

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

*OF*

**EXO-200**

**Model No.: EXO200**

Trademark: 

**FCC ID: PXX-EXO200**

**Report No.: KAD150325107E**

**Issue Date: June 24, 2015**

*Prepared for*

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DONGGUAN EMTEK CO., LTD.**

## VERIFICATION OF COMPLIANCE

|                      |                                                                                                                              |
|----------------------|------------------------------------------------------------------------------------------------------------------------------|
| Applicant:           | ECORE TECHNOLOGY COMPANY LIMITED<br>North of Bingang East Road, Huahu Development Zone, Ezhou city,<br>Hubei Province, China |
| Manufacturer:        | ECORE TECHNOLOGY COMPANY LIMITED<br>North of Bingang East Road, Huahu Development Zone, Ezhou city,<br>Hubei Province, China |
| Product Description: | EXO-200                                                                                                                      |
| Trade Mark:          |                                             |
| Model Number:        | EXO200                                                                                                                       |

### We hereby certify that:

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

Date of Test : March 25, 2015 to June 16, 2015

Prepared by :   
Ivy Huang/Editor

Reviewer :   
Hong Yang/Supervisor

Approved & Authorized  
Signer :   
Sam Lv/Manager

## Modified Information

| Version | Summary         | Revision Date | Report No.    |
|---------|-----------------|---------------|---------------|
| Ver.1.0 | Original Report | /             | KAD150325107E |
|         |                 |               |               |
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Appendix I (Photos of EUT) (3 pages)

## 1. GENERAL INFORMATION

### 1.1 Product Description

| Characteristics           | Description                 |
|---------------------------|-----------------------------|
| Product Name              | EXO-200                     |
| Model number              | EXO200                      |
| Power Supply              | DC 5V, 1A                   |
| Modulation                | GFSK, $\pi/4$ -DQPSK, 8DPSK |
| Operating Frequency Range | 2402-2480MHz                |
| Number of Channels        | 79                          |
| Transmit Power Max        | 1.21dBm(0.001321W)          |
| Antenna Type              | Internal PCB antenna        |
| Antenna Gain              | 0 dBi                       |

## 1.2 Test Facility

### Site Description

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

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

Name of Firm : DONGGUAN EMTEK CO., LTD.

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

## **2. System Test Configuration**

### **2.1 EUT Configuration**

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

### **2.2 EUT Exercise**

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

### **2.3 Test Procedure**

#### **2.3.1 Conducted Emissions**

The EUT is placed on a 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**

The EUT is placed on a 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 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 >1 MHz |
| 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) | LIMIT(rms)                        |                                   |                                 |
|-----------------------|-----------------------------------|-----------------------------------|---------------------------------|
|                       | 20dB bandwidth <250kHz(50Channel) | 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 1000MHz. 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 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 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.   | EXO-200   |  | EXO200      | PXK-EXO200 | <i><b>EUT</b></i>               |
| 2    | Adapter   | N/A                                                                               | TX050100-US | N/A        | <i><b>Support Equipment</b></i> |

**Note:**

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

### 3. Summary of Test Results

| FCC Rules           | Description Of Test           | Result    |
|---------------------|-------------------------------|-----------|
| §15.207             | AC Power Conducted Emission   | Compliant |
| §15.247(d), §15.209 | Radiated Emission             | Compliant |
| §15.247(a)(1)       | Channel Separation test       | Compliant |
| §15.247(a)(1)       | 20dB Bandwidth                | Compliant |
| §15.247(a)(1)(iii)  | Quantity of Hopping Channel   | Compliant |
| §15.247(a)(1)(iii)  | Time of Occupancy(Dwell Time) | Compliant |
| §15.247(b)          | Max Peak output Power test    | Compliant |
| §15.247(d)          | Band edge test                | Compliant |
| §15.203             | Antenna Requirement           | Compliant |

#### 4. Description of test modes

The EUT has been tested under its typical operating condition. Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting. Only the worst case data were reported.

The EUT has been associated with peripherals pursuant to ANSI C63.10-2013 and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation (9 KHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).

For Radiated: The EUT's antenna was pre-tested under the following modes:

| Test Mode     | Description     |
|---------------|-----------------|
| <b>Mode A</b> | <b>X-Y axis</b> |
| Mode B        | Y-Z axis        |
| Mode C        | X-Z axis        |

From the above modes, the worst case was found in Mode A. Therefore only the test data of the mode was recorded in this report.

The 3 channels of lower, medium and higher were chosen for test.

| Channel | Frequency(MHz) |
|---------|----------------|
| 1       | 2402           |
| 40      | 2441           |
| 79      | 2480           |

## 5. TEST SYSTEM UNCERTAINTY

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

| Parameter                      | Uncertainty               |
|--------------------------------|---------------------------|
| Radio Frequency                | $\pm 1 \times 10^{-5}$    |
| Maximum Peak Output Power Test | $\pm 1.0\text{dB}$        |
| Conducted Emissions Test       | $\pm 2.0\text{dB}$        |
| Radiated Emission Test         | $\pm 2.0\text{dB}$        |
| Power Density                  | $\pm 2.0\text{dB}$        |
| Occupied Bandwidth Test        | $\pm 1.0\text{dB}$        |
| Band Edge Test                 | $\pm 3\text{dB}$          |
| All emission, radiated         | $\pm 3\text{dB}$          |
| Antenna Port Emission          | $\pm 3\text{dB}$          |
| Temperature                    | $\pm 0.5^{\circ}\text{C}$ |
| Humidity                       | $\pm 3\%$                 |

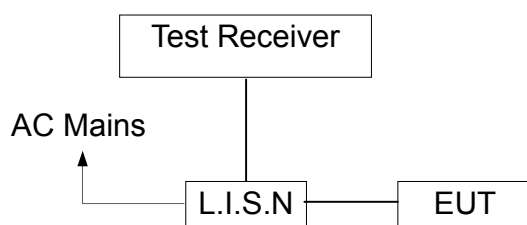
Measurement Uncertainty for a level of Confidence of 95%

## 6. Conducted Emissions Test

### 6.1 Measurement Procedure:

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured was complete.

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



### 6.3 Measurement Equipment Used:

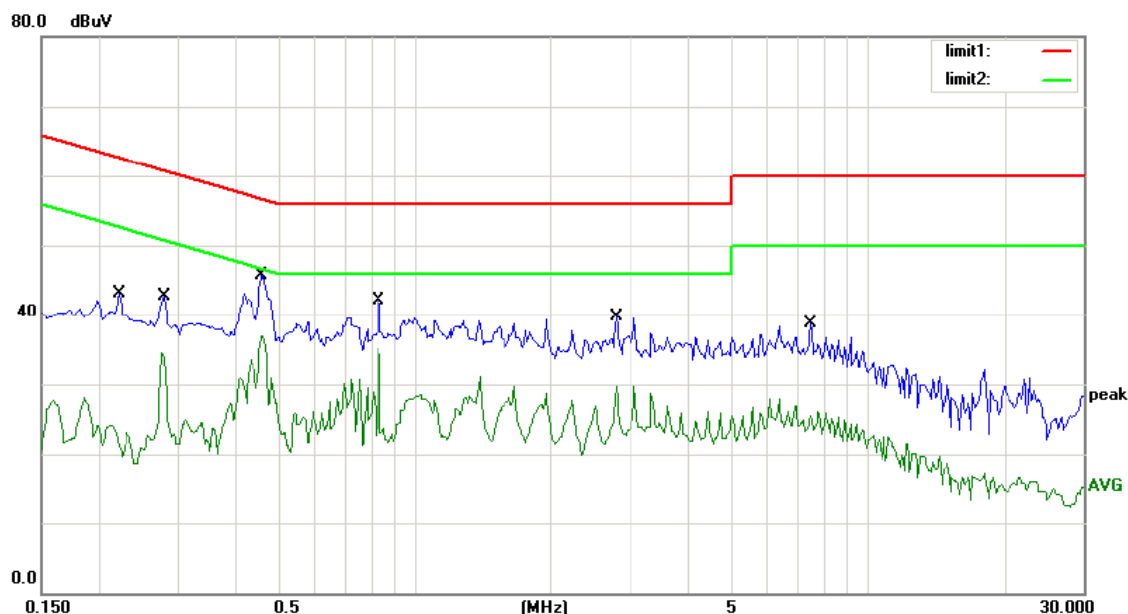
| Conducted Emission Test Site |                 |              |               |            |            |
|------------------------------|-----------------|--------------|---------------|------------|------------|
| EQUIPMENT TYPE               | MFR             | MODEL NUMBER | SERIAL NUMBER | Last Cal.  | Due date   |
| Test Receiver                | Rohde & Schwarz | ESCS30       | 100018        | 03/16/2015 | 03/15/2016 |
| L.I.S.N                      | Rohde & Schwarz | ENV216       | 100017        | 03/16/2015 | 03/15/2016 |
| RF Switching Unit            | CDS             | RSU-M2       | 38401         | 03/16/2015 | 03/15/2016 |
| Coaxial Cable                | CDS             | 79254        | 46107086      | 03/16/2015 | 03/15/2016 |

### 6.4 Measurement Result:

Pass.

All the modulation modes were tested the data of the worst mode (GFSK TX 2441MHz) are recorded in the following pages and the others modulation methods do not exceed the limits.

Please refer to the following data.



Site site #1

Limit: (CE)FCC PART 15 class B\_QP

Mode: TX

Note:

Phase: **L1**

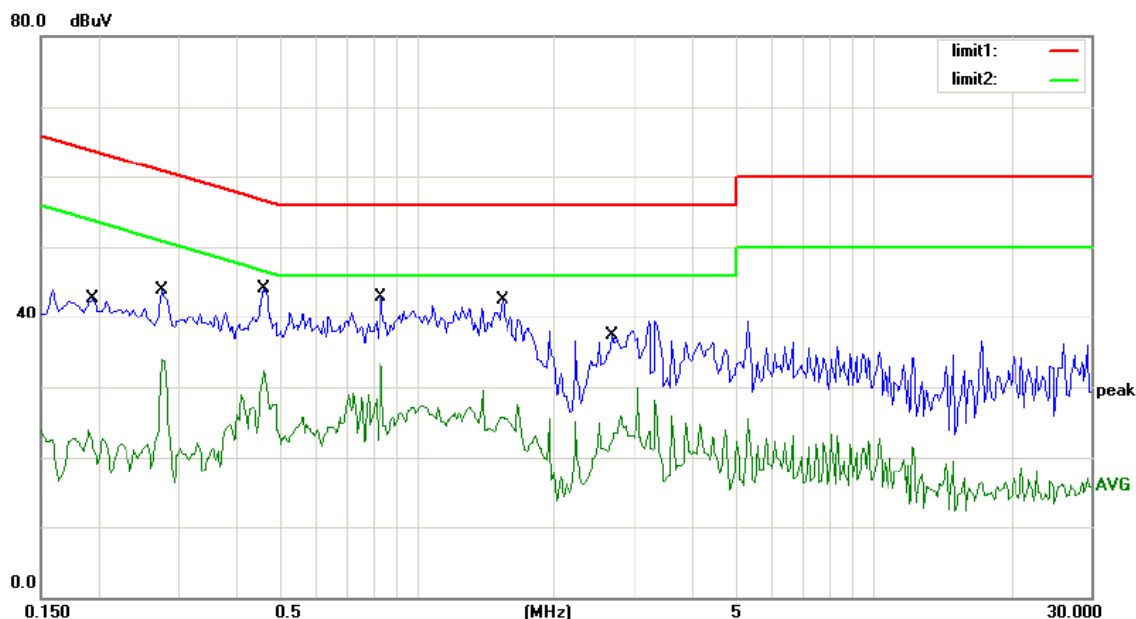
Power: AC 120V/60Hz

Temperature: 24

Humidity: 55 %

| No. | Mk. | Freq.  | Reading Level | Correct Factor | Measurement | Limit | Over   | Detector | Comment |
|-----|-----|--------|---------------|----------------|-------------|-------|--------|----------|---------|
|     |     | MHz    | dBuV          | dB             | dBuV        | dBuV  | dB     |          |         |
| 1   |     | 0.2220 | 41.35         | 0.00           | 41.35       | 62.74 | -21.39 | QP       |         |
| 2   |     | 0.2220 | 25.92         | 0.00           | 25.92       | 52.74 | -26.82 | AVG      |         |
| 3   |     | 0.2805 | 39.56         | 0.00           | 39.56       | 60.80 | -21.24 | QP       |         |
| 4   |     | 0.2805 | 34.55         | 0.00           | 34.55       | 50.80 | -16.25 | AVG      |         |
| 5   |     | 0.4605 | 42.89         | 0.00           | 42.89       | 56.68 | -13.79 | QP       |         |
| 6   | *   | 0.4605 | 36.99         | 0.00           | 36.99       | 46.68 | -9.69  | AVG      |         |
| 7   |     | 0.8340 | 39.78         | 0.00           | 39.78       | 56.00 | -16.22 | QP       |         |
| 8   |     | 0.8340 | 35.19         | 0.00           | 35.19       | 46.00 | -10.81 | AVG      |         |
| 9   |     | 2.7800 | 36.89         | 0.00           | 36.89       | 56.00 | -19.11 | QP       |         |
| 10  |     | 2.7800 | 29.66         | 0.00           | 29.66       | 46.00 | -16.34 | AVG      |         |
| 11  |     | 7.5100 | 35.78         | 0.00           | 35.78       | 60.00 | -24.22 | QP       |         |
| 12  |     | 7.5100 | 26.08         | 0.00           | 26.08       | 50.00 | -23.92 | AVG      |         |

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



Site site #1 Phase: **N** Temperature: 24  
 Limit: (CE)FCC PART 15 class B\_QP Power: AC 120V/60Hz Humidity: 55 %  
 Mode: TX  
 Note:

| No. Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV | Limit<br>dBuV | Over<br>dB | Detector | Comment |
|---------|--------------|--------------------------|-------------------------|--------------------------|---------------|------------|----------|---------|
| 1       | 0.1950       | 39.56                    | 0.00                    | 39.56                    | 63.82         | -24.26     | QP       |         |
| 2       | 0.1950       | 23.83                    | 0.00                    | 23.83                    | 53.82         | -29.99     | AVG      |         |
| 3       | 0.2760       | 41.23                    | 0.00                    | 41.23                    | 60.94         | -19.71     | QP       |         |
| 4       | 0.2760       | 33.84                    | 0.00                    | 33.84                    | 50.94         | -17.10     | AVG      |         |
| 5       | 0.4650       | 42.23                    | 0.00                    | 42.23                    | 56.60         | -14.37     | QP       |         |
| 6       | 0.4650       | 32.22                    | 0.00                    | 32.22                    | 46.60         | -14.38     | AVG      |         |
| 7       | 0.8340       | 39.45                    | 0.00                    | 39.45                    | 56.00         | -16.55     | QP       |         |
| 8 *     | 0.8340       | 33.40                    | 0.00                    | 33.40                    | 46.00         | -12.60     | AVG      |         |
| 9       | 1.5360       | 38.89                    | 0.00                    | 38.89                    | 56.00         | -17.11     | QP       |         |
| 10      | 1.5360       | 27.49                    | 0.00                    | 27.49                    | 46.00         | -18.51     | AVG      |         |
| 11      | 2.6700       | 35.48                    | 0.00                    | 35.48                    | 56.00         | -20.52     | QP       |         |
| 12      | 2.6700       | 29.82                    | 0.00                    | 29.82                    | 46.00         | -16.18     | AVG      |         |

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

**6.5 Conducted Measurement Photos:**



## 7. Radiated Emission Test

### 7.1 Measurement Procedure

1. Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measured were complete.
5. The following table is the setting of spectrum analyzer:

When spectrum scanned from 30MHz to 1GHz setting resolution bandwidth 120KHz and video bandwidth 300KHz:

| EMI Test Receiver | Setting  |
|-------------------|----------|
| Attenuation       | Auto     |
| RBW               | 120KHz   |
| VBW               | 300KHz   |
| Detector          | QP       |
| Trace             | Max hold |

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 3MHz:

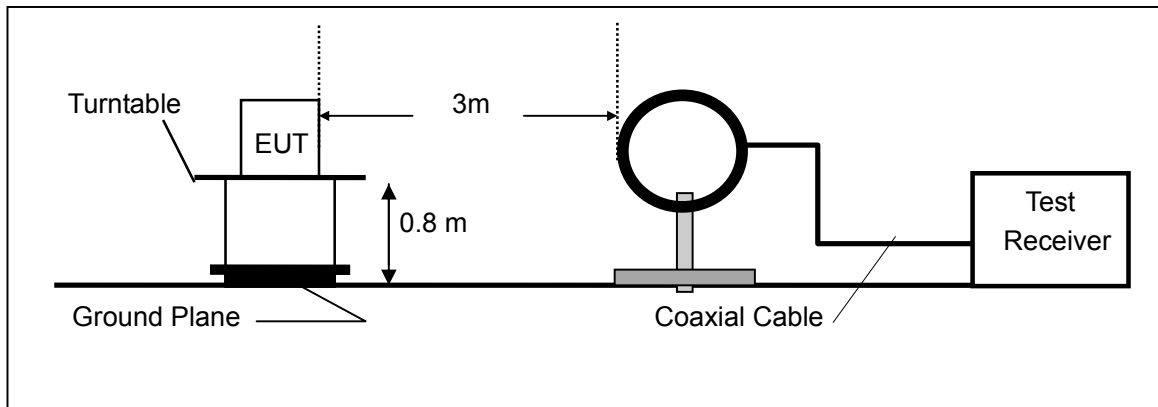
| EMI Test Receiver | Setting  |
|-------------------|----------|
| Attenuation       | Auto     |
| RBW               | 1MHz     |
| VBW               | 3MHz     |
| Detector          | Peak     |
| Trace             | Max hold |

