



REPORT No.: SZ18110335W02

# TEST REPORT

**APPLICANT** : Anker Innovations Limited

**PRODUCT NAME** : Nebula Capsule II

**MODEL NAME** : D2421

**BRAND NAME** : Nebula

**FCC ID** : 2AOKB-D2421

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

**RECEIPT DATE** : 2018-12-06

**TEST DATE** : 2018-12-24 to 2019-01-21

**ISSUE DATE** : 2019-03-01

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| Change History |            |                   |
|----------------|------------|-------------------|
| Version        | Date       | Reason for change |
| 1.0            | 2019-03-01 | First edition     |
|                |            |                   |



# 1. Technical Information

**Note:** Provide by applicant.

## 1.1. Applicant and Manufacturer Information

|                              |                                                                           |
|------------------------------|---------------------------------------------------------------------------|
| <b>Applicant:</b>            | Anker Innovations Limited                                                 |
| <b>Applicant Address:</b>    | Room 1318-19,Hollywood Plaza,610 Nathan Road, Mongkok, Kowloon, Hong Kong |
| <b>Manufacturer:</b>         | Anker Innovations Limited                                                 |
| <b>Manufacturer Address:</b> | Room 1318-19,Hollywood Plaza,610 Nathan Road, Mongkok, Kowloon, Hong Kong |

## 1.2. Equipment Under Test (EUT) Description

|                                   |                                                                                    |                               |
|-----------------------------------|------------------------------------------------------------------------------------|-------------------------------|
| <b>Product Name:</b>              | Nebula Capsule II                                                                  |                               |
| <b>Serial No:</b>                 | (N/A, marked #1 by test site)                                                      |                               |
| <b>Hardware Version:</b>          | A277                                                                               |                               |
| <b>Software Version:</b>          | V0.0.06                                                                            |                               |
| <b>Modulation Type:</b>           | FHSS (GFSK(1Mbps), $\pi/4$ -DQPSK(EDR 2Mbps), 8-DPSK(EDR 3Mbps))                   |                               |
| <b>Operating Frequency Range:</b> | The frequency range used is 2402MHz – 2480MHz (79 channels, at intervals of 1MHz); |                               |
| <b>Bluetooth Version:</b>         | Bluetooth classic                                                                  |                               |
| <b>Antenna Type:</b>              | FPC Antenna                                                                        |                               |
| <b>Antenna Gain:</b>              | 2.84 dBi                                                                           |                               |
| <b>Accessory Information:</b>     | Battery                                                                            |                               |
|                                   | <b>Brand Name:</b>                                                                 | N/A                           |
|                                   | <b>Model No.:</b>                                                                  | INR21700M50T(21CR22/71)       |
|                                   | <b>Serial No.:</b>                                                                 | (N/A, marked #1 by test site) |
|                                   | <b>Rated Input:</b>                                                                | 4850mAh                       |
|                                   | <b>Rated Output:</b>                                                               | 7.26V                         |
|                                   | <b>Charge Limit:</b>                                                               | 8.4V                          |



|                               |               |                                        |
|-------------------------------|---------------|----------------------------------------|
| <b>Accessory Information:</b> | AC Adapter    |                                        |
|                               | Brand Name:   | ANKER                                  |
|                               | Model No.:    | A2014                                  |
|                               | Serial No.:   | (N/A, marked #1 by test site)          |
|                               | Rated Input:  | 100-240V ~ 50/60Hz 1.2A                |
|                               | Rated Output: | 5V---3A, 9V---3A, 15V---2A, 20V---1.5A |

**Note 1:** This test report is updated from original report SZ18110110W02 (Model: D2241, FCC ID: 2AOKB-D2241). And this report recorded the results of module(DM8060) for BT classic function. According to the certificate holder, they declared that the model D2421 contains two main modules, module(DM8060) and module(T835). One of the module(DM8060) used in model D2421 is the same module used in model D2241. The changes only affect the test results of Conducted Emission, Restricted Frequency Bands and Radiated Emission.

**Note 2:** The EUT contains Bluetooth Module operating at 2.4GHz ISM band; the frequencies is  $F(\text{MHz})=2402+1*n$  ( $0 \leq n \leq 78$ ). The lowest, middle, highest channel numbers of the Bluetooth Module used and tested in this report are separately 0 (2402MHz), 39 (2441MHz) and 78 (2480MHz).

**Note 3:** The EUT connected to the serial port of the computer with a serial communication cable, we use the dedicated software to control the EUT into the test mode, and then use MT8852B base station to control the EUT continuous transmission.

**Note 4:** For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.



### 1.3. 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                    |
|-----|----------------------|--------------------------------|--------------|---------------|---------------------------|
| 1   | 15.203               | Antenna Requirement            | N/A          | N/A           | PASS                      |
| 2   | 15.247(a)            | Number of Hopping Frequency    | Dec 24, 2018 | Wang Meng     | PASS <small>Note1</small> |
| 3   | 15.247(b)            | Peak Output Power              | Dec 24, 2018 | Wang Meng     | PASS <small>Note1</small> |
| 4   | 15.247(a)            | 20dB Bandwidth                 | Dec 24, 2018 | Wang Meng     | PASS <small>Note1</small> |
| 5   | 15.247(a)            | Carrier Frequency Separation   | Dec 24, 2018 | Wang Meng     | PASS <small>Note1</small> |
| 6   | 15.247(a)            | Time of Occupancy (Dwell time) | Dec 24, 2018 | Wang Meng     | PASS <small>Note1</small> |
| 7   | 15.247(d)            | Conducted Spurious Emission    | Dec 24, 2018 | Wang Meng     | PASS <small>Note1</small> |
| 8   | 15.207               | Conducted Emission             | Jan 01, 2018 | Ya Xinhou     | PASS                      |
| 9   | 15.247(d)            | Restricted Frequency Bands     | Jan 21, 2018 | Ya Xinhou     | PASS                      |
| 10  | 15.209,<br>15.247(d) | Radiated Emission              | Jan 11, 2018 | Ya Xinhou     | PASS                      |

**Note1:** The test results of these test items in this report refer to the test report (Report No.: SZ18110110W02).

**Note 2:** The tests were performed according to the method of measurements prescribed in ANSI C63.10-2013.

**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.

### 1.4. 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. Result: Compliant

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

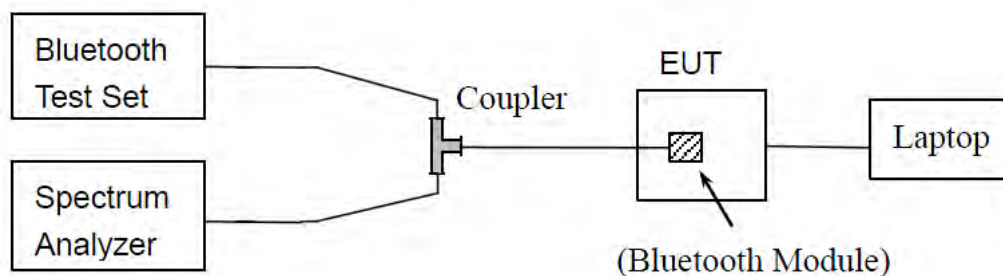
### 2.2. Number of Hopping Frequency

#### 2.2.1. 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.

#### 2.2.2. Test Description

##### A. 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.

**B. Equipments List:**

Please reference ANNEX B(4).

**2.2.3. Test Procedure**

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

Span = the frequency band of operation

RBW  $\geq$  1% of the span

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize

**2.2.4. Test Result**

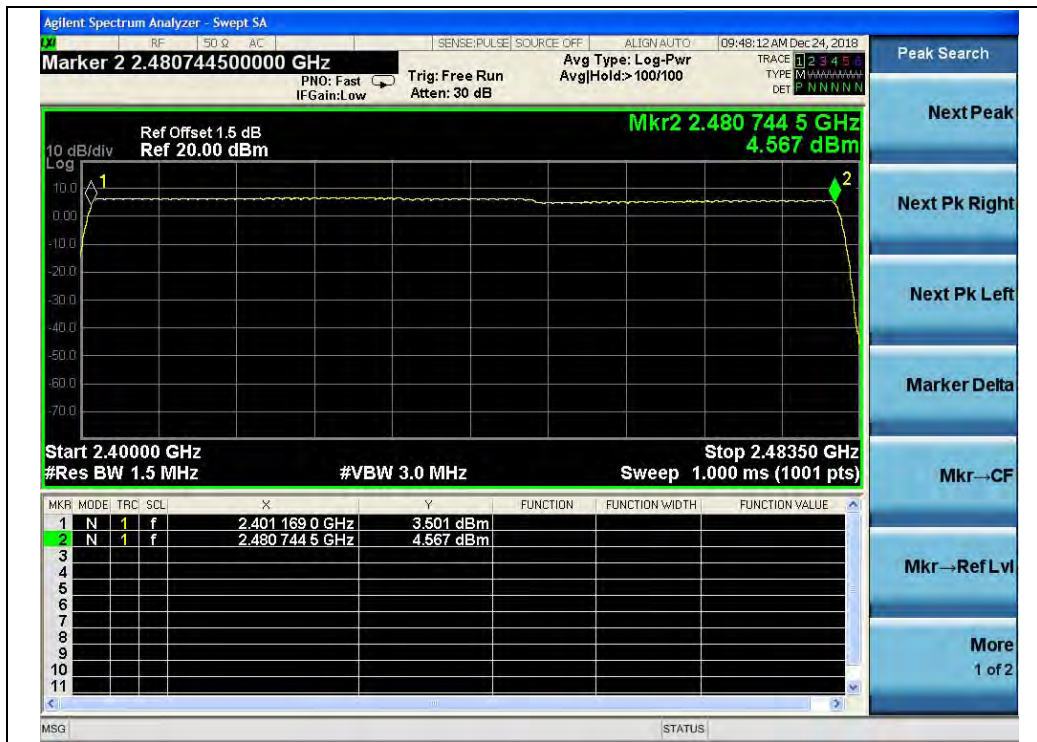
The Bluetooth Module operates at hopping-on test mode; the frequencies number employed is counted to verify the Module's using the number of hopping frequency.

**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    |

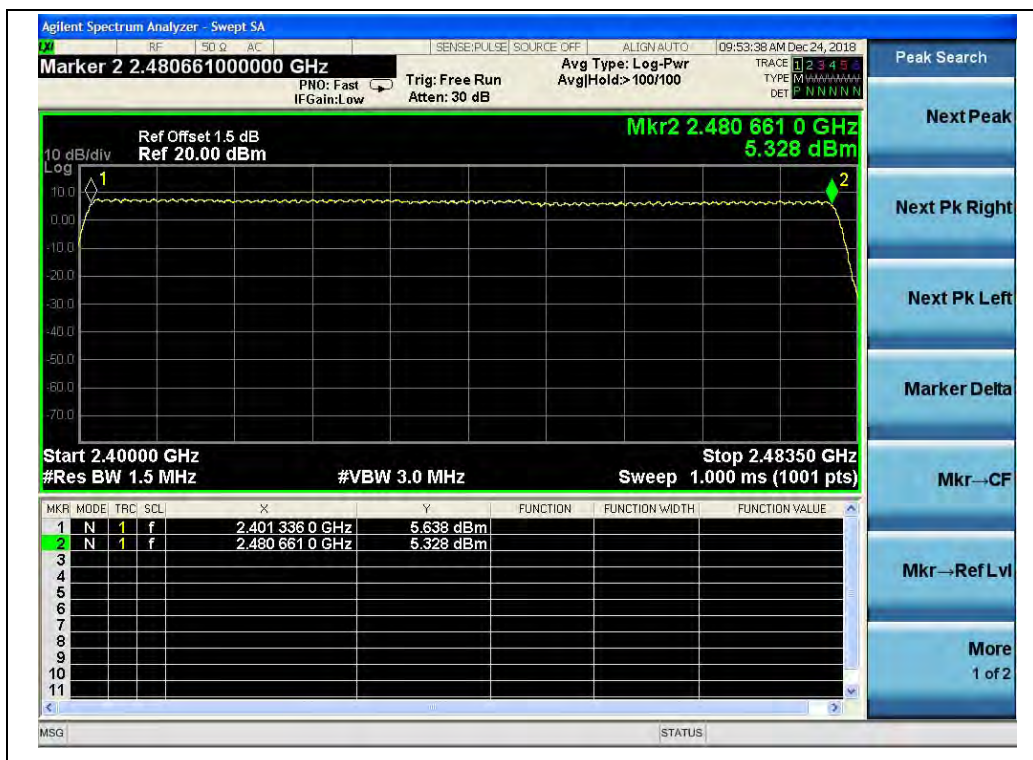


## B. Test Plots:



(GFSK)

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



(8- DPSK)

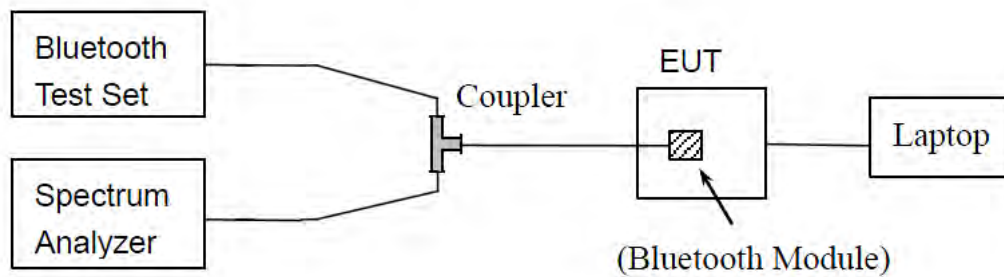
## 2.3. Peak Output Power

### 2.3.1. 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.

### 2.3.2. Test Description

#### A. 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.

#### B. Equipments List:

Please refer ANNEX B(4).



### 2.3.3. Test Result

The Bluetooth Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the module.

#### GFSK Mode

##### A. Test Verdict:

| Channel | Frequency (MHz) | Measured Output Peak Power |       | Limit |       | Verdict |
|---------|-----------------|----------------------------|-------|-------|-------|---------|
|         |                 | dBm                        | W     | dBm   | W     |         |
| 0       | 2402            | 6.43                       | 0.004 | 20.96 | 0.125 | PASS    |
| 39      | 2441            | 6.35                       | 0.004 |       |       | PASS    |
| 78      | 2480            | 5.75                       | 0.004 |       |       | PASS    |

##### B. Test Plots:



(GFSK, Channel 0, 2402MHz)



(GFSK, Channel 39, 2441MHz)



(GFSK, Channel 78, 2480MHz)

 **$\pi/4$ -DQPSK Mode****A. Test Verdict:**

| Channel | Frequency<br>(MHz) | Measured Output Peak Power |       | Limit |       | Verdict |
|---------|--------------------|----------------------------|-------|-------|-------|---------|
|         |                    | dBm                        | W     | dBm   | W     |         |
| 0       | 2402               | 7.65                       | 0.006 | 20.96 | 0.125 | PASS    |
| 39      | 2441               | 7.36                       | 0.005 |       |       | PASS    |
| 78      | 2480               | 7.02                       | 0.005 |       |       | PASS    |

**B. Test Plots:**

(π/4-DQPSK, Channel 0, 2402MHz)



( $\pi/4$ -DQPSK, Channel 39, 2441MHz)



( $\pi/4$ -DQPSK, Channel 78, 2480MHz)



## 8-DPSK Mode

### A. Test Verdict:

| Channel | Frequency<br>(MHz) | Measured Output Peak Power |       | Limit |       | Verdict |
|---------|--------------------|----------------------------|-------|-------|-------|---------|
|         |                    | dBm                        | W     | dBm   | W     |         |
| 0       | 2402               | 6.41                       | 0.004 | 20.96 | 0.125 | PASS    |
| 39      | 2441               | 6.29                       | 0.004 |       |       | PASS    |
| 78      | 2480               | 5.74                       | 0.004 |       |       | PASS    |

### B. Test Plots:



(8-DPSK, Channel 0, 2402MHz)



(8-DPSK, Channel 39, 2441MHz)



(8-DPSK, Channel 78, 2480MHz)

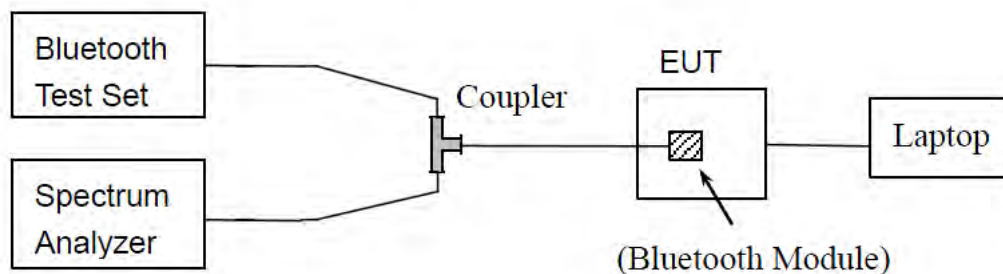
## 2.4. 20dB Bandwidth

### 2.4.1. Definition

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

### 2.4.2. Test Description

#### A. 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.

#### B. Equipments List:

Please refer ANNEX B(4).

### 2.4.3. Test Procedure

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW  $\geq$  1% of the 20 dB bandwidth

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold



#### 2.4.4. Test Result

The Bluetooth Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to record the 20dB bandwidth of the Module.

