

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

*OF*

**MARINE Bluetooth USB/MP3/WMA RECEIVER**

**Model No.: M505**

**Trade Mark: Clarion**

**FCC ID: 2AB7S-M505**

**Report No.: KAD141031068E**

**Issue Date: December 17, 2014**

*Prepared for*

**SOUNDMAX ELECTRONICS LIMITED  
17/F.,Eu Yang Sang Tower, 11-15 Chatham Road South, Tsim Sha Tsui ,  
Kowloon., Hong Kong**

*Prepared by*

**DONGGUAN EMTEK CO., LTD.**

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

**This report shall not be reproduced, except in full, without the written approval of  
DONGGUAN EMTEK CO., LTD.**

## VERIFICATION OF COMPLIANCE

Applicant:	SOUNDMAX ELECTRONICS LIMITED 17/F.,Eu Yang Sang Tower, 11-15 Chatham Road South, Tsim Sha Tsui , Kowloon., Hong Kong
Manufacturer:	SOUNDMAX ELECTRONICS LIMITED 17/F.,Eu Yang Sang Tower, 11-15 Chatham Road South, Tsim Sha Tsui , Kowloon., Hong Kong
Product Description:	MARINE Bluetooth USB/MP3/WMA RECEIVER
Trade Mark:	Clarion
Model Number:	M505
Kind of Device:	Bluetooth Ver.2.1+EDR
Date of Test:	October 31, 2014 to November 10, 2014

### 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 C63.4 (2009) 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).

*Approved By*



---

**Sam Lv / Q.A. Manager  
DONGGUAN EMTEK CO., LTD.**

## Modified Information

Version	Summary	Revision Date	Report No.
Ver.1.0	Original Report	/	KAD141031068E

## Table of Contents

<b>1.</b>	<b>GENERAL INFORMATION .....</b>	<b>6</b>
1.1	PRODUCT DESCRIPTION.....	6
1.2	RELATED SUBMITTAL(S) / GRANT (S).....	6
1.3	TEST METHODOLOGY .....	6
1.4	SPECIAL ACCESSORIES.....	6
1.5	EQUIPMENT MODIFICATIONS .....	6
1.6	TEST FACILITY .....	7
<b>2.</b>	<b>SYSTEM TEST CONFIGURATION .....</b>	<b>8</b>
2.1	EUT CONFIGURATION.....	8
2.2	EUT EXERCISE.....	8
2.3	TEST PROCEDURE .....	8
2.4	LIMITATION .....	8
2.5	CONFIGURATION OF TESTED SYSTEM .....	12
<b>3.</b>	<b>SUMMARY OF TEST RESULTS.....</b>	<b>13</b>
<b>4.</b>	<b>DESCRIPTION OF TEST MODES.....</b>	<b>13</b>
<b>5.</b>	<b>RADIATED EMISSION TEST .....</b>	<b>14</b>
5.1	MEASUREMENT PROCEDURE .....	14
5.2	TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	15
5.3	MEASUREMENT EQUIPMENT USED:.....	16
5.4	MEASUREMENT RESULT.....	16
5.5	RADIATED MEASUREMENT PHOTOS:.....	26
<b>6.</b>	<b>CHANNEL SEPARATION TEST .....</b>	<b>27</b>
6.1	MEASUREMENT PROCEDURE .....	27
6.2	TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	27
6.3	MEASUREMENT EQUIPMENT USED:.....	27
6.4	MEASUREMENT RESULTS:.....	27
<b>7.</b>	<b>20DB BANDWIDTH TEST .....</b>	<b>34</b>
7.1	MEASUREMENT PROCEDURE .....	34
7.2	TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	34
7.3	MEASUREMENT EQUIPMENT USED:.....	34
7.4	MEASUREMENT RESULTS:.....	34
<b>8.</b>	<b>QUANTITY OF HOPPING CHANNEL TEST .....</b>	<b>41</b>
8.1	MEASUREMENT PROCEDURE .....	41
8.2	TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	41
8.3	MEASUREMENT EQUIPMENT USED:.....	41
8.4	MEASUREMENT RESULTS:.....	41

<b>9.</b>	<b>TIME OF OCCUPANCY (DWELL TIME) TEST .....</b>	<b>42</b>
9.1	TEST DESCRIPTION .....	42
9.2	TEST REQUIREMENTS / LIMITS.....	42
9.3	TEST PROTOCOL.....	42
9.4	TEST RESULT: DWELL TIME.....	43
<b>10.</b>	<b>MAXIMUM PEAK OUTPUT POWER TEST .....</b>	<b>45</b>
10.1	MEASUREMENT PROCEDURE .....	45
10.2	TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	45
10.3	MEASUREMENT EQUIPMENT USED:.....	45
10.4	MEASUREMENT RESULTS:.....	46
<b>11.</b>	<b>BAND EDGE TEST.....</b>	<b>52</b>
11.1	MEASUREMENT PROCEDURE .....	52
11.2	TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	52
11.3	MEASUREMENT EQUIPMENT USED:.....	52
11.4	MEASUREMENT RESULTS:.....	53
<b>12.</b>	<b>ANTENNA APPLICATION .....</b>	<b>55</b>
12.1	ANTENNA REQUIREMENT .....	55
12.2	RESULT.....	55
<b>13.</b>	<b>RF EXPOSURE EVALUATION .....</b>	<b>56</b>
13.1	FRIIS TRANSMISSION FORMULA: $P_D=(P_{OUT}*G)/(4*\pi*R^2)$ .....	56
13.2	MEASUREMENT RESULT.....	56

## 1. GENERAL INFORMATION

### 1.1 Product Description

The SOUNDMAX ELECTRONICS LIMITED, Model: M505 (referred to as the EUT in this report) The EUT is an short range, lower power transmitter. It is designed by way of utilizing the following modulation achieves the system operating.

A major technical descriptions of EUT is described as following:

- A). Operation Frequency: 2402-2480MHz
- B). Modulation: GFSK,  $\pi/4$ -DQPSK, 8DPSK
- C). Number of Channel: 79
- D). Channel space: 1MHz
- E). Rated RF Output Power: -3.57dBm(0.0004W)
- F). Antenna Type: Inverted-E antenna
- G). Antenna Gain: 4dBi
- H). Power Supply: DC 10.8-15.6V

The basic data rate of 1Mbps uses GFSK modulation and the enhanced data rate uses PSK modulation. For the enhanced data rate of 3Mbps 8DPSK modulation and of 2Mbps  $\pi/4$ -DQPSK modulation is used.

### 1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: 2AB7S-M505 filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules and FCC Public Notice DA 00-705.

### 1.3 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4 (2009). Radiated testing was performed at an antenna to EUT distance 3 meters.

### 1.4 Special Accessories

Not available for this EUT intended for grant.

### 1.5 Equipment Modifications

Not available for this EUT intended for grant.

## 1.6 Test Facility

### Site Description

EMC Lab. :

Accredited by FCC, June 18, 2014  
The Certificate Number is 247565

Accredited by Industry Canada, February 19, 2014  
The Certificate Number is 9444A.

Name of Firm : DONGGUAN EMTEK CO., LTD.

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

## 2. System Test Configuration

### 2.1 EUT Configuration

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

### 2.2 EUT Exercise

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

### 2.3 Test Procedure

#### 2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4-2009. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and average detector mode.

#### 2.3.2 Radiated Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter(EUT) was rotated through three orthogonal axes according to the requirements in Section 13.1.4.1 of ANSI C63.4-2009.

### 2.4 Limitation

#### (1) Channel Separation test

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

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



**(2) 20dB Bandwidth**

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

**(3) Quantity of Hopping Channel**

FCC Part 15, Subpart C Section 15.247

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

**(4) Time of Occupancy(Dwell Time)**

FCC Part 15, Subpart C Section 15.247

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

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

**(5) Maximum Peak Output Power**

FCC Part 15, Subpart C Section 15.247

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

**(6) Band edge**

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

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

**(7) Conducted Emission**

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

**Note:**

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

**(8) Radiated Emission**

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

Frequency (MHz)	Field strength $\mu\text{V/m}$	Distance(m)	Field strength at 3m $\text{dB}\mu\text{V/m}$
0.009-0.490	2400/F(kHz)	300	/
0.490-1.705	24000/F(kHz)	30	/
1.705-30.0	30	30	/
30-88	100	3	40
88-216	150	3	43.5
216-960	200	3	46
Above 960	500	3	54

Remark 1. Emission level in  $\text{dB}\mu\text{V/m}=20 \log (\mu\text{V/m})$   
 : 2. Measurement was performed at an antenna to the closed point of EUT distance of meters.

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

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

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

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

## 2.5 Configuration of Tested System

**Fig. 2-1 Configuration of Tested System**

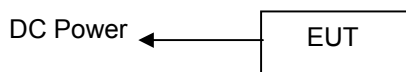


Table 2-1 Equipment Used in Tested System

Item	Equipment	Trade Mark	Model No.	FCC ID	Note
1.	MARINE Bluetooth USB/MP3/WMA RECEIVER	Clarion	M505	2AB7S-M505	<b><i>EUT</i></b>

**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
§15.247(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
§15.207	AC Power Conducted Emission	N/A
§15.247(d),§15.209	Radiated Emission	Compliant
§15.203	Antenna Requirement	Compliant
§1.1310	RF Exposure	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,  $\pi/4$ -DQPSK, 8DPSK have been tested. 79 Channels are provided by EUT. The 3 channels of lower, medium and higher were chosen for test.

Channel	Frequency(MHz)
1	2402
40	2441
79	2480

## 5. Radiated Emission Test

### 5.1 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m 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.

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:

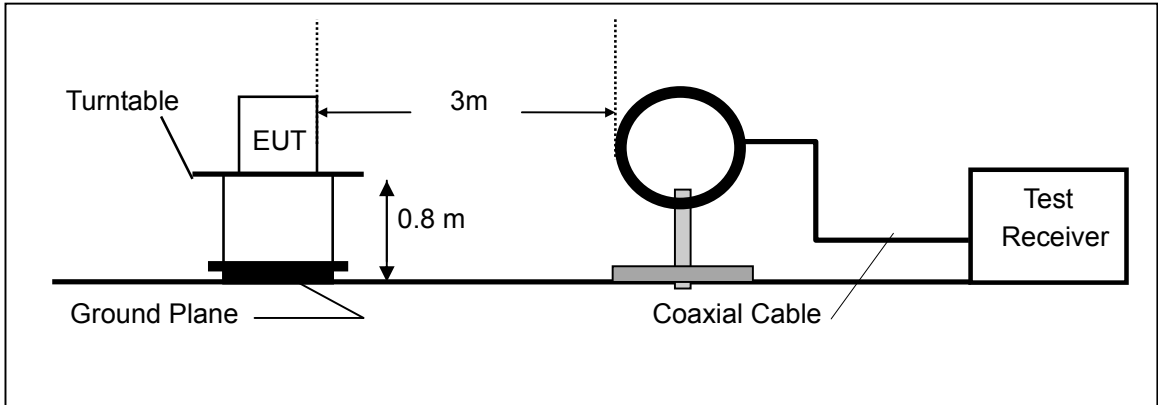
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	3MHz
Detector	Peak
Trace	Max hold

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

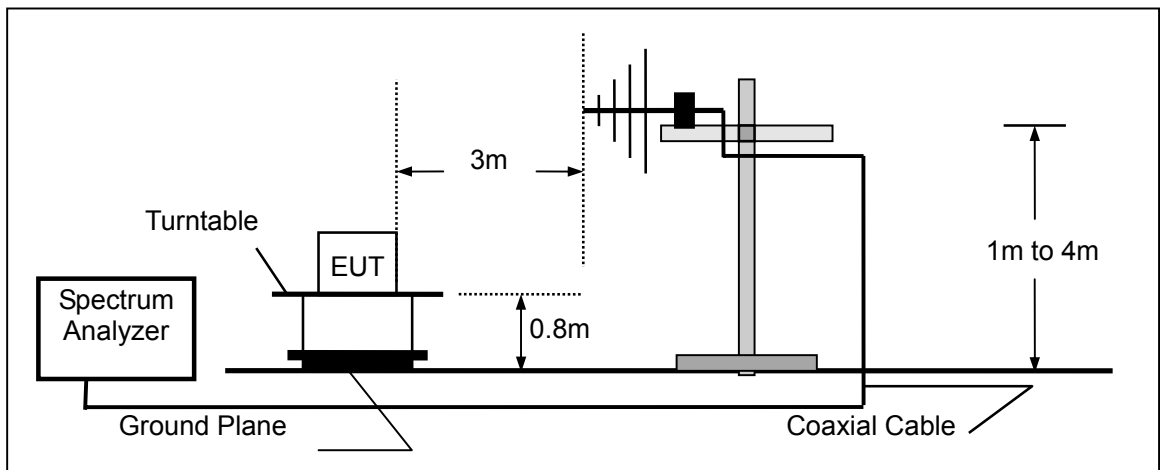
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	10Hz
Detector	Peak
Trace	Max hold

## 5.2 Test SET-UP (Block Diagram of Configuration)

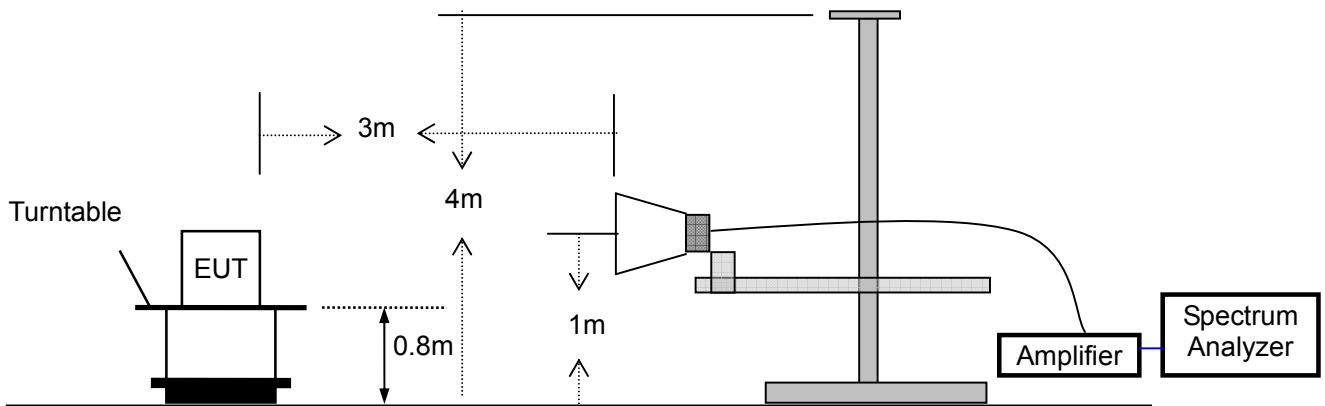
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



