



## 6. CONDUCTED BAND EDGE AND SPURIOUS EMISSION

|                   |                                         |
|-------------------|-----------------------------------------|
| Test Requirement: | FCC Part15 C Section 15.247 (d)         |
| Test Method:      | KDB558074 D0115.247 Meas Guidancev05r02 |

### 6.1 Limit

Regulation 15.247 (d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### 6.2 Test Setup



### 6.3 Test procedure

Using the following spectrum analyzer setting:

- A) Set the RBW = 100KHz.
- B) Set the VBW = 300KHz.
- C) Sweep time = auto couple.
- D) Detector function = peak.
- E) Trace mode = max hold.
- F) Allow trace to fully stabilize.

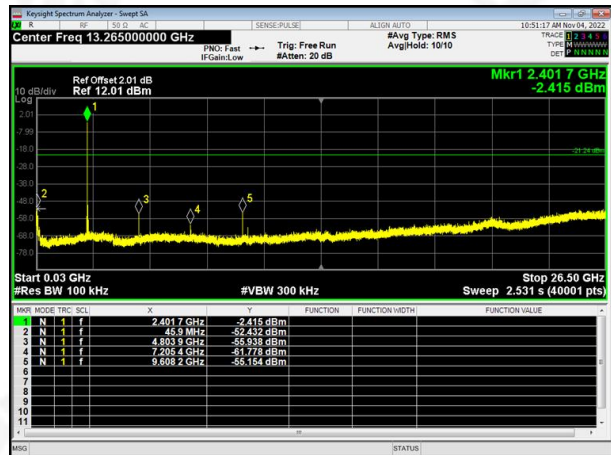
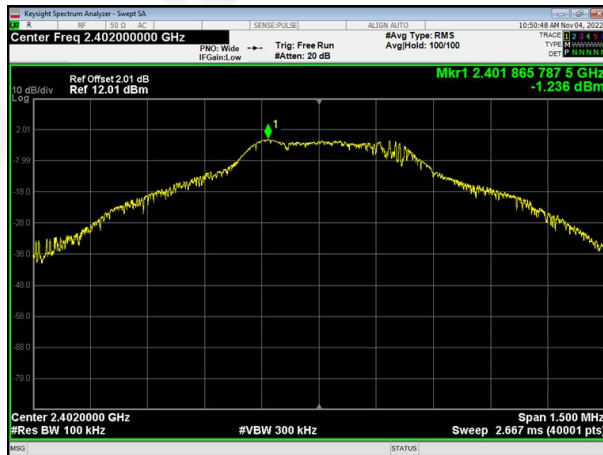
### 6.4 DEVIATION FROM STANDARD

No deviation.

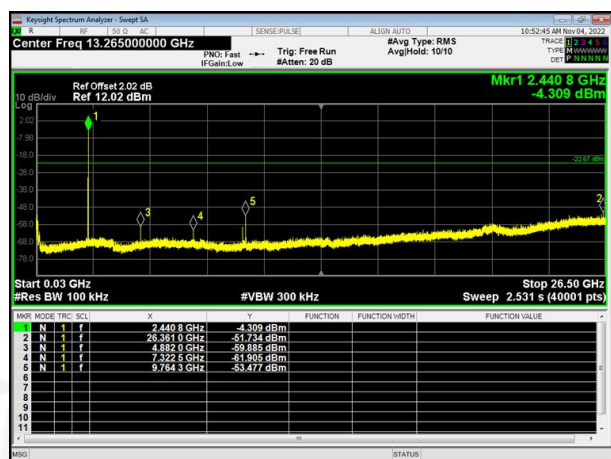
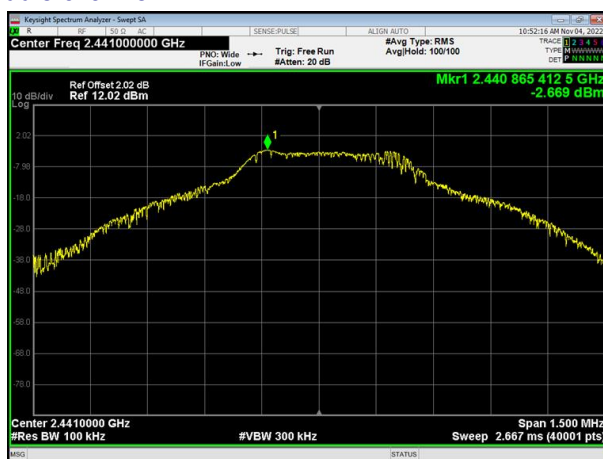


## 6.5 Test Result

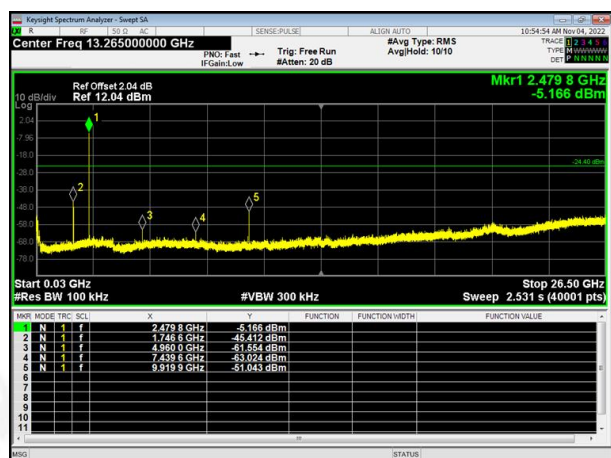
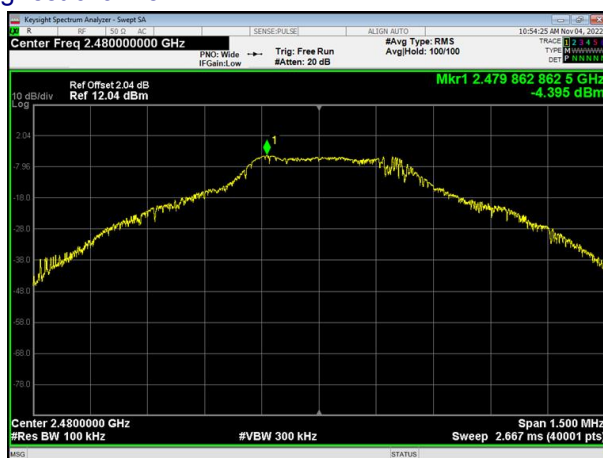
### GFSK mode: Lowest channel



### Middle channel



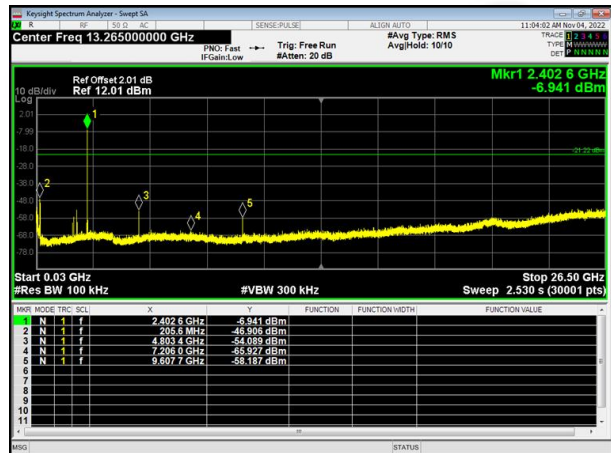
### Highest channel



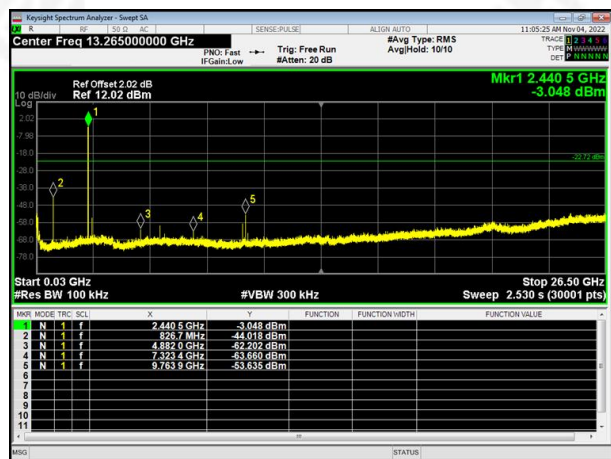
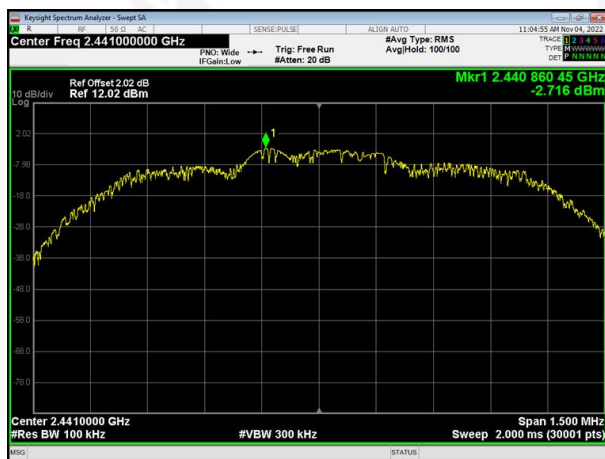
30MHz~26.5GHz



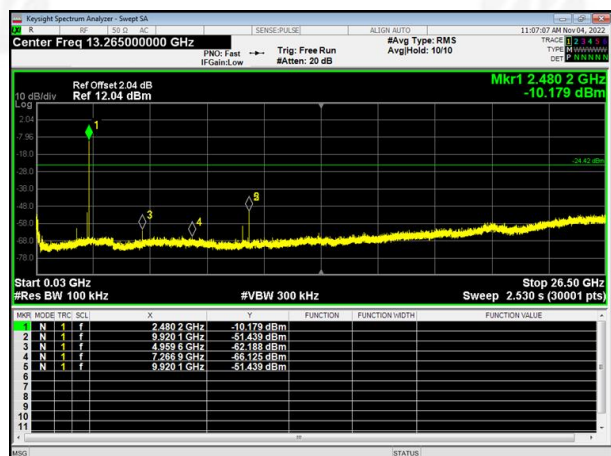
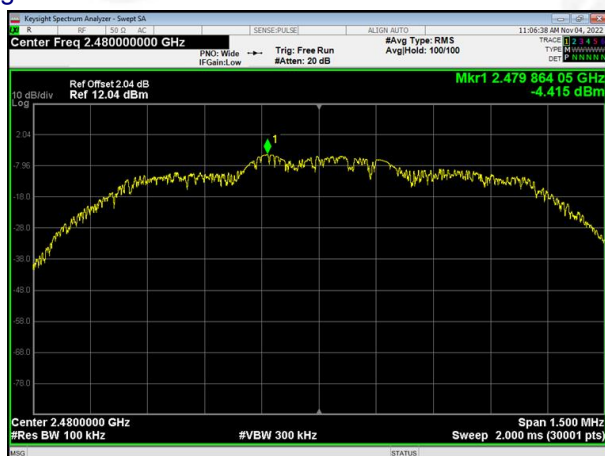
## $\pi/4$ -DQPSK mode Lowest channel



## Middle channel



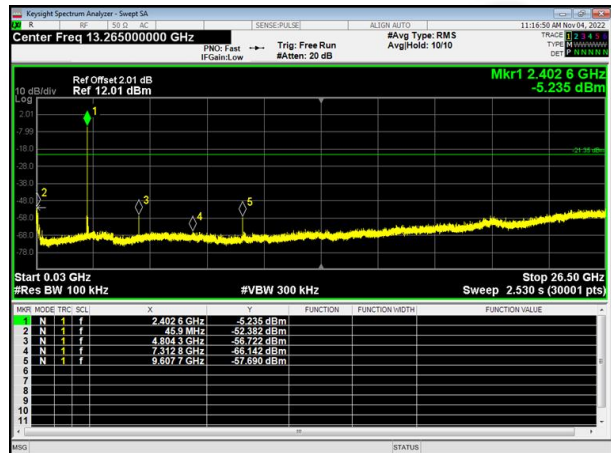
## Highest channel



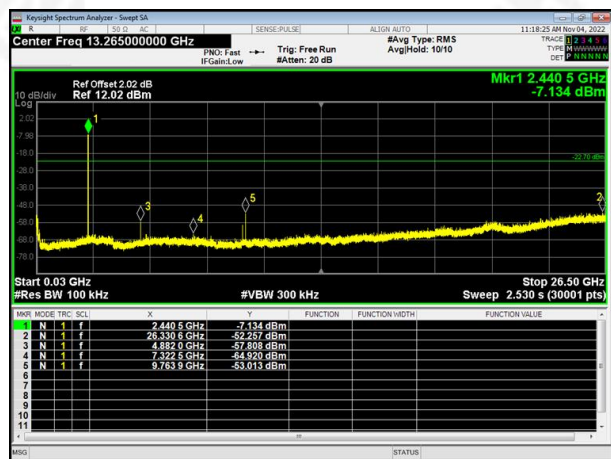
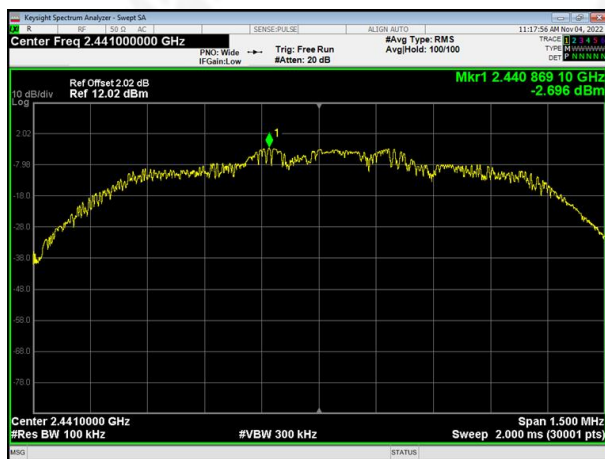
30MHz~26.5GHz



