

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

OF

Stereo bluetooth wireless headset

Model No.: 306B, 155B, 303B, 305B, 303BD, 305BD, 306BD

Trademark:  **MARROW**

FCC ID: 2AHGI-306B

Report No.: ED160119001E1

Issue Date: February 24, 2016

Prepared for

**LISONG ELECTRONICS CO.,LTD
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Prepared by

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EMTEK(DONGGUAN) CO., LTD.**

VERIFICATION OF COMPLIANCE

Applicant:	LISONG ELECTRONICS CO.,LTD Jiling Village, Lianping, Dalingshan Town, Dongguan City, Guang Dong Province, China
Manufacturer:	LISONG ELECTRONICS CO.,LTD Jiling Village, Lianping, Dalingshan Town, Dongguan City, Guang Dong Province, China
Product Description:	Stereo bluetooth wireless headset
Trade Mark:	 MARROW
Model Number:	306B, 155B, 303B, 305B, 303BD, 305BD, 306BD (Note: The samples are the same except difference color of appearance and model number. So 306B was selected for full test.)

We hereby certify that:

The above equipment was tested by EMTEK(DONGGUAN) 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 : January 19, 2016 to February 24, 2016

Prepared by : Ivy Huang
Ivy Huang/Editor

Reviewer : Alan He
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Approved & Authorized
Signer : Sam Lv
Sam Lv/Manager

Modified Information

Version	Summary	Revision Date	Report No.
Ver.1.0	Original Report	/	ED160119001E1

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Appendix I (Photos of EUT) (11 pages)

1. GENERAL INFORMATION

1.1 Product Description

Product Name	Stereo bluetooth wireless headset	
Model number	306B	
Power Supply	DC 3.7V, 360mA Lithium Battery	
Technical Description		
	Bluetooth 4.0	Bluetooth 2.1+EDR
Operation Frequency	2402-2480MHz	
Modulation	GFSK	GFSK, π/4-DQPSK, 8DPSK
Number of Channel	40	79
Channel space	2MHz	1MHz
Max RF Output Power	2.64dBm(0.001837W)	1.35dBm(0.001365W)
Antenna Type	Internal PCB antenna	
Antenna Gain	-0.61dBi	

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 : EMTEK(DONGGUAN) 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

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 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	Trade Mark	Model No.	FCC ID	Note
1.	Stereo bluetooth wireless headset	 MARROW	306B	2AHGI-306B	EUT
2	Adapter	N/A	PSED120200U W	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 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. All the x/y/z orientation has been investigated, and only worst case is presented 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	$\pm 0.5 \text{ }^{\circ}\text{C}$
Humidity	$\pm 3 \%$

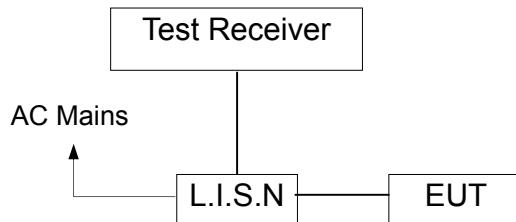
Remark: The coverage Factor (k=2), and measurement Uncertainty for a level of Confidence of 95%

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:

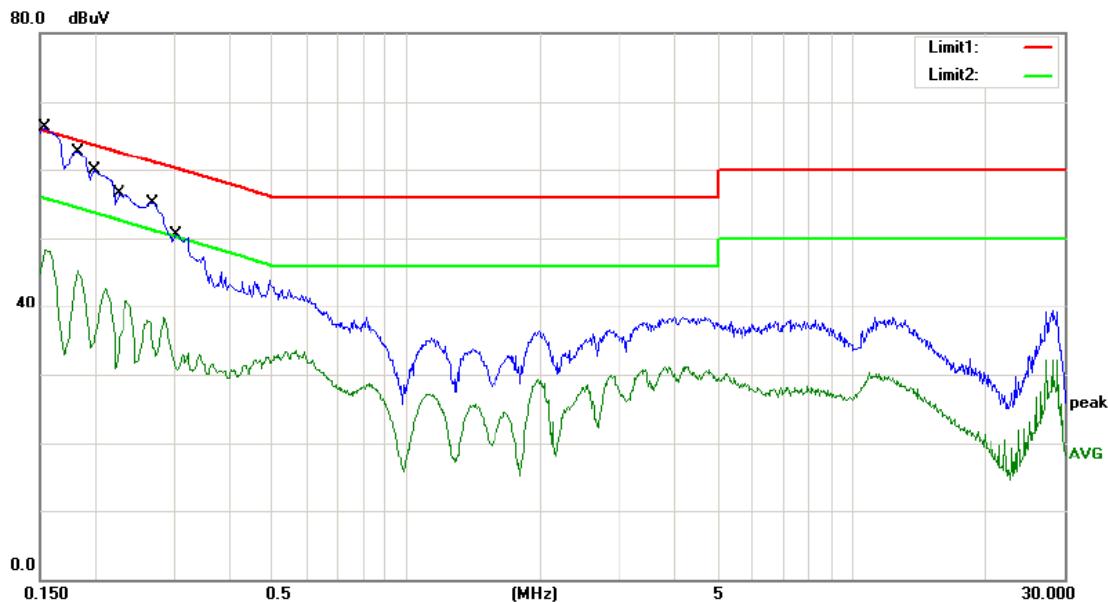
Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Last Cal.	Due date
Test Receiver	Rohde & Schwarz	ESCS30	100018	06/24/2015	06/23/2016
L.I.S.N	Rohde & Schwarz	ENV216	100017	06/24/2015	06/23/2016
RF Switching Unit	CDS	RSU-M2	38401	06/24/2015	06/23/2016
Coaxial Cable	CDS	79254	46107086	06/24/2015	06/23/2016

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: AC 120V/60Hz

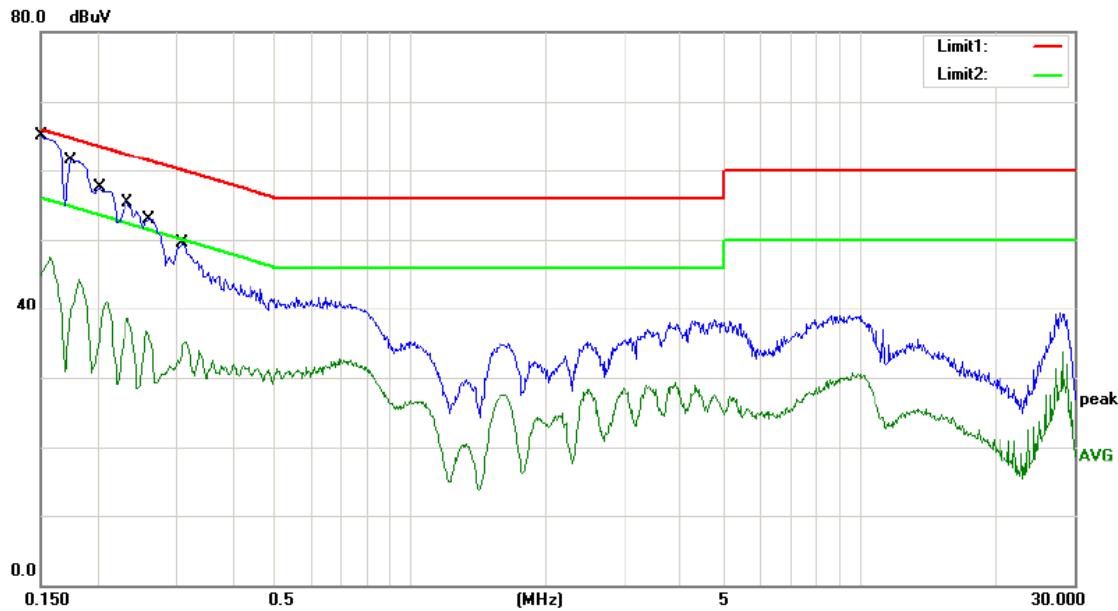
Humidity: 55 %

Mode: DSS(TX2402)

Note:

No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Detector	Comment
			Level	Factor	ment				
		MHz	dBuV	dB	dBuV	dBuV	dB		
1	*	0.1540	52.02	10.11	62.13	65.78	-3.65		QP
2		0.1540	38.11	10.11	48.22	55.78	-7.56		AVG
3		0.1820	49.08	10.12	59.20	64.39	-5.19		QP
4		0.1820	35.22	10.12	45.34	54.39	-9.05		AVG
5		0.1980	49.77	10.12	59.89	63.69	-3.80		QP
6		0.1980	24.30	10.12	34.42	53.69	-19.27		AVG
7		0.2260	46.40	10.13	56.53	62.60	-6.07		QP
8		0.2260	25.41	10.13	35.54	52.60	-17.06		AVG
9		0.2700	44.96	10.14	55.10	61.12	-6.02		QP
10		0.2700	26.24	10.14	36.38	51.12	-14.74		AVG
11		0.3020	40.32	10.14	50.46	60.19	-9.73		QP
12		0.3020	20.67	10.14	30.81	50.19	-19.38		AVG

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



Site site #1

Phase: **N**

Temperature: 24

Limit: (CE)FCC PART 15 class B_QP

Power: AC 120V/60Hz

Humidity: 55 %

Mode: DSS(TX2402)

Note:

No.	Mk.	Freq. MHz	Reading	Correct	Measure-	Limit	Over	Detector	Comment
			Level dBuV	Factor dB	ment dBuV				
1		0.1500	50.39	10.11	60.50	66.00	-5.50	QP	
2		0.1500	34.81	10.11	44.92	56.00	-11.08	AVG	
3 *		0.1740	51.47	10.12	61.59	64.77	-3.18	QP	
4		0.1740	29.76	10.12	39.88	54.77	-14.89	AVG	
5		0.2020	47.44	10.12	57.56	63.53	-5.97	QP	
6		0.2020	27.55	10.12	37.67	53.53	-15.86	AVG	
7		0.2340	45.14	10.13	55.27	62.31	-7.04	QP	
8		0.2340	28.42	10.13	38.55	52.31	-13.76	AVG	
9		0.2620	42.75	10.14	52.89	61.37	-8.48	QP	
10		0.2620	25.62	10.14	35.76	51.37	-15.61	AVG	
11		0.3100	39.31	10.15	49.46	59.97	-10.51	QP	
12		0.3100	24.47	10.15	34.62	49.97	-15.35	AVG	

*:Maximum data

x:Over limit

!:over margin

Comment: Factor build in receiver.

Operator:

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:

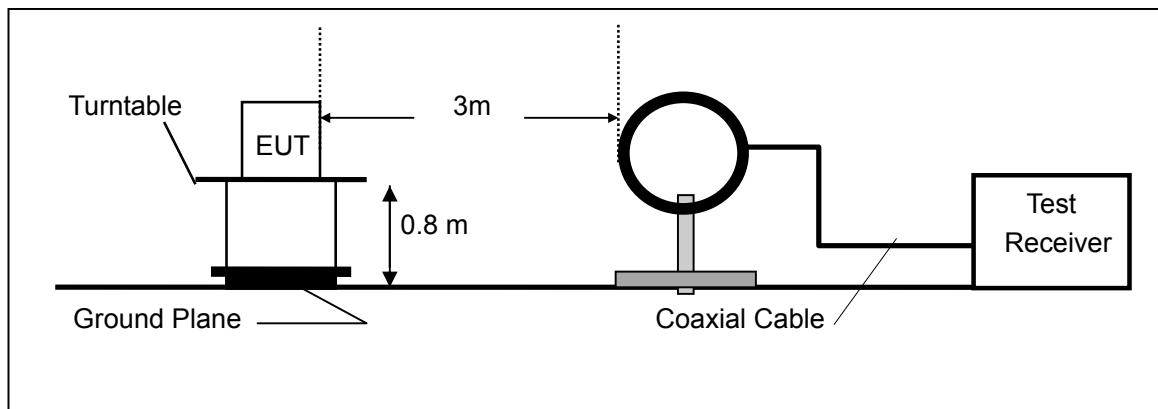
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	3MHz
Detector	Peak
Trace	Max hold

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

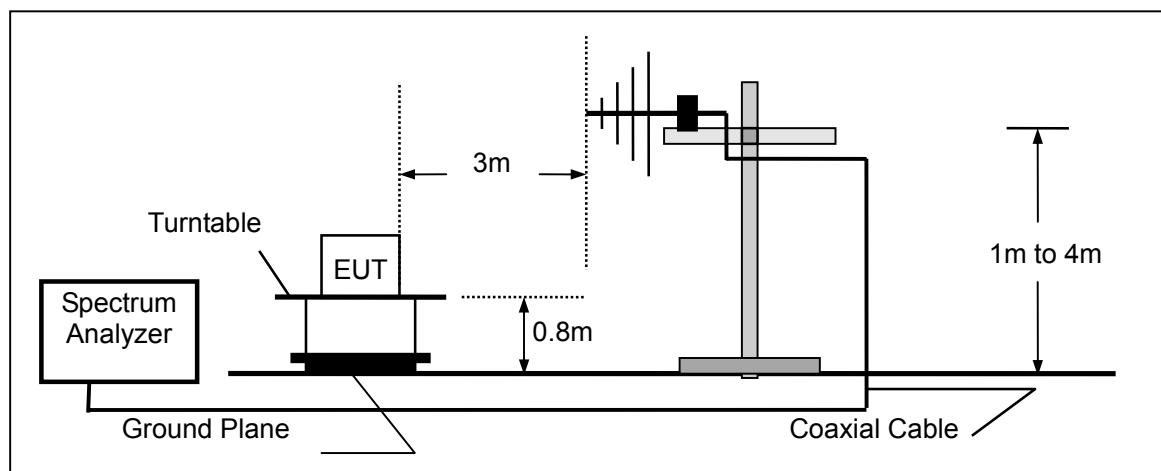
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	10Hz
Detector	Peak
Trace	Max hold

7.2 Test SET-UP (Block Diagram of Configuration)

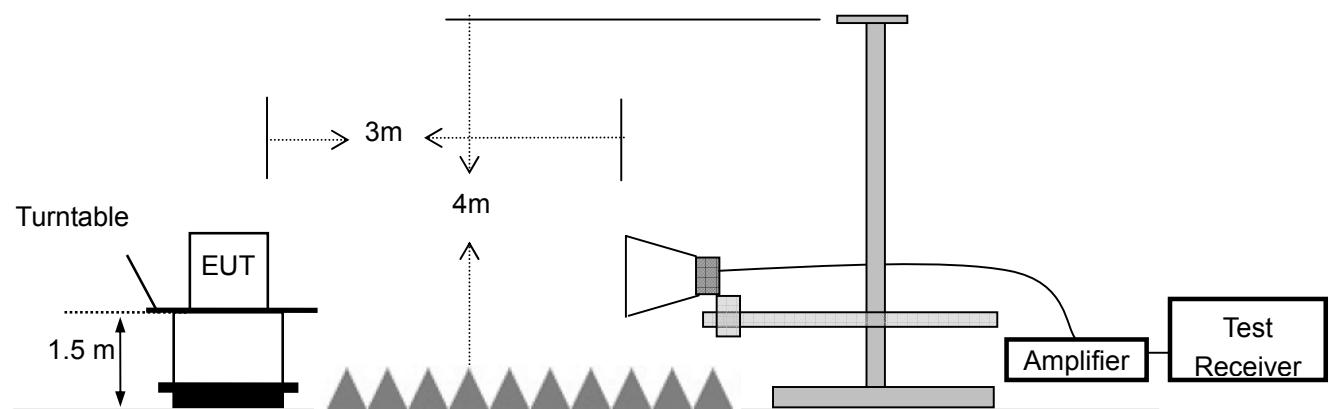
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(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.	Last Cal.	Cal. Interval
1.	Test Receiver	Rohde & Schwarz	ESCI	1166.5950.03	06/24/2015	1 Year
2.	Bilog Antenna	Schwarzbeck	VULB9163	000141	06/24/2015	1 Year
3.	Power Amplifier	CDS	RSU-M352	818	06/24/2015	1 Year
4.	Power Amplifier	HP	8447F	OPT H64	06/24/2015	1 Year
5.	Color Monitor	SUNSPO	SP-140A	N/A	06/24/2015	1 Year
6.	Single Line Filter	JIANLI	XL-3	N/A	06/24/2015	1 Year
7.	Single Phase Power Line Filter	JIANLI	DL-2X100B	N/A	06/24/2015	1 Year
8.	3 Phase Power Line Filter	JIANLI	DL-4X100B	N/A	06/24/2015	1 Year
9.	DC Power Filter	JIANLI	DL-2X50B	N/A	06/24/2015	1 Year
10.	Cable	Schwarzbeck	PLF-100	549489	06/24/2015	1 Year
11.	Cable	Rosenberger	CIL02	A0783566	06/24/2015	1 Year
12.	Cable	Rosenberger	RG 233/U	525178	06/24/2015	1 Year
13.	Signal Analyzer	Rohde & Schwarz	FSV30	103040	06/24/2015	1 Year
14.	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1272	06/24/2015	1 Year
15.	Power Amplifier	LUNAR EM	LNA1G18-40	J10100000081	06/24/2015	1 Year
16.	Cable	H+S	CBL-26	N/A	06/24/2015	1 Year
17.	Cable	H+S	CBL-26	N/A	06/24/2015	1 Year
18.	Cable	H+S	CBL-26	N/A	06/24/2015	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 :	February 18, 2016
Frequency Range:	9KHz~30MHz	Temperature :	28°C
Test Result:	PASS	Humidity :	65 %
Measured Distance:	3m	Test By:	Andy

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

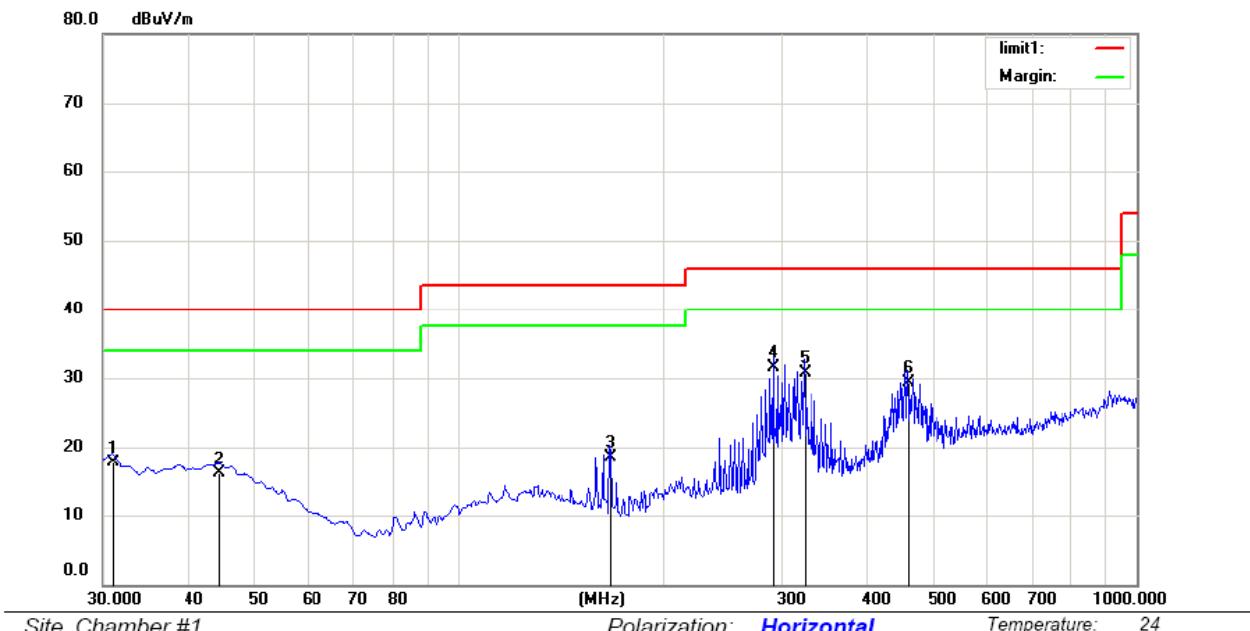
Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

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.

