



## Test Report

Date : 2017-06-15

No. : MH193419

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**Applicant** : Shenzhen Allcomm Electronic Company Limited  
Guangtian Road Left Side, Tangxiayong Community Songgang Street,  
Shenzhen City, Guangdong Province

**Supplier / Manufacturer** : Shenzhen Allcomm Electronic Company Limited  
Guangtian Road Left Side, Tangxiayong Community Songgang Street,  
Shenzhen City, Guangdong Province

**Description of Sample(s)** : Submitted sample(s) said to be  
Product: Photolysis Air Purifier  
Brand Name: N/A  
Model No.: RO222  
FCC ID: 2AMWMRO222

**Date Samples Received** : 2017-06-06

**Date Tested** : 2017-05-26 to 2017-06-14

**Investigation Requested** : Perform ElectroMagnetic Interference measurement in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2015 and ANSI C63.10:2013 for FCC Certification.

**Conclusions** : The submitted product COMPLIED with the requirements of Federal Communications Commission [FCC] Rules and Regulations Part 15. The tests were performed in accordance with the standards described above and on Section 2.2 in this Test Report.

**Remarks** : Bluetooth DTS (GFSK)  
For additional model(s) details, see page 3.  
Measurements was carried out with EUT which have been operated before and after stabilization has been reached, stabilization times is 30 minute.

  
Dr. LEE Kam Chuen  
Authorized Signatory

ElectroMagnetic Compatibility Department  
For and on behalf of  
The Hong Kong Standards and Testing Centre Ltd.

The Hong Kong Standards and Testing Centre Limited

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### **1.0 General Details**

#### **1.1 Test Laboratory**

The Hong Kong Standards and Testing Centre Ltd.

EMC Laboratory

Head Office: 10 Dai Wang Street, Taipo Industrial Estate, Tai Po, N.T., Hong Kong

Telephone: 852 2666 1888

Fax: 852 2664 4353

#### **1.2 Equipment Under Test [EUT]**

##### **Description of Sample(s)**

Product: Photolysis Air Purifier

Manufacturer: Shenzhen Allcomm Electronic Company Limited  
Guangtian Road Left Side, Tangxiayong Community Songgang  
Street, Shenzhen City, Guangdong Province

Brand Name: N/A

Model Number: RO222

Additional Model Number: RO222-A1, RO222-A2

Rating: 100-240V a.c. 50/60Hz

##### **1.2.1 Description of EUT Operation**

The Equipment Under Test (EUT) is a Photolysis Air Purifier. The transmission signal is digital modulated with channel frequency range 2402-2480MHz. The R.F. signal was modulated by IC; the type of modulation used was frequency hopping spread spectrum Modulation.

#### **1.3 Date of Order**

2017-06-06

#### **1.4 Submitted Sample(s):**

1 Sample

#### **1.5 Test Duration**

2017-05-26 to 2017-06-14

#### **1.6 Country of Origin**

China

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### 1.7 RF Module Details

Module Model Number: nRF51822  
Module FCC ID: N/A  
Module Transmission Type: Bluetooth V4.1 BLE  
Modulation: GFSK  
Data Rates: 1Mbps  
Frequency Range: 2400-2483.5MHz  
Carrier Frequencies: 2402MHz – 2480MHz

Module Specification (specification provided by manufacturer)

### 1.8 Antenna Details

Antenna Type: PCB antenna  
Antenna Gain: 1.26dBi

### 1.9 Channel List

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|
| 0       | 2402            | 20      | 2442            |
| 1       | 2404            | 21      | 2444            |
| 2       | 2406            | 22      | 2446            |
| 3       | 2408            | 23      | 2448            |
| 4       | 2410            | 24      | 2450            |
| 5       | 2412            | 25      | 2452            |
| 6       | 2414            | 26      | 2454            |
| 7       | 2416            | 27      | 2456            |
| 8       | 2418            | 28      | 2458            |
| 9       | 2420            | 29      | 2460            |
| 10      | 2422            | 30      | 2462            |
| 11      | 2424            | 31      | 2464            |
| 12      | 2426            | 32      | 2466            |
| 13      | 2428            | 33      | 2468            |
| 14      | 2430            | 34      | 2470            |
| 15      | 2432            | 35      | 2472            |
| 16      | 2434            | 36      | 2474            |
| 17      | 2436            | 37      | 2476            |
| 18      | 2438            | 38      | 2478            |
| 19      | 2440            | 39      | 2480            |

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### 2.0 Technical Details

#### **2.1 Investigations Requested**

Perform Electromagnetic Interference measurements in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2015 Regulations and ANSI C63.10:2013 for FCC Certification.

According FCC KDB 558074 DTS Measurement Guidance, Duty cycle  $\geq 98\%$ .

The device was realized by test software.

#### **2.2 Test Standards and Results Summary Tables**

| <b>EMISSION<br/>Results Summary</b> |                        |                   |                  |                                     |                          |                          |
|-------------------------------------|------------------------|-------------------|------------------|-------------------------------------|--------------------------|--------------------------|
| Test Condition                      | Test Requirement       | Test Method       | Class / Severity | Test Result                         |                          |                          |
|                                     |                        |                   |                  | Pass                                | Failed                   | N/A                      |
| Maximum Peak Output Power           | FCC 47CFR 15.247(b)(3) | ANSI C63.10: 2013 | N/A              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Radiated Spurious Emissions         | FCC 47CFR 15.209       | ANSI C63.10: 2013 | N/A              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| AC Mains Conducted Emissions        | FCC 47CFR 15.207       | ANSI C63.10: 2013 | N/A              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Power Spectral Density              | FCC 47CFR 15.247(e)    | ANSI C63.10: 2013 | N/A              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6dB Bandwidth                       | FCC 47CFR 15.247(a)(2) | ANSI C63.10: 2013 | N/A              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Band Edge Emissions (Radiated)      | FCC 47CFR 15.247(d)    | ANSI C63.10: 2013 | N/A              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Antenna requirement                 | FCC 47CFR 15.203       | N/A               | N/A              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| RF Exposure                         | FCC 47CFR 15.247(i)    | N/A               | N/A              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Note: N/A - Not Applicable

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### 3.0 Test Results

#### 3.1 Emission

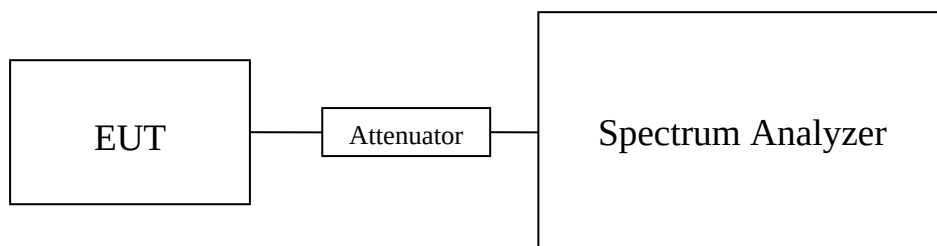
##### 3.1.1 Maximum Peak Output Power

|                    |                        |
|--------------------|------------------------|
| Test Requirement:  | FCC 47CFR 15.247(b)(3) |
| Test Method:       | ANSI C63.10: 2013      |
| Test Date:         | 2017-06-09             |
| Mode of Operation: | Bluetooth DTS Tx mode  |

#### **Test Method:**

The RF output of the EUT was connected to the spectrum analyzer. All the attenuation or cable loss will be added to the measured maximum output power. The results are recorded in Watt.

#### **Test Setup:**



Note: a temporary antenna connector was soldered to the RF output.

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### **Limits for Peak Output Power of Fundamental & Harmonics Emissions [FCC 47CFR 15.247]:**

For Digital Transmission systems in 2400-2483.5 MHz Band: 1 Watt (30dBm)

#### **Results of BT DTS Tx Mode (2402MHz to 2480MHz) : Pass (TX Unit) (GFSK) Maximum conducted output power**

| Channel | Frequency(MHz) | Output Power(Watt) |
|---------|----------------|--------------------|
| 0       | 2402           | 0.000560           |
| 19      | 2440           | 0.000514           |
| 39      | 2480           | 0.000415           |

Calculated measurement uncertainty : 30MHz to 1GHz 1.7dB  
1GHz to 26GHz 1.7dB

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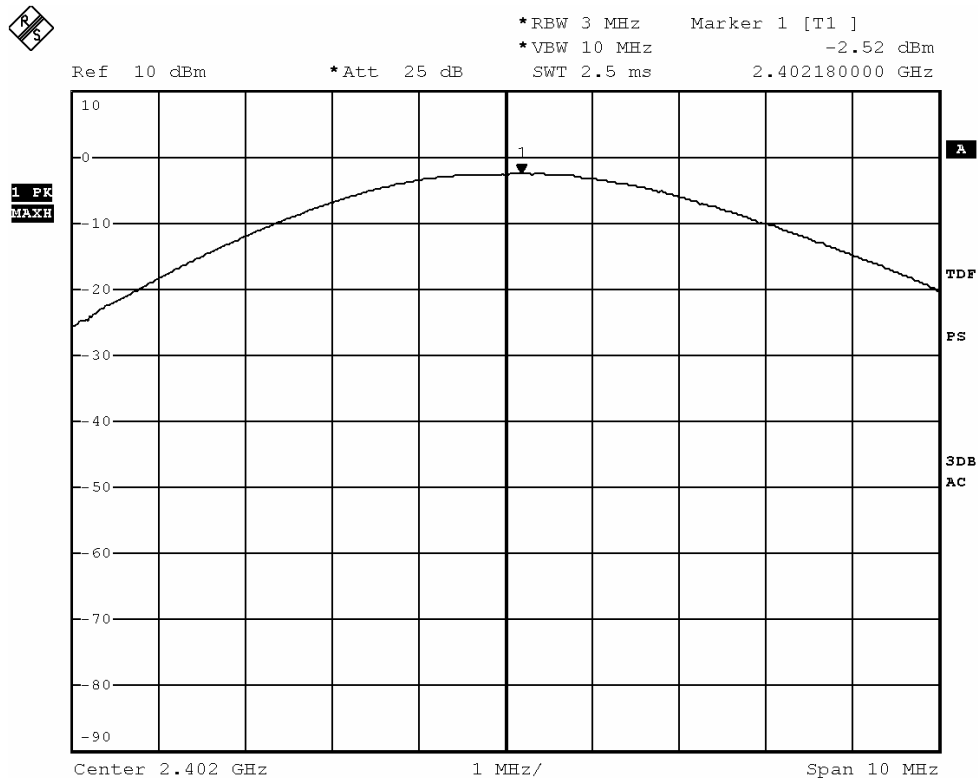
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Test plot of Maximum Peak Conducted Output Power :

Bluetooth Communication mode (BT DTS-GFSK, 2402MHz)



