Microtest
微 测 检 测

Test Report

Report No.: MTi211206025-05E1

Date of issue: Jan. 20, 2022

Applicant: Protempo US limited, DBA Outdoor Tech

Product: Ravens

Model(s): Ravens OT5950

FCC ID: 2A2L8-OT5950

Shenzhen Microtest Co., Ltd.

http://www.mtitest.com

Address: 101, No. 7, Zone 2, Xinxing Industrial Park, Fuhai Avenue, Xinhe Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China
Tel: (86-755)88850135 Fax: (86-755) 88850136 Web: www.mtitest.com E-mail: mti@51mti.com

Instructions

1. This test report shall not be partially reproduced without the written consent of the laboratory.

2. The test results in this test report are only responsible for the samples submitted

3. This test report is invalid without the seal and signature of the laboratory.

4. This test report is invalid if transferred, altered, or tampered with in any form without authorization.

5. Any objection to this test report shall be submitted to the laboratory within 15 days from the date of receipt of the report.

Contents

1 General Description 5
1.1 Description of the EUT 5
1.2 Description of test modes 5
1.3 Measurement uncertainty 6
2 Summary of Test Result 7
3 Test Facilities and Accreditations 8
3.1 Test laboratory 8
4 Equipment List 9
5 Test Result 10
5.1 Antenna requirement 10
5.2 AC power line conducted emissions 11
5.3 20dB occupied bandwidth 14
5.4 Conducted peak output power 18
5.5 Carrier frequency separation 22
5.6 Average time of occupancy 24
5.7 Number of hopping channels 28
5.8 Conducted emissions at the band edge 30
5.9 Conducted spurious emissions 34
5.10 Radiated spurious emission 37
Photographs of the Test Setup 55
Photographs of the EUT 56

Test Result Certification	
Applicant:	**Protempo US limited, DBA Outdoor Tech**
Address:	32 Executive Park, Suite 110 Irvine, CA 92614 USA
Manufacturer:	**Shenzhen Jonter Digital Co., Ltd**
Address:	3/F, Building4, Jinfo Industrial Park, Hezhou Village, Hangcheng Town, Bao'an District, Shenzhen, Guangdong, China
Factory:	**Dongguan Jonter Digital Co., Ltd.**
Address:	Building 1, No. 5, Daguizi East Street, Tangjiao Village, Chashan Town, Dongguan, Guangdong, China
Product description	
Product name:	Ravens
Trademark:	OUTDOOR TECH
Model name:	Ravens OT5950
Serial Model:	N/A
Standards:	FCC 47 CFR Part 15 Subpart C
Test method:	ANSI C63.10-2013
Date of Test	
Date of test:	2021-12-28 ~ 2022-01-20
Test result:	Pass

Test Engineer : Danny Xu

(Danny Xu)

Reviewed By: : Leon Chen

(Leon Chen)

Approved By: : Tom Xue

(Tom Xue)

1 General Description

1.1 Description of the EUT

Product name:	Ravens
Model name:	Ravens OT5950
Series Model:	N/A
Model difference:	N/A
Electrical rating:	For earbuds: Powered by internal battery Battery for earbuds: 3.6V 60mAh Battery for charging case: 3.7V 500mAh 1.85Wh
Hardware version:	V2.0
Software version:	V1.4
Accessories:	Cable: USB-A to USB-C cable (0.3m)
EUT serial number:	MTi211206025-05-S0001
RF specification:	
Bluetooth version:	V5.0
Operation frequency:	2402 MHz ~ 2480 MHz
Modulation type:	GFSK, π/4-DQPSK, 8DPSK
Antenna designation:	FPC antenna, antenna Gain: 0 dBi
Max. peak conducted output power:	6.753 dBm

1.2 Description of test modes

1.2.1 Operation channel list

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461	-	-

1.2.2 Test channels

Chanel	Frequency
Lowest (CH0)	2402MHz
Middle (CH39)	2441MHz
Highest (CH78)	2480MHz

Note: The test software has been used to control EUT for working in engineering mode, that enables selectable channel, and capable of continuous transmitting mode.

1.2.3 Description of support units

Support equipment list			
Description	Model	Serial No.	Manufacturer
Adapter	HW-090200CH0	/	Huizhou BYD Electronics Co., Ltd.

1.3 Measurement uncertainty

Parameter	Measurement uncertainty
AC power line conducted emission (9 kHz~30 MHz)	±2.5 dB
Occupied Bandwidth	±3 %
Conducted RF output power	±0.16 dB
Conducted spurious emissions	±0.21 dB
Radiated emission (9 kHz ~ 30 MHz)	±4.0 dB
Radiated emission (30 MHz~1 GHz)	±4.2 dB
Radiated emission (above 1 GHz)	±4.3 dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

2 Summary of Test Result

No.	FCC reference	Description of test	Result
1	§ 15.203	Antenna requirement	Pass
2	§ 15.207	AC power line conducted emissions	Pass
3	15.247(a)(1)	20dB occupied bandwidth	Pass
4	15.247(b)(1)	Conducted peak output power	Pass
5	15.247(a)(1)	Carrier Frequencies Separation	Pass
6	15.247(a)(1)	Average time of occupancy (Dwell time)	Pass
7	15.247(a)(1)	Number of hopping channels	Pass
8	15.247(d)	Conducted emission at the band edge	Pass
9	15.247(d)	Conducted spurious emissions	Pass
10	15.247(d)	Radiated spurious emissions	Pass

Note: N/A means not applicable.

3 Test Facilities and Accreditations

3.1 Test laboratory

Test laboratory:	Shenzhen Microtest Co., Ltd.
Test site location:	101, No. 7, Zone 2, Xinxing Industrial Park, Fuhai Avenue, Xinhe Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China
Telephone:	(86-755)88850135
Fax:	(86-755)88850136
CNAS Registration No.:	CNAS L5868
FCC Registration No.:	448573

4 Equipment List

No.	Equipment	Manufacturer	Model	Serial No.	Cal. date	Cal. Due
MTi-E002	EMI Test Receiver	R&S	ESCI3	101368	2021/06/02	2022/06/01
MTi-E023	Artificial power network	Schwarzbeck	NSLK8127	NSLK8127#841	2021/06/02	2022/06/01
MTi-E025	Artificial power network	Schwarzbeck	NSLK8127	8127183	2021/06/02	2022/06/01
MTI-E043	EMI test receiver	R&S	ESCI7	101166	2021/06/02	2022/06/01
MTI-E046	Active Loop Antenna	Schwarzbeck	FMZB 1519 B	00044	2021/05/30	2023/05/29
MTI-E044	Broadband antenna	Schwarzbeck	VULB9163	9163-1338	2021/05/30	2023/05/29
MTI-E045	Horn antenna	Schwarzbeck	BBHA9120D	9120D-2278	2021/05/30	2023/05/29
MTI-E047	Pre-amplifier	Hewlett-Packard	8447F	3113A06184	2021/06/02	2022/06/01
MTI-E048	Pre-amplifier	Agilent	8449B	3008A01120	2021/06/02	2022/06/01
MTi-E120	Broadband antenna	Schwarzbeck	VULB9163	9163-1419	2021/05/30	2023/05/29
MTi-E121	Pre-amplifier	Hewlett-Packard	8447D	2944A09365	2021/04/16	2022/04/15
MTi-E123	Pre-amplifier	Agilent	8449B	3008A04723	2021/05/06	2022/05/05
MTi-E135	Horn antenna	Schwarzbeck	BBHA 9170	00987	2021/05/30	2023/05/29
MTi-E136	Pre-amplifier	Space-Dtronics	EWLAN1840G-G45	210405001	2021/06/02	2022/06/01
MTi-E062	PXA Signal Analyzer	Agilent	N9030A	MY51350296	2021/06/23	2022/06/22
MTi-E067	RF Control Unit	Tonscend	JS0806-1	19D8060152	2021/06/02	2022/06/01
MTi-E068	RF Control Unit	Tonscend	JS0806-2	19D8060153	2021/06/02	2022/06/01
MTi-E069	Band Reject Filter Group	Tonscend	JS0806-F	19D8060160	2021/06/02	2022/06/01
MTI-E010S	EMI Measurement Software	Farad	EZ-EMC Ver. EMEC-3A1	/	/	/
MTI-E014S	RF Test System	Tonscend	TS®JS1120 V2.6.88.0330	/	/	/

