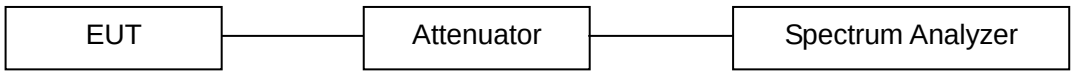
13.3 Channel Separation test

LIMIT

Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

BLOCK DIAGRAM OF TEST SETUP



TEST PROCEDURES

a. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

b. Set to the maximum power setting and enable the EUT transmit continuously.

c. Enable the EUT hopping function.

d. Set spectrum analyzer and perform testing according to ANSI C63.10-2013 clause 7.8.2.

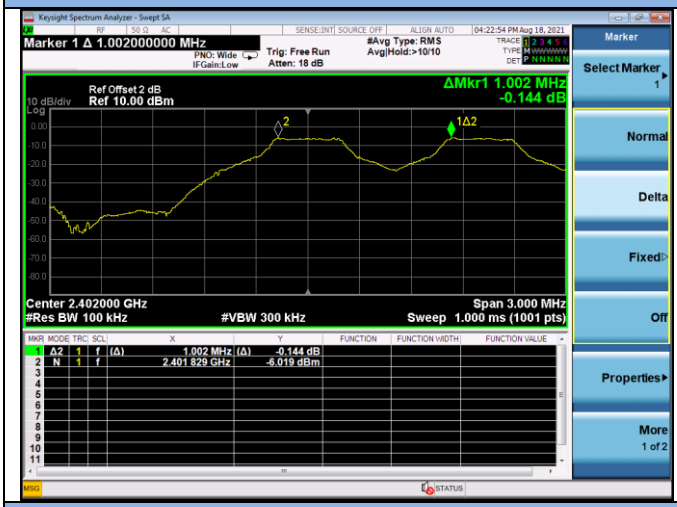
TEST RESULTS

PASS

Please refer to the following table.

Modulation	Channel	Frequency (MHz)	Hopping Separation Measurement (MHz)	Hopping Separation Limit (MHz)	Test Result
GFSK	Low	2402	1.002	>0.689	Pass
	Mid	2441	1.002	>0.693	Pass
	High	2480	1.002	>0.687	Pass
π/4-DQPSK	Low	2402	1.002	>0.910	Pass
	Mid	2441	1.002	>0.911	Pass
	High	2480	1.002	>0.913	Pass
8DPSK	Low	2402	1.002	>0.900	Pass
	Mid	2441	1.002	>0.900	Pass
	High	2480	1.002	>0.901	Pass

GFSK / Low Channel

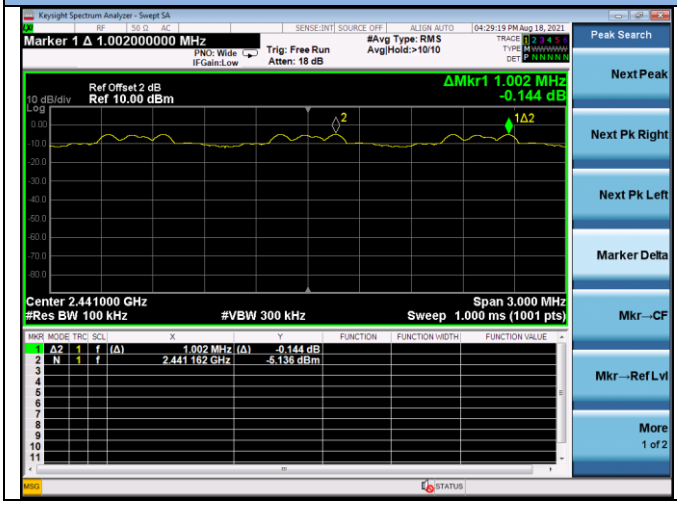


GFSK / Mid Channel

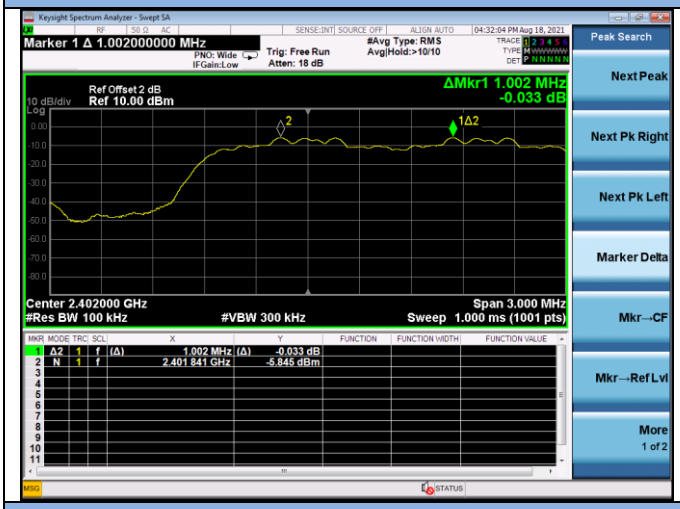
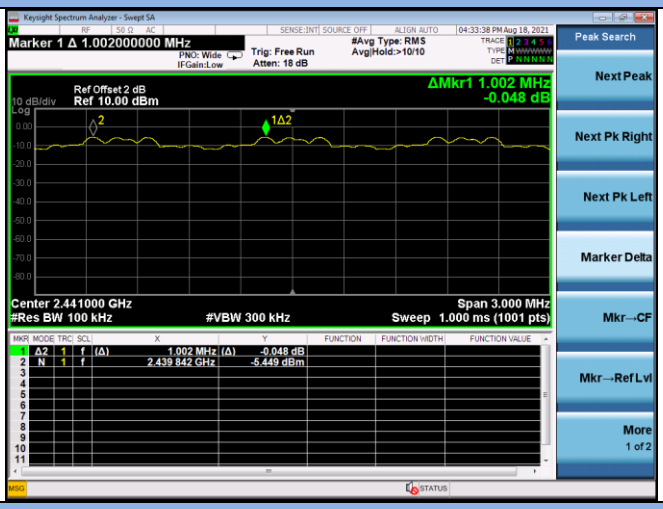
GFSK / High Channel

π/4-DQPSK / Low Channel

π/4-DQPSK / Mid Channel



π/4-DQPSK / High Channel

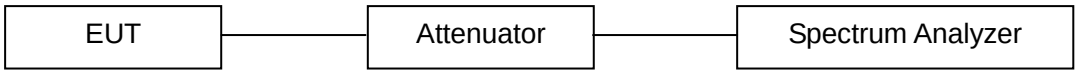
8DPSK / Low Channel	8DPSK / Mid Channel
	
8DPSK / High Channel	**---**
	Blank

13.4 20dB Bandwidth

LIMIT

N/A

BLOCK DIAGRAM OF TEST SETUP



TEST PROCEDURES

a. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

b. Set to the maximum power setting and enable the EUT transmit continuously.

c. Set spectrum analyzer and perform testing according to ANSI C63.10-2013 clause 6.9.2.

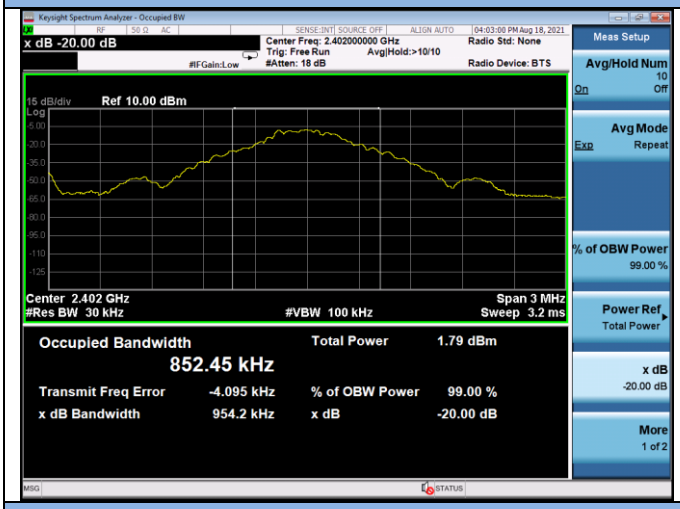
TEST RESULTS

PASS

Please refer to the following table.

