

FCC TEST REPORT

FCC ID: L76-PORTAPRO2P0

Report No. : SSP24050269-1E

Applicant : Koss Corporation

Product Name : Bluetooth Headset

Model Name : Porta Pro Wireless 2.0

Test Standard : FCC Part 15.247

Date of Issue : 2024-08-03



Shenzhen CCUT Quality Technology Co., Ltd.

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This test report is limited to the above client company and the product model only. It may not be duplicated without prior permitted by Shenzhen CCUT Quality Technology Co., Ltd.

Test Report Basic Information

Applicant:	Koss Corporation 4129 N. Port Washington Avenue, Milwaukee, Wisconsin 53212, United States
Address of Applicant:	States
Manufacturer:	Koss Corporation 4129 N. Port Washington Avenue, Milwaukee, Wisconsin 53212, United States
Address of Manufacturer:	States
Product Name:	Bluetooth Headset
Brand Name:	KOSS
Main Model:	Porta Pro Wireless 2.0
Series Models:	-
Test Standard:	FCC Part 15 Subpart C ANSI C63.4-2014 ANSI C63.10-2013
Date of Test	2024-05-31 to 2024-07-16
Test Result:	PASS
Tested By	<u>Colin Chen</u> (Colin Chen)
Reviewed By:	<u>Lieber Ouyang</u> (Lieber Ouyang)
Authorized Signatory:	<u>Lahm Peng</u> (Lahm Peng)
<p>Note : This test report is limited to the above client company and the product model only. It may not be duplicated without prior permitted by Shenzhen CCUT Quality Technology Co., Ltd.. All test data presented in this test report is only applicable to presented test sample.</p>	



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Revision History

Revision	Issue Date	Description	Revised By
V1.0	2024-08-03	Initial Release	Lahm Peng

1. General Information

1.1 Product Information

Product Name:	Bluetooth Headset
Trade Name:	KOSS
Main Model:	Porta Pro Wireless 2.0
Series Models:	-
Rated Voltage:	DC 3.7V by battery, USB 5V charging
Battery:	DC3.7V, 100mAh
Test Sample No:	SSP24050269-1
Hardware Version:	PPWV2-V6
Software Version:	V2
Note 1: The test data is gathered from a production sample, provided by the manufacturer.	

Wireless Specification	
Wireless Standard:	Bluetooth BR/EDR
Operating Frequency:	2402MHz ~ 2480MHz
RF Output Power:	-2.45dBm
Number of Channel:	79
Channel Separation:	1MHz
Modulation:	GFSK, Pi/4 DQPSK, 8DPSK
Antenna Gain:	1.75dBi
Type of Antenna:	SMD Antenna
Type of Device:	<input checked="" type="checkbox"/> Portable Device <input type="checkbox"/> Mobile Device <input type="checkbox"/> Modular Device

1.2 Test Setup Information

List of Test Modes			
Test Mode	Description	Remark	
TM1	Lowest Channel	2402MHz(DH5/2DH5/3DH5)	
TM2	Middle Channel	2441MHz(DH5/2DH5/3DH5)	
TM3	Highest Channel	2480MHz(DH5/2DH5/3DH5)	
TM4	Hopping	2402MHz~2480MHz	
TM5	Charging	AC 120V/60Hz	
List and Details of Auxiliary Cable			
Description	Length (cm)	Shielded/Unshielded	With/Without Ferrite
-	-	-	-
-	-	-	-
List and Details of Auxiliary Equipment			
Description	Manufacturer	Model	Serial Number
Adapter	Huawei	HW-100225C00	HC78E2N6A23645
-	-	-	-

List of Channels							
No. of Channel	Frequency (MHz)	No. of Channel	Frequency (MHz)	No. of Channel	Frequency (MHz)	No. of Channel	Frequency (MHz)
01	2402	21	2422	41	2442	61	2462
02	2403	22	2423	42	2443	62	2463
03	2404	23	2424	43	2444	63	2464
04	2405	24	2425	44	2445	64	2465
05	2406	25	2426	45	2446	65	2466
~	~	~	~	~	~	~	~
16	2417	36	2437	56	2457	76	2477
17	2418	37	2438	57	2458	77	2478
18	2419	38	2439	58	2459	78	2479
19	2420	39	2440	59	2460	79	2480
20	2421	40	2441	60	2461		

1.3 Compliance Standards

Compliance Standards	
FCC Part 15 Subpart C	FEDERAL COMMUNICATIONS COMMISSION, RADIO FREQUENCY DEVICES, Intentional Radiators
All measurements contained in this report were conducted with all above standards	
According to standards for test methodology	
FCC Part 15 Subpart C	FEDERAL COMMUNICATIONS COMMISSION, RADIO FREQUENCY DEVICES, Intentional Radiators
ANSI C63.4-2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Maintenance of compliance is the responsibility of the manufacturer or applicant. Any modification of the product, which result is lowering the emission, should be checked to ensure compliance has been maintained.	

1.4 Test Facilities

Laboratory Name:	Shenzhen CCUT Quality Technology Co., Ltd. 1F, Building 35, Changxing Technology Industrial Park, Yutang Street, Guangming District, Shenzhen, Guangdong, China
CNAS Laboratory No.:	L18863
A2LA Certificate No.:	6893.01
FCC Registration No:	583813
ISED Registration No.:	CN0164
All measurement facilities used to collect the measurement data are located at 1F, Building 35, Changxing Technology Industrial Park, Yutang Street, Guangming District, Shenzhen, Guangdong, China.	

1.5 List of Measurement Instruments

Description	Manufacturer	Model	Serial Number	Cal. Date	Due. Date
Conducted Emissions					
AMN	ROHDE&SCHWARZ	ENV216	101097	2023-10-21	2024-10-20
EMI Test Receiver	ROHDE&SCHWARZ	ESPI	100242	2023-07-31	2024-07-30
Test Cable	N/A	Cable 5	N/A	2023-07-31	2024-07-30
EMI Test Software	FARA	EZ-EMC	EMEC-3A1+	N/A	N/A
Radiated Emissions					
EMI Test Receiver	ROHDE&SCHWARZ	ESPI	100154	2023-07-31	2024-07-30
Spectrum Analyzer	KEYSIGHT	N9020A	MY48030972	2023-07-31	2024-07-30
Spectrum Analyzer	ROHDE&SCHWARZ	FSV40-N	101692	2023-07-31	2024-07-30
Amplifier	SCHWARZBECK	BBV 9743B	00251	2023-07-31	2024-07-30
Amplifier	HUABO	YXL0518-2.5-45	--	2023-07-31	2024-07-30
Amplifier	COM-MW	DLAN-18G-4G-02	10229104	2023-07-31	2024-07-30
Loop Antenna	DAZE	ZN30900C	21104	2023-08-07	2024-08-06
Broadband Antenna	SCHWARZBECK	VULB 9168	01320	2023-08-07	2024-08-06
Horn Antenna	SCHWARZBECK	BBHA 9120D	02553	2023-08-07	2024-08-06
Horn Antenna	COM-MW	ZLB7-18-40G-950	12221225	2023-08-07	2024-08-06
Attenuator	QUANJUDA	6dB	220731	2023-08-07	2024-08-06
Test Cable	N/A	Cable 1	N/A	2023-07-31	2024-07-30
Test Cable	N/A	Cable 2	N/A	2023-07-31	2024-07-30
Test Cable	N/A	Cable 3	N/A	2023-07-31	2024-07-30
Test Cable	N/A	Cable 4	N/A	2023-07-31	2024-07-30
Test Cable	N/A	Cable 8	N/A	2023-07-31	2024-07-30
Test Cable	N/A	Cable 9	N/A	2023-07-31	2024-07-30
EMI Test Software	FARA	EZ-EMC	FA-03A2 RE+	N/A	N/A
Conducted RF Testing					
RF Test System	MWRFTTest	MW100-RFCB	220418SQS-37	2023-07-31	2024-07-30
Spectrum Analyzer	KEYSIGHT	N9020A	ATO-90521	2023-07-31	2024-07-30
RF Test Software	MWRFTTest	MTS 8310	N/A	N/A	N/A
Laptop	Lenovo	ThlnkPad E15 Gen 3	SPPOZ22485	N/A	N/A
DUT Test Software	Bekencorp	BK32xx RF Test	V1.8.2	N/A	N/A

1.6 Measurement Uncertainty

Test Item	Conditions	Uncertainty
Conducted Emissions	9kHz ~ 30MHz	±1.64 dB
Radiated Emissions	9kHz ~ 30MHz	±2.88 dB
	30MHz ~ 1GHz	±3.32 dB
	1GHz ~ 18GHz	±3.50 dB
	18GHz ~ 40GHz	±3.66 dB
Conducted Output Power	9kHz ~ 26GHz	±0.50 dB
Occupied Bandwidth	9kHz ~ 26GHz	±4.0 %
Conducted Spurious Emission	9kHz ~ 26GHz	±1.32 dB

2. Summary of Test Results

FCC Rule	Description of Test Item	Result
FCC Part 15.203	Antenna Requirement	Passed
FCC Part 15.247(i)	RF Exposure(see the RF exposure report)	Passed
FCC Part 15.207	Conducted Emissions	Passed
FCC Part 15.209, 15.247(d)	Radiated Emissions	Passed
FCC Part 15.247(d)	Band-edge Emissions(Radiated)	Passed
FCC Part 15.247(a)(1), (g), (h)	Frequency Hopping System	Passed
FCC Part 15.247(a)(1)(iii)	Dwell Time	Passed
FCC Part 15.247(b)(1)	Maximum Peak Conducted Output Power	Passed
FCC Part 15.215(c)	Occupied Bandwidth(-20dB)	Passed
FCC Part 15.247(a)(1)	Carrier Frequencies Separation	Passed
FCC Part 15.247(a)(1)(iii)	Number of Hopping Channel	Passed
FCC Part 15.247(d)	Band-edge Emissions(Conducted)	Passed
FCC Part 15.247(d)	Conducted RF Spurious Emissions	Passed
Passed: The EUT complies with the essential requirements in the standard Failed: The EUT does not comply with the essential requirements in the standard N/A: Not applicable		

3. Antenna Requirement

3.1 Standard and Limit

According to FCC Part 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 an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

3.2 Test Result

This product has an SMD antenna, fulfill the requirement of this section.

4. Conducted Emissions

4.1 Standard and Limit

According to the rule FCC Part 15.207, Conducted emissions limit, the limit for a wireless device as below:

Frequency of Emission (MHz)	Conducted emissions (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50

Note 1: Decreases with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz
 Note 2: The lower limit applies at the band edges

4.2 Test Procedure

Test is conducting under the description of ANSI C63.10 - 2013 section 6.2.



Test Setup Block Diagram

a) The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

b) The following is the setting of the receiver

Attenuation: 10dB

Start Frequency: 0.15MHz

Stop Frequency: 30MHz

IF Bandwidth: 9kHz

c) The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipment powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

d) Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

e) I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

f) LISN is at least 80 cm from nearest part of EUT chassis.

g) For the actual test configuration, please refer to the related Item - photographs of the test setup.

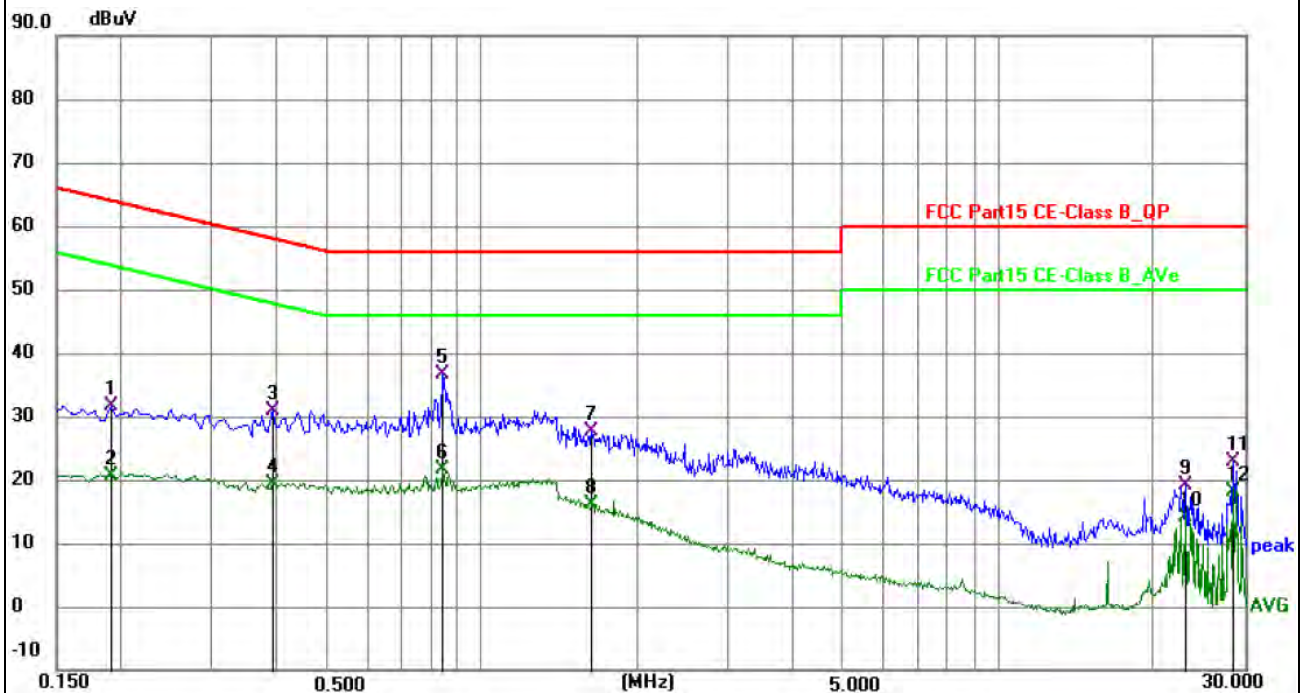
4.3 Test Data and Results

Based on all tested data, the EUT complied with the FCC Part 15.207 standard limit for a wireless device, and with the worst case as below:

Remark: Level = Reading + Factor, Margin = Level - Limit

Test Plots and Data of Conducted Emissions

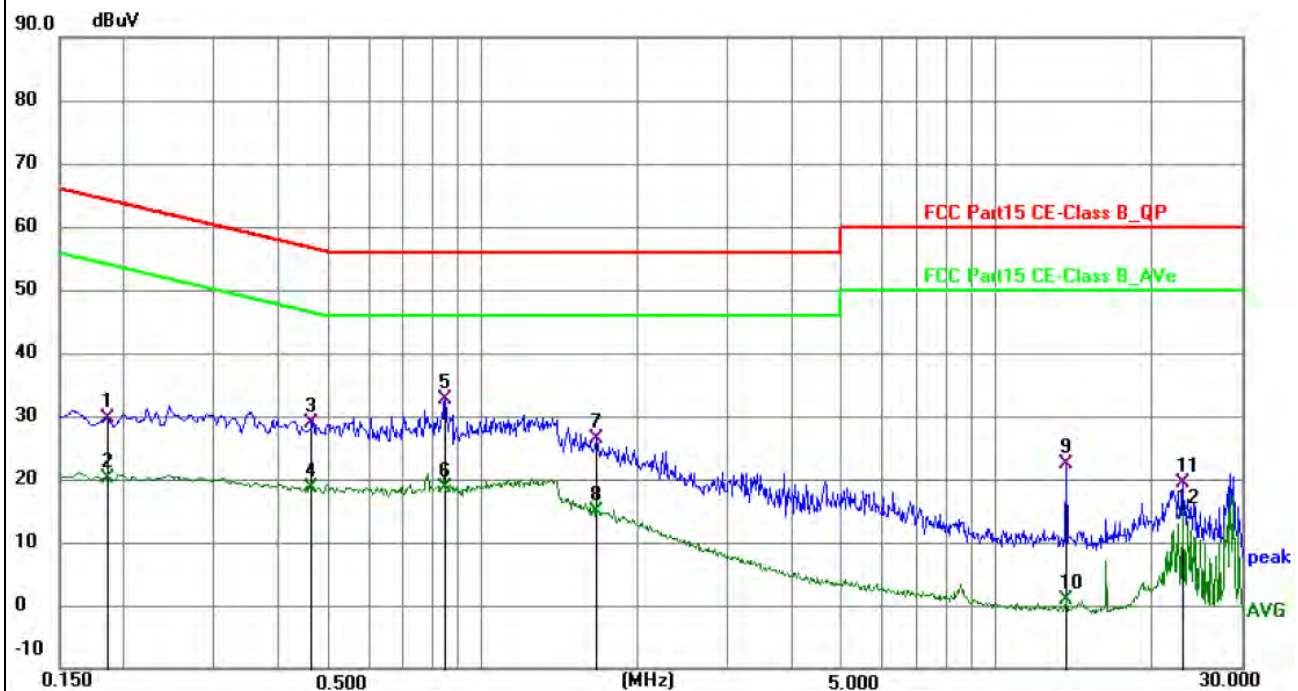
Tested Mode:	TM5
Test Voltage:	AC 120V/60Hz
Test Power Line:	Neutral
Remark:	



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.1905	22.11	9.44	31.55	64.01	-32.46	QP	P	
2	0.1905	11.13	9.44	20.57	54.01	-33.44	AVG	P	
3	0.3930	20.94	9.86	30.80	58.00	-27.20	QP	P	
4	0.3930	9.55	9.86	19.41	48.00	-28.59	AVG	P	
5 *	0.8430	26.95	9.62	36.57	56.00	-19.43	QP	P	
6	0.8430	12.03	9.62	21.65	46.00	-24.35	AVG	P	
7	1.6305	17.52	10.04	27.56	56.00	-28.44	QP	P	
8	1.6305	5.98	10.04	16.02	46.00	-29.98	AVG	P	
9	23.1225	8.65	10.43	19.08	60.00	-40.92	QP	P	
10	23.1225	3.62	10.43	14.05	50.00	-35.95	AVG	P	
11	28.5180	12.56	10.28	22.84	60.00	-37.16	QP	P	
12	28.5180	7.91	10.28	18.19	50.00	-31.81	AVG	P	

Test Plots and Data of Conducted Emissions

Tested Mode:	TM5
Test Voltage:	AC 120V/60Hz
Test Power Line:	Live
Remark:	



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.1860	20.70	9.01	29.71	64.21	-34.50	QP	P	
2	0.1860	11.13	9.01	20.14	54.21	-34.07	AVG	P	
3	0.4637	19.04	9.94	28.98	56.63	-27.65	QP	P	
4	0.4637	8.61	9.94	18.55	46.63	-28.08	AVG	P	
5 *	0.8475	22.78	9.81	32.59	56.00	-23.41	QP	P	
6	0.8475	8.81	9.81	18.62	46.00	-27.38	AVG	P	
7	1.6665	16.39	10.04	26.43	56.00	-29.57	QP	P	
8	1.6665	4.80	10.04	14.84	46.00	-31.16	AVG	P	
9	13.6680	12.19	10.19	22.38	60.00	-37.62	QP	P	
10	13.6680	-9.40	10.19	0.79	50.00	-49.21	AVG	P	
11	23.1225	8.99	10.39	19.38	60.00	-40.62	QP	P	
12	23.1225	3.90	10.39	14.29	50.00	-35.71	AVG	P	

5. Radiated Emissions

5.1 Standard and Limit

According to §15.247(d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

According to the rule FCC Part 15.209, Radiated emission limit for a wireless device as below:

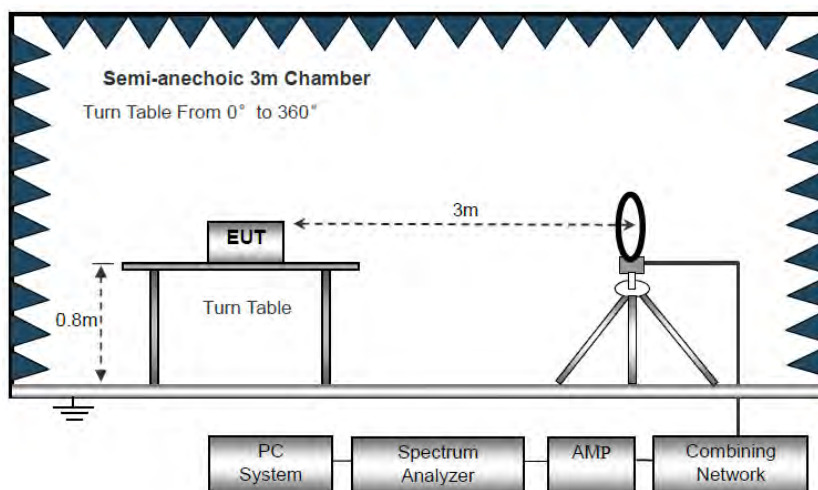
Frequency of emission (MHz)	Radiated emissions (3m)
	Quasi-peak (dBuV/m)
30-88	40
88-216	43.5
216-960	46
Above 960	54
Note: The more stringent limit applies at transition frequencies.	

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

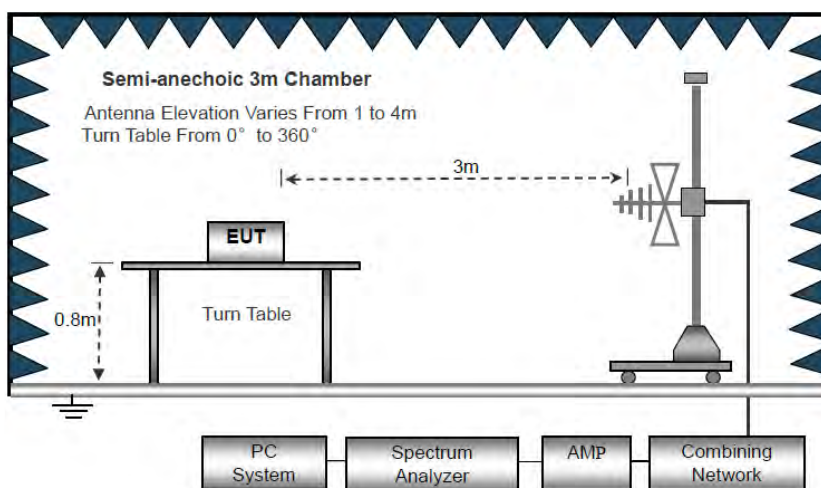
Note: Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

5.2 Test Procedure

Test is conducting under the description of ANSI C63.10 - 2013 section 6.3 to 6.6.



Block Diagram of Radiated Emission Below 30MHz



Block Diagram of Radiated Emission From 30MHz to 1GHz



Block Diagram of Radiated Emission Above 1GHz

- a) The EUT is placed on a turntable, which is 0.8m above ground plane for test frequency range below 1GHz, and 1.5m above ground plane for test frequency range above 1GHz.
- b) EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
- c) Use the following spectrum analyzer settings:
Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for $f \geq 1\text{GHz}$, 100 kHz for $f < 1\text{GHz}$, 10kHz for $f < 30\text{MHz}$
VBW \geq RBW, Sweep = auto
Detector function = peak
Trace = max hold
- d) Follow the guidelines in ANSI C63.4-2014 with respect to maximizing the emission by rotating the EUT, adjusting the measurement antenna height and polarization, etc. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, submit this data. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- e) The peak level, once corrected, must comply with the limit specified in Section 15.209. Set the RBW = 1MHz, VBW = 10Hz, Detector = PK for AV value, while maintaining all of the other instrument settings.
- f) For the actual test configuration, please refer to the related item - EUT test photos.

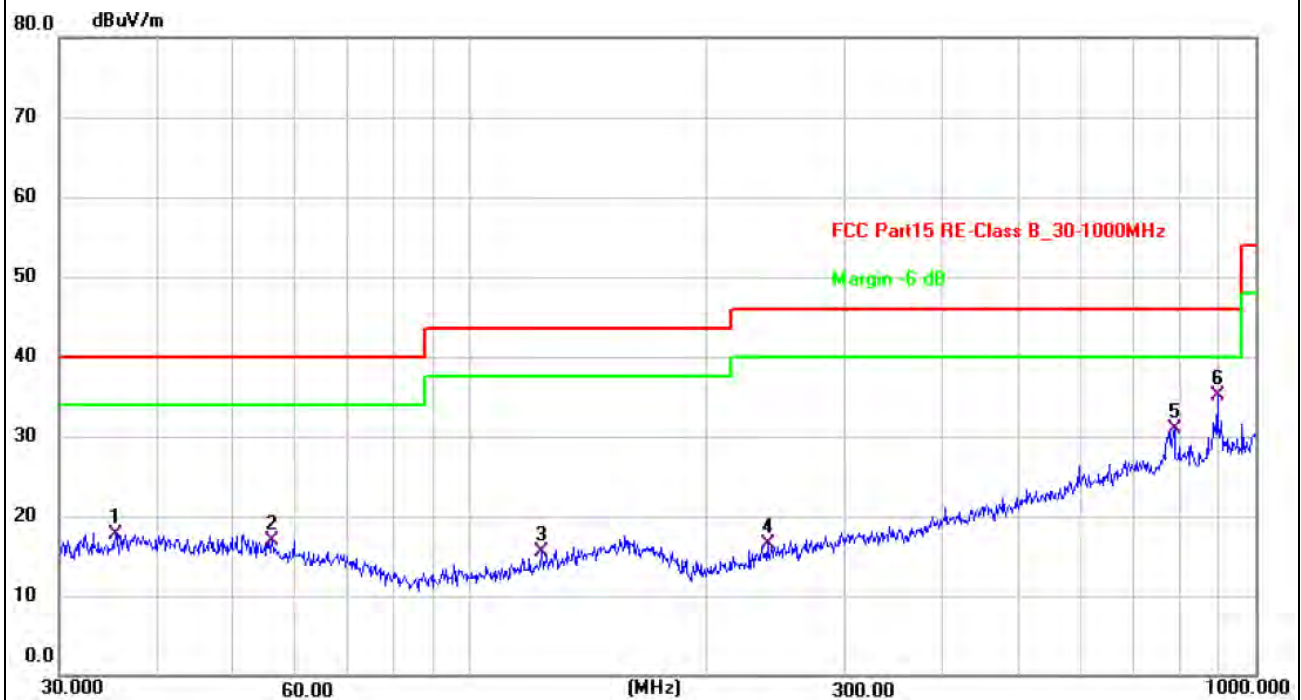
5.3 Test Data and Results

All of the GFSK and $\pi/4$ DQPSK and 8DPSK modes have been tested, the EUT complied with the FCC Part 15.247 standard limit for a wireless device, and with the worst case GFSK_2402MHz as below:

Remark: Level = Reading + Factor, Margin = Level - Limit

Radiated Emission Test Data (30MHz to 1GHz)

Tested Mode:	TM1
Test Antenna Polarization:	Horizontal
Remark:	-



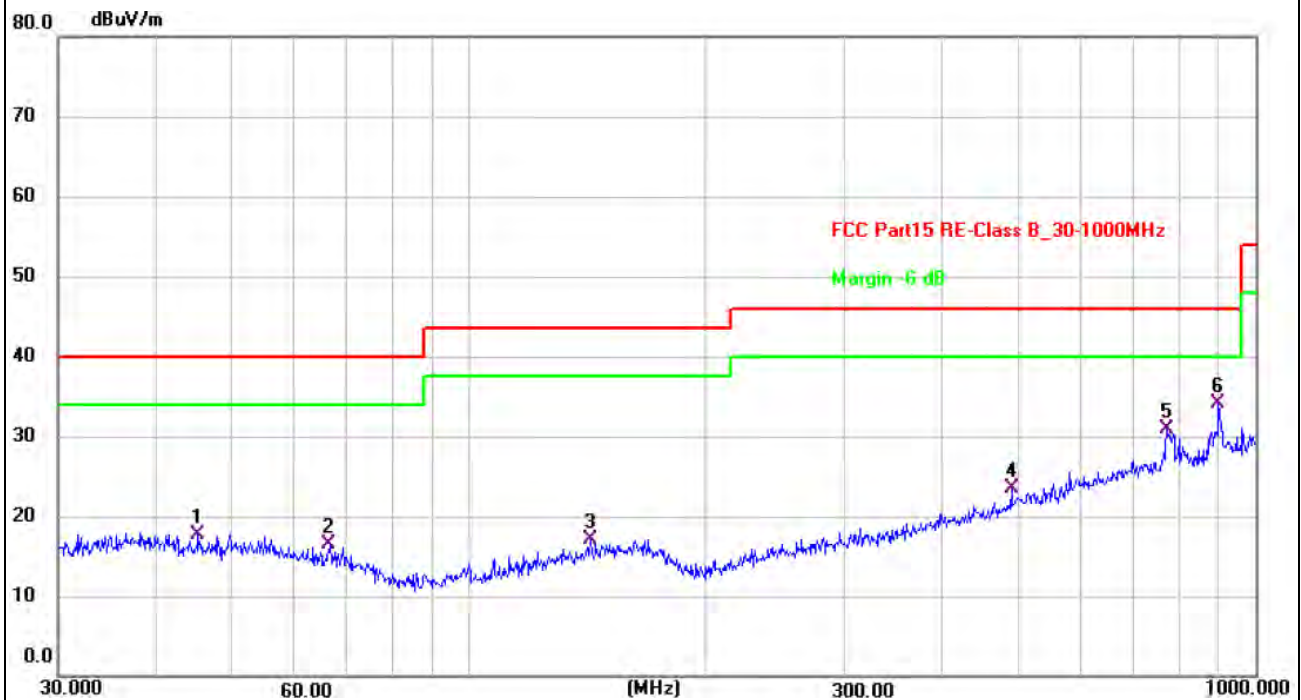
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	35.3750	26.45	-8.66	17.79	40.00	-22.21	QP	100	172	P	
2	56.0007	26.28	-9.38	16.90	40.00	-23.10	QP	100	0	P	
3	123.2655	25.87	-10.38	15.49	43.50	-28.01	QP	100	245	P	
4	239.1473	26.55	-9.98	16.57	46.00	-29.43	QP	100	348	P	
5	787.8513	28.99	1.97	30.96	46.00	-15.04	QP	100	3	P	
6 *	893.8567	31.54	3.53	35.07	46.00	-10.93	QP	100	37	P	

Radiated Emission Test Data (30MHz to 1GHz)

Tested Mode: TM1

Test Antenna Polarization: Vertical

Remark: -



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	45.2166	27.06	-9.30	17.76	40.00	-22.24	QP	100	74	P	
2	66.4989	26.95	-10.54	16.41	40.00	-23.59	QP	100	284	P	
3	142.3243	26.32	-9.14	17.18	43.50	-26.32	QP	100	157	P	
4	489.0269	27.53	-3.94	23.59	46.00	-22.41	QP	100	221	P	
5	771.4486	29.54	1.45	30.99	46.00	-15.01	QP	100	303	P	
6 *	896.9965	30.52	3.64	34.16	46.00	-11.84	QP	100	336	P	

Radiated Emission Test Data (Above 1GHz)							
Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
MHz	dBuV/m	dB/m	dBuV/m	dBuV/m	dB	H/V	PK/AV
Lowest Channel (2402MHz)							
4804	77.73	-14.72	63.01	74	-10.99	H	PK
4804	62.03	-14.72	47.31	54	-6.69	H	AV
7206	64.02	-8.41	55.61	74	-18.39	H	PK
7206	47.01	-8.41	38.6	54	-15.4	H	AV
4804	74.24	-14.72	59.52	74	-14.48	V	PK
4804	59.86	-14.72	45.14	54	-8.86	V	AV
7206	64.76	-8.41	56.35	74	-17.65	V	PK
7206	49.25	-8.41	40.84	54	-13.16	V	AV
Middle Channel (2441MHz)							
4882	77.58	-14.64	62.94	74	-11.06	H	PK
4882	61.83	-14.64	47.19	54	-6.81	H	AV
7323	62.54	-8.28	54.26	74	-19.74	H	PK
7323	45.1	-8.28	36.82	54	-17.18	H	AV
4882	77.74	-14.64	63.1	74	-10.9	V	PK
4882	60.87	-14.64	46.23	54	-7.77	V	AV
7323	62.84	-8.28	54.56	74	-19.44	V	PK
7323	45.31	-8.28	37.03	54	-16.97	V	AV
Highest Channel (2480MHz)							
4960	76.61	-14.53	62.08	74	-11.92	H	PK
4960	61.41	-14.53	46.88	54	-7.12	H	AV
7440	65.53	-8.13	57.4	74	-16.6	H	PK
7440	47.59	-8.13	39.46	54	-14.54	H	AV
4960	77.23	-14.53	62.7	74	-11.3	V	PK
4960	60.89	-14.53	46.36	54	-7.64	V	AV
7440	64	-8.13	55.87	74	-18.13	V	PK
7440	50.01	-8.13	41.88	54	-12.12	V	AV

Note 1: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.

Note 2: Testing is carried out with frequency rang 9kHz to the tenth harmonics. The measurements greater than 20dB below the limit from 9kHz to 30MHz.

Note3: Other emissions are attenuated 20dB below the limits from 9kHz to 30MHz, so it does not recorded in report. 18GHz-26GHz not recorded for no spurious point have a margin of less than 6 dB with respect to the limits.

6. Band-edge Emissions(Radiated)

6.1 Standard and Limit

According to §15.247(d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

6.2 Test Procedure

Test is conducting under the description of ANSI C63.10 - 2013 section 6.3 to 6.6 and section 6.10.



Test Setup Block Diagram

As the radiated emissions testing, set the Lowest and Highest Transmitting Channel, observed the outside band of 2310MHz to 2400MHz and 2483.5MHz to 2500MHz, than mark the higher-level emission for comparing with the FCC rules.

6.3 Test Data and Results

All of the GFSK and $\pi/4$ DQPSK and 8DPSK modes have been tested, the EUT complied with the FCC Part 15.247 standard limit, and with the worst case as below:

Test Mode	Frequency	Limit	Result
	MHz	dBuV/dBc	
Lowest	2310.00	<54 dBuV	Pass
	2390.00	<54 dBuV	Pass
Highest	2483.50	<54 dBuV	Pass
	2500.00	<54 dBuV	Pass

Radiated Emission Test Data (Band edge emissions)							
Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
MHz	dBuV/m	dB/m	dBuV/m	dBuV/m	dB	H/V	PK/AV
Lowest Channel GFSK (2402MHz)							
2310	64.67	-21.34	43.33	74	-30.67	H	PK
2310	51.12	-21.34	29.78	54	-24.22	H	AV
2390	64.91	-20.96	43.95	74	-30.05	H	PK
2390	49.48	-20.96	28.52	54	-25.48	H	AV
2400	74.86	-20.91	53.95	74	-20.05	H	PK
2400	55.88	-20.91	34.97	54	-19.03	H	AV
2310	66.06	-21.34	44.72	74	-29.28	V	PK
2310	51.64	-21.34	30.3	54	-23.7	V	AV
2390	67.14	-20.96	46.18	74	-27.82	V	PK
2390	52.3	-20.96	31.34	54	-22.66	V	AV
2400	71.99	-20.91	51.08	74	-22.92	V	PK
2400	54.29	-20.91	33.38	54	-20.62	V	AV
Highest Channel GFSK (2480MHz)							
2483.50	72.37	-20.51	51.86	74	-22.14	H	PK
2483.50	52.71	-20.51	32.2	54	-21.8	H	AV
2500	64.87	-20.43	44.44	74	-29.56	H	PK
2500	50.41	-20.43	29.98	54	-24.02	H	AV
2483.50	71.16	-20.51	50.65	74	-23.35	V	PK
2483.50	52.78	-20.51	32.27	54	-21.73	V	AV
2500	66.77	-20.43	46.34	74	-27.66	V	PK
2500	49.94	-20.43	29.51	54	-24.49	V	AV

Remark: Level = Reading + Factor, Margin = Level - Limit

7. Frequency Hopping System

7.1 Standard and Limit

According to FCC Part 15.247(a)(1), The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

7.2 Test Procedure

This device uses Bluetooth radio which operates in 2400-2483.5 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centred from 2402 to 2480 MHz) in the range 2,400-2,483.5 MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH-enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used.

This device was tested with an bluetooth system receiver to check that the device maintained hopping synchronization, and the device complied with these requirements for DA 00-705 and FCC Part 15.247 rule.

7.3 Test Data and Results

Pseudorandom Frequency Hopping Sequence Table as below:

Channel: 08, 24, 40, 56, 40, 56, 72, 09, 01, 09, 33, 41, 33, 41, 65, 73, 53, 69, 06, 22, 04, 20, 36, 52, 38, 46, 70, 78, 68, 76, 21, 29, 10, 26, 42, 58, 44, 60, 76, 13, 03, 11, 35, 43, 37, 45, 69, 77, 55, 71, 08, 24, 08, 24, 40, 56, 40, 48, 72, 01, 72, 01, 25, 33, 12, 28, 44, 60, 42, 58, 74, 11, 05, 13, 37, 45 etc.

The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

8. Dwell Time

8.1 Standard and Limit

According to 15.247 (a)(1)(iii), Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. 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.

8.2 Test Procedure

- 1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
- 2) Spectrum Setting: RBW=1MHz, VBW=3MHz, Span=0Hz, Detector=Peak
- 3) Use video trigger with the trigger level set to enable triggering only on full pulses.
- 4) Sweep Time is more than once pulse time.
- 5) Set the center frequency on any frequency would be measure and set the frequency span to zero span.
- 6) Measure the maximum time duration of one single pulse.
- 7) Set the EUT for packet transmitting.
- 8) Measure the maximum time duration of one single pulse.
- 9) The EUT was set to the Hopping Mode for Dwell Time Test.

