

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

*OF*

**Car Radio**

**Model No.: PMX0**

Trademark: 

**FCC ID: 2AA7S-PMX0**

**Report No.: ED151012040E**

**Issue Date: October 26, 2015**

*Prepared for*

**Rockford Corporation  
600 South Rockford Drive Tempe Arizona United States**

*Prepared by*

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EMTEK(Dongguan) Co., Ltd.**

## VERIFICATION OF COMPLIANCE

|                      |                                                                                                                         |
|----------------------|-------------------------------------------------------------------------------------------------------------------------|
| Applicant:           | Rockford Corporation<br>600 South Rockford Drive Tempe Arizona United States                                            |
| Manufacturer:        | SOUNDMAX ELECTRONICS LIMITED<br>17/F.,Eu Yang Sang Tower, 11-15 Chatham Road South, Tsim Sha Tsui , Kowloon., Hong Kong |
| Product Description: | Car Radio                                                                                                               |
| Trademark:           | N/A                                                                                                                     |
| Model Number:        | PMX0                                                                                                                    |
| Kind of Device:      | Bluetooth Ver.2.1 +EDR                                                                                                  |
| Date of Test:        | October 12, 2015 to October 26, 2015                                                                                    |

### 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).

***Approved By***




---

**Sam Lv / Q.A. Manager  
EMTEK(Dongguan) Co., Ltd.**

## Modified Information

| Version | Summary         | Revision Date | Report No.   |
|---------|-----------------|---------------|--------------|
| Ver.1.0 | Original Report | /             | ED151012040E |
|         |                 |               |              |
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## **1. GENERAL INFORMATION**

### **1.1 Product Description**

The Car Radio, Model: PMX0 (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). Kind of Device: Bluetooth Ver.2.1+EDR
- C).Modulation: GFSK,  $\pi/4$ -DQPSK, 8DPSK
- D).Number of Channel: 79
- E). Channel space: 1MHz
- F). Measured RF Output Power: 1.02dBm(0. 001265W)
- G). Antenna Type: PCB Antenna
- H). Antenna Gain: 4dBi
- I). Power Supply: DC 12V
- J).Software Version: PMX0\_V46\_1007.MVA
- K).Hardware Version: VER1.2

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: 2AA7S-PMX0 filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

### **1.3 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.

### **1.4 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. :  
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 through three orthogonal axes according to the requirements in Section 13.1.4.1 of ANSI C63.10-2013.

### 2.4 Limitation

#### (1) Channel Separation test

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

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



## (2) 20dB Bandwidth

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

## (3) Quantity of Hopping Channel

FCC Part 15, Subpart C Section 15.247

| Frequency Range (MHz) | Limit(Quantity of Hopping Channel) |                        |                      |                      |
|-----------------------|------------------------------------|------------------------|----------------------|----------------------|
|                       | 20dB bandwidth <250kHz             | 20dB bandwidth >250kHz | 20dB bandwidth <1MHz | 20dB bandwidth >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).

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

#### (7) Conducted Emission

| Frequency(MHz) | Quasi-peak | Average |
|----------------|------------|---------|
| 0.15-0.5       | 66-56      | 56-46   |
| 0.5-5.0        | 56         | 46      |
| 5.0-30.0       | 60         | 50      |

**Note:**

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

**(8) Radiated Emission**

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

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

Remark 1. Emission level in dB $\mu\text{V/m}$ =20 log ( $\mu\text{V/m}$ )

: 2. Measurement was performed at an antenna to the closed point of EUT distance of meters.

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

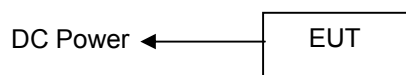
| Frequency(MHz) | Class A(dB $\mu\text{V/m}$ )(at 3m) |         | Class B(dB $\mu\text{V/m}$ )(at 3m) |         |
|----------------|-------------------------------------|---------|-------------------------------------|---------|
|                | PEAK                                | AVERAGE | PEAK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

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

| Frequency(MHz) | Filed Strength of<br>Fundamental(at 3m) |         | Filed Strength of<br>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 | Trademark | Model No. | FCC ID     | Note       |
|------|-----------|-----------|-----------|------------|------------|
| 1.   | Car Radio | N/A       | PMX0      | 2AA7S-PMX0 | <b>EUT</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 testing follows the guidelines in Spurious Radiated Emissions of ANSI C63.10-2013.
2. Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane.
3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (From 1m to 4m) and turntable (from 0 degree to 360 degree) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Final measurement (Above 1GHz): The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1MHz. The measurement will be performed in horizontal and vertical polarization of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 degree to 360 degree in order to have the antenna inside the cone of radiation.
7. Test Procedure of measurement (For Above 1GHz):
  - 1) Monitor the frequency range at horizontal polarization and move the antenna over all sides of the EUT(if necessary move the EUT to another orthogonal axis).
  - 2) Change the antenna polarization and repeat 1) with vertical polarization.
  - 3) Make a hardcopy of the spectrum.
  - 4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
  - 5) Change the analyser mode to Clear/ Write and found the cone of emission.
  - 6) Rotate and move the EUT, so that the measuring distance can be enlarged to 3m and the antenna will be still inside the cone of emission.
  - 7) Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarization and azimuth and the peak and average detector, which causes the maximum emission.
  - 8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beam width.

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:

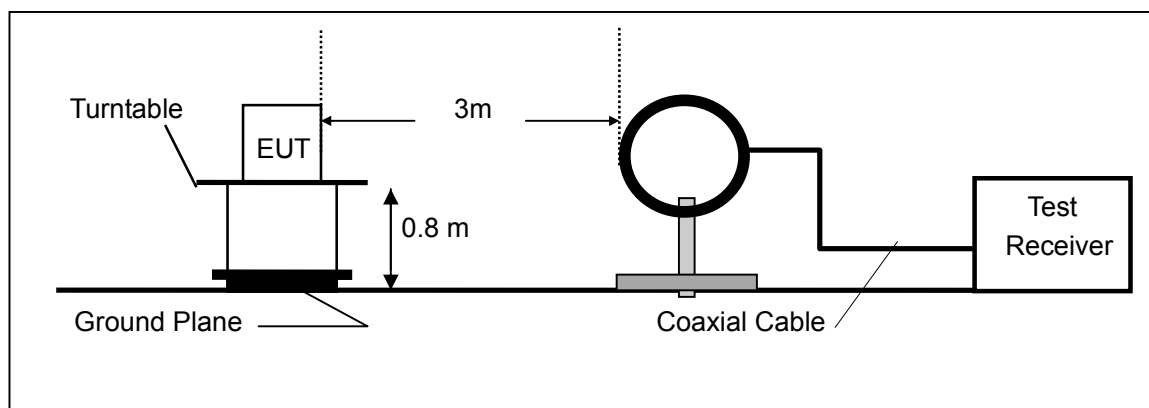
| EMI Test Receiver | Setting  |
|-------------------|----------|
| Attenuation       | Auto     |
| RB                | 1MHz     |
| VB                | 3MHz     |
| Detector          | Peak     |
| Trace             | Max hold |

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

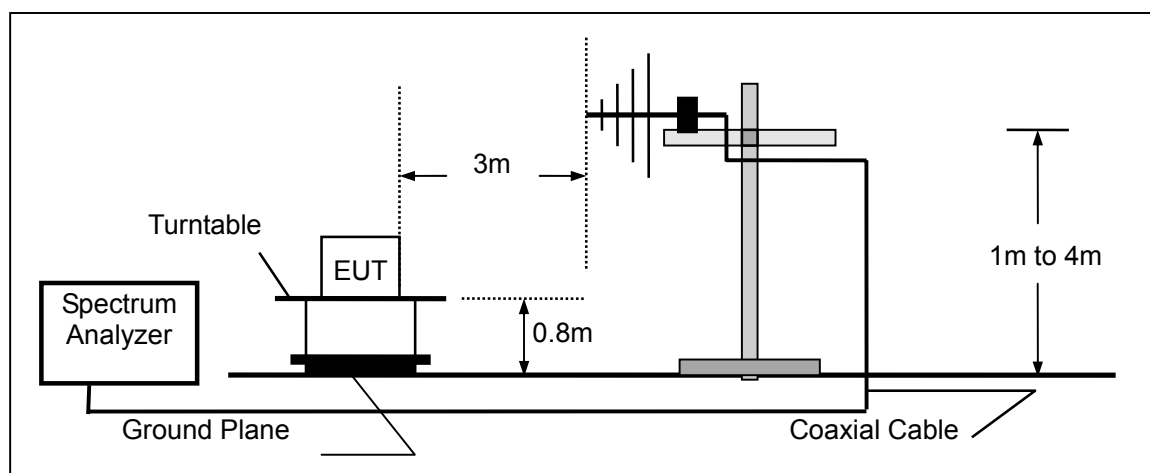
| EMI Test Receiver | Setting  |
|-------------------|----------|
| Attenuation       | Auto     |
| RB                | 1MHz     |
| VB                | 10Hz     |
| Detector          | Peak     |
| Trace             | Max hold |

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

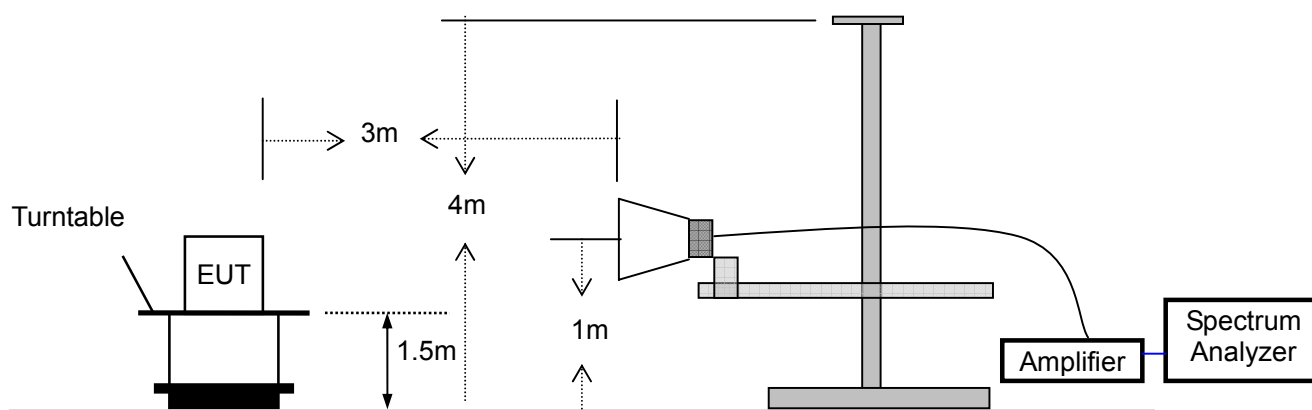
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(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    | 06/15/2015 | 06/14/2016 |
| EMI Test Receiver | Rohde & Schwarz | ESU          | 1302.6005.26  | 06/15/2015 | 06/14/2016 |
| Pre-Amplifier     | HP              | 8447D        | 2944A07999    | 06/02/2015 | 06/01/2016 |
| Bilog Antenna     | SCHWARZBECK     | VULB9163     | 142           | 06/03/2015 | 06/02/2016 |
| Loop Antenna      | ARA             | PLA-1030/B   | 1029          | 06/03/2015 | 06/02/2016 |
| Horn Antenna      | Schwarzbeck     | BBHA9170     | BBHA9170399   | 06/04/2015 | 06/03/2016 |
| Horn Antenna      | Schwarzbeck     | BBHA9120D    | D143          | 06/04/2015 | 06/03/2016 |
| Cable             | Schwarzbeck     | AK9513       | ACRX1         | 06/15/2015 | 06/14/2016 |
| Cable             | Schwarzbeck     | AK9513       | FP2RX2        | 05/15/2015 | 05/14/2016 |
| Cable             | Schwarzbeck     | AK9513       | CRPX1         | 05/17/2015 | 05/16/2016 |
| Cable             | Schwarzbeck     | AK9513       | CRRX2         | 05/22/2015 | 05/21/2016 |

### 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 : October 13, 2015  
Frequency Range: 9KHz~30MHz      Temperature : 28℃  
Test Result: PASS      Humidity : 60 %  
Measured Distance: 3m      Test By: Andy

| Freq.<br>(MHz) | Ant.Pol.<br>H/V | Emission Level<br>(dBuV/m) | Limit 3m<br>(dBuV/m) | Over<br>(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 =  $40\log(\text{Specific distance}/\text{test distance})$  (dB);

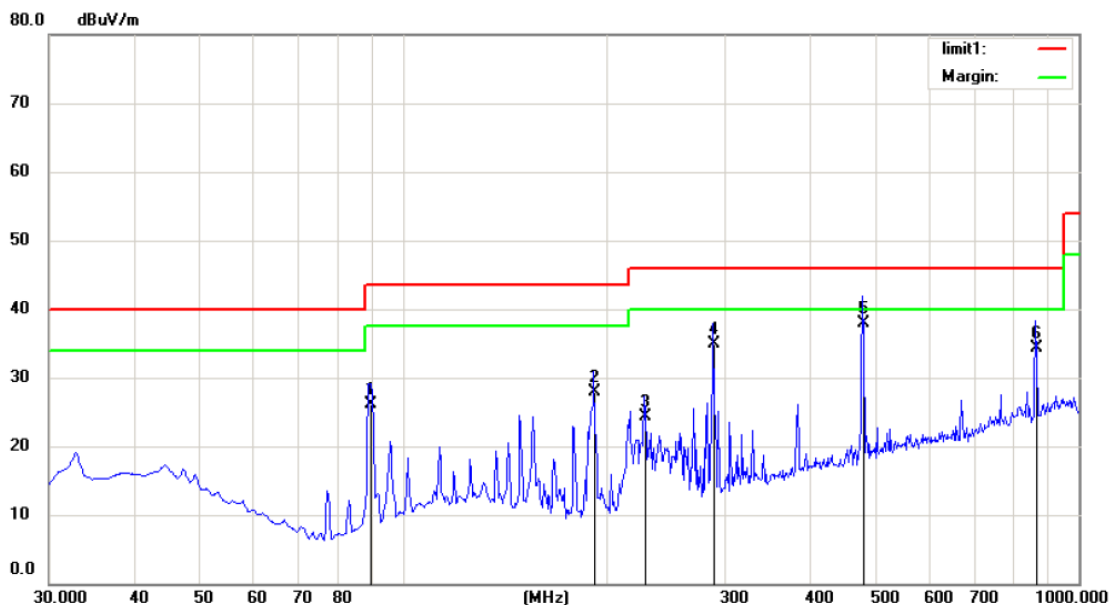
Limit line = Specific limits (dBuV) + distance extrapolation factor.

#### Below 1000MHz:

Pass.

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

Please refer to the following data.



Site Chamber #1

Polarization: **Horizontal**

Temperature: 24

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

Power: DC 12V

Humidity: 55 %

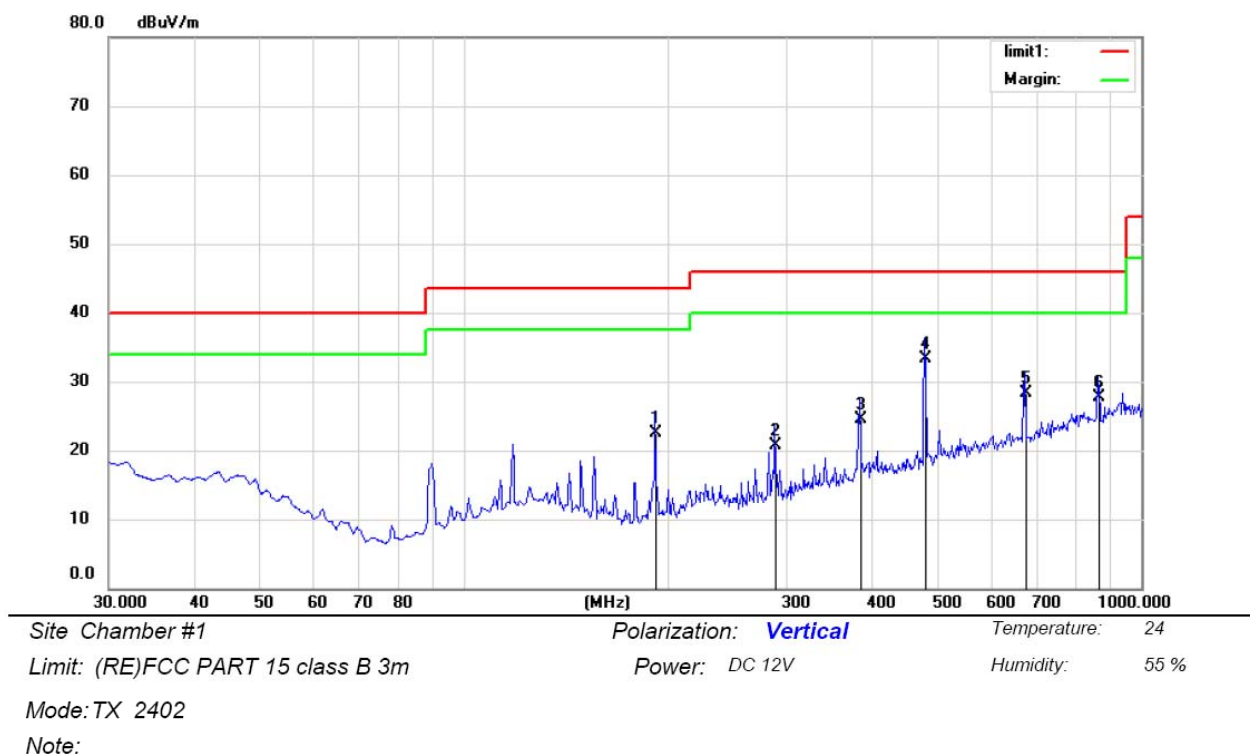
Mode: TX 2402

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   |     | 89.5900  | 47.05         | -20.94         | 26.11       | 43.50  | -17.39 | QP             |              |         |
| 2   |     | 191.9900 | 45.99         | -18.14         | 27.85       | 43.50  | -15.65 | QP             |              |         |
| 3   |     | 227.8800 | 40.37         | -16.05         | 24.32       | 46.00  | -21.68 | QP             |              |         |
| 4   |     | 288.0200 | 49.75         | -14.77         | 34.98       | 46.00  | -11.02 | QP             |              |         |
| 5   | *   | 480.0800 | 48.36         | -10.54         | 37.82       | 46.00  | -8.18  | QP             |              |         |
| 6   |     | 864.2000 | 38.73         | -4.40          | 34.33       | 46.00  | -11.67 | QP             |              |         |

