ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT
INTENTIONAL RADIATOR CERTIFICATION TO
FCC PART 15 SUBPART C REQUIREMENT

OF

Bluetooth Clip-on Speaker

Model No.: iWBT1, iWBT1X(X denotes as color of cabinet)

Trademark: iHome

FCC ID: EMOIWBT1

Report No.: KAD150528149E1

Issue Date: October 31, 2015

Prepared for

SDI Technologies Inc
1299, Main Street, Rahway, NJ 07065, U.S.A.

Prepared by

DONGGUAN EMTEK CO., LTD.

No.281, Guantai Road, Nancheng District,
Dongguan, Guangdong, China
TEL: 86-769-22807078
FAX: 86-769-22807079

This report shall not be reproduced, except in full, without the written approval of DONGGUAN EMTEK CO., LTD.

VERIFICATION OF COMPLIANCE

Applicant:	SDI Technologies Inc 1299, Main Street, Rahway, NJ 07065, U.S.A.
Manufacturer:	SDI Technologies Inc 1299, Main Street, Rahway, NJ 07065, U.S.A.
Product Description:	Bluetooth Clip-on Speaker
Trade Mark:	iHome
Model Number:	iWBT1, iWBT1X(X denotes as color of cabinet) (Note: The samples are the same except difference color and model number. So iWBT1 was selected for full test.)

We hereby certify that:

The above equipment was tested by DONGGUAN EMTEK CO., LTD. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10-2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.247(2015).

Date of Test : May 28, 2015 to August 20, 2015

Prepared by : Ivy Huang/Editor

Reviewer : Alan He/Supervisor

Approved & Authorized Signer : Sam Lv/Manager

Modified Information

Version	Summary	Revision Date	Report No.
Ver.1.0	Original Report	/	KAD150528149E1

Table of Contents

1. GENERAL INFORMATION 6
1.1 PRODUCT DESCRIPTION 6
1.2 TEST METHODOLOGY 6
1.3 TEST FACILITY 7
2. SYSTEM TEST CONFIGURATION 8
2.1 EUT CONFIGURATION 8
2.2 EUT EXERCISE 8
2.3 TEST PROCEDURE 8
2.4 CONFIGURATION OF TESTED SYSTEM 9
3. SUMMARY OF TEST RESULTS 10
4. DESCRIPTION OF TEST MODES 11
5. TEST SYSTEM UNCERTAINTY 11
6. CONDUCTED EMISSIONS TEST 13
6.1 MEASUREMENT PROCEDURE: 13
6.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) 13
6.3 MEASUREMENT EQUIPMENT USED: 13
6.4 MEASUREMENT RESULT: 13
6.5 CONDUCTED MEASUREMENT PHOTOS: 16
7. RADIATED EMISSION TEST 17
7.1 MEASUREMENT PROCEDURE 17
7.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) 19
7.3 MEASUREMENT EQUIPMENT USED: 20
7.4 RADIATED EMISSION LIMIT 21
7.5 MEASUREMENT RESULT 22
7.5 RADIATED MEASUREMENT PHOTOS: 34
8. CHANNEL SEPARATION TEST 35
8.1 MEASUREMENT PROCEDURE 35
8.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) 35
8.3 MEASUREMENT EQUIPMENT USED: 35
8.4 MEASUREMENT RESULTS: 35
9. 20DB BANDWIDTH TEST 42
9.1 MEASUREMENT PROCEDURE 42
9.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) 42
9.3 MEASUREMENT EQUIPMENT USED: 42
9.4 MEASUREMENT RESULTS: 42
10. QUANTITY OF HOPPING CHANNEL TEST 49

10.1 MEASUREMENT PROCEDURE 49
10.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) 49
10.3 MEASUREMENT EQUIPMENT USED: 49
10.4 MEASUREMENT RESULTS: 49
11. TIME OF OCCUPANCY (DWELL TIME) TEST 50
11.1 TEST DESCRIPTION 50
11.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) 50
11.3 MEASUREMENT EQUIPMENT USED: 50
11.4 TEST REQUIREMENTS / LIMITS 50
11.5 TEST RESULT 51
12. MAXIMUM PEAK OUTPUT POWER TEST 53
12.1 MEASUREMENT PROCEDURE 53
12.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) 53
12.3 MEASUREMENT EQUIPMENT USED: 53
12.4 MEASUREMENT RESULTS: 54
13. BAND EDGE TEST 60
13.1 MEASUREMENT PROCEDURE 60
13.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) 60
13.3 MEASUREMENT EQUIPMENT USED: 61
13.4 MEASUREMENT RESULTS: 62
14. ANTENNA APPLICATION 64
14.1 ANTENNA REQUIREMENT 64
14.2 RESULT 64

Appendix I (Photos of EUT) (6 pages)

1. GENERAL INFORMATION

1.1 Product Description

Characteristics	Description
Product Name	Bluetooth Clip-on Speaker
Model number	IWBT1
Power Supply	DC 5V, 1A or DC 3.7V, 280mA Lithium Battery
Kind of Device	Bluetooth Ver.2.1+EDR
Modulation	GFSK, π/4-DQPSK, 8DPSK
Operating Frequency Range	2402-2480MHz
Number of Channels	79
Transmit Power Max (Peak Power)	0.98dBm(0.001253W)
Antenna Type	Internal PCB antenna
Antenna Gain	0dBi
Product Software Version	iWBT1_150603
Product Hardware version	iWBT1_2015_0627
Radio Software Version	iwbt1_150717
Radio Hardware version	CSM_006_0A
Test Software Version	BlueSuite 2.5.0

1.2 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10-2013 and FCC Public Notice DA 00-705. Radiated testing was performed at an antenna to EUT distance 3 meters.

1.3 Test Facility

Site Description

EMC Lab.	:	Registered on FCC, June 18, 2014 The Certificate Number is 247565. Registered on Industry Canada, February 19, 2014 The Certificate Number is 9444A
Name of Firm	:	DONGGUAN EMTEK CO., LTD.
Site Location	:	No.281, Guantai Road, Nancheng District, Dongguan, Guangdong, China

2. System Test Configuration

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

The Transmitter was operated in the normal operating mode. The Tx frequency was fixed which was for the purpose of the measurements.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.10-2013. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and average detector mode.

2.3.2 Radiated Emissions

Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of EUT was rotated through three orthogonal axes according to the requirements in Section 13.1.4.1 of ANSI C63.10-2013.

2.4 Configuration of Tested System

Fig. 2-1 Configuration of Tested System

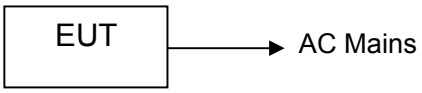


Table 2-1 Equipment Used in Tested System

Item	Equipment	Trademark	Model No.	FCC ID	Note
1.	Bluetooth Clip-on Speaker	iHome	iWBT1	EMOIWBT1	***EUT***
2	Adapter	N/A	YSV6-0501000 US Input: AC 100-240V, 50/60Hz Output: DC 5V, 1000mA	N/A	***Support Equipment***

Note:

(1) Unless otherwise denoted as EUT in『Remark』column , device(s) used in tested system is a support equipment.

3. Summary of Test Results

FCC Rules	Description Of Test	Result
§15.207	AC Power Conducted Emission	Compliant
§15.247(d),§15.209	Radiated Emission	Compliant
§15.247(a)(1)	Channel Separation test	Compliant
§15.247(a)(1)	20dB Bandwidth	Compliant
§15.247(a)(1)(iii)	Quantity of Hopping Channel	Compliant
§15.247(a)(1)(iii)	Time of Occupancy(Dwell Time)	Compliant
§15.247(b)	Max Peak output Power test	Compliant
§15.247(d)	Band edge test	Compliant
§15.203	Antenna Requirement	Compliant

Remark:

1. The EUT is powered by fully-charged battery during the test.

.

4. Description of test modes

The EUT has been tested under its typical operating condition. Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting. Only the worst case data were reported.

The EUT has been associated with peripherals pursuant to ANSI C63.10-2013 and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation (9 KHz to the 10th harmonics of the highest fundamental frequency or to 40 GHz, whichever is lower).

For Radiated: The EUT's antenna was pre-tested under the following modes:

Test Mode	Description
Mode A	**X-Y axis**
Mode B	Y-Z axis
Mode C	X-Z axis

From the above modes, the worst case was found in Mode A. Therefore only the test data of the mode was recorded in this report.

The EUT has been tested under TX operating condition.

This EUT is a FHSS system, were conducted to determine the final configuration from all possible combinations. We use a notebook which had installed the fixed frequency software, and then combined the EUT and notebook by a fixed frequency tool, finally run the software to control the EUT, Let EUT fixed at the lowest, middle, or highest channel. All the modes GFSK, Π/4-DQPSK, 8DPSK have been tested. 79 Channels are provided by EUT.

Channel	**Frequency(MHz)**
1	2402
40	2441
79	2480

5. TEST SYSTEM UNCERTAINTY

The following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty
Radio Frequency	±1x10^-5
Maximum Peak Output Power Test	±1.0dB
Conducted Emissions Test	±2.0dB
Radiated Emission Test	±2.0dB
Power Density	±2.0dB
Occupied Bandwidth Test	±1.0dB
Band Edge Test	±3dB
All emission, radiated	±3dB
Antenna Port Emission	±3dB
Temperature	±0.5℃
Humidity	±3%

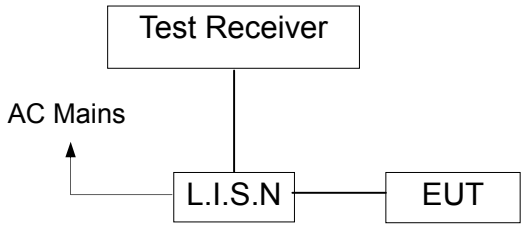
Remark: The coverage Factor (k=2), and measurement Uncertainty for a level of Confidence of 95%

6. Conducted Emissions Test

6.1 Measurement Procedure:

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured was complete.

6.2 Test SET-UP (Block Diagram of Configuration)



6.3 Measurement Equipment Used:

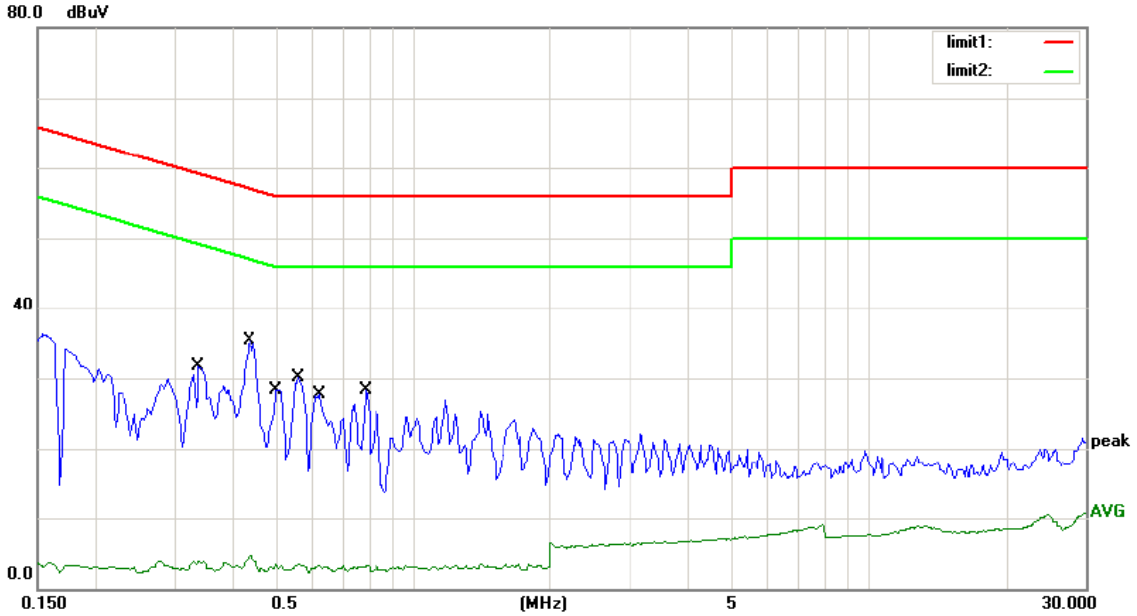
Conducted Emission Test Site						
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**Characteristics**	**Last Cal.**	**Due date**
Test Receiver	Rohde & Schwarz	ESCS30	100018	9kHz~3GHz	03/15/2015	03/14/2016
L.I.S.N	Rohde & Schwarz	ENV216	100017	9KHz-300MHz	03/15/2015	03/14/2016
RF Switching Unit	CDS	RSU-M2	38401	9KHz-300MHz	03/15/2015	03/14/2016
Coaxial Cable	CDS	79254	46107086	9kHz~3GHz	03/15/2015	03/14/2016

6.4 Measurement Result:

Pass.

All the modulation modes were tested the data of the worst mode (GFSK TX 2402MHz) are recorded in the following pages and the others modulation methods do not exceed the limits.

Please refer to the following data.



Site site #1 Phase: *L1* Temperature: 24

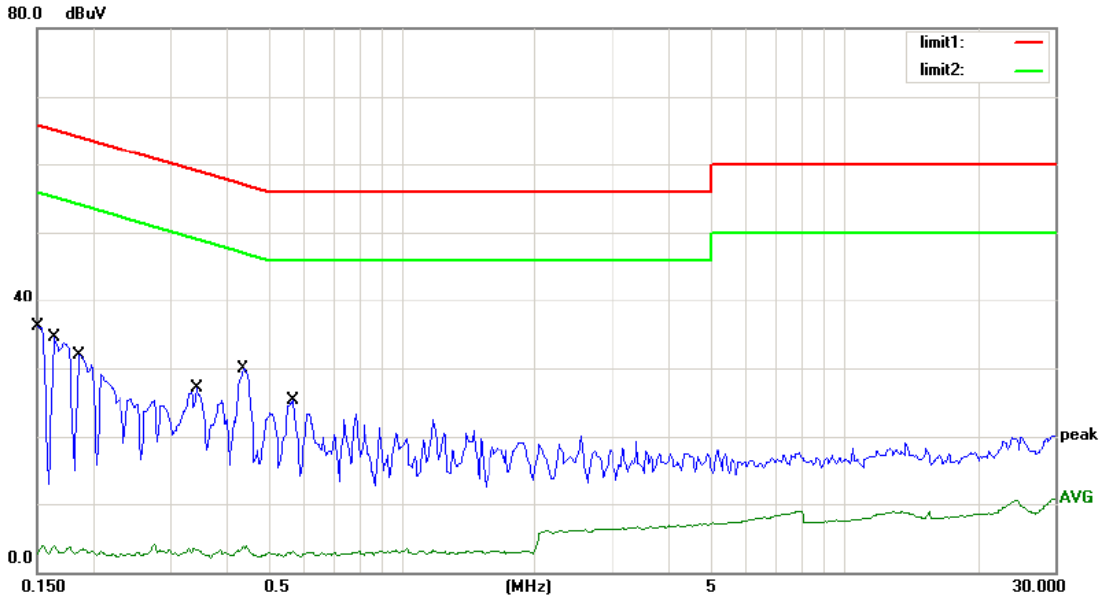
Limit: (CE)FCC Part 15 B_QP Power: AC120V/60Hz Humidity: 55 %

Mode: TX2402

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.3390	28.51	0.00	28.51	59.23	-30.72	QP	
2		0.3390	3.82	0.00	3.82	49.23	-45.41	AVG	
3		0.4380	32.54	0.00	32.54	57.10	-24.56	QP	
4		0.4380	4.68	0.00	4.68	47.10	-42.42	AVG	
5		0.5010	25.47	0.00	25.47	56.00	-30.53	QP	
6		0.5010	3.43	0.00	3.43	46.00	-42.57	AVG	
7		0.5594	28.64	0.00	28.64	56.00	-27.36	QP	
8		0.5594	3.46	0.00	3.46	46.00	-42.54	AVG	
9		0.6225	25.41	0.00	25.41	56.00	-30.59	QP	
10		0.6225	3.35	0.00	3.35	46.00	-42.65	AVG	
11	*	0.7890	35.64	0.00	35.64	56.00	-20.36	QP	
12		0.7890	3.31	0.00	3.31	46.00	-42.69	AVG	

*:Maximum data x:Over limit !:over margin Comment: Factor build in receiver.



Site site #1 Phase: N Temperature: 24

Limit: (CE)FCC Part 15 B_QP Power: AC120V/60Hz Humidity: 55 %

Mode: TX2402

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1500	34.51	0.00	34.51	66.00	-31.49	QP	
2		0.1500	4.00	0.00	4.00	56.00	-52.00	AVG	
3		0.1635	32.41	0.00	32.41	65.28	-32.87	QP	
4		0.1635	3.99	0.00	3.99	55.28	-51.29	AVG	
5		0.1860	28.47	0.00	28.47	64.21	-35.74	QP	
6		0.1860	3.47	0.00	3.47	54.21	-50.74	AVG	
7		0.3435	25.41	0.00	25.41	59.12	-33.71	QP	
8		0.3435	3.41	0.00	3.41	49.12	-45.71	AVG	
9	*	0.4380	28.67	0.00	28.67	57.10	-28.43	QP	
10		0.4380	3.90	0.00	3.90	47.10	-43.20	AVG	
11		0.5685	23.41	0.00	23.41	56.00	-32.59	QP	
12		0.5685	3.03	0.00	3.03	46.00	-42.97	AVG	

*:Maximum data x:Over limit !:over margin Comment: Factor build in receiver.

6.5 Conducted Measurement Photos:

7. Radiated Emission Test

7.1 Measurement Procedure

1. The testing follows the guidelines in Spurious Radiated Emissions of ANSI C63.10-2013.
2. Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane.
3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (From 1m to 4m) and turntable (from 0 degree to 360 degree) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Final measurement (Above 1GHz): The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1MHz. The measurement will be performed in horizontal and vertical polarization of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 degree to 360 degree in order to have the antenna inside the cone of radiation.
7. Test Procedure of measurement (For Above 1GHz):
   1) Monitor the frequency range at horizontal polarization and move the antenna over all sides of the EUT(if necessary move the EUT to another orthogonal axis).
   2) Change the antenna polarization and repeat 1) with vertical polarization.
   3) Make a hardcopy of the spectrum.
   4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
   5) Change the analyser mode to Clear/ Write and found the cone of emission.
   6) Rotate and move the EUT, so that the measuring distance can be enlarged to 3m and the antenna will be still inside the cone of emission.
   7) Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarization and azimuth and the peak and average detector, which causes the maximum emission.
   8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beamwidth.

