

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

OF

EXO-200

Model No.: EXO200

Trademark: 

FCC ID: PXX-EXO200

Report No.: KAD150325107E

Issue Date: June 24, 2015

Prepared for

**ECORE TECHNOLOGY COMPANY LIMITED
North of Bingang East Road, Huahu Development Zone, Ezhou city, Hubei
Province, China**

Prepared by

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DONGGUAN EMTEK CO., LTD.**

VERIFICATION OF COMPLIANCE

Applicant:	ECORE TECHNOLOGY COMPANY LIMITED North of Bingang East Road, Huahu Development Zone, Ezhou city, Hubei Province, China
Manufacturer:	ECORE TECHNOLOGY COMPANY LIMITED North of Bingang East Road, Huahu Development Zone, Ezhou city, Hubei Province, China
Product Description:	EXO-200
Trade Mark:	
Model Number:	EXO200

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 : March 25, 2015 to June 16, 2015

Prepared by : 
Ivy Huang/Editor

Reviewer : 
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Approved & Authorized
Signer : 
Sam Lv/Manager

Modified Information

Version	Summary	Revision Date	Report No.
Ver.1.0	Original Report	/	KAD150325107E

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Appendix I (Photos of EUT) (3 pages)

1. GENERAL INFORMATION

1.1 Product Description

Characteristics	Description
Product Name	EXO-200
Model number	EXO200
Power Supply	DC 5V, 1A
Modulation	GFSK, $\pi/4$ -DQPSK, 8DPSK
Operating Frequency Range	2402-2480MHz
Number of Channels	79
Transmit Power Max	1.21dBm(0.001321W)
Antenna Type	Internal PCB antenna
Antenna Gain	0 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 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

The EUT is a placed on as 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 >1 MHz
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.	EXO-200		EXO200	PXK-EXO200	<i>EUT</i>
2	Adapter	N/A	TX050100-US	N/A	<i>Support Equipment</i>

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 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 harmonic 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 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	$\pm 3\%$

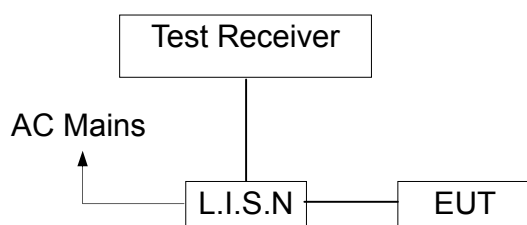
Measurement Uncertainty for a level of Confidence of 95%

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:

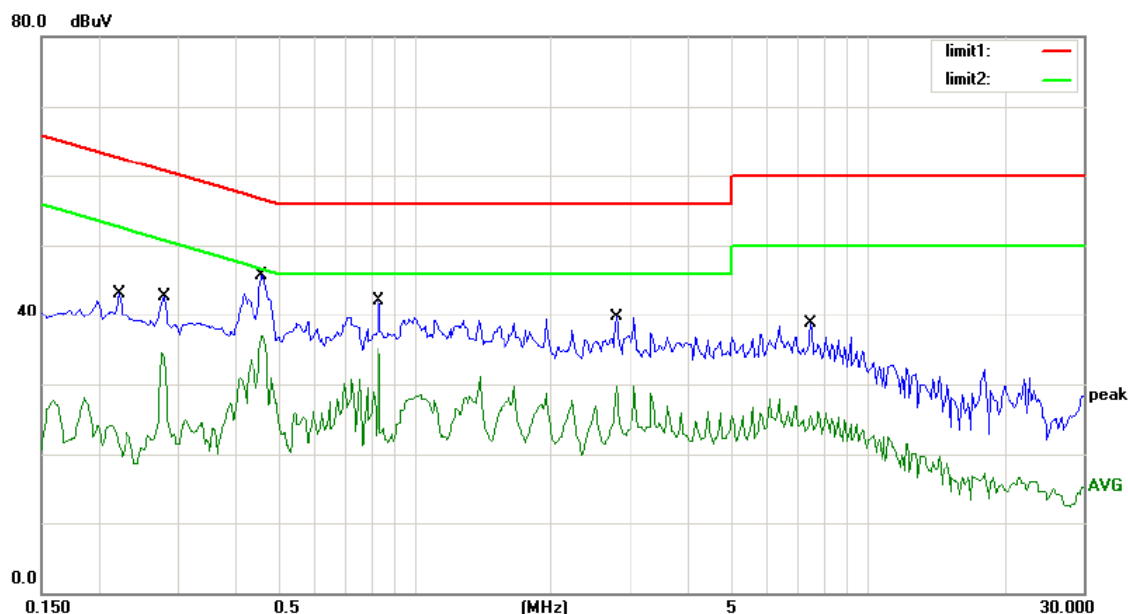
Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Last Cal.	Due date
Test Receiver	Rohde & Schwarz	ESCS30	100018	03/16/2015	03/15/2016
L.I.S.N	Rohde & Schwarz	ENV216	100017	03/16/2015	03/15/2016
RF Switching Unit	CDS	RSU-M2	38401	03/16/2015	03/15/2016
Coaxial Cable	CDS	79254	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 2441MHz) are recorded in the following pages and the others modulation methods do not exceed the limits.

Please refer to the following data.

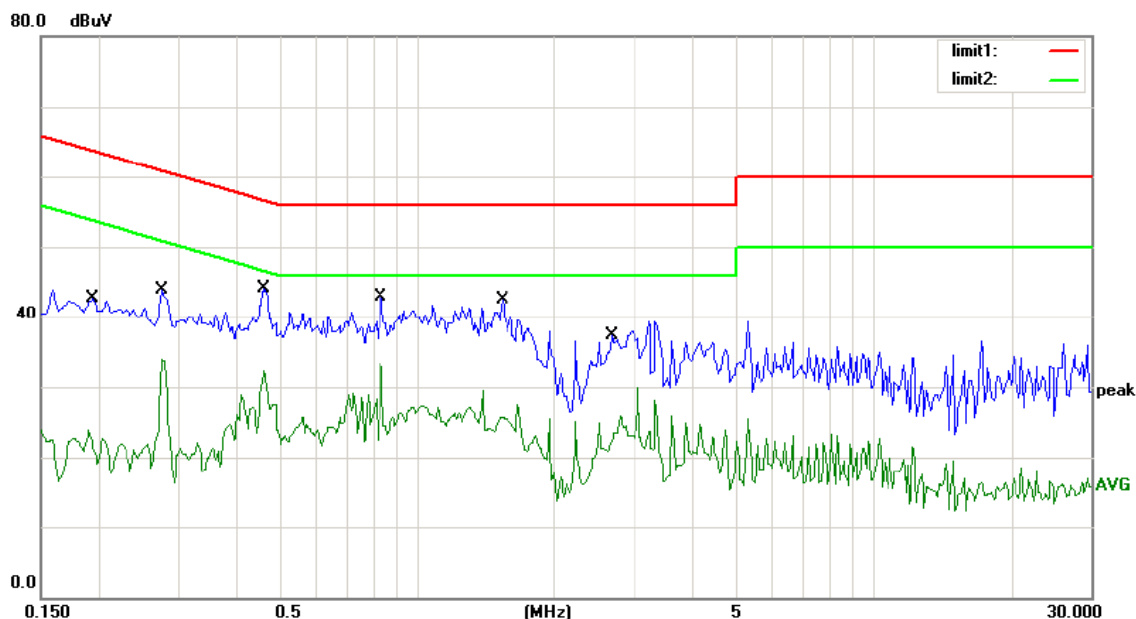


Site site #1
 Limit: (CE)FCC PART 15 class B_QP
 Mode: TX
 Note:

Phase: **L1**
 Power: AC 120V/60Hz
 Temperature: 24
 Humidity: 55 %

No. Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector	Comment
	MHz	dBuV	dB	dBuV	dBuV	dB		
1	0.2220	41.35	0.00	41.35	62.74	-21.39	QP	
2	0.2220	25.92	0.00	25.92	52.74	-26.82	AVG	
3	0.2805	39.56	0.00	39.56	60.80	-21.24	QP	
4	0.2805	34.55	0.00	34.55	50.80	-16.25	AVG	
5	0.4605	42.89	0.00	42.89	56.68	-13.79	QP	
6 *	0.4605	36.99	0.00	36.99	46.68	-9.69	AVG	
7	0.8340	39.78	0.00	39.78	56.00	-16.22	QP	
8	0.8340	35.19	0.00	35.19	46.00	-10.81	AVG	
9	2.7800	36.89	0.00	36.89	56.00	-19.11	QP	
10	2.7800	29.66	0.00	29.66	46.00	-16.34	AVG	
11	7.5100	35.78	0.00	35.78	60.00	-24.22	QP	
12	7.5100	26.08	0.00	26.08	50.00	-23.92	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 class B_QP

Power: AC 120V/60Hz

Humidity: 55 %

Mode: TX

Note:

No. Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1	0.1950	39.56	0.00	39.56	63.82	-24.26	QP	
2	0.1950	23.83	0.00	23.83	53.82	-29.99	AVG	
3	0.2760	41.23	0.00	41.23	60.94	-19.71	QP	
4	0.2760	33.84	0.00	33.84	50.94	-17.10	AVG	
5	0.4650	42.23	0.00	42.23	56.60	-14.37	QP	
6	0.4650	32.22	0.00	32.22	46.60	-14.38	AVG	
7	0.8340	39.45	0.00	39.45	56.00	-16.55	QP	
8 *	0.8340	33.40	0.00	33.40	46.00	-12.60	AVG	
9	1.5360	38.89	0.00	38.89	56.00	-17.11	QP	
10	1.5360	27.49	0.00	27.49	46.00	-18.51	AVG	
11	2.6700	35.48	0.00	35.48	56.00	-20.52	QP	
12	2.6700	29.82	0.00	29.82	46.00	-16.18	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
RBW	120KHz
VBW	300KHz
Detector	QP
Trace	Max hold

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

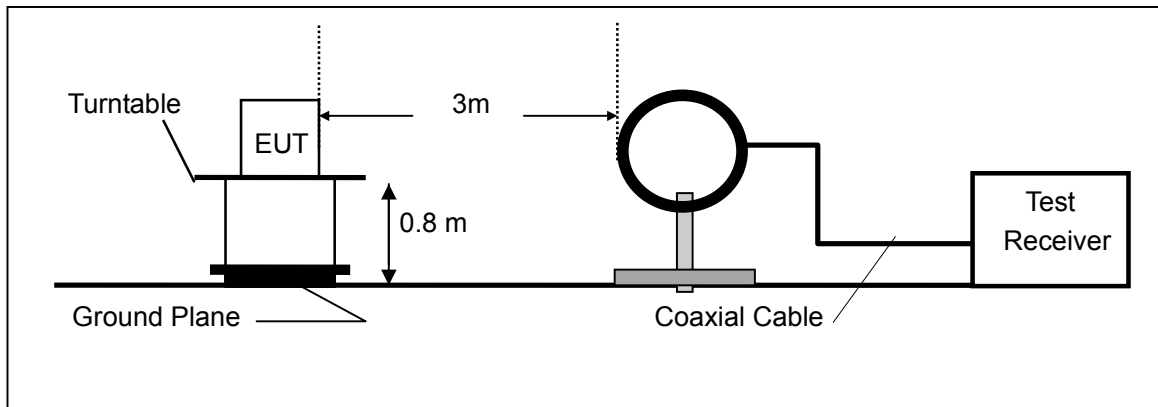
EMI Test Receiver	Setting
Attenuation	Auto
RBW	1MHz
VBW	3MHz
Detector	Peak
Trace	Max hold

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

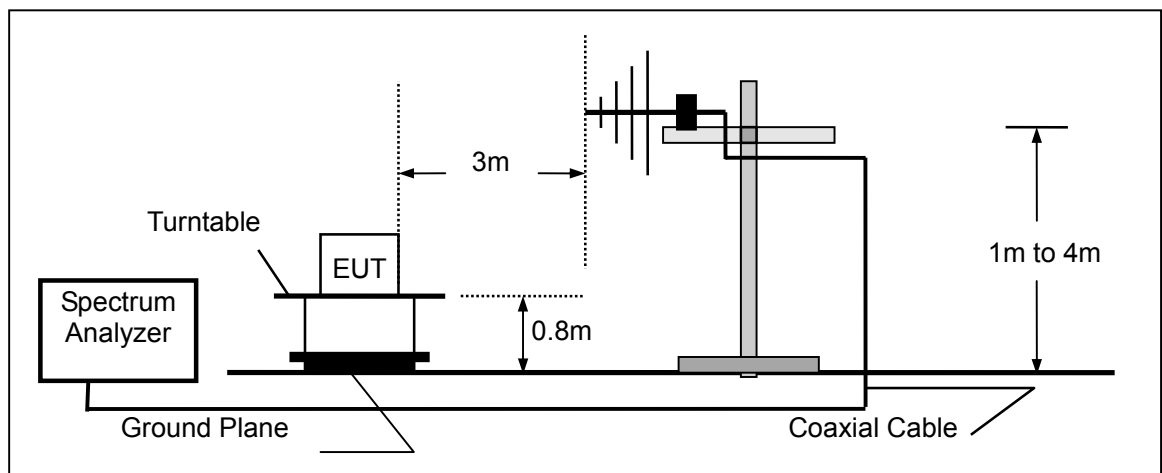
EMI Test Receiver	Setting
Attenuation	Auto
RBW	1MHz
VBW	10Hz
Detector	Peak
Trace	Max hold

7.2 Test SET-UP (Block Diagram of Configuration)

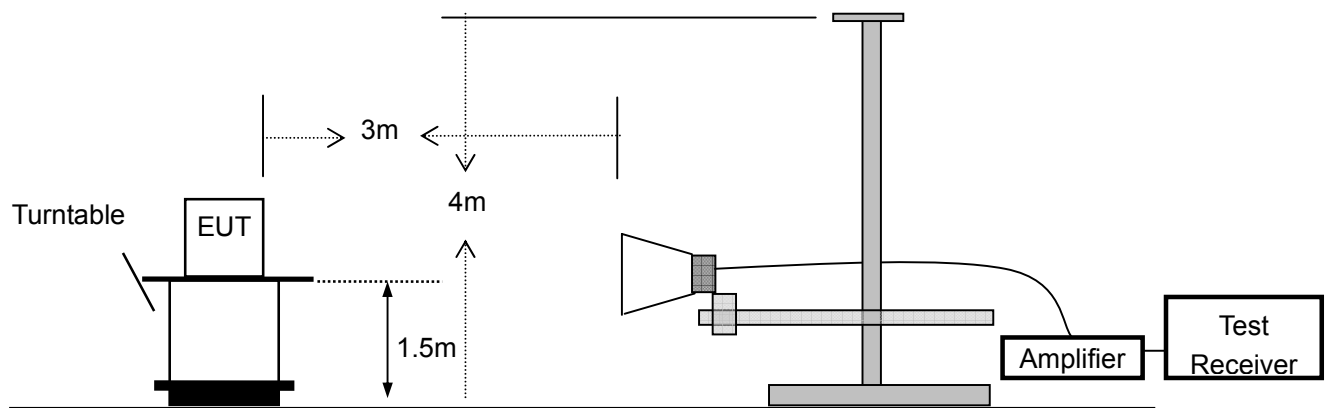
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(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 :	March 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)
--	--	--	--	--