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

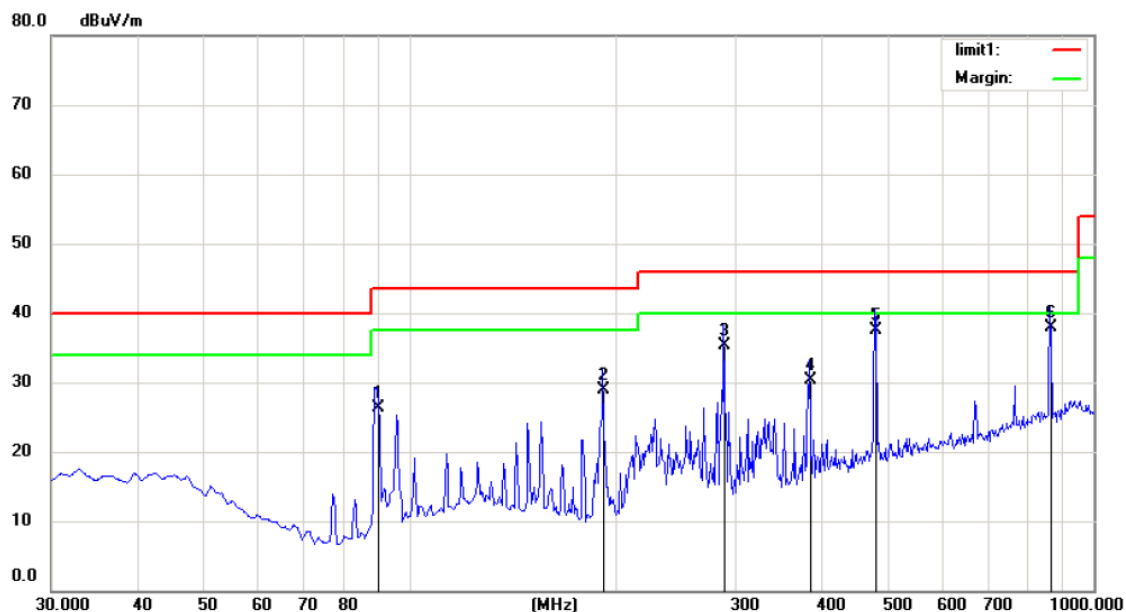
Operator:



| 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 | 40.71         | -18.14         | 22.57       | 43.50  | -20.93 | QP             |              |         |
| 2   |     | 288.0200 | 35.41         | -14.77         | 20.64       | 46.00  | -25.36 | QP             |              |         |
| 3   |     | 384.0500 | 36.46         | -11.96         | 24.50       | 46.00  | -21.50 | QP             |              |         |
| 4   | *   | 480.0800 | 43.82         | -10.54         | 33.28       | 46.00  | -12.72 | QP             |              |         |
| 5   |     | 673.1100 | 36.03         | -7.67          | 28.36       | 46.00  | -17.64 | QP             |              |         |
| 6   |     | 864.2000 | 32.05         | -4.40          | 27.65       | 46.00  | -18.35 | QP             |              |         |

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

Operator:

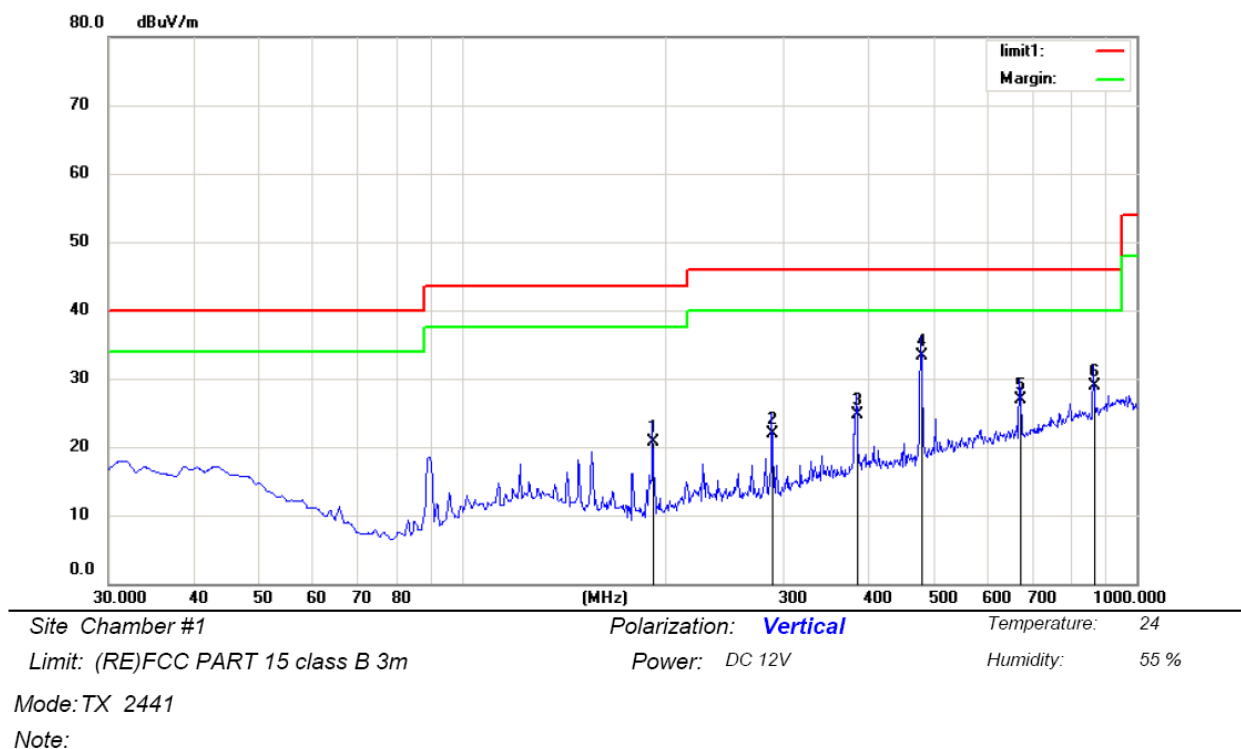


Site Chamber #1 Polarization: **Horizontal** Temperature: 24  
 Limit: (RE)FCC PART 15 class B 3m Power: DC 12V Humidity: 55 %  
 Mode: TX 2441  
 Note:

| No. | Mk. | Freq.    | Reading Level | Correct Factor | Measure-ment | Limit  | Over   | Antenna Height | Table Degree |        |
|-----|-----|----------|---------------|----------------|--------------|--------|--------|----------------|--------------|--------|
|     |     | MHz      | dBuV          | dB             | dBuV/m       | dBuV/m | dB     | Detector       | cm           | degree |
| 1   |     | 90.1400  | 47.17         | -20.85         | 26.32        | 43.50  | -17.18 | QP             |              |        |
| 2   |     | 191.9900 | 46.95         | -18.14         | 28.81        | 43.50  | -14.69 | QP             |              |        |
| 3   |     | 288.0200 | 50.03         | -14.77         | 35.26        | 46.00  | -10.74 | QP             |              |        |
| 4   |     | 384.0500 | 42.27         | -11.96         | 30.31        | 46.00  | -15.69 | QP             |              |        |
| 5   |     | 480.0800 | 48.12         | -10.54         | 37.58        | 46.00  | -8.42  | QP             |              |        |
| 6   | *   | 865.1700 | 42.23         | -4.38          | 37.85        | 46.00  | -8.15  | QP             |              |        |

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

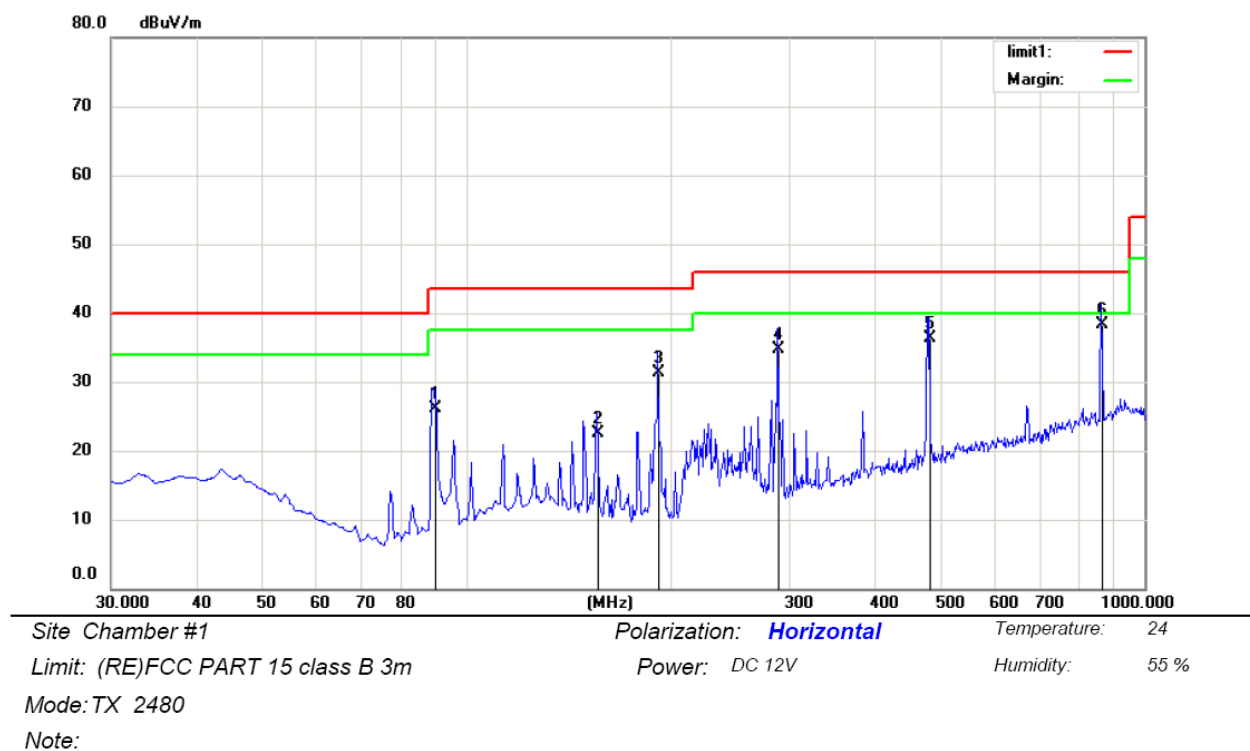
Operator:



| No. | Mk. | Freq.    | Reading Level | Correct Factor | Measure-ment | Limit  | Over   | Antenna Height | Table Degree |        |
|-----|-----|----------|---------------|----------------|--------------|--------|--------|----------------|--------------|--------|
|     |     | MHz      | dBuV          | dB             | dBuV/m       | dBuV/m | dB     | Detector       | cm           | degree |
| 1   |     | 191.9900 | 38.89         | -18.14         | 20.75        | 43.50  | -22.75 | QP             |              |        |
| 2   |     | 288.0200 | 36.74         | -14.77         | 21.97        | 46.00  | -24.03 | QP             |              |        |
| 3   |     | 384.0500 | 36.76         | -11.96         | 24.80        | 46.00  | -21.20 | QP             |              |        |
| 4   | *   | 480.0800 | 43.83         | -10.54         | 33.29        | 46.00  | -12.71 | QP             |              |        |
| 5   |     | 672.1400 | 34.69         | -7.69          | 27.00        | 46.00  | -19.00 | QP             |              |        |
| 6   |     | 864.2000 | 33.28         | -4.40          | 28.88        | 46.00  | -17.12 | QP             |              |        |

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

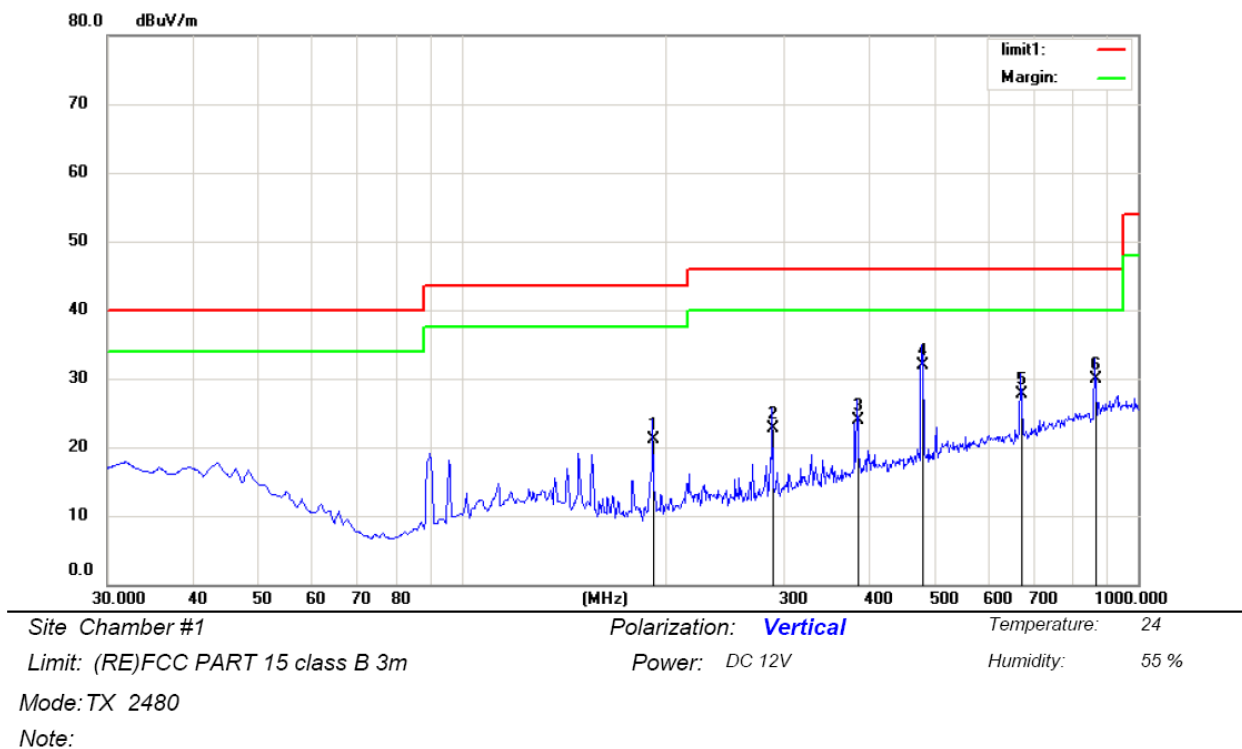
Operator:



| 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   |     | 90.1400  | 46.93         | -20.85         | 26.08       | 43.50  | -17.42 | QP             |              |         |
| 2   |     | 156.1000 | 40.72         | -18.25         | 22.47       | 43.50  | -21.03 | QP             |              |         |
| 3   |     | 191.9900 | 49.49         | -18.14         | 31.35       | 43.50  | -12.15 | QP             |              |         |
| 4   |     | 288.0200 | 49.52         | -14.77         | 34.75       | 46.00  | -11.25 | QP             |              |         |
| 5   |     | 481.0500 | 46.85         | -10.54         | 36.31       | 46.00  | -9.69  | QP             |              |         |
| 6   | *   | 864.2000 | 42.74         | -4.40          | 38.34       | 46.00  | -7.66  | QP             |              |         |

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

Operator:



| No. | Mk. | Freq.    | Reading Level | Correct Factor | Measure-ment | Limit  | Over   | Antenna Height | Table Degree |        |
|-----|-----|----------|---------------|----------------|--------------|--------|--------|----------------|--------------|--------|
|     |     | MHz      | dBuV          | dB             | dBuV/m       | dBuV/m | dB     | Detector       | cm           | degree |
| 1   |     | 191.9900 | 39.21         | -18.14         | 21.07        | 43.50  | -22.43 | QP             |              |        |
| 2   |     | 288.0200 | 37.45         | -14.77         | 22.68        | 46.00  | -23.32 | QP             |              |        |
| 3   |     | 384.0500 | 35.89         | -11.96         | 23.93        | 46.00  | -22.07 | QP             |              |        |
| 4   | *   | 480.0800 | 42.51         | -10.54         | 31.97        | 46.00  | -14.03 | QP             |              |        |
| 5   |     | 672.1400 | 35.30         | -7.69          | 27.61        | 46.00  | -18.39 | QP             |              |        |
| 6   |     | 864.2000 | 34.35         | -4.40          | 29.95        | 46.00  | -16.05 | QP             |              |        |

