EMTEK
Access to the World

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

OF

WATERPROOF MEDIA PLAYER

Model No.: AQ-MP-5UBT, AQ-MP-5UBT-H, AQ-MP-5UBTS, AQ-MP-5UBT-HS

Trademark: AQUATIC AV

FCC ID: WBQ-SM78I

Report No.: KAD150529177E

Issue Date: February 24, 2016

Prepared for

AQUATIC AV
282 Kinney Drive, San Jose, California United States

Prepared by

EMTEK(DONGGUAN) CO., LTD.

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

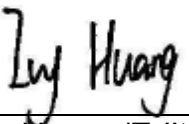
VERIFICATION OF COMPLIANCE

Applicant:	AQUATIC AV 282 Kinney Drive, San Jose, California United States
Manufacturer:	AQUATIC AV 282 Kinney Drive, San Jose, California United States
Product Description:	WATERPROOF MEDIA PLAYER
Trademark:	AQUATIC AV
Model Number:	AQ-MP-5UBT, AQ-MP-5UBT-H, AQ-MP-5UBTS, AQ-MP-5UBT-HS (Note: The samples are the same except appearance (for color and silk-screen only) and model number. So we prepared AQ-MP-5UBT for full test.)
Kind of Device:	Bluetooth Ver.2.1+EDR

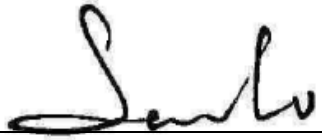
We hereby certify that:

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 : May 29, 2015 to September 15, 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	/	KAD150529177E

Table of Contents

1. GENERAL INFORMATION

1.1 Product Description

Characteristics	Description
Product Name	WATERPROOF MEDIA PLAYER
Model number	AQ-MP-5UBT
Power Supply	DC 12V
Kind of Device	Bluetooth Ver.2.1+EDR
Modulation	GFSK, π/4-DQPSK, 8DPSK
Operating Frequency Range	2402-2480MHz
Number of Channels	79
Transmit Power Max(PK)	2.60dBm(0. 00182W)
Antenna Type	Wire antenna
Antenna Gain	4dBi
Product Software Version	1509070011
Product Hardware version	VER1.0

1.2 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.10-2013. Radiated testing was performed at an antenna to EUT distance 3 meters.

1.3 Test Facility

Site Description

EMC Lab. :

Registered on FCC, June 18, 2014
The Certificate Number is 247565

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

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

2.3.2 Radiated Emissions

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

2.4 Configuration of Tested System

Fig. 2-1 Configuration of Tested System

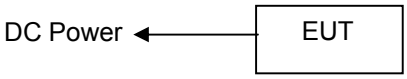


Table 2-1 Equipment Used in Tested System

Item	Equipment	Trademark	Model No.	FCC ID	Note
1.	WATERPROOF MEDIA PLAYER	AQUATIC AV	AQ-MP-5UBT	WBQ-SM78I	***EUT***

Note:

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

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

3. Summary of Test Results

FCC Rules	Description Of Test	Result
§15.207	AC Power Conducted Emission	N/A
§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: The EUT is supplied by battery, there is no need for AC Power Conducted Emission test to be performed on this product.

4. Description of test modes

The EUT has been tested under TX operating condition.
This EUT is a FHSS system, were conducted to determine the final configuration from all possible combinations. We use software control the EUT, Let EUT hopping on and transmit with highest power, All the modes GFSK,Π/4-DQPSK, 8DPSK have been tested. 79 Channels are provided by EUT. The 3 channels of lower, medium and higher were chosen for test.

Channel	Frequency(MHz)
1	2402
40	2441
79	2480

5. TEST SYSTEM UNCERTAINTY

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

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

Measurement Uncertainty for a level of Confidence of 95%

6. Radiated Emission Test

6.1 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. For range 9KHz~30MHz, The measured value is really too low to be recorded.
6. For the radiated emission test above 1GHz:
   Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

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:

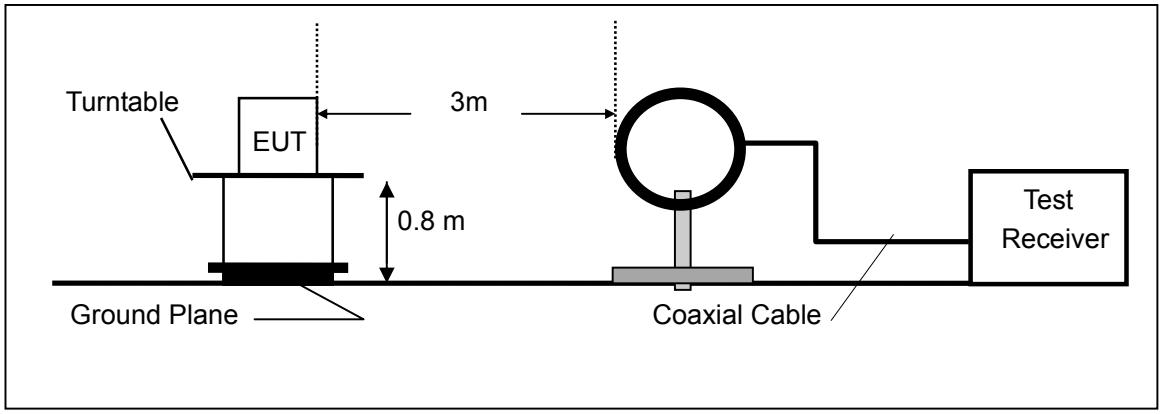
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	3MHz
Detector	Peak
Trace	Max hold

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

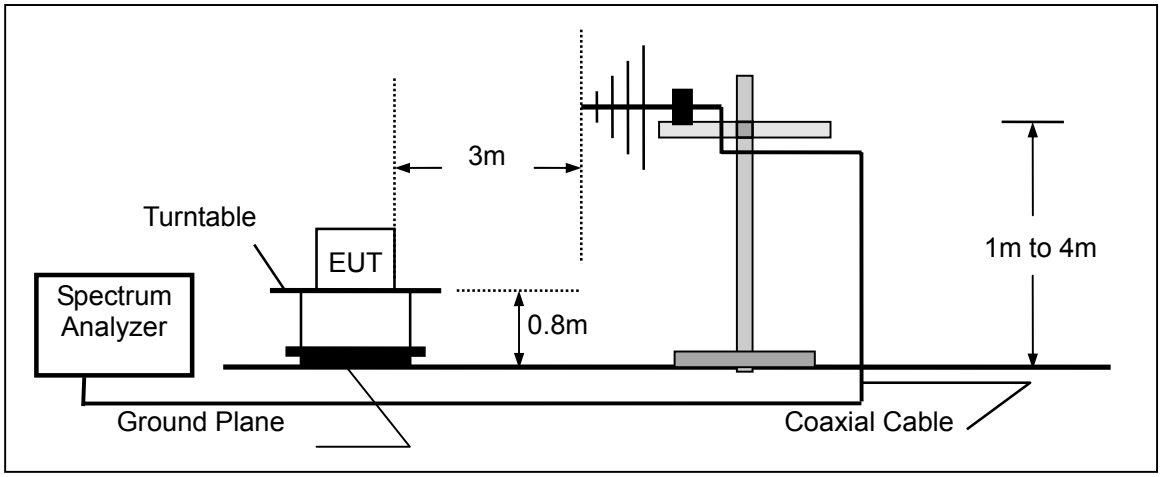
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	10Hz
Detector	Peak
Trace	Max hold

6.2 Test SET-UP (Block Diagram of Configuration)

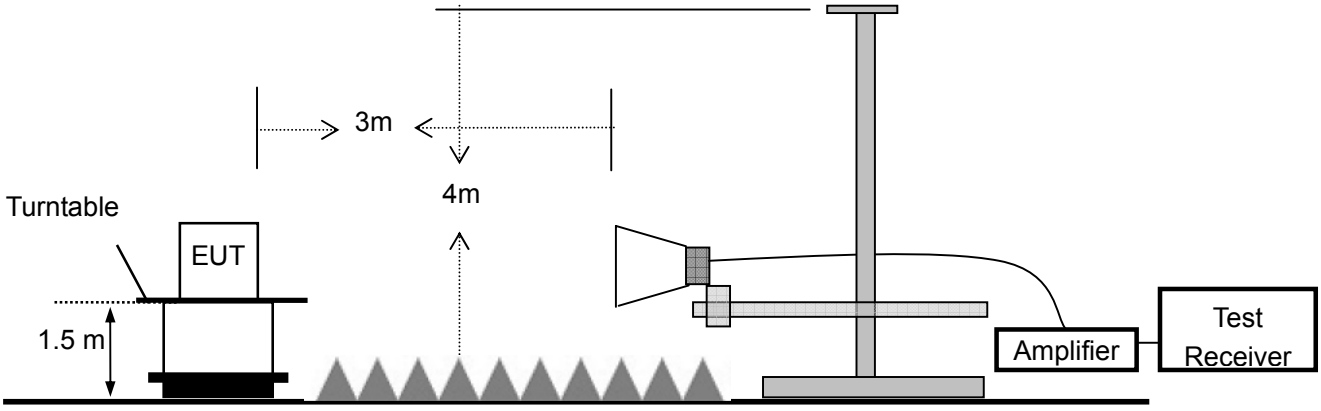
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



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



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



6.3 Measurement Equipment Used:

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

6.4 Measurement Result

Below 30MHz:

All the modulation modes were tested the data of the test mode are recorded in the following pages.

Operation Mode:	TX Mode	Test Date :	August 13, 2015
Frequency Range:	9KHz~30MHz	Temperature :	28℃
Test Result:	PASS	Humidity :	60 %
Measured Distance:	3m	Test By:	Andy

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

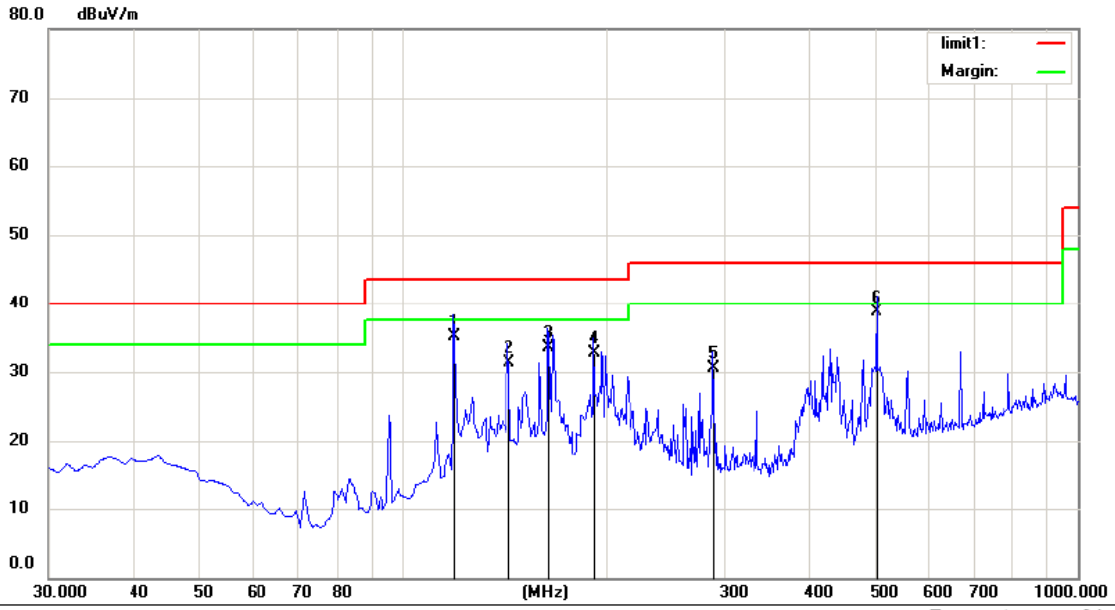
Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.
Distance extrapolation factor =40log(Specific distance/ test distance)(dB);
Limit line=Specific limits(dBuV) + distance extrapolation factor.

Below 1000MHz:

Pass.

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

Please refer to the following data.



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

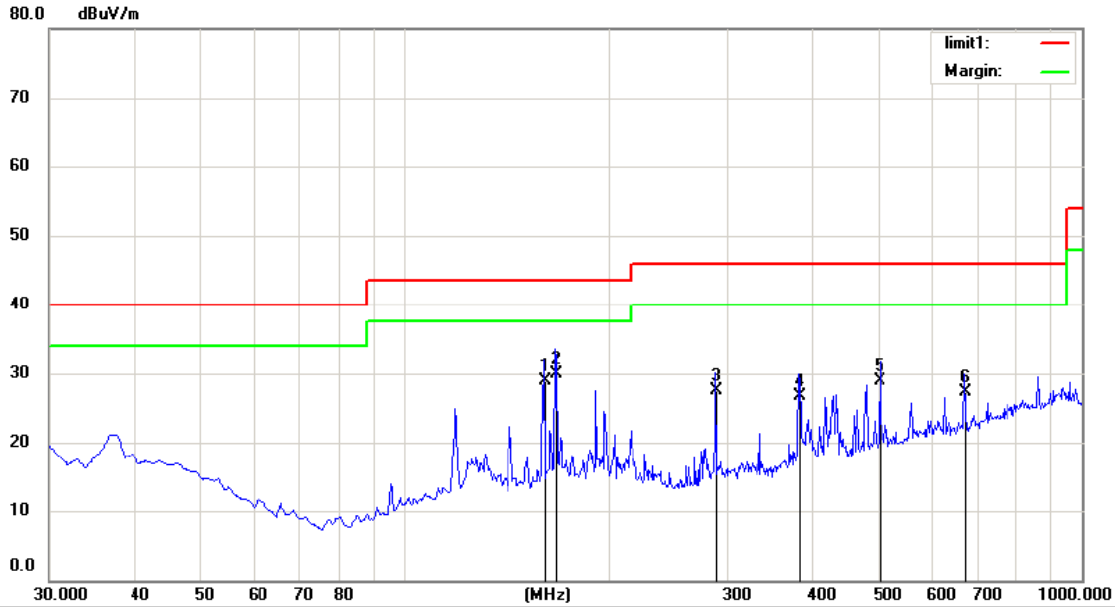
Limit: (RE)FCC PART 15 class B 3m Power: DC 12V Humidity: 55 %

Mode: TX 2402(GFSK)

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		119.2400	52.07	-17.01	35.06	43.50	-8.44	QP			
2		143.4900	48.64	-17.29	31.35	43.50	-12.15	QP			
3		164.8300	51.85	-18.39	33.46	43.50	-10.04	QP			
4		191.9900	50.90	-18.14	32.76	43.50	-10.74	QP			
5		288.0200	45.32	-14.77	30.55	46.00	-15.45	QP			
6	*	504.3300	48.94	-10.28	38.66	46.00	-7.34	QP			

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



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

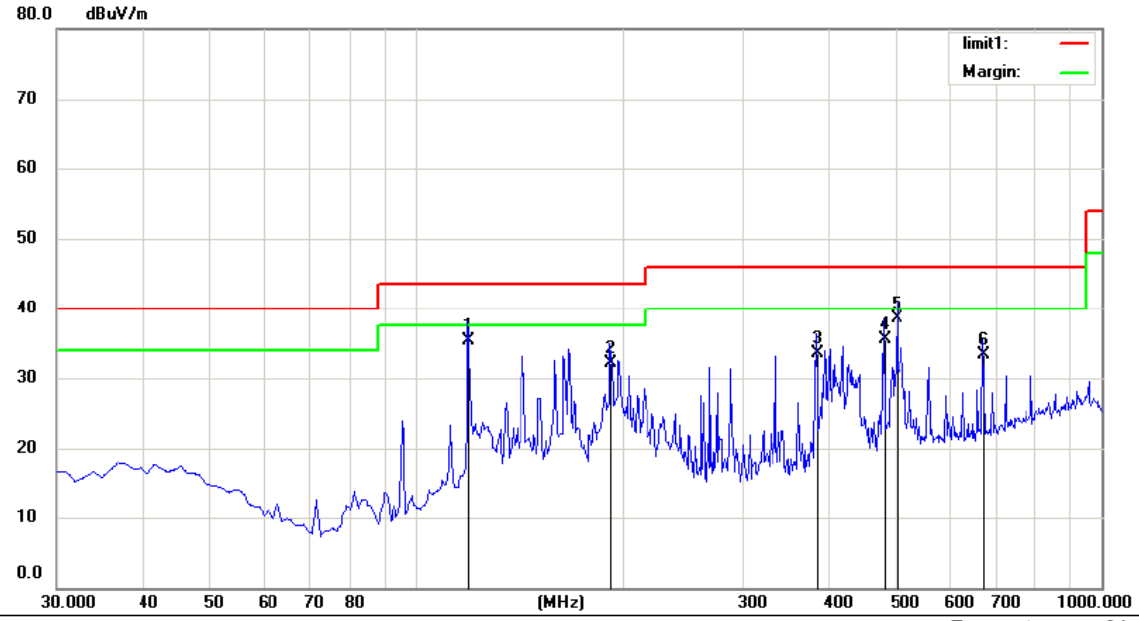
Limit: (RE)FCC PART 15 class B 3m Power: DC 12V Humidity: 55 %

Mode: TX 2402(GFSK)

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		160.9500	47.26	-18.43	28.83	43.50	-14.67	QP			
2	*	167.7400	48.22	-18.41	29.81	43.50	-13.69	QP			
3		288.0200	42.19	-14.77	27.42	46.00	-18.58	QP			
4		383.0800	38.63	-12.01	26.62	46.00	-19.38	QP			
5		504.3300	39.12	-10.28	28.84	46.00	-17.16	QP			
6		672.1400	35.08	-7.69	27.39	46.00	-18.61	QP			

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



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

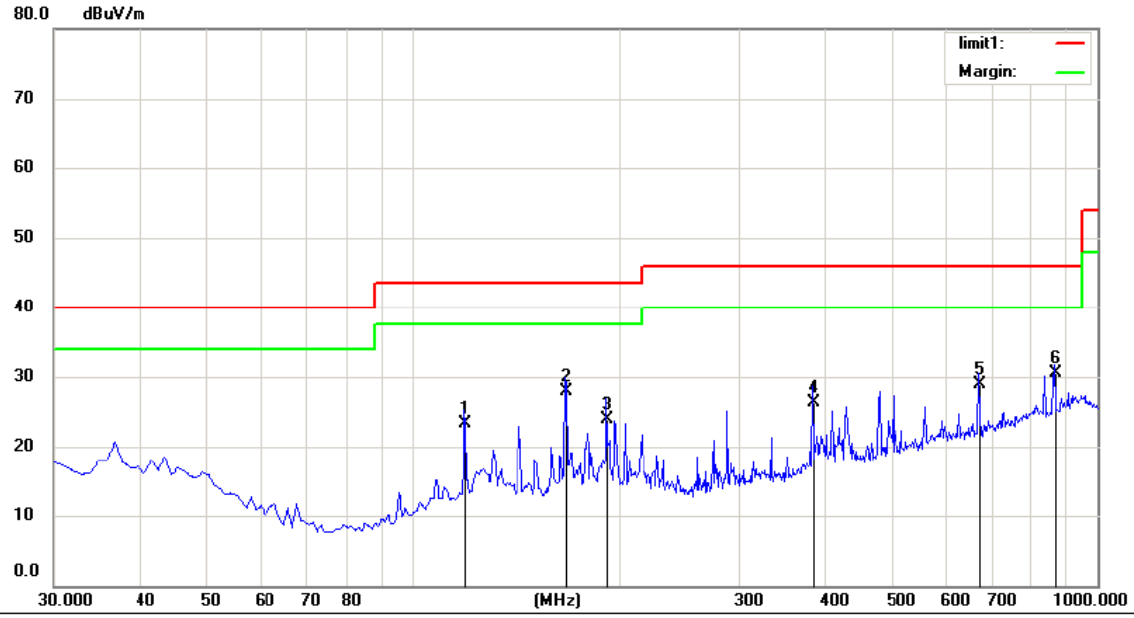
Limit: (RE)FCC PART 15 class B 3m Power: DC 12V Humidity: 55 %