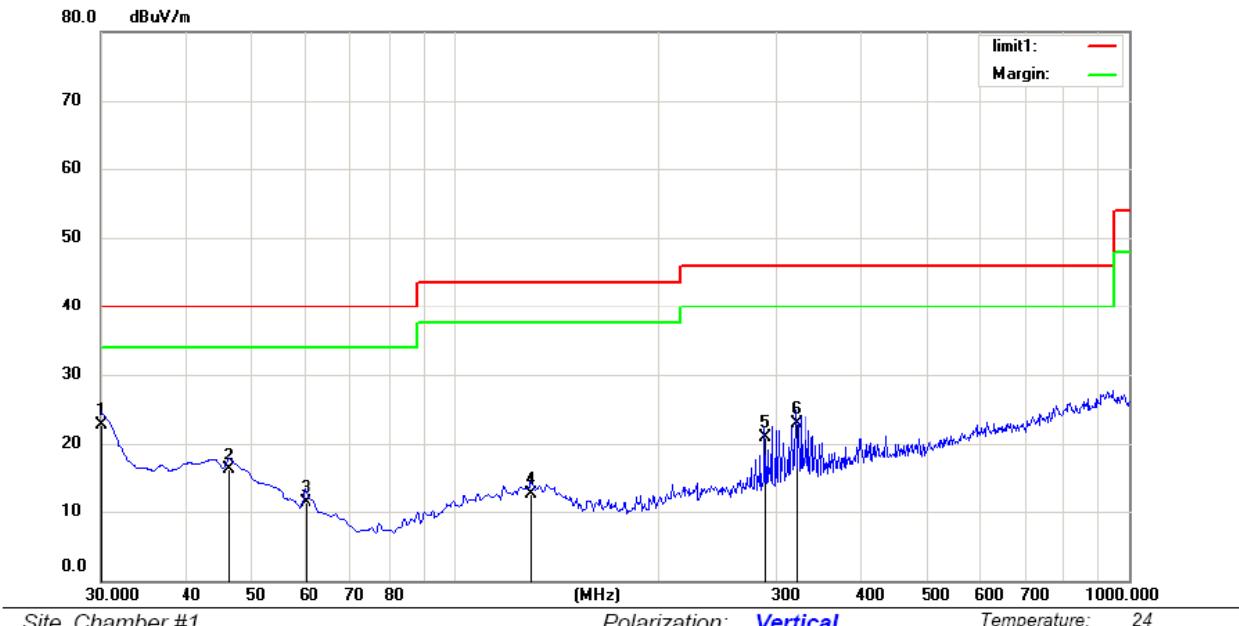
Please refer to the following data.



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm		Table Degree	Comment
								Detector	degree		
1		30.9700	32.52	-14.90	17.62	40.00	-22.38	QP			
2		44.5500	29.50	-13.47	16.03	40.00	-23.97	QP			
3		167.7400	36.85	-18.41	18.44	43.50	-25.06	QP			
4	*	291.9000	46.15	-14.69	31.46	46.00	-14.54	QP			
5		323.9100	43.68	-13.07	30.61	46.00	-15.39	QP			
6		459.7100	40.21	-11.00	29.21	46.00	-16.79	QP			

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

Operator: Jack



Site Chamber #1

Polarization: **Vertical**

Temperature: 24

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

Power: Battery 3.7V

Humidity: 55 %

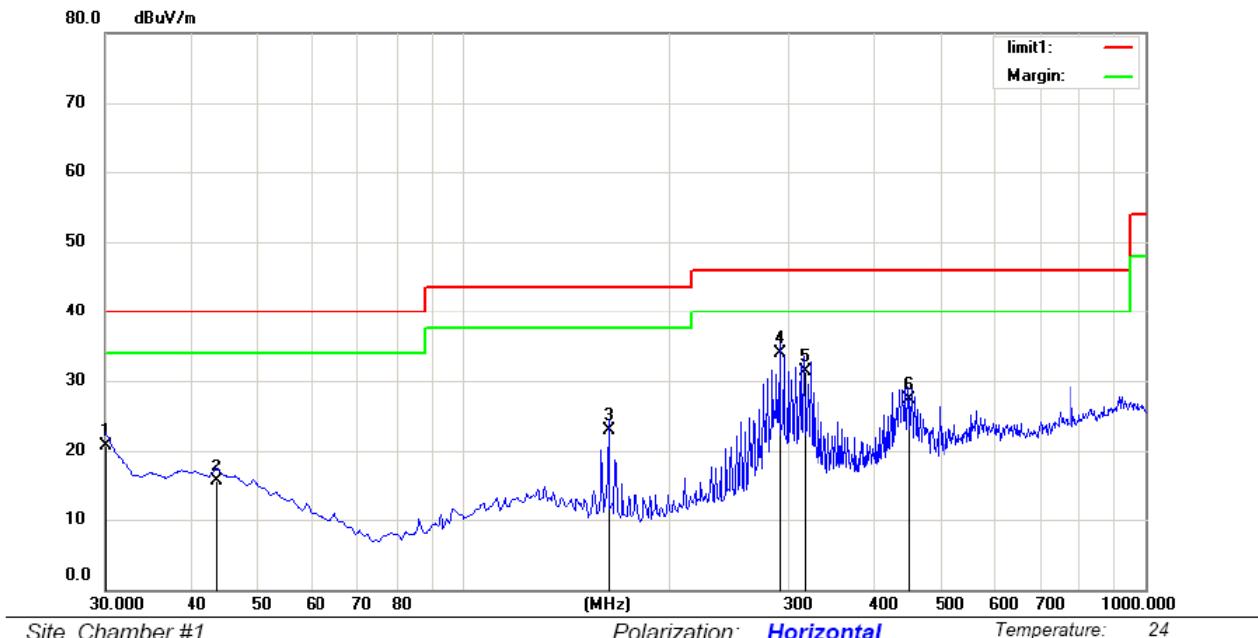
Mode: TX2402

Note:

No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Antenna	Table	
			Level	Factor	ment					
			MHz	dBuV	dB	dBuV/m	dBuV/m	cm	degree	Comment
1	*	30.0000	37.85	-15.15	22.70	40.00	-17.30	QP		
2		46.4900	30.13	-14.06	16.07	40.00	-23.93	QP		
3		60.0700	30.65	-19.42	11.23	40.00	-28.77	QP		
4		129.9100	28.78	-16.35	12.43	43.50	-31.07	QP		
5		288.0200	35.69	-14.77	20.92	46.00	-25.08	QP		
6		320.0300	36.25	-13.26	22.99	46.00	-23.01	QP		

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

Operator: Jack



Site Chamber #1

Polarization: **Horizontal**

Temperature: 24

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

Power: Battery 3.7V

Humidity: 55 %

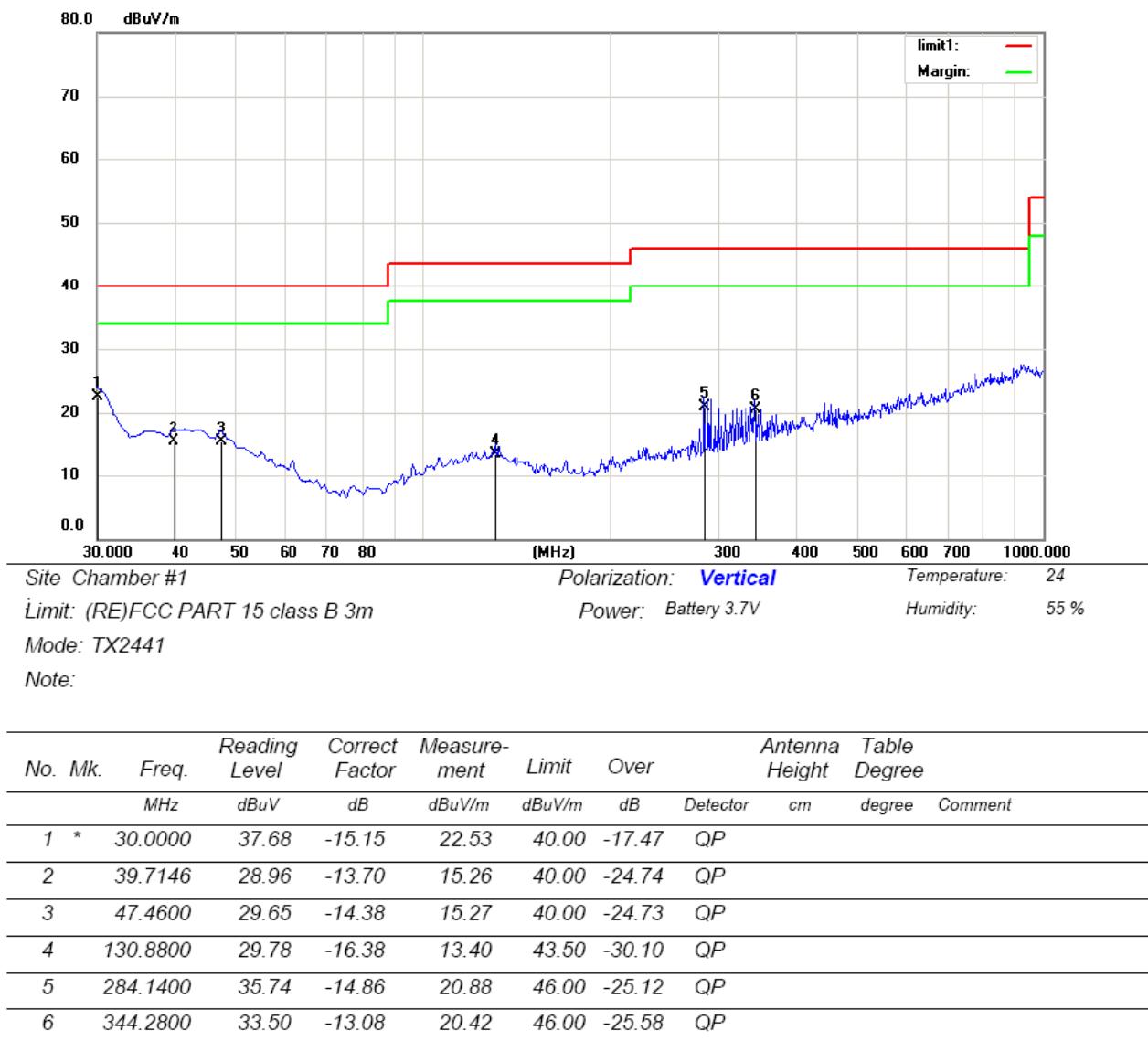
Mode: TX2441

Note:

No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Antenna	Table	
			Level	Factor	ment					
		MHz	dBuV	dB	dBuV/m	dB	Detector	cm	degree	Comment
1		30.0000	35.85	-15.15	20.70	40.00	-19.30	QP		
2		43.5800	28.96	-13.37	15.59	40.00	-24.41	QP		
3		163.8600	41.23	-18.39	22.84	43.50	-20.66	QP		
4	*	291.9000	48.56	-14.69	33.87	46.00	-12.13	QP		
5		316.1500	44.68	-13.30	31.38	46.00	-14.62	QP		
6		448.0700	38.62	-11.22	27.40	46.00	-18.60	QP		

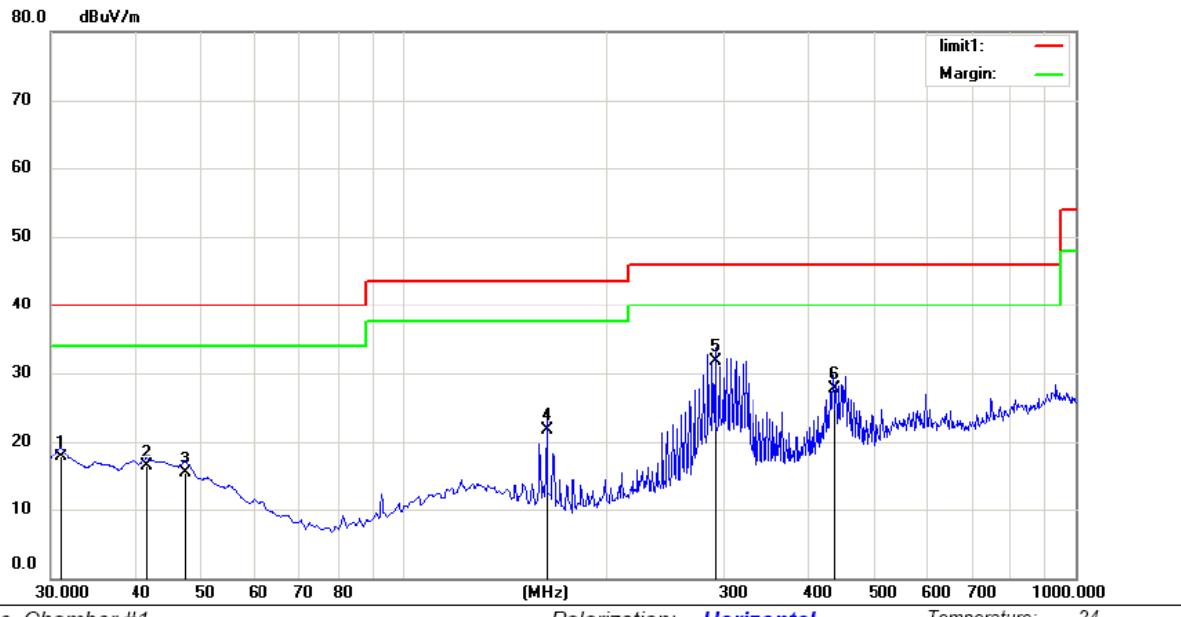
*:Maximum data x:Over limit !:over margin

