

# TEST REPORT

**Reference No.**..... : WTD21D11127619W001  
**FCC ID**..... : 2A3SN-D6  
**Applicant** ..... : PHEANOO AUDIO LTD  
**Address** ..... : 6253 SW HAMILTON WAY, PORTLAND, OR 97221, USA  
**Manufacturer** ..... : PHEANOO AUDIO LTD  
**Address** ..... : 6253 SW HAMILTON WAY, PORTLAND, OR 97221, USA  
**Product** ..... : Audio Product  
**Brand Name**..... : PHEANOO  
**Model(s)**..... : D2, D3, D5, D6, D7, D8, D9, D10, D11, D12, D15, D16, D18, D19, D20, D30, D40, D50, D60, D70, D80, D90, D100, D110, D120, D130, D140, P12, P15, P16, P18, P19, P21, P20, P22, P24, P25, P27, P28, P29, P30, P32, P35, P36, P40, P42, P45, P48, P50, P51, P52, P53, P54, P55, P56, P58, P59, GT01, GT02, GT03, GT04, GT05, GT06, GT07, GT08, GT09, GT10, TG11, GT12, GT13, GT14, GT15, GT16, GT17, GT18, GT19, GT20, GT30, GT40, GT50, GT60, GT70, GT80, GT90, GT100, GT200, GT300, GT400, GT500, GT600, GT700, GT800, GT900  
**Standards** ..... : FCC CFR 47 Part 15 Section 15.247  
**Date of Receipt sample** .... : 2021-11-23  
**Date of Test** ..... : 2021-11-23 to 2021-11-26  
**Date of Issue** ..... : 2021-11-26  
**Test Result** ..... : **Pass**

**Remarks:**

The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

**Prepared By:**

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### 3 Revision History

| Test Report No.    | Date of Receipt Sample | Date of Test                   | Date of Issue | Purpose  | Comment | Approved |
|--------------------|------------------------|--------------------------------|---------------|----------|---------|----------|
| WTD21D11127619W001 | 2021-11-23             | 2021-11-23<br>to<br>2021-11-26 | 2021-11-26    | Original | -       | Valid    |

## 4 General Information

### 4.1 General Description of E.U.T

|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Product:</b>               | Audio Product                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Model(s):</b>              | D2, D3, D5, D6, D7, D8, D9, D10, D11, D12, D15, D16, D18, D19, D20, D30, D40, D50, D60, D70, D80, D90, D100, D110, D120, D130, D140, P12, P15, P16, P18, P19, P21, P20, P22, P24, P25, P27, P28, P29, P30, P32, P35, P36, P40, P42, P45, P48, P50, P51, P52, P53, P54, P55, P56, P58, P59, GT01, GT02, GT03, GT04, GT05, GT06, GT07, GT08, GT09, GT10, TG11, GT12, GT13, GT14, GT15, GT16, GT17, GT18, GT19, GT20, GT30, GT40, GT50, GT60, GT70, GT80, GT90, GT100, GT200, GT300, GT400, GT500, GT600, GT700, GT800, GT900 |
| <b>Model difference:</b>      | Except for small differences in appearance that do not affect the structure, and the model name is different. Other functions, circuit working principle and so on are the same.<br>Test sample model is D6.                                                                                                                                                                                                                                                                                                               |
| <b>BT Version:</b>            | 5.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Operation Frequency:</b>   | 2402-2480MHz, 79 Channels in total                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Max. RF output power:</b>  | 0.28dBm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Antenna installation:</b>  | PCB Printed Antenna                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Antenna Gain:</b>          | 0dBi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Type of Modulation:</b>    | FHSS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Modulation Technology:</b> | GFSK, $\pi/4$ DQPSK, 8DPSK                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Hardware Version:</b>      | FS25DH Ver1.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Software Version:</b>      | FS25TDS-(D6)-V22                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

### 4.2 Details of E.U.T

|                 |                                                                                       |
|-----------------|---------------------------------------------------------------------------------------|
| <b>Ratings:</b> | DC 24V from adapter                                                                   |
| <b>Adapter:</b> | Model: GM42-240175-1A<br>Input: 100-240V ~ 50/60Hz 1.5A<br>Output: 24V $\equiv$ 1.75A |

### 4.3 Channel List

| Channel No. | Frequency (MHz) | Channel No. | Frequency (MHz) | Channel No. | Frequency (MHz) | Channel No. | Frequency (MHz) |
|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|
| 1           | 2402            | 2           | 2403            | 3           | 2404            | 4           | 2405            |
| 5           | 2406            | 6           | 2407            | 7           | 2408            | 8           | 2409            |
| 9           | 2410            | 10          | 2411            | 11          | 2412            | 12          | 2413            |
| 13          | 2414            | 14          | 2415            | 15          | 2416            | 16          | 2417            |
| 17          | 2418            | 18          | 2419            | 19          | 2420            | 20          | 2421            |
| 21          | 2422            | 22          | 2423            | 23          | 2424            | 24          | 2425            |
| 25          | 2426            | 26          | 2427            | 27          | 2428            | 28          | 2429            |
| 29          | 2430            | 30          | 2431            | 31          | 2432            | 32          | 2433            |
| 33          | 2434            | 34          | 2435            | 35          | 2436            | 36          | 2437            |
| 37          | 2438            | 38          | 2439            | 39          | 2440            | 40          | 2441            |
| 41          | 2442            | 42          | 2443            | 43          | 2444            | 44          | 2445            |
| 45          | 2446            | 46          | 2447            | 47          | 2448            | 48          | 2449            |
| 49          | 2450            | 50          | 2451            | 51          | 2452            | 52          | 2453            |
| 53          | 2454            | 54          | 2455            | 55          | 2456            | 56          | 2457            |
| 57          | 2458            | 58          | 2459            | 59          | 2460            | 60          | 2461            |
| 61          | 2462            | 62          | 2463            | 63          | 2464            | 64          | 2465            |
| 65          | 2466            | 66          | 2467            | 67          | 2468            | 68          | 2469            |
| 69          | 2470            | 70          | 2471            | 71          | 2472            | 72          | 2473            |
| 73          | 2474            | 74          | 2475            | 75          | 2476            | 76          | 2477            |
| 77          | 2478            | 78          | 2479            | 79          | 2480            | -           | -               |

#### Frequency hopping systems (FHS):

This transmitter device is frequency hopping device, and complies with FCC Part15.247 Requirements.

This device uses Bluetooth radio which operates in 2400-2483.5 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centred from 2402 to 2480 MHz) in the range 2,400-2,483.5MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. The average time of occupancy on any channel is less than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels (79 channels) employed.

All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH-enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used.

This device was tested with an Bluetooth system receiver to check that the device maintained hopping synchronization, and the device complied with these requirements for FCC Part15.247.

Pseudorandom Frequency Hopping Sequence Table as below:

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<http://www.waltek.com.cn>

Channel: 08, 24, 19, 56, 40, 18, 50, 09, 02, 23, 32, 41, 33, 31, 65, 73, 53, 69, 06, 22, 67, 04, 20, 36, 52, 38, 46, 70, 78, 68, 76, 21, 29, 10, 26, 42, 58, 17, 60, 63, 54, 03, 00, 59, 64, 75, 35, 66, 43, 15, 45, 39, 77, 55, 71, 47, 61, 27, 30, 48, 72, 01, 14, 07, 25, 34, 12, 28, 44, 51, 16, 49, 74, 11, 05, 13, 37, 62 etc.

The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

#### 4.4 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

| Test mode    | Low channel | Middle channel | High channel |
|--------------|-------------|----------------|--------------|
| Transmitting | 2402MHz     | 2441MHz        | 2480MHz      |

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

#### 4.5 Test Facility

The test facility has a test site registered with the following organizations:

**ISED CAB identifier: CN0013. Test Firm Registration No.: 7760A.**

Waltek Testing Group Co., Ltd. Has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files. Registration number 7760A, October 15, 2016.

**FCC Designation No.: CN1201. Test Firm Registration No.: 523476.**

Waltek Testing Group Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration number 523476, September 10, 2019.

## 5 Equipment Used during Test

### 5.1 Equipments List

| Conducted Emissions                                      |                           |              |                       |            |                |       |
|----------------------------------------------------------|---------------------------|--------------|-----------------------|------------|----------------|-------|
| Item                                                     | Equipment                 | Manufacturer | Model No.             | Serial No. | Last Cal. Date | Valid |
| 1                                                        | EMI Test Receiver         | R&S          | ESCI                  | 100947     | 2021-07-26     | 1Year |
| 2                                                        | LISN                      | R&S          | ENV216                | 100115     | 2021-07-26     | 1Year |
| 3                                                        | Cable                     | Top          | TYPE16(3.5M)          | -          | 2021-07-26     | 1Year |
| 4                                                        | Test software             | EZ-EMC       | RA-03A1-1             | -          | N/A            | N/A   |
| 3m Semi-anechoic Chamber for Radiation Emissions (SAEMC) |                           |              |                       |            |                |       |
| Item                                                     | Equipment                 | Manufacturer | Model No.             | Serial No. | Last Cal. Date | Valid |
| 1                                                        | Spectrum Analyzer         | R&S          | FSP30                 | 100091     | 2021-04-26     | 1Year |
| 2                                                        | Amplifier                 | Agilent      | 8447D                 | 2944A10178 | 2021-07-26     | 1Year |
| 3                                                        | Tri-log Broadband Antenna | SCHWARZBECK  | VULB9163              | 336        | 2021-08-23     | 1Year |
| 4                                                        | Coaxial Cable             | Top          | TYPE16(13M)           | -          | 2021-04-26     | 1Year |
| 5                                                        | Broad-band Horn Antenna   | SCHWARZBECK  | BBHA 9120D            | 667        | 2021-04-30     | 1Year |
| 6                                                        | Broad-band Horn Antenna   | SCHWARZBECK  | BBHA 9170             | 335        | 2021-07-30     | 1Year |
| 7                                                        | Broadband Preamplifier    | COMPLIANCE   | PAP-1G18              | 2004       | 2021-07-26     | 1Year |
| 8                                                        | Coaxial Cable             | Top          | ZT26-NJ-NJ-8M/FA      | -          | 2021-04-26     | 1Year |
| 9                                                        | Microwave Amplifier       | SCHWARZBECK  | BBV 9721              | 100472     | 2021-07-26     | 1Year |
| 10                                                       | Coaxial Cable             | Top          | ZT40-2.92J-2.92J-2.0M | 17100919   | 2021-04-26     | 1Year |
| 11                                                       | Test software             | EZ-EMC       | RA-03A1-1             | -          | N/A            | N/A   |
| 3m Semi-anechoic Chamber for Radiation Emissions (TDK)   |                           |              |                       |            |                |       |
| Item                                                     | Equipment                 | Manufacturer | Model No.             | Serial No. | Last Cal. Date | Valid |
| 1                                                        | Test Receiver             | R&S          | ESCI                  | 101296     | 2021-04-26     | 1Year |
| 2                                                        | Trilog Broadband Antenna  | SCHWARZBECK  | VULB9160              | 9160-3325  | 2021-10-30     | 1Year |
| 3                                                        | Active Loop Antenna       | Com-Power    | AL-130R               | 10160007   | 2021-04-29     | 1Year |
| 4                                                        | Amplifier                 | ANRITSU      | MH648A                | M43381     | 2021-04-26     | 1Year |
| 5                                                        | Cable                     | HUBER+SUHNER | CBL2                  | 525178     | 2021-04-26     | 1Year |
| 6                                                        | Test software             | EZ-EMC       | RA-03A1-1             | -          | N/A            | N/A   |
| RF Conducting                                            |                           |              |                       |            |                |       |
| Item                                                     | Equipment                 | Manufacturer | Model No.             | Serial No. | Last Cal. Date | Valid |
| 1                                                        | Spectrum Analyzer         | R&S          | FSP40                 | 100501     | 2021-07-26     | 1Year |
| 2                                                        | Spectrum Analyzer         | Agilent      | N9020A                | MY49100060 | 2021-07-26     | 1Year |

### 5.2 Test Equipment Calibration

All the test equipments used are valid and calibrated by CEPREI Certification Body that address is No.110 Dongguan Zhuang RD. Guangzhou, P.R.China.

### 5.3 Measurement Uncertainty

| Parameter                                        | Uncertainty                           |
|--------------------------------------------------|---------------------------------------|
| Radio Frequency                                  | $\pm 1 \times 10^{-6}$                |
| RF Power                                         | $\pm 1.0$ dB                          |
| RF Power Density                                 | $\pm 2.2$ dB                          |
| Radiated Spurious Emissions test                 | $\pm 5.03$ dB (30M~1000MHz)           |
|                                                  | $\pm 5.47$ dB (1000M~25000MHz)        |
| Conducted Emissions test                         | $\pm 3.64$ dB (AC mains 150KHz~30MHz) |
| Confidence interval: 95%. Confidence factor: k=2 |                                       |

### 5.4 Subcontracted

Whether parts of tests for the product have been subcontracted to other labs:

☐ Yes ☒ No

If Yes, list the related test items and lab information:

Test Lab: N/A

Lab address: N/A

Test items: N/A

## 6 Test Summary

| Test Items                                                                   | Test Requirement                 | Result |
|------------------------------------------------------------------------------|----------------------------------|--------|
| Conduct Emission                                                             | 15.207                           | Pass   |
| Radiated Spurious Emissions                                                  | 15.205(a)<br>15.209<br>15.247(d) | Pass   |
| Band edge                                                                    | 15.247(d)<br>15.205(a)           | Pass   |
| Bandwidth                                                                    | 15.247(a)(1)                     | Pass   |
| Maximum Peak Output Power                                                    | 15.247(b)(1)                     | Pass   |
| Frequency Separation                                                         | 15.247(a)(1)                     | Pass   |
| Number of Hopping Frequency                                                  | 15.247(a)(1)(iii)                | Pass   |
| Dwell time                                                                   | 15.247(a)(1)(iii)                | Pass   |
| Antenna Requirement                                                          | 15.203                           | Pass   |
| RF Exposure                                                                  | 1.1307(b)(1)                     | Pass   |
| Note: Pass=Compliance; NC=Not Compliance; NT=Not Tested; N/A=Not Applicable. |                                  |        |

## 7 Conducted Emission

Test Requirement: FCC CFR 47 Part 15 Section 15.207

Test Method: ANSI C63.10:2013

Test Result: PASS

Frequency Range: 150kHz to 30MHz

Limit:

| Frequency (MHz) | Conducted Limit (dB $\mu$ V) |           |
|-----------------|------------------------------|-----------|
|                 | Quasi-peak                   | Average   |
| 0.15 to 0.5     | 66 to 56*                    | 56 to 46* |
| 0.5 to 5.0      | 56                           | 46        |
| 5.0 to 30       | 60                           | 50        |

\*Decreases with the logarithm of the frequency.