Mode: TX 2402(Pi/4-DQPSK)

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		119.2400	52.30	-17.01	35.29	43.50	-8.21	QP			
2		191.9900	50.21	-18.14	32.07	43.50	-11.43	QP			
3		384.0500	45.39	-11.96	33.43	46.00	-12.57	QP			
4		481.0500	46.12	-10.54	35.58	46.00	-10.42	QP			
5	*	504.3300	48.77	-10.28	38.49	46.00	-7.51	QP			
6		672.1400	40.89	-7.66	33.23	46.00	-12.77	QP			

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



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

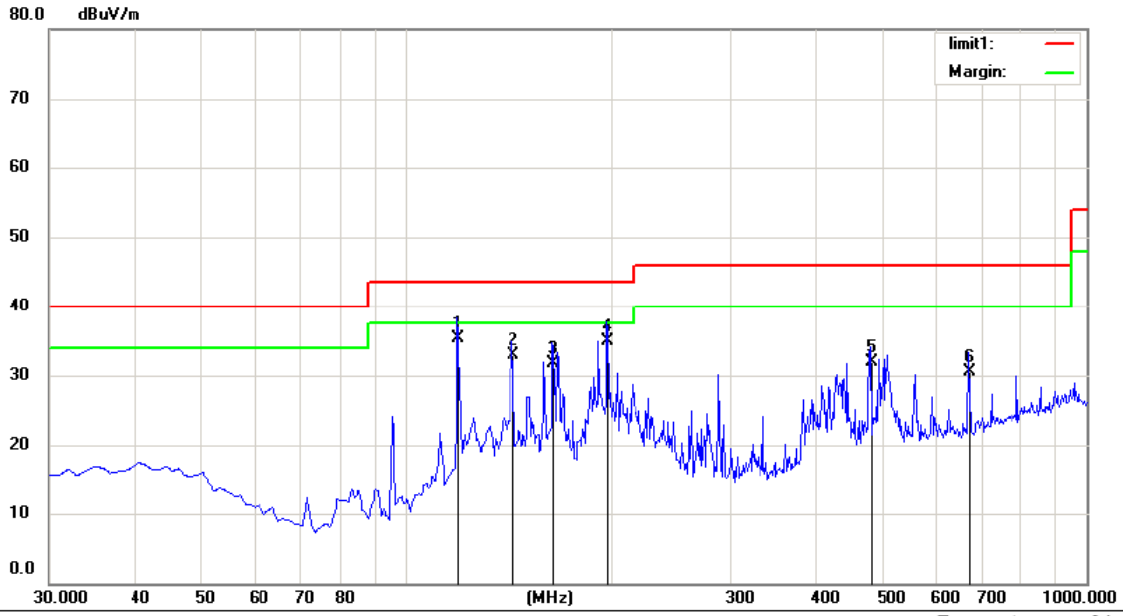
Limit: (RE)FCC PART 15 class B 3m Power: DC 12V Humidity: 55 %

Mode: TX 2402(Pi/4-DQPSK)

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		119.2400	40.31	-17.01	23.30	43.50	-20.20	QP			
2		167.7400	46.28	-18.41	27.87	43.50	-15.63	QP			
3		191.9900	42.11	-18.14	23.97	43.50	-19.53	QP			
4		384.0500	38.29	-11.96	26.33	46.00	-19.67	QP			
5		672.1400	36.50	-7.69	28.81	46.00	-17.19	QP			
6	*	866.1400	34.79	-4.37	30.42	46.00	-15.58	QP			

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



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

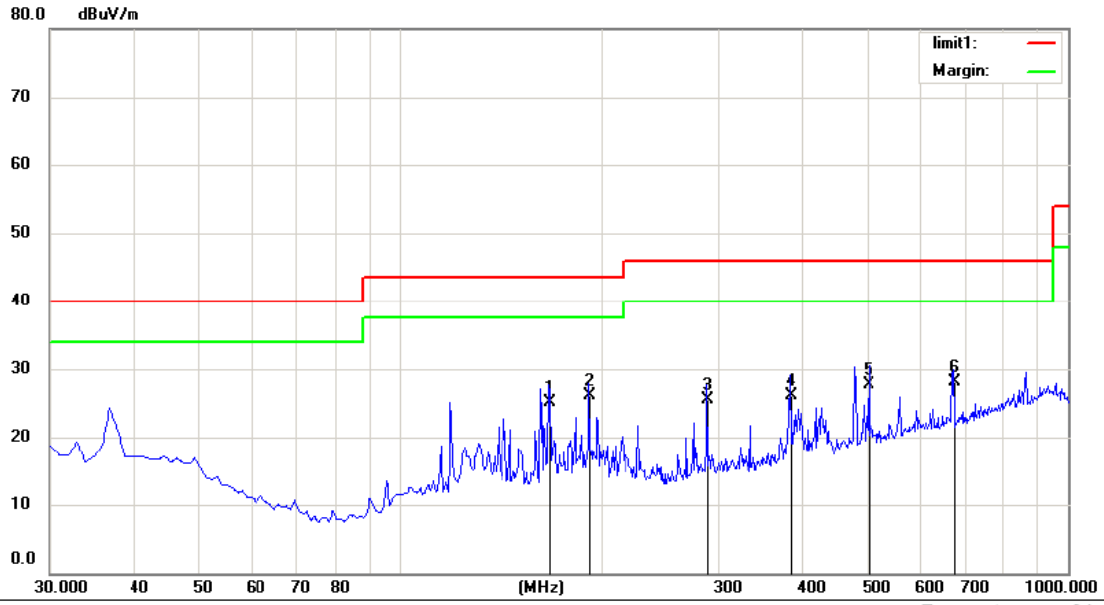
Limit: (RE)FCC PART 15 class B 3m Power: DC 12V Humidity: 55 %

Mode: TX 2402(8DPSK)

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	119.2400	52.39	-17.01	35.38	43.50	-8.12	QP			
2		143.4900	50.27	-17.29	32.98	43.50	-10.52	QP			
3		164.8300	50.11	-18.39	31.72	43.50	-11.78	QP			
4		197.8100	52.69	-17.78	34.91	43.50	-8.59	QP			
5		481.0500	42.37	-10.54	31.83	46.00	-14.17	QP			
6		672.1400	38.26	-7.66	30.60	46.00	-15.40	QP			

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



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

Limit: (RE)FCC PART 15 class B 3m Power: DC 12V Humidity: 55 %

Mode: TX 2402(8DPSK)

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		167.7400	43.59	-18.41	25.18	43.50	-18.32	QP			
2	*	191.9900	44.32	-18.14	26.18	43.50	-17.32	QP			
3		288.0200	40.21	-14.77	25.44	46.00	-20.56	QP			
4		384.0500	38.02	-11.96	26.06	46.00	-19.94	QP			
5		504.3300	37.95	-10.28	27.67	46.00	-18.33	QP			
6		673.1100	35.69	-7.67	28.02	46.00	-17.98	QP			

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

Above 1000MHz~10th Harmonics:

Operation Mode: GFSK (CH1: 2402MHz) Test Date : August 13, 2015

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4804	V	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

Operation Mode: GFSK (CH40: 2441MHz) Test Date : August 13, 2015

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4882	V	65.39	46.66	74	54	-8.61	-7.34
7323	V	64.37	45.47	74	54	-9.63	-8.53
9764	V	63.48	44.67	74	54	-10.52	-9.33
12205	V	62.67	43.57	74	54	-11.33	-10.43
14646	V	61.59	42.68	74	54	-12.41	-11.32
17087	V	60.37	41.59	74	54	-13.63	-12.41
4882	H	65.2	46.13	74	54	-8.8	-7.87
7323	H	64.27	45.37	74	54	-9.73	-8.63
9764	H	63.39	44.35	74	54	-10.61	-9.65
12205	H	62.19	43.57	74	54	-11.81	-10.43
14646	H	61.57	42.68	74	54	-12.43	-11.32
17087	H	60.49	41.64	74	54	-13.51	-12.36

Operation Mode: TX Mode (CH79: 2480MHz) Test Date : August 13, 2015

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4960	V	65.09	46.88	74	54	-8.91	-7.12
7440	V	64.59	45.82	74	54	-9.41	-8.18
9920	V	63.58	44.38	74	54	-10.42	-9.62
12400	V	62.49	43.58	74	54	-11.51	-10.42
14880	V	61.35	42.67	74	54	-12.65	-11.33
17360	V	60.97	41.38	74	54	-13.03	-12.62
4960	H	66.98	45.29	74	54	-7.02	-8.71
7440	H	65.37	44.78	74	54	-8.63	-9.22
9920	H	64.29	43.64	74	54	-9.71	-10.36
12400	H	63.98	42.39	74	54	-10.02	-11.61
14880	H	62.49	41.86	74	54	-11.51	-12.14
17360	H	61.49	40.97	74	54	-12.51	-13.03

Operation Mode: Pi/4-DQPSK (CH1: 2402MHz) Test Date : August 13, 2015

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4804	V	64.19	45.12	74	54	-9.81	-8.88
7206	V	63.19	44.25	74	54	-10.81	-9.75
9608	V	62.49	43.58	74	54	-11.51	-10.42
12010	V	61.29	42.67	74	54	-12.71	-11.33
14412	V	60.37	41.56	74	54	-13.63	-12.44
16814	V	59.68	40.58	74	54	-14.32	-13.42
4804	H	65.24	45.06	74	54	-8.76	-8.94
7206	H	64.58	44.35	74	54	-9.42	-9.65
9608	H	63.93	43.75	74	54	-10.07	-10.25
12010	H	62.97	42.89	74	54	-11.03	-11.11
14412	H	61.94	41.49	74	54	-12.06	-12.51
16814	H	60.49	40.46	74	54	-13.51	-13.54

Operation Mode: Pi/4-DQPSK (CH40: 2441MHz) Test Date : August 13, 2015

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4882	V	64.26	45.81	74	54	-9.74	-8.19
7323	V	63.25	44.35	74	54	-10.75	-9.65
9764	V	62.13	43.28	74	54	-11.87	-10.72
12205	V	61.78	42.87	74	54	-12.22	-11.13
14646	V	60.39	41.97	74	54	-13.61	-12.03
17087	V	59.68	40.64	74	54	-14.32	-13.36
4882	H	65.36	46.77	74	54	-8.64	-7.23
7323	H	64.56	45.37	74	54	-9.44	-8.63
9764	H	63.47	44.57	74	54	-10.53	-9.43
12205	H	62.39	43.64	74	54	-11.61	-10.36
14646	H	61.59	42.69	74	54	-12.41	-11.31
17087	H	60.58	41.57	74	54	-13.42	-12.43

Operation Mode: Pi/4-DQPSK (CH79: 2480MHz) Test Date : August 13, 2015

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4960	V	63.55	45.29	74	54	-10.45	-8.71
7440	V	62.59	44.67	74	54	-11.41	-9.33
9920	V	61.67	43.59	74	54	-12.33	-10.41
12400	V	60.38	42.67	74	54	-13.62	-11.33
14880	V	59.89	41.32	74	54	-14.11	-12.68
17360	V	58.67	40.98	74	54	-15.33	-13.02
4960	H	66.93	44.41	74	54	-7.07	-9.59
7440	H	65.39	43.67	74	54	-8.61	-10.33
9920	H	64.59	42.61	74	54	-9.41	-11.39
12400	H	63.95	41.32	74	54	-10.05	-12.68
14880	H	63.47	40.78	74	54	-10.53	-13.22
17360	H	62.85	39.68	74	54	-11.15	-14.32

Operation Mode: 8DPSK (CH1: 2402MHz) Test Date : August 13, 2015

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4804	V	65.38	44.82	74	54	-8.62	-9.18
7206	V	64.29	43.45	74	54	-9.71	-10.55
9608	V	63.19	42.58	74	54	-10.81	-11.42
12010	V	62.49	41.67	74	54	-11.51	-12.33
14412	V	61.38	40.78	74	54	-12.62	-13.22
16814	V	60.78	39.46	74	54	-13.22	-14.54
4804	H	65.03	45.99	74	54	-8.97	-8.01
7206	H	64.28	44.35	74	54	-9.72	-9.65
9608	H	63.89	43.67	74	54	-10.11	-10.33
12010	H	62.48	42.19	74	54	-11.52	-11.81
14412	H	61.49	40.38	74	54	-12.51	-13.62
16814	H	60.79	39.87	74	54	-13.21	-14.13

Operation Mode: 8DPSK (CH40: 2441MHz) Test Date : August 13, 2015

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4882	V	66.03	46.05	74	54	-7.97	-7.95
7323	V	65.28	45.67	74	54	-8.72	-8.33
9764	V	64.59	44.38	74	54	-9.41	-9.62
12205	V	63.29	43.65	74	54	-10.71	-10.35
14646	V	62.18	42.46	74	54	-11.82	-11.54
17087	V	61.37	41.38	74	54	-12.63	-12.62
4882	H	65.44	45.22	74	54	-8.56	-8.78
7323	H	64.38	44.25	74	54	-9.62	-9.75
9764	H	63.94	43.59	74	54	-10.06	-10.41
12205	H	62.59	42.16	74	54	-11.41	-11.84
14646	H	61.49	41.46	74	54	-12.51	-12.54
17087	H	60.79	40.59	74	54	-13.21	-13.41

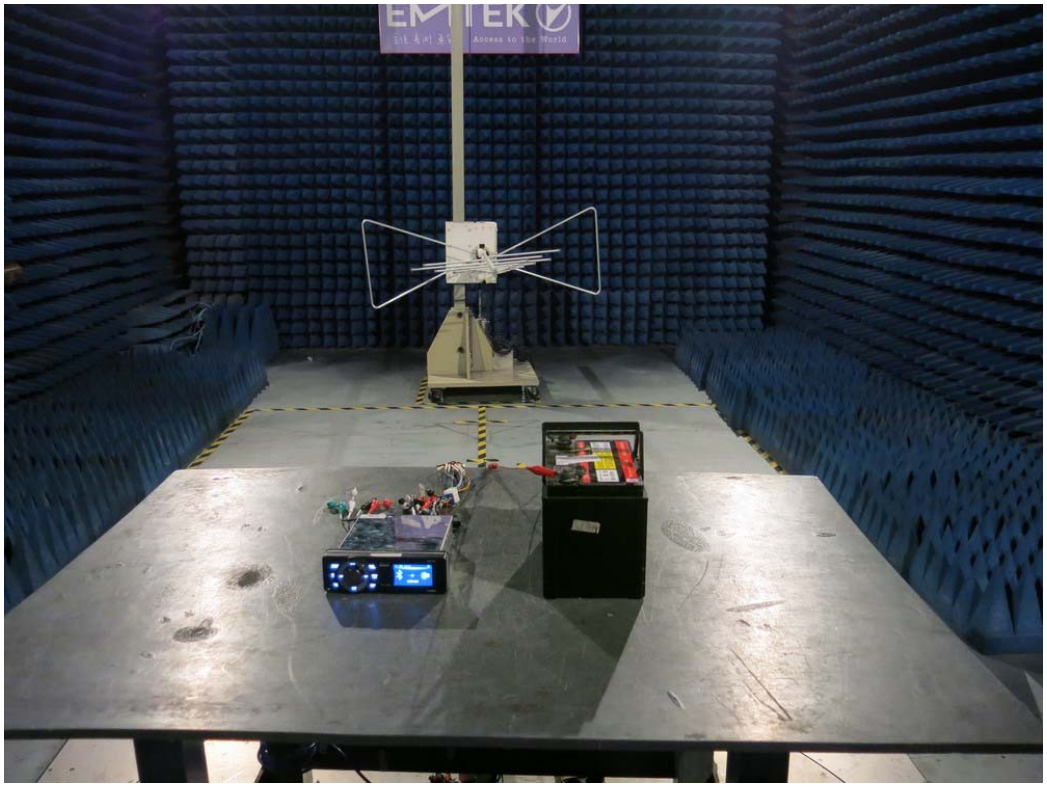
Operation Mode: 8DPSK (CH79: 2480MHz) Test Date : August 13, 2015

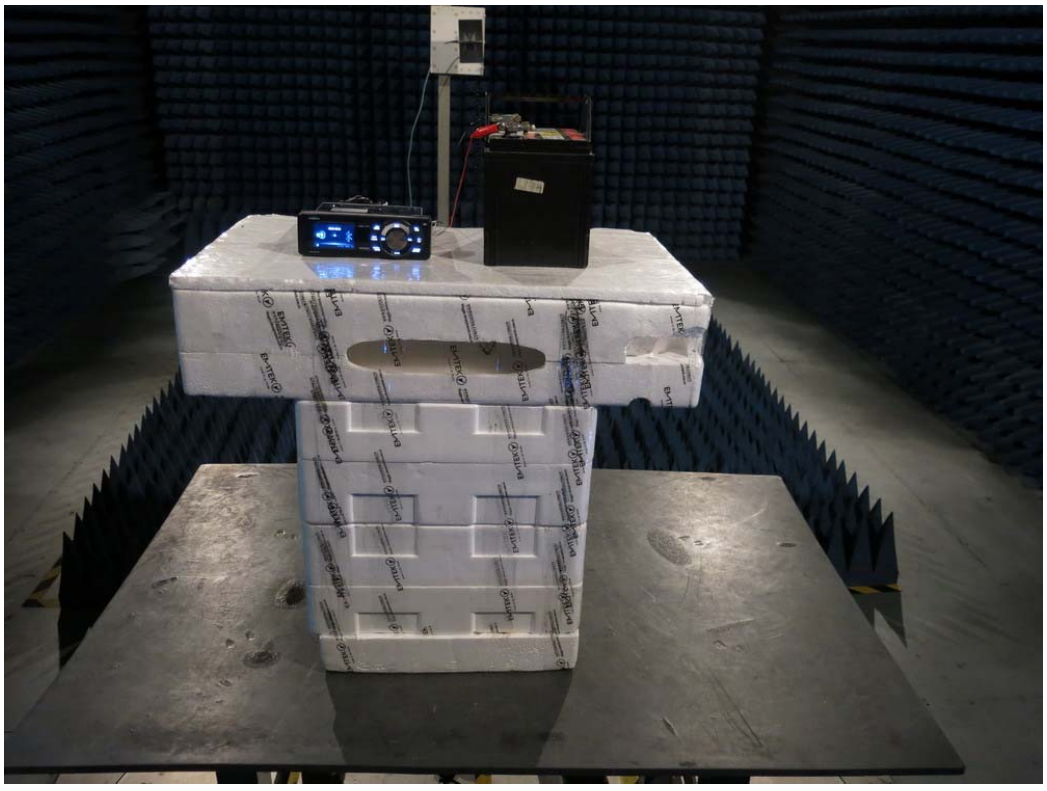
Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4960	V	66.68	45.36	74	54	-7.32	-8.64
7440	V	65.52	44.69	74	54	-8.48	-9.31
9920	V	64.26	43.35	74	54	-9.74	-10.65
12400	V	63.25	42.65	74	54	-10.75	-11.35
14880	V	62.69	41.58	74	54	-11.31	-12.42
17360	V	61.59	40.26	74	54	-12.41	-13.74
4960	H	60.58	45.36	74	54	-13.42	-8.64
7440	H	60.53	44.36	74	54	-13.47	-9.64
9920	H	59.96	43.26	74	54	-14.04	-10.74
12400	H	59.66	42.25	74	54	-14.34	-11.75
14880	H	59.62	41.72	74	54	-14.38	-12.28
17360	H	58.63	40.53	74	54	-15.37	-13.47

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.

6.5 Radiated Measurement Photos:



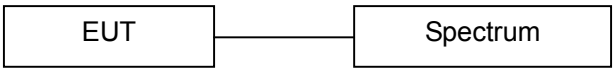


7. Channel Separation test

7.1 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.