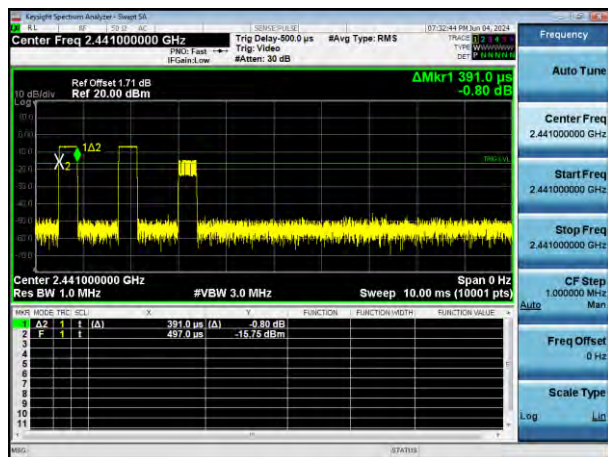


Test Setup Block Diagram

8.3 Test Data and Results

Test Mode	Data Packet	Channel (MHz)	Pulse Duration (ms)	Dwell Time (ms)	Limit (ms)	Result
GFSK	DH1	2441	0.391	80.546	<400	Pass
	DH3	2441	1.645	195.755	<400	Pass
	DH5	2441	2.893	248.798	<400	Pass
Pi/4 DQPSK	2DH1	2441	0.38	77.14	<400	Pass
	2DH3	2441	1.631	197.351	<400	Pass
	2DH5	2441	2.889	245.565	<400	Pass
8DPSK	3DH1	2441	0.388	71.392	<400	Pass
	3DH3	2441	1.635	196.2	<400	Pass
	3DH5	2441	2.886	253.968	<400	Pass

Burst(DH1)



Keyight Spectrum Analyzer - Sheet 26

RL 40 50 60

SOURCE: PULSE

07:33:19 PM Jun 04, 2024

Center Freq 2.441000000 GHz

TRACED: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981

Keysight Spectrum Analyzer - Sheet 01

Center Freq 2.441000000 GHz Trig Delay: 500.0 μ s #Avg Type: RMS

Ref Offset 171 dB Ref 20.00 dBm

Δ Mkr1 1.645 ms 4.04 dB

Center 2.441000000 GHz Res BW 1.0 MHz #VBW 3.0 MHz Sweep 10.00 ms (10001 pts) Span 0 Hz

Marker	Mode	THC	CLL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	Δ	1	1	2.441 GHz	1.645 ms (Δ)	1.64 dB		
2	F	1	1	2.441 GHz	499.0 μ s	-33.78 dBm		

Keysight Spectrum Analyzer - Sheet 53

Center Freq 2.441000000 GHz

Ref Offset 171 dB

Ref 20.0 dBm

Span 0 Hz

Res BW 1.0 MHz

#VBW 3.0 MHz

Sweep 31.60 s (10001 pts)

Auto Tuning

Center Freq 2.441000000 GHz

Start Freq 2.441000000 GHz

Stop Freq 2.441000000 GHz

CF Step 1.000000 MHz

Freq Offset 0 Hz

Scale Type

Auto

Log

Trace 1 2 3 4 5 6 7 8 9 10

Time Spanning

DET

Source Power

07:34:20 PM Jun 04, 2023

PMO: Fast

Trig: Free Run

#Att: 30 dB

10 dB/div

5.0

0.0

-5.0

-10.0

-15.0

-20.0

-25.0

-30.0

-35.0

-40.0

-45.0

-50.0

-55.0

-60.0

-65.0

-70.0

-75.0

-80.0

-85.0

-90.0

-95.0

-100.0

-105.0

-110.0

-115.0

-120.0

-125.0

-130.0

-135.0

-140.0

-145.0

-150.0

-155.0

-160.0

-165.0

-170.0

-175.0

-180.0

-185.0

-190.0

-195.0

-200.0

-205.0

-210.0

-215.0

-220.0

-225.0

-230.0

-235.0

-240.0

-245.0

-250.0

-255.0

-260.0

-265.0

-270.0

-275.0

-280.0

-285.0

-290.0

-295.0

-300.0

-305.0

-310.0

-315.0

-320.0

-325.0

-330.0

-335.0

-340.0

-345.0

-350.0

-355.0

-360.0

-365.0

-370.0

-375.0

-380.0

-385.0

-390.0

-395.0

-400.0

-405.0

-410.0

-415.0

-420.0

-425.0

-430.0

-435.0

-440.0

-445.0

-450.0

-455.0

-460.0

-465.0

-470.0

-475.0

-480.0

-485.0

-490.0

-495.0

-500.0

-505.0

-510.0

-515.0

-520.0

-525.0

-530.0

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-540.0

-545.0

-550.0

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-560.0

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-575.0

-580.0

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-590.0

-595.0

-600.0

-605.0

-610.0

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-620.0

-625.0

-630.0

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-640.0

-645.0

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-655.0

-660.0

-665.0

-670.0

-675.0

-680.0

-685.0

-690.0

-695.0

-700.0

-705.0

-710.0

-715.0

-720.0

-725.0

-730.0

-735.0

-740.0

-745.0

-750.0

-755.0

-760.0

-765.0

-770.0

-775.0

-780.0

-785.0

-790.0

-795.0

-800.0

-805.0

-810.0

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-820.0

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-885.0

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-895.0

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-905.0

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-985.0

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-1000.0

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-1015.0

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-1065.0

-1070.0

-1075.0

-1080.0

-1085.0

-1090.0

-1095.0

-1100.0

-1105.0

-1110.0

-1115.0

-1120.0

-1125.0

-1130.0

-1135.0

-1140.0

-1145.0

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-1160.0

-1165.0

-1170.0

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-1185.0

-1190.0

-1195.0

-1200.0

-1205.0

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-1480.0

-1485.0

-1490.0

-1495.0

-1500.0

-1505.0

-1510.0

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-1525.0

-1530.0

-1535.0

-1540.0

-1545.0

-1550.0

-1555.0

-1560.0

-1565.0

-1570.0

-1575.0

-1580.0

-1585.0

-1590.0

-1595.0

-1600.0

-1605.0

-1610.0

-1615.0

-1620.0

Keysight Spectrum Analyzer - Sweet 25

Center Freq 2.441000000 GHz Trg Delay 500.0 μ s #Avg Type: RMS

PRM: Fast Trg: Video #Att: 30 dB

Ref Offset 171 dB
Ref 20.00 dBm

DMkr1 2.893 ms
1.33 dB

Center 2.441000000 GHz
Res BW 1.0 MHz #VBW 3.0 MHz Sweep 10.00 ms Span 0 Hz

MN	PRM	UNIT	VAL	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
2	1	dB	2.893 ms	1.33 dB		
2	1	dB	489.0 μ s	-22.60 dBm		

Keysight Spectrum Analyzer - Sweet 26

AL 40 50 60

Center Freq 2.441000000 GHz

Trig: Free Run #Att: 30 dB

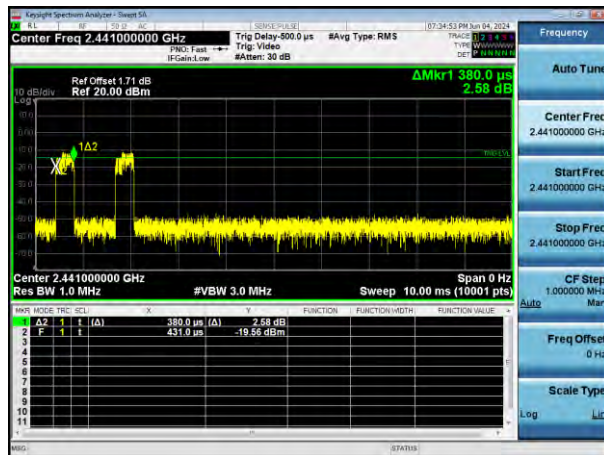
#Avg Type: RMS

07:14:50 PM Jun 04, 2024

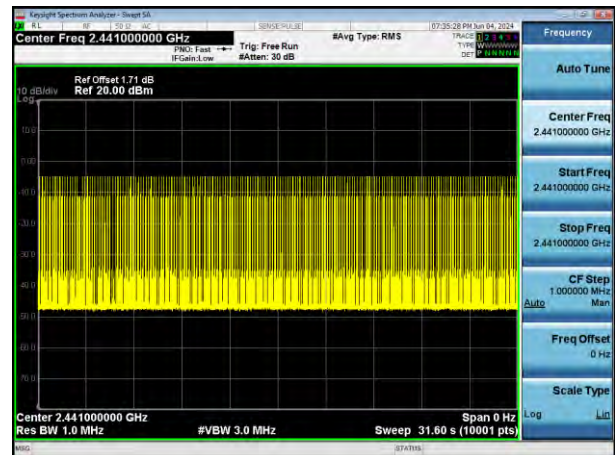
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Pi/4 DQPSK (2441MHz)

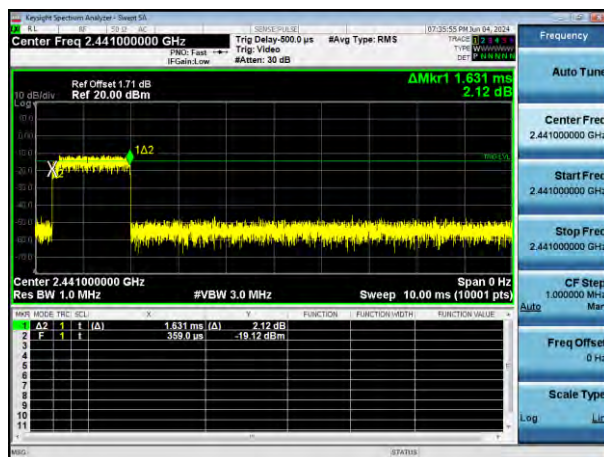
Burst(2DH1)



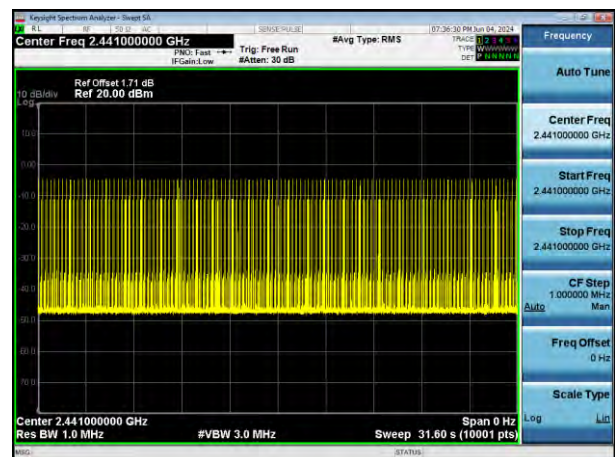
Accumulate(2DH1)



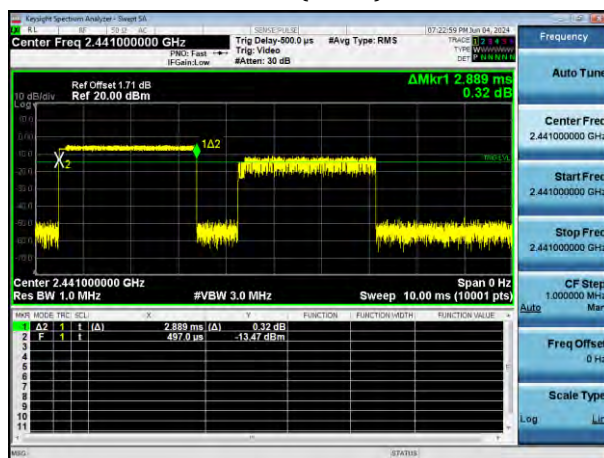
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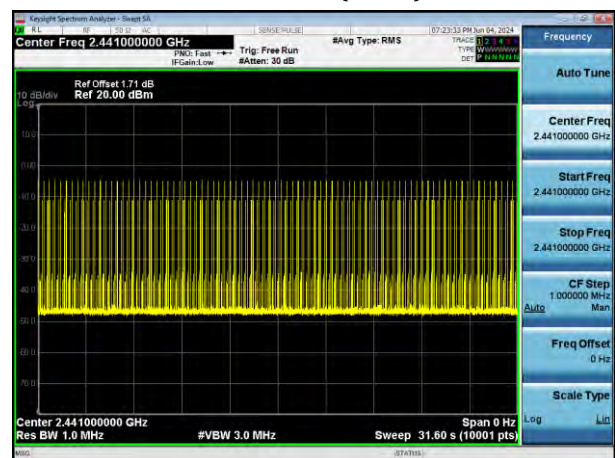
Accumulate(2DH3)



Burst(2DH5)

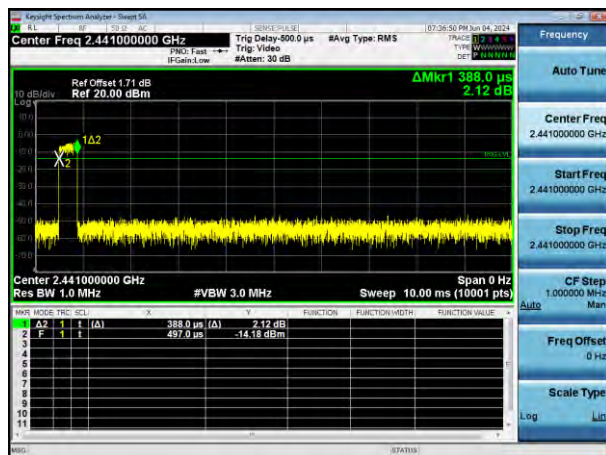


Accumulate(2DH5)

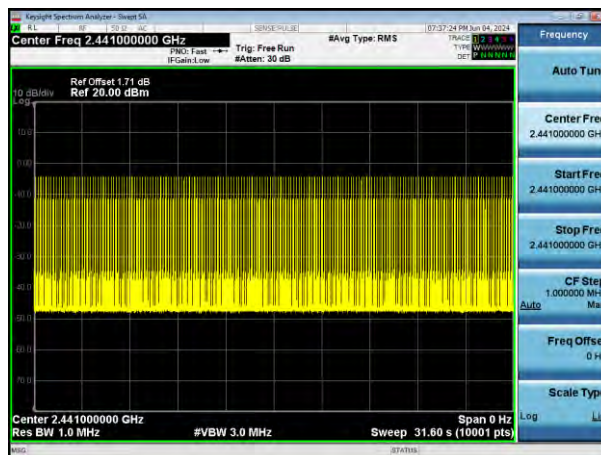


8DPSK (2441MHz)