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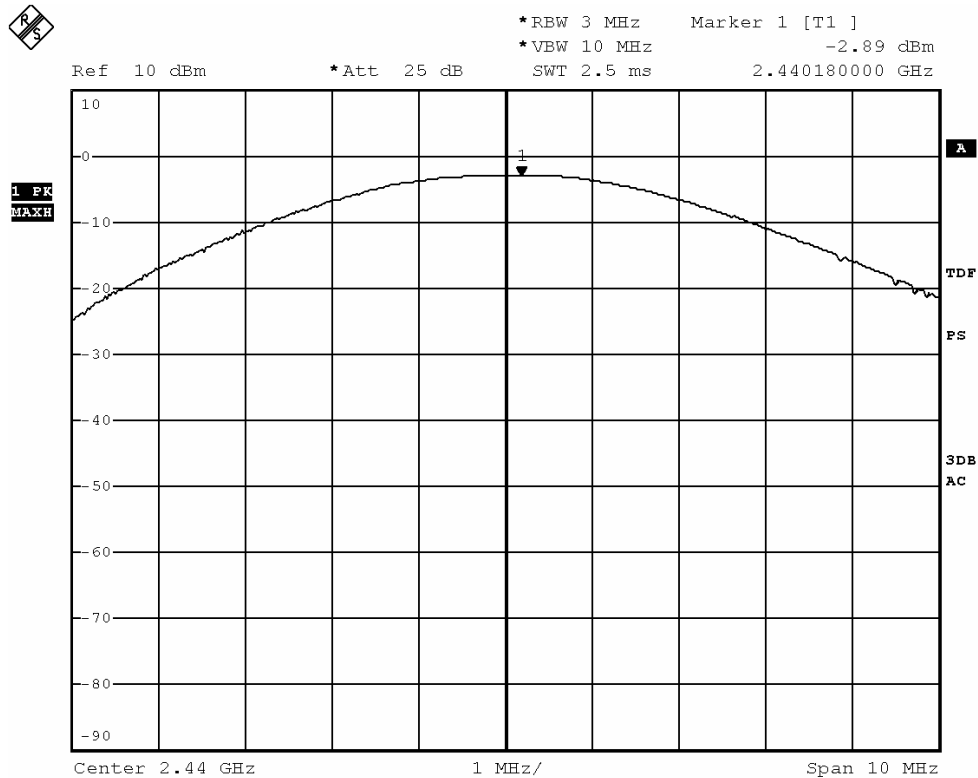
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### Bluetooth Communication mode (BT DTS-GFSK, 2440MHz)



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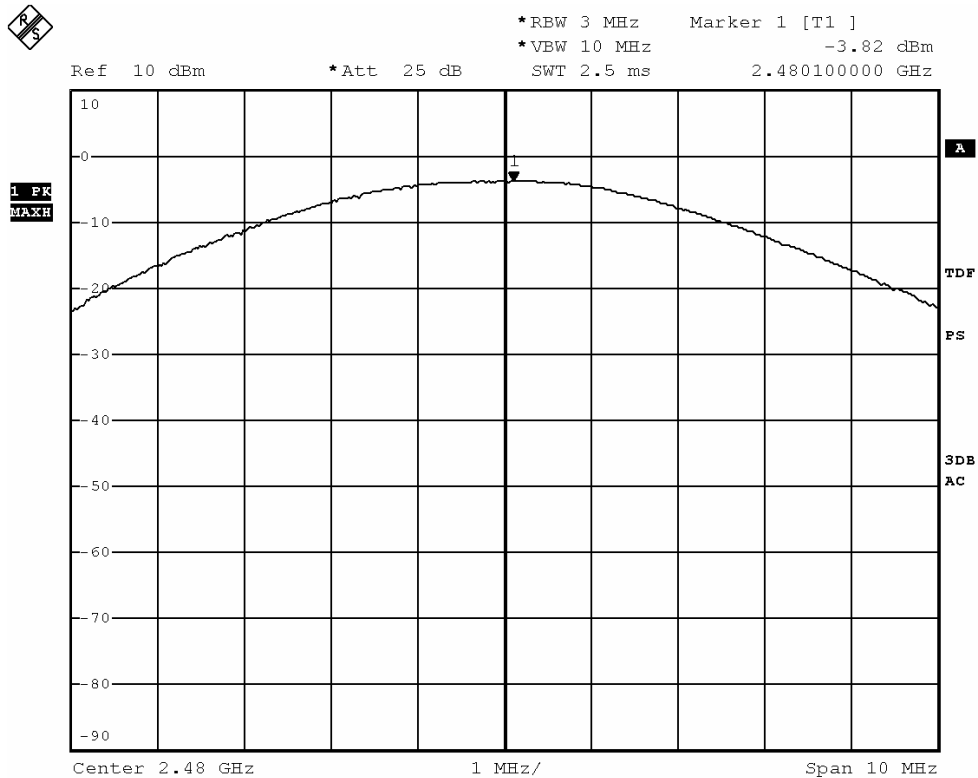
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### Bluetooth Communication mode (BT DTS-GFSK, 2480MHz)



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### 3.1.2 Radiated Emissions

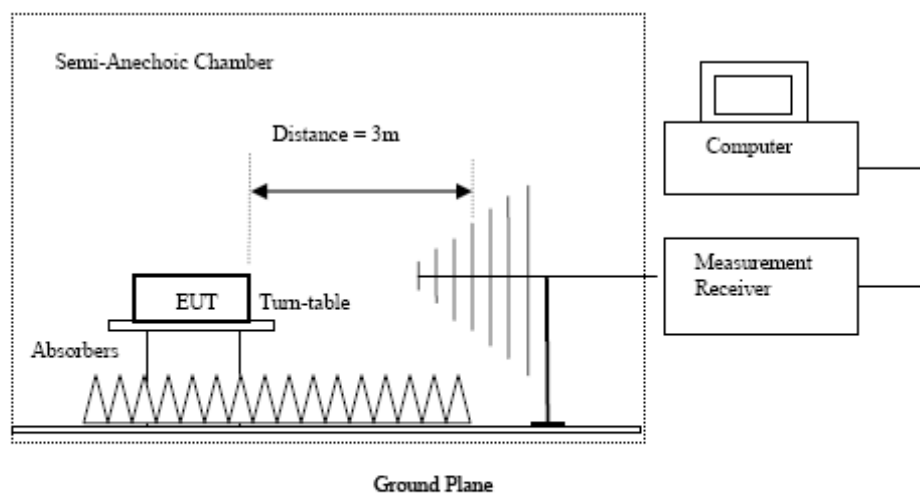
|                    |                                               |
|--------------------|-----------------------------------------------|
| Test Requirement:  | FCC 47CFR 15.209                              |
| Test Method:       | ANSI C63.10:2013                              |
| Test Date:         | 2017-06-10                                    |
| Mode of Operation: | Tx mode / Bluetooth Communication mode (GFSK) |

#### Test Method:

For emission measurements at or below 1 GHz, the sample was placed 0.8m above the ground plane of semi-anechoic Chamber\*. For emission measurements above 1 GHz, the sample was placed 1.5m above the ground plane of semi-anechoic Chamber\*. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.

\* Semi-Anechoic chamber located on the G/F of The Hong Kong Standards and Testing Centre Ltd. with a metal ground plane filed with the FCC pursuant to section 2.948 of the FCC rules, with Registration Number: 607756.

#### Test Setup:



- Absorbers placed on top of the ground plane are for measurements above 1000MHz only.
- Measurements between 30MHz to 1000MHz made with Bi-log antennas, above 1000MHz horn antennas are used, 9kHz to 30MHz loop antennas are used.

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### Limits for Radiated Emissions FCC 47 CFR 15.247 Class B1:

| Frequency Range | Quasi-Peak Limits |
|-----------------|-------------------|
| [MHz]           | [ $\mu$ V/m]      |
| 0.009-0.490     | 2400/F (kHz)      |
| 0.490-1.705     | 24000/F (kHz)     |
| 1.705-30        | 30                |
| 30-88           | 100               |
| 88-216          | 150               |
| 216-960         | 200               |
| Above 960       | 500               |

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

### Result of Tx mode (2402.0 MHz) (GFSK) (9kHz – 30MHz): Pass

| Field Strength of Spurious Emissions<br>Peak Value          |                |                   |                |                |           |                  |
|-------------------------------------------------------------|----------------|-------------------|----------------|----------------|-----------|------------------|
| Frequency                                                   | Measured Level | Correction Factor | Field Strength | Field Strength | Limit     | E-Field Polarity |
| MHz                                                         | dB $\mu$ V     | dB/m              | dB $\mu$ V/m   | $\mu$ V/m      | $\mu$ V/m |                  |
| Emissions detected are more than 20 dB below the FCC Limits |                |                   |                |                |           |                  |

### Result of Tx mode (2402.0 MHz) (GFSK) (Above 1GHz): Pass

| Field Strength of Spurious Emissions<br>Peak Value |                    |                   |                |              |        |                  |
|----------------------------------------------------|--------------------|-------------------|----------------|--------------|--------|------------------|
| Frequency                                          | Measured Level @3m | Correction Factor | Field Strength | Limit @3m    | Margin | E-Field Polarity |
| MHz                                                | dB $\mu$ V         | dB/m              | dB $\mu$ V/m   | dB $\mu$ V/m | dB     |                  |
| 4804.0                                             | 15.6               | 41.5              | 57.1           | 74.0         | 16.9   | Vertical         |
| 4804.0                                             | 12.9               | 42.4              | 55.3           | 74.0         | 18.7   | Horizontal       |
| 7206.0                                             | 8.0                | 45.1              | 53.1           | 74.0         | 20.9   | Vertical         |
| 7206.0                                             | 8.2                | 46.2              | 54.4           | 74.0         | 19.6   | Horizontal       |
| 9608.0                                             | 6.3                | 48.0              | 54.3           | 74.0         | 19.7   | Vertical         |
| 9608.0                                             | 4.8                | 48.8              | 53.6           | 74.0         | 20.4   | Horizontal       |
| 12010.0                                            | 4.1                | 51.8              | 55.9           | 74.0         | 18.1   | Vertical         |
| 12010.0                                            | 2.9                | 52.4              | 55.3           | 74.0         | 18.7   | Horizontal       |

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| Field Strength of Spurious Emissions<br>Average Value |                               |                              |                             |                        |              |                     |
|-------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|--------------|---------------------|
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBμV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB | E-Field<br>Polarity |
| 4804.0                                                | 0.2                           | 41.5                         | 41.7                        | 54.0                   | 12.3         | Vertical            |
| 4804.0                                                | -2.8                          | 42.4                         | 39.6                        | 54.0                   | 14.4         | Horizontal          |
| 7206.0                                                | -7.5                          | 45.1                         | 37.6                        | 54.0                   | 16.4         | Vertical            |
| 7206.0                                                | -5.4                          | 46.2                         | 40.8                        | 54.0                   | 13.2         | Horizontal          |
| 9608.0                                                | -9.1                          | 48.0                         | 38.9                        | 54.0                   | 15.1         | Vertical            |
| 9608.0                                                | -11.5                         | 48.8                         | 37.3                        | 54.0                   | 16.7         | Horizontal          |
| 12010.0                                               | -11.6                         | 51.8                         | 40.2                        | 54.0                   | 13.8         | Vertical            |
| 12010.0                                               | -11.5                         | 52.4                         | 40.9                        | 54.0                   | 13.1         | Horizontal          |

