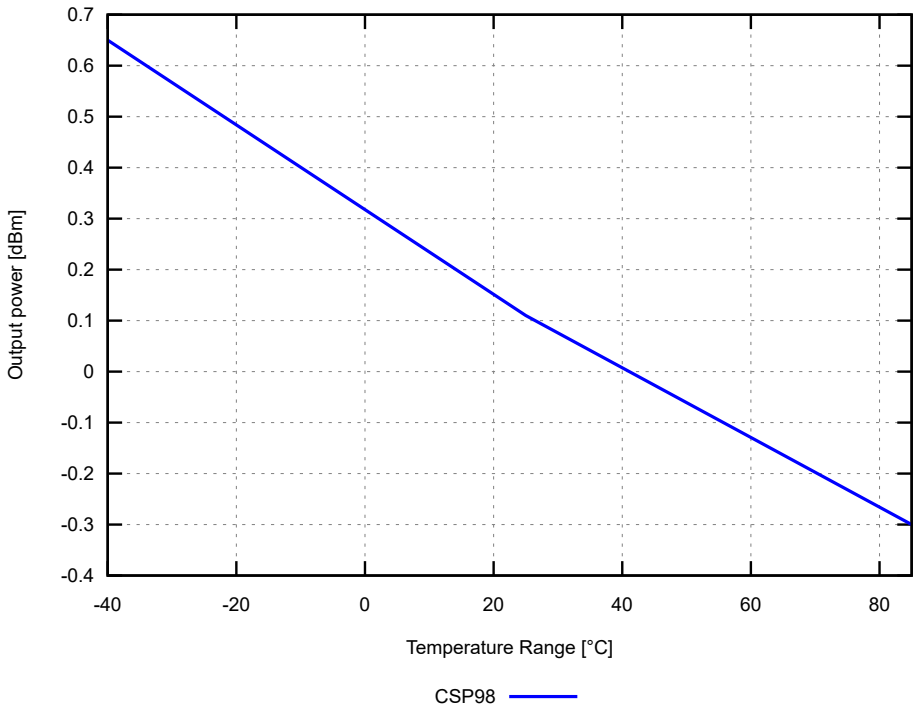


Figure 207: Output power, 1 Mbps Bluetooth low energy mode, at 0 dBm setting (typical values)

11.14.5 Receiver operation

Symbol	Description	Min.	Typ.	Max.	Units
$P_{RX,MAX}$	Maximum received signal strength at < 0.1% PER		0		dBm
$P_{SENS,IT,SP,1M,BLE}$	Sensitivity, 1 Mbps Bluetooth LE ideal transmitter, packet length ≤ 37 bytes BER = 1E-3[4]		-95.5		dBm
$P_{SENS,IT,LP,1M,BLE}$	Sensitivity, 1 Mbps Bluetooth LE ideal transmitter, packet length ≥ 128 bytes BER = 1E-4		-94		dBm
$P_{SENS,IT,SP,2M,BLE}$	Sensitivity, 2 Mbps Bluetooth LE ideal transmitter, packet length ≤ 37 bytes		-93		dBm
$P_{SENS,IT,BLE\ LE125k}$	Sensitivity, 125 kbps Bluetooth LE mode		-103		dBm
$P_{SENS,IT,BLE\ LE500k}$	Sensitivity, 500 kbps Bluetooth LE mode		-98		dBm
$P_{SENS,IEEE\ 802.15.4}$	Sensitivity in IEEE 802.15.4 mode		-101		dBm

[4] As defined in the *Bluetooth Core Specification v4.0 Volume 6: Core System Package (Low Energy Controller Volume)*.

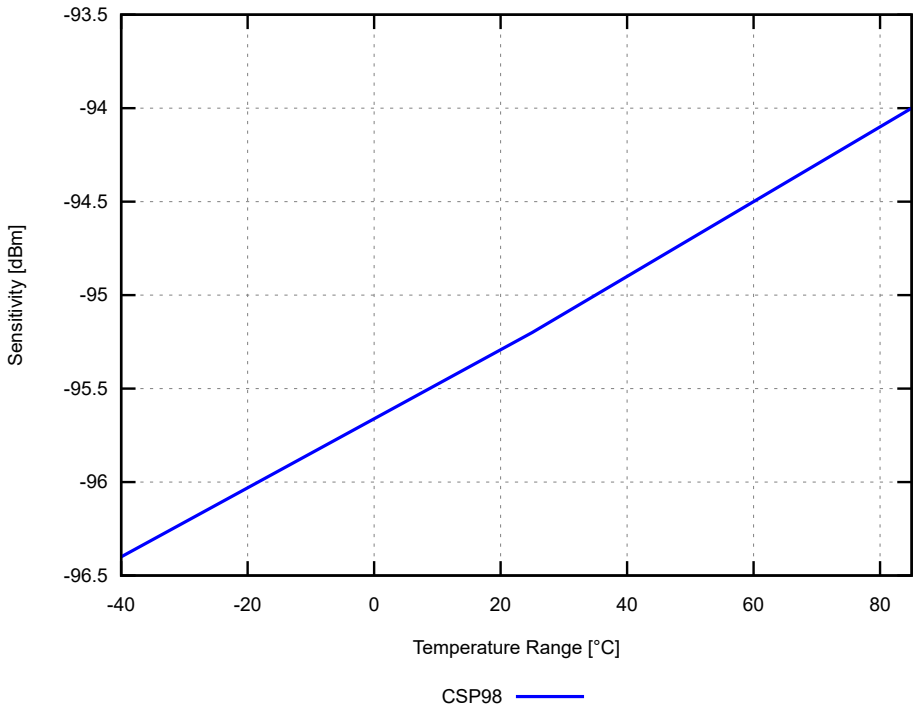


Figure 208: Sensitivity, 1 Mbps Bluetooth LE ideal transmitter, packet length ≤ 37 bytes BER = 1E-3 (typical values)

11.14.6 RX selectivity

RX selectivity with equal modulation on interfering signal[5]

Symbol	Description	Min.	Typ.	Max.	Units
$C/I_{1MBLE,co\text{-}channel}$	1 Mbps Bluetooth LE mode, co-channel interference		5		dB
$C/I_{1MBLE,-1MHz}$	1 Mbps Bluetooth LE mode, Adjacent (-1 MHz) interference		-3		dB
$C/I_{1MBLE,+1MHz}$	1 Mbps Bluetooth LE mode, Adjacent (+1 MHz) interference		-7		dB
$C/I_{1MBLE,-2MHz}$	1 Mbps Bluetooth LE mode, Adjacent (-2 MHz) interference		-29		dB
$C/I_{1MBLE,+2MHz}$	1 Mbps Bluetooth LE mode, Adjacent (+2 MHz) interference		-43		dB
$C/I_{1MBLE,>3MHz}$	1 Mbps Bluetooth LE mode, Adjacent (≥3 MHz) interference		-46		dB
$C/I_{1MBLE,image}$	Image frequency interference		-29		dB
$C/I_{1MBLE,image,1MHz}$	Adjacent (1 MHz) interference to in-band image frequency		-36		dB
$C/I_{2MBLE,co\text{-}channel}$	2 Mbps Bluetooth LE mode, co-channel interference		5		dB
$C/I_{2MBLE,-2MHz}$	2 Mbps Bluetooth LE mode, Adjacent (-2 MHz) interference		-4		dB
$C/I_{2MBLE,+2MHz}$	2 Mbps Bluetooth LE mode, Adjacent (+2 MHz) interference		-7		dB
$C/I_{2MBLE,-4MHz}$	2 Mbps Bluetooth LE mode, Adjacent (-4 MHz) interference		-28		dB
$C/I_{2MBLE,+4MHz}$	2 Mbps Bluetooth LE mode, Adjacent (+4 MHz) interference		-45		dB
$C/I_{2MBLE,≥6MHz}$	2 Mbps Bluetooth LE mode, Adjacent (≥6 MHz) interference		-47		dB
$C/I_{2MBLE,image}$	Image frequency interference		-28		dB
$C/I_{2MBLE,image,\ 2MHz}$	Adjacent (2 MHz) interference to in-band image frequency		-35		dB
$C/I_{125k\ BLE\ LR,co\text{-}channel}$	125 kbps Bluetooth LE LR mode, co-channel interference		1		dB
$C/I_{125k\ BLE\ LR,-1MHz}$	125 kbps Bluetooth LE LR mode, Adjacent (-1 MHz) interference		-13		dB
$C/I_{125k\ BLE\ LR,+1MHz}$	125 kbps Bluetooth LE LR mode, Adjacent (+1 MHz) interference		-17		dB
$C/I_{125k\ BLE\ LR,-2MHz}$	125 kbps Bluetooth LE LR mode, Adjacent (-2 MHz) interference		-36		dB

[5] Desired signal level at P_{IN} = -67 dBm. One interferer is used, having equal modulation as the desired signal. The input power of the interferer where the sensitivity equals BER = 0.1% is presented.

Symbol	Description	Min.	Typ.	Max.	Units
$C/I_{125k\ BLE\ LR,+2MHz}$	125 kbps Bluetooth LE LR mode, Adjacent (+2 MHz) interference		-52		dB
$C/I_{125k\ BLE\ LR,>3MHz}$	125 kbps Bluetooth LE LR mode, Adjacent (≥3 MHz) interference		-55		dB
$C/I_{125k\ BLE\ LR,image}$	Image frequency interference		-35		dB

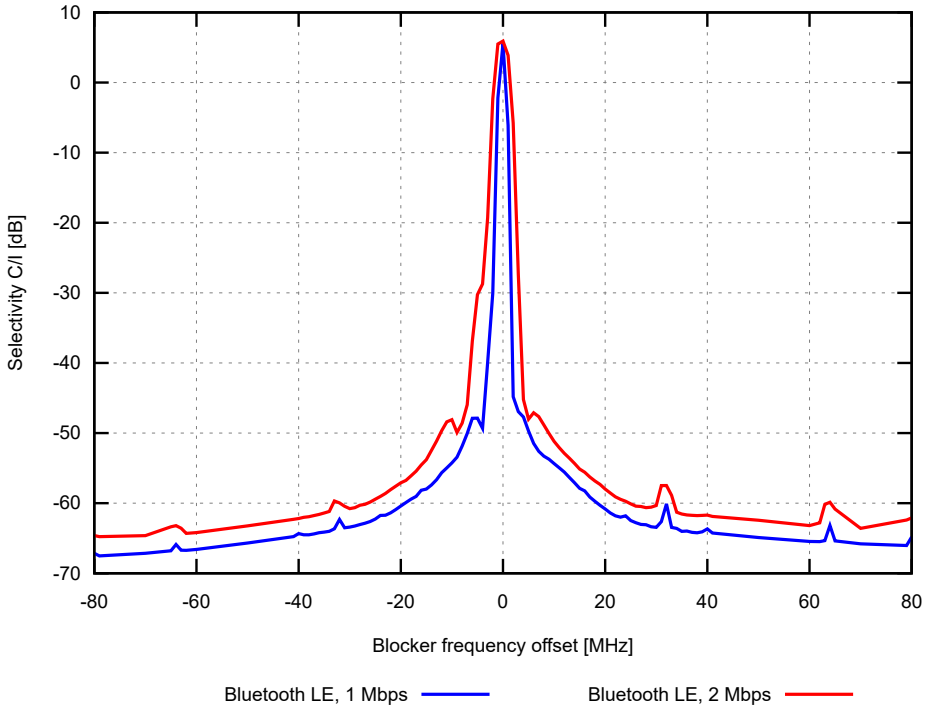


Figure 209: Selectivity Bluetooth Low Energy (Typical performance; wanted signal at channel 2440 MHz and -67 dBm input level)

11.14.7 RX intermodulation

RX intermodulation. Desired signal level at P_{IN} = -64 dBm. Two interferers with equal input power are used. The interferer closest in frequency is not modulated, the other interferer is modulated equal with the desired signal. The input power of the interferers where the sensitivity equals BER = 1E-3 is presented.

