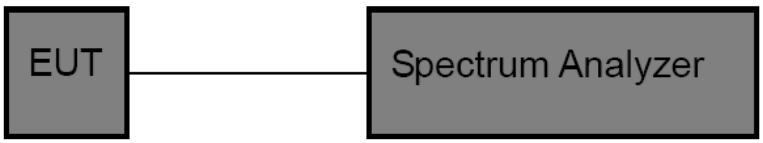
3.4. Band Edge and Spurious Emissions (Conducted)

Limit

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (d)
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.

Test Configuration



Test Procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator, the path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
   RBW = 100 kHz, VBW ≥ RBW, scan up through 10th harmonic.
   Sweep = auto, Detector function = peak, Trace = max hold.
4. Measure and record the results in the test report.

Test Mode

Please refer to the clause 2.4.

Test Result

Band Edge Conducted Test & Conducted Spurious Emissions Test

Non-Hopping

Modulation	Packet	Channel	OOB Emission Frequency (MHz)	OOB Emission Level (dBm)	Limit (dBm)	Result
GFSK	DH5	0	2400.00	-53.934	-16.52	PASS
			4999.78	-50.730	-16.52	PASS
		39	4999.78	-51.112	-16.4	PASS
		78	2483.50	-61.681	-16.91	PASS
			1766.08	-47.636	-16.91	PASS
π/4DQPSK	2-DH5	0	2400.00	-53.251	-17.04	PASS
			4999.78	-50.787	-17.04	PASS
		39	4999.78	-51.262	-17.32	PASS
		78	2483.50	-62.648	-17.85	PASS
			4999.78	-50.385	-17.85	PASS
8DPSK	3-DH5	0	2400.00	-52.529	-17.01	PASS
			4999.78	-51.400	-17.01	PASS
		39	4999.78	-51.304	-17.32	PASS
		78	2483.50	-61.697	-16.44	PASS
			4999.78	-51.217	-16.44	PASS

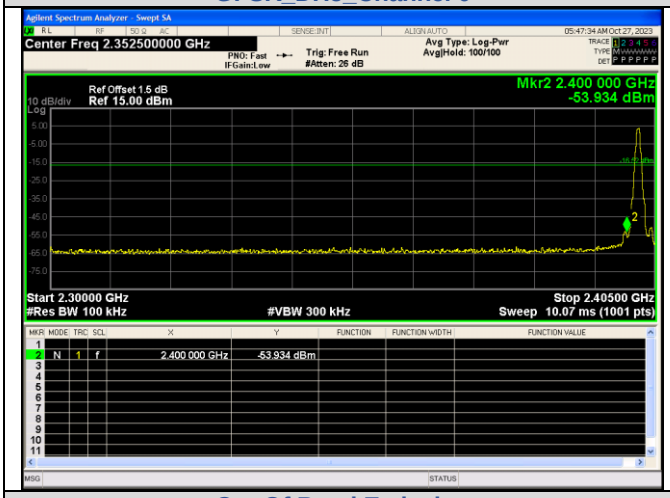
Hopping

Modulation	Packet	OOB Emission Frequency (MHz)	OOB Emission Level (dBm)	Limit (dBm)	Result
GFSK	DH5	2400.00	-54.523	-16.39	PASS
		2483.50	-62.633	-16.83	PASS
π/4DQPSK	2-DH5	2400.00	-52.231	-15.61	PASS
		2483.50	-62.039	-16.25	PASS
8DPSK	3-DH5	2400.00	-52.452	-15.74	PASS
		2483.50	-61.417	-16.26	PASS

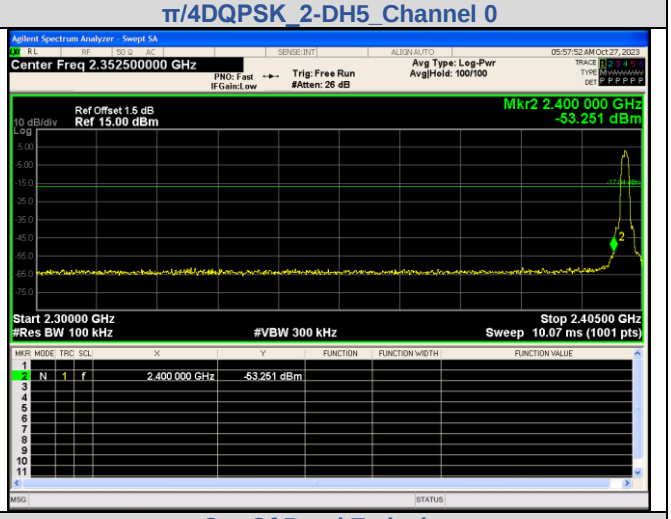
Test plot as follows:

In-Band Reference Level
GFSK_DH5_Channel 0

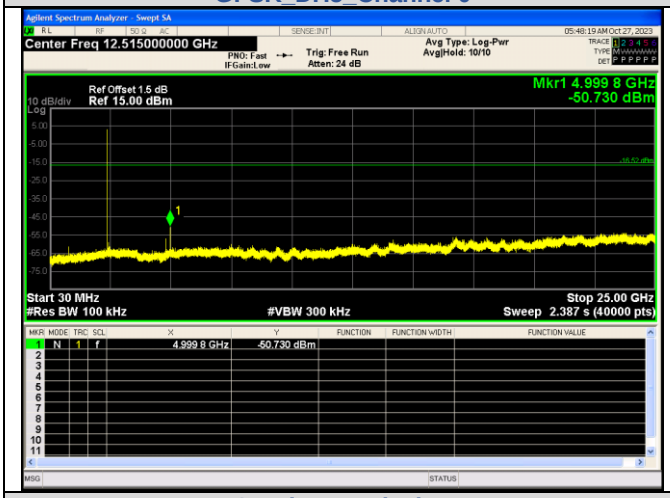
In-Band Reference Level
π/4DQPSK_2-DH5_Channel 0



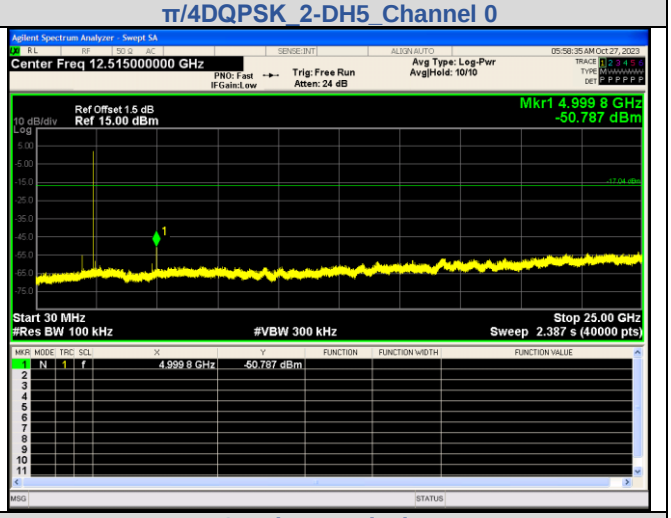
Out Of Band Emission
GFSK_DH5_Channel 0



Out Of Band Emission
π/4DQPSK_2-DH5_Channel 0



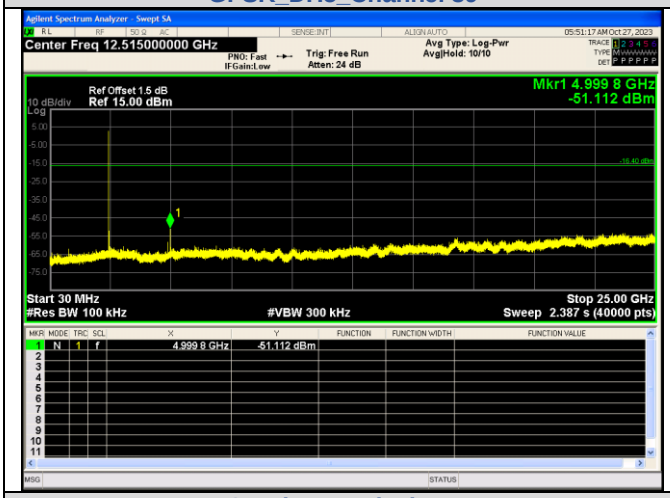
Spurious Emission
GFSK_DH5_Channel 0



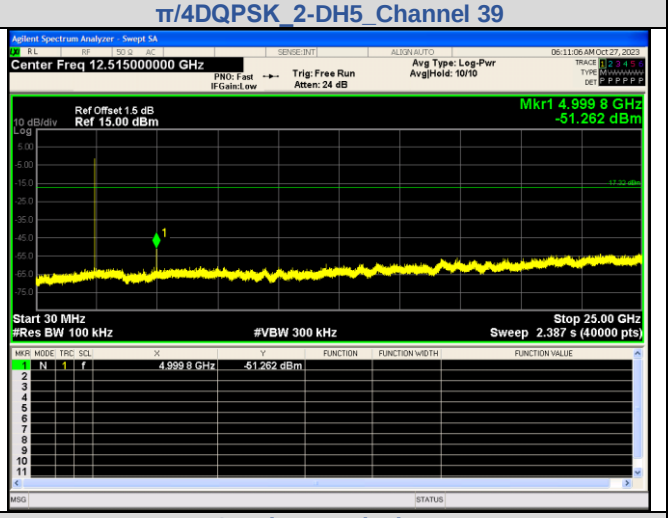
Spurious Emission
π/4DQPSK_2-DH5_Channel 0

In-Band Reference Level
GFSK_DH5_Channel 39

In-Band Reference Level
π/4DQPSK_2-DH5_Channel 39

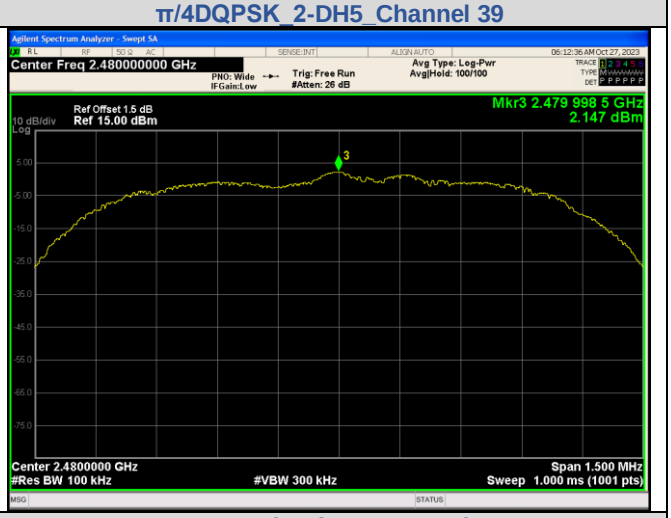


Spurious Emissions
GFSK_DH5_Channel 39

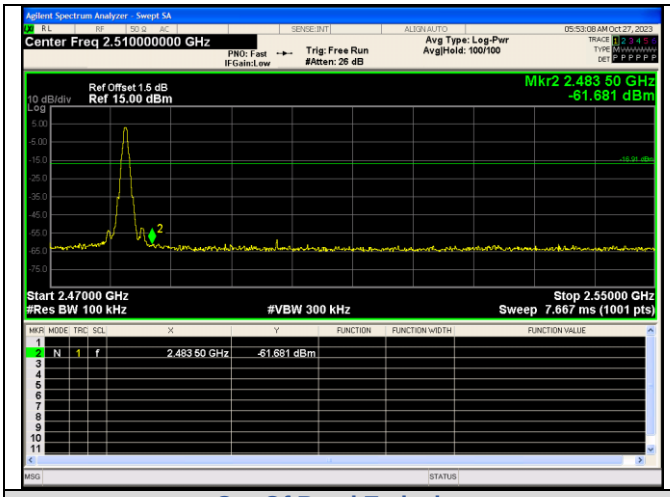


Spurious Emissions
π/4DQPSK_2-DH5_Channel 39

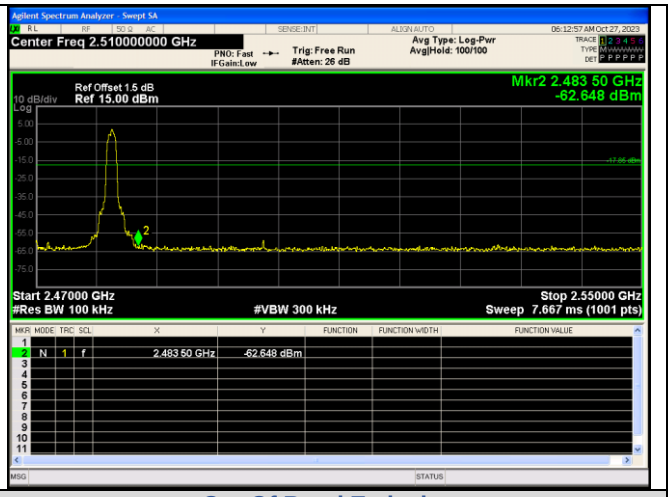
In-Band Reference Level
GFSK_DH5_Channel 78



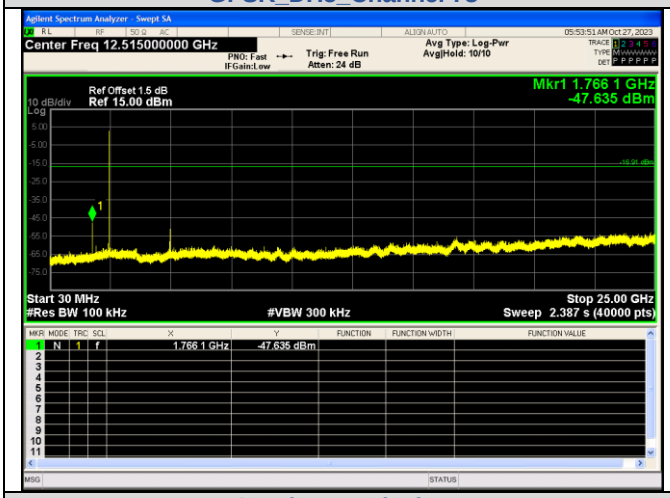
In-Band Reference Level
π/4DQPSK_2-DH5_Channel 78



