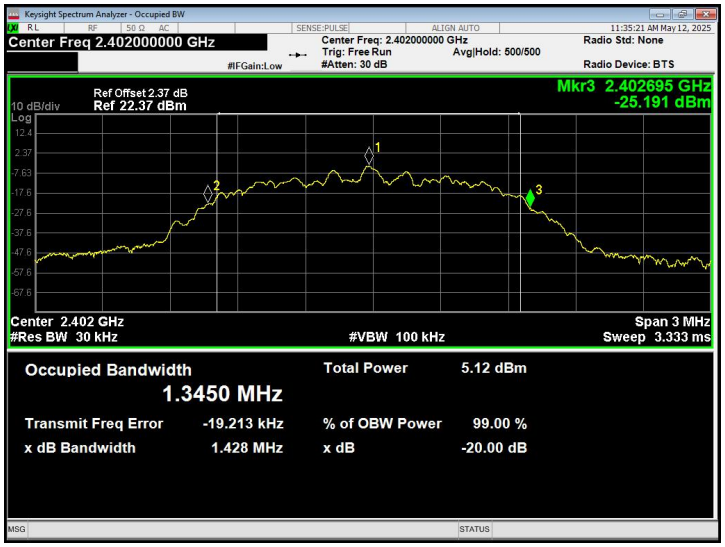
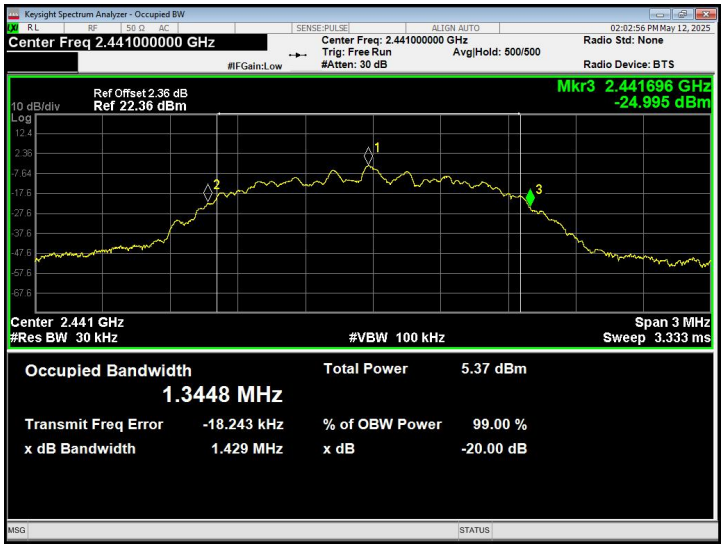
π/4-DQPSK - 2-DH1 Test plots

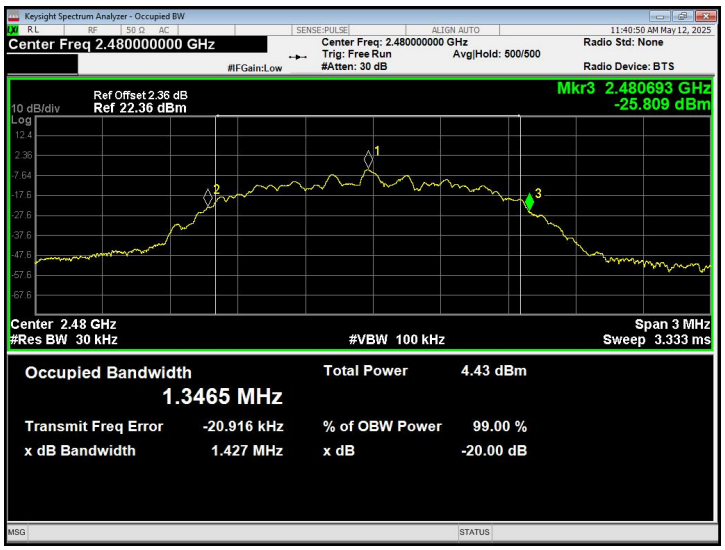
Low Channel



Middle Channel

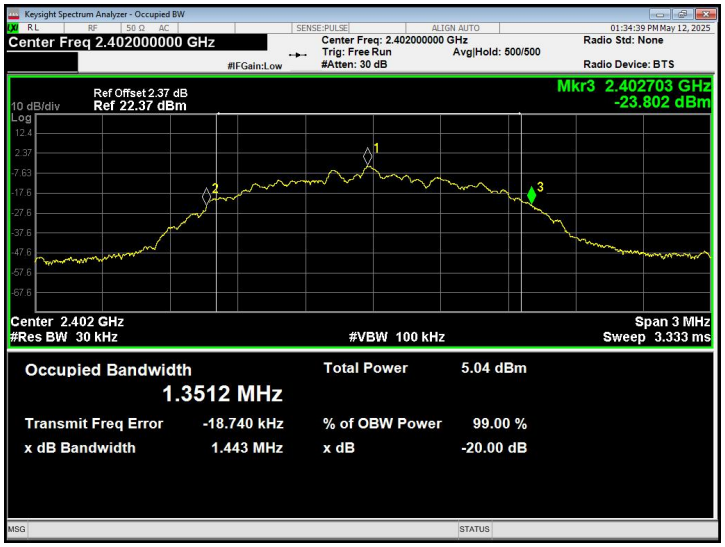


High Channel

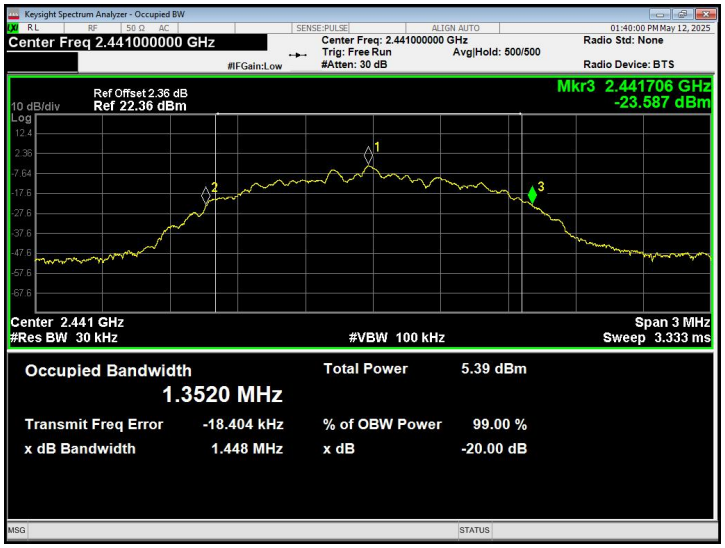


8-DPSK - 3-DH1 Test plots

Low Channel



Middle Channel

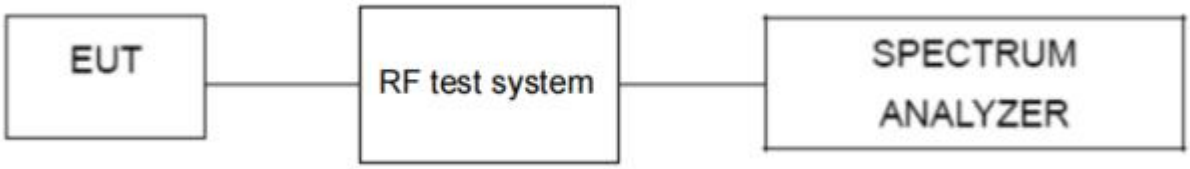


High Channel

8. MAXIMUM PEAK OUTPUT POWER

Test Requirement:	FCC Part15 C Section 15.247 (b)(1)
Test Method:	ANSI C63.10:2013
Limit:	GFSK: 30dBm π/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.

