



# FCC RADIO TEST REPORT

**FCC ID: 2AULJTSD-BT908**

**Product:** Bluetooth earphone

**Trade Name:** N/A

**Model Name:** TSD-BT908

**Serial Model:** N/A

**Report No.:** PTC19091001594E-FC01

## Prepared for

Tai-Sound Technology Co.,Ltd

Laili Building, Baoyuan Road, Xixiang Street, Baoan Dist., Shenzhen,  
Guangdong, China.

## Prepared by

DongGuan Precise testing &Certification Corp. Ltd

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## TEST RESULT CERTIFICATION

**Applicant's name**.....: Tai-Sound Technology Co.,Ltd  
**Address**.....: Laili Building, Baoyuan Road, Xixiang Street, Baoan Dist.,  
Shenzhen, Guangdong, China.  
**Manufacture's Name**.....: Tai-Sound Technology Co.,Ltd  
**Address**.....: Laili Building, Baoyuan Road, Xixiang Street, Baoan Dist.,  
Shenzhen, Guangdong, China.

### Product description

**Product name**.....: Bluetooth earphone  
**Trade Mark**.....: N/A  
**Model and/or type reference** ..: TSD-BT908

**Standards**.....: FCC Rules and Regulations Part 15 Subpart C Section 15.247  
ANSI C63.10: 2013

This device described above has been tested by DongGuan Precise testing & Certification Corp. Ltd and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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**Date of Test**.....:

**Date (s) of performance of tests**.....: Step. 4 ~ 6, 2019

**Date of Issue**.....: Step. 9, 2019

**Test Result**.....: Pass

Prepared by:

Leo Yang / Engineer

Reviewer:

Chris Du / Manager



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## 1. TEST SUMMARY

### TEST PROCEDURES AND RESULTS

| DESCRIPTION OF TEST            | RESULT    |
|--------------------------------|-----------|
| CONDUCTED EMISSIONS TEST       | COMPLIANT |
| RADIATED EMISSION TEST         | COMPLIANT |
| BAND EDGE                      | COMPLIANT |
| OCCUPIED BANDWIDTH MEASUREMENT | COMPLIANT |
| MAXIMUM PEAK OUTPUT POWER      | COMPLIANT |
| FREQUENCY SEPARATION           | COMPLIANT |
| CONDUCTED BANDEGE MEASUREMENT  | COMPLIANT |
| SPURIOUS RF CONDUCTED EMISSION | COMPLIANT |
| NUMBER OF HOPPING FREQUENCY    | COMPLIANT |
| TIME OF OCCUPANCY(DWELL TIME)  | COMPLIANT |
| ANTENNA REQUIREMENT            | COMPLIANT |

### TEST FACILITY

Test Firm : DongGuan Precise testing & Certification Corp. Ltd

Address : Building D, Baoding Technology Park, Guangming Road 2, Guangming  
Community, Dongcheng District, Dongguan, Guangdong, Chinaaa

FCC Registration Number: 790290

A2LA Certificate No.: 4408.01

IC Registration Number: 12191A-1

### MEASUREMENT UNCERTAINTY

#### Measurement Uncertainty

|                                                       |               |
|-------------------------------------------------------|---------------|
| Conducted Emission Expanded Uncertainty               | = 2.23dB, k=2 |
| Radiated emission expanded uncertainty(9kHz-30MHz)    | = 3.08dB, k=2 |
| Radiated emission expanded uncertainty(30MHz-1000MHz) | = 4.42dB, k=2 |
| Radiated emission expanded uncertainty(Above 1GHz)    | = 4.06dB, k=2 |



## 2. GENERAL INFORMATION

### 2.1 GENERAL DESCRIPTION OF EUT

|                    |                                   |
|--------------------|-----------------------------------|
| Equipment          | Bluetooth earphone                |
| Trade Mark         | N/A                               |
| Model Name         | TSD-BT908                         |
| Serial No.         | N/A                               |
| Model Difference   | N/A                               |
| FCC ID             | 2AULJTSD-BT908                    |
| Antenna Type       | PCB Antenna                       |
| Antenna Gain       | 2dBi                              |
| Frequency Range    | 2402-2480MHz                      |
| Number of Channels | 79 channels for BR+EDR            |
| Modulation Type    | GFSK, Pi/4 QPSK, 8DPSK for BR+EDR |
| Power Source       | Micro USB 5V or 3.7V from battery |

Table for auxiliary equipment:

| Equipment Description | Manufacturer | Model        | Calibration Due Date | Remark   |
|-----------------------|--------------|--------------|----------------------|----------|
| Notebook              | Lenovo       | Lenovo G475  | GB14477457           | N/A      |
| Adapter               | BI           | BI05-050100U | N/A                  | DC 5V/1A |



## 2.2 Carrier Frequency of Channels

| Channel List |                 |         |                 |         |                 |         |                 |
|--------------|-----------------|---------|-----------------|---------|-----------------|---------|-----------------|
| Channel      | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
| 00           | 2402            | 21      | 2423            | 42      | 2444            | 63      | 2465            |
| 01           | 2403            | 22      | 2424            | 43      | 2445            | 64      | 2466            |
| 02           | 2404            | 23      | 2425            | 44      | 2446            | 65      | 2467            |
| 03           | 2405            | 24      | 2426            | 45      | 2447            | 66      | 2468            |
| 04           | 2406            | 25      | 2427            | 46      | 2448            | 67      | 2469            |
| 05           | 2407            | 26      | 2428            | 47      | 2449            | 68      | 2470            |
| 06           | 2408            | 27      | 2429            | 48      | 2450            | 69      | 2471            |
| 07           | 2409            | 28      | 2430            | 49      | 2451            | 70      | 2472            |
| 08           | 2410            | 29      | 2431            | 50      | 2452            | 71      | 2473            |
| 09           | 2411            | 30      | 2432            | 51      | 2453            | 72      | 2474            |
| 10           | 2412            | 31      | 2433            | 52      | 2454            | 73      | 2475            |
| 11           | 2413            | 32      | 2434            | 53      | 2455            | 74      | 2476            |
| 12           | 2414            | 33      | 2435            | 54      | 2456            | 75      | 2477            |
| 13           | 2415            | 34      | 2436            | 55      | 2457            | 76      | 2478            |
| 14           | 2416            | 35      | 2437            | 56      | 2458            | 77      | 2479            |
| 15           | 2417            | 36      | 2438            | 57      | 2459            | 78      | 2480            |
| 16           | 2418            | 37      | 2439            | 58      | 2460            |         |                 |
| 17           | 2419            | 38      | 2440            | 59      | 2461            |         |                 |
| 18           | 2420            | 39      | 2441            | 60      | 2462            |         |                 |
| 19           | 2421            | 40      | 2442            | 61      | 2463            |         |                 |
| 20           | 2422            | 41      | 2443            | 62      | 2464            |         |                 |

## 2.3 Operation of EUT during testing

### Operating Mode

The mode is used: Transmitting mode

Low Channel: 2402MHz

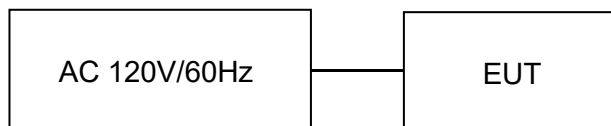
Middle Channel: 2441MHz

High Channel: 2480MHz

Test SW Version: Blue MP Tool

## 2.4 DESCRIPTION OF TEST SETUP

Operation of EUT during Conducted testing:



Operation of EUT during Radiation testing:



## 2.5 MEASUREMENT INSTRUMENTS LIST

| Item                     | Equipment                                 | Manufacturer  | Model No.   | Serial No.    | Calibrated until |
|--------------------------|-------------------------------------------|---------------|-------------|---------------|------------------|
| CONDUCTED EMISSIONS TEST |                                           |               |             |               |                  |
| 1                        | AMN                                       | Schwarzbeck   | NNLK8121    | 8121370       | 2019.9.9         |
| 2                        | AMN                                       | ETS           | 3810/2      | 00020199      | 2019.9.9         |
| 3                        | EMI TEST RECEIVER                         | Rohde&Schwarz | ESCI        | 101210        | 2019.9.9         |
| 4                        | AAN                                       | TESEQ         | T8-Cat6     | 38888         | 2019.9.9         |
| RADIATED EMISSION TEST   |                                           |               |             |               |                  |
| 1                        | Horn Antenna                              | Sunol         | DRH-118     | A101415       | 2019.9.29        |
| 2                        | BicoNLog Antenna                          | Sunol         | JB1 Antenna | A090215       | 2019.9.29        |
| 3                        | PREAMP                                    | HP            | 8449B       | 3008A00160    | 2019.9.9         |
| 4                        | PREAMP                                    | HP            | 8447D       | 2944A07999    | 2019.9.9         |
| 5                        | EMI TEST RECEIVER                         | Rohde&Schwarz | ESR3        | 101891        | 2019.9.9         |
| 6                        | VECTOR Signal Generator                   | Rohde&Schwarz | SMU200A     | 101521        | 2019.9.28        |
| 7                        | Signal Generator                          | Agilent       | E4421B      | MY4335105     | 2019.9.28        |
| 8                        | MXA Signal Analyzer                       | Agilent       | N9020A      | MY50510140    | 2019.9.28        |
| 9                        | MXA Signal Analyzer                       | Agilent       | N9020A      | MY51110104    | 2019.9.9         |
| 10                       | ANT Tower&Turn table Controller           | Champro       | EM 1000     | 60764         | 2019.9.28        |
| 11                       | Anechoic Chamber                          | Taihe Maorui  | 9m*6m*6m    | 966A0001      | 2019.9.9         |
| 12                       | Shielding Room                            | Taihe Maorui  | 6.4m*4m*3m  | 643A0001      | 2019.9.9         |
| 13                       | RF Power sensor                           | DARE          | RPR3006W    | 15I00041SNO88 | 2020.3.14        |
| 14                       | RF Power sensor                           | DARE          | RPR3006W    | 15I00041SNO89 | 2020.3.14        |
| 15                       | RF power divider                          | Anritsu       | K241B       | 992289        | 2019.9.28        |
| 16                       | Wideband radio communication tester       | Rohde&Schwarz | CMW500      | 154987        | 2019.9.28        |
| 17                       | Biconical antenna                         | Schwarzbeck   | VHA 9103    | 91032360      | 2019.9.8         |
| 18                       | Biconical antenna                         | Schwarzbeck   | VHA 9103    | 91032361      | 2019.9.8         |
| 19                       | Broadband Hybrid Antennas                 | Schwarzbeck   | VULB9163    | VULB9163#958  | 2019.9.8         |
| 20                       | Horn Antenna                              | Schwarzbeck   | BBHA9120D   | 9120D-1680    | 2020.1.12        |
| 21                       | Active Receive Loop Antenna               | Schwarzbeck   | FMZB 1919B  | 00023         | 2019.11.02       |
| 22                       | Horn Antenna                              | Schwarzbeck   | BBHA 9170   | BBHA9170651   | 2020.03.14       |
| 23                       | Microwave Broadband PreBluetooth earphone | Schwarzbeck   | BBV 9721    | 100472        | 2019.10.24       |
| 24                       | Active Loop Antenna                       | Com-Power     | AL-130R     | 10160009      | 2019.9.8         |
| 25                       | Power Meter                               | KEYSIGHT      | N1911A      | MY50520168    | 2019.9.8         |
| 26                       | Frequency Meter                           | VICTOR        | VC2000      | 997406086     | 2019.9.8         |
| 27                       | DC Power Source                           | HYELEC        | HY5020E     | 055161818     | 2019.9.8         |
| Test software            |                                           |               |             |               |                  |
| 1                        | E3                                        | Audix         | 6.101223a   | N/A           | N/A              |