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



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



### 5.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	05/16/2014	05/15/2015
EMI Test Receiver	Rohde & Schwarz	ESU	1302.6005.26	05/16/2014	05/15/2015
Pre-Amplifier	HP	8447D	2944A07999	05/16/2014	05/15/2015
Bilog Antenna	SCHWARZBECK	VULB9163	142	05/16/2014	05/15/2015
Loop Antenna	ARA	PLA-1030/B	1029	05/16/2014	05/15/2015
Horn Antenna	Schwarzbeck	BBHA9170	BBHA9170399	05/16/2014	05/15/2015
Horn Antenna	Schwarzbeck	BBHA 9120	D143	05/16/2014	05/15/2015
Cable	Schwarzbeck	AK9513	ACRX1	05/16/2014	05/15/2015
Cable	Schwarzbeck	AK9513	FP2RX2	05/19/2014	05/18/2015
Cable	Schwarzbeck	AK9513	CRPX1	05/19/2014	05/18/2015
Cable	Schwarzbeck	AK9513	CRRX2	05/19/2014	05/18/2015

### 5.4 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 : November 03, 2014  
 Frequency Range: 9KHz~30MHz              Temperature : 28°C  
 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);

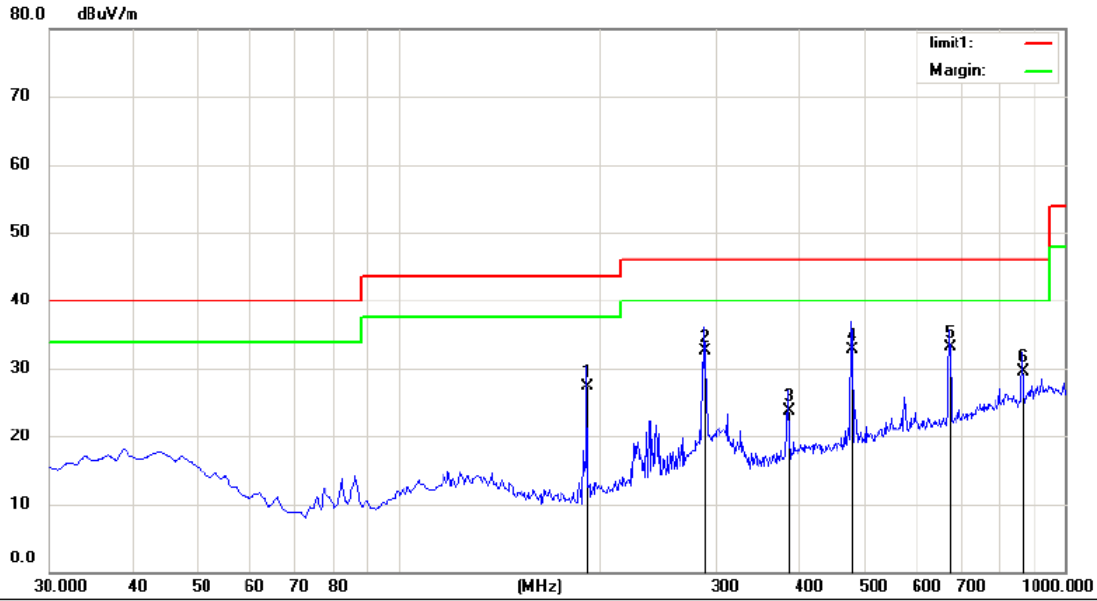
Limit line=Specific limits(dBuV) + distance extrapolation factor.

#### Below 1000MHz:

Pass.

Please refer to the following data.



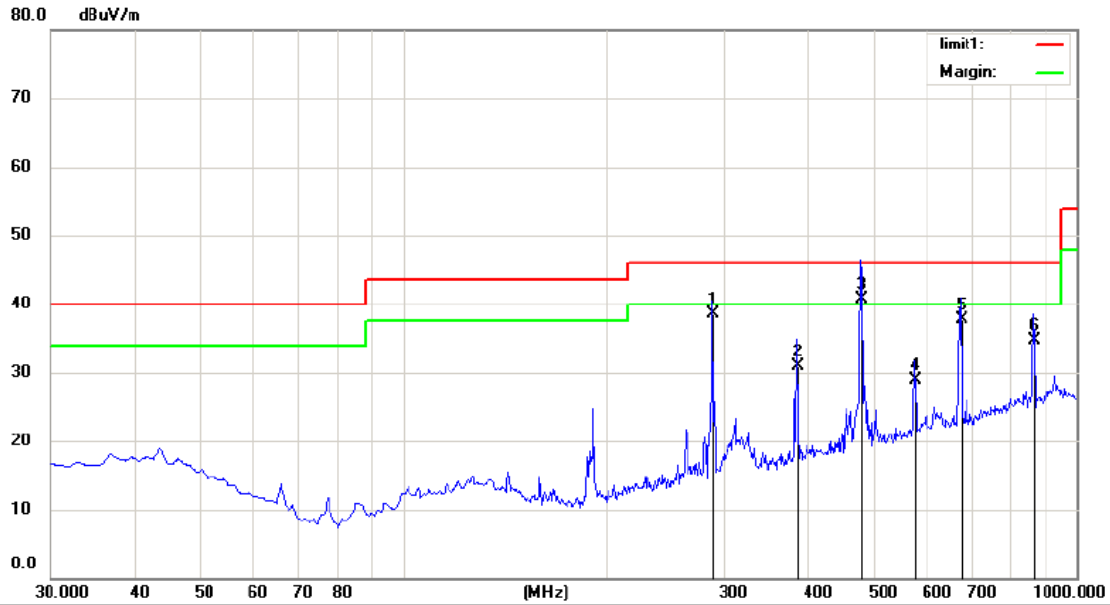


Site Chamber #1 Polarization: **Horizontal** Temperature: 26  
 Limit: (RE)FCC PART 15 class B 3m Power: DC 12V Humidity: 55 %  
 Mode: TX2402  
 Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		191.9900	45.40	-18.14	27.26	43.50	-16.24	QP		
2		288.0200	47.30	-14.77	32.53	46.00	-13.47	QP		
3		384.0500	35.60	-11.96	23.64	46.00	-22.36	QP		
4		480.0800	43.20	-10.54	32.66	46.00	-13.34	QP		
5	*	672.1400	40.70	-7.66	33.04	46.00	-12.96	QP		
6		865.1700	33.90	-4.38	29.52	46.00	-16.48	QP		

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

Operator: Snake

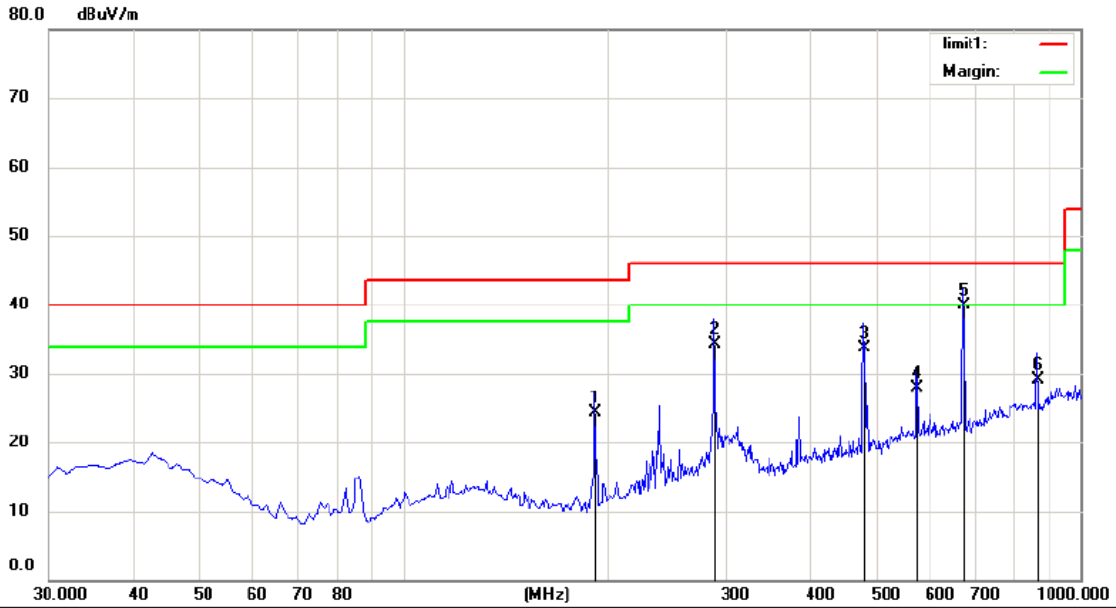


Site Chamber #1 Polarization: **Vertical** Temperature: 26  
 Limit: (RE)FCC PART 15 class B 3m Power: DC 12V Humidity: 55 %  
 Mode: TX2402  
 Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		288.0200	53.20	-14.77	38.43	46.00	-7.57	QP		
2		384.0500	42.90	-11.96	30.94	46.00	-15.06	QP		
3	*	480.0800	51.20	-10.54	40.66	46.00	-5.34	QP		
4		576.1100	37.60	-8.77	28.83	46.00	-17.17	QP		
5		673.1100	45.30	-7.67	37.63	46.00	-8.37	QP		
6		865.1700	39.10	-4.38	34.72	46.00	-11.28	QP		

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

Operator: Snake

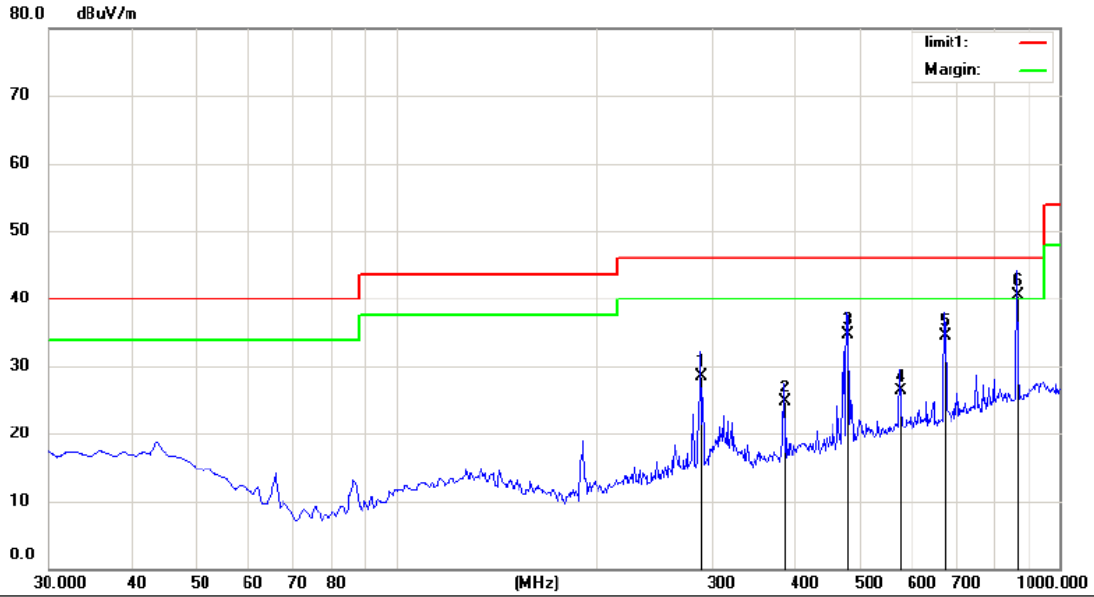


Site Chamber #1 Polarization: **Horizontal** Temperature: 26  
 Limit: (RE)FCC PART 15 class B 3m Power: DC 12V Humidity: 55 %  
 Mode: TX2441  
 Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	
1		191.9900	42.50	-18.14	24.36	43.50	-19.14	QP		
2		288.0200	49.10	-14.77	34.33	46.00	-11.67	QP		
3		480.0800	44.30	-10.54	33.76	46.00	-12.24	QP		
4		574.1700	36.70	-8.73	27.97	46.00	-18.03	QP		
5	*	672.1400	47.50	-7.66	39.84	46.00	-6.16	QP		
6		865.1700	33.40	-4.38	29.02	46.00	-16.98	QP		

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

Operator: Snake

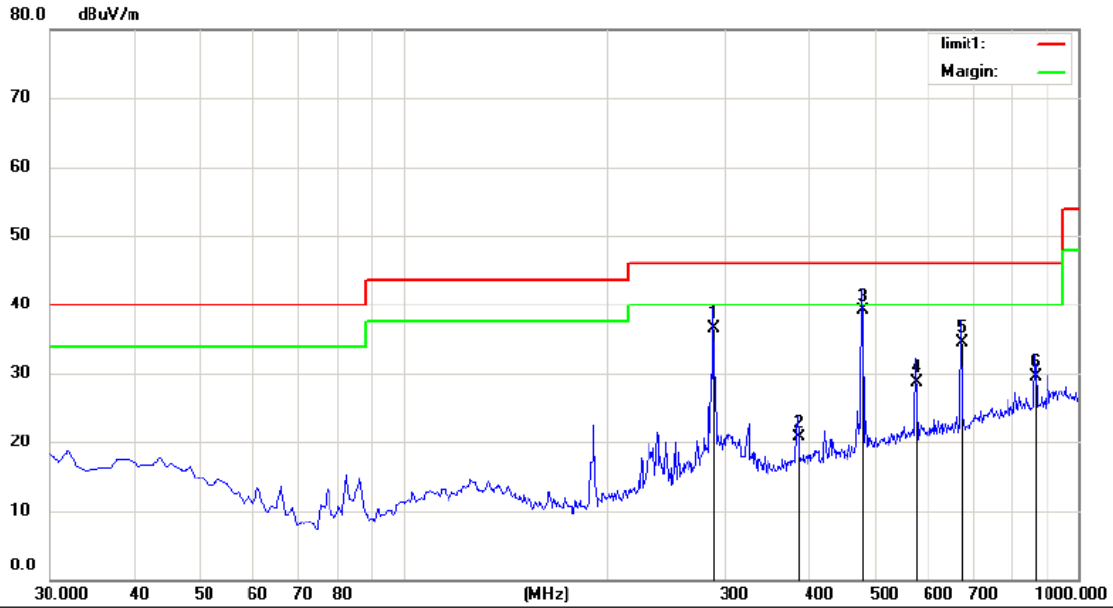


Site Chamber #1 Polarization: **Vertical** Temperature: 26  
 Limit: (RE)FCC PART 15 class B 3m Power: DC 12V Humidity: 55 %  
 Mode: TX2441  
 Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		288.0200	43.20	-14.77	28.43	46.00	-17.57	QP		
2		384.0500	36.70	-11.96	24.74	46.00	-21.26	QP		
3		479.1100	45.30	-10.57	34.73	46.00	-11.27	QP		
4		575.1400	35.10	-8.79	26.31	46.00	-19.69	QP		
5		672.1400	42.20	-7.69	34.51	46.00	-11.49	QP		
6	*	865.1700	44.90	-4.38	40.52	46.00	-5.48	QP		