**Result of Tx mode (2440.0 MHz) (GFSK) (9kHz – 30MHz): Pass**

| Field Strength of Spurious Emissions<br>Peak Value                 |                           |                              |                             |                           |               |                     |
|--------------------------------------------------------------------|---------------------------|------------------------------|-----------------------------|---------------------------|---------------|---------------------|
| Frequency<br>MHz                                                   | Measured<br>Level<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Field<br>Strength<br>uV/m | Limit<br>uV/m | E-Field<br>Polarity |
| <b>Emissions detected are more than 20 dB below the FCC Limits</b> |                           |                              |                             |                           |               |                     |

**Result of Tx mode (2440.0 MHz) (GFSK) (Above 1GHz): Pass**

| Field Strength of Spurious Emissions<br>Peak Value |                               |                              |                             |                        |              |                     |
|----------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|--------------|---------------------|
| Frequency<br>MHz                                   | Measured<br>Level @3m<br>dBμV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB | E-Field<br>Polarity |
| 4880.0                                             | 15.1                          | 41.6                         | 56.7                        | 74.0                   | 17.3         | Vertical            |
| 4880.0                                             | 12.3                          | 42.5                         | 54.8                        | 74.0                   | 19.2         | Horizontal          |
| 7320.0                                             | 1.5                           | 53.2                         | 54.7                        | 74.0                   | 19.3         | Vertical            |
| 7320.0                                             | 8.3                           | 46.3                         | 54.6                        | 74.0                   | 19.4         | Horizontal          |
| 9760.0                                             | 6.1                           | 48.1                         | 54.2                        | 74.0                   | 19.8         | Vertical            |
| 9760.0                                             | 6.3                           | 48.9                         | 55.2                        | 74.0                   | 18.8         | Horizontal          |
| 12200.0                                            | 4.0                           | 51.6                         | 55.6                        | 74.0                   | 18.4         | Vertical            |
| 12200.0                                            | 3.7                           | 52.5                         | 56.2                        | 74.0                   | 17.8         | Horizontal          |

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| Field Strength of Spurious Emissions<br>Average Value |                               |                              |                             |                        |              |                     |
|-------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|--------------|---------------------|
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBμV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB | E-Field<br>Polarity |
| 4880.0                                                | -0.3                          | 41.6                         | 41.3                        | 54.0                   | 12.7         | Vertical            |
| 4880.0                                                | -3.0                          | 42.5                         | 39.5                        | 54.0                   | 14.5         | Horizontal          |
| 7320.0                                                | -5.0                          | 45.2                         | 40.2                        | 54.0                   | 13.8         | Vertical            |
| 7320.0                                                | -6.4                          | 46.3                         | 39.9                        | 54.0                   | 14.1         | Horizontal          |
| 9760.0                                                | -9.2                          | 48.1                         | 38.9                        | 54.0                   | 15.1         | Vertical            |
| 9760.0                                                | -8.3                          | 48.9                         | 40.6                        | 54.0                   | 13.4         | Horizontal          |
| 12200.0                                               | -11.4                         | 51.6                         | 40.2                        | 54.0                   | 13.8         | Vertical            |
| 12200.0                                               | -10.7                         | 52.5                         | 41.8                        | 54.0                   | 12.2         | Horizontal          |

**Result of Tx mode (2480.0 MHz) (GFSK) (9kHz – 30MHz): Pass**

| Field Strength of Spurious Emissions<br>Peak Value                 |                           |                              |                             |                           |               |                     |
|--------------------------------------------------------------------|---------------------------|------------------------------|-----------------------------|---------------------------|---------------|---------------------|
| Frequency<br>MHz                                                   | Measured<br>Level<br>dBuV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBuV/m | Field<br>Strength<br>uV/m | Limit<br>uV/m | E-Field<br>Polarity |
| <b>Emissions detected are more than 20 dB below the FCC Limits</b> |                           |                              |                             |                           |               |                     |

**Result of Tx mode (2480.0 MHz) (GFSK) (Above 1GHz): Pass**

| Field Strength of Spurious Emissions<br>Peak Value |                               |                              |                             |                        |              |                     |
|----------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|--------------|---------------------|
| Frequency<br>MHz                                   | Measured<br>Level @3m<br>dBμV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB | E-Field<br>Polarity |
| 4960.0                                             | 14.9                          | 41.4                         | 56.3                        | 74.0                   | 17.7         | Vertical            |
| 4960.0                                             | 11.5                          | 42.7                         | 54.2                        | 74.0                   | 19.8         | Horizontal          |
| 7440.0                                             | 7.6                           | 45.6                         | 53.2                        | 74.0                   | 20.8         | Vertical            |
| 7440.0                                             | 9.2                           | 46.5                         | 55.7                        | 74.0                   | 18.3         | Horizontal          |
| 9920.0                                             | 5.3                           | 48.6                         | 53.9                        | 74.0                   | 20.1         | Vertical            |
| 9920.0                                             | 5.2                           | 49.7                         | 54.9                        | 74.0                   | 19.1         | Horizontal          |
| 12400.0                                            | 4.0                           | 51.7                         | 55.7                        | 74.0                   | 18.3         | Vertical            |
| 12400.0                                            | 3.3                           | 52.7                         | 56.0                        | 74.0                   | 18.0         | Horizontal          |

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| Field Strength of Spurious Emissions<br>Average Value |                               |                              |                             |                        |              |                     |
|-------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|--------------|---------------------|
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBμV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB | E-Field<br>Polarity |
| 4960.0                                                | -0.4                          | 41.4                         | 41.0                        | 54.0                   | 13.0         | Vertical            |
| 4960.0                                                | -2.9                          | 42.7                         | 39.8                        | 54.0                   | 14.2         | Horizontal          |
| 7440.0                                                | -7.9                          | 45.6                         | 37.7                        | 54.0                   | 16.3         | Vertical            |
| 7440.0                                                | -6.2                          | 46.5                         | 40.3                        | 54.0                   | 13.7         | Horizontal          |
| 9920.0                                                | -10.4                         | 48.6                         | 38.2                        | 54.0                   | 15.8         | Vertical            |
| 9920.0                                                | -9.5                          | 49.7                         | 40.2                        | 54.0                   | 13.8         | Horizontal          |
| 12400.0                                               | -11.7                         | 51.7                         | 40.0                        | 54.0                   | 14.0         | Vertical            |
| 12400.0                                               | -12.4                         | 52.7                         | 40.3                        | 54.0                   | 13.7         | Horizontal          |

Note: Above 13GHz Emissions detected are more than 20 dB below the FCC Limits .

Remarks:

No additional spurious emissions found between lowest internal used/generated frequency and 30 MHz

\* Denotes restricted band of operation.

Measurements were made using a peak detector. Any emission less than 1000MHz and falling within the restricted bands of FCC Rules Part 15 Section 15.205 and the limits of FCC Rules Part 15 Section 15.209 were applied.

Correction Factor included Antenna Factor and Cable Attenuation.

Calculated measurement uncertainty : 9kHz-30MHz 2.0dB  
30MHz -1GHz 4.9dB  
1GHz -26GHz 4.02dB

Emissions in the vertical and horizontal polarizations have been investigated and the worst-case test results are recorded in this report.

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### **Radiated Emissions Measurement:**

#### **Limit :**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz 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) (see Section 5.205(c)).

### **Result: RF Radiated Emissions (Lowest)-GFSK**

| Field Strength of Band-edge Compliance<br>Peak Value |                               |                              |                             |                        |              |                     |
|------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|--------------|---------------------|
| Frequency<br>MHz                                     | Measured<br>Level @3m<br>dBμV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB | E-Field<br>Polarity |
| 2390.0                                               | 17.6                          | 36.8                         | 54.4                        | 74.0                   | 19.6         | Vertical            |

| Field Strength of Band-edge Compliance<br>Average Value |                               |                              |                             |                        |              |                     |
|---------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|--------------|---------------------|
| Frequency<br>MHz                                        | Measured<br>Level @3m<br>dBμV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB | E-Field<br>Polarity |
| 2390.0                                                  | 1.5                           | 36.8                         | 38.3                        | 54.0                   | 15.7         | Vertical            |

### **Result: RF Radiated Emissions (Highest) -GFSK**

| Field Strength of Band-edge Compliance<br>Peak Value |                               |                              |                             |                        |              |                     |
|------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|--------------|---------------------|
| Frequency<br>MHz                                     | Measured<br>Level @3m<br>dBμV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB | E-Field<br>Polarity |
| 2483.5                                               | 23.8                          | 36.8                         | 60.6                        | 74.0                   | 13.4         | Vertical            |
| 2494.4                                               | 25.8                          | 36.8                         | 62.6                        | 74.0                   | 11.4         | Vertical            |

| Field Strength of Band-edge Compliance<br>Average Value |                               |                              |                             |                        |              |                     |
|---------------------------------------------------------|-------------------------------|------------------------------|-----------------------------|------------------------|--------------|---------------------|
| Frequency<br>MHz                                        | Measured<br>Level @3m<br>dBμV | Correction<br>Factor<br>dB/m | Field<br>Strength<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB | E-Field<br>Polarity |
| 2483.5                                                  | 4.3                           | 36.8                         | 41.1                        | 54.0                   | 12.9         | Vertical            |
| 2494.4                                                  | 6.3                           | 36.8                         | 43.1                        | 54.0                   | 10.9         | Vertical            |

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### Limits for Radiated Emissions FCC 47 CFR 15.247 Class B]:

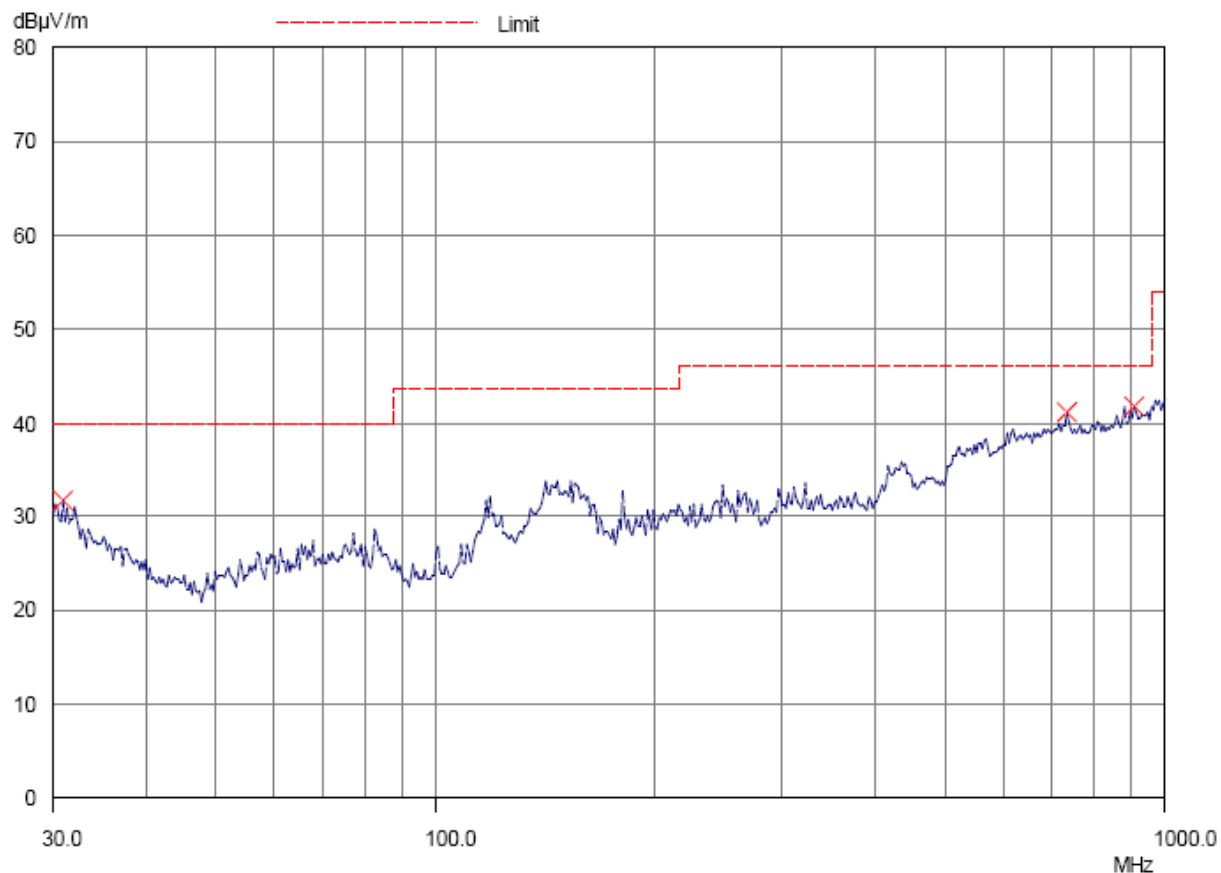
| Frequency Range | Quasi-Peak Limits |
|-----------------|-------------------|
| [MHz]           | [ $\mu$ V/m]      |
| 0.009-0.490     | 2400/F (kHz)      |
| 0.490-1.705     | 24000/F (kHz)     |
| 1.705-30        | 30                |
| 30-88           | 100               |
| 88-216          | 150               |
| 216-960         | 200               |
| Above960        | 500               |

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

### Results of Bluetooth Communication mode(max power) (2402.0 MHz) (30MHz – 1GHz): Pass

Please refer to the following table for result details(The data is the worst cases)

Horizontal



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**Result of Bluetooth Communication mode(max power) (2402.0 MHz) (30MHz – 1GHz): Pass**

| Radiated Emissions           |                     |                        |                        |                      |                      |
|------------------------------|---------------------|------------------------|------------------------|----------------------|----------------------|
| Quasi-Peak                   |                     |                        |                        |                      |                      |
| Emission<br>Frequency<br>MHz | E-Field<br>Polarity | Level<br>@3m<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Level<br>@3m<br>μV/m | Limit<br>@3m<br>μV/m |
| 30.8                         | Horizontal          | 29.2                   | 40.0                   | 28.8                 | 100                  |
| 732.8                        | Horizontal          | 36.3                   | 46.0                   | 65.3                 | 200                  |
| 903.7                        | Horizontal          | 36.5                   | 46.0                   | 66.8                 | 200                  |

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### Limits for Radiated Emissions FCC 47 CFR 15.247 Class B1:

| Frequency Range | Quasi-Peak Limits |
|-----------------|-------------------|
| [MHz]           | [ $\mu$ V/m]      |
| 0.009-0.490     | 2400/F (kHz)      |
| 0.490-1.705     | 24000/F (kHz)     |
| 1.705-30        | 30                |
| 30-88           | 100               |
| 88-216          | 150               |
| 216-960         | 200               |
| Above960        | 500               |

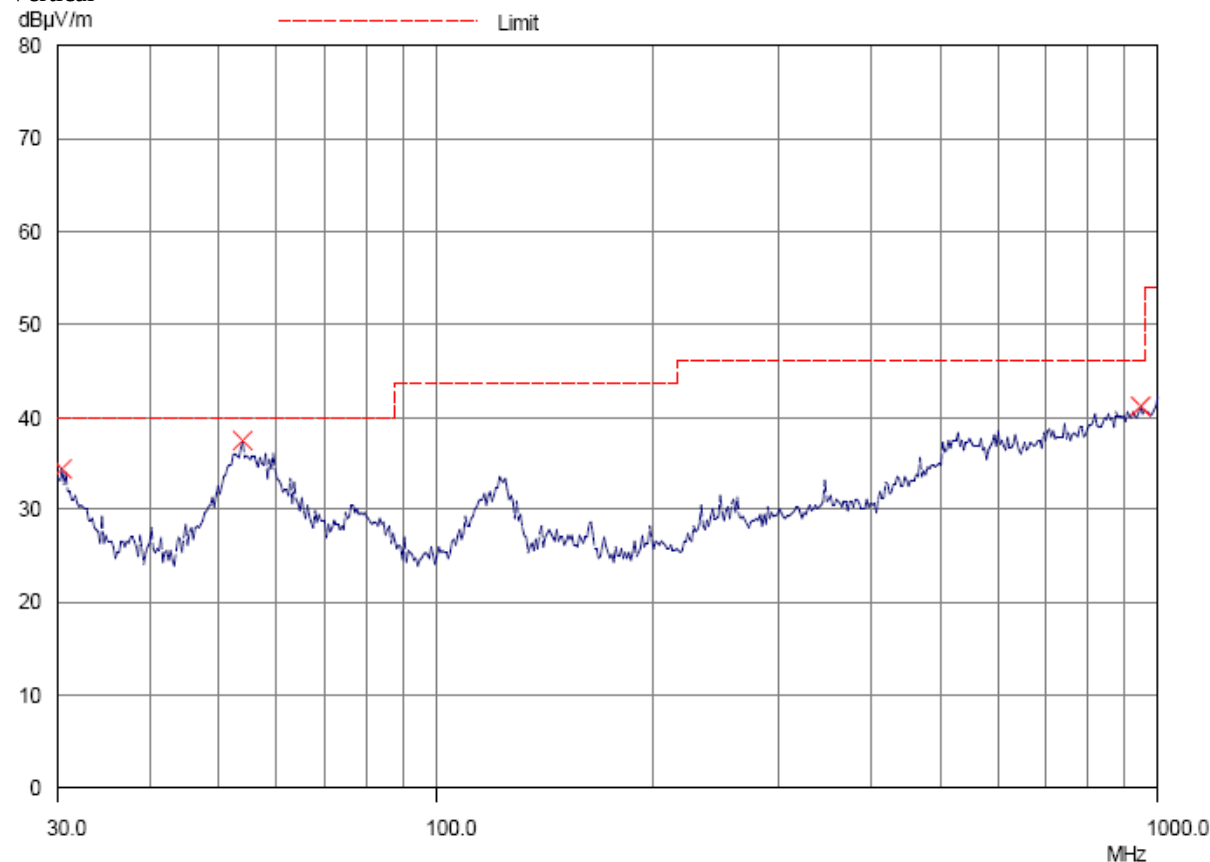
The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

### Results of Bluetooth Communication mode(max power) (2402.0 MHz) (30MHz – 1GHz): Pass

Please refer to the following table for result details(The data is the worst cases)

Vertical

dB $\mu$ V/m



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**Result of Bluetooth Communication mode(max power) (2402.0 MHz) (30MHz – 1GHz): Pass**

| Radiated Emissions           |                     |                        |                        |                      |                      |
|------------------------------|---------------------|------------------------|------------------------|----------------------|----------------------|
| Quasi-Peak                   |                     |                        |                        |                      |                      |
| Emission<br>Frequency<br>MHz | E-Field<br>Polarity | Level<br>@3m<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Level<br>@3m<br>μV/m | Limit<br>@3m<br>μV/m |
| 30.2                         | Vertical            | 31.9                   | 40.0                   | 39.4                 | 100                  |
| 54.0                         | Vertical            | 35.1                   | 40.0                   | 56.9                 | 100                  |
| 946.3                        | Vertical            | 36.2                   | 46.0                   | 64.6                 | 200                  |

Remarks:

Calculated measurement uncertainty (30MHz – 1GHz): 4.9dB

Emissions in the vertical and horizontal polarizations have been investigated and the worst-case test results are recorded in this report.

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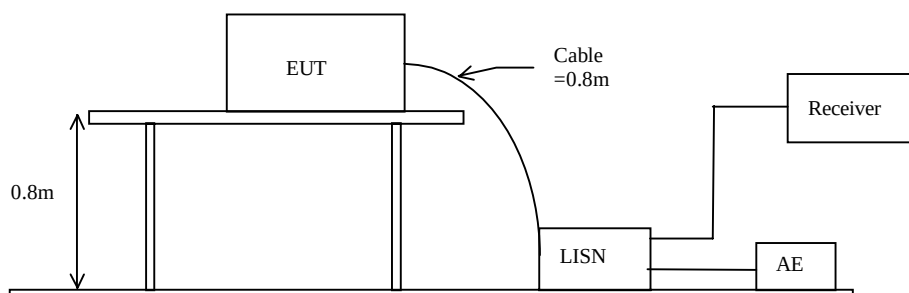
### 3.1.3 AC Mains Conducted Emissions (0.15MHz to 30MHz)

|                    |                              |
|--------------------|------------------------------|
| Test Requirement:  | FCC 47CFR 15.207             |
| Test Method:       | ANSI C63.10:2013             |
| Test Date:         | 2017-05-26                   |
| Mode of Operation: | Bluetooth Communication mode |
| Test Voltage:      | 120Va.c. 60Hz                |

#### Test Method:

The test was performed in accordance with ANSI C63.10:2013, with the following: an initial measurement was performed in peak and average detection mode on the live line, any emissions recorded within 30dB of the relevant limit line were re-measured using quasi-peak and average detection on the live and neutral lines with the worst case recorded in the table of results.