Use the following spectrum analyzer settings:

When spectrum scanned from 30MHz to 1GHz setting resolution bandwidth 120KHz and video bandwidth 300KHz:

EMI Test Receiver	Setting
Attenuation	Auto
RB	120KHz
VB	300KHz
Detector	QP
Trace	Max hold

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 3MHz:

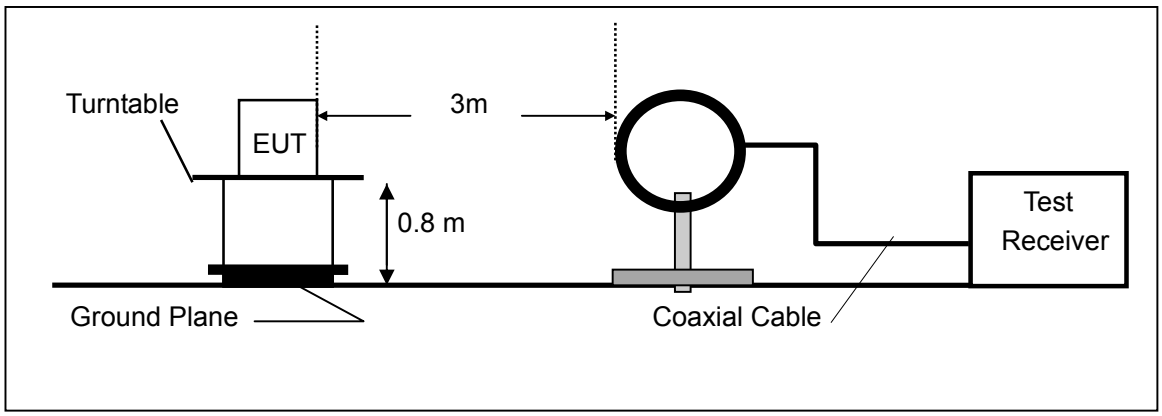
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	3MHz
Detector	Peak
Trace	Max hold

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 10Hz:

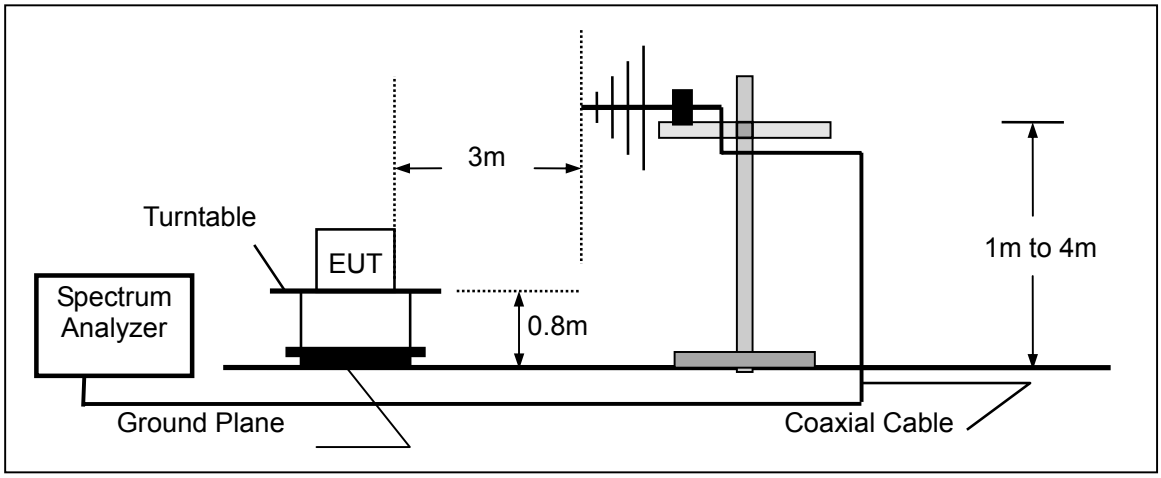
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	10Hz
Detector	Peak
Trace	Max hold

7.2 Test SET-UP (Block Diagram of Configuration)

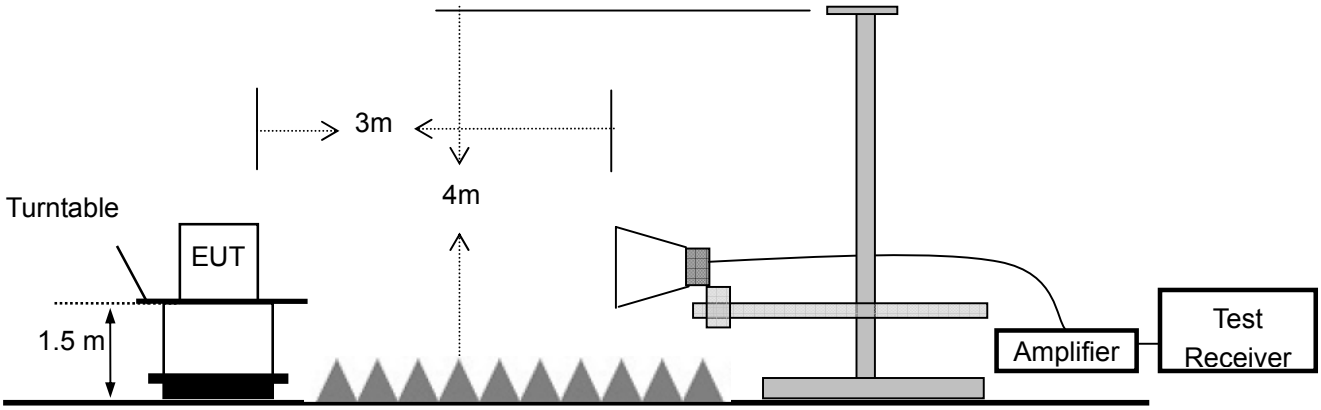
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(C) Radiated Emission Test Set-Up, Frequency above 1000MHz



7.3 Measurement Equipment Used:

Item	Equipment	Manufacturer	Model No.	Serial No.	Characteristics	Last Cal.	Cal. Interval
1.	Test Receiver	Rohde & Schwarz	ESCI	1166.5950.03	9KHz-3GHz	3/15/2015	1 Year
2.	Loop Antenna	Schwarzbeck	FMZB 1519	012	9 KHz -30MHz	12/29/2014	1 Year
3.	Bilog Antenna	Schwarzbeck	VULB9163	000141	25MHz-2GHz	3/15/2015	1 Year
4.	Power Amplifier	CDS	RSU-M352	818	1MHz-1GHz	3/15/2015	1 Year
5.	Power Amplifier	HP	8447F	OPT H64	1GHz-26.5GHz	3/15/2015	1 Year
6.	Color Monitor	SUNSPO	SP-140A	N/A	--	3/15/2015	1 Year
7.	Single Line Filter	JIANLI	XL-3	N/A	--	3/15/2015	1 Year
8.	Single Phase Power Line Filter	JIANLI	DL-2X100B	N/A	--	3/15/2015	1 Year
9.	3 Phase Power Line Filter	JIANLI	DL-4X100B	N/A	--	3/15/2015	1 Year
10.	DC Power Filter	JIANLI	DL-2X50B	N/A	--	3/15/2015	1 Year
11.	Cable	Schwarzbeck	PLF-100	549489	9KHz-3GHz	3/15/2015	1 Year
12.	Cable	Rosenberger	CIL02	A0783566	9KHz-3GHz	3/15/2015	1 Year
13.	Cable	Rosenberger	RG 233/U	525178	9KHz-3GHz	3/15/2015	1 Year
14.	Signal Analyzer	Rohde & Schwarz	FSV30	103040	9KHz-40GHz	12/29/2014	1 Year
15.	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1272	1GHz-18GHz	12/29/2014	1 Year
16.	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170399	14GHz -26.5GHz	12/29/2014	1 Year
17.	Power Amplifier	LUNAR EM	LNA1G18-40	J10100000081	1GHz-26.5GHz	12/29/2014	1 Year
18.	Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	12/29/2014	1 Year
19.	Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	12/29/2014	1 Year
20.	Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	12/29/2014	1 Year

7.4 Radiated Emission Limit

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table 15.209(a):

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

15.205 Restricted bands of operation

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])

Remark : 1. Emission level in dBuV/m=20 log (uV/m)
2. Measurement was performed at an antenna to the closed point of EUT distance of meters.
3. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of ξ 15.205, and the emissions located in restricted bands also comply with 15.209 limit.

7.5 Measurement Result

Below 30MHz:

Operation Mode:	TX	Test Date :	July 30, 2015
Frequency Range:	9KHz~30MHz	Temperature :	28℃
Test Result:	PASS	Humidity :	65 %
Measured Distance:	3m	Test By:	Andy

Freq. (MHz)	Ant.Pol. H/V	Emission Level (dBuV/m)	Limit 3m (dBuV/m)	Over (dB)
--	--	--	--	--

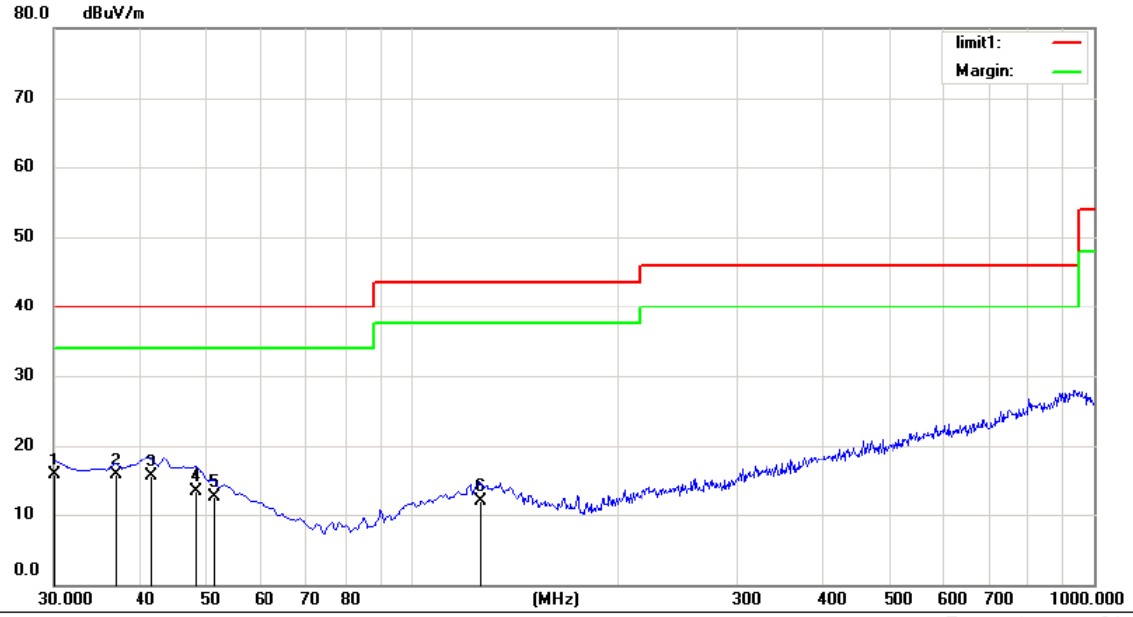
Note: The low frequency, which started from 9KHz-30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

Below 1000MHz:

Pass.

All the modulation modes were tested the data of the worst mode (TX 2402MHz) are recorded in the following pages and the others modulation methods do not exceed the limits.

Please refer to the following data.



Site Chamber #1 Polarization: **Horizontal** Temperature: 24

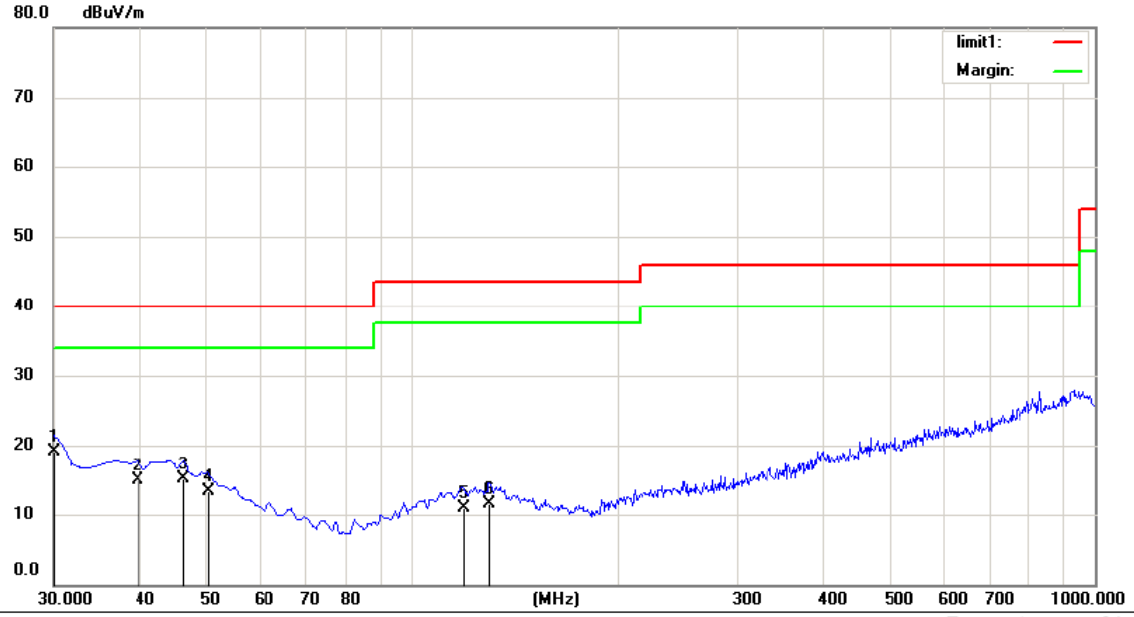
Limit: (RE)FCC PART 15 class B 3m Power: Battery 3.7V Humidity: 55 %

Mode: TX 2402(GFSK)

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	30.0000	30.95	-15.15	15.80	40.00	-24.20	QP			
2		36.7900	29.64	-13.95	15.69	40.00	-24.31	QP			
3		41.6400	29.16	-13.58	15.58	40.00	-24.42	QP			
4		48.4300	28.11	-14.74	13.37	40.00	-26.63	QP			
5		51.3400	28.52	-15.96	12.56	40.00	-27.44	QP			
6		126.0300	28.25	-16.37	11.88	43.50	-31.62	QP			

*:Maximum data x:Over limit !:over margin Operator:



Site Chamber #1 Polarization: **Vertical** Temperature: 24

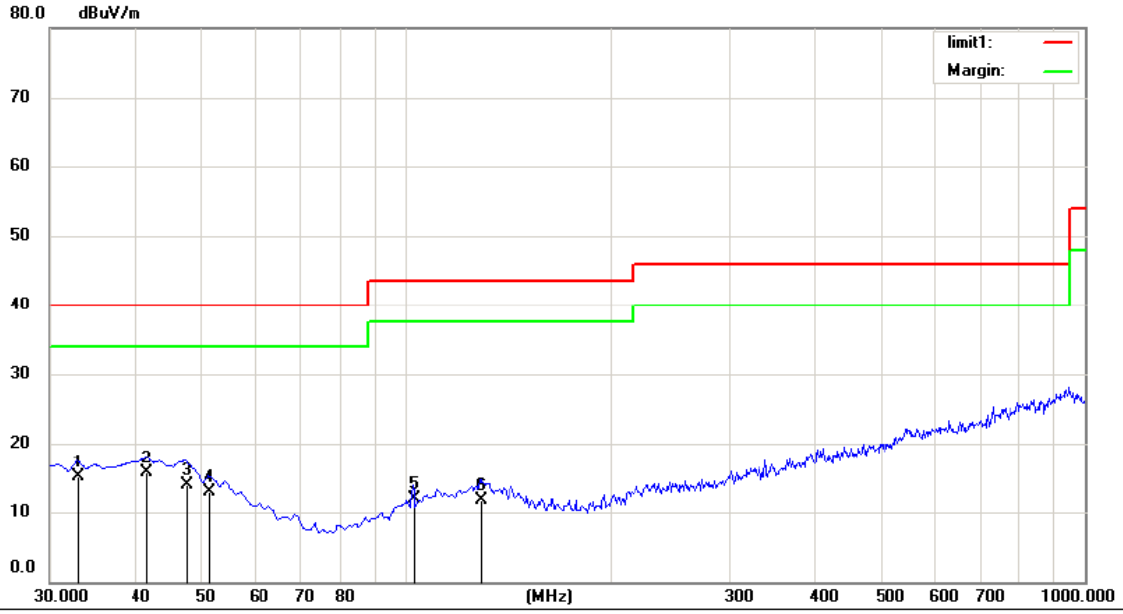
Limit: (RE)FCC PART 15 class B 3m Power: Battery 3.7V Humidity: 55 %

Mode: TX 2402(GFSK)

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	30.0000	34.28	-15.15	19.13	40.00	-20.87	QP			
2		39.7000	28.69	-13.71	14.98	40.00	-25.02	QP			
3		46.4900	29.14	-14.06	15.08	40.00	-24.92	QP			
4		50.3700	28.79	-15.58	13.21	40.00	-26.79	QP			
5		119.2400	27.95	-17.01	10.94	43.50	-32.56	QP			
6		129.9100	27.83	-16.35	11.48	43.50	-32.02	QP			

*:Maximum data x:Over limit !:over margin Operator:



Site Chamber #1 Polarization: **Horizontal** Temperature: 24

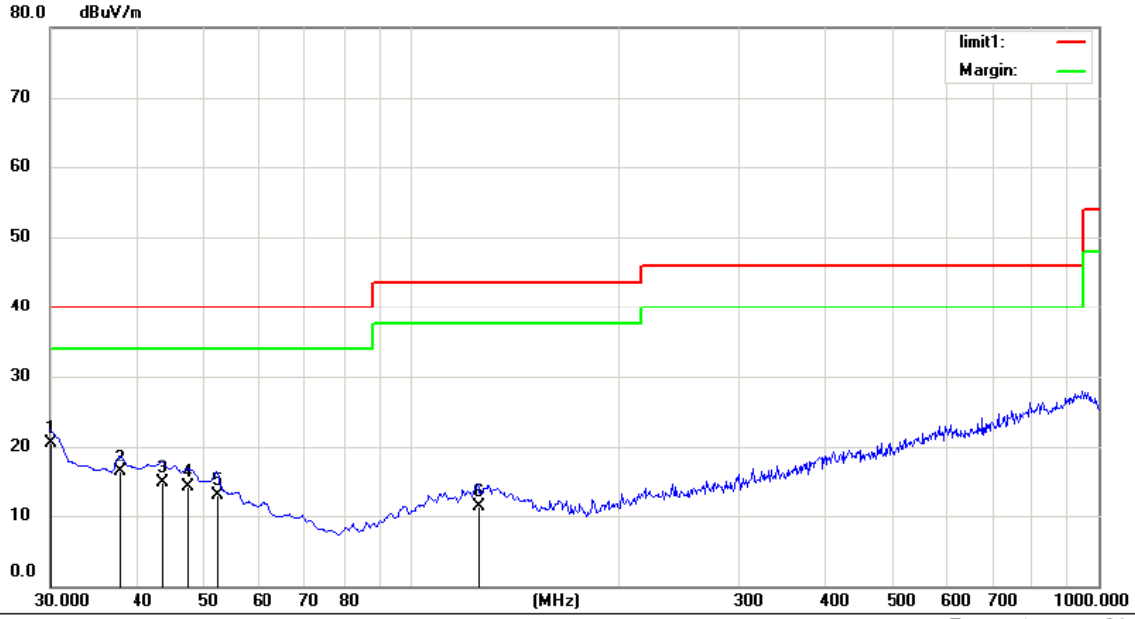
Limit: (RE)FCC PART 15 class B 3m Power: Battery 3.7V Humidity: 55 %

Mode: TX 2402(Pi/4-DQPSK)

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		32.9100	29.64	-14.46	15.18	40.00	-24.82	QP			
2	*	41.6400	29.33	-13.58	15.75	40.00	-24.25	QP			
3		47.8260	28.51	-14.51	14.00	40.00	-26.00	QP			
4		51.3400	28.96	-15.96	13.00	40.00	-27.00	QP			
5		102.7500	30.45	-18.59	11.86	43.50	-31.64	QP			
6		128.9400	27.91	-16.27	11.64	43.50	-31.86	QP			

*:Maximum data x:Over limit !:over margin Operator:



Site Chamber #1 Polarization: **Vertical** Temperature: 24

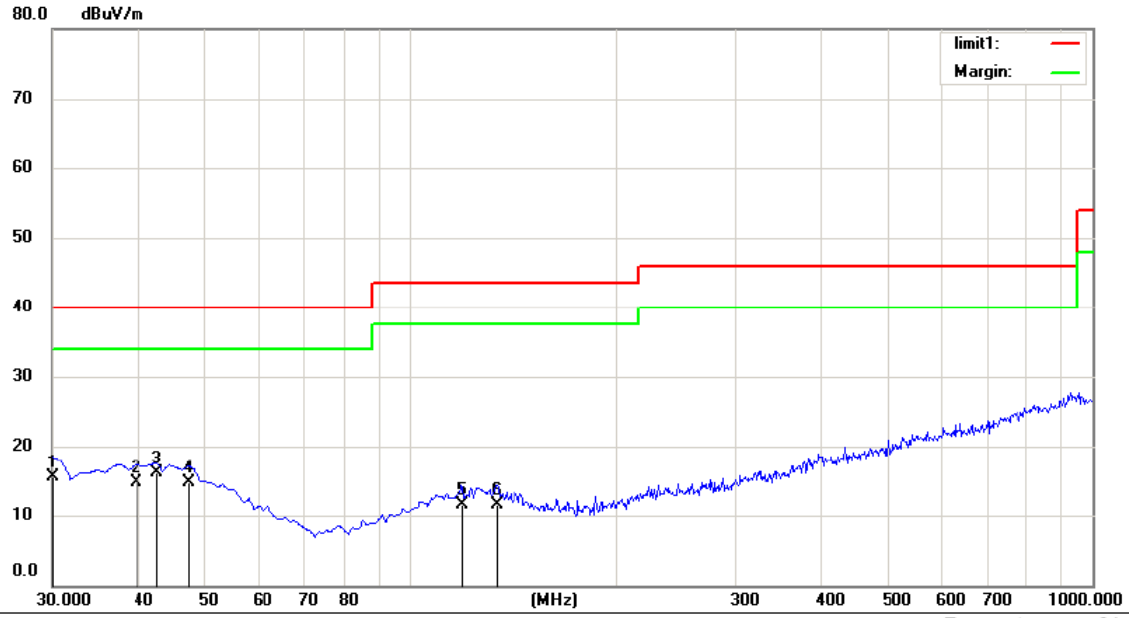
Limit: (RE)FCC PART 15 class B 3m Power: Battery 3.7V Humidity: 55 %

Mode: TX 2402(Pi/4-DQPSK)

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	30.0000	35.62	-15.15	20.47	40.00	-19.53	QP			
2		37.7600	30.21	-13.84	16.37	40.00	-23.63	QP			
3		43.5800	28.01	-13.37	14.64	40.00	-25.36	QP			
4		47.4600	28.56	-14.38	14.18	40.00	-25.82	QP			
5		52.3100	29.14	-16.32	12.82	40.00	-27.18	QP			
6		125.0600	27.65	-16.40	11.25	43.50	-32.25	QP			

*:Maximum data x:Over limit !:over margin Operator:



Site Chamber #1 Polarization: **Horizontal** Temperature: 24

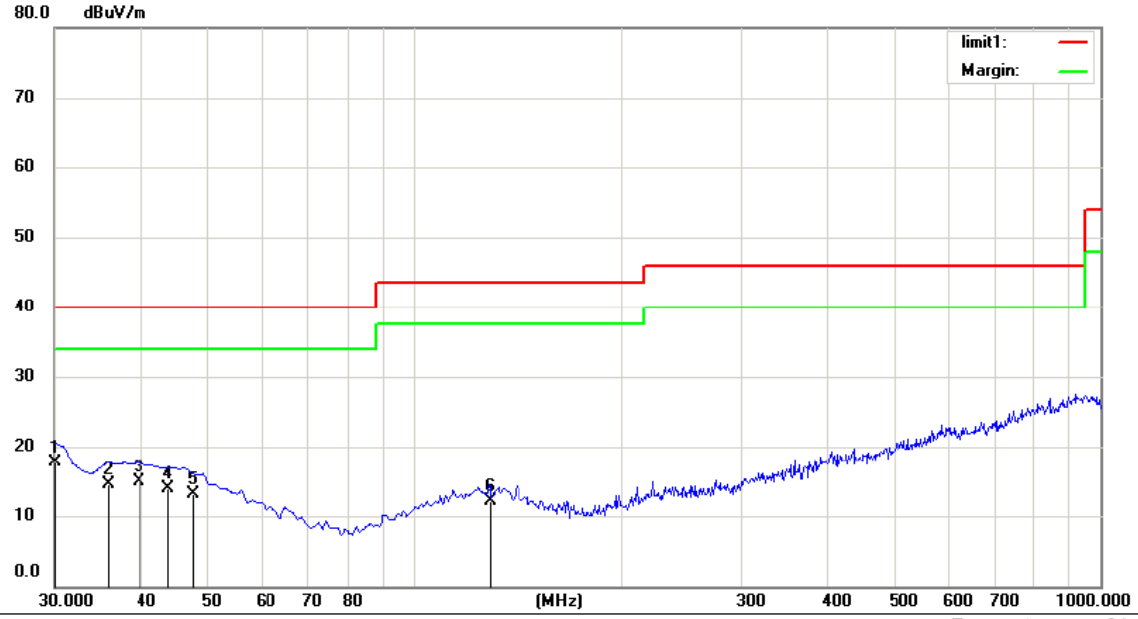
Limit: (RE)FCC PART 15 class B 3m Power: Battery 3.7V Humidity: 55 %

Mode: TX 2402(8DPSK)

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		30.0000	30.70	-15.15	15.55	40.00	-24.45	QP			
2		39.7146	28.43	-13.70	14.73	40.00	-25.27	QP			
3	*	42.6100	29.59	-13.49	16.10	40.00	-23.90	QP			
4		47.4600	29.08	-14.38	14.70	40.00	-25.30	QP			
5		119.2400	28.60	-17.01	11.59	43.50	-31.91	QP			
6		133.7900	27.88	-16.43	11.45	43.50	-32.05	QP			

*:Maximum data x:Over limit !:over margin Operator:



Site Chamber #1 Polarization: **Vertical** Temperature: 24

Limit: (RE)FCC PART 15 class B 3m Power: Battery 3.7V Humidity: 55 %

Mode: TX 2402(8DPSK)

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	30.0000	32.78	-15.15	17.63	40.00	-22.37	QP			
2		35.8200	28.55	-14.08	14.47	40.00	-25.53	QP			
3		39.7146	28.61	-13.70	14.91	40.00	-25.09	QP			
4		43.9658	27.32	-13.33	13.99	40.00	-26.01	QP			
5		47.8260	27.69	-14.51	13.18	40.00	-26.82	QP			
6		128.9400	28.38	-16.35	12.03	43.50	-31.47	QP			

*:Maximum data x:Over limit !:over margin Operator:

Above 1000MHz~10th Harmonics:

Operation Mode: GFSK (CH1: 2402MHz) Test Date : July 30, 2015

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4804	V	64.29	45.02	74	54	-9.71	-8.98
7206	V	63.62	44.19	74	54	-10.38	-9.81
9608	V	62.08	43.61	74	54	-11.92	-10.39
12010	V	61.85	42.78	74	54	-12.15	-11.22
14412	V	60.02	41.26	74	54	-13.98	-12.74
16814	V	59.18	40.91	74	54	-14.82	-13.09
4804	H	64.42	44.92	74	54	-9.58	-9.08
7206	H	63.15	43.65	74	54	-10.85	-10.35
9608	H	62.45	42.81	74	54	-11.55	-11.19
12010	H	60.33	41.26	74	54	-13.67	-12.74
14412	H	59.74	40.22	74	54	-14.26	-13.78
16814	H	58.11	39.65	74	54	-15.89	-14.35

Operation Mode: GFSK (CH40: 2441MHz) Test Date : July 30, 2015

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4882	V	65.11	45.02	74	54	-8.89	-8.98
7323	V	64.92	44.29	74	54	-9.08	-9.71
9764	V	63.35	43.18	74	54	-10.65	-10.82
12205	V	62.1	42.65	74	54	-11.9	-11.35
14646	V	61.09	41.78	74	54	-12.91	-12.22
17087	V	60.85	39.44	74	54	-13.15	-14.56
4882	H	65.01	46.07	74	54	-8.99	-7.93
7323	H	64.88	44.76	74	54	-9.12	-9.24
9764	H	63.22	42.19	74	54	-10.78	-11.81
12205	H	62.47	41.05	74	54	-11.53	-12.95
14646	H	61.02	39.26	74	54	-12.98	-14.74
17087	H	59.28	38.65	74	54	-14.72	-15.35

Operation Mode: GFSK (CH79: 2480MHz) Test Date : July 30, 2015

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4960	V	64.92	44.95	74	54	-9.08	-9.05
7440	V	63.51	43.61	74	54	-10.49	-10.39
9920	V	62.19	41.3	74	54	-11.81	-12.7
12400	V	61.48	40.16	74	54	-12.52	-13.84
14880	V	60.32	39.65	74	54	-13.68	-14.35
17360	V	59.84	38.21	74	54	-14.16	-15.79
4960	H	65.29	45.02	74	54	-8.71	-8.98
7440	H	64.15	44.18	74	54	-9.85	-9.82
9920	H	63.24	43.65	74	54	-10.76	-10.35
12400	H	62.91	42.81	74	54	-11.09	-11.19
14880	H	60.23	40.77	74	54	-13.77	-13.23
17360	H	59.64	39.28	74	54	-14.36	-14.72

Operation Mode: Pi/4-DQPSK (CH1: 2402MHz) Test Date : July 30, 2015

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4804	V	65.09	45.02	74	54	-8.91	-8.98
7206	V	64.14	44.29	74	54	-9.86	-9.71
9608	V	62.35	43.09	74	54	-11.65	-10.91
12010	V	61.24	42.15	74	54	-12.76	-11.85
14412	V	60.64	41.03	74	54	-13.36	-12.97
16814	V	59.84	39.62	74	54	-14.16	-14.38
4804	H	64.21	44.91	74	54	-9.79	-9.09
7206	H	63.29	43.26	74	54	-10.71	-10.74
9608	H	62.46	42.84	74	54	-11.54	-11.16
12010	H	61.24	41.13	74	54	-12.76	-12.87
14412	H	60.48	40.17	74	54	-13.52	-13.83
16814	H	59.24	38.92	74	54	-14.76	-15.08

Operation Mode: Pi/4-DQPSK (CH40: 2441MHz) Test Date : July 30, 2015

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4882	V	66.03	45.26	74	54	-7.97	-8.74
7323	V	65.21	44.61	74	54	-8.79	-9.39
9764	V	64.89	43.85	74	54	-9.11	-10.15
12205	V	63.13	42.15	74	54	-10.87	-11.85
14646	V	62.51	41.02	74	54	-11.49	-12.98
17087	V	60.02	40.01	74	54	-13.98	-13.99
4882	H	65.26	44.69	74	54	-8.74	-9.31
7323	H	64.89	42.95	74	54	-9.11	-11.05
9764	H	63.25	41.05	74	54	-10.75	-12.95
12205	H	62.05	39.65	74	54	-11.95	-14.35
14646	H	61.64	38.85	74	54	-12.36	-15.15
17087	H	59.48	38.02	74	54	-14.52	-15.98

Operation Mode: Pi/4-DQPSK (CH79: 2480MHz) Test Date : July 30, 2015

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4960	V	66.09	45.31	74	54	-7.91	-8.69
7440	V	65.21	43.68	74	54	-8.79	-10.32
9920	V	64.95	42.7	74	54	-9.05	-11.3
12400	V	62.19	41.52	74	54	-11.81	-12.48
14880	V	59.28	40.53	74	54	-14.72	-13.47
17360	V	58.08	38.06	74	54	-15.92	-15.94
4960	H	64.93	45.74	74	54	-9.07	-8.26
7440	H	63.17	43.14	74	54	-10.83	-10.86
9920	H	61.34	42.86	74	54	-12.66	-11.14
12400	H	60.02	41.23	74	54	-13.98	-12.77
14880	H	59.28	39.65	74	54	-14.72	-14.35
17360	H	58.65	38.95	74	54	-15.35	-15.05

Operation Mode: 8DPSK (CH1: 2402MHz) Test Date : July 30, 2015

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4804	V	65.39	46.66	74	54	-8.61	-7.34
7206	V	64.71	45.57	74	54	-9.29	-8.43
9608	V	63.65	44.64	74	54	-10.35	-9.36
12010	V	62.56	43.51	74	54	-11.44	-10.49
14412	V	61.59	42.67	74	54	-12.41	-11.33
16814	V	60.39	41.67	74	54	-13.61	-12.33
4804	H	65.2	46.13	74	54	-8.8	-7.87
7206	H	64.57	45.92	74	54	-9.43	-8.08
9608	H	63.29	44.67	74	54	-10.71	-9.33
12010	H	62.95	43.67	74	54	-11.05	-10.33
14412	H	61.48	42.34	74	54	-12.52	-11.66
16814	H	60.93	41.93	74	54	-13.07	-12.07

Operation Mode: 8DPSK (CH40: 2441MHz) Test Date : July 30, 2015

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4882	V	65.09	46.88	74	54	-8.91	-7.12
7323	V	64.38	45.64	74	54	-9.62	-8.36
9764	V	63.64	44.38	74	54	-10.36	-9.62
12205	V	62.98	43.28	74	54	-11.02	-10.72
14646	V	61.37	42.18	74	54	-12.63	-11.82
17087	V	60.35	41.39	74	54	-13.65	-12.61
4882	H	66.98	45.29	74	54	-7.02	-8.71
7323	H	65.34	44.28	74	54	-8.66	-9.72
9764	H	64.72	43.78	74	54	-9.28	-10.22
12205	H	63.29	42.94	74	54	-10.71	-11.06
14646	H	62.48	41.67	74	54	-11.52	-12.33
17087	H	61.49	40.38	74	54	-12.51	-13.62

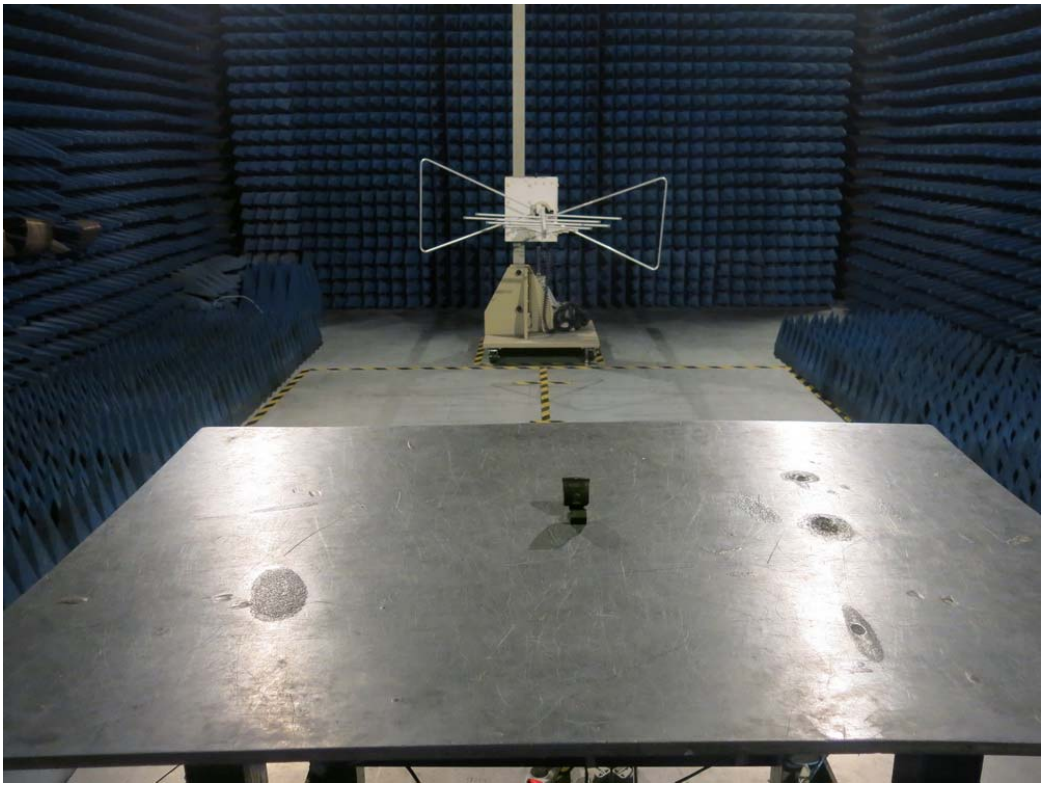
Operation Mode: 8DPSK (CH79: 2480MHz) Test Date : July 30, 2015

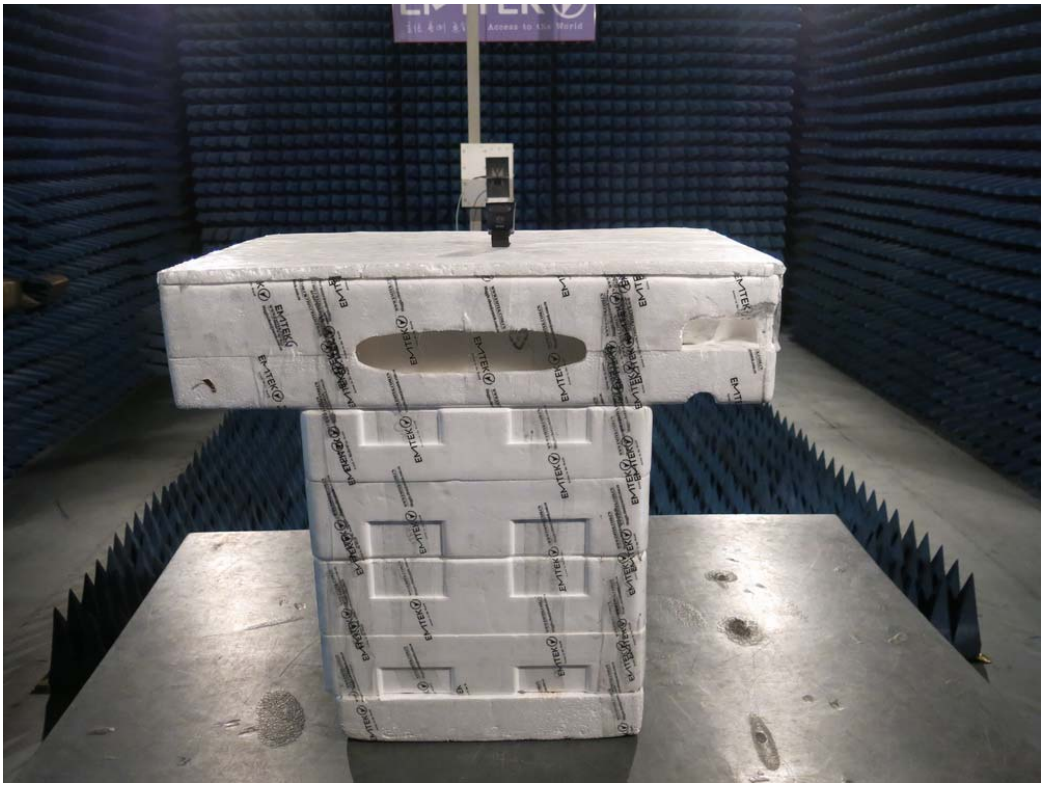
Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4960	V	64.19	45.12	74	54	-9.81	-8.88
7440	V	63.28	44.57	74	54	-10.72	-9.43
9920	V	62.89	43.64	74	54	-11.11	-10.36
12400	V	61.52	42.82	74	54	-12.48	-11.18
14880	V	60.93	41.29	74	54	-13.07	-12.71
17360	V	59.82	40.38	74	54	-14.18	-13.62
4960	H	65.24	45.06	74	54	-8.76	-8.94
7440	H	64.37	44.39	74	54	-9.63	-9.61
9920	H	63.85	43.29	74	54	-10.15	-10.71
12400	H	62.95	42.67	74	54	-11.05	-11.33
14880	H	61.76	41.34	74	54	-12.24	-12.66
17360	H	60.34	40.56	74	54	-13.66	-13.44

Other harmonics emissions are lower than 20dB below the allowable limit.

Note: (1) All Readings are Peak Value and AV.
(2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
(3) The average measurement was not performed when the peak measured data under the limit of average detection.
(4) Measuring frequencies from 1GHz to 25GHz.

7.5 Radiated Measurement Photos:



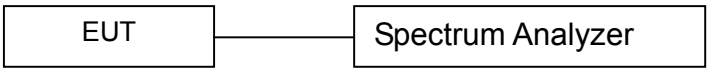


8. Channel Separation test

8.1 Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

8.2 Test SET-UP (Block Diagram of Configuration)



8.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	03/15/2015	03/14/2016
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	03/15/2015	03/14/2016
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	03/15/2015	03/14/2016

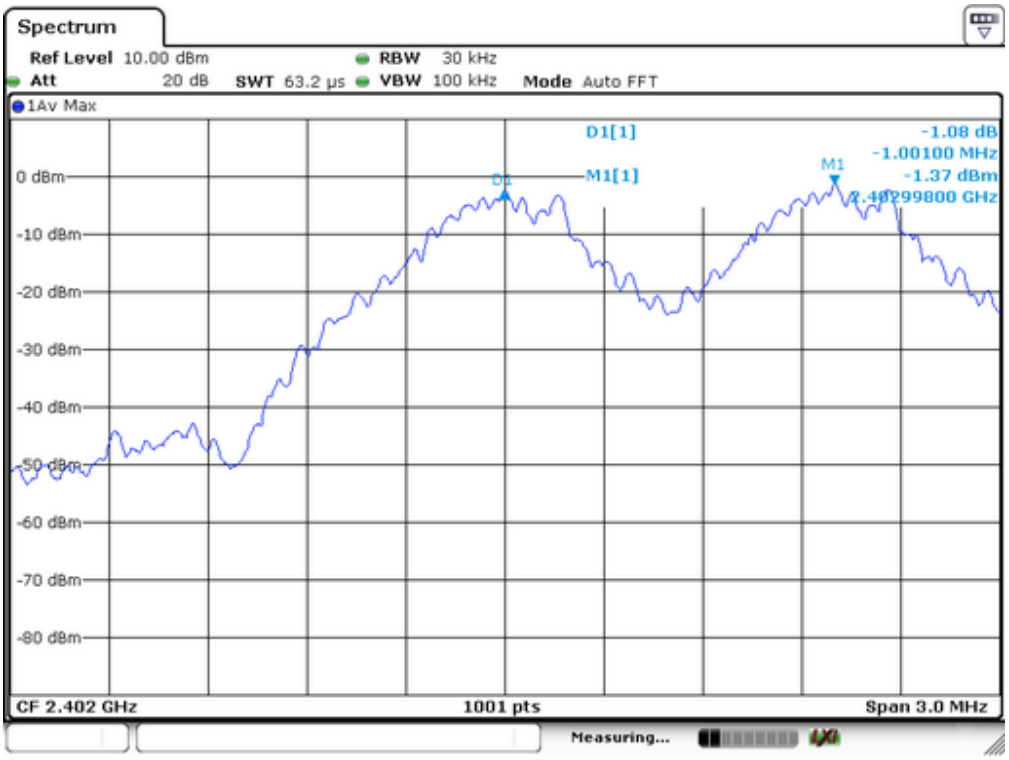
Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

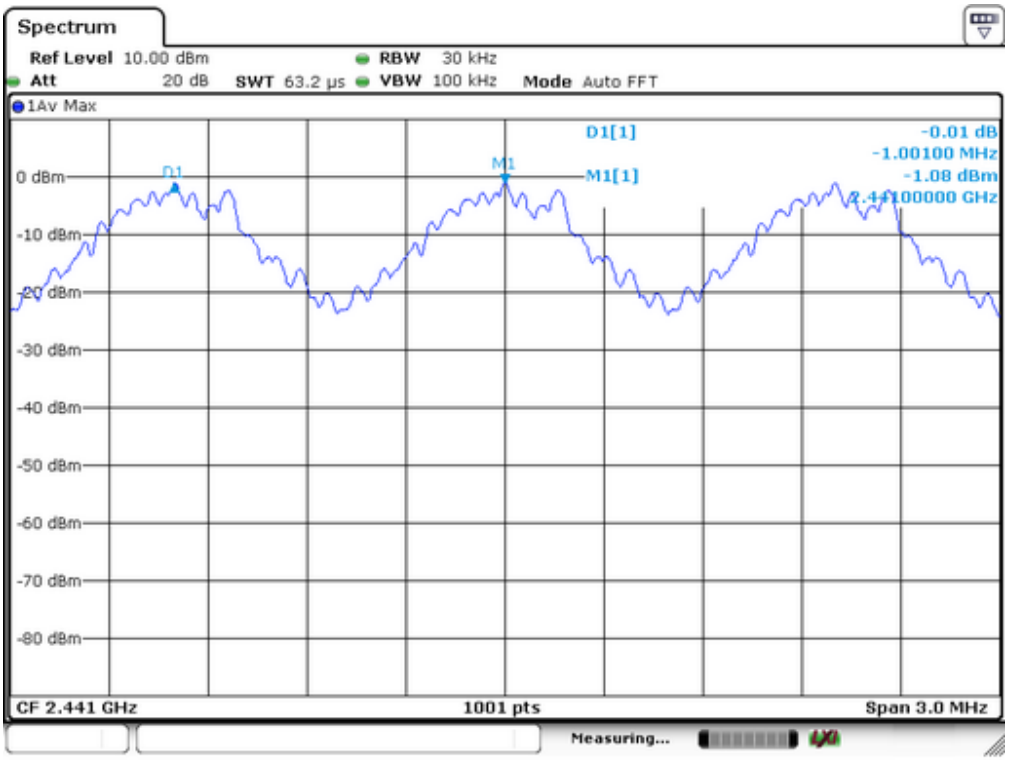
8.4 Measurement Results:

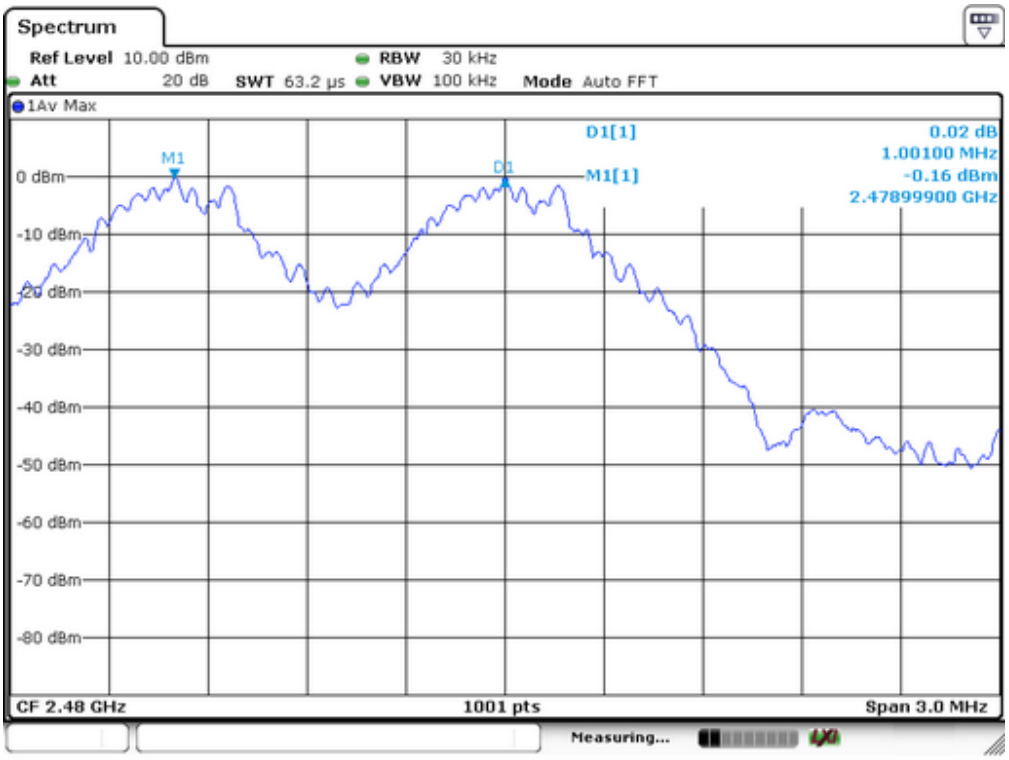
Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	July 30, 2015
Test By:	Andy	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %
Modulation:	GFSK		

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit (kHz)
1	2402	1001	>845
40	2441	1001	>836
79	2480	1001	>836

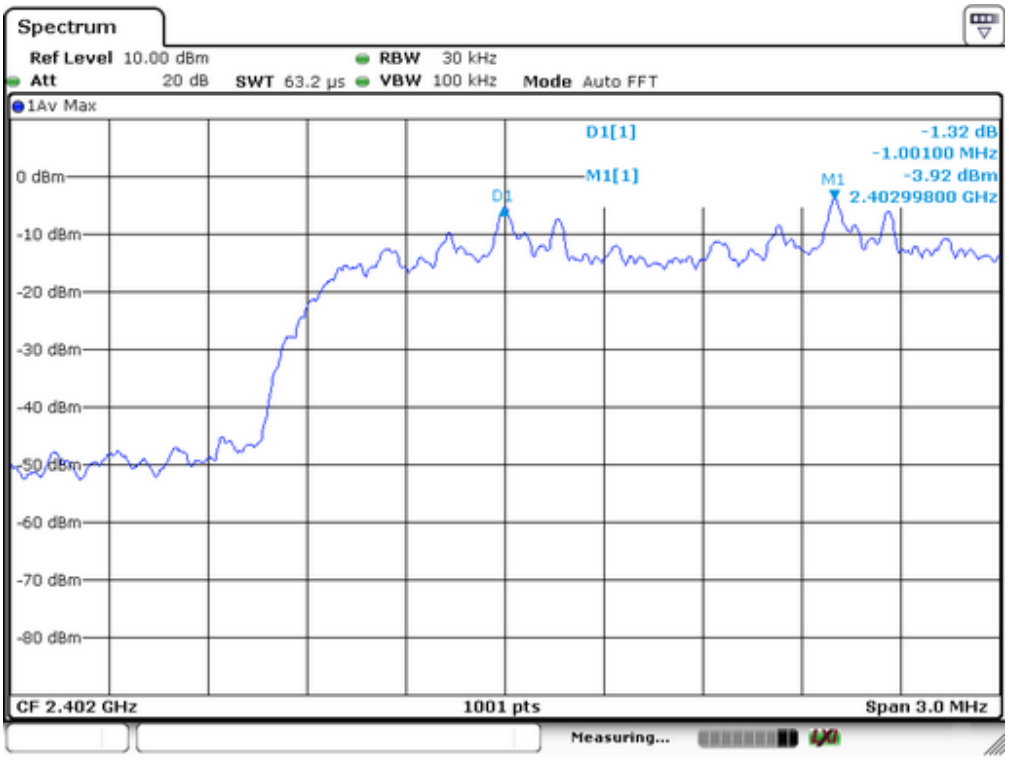

Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Av Max
D1[1]
-1.08 dB
-1.00100 MHz
M1[1]
-1.37 dBm
2.40299800 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.402 GHz
1001 pts
Span 3.0 MHz
Measuring...

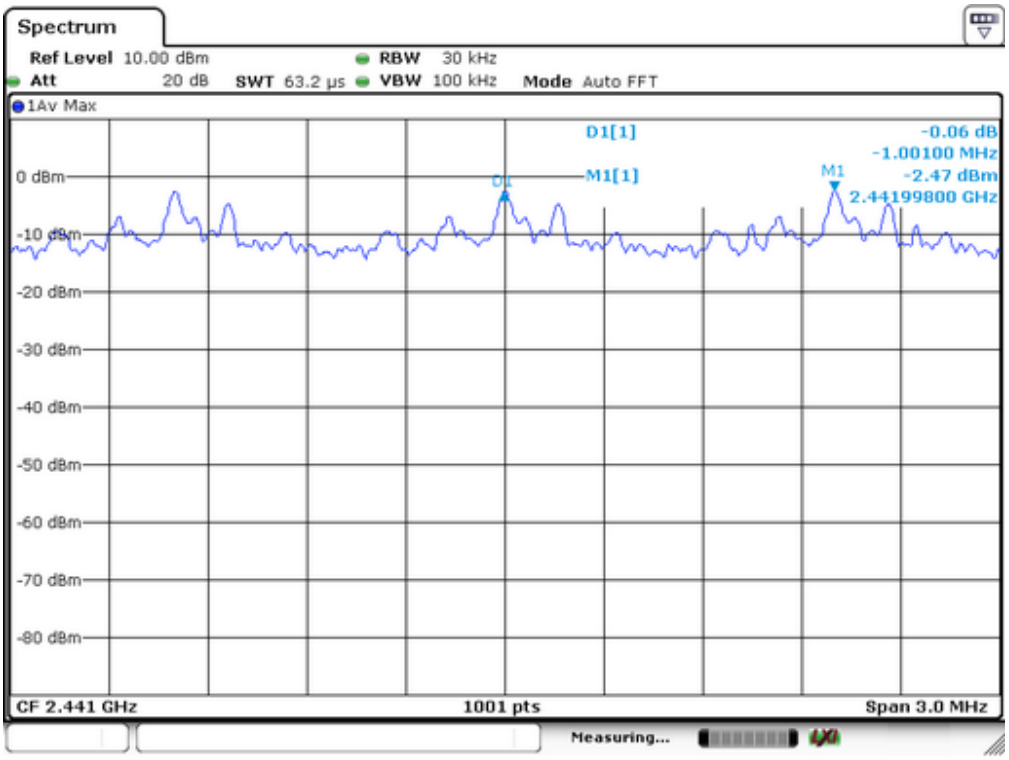

Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Av Max
D1[1]
-0.01 dB
-1.00100 MHz
M1[1]
-1.08 dBm
2.44100000 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
1001 pts
Span 3.0 MHz
Measuring...

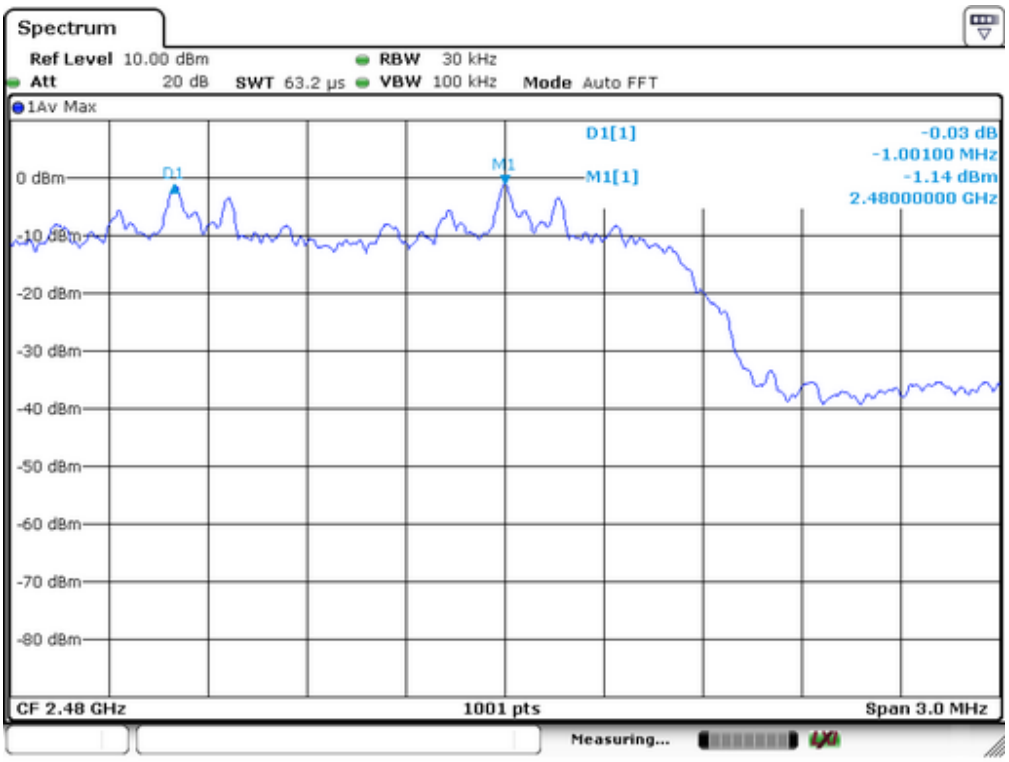


Spectrum Detector:	PK	Test Date :	July 30, 2015
Test By:	Andy	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	Π/4-DQPSK		

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	1001	>845
40	2441	1001	>827
79	2480	1001	>831

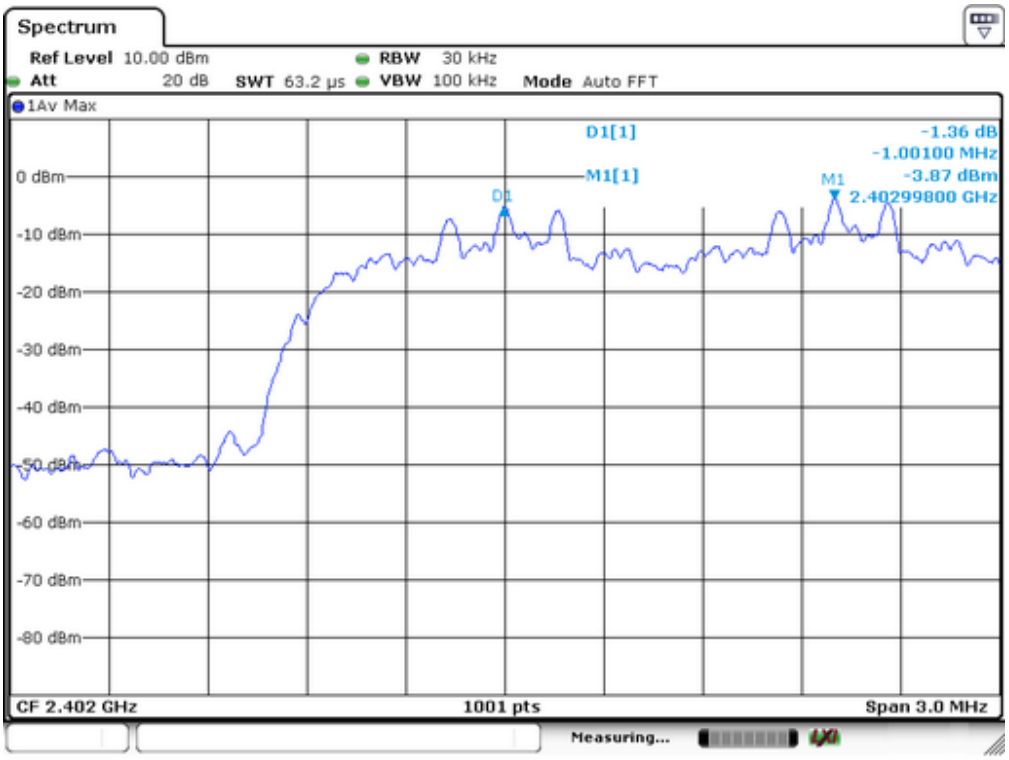

Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Av Max
D1[1]
-1.32 dB
-1.00100 MHz
M1[1]
-3.92 dBm
2.40299800 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.402 GHz
1001 pts
Span 3.0 MHz
Measuring...

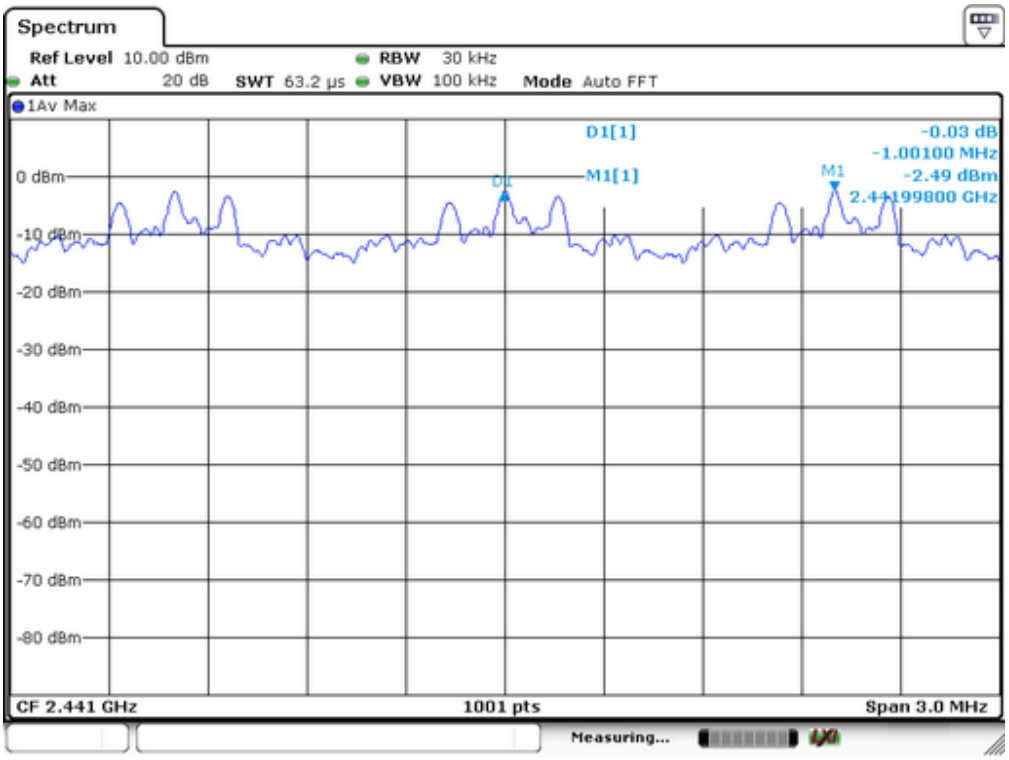

Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Av Max
D1[1]
-0.06 dB
-1.00100 MHz
M1[1]
-2.47 dBm
2.44199800 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
1001 pts
Span 3.0 MHz
Measuring...

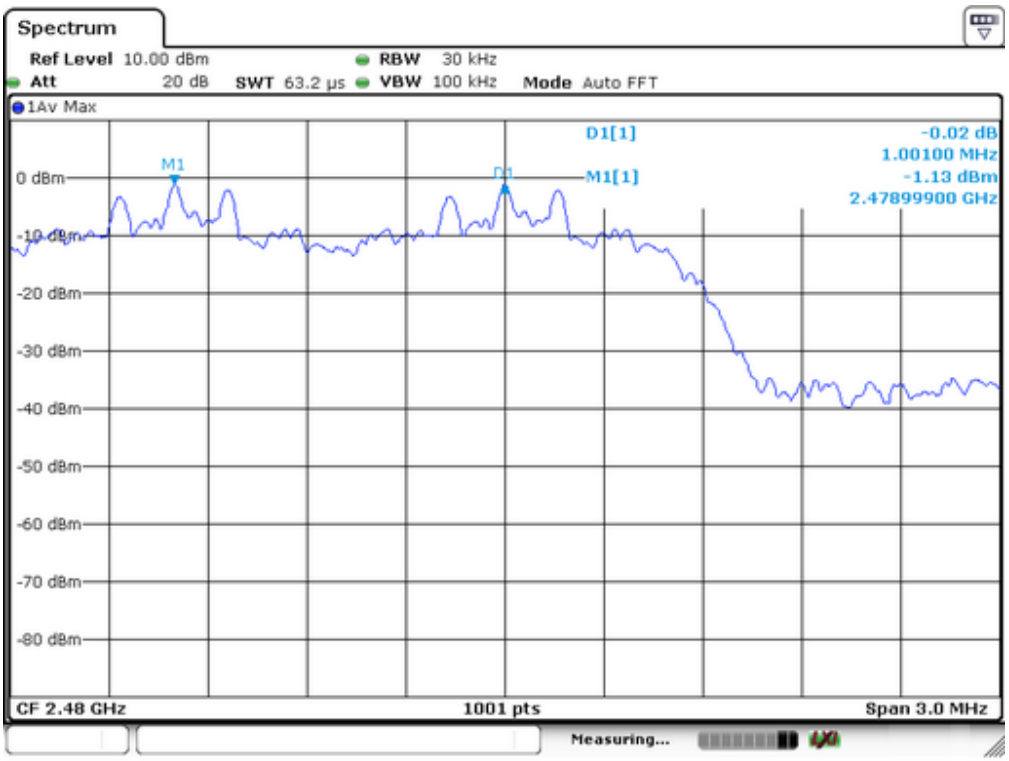


Spectrum Detector:	PK	Test Date :	July 30, 2015
Test By:	Andy	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	8DPSK		

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	1001	>817
40	2441	1001	>839
79	2480	1001	>840


Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Av Max
D1[1]
-1.36 dB
-1.00100 MHz
M1[1]
-3.87 dBm
2.40299800 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.402 GHz
1001 pts
Span 3.0 MHz
Measuring...


Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Av Max
D1[1]
-0.03 dB
-1.00100 MHz
M1[1]
-2.49 dBm
2.44199800 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
1001 pts
Span 3.0 MHz
Measuring...

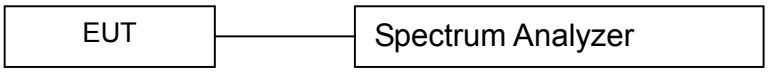

Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Av Max
D1[1]
-0.02 dB
1.00100 MHz
-1.13 dBm
2.47899900 GHz
M1
D1
M1[1]
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
1001 pts
Span 3.0 MHz
Measuring...