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

Operator: Snake

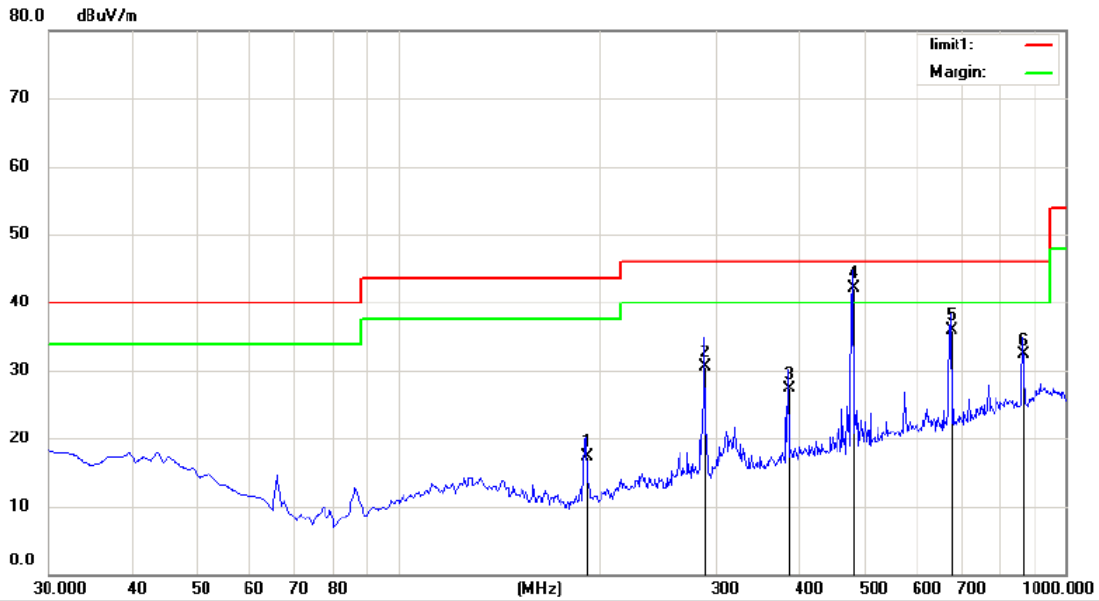


Site Chamber #1 Polarization: **Horizontal** Temperature: 26  
 Limit: (RE)FCC PART 15 class B 3m Power: DC 12V Humidity: 55 %  
 Mode: TX2480  
 Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	
1		288.0200	51.30	-14.77	36.53	46.00	-9.47	QP		
2		384.0500	32.70	-11.96	20.74	46.00	-25.26	QP		
3	*	480.0800	49.60	-10.54	39.06	46.00	-6.94	QP		
4		576.1100	37.50	-8.72	28.78	46.00	-17.22	QP		
5		672.1400	42.20	-7.66	34.54	46.00	-11.46	QP		
6		865.1700	33.80	-4.38	29.42	46.00	-16.58	QP		

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

Operator: Snake



Site Chamber #1 Polarization: **Vertical** Temperature: 26  
 Limit: (RE)FCC PART 15 class B 3m Power: DC 12V Humidity: 55 %  
 Mode: TX2480  
 Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		191.9900	35.50	-18.14	17.36	43.50	-26.14	QP		
2		288.0200	45.20	-14.77	30.43	46.00	-15.57	QP		
3		384.0500	39.30	-11.96	27.34	46.00	-18.66	QP		
4	*	481.0500	52.70	-10.54	42.16	46.00	-3.84	QP		
5		673.1100	43.50	-7.67	35.83	46.00	-10.17	QP		
6		864.2000	36.80	-4.40	32.40	46.00	-13.60	QP		

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

Operator: Snake

Operation Mode: TX Mode (CH1: 2402MHz) Test Date : November 03, 2014  
 Frequency Range: 1-25GHz Temperature : 25 °C  
 Test Result: PASS Humidity : 50 %  
 Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
4804	V	65.36	44.19	74	54	-8.64	-9.81
7206	V	64.06	43.05	74	54	-9.94	-10.95
9608	V	63.59	42.95	74	54	-10.41	-11.05
12010	V	62.01	41.19	74	54	-11.99	-12.81
14412	V	61.09	40.59	74	54	-12.91	-13.41
16814	V	60.55	39.72	74	54	-13.45	-14.28
4804	H	64.09	43.34	74	54	-9.91	-10.66
7206	H	63.29	42.69	74	54	-10.71	-11.31
9608	H	62.37	41.18	74	54	-11.63	-12.82
12010	H	61.13	40.27	74	54	-12.87	-13.73
14412	H	60.59	39.00	74	54	-13.41	-15.00
16814	H	59.38	38.49	74	54	-14.62	-15.51

**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 was recorded.

Operation Mode: TX Mode (CH40: 2441MHz) Test Date : November 03, 2014  
 Frequency Range: 1-25GHz Temperature : 25 °C  
 Test Result: PASS Humidity : 50 %  
 Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
4882	V	66.33	45.95	74	54	-7.67	-8.05
7323	V	65.29	44.17	74	54	-8.71	-9.83
9764	V	64.07	43.59	74	54	-9.93	-10.41
12205	V	63.49	42.07	74	54	-10.51	-11.93
14646	V	62.95	41.72	74	54	-11.05	-12.28
17087	V	61.03	40.59	74	54	-12.97	-13.41
4882	H	65.07	46.59	74	54	-8.93	-7.41
7323	H	64.29	45.85	74	54	-9.71	-8.15
9764	H	63.85	44.17	74	54	-10.15	-9.83
12205	H	63.71	43.92	74	54	-10.29	-10.08
14646	H	62.59	42.07	74	54	-11.41	-11.93
17087	H	61.07	41.52	74	54	-12.93	-12.48

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 was recorded.



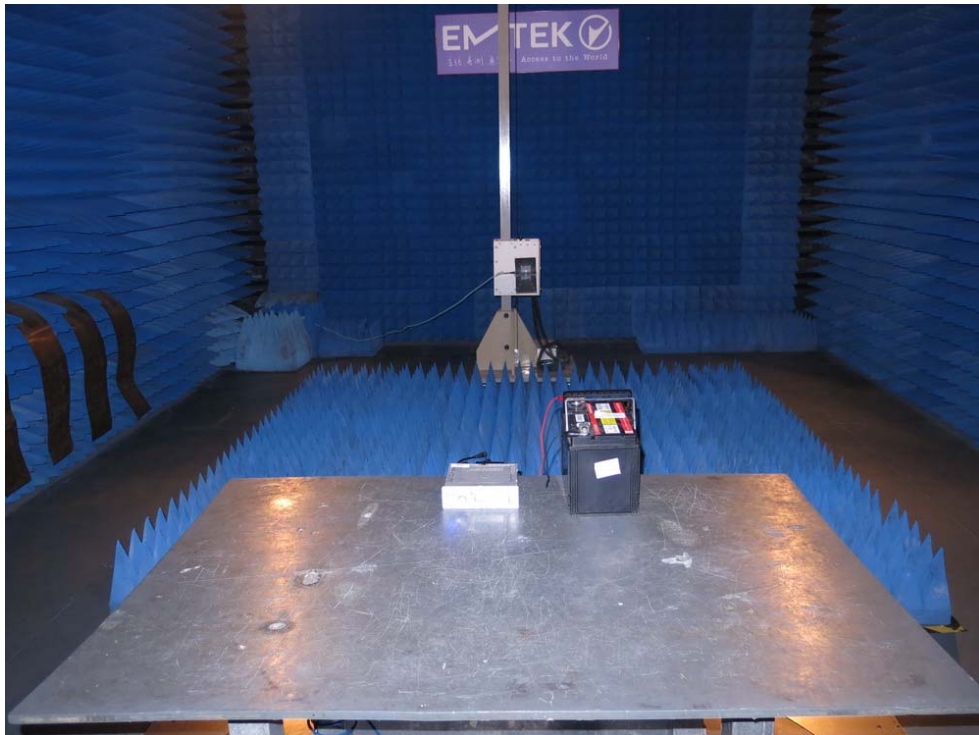
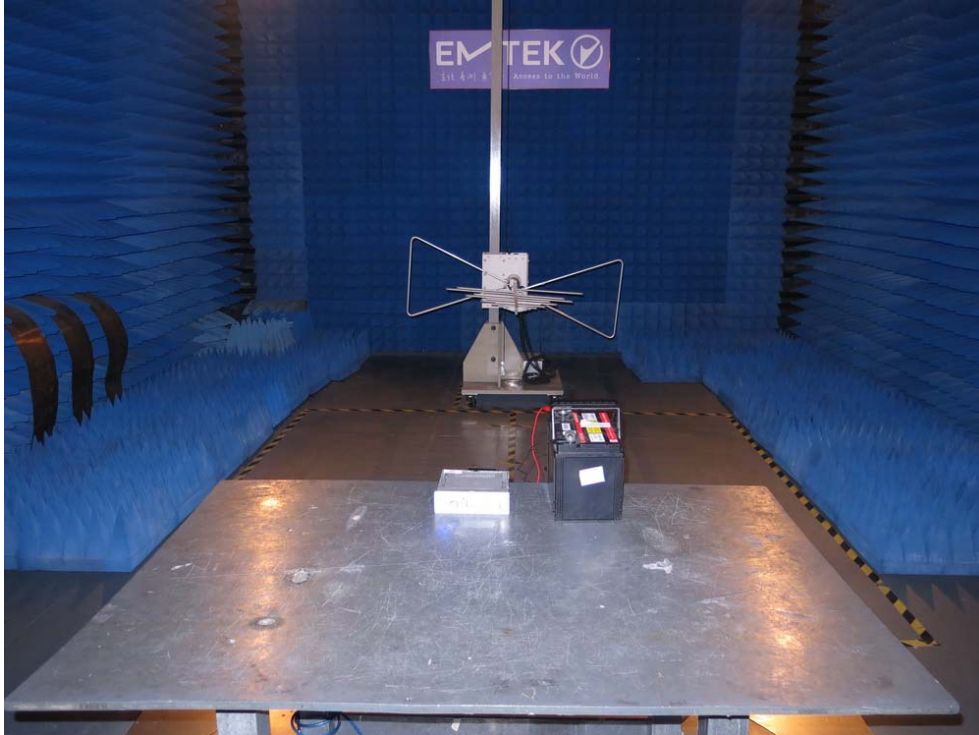
Operation Mode: TX Mode (CH79: 2480MHz) Test Date : November 03, 2014  
 Frequency Range: 1-25GHz Temperature : 25 °C  
 Test Result: PASS Humidity : 50 %  
 Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
4960	V	67.59	44.08	74	54	-6.41	-9.92
7440	V	66.22	43.13	74	54	-7.78	-10.87
9920	V	65.07	42.95	74	54	-8.93	-11.05
12400	V	64.18	41.07	74	54	-9.82	-12.93
14880	V	63.89	40.22	74	54	-10.11	-13.78
17360	V	62.73	39.83	74	54	-11.27	-14.17
4960	H	66.72	46.28	74	54	-7.28	-7.72
7440	H	65.38	45.10	74	54	-8.62	-8.90
9920	H	64.08	44.29	74	54	-9.92	-9.71
12400	H	63.92	43.92	74	54	-10.08	-10.08
14880	H	62.17	42.72	74	54	-11.83	-11.28
17360	H	61.07	41.13	74	54	-12.93	-12.87

**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 was recorded.

### 5.5 Radiated Measurement Photos:

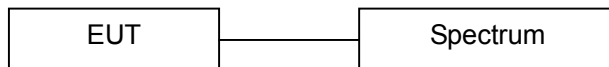


## 6. Channel Separation test

### 6.1 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.

### 6.2 Test SET-UP (Block Diagram of Configuration)



### 6.3 Measurement Equipment Used:

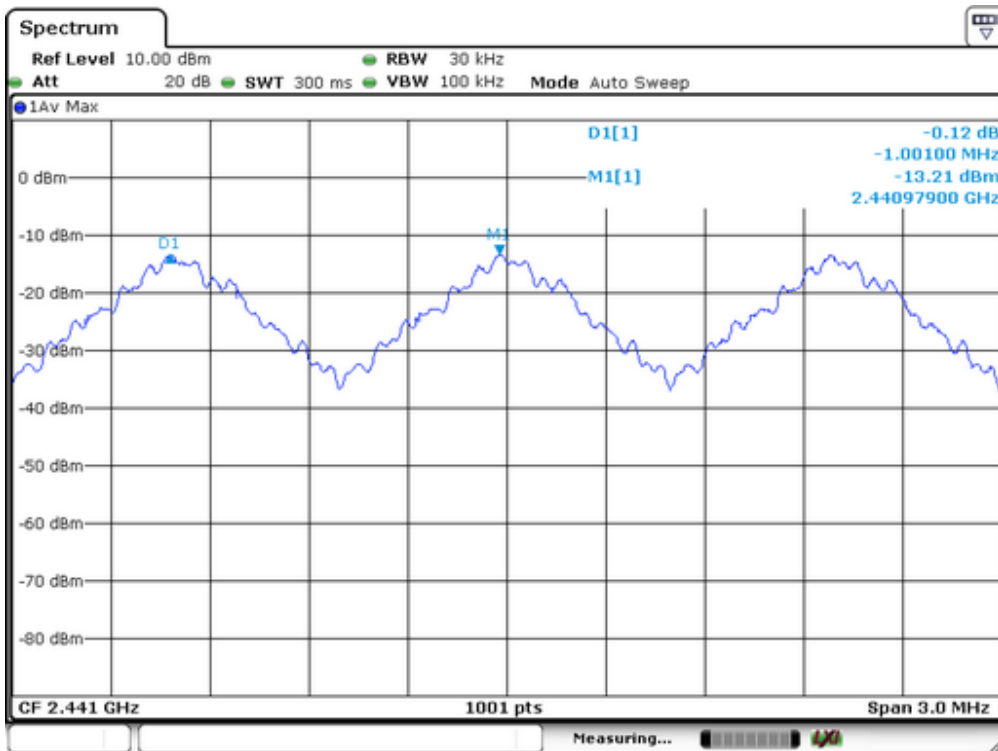
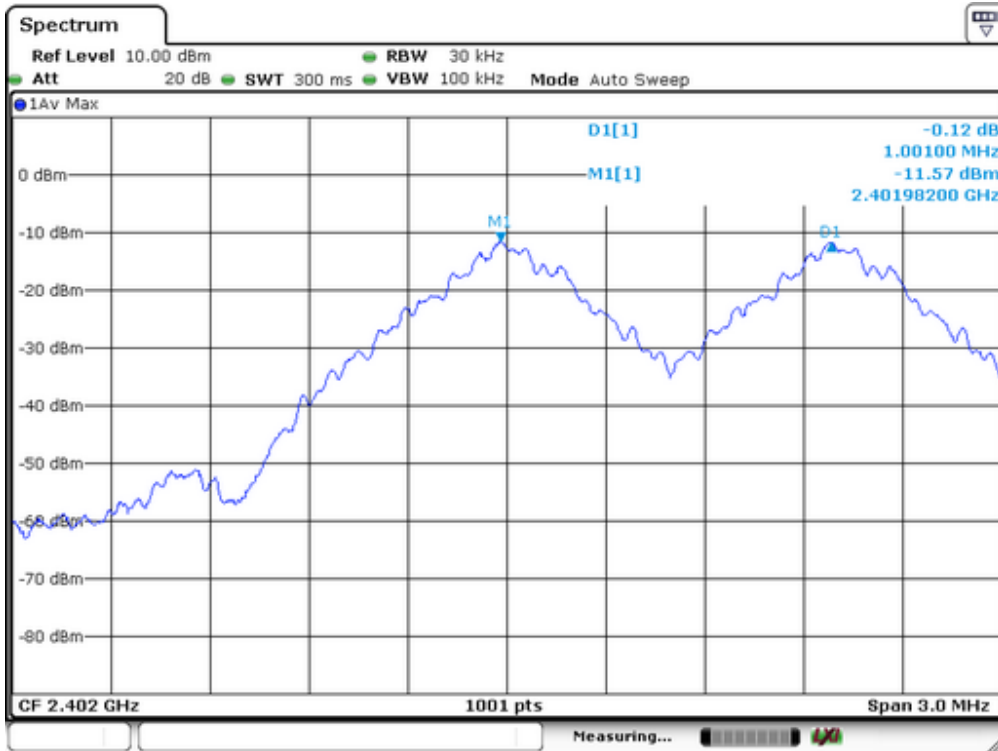
Same as 5.3 Radiated Emission Measurement.