Operator: Jack



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

Operator: Jack



Site Chamber #1

Polarization: **Horizontal**

Temperature: 24

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

Power: Battery 3.7V

Humidity: 55 %

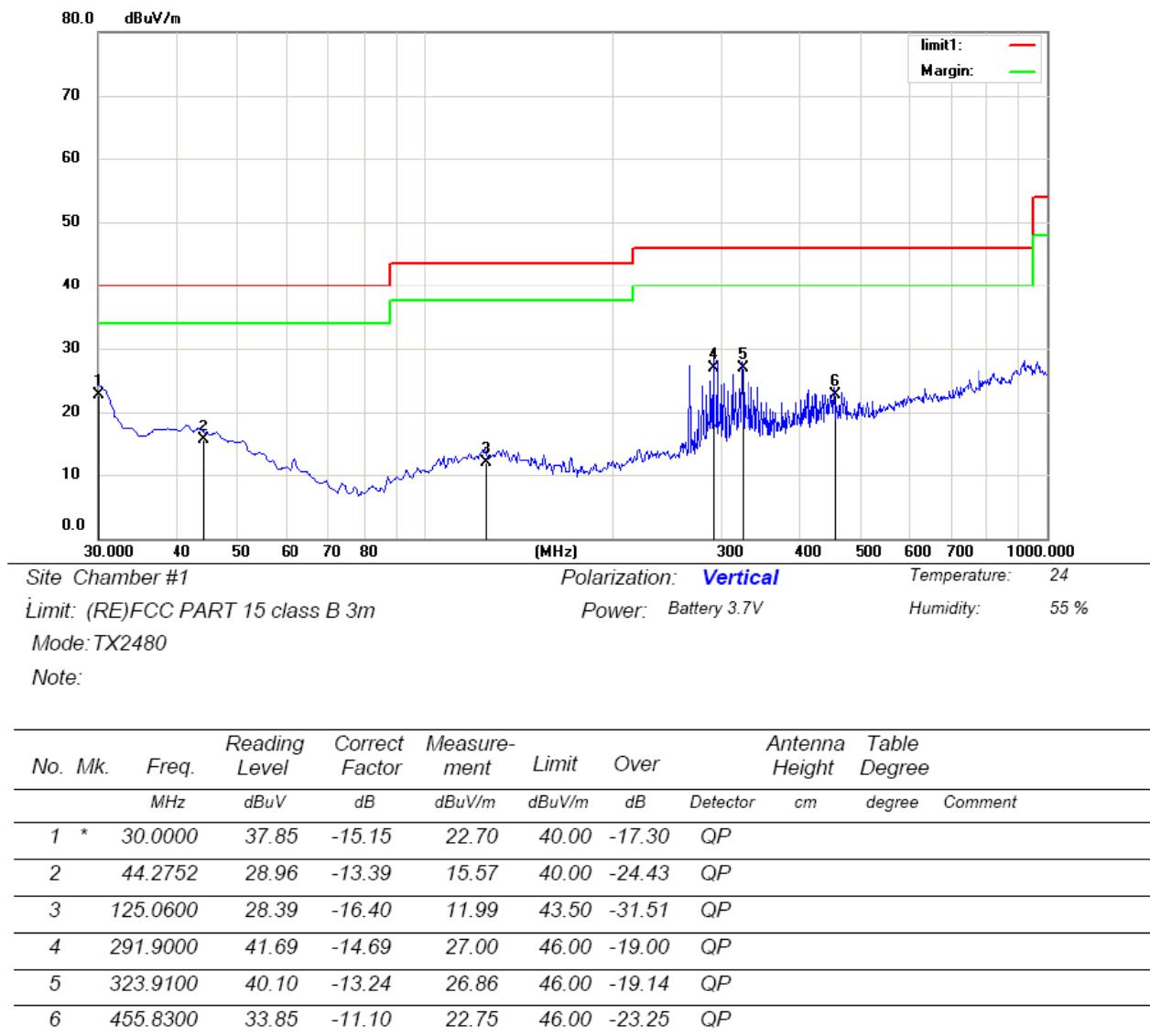
Mode: TX2480

Note:

No.	Mk.	Reading Level	Correct Factor	Measure-ment	Limit	Over	Antenna Height	Table Degree	Comment
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree
1	30.9700	32.69	-14.90	17.79	40.00	-22.21	QP		
2	41.6400	29.85	-13.58	16.27	40.00	-23.73	QP		
3	47.4600	29.63	-14.38	15.25	40.00	-24.75	QP		
4	163.8600	40.13	-18.39	21.74	43.50	-21.76	QP		
5 *	291.9000	46.39	-14.69	31.70	46.00	-14.30	QP		
6	436.4300	38.96	-11.29	27.67	46.00	-18.33	QP		

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

Operator: Jack



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

Operator: Jack

Above 1000MHz

Worst Operation Mode: GFSK (CH1: 2402MHz) Test Date : February 18, 2016
 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	66.19	44.71	74	54	-7.81	-9.29
7206	V	65.66	43.41	74	54	-8.34	-10.59
9608	V	64.47	42.24	74	54	-9.53	-11.76
12010	V	62.18	41.17	74	54	-11.82	-12.83
14412	V	61.29	40.47	74	54	-12.71	-13.53
16814	V	58.47	38.74	74	54	-15.53	-15.26
4804	H	65.34	45.09	74	54	-8.66	-8.91
7206	H	64.81	43.14	74	54	-9.19	-10.86
9608	H	63.28	42.01	74	54	-10.72	-11.99
12010	H	62.71	40.42	74	54	-11.29	-13.58
14412	H	59.14	39.64	74	54	-14.86	-14.36
16814	H	57.77	38.61	74	54	-16.23	-15.39

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 : February 18, 2016
 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	66.26	45.49	74	54	-7.74	-8.51
7323	V	63.41	43.11	74	54	-10.59	-10.89
9764	V	62.75	42.41	74	54	-11.25	-11.59
12205	V	61.27	41.35	74	54	-12.73	-12.65
14646	V	58.69	39.11	74	54	-15.31	-14.89
17087	V	57.42	38.34	74	54	-16.58	-15.66
4882	H	65.84	45.77	74	54	-8.16	-8.23
7323	H	64.39	44.83	74	54	-9.61	-9.17
9764	H	62.95	43.77	74	54	-11.05	-10.23
12205	H	61.64	42.43	74	54	-12.36	-11.57
14646	H	59.85	39.17	74	54	-14.15	-14.83
17087	H	58.88	38.45	74	54	-15.12	-15.55

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.

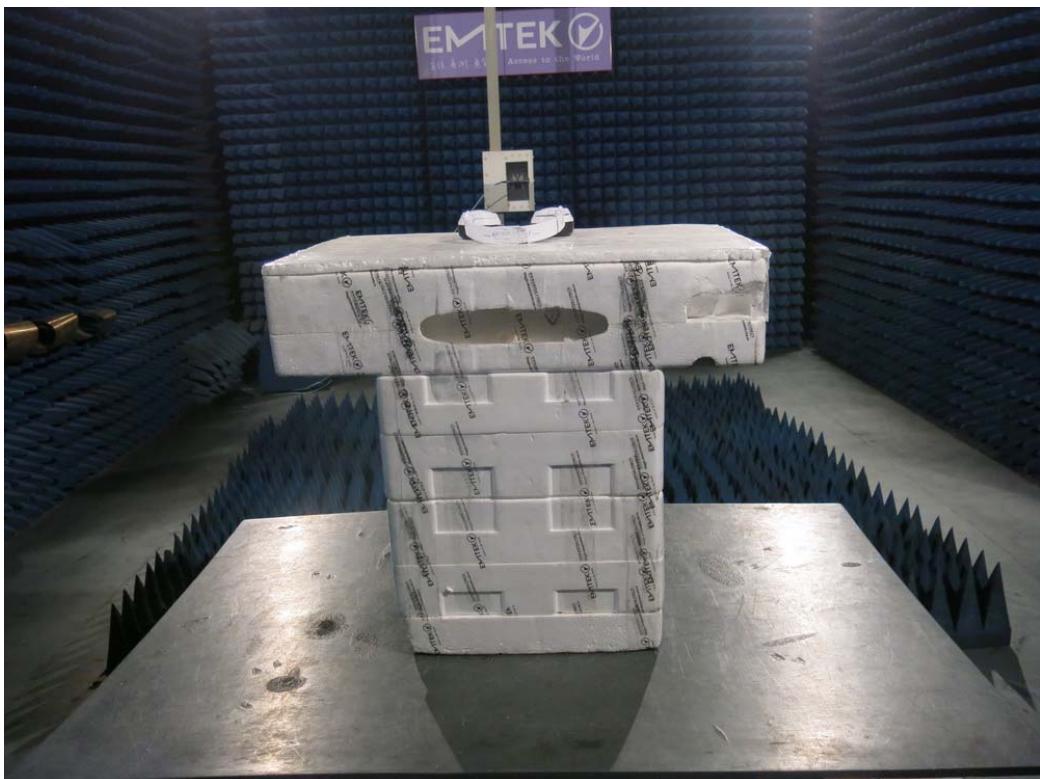
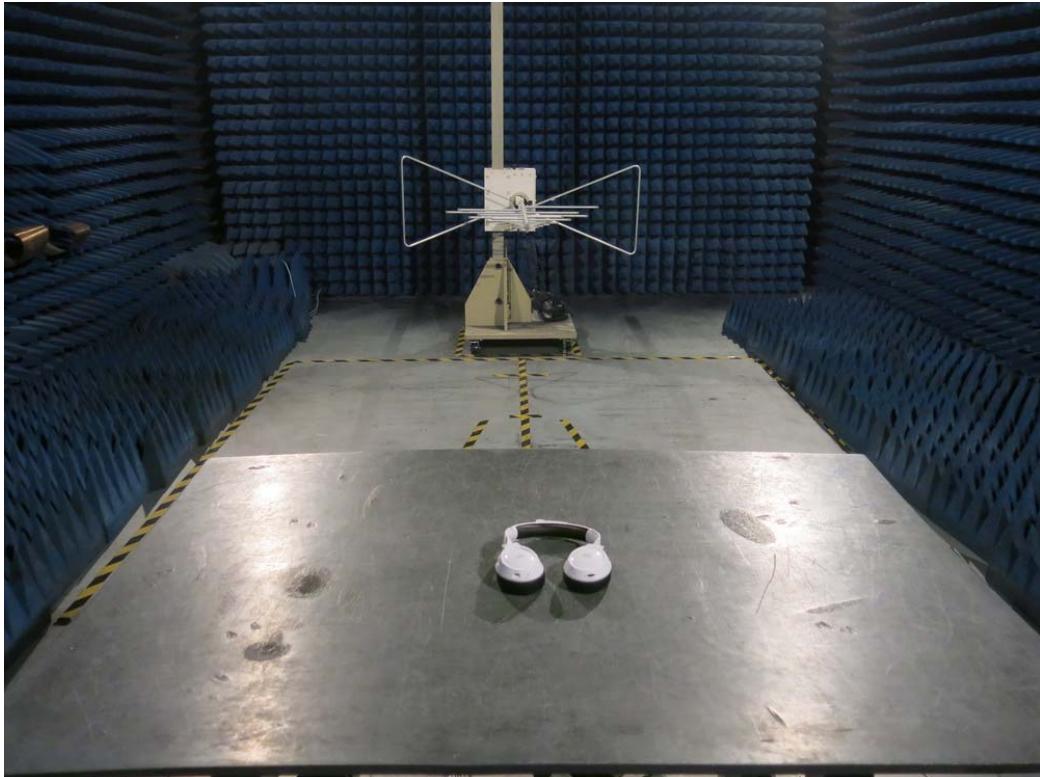
Worst Operation Mode: GFSK (CH79: 2480MHz) Test Date : February 18, 2016
 Frequency Range: 1-25GHz Temperature : 25 °C
 Test Result: PASS Humidity : 50 %
 Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
4960	V	65.45	44.89	74	54	-8.55	-9.11
7440	V	64.94	43.07	74	54	-9.06	-10.93
9920	V	63.88	41.27	74	54	-10.12	-12.73
12400	V	62.37	40.95	74	54	-11.63	-13.05
14880	V	60.54	39.78	74	54	-13.46	-14.22
17360	V	58.67	38.89	74	54	-15.33	-15.11
4960	H	66.49	45.01	74	54	-7.51	-8.99
7440	H	65.24	44.22	74	54	-8.76	-9.78
9920	H	63.62	43.53	74	54	-10.38	-10.47
12400	H	62.71	41.33	74	54	-11.29	-12.67
14880	H	61.48	39.57	74	54	-12.52	-14.43
17360	H	60.64	38.69	74	54	-13.36	-15.31

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:

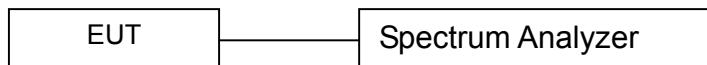


8. Channel Separation test

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:

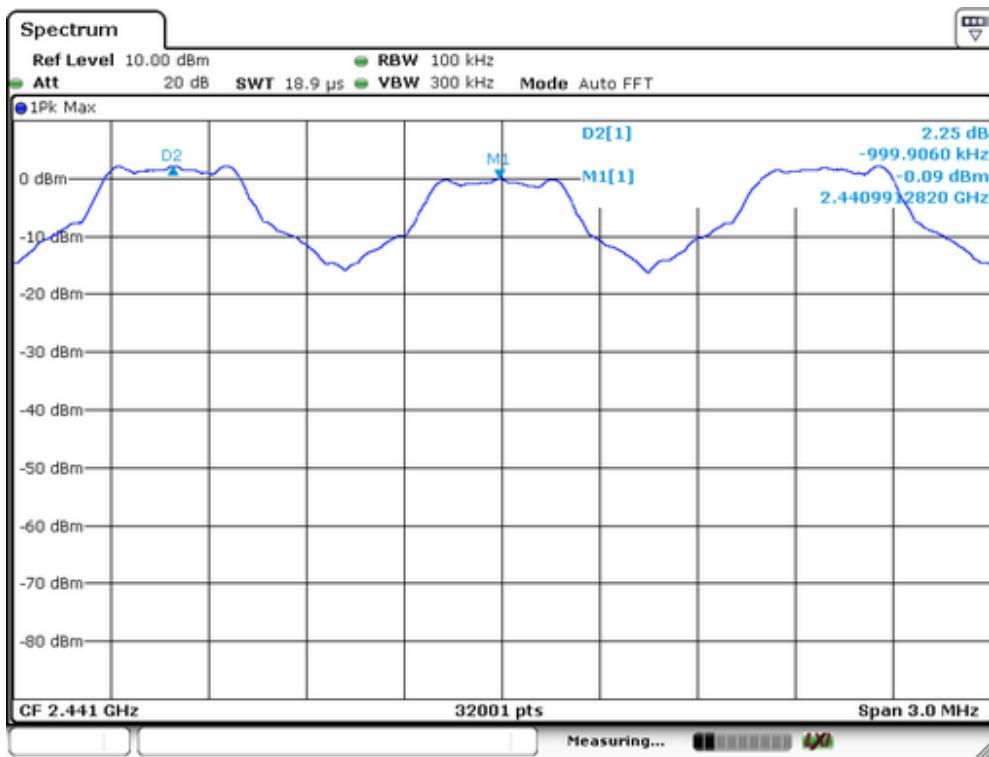
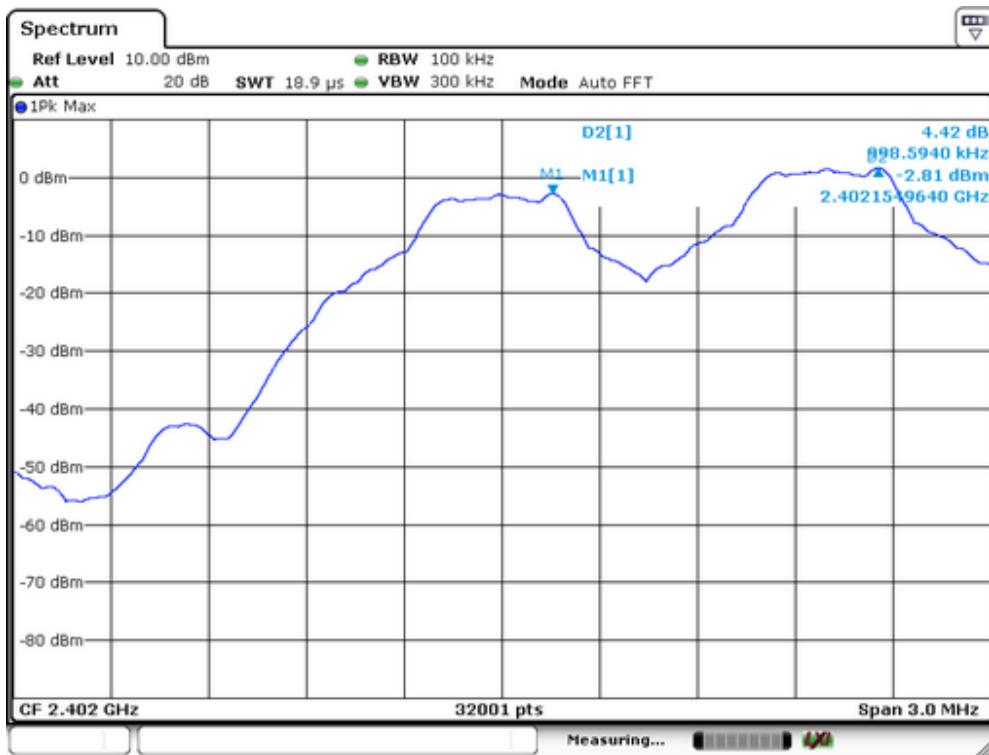
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	06/24/2015	06/23/2016
Coaxial Cable	CDS	79254	46107086	06/24/2015	06/23/2016

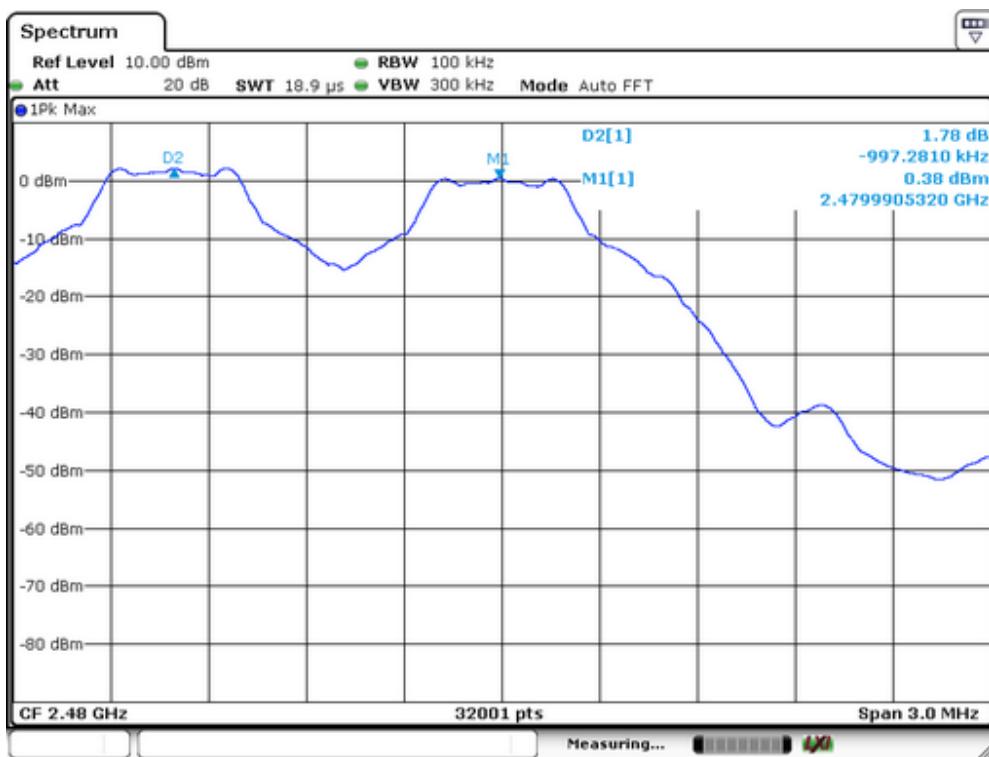
8.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	February 18, 2016
Test By:	Andy	Temperature :	25 °C
Test Result:	PASS	Humidity :	50 %
Modulation:	GFSK		