### 3. CONDUCTED EMISSIONS TEST

#### 3.1 Conducted Power Line Emission Limit

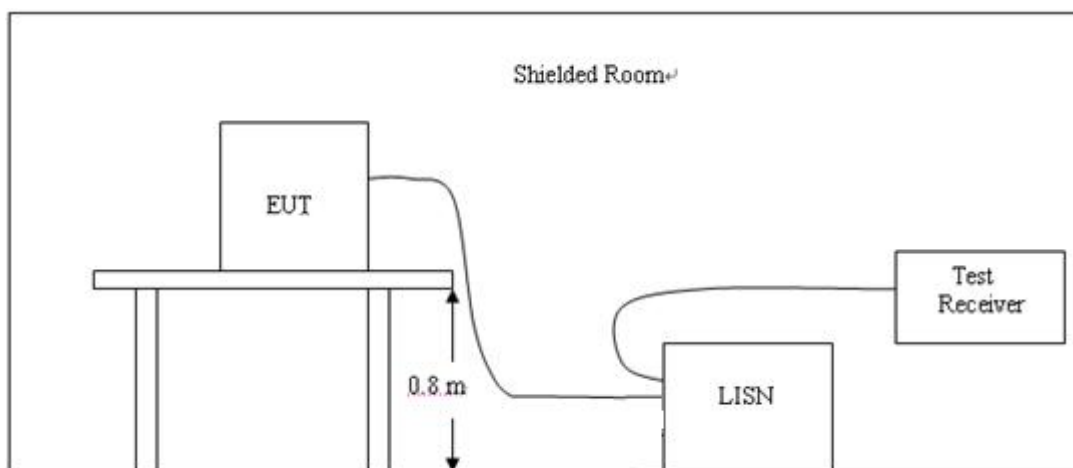
For unintentional device, according to § 15.107(a) Line Conducted Emission Limits is as following

| Frequency<br>(MHz) | Maximum RF Line Voltage(dBμV) |      |         |        |
|--------------------|-------------------------------|------|---------|--------|
|                    | CLASS A                       |      | CLASS B |        |
|                    | Q.P.                          | Ave. | Q.P.    | Ave.   |
| 0.15~0.50          | 79                            | 66   | 66~56*  | 56~46* |
| 0.50~5.00          | 73                            | 60   | 56      | 46     |
| 5.00~30.0          | 73                            | 60   | 60      | 50     |

\* Decreasing linearly with the logarithm of the frequency

For intentional device, according to §15.207(a) Line Conducted Emission Limit is same as above table.

#### 3.2 Test Setup



#### 3.3 Test Procedure

- 1, The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10.
- 2, Support equipment, if needed, was placed as per ANSI C63.10.
- 3, All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.
- 4, If a EUT received DC power from the USB Port of Notebook PC, the PC's adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
- 5, All support equipments received AC power from a second LISN, if any.
- 6, The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
- 7, Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.

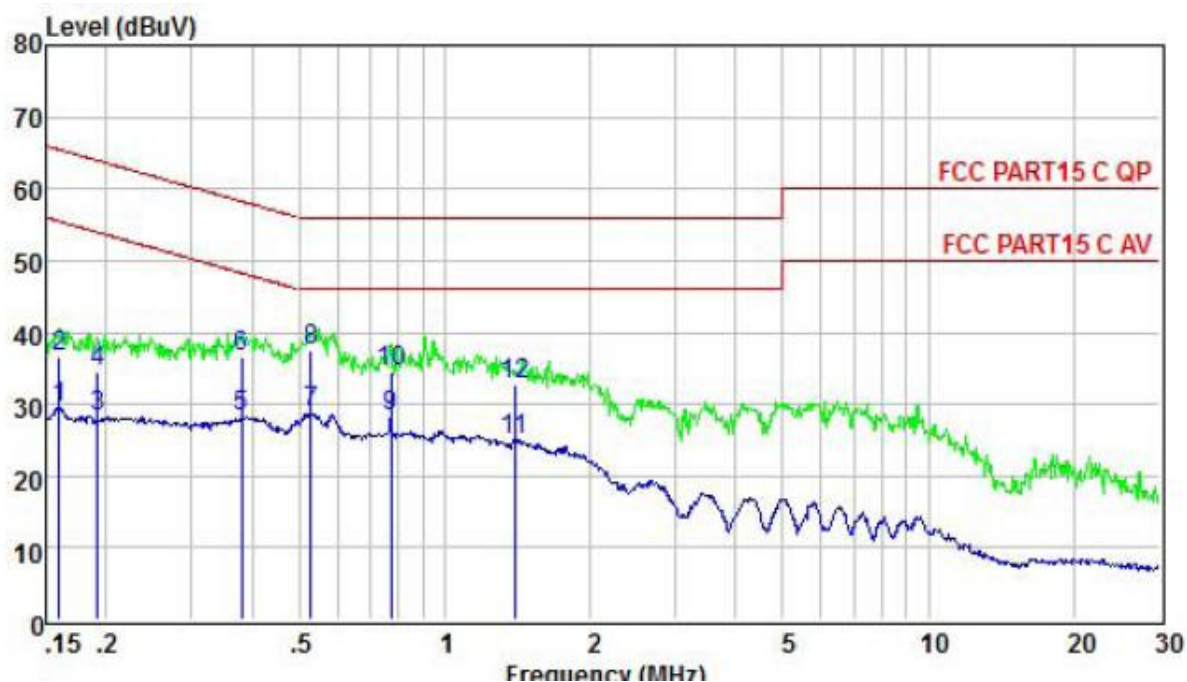
#### 3.4 Test Result

Pass

Remark:

1. All modes were tested at AC 120V and 240V, only the worst result of AC 120V was reported.
2. All modes of Low, Middle, and High channel were tested, only the worst result of High Channel was reported as below:

|               |                                   |                    |         |
|---------------|-----------------------------------|--------------------|---------|
| Temperature:  | 24°C                              | Relative Humidity: | 48%     |
| Test Date:    | Step. 3, 2019                     | Pressure:          | 1010hPa |
| Test Voltage: | AC 120V, 60Hz                     | Phase:             | Line    |
| Test Mode:    | Transmitting mode of GFSK 2480MHz |                    |         |

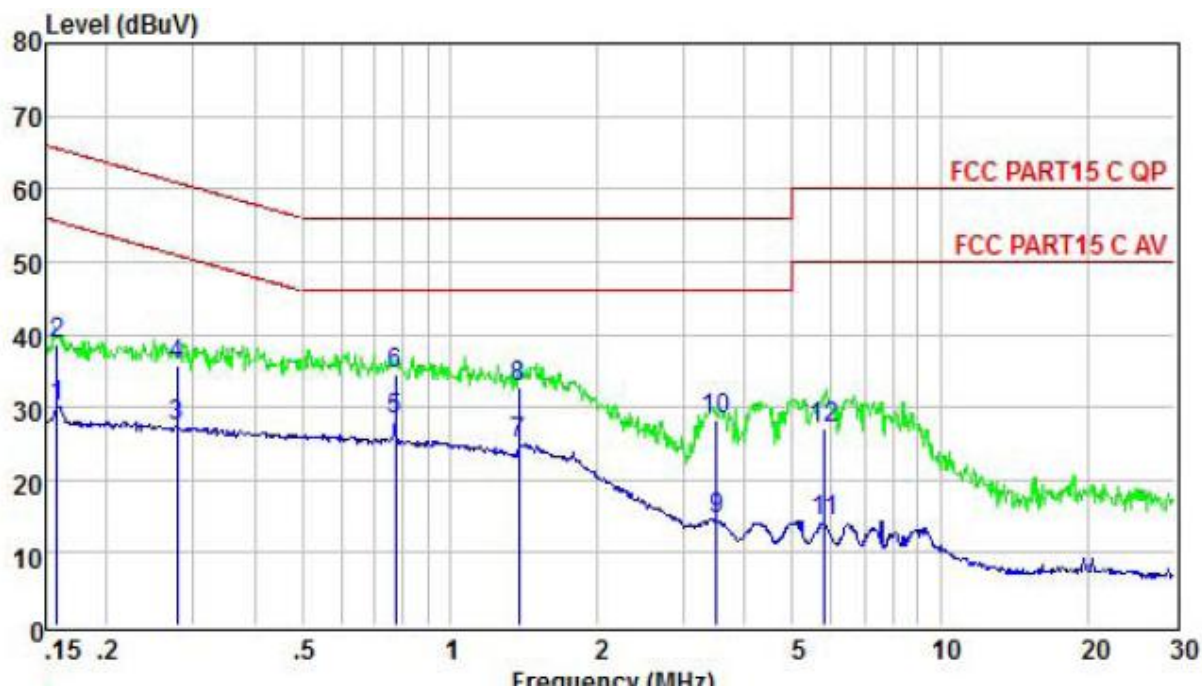


|    | Freq  | Level | Limit | Over   | Remark  |
|----|-------|-------|-------|--------|---------|
|    | MHz   | dBuV  | Line  | Limit  |         |
|    |       |       | dBuV  | dB     |         |
| 1  | 0.160 | 29.59 | 55.47 | -25.88 | Average |
| 2  | 0.160 | 36.69 | 65.47 | -28.78 | QP      |
| 3  | 0.191 | 28.26 | 53.98 | -25.72 | Average |
| 4  | 0.191 | 34.59 | 63.98 | -29.39 | QP      |
| 5  | 0.381 | 28.34 | 48.25 | -19.91 | Average |
| 6  | 0.381 | 36.69 | 58.25 | -21.56 | QP      |
| 7  | 0.529 | 28.70 | 46.00 | -17.30 | Average |
| 8  | 0.529 | 37.58 | 56.00 | -18.42 | QP      |
| 9  | 0.775 | 28.20 | 46.00 | -17.80 | Average |
| 10 | 0.775 | 34.59 | 56.00 | -21.41 | QP      |
| 11 | 1.396 | 25.03 | 46.00 | -20.97 | Average |
| 12 | 1.396 | 32.68 | 56.00 | -23.32 | QP      |

Remark: Factor = Insertion Loss + Cable Loss, Result = Reading + Factor, Margin = Result – Limit.



|               |                                   |                    |         |
|---------------|-----------------------------------|--------------------|---------|
| Temperature:  | 24°C                              | Relative Humidity: | 48%     |
| Test Date:    | Step. 3, 2019                     | Pressure:          | 1010hPa |
| Test Voltage: | AC 120V, 60Hz                     | Phase:             | Neutral |
| Test Mode:    | Transmitting mode of GFSK 2480MHz |                    |         |



|    | Freq  | Level | Limit | Over   | Remark  |
|----|-------|-------|-------|--------|---------|
|    | MHz   | dBuV  | dBuV  | dB     |         |
| 1  | 0.158 | 30.17 | 55.56 | -25.39 | Average |
| 2  | 0.158 | 38.55 | 65.56 | -27.01 | QP      |
| 3  | 0.277 | 27.31 | 50.90 | -23.59 | Average |
| 4  | 0.277 | 35.69 | 60.90 | -25.21 | QP      |
| 5  | 0.775 | 28.17 | 46.00 | -17.83 | Average |
| 6  | 0.775 | 34.58 | 56.00 | -21.42 | QP      |
| 7  | 1.381 | 24.88 | 46.00 | -21.12 | Average |
| 8  | 1.381 | 32.69 | 56.00 | -23.31 | QP      |
| 9  | 3.491 | 14.60 | 46.00 | -31.40 | Average |
| 10 | 3.491 | 28.12 | 56.00 | -27.88 | QP      |
| 11 | 5.805 | 14.33 | 50.00 | -35.67 | Average |
| 12 | 5.805 | 26.99 | 60.00 | -33.01 | QP      |

Remark: Factor = Insertion Loss + Cable Loss, Result = Reading + Factor, Margin = Result – Limit.