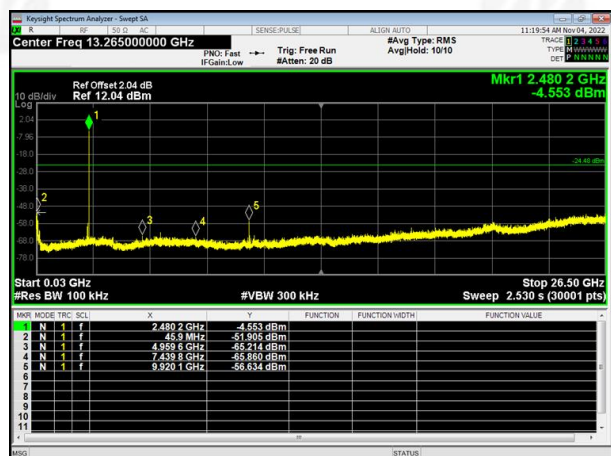
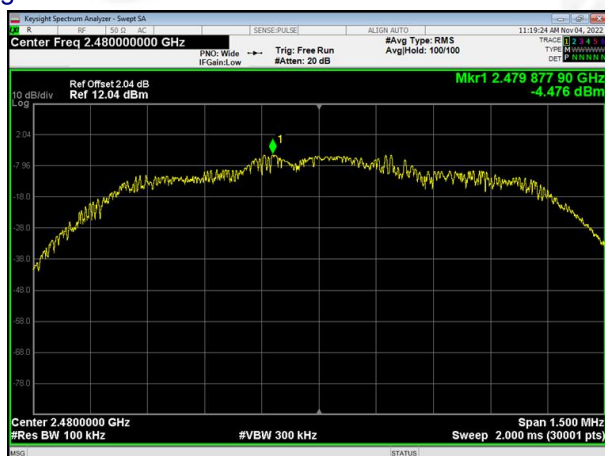
## 8-DPSK mode: Lowest channel