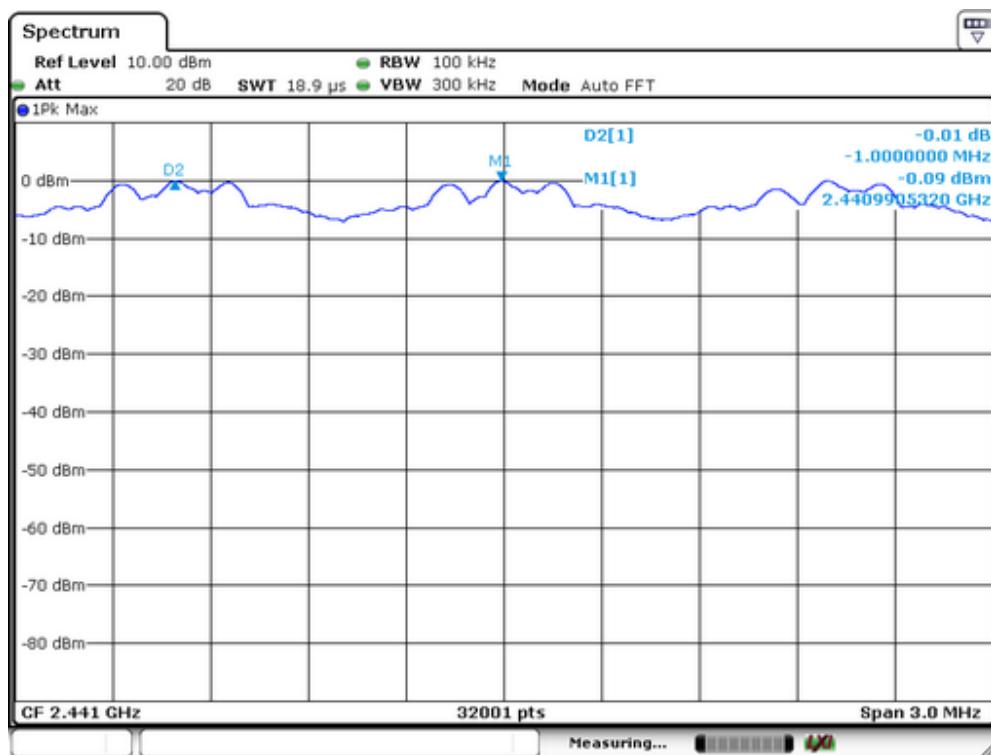
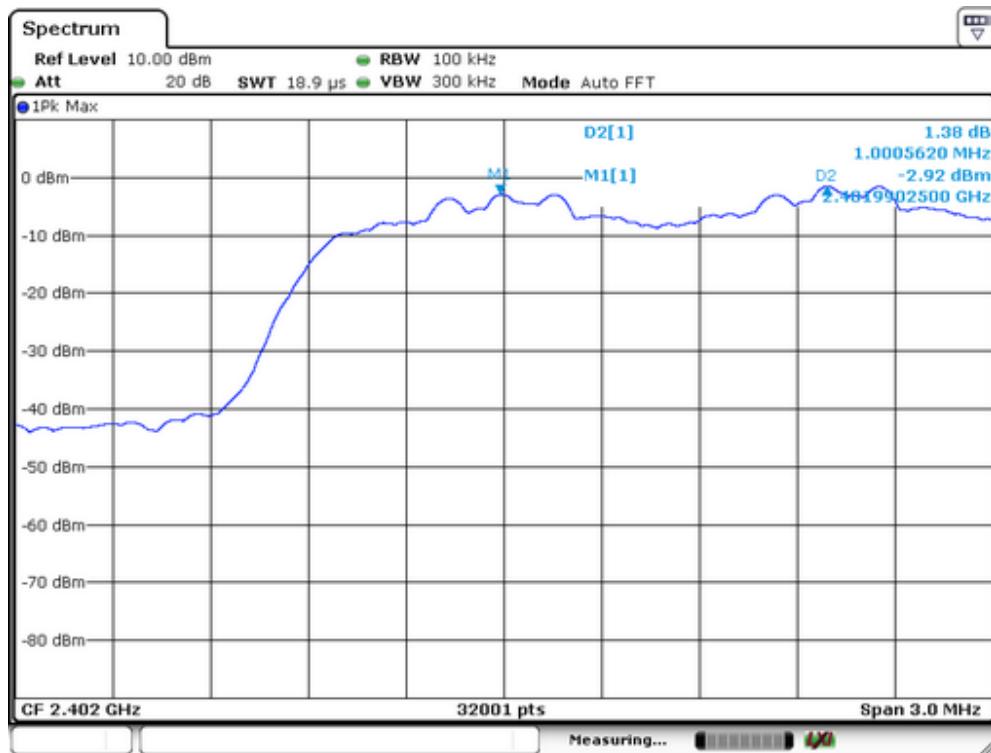
Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	898	>736
40	2441	999	>742
79	2480	997	>736

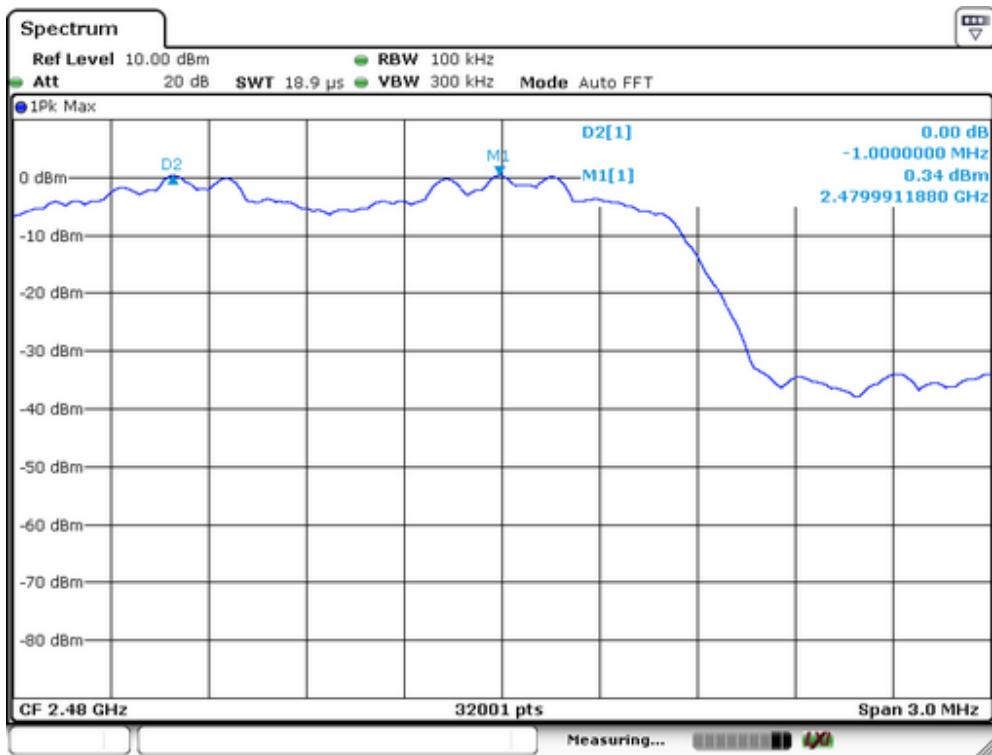




Spectrum Detector: PK Test Date : February 18, 2016
 Test By: Andy Temperature : 24°C
 Test Result: PASS Humidity : 53 %
 Modulation: Π/4-DQPSK

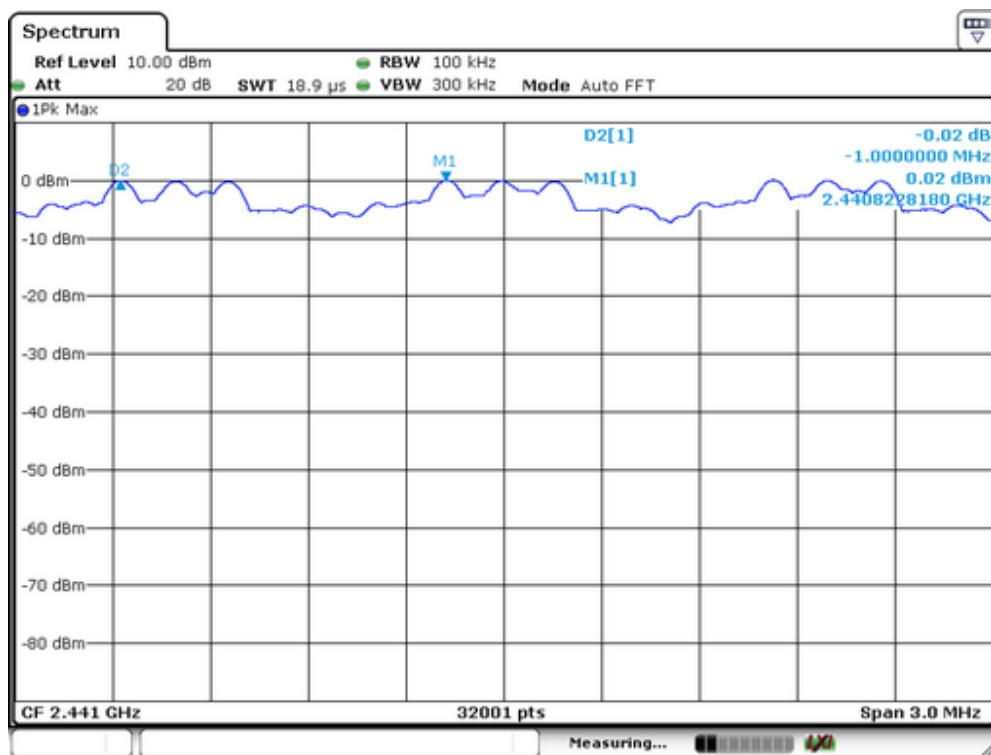
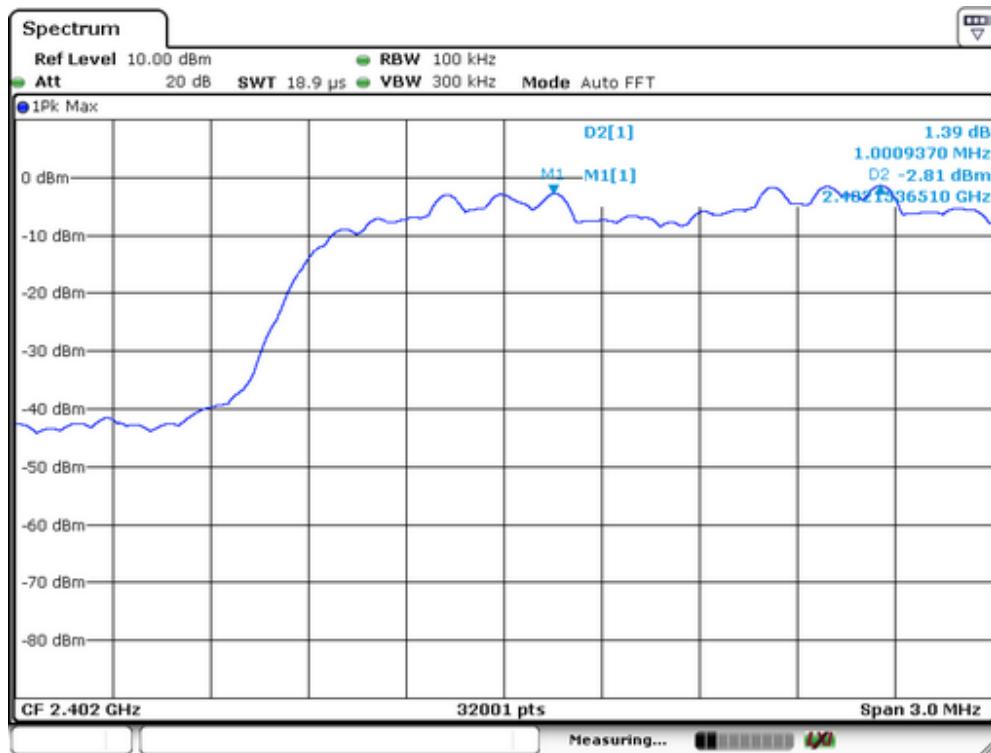
Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	1000	>906
40	2441	1000	>908
79	2480	1000	>906

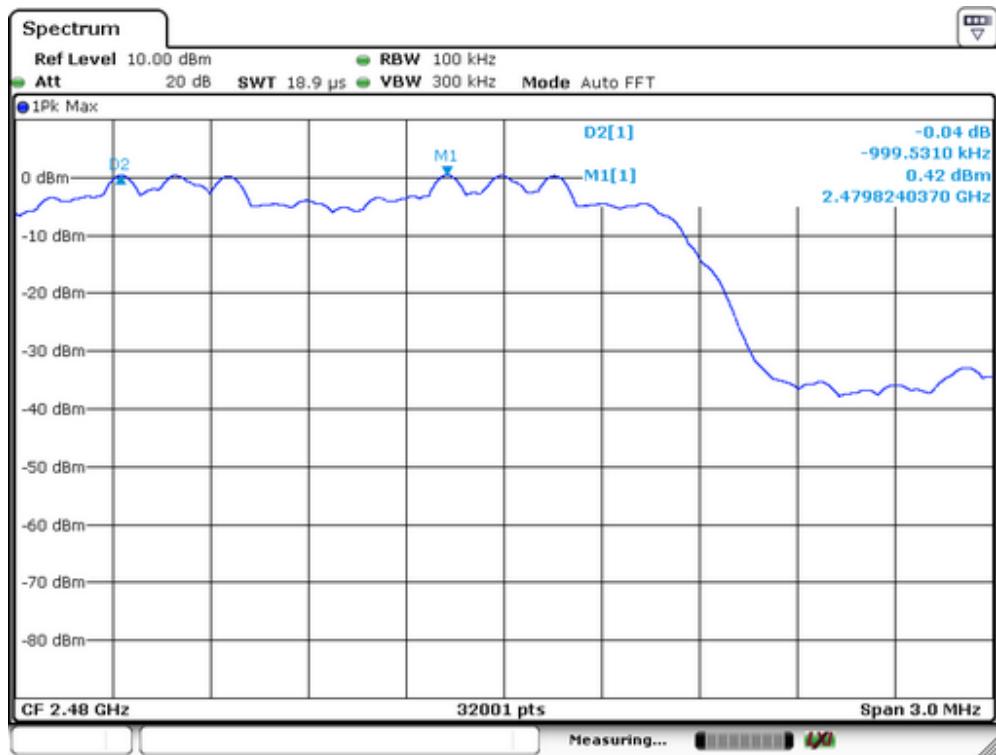




Spectrum Detector: PK Test Date : February 18, 2016
 Test By: Andy Temperature : 24°C
 Test Result: PASS Humidity : 53 %
 Modulation: 8DPSK

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	1000	>911
40	2441	1000	>912
79	2480	999	>912



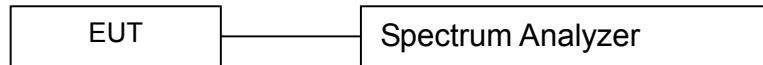


9. 20dB Bandwidth test

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:

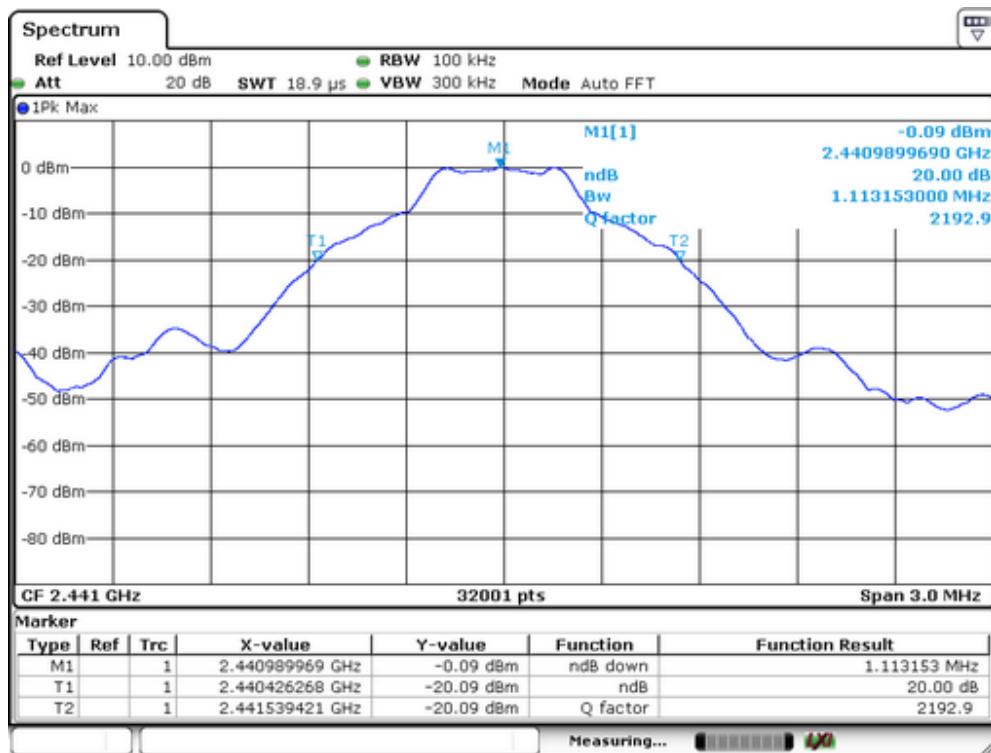
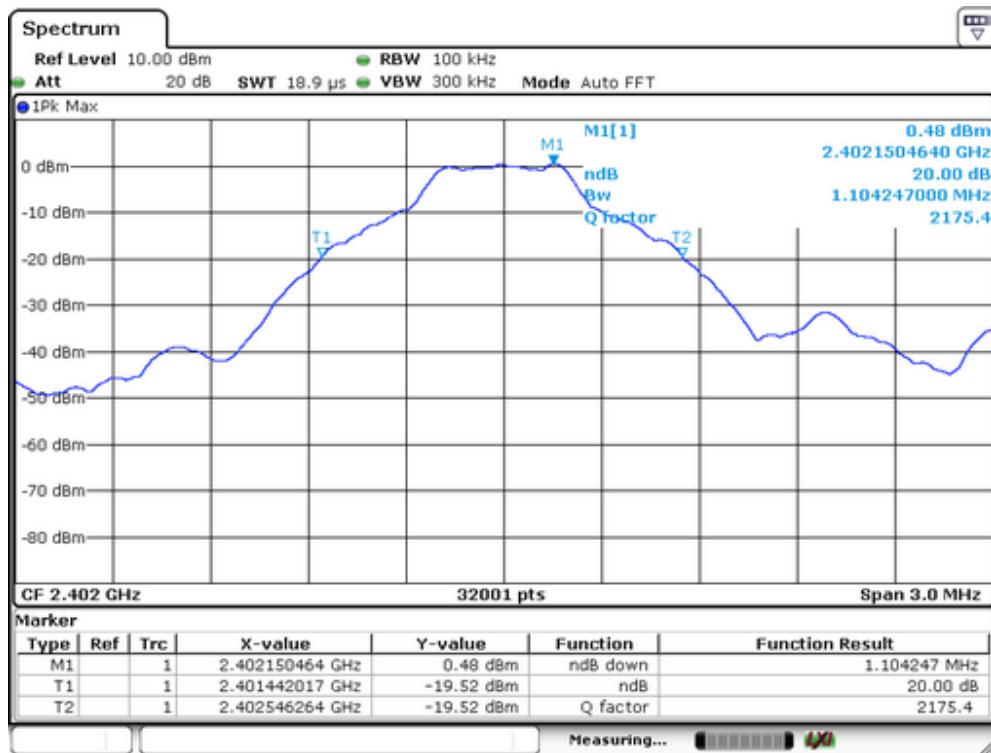
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	06/24/2015	06/23/2016
Coaxial Cable	CDS	79254	46107086	06/24/2015	06/23/2016

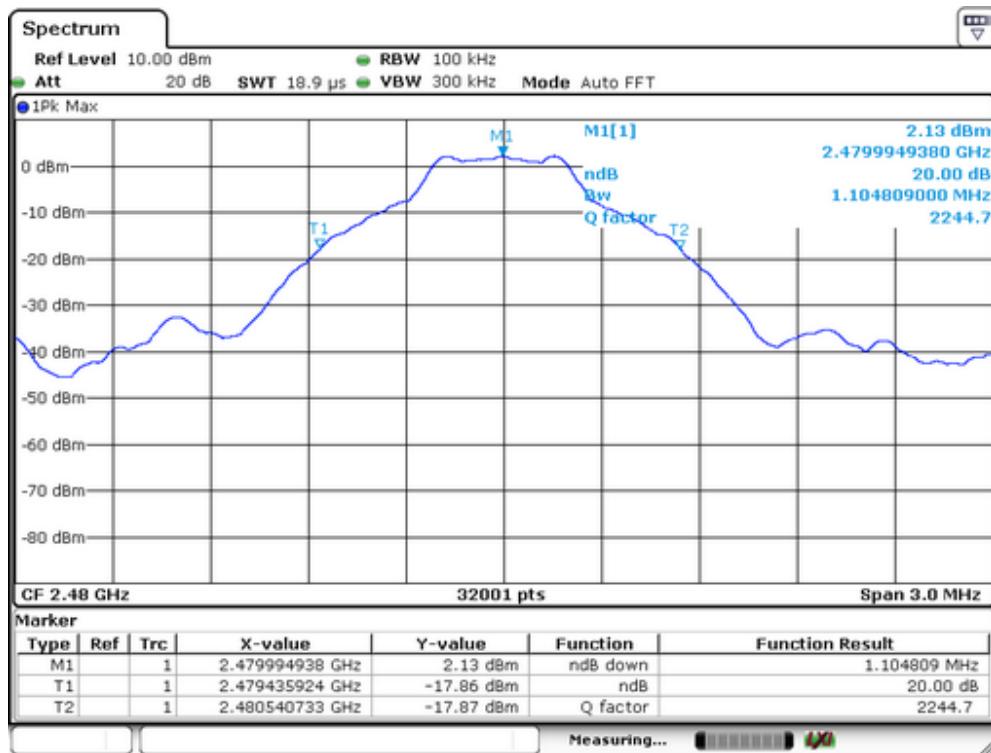
9.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	February 18, 2016
Test By:	Andy	Temperature :	24°C
Test Result:	PASS	Humidity :	53 %
Modulation:	GFSK		

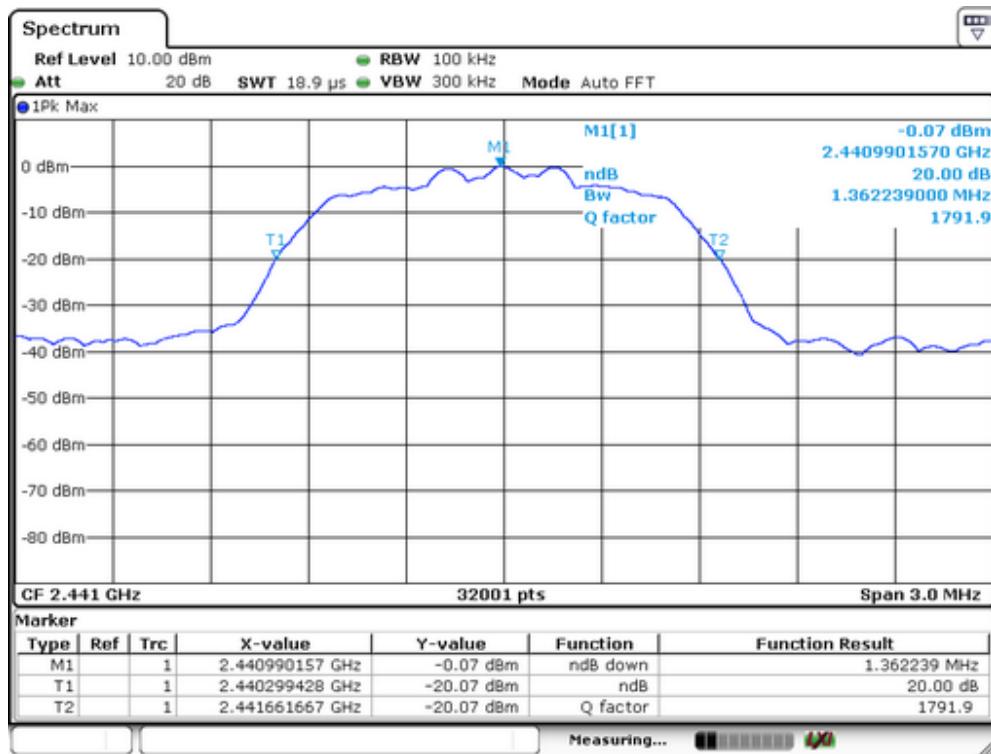
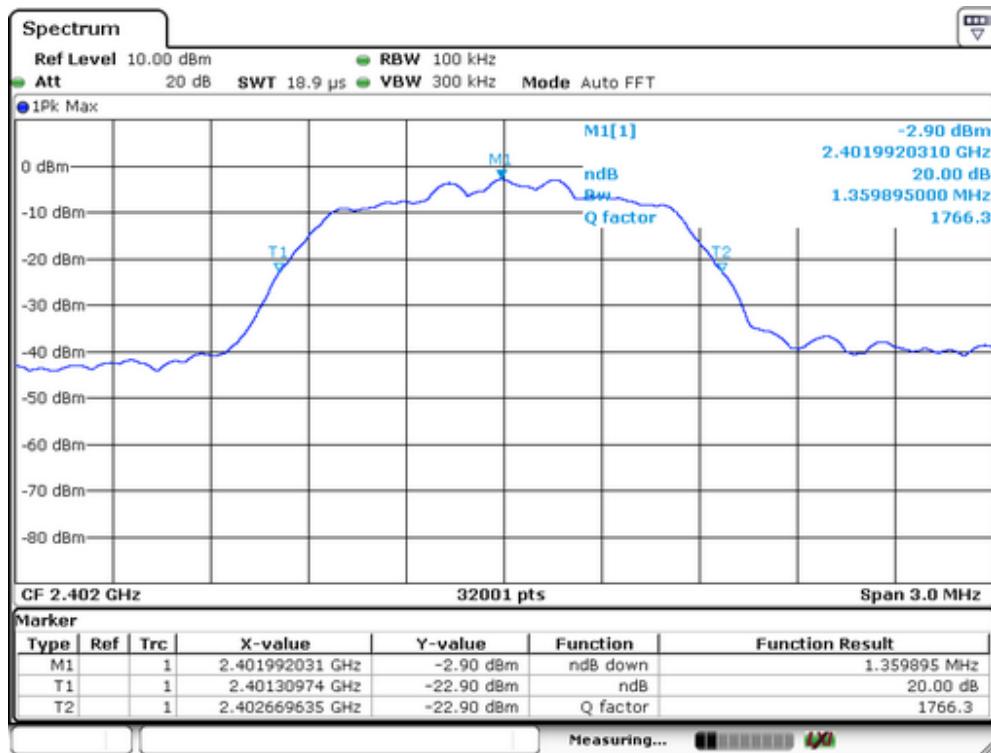
Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	1104
40	2441	1113
79	2480	1104

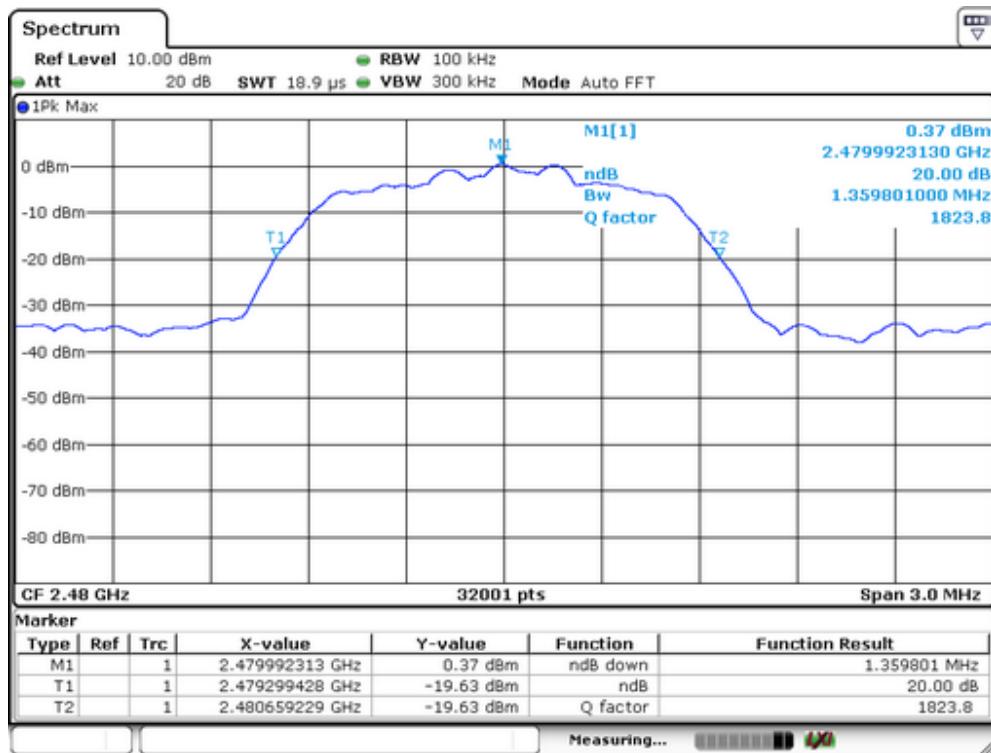




Spectrum Detector: PK Test Date : February 18, 2016
 Test By: Andy Temperature : 24°C
 Test Result: PASS Humidity : 53 %
 Modulation: $\Pi/4$ -DQPSK

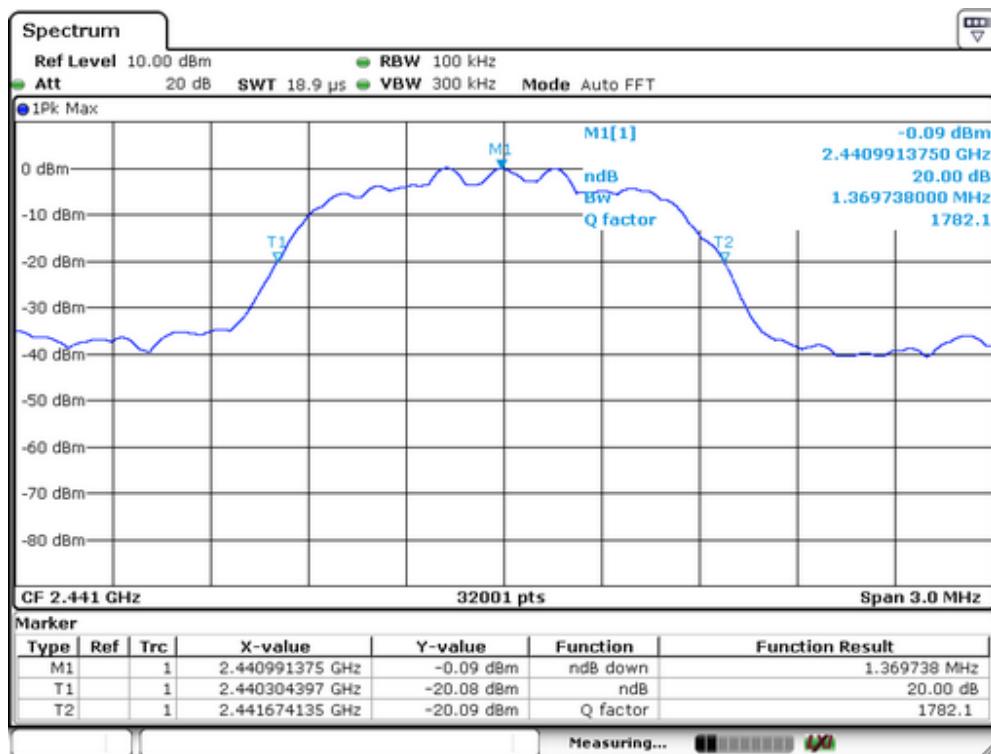
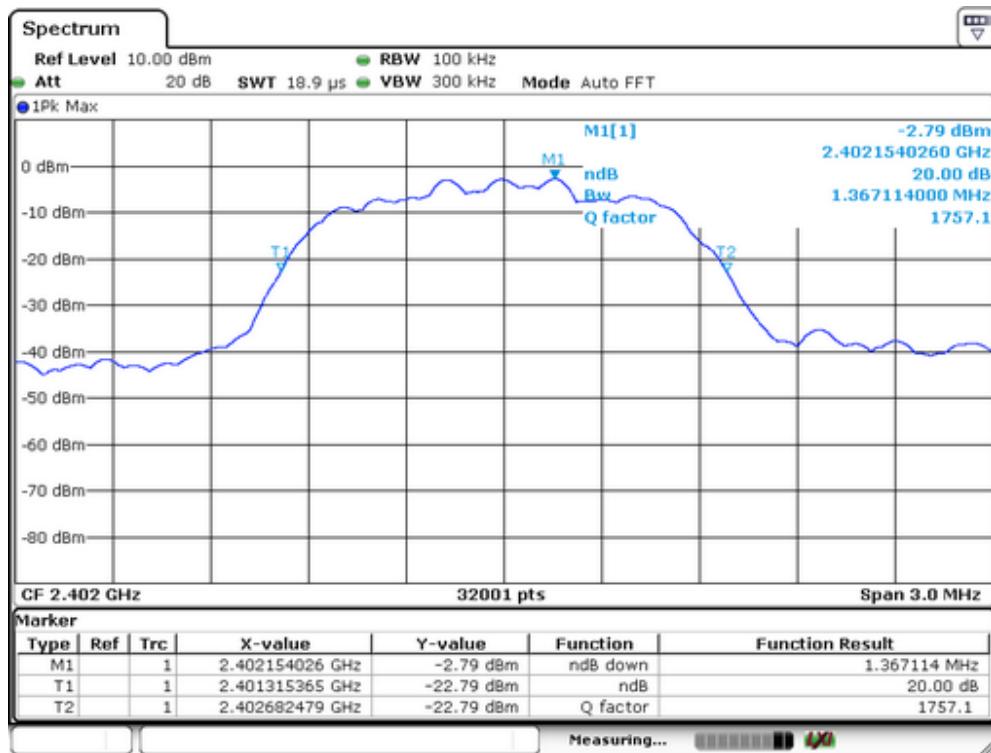
Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	1359
40	2441	1362
79	2480	1359