## 4. RADIATED EMISSION TEST

### 4.1 Radiation Limit

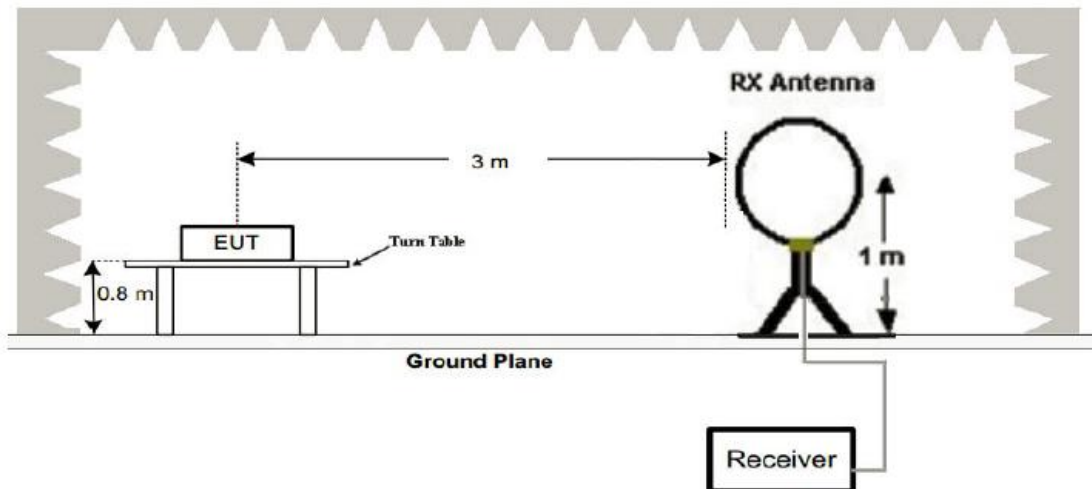
For unintentional device, according to § 15.109(a), except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

| Frequency (MHz) | Distance (Meters) | Radiated (dB $\mu$ V/m) | Radiated ( $\mu$ V/m) |
|-----------------|-------------------|-------------------------|-----------------------|
| 30-88           | 3                 | 40                      | 100                   |
| 88-216          | 3                 | 43.5                    | 150                   |
| 216-960         | 3                 | 46                      | 200                   |
| Above 960       | 3                 | 54                      | 500                   |

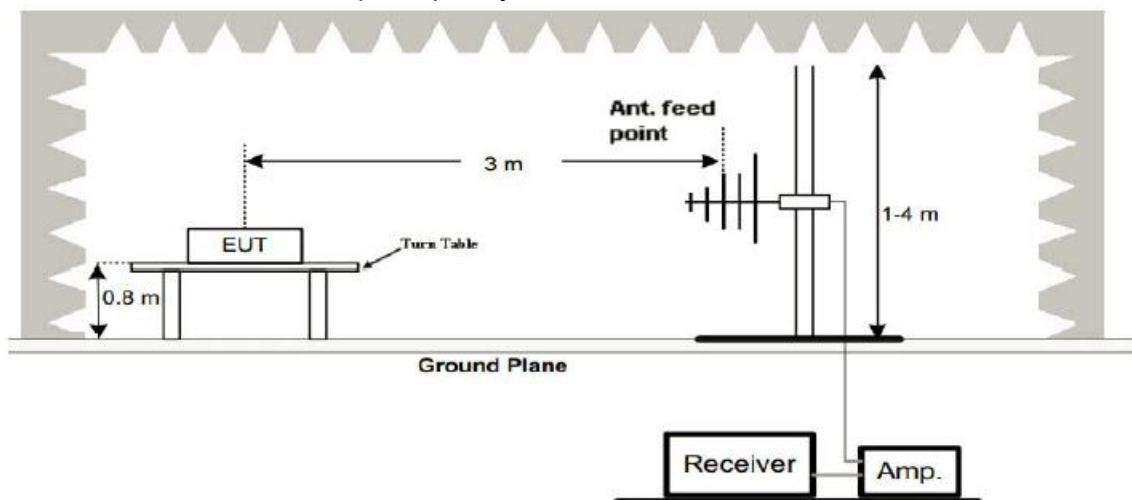
For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the above table.

### 4.2 Test Setup

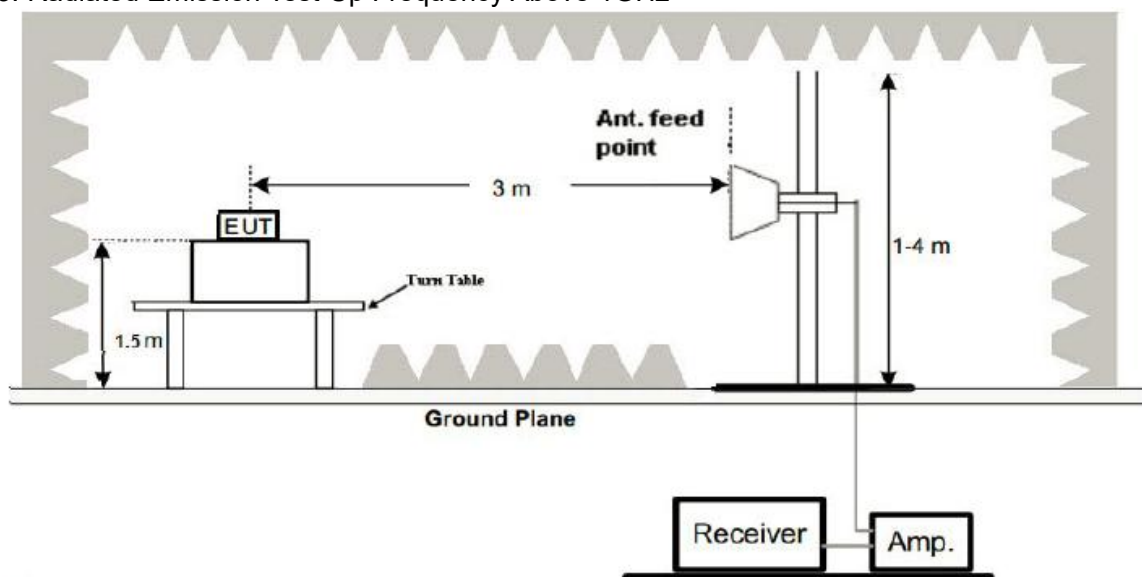
#### 1. Radiated Emission Test-Up Frequency Below 30MHz



#### 2. Radiated Emission Test-Up Frequency 30MHz~1GHz



### 3. Radiated Emission Test-Up Frequency Above 1GHz



### 4.3 Test Procedure

- Below 1GHz measurement the EUT is placed on turntable which is 0.8m above ground plane. And above 1GHz measurement EUT was placed on low permittivity and low tangent turn table which is 1.5m above ground plane.
- The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
- EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
- Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- Repeat above procedures until the measurements for all frequencies are complete.
- The test frequency range from 9KHz to 25GHz per FCC PART 15.33(a).
- The distance between test antenna and EUT as following table states:

| Test Frequency range | Test Antenna Type   | Test Distance |
|----------------------|---------------------|---------------|
| 9KHz-30MHz           | Active Loop Antenna | 3             |
| 30MHz-1GHz           | Bilog Antenna       | 3             |
| 1GHz-18GHz           | Horn Antenna        | 3             |
| 18GHz-25GHz          | Horn Antenna        | 1             |

Note:

For battery operated equipment, the equipment tests shall be performed using a new battery.

### 4.4 Test Result

PASS

Remark:

- All modes of GFSK,  $\pi/4$  DQPSK, 8DPSK were test at Low, Middle, and High channel, only the worst result of GFSK High Channel was reported for below 1GHz test.
- For BT3.0 above 1GHz test all modes of GFSK,  $\pi/4$  DQPSK, and 8DPSK were test at Low, Middle, and High channel, only the worst result of GFSK DH5 was reported.
- By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that "Z axis" position was the worst, and test data recorded in this report.
- Radiated emission test from 9KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9KHz to 30MHz and not recorded in this report.



|               |                                   |                    |            |
|---------------|-----------------------------------|--------------------|------------|
| Temperature:  | 22°C                              | Relative Humidity: | 48%        |
| Test Date:    | Step. 3, 2019                     | Pressure:          | 1010hPa    |
| Test Voltage: | DC 3.7V                           | Polarization:      | Horizontal |
| Test Mode:    | Transmitting mode of GFSK 2480MHz |                    |            |

**Below 30MHz**

| Freq. | Reading  | Limit    | Margin | State |
|-------|----------|----------|--------|-------|
| (MHz) | (dBuV/m) | (dBuV/m) | (dB)   | P/F   |
| --    | --       | --       | --     | P     |
| --    | --       | --       | --     | P     |

**Note:**

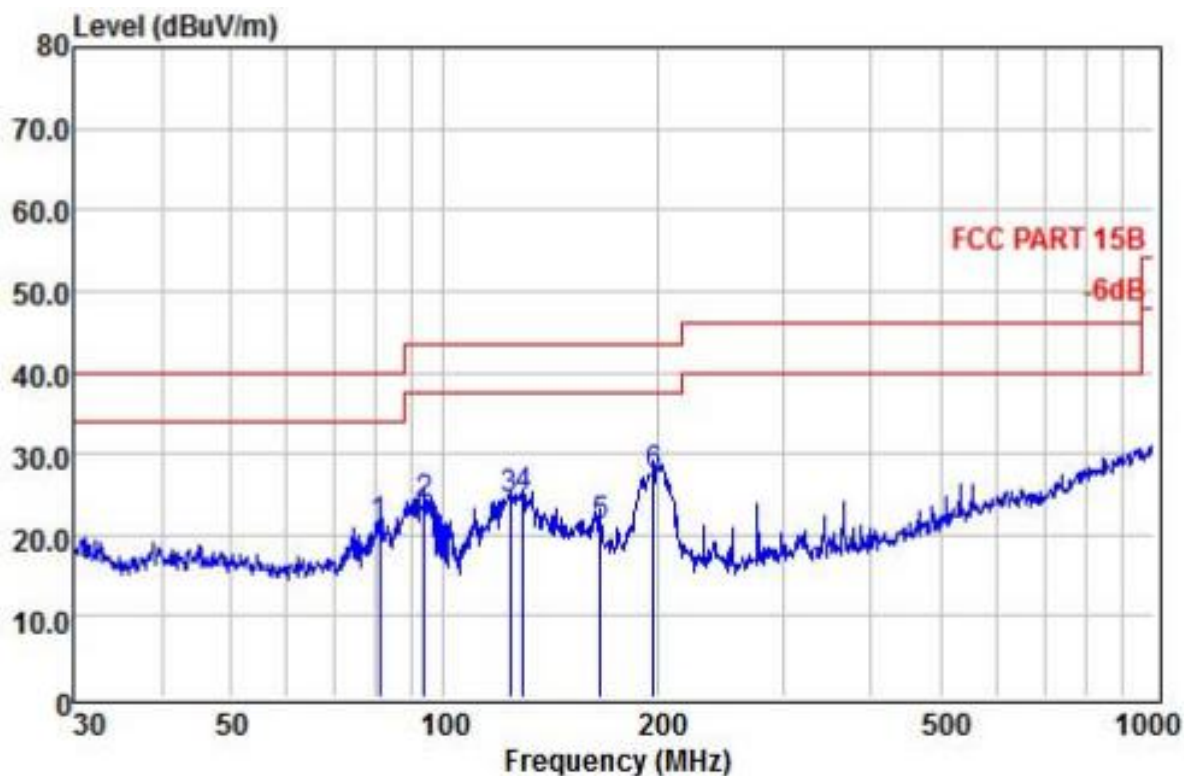
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Distance extrapolation factor =  $40 \log (\text{specific distance/test distance})(\text{dB})$ ;  
Limit line = specific limits(dBuv) + distance extrapolation factor.



