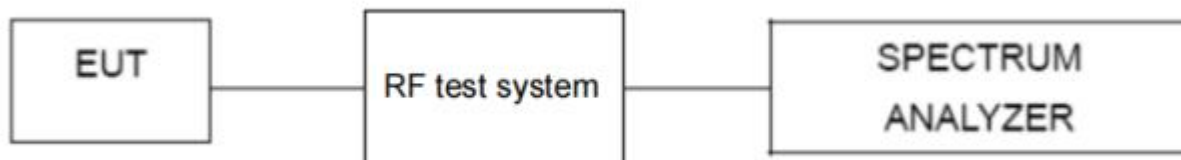




8. Maximum Peak Output Power

Test Requirement:	FCC Part15 C Section 15.247 (b)(1)
Test Method:	ANSI C63.10:2013
Limit:	GFSK: 30dBm $\pi/4$ -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.

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.



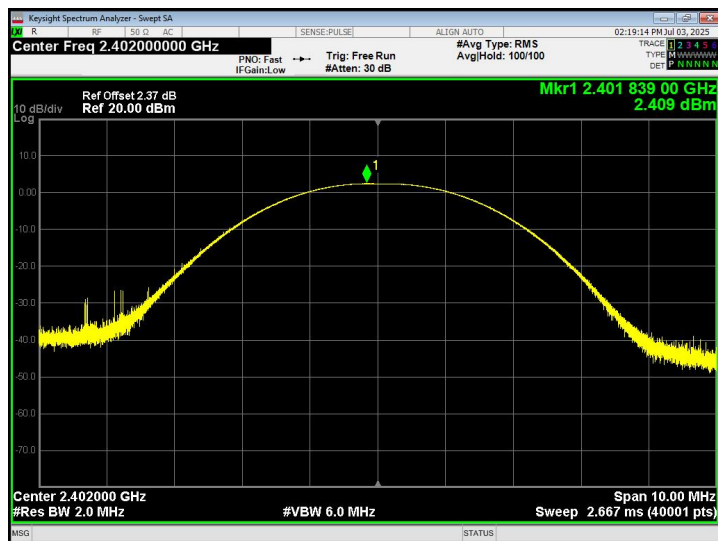
8.5 TEST RESULT

Modulation	Packet	Test Channel	Peak Output Power (dBm)	Limit (dBm)	Result
GFSK	1-DH1	Lowest	2.409	30.00	Pass
		Middle	2.593		
		Highest	2.068		
$\pi/4$ -DQPSK	2-DH1	Lowest	3.179	21.00	Pass
		Middle	3.310		
		Highest	2.787		
8-DPSK	3-DH1	Lowest	3.591	21.00	Pass
		Middle	3.688		
		Highest	3.181		