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

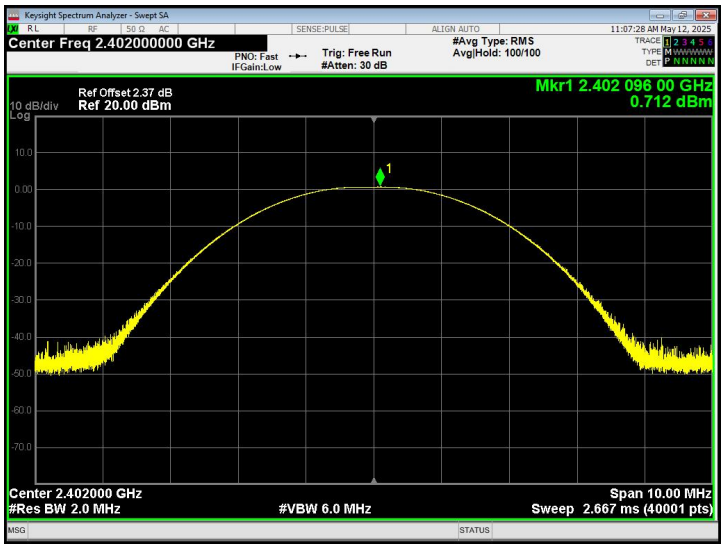
No deviation.

8.5 TEST RESULT

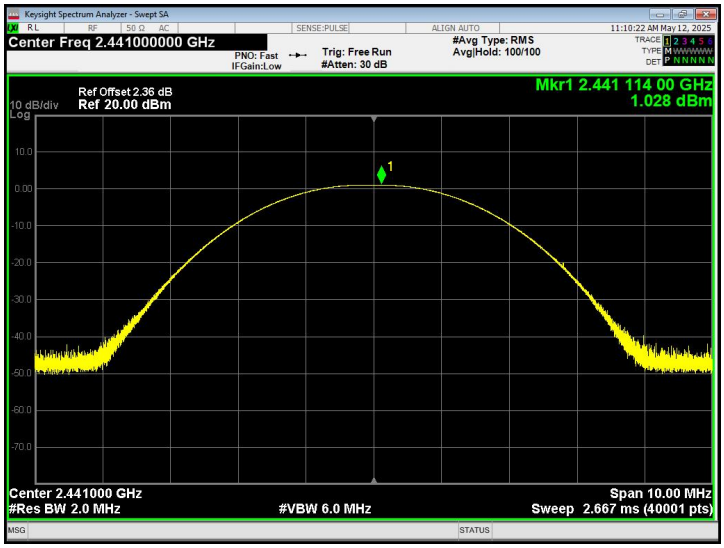
Modulation	Packet	Test Channel	Peak Output Power (dBm)	Limit (dBm)	Result
GFSK	1-DH1	Lowest	0.712	30.00	Pass
		Middle	1.028		
		Highest	0.000		
π/4-DQPSK	2-DH1	Lowest	-0.228	21.00	Pass
		Middle	-0.108		
		Highest	-1.041		
8-DPSK	3-DH1	Lowest	-0.183	21.00	Pass
		Middle	0.044		
		Highest	-0.995		

