



## 9 20 dB Bandwidth Measurement

Test Requirement : FCC CFR47 Part 15 Section 15.247

Test Method : ANSI C63.10:2013

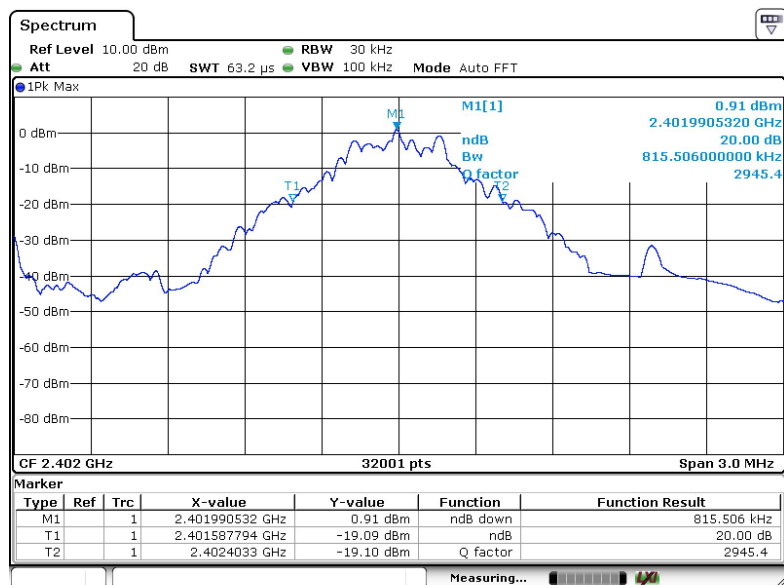
### 9.1 Test Procedure

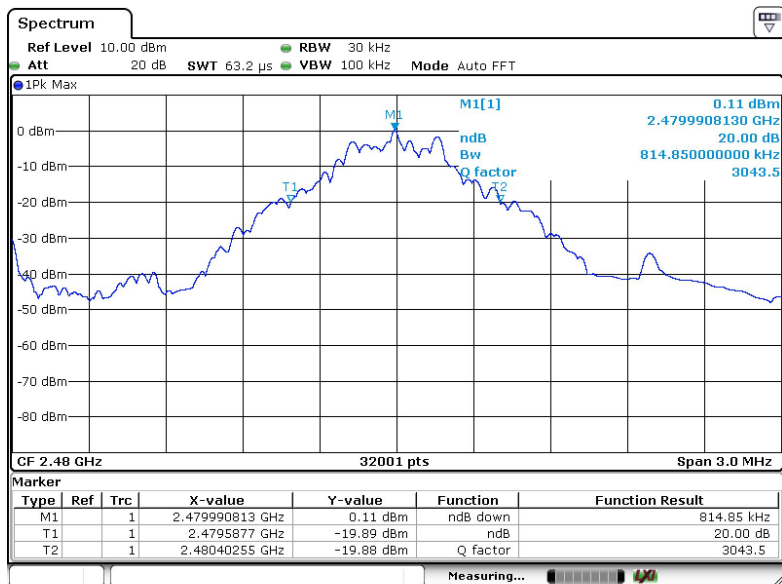
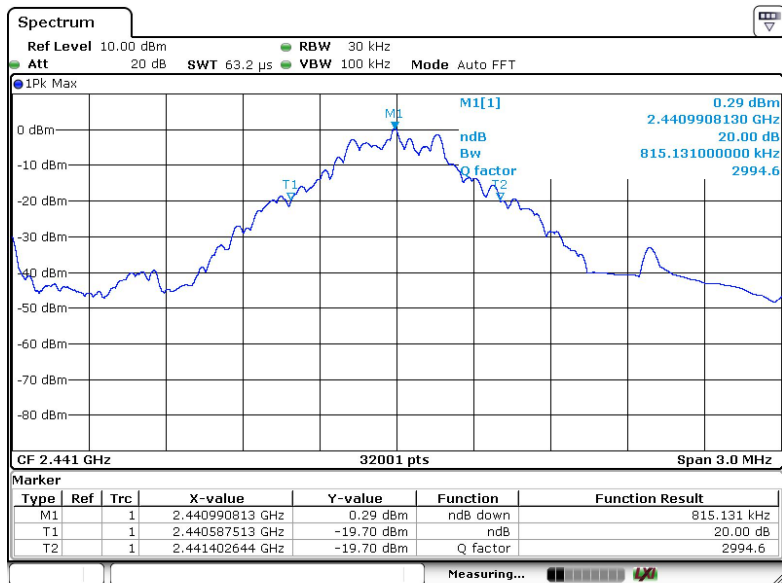
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW =30kHz, VBW = 100kHz

### 9.2 Test Result

Test Mode: CH00 / CH39 / CH78 (GFSK/(1Mbps)Mode)

| Channel number | Channel frequency (MHz) | 20dB Down BW(kHz) |
|----------------|-------------------------|-------------------|
| 00             | 2402                    | 816               |
| 39             | 2441                    | 815               |
| 78             | 2480                    | 815               |

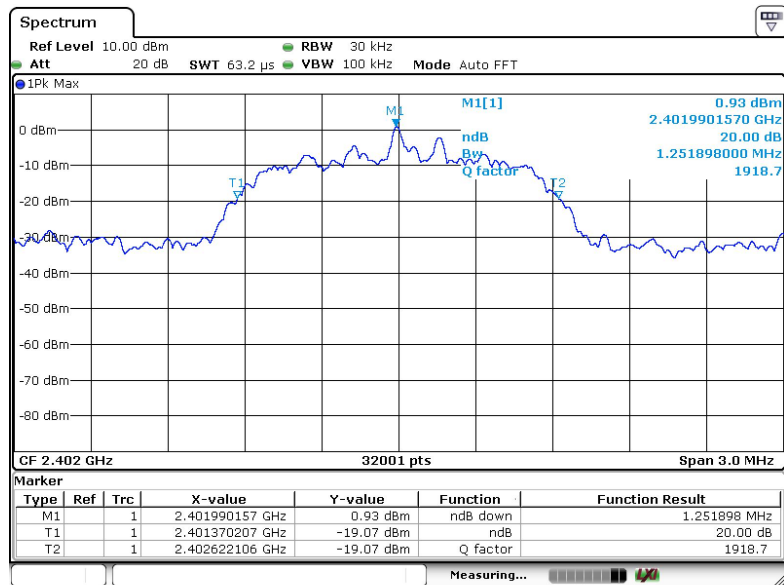


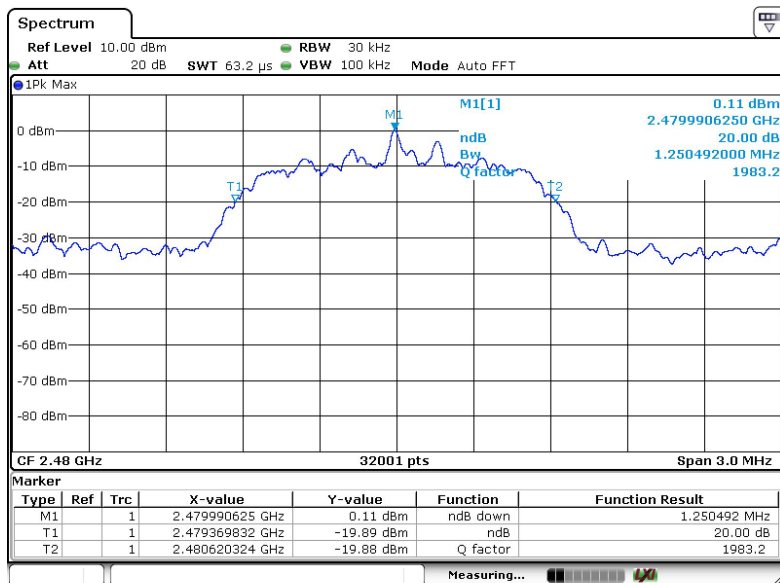
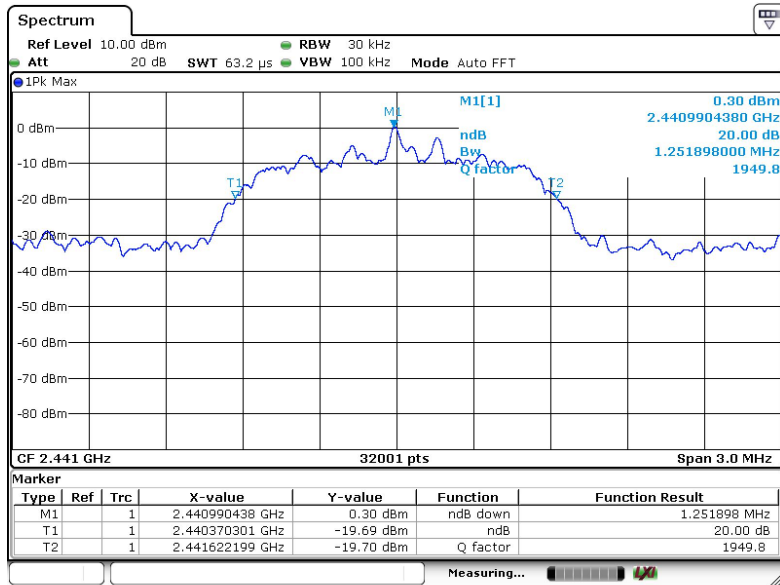




