



9. HOPPING CHANNEL SEPARATION

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2020
Receiver setup:	RBW=30KHz, VBW=100KHz, detector=Peak
Limit:	GFSK: 20dB Bandwidth $\pi/4$ -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	Packet	Test Channel	Separation (MHz)	Limit (MHz)	Result
GFSK	1-DH1	Low	1.002	0.875	PASS
		Middle	0.990	0.875	PASS
		High	0.999	0.875	PASS
$\pi/4$ -DQPSK	2-DH1	Low	0.999	0.827	PASS
		Middle	1.014	0.831	PASS
		High	0.990	0.829	PASS
8-DPSK	3-DH1	Low	1.005	0.807	PASS
		Middle	1.002	0.808	PASS
		High	1.014	0.807	PASS



GFSK - 1-DH1 Test plots

Low Channel



Middle Channel

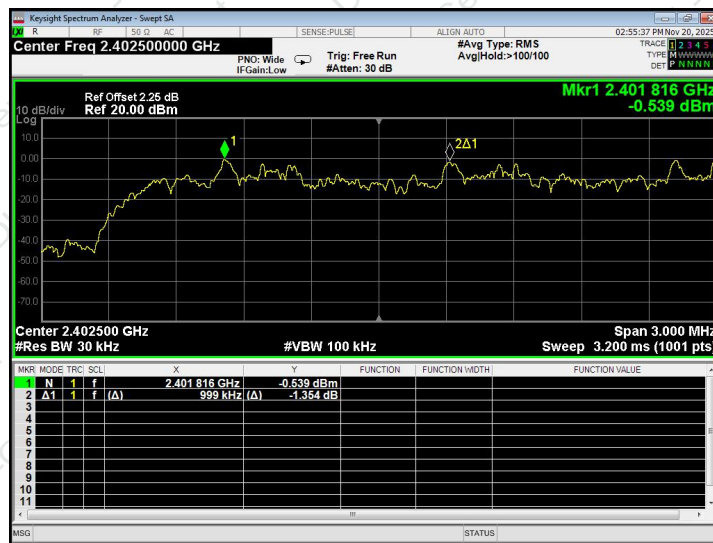


High Channel

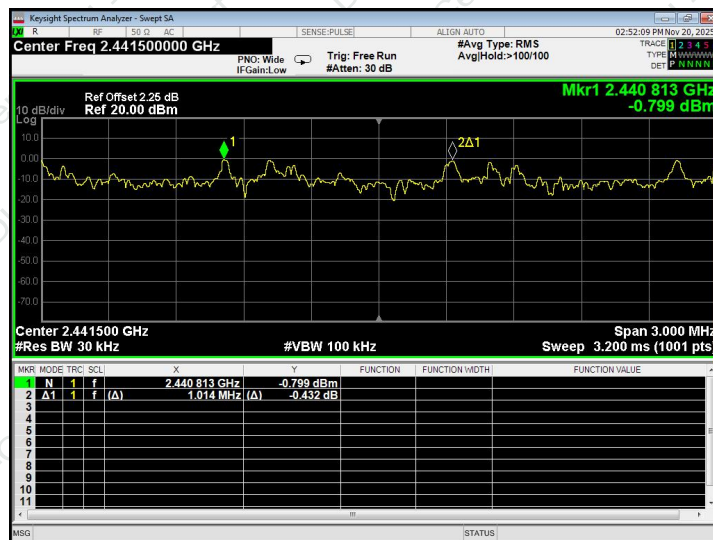


 $\pi/4$ -DQPSK - 2-DH1 Test plots

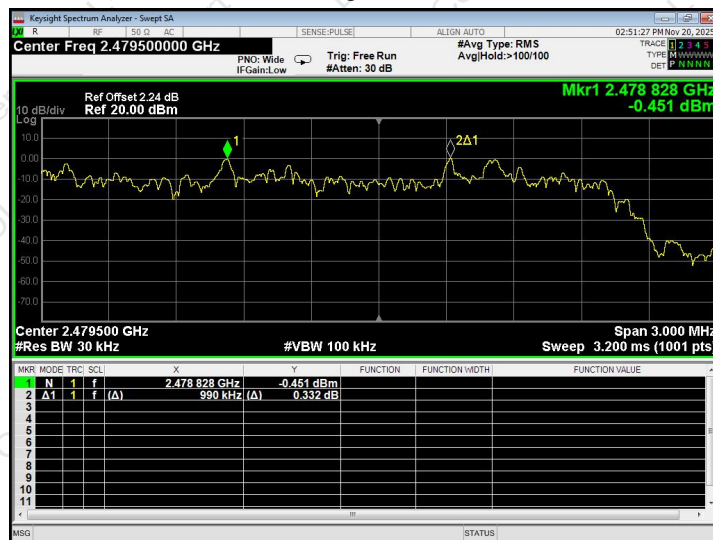
Low Channel



Middle Channel



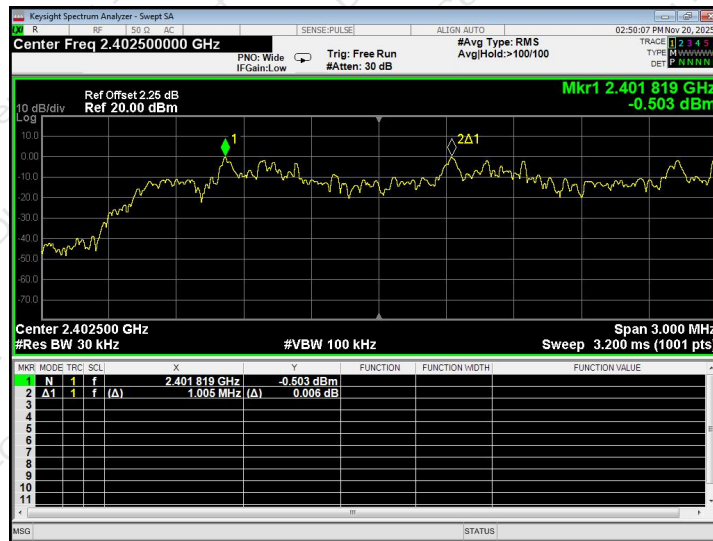
High Channel



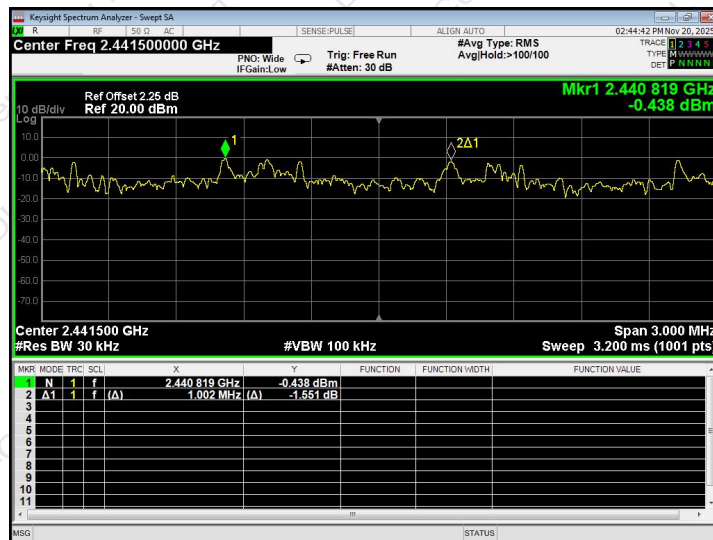


8-DPSK - 3-DH1 Test plots

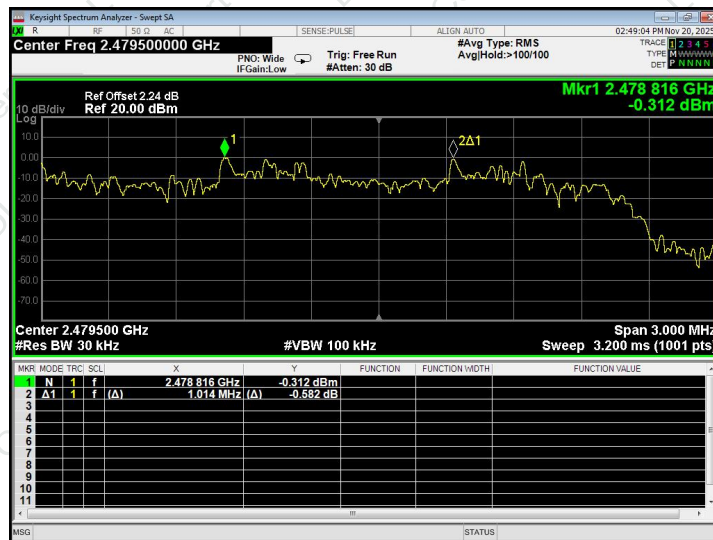
Low Channel



Middle Channel