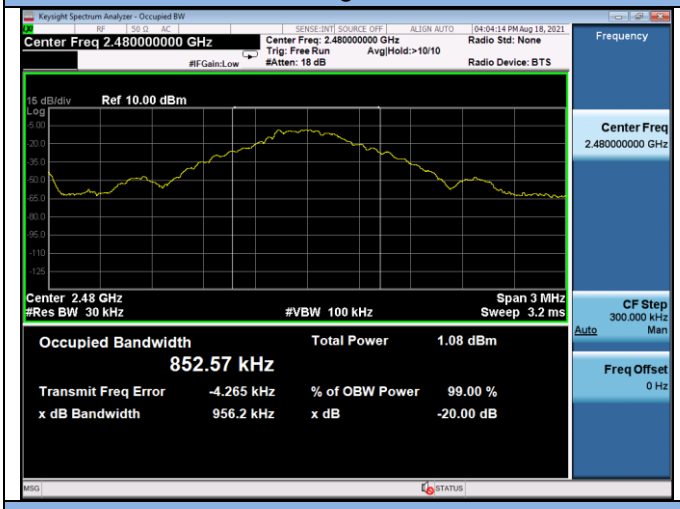
Modulation	Channel	Frequency (MHz)	20dB Measurement (MHz)	Limit (MHz)	Remark
GFSK	Low	2402	0.9542	---	Reporting only
	Mid	2441	0.9561	---	
	High	2480	0.9562	---	
π/4-DQPSK	Low	2402	1.286	---	
	Mid	2441	1.287	---	
	High	2480	1.306	---	
8DPSK	Low	2402	1.301	---	
	Mid	2441	1.303	---	
	High	2480	1.303	---	

GFSK / Low Channel

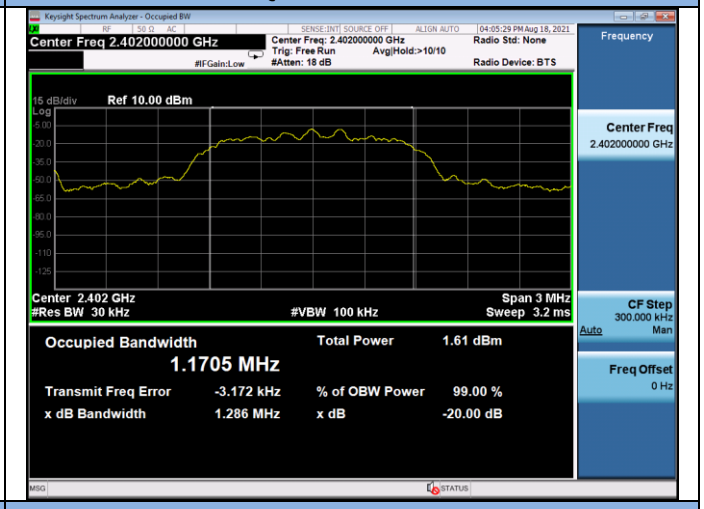


GFSK / Mid Channel

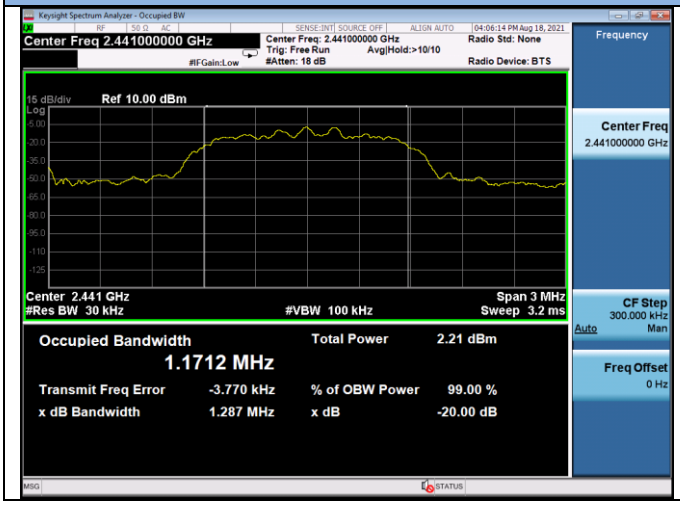
GFSK / High Channel



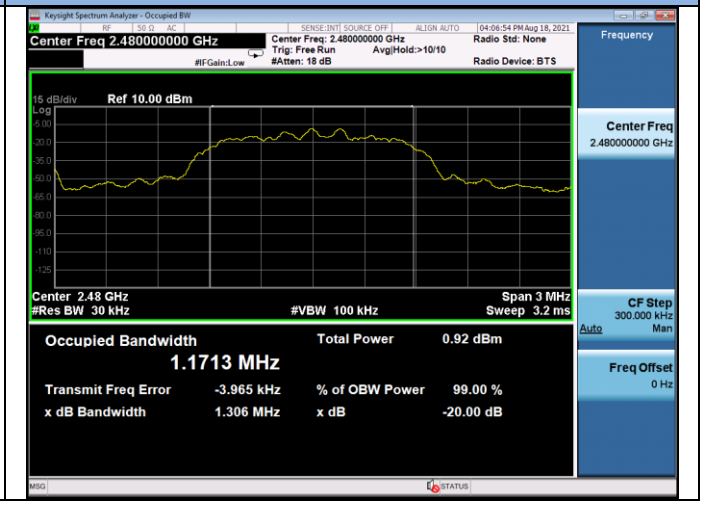
π/4-DQPSK / Low Channel

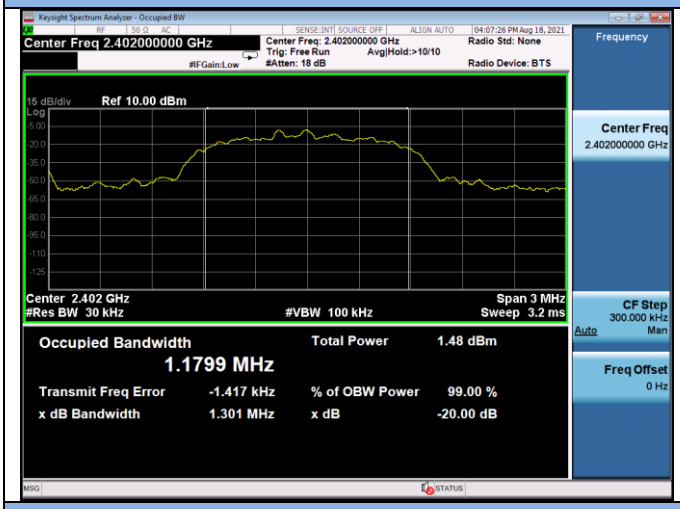
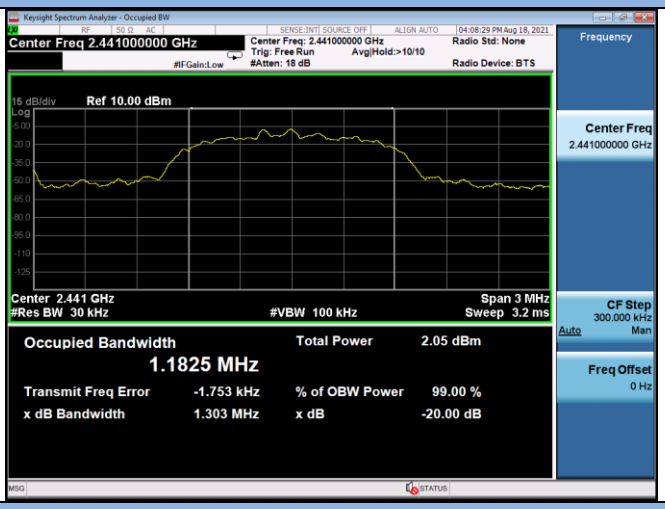