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

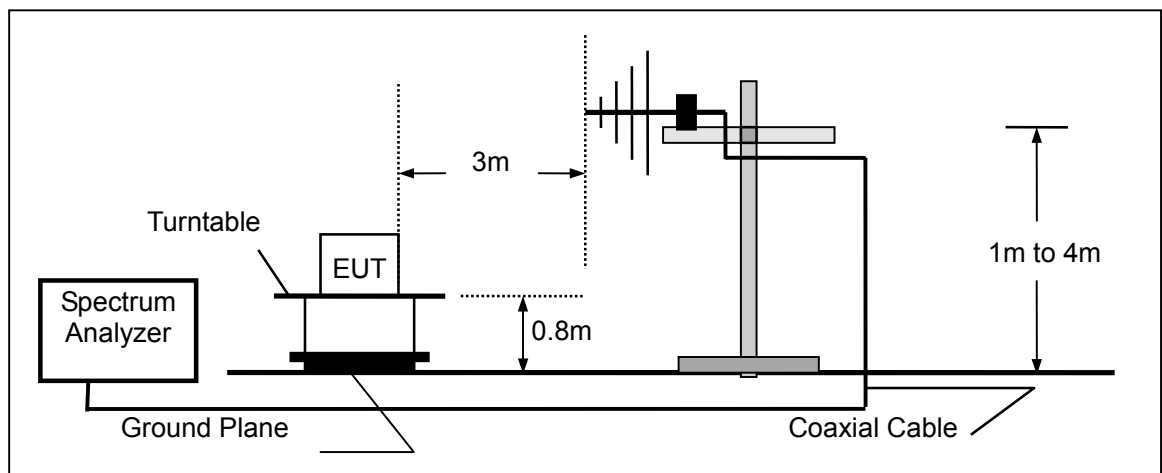
| EMI Test Receiver | Setting  |
|-------------------|----------|
| Attenuation       | Auto     |
| RBW               | 1MHz     |
| VBW               | 10Hz     |
| Detector          | Peak     |
| Trace             | Max hold |

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

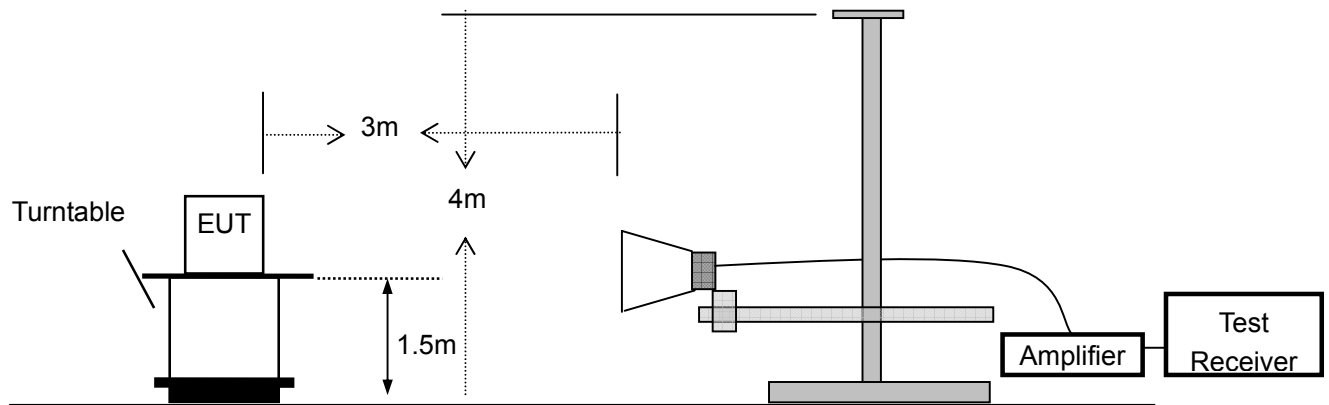
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



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



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



### 7.3 Measurement Equipment Used:

| Item | Equipment                      | Manufacturer    | Model No.  | Serial No.   | Last Cal.  | Cal. Interval |
|------|--------------------------------|-----------------|------------|--------------|------------|---------------|
| 1.   | Test Receiver                  | Rohde & Schwarz | ESCI       | 1166.5950.03 | 03/16/2015 | 1 Year        |
| 2.   | Bilog Antenna                  | Schwarzbeck     | VULB9163   | 000141       | 03/16/2015 | 1 Year        |
| 3.   | Power Amplifier                | CDS             | RSU-M352   | 818          | 03/16/2015 | 1 Year        |
| 4.   | Power Amplifier                | HP              | 8447F      | OPT H64      | 03/16/2015 | 1 Year        |
| 5.   | Color Monitor                  | SUNSP0          | SP-140A    | N/A          | 03/16/2015 | 1 Year        |
| 6.   | Single Line Filter             | JIANLI          | XL-3       | N/A          | 03/16/2015 | 1 Year        |
| 7.   | Single Phase Power Line Filter | JIANLI          | DL-2X100B  | N/A          | 03/16/2015 | 1 Year        |
| 8.   | 3 Phase Power Line Filter      | JIANLI          | DL-4X100B  | N/A          | 03/16/2015 | 1 Year        |
| 9.   | DC Power Filter                | JIANLI          | DL-2X50B   | N/A          | 03/16/2015 | 1 Year        |
| 10.  | Cable                          | Schwarzbeck     | PLF-100    | 549489       | 03/16/2015 | 1 Year        |
| 11.  | Cable                          | Rosenberger     | CIL02      | A0783566     | 03/16/2015 | 1 Year        |
| 12.  | Cable                          | Rosenberger     | RG 233/U   | 525178       | 03/16/2015 | 1 Year        |
| 13.  | Signal Analyzer                | Rohde & Schwarz | FSV30      | 103040       | 12/29/2014 | 1 Year        |
| 14.  | Horn Antenna                   | Schwarzbeck     | BBHA9120D  | 9120D-1272   | 12/29/2014 | 1 Year        |
| 15.  | Power Amplifier                | LUNAR EM        | LNA1G18-40 | J10100000081 | 12/29/2014 | 1 Year        |
| 16.  | Cable                          | H+S             | CBL-26     | N/A          | 12/29/2014 | 1 Year        |
| 17.  | Cable                          | H+S             | CBL-26     | N/A          | 12/29/2014 | 1 Year        |
| 18.  | Cable                          | H+S             | CBL-26     | N/A          | 12/29/2014 | 1 Year        |

## 7.4 Radiated Emission Limit

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table 15.209(a):

| Frequencies<br>(MHz) | Field Strength<br>(micorvolts/meter) | Measurement Distance<br>(meters) |
|----------------------|--------------------------------------|----------------------------------|
| 0.009~0.490          | 2400/F(KHz)                          | 300                              |
| 0.490~1.705          | 24000/F(KHz)                         | 30                               |
| 1.705~30.0           | 30                                   | 30                               |
| 30~88                | 100                                  | 3                                |
| 88~216               | 150                                  | 3                                |
| 216~960              | 200                                  | 3                                |
| Above 960            | 500                                  | 3                                |

### 15.205 Restricted bands of operation

| MHz                        | MHz                   | MHz             | GHz              |
|----------------------------|-----------------------|-----------------|------------------|
| 0.090 - 0.110              | 16.42 - 16.423        | 399.9 - 410     | 4.5 - 5.15       |
| <sup>1</sup> 0.495 - 0.505 | 16.69475 - 16.69525   | 608 - 614       | 5.35 - 5.46      |
| 2.1735 - 2.1905            | 16.80425 - 16.80475   | 960 - 1240      | 7.25 - 7.75      |
| 4.125 - 4.128              | 25.5 - 25.67          | 1300 - 1427     | 8.025 - 8.5      |
| 4.17725 - 4.17775          | 37.5 - 38.25          | 1435 - 1626.5   | 9.0 - 9.2        |
| 4.20725 - 4.20775          | 73 - 74.6             | 1645.5 - 1646.5 | 9.3 - 9.5        |
| 6.215 - 6.218              | 74.8 - 75.2           | 1660 - 1710     | 10.6 - 12.7      |
| 6.26775 - 6.26825          | 108 - 121.94          | 1718.8 - 1722.2 | 13.25 - 13.4     |
| 6.31175 - 6.31225          | 123 - 138             | 2200 - 2300     | 14.47 - 14.5     |
| 8.291 - 8.294              | 149.9 - 150.05        | 2310 - 2390     | 15.35 - 16.2     |
| 8.362 - 8.366              | 156.52475 - 156.52525 | 2483.5 - 2500   | 17.7 - 21.4      |
| 8.37625 - 8.38675          | 156.7 - 156.9         | 2690 - 2900     | 22.01 - 23.12    |
| 8.41425 - 8.41475          | 162.0125 - 167.17     | 3260 - 3267     | 23.6 - 24.0      |
| 12.29 - 12.293             | 167.72 - 173.2        | 3332 - 3339     | 31.2 - 31.8      |
| 12.51975 - 12.52025        | 240 - 285             | 3345.8 - 3358   | 36.43 - 36.5     |
| 12.57675 - 12.57725        | 322 - 335.4           | 3600 - 4400     | ( <sup>2</sup> ) |

Remark 1. Emission level in dBuV/m=20 log (uV/m)

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

3. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of § 15.205, and the emissions located in restricted bands also comply with 15.209 limit.

## 7.5 Measurement Result

### Below 30MHz:

|                    |            |               |                |
|--------------------|------------|---------------|----------------|
| Operation Mode:    | TX         | Test Date :   | March 30, 2015 |
| Frequency Range:   | 9KHz~30MHz | Temperature : | 28℃            |
| Test Result:       | PASS       | Humidity :    | 65 %           |
| Measured Distance: | 3m         | Test By:      | Andy           |

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

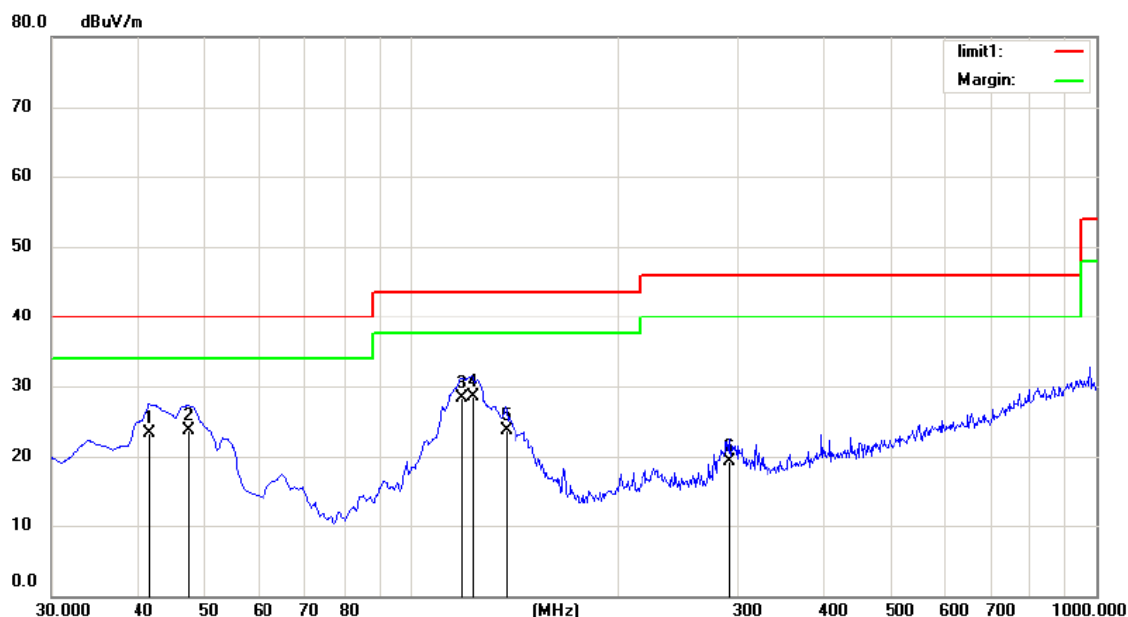
Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

### 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.

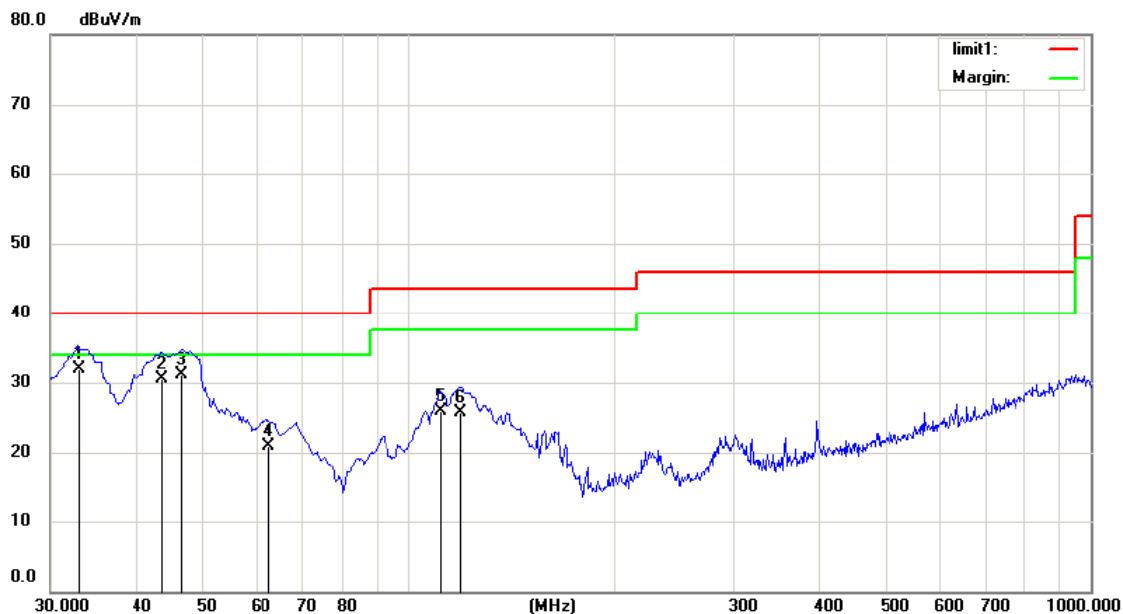


Site Chamber #1 Polarization: **Horizontal** Temperature: 24  
 Limit: (RE)FCC PART 15 class B 3m Power: AC 120V/60Hz Humidity: 55 %  
 Mode: TX2402  
 Note:

| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV/m | Limit<br>dBuV/m | Over<br>dB | Antenna<br>Height<br>cm | Table<br>Degree | Comment |
|-----|-----|--------------|--------------------------|-------------------------|----------------------------|-----------------|------------|-------------------------|-----------------|---------|
| 1   |     | 41.6400      | 36.80                    | -13.58                  | 23.22                      | 40.00           | -16.78     | QP                      |                 |         |
| 2   |     | 47.4600      | 38.10                    | -14.38                  | 23.72                      | 40.00           | -16.28     | QP                      |                 |         |
| 3   |     | 118.2700     | 45.30                    | -17.07                  | 28.23                      | 43.50           | -15.27     | QP                      |                 |         |
| 4   | *   | 123.1200     | 45.10                    | -16.61                  | 28.49                      | 43.50           | -15.01     | QP                      |                 |         |
| 5   |     | 137.6700     | 40.40                    | -16.79                  | 23.61                      | 43.50           | -19.89     | QP                      |                 |         |
| 6   |     | 291.9000     | 33.90                    | -14.69                  | 19.21                      | 46.00           | -26.79     | QP                      |                 |         |

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

Operator: Snake



Site Chamber #1

Polarization: **Vertical**

Temperature: 24

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

Power: AC 120V/60Hz

Humidity: 55 %

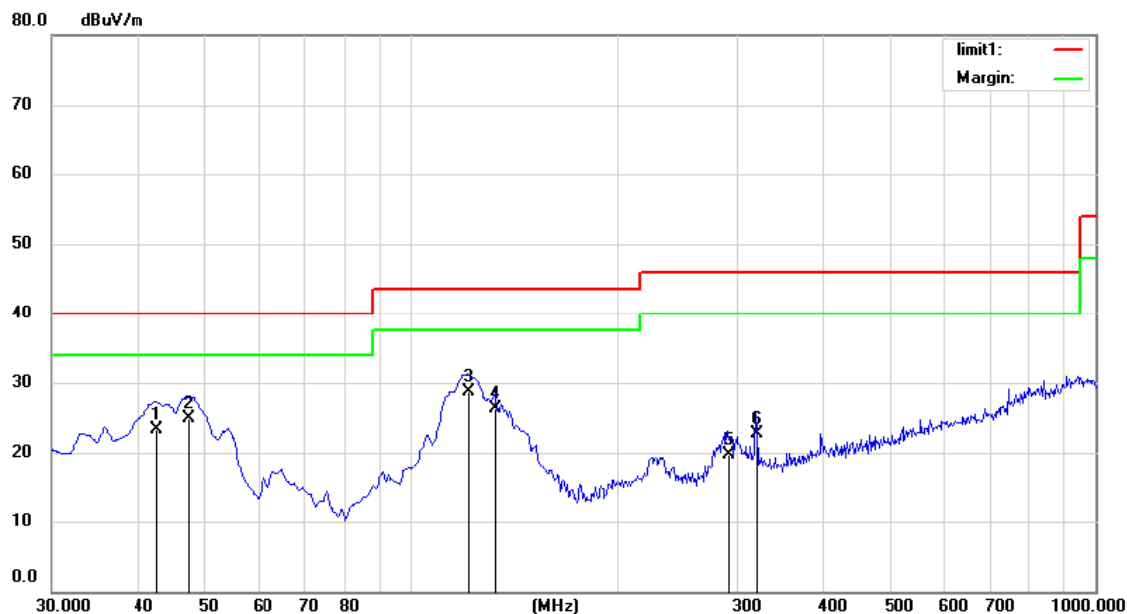
Mode: TX2402

Note:

| No. | Mk. | Freq.    | Reading | Correct | Measure- | Limit  | Over   | Antenna  | Table  |        |
|-----|-----|----------|---------|---------|----------|--------|--------|----------|--------|--------|
|     |     | MHz      | Level   | Factor  | ment     |        |        | Height   | Degree |        |
|     |     |          | dBuV    | dB      | dBuV/m   | dBuV/m | dB     | Detector | cm     | degree |
| 1   | *   | 32.9100  | 46.30   | -14.46  | 31.84    | 40.00  | -8.16  | QP       |        |        |
| 2   |     | 43.5800  | 43.90   | -13.37  | 30.53    | 40.00  | -9.47  | QP       |        |        |
| 3   |     | 46.6662  | 45.20   | -14.11  | 31.09    | 40.00  | -8.91  | QP       |        |        |
| 4   |     | 62.6505  | 41.10   | -20.18  | 20.92    | 40.00  | -19.08 | QP       |        |        |
| 5   |     | 111.4800 | 43.30   | -17.48  | 25.82    | 43.50  | -17.68 | QP       |        |        |
| 6   |     | 119.2400 | 42.80   | -17.01  | 25.79    | 43.50  | -17.71 | QP       |        |        |