## Middle channel



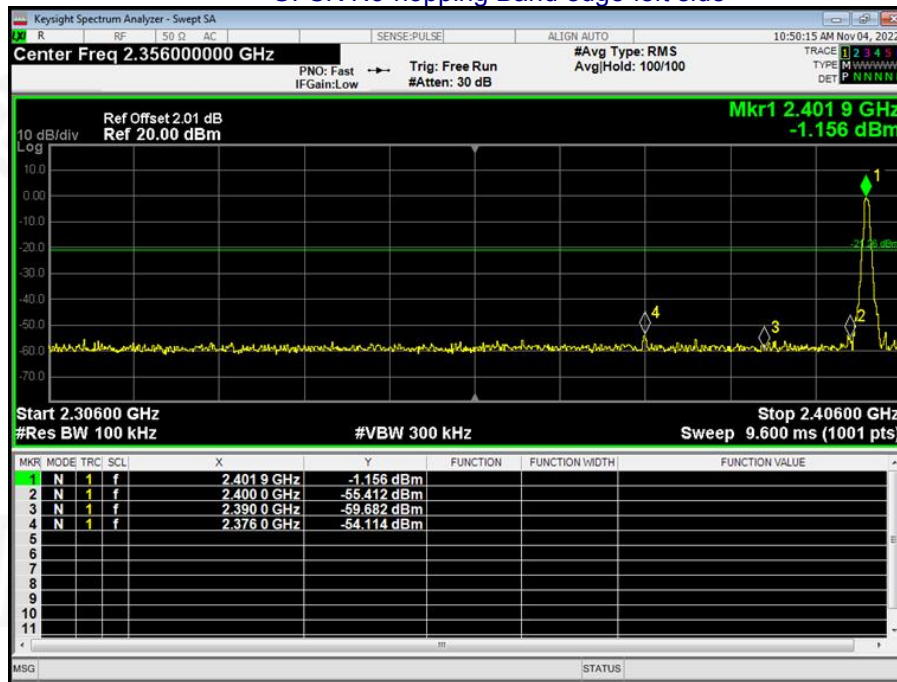
## Highest channel



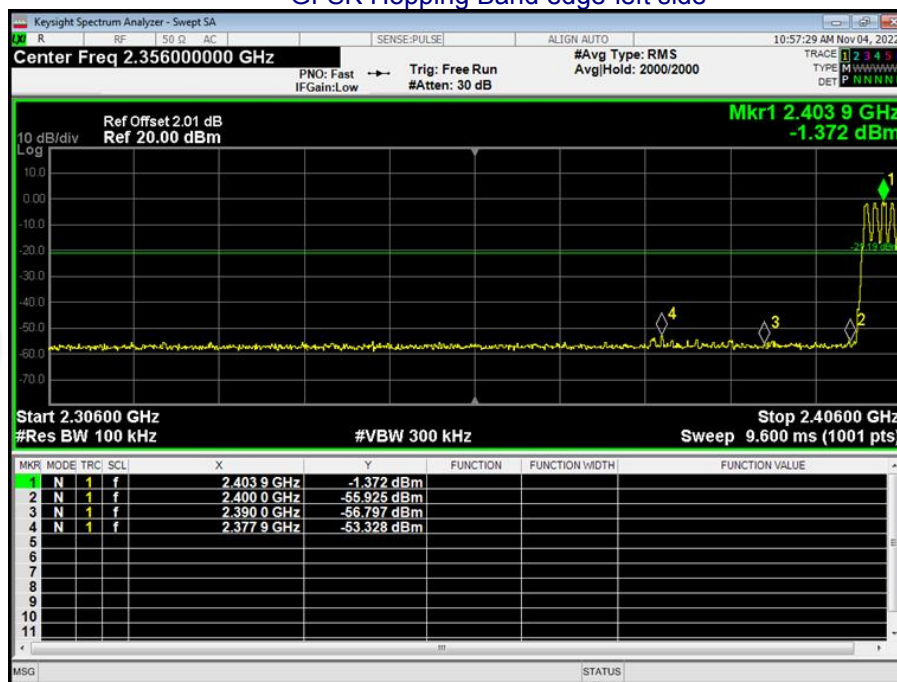
30MHz~26.5GHz



GFSK No-hopping Band edge-left side

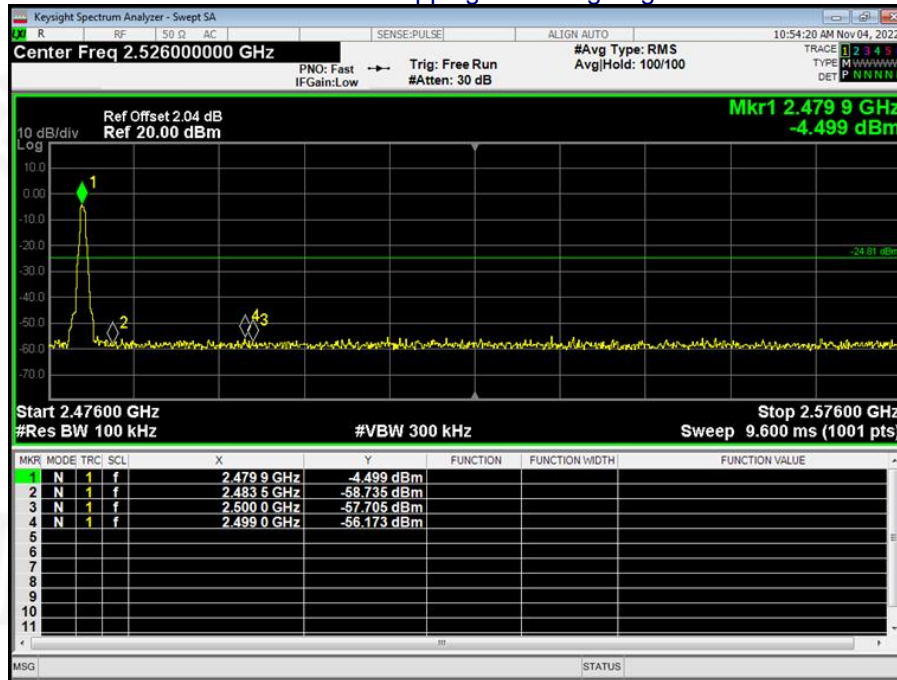


GFSK Hopping Band edge-left side

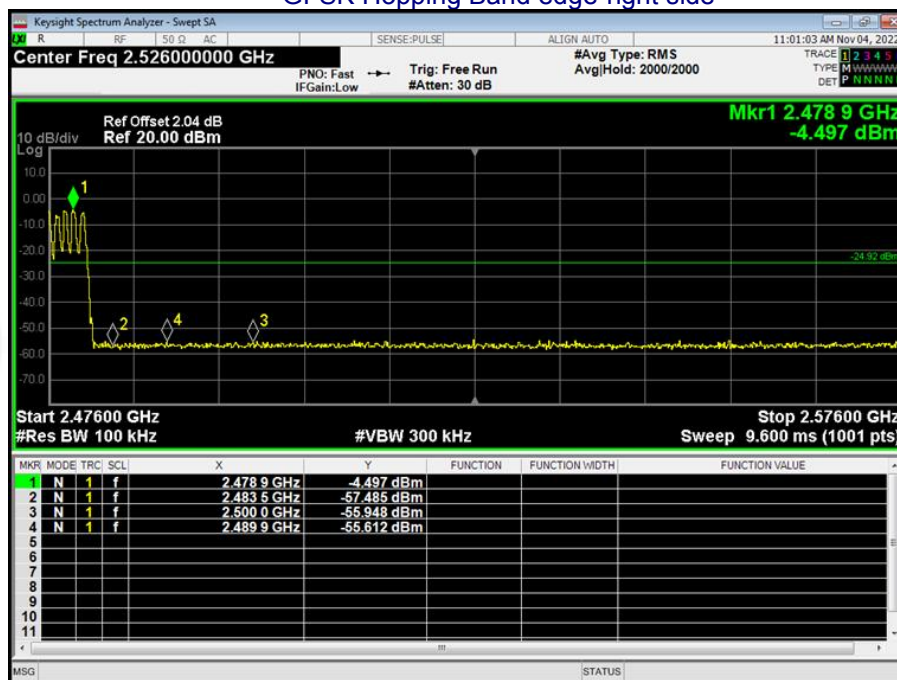




### GFSK No-hopping Band edge-right side

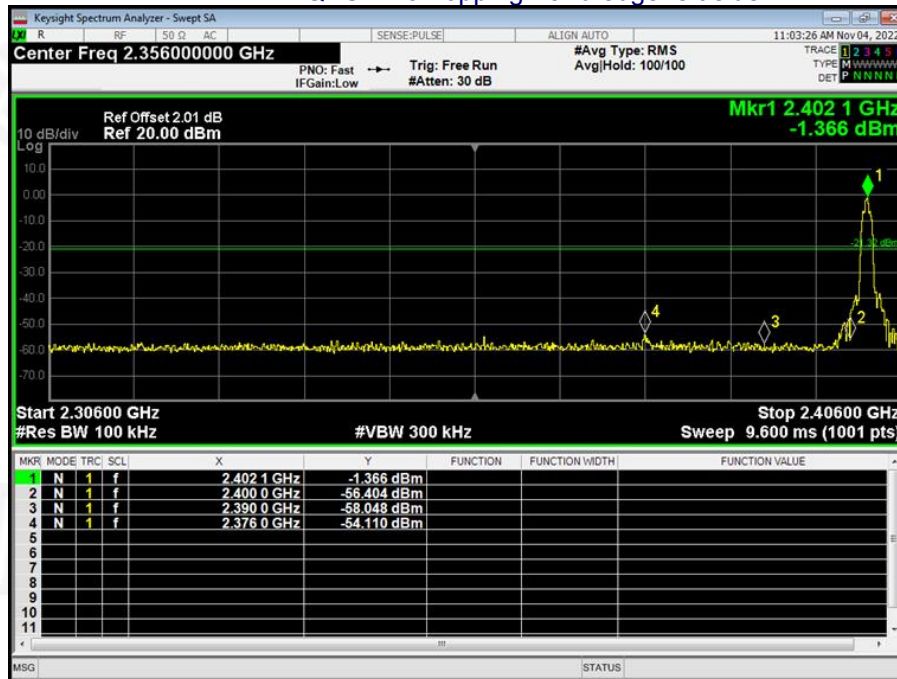


### GFSK Hopping Band edge-right side

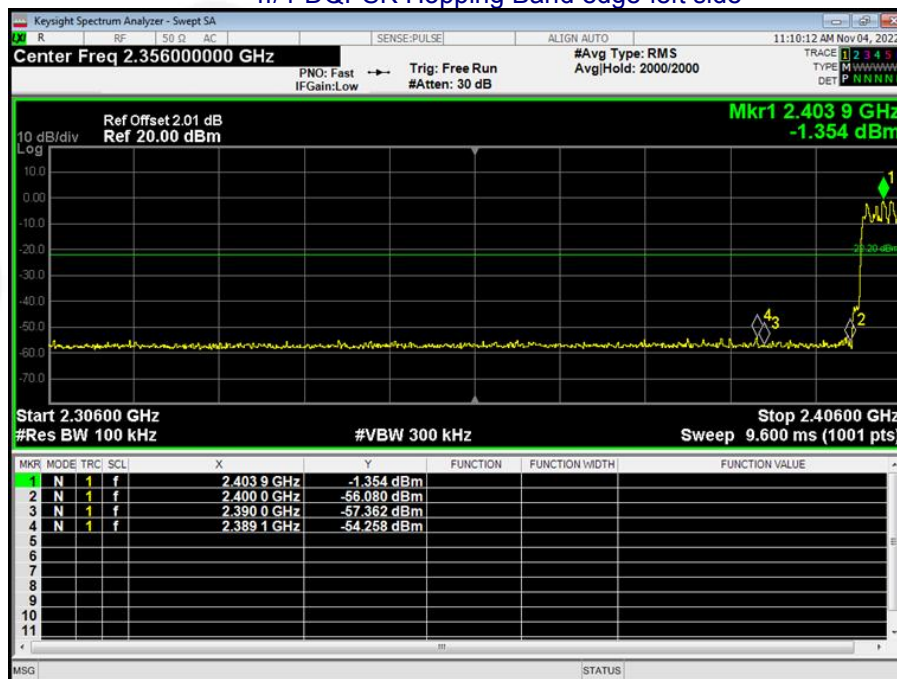




$\pi/4$ -DQPSK No-hopping Band edge-left side

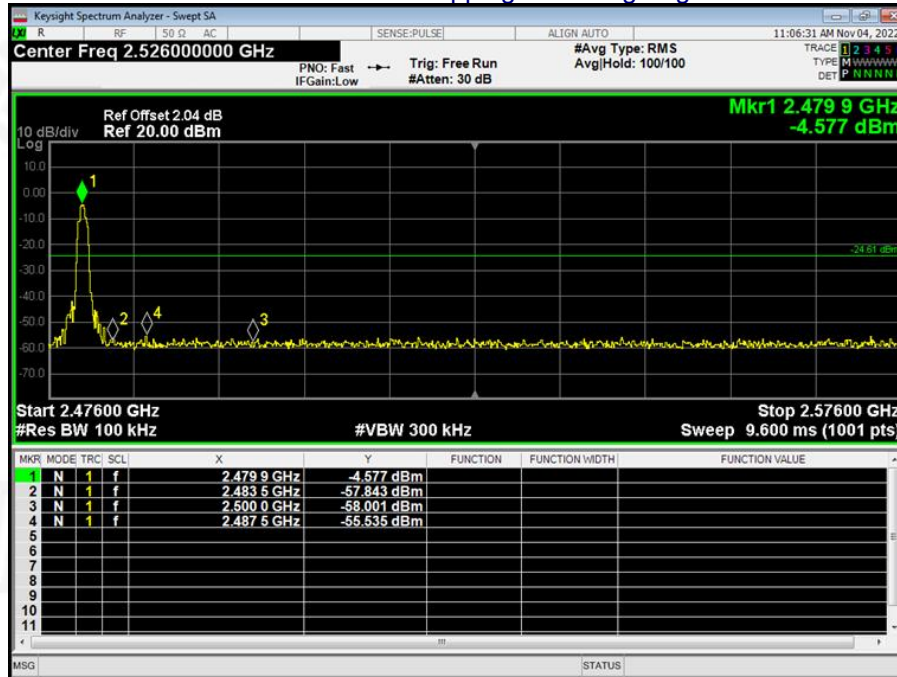


$\pi/4$ -DQPSK Hopping Band edge-left side

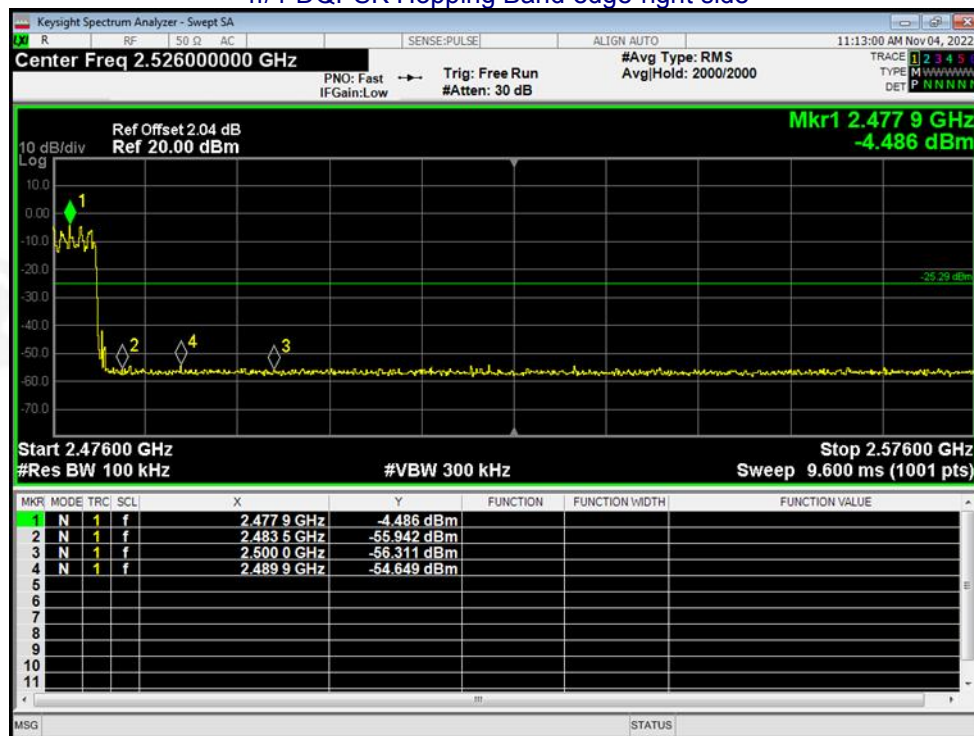




### $\pi/4$ -DQPSK No-hopping Band edge-right side

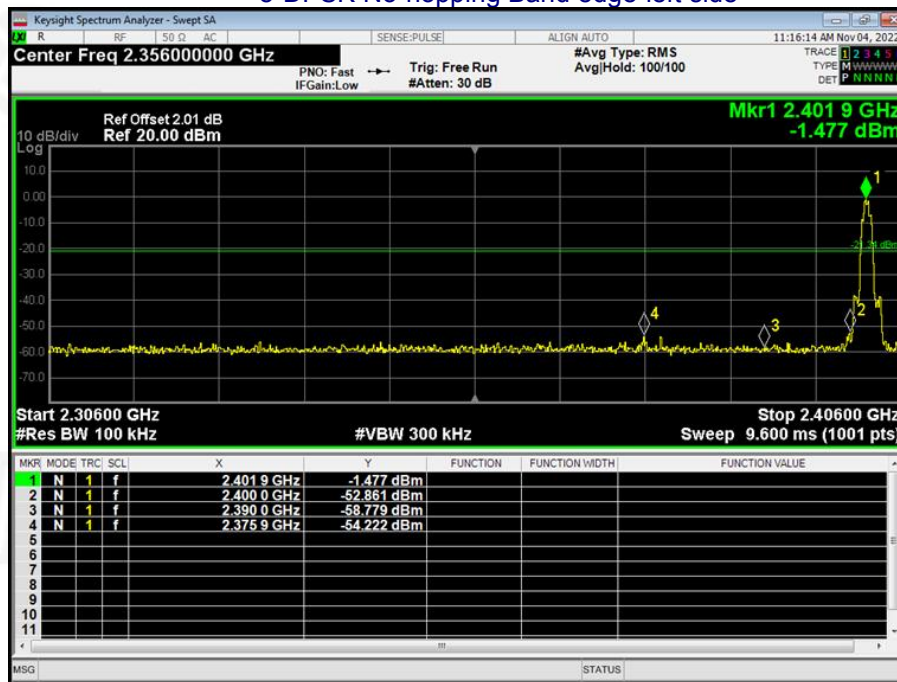


### $\pi/4$ -DQPSK Hopping Band edge-right side

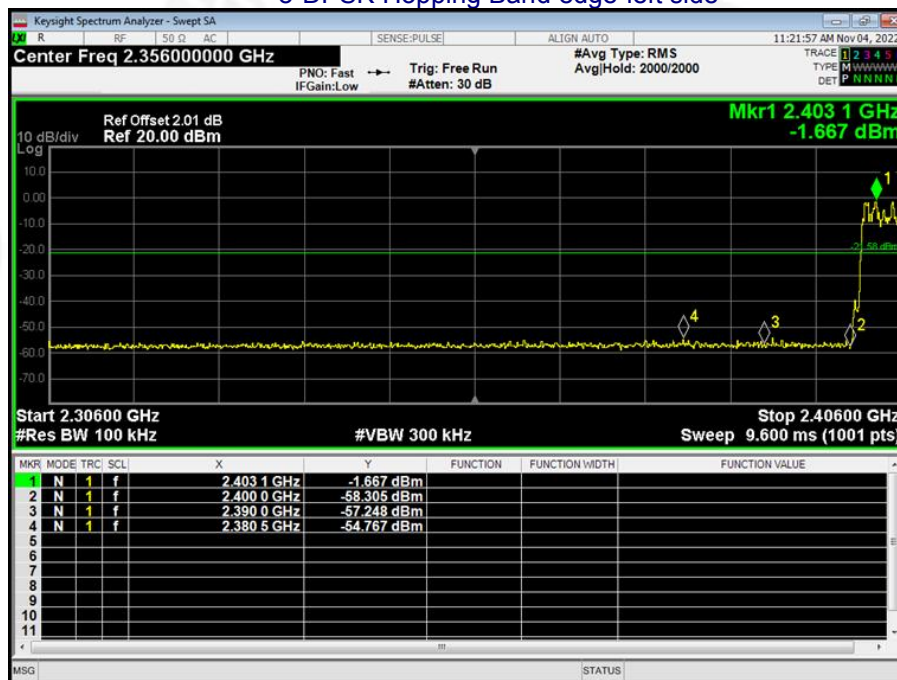




### 8-DPSK No-hopping Band edge-left side

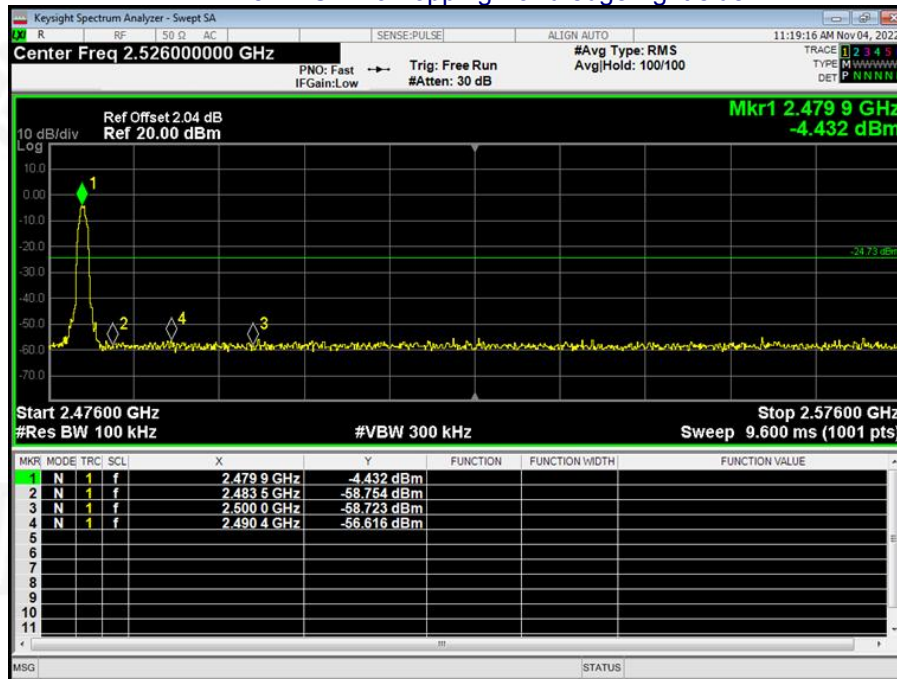


### 8-DPSK Hopping Band edge-left side

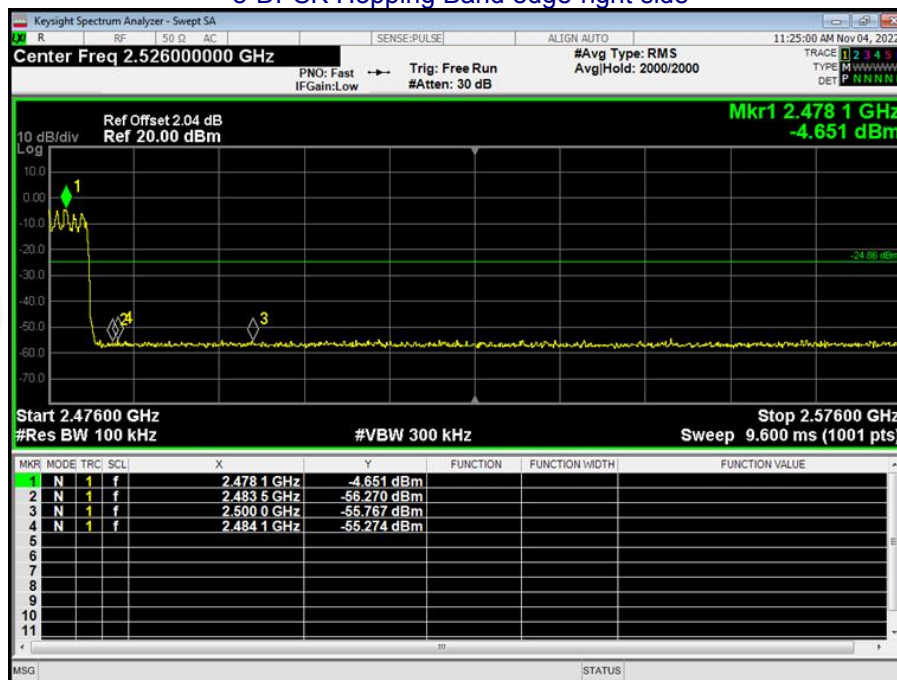




### 8-DPSK No-hopping Band edge-right side



### 8-DPSK Hopping Band edge-right side





## 7. 20DB&99% BANDWIDTH

|                   |                                    |
|-------------------|------------------------------------|
| Test Requirement: | FCC Part15 C Section 15.247 (a)(1) |
| Test Method:      | ANSI C63.10:2013                   |

### 7.1 Test Setup



### 7.2 Limit

N/A

### 7.3 Test procedure

1. Set RBW = 30 kHz.
2. Set the video bandwidth (VBW)  $\geq 3 \times$  RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

### 7.4 DEVIATION FROM STANDARD

No deviation.