Symbol	Description	Min.	Typ.	Max.	Units
$P_{IMD,5TH,1M,BLE}$	IMD performance, Bluetooth LE 1 Mbps, 5th offset channel, packet length ≤ 37 bytes		-29		dBm
$P_{IMD,5TH,2M,BLE}$	IMD performance, Bluetooth LE 2 Mbps, 5th offset channel, packet length ≤ 37 bytes		-29		dBm

11.14.8 Radio timing

Symbol	Description	Min.	Typ.	Max.	Units
$t_{TXEN,BLE,1M}$	Time between TXEN task and READY event after channel FREQUENCY configured (1 Mbps Bluetooth LE and 150 µs TIFS)		140		µs
$t_{TXEN,FAST,BLE,1M}$	Time between TXEN task and READY event after channel FREQUENCY configured (1 Mbps Bluetooth LE with fast ramp-up and 150 µs TIFS)		40		µs
$t_{TXDIS,BLE,1M}$	When in TX, delay between DISABLE task and DISABLED event for MODE = Nrf_1Mbit and MODE = Ble_1Mbit		2		µs

Symbol	Description	Min.	Typ.	Max.	Units
$t_{RXEN,BLE,1M}$	Time between the RXEN task and READY event after channel FREQUENCY configured (1 Mbps Bluetooth LE)		134		µs
$t_{RXEN,FAST,BLE,1M}$	Time between the RXEN task and READY event after channel FREQUENCY configured (1 Mbps Bluetooth LE with fast ramp-up)		40		µs
$t_{RXDIS,BLE,1M}$	When in RX, delay between DISABLE task and DISABLED event for MODE = Nrf_1Mbit and MODE = Ble_1Mbit		1		µs
$t_{TXDIS,BLE,2M}$	When in TX, delay between DISABLE task and DISABLED event for MODE = Nrf_2Mbit and MODE = Ble_2Mbit		2		µs
$t_{RXDIS,BLE,2M}$	When in RX, delay between DISABLE task and DISABLED event for MODE = Nrf_2Mbit and MODE = Ble_2Mbit		1		µs
$t_{TXEN,IEEE\ 802.15.4}$	Time between TXEN task and READY event after channel FREQUENCY configured (IEEE 802.15.4 mode)		130		µs
$t_{TXEN,FAST,IEEE\ 802.15.4}$	Time between TXEN task and READY event after channel FREQUENCY configured (IEEE 802.15.4 mode with fast ramp-up)		40		µs
$t_{TXDIS,IEEE\ 802.15.4}$	When in TX, delay between DISABLE task and DISABLED event (IEEE 802.15.4 mode)		18		µs
$t_{RXEN,IEEE\ 802.15.4}$	Time between the RXEN task and READY event after channel FREQUENCY configured (IEEE 802.15.4 mode)		130		µs
$t_{RXEN,FAST,IEEE\ 802.15.4}$	Time between the RXEN task and READY event after channel FREQUENCY configured (IEEE 802.15.4 mode with fast ramp-up)		40		µs
$t_{RXDIS,IEEE\ 802.15.4}$	When in RX, delay between DISABLE task and DISABLED event (IEEE 802.15.4 mode)		0.2		µs
$t_{RX\text{-}to\text{-}TX\ turnaround,\ IEEE\ 802.15.4}$	Maximum RX-to-TX turnaround time in IEEE 802.15.4 mode		17		µs

11.14.9 Received signal strength indicator (RSSI) specifications

Symbol	Description	Min.	Typ.	Max.	Units
$RSSI_{ACC}$	RSSI accuracy in the range -90 to -30 dBm		±2		dB
$RSSI_{RESOLUTION}$	RSSI resolution		1		dB
$RSSI_{PERIOD}$	RSSI sampling time from RSSISTART task		0.25		µs
$RSSI_{SETTLE}$	RSSI settling time after signal level change		15	20	µs

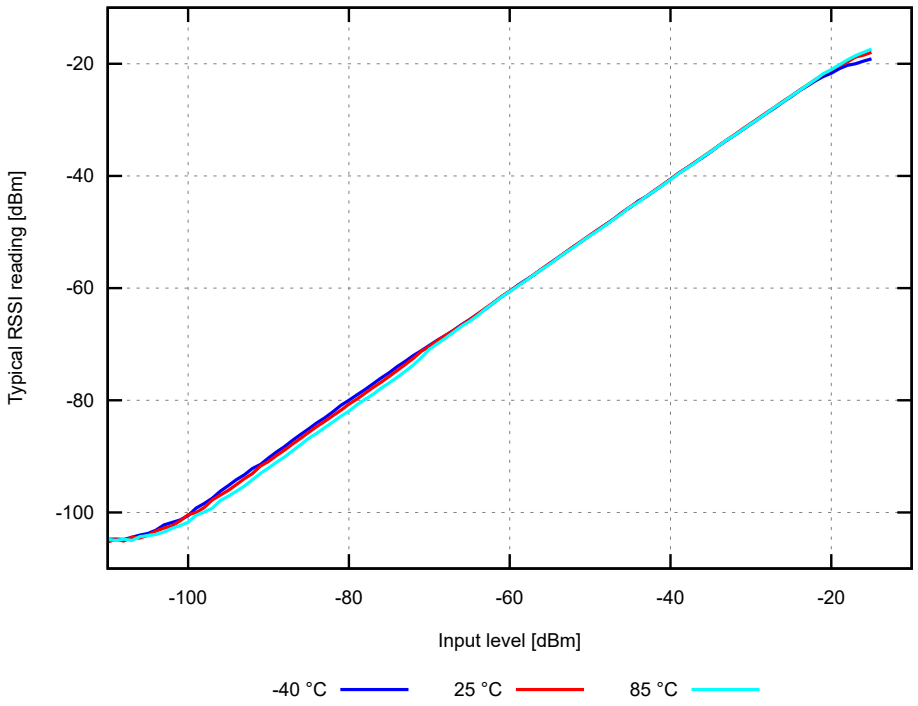


Figure 210: RSSI reading versus input level. Typical values.

11.14.10 Jitter

Symbol	Description	Min.	Typ.	Max.	Units
$t_{DISABLEDJITTER}$	Jitter on DISABLED event relative to END event when shortcut between END and DISABLE is enabled		0.25		µs
$t_{READYJITTER}$	Jitter on READY event relative to TXEN and RXEN task		0.25		µs

11.14.11 IEEE 802.15.4 mode energy detection constants

Symbol	Description	Min.	Typ.	Max.	Units
ED_RSSISCALE	Scaling value when converting between hardware-reported value and dBm	4	4	4	
ED_RSSIOFFS	Offset value when converting between hardware-reported value and dBm	-92	-92	-92	

11.15 REGULATORS Electrical specification

11.15.1 Recommended operating conditions

Symbol	Description	Min.	Typ.	Max.	Units
V_{DD}	VDD supply voltage.	1.7		3.6	V

11.15.2 Power-fail comparator

Symbol	Description	Min.	Typ.	Max.	Units
V_{POF}	Voltage level warning thresholds (falling supply voltage). Levels are configurable between min. and max. in increments of 100 mV.	1.7		3.2	V
V_{POFTOL}	Threshold voltage tolerance.	-2		2	%
$V_{POFHYST}$	Threshold voltage hysteresis.	40	50	55	mV
$V_{BOR,OFF}$	Brownout reset voltage range System OFF mode. Brownout only applies to the voltage on VDD.	1.56		1.64	V
$V_{BOR,ON}$	Brownout reset voltage range System ON mode. Brownout only applies to the voltage on VDD.	1.57		1.64	V

11.16 RESET Electrical specification

11.16.1 Startup times

Symbol	Description	Min.	Typ.	Max.	Units
$t_{POR,10us}$	Time measured as time in power-on reset after supply reaches minimum operating voltage, with VDD rise time from 1 µs to 100ms.		0.2	2	ms

11.17 RRAMC Electrical specification

11.17.1 RRAM programming

Symbol	Description	Min.	Typ.	Max.	Units
$n_{ENDURANCE}$	Number of times a 128-bit data unit can be written	10000			

11.18 SAADC Electrical specification

11.18.1 SAADC Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
DNL_{10}	Differential non-linearity, 10-bit resolution	1	<3		LSB11b
V_{OS}	Differential offset error (calibrated), 10-bit resolution [a]	-5	0	5	LSB10b
f_{SAMPLE}	Maximum sampling rate			2000	kHz
$f_{BW,NS1}$	Input signal bandwidth for NOISESHAPE=NS1			40	kHz
$f_{BW,NS2}$	Input signal bandwidth for NOISESHAPE=NS2			20	kHz
$t_{ACQ,2k}$	Acquisition time (configurable), source Resistance <= 2kOhm		0.25		µs
$t_{ACQ,10k}$	Acquisition time (configurable), source Resistance <= 10kOhm		0.5		µs
$t_{ACQ,20k}$	Acquisition time (configurable), source Resistance <= 20kOhm		1		µs
$t_{ACQ,40k}$	Acquisition time (configurable), source Resistance <= 40kOhm		2		µs
$t_{ACQ,100k}$	Acquisition time (configurable), source Resistance <= 100kOhm		5		µs
$t_{ACQ,200k}$	Acquisition time (configurable), source Resistance <= 200kOhm		10		µs

[a] Digital output code at zero volt differential input.