7.2 Test SET-UP (Block Diagram of Configuration)



7.3 Measurement Equipment Used:

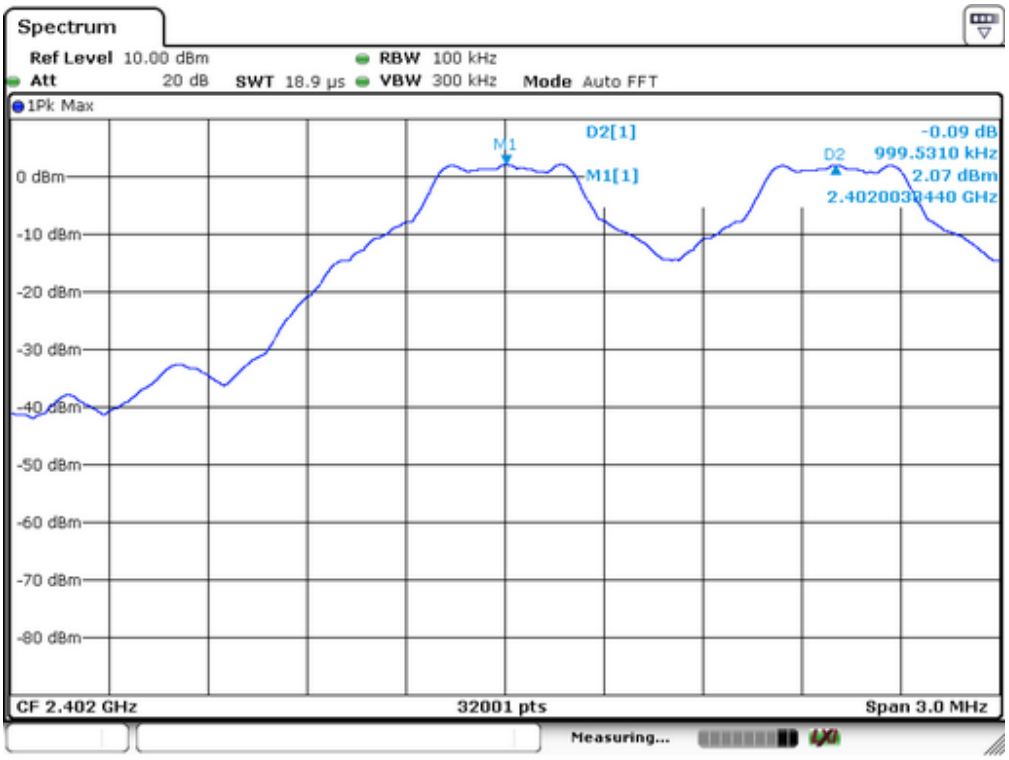
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	Cal. Interval
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	03/15/2015	1 Year
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	03/15/2015	1 Year
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	03/15/2015	1 Year

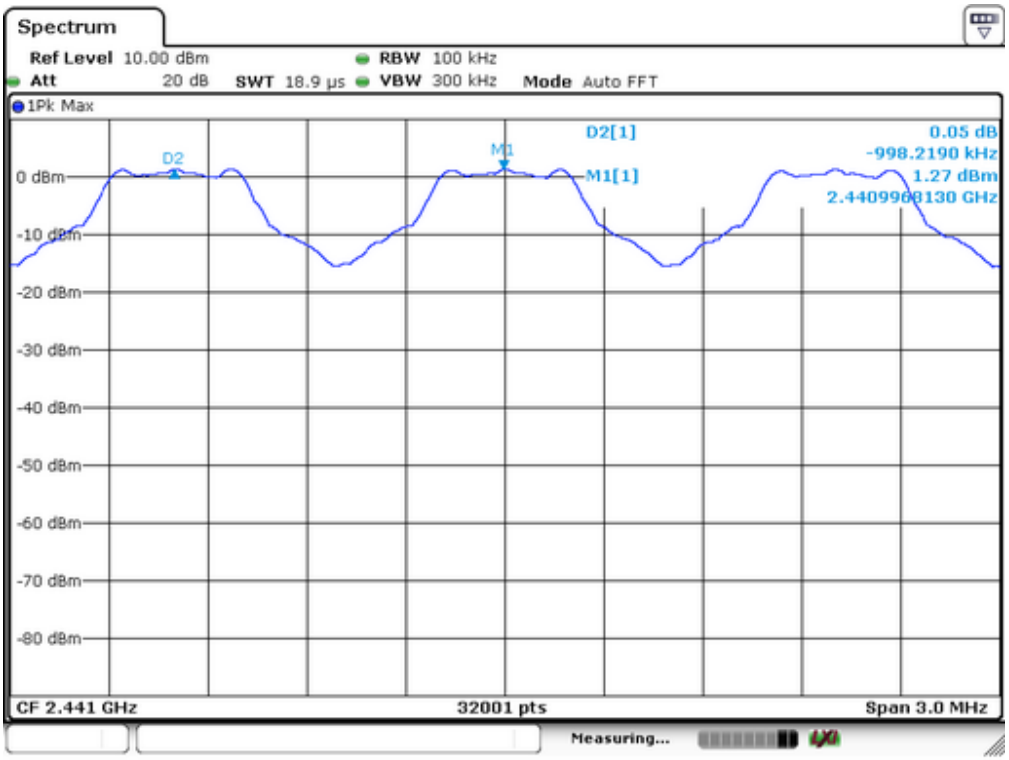
7.4 Measurement Results:

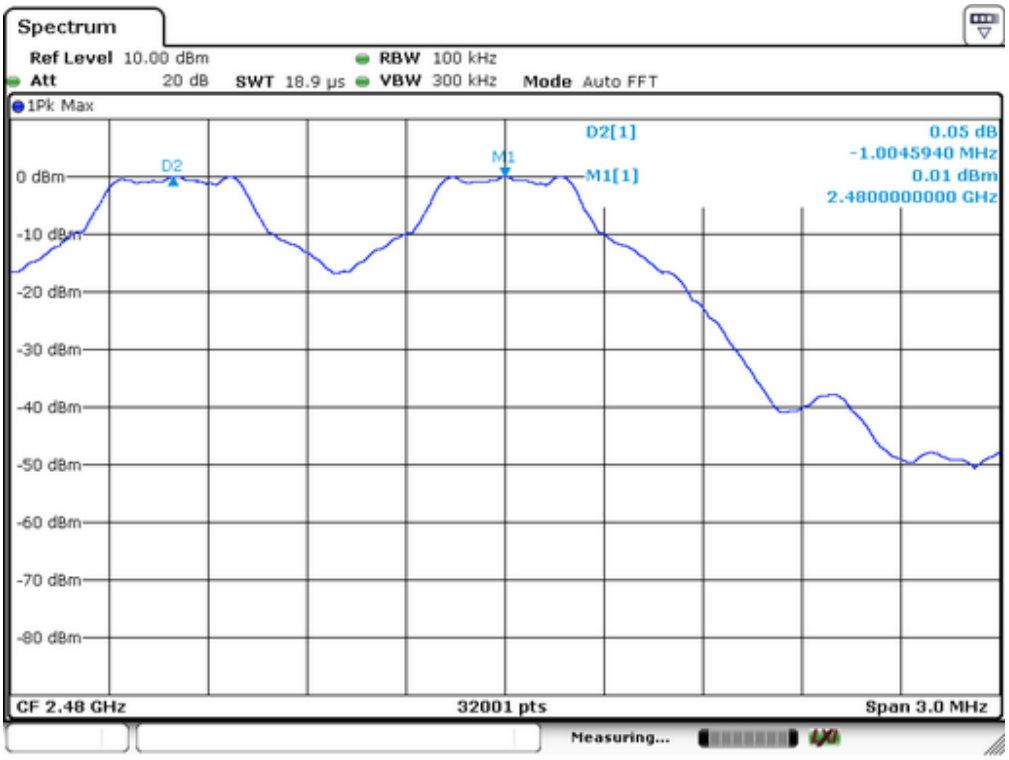
Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	August 13, 2015
Test By:	Andy	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	GFSK		

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	999	>735
40	2441	998	>738
79	2480	1004	>738

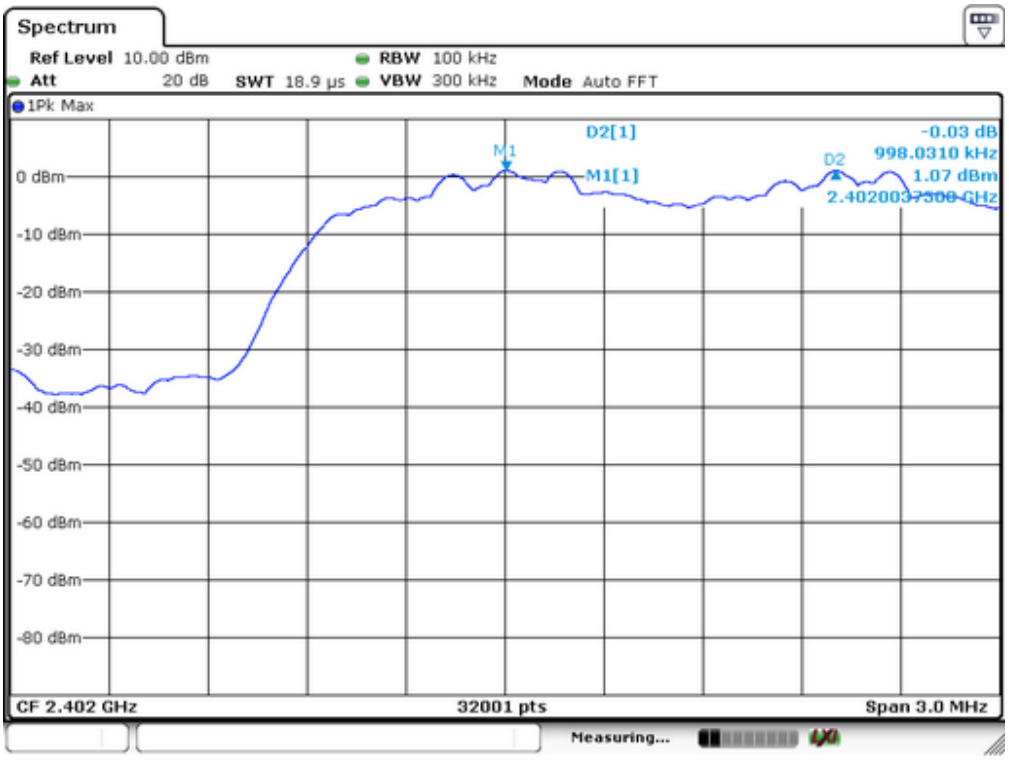

Spectrum
Ref Level 10.00 dBm
RBW 100 kHz
Att 20 dB
SWT 18.9 µs
VBW 300 kHz
Mode Auto FFT
1Pk Max
D2[1]
-0.09 dB
M1
D2
999.5310 kHz
M1[1]
2.07 dBm
2.4020038440 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.402 GHz
32001 pts
Span 3.0 MHz
Measuring...

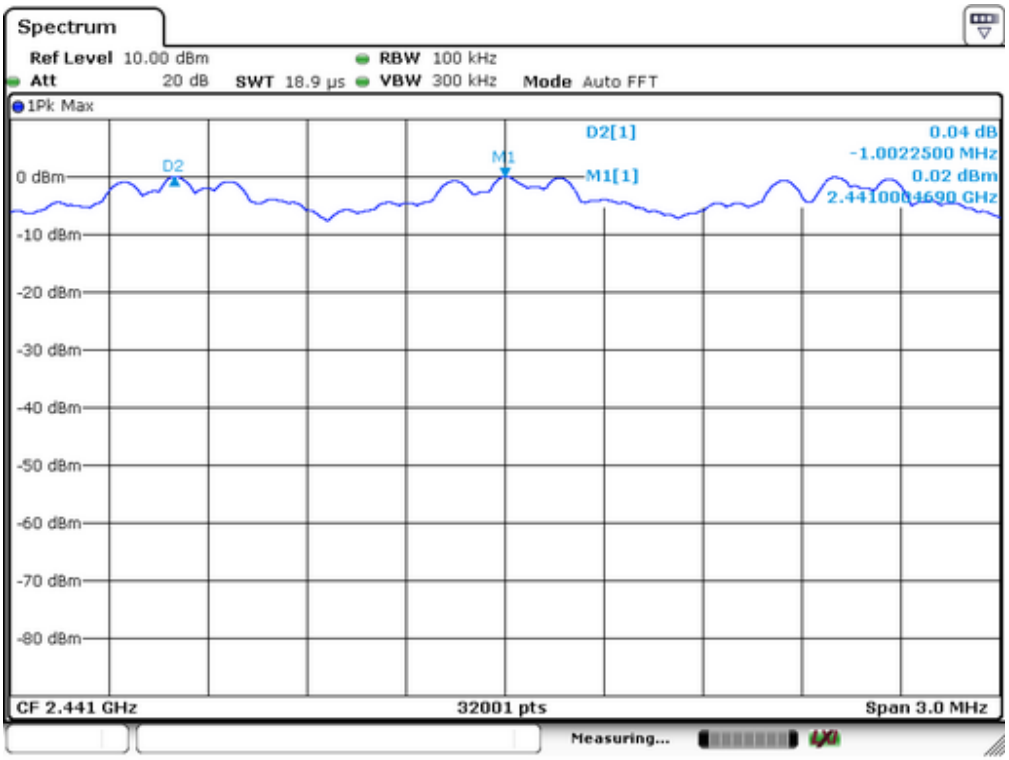

Spectrum
Ref Level 10.00 dBm
RBW 100 kHz
Att 20 dB
SWT 18.9 µs
VBW 300 kHz
Mode Auto FFT
1Pk Max
D2[1]
0.05 dB
D2
M1
-998.2190 kHz
M1[1]
1.27 dBm
2.4409908130 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
32001 pts
Span 3.0 MHz
Measuring...

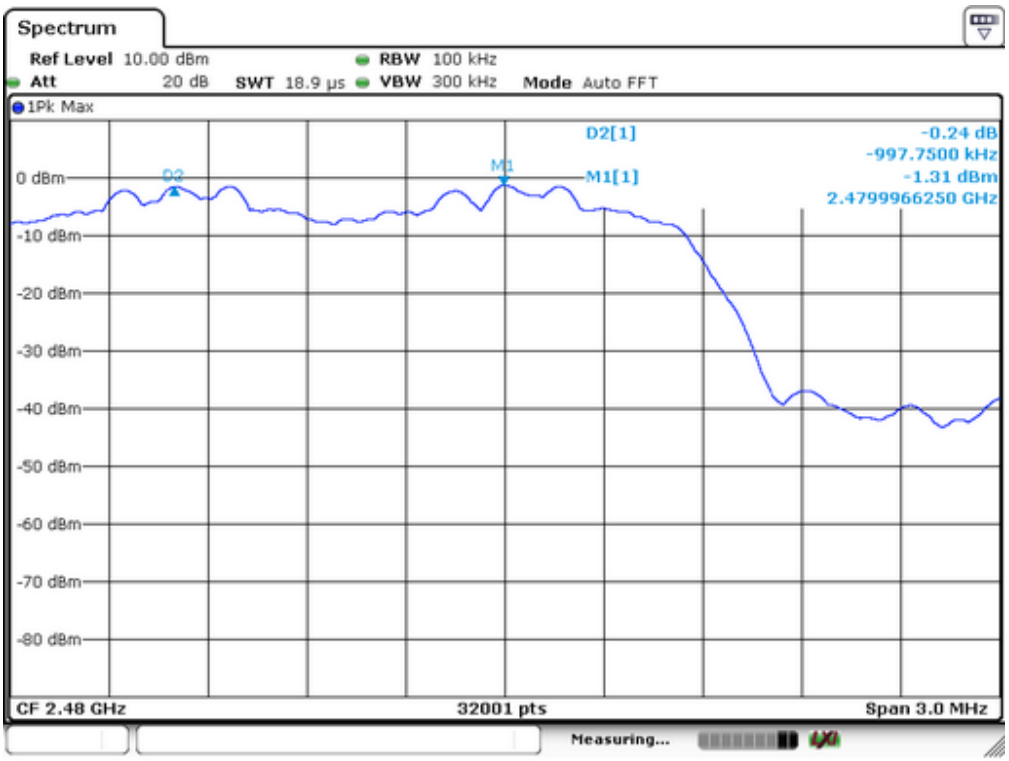


Spectrum Detector:	PK	Test Date :	August 13, 2015
Test By:	Andy	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	1/4Π-DQPSK		

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	998	>916
40	2441	1002	>911
79	2480	997	>911

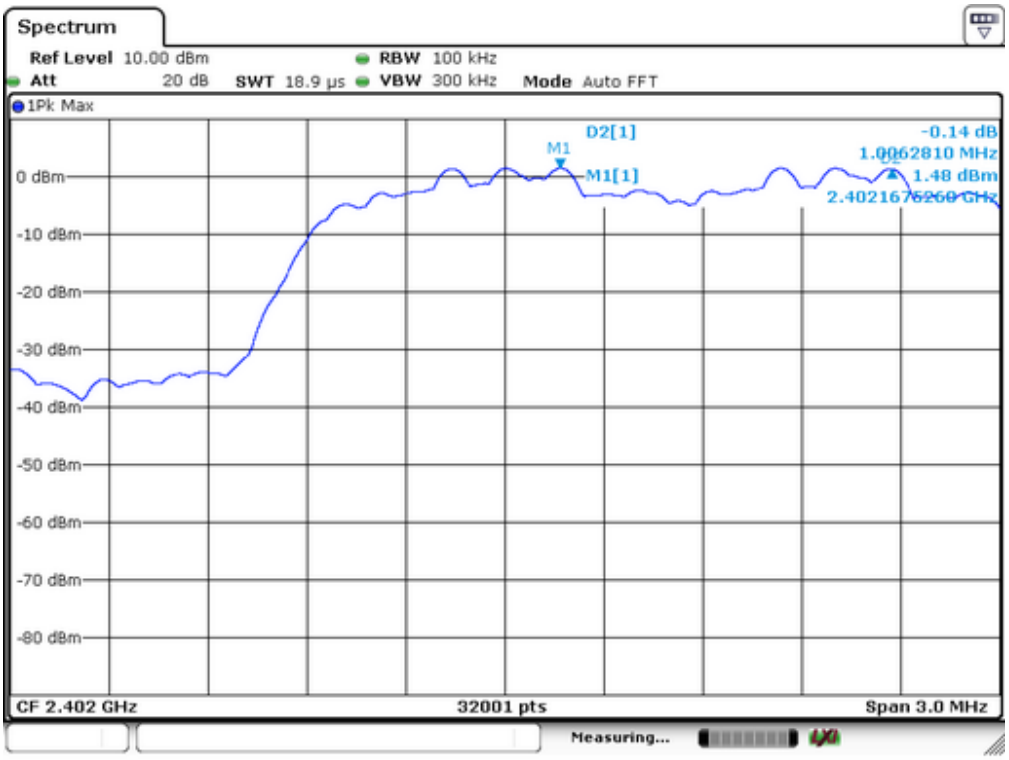

Spectrum
Ref Level 10.00 dBm
RBW 100 kHz
Att 20 dB
SWT 18.9 µs
VBW 300 kHz
Mode Auto FFT
1Pk Max
D2[1]
-0.03 dB
998.0310 kHz
M1[1]
1.07 dBm
2.402003
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.402 GHz
32001 pts
Span 3.0 MHz
Measuring...

