FCC EMC Test Report

(Verification of Conformity)

For

Electromagnetic Interference

Of

Product: BeagleBone Green

Trade Name: Seeedstudio

Model Number: BeagleBone Green

Prepared for

Seeed Technology Limited

5th Floor, 8th Building, Shiling industrial Park, XiLi Town,
NanShan dist. Shenzhen, Guangdong, China

Prepared by

Shenzhen NTEK Testing Technology Co., Ltd.

1/F, Building E, Fenda Science Park, Sanwei Community, Xixiang Street,
Bao'an District, Shenzhen P.R. China

Tel.: +86-0755-61156588 Fax.: +86-0755-61156599
Website: www.ntek.org.cn

TEST RESULT CERTIFICATION

Applicant's name	:	Seeed Technology Limited
Address	:	5th Floor, 8th Building, Shiling industrial Park, XiLi Town, NanShan dist. Shenzhen, Guangdong, China
Manufacturer's Name	:	Seeed Technology Limited
Address	:	5th Floor, 8th Building, Shiling industrial Park, XiLi Town, NanShan dist. Shenzhen, Guangdong, China
Product description		
Product name	:	BeagleBone Green
Model and/or type reference	:	BeagleBone Green
Standards	:	47 CFR FCC part15 subpart B, 10-1-2014 ANSI C63.4:2014

This device described above has been tested by NTEK, and the test results show that the equipment under test (EUT) is in compliance with Part 15 of FCC Rules. And it is applicable only to the tested sample identified in the report.

This report shall not be reproduced except in full, without the written approval of NTEK, this document may be altered or revised by NTEK, personal only, and shall be noted in the revision of the document.

Date of Test	:	
Date (s) of performance of tests	:	02 Jun. 2015 ~10 Jun. 2015
Date of Issue	:	10 Jun. 2015
Test Result	:	**Pass**

Testing Engineer : Jane lv
(Jane Lv)

Technical Manager : Eileen Liu
(Eileen Liu)

NTEK TESTING TECHNOLOGY CO., LTD. APPROVED

Authorized Signatory : Bill Yao
(Bill Yao)

Table of Contents **Page**

1. TEST SUMMARY

Test procedures according to the technical standards:

EMC Emission				
Standard	Test Item	Limit	Judgment	Remark
FCC part15 subpart B, 10-1-2014 ANSI C63.4: 2009	Conducted Emission	Class B	N/A	
	Radiated Emission	Class B	PASS	

NOTE:

(1) 'N/A' denotes test is not applicable in this Test Report

(2) For client's request and manual description, the test will not be executed.

1.1 TEST FACILITY

NTEK Testing Technology Co., Ltd
Add. : 1/F, Building E, Fenda Science Park, Sanwei Community, Xixiang Street, Bao'an District, Shenzhen P.R. China.
FCC Registration Number:238937; IC Registration Number:9270A-1
CNAS Registration Number:L5516

1.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement **y** ± **U**，where expended uncertainty **U** is based on a standard uncertainty multiplied by a coverage factor of **k=2**，providing a level of confidence of approximately **95** %.

A. Conducted Measurement :

Test Site	Method	Measurement Frequency Range	U，(dB)	NOTE
NTEKC01	ANSI	150 kHz ~ 30MHz	3.6	

B. Radiated Measurement :

Test Site	Method	Measurement Frequency Range	U，(dB)	NOTE
NTEKA01	ANSI	30MHz ~ 1000MHz	4.8	
		1GHz ~6GHz	4.5	

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

Equipment	BeagleBone Green
Model Name	BeagleBone Green
Additional Model Number(s)	N/A
Model Difference	N/A
Product Description	The EUT is a BeagleBone Green. Operating frequency: 1GHz Connecting I/O port: USB, RJ45 Based on the application, features, or specification exhibited in User's Manual, the EUT is considered as an ITE/Computing Device. More details of EUT technical specification, please refer to the User's Manual.
Power Source	DC Voltage
Power Rating	DC 5V, 200mA