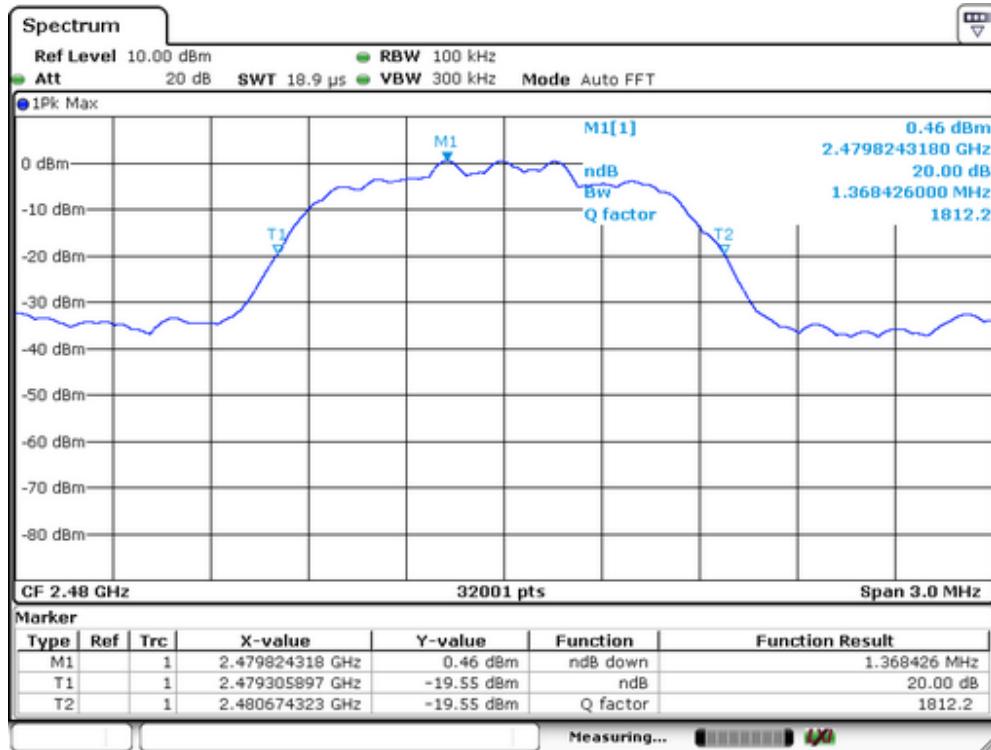




Spectrum Detector: PK Test Date : February 18, 2016
 Test By: Andy Temperature : 24°C
 Test Result: PASS Humidity : 53 %
 Modulation: 8DPSK

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	1367
40	2441	1369
79	2480	1368



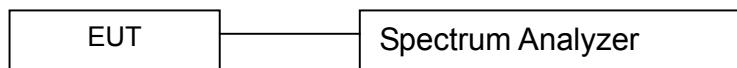


10. Quantity of Hopping Channel Test

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:

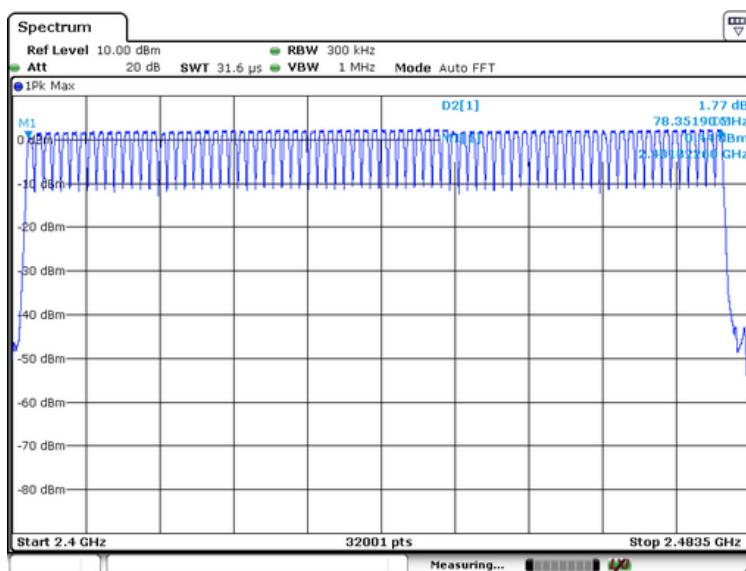
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	06/24/2015	06/23/2016
Coaxial Cable	CDS	79254	46107086	06/24/2015	06/23/2016

10.4 Measurement Results:

Refer to attached data chart.

Worst Test Mode GFSK Test Date : February 18, 2016
 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:

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

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
- $31.6 \text{ s} = 0.4 \text{ seconds multiplied by the number of hopping channels} = 0.4 \text{ s} * 79$

The highest value of the dwell time is reported.

11.2 Test Requirements / Limits

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

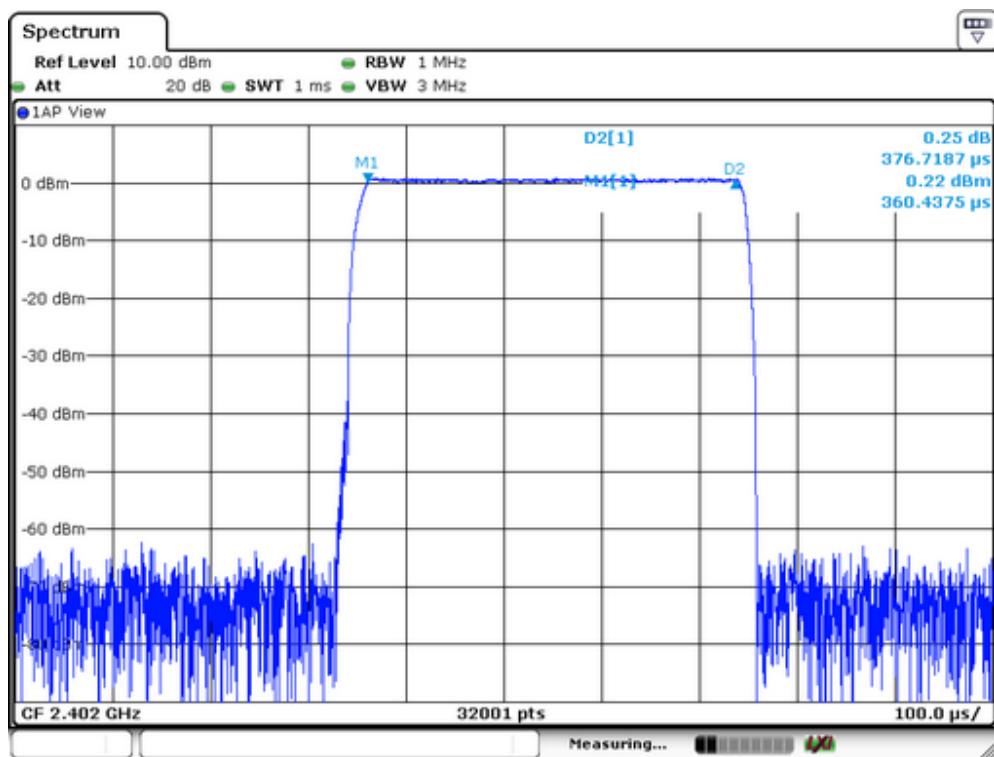
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Since the Bluetooth technology uses 79 channels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

11.3 Test result

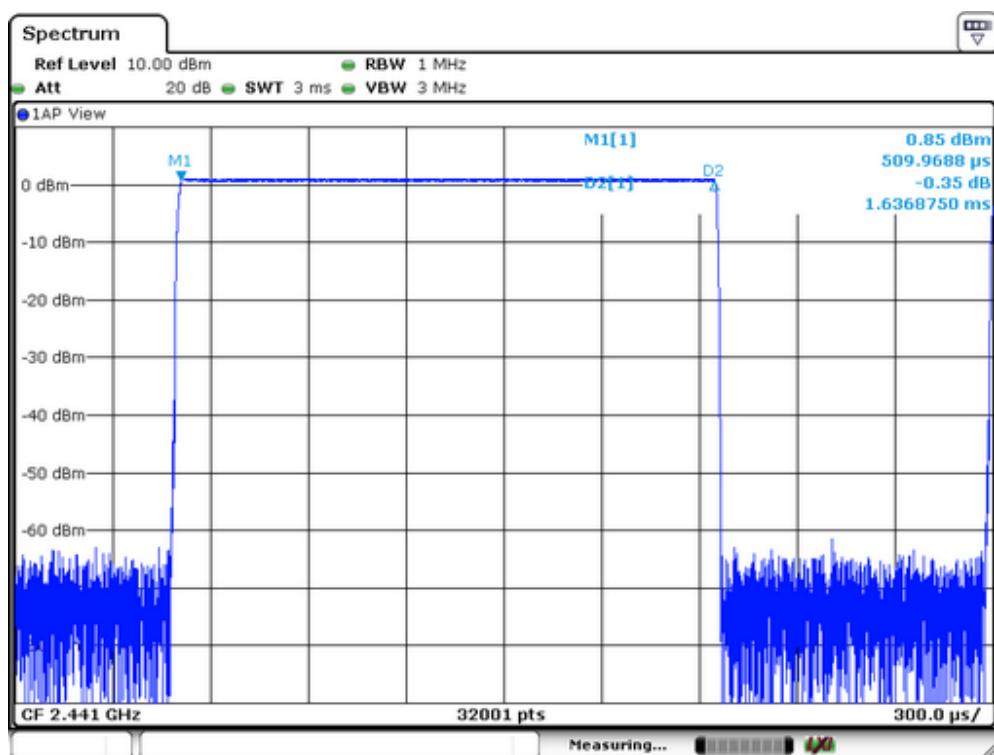
Mode	Number of transmission in a 31.6(79 Hopping*0.4)	Length of transmissions time(msec)	Result (msec)	Limit (msec)
DH1	$1600/(2*79) \times 31.6 = 320$	0.376	120.32	400
DH3	$1600/(4*79) \times 31.6 = 160$	1.636	261.76	400
DH5	$1600/(6*79) \times 31.6 = 106.67$	2.872	306.35	400

Remark: The results of worst cased was recorded.

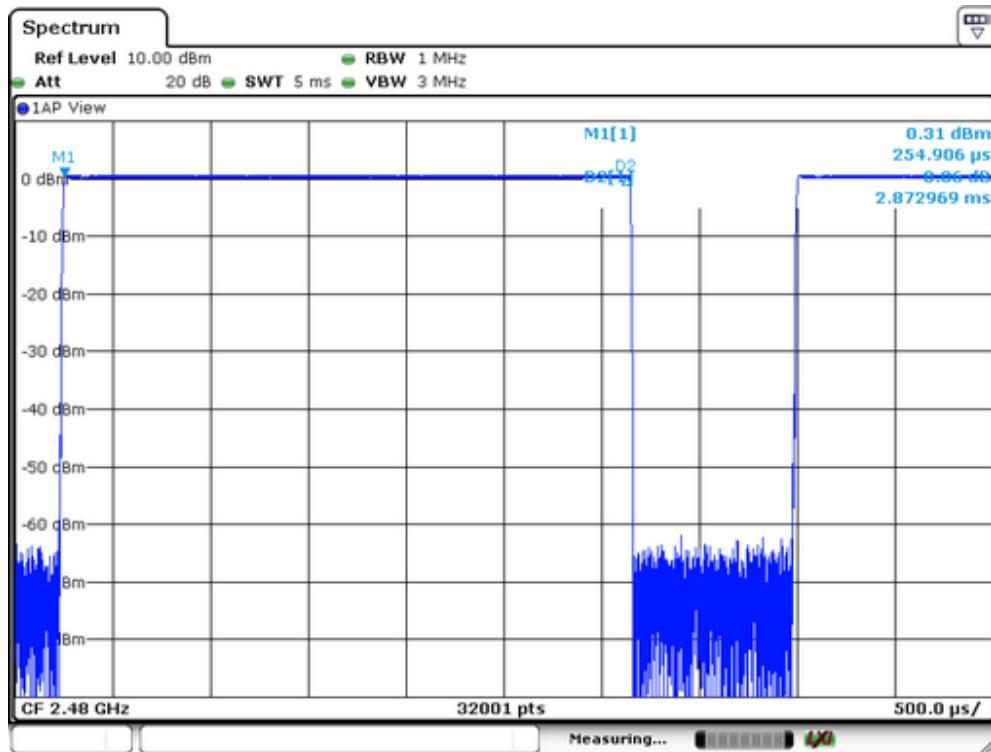
DH1:



DH3:



DH5:

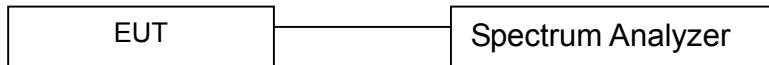


12. MAXIMUM PEAK OUTPUT POWER TEST

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:

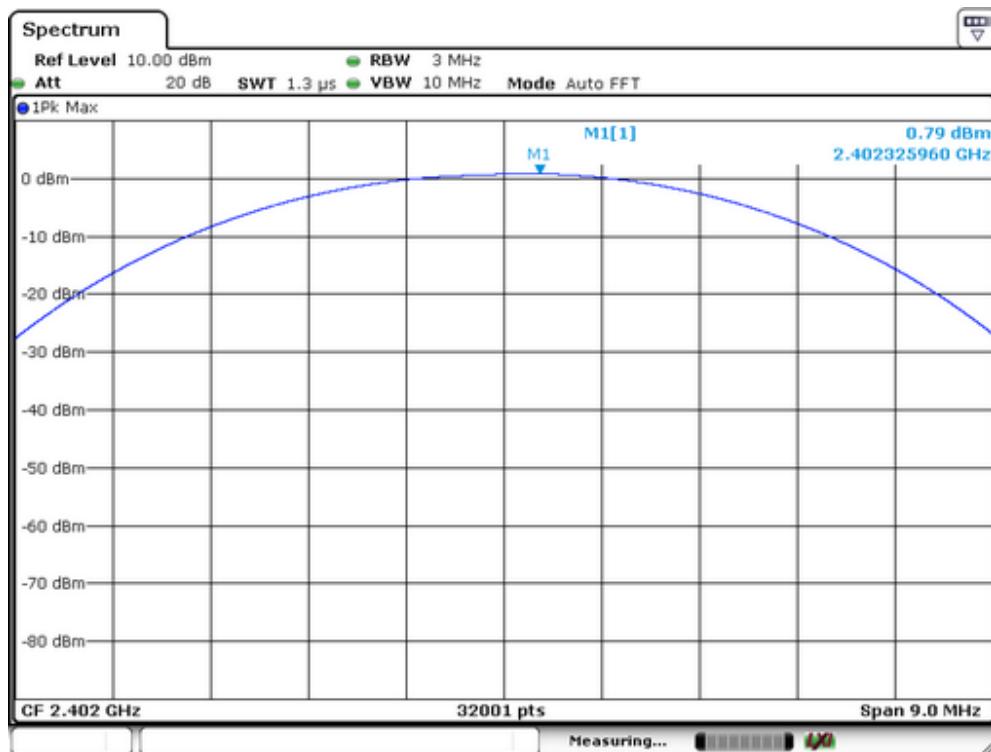
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	06/24/2015	06/23/2016
Coaxial Cable	CDS	79254	46107086	06/24/2015	06/23/2016

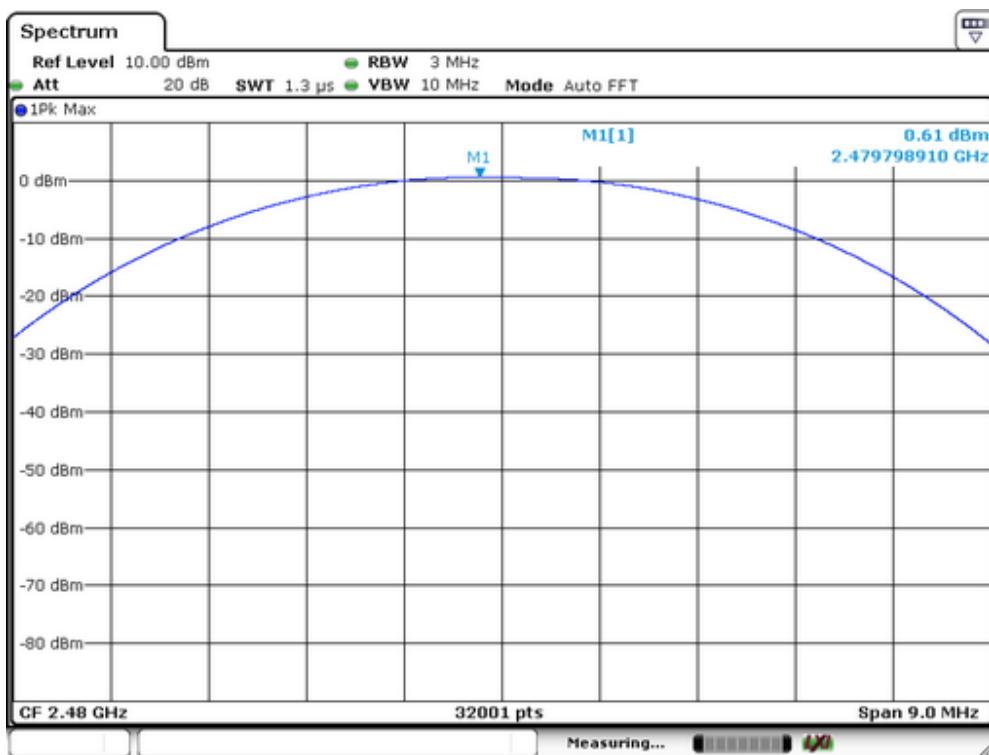
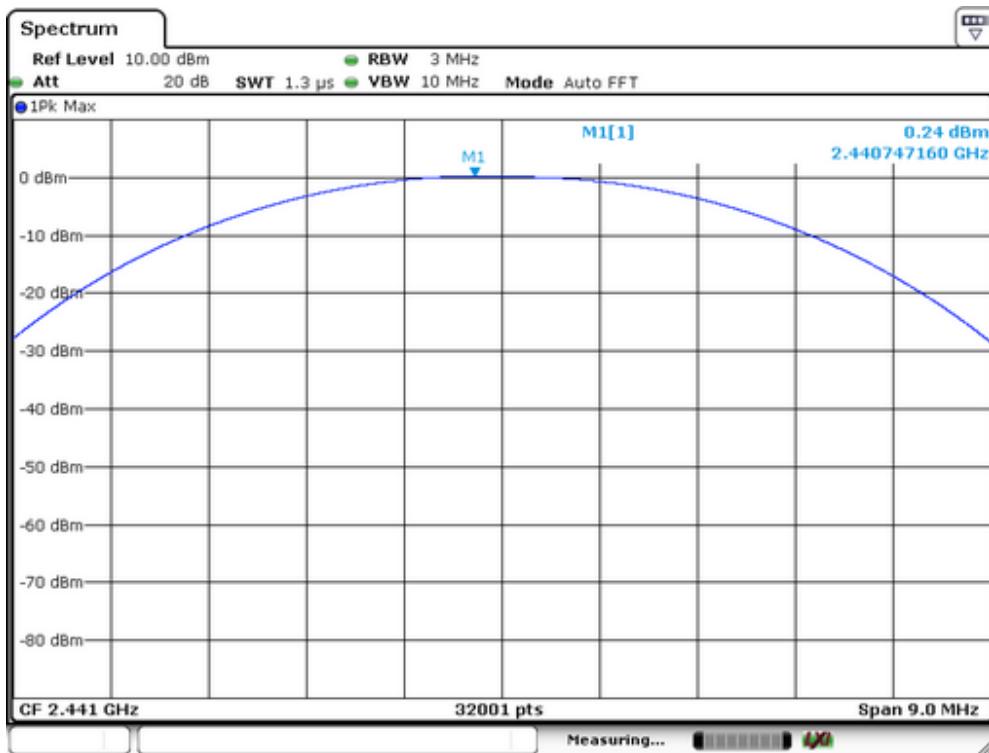
12.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	February 18, 2016
Test By:	Andy	Temperature :	25 °C
Test Result:	PASS	Humidity :	50 %
Modulation:	GFSK		