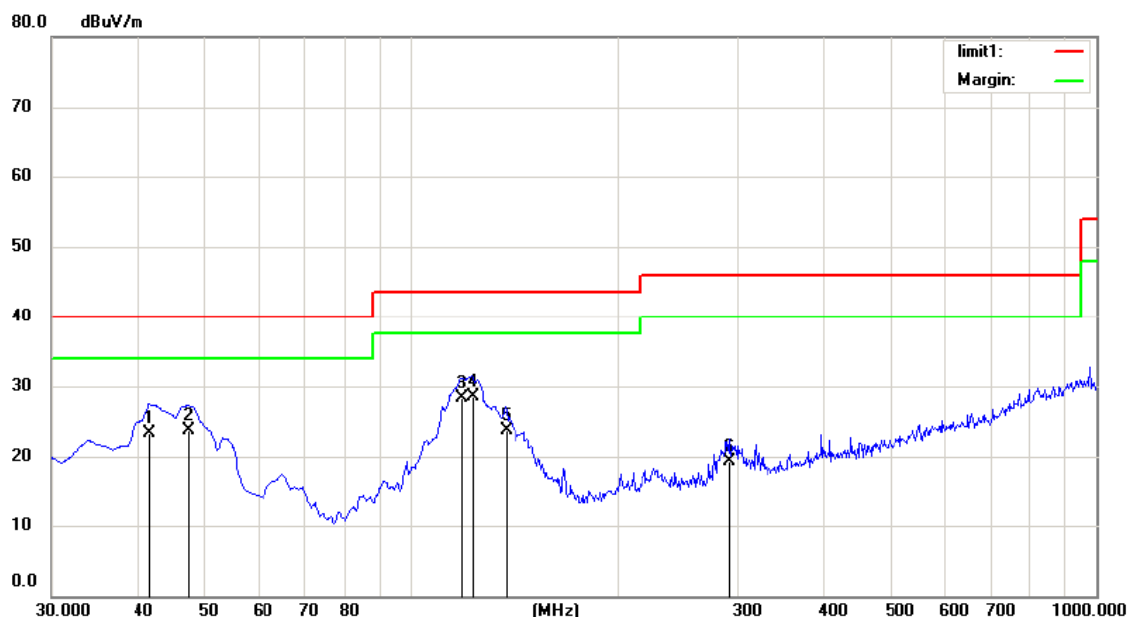
Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

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.



Site Chamber #1

Polarization: **Horizontal**

Temperature: 24

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

Power: AC 120V/60Hz

Humidity: 55 %

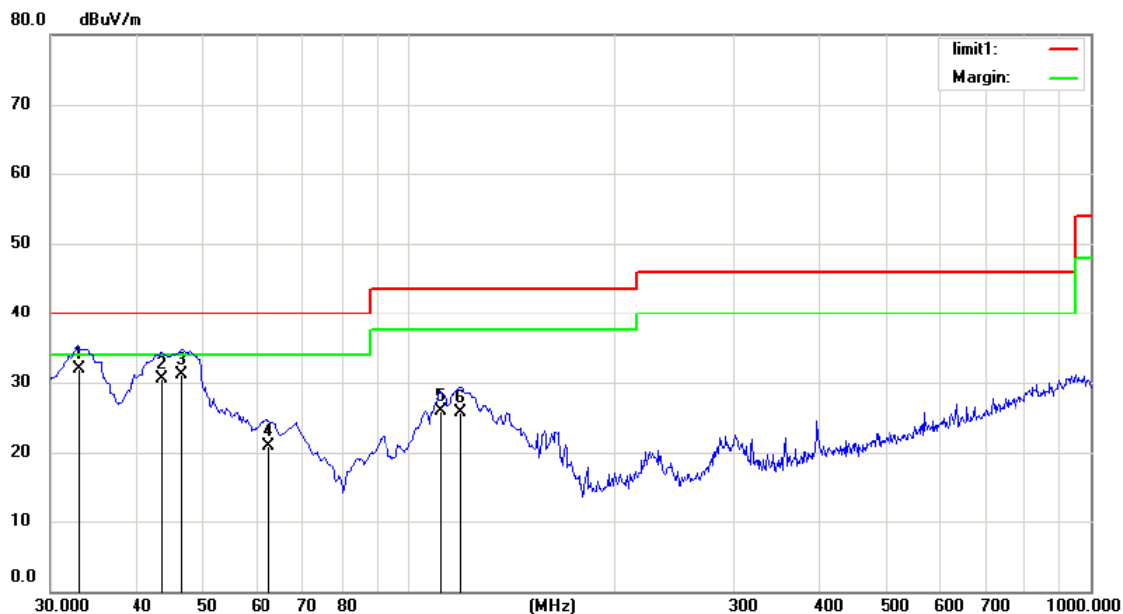
Mode: TX2402

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree	Comment
1		41.6400	36.80	-13.58	23.22	40.00	-16.78	QP		
2		47.4600	38.10	-14.38	23.72	40.00	-16.28	QP		
3		118.2700	45.30	-17.07	28.23	43.50	-15.27	QP		
4	*	123.1200	45.10	-16.61	28.49	43.50	-15.01	QP		
5		137.6700	40.40	-16.79	23.61	43.50	-19.89	QP		
6		291.9000	33.90	-14.69	19.21	46.00	-26.79	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: AC 120V/60Hz

Humidity: 55 %

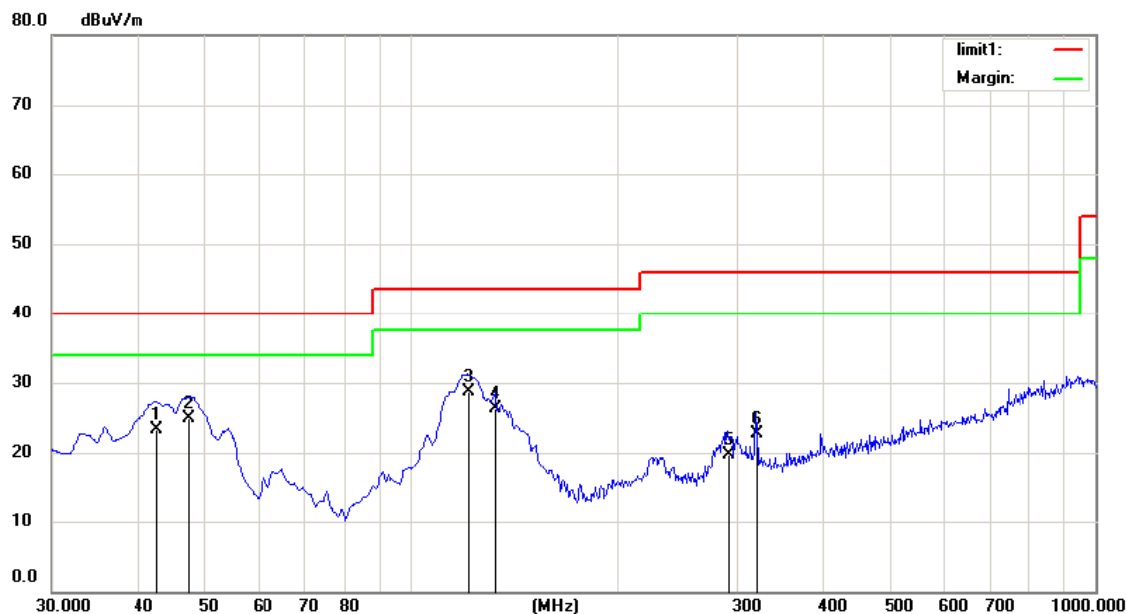
Mode: TX2402

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	*	32.9100	46.30	-14.46	31.84	40.00	-8.16	QP		
2		43.5800	43.90	-13.37	30.53	40.00	-9.47	QP		
3		46.6662	45.20	-14.11	31.09	40.00	-8.91	QP		
4		62.6505	41.10	-20.18	20.92	40.00	-19.08	QP		
5		111.4800	43.30	-17.48	25.82	43.50	-17.68	QP		
6		119.2400	42.80	-17.01	25.79	43.50	-17.71	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: AC 120V/60Hz

Humidity: 55 %

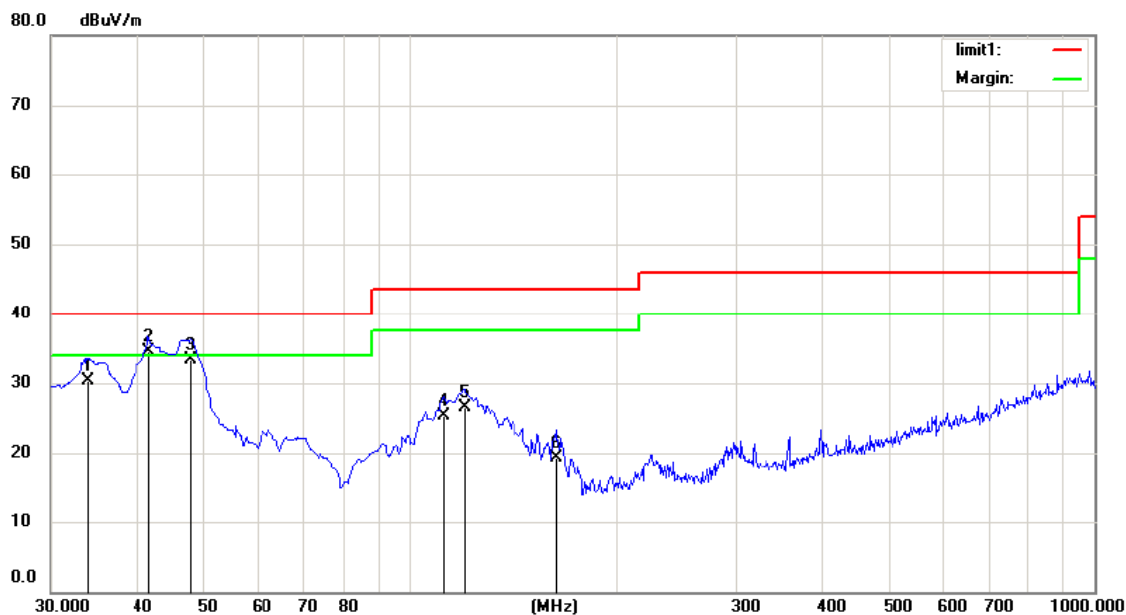
Mode: TX2441

Note:

No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Antenna	Table	
		MHz	Level	Factor	ment			Height	Degree	
			dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		42.6100	36.80	-13.49	23.31	40.00	-16.69	QP		
2		47.4600	39.20	-14.38	24.82	40.00	-15.18	QP		
3	*	121.1800	45.60	-16.82	28.78	43.50	-14.72	QP		
4		132.8200	42.70	-16.39	26.31	43.50	-17.19	QP		
5		290.9300	34.50	-14.71	19.79	46.00	-26.21	QP		
6		319.0600	35.90	-13.10	22.80	46.00	-23.20	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: AC 120V/60Hz

Humidity: 55 %

Mode: TX2441

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Antenna Height cm	Table Degree degree	Comment
1		33.8800	44.60	-14.31	30.29	40.00	-9.71	QP			
2	*	41.6400	48.10	-13.58	34.52	40.00	-5.48	QP			
3		47.9940	47.90	-14.57	33.33	40.00	-6.67	QP			
4		112.4500	42.80	-17.43	25.37	43.50	-18.13	QP			
5		120.2100	43.40	-16.93	26.47	43.50	-17.03	QP			
6		163.8600	37.60	-18.39	19.21	43.50	-24.29	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: AC 120V/60Hz

Humidity: 55 %

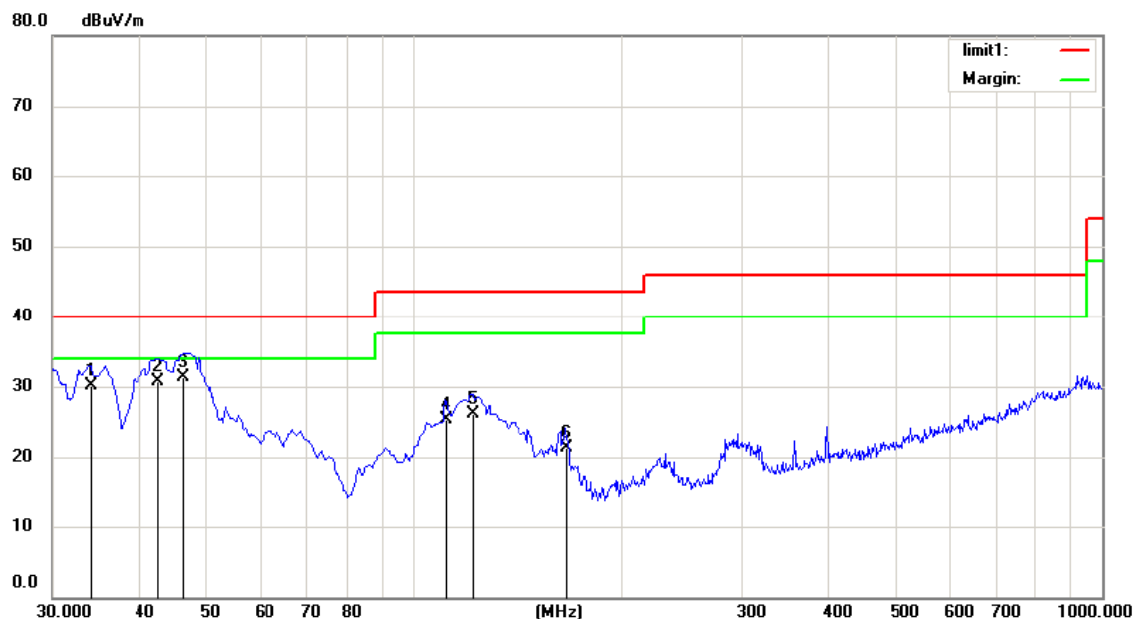
Mode: TX2480

Note:

No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Antenna	Table	
		MHz	Level	Factor	ment			Height	Degree	
			dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree
1		43.5800	36.80	-13.37	23.43	40.00	-16.57	QP		
2	*	47.4600	38.60	-14.38	24.22	40.00	-15.78	QP		
3		119.2400	44.30	-17.01	27.29	43.50	-16.21	QP		
4		124.1330	43.70	-16.50	27.20	43.50	-16.30	QP		
5		226.9100	32.90	-16.10	16.80	46.00	-29.20	QP		
6		320.0300	34.40	-13.05	21.35	46.00	-24.65	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: AC 120V/60Hz

Humidity: 55 %

Mode: TX2480

Note:

No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Antenna	Table	
		MHz	Level	Factor	ment			Height	Degree	Comment
			dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree
1		34.0363	44.30	-14.28	30.02	40.00	-9.98	QP		
2		42.6100	44.10	-13.49	30.61	40.00	-9.39	QP		
3	*	46.4900	45.30	-14.06	31.24	40.00	-8.76	QP		
4		111.4800	42.80	-17.48	25.32	43.50	-18.18	QP		
5		122.1500	42.90	-16.72	26.18	43.50	-17.32	QP		
6		166.7700	39.70	-18.40	21.30	43.50	-22.20	QP		

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

Operator: Snake

Above 1000MHz

Worst Operation Mode: GFSK (CH1: 2402MHz) Test Date : March 30, 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	66.23	44.18	74	54	-7.77	-9.82
7206	V	65.41	43.25	74	54	-8.59	-10.75
9608	V	64.58	42.13	74	54	-9.42	-11.87
12010	V	63.27	42.07	74	54	-10.73	-11.93
14412	V	61.58	41.74	74	54	-12.42	-12.26
16814	V	59.66	40.86	74	54	-14.34	-13.14
4804	H	66.37	45.97	74	54	-7.63	-8.03
7206	H	65.84	44.75	74	54	-8.16	-9.25
9608	H	64.31	43.61	74	54	-9.69	-10.39
12010	H	62.58	42.76	74	54	-11.42	-11.24
14412	H	61.47	41.23	74	54	-12.53	-12.77
16814	H	58.46	40.72	74	54	-15.54	-13.28

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 : March 30, 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	66.92	45.93	74	54	-7.08	-8.07
7323	V	65.47	44.52	74	54	-8.53	-9.48
9764	V	64.71	43.61	74	54	-9.29	-10.39
12205	V	63.27	42.56	74	54	-10.73	-11.44
14646	V	62.58	41.29	74	54	-11.42	-12.71
17087	V	61.45	40.12	74	54	-12.55	-13.88
4882	H	65.91	46.54	74	54	-8.09	-7.46
7323	H	64.75	45.98	74	54	-9.25	-8.02
9764	H	63.28	43.64	74	54	-10.72	-10.36
12205	H	62.37	42.37	74	54	-11.63	-11.63
14646	H	61.56	41.08	74	54	-12.44	-12.92
17087	H	59.77	39.74	74	54	-14.23	-14.26

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.

