

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

OF

Bluetooth 150Mbps Wireless N USB Module

Model No.: BL-R8723RB1

FCC ID: S8J-R8723RB1

Trademark: LB-LINK

Report No.: KAD150528148E1

Issue Date: July 14, 2015

Prepared for

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VERIFICATION OF COMPLIANCE

Applicant:	Shenzhen Bilian Electronic Co., Ltd. Building B1, Zhongxing Industrial Zone, Juling Jutang Community, Guanlan street, Bao'an, Shenzhen China
Manufacturer:	Shenzhen Bilian Electronic Co., Ltd. Building B1, Zhongxing Industrial Zone, Juling Jutang Community, Guanlan street, Bao'an, Shenzhen China
Product Description:	Bluetooth 150Mbps Wireless N USB Module
Trade Mark:	LB-LINK
Model Number:	BL-R8723RB1

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(2014).

Date of Test : May 28, 2015 to June 27, 2015

Prepared by : 
Ivy Huang/Editor

Reviewer : 
Hong Yang/Supervisor

Approved & Authorized
Signer : 
Sam Lv/Manager

Modified Information

Version	Summary	Revision Date	Report No.
Ver.1.0	Original Report	/	KAD150528148E1

Table of Contents

1. GENERAL INFORMATION	6
1.1 PRODUCT DESCRIPTION.....	6
1.2 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 LIMITATION.....	9
2.5 CONFIGURATION OF TESTED SYSTEM	12
3. SUMMARY OF TEST RESULTS	13
4. DESCRIPTION OF TEST MODES	14
5. TEST SYSTEM UNCERTAINTY	15
6. CONDUCTED EMISSIONS TEST	16
6.1 MEASUREMENT PROCEDURE:	16
6.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	16
6.3 MEASUREMENT EQUIPMENT USED:	16
6.4 MEASUREMENT RESULT:.....	16
6.5 CONDUCTED MEASUREMENT PHOTOS:	19
7. RADIATED EMISSION TEST.....	20
7.1 MEASUREMENT PROCEDURE	20
7.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	21
7.3 MEASUREMENT EQUIPMENT USED:	22
7.4 MEASUREMENT RESULT	24
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 REQUIREMENTS / LIMITS	50
11.3 TEST RESULT	50
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) (3 pages)

1. GENERAL INFORMATION

1.1 Product Description

Product Name	Bluetooth 150Mbps Wireless N USB Module		
Model number	BL-R8723RB1		
Power Supply	DC From PC		
Technical Description			
Kind of Device	Bluetooth 4.0	Bluetooth 3.0+EDR	WiFi
Operation Frequency	2402-2480MHz		2412-2462MHz for 802.11b/g/n(HT20) ; 2422-2452MHz for 802.11n(HT40)
Modulation	GFSK	GFSK, $\pi/4$ -DQPSK, 8DPSK	OFDM with BPSK/QPSK/16QAM/64QAM for 802.11g/n, DSSS with DBPSK/DQPSK/CCK for 802.11b;
Number of Channel	40	79	11 Channels for 802.11b/g/n(HT20) 7 Channels for 802.11n(HT40)
Channel space	2MHz	1MHz	5MHz
Max RF Output Power	2.02dBm	4.43dBm	14.10dBm
Antenna Type	Internal PCB antenna		External Antenna
Antenna Gain	2 dBi		

1.2 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 placed on a 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

The EUT is placed on a turn table which is 0.8 m 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 Limitation

(1) Channel Separation test

FCC Part 15, Subpart C Section 15.247(a)(1). Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20 Bandwidth of the hopping channel, whichever is greater.

Frequency Range (MHz)	Limit(kHz)
902-928	>25kHz
2400-2483.5	>25kHz
5725-5850	>25kHz

(2) 20dB Bandwidth

Frequency Range(MHz)	Quantity of Hopping Channel	Limit(kHz)			
		50	25	15	75
	902-928	<250	>250	NA	NA
	2400-2483.5	NA	NA	>1000	<1000

(3) Quantity of Hopping Channel

FCC Part 15, Subpart C Section 15.247

Frequency Range (MHz)	Limit(Quantity of Hopping Channel)			
	20dB bandwidth <250kHz	20dB bandwidth >250kHz	20dB bandwidth <1MHz	20dB bandwidth >1MHz
902-928	50	25	NA	NA
2400-2483.5	NA	NA	15	15
5725-5850	NA	NA	75	NA

(4) Time of Occupancy(Dwell Time)

FCC Part 15, Subpart C Section 15.247

Frequency Range (MHz)	LIMIT(rms)		
	20dB bandwidth <250kHz(50Channel)	20dB bandwidth >250kHz(25Channel)	20dB bandwidth <1MHz(75Channel)
902-928	400(20S)	400(10S)	NA
2400-2483.5	NA	NA	400(30S)
5725-5850	NA	NA	400(30S)

Note: The “()” is all channel's average time of occupancy.

(5) Maximum Peak Output Power

FCC Part 15, Subpart C Section 15.247

Frequency Range (MHz)	Quantity of Hopping Channel	LIMIT(W)			
		50	25	15	75
902-928		1(30dBm)	0.125(21dBm)	NA	NA
2400-2483.5		NA	NA	0.125(21dBm)	1(30dBm)
5725-5850		NA	NA	NA	1(30dBm)

(6) Band edge

FCC Part15, Subpart C Section 15.247, In any 100kHz bandwidth outside the frequency band in with the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, attenuation below the general limits specified in section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a).

Operating Frequency Range(MHz)	Spurious emission frequency	Peak power ration to emission(dBc)	Limit Emission level(dBuV/m)
902-928	<902	>20	NA
	>928	>20	NA
	960-1240	NA	54
2400-2483.5	<2400	>20	NA
	>2483.5-2500	NA	54
5725-5850	<5350-5460	NA	54
	<5725	>20	NA
	>5850	>20	NA

(7) Conducted Emission

Frequency(MHz)	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

Note:

1. The lower limit shall apply at the transition frequencies
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

(8) Radiated Emission

FCC Part 15, Subpart C Section 15.209 limit of radiated emission for frequency below 1000MHz. The emissions from an intentional radiator shall not exceed the field strength level specified in the following table:

Frequency (MHz)	Field strength $\mu\text{V/m}$	Distance(m)	Field strength at 3m dB $\mu\text{V/m}$
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	40
88-216	150	3	43.5
216-960	200	3	46
Above 960	500	3	54

Remark 1. Emission level in dB $\mu\text{V/m}$ =20 log ($\mu\text{V/m}$)

: 2. Measurement was performed at an antenna to the closed point of EUT distance of meters.

FCC Part 15, Section 15.35(b) limit of radiated emission for frequency above 1000MHz

Frequency(MHz)	Class A(dB $\mu\text{V/m}$)(at 3m)		Class B(dB $\mu\text{V/m}$)(at 3m)	
	PEAK	AVERAGE	PEAK	AVERAGE
Above 1000	80.0	60.0	74.0	54.0

FCC Part 15, Subpart C Section 15.249. The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Frequency(MHz)	Filed Strength of Fundamental(at 3m)		Filed Strength of Harmonics(at 3m)	
	PEAK	AVERAGE	PEAK	AVERAGE
902-928	114	94	74.0	54.0
2400-2483.5	114	94	74.0	54.0
5725-5875	114	94	74.0	54.0
24000-24250	128	108	88.0	68.0

2.5 Configuration of Tested System

Fig. 2-1 Configuration of Tested System

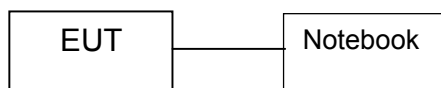


Table 2-1 Equipment Used in Tested System

Item	Equipment	Trade Mark	Model No.	FCC ID	Note
1.	Bluetooth 150Mbps Wireless N USB Module	LB-LINK	BL-R8723RB1	S8J-R8723RB1	EUT
2	Notebook	Dell	14R-N4110	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

4. Description of test modes

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 software control the EUT, Let EUT hopping on and transmit with highest power, all the modes GFSK, $\pi/4$ -DQPSK, 8DPSK have been tested. 79 Channels are provided by EUT. The 3 channels of lower, medium and higher were chosen for test.

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	$\pm 1 \times 10^{-5}$
Maximum Peak Output Power Test	$\pm 1.0\text{dB}$
Conducted Emissions Test	$\pm 2.0\text{dB}$
Radiated Emission Test	$\pm 2.0\text{dB}$
Power Density	$\pm 2.0\text{dB}$
Occupied Bandwidth Test	$\pm 1.0\text{dB}$
Band Edge Test	$\pm 3\text{dB}$
All emission, radiated	$\pm 3\text{dB}$
Antenna Port Emission	$\pm 3\text{dB}$
Temperature	$\pm 0.5^{\circ}\text{C}$
Humidity	$\pm 3\%$

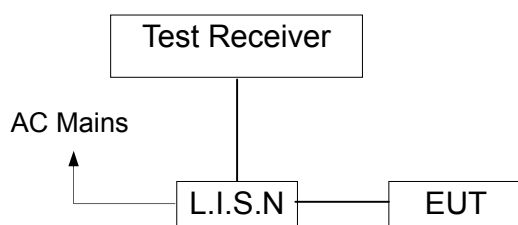
Measurement Uncertainty for a level of Confidence of 95%

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:

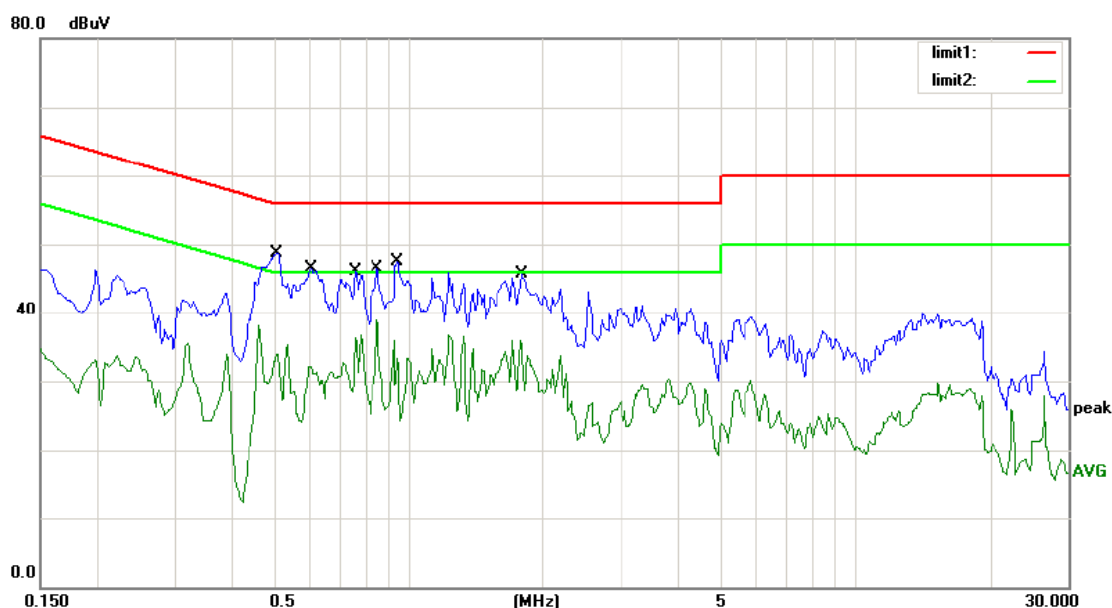
Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Last Cal.	Due date
Test Receiver	Rohde & Schwarz	ESCS30	100018	03/16/2015	03/15/2016
L.I.S.N	Rohde & Schwarz	ENV216	100017	03/16/2015	03/15/2016
RF Switching Unit	CDS	RSU-M2	38401	03/16/2015	03/15/2016
Coaxial Cable	CDS	79254	46107086	03/16/2015	03/15/2016

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.

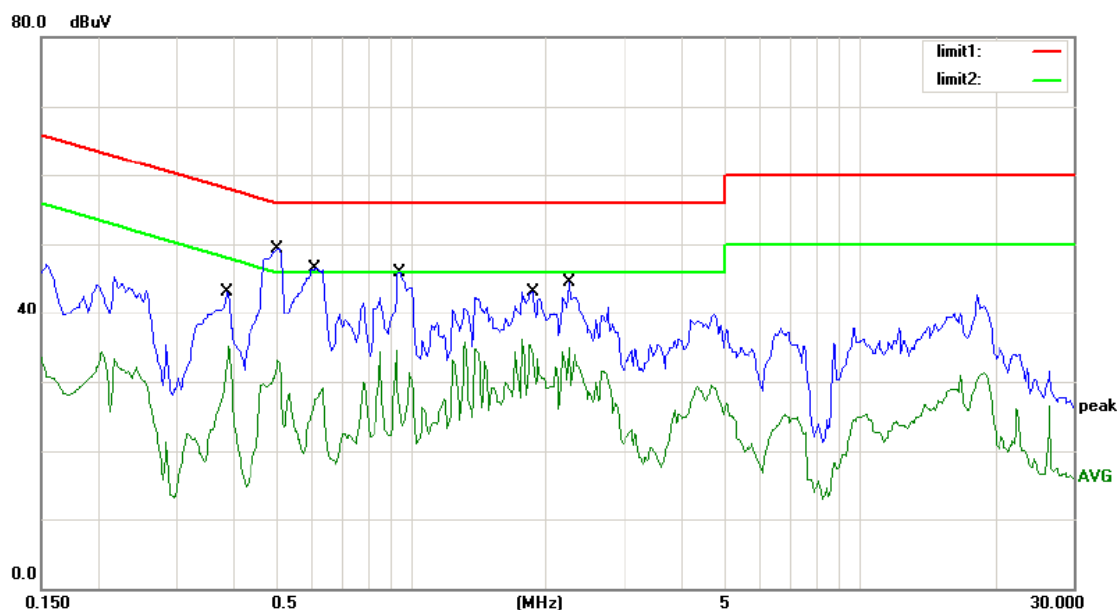
Please refer to the following data.



Site site #1 Phase: **L1** Temperature: 24
 Limit: (CE)FCC PART 15 class B_QP Power: DC 5V Humidity: 55 %
 Mode: TX(2402MHz)
 Note:

No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over		
		MHz	Level	Factor	ment				
			dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.5100	46.74	0.00	46.74	56.00	-9.26	QP	
2		0.5100	35.29	0.00	35.29	46.00	-10.71	AVG	
3		0.6045	44.25	0.00	44.25	56.00	-11.75	QP	
4		0.6045	32.08	0.00	32.08	46.00	-13.92	AVG	
5		0.7620	44.71	0.00	44.71	56.00	-11.29	QP	
6		0.7620	36.63	0.00	36.63	46.00	-9.37	AVG	
7		0.8520	44.12	0.00	44.12	56.00	-11.88	QP	
8	*	0.8520	38.81	0.00	38.81	46.00	-7.19	AVG	
9		0.9465	45.25	0.00	45.25	56.00	-10.75	QP	
10		0.9465	35.81	0.00	35.81	46.00	-10.19	AVG	
11		1.7925	43.24	0.00	43.24	56.00	-12.76	QP	
12		1.7925	33.68	0.00	33.68	46.00	-12.32	AVG	

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



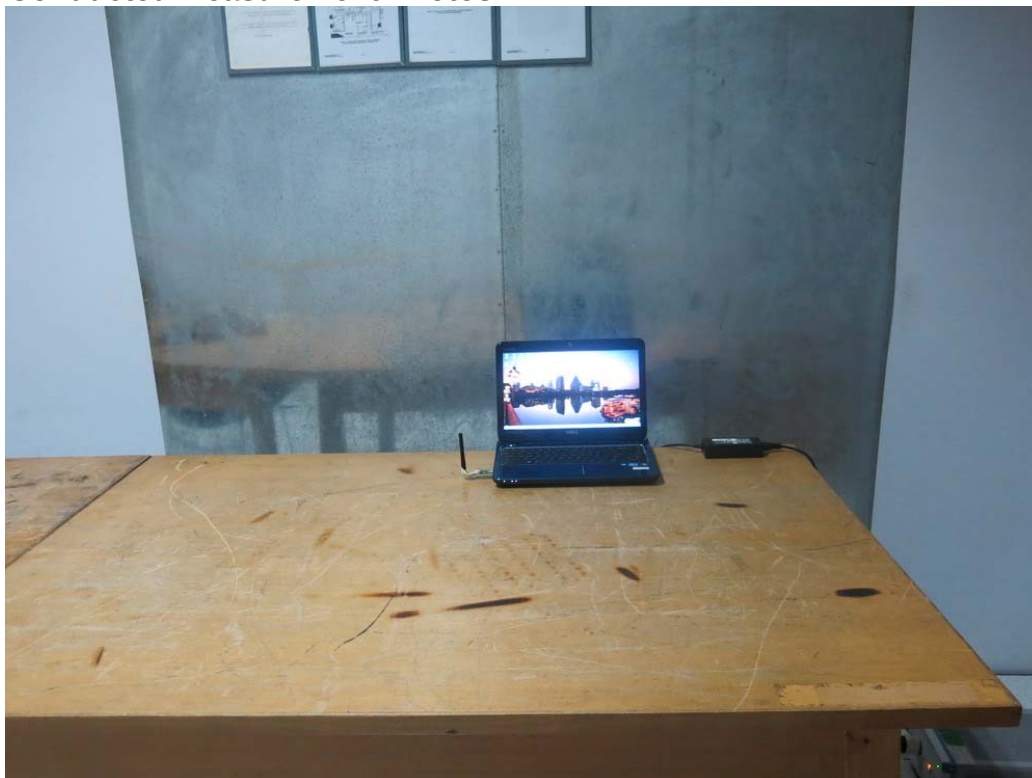
Site site #1
 Limit: (CE)FCC PART 15 class B_QP
 Mode: TX(2402MHz)
 Note:

Phase: **N**
 Power: DC 5V
 Temperature: 24
 Humidity: 55 %

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.3885	41.14	0.00	41.14	58.10	-16.96	QP	
2		0.3885	35.04	0.00	35.04	48.10	-13.06	AVG	
3	*	0.5054	47.54	0.00	47.54	56.00	-8.46	QP	
4		0.5054	33.04	0.00	33.04	46.00	-12.96	AVG	
5		0.6134	44.25	0.00	44.25	56.00	-11.75	QP	
6		0.6134	22.58	0.00	22.58	46.00	-23.42	AVG	
7		0.9465	43.54	0.00	43.54	56.00	-12.46	QP	
8		0.9465	26.24	0.00	26.24	46.00	-19.76	AVG	
9		1.8690	41.74	0.00	41.74	56.00	-14.26	QP	
10		1.8690	35.36	0.00	35.36	46.00	-10.64	AVG	
11		2.2500	42.63	0.00	42.63	56.00	-13.37	QP	
12		2.2500	34.89	0.00	34.89	46.00	-11.11	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. 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.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measured were complete.
5. The following table is the setting of spectrum analyzer:

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:

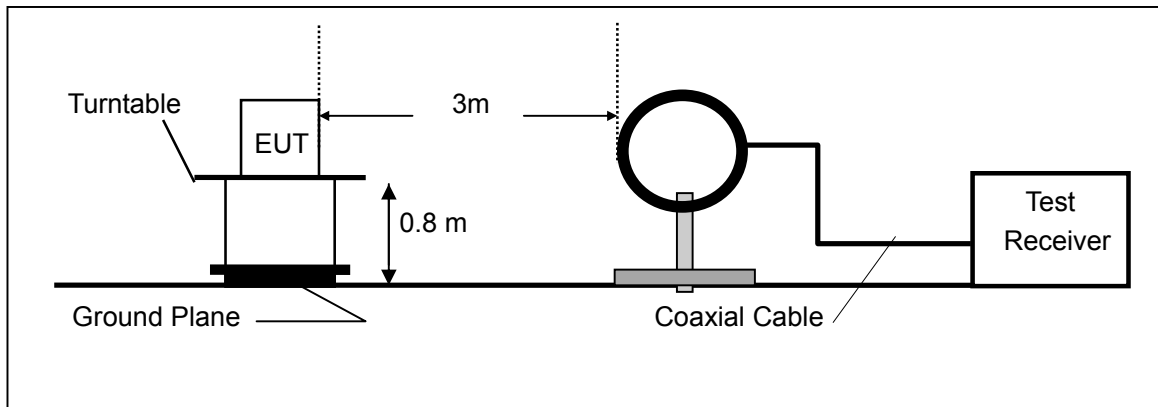
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	3MHz
Detector	Peak
Trace	Max hold

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

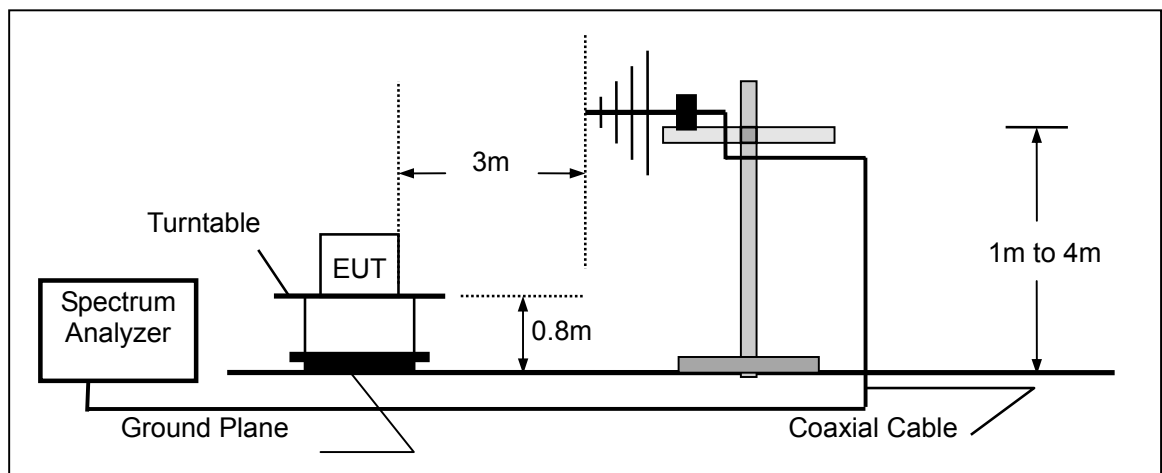
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	10Hz
Detector	Peak
Trace	Max hold

7.2 Test SET-UP (Block Diagram of Configuration)

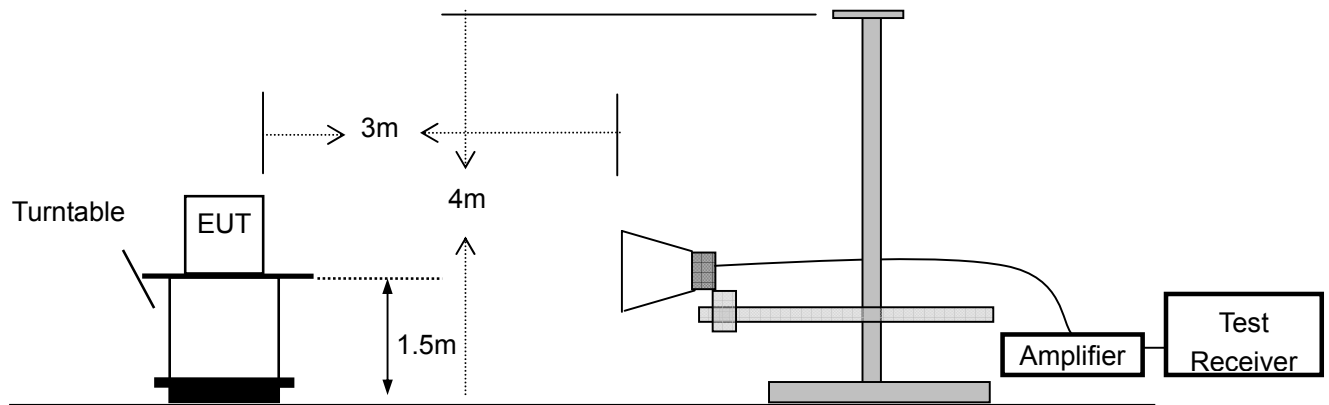
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(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.	Last Cal.	Cal. Interval
1.	Test Receiver	Rohde & Schwarz	ESCI	1166.5950.03	03/16/2015	1 Year
2.	Bilog Antenna	Schwarzbeck	VULB9163	000141	03/16/2015	1 Year
3.	Power Amplifier	CDS	RSU-M352	818	03/16/2015	1 Year
4.	Power Amplifier	HP	8447F	OPT H64	03/16/2015	1 Year
5.	Color Monitor	SUNSP0	SP-140A	N/A	03/16/2015	1 Year
6.	Single Line Filter	JIANLI	XL-3	N/A	03/16/2015	1 Year
7.	Single Phase Power Line Filter	JIANLI	DL-2X100B	N/A	03/16/2015	1 Year
8.	3 Phase Power Line Filter	JIANLI	DL-4X100B	N/A	03/16/2015	1 Year
9.	DC Power Filter	JIANLI	DL-2X50B	N/A	03/16/2015	1 Year
10.	Cable	Schwarzbeck	PLF-100	549489	03/16/2015	1 Year
11.	Cable	Rosenberger	CIL02	A0783566	03/16/2015	1 Year
12.	Cable	Rosenberger	RG 233/U	525178	03/16/2015	1 Year
13.	Signal Analyzer	Rohde & Schwarz	FSV30	103040	12/29/2014	1 Year
14.	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1272	12/29/2014	1 Year
15.	Power Amplifier	LUNAR EM	LNA1G18-40	J10100000081	12/29/2014	1 Year
16.	Cable	H+S	CBL-26	N/A	12/29/2014	1 Year
17.	Cable	H+S	CBL-26	N/A	12/29/2014	1 Year
18.	Cable	H+S	CBL-26	N/A	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 § 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 :	June 12, 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)
--	--	--	--	--

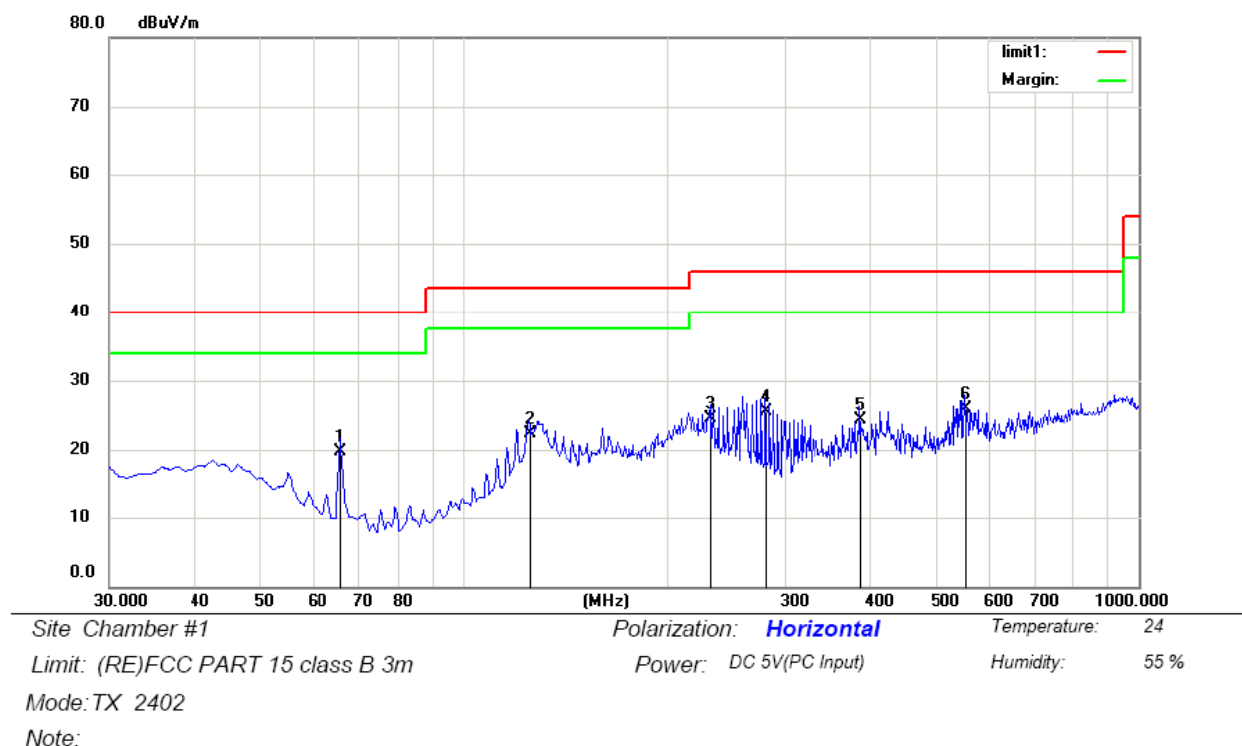
Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

Below 1000MHz:

Pass.

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

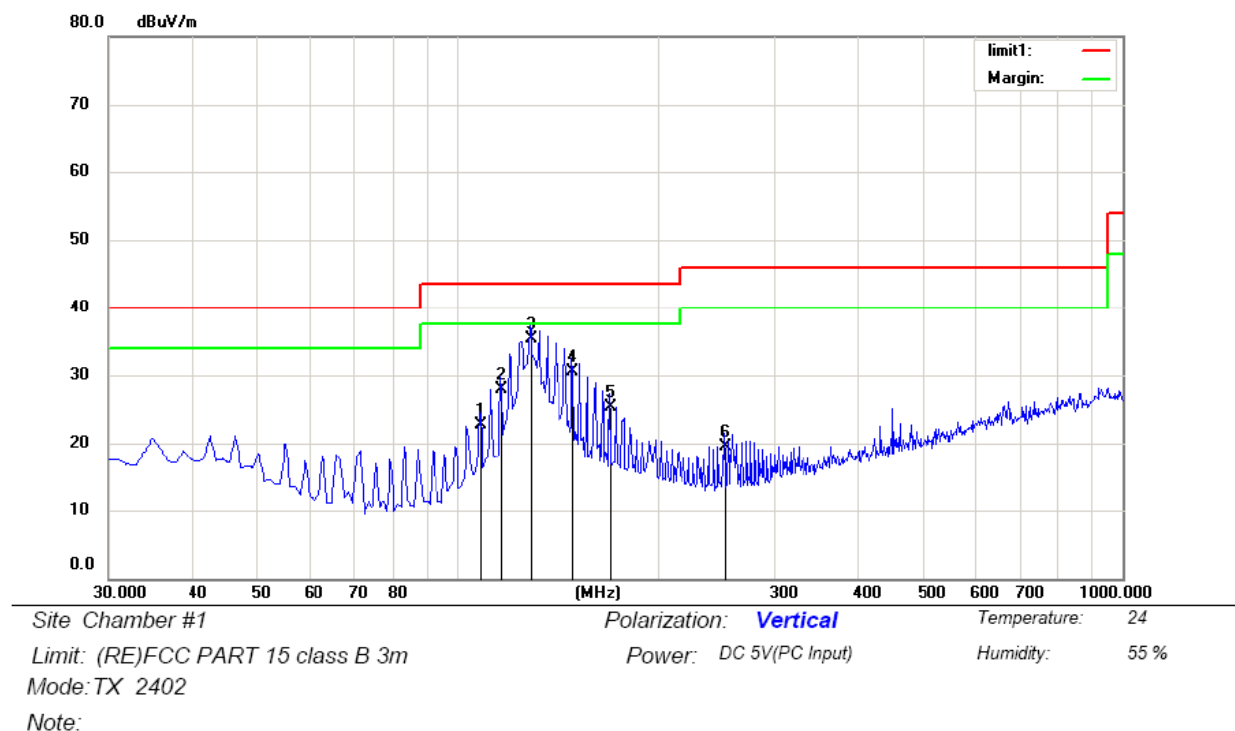
Please refer to the following data.