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

Operator:

**Above 1000MHz~10<sup>th</sup> Harmonics:**

Operation Mode: GFSK (CH1: 2402MHz) Test Date : October 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         | 66.23                  | 46.25 | 74               | 54 | -7.77    | -7.75  |
| 7206  | V         | 65.21                  | 45.21 | 74               | 54 | -8.79    | -8.79  |
| 9608  | V         | 64.58                  | 44.57 | 74               | 54 | -9.42    | -9.43  |
| 12010 | V         | 63.26                  | 43.26 | 74               | 54 | -10.74   | -10.74 |
| 14412 | V         | 62.35                  | 42.21 | 74               | 54 | -11.65   | -11.79 |
| 16814 | V         | 59.61                  | 41.29 | 74               | 54 | -14.39   | -12.71 |
| 4804  | H         | 65.59                  | 45.28 | 74               | 54 | -8.41    | -8.72  |
| 7206  | H         | 64.27                  | 44.59 | 74               | 54 | -9.73    | -9.41  |
| 9608  | H         | 63.29                  | 43.27 | 74               | 54 | -10.71   | -10.73 |
| 12010 | H         | 62.51                  | 42.28 | 74               | 54 | -11.49   | -11.72 |
| 14412 | H         | 61.28                  | 40.21 | 74               | 54 | -12.72   | -13.79 |
| 16814 | H         | 60.24                  | 39.29 | 74               | 54 | -13.76   | -14.71 |

Operation Mode: GFSK (CH40: 2441MHz) Test Date : October 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         | 65.21                  | 46.62 | 74               | 54 | -8.79    | -7.38  |
| 7323  | V         | 64.25                  | 45.28 | 74               | 54 | -9.75    | -8.72  |
| 9764  | V         | 63.59                  | 44.21 | 74               | 54 | -10.41   | -9.79  |
| 12205 | V         | 62.31                  | 43.59 | 74               | 54 | -11.69   | -10.41 |
| 14646 | V         | 61.24                  | 42.58 | 74               | 54 | -12.76   | -11.42 |
| 17087 | V         | 60.29                  | 41.58 | 74               | 54 | -13.71   | -12.42 |
| 4882  | H         | 64.28                  | 46.59 | 74               | 54 | -9.72    | -7.41  |
| 7323  | H         | 64.26                  | 45.27 | 74               | 54 | -9.74    | -8.73  |
| 9764  | H         | 63.59                  | 44.57 | 74               | 54 | -10.41   | -9.43  |
| 12205 | H         | 62.51                  | 43.29 | 74               | 54 | -11.49   | -10.71 |
| 14646 | H         | 61.51                  | 42.61 | 74               | 54 | -12.49   | -11.39 |
| 17087 | H         | 60.28                  | 41.08 | 74               | 54 | -13.72   | -12.92 |



Operation Mode: TX Mode (CH79: 2480MHz) Test Date : October13, 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         | 66.29                  | 46.29 | 74               | 54 | -7.71    | -7.71  |
| 7440  | V         | 65.21                  | 45.21 | 74               | 54 | -8.79    | -8.79  |
| 9920  | V         | 64.58                  | 44.29 | 74               | 54 | -9.42    | -9.71  |
| 12400 | V         | 63.58                  | 43.29 | 74               | 54 | -10.42   | -10.71 |
| 14880 | V         | 62.56                  | 42.58 | 74               | 54 | -11.44   | -11.42 |
| 17360 | V         | 61.29                  | 41.24 | 74               | 54 | -12.71   | -12.76 |
| 4960  | H         | 66.02                  | 45.69 | 74               | 54 | -7.98    | -8.31  |
| 7440  | H         | 65.06                  | 44.29 | 74               | 54 | -8.94    | -9.71  |
| 9920  | H         | 64.26                  | 43.65 | 74               | 54 | -9.74    | -10.35 |
| 12400 | H         | 63.21                  | 42.51 | 74               | 54 | -10.79   | -11.49 |
| 14880 | H         | 62.59                  | 41.59 | 74               | 54 | -11.41   | -12.41 |
| 17360 | H         | 61.28                  | 40.29 | 74               | 54 | -12.72   | -13.71 |

Operation Mode: Pi/4-DQPSK (CH1: 2402MHz) Test Date : October 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         | 65.29                  | 45.31 | 74               | 54 | -8.71    | -8.69  |
| 7206  | V         | 64.59                  | 44.26 | 74               | 54 | -9.41    | -9.74  |
| 9608  | V         | 63.26                  | 43.62 | 74               | 54 | -10.74   | -10.38 |
| 12010 | V         | 62.54                  | 42.61 | 74               | 54 | -11.46   | -11.39 |
| 14412 | V         | 61.28                  | 40.25 | 74               | 54 | -12.72   | -13.75 |
| 16814 | V         | 60.59                  | 39.52 | 74               | 54 | -13.41   | -14.48 |
| 4804  | H         | 64.26                  | 44.21 | 74               | 54 | -9.74    | -9.79  |
| 7206  | H         | 63.21                  | 43.62 | 74               | 54 | -10.79   | -10.38 |
| 9608  | H         | 62.54                  | 42.26 | 74               | 54 | -11.46   | -11.74 |
| 12010 | H         | 61.06                  | 41.29 | 74               | 54 | -12.94   | -12.71 |
| 14412 | H         | 60.29                  | 40.59 | 74               | 54 | -13.71   | -13.41 |
| 16814 | H         | 59.62                  | 39.62 | 74               | 54 | -14.38   | -14.38 |

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

| Freq.<br>(MHz) | Ant. Pol.<br>H/V | Emission Level(dBuV/m) |       | Limit 3m(dBuV/m) |    | Over(dB) |        |
|----------------|------------------|------------------------|-------|------------------|----|----------|--------|
|                |                  | PK                     | AV    | PK               | AV | PK       | AV     |
| 4882           | V                | 65.26                  | 45.62 | 74               | 54 | -8.74    | -8.38  |
| 7323           | V                | 64.23                  | 44.59 | 74               | 54 | -9.77    | -9.41  |
| 9764           | V                | 63.21                  | 43.26 | 74               | 54 | -10.79   | -10.74 |
| 12205          | V                | 62.59                  | 42.21 | 74               | 54 | -11.41   | -11.79 |
| 14646          | V                | 61.24                  | 39.62 | 74               | 54 | -12.76   | -14.38 |
| 17087          | V                | 60.59                  | 38.63 | 74               | 54 | -13.41   | -15.37 |
| 4882           | H                | 64.21                  | 45.26 | 74               | 54 | -9.79    | -8.74  |
| 7323           | H                | 63.59                  | 44.41 | 74               | 54 | -10.41   | -9.59  |
| 9764           | H                | 62.51                  | 43.62 | 74               | 54 | -11.49   | -10.38 |
| 12205          | H                | 61.24                  | 42.26 | 74               | 54 | -12.76   | -11.74 |
| 14646          | H                | 60.25                  | 41.21 | 74               | 54 | -13.75   | -12.79 |
| 17087          | H                | 59.63                  | 40.25 | 74               | 54 | -14.37   | -13.75 |

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

| Freq.<br>(MHz) | Ant. Pol.<br>H/V | Emission Level(dBuV/m) |       | Limit 3m(dBuV/m) |    | Over(dB) |        |
|----------------|------------------|------------------------|-------|------------------|----|----------|--------|
|                |                  | PK                     | AV    | PK               | AV | PK       | AV     |
| 4960           | V                | 64.52                  | 46.52 | 74               | 54 | -9.48    | -7.48  |
| 7440           | V                | 63.21                  | 45.21 | 74               | 54 | -10.79   | -8.79  |
| 9920           | V                | 62.59                  | 44.52 | 74               | 54 | -11.41   | -9.48  |
| 12400          | V                | 61.28                  | 43.59 | 74               | 54 | -12.72   | -10.41 |
| 14880          | V                | 60.29                  | 42.51 | 74               | 54 | -13.71   | -11.49 |
| 17360          | V                | 59.63                  | 41.26 | 74               | 54 | -14.37   | -12.74 |
| 4960           | H                | 63.59                  | 45.68 | 74               | 54 | -10.41   | -8.32  |
| 7440           | H                | 62.21                  | 44.57 | 74               | 54 | -11.79   | -9.43  |
| 9920           | H                | 63.59                  | 43.26 | 74               | 54 | -10.41   | -10.74 |
| 12400          | H                | 62.51                  | 42.51 | 74               | 54 | -11.49   | -11.49 |
| 14880          | H                | 61.59                  | 41.27 | 74               | 54 | -12.41   | -12.73 |
| 17360          | H                | 60.32                  | 40.28 | 74               | 54 | -13.68   | -13.72 |

Operation Mode: 8DPSK (CH1: 2402MHz) Test Date : October13, 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         | 66.39                  | 45.26 | 74               | 54 | -7.61    | -8.74  |
| 7206  | V         | 65.27                  | 44.21 | 74               | 54 | -8.73    | -9.79  |
| 9608  | V         | 64.27                  | 43.29 | 74               | 54 | -9.73    | -10.71 |
| 12010 | V         | 63.59                  | 42.51 | 74               | 54 | -10.41   | -11.49 |
| 14412 | V         | 62.51                  | 41.58 | 74               | 54 | -11.49   | -12.42 |
| 16814 | V         | 61.57                  | 40.29 | 74               | 54 | -12.43   | -13.71 |
| 4804  | H         | 65.39                  | 44.59 | 74               | 54 | -8.61    | -9.41  |
| 7206  | H         | 64.27                  | 43.61 | 74               | 54 | -9.73    | -10.39 |
| 9608  | H         | 62.59                  | 42.51 | 74               | 54 | -11.41   | -11.49 |
| 12010 | H         | 61.24                  | 41.27 | 74               | 54 | -12.76   | -12.73 |
| 14412 | H         | 60.29                  | 40.29 | 74               | 54 | -13.71   | -13.71 |
| 16814 | H         | 59.62                  | 39.65 | 74               | 54 | -14.38   | -14.35 |

Operation Mode: 8DPSK (CH40: 2441MHz) Test Date : October 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         | 66.26                  | 46.52 | 74               | 54 | -7.74    | -7.48  |
| 7323  | V         | 65.51                  | 45.27 | 74               | 54 | -8.49    | -8.73  |
| 9764  | V         | 64.15                  | 44.59 | 74               | 54 | -9.85    | -9.41  |
| 12205 | V         | 63.25                  | 43.26 | 74               | 54 | -10.75   | -10.74 |
| 14646 | V         | 62.51                  | 42.51 | 74               | 54 | -11.49   | -11.49 |
| 17087 | V         | 61.26                  | 41.29 | 74               | 54 | -12.74   | -12.71 |
| 4882  | H         | 65.45                  | 45.51 | 74               | 54 | -8.55    | -8.49  |
| 7323  | H         | 64.39                  | 44.26 | 74               | 54 | -9.61    | -9.74  |
| 9764  | H         | 63.25                  | 43.21 | 74               | 54 | -10.75   | -10.79 |
| 12205 | H         | 62.51                  | 42.16 | 74               | 54 | -11.49   | -11.84 |
| 14646 | H         | 61.59                  | 41.25 | 74               | 54 | -12.41   | -12.75 |
| 17087 | H         | 60.59                  | 40.29 | 74               | 54 | -13.41   | -13.71 |

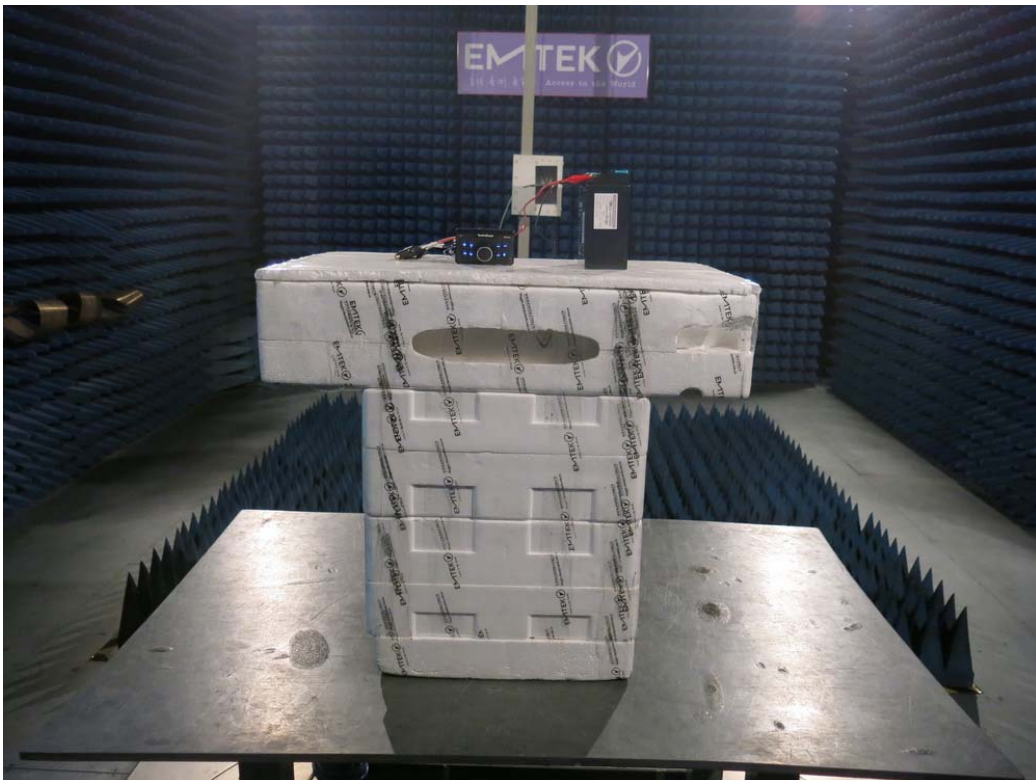
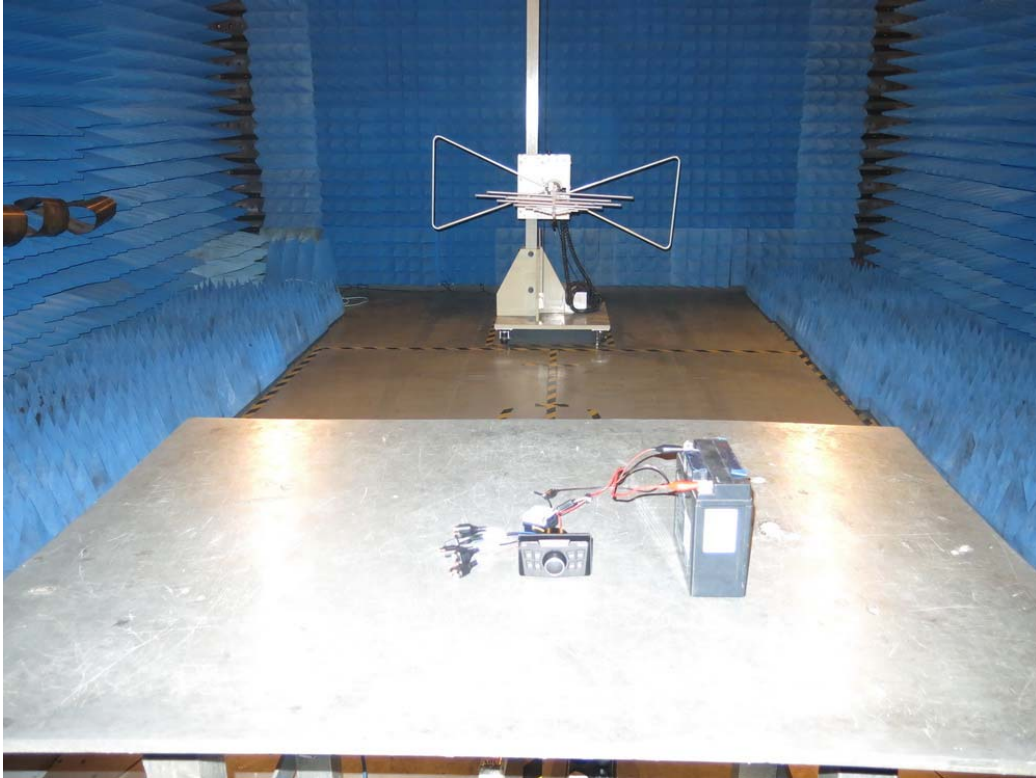
Operation Mode: 8DPSK (CH79: 2480MHz) Test Date : October 13, 2015

| Freq.<br>(MHz) | Ant. Pol. | Emission Level(dBuV/m) |       | Limit 3m(dBuV/m) |    | Over(dB) |        |
|----------------|-----------|------------------------|-------|------------------|----|----------|--------|
|                |           | PK                     | AV    | PK               | AV | PK       | AV     |
| 4960           | V         | 66.59                  | 45.62 | 74               | 54 | -7.41    | -8.38  |
| 7440           | V         | 65.54                  | 44.25 | 74               | 54 | -8.46    | -9.75  |
| 9920           | V         | 64.52                  | 43.26 | 74               | 54 | -9.48    | -10.74 |
| 12400          | V         | 63.26                  | 42.21 | 74               | 54 | -10.74   | -11.79 |
| 14880          | V         | 62.51                  | 41.15 | 74               | 54 | -11.49   | -12.85 |
| 17360          | V         | 61.58                  | 40.29 | 74               | 54 | -12.42   | -13.71 |
| 4960           | H         | 65.26                  | 44.27 | 74               | 54 | -8.74    | -9.73  |
| 7440           | H         | 64.51                  | 43.56 | 74               | 54 | -9.49    | -10.44 |
| 9920           | H         | 63.25                  | 42.21 | 74               | 54 | -10.75   | -11.79 |
| 12400          | H         | 62.21                  | 41.23 | 74               | 54 | -11.79   | -12.77 |
| 14880          | H         | 61.59                  | 40.21 | 74               | 54 | -12.41   | -13.79 |
| 17360          | H         | 60.51                  | 39.62 | 74               | 54 | -13.49   | -14.38 |

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.