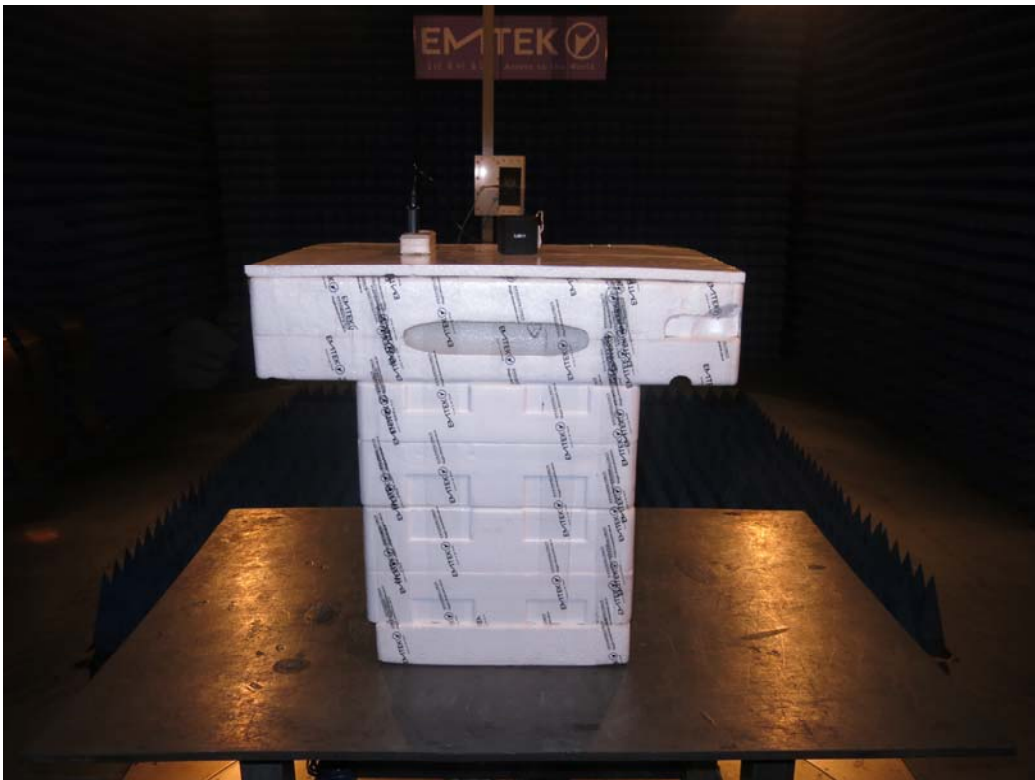
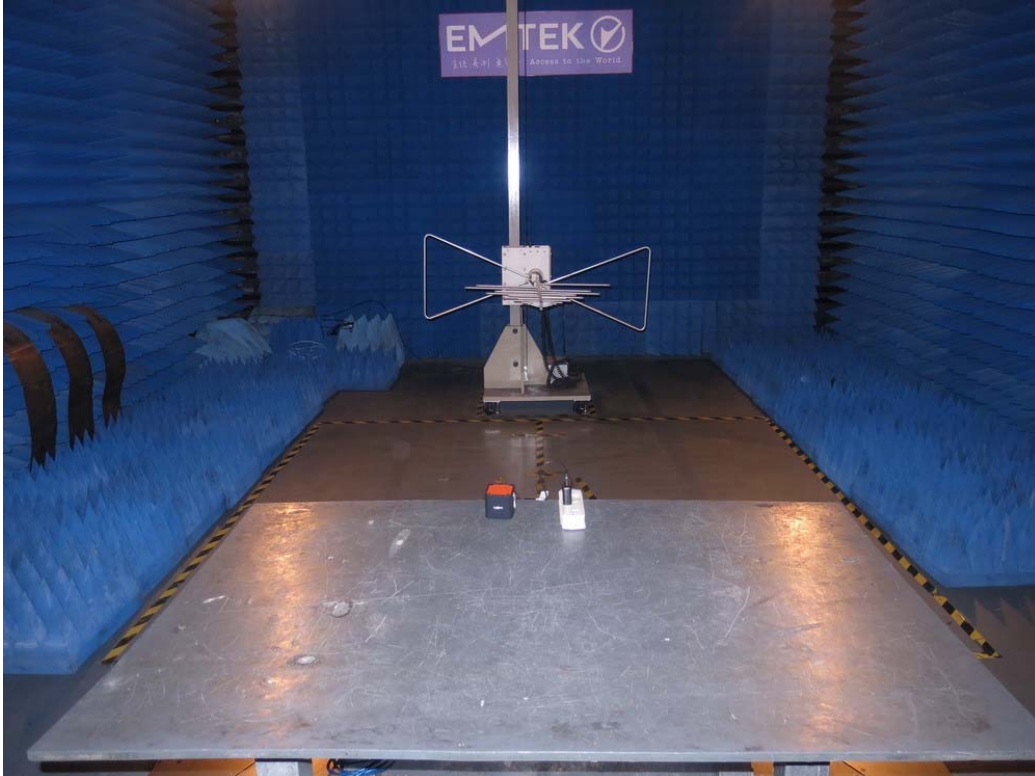
Worst Operation Mode: GFSK (CH79: 2480MHz) Test Date : March 30, 2015
Frequency Range: 1-25GHz Temperature : 25 °C
Test Result: PASS Humidity : 50 %
Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
4960	V	65.33	44.18	74	54	-8.67	-9.82
7440	V	64.72	43.38	74	54	-9.28	-10.62
9920	V	63.59	42.82	74	54	-10.41	-11.18
12400	V	62.15	41.13	74	54	-11.85	-12.87
14880	V	61.02	40.59	74	54	-12.98	-13.41
17360	V	60.38	38.95	74	54	-13.62	-15.05
4960	H	66.33	45.72	74	54	-7.67	-8.28
7440	H	65.82	44.66	74	54	-8.18	-9.34
9920	H	64.72	43.69	74	54	-9.28	-10.31
12400	H	63.81	42.17	74	54	-10.19	-11.83
14880	H	62.33	41.35	74	54	-11.67	-12.65
17360	H	60.82	40.07	74	54	-13.18	-13.93

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:

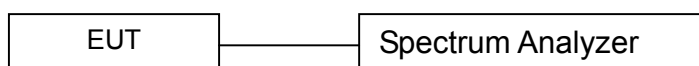


8. Channel Separation test

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:

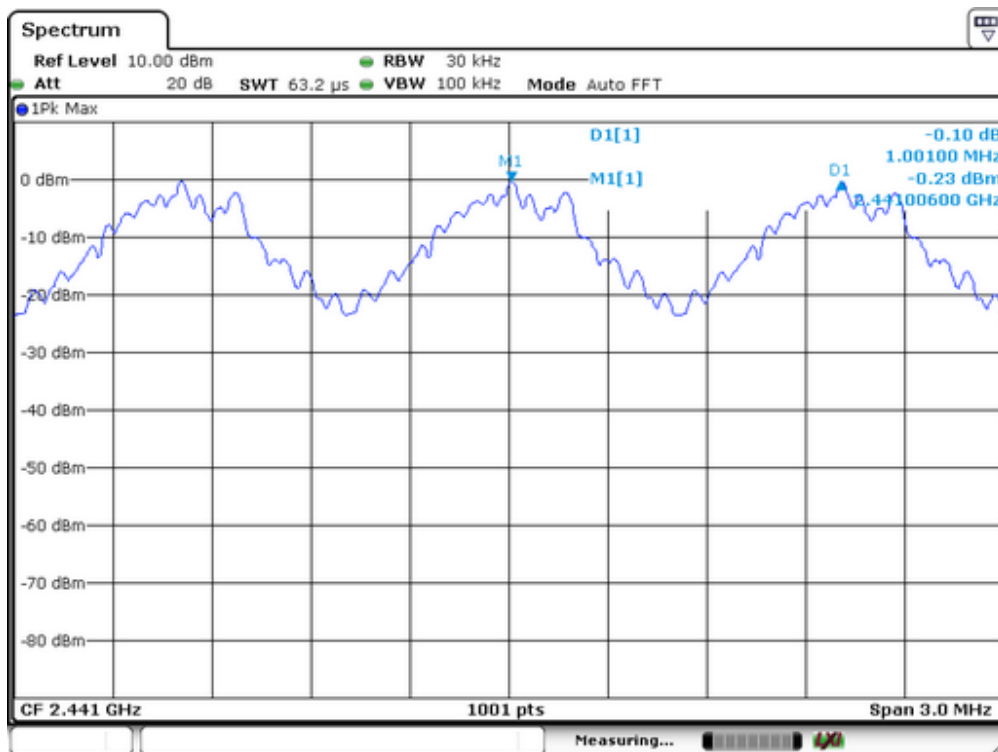
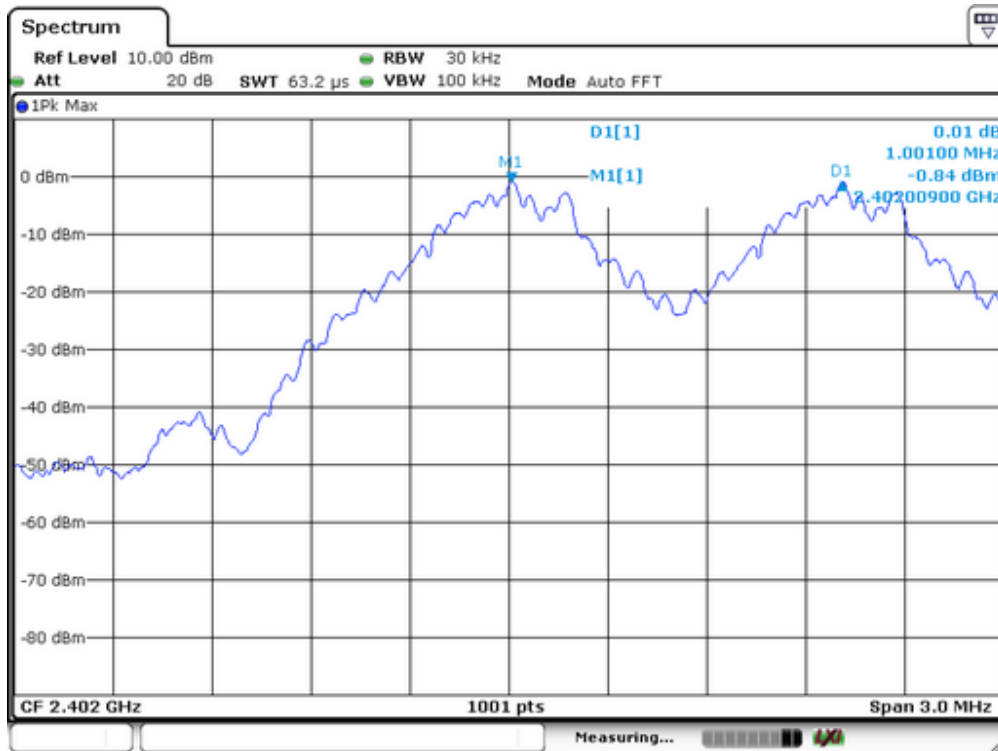
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	03/16/2015	03/15/2016
Coaxial Cable	CDS	79254	46107086	03/16/2015	03/15/2016

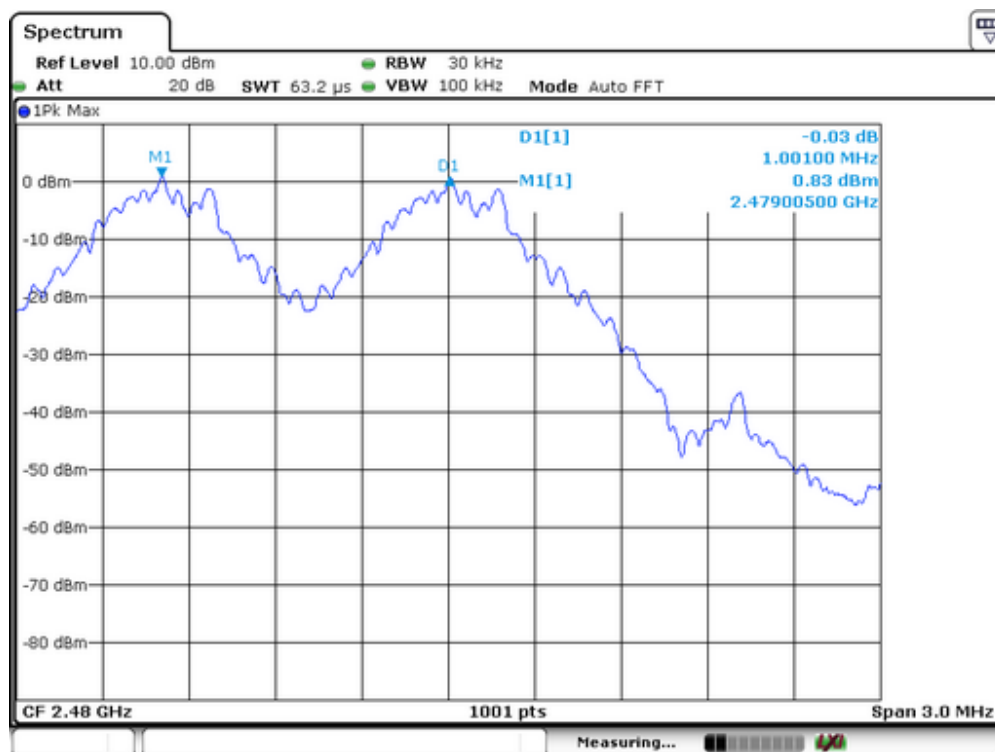
8.4 Measurement Results:

Refer to attached data chart.