Below 1GHz Test Results:

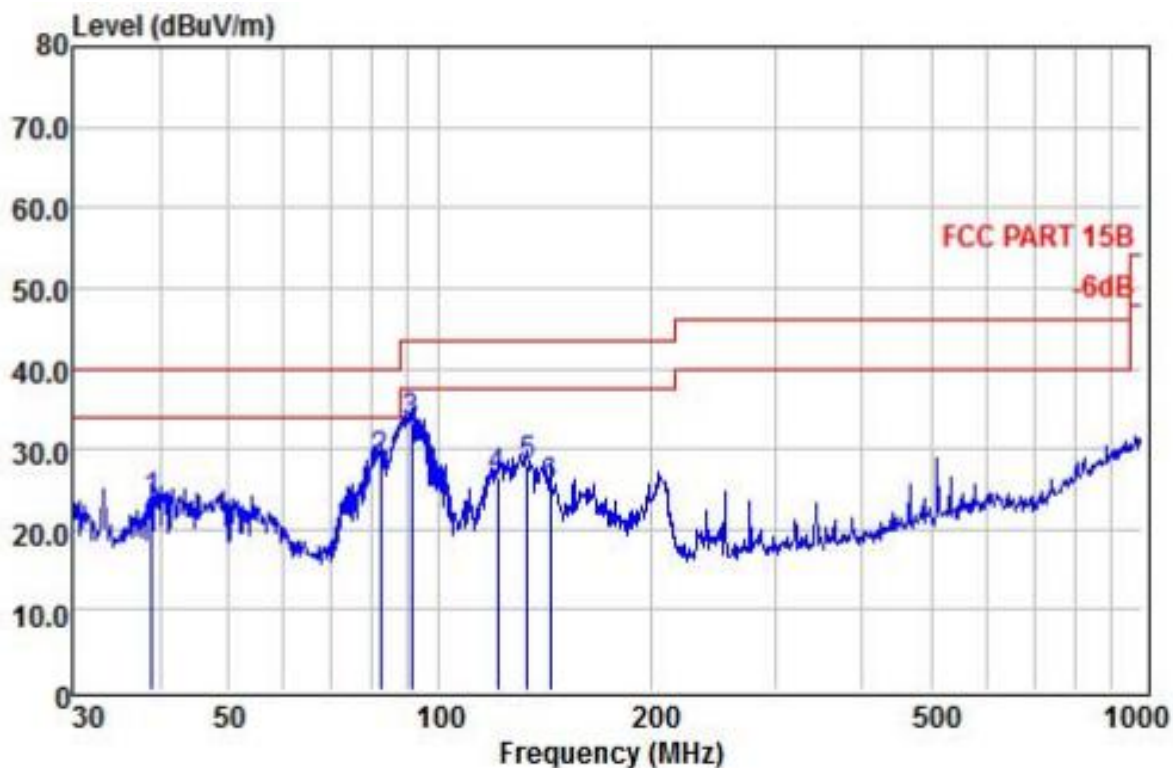
|               |                                   |                    |            |
|---------------|-----------------------------------|--------------------|------------|
| Temperature:  | 22°C                              | Relative Humidity: | 48%        |
| Test Date:    | Step. 3, 2019                     | Pressure:          | 1010hPa    |
| Test Voltage: | DC 3.7V                           | Polarization:      | Horizontal |
| Test Mode:    | Transmitting mode of GFSK 2402MHz |                    |            |



|   | Freq    | Level  | Antenna Factor | Cable Loss | Limit Line | Over Limit | Remark |
|---|---------|--------|----------------|------------|------------|------------|--------|
|   | MHz     | dBuV/m | dB/m           | dB         | dBuV/m     | dB         |        |
| 1 | 80.927  | 21.05  | 13.04          | 0.15       | 40.00      | -18.95     | QP     |
| 2 | 93.768  | 23.72  | 11.92          | 0.16       | 43.50      | -19.78     | QP     |
| 3 | 123.699 | 24.29  | 12.89          | 0.21       | 43.50      | -19.21     | QP     |
| 4 | 129.468 | 24.63  | 13.75          | 0.22       | 43.50      | -18.87     | QP     |
| 5 | 166.068 | 21.22  | 14.73          | 0.23       | 43.50      | -22.28     | QP     |
| 6 | 197.200 | 27.23  | 11.57          | 0.31       | 43.50      | -16.27     | QP     |

Remark: Absolute Level = Reading Level + Factor, Margin = Absolute Level – Limit  
Factor = Ant. Factor + Cable Loss

|               |                                   |                    |          |
|---------------|-----------------------------------|--------------------|----------|
| Temperature:  | 22°C                              | Relative Humidity: | 48%      |
| Test Date:    | Step. 3, 2019                     | Pressure:          | 1010hPa  |
| Test Voltage: | DC 3.7V                           | Polarization:      | Vertical |
| Test Mode:    | Transmitting mode of GFSK 2480MHz |                    |          |



|   | Freq    | Level  | Antenna Factor | Cable Loss | Limit Line | Over Limit | Remark |
|---|---------|--------|----------------|------------|------------|------------|--------|
|   | MHz     | dBuV/m | dB/m           | dB         | dBuV/m     | dB         |        |
| 1 | 38.888  | 23.60  | 13.35          | 0.15       | 40.00      | -16.40     | QP     |
| 2 | 82.359  | 28.49  | 11.17          | 0.15       | 40.00      | -11.51     | QP     |
| 3 | 91.175  | 33.24  | 11.37          | 0.16       | 43.50      | -10.26     | QP     |
| 4 | 121.123 | 26.60  | 12.50          | 0.20       | 43.50      | -16.90     | QP     |
| 5 | 133.619 | 27.82  | 14.34          | 0.22       | 43.50      | -15.68     | QP     |
| 6 | 143.830 | 25.14  | 15.31          | 0.23       | 43.50      | -18.36     | QP     |

Remark: Absolute Level = Reading Level + Factor, Margin = Absolute Level – Limit  
Factor = Ant. Factor + Cable Loss

Remark:

- (1) Measuring frequencies from 9 KHz to the 1 GHz, Radiated emission test from 9KHz to 30MHz was verified, and no any emission was found except system noise floor.
- (2) \* denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
- (3) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz.

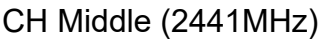
### Above 1 GHz Test Results (GFSK Worst Case): CH Middle (2402MHz)

Horizontal:

[illegible]

Vertical:

[illegible]

[illegible][illegible]



# CH High (2480MHz)

## Horizontal:

| Frequency                                                                               | Reading Result | Factor | Emission Level | Limits   | Margin | Detector |
|-----------------------------------------------------------------------------------------|----------------|--------|----------------|----------|--------|----------|
| (MHz)                                                                                   | (dBμV)         | (dB)   | (dBμV/m)       | (dBμV/m) | (dB)   | Type     |
| 2480                                                                                    | 108.49         | -5.84  | 102.65         | 114.00   | -11.35 | PK       |
| 2480                                                                                    | 85.66          | -5.84  | 79.82          | 94.00    | -14.18 | AV       |
| 4960                                                                                    | 61.35          | -3.64  | 57.71          | 74.00    | -16.29 | PK       |
| 4960                                                                                    | 49.63          | -3.64  | 45.99          | 54.00    | -8.01  | AV       |
| 7440                                                                                    | 62.44          | -0.95  | 61.49          | 74.00    | -12.51 | PK       |
| 7440                                                                                    | 47.82          | -0.95  | 46.87          | 54.00    | -7.13  | AV       |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amp. Margin = Absolute Level – Limit |                |        |                |          |        |          |

## Vertical:

| Frequency                                                                               | Reading Result | Factor | Emission Level | Limits   | Margin | Detector |
|-----------------------------------------------------------------------------------------|----------------|--------|----------------|----------|--------|----------|
| (MHz)                                                                                   | (dBμV)         | (dB)   | (dBμV/m)       | (dBμV/m) | (dB)   | Type     |
| 2480                                                                                    | 107.14         | -5.84  | 101.3          | 114.00   | -12.7  | PK       |
| 2480                                                                                    | 83.86          | -5.84  | 78.02          | 94.00    | -15.98 | AV       |
| 4960                                                                                    | 62.49          | -3.64  | 58.85          | 74.00    | -15.15 | PK       |
| 4960                                                                                    | 50.43          | -3.64  | 46.79          | 54.00    | -7.21  | AV       |
| 7440                                                                                    | 60.86          | -0.95  | 59.91          | 74.00    | -14.09 | PK       |
| 7440                                                                                    | 46.38          | -0.95  | 45.43          | 54.00    | -8.57  | AV       |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amp. Margin = Absolute Level – Limit |                |        |                |          |        |          |

### Remark:

- (1) Measuring frequencies from 1 GHz to the 25 GHz.
- (2) "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency.
- (3) \* denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
- (4) Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for peak measurement with peak detector at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 10Hz for Average measurement with peak detection at frequency above 1GHz.
- (6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.
- (7) All modes of operation were investigated and the worst-case emissions are reported.

## 5. BAND EDGE

### 5.1 Limits

FCC PART 15.247 Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

### 5.2 Test Procedure

The band edge compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization etc. Set RBW to 1MHz and VBM to 3MHz to measure the peak field strength and set RBW to 1MHz and VBW to 10kHz to measure the average radiated field strength. The conducted RF band edge was measured by using a spectrum analyzer. Set span wide enough to capture the highest in-band emission and the emission at the band edge. Set RBW to 100 KHz and VBW to 300 KHz, to measure the conducted peak band edge.