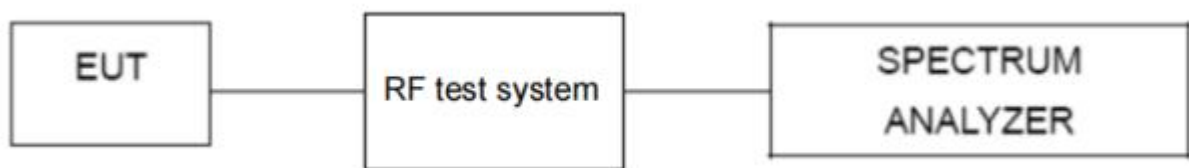


High Channel



**10.NUMBER OF HOPPING FREQUENCY**

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)(iii)
Test Method:	ANSI C63.10:2020
Receiver setup:	RBW=100kHz, VBW=300kHz Frequency Range=2400MHz-2483.5MHz Detector=Peak
Limit:	$P_{\max-pk} \leq 1W$, $N_{ch} \geq 75$ Channels $P_{\max-pk} \leq 0.125W$, $N_{ch} \geq 15$ 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

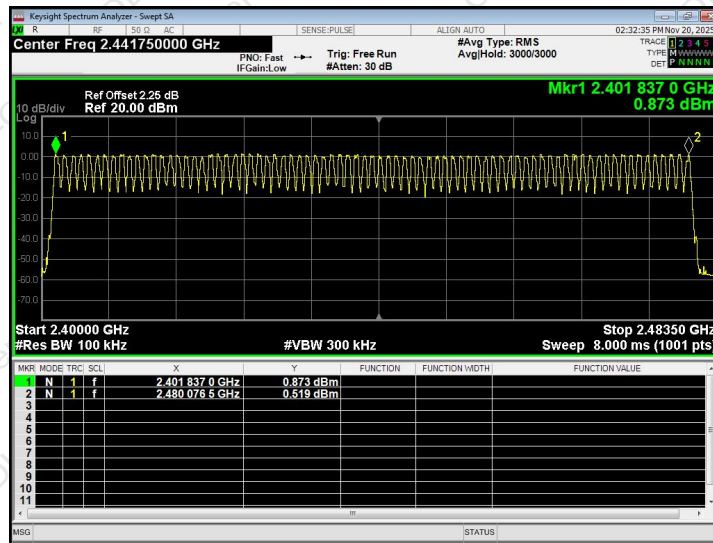
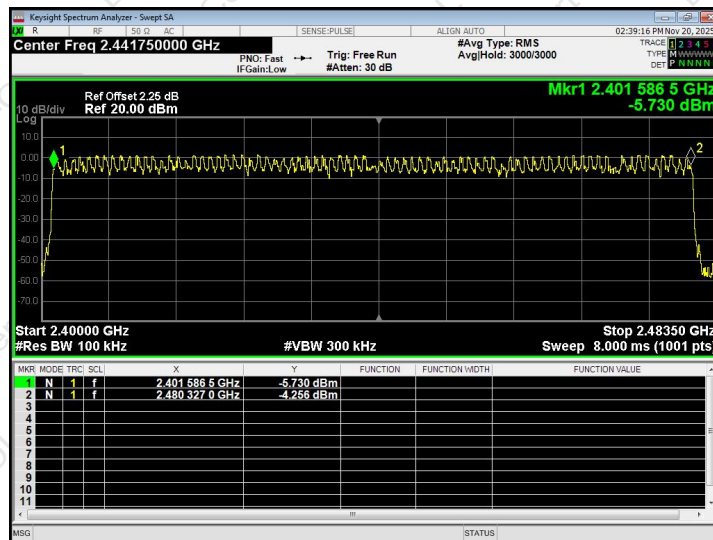
No deviation.