π/4-DQPSK / Mid Channel



π/4-DQPSK / High Channel



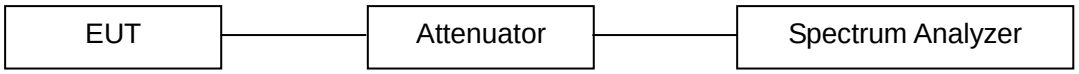
8DPSK / Low Channel	8DPSK / Mid Channel
	
8DPSK / High Channel	**---**
	Blank

13.5 Hopping Channel Number

LIMIT

Frequency hopping systems in the 2400-2483.5MHz band shall use at least 15 channels.

BLOCK DIAGRAM OF TEST SETUP



TEST PROCEDURES

a. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

b. Set to the maximum power setting and enable the EUT transmit continuously.

c. Enable the EUT hopping function.

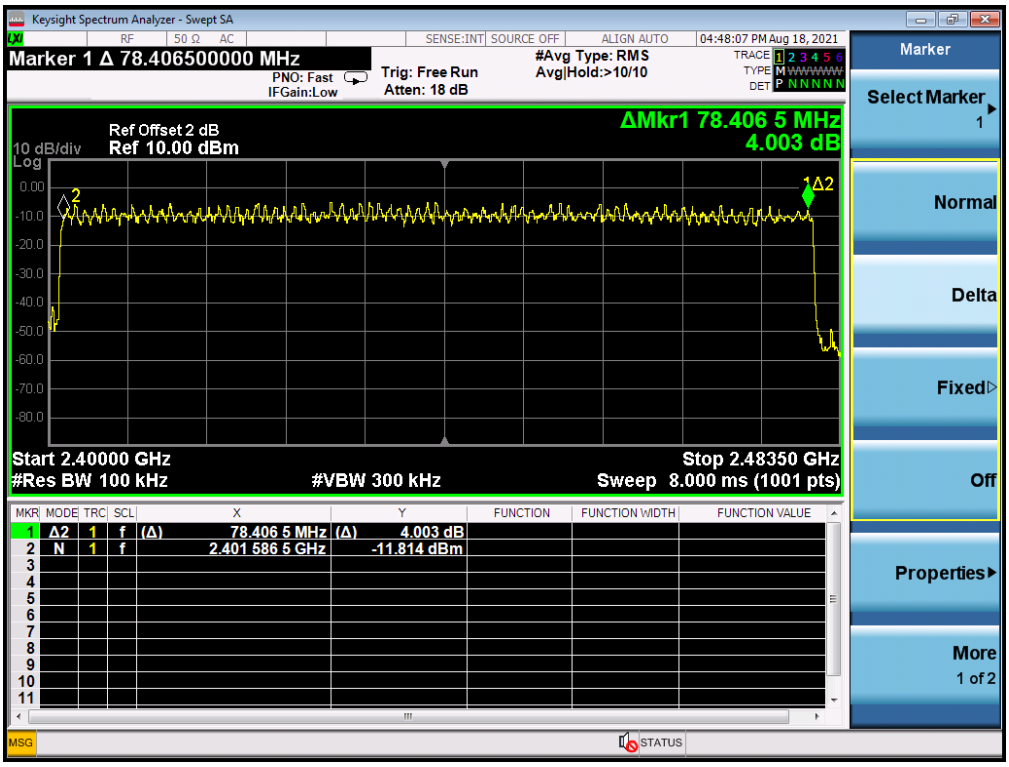
d. Set spectrum analyzer and perform testing according to ANSI C63.10-2013 clause 7.8.3.

TEST RESULTS

PASS

Please refer to the following table.

Modulation	Number of Hopping Channels Measurement	Limit	Test Result
GFSK	79	≥15	PASS
π/4-DQPSK	79	≥15	PASS
8DPSK	79	≥15	PASS
The worst case: 8DPSK			

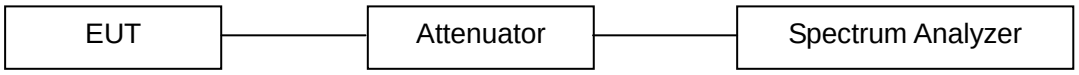


13.6 Time of Occupancy (Dwell Time)

LIMIT

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

BLOCK DIAGRAM OF TEST SETUP



TEST PROCEDURES

a. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

b. Set to the maximum power setting and enable the EUT transmit continuously.

c. Enable the EUT hopping function.

d. Set spectrum analyzer and perform testing according to ANSI C63.10-2013 clause 7.8.4.

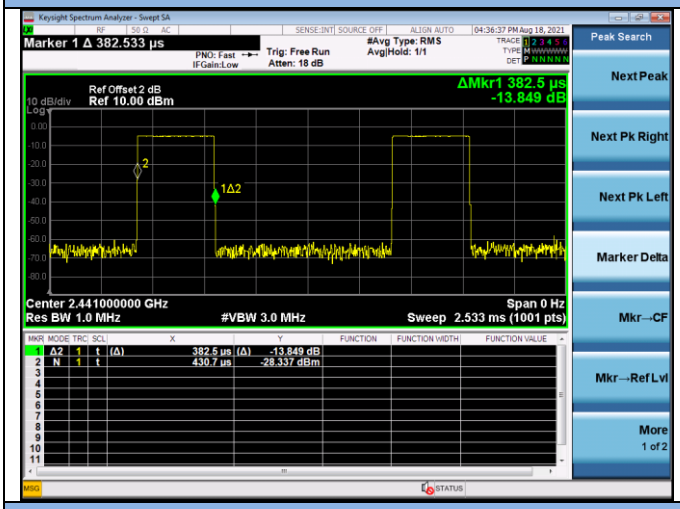
TEST RESULTS

PASS

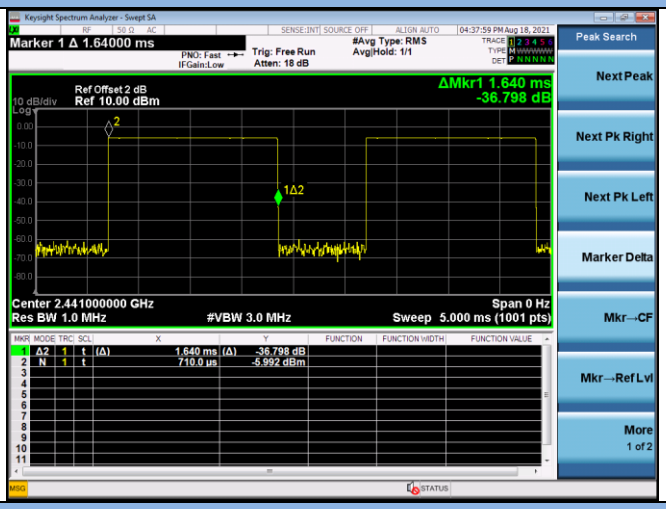
Please refer to the following table.