2.2 DESCRIPTION OF TEST MODES

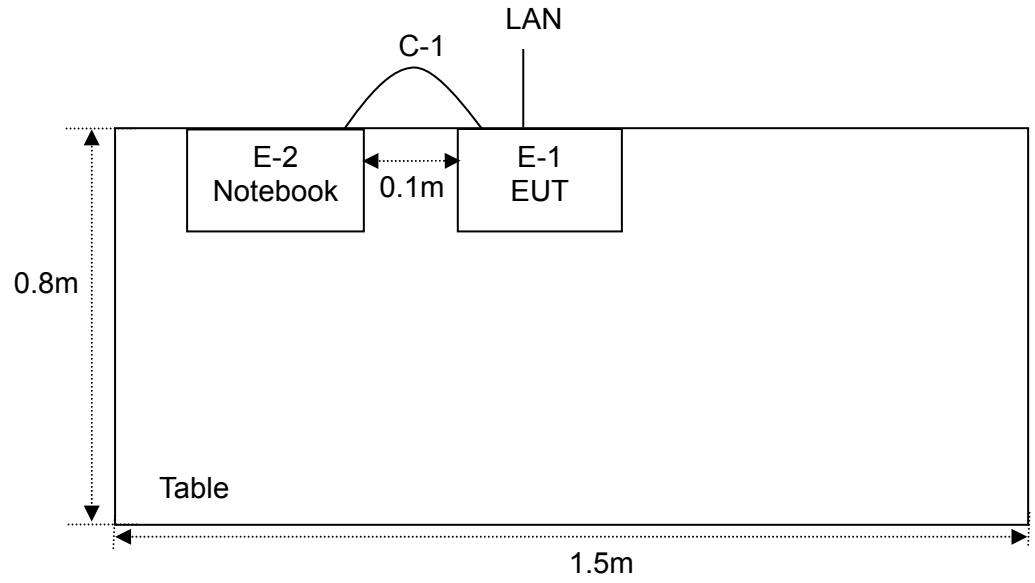
To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Pretest Mode	Description
Mode 1	Running

For Radiated Test	
Final Test Mode	Description
Mode 1	Running

2.3 DESCRIPTION OF TEST SETUP

Mode RE: Running



2.4 DESCRIPTION TEST PERIPHERAL AND EUT PERIPHERAL

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Brand	Model/Type No.	Series No.	Note
E-1	BeagleBone Green	Seeedstudio	BeagleBone Green	N/A	EUT
E-2	Notebook	Lenovo	ThinkPad Edge E430	N/A	

Item	Shielded Type	Ferrite Core	Length	Note
C-1	NO	NO	30cm	

Note:

(1) The support equipment was authorized by Declaration of Confirmation.
(2) For detachable type I/O cable should be specified the length in cm in 『Length』 column.
(3) “YES” means “shielded” “with core”; “NO” means “unshielded” “without core”.

2.5 MEASUREMENT INSTRUMENTS LIST

2.5.1 RADIATED TEST SITE

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	Bilog Antenna	TESEQ	CBL6111D	31216	Jun. 16, 2014	Jun. 15, 2015	1 year
2	Test Cable	N/A	R-01	N/A	Jun. 16, 2014	Jun. 15, 2015	1 year
3	Test Cable	N/A	R-02	N/A	Jun. 16, 2014	Jun. 15, 2015	1 year
4	EMI Test Receiver	R&S	ESCI-7	101318	Jun. 16, 2014	Jun. 15, 2015	1 year
5	Antenna Mast	EM	SC100_1	N/A	N/A	N/A	N/A
6	Turn Table	EM	SC100	060531	N/A	N/A	N/A
7	50Ω Switch	Anritsu Corp	MP59B	6200983705	Jun. 16, 2014	Jun. 15, 2015	1 year
8	Horn Antenna	EM	EM-AH-10180	2011071402	Jun. 16, 2014	Jun. 15, 2015	1 year
9	BBV9718 Broadband Preamplifier 0.15-18GHz	SCHWARZBECK	9718-218	N/A	Oct. 30, 2014	Oct. 29, 2015	1 year

3. EMC EMISSION TEST

3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 POWER LINE CONDUCTED EMISSION (Frequency Range 150kHz-30MHz)

FREQUENCY (MHz)	☐Class A (dBμV)		☒Class B (dBμV)	
	Quasi-peak	Average	Quasi-peak	Average
0.15 -0.5	79.00	66.00	66 - 56 *	56 - 46 *
0.50 -5.0	73.00	60.00	56.00	46.00
5.0 -30.0	73.00	60.00	60.00	50.00

Note:

(1) The tighter limit applies at the band edges.