GFSK - 1-DH1 Test plots

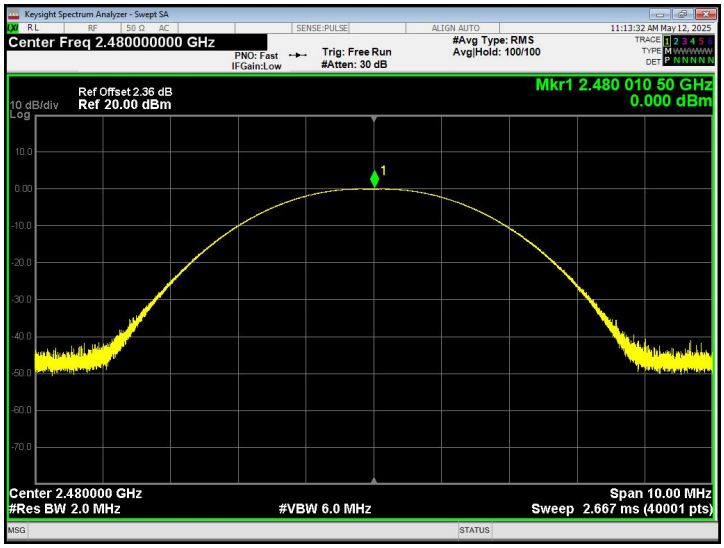
Low Channel



Middle Channel

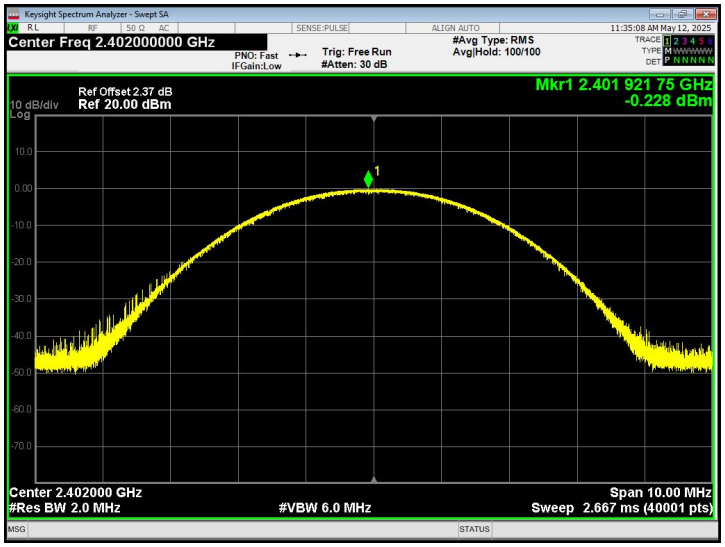


High Channel

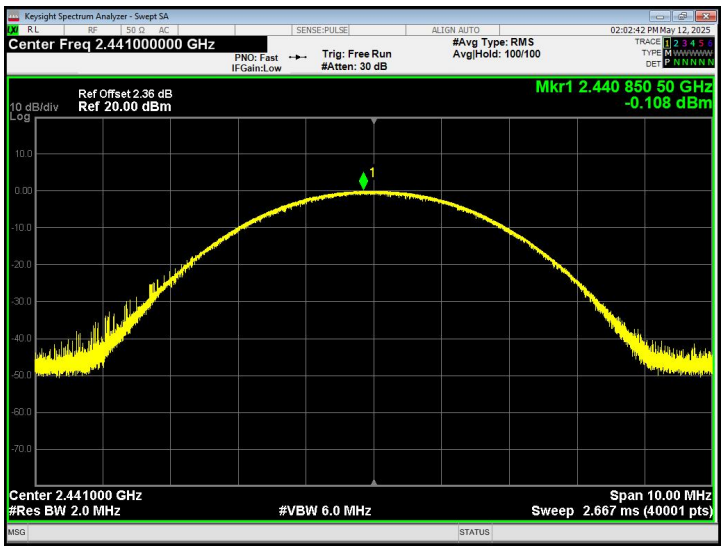


π/4-DQPSK - 2-DH1 Test plots

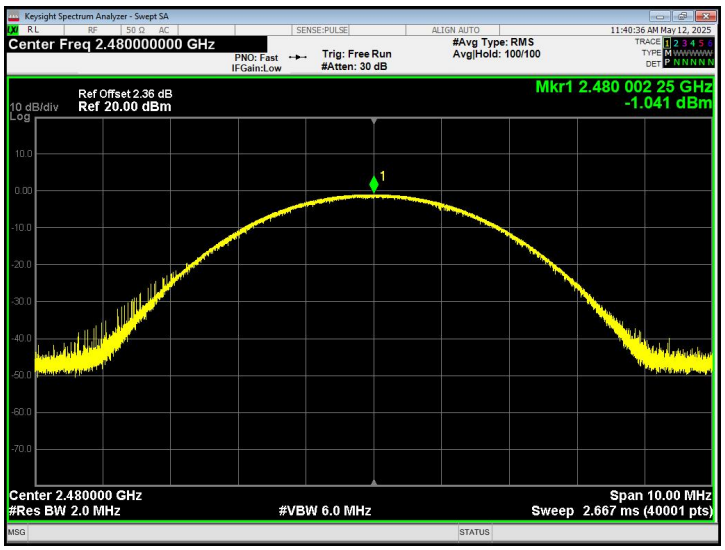
Low Channel



Middle Channel

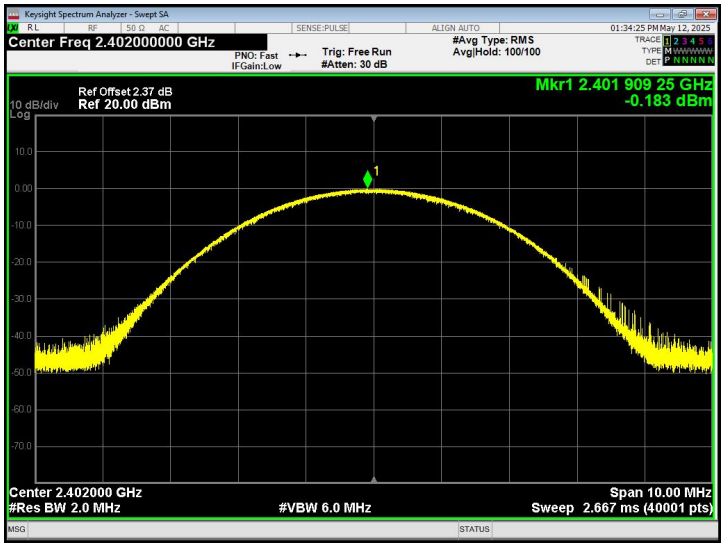


High Channel

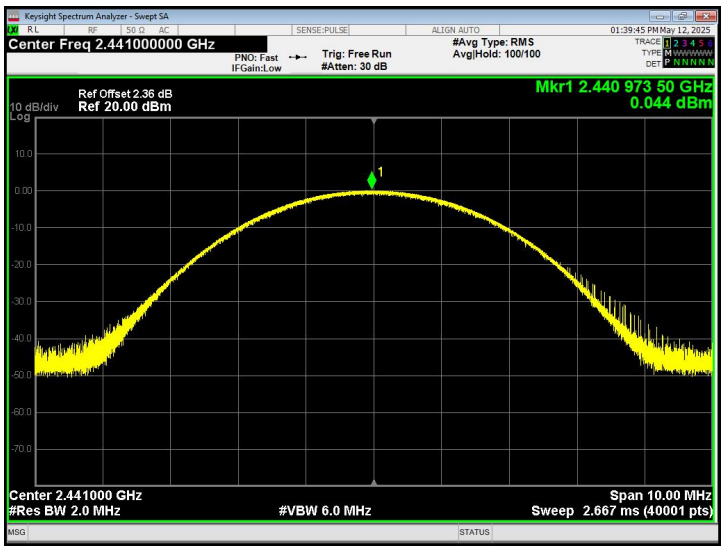


8-DPSK - 3-DH1 Test plots

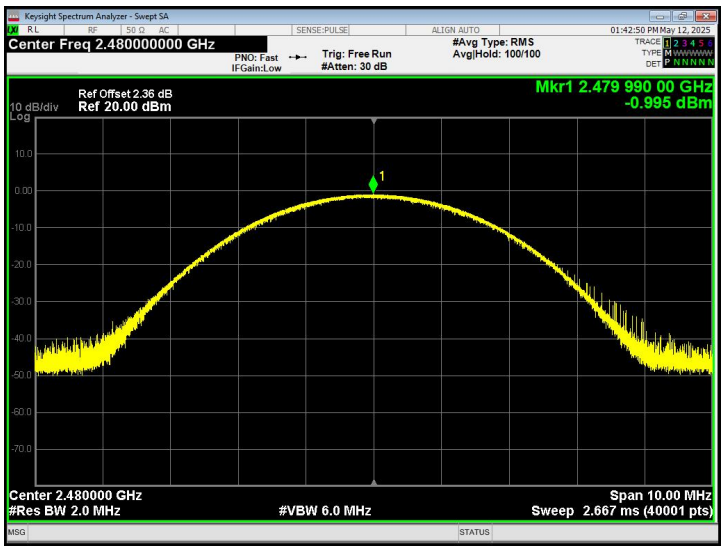
Low Channel



Middle Channel



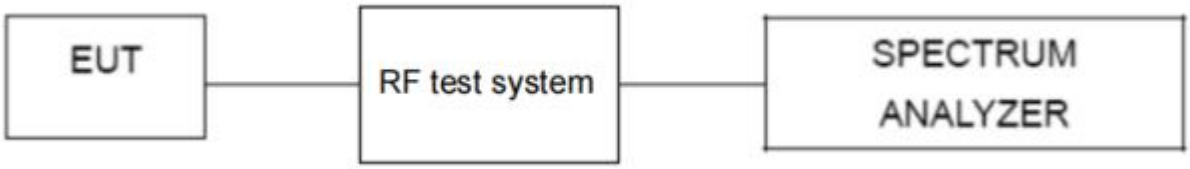
High Channel



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 π/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