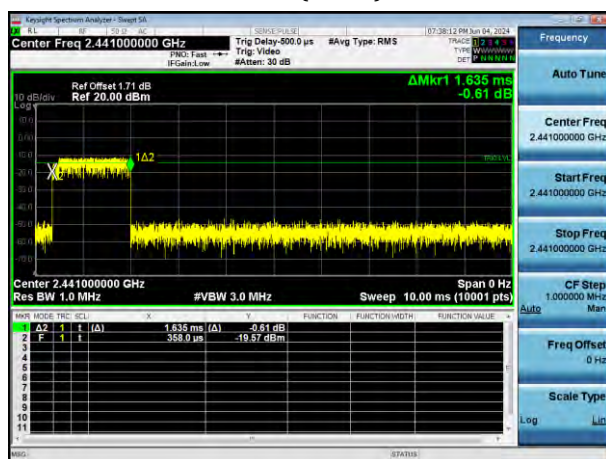
Burst(3DH1)



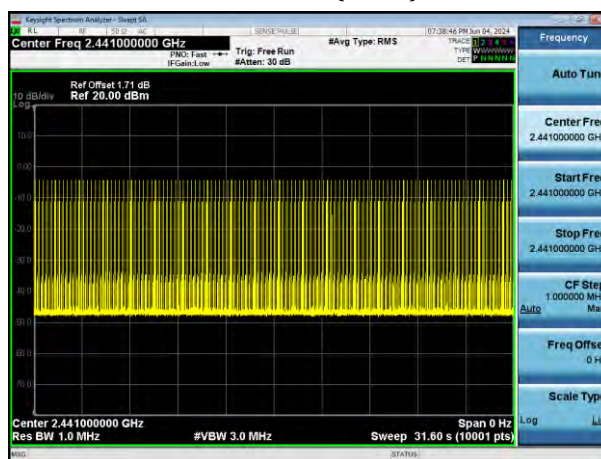
Accumulate(3DH1)



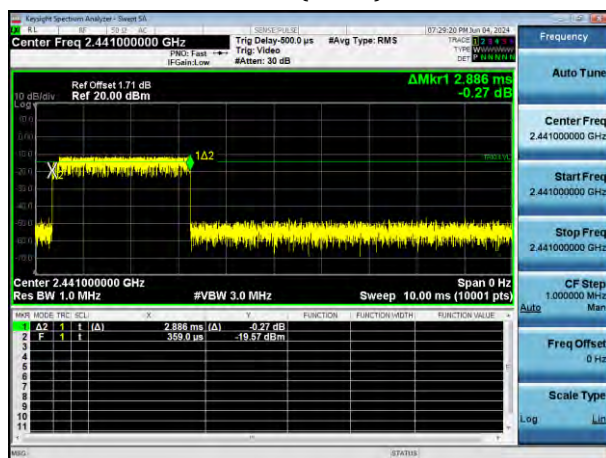
Burst(3DH3)



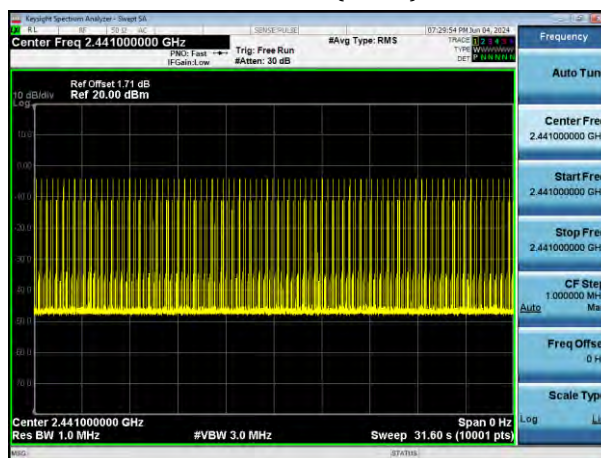
Accumulate(3DH3)



Burst(3DH5)



Accumulate(3DH5)



9. Maximum Peak Conducted Output Power

9.1 Standard and Limit

According to 15.247(b)(1). 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.

9.2 Test Procedure

- 1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
- 2) Set the spectrum analyzer to any one measured frequency within its operating range.
- 3) Set RBW = 2MHz, VBW = 6MHz, Sweep = Auto, Detector = Peak.
- 4) Measure the highest amplitude appearing on spectral display and mark the value.
- 5) Repeat the above procedures until all frequencies measured were complete.



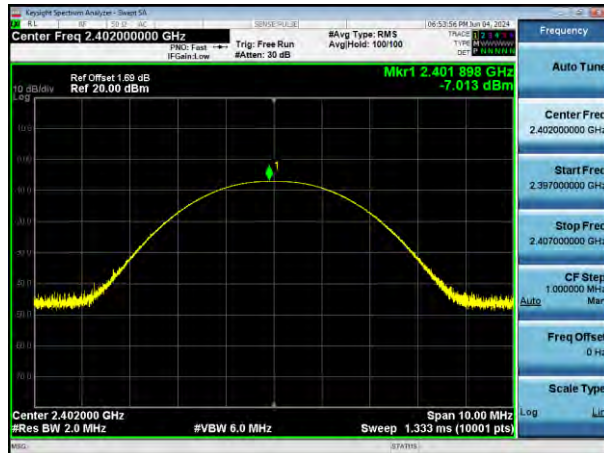
Test Setup Block Diagram

9.3 Test Data and Results

Test Mode	Test Channel MHz	Conducted Output Power (dBm)	Limit (dBm)	Test Result
GFSK	2402	-7.01	21	Pass
	2441	-6.53	21	Pass
	2480	-5.25	21	Pass
Pi/4 DQPSK	2402	-4.66	21	Pass
	2441	-4.23	21	Pass
	2480	-2.99	21	Pass
8DPSK	2402	-4.22	21	Pass
	2441	-3.73	21	Pass
	2480	-2.45	21	Pass

GFSK

2402MHz

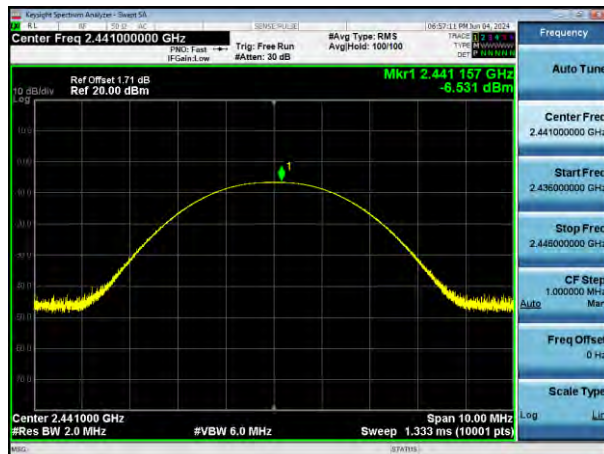


Pi/4 DQPSK

2402MHz



2441MHz



2441MHz



2480MHz



2480MHz



8DPSK

2402MHz



2441MHz



2480MHz



10. Occupied Bandwidth(-20dB)

10.1 Standard and Limit

According to 15.215 (c), intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

10.2 Test Procedure

According to the ANSI 63.10-2013, section 6.9, the emission bandwidth test method as follows.

- 1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
- 2) Set the spectrum analyzer to any one measured frequency within its operating range.
- 3) Set RBW = 30kHz, VBW = 100kHz, Sweep = Auto.
- 4) Set a reference level on the measuring instrument equal to the highest peak value.
- 5) Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.
- 6) Repeat the above procedures until all frequencies measured were complete.



Test Setup Block Diagram

10.3 Test Data and Results

Test Mode	Test Channel (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (kHz)
GFSK	2402	0.95	866.40
	2441	0.948	864.51
	2480	0.932	845.98
Pi/4 DQPSK	2402	1.274	1178.3
	2441	1.345	1190.9
	2480	1.276	1177.2
8DPSK	2402	1.294	1184.4
	2441	1.291	1188.2
	2480	1.287	1180.0

GFSK

2402MHz



Pi/4 DQPSK

2402MHz



2441MHz



2441MHz



2480MHz



2480MHz



8DPSK

2402MHz



2441MHz



2480MHz



11. Carrier Frequencies Separation

11.1 Standard and Limit

According to FCC 15.247(a)(1), 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, and frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

11.2 Test Procedure

- 1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
- 2) Set the spectrum analyzer to any one measured frequency within its operating range.
- 3) Set RBW = 30kHz, VBW = 100kHz, Sweep = Auto, Detector = Peak.
- 4) By using the Max Hold function, record the separation of two adjacent channels.
- 5) Measure the frequency difference of these two adjacent channels by spectrum analyzer mark function. and then plot the result on the screen of the spectrum analyzer.
- 6) Repeat above procedures until all frequencies measured were complete.



11.3 Test Data and Results

Test Mode	Test Channel	Test Freq. 1 (MHz)	Test Freq. 2 (MHz)	CFS (MHz)	Limit (MHz)
GFSK	Lowest	2402.178	2403.068	0.89	0.633
	Middle	2441.172	2441.842	0.67	0.632
	Highest	2478.848	2480.066	1.218	0.621
Pi/4 DQPSK	Lowest	2401.842	2402.838	0.996	0.849
	Middle	2440.852	2442.178	1.326	0.897
	Highest	2478.844	2479.836	0.992	0.851
8DPSK	Lowest	2401.844	2402.838	0.994	0.863
	Middle	2440.846	2441.828	0.982	0.861
	Highest	2478.844	2479.828	0.984	0.858