Test Mode: CH00 / CH39 / CH78 (Π/4-DQPSK /(2Mbps)Mode)

| Channel number | Channel frequency (MHz) | 20dB Down BW(kHz) |
|----------------|-------------------------|-------------------|
| 00             | 2402                    | 1252              |
| 39             | 2441                    | 1252              |
| 78             | 2480                    | 1250              |

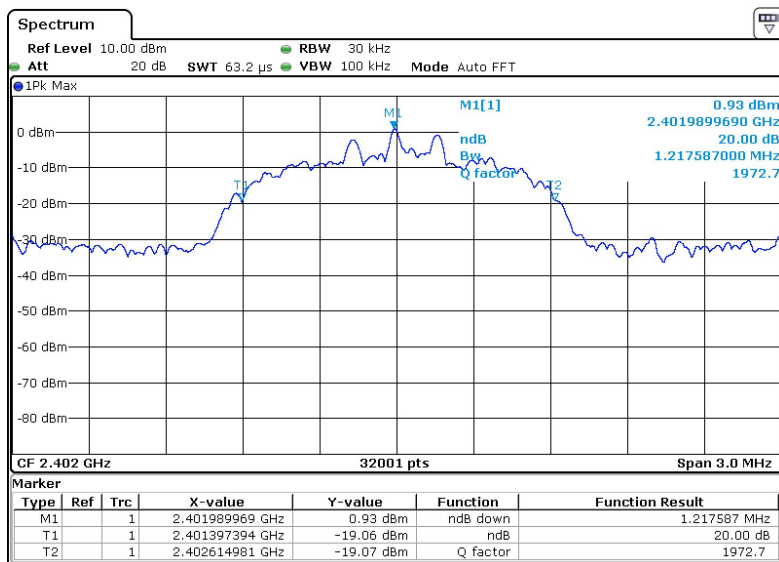


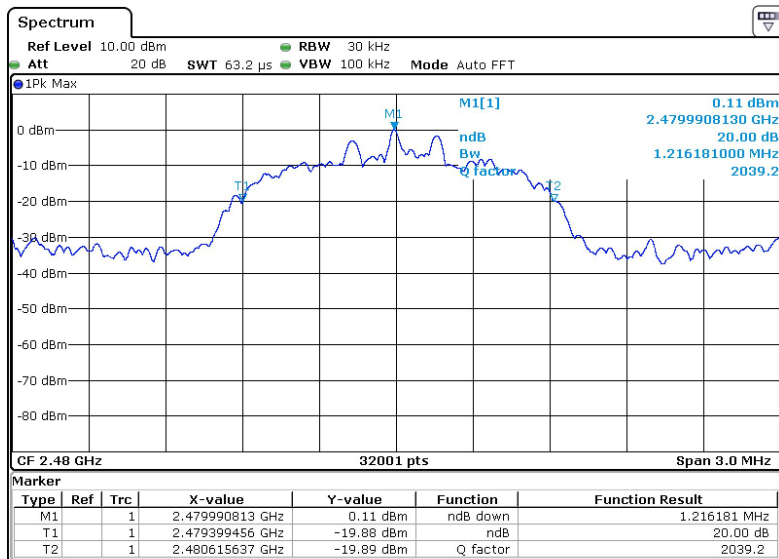
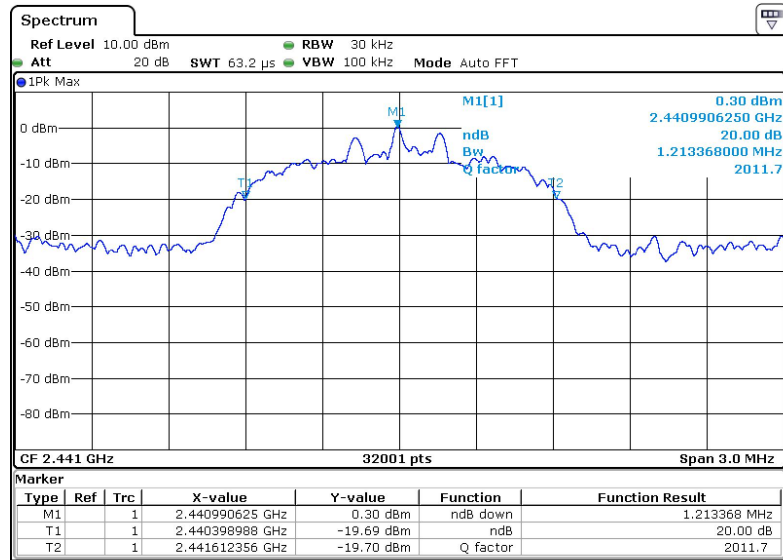




Test Mode: CH00 / CH39 / CH78 (8DPSK(3Mbps)Mode)

| Channel number | Channel frequency (MHz) | 20dB Down BW(kHz) |
|----------------|-------------------------|-------------------|
| 00             | 2402                    | 1218              |
| 39             | 2441                    | 1213              |
| 78             | 2480                    | 1217              |







## 10 Maximum Peak Output Power

Test Requirement : FCC CFR47 Part 15 Section 15.247

Test Method : ANSI C63.10:2013

Test Limit : Regulation 15.247 (b)(1), For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt (30dBm). For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

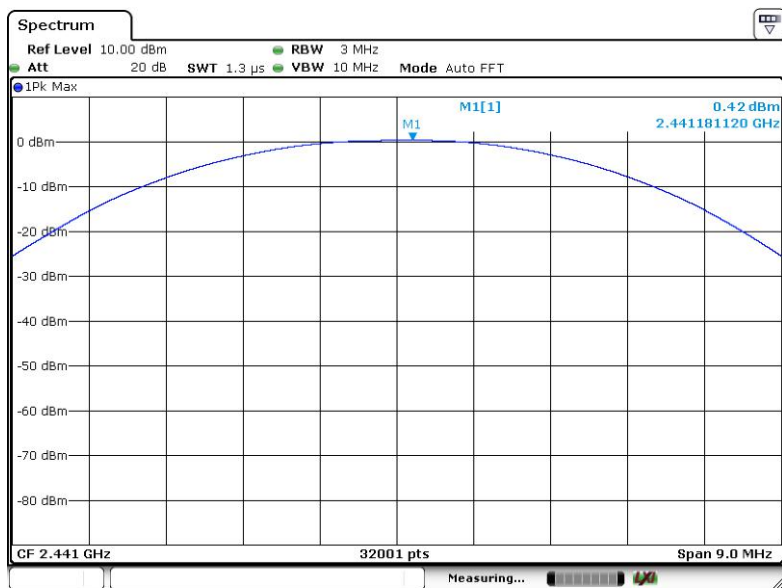
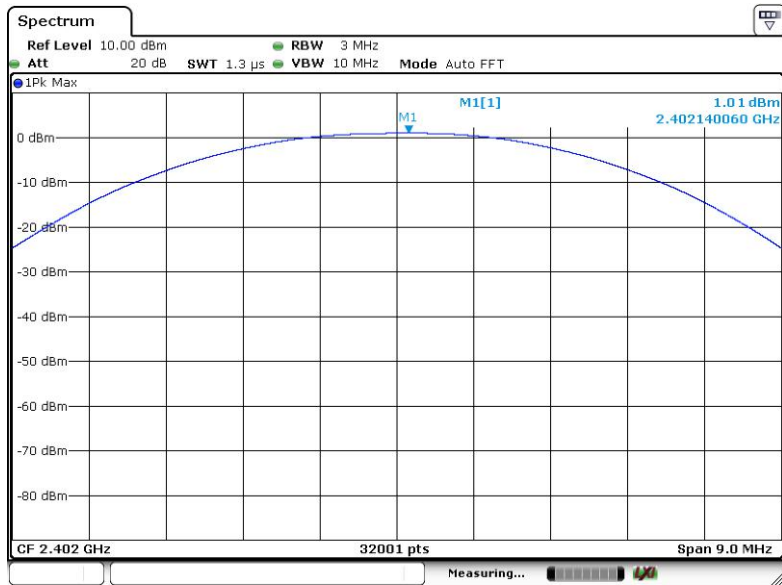
Refer to the result "Number of Hopping Frequency" of this document. The 0.125watts (20.97 dBm) limit applies.

