

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

*OF*

**Wireless Speakers**

**Model No.: DALI ZENSOR 1 AX, DALI ZENSOR 5 AX**

**Trademark: DALI**

**FCC ID: 2AFD2-ZENSOR**

**Report No.: KAD150629097E2**

**Issue Date: October 21, 2015**

*Prepared for*

**DALI A/S**

**Dali Allé 1, DK-9610, Noerager, Denmark**

*Prepared by*

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DONGGUAN EMTEK CO., LTD.**

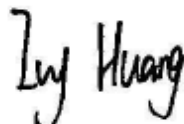
## VERIFICATION OF COMPLIANCE

|                      |                                                                                                                                             |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| Applicant:           | DALI A/S<br>Dali Allé 1, DK-9610, Noerager, Denmark                                                                                         |
| Manufacturer:        | DALI AUDIO MANUFACTURING(NINGBO)CO.,LTD<br>Building 7 No.1188, Zhongguan Road Ningbo zhejiang Province                                      |
| Product Description: | Wireless Speakers                                                                                                                           |
| Trade Mark:          | DALI                                                                                                                                        |
| Model Number:        | DALI ZENSOR 1 AX, DALI ZENSOR 5 AX<br>(Note: The samples are the same except model number. So DALI ZENSOR 5 AX was selected for full test.) |

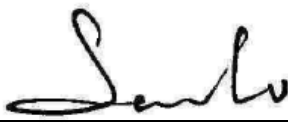
### We hereby certify that:

The above equipment was tested by DONGGUAN EMTEK CO., LTD. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2013) and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.247(2015).

Date of Test : June 29, 2015 to September 09, 2015

Prepared by :   
Ivy Huang/Editor

Reviewer :   
Alan He/Supervisor

Approved & Authorized  
Signer :   
Sam Lv/Manager

## Modified Information

| Version | Summary         | Revision Date | Report No.     |
|---------|-----------------|---------------|----------------|
| Ver.1.0 | Original Report | /             | KAD150629097E2 |
|         |                 |               |                |
|         |                 |               |                |
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## 1. GENERAL INFORMATION

### 1.1 Product Description

|                                   |                      |                             |
|-----------------------------------|----------------------|-----------------------------|
| Product Name                      | Wireless Speakers    |                             |
| Model number                      | DALI ZENSOR 5 AX     |                             |
| Power Supply                      | AC 100-240V, 50W     |                             |
| Product Software Version          | V.5.0                |                             |
| Product Hardware version          | V.A2                 |                             |
| Radio Software Version            | V2.02                |                             |
| Radio Hardware version            | V.B1                 |                             |
| Test Software Version             | V1.0                 |                             |
| RF Power Setting in Test Software | 0dbm                 |                             |
| Technical Description             |                      |                             |
|                                   | Bluetooth 4.0        | Bluetooth 2.1+EDR           |
| Operation Frequency               | 2402-2480MHz         |                             |
| Modulation                        | GFSK                 | GFSK, $\pi/4$ -DQPSK, 8DPSK |
| Number of Channel                 | 40                   | 79                          |
| Channel space                     | 2MHz                 | 1MHz                        |
| Max RF Output Power               | 5.48dBm(0.003532W)   | 5.31dBm(0.003396W)          |
| Antenna Type                      | Internal PCB antenna |                             |
| Antenna Gain                      | 0 dBi                |                             |

## 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

### 3. 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 details of test channels and bandwidth were for RF conductive measurement.

Channel List:

| Channel | Frequency (MHz) | Channel   | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|-----------|-----------------|---------|-----------------|
| 00      | <b>2402</b>     | 14        | 2430            | 28      | 2458            |
| 01      | 2404            | 15        | 2432            | 29      | 2460            |
| 02      | 2406            | 16        | 2434            | 30      | 2462            |
| 03      | 2408            | 17        | 2436            | 31      | 2464            |
| 04      | 2410            | 18        | 2438            | 32      | 2466            |
| 05      | 2412            | 19        | 2440            | 33      | 2468            |
| 06      | 2414            | <b>20</b> | <b>2442</b>     | 34      | 2470            |
| 07      | 2416            | 21        | 2444            | 35      | 2472            |
| 08      | 2418            | 22        | 2446            | 36      | 2474            |
| 09      | 2420            | 23        | 2448            | 37      | 2476            |
| 10      | 2422            | 24        | 2450            | 38      | 2478            |
| 11      | 2424            | 25        | 2452            | 39      | <b>2480</b>     |
| 12      | 2426            | 26        | 2454            |         |                 |
| 13      | 2428            | 27        | 2456            |         |                 |

Note:

1. Test of channel was included the lowest 2402MHz, middle 2442MHz and highest frequency 2480MHz in highest data rate and to perform the test, then record on this report.

#### 4. 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                       | $\pm 3\%$                 |

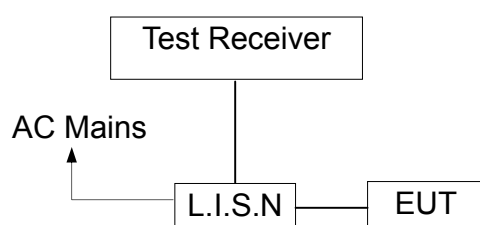
Measurement Uncertainty for a level of Confidence of 95%

## 5. Conducted Emissions Test

### 5.1 Measurement Procedure:

1. The EUT was placed on a table, which is 0.1m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured was complete.

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



### 5.3 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 |

### 5.4 Conducted Emission Limit

#### (7) Conducted Emission Frequency(MHz)

0.15-0.5  
0.5-5.0  
5.0-30.0

#### Quasi-peak

66-56  
56  
60

#### Average

56-46  
46  
50

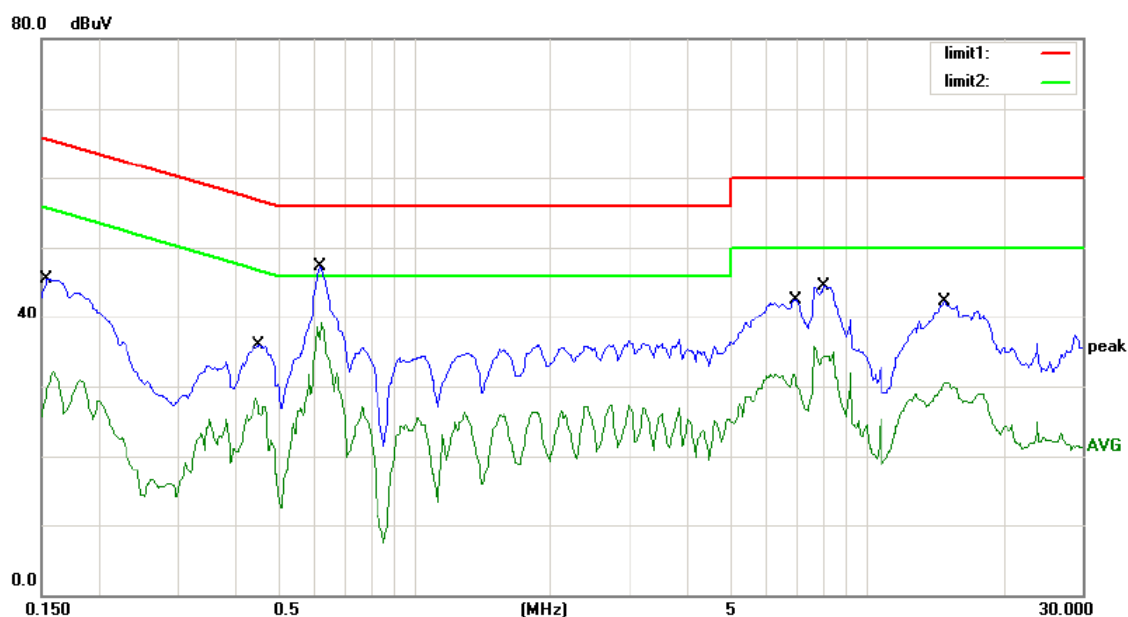
#### Note:

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.

### 5.5 Measurement Result:

**Pass.**

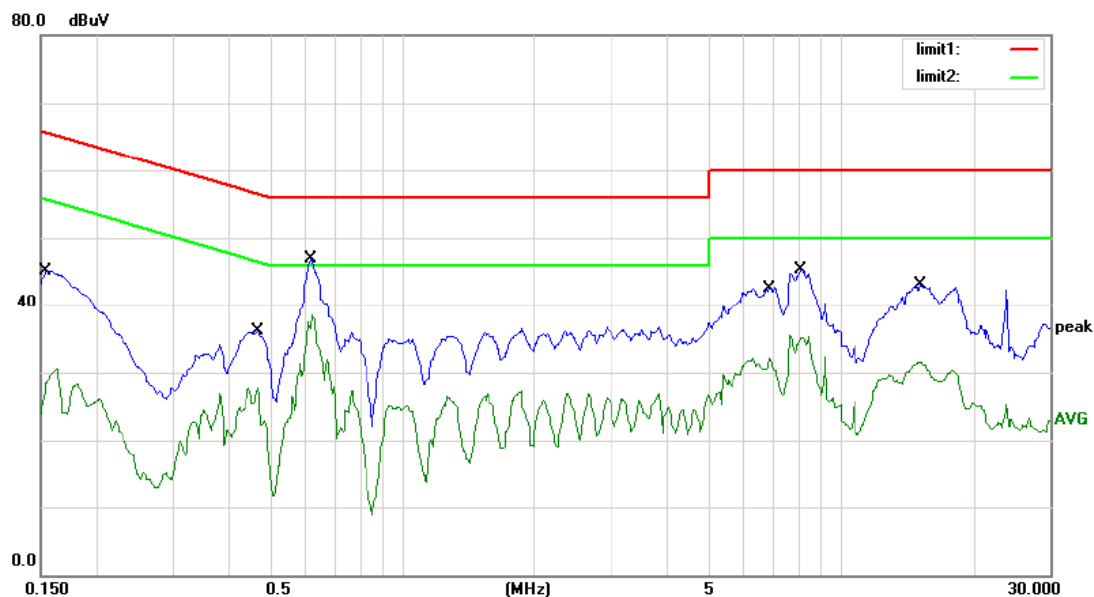
All tested the data of the worst mode (GFSK TX 2402MHz) are recorded in the following pages