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

Operator: Snake



Site: Chamber #1

Polarization: **Horizontal**

Temperature: 24

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

Power: AC 120V/60Hz

Humidity: 55 %

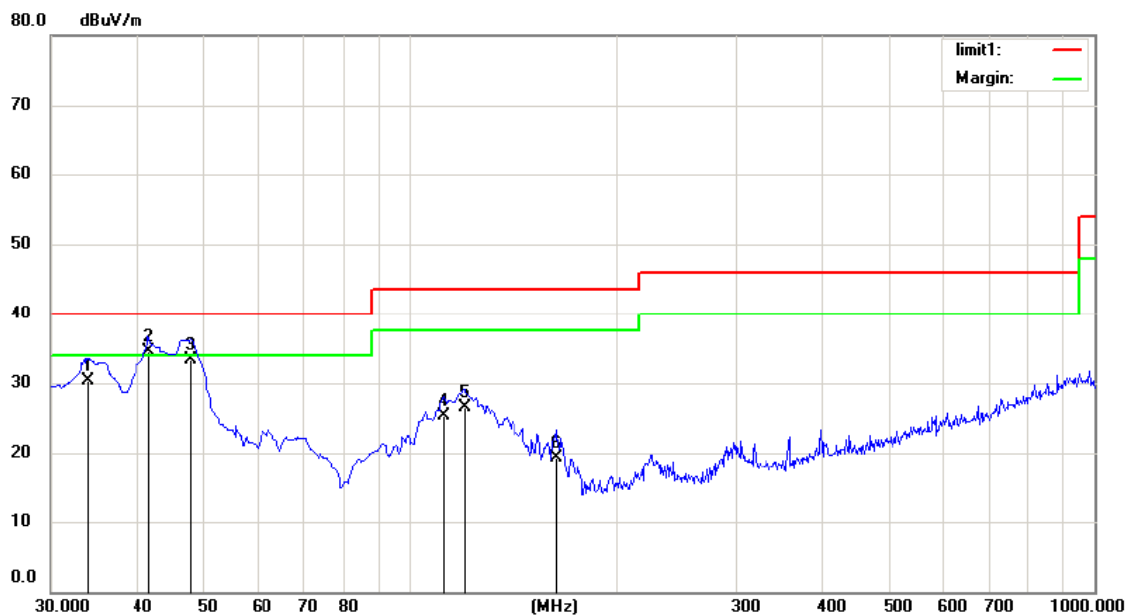
Mode: TX2441

Note:

| No. | Mk. | Freq.    | Reading | Correct | Measure- | Limit  | Over   | Antenna | Table  |         |
|-----|-----|----------|---------|---------|----------|--------|--------|---------|--------|---------|
|     |     | MHz      | Level   | Factor  | ment     |        |        | Height  | Degree |         |
|     |     |          | dBuV    | dB      | dBuV/m   | dBuV/m | dB     | cm      | degree | Comment |
| 1   |     | 42.6100  | 36.80   | -13.49  | 23.31    | 40.00  | -16.69 | QP      |        |         |
| 2   |     | 47.4600  | 39.20   | -14.38  | 24.82    | 40.00  | -15.18 | QP      |        |         |
| 3   | *   | 121.1800 | 45.60   | -16.82  | 28.78    | 43.50  | -14.72 | QP      |        |         |
| 4   |     | 132.8200 | 42.70   | -16.39  | 26.31    | 43.50  | -17.19 | QP      |        |         |
| 5   |     | 290.9300 | 34.50   | -14.71  | 19.79    | 46.00  | -26.21 | QP      |        |         |
| 6   |     | 319.0600 | 35.90   | -13.10  | 22.80    | 46.00  | -23.20 | QP      |        |         |

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

Operator: Snake



Site Chamber #1

Polarization: **Vertical**

Temperature: 24

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

Power: AC 120V/60Hz

Humidity: 55 %

Mode: TX2441

Note:

| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV/m | Limit<br>dBuV/m | Over<br>dB | Detector | Antenna<br>Height<br>cm | Table<br>Degree | Comment |
|-----|-----|--------------|--------------------------|-------------------------|----------------------------|-----------------|------------|----------|-------------------------|-----------------|---------|
| 1   |     | 33.8800      | 44.60                    | -14.31                  | 30.29                      | 40.00           | -9.71      | QP       |                         |                 |         |
| 2   | *   | 41.6400      | 48.10                    | -13.58                  | 34.52                      | 40.00           | -5.48      | QP       |                         |                 |         |
| 3   |     | 47.9940      | 47.90                    | -14.57                  | 33.33                      | 40.00           | -6.67      | QP       |                         |                 |         |
| 4   |     | 112.4500     | 42.80                    | -17.43                  | 25.37                      | 43.50           | -18.13     | QP       |                         |                 |         |
| 5   |     | 120.2100     | 43.40                    | -16.93                  | 26.47                      | 43.50           | -17.03     | QP       |                         |                 |         |
| 6   |     | 163.8600     | 37.60                    | -18.39                  | 19.21                      | 43.50           | -24.29     | QP       |                         |                 |         |

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

Operator: Snake

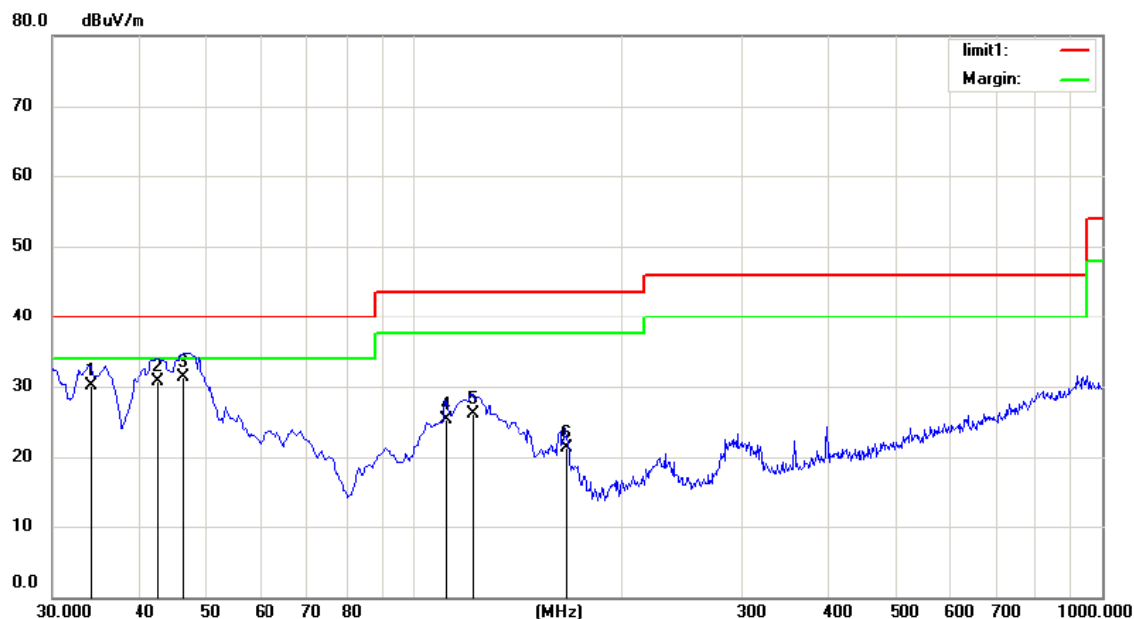


Site Chamber #1 Polarization: **Horizontal** Temperature: 24  
 Limit: (RE)FCC PART 15 class B 3m Power: AC 120V/60Hz Humidity: 55 %  
 Mode: TX2480  
 Note:

| No. | Mk. | Freq.    | Reading | Correct | Measure- | Limit  | Over   | Antenna  | Table  |        |
|-----|-----|----------|---------|---------|----------|--------|--------|----------|--------|--------|
|     |     | MHz      | Level   | Factor  | ment     |        |        | Height   | Degree |        |
|     |     |          | dBuV    | dB      | dBuV/m   | dBuV/m | dB     | Detector | cm     | degree |
| 1   |     | 43.5800  | 36.80   | -13.37  | 23.43    | 40.00  | -16.57 | QP       |        |        |
| 2   | *   | 47.4600  | 38.60   | -14.38  | 24.22    | 40.00  | -15.78 | QP       |        |        |
| 3   |     | 119.2400 | 44.30   | -17.01  | 27.29    | 43.50  | -16.21 | QP       |        |        |
| 4   |     | 124.1330 | 43.70   | -16.50  | 27.20    | 43.50  | -16.30 | QP       |        |        |
| 5   |     | 226.9100 | 32.90   | -16.10  | 16.80    | 46.00  | -29.20 | QP       |        |        |
| 6   |     | 320.0300 | 34.40   | -13.05  | 21.35    | 46.00  | -24.65 | QP       |        |        |

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

Operator: Snake



Site Chamber #1 Polarization: **Vertical** Temperature: 24  
 Limit: (RE)FCC PART 15 class B 3m Power: AC 120V/60Hz Humidity: 55 %  
 Mode: TX2480  
 Note:

| No. | Mk. | Freq.    | Reading | Correct | Measure- | Limit  | Over     | Antenna | Table   |
|-----|-----|----------|---------|---------|----------|--------|----------|---------|---------|
|     |     | MHz      | Level   | Factor  | ment     |        |          | Height  | Degree  |
|     |     |          | dBuV    | dB      | dBuV/m   | dBuV/m | dB       | cm      | degree  |
|     |     |          |         |         |          |        | Detector |         | Comment |
| 1   |     | 34.0363  | 44.30   | -14.28  | 30.02    | 40.00  | -9.98    | QP      |         |
| 2   |     | 42.6100  | 44.10   | -13.49  | 30.61    | 40.00  | -9.39    | QP      |         |
| 3   | *   | 46.4900  | 45.30   | -14.06  | 31.24    | 40.00  | -8.76    | QP      |         |
| 4   |     | 111.4800 | 42.80   | -17.48  | 25.32    | 43.50  | -18.18   | QP      |         |
| 5   |     | 122.1500 | 42.90   | -16.72  | 26.18    | 43.50  | -17.32   | QP      |         |
| 6   |     | 166.7700 | 39.70   | -18.40  | 21.30    | 43.50  | -22.20   | QP      |         |

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

Operator: Snake

## Above 1000MHz

Worst Operation Mode: GFSK (CH1: 2402MHz) Test Date : March 30, 2015  
 Frequency Range: 1-25GHz Temperature : 25 °C  
 Test Result: PASS Humidity : 50 %  
 Measured Distance: 3m Test By: Andy

| Freq.<br>(MHz) | Ant.Pol.<br>H/V | Emission Level(dBuV/m) |       | Limit 3m(dBuV/m) |    | Margin(dB) |        |
|----------------|-----------------|------------------------|-------|------------------|----|------------|--------|
|                |                 | PK                     | AV    | PK               | AV | PK         | AV     |
| 4804           | V               | 66.23                  | 44.18 | 74               | 54 | -7.77      | -9.82  |
| 7206           | V               | 65.41                  | 43.25 | 74               | 54 | -8.59      | -10.75 |
| 9608           | V               | 64.58                  | 42.13 | 74               | 54 | -9.42      | -11.87 |
| 12010          | V               | 63.27                  | 42.07 | 74               | 54 | -10.73     | -11.93 |
| 14412          | V               | 61.58                  | 41.74 | 74               | 54 | -12.42     | -12.26 |
| 16814          | V               | 59.66                  | 40.86 | 74               | 54 | -14.34     | -13.14 |
| 4804           | H               | 66.37                  | 45.97 | 74               | 54 | -7.63      | -8.03  |
| 7206           | H               | 65.84                  | 44.75 | 74               | 54 | -8.16      | -9.25  |
| 9608           | H               | 64.31                  | 43.61 | 74               | 54 | -9.69      | -10.39 |
| 12010          | H               | 62.58                  | 42.76 | 74               | 54 | -11.42     | -11.24 |
| 14412          | H               | 61.47                  | 41.23 | 74               | 54 | -12.53     | -12.77 |
| 16814          | H               | 58.46                  | 40.72 | 74               | 54 | -15.54     | -13.28 |

Other harmonics emissions are lower than 20dB below the allowable limit.

- Note:**
- (1) All Readings are Peak Value and AV.
  - (2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
  - (3) The average measurement was not performed when the peak measured data under the limit of average detection.
  - (4) The results of worst cased (GFSK) was recorded.

Worst Operation Mode: GFSK (CH40: 2441MHz) Test Date : March 30, 2015  
Frequency Range: 1-25GHz Temperature : 25 °C  
Test Result: PASS Humidity : 50 %  
Measured Distance: 3m Test By: Andy

| Freq.<br>(MHz) | Ant.Pol.<br>H/V | Emission Level(dBuV/m) |       | Limit 3m(dBuV/m) |    | Margin(dB) |        |
|----------------|-----------------|------------------------|-------|------------------|----|------------|--------|
|                |                 | PK                     | AV    | PK               | AV | PK         | AV     |
| 4882           | V               | 66.92                  | 45.93 | 74               | 54 | -7.08      | -8.07  |
| 7323           | V               | 65.47                  | 44.52 | 74               | 54 | -8.53      | -9.48  |
| 9764           | V               | 64.71                  | 43.61 | 74               | 54 | -9.29      | -10.39 |
| 12205          | V               | 63.27                  | 42.56 | 74               | 54 | -10.73     | -11.44 |
| 14646          | V               | 62.58                  | 41.29 | 74               | 54 | -11.42     | -12.71 |
| 17087          | V               | 61.45                  | 40.12 | 74               | 54 | -12.55     | -13.88 |
| 4882           | H               | 65.91                  | 46.54 | 74               | 54 | -8.09      | -7.46  |
| 7323           | H               | 64.75                  | 45.98 | 74               | 54 | -9.25      | -8.02  |
| 9764           | H               | 63.28                  | 43.64 | 74               | 54 | -10.72     | -10.36 |
| 12205          | H               | 62.37                  | 42.37 | 74               | 54 | -11.63     | -11.63 |
| 14646          | H               | 61.56                  | 41.08 | 74               | 54 | -12.44     | -12.92 |
| 17087          | H               | 59.77                  | 39.74 | 74               | 54 | -14.23     | -14.26 |

Other harmonics emissions are lower than 20dB below the allowable limit.

- Note:**
- (1) All Readings are Peak Value and AV.
  - (2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
  - (3) The average measurement was not performed when the peak measured data under the limit of average detection.
  - (4) The results of worst cased (GFSK) was recorded.

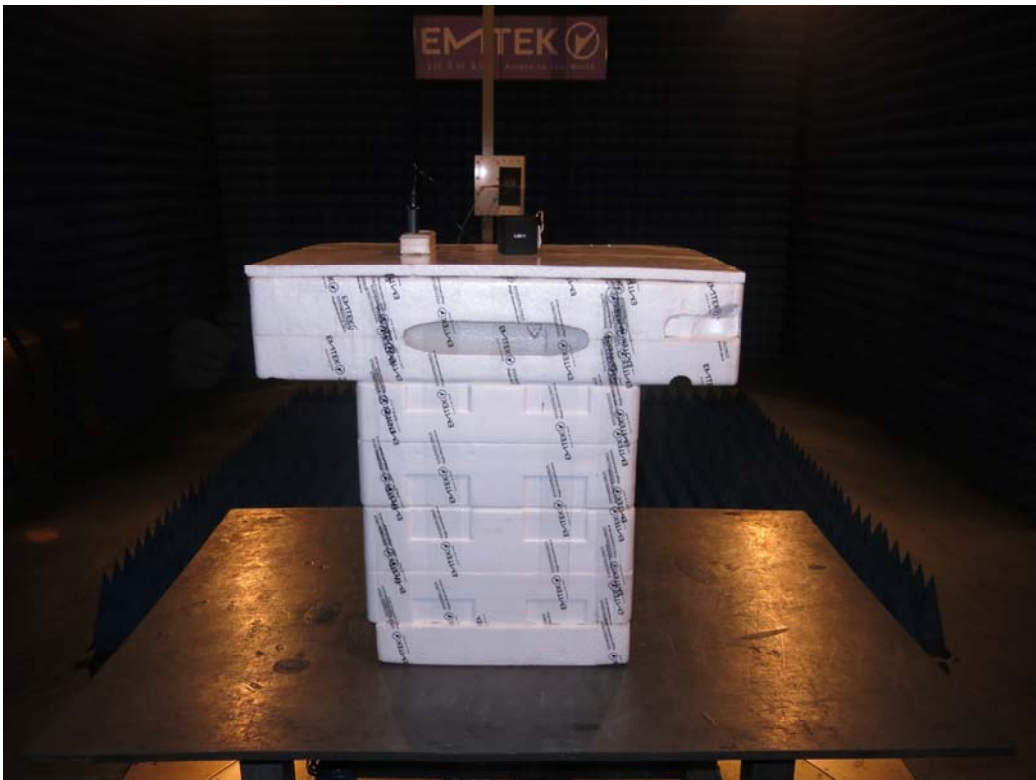
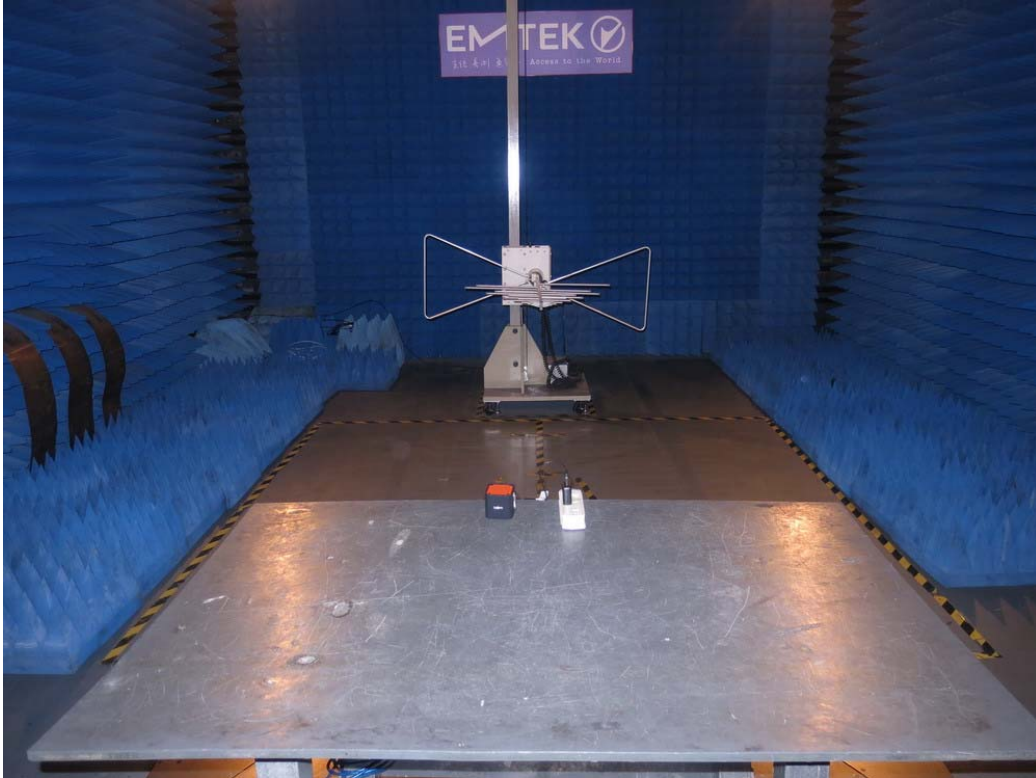
Worst Operation Mode: GFSK (CH79: 2480MHz) Test Date : March 30, 2015  
Frequency Range: 1-25GHz Temperature : 25 °C  
Test Result: PASS Humidity : 50 %  
Measured Distance: 3m Test By: Andy