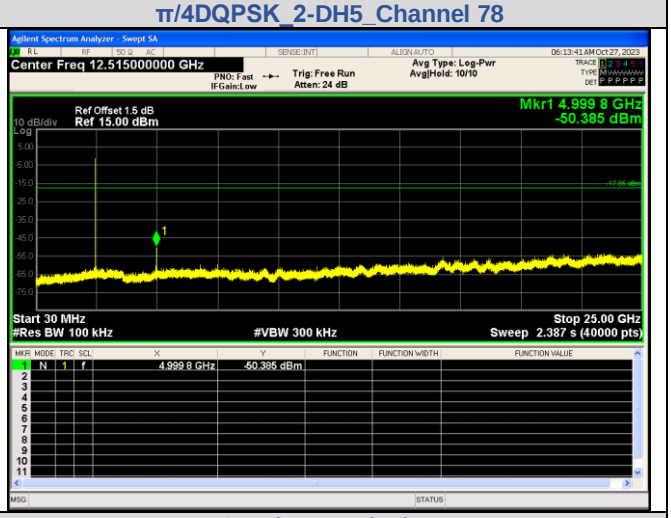
Out Of Band Emission
GFSK_DH5_Channel 78



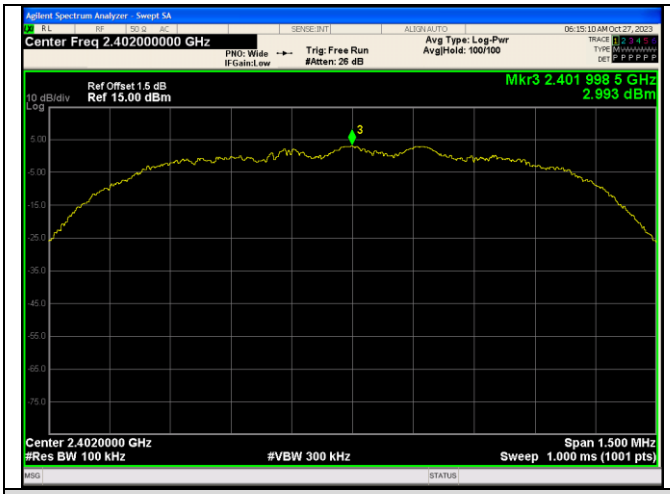
Out Of Band Emission
π/4DQPSK_2-DH5_Channel 78



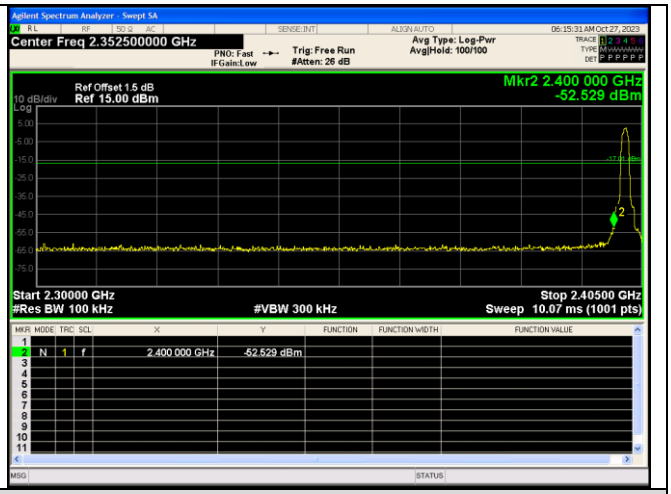
Spurious Emission
GFSK_DH5_Channel 78



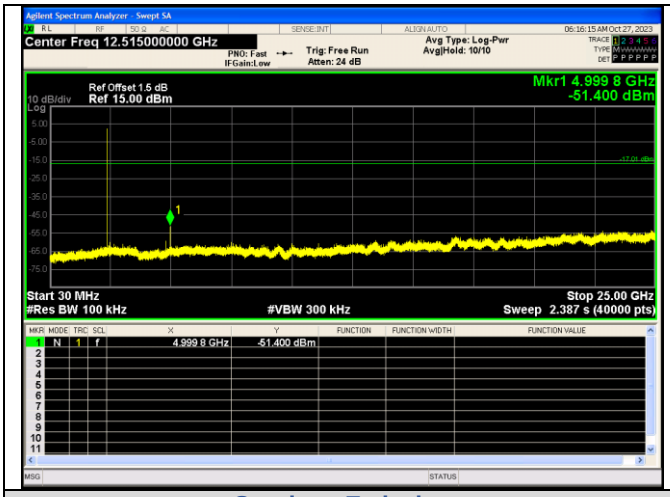
Spurious Emission
π/4DQPSK_2-DH5_Channel 78



In-Band Reference Level
8DPSK_3-DH5_Channel 0

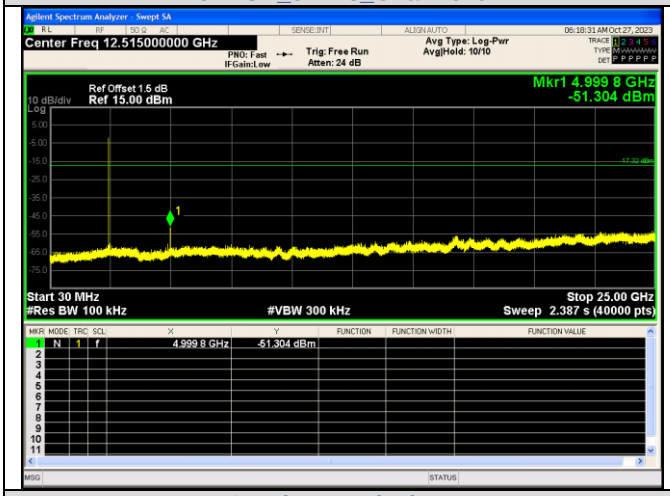


Out Of Band Emission
8DPSK_3-DH5_Channel 0

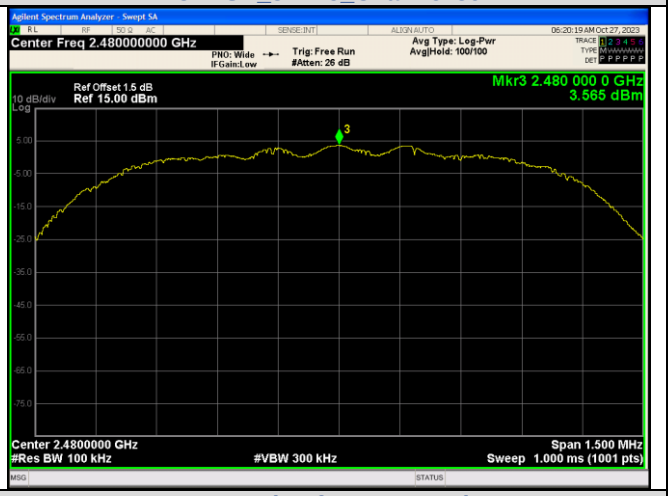


Spurious Emission
8DPSK_3-DH5_Channel 0

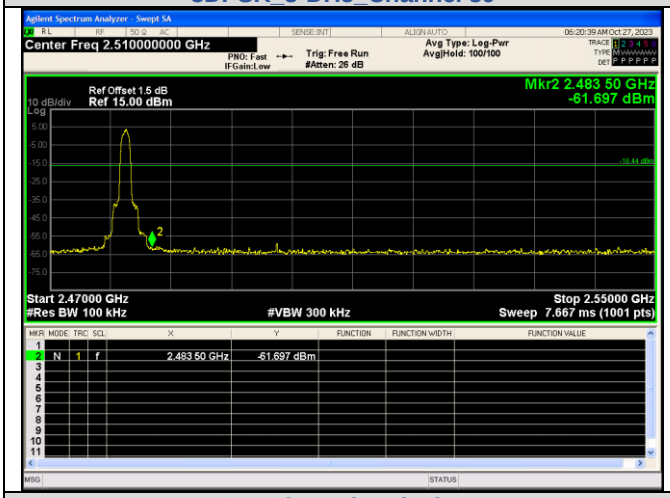
In-Band Reference Level
8DPSK_3-DH5_Channel 39



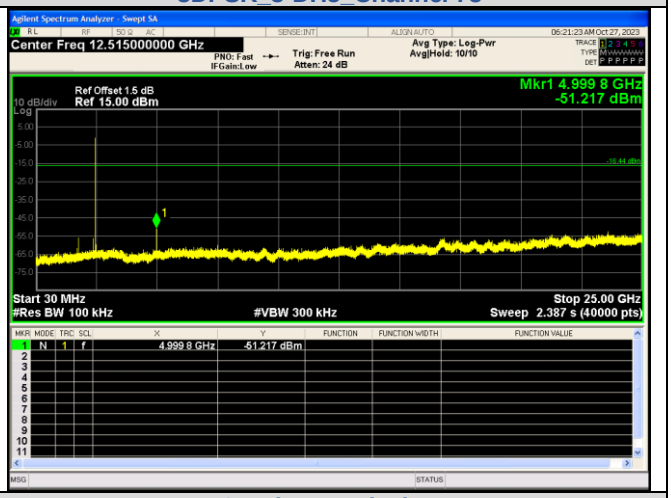
Spurious Emissions
8DPSK_3-DH5_Channel 39



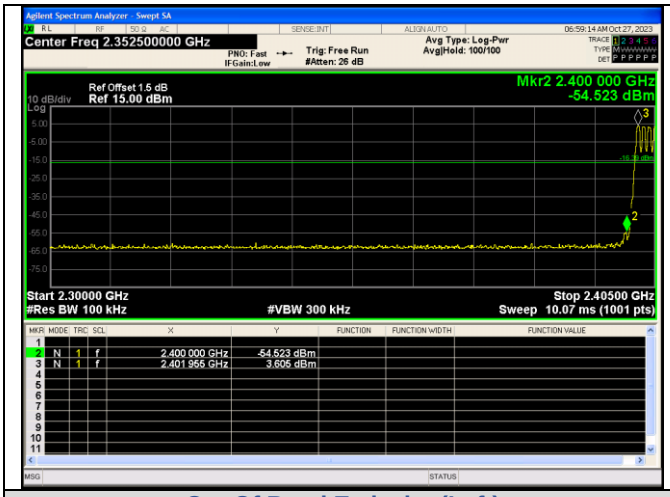
In-Band Reference Level
8DPSK_3-DH5_Channel 78



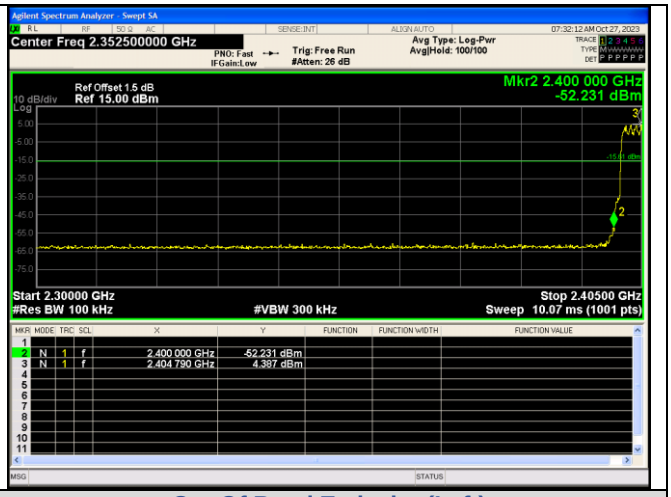
Out Of Band Emission
8DPSK_3-DH5_Channel 78



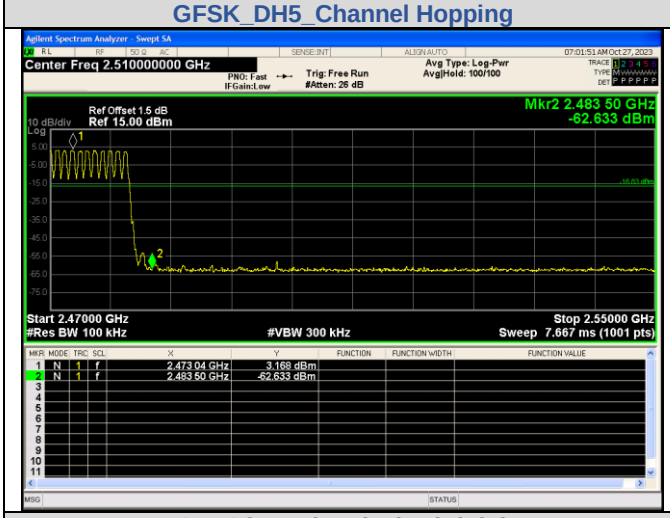
Spurious Emission
8DPSK_3-DH5_Channel 78



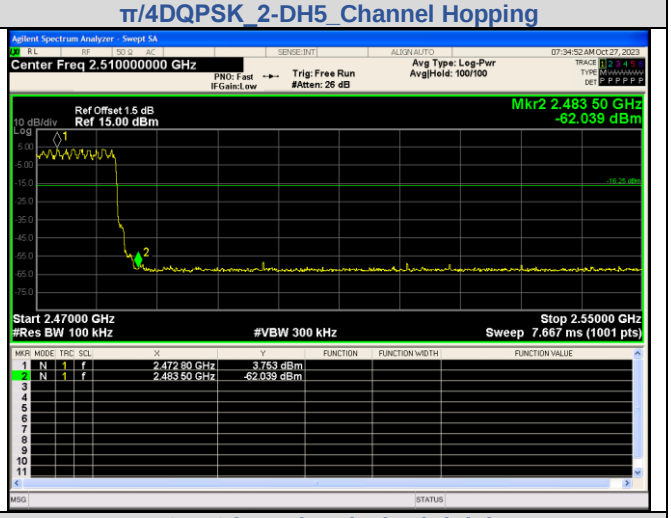
Out Of Band Emission(Left)
GFSK_DH5_Channel Hopping