5 Test Result

5.1 Antenna requirement

15.203 requirement

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. 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. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

Description of the antenna of EUT

The antenna of EUT is FPC antenna (Antenna Gain: 0 dBi). which is no consideration of replacement.

5.2 AC power line conducted emissions

5.2.1 Limits

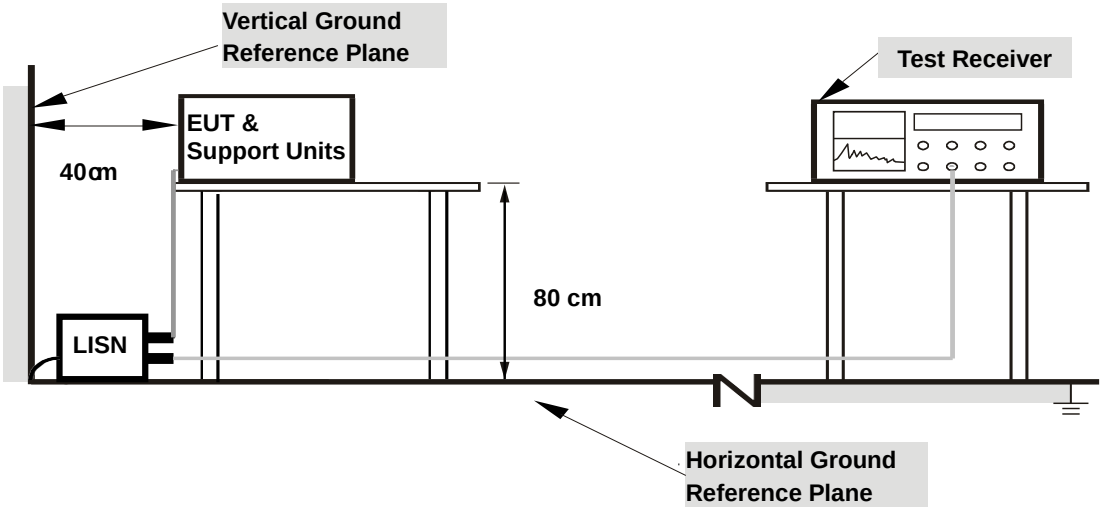
Frequency (MHz)	Detector type / Bandwidth	Limit-Quasi-peak dBμV	Limit-Average dBμV
0.15 -0.5	Average / 9 kHz	66 to 56	56 to 46
0.5 -5		56	46
5 -30		60	50

Note 1: the limit decreases with the logarithm of the frequency in the range of 0.15 MHz to 0.5 MHz.

5.2.2 Test Procedures

a) The test setup is refer to the standard ANSI C63.10-2013.
b) The EUT is connected to the main power through a line impedance stabilization network (LISN). All support equipment is powered from additional LISN(s).
c) Emissions were measured on each current carrying line of the EUT using an EMI test receiver connected to the LISN powering the EUT.
d) The test receiver scanned from 150 kHz to 30 MHz for emissions in each of the test modes described in Item 1.2.
e) The test data of the worst-case condition(s) was recorded.

5.2.3 Test setup



For the actual test configuration, please refer to the related item – Photographs of the test setup.

5.2.4 Test Result

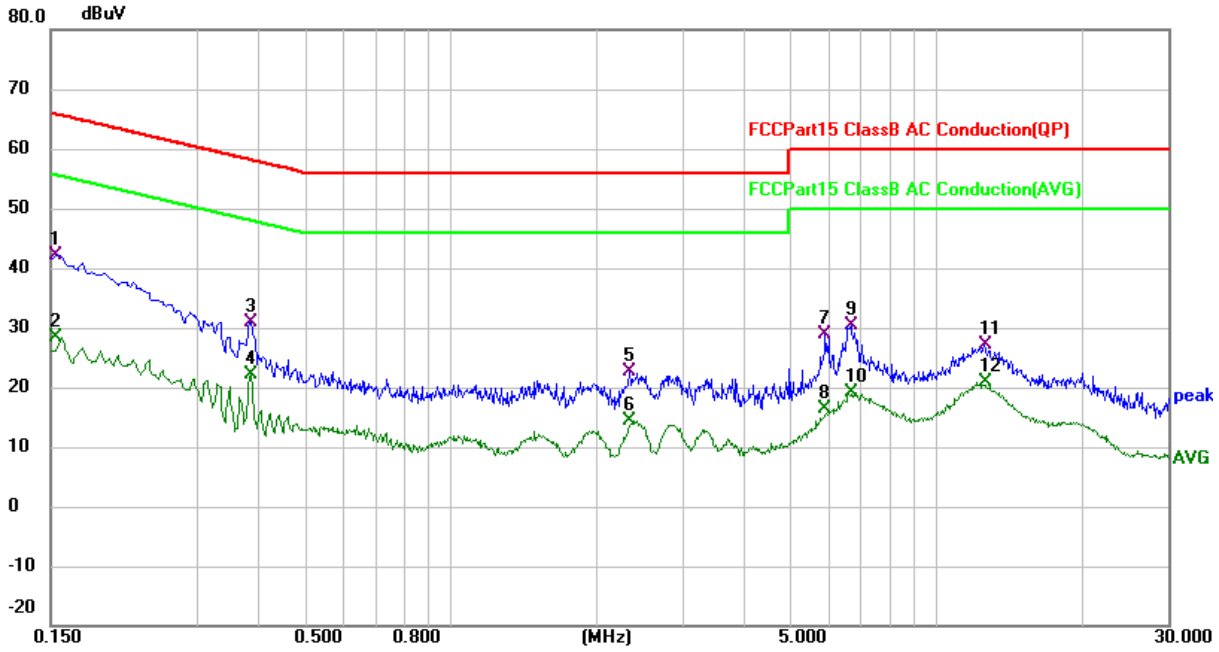
Notes:

All modes of operation of the EUT were investigated, and only the worst-case results are reported.