Symbol	Description	Min.	Typ.	Max.	Units
$t_{ACQ,400k}$	Acquisition time (configurable), source Resistance <= 400kOhm		20		µs
$t_{ACQ,800k}$	Acquisition time (configurable), source Resistance <= 800kOhm		40		µs
t_{CONV}	Conversion time		0.5		µs
$E_{G2/5}$	Error[b] for Gain = 2/5	-1.2		1.2	%
$E_{G1/2}$	Error[b] for Gain = 1/2	-1.2		1.2	%
E_{G1}	Error[b] for Gain = 1	-1.2		1.2	%
E_{G2}	Error[b] for Gain = 2	-1.2		1.2	%
R_{INPUT}	Input resistance for input frequencies in range 0-200 kHz		735		kΩ
R_{INPUT}	Input resistance for input frequencies in range 200 kHz - 1 MHz	157			kΩ
E_{NOB}	Effective number of bits, differential mode, 12-bit resolution, 1/1 gain, 250 ns acquisition time, HFXO, 2 Msps		9		Bit
S_{NDR}	Peak signal to noise and distortion ratio, differential mode, 12-bit resolution, 1/1 gain, 250 ns acquisition time, HFXO, 2 Msps		56		dB
S_{FDR}	Spurious free dynamic range, differential mode, 12-bit resolution, 1/1 gain, 250 ns acquisition time, HFXO, 2 Msps		60		dBc

11.19 SPIM Electrical specification

11.19.1 Timing specifications

Symbol	Description	Min.	Typ.	Max.	Units
f_{SPIM}	Bit rates for SPIM[6]			8	Mbps
$f_{SPIM,HS}$	Bit rates for high-speed SPIM instances[7]			32[8]	Mbps
$t_{SPIM,START}$	Time from START task to transmission started		1		µs
$t_{SPIM,CSCK}$	SCK period	31.25			ns
$t_{SPIM,RSCK,LD}$	SCK rise time, standard drive[9]			$t_{RF,25pF}$	
$t_{SPIM,RSCK,HD}$	SCK rise time, high drive[9]			$t_{HRF,25pF}$	
$t_{SPIM,FSCK,LD}$	SCK fall time, standard drive[9]			$t_{RF,25pF}$	
$t_{SPIM,FSCK,HD}$	SCK fall time, high drive[9]			$t_{HRF,25pF}$	
$t_{SPIM,WHSCK}$	SCK high time[9]	(t_{CSCK}/2) - t_{RSCK} - 1.5 ns			
$t_{SPIM,WLSCK}$	SCK low time[9]	(t_{CSCK}/2) - t_{FSCK} - 1.5 ns			

b Does not include temperature drift

6 High bit rates may require GPIOs to be set as High Drive or Extra High Drive, see GPIO chapter for more details.

7 High bit rates may require GPIOs to be set as High Drive or Extra High Drive, see GPIO chapter for more details.

8 For SPIM00 using GPIO port P2.

9 At 25pF load, including GPIO pin capacitance, see GPIO spec.

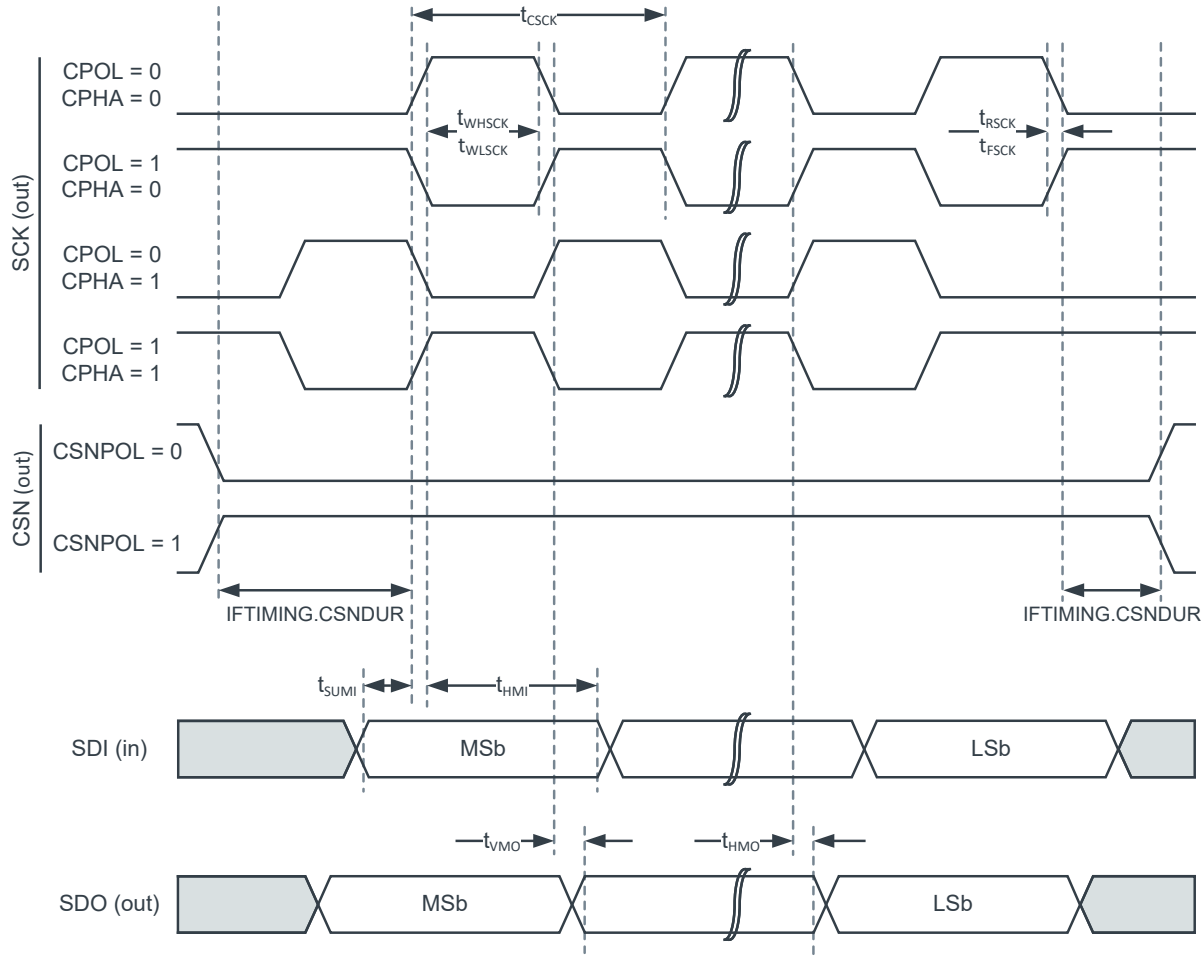


Figure 211: SPIM timing diagram

11.19.2 Timing specifications for GPIO port P0 using Standard drive strength

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIM,SUMI}$	SDI to CLK edge setup time	51			ns
$t_{SPIM,HMI}$	CLK edge to SDI hold time	0			ns
$t_{SPIM,VMO}$	CLK edge to SDO valid			12	ns
$t_{SPIM,HMO}$	SDO hold time after CLK edge	-4			ns

11.19.3 Timing specifications for GPIO port P0 using High drive strength

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIM,SUMI}$	SDI to CLK edge setup time	48			ns
$t_{SPIM,HMI}$	CLK edge to SDI hold time	0			ns
$t_{SPIM,VMO}$	CLK edge to SDO valid			15	ns
$t_{SPIM,HMO}$	SDO hold time after CLK edge	-6			ns

11.19.4 Timing specifications for GPIO port P1 using Standard drive strength

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIM,SUMI}$	SDI to CLK edge setup time	38			ns
$t_{SPIM,HMI}$	CLK edge to SDI hold time	0			ns
$t_{SPIM,VMO}$	CLK edge to SDO valid			5	ns
$t_{SPIM,HMO}$	SDO hold time after CLK edge	-2			ns

11.19.5 Timing specifications for GPIO port P1 using High drive strength

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIM,SUMI}$	SDI to CLK edge setup time	34			ns
$t_{SPIM,HMI}$	CLK edge to SDI hold time	0			ns
$t_{SPIM,VMO}$	CLK edge to SDO valid			8	ns
$t_{SPIM,HMO}$	SDO hold time after CLK edge	-6			ns

11.19.6 Timing specifications for GPIO port P2 using Standard drive strength

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIM,SUMI}$	SDI to CLK edge setup time	38			ns
$t_{SPIM,HMI}$	CLK edge to SDI hold time	0			ns
$t_{SPIM,VMO}$	CLK edge to SDO valid			5	ns
$t_{SPIM,HMO}$	SDO hold time after CLK edge	-2			ns

11.19.7 Timing specifications for GPIO port P2 using High drive strength

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIM,SUMI}$	SDI to CLK edge setup time	34			ns
$t_{SPIM,HMI}$	CLK edge to SDI hold time	0			ns
$t_{SPIM,VMO}$	CLK edge to SDO valid			8	ns
$t_{SPIM,HMO}$	SDO hold time after CLK edge	-6			ns

11.19.8 Timing specifications for GPIO port P2 using Extra high drive strength

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIM,SUMI}$	SDI to CLK edge setup time	13			ns
$t_{SPIM,HMI}$	CLK edge to SDI hold time	0			ns
$t_{SPIM,VMO}$	CLK edge to SDO valid			2	ns
$t_{SPIM,HMO}$	SDO hold time after CLK edge	-1			ns

11.19.9 Timing specifications for GPIO port P3 using Standard drive strength

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIM,SUMI}$	SDI to CLK edge setup time	38			ns
$t_{SPIM,HMI}$	CLK edge to SDI hold time	0			ns
$t_{SPIM,VMO}$	CLK edge to SDO valid			5	ns
$t_{SPIM,HMO}$	SDO hold time after CLK edge	-3			ns

11.19.10 Timing specifications for GPIO port P3 using High drive strength

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIM,SUMI}$	SDI to CLK edge setup time	35			ns
$t_{SPIM,HMI}$	CLK edge to SDI hold time	0			ns
$t_{SPIM,VMO}$	CLK edge to SDO valid			7	ns
$t_{SPIM,HMO}$	SDO hold time after CLK edge	-5			ns

11.20 SPIS Electrical specification

11.20.1 SPIS slave interface electrical specifications

Symbol	Description	Min.	Typ.	Max.	Units
f_{SPIS}	Bit rates for SPIS[10]			8[11]	Mbps
$t_{SPIS,START}$	Time from RELEASE task to receive/transmit (CSN active)		1		µs

11.20.2 Serial Peripheral Interface Slave (SPIS) timing specifications

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIS,CSCKIN}$	SCK input period	125			ns
$t_{SPIS,RFSCKIN}$	SCK input rise/fall time			30	ns
$t_{SPIS,WHSCKIN}$	SCK input high time	30			ns
$t_{SPIS,WLSCKIN}$	SCK input low time	30			ns
$t_{SPIS,SUCSN}$	CSN to CLK setup time	1000[12]			ns
$t_{SPIS,HCSN}$	CLK to CSN hold time	1000			ns
$t_{SPIS,ASA}$	CSN to SDO driven			70	ns
$t_{SPIS,ASO}$	CSN to SDO valid[13]			1000	ns
$t_{SPIS,DISSO}$	CSN to SDO disabled[13]			70	ns
$t_{SPIS,CWH}$	CSN inactive time	300			ns

[10] High bit rates may require GPIOs to be set as High Drive, see GPIO chapter for more details.
[11] The actual maximum data rate depends on the master's CLK to SDO and SDI setup and hold timings.
[12] Excluding any start-up delay for the high frequency clock in low power mode.
[13] At 25pF load, including GPIO capacitance, see GPIO spec.