**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:

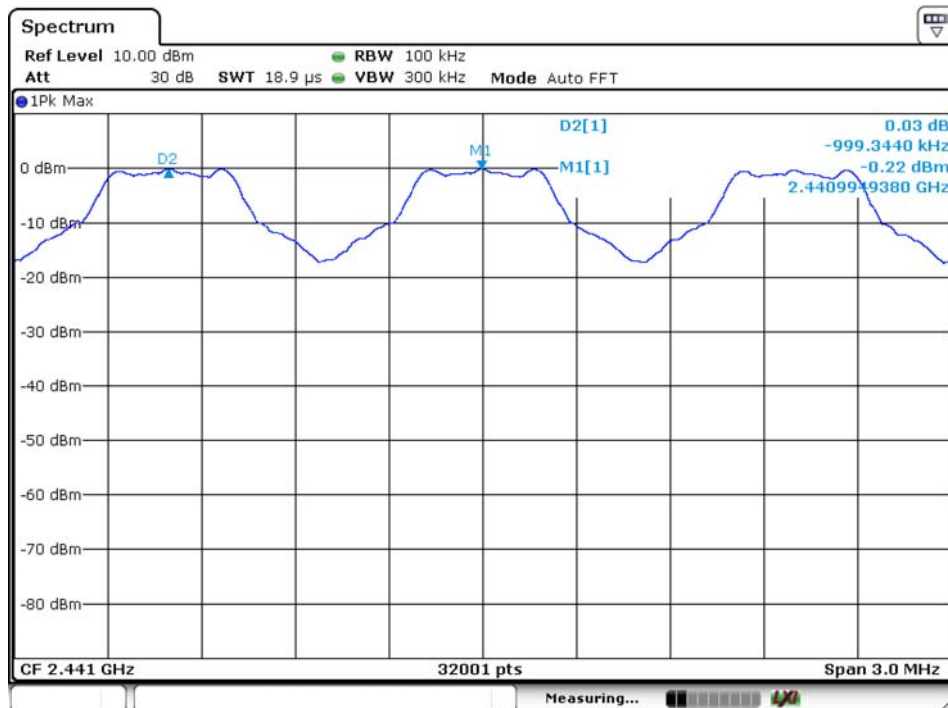
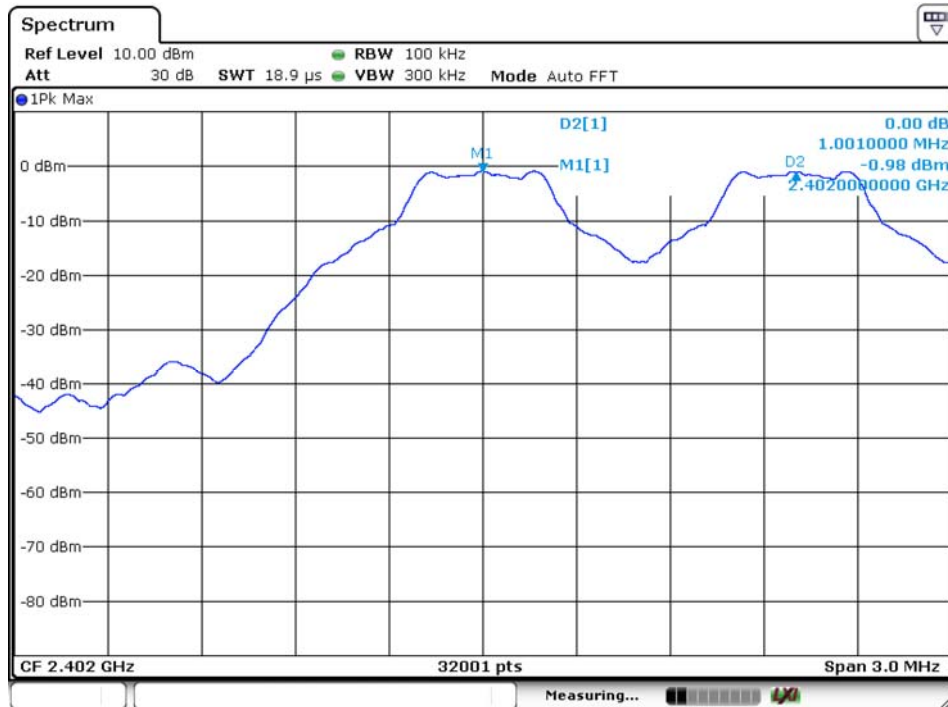
| EQUIPMENT TYPE                                                                                                                                                               | MFR             | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------|---------------|------------|------------|
| 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 |
| Note: 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. |                 |              |               |            |            |

### 6.4 Measurement Results:

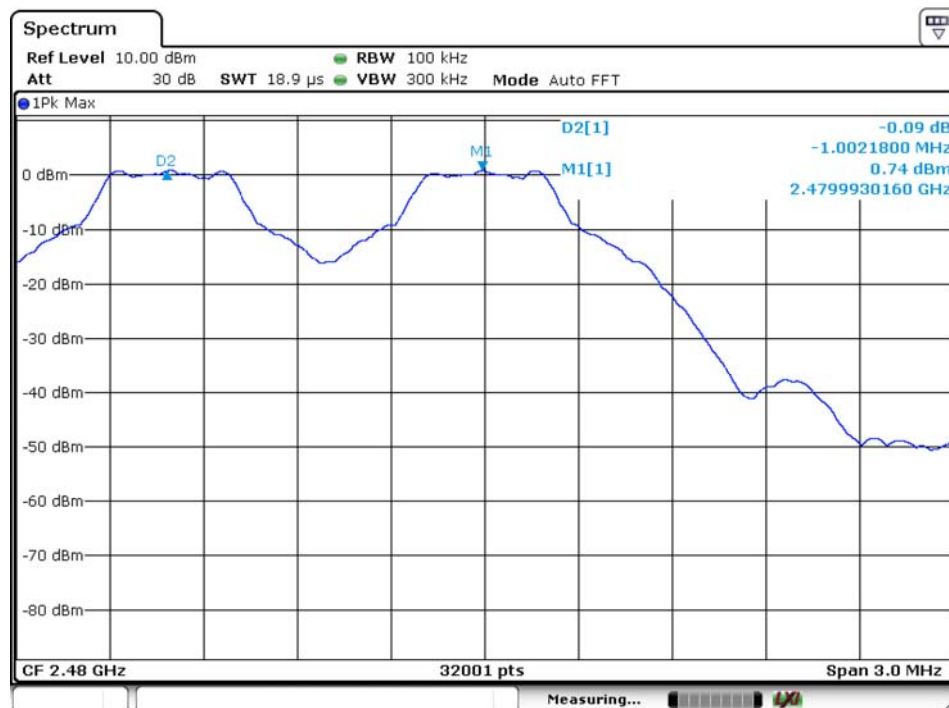
Refer to attached data chart.

|                    |      |               |                  |
|--------------------|------|---------------|------------------|
| Spectrum Detector: | PK   | Test Date :   | October 13, 2015 |
| 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                        | >815                               |
| 40             | 2441                    | 999                         | >818                               |
| 79             | 2480                    | 1002                        | >815                               |



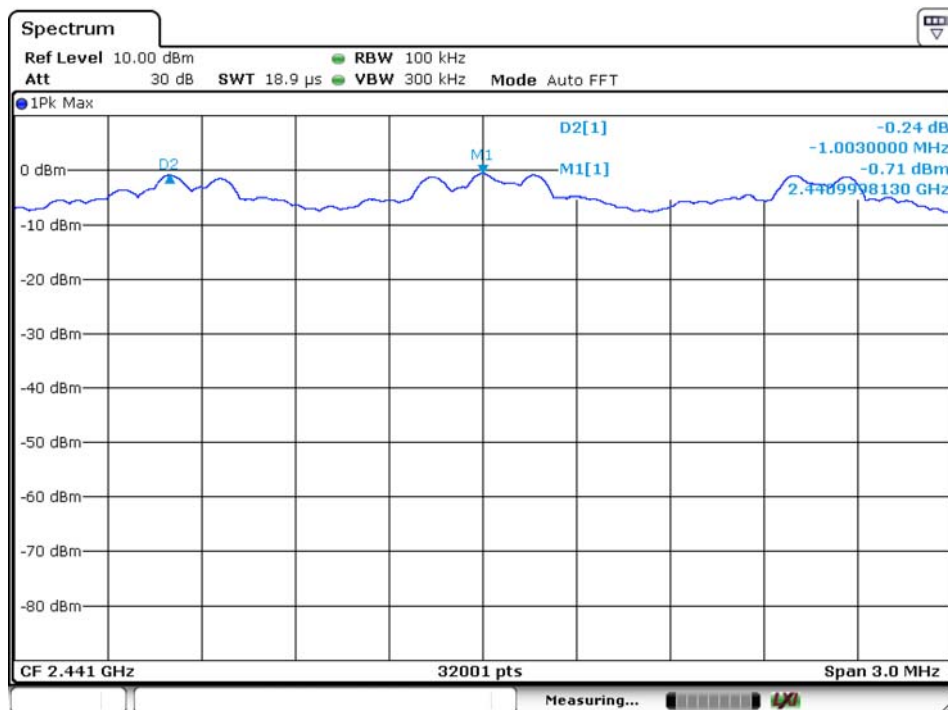
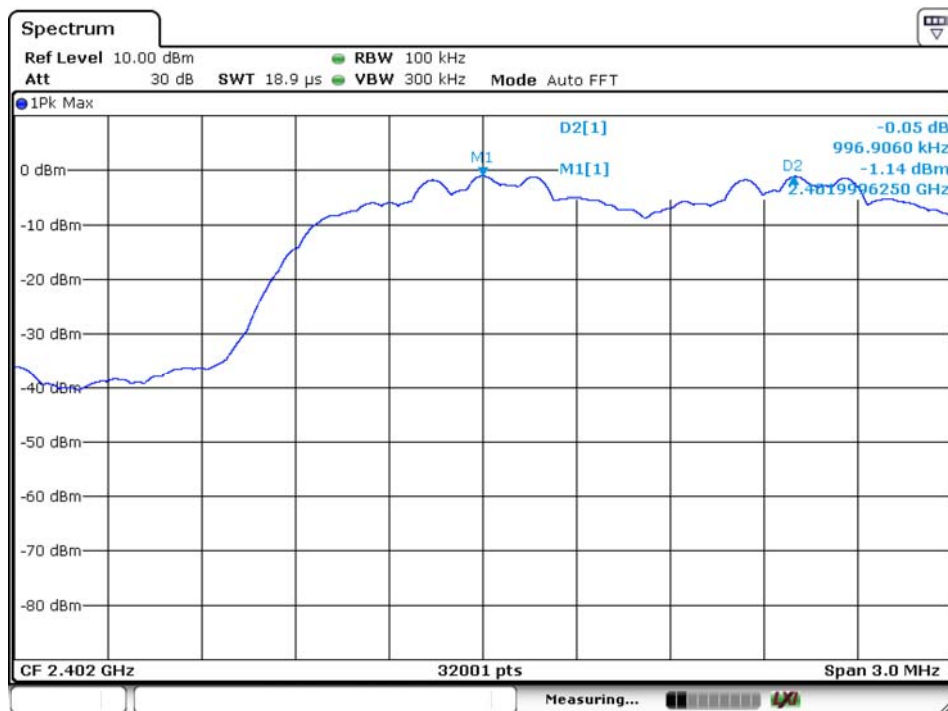


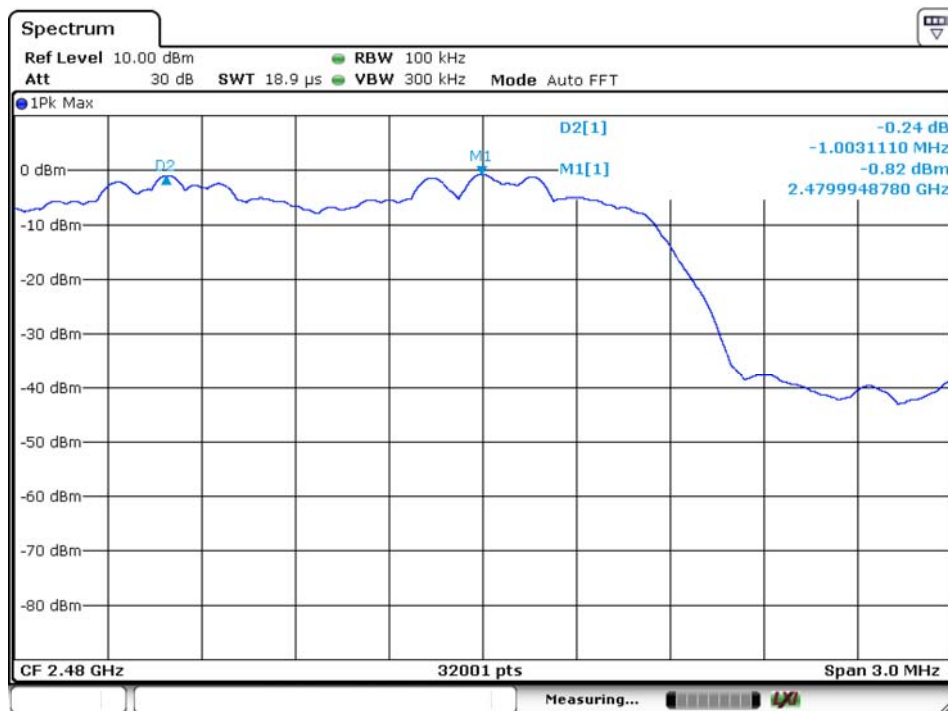


|                    |            |               |                  |
|--------------------|------------|---------------|------------------|
| Spectrum Detector: | PK         | Test Date :   | October 13, 2015 |
| Test By:           | Andy       | Temperature : | 24°C             |
| Test Result:       | 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                    | 997                         | >831                                   |
| 40             | 2441                    | 1003                        | >831                                   |
| 79             | 2480                    | 1003                        | >827                                   |

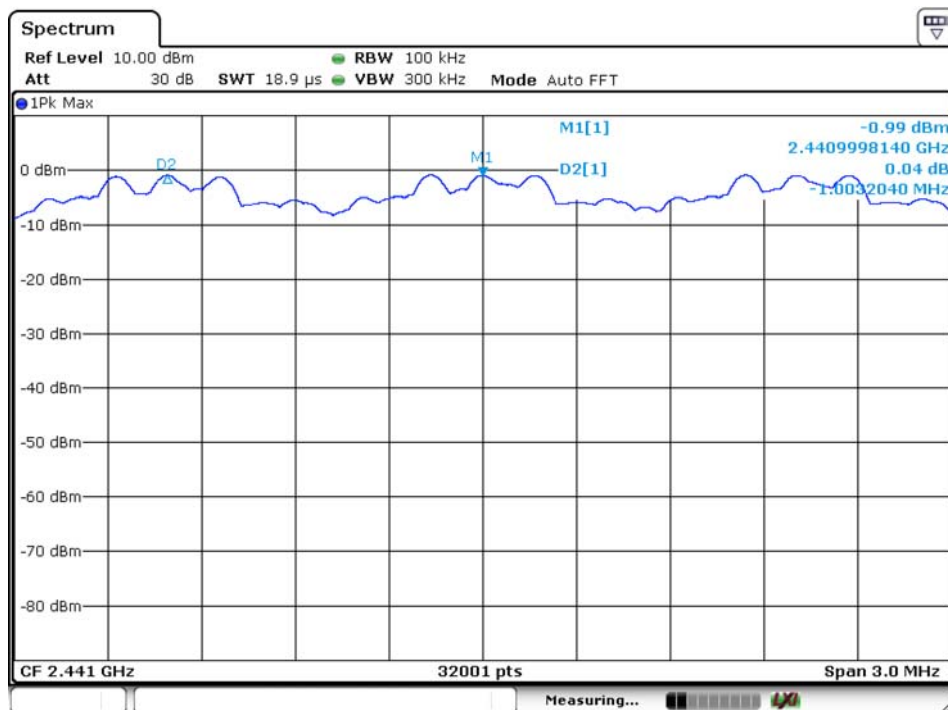
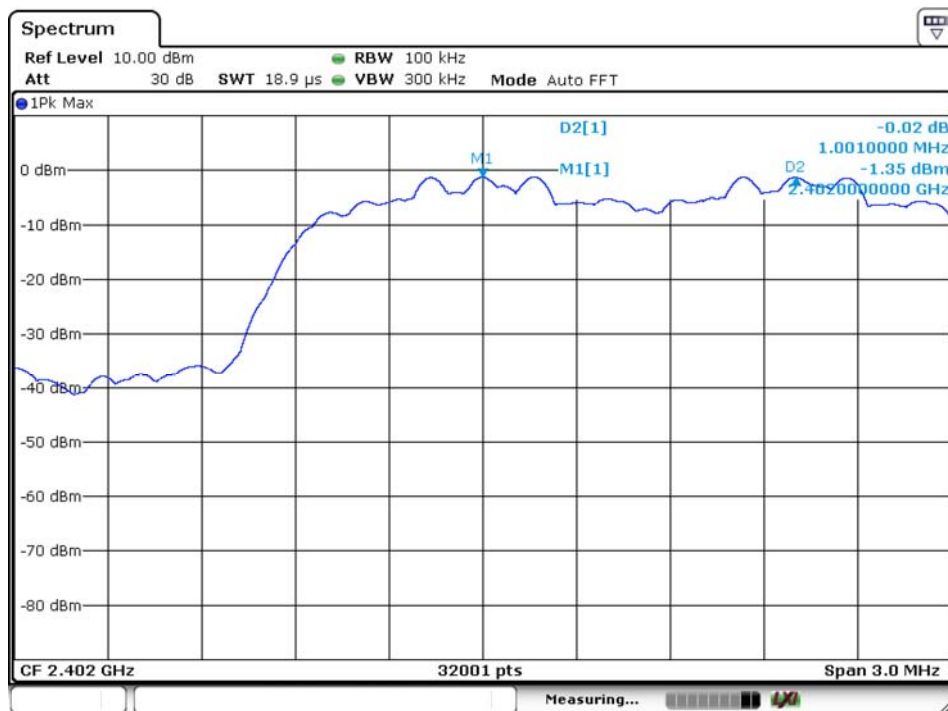