Calculation formula:

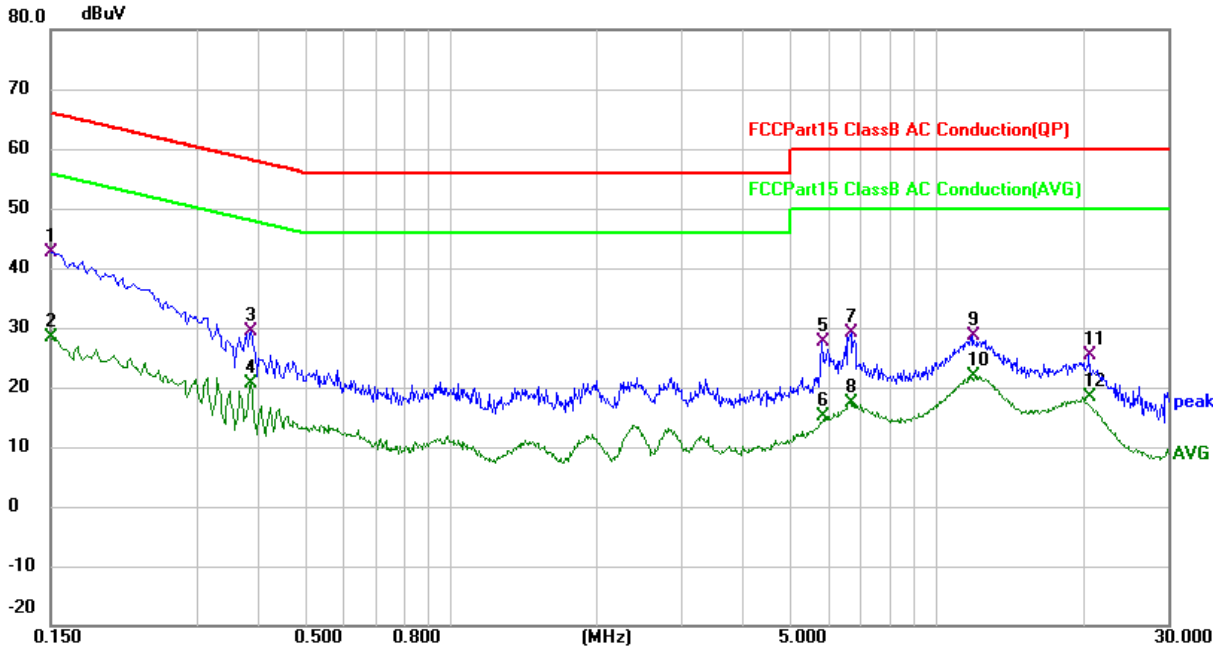
Measurement (dBμV) = Reading Level (dBμV) + Correct Factor (dB)
Over (dB) = Measurement (dBμV) – Limit (dBμV)

Test mode:	Charging+TX	Phase:	L
Power supply:	Power by AC/DC adapter (AC 120V/60Hz)	Test site:	CE chamber 1



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1	*	0.1539	31.18	10.99	42.17	65.79	-23.62	QP
2		0.1539	17.38	10.99	28.37	55.79	-27.42	AVG
3		0.3860	19.98	10.96	30.94	58.15	-27.21	QP
4		0.3860	11.12	10.96	22.08	48.15	-26.07	AVG
5		2.3420	6.46	16.08	22.54	56.00	-33.46	QP
6		2.3420	-1.64	16.08	14.44	46.00	-31.56	AVG
7		5.9100	17.22	11.54	28.76	60.00	-31.24	QP
8		5.9100	4.80	11.54	16.34	50.00	-33.66	AVG
9		6.6940	18.88	11.59	30.47	60.00	-29.53	QP
10		6.6940	7.61	11.59	19.20	50.00	-30.80	AVG
11		12.5780	15.40	11.64	27.04	60.00	-32.96	QP
12		12.5780	9.14	11.64	20.78	50.00	-29.22	AVG

Test mode:	Charging+TX	Phase:	N
Power supply:	Power by AC/DC adapter (AC 120V/60Hz)	Test site:	CE chamber 1



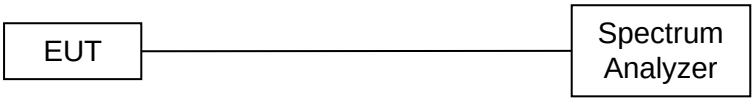
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1	*	0.1500	31.60	10.99	42.59	66.00	-23.41	QP
2		0.1500	17.36	10.99	28.35	56.00	-27.65	AVG
3		0.3860	18.37	10.89	29.26	58.15	-28.89	QP
4		0.3860	9.81	10.89	20.70	48.15	-27.45	AVG
5		5.8340	16.25	11.39	27.64	60.00	-32.36	QP
6		5.8340	3.75	11.39	15.14	50.00	-34.86	AVG
7		6.6660	17.84	11.39	29.23	60.00	-30.77	QP
8		6.6660	6.06	11.39	17.45	50.00	-32.55	AVG
9		11.9140	17.03	11.61	28.64	60.00	-31.36	QP
10		11.9140	10.29	11.61	21.90	50.00	-28.10	AVG
11		20.6220	13.43	11.84	25.27	60.00	-34.73	QP
12		20.6220	6.45	11.84	18.29	50.00	-31.71	AVG

5.3 20dB occupied bandwidth

5.3.1 Limits

None, for reporting purposes only.

5.3.2 Test setup



5.3.3 Test procedures

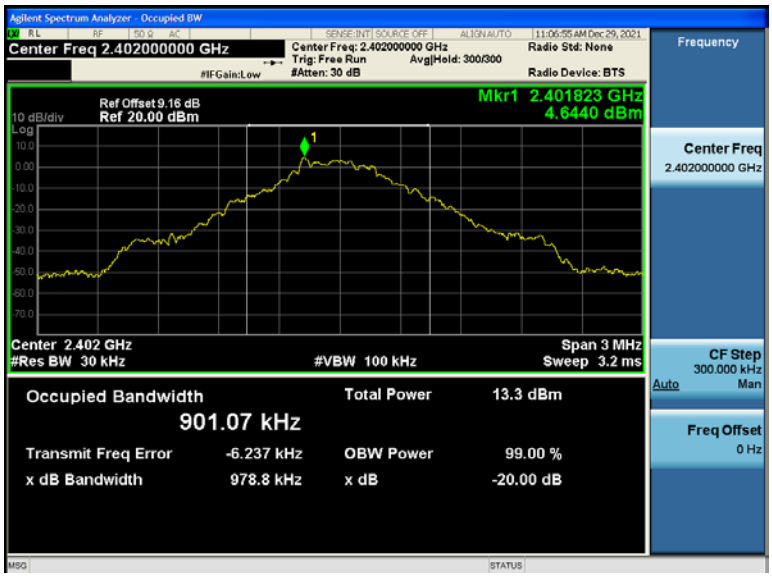
a) Test method: ANSI C63.10-2013 Section 6.9.2.
b) The transmitter output of EUT is connected to the spectrum analyzer.
c) Spectrum analyzer setting: RBW=30 kHz, VBW=100 kHz, detector= Peak