| Freq.<br>(MHz) | Ant. Pol.<br>H/V | Emission Level(dBuV/m) |       | Limit 3m(dBuV/m) |    | Margin(dB) |        |
|----------------|------------------|------------------------|-------|------------------|----|------------|--------|
|                |                  | PK                     | AV    | PK               | AV | PK         | AV     |
| 4960           | V                | 65.33                  | 44.18 | 74               | 54 | -8.67      | -9.82  |
| 7440           | V                | 64.72                  | 43.38 | 74               | 54 | -9.28      | -10.62 |
| 9920           | V                | 63.59                  | 42.82 | 74               | 54 | -10.41     | -11.18 |
| 12400          | V                | 62.15                  | 41.13 | 74               | 54 | -11.85     | -12.87 |
| 14880          | V                | 61.02                  | 40.59 | 74               | 54 | -12.98     | -13.41 |
| 17360          | V                | 60.38                  | 38.95 | 74               | 54 | -13.62     | -15.05 |
| 4960           | H                | 66.33                  | 45.72 | 74               | 54 | -7.67      | -8.28  |
| 7440           | H                | 65.82                  | 44.66 | 74               | 54 | -8.18      | -9.34  |
| 9920           | H                | 64.72                  | 43.69 | 74               | 54 | -9.28      | -10.31 |
| 12400          | H                | 63.81                  | 42.17 | 74               | 54 | -10.19     | -11.83 |
| 14880          | H                | 62.33                  | 41.35 | 74               | 54 | -11.67     | -12.65 |
| 17360          | H                | 60.82                  | 40.07 | 74               | 54 | -13.18     | -13.93 |

Other harmonics emissions are lower than 20dB below the allowable limit.

- Note:**
- (1) All Readings are Peak Value and AV.
  - (2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
  - (3) The average measurement was not performed when the peak measured data under the limit of average detection.
  - (4) The results of worst cased (GFSK) was recorded.

### 7.5 Radiated Measurement Photos:

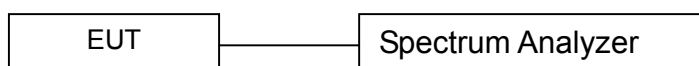


## 8. Channel Separation test

### 8.1 Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

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



### 8.3 Measurement Equipment Used:

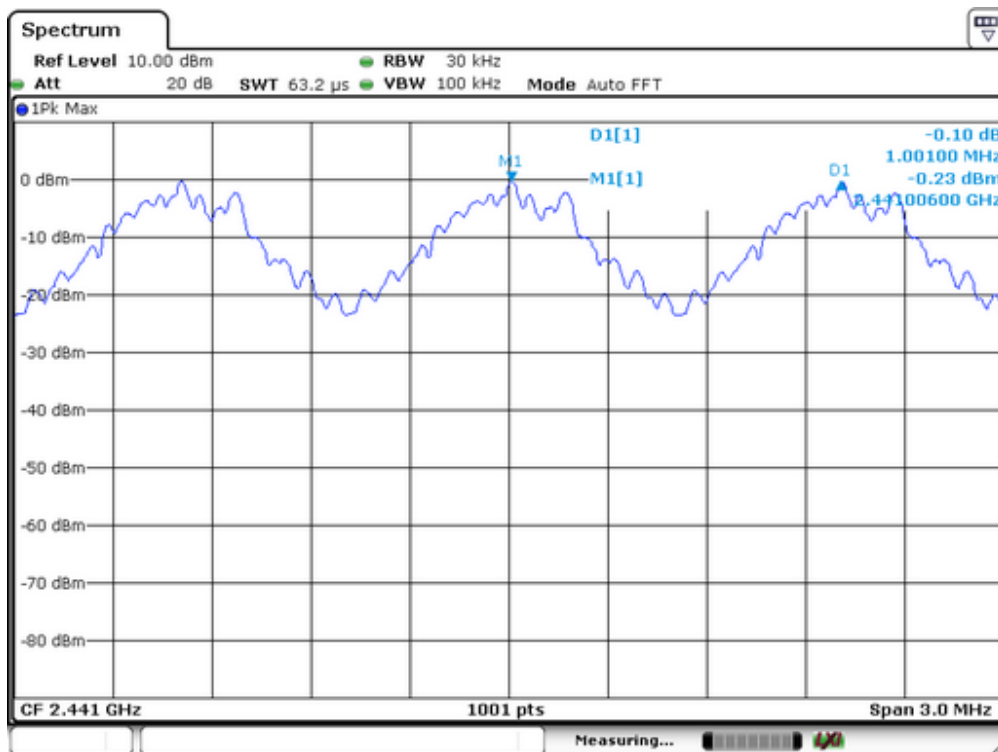
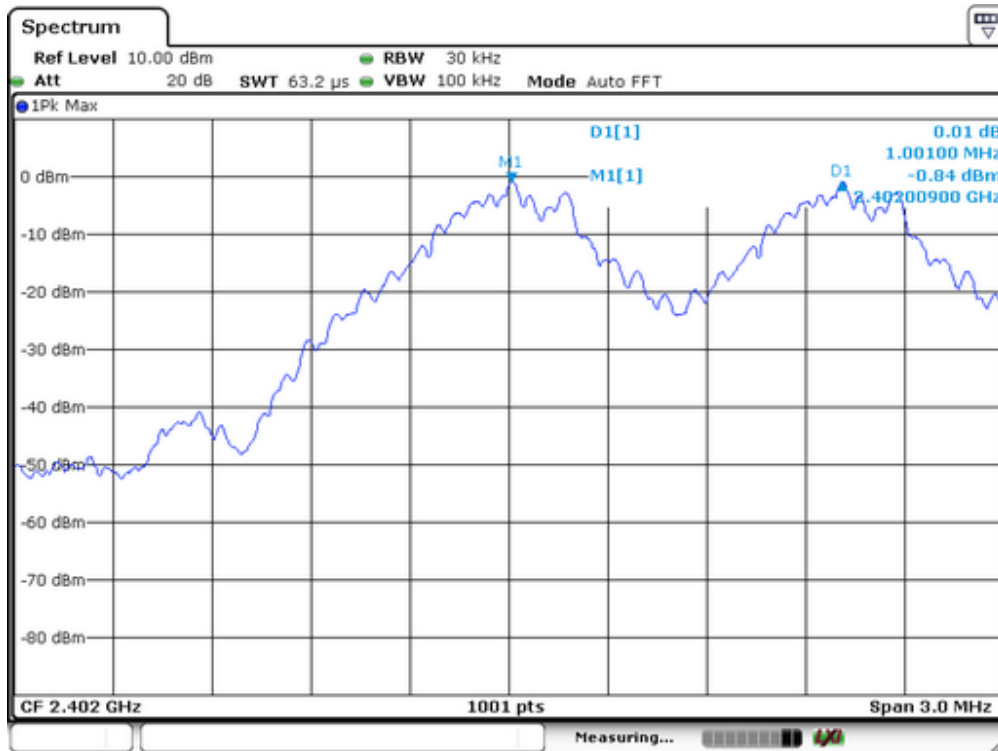
| EQUIPMENT TYPE    | MFR             | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|-------------------|-----------------|--------------|---------------|------------|------------|
| Spectrum Analyzer | Rohde & Schwarz | FSV30        | 1321.3008K    | 03/16/2015 | 03/15/2016 |
| Coaxial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

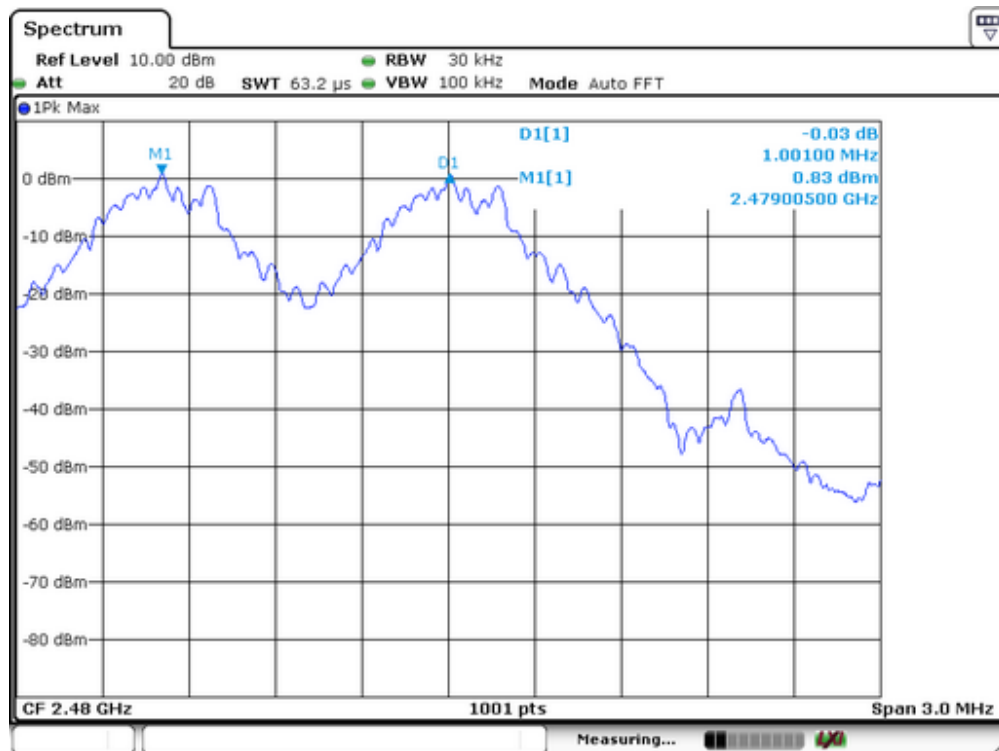
### 8.4 Measurement Results:

Refer to attached data chart.

|                    |      |               |                |
|--------------------|------|---------------|----------------|
| Spectrum Detector: | PK   | Test Date :   | March 30, 2015 |
| Test By:           | Andy | Temperature : | 25 °C          |
| Test Result:       | PASS | Humidity :    | 50 %           |
| Modulation:        | GFSK |               |                |

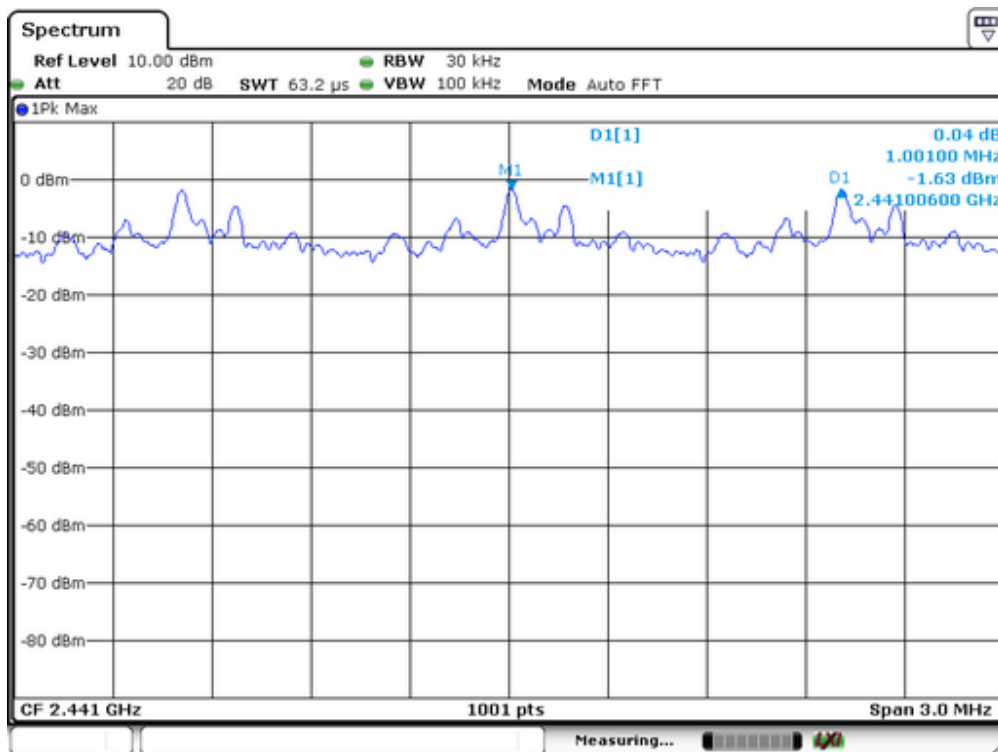
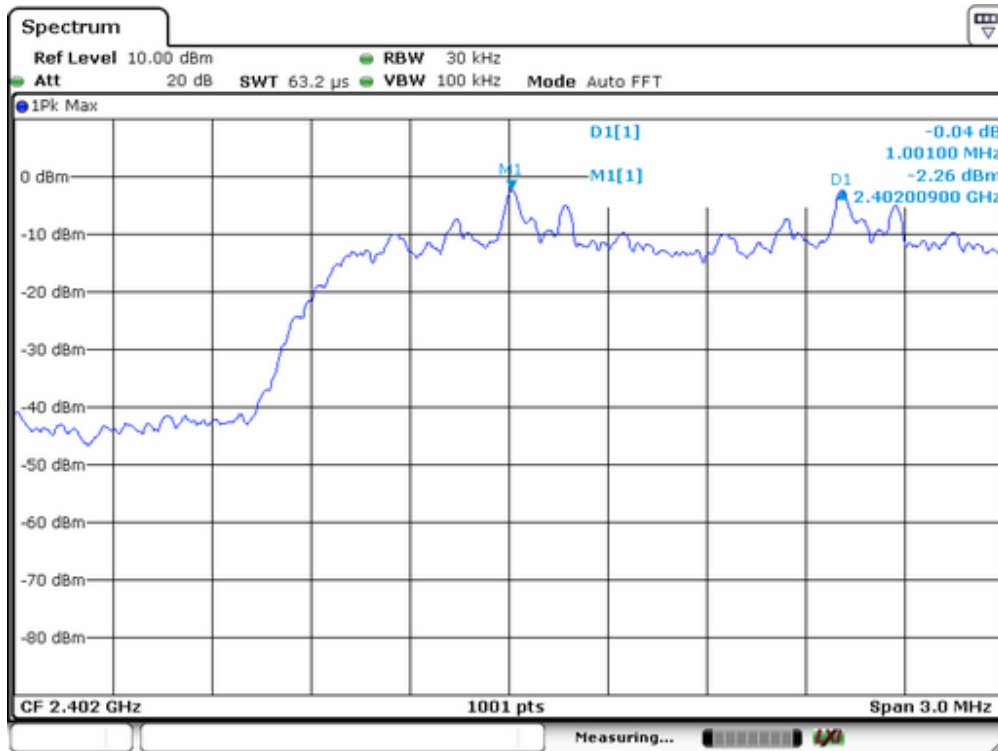
| Channel number | Channel frequency (MHz) | Separation Read Value (kHz) | Separation Limit (kHz) |
|----------------|-------------------------|-----------------------------|------------------------|
| 1              | 2402                    | 1001                        | >815                   |
|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

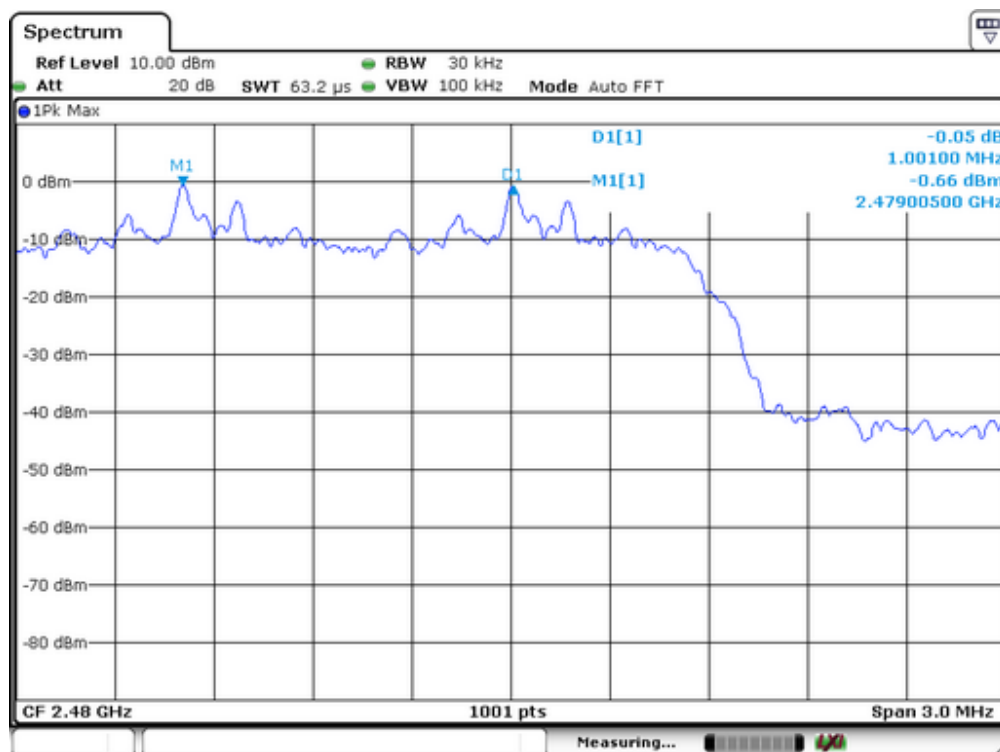




|                    |                |               |                |
|--------------------|----------------|---------------|----------------|
| Spectrum Detector: | PK             | Test Date :   | March 30, 2015 |
| Test By:           | Andy           | Temperature : | 24°C           |
| Test Result:       | PASS           | Humidity :    | 53 %           |
| Modulation:        | $\Pi/4$ -DQPSK |               |                |

