

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

OF

Singing Machine

**Model No.: iSM1060BT, iSM1020BT, iSM1040BT, iSM1020BTXY,
iSM1040BTXY, iSM1060BTXY (The combination of XY means unit color. X
can be A to Z or blank & Y can be A to Z or blank)**

Trademark: N/A

FCC ID: BGRISM1060BT

Report No.: KAD150630100E

Issue Date: August 19, 2015

Prepared for

**Star Light Electronics Co. Ltd
5/F, Shing Dao Industrial Building, 232 Aberdeen Main Road, Aberdeen,
Hong Kong**

Prepared by

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DONGGUAN EMTEK CO., LTD.**

VERIFICATION OF COMPLIANCE

Applicant:	Star Light Electronics Co. Ltd 5/F, Shing Dao Industrial Building, 232 Aberdeen Main Road, Aberdeen, Hong Kong
Manufacturer:	Star Light Electronics Co. Ltd 5/F, Shing Dao Industrial Building, 232 Aberdeen Main Road, Aberdeen, Hong Kong
Product Description:	Singing Machine
Trade Mark:	N/A
Model Number:	iSM1060BT, iSM1020BT, iSM1040BT, iSM1020BTXY, iSM1040BTXY, iSM1060BTXY (The combination of XY means unit color. X can be A to Z or blank & Y can be A to Z or blank) (Note: The samples are the same except appearance and model number. So iSM1060BT was selected for full test.)

We hereby certify that:

The above equipment was tested by DONGGUAN EMTEK CO., LTD. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10-2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.247(2014).

Date of Test : June 30, 2015 to August 05, 2015

Prepared by : 
Ivy Huang/Editor

Reviewer : 
Alan He/Supervisor

Approved & Authorized
Signer : 
Sam Lv/Manager

Modified Information

Version	Summary	Revision Date	Report No.
Ver.1.0	Original Report	/	KAD150630100E

Table of Contents

1. GENERAL INFORMATION	6
1.1 PRODUCT DESCRIPTION.....	6
1.2 TEST FACILITY	7
2. SYSTEM TEST CONFIGURATION.....	8
2.1 EUT CONFIGURATION	8
2.2 EUT EXERCISE	8
2.3 TEST PROCEDURE	8
2.4 CONFIGURATION OF TESTED SYSTEM	9
3. SUMMARY OF TEST RESULTS	10
4. DESCRIPTION OF TEST MODES	11
5. TEST SYSTEM UNCERTAINTY	12
6. CONDUCTED EMISSIONS TEST	13
6.1 MEASUREMENT PROCEDURE:	13
6.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	13
6.3 MEASUREMENT EQUIPMENT USED:	13
6.4 MEASUREMENT RESULT:.....	13
6.5 CONDUCTED MEASUREMENT PHOTOS:	16
7. RADIATED EMISSION TEST.....	17
7.1 MEASUREMENT PROCEDURE	17
7.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	18
7.3 MEASUREMENT EQUIPMENT USED:	19
7.4 RADIATED EMISSION LIMIT	20
7.5 MEASUREMENT RESULT	21
7.5 RADIATED MEASUREMENT PHOTOS:	31
8. CHANNEL SEPARATION TEST.....	32
8.1 MEASUREMENT PROCEDURE	32
8.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	32
8.3 MEASUREMENT EQUIPMENT USED:	32
8.4 MEASUREMENT RESULTS:.....	32
9. 20DB BANDWIDTH TEST	37
9.1 MEASUREMENT PROCEDURE	37
9.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	37
9.3 MEASUREMENT EQUIPMENT USED:	37
9.4 MEASUREMENT RESULTS:.....	37
10. QUANTITY OF HOPPING CHANNEL TEST	42

10.1 MEASUREMENT PROCEDURE	42
10.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	42
10.3 MEASUREMENT EQUIPMENT USED:	42
10.4 MEASUREMENT RESULTS:.....	42
11. TIME OF OCCUPANCY (DWELL TIME) TEST	43
11.1 TEST DESCRIPTION	43
11.2 TEST REQUIREMENTS / LIMITS	43
11.3 TEST RESULT	43
12. MAXIMUM PEAK OUTPUT POWER TEST	46
12.1 MEASUREMENT PROCEDURE	46
12.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	46
12.3 MEASUREMENT EQUIPMENT USED:	46
12.4 MEASUREMENT RESULTS:.....	47
13. BAND EDGE TEST	51
13.1 MEASUREMENT PROCEDURE	51
13.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	51
13.3 MEASUREMENT EQUIPMENT USED:	52
13.4 MEASUREMENT RESULTS:.....	53
14. ANTENNA APPLICATION	55
14.1 ANTENNA REQUIREMENT	55
14.2 RESULT	55

Appendix I (Photos of EUT) (10 pages)

1. GENERAL INFORMATION

1.1 Product Description

Characteristics	Description
Product Name	Singing Machine
Model number	iSM1060BT
Power Supply	AC 120V, 60Hz
Kind of Device	Bluetooth Ver.2.1+EDR
Modulation	GFSK, $\pi/4$ -DQPSK
Operating Frequency Range	2402-2480MHz
Number of Channels	79
Transmit Power Max	-0.84dBm(0.000824W)
Antenna Type	Internal PCB antenna
Antenna Gain	-0.68 dBi

1.2 Test Facility

Site Description

EMC Lab. : Registered on FCC, June 18, 2014
The Certificate Number is 247565.

Registered on Industry Canada, February 19, 2014
The Certificate Number is 9444A

Name of Firm : DONGGUAN EMTEK CO., LTD.

Site Location : No.281, Guantai Road, Nancheng District,
Dongguan, Guangdong, China

2. System Test Configuration

2.1 EUT Configuration

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

2.2 EUT Exercise

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

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is placed on a table which is 0.1 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.10-2013. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and average detector mode.

2.3.2 Radiated Emissions

The EUT is placed on a table which is 0.1 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 Configuration of Tested System



Table 2-1 Equipment Used in Tested System

Item	Equipment	Trade Mark	Model No.	FCC ID	Note
1.	Singing Machine	N/A	iSM1060BT	BGRISM1060BT	<i>EUT</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 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	$\pm 3\%$

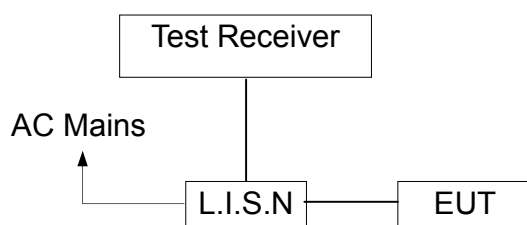
Measurement Uncertainty for a level of Confidence of 95%

6. Conducted Emissions Test

6.1 Measurement Procedure:

1. The EUT was placed on a table, which is 0.1m 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:

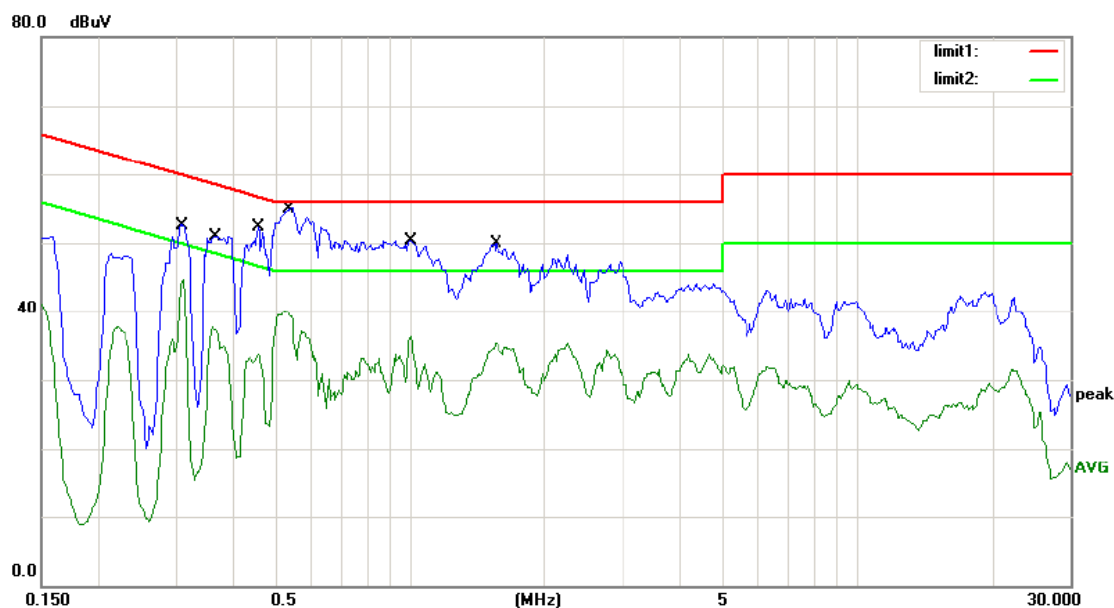
Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Last Cal.	Due date
Test Receiver	Rohde & Schwarz	ESCS30	100018	03/16/2015	03/15/2016
L.I.S.N	Rohde & Schwarz	ENV216	100017	03/16/2015	03/15/2016
RF Switching Unit	CDS	RSU-M2	38401	03/16/2015	03/15/2016
Coaxial Cable	CDS	79254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

Phase: **L1**

Temperature: 24

Limit: (CE)FCC PART 15 class B_QP

Power: AC 120V/60Hz

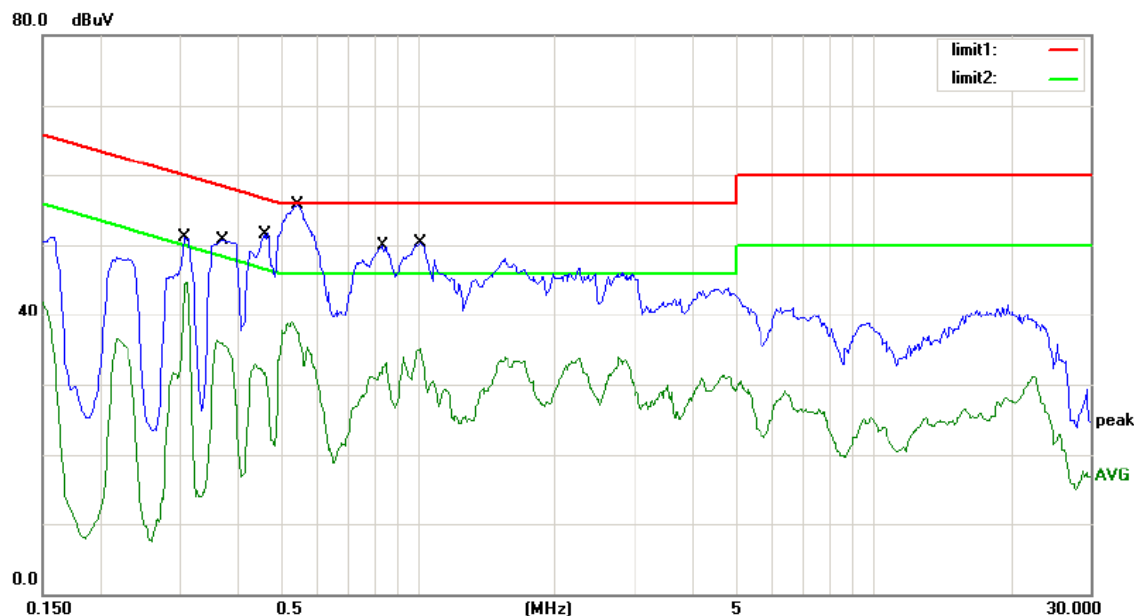
Humidity: 55 %

Mode: TX 2402

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.3120	46.68	0.00	46.68	59.92	-13.24	QP	
2	*	0.3120	44.80	0.00	44.80	49.92	-5.12	AVG	
3		0.3613	47.00	0.00	47.00	58.70	-11.70	QP	
4		0.3613	37.60	0.00	37.60	48.70	-11.10	AVG	
5		0.4605	46.47	0.00	46.47	56.68	-10.21	QP	
6		0.4605	33.67	0.00	33.67	46.68	-13.01	AVG	
7		0.5322	50.14	0.00	50.14	56.00	-5.86	QP	
8		0.5322	39.88	0.00	39.88	46.00	-6.12	AVG	
9		1.0050	46.36	0.00	46.36	56.00	-9.64	QP	
10		1.0050	36.30	0.00	36.30	46.00	-9.70	AVG	
11		1.5601	45.84	0.00	45.84	56.00	-10.16	QP	
12		1.5601	35.32	0.00	35.32	46.00	-10.68	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 2402

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector	Comment
		MHz	dBuV	dB	dBuV	dBuV	dB		
1		0.3074	47.03	0.00	47.03	60.04	-13.01	QP	
2	*	0.3074	44.70	0.00	44.70	50.04	-5.34	AVG	
3		0.3704	46.63	0.00	46.63	58.49	-11.86	QP	
4		0.3704	33.37	0.00	33.37	48.49	-15.12	AVG	
5		0.4611	46.46	0.00	46.46	56.67	-10.21	QP	
6		0.4611	32.82	0.00	32.82	46.67	-13.85	AVG	
7		0.5460	50.61	0.00	50.61	56.00	-5.39	QP	
8		0.5460	36.28	0.00	36.28	46.00	-9.72	AVG	
9		0.8385	45.95	0.00	45.95	56.00	-10.05	QP	
10		0.8385	33.14	0.00	33.14	46.00	-12.86	AVG	
11		1.0140	45.36	0.00	45.36	56.00	-10.64	QP	
12		1.0140	35.19	0.00	35.19	46.00	-10.81	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 0.1m above ground plane. And above 1000MHz, The EUT was placed on a table which is 0.1m 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:

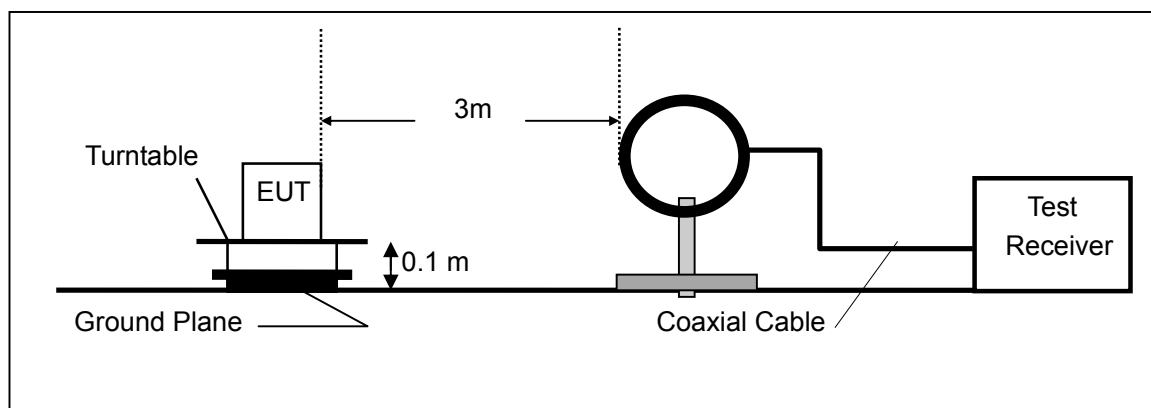
EMI Test Receiver	Setting
Attenuation	Auto
RBW	1MHz
VBW	3MHz
Detector	Peak
Trace	Max hold

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

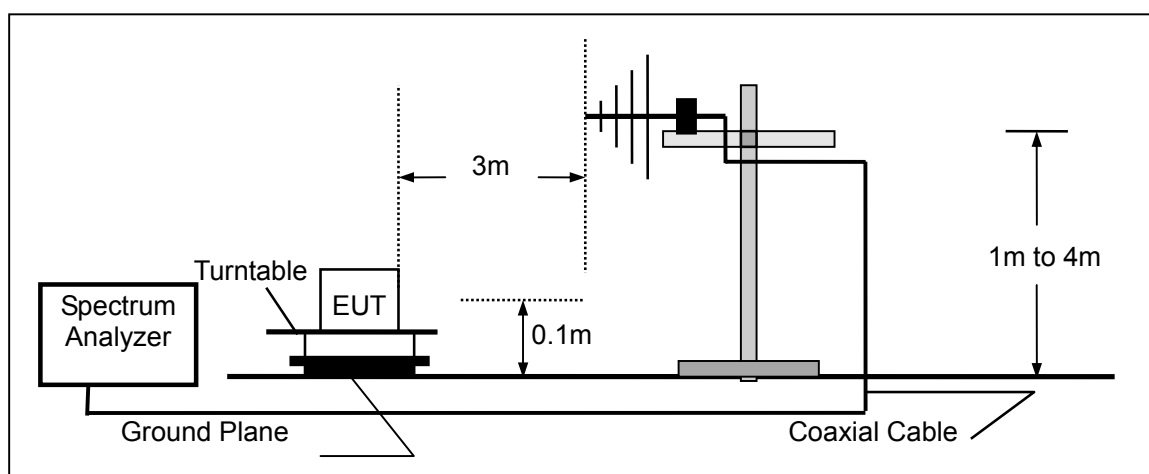
EMI Test Receiver	Setting
Attenuation	Auto
RBW	1MHz
VBW	10Hz
Detector	Peak
Trace	Max hold

7.2 Test SET-UP (Block Diagram of Configuration)

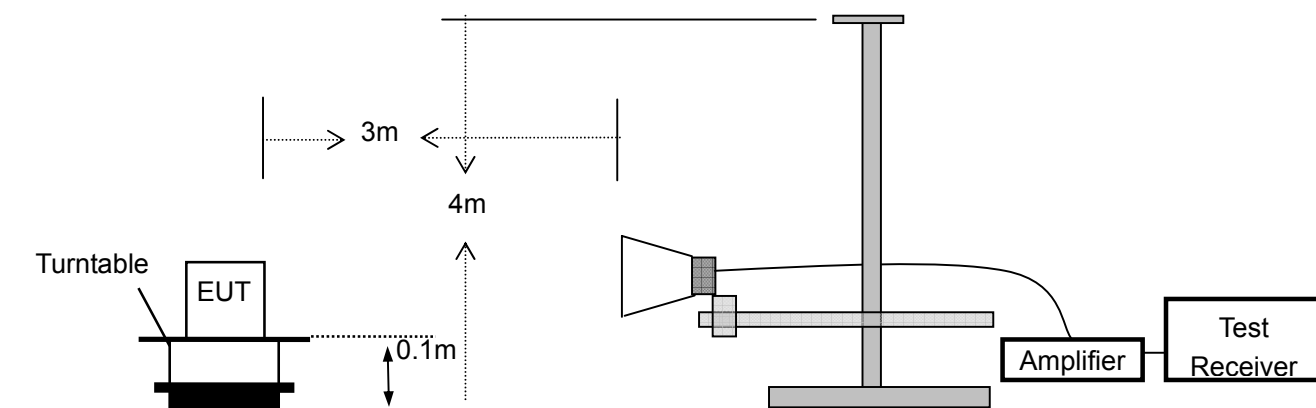
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(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 :	July 24, 2015
Frequency Range:	9KHz~30MHz	Temperature :	28℃
Test Result:	PASS	Humidity :	65 %
Measured Distance:	3m	Test By:	Andy

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

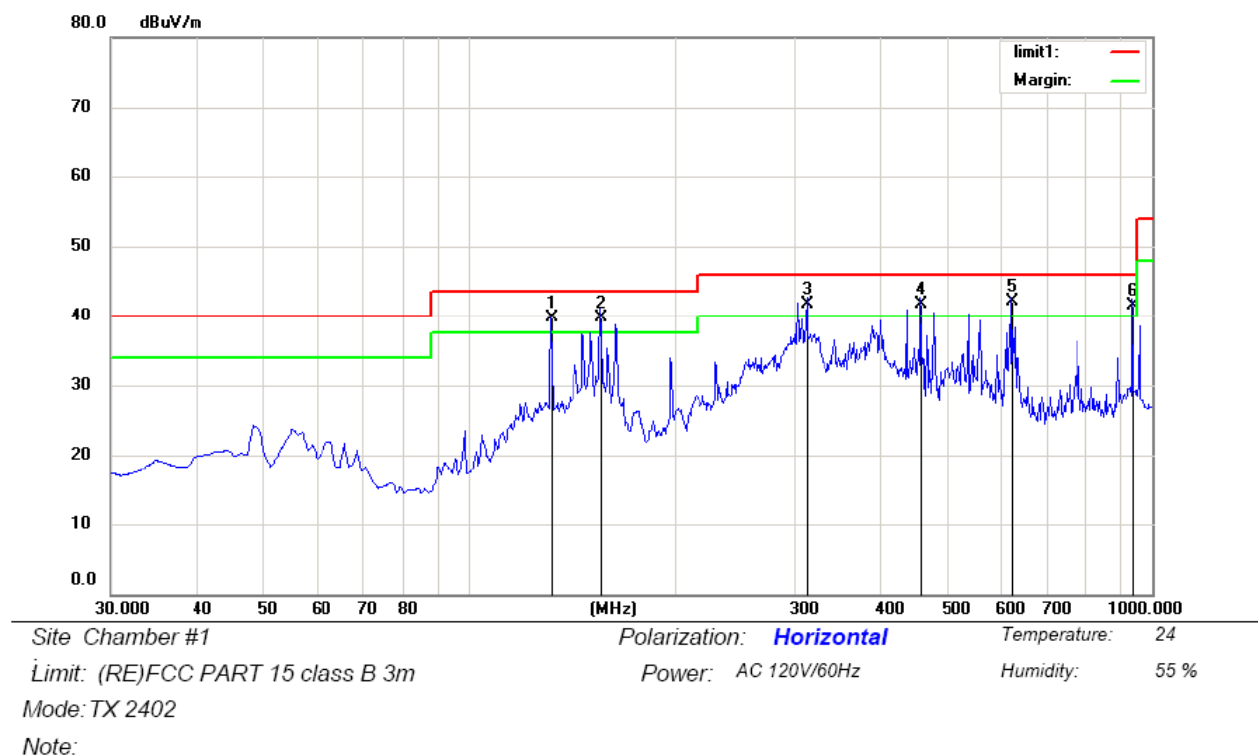
Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

Below 1000MHz:

Pass.

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

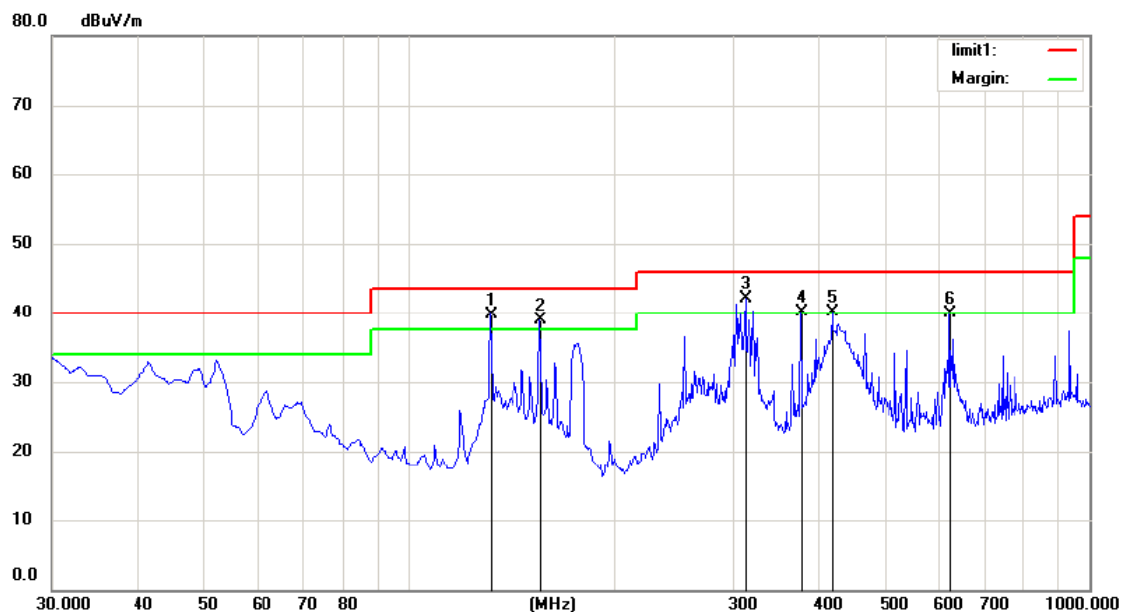
Please refer to the following data.