### 5.3 Test Result

**PASS**

Remark: All modes of GFSK,  $\pi/4$  DQPSK, 8DPSK were tested, only the worst result of GFSK was reported as below:

### Radiated Band Edge Test:

### Worst case on GFSK

Operation Mode: TX CH Low (2402MHz)

Horizontal:

| Frequency | Reading Result | Factor | Emission Level | Limits   | Margin | Detector Type |
|-----------|----------------|--------|----------------|----------|--------|---------------|
| (MHz)     | (dBμV)         | (dB)   | (dBμV/m)       | (dBμV/m) | (dB)   |               |
| 2310      | 53.47          | -5.81  | 47.66          | 74.00    | -26.34 | PK            |
| 2310      | /              | -5.81  | /              | 54.00    | /      | AV            |
| 2390      | 52.66          | -5.84  | 46.82          | 74.00    | -27.18 | PK            |
| 2390      | /              | -5.84  | /              | 54.00    | /      | AV            |
| 2400      | 52.34          | -5.84  | 46.5           | 74.00    | -27.5  | PK            |
| 2400      | /              | -5.84  | /              | 54.00    | /      | AV            |

Remark: Factor = Antenna Factor + Cable Loss – Pre-amp.

Vertical:

| Frequency | Reading Result | Factor | Emission Level | Limits   | Margin | Detector Type |
|-----------|----------------|--------|----------------|----------|--------|---------------|
| (MHz)     | (dBμV)         | (dB)   | (dBμV/m)       | (dBμV/m) | (dB)   |               |
| 2310      | 52.68          | -5.81  | 46.87          | 74.00    | -27.13 | PK            |
| 2310      | /              | -5.81  | /              | 54.00    | /      | AV            |
| 2390      | 52.68          | -5.84  | 46.84          | 74.00    | -27.16 | PK            |
| 2390      | /              | -5.84  | /              | 54.00    | /      | AV            |
| 2400      | 51.46          | -5.84  | 45.62          | 74.00    | -28.38 | PK            |
| 2400      | /              | -5.84  | /              | 54.00    | /      | AV            |

Remark: Factor = Antenna Factor + Cable Loss – Pre-amp.

Operation Mode: TX CH High (2480MHz)

Horizontal :

| Frequency | Reading Result | Factor | Emission Level | Limits   | Margin | Detector Type |
|-----------|----------------|--------|----------------|----------|--------|---------------|
| (MHz)     | (dBμV)         | (dB)   | (dBμV/m)       | (dBμV/m) | (dB)   |               |
| 2483.5    | 51.63          | -5.65  | 45.98          | 74.00    | -28.02 | PK            |
| 2483.5    | /              | -5.65  | /              | 54.00    | /      | AV            |
| 2500      | 52.34          | -5.72  | 46.62          | 74.00    | -27.38 | PK            |
| 2500      | /              | -5.72  | /              | 54.00    | /      | AV            |

Remark: Factor = Antenna Factor + Cable Loss – Pre-amp.

Vertical:

| Frequency | Reading Result | Factor | Emission Level | Limits   | Margin | Detector Type |
|-----------|----------------|--------|----------------|----------|--------|---------------|
| (MHz)     | (dBµV)         | (dB)   | (dBµV/m)       | (dBµV/m) | (dB)   |               |
| 2483.5    | 51.43          | -5.65  | 45.78          | 74.00    | -28.22 | PK            |
| 2483.5    | /              | -5.65  | /              | 54.00    | /      | AV            |
| 2500      | 52.38          | -5.72  | 46.66          | 74.00    | -27.34 | PK            |
| 2500      | /              | -5.72  | /              | 54.00    | /      | AV            |

Remark: Factor = Antenna Factor + Cable Loss – Pre-amp.



## 6. OCCUPIED BANDWIDTH MEASUREMENT

### 6.1 Test Setup

Same as Radiated Emission Measurement

### 6.2 Test Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set EUT as normal operation.
3. Based on ANSI C63.10 section 6.9.2: RBW=30KHz, VBW=100KHz, Span=3MHz.
4. The useful radiated emission from the EUT was detected by the spectrum analyser with peak detector.

### 6.3 Measurement Equipment Used

Same as Radiated Emission Measurement

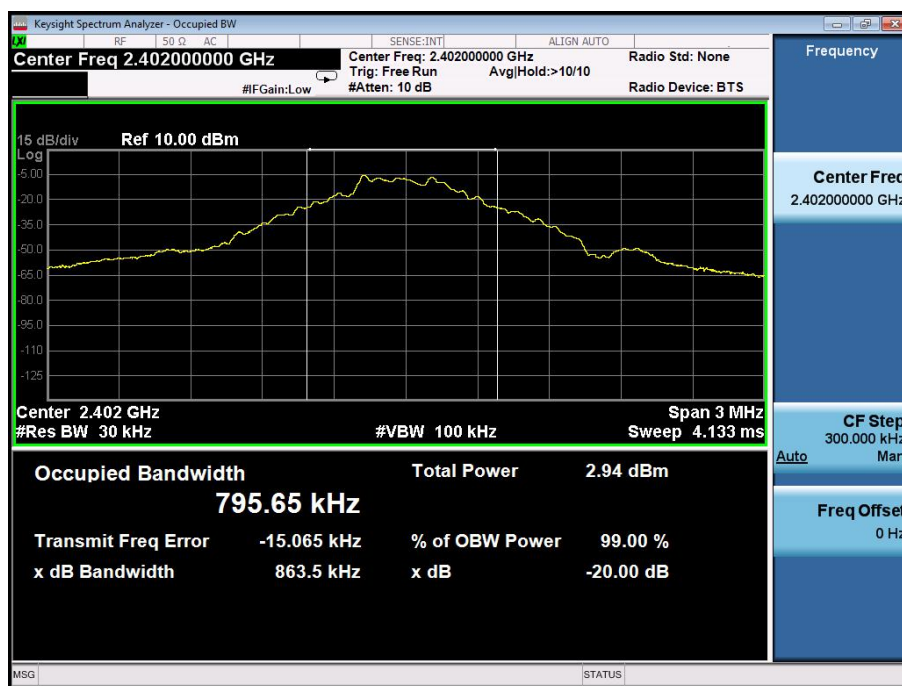
### 6.4 Test Result

PASS

GFSK Modulation:

| Frequency<br>(MHz) | 20dB Bandwidth<br>(MHz) | Result |
|--------------------|-------------------------|--------|
| 2402               | 0.864                   | PASS   |
| 2441               | 0.864                   | PASS   |
| 2480               | 0.867                   | PASS   |

CH: 2402MHz

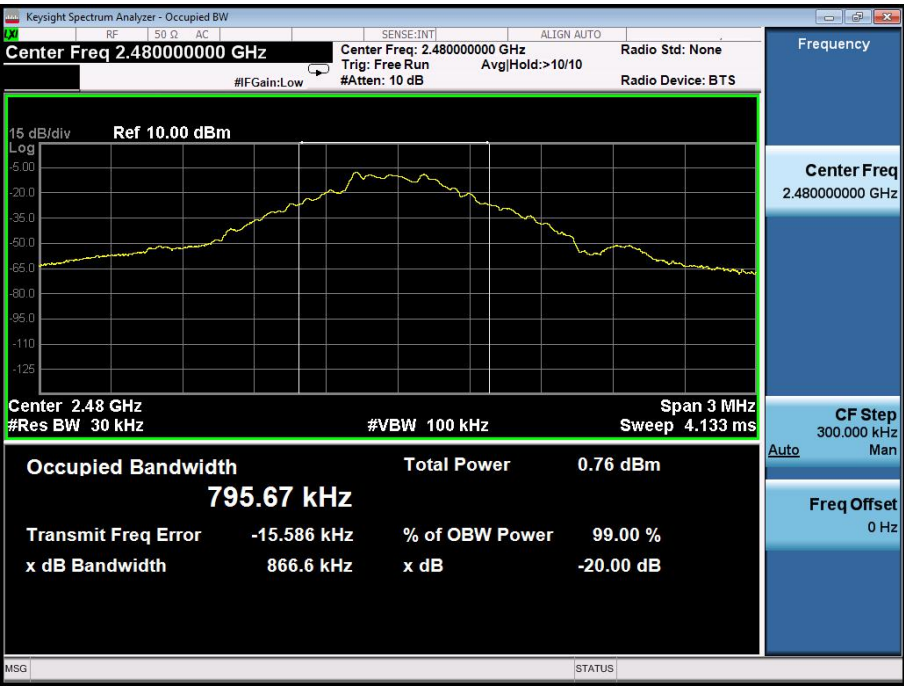




CH: 2441MHz



CH: 2480MHz





$\pi/4$  DQPSK Modulation:

| Frequency (MHz) | 20dB Bandwidth (MHz) | Result |
|-----------------|----------------------|--------|
| 2402            | 1.208                | PASS   |
| 2441            | 1.278                | PASS   |
| 2480            | 1.268                | PASS   |

CH: 2402MHz

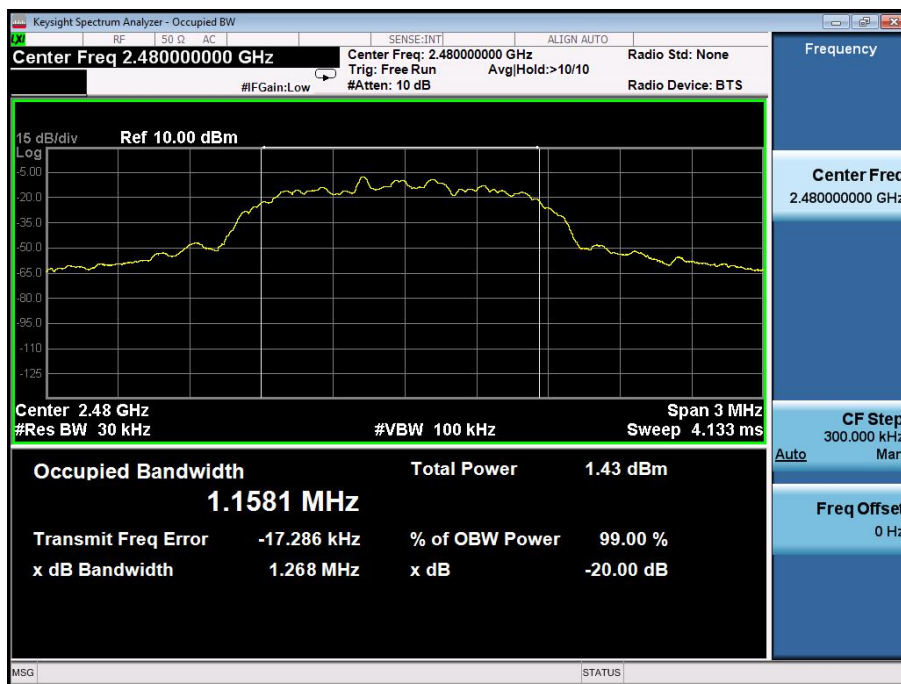


CH: 2441MHz





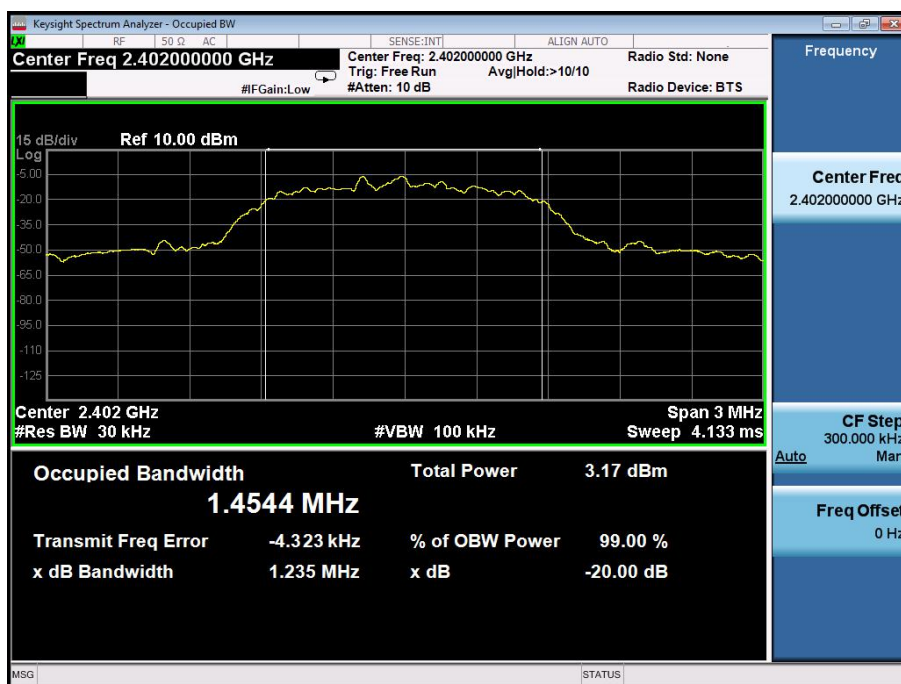
CH: 2480MHz



8DPSK Modulation:

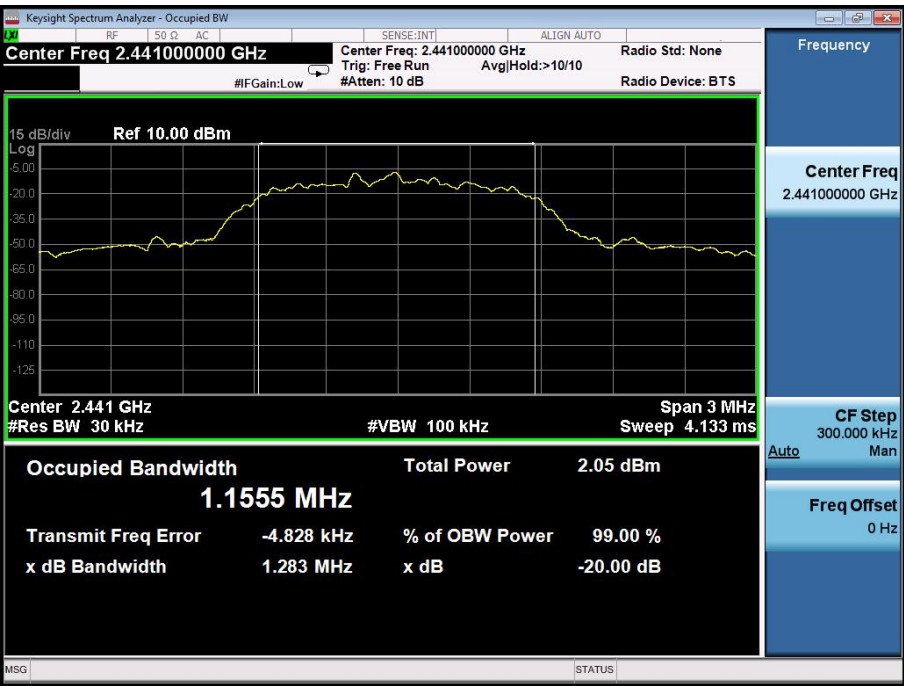
| Frequency (MHz) | 20dB Bandwidth (MHz) | Result |
|-----------------|----------------------|--------|
| 2402            | 1.235                | PASS   |
| 2441            | 1.283                | PASS   |
| 2480            | 1.295                | PASS   |

CH: 2402MHz

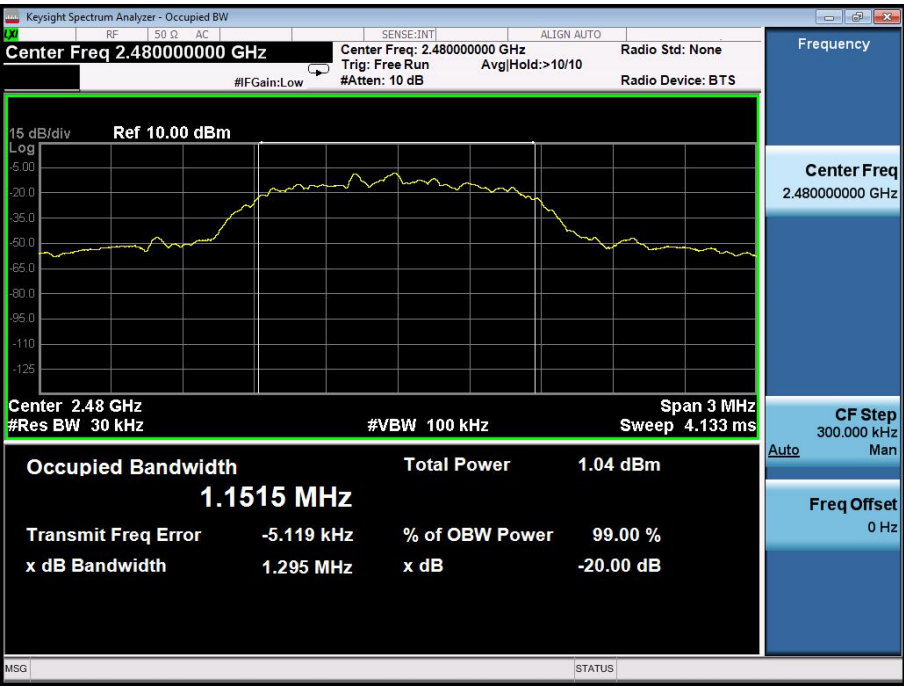




CH: 2441MHz



CH: 2480MHz



## 7. MAXIMUM PEAK OUTPUT POWER

### 7.1 Test Setup



### 7.2 Test Procedure

According to ANSI C63.10:2013 Maximum peak conducted output power for HFSS devices:

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the HFSS bandwidth and shall utilize a fast-responding diode detector.

The maximum Average conducted output power may be measured using a wideband RF power meter with a thermocouple detector or equivalent. The power meter shall have a video bandwidth that is greater than or equal to the HFSS bandwidth and shall utilize a fast-responding diode detector.

### 7.3 Limit

For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

### 7.4 Test Result

PASS

| Type          | Channel | Peak Output power (dBm) | Limit (dBm) | Result |
|---------------|---------|-------------------------|-------------|--------|
| GFSK          | Low     | <b>0.673</b>            | 30          | Pass   |
|               | Mid     | 0.148                   |             |        |
|               | High    | -0.389                  |             |        |
| $\pi/4$ DQPSK | Low     | -0.436                  | 21          | Pass   |
|               | Mid     | -0.975                  |             |        |
|               | High    | -1.217                  |             |        |
| 8DPSK         | Low     | -0.765                  | 21          | Pass   |
|               | Mid     | -1.084                  |             |        |
|               | High    | -1.216                  |             |        |





CH: 2441MHz



CH: 2480MHz



| Type/Modulation                | CH                | CH Frequency (MHz) | CH Separation (MHz) | Limit (MHz) | Result |
|--------------------------------|-------------------|--------------------|---------------------|-------------|--------|
| CH Separation<br>$\pi/4$ DQPSK | Low Channel       | 2402               | 0.998               | 0.805       | pass   |
|                                | Adjacency Channel | 2403               |                     |             |        |
|                                | Mid Channel       | 2441               | 1.000               | 0.852       | pass   |
|                                | Adjacency Channel | 2442               |                     |             |        |
|                                | High Channel      | 2480               | 0.996               | 0.845       | pass   |
|                                | Adjacency Channel | 2479               |                     |             |        |

CH: 2402MHz



CH: 2441MHz





CH: 2480MHz



| Type/Modulation     | CH                | CH Frequency (MHz) | CH Separation (MHz) | Limit (MHz) | Result |
|---------------------|-------------------|--------------------|---------------------|-------------|--------|
| CH Separation 8DPSK | Low Channel       | 2402               | 1.000               | 0.823       | pass   |
|                     | Adjacency Channel | 2403               |                     |             |        |
|                     | Mid Channel       | 2441               | 1.006               | 0.855       | pass   |
|                     | Adjacency Channel | 2442               |                     |             |        |
|                     | High Channel      | 2480               | 1.004               | 0.863       | pass   |
|                     | Adjacency Channel | 2479               |                     |             |        |

CH: 2402MHz





CH: 2441MHz



CH: 2480MHz



## 9. CONDUCTED BANDEGE MEASUREMENT

### 9.1 Test Setup



### 9.2 Test Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set EUT as TX operation and connect directly to the spectrum analyzer.
3. Based on FCC Part15 C Section 15.247: RBW=100KHz, VBW=300KHz.
4. Set detected by the spectrum analyzer with peak detector.

### 9.3 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20dB.

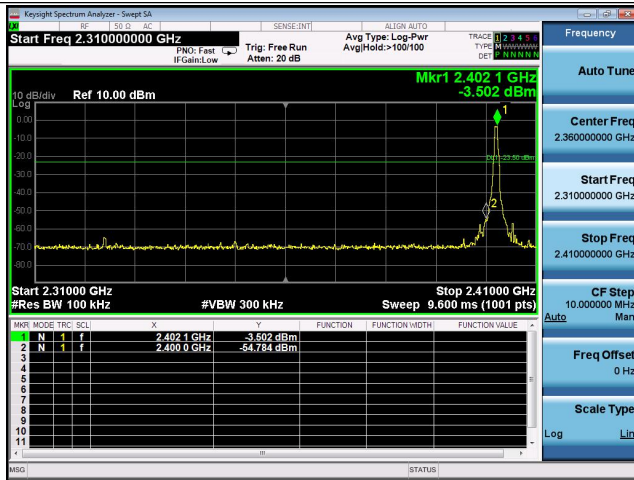
### 9.4 Test Result

PASS

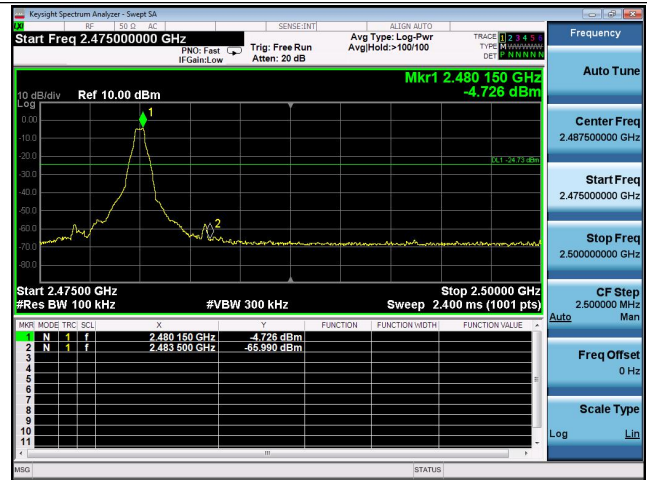
| Modulation    |             | Frequency Band | Delta Peak to band emission (dBc) | > Limit (dBc) | Result |
|---------------|-------------|----------------|-----------------------------------|---------------|--------|
| GFSK          | Non-hopping | Left Band      | 51.28                             | 20            | Pass   |
|               |             | Right Band     | 51.26                             | 20            | Pass   |
|               | hopping     | Left Band      | 63.10                             | 20            | Pass   |
|               |             | Right Band     | 63.20                             | 20            | Pass   |
| $\pi/4$ DQPSK | Non-hopping | Left Band      | 51.38                             | 20            | Pass   |
|               |             | Right Band     | 61.71                             | 20            | Pass   |
|               | hopping     | Left Band      | 51.95                             | 20            | Pass   |
|               |             | Right Band     | 63.55                             | 20            | Pass   |
| 8DPSK         | Non-hopping | Left Band      | 43.86                             | 20            | Pass   |
|               |             | Right Band     | 50.93                             | 20            | Pass   |
|               | hopping     | Left Band      | 44.46                             | 20            | Pass   |
|               |             | Right Band     | 53.02                             | 20            | Pass   |