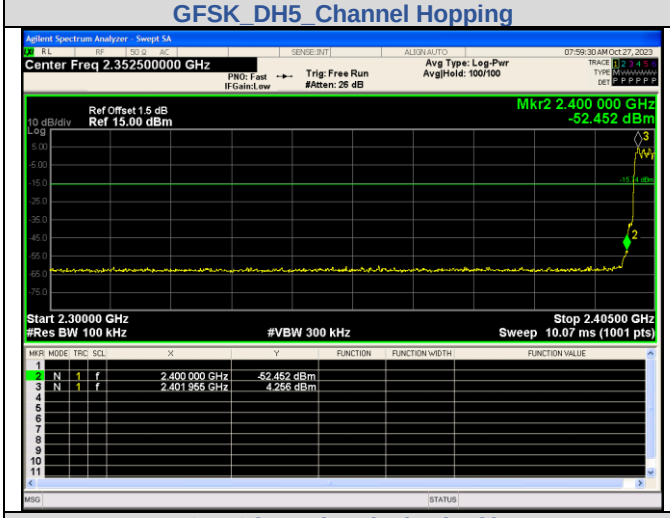
Out Of Band Emission(Left)
π/4DQPSK_2-DH5_Channel Hopping



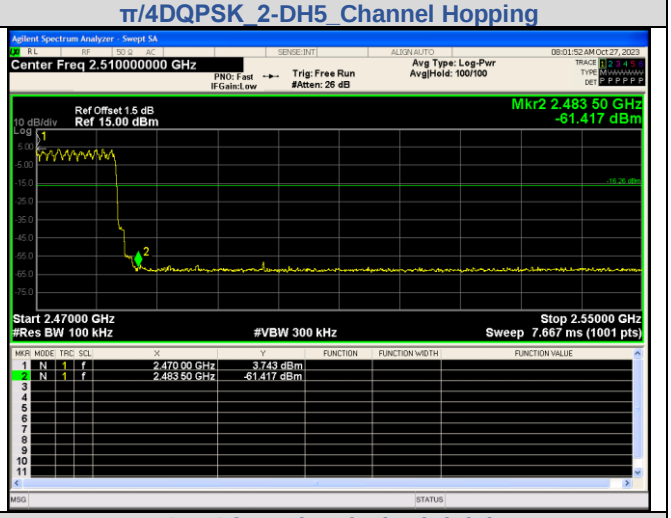
Out Of Band Emission(Right)
GFSK_DH5_Channel Hopping



Out Of Band Emission(Right)
π/4DQPSK_2-DH5_Channel Hopping



Out Of Band Emission(Left)
8DPSK_3-DH5_Channel Hopping



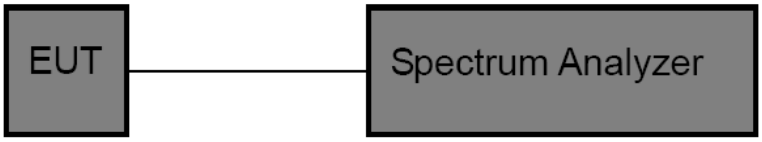
Out Of Band Emission(Right)
8DPSK_3-DH5_Channel Hopping

3.5. 20dB Bandwidth

Limit

N/A

Test Configuration



Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
2. OCB and 20dB Spectrum Setting:
   (1) Set RBW = 1% ~ 5% occupied bandwidth.
   (2) Set the video bandwidth (VBW) ≥ 3 RBW.
   (3) Detector = Peak.
   (4) Trace mode = Max hold.
   (5) Sweep = Auto couple.

Note: The EUT was set to continuously transmitting in each mode and low, Middle and high channel for the test.

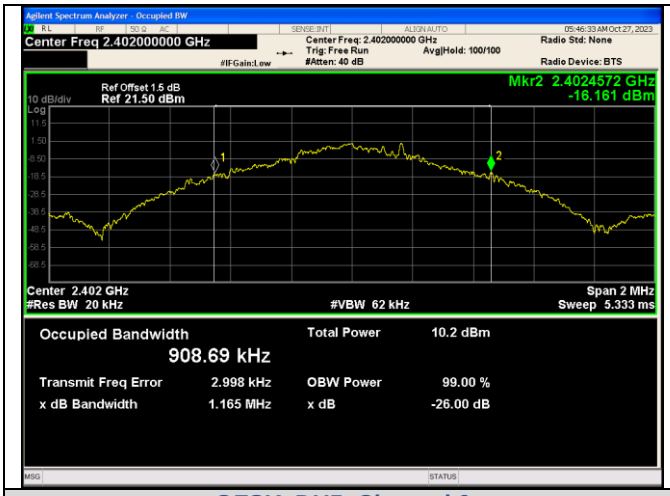
Test Mode

Please refer to the clause 2.4.

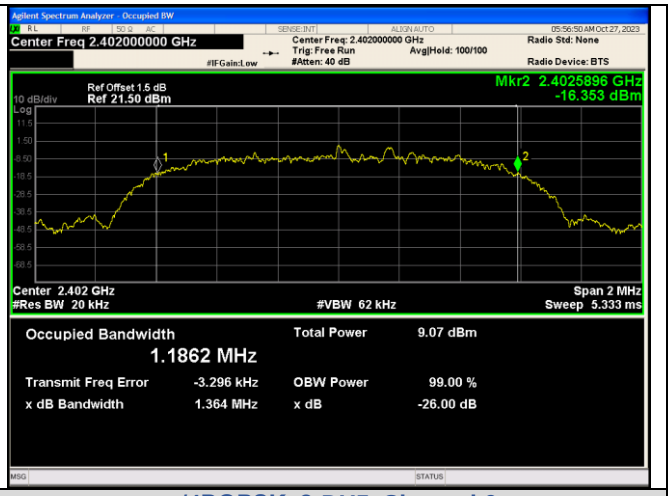
Test Result

Test Mode	Frequency (MHz)	99% Bandwidth (MHz)	20dB Bandwidth (MHz)	20dB Bandwidth *2/3 (MHz)
GFSK	2402	0.90869	1.028	0.685
	2441	0.90447	0.9868	0.658
	2480	0.88727	0.9888	0.659
π/4-DQPSK	2402	1.1862	1.300	0.867
	2441	1.1863	1.284	0.856
	2480	1.1859	1.292	0.861
8-DPSK	2402	1.1801	1.275	0.850
	2441	1.1790	1.291	0.861
	2480	1.1658	1.271	0.847

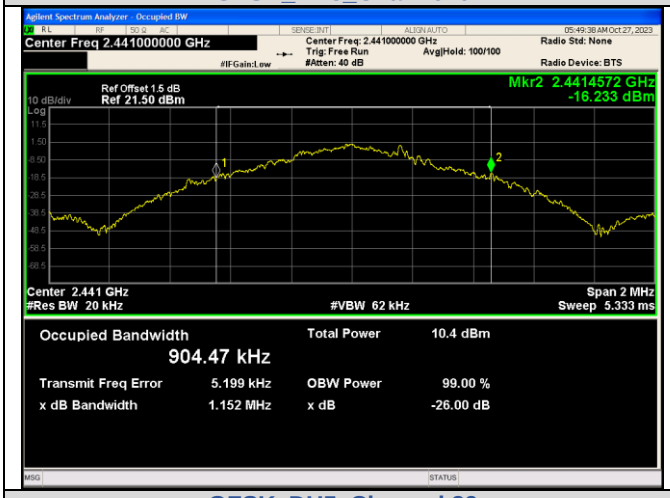
99% Bandwidth:



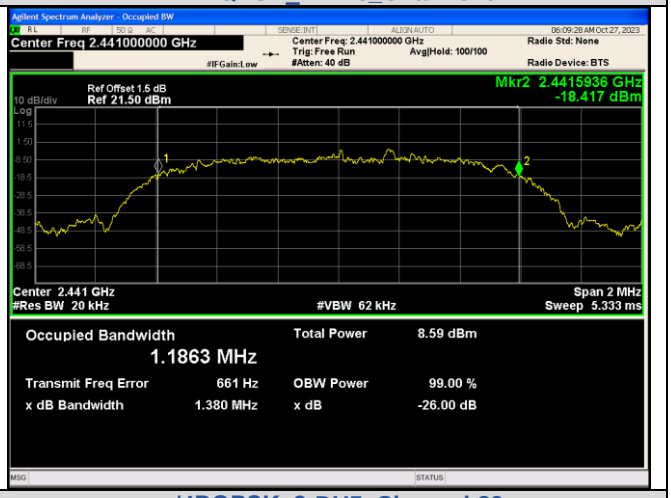
GFSK_DH5_Channel 0



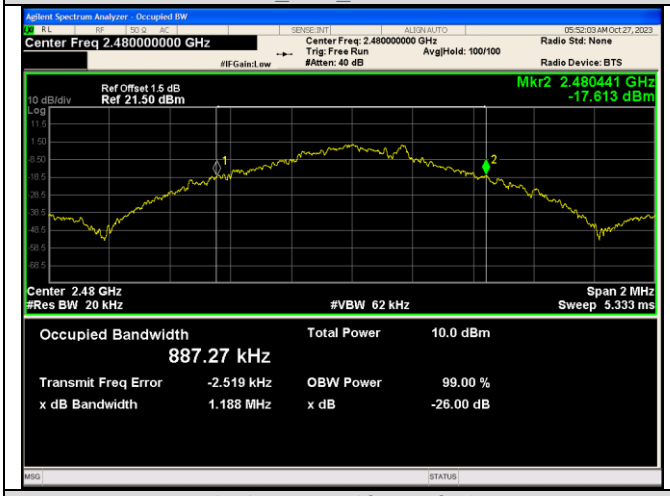
π/4DQPSK_2-DH5_Channel 0



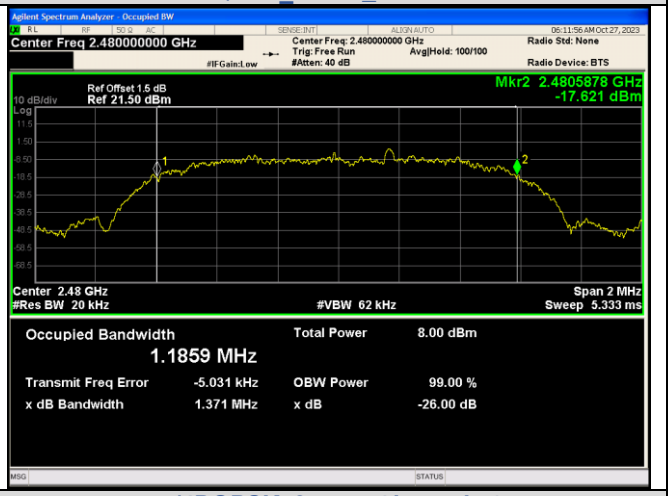
GFSK_DH5_Channel 39



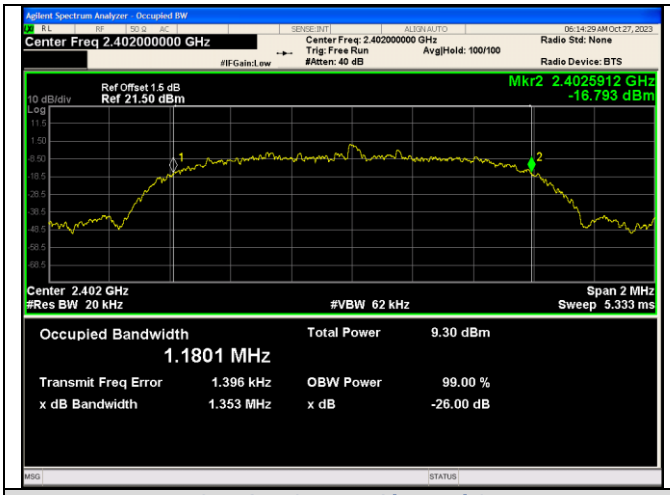
π/4DQPSK_2-DH5_Channel 39



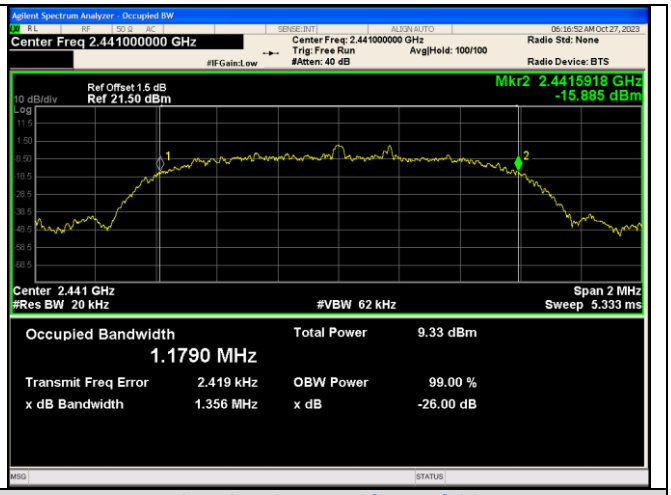
GFSK_DH5_Channel 78



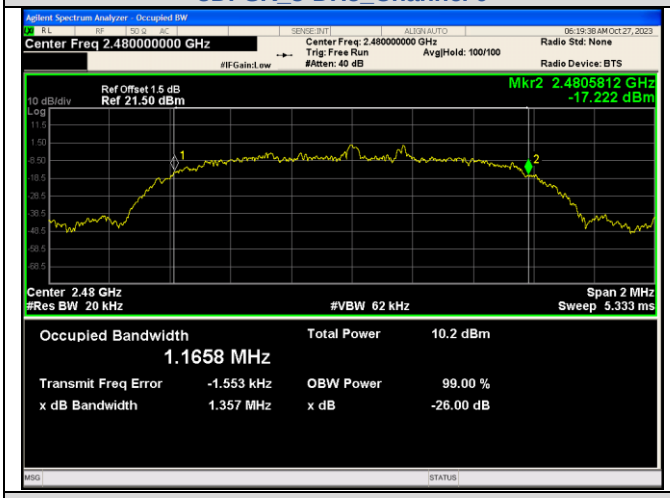
π/4DQPSK_2-DH5_Channel 78



8DPSK_3-DH5_Channel 0



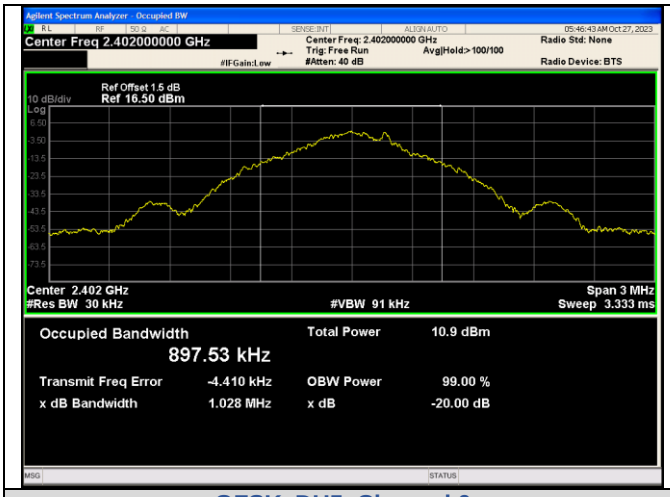
8DPSK_3-DH5_Channel 39



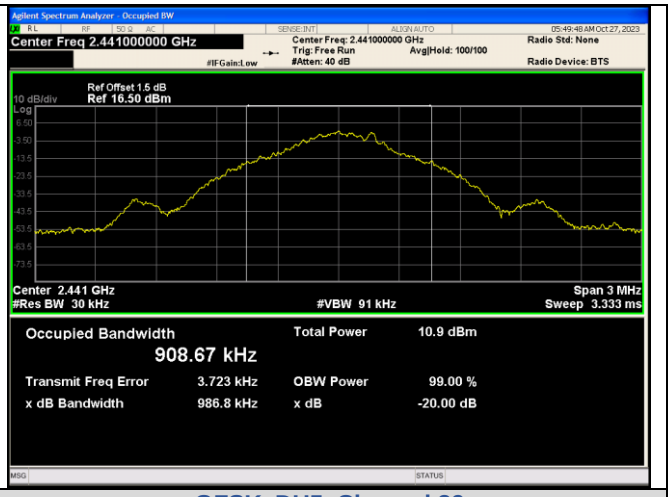
8DPSK_3-DH5_Channel 78

Void

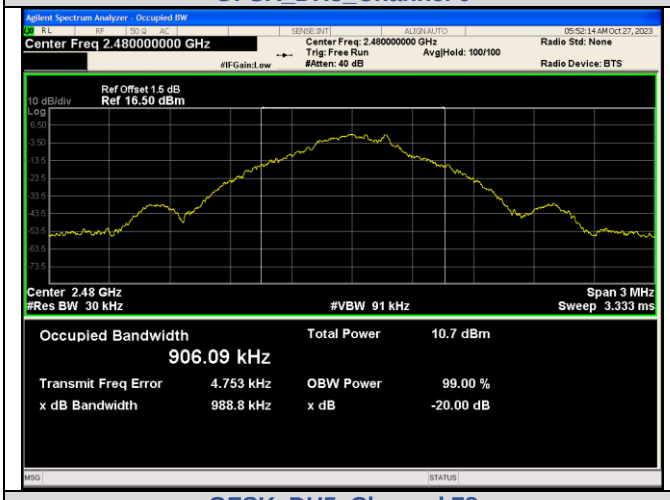
20dB Bandwidth:



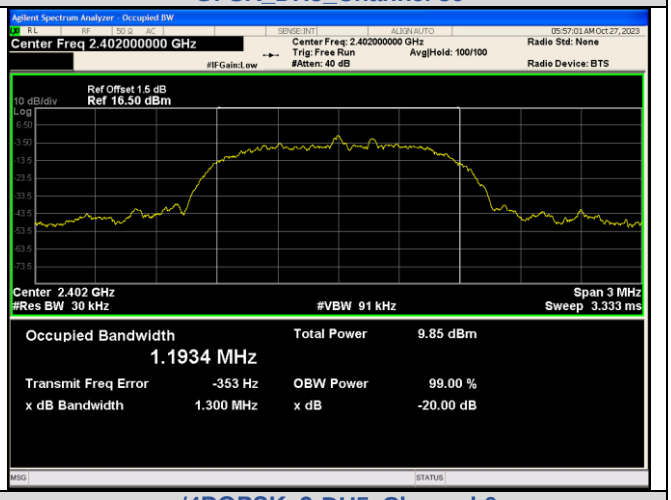
GFSK_DH5_Channel 0



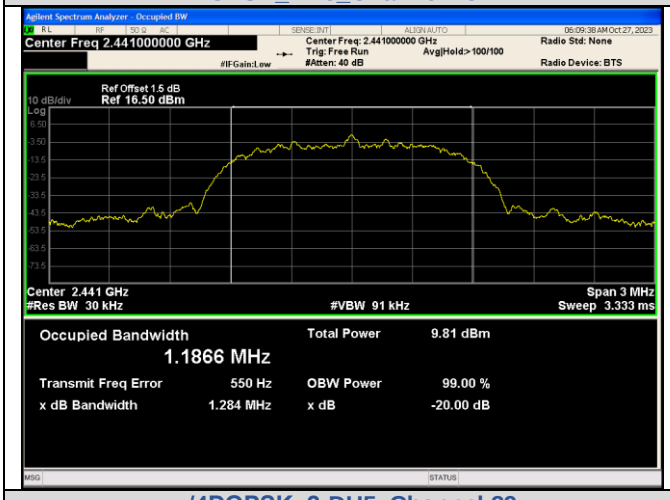
GFSK_DH5_Channel 39



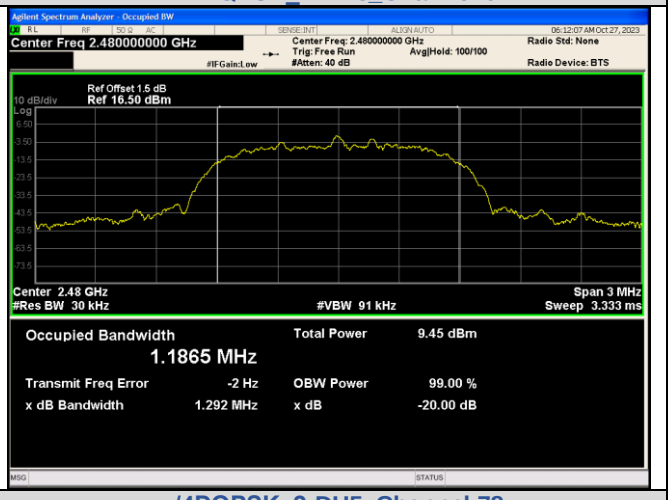
GFSK_DH5_Channel 78



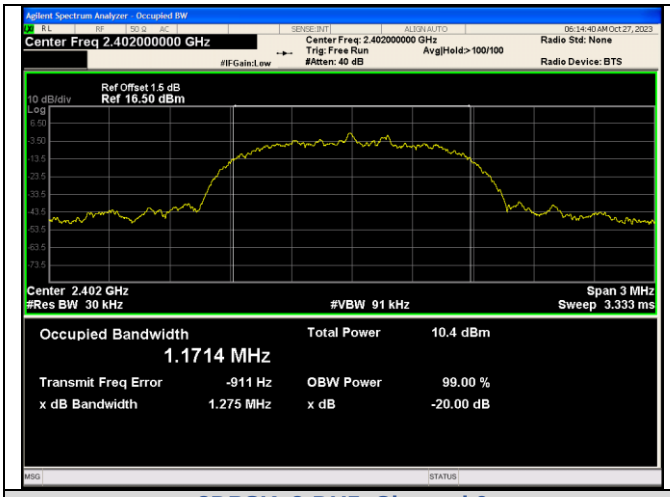
π/4DQPSK_2-DH5_Channel 0



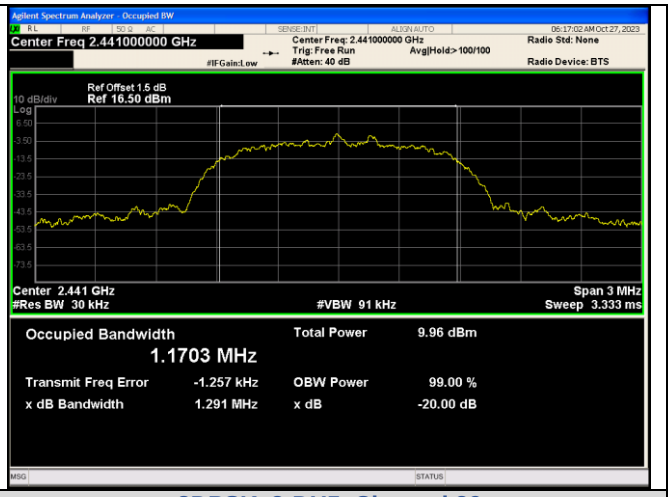
π/4DQPSK_2-DH5_Channel 39



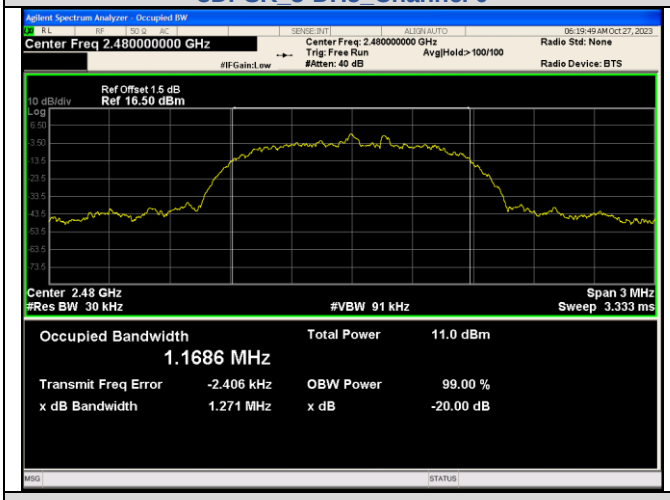
π/4DQPSK_2-DH5_Channel 78



8DPSK_3-DH5_Channel 0



8DPSK_3-DH5_Channel 39



8DPSK_3-DH5_Channel 78

Void

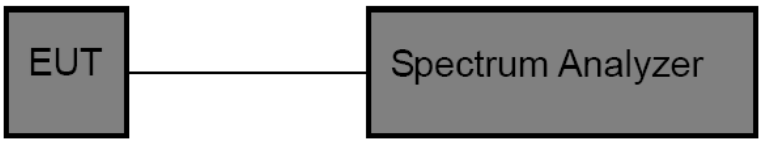
3.6. Channel Separation

Limit

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(1)

Test Item	Limit	Frequency Range (MHz)
Channel Separation	>25kHz or >two-thirds of the 20 dB bandwidth Which is greater	2400~2483.5

Test Configuration



Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
2. Spectrum Setting:
   (1) Set RBW = 100 kHz.
   (2) Set the video bandwidth (VBW) ≥ 3 RBW.
   (3) Detector = Peak.
   (4) Trace mode = Max hold.
   (5) Sweep = Auto couple.

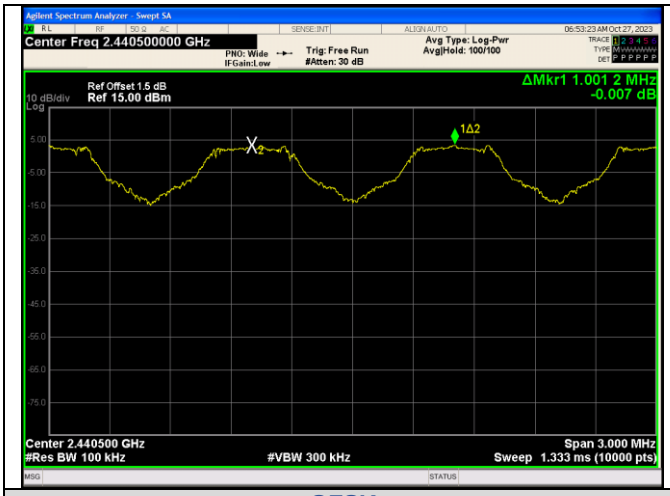
Test Mode

Please refer to the clause 2.4.