No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Antenna	Table	
		MHz	Level	Factor	ment			Height	Degree	
			dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree
1	!	131.8500	56.03	-16.34	39.69	43.50	-3.81	QP		
2	*	156.1000	58.01	-18.25	39.76	43.50	-3.74	QP		
3	!	312.2700	55.31	-13.53	41.78	46.00	-4.22	QP		
4	!	458.7400	52.72	-11.02	41.70	46.00	-4.30	QP		
5	!	624.6100	50.25	-8.24	42.01	46.00	-3.99	QP		
6	!	936.9500	44.08	-2.61	41.47	46.00	-4.53	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: AC 120V/60Hz

Humidity: 55 %

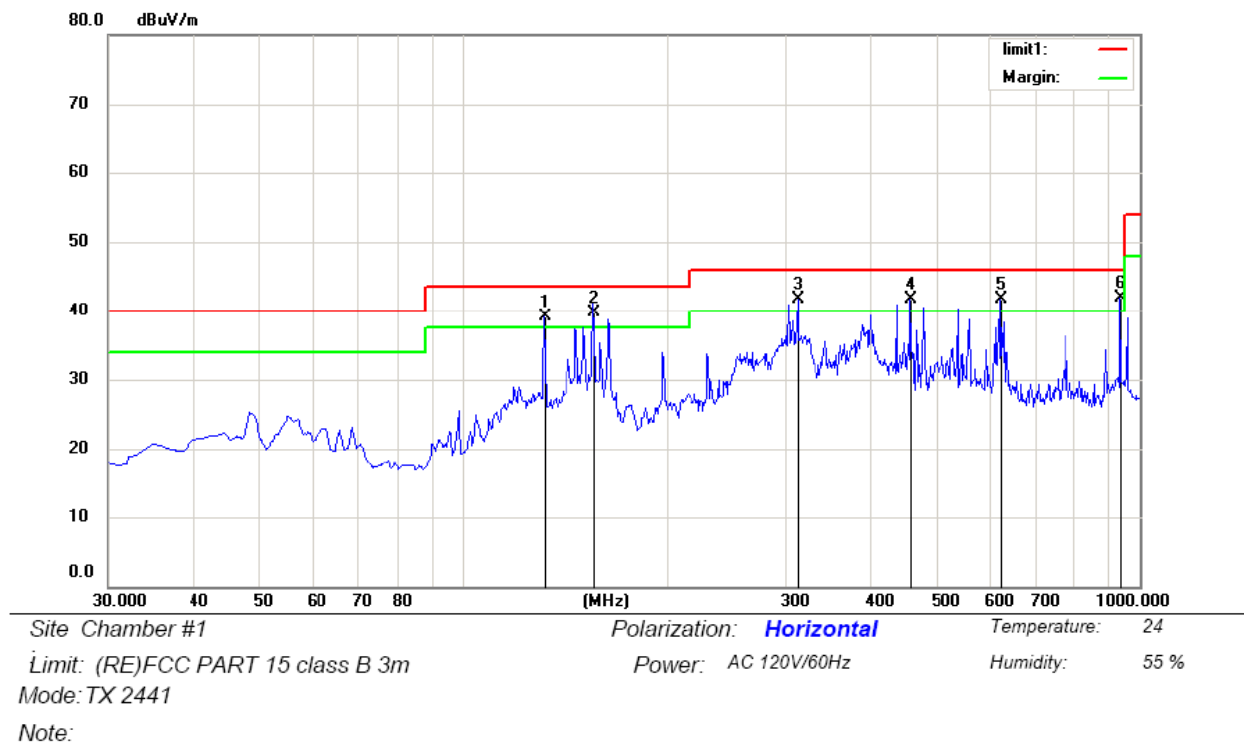
Mode: TX 2402

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1	*	131.8500	56.10	-16.40	39.70	43.50	-3.80	QP		
2	!	156.1000	57.12	-18.25	38.87	43.50	-4.63	QP		
3	!	312.2700	55.82	-13.66	42.16	46.00	-3.84	QP		
4	!	377.2600	52.34	-12.21	40.13	46.00	-5.87	QP		
5	!	419.9400	51.56	-11.39	40.17	46.00	-5.83	QP		
6		624.6100	48.17	-8.25	39.92	46.00	-6.08	QP		

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

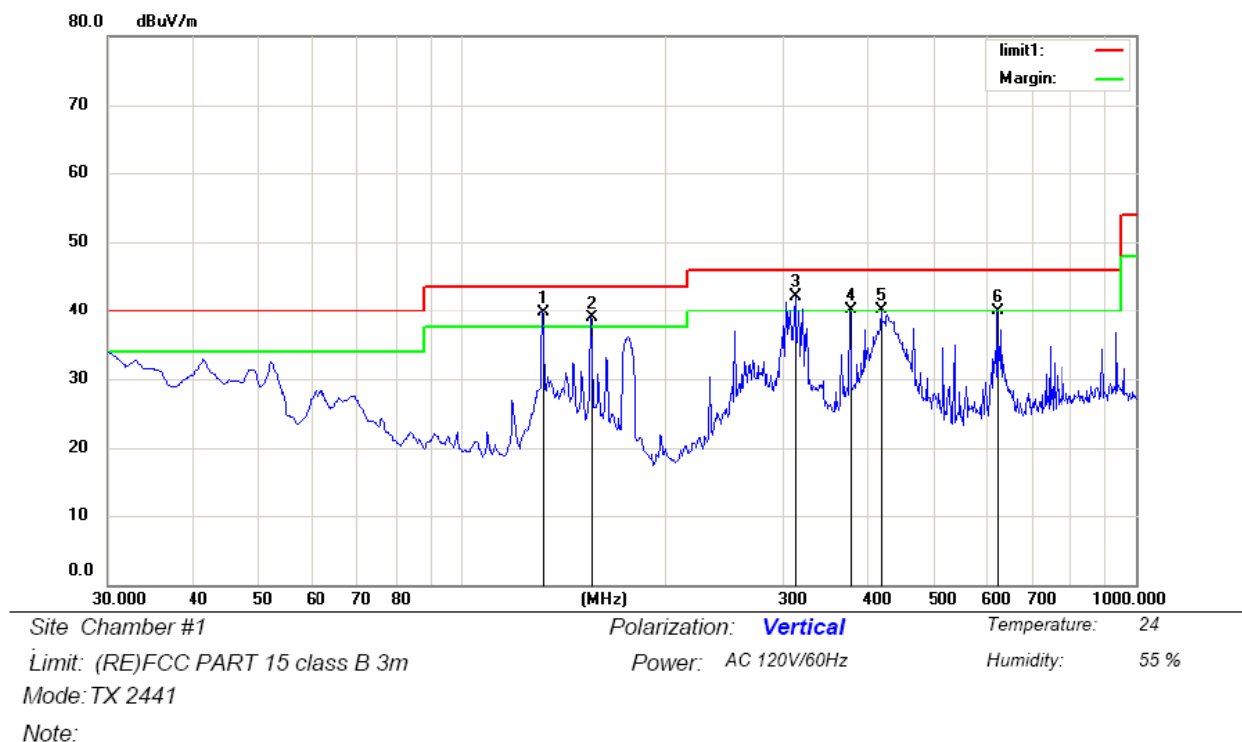
Operator: Jack



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	!	131.8500	55.53	-16.34	39.19	43.50	-4.31	QP		
2	*	156.1000	57.87	-18.25	39.62	43.50	-3.88	QP		
3	!	312.2700	55.31	-13.53	41.78	46.00	-4.22	QP		
4	!	458.7400	52.72	-11.02	41.70	46.00	-4.30	QP		
5	!	624.6100	49.90	-8.24	41.66	46.00	-4.34	QP		
6	!	936.9500	44.58	-2.61	41.97	46.00	-4.03	QP		

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

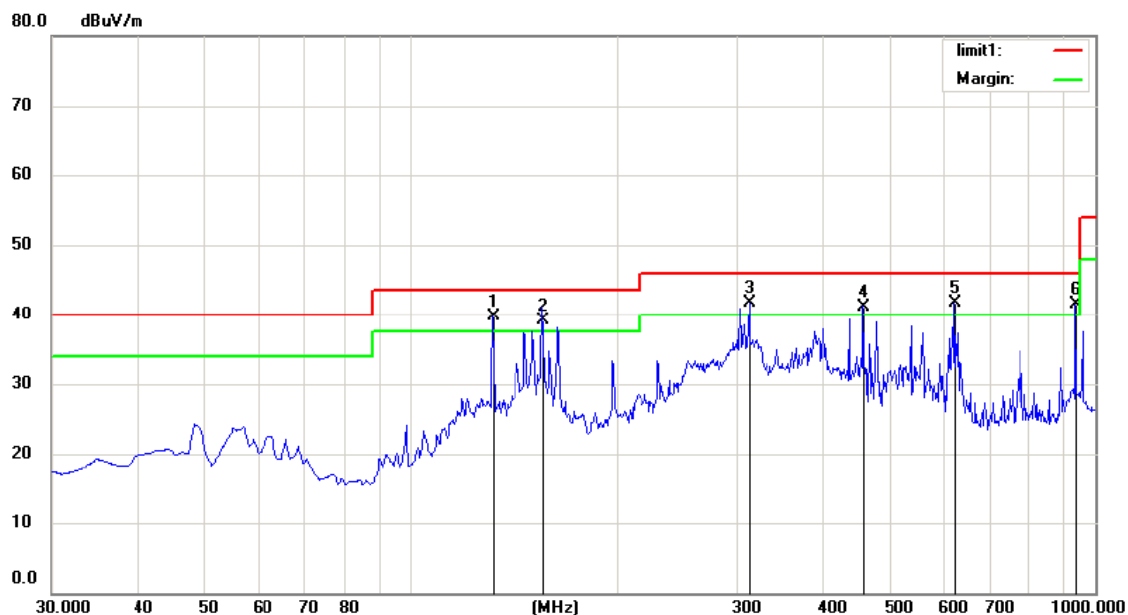
Operator: Jack



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	*	131.8500	56.10	-16.40	39.70	43.50	-3.80	QP		
2	!	156.1000	57.12	-18.25	38.87	43.50	-4.63	QP		
3	!	312.2700	55.82	-13.66	42.16	46.00	-3.84	QP		
4	!	377.2600	52.34	-12.21	40.13	46.00	-5.87	QP		
5	!	419.9400	51.56	-11.39	40.17	46.00	-5.83	QP		
6		624.6100	48.17	-8.25	39.92	46.00	-6.08	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: AC 120V/60Hz

Humidity: 55 %

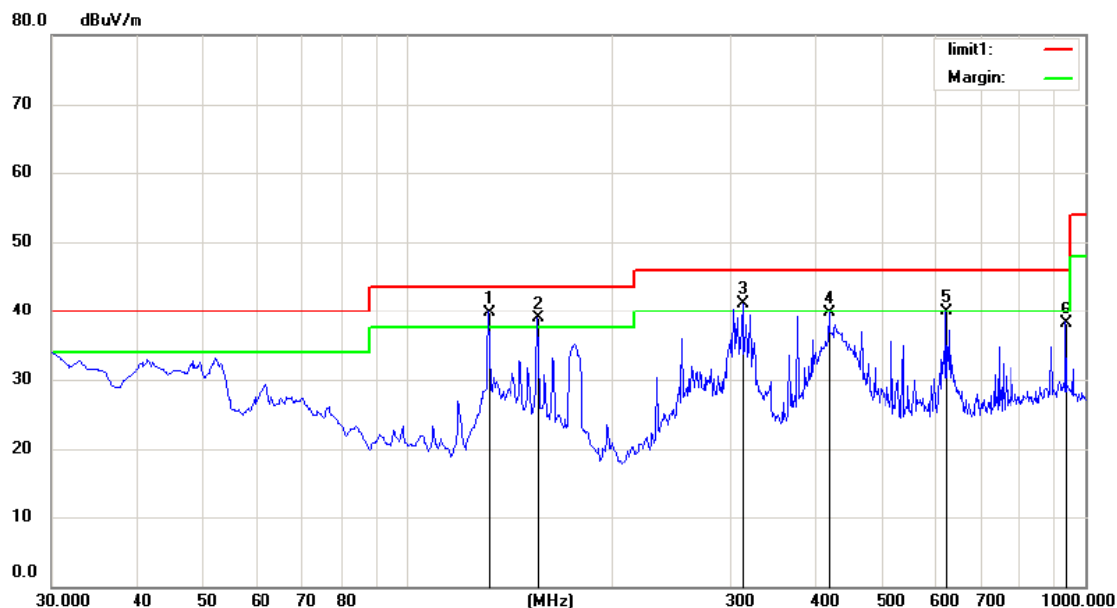
Mode: TX 2480

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree
1	*	131.8500	56.03	-16.34	39.69	43.50	-3.81	QP		
2	!	156.1000	57.31	-18.25	39.06	43.50	-4.44	QP		
3	!	312.2700	55.31	-13.53	41.78	46.00	-4.22	QP		
4	!	458.7400	52.22	-11.02	41.20	46.00	-4.80	QP		
5	!	624.6100	49.90	-8.24	41.66	46.00	-4.34	QP		
6	!	936.9500	44.08	-2.61	41.47	46.00	-4.53	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: AC 120V/60Hz

Humidity: 55 %

Mode: TX 2480

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1	*	131.8500	56.05	-16.40	39.65	43.50	-3.85	QP		
2	!	156.1000	57.12	-18.25	38.87	43.50	-4.63	QP		
3	!	312.2700	54.82	-13.66	41.16	46.00	-4.84	QP		
4		419.9400	51.06	-11.39	39.67	46.00	-6.33	QP		
5		624.6100	48.17	-8.25	39.92	46.00	-6.08	QP		
6		936.9500	40.73	-2.53	38.20	46.00	-7.80	QP		

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

Operator: Jack

Above 1000MHz

Worst Operation Mode: GFSK (CH1: 2402MHz) Test Date : July 24, 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	66.09	45.31	74	54	-7.91	-8.69
7206	V	65.21	43.68	74	54	-8.79	-10.32
9608	V	64.95	42.7	74	54	-9.05	-11.3
12010	V	62.19	41.52	74	54	-11.81	-12.48
14412	V	59.28	40.53	74	54	-14.72	-13.47
16814	V	58.08	38.06	74	54	-15.92	-15.94
4804	H	64.93	45.74	74	54	-9.07	-8.26
7206	H	63.17	43.14	74	54	-10.83	-10.86
9608	H	61.34	42.86	74	54	-12.66	-11.14
12010	H	60.02	41.23	74	54	-13.98	-12.77
14412	H	59.28	39.65	74	54	-14.72	-14.35
16814	H	58.65	38.95	74	54	-15.35	-15.05

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 : July 24, 2015
Frequency Range: 1-25GHz Temperature : 25 °C
Test Result: PASS Humidity : 50 %
Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
4882	V	65.39	46.66	74	54	-8.61	-7.34
7323	V	64.25	45.24	74	54	-9.75	-8.76
9764	V	63.89	44.85	74	54	-10.11	-9.15
12205	V	62.75	43.62	74	54	-11.25	-10.38
14646	V	61.25	42.31	74	54	-12.75	-11.69
17087	V	60.93	41.82	74	54	-13.07	-12.18
4882	H	65.2	46.13	74	54	-8.8	-7.87
7323	H	64.12	45.97	74	54	-9.88	-8.03
9764	H	63.54	44.68	74	54	-10.46	-9.32
12205	H	62.91	43.96	74	54	-11.09	-10.04
14646	H	61.21	42.29	74	54	-12.79	-11.71
17087	H	60.38	41.31	74	54	-13.62	-12.69

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.