## GFSK

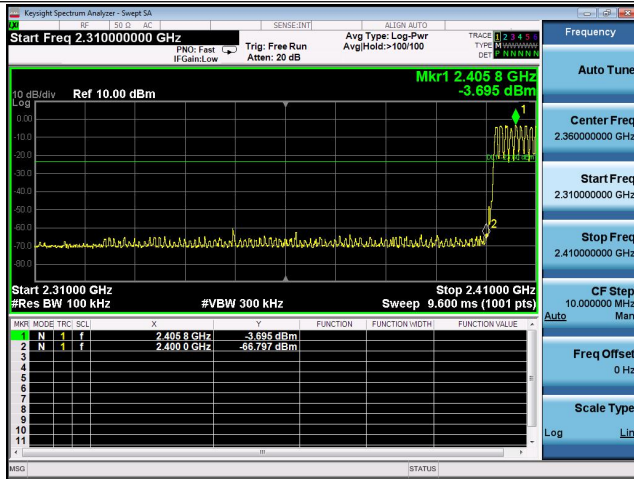
### 2402MHz



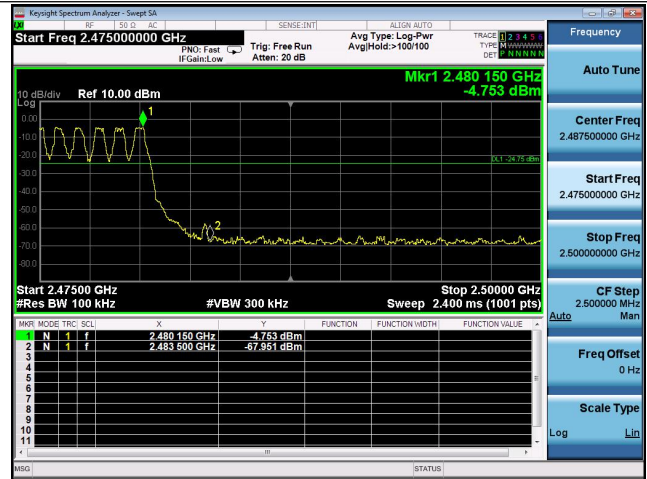
### 2480MHz



### Hoping Off



### Hoping Off



### Hoping On

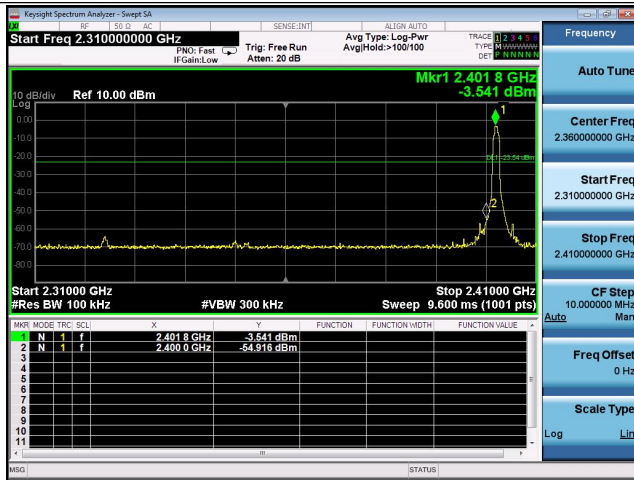


### Hoping On

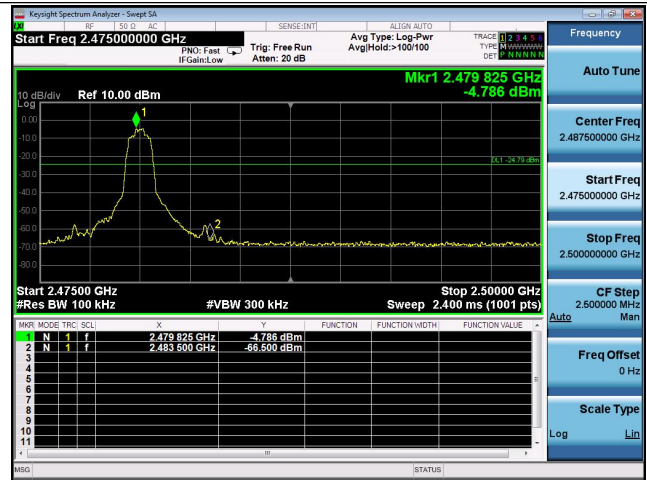


$\pi$  /4DQPSK

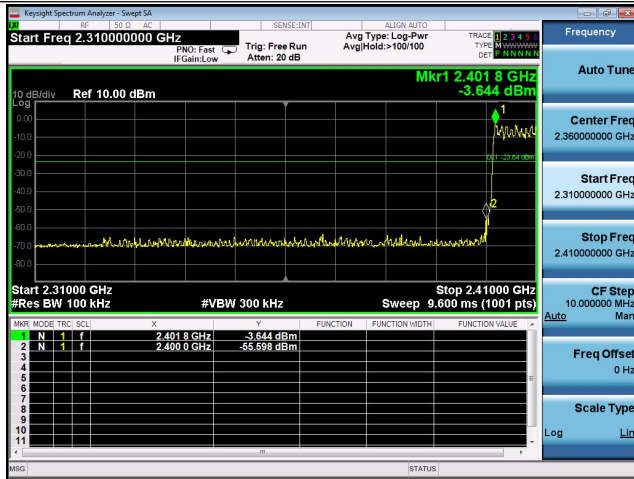
2402MHz



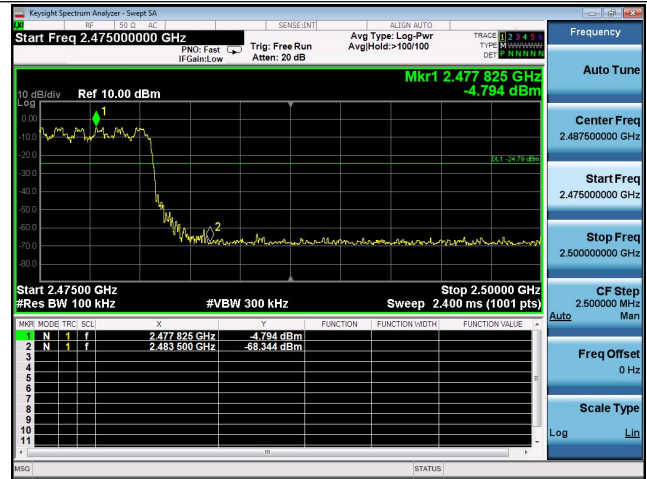
2480MHz



Hoping Off



Hoping Off



Hoping On

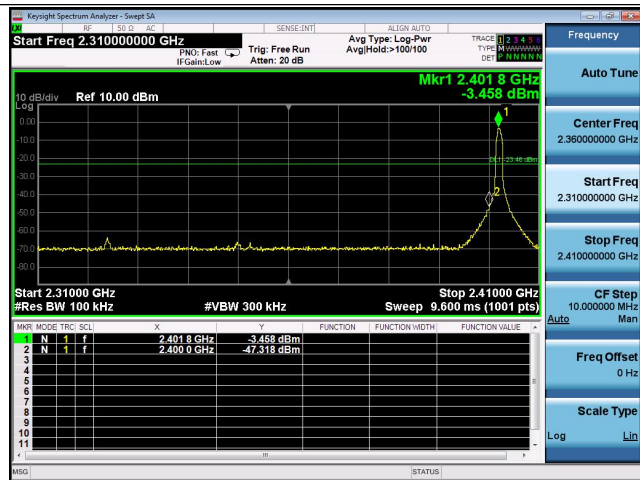


Hoping On

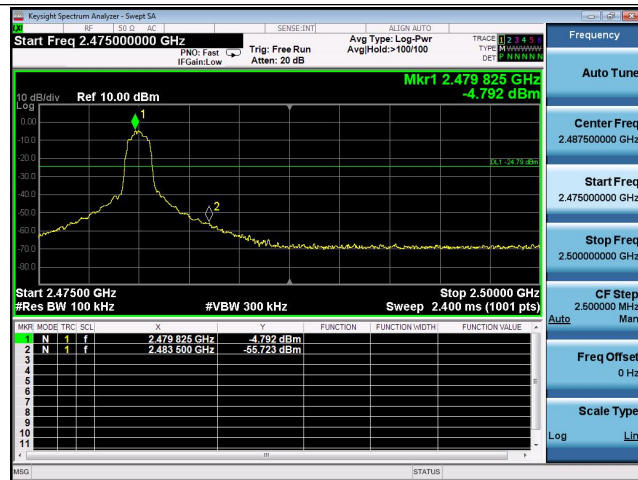


## 8DPSK

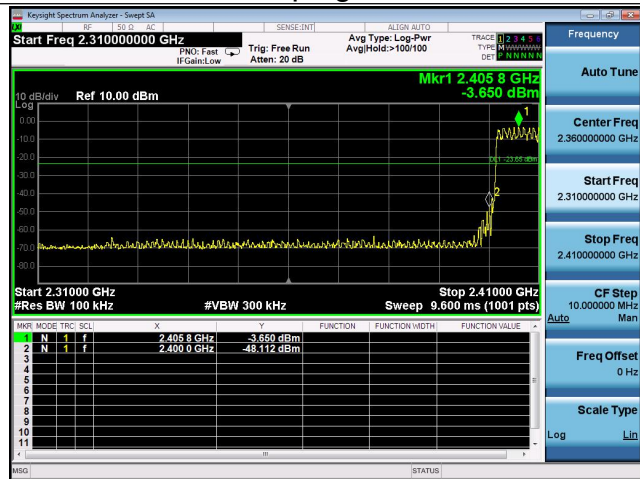
2402MHz



2480MHz



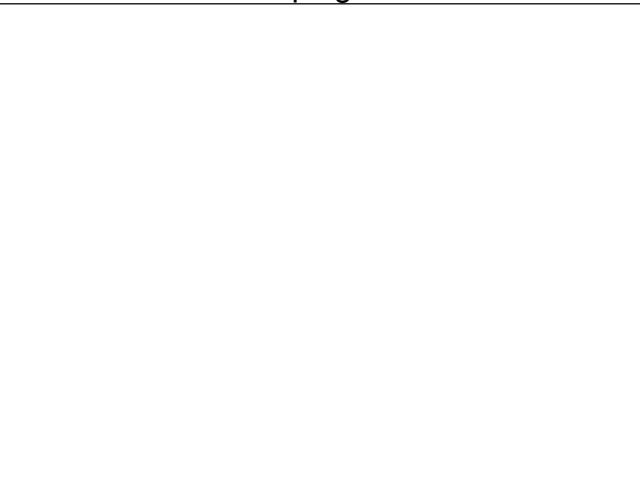
Hoping Off



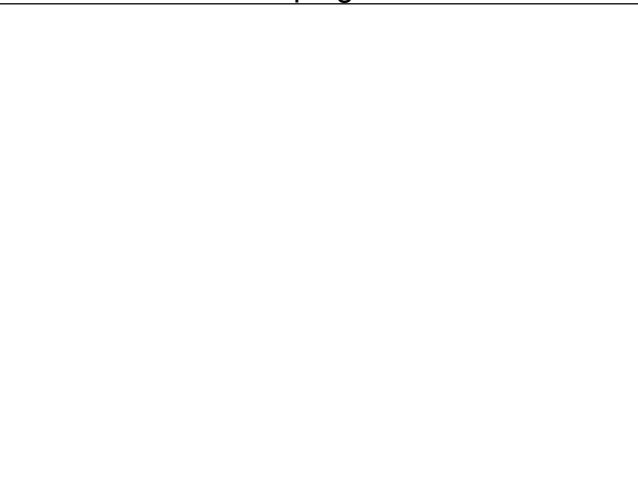
Hoping Off



Hoping On



Hoping On



## 10. SPURIOUS RF CONDUCTED EMISSION

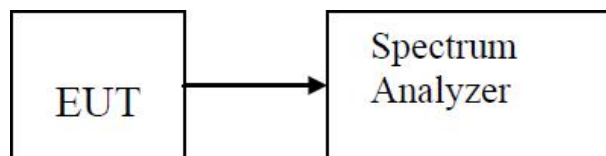
### 10.1 Test Limit

1. Below -20dB of the highest emission level in operating band.
2. Fall in the restricted bands listed in section 15.205. The maximum permitted average field strength is listed in section 15.209.