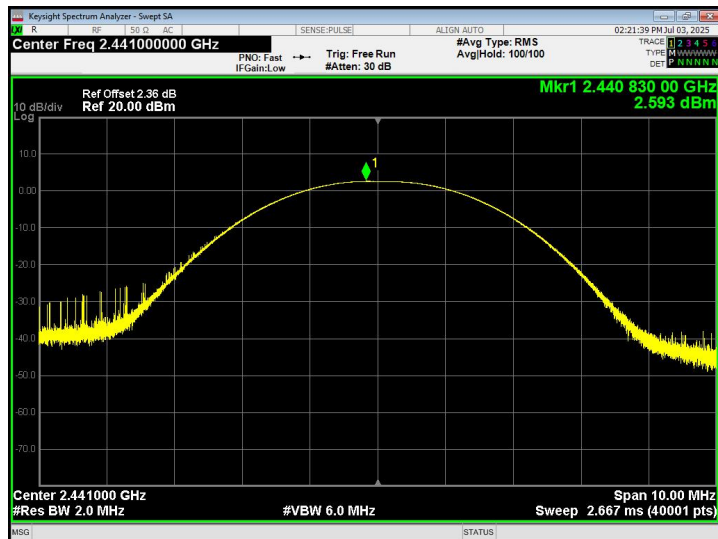


GFSK - 1-DH1 Test plots

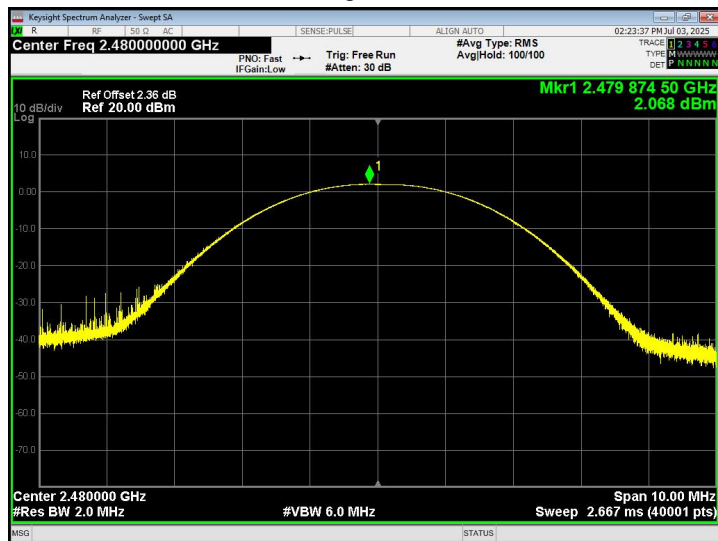
Low Channel



Middle Channel

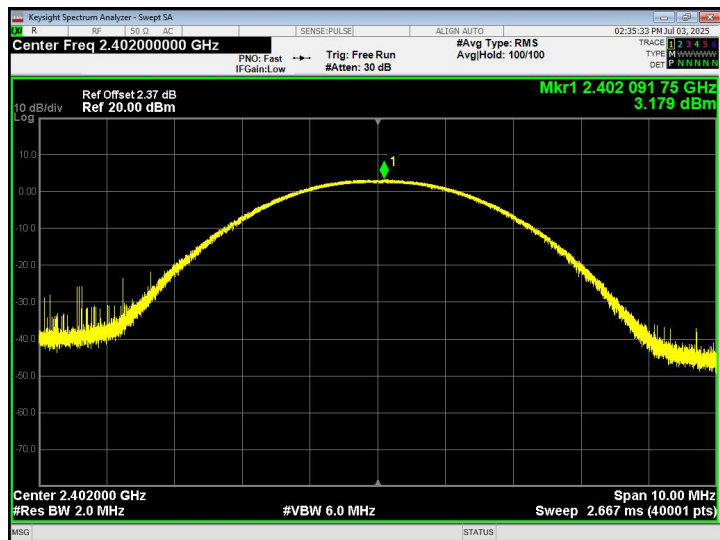


High Channel

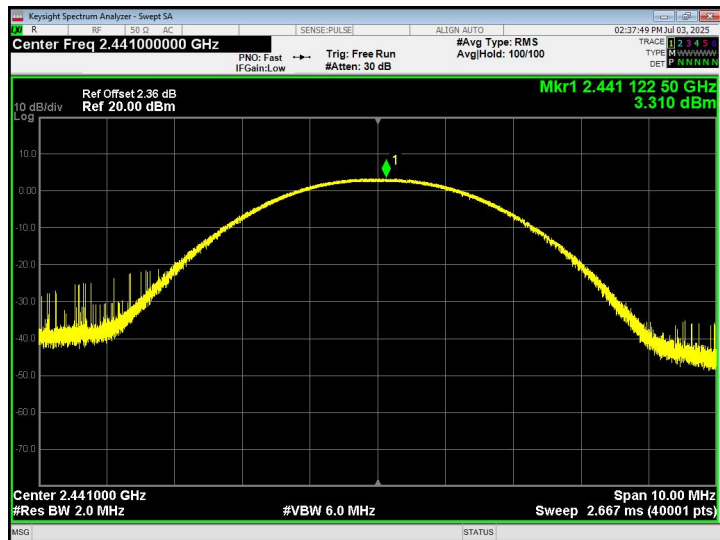


 $\pi/4$ -DQPSK - 2-DH1 Test plots

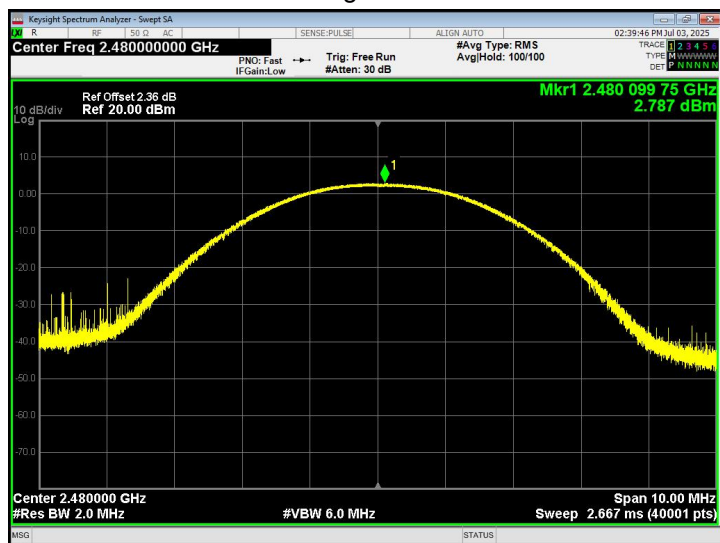
Low Channel



Middle Channel



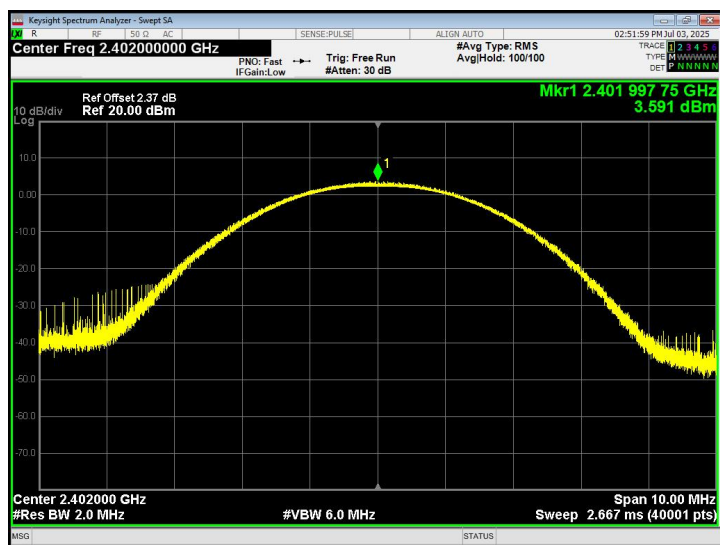