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

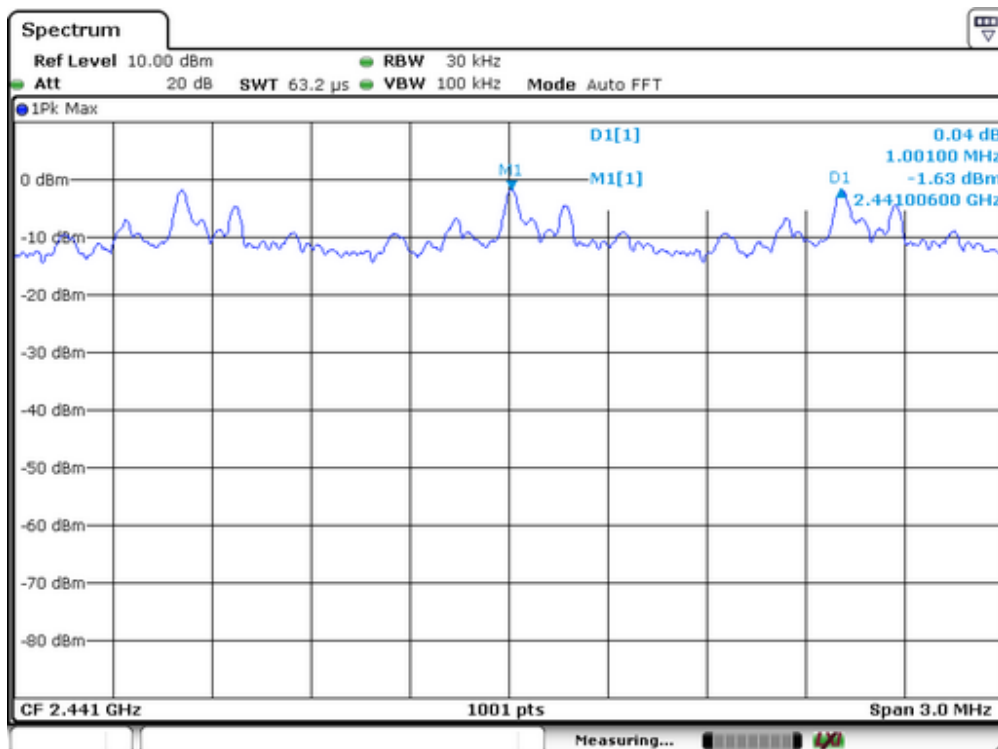
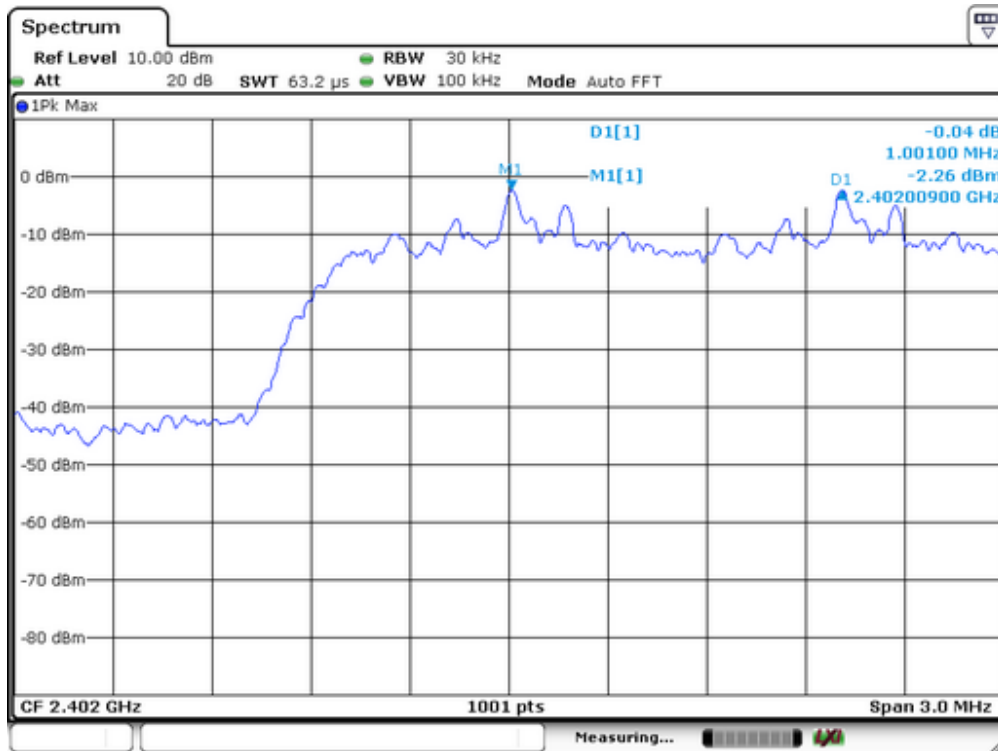
Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit (kHz)
1	2402	1001	>815
40	2441	1001	>818
79	2480	1001	>815

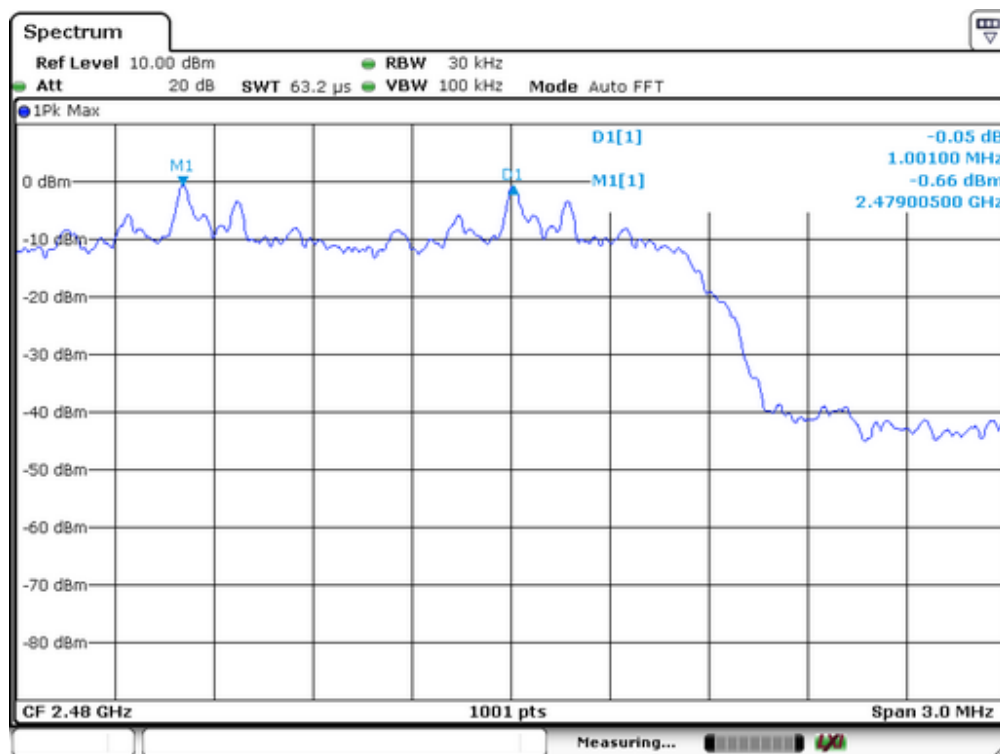




Spectrum Detector:	PK	Test Date :	March 30, 2015
Test By:	Andy	Temperature :	24°C
Test Result:	PASS	Humidity :	53 %
Modulation:	$\Pi/4$ -DQPSK		

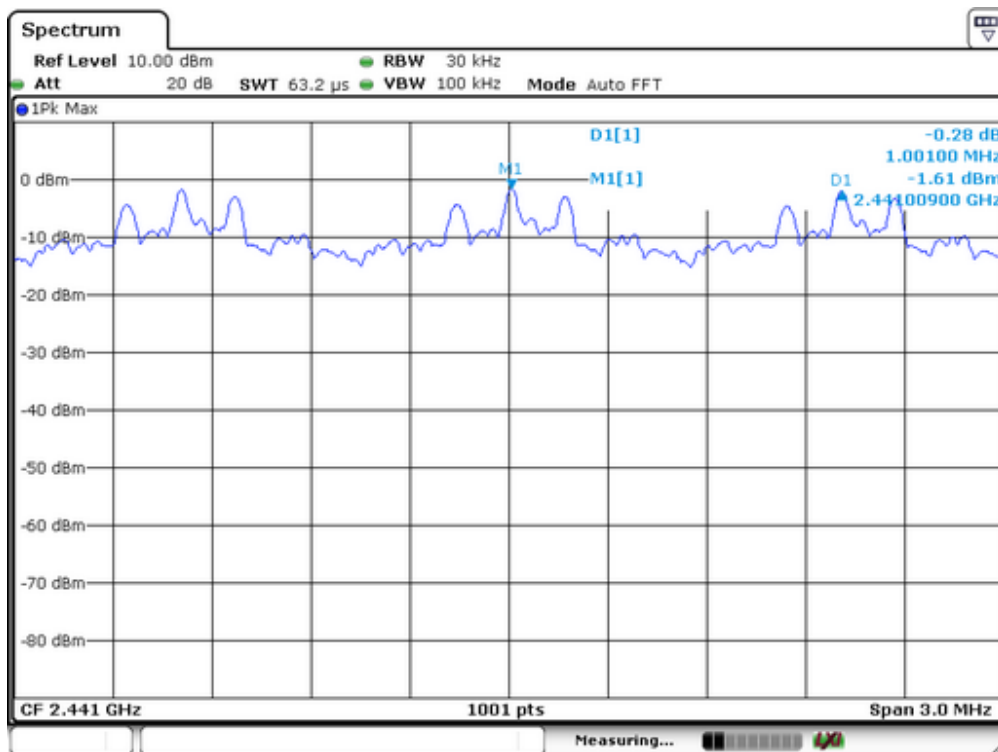
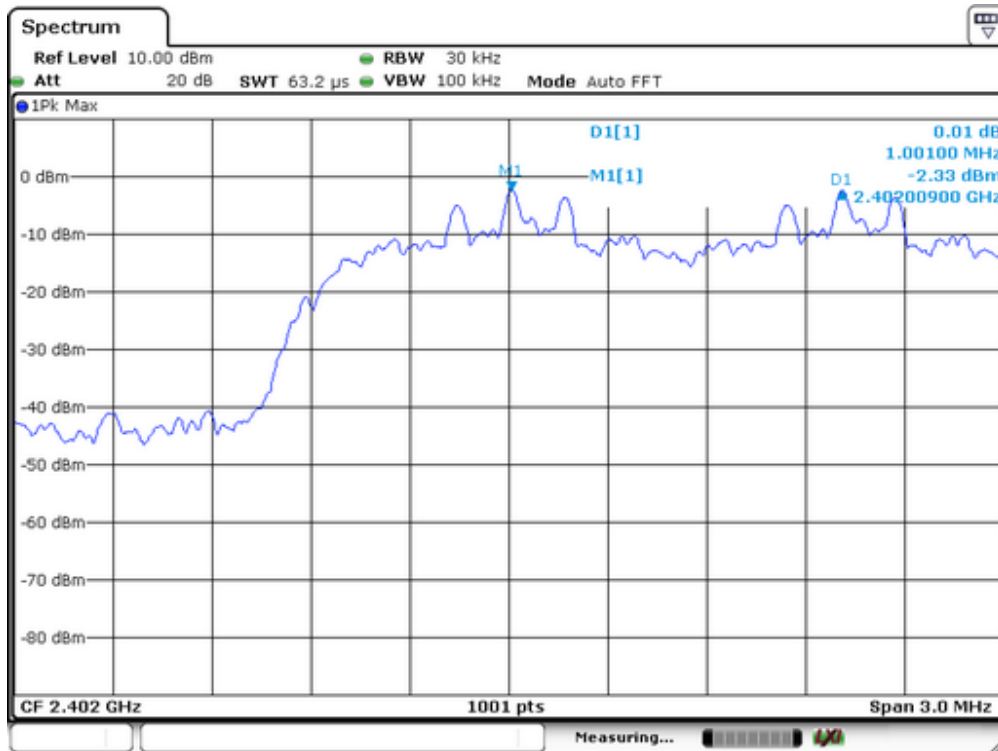
Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	1001	>830
40	2441	1001	>830
79	2480	1001	>826

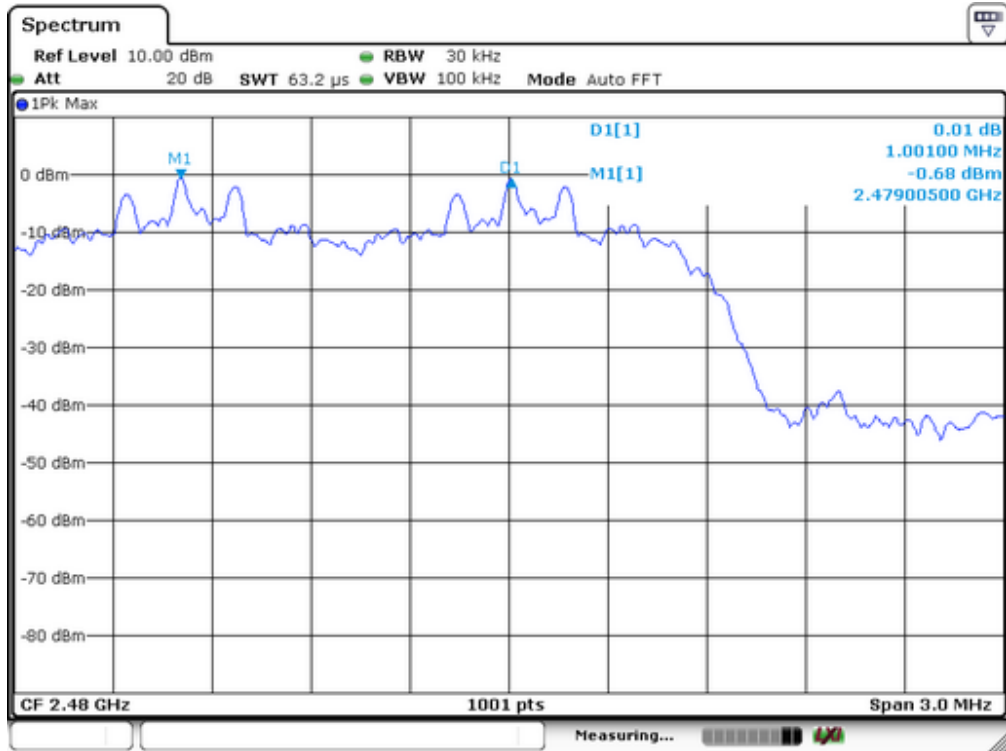




Spectrum Detector:	PK	Test Date :	March 30, 2015
Test By:	Andy	Temperature :	24 °C
Test Result:	PASS	Humidity :	53 %
Modulation:	8DPSK		