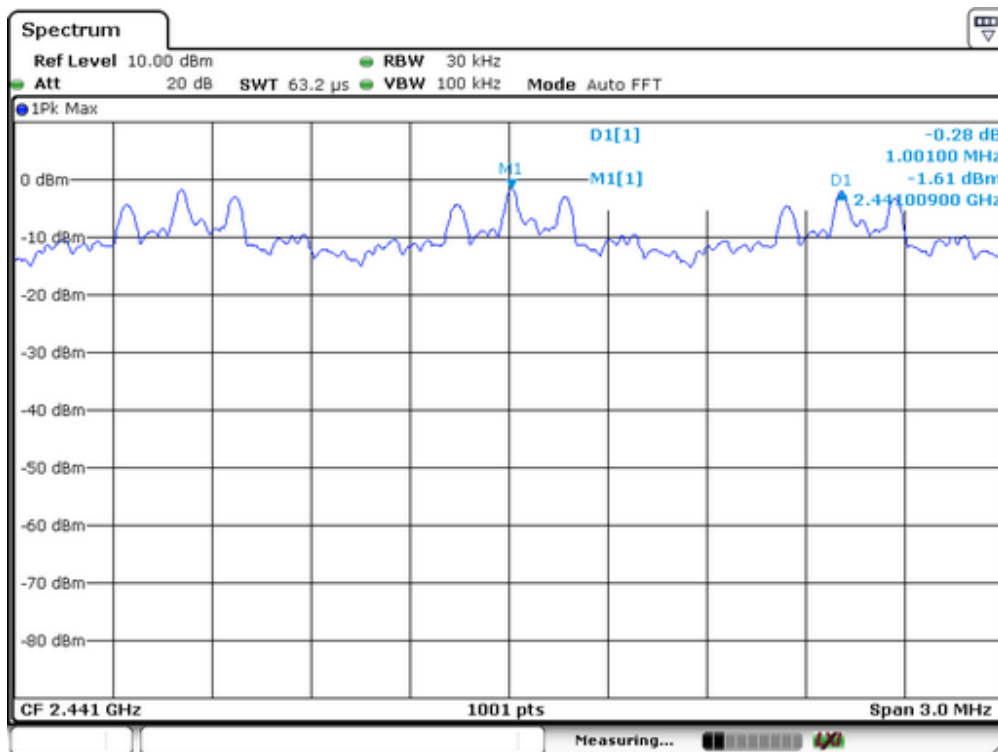
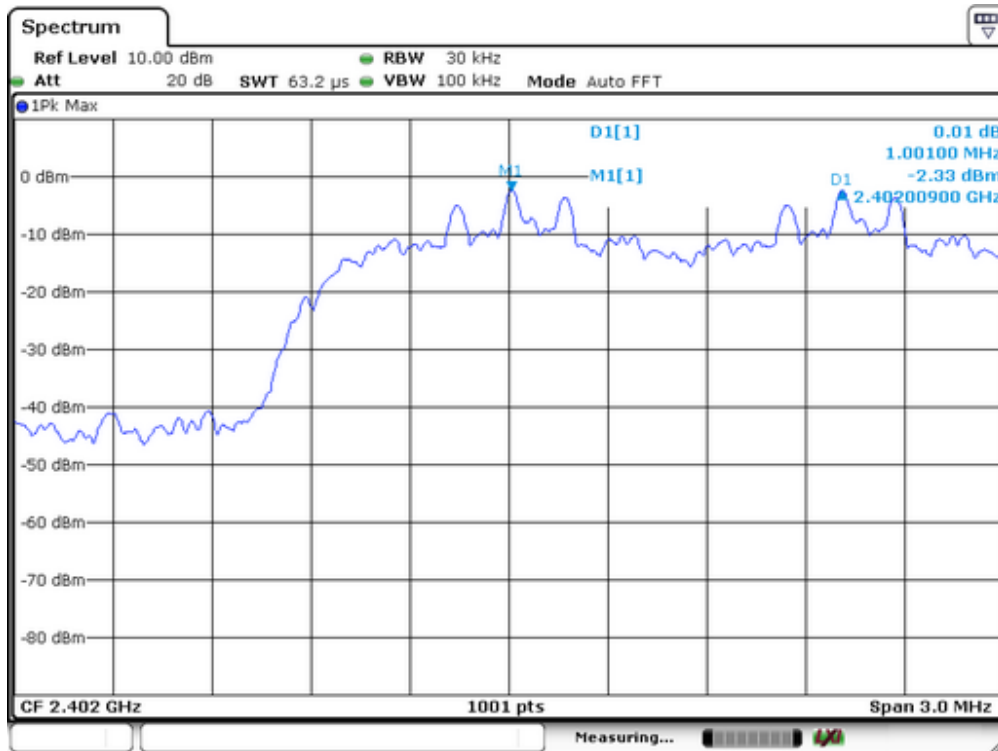
| Channel number | Channel frequency (MHz) | Separation Read Value (kHz) | Separation Limit 2/3 20dB Down BW(kHz) |
|----------------|-------------------------|-----------------------------|----------------------------------------|
| 1              | 2402                    | 1001                        | >830                                   |
| 40             | 2441                    | 1001                        | >830                                   |
| 79             | 2480                    | 1001                        | >826                                   |

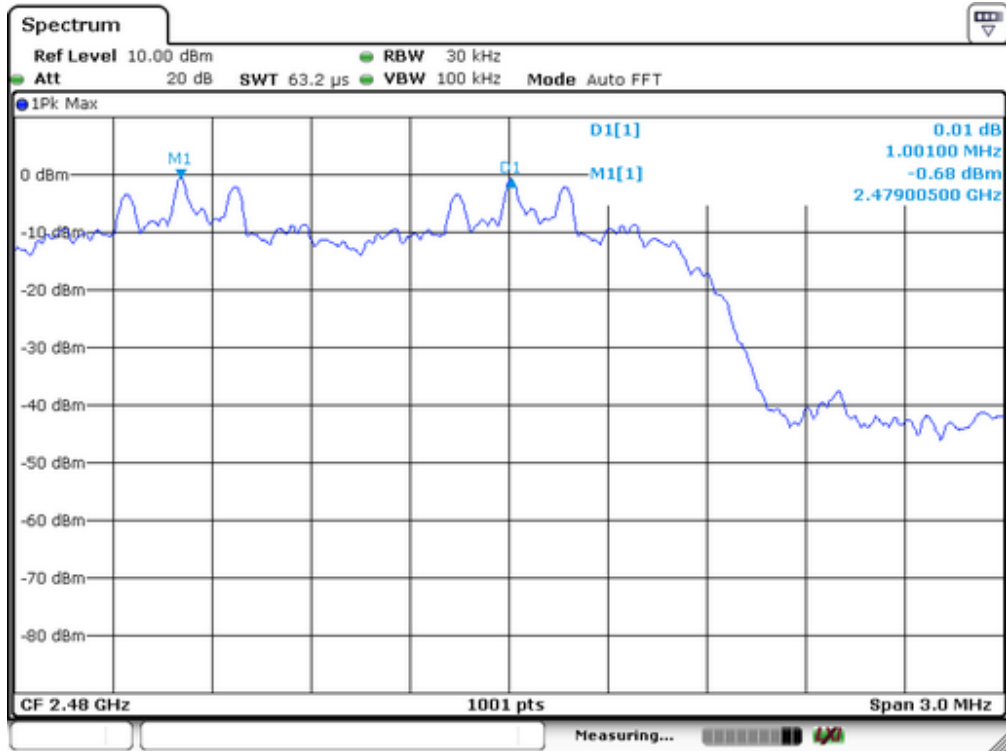




|                    |       |               |                |
|--------------------|-------|---------------|----------------|
| Spectrum Detector: | PK    | Test Date :   | March 30, 2015 |
| Test By:           | Andy  | Temperature : | 24 °C          |
| Test Result:       | PASS  | Humidity :    | 53 %           |
| Modulation:        | 8DPSK |               |                |

| Channel number | Channel frequency (MHz) | Separation Read Value (kHz) | Separation Limit 2/3 20dB Down BW(kHz) |
|----------------|-------------------------|-----------------------------|----------------------------------------|
| 1              | 2402                    | 1001                        | >810                                   |
| 40             | 2441                    | 1001                        | >814                                   |
| 79             | 2480                    | 1001                        | >806                                   |



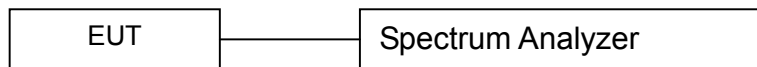


## 9. 20dB Bandwidth test

### 9.1 Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

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



### 9.3 Measurement Equipment Used:

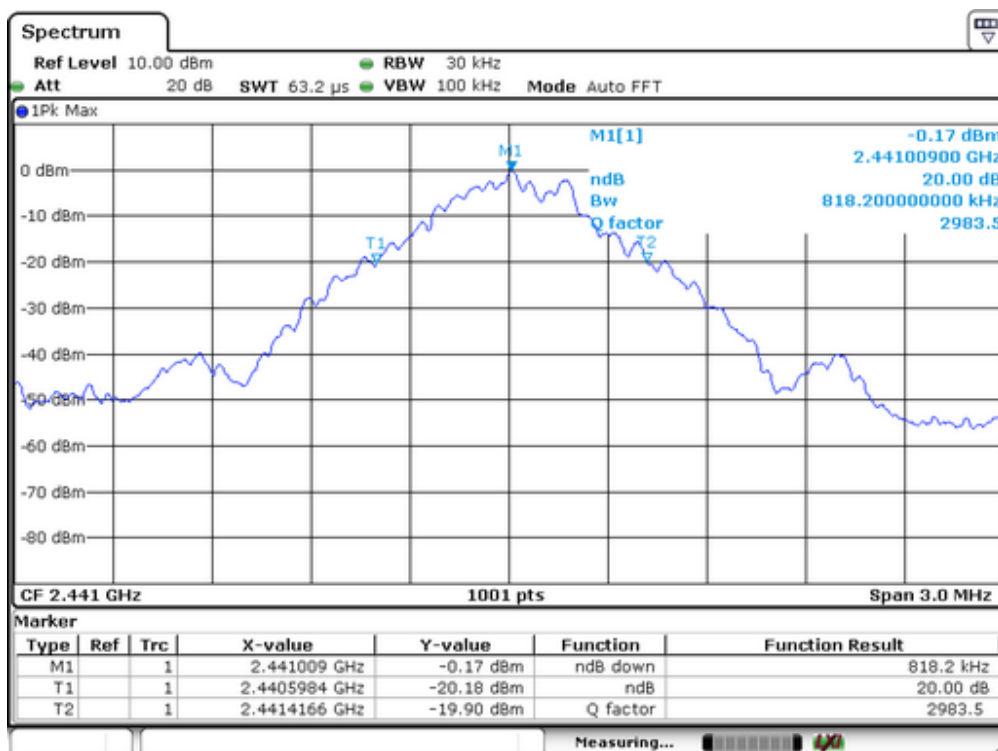
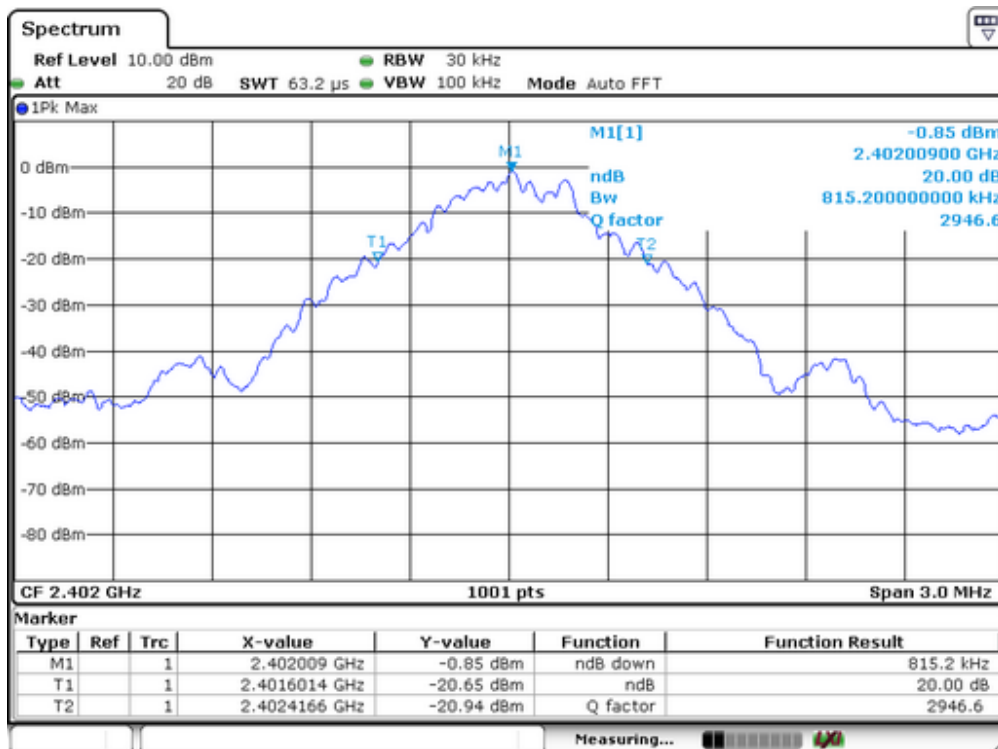
| EQUIPMENT TYPE    | MFR             | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|-------------------|-----------------|--------------|---------------|------------|------------|
| Spectrum Analyzer | Rohde & Schwarz | FSV30        | 1321.3008K    | 03/16/2015 | 03/15/2016 |
| Coaxial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

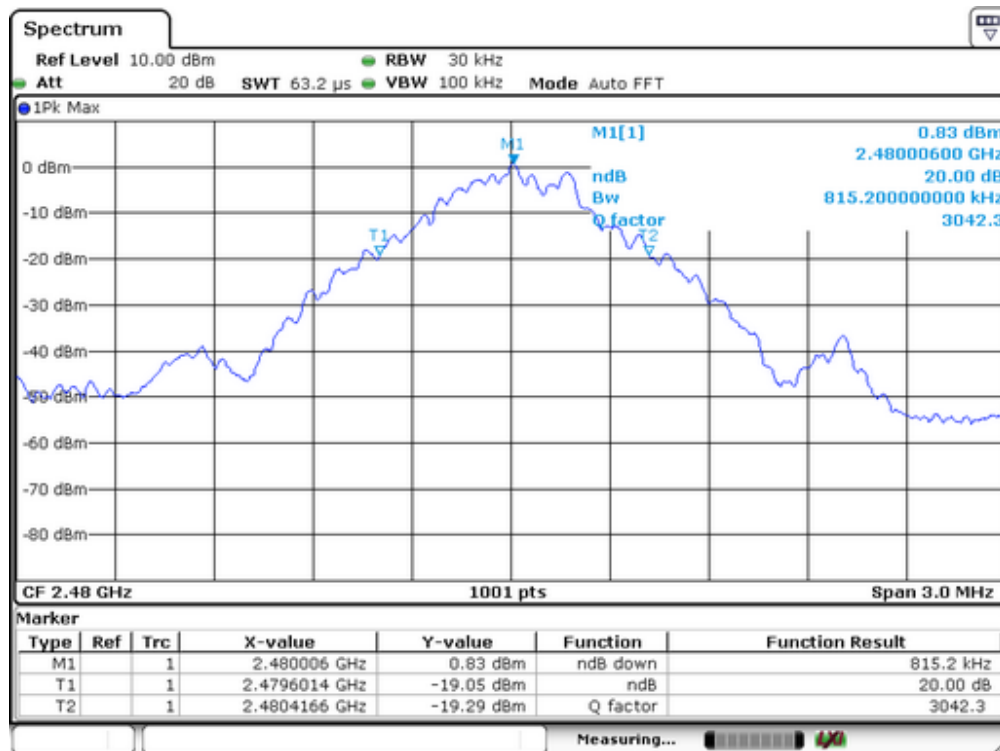
### 9.4 Measurement Results:

Refer to attached data chart.

|                    |      |               |                |
|--------------------|------|---------------|----------------|
| Spectrum Detector: | PK   | Test Date :   | March 30, 2015 |
| Test By:           | Andy | Temperature : | 24°C           |
| Test Result:       | PASS | Humidity :    | 53 %           |
| Modulation:        | GFSK |               |                |

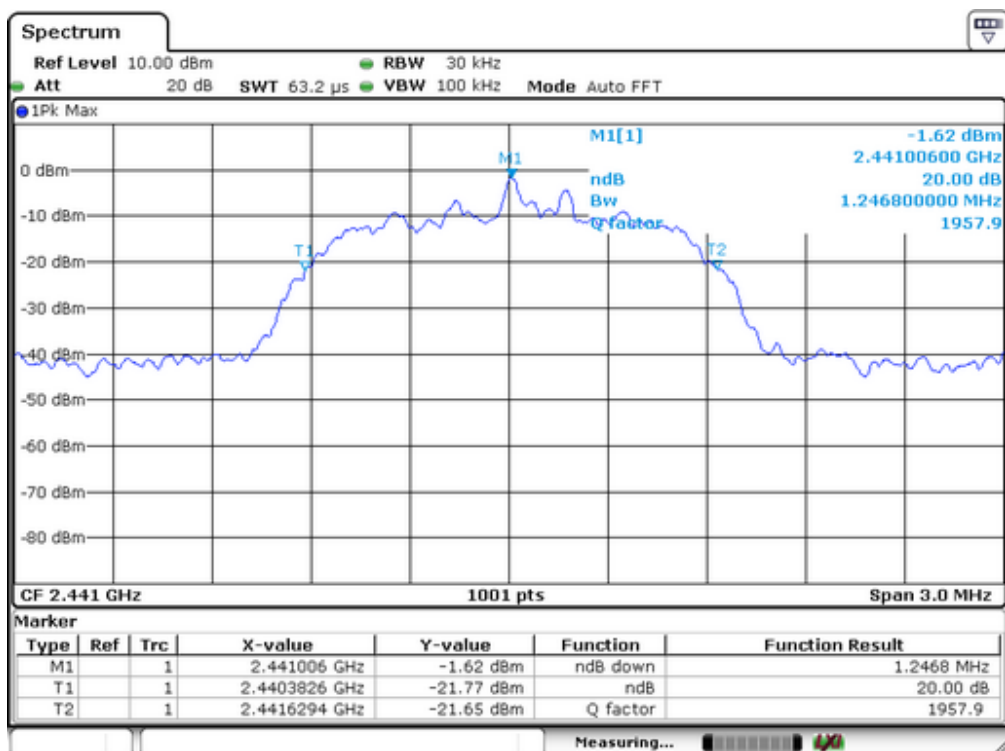
| Channel number | Channel frequency (MHz) | 20dB Down BW(kHz) |
|----------------|-------------------------|-------------------|
| 1              | 2402                    | 815.200           |
| 40             | 2441                    | 818.200           |
| 79             | 2480                    | 815.200           |