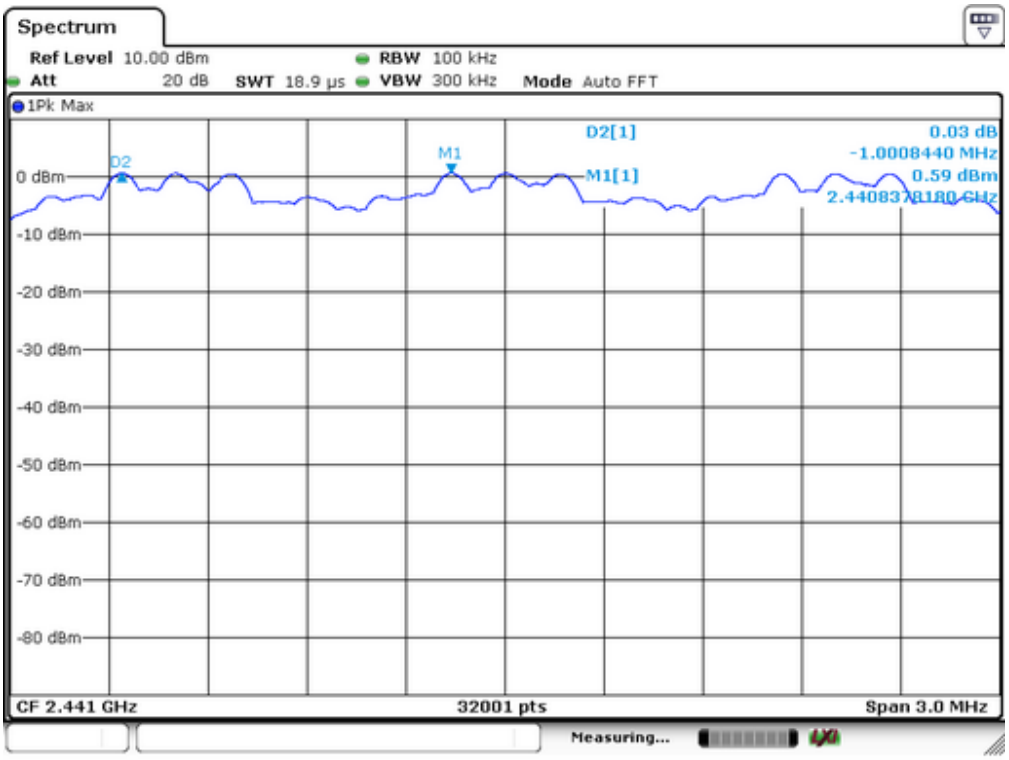

Spectrum
Ref Level 10.00 dBm
RBW 100 kHz
Att 20 dB
SWT 18.9 µs
VBW 300 kHz
Mode Auto FFT
1Pk Max
D2[1]
0.04 dB
-1.0022500 MHz
M1[1]
0.02 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
32001 pts
Span 3.0 MHz
Measuring...

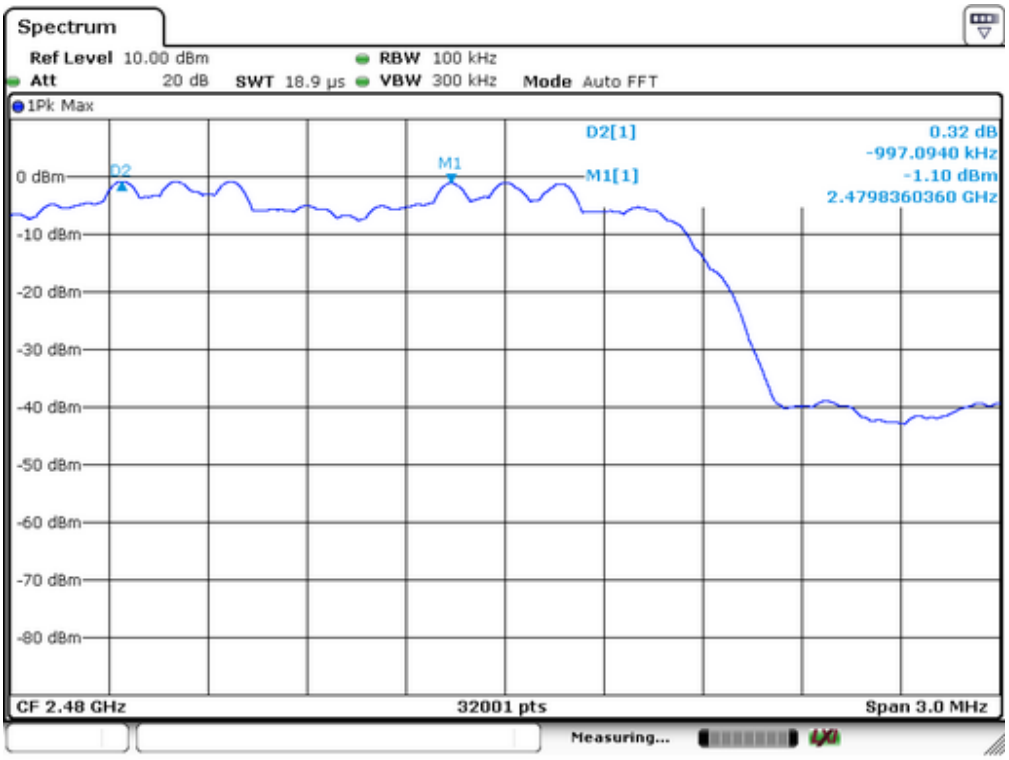


Spectrum Detector:	PK	Test Date :	August 13, 2015
Test By:	Andy	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	8DPSK		

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	1006	>918
40	2441	1000	>922
79	2480	997	>920


Spectrum
Ref Level 10.00 dBm
RBW 100 kHz
Att 20 dB
SWT 18.9 µs
VBW 300 kHz
Mode Auto FFT
1Pk Max
D2[1]
-0.14 dB
1.0062810 MHz
M1
M1[1]
1.48 dBm
2.4021676260 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.402 GHz
32001 pts
Span 3.0 MHz
Measuring...


Spectrum
Ref Level 10.00 dBm
RBW 100 kHz
Att 20 dB
SWT 18.9 µs
VBW 300 kHz
Mode Auto FFT
1Pk Max
D2[1]
0.03 dB
-1.0008440 MHz
D2
M1
M1[1]
0.59 dBm
2.4408376180 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
32001 pts
Span 3.0 MHz
Measuring...

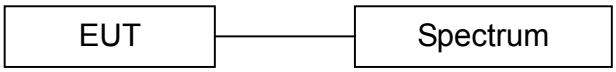

Spectrum
Ref Level 10.00 dBm
RBW 100 kHz
Att 20 dB
SWT 18.9 µs
VBW 300 kHz
Mode Auto FFT
1Pk Max
D2[1]
0.32 dB
-997.0940 kHz
M1[1]
-1.10 dBm
2.4798360360 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
D2
M1
CF 2.48 GHz
32001 pts
Span 3.0 MHz
Measuring...

8. 20dB Bandwidth 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:

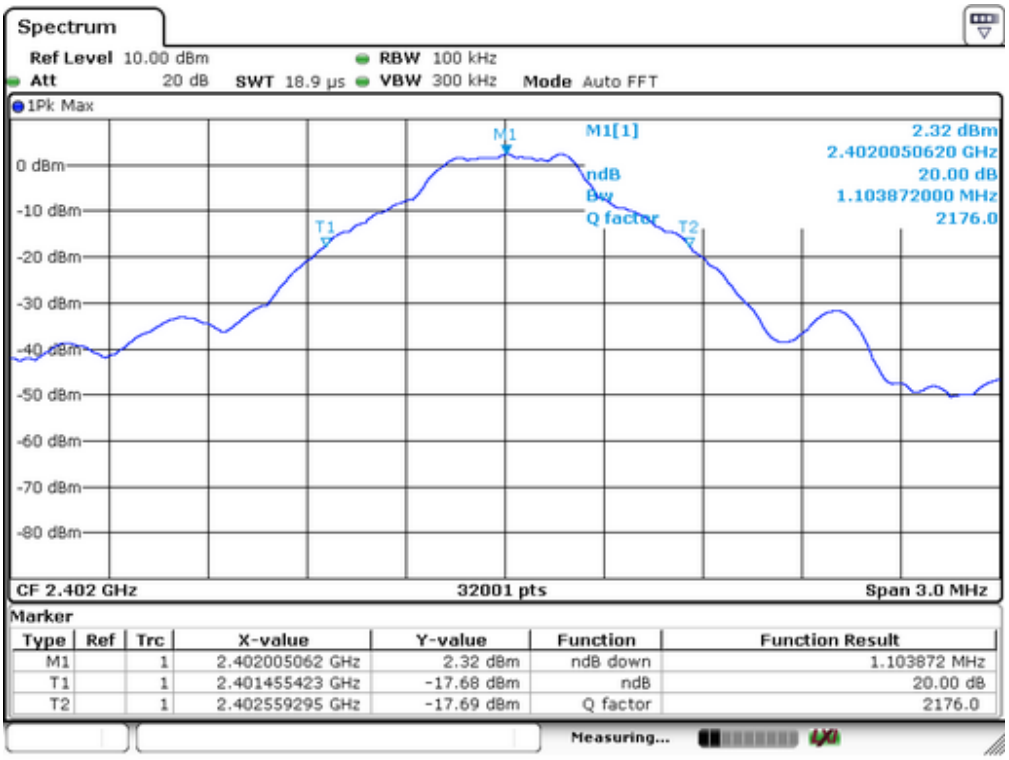
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	05/16/2015	05/15/2016
Coaxial Cable	CDS	79254	46107086	05/16/2015	05/15/2016
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	05/16/2015	05/15/2016

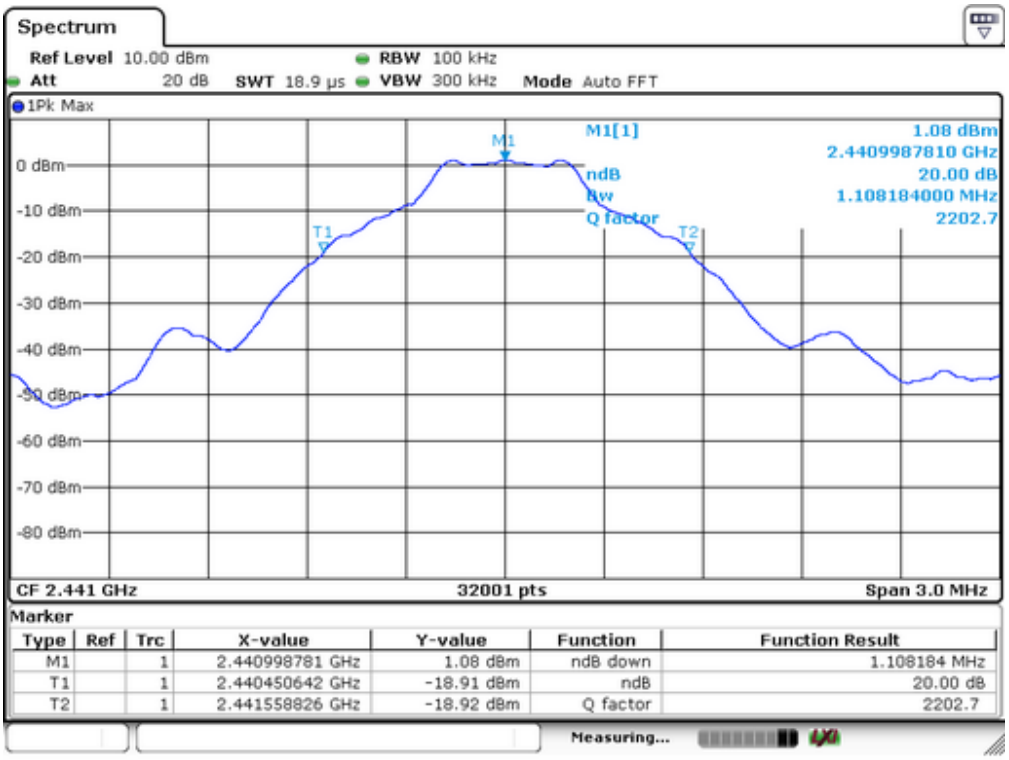
8.4 Measurement Results:

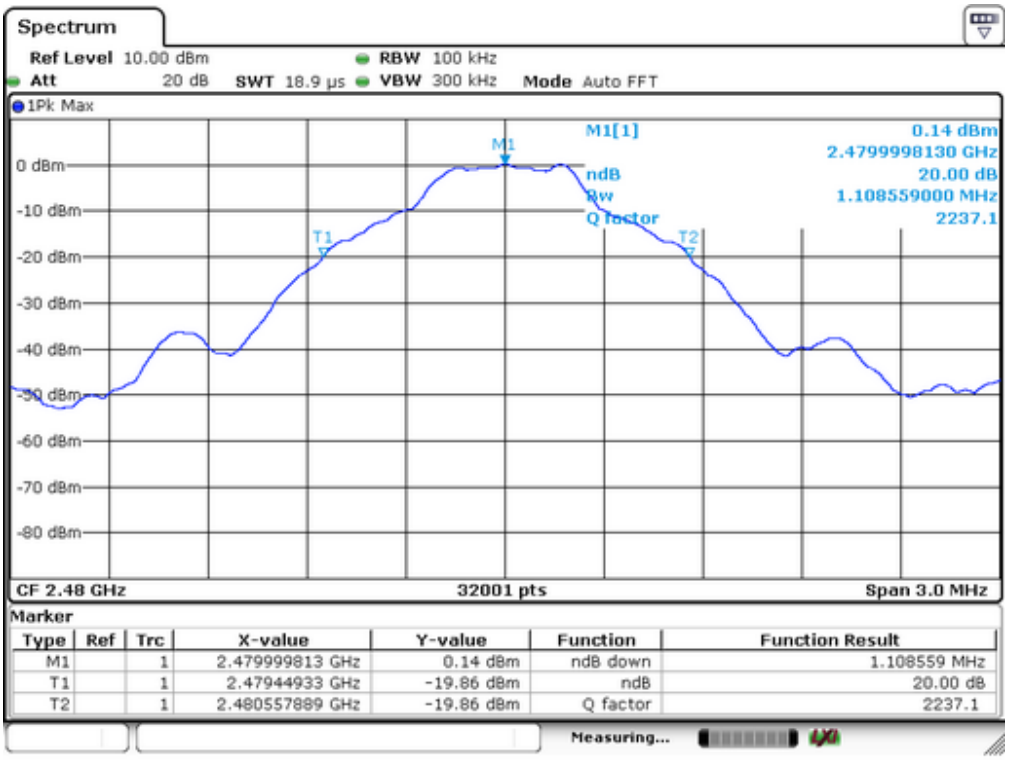
Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	August 13, 2015
Test By:	Andy	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %
Modulation:	GFSK		

Channel number	Channel frequency (MHz)	20dB Down BW(KHz)
1	2402	1103
40	2441	1108
79	2480	1108

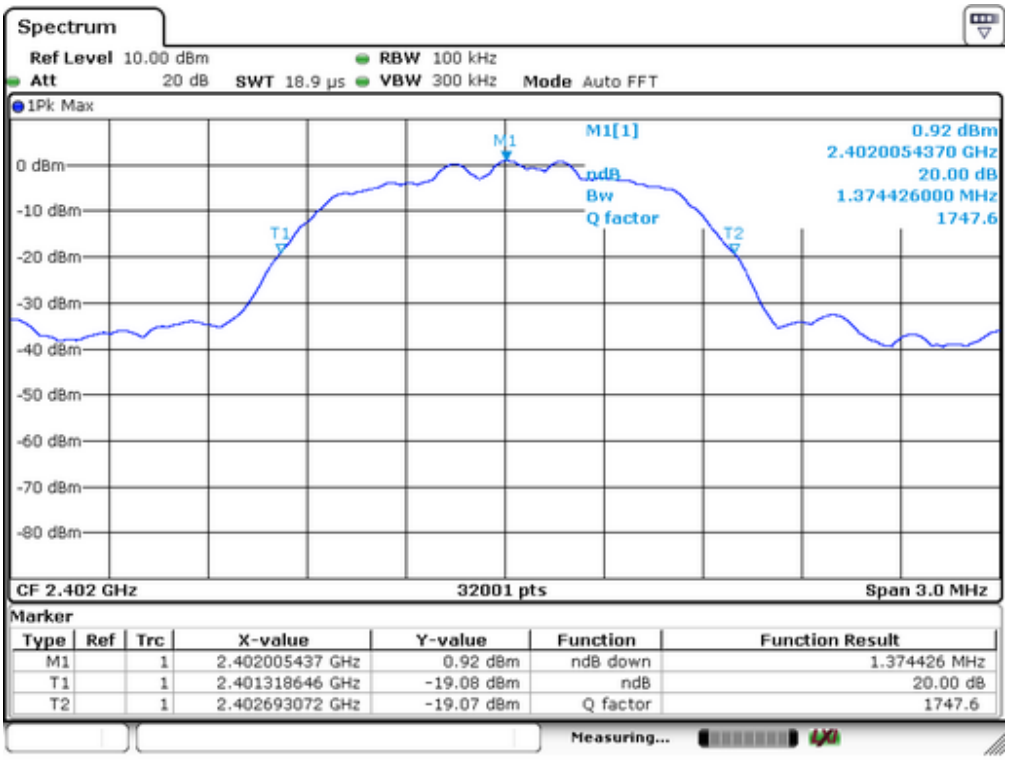

Spectrum
Ref Level 10.00 dBm
RBW 100 kHz
Att 20 dB
SWT 18.9 µs
VBW 300 kHz
Mode Auto FFT
1Pk Max
M1[1]
2.32 dBm
2.4020050620 GHz
ndB 20.00 dB
Bw 1.103872000 MHz
Q factor 2176.0
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.402 GHz
32001 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.402005062 GHz 2.32 dBm ndB down 1.103872 MHz
T1 1 2.401455423 GHz -17.68 dBm ndB 20.00 dB
T2 1 2.402559295 GHz -17.69 dBm Q factor 2176.0
Measuring...

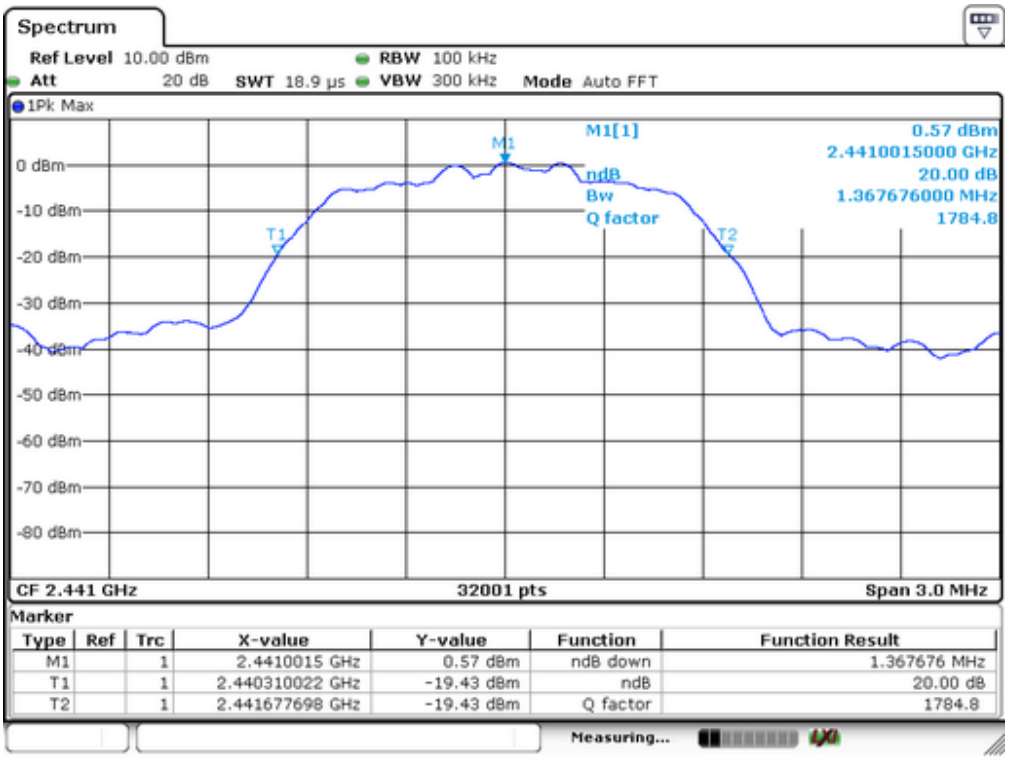

Spectrum
Ref Level 10.00 dBm
RBW 100 kHz
Att 20 dB
SWT 18.9 µs
VBW 300 kHz
Mode Auto FFT
1Pk Max
M1[1]
1.08 dBm
2.4409987810 GHz
ndB 20.00 dB
Bw 1.108184000 MHz
Q factor 2202.7
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
32001 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.440998781 GHz 1.08 dBm ndB down 1.108184 MHz
T1 1 2.440450642 GHz -18.91 dBm ndB 20.00 dB
T2 1 2.441558826 GHz -18.92 dBm Q factor 2202.7
Measuring...