### 7.1 E.U.T. Operation

Operating Environment:

Temperature: 21.4 °C

Humidity: 50.7 % RH

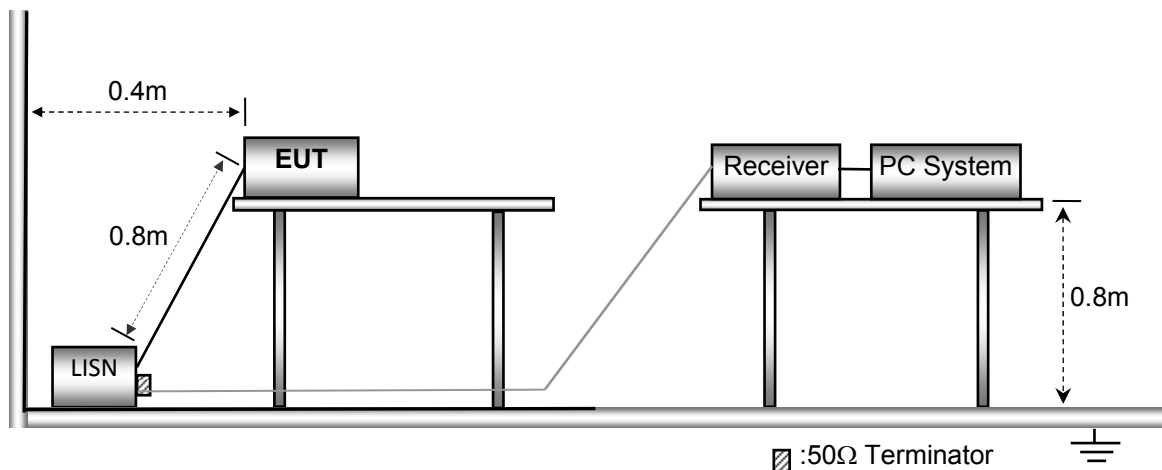
Atmospheric Pressure: 101.6kPa

Test Voltage: AC 120V, 60Hz

EUT Operation: The test was performed in Transmitting mode, the worst test data (8DPSK modulation Low channel) were shown in the report.

### 7.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10:2013.



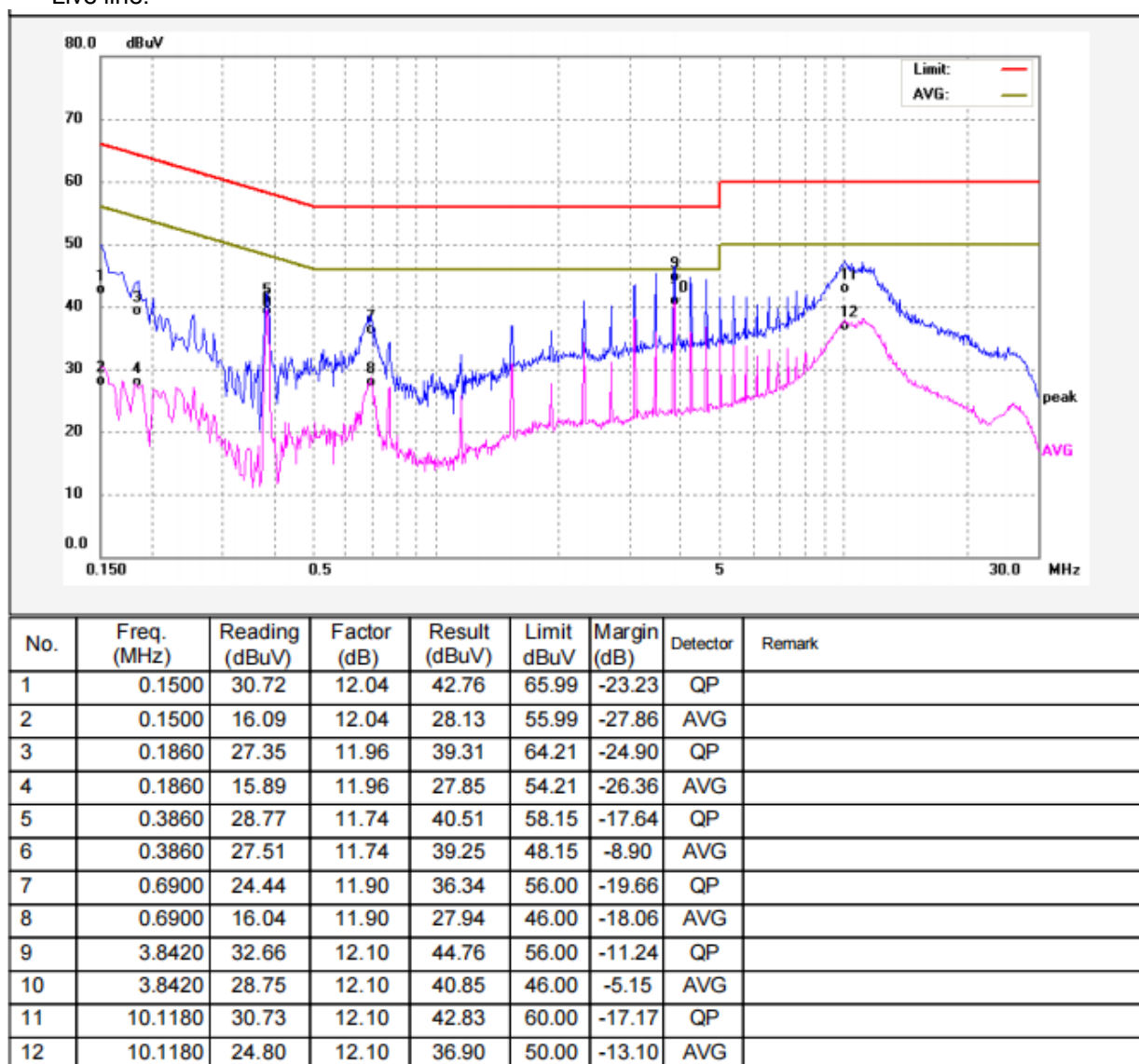
### 7.3 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

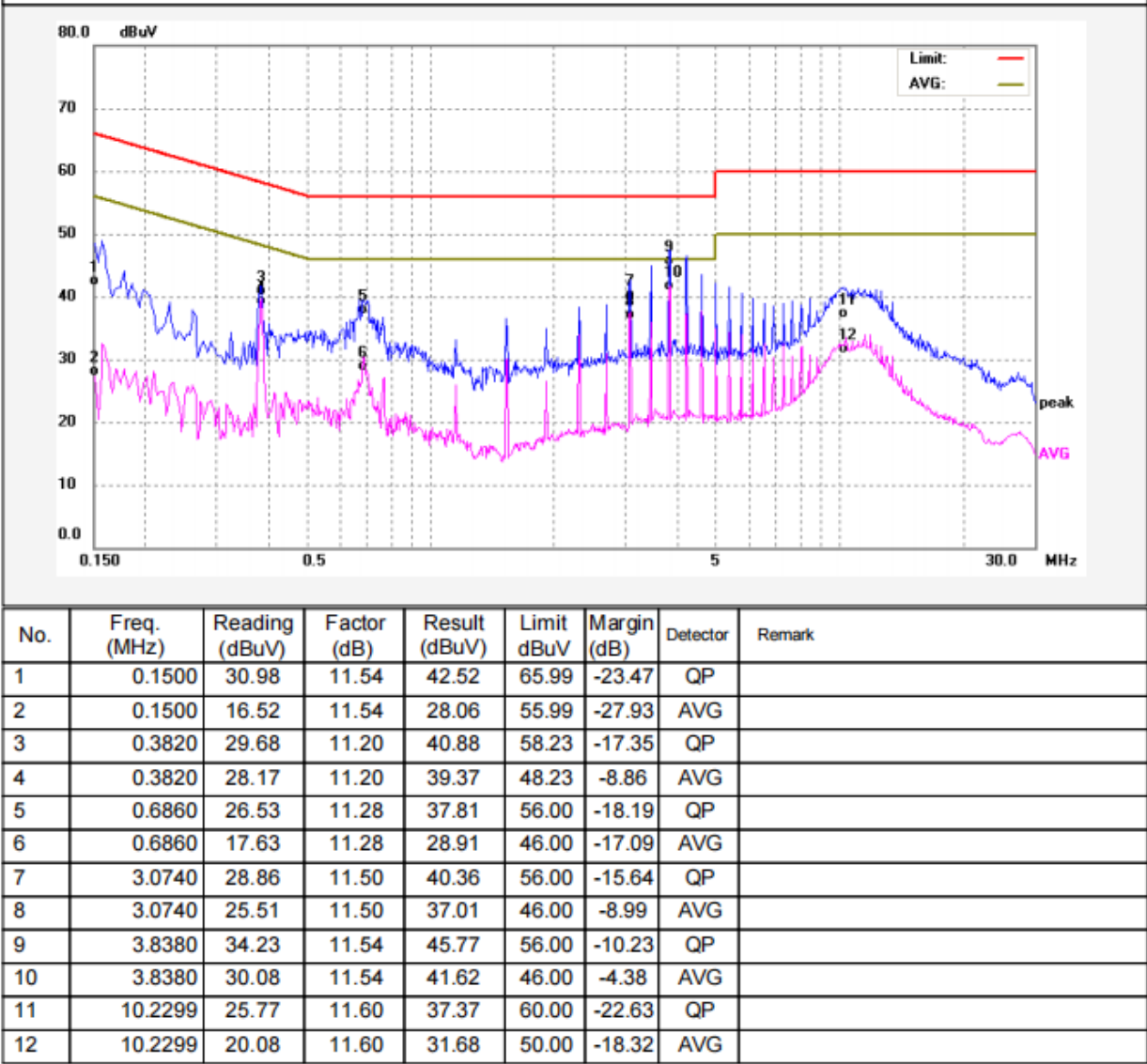
### 7.4 Conducted Emission Test Result

Remark: only the worst data (8DPSK modulation High channel mode) were reported

Live line:



Neutral line:



## 8 Radiated Emissions

Test Requirement: FCC CFR47 Part 15 Section 15.209 & 15.247

Test Method: ANSI C63.10:2013

Test Result: PASS

Measurement Distance: 3m

Limit:

| Frequency<br>(MHz) | Field Strength        |                 | Field Strength Limit at 3m Measurement Dist |                                       |
|--------------------|-----------------------|-----------------|---------------------------------------------|---------------------------------------|
|                    | uV/m                  | Distance<br>(m) | uV/m                                        | dBuV/m                                |
| 0.009 ~ 0.490      | $2400/F(\text{kHz})$  | 300             | $10000 * 2400/F(\text{kHz})$                | $20\log^{(2400/F(\text{kHz}))} + 80$  |
| 0.490 ~ 1.705      | $24000/F(\text{kHz})$ | 30              | $100 * 24000/F(\text{kHz})$                 | $20\log^{(24000/F(\text{kHz}))} + 40$ |
| 1.705 ~ 30         | 30                    | 30              | $100 * 30$                                  | $20\log^{(30)} + 40$                  |
| 30 ~ 88            | 100                   | 3               | 100                                         | $20\log^{(100)}$                      |
| 88 ~ 216           | 150                   | 3               | 150                                         | $20\log^{(150)}$                      |
| 216 ~ 960          | 200                   | 3               | 200                                         | $20\log^{(200)}$                      |
| Above 960          | 500                   | 3               | 500                                         | $20\log^{(500)}$                      |

### 8.1 EUT Operation

Operating Environment:

Temperature: 21.3 °C

Humidity: 50.3 % RH

Atmospheric Pressure: 101.6kPa

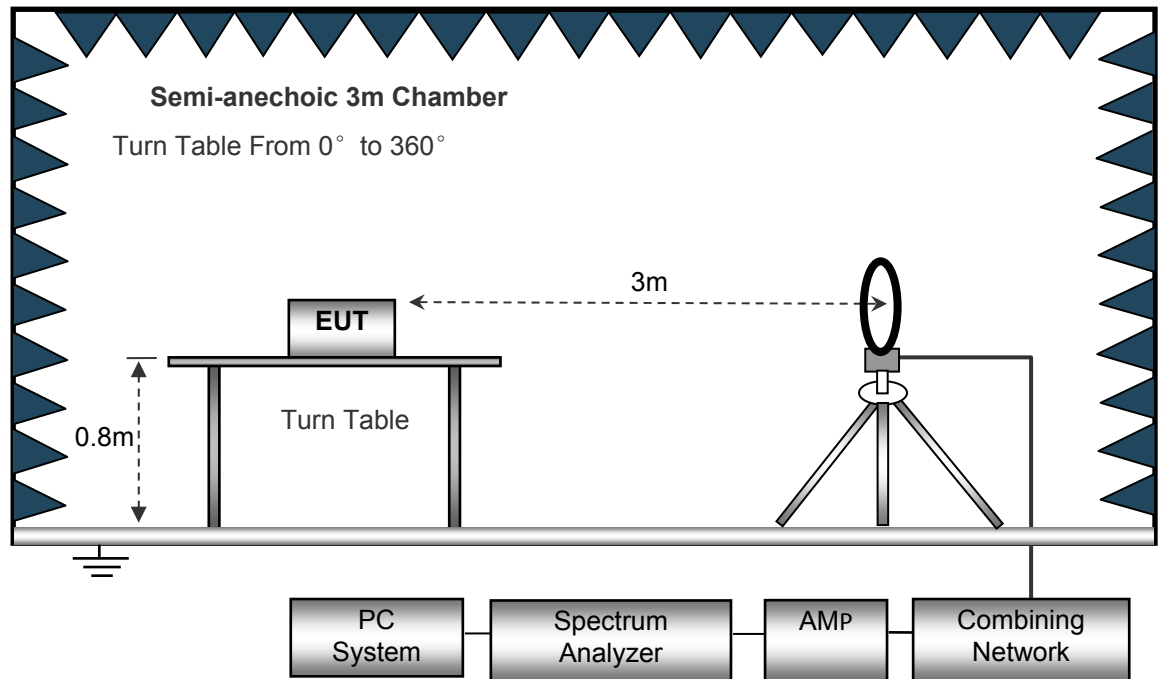
Test Voltage: AC 120V, 60Hz

EUT Operation: The test was performed in Transmitting mode, the worst test data (8DPSK modulation) were shown in the report.