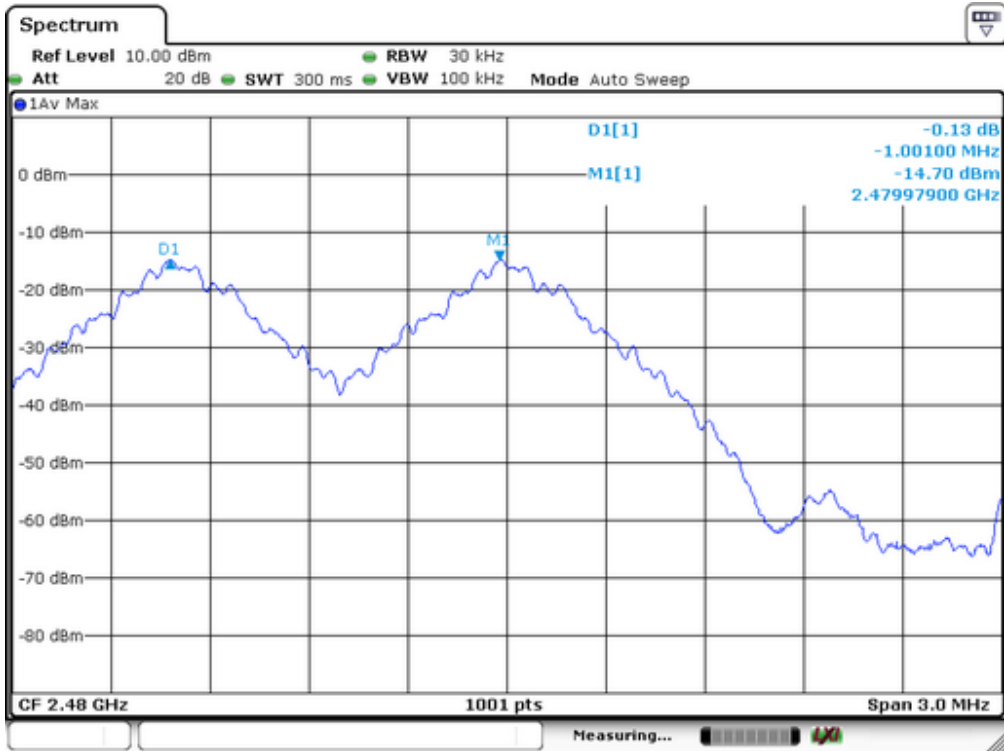
### 6.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	November 03, 2014
Test By:	Andy	Temperature :	24°C
Test Result:	PASS	Humidity :	53 %
Modulation:	GFSK		

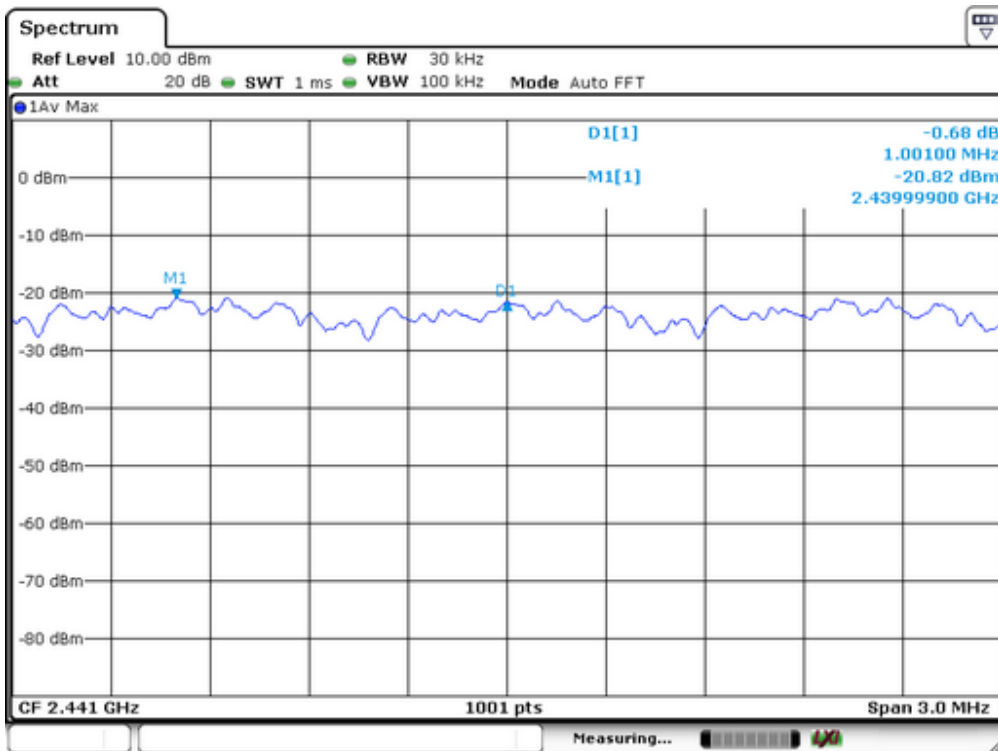
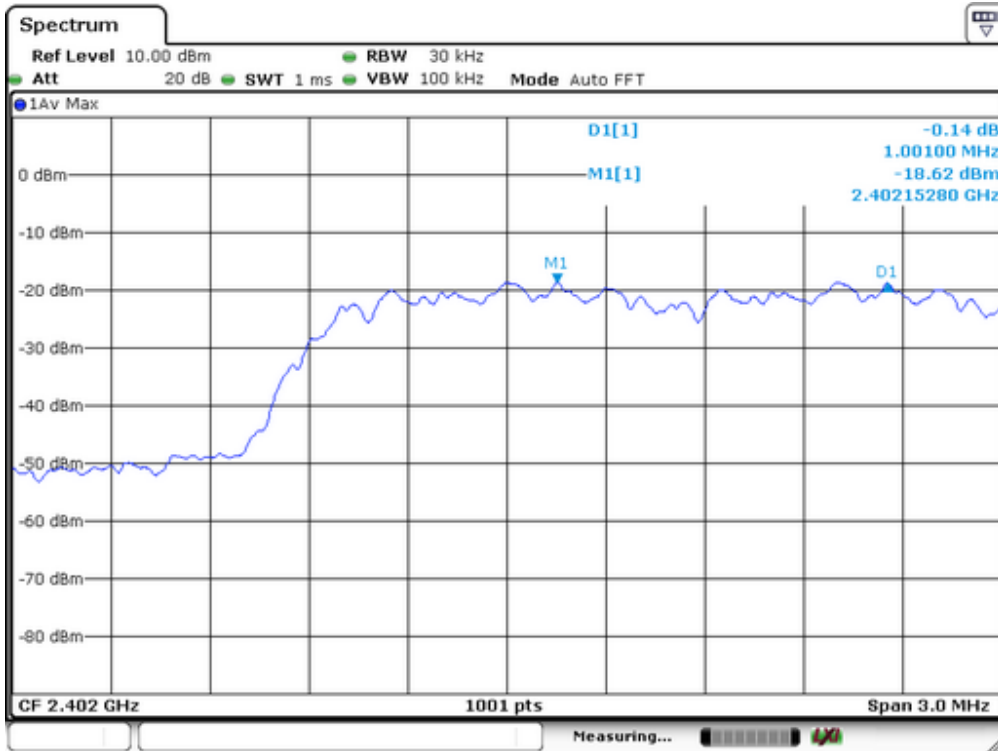
Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 20dB Down BW(kHz)
1	2402	1001	>857
40	2441	1001	>854
79	2480	1001	>854

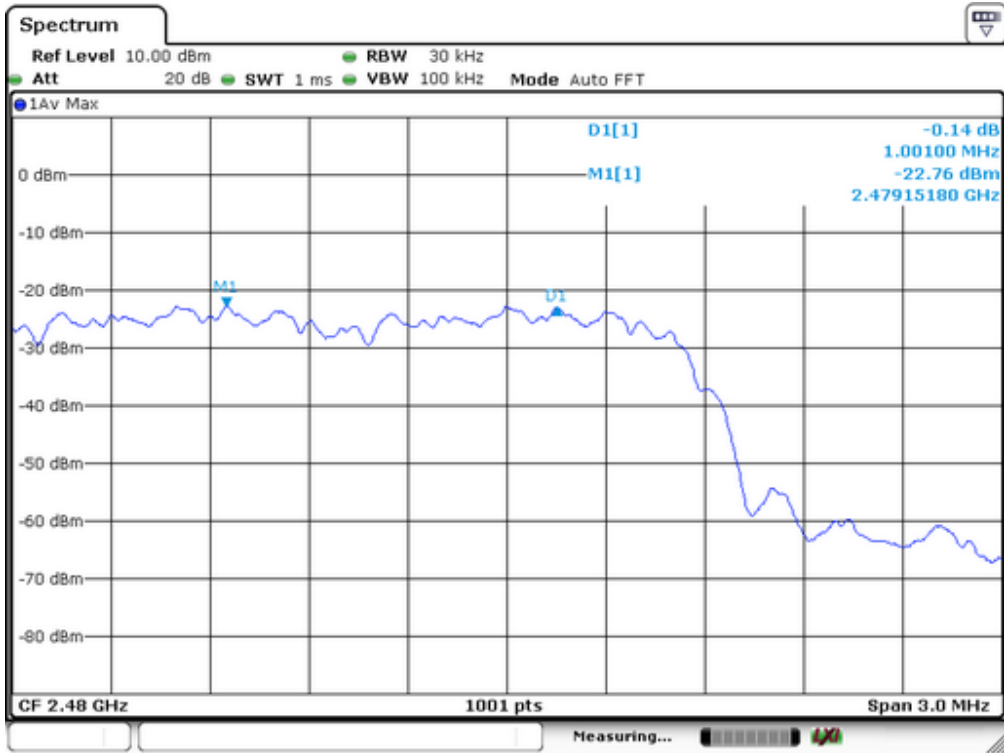




Spectrum Detector: PK                      Test Date : November 03, 2014  
 Test By: Andy                              Temperature : 24°C  
 Test Result: PASS                        Humidity : 53 %  
 Modulation: 1/4Π-DQPSK

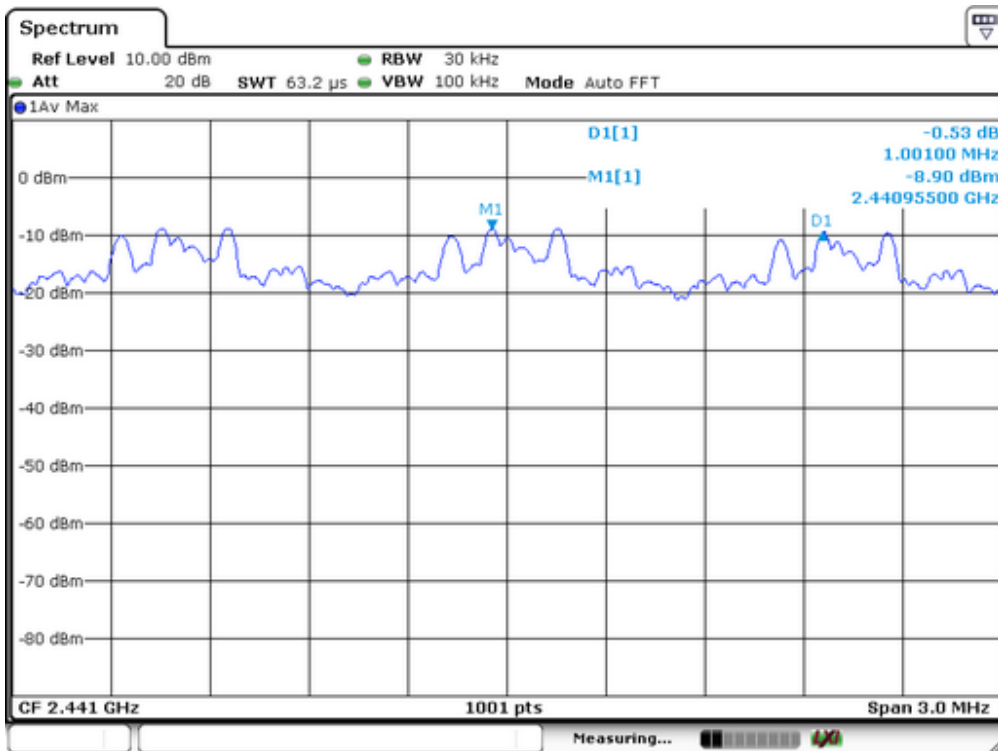
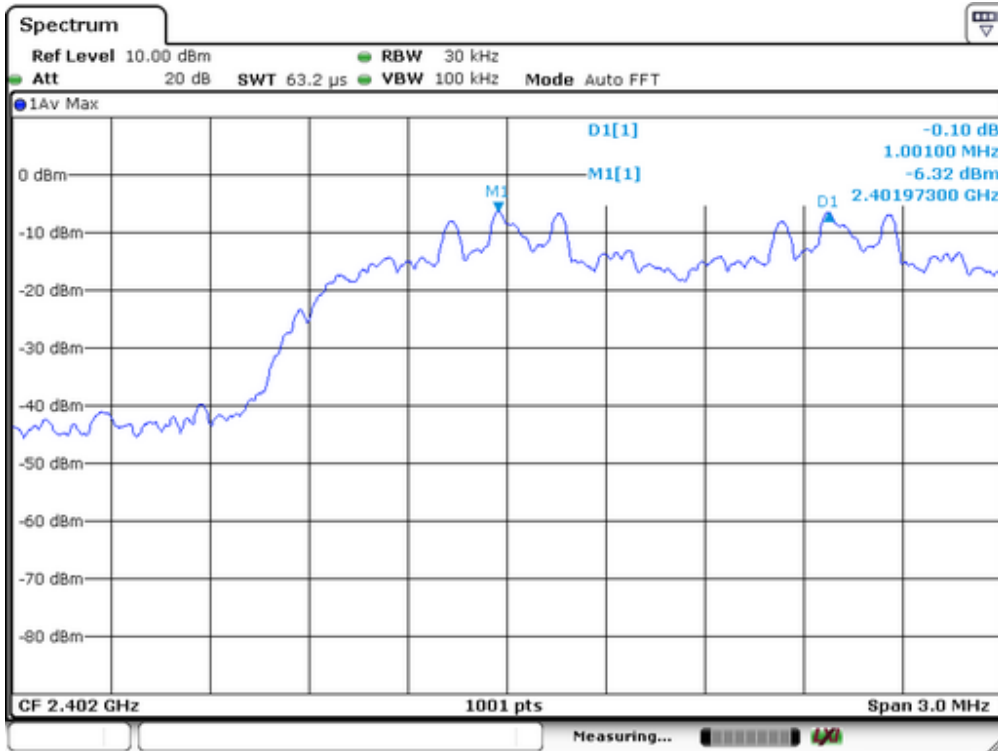
Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	1001	>920
40	2441	1001	>920
79	2480	1001	>922