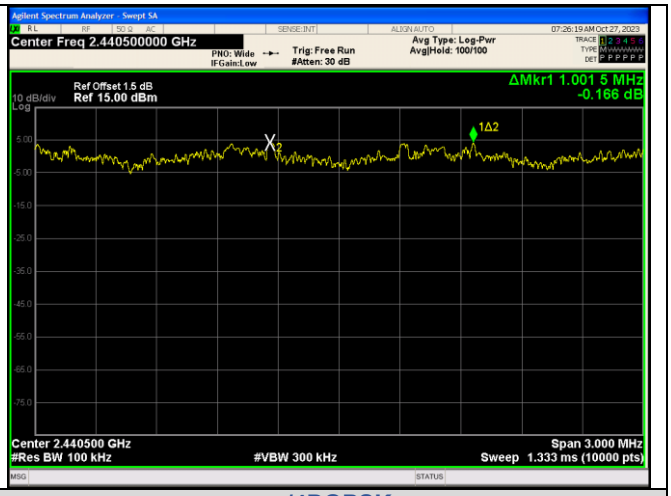
Test Result

Test Mode	Frequency (MHz)	Carrier Frequencies Separation (MHz)	Limit (MHz)	Verdict
GFSK	Hop_2441	1.0012	0.685	Pass
π/4-DQPSK	Hop_2441	1.0015	0.867	Pass
8-DPSK	Hop_2441	1.0243	0.861	Pass

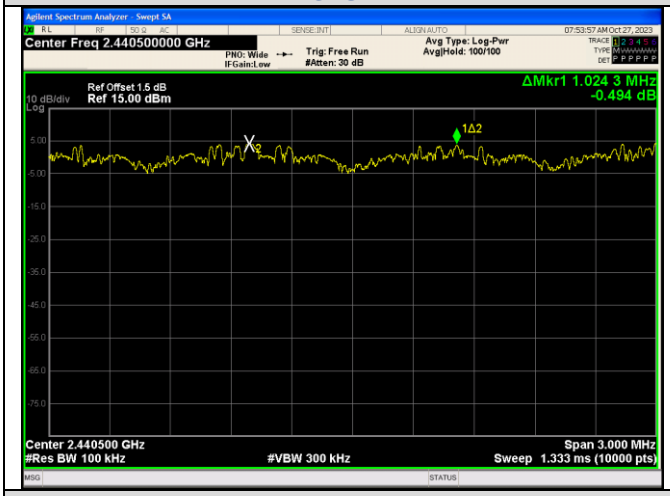
Test plot as follows:



GFSK



π/4DQPSK



8DPSK

Void

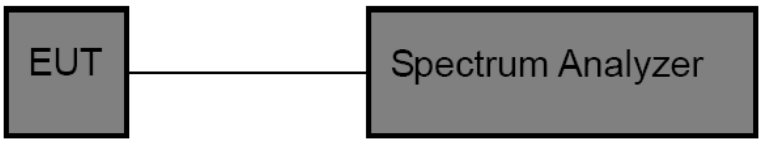
3.7. Number of Hopping Channel

Limit

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(iii)

Section	Test Item	Limit
15.247 (a)(iii) RSS-247 5.1 d	Number of Hopping Channel	⩾15

Test Configuration



Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
2. Spectrum Setting:
   (1) Peak Detector: RBW=100 kHz, VBW≥RBW, Sweep time= Auto.

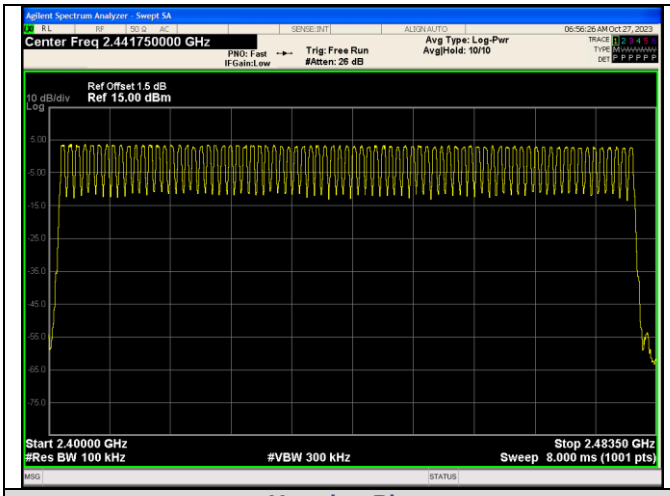
Test Mode

Please refer to the clause 2.4.

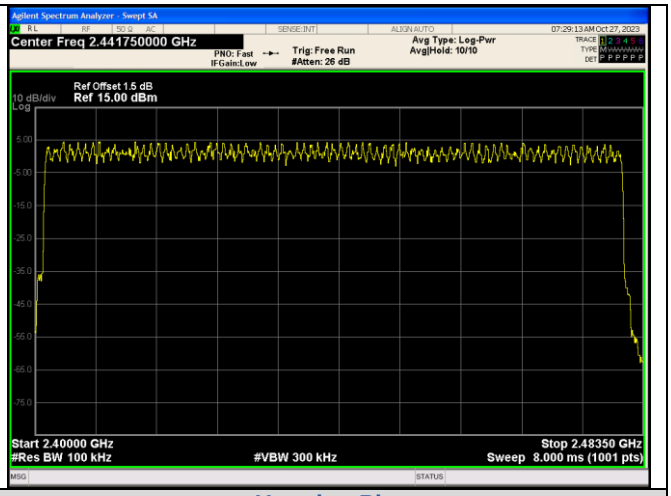
Test Result

Test Mode	Channel Number	Limit	Verdict
GFSK	79	≥15	Pass
π/4-DQPSK	79	≥15	Pass
8-DPSK	79	≥15	Pass

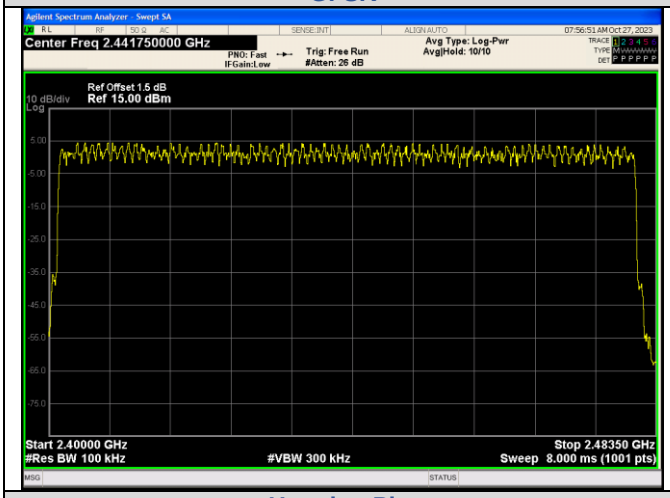
Test plot as follows:



Hopping Plot
GFSK



Hopping Plot
π/4DQPSK



Hopping Plot
8DPSK

Void

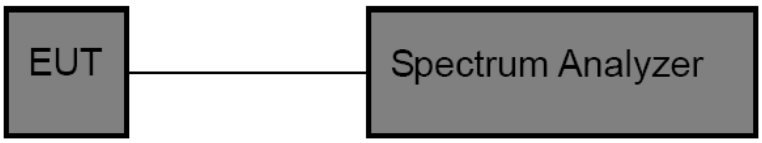
3.8. Dwell Time

Limit

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(iii)

Section	Test Item	Limit
15.247 (a)(iii) RSS-247 5.1 d	Average Time of Occupancy	0.4 sec

Test Configuration



Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
2. Spectrum Setting:
   (1) Spectrum Setting: RBW=1MHz, VBW≥RBW.
   (2) Use video trigger with the trigger level set to enable triggering only on full pulses.
   (3) Sweep Time is more than once pulse time.
   (4) Set the center frequency on any frequency would be measure and set the frequency span to zero.
   (5) Measure the maximum time duration of one single pulse.
   (6) Set the EUT for packet transmitting.

Test Mode

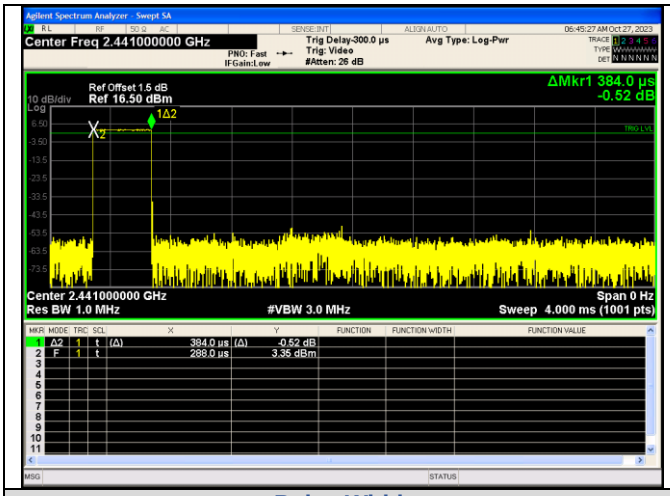
Please refer to the clause 2.4.

Test Result

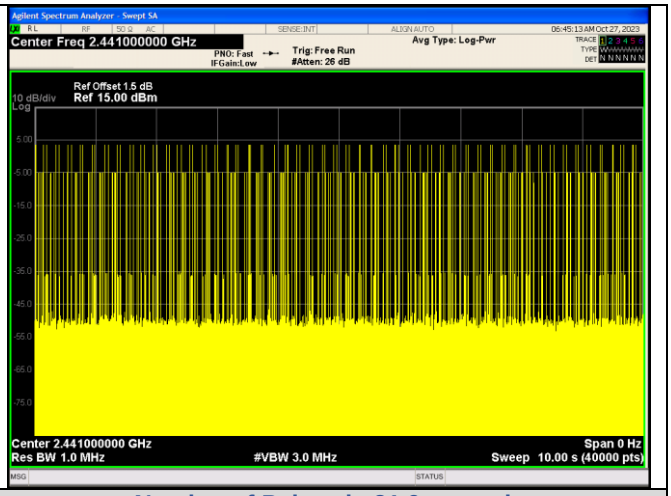
Test Mode	Channel	Frequency (MHz)	Pulse Time (ms)	Number of Pulses in 31.6 seconds	Total of Dwell (ms)	Period Time (ms)	Limit (second)	Verdict
GFSK	DH1	2441	0.3840	100	122.9	31.60	≤0.40	Pass
	DH3	2441	1.636	56	261.8	31.60		
	DH5	2441	2.888	33	308.1	31.60		
π /4-DQPSK	2DH1	2441	0.3920	99	125.4	31.60	≤0.40	Pass
	2DH3	2441	1.640	48	262.4	31.60		
	2DH5	2441	2.888	34	308.1	31.60		
8-DPSK	3DH1	2441	0.3920	101	125.4	31.60	≤0.40	Pass
	3DH3	2441	1.640	44	262.4	31.60		
	3DH5	2441	2.840	42	302.9	31.60		

Note: 1DH1/2DH1/3DH1 Total of Dwell = Pulse Time(1600/2)*31.6/79*
1DH3/2DH3/3DH3 Total of Dwell = Pulse Time(1600/4)*31.6/79*
1DH5/2DH5/3DH5 Total of Dwell = Pulse Time(1600/6)*31.6/79*

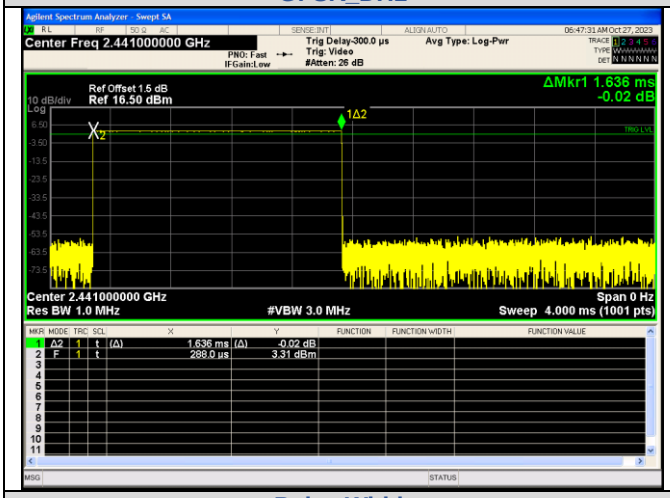
Test plot as follows:



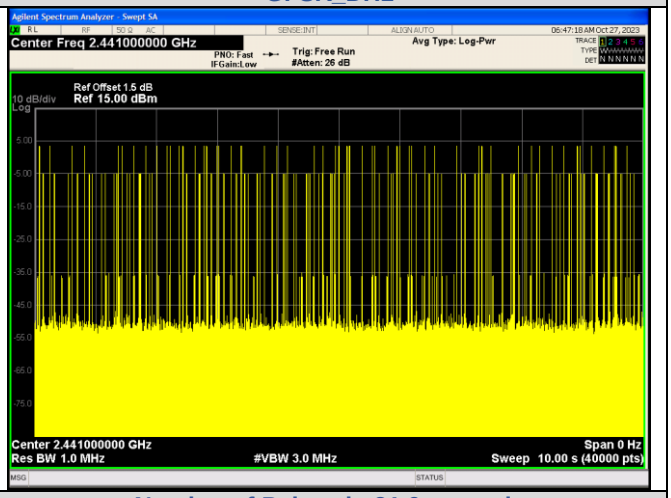
Pulse Width
GFSK_DH1



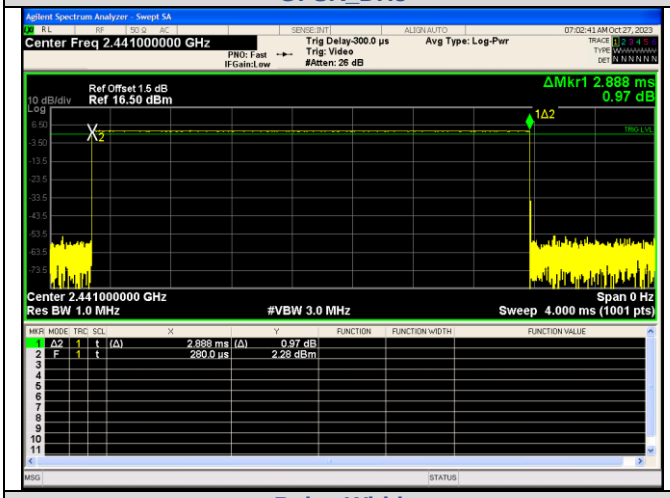
Number of Pulses in 31.6 seconds
GFSK_DH1