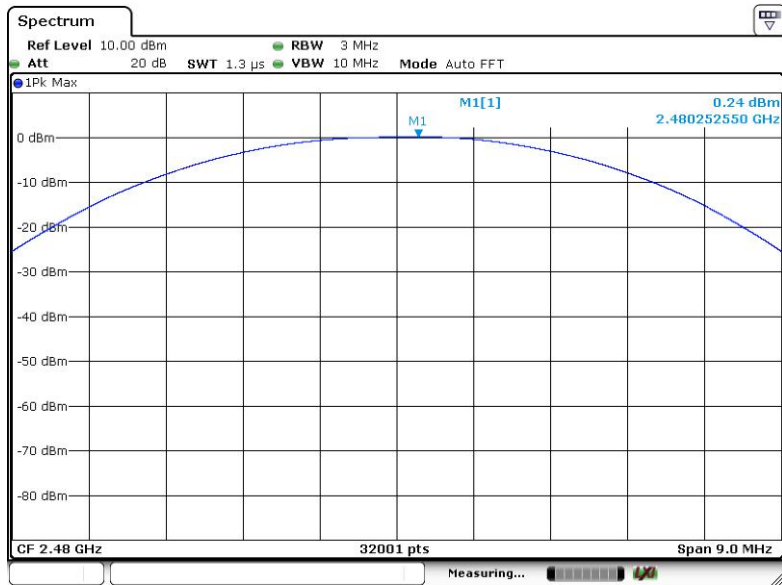
### 10.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyser: RBW = 3 MHz. VBW = 10 MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

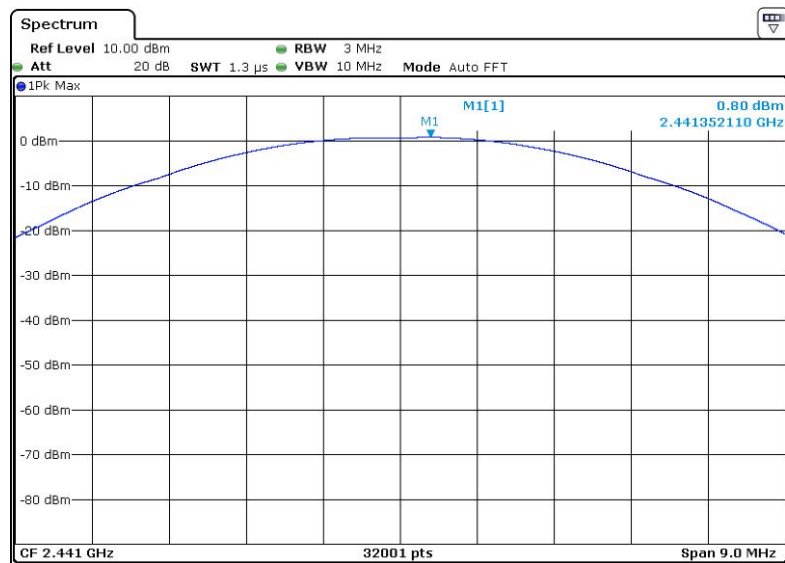
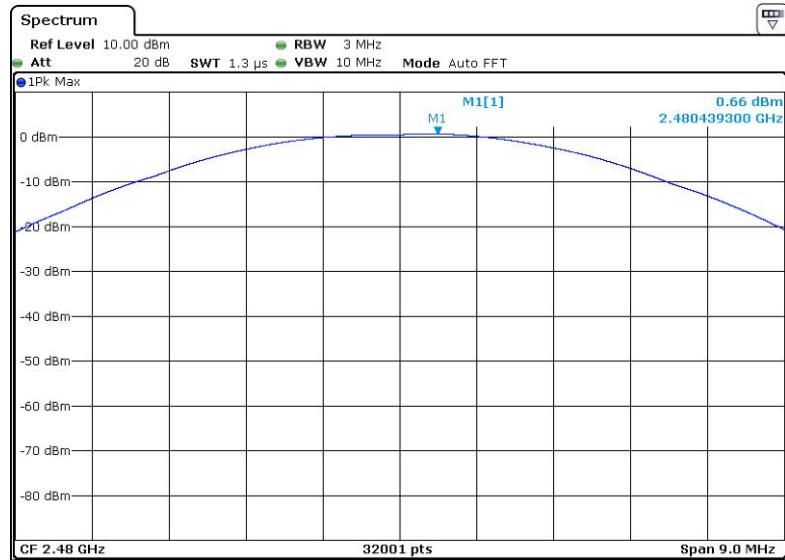
### 10.2 Test Result

| GFSK(1Mbps)  |           |                             |                             |       |           |
|--------------|-----------|-----------------------------|-----------------------------|-------|-----------|
| Test Channel | Frequency | Conducted Output Peak Power | Conducted Output Peak Power | LIMIT | Pass/Fail |
|              | (MHz)     | (dBm)                       | (W)                         | (W)   |           |
| CH00         | 2402      | 1.01                        | 0.00126                     | 0.125 | Pass      |
| CH39         | 2441      | 0.42                        | 0.00110                     | 0.125 | Pass      |
| CH78         | 2480      | 0.24                        | 0.00106                     | 0.125 | Pass      |



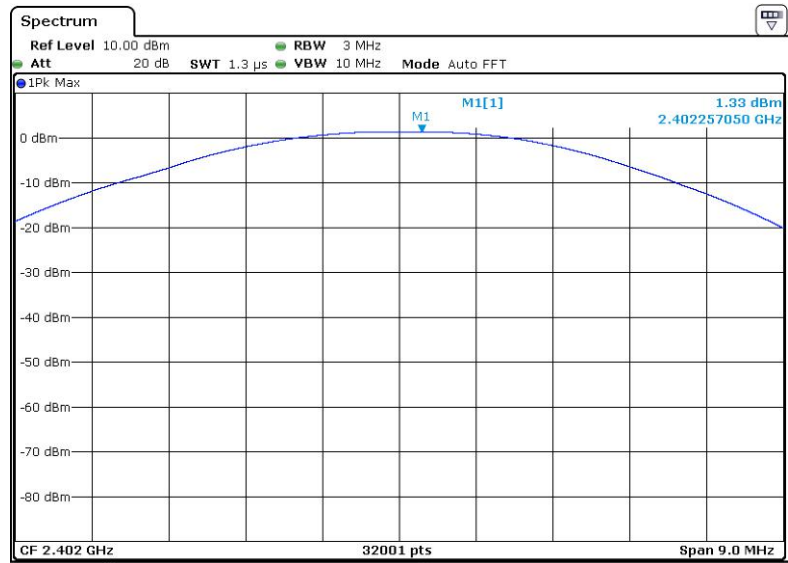


| $\pi/4$ QPSK(2Mbps) |           |                             |                             |       |           |
|---------------------|-----------|-----------------------------|-----------------------------|-------|-----------|
| Test Channel        | Frequency | Conducted Output Peak Power | Conducted Output Peak Power | LIMIT | Pass/Fail |
|                     | (MHz)     | (dBm)                       | (W)                         | (W)   |           |
| CH00                | 2402      | 1.33                        | 0.00116                     | 0.125 | Pass      |
| CH39                | 2441      | 0.80                        | 0.00120                     | 0.125 | Pass      |
| CH78                | 2480      | 0.66                        | 0.00136                     | 0.125 | Pass      |