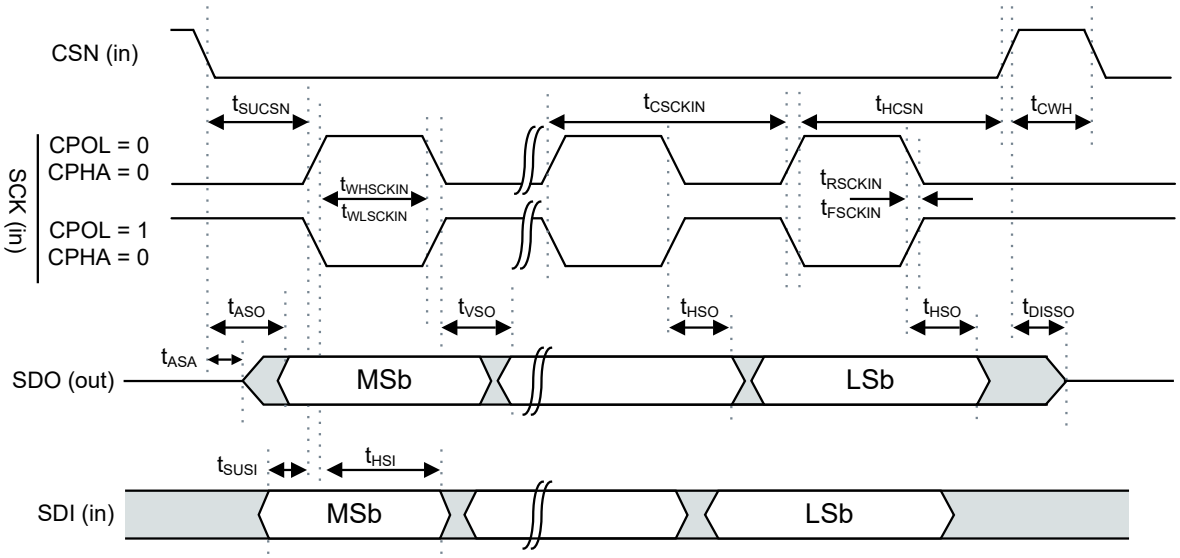


Figure 212: SPIS timing diagram, CPHA = 0

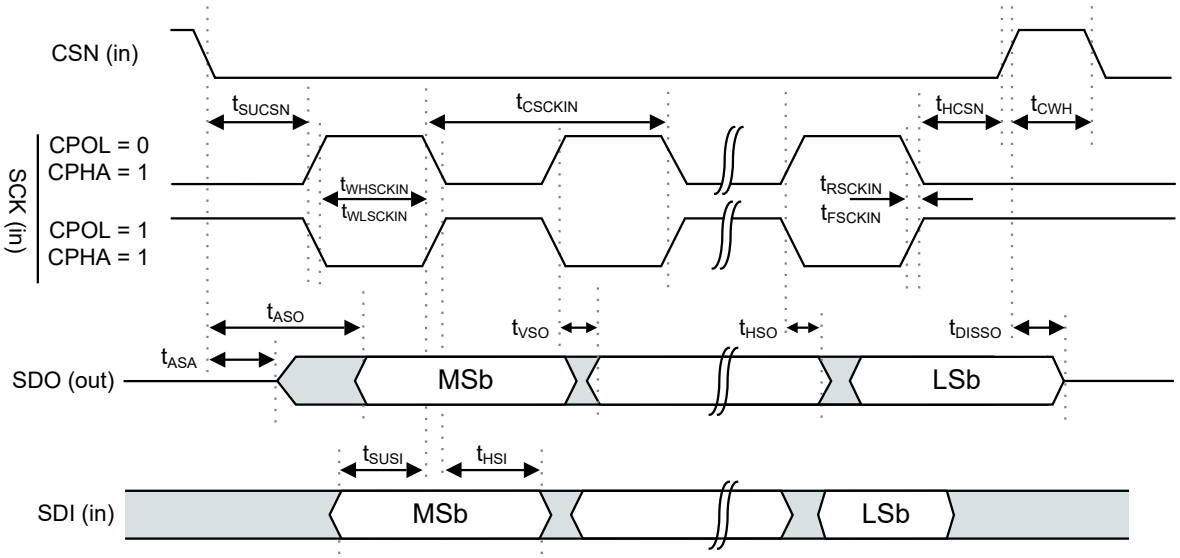


Figure 213: SPIS timing diagram, CPHA = 1

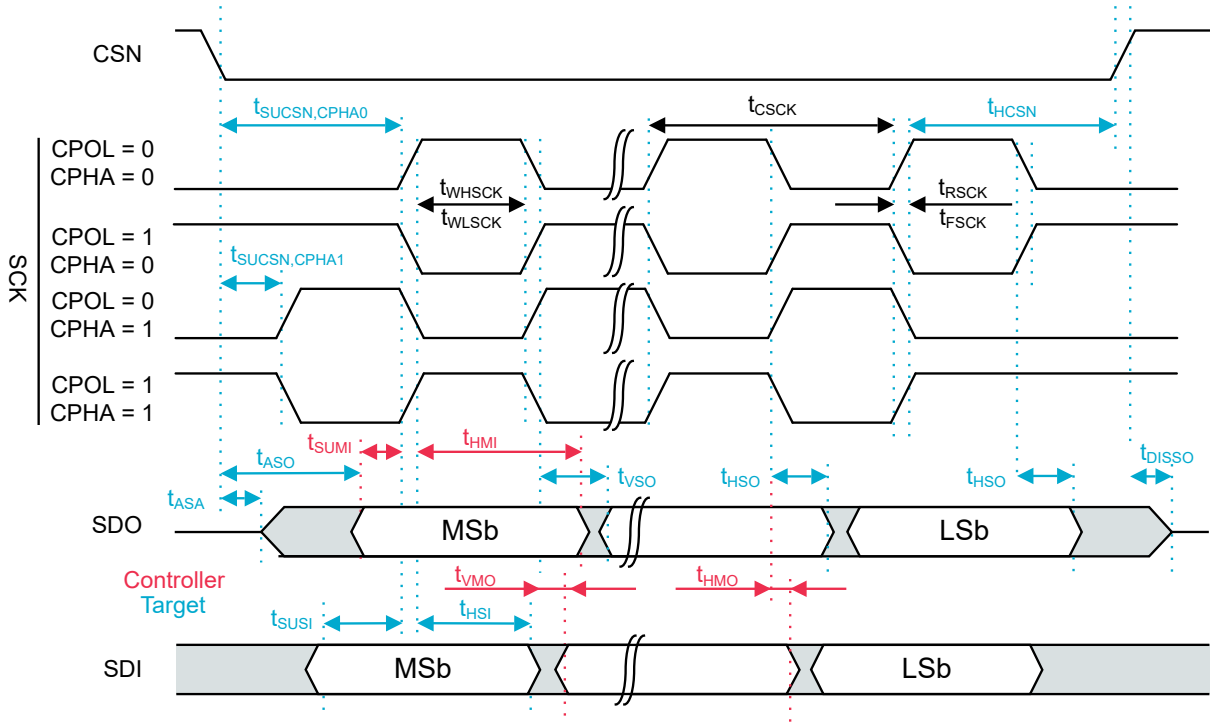


Figure 214: Common SPIM and SPIS timing diagram

11.20.3 Timing specifications for GPIO port P0 using Standard drive strength

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIS,VSO}$	CLK edge to SDO valid			46	ns
$t_{SPIS,HSO}$	SDO hold time after CLK edge	5			ns
$t_{SPIS,SUSI}$	SDI to CLK edge setup time	17			ns
$t_{SPIS,HSI}$	CLK edge to SDI hold time	1			ns

11.20.4 Timing specifications for GPIO port P0 using High drive strength

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIS,VSO}$	CLK edge to SDO valid			43	ns
$t_{SPIS,HSO}$	SDO hold time after CLK edge	5			ns
$t_{SPIS,SUSI}$	SDI to CLK edge setup time	17			ns
$t_{SPIS,HSI}$	CLK edge to SDI hold time	1			ns

11.20.5 Timing specifications for GPIO port P1 using Standard drive strength

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIS,VSO}$	CLK edge to SDO valid			37	ns
$t_{SPIS,HSO}$	SDO hold time after CLK edge	4			ns
$t_{SPIS,SUSI}$	SDI to CLK edge setup time	5			ns
$t_{SPIS,HSI}$	CLK edge to SDI hold time	2			ns

11.20.6 Timing specifications for GPIO port P1 using High drive strength

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIS,VSO}$	CLK edge to SDO valid			33	ns
$t_{SPIS,HSO}$	SDO hold time after CLK edge	4			ns
$t_{SPIS,SUSI}$	SDI to CLK edge setup time	5			ns
$t_{SPIS,HSI}$	CLK edge to SDI hold time	2			ns

11.20.7 Timing specifications for GPIO port P2 using Standard drive strength

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIS,VSO}$	CLK edge to SDO valid			37	ns
$t_{SPIS,HSO}$	SDO hold time after CLK edge	4			ns
$t_{SPIS,SUSI}$	SDI to CLK edge setup time	5			ns
$t_{SPIS,HSI}$	CLK edge to SDI hold time	0			ns

11.20.8 Timing specifications for GPIO port P2 using High drive strength

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIS,VSO}$	CLK edge to SDO valid			33	ns
$t_{SPIS,HSO}$	SDO hold time after CLK edge	4			ns
$t_{SPIS,SUSI}$	SDI to CLK edge setup time	5			ns
$t_{SPIS,HSI}$	CLK edge to SDI hold time	0			ns

11.20.9 Timing specifications for GPIO port P2 using Extra high drive strength

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIS,VSO}$	CLK edge to SDO valid			13	ns
$t_{SPIS,HSO}$	SDO hold time after CLK edge	3			ns
$t_{SPIS,SUSI}$	SDI to CLK edge setup time	3			ns
$t_{SPIS,HSI}$	CLK edge to SDI hold time	1			ns

11.20.10 Timing specifications for GPIO port P3 using Standard drive strength

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIS,VSO}$	CLK edge to SDO valid			37	ns
$t_{SPIS,HSO}$	SDO hold time after CLK edge	5			ns
$t_{SPIS,SUSI}$	SDI to CLK edge setup time	5			ns
$t_{SPIS,HSI}$	CLK edge to SDI hold time	0			ns

11.20.11 Timing specifications for GPIO port P3 using High drive strength

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIS,VSO}$	CLK edge to SDO valid			34	ns
$t_{SPIS,HSO}$	SDO hold time after CLK edge	5			ns
$t_{SPIS,SUSI}$	SDI to CLK edge setup time	5			ns
$t_{SPIS,HSI}$	CLK edge to SDI hold time	1			ns

11.21 SWDP Electrical specification

11.21.1 SW-DP

Symbol	Description	Min.	Typ.	Max.	Units
R_{pull}	Internal SWDIO and SWDCLK pull-up/pull-down resistance		14		kΩ
f_{SWDCLK}	SWDCLK frequency	0.125		20	MHz
t_{SUI}	SWDIO input setup before SWDCLK	17			ns
t_{HI}	SWDIO input hold after SWDCLK	2			ns
t_{VO}	SWDCLK to SWDIO output valid			36	ns
t_{HO}	SWDIO output hold after SWDCLK	4			ns

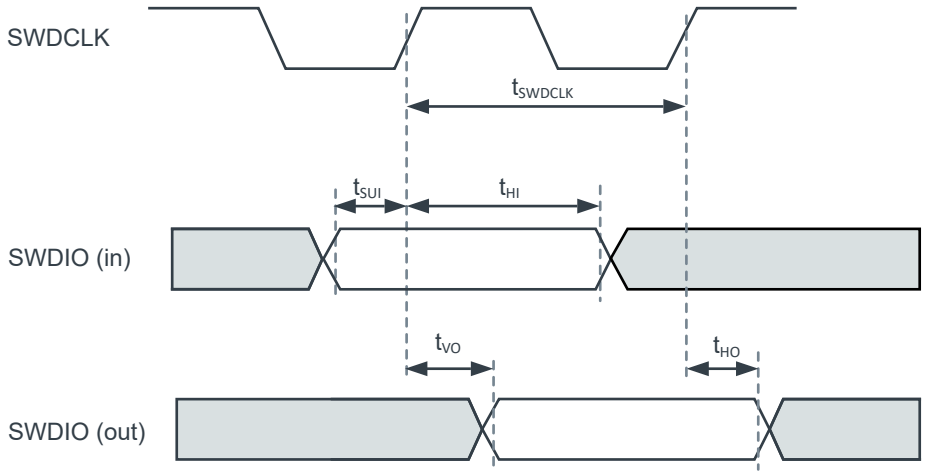


Figure 215: SWD timing diagram

11.21.2 Trace port

Symbol	Description	Min.	Typ.	Max.	Units
T_{cyc}	Clock period, as defined by Arm in Embedded Trace Macrocell Architecture Specification	15.625		250	ns