5.3.4 Test results

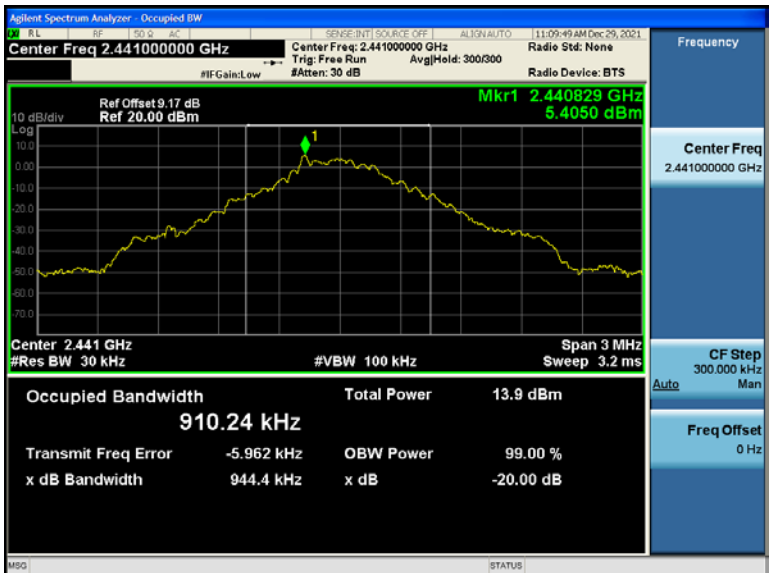
Mode	Test channel	Frequency (MHz)	20dB Bandwidth (MHz)
GFSK	CH0	2402	0.9788
	CH39	2441	0.9444
	CH78	2480	0.9557
π/4-DQPSK	CH0	2402	1.275
	CH39	2441	1.278
	CH78	2480	1.275
8DPSK	CH0	2402	1.208
	CH39	2441	1.248
	CH78	2480	1.253