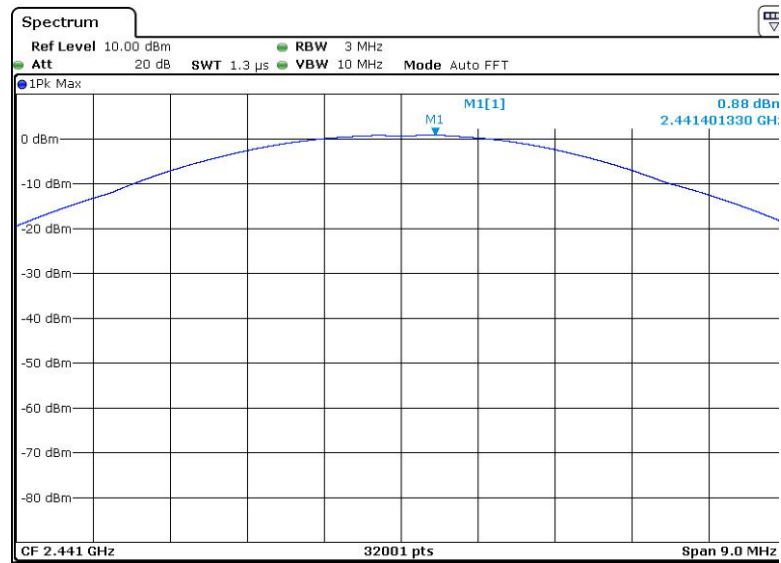
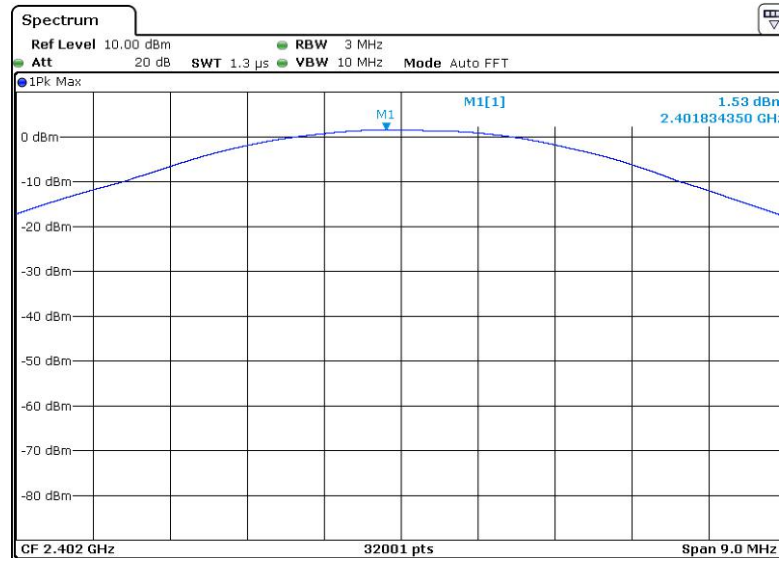


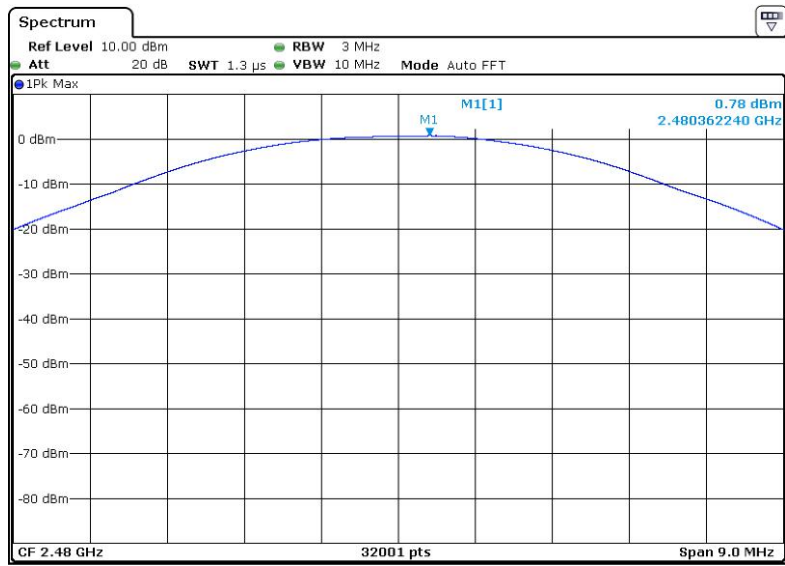


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| 8DPSK(3Mbps) |           |                             |                             |       |           |
|--------------|-----------|-----------------------------|-----------------------------|-------|-----------|
| Test Channel | Frequency | Conducted Output Peak Power | Conducted Output Peak Power | LIMIT | Pass/Fail |
|              | (MHz)     | (dBm)                       | (W)                         | (W)   |           |
| CH00         | 2402      | 1.53                        | 0.00142                     | 0.125 | Pass      |
| CH39         | 2441      | 0.88                        | 0.00123                     | 0.125 | Pass      |
| CH78         | 2480      | 0.78                        | 0.00120                     | 0.125 | Pass      |







## 11 Hopping Channel Separation

|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement | : FCC CFR47 Part 15 Section 15.247                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Test Method      | : ANSI C63.10:2013                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Test Limit       | : Regulation 15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 1W. |
| Test Mode        | : Hopping                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

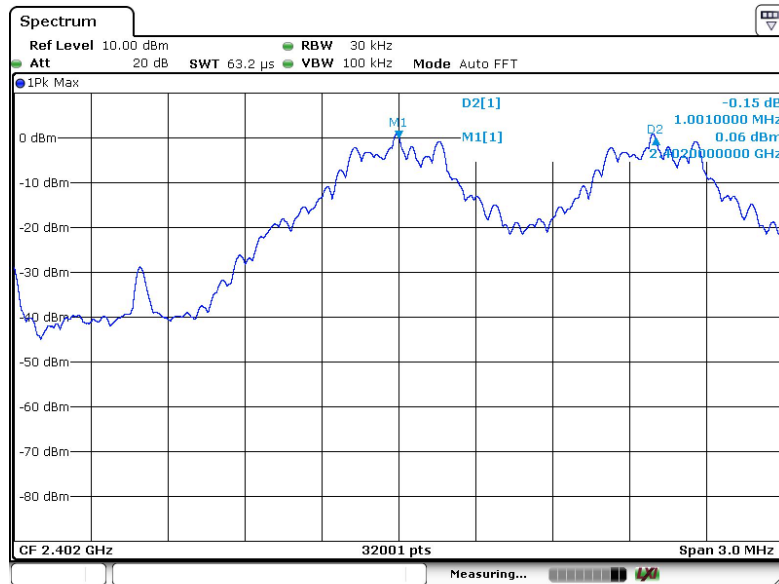
### 11.1 Test Procedure

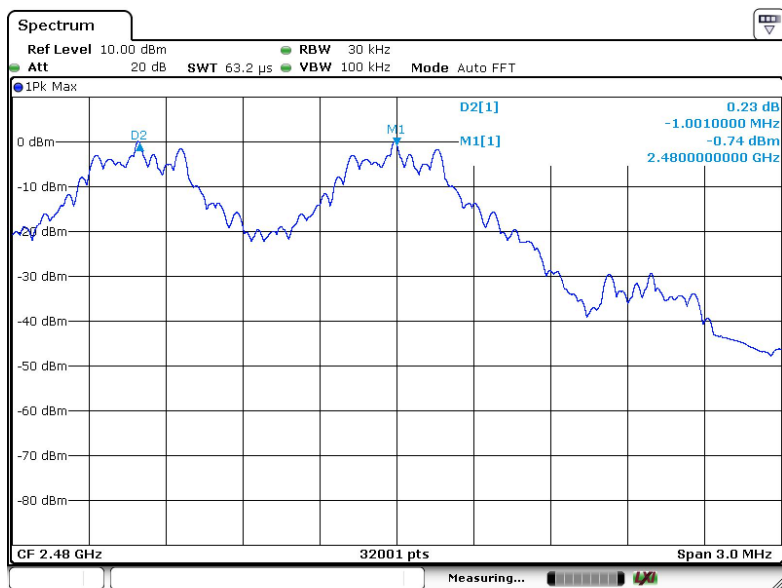
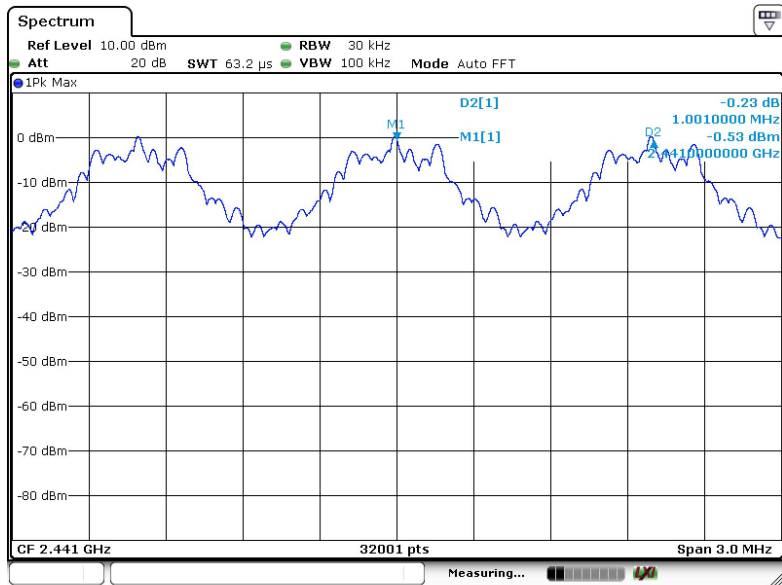
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 30KHz. VBW = 100KHz, Span = 3.0MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

