



REPORT No.: SZ21070182W04

# TEST REPORT

**APPLICANT** : Audio-Technica Corporation

**PRODUCT NAME** : Wireless Headphones

**MODEL NAME** : ATH-TWX9

**BRAND NAME** : audio-technica

**FCC ID** : JFZTWX9R

**STANDARD(S)** : 47 CFR Part 15 Subpart C

**RECEIPT DATE** : 2021-07-20

**TEST DATE** : 2021-07-27 to 2021-08-09

**ISSUE DATE** : 2021-09-01

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| Change History |            |                   |
|----------------|------------|-------------------|
| Version        | Date       | Reason for change |
| 1.0            | 2021-09-01 | First edition     |
|                |            |                   |



# 1. Technical Information

**Note:** Provide by applicant.

## 1.1. Applicant and Manufacturer Information

|                              |                                                     |
|------------------------------|-----------------------------------------------------|
| <b>Applicant:</b>            | Audio-Technica Corporation                          |
| <b>Applicant Address:</b>    | 2-46-1 Nishi-naruse, Machida, Tokyo 194-8666, Japan |
| <b>Manufacturer:</b>         | Audio-Technica Corporation                          |
| <b>Manufacturer Address:</b> | 2-46-1 Nishi-naruse, Machida, Tokyo 194-8666, Japan |

## 1.2. Equipment Under Test (EUT) Description

|                                   |                                                                  |                                     |
|-----------------------------------|------------------------------------------------------------------|-------------------------------------|
| <b>Product Name:</b>              | Wireless Headphones                                              |                                     |
| <b>Sample No.:</b>                | 1#                                                               |                                     |
| <b>Hardware Version:</b>          | V01                                                              |                                     |
| <b>Software Version:</b>          | V0755                                                            |                                     |
| <b>Equipment Type:</b>            | Bluetooth classic                                                |                                     |
| <b>Bluetooth Version:</b>         | 5.2                                                              |                                     |
| <b>Modulation Type:</b>           | FHSS (GFSK(1Mbps), $\pi/4$ -DQPSK(EDR 2Mbps), 8-DPSK(EDR 3Mbps)) |                                     |
| <b>Operating Frequency Range:</b> | 2402MHz–2480MHz                                                  |                                     |
| <b>Antenna Type:</b>              | LDS Antenna                                                      |                                     |
| <b>Antenna Gain:</b>              | -4.5dBi                                                          |                                     |
| <b>Accessory Information:</b>     | Battery Cell (Headphones)                                        |                                     |
|                                   | <b>Brand Name:</b>                                               | N/A                                 |
|                                   | <b>Model No.:</b>                                                | ZJ1254H                             |
|                                   | <b>Serial No.:</b>                                               | N/A                                 |
|                                   | <b>Capacity:</b>                                                 | 70mAh                               |
|                                   | <b>Rated Voltage:</b>                                            | 3.85V                               |
|                                   | <b>Charge Limit:</b>                                             | 4.4V                                |
|                                   | <b>Manufacturer:</b>                                             | Chongqing VDL Electronics Co., Ltd. |



|                               |                              |                                        |
|-------------------------------|------------------------------|----------------------------------------|
| <b>Accessory Information:</b> | Battery Cell (Charging Case) |                                        |
|                               | Brand Name:                  | N/A                                    |
|                               | Model No.:                   | 10430                                  |
|                               | Serial No.:                  | N/A                                    |
|                               | Capacity:                    | 500mAh                                 |
|                               | Rated Voltage:               | 3.85V                                  |
|                               | Charge Limit:                | 4.4V                                   |
|                               | Manufacturer:                | Chongqing VDL Electronics Co., Ltd.    |
|                               | Charging Case                |                                        |
|                               | Brand Name:                  | audio-technica                         |
|                               | Model No.:                   | ATH-TWX9                               |
|                               | Serial No.:                  | N/A                                    |
|                               | Rated Output:                | 5V $\pm$ 0.1 $\times$ 2A               |
|                               | Rated Input:                 | 5V $\pm$ 1A                            |
|                               | Manufacturer:                | Audio-Technica Corporation             |
|                               | UCB Cable                    |                                        |
|                               | Model No.:                   | 158-07249-002-040                      |
|                               | Manufacturer:                | Shenzhen Comlink Electronics Co., Ltd. |

**Note 1:** We use the dedicated software to control the EUT continuous transmission.

**Note 2:** For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.



### 1.3. The Channel Number and Frequency

| Channel  | Frequency (MHz) | Channel   | Frequency (MHz) | Channel | Frequency (MHz) | Channel   | Frequency (MHz) |
|----------|-----------------|-----------|-----------------|---------|-----------------|-----------|-----------------|
| <b>0</b> | <b>2402</b>     | 20        | 2422            | 40      | 2442            | 60        | 2462            |
| 1        | 2403            | 21        | 2423            | 41      | 2443            | 61        | 2463            |
| 2        | 2404            | 22        | 2424            | 42      | 2444            | 62        | 2464            |
| 3        | 2405            | 23        | 2425            | 43      | 2445            | 63        | 2465            |
| 4        | 2406            | 24        | 2426            | 44      | 2446            | 64        | 2466            |
| 5        | 2407            | 25        | 2427            | 45      | 2447            | 65        | 2467            |
| 6        | 2408            | 26        | 2428            | 46      | 2448            | 66        | 2468            |
| 7        | 2409            | 27        | 2429            | 47      | 2449            | 67        | 2469            |
| 8        | 2410            | 28        | 2430            | 48      | 2450            | 68        | 2470            |
| 9        | 2411            | 29        | 2431            | 49      | 2451            | 69        | 2471            |
| 10       | 2412            | 30        | 2432            | 50      | 2452            | 70        | 2472            |
| 11       | 2413            | 31        | 2433            | 51      | 2453            | 71        | 2473            |
| 12       | 2414            | 32        | 2434            | 52      | 2454            | 72        | 2474            |
| 13       | 2415            | 33        | 2435            | 53      | 2455            | 73        | 2475            |
| 14       | 2416            | 34        | 2436            | 54      | 2456            | 74        | 2476            |
| 15       | 2417            | 35        | 2437            | 55      | 2457            | 75        | 2477            |
| 16       | 2418            | 36        | 2438            | 56      | 2458            | 76        | 2478            |
| 17       | 2419            | 37        | 2439            | 57      | 2459            | 77        | 2479            |
| 18       | 2420            | 38        | 2440            | 58      | 2460            | <b>78</b> | <b>2480</b>     |
| 19       | 2421            | <b>39</b> | <b>2441</b>     | 59      | 2461            |           |                 |

**Note 1:** The black bold channels were selected for test.



## 1.4. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C for the EUT FCC ID Certification:

| No. | Identity       | Document Title          |
|-----|----------------|-------------------------|
| 1   | 47 CFR Part 15 | Radio Frequency Devices |

Test detailed items/section required by FCC rules and results are as below:

| No. | Section                | Description                            | Test Date    | Test Engineer | Result               | Method Determination /Remark |
|-----|------------------------|----------------------------------------|--------------|---------------|----------------------|------------------------------|
| 1   | 15.203                 | Antenna Requirement                    | N/A          | N/A           | PASS                 | No deviation                 |
| 2   | 15.247(a)<br>15.247(h) | Hopping Mechanism                      | N/A          | N/A           | PASS                 | No deviation                 |
| 3   | 15.247(a)              | Number of Hopping Frequency            | Jul 30, 2021 | Meng Shurui   | PASS                 | No deviation                 |
| 4   | ANSI C63.10            | Duty Cycle                             | Jul 30, 2021 | Meng Shurui   | PASS                 | No deviation                 |
| 5   | 15.247(b)              | Maximum Peak Conducted Output Power    | Jul 30, 2021 | Meng Shurui   | PASS                 | No deviation                 |
| 6   | 15.247(b)              | Maximum Average Conducted Output Power | Jul 27, 2021 | Meng Shurui   | PASS                 | No deviation                 |
| 7   | 15.247(a)              | 20dB Bandwidth                         | Jul 30, 2021 | Meng Shurui   | PASS                 | No deviation                 |
| 8   | 15.247(a)              | Carrier Frequency Separation           | Jul 30, 2021 | Meng Shurui   | PASS                 | No deviation                 |
| 9   | 15.247(a)              | Time of Occupancy (Dwell time)         | Jul 30, 2021 | Meng Shurui   | PASS                 | No deviation                 |
| 10  | 15.247(d)              | Conducted Spurious Emission            | Jul 30, 2021 | Meng Shurui   | PASS                 | No deviation                 |
| 11  | 15.207                 | Conducted Emission                     | N/A          | N/A           | N/A <sub>Note1</sub> | N/A                          |
| 12  | 15.247(d)              | Restricted Frequency Bands             | Aug 09, 2021 | Huang Zhiye   | PASS                 | No deviation                 |
| 13  | 15.209,<br>15.247(d)   | Radiated Emission                      | Aug 07, 2021 | Huang Zhiye   | PASS                 | No deviation                 |



**Note 1:** Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines.

**Note 2:** The tests were performed according to the method of measurements prescribed in ANSI C63.10-2013, KDB558074 D01 v05r02 and DA 00-075.

**Note 3:** The path loss during the RF test is calibrated to correct the results by the offset setting in the test equipments. The Ref offset 1.5dB means the cable loss is 1.5dB.

**Note 4:** Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table.

**Note 5:** When the test result is a critical value, we will use the measurement uncertainty give the judgment result based on the 95% confidence intervals.

## 1.5. Environmental Conditions

During the measurement, the environmental conditions were within the listed ranges:

|                             |        |
|-----------------------------|--------|
| Temperature (°C):           | 15-35  |
| Relative Humidity (%):      | 30-60  |
| Atmospheric Pressure (kPa): | 86-106 |



## 2.47 CFR Part 15C Requirements

### 2.1. Antenna Requirement

#### 2.1.1. Applicable Standard

According to FCC 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

#### 2.1.2. Test Result: Compliant

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

### 2.2. Hopping Mechanism

#### 2.2.1. Requirement

According to FCC §15.247(a)(1), a frequency hopping spread spectrum system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

According to FCC §15.247(h), the incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

#### 2.2.2. Result: Compliant

The hopping mechanism of the EUT is in compliance with the document "**Bluetooth core specification v5.1**".

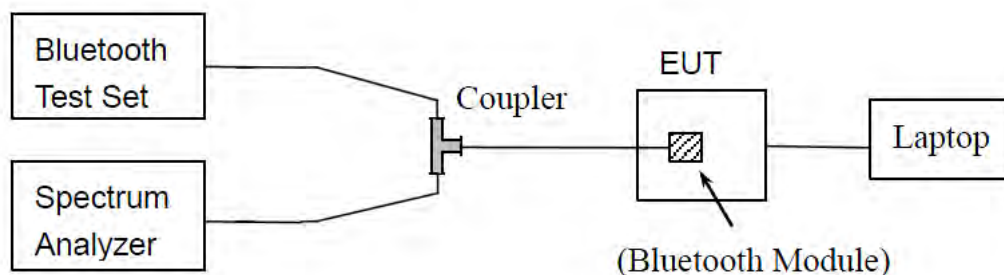
## 2.3. Number of Hopping Frequency

### 2.3.1. Requirement

According to FCC §15.247(a)(1)(iii), frequency hopping systems operating in the 2400MHz to 2483.5MHz bands shall use at least 15 hopping frequencies.

### 2.3.2. Test Description

#### Test Setup:



The Bluetooth Module of the EUT is coupled to the Spectrum Analyzer (SA) and the Bluetooth Test Set through the coupler; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

### 2.3.3. Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = the frequency band of operation

RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize



## 2.3.4. Test Result

### A. Test Verdict:

| Test Mode      | Frequency Block (MHz) | Measured Channel Numbers | Min. Limit | Verdict |
|----------------|-----------------------|--------------------------|------------|---------|
| GFSK           | 2400 - 2483.5         | 79                       | 15         | PASS    |
| $\pi/4$ -DQPSK | 2400 - 2483.5         | 79                       | 15         | PASS    |
| 8-DPSK         | 2400 - 2483.5         | 79                       | 15         | PASS    |

### B. Test Plot:



(GFSK)



( $\pi/4$ -DQPSK)



(8-DPSK)

## 2.4. Duty Cycle of Test Signal

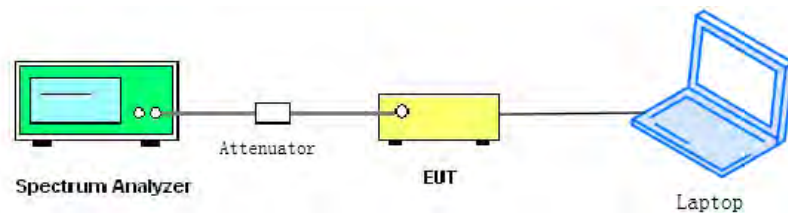
### 2.4.1. Requirement

Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be used to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration (T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can then be used if the measurement/sweep time of the analyzer can be set such that it does not exceed T at any time that data are being acquired (i.e., no transmitter OFF-time is to be considered).

When continuous transmission cannot be achieved and sweep triggering/signal gating cannot be implemented, alternative procedures are provided that can be used to measure the average power; however, they will require an additional measurement of the transmitter duty cycle (D). Within this sub clause, the duty cycle refers to the fraction of time over which the transmitter is ON and is transmitting at its maximum power control level. The duty cycle is considered to be constant if variations are less than  $\pm 2\%$ ; otherwise, the duty cycle is considered to be nonconstant.

### 2.4.2. Test Description

#### Test Setup:



ANSI C63.10 2013 Clause 11.6 was used in order to prove compliance.

### 2.4.3. Test Result

| Test Mode      | Duty Cycle (%)<br>(D) | Duty Factor<br>( $10 \cdot \lg[1/D]$ ) |
|----------------|-----------------------|----------------------------------------|
| GFSK           | 77.33                 | 1.12                                   |
| $\pi/4$ -DQPSK | 76.80                 | 1.15                                   |
| 8-DPSK         | 76.80                 | 1.15                                   |

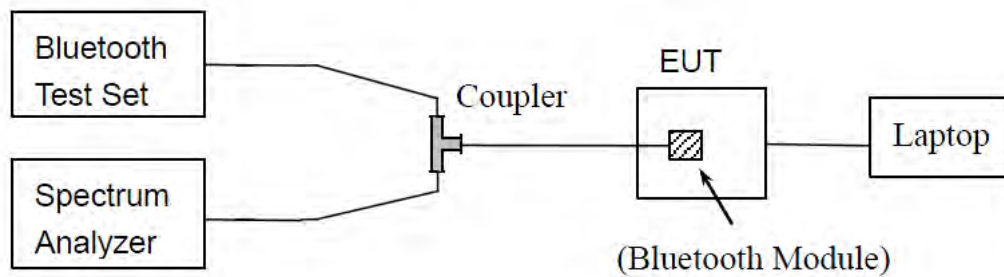
## 2.5. Maximum Peak Conducted Output Power

### 2.5.1. Requirement

According to FCC §15.247(b)(1), for frequency hopping systems that operates in the 2400MHz to 2483.5MHz band employing at least 75 hopping channels, the maximum peak output power of the intentional radiator shall not exceed 1Watt. For all other frequency hopping systems in the 2400MHz to 2483.5MHz band, it is 0.125Watts.

### 2.5.2. Test Description

#### Test Setup:



The Bluetooth Module of the EUT is coupled to the Spectrum Analyzer (SA) and the Bluetooth Test Set through the coupler; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.



### 2.5.3. Test Result

#### GFSK Mode

##### A. Test Verdict:

| Channel | Frequency (MHz) | Measured Output Peak Power |       | Limit |       | Verdict |
|---------|-----------------|----------------------------|-------|-------|-------|---------|
|         |                 | dBm                        | W     | dBm   | W     |         |
| 0       | 2402            | 7.89                       | 0.006 | 20.96 | 0.125 | PASS    |
| 39      | 2441            | 8.09                       | 0.006 |       |       | PASS    |
| 78      | 2480            | 8.28                       | 0.007 |       |       | PASS    |

##### B. Test Plot:



(Channel 0, GFSK)



(Channel 39, GFSK)



(Channel 78, GFSK)



$\pi/4$ -DQPSK Mode

A. Test Verdict:

| Channel | Frequency<br>(MHz) | Measured Output Peak Power |       | Limit |       | Verdict |
|---------|--------------------|----------------------------|-------|-------|-------|---------|
|         |                    | dBm                        | W     | dBm   | W     |         |
| 0       | 2402               | 7.37                       | 0.005 | 20.96 | 0.125 | PASS    |
| 39      | 2441               | 7.58                       | 0.006 |       |       | PASS    |
| 78      | 2480               | 7.80                       | 0.006 |       |       | PASS    |

B. Test Plot:



(Channel 0,  $\pi/4$ -DQPSK)

(Channel 39,  $\pi/4$ -DQPSK)(Channel 78,  $\pi/4$ -DQPSK)

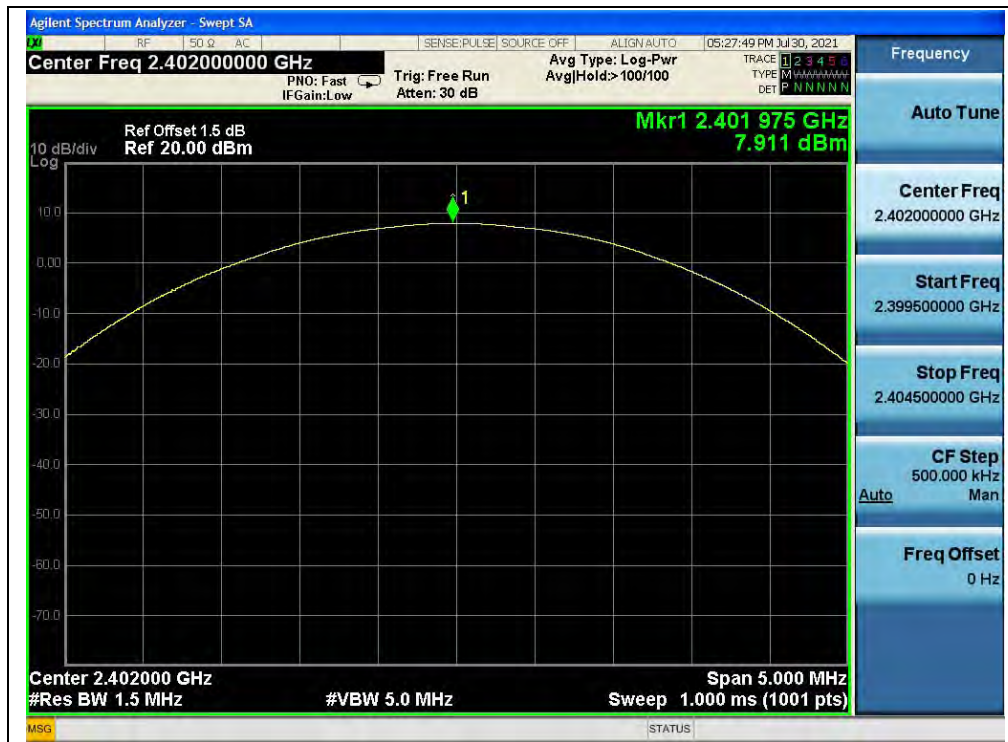


## 8-DPSK Mode

### A. Test Verdict:

| Channel | Frequency<br>(MHz) | Measured Output Peak Power |              | Limit |       | Verdict |
|---------|--------------------|----------------------------|--------------|-------|-------|---------|
|         |                    | dBm                        | W            | dBm   | W     |         |
| 0       | 2402               | 7.91                       | 0.006        | 20.96 | 0.125 | PASS    |
| 39      | 2441               | 8.11                       | 0.006        |       |       | PASS    |
| 78      | 2480               | <b>8.35</b>                | <b>0.007</b> |       |       | PASS    |

### B. Test Plot:



(Channel 0, 8-DPSK)



(Channel 39, 8-DPSK)



(Channel 78, 8-DPSK)

## 2.6. Maximum Average Conducted Output Power

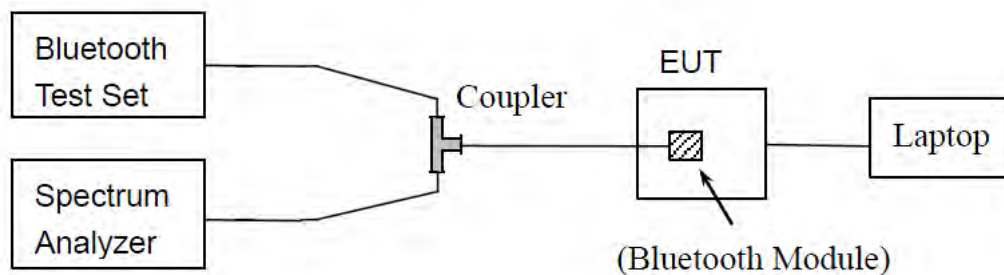
### 2.6.1. Requirement

According to FCC §15.247(b), for frequency hopping systems that operates in the 2400MHz to 2483.5MHz band employing at least 75 hopping channels, the maximum average output power of the intentional radiator shall not exceed 1Watt. For all other frequency hopping systems in the 2400MHz to 2483.5MHz band, it is 0.125Watts.