10.4 TEST RESULT

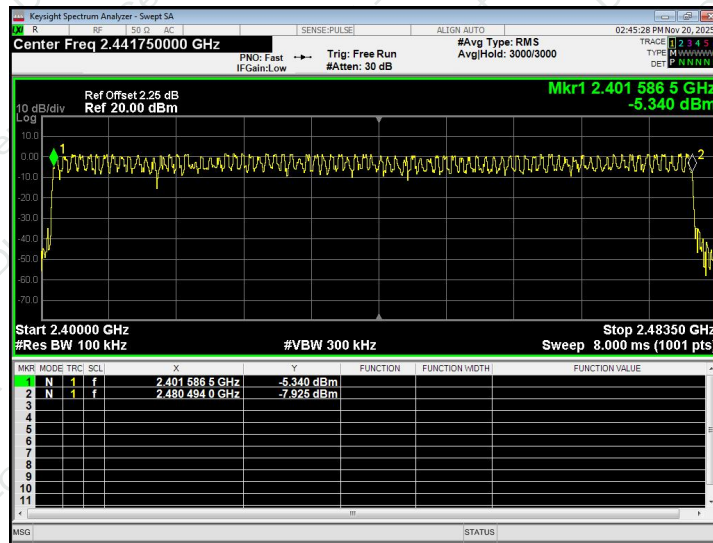
Modulation	Packet	Hopping Number	Limit	Result
GFSK	1-DH1	79	≥75	Pass
$\pi/4$ -DQPSK	2-DH1	79	≥15	Pass
8-DPSK	3-DH1	79	≥15	Pass

GFSK - 1-DH1 Test Plots

 $\pi/4$ -DQPSK - 2-DH1 Test Plots



8-DPSK - 3-DH1 Test Plots

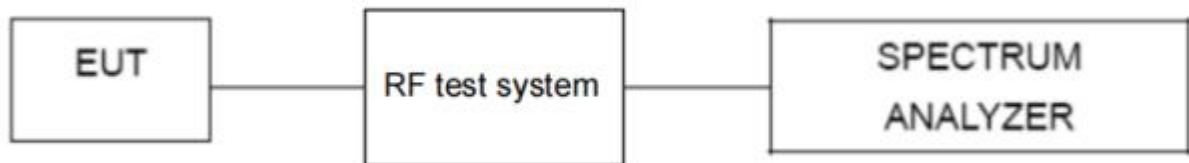




11. DWELL TIME

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)(iii)
Test Method:	ANSI C63.10:2020
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	0.401	128.320	400	Pass
2441MHz	1-DH3	1.657	265.120	400	Pass
2441MHz	1-DH5	2.905	309.867	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= $0.401(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 128.320(\text{ms})$

CH:2441MHz time slot= $1.657(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 265.120(\text{ms})$

CH:2441MHz time slot= $2.905(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 309.867(\text{ms})$

 $\pi/4$ -DQPSK mode:

Frequency	Packet	Pulse Time (ms)	Total Dwell Time (ms)	Limit (ms)	Result
2441MHz	2-DH1	0.410	131.20	400	Pass
2441MHz	2-DH3	1.663	266.08	400	Pass
2441MHz	2-DH5	2.910	310.40	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= $0.410(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 131.20(\text{ms})$

CH:2441MHz time slot= $1.663(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 266.08(\text{ms})$

CH:2441MHz time slot= $2.910(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 310.40(\text{ms})$

8-DPSK mode:

Frequency	Packet	Pulse Time (ms)	Total Dwell Time (ms)	Limit (ms)	Result
2441MHz	3-DH1	0.413	132.16	400	Pass
2441MHz	3-DH3	1.662	265.92	400	Pass
2441MHz	3-DH5	2.913	310.72	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= $0.413(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 132.16\text{ms}$