#### GFSK Mode

##### A. Test Verdict:

| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) | Result |
|---------|-----------------|----------------------|--------|
| 0       | 2402            | 1.057                | PASS   |
| 39      | 2441            | 1.031                | PASS   |
| 78      | 2480            | 1.033                | PASS   |

##### B. Test Plots:



(GFSK, Channel 0, 2402MHz)



(GFSK, Channel 39, 2441MHz)



(GFSK, Channel 78, 2480MHz)



$\pi/4$ -DQPSK Mode

A. Test Verdict:

| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) | Result |
|---------|-----------------|----------------------|--------|
| 0       | 2402            | 1.357                | PASS   |
| 39      | 2441            | 1.357                | PASS   |
| 78      | 2480            | 1.358                | PASS   |

B. Test Plots:



( $\pi/4$ -DQPSK, Channel 0, 2402MHz)



( $\pi/4$ -DQPSK, Channel 39, 2441MHz)



( $\pi/4$ -DQPSK, Channel 78, 2480MHz)



## 8-DPSK Mode

### A. Test Verdict:

| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) | Result |
|---------|-----------------|----------------------|--------|
| 0       | 2402            | 1.334                | PASS   |
| 39      | 2441            | 1.334                | PASS   |
| 78      | 2480            | 1.336                | PASS   |

### B. Test Plots:



(8-DPSK, Channel 0, 2402MHz)



(8-DPSK, Channel 39, 2441MHz)



(8-DPSK, Channel 78, 2480MHz)

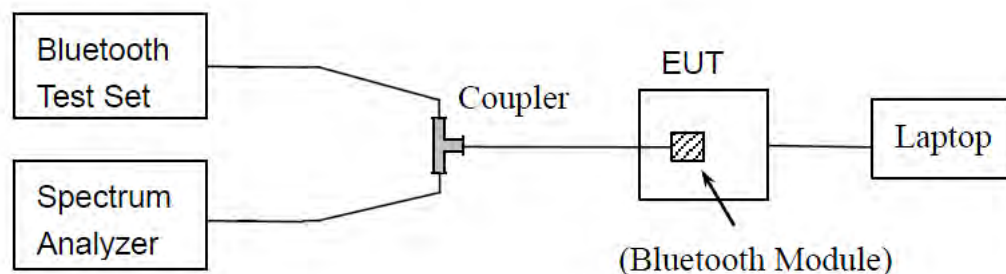
## 2.5. Carried Frequency Separation

### 2.5.1. 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.

### 2.5.2. Test Description

#### A. 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.

#### B. Equipments List:

Please refer ANNEX B(4).

### 2.5.3. Test Procedure

The EUT must have its hopping function enabled. 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

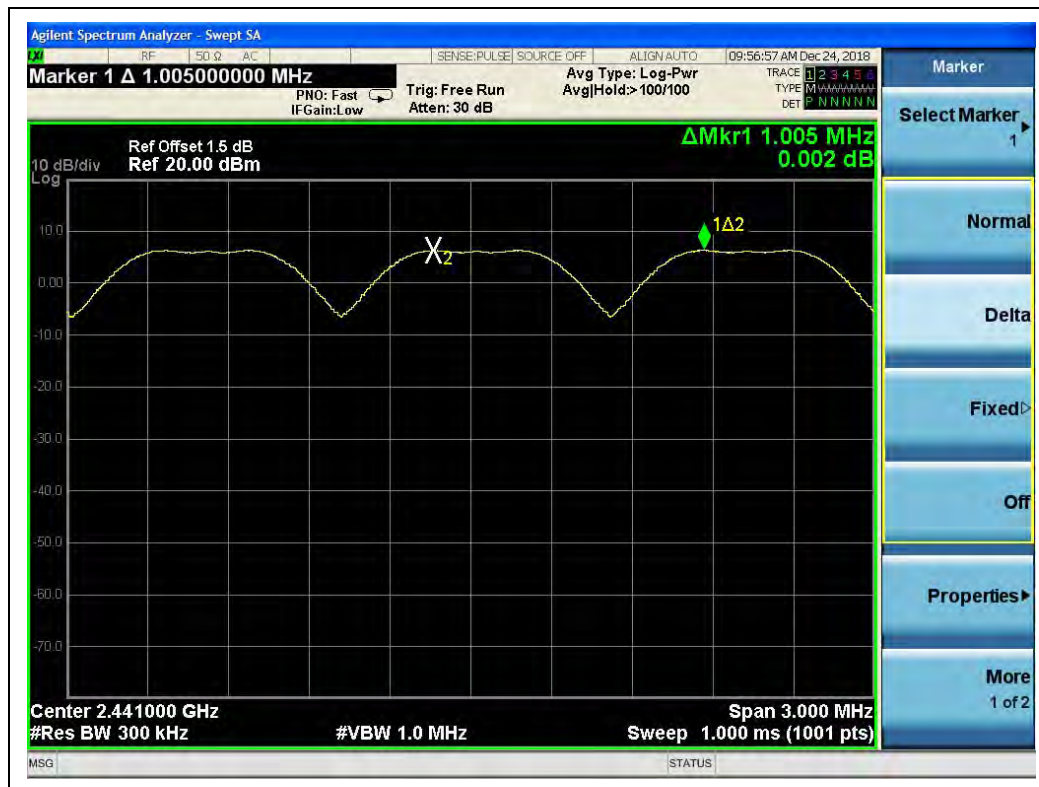
Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.



#### 2.5.4. Test Result

The Bluetooth Module operates at hopping-on test mode. For any adjacent channels (e.g. the channel 39 and 40 as showed below), the Module does have hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel (refer to section 2.4.4), whichever is greater. So, the verdict is PASSING.

| Test Mode      | Measured Channel Numbers | Carried Frequency Separation | 20dB bandwidth (MHz) | Min. Limit                       | Verdict |
|----------------|--------------------------|------------------------------|----------------------|----------------------------------|---------|
| GFSK           | 39 and 40                | 1.005                        | 1.031                | two-thirds of the 20dB bandwidth | PASS    |
| $\pi/4$ -DQPSK | 39 and 40                | 1.002                        | 1.357                |                                  | PASS    |
| 8-DPSK         | 39 and 40                | 1.023                        | 1.334                |                                  | PASS    |



(GFSK)



( $\pi/4$ -DQPSK)



(8-DPSK)

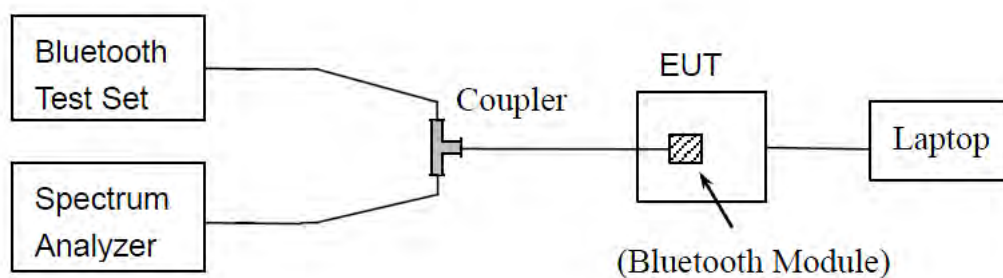
## 2.6. Time of Occupancy (Dwell time)

### 2.6.1. 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.

### 2.6.2. Test Description

#### A. 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.

#### B. Equipments List:

Please refer ANNEX B(4).

### 2.6.3. Test Procedure

Option 1:

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

AFH Mode:

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



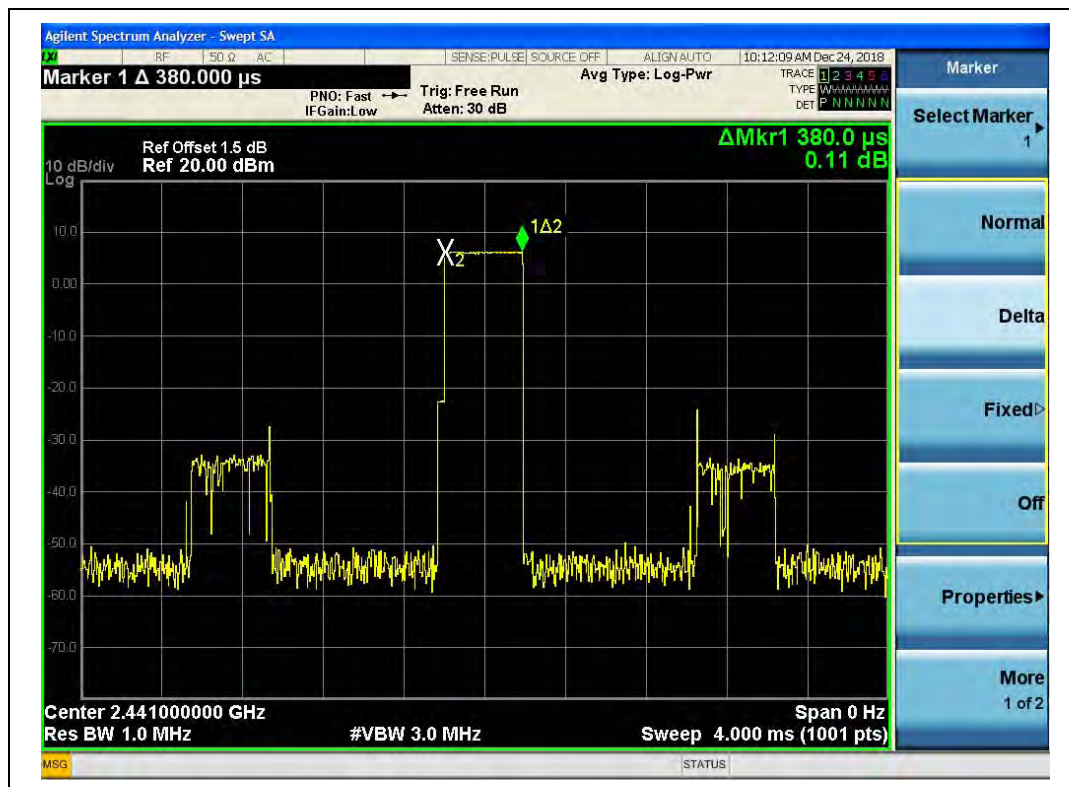
## 2.6.4. Test Result

### GFSK Mode

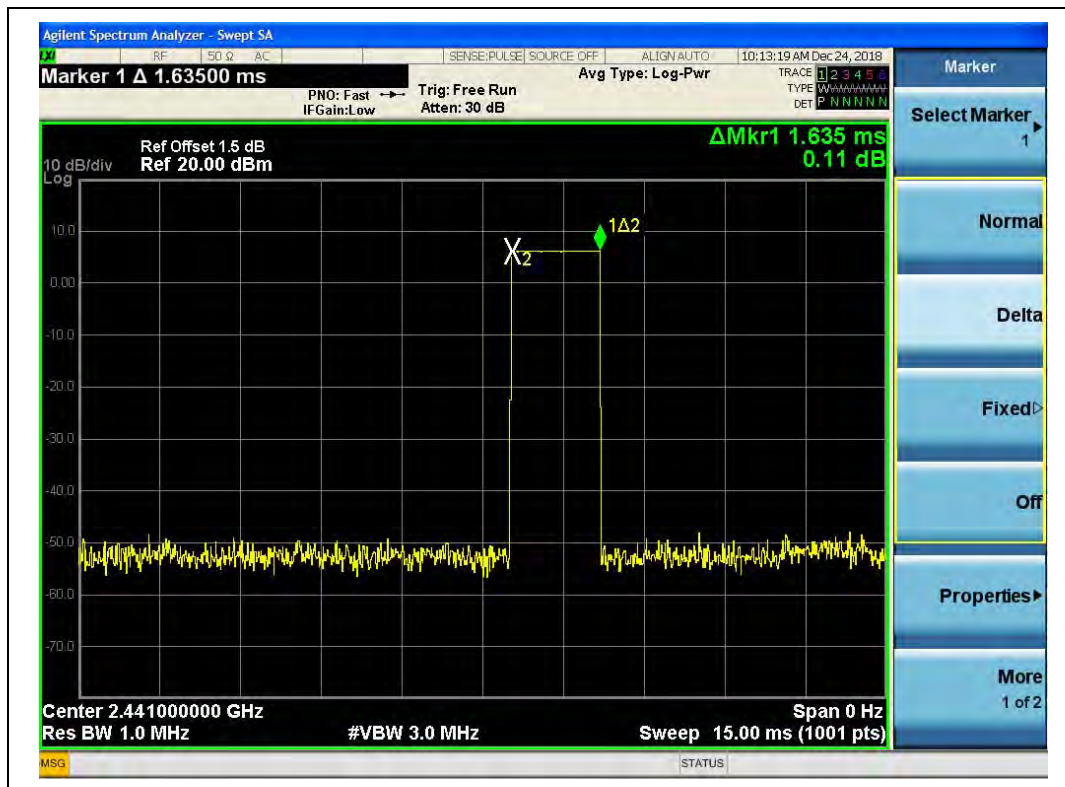
#### A. Test Verdict:

| DH Packet | Pulse Width (ms) | Dwell Time (ms) |          | Limit (sec) | Verdict |
|-----------|------------------|-----------------|----------|-------------|---------|
|           |                  | Normal Mode     | AFH Mode |             |         |
| DH1       | 0.38             | 121.60          | 60.80    | 0.4         | PASS    |
| DH3       | 1.64             | 262.40          | 131.20   |             | PASS    |
| DH5       | 2.90             | 309.33          | 154.67   |             | PASS    |

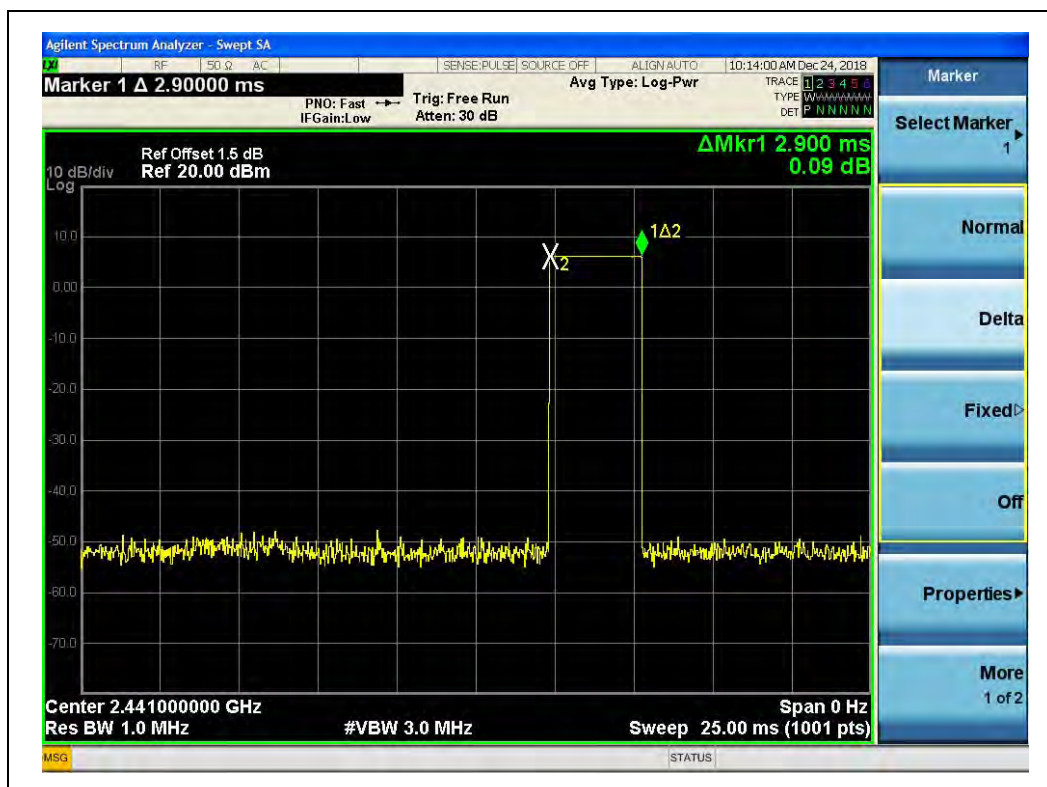
#### B. Test Plots:



(DH1, GFSK)



(DH3, GFSK)



(DH5, GFSK)