### 2.6.2. Test Description

The measured output power was calculated by the reading of the USB Wideband Power Sensor and calibration.

#### Test Setup:



The Bluetooth Module of the EUT is coupled to the Spectrum Analyzer (SA) and the Bluetooth Test Set through the coupler; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.



### 2.6.3. Test Result

#### GFSK Mode

| Channel | Frequency<br>(MHz) | Measured | Average Power  |                        |              | Limit |       | Verdict |
|---------|--------------------|----------|----------------|------------------------|--------------|-------|-------|---------|
|         |                    |          | Duty<br>Factor | Duty Factor Calculated |              |       |       |         |
|         |                    | dBm      |                | dBm                    | W            | dBm   | W     |         |
| 0       | 2402               | 6.49     | 1.12           | 7.61                   | 0.006        | 20.96 | 0.125 | PASS    |
| 39      | 2441               | 6.83     |                | <b>7.95</b>            | <b>0.006</b> |       |       | PASS    |
| 78      | 2480               | 6.81     |                | 7.93                   | 0.006        |       |       | PASS    |

#### $\pi/4$ -DQPSK Mode

| Channel | Frequency<br>(MHz) | Measured | Average Power  |                        |       | Limit |       | Verdict |
|---------|--------------------|----------|----------------|------------------------|-------|-------|-------|---------|
|         |                    | dBm      | Duty<br>Factor | Duty Factor Calculated |       |       |       |         |
|         |                    |          |                |                        | dBm   | W     | dBm   |         |
| 0       | 2402               | 3.86     | 1.15           | 5.01                   | 0.003 | 20.96 | 0.125 | PASS    |
| 39      | 2441               | 4.07     |                | 5.22                   | 0.003 |       |       | PASS    |
| 78      | 2480               | 3.68     |                | 4.83                   | 0.003 |       |       | PASS    |

#### 8-DPSK Mode

| Channel | Frequency<br>(MHz) | Measured | Average Power  |                        |       | Limit |       | Verdict |
|---------|--------------------|----------|----------------|------------------------|-------|-------|-------|---------|
|         |                    | dBm      | Duty<br>Factor | Duty Factor Calculated |       |       |       |         |
|         |                    |          |                |                        |       | dBm   | W     |         |
| 0       | 2402               | 3.75     | 1.15           | 4.90                   | 0.003 | 20.96 | 0.125 | PASS    |
| 39      | 2441               | 4.06     |                | 5.21                   | 0.003 |       |       | PASS    |
| 78      | 2480               | 3.71     |                | 4.86                   | 0.003 |       |       | PASS    |

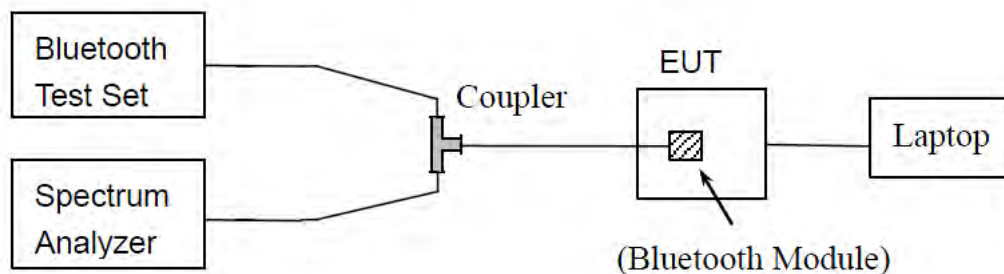
## 2.7. 20 dB Bandwidth

### 2.7.1. Definition

According to FCC §15.247(a)(1), the 20 dB bandwidth is known as the 99% emission bandwidth, or 20 dB bandwidth ( $10 \cdot \log 1\% = 20$  dB) taking the total RF output power.

### 2.7.2. Test Description

#### Test Setup:



The Bluetooth Module of the EUT is coupled to the Spectrum Analyzer (SA) and the Bluetooth Test Set through the coupler; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

### 2.7.3. Test Procedure

Use the following spectrum analyzer settings:

Span = between 2 to 5 times the OBW, centered on the test channel

RBW= 1% to 5% of the OBW

VBW  $\geq 3 \times$  RBW

Sweep = auto

Detector function = peak

Trace = max hold



## 2.7.4. Test Result

### GFSK Mode

#### A. Test Verdict:

| Channel | Frequency (MHz) | 20 dB Bandwidth (MHz) | Result |
|---------|-----------------|-----------------------|--------|
| 0       | 2402            | 0.956                 | PASS   |
| 39      | 2441            | 0.954                 | PASS   |
| 78      | 2480            | 0.955                 | PASS   |

#### B. Test Plot:



(Channel 0, GFSK)



(Channel 39, GFSK)



(Channel 78, GFSK)



$\pi/4$ -DQPSK Mode

**A. Test Verdict:**

| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) | Result |
|---------|-----------------|----------------------|--------|
| 0       | 2402            | 1.335                | PASS   |
| 39      | 2441            | 1.328                | PASS   |
| 78      | 2480            | 1.325                | PASS   |

**B. Test Plot:**



(Channel 0,  $\pi/4$ -DQPSK)

(Channel 39,  $\pi/4$ -DQPSK)(Channel 78,  $\pi/4$ -DQPSK)



## 8-DPSK Mode

### A. Test Verdict:

| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) | Result |
|---------|-----------------|----------------------|--------|
| 0       | 2402            | 1.305                | PASS   |
| 39      | 2441            | 1.302                | PASS   |
| 78      | 2480            | 1.302                | PASS   |

### B. Test Plot:



(Channel 0, 8-DPSK)



(Channel 39, 8-DPSK)



(Channel 78, 8-DPSK)

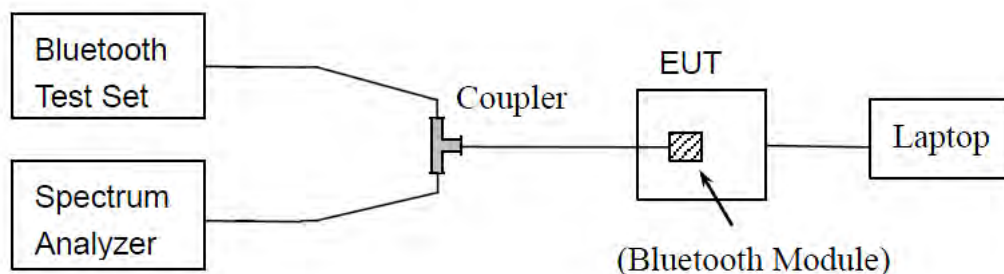
## 2.8. Carried Frequency Separation

### 2.8.1. Definition

According to FCC §15.247(a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

### 2.8.2. Test Description

#### Test Setup:



The Bluetooth Module of the EUT is coupled to the Spectrum Analyzer (SA) and the Bluetooth Test Set through the coupler; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

### 2.8.3. Test Procedure

The EUT must have its hopping function enabled. According to DA 00-705, use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW)  $\geq 1\%$  of the span

Video (or Average) Bandwidth (VBW)  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.



## 2.8.4. Test Result

### A. Test Verdict:

| Test Mode      | Measured Channel Numbers | Carried Frequency Separation (MHz) | 20 dB Bandwidth (MHz) | Min. Limit                       | Verdict |
|----------------|--------------------------|------------------------------------|-----------------------|----------------------------------|---------|
| GFSK           | 39 and 40                | 1.020                              | 0.956                 | two-thirds of the 20dB bandwidth | PASS    |
| $\pi/4$ -DQPSK | 39 and 40                | 1.002                              | 1.335                 |                                  | PASS    |
| 8-DPSK         | 39 and 40                | 1.011                              | 1.305                 |                                  | PASS    |

### B. Test Plot:



(GFSK)

 $(\pi/4\text{-DQPSK})$  $(8\text{-DPSK})$

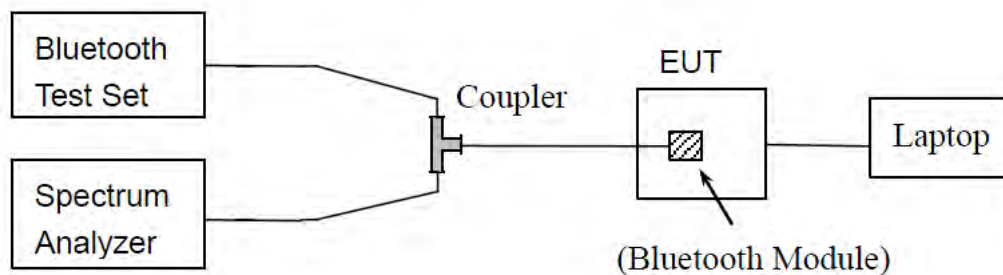
## 2.9. Time of Occupancy (Dwell time)

### 2.9.1. Requirement

According to FCC §15.247(a) (1) (iii), frequency hopping systems in the 2400 - 2483.5MHz band shall use at least 15 non-overlapping 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.

### 2.9.2. Test Description

#### Test Setup:



The Bluetooth Module of the EUT is coupled to the Spectrum Analyzer (SA) and the Bluetooth Test Set through the coupler; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

### 2.9.3. Test Procedure

#### Normal Mode:

DH1: Dwell time equal to Pulse time (ms) \* (1600 / 2 / 79) \* 31.6 Millisecond  
DH3: Dwell time equal to Pulse time (ms) \* (1600 / 4 / 79) \* 31.6 Millisecond  
DH5: Dwell time equal to Pulse Time (ms) \* (1600 / 6 / 79) \* 31.6 Millisecond

#### AFH Mode:

DH1: Dwell time equal to Pulse time (ms) \* (800 / 2 / 20) \* (0.4 \* 20) Millisecond  
DH3: Dwell time equal to Pulse time (ms) \* (800 / 4 / 20) \* (0.4 \* 20) Millisecond  
DH5: Dwell time equal to Pulse Time (ms) \* (800 / 6 / 20) \* (0.4 \* 20) Millisecond.



## 2.9.4. Test Result

### GFSK Mode

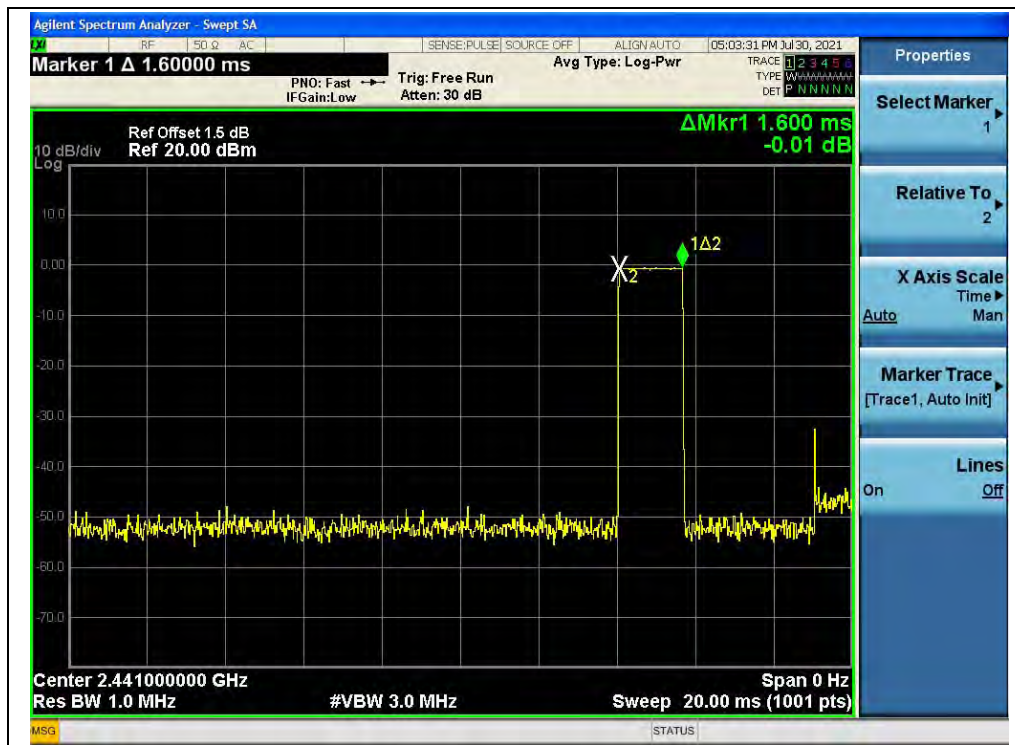
#### A. Test Verdict:

| DH Packet | Pulse Width (ms) | Dwell Time (ms) |          | Limit (sec) | Verdict |
|-----------|------------------|-----------------|----------|-------------|---------|
|           |                  | Normal Mode     | AFH Mode |             |         |
| DH1       | 0.37             | 118.40          | 59.20    | 0.4         | PASS    |
| DH3       | 1.60             | 256.00          | 128.00   |             | PASS    |
| DH5       | 2.88             | 307.20          | 153.60   |             | PASS    |

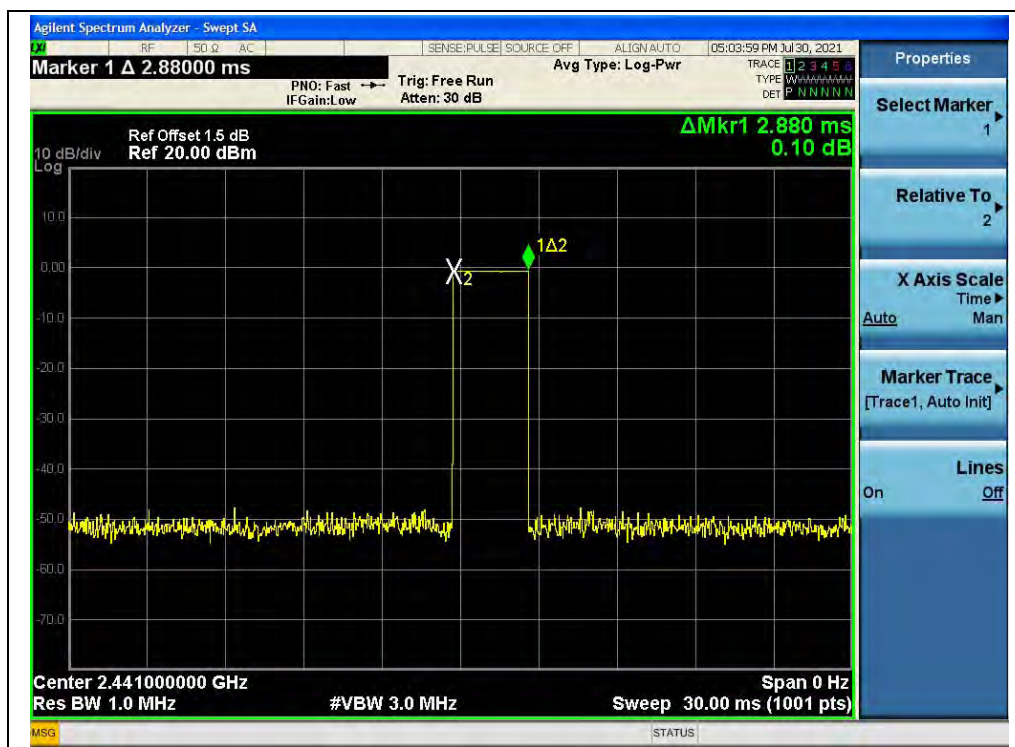
#### B. Test Plot:



(DH1, GFSK)



(DH3, GFSK)



(DH5, GFSK)