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		65.8900	40.81	-21.07	19.74	40.00	-20.26	QP		
2		125.0600	38.63	-16.40	22.23	43.50	-21.27	QP		
3		232.7300	40.45	-15.93	24.52	46.00	-21.48	QP		
4		280.2600	40.36	-14.90	25.46	46.00	-20.54	QP		
5		386.9600	36.19	-11.84	24.35	46.00	-21.65	QP		
6	*	554.7700	34.77	-8.93	25.84	46.00	-20.16	QP		

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

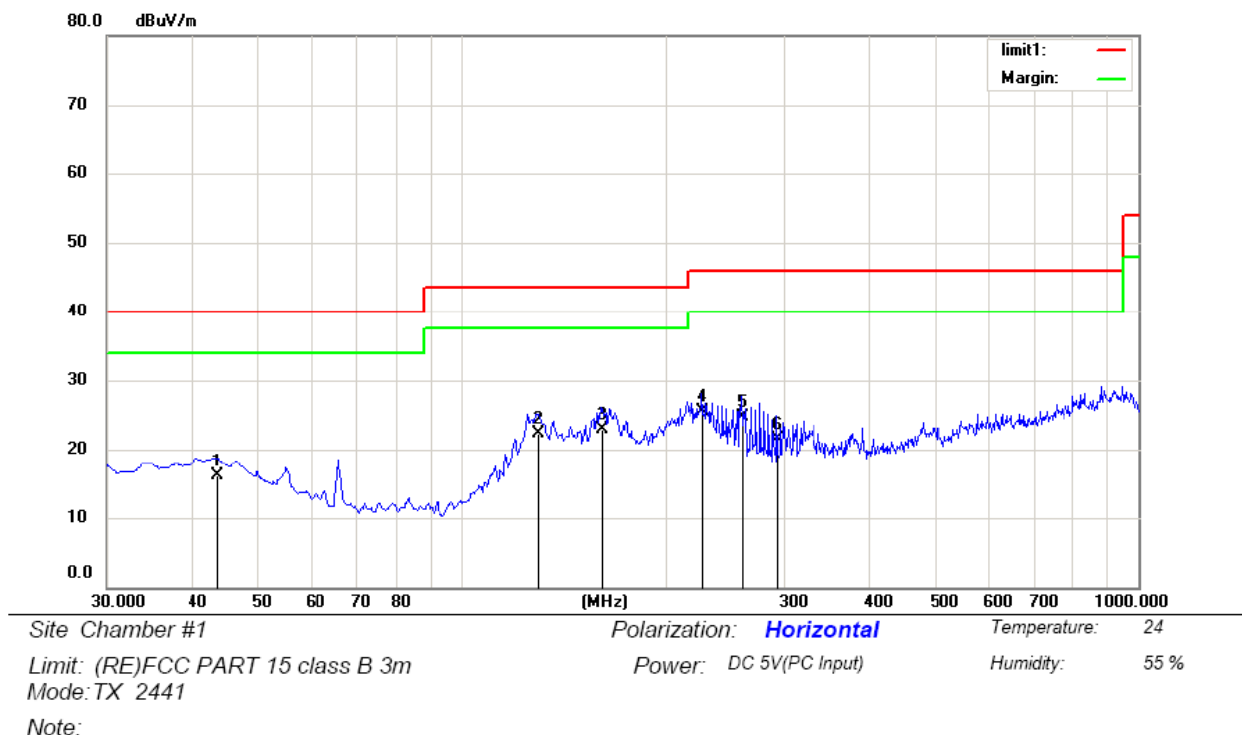
Operator: Snake



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree
1		108.5700	40.51	-17.75	22.76	43.50	-20.74	QP		
2		116.3300	45.02	-17.21	27.81	43.50	-15.69	QP		
3	*	128.9400	51.62	-16.35	35.27	43.50	-8.23	QP		
4		149.3100	48.17	-17.68	30.49	43.50	-13.01	QP		
5		169.6800	43.63	-18.42	25.21	43.50	-18.29	QP		
6		252.1300	35.07	-15.54	19.53	46.00	-26.47	QP		

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

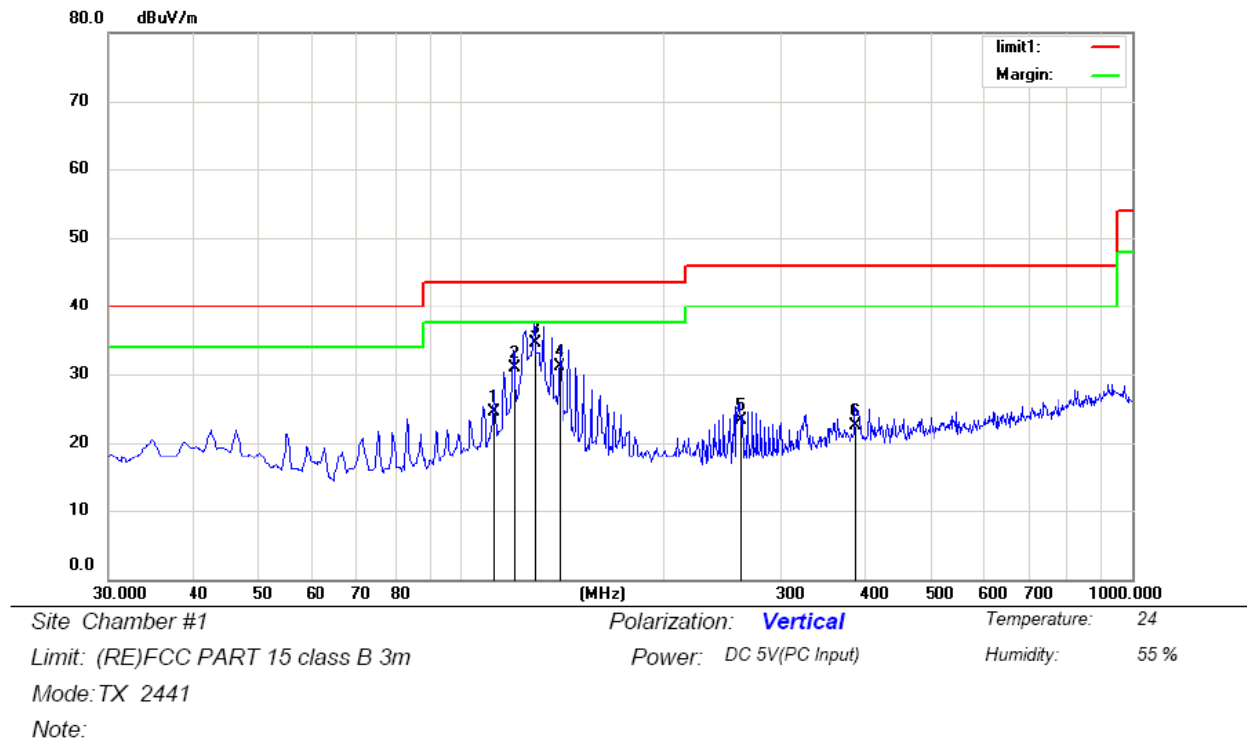
Operator: Snake



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree degree	Comment
1		43.5800	29.57	-13.37	16.20	40.00	-23.80	QP		
2		129.9100	38.46	-16.25	22.21	43.50	-21.29	QP		
3		160.9500	41.30	-18.43	22.87	43.50	-20.63	QP		
4	*	226.9100	41.58	-16.10	25.48	46.00	-20.52	QP		
5		259.8900	40.00	-15.38	24.62	46.00	-21.38	QP		
6		292.8700	36.25	-14.69	21.56	46.00	-24.44	QP		

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

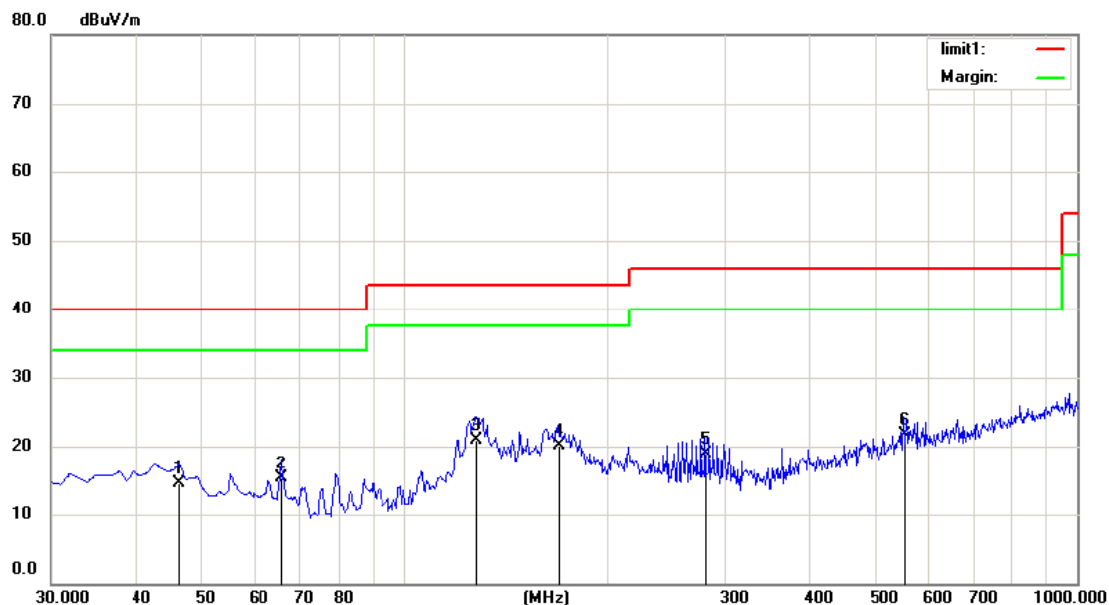
Operator: Snake



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		112.4500	42.01	-17.43	24.58	43.50	-18.92	QP		
2		120.2100	47.80	-16.93	30.87	43.50	-12.63	QP		
3	*	128.9400	50.92	-16.35	34.57	43.50	-8.93	QP		
4		140.5800	48.21	-17.09	31.12	43.50	-12.38	QP		
5		261.8300	38.65	-15.36	23.29	46.00	-22.71	QP		
6		387.9300	34.33	-11.79	22.54	46.00	-23.46	QP		

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

Operator: Snake



Site Chamber #1

Polarization: **Horizontal**

Temperature: 24

Limit: (RE)FCC PART 15 class B 3m

Power: DC 5V(PC Input)

Humidity: 55 %

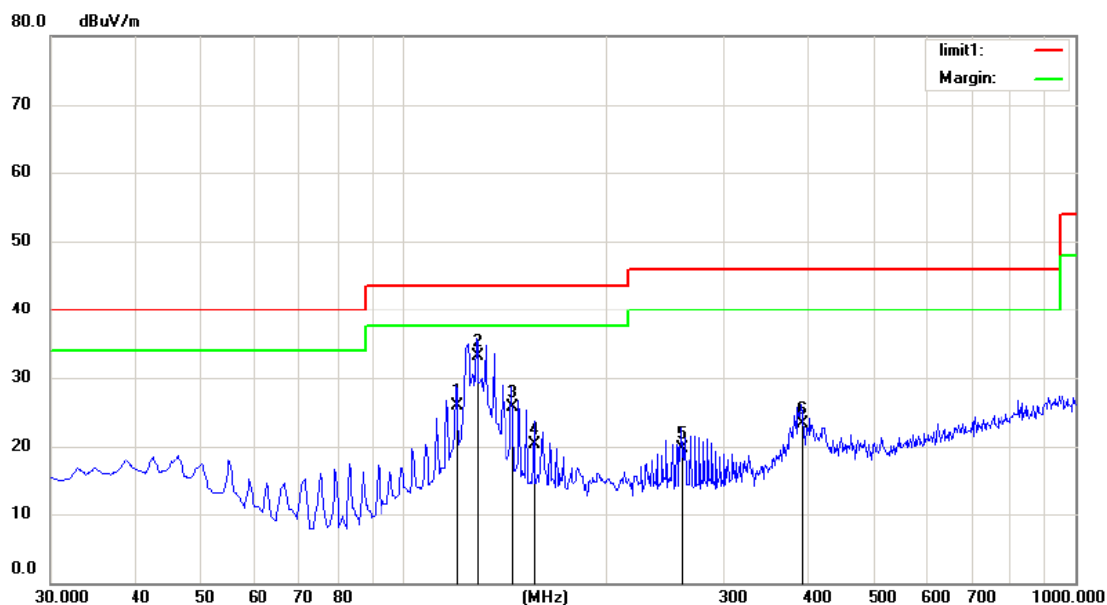
Mode: TX 2480

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		46.4900	28.53	-14.06	14.47	40.00	-25.53	QP		
2		65.8900	36.42	-21.07	15.35	40.00	-24.65	QP		
3	*	127.9700	37.21	-16.31	20.90	43.50	-22.60	QP		
4		169.6800	38.55	-18.42	20.13	43.50	-23.37	QP		
5		280.2600	33.74	-14.90	18.84	46.00	-27.16	QP		
6		554.7700	30.59	-8.93	21.66	46.00	-24.34	QP		

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

Operator: Snake



Site Chamber #1

Polarization: **Vertical**

Temperature: 24

Limit: (RE)FCC PART 15 class B 3m

Power: DC 5V(PC Input)

Humidity: 55 %

Mode: TX 2480

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		120.2100	42.90	-16.93	25.97	43.50	-17.53	QP		
2	*	128.9400	49.36	-16.35	33.01	43.50	-10.49	QP		
3		145.4300	43.12	-17.42	25.70	43.50	-17.80	QP		
4		157.0700	38.65	-18.28	20.37	43.50	-23.13	QP		
5		259.8900	35.12	-15.38	19.74	46.00	-26.26	QP		
6		392.7800	34.86	-11.58	23.28	46.00	-22.72	QP		

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

Operator: Snake

Above 1000MHz

Worst Operation Mode: GFSK (CH1: 2402MHz) Test Date : June 12, 2015
 Frequency Range: 1-25GHz Temperature : 25 °C
 Test Result: PASS Humidity : 50 %
 Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
4804	V	65.01	45.15	74	54	-8.99	-8.85
7206	V	63.24	44.01	74	54	-10.76	-9.99
9608	V	62.74	43.62	74	54	-11.26	-10.38
12010	V	61.62	42.15	74	54	-12.38	-11.85
14412	V	60.25	41.82	74	54	-13.75	-12.18
16814	V	59.72	40.24	74	54	-14.28	-13.76
4804	H	64.35	46.35	74	54	-9.65	-7.65
7206	H	63.15	45.18	74	54	-10.85	-8.82
9608	H	62.04	44.05	74	54	-11.96	-9.95
12010	H	61.72	43.62	74	54	-12.28	-10.38
14412	H	60.92	42.18	74	54	-13.08	-11.82
16814	H	59.48	40.27	74	54	-14.52	-13.73

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) The results of worst cased (GFSK) was recorded.

Worst Operation Mode: GFSK (CH40: 2441MHz) Test Date : June 12, 2015
 Frequency Range: 1-25GHz Temperature : 25 °C
 Test Result: PASS Humidity : 50 %
 Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
4882	V	65.35	45.72	74	54	-8.65	-8.28
7323	V	64.05	44.35	74	54	-9.95	-9.65
9764	V	63.72	43.62	74	54	-10.28	-10.38
12205	V	62.15	42.15	74	54	-11.85	-11.85
14646	V	61.04	41.05	74	54	-12.96	-12.95
17087	V	60.25	40.82	74	54	-13.75	-13.18
4882	H	64.72	46.35	74	54	-9.28	-7.65
7323	H	63.92	45.25	74	54	-10.08	-8.75
9764	H	62.15	44.15	74	54	-11.85	-9.85
12205	H	61.8	43.92	74	54	-12.2	-10.08
14646	H	60.24	42.01	74	54	-13.76	-11.99
17087	H	59.1	41.58	74	54	-14.9	-12.42

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) The results of worst cased (GFSK) was recorded.

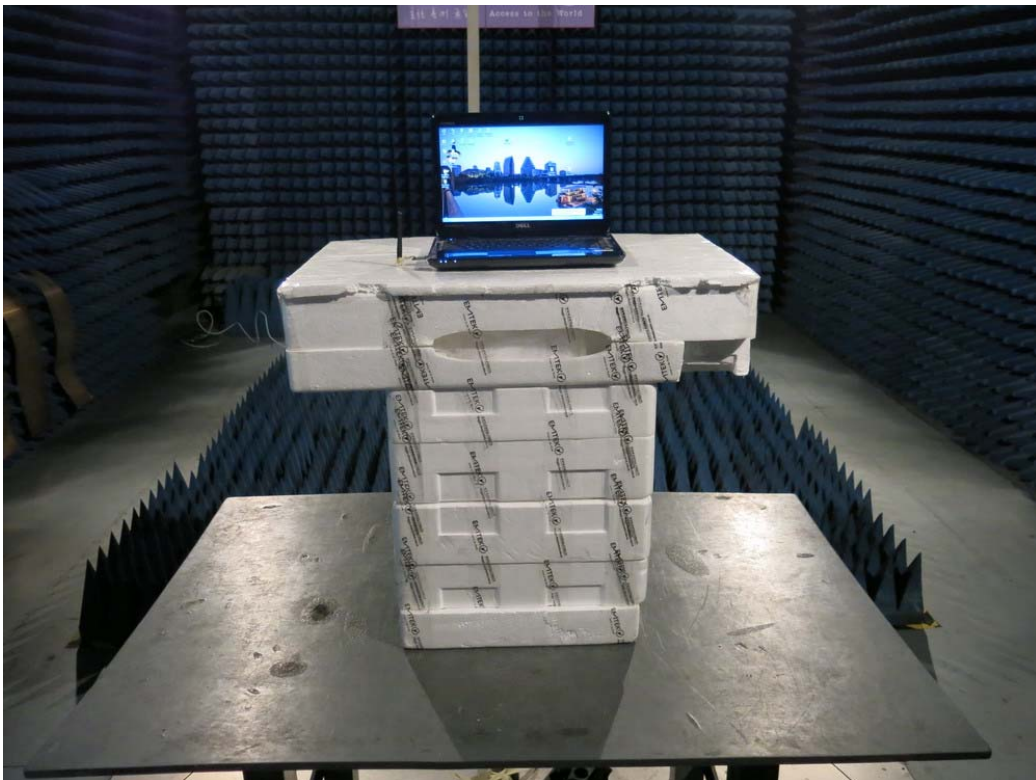
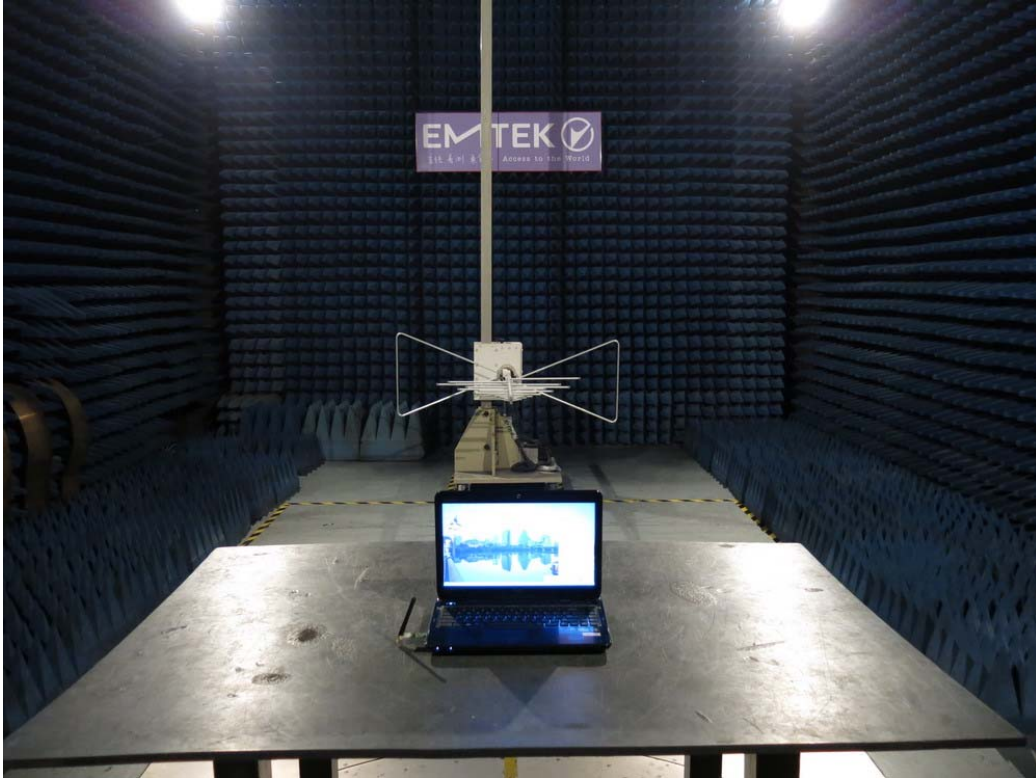
Worst Operation Mode: GFSK (CH79: 2480MHz) Test Date : June 12, 2015
Frequency Range: 1-25GHz Temperature : 25 °C
Test Result: PASS Humidity : 50 %
Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
4960	V	65.32	45.15	74	54	-8.68	-8.85
7440	V	64.15	44.35	74	54	-9.85	-9.65
9920	V	63.72	43.62	74	54	-10.28	-10.38
12400	V	62.05	42.05	74	54	-11.95	-11.95
14880	V	61.82	41.82	74	54	-12.18	-12.18
17360	V	60.72	40.71	74	54	-13.28	-13.29
4960	H	65.72	45.6	74	54	-8.28	-8.4
7440	H	64.2	44.15	74	54	-9.8	-9.85
9920	H	63.62	43.62	74	54	-10.38	-10.38
12400	H	62.15	42.01	74	54	-11.85	-11.99
14880	H	61.87	41.82	74	54	-12.13	-12.18
17360	H	60	40.3	74	54	-14	-13.7