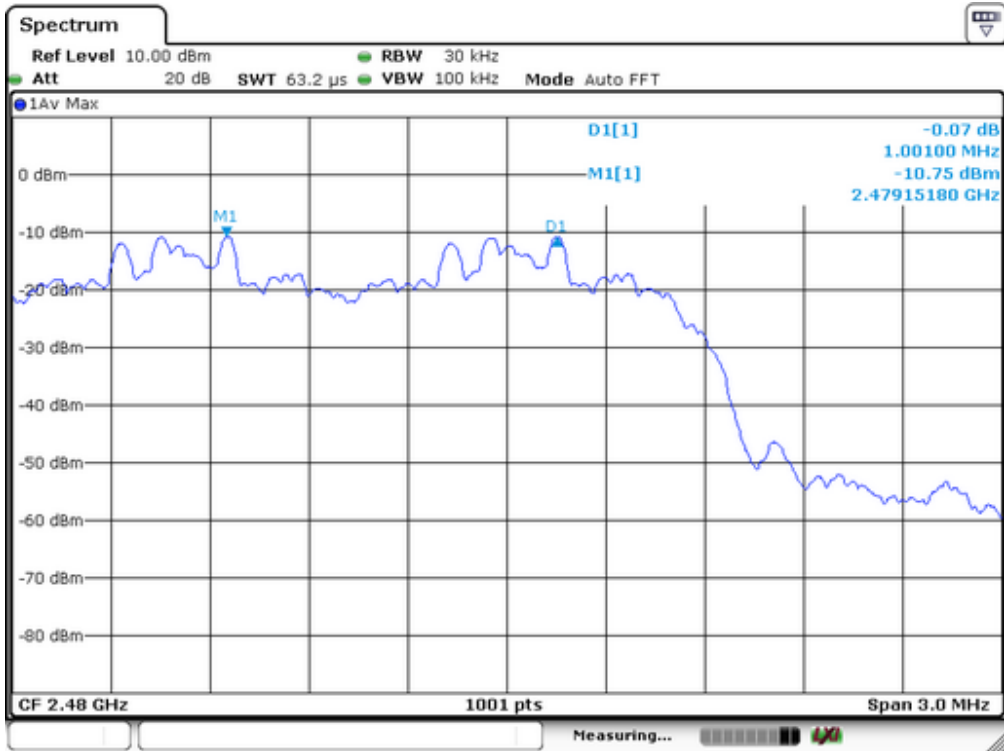


Spectrum Detector: PK Test Date : November 03, 2014  
 Test By: Andy Temperature : 24°C  
 Test Result: PASS Humidity : 53 %  
 Modulation: 8DPSK

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	1001	>854
40	2441	1001	>860
79	2480	1001	>864





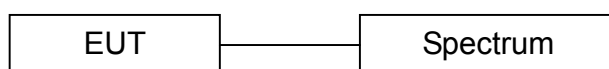


## 7. 20dB Bandwidth test

### 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:

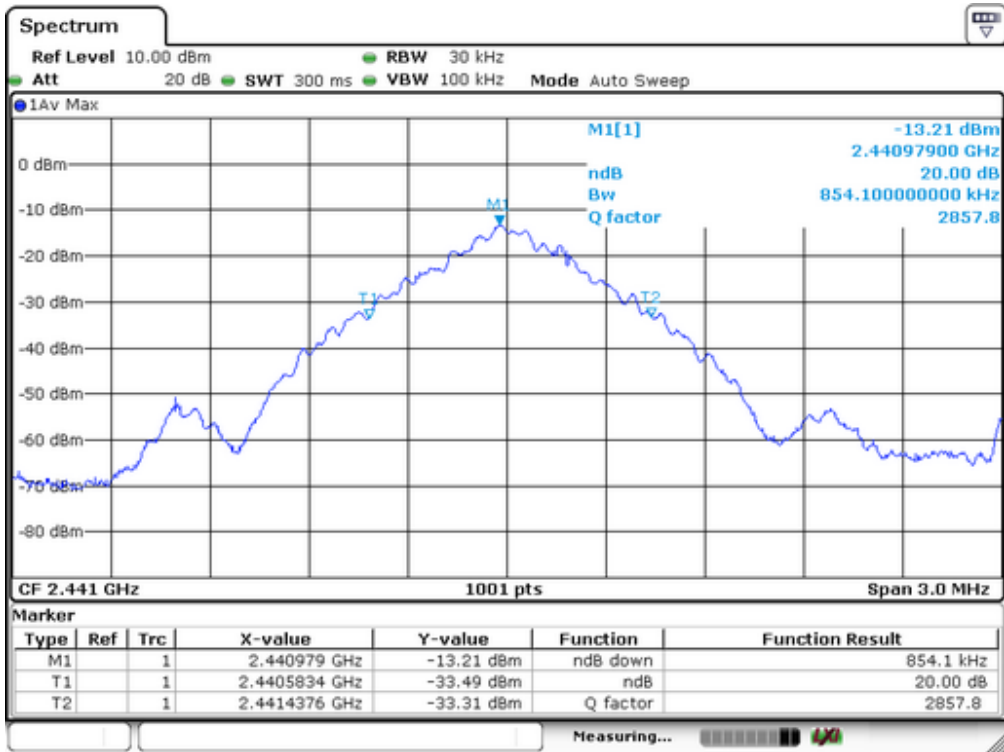
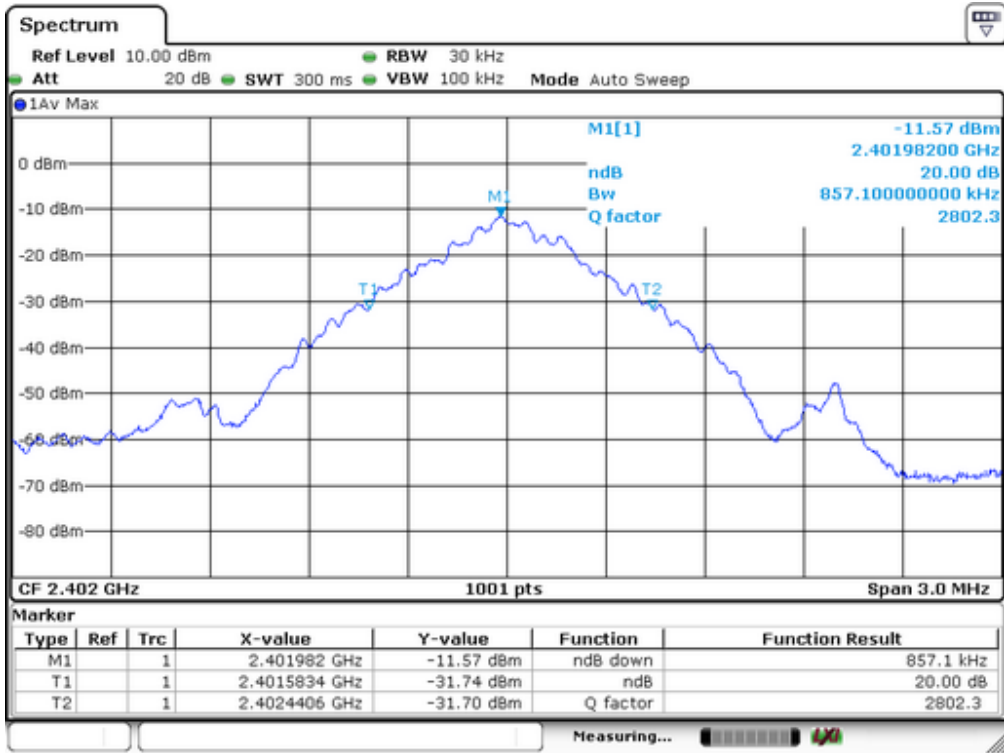
Same as 5.3 Radiated Emission Measurement.

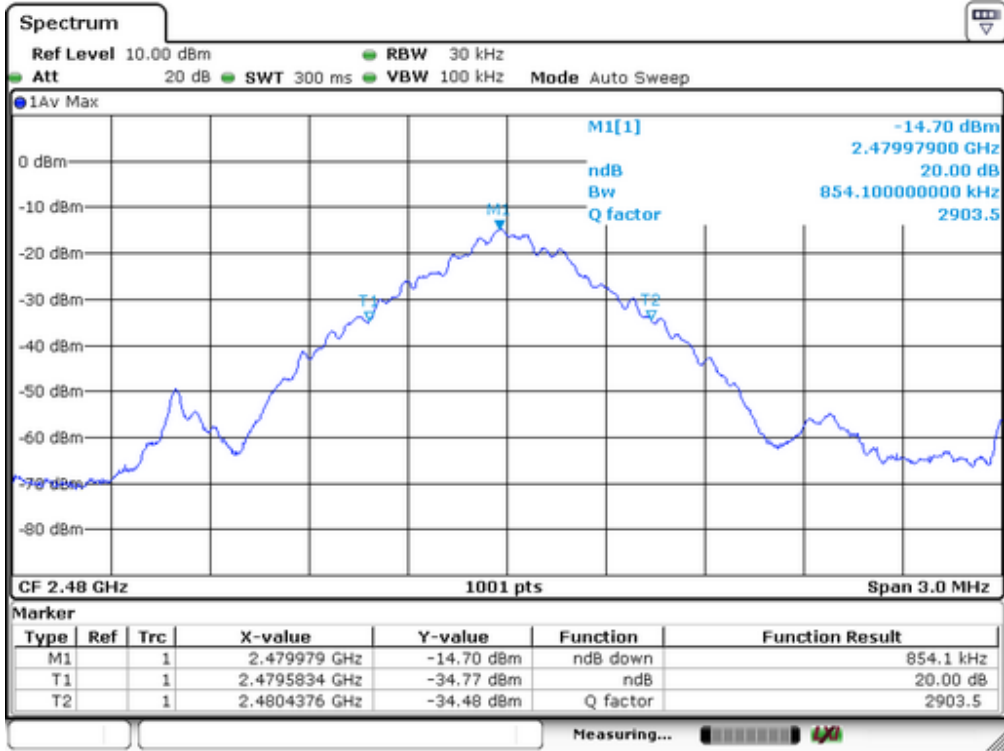
### 7.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	November 03, 2014
Test By:	Andy	Temperature :	25 °C
Test Result:	PASS	Humidity :	50 %
Modulation:	GFSK		

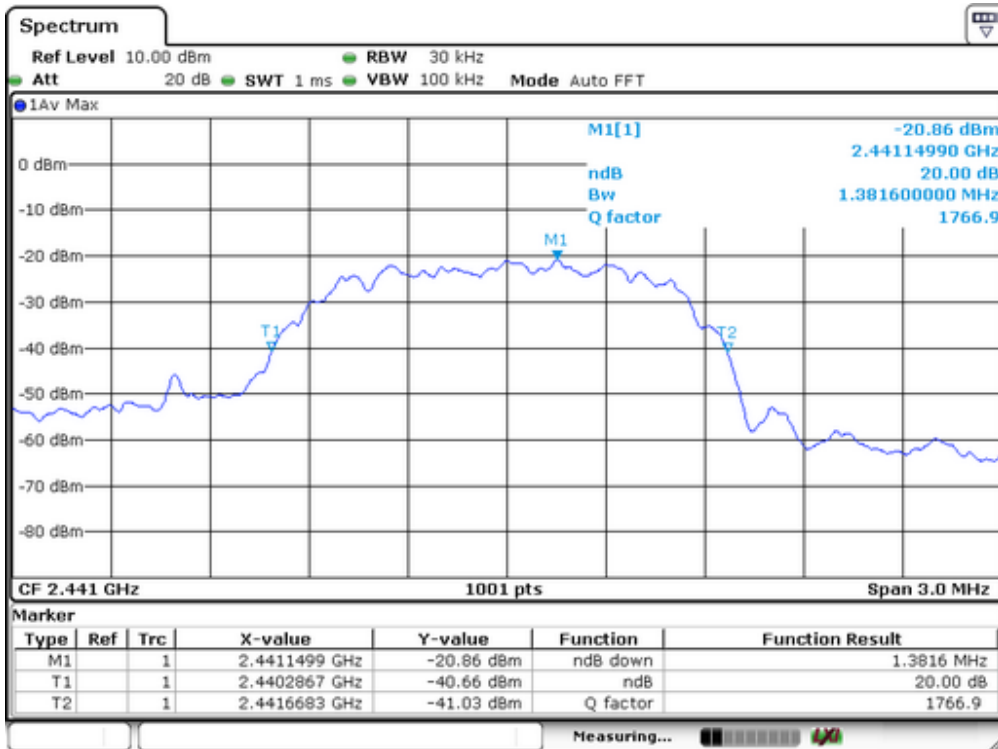
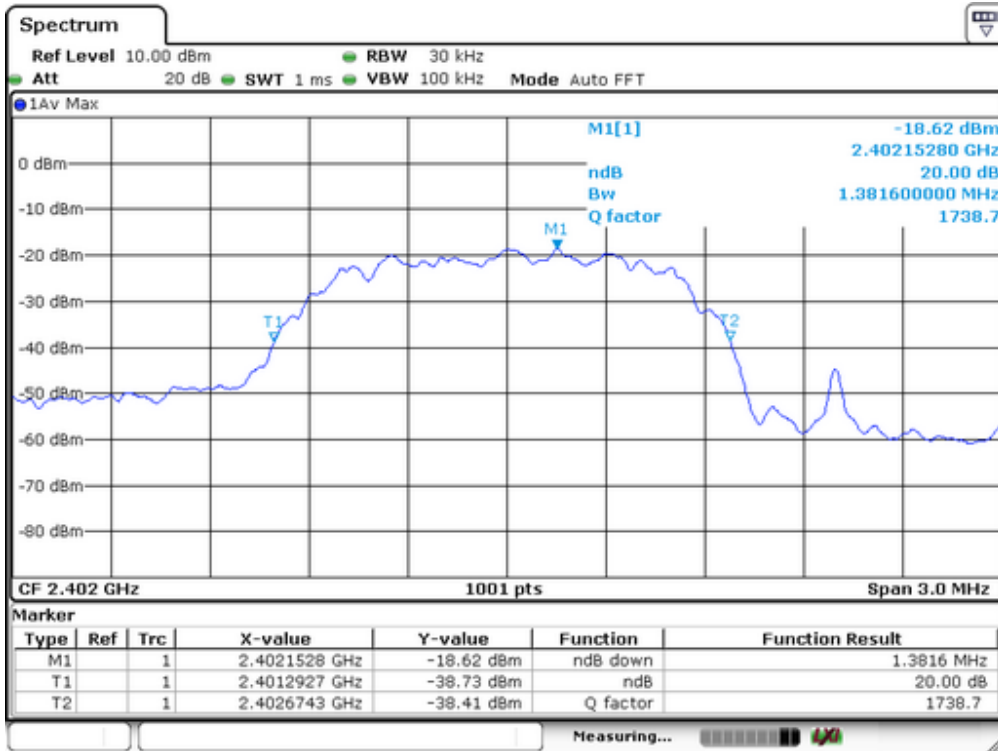
Channel number	Channel frequency (MHz)	20dB Down BW(KHz)
1	2402	857
40	2441	854
79	2480	854