11.22 TEMP Electrical specification

11.22.1 Temperature Sensor Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
t_{TEMP}	Time required for temperature measurement		36		µs
$T_{TEMP,RANGE}$	Temperature sensor range	-20		70	°C
$T_{TEMP,ACC}$	Temperature sensor accuracy over $T_{TEMP,RANGE}$ range	-5		5	°C
$T_{TEMP,RANGE,EXT}$	Temperature sensor extended temperature range	-40		85	°C
$T_{TEMP,ACC,EXT}$	Temperature sensor accuracy over $T_{TEMP,RANGE,EXT}$ range	-7		7	°C
$T_{TEMP,RES}$	Temperature sensor resolution		0.25		°C
$T_{TEMP,STB}$	Sample to sample stability at constant device temperature			±0.25	°C
$T_{TEMP,OFFST}$	Sample offset at 25°C	-3		3	°C

11.23 TDM Electrical specification

11.23.1 TDM timing specification

Symbol	Description	Min.	Typ.	Max.	Units
f_{MCK}	MCK frequency			12288	kHz
f_{SCK}	SCK frequency			12288	kHz

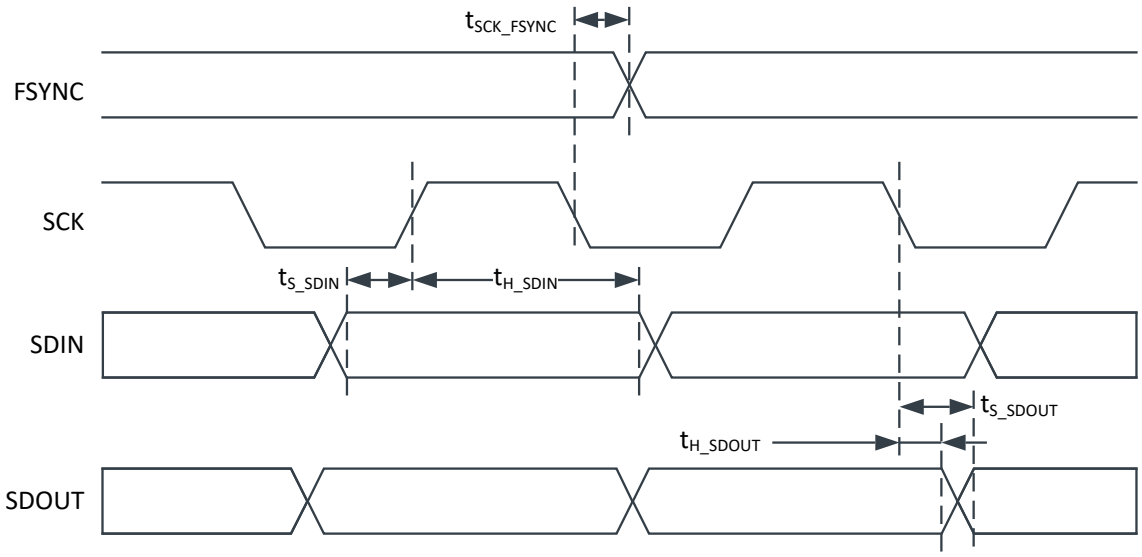


Figure 216: TDM timing diagram

11.23.2 Timing specifications for Slave mode

Symbol	Description	Min.	Typ.	Max.	Units
t_{S_SDIN}	SDIN setup time before SCK rising	6			ns
t_{H_SDIN}	SDIN hold time after SCK rising	0			ns
t_{S_SDOUT}	SCK falling edge to SDOUT valid			31	ns
t_{H_SDOUT}	SDOUT hold time after SCK falling	5			ns

11.23.3 Timing specifications for Master mode

Symbol	Description	Min.	Typ.	Max.	Units
t_{S_SDIN}	SDIN setup time before SCK rising	36			ns
t_{H_SDIN}	SDIN hold time after SCK rising	0			ns
t_{S_SDOUT}	SCK falling edge to SDOUT valid			7	ns
t_{H_SDOUT}	SDOUT hold time after SCK falling	4			ns

11.24 TWIM Electrical specification

11.24.1 TWIM interface electrical specifications

Symbol	Description	Min.	Typ.	Max.	Units
$f_{TWIM,SCL}$	Bit rates for TWIM[14]	100		1000	kbps
$t_{TWIM,START}$	Time from STARTRX/STARTTX task to transmission started		1.5		µs

11.24.2 Two Wire Interface Master (TWIM) timing specifications

Symbol	Description	Min.	Typ.	Max.	Units
t_{TWIM,SU_DATI}	Input data setup time before positive edge on SCL – all modes	20			ns
t_{TWIM,HD_DATO}	Output data hold time after negative edge on SCL – 100, 250 and 400 kbps	500		625	ns
$t_{TWIM,HD\_STA,100kbps}$	TWIM master hold time for START and repeated START condition, 100 kbps	10000			ns
$t_{TWIM,HD\_STA,250kbps}$	TWIM master hold time for START and repeated START condition, 250 kbps	4000			ns
$t_{TWIM,HD\_STA,400kbps}$	TWIM master hold time for START and repeated START condition, 400 kbps	2400			ns
$t_{TWIM,SU\_STO,100kbps}$	TWIM master setup time from SCL high to STOP condition, 100 kbps	5000			ns
$t_{TWIM,SU\_STO,250kbps}$	TWIM master setup time from SCL high to STOP condition, 250 kbps	2000			ns
$t_{TWIM,SU\_STO,400kbps}$	TWIM master setup time from SCL high to STOP condition, 400 kbps	1250			ns
$t_{R,100kbps}$	Rise time of both SDA and SCL signals, 100kbps			1000	ns
$t_{F,100kbps}$	Fall time of both SDA and SCL signals, 100kbps			300	ns
$t_{R,400kbps}$	Rise time of both SDA and SCL signals, 400kbps			300	ns
$t_{F,400kbps}$	Fall time of both SDA and SCL signals, 400kbps			300	ns
$t_{TWIM,BUF,100kbps}$	TWIM master bus free time between STOP and START conditions, 100 kbps	5200			ns
$t_{TWIM,BUF,250kbps}$	TWIM master bus free time between STOP and START conditions, 250 kbps	2200			ns
$t_{TWIM,BUF,400kbps}$	TWIM master bus free time between STOP and START conditions, 400 kbps	1500			ns

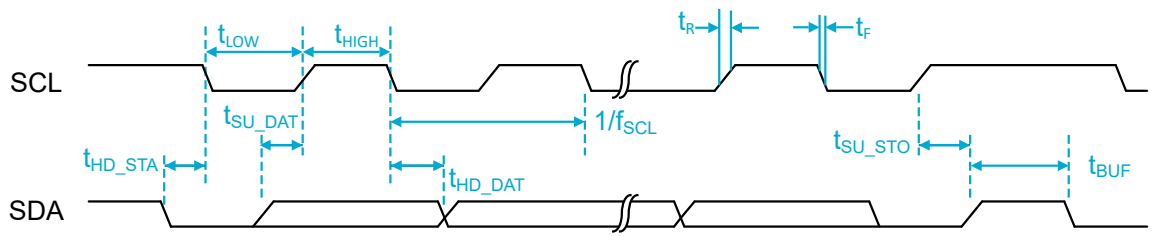


Figure 217: TWIM timing diagram, 1 byte transaction

[14] High bit rates or stronger pull-ups may require GPIOs to be set as High Drive, see GPIO — General purpose input/output on page 292 for more details.

11.25 TWIS Electrical specification

11.25.1 TWIS slave timing specifications

Symbol	Description	Min.	Typ.	Max.	Units
$f_{TWIS,SCL}$	Bit rates for TWIS[15]	100		400	kbps
$t_{TWIS,START}$	Time from PREPARERX/PREPARETX task to ready to receive/transmit		1.5		µs
t_{TWIS,SU_DATI}	Input data setup time before positive edge on SCL – all modes	20			ns
t_{TWIS,HD_DATI}	Input data hold time after negative edge on SCL – all modes	0			ns
t_{TWIS,HD_DATO}	Output data hold time after negative edge on SCL – all modes	350		600	ns
$t_{TWIS,HD\_STA,100kbps}$	TWI slave hold time from for START condition (SDA low to SCL low), 100 kbps	500			ns
$t_{TWIS,HD\_STA,400kbps}$	TWI slave hold time from for START condition (SDA low to SCL low), 400 kbps	500			ns
$t_{TWIS,SU\_STO,100kbps}$	TWI slave setup time from SCL high to STOP condition, 100 kbps	500			ns
$t_{TWIS,SU\_STO,400kbps}$	TWI slave setup time from SCL high to STOP condition, 400 kbps	500			ns
$t_{TWIS,BUF,100kbps}$	TWI slave bus free time between STOP and START conditions, 100 kbps	500			ns
$t_{TWIS,BUF,400kbps}$	TWI slave bus free time between STOP and START conditions, 400 kbps	500			ns

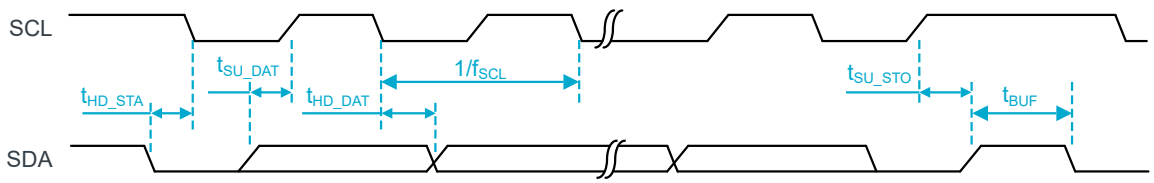


Figure 218: TWIS timing diagram, 1 byte transaction

11.26 UARTE Electrical specification

11.26.1 UARTE electrical specification

Symbol	Description	Min.	Typ.	Max.	Units
f_{UARTE}	Baud rate for UARTE			1000	kbps
$f_{UARTE,HS}$	Bit rates for high-speed UARTE instances[16]			4000	kbps
$t_{UARTE,CTSH}$	CTS high time	0.5			µs
$t_{UARTE,START}$	Time from STARTRX/STARTTX task to transmission started		0.5		µs

15 High bit rates or stronger pull-ups may require GPIOs to be set as High Drive, see GPIO chapter for more details.

16 High baud rates may require GPIOs to be set as High Drive, see GPIO chapter for more details.

11.27 USBHS Electrical specification

11.27.1 USBHS Electrical specification

Symbol	Description	Min.	Typ.	Max.	Units
VBUS	VBUS USB supply voltage.	3.67		5.5	V
V_{D+D-}	Voltage on D+ and D- lines.	VSS - 0.3		VDECUSB + 0.3	V

11.28 WDT Electrical specification

11.28.1 Watchdog Timer Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
t_{WDT}	Time out interval	458 µs		36 h	

12 Recommended operating conditions

The operating conditions are the physical parameters that the device can operate within.