Note: CFS(Channel Frequency Separation) = Test Freq. 2 - Test Freq. 1

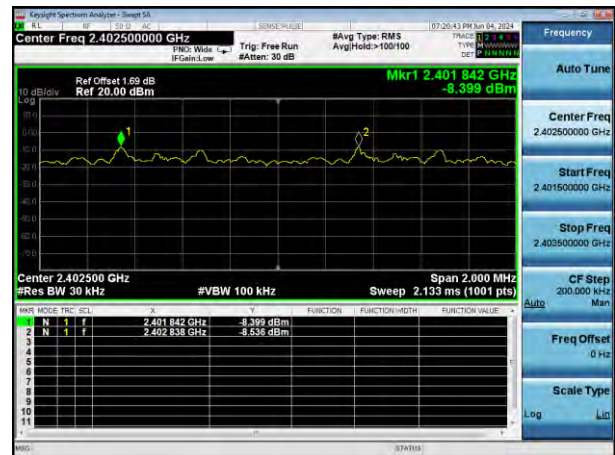
GFSK

Lowest



Pi/4 DQPSK

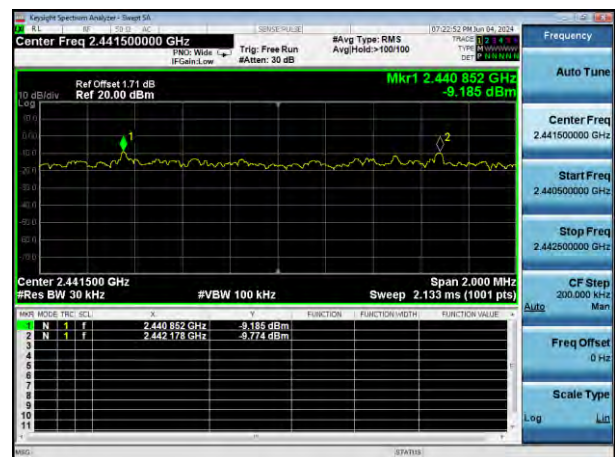
Lowest



Middle



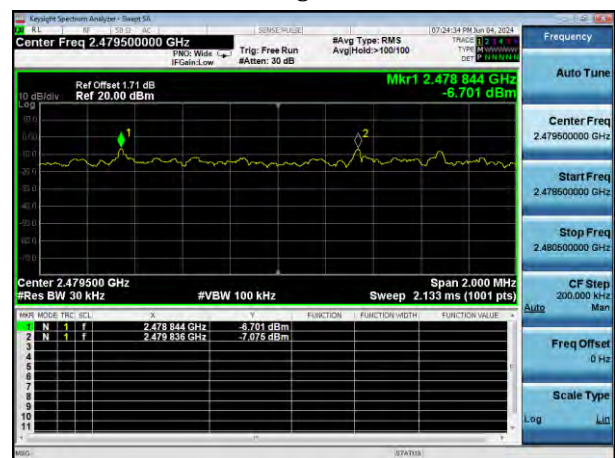
Middle



Highest

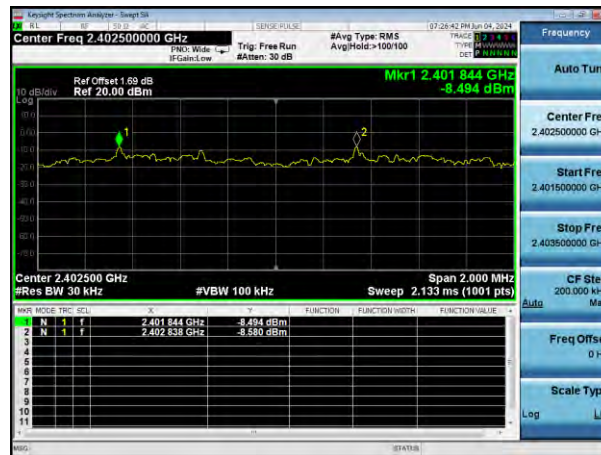


Highest

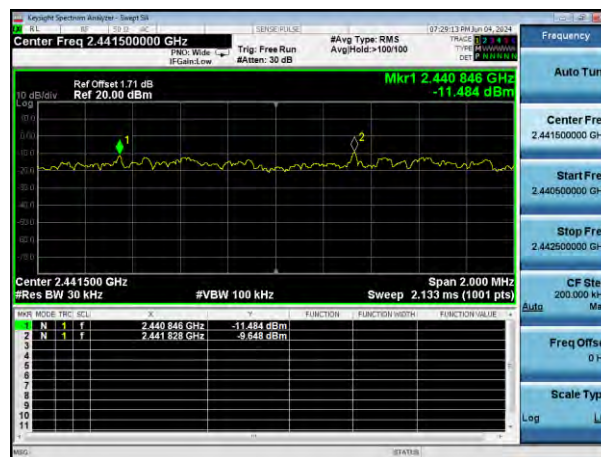


8DPSK

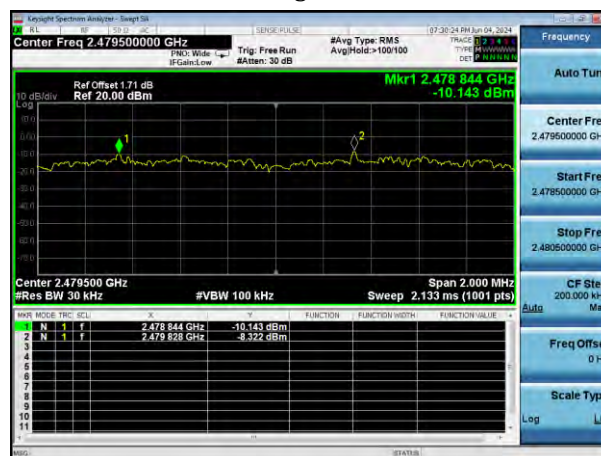
Lowest



Middle



Highest



12. Number of Hopping Channel

12.1 Standard and Limit

According to FCC 15.247(a)(1), 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, and frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

12.2 Test Procedure

- 1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
- 2) Set the spectrum analyzer to any one measured frequency within its operating range.
- 3) Set RBW = 100kHz, VBW = 300kHz, Sweep = Auto, Detector = Peak.
- 4) Set the spectrum analyzer on Max hold mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
- 5) Set the spectrum analyzer on View mode and then plot the result on the screen of the spectrum analyzer.
- 6) Repeat the above procedures until all frequencies measured were complete.



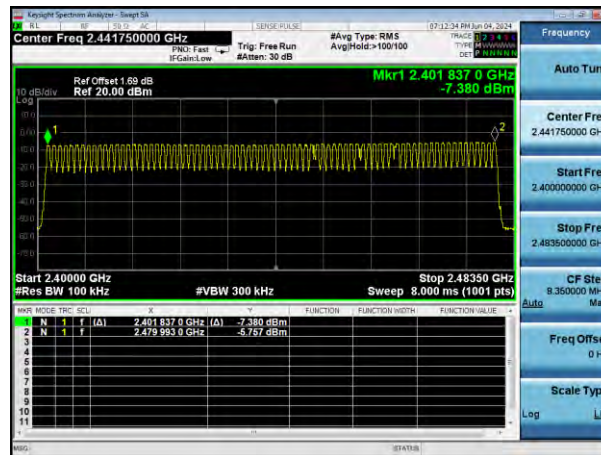
Test Setup Block Diagram

12.3 Test Data and Results

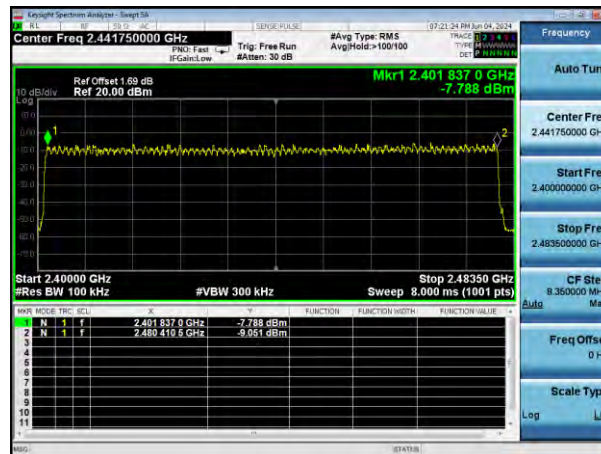
Test Mode	Number of Hopping Channel	Limit	Test Result
GFSK	79	15	Pass
Pi/4 DQPSK	79	15	Pass
8DPSK	79	15	Pass

Number of Hopping Channel

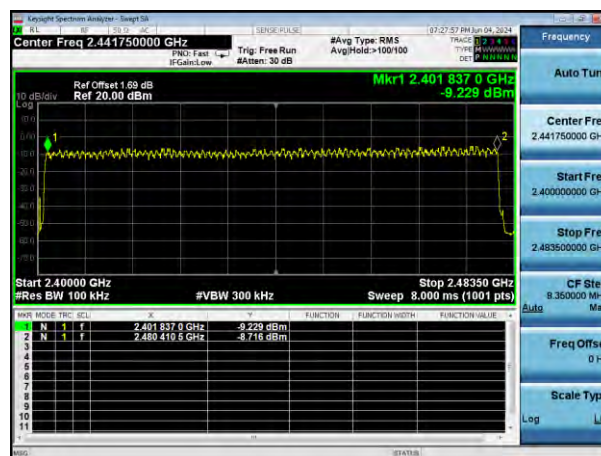
GFSK



Pi/4 DQPSK



8DPSK



13. Band-edge Emission(Conducted)

13.1 Standard and Limit

According to §15.247(d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

13.2 Test Procedure

Test is conducting under the description of ANSI C63.10 - 2013 section 6.10.

- 1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
- 2) Set the spectrum analyzer to any one measured frequency within its operating range.
- 3) Set RBW = 100kHz, VBW = 300kHz, Sweep = Auto, Detector = Peak.
- 4) Measure the highest amplitude appearing on spectral display and set it as a reference level.
- 5) Set a convenient frequency span including 100 kHz bandwidth from band edge.
- 6) Measure the emission and marking the edge frequency.
- 7) Repeat above procedures until all frequencies measured were complete.



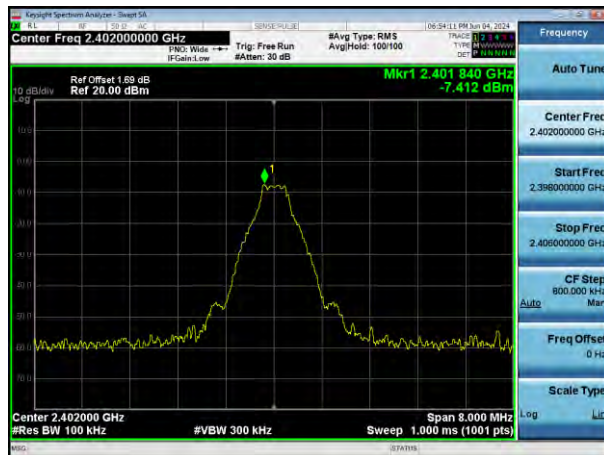
Test Setup Block Diagram

13.3 Test Data and Results

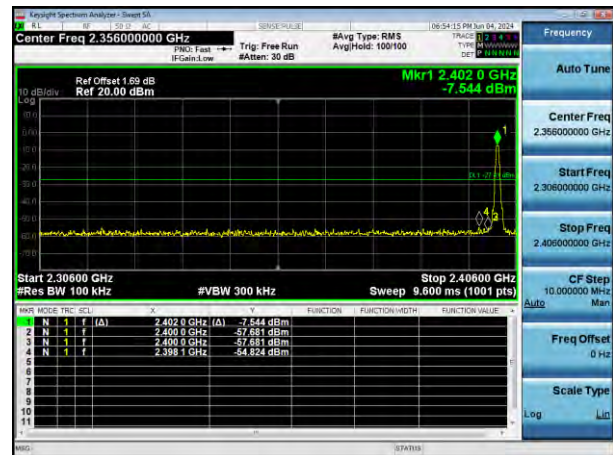
Test Mode	Band-edge	Test Channel (MHz)	Max. Value (dBc)	Limit (dBc)	Test Result
No-Hopping					
GFSK	Lowest	2402	-47.41	-20	Pass
	Highest	2480	-49.25	-20	Pass
Pi/4 DQPSK	Lowest	2402	-47.38	-20	Pass
	Highest	2480	-49.76	-20	Pass
8DPSK	Lowest	2402	-46.79	-20	Pass
	Highest	2480	-50.02	-20	Pass
Hopping					
GFSK	Lowest	2402	-47.38	-20	Pass
	Highest	2480	-47.7	-20	Pass
Pi/4 DQPSK	Lowest	2402	-45.16	-20	Pass
	Highest	2480	-47.42	-20	Pass
8DPSK	Lowest	2402	-46.46	-20	Pass
	Highest	2480	-48.12	-20	Pass