GFSK mode - 20dB occupied bandwidth

CH00



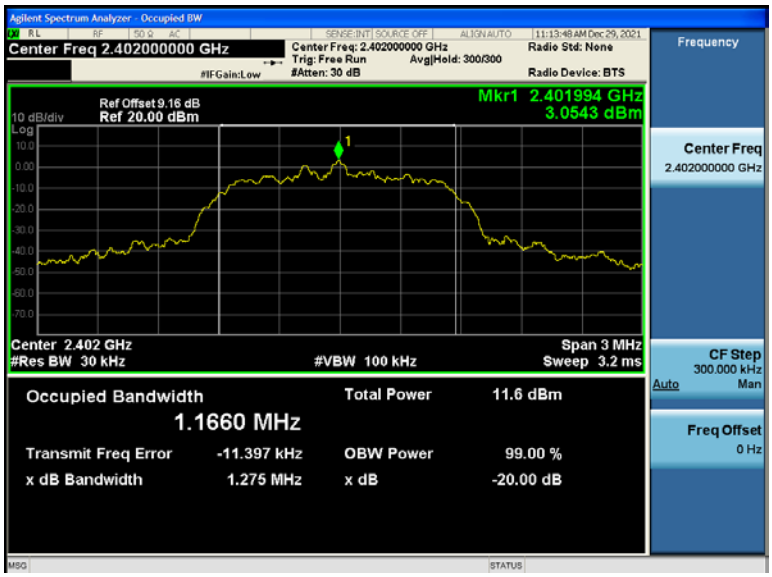
CH39



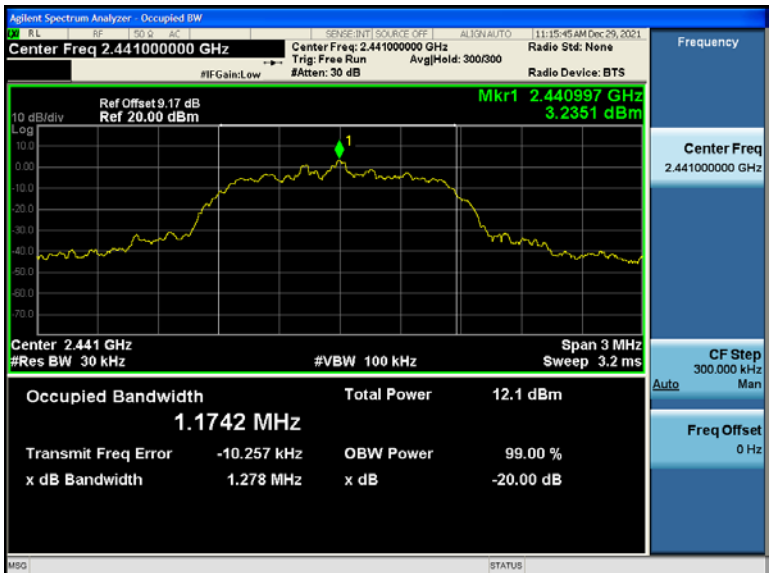
CH78

π/4-DQPSK mode - 20dB occupied bandwidth

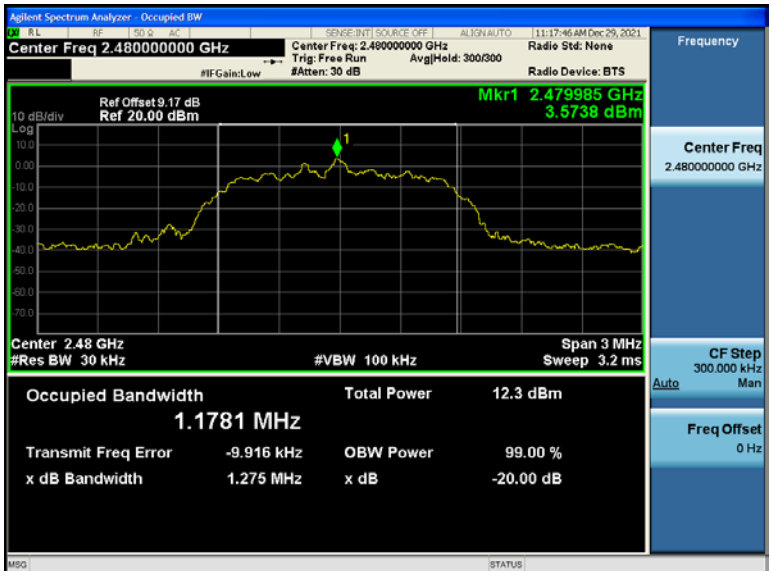
CH00



CH39

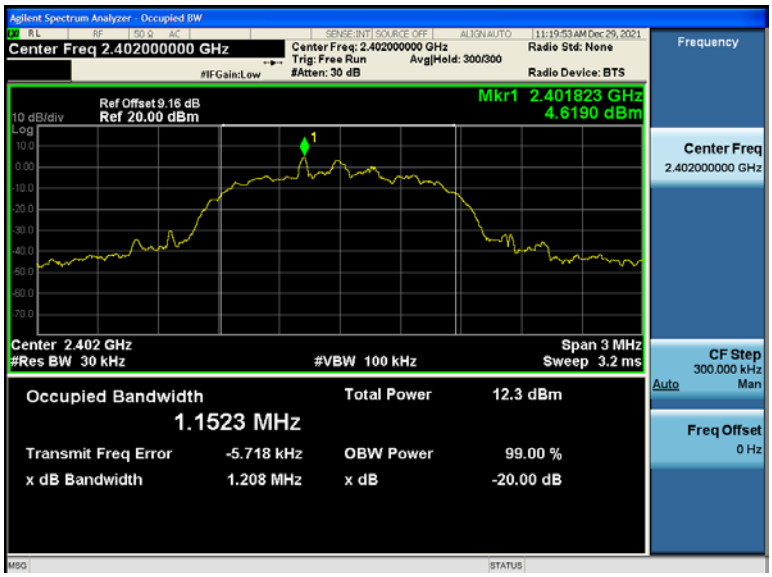


CH78



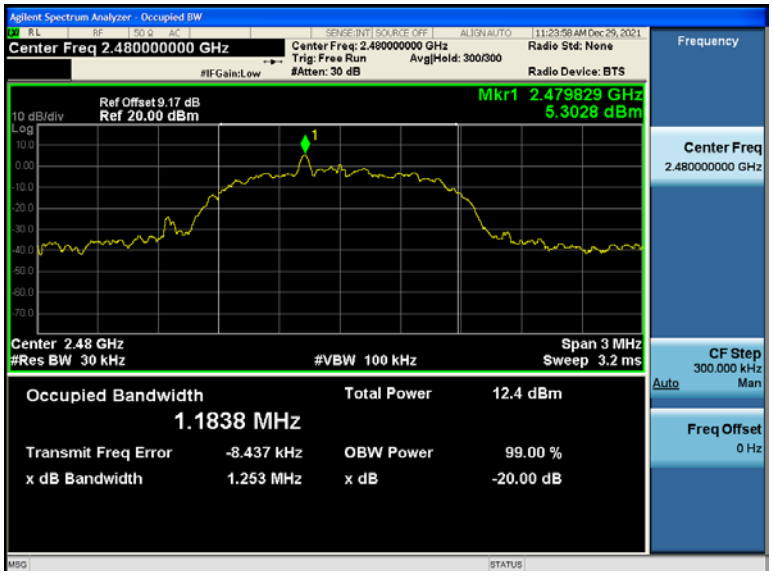
8DPSK mode - 20dB occupied bandwidth

CH00



CH39

CH78

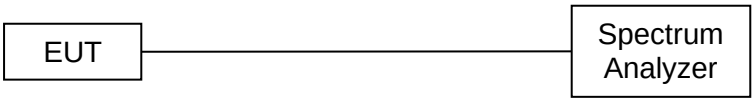


5.4 Conducted peak output power

5.4.1 Limits

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.

5.4.2 Test setup



5.4.3 Test procedure

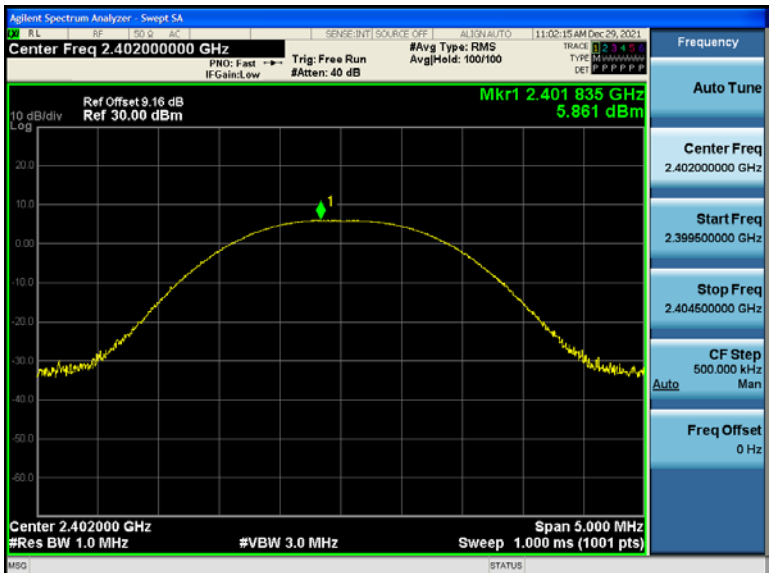
a) Test method: ANSI C63.10-2013 Section 7.8.5.
b) The EUT was set to continuously transmitting in the max power during the test.
c) The transmitter output of EUT is connected to the spectrum analyzer.
d) Spectrum analyzer setting: RBW > 20dB occupied bandwidth, VBW ≥ RBW, detector= Peak

5.4.4 Test results

Mode	Test channel	Frequency (MHz)	Conducted peak output power (dBm)	Limit (dBm)
GFSK	CH00	2402	5.861	≤ 20.97
	CH39	2441	6.400	≤ 20.97
	CH78	2480	6.272	≤ 20.97
π/4-DQPSK	CH00	2402	6.058	≤ 20.97
	CH39	2441	6.532	≤ 20.97
	CH78	2480	6.383	≤ 20.97
8DPSK	CH00	2402	6.362	≤ 20.97
	CH39	2441	6.753	≤ 20.97
	CH78	2480	6.551	≤ 20.97