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) The results of worst cased (GFSK) was recorded.

7.5 Radiated Measurement Photos:

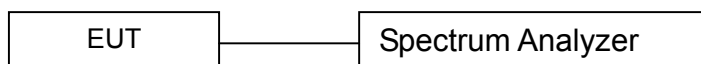


8. Channel Separation test

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:

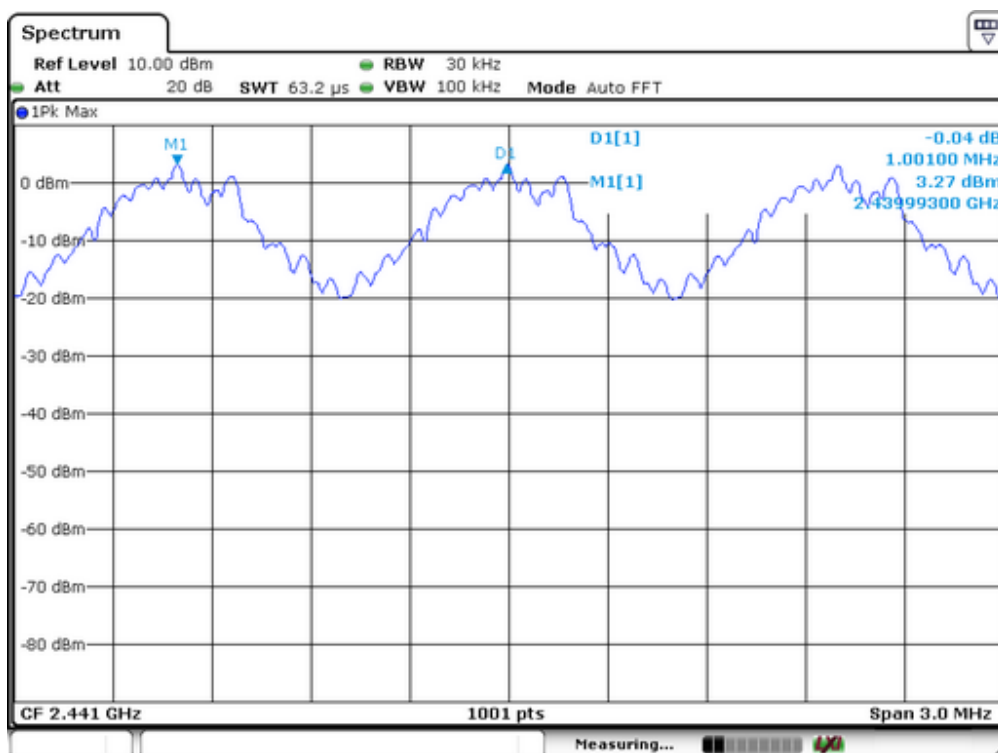
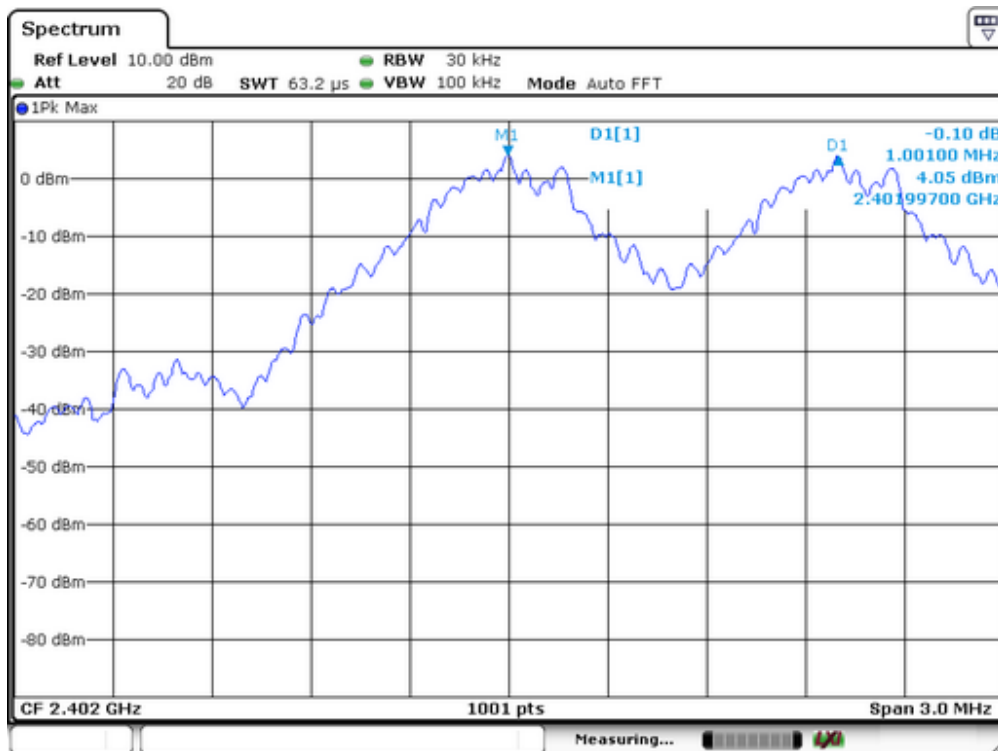
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	03/16/2015	03/15/2016
Coaxial Cable	CDS	79254	46107086	03/16/2015	03/15/2016

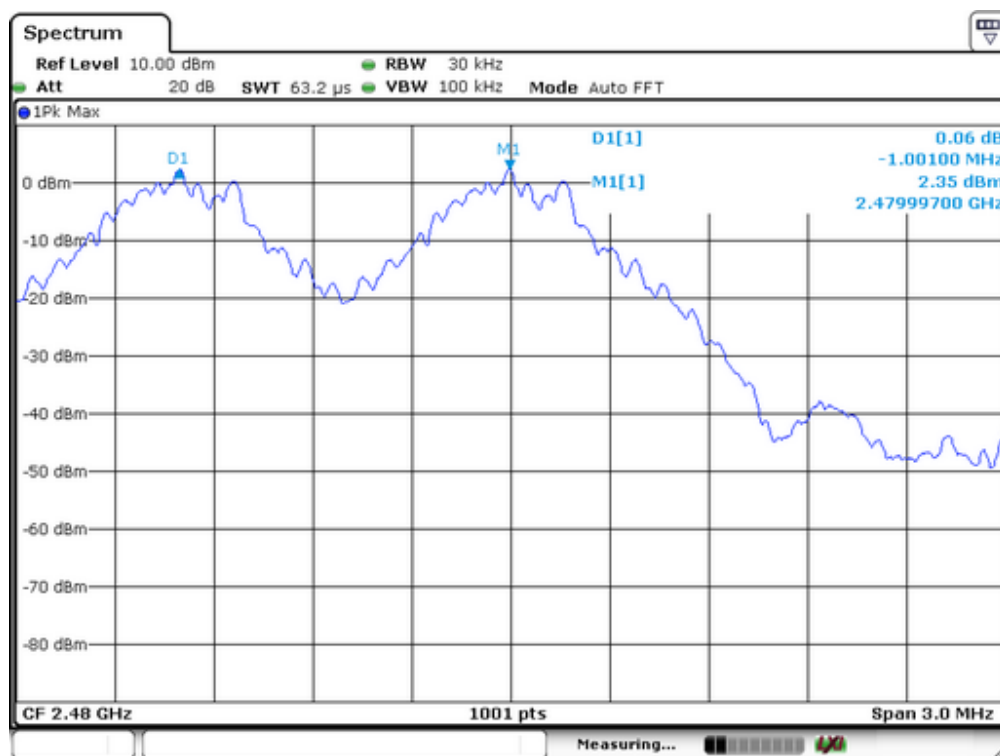
8.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	June 12, 2015
Test By:	Andy	Temperature :	25 °C
Test Result:	PASS	Humidity :	50 %
Modulation:	GFSK		

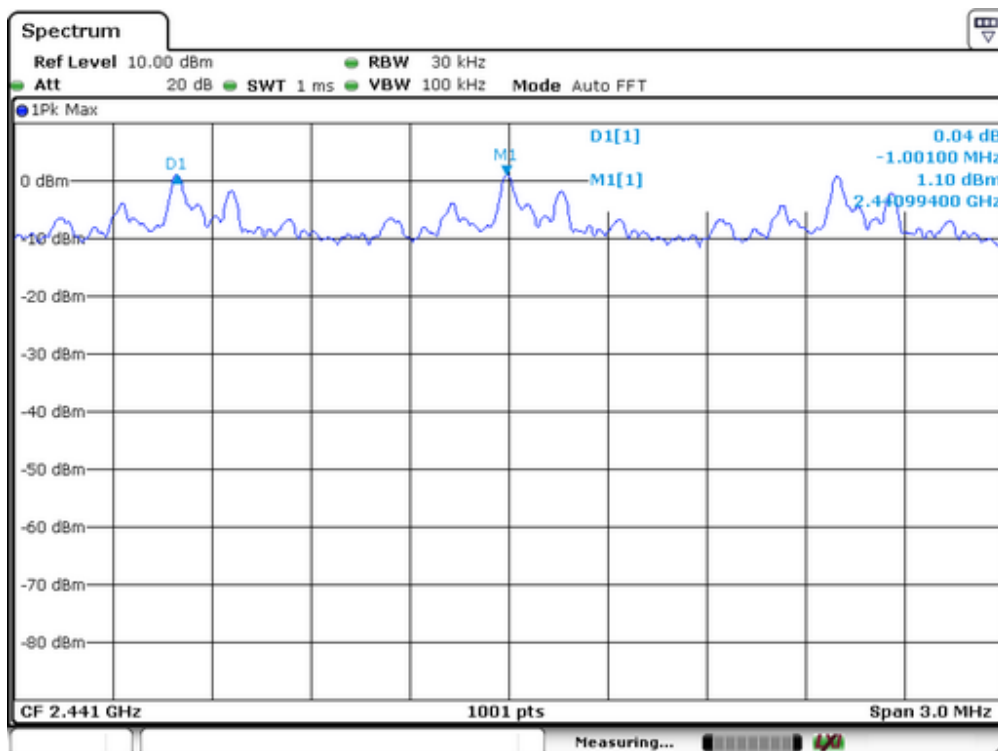
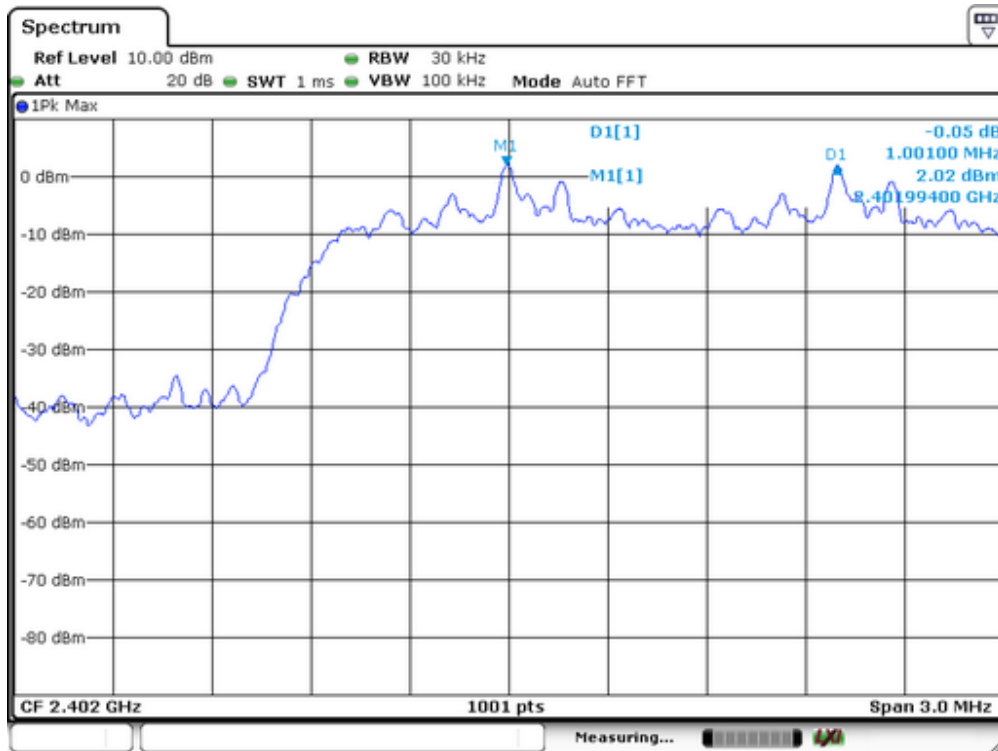
Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit (kHz)
1	2402	1001	>815
40	2441	1001	>818
79	2480	1001	>818

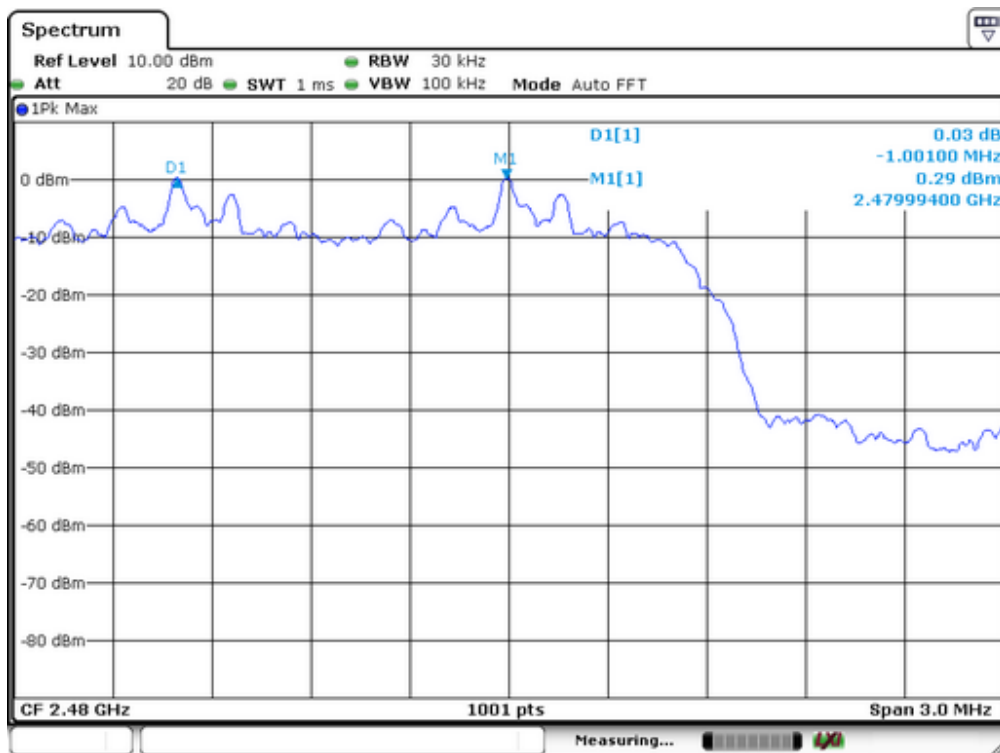




Spectrum Detector:	PK	Test Date :	June 12, 2015
Test By:	Andy	Temperature :	24°C
Test Result:	PASS	Humidity :	53 %
Modulation:	Π/4-DQPSK		