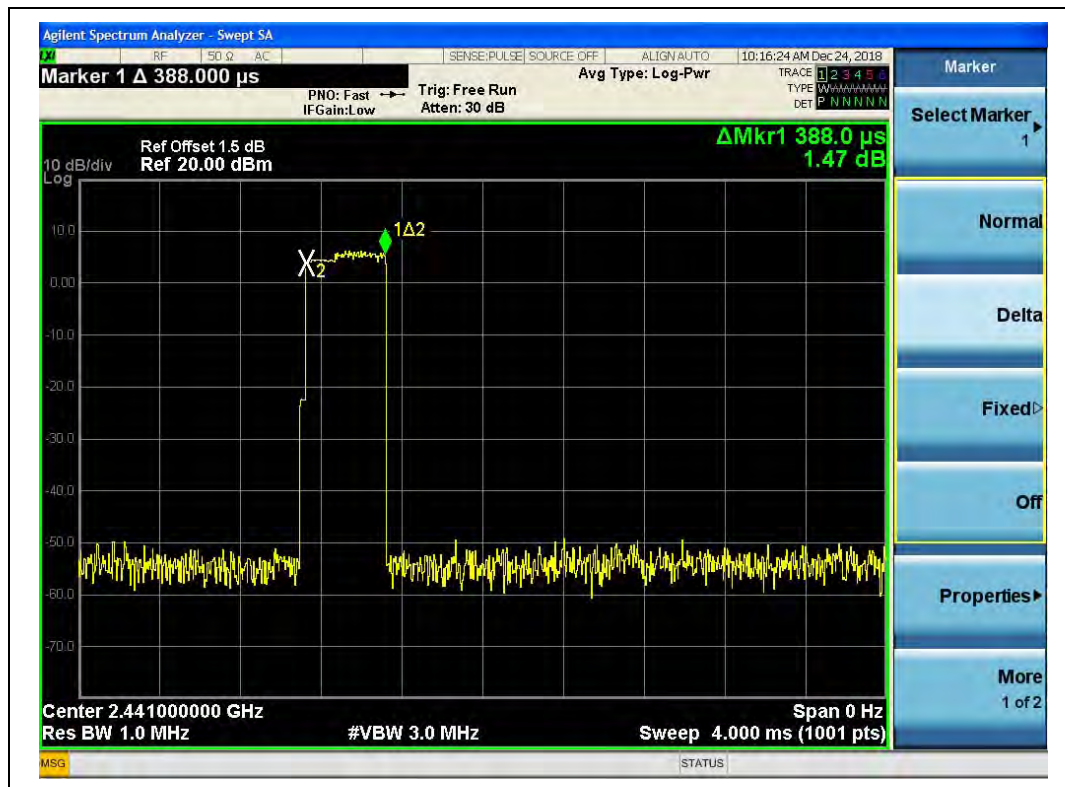


## $\pi/4$ -DQPSK Mode

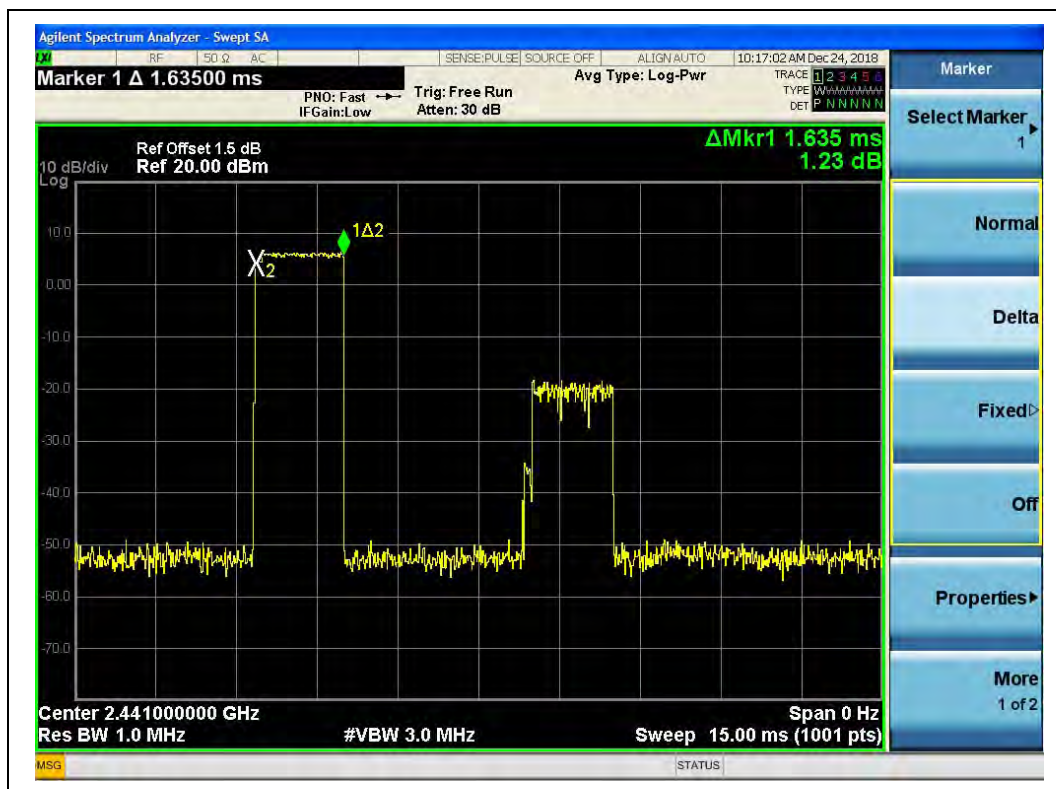
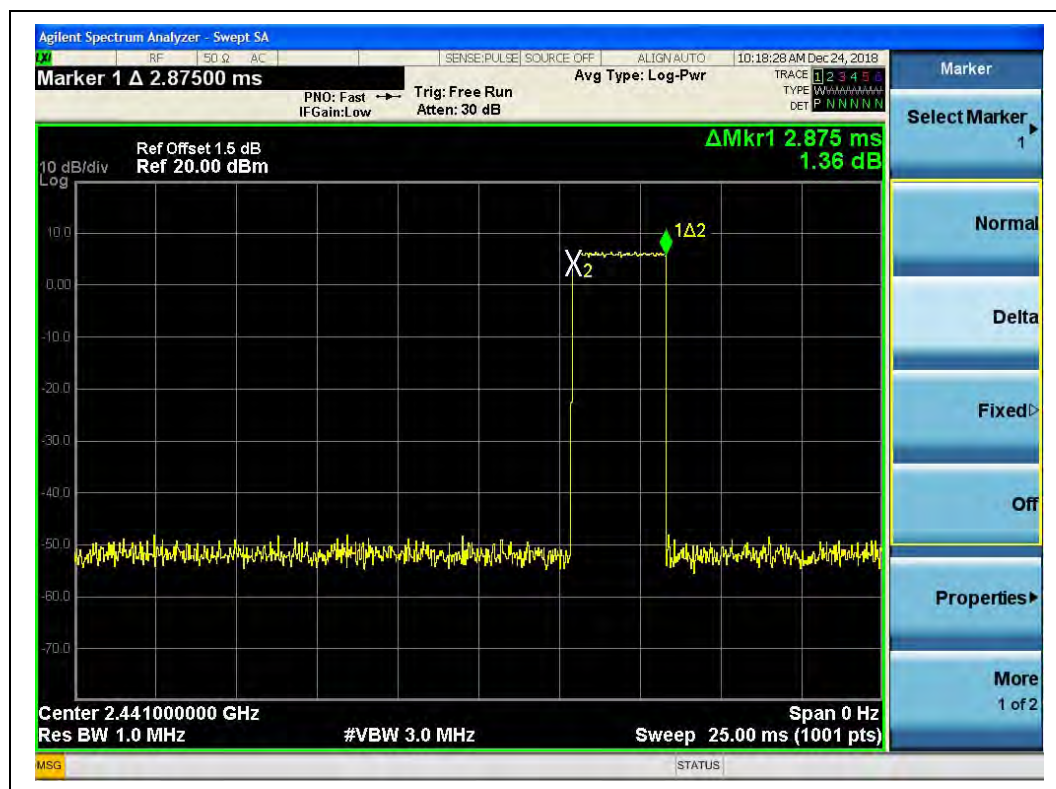
### A. Test Verdict:

| DH Packet | Pulse Width (ms) | Dwell Time (ms) |          | Limit (sec) | Verdict |
|-----------|------------------|-----------------|----------|-------------|---------|
|           |                  | Normal Mode     | AFH Mode |             |         |
| DH1       | 0.39             | 124.80          | 62.40    | 0.4         | PASS    |
| DH3       | 1.64             | 262.40          | 131.20   |             | PASS    |
| DH5       | 2.88             | 307.20          | 153.60   |             | PASS    |

### B. Test Plots:



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


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

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

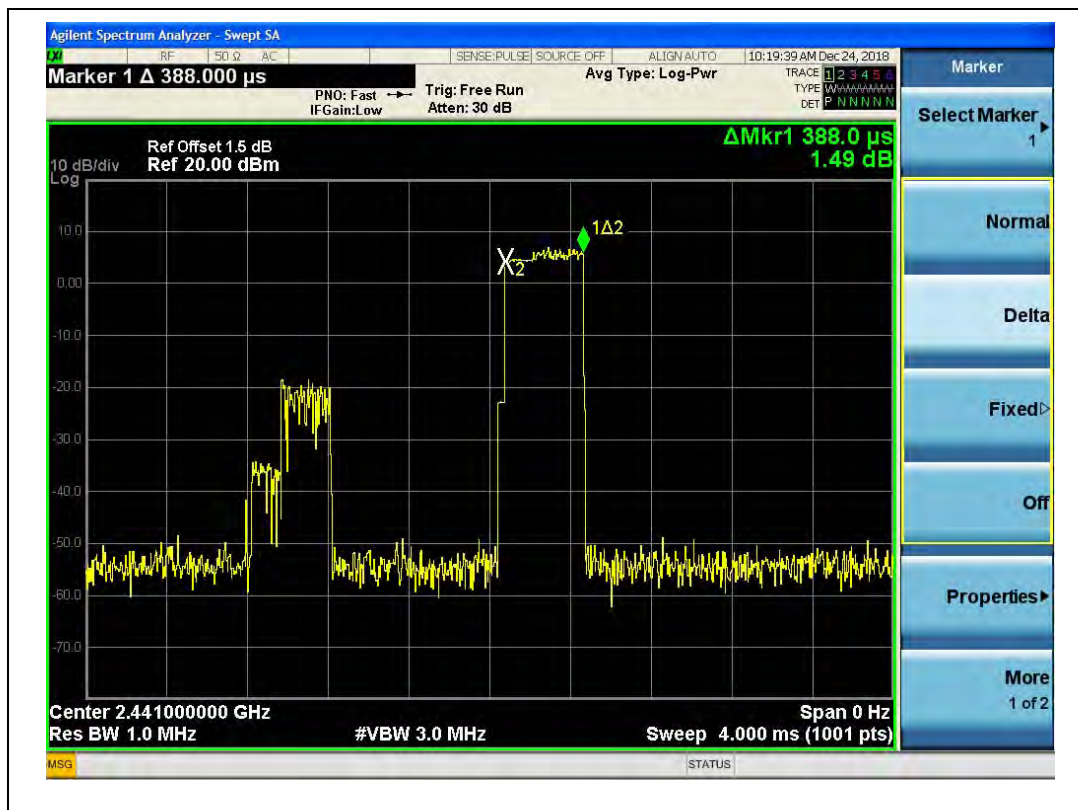


## 8-DPSK mode

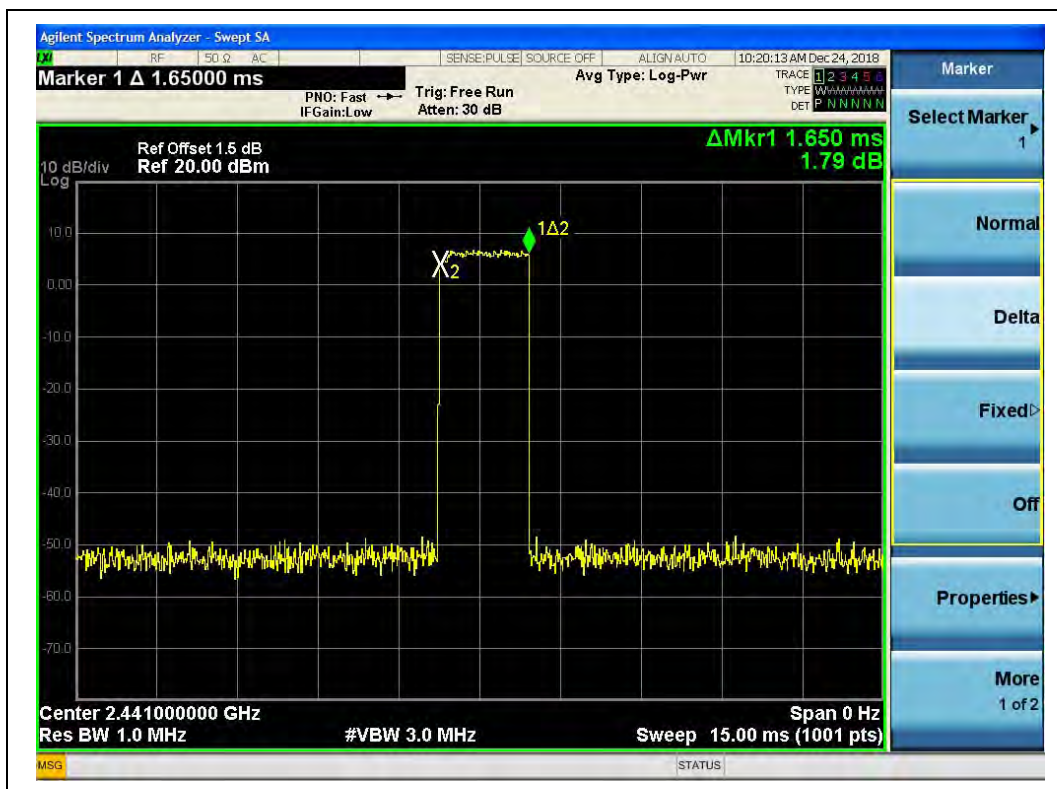
### A. Test Verdict:

| DH Packet | Pulse Width (ms) | Dwell Time (ms) |          | Limit (sec) | Verdict |
|-----------|------------------|-----------------|----------|-------------|---------|
|           |                  | Normal Mode     | AFH Mode |             |         |
| DH1       | 0.39             | 124.80          | 62.40    | 0.4         | PASS    |
| DH3       | 1.65             | 264.00          | 132.00   |             | PASS    |
| DH5       | 2.88             | 307.20          | 153.60   |             | PASS    |

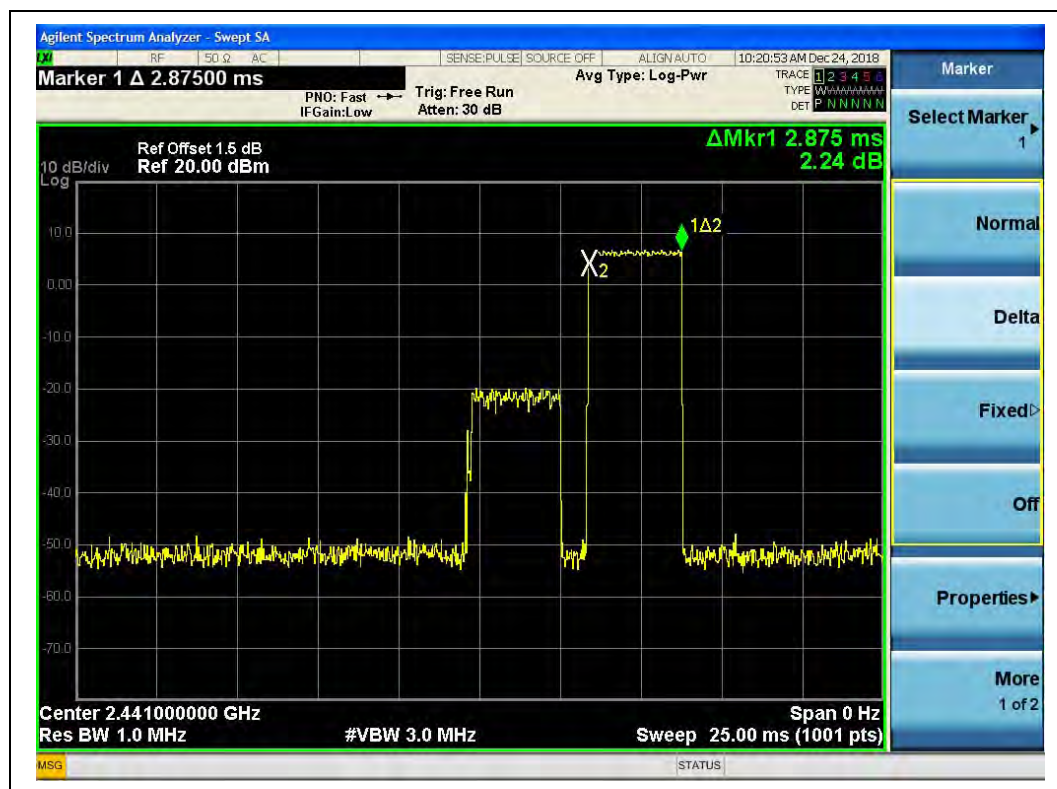
### B. Test Plots:



(DH1, 8-DPSK)



(DH3, 8-DPSK)



(DH5, 8-DPSK)

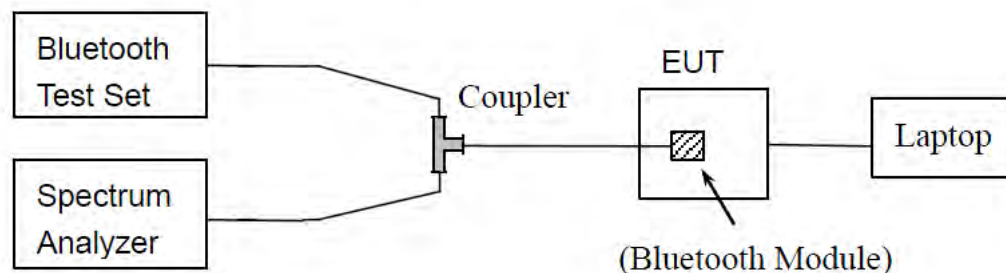
## 2.7. Conducted Spurious Emissions

### 2.7.1. 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 20dB 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.

### 2.7.2. Test Description

#### A. 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.

#### B. Equipments List:

Please refer ANNEX B(4).