High Channel



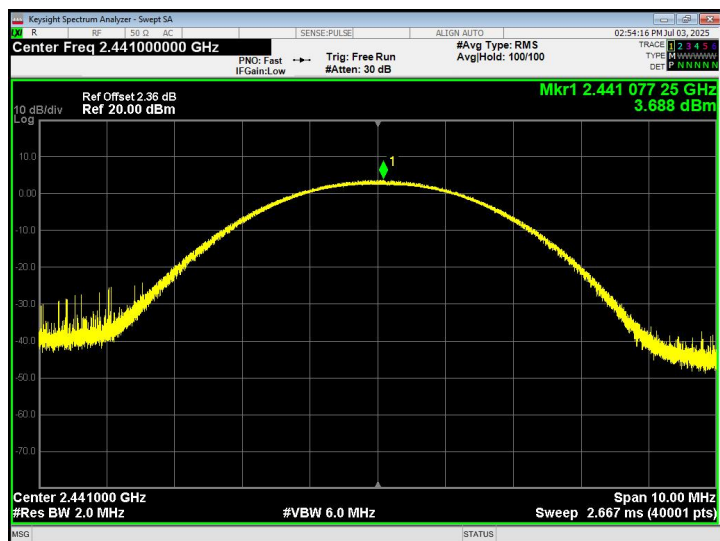


8-DPSK - 3-DH1 Test plots

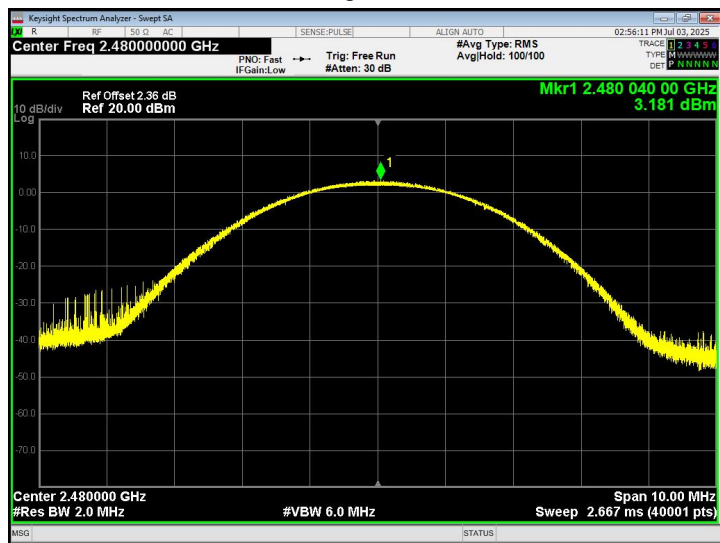
Low Channel



Middle Channel



High Channel

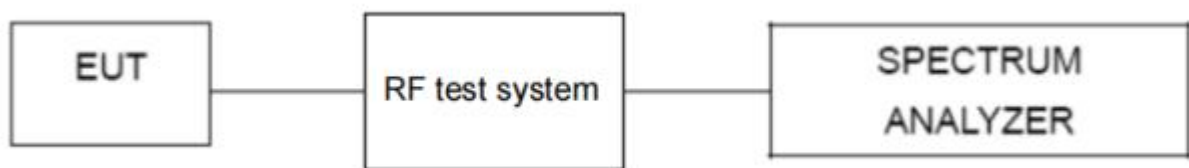




9. HOPPING CHANNEL SEPARATION

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 $\pi/4$ -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.