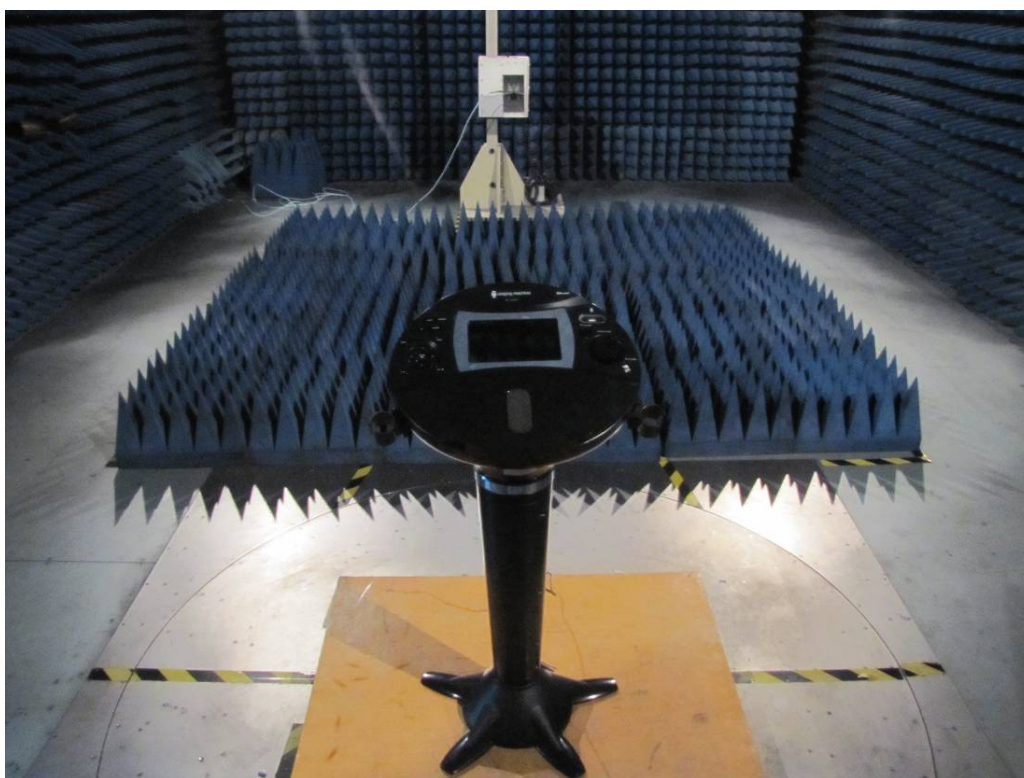
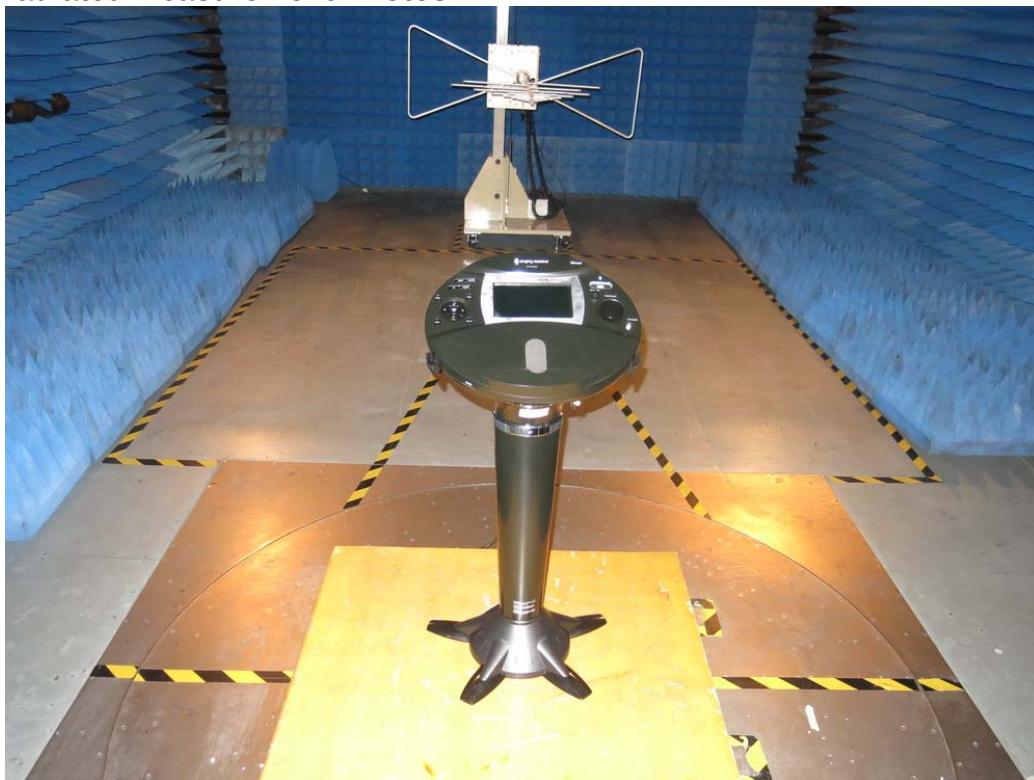
Worst Operation Mode: GFSK (CH79: 2480MHz) Test Date : July 24, 2015
Frequency Range: 1-25GHz Temperature : 25 °C
Test Result: PASS Humidity : 50 %
Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
4960	V	65.09	46.88	74	54	-8.91	-7.12
7440	V	64.58	45.54	74	54	-9.42	-8.46
9920	V	63.54	44.12	74	54	-10.46	-9.88
12400	V	62.83	43.85	74	54	-11.17	-10.15
14880	V	61.42	42.64	74	54	-12.58	-11.36
17360	V	60.83	41.38	74	54	-13.17	-12.62
4960	H	66.98	45.29	74	54	-7.02	-8.71
7440	H	65.21	45.47	74	54	-8.79	-8.53
9920	H	64.54	44.34	74	54	-9.46	-9.66
12400	H	63.93	43.85	74	54	-10.07	-10.15
14880	H	62.54	42.81	74	54	-11.46	-11.19
17360	H	61.41	41.64	74	54	-12.59	-12.36

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:

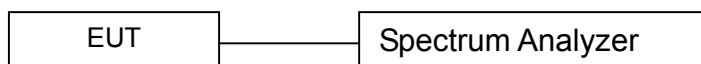


8. Channel Separation test

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:

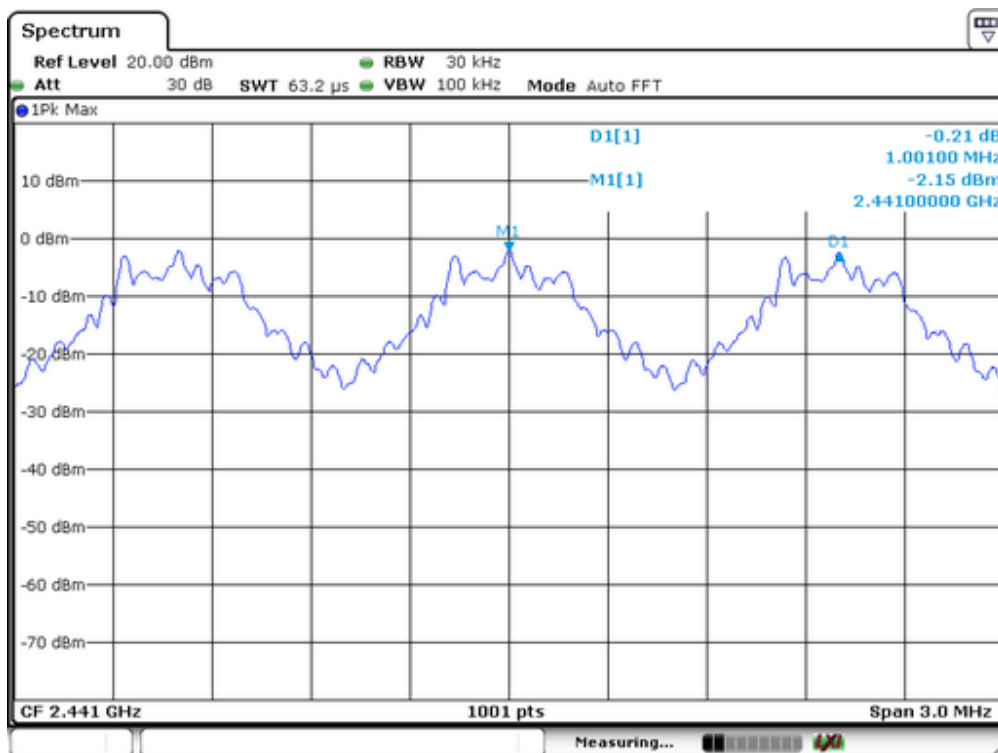
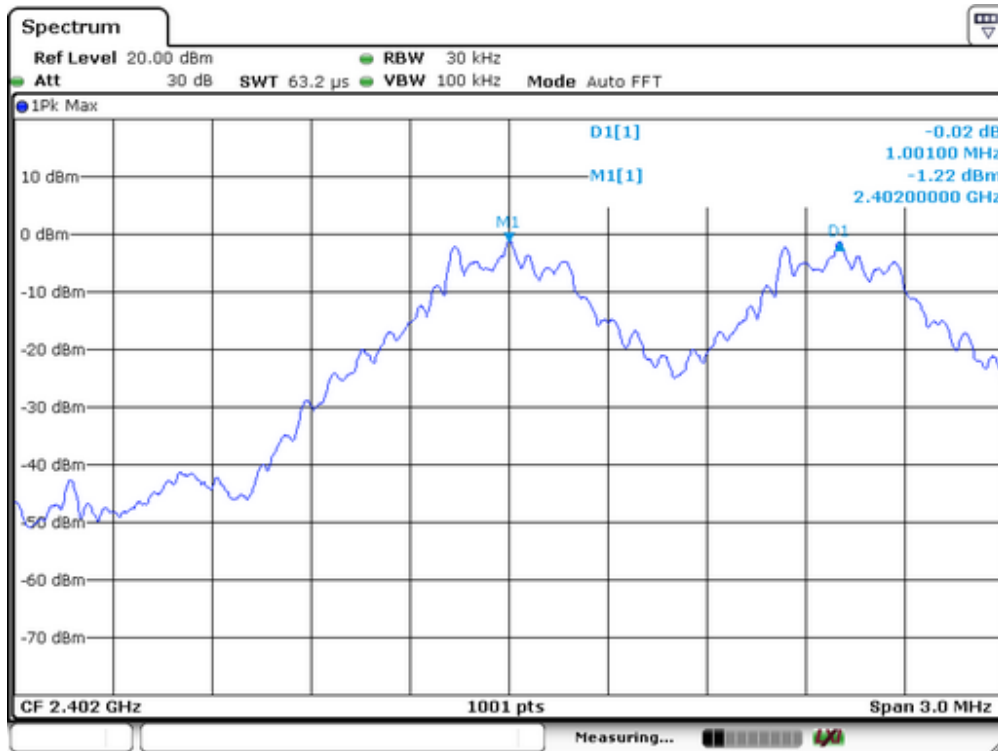
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	03/16/2015	03/15/2016
Coaxial Cable	CDS	79254	46107086	03/16/2015	03/15/2016

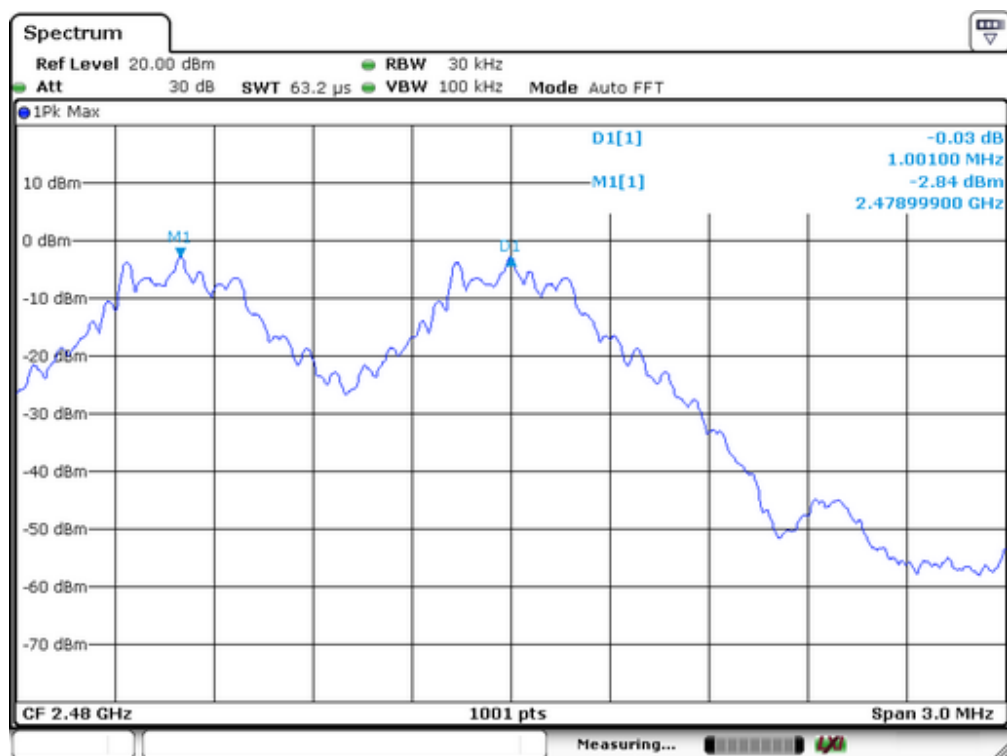
8.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	July 24, 2015
Test By:	Andy	Temperature :	25 °C
Test Result:	PASS	Humidity :	50 %
Modulation:	GFSK		