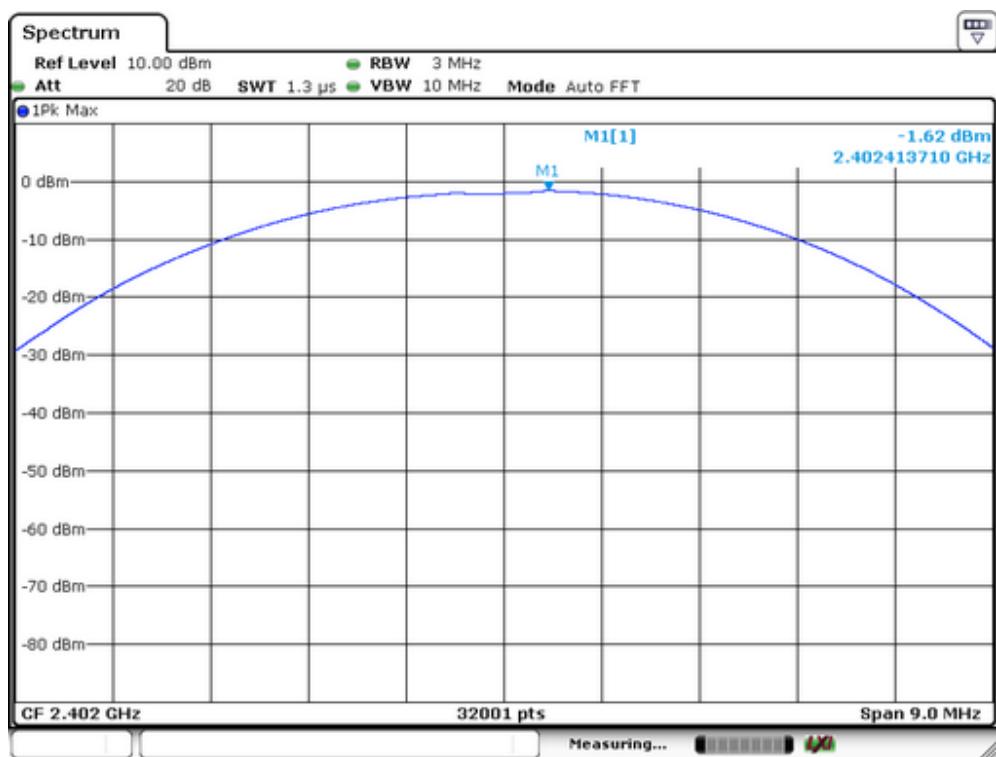
Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
01	2402	0.79	1.199	125	PASS
40	2441	0.24	1.057	125	PASS
79	2480	0.61	1.151	125	PASS

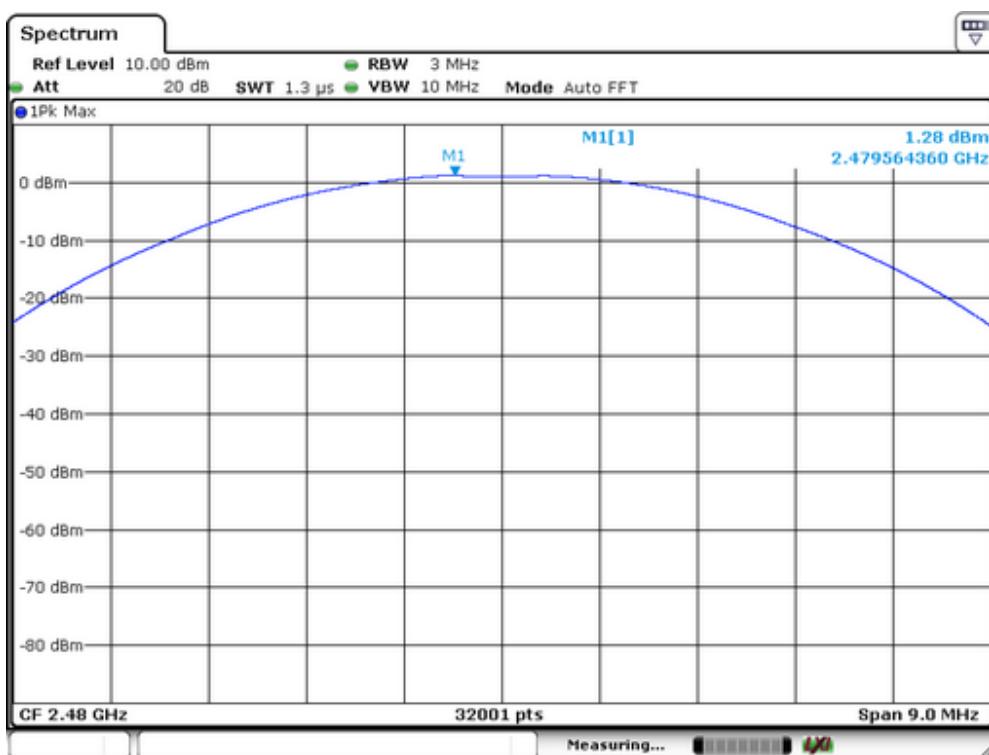
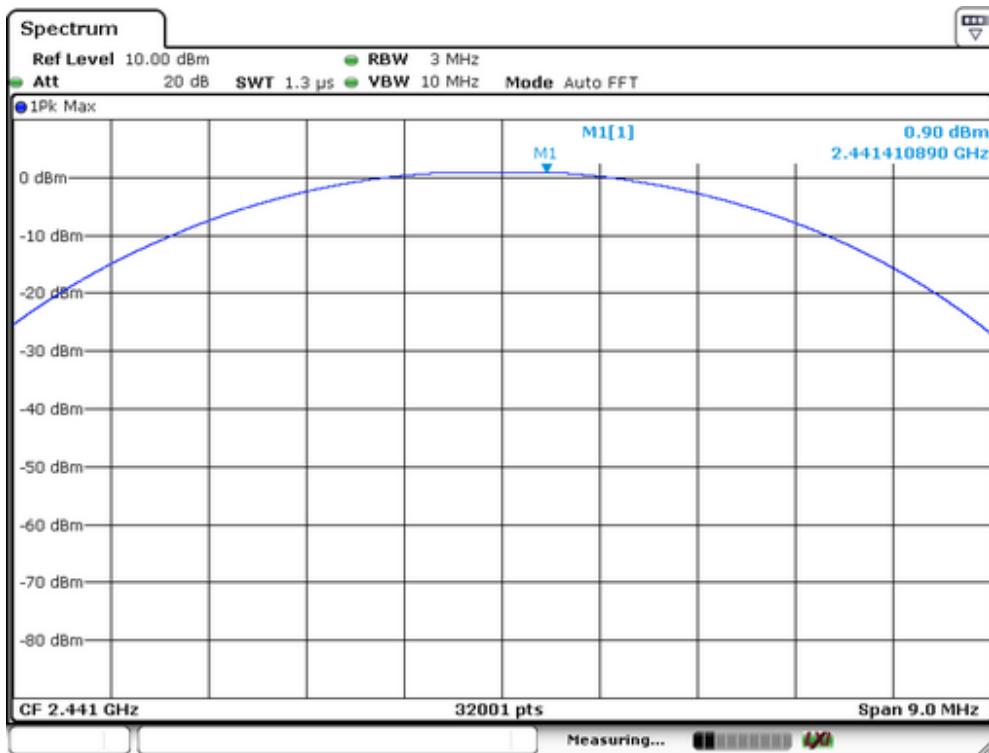




Spectrum Detector: PK Test Date : February 18, 2016
 Test By: Andy Temperature : 25 °C
 Test Result: PASS Humidity : 50 %
 Modulation: Π/4-DQPSK

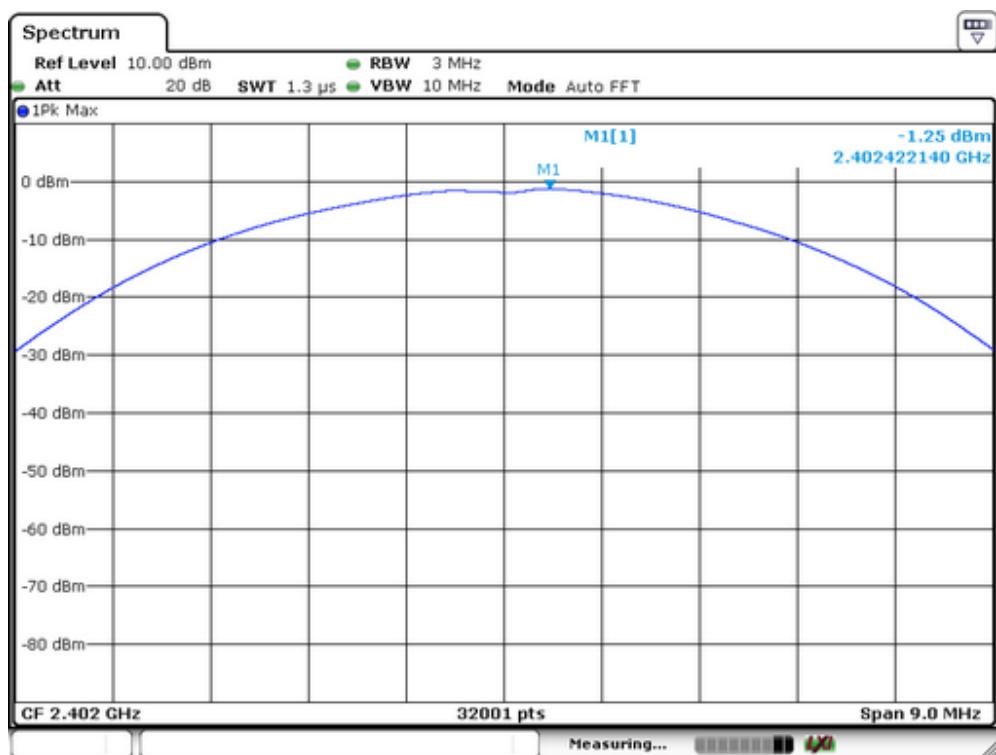
Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
01	2402	-1.62	0.689	125	PASS
40	2441	0.9	1.230	125	PASS
79	2480	1.28	1.343	125	PASS

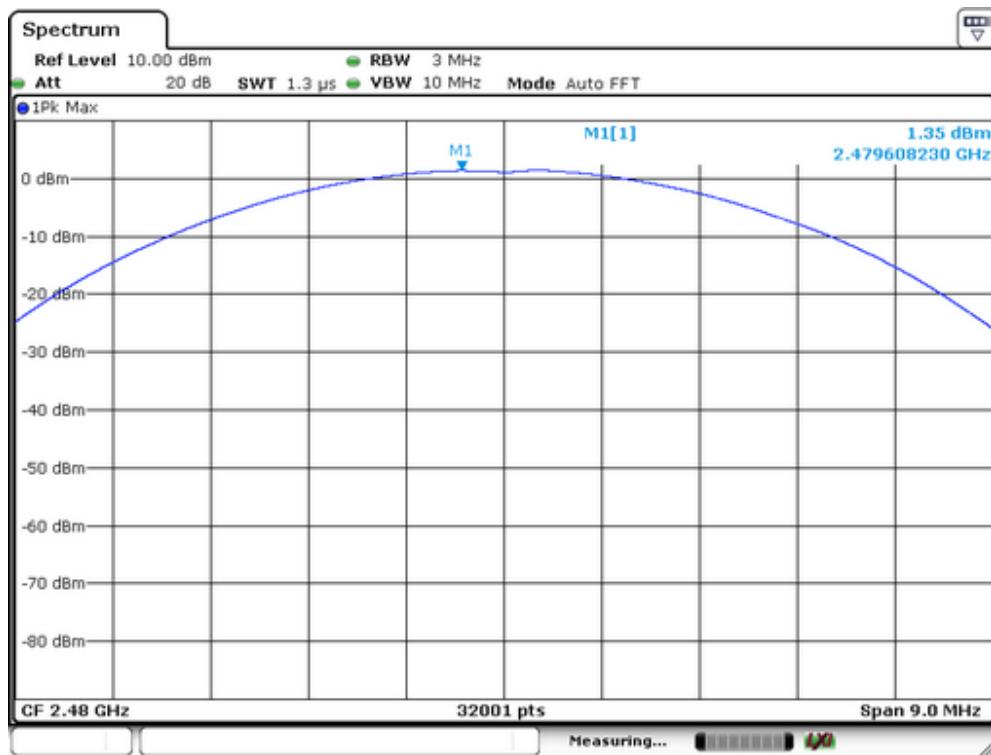
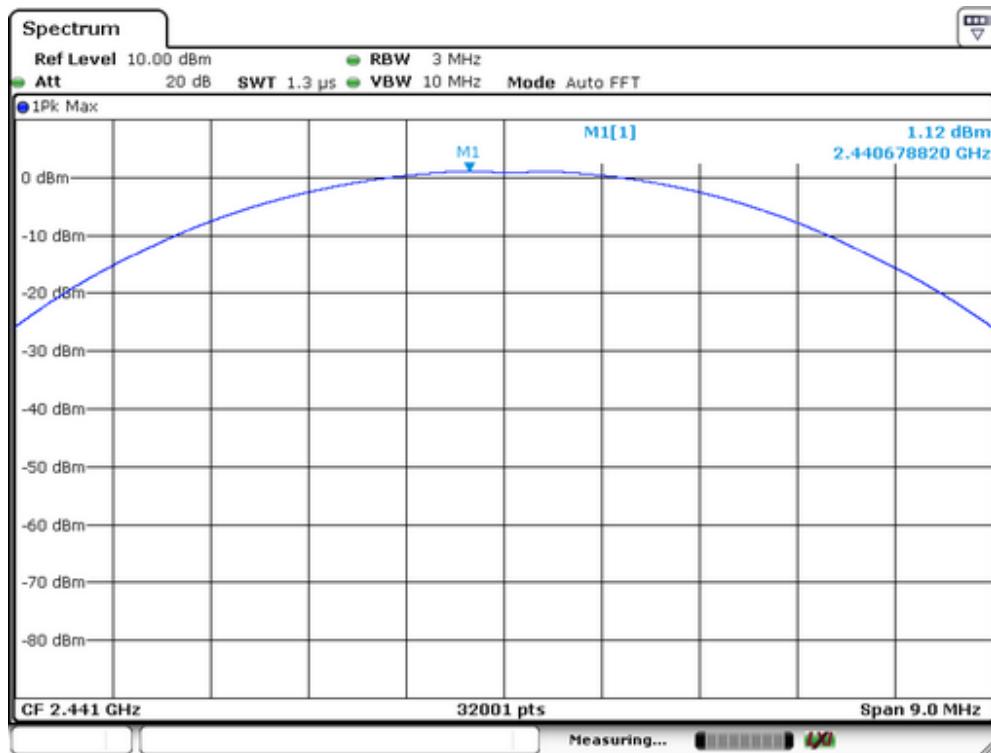




Spectrum Detector: PK Test Date : February 18, 2016
 Test By: Andy Temperature : 25 °C
 Test Result: PASS Humidity : 50 %
 Modulation: 8DPSK

Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
01	2402	-1.25	0.750	125	PASS
40	2441	1.12	1.294	125	PASS
79	2480	1.35	1.365	125	PASS





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:

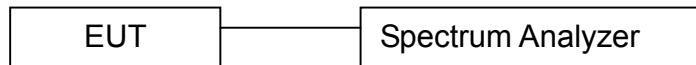
EMI Test Receiver	Setting
Attenuation	Auto
RBW	1MHz
VBW	3MHz
Detector	Peak
Trace	Max hold