### 2.7.3. 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.



#### 2.7.4. Test Result

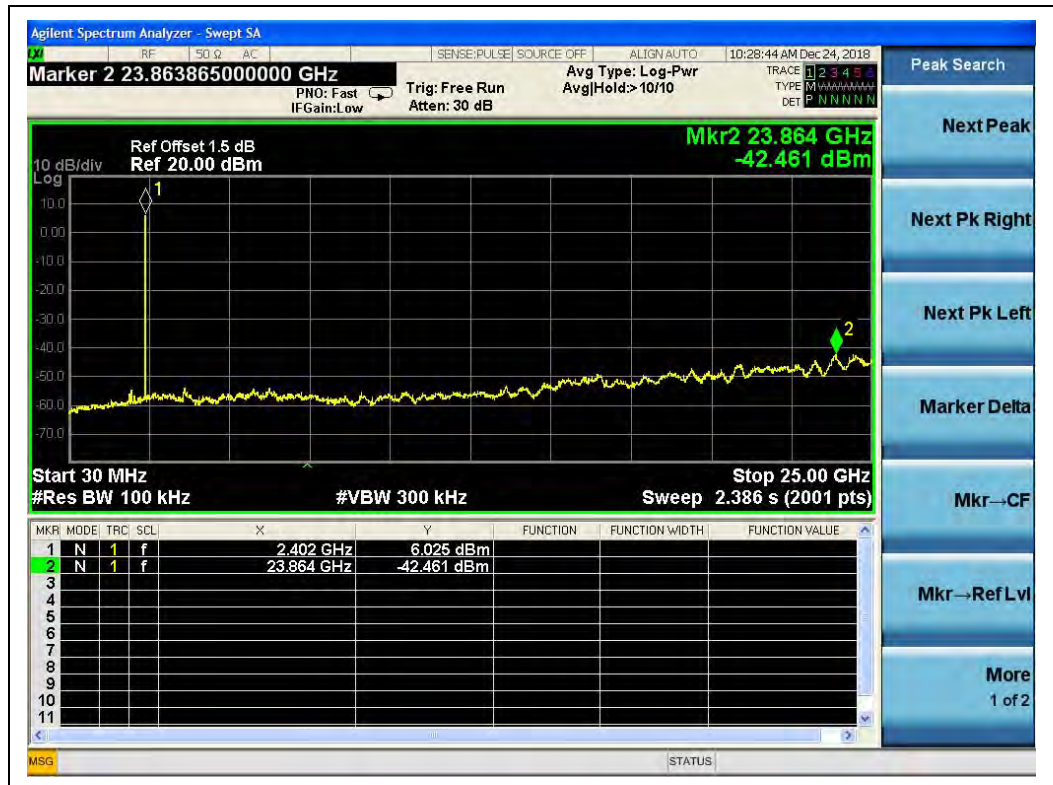
The Bluetooth Module operates at hopping-off test mode. The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions.

##### GFSK Mode

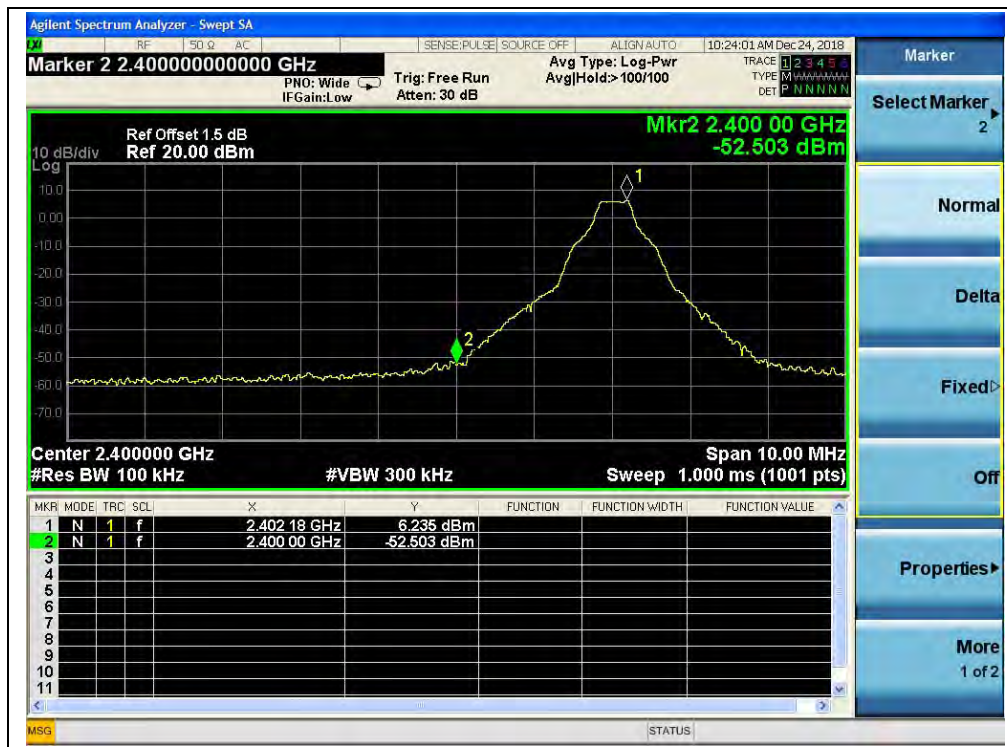
##### A. Test Verdict:

| Channel | Frequency (MHz) | Measured Max. Out of Band Emission (dBm) | Limit (dBm)   |                         | Verdict |
|---------|-----------------|------------------------------------------|---------------|-------------------------|---------|
|         |                 |                                          | Carrier Level | Calculated -20dBc Limit |         |
| 0       | 2402            | -42.46                                   | 6.03          | -13.97                  | PASS    |
| 39      | 2441            | -43.01                                   | 5.88          | -14.12                  | PASS    |
| 78      | 2480            | -42.61                                   | 4.72          | -15.28                  | PASS    |

##### B. Test Plots:



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



(Channel = 0, Band edge, GFSK Mode)



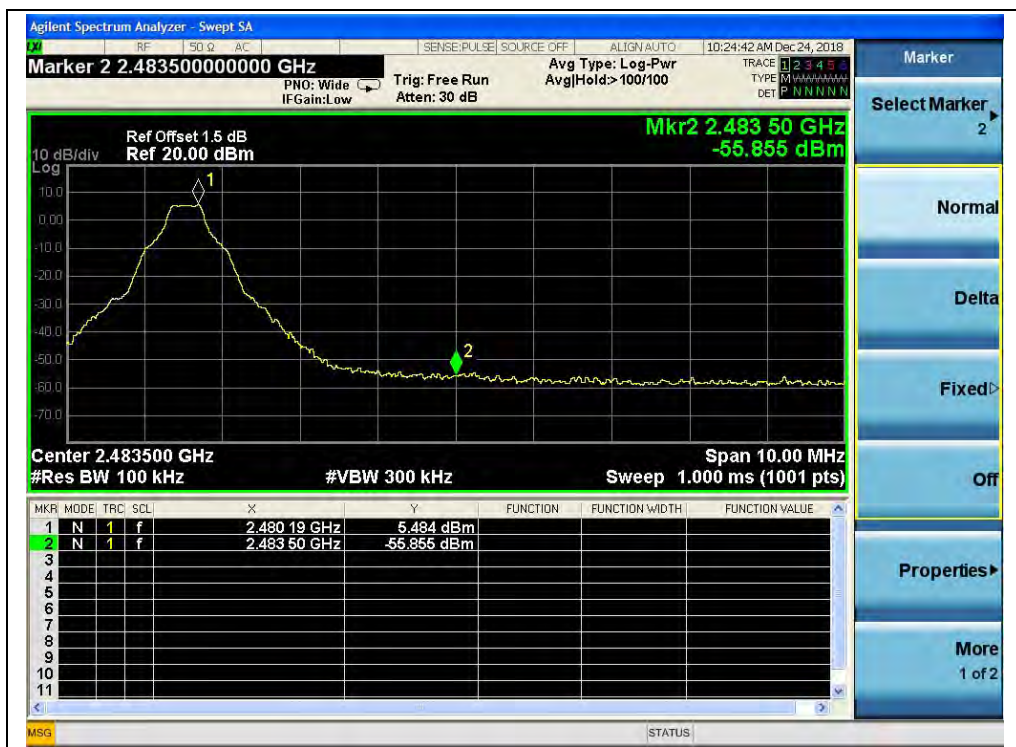
(Channel = 0, Band edge with hopping on, GFSK Mode)



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



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



(Channel = 78, Band edge, GFSK Mode)



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



$\pi/4$ -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            | -43.32                                   | 3.72          | -16.28                  | PASS    |
| 39      | 2441            | -42.64                                   | 3.63          | -16.37                  | PASS    |
| 78      | 2480            | -43.13                                   | 1.36          | -18.64                  | PASS    |

**B. Test Plots:**

**Note:** the power of the Module transmitting frequency should be ignored.



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



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



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



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



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



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



(Channel = 78, Band edge with hopping on,  $\pi/4$ -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            | -43.62                                   | 5.04          | -14.96                  | PASS    |
| 39      | 2441            | -43.16                                   | 4.47          | -15.53                  | PASS    |
| 78      | 2480            | -43.14                                   | 1.67          | -18.33                  | PASS    |

### B. Test Plots:

**Note:** the power of the Module transmitting frequency should be ignored.



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



(Channel = 0, Band edge, 8-DPSK)



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



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



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



(Channel = 78, Band edge, 8-DPSK)



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

## 2.8. Conducted Emission

### 2.8.1. 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).

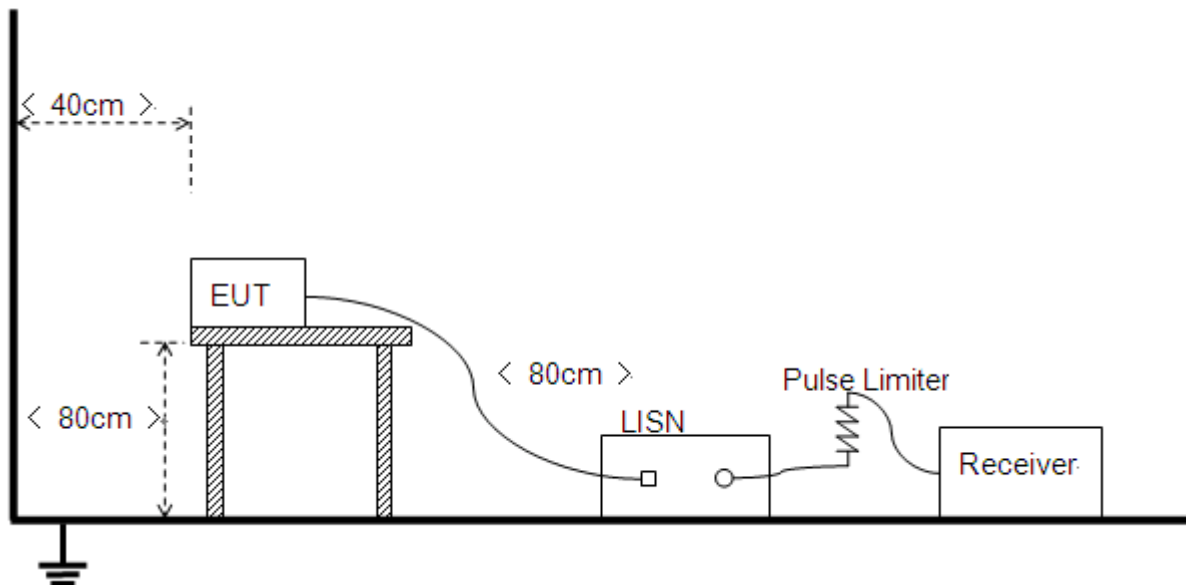
| Frequency<br>(MHz) | range | Conducted Limit (dB $\mu$ V) |          |
|--------------------|-------|------------------------------|----------|
|                    |       | Quai-peak                    | Average  |
| 0.15 - 0.50        |       | 66 to 56                     | 56 to 46 |
| 0.50 -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

#### NOTE:

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

### 2.8.2. Test Description

#### A. 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.



The factors of the site are calibrated to correct the reading. During the measurement, the Bluetooth EUT is activated and controlled by the Bluetooth Service Supplier (SS) via a Common Antenna, and is set to operate under hopping-on test mode transmitting 339 bytes DH5 packages at maximum power.

**B. Equipments List:**

Please reference ANNEX B(4).

**2.8.3. Test Result**

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

**Note:** Both of the test voltage AC 120V/60Hz and AC 230V/50Hz were considered and tested respectively, only the results of the worst case AC 120V/60Hz were recorded in this report.

**A. Test setup:**

Test Mode: EUT+ADAPTER+USB+BT TX

Test voltage: AC 120V/60Hz

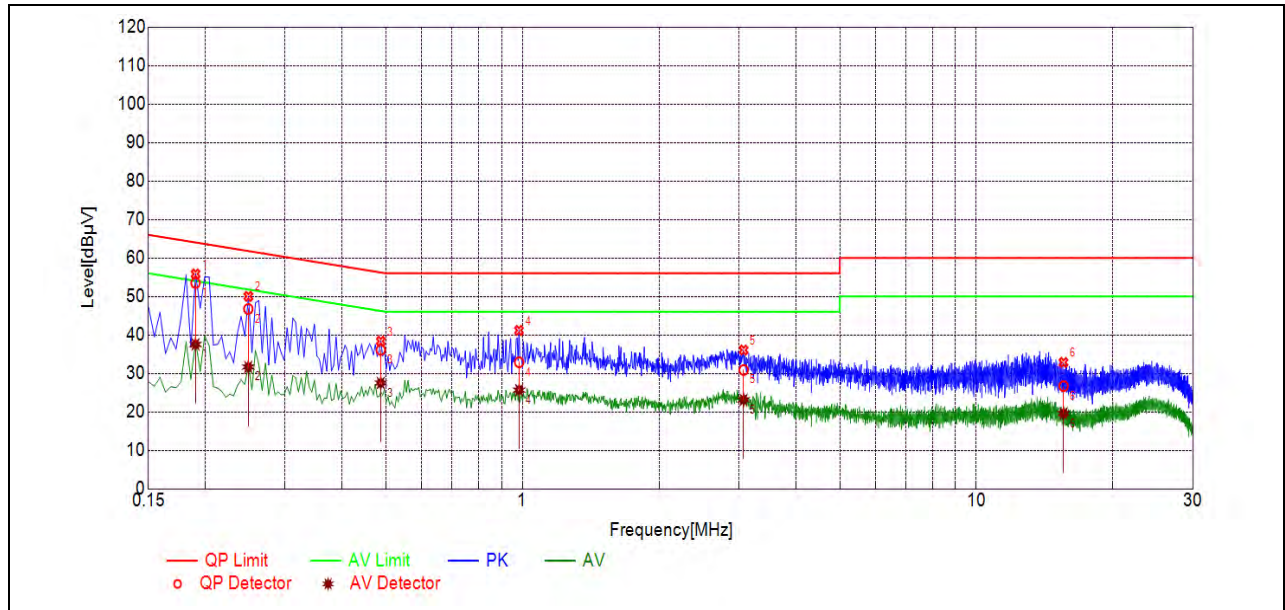
The measurement results are obtained as below:

$$E \text{ [dB}\mu\text{V]} = U_R + L_{\text{Cable loss}} \text{ [dB]} + A_{\text{Factor}}$$

$U_R$ : Receiver Reading

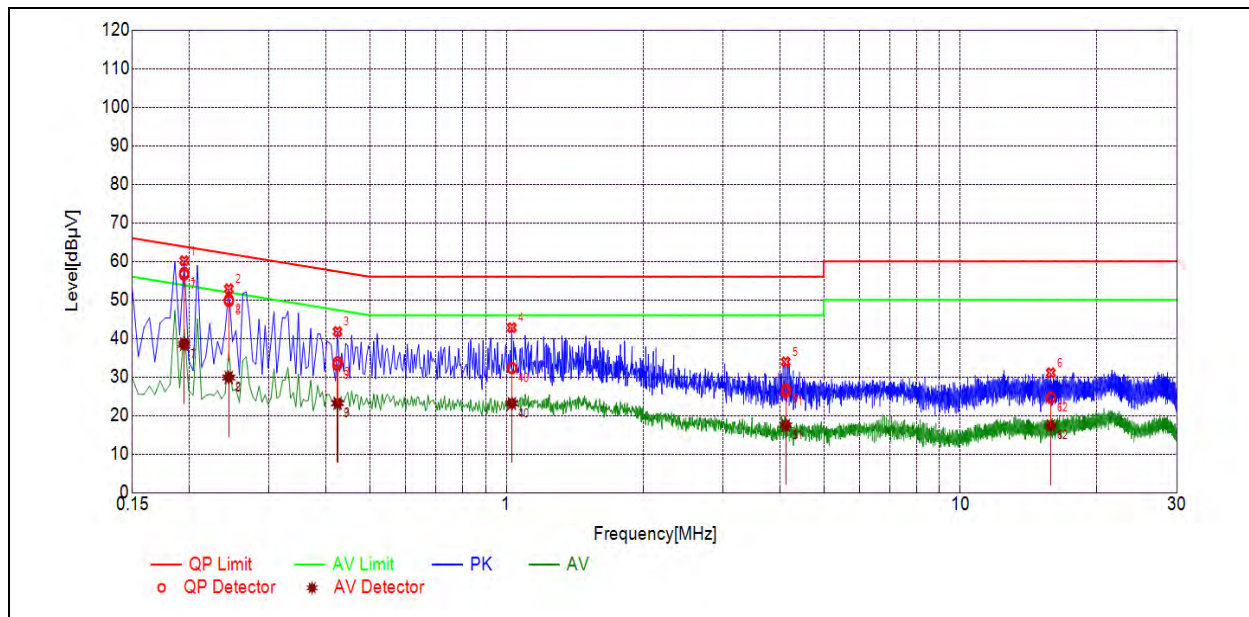
$A_{\text{Factor}}$ : Voltage division factor of LISN