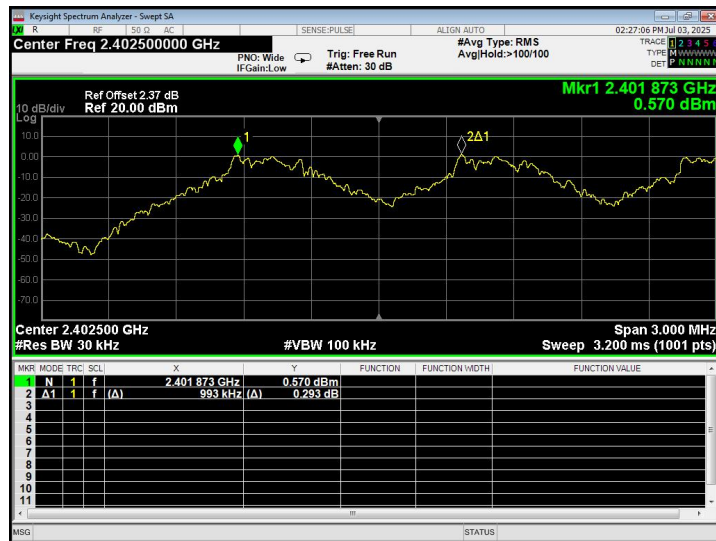
9.4 TEST RESULT

Modulation	Packet	Test Channel	Separation (MHz)	Limit (MHz)	Result
GFSK	1-DH1	Low	0.993	0.880	PASS
		Middle	1.005	0.875	PASS
		High	0.999	0.876	PASS
$\pi/4$ -DQPSK	2-DH1	Low	1.011	0.837	PASS
		Middle	0.996	0.835	PASS
		High	1.002	0.833	PASS
8-DPSK	3-DH1	Low	1.014	0.828	PASS
		Middle	1.011	0.829	PASS
		High	1.002	0.825	PASS