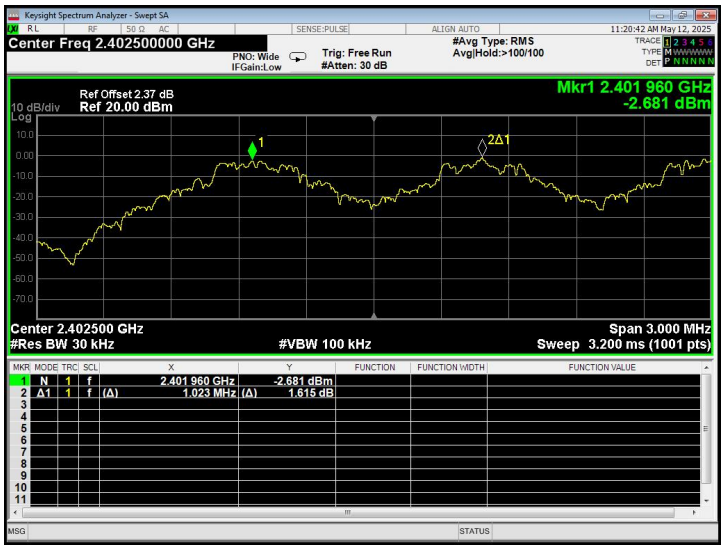
No deviation.

9.4 TEST RESULT

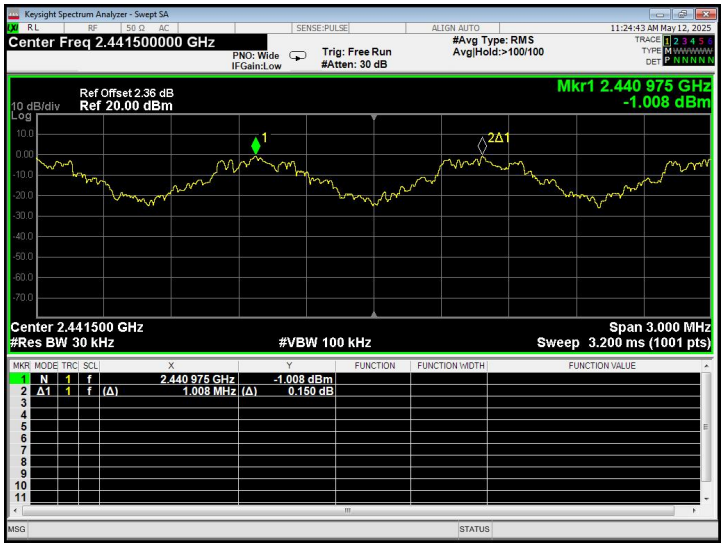
Modulation	Packet	Test Channel	Separation (MHz)	Limit (MHz)	Result
GFSK	1-DH1	Low	1.023	0.906	PASS
		Middle	1.008	0.907	PASS
		High	0.999	0.908	PASS
π/4-DQPSK	2-DH1	Low	1.008	0.952	PASS
		Middle	1.008	0.956	PASS
		High	0.993	0.951	PASS
8-DPSK	3-DH1	Low	0.987	0.962	PASS
		Middle	0.993	0.965	PASS
		High	1.149	0.965	PASS