## B. Test Plots:



(L Phase)

| NO. | Fre.<br>(MHz) | Emission Level (dBμV) |         | Limit (dBμV) |         | Power-line | Verdict |
|-----|---------------|-----------------------|---------|--------------|---------|------------|---------|
|     |               | Quai-peak             | Average | Quai-peak    | Average |            |         |
| 1   | 0.1904        | 53.50                 | 37.54   | 64.02        | 54.02   | Line       | PASS    |
| 2   | 0.2488        | 46.74                 | 31.66   | 61.80        | 51.80   |            | PASS    |
| 3   | 0.4873        | 36.09                 | 27.50   | 56.21        | 46.21   |            | PASS    |
| 4   | 0.9830        | 32.88                 | 25.65   | 56.00        | 46.00   |            | PASS    |
| 5   | 3.0707        | 30.87                 | 23.13   | 56.00        | 46.00   |            | PASS    |
| 6   | 15.5632       | 26.69                 | 19.58   | 60.00        | 50.00   |            | PASS    |



(N Phase)

| NO. | Fre.<br>(MHz) | Emission Level (dBμV) |         | Limit (dBμV) |         | Power-line | Verdict |
|-----|---------------|-----------------------|---------|--------------|---------|------------|---------|
|     |               | Quai-peak             | Average | Quai-peak    | Average |            |         |
| 1   | 0.1950        | 57.07                 | 38.77   | 63.82        | 53.82   | Neutral    | PASS    |
| 2   | 0.2444        | 50.10                 | 29.96   | 61.94        | 51.94   |            | PASS    |
| 3   | 0.4247        | 33.90                 | 23.30   | 57.36        | 47.36   |            | PASS    |
| 4   | 1.0285        | 32.26                 | 23.15   | 56.00        | 46.00   |            | PASS    |
| 5   | 4.1275        | 26.84                 | 17.44   | 56.00        | 46.00   |            | PASS    |
| 6   | 15.8156       | 24.53                 | 17.34   | 60.00        | 50.00   |            | PASS    |

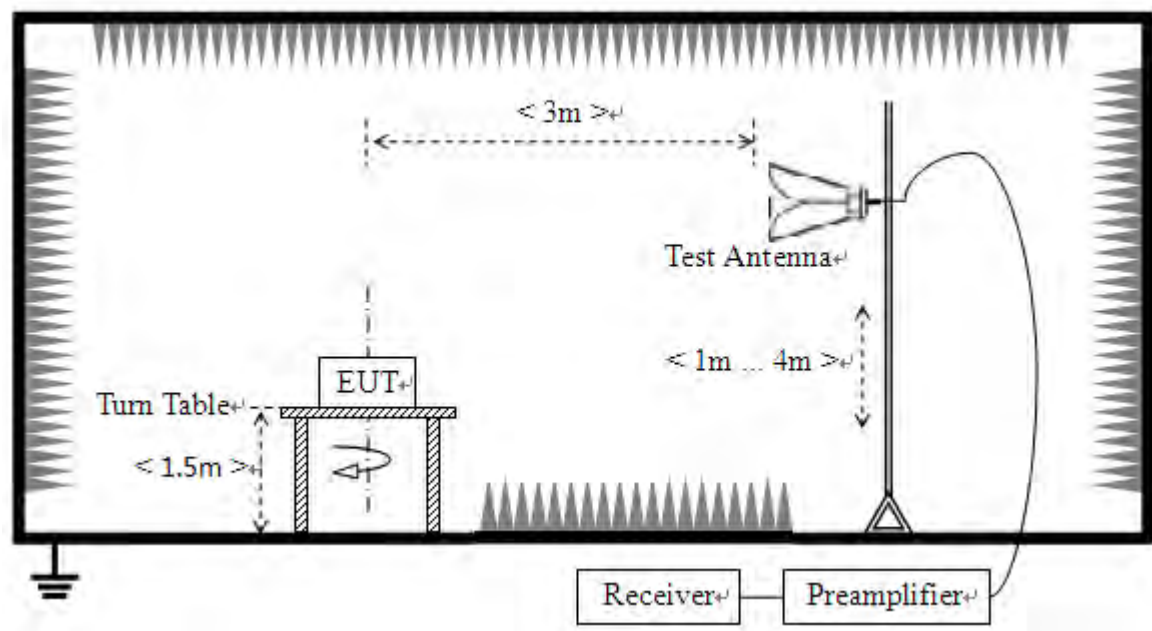
## 2.9. Restricted Frequency Bands

### 2.9.1. 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).

### 2.9.2. Test Description

#### A. 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. During the measurement, the Bluetooth Module of the EUT is activated and controlled by the Bluetooth Service Supplier (SS) via a Common Antenna, and is set to operate under non hopping-on test mode transmitting 339 bytes DH5, 679 bytes 2DH5 and 1021 bytes 3DH5 packages at maximum power.

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.

**B. Equipments List:**

Please refer ANNEX B(4).

**2.9.3. 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 for peak and 10Hz for average

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize.

**2.9.4. 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

Gpreamp: Preamplifier Gain

AFactor: Antenna Factor at 3m

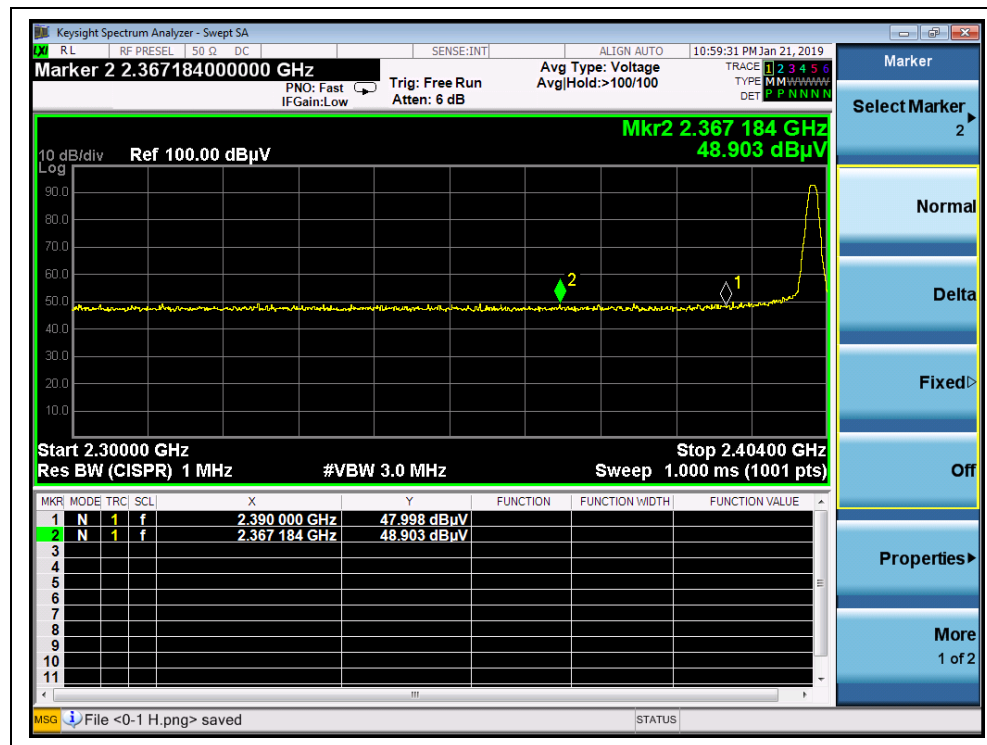
**Note:** Restricted Frequency Bands were performed when antenna was at vertical and horizontal polarity, and only the worse test condition (vertical) was recorded in this test report.

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

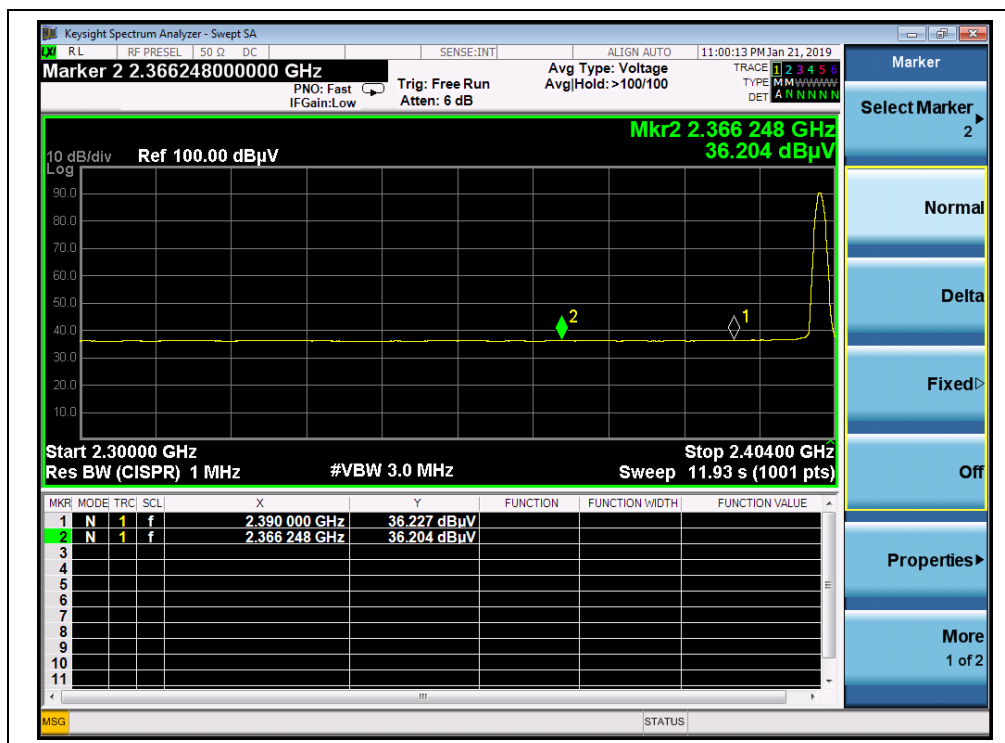
| Channel | Frequency (MHz) | Detector | Receiver Reading $U_R$ (dBuV) | $A_T$ (dB) | $A_{\text{Factor}}$ (dB@3m) | Max. Emission E (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Verdict |
|---------|-----------------|----------|-------------------------------|------------|-----------------------------|--------------------------------|----------------------|---------|
|         |                 | PK/ AV   |                               |            |                             |                                |                      |         |
| 0       | 2367.18         | PK       | 48.90                         | -29.67     | 32.56                       | 51.79                          | 74                   | PASS    |
| 0       | 2390.00         | AV       | 36.23                         | -29.67     | 32.56                       | 39.12                          | 54                   | PASS    |
| 78      | 2485.97         | PK       | 48.38                         | -29.67     | 32.56                       | 51.27                          | 74                   | PASS    |
| 78      | 2483.50         | AV       | 36.17                         | -29.67     | 32.56                       | 39.06                          | 54                   | PASS    |



## B. Test Plots:



(Channel = 0, PEAK, GFSK)



(Channel = 0, AVERAGE, GFSK)



(Channel = 78, PEAK, GFSK)



(Channel = 78, AVERAGE, GFSK)

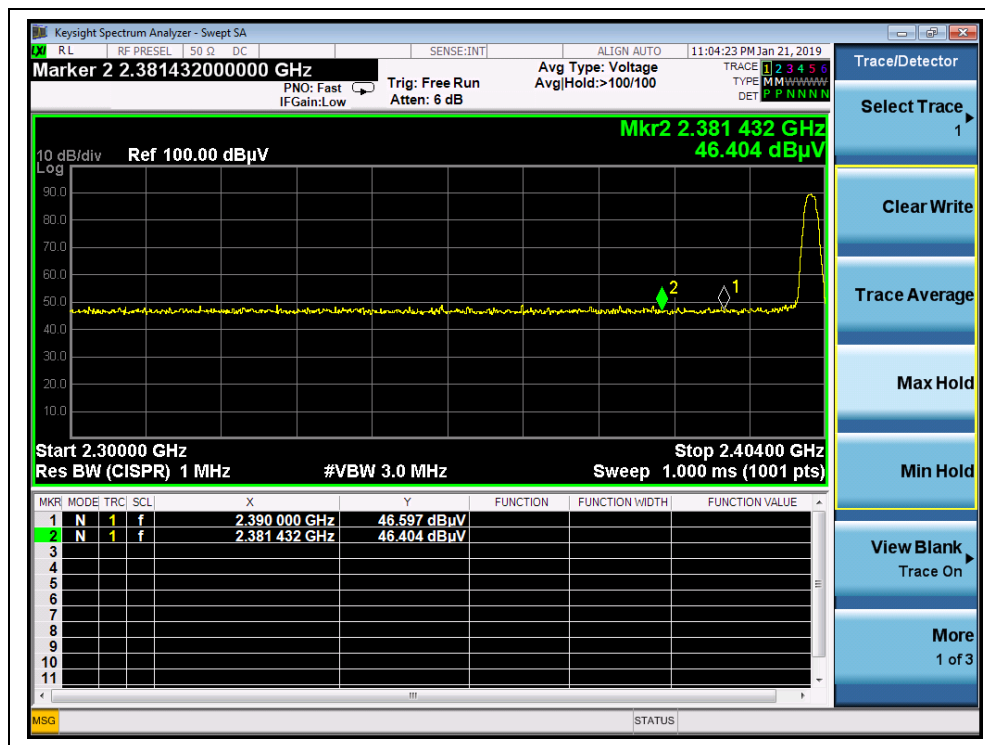


$\pi/4$ -DQPSK Mode

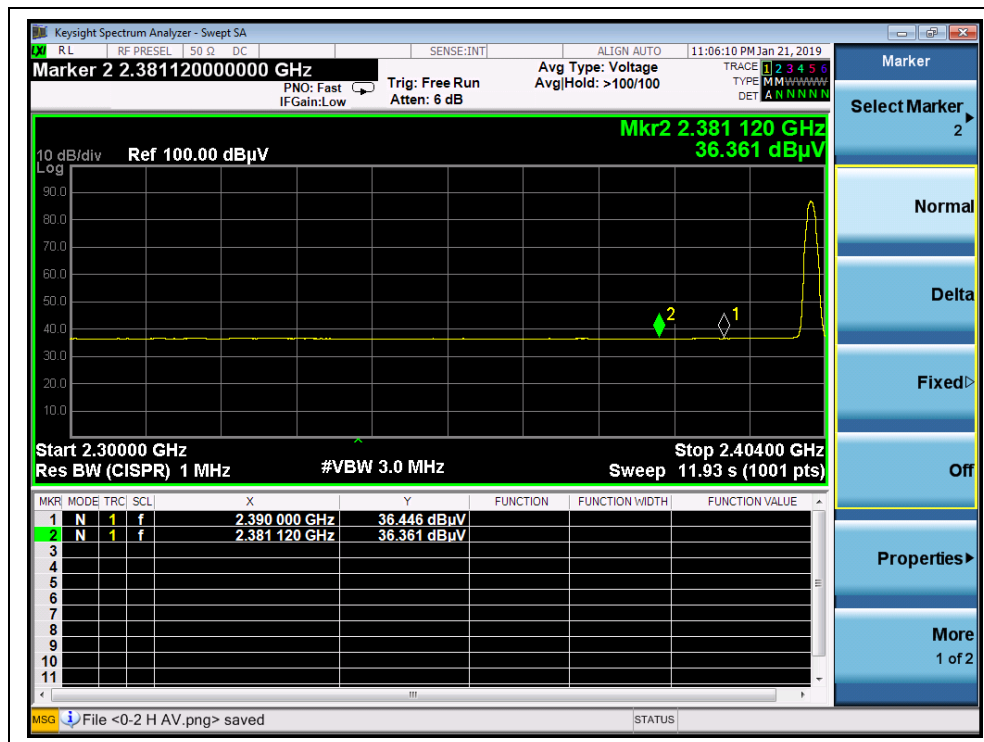
**A. Test Verdict:**

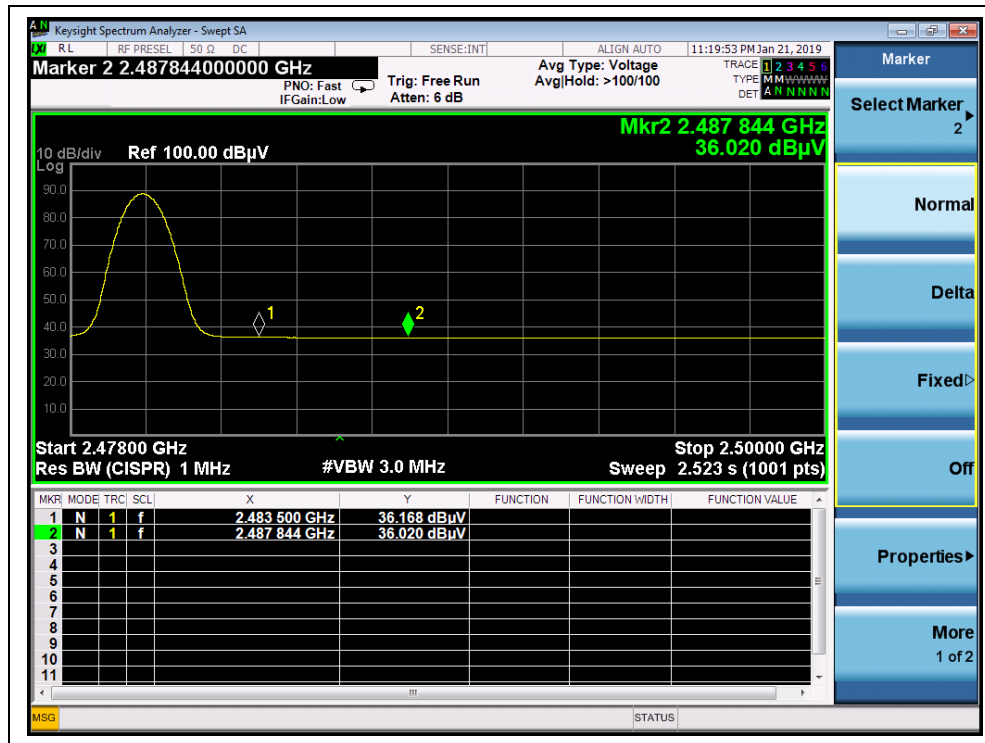
| Channel | Frequency (MHz) | Detector | Receiver Reading<br>$U_R$<br>(dBuV) | $A_T$<br>(dB) | $A_{Factor}$<br>(dB@3m) | Max. Emission<br>$E$<br>(dB $\mu$ V/m) | Limit<br>(dB $\mu$ V/m) | Verdict |
|---------|-----------------|----------|-------------------------------------|---------------|-------------------------|----------------------------------------|-------------------------|---------|
|         |                 | PK/ AV   |                                     |               |                         |                                        |                         |         |
| 0       | 2390.00         | PK       | 45.60                               | -29.67        | 32.56                   | 48.49                                  | 74                      | PASS    |
| 0       | 2390.00         | AV       | 36.45                               | -29.67        | 32.56                   | 39.34                                  | 54                      | PASS    |
| 78      | 2483.50         | PK       | 47.45                               | -29.67        | 32.56                   | 50.34                                  | 74                      | PASS    |
| 78      | 2483.50         | AV       | 36.17                               | -29.67        | 32.56                   | 39.06                                  | 54                      | PASS    |