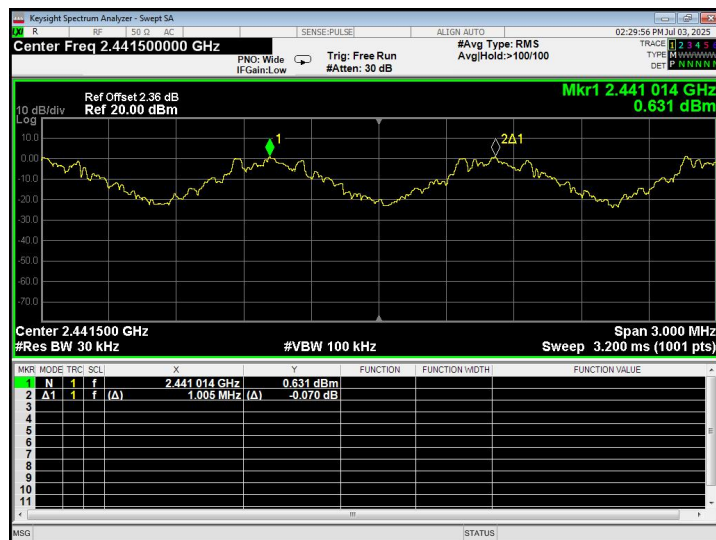


GFSK - 1-DH1 Test plots

Low Channel

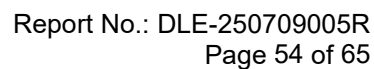


Middle Channel

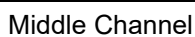


High Channel

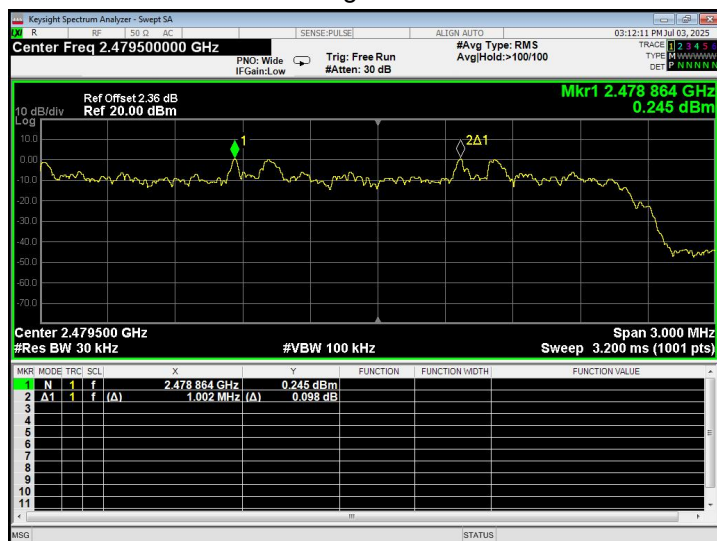




Low Channel



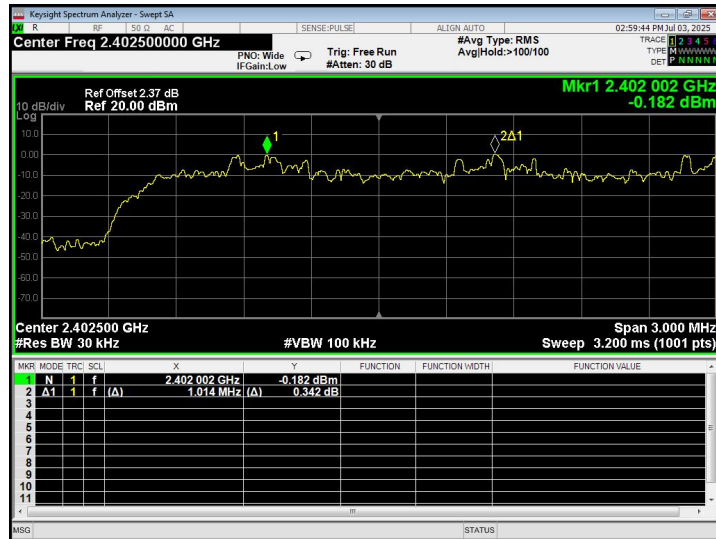
High Channel