No-Hopping GFSK Lowest

Reference Power

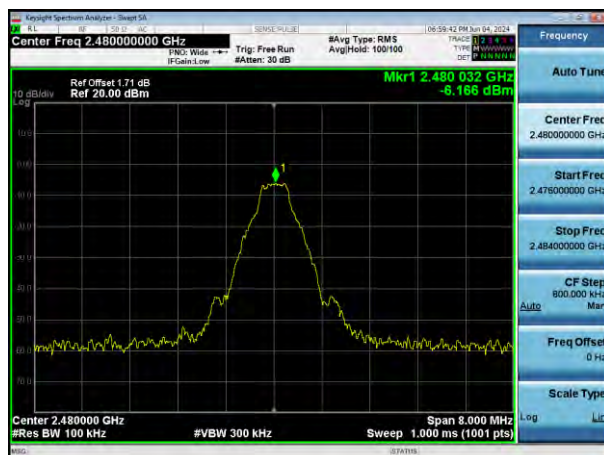


Band-edge Emission

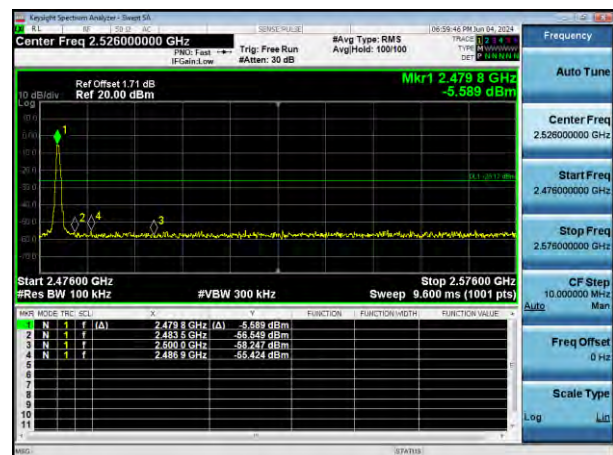


No-Hopping GFSK Highest

Reference Power

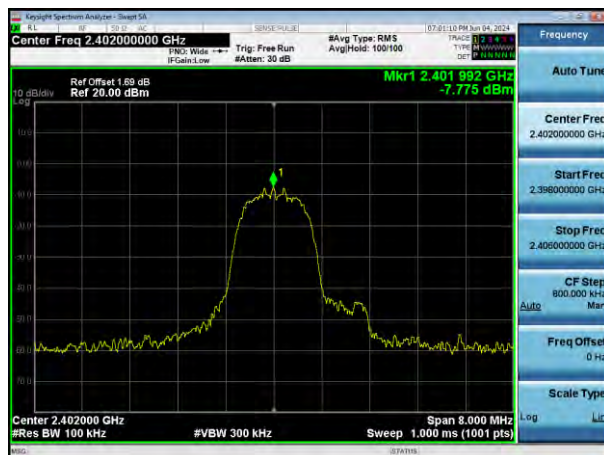


Band-edge Emission

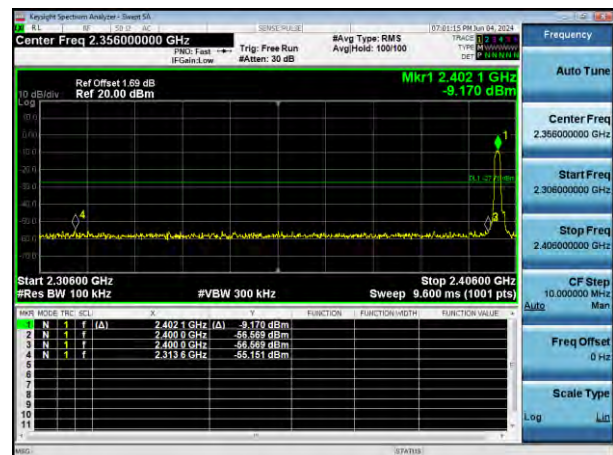


No-Hopping Pi/4 DQPSK Lowest

Reference Power

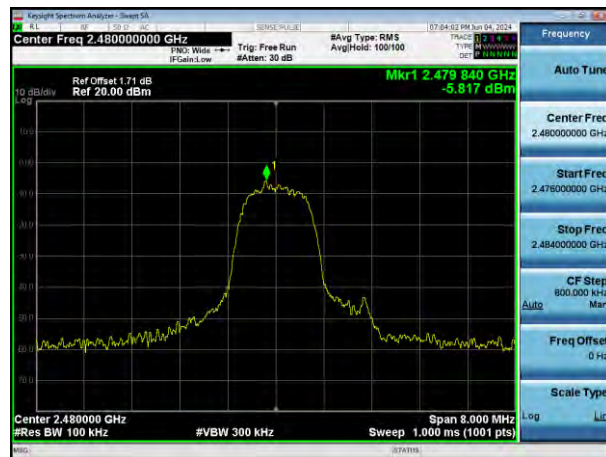


Band-edge Emission

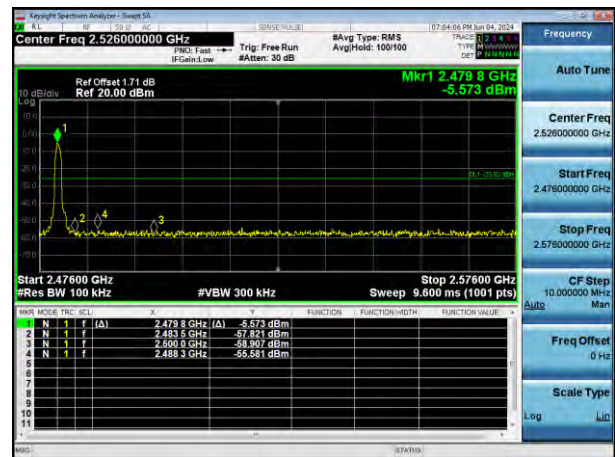


No-Hopping Pi/4 DQPSK Highest

Reference Power

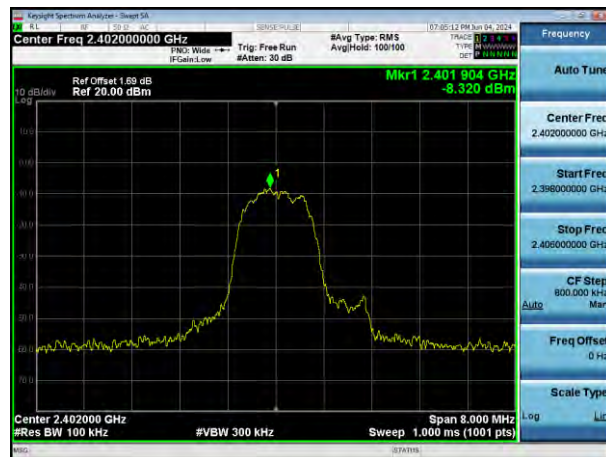


Band-edge Emission

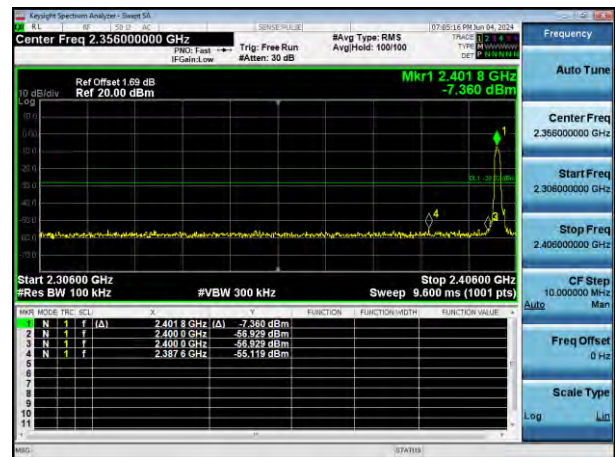


No-Hopping 8DPSK Lowest

Reference Power

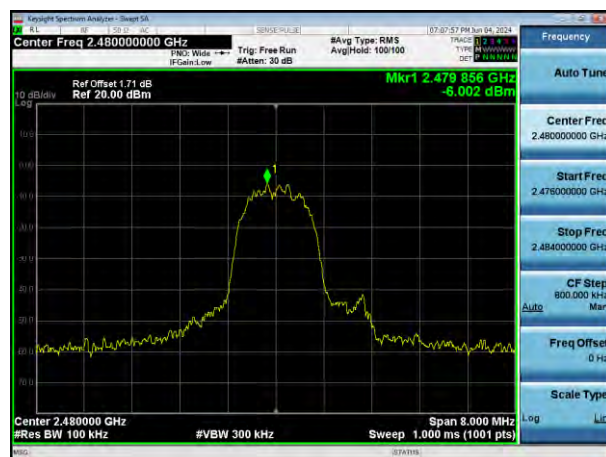


Band-edge Emission

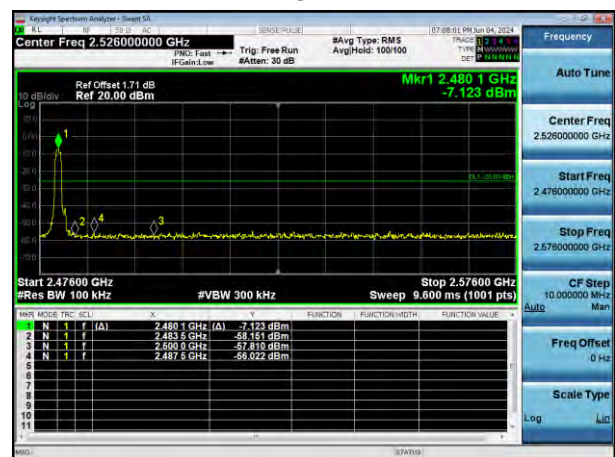


No-Hopping 8DPSK Highest

Reference Power

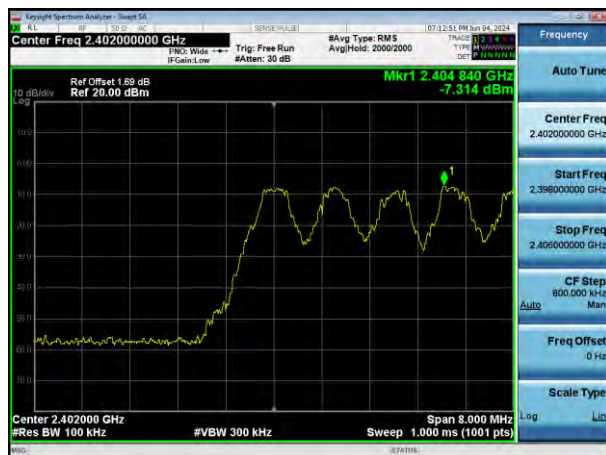


Band-edge Emission

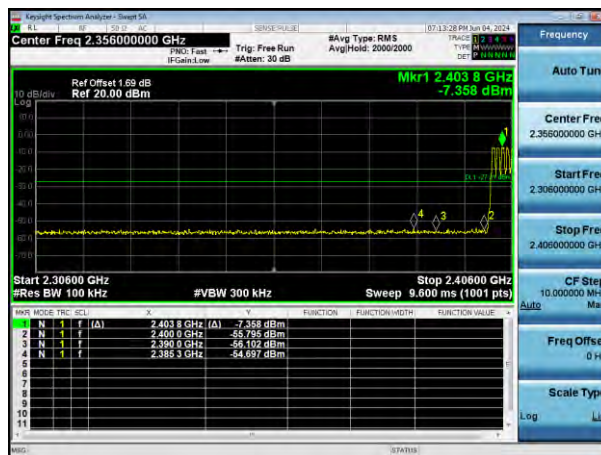


Hopping GFSK Lowest

Reference Power

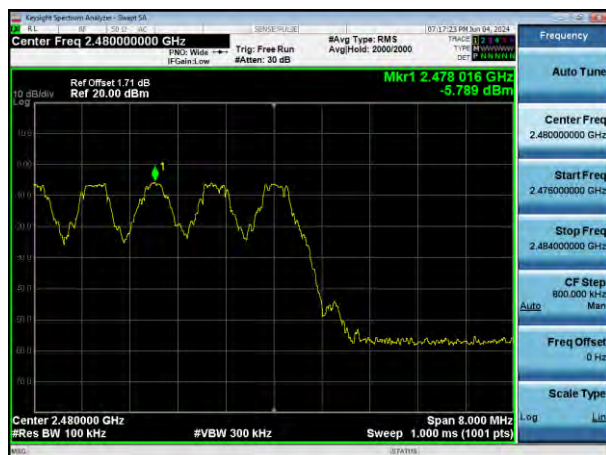


Band-edge Emission

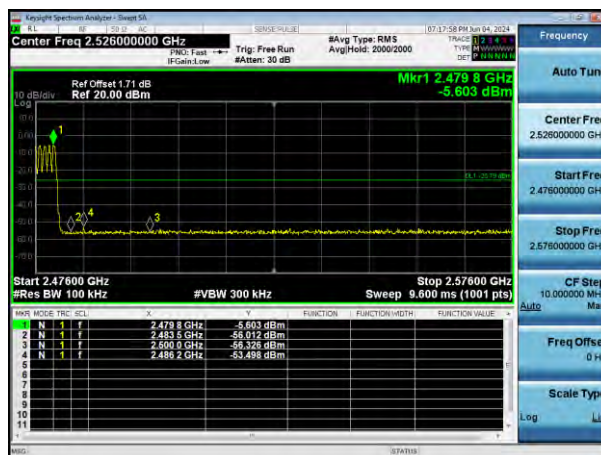


Hopping GFSK Highest

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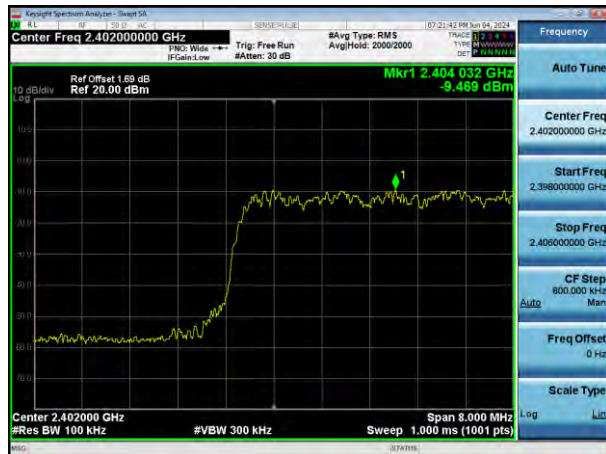