GFSK - 1-DH1 Test plots

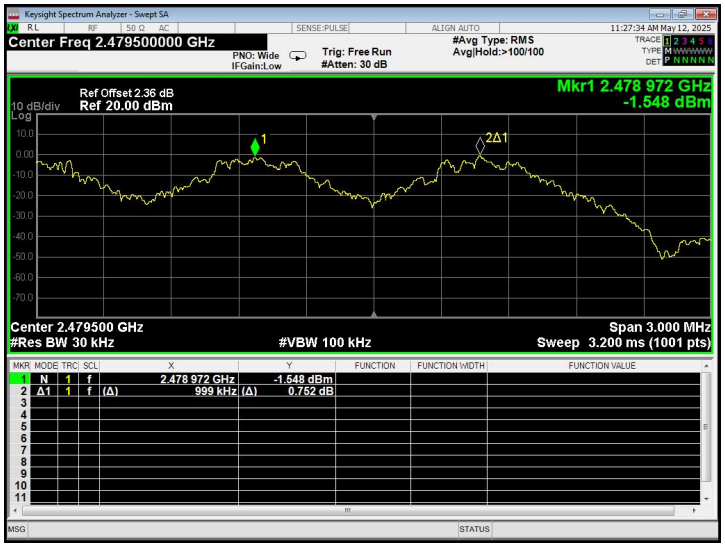
Low Channel



Middle Channel

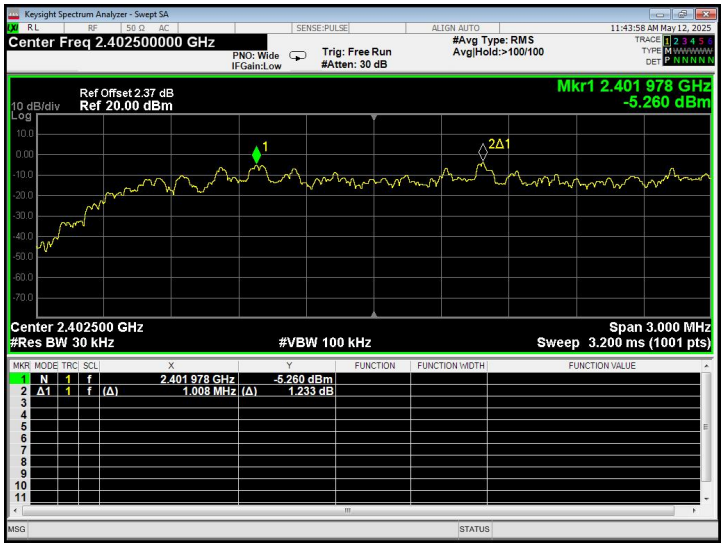


High Channel

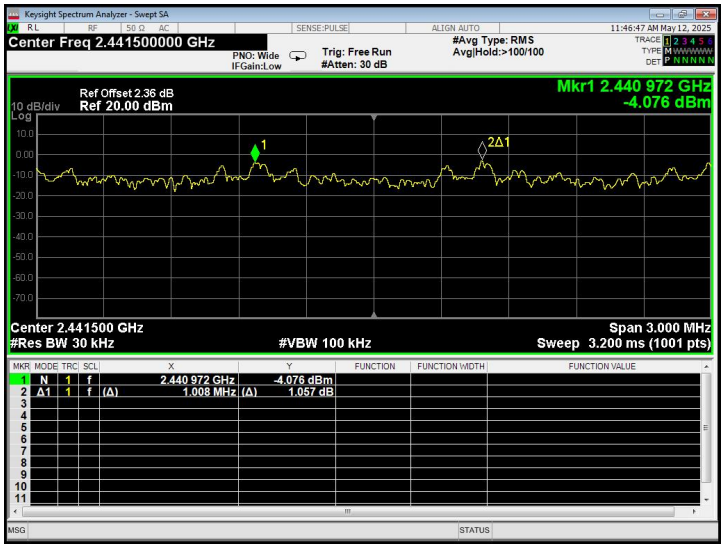


π/4-DQPSK - 2-DH1 Test plots

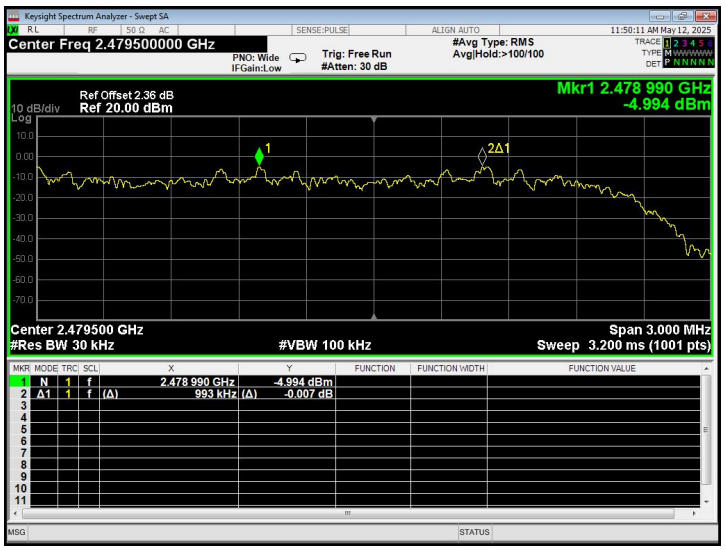
Low Channel



Middle Channel

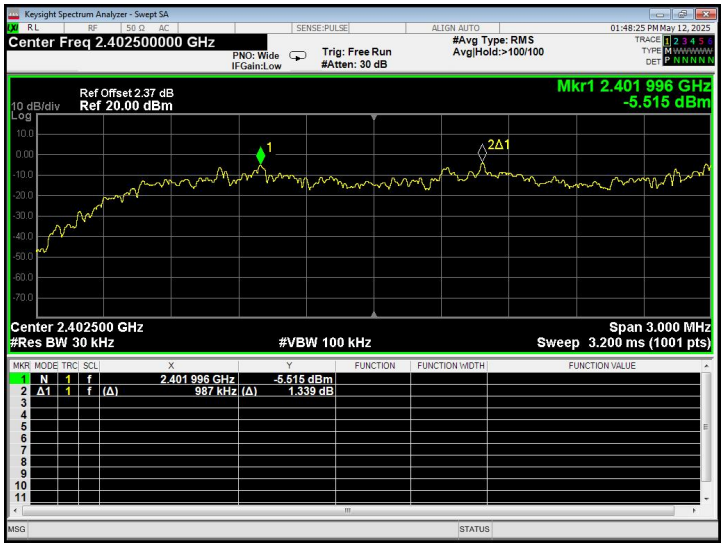


High Channel

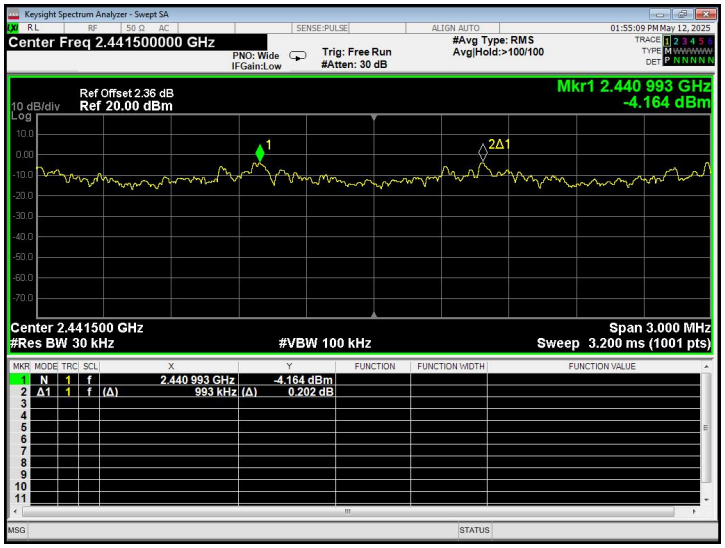


8-DPSK - 3-DH1 Test plots

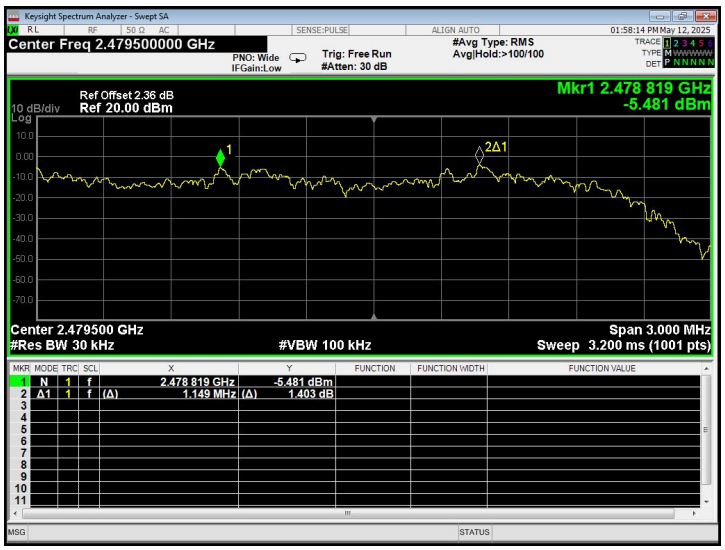
Low Channel



Middle Channel



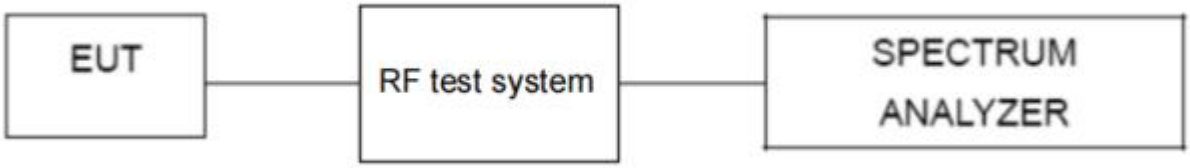
High Channel



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:	$P_{max\text{-}pk} \leq 1W$, $N_{ch} \geq 75$ Channels $P_{max\text{-}pk} \leq 0.125W$, $N_{ch} \geq 15$ 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;