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

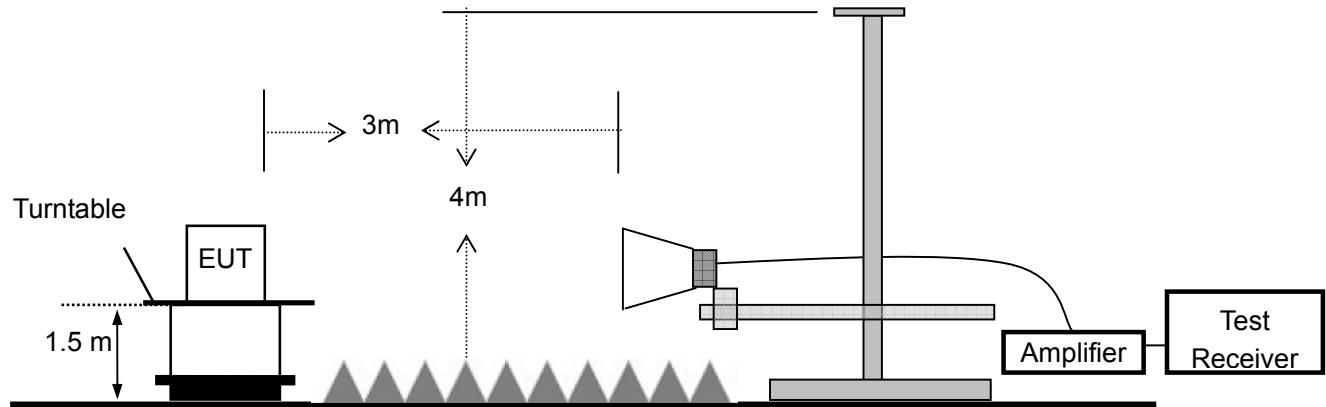
EMI Test Receiver	Setting
Attenuation	Auto
RBW	100KHz
VBW	300KHz
Detector	Peak
Trace	Max hold

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	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	06/24/2015	06/23/2016
Coaxial Cable	CDS	79254	46107086	06/24/2015	06/23/2016

For Radiated emission Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1	Signal Analyzer	Rohde & Schwarz	FSV30	103040	06/24/2015	1 Year
2	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1272	06/24/2015	1 Year
3	Power Amplifier	LUNAR EM	LNA1G18-40	J10100000081	06/24/2015	1 Year
4	Cable	H+S	CBL-26	N/A	06/24/2015	1 Year
5	Cable	H+S	CBL-26	N/A	06/24/2015	1 Year
6	Cable	H+S	CBL-26	N/A	06/24/2015	1 Year

13.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	February 18, 2016
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)
2399.16	GFSK	0.59	-51.47	52.06	>20dBc
2399.99	pi/4-DQPSK	-2.95	-52.23	49.28	>20dBc
2399.74	8DPSK	-2.83	-52	49.17	>20dBc
2483.99	GFSK	2.28	-56.67	58.95	>20dBc
2483.59	pi/4-DQPSK	0.43	-63.18	63.61	>20dBc
2484	8DPSK	0.55	-56.64	57.19	>20dBc

For Hopping Mode:

Frequency (MHz)	Modulation	Peak Power Output(dBm)	Emission read Value(dBm)	Result of Band edge(dBc)	Band edge Limit(dBc)
2399.19	GFSK	1.41	-55.42	56.83	>20dBc
2399.6	pi/4-DQPSK	-2.83	-53.44	50.61	>20dBc
2399.68	8DPSK	-1.42	-54.26	52.84	>20dBc
2483.99	GFSK	0.47	-67.67	68.14	>20dBc
2483.69	pi/4-DQPSK	0.33	-61.32	61.65	>20dBc
2483.75	8DPSK	0.33	-65.21	65.54	>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
2399.14	H	64.13	45.35	74	54	-9.87	-8.65
2398.05	V	60.72	39.15	74	54	-13.28	-14.85
2483.95	H	65.33	44.08	74	54	-8.67	-9.92
2484.13	V	59.18	38.46	74	54	-14.82	-15.54

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
2399.05	H	65.35	45.15	74	54	-8.65	-8.85
2399.48	V	59.05	39.05	74	54	-14.95	-14.95
2483.69	H	64.22	44.22	74	54	-9.78	-9.78
2484.06	V	58.48	40.28	74	54	-15.52	-13.72

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 -0.61 dBi and meets the requirement.

APPENDIX I

(Photos of EUT)

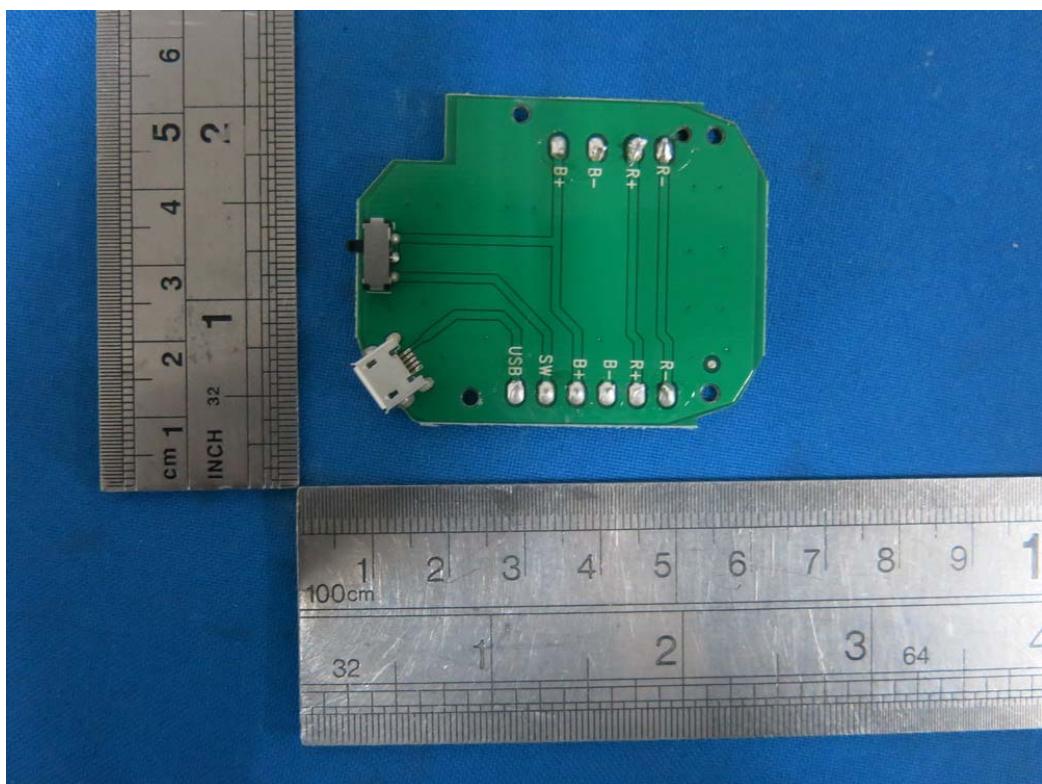


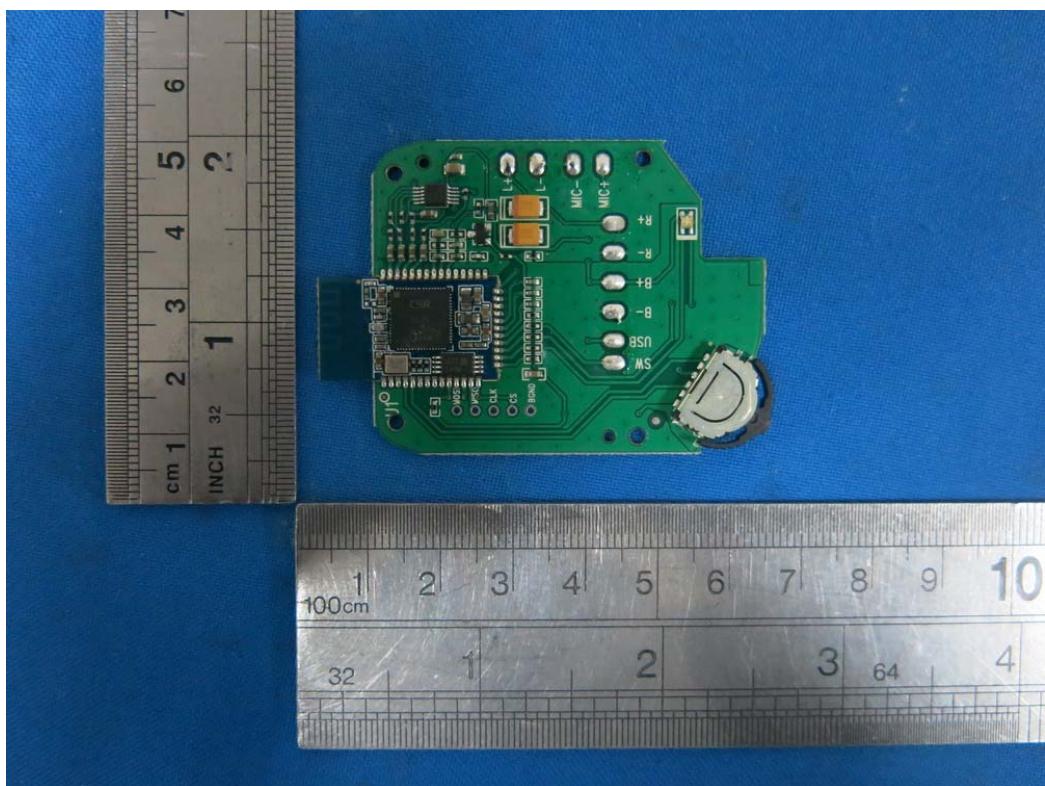
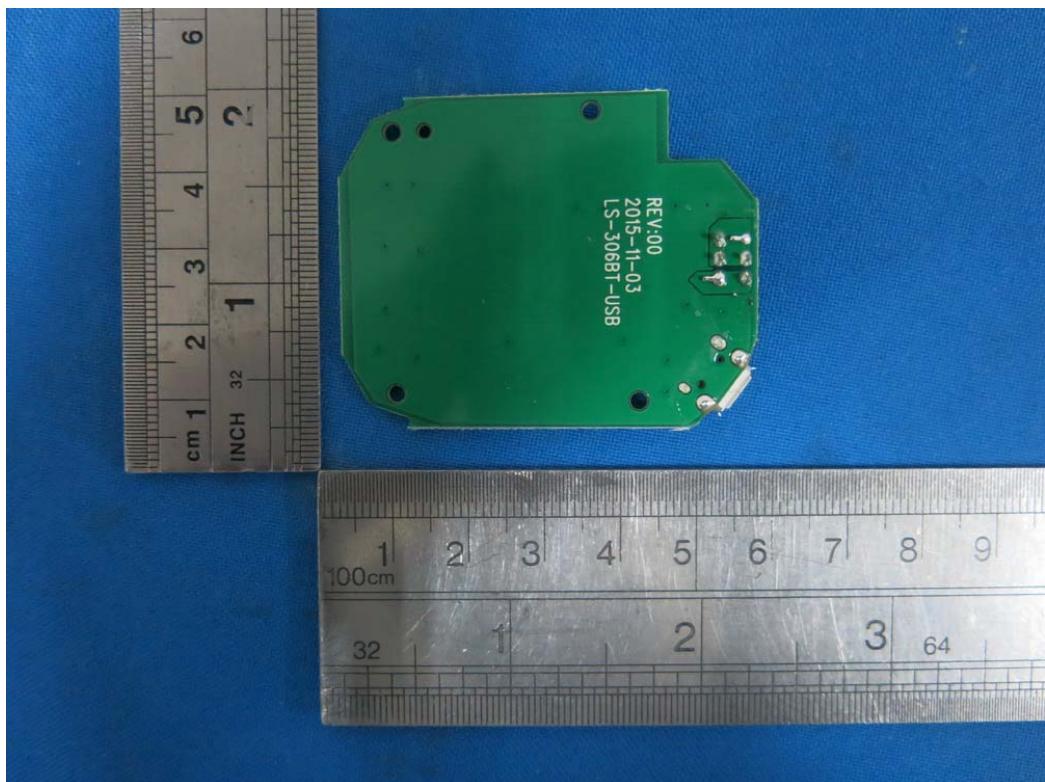
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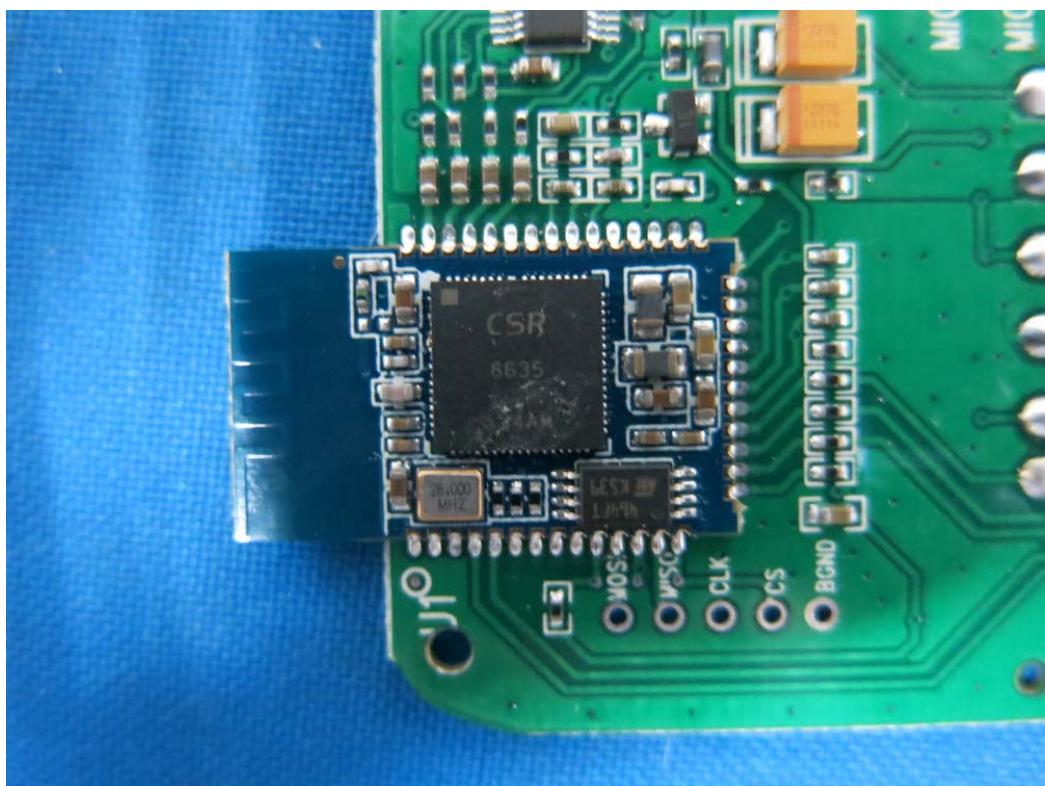
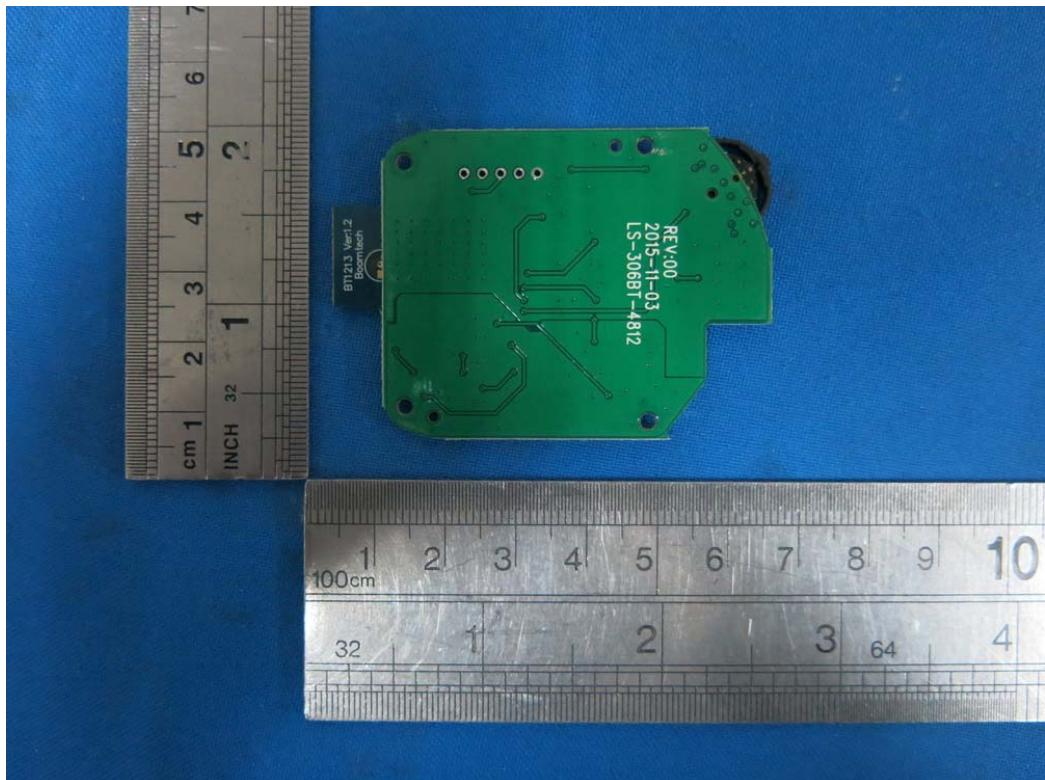


M/N: 306B











M/N: 155B



M/N: 155B



M/N: 303B



M/N: 303B



M/N: 305B



M/N: 305B



M/N: 303BD



M/N: 303BD



M/N: 305BD



M/N: 305BD



M/N: 306BD



M/N: 306BD