Site site #1 Phase: **L1** Temperature: 24  
 Limit: (CE)FCC Part 15B\_QP 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 | Limit<br>dBuV | Over<br>dB | Detector | Comment |
|-----|-----|--------------|--------------------------|-------------------------|--------------------------|---------------|------------|----------|---------|
| 1   |     | 0.1545       | 43.24                    | 0.00                    | 43.24                    | 65.75         | -22.51     | QP       |         |
| 2   |     | 0.1545       | 32.14                    | 0.00                    | 32.14                    | 55.75         | -23.61     | AVG      |         |
| 3   |     | 0.4560       | 33.14                    | 0.00                    | 33.14                    | 56.77         | -23.63     | QP       |         |
| 4   |     | 0.4560       | 28.29                    | 0.00                    | 28.29                    | 46.77         | -18.48     | AVG      |         |
| 5   |     | 0.6180       | 45.68                    | 0.00                    | 45.68                    | 56.00         | -10.32     | QP       |         |
| 6   | *   | 0.6180       | 39.02                    | 0.00                    | 39.02                    | 46.00         | -6.98      | AVG      |         |
| 7   |     | 7.0200       | 40.51                    | 0.00                    | 40.51                    | 60.00         | -19.49     | QP       |         |
| 8   |     | 7.0200       | 31.76                    | 0.00                    | 31.76                    | 50.00         | -18.24     | AVG      |         |
| 9   |     | 8.0600       | 42.14                    | 0.00                    | 42.14                    | 60.00         | -17.86     | QP       |         |
| 10  |     | 8.0600       | 34.91                    | 0.00                    | 34.91                    | 50.00         | -15.09     | AVG      |         |
| 11  |     | 14.8750      | 40.56                    | 0.00                    | 40.56                    | 60.00         | -19.44     | QP       |         |
| 12  |     | 14.8750      | 30.55                    | 0.00                    | 30.55                    | 50.00         | -19.45     | AVG      |         |

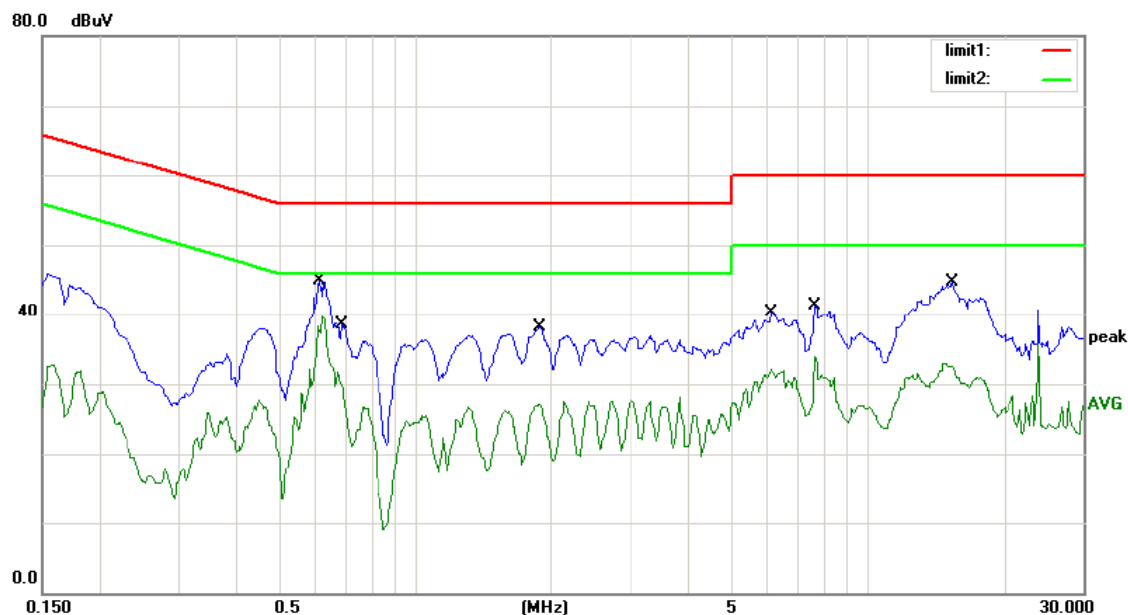
\*:Maximum data x:Over limit !:over margin Comment: Factor build in receiver.



Site site #1 Phase: **N** Temperature: 24  
 Limit: (CE)FCC Part 15B\_QP 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 | Limit<br>dBuV | Over<br>dB | Detector | Comment |
|-----|-----|--------------|--------------------------|-------------------------|--------------------------|---------------|------------|----------|---------|
| 1   |     | 0.1545       | 43.51                    | 0.00                    | 43.51                    | 65.75         | -22.24     | QP       |         |
| 2   |     | 0.1545       | 30.59                    | 0.00                    | 30.59                    | 55.75         | -25.16     | AVG      |         |
| 3   |     | 0.4695       | 34.21                    | 0.00                    | 34.21                    | 56.52         | -22.31     | QP       |         |
| 4   |     | 0.4695       | 27.77                    | 0.00                    | 27.77                    | 46.52         | -18.75     | AVG      |         |
| 5   |     | 0.6180       | 44.85                    | 0.00                    | 44.85                    | 56.00         | -11.15     | QP       |         |
| 6   | *   | 0.6180       | 38.45                    | 0.00                    | 38.45                    | 46.00         | -7.55      | AVG      |         |
| 7   |     | 6.9000       | 40.31                    | 0.00                    | 40.31                    | 60.00         | -19.69     | QP       |         |
| 8   |     | 6.9000       | 32.13                    | 0.00                    | 32.13                    | 50.00         | -17.87     | AVG      |         |
| 9   |     | 8.0700       | 43.67                    | 0.00                    | 43.67                    | 60.00         | -16.33     | QP       |         |
| 10  |     | 8.0700       | 35.44                    | 0.00                    | 35.44                    | 50.00         | -14.56     | AVG      |         |
| 11  |     | 15.2250      | 41.74                    | 0.00                    | 41.74                    | 60.00         | -18.26     | QP       |         |
| 12  |     | 15.2250      | 31.47                    | 0.00                    | 31.47                    | 50.00         | -18.53     | AVG      |         |

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

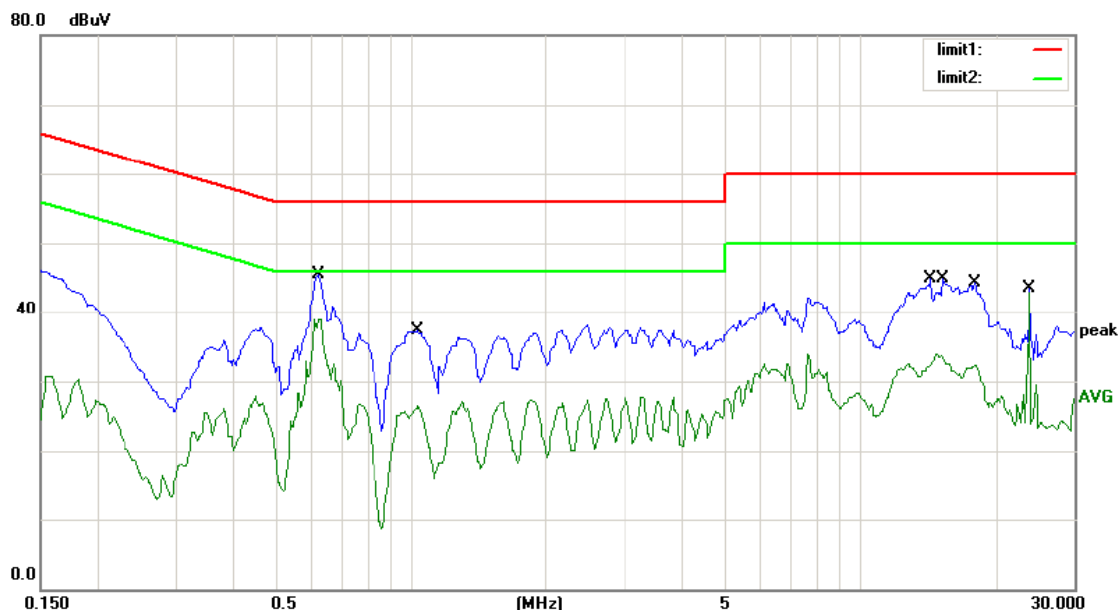


Site site #1  
 Limit: (CE)FCC PART 15\_QP  
 Mode: TX2402  
 Note:

Phase: **L1**  
 Power: AC 240V/50Hz  
 Temperature: 24  
 Humidity: 55 %

| 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   |     | 0.6140       | 44.89                    | 0.00                    | 44.89                    | 56.00         | -11.11     | QP       |         |
| 2   | *   | 0.6140       | 37.75                    | 0.00                    | 37.75                    | 46.00         | -8.25      | AVG      |         |
| 3   |     | 0.6863       | 38.45                    | 0.00                    | 38.45                    | 56.00         | -17.55     | QP       |         |
| 4   |     | 0.6863       | 29.85                    | 0.00                    | 29.85                    | 46.00         | -16.15     | AVG      |         |
| 5   |     | 1.8960       | 38.18                    | 0.00                    | 38.18                    | 56.00         | -17.82     | QP       |         |
| 6   |     | 1.8960       | 27.06                    | 0.00                    | 27.06                    | 46.00         | -18.94     | AVG      |         |
| 7   |     | 6.1400       | 40.40                    | 0.00                    | 40.40                    | 60.00         | -19.60     | QP       |         |
| 8   |     | 6.1400       | 32.05                    | 0.00                    | 32.05                    | 50.00         | -17.95     | AVG      |         |
| 9   |     | 7.6800       | 41.31                    | 0.00                    | 41.31                    | 60.00         | -18.69     | QP       |         |
| 10  |     | 7.6800       | 33.92                    | 0.00                    | 33.92                    | 50.00         | -16.08     | AVG      |         |
| 11  |     | 15.4500      | 44.66                    | 0.00                    | 44.66                    | 60.00         | -15.34     | QP       |         |
| 12  |     | 15.4500      | 31.40                    | 0.00                    | 31.40                    | 50.00         | -18.60     | AVG      |         |

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



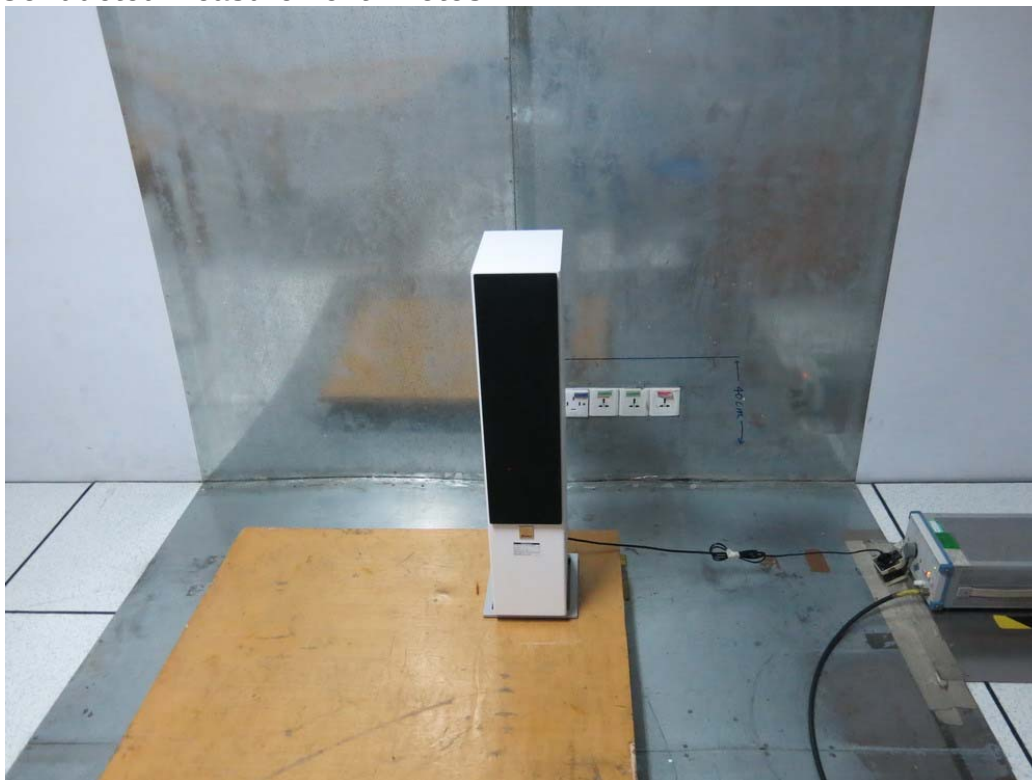
Site site #1  
 Limit: (CE)FCC PART 15\_QP  
 Mode: TX2402  
 Note:

Phase: **N**  
 Power: AC 240V/50Hz  
 Temperature: 24  
 Humidity: 55 %

| No. | Mk. | Freq.   | Reading Level | Correct Factor | Measure-ment | Limit | Over   |          |         |
|-----|-----|---------|---------------|----------------|--------------|-------|--------|----------|---------|
|     |     | MHz     | dBuV          | dB             | dBuV         | dBuV  | dB     | Detector | Comment |
| 1   |     | 0.6225  | 45.49         | 0.00           | 45.49        | 56.00 | -10.51 | QP       |         |
| 2   |     | 0.6225  | 38.93         | 0.00           | 38.93        | 46.00 | -7.07  | AVG      |         |
| 3   |     | 1.0410  | 37.29         | 0.00           | 37.29        | 56.00 | -18.71 | QP       |         |
| 4   |     | 1.0410  | 26.50         | 0.00           | 26.50        | 46.00 | -19.50 | AVG      |         |
| 5   |     | 14.2126 | 43.90         | 0.00           | 43.90        | 60.00 | -16.10 | QP       |         |
| 6   |     | 14.2126 | 32.05         | 0.00           | 32.05        | 50.00 | -17.95 | AVG      |         |
| 7   |     | 15.2261 | 44.90         | 0.00           | 44.90        | 60.00 | -15.10 | QP       |         |
| 8   |     | 15.2261 | 33.10         | 0.00           | 33.10        | 50.00 | -16.90 | AVG      |         |
| 9   |     | 17.9500 | 44.27         | 0.00           | 44.27        | 60.00 | -15.73 | QP       |         |
| 10  |     | 17.9500 | 32.32         | 0.00           | 32.32        | 50.00 | -17.68 | AVG      |         |
| 11  |     | 23.9250 | 43.52         | 0.00           | 43.52        | 60.00 | -16.48 | QP       |         |
| 12  | *   | 23.9250 | 42.98         | 0.00           | 42.98        | 50.00 | -7.02  | AVG      |         |

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

**4.6 Conducted Measurement Photos:**



## 6. Radiated Emission Test

### 5.1 Measurement Procedure

- 1 Below 1000MHz, The EUT was placed on a turn table which is 0.1m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 0.1m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measured were complete.

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 |

For Average Measurement:

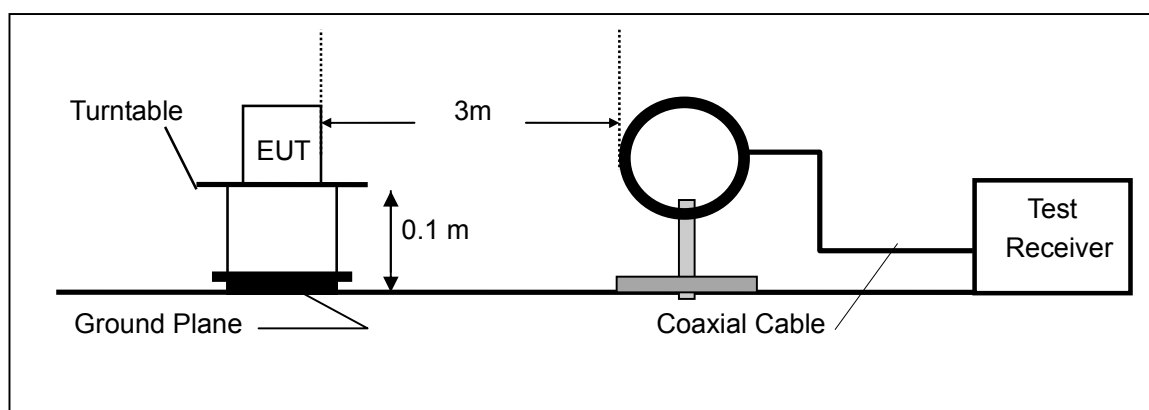
VBW=10Hz, when duty cycle is no less than 98 percent.

VBW $\geq$ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

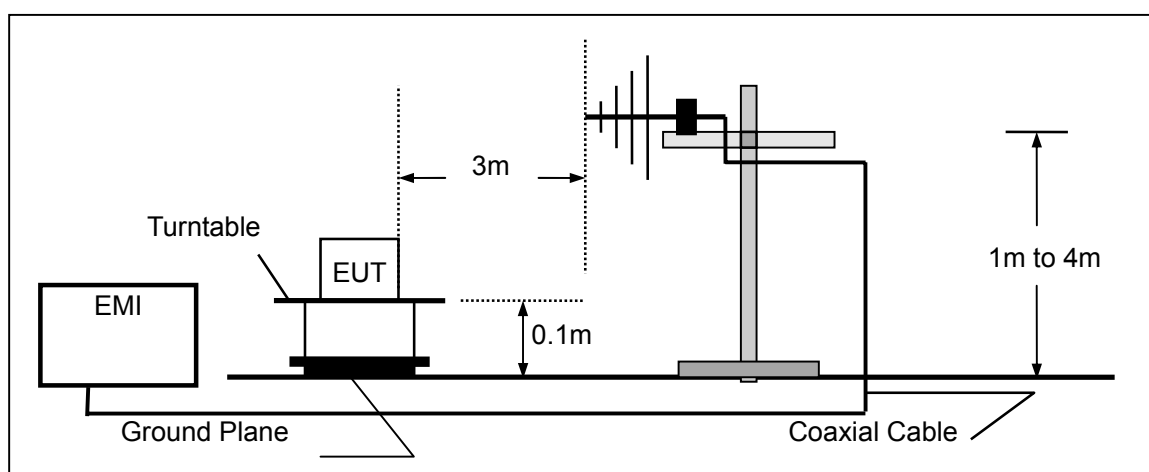
| Band      | Duty Cycle(%) | T( $\mu$ s) | 1/T(KHz) | Average Correction Factor | VBW Setting |
|-----------|---------------|-------------|----------|---------------------------|-------------|
| 2402-2480 | 100           | -           | -        | 0                         | 10Hz        |

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

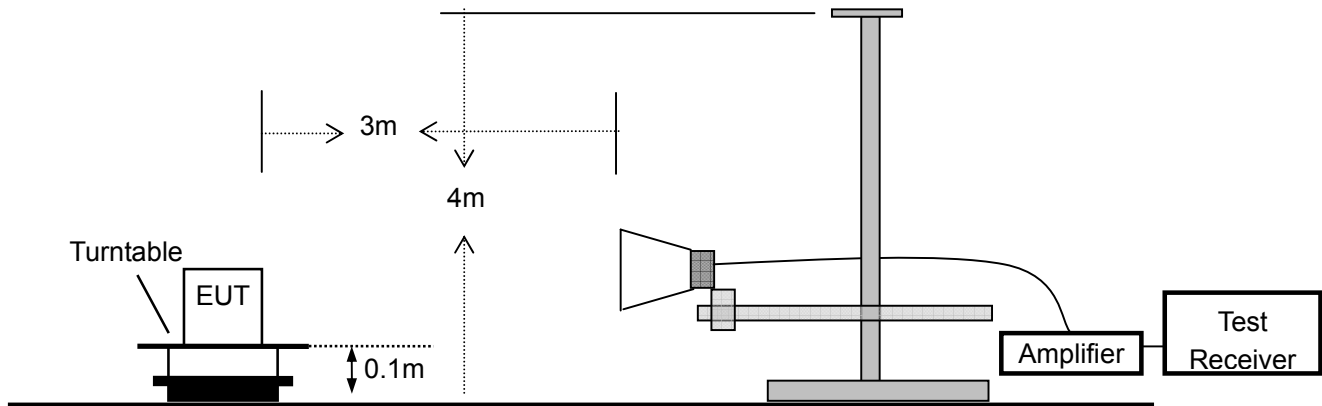
### (A) Radiated Emission Test Set-Up, Frequency Below 30MHz



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



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



**5.3 Measurement Equipment Used:**

| 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                  | SUNSPO          | 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        |

#### 5.4 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.

## 5.5 Measurement Result

### Below 30MHz:

|                    |            |               |                 |
|--------------------|------------|---------------|-----------------|
| Operation Mode:    | TX         | Test Date :   | August 25, 2015 |
| Frequency Range:   | 9KHz~30MHz | Temperature : | 28℃             |
| Test Result:       | PASS       | Humidity :    | 65 %            |
| Measured Distance: | 3m         | Test By:      | Andy            |

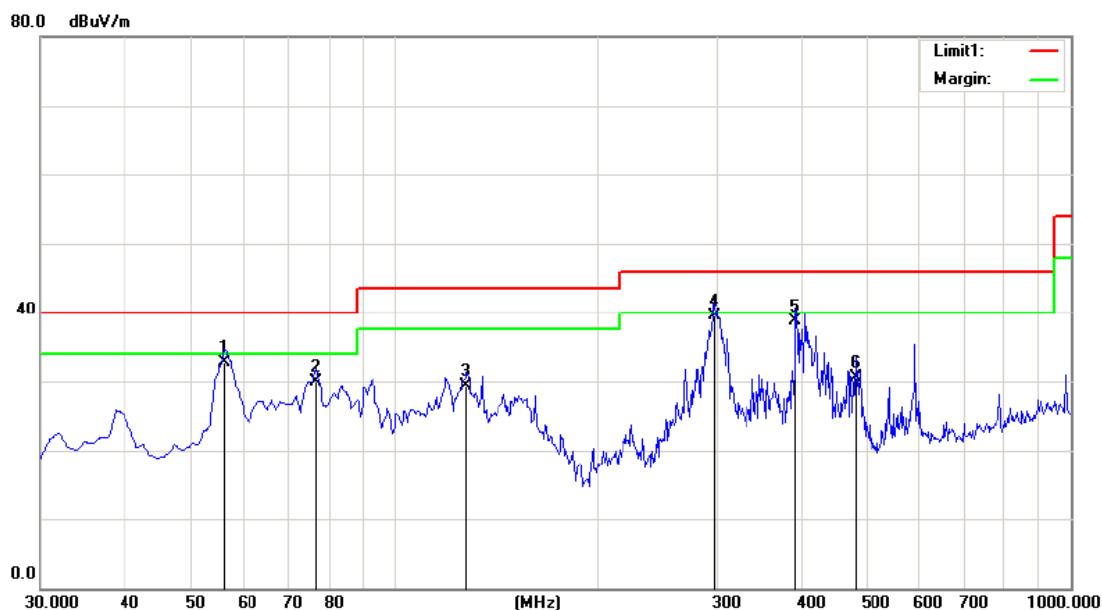
| Freq.<br>(MHz) | Ant.Pol.<br>H/V | Emission<br>Level<br>(dBuV/m) | Limit 3m<br>(dBuV/m) | Over<br>(dB) |
|----------------|-----------------|-------------------------------|----------------------|--------------|
| --             | --              | --                            | --               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

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 data of the mode (GFSK TX2402) are recorded in the following pages.