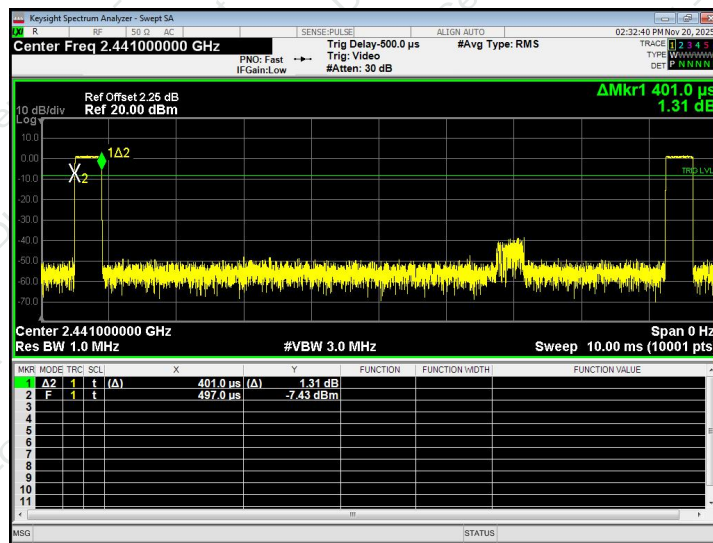
CH:2441MHz time slot= $1.662(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 265.92\text{ms}$

CH:2441MHz time slot= $2.913(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 310.72\text{ms}$