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	1001	>810
40	2441	1001	>814
79	2480	1001	>806



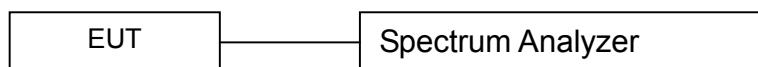


9. 20dB Bandwidth test

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:

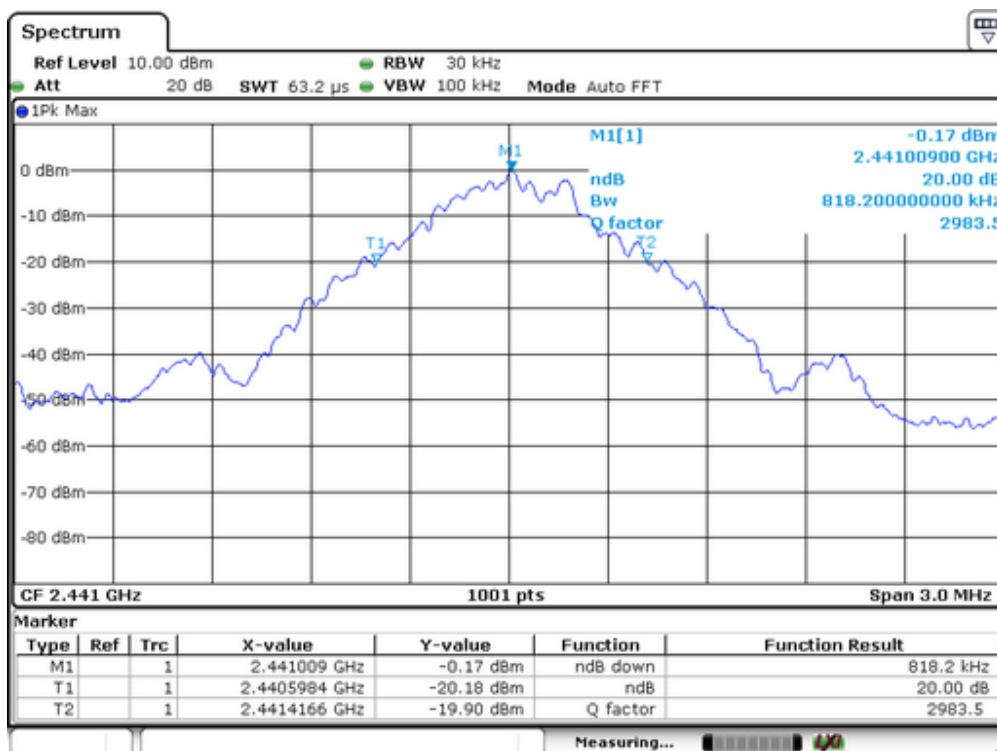
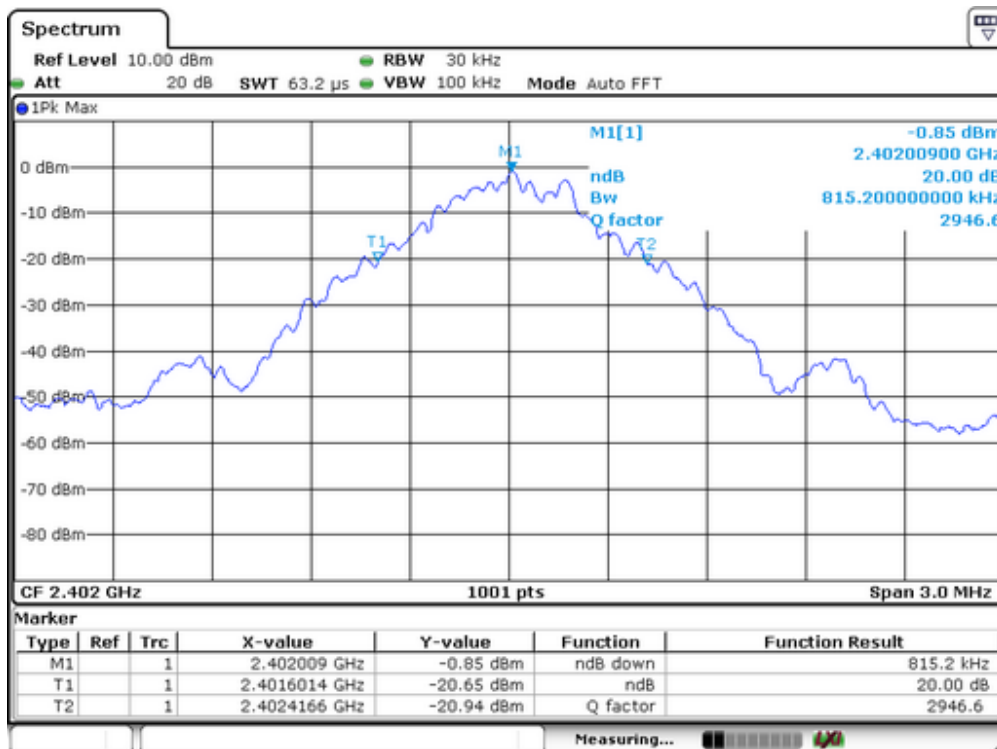
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	03/16/2015	03/15/2016
Coaxial Cable	CDS	79254	46107086	03/16/2015	03/15/2016

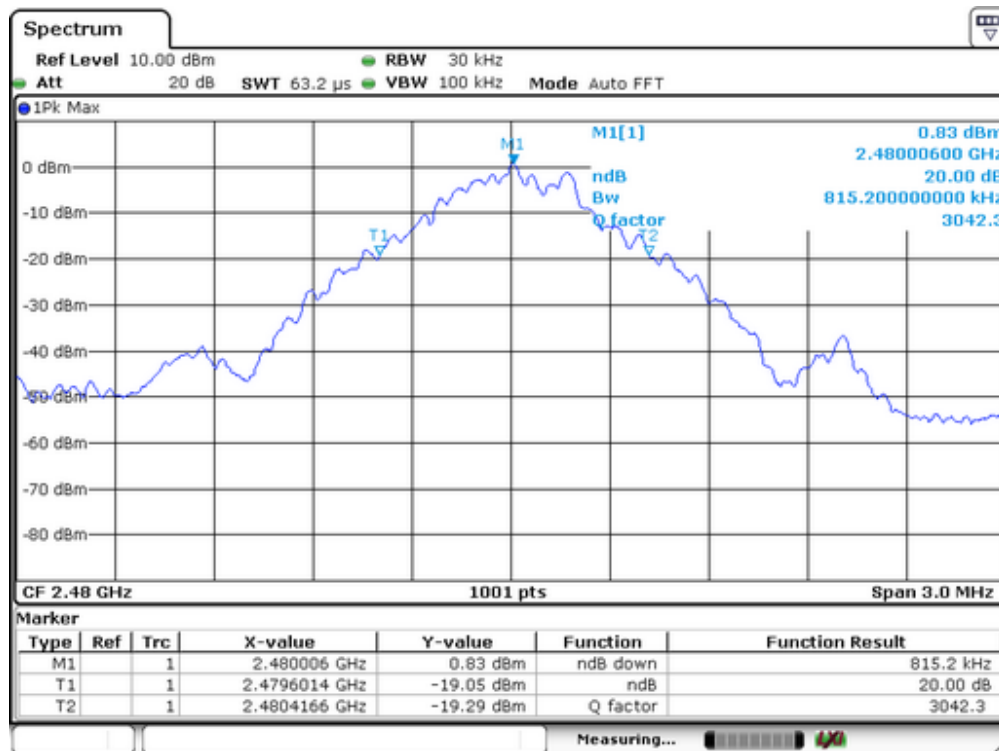
9.4 Measurement Results:

Refer to attached data chart.

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

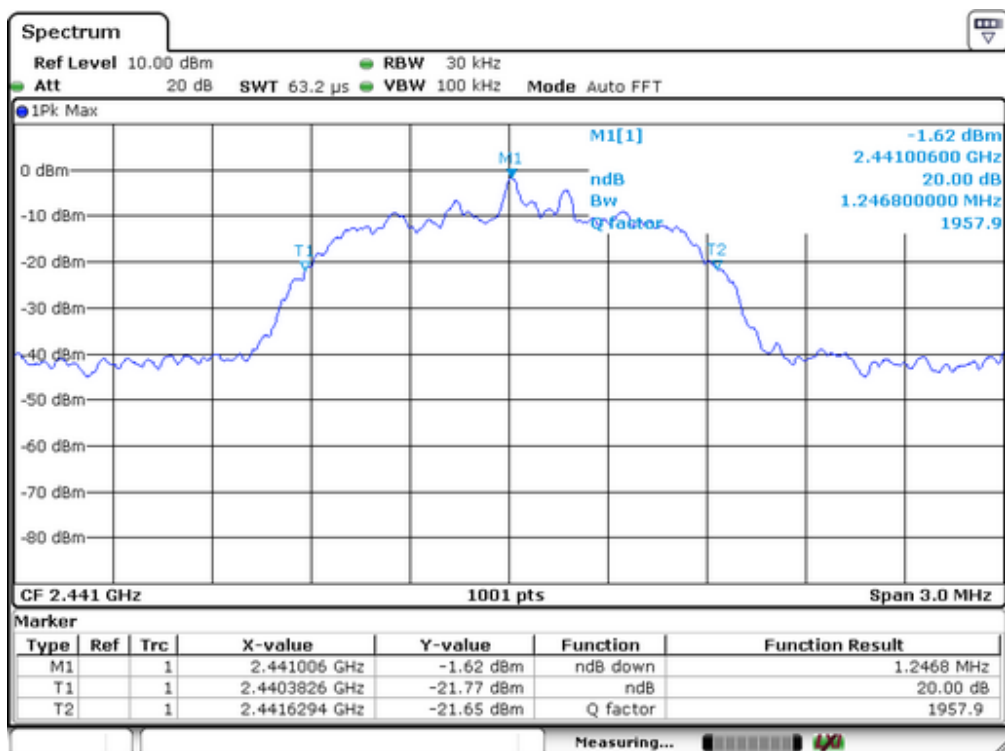
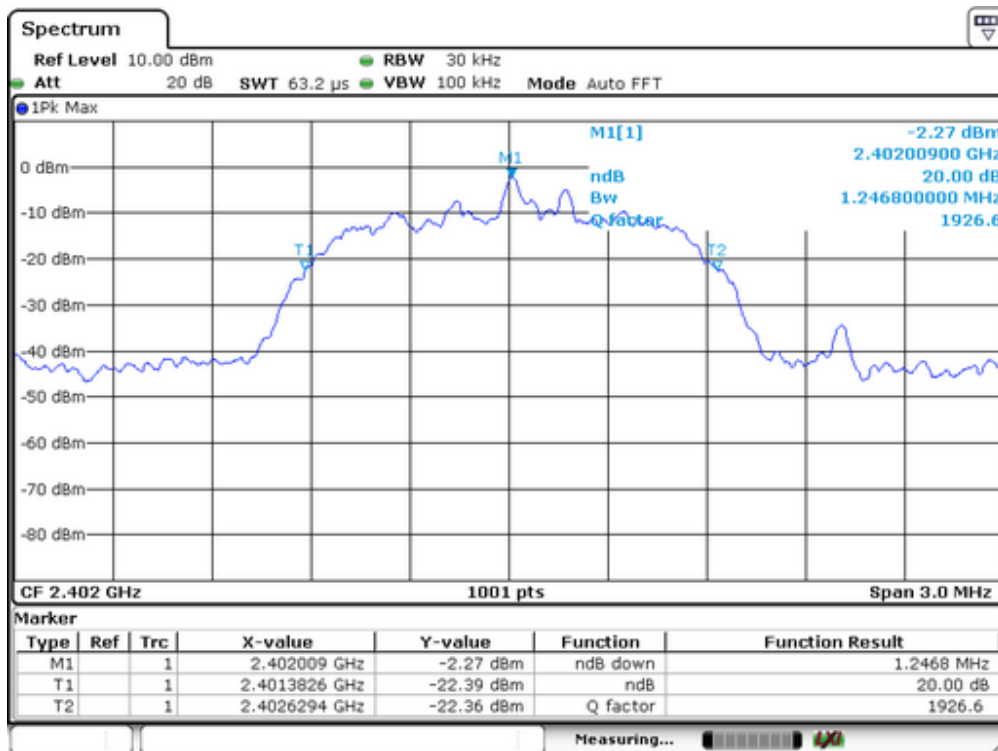
Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	815.200
40	2441	818.200
79	2480	815.200

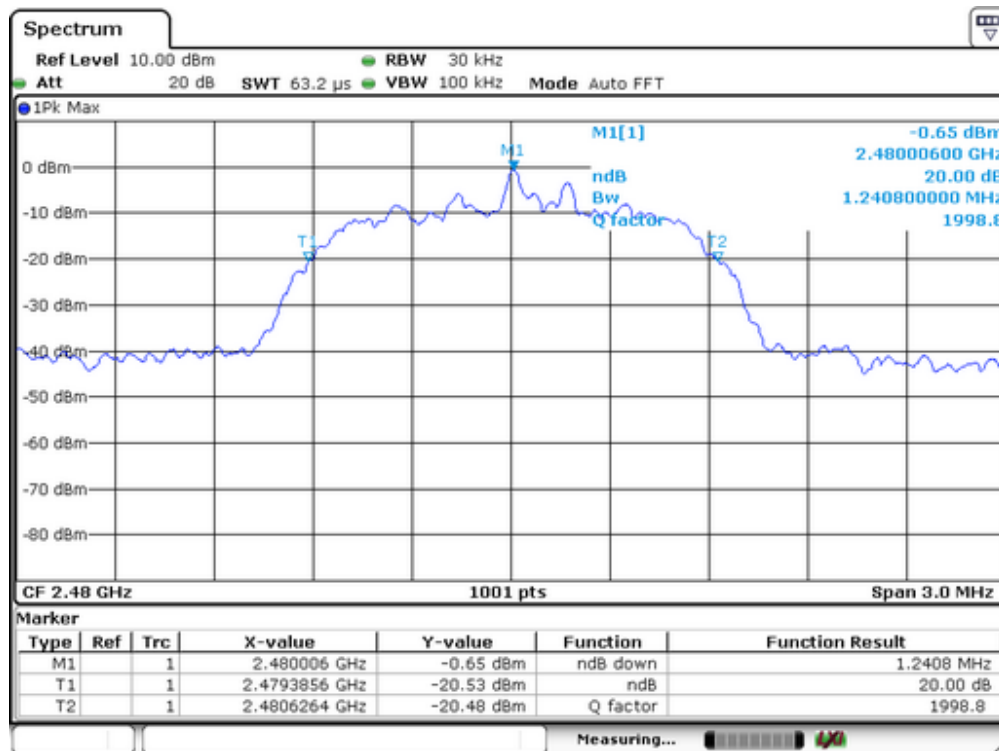




Spectrum Detector:	PK	Test Date :	March 30, 2015
Test By:	Andy	Temperature :	24°C
Test Result:	PASS	Humidity :	53 %
Modulation:	Π/4-DQPSK		