(2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

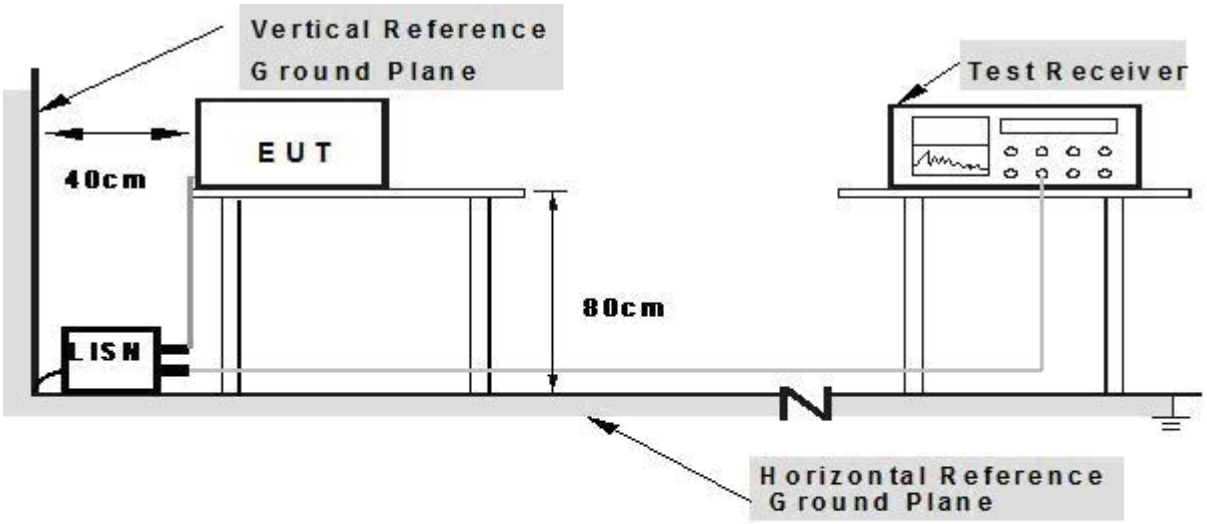
The following table is the setting of the receiver

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

3.1.2 TEST PROCEDURE

a. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
d. LISN at least 80 cm from nearest part of EUT chassis.
e. For the actual test configuration, please refer to the related Item –EUT Test Photos.

3.1.3 TEST SETUP



Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

3.1.4 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of **2.3** Unless otherwise a special operating condition is specified in the follows during the testing.

3.1.5 TEST RESULTS

EUT:	BeagleBone Green	Model Name. :	BeagleBone Green
Temperature:	26℃	Relative Humidity:	54%
Pressure:	1010hPa	Test Date:	N/A
Test Mode:	N/A	Phase:	N/A
Test Voltage:	N/A		

3.2 RADIATED EMISSION MEASUREMENT

3.2.1 LIMITS OF RADIATED EMISSION MEASUREMENT

FREQUENCY (MHz)	☐Class A (at 3m)	☒Class B (at 3m)
	dBμV/m	dBμV/m
30 ~ 88	49.0	40.0
88 ~ 216	53.5	43.5
216 ~ 960	56.5	46.0
Above 960	59.5	54.0

Notes:

(1) The limit for radiated test was performed according to as following: FCC PART 15B /ICES-003.

(2) The tighter limit applies at the band edges.

(3) Emission level (dBμV/m)=20log Emission level (uV/m).

3.2.2 TEST PROCEDURE

a. The measuring distance of at 10 m shall be used for measurements at frequency up to 1GHz. For frequencies above 1GHz, any suitable measuring distance may be used.

b. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 10 meter open area test site. The table was rotated 360 degrees to determine the position of the highest radiation.

c. The height of the equipment or of the substitution antenna shall be 0.8 m; the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

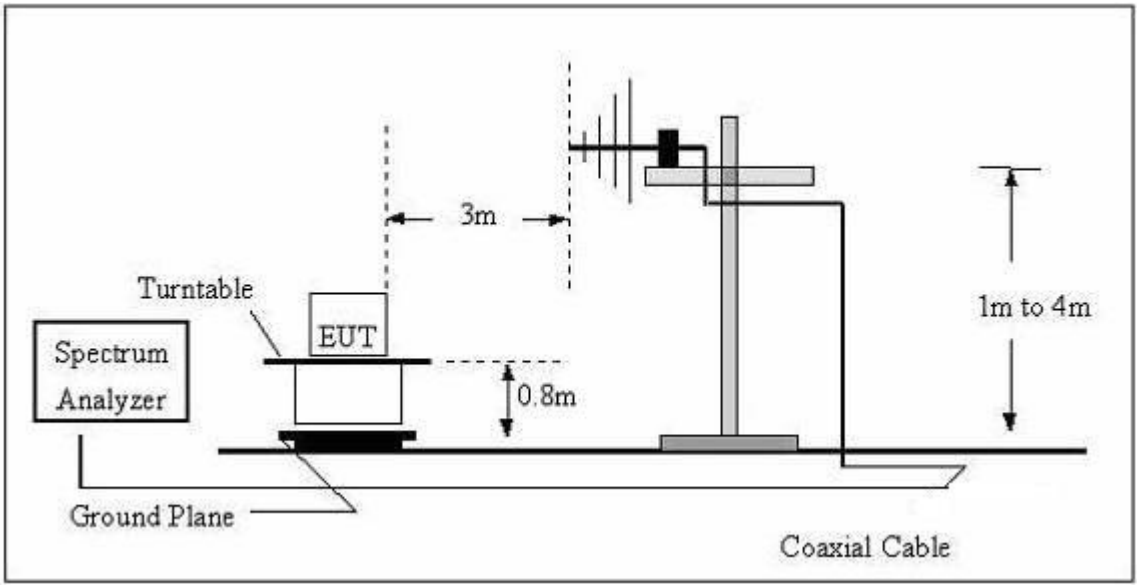
d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured, above 1G Average detector mode will be instead.

e. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP(AV) Limits and then no additional QP Mode measurement performed.