Site site #1

Polarization: **Horizontal**

Temperature: 24

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

Power: AC 120V/60Hz

Humidity: 55 %

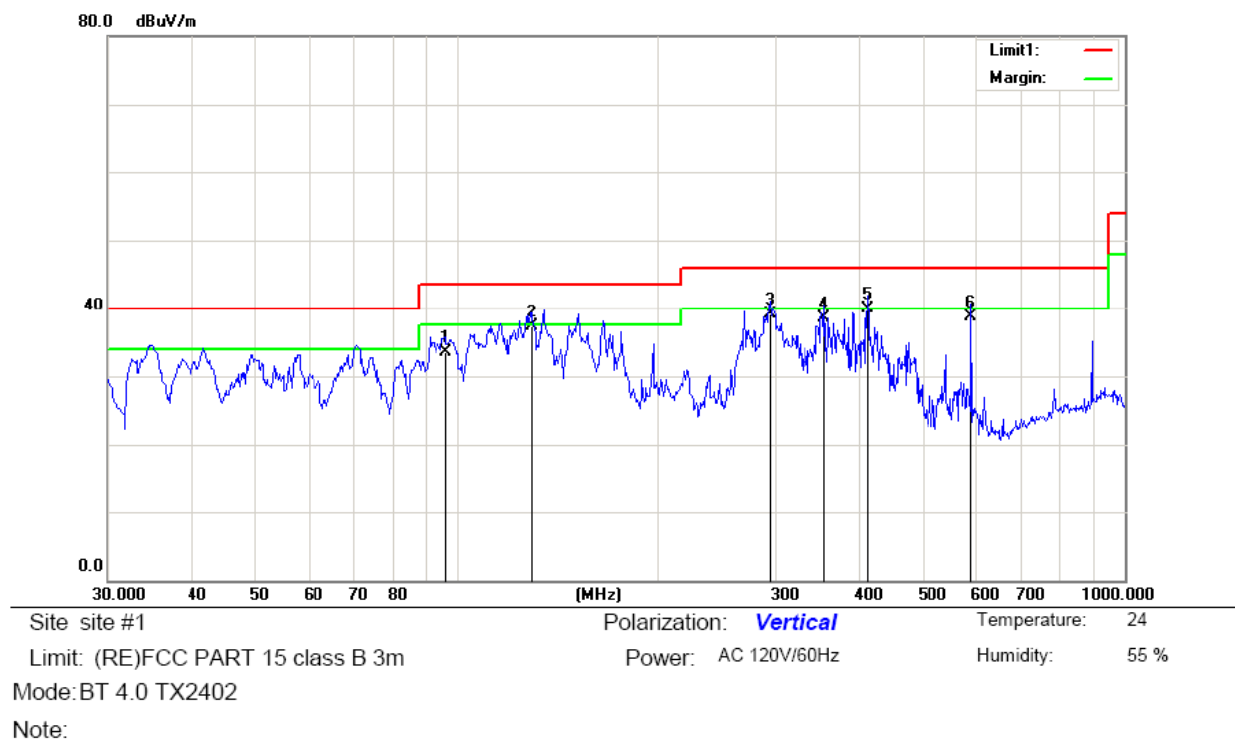
Mode: BT 4.0 TX2402

Note:

| No. | Mk. | Freq.    | Reading | Correct | Measure- | Limit  | Over   | Antenna | Table  |
|-----|-----|----------|---------|---------|----------|--------|--------|---------|--------|
|     |     | MHz      | Level   | Factor  | ment     |        |        | Height  | Degree |
|     |     |          | dBuV    | dB      | dBuV/m   | dBuV/m | dB     | cm      | degree |
| 1   |     | 56.1900  | 50.52   | -17.84  | 32.68    | 40.00  | -7.32  | QP      | 0      |
| 2   |     | 76.5600  | 52.64   | -22.66  | 29.98    | 40.00  | -10.02 | QP      | 0      |
| 3   |     | 127.9700 | 45.56   | -16.31  | 29.25    | 43.50  | -14.25 | QP      | 0      |
| 4   | *   | 297.7200 | 53.91   | -14.48  | 39.43    | 46.00  | -6.57  | QP      | 0      |
| 5   |     | 392.7800 | 50.34   | -11.58  | 38.76    | 46.00  | -7.24  | QP      | 0      |
| 6   |     | 481.0500 | 41.13   | -10.54  | 30.59    | 46.00  | -15.41 | QP      | 0      |

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

Operator: John



| No. | Mk. | Freq.    | Reading Level | Correct Factor | Measurement | Limit  | Over   | Antenna Height | Table Degree |        |
|-----|-----|----------|---------------|----------------|-------------|--------|--------|----------------|--------------|--------|
|     |     | MHz      | dBuV          | dB             | dBuV/m      | dBuV/m | dB     | Detector       | cm           | degree |
| 1   |     | 96.0985  | 53.23         | -19.80         | 33.43       | 43.50  | -10.07 | QP             |              | 0      |
| 2   |     | 129.0145 | 53.75         | -16.35         | 37.40       | 43.50  | -6.10  | QP             |              | 0      |
| 3   |     | 294.8100 | 53.73         | -14.67         | 39.06       | 46.00  | -6.94  | QP             |              | 0      |
| 4   |     | 355.9200 | 51.24         | -12.81         | 38.43       | 46.00  | -7.57  | QP             |              | 0      |
| 5   | *   | 412.1800 | 51.32         | -11.34         | 39.98       | 46.00  | -6.02  | QP             |              | 0      |
| 6   |     | 589.6900 | 47.16         | -8.54          | 38.62       | 46.00  | -7.38  | QP             |              | 0      |

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

Operator: John

## Above 1000MHz

Operation Mode: TX Mode (CH00: 2402MHz) Test Date : August 25, 2015  
 Frequency Range: 1-25GHz Temperature : 25 °C  
 Test Result: PASS Humidity : 50 %  
 Measured Distance: 3m Test By: Andy  
 Test Voltage: AC 120V/60Hz

| 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                | 65.39                  | 46.66 | 74               | 54 | -8.61      | -7.34  |
| 7206           | V                | 64.25                  | 45.53 | 74               | 54 | -9.75      | -8.47  |
| 9608           | V                | 63.56                  | 44.31 | 74               | 54 | -10.44     | -9.69  |
| 12010          | V                | 62.78                  | 43.26 | 74               | 54 | -11.22     | -10.74 |
| 14412          | V                | 61.13                  | 42.58 | 74               | 54 | -12.87     | -11.42 |
| 16814          | V                | 60.32                  | 41.78 | 74               | 54 | -13.68     | -12.22 |
| 4804           | H                | 65.2                   | 46.13 | 74               | 54 | -8.8       | -7.87  |
| 7206           | H                | 64.15                  | 45.21 | 74               | 54 | -9.85      | -8.79  |
| 9608           | H                | 63.25                  | 44.54 | 74               | 54 | -10.75     | -9.46  |
| 12010          | H                | 62.45                  | 43.68 | 74               | 54 | -11.55     | -10.32 |
| 14412          | H                | 61.68                  | 42.61 | 74               | 54 | -12.32     | -11.39 |
| 16814          | H                | 60.56                  | 41.92 | 74               | 54 | -13.44     | -12.08 |

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.

Operation Mode: TX Mode (CH20: 2442MHz) Test Date : August 25, 2015  
 Frequency Range: 1-25GHz Temperature : 25 °C  
 Test Result: PASS Humidity : 50 %  
 Measured Distance: 3m Test By: Andy  
 Test Voltage: AC 120V/60Hz

| Freq.<br>(MHz) | Ant. Pol.<br>H/V | Emission Level(dBuV/m) |       | Limit 3m(dBuV/m) |    | Margin(dB) |        |
|----------------|------------------|------------------------|-------|------------------|----|------------|--------|
|                |                  | PK                     | AV    | PK               | AV | PK         | AV     |
| 4884           | V                | 65.09                  | 46.88 | 74               | 54 | -8.91      | -7.12  |
| 7326           | V                | 64.52                  | 45.65 | 74               | 54 | -9.48      | -8.35  |
| 9768           | V                | 63.45                  | 44.52 | 74               | 54 | -10.55     | -9.48  |
| 12210          | V                | 62.98                  | 43.62 | 74               | 54 | -11.02     | -10.38 |
| 14652          | V                | 61.53                  | 42.76 | 74               | 54 | -12.47     | -11.24 |
| 17094          | V                | 60.82                  | 41.69 | 74               | 54 | -13.18     | -12.31 |
| 4884           | H                | 66.98                  | 45.29 | 74               | 54 | -7.02      | -8.71  |
| 7326           | H                | 65.83                  | 44.61 | 74               | 54 | -8.17      | -9.39  |
| 9768           | H                | 64.56                  | 43.58 | 74               | 54 | -9.44      | -10.42 |
| 12210          | H                | 63.74                  | 42.62 | 74               | 54 | -10.26     | -11.38 |
| 14652          | H                | 62.62                  | 41.89 | 74               | 54 | -11.38     | -12.11 |
| 17094          | H                | 61.73                  | 40.71 | 74               | 54 | -12.27     | -13.29 |

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.