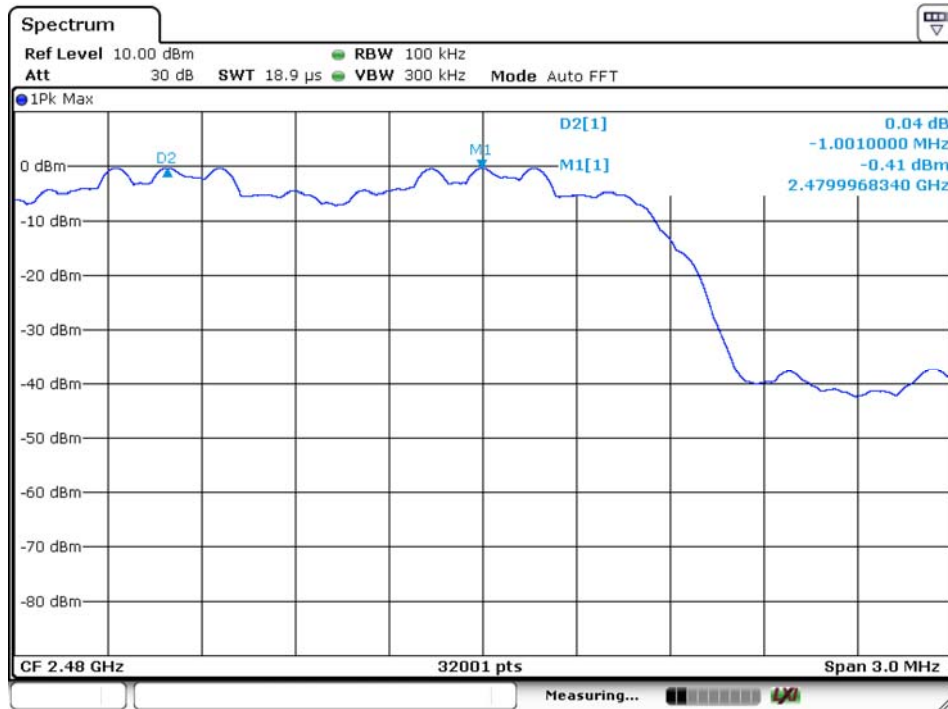




|                    |       |               |                  |
|--------------------|-------|---------------|------------------|
| Spectrum Detector: | PK    | Test Date :   | October 13, 2015 |
| Test By:           | Andy  | Temperature : | 24 °C            |
| Test Result:       | PASS  | Humidity :    | 53 %             |
| Modulation:        | 8DPSK |               |                  |

| Channel number | Channel frequency (MHz) | Separation Read Value (kHz) | Separation Limit 2/3 20dB Down BW(kHz) |
|----------------|-------------------------|-----------------------------|----------------------------------------|
| 1              | 2402                    | 1001                        | >811                                   |
| 40             | 2441                    | 1003                        | >815                                   |
| 79             | 2480                    | 1001                        | >807                                   |



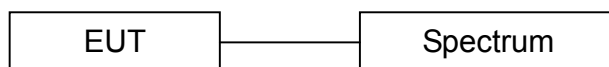


## 7. 20dB Bandwidth test

### 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:

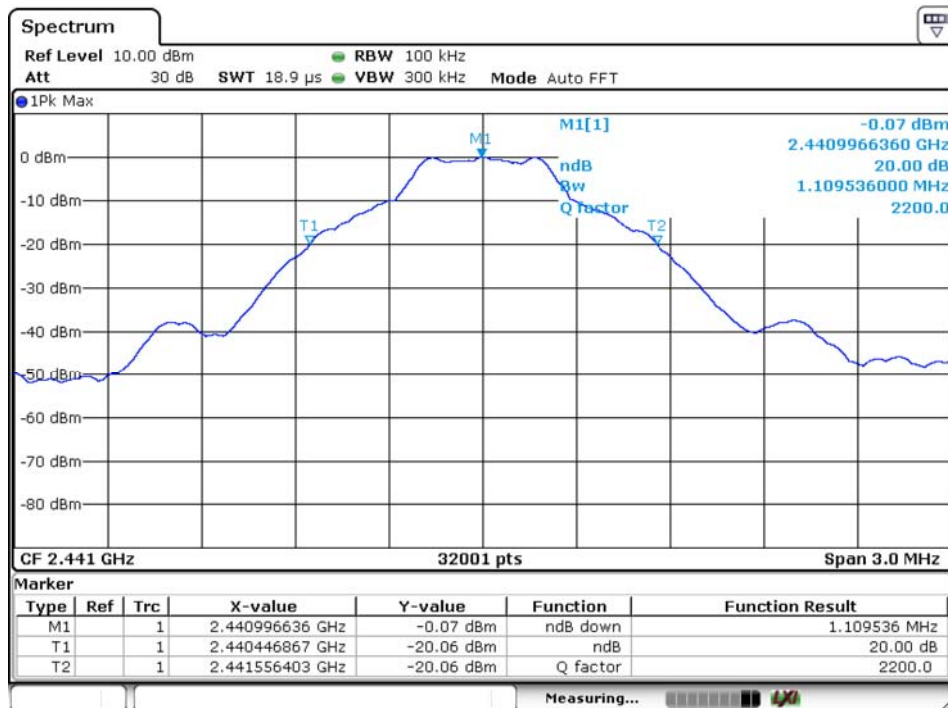
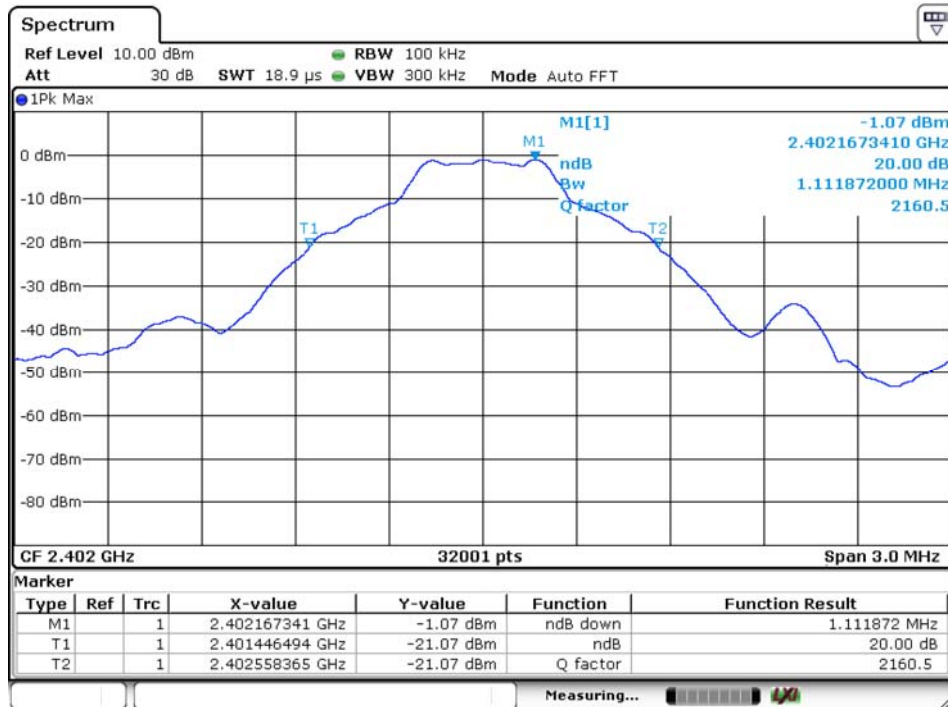
| EQUIPMENT TYPE                                                                                                                                                               | MFR             | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------|---------------|------------|------------|
| 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 |
| Note: 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. |                 |              |               |            |            |

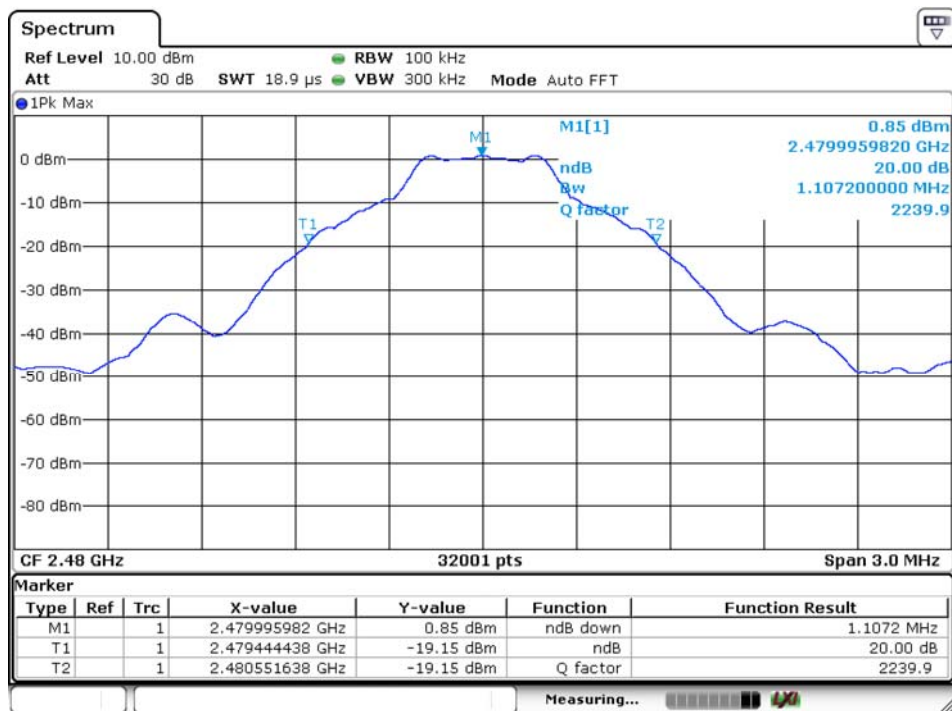
### 7.4 Measurement Results:

Refer to attached data chart.

|                    |      |               |                  |
|--------------------|------|---------------|------------------|
| Spectrum Detector: | PK   | Test Date :   | October 13, 2015 |
| Test By:           | Andy | Temperature : | 25 °C            |
| Test Result:       | PASS | Humidity :    | 50 %             |
| Modulation:        | GFSK |               |                  |

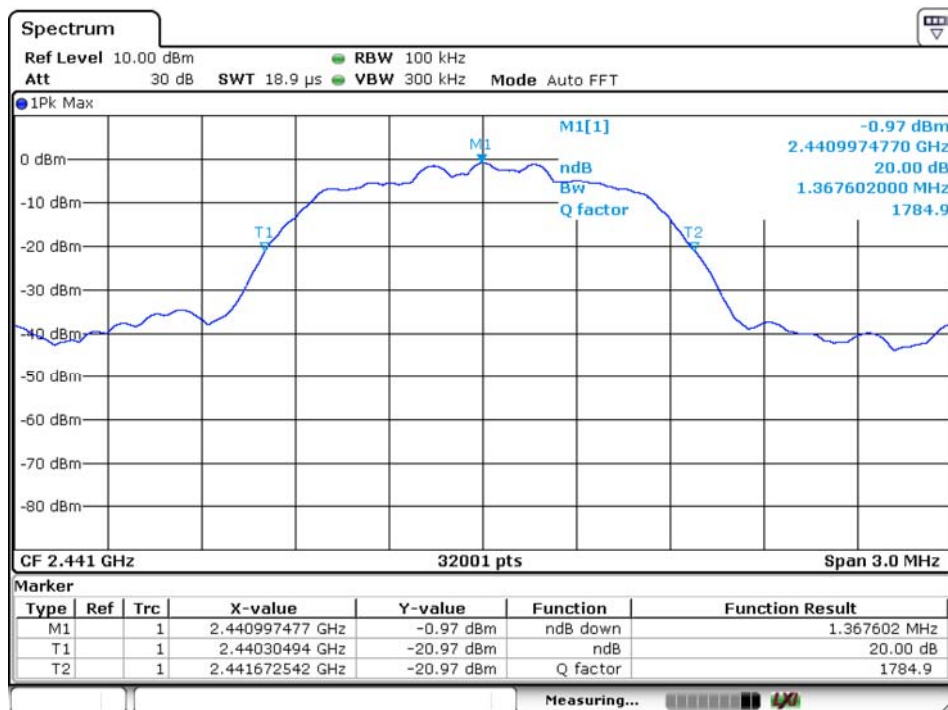
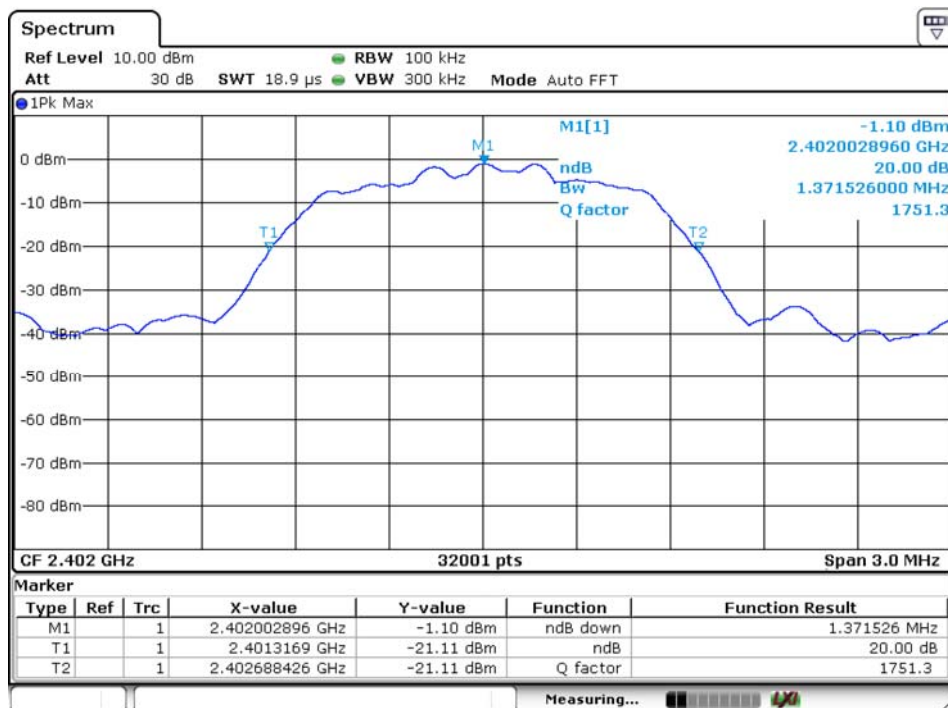
| Channel number | Channel frequency (MHz) | 20dB Down BW(KHz) |
|----------------|-------------------------|-------------------|
| 1              | 2402                    | 1111              |
| 40             | 2441                    | 1109              |
| 79             | 2480                    | 1107              |