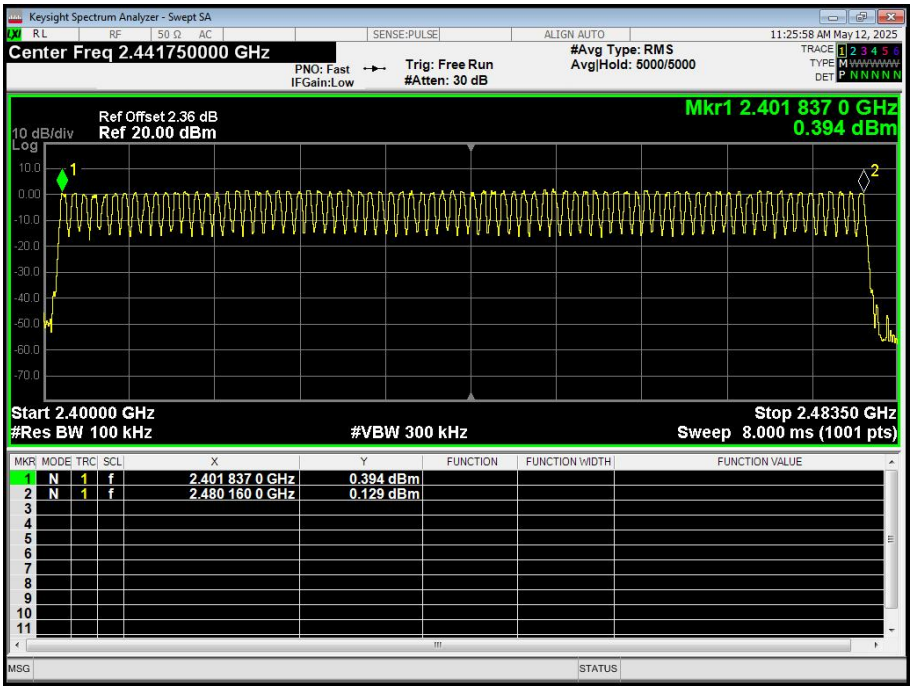
10.3 DEVIATION FROM STANDARD

No deviation.

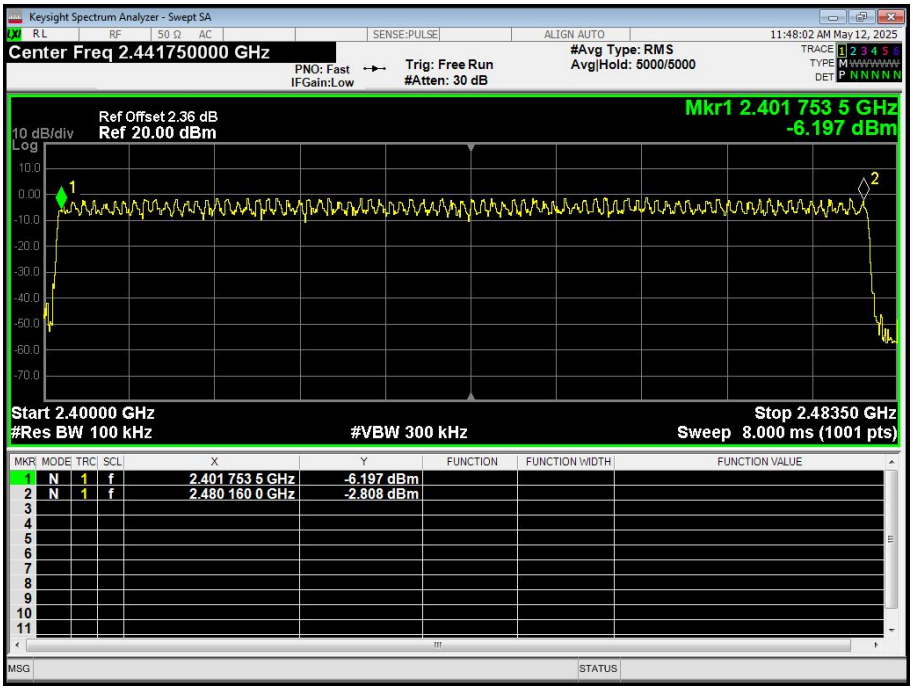
10.4 TEST RESULT

Modulation	Packet	Hopping Number	Limit	Result
GFSK	1-DH1	79	≥75	Pass
π/4-DQPSK	2-DH1	79	≥15	Pass
8-DPSK	3-DH1	79	≥15	Pass

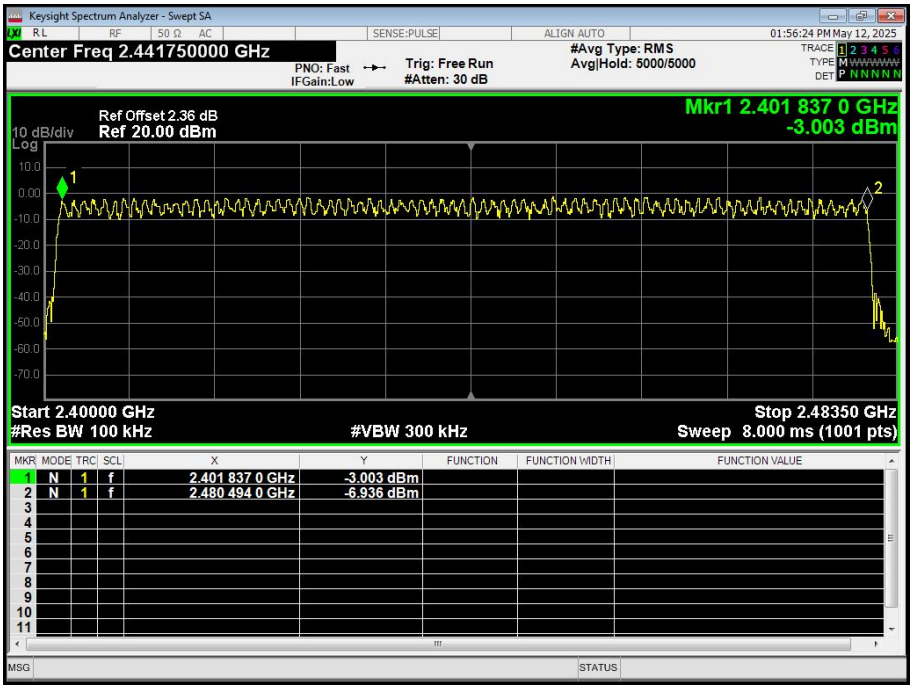
GFSK - 1-DH1 Test Plots



π/4-DQPSK - 2-DH1 Test Plots



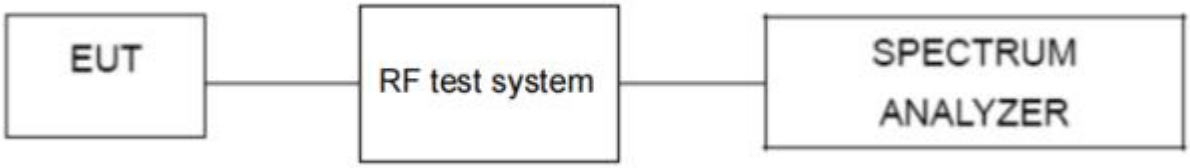
8-DPSK - 3-DH1 Test Plots



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	Pulse Time (ms)	Total Dwell Time (ms)	Limit (ms)	Result
2441MHz	1-DH1	0.381	121.920	400	Pass
2441MHz	1-DH3	1.637	261.920	400	Pass
2441MHz	1-DH5	2.885	307.733	400	Pass

Remarks:

The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s

Test channel: as blow

CH:2441MHz time slot=0.381(ms)*(1600/ (2*79))*31.6=121.920ms

CH:2441MHz time slot=1.637(ms)*(1600/ (4*79))*31.6=261.920ms

CH:2441MHz time slot=2.885(ms)*(1600/ (6*79))*31.6=307.733ms

π/4-DQPSK mode:

Frequency	Packet	Pulse Time (ms)	Total Dwell Time (ms)	Limit (ms)	Result
2441MHz	2-DH1	0.390	124.800	400	Pass
2441MHz	2-DH3	1.641	262.560	400	Pass
2441MHz	2-DH5	2.890	308.267	400	Pass

Remarks:

The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s

Test channel: as blow

CH:2441MHz time slot=0.390(ms)*(1600/ (2*79))*31.6=124.800ms

CH:2441MHz time slot=1.641(ms)*(1600/ (4*79))*31.6=262.560ms

CH:2441MHz time slot=2.890(ms)*(1600/ (6*79))*31.6=308.267ms

8-DPSK mode:

Frequency	Packet	Pulse Time (ms)	Total Dwell Time (ms)	Limit (ms)	Result
2441MHz	3-DH1	0.389	124.48	400	Pass
2441MHz	3-DH3	1.640	262.40	400	Pass
2441MHz	3-DH5	2.892	308.48	400	Pass

Remarks:

The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s

Test channel: as blow

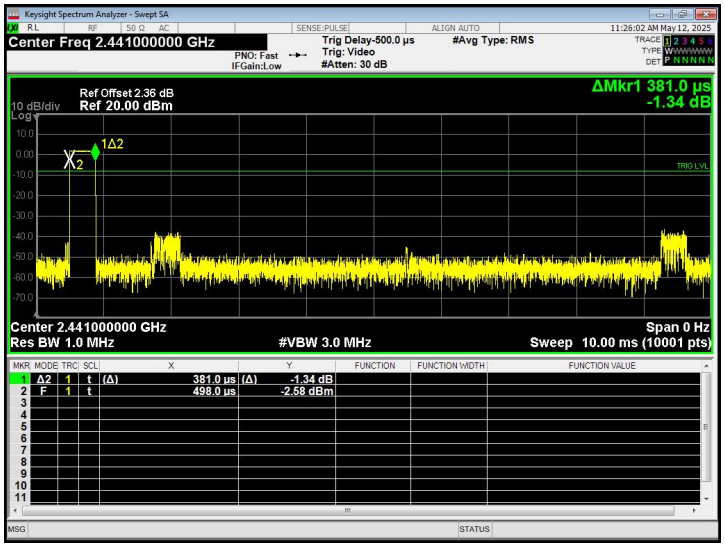
CH:2441MHz time slot=0.389(ms)*(1600/ (2*79))*31.6=124.48ms

CH:2441MHz time slot=1.640(ms)*(1600/ (4*79))*31.6=262.40ms

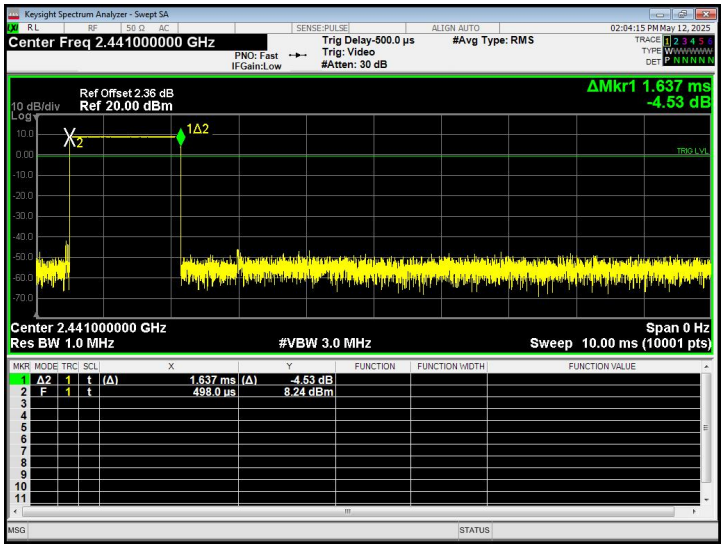
CH:2441MHz time slot=2.892(ms)*(1600/ (6*79))*31.6=308.48ms