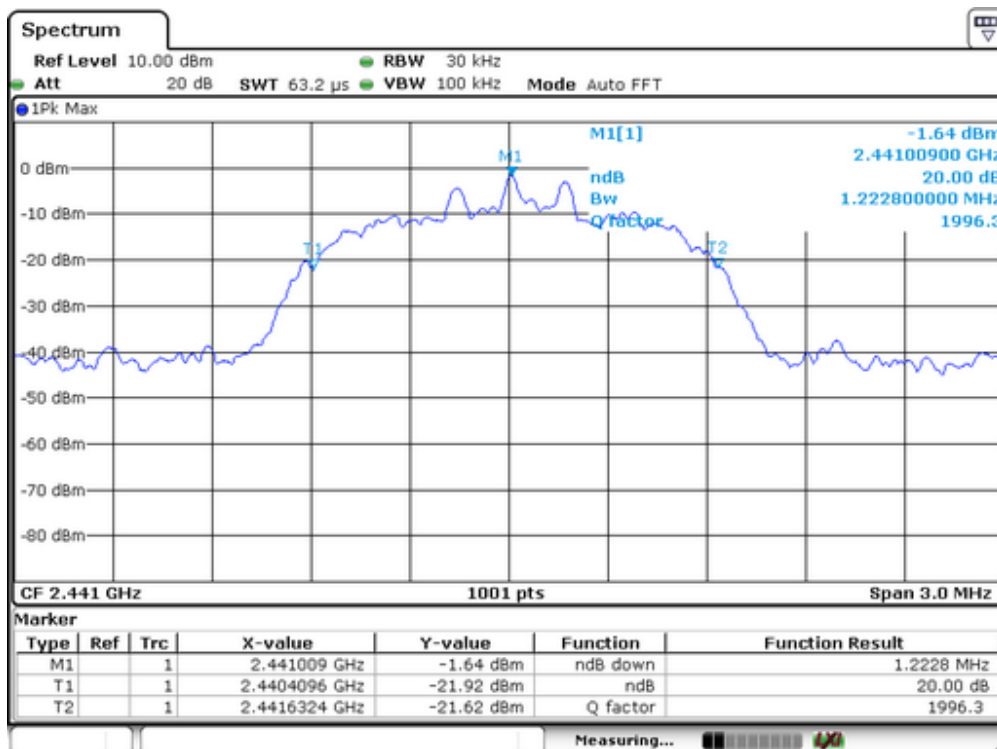
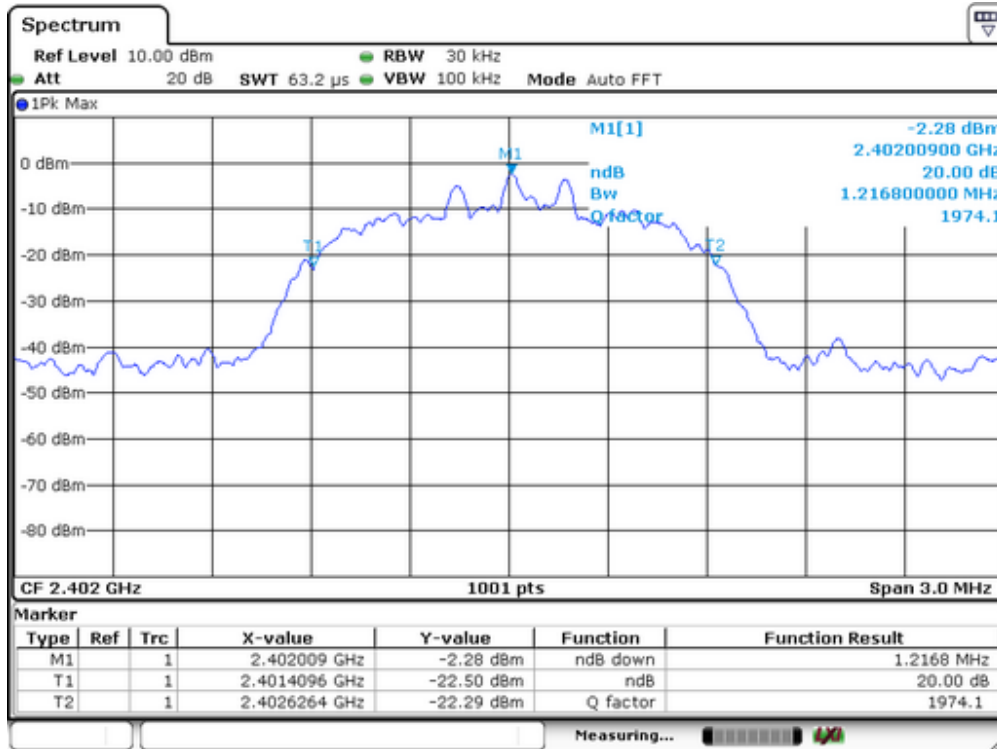
Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	1246.800
40	2441	1246.800
79	2480	1240.800

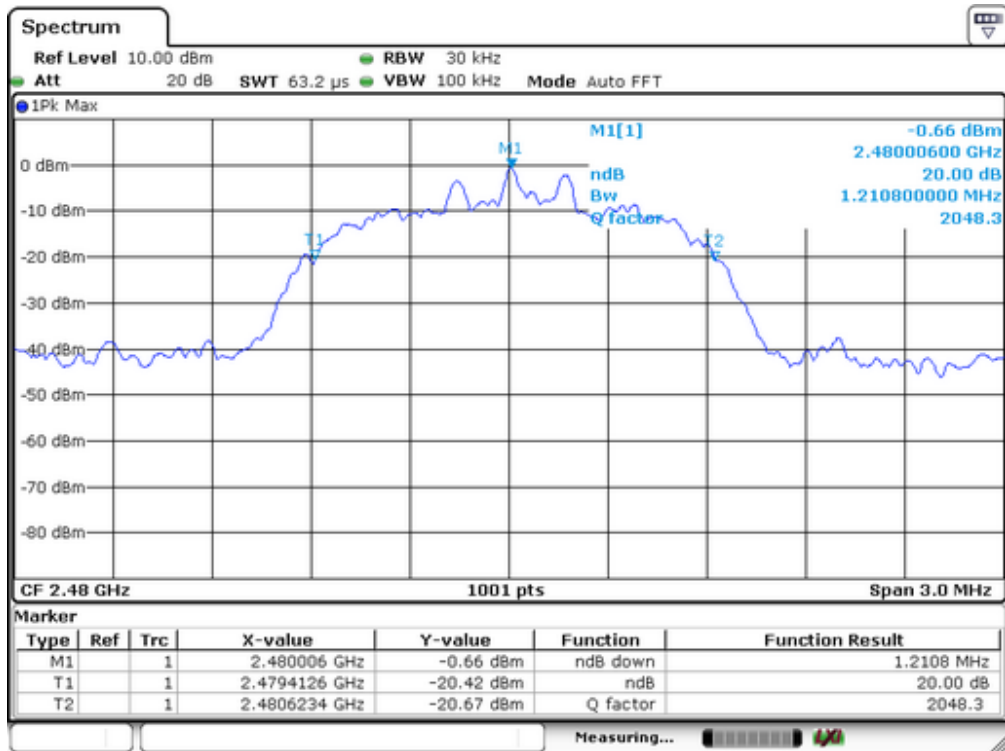




Spectrum Detector: PK Test Date : March 30, 2015
 Test By: Andy Temperature : 24 °C
 Test Result: PASS Humidity : 53 %
 Modulation: 8DPSK

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	1216.800
40	2441	1222.800
79	2480	1210.800



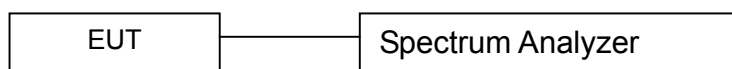


10. Quantity of Hopping Channel Test

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:

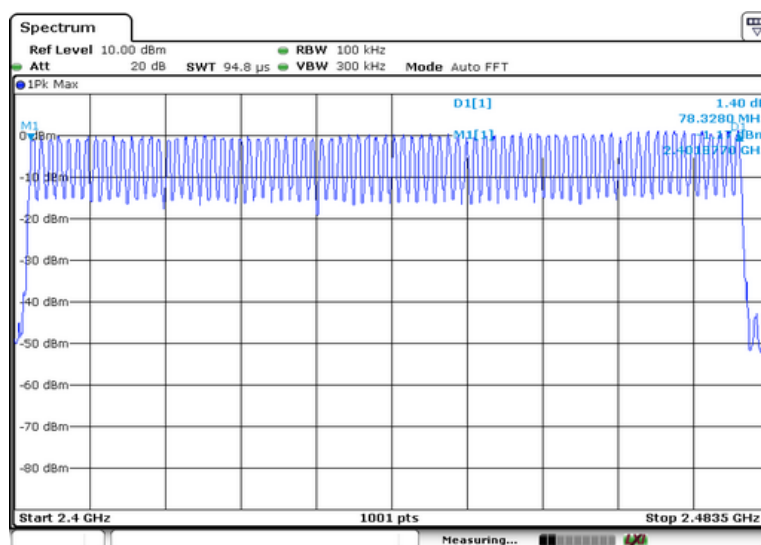
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	03/16/2015	03/15/2016
Coaxial Cable	CDS	79254	46107086	03/16/2015	03/15/2016

10.4 Measurement Results:

Refer to attached data chart.

Worst Test Mode	GFSK	Test Date :	March 30, 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)

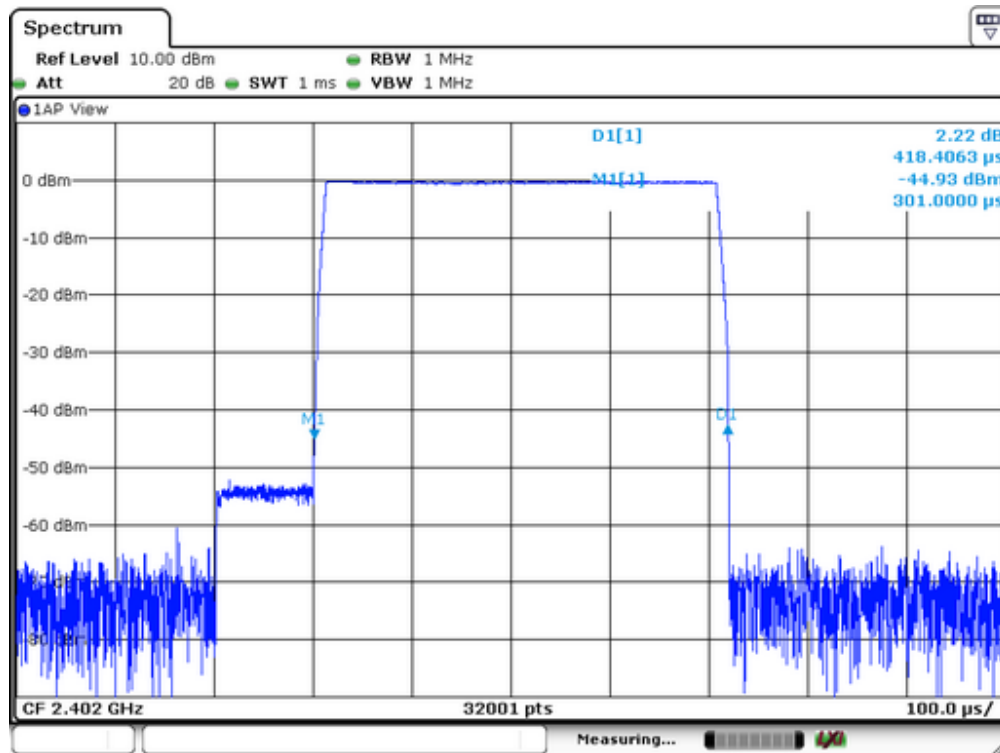
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Since the Bluetooth technology uses 79 channels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

11.3 Test result

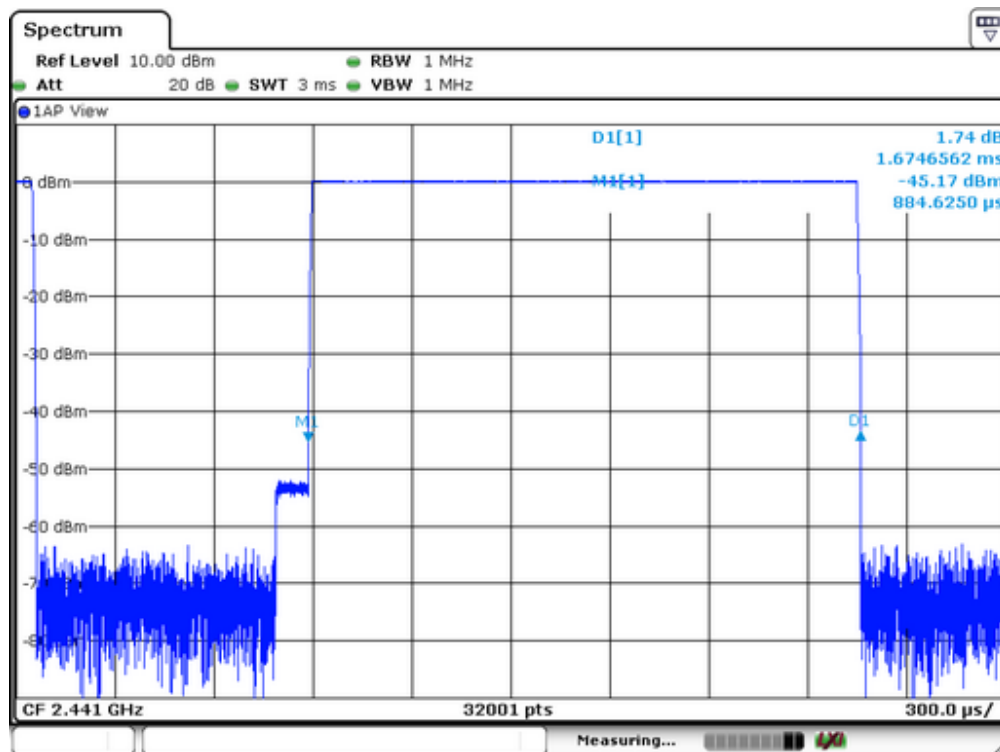
Mode	Number of transmission in a 31.6(79 Hopping*0.4)	Length of transmissions time(msec)	Result (msec)	Limit (msec)
DH1	$1600/(2*79) \times 31.6 = 320$	0.418	133.76	400
DH3	$1600/(4*79) \times 31.6 = 160$	1.675	268.00	400
DH5	$1600/(6*79) \times 31.6 = 106.67$	2.921	311.58	400

Remark: The results of worst cased was recorded.