## 11.2 Test Result

|            |                                       |
|------------|---------------------------------------|
| Test Mode: | CH00 / CH39 / CH78 (GFSK(1Mbps) Mode) |
|------------|---------------------------------------|

| Channel number | Channel frequency (MHz) | Separation Read Value (kHz) | Separation Limit 20dB Down BW(kHz) |
|----------------|-------------------------|-----------------------------|------------------------------------|
| 00             | 2402                    | 1001                        | >816                               |
| 39             | 2441                    | 1001                        | >815                               |
| 78             | 2480                    | 1001                        | >815                               |

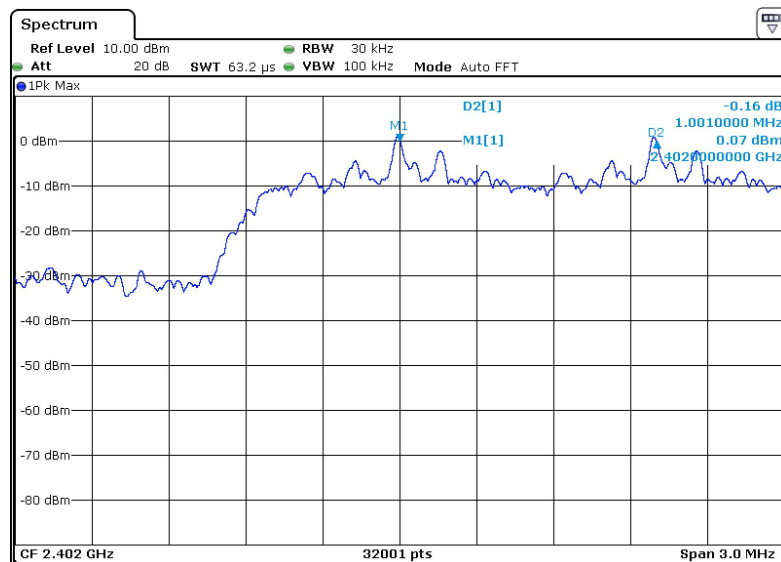


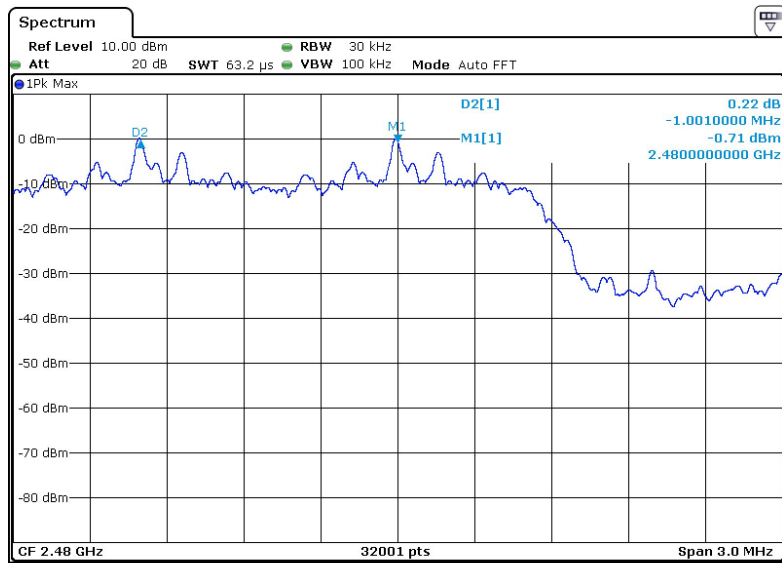
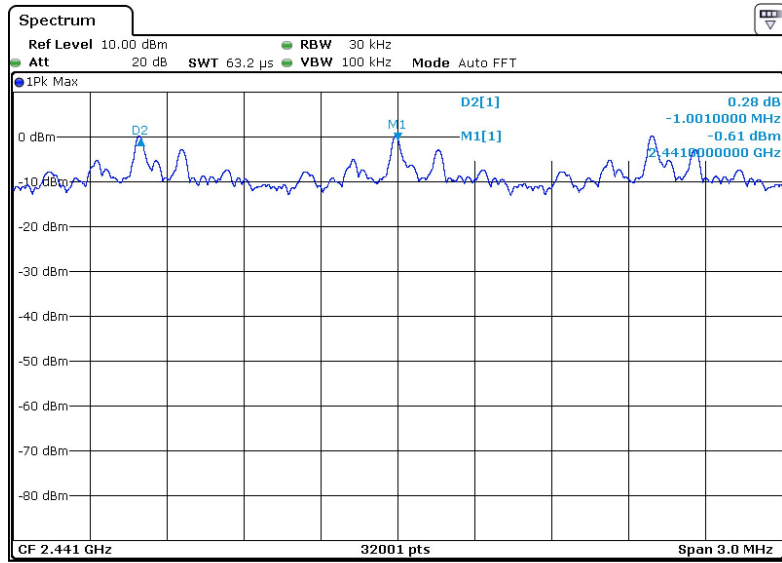




|            |                                                  |
|------------|--------------------------------------------------|
| Test Mode: | CH00 / CH39 / CH78 ( $\pi/4$ -DQPSK(2Mbps) Mode) |
|------------|--------------------------------------------------|

| Channel number | Channel frequency (MHz) | Separation Read Value (kHz) | Separation Limit<br>2/3 20dB Down BW(kHz) |
|----------------|-------------------------|-----------------------------|-------------------------------------------|
| 00             | 2402                    | 1001                        | >835                                      |
| 39             | 2441                    | 1001                        | >835                                      |
| 78             | 2480                    | 1001                        | >833                                      |