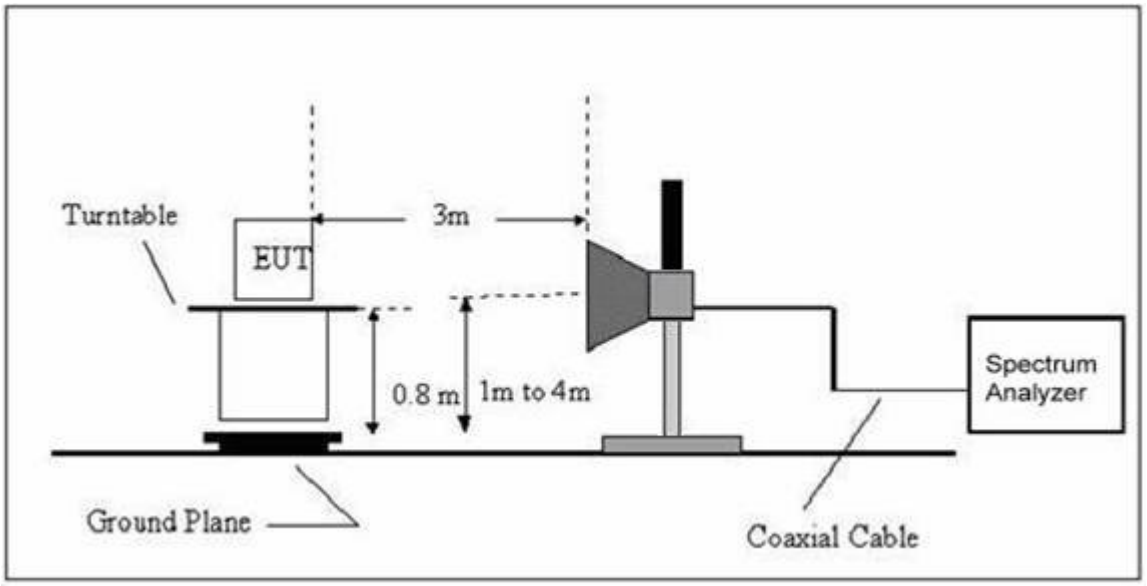
f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

3.2.3 TEST SETUP

(A) Radiated Emission Test Set-Up Frequency Below 1 GHz



(B) Radiated Emission Test Set-Up Frequency Above 1GHz



3.2.4 EUT OPERATING CONDITIONS

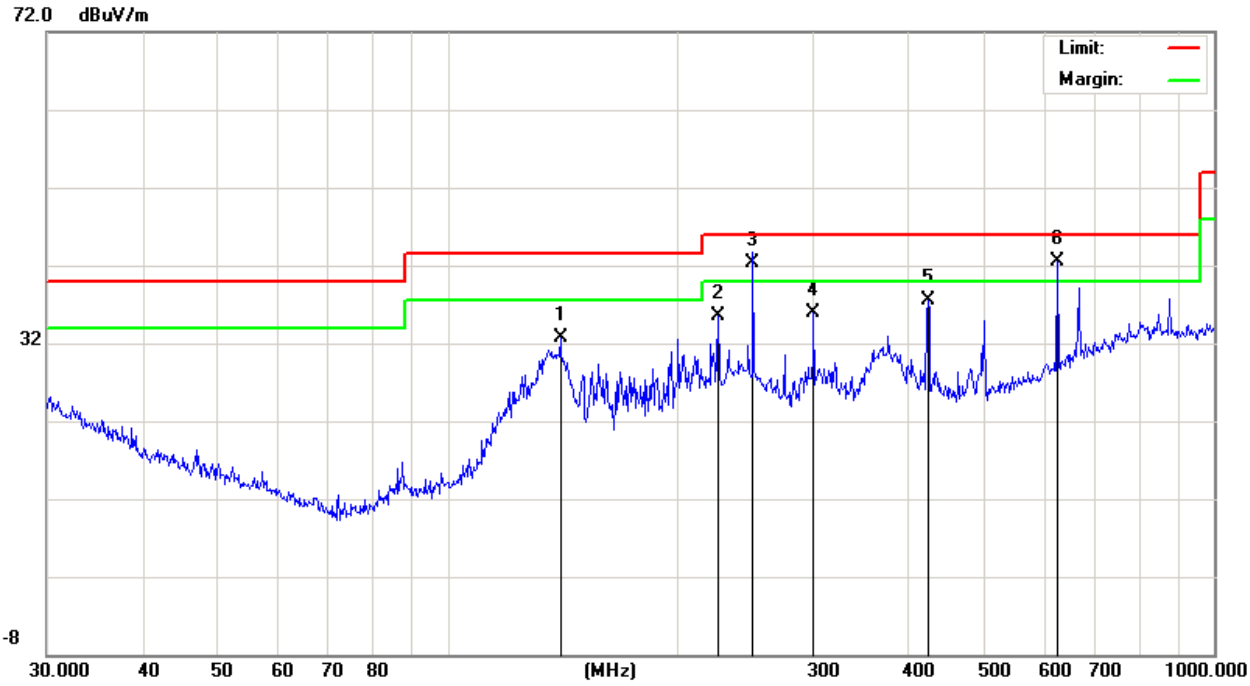
The EUT tested system was configured as the statements of **2.3** Unless otherwise a special operating condition is specified in the follows during the testing.