## 7.5 Test Result

| Mode           | Test channel | 20dB Emission Bandwidth (MHz) | Result |
|----------------|--------------|-------------------------------|--------|
| GFSK           | Lowest       | 0.9050                        | Pass   |
|                | Middle       | 0.9058                        |        |
|                | Highest      | 0.9052                        |        |
| $\pi/4$ -DQPSK | Lowest       | 1.1820                        | Pass   |
|                | Middle       | 1.2140                        |        |
|                | Highest      | 1.2130                        |        |
| 8-DPSK         | Lowest       | 1.2150                        | Pass   |
|                | Middle       | 1.2110                        |        |
|                | Highest      | 1.2070                        |        |

## Test plots

## GFSK Low Channel





### GFSK Middle Channel



### GFSK High Channel





### $\pi/4$ -DQPSK Low Channel

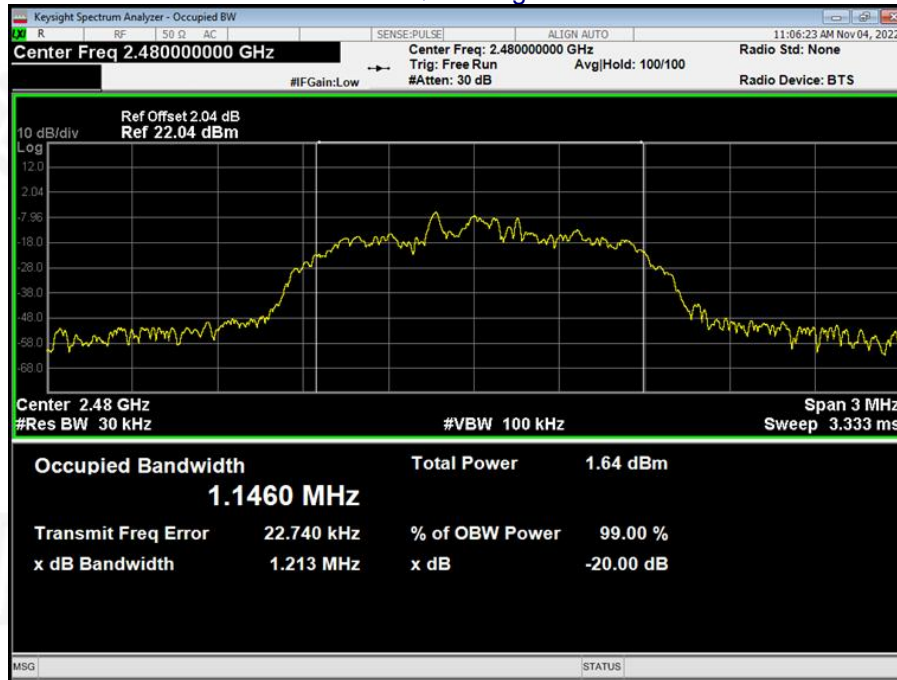


### $\pi/4$ -DQPSK Middle Channel

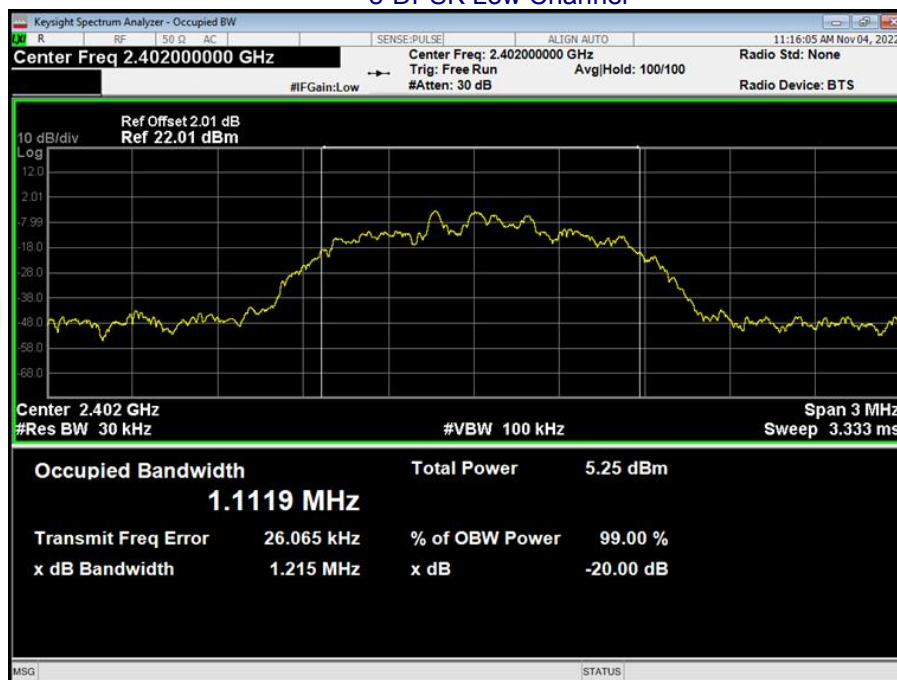




### $\pi/4$ -DQPSK High Channel

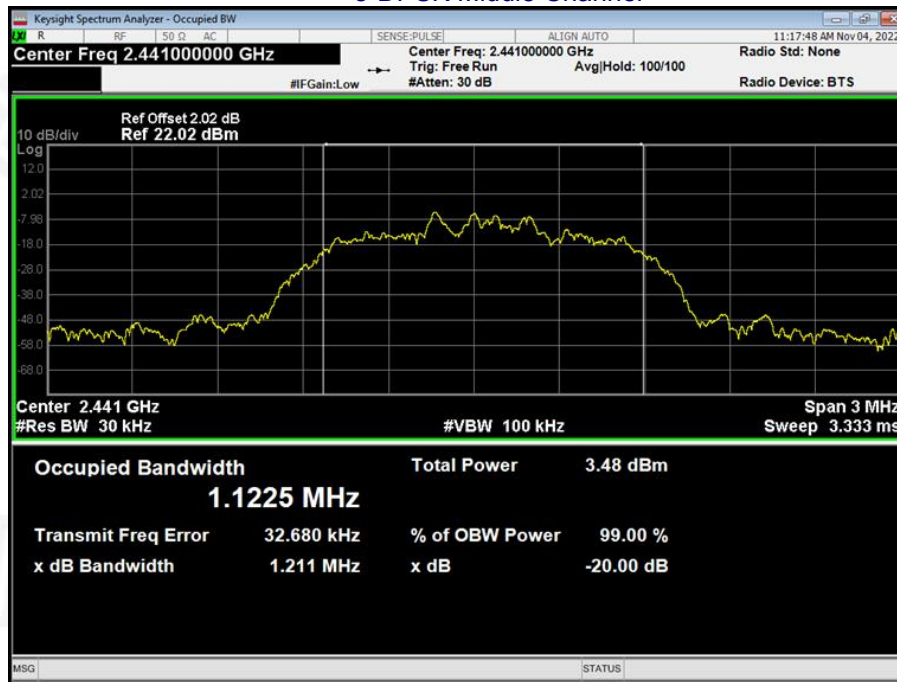


### 8-DPSK Low Channel





### 8-DPSK Middle Channel



### 8-DPSK High Channel





## 8. Maximum Peak Output Power

|                   |                                                  |
|-------------------|--------------------------------------------------|
| Test Requirement: | FCC Part15 C Section 15.247 (b)(1)               |
| Test Method:      | ANSI C63.10:2013                                 |
| Limit:            | GFSK:30 dBm<br>$\pi/4$ -DQPSK & 8-DPSK:20.97 dBm |

### 8.1 Block Diagram Of Test Setup



### 8.2 Limit

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

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W.

### 8.3 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 = 2MHz. VBW =6MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

### 8.4 DEVIATION FROM STANDARD

No deviation.

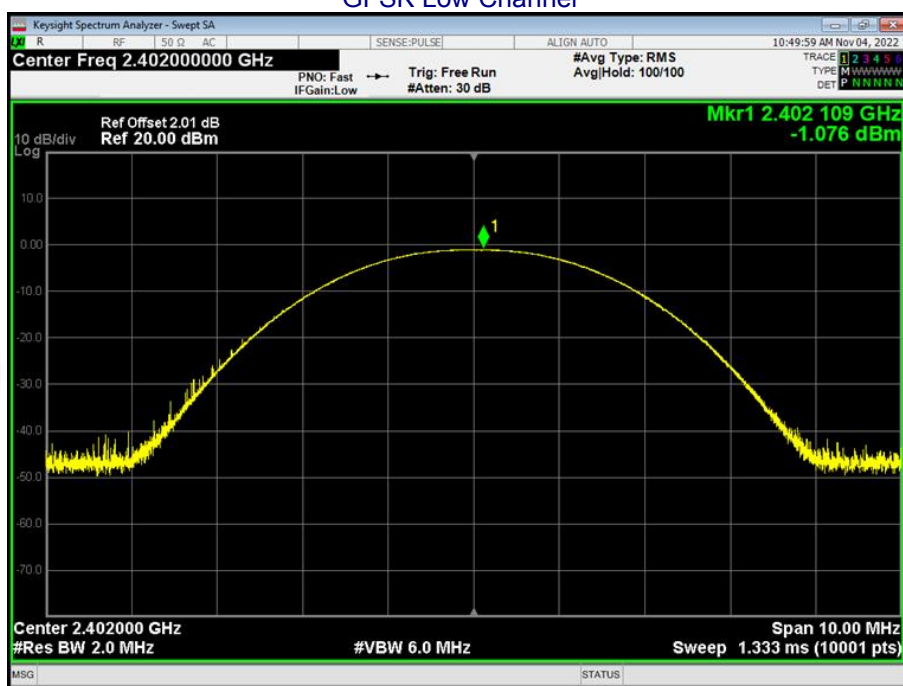


## 8.5 Test Result

| Mode           | Test channel | Peak Output Power (dBm) | FCC Limit (dBm) | Result |
|----------------|--------------|-------------------------|-----------------|--------|
| GFSK           | Lowest       | -1.076                  | 30.00           | Pass   |
|                | Middle       | -2.548                  |                 |        |
|                | Highest      | -4.392                  |                 |        |
| $\pi/4$ -DQPSK | Lowest       | -0.579                  | 21.00           | Pass   |
|                | Middle       | -1.969                  |                 |        |
|                | Highest      | -3.761                  |                 |        |
| 8-DPSK         | Lowest       | -0.116                  | 21.00           | Pass   |
|                | Middle       | -1.424                  |                 |        |
|                | Highest      | -3.212                  |                 |        |