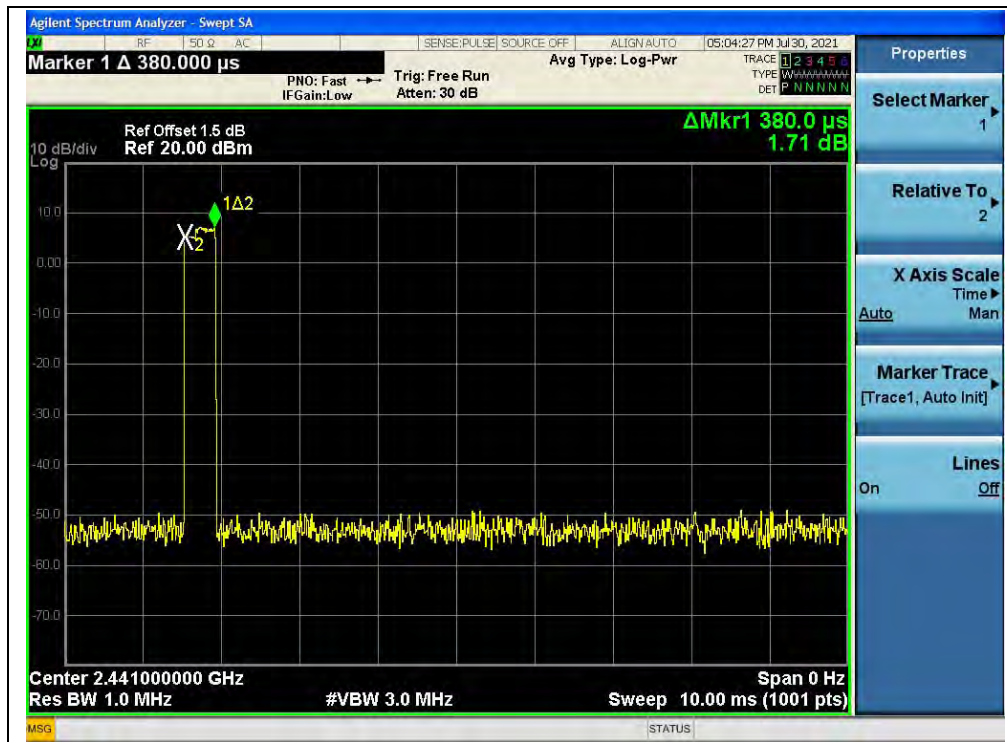


$\pi/4$ -DQPSK Mode

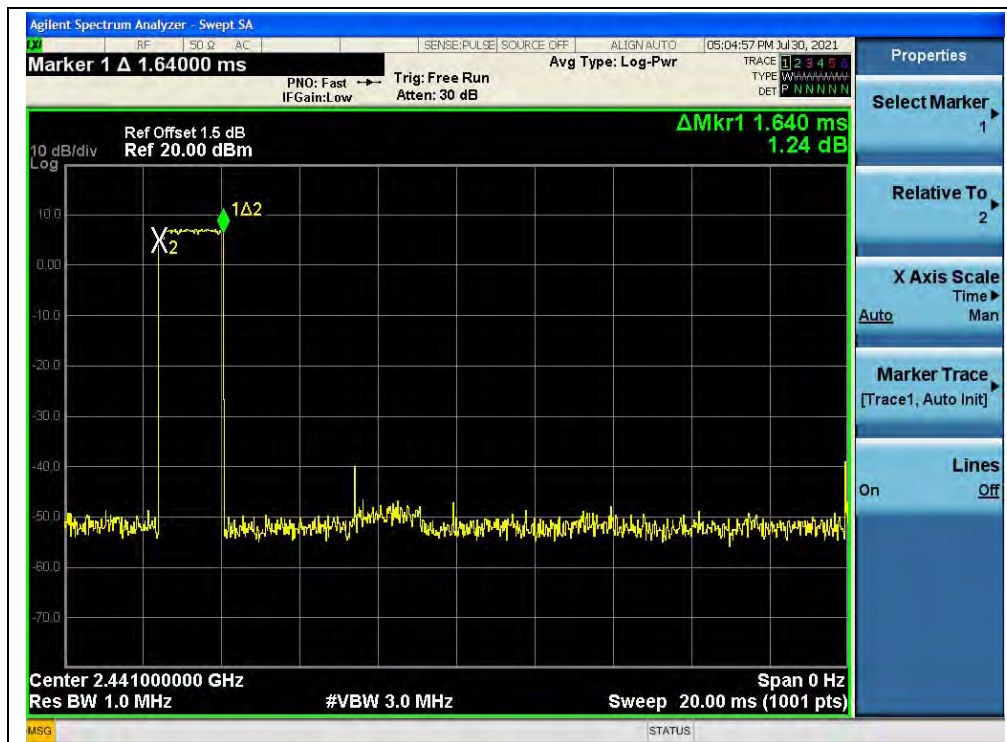
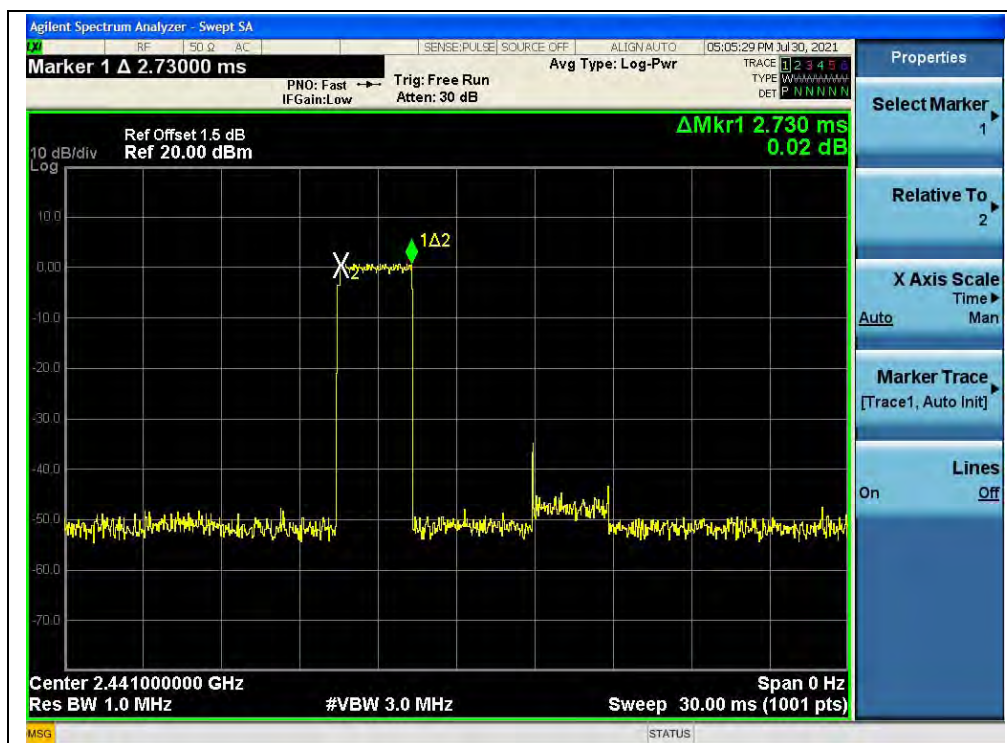
A. Test Verdict:

| DH Packet | Pulse Width (ms) | Dwell Time (ms) |          | Limit (sec) | Verdict |
|-----------|------------------|-----------------|----------|-------------|---------|
|           |                  | Normal Mode     | AFH Mode |             |         |
| DH1       | 0.38             | 121.60          | 60.80    | 0.4         | PASS    |
| DH3       | 1.64             | 262.40          | 131.20   |             | PASS    |
| DH5       | 2.73             | 291.20          | 145.60   |             | PASS    |

B. Test Plot:



(DH1,  $\pi/4$ -DQPSK)


(DH3,  $\pi/4$ -DQPSK)

(DH5,  $\pi/4$ -DQPSK)

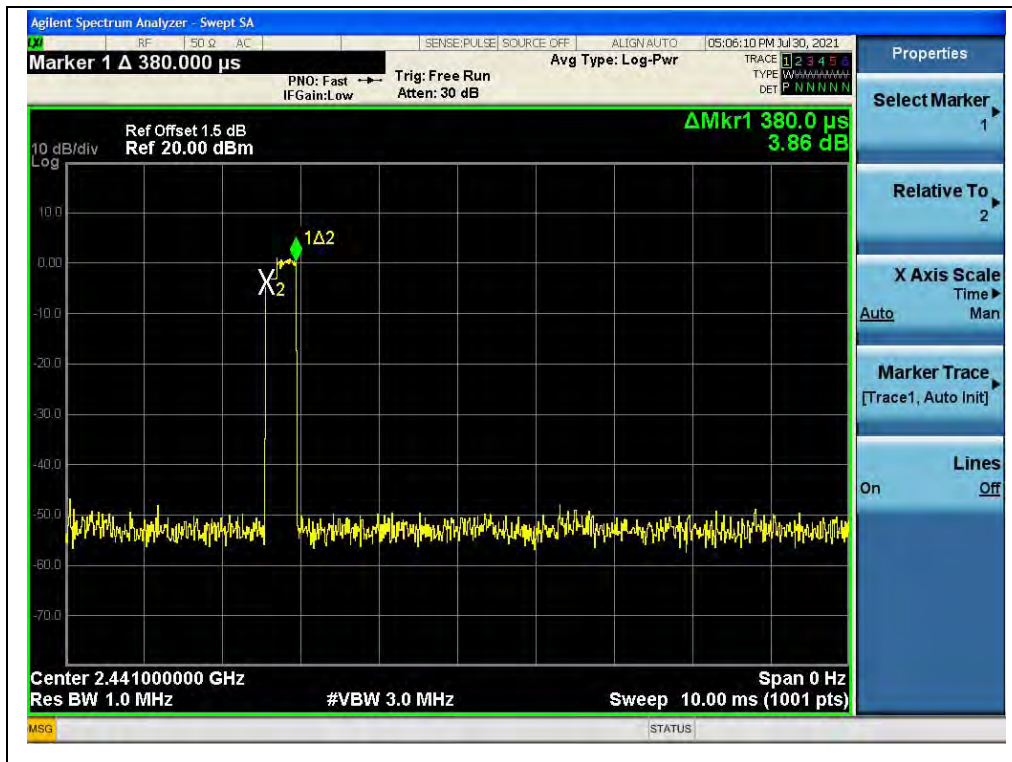


## 8-DPSK mode

### A. Test Verdict:

| DH Packet | Pulse Width (ms) | Dwell Time (ms) |          | Limit (sec) | Verdict |
|-----------|------------------|-----------------|----------|-------------|---------|
|           |                  | Normal Mode     | AFH Mode |             |         |
| DH1       | 0.38             | 121.60          | 60.80    | 0.4         | PASS    |
| DH3       | 1.60             | 256.00          | 128.00   |             | PASS    |
| DH5       | 2.73             | 291.20          | 145.60   |             | PASS    |

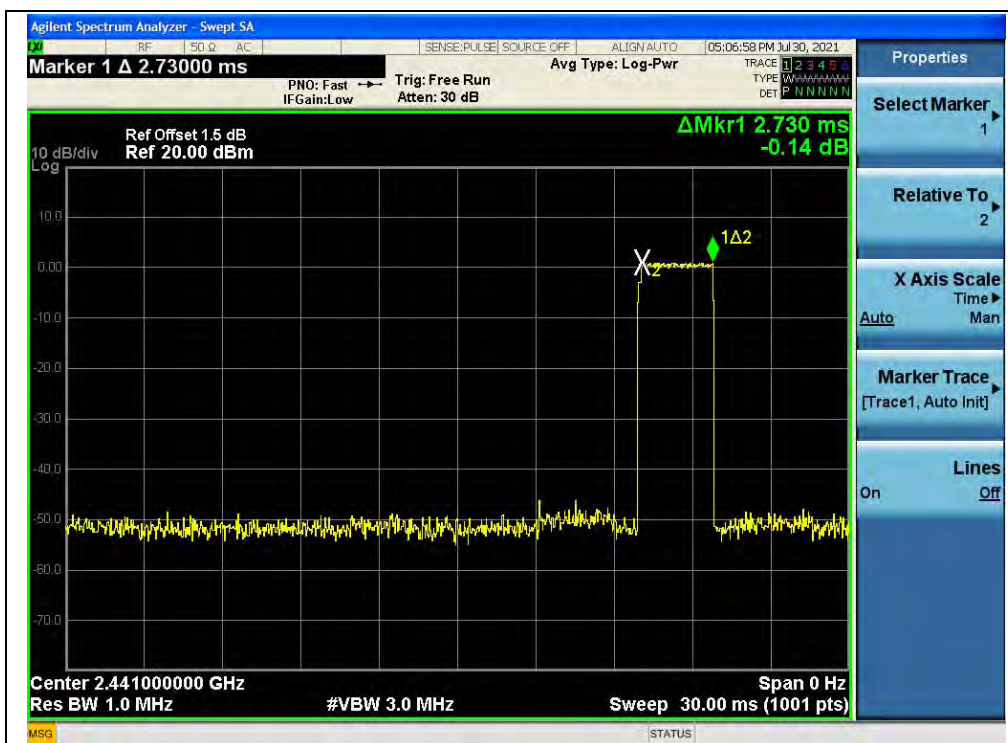
### B. Test Plot:



(DH1, 8-DPSK)



(DH3, 8-DPSK)



(DH5, 8-DPSK)

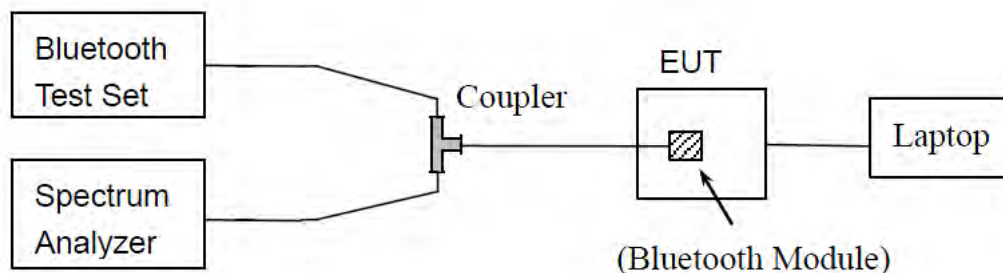
## 2.10. Conducted Spurious Emissions

### 2.10.1. Requirement

According to FCC §15.247(d), in any 100kHz 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 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

### 2.10.2. Test Description

#### Test Setup:



The Bluetooth Module of the EUT is coupled to the Spectrum Analyzer (SA) and the Bluetooth Test Set through the coupler; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

### 2.10.3. Test Procedure

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize.



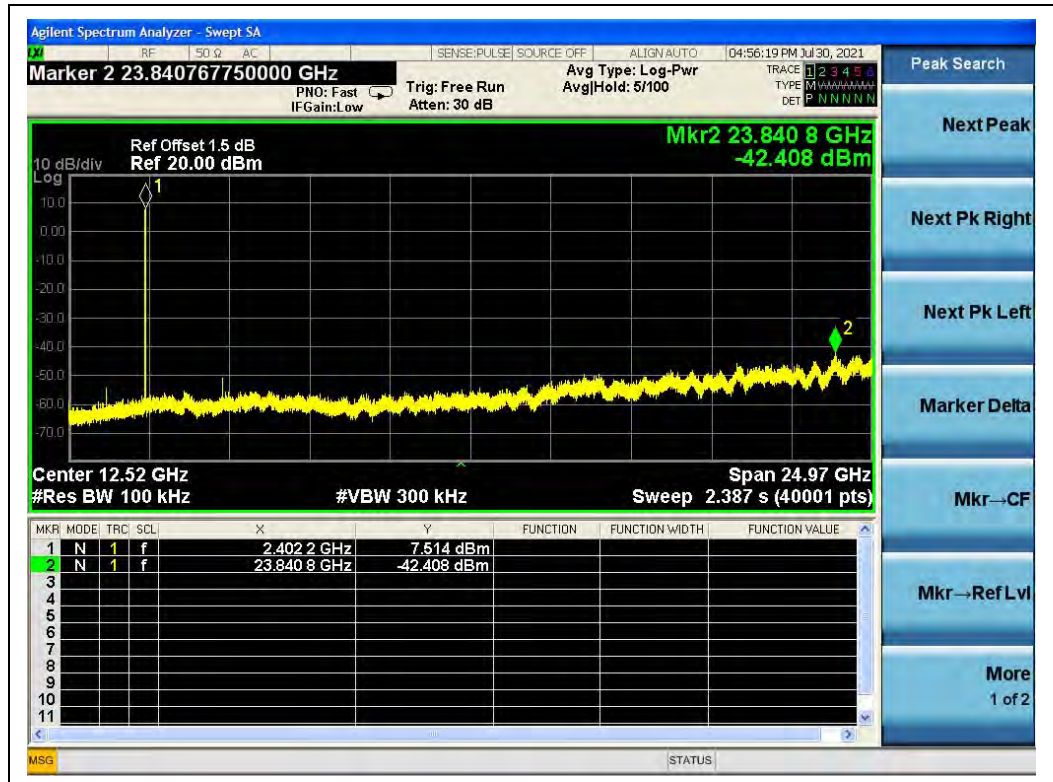
## 2.10.4. Test Result

### GFSK Mode

#### A. Test Verdict:

| Channel | Frequency (MHz) | Measured Max. Out of Band Emission (dBm) | Limit (dBm)   |                         | Verdict |
|---------|-----------------|------------------------------------------|---------------|-------------------------|---------|
|         |                 |                                          | Carrier Level | Calculated -20dBc Limit |         |
| 0       | 2402            | -42.41                                   | 7.51          | -12.49                  | PASS    |
| 39      | 2441            | -41.56                                   | 7.58          | -12.42                  | PASS    |
| 78      | 2480            | -43.06                                   | 7.98          | -12.02                  | PASS    |

#### B. Test Plot:



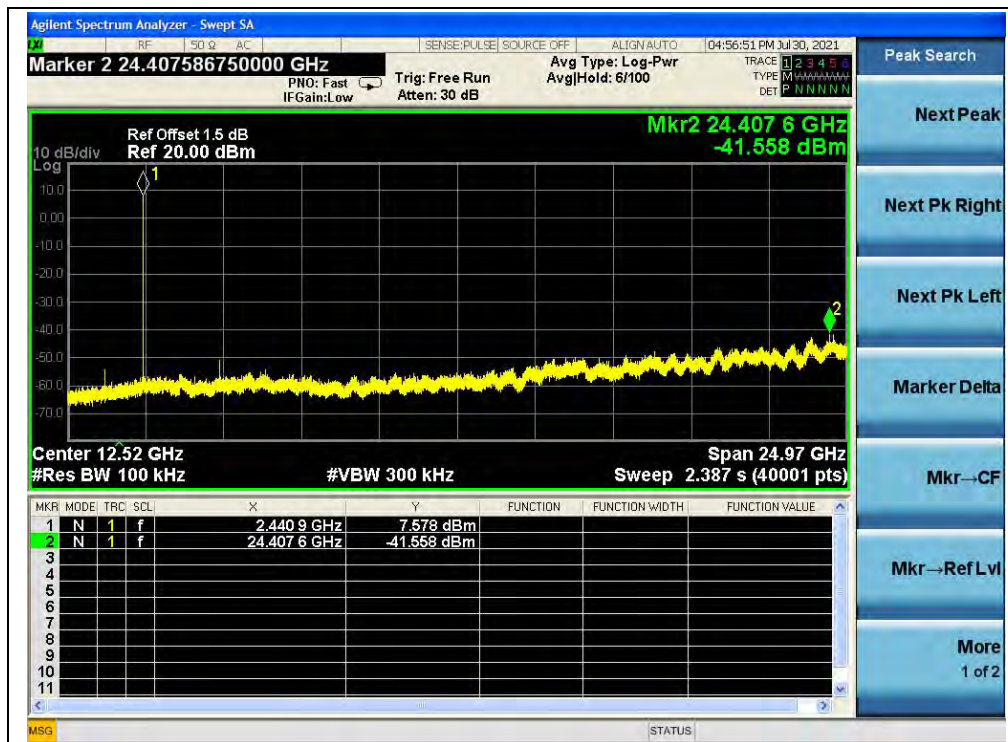
(30MHz to 25GHz, Channel 0, GFSK)



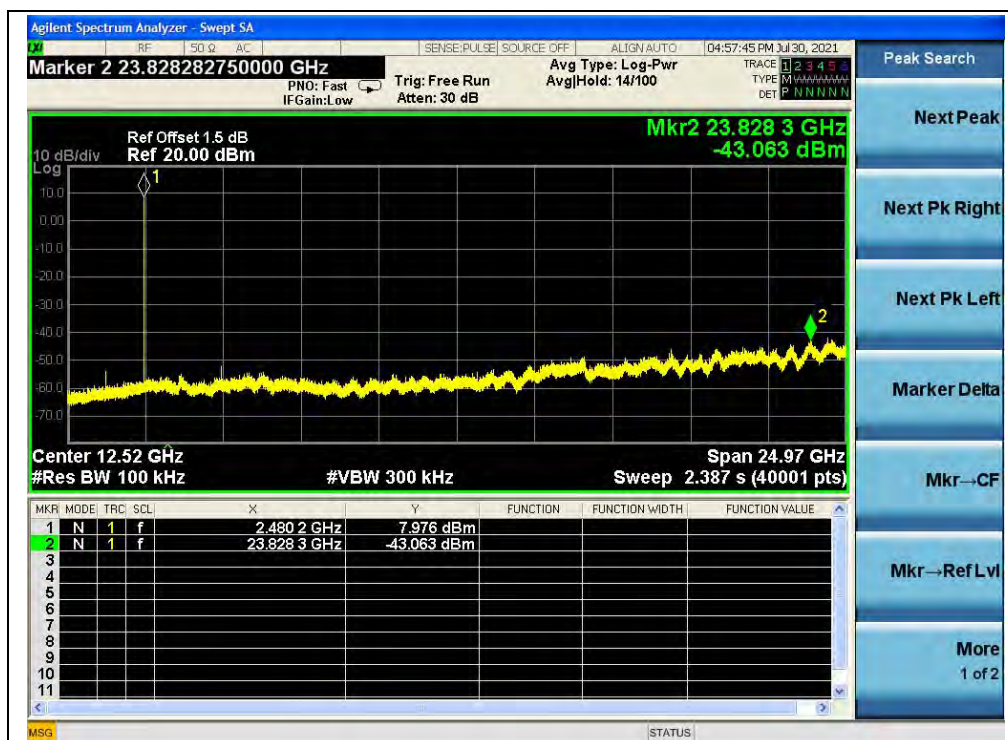
(Band edge, Channel 0, GFSK)



(Band edge with hopping on, Channel 0, GFSK)



(30MHz to 25GHz, Channel 39, GFSK)



(30MHz to 25GHz, Channel 78, GFSK)



(Band edge, Channel 78, GFSK)



(Band edge with hopping on, Channel 78, GFSK)