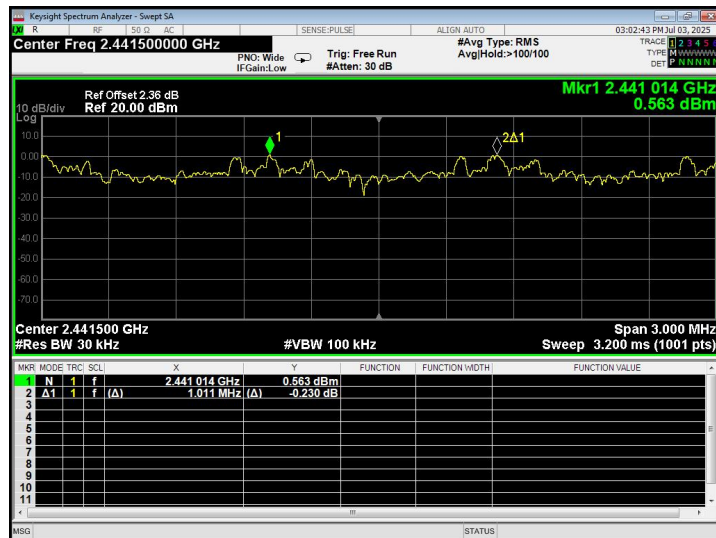


8-DPSK - 3-DH1 Test plots

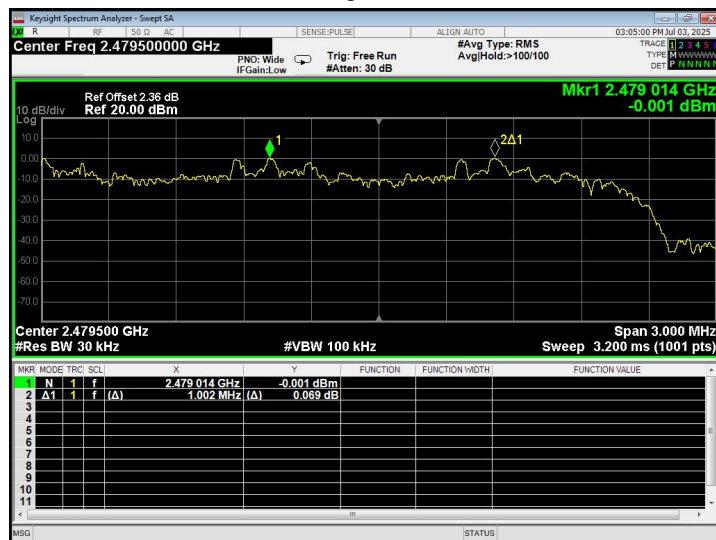
Low Channel



Middle Channel



High Channel

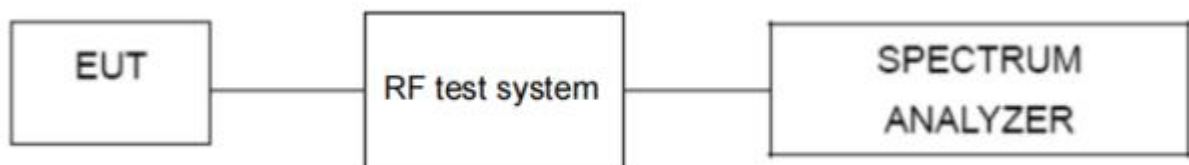




10.NUMBER OF HOPPING FREQUENCY

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

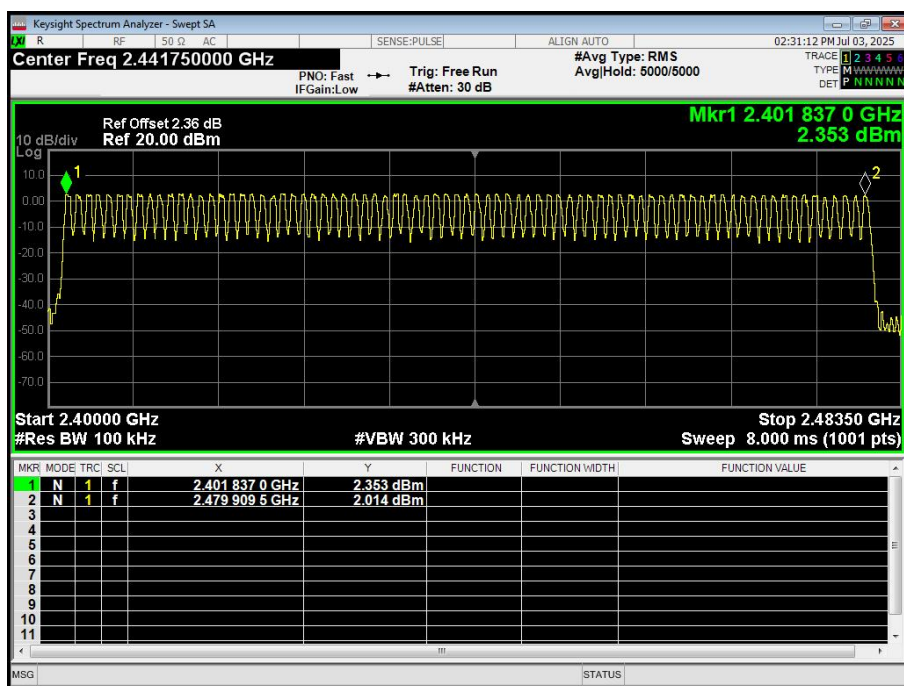
No deviation.