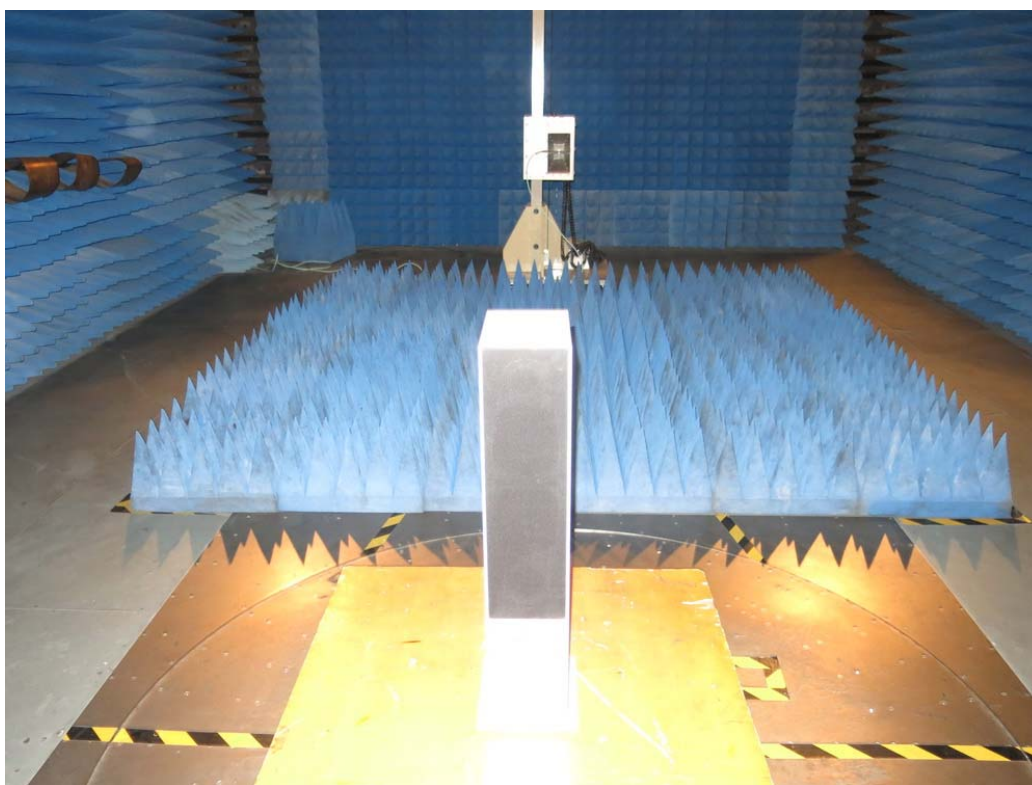
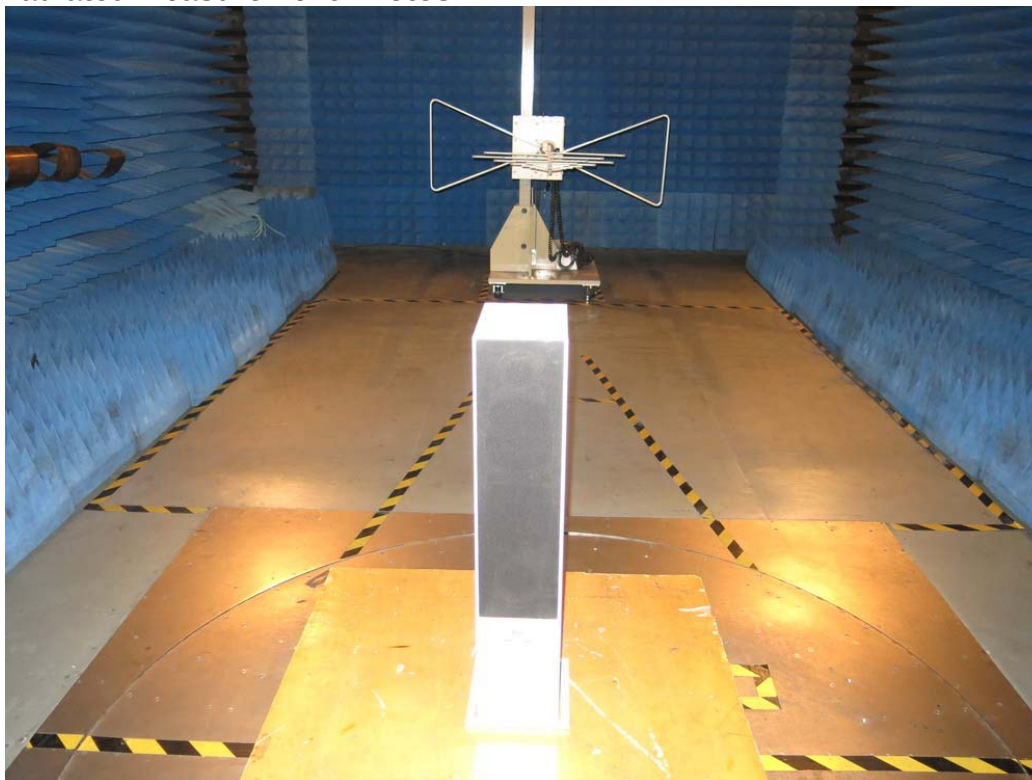
Operation Mode: TX Mode (CH39: 2480MHz) Test Date : August 25, 2015  
 Frequency Range: 1-25GHz Temperature : 25 °C  
 Test Result: PASS Humidity : 50 %  
 Measured Distance: 3m Test By: Andy  
 Test Voltage: AC 120V/60Hz

| 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                | 64.19                  | 45.12 | 74               | 54 | -9.81      | -8.88  |
| 7440           | V                | 63.25                  | 44.21 | 74               | 54 | -10.75     | -9.79  |
| 9920           | V                | 62.45                  | 43.54 | 74               | 54 | -11.55     | -10.46 |
| 12400          | V                | 61.47                  | 42.45 | 74               | 54 | -12.53     | -11.55 |
| 14880          | V                | 60.39                  | 41.78 | 74               | 54 | -13.61     | -12.22 |
| 17360          | V                | 59.87                  | 40.69 | 74               | 54 | -14.13     | -13.31 |
| 4960           | H                | 65.24                  | 45.06 | 74               | 54 | -8.76      | -8.94  |
| 7440           | H                | 64.42                  | 44.35 | 74               | 54 | -9.58      | -9.65  |
| 9920           | H                | 63.57                  | 43.67 | 74               | 54 | -10.43     | -10.33 |
| 12400          | H                | 62.28                  | 42.58 | 74               | 54 | -11.72     | -11.42 |
| 14880          | H                | 61.86                  | 41.74 | 74               | 54 | -12.14     | -12.26 |
| 17360          | H                | 60.34                  | 40.56 | 74               | 54 | -13.66     | -13.44 |

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.

**5.6 Radiated Measurement Photos:**

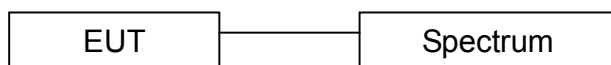


## 7. 6dB Bandwidth Measurement

### 6.1 Measurement Procedure

The EUT was operating in Bluetooth 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    | 03/16/2015 | 03/15/2016 |
| Coaxial Cable     | CDS             | 79254        | 46107086      | 03/16/2015 | 03/15/2016 |

### 6.4 Limit

The minimum 6dB bandwidth shall be at least 500kHz.

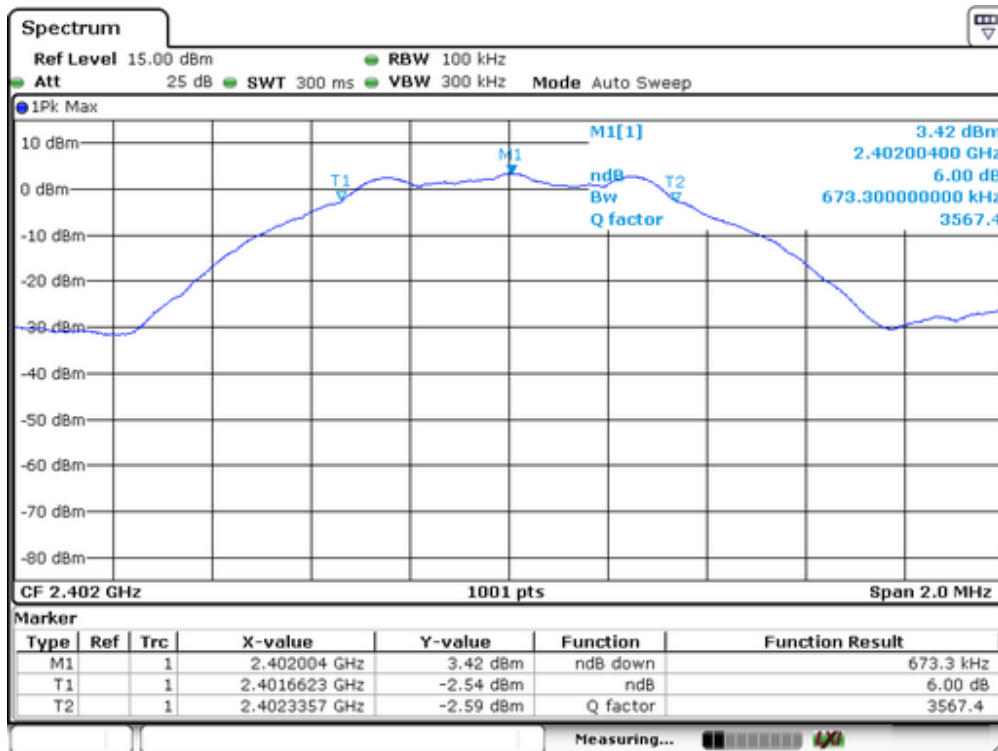
### 6.5 Measurement Results:

Refer to attached data chart.

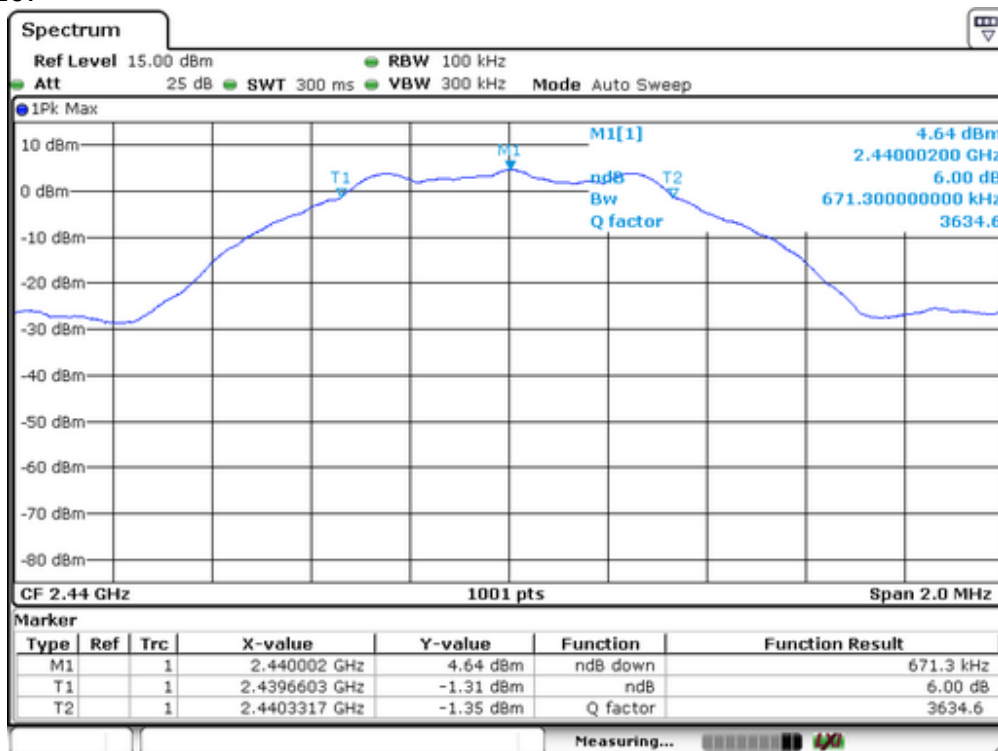
|                    |      |               |                 |
|--------------------|------|---------------|-----------------|
| Spectrum Detector: | PK   | Test Date :   | August 25, 2015 |
| Test By:           | Andy | Temperature : | 25 °C           |
| Test Result:       | PASS | Humidity :    |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

| Channel number | Channel frequency (MHz) | Measurement level (KHz) | Required Limit (KHz) |
|----------------|-------------------------|-------------------------|----------------------|
| 00             | 2402                    | 673                     | >500                 |
| 20             | 2442                    | 671                     | >500                 |
| 39             | 2480                    | 673                     | >500                 |