Modulation	Packet	Frequency (MHz)	Dwell Time Measurement (msec)			Limit (msec)	Test Result
GFSK	DH1	2441	0.3825	(ms)*(1600/(2*79))*31.6=	122.40	400	Pass
	DH3	2441	1.640	(ms)*(1600/(4*79))*31.6=	262.40	400	Pass
	DH5	2441	2.885	(ms)*(1600/(6*79))*31.6=	307.73	400	Pass
π/4-DQPSK	2-DH1	2441	0.3927	(ms)*(1600/(2*79))*31.6=	125.66	400	Pass
	2-DH3	2441	1.650	(ms)*(1600/(4*79))*31.6=	264.00	400	Pass
	2-DH5	2441	2.900	(ms)*(1600/(6*79))*31.6=	309.33	400	Pass
8DPSK	3-DH1	2441	0.3952	(ms)*(1600/(2*79))*31.6=	126.46	400	Pass
	3-DH3	2441	1.645	(ms)*(1600/(4*79))*31.6=	263.20	400	Pass
	3-DH5	2441	2.900	(ms)*(1600/(6*79))*31.6=	309.33	400	Pass

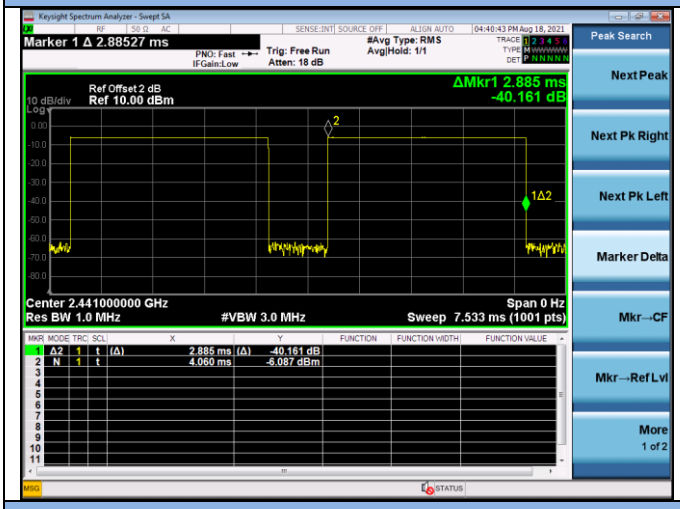
GFSK / DH1



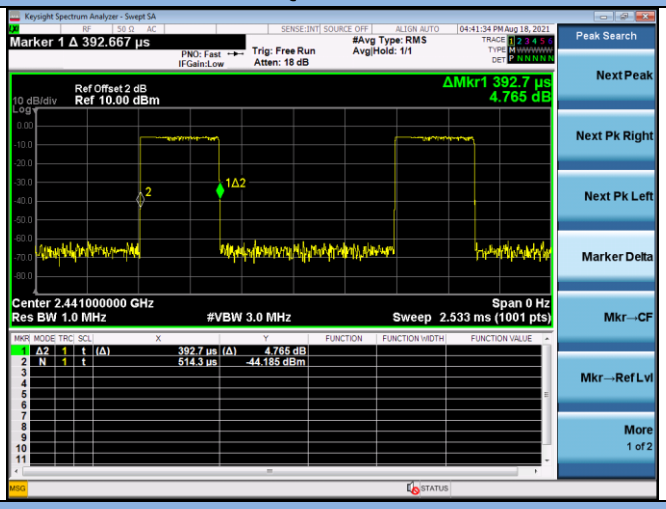
GFSK / DH3



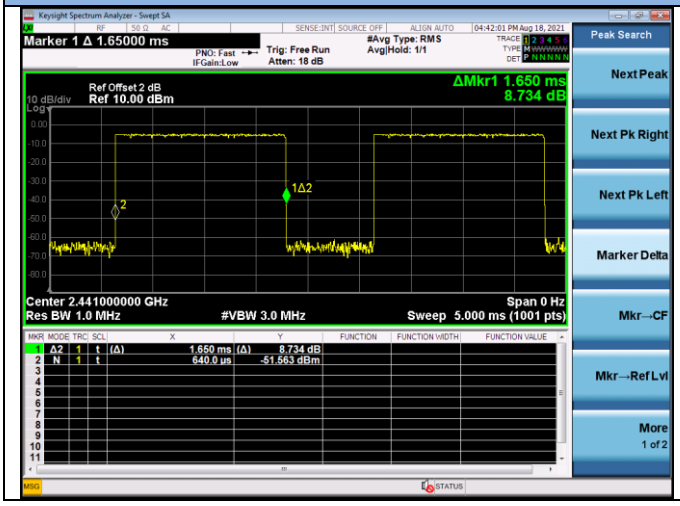
GFSK / DH5



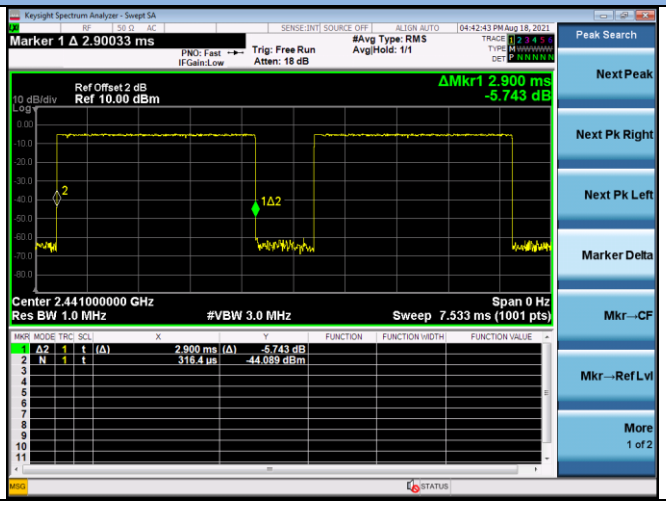
π/4-DQPSK / 2-DH1

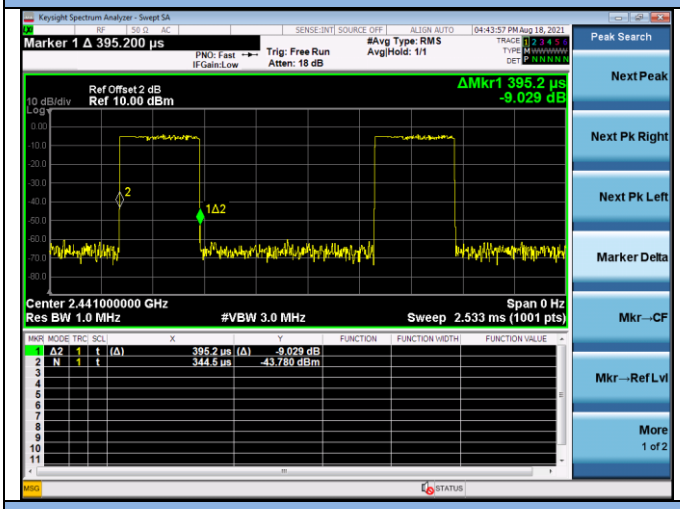


π/4-DQPSK / 2-DH3



π/4-DQPSK / 2-DH5



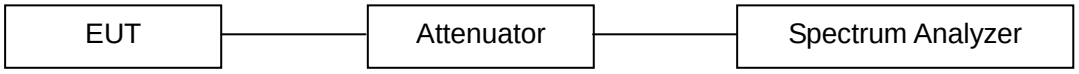
8DPSK / 3-DH1	8DPSK / 3-DH3
	
8DPSK / 3-DH5	**---**
	Blank

13.7 Maximum Peak Output Power

LIMIT

The maximum peak conducted output power of the intentional radiator shall not exceed the following: 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.

BLOCK DIAGRAM OF TEST SETUP



TEST PROCEDURES

a. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

b. Set to the maximum power setting and enable the EUT transmit continuously.

c. Set spectrum analyzer and perform testing according to ANSI C63.10-2013 clause 7.8.5.