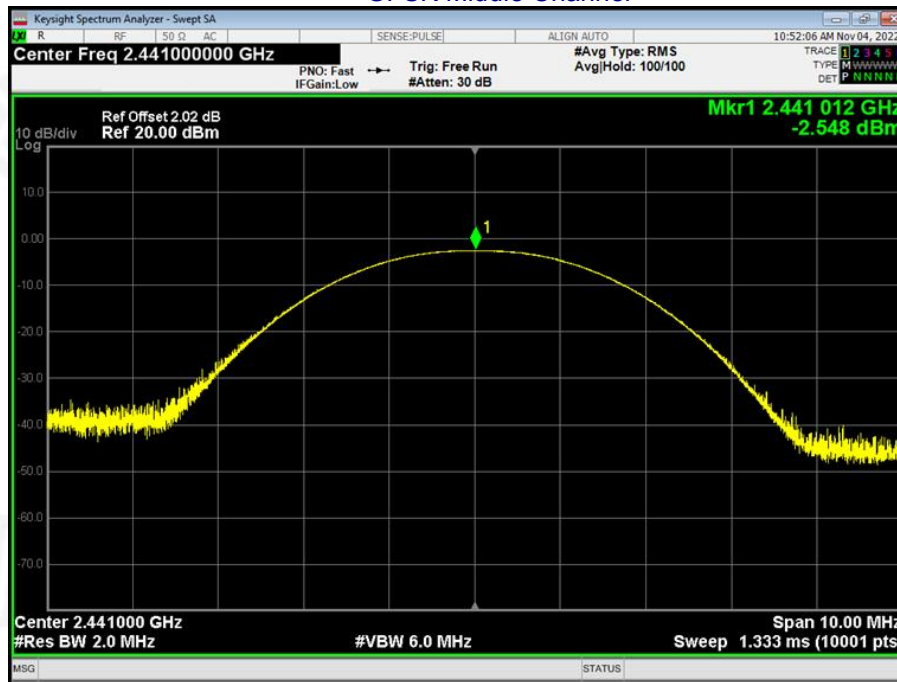
## Test plots

GFSK Low Channel

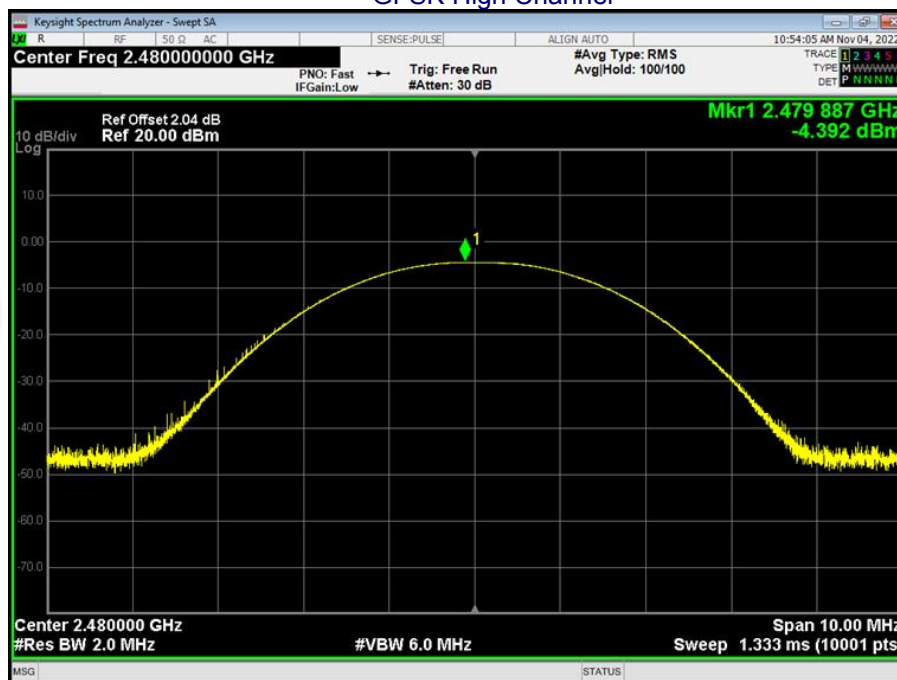




GFSK Middle Channel

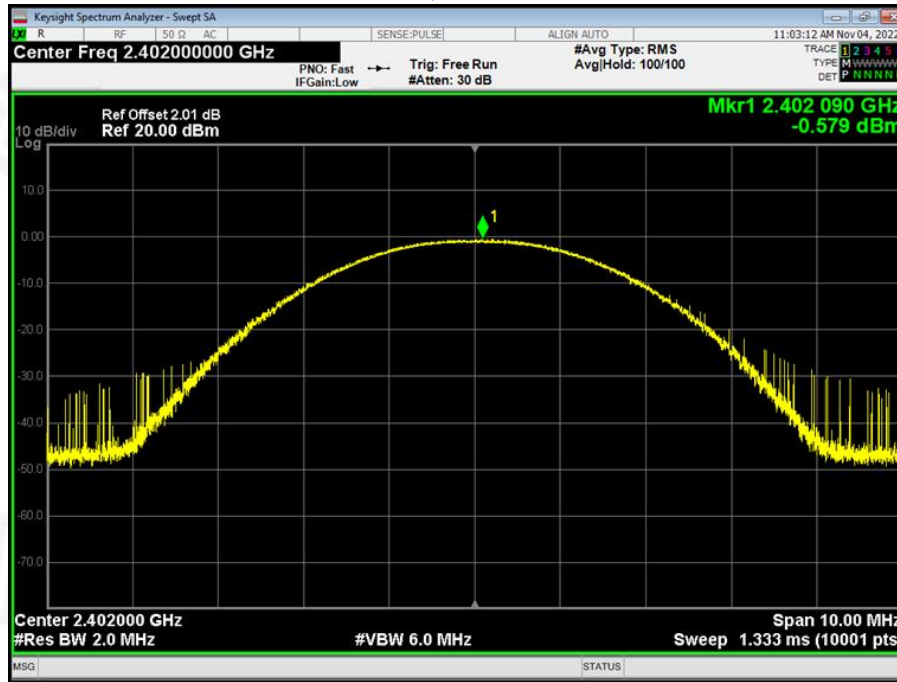


GFSK High Channel

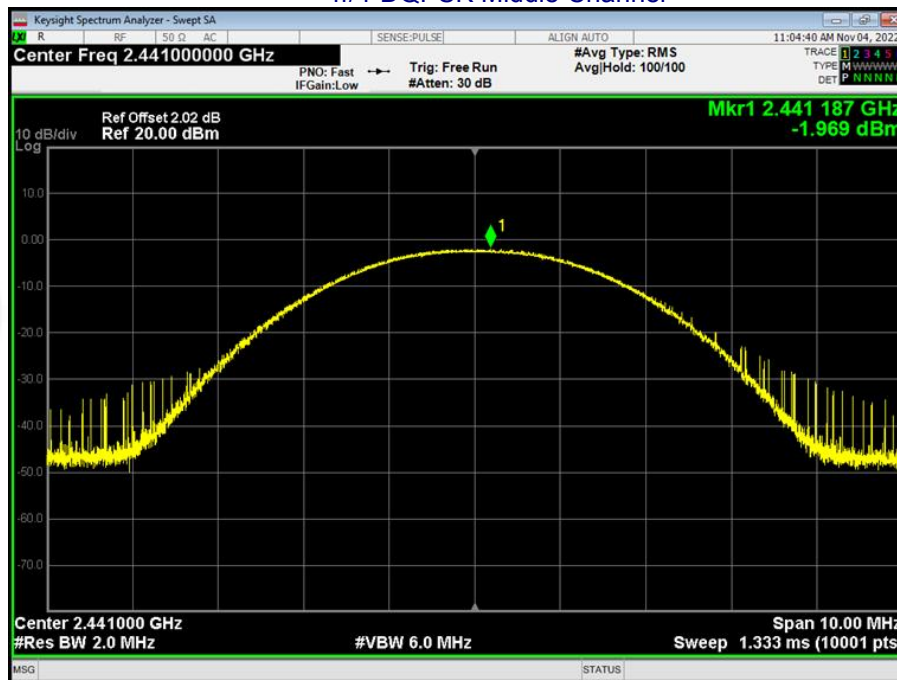




$\pi/4$ -DQPSK Low Channel

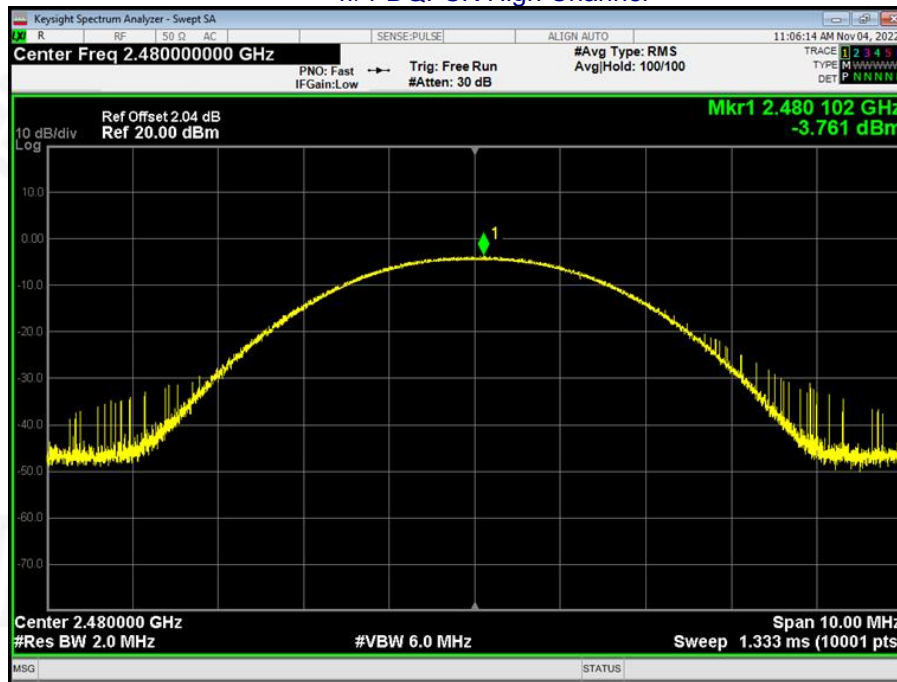


$\pi/4$ -DQPSK Middle Channel

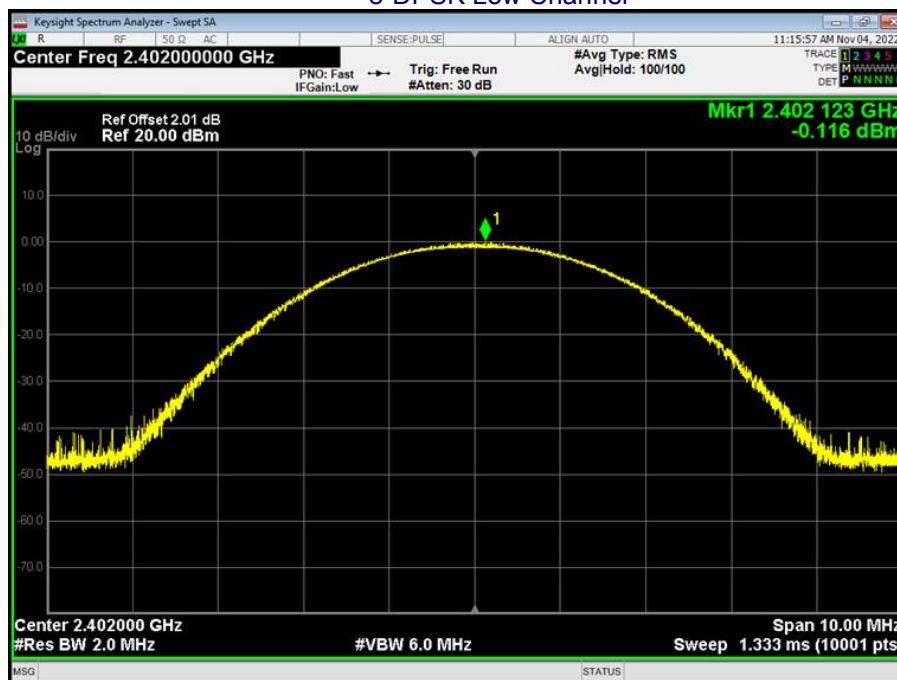




### $\pi/4$ -DQPSK High Channel

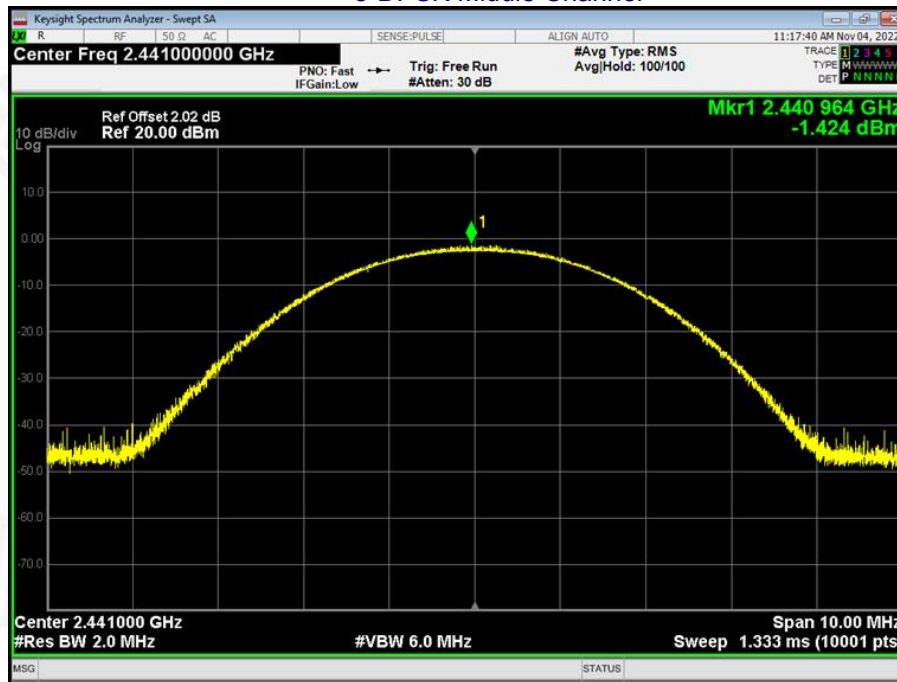


### 8-DPSK Low Channel

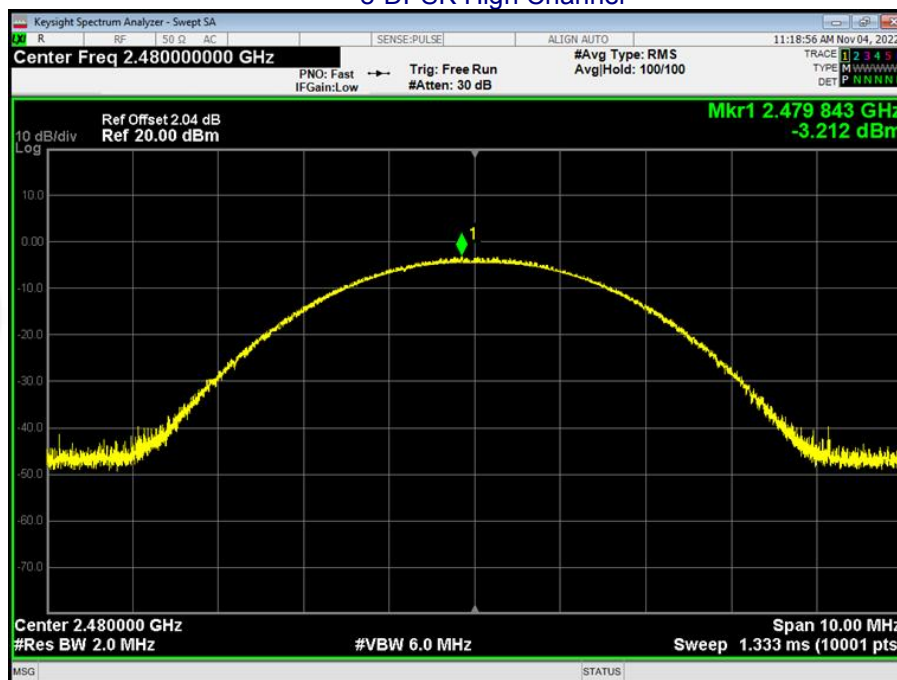




### 8-DPSK Middle Channel



### 8-DPSK High Channel





## 9. HOPPING CHANNEL SEPARATION

|                   |                                                                                                             |
|-------------------|-------------------------------------------------------------------------------------------------------------|
| Test Requirement: | FCC Part15 C Section 15.247 (a)(1)                                                                          |
| Test Method:      | ANSI C63.10:2013                                                                                            |
| Receiver setup:   | RBW=30KHz, VBW=100KHz, detector=Peak                                                                        |
| Limit:            | GFSK: 20dB bandwidth<br>$\pi/4$ -DQPSK & 8DSK: 0.025MHz or 2/3 of the 20dB bandwidth (whichever is greater) |

### 9.1 Test Setup



### 9.2 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.

### 9.3 DEVIATION FROM STANDARD

No deviation.



## 9.4 Test Result

| Modulation     | Test Channel | Separation (MHz) | Limit(MHz) | Result |
|----------------|--------------|------------------|------------|--------|