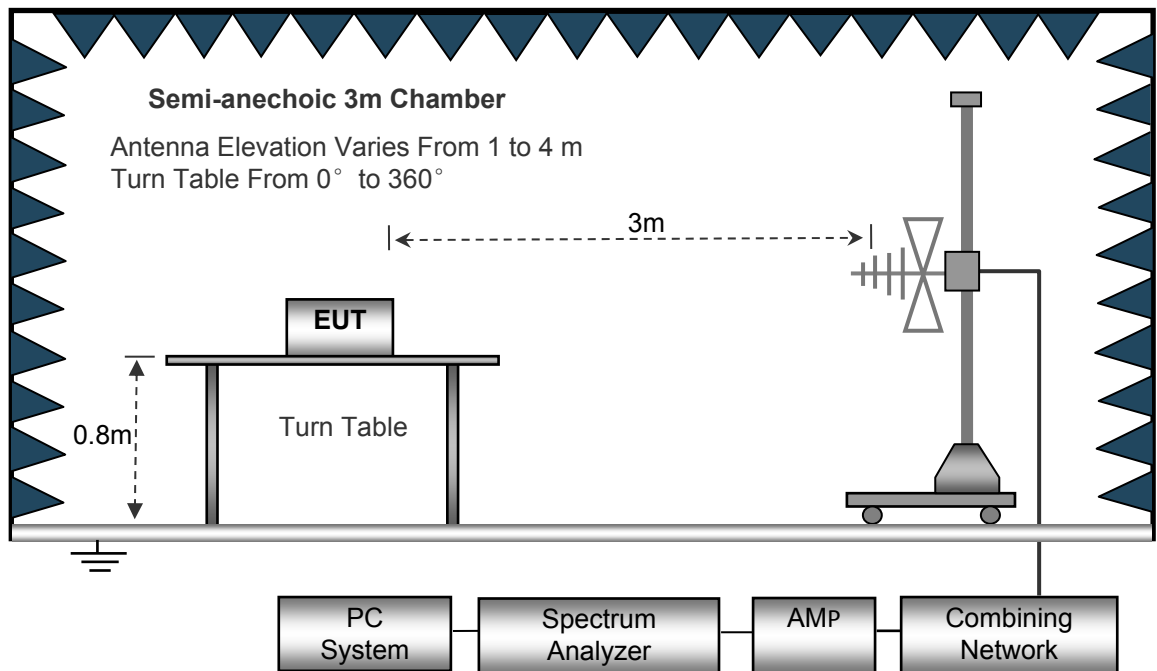
## 8.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10: 2013.

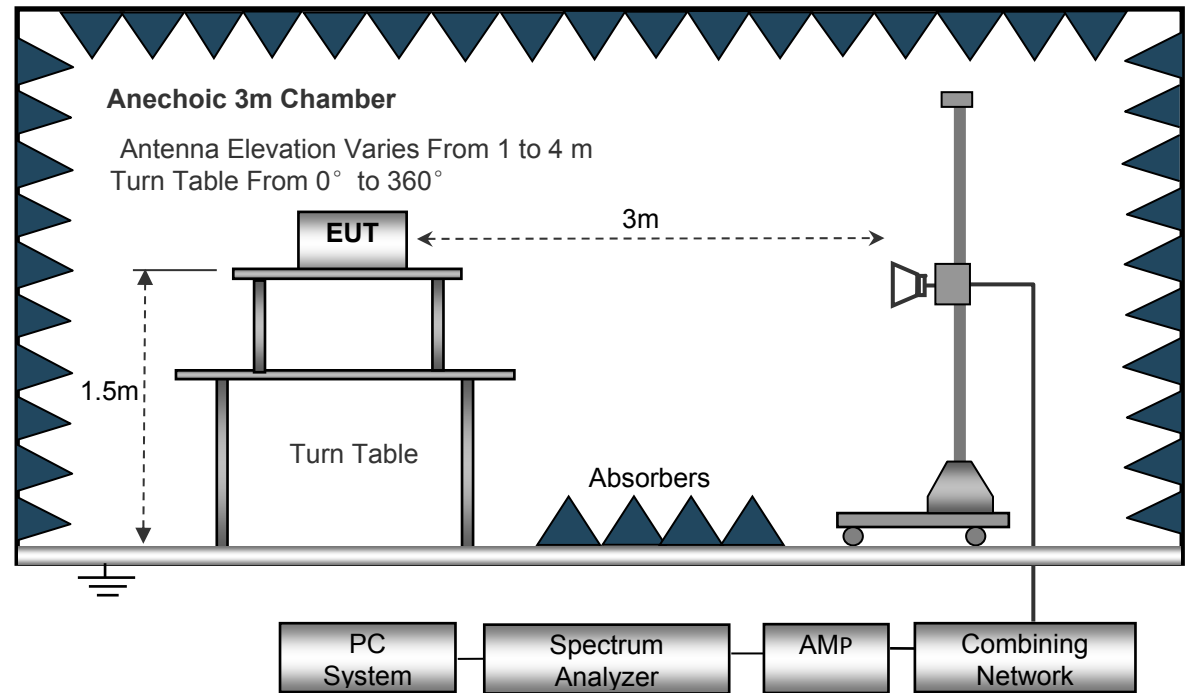
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz.



8.3 Spectrum Analyzer Setup

- Below 30MHz
- Sweep Speed ..... Auto
  - IF Bandwidth..... 10 kHz
  - Video Bandwidth..... 10 kHz
  - Resolution Bandwidth ..... 10 kHz
- 30MHz ~ 1GHz
- Sweep Speed ..... Auto
  - Detector ..... PK
  - Resolution Bandwidth..... 100 kHz
  - Video Bandwidth..... 300 kHz
- Above 1GHz
- Sweep Speed ..... Auto
  - Detector ..... PK
  - Resolution Bandwidth..... 1 MHz
  - Video Bandwidth..... 3 MHz
  - Detector ..... Ave.
  - Resolution Bandwidth..... 1 MHz
  - Video Bandwidth..... 10 Hz

## 8.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane for below 1GHz and 1.5m for above 1GHz.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The radiation measurements are tested under 3-axes(X, Y, Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.
8. For the radiated emission test above 1GHz:

Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

## 8.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

The "Margin" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B.

The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{Limit}$$

## 8.6 Summary of Test Results

**Note:** Only the worst-case 8DPSK mode were record in the report.

### Test Frequency: 9kHz ~ 30MHz

The measurements were more than 20 dB below the limit and not reported.

### Test Frequency: 30MHz ~ 8GHz

| Frequency                 | Receiver Reading | Detector    | Turn table Angle | RX Antenna |       | Corrected Factor | Corrected Amplitude | FCC Part 15.247/209/205 |        |
|---------------------------|------------------|-------------|------------------|------------|-------|------------------|---------------------|-------------------------|--------|
|                           |                  |             |                  | Height     | Polar |                  |                     | Limit                   | Margin |
| (MHz)                     | (dBμV)           | (PK/QP/Ave) | Degree           | (m)        | (H/V) | (dB)             | (dBμV/m)            | (dBμV/m)                | (dB)   |
| 8DPSK Low Channel 2402MHz |                  |             |                  |            |       |                  |                     |                         |        |
| 268.32                    | 37.10            | QP          | 344              | 1.7        | H     | -13.35           | 23.75               | 46.00                   | -22.25 |
| 268.32                    | 42.42            | QP          | 354              | 1.7        | V     | -13.35           | 29.07               | 46.00                   | -16.93 |
| 4804.00                   | 44.95            | PK          | 37               | 2.0        | V     | -1.06            | 43.89               | 74.00                   | -30.11 |
| 4804.00                   | 42.00            | Ave         | 37               | 2.0        | V     | -1.06            | 40.94               | 54.00                   | -13.06 |
| 7206.00                   | 40.83            | PK          | 233              | 1.7        | H     | 1.33             | 42.16               | 74.00                   | -31.84 |
| 7206.00                   | 36.52            | Ave         | 233              | 1.7        | H     | 1.33             | 37.85               | 54.00                   | -16.15 |
| 2325.19                   | 45.50            | PK          | 288              | 1.4        | V     | -13.19           | 32.31               | 74.00                   | -41.69 |
| 2325.19                   | 39.63            | Ave         | 288              | 1.4        | V     | -13.19           | 26.44               | 54.00                   | -27.56 |
| 2370.25                   | 42.10            | PK          | 170              | 1.8        | H     | -13.14           | 28.96               | 74.00                   | -45.04 |
| 2370.25                   | 36.64            | Ave         | 170              | 1.8        | H     | -13.14           | 23.50               | 54.00                   | -30.50 |
| 2492.48                   | 42.83            | PK          | 240              | 1.9        | V     | -13.08           | 29.75               | 74.00                   | -44.25 |
| 2492.48                   | 38.81            | Ave         | 240              | 1.9        | V     | -13.08           | 25.73               | 54.00                   | -28.27 |

| Frequency                    | Receiver Reading | Detector    | Turn table Angle | RX Antenna |       | Corrected Factor | Corrected Amplitude | FCC Part 15.247/209/205 |        |
|------------------------------|------------------|-------------|------------------|------------|-------|------------------|---------------------|-------------------------|--------|
|                              |                  |             |                  | Height     | Polar |                  |                     | Limit                   | Margin |
| (MHz)                        | (dBμV)           | (PK/QP/Ave) | Degree           | (m)        | (H/V) | (dB)             | (dBμV/m)            | (dBμV/m)                | (dB)   |
| 8DPSK Middle Channel 2441MHz |                  |             |                  |            |       |                  |                     |                         |        |
| 268.32                       | 37.55            | QP          | 252              | 1.7        | H     | -13.35           | 24.20               | 46.00                   | -21.80 |
| 268.32                       | 43.00            | QP          | 327              | 1.9        | V     | -13.35           | 29.65               | 46.00                   | -16.35 |
| 4882.00                      | 43.47            | PK          | 269              | 1.8        | V     | -0.62            | 42.85               | 74.00                   | -31.15 |
| 4882.00                      | 42.33            | Ave         | 269              | 1.8        | V     | -0.62            | 41.71               | 54.00                   | -12.29 |
| 7323.00                      | 39.50            | PK          | 203              | 2.0        | H     | 2.21             | 41.71               | 74.00                   | -32.29 |
| 7323.00                      | 36.82            | Ave         | 203              | 2.0        | H     | 2.21             | 39.03               | 54.00                   | -14.97 |
| 2332.42                      | 46.65            | PK          | 59               | 1.2        | V     | -13.19           | 33.46               | 74.00                   | -40.54 |
| 2332.42                      | 38.06            | Ave         | 59               | 1.2        | V     | -13.19           | 24.87               | 54.00                   | -29.13 |
| 2373.32                      | 43.53            | PK          | 178              | 1.7        | H     | -13.14           | 30.39               | 74.00                   | -43.61 |
| 2373.32                      | 37.58            | Ave         | 178              | 1.7        | H     | -13.14           | 24.44               | 54.00                   | -29.56 |
| 2497.28                      | 44.72            | PK          | 161              | 1.0        | V     | -13.08           | 31.64               | 74.00                   | -42.36 |
| 2497.28                      | 37.57            | Ave         | 161              | 1.0        | V     | -13.08           | 24.49               | 54.00                   | -29.51 |

| Frequency                  | Receiver Reading | Detector    | Turn table Angle | RX Antenna |       | Corrected Factor | Corrected Amplitude | FCC Part 15.247/209/205 |        |
|----------------------------|------------------|-------------|------------------|------------|-------|------------------|---------------------|-------------------------|--------|
|                            |                  |             |                  | Height     | Polar |                  |                     | Limit                   | Margin |
| (MHz)                      | (dBμV)           | (PK/QP/Ave) | Degree           | (m)        | (H/V) | (dB)             | (dBμV/m)            | (dBμV/m)                | (dB)   |
| 8DPSK High Channel 2480MHz |                  |             |                  |            |       |                  |                     |                         |        |
| 268.32                     | 37.98            | QP          | 82               | 1.7        | H     | -13.35           | 24.63               | 46.00                   | -21.37 |
| 268.32                     | 44.40            | QP          | 254              | 1.3        | V     | -13.35           | 31.05               | 46.00                   | -14.95 |
| 4960.00                    | 44.50            | PK          | 168              | 2.0        | V     | -0.24            | 44.26               | 74.00                   | -29.74 |
| 4960.00                    | 41.34            | Ave         | 168              | 2.0        | V     | -0.24            | 41.10               | 54.00                   | -12.90 |
| 7440.00                    | 38.62            | PK          | 259              | 1.8        | H     | 2.84             | 41.46               | 74.00                   | -32.54 |
| 7440.00                    | 36.00            | Ave         | 259              | 1.8        | H     | 2.84             | 38.84               | 54.00                   | -15.16 |
| 2341.97                    | 45.71            | PK          | 132              | 1.1        | V     | -13.19           | 32.52               | 74.00                   | -41.48 |
| 2341.97                    | 39.27            | Ave         | 132              | 1.1        | V     | -13.19           | 26.08               | 54.00                   | -27.92 |
| 2372.97                    | 44.32            | PK          | 89               | 1.5        | H     | -13.14           | 31.18               | 74.00                   | -42.82 |
| 2372.97                    | 36.94            | Ave         | 89               | 1.5        | H     | -13.14           | 23.80               | 54.00                   | -30.20 |
| 2484.36                    | 42.69            | PK          | 80               | 1.6        | V     | -13.08           | 29.61               | 74.00                   | -44.39 |
| 2484.36                    | 38.67            | Ave         | 80               | 1.6        | V     | -13.08           | 25.59               | 54.00                   | -28.41 |

**Test Frequency: 8GHz~25GHz**

The measurements were more than 20 dB below the limit and not reported.