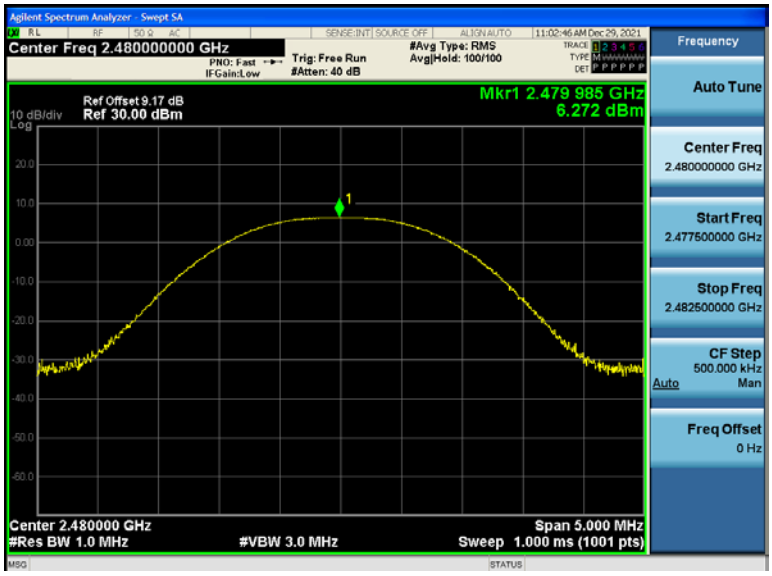
GFSK mode - peak conducted output power

CH00



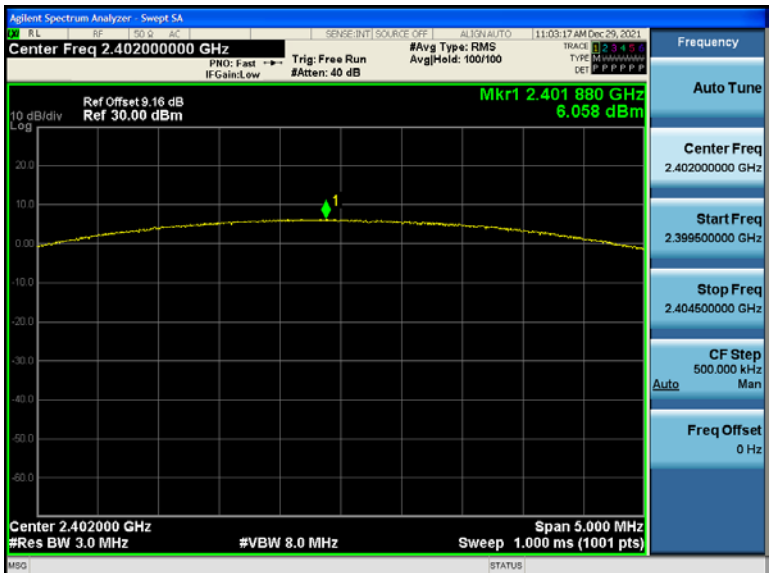
CH39

CH78

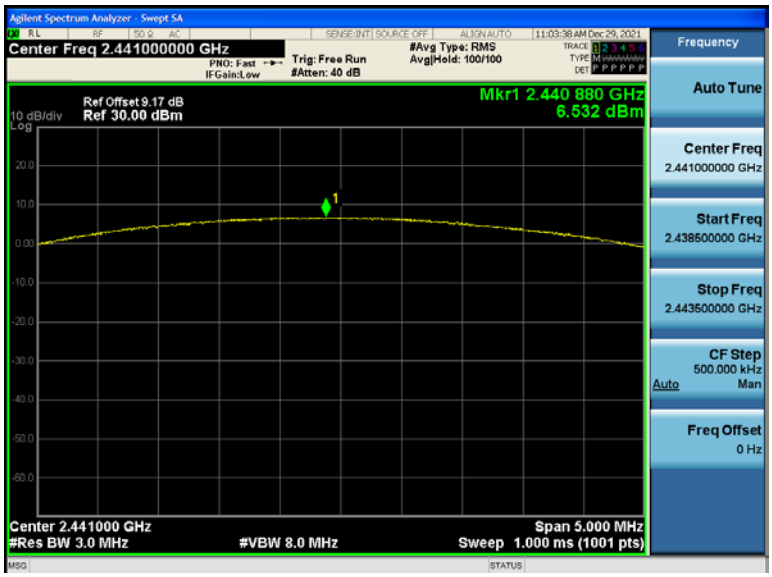


π/4-DQPSK mode - peak conducted output power

CH00



CH39

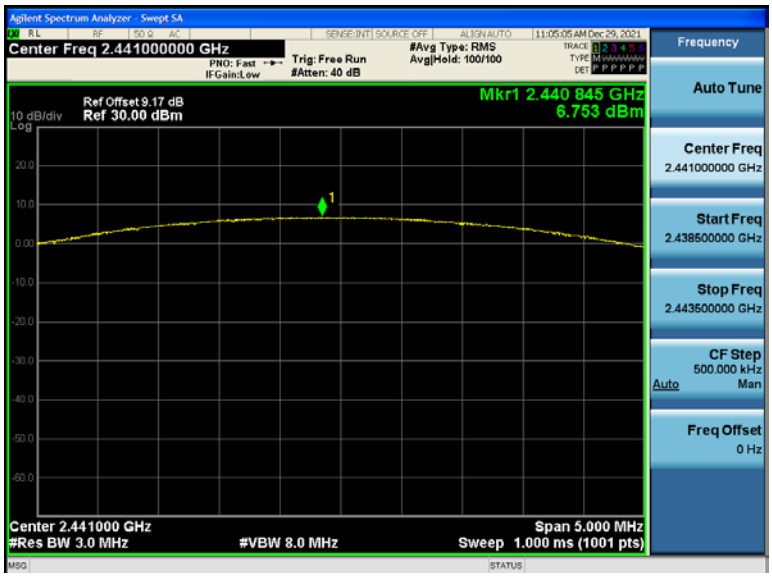


CH78

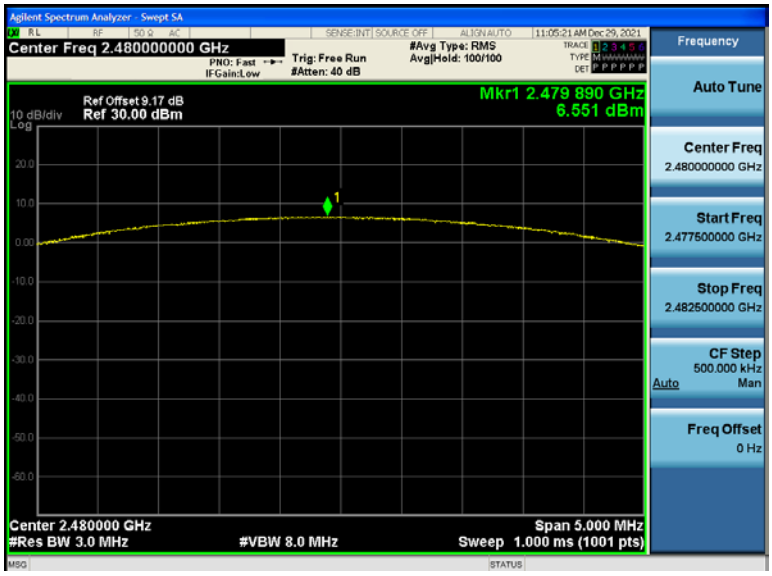
8DPSK mode – peak conducted output power

CH00

CH39



CH78



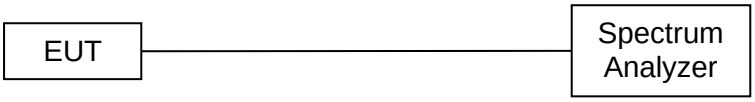
5.5 Carrier frequency separation

5.5.1 Limits

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Alternatively, 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

5.5.2 Test setup



5.5.3 Test procedure

a) Test method: ANSI C63.10-2013 Section 7.8.2.
b) The EUT was set to hopping mode during the test.
c) The transmitter output of EUT is connected to the spectrum analyzer.
d) Spectrum Setting: RBW = 30 kHz, VBW = 100 kHz, detector= Peak.

5.5.4 Test results

Mode	Test channel	Test Result (MHz)	Limit (MHz)	Result
GFSK	Hop-mode	0.996	>=0.653	Pass
π/4-DQPSK	Hop-mode	1.000	>=0.852	Pass
8DPSK	Hop-mode	0.996	>=0.835	Pass

Carrier frequency separation

GFSK

π/4-DQPSK

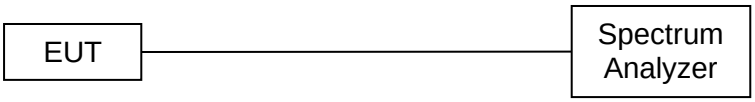
8DPSK

5.6 Average time of occupancy

5.6.1 Limits

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.

5.6.2 Test setup



5.6.3 Test procedure

a) Test method: ANSI C63.10-2013 Section 7.8.4
b) The EUT was set to hopping mode during the test.
c) The tranistter output of EUT is connneted to the specturm analyzer.
d) Spectrum analyzer setting: RBW = 1MHz, VBW = 3MHz, Span = 0Hz, Detector = Peak, weep time: As necessary to capture the entire dwell time per hopping channel.
e) Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:
f) The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements.