| GFSK           | Low          | 1.002            | 0.6033     | PASS   |
| GFSK           | Middle       | 1.002            | 0.6039     | PASS   |
| GFSK           | High         | 1.008            | 0.6035     | PASS   |
| $\pi/4$ -DQPSK | Low          | 0.834            | 0.7880     | PASS   |
| $\pi/4$ -DQPSK | Middle       | 0.999            | 0.8093     | PASS   |
| $\pi/4$ -DQPSK | High         | 1.143            | 0.8087     | PASS   |
| 8-DPSK         | Low          | 1.335            | 0.8100     | PASS   |
| 8-DPSK         | Middle       | 0.996            | 0.8073     | PASS   |
| 8-DPSK         | High         | 1.167            | 0.8047     | PASS   |

Test plots  
GFSK Low Channel



### GFSK Middle Channel

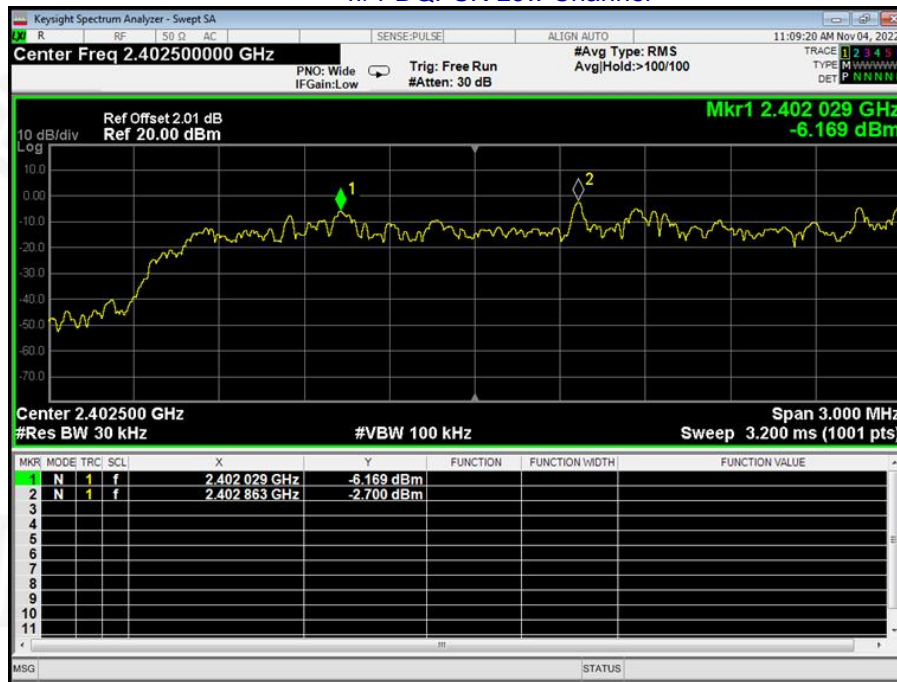


### GFSK High Channel

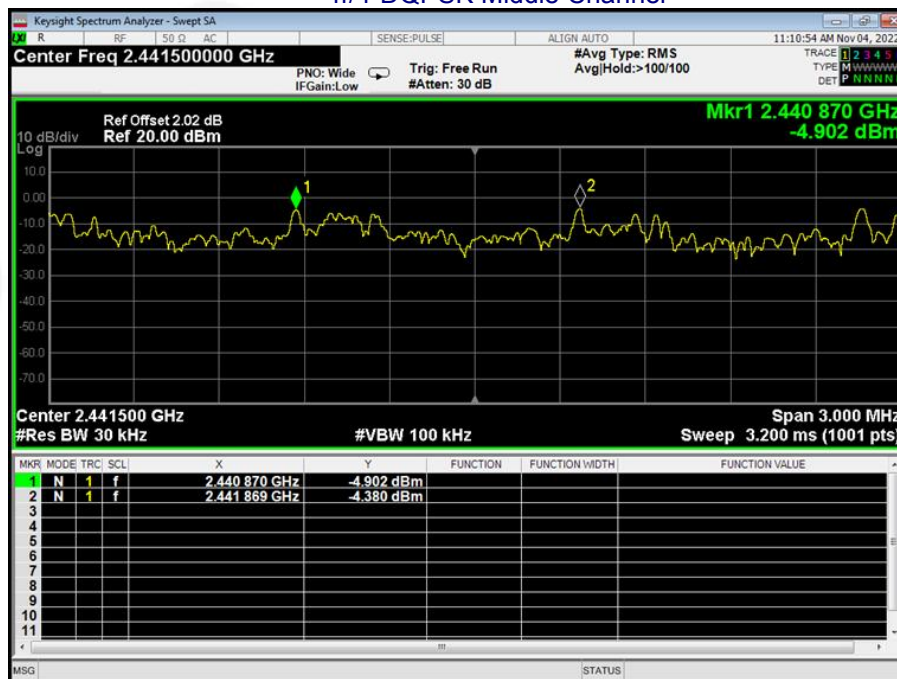




### $\pi/4$ -DQPSK Low Channel

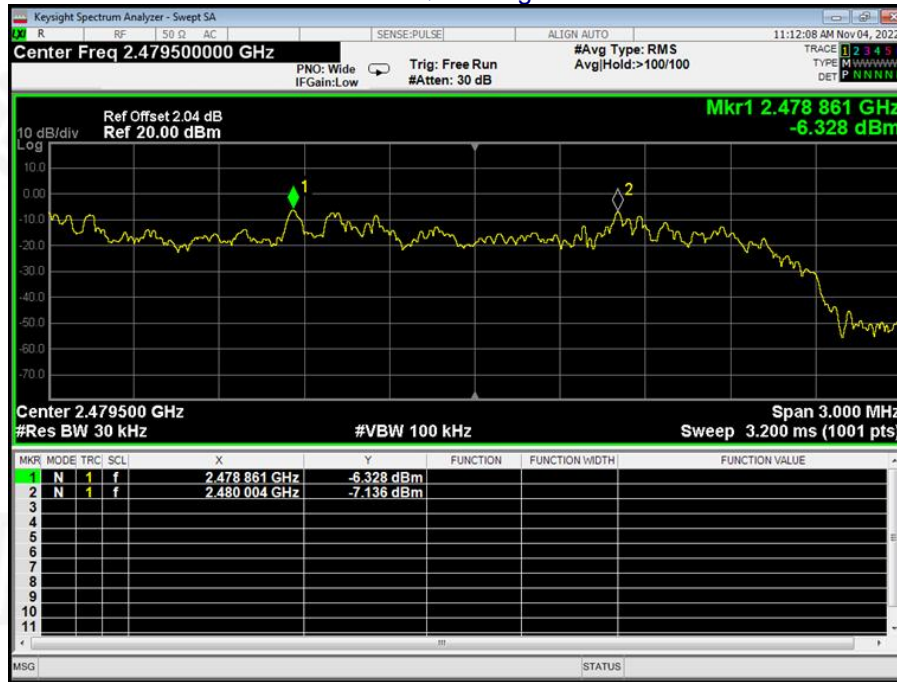


### $\pi/4$ -DQPSK Middle Channel

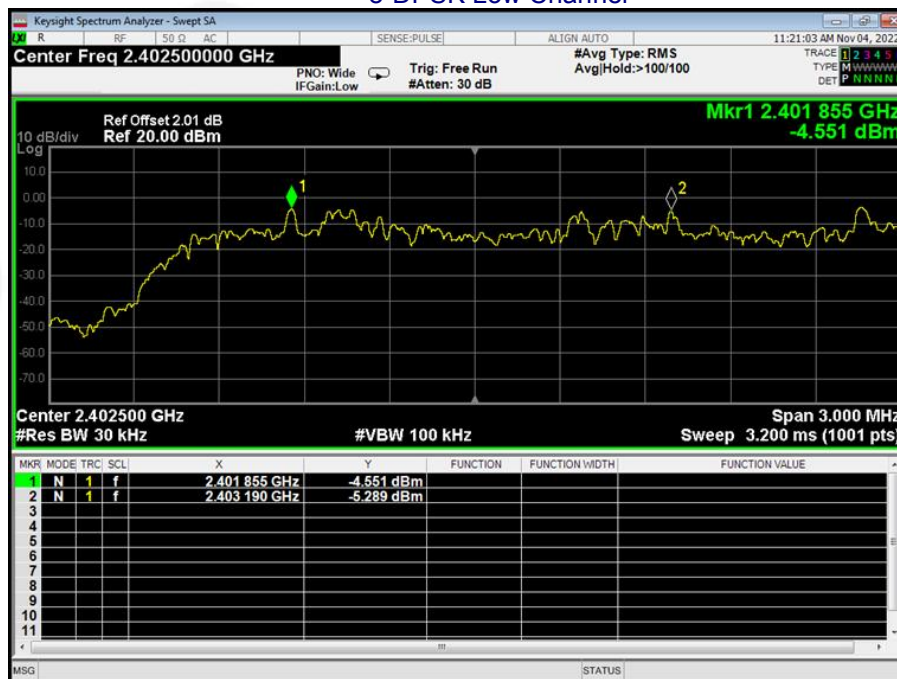




### $\pi/4$ -DQPSK High Channel

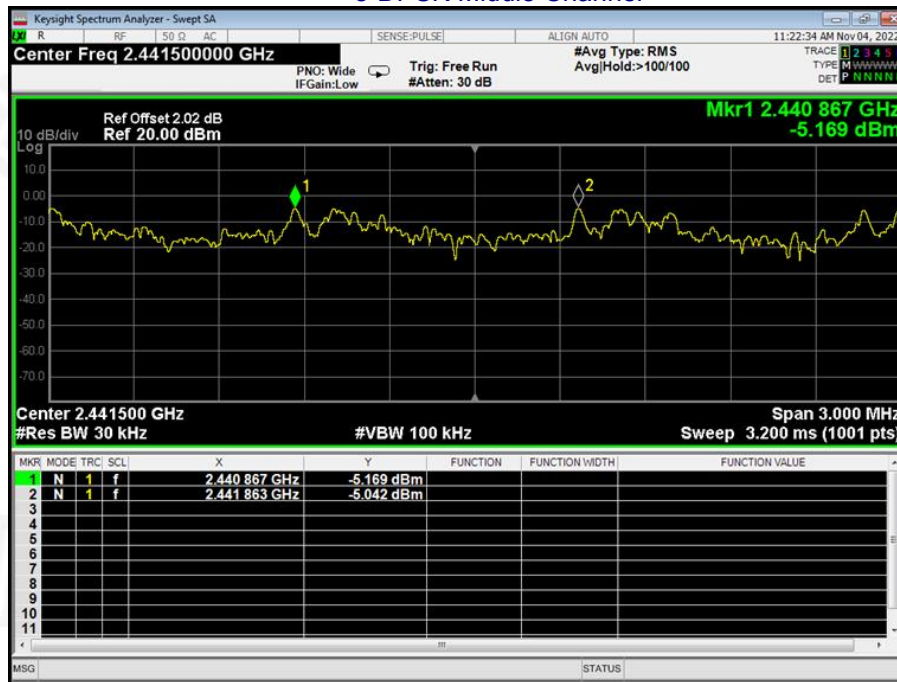


### 8-DPSK Low Channel





### 8-DPSK Middle Channel



### 8-DPSK High Channel





## 10. NUMBER OF HOPPING FREQUENCY

|                   |                                                                          |
|-------------------|--------------------------------------------------------------------------|
| Test Requirement: | FCC Part15 C Section 15.247 (a)(1)(iii)                                  |
| Test Method:      | ANSI C63.10:2013                                                         |
| Receiver setup:   | RBW=100kHz, VBW=300kHz, Frequency range=2400MHz-2483.5MHz, Detector=Peak |
| Limit:            | 15 channels                                                              |