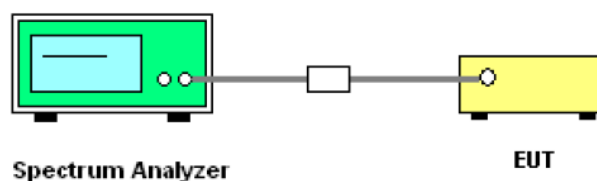
## 9 Band Edge Measurement

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement: | Section 15.247(d) 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 15.205(c)).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Test Method:      | ANSI C63.10:2013                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Test Limit:       | Regulation 15.247 (d), 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. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)). |
| Test Mode:        | Transmitting                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

### 9.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100 kHz, VBW = 300 kHz, Sweep = auto  
Detector function = peak, Trace = max hold

### 9.2 Test Setup

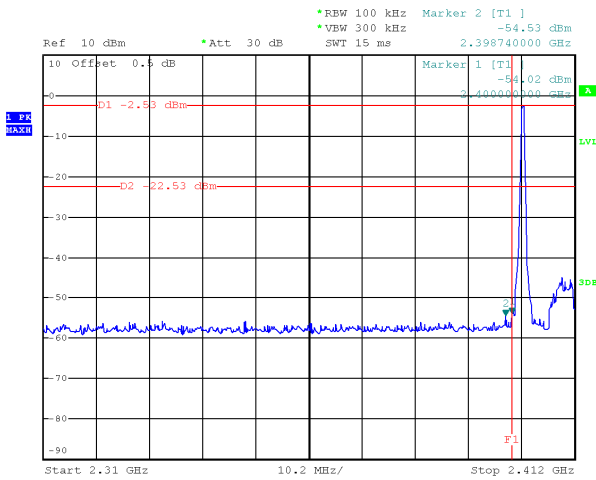


9.3 Test Result

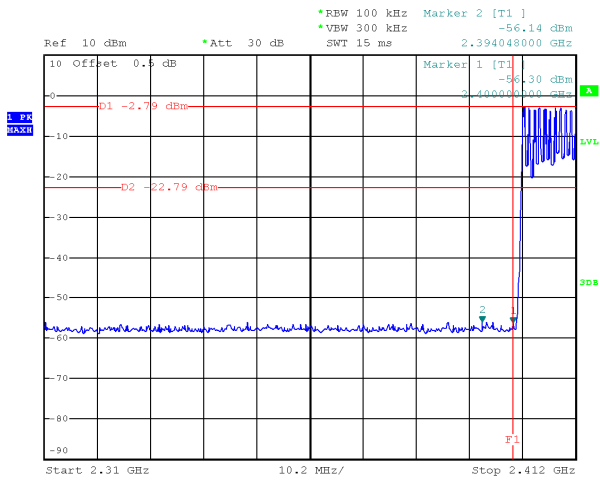
Test plots

Modulation: GFSK

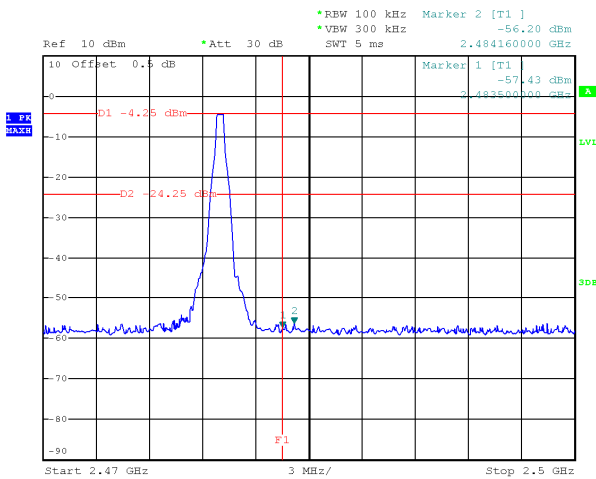
Transmitting Band edge-left side



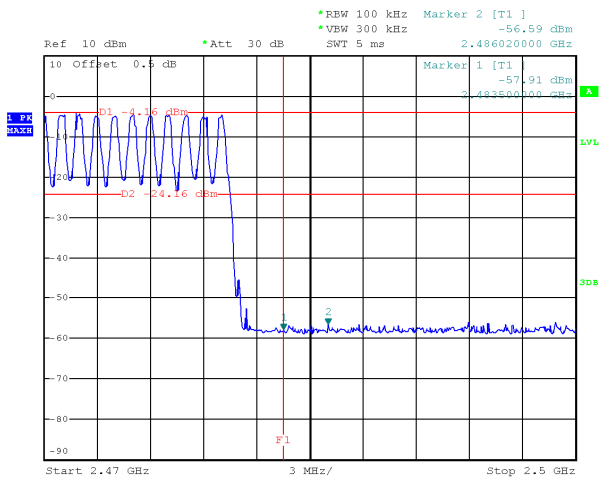
Hopping Band edge-left side



Transmitting Band edge-right side

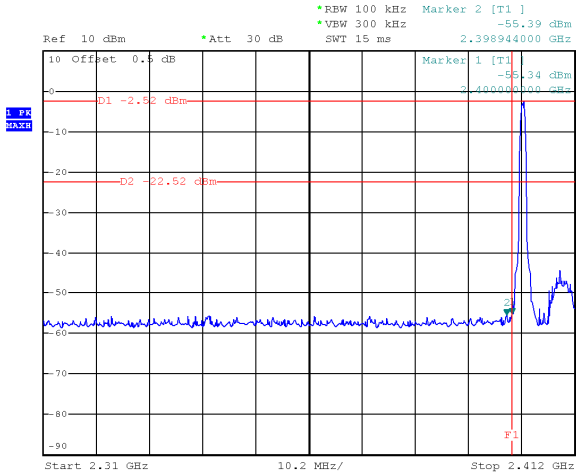


Hopping Band edge-right side

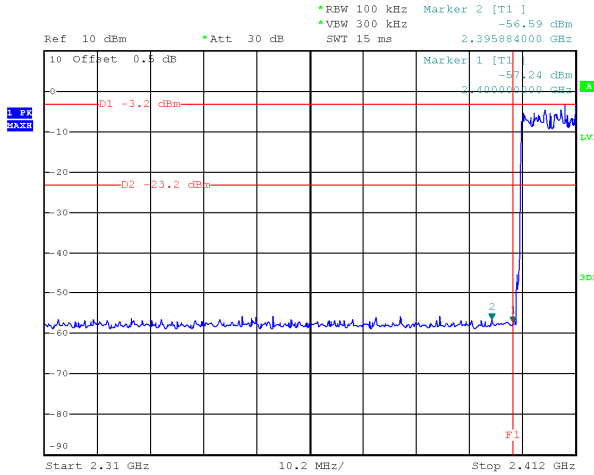


Modulation:  $\pi/4$  DQPSK

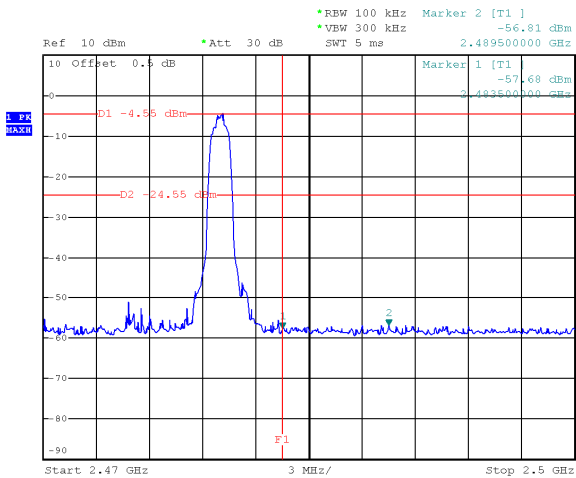
Transmitting Band edge-left side



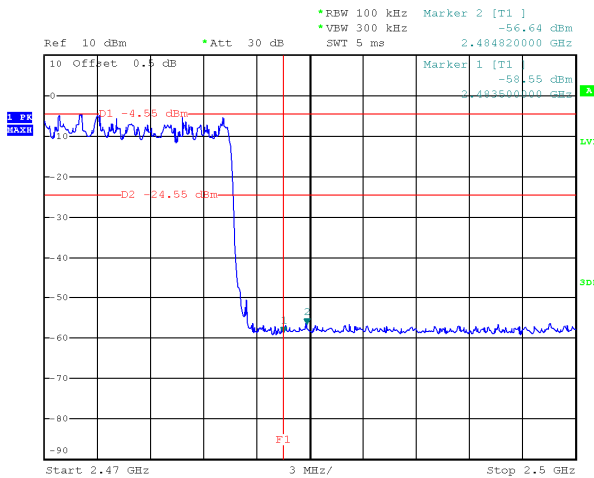
Hopping Band edge-left side



Transmitting Band edge-right side

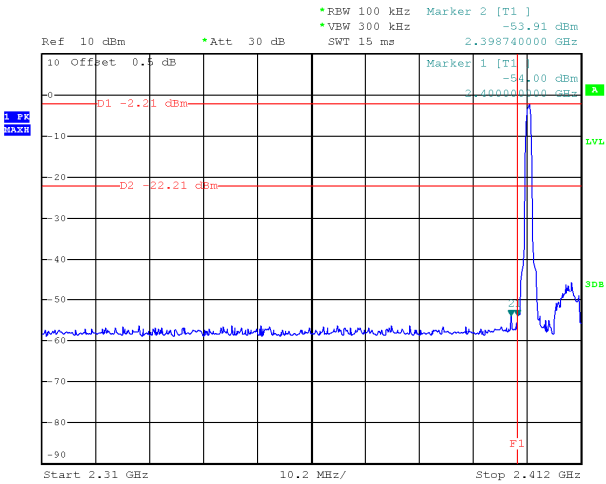


Hopping Band edge-right side

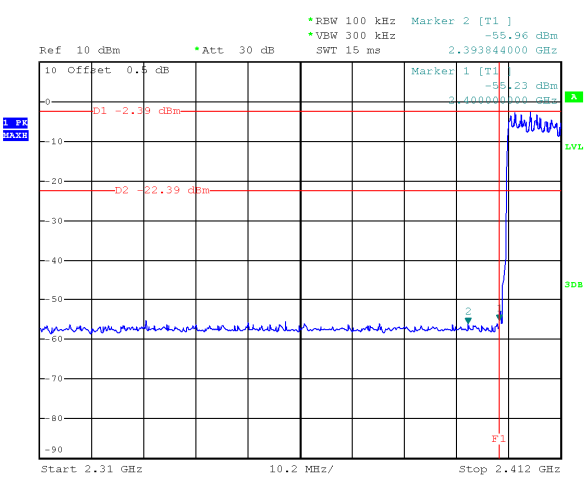


Modulation: 8DPSK

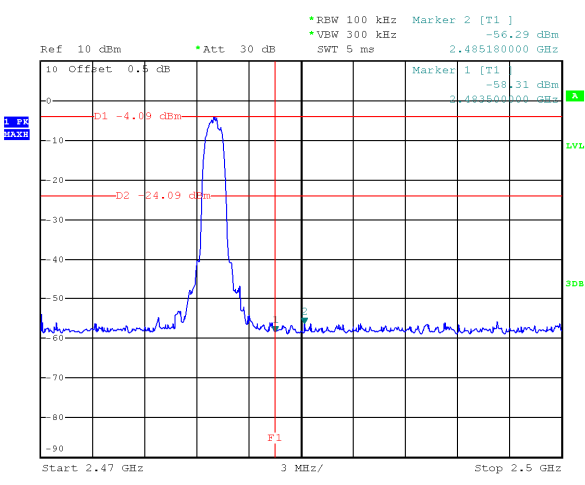
Transmitting Band edge-left side



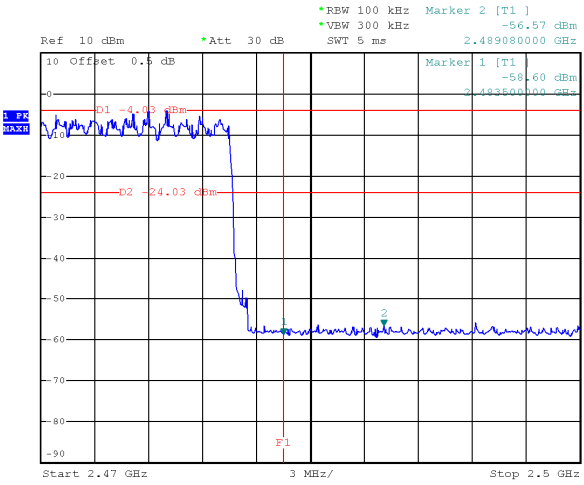
Hopping Band edge-left side



Transmitting Band edge-right side



Hopping Band edge-right side



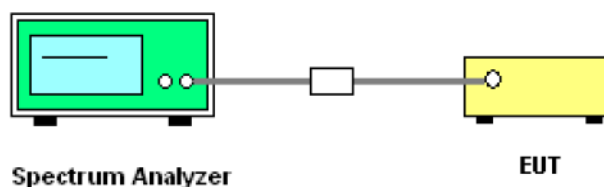
## 10 Bandwidth Measurement

|                   |                                                                  |
|-------------------|------------------------------------------------------------------|
| Test Requirement: | FCC CFR47 Part 15 Section 15.247 (a) (2)                         |
| Test Method:      | ANSI C63.10:2013                                                 |
| Test Limit:       | The minimum 6 dB bandwidth shall be at least 500 kHz.            |
| Test Mode:        | Test in fixing operating frequency at low, Middle, high channel. |