Symbol	Parameter	Min.	Nom.	Max.	Units
VDD	**VDD** supply voltage	1.7		3.6	V
VBUS	**VBUS** powers the USB physical interface	3.67	5.0	5.5	V
TA	Operating temperature	-40	25	85	°C
T_{RST}	Recommended storage temperature			40	°C
RH_{RST}	Recommended storage relative humidity			90	%

Table 91: Recommended operating conditions

Note: VDD supply is required for device operation. VBUS is optional and is only used to supply the USB physical interface when the USB interface is in use. VBUS cannot be used to power the device.

12.1 Light sensitivity

Some package types are sensitive to visible and close-range infrared light. For those packages, the final product design must shield the device properly, either by encapsulation or by shielding or coating of the package. Other package types are not light sensitive and do not require such protection.

Of the package options for the nRF54LM20A and nRF54LM20B devices, only the wafer-level CSP (WLCSP) package is light sensitive. WLCSP packages have a backside coating, where the marking side of the device is covered with a light absorbing film, but the side edges and the ball side remain exposed and must be protected in the final product by encapsulation or shielding/coating of the CSP device.

Flip-chip CSP (FCCSP) packages and Quad Flat No-lead (QFN) packages are not light sensitive.

Package	Package type	Light sensitive
CSP61 (CAAA)	Wafer-level CSP (WLCSP)	Yes
CSP98 (PAAA)	Flip-chip CSP (FCCSP)	No
QFN52 (QGAA)	Quad flat no-lead (QFN)	No

Table 92: Package light sensitivity

13 Absolute maximum ratings

Maximum ratings are the extreme limits to which the chip can be exposed for a limited amount of time without permanently damaging it. Exposure to absolute maximum ratings for prolonged periods of time may affect the reliability of the device.

For accelerated lifetime testing (HTOL, etc.), supply voltage should not exceed the recommended operating conditions max value, see Recommended operating conditions on page 1283.

	Parameter	Min.	Max.	Unit
VDD	VDD supply voltage	-0.3	3.9	V
VBUS	VBUS voltage for the USB physical interface	-0.3	6.0	V

Table 93: Supply voltage

	Parameter	Min.	Max.	Unit
$V_{I/O}$, VDD ≤3.6 V	IO voltage	-0.3	VDD + 0.3	V
$V_{I/O}$, VDD >3.6 V	IO voltage	-0.3	3.9	V

Table 94: I/O pin voltage

	Min.	Max.	Unit
RF input level		10	dBm

Table 95: Radio

	Note	Min.	Max.	Unit
Storage temperature		-40	+125	°C
Reflow soldering temperature	Reflow cycle time is 30 seconds with 3 maximum reflow cycles.		260	°C
Moisture Sensitivity Level (MSL)			2	
ESD Human Body Model (HBM)			1	kV
ESD Charged Device Model (CDM)			500	V

Table 96: Environmental QFN package types

	Note	Min.	Max.	Unit
Storage temperature	Recommended storage condition is < 40°C and < 90% RH (relative humidity)	-40	+125	°C
Reflow soldering temperature	Reflow cycle time is 30 seconds with 3 maximum reflow cycles.		260	°C
Moisture Sensitivity Level (MSL)			1	
ESD Human Body Model (HBM)			2	kV
ESD Charged Device Model (CDM)			250	V

Table 97: Environmental CSP package types

	Note	Min.	Max.	Unit
Storage temperature	Recommended storage condition is < 40°C and < 90% RH (relative humidity)	-40	+125	°C
Reflow soldering temperature	Reflow cycle time is 30 seconds with 3 maximum reflow cycles.		260	°C
Moisture Sensitivity Level (MSL)			3	
ESD Human Body Model (HBM)			2	kV
ESD Charged Device Model (CDM)			250	V

Table 98: Environmental FCCSP package types

	Min.	Max.	Unit
Endurance	10,000		Write/ rewrite cycles
Retention at 85°C	10		y

Table 99: RRAM memory


ATTENTION
OBSERVE PRECAUTIONS
FOR HANDLING
ELECTROSTATIC
SENSITIVE DEVICES

14 Ordering information

This chapter contains information on device marking, ordering codes, and container sizes.

14.1 Device marking

The package is marked as shown in the following figure.

N	5	4	L	<D	D	D	D>
<P	P>	<V	V>	<H>	<P>		
<Y	Y>	<W	W>	<L	L>		

Figure 219: Device marking

See the inner box label and outer box label for more information regarding the box label format.

14.2 Order code

The following are the order codes and definitions for the device.

n	R	F	5	4	L	<D	D	D	D>	-	<P	P>	<V	V>	-	<C	C>

Figure 220: Order code

Abbreviation	Definition and implemented codes
N54L/nRF54L	nRF54L series product
<DDDD>	Device code
<PP>	Package variant code
<VV>	Function variant code
<H><P><F>	Build code H - Hardware version code P - Production configuration code (production site, etc.) F - Firmware version code (only visible on shipping container label)
<YY><WW><LL>	Tracking code YY - Year code WW - Assembly week number LL - Wafer lot code
<CC>	Container code

Table 100: Abbreviations

14.3 Code ranges and values

Defined here are the code ranges and values.

<DDDD>	Device
M20A	nRF54LM20A
M20B	nRF54LM20B

Table 101: Device codes

<PP>	Package	Size (mm)	Pin/Ball count	Pitch (mm)
CA	CSP61	3.02x2.43	61	0.325
PA	CSP98	3.67x3.85	98	0.35
QG	QFN52	6.0x6.0	52	0.4

Table 102: Package variant codes

<VV>	Description
AA	Reserved

Table 103: Function variant codes

<H>	Description
[A . . Z]	Hardware version/revision identifier (incremental)

Table 104: Hardware version codes

<P>	Description
[0 . . 9]	Production device identifier (incremental)
[A . . Z]	Engineering device identifier (incremental)

Table 105: Production configuration codes

<F>	Description
[A . . N, P . . Z]	Version of preprogrammed firmware
[0]	Delivered with preprogrammed firmware to enable debug access

Table 106: Production version codes

<YY>	Description
[16 . . 99]	Production year: 2016 to 2099

Table 107: Year codes

<WW>	Description
[1 . . 52]	Week of production

Table 108: Week codes

<LL>	Description
[AA . . ZZ]	Wafer production lot identifier

Table 109: Lot codes

<CC>	Description
R7	7" Reel
R	13" Reel

Table 110: Container codes

14.4 Product options

Defined here are the product options for the device.

The following table lists the ordering code, as well as the minimum ordering quantity (MOQ).

Order code	MOQ
nRF54LM20A-CAAA-R7	1500
nRF54LM20A-CAAA-R	7000
nRF54LM20A-PAAA-R7	1500
nRF54LM20A-PAAA-R	6000
nRF54LM20A-QGAA-R7	1000
nRF54LM20A-QGAA-R	3000

Table 111: nRF54LM20A order codes

Order code	MOQ
nRF54LM20B-CAAA-R7	1500
nRF54LM20B-CAAA-R	7000
nRF54LM20B-PAAA-R7	1500
nRF54LM20B-PAAA-R	6000
nRF54LM20B-QGAA-R7	1000
nRF54LM20B-QGAA-R	3000

Table 112: nRF54LM20B order codes

Order code	Description
nRF54LM20-DK	nRF54LM20 Development Kit

Table 113: Development tools order code

14.5 Preprogrammed firmware

The device is preprogrammed with firmware to allow debug access over the serial wire debug (SWD) interface.

The preprogrammed firmware disables access port protection by writing the TAMPC.PROTECT registers, and thus ensures the device can be programmed using the SWD interface without an Erase all function.

For more information about debug access protection, see Access port protection on page 1176.

15 Legal notices

By using this documentation you agree to our terms and conditions of use. Nordic Semiconductor may change these terms and conditions at any time without notice.

Liability disclaimer

Nordic Semiconductor ASA reserves the right to make changes without further notice to the product to improve reliability, function, or design. Nordic Semiconductor ASA does not assume any liability arising out of the application or use of any product or circuits described herein.

Nordic Semiconductor ASA does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. If there are any discrepancies, ambiguities or conflicts in Nordic Semiconductor's documentation, the Datasheet prevails.

Nordic Semiconductor ASA reserves the right to make corrections, enhancements, and other changes to this document without notice.

Customer represents that, with respect to its applications, it has all the necessary expertise to create and implement safeguards that anticipate dangerous consequences of failures, monitor failures and their consequences, and lessen the likelihood of failures that might cause harm, and to take appropriate remedial actions.

Nordic Semiconductor ASA assumes no liability for applications assistance or the design of customers' products. Customers are solely responsible for the design, validation, and testing of its applications as well as for compliance with all legal, regulatory, and safety-related requirements concerning its applications.

Nordic Semiconductor ASA's products are not designed for use in life-critical medical equipment, support appliances, devices, or systems where malfunction of Nordic Semiconductor ASA's products can reasonably be expected to result in personal injury. Customer may not use any Nordic Semiconductor ASA's products in life-critical medical equipment unless adequate design and operating safeguards by customer's authorized officers have been made. Customer agrees that prior to using or distributing any life-critical medical equipment that include Nordic Semiconductor ASA's products, customer will thoroughly test such systems and the functionality of such products as used in such systems.

Customer will fully indemnify Nordic Semiconductor ASA and its representatives against any damages, costs, losses, and/or liabilities arising out of customer's non-compliance with this section.

RoHS and REACH statement

Refer to for complete hazardous substance reports, material composition reports, and latest version of Nordic's RoHS and REACH statements.

Trademarks

All trademarks, service marks, trade names, product names, and logos appearing in this documentation are the property of their respective owners.

Copyright notice

© 2026 Nordic Semiconductor ASA. All rights are reserved. Reproduction in whole or in part is prohibited without the prior written permission of the copyright holder.