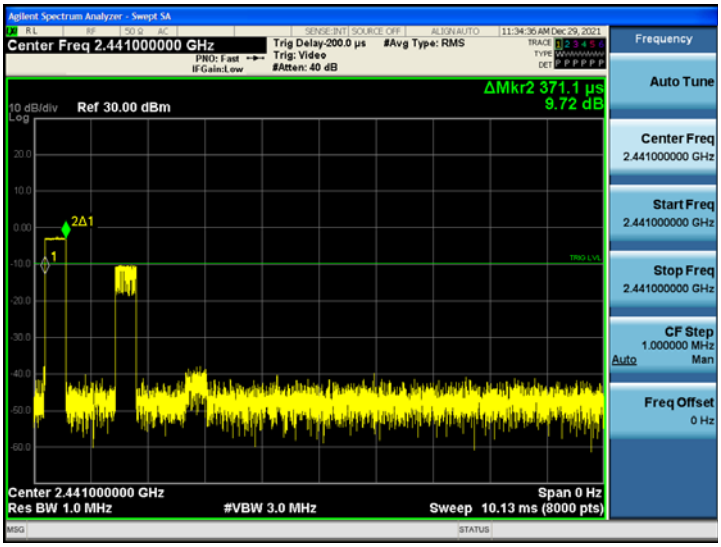
5.6.4 Test results

Mode	Data Packet	Frequency (MHz)	Pulse width (ms)	Number of pulses in 3.16 s	Average time of occupancy (s)	Limit (s)	Result
GFSK	DH1	2441	0.37	32	0.119	<=0.4	Pass
	DH3	2441	1.62	16	0.259	<=0.4	Pass
	DH5	2441	2.87	11	0.316	<=0.4	Pass
π/4-DQPSK	2DH1	2441	0.38	32	0.121	<=0.4	Pass
	2DH3	2441	1.63	16	0.261	<=0.4	Pass
	2DH5	2441	2.88	11	0.317	<=0.4	Pass
8DPSK	3DH1	2441	0.38	32	0.122	<=0.4	Pass
	3DH3	2441	1.63	16	0.261	<=0.4	Pass
	3DH5	2441	2.88	11	0.317	<=0.4	Pass

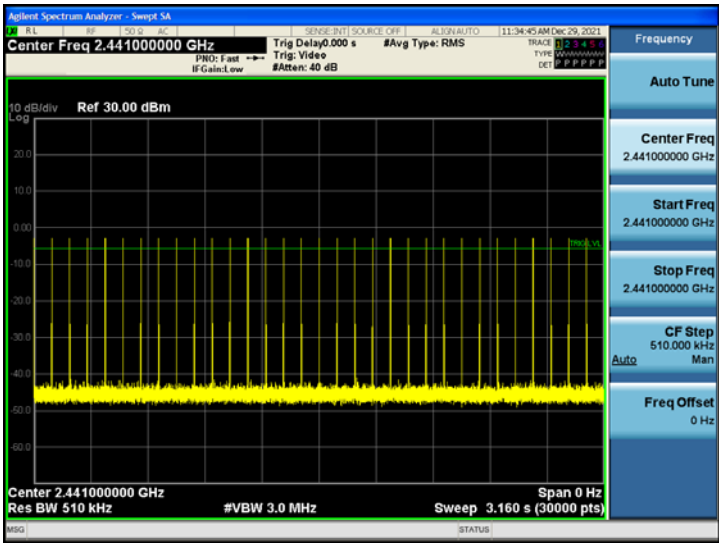
Notes:
1. Period time = 0.4 (s) * 79 = 31.6(s)
2. Average time of occupancy = Pulse width * Number of pulses in 3.16s * 10