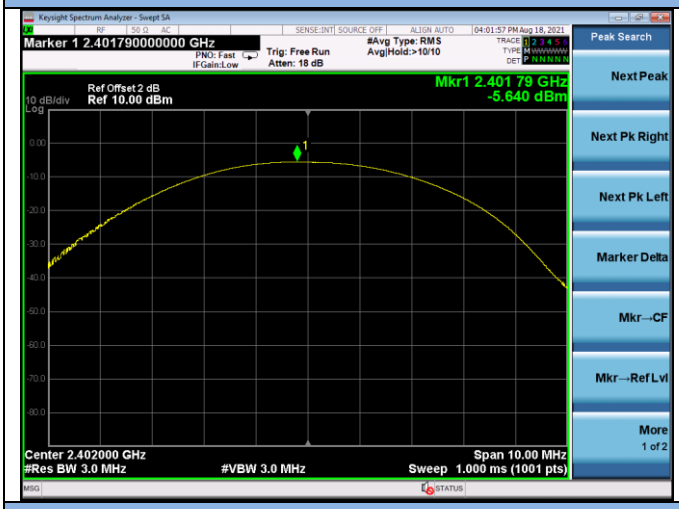
TEST RESULTS

PASS

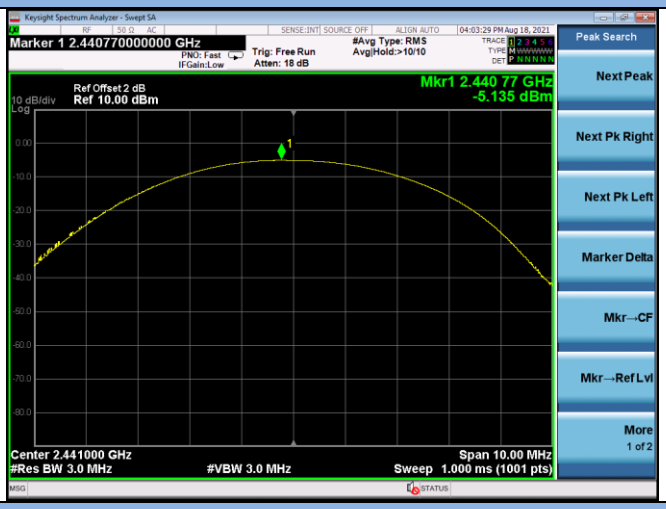
Please refer to the following table.

Modulation	Frequency (MHz)	Peak Power output Measurement (dBm)	Peak Power output Measurement (mW)	Peak Power Limit (dBm)	Test Result
GFSK	2402.00	-5.640	0.27	20.97	Pass
	2441.00	-5.135	0.31	20.97	Pass
	2480.00	-6.299	0.23	20.97	Pass
π/4-DQPSK	2402.00	-4.842	0.33	20.97	Pass
	2441.00	-4.294	0.37	20.97	Pass
	2480.00	-5.480	0.28	20.97	Pass
8DPSK	2402.00	-4.492	0.36	20.97	Pass
	2441.00	-3.950	0.40	20.97	Pass
	2480.00	-5.282	0.30	20.97	Pass