### 10.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 30kHz, VBW = 100kHz

### 10.2 Test Setup



### 10.3 Test Result

| Modulation    | Test Channel | 20 dB Bandwidth<br>MHz | 99% Bandwidth<br>MHz |
|---------------|--------------|------------------------|----------------------|
| GFSK          | Low          | 0.984                  | 0.852                |
| GFSK          | Middle       | 0.960                  | 0.858                |
| GFSK          | High         | 0.960                  | 0.852                |
| $\pi/4$ DQPSK | Low          | 1.332                  | 1.170                |
| $\pi/4$ DQPSK | Middle       | 1.332                  | 1.170                |
| $\pi/4$ DQPSK | High         | 1.332                  | 1.170                |
| 8DPSK         | Low          | 1.314                  | 1.182                |
| 8DPSK         | Middle       | 1.314                  | 1.176                |
| 8DPSK         | High         | 1.308                  | 1.182                |

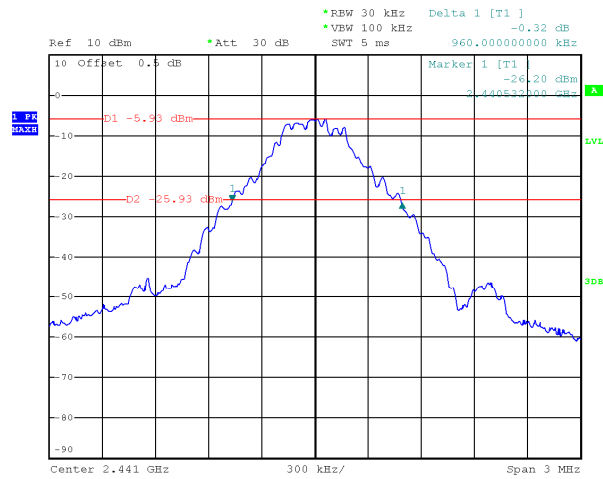
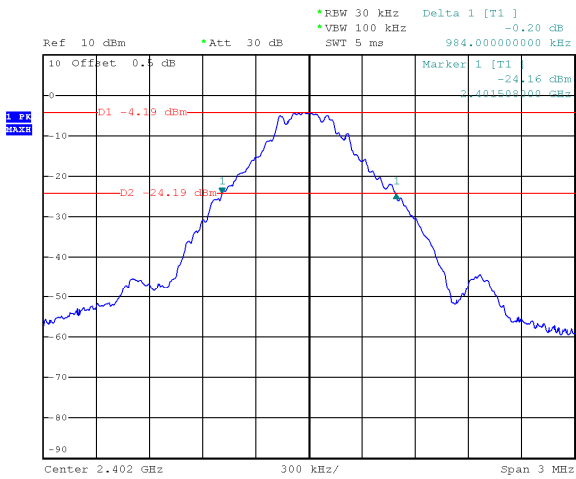
Test plots