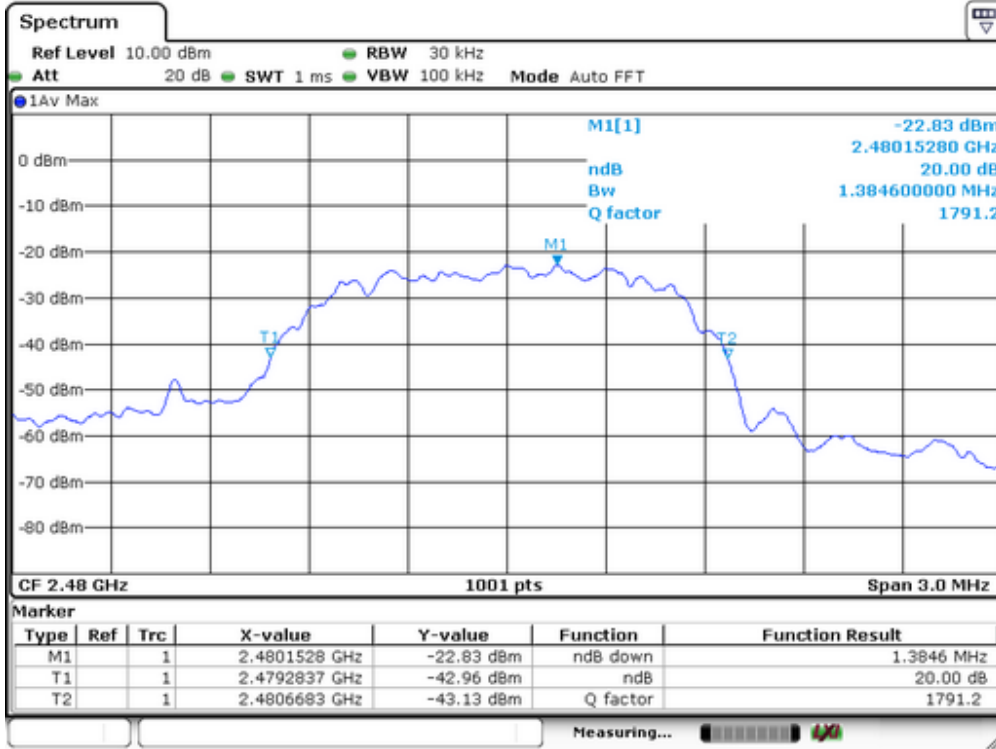




Spectrum Detector: PK Test Date : November 03, 2014  
 Test By: Andy Temperature : 24°C  
 Test Result: PASS Humidity : 53 %  
 Modulation: Π/4-DQPSK

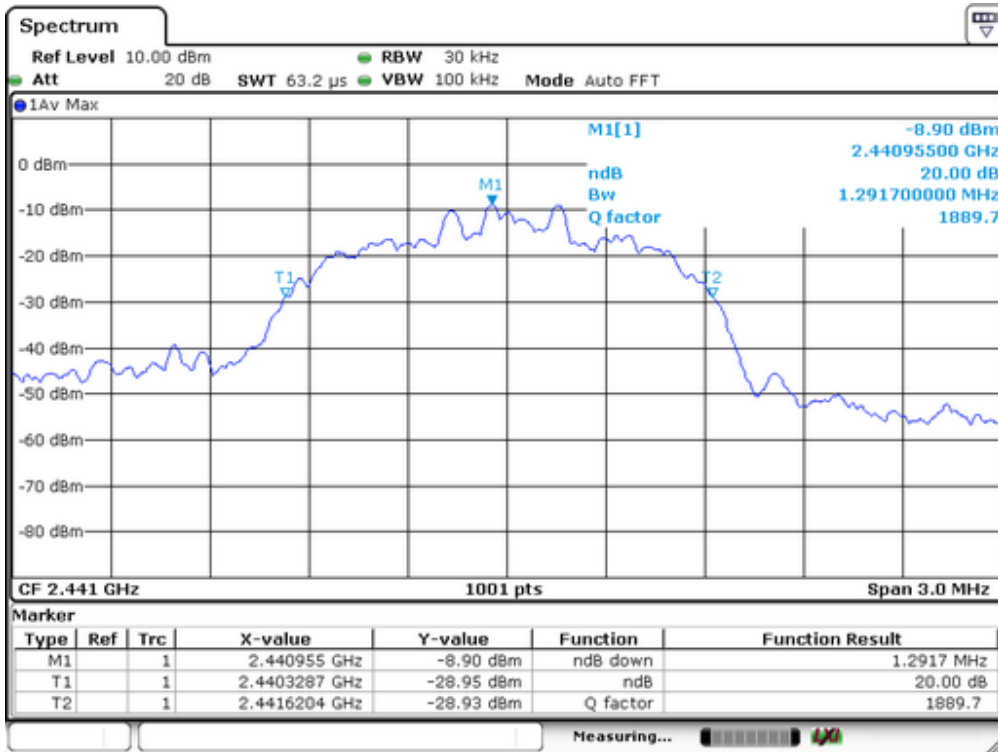
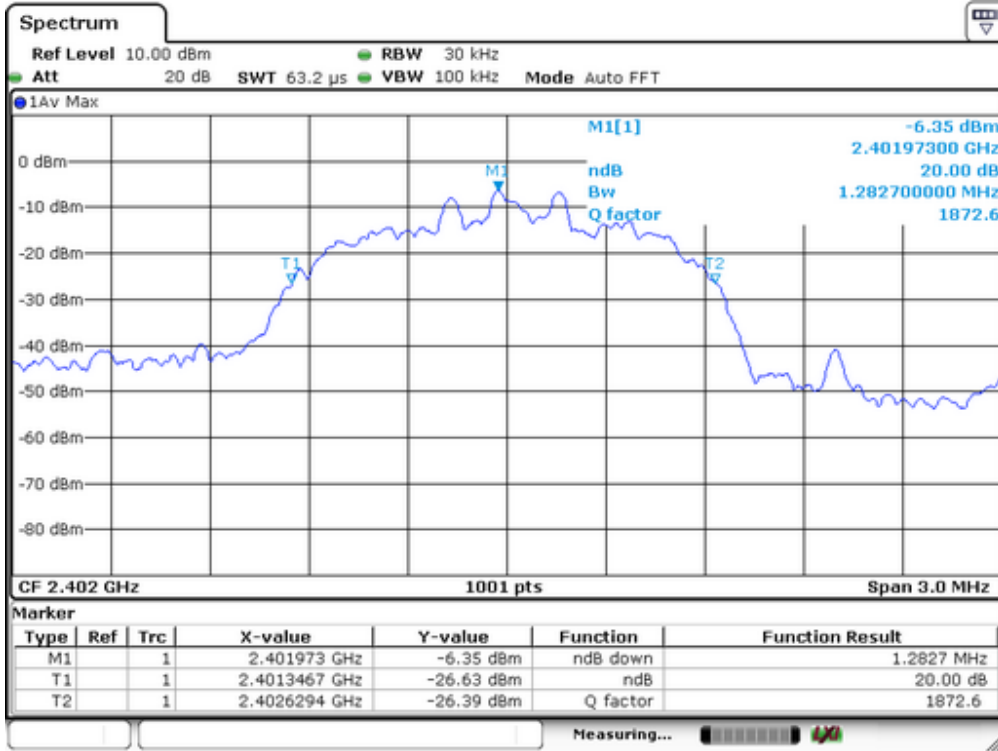
Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	1381
40	2441	1381
79	2480	1384

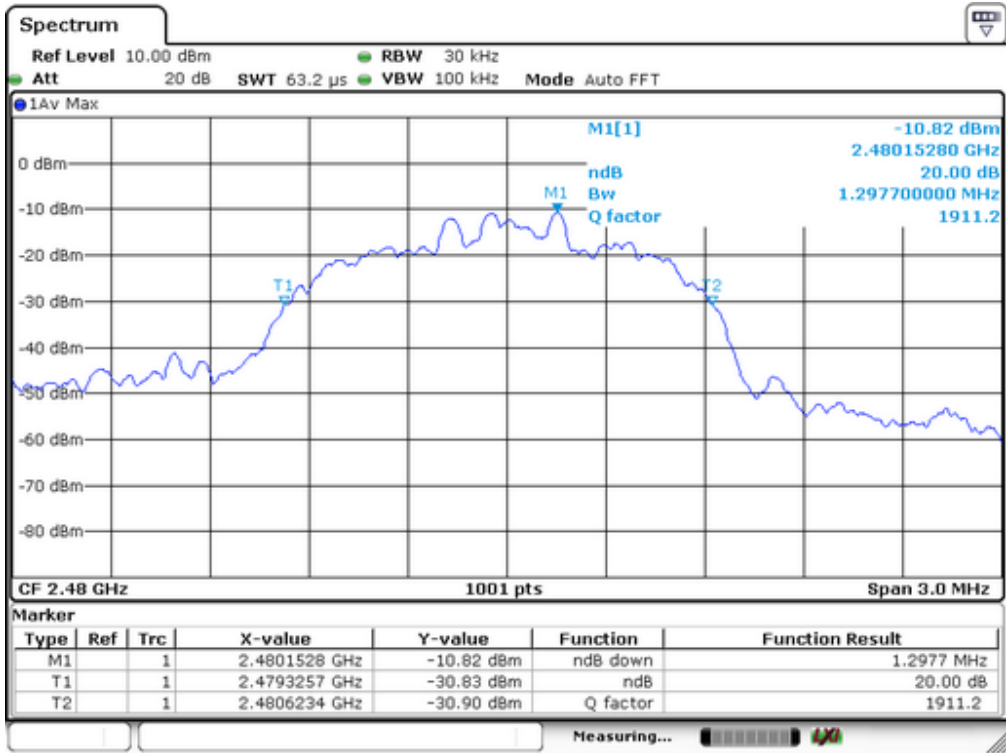




Spectrum Detector: PK                      Test Date : November 03, 2014  
 Test By: Andy                              Temperature : 24°C  
 Test Result: PASS                        Humidity : 53 %  
 Modulation: 8DPSK

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	1282
40	2441	1291
79	2480	1297





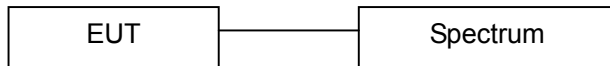


## 8. Quantity of Hopping Channel Test

### 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:

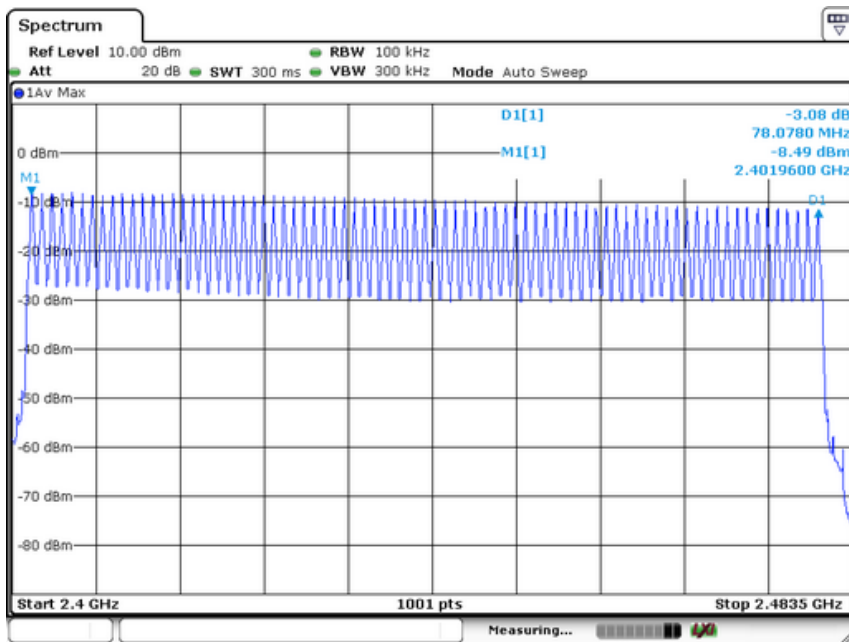
Same as 5.3 Radiated Emission Measurement.

### 8.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	November 03, 2014
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



## 9. Time of Occupancy (Dwell Time) test

### 9.1 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 =  $1600/2 * 1/\text{s}$  for DH1 packets =  $1600 \text{ s}^{-1}$
- hop rate =  $1600/4 * 1/\text{s}$  for DH3 packets =  $533.33 \text{ s}^{-1}$
- hop rate =  $1600/6 * 1/\text{s}$  for DH5 packets =  $320 \text{ s}^{-1}$
- 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.

### 9.2 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.

### 9.3 Test Protocol

Packet type	Time slot length(ms)	Dwell time	Dwell time(ms)
DH1	0.419	time slot length *1600/2 /79 * 31.6	134.08
DH3	1.677	time slot length *1600/4 /79 * 31.6	268.32
DH5	2.920	time slot length *1600/6 /79 * 31.6	311.47

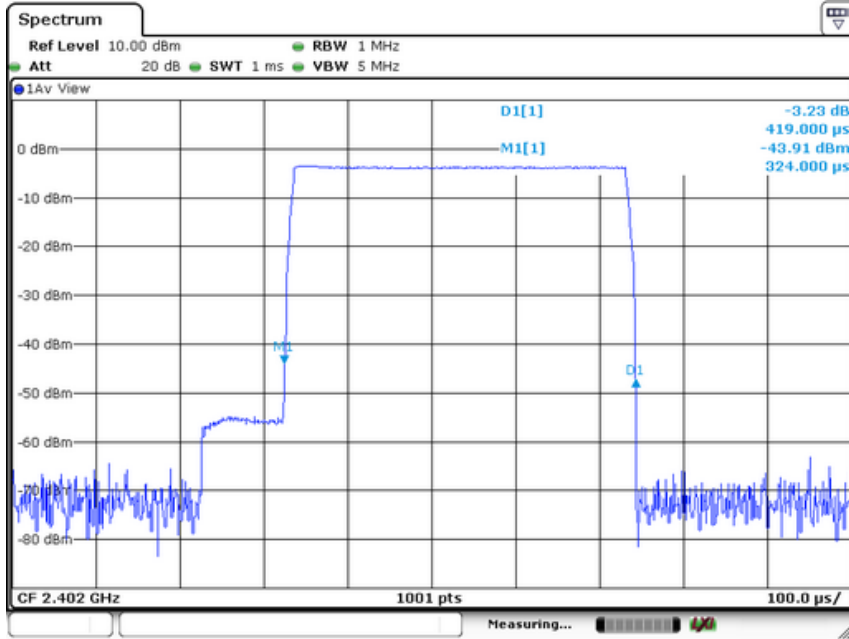
Remark:

- 1.The results of worst cased was recorded.