GFSK / Low Channel

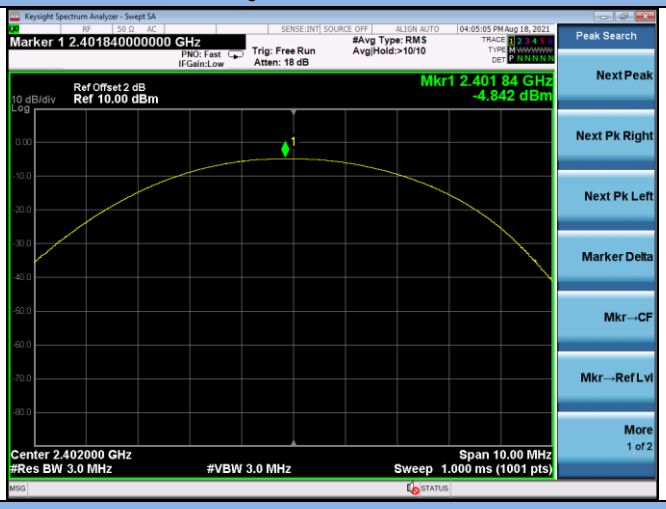


GFSK / Mid Channel

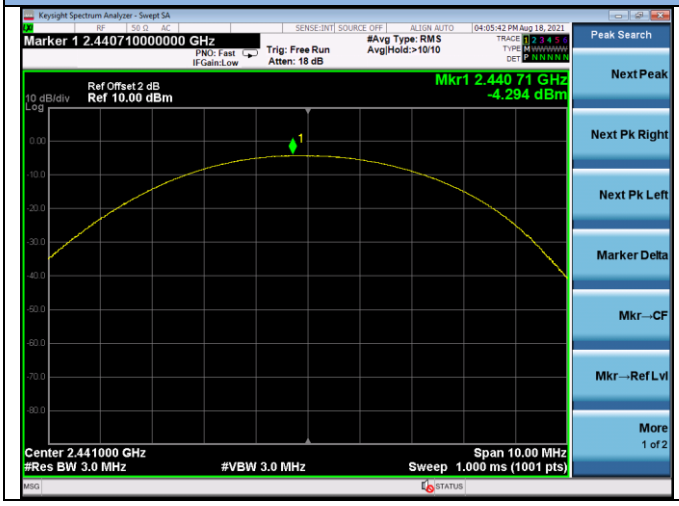


GFSK / High Channel

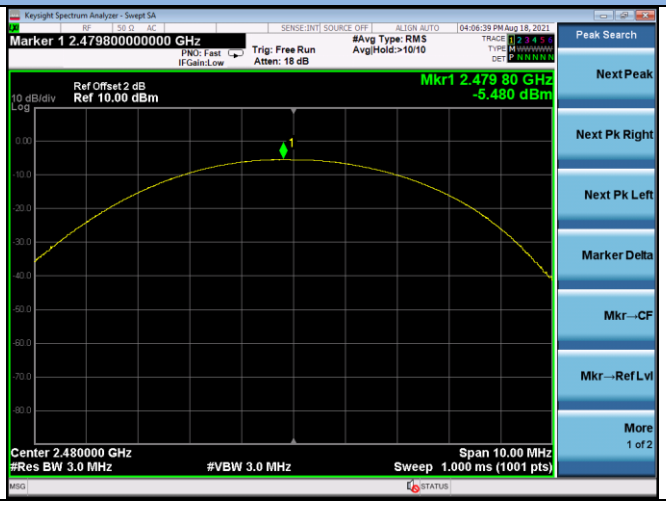
π/4-DQPSK / Low Channel

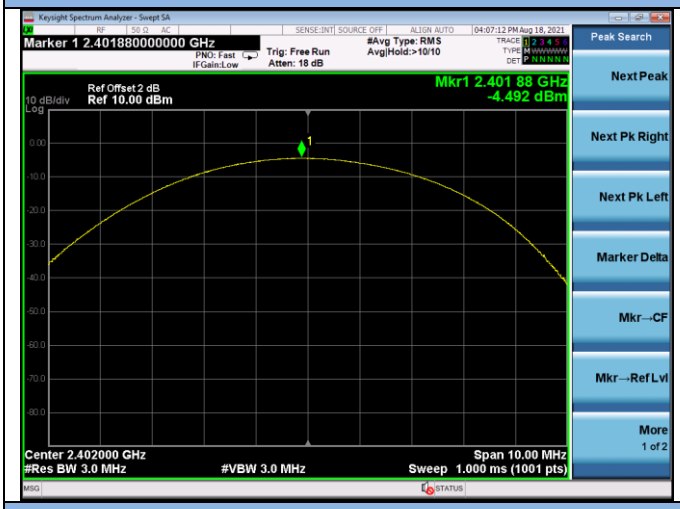
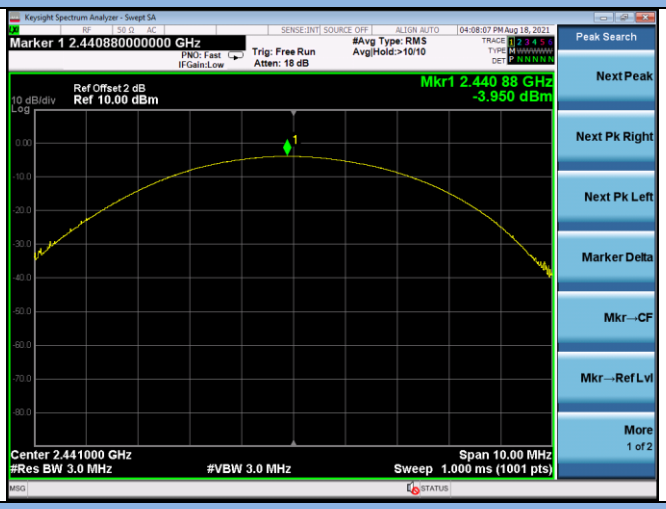
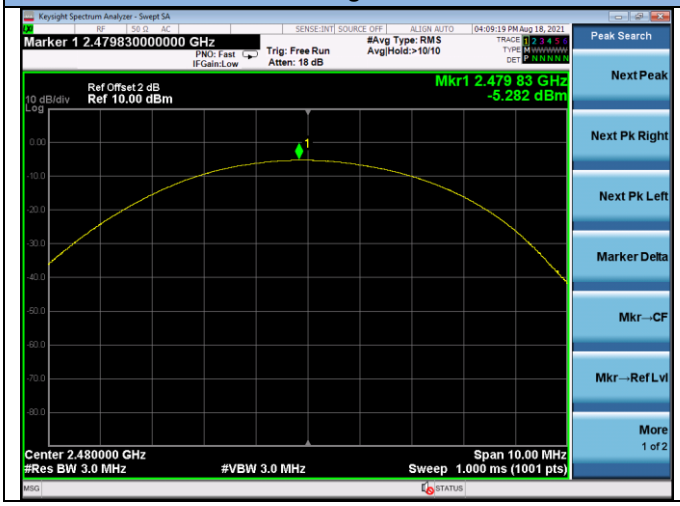


π/4-DQPSK / Mid Channel



π/4-DQPSK / High Channel



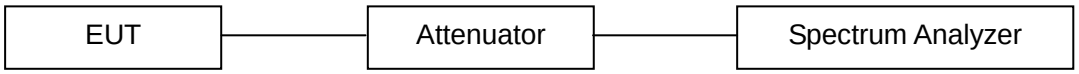
8DPSK / Low Channel	8DPSK / Mid Channel
	
8DPSK / High Channel	**---**
	Blank

13.8 Band Edge Conducted Spurious Emission Measurement

LIMIT

In any 100KHz 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 20dB below that in the 100KHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

BLOCK DIAGRAM OF TEST SETUP



TEST PROCEDURES

a. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

b. Set to the maximum power setting and enable the EUT transmit continuously.

c. Set spectrum analyzer and perform testing according to ANSI C63.10-2013 clause 7.8.6 and 6.10.

d. Enable hopping function of the EUT and then repeat steps above.

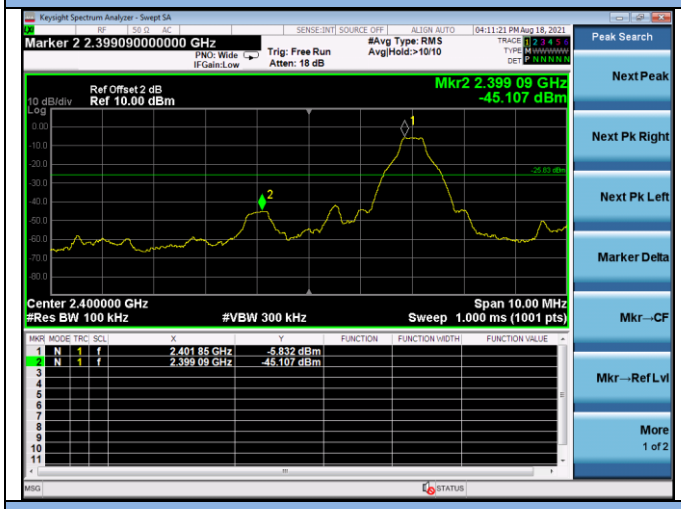
TEST RESULTS

PASS

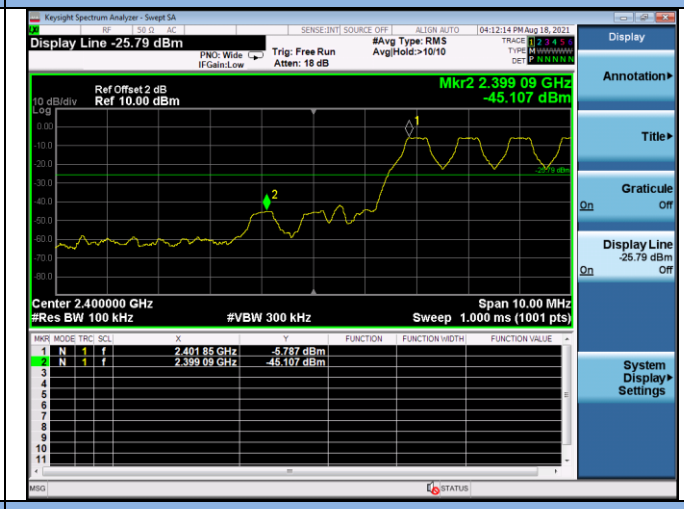
Please refer to the following test plots.