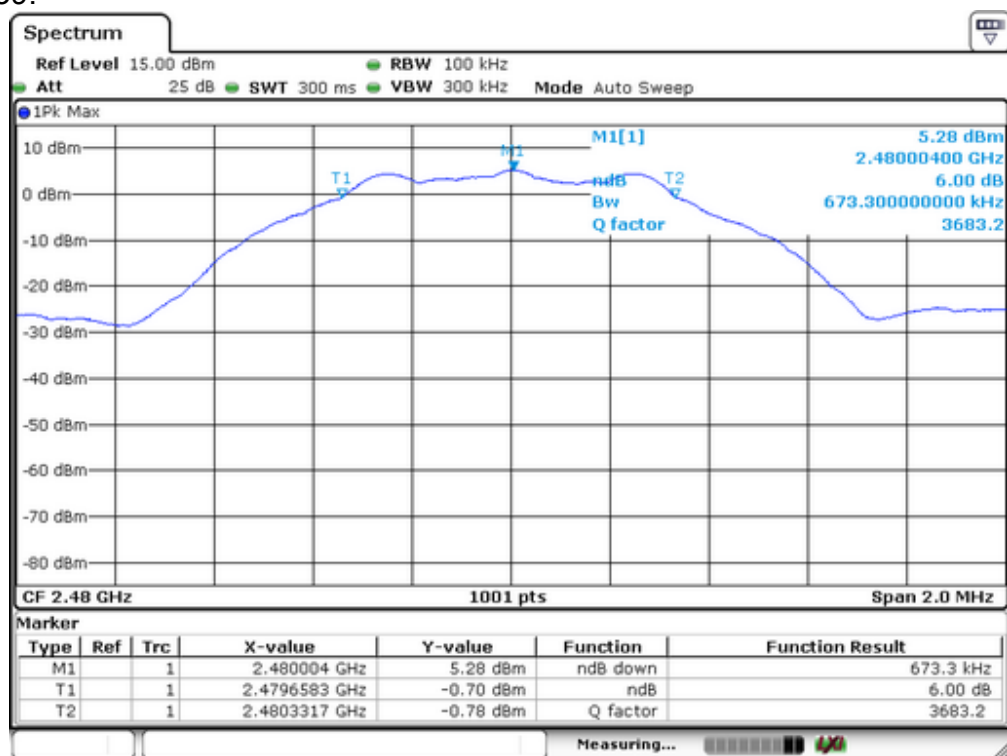
Channel 00:



Channel 20:



Channel 39:



## 7. MAXIMUM PEAK OUTPUT POWER TEST

### 7.1 Measurement Procedure

- The Transmitter output (antenna port) was connected to the spectrum Analyzer.
- Turn on the EUT and then record the peak power value.
- Repeat above procedures on all channels needed to be tested.

### 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    | 03/16/2015 | 03/15/2016 |
| Coaxial Cable     | CDS             | 79254        | 46107086      | 03/16/2015 | 03/15/2016 |

### 7.4 Peak Power output limit

The maximum peak power shall be less 1Watt.

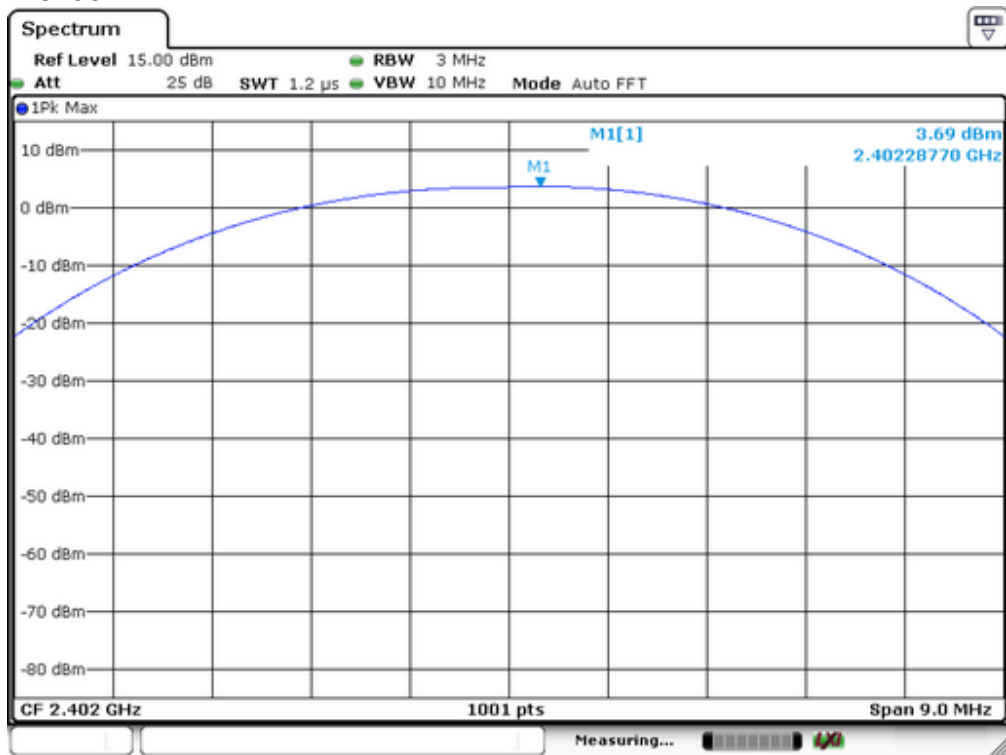
### 7.5 Measurement Results:

Refer to attached data chart.

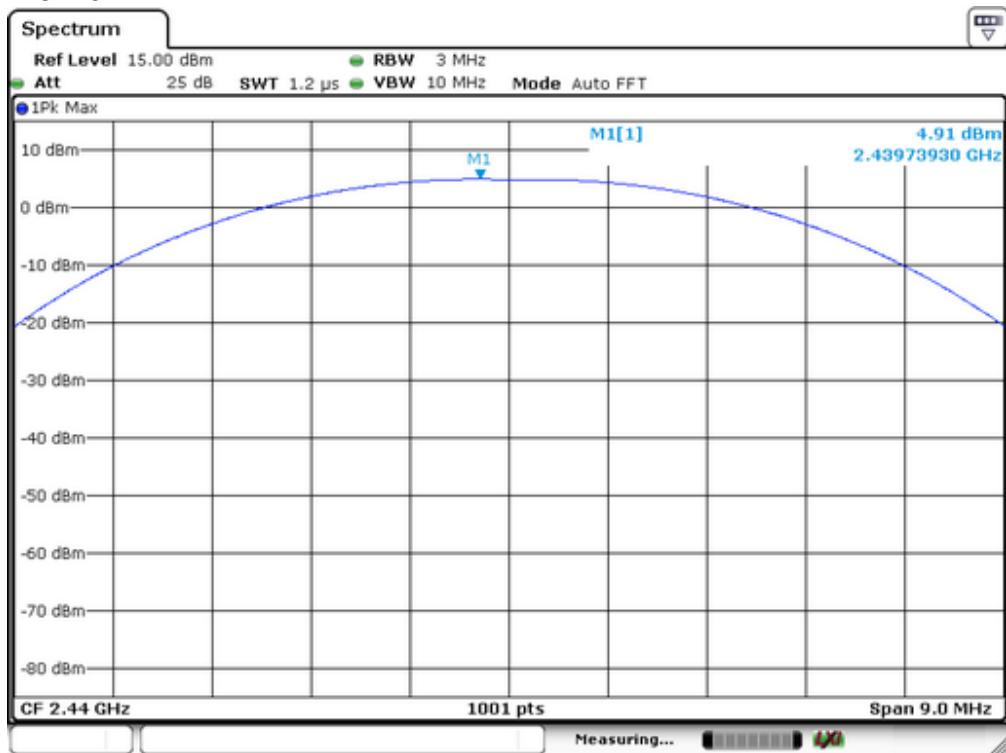
Spectrum Detector: PK      Test Date : August 25, 2015  
 Test By: Andy      Temperature : 25 °C  
 Test Result: PASS      Humidity : 50 %

| Channel number | Channel Frequency (MHz) | Peak Power output(dBm) | Peak Power output(mW) | Peak Power Limit(W) | Pass/Fail |
|----------------|-------------------------|------------------------|-----------------------|---------------------|-----------|
| 0              | 2402                    | 3.69                   | 2.339                 | 1W(30dBm)           | PASS      |
| 20             | 2442                    | 4.91                   | 3.097                 | 1W(30dBm)           | PASS      |
| 39             | 2480                    | <b>5.48</b>            | <b>3.532</b>          | 1W(30dBm)           | PASS      |

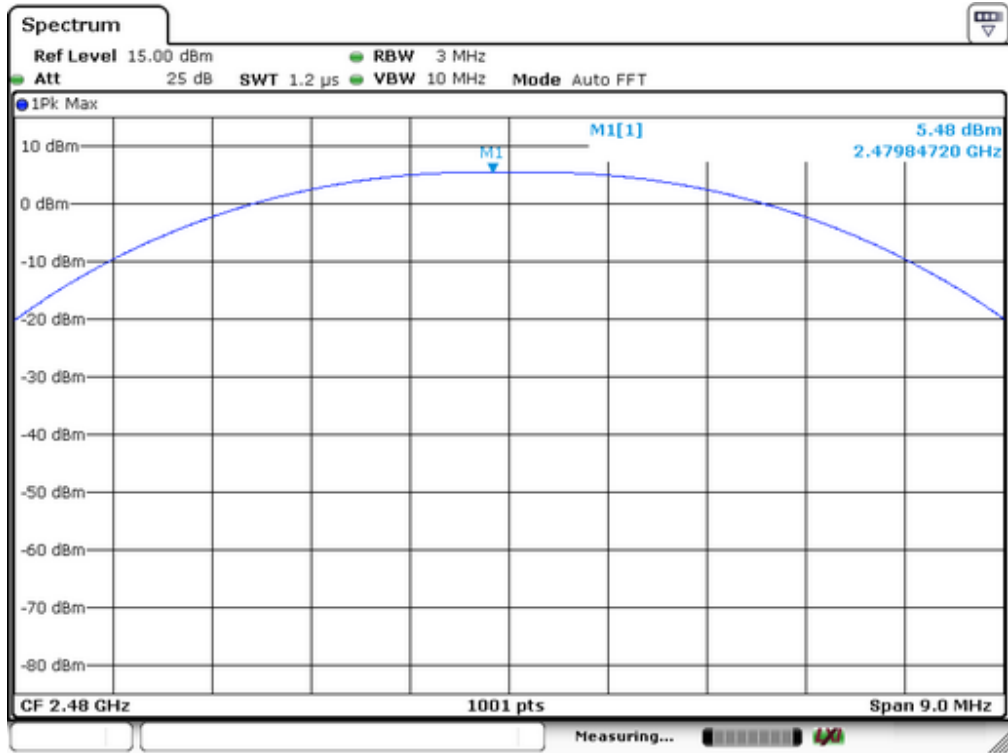
Channel 00:



Channel 20:



Channel 39:

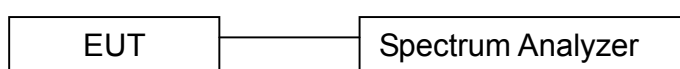


## 8. Power Spectral Density Measurement

### 8.1 Measurement Procedure

The EUT was operating in Bluetooth 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 Procedure

8.4.1 The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

8.4.2. Set to the maximum power setting and enable the EUT transmit continuously.

8.4.3. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)

8.4.4. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.

