# LoRaWAN Gateway Kit

LoRa is a perfect long-range wireless solution to create low-power, wide area networks. So far we have released several “LoRa” boards such as Seeeduino LoRaWan and Grove LoRa Radio etc. However if you want to build your own LoRa network, there are 3 things that you should prepare to get started: a Gateway, at least one Node and a local server where you can monitor all your devices.

This kit provides all the basic elements you need: a Raspberry Pi 3, a Seeeduino LoRaWAN with GPS and a gateway & local server that allow you to collect and transfer data among all your LoRa nodes. By connecting the gateway with Seeeduino LoRaWAN and Grove modules, you can build your IOT prototype within minutes.

Regarding the gateway module RHF0M301, it is a 10 channel(8 x Multi-SF + 1 x Standard LoRa + 1 x FSK) LoRaWan gateway module with a 24pin DIP port on board; users can easily connect the RHF0M301 with PRI 2 bridge RHF4T002, adapter for Raspberry Pi 3 and RHF0M301. We also included a 868MHz antenna, an 8GB SD card and USB cables, Ethernet Cables and other accessories.

Caution

Please always plug 3.7V Lipo battery in case USB power supply is not sufficient. This wiki works for both 868MHz kit and 915MHz kit.

### Features
- Low power consumption & wide area
- Industrial standard reliability
- Economic solution to build LoRa /LoRaWAN network
- Rich Accessories of sensor and actuator
- Real time monitoring

### Hardware Overview
<table>
<thead>
<tr>
<th>Parts number</th>
<th>Parts name</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Raspberry Pi 3</td>
<td>1 PCS</td>
</tr>
<tr>
<td>2</td>
<td>Gateway module RHF0M301–868</td>
<td>1 PCS</td>
</tr>
<tr>
<td>3</td>
<td>PRI 2 Bridge RHF4T002</td>
<td>1 PCS</td>
</tr>
<tr>
<td>4</td>
<td>Seeeduino LoRaWAN with GPS (RHF76-052AM)</td>
<td>1 PCS</td>
</tr>
<tr>
<td>5</td>
<td>USB to UART Adapter</td>
<td>1 PCS</td>
</tr>
<tr>
<td>6</td>
<td>upgrade to 16GB Micro SD Card – Class 10</td>
<td>1 PCS</td>
</tr>
<tr>
<td>7</td>
<td>0dBi Rubber Duck Antenna</td>
<td>1 PCS</td>
</tr>
<tr>
<td>8</td>
<td>5V/2.1A American Standard Adapter with Micro USB Connector</td>
<td>1 PCS</td>
</tr>
<tr>
<td>9</td>
<td>Micro USB Cable 20cm</td>
<td>1 PCS</td>
</tr>
<tr>
<td>10</td>
<td>Micro USB Cable 100cm</td>
<td>1 PCS</td>
</tr>
</tbody>
</table>
Application Ideas

- Internet of Things
- Smart House
- Security
- Smart Grid
- Intelligent Farm
- Intelligent Park

Getting Started

Hardware

Interfaces overview

Since there are many interfaces here, it is necessary to know the capabilities of these interfaces. Please refer to the following figure for details.

- **Micro-USB Input:**
  The whole system use this Micro-USB interface for power supply.

- **USB HOST Connector:**
  Output power to supply for Raspberry Pi

- **Raspberry Pi power input:** Input power for Raspberry.
HDMI: HD digital video output interface.

Headphone jack: 3.5mm Headphone jack

Ethernet interface: You can use the Ethernet interface to connect this system to the Internet. Or you can use Wifi after you configured the wireless network.

Hardware connection

2. Plug PRI 2 Bridge RHF4T002 into Raspberry Pi 3.
3. Connect 2 and 3 via the 20cm Micro-USB cable.
4. Connect the USB to UART Adapter to the GPIO of Raspberry Pi 3. Please connect them as the picture shown below.
5. Plug the USB to UART Adapter into your PC.
6. Connect 1 with 5V/2.1A Standard Adapter via 100cm Micro-USB cable.

When you finished all the steps, the whole system should be like the picture below.
Software

Software Tool

In the following guide, below tools will be needed, please install it to your computer.

- Arduino, portable serial tool, used to open the serial port of Seeeduino LoRaWAN with GPS (RH76-052AM) and send AT commands to it.
- PuTTY, terminal tool include both serial and SSH terminal, used to control Raspberry Pi.
- Internet browse, used to access RHF2S001 integrated LoRaWAN server (It is recommended to use Chrome or Firefox).