#### Test Setup:



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### Limits for Conducted Emissions (FCC 47 CFR 15.207):

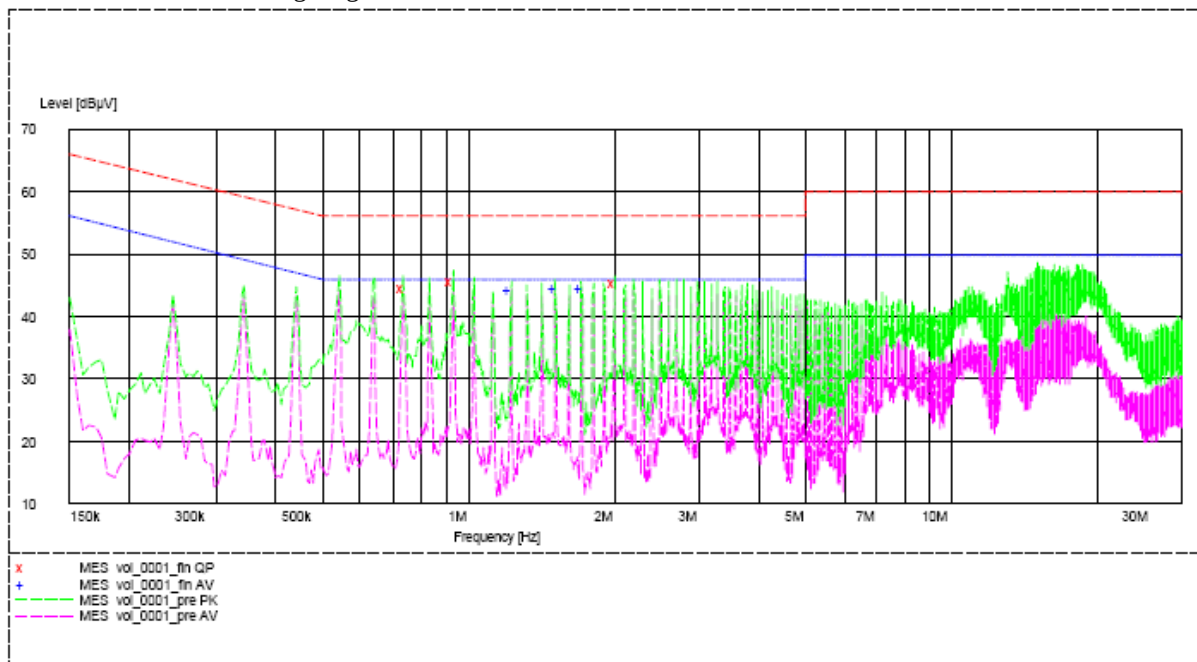
| Frequency Range<br>[MHz] | Quasi-Peak Limits<br>[dBμV] | Average<br>[dBμV] |
|--------------------------|-----------------------------|-------------------|
| 0.15-0.5                 | 66 to 56*                   | 56 to 46*         |
| 0.5-5.0                  | 56                          | 46                |
| 5.0-30.0                 | 60                          | 50                |

\* Decreases with the logarithm of the frequency.

Limits for Conducted Emissions Test, please refer to limit lines (Quasi-Peak and Average) in the following diagram.

### Results of Bluetooth Communication mode(max power) (L): PASS

Please refer to the following diagram for individual results.



| Conductor<br>Live or Neutral | Frequency<br>MHz | Quasi-peak    |               | Average       |               |
|------------------------------|------------------|---------------|---------------|---------------|---------------|
|                              |                  | Level<br>dBμV | Limit<br>dBμV | Level<br>dBμV | Limit<br>dBμV |
| Live                         | 0.735            | 44.8          | 56.0          | -*-           | -*-           |
| Live                         | 0.930            | 45.7          | 56.0          | -*-           | -*-           |
| Live                         | 2.010            | 45.2          | 56.0          | -*-           | -*-           |
| Live                         | 1.225            | -*-           | -*-           | 44.5          | 46.0          |
| Live                         | 1.520            | -*-           | -*-           | 44.6          | 46.0          |
| Live                         | 1.715            | -*-           | -*-           | 44.6          | 46.0          |

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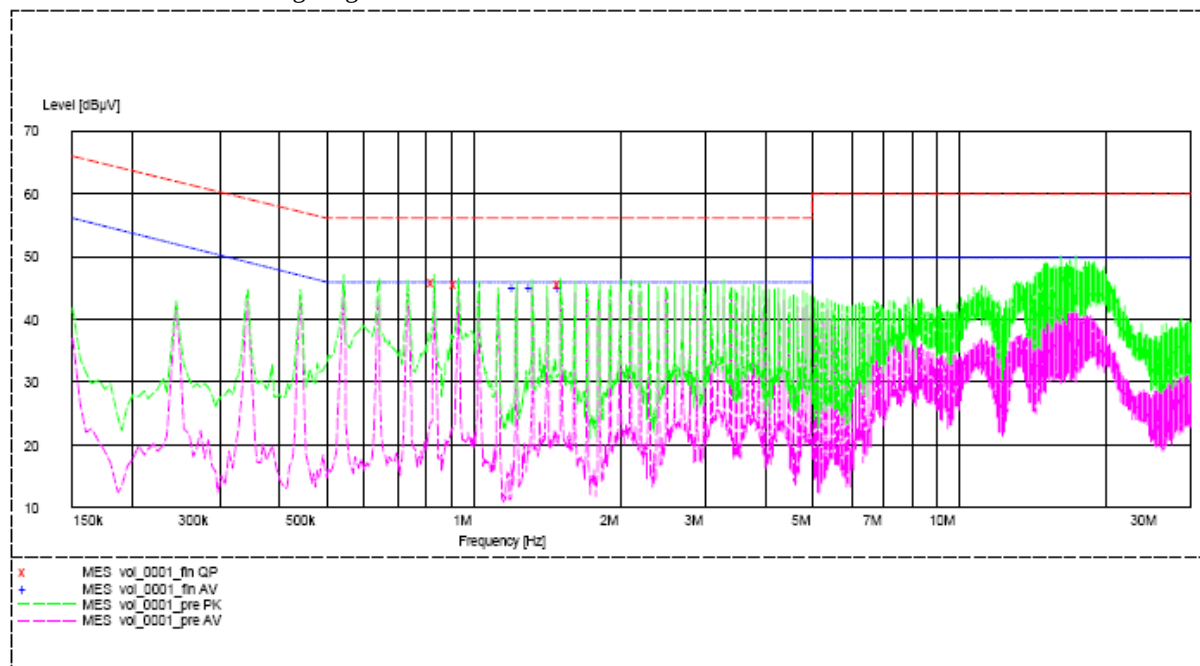
| Frequency Range<br>[MHz] | Quasi-Peak Limits<br>[dB $\mu$ V] | Average<br>[dB $\mu$ V] |
|--------------------------|-----------------------------------|-------------------------|
| 0.15-0.5                 | 66 to 56*                         | 56 to 46*               |
| 0.5-5.0                  | 56                                | 46                      |
| 5.0-30.0                 | 60                                | 50                      |

\* Decreases with the logarithm of the frequency.

Limits for Conducted Emissions Test, please refer to limit lines (Quasi-Peak and Average) in the following diagram.

### **Results of Bluetooth Communication mode (max power)(N): PASS**

Please refer to the following diagram for individual results.



| Conductor<br>Live or Neutral | Frequency<br>MHz | Quasi-peak          |                     | Average             |                     |
|------------------------------|------------------|---------------------|---------------------|---------------------|---------------------|
|                              |                  | Level<br>dB $\mu$ V | Limit<br>dB $\mu$ V | Level<br>dB $\mu$ V | Limit<br>dB $\mu$ V |
| Neutral                      | 0.835            | 46.0                | 56.0                | -*-                 | -*-                 |
| Neutral                      | 0.930            | 45.6                | 56.0                | -*-                 | -*-                 |
| Neutral                      | 1.520            | 45.7                | 56.0                | -*-                 | -*-                 |
| Neutral                      | 1.225            | -*-                 | -*-                 | 45.1                | 46.0                |
| Neutral                      | 1.325            | -*-                 | -*-                 | 45.0                | 46.0                |
| Neutral                      | 1.520            | -*-                 | -*-                 | 44.9                | 46.0                |

Remarks:

Calculated measurement uncertainty (0.15MHz – 30MHz): 3.25dB

-\*- Emission(s) that is far below the corresponding limit line.

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### 3.1.4 Power Spectral Density

Test Requirement: FCC 47CFR 15.247(e)  
Test Method: ANSI C63.10:2013  
Test Date: 2017-06-09  
Mode of Operation: Tx mode

#### Test Method:

The RF output of the EUT was connected to the spectrum analyzer. Set the fundamental frequency as the center frequency of the spectral analyzer. Use RBW=3kHz, VBW= 10KHz, Set the span to 1.5 times the DTS channel bandwidth. Detector = peak, Sweep time = auto couple, Trace mode = max hold. Measure the Power Spectral Density (PSD) and record the results in dBm.

#### Test Setup:

As Test Setup of clause 3.1.1 in this test report.

#### Test Limit:

The maximum power spectral density (PSD) shall not exceed 8dBm in any 3kHz band.

Results of Tx Mode GFSK (Tx:2402MHz to 2480MHz) : Pass (Tx Unit)

Maximum power spectral density

| Transmitter Frequency<br>(MHz) | Maximum Power spectral density<br>level / 3kHz band<br>(dBm) | Maximum Power spectral density<br>/ 3kHz band limit |
|--------------------------------|--------------------------------------------------------------|-----------------------------------------------------|
| 2402.0                         | -17.77                                                       | 8dBm                                                |
| 2440.0                         | -18.93                                                       | 8dBm                                                |
| 2480.0                         | -18.22                                                       | 8dBm                                                |

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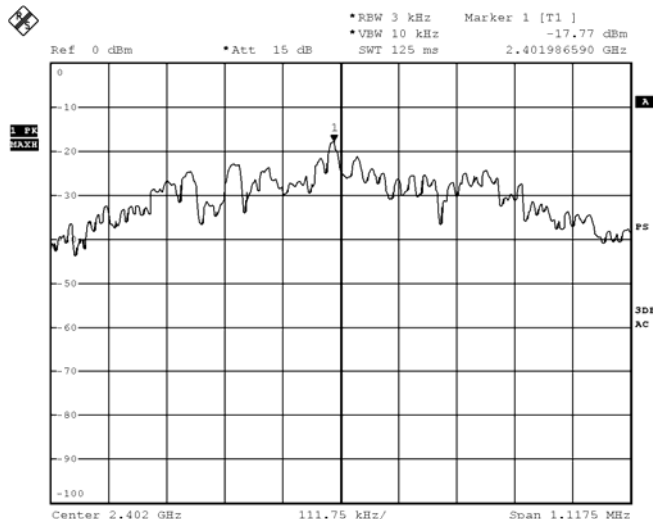
Date : 2017-06-15

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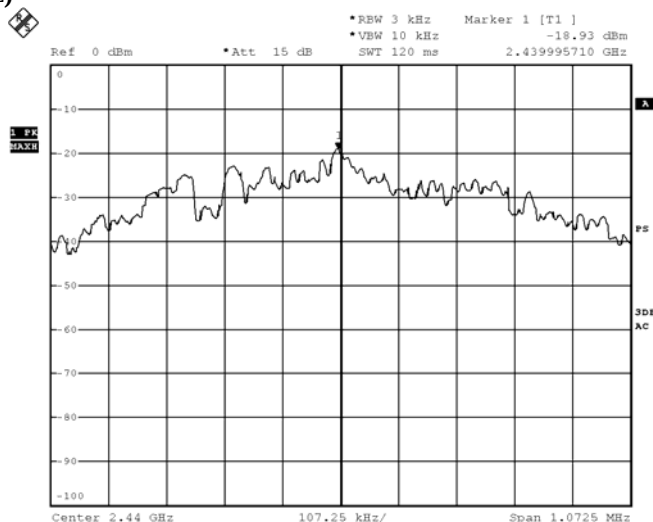
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**Tx mode GFSK (Tx: 2402MHz to 2480MHz)**