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	1001	>824
40	2441	1001	>824
79	2480	1001	>828

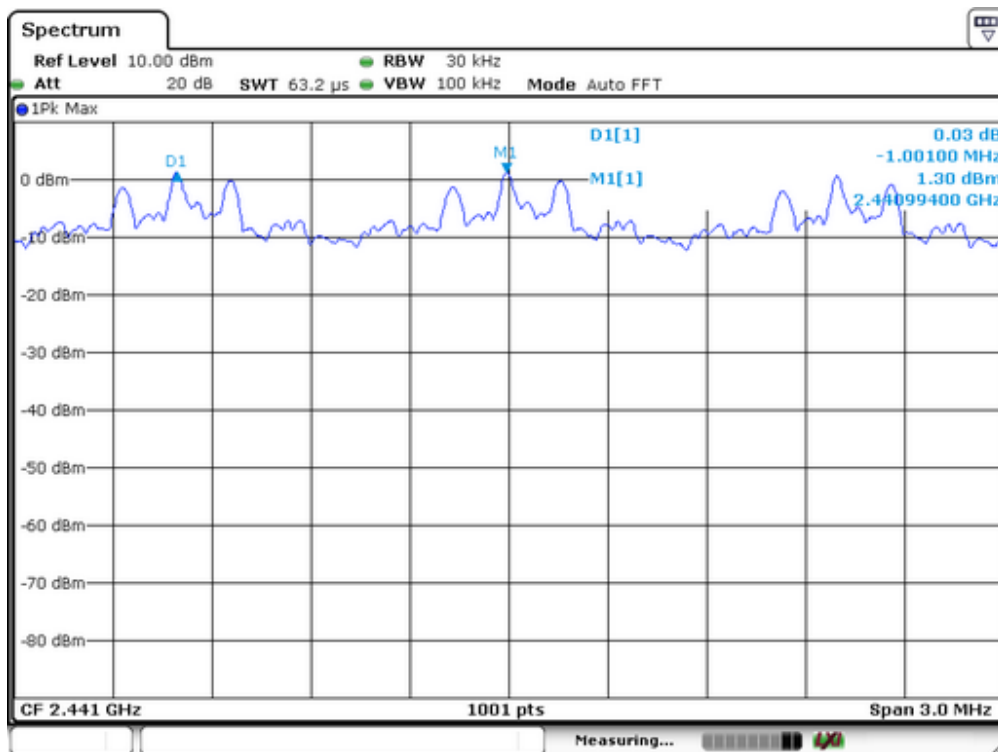
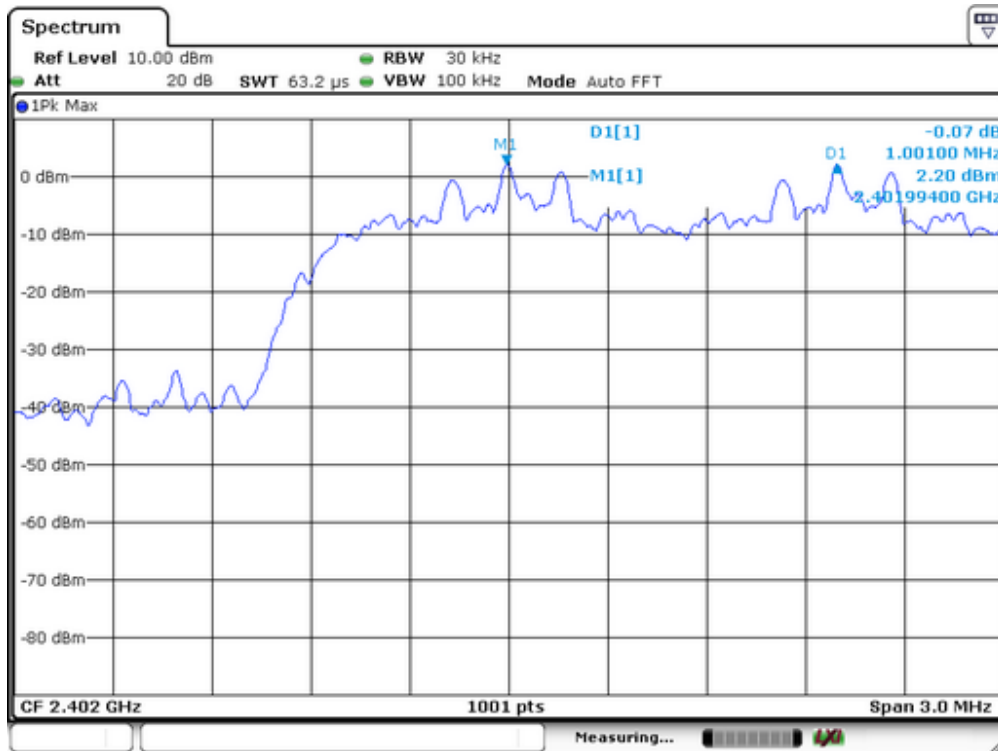


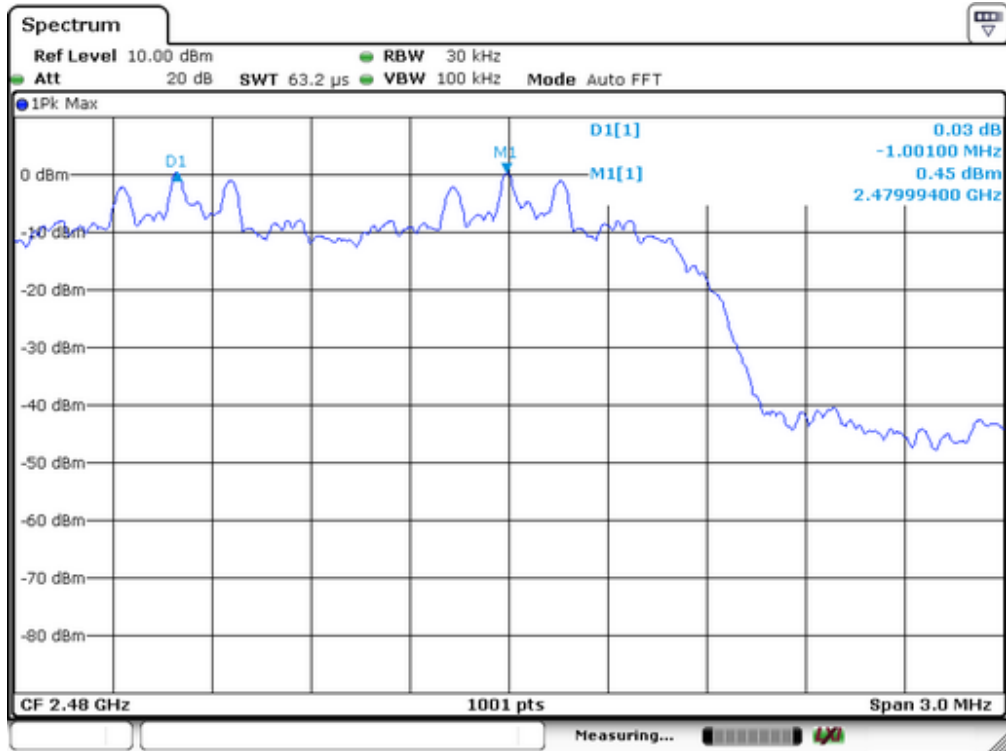


Spectrum Detector: PK
Test By: Andy
Test Result: PASS
Modulation: 8DPSK

Test Date : June 12, 2015
Temperature : 24°C
Humidity : 53 %

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	1001	>806
40	2441	1001	>806
79	2480	1001	>808



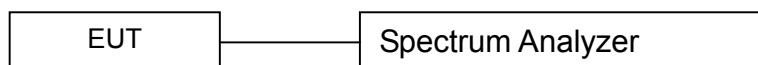


9. 20dB Bandwidth test

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:

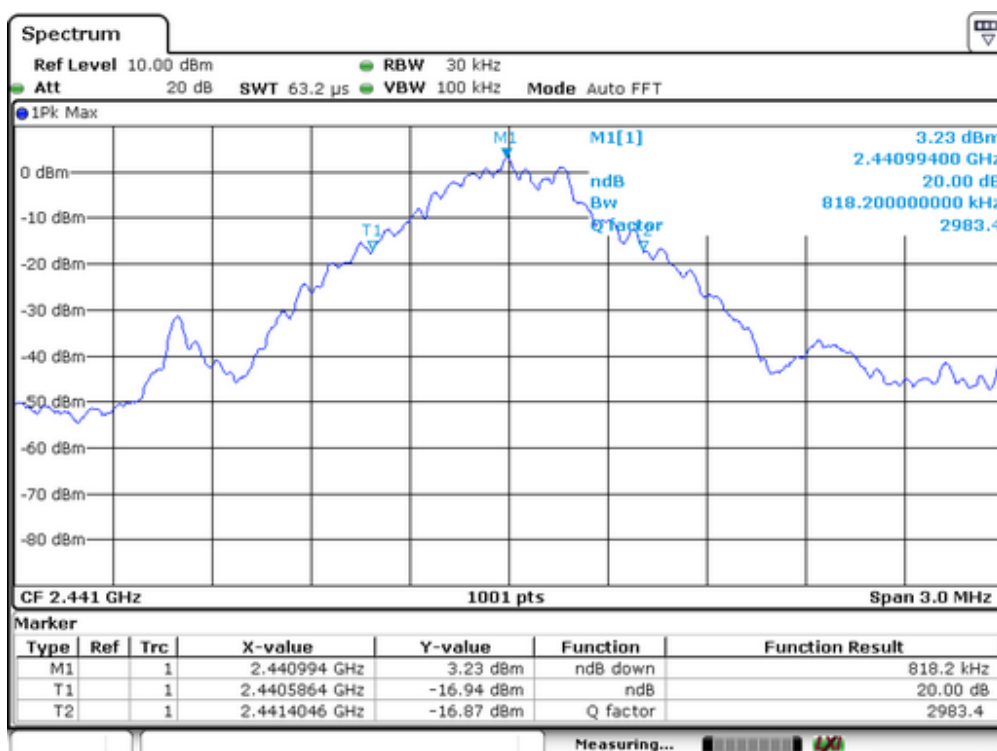
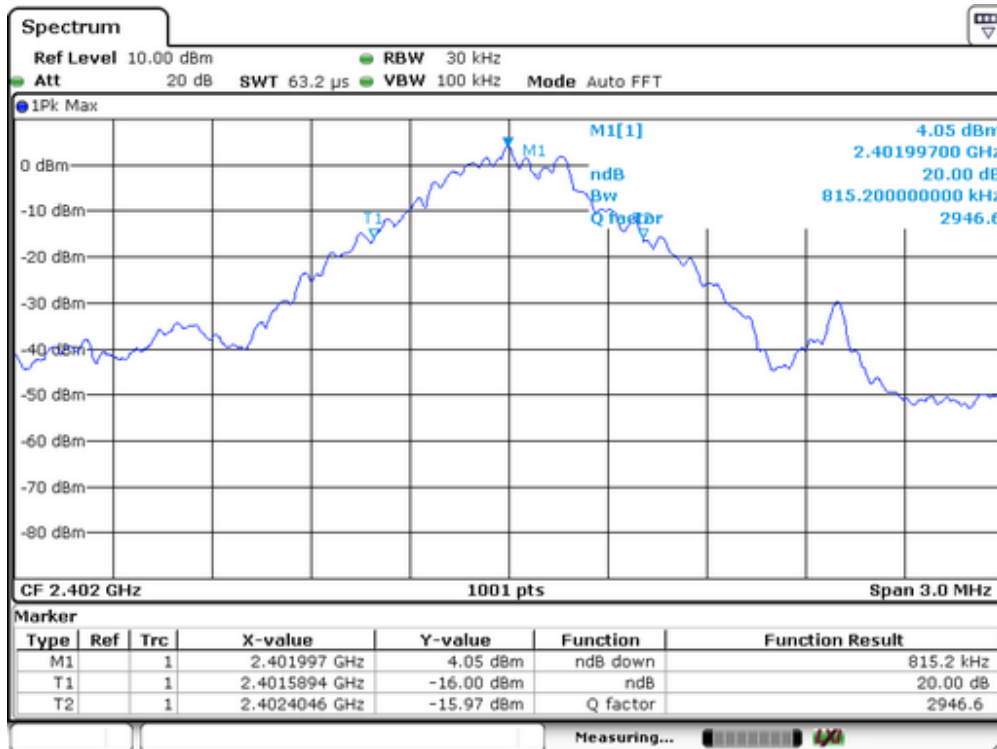
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	03/16/2015	03/15/2016
Coaxial Cable	CDS	79254	46107086	03/16/2015	03/15/2016

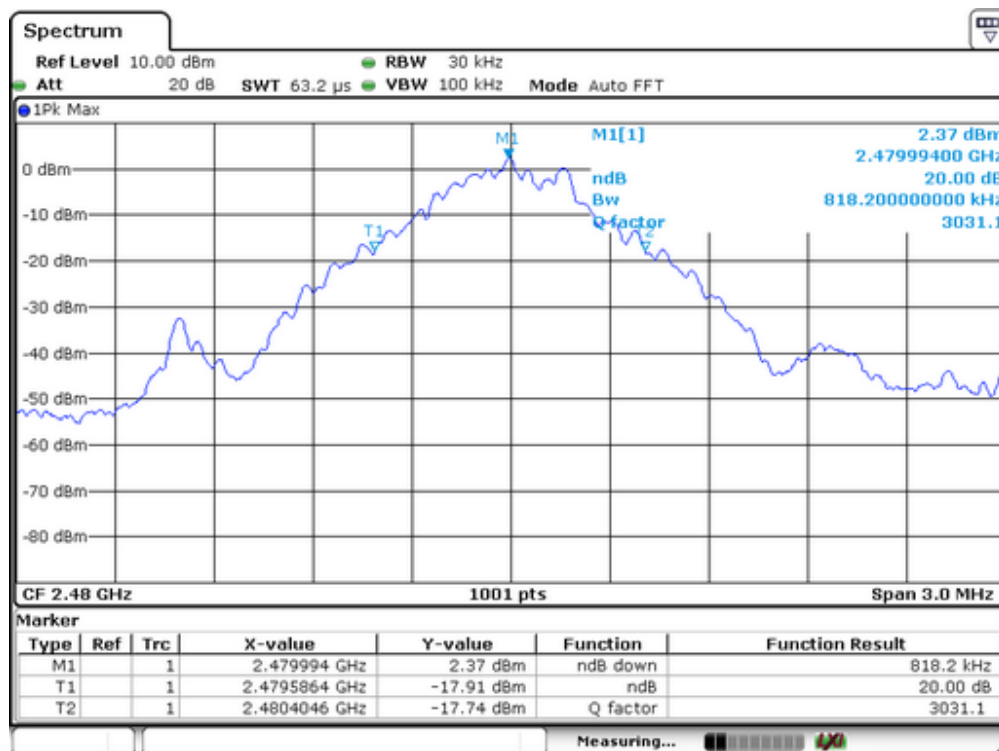
9.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	June 12, 2015
Test By:	Andy	Temperature :	24°C
Test Result:	PASS	Humidity :	53 %
Modulation:	GFSK		