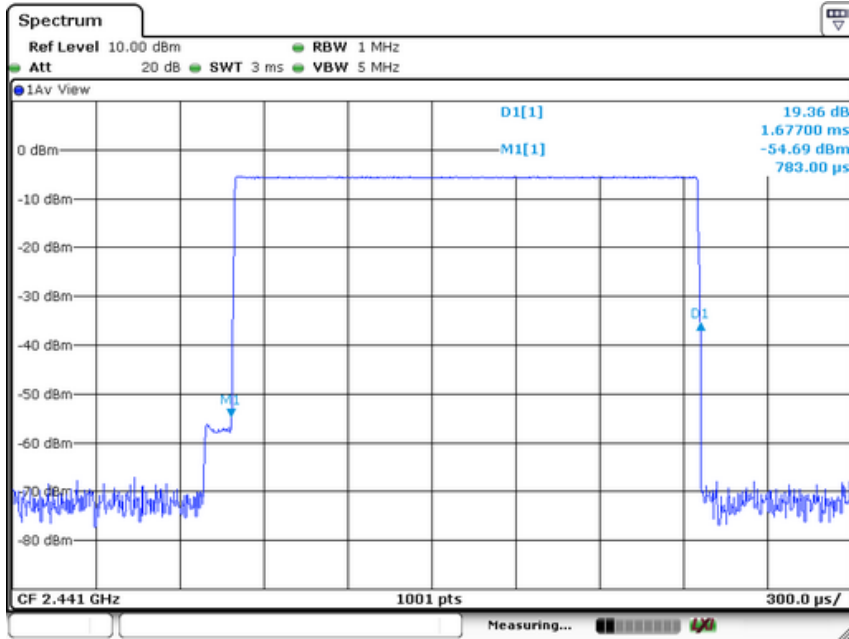
### 9.4 Test result: Dwell time

PASS.

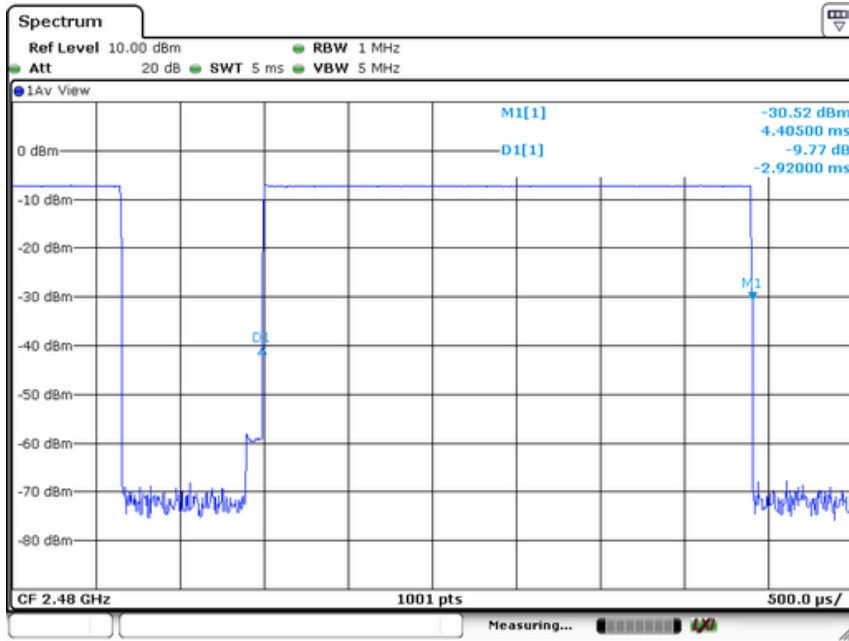
DH1:



DH3:



DH5:

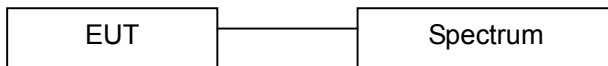


## 10. MAXIMUM PEAK OUTPUT POWER TEST

### 10.1 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.

### 10.2 Test SET-UP (Block Diagram of Configuration)



### 10.3 Measurement Equipment Used:

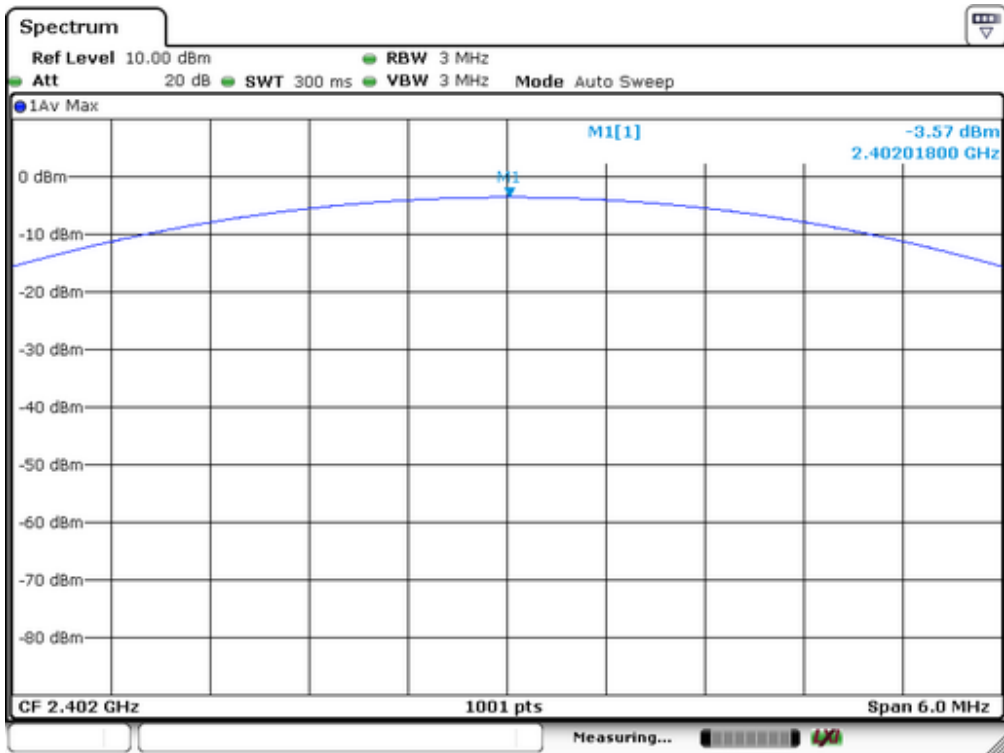
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	05/18/2014	05/17/2015
RF Switching Unit	CDS	RSU-M2	38401	05/16/2014	05/15/2015
Coaxial Cable	CDS	79254	46107086	05/16/2014	05/15/2015

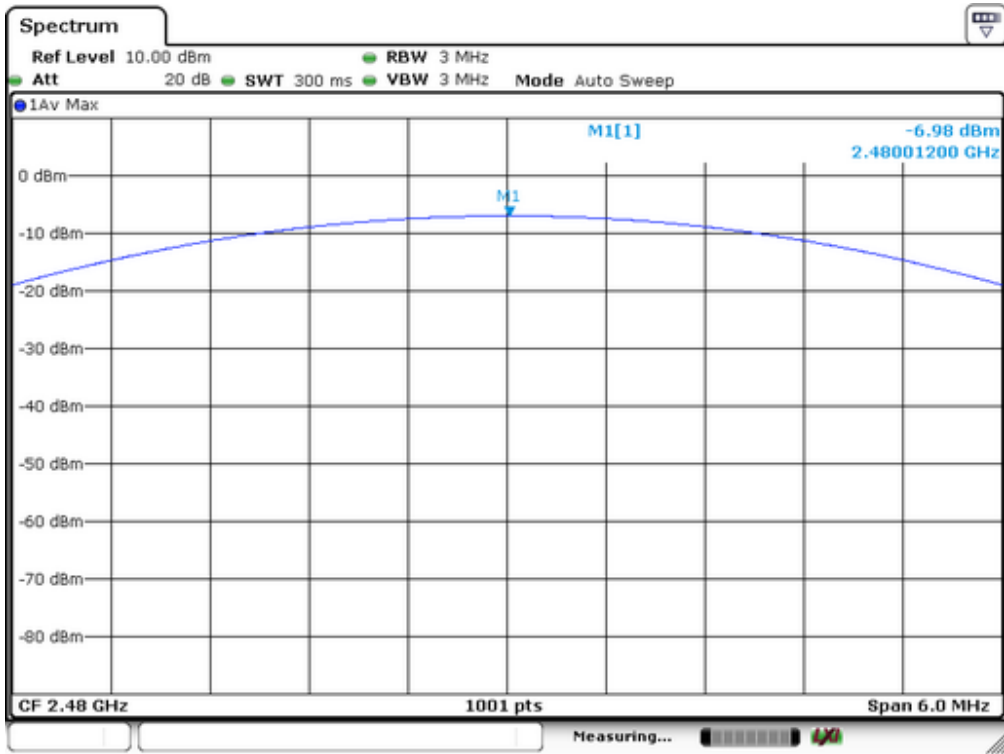
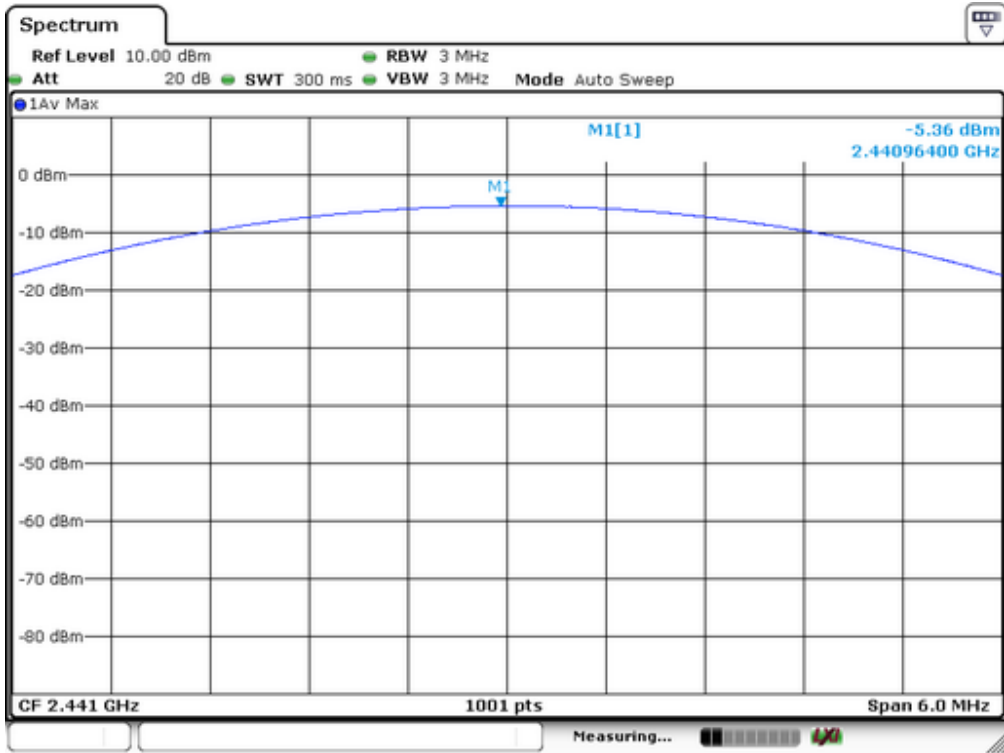
**10.4 Measurement Results:**

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	November 03, 2014
Test By:	Andy	Temperature :	25 °C
Test Result:	PASS	Humidity :	50 %
Modulation:	GFSK		

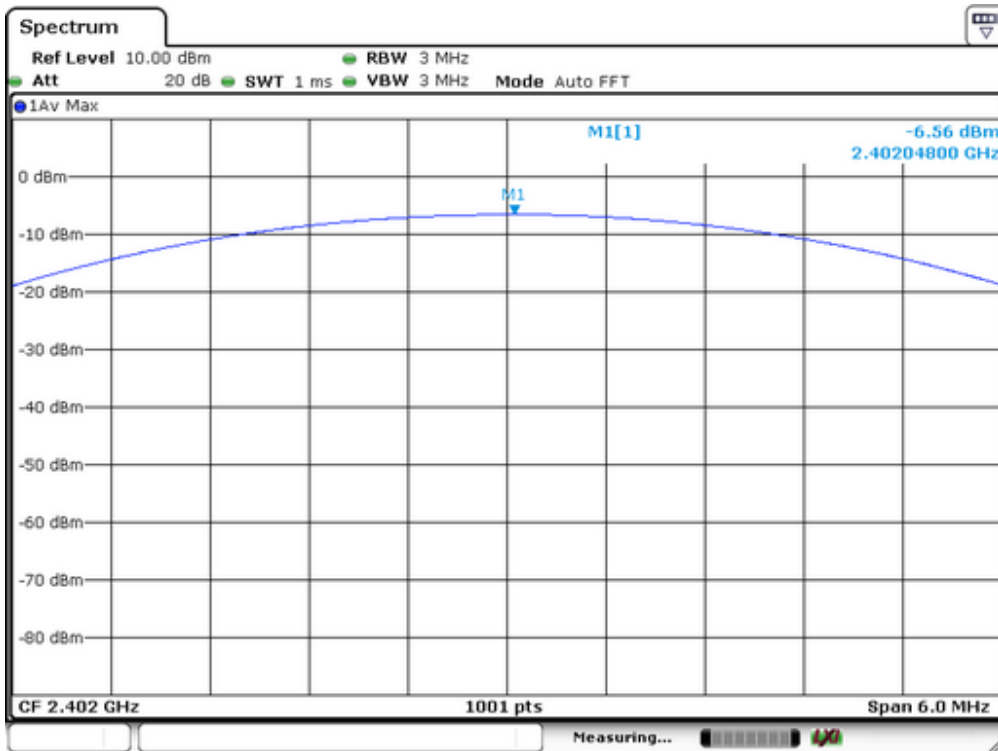
Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Cable Loss(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
1	2402	<b>-3.57</b>	0.4	<b>0.401</b>	1000	PASS
40	2441	-5.36	0.4	0.265	1000	PASS
79	2480	-6.98	0.4	0.183	1000	PASS