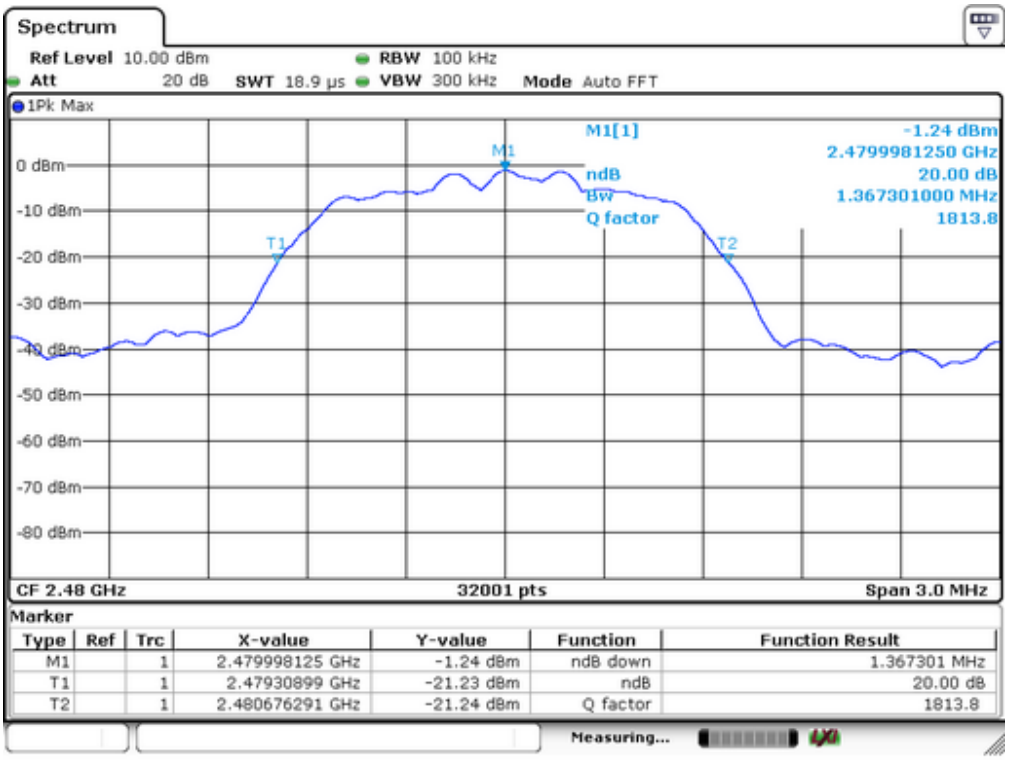


Spectrum Detector:	PK	Test Date :	August 13, 2015
Test By:	Andy	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	Π/4-DQPSK		

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	1374
40	2441	1367
79	2480	1367

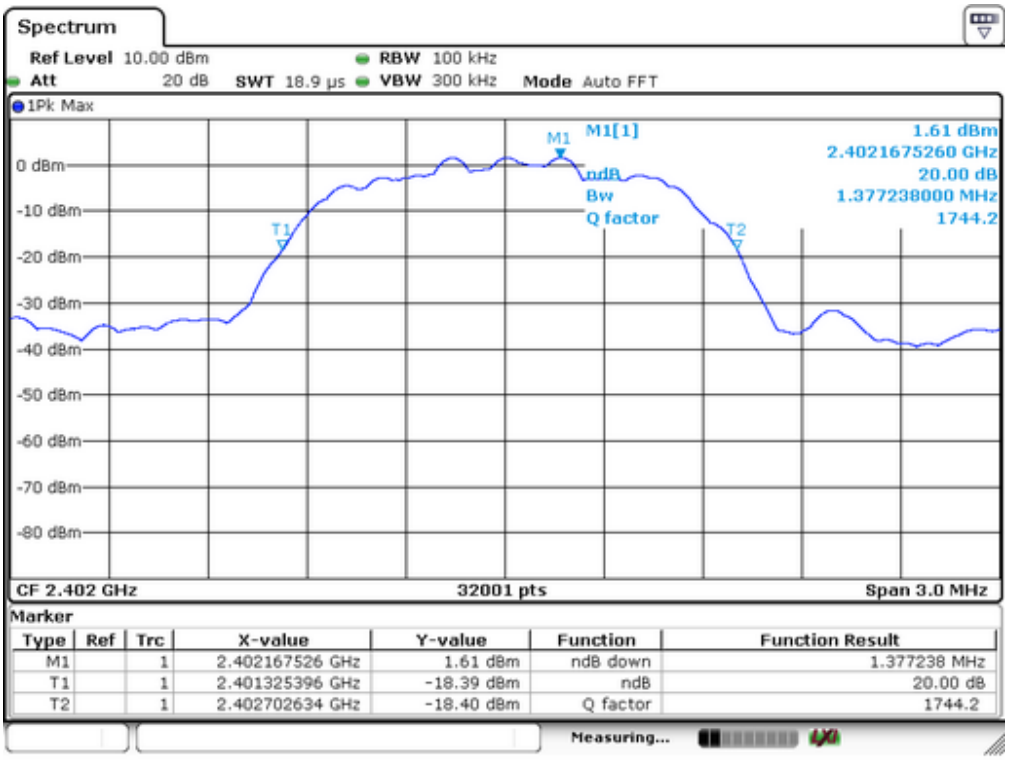

Spectrum
Ref Level 10.00 dBm
RBW 100 kHz
Att 20 dB
SWT 18.9 µs
VBW 300 kHz
Mode Auto FFT
1Pk Max
M1[1]
0.92 dBm
2.4020054370 GHz
ndB 20.00 dB
Bw 1.374426000 MHz
Q factor 1747.6
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.402 GHz
32001 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.402005437 GHz 0.92 dBm ndB down 1.374426 MHz
T1 1 2.401318646 GHz -19.08 dBm ndB 20.00 dB
T2 1 2.402693072 GHz -19.07 dBm Q factor 1747.6
Measuring...

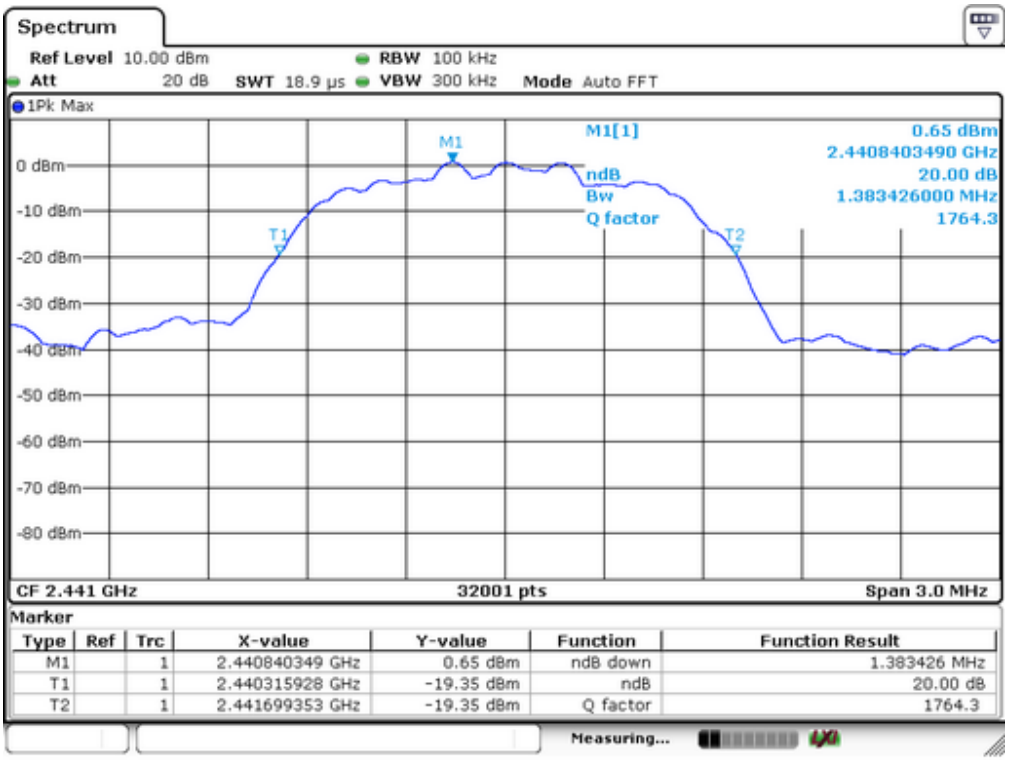

Spectrum
Ref Level 10.00 dBm
RBW 100 kHz
Att 20 dB
SWT 18.9 µs
VBW 300 kHz
Mode Auto FFT
1Pk Max
M1[1]
0.57 dBm
2.4410015000 GHz
ndB 20.00 dB
Bw 1.367676000 MHz
Q factor 1784.8
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
32001 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.4410015 GHz 0.57 dBm ndB down 1.367676 MHz
T1 1 2.440310022 GHz -19.43 dBm ndB 20.00 dB
T2 1 2.441677698 GHz -19.43 dBm Q factor 1784.8
Measuring...

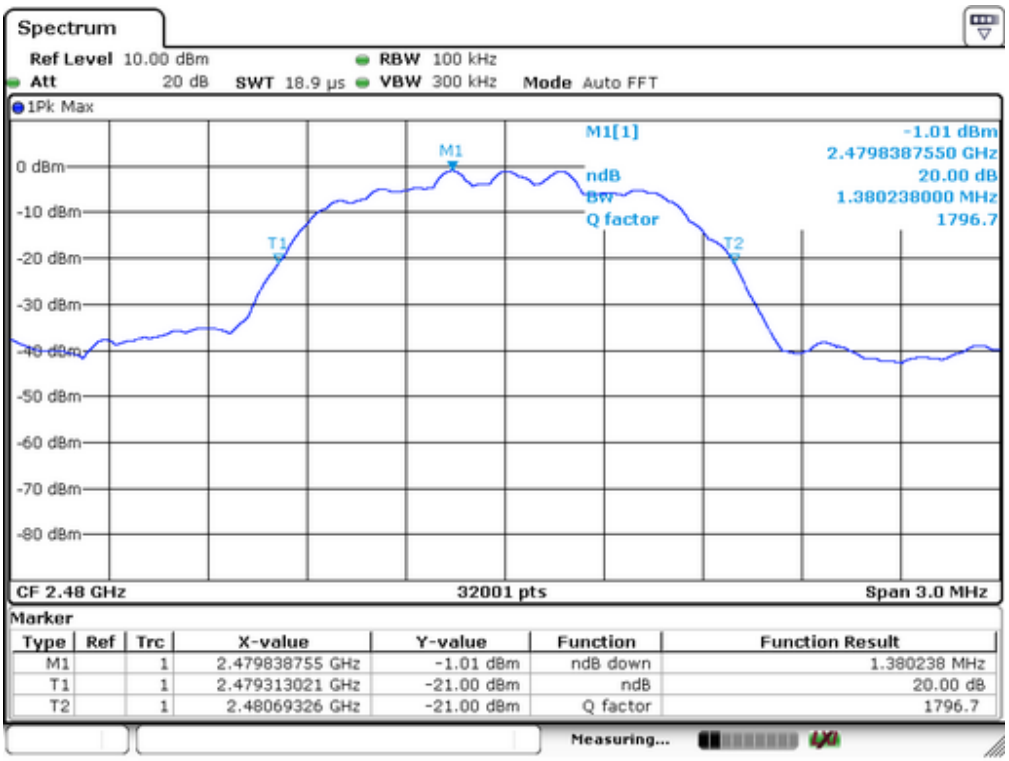


Spectrum Detector:	PK	Test Date :	August 13, 2015
Test By:	Andy	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	8DPSK		

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	1377
40	2441	1383
79	2480	1380


Spectrum
Ref Level 10.00 dBm
RBW 100 kHz
Att 20 dB
SWT 18.9 µs
VBW 300 kHz
Mode Auto FFT
1Pk Max
M1[1]
1.61 dBm
2.4021675260 GHz
ndB 20.00 dB
Bw 1.377238000 MHz
Q factor 1744.2
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.402 GHz
32001 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.402167526 GHz 1.61 dBm ndB down 1.377238 MHz
T1 1 2.401325396 GHz -18.39 dBm ndB 20.00 dB
T2 1 2.402702634 GHz -18.40 dBm Q factor 1744.2
Measuring...


Spectrum
Ref Level 10.00 dBm
RBW 100 kHz
Att 20 dB
SWT 18.9 µs
VBW 300 kHz
Mode Auto FFT
1Pk Max
M1[1]
0.65 dBm
2.4408403490 GHz
ndB 20.00 dB
Bw 1.383426000 MHz
Q factor 1764.3
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
32001 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.440840349 GHz 0.65 dBm ndB down 1.383426 MHz
T1 1 2.440315928 GHz -19.35 dBm ndB 20.00 dB
T2 1 2.441699353 GHz -19.35 dBm Q factor 1764.3
Measuring...

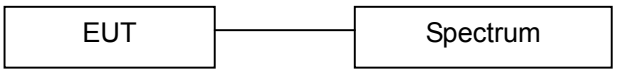

Spectrum
Ref Level 10.00 dBm
RBW 100 kHz
Att 20 dB
SWT 18.9 µs
VBW 300 kHz
Mode Auto FFT
1Pk Max
M1[1]
-1.01 dBm
2.4798387550 GHz
ndB 20.00 dB
Bw 1.380238000 MHz
Q factor 1796.7
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
T1
T2
CF 2.48 GHz
32001 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.479838755 GHz -1.01 dBm ndB down 1.380238 MHz
T1 1 2.479313021 GHz -21.00 dBm ndB 20.00 dB
T2 1 2.48069326 GHz -21.00 dBm Q factor 1796.7
Measuring...

9. Quantity of Hopping Channel 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.

8.2 Test SET-UP (Block Diagram of Configuration)



9.3 Measurement Equipment Used:

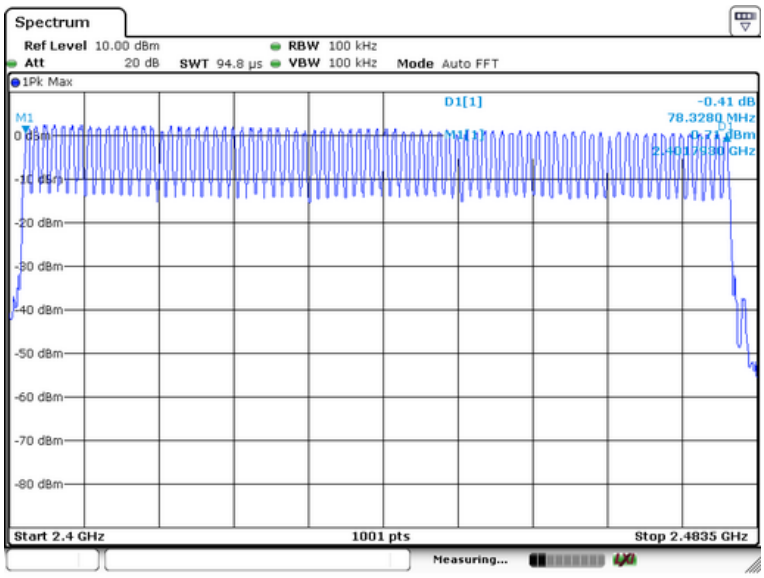
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	Cal. Interval
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	03/15/2015	1 Year
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	03/15/2015	1 Year
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	03/15/2015	1 Year

9.4 Measurement Results:

Worst test modulation GFSK

Spectrum Detector:	PK	Test Date :	August 13, 2015
Test By:	Andy	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %

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



10. Time of Occupancy (Dwell Time) test

10.1 Test Description

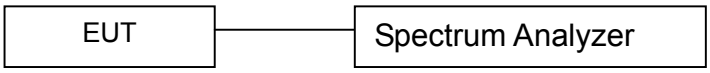
The Equipment Under Test (EUT) was set up to perform the dwell time measurements. The EUT was connected to the spectrum analyzer via a short coax cable. The dwell time is calculated by:

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

with:
- hop rate = 1600/2 * 1/s for DH1 packets = 1600 s^{-1}
- hop rate = 1600/4 * 1/s for DH3 packets = 533.33 s^{-1}
- hop rate = 1600/6 * 1/s for DH5 packets = 320 s^{-1}
- number of hopping channels = 79
- 31.6 s = 0.4 seconds multiplied by the number of hopping channels = 0.4 s * 79

The highest value of the dwell time is reported.