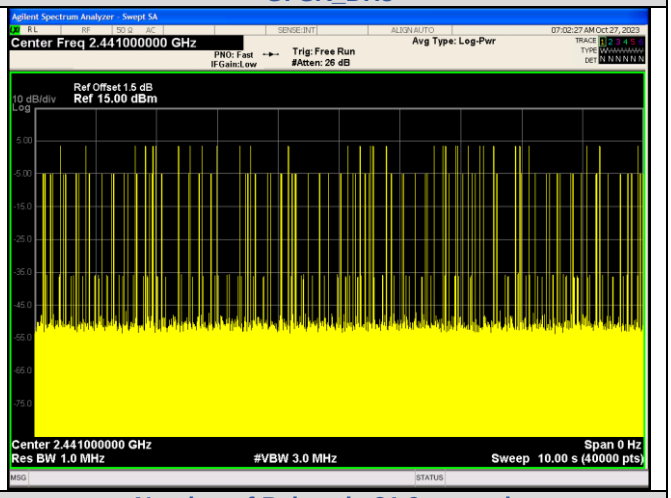
Pulse Width
GFSK_DH3



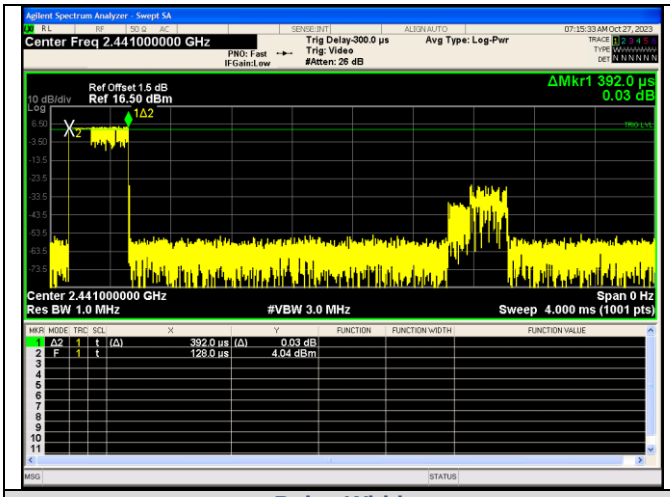
Number of Pulses in 31.6 seconds
GFSK_DH3



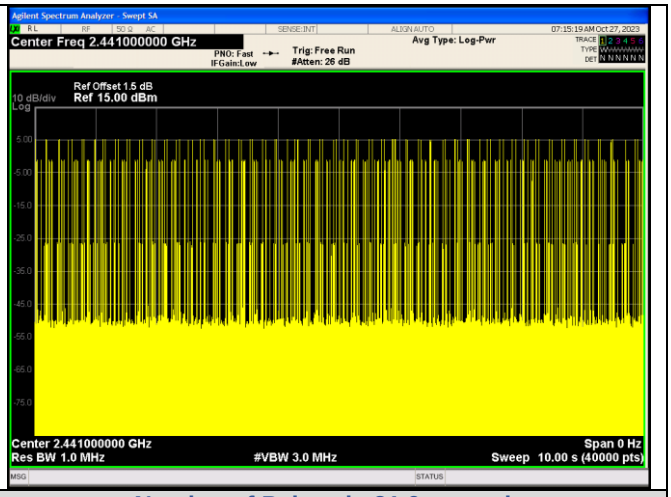
Pulse Width
GFSK_DH5



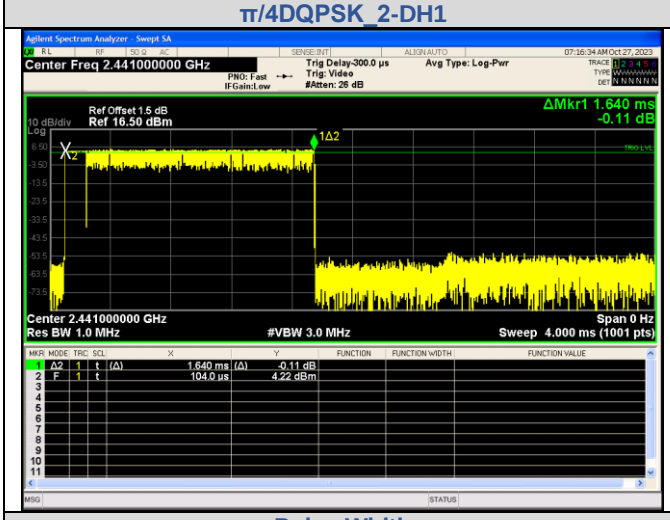
Number of Pulses in 31.6 seconds
GFSK_DH5



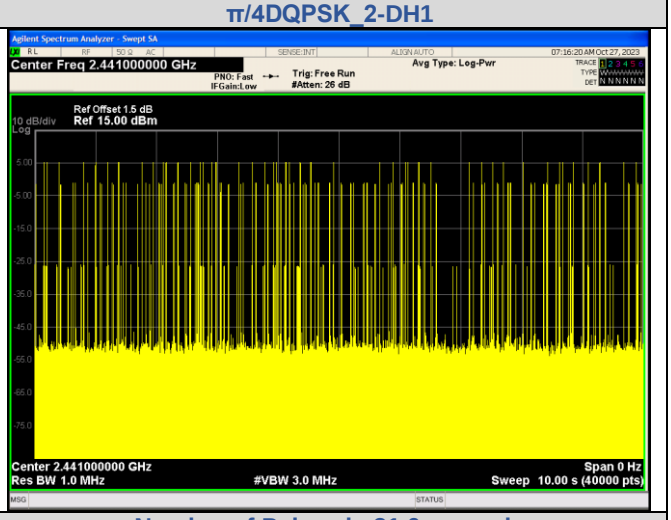
Pulse Width
π/4DQPSK_2-DH1



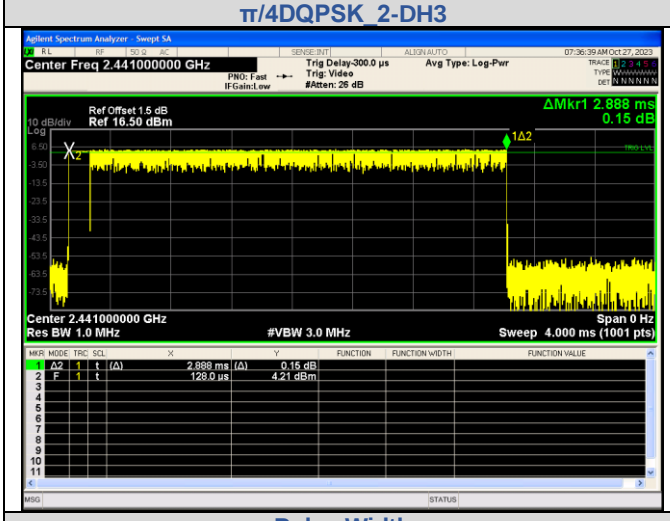
Number of Pulses in 31.6 seconds
π/4DQPSK_2-DH1



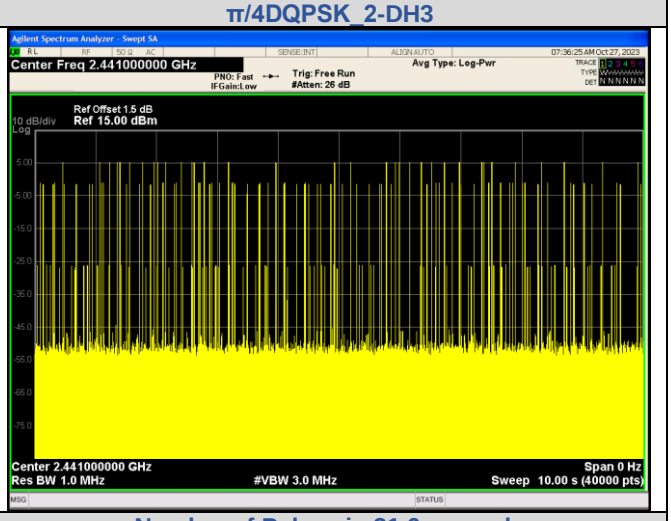
Pulse Width
π/4DQPSK_2-DH3



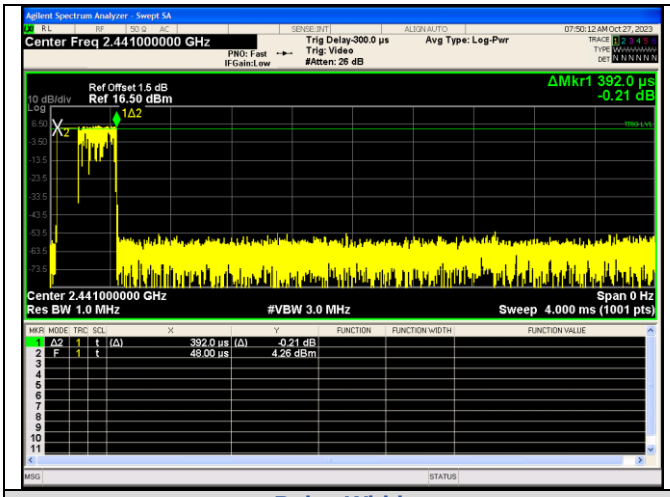
Number of Pulses in 31.6 seconds
π/4DQPSK_2-DH3



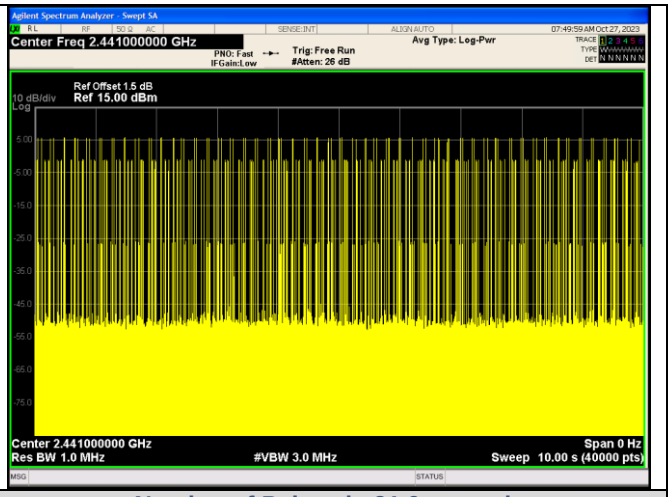
Pulse Width
π/4DQPSK_2-DH5



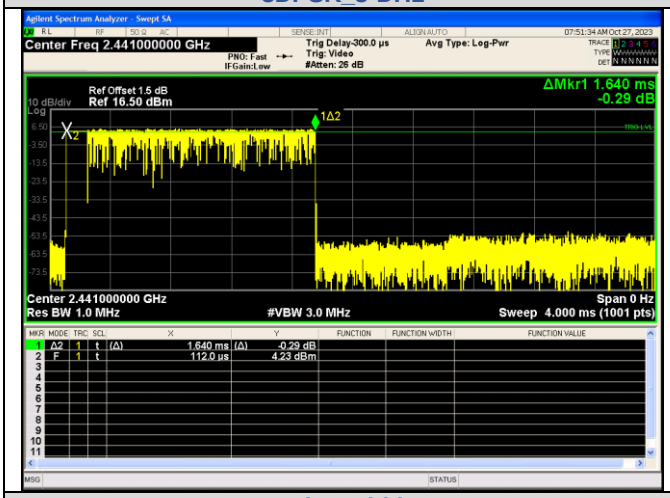
Number of Pulses in 31.6 seconds
π/4DQPSK_2-DH5



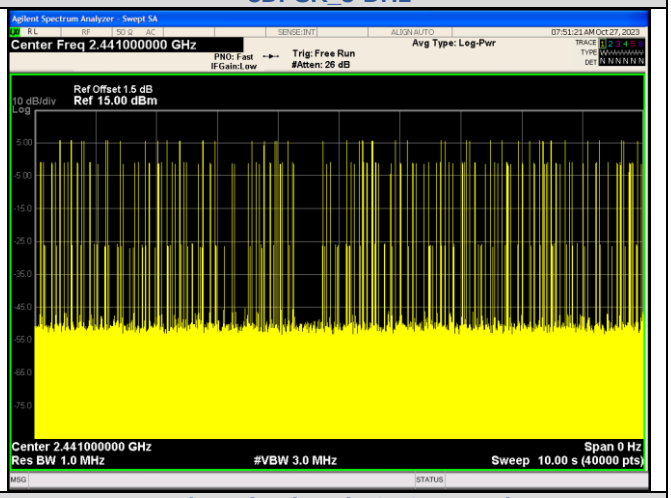
Pulse Width
8DPSK_3-DH1



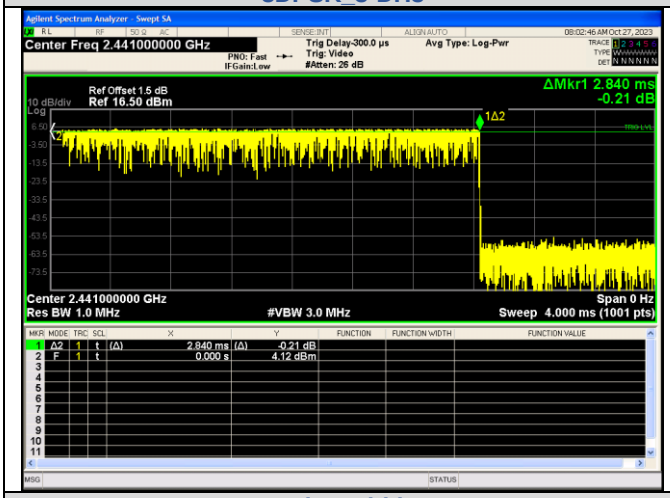
Number of Pulses in 31.6 seconds
8DPSK_3-DH1



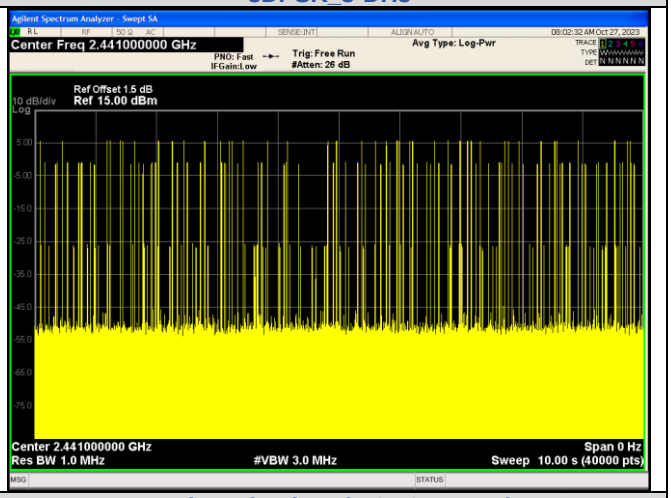
Pulse Width
8DPSK_3-DH3



Number of Pulses in 31.6 seconds
8DPSK_3-DH3



Pulse Width
8DPSK_3-DH5



Number of Pulses in 31.6 seconds
8DPSK_3-DH5

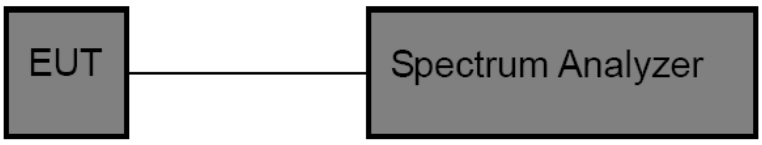
3.9. Peak Output Power

Limit

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (b)(1)

Section	Test Item	Limit	Frequency Range (MHz)
FCC CFR 47 Part15.247 (b)(1)	Maximum Conducted Output Power	Hopping Channels≥75, Power <1W(30dBm); Others <125mW(21dBm)	2400~2483.5

Test Configuration



Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
2. Spectrum Setting:
   (1) Set RBW > 20dB Bandwidth.
   (2) Set VBW ≥ RBW.
   (3) Detector = Peak.
   (4) Trace mode = Max hold.
   (5) Sweep = Auto couple.
   (6) Span = Approximately five times the 20dB bandwidth, centered on a hopping channel.