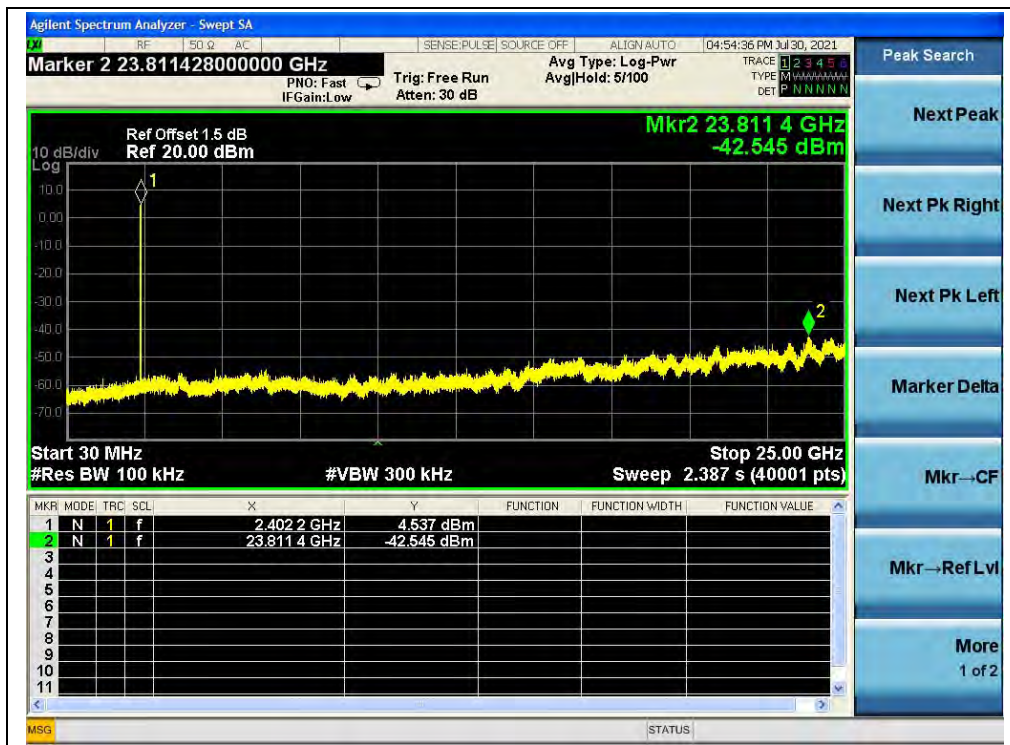


$\pi/4$ -DQPSK Mode

A. Test Verdict:

| Channel | Frequency (MHz) | Measured Max. Out of Band Emission (dBm) | Limit (dBm)   |                         | Verdict |
|---------|-----------------|------------------------------------------|---------------|-------------------------|---------|
|         |                 |                                          | Carrier Level | Calculated -20dBc Limit |         |
| 0       | 2402            | -42.55                                   | 4.54          | -15.46                  | PASS    |
| 39      | 2441            | -42.04                                   | 1.54          | -18.46                  | PASS    |
| 78      | 2480            | -43.20                                   | 2.60          | -17.40                  | PASS    |

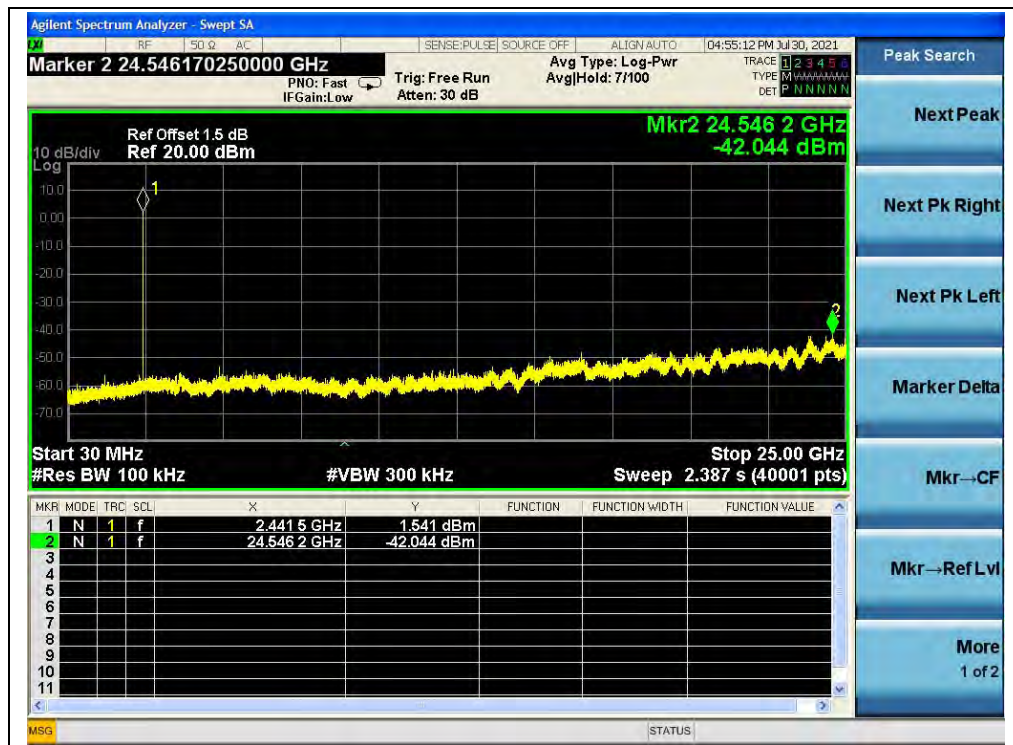
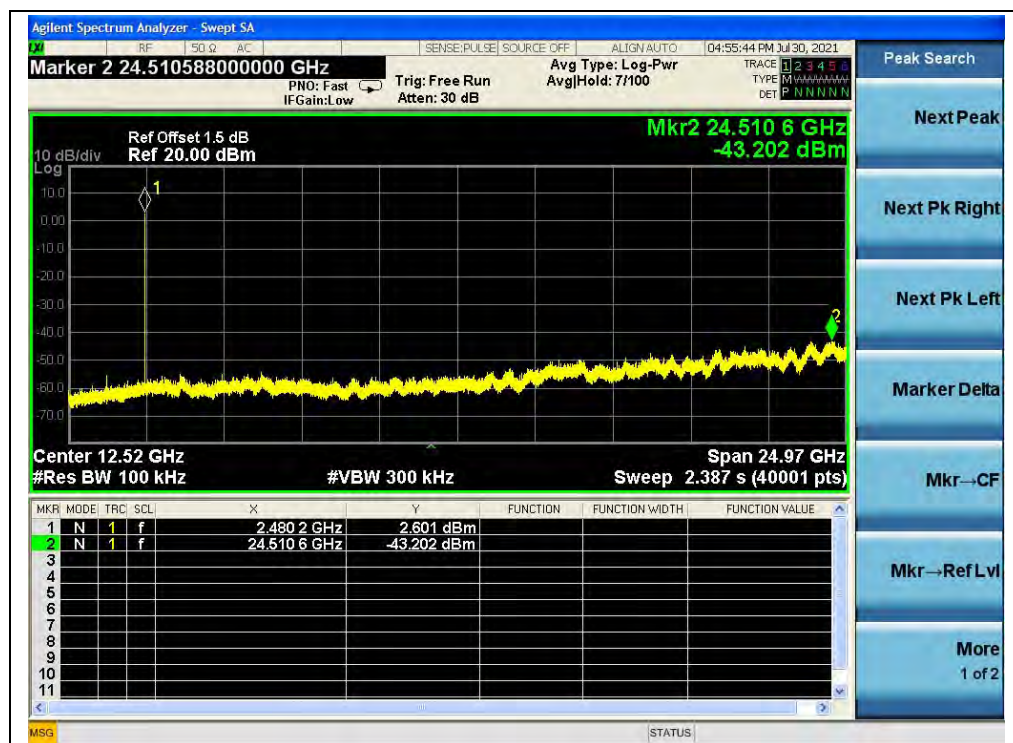
B. Test Plot:



(30MHz to 25GHz, Channel 0,  $\pi/4$ -DQPSK)


(Band edge, Channel 0,  $\pi/4$ -DQPSK)

(Band edge with hopping on, Channel 0,  $\pi/4$ -DQPSK)

(30MHz to 25GHz, Channel 39,  $\pi/4$ -DQPSK)(30MHz to 25GHz, Channel 78,  $\pi/4$ -DQPSK)


(Band edge, Channel 78,  $\pi/4$ -DQPSK)

(Band edge with hopping on, Channel 78,  $\pi/4$ -DQPSK)

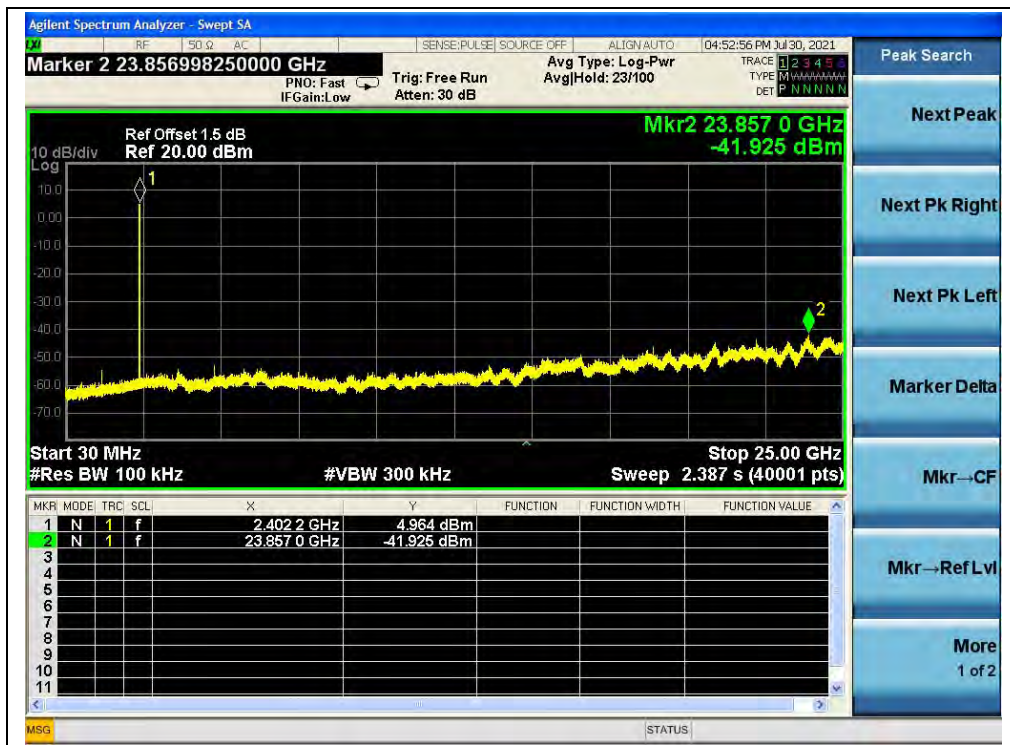


## 8-DPSK Mode

### A. Test Verdict:

| Channel | Frequency (MHz) | Measured Max. Out of Band Emission (dBm) | Limit (dBm)   |                         | Verdict |
|---------|-----------------|------------------------------------------|---------------|-------------------------|---------|
|         |                 |                                          | Carrier Level | Calculated -20dBc Limit |         |
| 0       | 2402            | -41.93                                   | 4.96          | -15.04                  | PASS    |
| 39      | 2441            | -42.56                                   | 4.52          | -15.48                  | PASS    |
| 78      | 2480            | -41.35                                   | 3.44          | -16.56                  | PASS    |

### B. Test Plot:



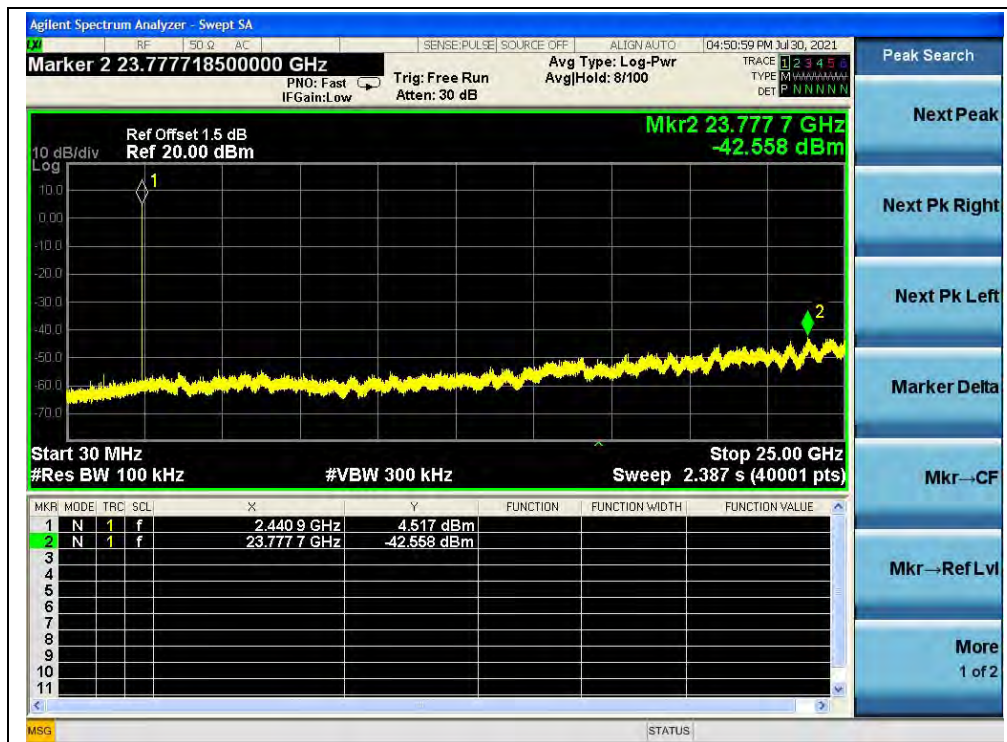
(30MHz to 25GHz, Channel 0, 8-DPSK)



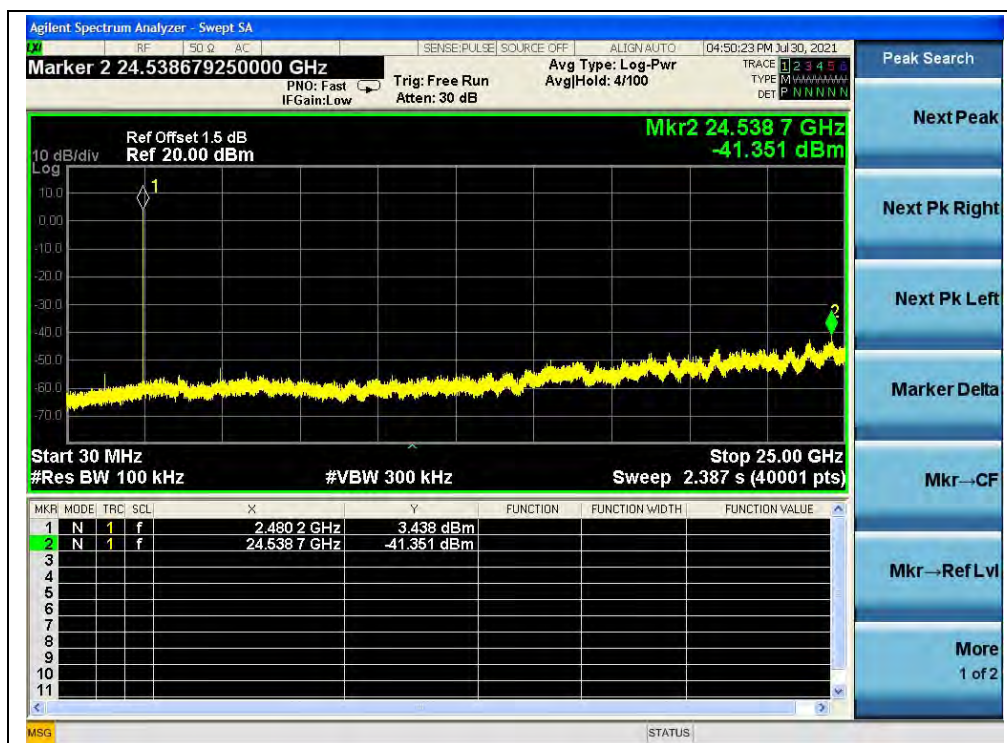
(Band edge, Channel 0, 8-DPSK)



(Band edge with hopping on, Channel 0, 8-DPSK)



(30MHz to 25GHz, Channel 39, 8-DPSK)



(30MHz to 25GHz, Channel 78, 8-DPSK)



(Band edge, Channel 78, 8-DPSK)



(Band edge with hopping on, Channel 78, 8-DPSK)

## 2.11. Conducted Emission

### 2.11.1. Requirement

According to FCC section 15.207, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50 $\mu$ H/50 $\Omega$  line impedance stabilization network (LISN).

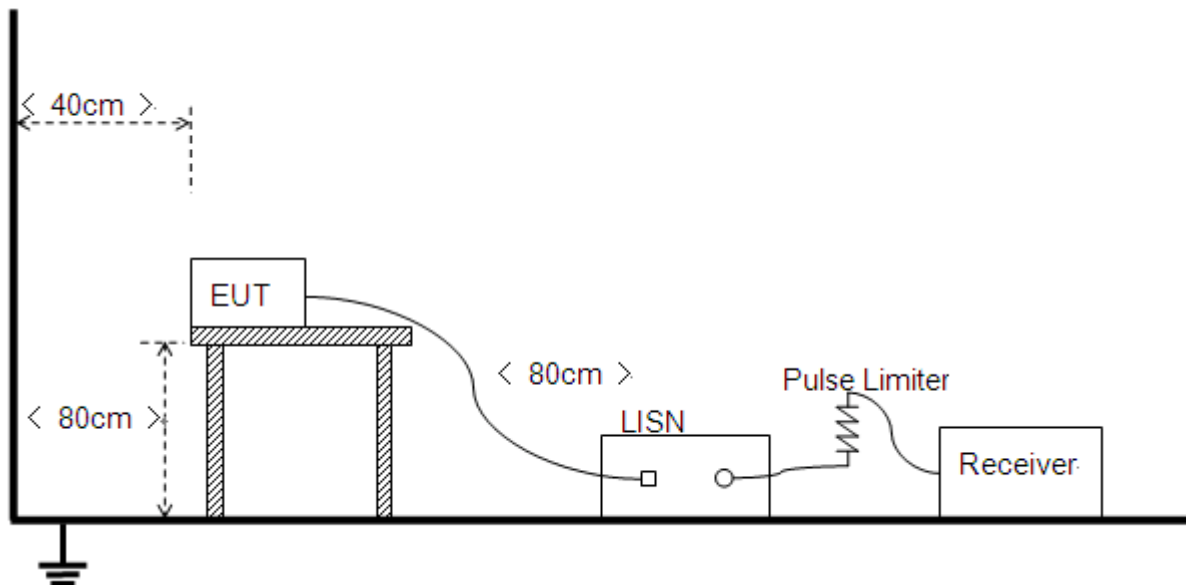
| Frequency Range (MHz) | Conducted Limit (dB $\mu$ V) |          |
|-----------------------|------------------------------|----------|
|                       | Quai-peak                    | Average  |
| 0.15 - 0.50           | 66 to 56                     | 56 to 46 |
| 0.50 - 5              | 56                           | 46       |
| 5- 30                 | 60                           | 50       |

**Note:**

- (a) The lower limit shall apply at the band edges.
- (b) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

### 2.11.2. Test Description

**Test Setup:**



The Table-top EUT was placed upon a non-metallic table 0.8m above the horizontal metal reference ground plane. EUT was connected to LISN and LISN was connected to reference Ground Plane. EUT was 80cm from LISN. The set-up and test methods were according to ANSI C63.10: 2013.



### 2.11.3. Test Result

This test case does not apply this kind of EUT.

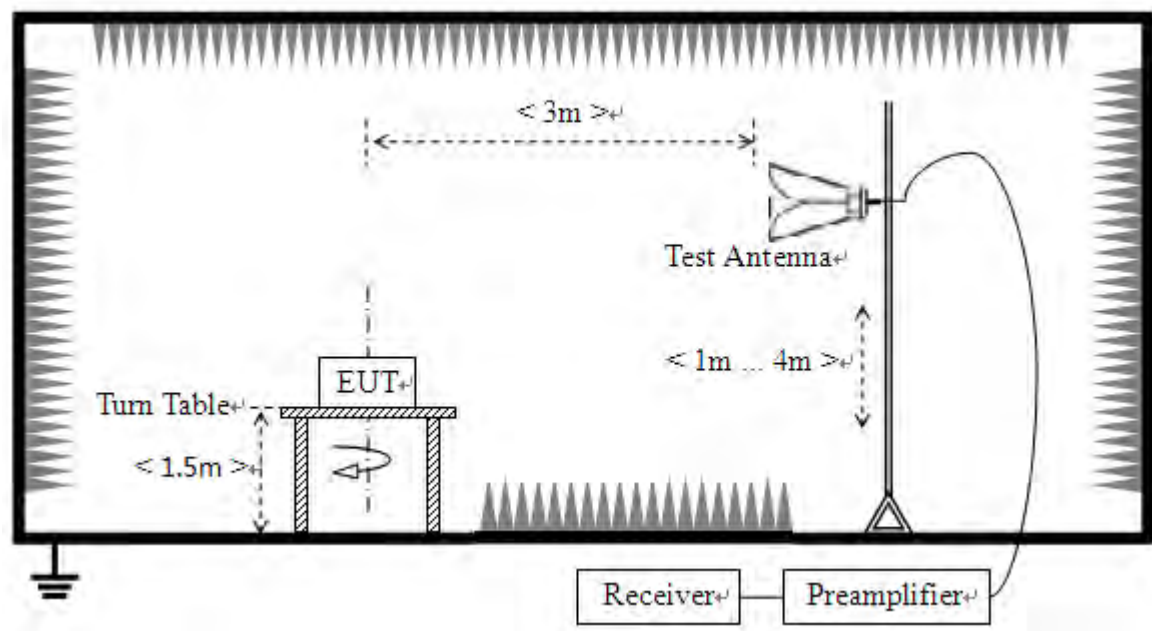
## 2.12. Restricted Frequency Bands

### 2.12.1. Requirement

According to FCC section 15.247(d), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power. 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).