GFSK Test Plots

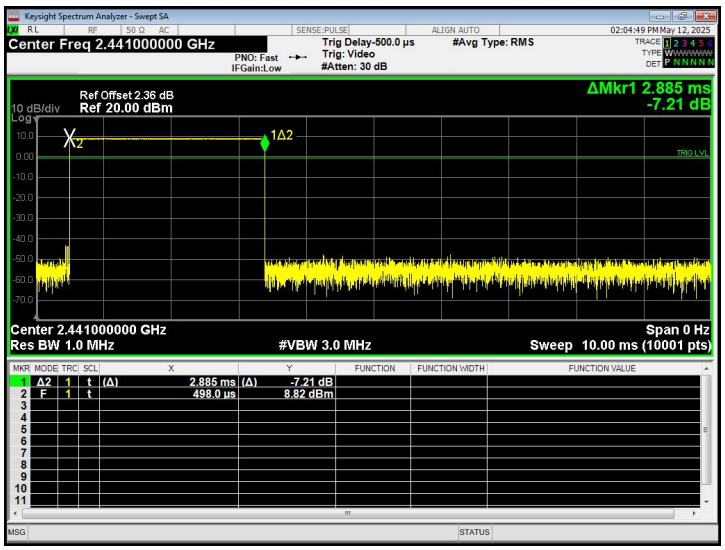
1-DH1 Middle Channel



1-DH3 Middle Channel

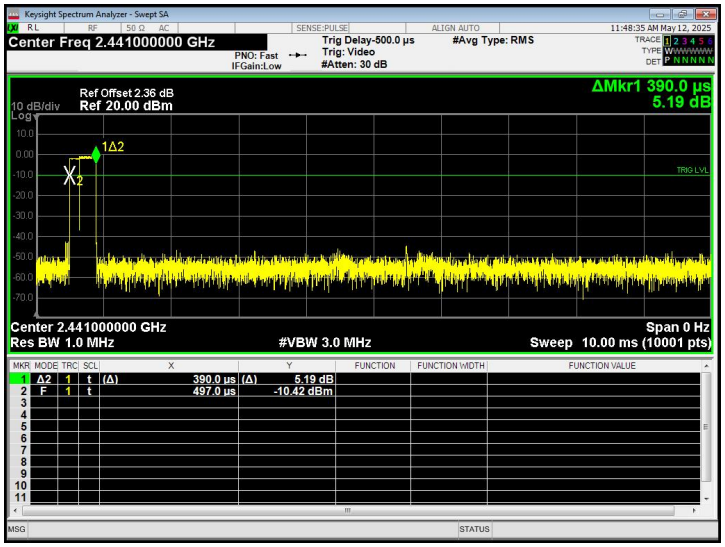


1-DH5 Middle Channel

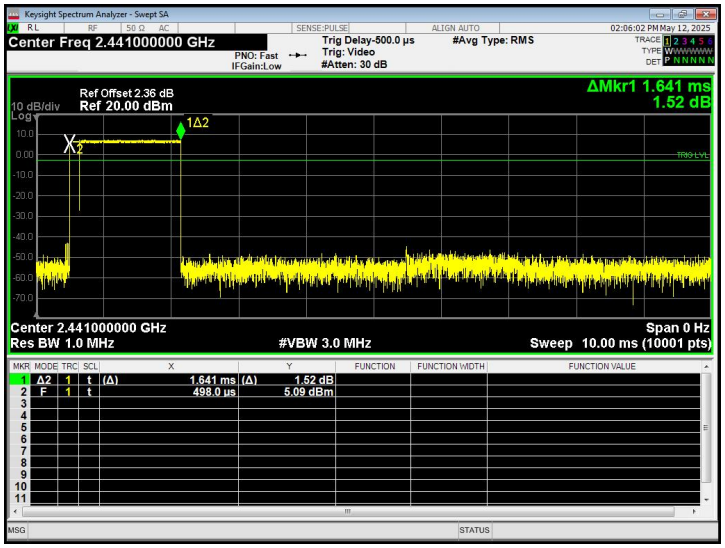


π/4-DQPSK Test Plots

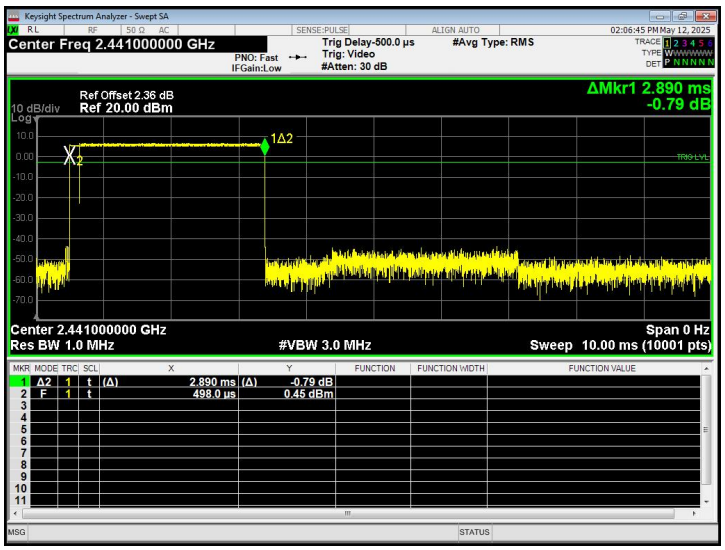
2-DH1 Middle Channel



2-DH3 Middle Channel

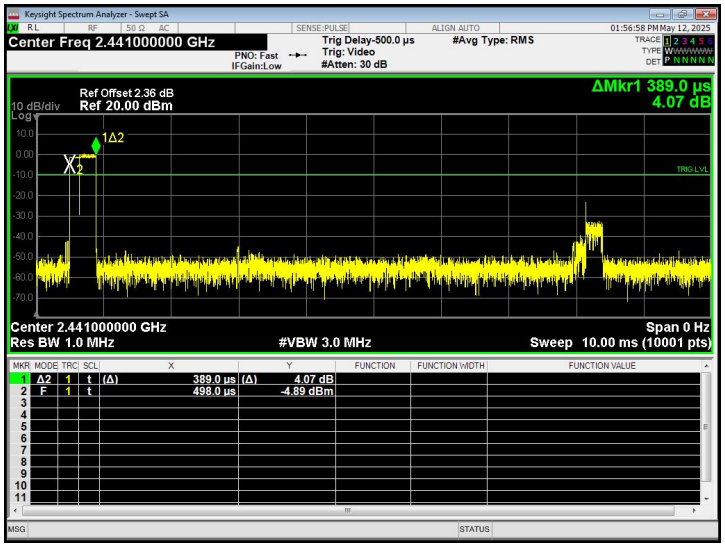


2-DH5 Middle Channel

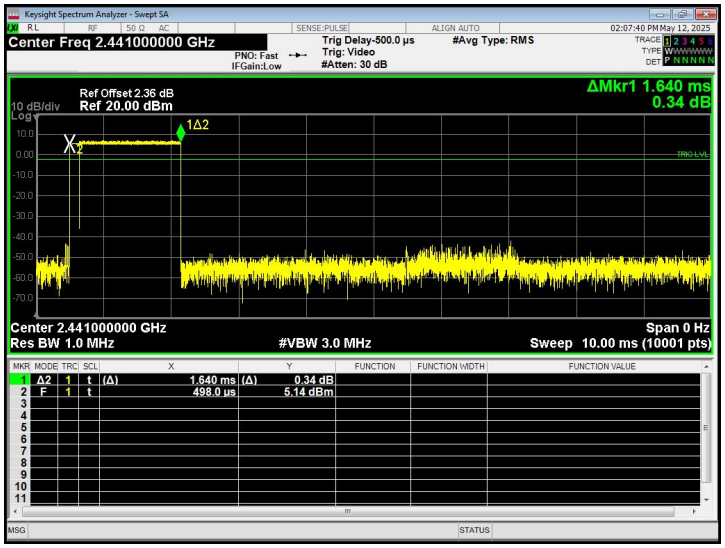


8-DPSK Test Plots

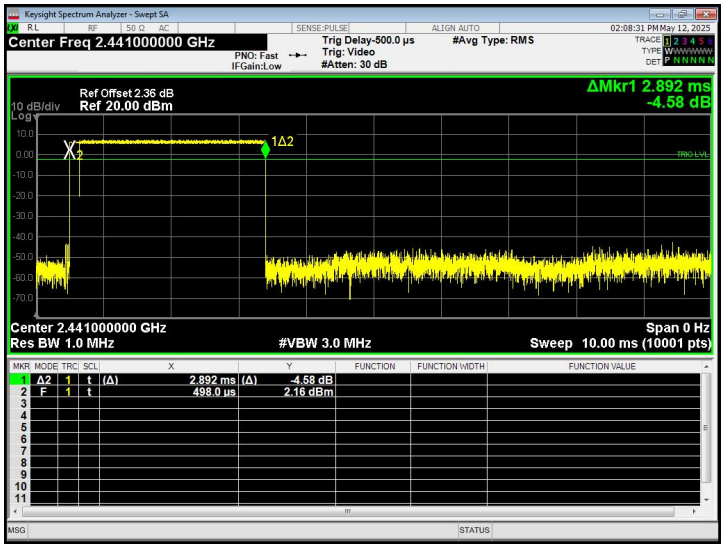
3-DH1 Middle Channel



3-DH3 Middle Channel



3-DH5 Middle Channel



12. ANTENNA REQUIREMENT

Standard requirement:	FCC Part15 C Section 15.203 /247(c)
15.203 requirement: 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. 15.247(c) (1)(i) requirement: (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.	
EUT Antenna:	
The antenna is PCB Antenna, the best case gain of the antennas is -1.80dBi, 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.

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