20 dB Bandwidth

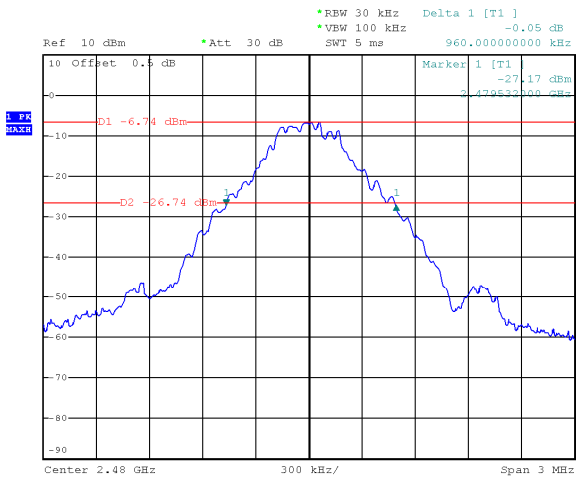
Modulation: GFSK

Low Channel

Middle Channel

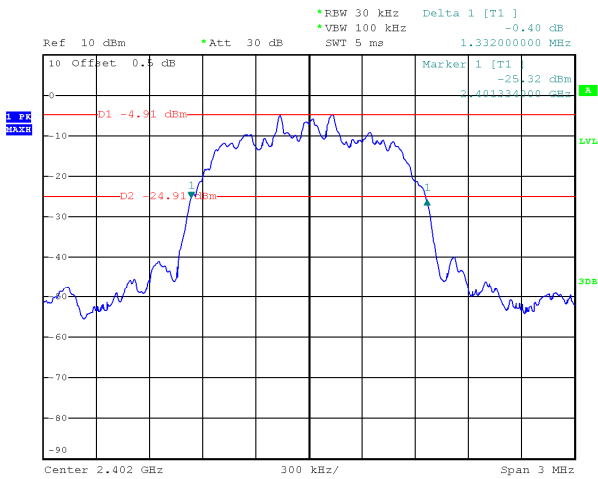


High Channel

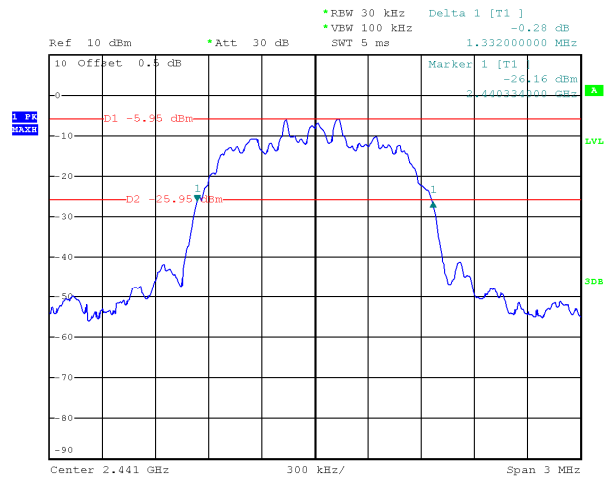


Modulation:  $\pi/4$  DQPSK

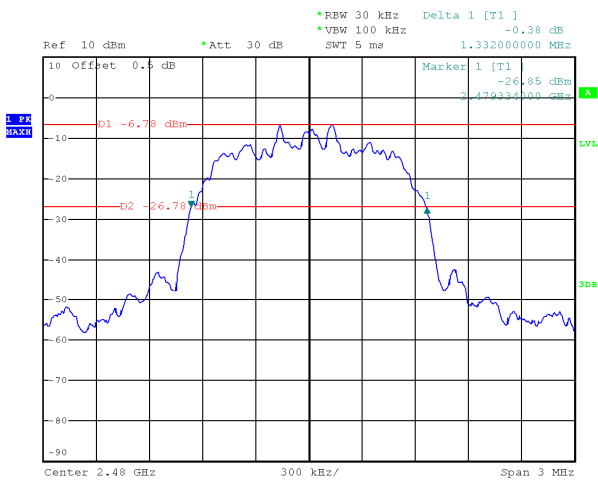
Low Channel



Middle Channel

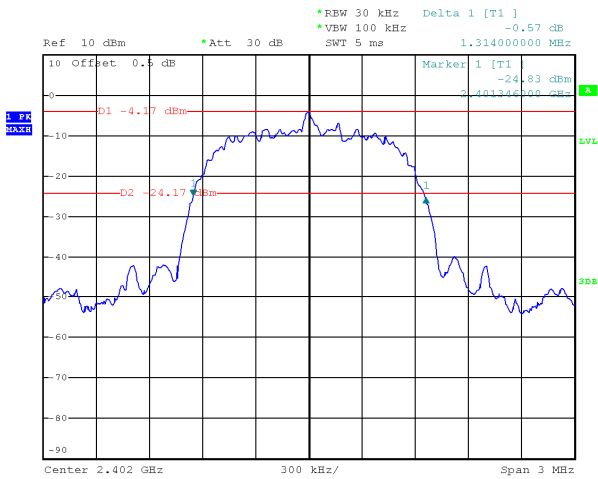


High Channel

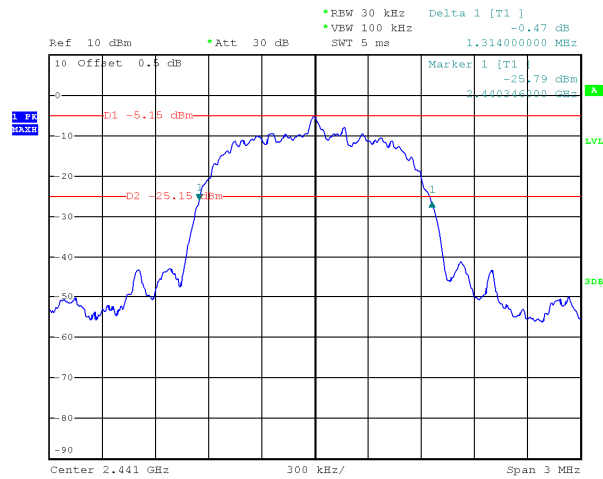


Modulation: 8DPSK

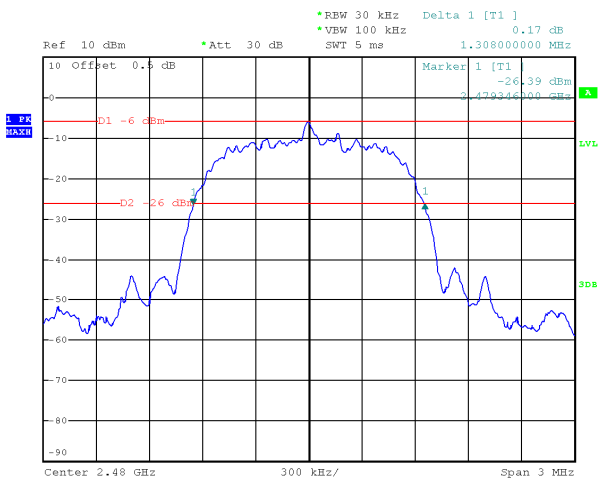
Low Channel



Middle Channel



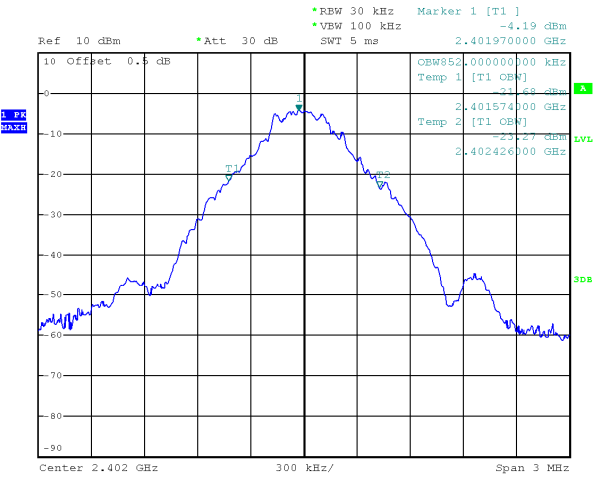
High Channel



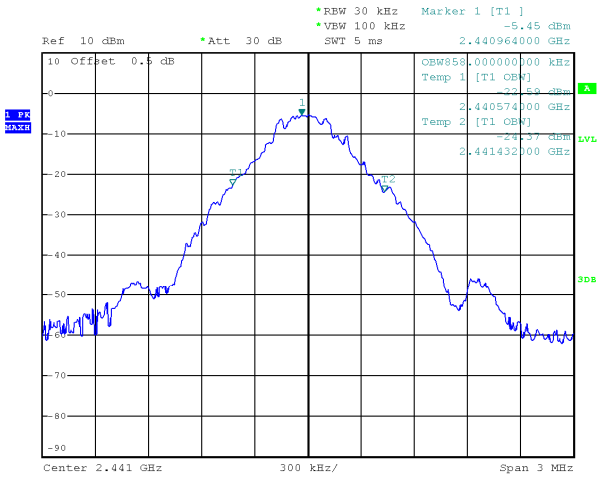
99% Bandwidth

Modulation: GFSK

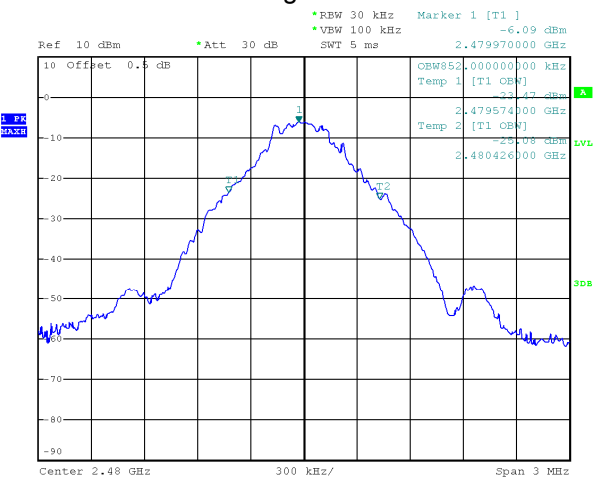
Low Channel



Middle Channel

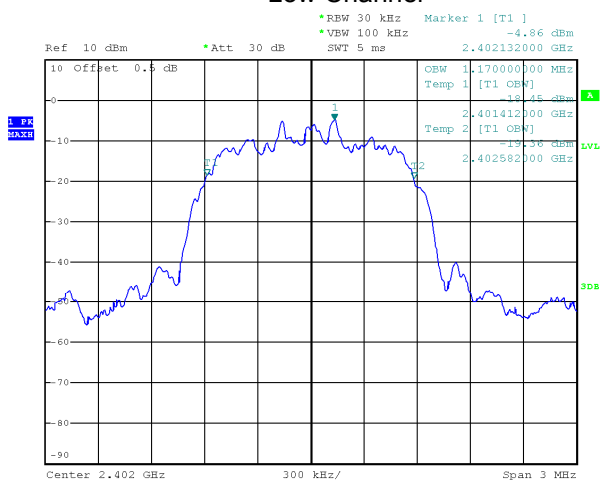


High Channel



Modulation:  $\pi/4$  DQPSK

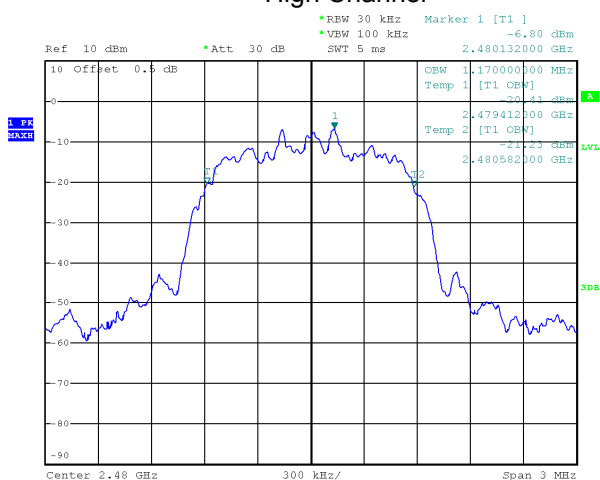
Low Channel



### Middle Channel

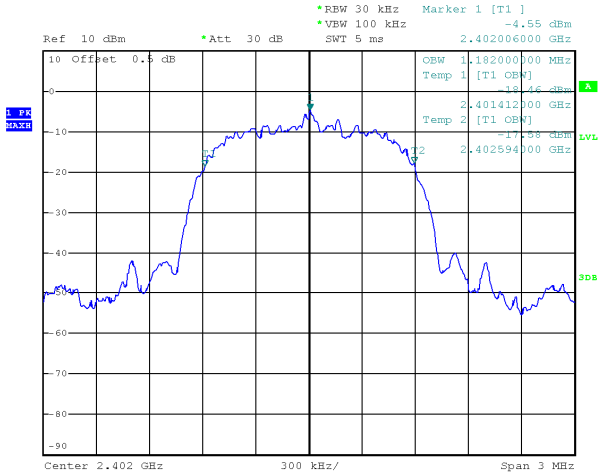


High Channel

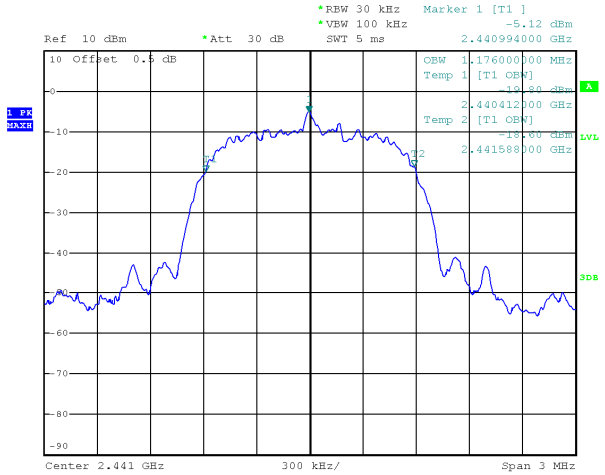


Modulation: 8DPSK

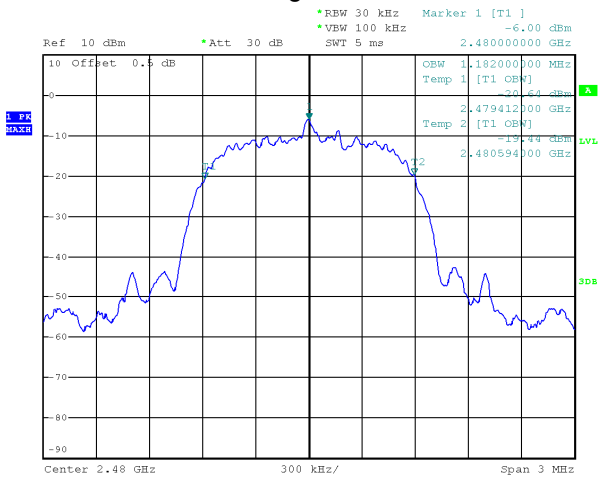
Low Channel



Middle Channel



High Channel



## 11 Maximum Peak Output Power

Test Requirement: FCC CFR47 Part 15 Section 15.247 (b)

Test Method: ANSI C63.10:2013

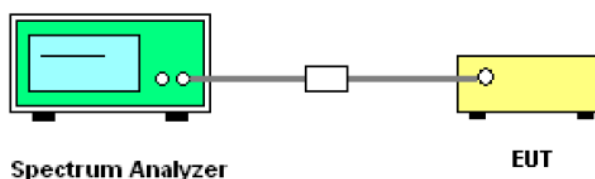
Test Limit: The maximum output power limit for DTS devices is specified as 1 W and is expressed in terms of either maximum peak conducted output power or maximum conducted output power.

Test Mode: Test in fixing operating frequency at low, Middle, high channel.

### 11.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3 MHz. VBW = 3 MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

### 11.2 Test Setup



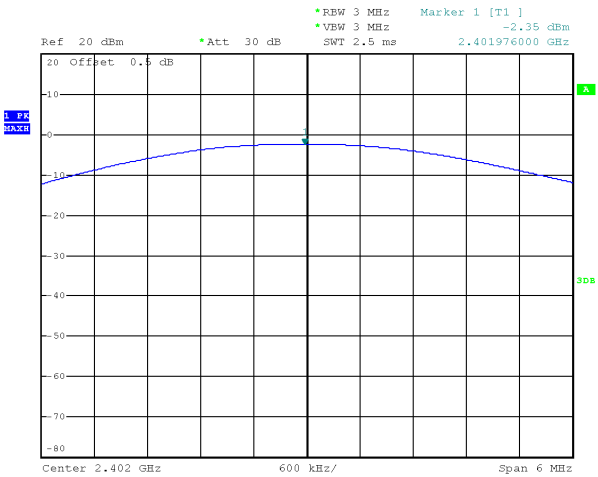
### 11.3 Test Result

| Test Mode     | Data Rate | Peak Power(dBm) |                |              | Limit (dBm) |
|---------------|-----------|-----------------|----------------|--------------|-------------|
|               |           | Low Channel     | Middle Channel | High Channel |             |
| GFSK          | 1Mbps     | -2.35           | -3.45          | -4.32        | 30          |
| $\pi/4$ DQPSK | 2Mbps     | -0.23           | -1.28          | -2.16        | 30          |
| 8DPSK         | 3Mbps     | <b>0.28</b>     | -0.86          | -1.75        | 30          |

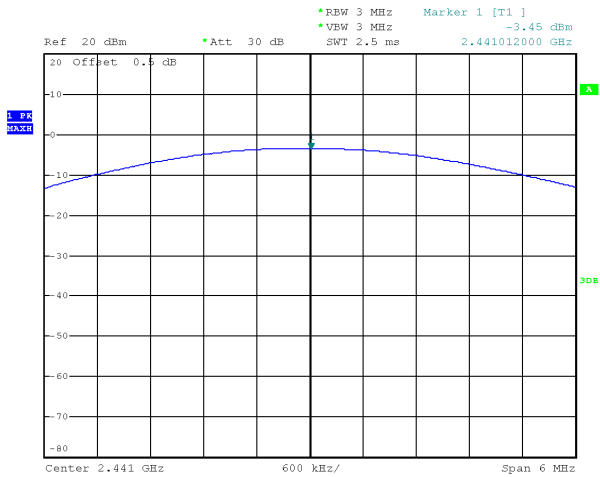
Test plots

Modulation: GFSK

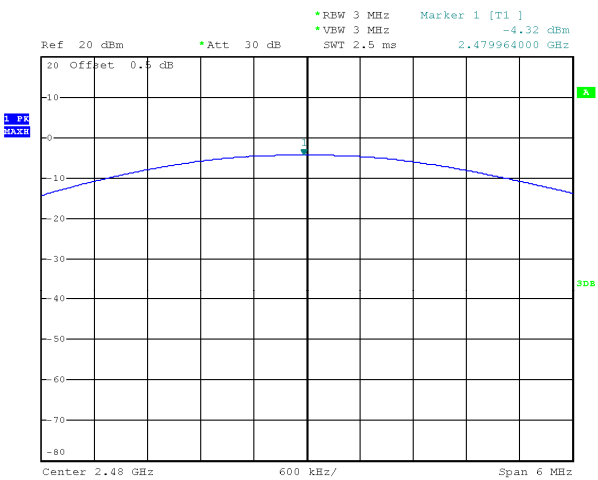
Low Channel



Middle Channel

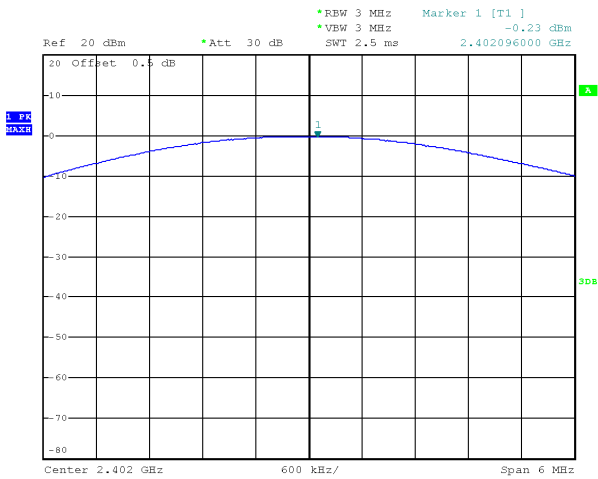


High Channel

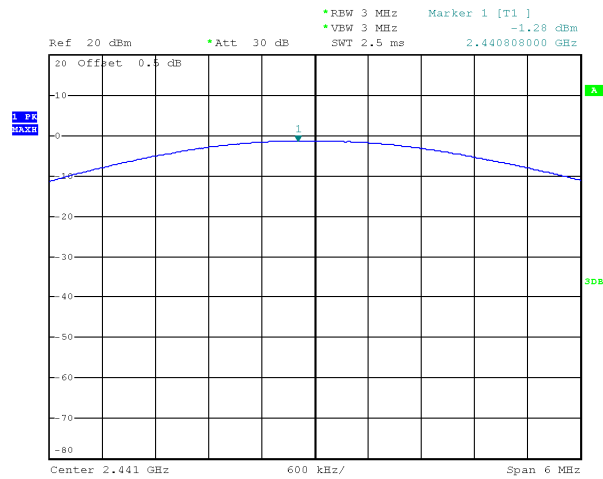


Modulation:  $\pi/4$  DQPSK

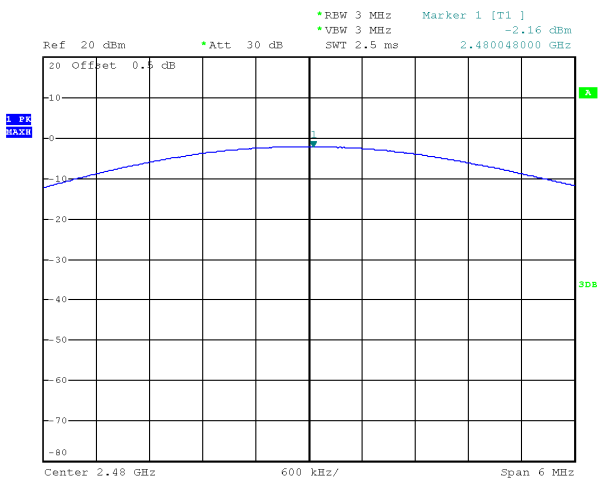
Low Channel



Middle Channel

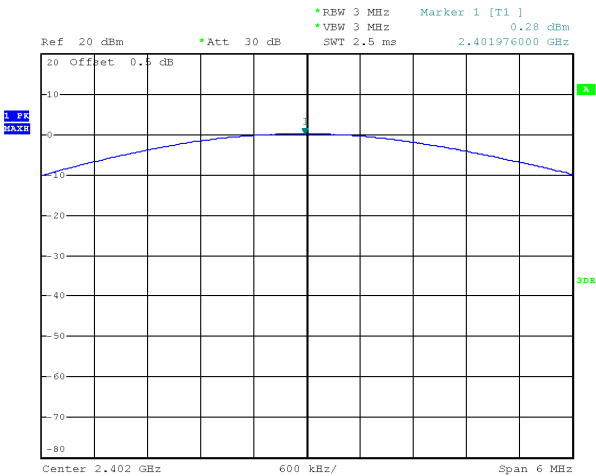


High Channel

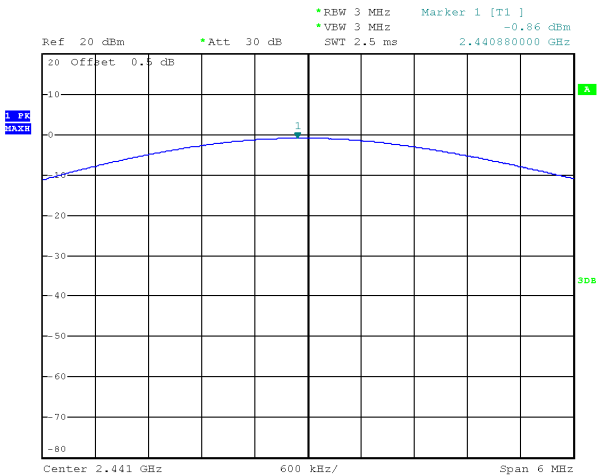


Modulation: 8DPSK

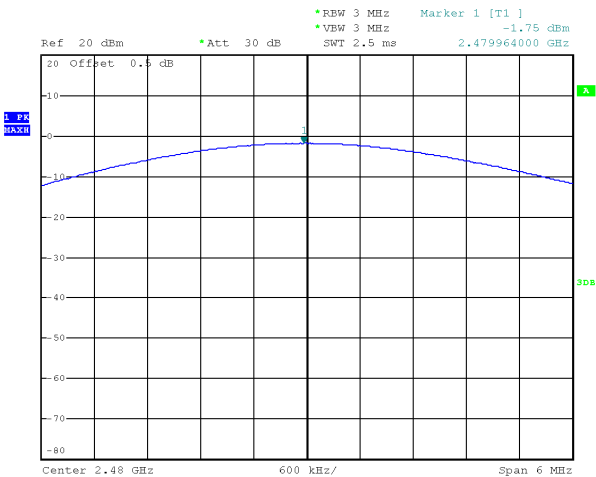
Low Channel



Middle Channel



High Channel



## 12 Hopping Channel Separation

Test Requirement: FCC CFR47 Part 15 Section 15.247 (a) (1)

Test Method: ANSI C63.10:2013

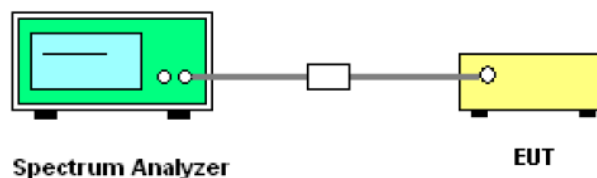
Test Limit: Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125mW.