3.2.5 TEST RESULTS

EUT:	BeagleBone Green	Model Name :	BeagleBone Green
Temperature:	24℃	Relative Humidity:	54%
Pressure:	1010hPa	Test Date:	2015-06-09
Test Mode:	Running	Polarization:	Horizontal
Test Power:	DC 5V from Notebook		

Freq. (MHz)	Reading (dBμV/m)	Factor (dB)	Measurement (dBμV/m)	Limit (dBμV/m)	Over (dB)	Detector
140.3420	21.28	11.37	32.65	43.50	-10.85	QP
225.3079	23.10	12.49	35.59	46.00	-10.41	QP
250.3012	28.70	13.59	42.29	46.00	-3.71	QP
300.3672	21.69	14.16	35.85	46.00	-10.15	QP
423.5403	18.76	18.78	37.54	46.00	-8.46	QP
625.0780	19.69	22.91	42.60	46.00	-3.40	QP

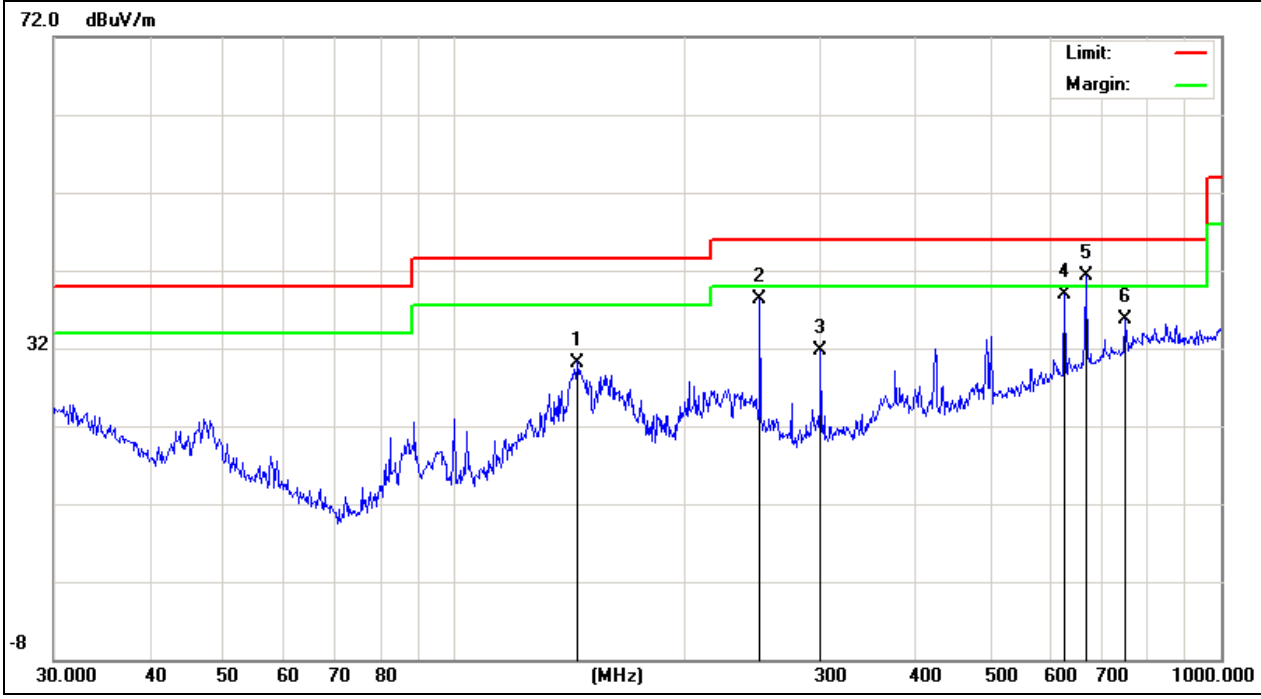
Remark:
Factor = Antenna Factor + Cable Loss.