3. For below 30MHz, For 9KHz-150kHz, 150K-10MHz, We use the RBW 1KHz, 10KHz, So the limit need to be calculated by " $10\lg(BW1/BW2)$ ". for example For 9KHz-150kHz, RBW 1KHz, The Limit= the highest emission level-20-10lg(100/1)= the highest emission level-40.

### 10.2 Test Procedure

The Spurious RF conducted emissions compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10-2013, For 9KHz-150kHz, Set RBW=1kHz and VBW= 3KHz; For 150KHz-10MHz, Set RBW=10kHz and VBW= 30KHz; For 10MHz-25GHz, Set RBW=100kHz and VBW= 300KHz in order to measure the peak field strength, and measure frequency range from 9KHz to 25GHz.

### 10.3 Test Setup



### 10.4 Test Result

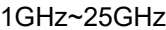
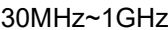
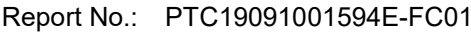
PASS

Remark: All modes of GFSK,  $\pi/4$  DQPSK, 8DPSK were tested, only the worst result of GFSK was reported as below:

GFSK

CH: 2402MHz

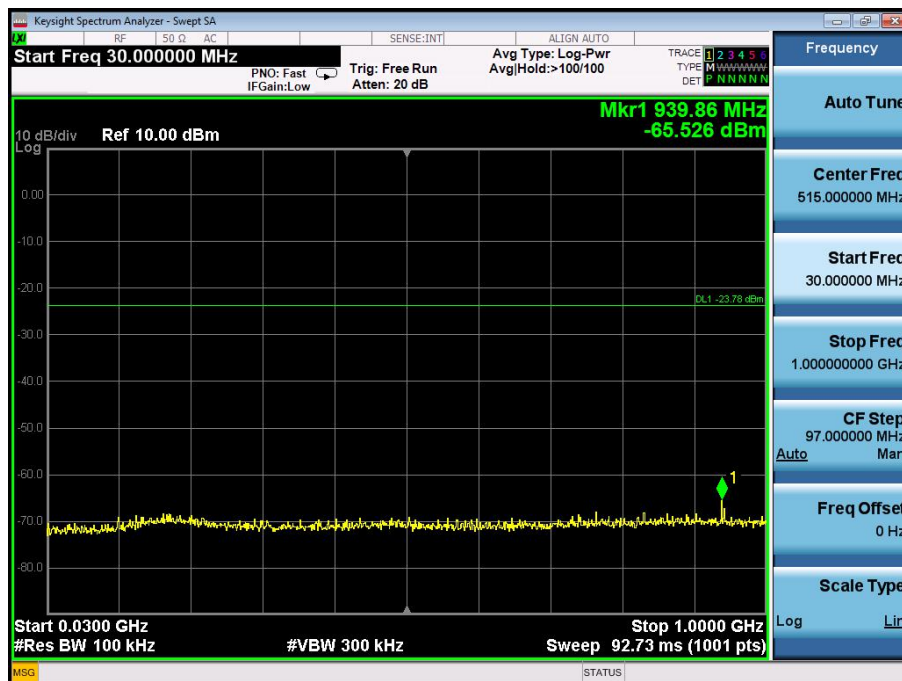




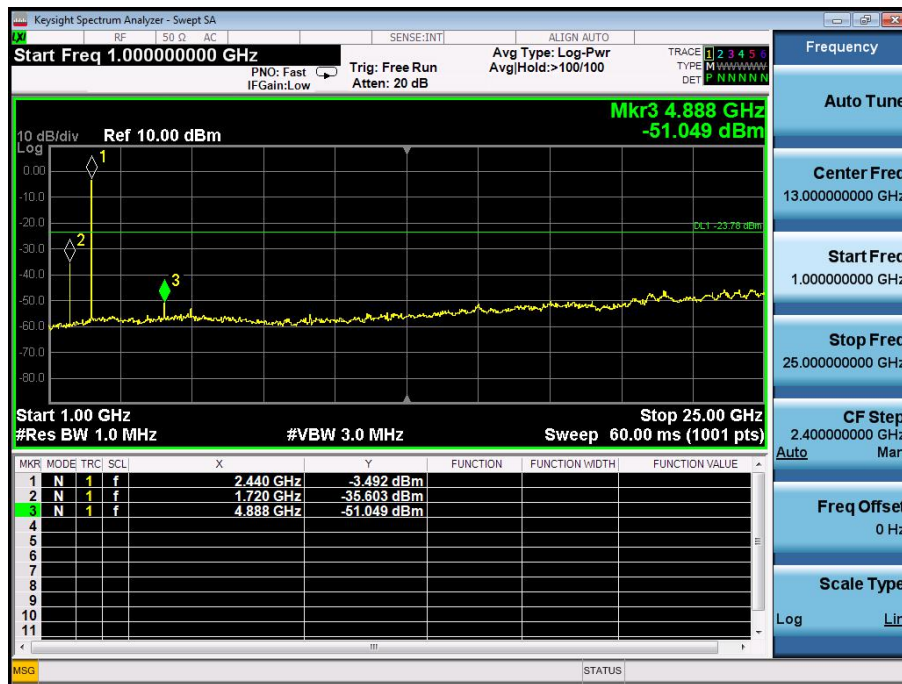


GFSK

CH: 2441MHz



30MHz~1GHz

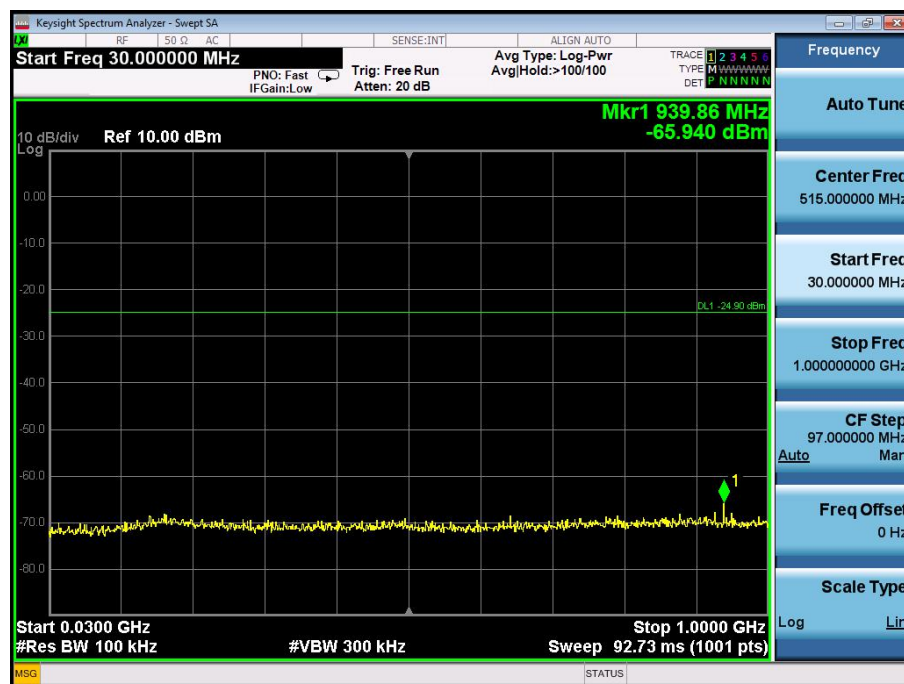


1GHz~25GHz

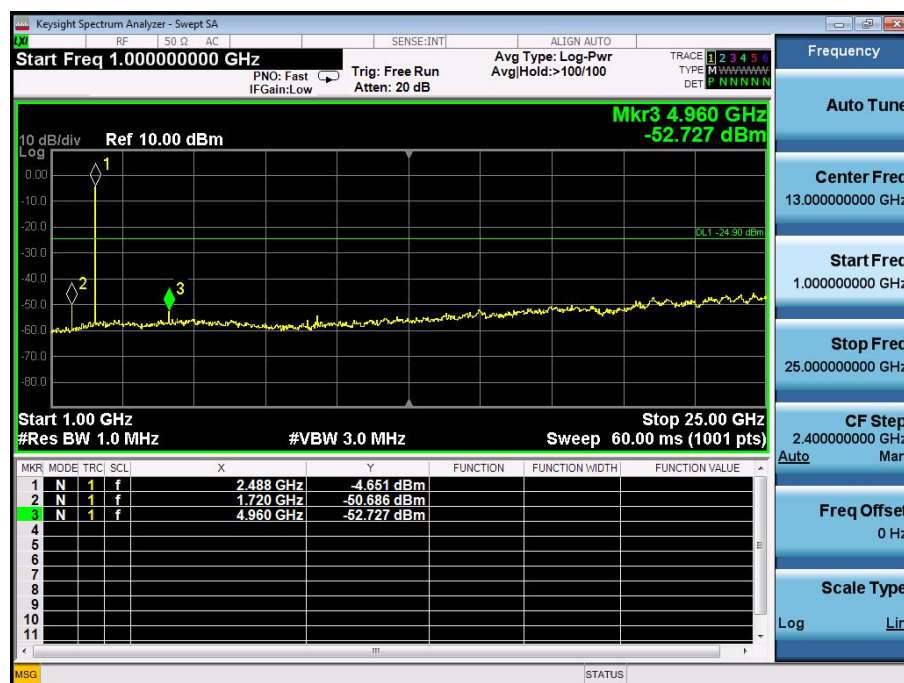
GFSK

CH: 2480MHz





30MHz~1GHz



1GHz~25GHz