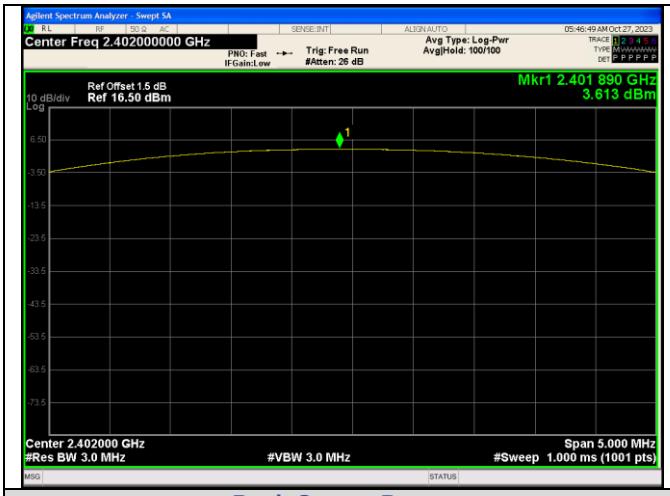
Test Mode

Please refer to the clause 2.4.

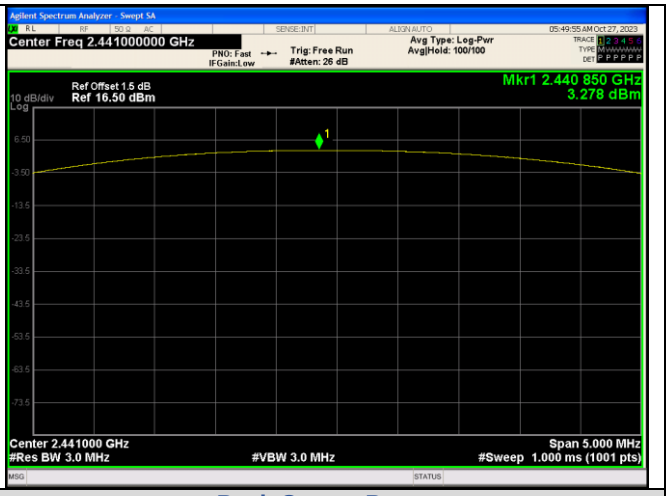
Test Result

Test Mode	Frequency (MHz)	Conducted Output Power (dBm)	FCC Limit (dBm)	Verdict
GFSK	2402	3.613	≤30	Pass
	2441	3.278	≤30	Pass
	2480	3.227	≤30	Pass
π/4-DQPSK	2402	3.977	≤30	Pass
	2441	4.144	≤30	Pass
	2480	3.651	≤30	Pass
8-DPSK	2402	4.933	≤30	Pass
	2441	4.630	≤30	Pass
	2480	5.518	≤30	Pass

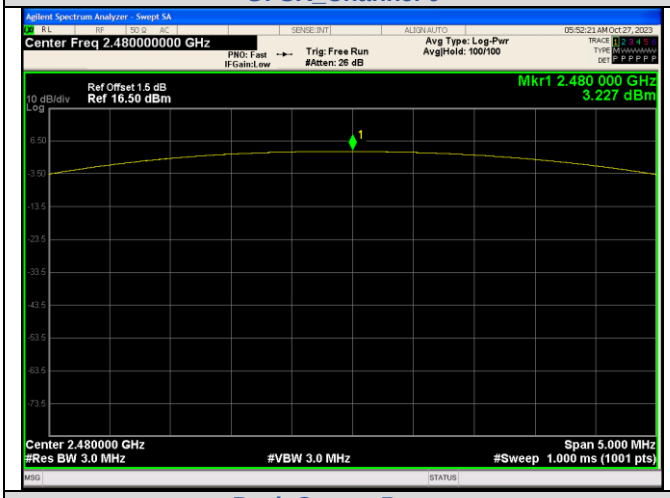
Test plot as follows:



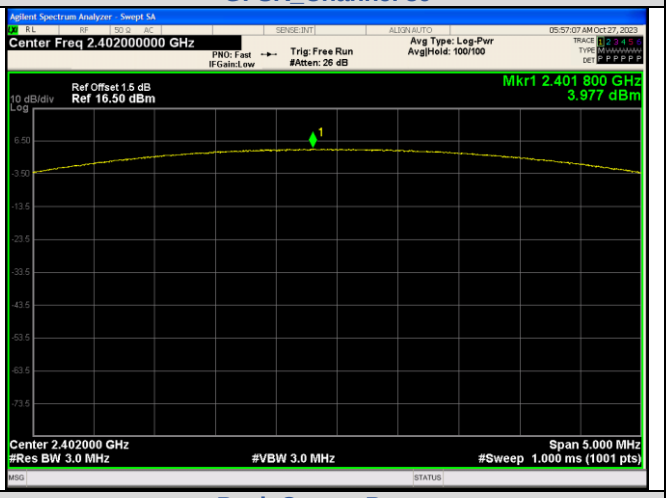
Peak Output Power
GFSK_Channel 0



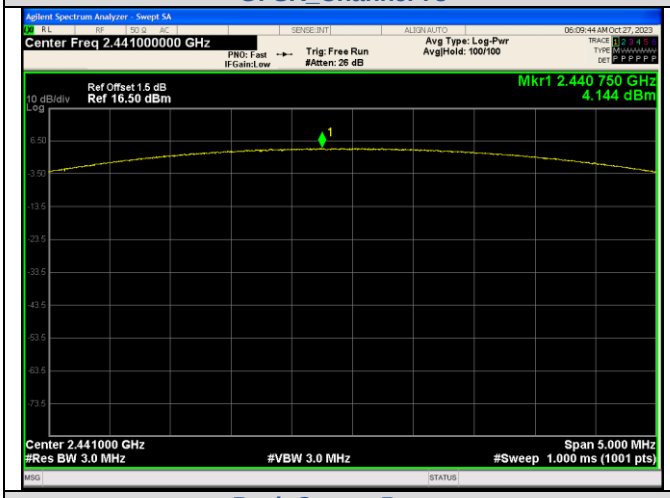
Peak Output Power
GFSK_Channel 39



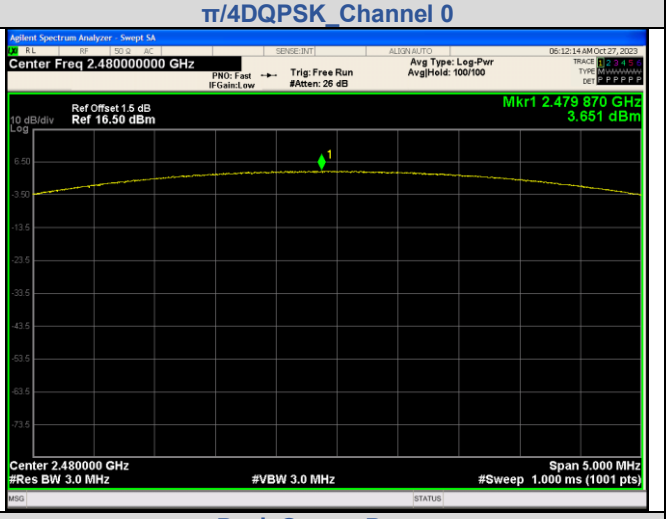
Peak Output Power
GFSK_Channel 78



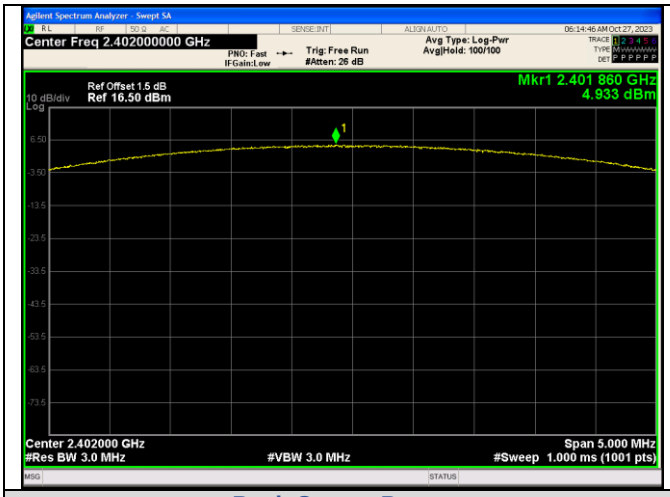
Peak Output Power
π/4DQPSK_Channel 0



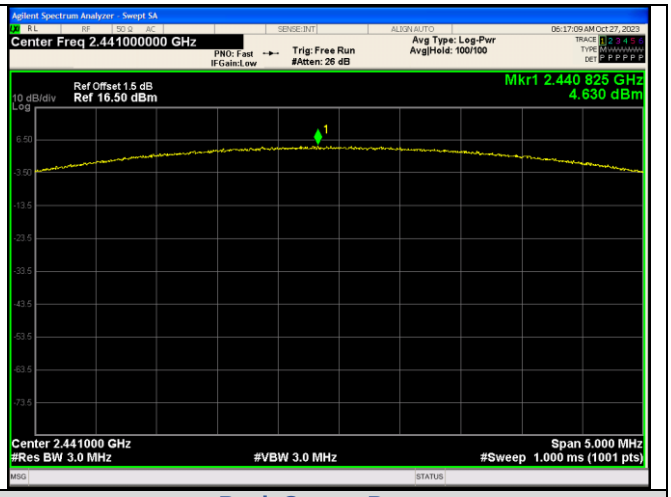
Peak Output Power
π/4DQPSK_Channel 39



Peak Output Power
π/4DQPSK_Channel 78



Peak Output Power
8DPSK_Channel 0



Peak Output Power
8DPSK_Channel 39

Peak Output Power
8DPSK_Channel 78

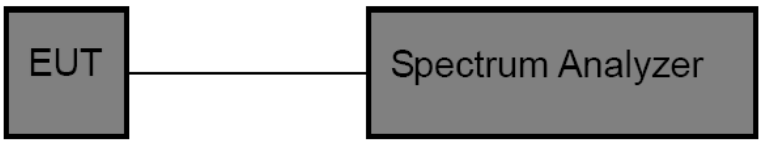
Void

3.10. Duty Cycle

Limit

None, for report purposes only.

Test Configuration



Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
2. The EUT was directly connected to the Spectrum Analyzer and antenna output port as show in the block diagram above. The measurement according to section 10.2 of KDB 558074 D01 DTS Meas Guidance v05r02.
3. Spectrum Setting:

Set analyzer center frequency to test channel center frequency.
Set the span to 0Hz.
Set the RBW to 10MHz.
Set the VBW to 10MHz.
Detector: Peak.
Sweep time: Auto.
Allow trace to fully stabilize. Then use the peak marker function to determine the maximum amplitude level.

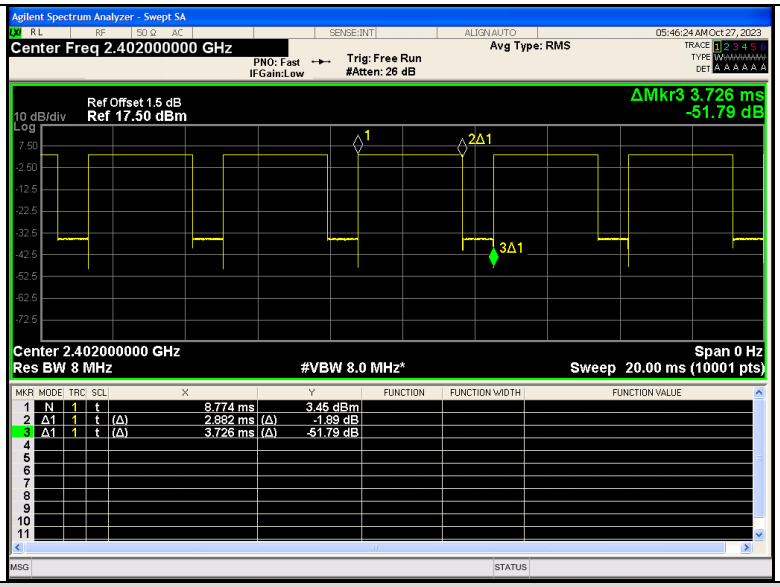
Test Mode

Please refer to the clause 2.4.