### 2.12.2. Test Description

#### Test Setup:



The EUT is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading.

For the Test Antenna:

Horn Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength.

**2.12.3. Test Procedure**

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for  $f \geq 1\text{GHz}$ , 100 kHz for  $f < 1\text{GHz}$

VBW = 3 MHz

Sweep = auto

Detector function = peak/average

Trace = max hold

Allow the trace to stabilize

**2.12.4. Test Result**

The lowest and highest channels are tested to verify Restricted Frequency Bands.

The measurement results are obtained as below:

$$E [\text{dB}\mu\text{V/m}] = U_R + A_T + A_{\text{Factor}} [\text{dB}]; A_T = L_{\text{Cable loss}} [\text{dB}] - G_{\text{preamp}} [\text{dB}]$$

AT: Total correction Factor except Antenna

UR: Receiver Reading

$G_{\text{preamp}}$ : Preamplifier Gain

$A_{\text{Factor}}$ : Antenna Factor at 3m

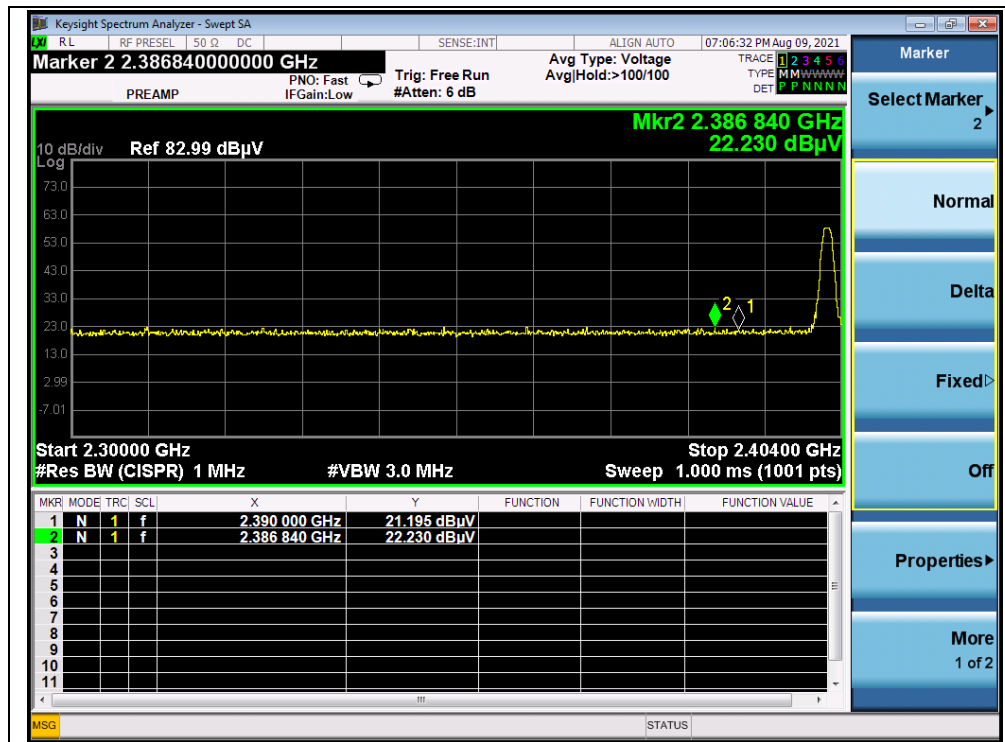
**Note:** Restricted Frequency Bands were performed when antenna was at vertical and horizontal polarity, and only the worse test condition (vertical) was recorded in this test report.

**GFSK Mode****A. Test Verdict:**

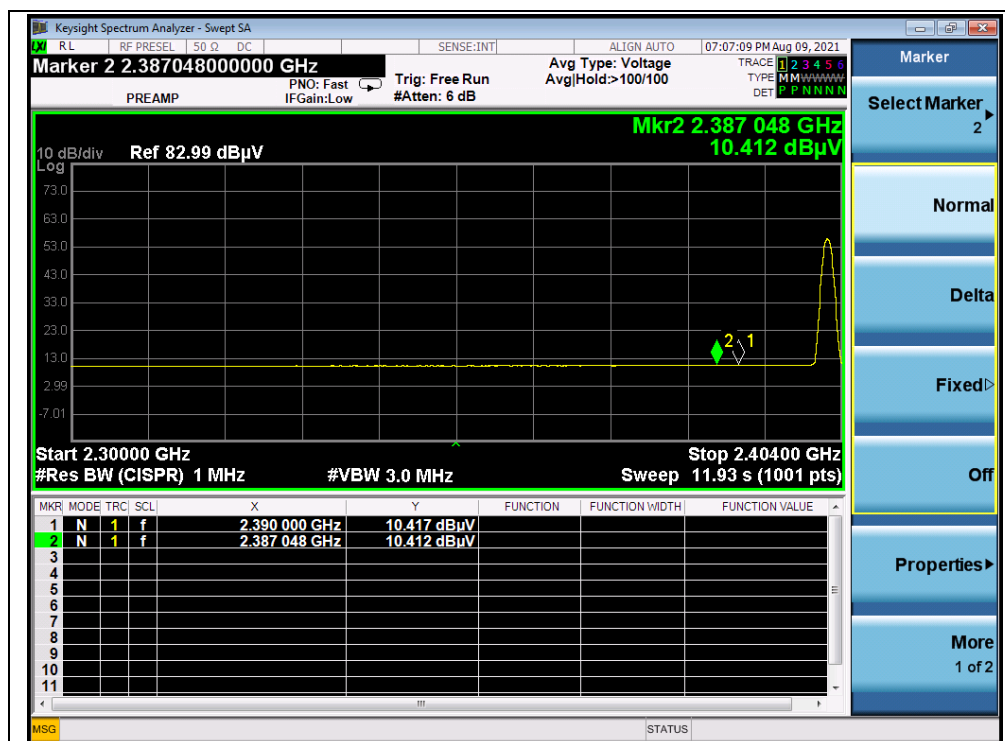
| Channel | Frequency (MHz) | Detector | Receiver Reading $U_R$ (dB $\mu$ V) | $A_T$ (dB) | $A_{\text{Factor}}$ (dB@3m) | Max. Emission E (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Verdict |
|---------|-----------------|----------|-------------------------------------|------------|-----------------------------|--------------------------------|----------------------|---------|
|         |                 | PK/ AV   |                                     |            |                             |                                |                      |         |
| 0       | 2386.84         | PK       | 22.23                               | 6.74       | 27.20                       | 56.17                          | 74                   | PASS    |
| 0       | 2390.00         | AV       | 10.42                               | 6.74       | 27.20                       | 44.36                          | 54                   | PASS    |
| 78      | 2484.73         | PK       | 21.93                               | 6.74       | 27.20                       | 55.87                          | 74                   | PASS    |
| 78      | 2483.91         | AV       | 10.15                               | 6.74       | 27.20                       | 44.09                          | 54                   | PASS    |



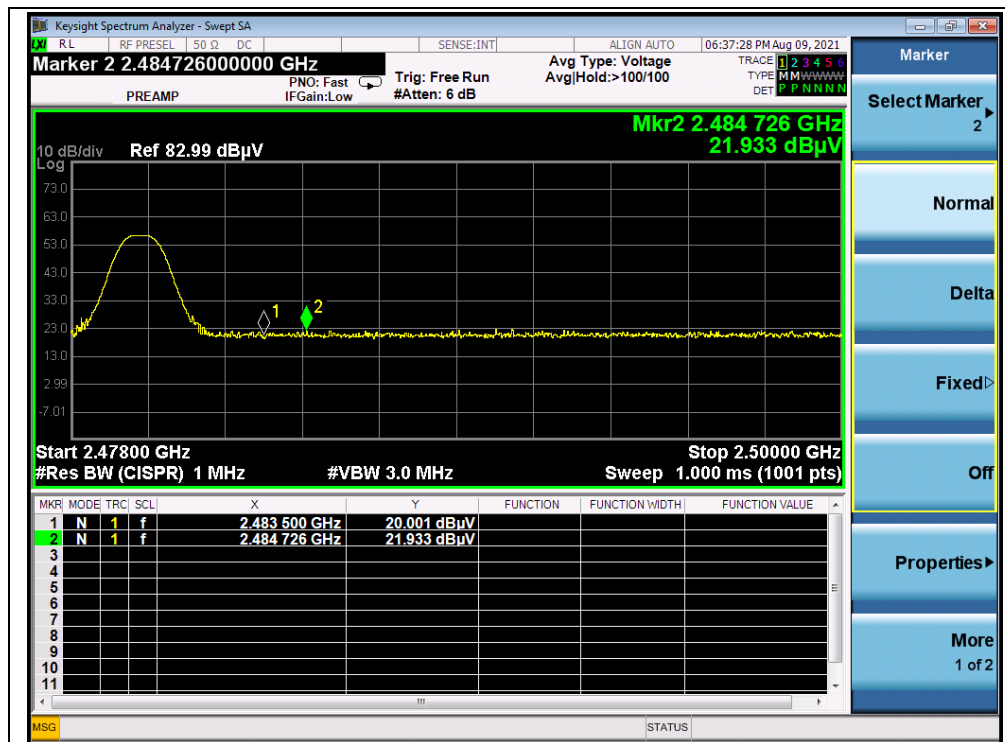
## B. Test Plot:



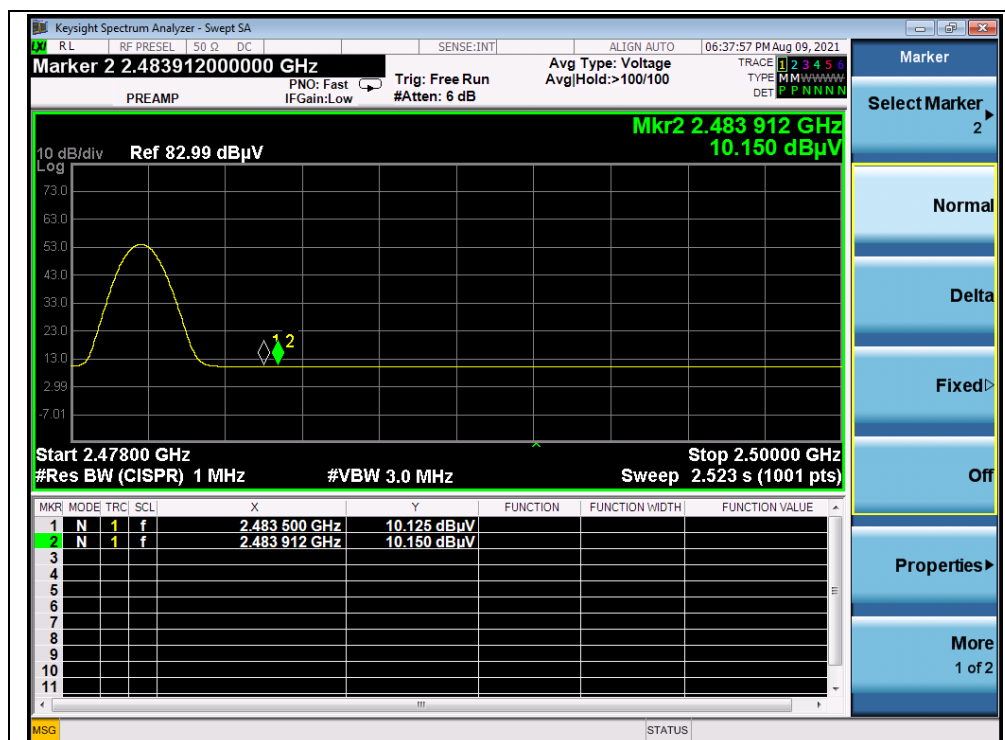
(PEAK, Channel 0, GFSK)



(AVERAGE, Channel 0, GFSK)



(PEAK, Channel 78, GFSK)



(AVERAGE, Channel 78, GFSK)

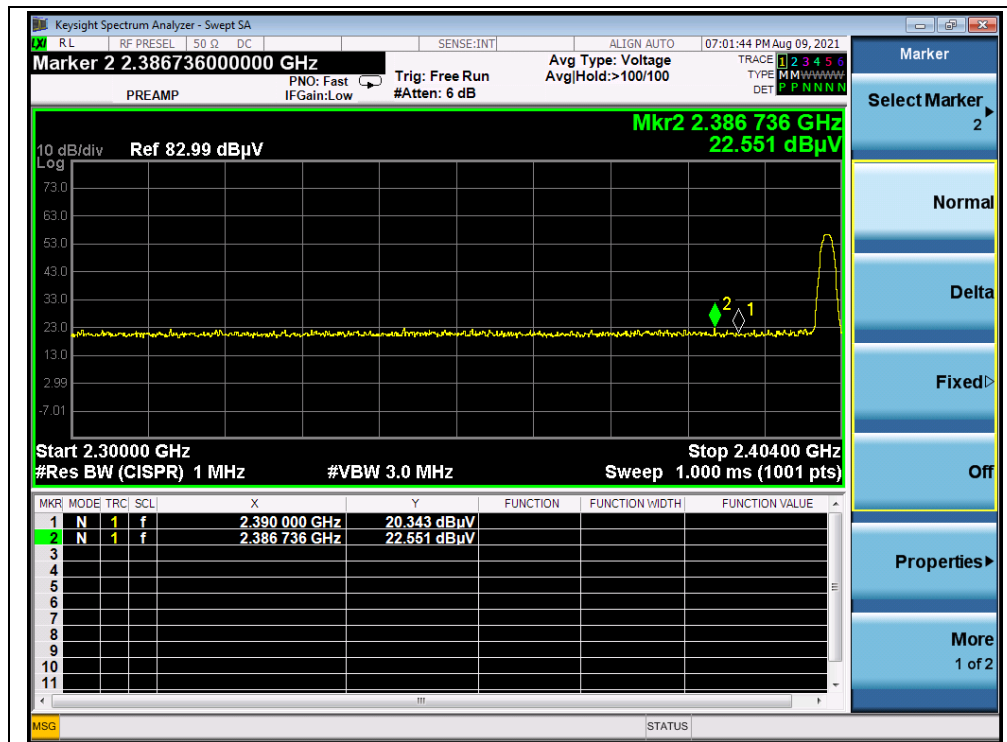


**$\pi/4$ -DQPSK Mode**

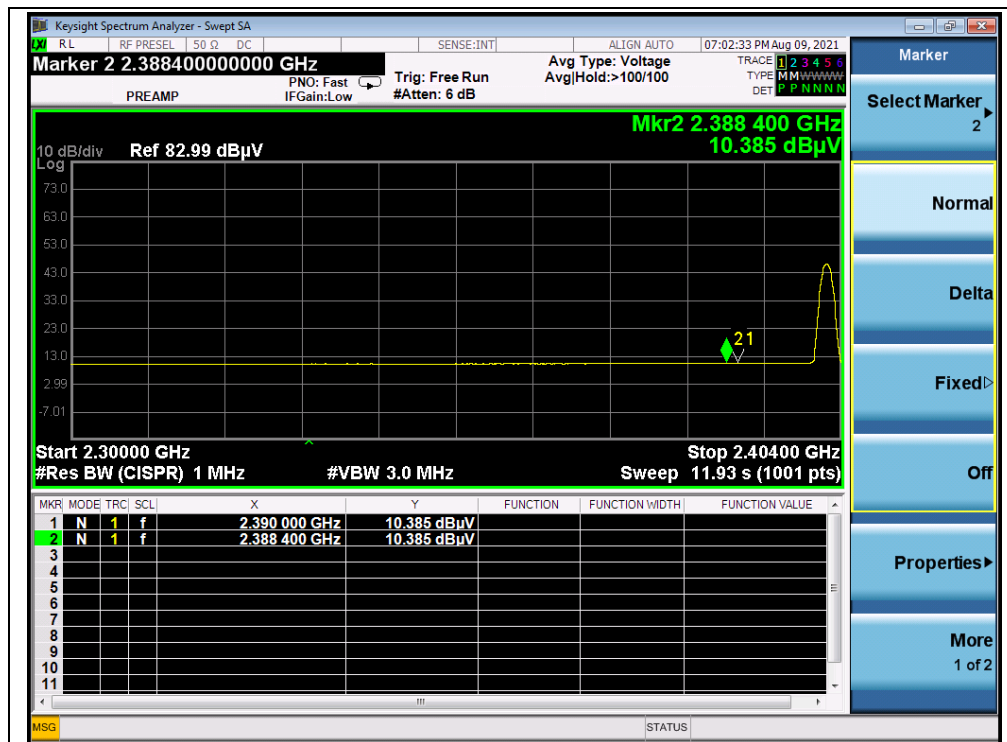
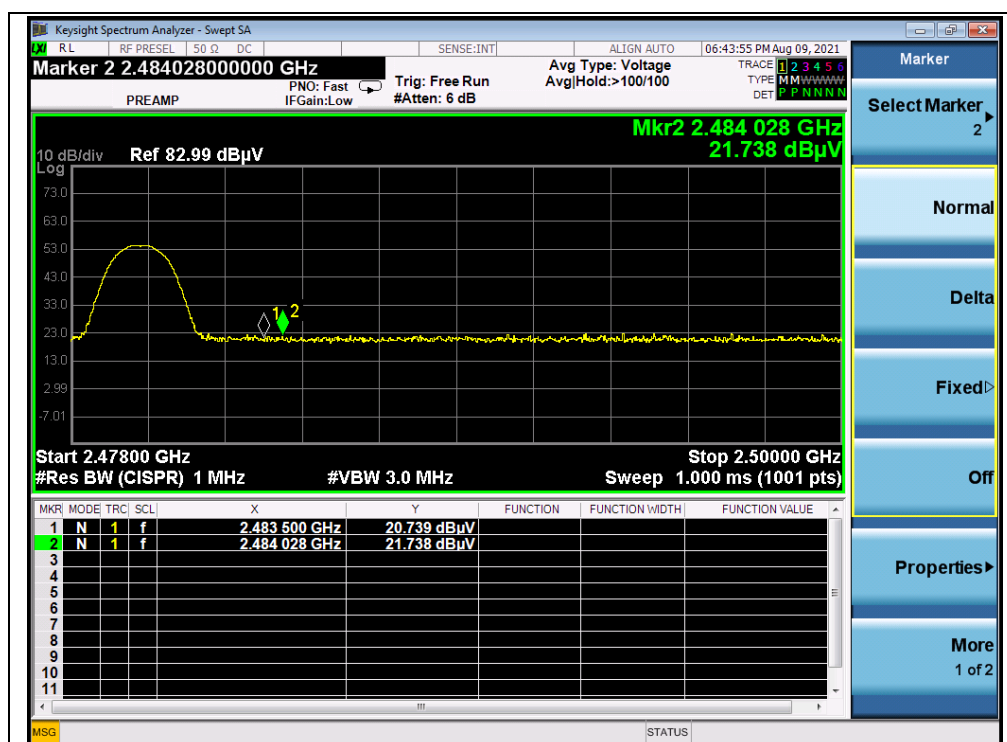
**A. Test Verdict:**