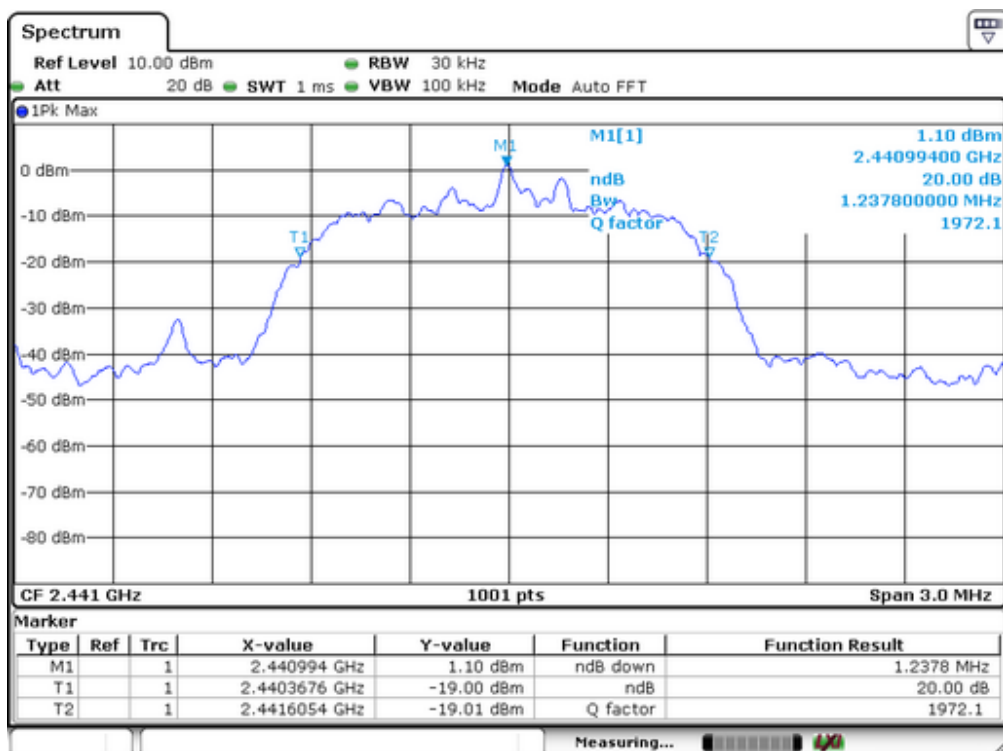
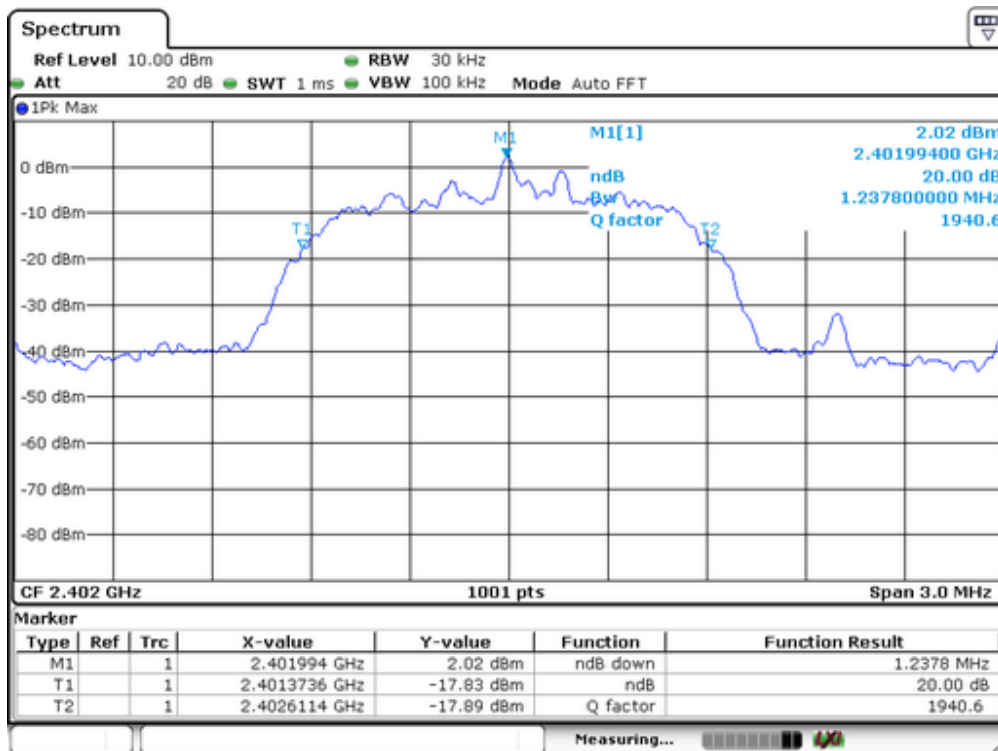
Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	815
40	2441	818
79	2480	818

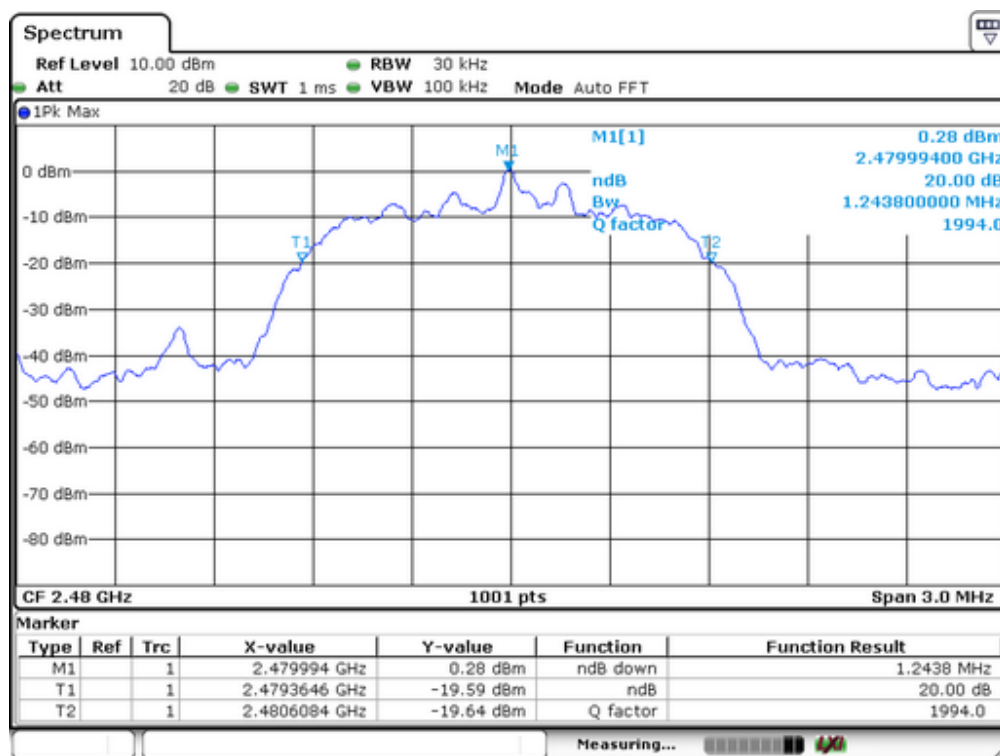




Spectrum Detector:	PK	Test Date :	June 12, 2015
Test By:	Andy	Temperature :	24°C
Test Result:	PASS	Humidity :	53 %
Modulation:	$\Pi/4$ -DQPSK		

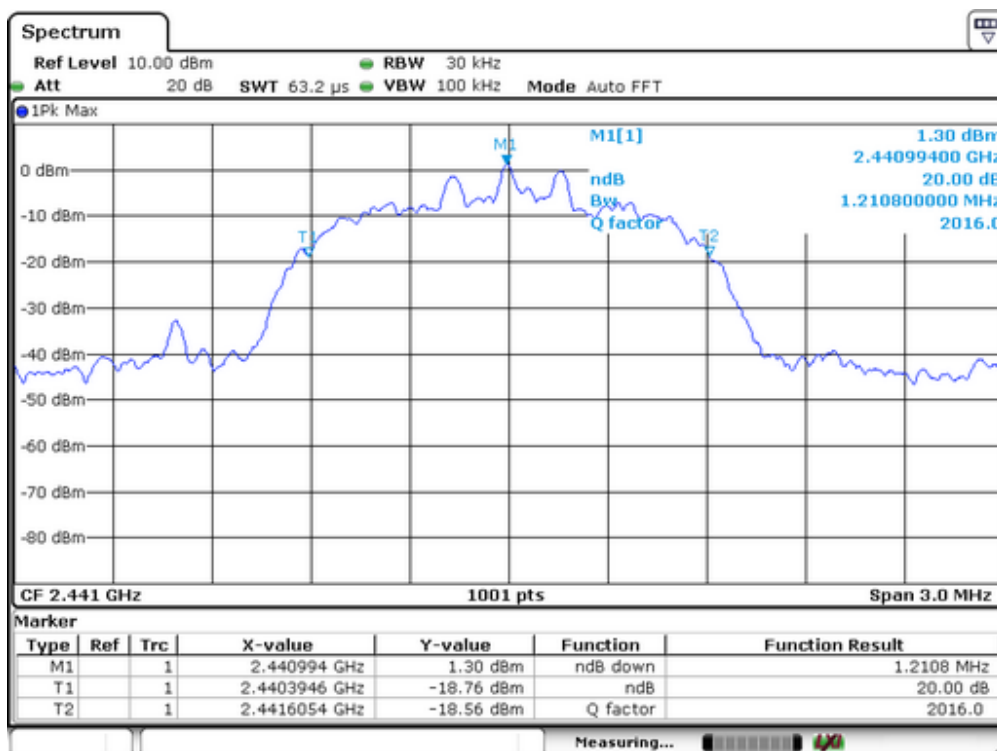
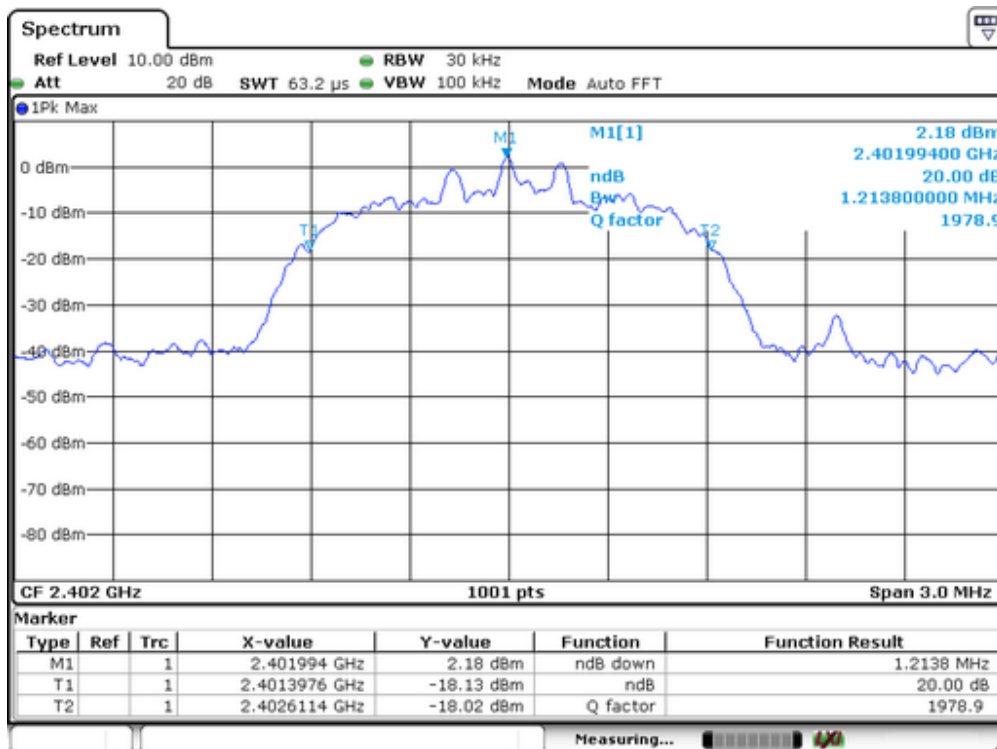
Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	1237
40	2441	1237
79	2480	1243

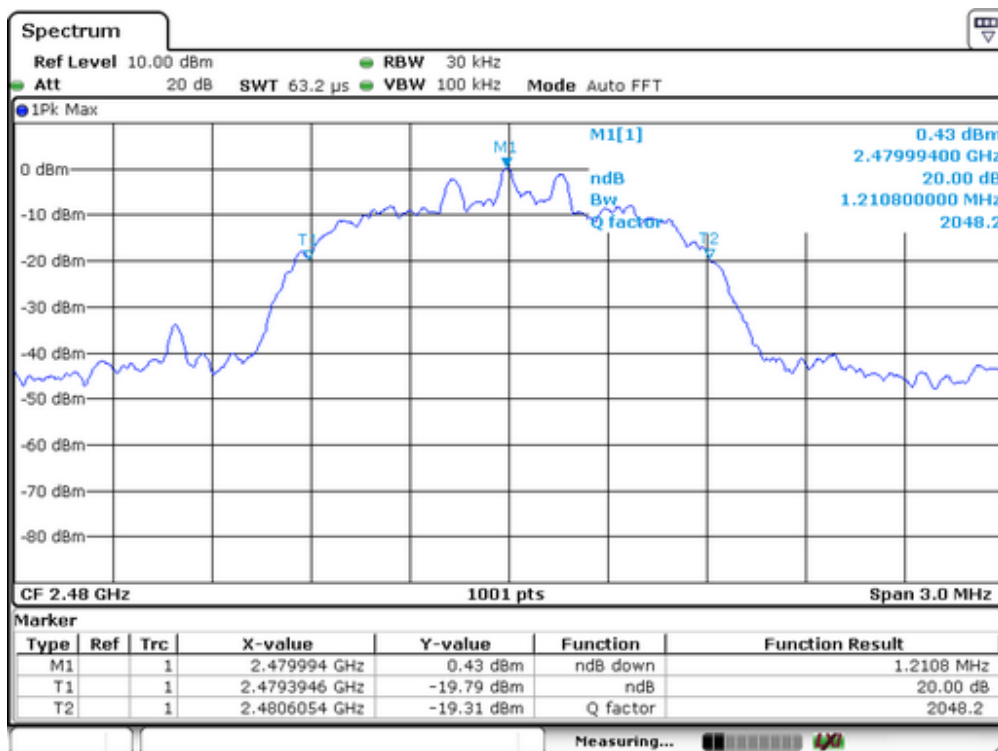




Spectrum Detector:	PK	Test Date :	June 12, 2015
Test By:	Andy	Temperature :	24°C
Test Result:	PASS	Humidity :	53 %
Modulation:	8DPSK		

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	1213
40	2441	1210
79	2480	1210



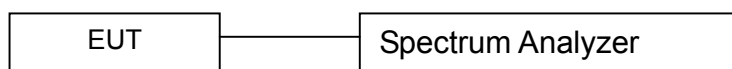


10. Quantity of Hopping Channel Test

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)



10.3 Measurement Equipment Used:

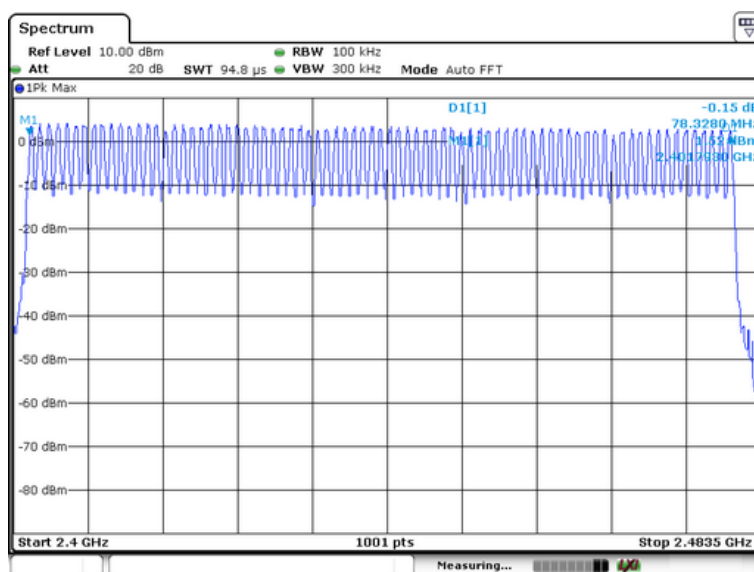
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	03/16/2015	03/15/2016
Coaxial Cable	CDS	79254	46107086	03/16/2015	03/15/2016

10.4 Measurement Results:

Refer to attached data chart.

Worst Test Mode	GFSK	Test Date :	June 12, 2015
Test By:	Andy	Temperature :	25 °C
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:

$$\text{Dwell time} = \text{time slot length} * \text{hop rate} / \text{number of hopping channels} * 31.6\text{s}$$

with:

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

The highest value of the dwell time is reported.