Note

You may have your other favorite serial tools, of course you can use them. However, if you are not sure about your tools, please use the ones we recommend.

Connect To Local Server

Step 1. Power up and connect to putty

a) First, make sure the serial tool and RR (RH76T002 Adapter) are connected correctly.

b) Plug F232 tool to PC (If COM port is not recognized correctly, please refer below driver installation chapter).

c) Open Device Manager of your PC to get the right COM port. Like COM15 for example. Configure ExtraPuTTY according to below picture (Speed 115200, others use defaults), click Open. As the gateway is still not opened, so there is nothing in the terminal.
d) Power the gateway up. Booting log will be showed in the PuTTY terminal, in the end it will prompt you to input your log in name. Please note it takes 1 or 2 minutes to get the prompt information.
Please use RHF2S001 default user name and password to log in. (Username: rxhf, Password: risinghf). Note, when input the password, there is no any echo.

f) Connect RHF2S001 with router through ethernet cable.

g) Run `ifconfig` to check the IP address and MAC address.

```
eth0  Link encap:Ethernet  HWaddr 08:27:eb:xx:xx:xx
  inet6 addr: fe80::11a6:6b9f:b1f8:b465/64 Scope:Link
  UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
  RX packets:449 errors:0 dropped:0 overruns:0 frame:0
  TX packets:69 errors:0 dropped:0 overruns:0 carrier:0
  collisions:0 txqueuelen:1000
  RX bytes:41222 (40.2 KiB) TX bytes:10920 (10.6 KiB)
```

IP is in the blue square, MAC address is in orange square (Format: b8:27:eb:xx:xx:xx)

Note

After you get the IP, it is recommended to login RHF2S001 again through SSH. Because SSH is faster (Ethernet than UART) and
stable. We normally use serial tool to get the IP. Reopen PuTTY, use the SSH module to connect again.

To login through SSH, you need to fill in the Hostname with the IP address you’ve just got. And use port 22, choose the SSH connection type. Just leave the other options by default. Then simply click Open.

---

**Step 2. Expand SD Card File System**

By default, the image enables only 2GB for Raspbian System, it is recommended to expand to use the whole SD card (8GB or 16GB). Or the SD card will be full soon.

Run below command in the PuTTY terminal to start raspi-config,

```
sudo raspi-config
```

Choose “Expand Filesystem”, when finished reboot to make it effect. Run below command in the PuTTY terminal to know the SD card capacity and usage.

```
df -h
```

Please refer to Raspberry Pi raspi-config tool instruction for details. Click here see more.

**Step 3. Use RH2S001 integrated LoRaWAN server**

a) Connect Gateway with internal server

Run below commands in the PuTTY terminal, and check the status:

```
sudo systemctl status pktfwd
```

If pktfwd service is not active, run below command to start it:

```
sudo systemctl enable pktfwd
sudo systemctl restart pktfwd
```

b) Frequency Plan

**Frequency Plan for EU868**

<table>
<thead>
<tr>
<th>CH</th>
<th>867.x</th>
<th>Uplink DR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH0</td>
<td>867.1</td>
<td>DR0 ~ DR5</td>
</tr>
<tr>
<td>CH1</td>
<td>867.3</td>
<td>DR0 ~ DR5</td>
</tr>
<tr>
<td>CH2</td>
<td>867.5</td>
<td>DR0 ~ DR5</td>
</tr>
<tr>
<td>CH3</td>
<td>867.7</td>
<td>DR0 ~ DR5</td>
</tr>
<tr>
<td>CH4</td>
<td>867.9</td>
<td>DR0 ~ DR5</td>
</tr>
<tr>
<td>CH5</td>
<td>868.1</td>
<td>DR0 ~ DR5</td>
</tr>
<tr>
<td>CH6</td>
<td>868.3</td>
<td>DR0 ~ DR5</td>
</tr>
<tr>
<td>CH7</td>
<td>868.5</td>
<td>DR0 ~ DR5</td>
</tr>
</tbody>
</table>

**Frequency Plan for US915 HYBRID**

<table>
<thead>
<tr>
<th>CH</th>
<th>902.x</th>
<th>Uplink DR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH0</td>
<td>902.3</td>
<td>DR0 ~ DR3</td>
</tr>
<tr>
<td>CH1</td>
<td>902.5</td>
<td>DR0 ~ DR3</td>
</tr>
</tbody>
</table>
c) RHF76-052AM Settings

Now let's configure the Seeeduino LoRaWAN with GPS (RHF76-052AM).