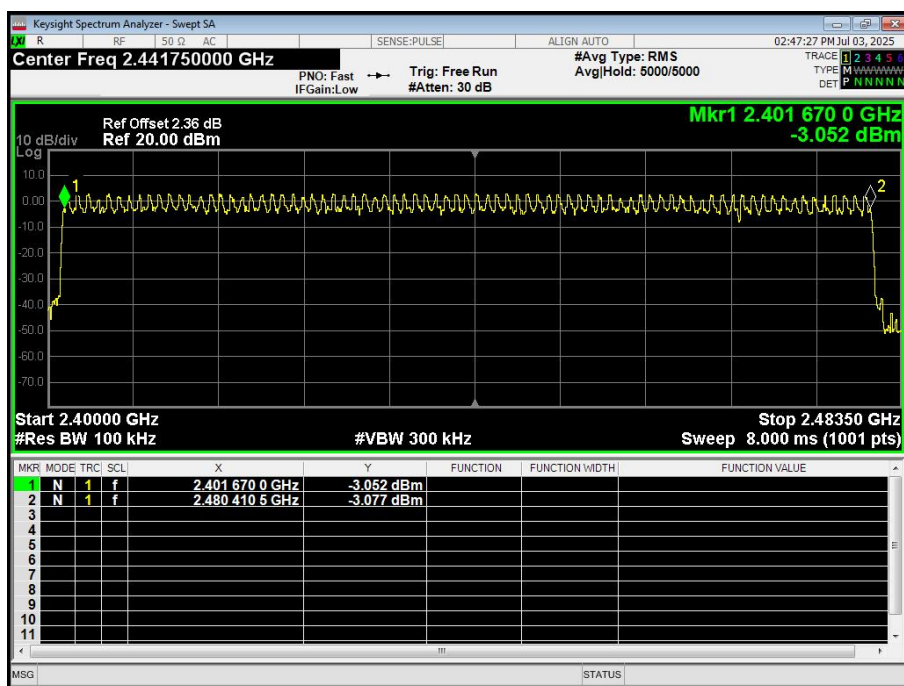
10.4 TEST RESULT

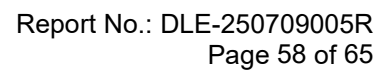
Modulation	Packet	Hopping Number	Limit	Result
GFSK	1-DH1	79	≥ 75	Pass
$\pi/4$ -DQPSK	2-DH1	79	≥ 15	Pass
8-DPSK	3-DH1	79	≥ 15	Pass

GFSK - 1-DH1 Test Plots



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



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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	0.383	122.560	400	Pass
2441MHz	1-DH3	1.639	262.240	400	Pass
2441MHz	1-DH5	2.887	307.947	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= $0.383(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 122.560(\text{ms})$

CH:2441MHz time slot= $1.639(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 262.240(\text{ms})$

CH:2441MHz time slot= $2.887(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 307.947(\text{ms})$

$\pi/4$ -DQPSK mode:

Frequency	Packet	Pulse Time (ms)	Total Dwell Time (ms)	Limit (ms)	Result
2441MHz	2-DH1	0.392	125.44	400	Pass
2441MHz	2-DH3	1.644	263.04	400	Pass
2441MHz	2-DH5	2.892	308.48	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= $0.392(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 125.44(\text{ms})$

CH:2441MHz time slot= $1.644(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 263.04(\text{ms})$

CH:2441MHz time slot= $2.892(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 308.48(\text{ms})$

8-DPSK mode:

Frequency	Packet	Pulse Time (ms)	Total Dwell Time (ms)	Limit (ms)	Result
2441MHz	3-DH1	0.392	125.440	400	Pass
2441MHz	3-DH3	1.643	262.880	400	Pass
2441MHz	3-DH5	2.894	308.693	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= $0.392(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 125.440\text{ms}$