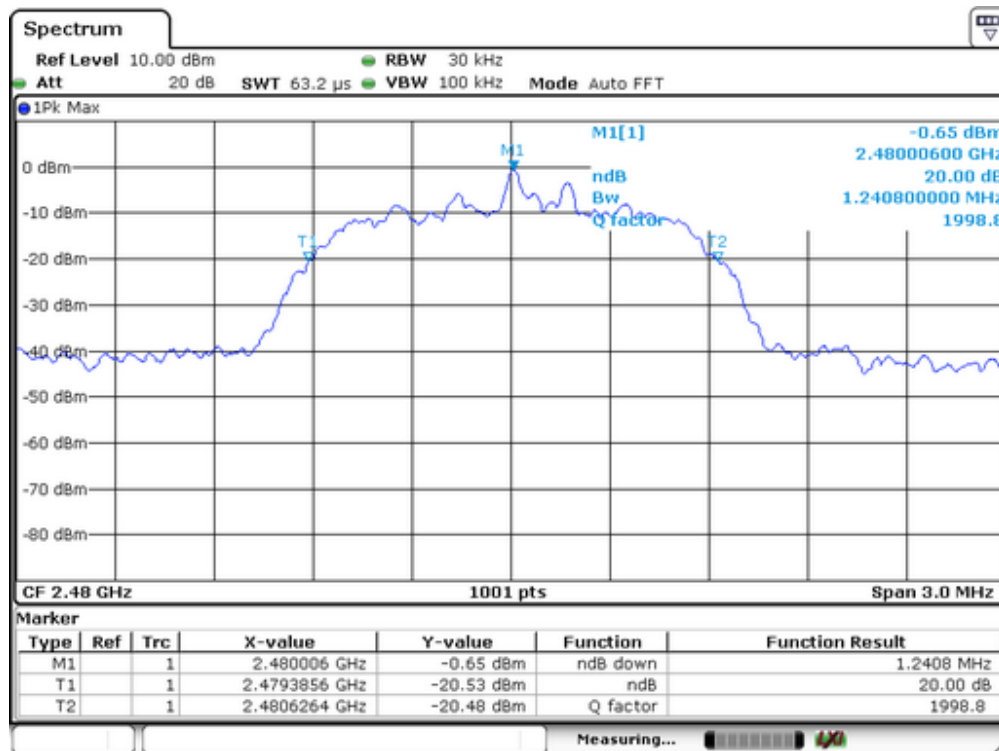




|                    |           |               |                |
|--------------------|-----------|---------------|----------------|
| Spectrum Detector: | PK        | Test Date :   | March 30, 2015 |
| Test By:           | Andy      | Temperature : | 24°C           |
| Test Result:       | PASS      | Humidity :    | 53 %           |
| Modulation:        | Π/4-DQPSK |               |                |

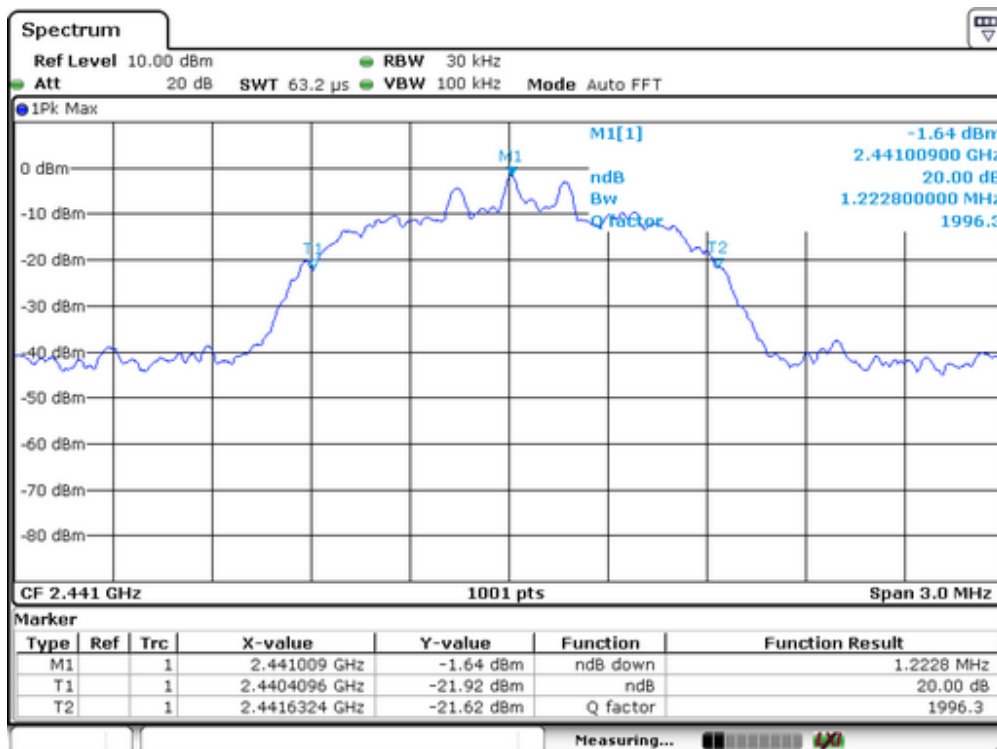
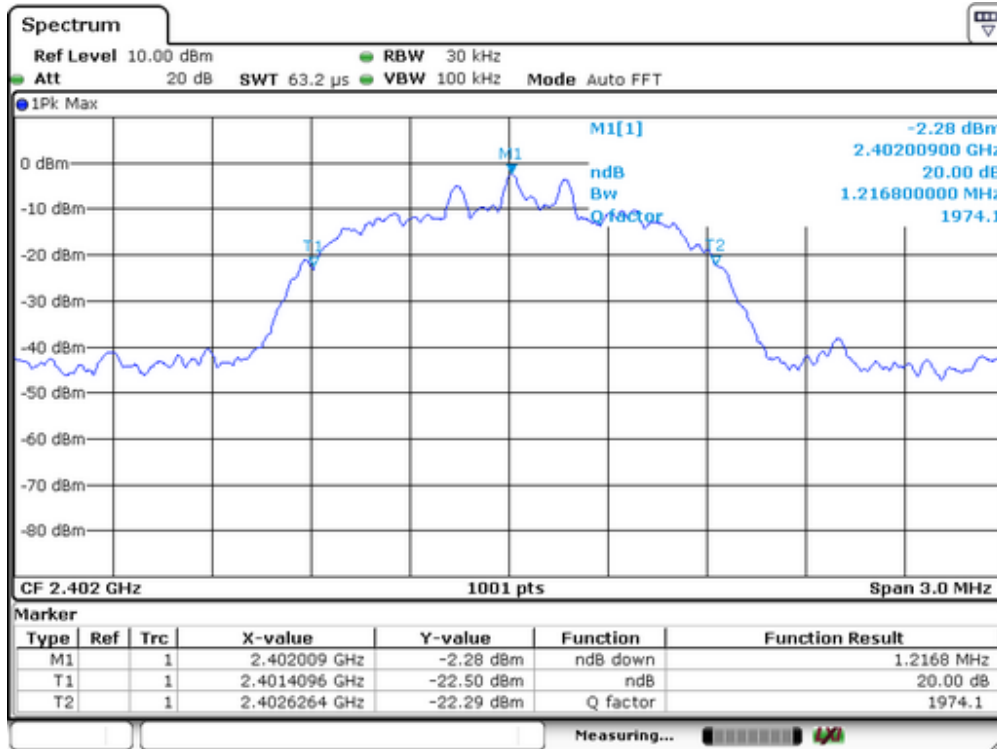
| Channel number | Channel frequency (MHz) | 20dB Down BW(kHz) |
|----------------|-------------------------|-------------------|
| 1              | 2402                    | 1246.800          |
| 40             | 2441                    | 1246.800          |
| 79             | 2480                    | 1240.800          |

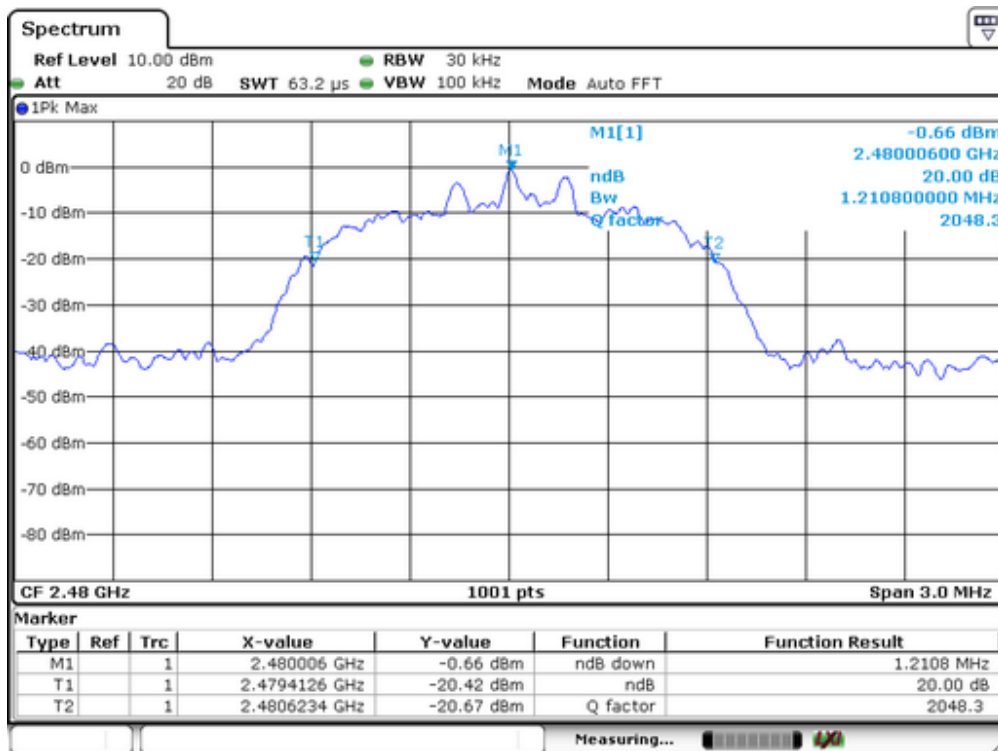




|                    |       |               |                |
|--------------------|-------|---------------|----------------|
| Spectrum Detector: | PK    | Test Date :   | March 30, 2015 |
| Test By:           | Andy  | Temperature : | 24 °C          |
| Test Result:       | PASS  | Humidity :    | 53 %           |
| Modulation:        | 8DPSK |               |                |

| Channel number | Channel frequency (MHz) | 20dB Down BW(kHz) |
|----------------|-------------------------|-------------------|
| 1              | 2402                    | 1216.800          |
| 40             | 2441                    | 1222.800          |
| 79             | 2480                    | 1210.800          |



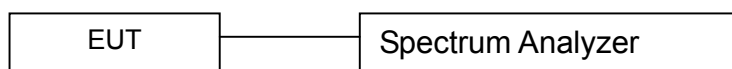


## 10. Quantity of Hopping Channel Test

### 10.1 Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

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



### 10.3 Measurement Equipment Used:

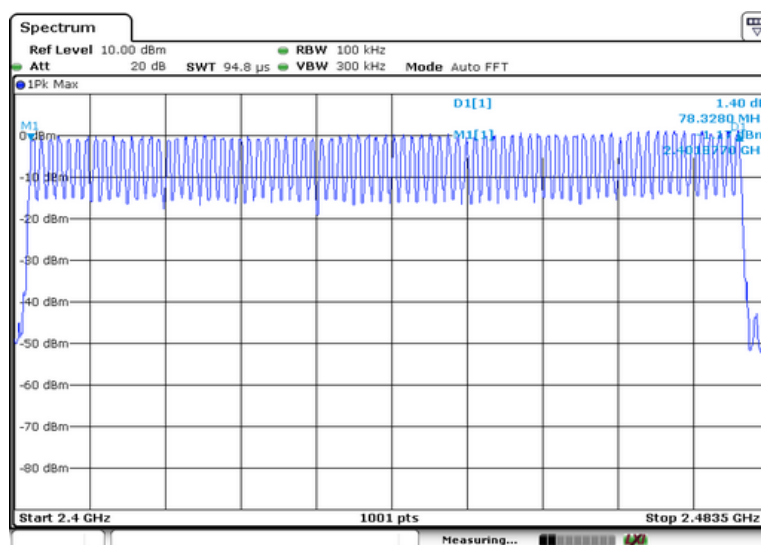
| EQUIPMENT TYPE    | MFR             | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|-------------------|-----------------|--------------|---------------|------------|------------|
| Spectrum Analyzer | Rohde & Schwarz | FSV30        | 1321.3008K    | 03/16/2015 | 03/15/2016 |
| Coaxial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

### 10.4 Measurement Results:

Refer to attached data chart.

|                 |      |               |                |
|-----------------|------|---------------|----------------|
| Worst Test Mode | GFSK | Test Date :   | March 30, 2015 |
| Test By:        | Andy | Temperature : | 25 °C          |
| Test Result:    | PASS | Humidity :    | 50 %           |

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



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

### 11.1 Test Description

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

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

with:

- hop rate =  $1600 * 1/\text{s}$  for DH1 packets =  $1600 \text{ s}^{-1}$
- hop rate =  $1600/3 * 1/\text{s}$  for DH3 packets =  $533.33 \text{ s}^{-1}$
- 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.

### 11.2 Test Requirements / Limits

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

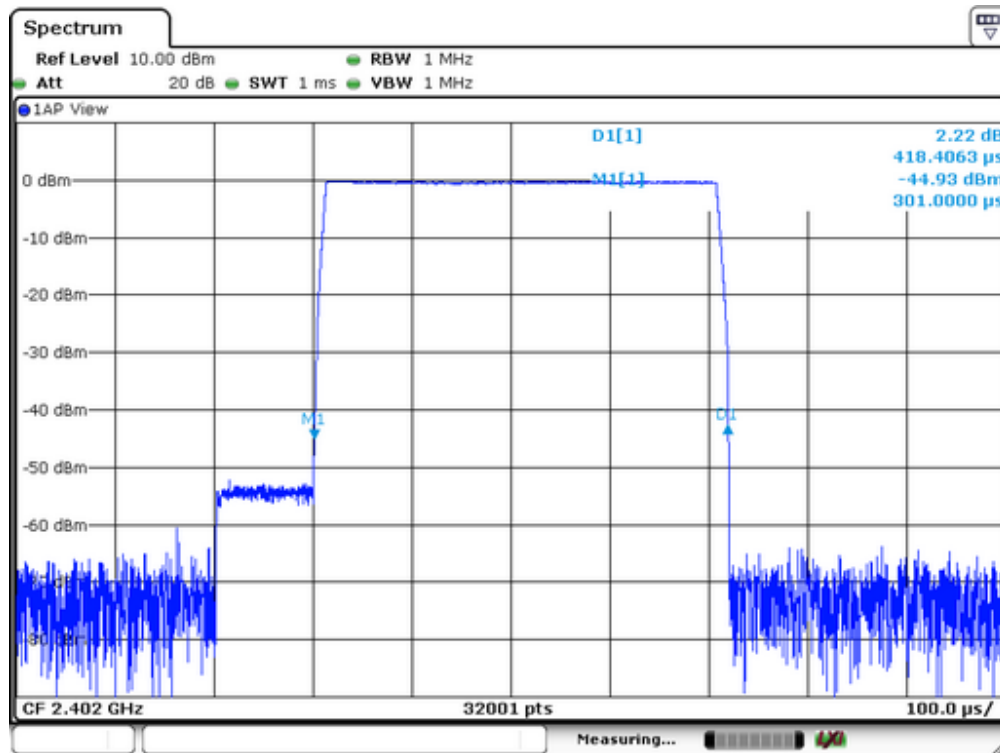
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Since the Bluetooth technology uses 79 channels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

### 11.3 Test result

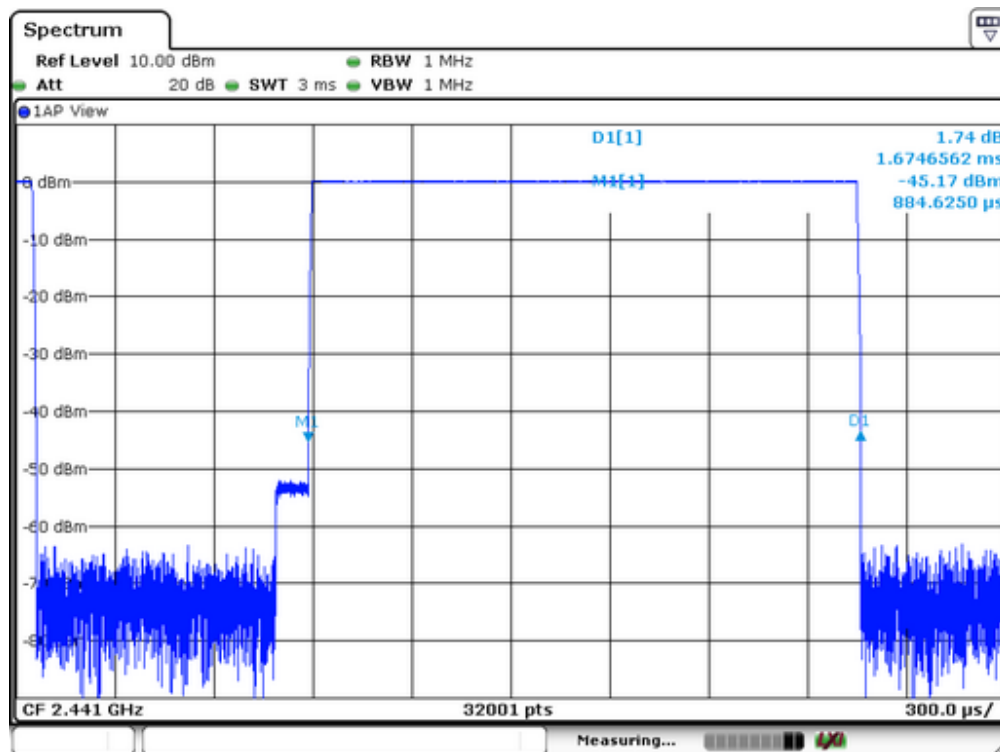
| Mode | Number of transmission in a 31.6( 79 Hopping*0.4) | Length of transmissions time(msec) | Result (msec) | Limit (msec) |
|------|---------------------------------------------------|------------------------------------|---------------|--------------|
| DH1  | $1600/(2*79) \times 31.6 = 320$                   | 0.418                              | 133.76        | 400          |
| DH3  | $1600/(4*79) \times 31.6 = 160$                   | 1.675                              | 268.00        | 400          |
| DH5  | $1600/(6*79) \times 31.6 = 106.67$                | 2.921                              | 311.58        | 400          |

Remark: The results of worst case was recorded.