QUALITY SYSTEM CERTIFICATION
DNV
ISO 9001

Contents

Feature overview . . . ii

1 Revision history . . . 3

2 About this document . . . 4

2.1 Document status . . . 4
2.2 Peripheral chapters . . . 4
2.2.1 Peripheral naming conventions . . . 4
2.2.2.1 Peripheral instantiation . . . 5
2.3 Register overview table . . . 6
2.4 Register tables . . . 6
2.4.1 Fields and values . . . 6
2.4.2 Permissions . . . 6
2.5 Registers . . . 7
2.5.1 DUMMY . . . 7

3 Product overview . . . 9

3.1 Block diagram . . . 9
3.2 Memory and package overview . . . 10
3.3 Power domains . . . 11
3.4 Address format . . . 11
3.5 Memory . . . 13
3.5.1 RAM — Random access memory . . . 13
3.5.2 NVM — Non-volatile memory . . . 13
3.5.3 Memory map . . . 14
3.5.4 Instantiation . . . 16

4 Application core . . . 21

4.1 Arm Cortex-M33 CPU . . . 21
4.1.1 CPU . . . 21
4.1.2 CPUC — CPU control . . . 22
4.1.3 Arm Cortex-M33 Peripherals . . . 28
4.2 Core components . . . 28
4.2.1 AMBA interconnect (AMBIX) . . . 28
4.2.2 EasyDMA . . . 29
4.2.3 CACHE — Instruction/data cache . . . 31
4.2.4 FICR — Factory information configuration registers . . . 39
4.2.5 MEMCONF — Memory configuration . . . 46
4.2.6 RRAMC — Resistive random access memory controller . . . 48
4.2.7 SICR — Secure information configuration region . . . 62
4.2.8 SWI — Software interrupts . . . 62
4.2.9 UICR — User information configuration registers . . . 63

5 Power and clock management . . . 69

5.1 System ON mode . . . 69
5.1.1 Sub-power modes . . . 69
5.2 System OFF mode . . . 70
5.2.1 Emulated System OFF mode . . . 70
5.3 Power supply supervisors . . . 71

5.3.1 Power-fail comparator . . . 71
5.4 CLOCK — Clock control . . . 72
5.4.1 HFCLK controller . . . 73
5.4.2 LFCLK controller . . . 75
5.4.3 Registers . . . 76
5.5 OSCILLATORS — Oscillator control . . . 94
5.5.1 High-frequency (32 MHz) crystal oscillator (HFXO) . . . 94
5.5.2 Low-frequency (32.768 kHz) crystal oscillator (LFXO) . . . 96
5.5.3 CPU clock frequency selection . . . 97
5.5.4 Registers . . . 98
5.6 POWER — Power control . . . 100
5.6.1 Registers . . . 100
5.7 REGULATORS — Regulator control . . . 105
5.7.1 VREGMAIN — Main regulator . . . 106
5.7.2 Registers . . . 106
5.8 RESET — Reset control . . . 109
5.8.1 Power-on reset . . . 110
5.8.2 Pin reset . . . 110
5.8.3 Brownout reset . . . 110
5.8.4 Glitch detector . . . 110
5.8.5 Wakeup from System OFF mode reset . . . 110
5.8.6 Soft reset . . . 110
5.8.7 CTRL-AP resets . . . 110
5.8.8 Watchdog timer reset . . . 111
5.8.9 Retained registers . . . 111
5.8.10 Reset behavior . . . 111
5.8.11 Registers . . . 112
5.9 Power and clock components . . . 114
5.9.1 USBREG — USB regulator control . . . 114

6 Event system . . . 118
6.1 DPPI latencies . . . 118
6.2 DPPI — Distributed programmable peripheral interconnect . . . 119
6.2.1 Channel publish and subscribe . . . 120
6.2.2 DPPI controller (DPPIC) . . . 122
6.2.3 Connection examples . . . 122
6.2.4 Special considerations for a system implementing TrustZone for Cortex-M processors . . . 123
6.2.5 Split security . . . 124
6.2.6 Registers . . . 124
6.3 PPIB — PPI Bridge . . . 128
6.3.1 PPIB connections . . . 128
6.3.2 Handshake and overflow . . . 129
6.3.3 Connection examples . . . 129
6.3.4.1 Security . . . 130
6.3.5 Registers . . . 131

7 Security . . . 134
7.1 Memory and peripheral access permissions . . . 134
7.2 TrustZone security . . . 136
7.3 Immutable boot region . . . 139
7.4 Security attributes . . . 139
7.5 Security fault . . . 139
7.6 Peripherals with split security access . . . 140

7.6.1 CRACEN . . . 141
7.6.2 DPPIC . . . 141
7.6.3 GPIO . . . 141
7.6.4 GPIOTE . . . 143
7.6.5 GRTC . . . 144
7.7 Physical security . . . 144
7.8 Security components . . . 144
7.8.1 CRACEN — Cryptographic accelerator engine . . . 144
7.8.2 GLITCHDET — Voltage glitch detectors . . . 178
7.8.3 KMU — Key management unit . . . 179
7.8.4 MPC — Memory Privilege Controller . . . 189
7.8.5 SPU — System protection unit . . . 195
7.8.6 TAMPC — Tamper controller . . . 206

8 Peripherals . . . 228

8.1 Peripheral interface . . . 228
8.1.2 Peripheral ID . . . 229
8.1.3 Peripherals with shared ID . . . 229
8.1.4 Peripheral registers . . . 229
8.1.5 Bit set and clear . . . 230
8.1.6 Tasks . . . 230
8.1.7 Events . . . 230
8.1.8 Publish and subscribe . . . 230
8.1.9 Shortcuts . . . 230
8.1.10 Interrupts . . . 231
8.2 Instantiation . . . 232
8.3 AAR — Accelerated address resolver . . . 236
8.3.1 Shared resources . . . 236
8.3.2 Resolving a resolvable address . . . 236
8.3.3 EasyDMA . . . 239
8.3.4 Use case example for chaining RADIO packet reception with address resolution using AAR 240
8.3.5 Registers . . . 241
8.4 AXONS — Neural processing unit . . . 248
8.4.1 Registers . . . 249
8.5 CCM — AES CCM mode encryption . . . 250
8.5.1 Shared resources . . . 251
8.5.2 Encryption and decryption . . . 251
8.5.3 Encrypting packets in radio transmit mode . . . 254
8.5.4 Decrypting packets received by the radio . . . 255
8.5.5 CCM data structure . . . 256
8.5.6 EasyDMA and ERROR event . . . 257
8.5.7 Registers . . . 257
8.6 COMP — Comparator . . . 265
8.6.1 START and STOP tasks . . . 266
8.6.2 Operation modes . . . 266
8.6.3 Current source on analog input . . . 267
8.6.4 Shared resources . . . 267
8.6.5 Differential mode . . . 267
8.6.6 Single-ended mode . . . 269
8.6.7 Registers . . . 271
8.7 ECB — AES electronic codebook mode encryption . . . 280
8.7.1 Shared resources . . . 282
8.7.2 EasyDMA . . . 282
8.7.3 Registers . . . 283

8.8 EGU — Event generator unit . . . 289
8.8.1 Registers . . . 289
8.9 GPIO — General purpose input/output . . . 292
8.9.1 Pin configuration . . . 293
8.9.2 Pin sense mechanism . . . 294
8.9.3 Port capabilities . . . 295
8.9.4 Peripheral and subsystem assignment . . . 296
8.9.5 Clock pins . . . 296
8.9.6 Fast port control . . . 297
8.9.7 Reset behavior . . . 298
8.9.8 Registers . . . 298
8.10 GPIOTE — GPIO tasks and events . . . 303
8.10.1 Pin events and tasks . . . 304
8.10.2 Port event . . . 304
8.10.3 Tasks and events pin configuration . . . 305
8.10.4 Split security attribute . . . 305
8.10.5 Registers . . . 305
8.11 GRTC — Global real-time counter . . . 313
8.11.1 GRTC clock sources . . . 314
8.11.2 SYSCOUNTER . . . 314
8.11.3 Pulse Width Modulation (PWM) . . . 317
8.11.4 Clock output . . . 318
8.11.5 Split Security . . . 318
8.11.6 Task priority . . . 319
8.11.7 Registers . . . 320
8.12 LPCOMP — Low-power comparator . . . 341
8.12.1 Operation . . . 341
8.12.2 Shared resources . . . 342
8.12.3 Pin configuration . . . 343
8.12.4 Registers . . . 343
8.13 NFCT — Near field communication tag . . . 352
8.13.1 Overview . . . 353
8.13.2 Operating states . . . 355
8.13.3 Pin configuration . . . 356
8.13.4 EasyDMA . . . 357
8.13.5 Frame assembler . . . 357
8.13.6 Frame disassembler . . . 359
8.13.7 Frame timing controller . . . 360
8.13.8 Collision resolution . . . 361
8.13.9 Antenna interface . . . 362
8.13.10 NFCT antenna recommendations . . . 362
8.13.11 Battery protection . . . 363
8.13.12 Digital Modulation Signal . . . 363
8.13.13 References . . . 364
8.13.14 Registers . . . 364
8.14 PDM — Pulse density modulation interface . . . 391
8.14.1 Master clock generator . . . 392
8.14.2 Module operation . . . 392
8.14.3 Decimation filter . . . 394
8.14.4 EasyDMA . . . 394
8.14.5 Hardware example . . . 395
8.14.6 Pin configuration . . . 397
8.14.7 Registers . . . 398
8.15 PWM — Pulse width modulation . . . 412

8.15.1 Wave counter . . . 413
8.15.2 Decoder with EasyDMA . . . 416
8.15.3 Limitations . . . 424
8.15.4 Pin configuration . . . 424
8.15.5 Registers . . . 424
8.16 QDEC — Quadrature decoder . . . 444
8.16.1 Sampling and decoding . . . 445
8.16.2 LED output . . . 446
8.16.3 Debounce filters . . . 446
8.16.4 Accumulators . . . 447
8.16.5 Output/input pins . . . 447
8.16.6 Pin configuration . . . 447
8.16.7 Registers . . . 448
8.17 RADIO — 2.4 GHz radio . . . 463
8.17.1 Packet configuration . . . 464
8.17.2 Address configuration . . . 465
8.17.3 Data whitening . . . 466
8.17.4 CRC . . . 466
8.17.5 Radio states . . . 467
8.17.6 Transmit sequence . . . 469
8.17.7 Receive sequence . . . 470
8.17.8 Received signal strength indicator (RSSI) . . . 472
8.17.9 Interframe spacing (IFS) . . . 472
8.17.10 Device address match . . . 473
8.17.11 Bit counter . . . 474
8.17.12 IEEE 802.15.4 operation . . . 474
8.17.13 EasyDMA . . . 484
8.17.14 Registers . . . 485
8.18 SAADC — Successive approximation analog-to-digital converter . . . 554
8.18.1 Shared resources . . . 554
8.18.2 Overview . . . 555
8.18.3 Digital output . . . 556
8.18.4 Analog inputs and channels . . . 556
8.18.5 Operation modes . . . 556
8.18.6 EasyDMA . . . 559
8.18.7 Reference . . . 560
8.18.8 Acquisition time . . . 561
8.18.9 Limits event monitoring . . . 562
8.18.10 Performance factors . . . 562
8.18.11 Registers . . . 563
8.19 SPIM — Serial peripheral interface controller with EasyDMA . . . 583
8.19.1 SPIM transaction sequence . . . 584
8.19.2 D/CX functionality . . . 585
8.19.3 Chip select hardware control . . . 585
8.19.4 Pin configuration . . . 586
8.19.5 Shared resources . . . 587
8.19.6 EasyDMA . . . 587
8.19.7 Low power . . . 588
8.19.8 Registers . . . 588
8.20 SPIS — Serial peripheral interface target with EasyDMA . . . 611
8.20.1 SPI modes . . . 612
8.20.2 Shared resources . . . 612
8.20.3 EasyDMA . . . 613
8.20.4 SPIS operation . . . 613