10.2 Test SET-UP (Block Diagram of Configuration)



10.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	Cal. Interval
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	03/15/2015	1 Year
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	03/15/2015	1 Year
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	03/15/2015	1 Year

10.4 Test Requirements / Limits

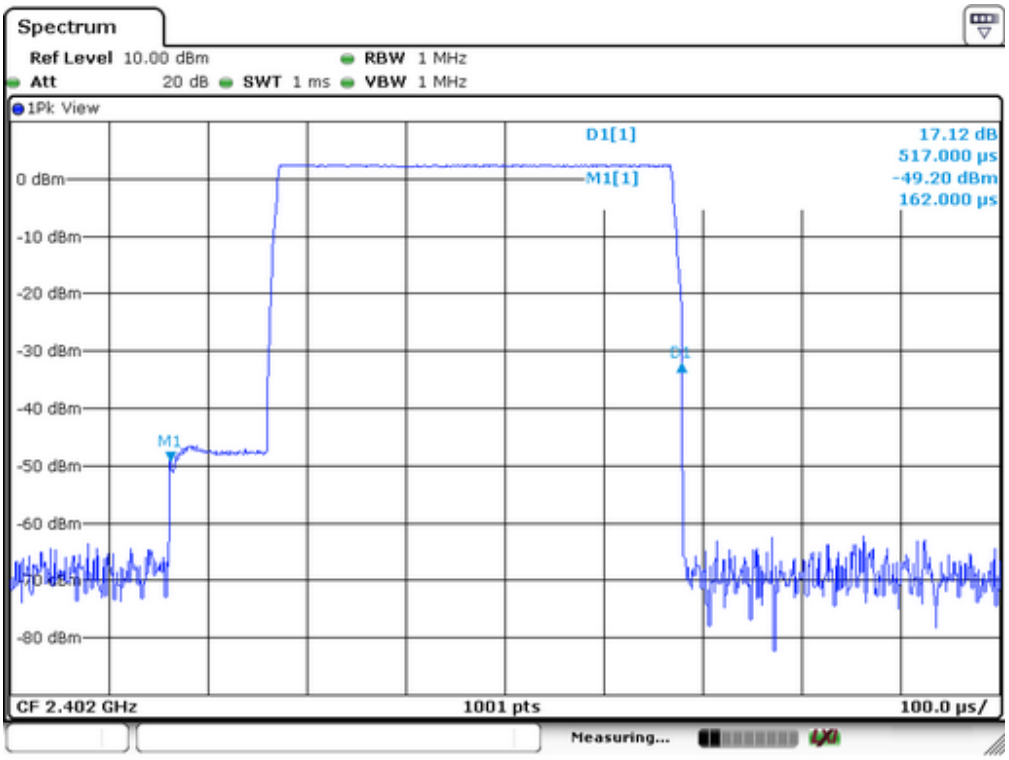
FCC Part 15, Subpart C, §15.247 (a) (1) (iii)

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

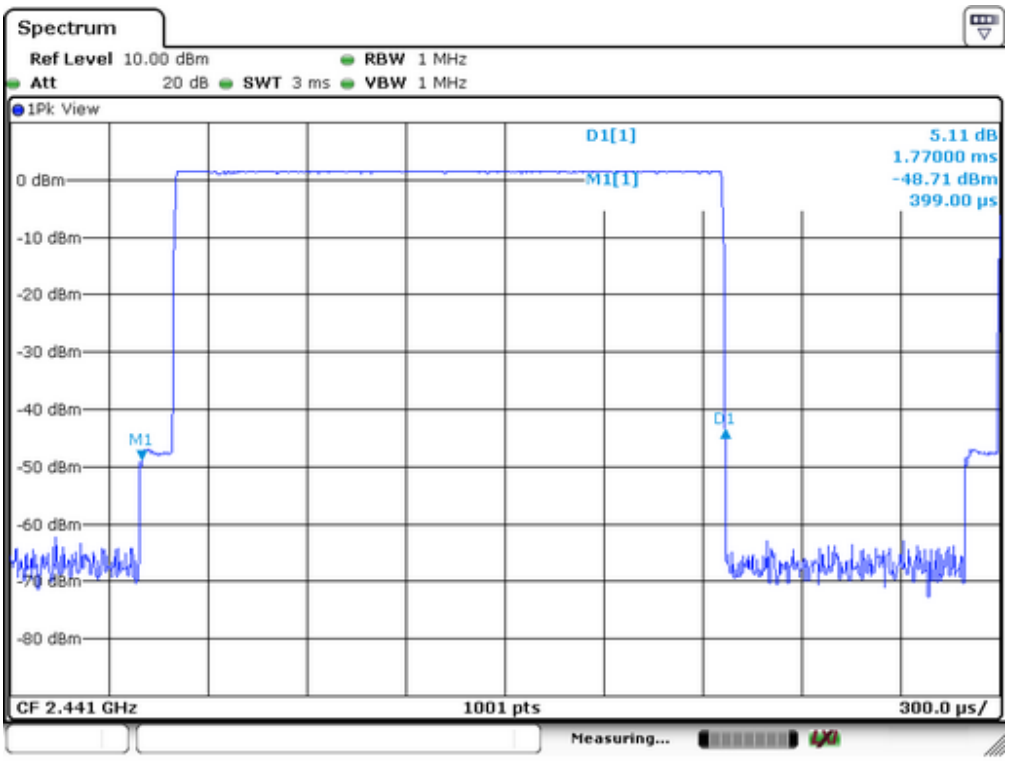
10.5 Measurement Results:

Packet type	Time slot length(ms)	Dwell time	Dwell time(ms)
DH1	0.517	time slot length *1600/2 /79 * 31.6	165.44
DH3	1.770	time slot length *1600/4 /79 * 31.6	283.20
DH5	3.025	time slot length *1600/6 /79 * 31.6	322.68

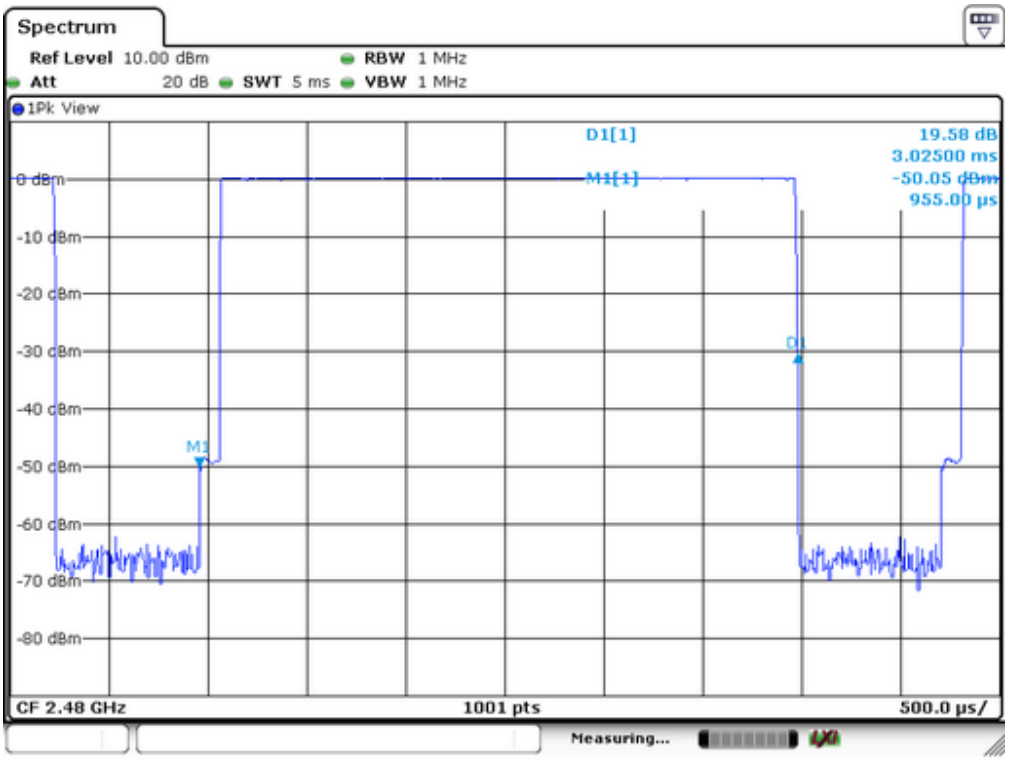
DH1:



DH3:


Spectrum
Ref Level 10.00 dBm
RBW 1 MHz
Att 20 dB SWT 3 ms VBW 1 MHz
1Pk View
D1[1] 5.11 dB
1.77000 ms
M1[1] -48.71 dBm
399.00 µs
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
D1
CF 2.441 GHz
1001 pts
300.0 µs/
Measuring...

DH5:


Spectrum
Ref Level 10.00 dBm
RBW 1 MHz
Att 20 dB SWT 5 ms VBW 1 MHz
1Pk View
D1[1] 19.58 dB
3.02500 ms
M1[1] -50.05 dBm
955.00 µs
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
D1
CF 2.48 GHz
1001 pts
500.0 µs/
Measuring...

11. MAXIMUM PEAK OUTPUT POWER TEST

11.1 Measurement Procedure

a. Check the calibration of the measuring instrument(SA) using either an internal calibrator or a known signal from an external generator.

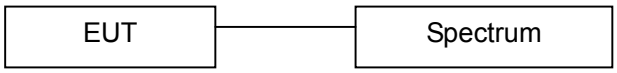
b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.

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.

11.2 Test SET-UP (Block Diagram of Configuration)



11.3 Measurement Equipment Used:

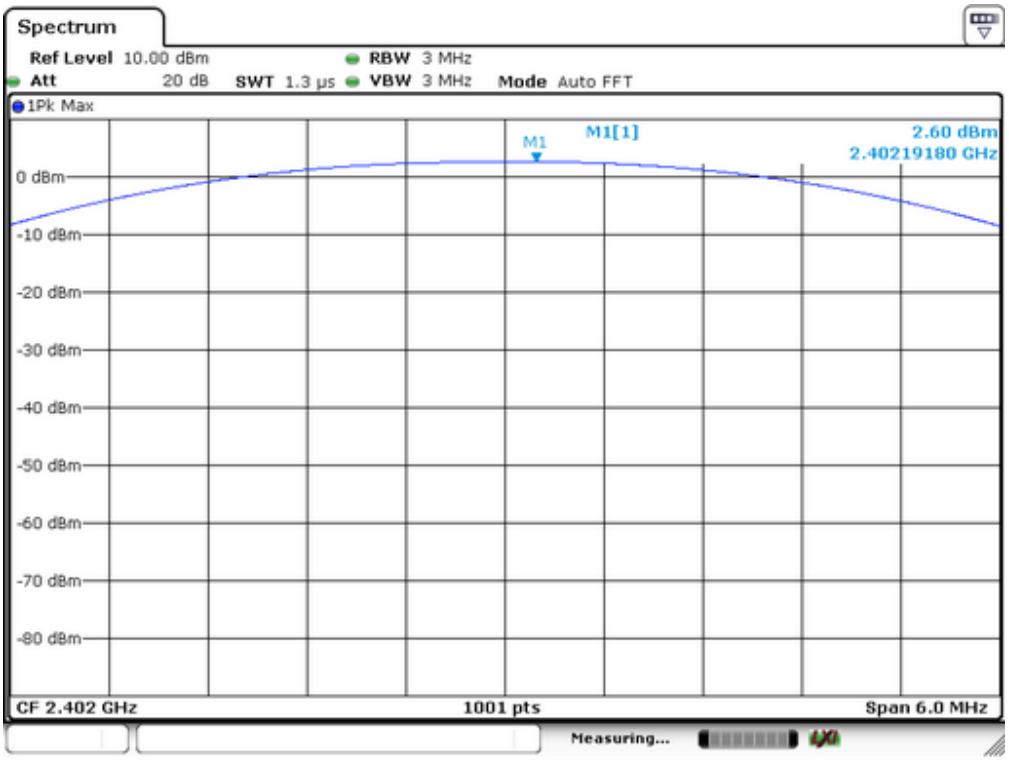
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	Cal. Interval
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	03/15/2015	1 Year
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	03/15/2015	1 Year
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	03/15/2015	1 Year

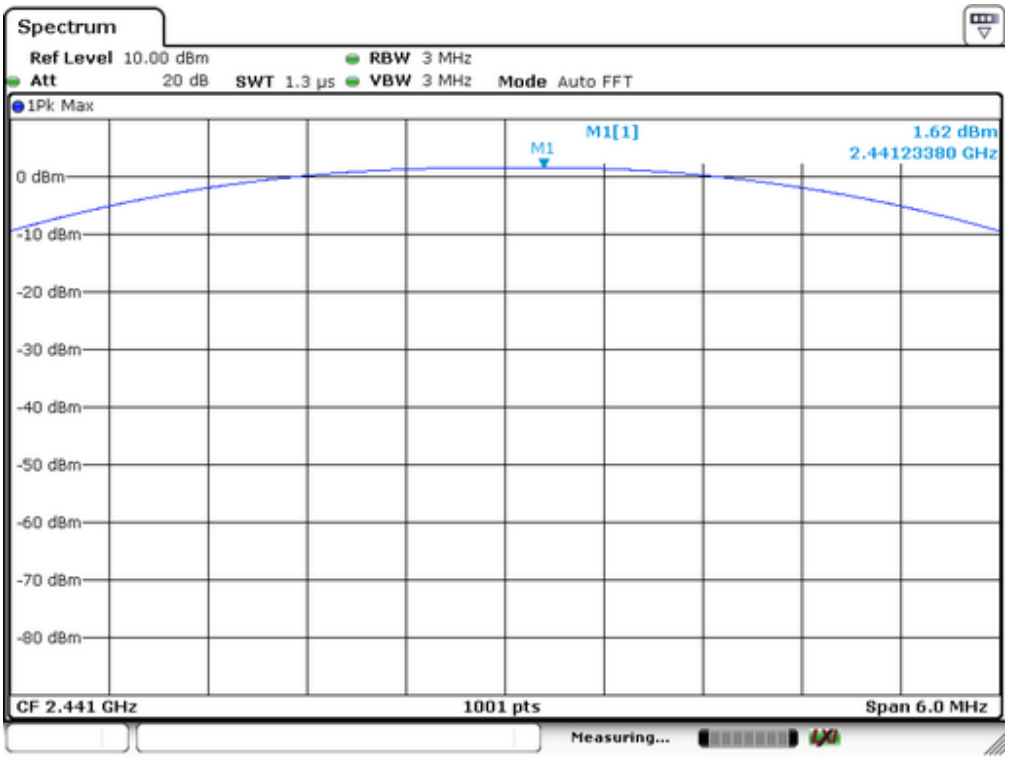
11.4Measurement Results:

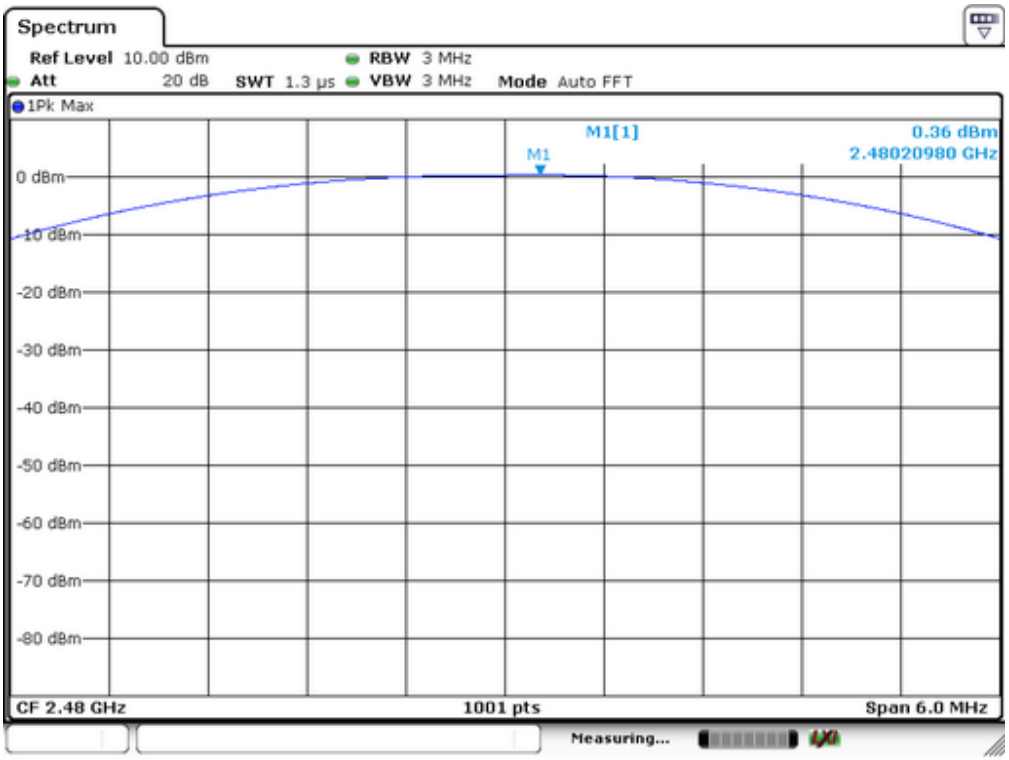
Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	August 13, 2015
Test By:	Andy	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %
Modulation:	GFSK		

Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
01	2402	**2.60**	**1.820**	1000	PASS
40	2441	1.62	1.452	1000	PASS
79	2480	0.36	1.086	1000	PASS

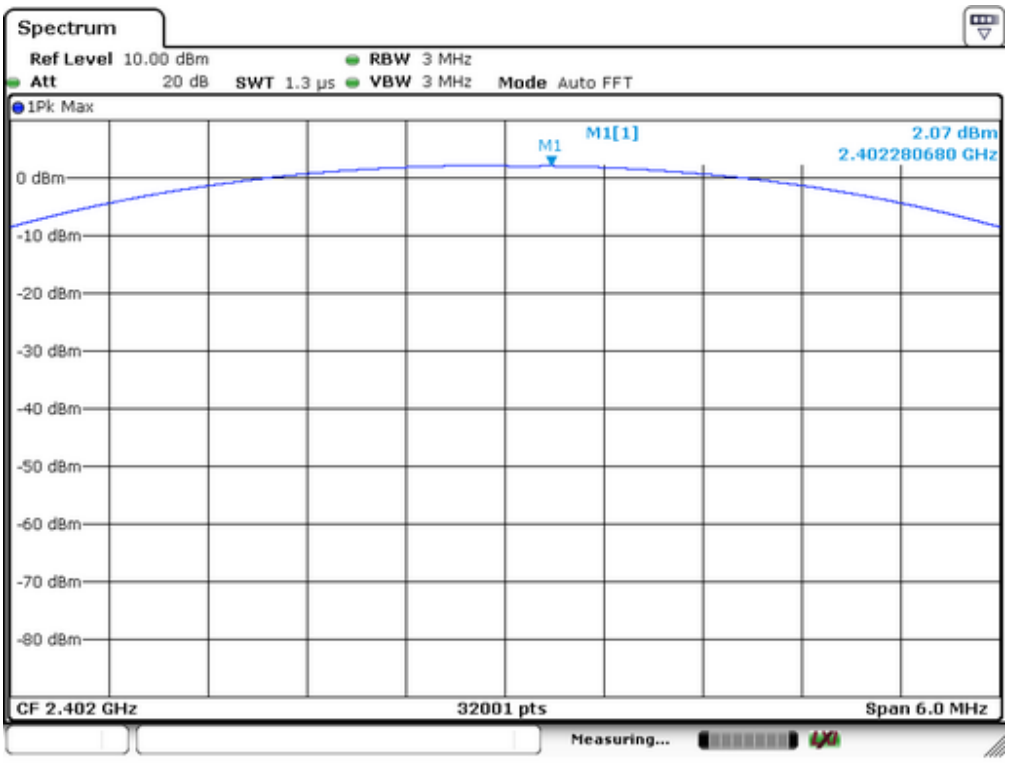


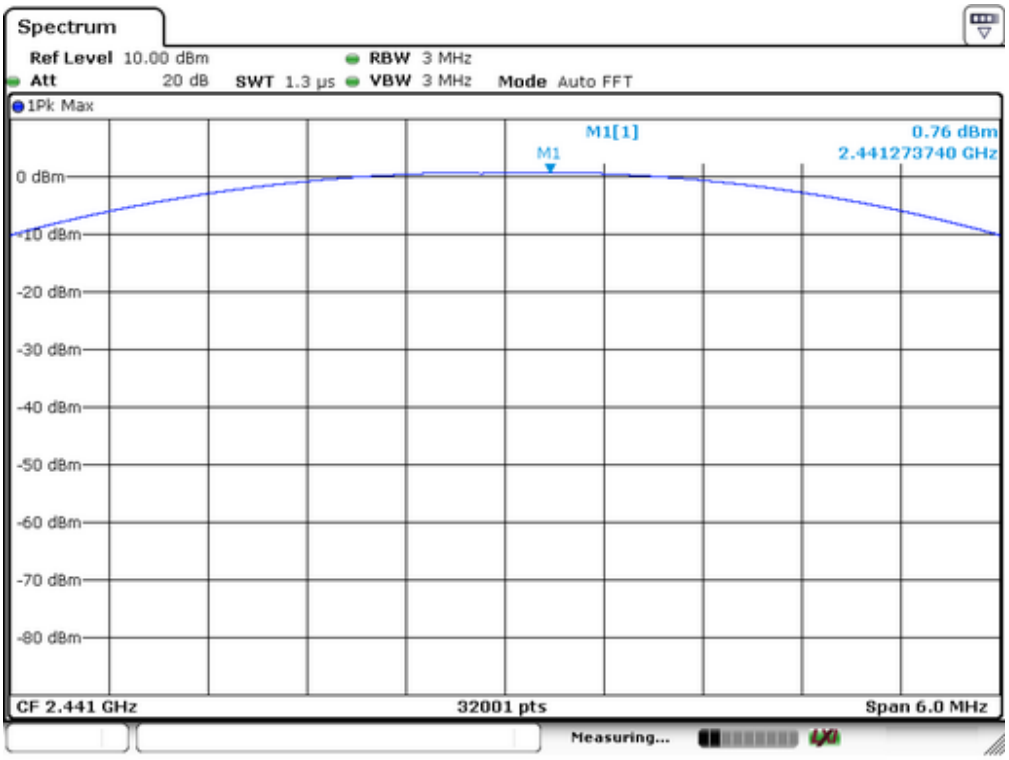

Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 20 dB
SWT 1.3 µs
VBW 3 MHz
Mode Auto FFT
1Pk Max
M1[1]
1.62 dBm
2.44123380 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
1001 pts
Span 6.0 MHz
Measuring...