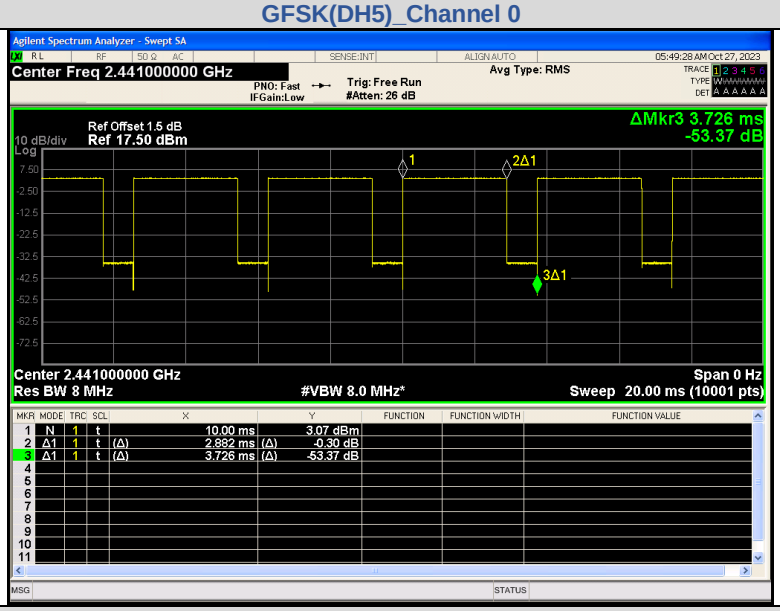
Test Result

Test Mode	Frequency (MHz)	Transmission Duration (ms)	Transmission Period (ms)	Duty Cycle (%)	1/T Minimum VBW (kHz)	Final Setting for VBW (kHz)
GFSK	2402	2.882	3.726	77.35	0.35	1
	2441	2.882	3.726	77.35	0.35	1
	2480	2.884	3.728	77.36	0.35	1
π/4-DQPSK	2402	2.870	3.712	77.30	0.35	1
	2441	2.870	3.712	77.30	0.35	1
	2480	2.890	3.712	77.84	0.35	1
8-DPSK	2402	2.890	3.712	77.84	0.35	1
	2441	2.890	3.712	77.84	0.35	1
	2480	2.890	3.712	77.84	0.35	1

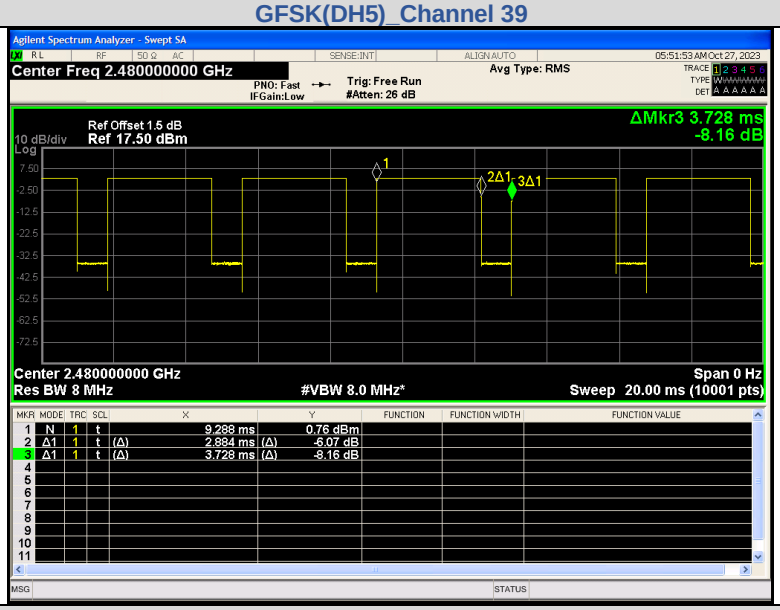
Test plot as follows:



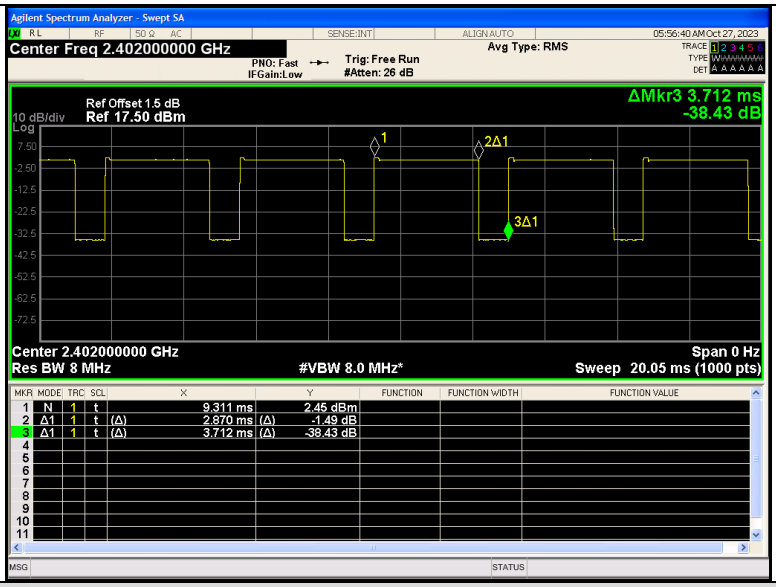
GFSK(DH5)_Channel 0



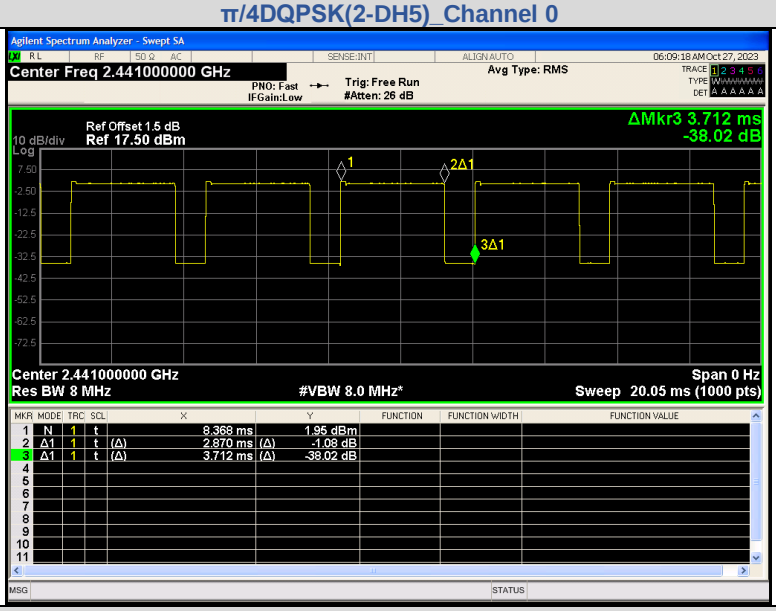
GFSK(DH5)_Channel 39



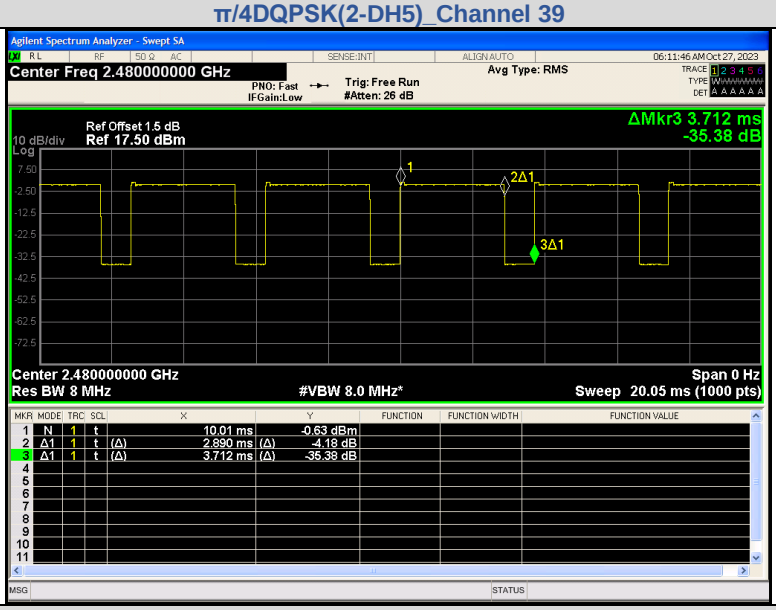
GFSK(DH5)_Channel 78



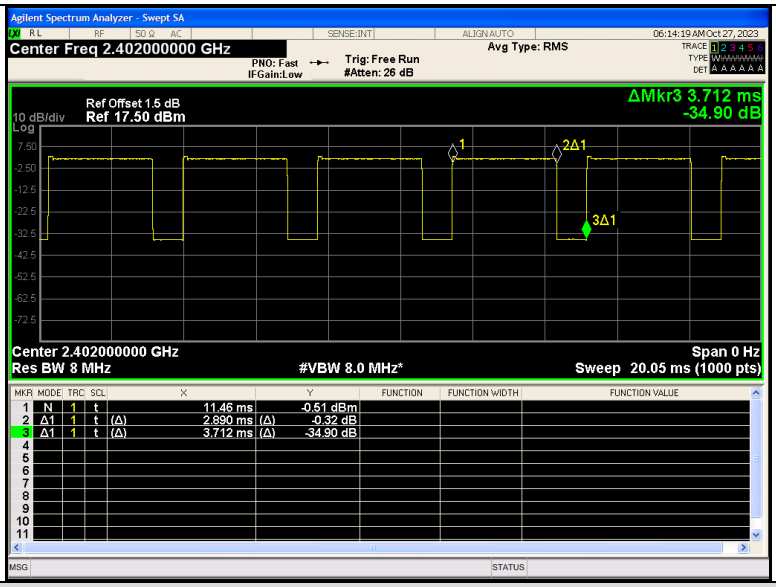
π/4DQPSK(2-DH5)_Channel 0



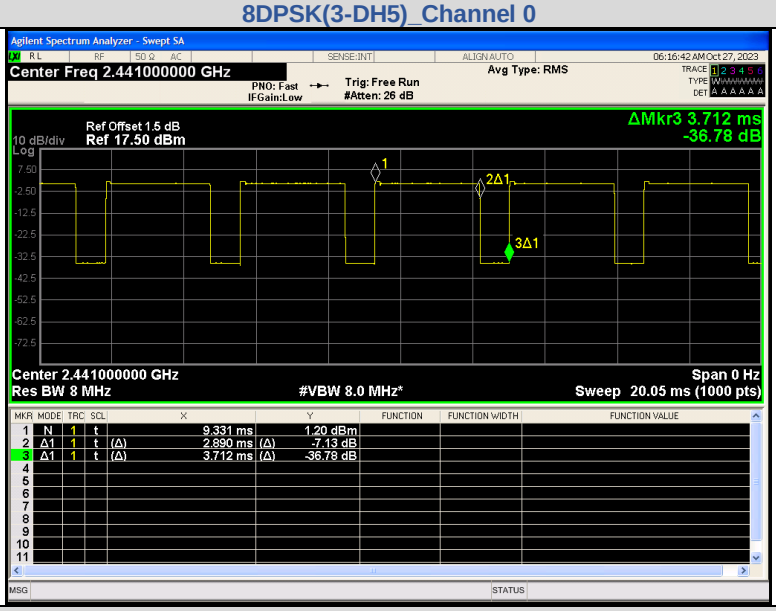
π/4DQPSK(2-DH5)_Channel 39



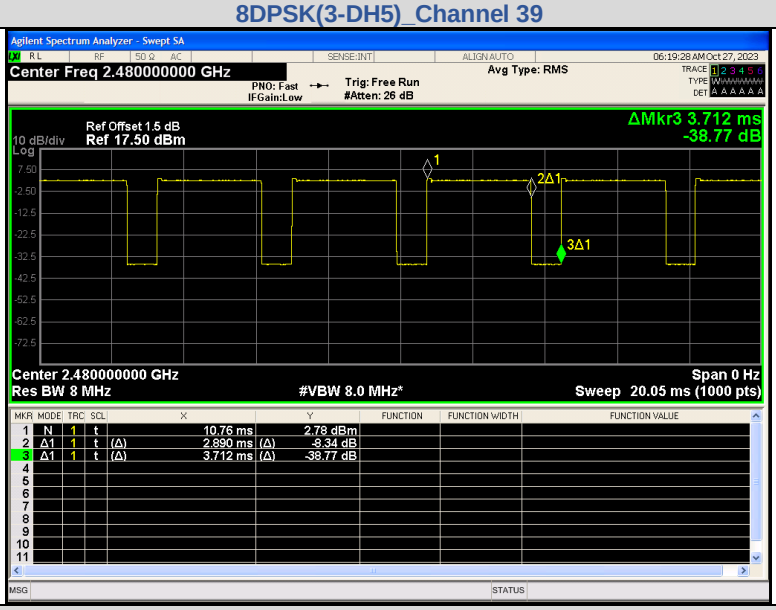
π/4DQPSK(2-DH5)_Channel 78



8DPSK(3-DH5)_Channel 0



8DPSK(3-DH5)_Channel 39



8DPSK(3-DH5)_Channel 78

3.11. Antenna Requirement

Requirement

FCC CFR Title 47 Part 15 Subpart C 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. The use of a permanently attached antenna or of 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.
FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1)(i)
(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.

Test Result

The directional gain of the antenna is less than 6dBi, please refer to the EUT internal photographs antenna photo.

************************THE END*************************