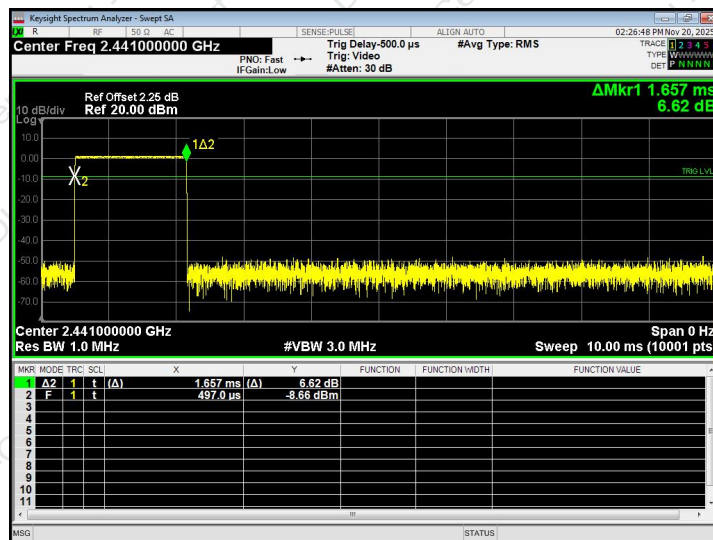


GFSK Test Plots

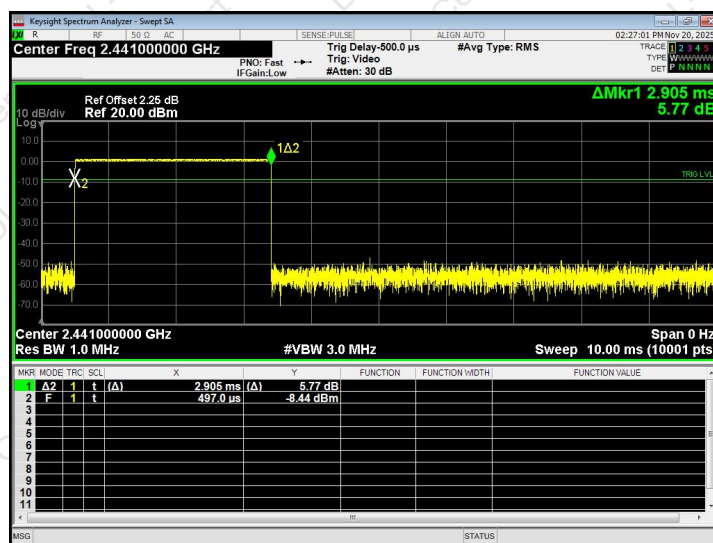
1-DH1 Middle Channel



1-DH3 Middle Channel

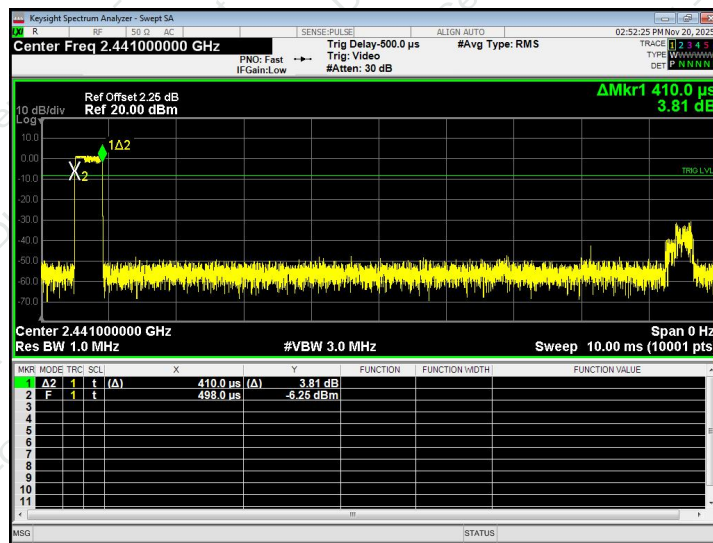


1-DH5 Middle Channel

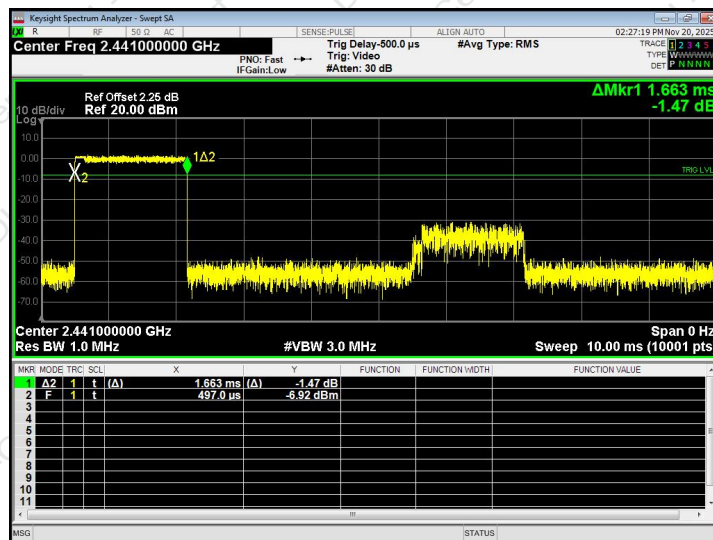


 $\pi/4$ -DQPSK Test Plots

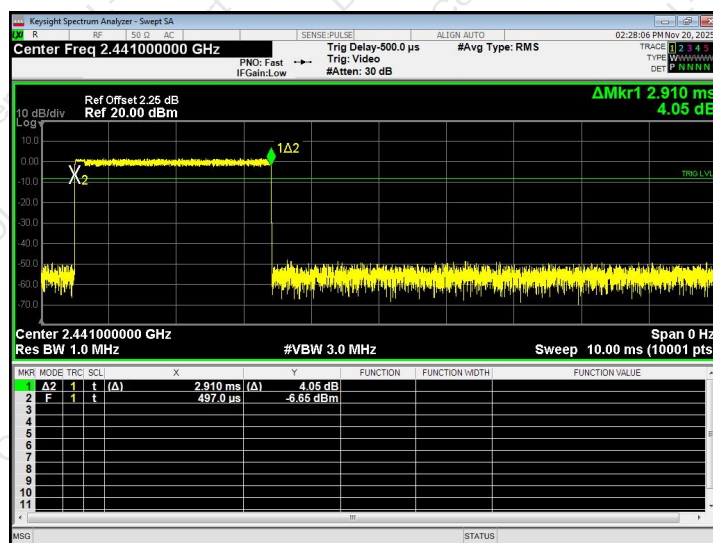
2-DH1 Middle Channel



2-DH3 Middle Channel