EUT:	BeagleBone Green	Model Name :	BeagleBone Green
Temperature:	24℃	Relative Humidity:	54%
Pressure:	1010hPa	Test Date:	2015-06-09
Test Mode:	Running	Polarization:	Vertical
Test Power:	DC 5V from Notebook		

Freq. (MHz)	Reading (dBμV/m)	Factor (dB)	Measurement (dBμV/m)	Limit (dBμV/m)	Over (dB)	Detector
144.8418	19.27	10.93	30.20	43.50	-13.30	QP
250.3012	24.70	13.59	38.29	46.00	-7.71	QP
300.3672	17.50	14.16	31.66	46.00	-14.34	QP
625.0780	16.02	22.91	38.93	46.00	-7.07	QP
665.8035	17.50	23.85	41.35	46.00	-4.65	QP
750.1083	9.61	26.10	35.71	46.00	-10.29	QP

Remark:
Factor = Antenna Factor + Cable Loss.

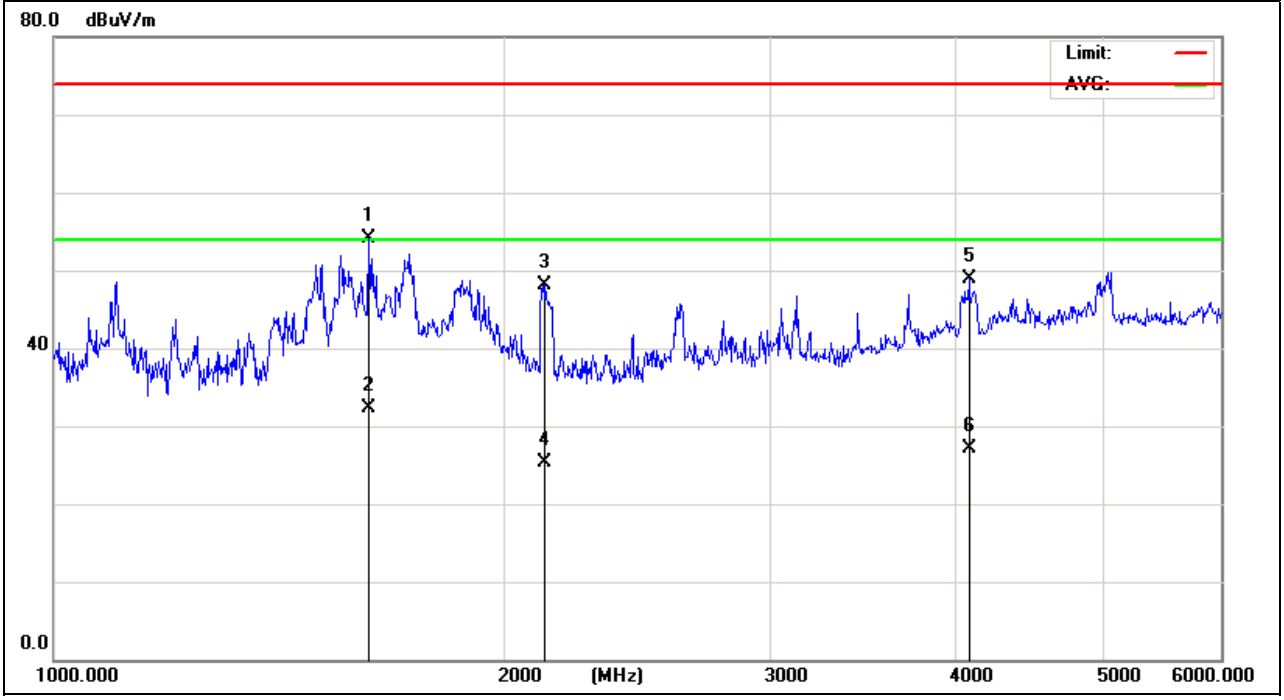


3.2.6 TEST RESULTS(Above 1GHz)

EUT:	BeagleBone Green	Model Name :	BeagleBone Green
Temperature:	24℃	Relative Humidity:	54%
Pressure:	1010hPa	Test Date:	2015-06-09
Test Mode:	Running	Polarization:	Horizontal
Test Power:	DC 5V from Notebook		

Freq. (MHz)	Reading (dBμV/m)	Factor (dB)	Measurement (dBμV/m)	Limit (dBμV/m)	Over (dB)	Detector
1622.1870	64.71	-10.61	54.10	74.00	-19.90	peak
1622.1870	42.82	-10.61	32.21	54.00	-21.79	AVG
2126.1880	55.23	-7.03	48.20	74.00	-25.80	peak
2126.1880	32.41	-7.03	25.38	54.00	-28.62	AVG
4074.4650	50.03	-1.03	49.00	74.00	-25.00	peak
4074.4650	28.15	-1.03	27.12	54.00	-26.88	AVG