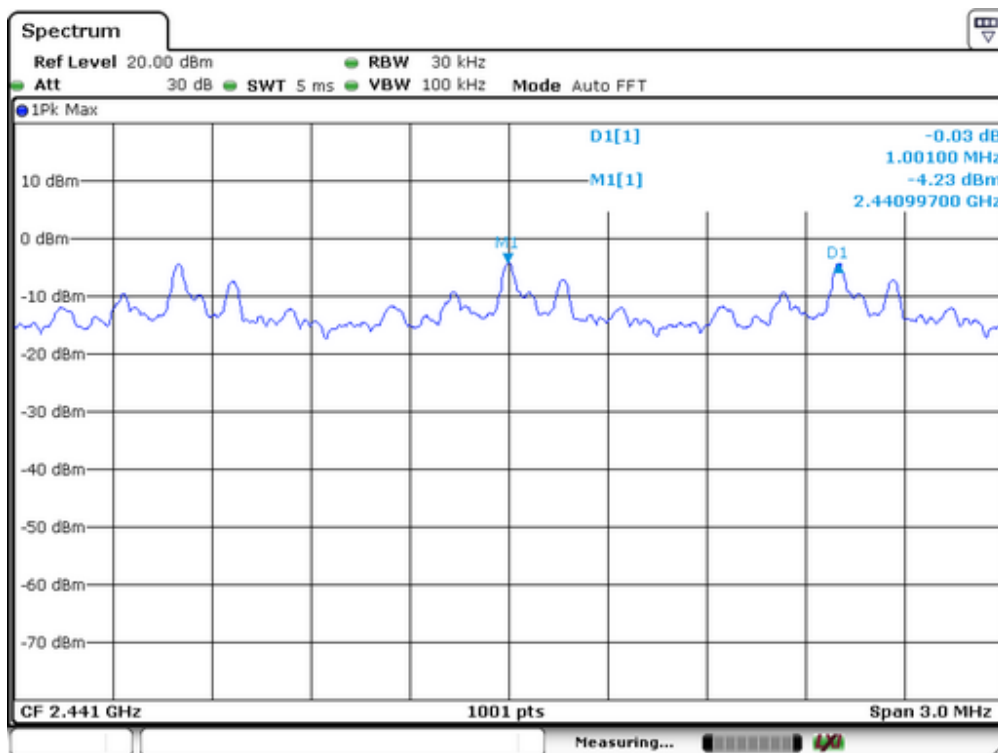
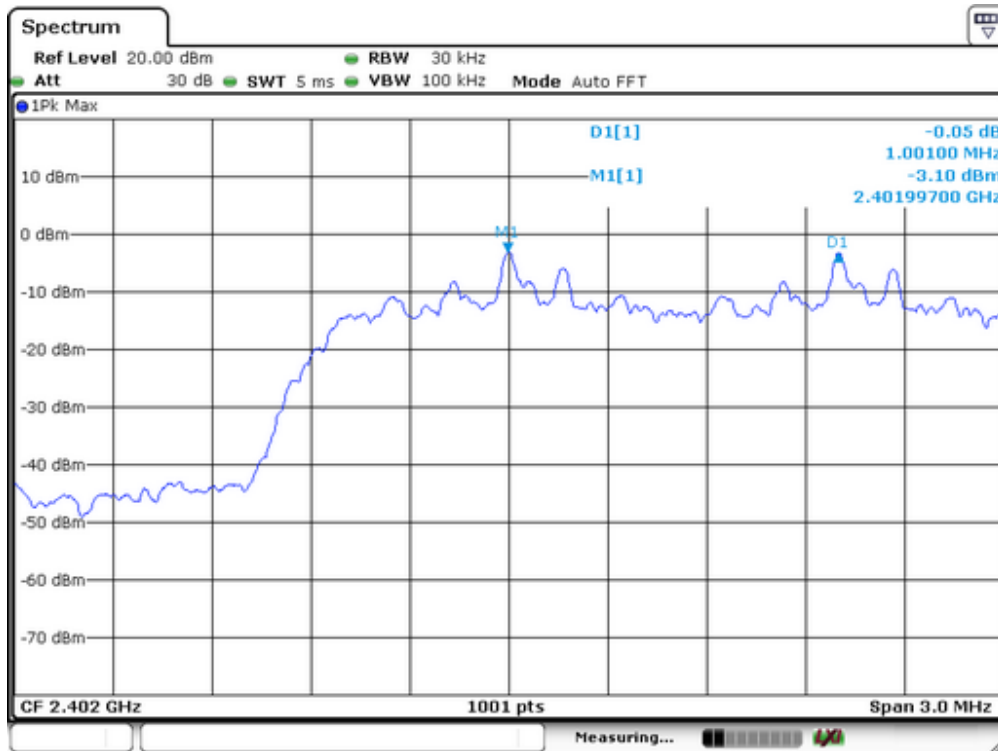
Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit (kHz)
1	2402	1001	>818
40	2441	1001	>815
79	2480	1001	>818

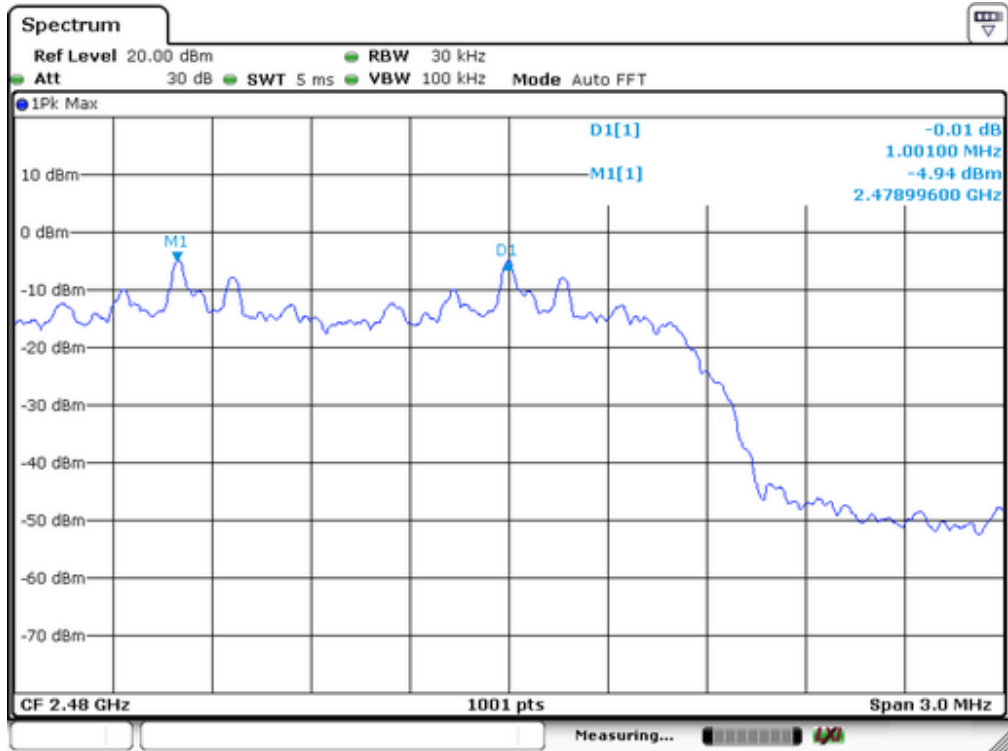




Spectrum Detector:	PK	Test Date :	July 24, 2015
Test By:	Andy	Temperature :	24°C
Test Result:	PASS	Humidity :	53 %
Modulation:	$\Pi/4$ -DQPSK		

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	1001	>826
40	2441	1001	>824
79	2480	1001	>824



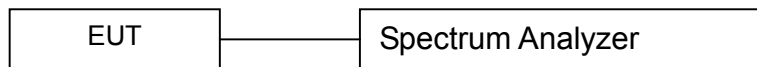


9. 20dB Bandwidth test

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:

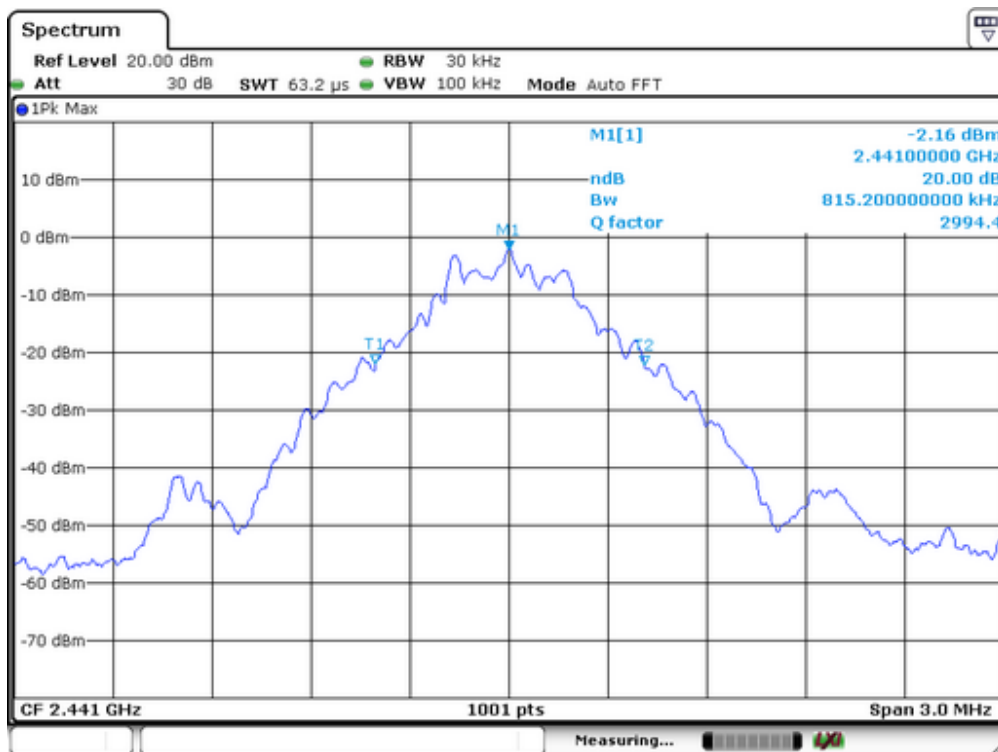
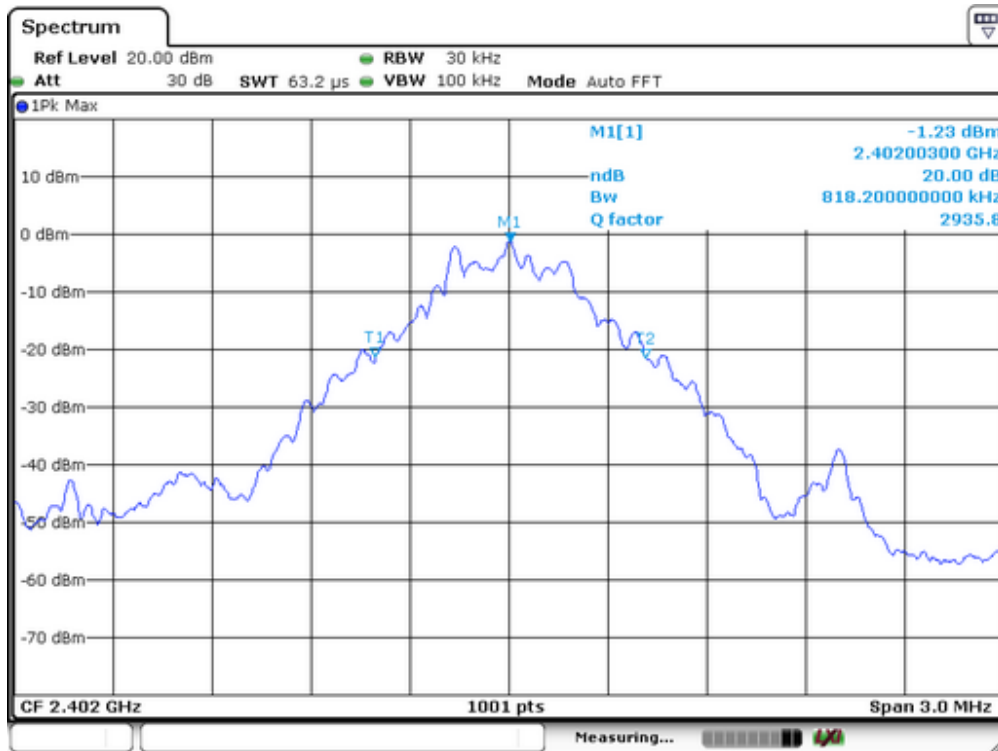
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	03/16/2015	03/15/2016
Coaxial Cable	CDS	79254	46107086	03/16/2015	03/15/2016