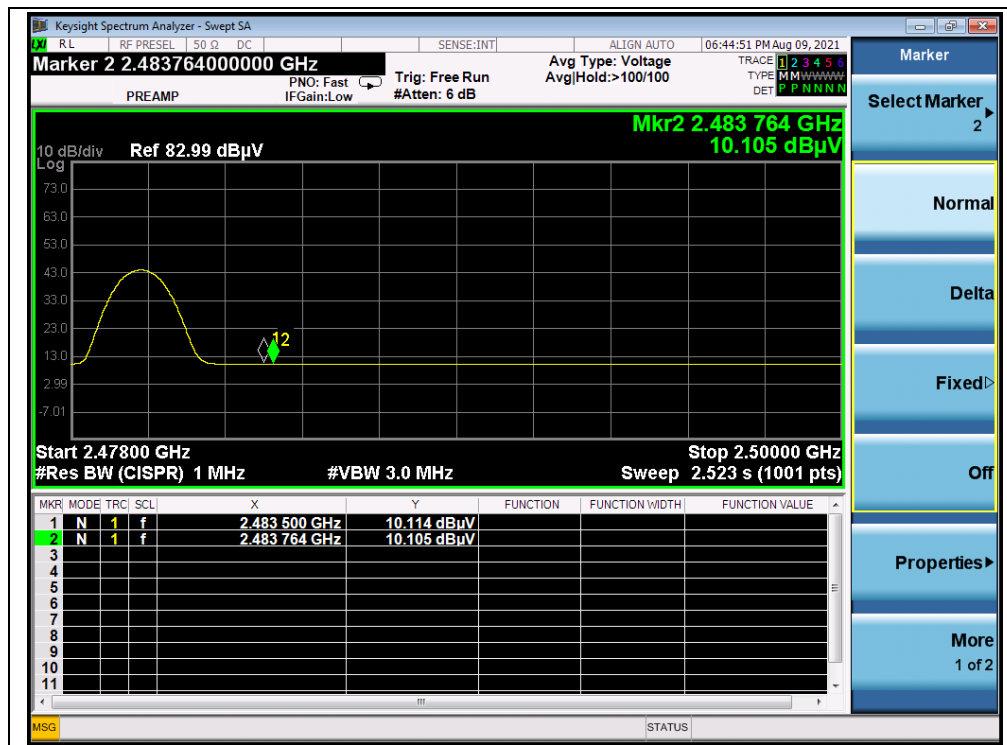
| Channel | Frequency (MHz) | Detector | Receiver Reading<br>$U_R$<br>(dB $\mu$ V) | $A_T$<br>(dB) | $A_{Factor}$<br>(dB@3m) | Max. Emission<br>$E$<br>(dB $\mu$ V/m) | Limit<br>(dB $\mu$ V/m) | Verdict |
|---------|-----------------|----------|-------------------------------------------|---------------|-------------------------|----------------------------------------|-------------------------|---------|
|         |                 | PK/ AV   |                                           |               |                         |                                        |                         |         |
| 0       | 2386.74         | PK       | 22.55                                     | 6.74          | 27.20                   | 56.49                                  | 74                      | PASS    |
| 0       | 2388.40         | AV       | 10.39                                     | 6.74          | 27.20                   | 44.33                                  | 54                      | PASS    |
| 78      | 2484.03         | PK       | 21.74                                     | 6.74          | 27.20                   | 55.68                                  | 74                      | PASS    |
| 78      | 2483.50         | AV       | 10.11                                     | 6.74          | 27.20                   | 44.05                                  | 54                      | PASS    |

**B. Test Plot:**



(PEAK, Channel 0,  $\pi/4$ -DQPSK)

(AVERAGE, Channel 0,  $\pi/4$ -DQPSK)(PEAK, Channel 78,  $\pi/4$ -DQPSK)

(AVERAGE, Channel 78,  $\pi/4$ -DQPSK)

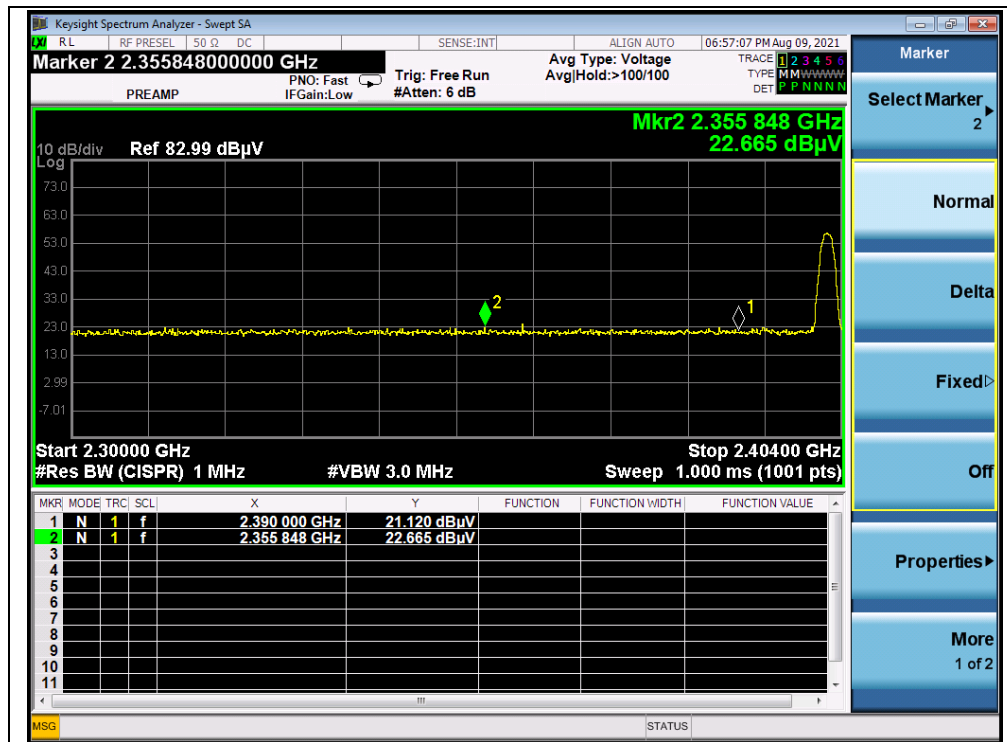


## 8-DPSK Mode

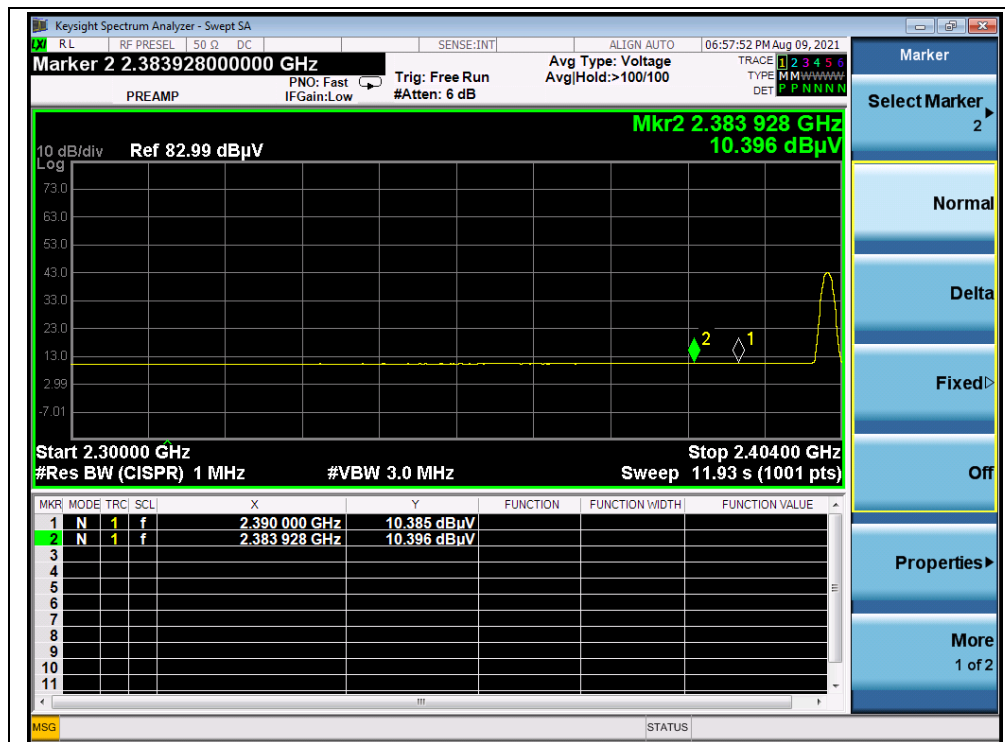
### A. Test Verdict:

| Channel | Frequency (MHz) | Detector | Receiver Reading<br>$U_R$<br>(dB $\mu$ V) | $A_T$<br>(dB) | $A_{Factor}$<br>(dB@3m) | Max. Emission<br>$E$<br>(dB $\mu$ V/m) | Limit<br>(dB $\mu$ V/m) | Verdict |
|---------|-----------------|----------|-------------------------------------------|---------------|-------------------------|----------------------------------------|-------------------------|---------|
|         |                 | PK/ AV   |                                           |               |                         |                                        |                         |         |
| 0       | 2355.85         | PK       | 22.67                                     | 6.74          | 27.20                   | 56.61                                  | 74                      | PASS    |
| 0       | 2383.93         | AV       | 10.40                                     | 6.74          | 27.20                   | 44.34                                  | 54                      | PASS    |
| 78      | 2483.68         | PK       | 21.51                                     | 6.74          | 27.20                   | 55.45                                  | 74                      | PASS    |
| 78      | 2483.65         | AV       | 10.09                                     | 6.74          | 27.20                   | 44.03                                  | 54                      | PASS    |

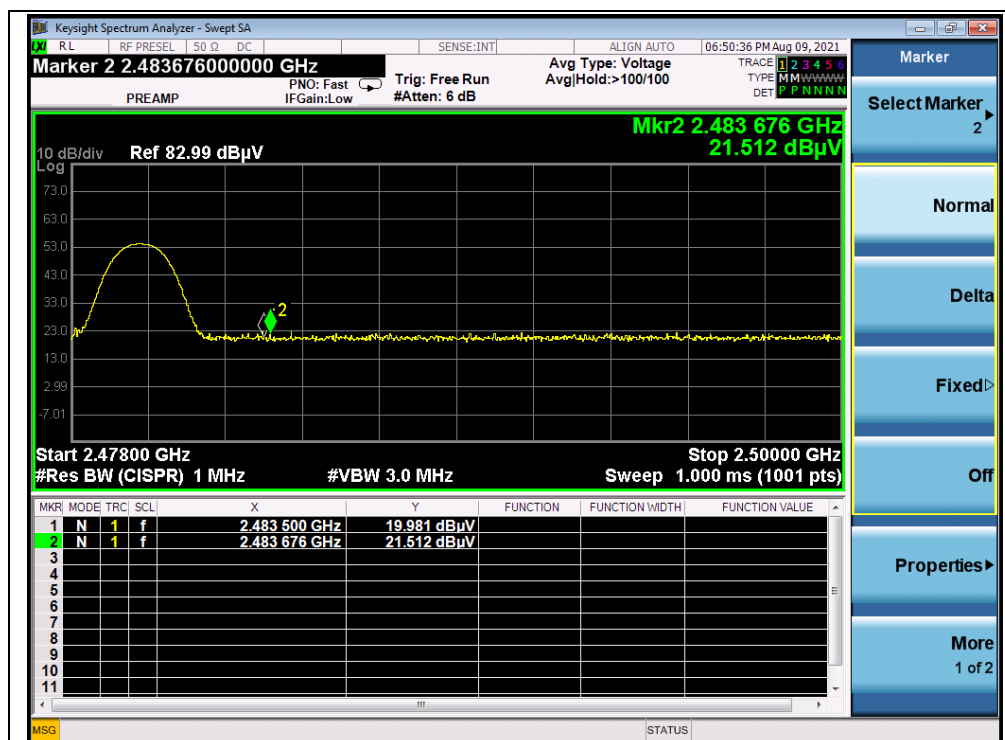
### B. Test Plot:



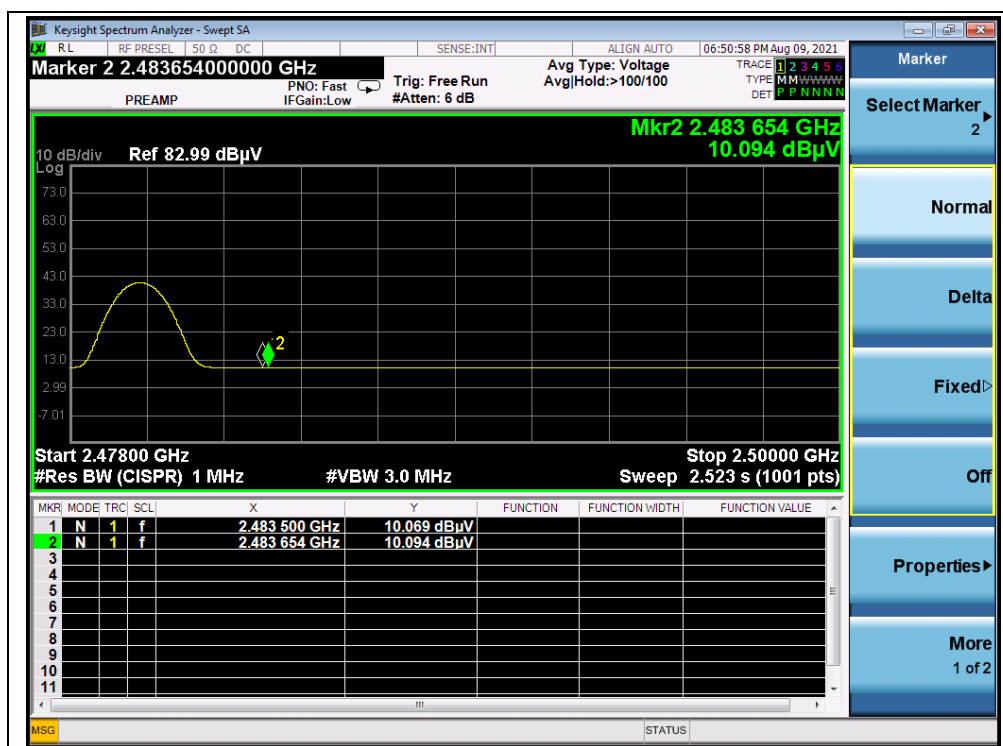
(PEAK, Channel 0, 8-DPSK)



(AVERAGE, Channel 0, 8-DPSK)



(PEAK, Channel 78, 8-DPSK)



(AVERAGE, Channel 78, 8-DPSK)

## 2.13. Radiated Emission

### 2.13.1. Requirement

According to FCC section 15.247(d), radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field Strength ( $\mu\text{V/m}$ ) | Measurement Distance (m) |
|-----------------|------------------------------------|--------------------------|
| 0.009 - 0.490   | 2400/F(kHz)                        | 300                      |
| 0.490 - 1.705   | 24000/F(kHz)                       | 30                       |
| 1.705 - 30.0    | 30                                 | 30                       |
| 30 - 88         | 100                                | 3                        |
| 88 - 216        | 150                                | 3                        |
| 216 - 960       | 200                                | 3                        |
| Above 960       | 500                                | 3                        |

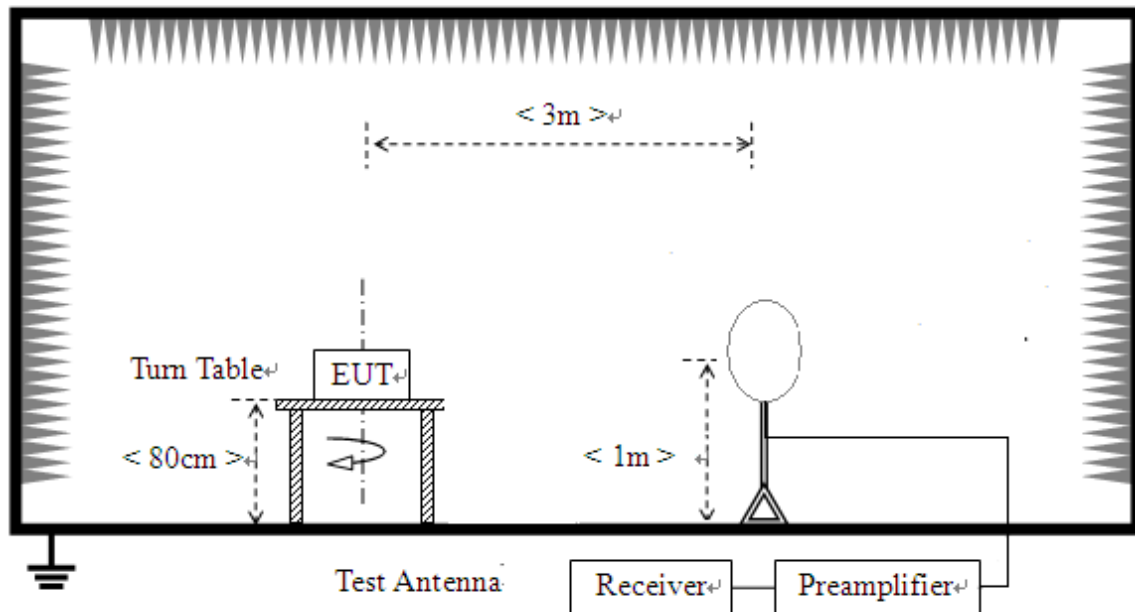
**Note1:** For above 1000MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.

**Note2:** For above 1000MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK). In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), also should comply with the radiated emission limits specified in Section 15.209(a)(above table).

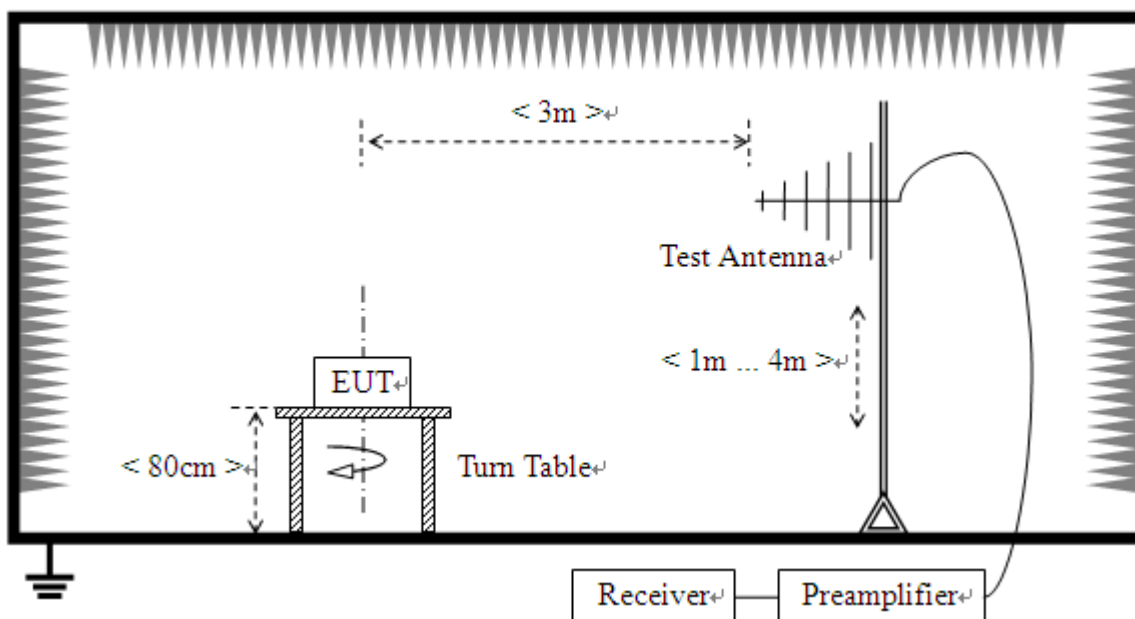
### 2.13.2. Test Description

#### Test Setup:

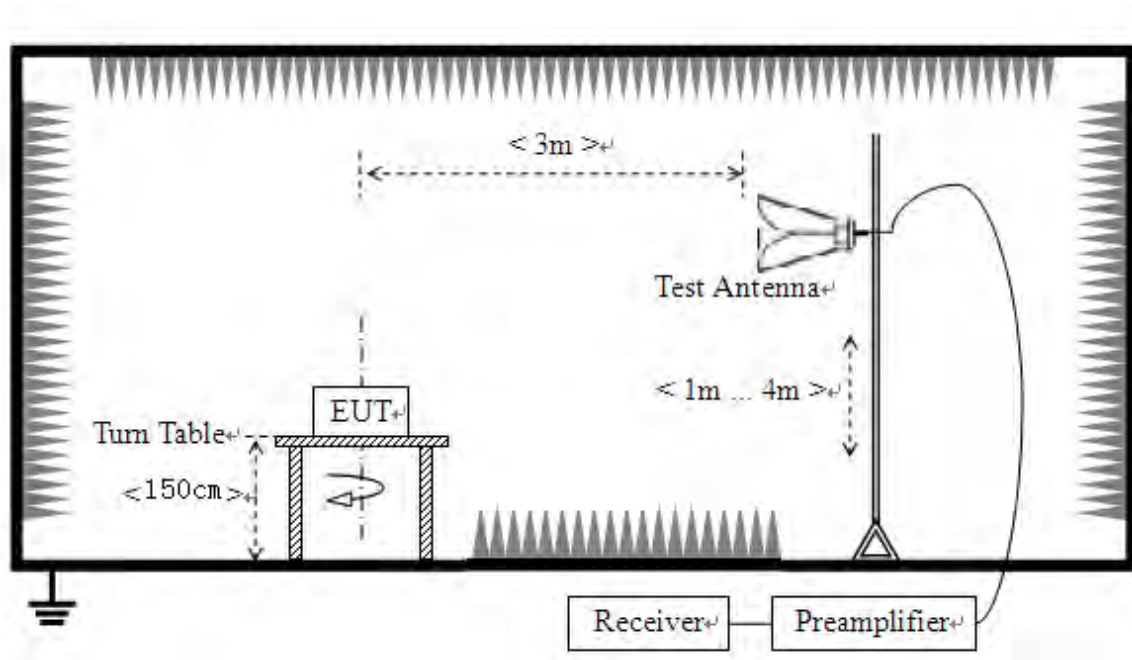
- 1) For radiated emissions from 9kHz to 30MHz



- 2) For radiated emissions from 30MHz to 1GHz



### 3) For radiated emissions above 1GHz



The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 30MHz, the emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9kHz-90 kHz, 110kHz-490 kHz. Radiated emission limits in these two bands are based on measurements employing an average detector.