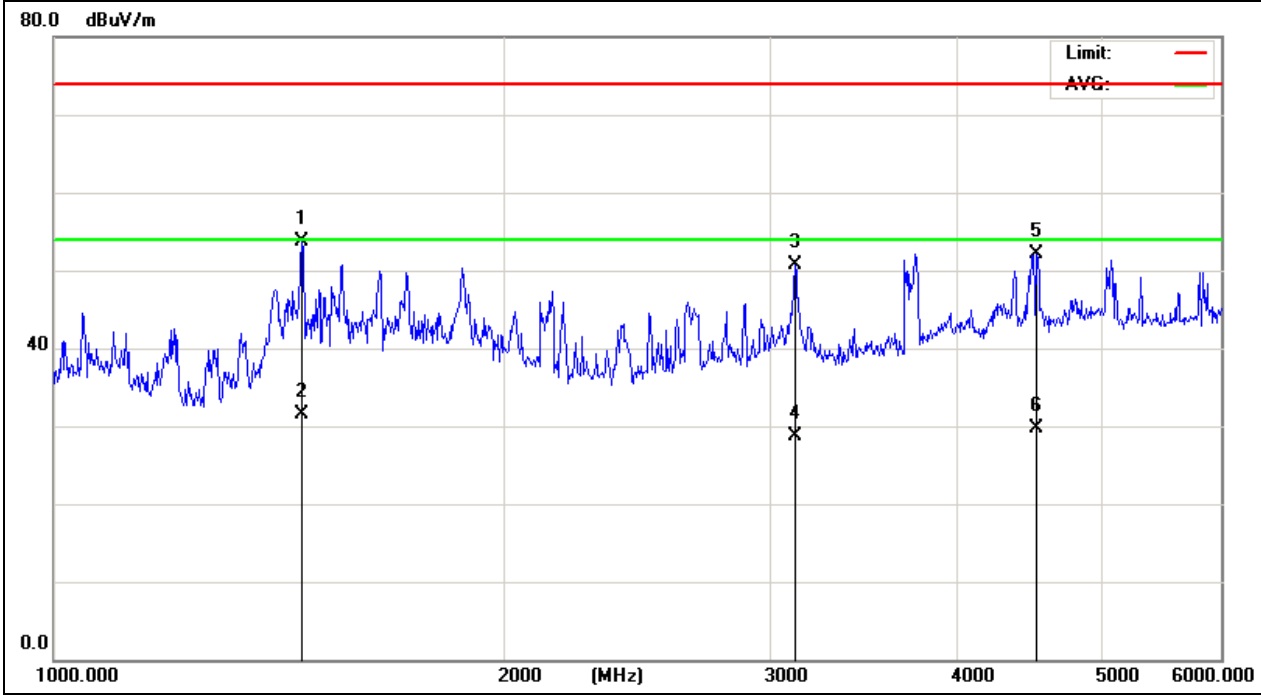
Remark:
Factor = Antenna Factor + Cable Loss.



EUT:	BeagleBone Green	Model Name :	BeagleBone Green
Temperature:	24℃	Relative Humidity:	54%
Pressure:	1010hPa	Test Date:	2015-06-09
Test Mode:	Running	Polarization:	Vertical
Test Power:	DC 5V from Notebook		