**B. Test Plots:**



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

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

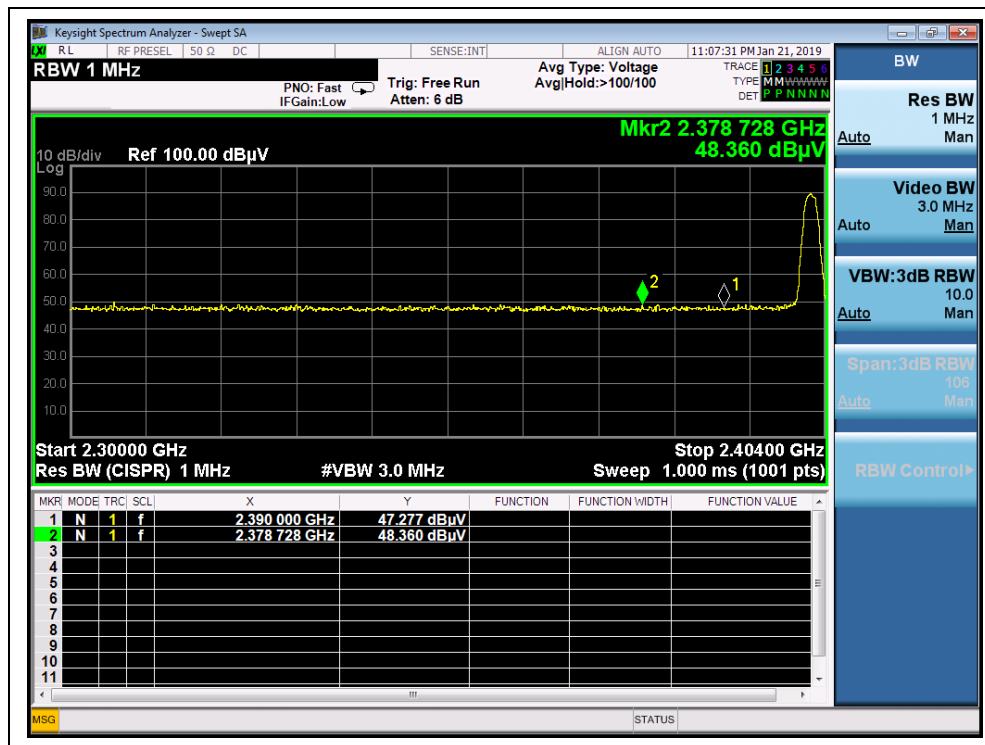


(Channel = 78, AVERAGE,  $\pi/4$ -DQPSK)

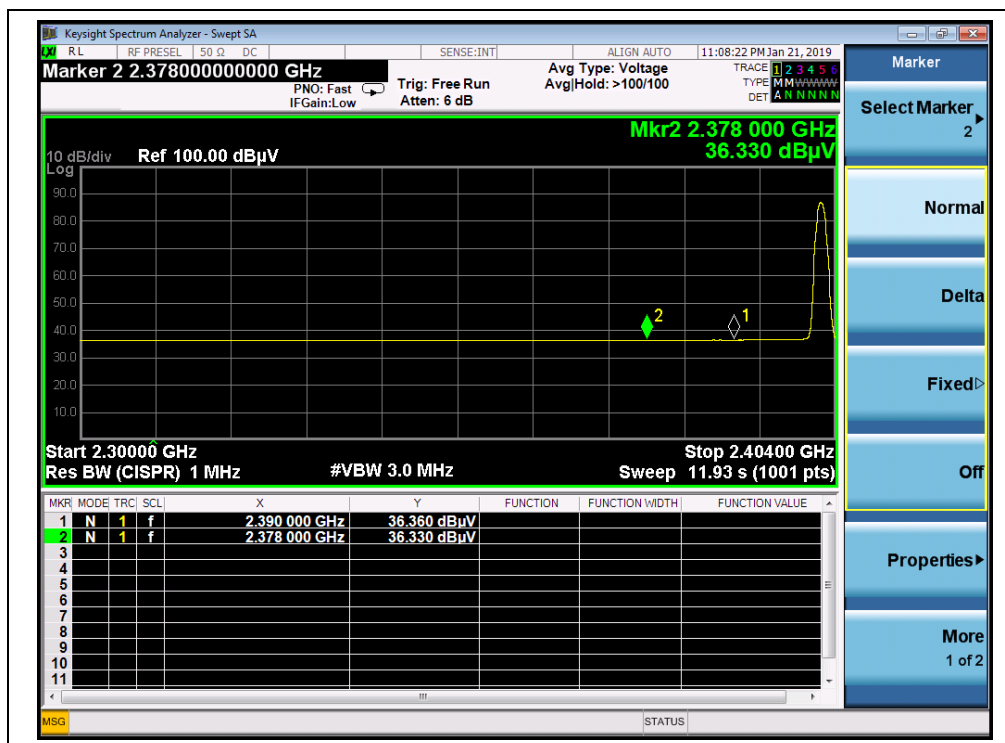
## 8-DPSK Mode

### A. Test Verdict:

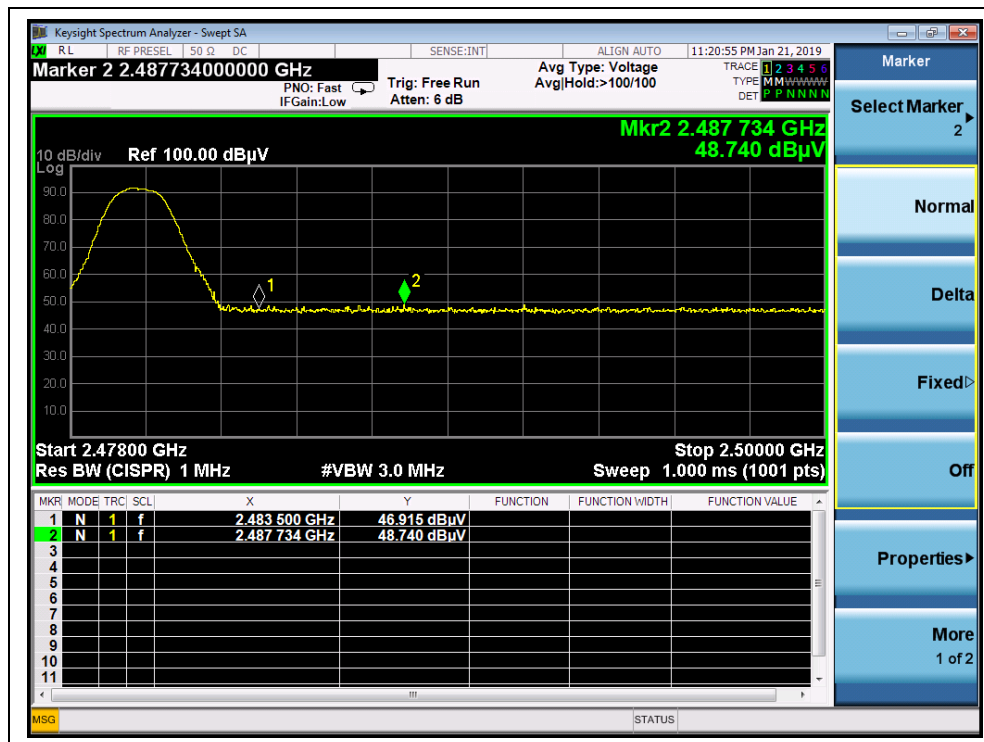
| Channel | Frequency (MHz) | Detector | Receiver Reading<br>$U_R$<br>(dBμV) | $A_T$<br>(dB) | $A_{Factor}$<br>(dB@3m) | Max. Emission<br>$E$<br>(dBμV/m) | Limit<br>(dBμV/m) | Verdict |
|---------|-----------------|----------|-------------------------------------|---------------|-------------------------|----------------------------------|-------------------|---------|
|         |                 | PK/ AV   |                                     |               |                         |                                  |                   |         |
| 0       | 2378.73         | PK       | 48.36                               | -29.67        | 32.56                   | 51.25                            | 74                | PASS    |
| 0       | 2390.00         | AV       | 36.36                               | -29.67        | 32.56                   | 39.25                            | 54                | PASS    |
| 78      | 2487.73         | PK       | 48.74                               | -29.67        | 32.56                   | 51.63                            | 74                | PASS    |
| 78      | 2483.50         | AV       | 36.18                               | -29.67        | 32.56                   | 39.07                            | 54                | PASS    |

**B. Test Plots:**

(Channel = 0, PEAK, 8-DPSK)



(Channel = 0, AVERAGE, 8-DPSK)



(Channel = 78, PEAK, 8-DPSK)



(Channel = 78, AVERAGE, 8-DPSK)

## 2.10. Radiated Emission

### 2.10.1. 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                        |

**Note:**

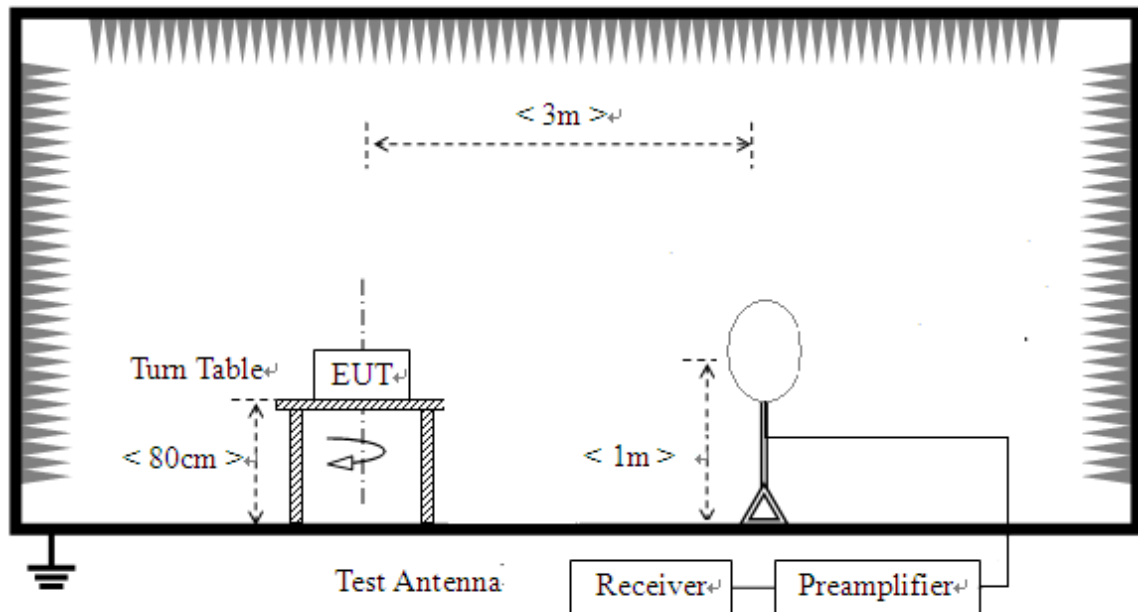
1. For Above 1000MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
2. For above 1000MHz, limit field strength 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)

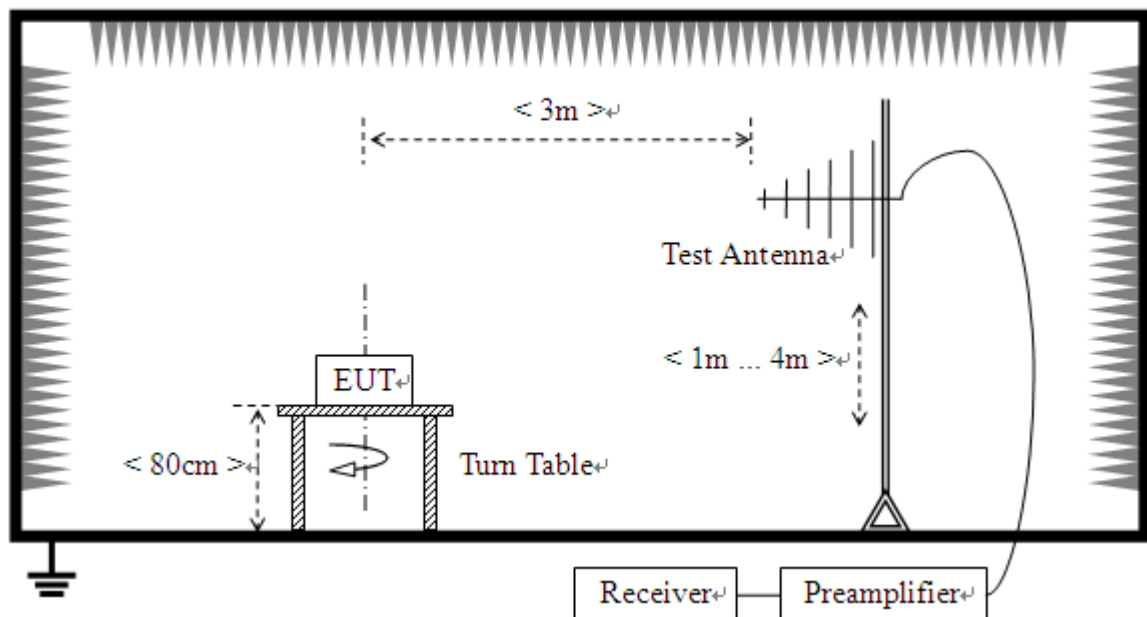
## 2.10.2. Test Description

### A. Test Setup:

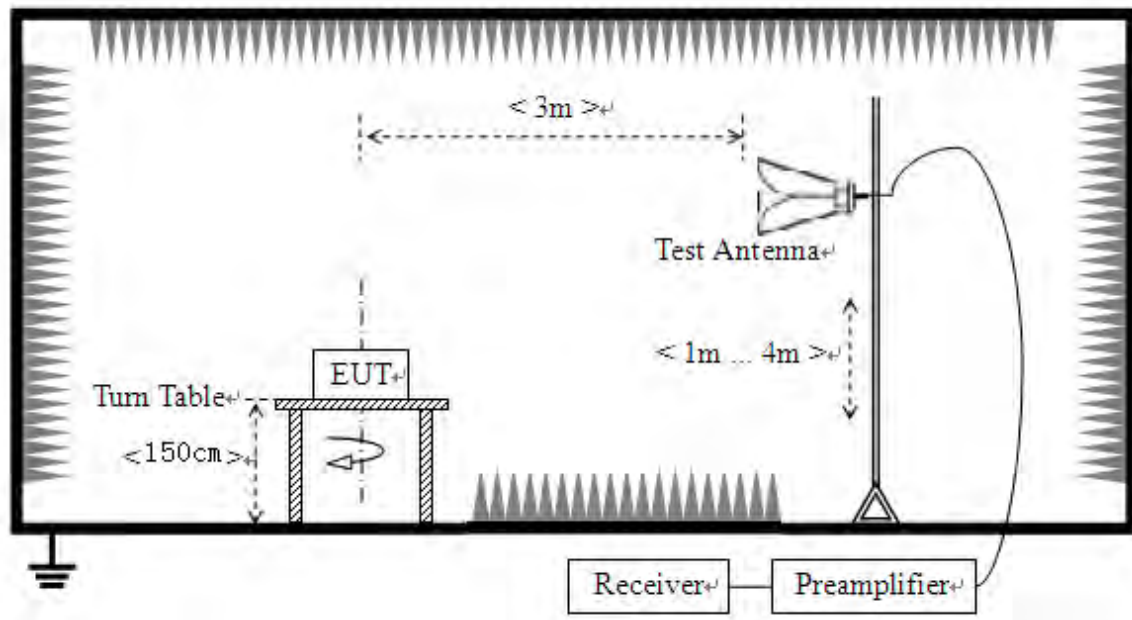
- 1) For radiated emissions from 9kHz to 30MHz



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



### 3) For radiated emissions above 1GHz



The RF absorbing material used on the reference ground plane and on the turntable have a maximum height (thickness) of 30 cm (12 in) and have a minimum-rated attenuation of 20 dB at all frequencies from 1 GHz to 18 GHz.