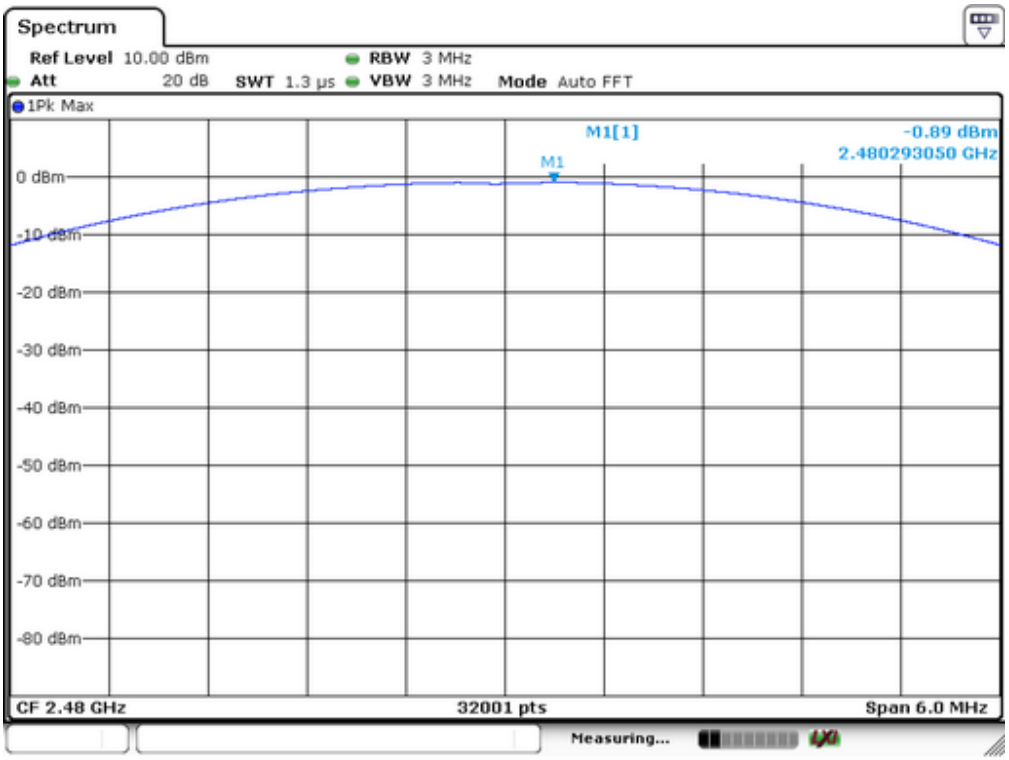

Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 20 dB
SWT 1.3 µs
VBW 3 MHz
Mode Auto FFT
1Pk Max
M1[1]
0.36 dBm
2.48020980 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
1001 pts
Span 6.0 MHz
Measuring...

Spectrum Detector:	PK	Test Date :	August 13, 2015
Test By:	Andy	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %
Modulation:	Π/4-DQPSK		

Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
01	2402	2.07	1.611	125	PASS
40	2441	0.76	1.191	125	PASS
79	2480	-0.89	0.815	125	PASS

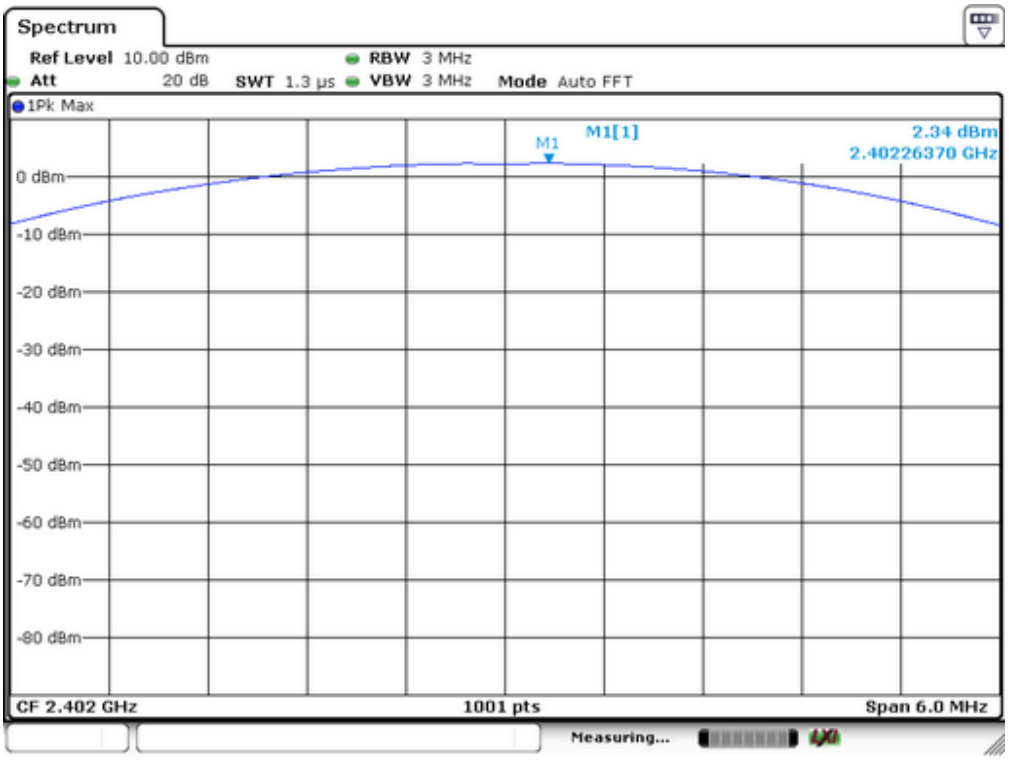


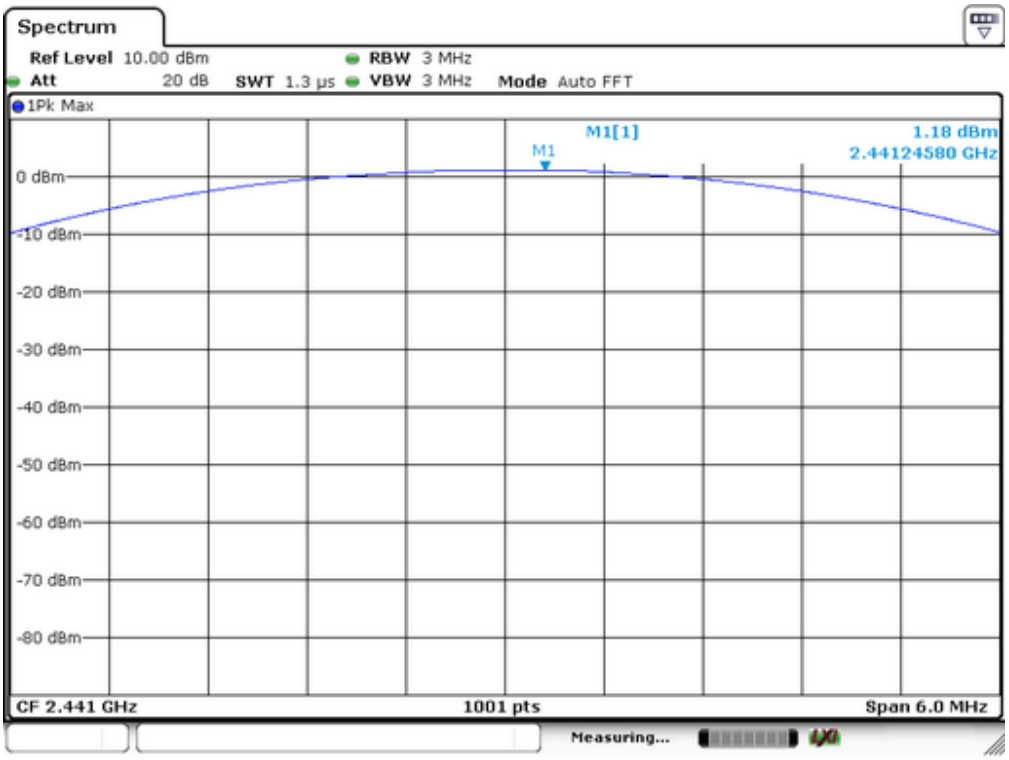

Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 20 dB
SWT 1.3 µs
VBW 3 MHz
Mode Auto FFT
1Pk Max
M1[1]
0.76 dBm
2.441273740 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
32001 pts
Span 6.0 MHz
Measuring...

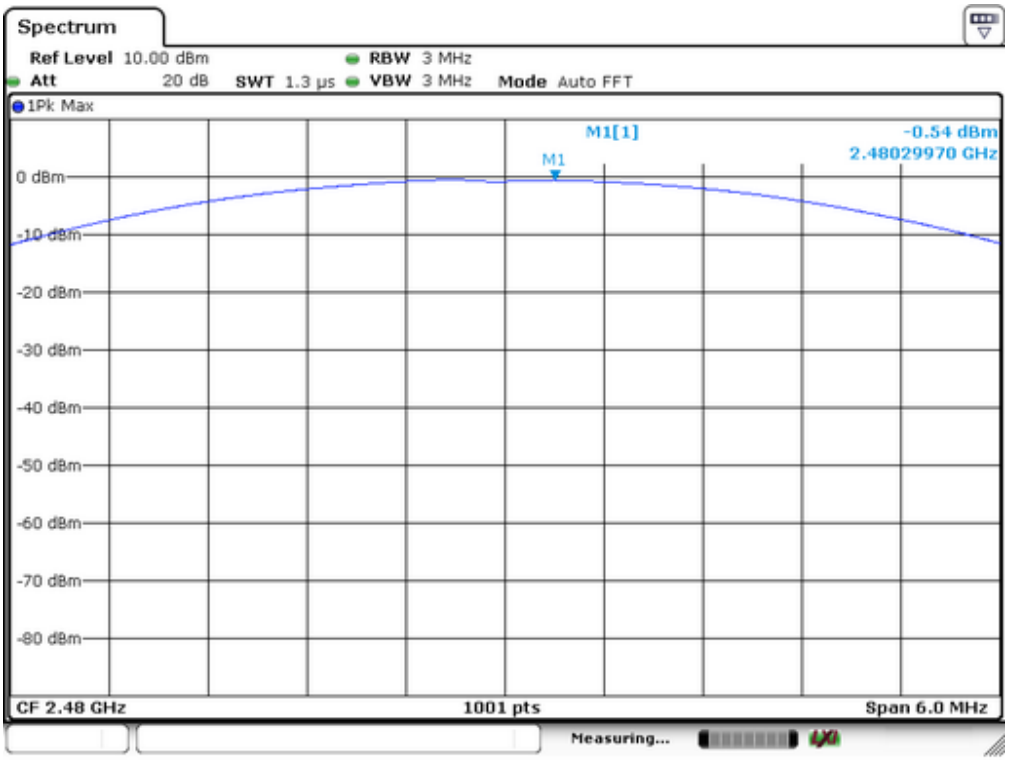

Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 20 dB
SWT 1.3 µs
VBW 3 MHz
Mode Auto FFT
1Pk Max
M1[1]
-0.89 dBm
2.480293050 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
32001 pts
Span 6.0 MHz
Measuring...

Spectrum Detector:	PK	Test Date :	August 13, 2015
Test By:	Andy	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %
Modulation:	8DPSK		

Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
01	2402	2.34	1.714	125	PASS
40	2441	1.18	1.312	125	PASS
79	2480	-0.54	0.883	125	PASS




Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 20 dB
SWT 1.3 µs
VBW 3 MHz
Mode Auto FFT
1Pk Max
M1[1]
1.18 dBm
2.44124580 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
1001 pts
Span 6.0 MHz
Measuring...


Spectrum
Ref Level 10.00 dBm
RBW 3 MHz
Att 20 dB
SWT 1.3 µs
VBW 3 MHz
Mode Auto FFT
1Pk Max
M1[1]
-0.54 dBm
2.48029970 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
1001 pts
Span 6.0 MHz
Measuring...

12. Band EDGE test

12.1 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:

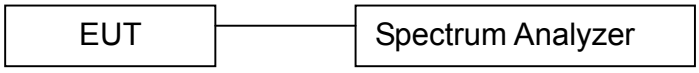
EMI Test Receiver	Setting
Attenuation	Auto
RBW	1MHz
VBW	3MHz
Detector	Peak
Trace	Max hold

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

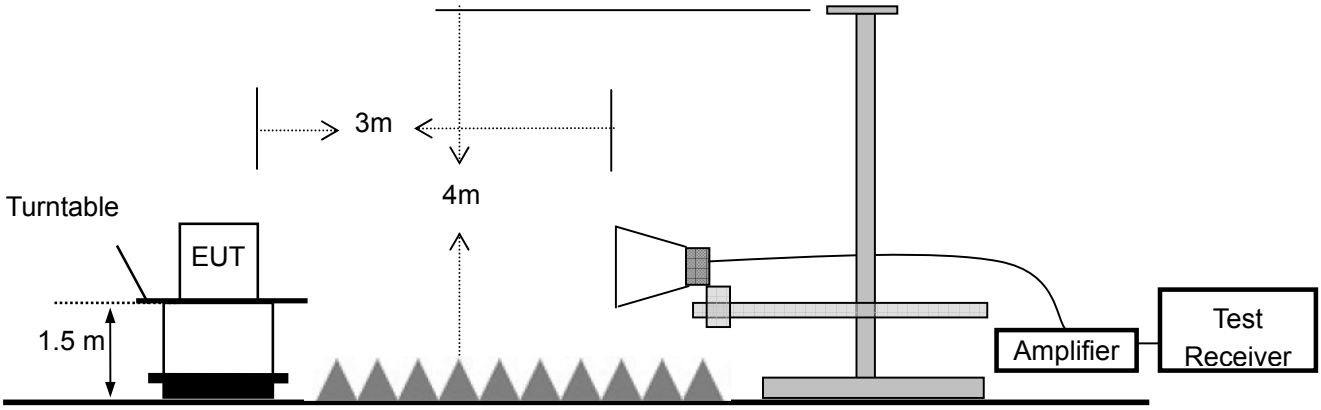
EMI Test Receiver	Setting
Attenuation	Auto
RBW	100KHz
VBW	300KHz
Detector	Peak
Trace	Max hold

12.2 Test SET-UP (Block Diagram of Configuration)

For Conducted Test



For Radiated emission Test



12.3 Measurement Equipment Used:

For Conducted Test

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	03/15/2015	1 Year
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	03/15/2015	1 Year
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	03/15/2015	1 Year

For Radiated emission Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Characteristics	Last Cal.	Cal. Interval
1	Signal Analyzer	Rohde & Schwarz	FSV30	103040	9KHz-40GHz	03/15/2015	1 Year
2	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1272	1GHz-18GHz	03/15/2015	1 Year
3	Power Amplifier	LUNAR EM	LNA1G18-40	J10100000081	1GHz-26.5GHz	03/15/2015	1 Year
4	Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	03/15/2015	1 Year
5	Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	03/15/2015	1 Year
6	Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	03/15/2015	1 Year

12.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	August 13, 2015
Test By:	Andy	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %

1. Conducted Test

For Non-Hopping Mode:

Frequency (MHz)	Modulation	Peak Power Output(dBm)	Emission read Value(dBm)	Result of Band edge(dBc)	Band edge Limit(dBc)
2399.98	GFSK	2.47	-39.32	41.79	>20dBc
2399.98	pi/4-DQPSK	1.63	-43.99	45.62	>20dBc
2399.98	8DPSK	1.78	-42.57	44.35	>20dBc
2484.01	GFSK	0.3	-49.03	49.33	>20dBc
2483.52	pi/4-DQPSK	-1.14	-44.09	42.95	>20dBc
2484	8DPSK	-1.4	-46.69	45.29	>20dBc

For Hopping Mode:

Frequency (MHz)	Modulation	Peak Power Output(dBm)	Emission read Value(dBm)	Result of Band edge(dBc)	Band edge Limit(dBc)
2399.98	GFSK	2.46	-39.63	42.09	>20dBc
2399.68	pi/4-DQPSK	1.5	-45.35	46.85	>20dBc
2399.6	8DPSK	1.76	-45.5	47.26	>20dBc
2483.69	GFSK	0.3	-52.6	52.9	>20dBc
2483.53	pi/4-DQPSK	-1.39	-47.83	46.44	>20dBc
2483.51	8DPSK	-1.38	-46.95	45.57	>20dBc

2.Radiated emission Test

Worst test modulation GFSK

For Non-Hopping Mode:

Frequency (MHz)	Antenna polarization	Emission (dBuV/m)		Band edge Limit (dBuV/m)		Margin (dB)	
	(H/V)	PK	AV	PK	AV	PK	AV
2398.456	H	63.25	45.04	74	54	-10.75	-8.96
2399.157	V	57.15	40.68	74	54	-16.85	-13.32
2484.013	H	65.72	44.13	74	54	-8.28	-9.87
2483.895	V	59.94	38.48	74	54	-14.06	-15.52

Worst test modulation GFSK

For Hopping Mode:

Frequency (MHz)	Antenna polarization	Emission (dBuV/m)		Band edge Limit (dBuV/m)		Margin (dB)	
	(H/V)	PK	AV	PK	AV	PK	AV
2399.369	H	63.59	44.23	74	54	-10.41	-9.77
2398.954	V	54.18	40.85	74	54	-19.82	-13.15
2484.123	H	65.24	46.31	74	54	-8.76	-7.69
2484.015	V	56.95	39.55	74	54	-17.05	-14.45

13. Antenna Application

13.1 Antenna requirement

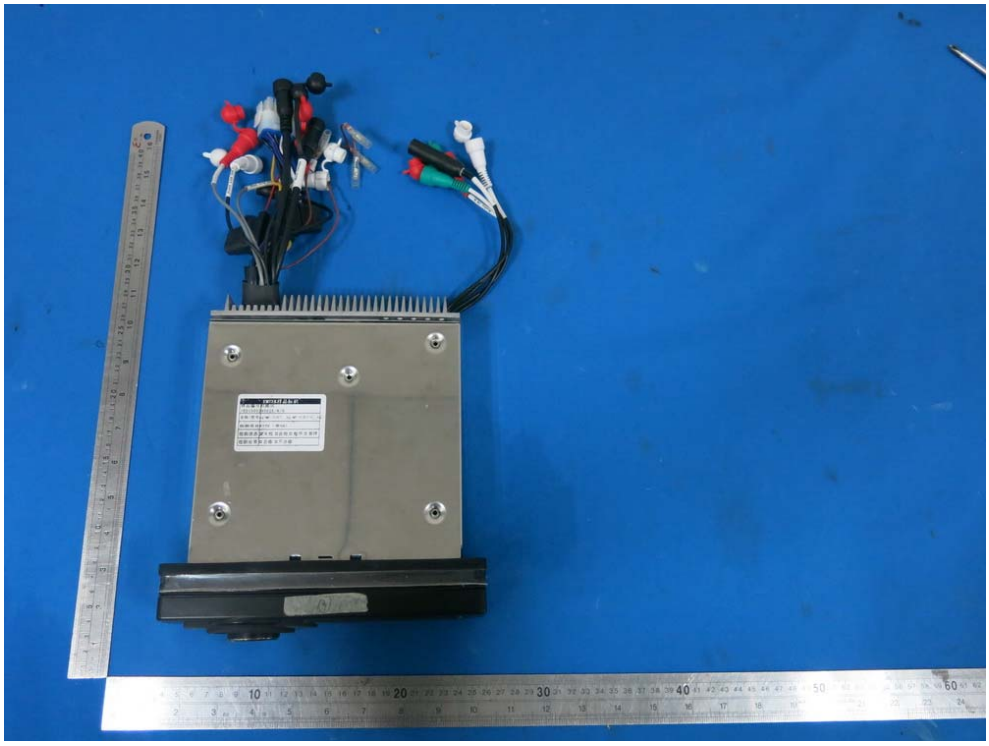
The EUT'S antenna is met the requirement of FCC part 15C section 15.203 and 15.247.