- Firstly, you need to connect Seeeduino LoRaWAN GPS to your PC.
- Secondly, open the Arduino IDE, and copy the code below into a new sketch.

```cpp
void setup()
{
    Serial1.begin(9600);
    SerialUSB.begin(115200);
}

void loop()
{
    while(Serial1.available())
    {
        SerialUSB.write(Serial1.read());
    }
    while(SerialUSB.available())
    {
        Serial1.write(SerialUSB.read());
    }
}
```

- Then choose the right serial port of Seeeduino Lora GPS, and choose the board Tool->Board->Seeeduino_LoRAWAN. After that you can click the upload button. If you cannot find Seeeduino_LoRAWAN in the board list or do not know how to update the code, please click here for more information.
Now please open the serial monitor in the upper right corner (or you can press Ctrl+Shift+M at the same time). Choose Newline (This option will add "\r\n" at the end of each command), set the baud rate 9600. Then tap the commands below and press send.

For EU868

```
AT+FDEFAULT=RISINGHF
AT+DR=EU868
```

For US915

```
AT+FDEFAULT=RISINGHF
AT+DR=US915HYBRID
AT+RXWIN2=923.3,DR8
```
Caution

After you plug Seeeduino LoRaWAN with GPS into your computer, you may find two serial Ports. One is for rasperry with putty, one is for Seeeduino LoRaWAN GPS with SSCOM, please choose the right one.

d) Access Internal Server Console

Fill your browser with the IP address [(IP of your gateway)], it will jump to the website below.

Step 4. Use Seeeduino LoRaWAN GPS(RHF76-052AM) access LoRaWAN server
There are two modes in this wiki: we only talk about the ABP Mode (This Mode is free for anyone), for more information about OTAA Mode (This model is commercial, you need to pay for it), you can click here.

a) Find the "Application" button in the upper right corner of the website above, click it and you will see a new page.

b) Now you need **APPEui, DevAddr, DevEui** of Seeeduino LoRaWAN to add a new application.
   In order to get the ID information of Seeeduino LoRaWAN, you need to tap the command below in the serial monitor of Arduino IDE. Click **Send**, you will get the ID then.

```
+ID: DevAddr, 00:FE:88:B2
+ID: DevEui, 47:99:E2:69:00:34:00:5C
```

c) Fill in the blank with the ID info. you just get. You can fill in the name and owner as your wish (here we use Seeed and my nick name: ), use the APPEui you've just got. Then click **Add** button.
Then you will jump into the configure page. In this page, we choose Personalised Motes. Fill in the **DevEUI** and **DevAddr** with ID info. of your Seeeduino LoRaWAN GPS. And set the **NWKSKEY** and **APPSKEY** by default. You can refer to the picture below.

**DevEui**:
Seeeduino LoRaWAN GPS get through AT+ID command

**DevAddr**:
Seeeduino LoRaWAN GPS get through AT+ID command

**NWKSKEY**:
Default value 2B7E151628AED2A6ABF7158809CF4F3C

**APPSKEY**:
Default value 2B7E151628AED2A6ABF7158809CF4F3C

d) To test whether you add the device successfully, you can use the serial monitor of Arduino IDE tap the command below.

```
at+mode=1wabp
AT+CMSGHEX="0a 0b 0c 0d 0e"
```

It should like something below.
Then turn to the website, click Application->Seeed (the name of the Application you just added)->View application data, you will see the data you've just sent from the Seeeduino LoRAWAN. Congratulations! Job done!