Band Edge

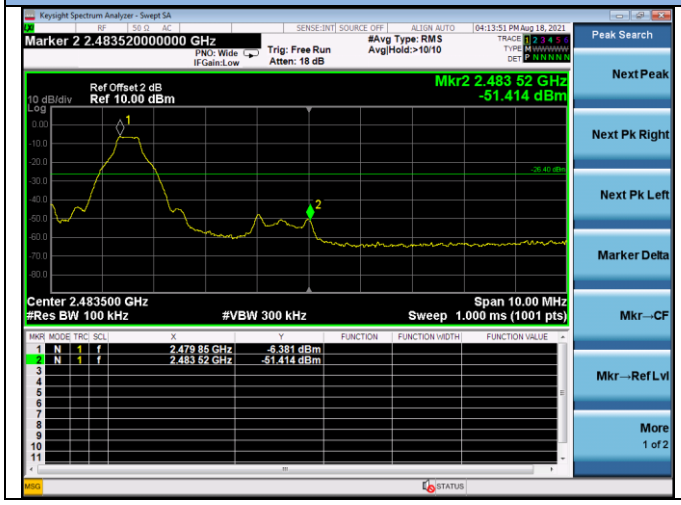
GFSK / Low / 2402



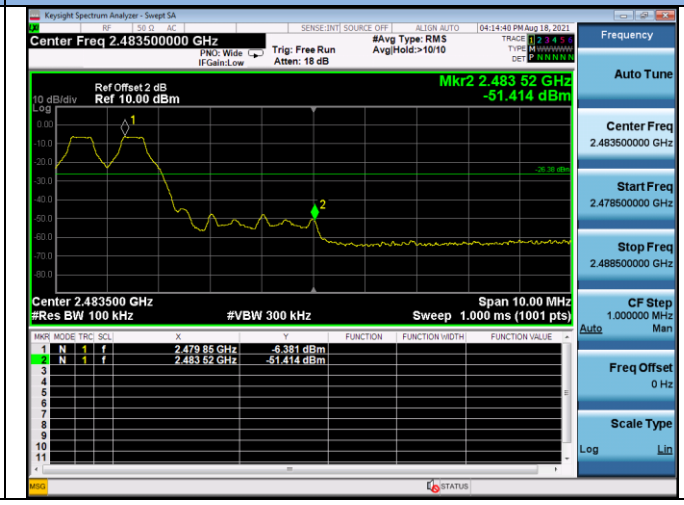
GFSK / Hopping



GFSK / High Channel / 2480



GFSK / Hopping

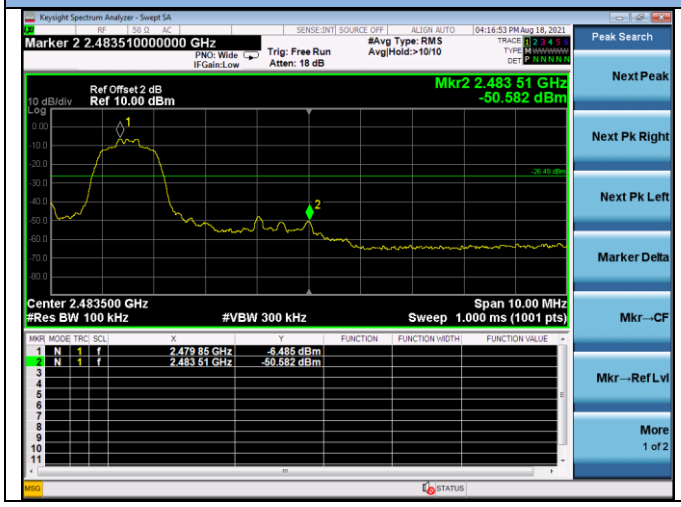


Band Edge

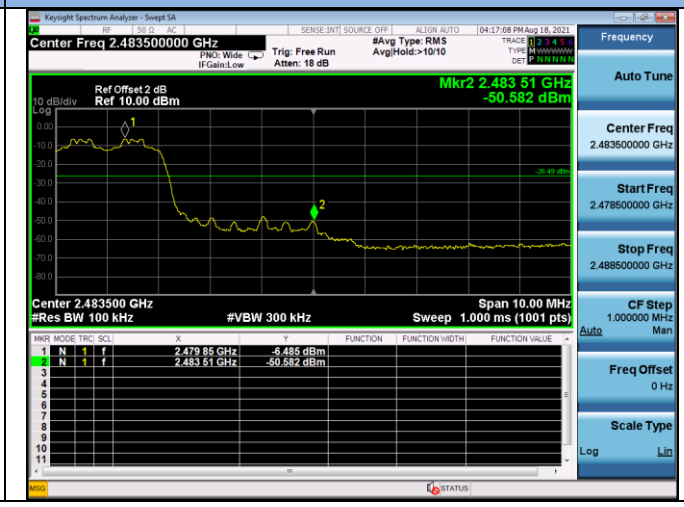
π/4-DQPSK / Low / 2402

π/4-DQPSK / Hopping

π/4-DQPSK / High / 2480



π/4-DQPSK / Hopping

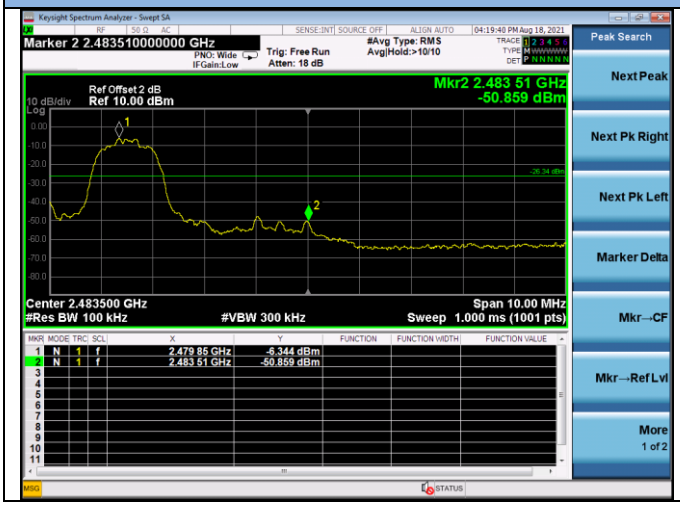


Band Edge

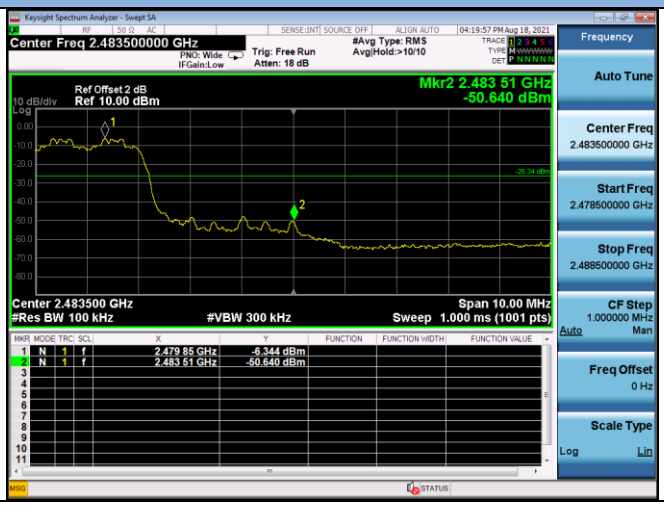
8DPSK / Low / 2402

8DPSK / Hopping

8DPSK / High / 2480

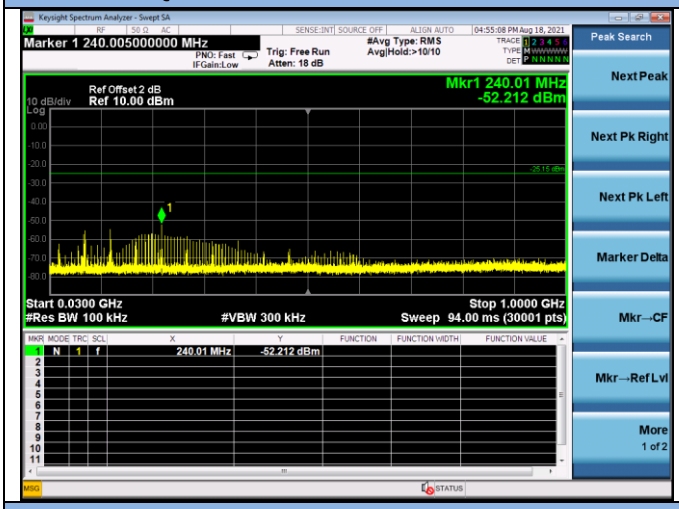


8DPSK / Hopping

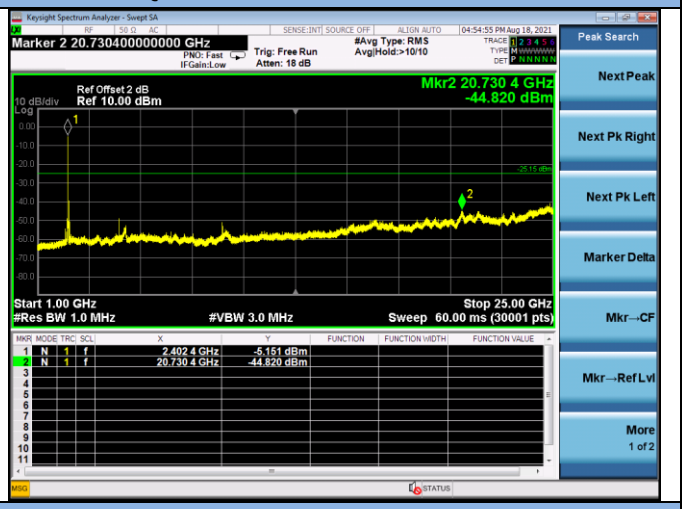


Conducted Spurious Emission (the worst case)