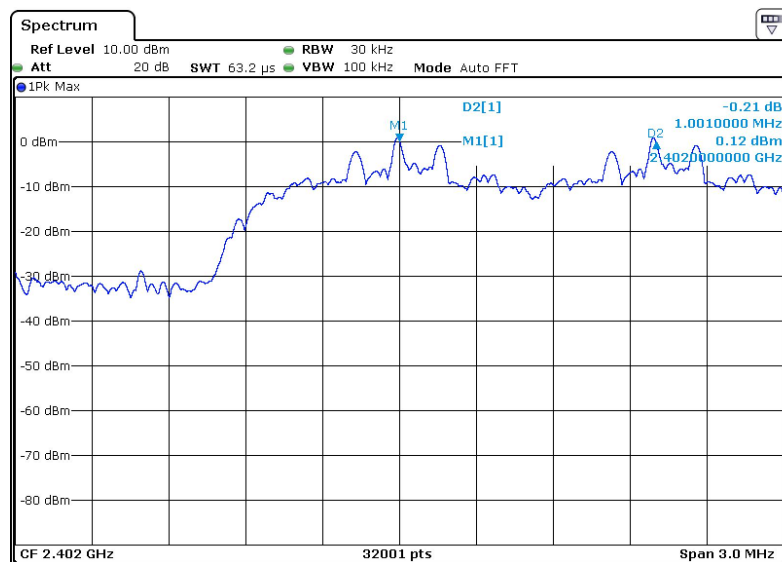


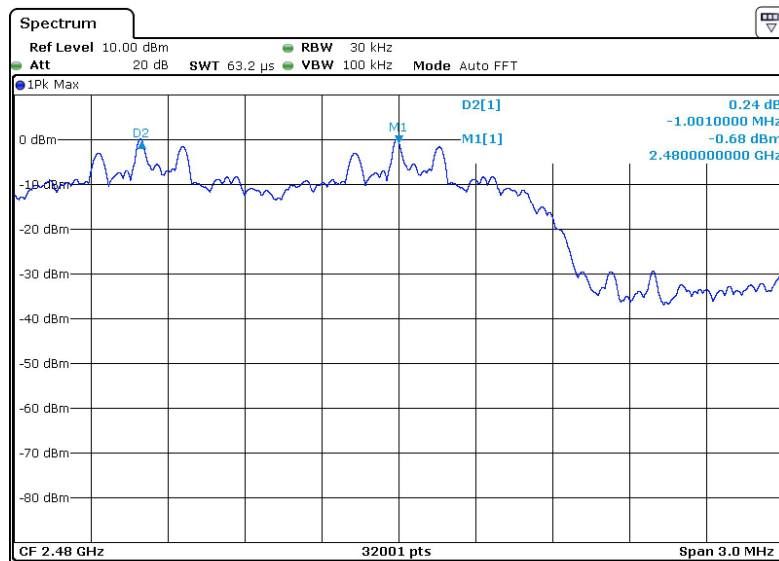
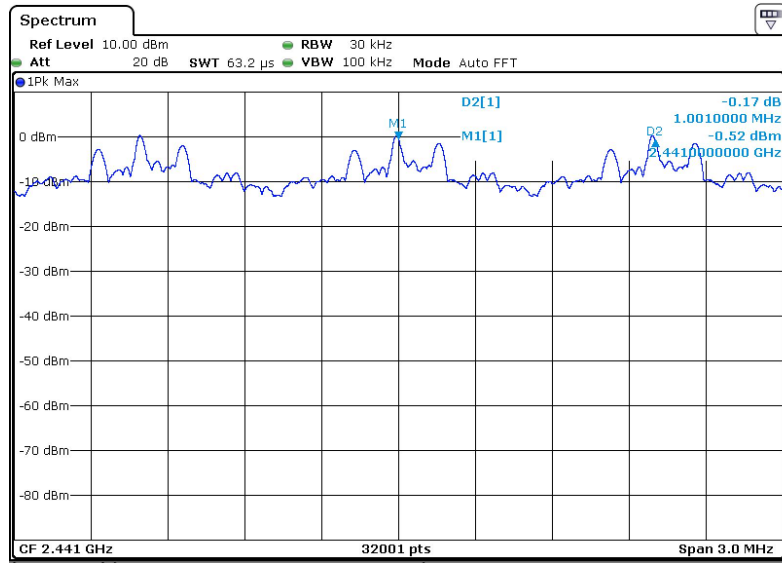




|            |                                       |
|------------|---------------------------------------|
| Test Mode: | CH00 / CH39 / CH78 (8DPSK(3Mbps)Mode) |
|------------|---------------------------------------|

| Channel number | Channel frequency (MHz) | Separation Read Value (kHz) | Separation Limit<br>2/3 20dB Down BW(kHz) |
|----------------|-------------------------|-----------------------------|-------------------------------------------|
| 00             | 2402                    | 1001                        | >812                                      |
| 39             | 2441                    | 1001                        | >809                                      |
| 78             | 2480                    | 1001                        | >811                                      |







## 12 Number of Hopping Frequency

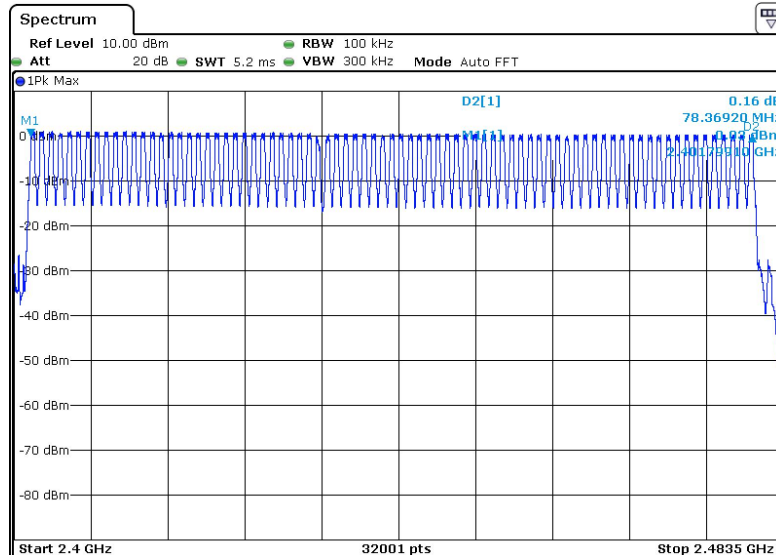
|                  |                                                                                                                       |
|------------------|-----------------------------------------------------------------------------------------------------------------------|
| Test Requirement | : FCC CFR47 Part 15 Section 15.247                                                                                    |
| Test Method      | : ANSI C63.10:2013                                                                                                    |
| Test Limit       | : Regulation 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. |
| Test Mode        | : Hopping(GFSK)                                                                                                       |

### 12.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100KHz. VBW = 100KHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency = 2.483GHz. Sweep=auto;

### 12.2 Test Result

| Channel Number | Limit     |
|----------------|-----------|
| 79             | $\geq 15$ |





### 13 Dwell Time

|                  |                                                                                                                                                                                                                                                                                               |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement | : FCC CFR47 Part 15 Section 15.247                                                                                                                                                                                                                                                            |
| Test Method      | : ANSI C63.10:2013                                                                                                                                                                                                                                                                            |
| Test Limit       | : Regulation 15.247(a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. |
| Test Mode        | : The worst case( $\pi/4$ -DQPSK) was recorded                                                                                                                                                                                                                                                |

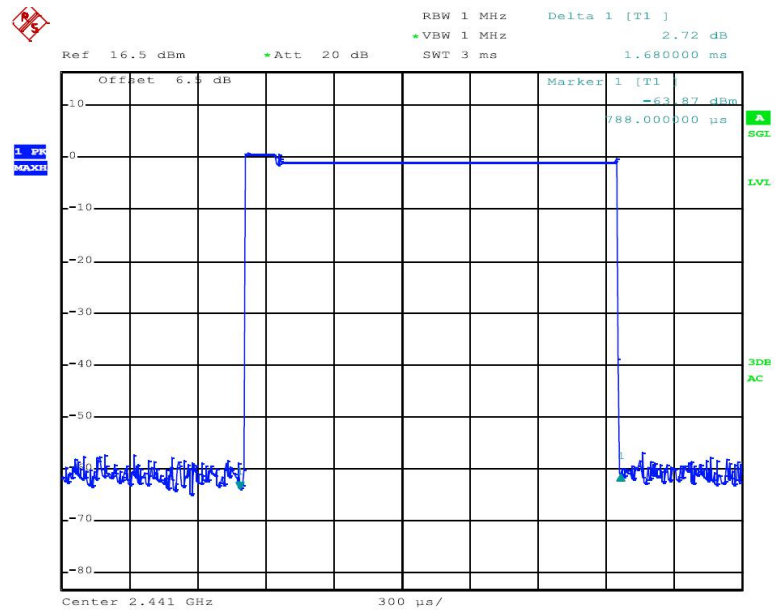
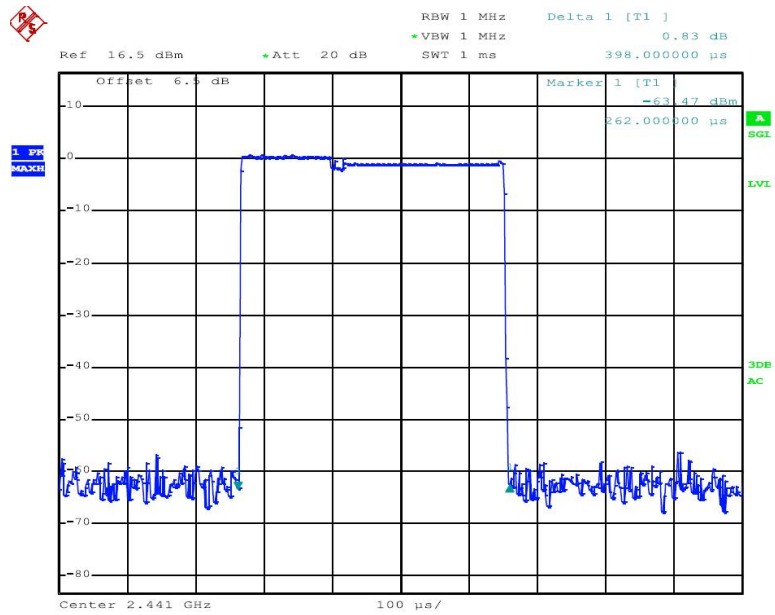
#### 13.1 Test Procedure