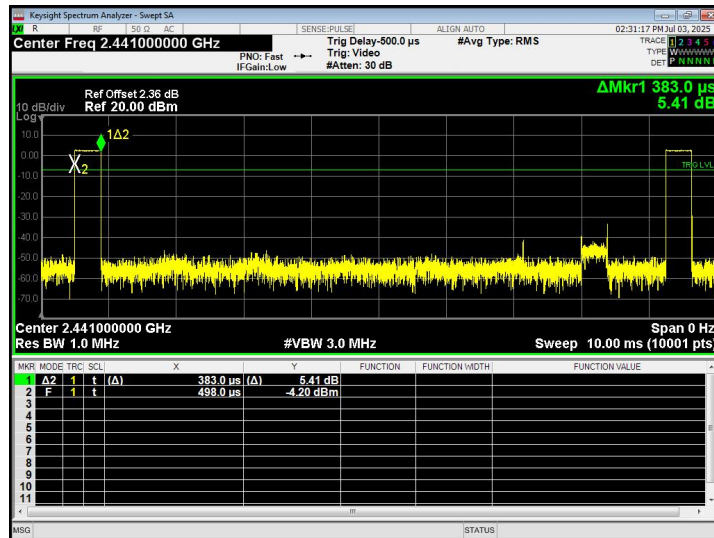
CH:2441MHz time slot= $1.643(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 262.880\text{ms}$

CH:2441MHz time slot= $2.894(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 308.693\text{ms}$

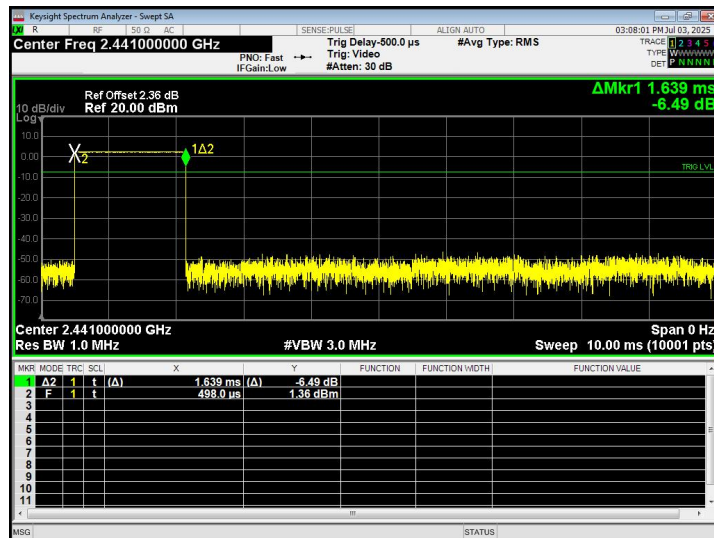


GFSK Test Plots

1-DH1 Middle Channel

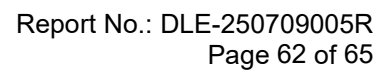


1-DH3 Middle Channel



1-DH5 Middle Channel

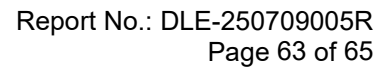




Spectrum Analyzer Settings:

- Center Freq: 2.441000000 GHz
- Ref Offset: 2.36 dB
- Ref: 20.00 dBm
- Trig Delay: 500.0 μs
- Trig: Video
- #Atten: 30 dB
- Avg Type: RMS
- Trace 1: 392.0 μs, -1.14 dB
- Span: 0 Hz
- Res BW: 1.0 MHz
- #VBW: 3.0 MHz
- Sweep: 10.00 ms (10001 pts)

[illegible][illegible]



Keysight Spectrum Analyzer - Sweep SA

Center Freq 2.441000000 GHz

Ref OffSet 2.36 dB
Ref 20.00 dBm

PNO: Fast IF Gain: Low

Trig Delay: 500.0 μ s
Trig: Video
#Atten: 30 dB

#Avg Type: RMS

Trace 1 2 3 4 5
Type W W W W W
Set P N N N N

Δ Mkr1 392.0 μ s
-3.37 dBm

Log

10 dB/div

0.00

X₂ 1A2

Center 2.441000000 GHz

Res BW 1.0 MHz

#VBW 3.0 MHz

Span 0 Hz

Sweep 10.00 ms (10001 pts)

MKR	MODE	TRC	SOL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	A2	1	t	(A)	392.0 μ s	(A)	-3.37 dB	
2	F	1	t		498.0 μ s		0.18 dBm	
3								
4								
5								
6								
7								
8								
9								
10								
11								

MSO

STATUS

[illegible][illegible]



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 FPC Antenna 1, the best case gain of the antennas is 1.35dBi, 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 *******