11.2 Test Requirements / Limits

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

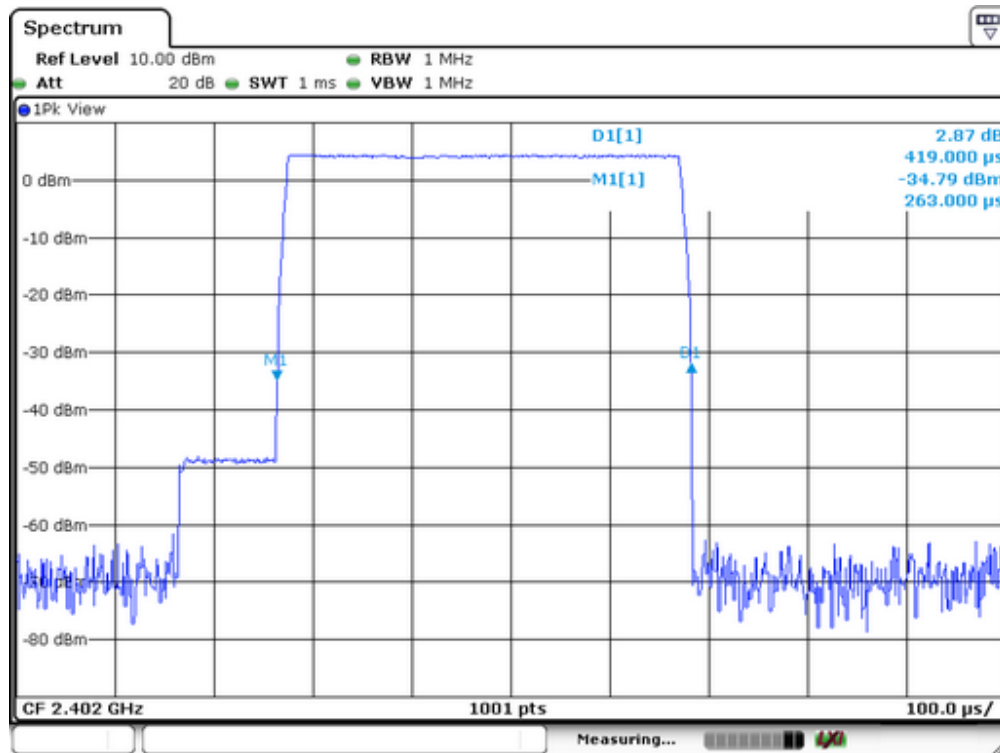
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Since the Bluetooth technology uses 79 channels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

11.3 Test result

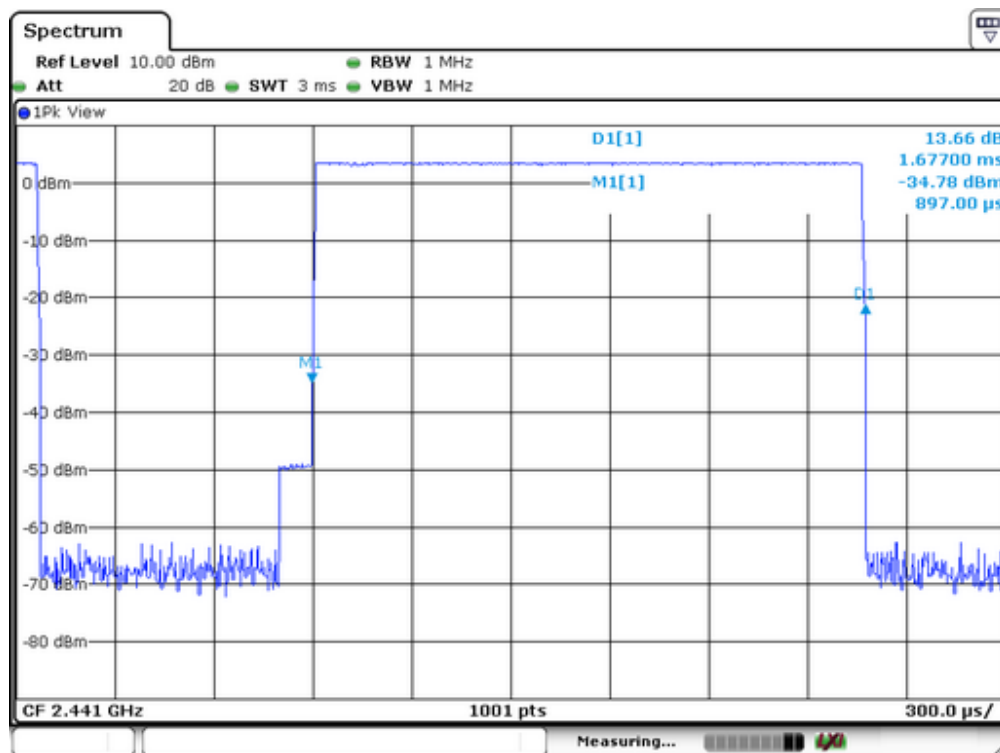
Mode	Number of transmission in a 31.6(79 Hopping*0.4)	Length of transmissions time(msec)	Result (msec)	Limit (msec)
DH1	$1600/(2*79) \times 31.6 = 320$	0.419	134.08	400
DH3	$1600/(4*79) \times 31.6 = 160$	1.677	268.32	400
DH5	$1600/(6*79) \times 31.6 = 106.67$	2.925	312.00	400

Remark: The results of worst case was recorded.

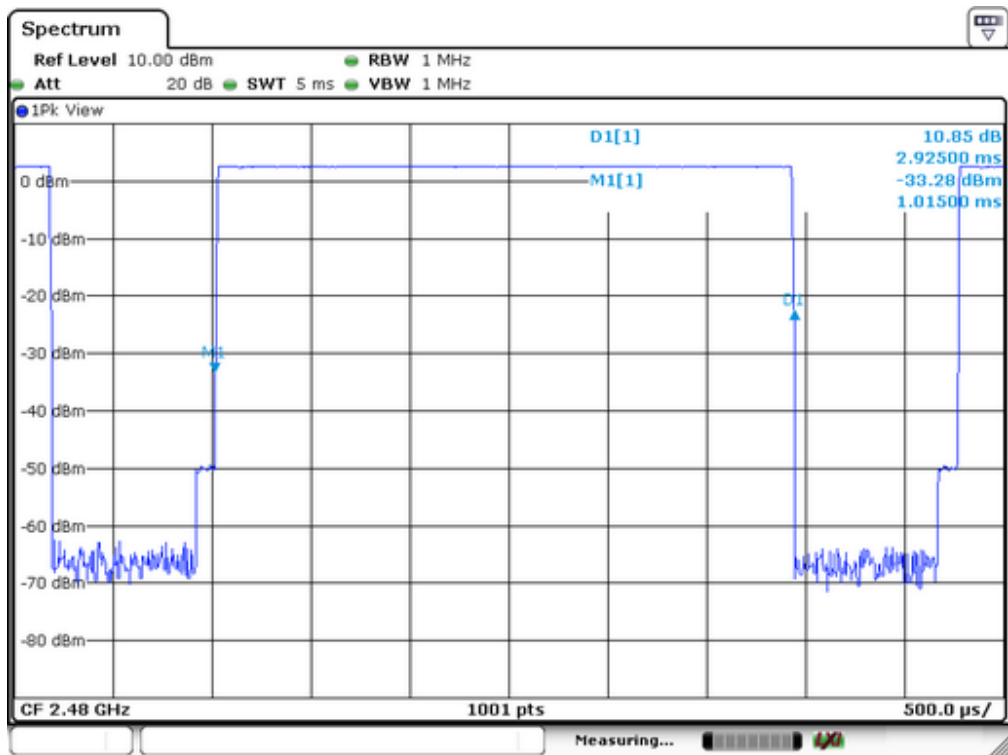
DH1:



DH3:



DH5:

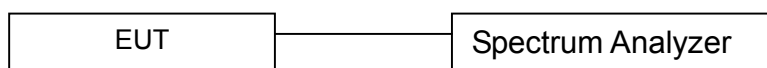


12. MAXIMUM PEAK OUTPUT POWER TEST

12.1 Measurement Procedure

- Check the calibration of the measuring instrument(SA) using either an internal calibrator or a known signal from an external generator.
- 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.
- The center frequency of the spectrum analyzer is set to the fundamental frequency and using proper RBW and VBW setting.
- Measure the captured power within the band and recording the plot.
- Repeat above procedures until all frequencies required were complete.

12.2 Test SET-UP (Block Diagram of Configuration)



12.3 Measurement Equipment Used:

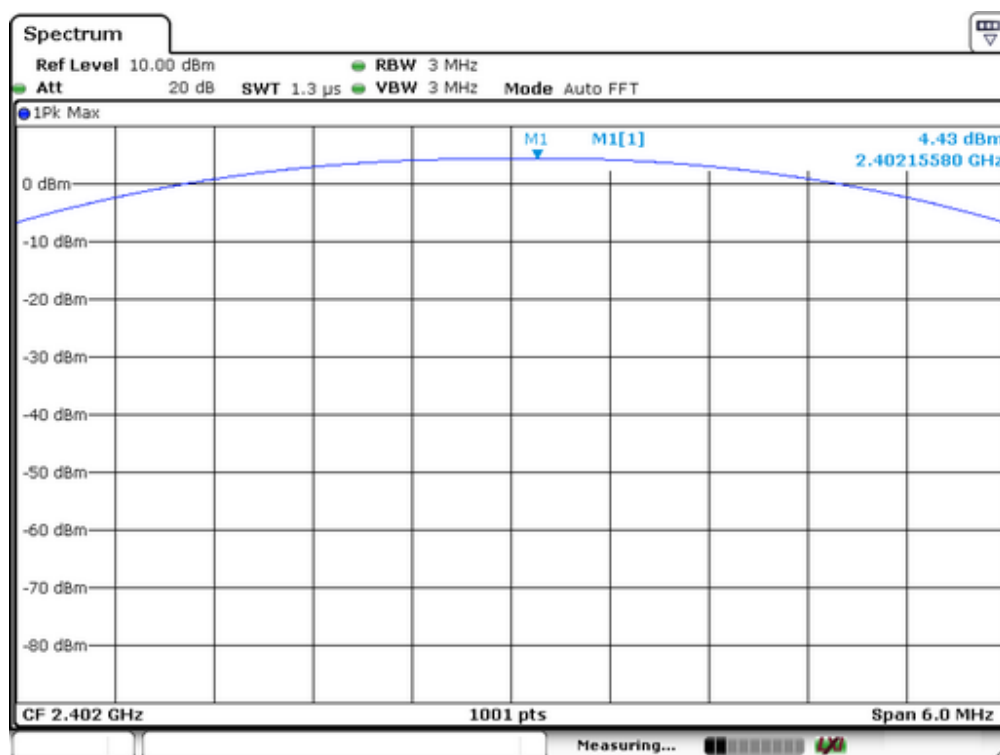
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	03/16/2015	03/15/2016
Coaxial Cable	CDS	79254	46107086	03/16/2015	03/15/2016

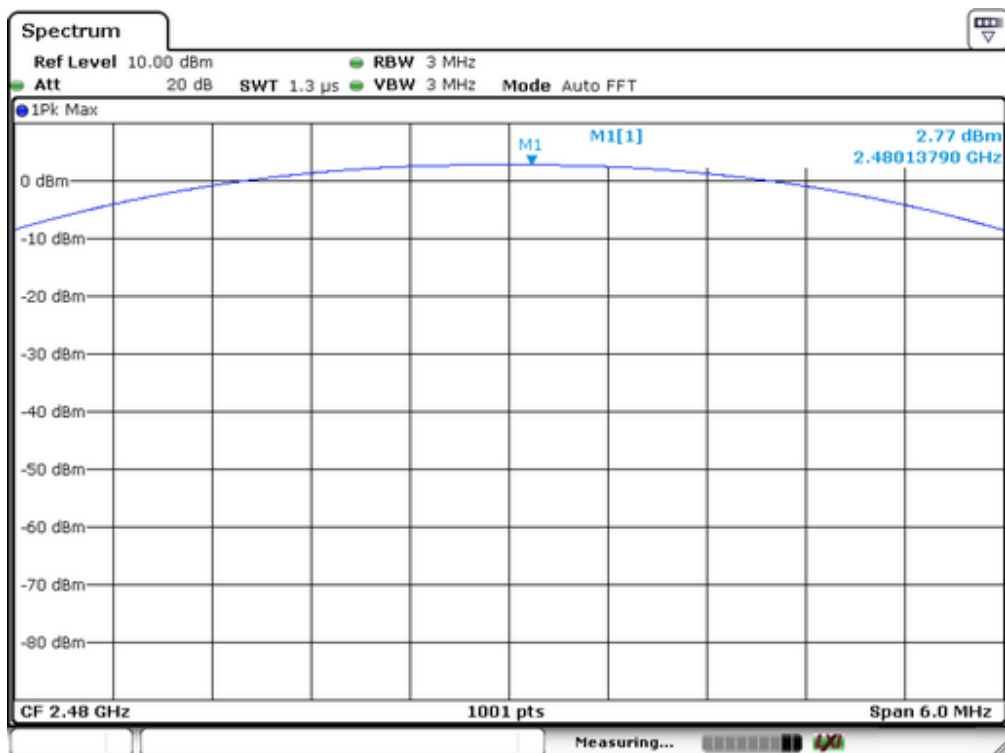
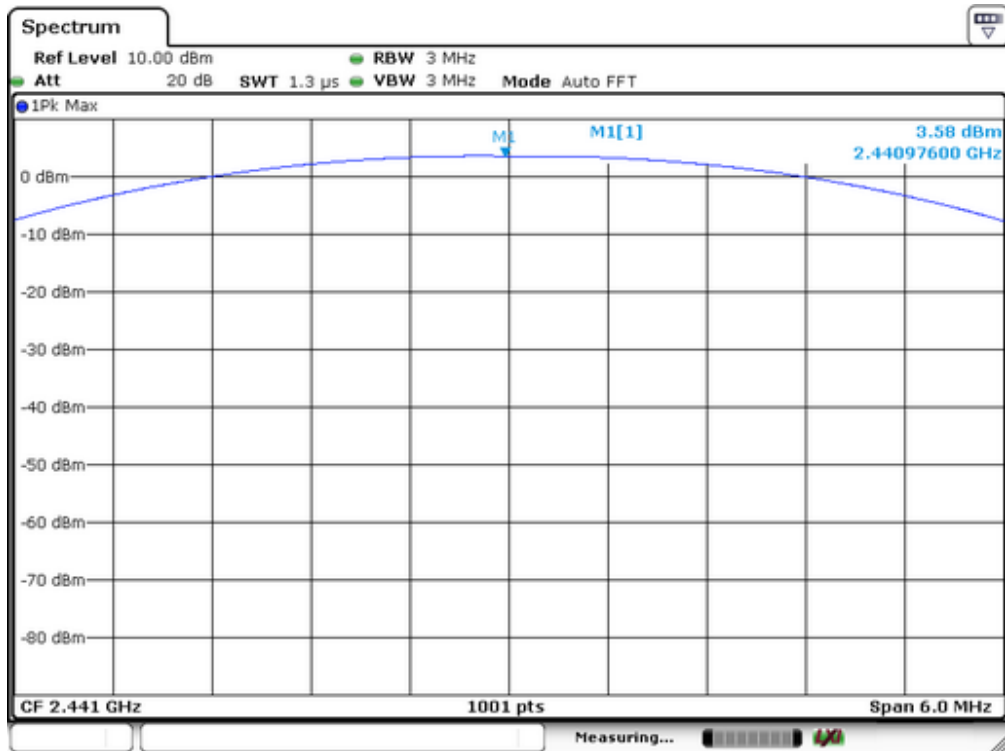
12.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	June 12, 2015
Test By:	Andy	Temperature :	25 °C
Test Result:	PASS	Humidity :	50 %
Modulation:	GFSK		

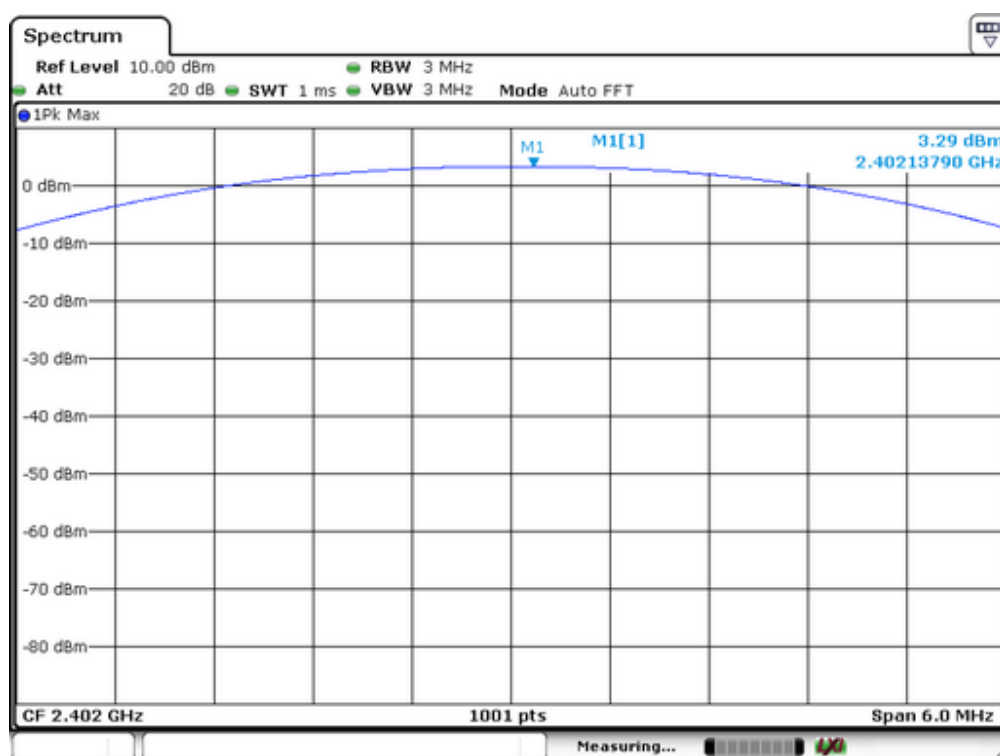
Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
01	2402	4.43	2.773	1000	PASS
40	2441	3.58	2.280	1000	PASS
79	2480	2.77	1.892	1000	PASS