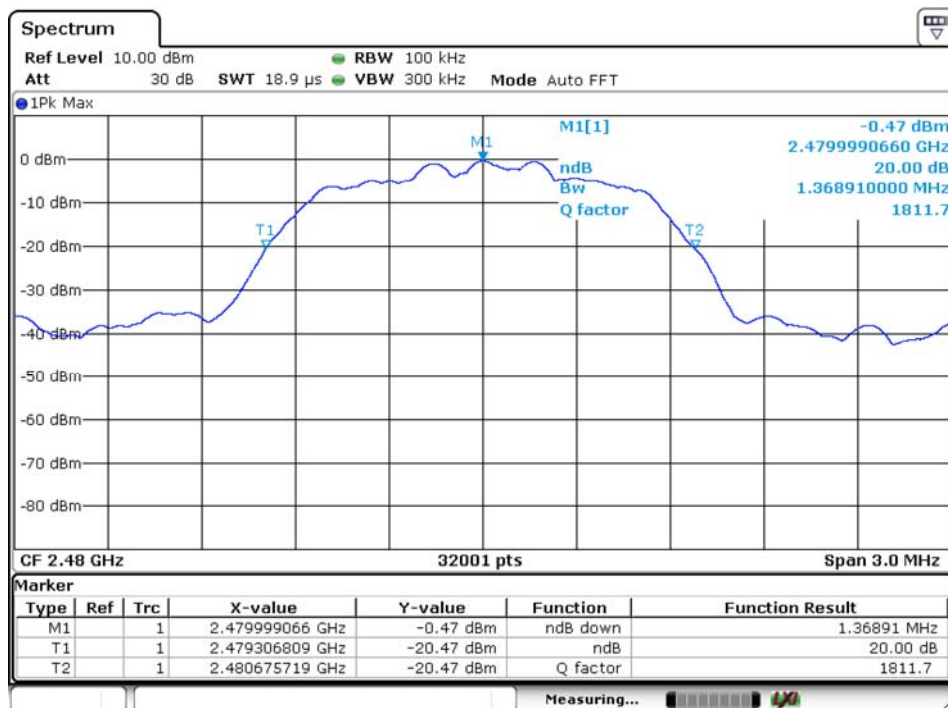


|                    |                |               |                  |
|--------------------|----------------|---------------|------------------|
| Spectrum Detector: | PK             | Test Date :   | October 13, 2015 |
| Test By:           | Andy           | Temperature : | 24 °C            |
| Test Result:       | PASS           | Humidity :    | 53 %             |
| Modulation:        | $\Pi/4$ -DQPSK |               |                  |

| Channel number | Channel frequency (MHz) | 20dB Down BW(kHz) |
|----------------|-------------------------|-------------------|
| 1              | 2402                    | 1371              |
| 40             | 2441                    | 1367              |
| 79             | 2480                    | 1369              |

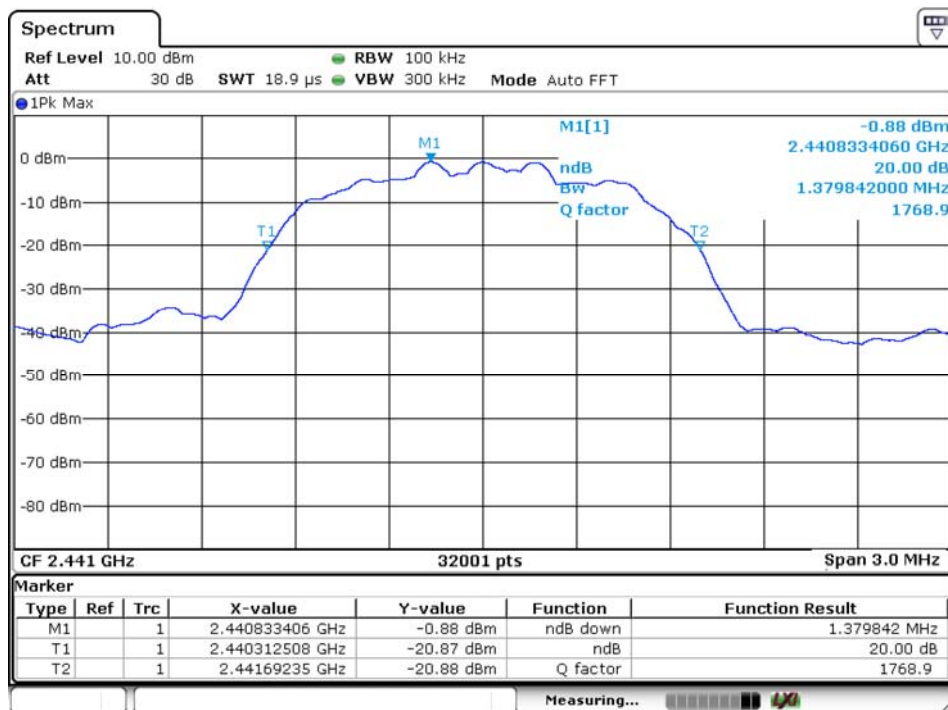
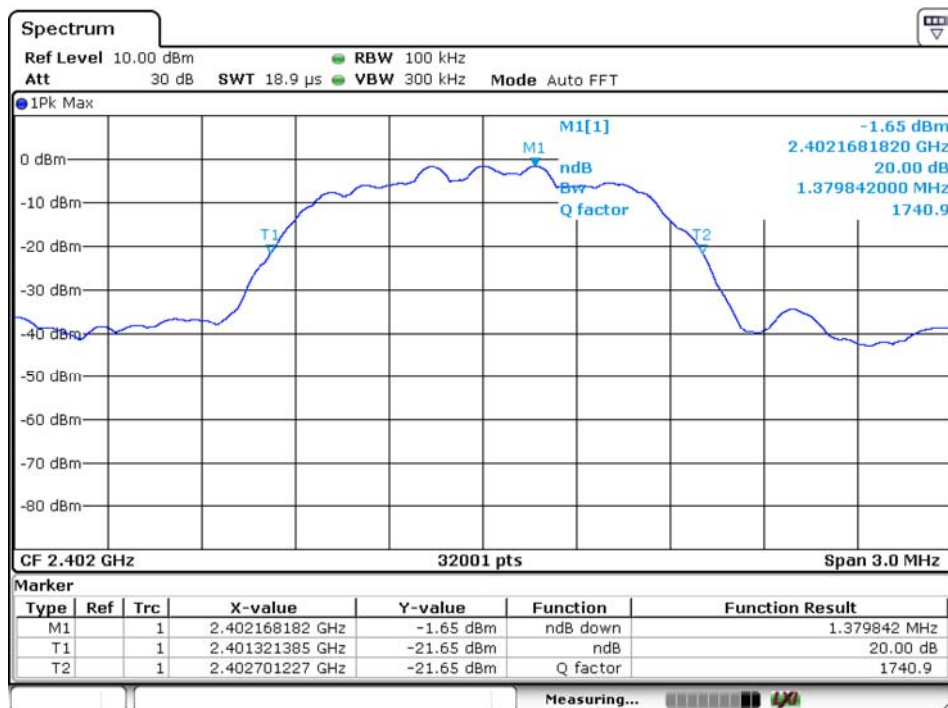


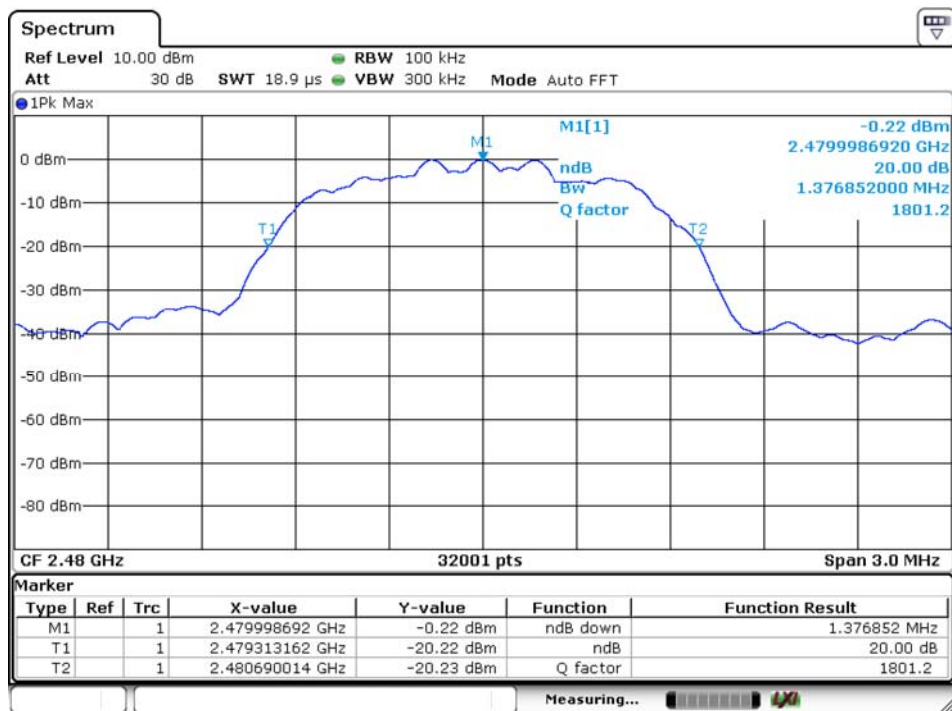




|                    |       |               |                  |
|--------------------|-------|---------------|------------------|
| Spectrum Detector: | PK    | Test Date :   | October 13, 2015 |
| Test By:           | Andy  | Temperature : | 24°C             |
| Test Result:       | PASS  | Humidity :    | 53 %             |
| Modulation:        | 8DPSK |               |                  |

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



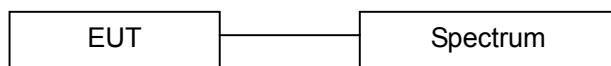


## 8. Quantity of Hopping Channel Test

### 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:

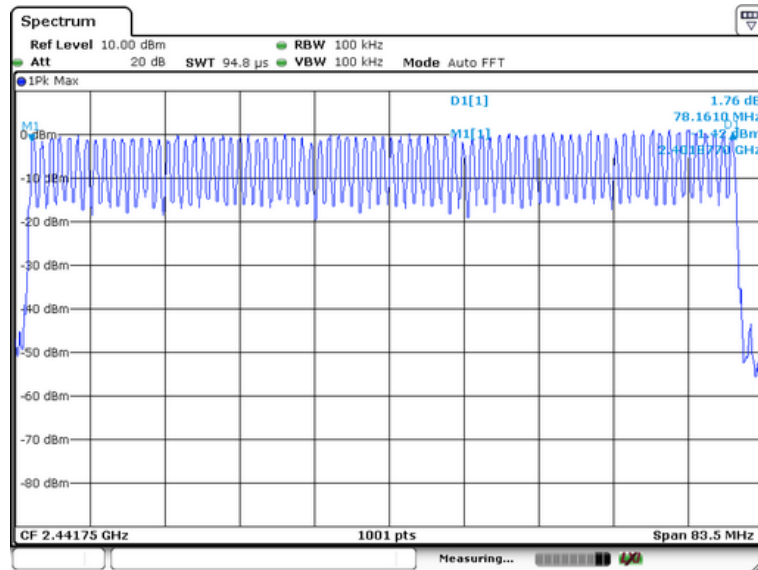
| EQUIPMENT TYPE                                                                                                                                                               | MFR             | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------|---------------|------------|------------|
| 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 |
| Note: 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. |                 |              |               |            |            |

### 8.4 Measurement Results:

#### Worst test modulation GFSK

|                    |      |               |                  |
|--------------------|------|---------------|------------------|
| Spectrum Detector: | PK   | Test Date :   | October 13, 2015 |
| Test By:           | Andy | Temperature : | 25 °C            |
| Test Result:       | PASS | Humidity :    | 50 %             |

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



## 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:

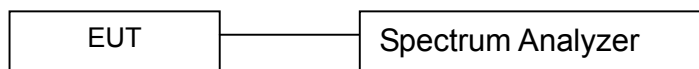
$$\text{Dwell time} = \text{time slot length} * \text{hop rate} / \text{number of hopping channels} * 31.6\text{s}$$

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 SET-UP (Block Diagram of Configuration)



### 9.3 Measurement Equipment Used:

| EQUIPMENT TYPE                                                                                                                                                               | MFR             | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------|---------------|------------|------------|
| Spectrum Analyzer                                                                                                                                                            | Rohde & Schwarz | FSV30        | 1321.3008K    | 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 |
| Note: 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. |                 |              |               |            |            |

### 9.4 Test Requirements / Limits

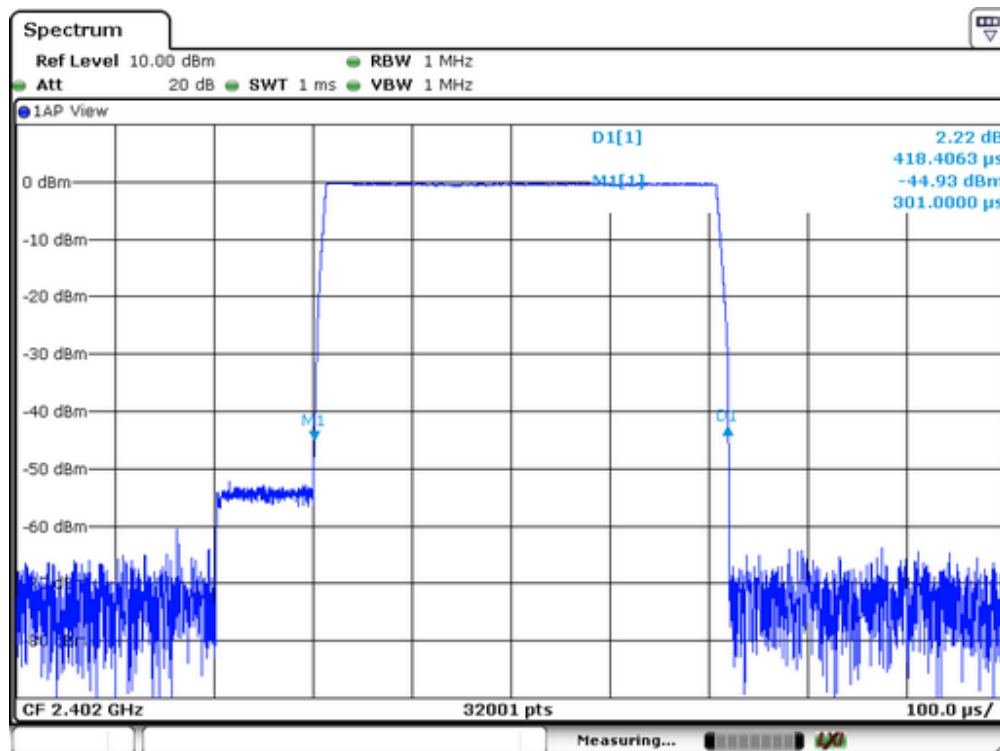
FCC Part 15, Subpart C, §15.247 (a) (1) (iii)

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.

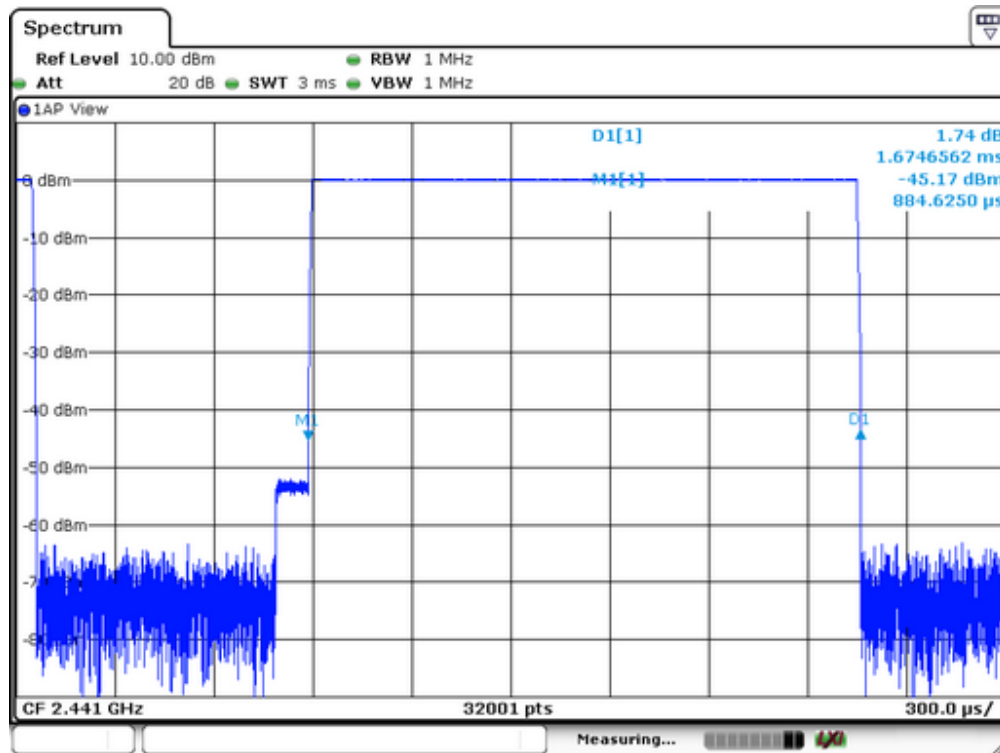
### 9.3 Measurement Results:

| Packet type | Time slot length(ms) | Dwell time                          | Dwell time(ms) |
|-------------|----------------------|-------------------------------------|----------------|
| DH1         | 0.418                | time slot length *1600/2 /79 * 31.6 | 133.76         |
| DH3         | 1.675                | time slot length *1600/4 /79 * 31.6 | 268.00         |
| DH5         | 2.921                | time slot length *1600/6 /79 * 31.6 | 311.57         |