Band-edge Emission

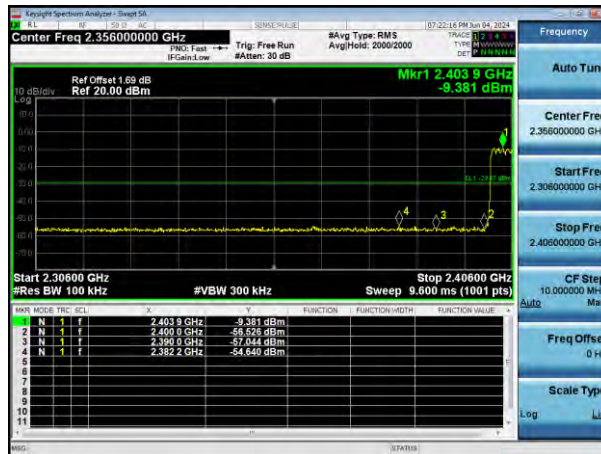


Hopping Pi/4 DQPSK Lowest

Reference Power



Band-edge Emission

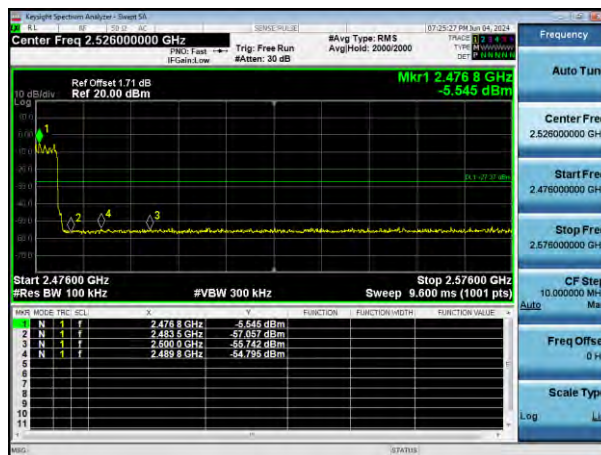


Hopping Pi/4 DQPSK Highest

Reference Power

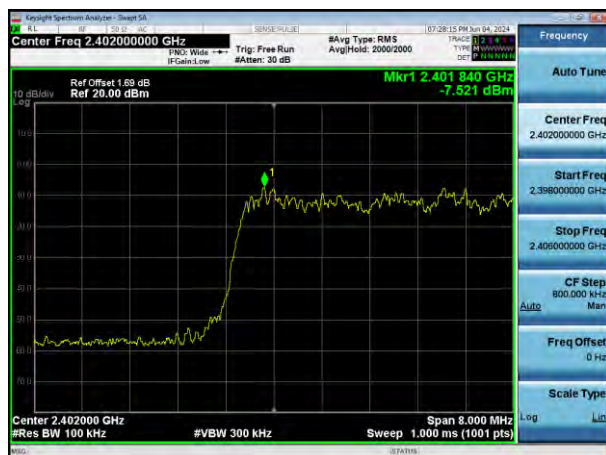


Band-edge Emission

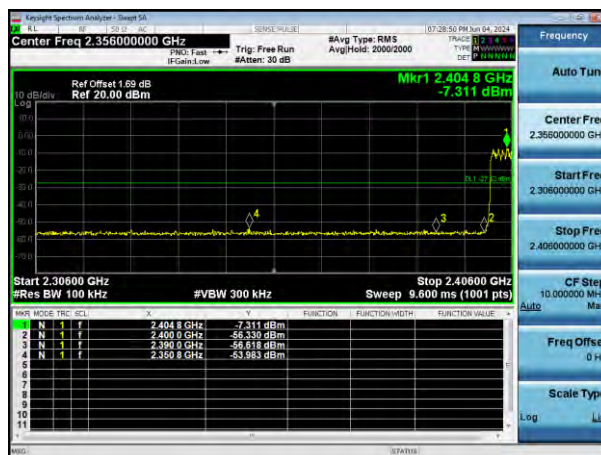


Hopping 8DPSK Lowest

Reference Power

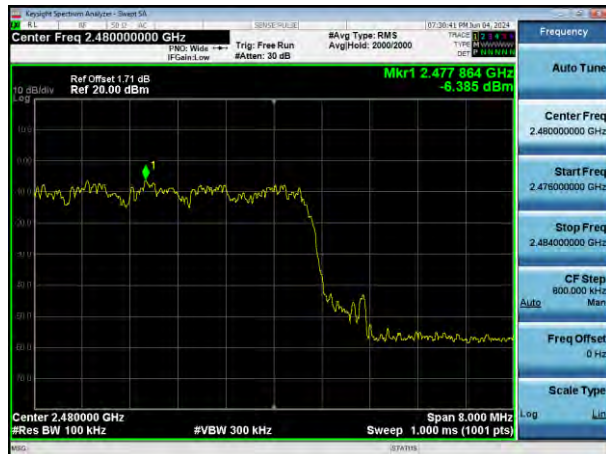


Band-edge Emission

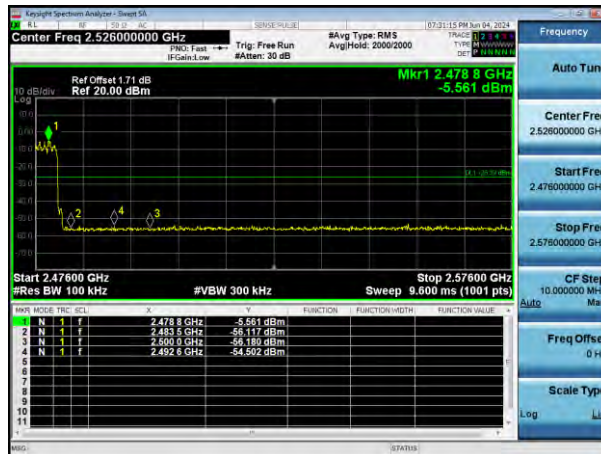


Hopping 8DPSK Highest

Reference Power



Band-edge Emission



14. Conducted RF Spurious Emissions

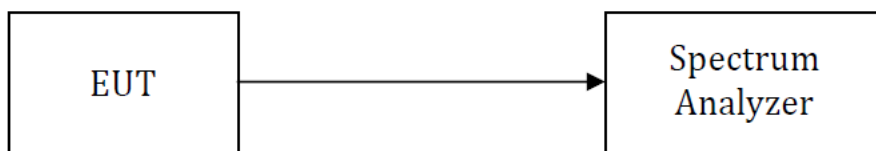
14.1 Standard and Limit

According to §15.247(d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

14.2 Test Procedure

Test is conducting under the description of ANSI C63.10 - 2013 section 6.7.

- 1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
- 2) Set the spectrum analyzer to any one measured frequency within its operating range.
- 3) Set RBW = 100kHz, VBW = 300kHz, Sweep = Auto, Detector = RMS.
- 4) Measure the highest amplitude appearing on spectral display and set it as a reference level.
- 5) Measure the spurious emissions with frequency range from 9kHz to 26.5GHz.
- 6) Repeat above procedures until all measured frequencies were complete.



Test Setup Block Diagram

14.3 Test Data and Results

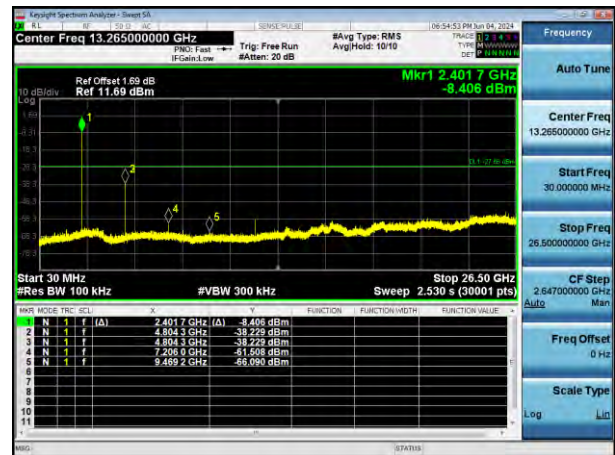
Note: The measurement frequency range is from 9kHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions measurement data.

GFSK Lowest

Reference Power



Spurious Emissions

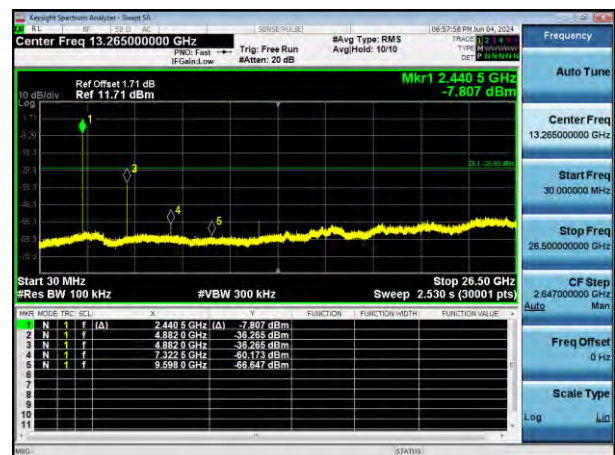


GFSK Middle

Reference Power



Spurious Emissions

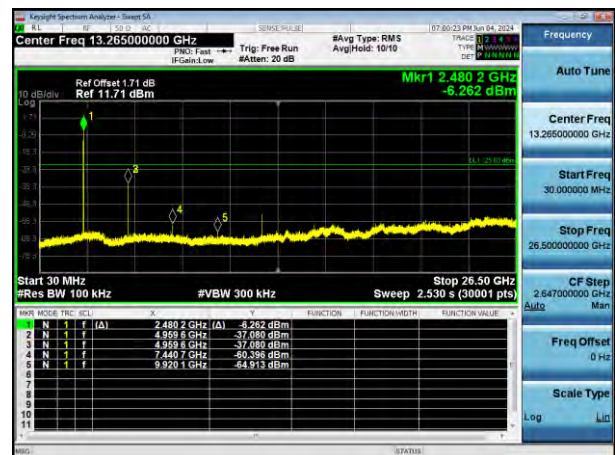


GFSK Highest

Reference Power



Spurious Emissions

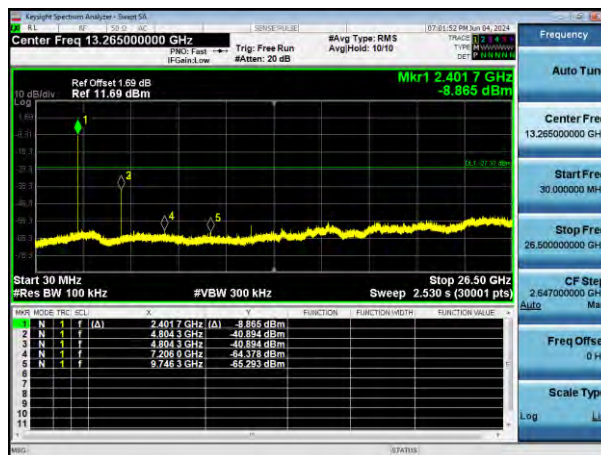


Pi/4 DQPSK Lowest

Reference Power



Spurious Emissions

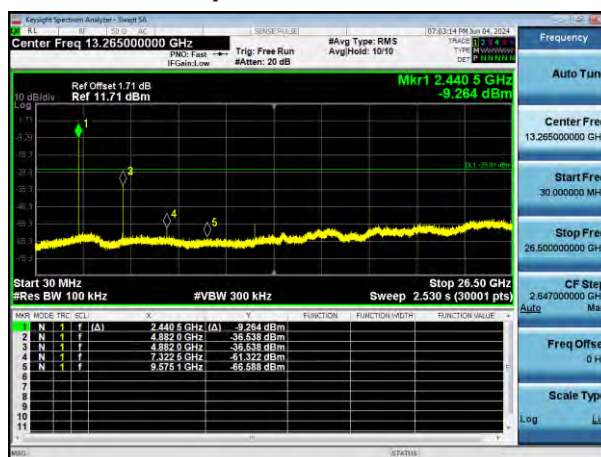


Pi/4 DQPSK Middle

Reference Power



Spurious Emissions

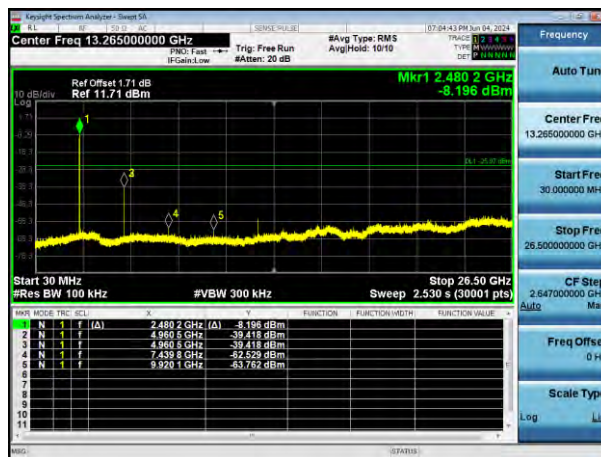


Pi/4 DQPSK Highest

Reference Power



Spurious Emissions

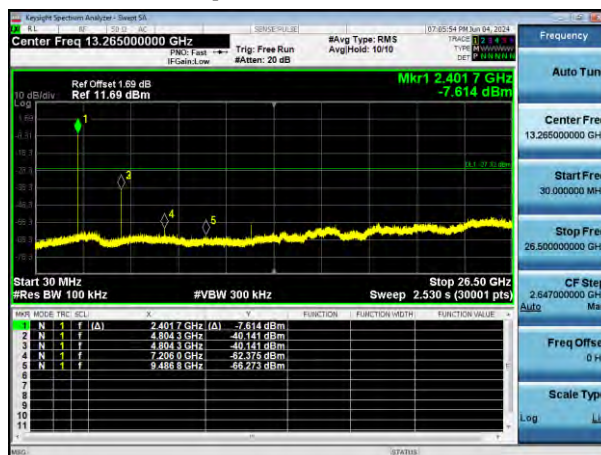


8DPSK Lowest

Reference Power



Spurious Emissions

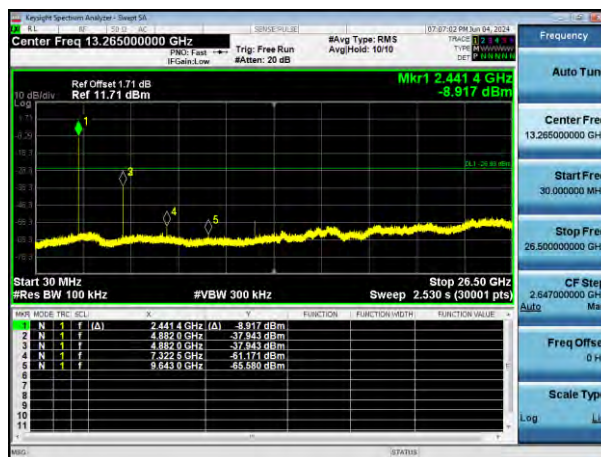


8DPSK Middle

Reference Power



Spurious Emissions

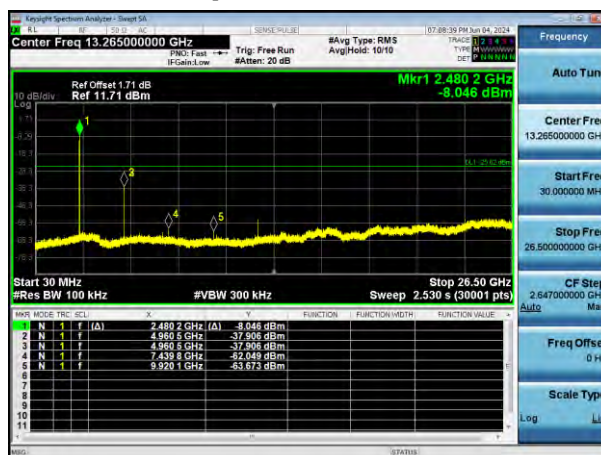


8DPSK Highest

Reference Power



Spurious Emissions



***** END OF REPORT *****