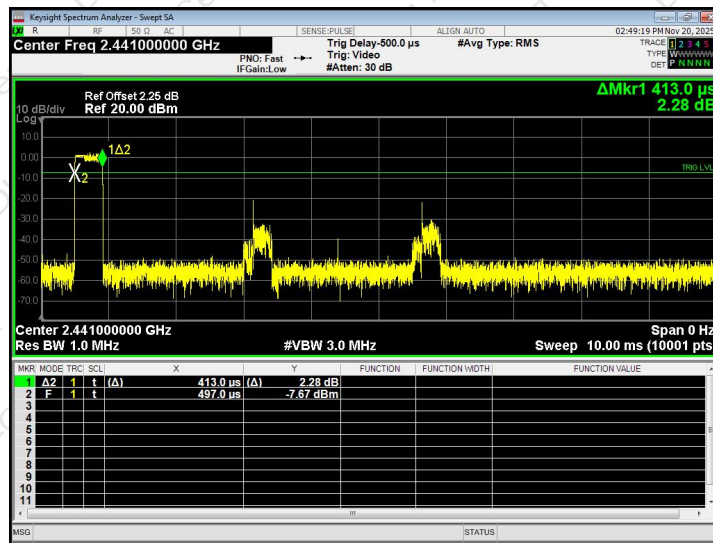
2-DH5 Middle Channel



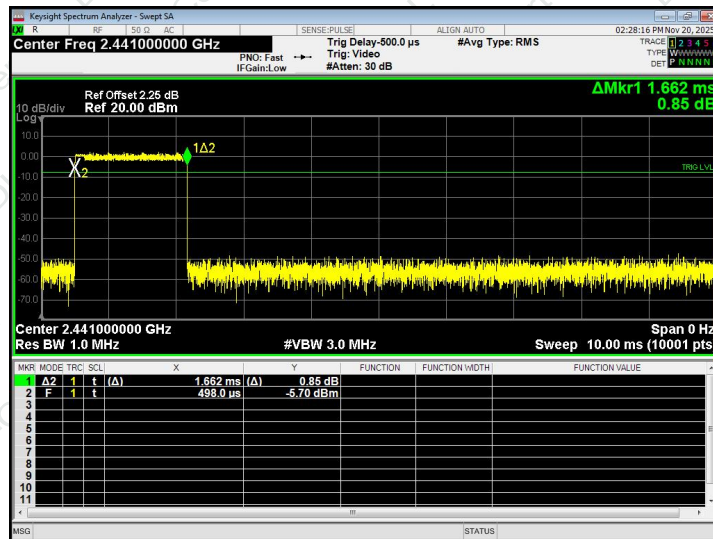


8-DPSK Test Plots

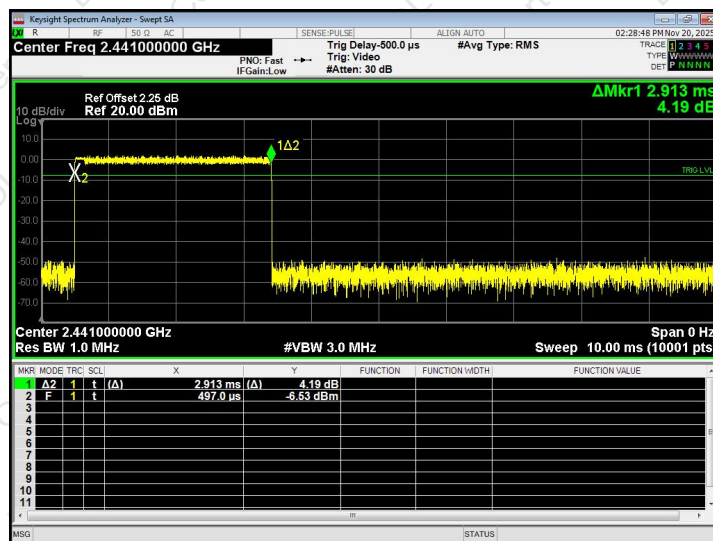
3-DH1 Middle Channel



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 Chip Antenna, the best case gain of the antennas is 1.7dBi, 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 *****