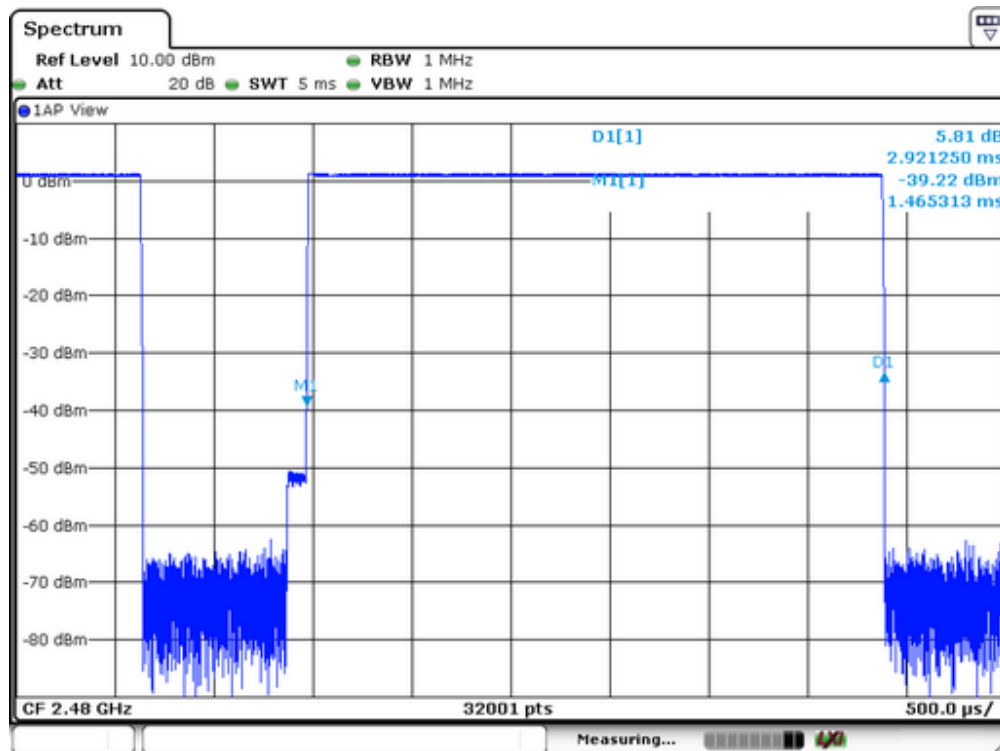
DH1:



DH3:



DH5:



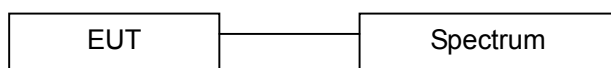


## 10. MAXIMUM PEAK OUTPUT POWER TEST

### 10.1 Measurement Procedure

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

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



### 10.3 Measurement Equipment Used:

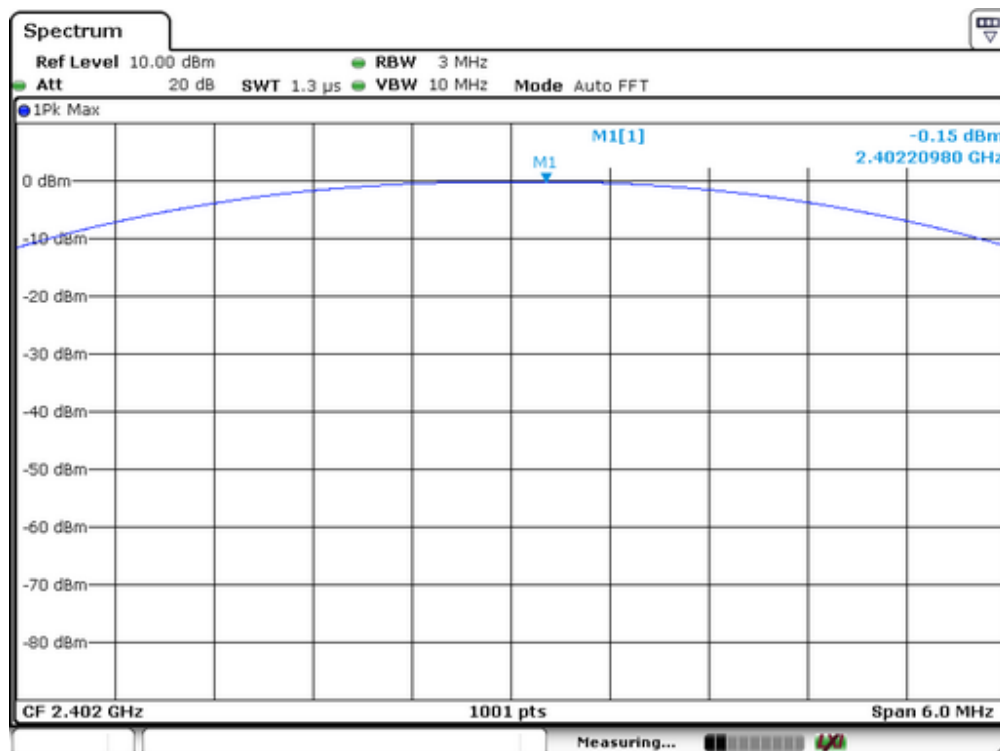
| EQUIPMENT TYPE                                                                                                                                                               | MFR             | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------|---------------|------------|------------|
| Spectrum Analyzer                                                                                                                                                            | Rohde & Schwarz | FSV30        | 1321.3008K    | 05/16/2015 | 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 |
| Note: 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. |                 |              |               |            |            |

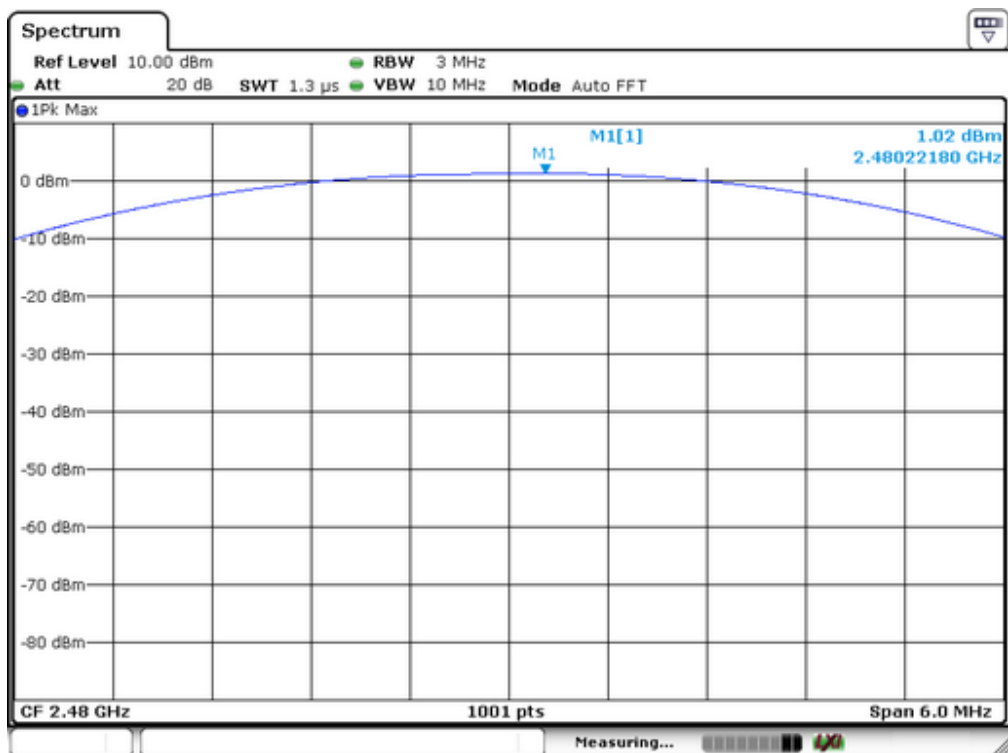
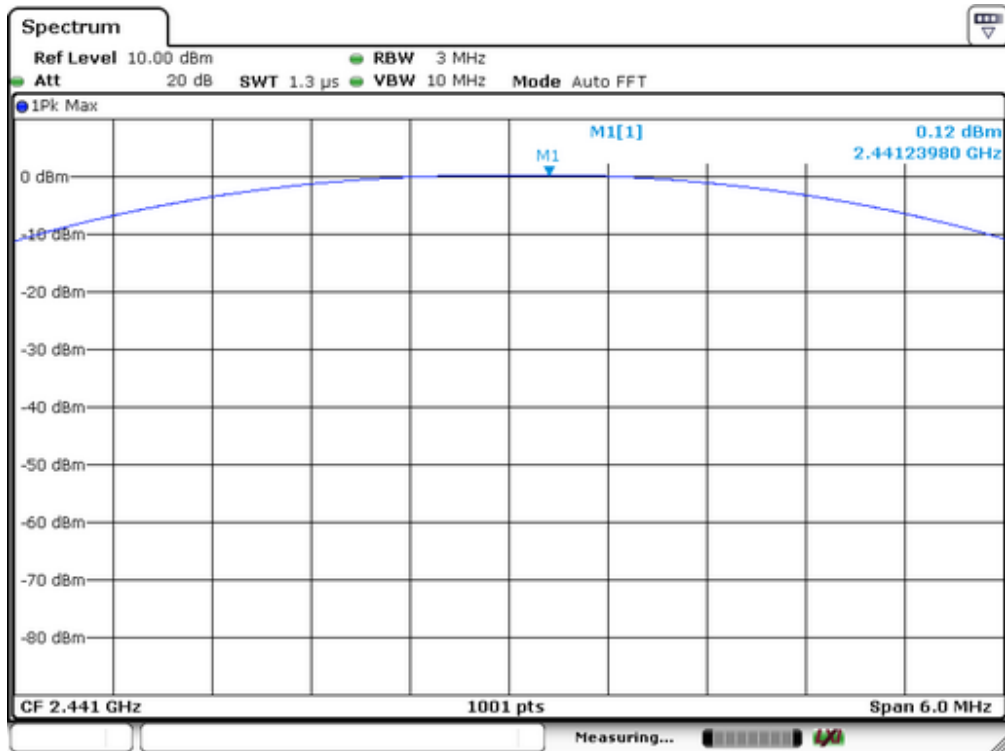
#### 10.4 Measurement Results:

Refer to attached data chart.

|                    |      |               |                  |
|--------------------|------|---------------|------------------|
| Spectrum Detector: | PK   | Test Date :   | October 13, 2015 |
| Test By:           | Andy | Temperature : | 25 °C            |
| Test Result:       | PASS | Humidity :    | 50 %             |
| Modulation:        | GFSK |               |                  |

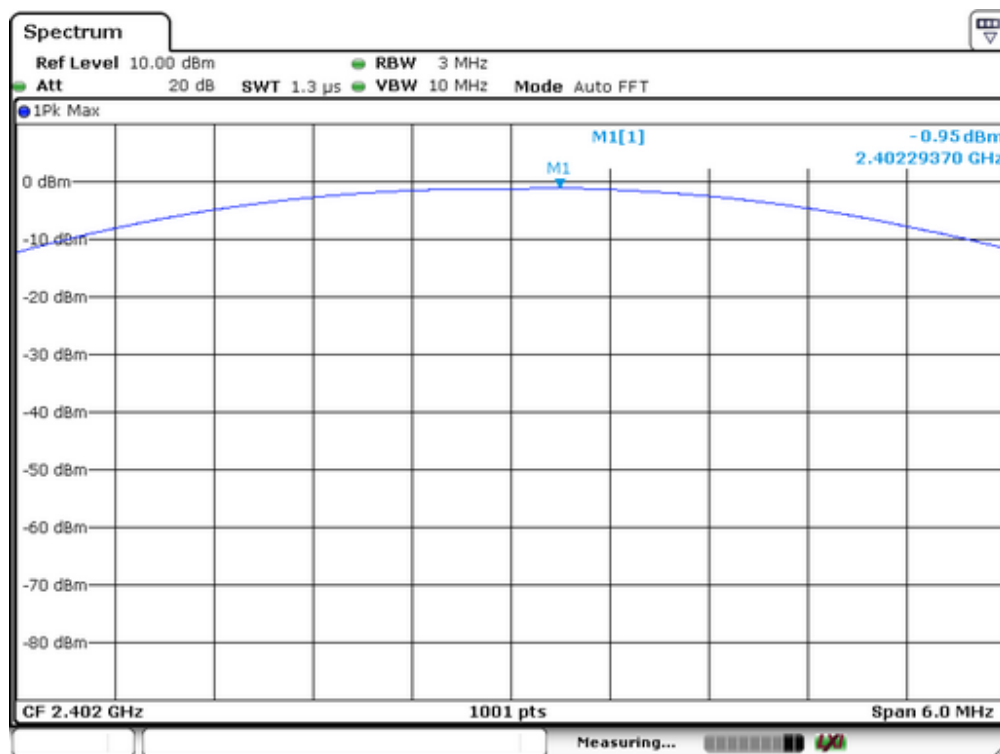
| Channel number | Channel Frequency (MHz) | Peak Power output(dBm) | Peak Power output(mW) | Peak Power Limit(mW) | Pass/Fail |
|----------------|-------------------------|------------------------|-----------------------|----------------------|-----------|
| 01             | 2402                    | -0.15                  | 0.966                 | 1000                 | PASS      |
| 40             | 2441                    | 0.12                   | 1.028                 | 1000                 | PASS      |
| 79             | 2480                    | <b>1.02</b>            | <b>1.265</b>          | 1000                 | PASS      |

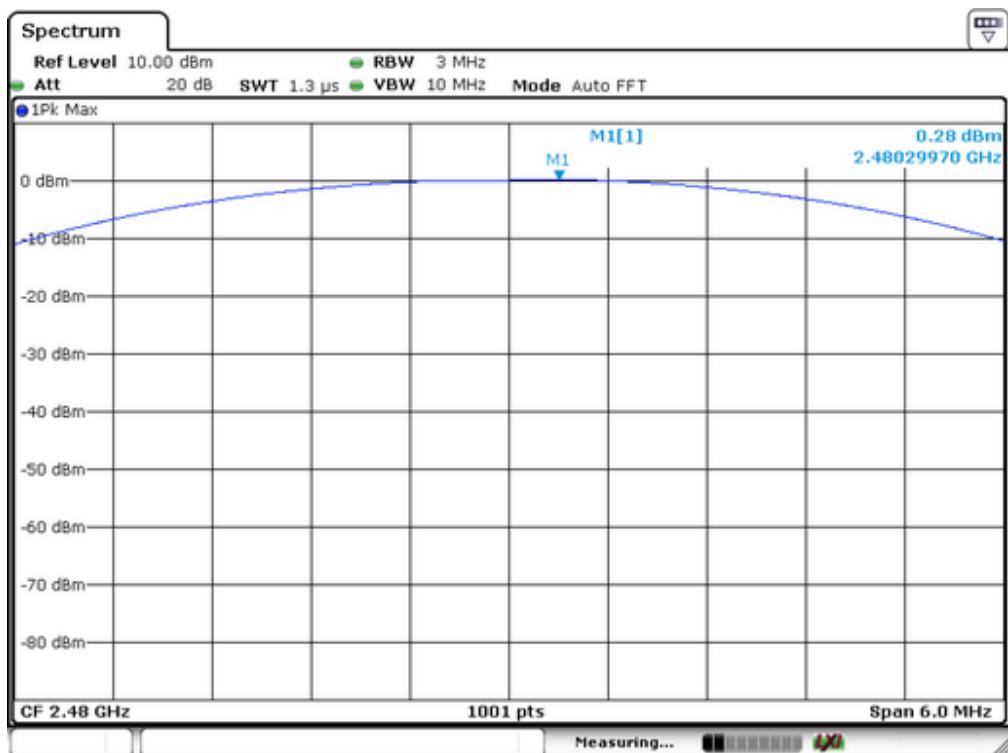
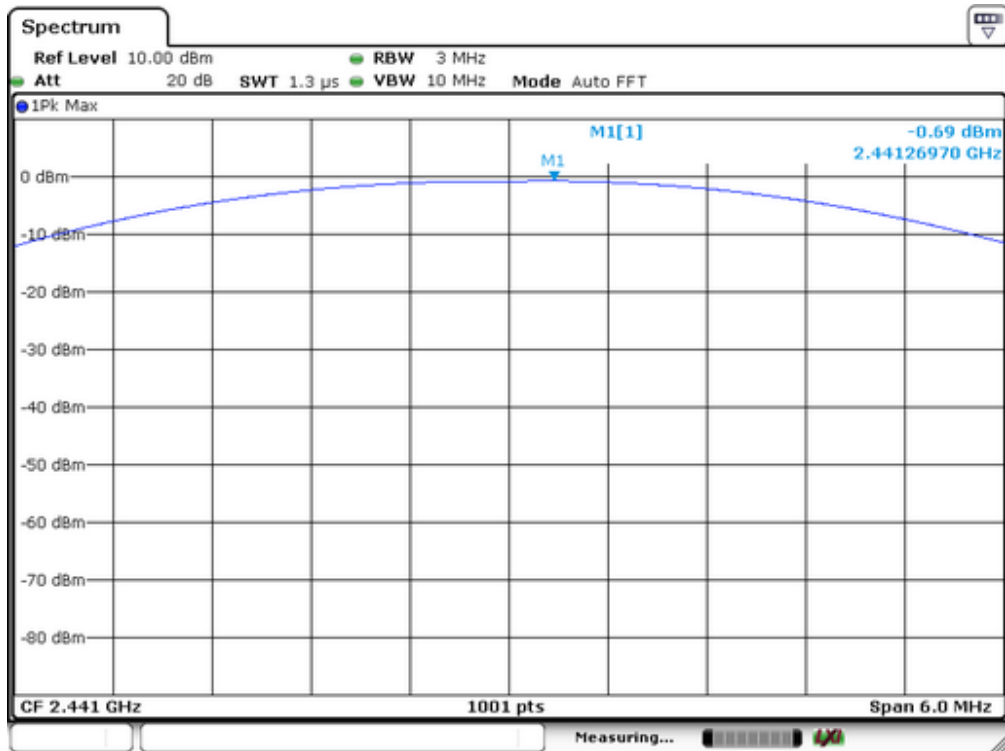




|                    |           |               |                  |
|--------------------|-----------|---------------|------------------|
| Spectrum Detector: | PK        | Test Date :   | October 13, 2015 |
| Test By:           | Andy      | Temperature : | 25 °C            |
| Test Result:      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