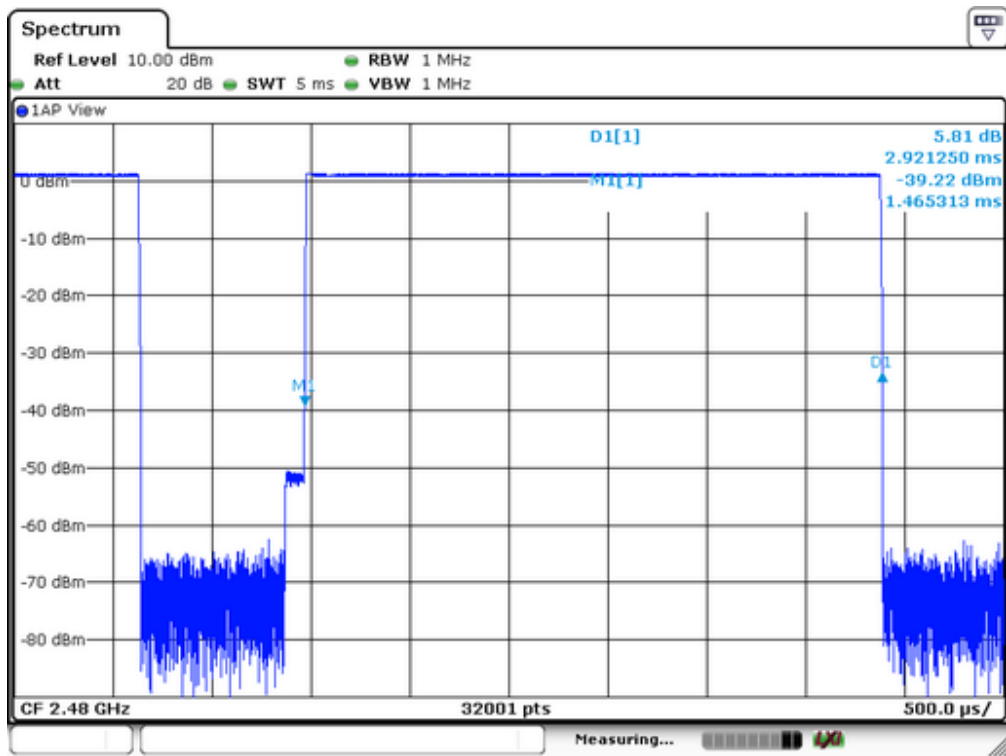
DH1:



DH3:



DH5:

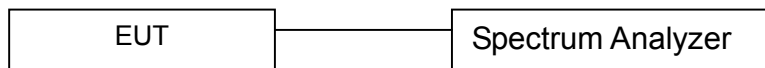


12. MAXIMUM PEAK OUTPUT POWER TEST

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:

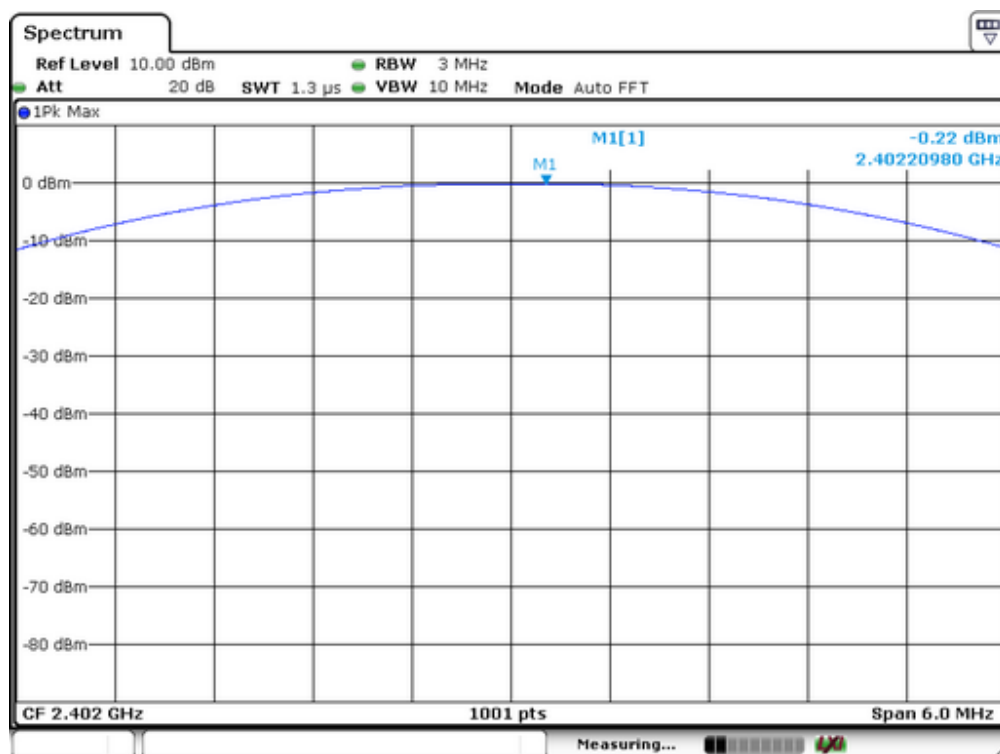
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	03/16/2015	03/15/2016
Coaxial Cable	CDS	79254	46107086	03/16/2015	03/15/2016

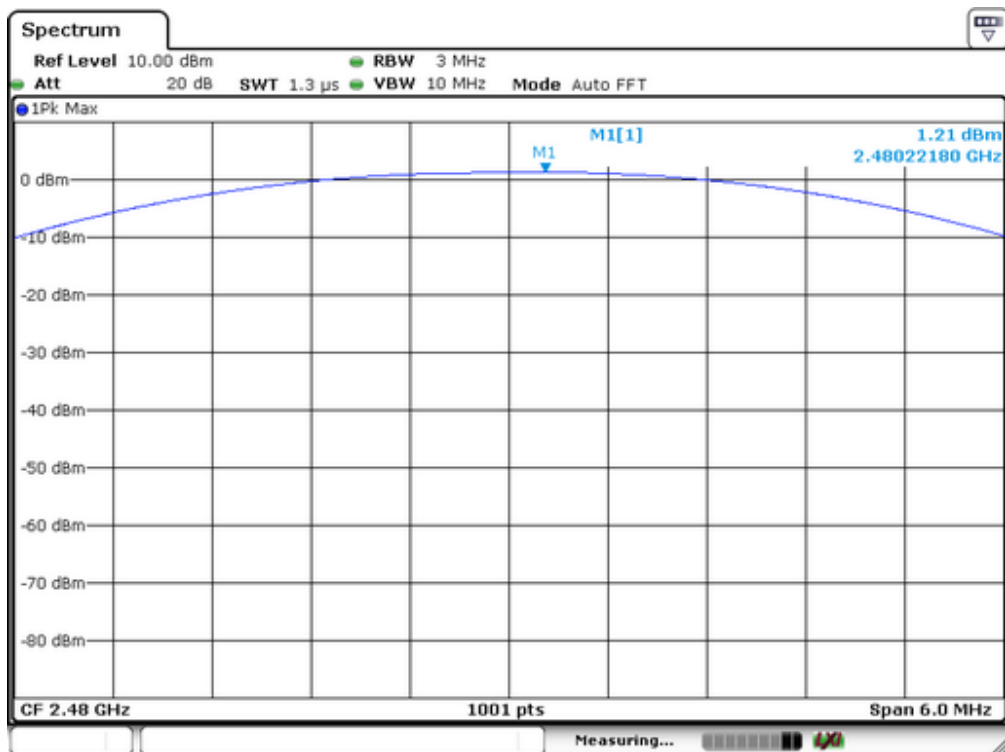
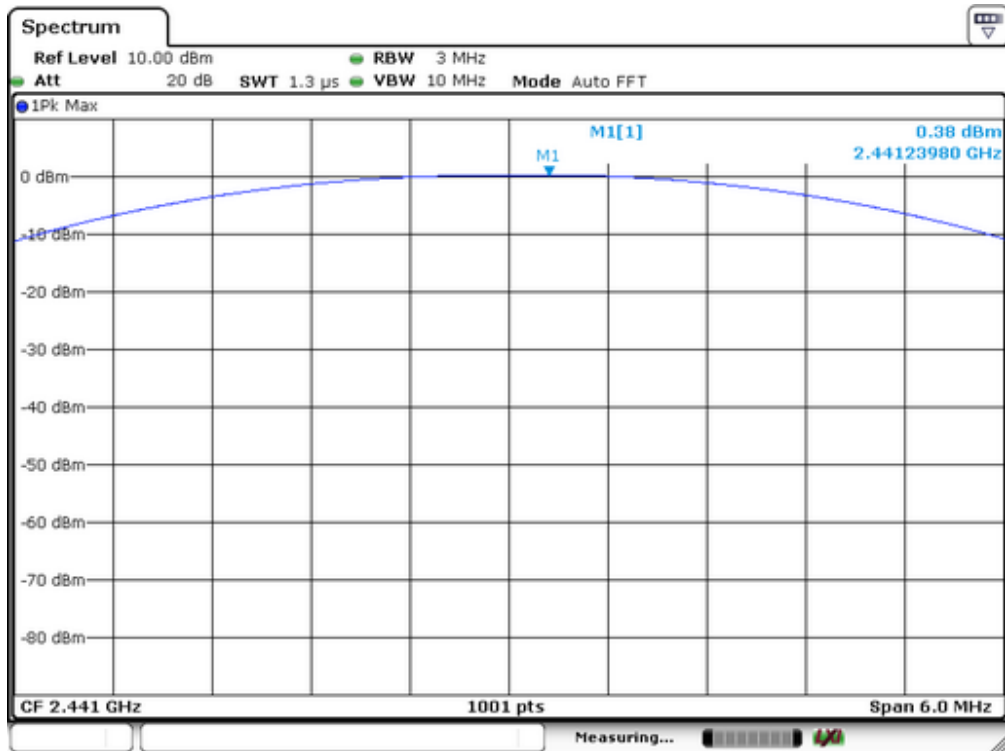
12.4 Measurement Results:

Refer to attached data chart.

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

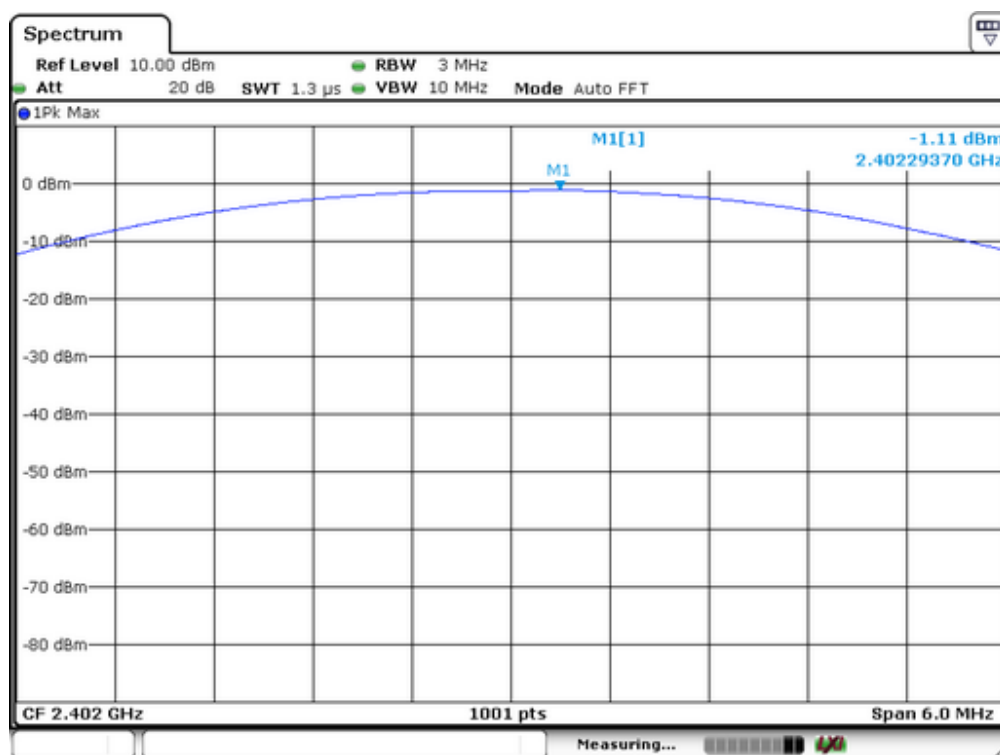
Channel Number	Channel Frequency(MHz)	Peak Power Output(dBm)	Peak Power Output(mW)	Peak Power Limit(mW)	Pass/Fail
1	2402	-0.22	0.951	1000	Pass
40	2441	0.38	1.091	1000	Pass
79	2480	1.21	1.321	1000	Pass