Test Mode: Test in hopping transmitting operating mode.

### 12.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 30 kHz. VBW = 100 kHz, Span = 3MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section  
Submit this plot.

### 12.2 Test Setup



### 12.3 Test Result

Test result plot as follows:

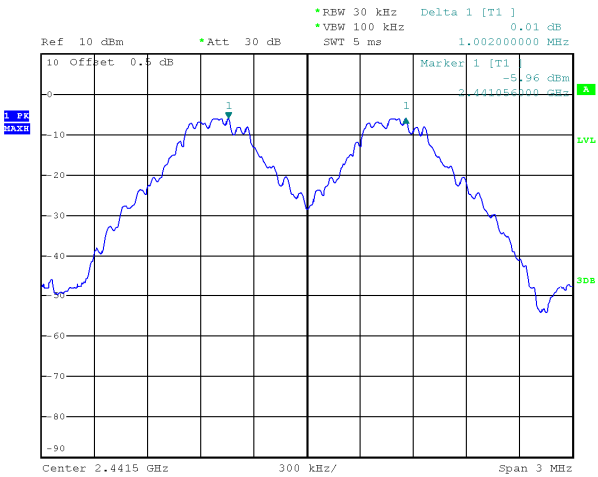
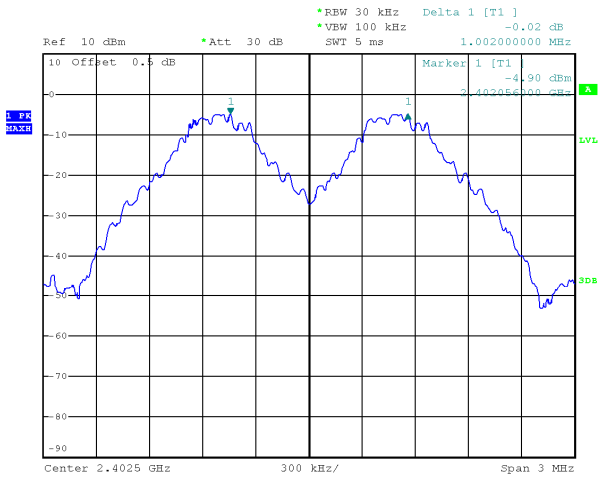
| Modulation    | Test Channel | Test Result<br>MHz | 20dB Bandwidth<br>MHz | Limits (2/3 20dB Bandwidth)<br>MHz |
|---------------|--------------|--------------------|-----------------------|------------------------------------|
| GFSK          | Low          | 1.002              | 0.984                 | 0.656                              |
| GFSK          | Middle       | 1.002              | 0.96                  | 0.640                              |
| GFSK          | High         | 1.002              | 0.96                  | 0.640                              |
| $\pi/4$ DQPSK | Low          | 0.996              | 1.332                 | 0.888                              |
| $\pi/4$ DQPSK | Middle       | 1.002              | 1.332                 | 0.888                              |
| $\pi/4$ DQPSK | High         | 1.008              | 1.332                 | 0.888                              |
| 8DPSK         | Low          | 1.008              | 1.314                 | 0.876                              |
| 8DPSK         | Middle       | 1.002              | 1.314                 | 0.876                              |
| 8DPSK         | High         | 1.002              | 1.308                 | 0.872                              |

Test plots

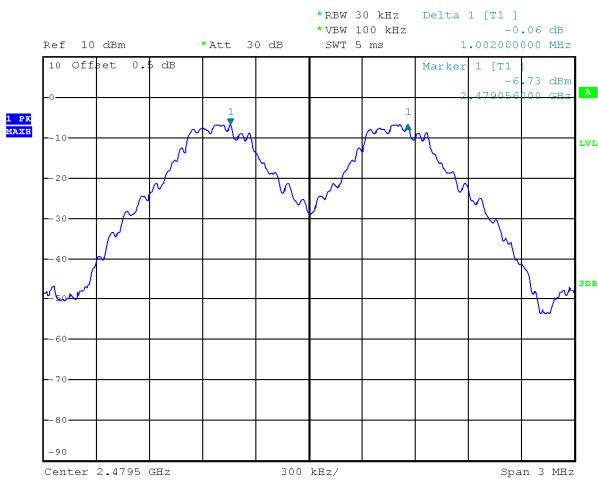
Modulation: GFSK

Low Channel

Middle Channel

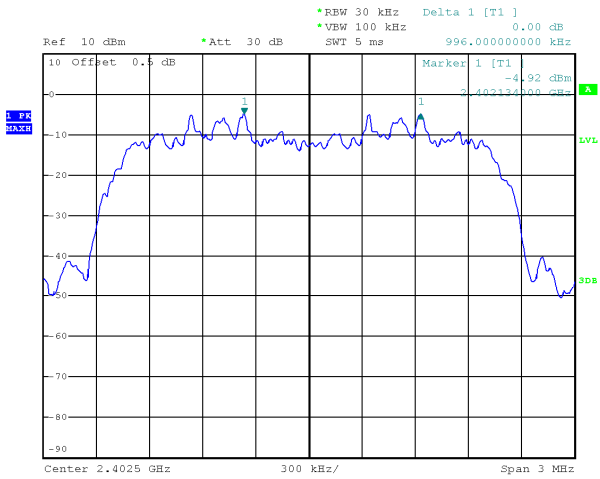


High Channel

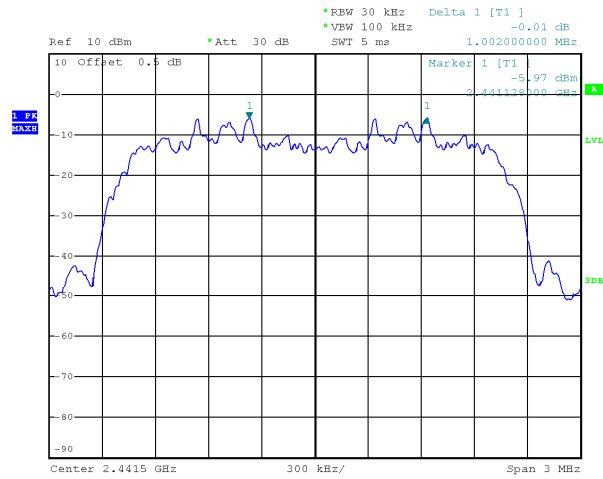


Modulation:  $\pi/4$  DQPSK

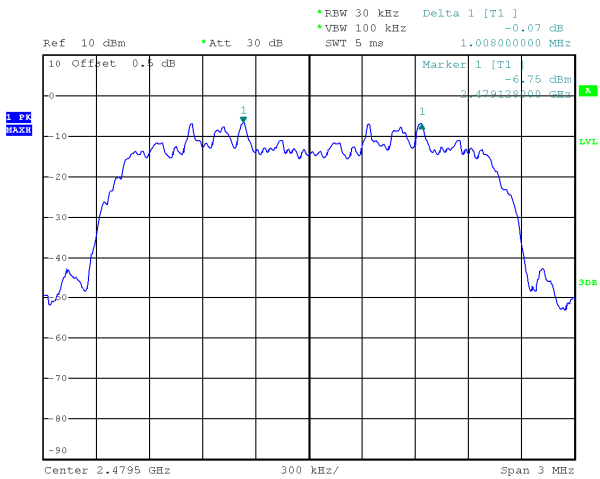
Low Channel



Middle Channel

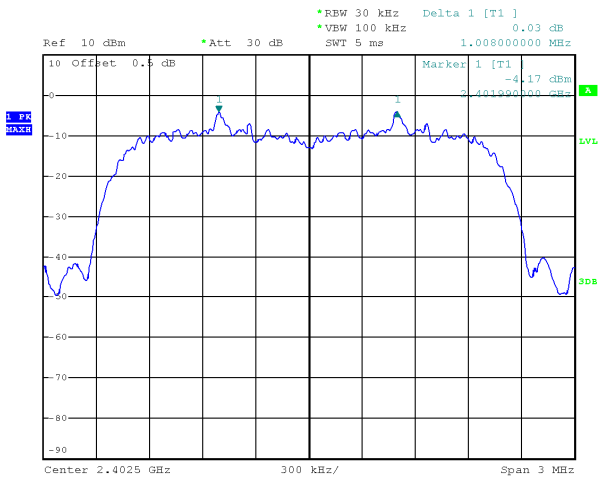


High Channel

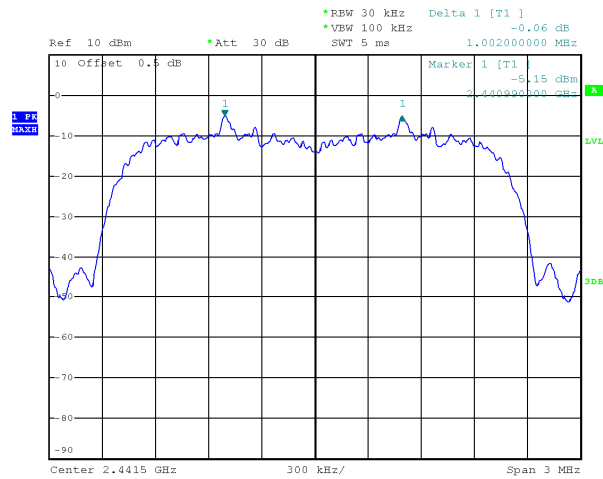


Modulation: 8DPSK

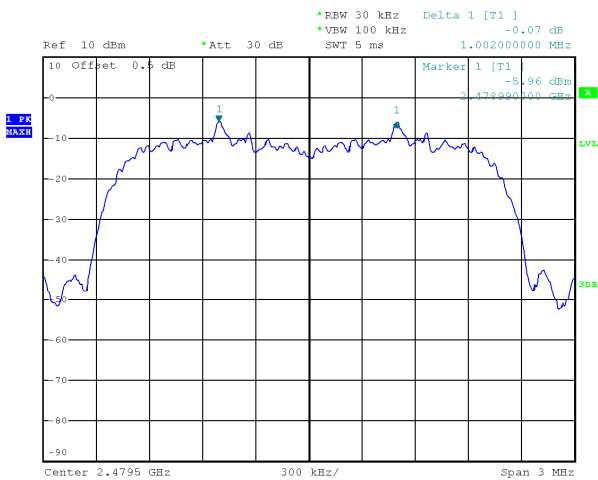
Low Channel



Middle Channel



High Channel



## 13 Number of Hopping Frequency

Test Requirement: FCC CFR47 Part 15 Section 15.247 (a) (1) (iii)

Test Method: ANSI C63.10:2013

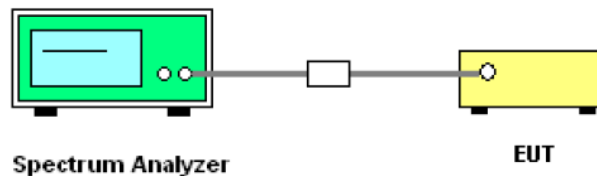
Test Limit: Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Mode: Test in hopping transmitting operating mode.

### 13.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100 kHz. VBW = 300 kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency = 2.4835GHz. Sweep=auto;

### 13.2 Test Setup

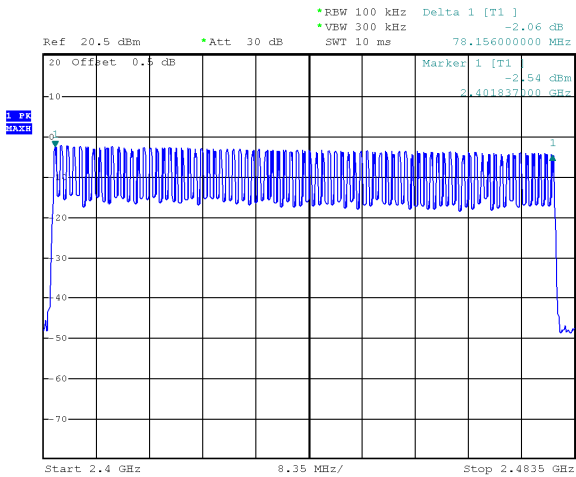


13.3 Test Result

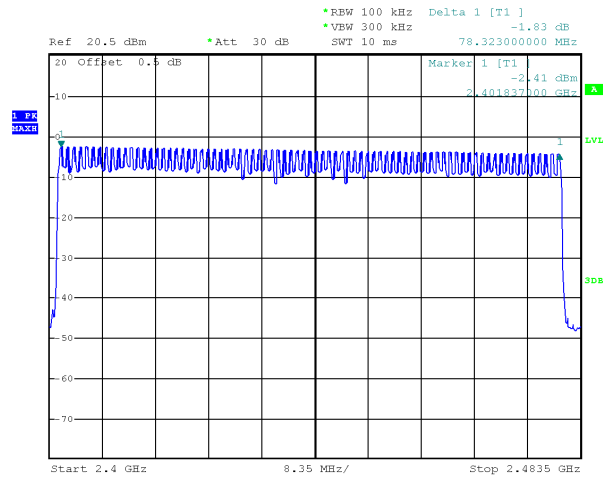
Total Channels are 79 Channels.