**CH 0 (2402.0 MHz)**



**CH 19 (2440.0 MHz)**



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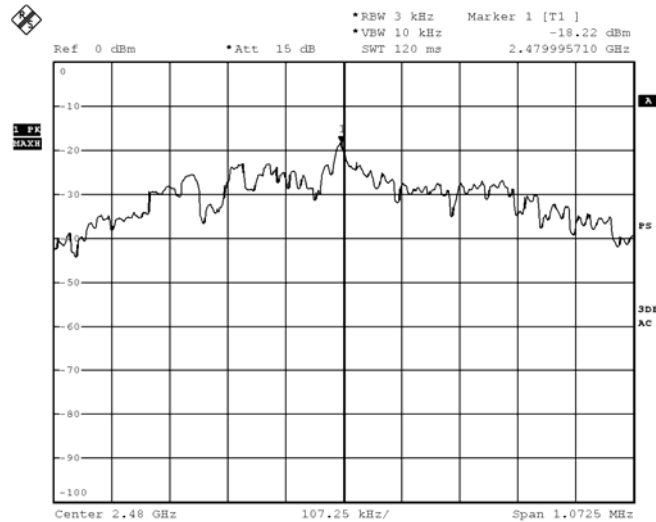
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CH 39 (2480.0 MHz)



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### **3.1.5 6dB Spectrum Bandwidth Measurement**

|                    |                        |
|--------------------|------------------------|
| Test Requirement:  | FCC 47CFR 15.247(a)(2) |
| Test Method:       | ANSI C63.10:2013       |
| Test Date:         | 2017-06-09             |
| Mode of Operation: | Tx mode                |

#### **Test Method:**

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst-case (i.e. the widest) bandwidth.

#### **Test Setup:**

As Test Setup of clause 3.1.1 in this test report.

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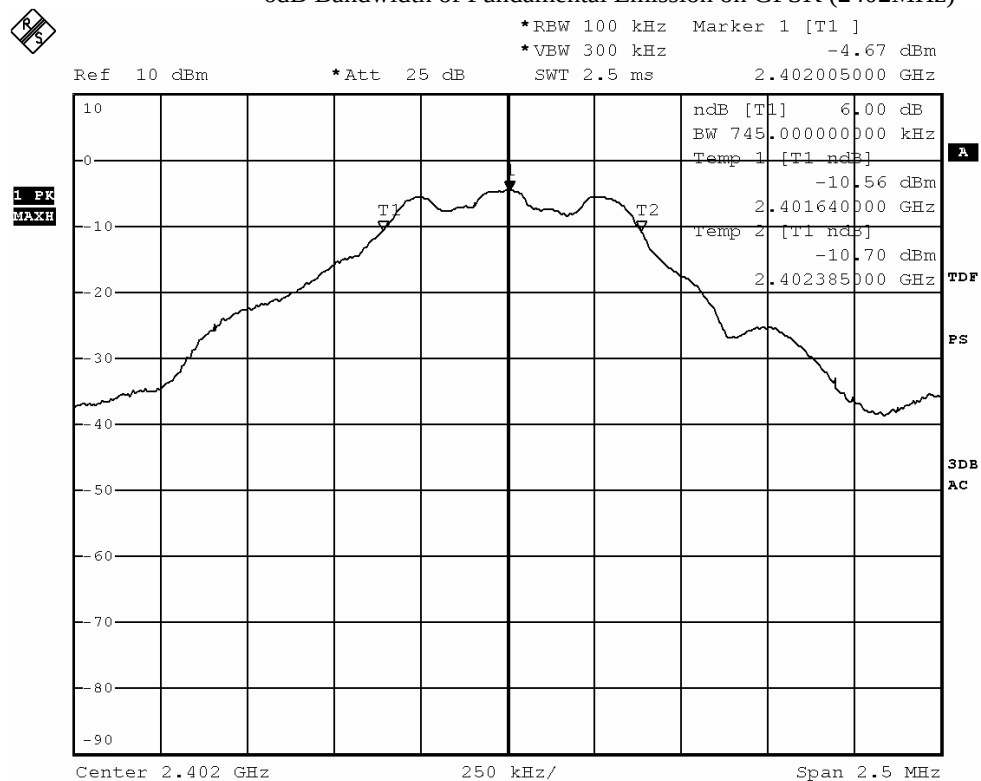
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### Limits for 6dB Spectrum Bandwidth Measurement:

| Center Frequency<br>[MHz] | 6dB Bandwidth<br>[KHz] | FCC Limits<br>[kHz] |
|---------------------------|------------------------|---------------------|
| 2402.0                    | 745.0                  | > 500               |

### 6dB Bandwidth of Fundamental Emission on GFSK (2402MHz)



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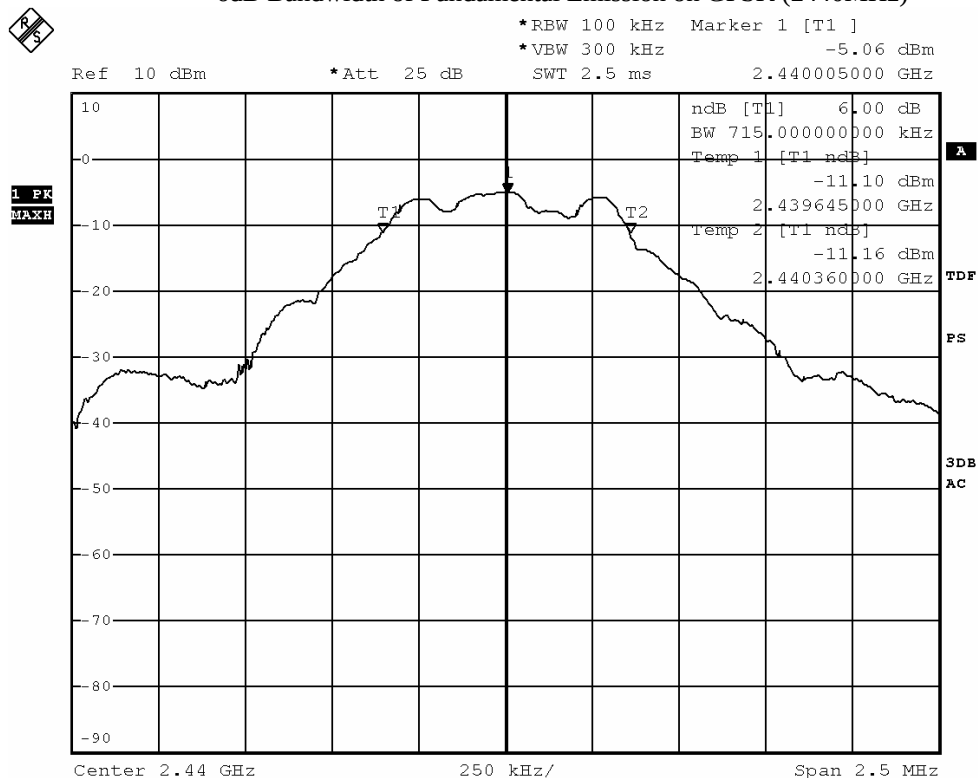
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### Limits for 6dB Spectrum Bandwidth Measurement:

| Frequency Range<br>[MHz] | 6dB Bandwidth<br>[KHz] | FCC Limits<br>[kHz] |
|--------------------------|------------------------|---------------------|
| 2440.0                   | 715.0                  | > 500               |

### 6dB Bandwidth of Fundamental Emission on GFSK (2440MHz)



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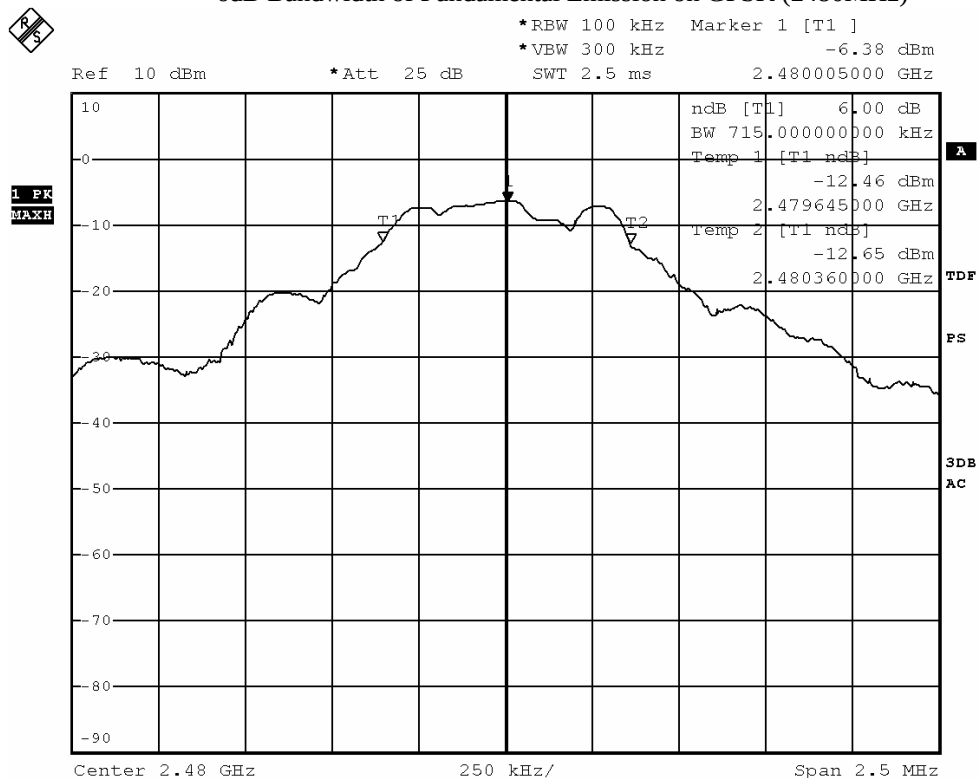
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### Limits for 6dB Spectrum Bandwidth Measurement:

| Frequency Range<br>[MHz] | 6dB Bandwidth<br>[KHz] | FCC Limits<br>[kHz] |
|--------------------------|------------------------|---------------------|
| 2480.0                   | 715.0                  | > 500               |

### 6dB Bandwidth of Fundamental Emission on GFSK (2480MHz)



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### **3.1.6 Band Edges Measurement**

|                    |                  |
|--------------------|------------------|
| Test Requirement:  | FCC 47CFR 15.247 |
| Test Method:       | ANSI C63.10:2013 |
| Test Date:         | 2017-06-09       |
| Mode of Operation: | Tx mode          |

#### **Test Method:**

The band edge is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. The RBW are set to 100kHz and VBW are set to 300kHz for this measurement.