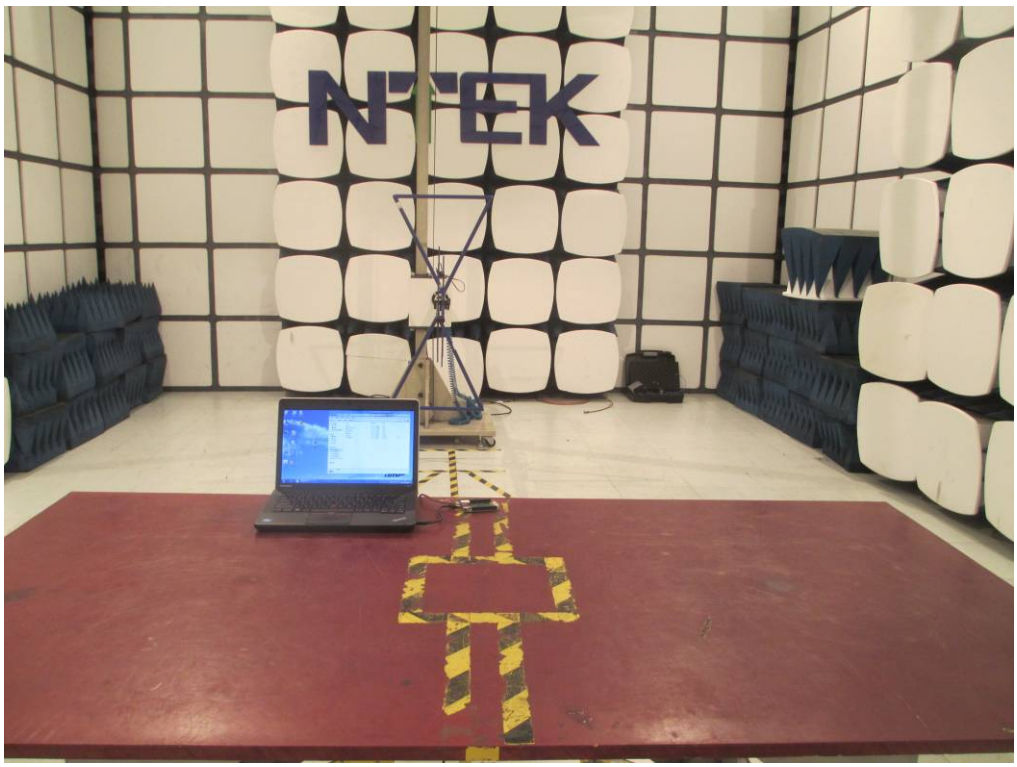
Freq. (MHz)	Reading (dBμV/m)	Factor (dB)	Measurement (dBμV/m)	Limit (dBμV/m)	Over (dB)	Detector
1462.0700	64.49	-10.69	53.80	74.00	-20.20	peak
1462.0700	42.24	-10.69	31.55	54.00	-22.45	AVG
3119.7950	56.54	-5.90	50.64	74.00	-23.36	peak
3119.7950	34.52	-5.90	28.62	54.00	-25.38	AVG
4520.6760	52.46	-0.36	52.10	74.00	-21.90	peak
4520.6760	30.16	-0.36	29.80	54.00	-24.20	AVG

Remark:
Factor = Antenna Factor + Cable Loss.



4. EUT TEST PHOTO

Radiated Measurement Photos



ATTACHMENT PHOTOGRAPHS OF EUT

Photo 1

Photo 2

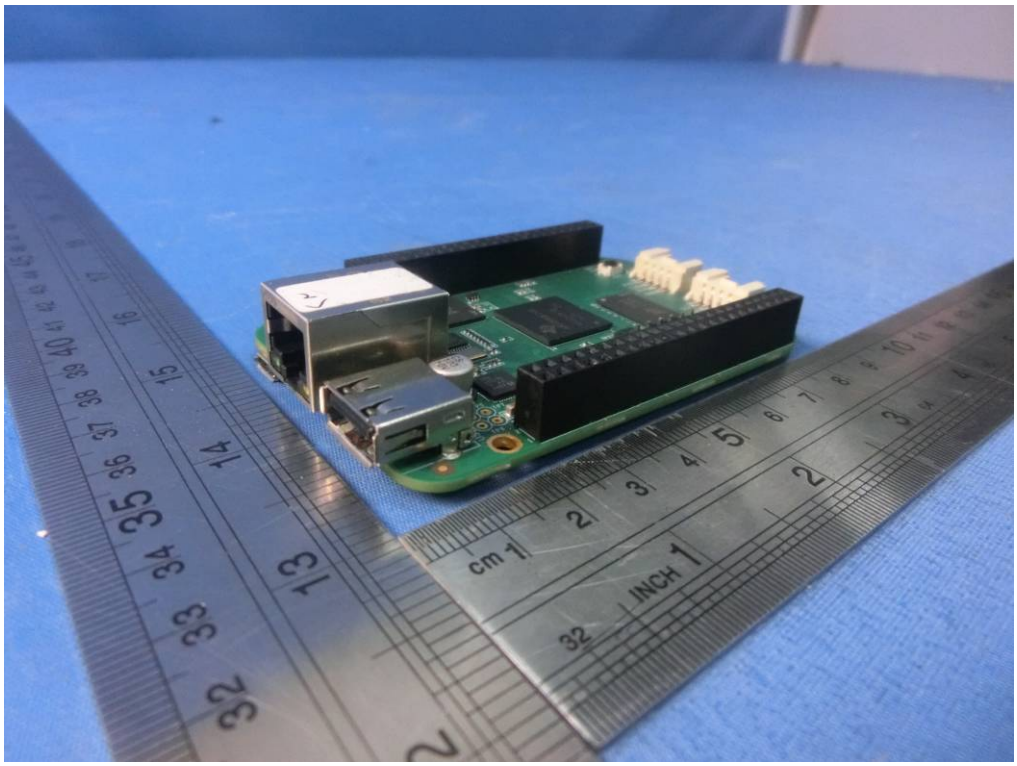


Photo 3