9. 20dB Bandwidth test

9.1 Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

9.2 Test SET-UP (Block Diagram of Configuration)



9.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	03/15/2015	03/14/2016
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	03/15/2015	03/14/2016
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	03/15/2015	03/14/2016

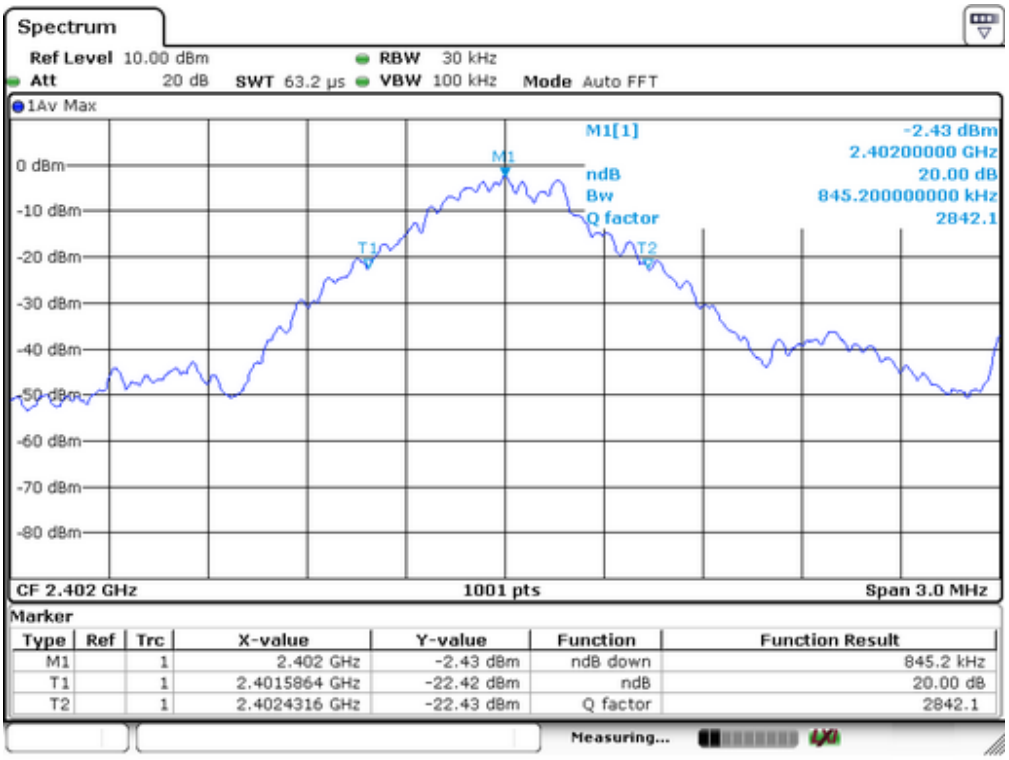
Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

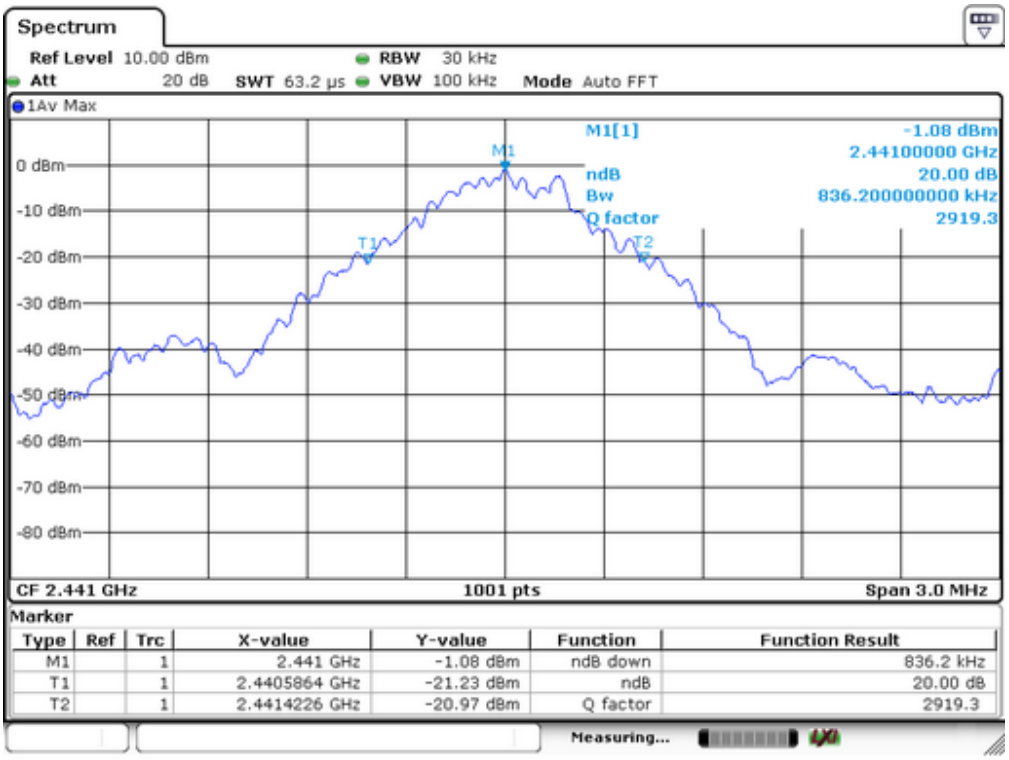
9.4 Measurement Results:

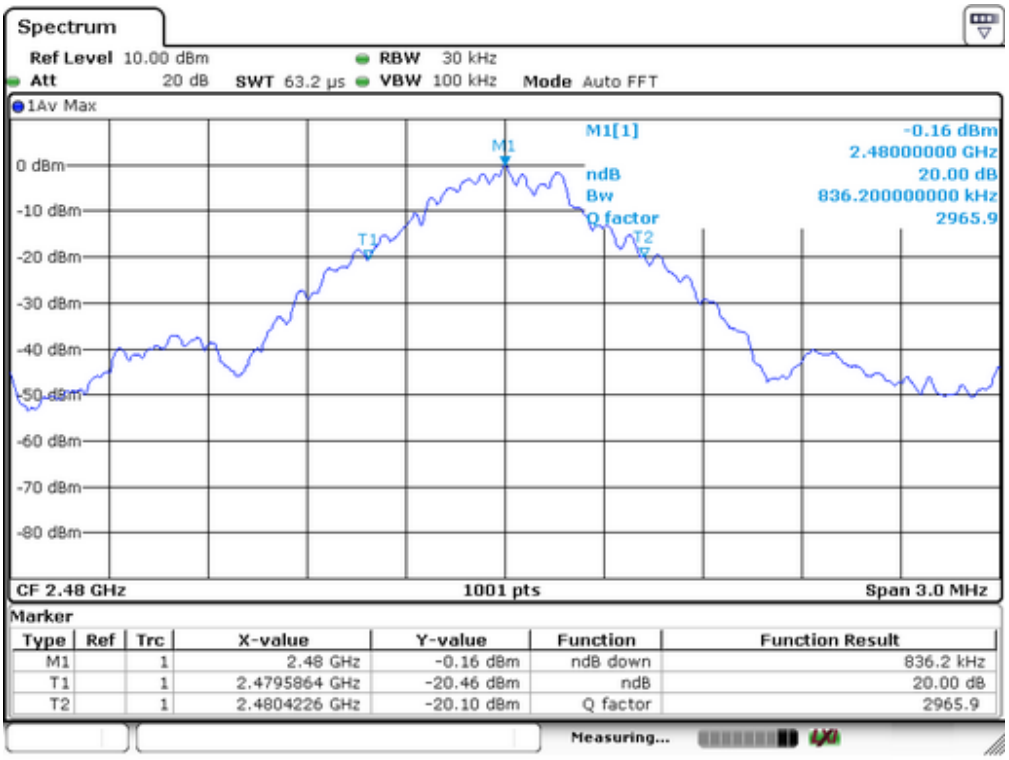
Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	July 30, 2015
Test By:	Andy	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	GFSK		

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	845
40	2441	836
79	2480	836

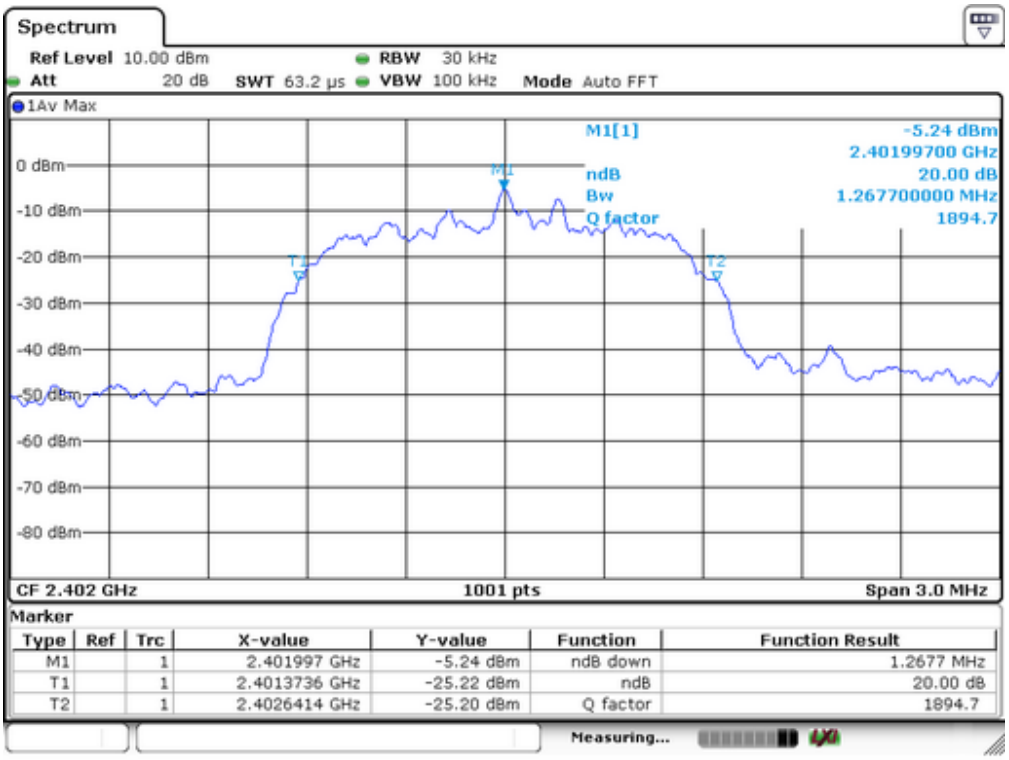

Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Av Max
M1[1]
-2.43 dBm
2.40200000 GHz
ndB
20.00 dB
Bw
845.200000000 kHz
Q factor
2842.1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.402 GHz
1001 pts
Span 3.0 MHz
Marker
Type | Ref | Trc | X-value | Y-value | Function | Function Result
M1 | | 1 | 2.402 GHz | -2.43 dBm | ndB down | 845.2 kHz
T1 | | 1 | 2.4015864 GHz | -22.42 dBm | ndB | 20.00 dB
T2 | | 1 | 2.4024316 GHz | -22.43 dBm | Q factor | 2842.1
Measuring...

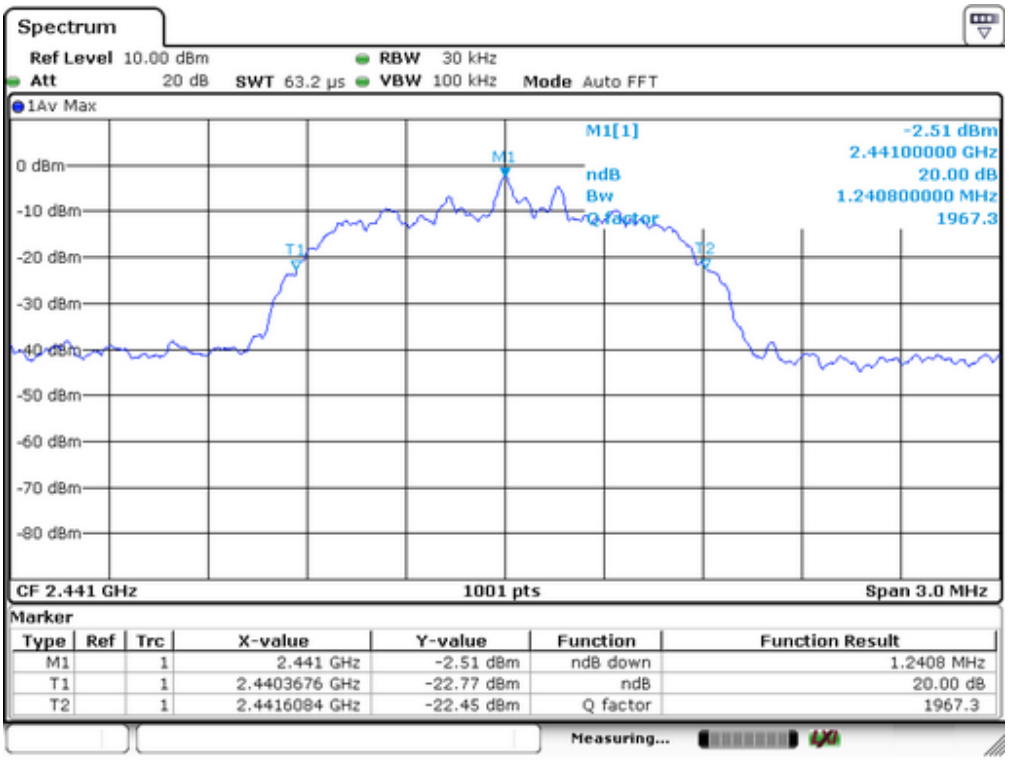

Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Av Max
M1[1]
-1.08 dBm
2.44100000 GHz
ndB
20.00 dB
Bw
836.200000000 kHz
Q factor
2919.3
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
1001 pts
Span 3.0 MHz
Marker
Type | Ref | Trc | X-value | Y-value | Function | Function Result
M1 | | 1 | 2.441 GHz | -1.08 dBm | ndB down | 836.2 kHz
T1 | | 1 | 2.4405864 GHz | -21.23 dBm | ndB | 20.00 dB
T2 | | 1 | 2.4414226 GHz | -20.97 dBm | Q factor | 2919.3
Measuring...

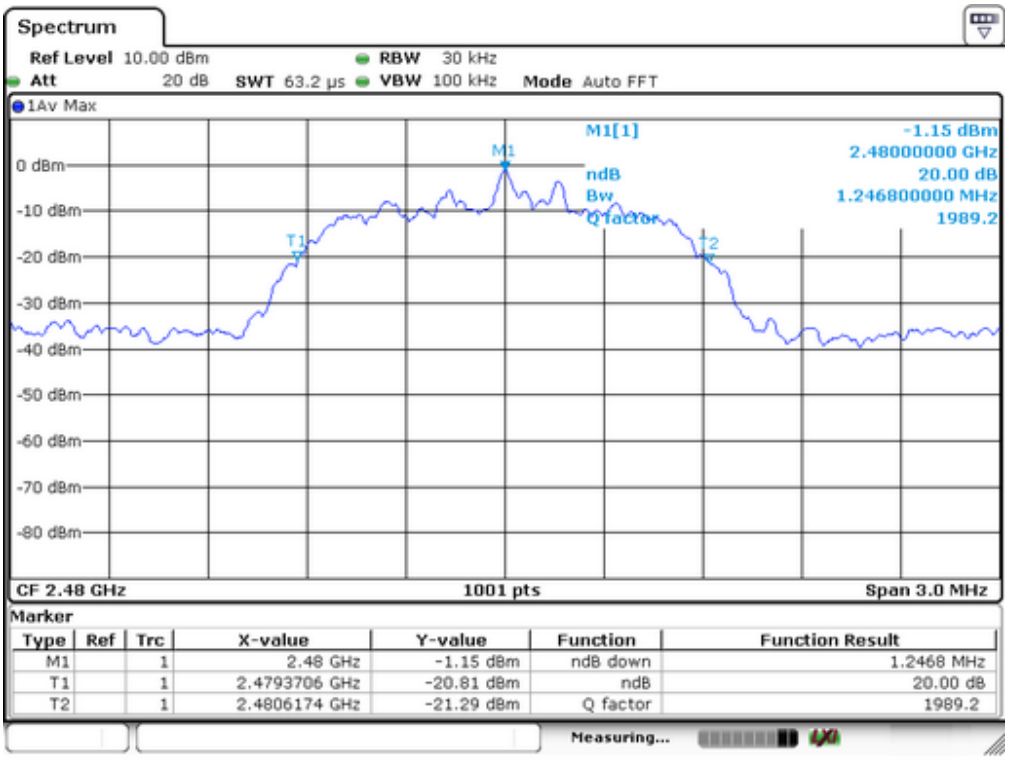


Spectrum Detector:	PK	Test Date :	July 30, 2015
Test By:	Andy	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	Π/4-DQPSK		

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	1268
40	2441	1241
79	2480	1247

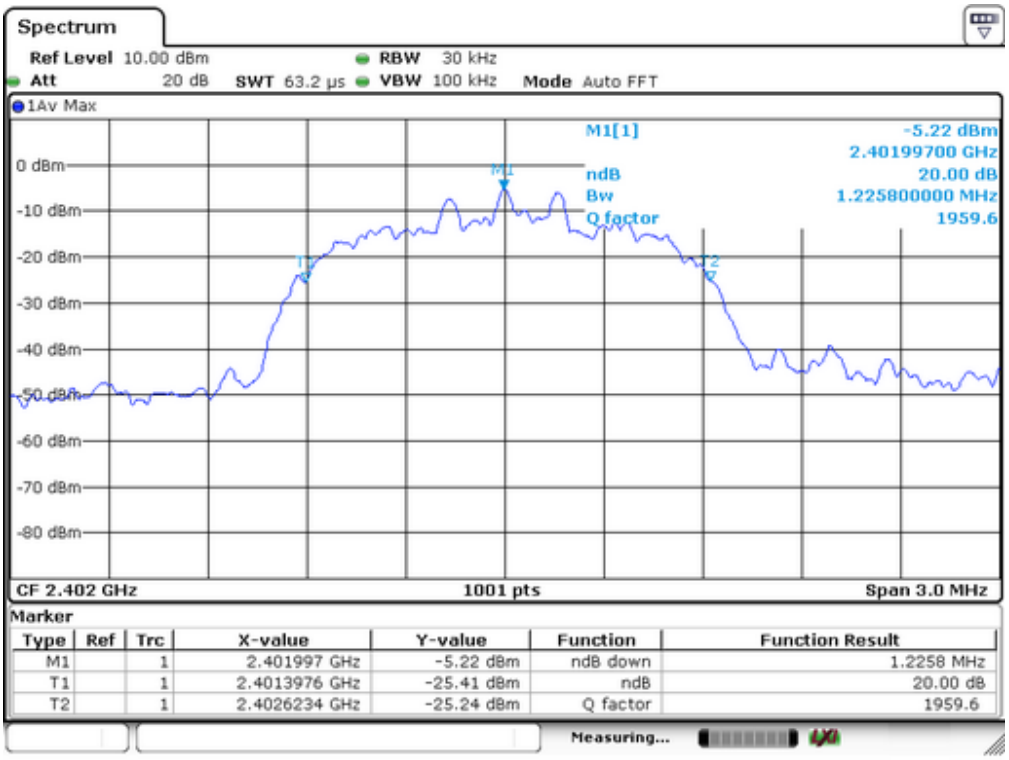

Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Av Max
M1[1]
-5.24 dBm
2.40199700 GHz
ndB 20.00 dB
Bw 1.267700000 MHz
Q factor 1894.7
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.402 GHz
1001 pts
Span 3.0 MHz
Marker
Type | Ref | Trc | X-value | Y-value | Function | Function Result
M1 | | 1 | 2.401997 GHz | -5.24 dBm | ndB down | 1.2677 MHz
T1 | | 1 | 2.4013736 GHz | -25.22 dBm | ndB | 20.00 dB
T2 | | 1 | 2.4026414 GHz | -25.20 dBm | Q factor | 1894.7
Measuring...

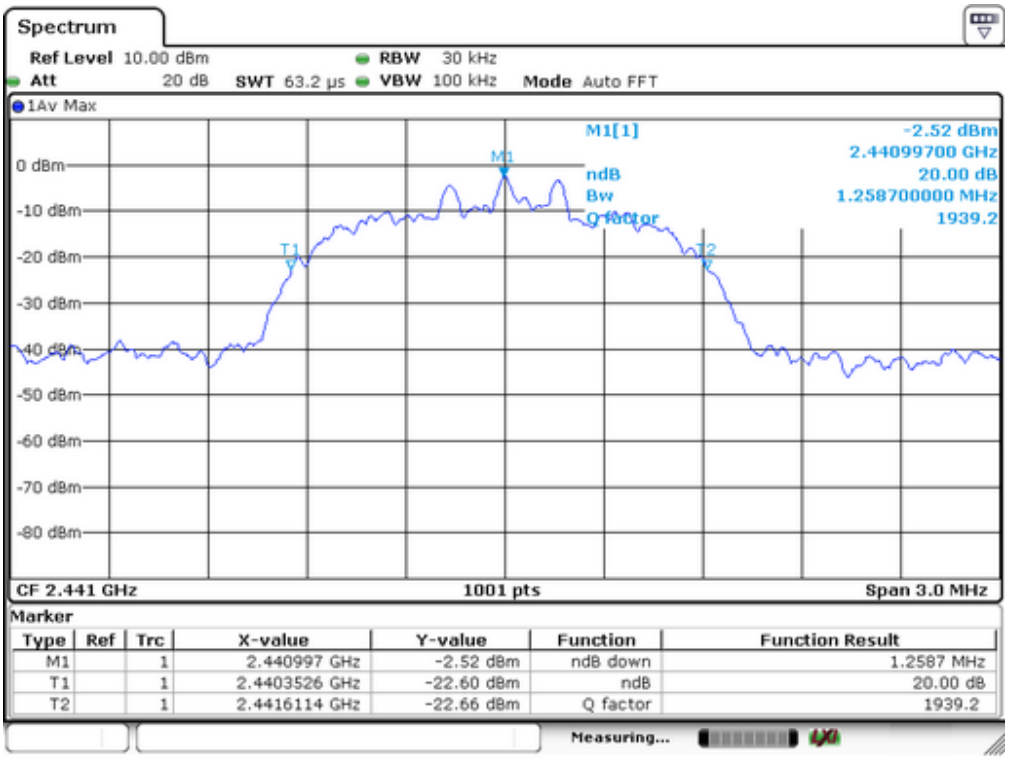

Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Av Max
M1[1]
-2.51 dBm
2.44100000 GHz
ndB 20.00 dB
Bw 1.240800000 MHz
Q factor 1967.3
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
1001 pts
Span 3.0 MHz
Marker
Type | Ref | Trc | X-value | Y-value | Function | Function Result
M1 | | 1 | 2.441 GHz | -2.51 dBm | ndB down | 1.2408 MHz
T1 | | 1 | 2.4403676 GHz | -22.77 dBm | ndB | 20.00 dB
T2 | | 1 | 2.4416084 GHz | -22.45 dBm | Q factor | 1967.3
Measuring...