8.20.5 Semaphore operation . . . 615
8.20.6 Pin configuration . . . 616
8.20.7 Registers . . . 617
8.21 TDM — Time division multiplexed audio interface . . . 636
8.21.1 Overview . . . 637
8.21.2 Transmitting and receiving . . . 637
8.21.3 Clocks . . . 639
8.21.4 Width and alignment . . . 641
8.21.5 Channel mask and EasyDMA . . . 643
8.21.6 Pin configuration . . . 648
8.21.7 Registers . . . 649
8.22 TEMP — Temperature sensor . . . 671
8.22.1 Operation . . . 671
8.22.2 Registers . . . 672
8.23 TIMER — Timer/counter . . . 679
8.23.1 TIMER modes . . . 680
8.23.2 Capture . . . 681
8.23.3 Compare . . . 681
8.23.4 Task delays . . . 681
8.23.5 Task priority . . . 681
8.23.6 Registers . . . 682
8.24 TWIM — I^2C compatible two-wire interface controller with EasyDMA . . . 689
8.24.1 TWIM operation . . . 690
8.24.2 Shared resources . . . 691
8.24.3 EasyDMA . . . 691
8.24.4 TWIM write sequence . . . 692
8.24.5 TWIM read sequence . . . 693
8.24.6 TWIM repeated start sequence . . . 694
8.24.7 Low power . . . 695
8.24.8 TWIM pin configuration . . . 695
8.24.9 Pull-up resistor . . . 695
8.24.10 Registers . . . 696
8.25 TWIS — I^2C compatible two-wire interface target with EasyDMA . . . 722
8.25.1 State machine . . . 722
8.25.2 Shared resources . . . 724
8.25.3 EasyDMA . . . 724
8.25.4 Read command response . . . 725
8.25.5 Write command response . . . 726
8.25.6 TWI controller repeated start sequence . . . 727
8.25.7 Terminate an ongoing TWI transaction . . . 728
8.25.8 Low power . . . 728
8.25.9 Target mode pin configuration . . . 728
8.25.10 Registers . . . 729
8.26 UARTE — Universal asynchronous receiver/transmitter with EasyDMA . . . 752
8.26.1 Baudrate . . . 753
8.26.2 EasyDMA . . . 753
8.26.3 Transmission . . . 754
8.26.4 Reception . . . 754
8.26.5 Data frame size . . . 756
8.26.6 Frame timeout interrupt . . . 757
8.26.7 Error conditions . . . 758
8.26.8 Using the UARTE without flow control . . . 758
8.26.9 Parity and stop bit configuration . . . 758
8.26.10 Compare match filter . . . 759

8.26.11 Low power . . . 759
8.26.12 Pin configuration . . . 759
8.26.13 Registers . . . 760
8.27 USBHS — Universal Serial Bus High Speed . . . 790
8.27.1 USB pins . . . 790
8.27.2 Interrupt sharing . . . 791
8.27.3 USBHS not in use . . . 791
8.27.4 Registers . . . 791
8.27.5 Registers . . . 797
8.28 VPR — RISC-V CPU . . . 1105
8.28.1 VPR registers . . . 1105
8.28.2 VPR CLIC registers . . . 1124
8.28.3 VPR Control Status Registers (CSRs) . . . 1126
8.29 WDT — Watchdog timer . . . 1164
8.29.1 Reload criteria . . . 1164
8.29.2 Temporarily pausing the watchdog . . . 1165
8.29.3 Watchdog reset . . . 1165
8.29.4 Stopping the watchdog . . . 1165
8.29.5 Registers . . . 1165

9 Debug and trace . . . 1174
9.1 Debug access port . . . 1174
9.1.1 Debug access port registers . . . 1175
9.2 Access port protection . . . 1176
9.3 Debug Interface mode . . . 1179
9.4 Real-time debug . . . 1179
9.5 Multidrop serial wire debug . . . 1180
9.6 Trace . . . 1180
9.6.1 Enabling the trace port . . . 1180
9.7 CTRL-AP — Control access port . . . 1181
9.7.1 Reset request . . . 1183
9.7.2 Erase all . . . 1183
9.7.3 Mailbox interface . . . 1185
9.7.4 Device information . . . 1186
9.7.5 Debugger registers . . . 1186
9.7.6 Peripheral registers . . . 1191
9.8 TAD — Trace and debug control . . . 1195
9.8.1 Registers . . . 1195
9.9 ETM — Embedded trace macrocell . . . 1197
9.9.1 Registers . . . 1197
9.10 TPIU — Trace port interface unit . . . 1218
9.10.1 Registers . . . 1218

10 Hardware and layout . . . 1219
10.1 Pin assignments . . . 1219
10.1.1 Dedicated pins . . . 1219
10.1.2 Clock pins . . . 1219
10.1.3 CSP61 (CAAA) package pin assignments . . . 1220
10.1.4 CSP98 (PAAA) package pin assignments . . . 1226
10.1.5 QFN52 (QGAA) package pin assignments . . . 1234
10.1.6 Pin function availability by package . . . 1239
10.2 Mechanical specifications . . . 1243
10.2.1 CSP61 (CAAA) package . . . 1243

10.2.2 CSP98 (PAAA) package . . . 1244
10.2.3 QFN52 (QGAA) package . . . 1245
10.3 Reference circuitry . . . 1246
10.3.1 Circuit configuration 1 for CSP98 (PAAA) . . . 1246
10.3.2 PCB layout example . . . 1248
10.3.3 PMIC support . . . 1250
10.4 Package thermal characteristics . . . 1250

11 Electrical specifications . . . 1252

11.1 Conditions . . . 1252
11.2 Current consumption . . . 1252
11.2.1 CURRENT Electrical specification . . . 1253
11.3 AXONS Electrical specification . . . 1257
11.3.1 Timing specifications . . . 1257
11.4 CLOCK Electrical specification . . . 1257
11.4.1 High frequency clock source (HFCLK) . . . 1257
11.4.2 32.768 kHz clock source (LFCLK) . . . 1258
11.5 COMP Electrical specification . . . 1258
11.5.1 COMP Electrical Specification . . . 1258
11.6 CPU Electrical specification . . . 1258
11.6.1 CPU performance . . . 1258
11.6.2 CPU wakeup times . . . 1259
11.7 GPIO Electrical specification . . . 1259
11.7.1 GPIO Electrical Specification . . . 1259
11.8 LPCOMP Electrical specification . . . 1260
11.8.1 LPCOMP Electrical Specification . . . 1260
11.9 NFCT Electrical specification . . . 1260
11.9.1 NFCT Electrical Specification . . . 1260
11.9.2 NFCT Timing Parameters . . . 1260
11.10 OSCILLATORS Electrical specification . . . 1261
11.10.1 32 MHz crystal oscillator (HFXO) . . . 1261
11.10.2 32.768 kHz crystal oscillator (LFXO) . . . 1261
11.11 PPI Electrical specification . . . 1262
11.11.1 Typical PPI latencies . . . 1262
11.12 PDM Electrical specification . . . 1262
11.12.1 PDM Electrical Specification . . . 1262
11.13 QDEC Electrical specification . . . 1263
11.13.1 QDEC Electrical Specification . . . 1263
11.14 RADIO Electrical specification . . . 1263
11.14.1 General radio characteristics . . . 1263
11.14.2 Radio current consumption (transmitter) . . . 1263
11.14.3 Radio current consumption (Receiver) . . . 1264
11.14.4 Transmitter specification . . . 1264
11.14.5 Receiver operation . . . 1265
11.14.6 RX selectivity . . . 1266
11.14.7 RX intermodulation . . . 1267
11.14.8 Radio timing . . . 1267
11.14.9 Received signal strength indicator (RSSI) specifications . . . 1268
11.14.10 Jitter . . . 1269
11.14.11 IEEE 802.15.4 mode energy detection constants . . . 1269
11.15 REGULATORS Electrical specification . . . 1269
11.15.1 Recommended operating conditions . . . 1269
11.15.2 Power-fail comparator . . . 1270
11.16 RESET Electrical specification . . . 1270

11.16.1 Startup times . . . 1270
11.17 RRAMC Electrical specification . . . 1270
11.17.1 RRAM programming . . . 1270
11.18 SAADC Electrical specification . . . 1270
11.18.1 SAADC Electrical Specification . . . 1270
11.19 SPIM Electrical specification . . . 1271
11.19.1 Timing specifications . . . 1271
11.19.2 Timing specifications for GPIO port P0 using Standard drive strength . . . 1272
11.19.3 Timing specifications for GPIO port P0 using High drive strength . . . 1272
11.19.4 Timing specifications for GPIO port P1 using Standard drive strength . . . 1273
11.19.5 Timing specifications for GPIO port P1 using High drive strength . . . 1273
11.19.6 Timing specifications for GPIO port P2 using Standard drive strength . . . 1273
11.19.7 Timing specifications for GPIO port P2 using High drive strength . . . 1273
11.19.8 Timing specifications for GPIO port P2 using Extra high drive strength . . . 1273
11.19.9 Timing specifications for GPIO port P3 using Standard drive strength . . . 1274
11.19.10 Timing specifications for GPIO port P3 using High drive strength . . . 1274
11.20 SPIS Electrical specification . . . 1274
11.20.1 SPIS slave interface electrical specifications . . . 1274
11.20.2 Serial Peripheral Interface Slave (SPIS) timing specifications . . . 1274
11.20.3 Timing specifications for GPIO port P0 using Standard drive strength . . . 1276
11.20.4 Timing specifications for GPIO port P0 using High drive strength . . . 1276
11.20.5 Timing specifications for GPIO port P1 using Standard drive strength . . . 1276
11.20.6 Timing specifications for GPIO port P1 using High drive strength . . . 1277
11.20.7 Timing specifications for GPIO port P2 using Standard drive strength . . . 1277
11.20.8 Timing specifications for GPIO port P2 using High drive strength . . . 1277
11.20.9 Timing specifications for GPIO port P2 using Extra high drive strength . . . 1277
11.20.10 Timing specifications for GPIO port P3 using Standard drive strength . . . 1277
11.20.11 Timing specifications for GPIO port P3 using High drive strength . . . 1278
11.21 SWDP Electrical specification . . . 1278
11.21.1 SW-DP . . . 1278
11.21.2 Trace port . . . 1278
11.22 TEMP Electrical specification . . . 1279
11.22.1 Temperature Sensor Electrical Specification . . . 1279
11.23 TDM Electrical specification . . . 1279
11.23.1 TDM timing specification . . . 1279
11.23.2 Timing specifications for Slave mode . . . 1279
11.23.3 Timing specifications for Master mode . . . 1280
11.24 TWIM Electrical specification . . . 1280
11.24.1 TWIM interface electrical specifications . . . 1280
11.24.2 Two Wire Interface Master (TWIM) timing specifications . . . 1280
11.25 TWIS Electrical specification . . . 1281
11.25.1 TWIS slave timing specifications . . . 1281
11.26 UARTE Electrical specification . . . 1281
11.26.1 UARTE electrical specification . . . 1281
11.27 USBHS Electrical specification . . . 1282
11.27.1 USBHS Electrical specification . . . 1282
11.28 WDT Electrical specification . . . 1282
11.28.1 Watchdog Timer Electrical Specification . . . 1282

12 Recommended operating conditions . . . 1283
12.1 Light sensitivity . . . 1283

13 Absolute maximum ratings . . . 1284

14 Ordering information 1287
14.1 Device marking 1287
14.2 Order code 1287
14.3 Code ranges and values 1288
14.4 Product options 1289
14.5 Preprogrammed firmware 1290

15 Legal notices 1291