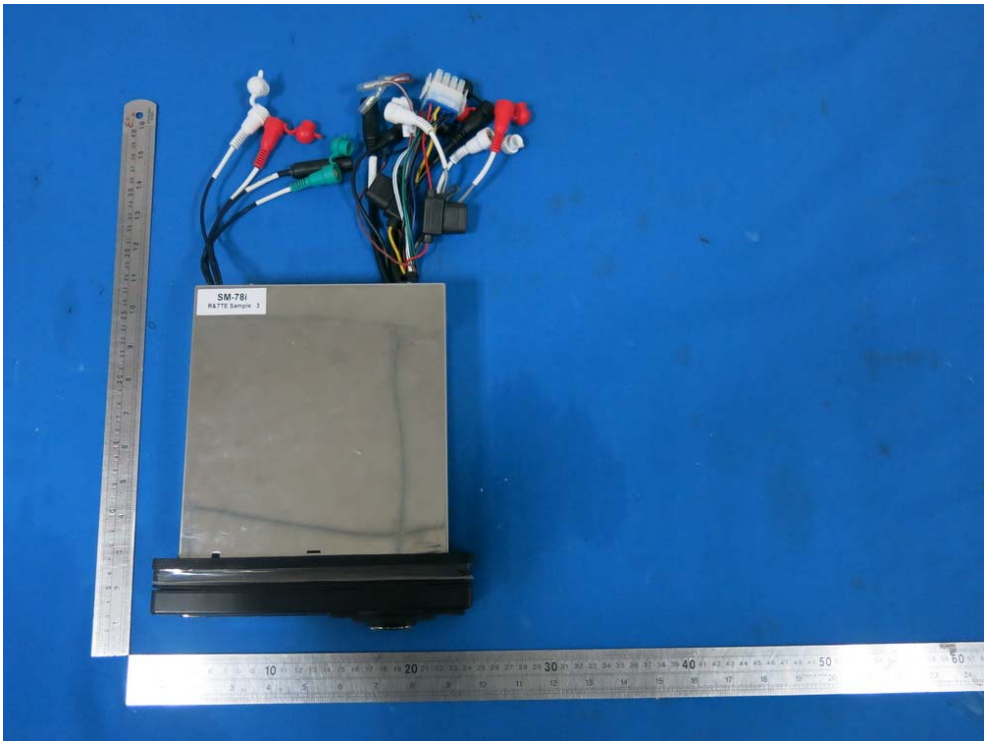
FCC part 15C section 15.247 requirements:
Systems operating in the 2402-2480MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by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

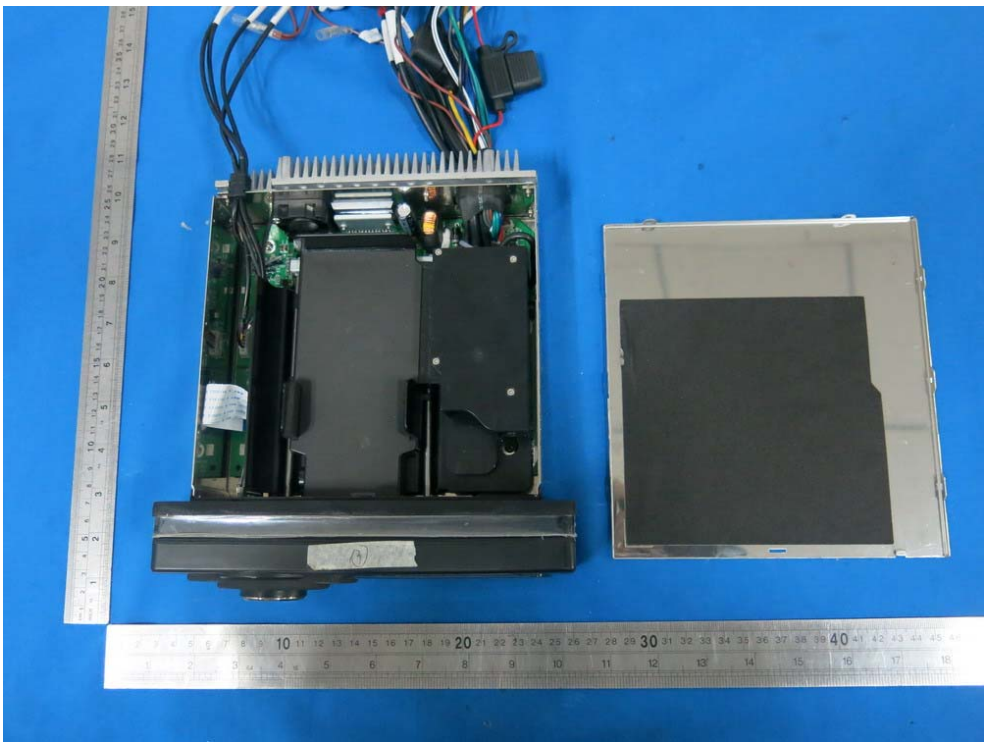
13.2 Result

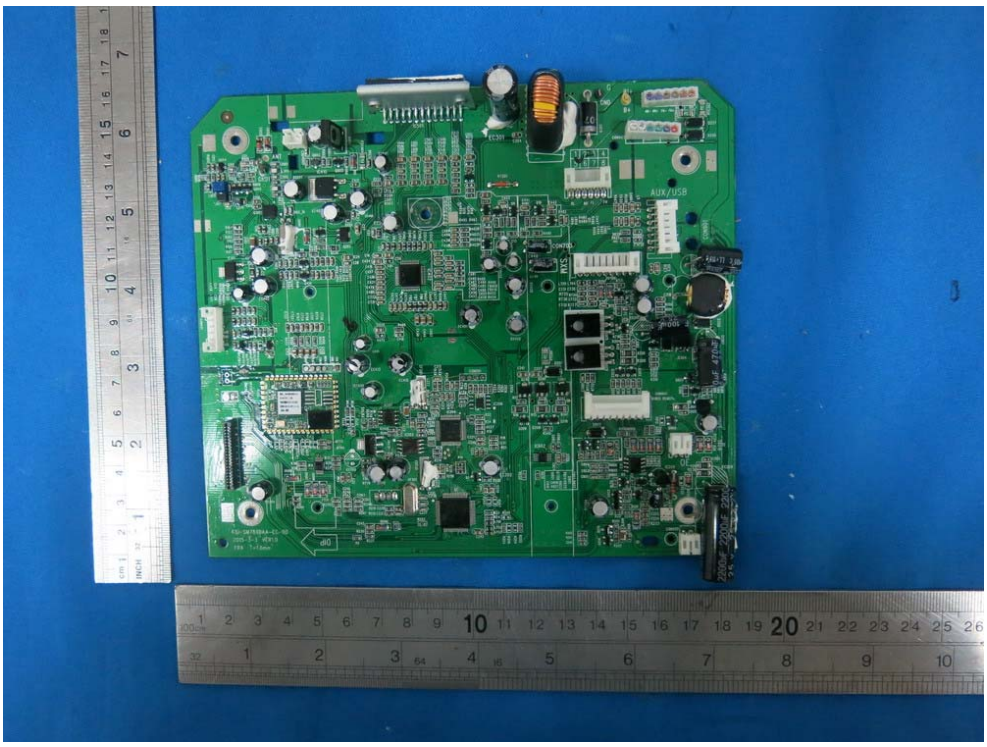
The EUT used Wire Antenna. The antenna's gain is 4dBi and meets the requirement.

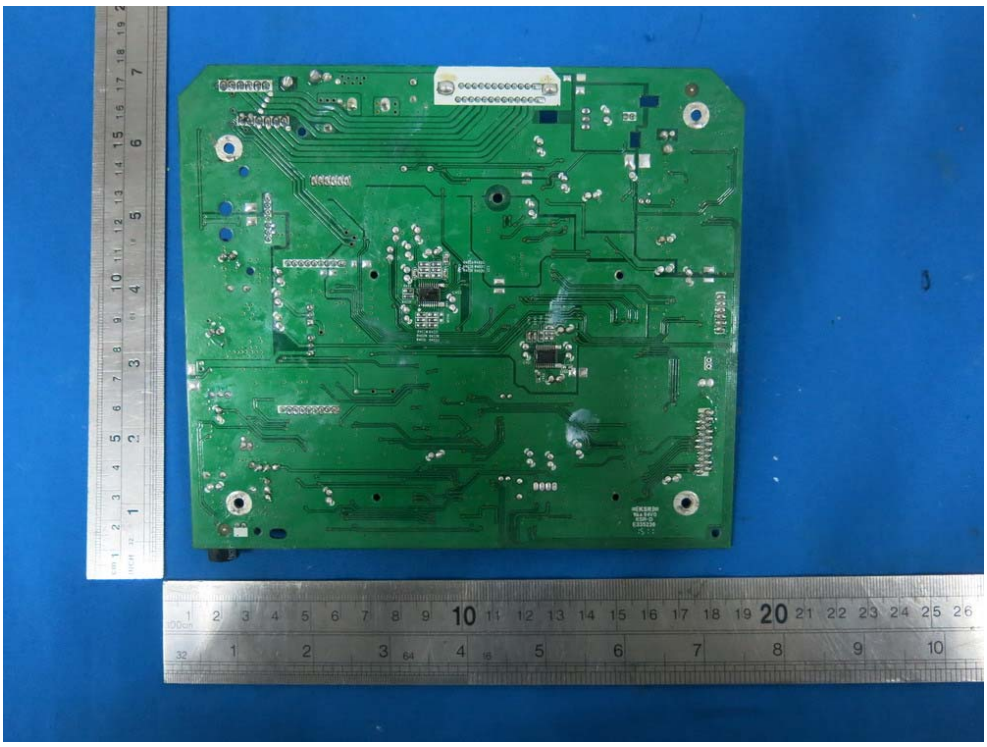
General Appearance of the EUT

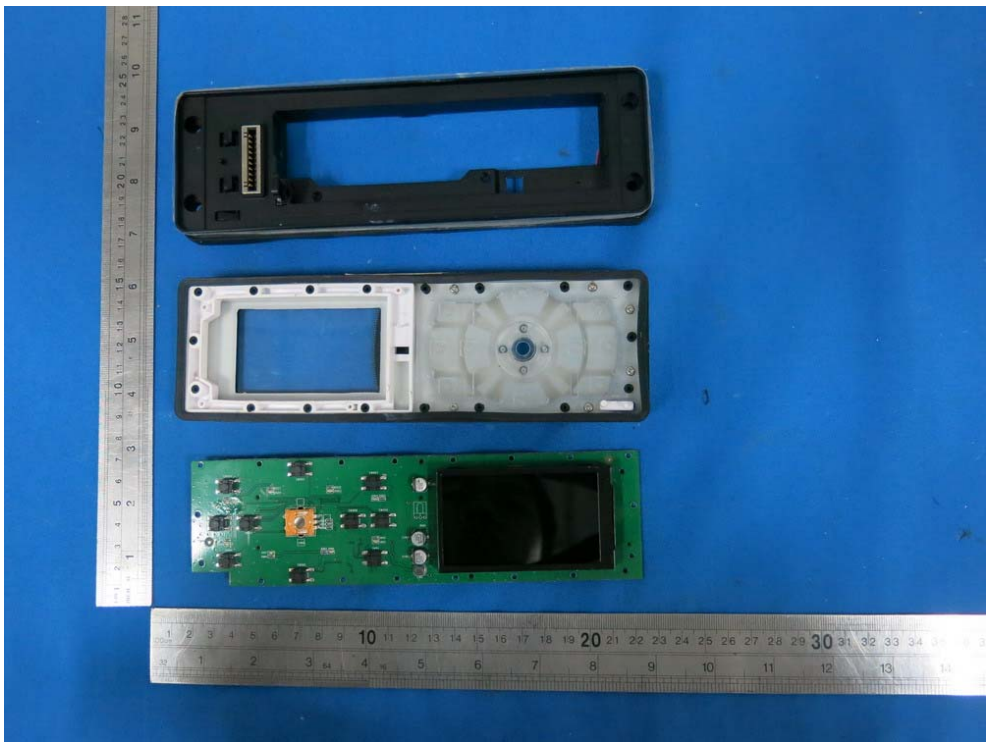


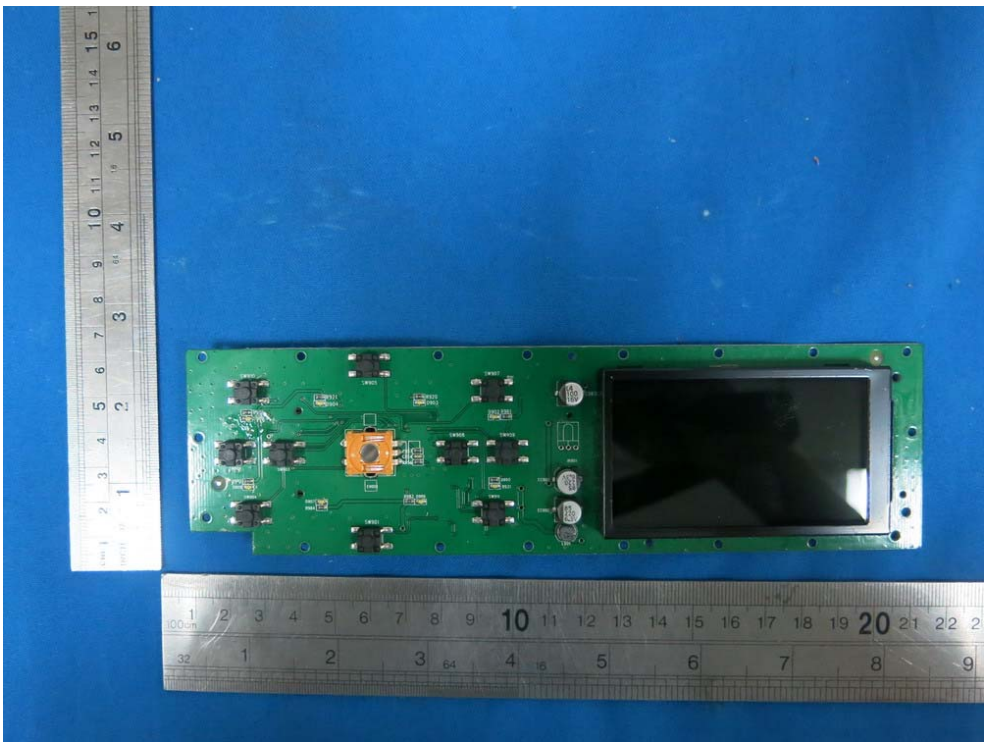


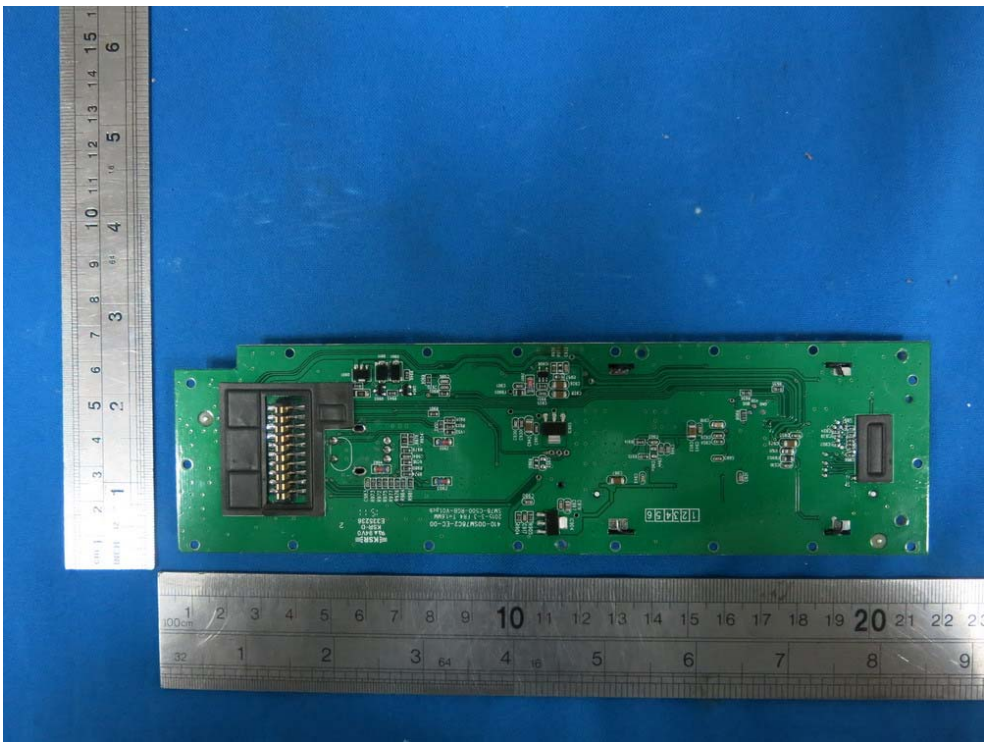


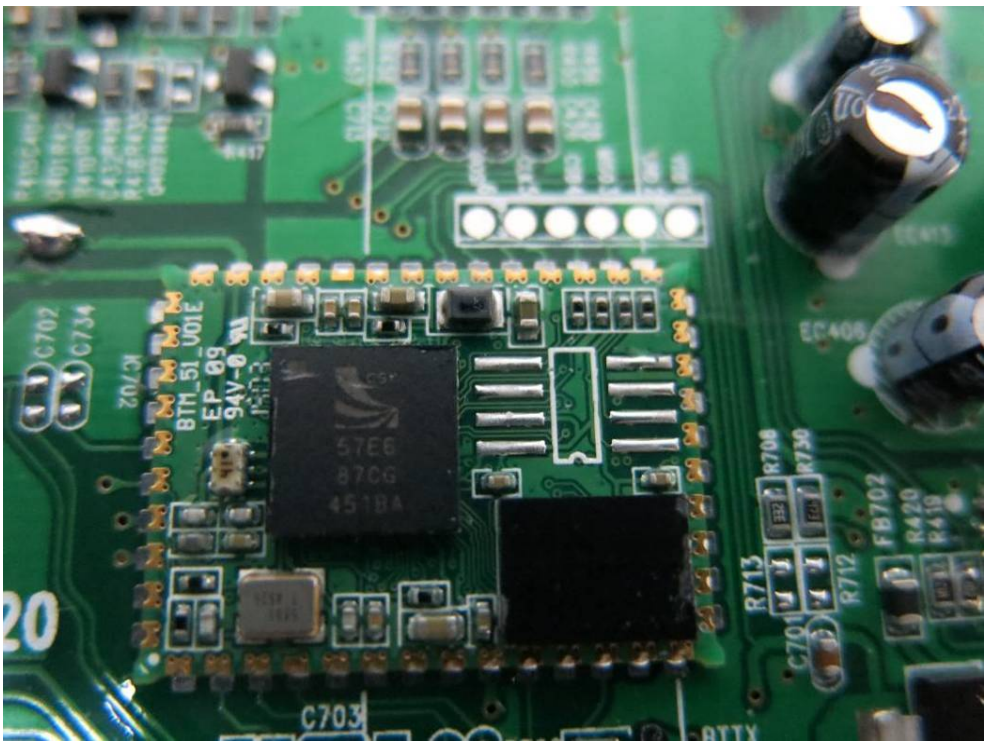











C702
C734
C702
BTM_51_V01E
EP 09
94V-0
57E6
87CG
451BA
R708
R750
FB702
R420
R419
R713
R712
C701
C703