For measurements below 1GHz the resolution bandwidth is set to 100kHz for peak detection measurements or 120kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1GHz the resolution bandwidth is set to 1MHz, the video band width is set to 3MHz for peak measurements and as applicable for average measurements.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.



### 2.13.3. Test Result

According to ANSI C63.10, because of peak detection will yield amplitudes equal to or greater than amplitudes measured with the quasi-peak (or average) detector, the measurement data from a spectrum analyzer peak detector will represent the worst-case results, if the peak measured value complies with the quasi-peak (or average) limit, it is unnecessary to perform an quasi-peak measurement (or average).

The measurement results are obtained as below:

$$E [\text{dB}\mu\text{V/m}] = U_R + A_T + A_{\text{Factor}} [\text{dB}]; A_T = L_{\text{Cable loss}} [\text{dB}] - G_{\text{preamp}} [\text{dB}]$$

$A_T$ : Total correction Factor except Antenna

$U_R$ : Receiver Reading

$G_{\text{preamp}}$ : Preamplifier Gain

$A_{\text{Factor}}$ : Antenna Factor at 3m

During the test, the total correction Factor  $A_T$  and  $A_{\text{Factor}}$  were built in test software.

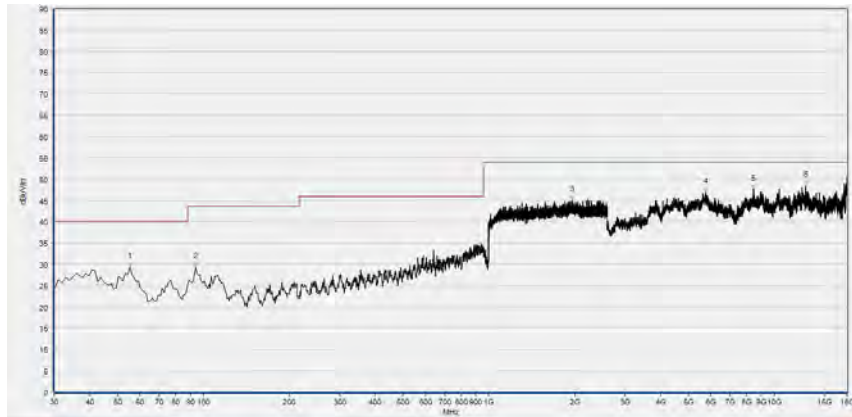
**Note 1:** All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

**Note 2:** For the frequency, which started from 9kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

**Note 3:** For the frequency, which started from 18GHz to 40GHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

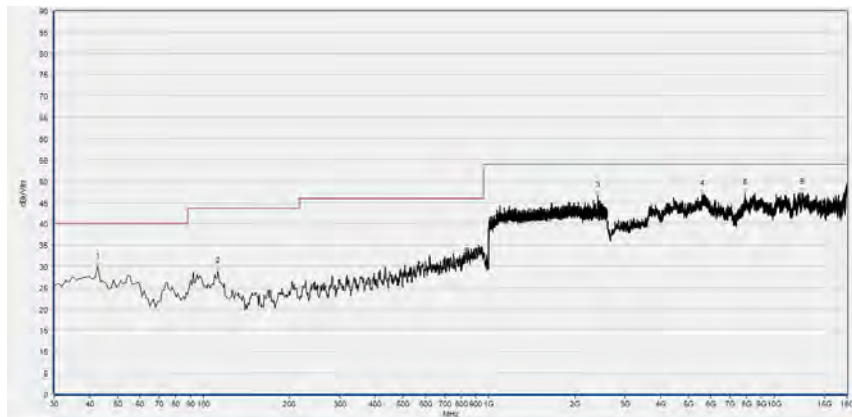
**GFSK Mode**

## Plots for Channel 0



| Fre. (MHz) | PK<br>(dBμV/m) | QP<br>(dBμV/m) | AV<br>(dBμV/m) | Limit-PK<br>(dBμV/m) | Limit-QP<br>(dBμV/m) | Limit-AV<br>(dBμV/m) | Antenna    | Verdict |
|------------|----------------|----------------|----------------|----------------------|----------------------|----------------------|------------|---------|
| 55.220     | 29.36          | N/A            | N/A            | N/A                  | 40.00                | N/A                  | Horizontal | PASS    |
| 94.020     | 29.29          | N/A            | N/A            | N/A                  | 43.50                | N/A                  | Horizontal | PASS    |
| 1955.200   | 45.07          | N/A            | N/A            | 74.00                | N/A                  | 54.00                | Horizontal | PASS    |
| 5747.760   | 46.85          | N/A            | N/A            | 74.00                | N/A                  | 54.00                | Horizontal | PASS    |
| 8436.600   | 47.52          | N/A            | N/A            | 74.00                | N/A                  | 54.00                | Horizontal | PASS    |
| 12887.200  | 48.49          | N/A            | N/A            | 74.00                | N/A                  | 54.00                | Horizontal | PASS    |

(Antenna Horizontal, 30MHz to 18GHz)

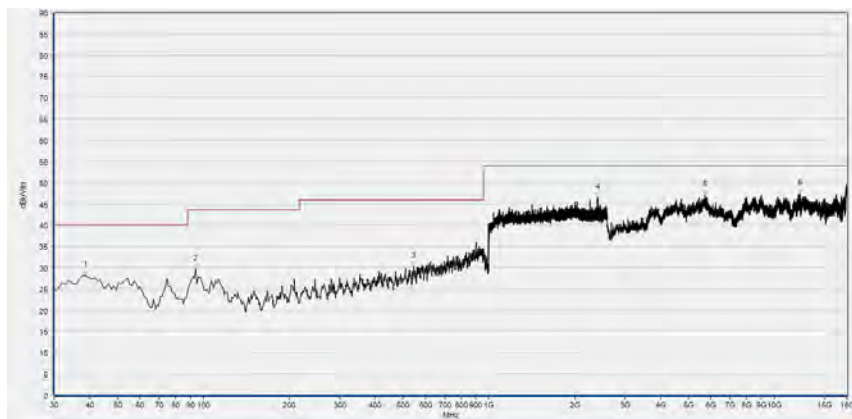


| Fre.<br>(MHz) | PK<br>(dBμV/m) | QP<br>(dBμV/m) | AV<br>(dBμV/m) | Limit-PK<br>(dBμV/m) | Limit-QP<br>(dBμV/m) | Limit-AV<br>(dBμV/m) | Antenna  | Verdict |
|---------------|----------------|----------------|----------------|----------------------|----------------------|----------------------|----------|---------|
| 42.610        | 29.87          | N/A            | N/A            | N/A                  | 40.00                | N/A                  | Vertical | PASS    |
| 112.450       | 28.78          | N/A            | N/A            | N/A                  | 43.50                | N/A                  | Vertical | PASS    |
| 2414.400      | 46.54          | N/A            | N/A            | 74.00                | N/A                  | 54.00                | Vertical | PASS    |
| 5599.920      | 46.92          | N/A            | N/A            | 74.00                | N/A                  | 54.00                | Vertical | PASS    |
| 7916.080      | 47.03          | N/A            | N/A            | 74.00                | N/A                  | 54.00                | Vertical | PASS    |
| 12526.840     | 47.25          | N/A            | N/A            | 74.00                | N/A                  | 54.00                | Vertical | PASS    |

(Antenna Vertical, 30MHz to 18GHz)

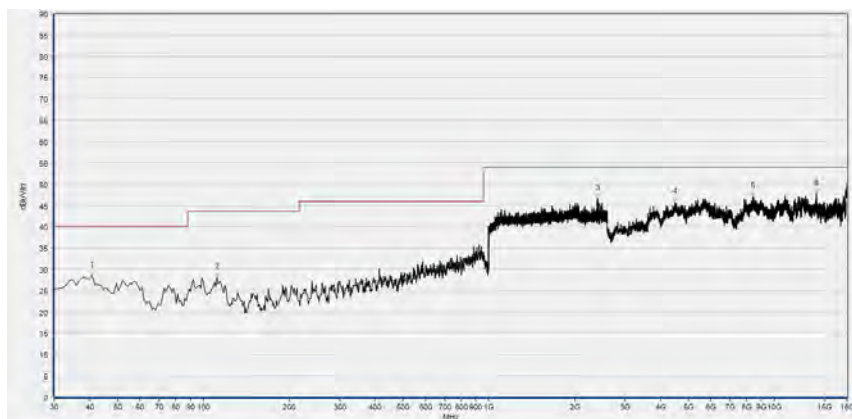


Plot for Channel 39



| Fre. (MHz) | PK (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna    | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 38.730     | 28.16       | N/A         | N/A         | N/A               | 40.00             | N/A               | Horizontal | PASS    |
| 94.020     | 29.72       | N/A         | N/A         | N/A               | 43.50             | N/A               | Horizontal | PASS    |
| 546.040    | 30.36       | N/A         | N/A         | N/A               | 46.00             | N/A               | Horizontal | PASS    |
| 2409.600   | 46.55       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 5707.720   | 47.05       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 12295.840  | 47.45       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

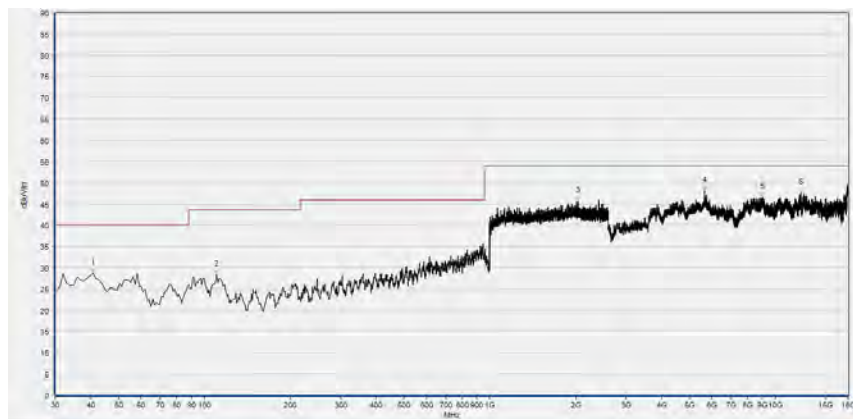
(Antenna Horizontal, 30MHz to 18GHz)



| Fre. (MHz) | PK (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna    | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 40.670     | 28.57       | N/A         | N/A         | N/A               | 40.00             | N/A               | Horizontal | PASS    |
| 111.480    | 28.21       | N/A         | N/A         | N/A               | 43.50             | N/A               | Horizontal | PASS    |
| 2409.600   | 46.53       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 4481.880   | 45.69       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 8421.200   | 47.10       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 14060.680  | 47.81       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

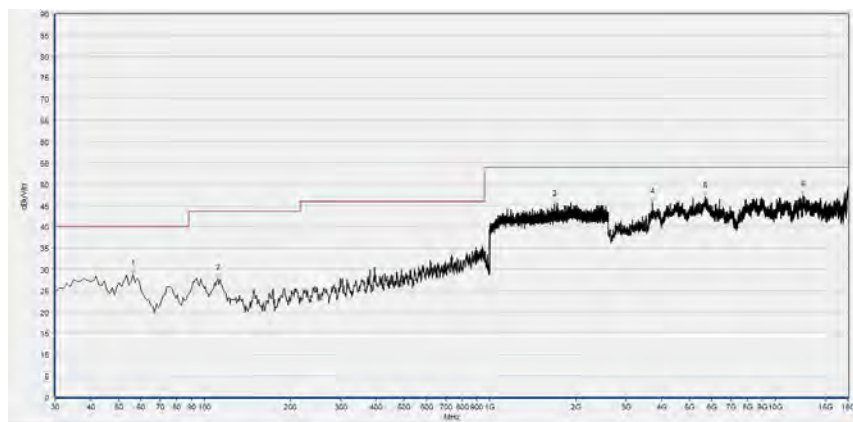
(Antenna Vertical, 30MHz to 18GHz)

Plot for Channel 78



| Fre. (MHz) | PK (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna    | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 40.670     | 28.70       | N/A         | N/A         | N/A               | 40.00             | N/A               | Horizontal | PASS    |
| 110.510    | 28.27       | N/A         | N/A         | N/A               | 43.50             | N/A               | Horizontal | PASS    |
| 2039.467   | 45.58       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 5661.520   | 48.08       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 8997.160   | 46.53       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 12295.840  | 47.53       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

(Antenna Horizontal, 30MHz to 18GHz)

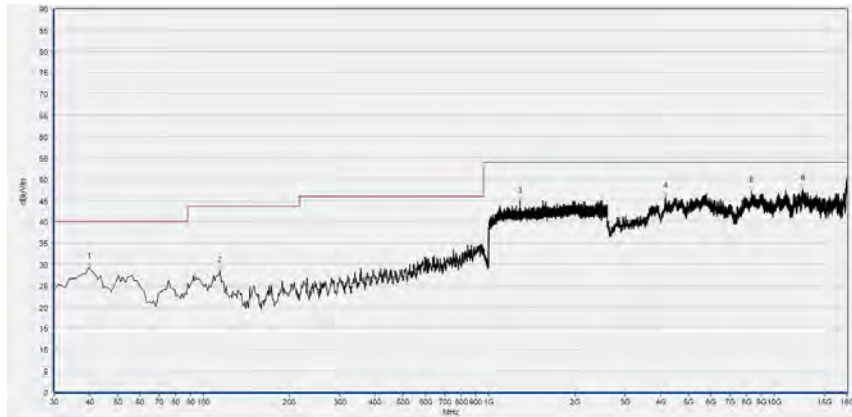


| Fre. (MHz) | PK (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna  | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|----------|---------|
| 56.190     | 28.82       | N/A         | N/A         | N/A               | 40.00             | N/A               | Vertical | PASS    |
| 111.480    | 27.76       | N/A         | N/A         | N/A               | 43.50             | N/A               | Vertical | PASS    |
| 1689.067   | 45.24       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 3711.880   | 45.67       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 5670.760   | 47.12       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 12545.320  | 47.36       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |

(Antenna Vertical, 30MHz to 18GHz)

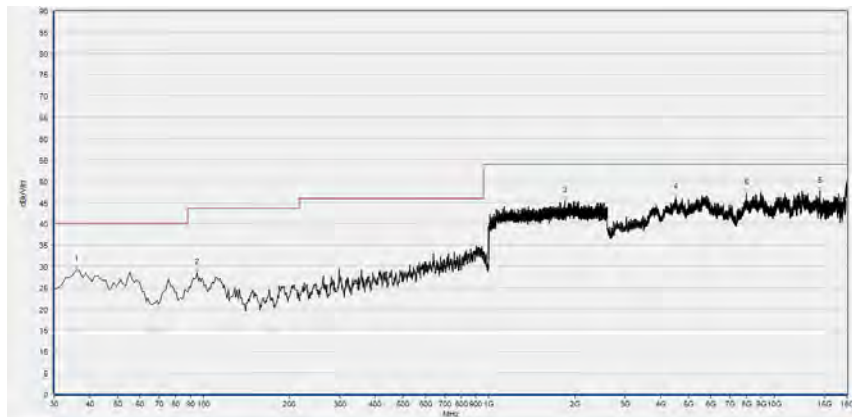
 **$\pi/4$ -DQPSK Mode**

## Plots for Channel 0



| Fre. (MHz) | PK<br>(dBμV/m) | QP<br>(dBμV/m) | AV<br>(dBμV/m) | Limit-PK<br>(dBμV/m) | Limit-QP<br>(dBμV/m) | Limit-AV<br>(dBμV/m) | Antenna    | Verdict |
|------------|----------------|----------------|----------------|----------------------|----------------------|----------------------|------------|---------|
| 39.700     | 29.28          | N/A            | N/A            | N/A                  | 40.00                | N/A                  | Horizontal | PASS    |
| 114.390    | 28.41          | N/A            | N/A            | N/A                  | 43.50                | N/A                  | Horizontal | PASS    |
| 1287.467   | 44.74          | N/A            | N/A            | 74.00                | N/A                  | 54.00                | Horizontal | PASS    |
| 4170.800   | 45.86          | N/A            | N/A            | 74.00                | N/A                  | 54.00                | Horizontal | PASS    |
| 8301.080   | 47.10          | N/A            | N/A            | 74.00                | N/A                  | 54.00                | Horizontal | PASS    |
| 12573.040  | 47.74          | N/A            | N/A            | 74.00                | N/A                  | 54.00                | Horizontal | PASS    |

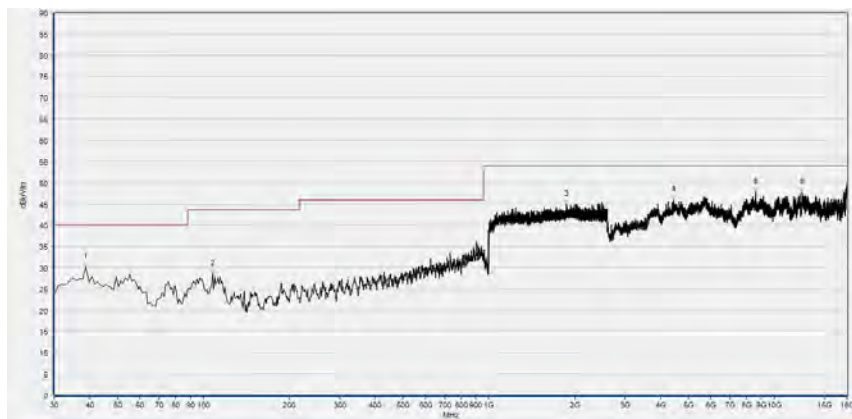
(Antenna Horizontal, 30MHz to 18GHz)



| Fre.<br>(MHz) | PK<br>(dBμV/m) | QP<br>(dBμV/m) | AV<br>(dBμV/m) | Limit-PK<br>(dBμV/m) | Limit-QP<br>(dBμV/m) | Limit-AV<br>(dBμV/m) | Antenna  | Verdict |
|---------------|----------------|----------------|----------------|----------------------|----------------------|----------------------|----------|---------|
| 35.820        | 29.09          | N/A            | N/A            | N/A                  | 40.00                | N/A                  | Vertical | PASS    |
| 94.990        | 28.56          | N/A            | N/A            | N/A                  | 43.50                | N/A                  | Vertical | PASS    |
| 1844.267      | 45.39          | N/A            | N/A            | 74.00                | N/A                  | 54.00                | Vertical | PASS    |
| 4512.680      | 46.20          | N/A            | N/A            | 74.00                | N/A                  | 54.00                | Vertical | PASS    |
| 7986.920      | 47.02          | N/A            | N/A            | 74.00                | N/A                  | 54.00                | Vertical | PASS    |
| 14430.280     | 47.59          | N/A            | N/A            | 74.00                | N/A                  | 54.00                | Vertical | PASS    |