#### **Test Setup:**

As Test Setup of clause 3.1.2 in this test report.

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### Band-edge Compliance of RF Conducted Emissions Measurement:

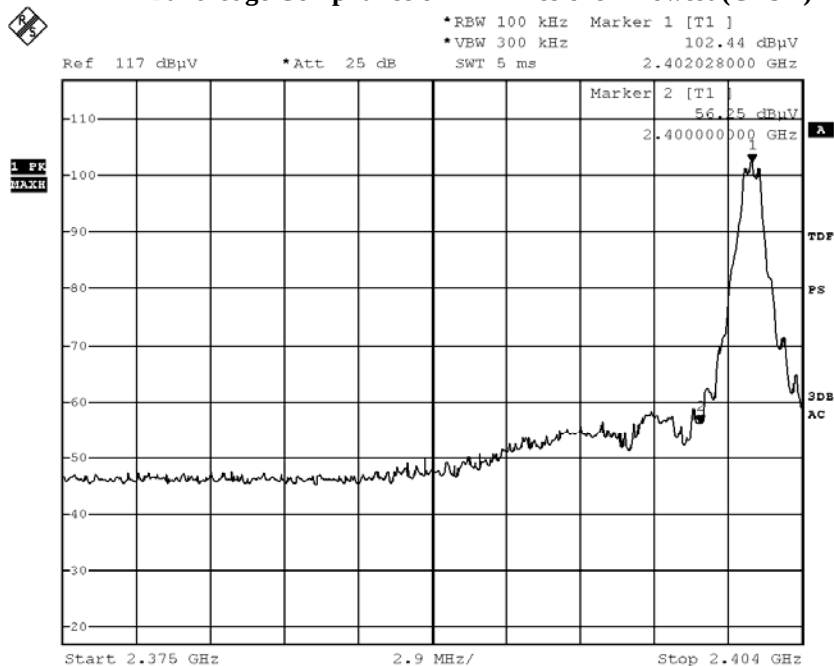
#### Limit :

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz 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.

Remark: Emissions under the fixed frequency mode and hopping mode have been investigated, the worst-case measurement results were recorded in the test report

| Frequency Range<br>[MHz]         | Radiated Emission Attenuated below the Fundamental<br>[dB] |
|----------------------------------|------------------------------------------------------------|
| 2400 – Lowest Fundamental (2402) | 46.19                                                      |

### Band-edge Compliance of RF Emissions – Lowest (GFSK)



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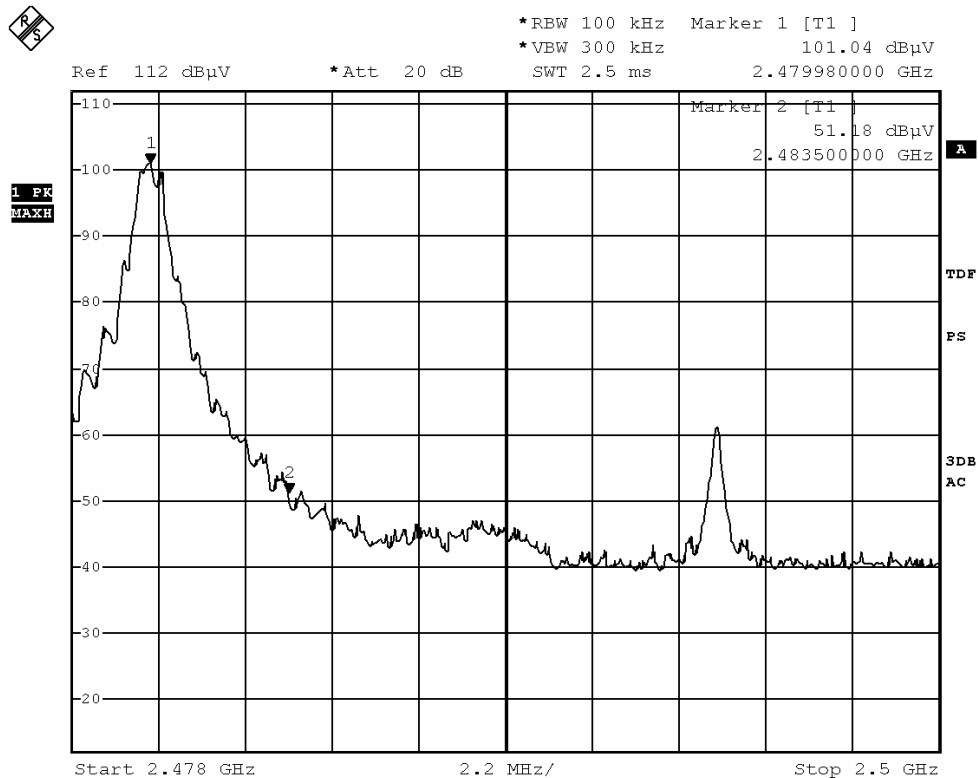
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### Band-edge Compliance of RF Conducted Emissions Measurement:

| Frequency Range<br>[MHz]            | Radiated Emission Attenuated below the Fundamental<br>[dB] |
|-------------------------------------|------------------------------------------------------------|
| 2483.5 - Highest Fundamental (2480) | 49.86                                                      |

### Band-edge Compliance of RF Emissions – Highest (GFSK)



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### 3.1.7 RF Exposure

Test Requirement: FCC 47CFR 15.247(i)  
Test Date: 2017-06-14  
Mode of Operation: Tx mode

#### Test Method:

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

#### Test Results:

The EUT complied with the requirement(s) of this section.  
EUT meets the requirements of these sections as proven through MPE calculation  
The MPE calculation for EUT @ 20cm  
Based on the highest P = 0.56 mW

The power tune up tolerance is  $-3.52 \pm 1.0$  dBm  
Max. duty factor is 100%

$$\begin{aligned} P_d &= PG / 4\pi R^2 = (0.56 \times 1.34) / 12.566 \times (20)^2 \\ &= (0.7504) / 12.566 \times 400 = 0.7504 / 5026.4 \\ &= 0.000149 \text{ mW/cm}^2 \end{aligned}$$

where:

- \*  $P_d$  = power density in mW/cm<sup>2</sup>
- \*  $G$  = Antenna numeric gain (1.34);  $\text{Log } G = g/10$  (  $g = 1.26$  dBi ).
- \*  $P$  = Conducted RF power to antenna (0.56 mW).
- \*  $R$  = Minimum allowable distance.(20 cm)

\*The power density  $P_d = 0.000149 \text{ mW/cm}^2$  is less than  $1 \text{ mW/cm}^2$  (listed MPE limit)

\*The SAR evaluation is not needed ( this is a desk top device,  $R > 20 \text{ cm}$  )

\* The EUT( antenna ) must be 0.2 meters away from the General Population.

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### Appendix A

#### List of Measurement Equipment

##### Radiated Emission

| EQP NO. | DESCRIPTION                          | MANUFACTURER         | MODEL NO. | SERIAL NO. | LAST CAL   | DUE CAL    |
|---------|--------------------------------------|----------------------|-----------|------------|------------|------------|
| EM299   | Double-Ridged Waveguide Horn Antenna | ETS-Lindgren         | 3115      | 00114120   | 2016/04/27 | 2018/04/27 |
| EM300   | Pyramidal Standard Gain Horn Antenna | ETS-Lindgren         | 3160-09   | 00130130   | 2016/05/13 | 2018/05/13 |
| EM301   | Pyramidal Standard Gain Horn Antenna | ETS-Lindgren         | 3160-10   | 00130988   | 2016/05/13 | 2018/05/13 |
| EM215   | MULTIDEVICE CONTROLLER               | EMCO                 | 2090      | 00024676   | N/A        | N/A        |
| EM216   | MINI MAST SYSTEM                     | EMCO                 | 2075      | 00026842   | N/A        | N/A        |
| EM217   | ELECTRIC POWERED TURNTABLE           | EMCO                 | 2088      | 00029144   | N/A        | N/A        |
| EM218   | ANECHOIC CHAMBER                     | ETS-LINDGREN         | FACT-3    | --         | 2017/04/20 | 2018/04/20 |
| EM355   | Biconilog Antenna                    | ETS-Lindgren         | 3143B     | 00094856   | 2016/03/03 | 2018/03/03 |
| EM353   | LOOP ANTENNA                         | ETS_LINDGREN         | 6502      | 00206533   | 2016/03/16 | 2018/03/16 |
| EM293   | Spectrum Analyzer                    | Agilent Technologies | N9020A    | MY50510152 | 2016/08/22 | 2017/08/22 |

##### Line Conducted

| EQP NO. | DESCRIPTION       | MANUFACTURER                        | MODEL NO. | SERIAL NO.      | LAST CAL   | DUE CAL    |
|---------|-------------------|-------------------------------------|-----------|-----------------|------------|------------|
| EM119   | LISN              | R & S                               | ESH3-Z5   | 0831.5518.52    | 2016/11/29 | 2017/11/29 |
| EM145   | EMI TEST RECEIVER | R & S                               | ESCS 30   | 830245/021      | 2017/06/01 | 2018/06/01 |
| EM179   | IMPULSE LIMITER   | ROHDE & SCHWARZ                     | ESH3-Z2   | 357-8810.52/54  | 2017/01/11 | 2018/01/11 |
| EM154   | SHIELDING ROOM    | SIEMENS<br>MATSUSHITA<br>COMPONENTS | N/A       | 803-740-057-99A | 2017/02/02 | 2022/02/02 |

#### Remarks:-

CM      Corrective Maintenance  
N/A      Not Applicable  
TBD      To Be Determined