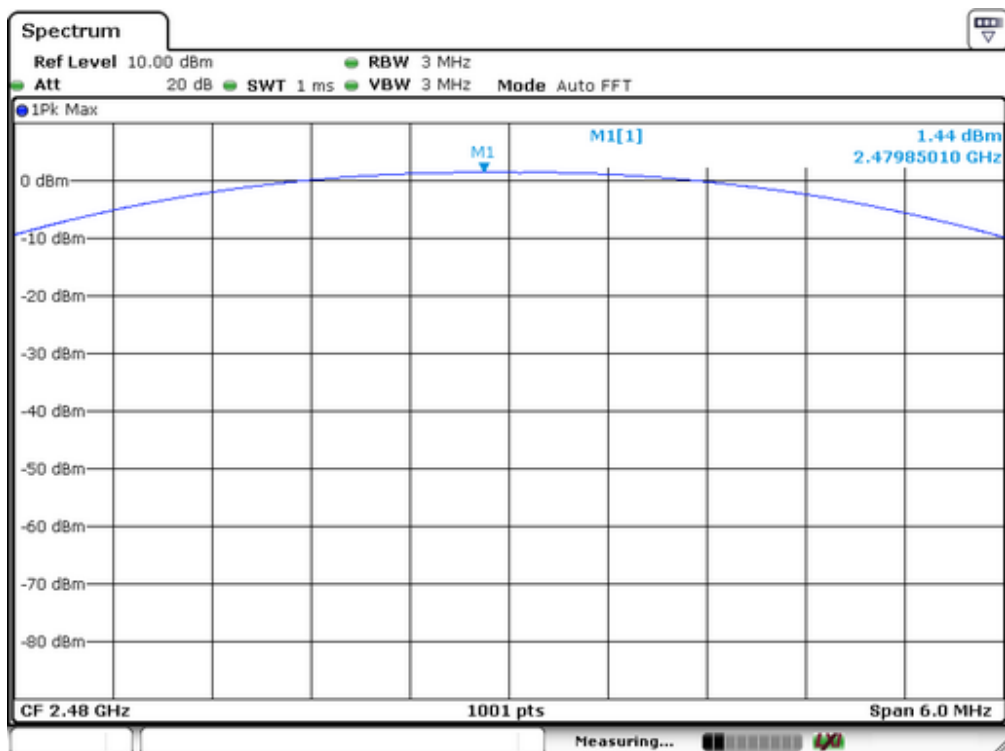
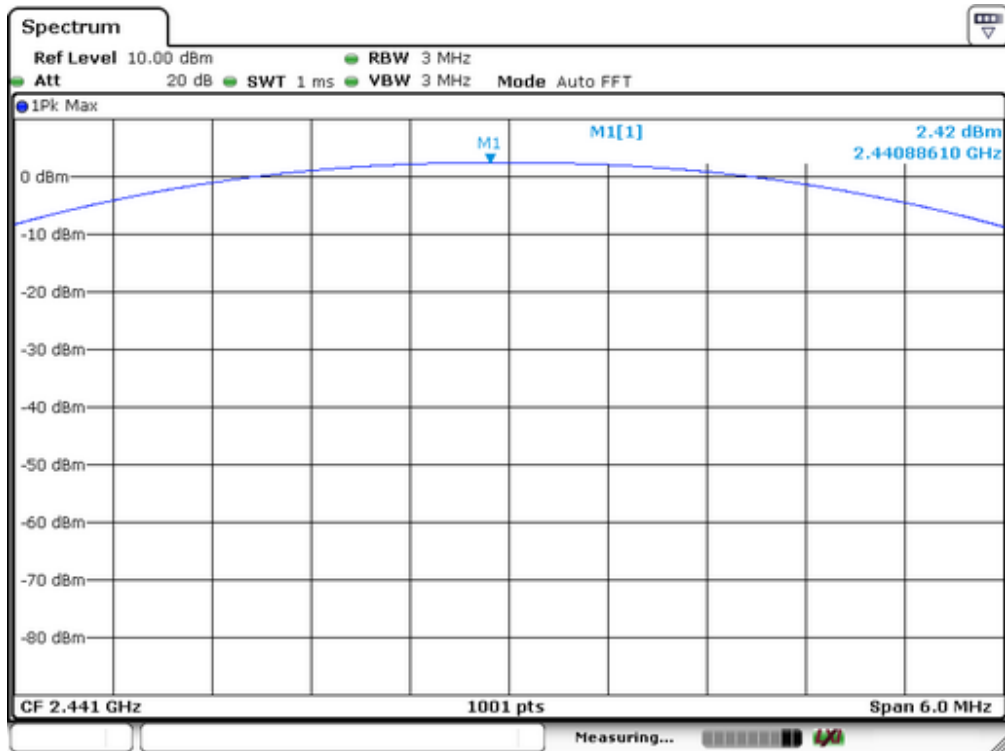




Spectrum Detector: PK Test Date : June 12, 2015
Test By: Andy Temperature : 25 °C
Test Result: PASS Humidity : 50 %
Modulation: Π/4-DQPSK

Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
01	2402	3.29	2.133	125	PASS
40	2441	2.42	1.746	125	PASS
79	2480	1.44	1.393	125	PASS

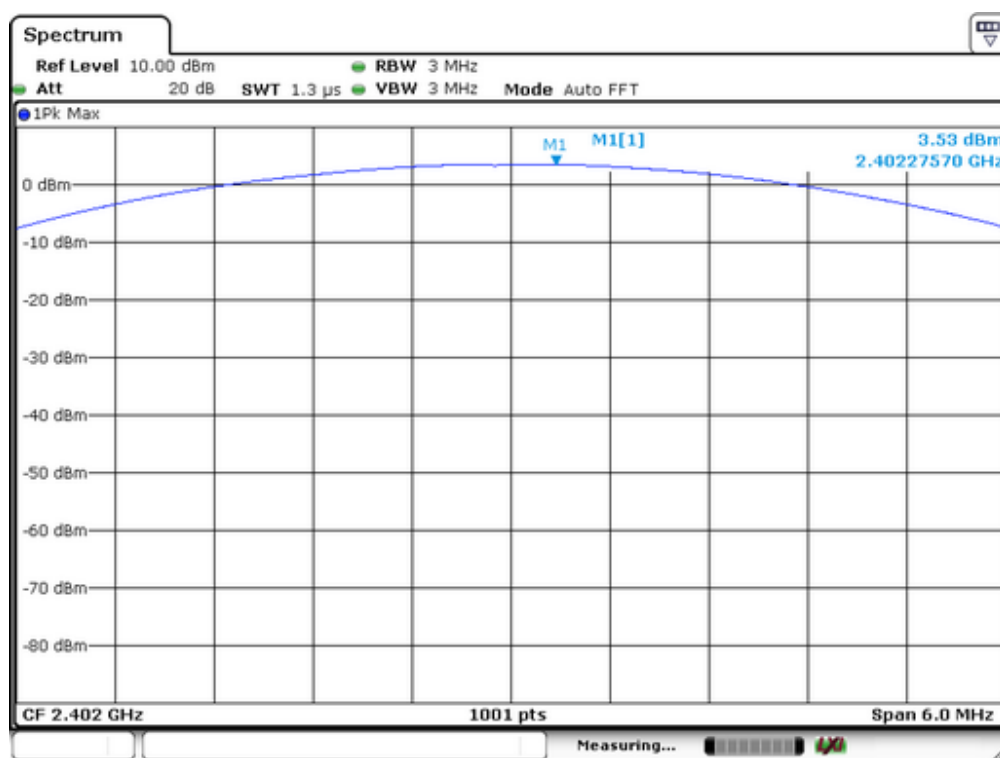


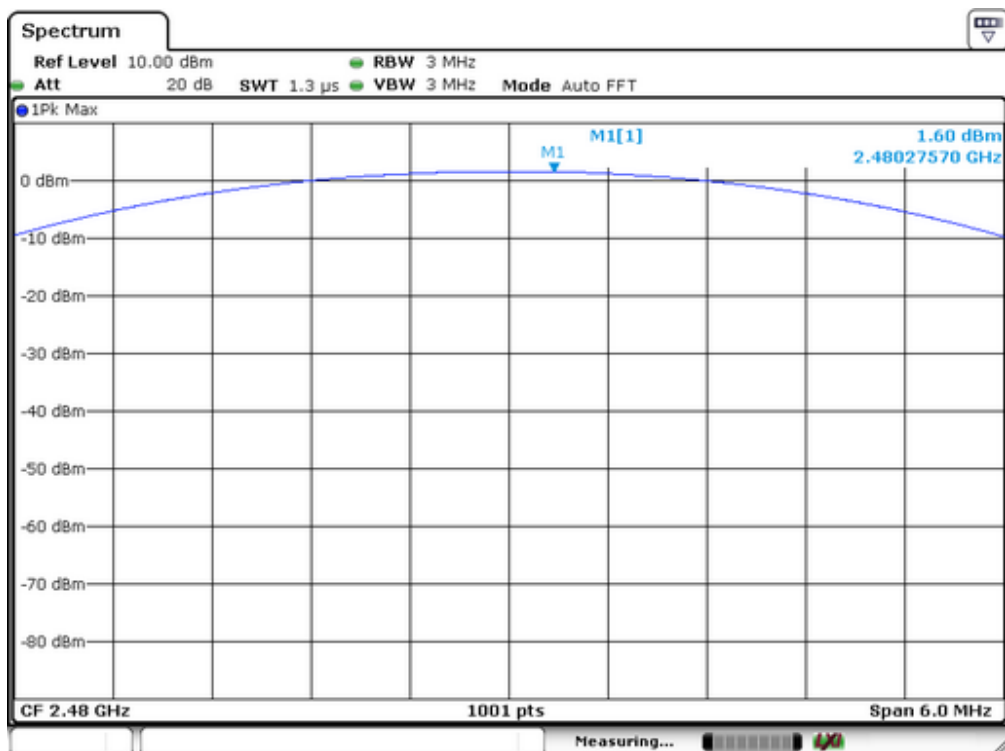
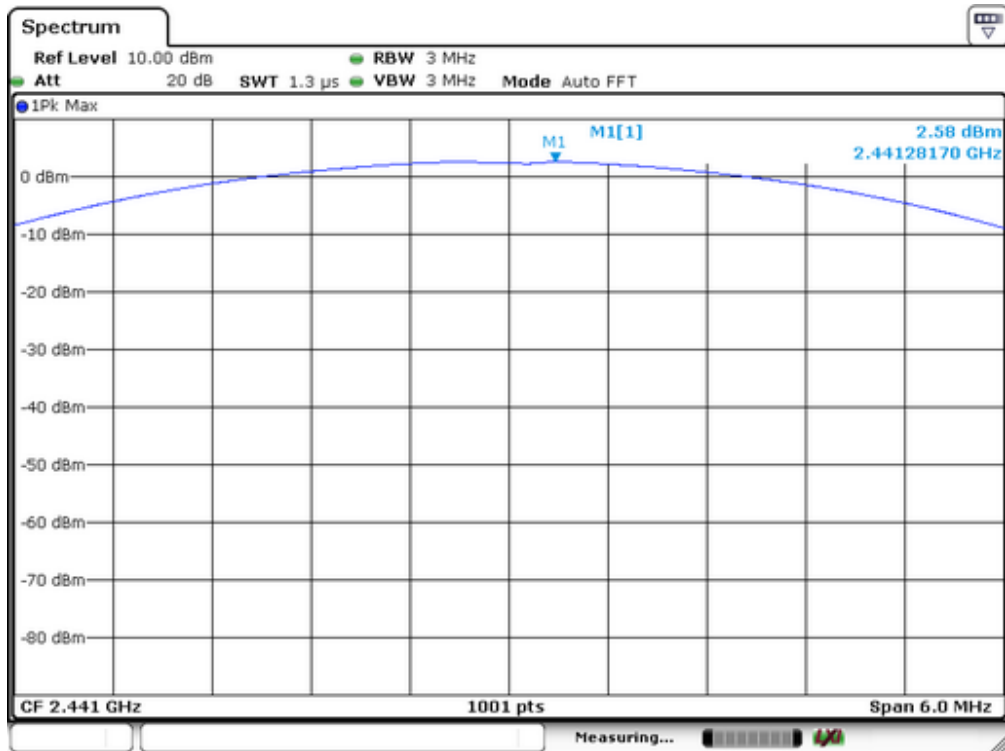


Spectrum Detector: PK
 Test By: Andy
 Test Result: PASS
 Modulation: 8DPSK

Test Date : June 12, 2015
 Temperature : 25 °C
 Humidity : 50 %

Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
01	2402	3.53	2.254	125	PASS
40	2441	2.58	1.811	125	PASS
79	2480	1.60	1.445	125	PASS





13. Band EDGE test

13.1 Measurement Procedure

1. The EUT was Operating in hopping mode or could be controlled its channel. Printed out test result from the spectrum by hard copy function.
2. The EUT was placed on a styrofoam table which is 1.5m above ground plane.
3. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
4. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
5. Repeat above procedures until all frequency measured were complete.
6. Use the following spectrum analyzer settings:

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:

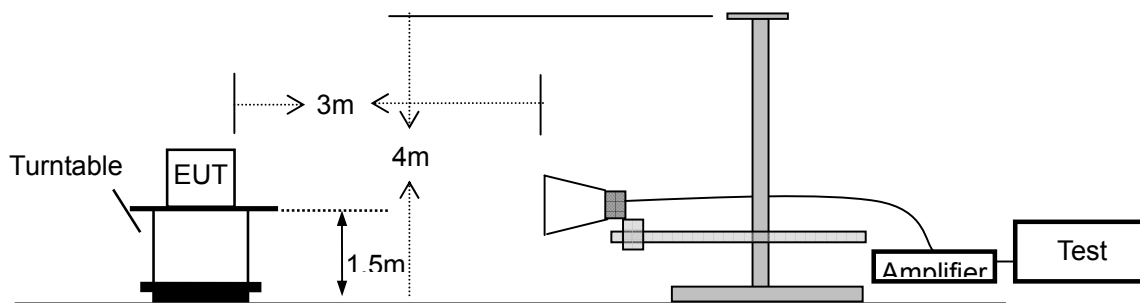
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	10Hz
Detector	Peak
Trace	Max hold

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	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	03/16/2015	03/15/2016
Coaxial Cable	CDS	79254	46107086	03/16/2015	03/15/2016

For Radiated emission Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1	Signal Analyzer	Rohde & Schwarz	FSV30	103040	12/29/2014	1 Year
2	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1272	12/29/2014	1 Year
3	Power Amplifier	LUNAR EM	LNA1G18-40	J101000000 81	12/29/2014	1 Year
4	Cable	H+S	CBL-26	N/A	12/29/2014	1 Year
5	Cable	H+S	CBL-26	N/A	12/29/2014	1 Year
6	Cable	H+S	CBL-26	N/A	12/29/2014	1 Year

13.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	June 12, 2015
Test By:	Andy	Temperature :	25 °C
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	4.28	-41.62	45.9	>20dBc
2399.2	pi/4-DQPSK	2.51	-43.62	46.13	>20dBc
2399.99	8DPSK	2.57	-43.91	46.48	>20dBc
2484.69	GFSK	2.58	-60.42	63	>20dBc
2483.51	pi/4-DQPSK	0.75	-57.02	57.77	>20dBc
2483.5	8DPSK	0.84	-58.3	59.14	>20dBc

For Hopping Mode:

Frequency (MHz)	Modulation	Peak Power Output(dBm)	Emission read Value(dBm)	Result of Band edge(dBc)	Band edge Limit(dBc)
2399.99	GFSK	4.24	-42.22	46.46	>20dBc
2399.99	pi/4-DQPSK	2.25	-43.83	46.08	>20dBc
2399.98	8DPSK	2.57	-43.76	46.33	>20dBc
2383.98	GFSK	2.56	-60.67	63.23	>20dBc
2483.51	pi/4-DQPSK	0.76	-58.4	59.16	>20dBc
2483.52	8DPSK	0.8	-59.69	60.49	>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
2399.98	H	64.01	43.62	74	54	-9.99	-10.38
2398.95	V	60.24	40.15	74	54	-13.76	-13.85
2484.16	H	65.72	44.17	74	54	-8.28	-9.83
2483.69	V	59.72	38.72	74	54	-14.28	-15.28

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
2399.59	H	64.15	45.72	74	54	-9.85	-8.28
2398.82	V	60.38	39.15	74	54	-13.62	-14.85
2483.95	H	65.27	44.2	74	54	-8.73	-9.8
2484.12	V	59.35	40.72	74	54	-14.65	-13.28

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 2 dBi and meets the requirement.

APPENDIX I (Photos of EUT)