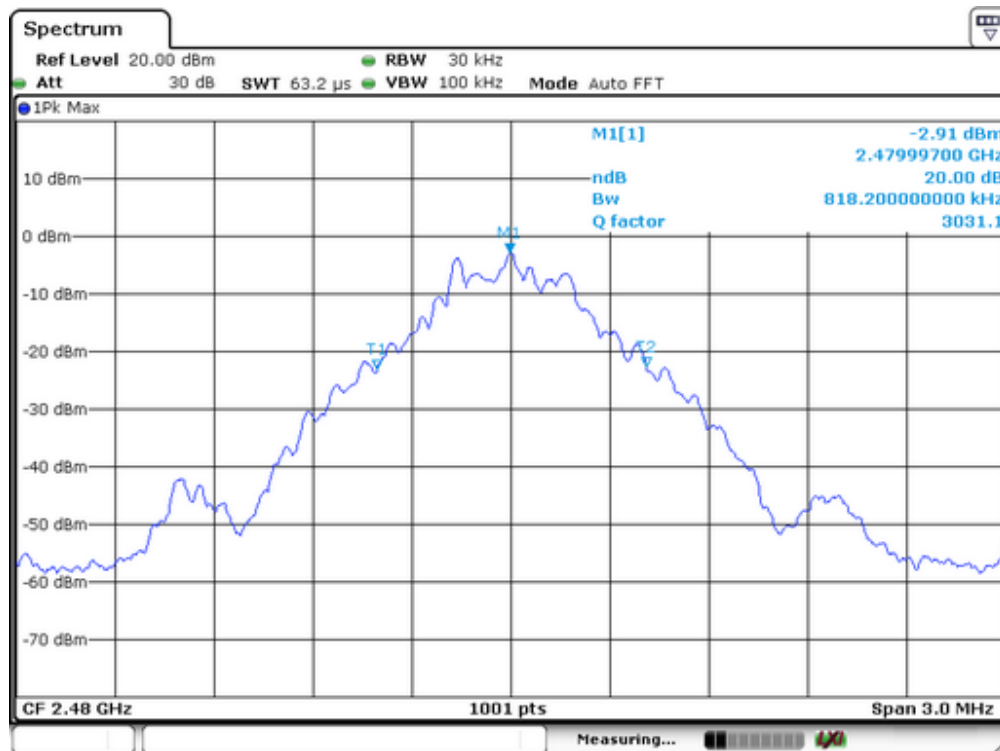
9.4 Measurement Results:

Refer to attached data chart.

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

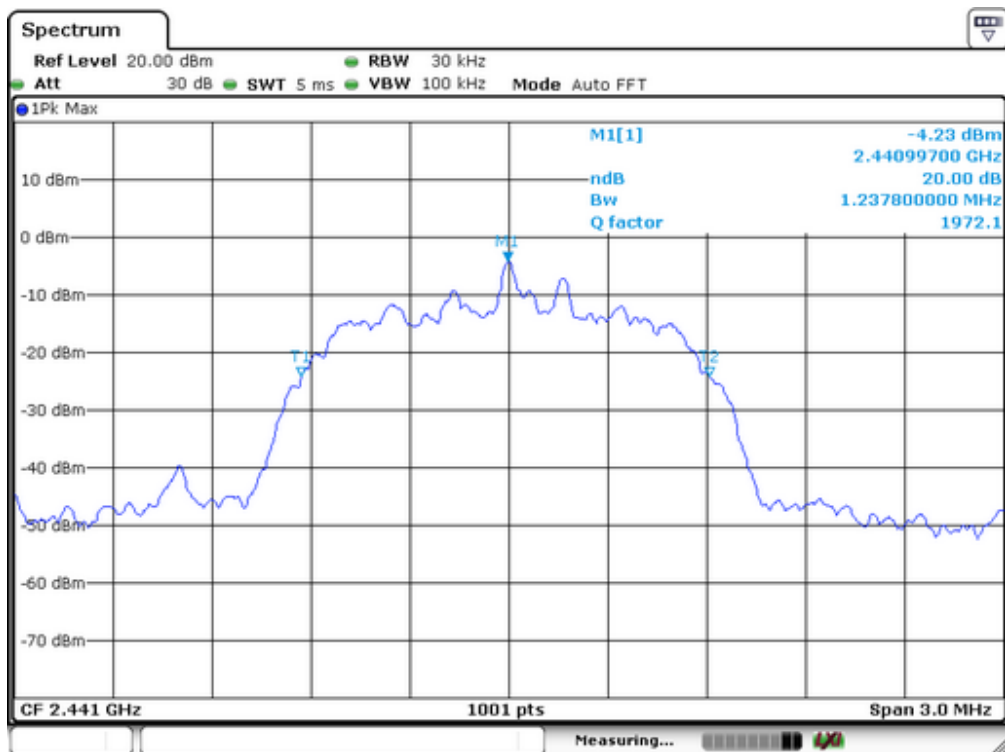
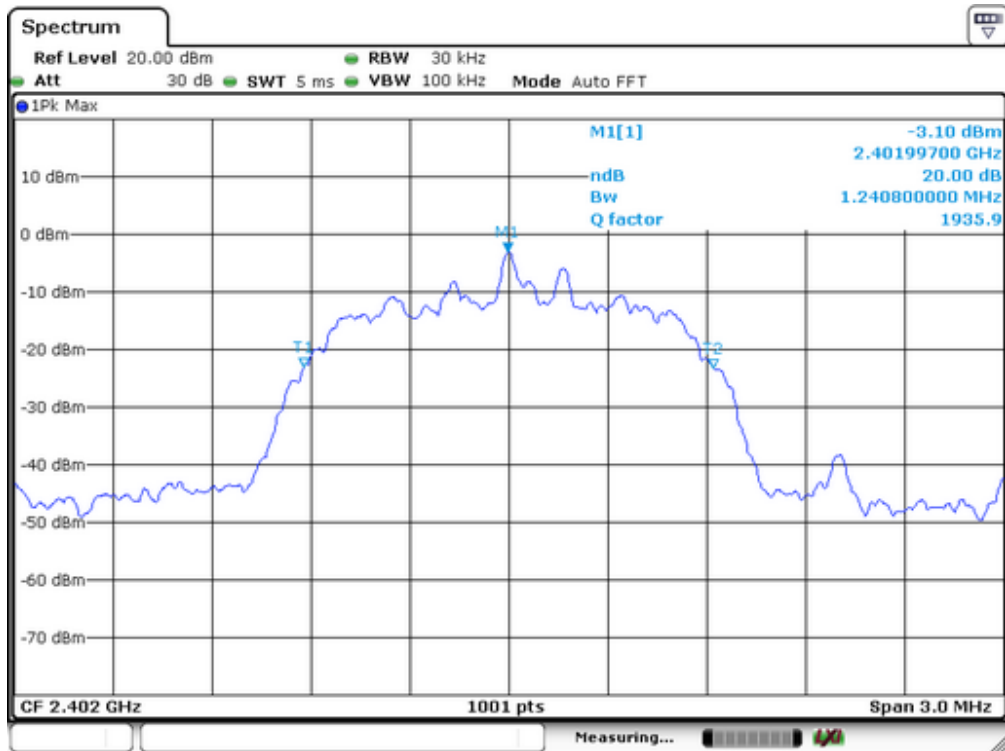
Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	818
40	2441	815
79	2480	818

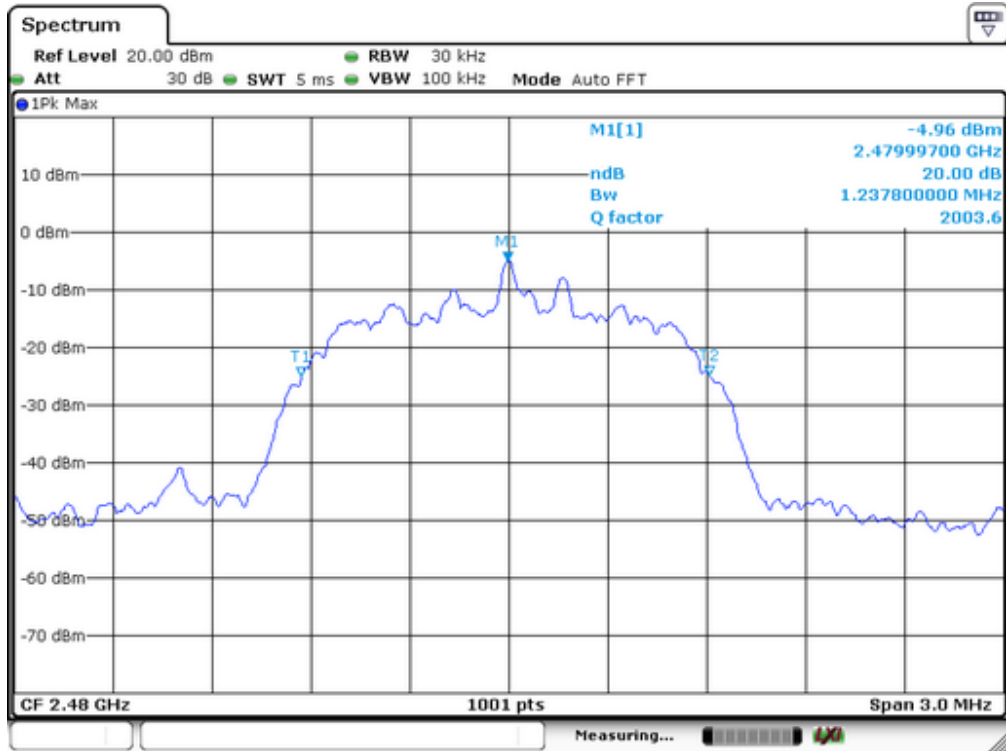




Spectrum Detector:	PK	Test Date :	July 24, 2015
Test By:	Andy	Temperature :	24°C
Test Result:	PASS	Humidity :	53 %
Modulation:	$\Pi/4$ -DQPSK		

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	1240
40	2441	1237
79	2480	1237



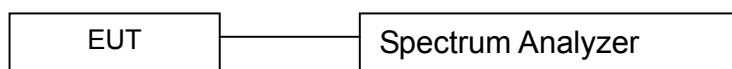


10. Quantity of Hopping Channel Test

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:

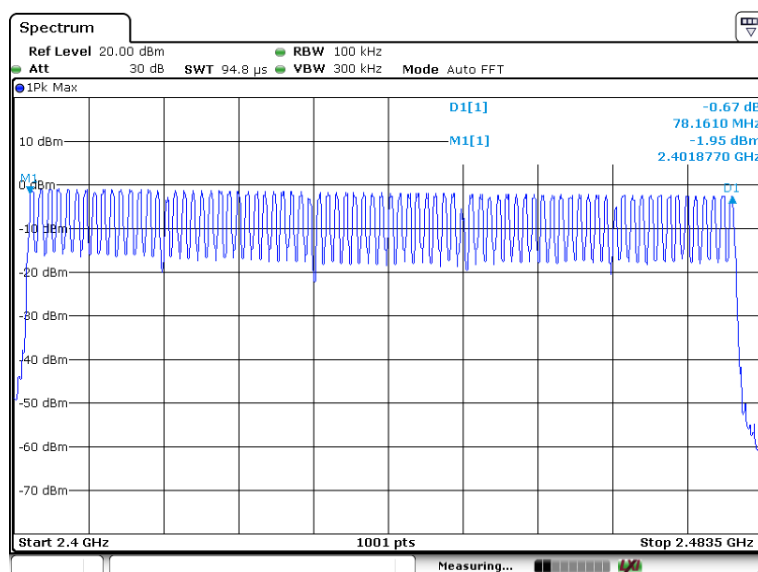
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	03/16/2015	03/15/2016
Coaxial Cable	CDS	79254	46107086	03/16/2015	03/15/2016

10.4 Measurement Results:

Refer to attached data chart.