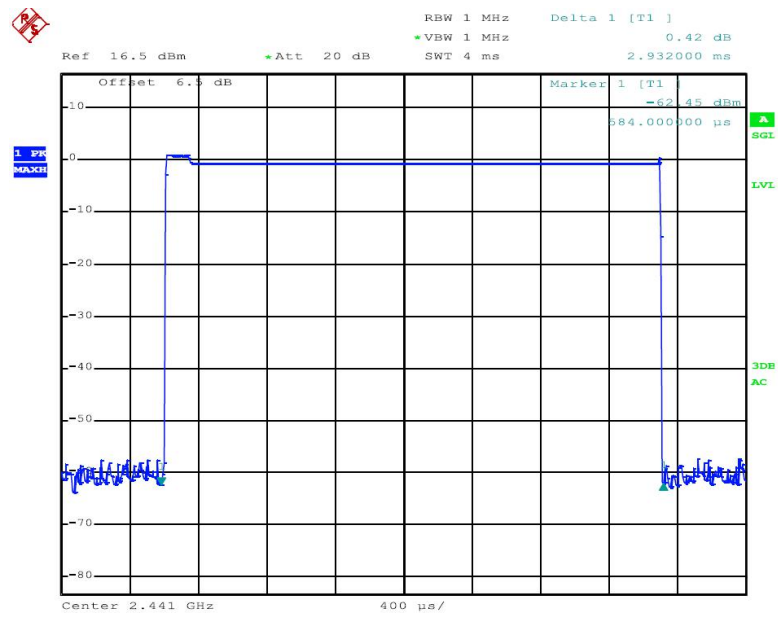
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set spectrum analyzer span = 0. Centred on a hopping channel;
3. Set RBW = 1MHz and VBW = 3MHz. Sweep = as necessary to capture the entire dwell time per hopping channel. Set the EUT for DH5, DH3 and DH1 packet transmitting.
4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

#### 13.2 Test Result

|            |             |
|------------|-------------|
| Test Mode: | GFSK(1Mbps) |
|------------|-------------|

| Mode | Packet                                                                                                                                                                                                                                                                                                                                                                                                                 | Length of transmissions time(sec) | Result (sec) | Limit (sec) |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|--------------|-------------|
| GFSK | DH1                                                                                                                                                                                                                                                                                                                                                                                                                    | 0.398                             | 0.127        | 0.4         |
|      | DH3                                                                                                                                                                                                                                                                                                                                                                                                                    | 1.680                             | 0.269        | 0.4         |
|      | DH5                                                                                                                                                                                                                                                                                                                                                                                                                    | 2.932                             | 0.313        | 0.4         |
|      | Note:<br>The test period= 0.4 Second/channel * 79 channel = 31.6s<br>Calculation Formula: Dwell time= Ton time per hop*Hopping numbers*Period<br>For Example:<br>DH1 time slot= $0.398 \times (1600 / (2 \times 79)) \times 31.6 = 127\text{ms}$<br>DH3 time slot= $1.680 \times (1600 / (4 \times 79)) \times 31.6 = 269\text{ms}$<br>DH5 time slot= $2.932 \times (1600 / (6 \times 79)) \times 31.6 = 313\text{ms}$ |                                   |              |             |







## **14 Antenna Requirement**

### **14.1 Antenna Requirement**

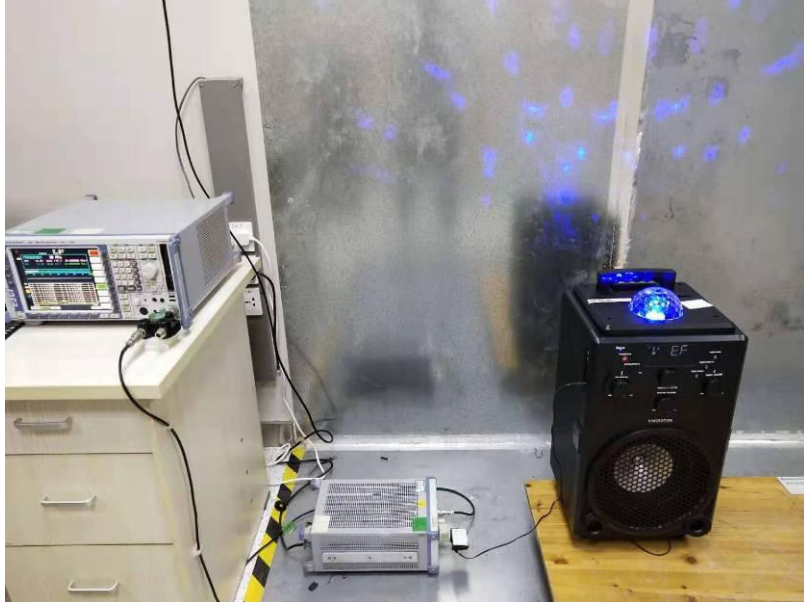
For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

### **14.2 Result**

The EUT'S antenna, permanent attached antenna, is PCB antenna. The antenna's gain is 0dBi and meets the requirement.

## 15 TEST PHOTOS

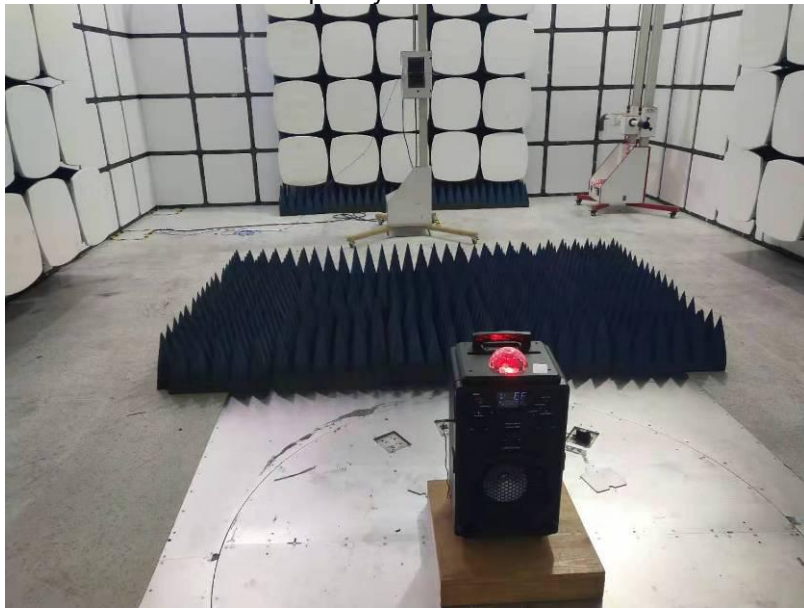
Conducted Emissions



Radiated Spurious Emissions  
Test Frequency From Below 30MHz



Test frequency from Above 1GHz



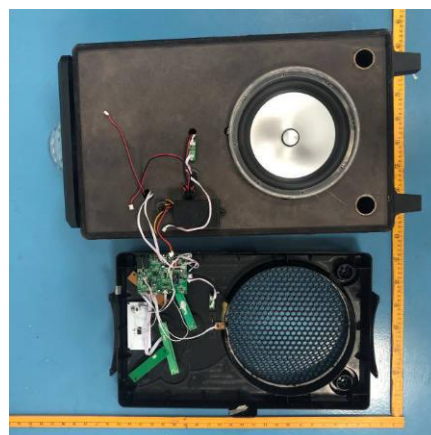
## 16 EUT PHOTOS

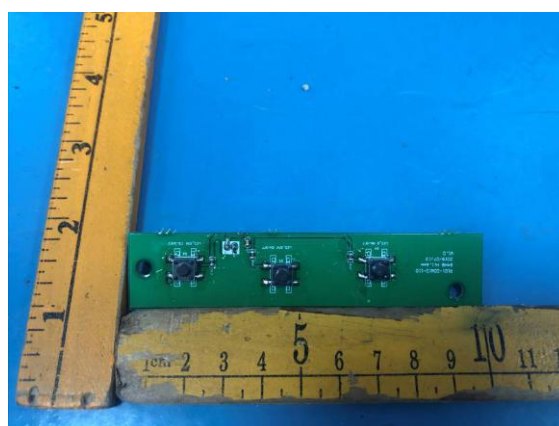
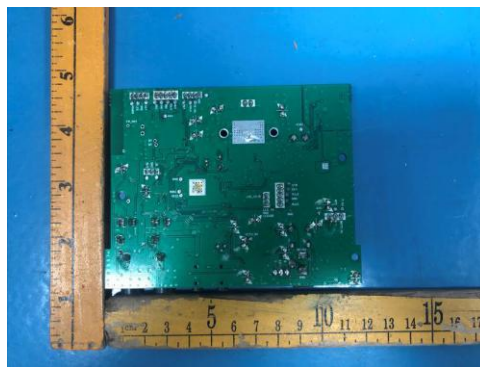