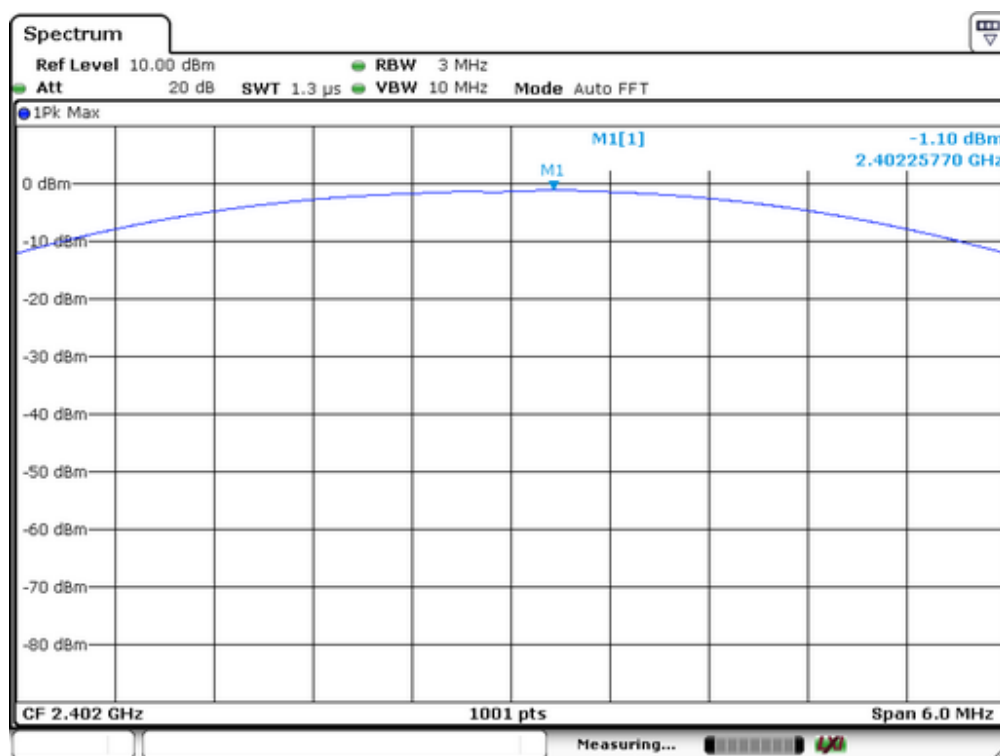
| Channel number | Channel Frequency (MHz) | Peak Power output(dBm) | Peak Power output(mW) | Peak Power Limit(mW) | Pass/Fail |
|----------------|-------------------------|------------------------|-----------------------|----------------------|-----------|
| 01             | 2402                    | -0.950                 | 0.804                 | 125                  | PASS      |
| 40             | 2441                    | -0.690                 | 0.853                 | 125                  | PASS      |
| 79             | 2480                    | 0.280                  | 1.067                 | 125                  | PASS      |

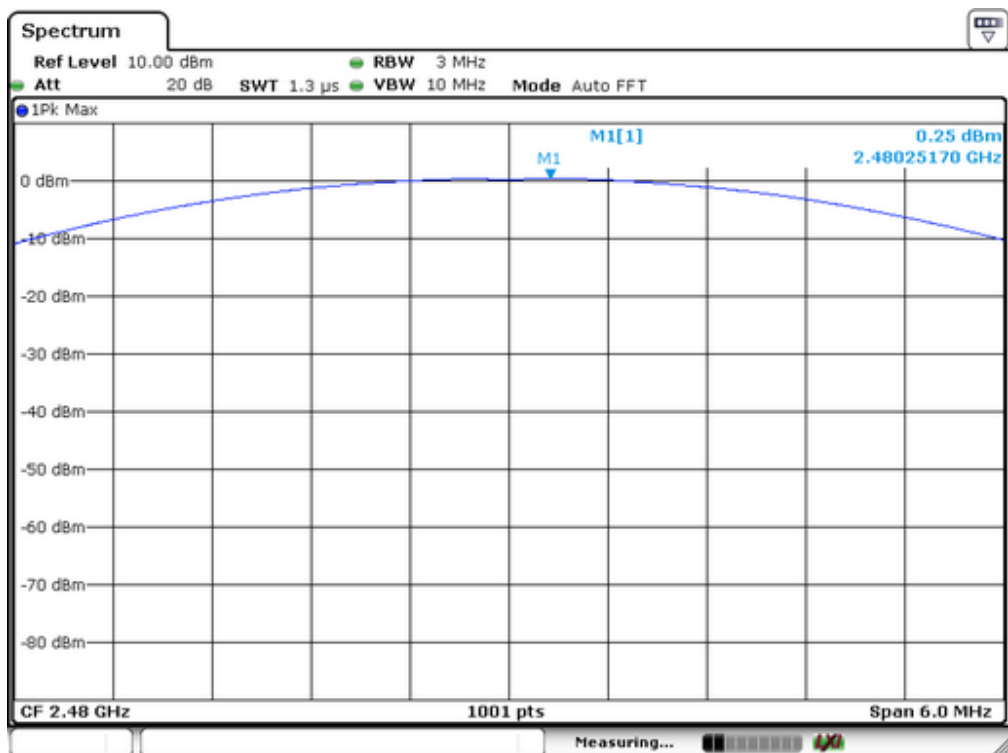
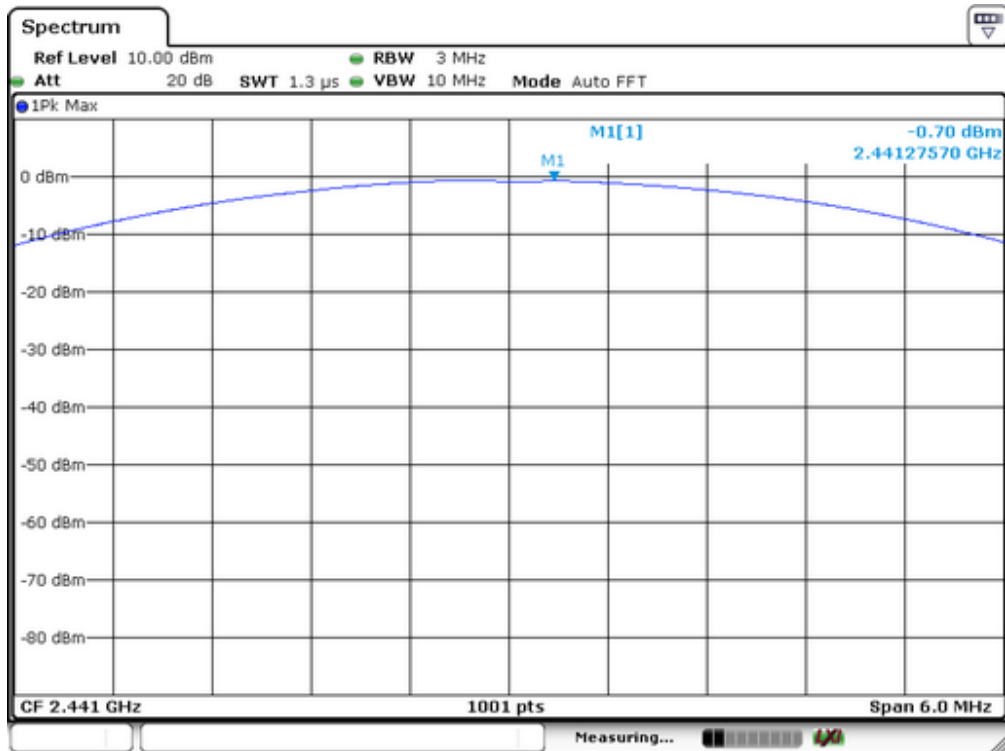




|                    |       |               |                  |
|--------------------|-------|---------------|------------------|
| Spectrum Detector: | PK    | Test Date :   | October 13, 2015 |
| Test By:           | Andy  | Temperature : | 25 °C            |
| Test Result:       | PASS  | Humidity :    | 50 %             |
| Modulation:        | 8DPSK |               |                  |

| Channel number | Channel Frequency (MHz) | Peak Power output(dBm) | Peak Power output(mW) | Peak Power Limit(mW) | Pass/Fail |
|----------------|-------------------------|------------------------|-----------------------|----------------------|-----------|
| 01             | 2402                    | -1.100                 | 0.776                 | 125                  | PASS      |
| 40             | 2441                    | -0.700                 | 0.851                 | 125                  | PASS      |
| 79             | 2480                    | 0.250                  | 1.059                 | 125                  | PASS      |





## 11. Band EDGE test

### 11.1 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 band edges was simplified by performing the measurement in just one plot. Both, the in-band-emission and the unwanted emission were encompassed by the span. After trace stabilization, the maximum peak was 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 |

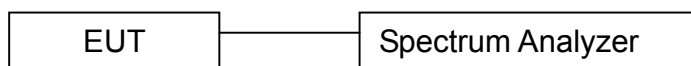
For Non-Restricted Band, When spectrum scanned above 1GHz setting resolution bandwidth 100KHz, video bandwidth 300KHz:

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

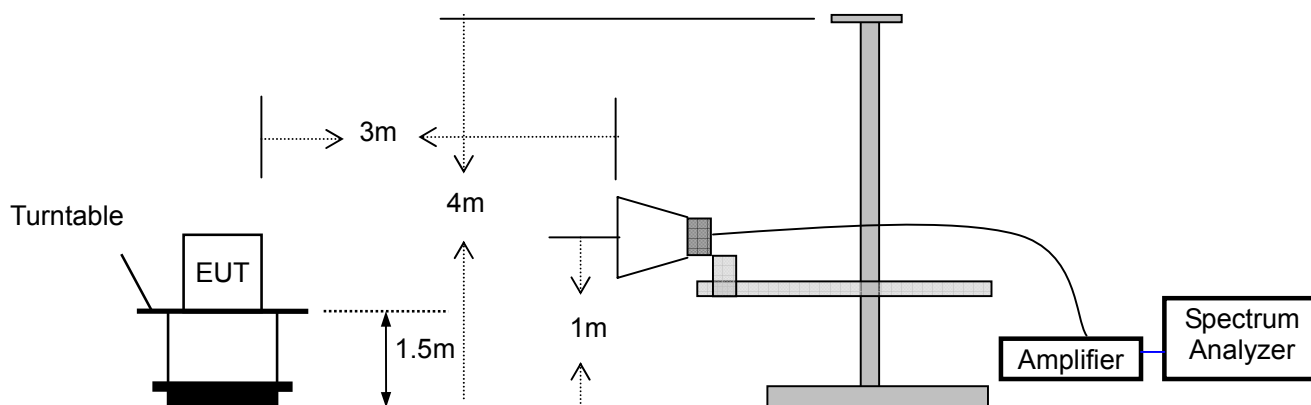


## 11.2 Test SET-UP (Block Diagram of Configuration)

For Conducted Test



For Radiated emission Test



## 11.3 Measurement Equipment Used:

For Conducted Test

| EQUIPMENT TYPE                                                                                                                                                              | MFR             | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------|---------------|------------|------------|
| Spectrum Analyzer                                                                                                                                                           | Rohde & Schwarz | FSV30        | 1321.3008K    | 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 |
| Note: 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 |                 |              |               |            |            |

### For Radiated emission Test

| Item | Equipment       | Manufacturer    | Model No.  | Serial No.   | Last Cal.  | Cal. Interval |
|------|-----------------|-----------------|------------|--------------|------------|---------------|
| 1    | Signal Analyzer | Rohde & Schwarz | FSV30      | 103040       | 05/16/2015 | 1 Year        |
| 2    | Horn Antenna    | Schwarzbeck     | BBHA9120D  | 9120D-1272   | 05/16/2015 | 1 Year        |
| 3    | Power Amplifier | LUNAR EM        | LNA1G18-40 | J10100000081 | 05/16/2015 | 1 Year        |
| 4    | Cable           | H+S             | CBL-26     | N/A          | 05/16/2015 | 1 Year        |
| 5    | Cable           | H+S             | CBL-26     | N/A          | 05/16/2015 | 1 Year        |
| 6    | Cable           | H+S             | CBL-26     | N/A          | 05/16/2015 | 1 Year        |

#### 11.4 Measurement Results:

Refer to attached data chart.

|                    |      |               |                  |
|--------------------|------|---------------|------------------|
| Spectrum Detector: | PK   | Test Date :   | October 13, 2015 |
| Test By:           | Andy | Temperature : | 25 °C            |
| Test Result:       | PASS | Humidity :    | 50 %             |

##### 1. Conducted Test

For Non-Hopping Mode:

| Frequency (MHz) | Modulation | Peak Power Output(dBm) | Emission read Value(dBm) | Result of Band edge(dBc) | Band edge Limit(dBc) |
|-----------------|------------|------------------------|--------------------------|--------------------------|----------------------|
| 2399.99         | GFSK       | -0.2                   | -43.35                   | 43.15                    | >20dBc               |
| 2398.65         | pi/4-DQPSK | -1.87                  | -46.28                   | 44.41                    | >20dBc               |
| 2400            | 8DPSK      | -1.82                  | -46.3                    | 44.48                    | >20dBc               |
| 2483.51         | GFSK       | 1.27                   | -51.04                   | 52.31                    | >20dBc               |
| 2483.52         | pi/4-DQPSK | -0.29                  | -44.86                   | 44.57                    | >20dBc               |
| 2483.51         | 8DPSK      | -0.24                  | -45.69                   | 45.45                    | >20dBc               |

For Hopping Mode:

| Frequency (MHz) | Modulation | Peak Power Output(dBm) | Emission read Value(dBm) | Result of Band edge(dBc) | Band edge Limit(dBc) |
|-----------------|------------|------------------------|--------------------------|--------------------------|----------------------|
| 2399.98         | GFSK       | -0.24                  | -43.98                   | 43.74                    | >20dBc               |
| 2399.66         | pi/4-DQPSK | -1.9                   | -48.17                   | 46.27                    | >20dBc               |
| 2399.69         | 8DPSK      | -1.86                  | -47.29                   | 45.43                    | >20dBc               |
| 2483.51         | GFSK       | 1.27                   | -52.38                   | 53.65                    | >20dBc               |
| 2483.54         | pi/4-DQPSK | -0.33                  | -46.78                   | 46.45                    | >20dBc               |
| 2483.51         | 8DPSK      | -0.28                  | -46.03                   | 45.75                    | >20dBc               |

## 2. Radiated emission Test

### Worst test modulation GFSK

For Non-Hopping Mode:

| Frequency<br>(MHz) | Antenna<br>polarization<br>(H/V) | Emission<br>(dBuV/m) |       | Band edge Limit<br>(dBuV/m) |    | Margin<br>(dB) |        |
|--------------------|----------------------------------|----------------------|-------|-----------------------------|----|----------------|--------|
|                    |                                  | PK                   | AV    | PK                          | AV | PK             | AV     |
| 2398.456           | H                                | 64.52                | 46.52 | 74                          | 54 | -9.48          | -7.48  |
| 2399.157           | V                                | 58.62                | 44.51 | 74                          | 54 | -15.38         | -9.49  |
| 2484.013           | H                                | 62.51                | 45.51 | 74                          | 54 | -11.49         | -8.49  |
| 2483.895           | V                                | 56.26                | 39.62 | 74                          | 54 | -17.74         | -14.38 |

### Worst test modulation GFSK

For Hopping Mode:

| Frequency<br>(MHz) | Antenna<br>polarization<br>(H/V) | Emission<br>(dBuV/m) |       | Band edge Limit<br>(dBuV/m) |    | Margin<br>(dB) |        |
|--------------------|----------------------------------|----------------------|-------|-----------------------------|----|----------------|--------|
|                    |                                  | PK                   | AV    | PK                          | AV | PK             | AV     |
| 2399.369           | H                                | 66.26                | 45.61 | 74                          | 54 | -7.74          | -8.39  |
| 2398.954           | V                                | 64.51                | 38.69 | 74                          | 54 | -9.49          | -15.31 |
| 2484.123           | H                                | 65.52                | 44.62 | 74                          | 54 | -8.48          | -9.38  |
| 2484.015           | V                                | 60.21                | 37.65 | 74                          | 54 | -13.79         | -16.35 |

## **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 PCB Antenna. The antenna's gain is 4dBi and meets the requirement.

## General Appearance of the EUT