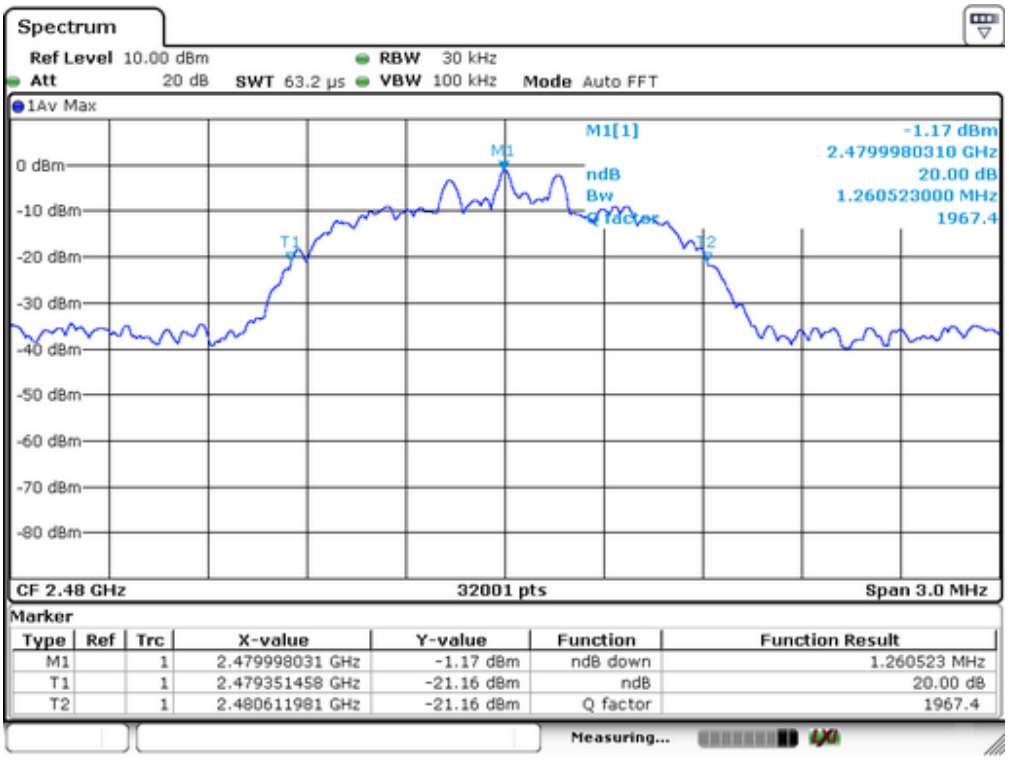


Spectrum Detector:	PK	Test Date :	July 30, 2015
Test By:	Andy	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	8DPSK		

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	1226
40	2441	1259
79	2480	1261


Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Av Max
M1[1]
-5.22 dBm
2.40199700 GHz
ndB
20.00 dB
Bw
1.225800000 MHz
Q factor
1959.6
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.402 GHz
1001 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.401997 GHz -5.22 dBm ndB down 1.2258 MHz
T1 1 2.4013976 GHz -25.41 dBm ndB 20.00 dB
T2 1 2.4026234 GHz -25.24 dBm Q factor 1959.6
Measuring...


Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 20 dB
SWT 63.2 µs
VBW 100 kHz
Mode Auto FFT
1Av Max
M1[1]
-2.52 dBm
2.44099700 GHz
ndB
20.00 dB
Bw
1.258700000 MHz
Q factor
1939.2
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
1001 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.440997 GHz -2.52 dBm ndB down 1.2587 MHz
T1 1 2.4403526 GHz -22.60 dBm ndB 20.00 dB
T2 1 2.4416114 GHz -22.66 dBm Q factor 1939.2
Measuring...



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.479998031 GHz	-1.17 dBm	ndB down	1.260523 MHz
T1		1	2.479351458 GHz	-21.16 dBm	ndB	20.00 dB
T2		1	2.480611981 GHz	-21.16 dBm	Q factor	1967.4

10. Quantity of Hopping Channel Test

10.1 Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

10.2 Test SET-UP (Block Diagram of Configuration)

EUT ——— Spectrum Analyzer

10.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	03/15/2015	03/14/2016
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	03/15/2015	03/14/2016
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	03/15/2015	03/14/2016

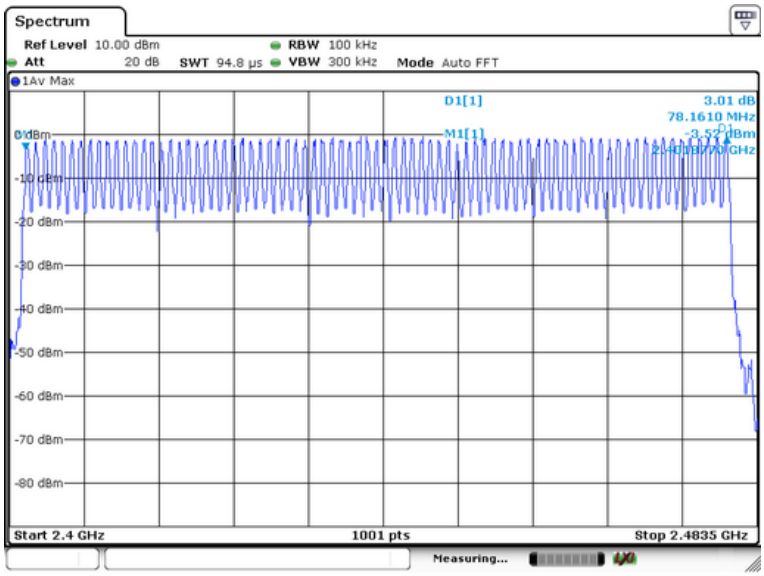
Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

10.4 Measurement Results:

Refer to attached data chart.

Worst Test Mode	GFSK	Test Date :	July 30, 2015
Test By:	Andy	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %

Hopping Channel Frequency Range	Quantity of Hopping Channel	Quantity of Hopping Channel
2402-2480	79	＞15



11. Time of Occupancy (Dwell Time) test

11.1 Test Description

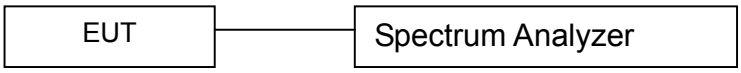
The Equipment Under Test (EUT) was set up to perform the dwell time measurements. The EUT was connected to the spectrum analyzer via a short coax cable. The dwell time is calculated by:

Dwell time = time slot length * hop rate / number of hopping channels * 31.6s

with:
- hop rate = 1600 * 1/s for DH1 packets = 1600 s^{-1}
- hop rate = 1600/3 * 1/s for DH3 packets = 533.33 s^{-1}
- number of hopping channels = 79
- 31.6 s = 0.4 seconds multiplied by the number of hopping channels = 0.4 s * 79

The highest value of the dwell time is reported.

11.2 Test SET-UP (Block Diagram of Configuration)



11.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	03/15/2015	03/14/2016
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	03/15/2015	03/14/2016
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	03/15/2015	03/14/2016

Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

11.4 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (1) (iii)

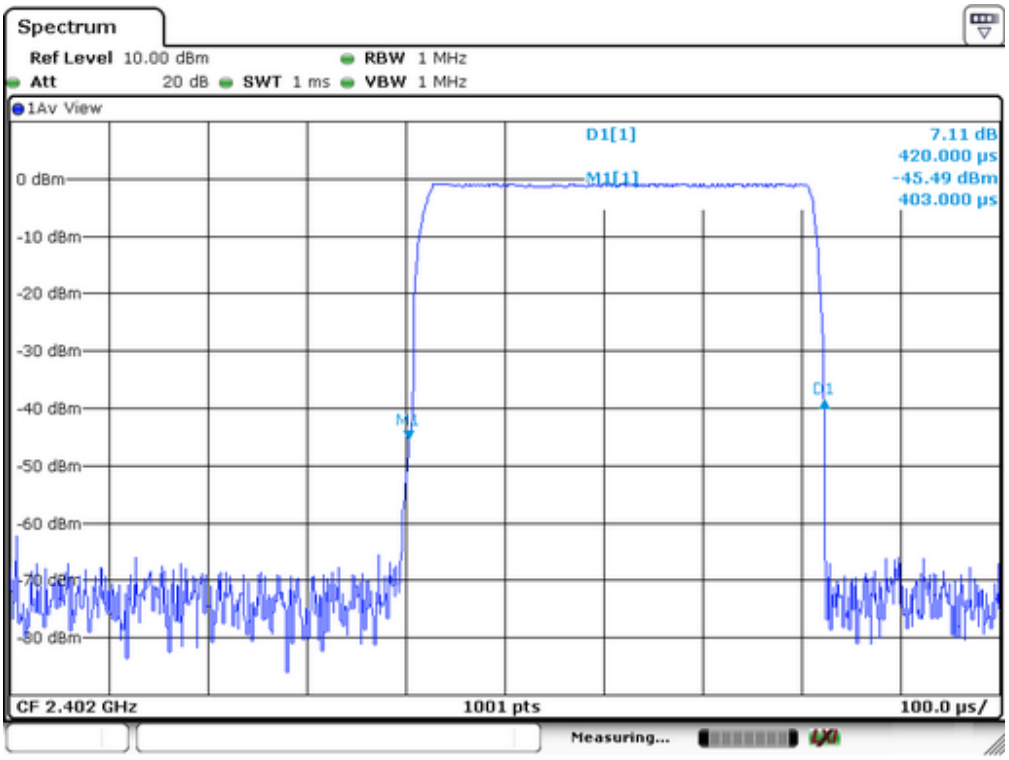
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Since the Bluetooth technology uses 79 channels this period is calculated to be 31.6seconds. Refer to attached data chart.

11.5 Test result

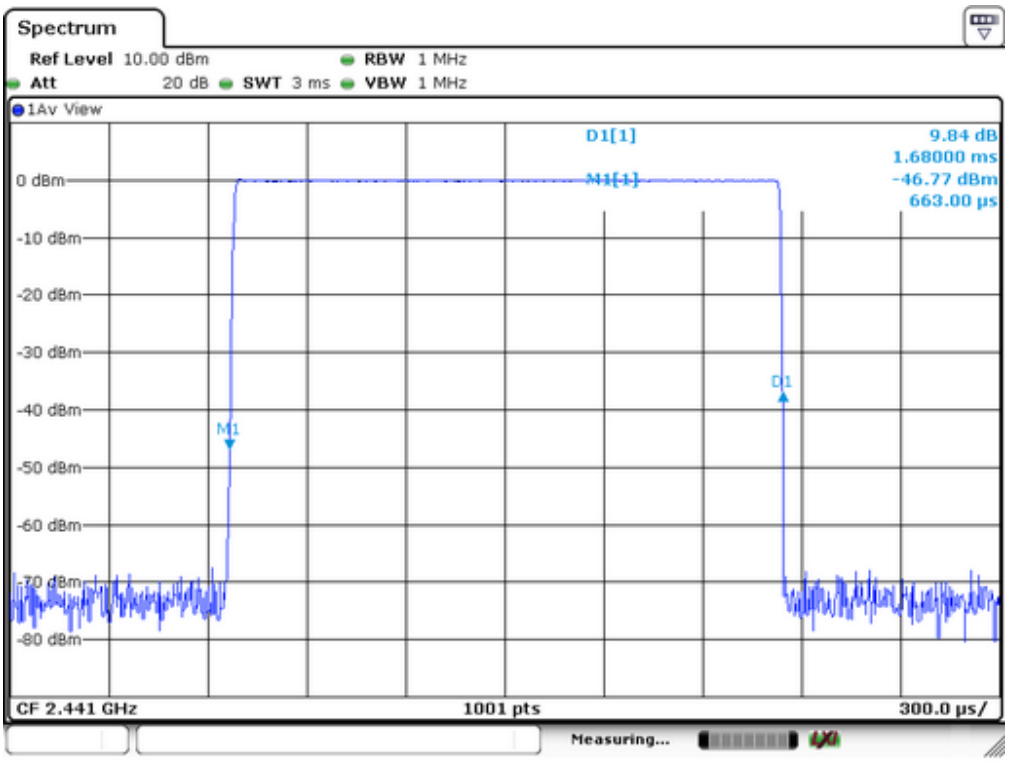
Mode	Number of transmission in a 31.6(79 Hopping*0.4)	Length of transmissions time(msec)	Result (msec)	Limit (msec)
DH1	1600/(2*79) x 31.6 = 320	0.420	134.40	400
DH3	1600/(4*79) x 31.6 =160	1.680	268.80	400
DH5	1600/(6*79) x 31.6 =106.67	2.930	312.54	400

Remark: The results of worst cased was recorded.
.

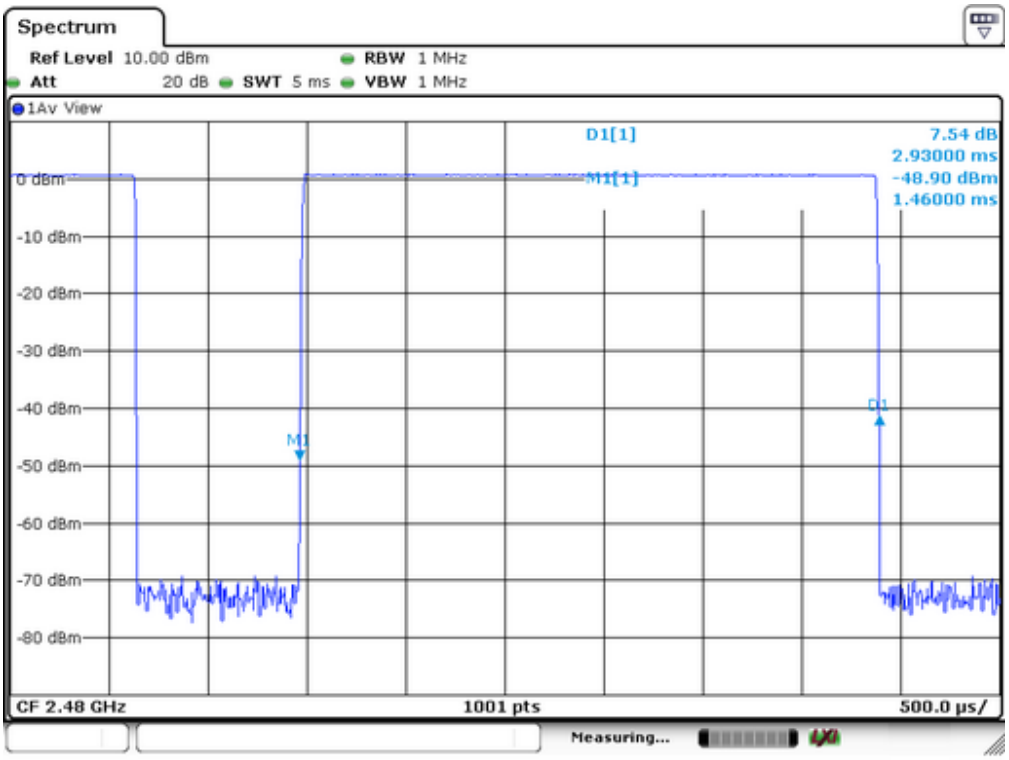
DH1:



DH3:


Spectrum
Ref Level 10.00 dBm
RBW 1 MHz
Att 20 dB
SWT 3 ms
VBW 1 MHz
1Av View
D1[1]
9.84 dB
1.68000 ms
M1[1]
-46.77 dBm
663.00 µs
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
D1
CF 2.441 GHz
1001 pts
300.0 µs/
Measuring...

DH5:

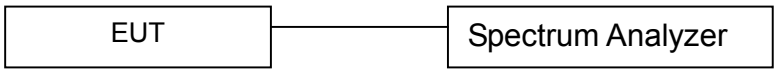

Spectrum
Ref Level 10.00 dBm
RBW 1 MHz
Att 20 dB
SWT 5 ms
VBW 1 MHz
1Av View
D1[1]
7.54 dB
2.93000 ms
M1[1]
-48.90 dBm
1.46000 ms
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
D1
CF 2.48 GHz
1001 pts
500.0 µs/
Measuring...

12. MAXIMUM PEAK OUTPUT POWER TEST

12.1 Measurement Procedure

a. Check the calibration of the measuring instrument(SA) using either an internal calibrator or a known signal from an external generator.
b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
c. The center frequency of the spectrum analyzer is set to the fundamental frequency and using proper RBW and VBW setting.
d. Measure the captured power within the band and recording the plot.
e. Repeat above procedures until all frequencies required were complete.

12.2 Test SET-UP (Block Diagram of Configuration)



12.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	03/15/2015	03/14/2016
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	03/15/2015	03/14/2016
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	03/15/2015	03/14/2016

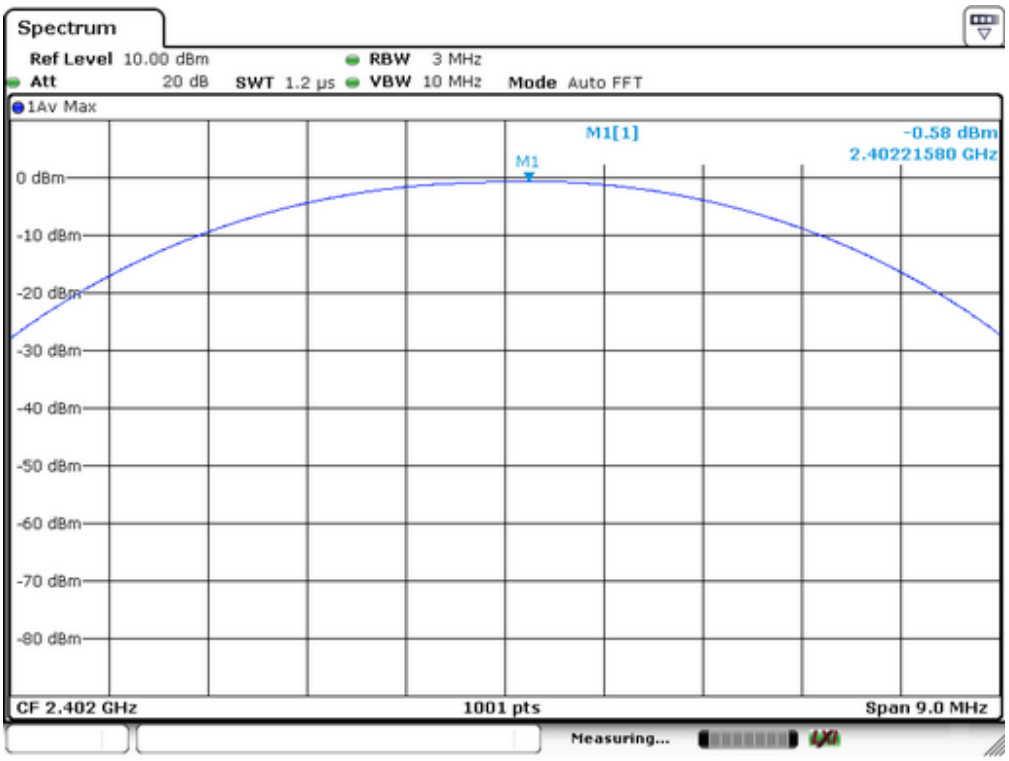
Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

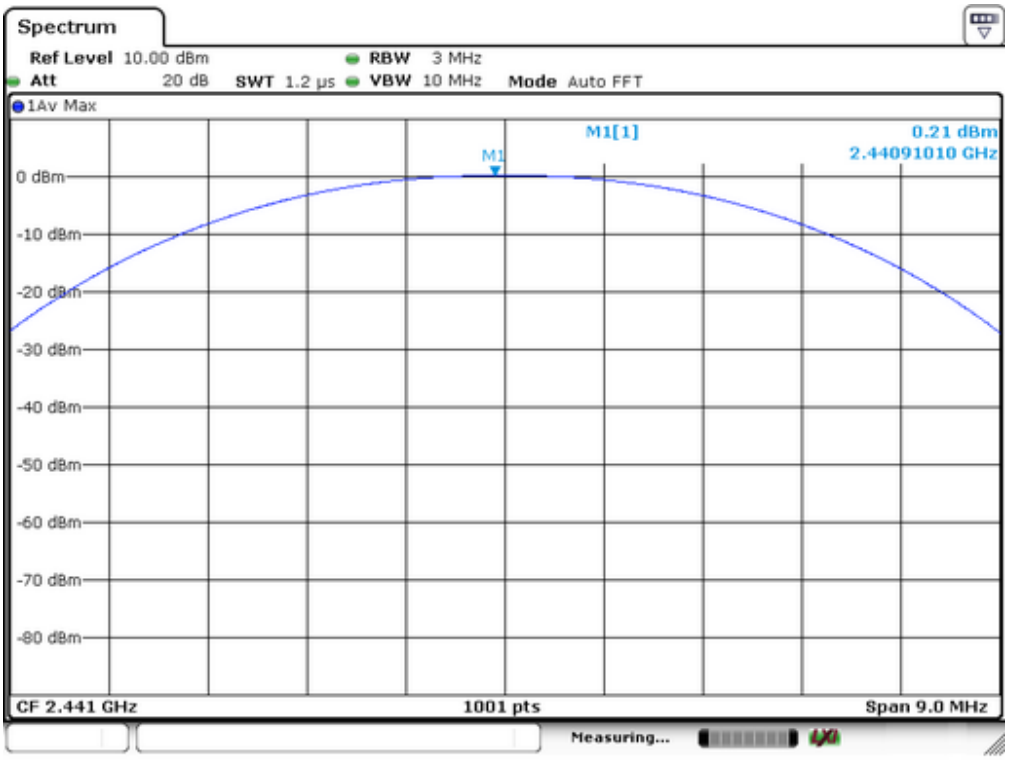
12.4 Measurement Results:

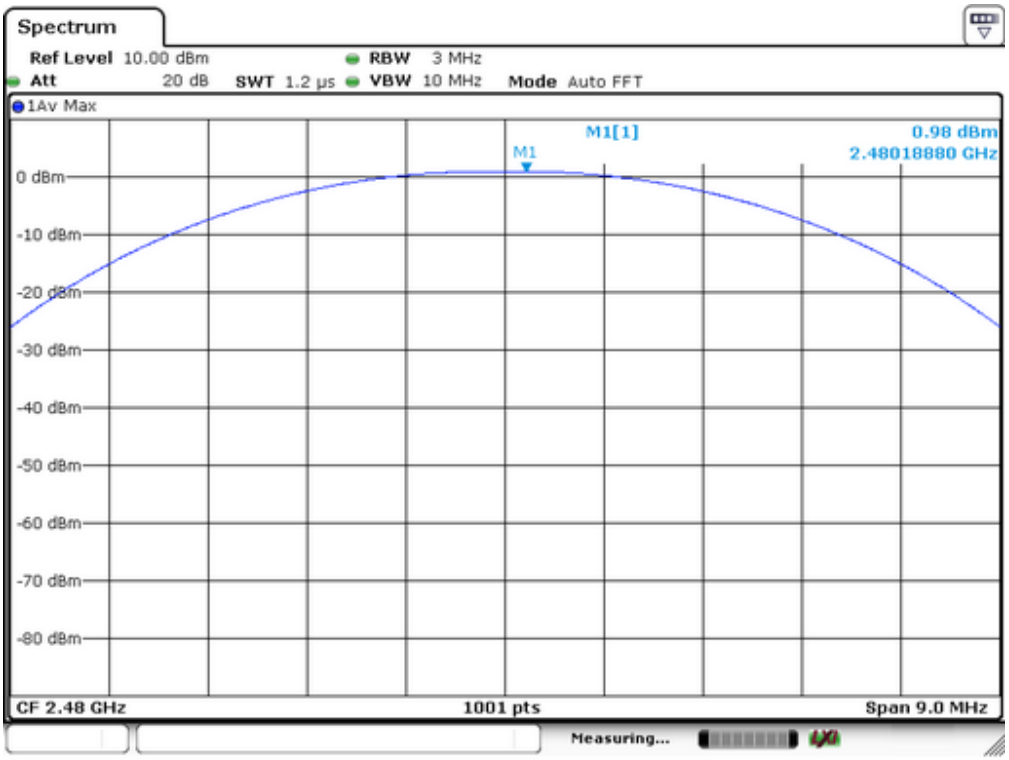
Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	July 30, 2015
Test By:	Andy	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %
Modulation:	GFSK		

Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
01	2402	-0.58	0.875	1000	PASS
40	2441	0.21	1.050	1000	PASS
79	2480	**0.98**	**1.253**	1000	PASS

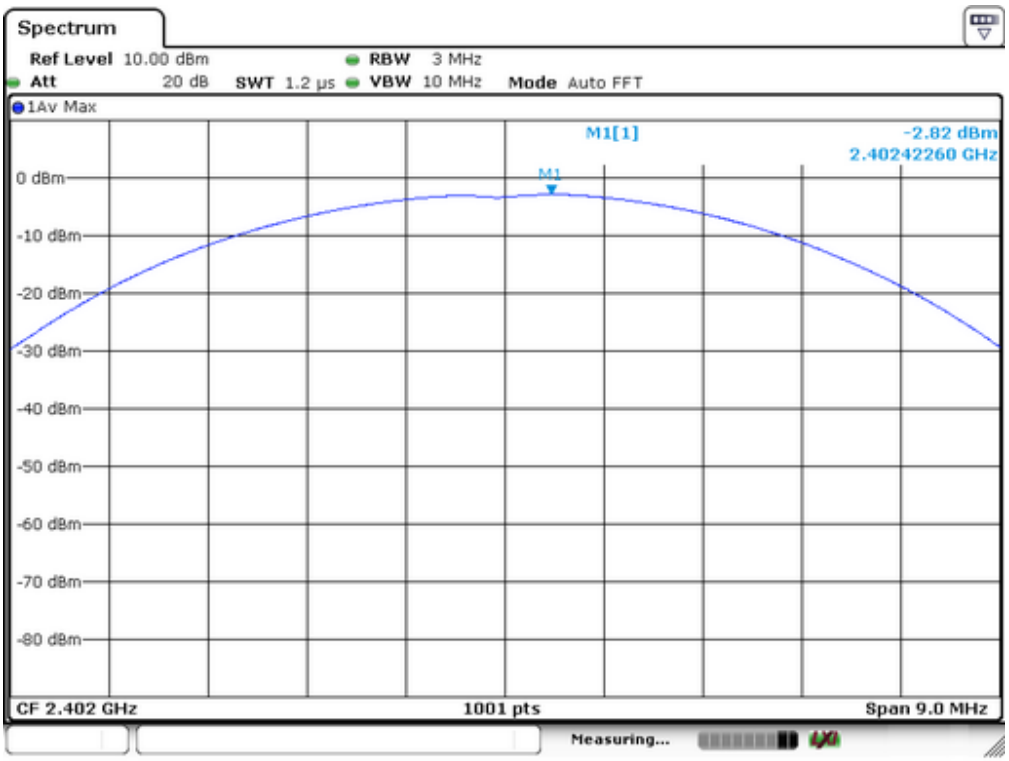


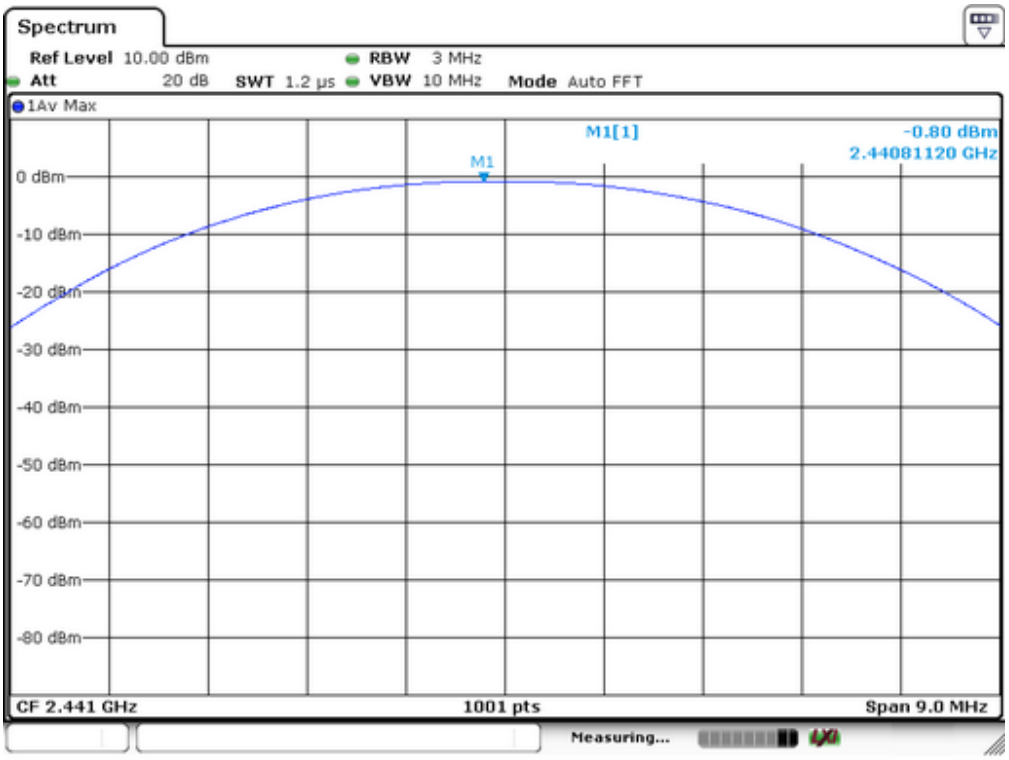

Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 20 dB
SWT 1.2 µs
VBW 10 MHz
Mode Auto FFT
1Av Max
M1[1]
0.21 dBm
2.44091010 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
1001 pts
Span 9.0 MHz
Measuring...

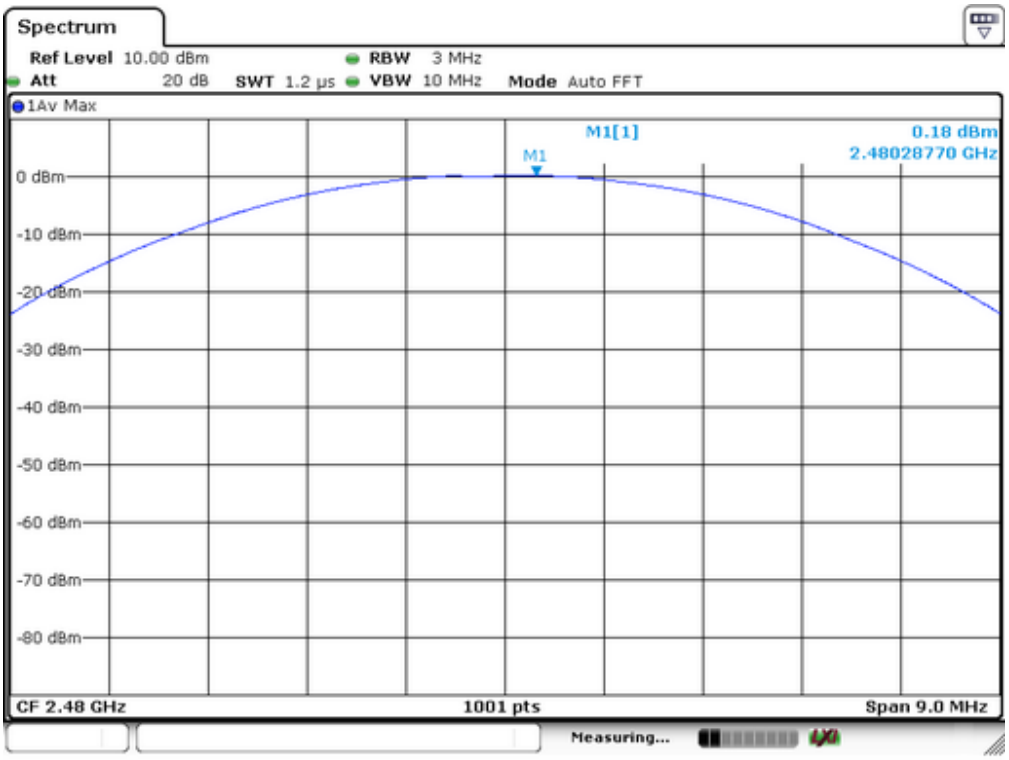

Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 20 dB
SWT 1.2 µs
VBW 10 MHz
Mode Auto FFT
1Av Max
M1[1]
0.98 dBm
2.48018880 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
1001 pts
Span 9.0 MHz
Measuring...

Spectrum Detector:	PK	Test Date :	July 30, 2015
Test By:	Andy	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %
Modulation:	Π/4-DQPSK		

Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
01	2402	-2.82	0.522	125	PASS
40	2441	-0.8	0.832	125	PASS
79	2480	0.18	1.042	125	PASS

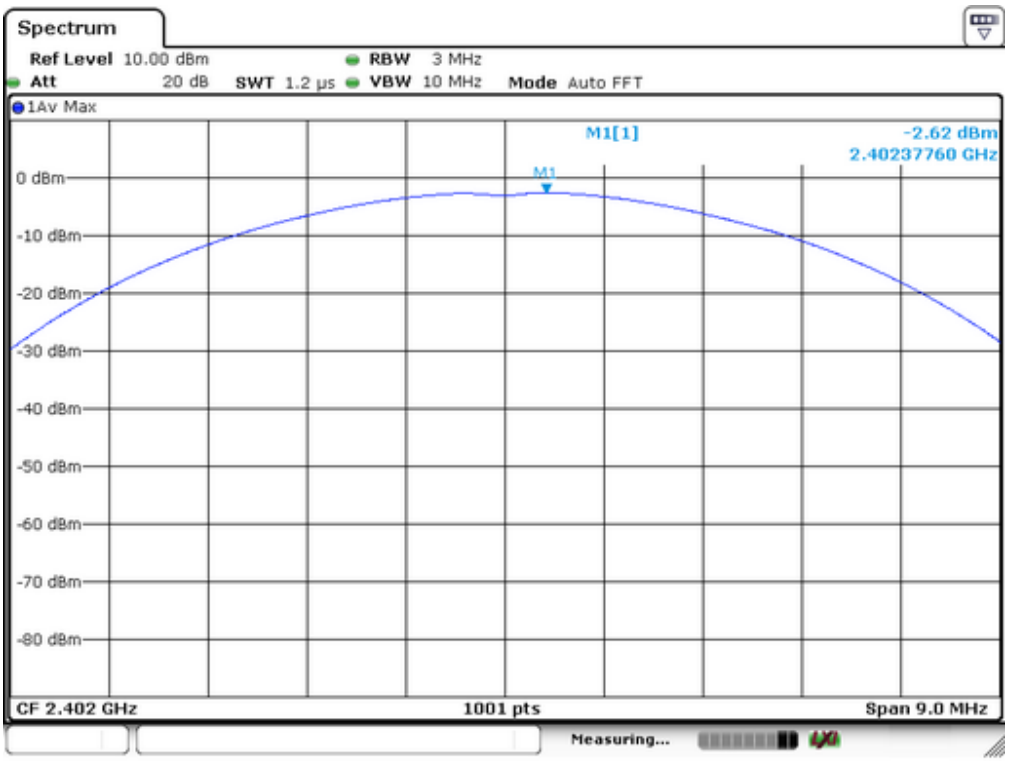


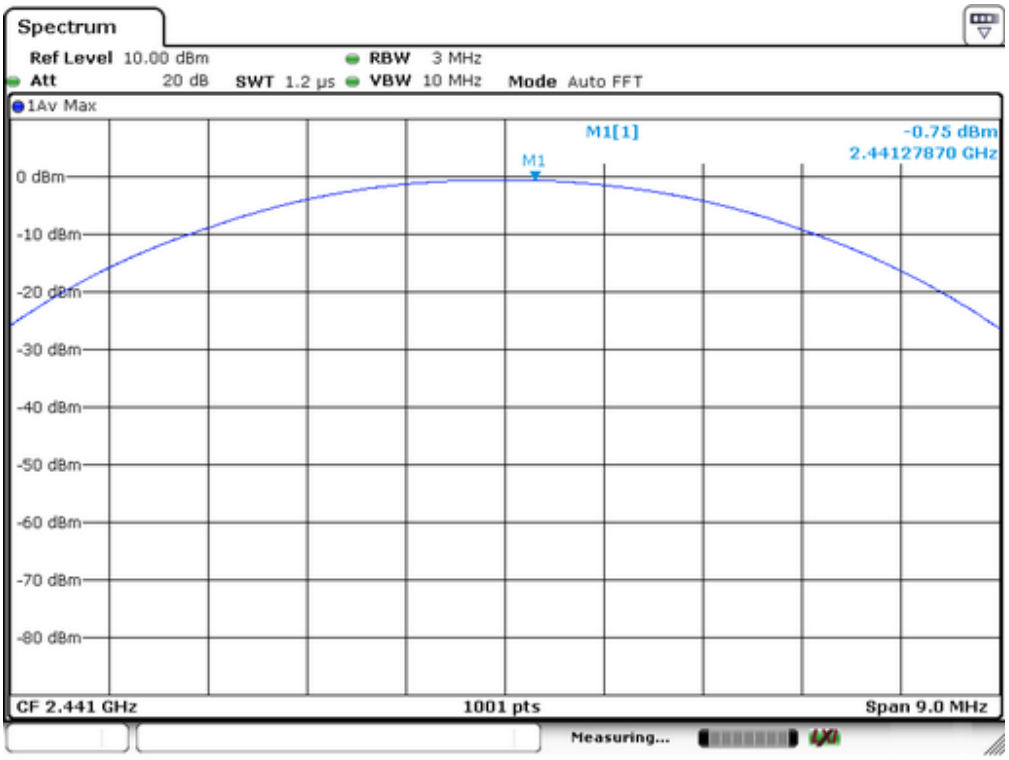

Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 20 dB
SWT 1.2 µs
VBW 10 MHz
Mode Auto FFT
1Av Max
M1[1]
-0.80 dBm
2.44081120 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
1001 pts
Span 9.0 MHz
Measuring...

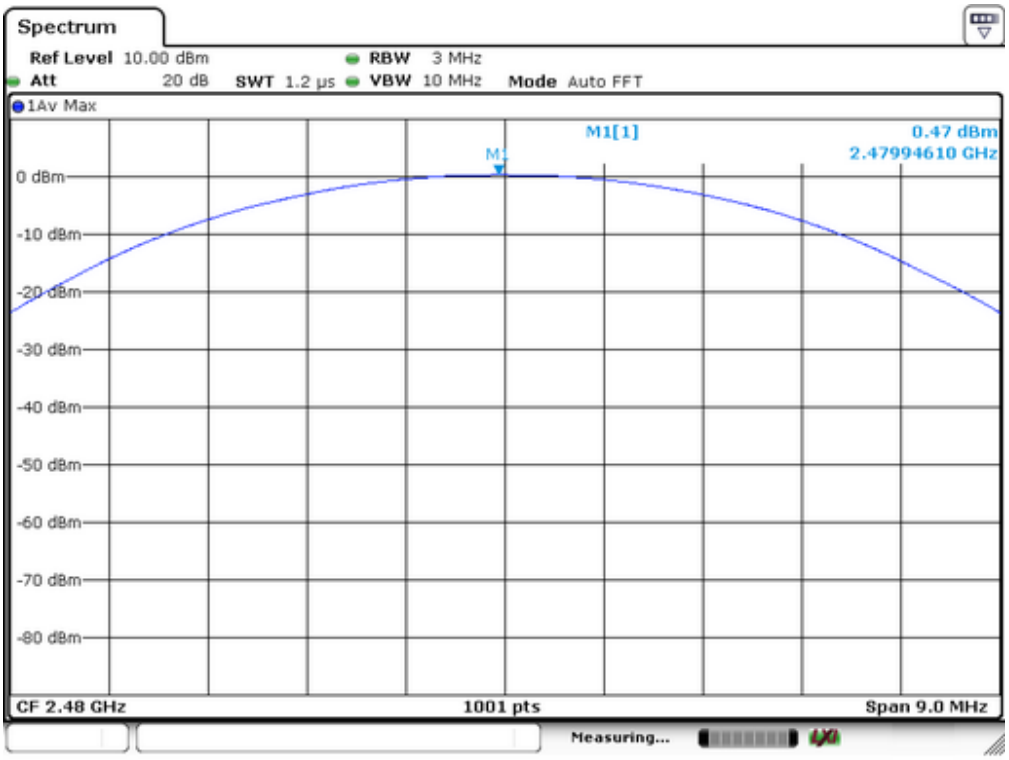

Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 20 dB
SWT 1.2 µs
VBW 10 MHz
Mode Auto FFT
1Av Max
M1[1]
0.18 dBm
2.48028770 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
1001 pts
Span 9.0 MHz
Measuring...

Spectrum Detector:	PK	Test Date :	July 30, 2015
Test By:	Andy	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %
Modulation:	8DPSK		

Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
01	2402	-2.62	0.547	125	PASS
40	2441	-0.75	0.841	125	PASS
79	2480	0.47	1.114	125	PASS




Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 20 dB
SWT 1.2 µs
VBW 10 MHz
Mode Auto FFT
1Av Max
M1[1]
-0.75 dBm
2.44127870 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
1001 pts
Span 9.0 MHz
Measuring...


Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 20 dB
SWT 1.2 µs
VBW 10 MHz
Mode Auto FFT
1Av Max
M1[1]
0.47 dBm
2.47994610 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
1001 pts
Span 9.0 MHz
Measuring...

13. Band EDGE test

13.1 Measurement Procedure

For Conducted Test

1. The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100KHz. The video bandwidth is set to 300KHz.
2. The spectrum from 30MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

EMI Test Receiver	Setting
Attenuation	Auto
RBW	100KHz
VBW	300KHz
Detector	Peak
Trace	Max hold

For Radiated emission Test

The EUT was placed on a styrofoam table which is 1.5m above ground plane.