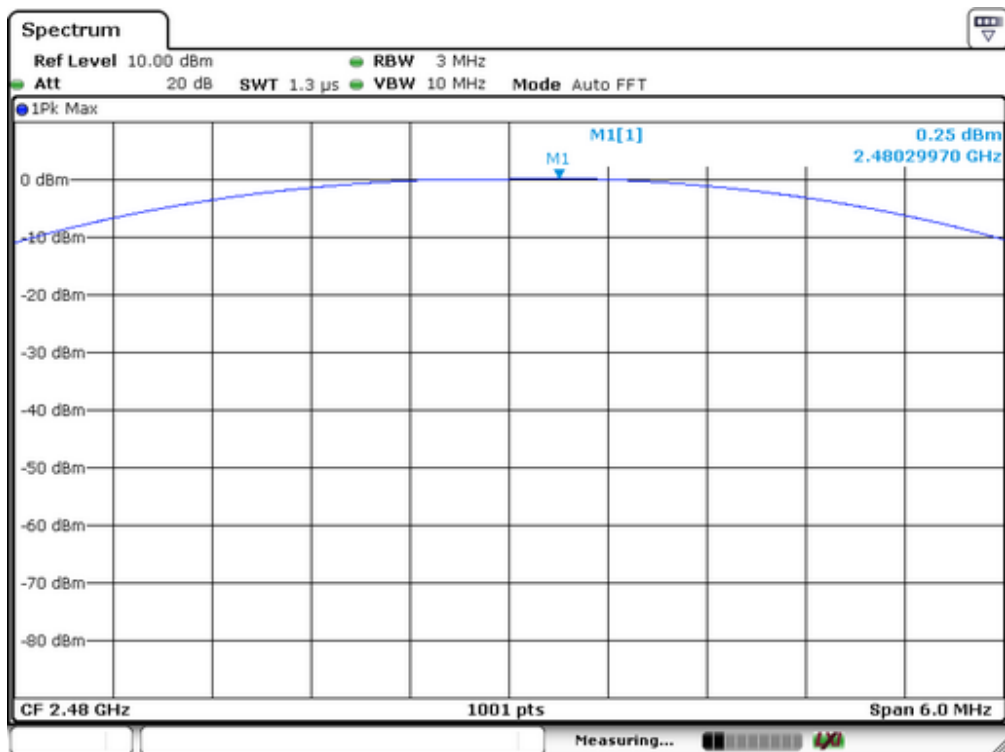
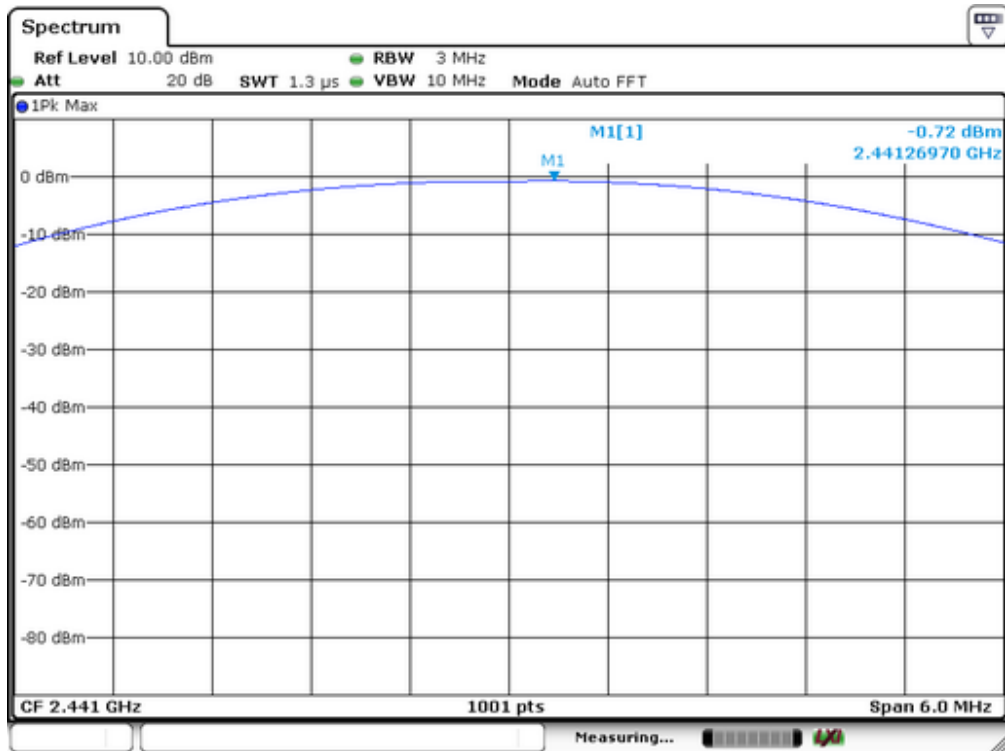




Spectrum Detector:	PK	Test Date :	March 30, 2015
Test By:	Andy	Temperature :	25 °C
Test Result:	PASS	Humidity :	50 %
Modulation:	$\Pi/4$ -DQPSK		

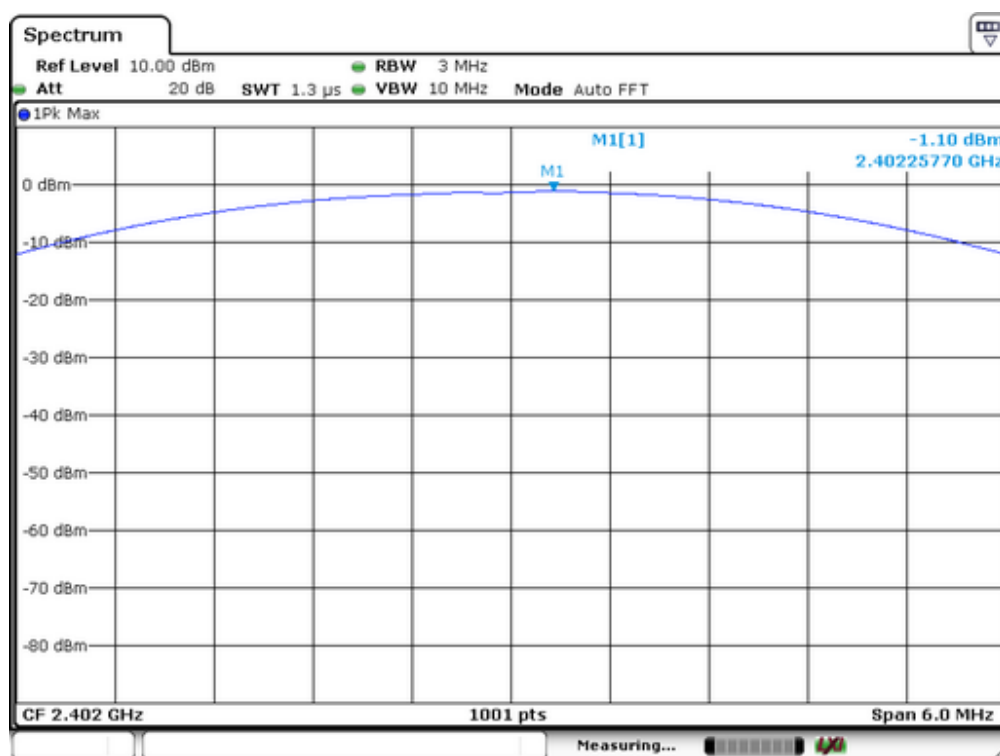
Channel Number	Channel Frequency(MHz)	Peak Power Output(dBm)	Peak Power Output(mW)	Peak Power Limit(mW)	Pass/Fail
1	2402	-1.11	0.774	125	Pass
40	2441	-0.72	0.847	125	Pass
79	2480	0.25	1.059	125	Pass

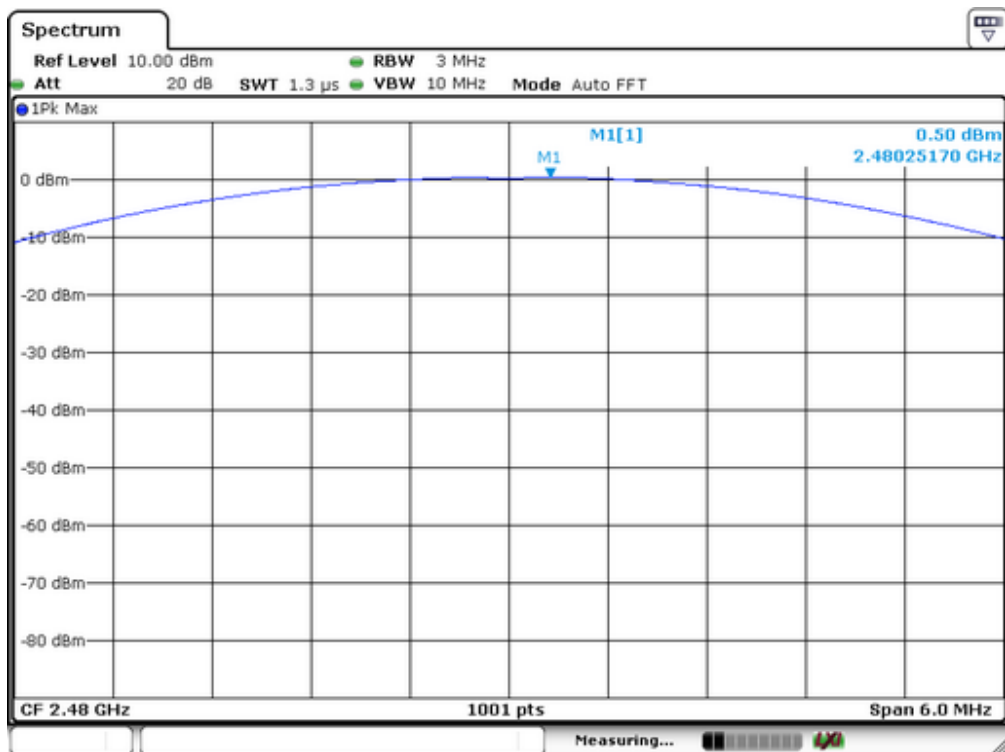
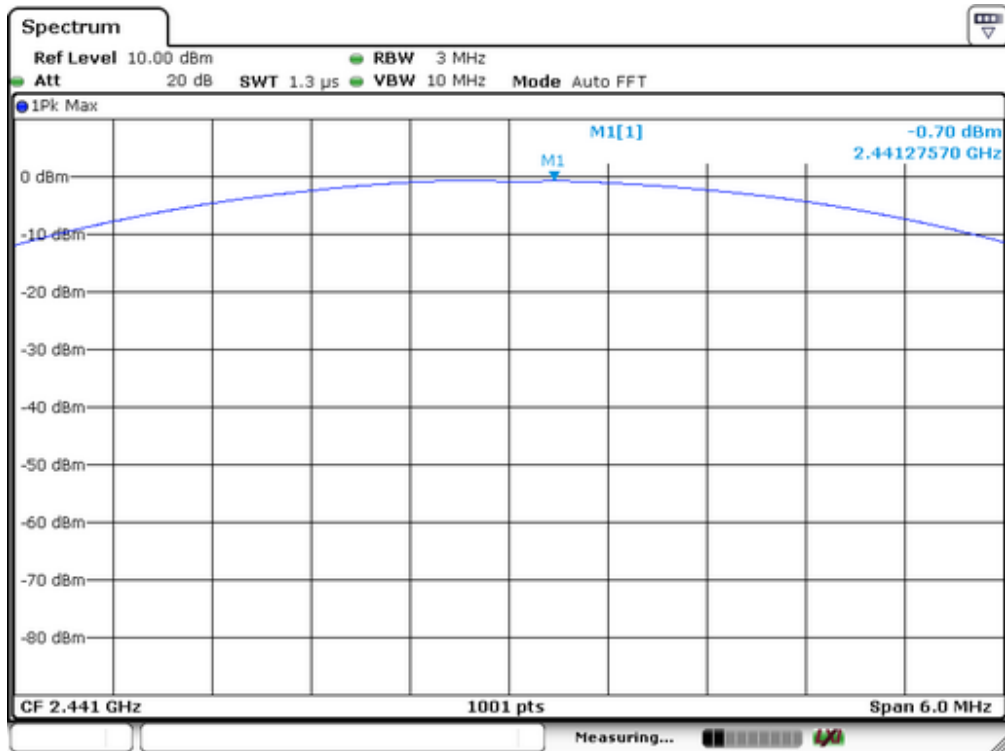




Spectrum Detector:	PK	Test Date :	March 30, 2015
Test By:	Andy	Temperature :	25 °C
Test Result:	PASS	Humidity :	50 %
Modulation:	8DPSK		

Channel Number	Channel Frequency(MHz)	Peak Power Output(dBm)	Peak Power Output(mW)	Peak Power Limit(mW)	Pass/Fail
1	2402	-1.10	0.776	125	Pass
40	2441	-0.70	0.851	125	Pass
79	2480	0.50	1.122	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
RBW	1MHz
VBW	3MHz
Detector	Peak
Trace	Max hold

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

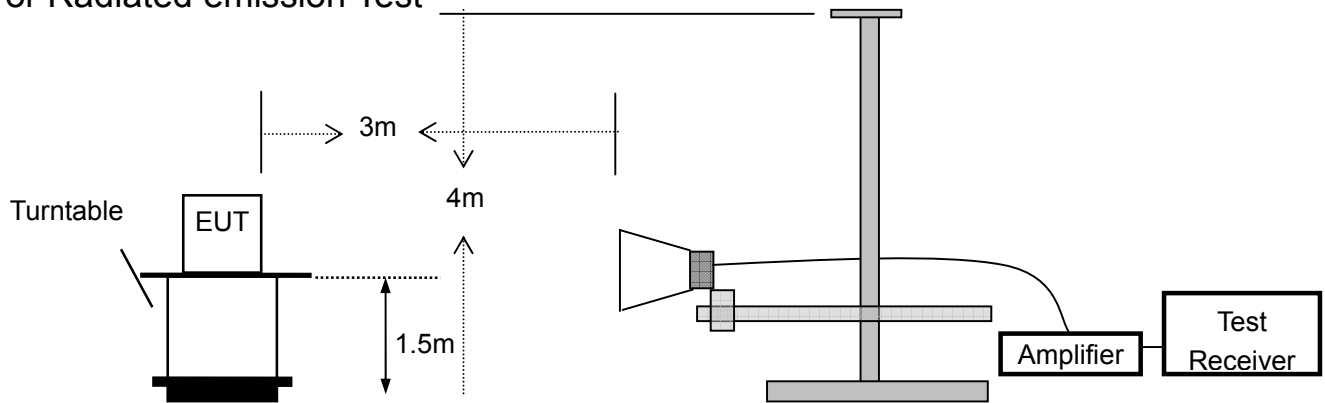
EMI Test Receiver	Setting
Attenuation	Auto
RBW	1MHz
VBW	10Hz
Detector	Peak
Trace	Max hold

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	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

13.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	March 30, 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)
2399.990	GFSK	-0.20	-43.35	43.15	>20dBc
2399.650	pi/4-DQPSK	-1.87	-46.28	44.41	>20dBc
2399.769	8DPSK	-1.82	-46.30	44.48	>20dBc
2483.509	GFSK	1.27	-51.04	52.31	>20dBc
2483.519	pi/4-DQPSK	-0.29	-44.86	44.57	>20dBc
2483.510	8DPSK	-0.24	-45.69	45.45	>20dBc

For Hopping Mode:

Frequency (MHz)	Modulation	Peak Power Output(dBm)	Emission Read Value(dBm)	Result of Band Edge(dBc)	Band Edge Limit(dBc)
2399.980	GFSK	-0.24	-43.98	43.74	>20dBc
2399.660	pi/4-DQPSK	-1.90	-48.17	46.27	>20dBc
2399.690	8DPSK	-1.86	-47.29	45.43	>20dBc
2483.510	GFSK	1.27	-52.38	53.65	>20dBc
2483.539	pi/4-DQPSK	-0.33	-46.78	46.45	>20dBc
2483.510	8DPSK	-0.28	-46.03	45.75	>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
2399.652	H	63.58	45.12	74	54	-10.42	-8.88
2398.531	V	64.74	44.71	74	54	-9.26	-9.29
2483.997	H	63.46	43.28	74	54	-10.54	-10.72
2484.023	V	62.91	41.55	74	54	-11.09	-12.45

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
2399.516	H	62.35	43.18	74	54	-11.65	-10.82
2398.636	V	63.25	42.84	74	54	-10.75	-11.16
2483.674	H	63.19	42.06	74	54	-10.81	-11.94
2484.921	V	62.76	40.38	74	54	-11.24	-13.62

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)