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4dB according to the standards: ANSI C63.10 (2013). For radiated emissions below or equal to 1GHz, the EUT was set-up on insulator 80cm above the Ground Plane, For radiated emissions above 1GHz, The EUT was set-up on insulator 150cm above the Ground Plane. The set-up and test methods were according to ANSI C63.10.

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:

- In the frequency range of 9kHz to 30MHz, magnetic field is measured with Loop Test Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
- In the frequency range above 30MHz, Bi-Log Test Antenna (30MHz to 1GHz) and Horn Test Antenna (above 1GHz) are used. Place the test antenna at 3m away from area of the EUT, while keeping the test antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The test 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 test antenna elevation shall be that which maximizes the emissions. The test 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. The emission levels at both horizontal and vertical polarizations should be tested.

## B. Equipments List:

Please reference ANNEX B(4).

### 2.10.3. Test Procedure

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

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

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

### 2.10.4. 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 limit, it is unnecessary to perform an quasi-peak measurement.

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.

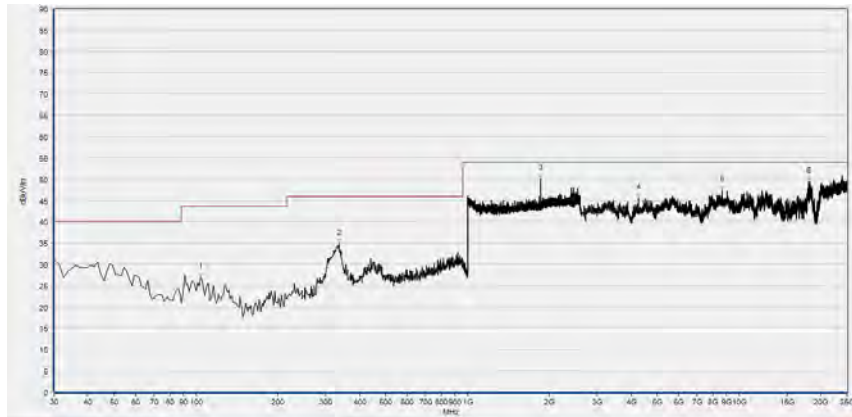
**Note1:** All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

**Note2:** For the frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

**Note3:** For the frequency, which started from 25GHz to 40GHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

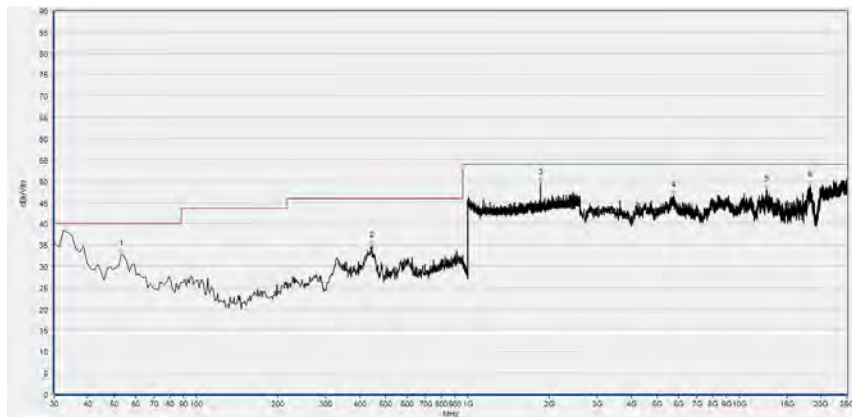
**GFSK Mode**

Plots for Channel = 0



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna    | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 104.055    | 27.01       | N/A         | N/A         | N/A               | 43.50             | N/A               | Horizontal | PASS    |
| 335.932    | 34.80       | N/A         | N/A         | N/A               | 46.00             | N/A               | Horizontal | PASS    |
| 1856.022   | 50.14       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 4266.048   | 45.52       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 8657.247   | 47.51       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 18001.782  | 49.48       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

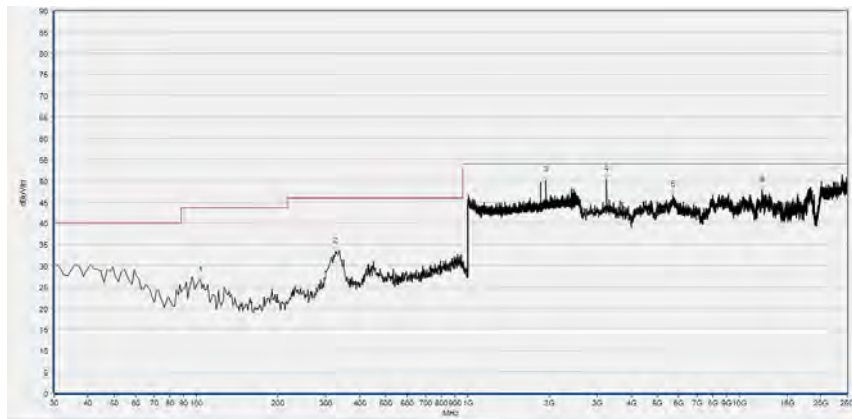
(30MHz to 25GHz, Antenna Horizontal, GFSK, channel 0)



| 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 |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|----------|---------|
| 53.066     | 32.84       | N/A         | N/A         | N/A               | 40.00             | N/A               | Vertical | PASS    |
| 443.980    | 34.92       | N/A         | N/A         | N/A               | 46.00             | N/A               | Vertical | PASS    |
| 1856.022   | 49.55       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 5724.350   | 46.52       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 12592.217  | 48.14       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 18258.411  | 48.86       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |

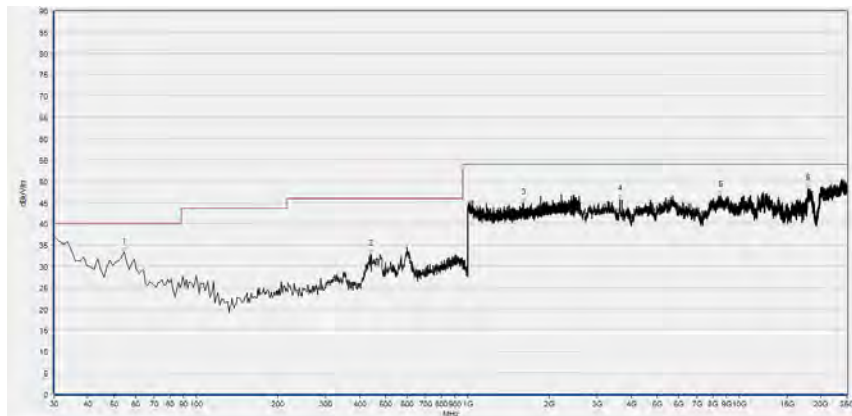
(30MHz to 25GHz, Antenna Vertical, GFSK, channel 0)

### 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 |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 104.055    | 26.48       | N/A         | N/A         | N/A               | 43.50             | N/A               | Horizontal | PASS    |
| 326.220    | 33.40       | N/A         | N/A         | N/A               | 46.00             | N/A               | Horizontal | PASS    |
| 1944.378   | 50.08       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 3251.755   | 50.34       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 5703.983   | 46.63       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 12180.797  | 47.77       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

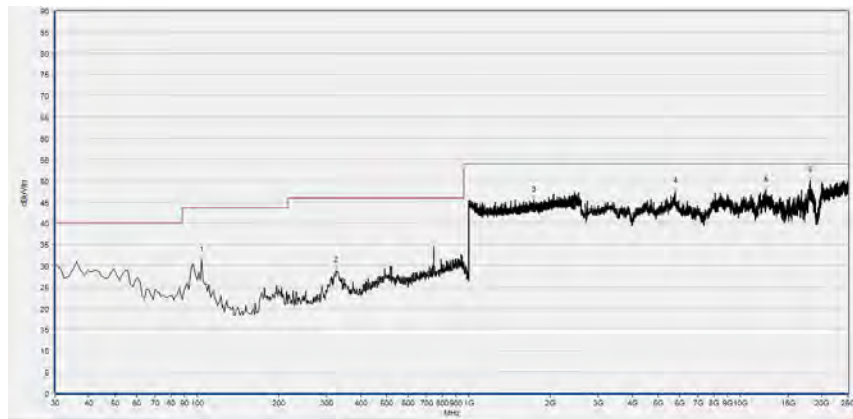
(30MHz to 25GHz, Antenna Horizontal, GFSK, channel 39)



| 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 |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|----------|---------|
| 54.280     | 33.43       | N/A         | N/A         | N/A               | 40.00             | N/A               | Vertical | PASS    |
| 440.338    | 32.83       | N/A         | N/A         | N/A               | 46.00             | N/A               | Vertical | PASS    |
| 1609.524   | 44.86       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 3646.881   | 45.80       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 8571.704   | 46.68       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 17969.194  | 48.33       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |

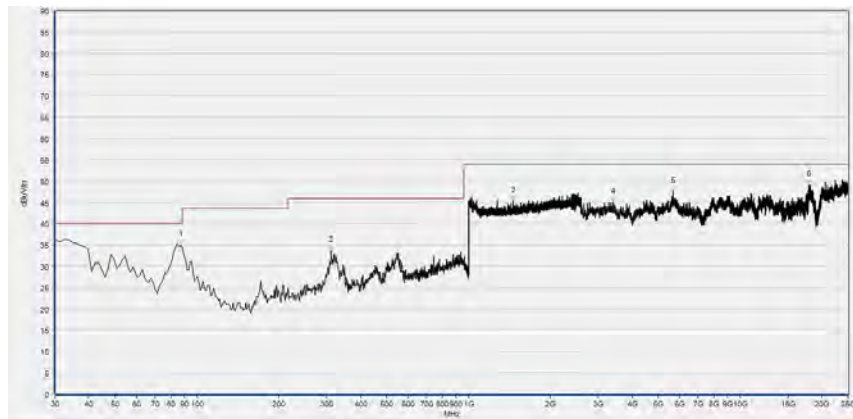
(30MHz to 25GHz, Antenna Vertical, GFSK, channel 39)

### 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 |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 104.055    | 31.14       | N/A         | N/A         | N/A               | 43.50             | N/A               | Horizontal | PASS    |
| 325.006    | 28.82       | N/A         | N/A         | N/A               | 46.00             | N/A               | Horizontal | PASS    |
| 1743.337   | 45.48       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 5756.938   | 47.50       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 12486.307  | 47.71       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 18160.647  | 50.05       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

(30MHz to 25GHz, Antenna Horizontal, GFSK, channel 78)

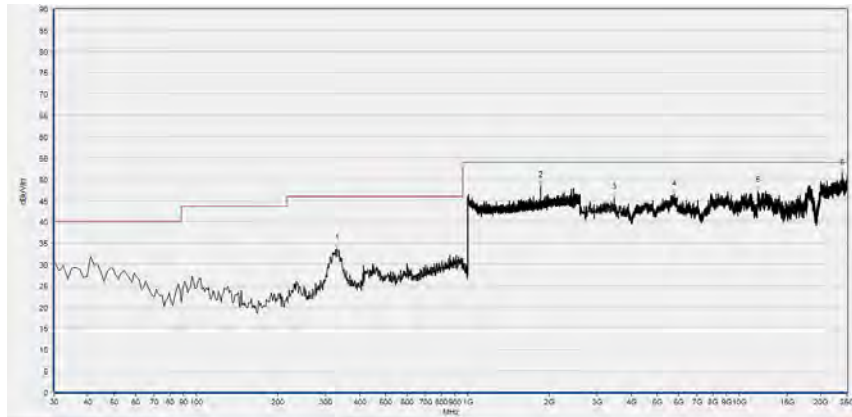


| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna  | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|----------|---------|
| 87.059     | 35.05       | N/A         | N/A         | N/A               | 40.00             | N/A               | Vertical | PASS    |
| 311.652    | 33.73       | N/A         | N/A         | N/A               | 46.00             | N/A               | Vertical | PASS    |
| 1455.222   | 45.46       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 3398.400   | 45.03       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 5675.468   | 47.66       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 17969.194  | 49.11       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |

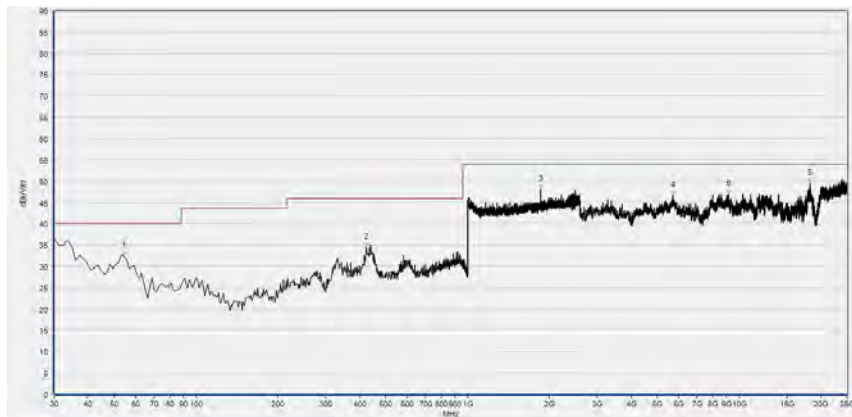
(30MHz to 25GHz, Antenna Vertical, GFSK, channel 78)

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

Plots for Channel = 0



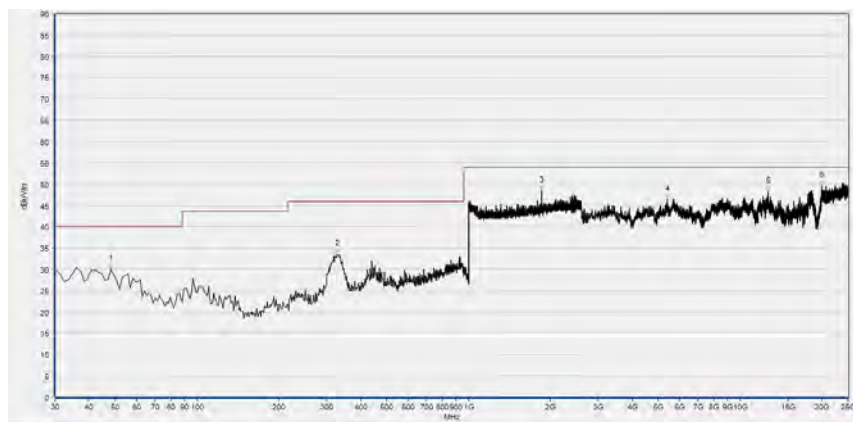
| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna    | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 329.862    | 33.61       | N/A         | N/A         | N/A               | 46.00             | N/A               | Horizontal | PASS    |
| 1856.022   | 48.44       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 3467.649   | 45.61       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 5761.011   | 46.34       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 11736.789  | 47.23       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 23961.266  | 51.25       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

(30MHz to 25GHz, Antenna Horizontal,  $\pi/4$ -DQPSK, 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 |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|----------|---------|
| 54.280     | 32.27       | N/A         | N/A         | N/A               | 40.00             | N/A               | Vertical | PASS    |
| 423.342    | 34.43       | N/A         | N/A         | N/A               | 46.00             | N/A               | Vertical | PASS    |
| 1856.022   | 48.14       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 5683.615   | 46.57       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 9154.210   | 46.89       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 18201.382  | 49.42       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |

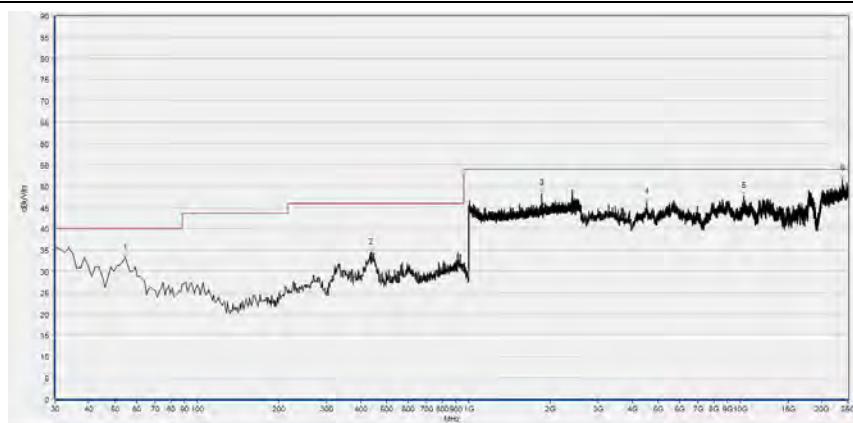
(30MHz to 25GHz, Antenna Vertical,  $\pi/4$ -DQPSK, channel 0)

### 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 |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 48.210     | 29.97       | N/A         | N/A         | N/A               | 40.00             | N/A               | Horizontal | PASS    |
| 328.648    | 33.51       | N/A         | N/A         | N/A               | 46.00             | N/A               | Horizontal | PASS    |
| 1856.022   | 48.42       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 5402.546   | 46.47       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 12694.053  | 48.24       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 20030.369  | 49.65       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

(30MHz to 25GHz, Antenna Horizontal,  $\pi/4$ -DQPSK, channel 39)