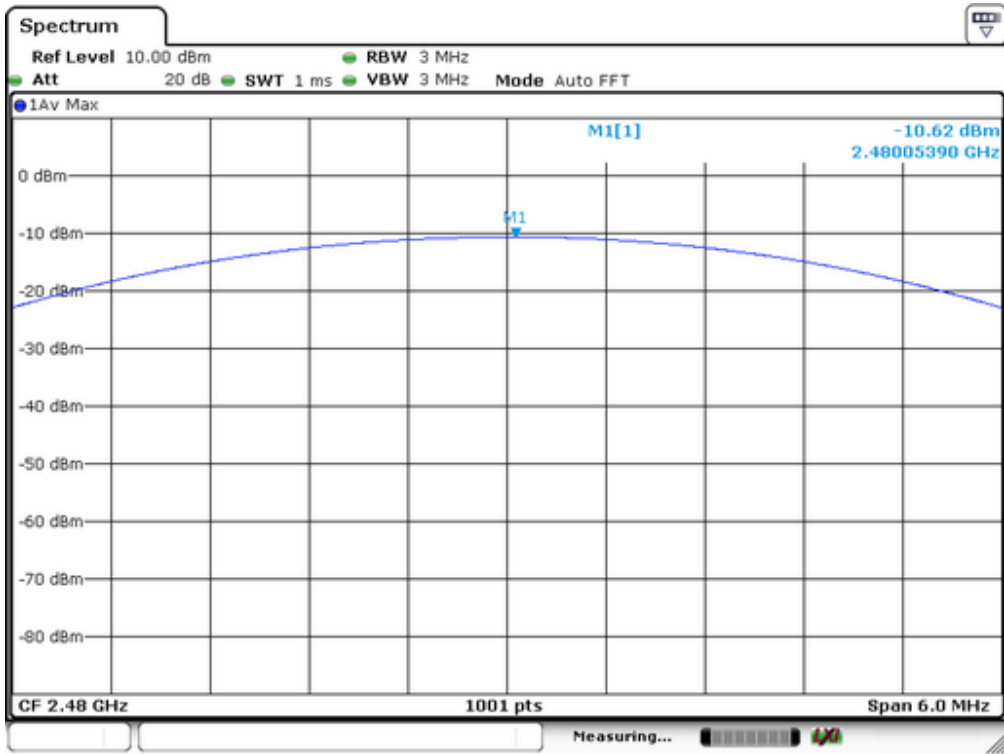
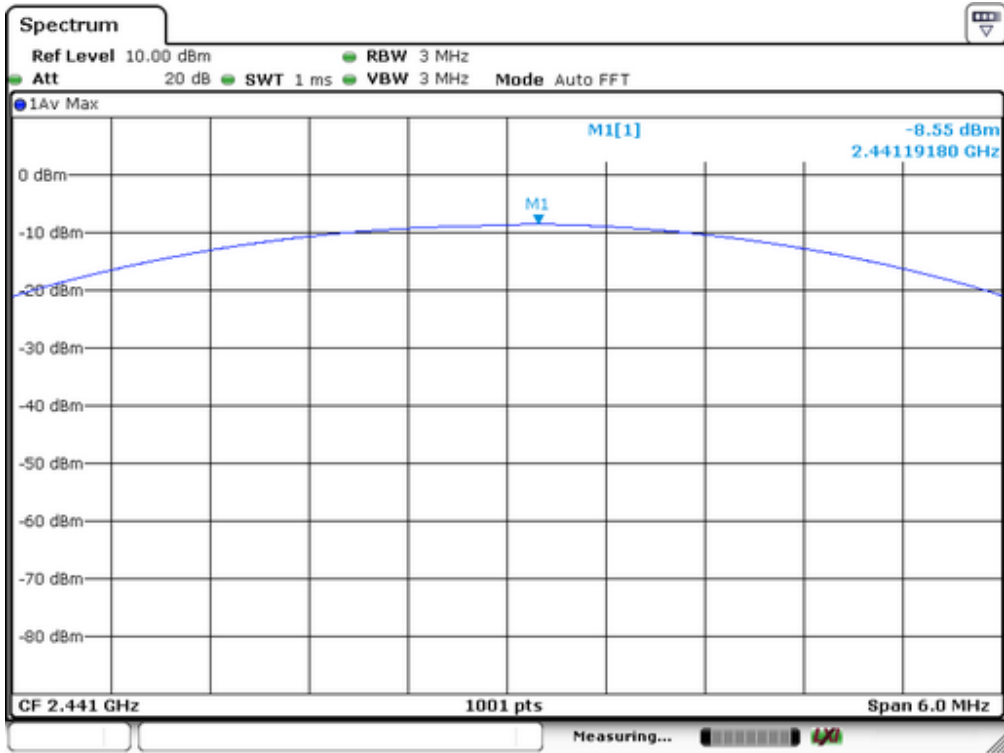


Spectrum Detector: PK                      Test Date : November 03, 2014  
 Test By: Andy                              Temperature : 25 °C  
 Test Result: PASS                      Humidity : 50 %  
 Modulation: Π/4-DQPSK

Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Cable Loss(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
1	2402	-6.56	0.4	0.201	125	PASS
40	2441	-8.55	0.4	0.127	125	PASS
79	2480	-10.62	0.4	0.079	125	PASS

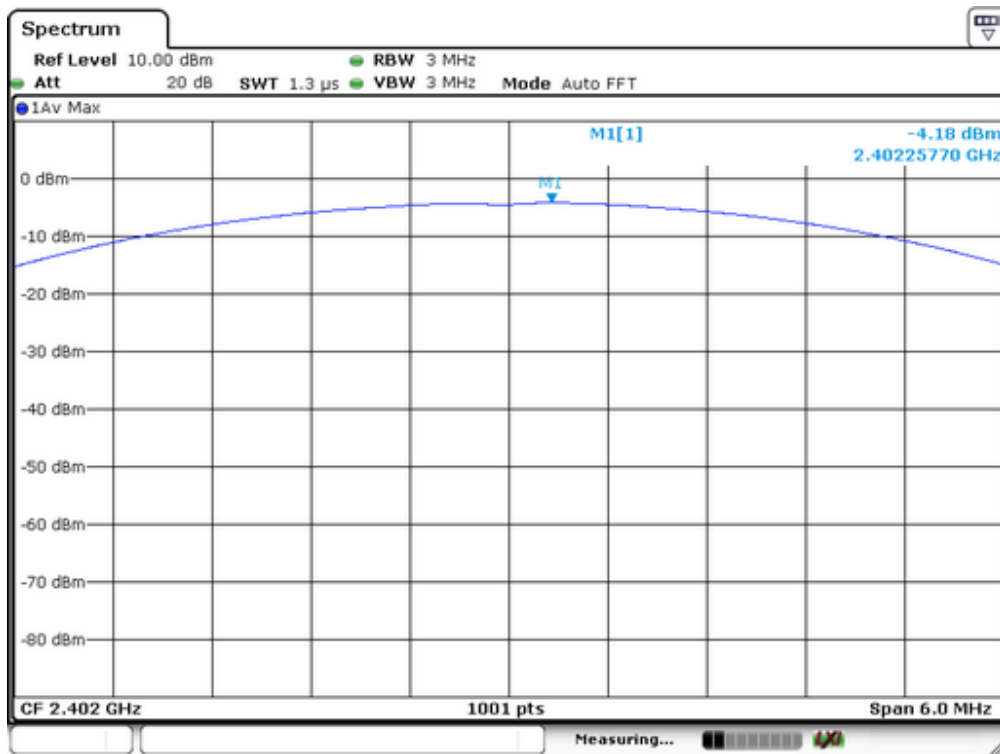


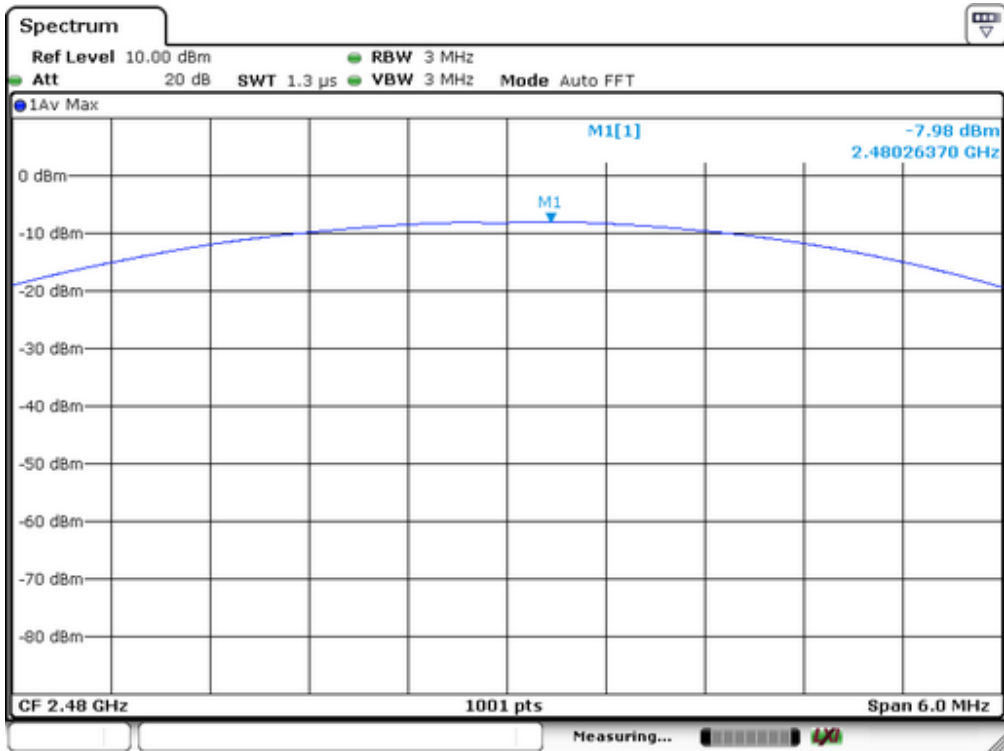
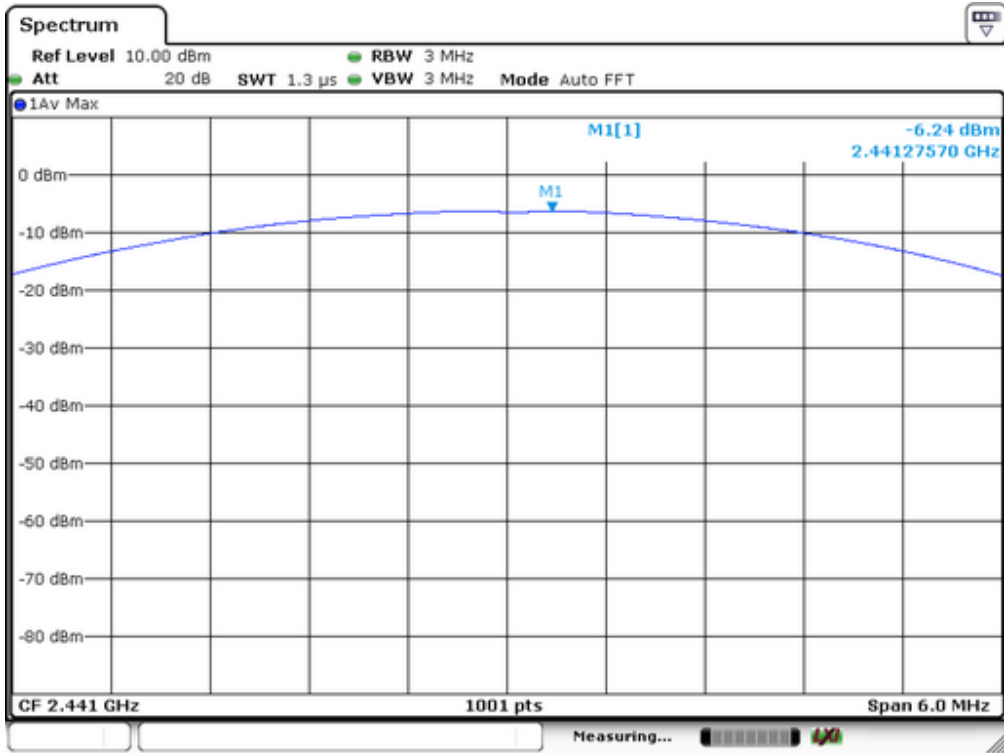




Spectrum Detector: PK                      Test Date : November 03, 2014  
 Test By: Andy                              Temperature : 25 °C  
 Test Result: PASS                      Humidity : 50 %  
 Modulation: 8DPSK

Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Cable Loss(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
1	2402	-4.18	0.4	0.348	125	PASS
40	2441	-6.24	0.4	0.217	125	PASS
79	2480	-7.98	0.4	0.145	125	PASS





## 11. Band EDGE test

### 11.1 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 turn table which is 0.8m 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.

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

### 11.2 Test SET-UP (Block Diagram of Configuration)

Same as 5.2 Radiated Emission Set-up.

### 11.3 Measurement Equipment Used:

Same as 5.3 Radiated Emission Measurement.

### 11.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector: PK                      Test Date :              November 03, 2014  
 Test By: Andy                              Temperature :          25 °C  
 Test Result: PASS                      Humidity :              50 %

#### 1. Conducted Test

For Non-Hopping mode:

Frequency (MHz)	Peak Power Output(dBm)	Emission read Value(dBm)	Result of Band edge(dBc)	Band edge Limit(dBc)
<2400	-7.85	-48.69	40.84	>20dBc
	-14.57	-45.95	31.38	>20dBc
	-6.51	-47.71	41.20	>20dBc
>2483.5	-11.13	-63.51	52.38	>20dBc
	-18.63	-56.39	37.76	>20dBc
	-10.88	-59.15	48.27	>20dBc

For Hopping mode:

Frequency (MHz)	Peak Power Output(dBm)	Emission read Value(dBm)	Result of Band edge(dBc)	Band edge Limit(dBc)
<2400	-8.00	-47.65	39.65	>20dBc
	-15.75	-43.51	27.76	>20dBc
	-6.64	-49.27	42.63	>20dBc
>2483.5	-11.32	-61.79	50.47	>20dBc
	-19.64	-55.71	36.07	>20dBc
	-10.74	-59.90	49.16	>20dBc

## 2. Radiated emission Test

For Non-Hopping mode:

Frequency (MHz)	Antenna polarization (H/V)	Emission (dBuV/m)		Band edge Limit (dBuV/m)	
		PK	AV	PK	AV
<2400	V	65.08	45.07	74.00	54.00
	H	59.39	40.37	74.00	54.00
>2483.5	V	64.13	45.53	74.00	54.00
	H	60.59	39.72	74.00	54.00

For Hopping mode:

Frequency (MHz)	Antenna polarization (H/V)	Emission (dBuV/m)		Band edge Limit (dBuV/m)	
		PK	AV	PK	AV
<2400	V	63.25	41.29	74.00	54.00
	H	57.17	34.59	74.00	54.00
>2483.5	V	66.59	43.52	74.00	54.00
	H	60.72	36.89	74.00	54.00

## **12. Antenna Application**

### **12.1 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.

### **12.2 Result**

The EUT used inverted-E antenna. The antenna's gain is 4dBi and meets the requirement.

### 13. RF EXPOSURE EVALUATION

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency(RF) Radiation as specified in §1.1307(b)

Limits for Maximum Permissible Exposure(MPE)

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density(mW/cm <sup>2</sup> )	Average Time
<b>(A) Limits for Occupational/Control Exposures</b>				
300-1500	--	--	F/300	6
1500-100000	--	--	5	6
<b>(B) Limits for General Population/Uncontrol Exposures</b>				
300-1500	--	--	F/1500	6
1500-100000	--	--	1	30

#### 13.1 Friis transmission formula: $P_d = (P_{out} * G) / (4 * \pi * R^2)$

Where

$P_d$  = Power density in mW/cm<sup>2</sup>

$P_{out}$  = output power to antenna in Mw

$G$  = gain of antenna in linear scale

$\pi$  = 3.1416

$R$  = distance between observation point and center of the radiator in cm

$P_d$  the limit of MPE, 1mW/cm<sup>2</sup>. If we know the maximum gain of the antenna and total power input to the antenna, through the calculation, we will know the distance where the MPE limit is reached.

#### 13.2 Measurement Result.

Channel Frequency (MHz)	Output Peak power (mW)	Antenna Gain (dBi)	Antenna Gain (numeric)	Power density at 20cm (mW/cm <sup>2</sup> )	Power density Limits (mW/cm <sup>2</sup> )
2402	0.440	4	2.511	0.0002198	1
2441	0.291	4	2.511	0.0001454	1
2480	0.200	4	2.511	0.0000999	1
2402	0.221	4	2.511	0.0001104	1
2441	0.140	4	2.511	0.0000699	1
2480	0.087	4	2.511	0.0000435	1
2402	0.382	4	2.511	0.0001908	1
2441	0.238	4	2.511	0.0001189	1
2480	0.159	4	2.511	0.0000794	1



## General Appearance of the EUT