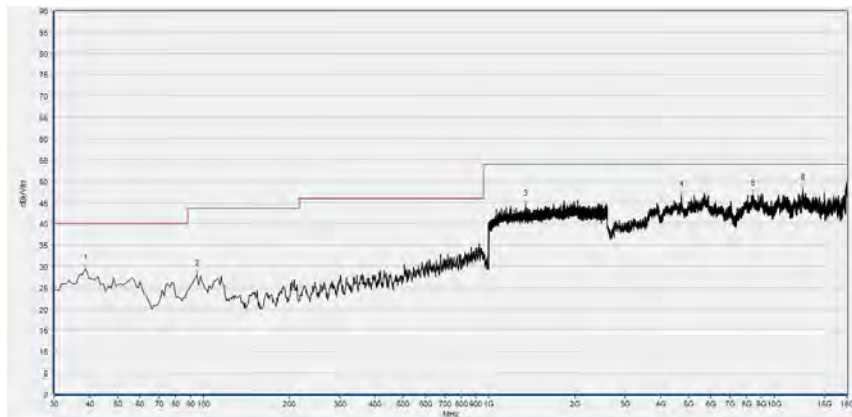
(Antenna Vertical, 30MHz to 18GHz)

Plot for Channel 39



| Fre. (MHz) | PK (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna    | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 38.730     | 30.21       | N/A         | N/A         | N/A               | 40.00             | N/A               | Horizontal | PASS    |
| 107.600    | 28.55       | N/A         | N/A         | N/A               | 43.50             | N/A               | Horizontal | PASS    |
| 1865.067   | 44.87       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 4438.760   | 45.87       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 8615.240   | 47.76       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 12520.680  | 47.84       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

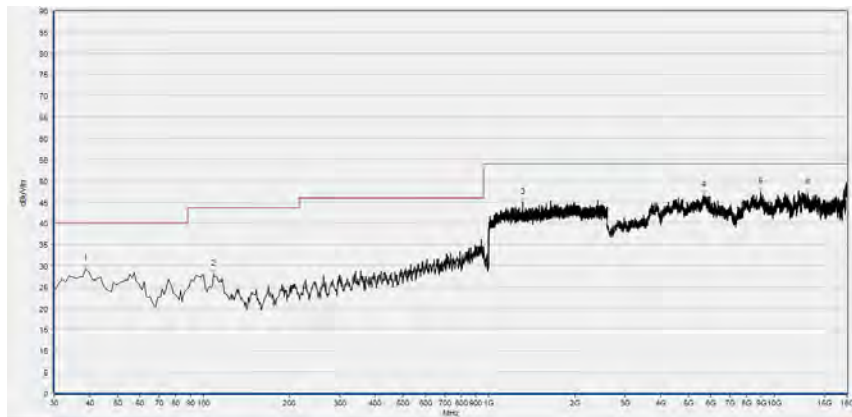
(Antenna Horizontal, 30MHz to 18GHz)



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna  | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|----------|---------|
| 38.730     | 29.57       | N/A         | N/A         | N/A               | 40.00             | N/A               | Vertical | PASS    |
| 94.990     | 28.11       | N/A         | N/A         | N/A               | 43.50             | N/A               | Vertical | PASS    |
| 1348.800   | 44.66       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 4719.040   | 46.69       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 8421.200   | 46.95       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 12573.040  | 48.28       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |

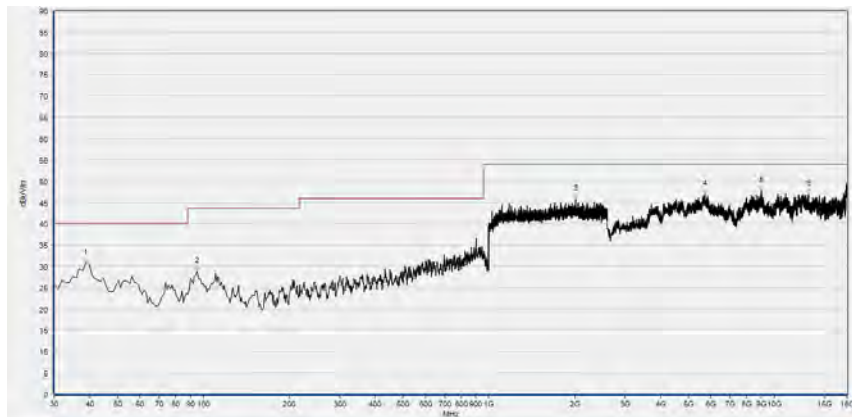
(Antenna Vertical, 30MHz to 18GHz)

Plot for Channel 78



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna    | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 38.730     | 29.20       | N/A         | N/A         | N/A               | 40.00             | N/A               | Horizontal | PASS    |
| 108.570    | 27.92       | N/A         | N/A         | N/A               | 43.50             | N/A               | Horizontal | PASS    |
| 1317.333   | 44.87       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 5664.600   | 46.53       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 8984.840   | 47.51       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 13099.720  | 47.04       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

(Antenna Horizontal, 30MHz to 18GHz)

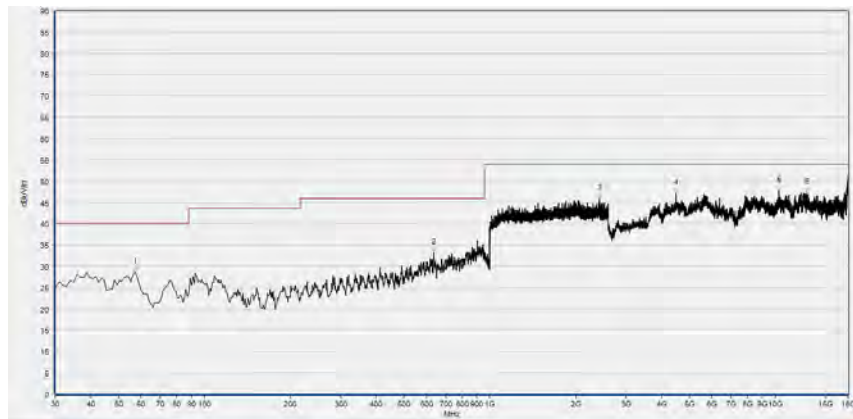


| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna  | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|----------|---------|
| 38.730     | 30.71       | N/A         | N/A         | N/A               | 40.00             | N/A               | Vertical | PASS    |
| 94.990     | 28.90       | N/A         | N/A         | N/A               | 43.50             | N/A               | Vertical | PASS    |
| 2014.400   | 45.68       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 5704.640   | 46.86       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 9012.560   | 47.84       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 13161.320  | 46.98       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |

(Antenna Vertical, 30MHz to 18GHz)

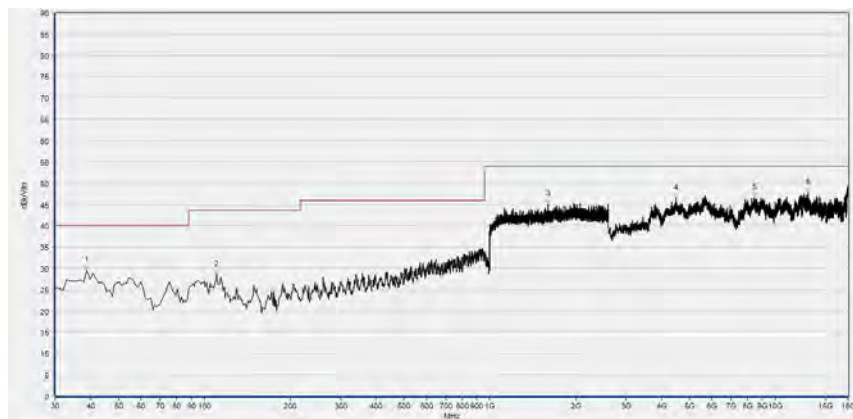
**8-DPSK Mode**

## Plots for Channel 0



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna    | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 57.160     | 28.60       | N/A         | N/A         | N/A               | 40.00             | N/A               | Horizontal | PASS    |
| 637.220    | 33.17       | N/A         | N/A         | N/A               | 46.00             | N/A               | Horizontal | PASS    |
| 2416.000   | 45.87       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 4500.360   | 47.06       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 10284.600  | 47.73       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 12921.080  | 47.23       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

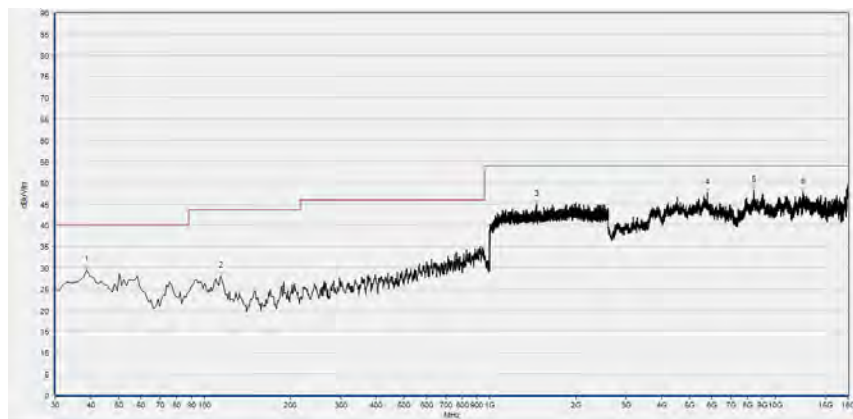
(Antenna Horizontal, 30MHz to 18GHz)



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna  | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|----------|---------|
| 38.730     | 29.52       | N/A         | N/A         | N/A               | 40.00             | N/A               | Vertical | PASS    |
| 110.510    | 28.47       | N/A         | N/A         | N/A               | 43.50             | N/A               | Vertical | PASS    |
| 1599.467   | 45.05       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 4491.120   | 46.45       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 8452.000   | 46.57       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 13031.960  | 47.77       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |

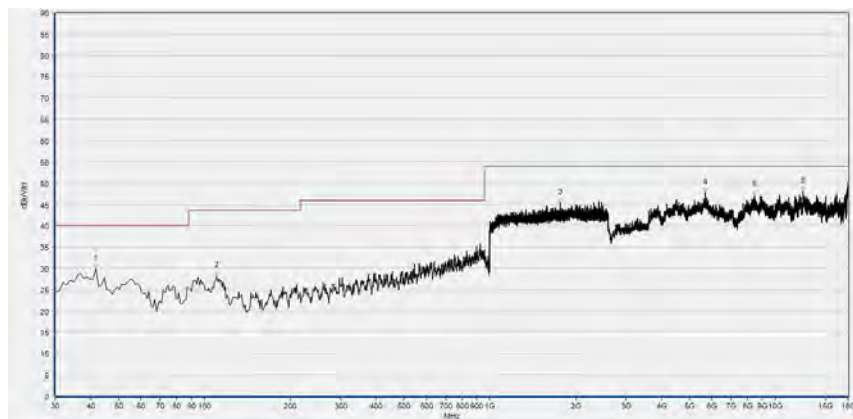
(Antenna Vertical, 30MHz to 18GHz)

Plot for Channel 39



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna    | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 38.730     | 29.48       | N/A         | N/A         | N/A               | 40.00             | N/A               | Horizontal | PASS    |
| 114.390    | 27.99       | N/A         | N/A         | N/A               | 43.50             | N/A               | Horizontal | PASS    |
| 1457.600   | 44.85       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 5775.480   | 47.61       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 8424.280   | 48.26       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 12520.680  | 47.73       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

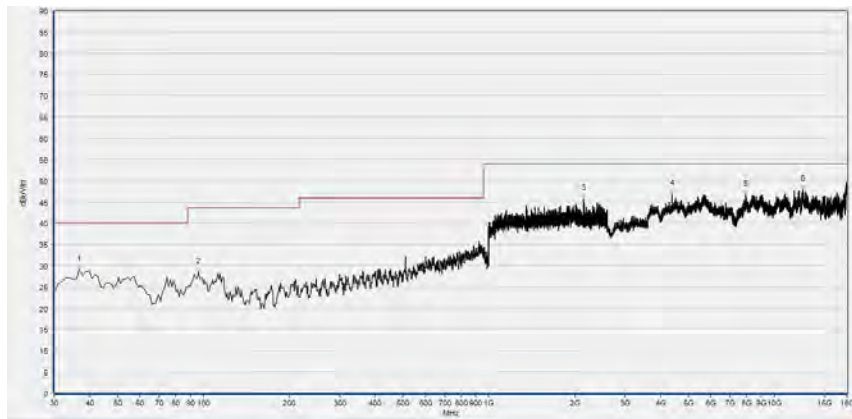
(Antenna Horizontal, 30MHz to 18GHz)



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna  | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|----------|---------|
| 41.640     | 29.85       | N/A         | N/A         | N/A               | 40.00             | N/A               | Vertical | PASS    |
| 110.510    | 28.13       | N/A         | N/A         | N/A               | 43.50             | N/A               | Vertical | PASS    |
| 1766.400   | 45.47       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 5680.000   | 47.70       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 8442.760   | 47.10       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 12514.520  | 48.05       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |

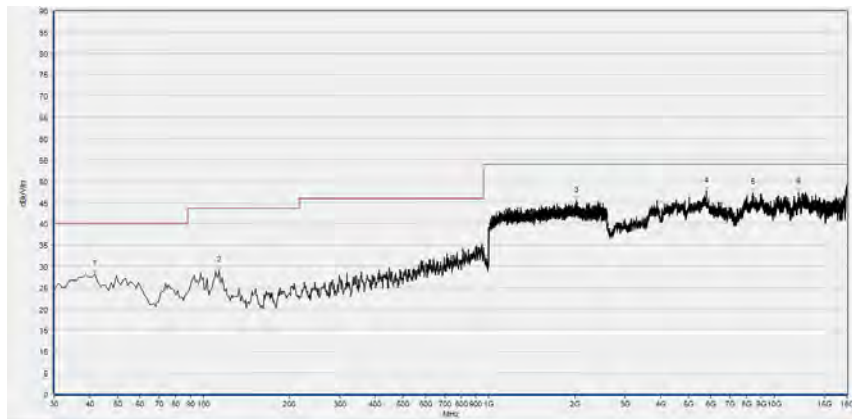
(Antenna Vertical, 30MHz to 18GHz)

Plot for Channel 78



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna    | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 36.790     | 29.02       | N/A         | N/A         | N/A               | 40.00             | N/A               | Horizontal | PASS    |
| 95.960     | 28.44       | N/A         | N/A         | N/A               | 43.50             | N/A               | Horizontal | PASS    |
| 2145.067   | 45.67       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 4374.080   | 46.97       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 7928.400   | 46.69       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 12585.360  | 47.86       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

(Antenna Horizontal, 30MHz to 18GHz)



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna  | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|----------|---------|
| 41.640     | 28.24       | N/A         | N/A         | N/A               | 40.00             | N/A               | Vertical | PASS    |
| 113.420    | 28.94       | N/A         | N/A         | N/A               | 43.50             | N/A               | Vertical | PASS    |
| 2029.867   | 45.34       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 5781.640   | 47.65       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 8430.440   | 47.20       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 12141.840  | 47.43       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |

(Antenna Vertical, 30MHz to 18GHz)

## Annex A Test Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for test performed on the EUT as specified in CISPR 16-1-2:

| Test Items                     | Uncertainty |
|--------------------------------|-------------|
| Number of Hopping Frequency    | ±5%         |
| Peak Output Power              | ±2.22dB     |
| Bandwidth                      | ±5%         |
| Carrier Frequency Separation   | ±5%         |
| Time of Occupancy (Dwell time) | ±5%         |
| Conducted Spurious Emission    | ±2.77dB     |
| Restricted Frequency Bands     | ±5%         |
| Radiated Emission              | ±2.95dB     |
| Conducted Emission             | ±2.44dB     |

This uncertainty represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.



## Annex B Testing Laboratory Information

### 1. Identification of the Responsible Testing Laboratory

|                            |                                                                                                                                  |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| <b>Laboratory Name:</b>    | Shenzhen Morlab Communications Technology Co., Ltd.                                                                              |
| <b>Laboratory Address:</b> | FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China |
| <b>Telephone:</b>          | +86 755 36698555                                                                                                                 |
| <b>Facsimile:</b>          | +86 755 36698525                                                                                                                 |

### 2. Identification of the Responsible Testing Location

|                 |                                                                                                                                  |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------|
| <b>Name:</b>    | Shenzhen Morlab Communications Technology Co., Ltd.                                                                              |
| <b>Address:</b> | FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China |

### 3. Facilities and Accreditations

All measurement facilities used to collect the measurement data are located at FL.3, Building A, FeiYang Science Park, Block 67, BaoAn District, Shenzhen, 518101 P. R. China. The test site is constructed in conformance with the requirements of ANSI C63.10-2013 and CISPR Publication 22; the FCC designation number is CN1192, the test firm registration number is 226174.



#### 4. Test Equipments Utilized

##### 4.1 Conducted Test Equipments

| Equipment Name         | Serial No. | Type     | Manufacturer     | Cal. Date  | Due Date   |
|------------------------|------------|----------|------------------|------------|------------|
| Bluetooth Base Station | 6K00006210 | MT8852B  | Anritsu          | 2021.03.25 | 2022.03.24 |
| Directional Coupler    | 17041703   | DTO-5-30 | ShangHaiHuaxiang | N/A        | N/A        |
| EXA Signal Analyzer    | MY53470836 | N9010A   | Agilent          | 2021.03.25 | 2022.03.24 |
| RF Cable (30MHz-26GHz) | CB01       | RF01     | Morlab           | N/A        | N/A        |
| Coaxial Cable          | CB02       | RF02     | Morlab           | N/A        | N/A        |
| SMA Connector          | CN01       | RF03     | HUBER-SUHNER     | N/A        | N/A        |

##### 4.2 List of Software Used

| Description      | Manufacturer | Software Version |
|------------------|--------------|------------------|
| Test System      | Tonscend     | V2.5.77.0418     |
| Morlab EMCR V1.2 | Morlab       | V1.0             |
| TS+ -[JS32-CE]   | Tonscend     | V2.5.0.0         |

**4.3 Radiated Test Equipments**

| <b>Equipment Name</b>                | <b>Serial No.</b> | <b>Type</b>           | <b>Manufacturer</b> | <b>Cal. Date</b> | <b>Due Date</b> |
|--------------------------------------|-------------------|-----------------------|---------------------|------------------|-----------------|
| Receiver                             | MY54130016        | N9038A                | Agilent             | 2021.07.16       | 2022.07.15      |
| Test Antenna - Bi-Log                | 9163-519          | VULB 9163             | Schwarzbeck         | 2019.05.24       | 2022.05.23      |
| Test Antenna - Loop                  | 1519-022          | FMZB1519              | Schwarzbeck         | 2019.02.14       | 2022.02.13      |
| Test Antenna – Horn                  | 01774             | BBHA 9120D            | Schwarzbeck         | 2019.07.26       | 2022.07.25      |
| Test Antenna – Horn                  | BBHA9170 #774     | BBHA9170              | Schwarzbeck         | 2019.07.26       | 2022.07.25      |
| Coaxial Cable (N male) (9KHz-30MHz)  | CB04              | EMC04                 | Morlab              | N/A              | N/A             |
| Coaxial Cable (N male) (30MHz-26GHz) | CB02              | EMC02                 | Morlab              | N/A              | N/A             |
| Coaxial Cable (N male) (30MHz-26GHz) | CB03              | EMC03                 | Morlab              | N/A              | N/A             |
| Coaxial Cable (N male) (30MHz-40GHz) | CB05              | EMC05                 | Morlab              | N/A              | N/A             |
| 1-18GHz pre-Amplifier                | 61171/61172       | S020180L32 03         | Tonscend            | 2021.07.16       | 2022.07.15      |
| 18-26.5GHz pre-Amplifier             | 46732             | S10M100L38 02         | Tonscend            | 2021.07.16       | 2022.07.15      |
| 26-40GHz pre-Amplifier               | 56774             | S40M400L40 02         | Tonscend            | 2021.07.16       | 2022.07.15      |
| Notch Filter                         | N/A               | WRCG-2400-2483.5-60SS | Wainwright          | 2021.07.16       | 2022.07.15      |
| Anechoic Chamber                     | N/A               | 9m*6m*6m              | CRT                 | 2020.01.06       | 2023.01.05      |

\_\_\_\_\_ END OF REPORT \_\_\_\_\_