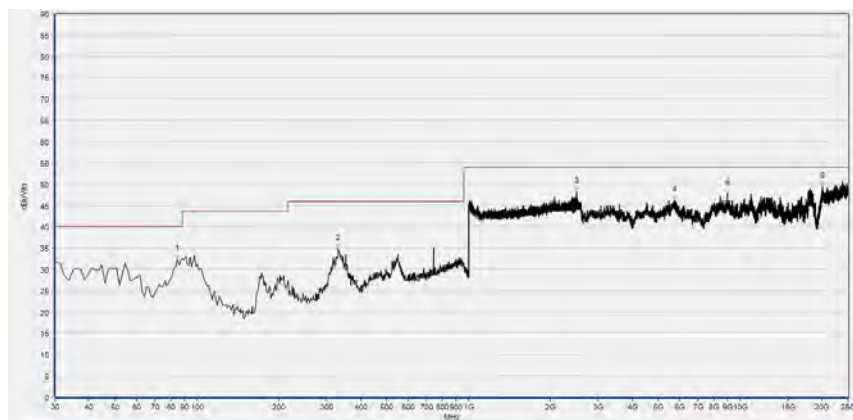


| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna  | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|----------|---------|
| 54.280     | 33.12       | N/A         | N/A         | N/A               | 40.00             | N/A               | Vertical | PASS    |
| 435.482    | 34.30       | N/A         | N/A         | N/A               | 46.00             | N/A               | Vertical | PASS    |
| 1856.022   | 48.25       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 4538.971   | 46.27       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 10327.369  | 47.56       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 23875.723  | 51.70       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |

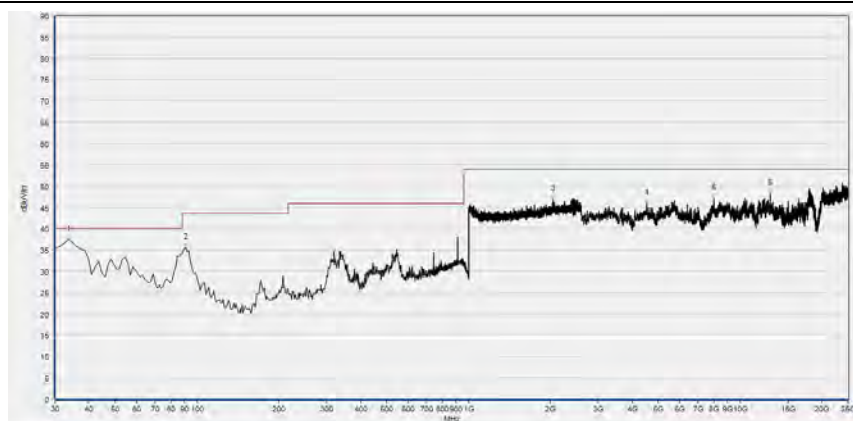
(30MHz to 25GHz, Antenna Vertical,  $\pi/4$ -DQPSK, channel 39)



## 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 |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 84.631     | 32.36       | N/A         | N/A         | N/A               | 40.00             | N/A               | Horizontal | PASS    |
| 331.076    | 34.80       | N/A         | N/A         | N/A               | 46.00             | N/A               | Horizontal | PASS    |
| 2494.998   | 48.19       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 5736.570   | 46.27       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 8991.271   | 47.75       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 20144.426  | 49.39       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

(30MHz to 25GHz, Antenna Horizontal,  $\pi/4$ -DQPSK, channel 78)

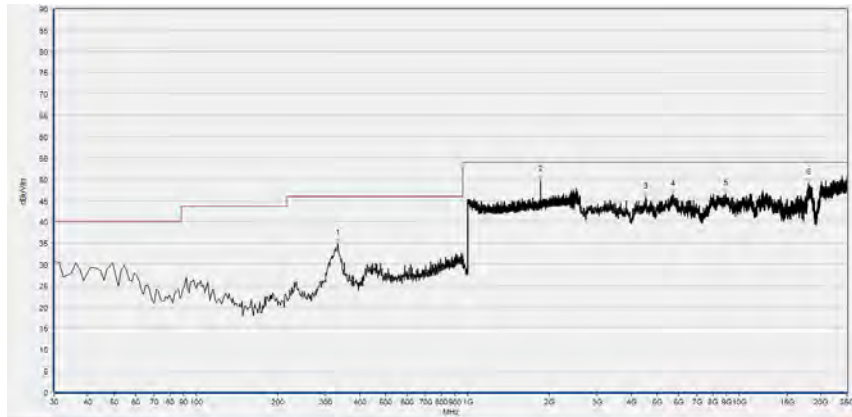
| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna  | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|----------|---------|
| 33.642     | 37.45       | N/A         | N/A         | N/A               | 40.00             | N/A               | Vertical | PASS    |
| 90.701     | 35.56       | N/A         | N/A         | N/A               | 43.50             | N/A               | Vertical | PASS    |
| 2051.941   | 46.95       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 4530.824   | 45.93       | N/A         | 41.35       | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 7989.198   | 47.03       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 12889.580  | 48.28       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |

(30MHz to 25GHz, Antenna Vertical,  $\pi/4$ -DQPSK, channel 78)



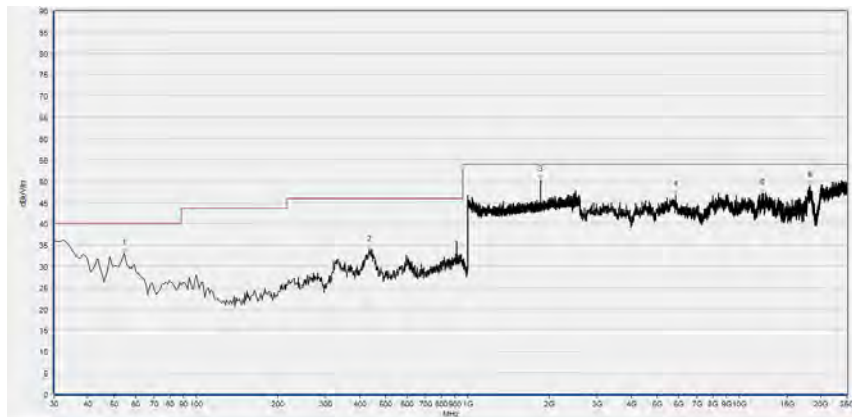
## 8-DPSK Mode

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 |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 332.290    | 34.79       | N/A         | N/A         | N/A               | 46.00             | N/A               | Horizontal | PASS    |
| 1856.022   | 49.81       | N/A         | N/A         | 46.00             | 46.00             | 46.00             | Horizontal | PASS    |
| 4526.750   | 45.82       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 5695.836   | 46.49       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 8901.655   | 46.66       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 17989.562  | 49.14       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

(30MHz to 25GHz, Antenna Horizontal, 8-DPSK, channel 0)

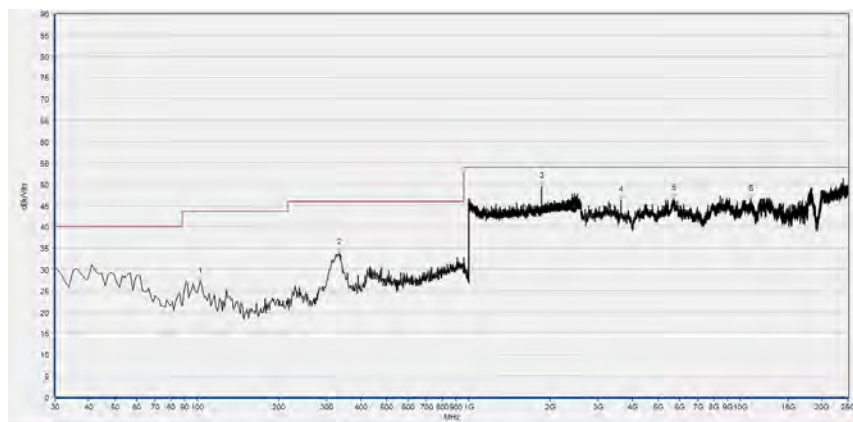


| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna  | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|----------|---------|
| 54.280     | 33.05       | N/A         | N/A         | N/A               | 40.00             | N/A               | Vertical | PASS    |
| 433.054    | 33.92       | N/A         | N/A         | N/A               | 46.00             | N/A               | Vertical | PASS    |
| 1856.022   | 50.23       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 5838.407   | 46.78       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 12160.429  | 47.05       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 18242.117  | 48.94       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |

(30MHz to 25GHz, Antenna Vertical, 8-DPSK, channel 0)

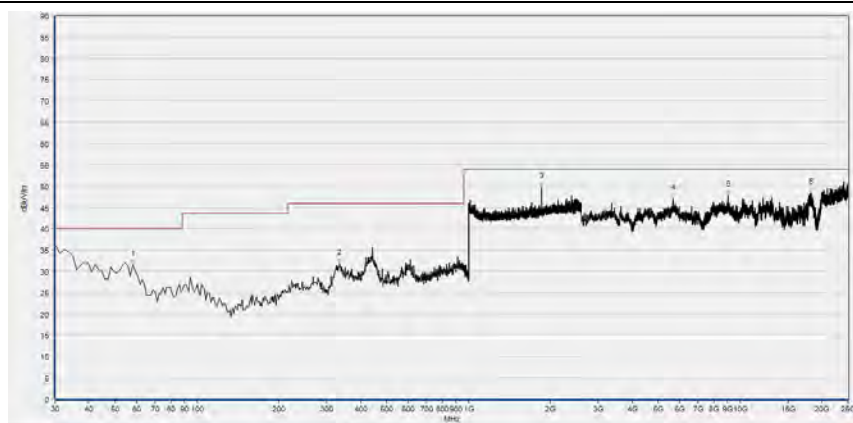


## Plot for Channel = 39



| 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 |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 102.841    | 27.22       | N/A         | N/A         | N/A               | 43.50             | N/A               | Horizontal | PASS    |
| 333.504    | 33.86       | N/A         | N/A         | N/A               | 46.00             | N/A               | Horizontal | PASS    |
| 1856.022   | 49.47       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 3646.881   | 46.21       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 5703.983   | 46.60       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 10987.270  | 46.46       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

(30MHz to 25GHz, Antenna Horizontal, 8-DPSK, channel 39)

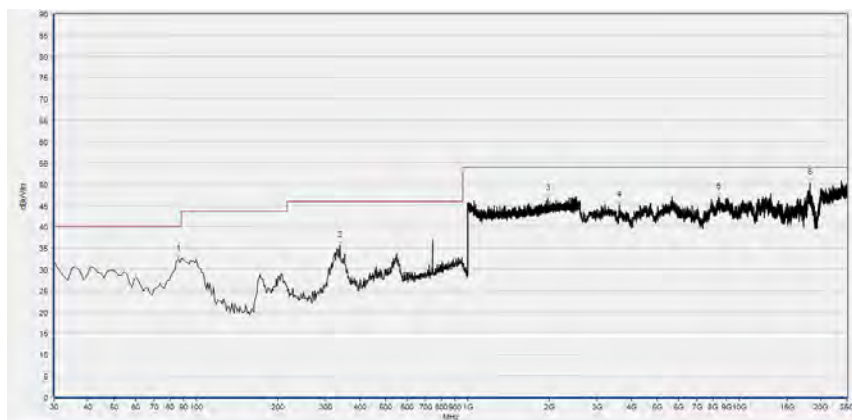


| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna  | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|----------|---------|
| 57.922     | 31.55       | N/A         | N/A         | N/A               | 40.00             | N/A               | Vertical | PASS    |
| 334.718    | 31.87       | N/A         | N/A         | N/A               | 46.00             | N/A               | Vertical | PASS    |
| 1856.022   | 49.84       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 5671.395   | 47.08       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 9015.712   | 48.02       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 18189.162  | 48.50       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |

(30MHz to 25GHz, Antenna Vertical, 8-DPSK, channel 39)

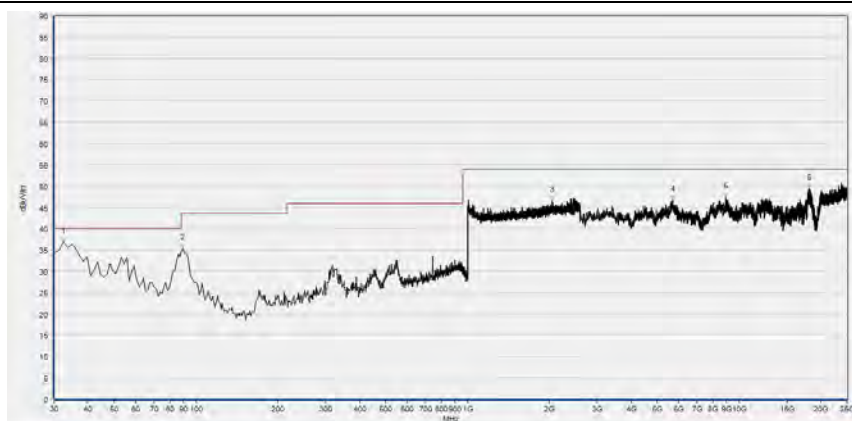


## Plot for Channel = 78



| 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 |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 85.845     | 32.43       | N/A         | N/A         | N/A               | 40.00             | N/A               | Horizontal | PASS    |
| 339.574    | 35.47       | N/A         | N/A         | N/A               | 46.00             | N/A               | Horizontal | PASS    |
| 1974.470   | 46.53       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 3626.514   | 45.17       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 8420.986   | 46.90       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 18189.162  | 50.20       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

(30MHz to 25GHz, Antenna Horizontal, 8-DPSK, 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 |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|----------|---------|
| 32.428     | 36.84       | N/A         | N/A         | N/A               | 40.00             | N/A               | Vertical | PASS    |
| 89.487     | 35.29       | N/A         | N/A         | N/A               | 43.50             | N/A               | Vertical | PASS    |
| 2050.020   | 46.51       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 5708.056   | 46.75       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 8922.022   | 47.48       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 18176.941  | 49.51       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |

(30MHz to 25GHz, Antenna Vertical, 8-DPSK, channel 78)



## 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     |
| 20dB Bandwidth                 | ±5%         |
| Carrier Frequency Separation   | ±5%         |
| Time of Occupancy (Dwell time) | ±5%         |
| Conducted Spurious Emission    | ±2.77 dB    |
| 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.<br>Morlab Laboratory                                                         |
| <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.<br>Morlab Laboratory                                                         |
| <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  | Cal. Due   |
|------------------------|------------|-----------|-------------------|------------|------------|
| Bluetooth Base Station | 6K00006210 | MT8852B   | Anritsu           | 2018.04.17 | 2019.04.16 |
| Directional coupler    | 17041703   | DTO-5-30  | ShangHai Huaxiang | N/A        | N/A        |
| EXA Signal Analyzer    | MY53470836 | N9010A    | Agilent           | 2018.11.06 | 2019.11.05 |
| 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        |
| Computer               | T430i      | Think Pad | Lenovo            | N/A        | N/A        |

##### 4.2 Conducted Emission Test Equipments

| Equipment Name                   | Serial No. | Type        | Manufacturer | Cal. Date  | Cal. Due   |
|----------------------------------|------------|-------------|--------------|------------|------------|
| Receiver                         | MY56400093 | N9038A      | KEYSIGHT     | 2018.05.08 | 2019.05.07 |
| LISN                             | 812744     | NSLK 8127   | Schwarzbeck  | 2018.05.08 | 2019.05.07 |
| Pulse Limiter (20dB)             | 9391       | VTSD 9561-D | Schwarzbeck  | 2018.05.08 | 2019.05.07 |
| Coaxial cable(BNC) (30MHz-26GHz) | CB01       | EMC01       | Morlab       | N/A        | N/A        |

##### 4.3 List of Software Used

| Description      | Manufacturer | Software Version |
|------------------|--------------|------------------|
| Test system      | Tonscend     | V2.6             |
| Power Panel      | Agilent      | V3.8             |
| MORLAB EMCR V1.2 | MORLAB       | V 1.0            |

**4.4 Radiated Test Equipments**

| <b>Equipment Name</b>                | <b>Serial No.</b> | <b>Type</b>           | <b>Manufacturer</b> | <b>Cal. Date</b> | <b>Cal. Due</b> |
|--------------------------------------|-------------------|-----------------------|---------------------|------------------|-----------------|
| Receiver                             | MY54130016        | N9038A                | Agilent             | 2018.08.04       | 2019.08.03      |
| Test Antenna - Bi-Log                | 9163-519          | VULB 9163             | Schwarzbeck         | 2018.05.18       | 2019.05.17      |
| Test Antenna - Loop                  | 1519-022          | FMZB1519              | Schwarzbeck         | 2018.03.03       | 2019.03.02      |
| Test Antenna – Horn                  | 01774             | BBHA 9120D            | Schwarzbeck         | 2018.08.06       | 2019.08.05      |
| Test Antenna – Horn                  | BBHA9170 #774     | BBHA9170              | Schwarzbeck         | 2018.08.02       | 2019.08.01      |
| 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             |
| 1-18GHz pre-Amplifier                | MA02              | TS-PR18               | Rohde& Schwarz      | 2018.05.08       | 2019.05.07      |
| 18-26.5GHz pre-Amplifier             | MA03              | TS-PR18               | Rohde& Schwarz      | 2018.05.08       | 2019.05.07      |
| Notch Filter                         | N/A               | WRCG-2400-2483.5-60SS | Wainwright          | 2018.12.01       | 2019.11.30      |
| Anechoic Chamber                     | N/A               | 9m*6m*6m              | CRT                 | 2017.11.19       | 2020.11.18      |

————— END OF REPORT —————