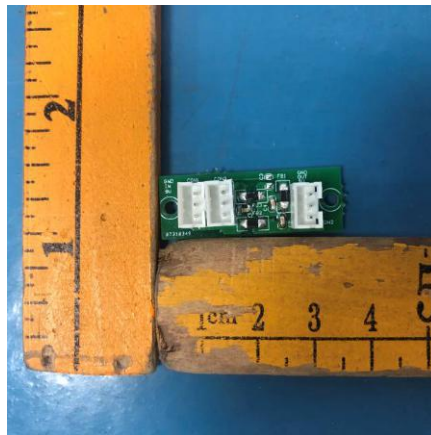


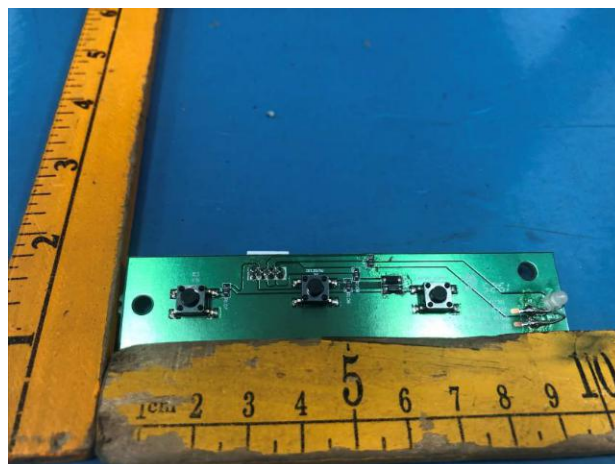
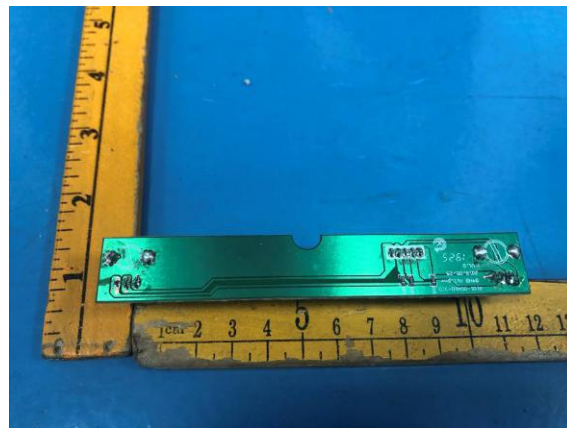
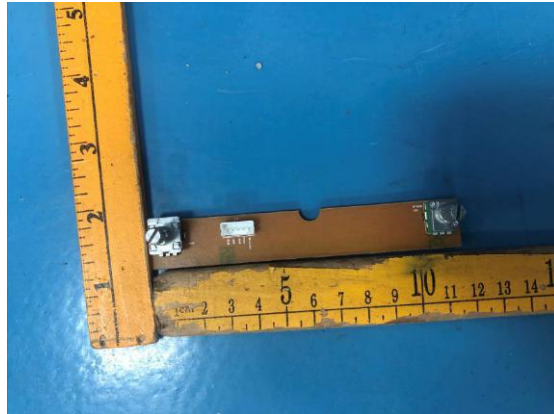


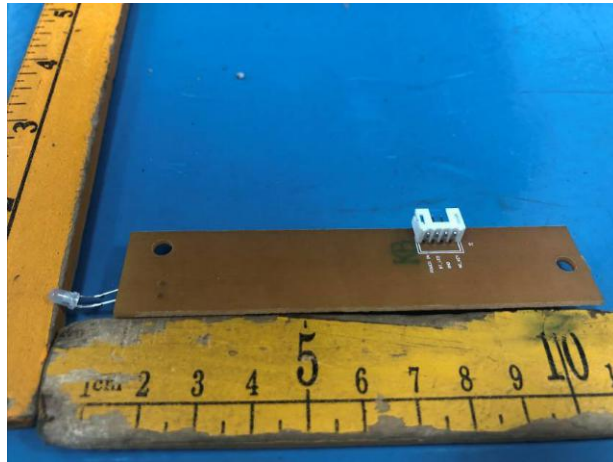


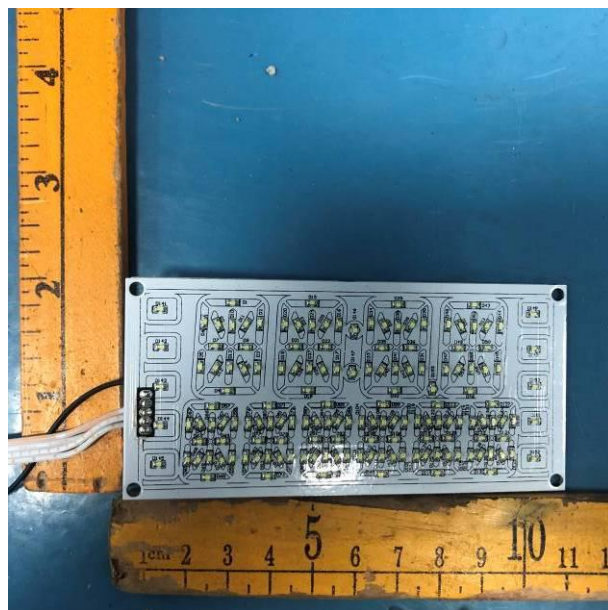
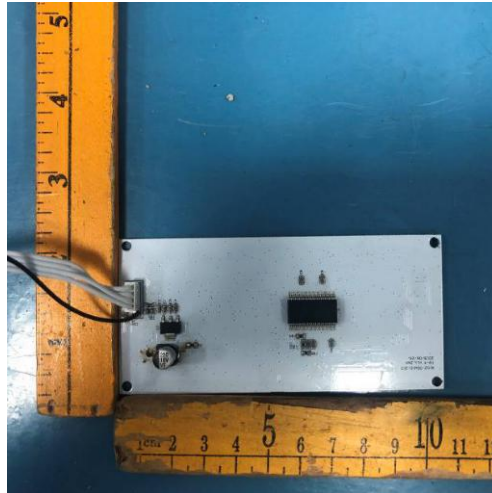


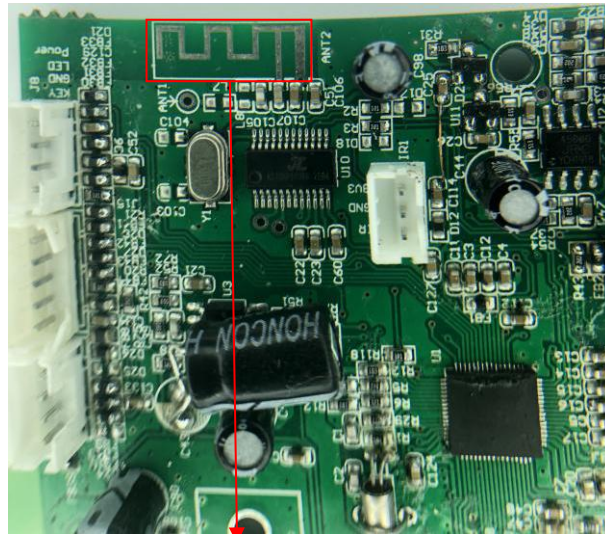












\*\*\*\*\*THE END REPORT\*\*\*\*\*