**Connect To Loriot Server**

**Step 1: Loriot Server Gateway Registration**

a) New user need register an account first, click registration address. Fill in UserName, Password and email address to register, after registration an email will be sent to you, please follow the instruction in the email to activate.
b) After successful activation, click here to log in. Default tier is “Community Network”, it supports 1 Gateway (RHF2S001) and 10 nodes.

c) Enter Dashboard -> Gateway, click Add Gateway start to add Gateway.

d) Select Raspberry Pi 3

e) Set as below:
   - Radio front-end -> RHF2S001 868/915 MHz (SX1257)
   - BUS -> SPI

f) Fill in the MAC address of your RHF2S001, should be in format of b8:27:eb:xx:xx:xx. And also input Gateway Location information.

g) Click “Register Raspberry Pi gateway” to finish the registration.

h) Click the registered gateway to enter configuration page, switch “Frequency Plan” manually, your plan here is decided by the type of your RHF2S001 type, available plan are CN470, CN473, CN434, CN780, EU868, after selected please refresh the page to get the exact channel. In this wiki we choose EU868.

i) Run the command in the putty terminal:

   ```
   cd /home/rhf/loriot/1.0.2
   sudo systemctl stop pktfwd
   sudo gwrst
   chmod +x loriot-gw.bin
   ./loriot-gw.bin -f -s cn1.loriot.io
   ```

j) Finish gateway registration. You will see the gateway is Connected now. Next is to register node.
Step 2. Loriot Server Connect Node device

a) Get the available gateway channels

Current gateway channels could be got from Dashboard -> Gateway -> Your Gateway, you can see the available channels as the picture below.

<table>
<thead>
<tr>
<th>Radio</th>
<th>Center frequency [MHz]</th>
<th>Bandwidth [kHz]</th>
<th>Modulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>868.100</td>
<td>125</td>
<td>MultiSF</td>
</tr>
<tr>
<td>1</td>
<td>868.300</td>
<td>125</td>
<td>MultiSF</td>
</tr>
<tr>
<td>1</td>
<td>868.500</td>
<td>125</td>
<td>MultiSF</td>
</tr>
<tr>
<td>0</td>
<td>867.100</td>
<td>125</td>
<td>MultiSF</td>
</tr>
<tr>
<td>0</td>
<td>867.300</td>
<td>125</td>
<td>MultiSF</td>
</tr>
<tr>
<td>0</td>
<td>867.500</td>
<td>125</td>
<td>MultiSF</td>
</tr>
<tr>
<td>0</td>
<td>867.700</td>
<td>125</td>
<td>MultiSF</td>
</tr>
<tr>
<td>0</td>
<td>867.900</td>
<td>125</td>
<td>MultiSF</td>
</tr>
<tr>
<td>1</td>
<td>868.300</td>
<td>250</td>
<td>SF7</td>
</tr>
<tr>
<td>1</td>
<td>868.800</td>
<td>125</td>
<td>FSK</td>
</tr>
</tbody>
</table>

b) Seeeduino LoRAWAN GPS(RHF3M076) Configuration

Open the serial monitor of Arduino IDE, tap the command below:

```plaintext
at+ch
```
To confirm the default channel of your Seeeduino LoRAWAN GPS, you will get 3 channels. If there is no available channel, you can change the channels of Seeeduino LoRAWAN by the command below.

```
AT+CH=0,868.1
AT+CH=1,868.3
AT+CH=2,868.5
```

Then you can use `at+ch` again to check.

c) Add Seeeduino LoRAWAN GPS as an ABP Node

Log in Loriot server, Click `Dashboard` -> `Applications` -> `SimpleApp` -> Click `Import ABP`, input below items:

- **DevAddr**: Seeeduino LoRAWAN GPS get through "AT+ID" command (Note: Loriot doesn't support colon connector, need remove manually)
- **FCntUp**: Set to 1
- **FCntDn**: Set to 1
- **NWKSKEY**: Default value 2B7E151628AED2A6ABF71588090C4F3C
- **APPSKEY**: Default value 2B7E151628AED2A6ABF71588090C4F3C
- **EUI**: DevEUI, Seeeduino LoRAWAN GPS get through "AT+ID" command

Click `Import Device` button to finish the device import.

Now choose `Dashboard` -> `Applications` -> `SampleApp`, you will see the new ABP Node you've just added.
d) Send data from Seeeduino_LoRAWAN

Back to serial monitor of Arduino IDE, send command:

```
AT+CMSGHEX="0a 0b 0c 0d 0e"
```

Then go to Dashboard -> Applications -> SampleApp -> Device, click the Node Device EUI or DevAddr, you will find the data you've just sent here.

**FAQs**

Please click here to see all LoRa/LoRaWAN Gateway Kit FAQs.

**Tech support**

Please do not hesitate to contact techsupport@seeed.cc if you require further information.

**Resources**
- [PDF] Download Wiki PDF
- [More Reading] Wiki of Seeeduino LoRaWAN
- [More Reading] RisingHF Website