Worst Test Mode	GFSK	Test Date :	July 24, 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)

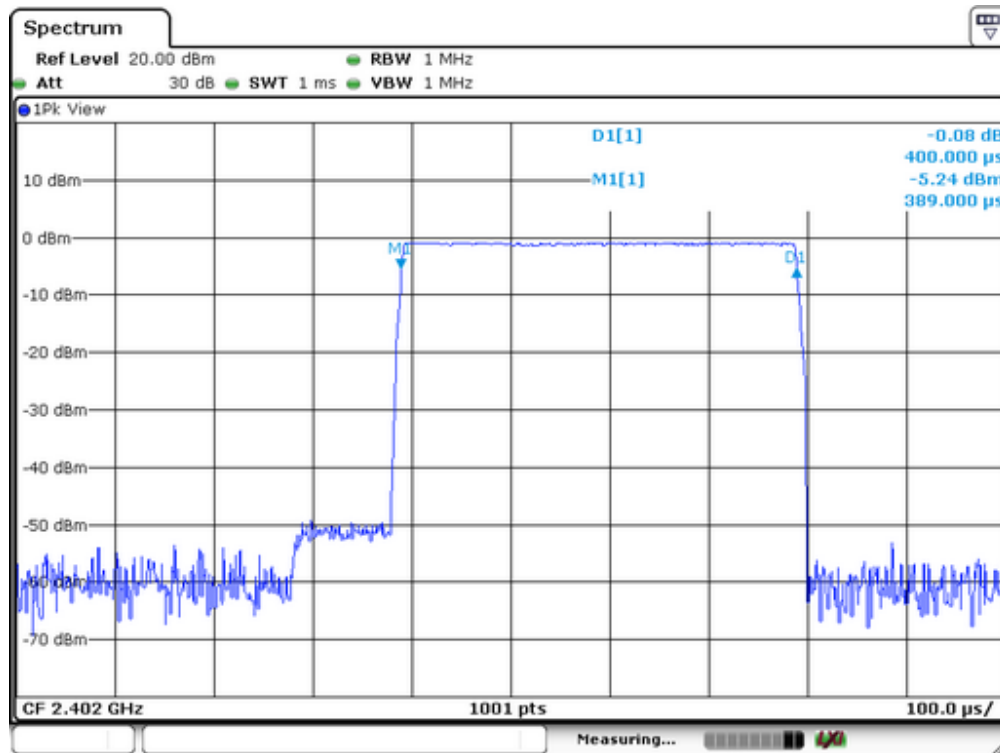
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Since the Bluetooth technology uses 79 channels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

11.3 Test result

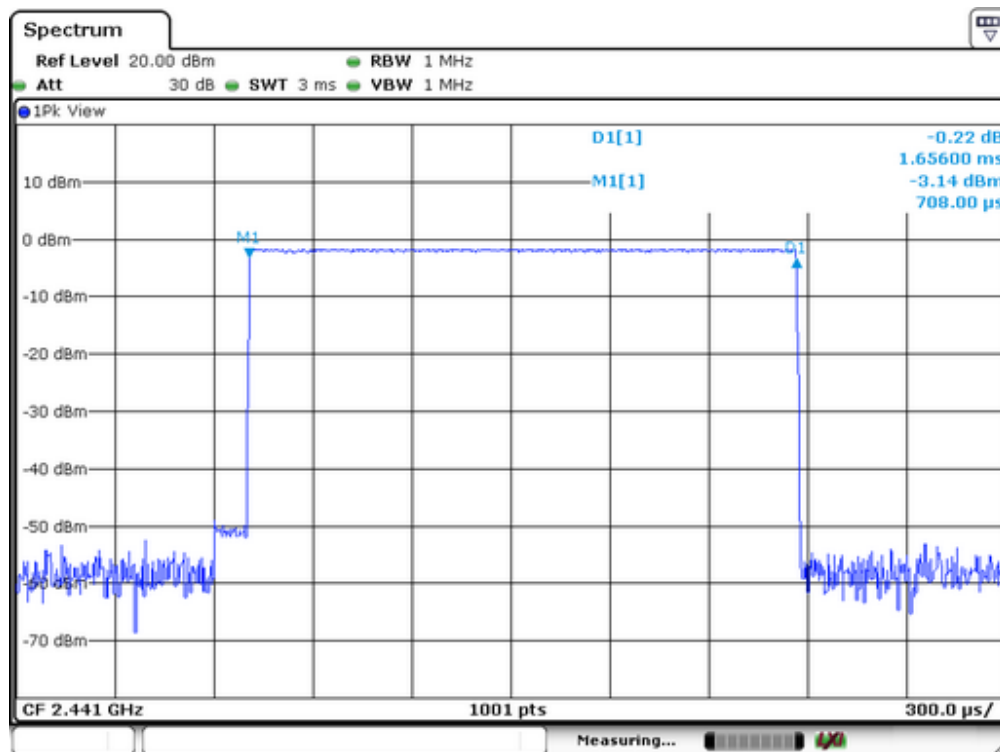
Mode	Number of transmission in a 31.6(79 Hopping*0.4)	Length of transmissions time(msec)	Result (msec)	Limit (msec)
DH1	$1600/(2*79) \times 31.6 = 320$	0.400	128	400
DH3	$1600/(4*79) \times 31.6 = 160$	1.656	264	400
DH5	$1600/(6*79) \times 31.6 = 106.67$	2.905	309	400

Remark: The results of worst case was recorded.

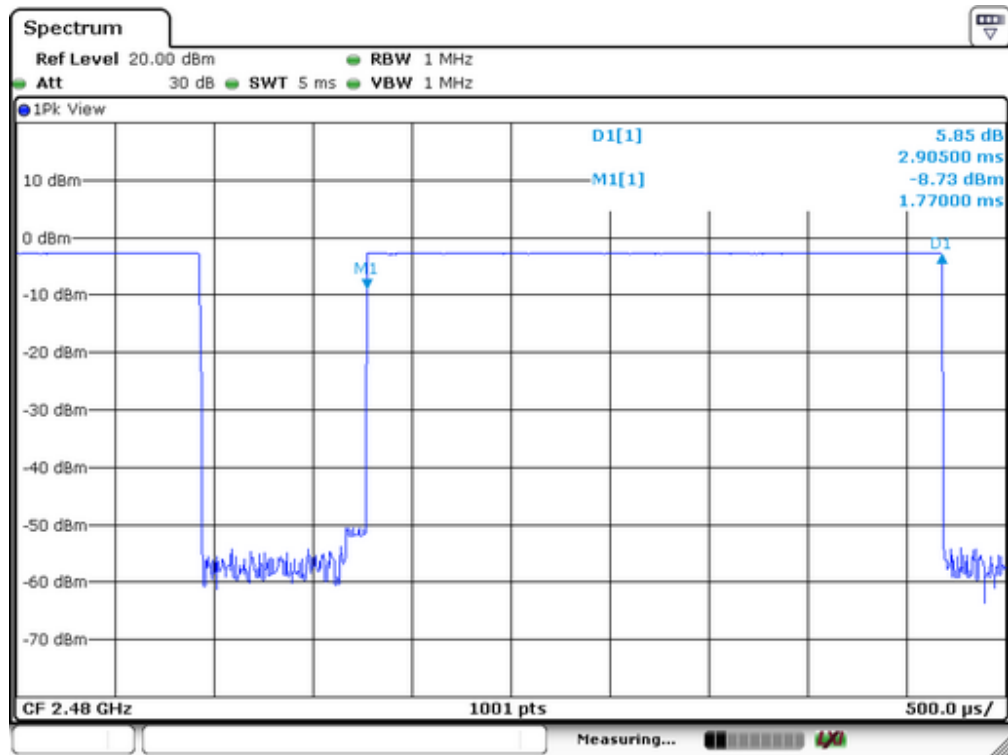
DH1:



DH3:



DH5:

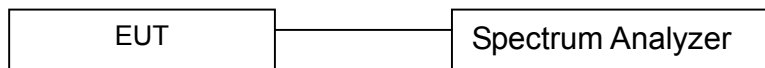


12. MAXIMUM PEAK OUTPUT POWER TEST

12.1 Measurement Procedure

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

12.2 Test SET-UP (Block Diagram of Configuration)



12.3 Measurement Equipment Used:

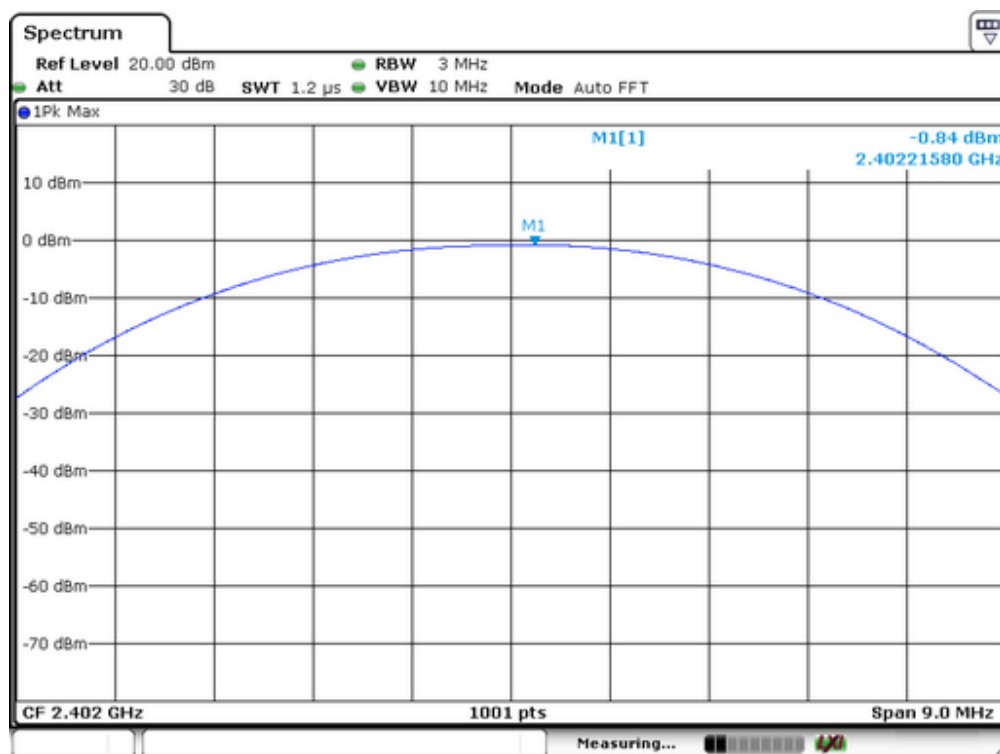
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	03/16/2015	03/15/2016
Coaxial Cable	CDS	79254	46107086	03/16/2015	03/15/2016

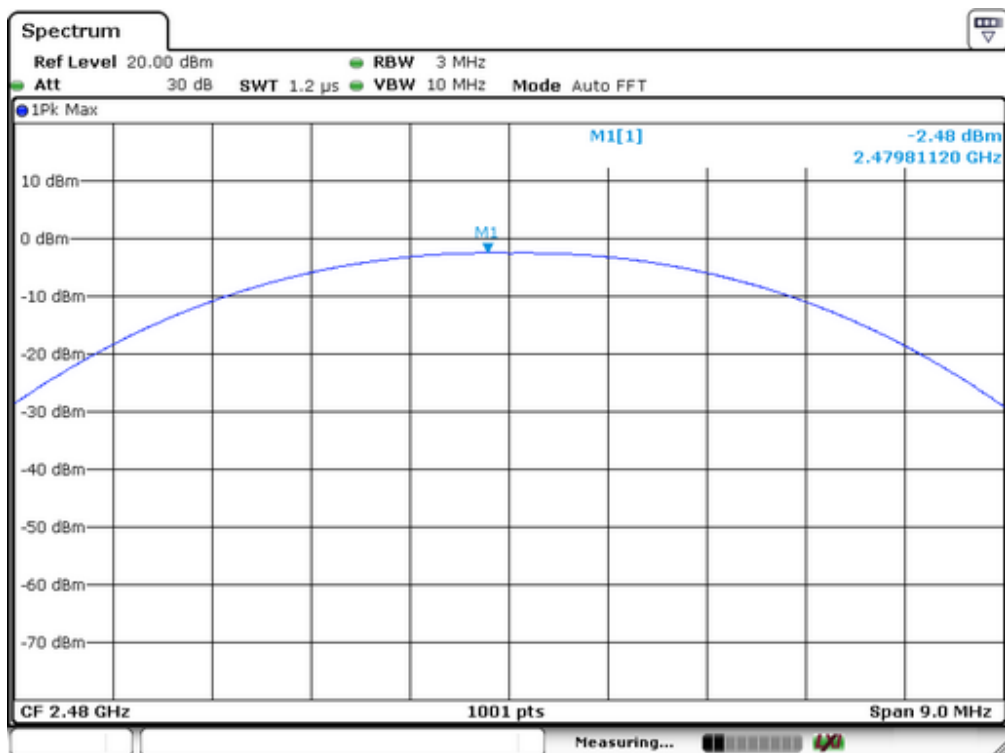
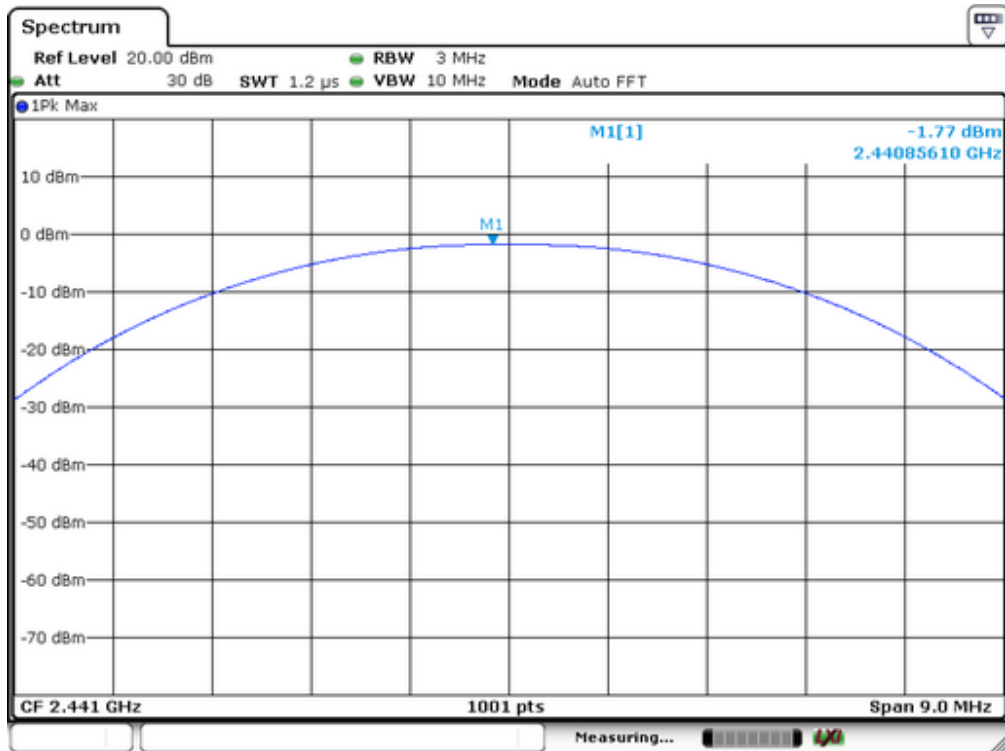
12.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	July 24, 2015
Test By:	Andy	Temperature :	25 °C
Test Result:	PASS	Humidity :	50 %
Modulation:	GFSK		