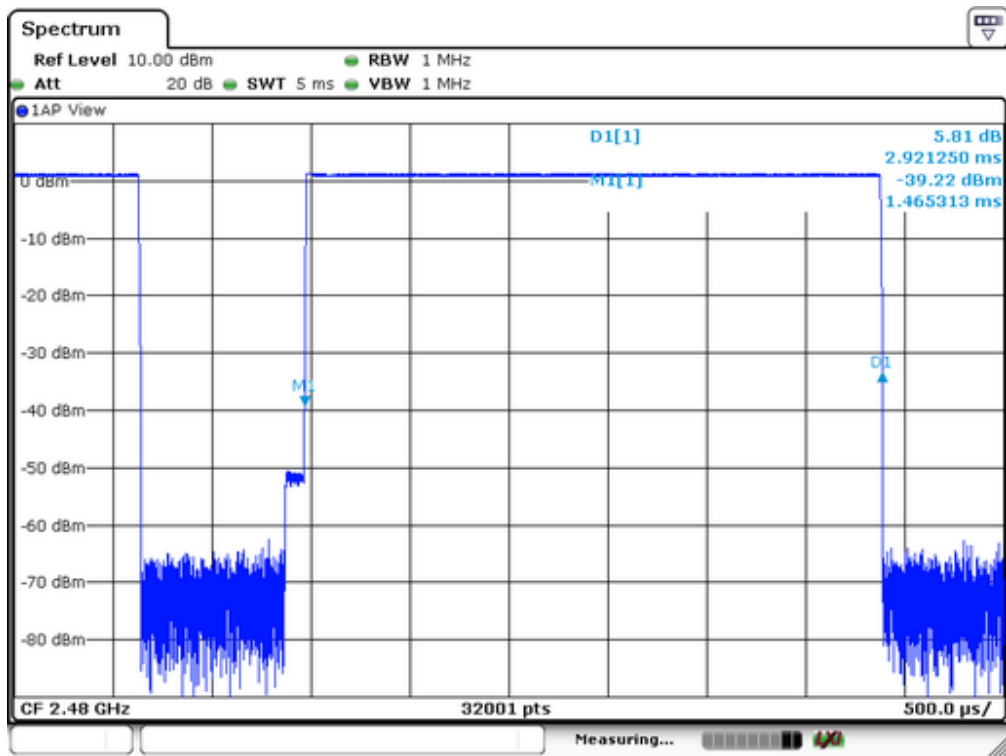
DH1:



DH3:



DH5:

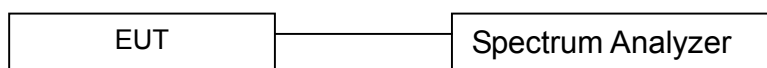


## 12. MAXIMUM PEAK OUTPUT POWER TEST

### 12.1 Measurement Procedure

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

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



### 12.3 Measurement Equipment Used:

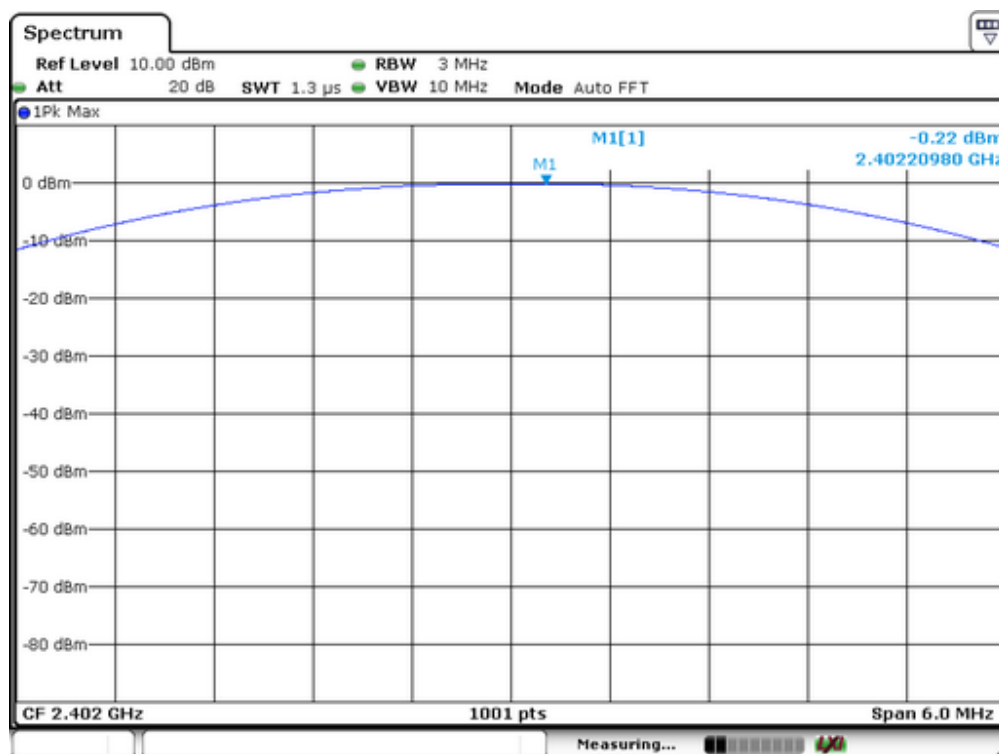
| EQUIPMENT TYPE    | MFR             | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|-------------------|-----------------|--------------|---------------|------------|------------|
| Spectrum Analyzer | Rohde & Schwarz | FSV30        | 1321.3008K    | 03/16/2015 | 03/15/2016 |
| Coaxial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

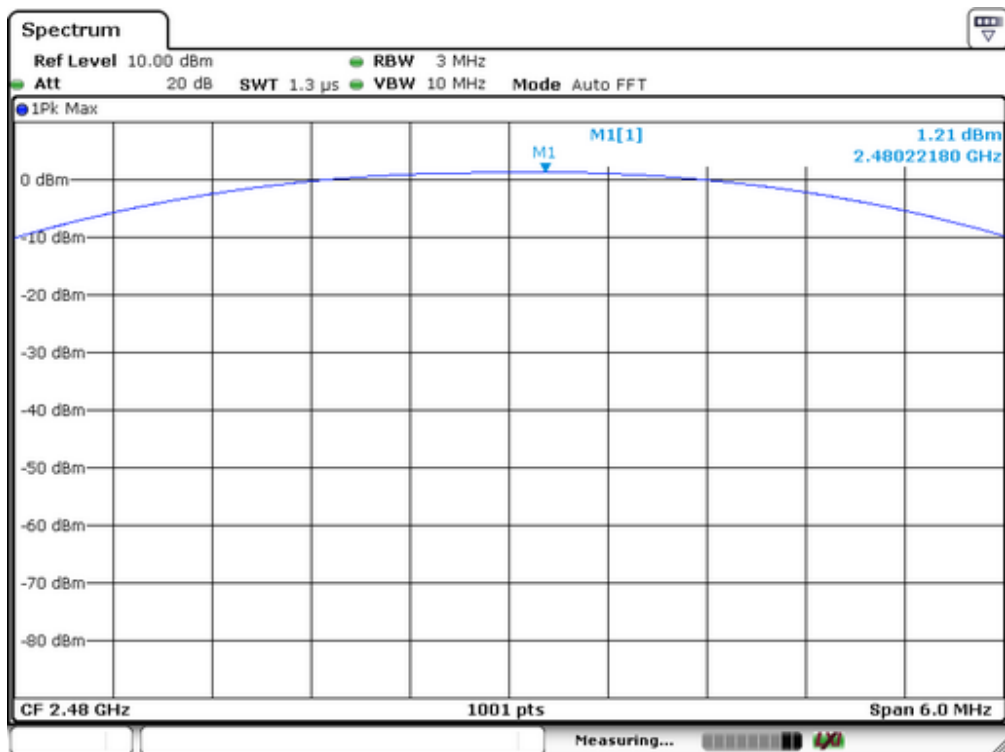
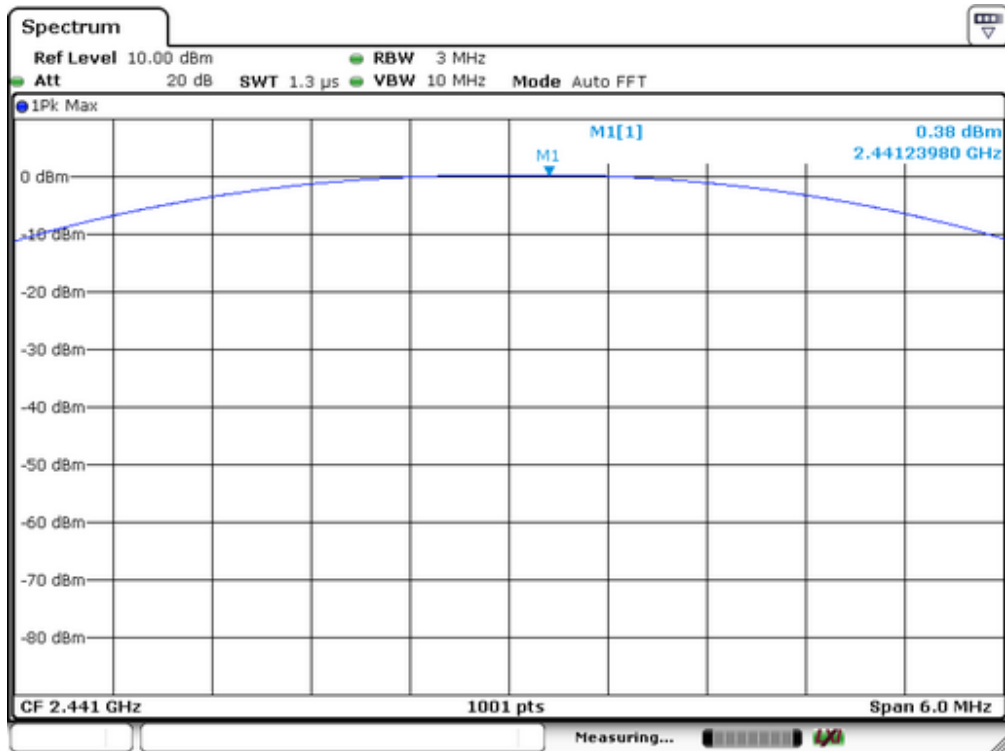
## 12.4 Measurement Results:

Refer to attached data chart.

|                    |      |               |                |
|--------------------|------|---------------|----------------|
| Spectrum Detector: | PK   | Test Date :   | March 30, 2015 |
| Test By:           | Andy | Temperature : | 25 °C          |
| Test Result:       | PASS | Humidity :    | 50 %           |
| Modulation:        | GFSK |               |                |

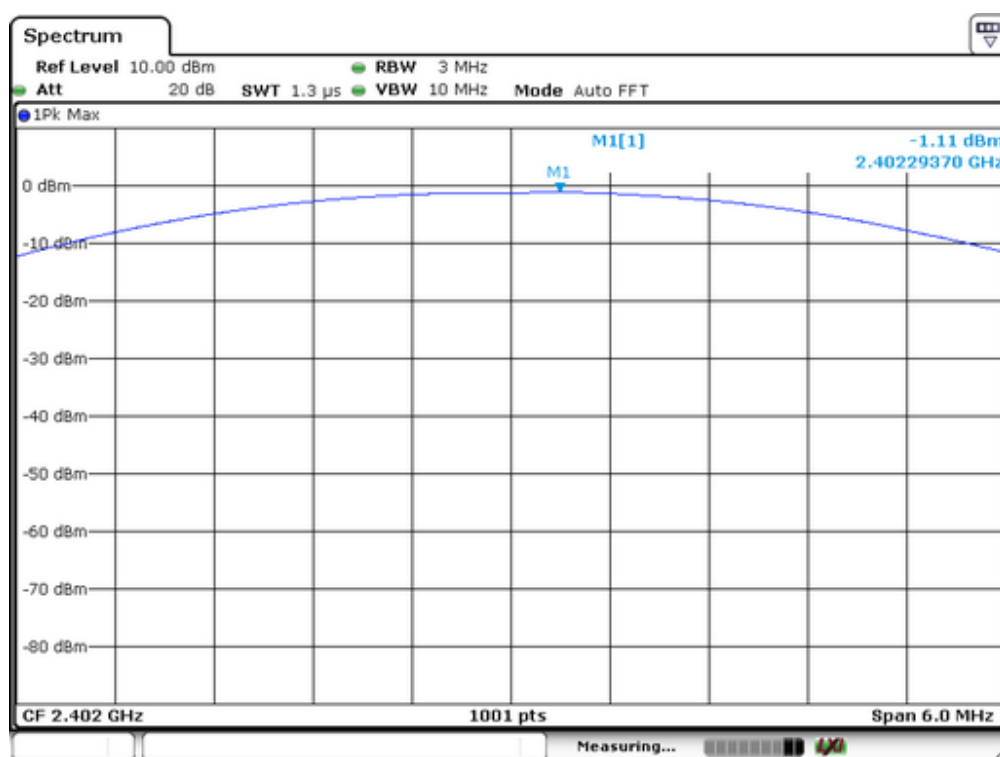
| Channel Number | Channel Frequency(MHz) | Peak Power Output(dBm) | Peak Power Output(mW) | Peak Power Limit(mW) | Pass/Fail |
|----------------|------------------------|------------------------|-----------------------|----------------------|-----------|
| 1              | 2402                   | -0.22                  | 0.951                 | 1000                 | Pass      |
| 40             | 2441                   | 0.38                   | 1.091                 | 1000                 | Pass      |
| 79             | 2480                   | <b>1.21</b>            | <b>1.321</b>          | 1000                 | Pass      |

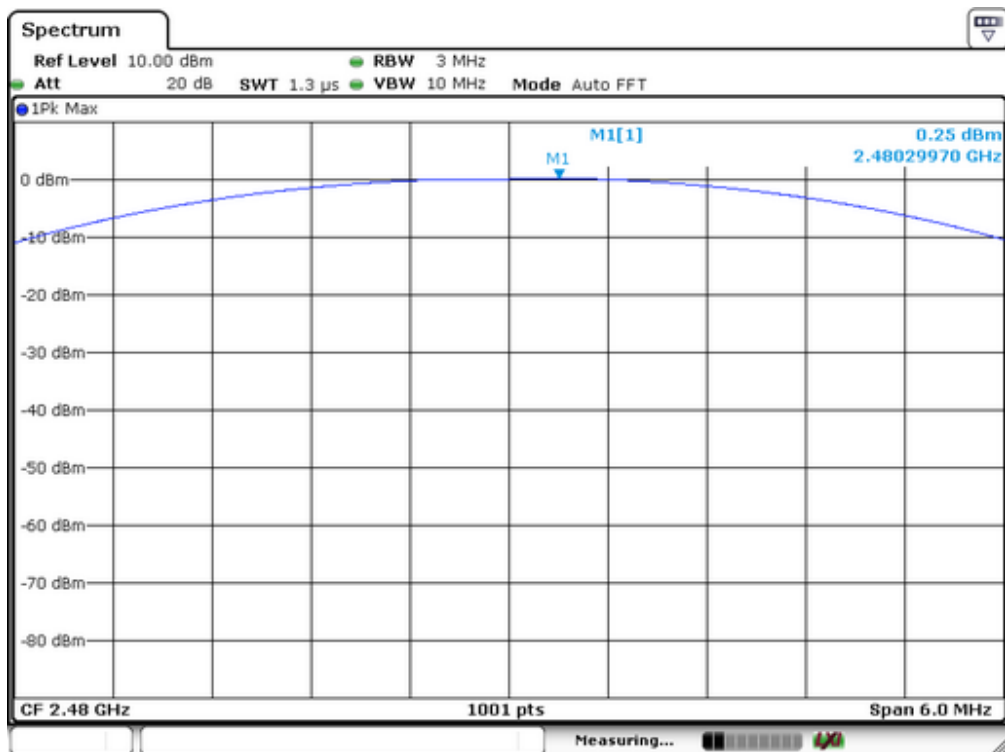
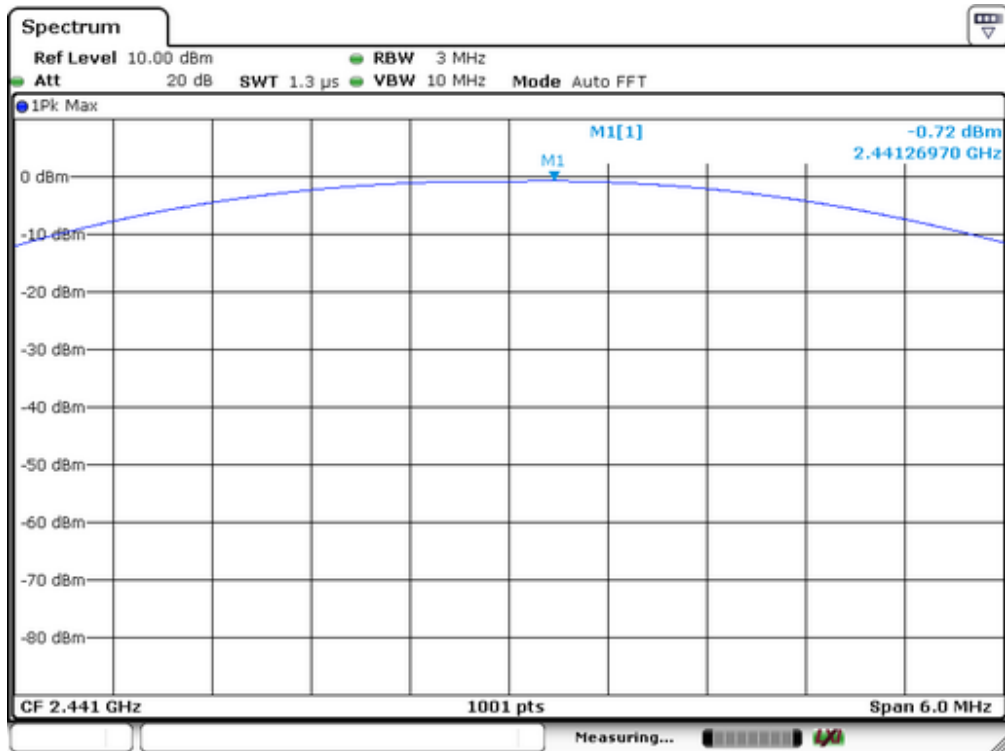