Test Plot

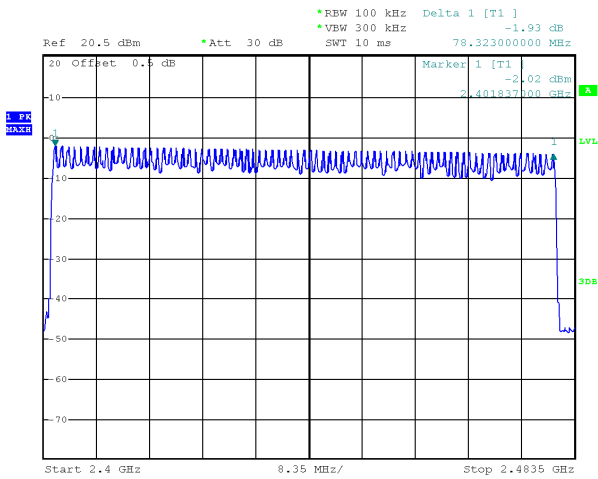
Modulation: GFSK



Modulation:  $\pi/4$  DQPSK



Modulation: 8DPSK



## 14 Dwell Time

Test Requirement: FCC CFR47 Part 15 Section 15.247 (a) (1) (iii)

Test Method: ANSI C63.10:2013

Test Limit: Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Mode: Test in hopping transmitting operating mode.

### 14.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set spectrum analyzer span = 0Hz. Centred on a hopping channel;
3. Set RBW = 1 MHz and VBW = 3MHz. Sweep = as necessary to capture the entire dwell time per hopping channel.
4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g. data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

The test period:  $T = 0.4(s) \times 79 = 31.6(s)$

DH5 Packet permit maximum  $1600 / 79 / 6$  hops per second in each channel (5 time slots RX, 1 time slot TX).

DH3 Packet permit maximum  $1600 / 79 / 4$  hops per second in each channel (3 time slots RX, 1 time slot TX).

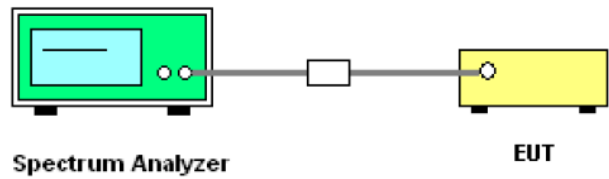
DH1 Packet permit maximum  $1600 / 79 / 2$  hops per second in each channel (1 time slot RX, 1 time slot TX).

So, the Dwell Time can be calculated as follows:

| Data Packet | Dwell Time(s)                                         |
|-------------|-------------------------------------------------------|
| DH5         | $1600/79/6 \times 31.6 \times (\text{MkrDelta})/1000$ |
| DH3         | $1600/79/4 \times 31.6 \times (\text{MkrDelta})/1000$ |
| DH1         | $1600/79/2 \times 31.6 \times (\text{MkrDelta})/1000$ |
| Remark      | Mkr Delta is single pulse time.                       |

Dwell time = Pulse wide x (Hopping rate / Number of channels) x Period

14.2 Test Setup



14.3 Test Result

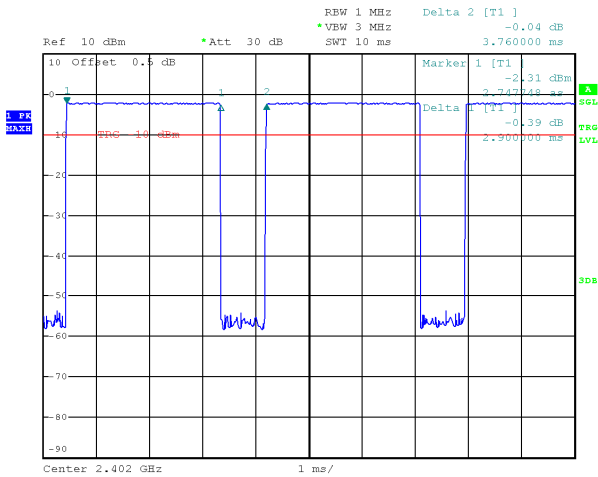
| Modulation    | Data Packet | Channel | pulse time(ms) | Dwell Time(s) | Limits(s) |
|---------------|-------------|---------|----------------|---------------|-----------|
| GFSK          | DH5         | Low     | 2.900          | 0.309         | <0.4      |
|               |             | Middle  | 2.900          | 0.309         | <0.4      |
|               |             | High    | 2.900          | 0.309         | <0.4      |
| $\pi/4$ DQPSK | 2DH5        | Low     | 2.900          | 0.309         | <0.4      |
|               |             | Middle  | 2.900          | 0.309         | <0.4      |
|               |             | High    | 2.900          | 0.309         | <0.4      |
| 8DPSK         | 3DH5        | Low     | 2.920          | 0.311         | <0.4      |
|               |             | Middle  | 2.920          | 0.311         | <0.4      |
|               |             | High    | 2.920          | 0.311         | <0.4      |

Test Plot

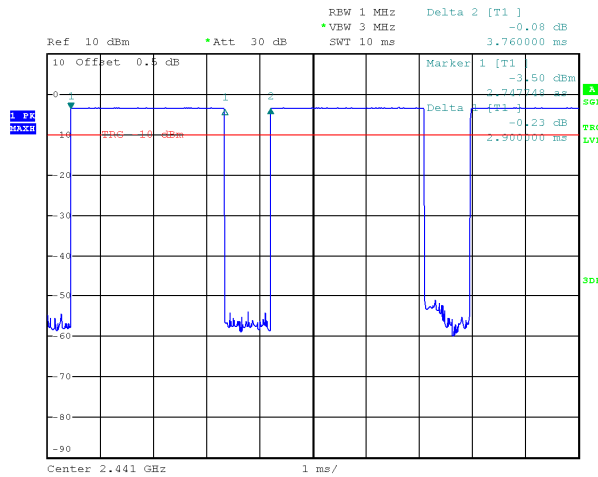
Modulation: GFSK

Data Packet: DH5

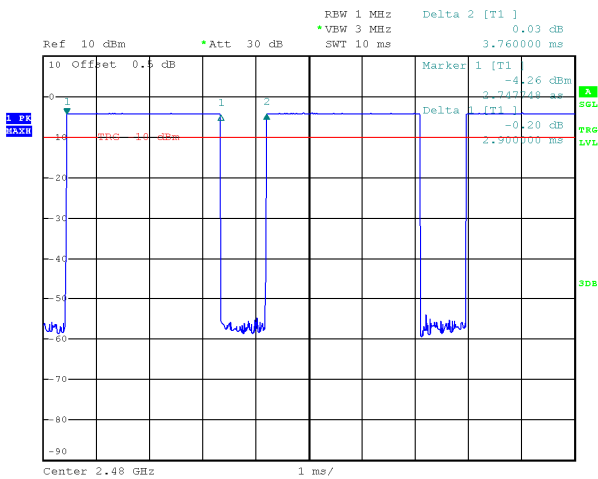
Low Channel



Middle Channel



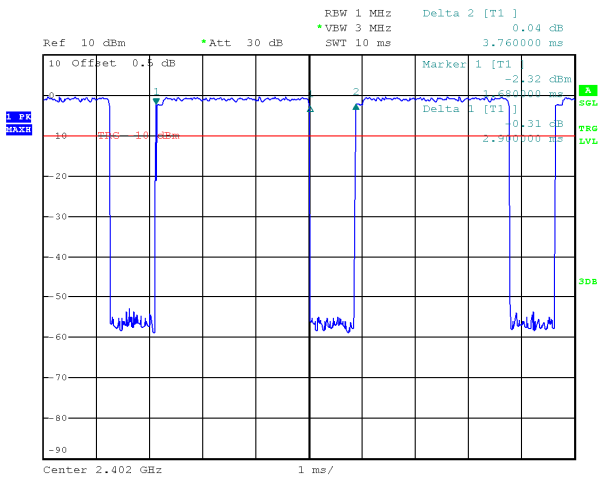
High Channel



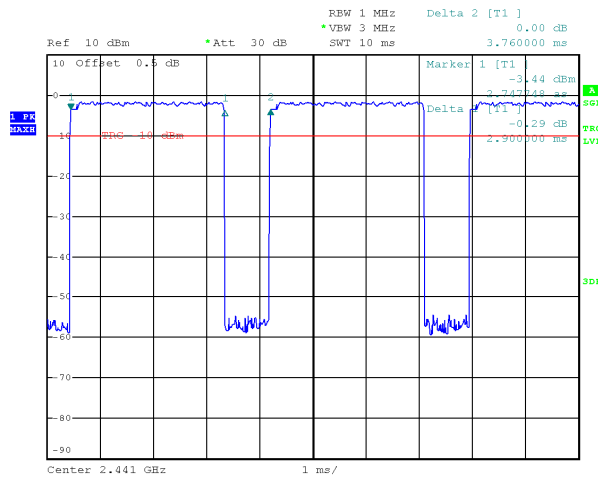
Modulation:  $\pi/4$  DQPSK

Data Packet: 2DH5

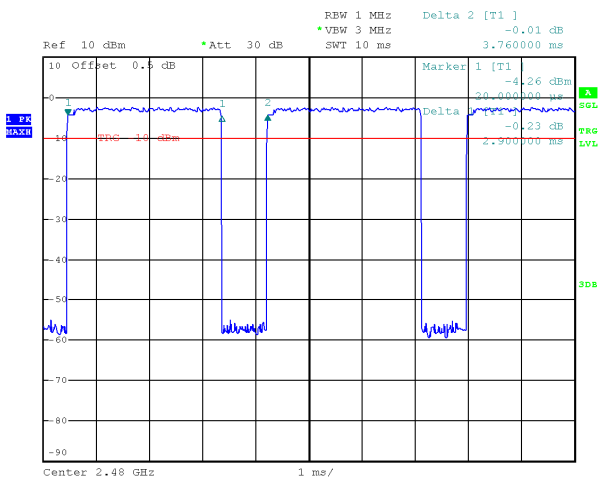
Low Channel



Middle Channel



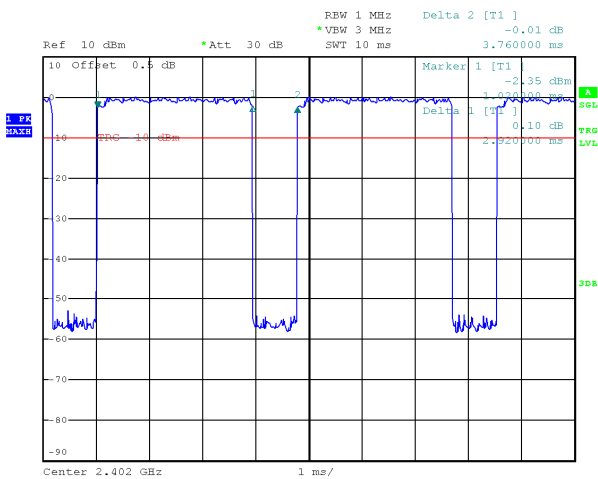
High Channel



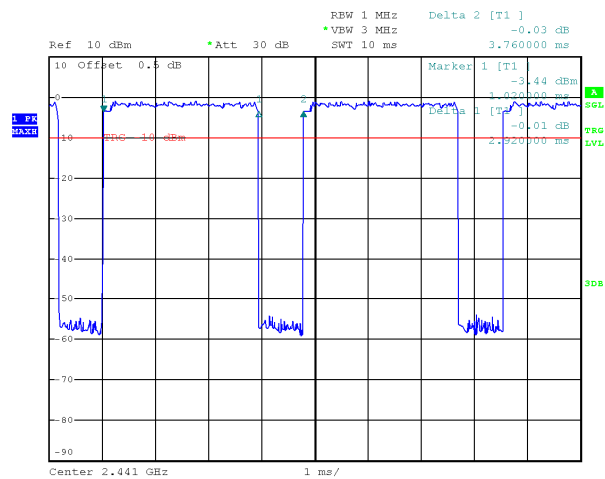
Modulation: 8DPSK

Data Packet: 3DH5

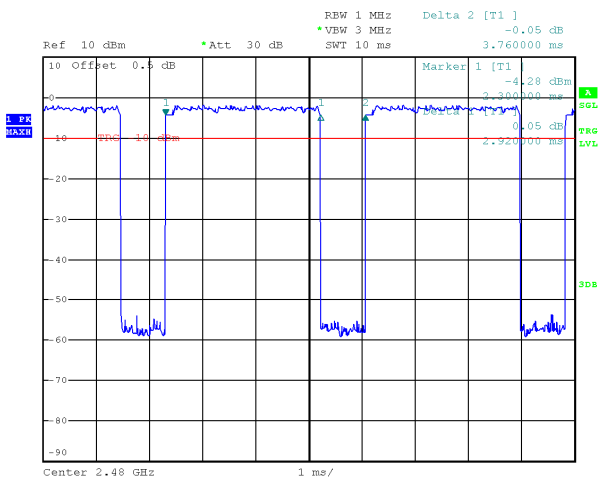
Low Channel



Middle Channel



High Channel



## **15 Antenna Requirement**

According to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

This product has an integrated antenna fulfill the requirement of this section.

Note: Please refer to EUT photos for more details.

## **16 RF Exposure**

Note: Please refer to RF Exposure Report: WTD21D11127619W002\_FCC MPE report.

## **17 Photographs –Test Setup and EUT Photos**

Note: Please refer to appendix: Appendix-D6-Photos.

=====End of Report=====