8.4.5. Measure and record the results in the test report.

8.4.6. The Measured power density (dBm)/ 100KHz is a reference level and used as 20dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

## 8.5 Measurement Results:

The following table is the setting of spectrum analyzer.

|                   |                                              |
|-------------------|----------------------------------------------|
| Spectrum analyzer | Setting                                      |
| Attenuation       | Auto                                         |
| Span Frequency    | Set the span to 1.5 times the DTS bandwidth. |
| RB                | 3KHz                                         |
| VB                | 10KHz                                        |
| Detector          | Peak                                         |
| Trace             | Max hold                                     |
| Sweep Time        | Automatic                                    |

Refer to attached data chart.

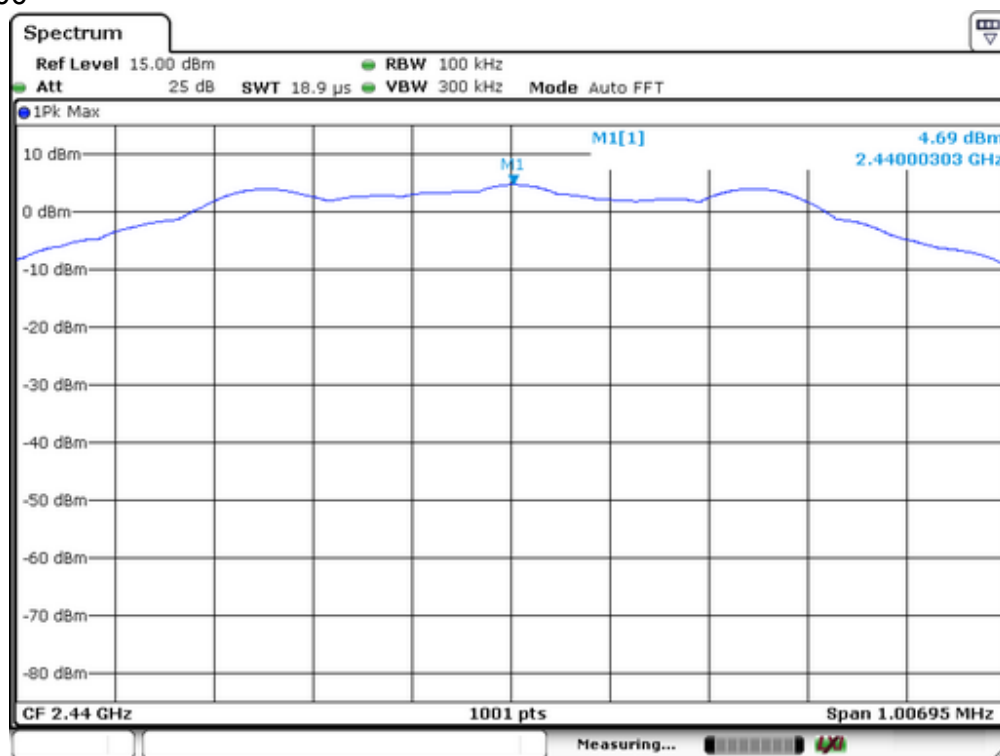
|                    |      |               |                 |
|--------------------|------|---------------|-----------------|
| Spectrum Detector: | PK   | Test Date :   | August 25, 2015 |
| Test By:           | Andy | Temperature : | 25 °C           |
| Test Result:       | PASS | Humidity :    |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

| Channel number | Channel frequency (MHz) | Measurement level (dBm) |          | Required Limit (dBm/3kHz) | Pass/Fail |
|----------------|-------------------------|-------------------------|----------|---------------------------|-----------|
|                |                         | PSD/100kHz              | PSD/3kHz |                           |           |
| 00             | 2402                    | 4.69                    | -12.23   | 8                         | PASS      |
| 20             | 2442                    | 4.70                    | -10.86   | 8                         | PASS      |
| 39             | 2480                    | 5.31                    | -10.32   | 8                         | PASS      |

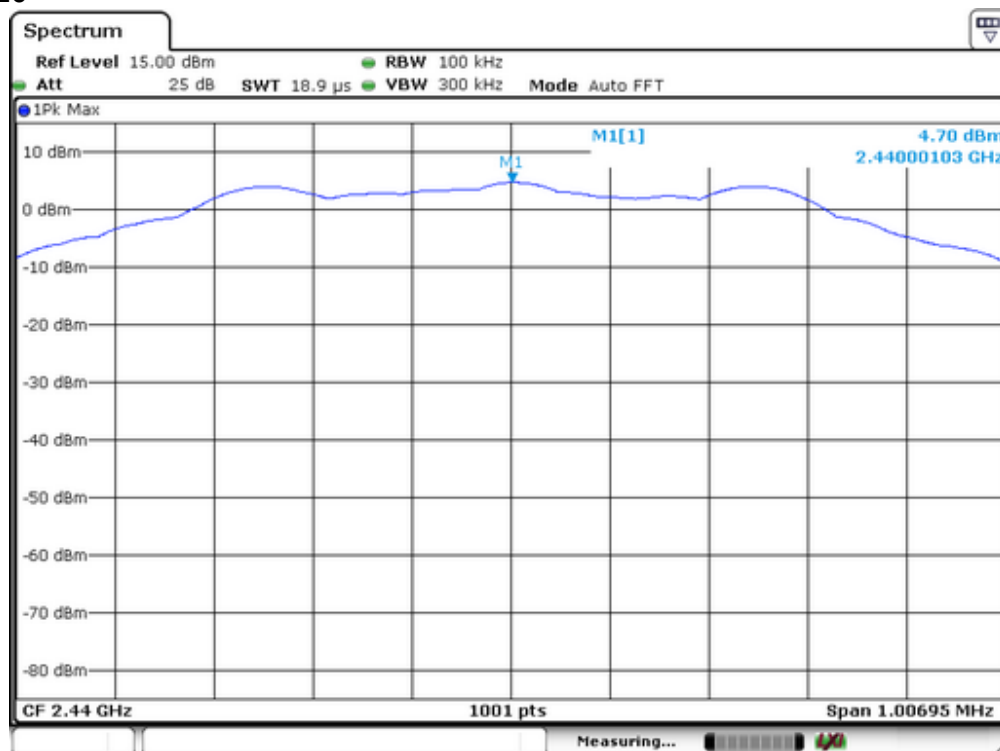
Note:

1. Measured power density(dBm) has offset with cable loss.
2. The measured power density(dBm)/100KHz is reference level and used as 20dBc down for Conducted Band Edges and Conducted Spurious Emission limit line.