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### Appendix B

#### Photographs of EUT

**Front View of the product**



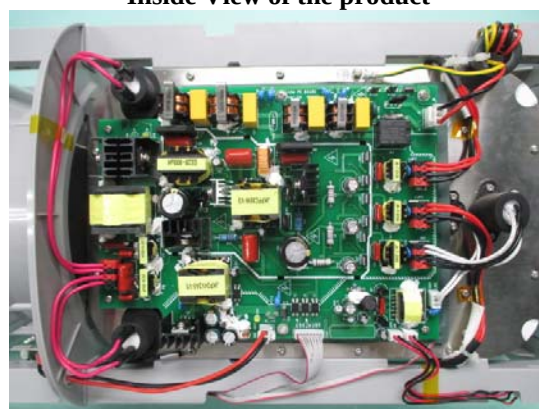
**Rear View of the product**



**Inside View of the product**



**Inside View of the product**



**Inner Circuit Top View**



**Inner Circuit Bottom View**



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### Photographs of EUT

Inner Circuit Top View



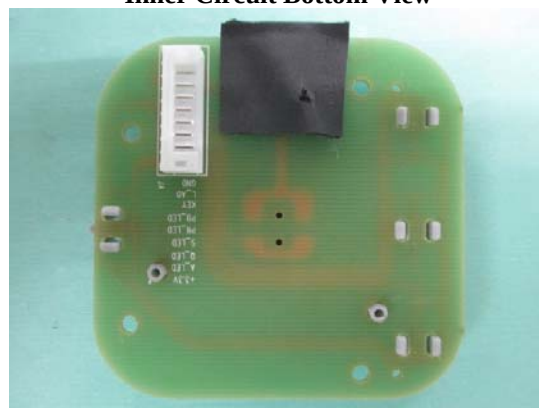
Inner Circuit Top View



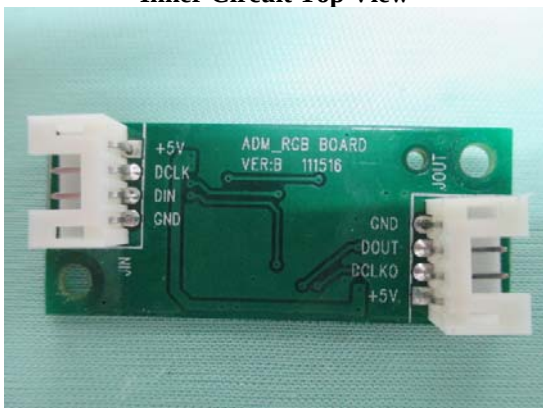
Inner Circuit Top View



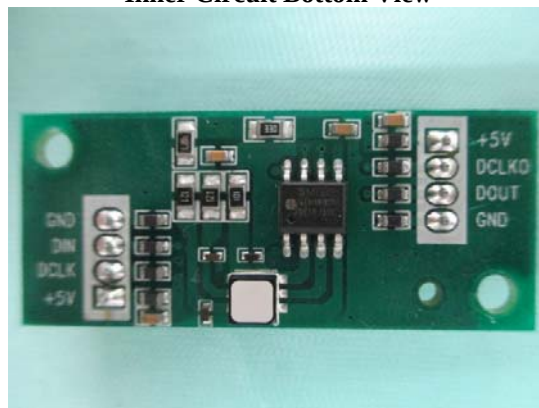
Inner Circuit Bottom View



Inner Circuit Top View



Inner Circuit Bottom View



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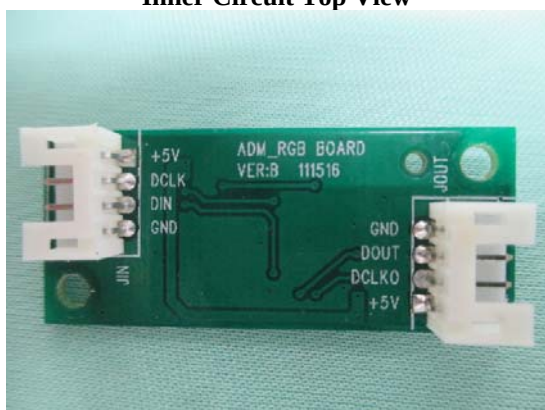
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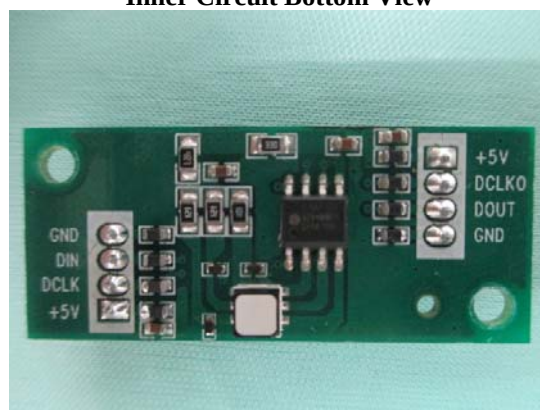
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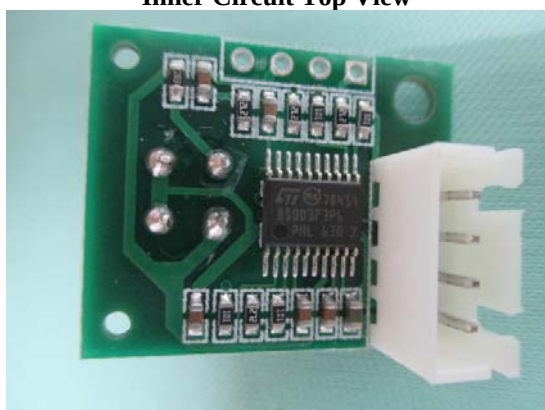
**Inner Circuit Top View**



**Inner Circuit Bottom View**



**Inner Circuit Top View**



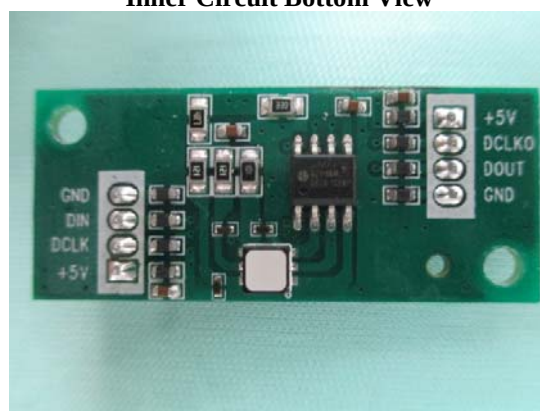
**Inner Circuit Bottom View**



**Inner Circuit Top View**



**Inner Circuit Bottom View**



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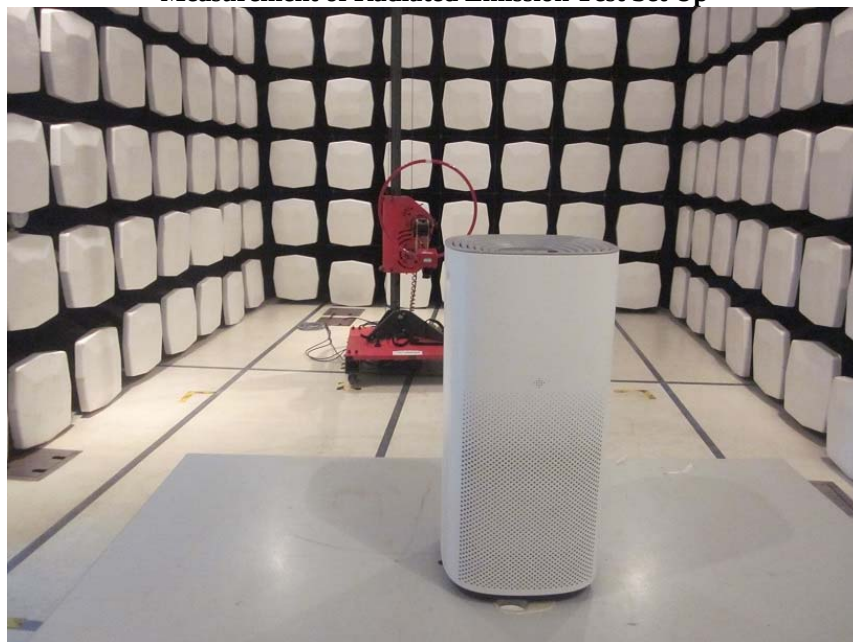
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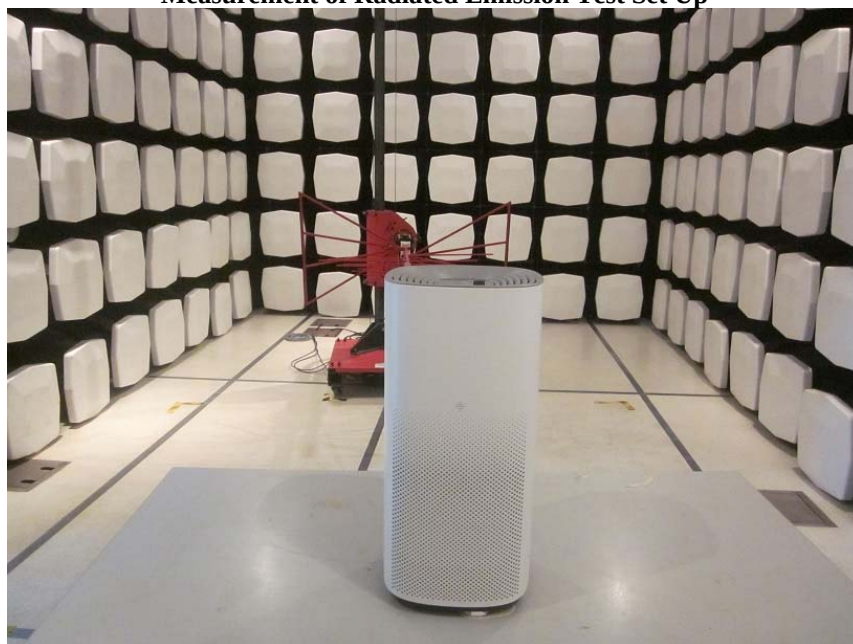
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### Photographs of EUT

**Measurement of Radiated Emission Test Set Up**



**Measurement of Radiated Emission Test Set Up**



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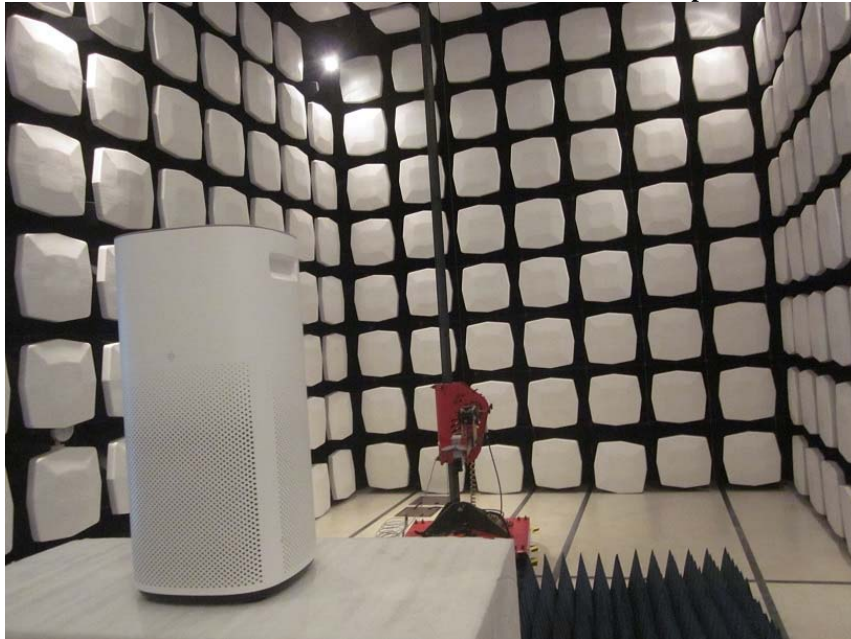
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### Photographs of EUT

**Measurement of Radiated Emission Test Set Up**



**Measurement of Conducted Emission Test Set Up**



**\*\*\*\*\* End of Test Report \*\*\*\*\***

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