### 10.1 Test Setup



### 10.2 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 = 300kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency = 2.4835GHz. Sweep=auto;

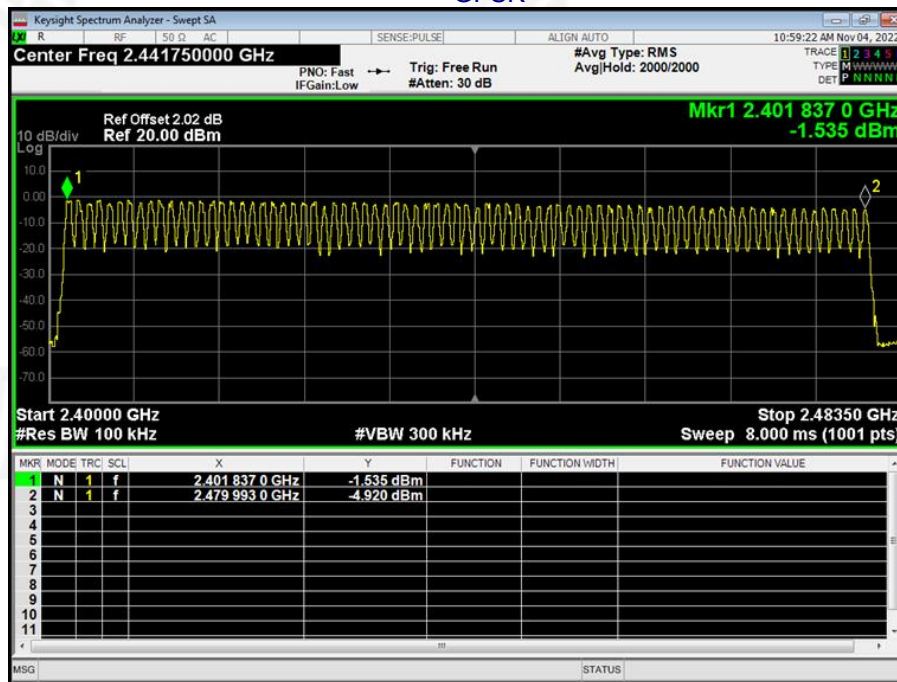
### 10.3 DEVIATION FROM STANDARD

No deviation.



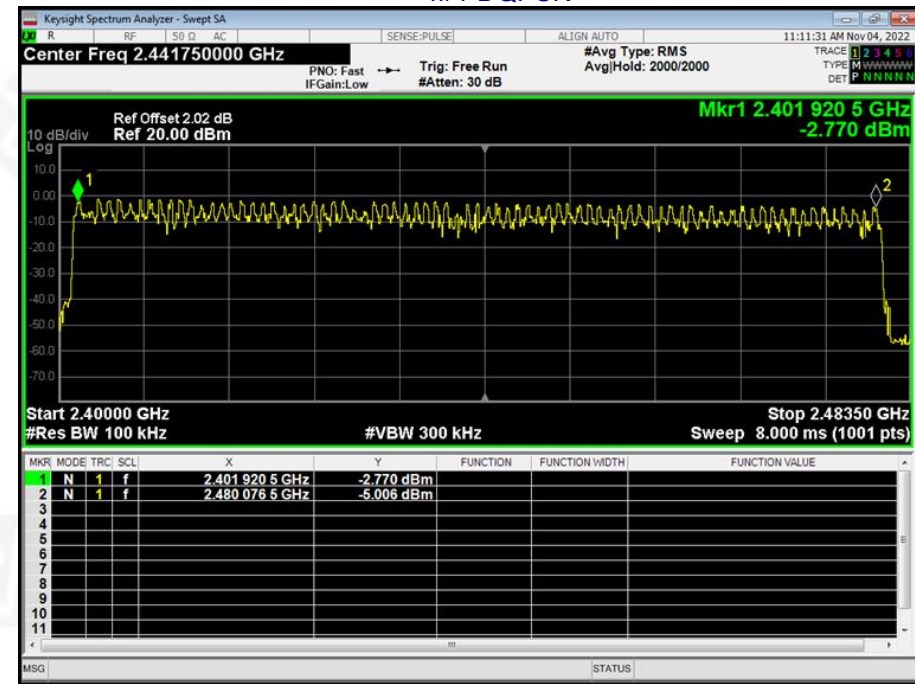
## 10.4 Test Result

Test Plots:  
79 Channels in total  
GFSK

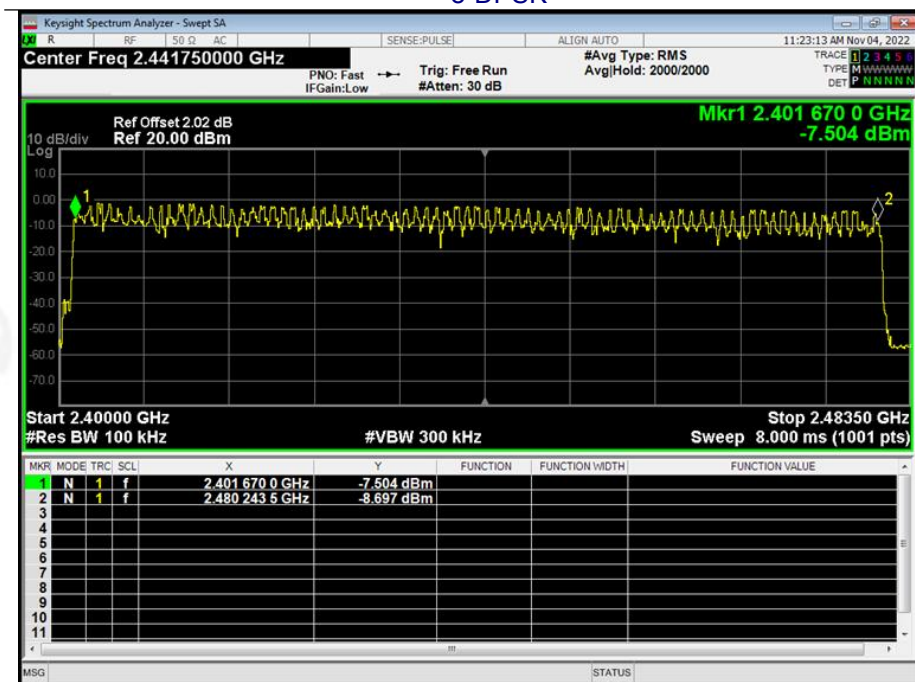




### $\pi/4$ -DQPSK



### 8-DPSK





## 11. DWELL TIME

|                   |                                             |
|-------------------|---------------------------------------------|
| Test Requirement: | FCC Part15 C Section 15.247 (a)(1)(iii)     |
| Test Method:      | ANSI C63.10:2013                            |
| Receiver setup:   | RBW=1MHz, VBW=3MHz, Span=0Hz, Detector=Peak |
| Limit:            | 0.4 Second                                  |

### 11.1 Test Setup



### 11.2 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set spectrum analyzer span = 0Hz;
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).

### 11.3 DEVIATION FROM STANDARD

No deviation.



## 11.4 Test Result

GFSK mode:

| Frequency | Packet | Dwell time(ms) | Limit(ms) | Result |
|-----------|--------|----------------|-----------|--------|
| 2441MHz   | DH1    | 124.480        | 400       | Pass   |
| 2441MHz   | DH3    | 262.720        | 400       | Pass   |
| 2441MHz   | DH5    | 308.587        | 400       | Pass   |

Remarks:

The test period:  $T = 0.4 \text{ Second/Channel} \times 79 \text{ Channel} = 31.6 \text{ s}$ 

Test channel: as blow

CH:2441MHz time slot= $0.389(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 124.480 \text{ms}$ CH:2441MHz time slot= $1.642(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 262.720 \text{ms}$ CH:2441MHz time slot= $2.893(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 308.587 \text{ms}$  $\pi/4$ -DQPSK mode:

| Frequency | Packet | Dwell time(ms) | Limit(ms) | Result |
|-----------|--------|----------------|-----------|--------|
| 2441MHz   | 2DH1   | 126.400        | 400       | Pass   |
| 2441MHz   | 2DH3   | 264.160        | 400       | Pass   |
| 2441MHz   | 2DH5   | 309.227        | 400       | Pass   |

Remarks:

The test period:  $T = 0.4 \text{ Second/Channel} \times 79 \text{ Channel} = 31.6 \text{ s}$ 

Test channel: as blow

CH:2441MHz time slot= $0.395(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 126.400 \text{ms}$ CH:2441MHz time slot= $1.651(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 264.160 \text{ms}$ CH:2441MHz time slot= $2.899(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 309.227 \text{ms}$ 

8-DPSK mode:

| Frequency | Packet | Dwell time(ms) | Limit(ms) | Result |
|-----------|--------|----------------|-----------|--------|
| 2441MHz   | 3DH1   | 127.040        | 400       | Pass   |
| 2441MHz   | 3DH3   | 264.160        | 400       | Pass   |
| 2441MHz   | 3DH5   | 309.440        | 400       | Pass   |

Remarks:

The test period:  $T = 0.4 \text{ Second/Channel} \times 79 \text{ Channel} = 31.6 \text{ s}$ 

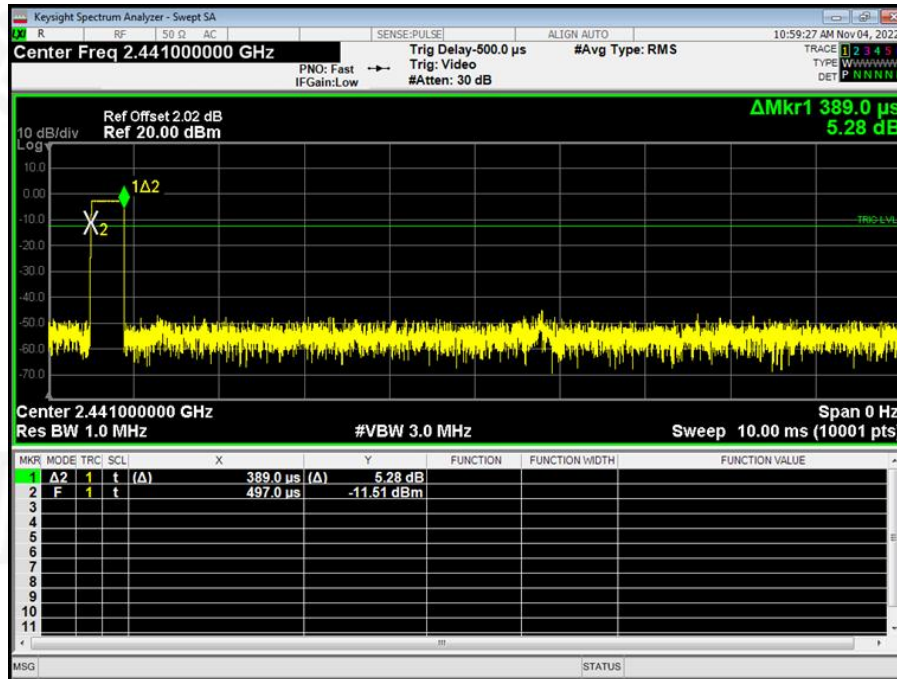
Test channel: as blow

CH:2441MHz time slot= $0.397(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 127.040 \text{ms}$ CH:2441MHz time slot= $1.651(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 264.160 \text{ms}$ CH:2441MHz time slot= $2.901(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 309.440 \text{ms}$