Spectrum Detector: PK      Test Date : March 30, 2015  
 Test By: Andy      Temperature : 25 °C  
 Test Result: PASS      Humidity : 50 %  
 Modulation:  $\pi/4$ -DQPSK

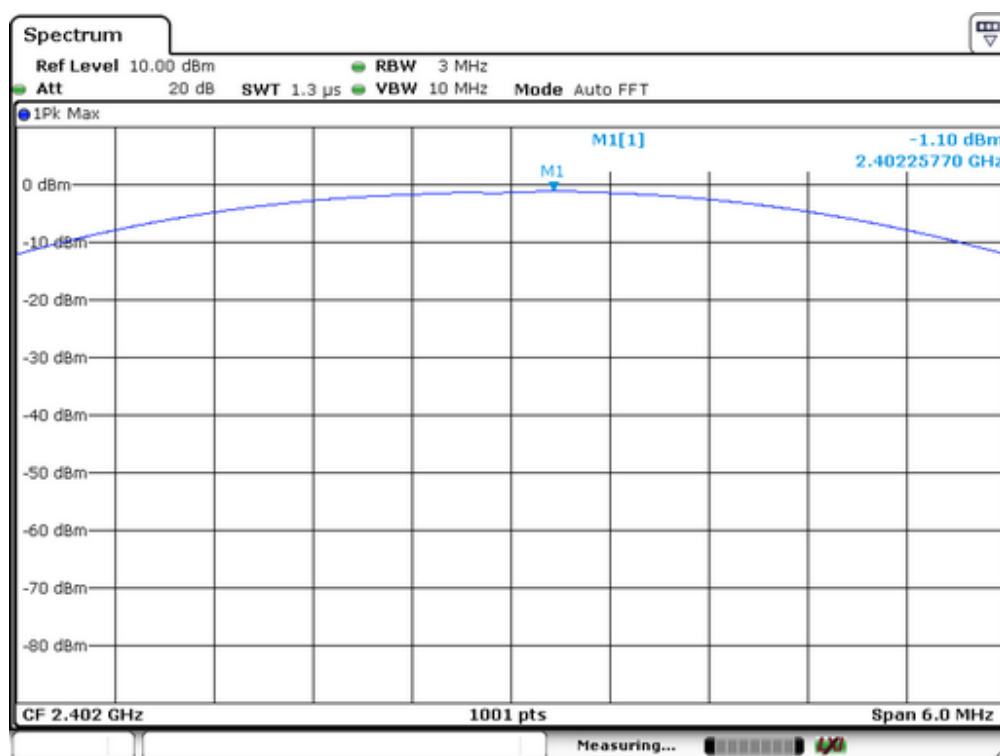
| Channel Number | Channel Frequency(MHz) | Peak Power Output(dBm) | Peak Power Output(mW) | Peak Power Limit(mW) | Pass/Fail |
|----------------|------------------------|------------------------|-----------------------|----------------------|-----------|
| 1              | 2402                   | -1.11                  | 0.774                 | 125                  | Pass      |
| 40             | 2441                   | -0.72                  | 0.847                 | 125                  | Pass      |
| 79             | 2480                   | <b>0.25</b>            | <b>1.059</b>          | 125                  | Pass      |

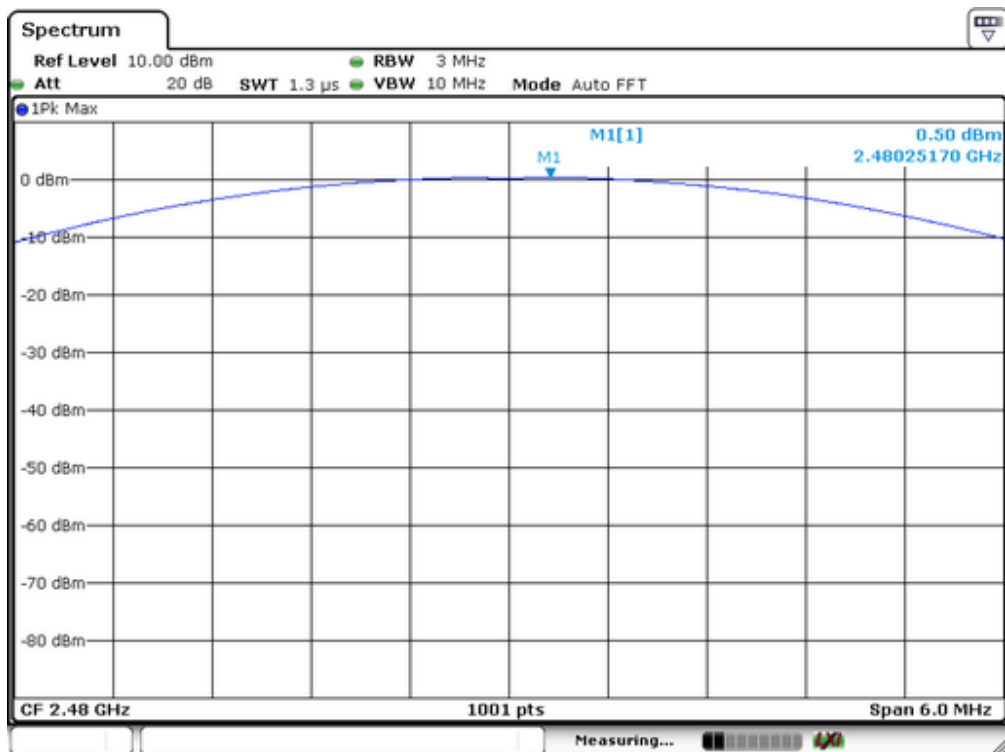
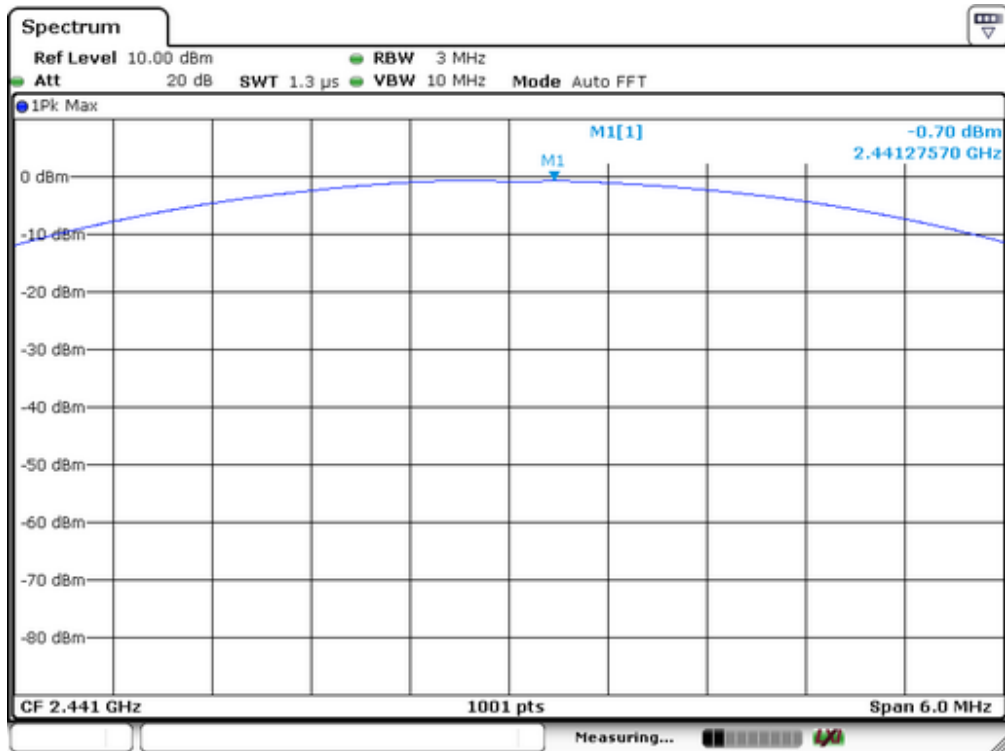




|                    |       |               |                |
|--------------------|-------|---------------|----------------|
| Spectrum Detector: | PK    | Test Date :   | March 30, 2015 |
| Test By:           | Andy  | Temperature : | 25 °C          |
| Test Result:       | PASS  | Humidity :    | 50 %           |
| Modulation:        | 8DPSK |               |                |

| Channel Number | Channel Frequency(MHz) | Peak Power Output(dBm) | Peak Power Output(mW) | Peak Power Limit(mW) | Pass/Fail |
|----------------|------------------------|------------------------|-----------------------|----------------------|-----------|
| 1              | 2402                   | -1.10                  | 0.776                 | 125                  | Pass      |
| 40             | 2441                   | -0.70                  | 0.851                 | 125                  | Pass      |
| 79             | 2480                   | <b>0.50</b>            | <b>1.122</b>          | 125                  | Pass      |





## 13. Band EDGE test

### 13.1 Measurement Procedure

1. The EUT was Operating in hopping mode or could be controlled its channel. Printed out test result from the spectrum by hard copy function.
2. The EUT was placed on a styrofoam table which is 1.5m above ground plane.
3. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
4. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
5. Repeat above procedures until all frequency measured were complete.
6. Use the following spectrum analyzer settings:

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 3MHz:

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

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

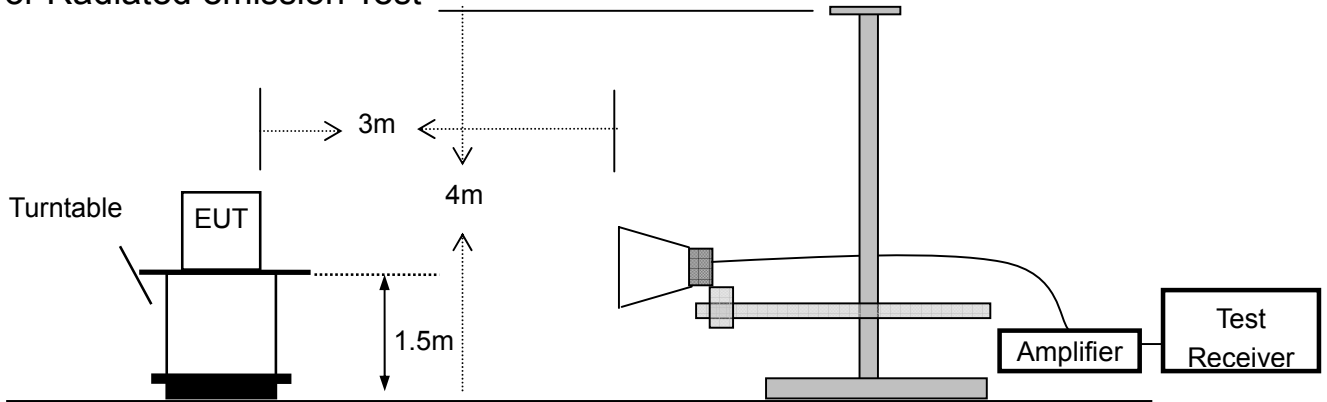
| EMI Test Receiver | Setting  |
|-------------------|----------|
| Attenuation       | Auto     |
| RBW               | 1MHz     |
| VBW               | 10Hz     |
| Detector          | Peak     |
| Trace             | Max hold |

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

For Conducted Test



### For Radiated emission Test



### 13.3 Measurement Equipment Used:

### For Conducted Test

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

### For Radiated emission Test

| Item | Equipment                      | Manufacturer    | Model No.  | Serial No.   | Last Cal.  | Cal. Interval |
|------|--------------------------------|-----------------|------------|--------------|------------|---------------|
| 1    | Test Receiver                  | Rohde & Schwarz | ESCI       | 1166.5950.03 | 03/16/2015 | 1 Year        |
| 2    | Bilog Antenna                  | Schwarzbeck     | VULB9163   | 000141       | 03/16/2015 | 1 Year        |
| 3    | Power Amplifier                | CDS             | RSU-M352   | 818          | 03/16/2015 | 1 Year        |
| 4    | Power Amplifier                | HP              | 8447F      | OPT H64      | 03/16/2015 | 1 Year        |
| 5    | Color Monitor                  | SUNSP0          | SP-140A    | N/A          | 03/16/2015 | 1 Year        |
| 6    | Single Line Filter             | JIANLI          | XL-3       | N/A          | 03/16/2015 | 1 Year        |
| 7    | Single Phase Power Line Filter | JIANLI          | DL-2X100B  | N/A          | 03/16/2015 | 1 Year        |
| 8    | 3 Phase Power Line Filter      | JIANLI          | DL-4X100B  | N/A          | 03/16/2015 | 1 Year        |
| 9    | DC Power Filter                | JIANLI          | DL-2X50B   | N/A          | 03/16/2015 | 1 Year        |
| 10   | Cable                          | Schwarzbeck     | PLF-100    | 549489       | 03/16/2015 | 1 Year        |
| 11   | Cable                          | Rosenberger     | CIL02      | A0783566     | 03/16/2015 | 1 Year        |
| 12   | Cable                          | Rosenberger     | RG 233/U   | 525178       | 03/16/2015 | 1 Year        |
| 13   | Signal Analyzer                | Rohde & Schwarz | FSV30      | 103040       | 12/29/2014 | 1 Year        |
| 14   | Horn Antenna                   | Schwarzbeck     | BBHA9120D  | 9120D-1272   | 12/29/2014 | 1 Year        |
| 15   | Power Amplifier                | LUNAR EM        | LNA1G18-40 | J10100000081 | 12/29/2014 | 1 Year        |
| 16   | Cable                          | H+S             | CBL-26     | N/A          | 12/29/2014 | 1 Year        |
| 17   | Cable                          | H+S             | CBL-26     | N/A          | 12/29/2014 | 1 Year        |
| 18   | Cable                          | H+S             | CBL-26     | N/A          | 12/29/2014 | 1 Year        |

### 13.4 Measurement Results:

Refer to attached data chart.

|                    |      |               |                |
|--------------------|------|---------------|----------------|
| Spectrum Detector: | PK   | Test Date :   | March 30, 2015 |
| Test By:           | Andy | Temperature : | 25 °C          |
| Test Result:       | PASS | Humidity :    | 50 %           |

#### 1. Conducted Test

For Non-Hopping Mode:

| Frequency (MHz) | Modulation | Peak Power Output(dBm) | Emission Read Value(dBm) | Result of Band Edge(dBc) | Band Edge Limit(dBc) |
|-----------------|------------|------------------------|--------------------------|--------------------------|----------------------|
| 2399.990        | GFSK       | -0.20                  | -43.35                   | 43.15                    | >20dBc               |
| 2399.650        | pi/4-DQPSK | -1.87                  | -46.28                   | 44.41                    | >20dBc               |
| 2399.769        | 8DPSK      | -1.82                  | -46.30                   | 44.48                    | >20dBc               |
| 2483.509        | GFSK       | 1.27                   | -51.04                   | 52.31                    | >20dBc               |
| 2483.519        | pi/4-DQPSK | -0.29                  | -44.86                   | 44.57                    | >20dBc               |
| 2483.510        | 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) |
|-----------------|------------|------------------------|--------------------------|--------------------------|----------------------|
| 2399.980        | GFSK       | -0.24                  | -43.98                   | 43.74                    | >20dBc               |
| 2399.660        | pi/4-DQPSK | -1.90                  | -48.17                   | 46.27                    | >20dBc               |
| 2399.690        | 8DPSK      | -1.86                  | -47.29                   | 45.43                    | >20dBc               |
| 2483.510        | GFSK       | 1.27                   | -52.38                   | 53.65                    | >20dBc               |
| 2483.539        | pi/4-DQPSK | -0.33                  | -46.78                   | 46.45                    | >20dBc               |
| 2483.510        | 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     |
| 2399.652           | H                                | 63.58                | 45.12 | 74                          | 54 | -10.42         | -8.88  |
| 2398.531           | V                                | 64.74                | 44.71 | 74                          | 54 | -9.26          | -9.29  |
| 2483.997           | H                                | 63.46                | 43.28 | 74                          | 54 | -10.54         | -10.72 |
| 2484.023           | V                                | 62.91                | 41.55 | 74                          | 54 | -11.09         | -12.45 |

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     |
| 2399.516           | H                                | 62.35                | 43.18 | 74                          | 54 | -11.65         | -10.82 |
| 2398.636           | V                                | 63.25                | 42.84 | 74                          | 54 | -10.75         | -11.16 |
| 2483.674           | H                                | 63.19                | 42.06 | 74                          | 54 | -10.81         | -11.94 |
| 2484.921           | V                                | 62.76                | 40.38 | 74                          | 54 | -11.24         | -13.62 |

## **14. Antenna Application**

### **14.1 Antenna requirement**

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

FCC part 15C section 15.247 requirements:

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

### **14.2 Result**

The EUT's antenna, permanent attached antenna, used a PCB antenna and integrated on PCB, The antenna's gain is 0 dBi and meets the requirement.

# APPENDIX I (Photos of EUT)