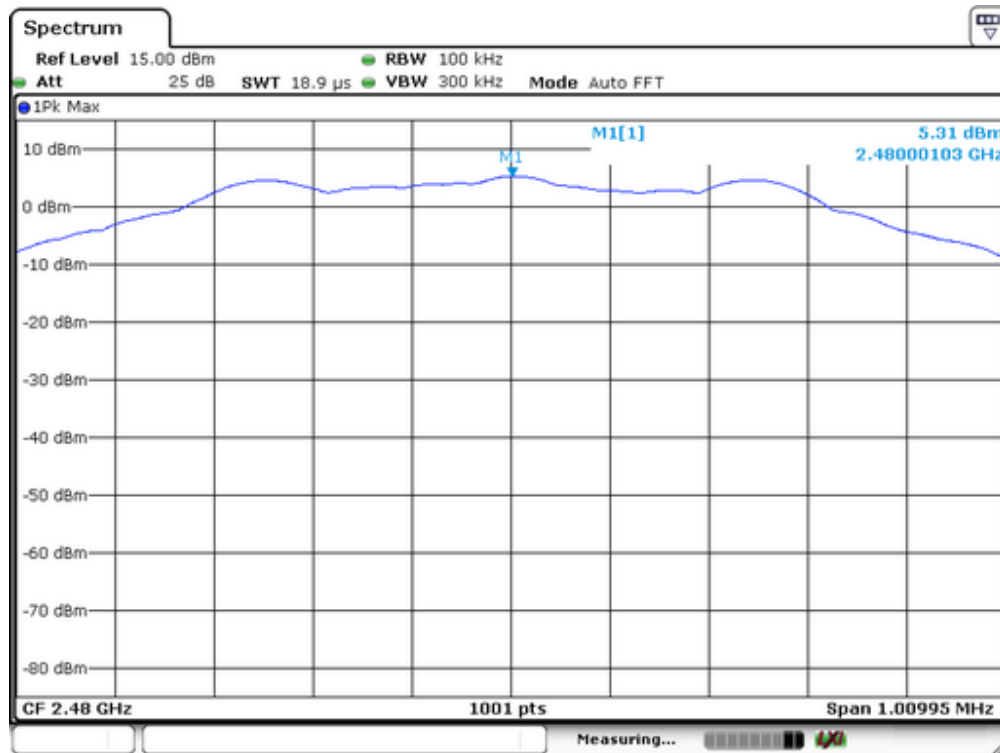
PSD 100kHz Plot:  
Channel 00



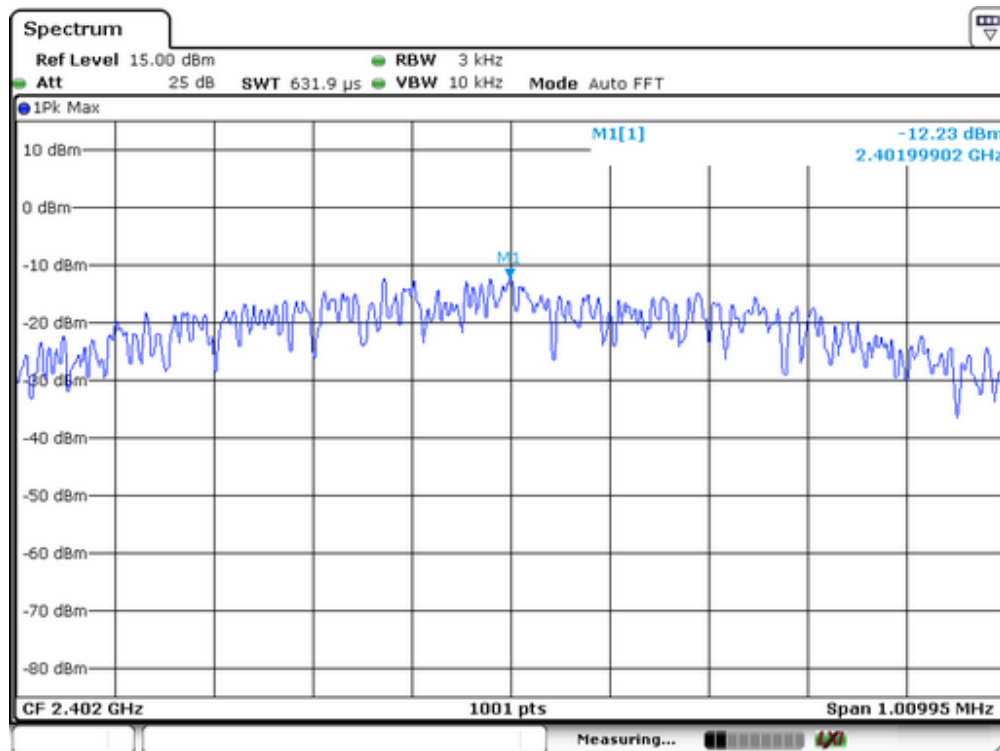
Channel 20



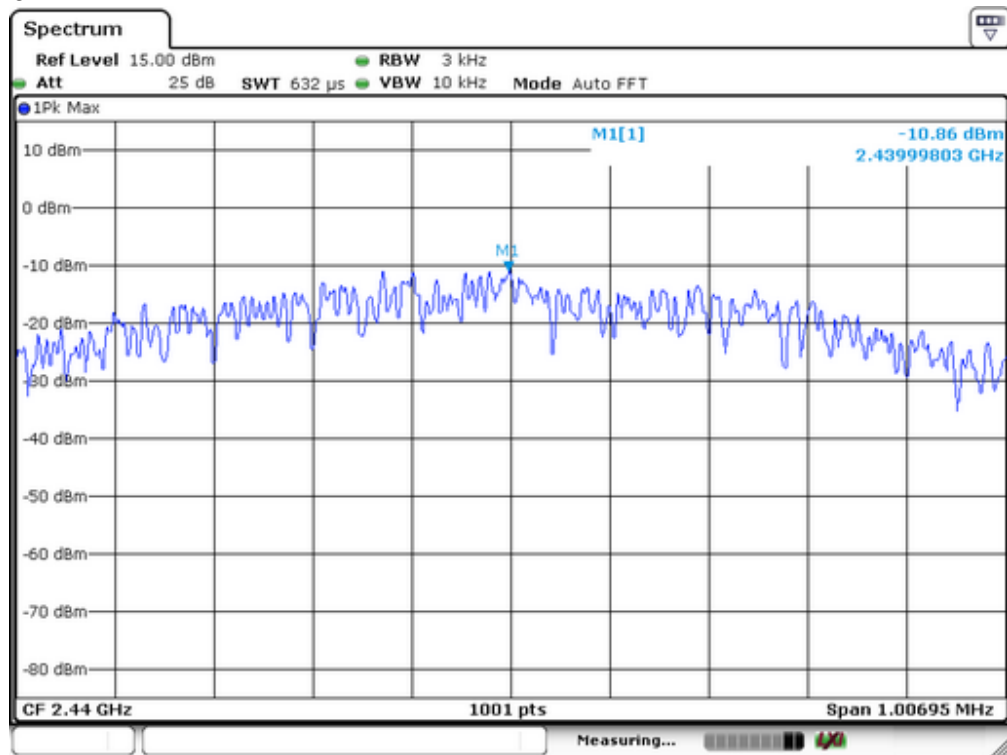
Channel 39



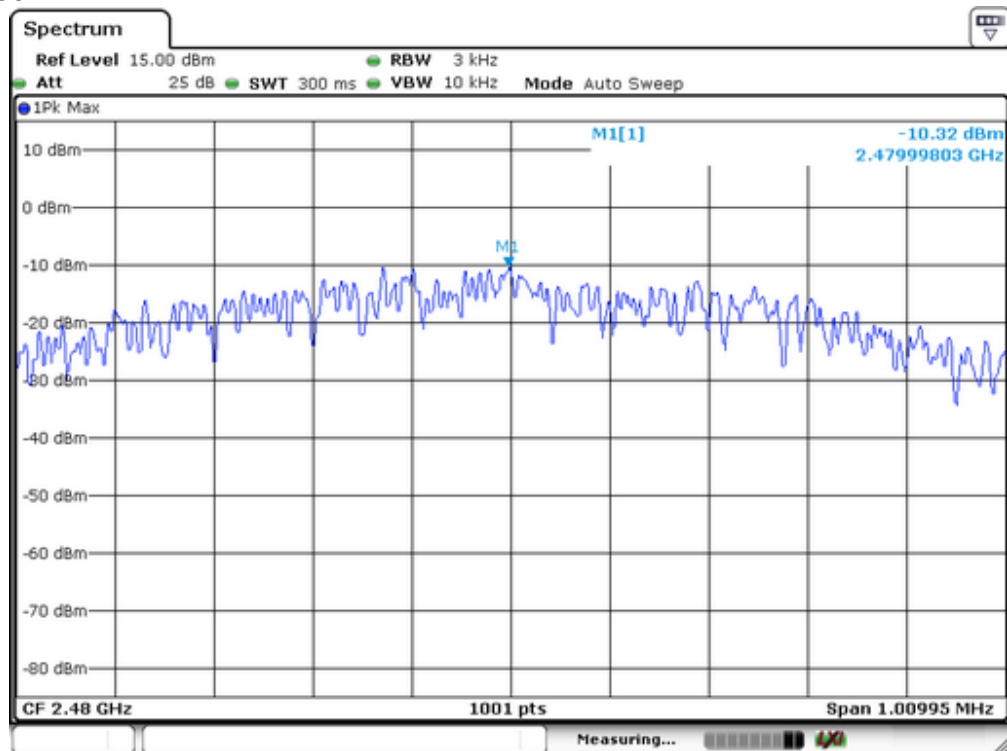
PSD 3KHz Plot:  
Channel 00



## Channel 20



## Channel 39



## 9. Band EDGE test

### 9.1 Measurement Procedure

#### For Conducted Test

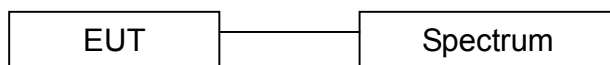
1. The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100KHz. The video bandwidth is set to 300KHz.
2. The spectrum from 30MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.
3. Preliminary tests on individual chains, and on all chains with a combiner, were performed. The worst-case configuration was with a combiner, therefore final test were preformed with all chains feeding a combiner.

#### For Radiated emission Test

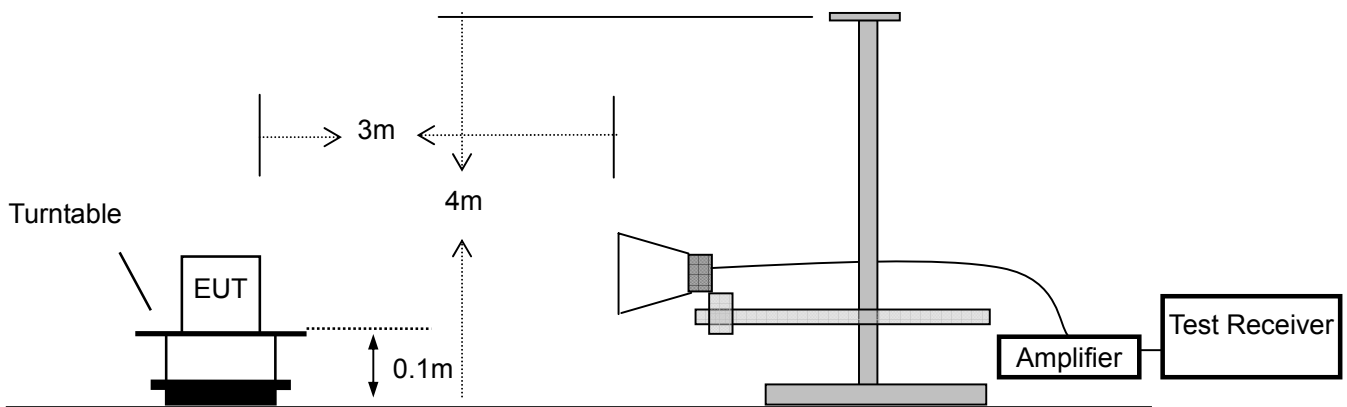
1. The EUT was Operating in hopping mode or could be controlled its channel. Printed out test result from the spectrum by hard copy function.
2. The EUT was placed on a turn table which is 0.1m above ground plane.
3. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
4. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
5. Repeat above procedures until all frequency measured were complete.

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

#### For Conducted Test



#### For Radiated emission Test



### 9.3 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    | Signal Analyzer | Rohde & Schwarz | FSV30      | 103040       | 12/29/2014 | 1 Year        |
| 2    | Horn Antenna    | Schwarzbeck     | BBHA9120D  | 9120D-1272   | 12/29/2014 | 1 Year        |
| 3    | Power Amplifier | LUNAR EM        | LNA1G18-40 | J10100000081 | 12/29/2014 | 1 Year        |
| 4    | Cable           | H+S             | CBL-26     | N/A          | 12/29/2014 | 1 Year        |
| 5    | Cable           | H+S             | CBL-26     | N/A          | 12/29/2014 | 1 Year        |
| 6    | Cable           | H+S             | CBL-26     | N/A          | 12/29/2014 | 1 Year        |

### 9.4 Measurement Results:

Refer to attached data chart.

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

#### 1. Conducted Test

| Frequency (MHz) | Peak Power Output(dBm) | Emission read Value(dBm) | Result of Band edge(dBc) | Band edge Limit(dBc) |
|-----------------|------------------------|--------------------------|--------------------------|----------------------|
| 2399.99         | 3.45                   | -48.07                   | 51.52                    | >20dBc               |
| 2484.00         | 5.42                   | -59.44                   | 64.86                    | >20dBc               |

## 2. Radiated emission Test

| 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     |
| 2397.05            | H                                | 64.05                | 45.05 | 74                          | 54 | -9.95          | -8.95  |
| 2399.35            | V                                | 60.27                | 41.27 | 74                          | 54 | -13.73         | -12.73 |
| 2484.19            | H                                | 65.17                | 46.37 | 74                          | 54 | -8.83          | -7.63  |
| 2485.06            | V                                | 59.35                | 40.27 | 74                          | 54 | -14.65         | -13.73 |

## **10 Antenna Application**

### **10.1 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.

### **10.2 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)