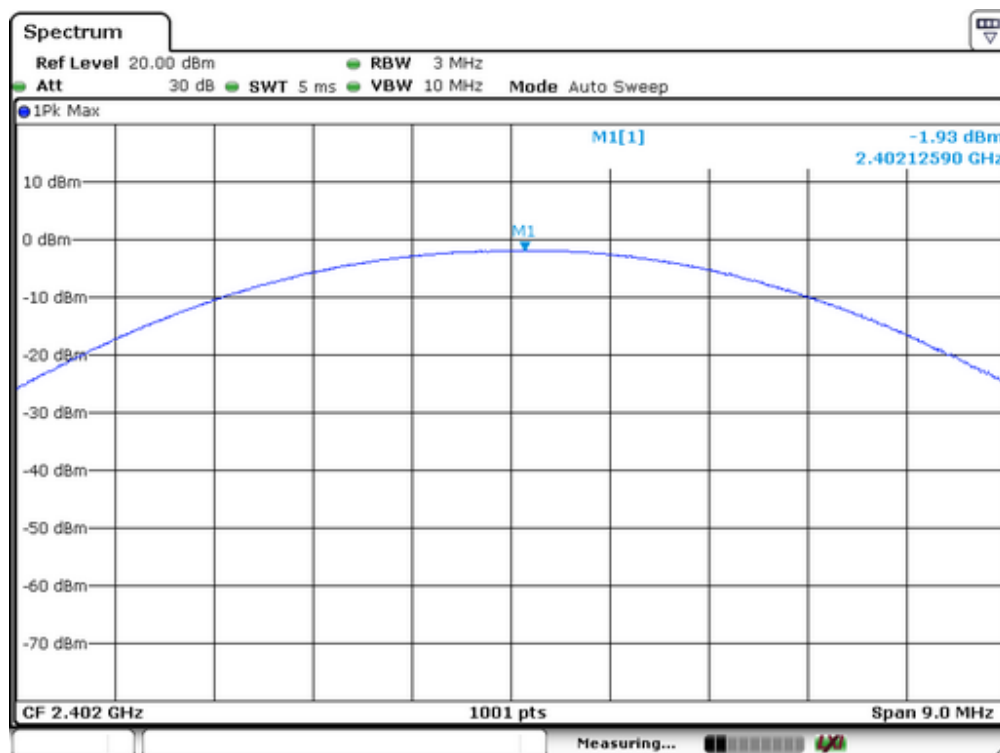
Channel Number	Channel Frequency(MHz)	Peak Power Output(dBm)	Peak Power Output(mW)	Peak Power Limit(mW)	Pass/Fail
1	2402	-0.84	0.824	1000	Pass
40	2441	-1.77	0.665	1000	Pass
79	2480	-2.48	0.565	1000	Pass

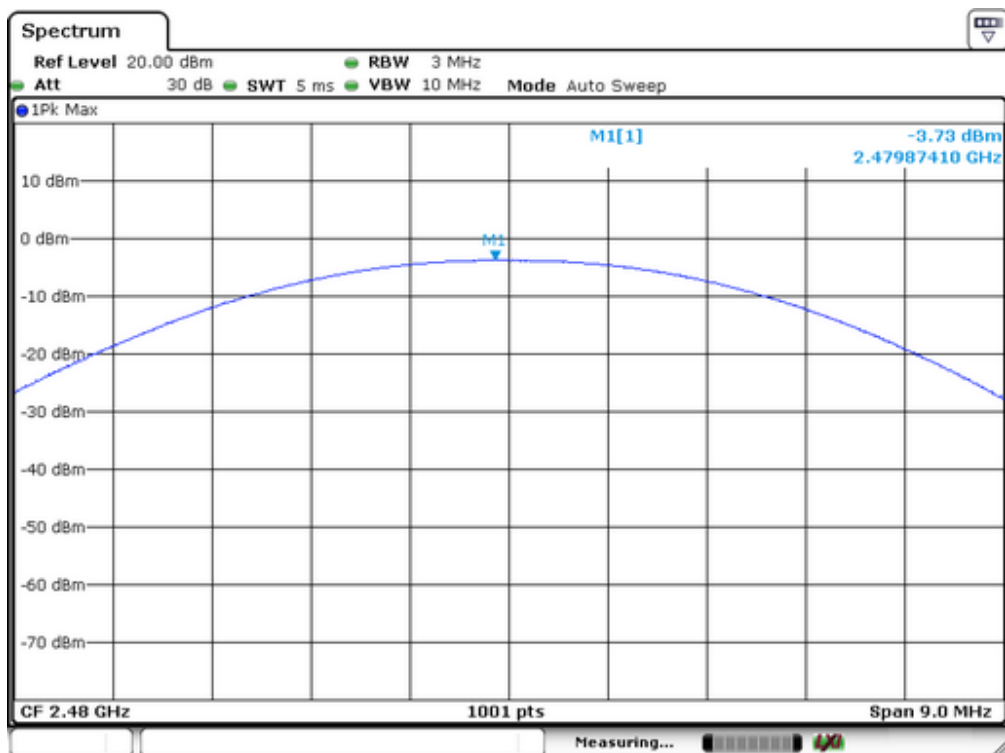
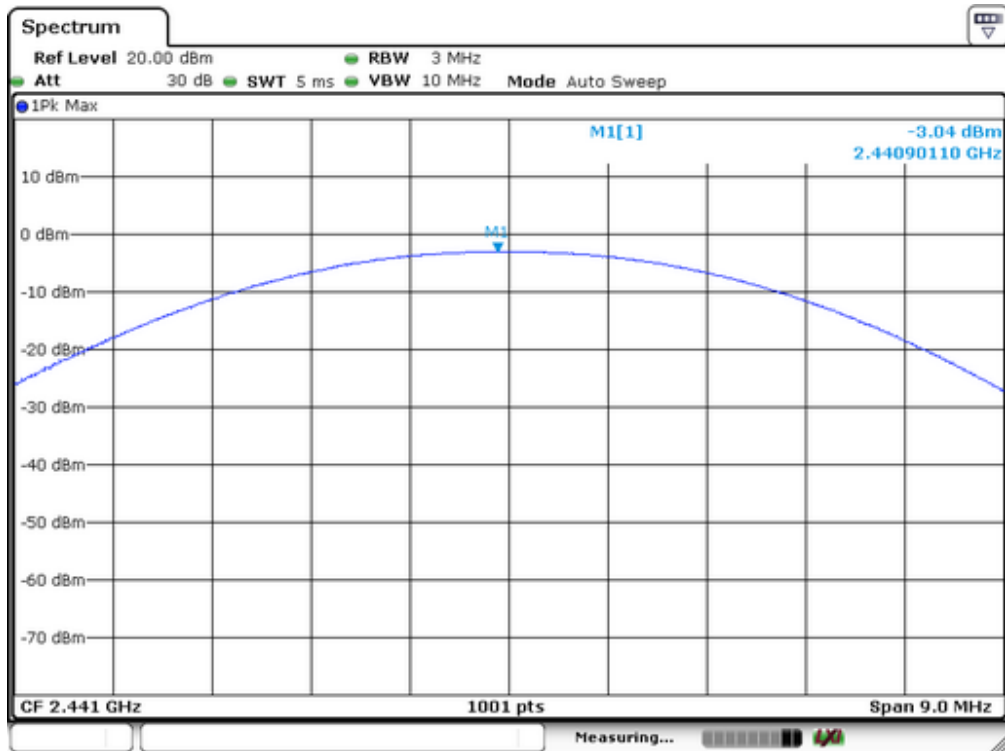




Spectrum Detector:	PK	Test Date :	July 24, 2015
Test By:	Andy	Temperature :	25 °C
Test Result:	PASS	Humidity :	50 %
Modulation:	Π/4-DQPSK		

Channel Number	Channel Frequency(MHz)	Peak Power Output(dBm)	Peak Power Output(mW)	Peak Power Limit(mW)	Pass/Fail
1	2402	-1.93	0.641	125	Pass
40	2441	-3.04	0.497	125	Pass
79	2480	-3.73	0.424	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 table which is 0.1m 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:

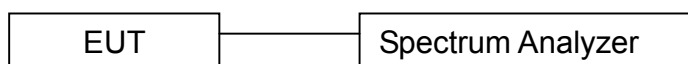
EMI Test Receiver	Setting
Attenuation	Auto
RBW	1MHz
VBW	3MHz
Detector	Peak
Trace	Max hold

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

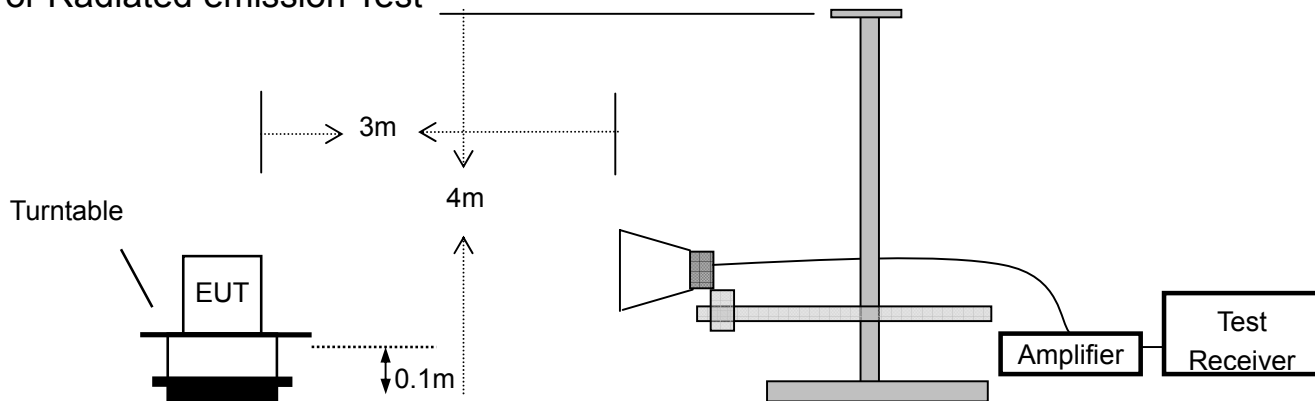
EMI Test Receiver	Setting
Attenuation	Auto
RBW	1MHz
VBW	10Hz
Detector	Peak
Trace	Max hold

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 :	July 24, 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	-1.01	-41.62	40.61	>20dBc
2399.990	pi/4-DQPSK	-1.04	-43.99	42.95	>20dBc
2484.02	GFSK	-2.64	-54.31	51.67	>20dBc
2486.94	pi/4-DQPSK	-2.64	-56.59	53.95	>20dBc

For Hopping Mode:

Frequency (MHz)	Modulation	Peak Power Output(dBm)	Emission Read Value(dBm)	Result of Band Edge(dBc)	Band Edge Limit(dBc)
2399.990	GFSK	-2.84	-45.18	42.34	>20dBc
2399.520	pi/4-DQPSK	-2.85	-45.64	42.79	>20dBc
2483.610	GFSK	-4.64	-53.9	49.26	>20dBc
2483.54	pi/4-DQPSK	-4.65	-54.12	49.47	>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
2399.568	H	64.15	44.15	74	54	-9.85	-9.85
2399.075	V	60.35	40.72	74	54	-13.65	-13.28
2485.36	H	63.28	45.05	74	54	-10.72	-8.95
2484.115	V	59.04	38.92	74	54	-14.96	-15.08

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
2399.548	H	63.05	44.25	74	54	-10.95	-9.75
2398.041	V	60.48	41.05	74	54	-13.52	-12.95
2483.628	H	61.27	43.09	74	54	-12.73	-10.91
2484.156	V	59.38	38.78	74	54	-14.62	-15.22

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 -0.68 dBi and meets the requirement.

APPENDIX I (Photos of EUT)