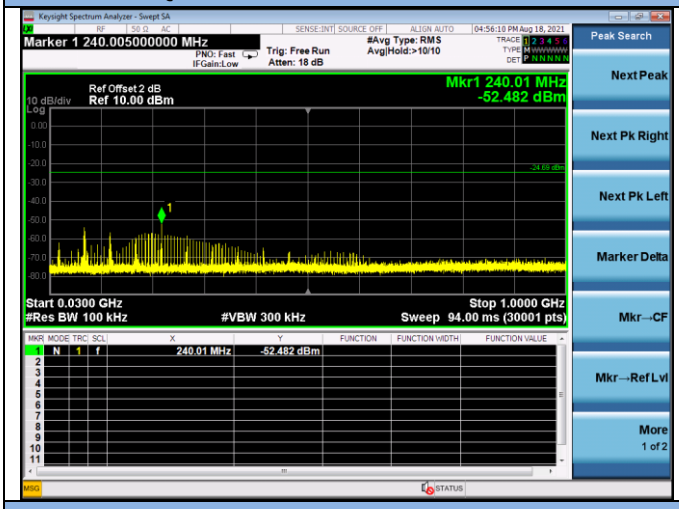
π/4-DQPSK / Low Channel / 30MHz~1GHz



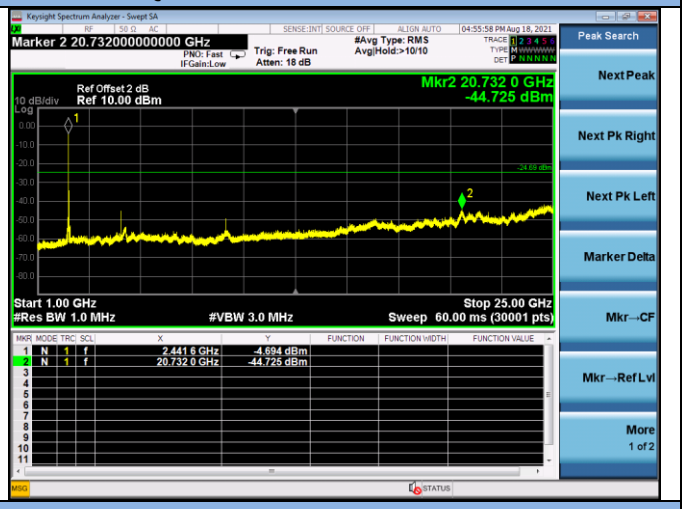
π/4-DQPSK / Low Channel / 1GHz~25GHz



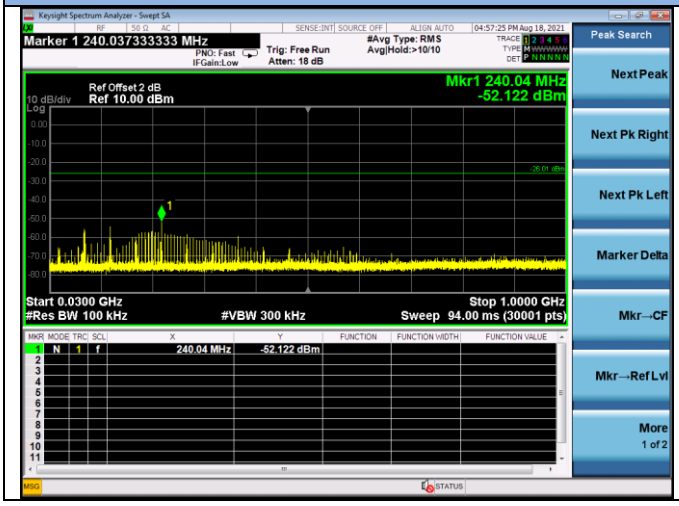
π/4-DQPSK / Mid Channel / 30MHz~1GHz



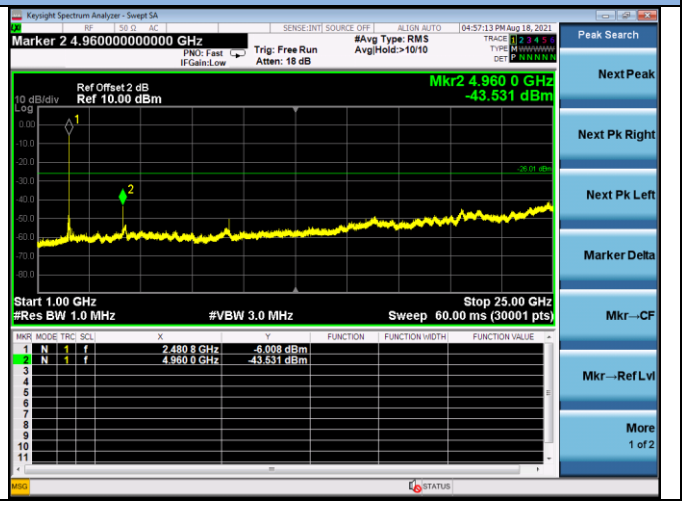
π/4-DQPSK / Mid Channel / 1GHz~25GHz



π/4-DQPSK / High Channel / 30MHz~1GHz



π/4-DQPSK / High Channel / 1GHz~25GHz



13.9 Antenna Requirement

STANDARD APPLICABLE

According to of FCC part 15C section 15.203 and 15.204:

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.

Systems operating in the 2400-2483.5MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

ANTENNA CONNECTED CONSTRUCTION

The antenna is PCB antenna that no antenna other than furnished by the responsible party shall be used with the device, and the best case gain of the antenna is -0.68 dBi, Therefore, the antenna is consider meet the requirement.

14. Test Equipment List

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Test Receiver	Rohde & Schwarz	ESCI7	100837	Mar. 13, 2021	1 Year
2.	Antenna	Schwarzbeck	VULB9162	9162-010	Mar. 23, 2021	1 Year
3.	Spectrum Analyzer	Rohde & Schwarz	FSU26	200409/026	Mar. 13, 2021	1 Year
4.	Spectrum Analyzer	Keysight	N9020A	MY54200831	Mar. 13, 2021	1 Year
5.	Spectrum Analyzer	Rohde & Schwarz	FSV40	101094	Mar. 13, 2021	1 Year
6.	Horn Antenna	Schwarzbeck	BBHA9170	9170-172	Mar. 23, 2021	2 Year
7.	Power Sensor	DARE	RPR3006W	15I00041SNO64	Mar. 13, 2021	1 Year
8.	Horn Antenna	COM-Power	AH-118	071078	Mar. 23, 2021	1 Year
9.	Pre-Amplifier	HP	HP 8449B	3008A00964	Mar. 13, 2021	1 Year
10.	Pre-Amplifier	HP	HP 8447D	1145A00203	Mar. 13, 2021	1 Year
11.	Loop Antenna	Schwarzbeck	FMZB 1513	1513-272	Mar. 23, 2021	1 Year
12.	Test Receiver	Rohde & Schwarz	ESCI	101152	Mar. 13, 2021	1 Year
13.	L.I.S.N	Rohde & Schwarz	ENV 216	101317	Mar. 13, 2021	1 Year
14.	RF Switching Unit	Compliance Direction Systems Inc.	RSU-M2	38311	Mar.13, 2021	1 Year
15.	Temporary antenna connector	TESCOM	SS402	N/A	N/A	N/A
16.	Test Software	EZ	EZ_EMC	N/A	N/A	N/A

Note: For photographs of EUT and measurement, please refer to appendix in separate documents.

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