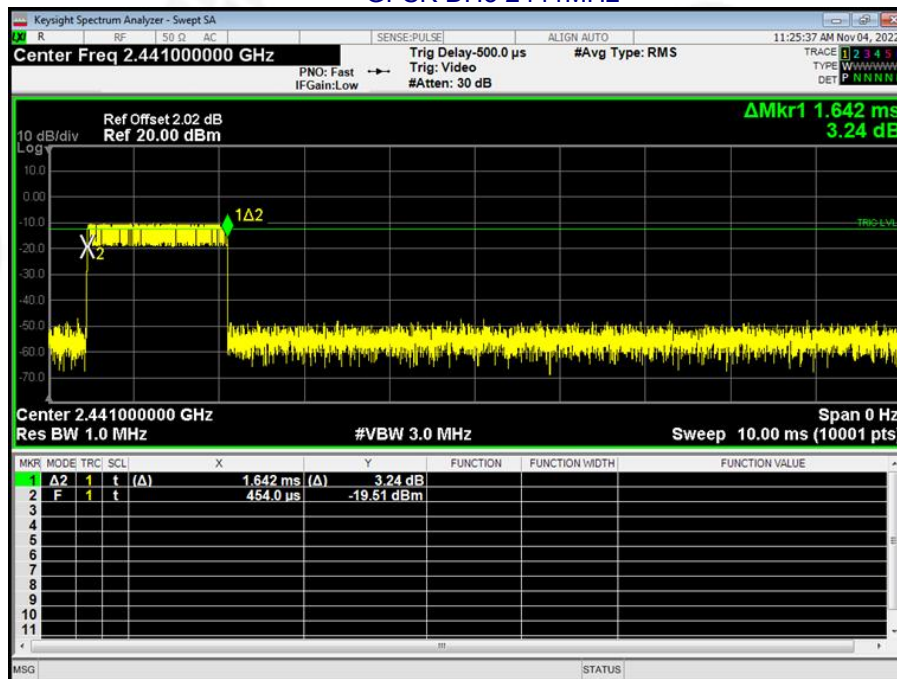


## Test Plots

### GFSK DH1 2441MHz

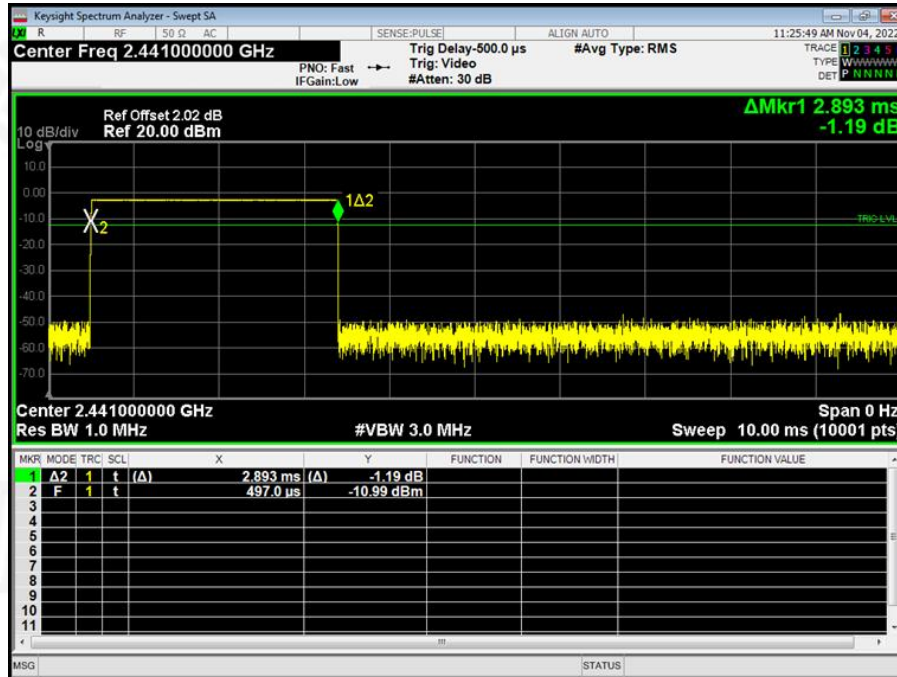


### GFSK DH3 2441MHz

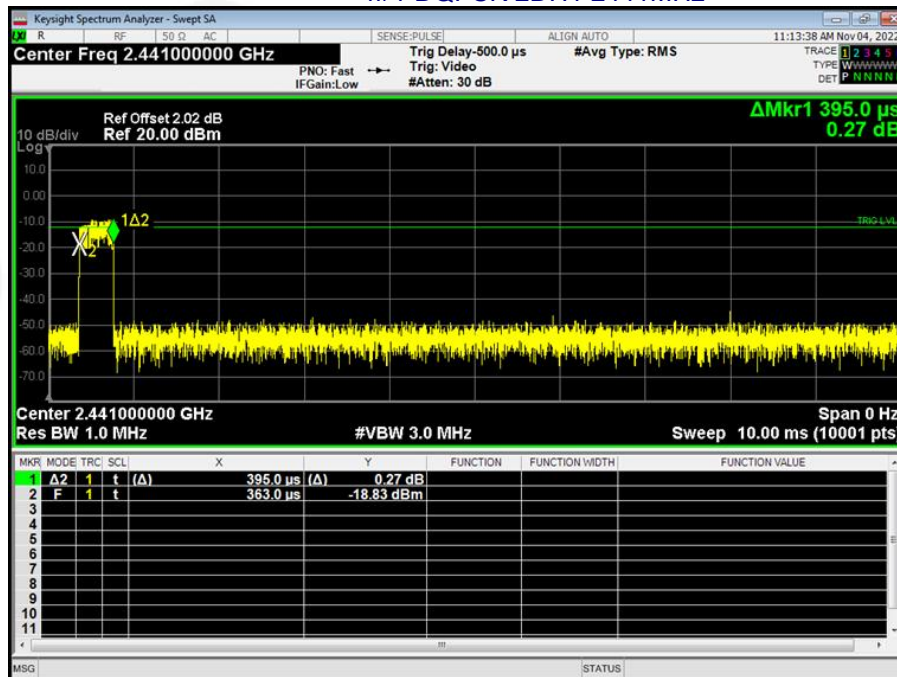




### GFSK DH5 2441MHz

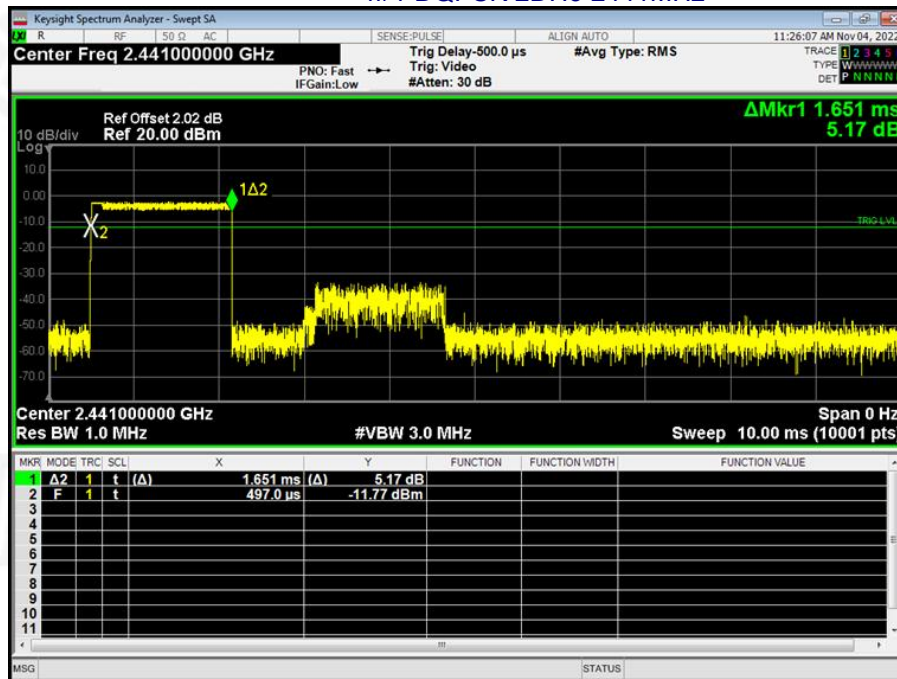


### $\pi/4$ -DQPSK 2DH1 2441MHz

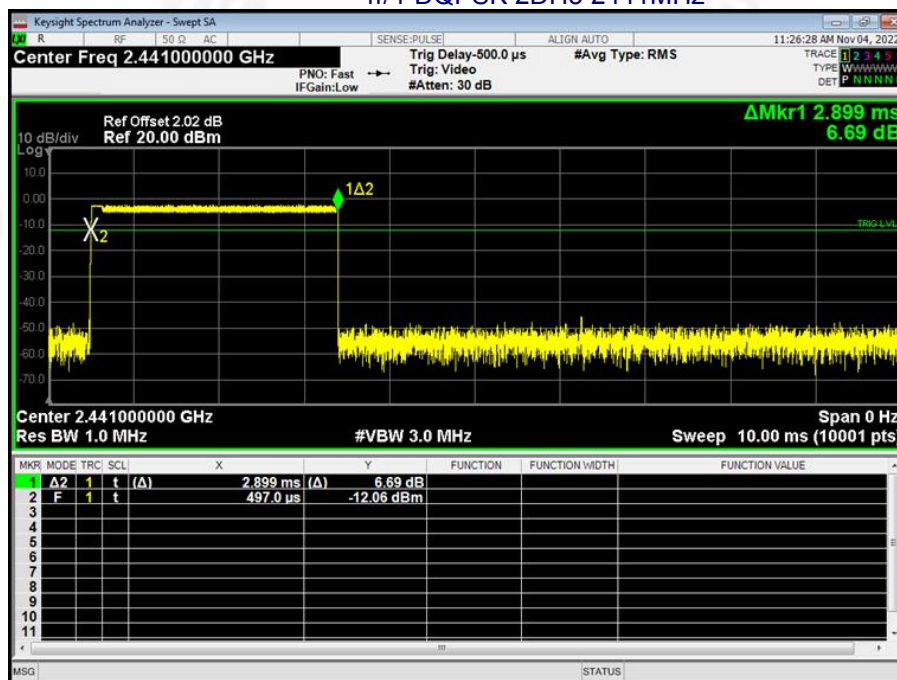




$\pi/4$ -DQPSK 2DH3 2441MHz



$\pi/4$ -DQPSK 2DH5 2441MHz





Key Settings and Readings:

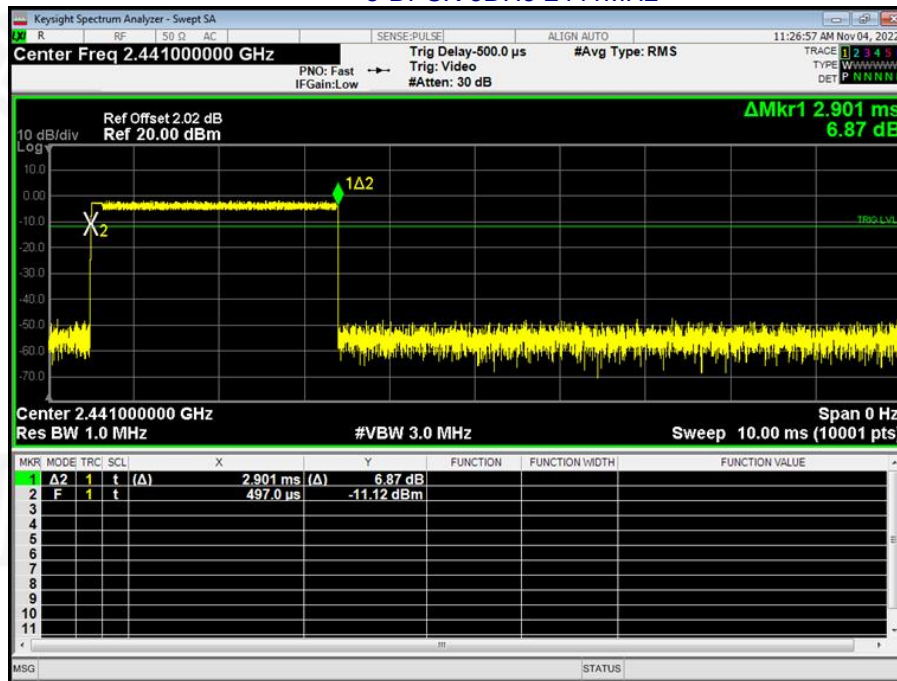
- Center Freq: 2.441000000 GHz
- Ref Offset: 2.02 dB
- Ref: 20.00 dBm
- Trig Delay: 500.0 μs
- Trig: Video
- #Avn Type: RMS
- PNO: Fast
- IFGain: Low
- #Atten: 30 dB
- Span: 0 Hz
- Res BW: 1.0 MHz
- #VBW: 3.0 MHz
- Sweep: 10.00 ms (10001 pts)
- ΔMkr1: 397.0 μs
- 3.55 dB

| MKR | MODE | TRC | SCL | X   | Y        | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|-----|------|-----|-----|-----|----------|----------|----------------|----------------|
| 1   | Δ2   | 1   | t   | (Δ) | 397.0 μs | (Δ)      | 3.55 dB        |                |
| 2   | F    | 1   | t   |     | 362.0 μs |          | -17.86 dBm     |                |

[illegible]



### 8-DPSK 3DH5 2441MHz





## 12. Antenna Requirement

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| Standard requirement:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | FCC Part15 C Section 15.203 /247(c) |
| <p>15.203 requirement:<br/>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, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.</p> <p>15.247(c) (1)(i) requirement:<br/>(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.</p> |                                     |
| <b>EUT Antenna:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                     |
| The antenna is FPCB Antenna, the best case gain of the antennas is 2.99 dBi, reference to the appendix II for details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                     |



### 13. Test Setup Photo

Reference to the appendix I for details.

### 14. EUT Constructional Details

Reference to the appendix II for details.

\*\*\*\*\* END OF REPORT \*\*\*\*\*