The measurement procedure at the ban edges was simplified by performing the measurement in just one plot. Both, the in-band-emission and the unwanted emission were be encompassed by the span. After trace stabilization, the maximum peak was be determined by a peak detector and the value was marked by an appropriate limit line. The second limit line, which is 20dB below the first, marks the limit for the emissions in the unrestricted band. A maximum-peak-detector marks the highest emission in the unrestricted band next to the band edge.

The measurements were performed at the lower end of the 2.4GHz band.

Use the following spectrum analyzer settings:

For Restricted Band, When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 3MHz:

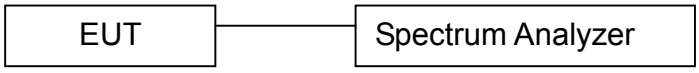
EMI Test Receiver	Setting
Attenuation	Auto
RBW	1MHz
VBW	3MHz
Detector	Peak
Trace	Max hold

For Non-Restricted Band, When spectrum scanned above 1GHz setting resolution bandwidth 100KHz, video bandwidth 300KHz:

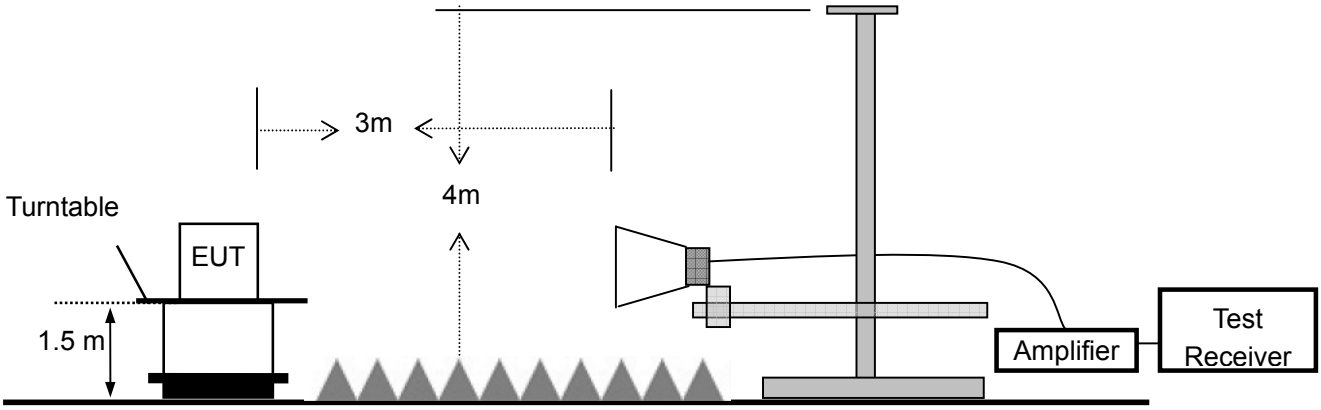
EMI Test Receiver	Setting
Attenuation	Auto
RBW	100KHz
VBW	300KHz
Detector	Peak
Trace	Max hold

13.2 Test SET-UP (Block Diagram of Configuration)

For Conducted Test



For Radiated emission Test



13.3 Measurement Equipment Used:

For Conducted Test

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	03/15/2015	03/14/2016
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	03/15/2015	03/14/2016
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	03/15/2015	03/14/2016

Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

For Radiated emission Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Characteristics	Last Cal.	Cal. Interval
1	Signal Analyzer	Rohde & Schwarz	FSV30	103040	9KHz-40GHz	12/29/2014	1 Year
2	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1272	1GHz-18GHz	12/29/2014	1 Year
3	Power Amplifier	LUNAR EM	LNA1G18-40	J10100000081	1GHz-26.5GHz	12/29/2014	1 Year
4	Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	12/29/2014	1 Year
5	Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	12/29/2014	1 Year
6	Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	12/29/2014	1 Year

13.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	July 30, 2015
Test By:	Andy	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %

1. Conducted Test

For Non-Hopping Mode:

Frequency (MHz)	Modulation	Peak Power Output(dBm)	Emission read Value(dBm)	Result of Band edge(dBc)	Band edge Limit(dBc)
2399.99	GFSK	0.84	-52.22	53.06	>20dBc
2399.53	pi/4-DQPSK	0.79	-50.65	51.44	>20dBc
2399.54	8DPSK	1.62	-58.13	59.75	>20dBc
2483.99	GFSK	5.74	-59.51	65.25	>20dBc
2483.50	pi/4-DQPSK	3.73	-53.59	57.32	>20dBc
2483.52	8DPSK	3.82	-60.24	64.06	>20dBc

For Hopping Mode:

Frequency (MHz)	Modulation	Peak Power Output(dBm)	Emission read Value(dBm)	Result of Band edge(dBc)	Band edge Limit(dBc)
2399.18	GFSK	4.93	-51.8	56.73	>20dBc
2399.89	pi/4-DQPSK	1.55	-53.37	54.92	>20dBc
2399.86	8DPSK	2.31	-53.68	55.99	>20dBc
2484.03	GFSK	5.65	-60.67	66.32	>20dBc
2487.14	pi/4-DQPSK	2.06	-61.14	63.2	>20dBc
2483.78	8DPSK	3.83	-62.21	66.04	>20dBc

2. Radiated emission Test

Worst test modulation GFSK

For Non-Hopping Mode:

Frequency (MHz)	Antenna polarization (H/V)	Emission (dBuV/m)		Band edge Limit (dBuV/m)		Margin (dB)	
		PK	AV	PK	AV	PK	AV
2398.56	H	65.05	45.15	74	54	-8.95	-8.85
2399.04	V	60.42	39.05	74	54	-13.58	-14.95
2484.12	H	64.35	44.27	74	54	-9.65	-9.73
2485.36	V	59.38	40.75	74	54	-14.62	-13.25

For Hopping Mode:

Frequency (MHz)	Antenna polarization (H/V)	Emission (dBuV/m)		Band edge Limit (dBuV/m)		Margin (dB)	
		PK	AV	PK	AV	PK	AV
2399.95	H	65.32	44.05	74	54	-8.68	-9.95
2399.15	V	59.05	39.25	74	54	-14.95	-14.75
2483.69	H	64.24	45.15	74	54	-9.76	-8.85
2484.15	V	58.36	38.75	74	54	-15.64	-15.25

14. Antenna Application

14.1 Antenna requirement

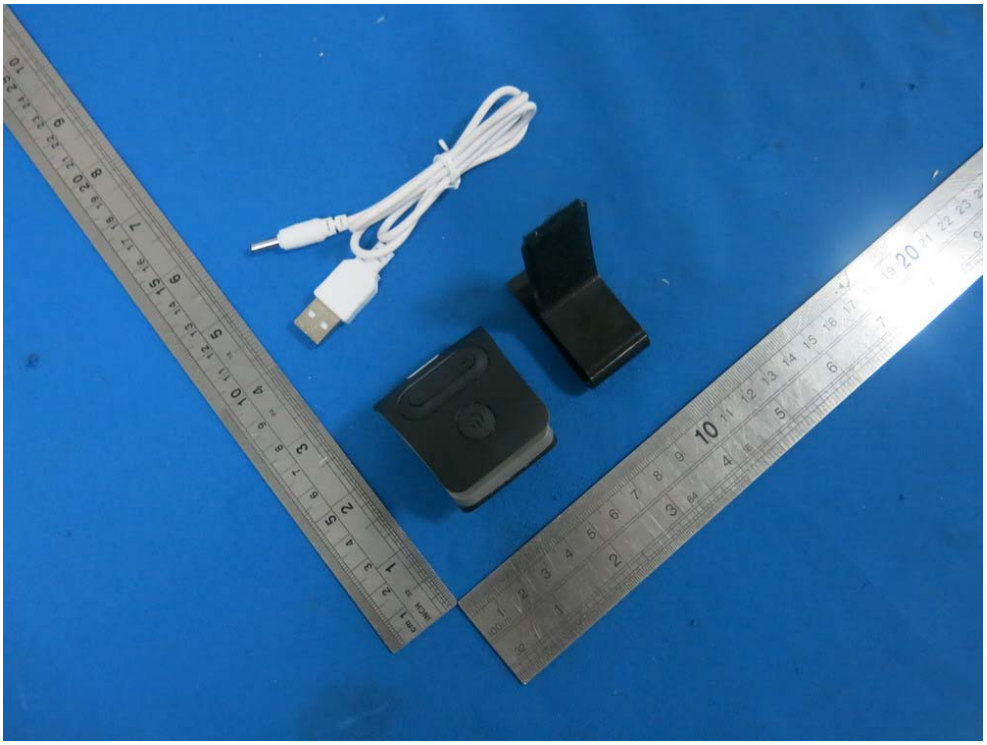
The EUT'S antenna is met the requirement of FCC part 15C section 15.203 and 15.247.

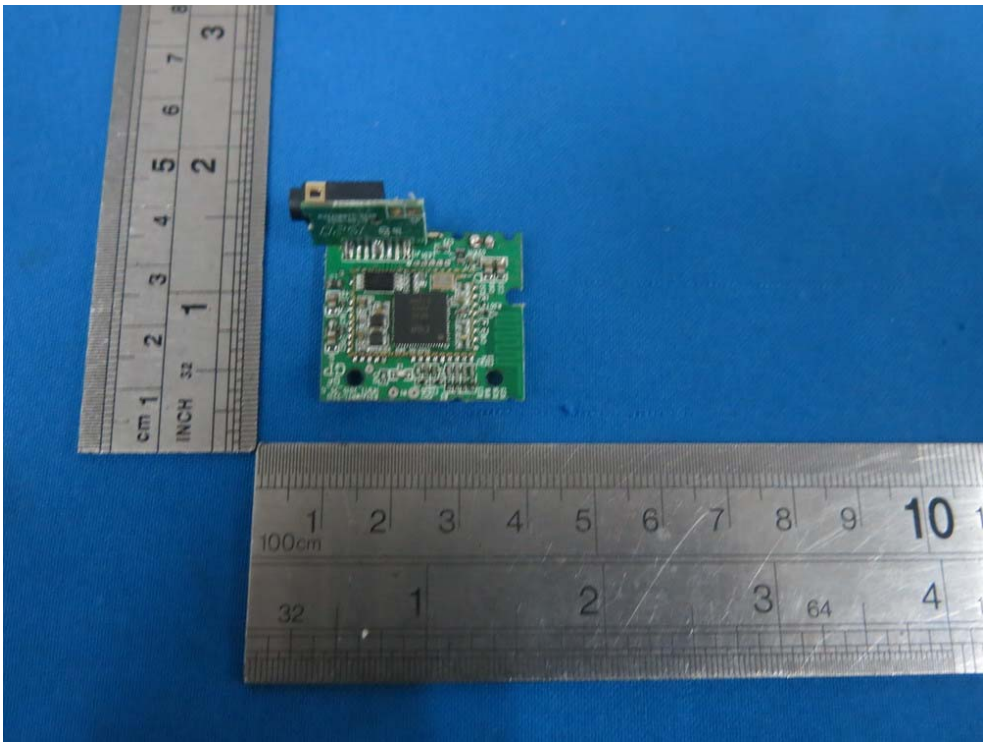
FCC part 15C section 15.247 requirements:
Systems operating in the 2402-2480MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

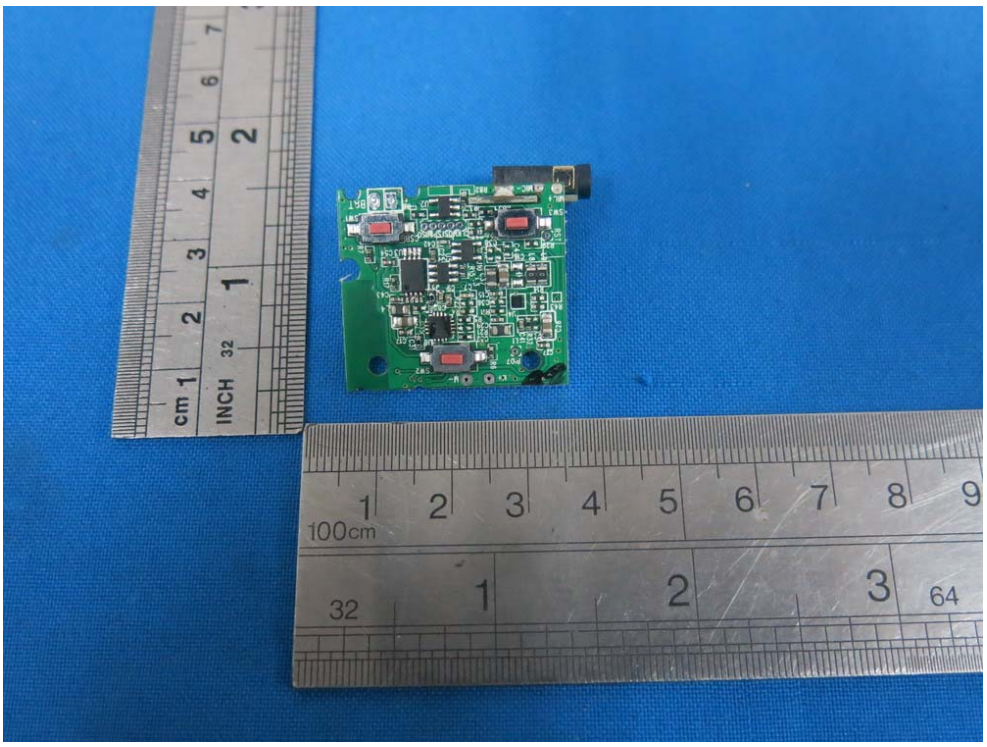
14.2 Result

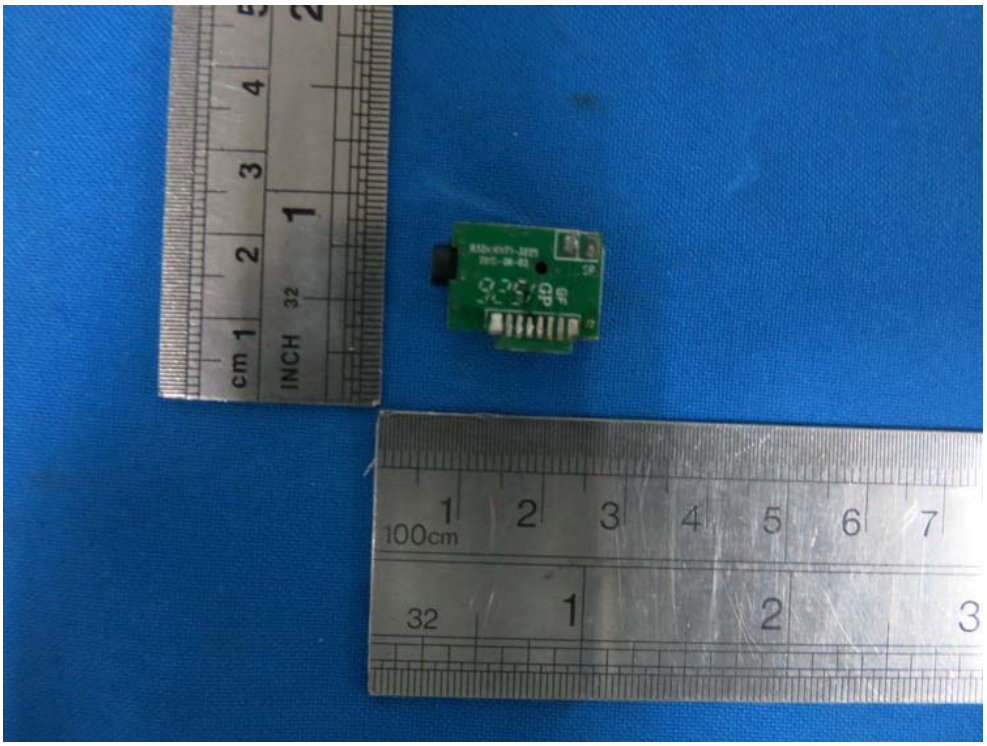
The EUT's antenna, permanent attached antenna, used a PCB antenna and integrated on PCB, The antenna's gain is 0 dBi and meets the requirement.

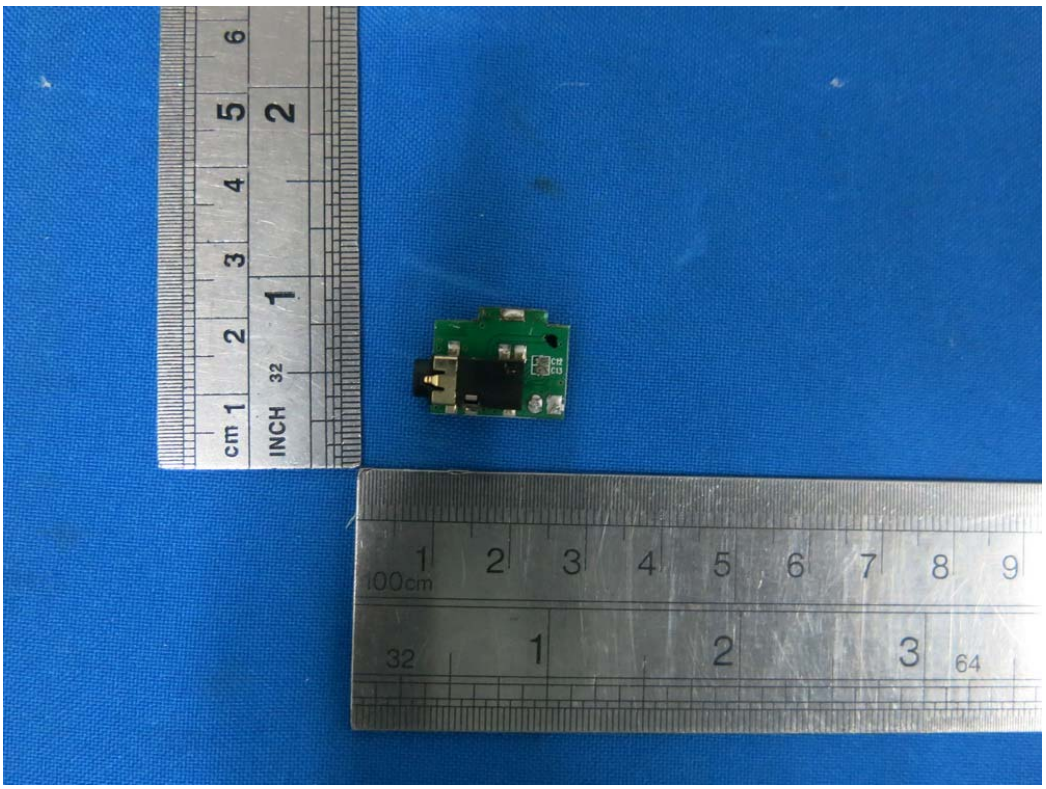
APPENDIX I
(Photos of EUT)



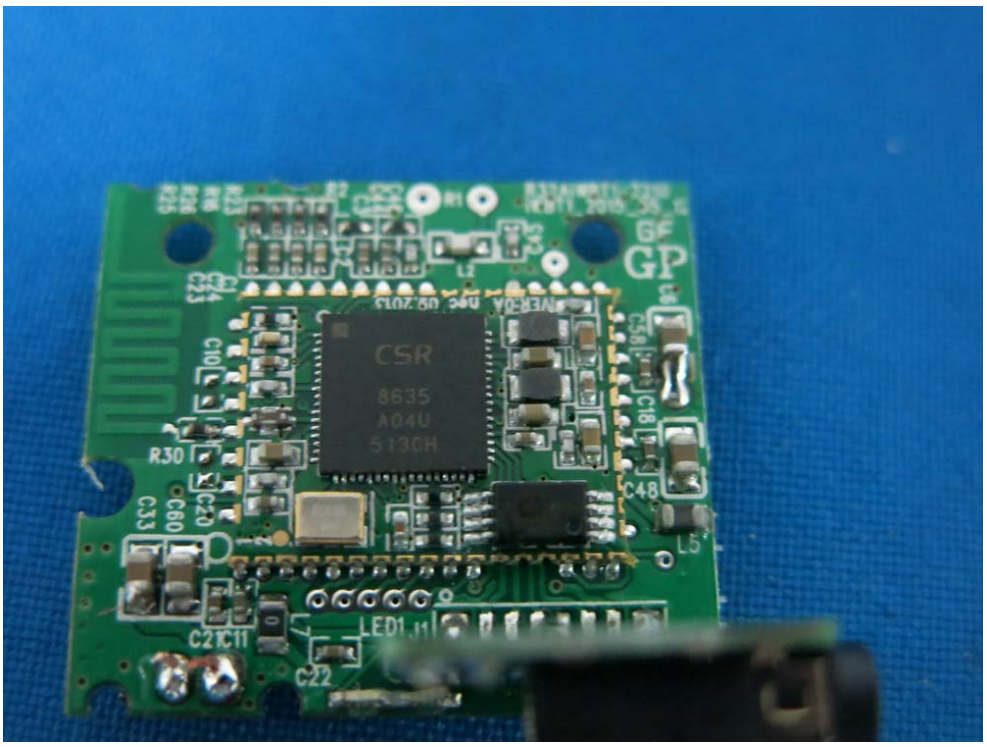



cm
INCH
100cm
32
64


cm
INCH
100cm
32



3.7V 280mAh 1.04Wh
552020
141220-29S
MADE IN CHINA


CSR
8635
A04U
513CH
GP
R30
C33
C60
C20
C21
C11
C22
LED1
C48
L5
C18
C10