GFSK mode - Average time of occupancy

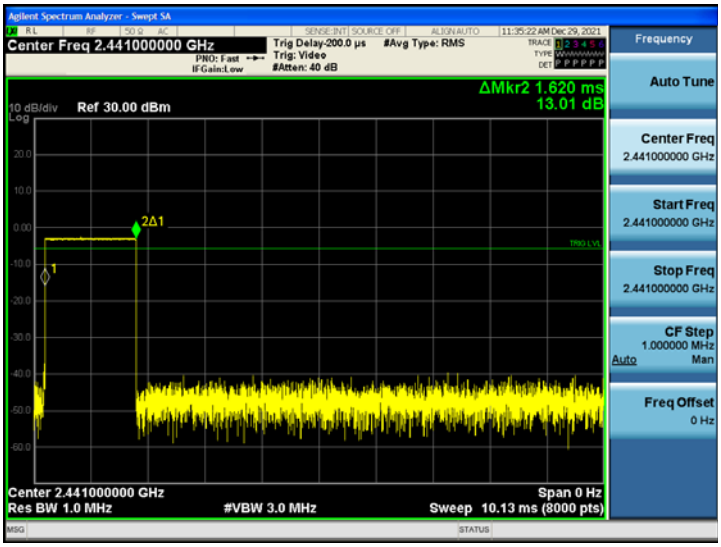
Pulse width – DH1



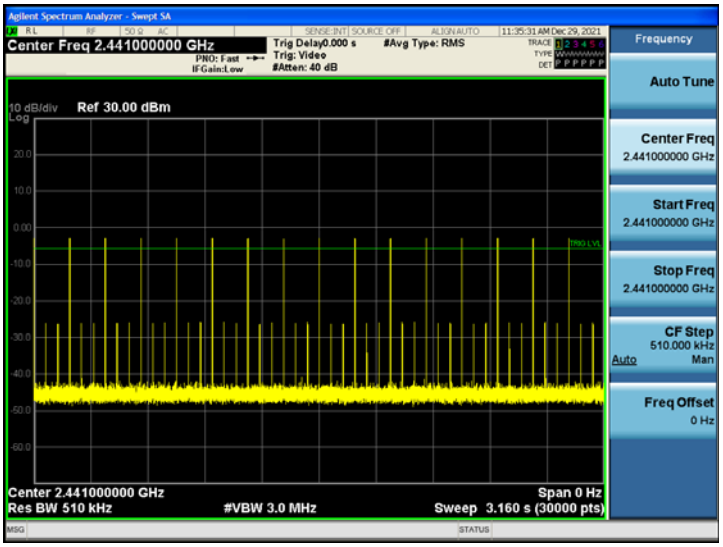
Number of pulses in 3.16 s – DH1



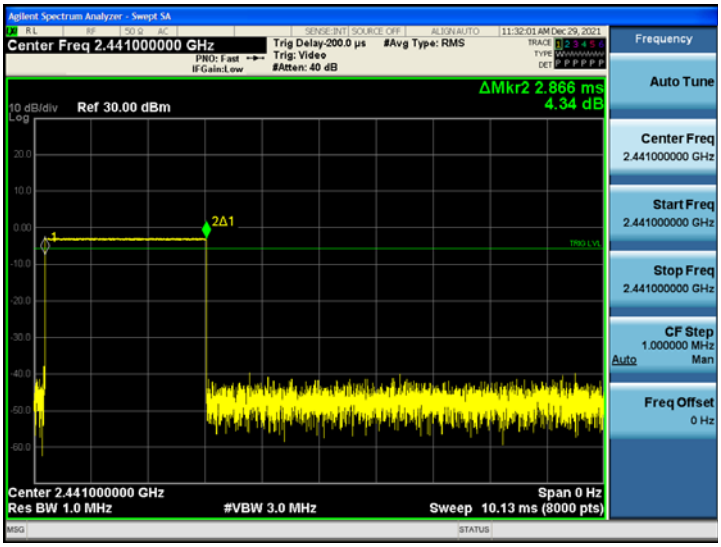
Pulse width – DH3



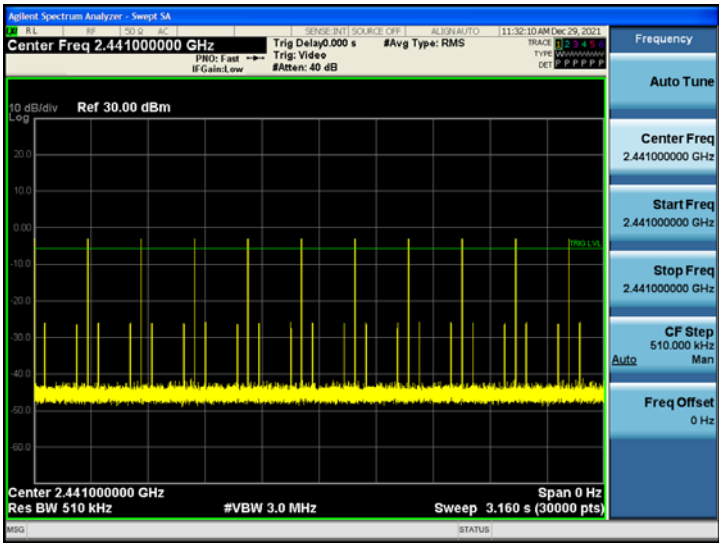
Number of pulses in 3.16 s – DH3



Pulse width – DH5

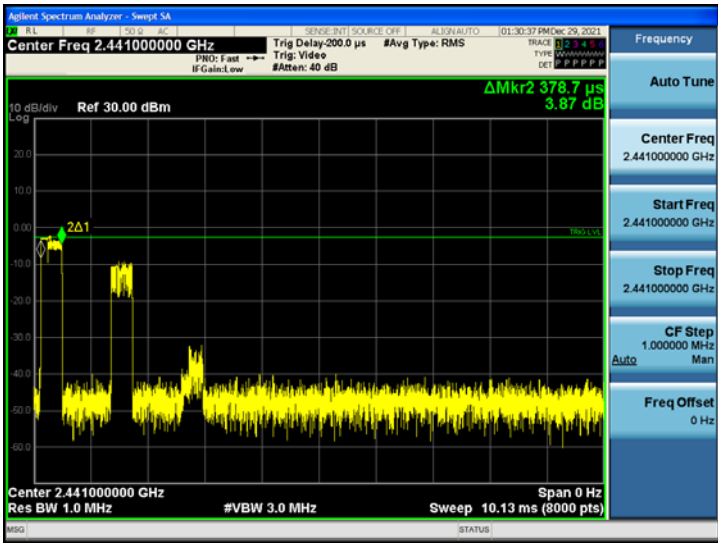


Number of pulses in 3.16 s – DH5

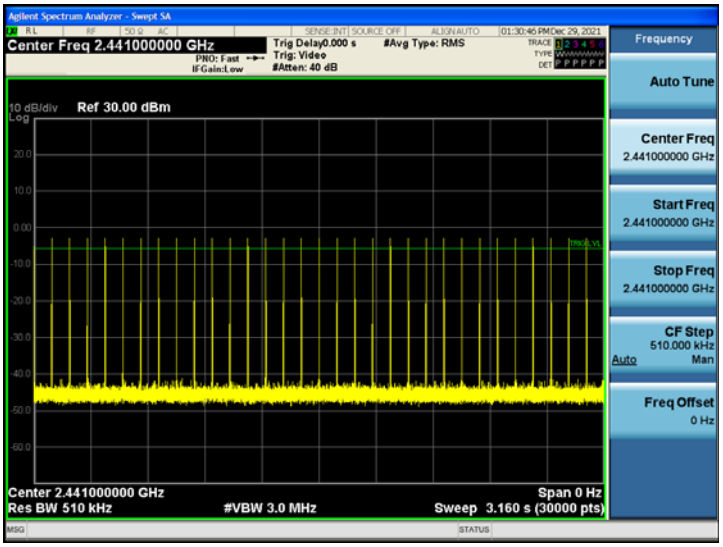


π/4-DQPSK - Average time of occupancy

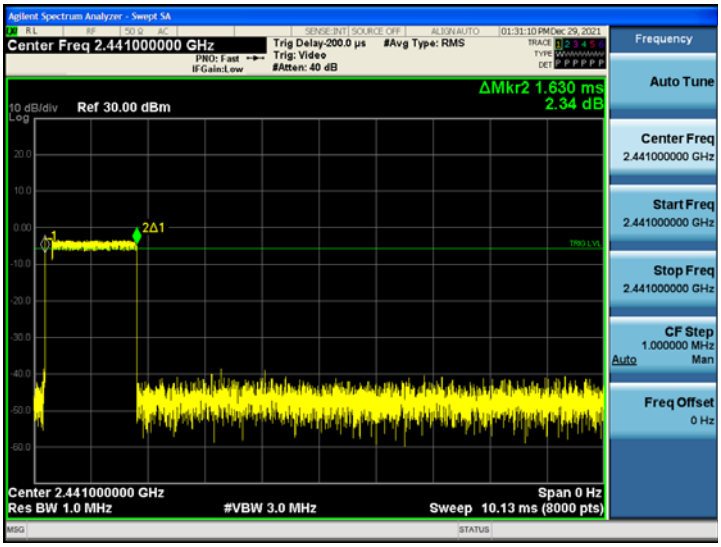
Pulse width – 2DH1



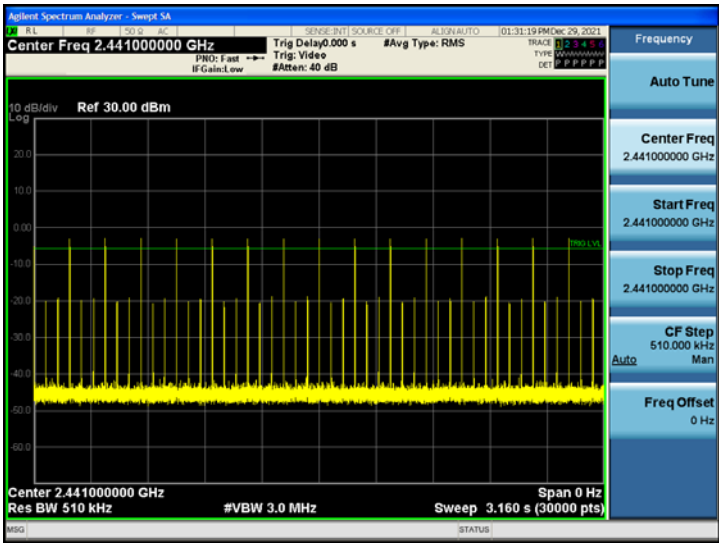
Number of pulses in 3.16 s – 2DH1



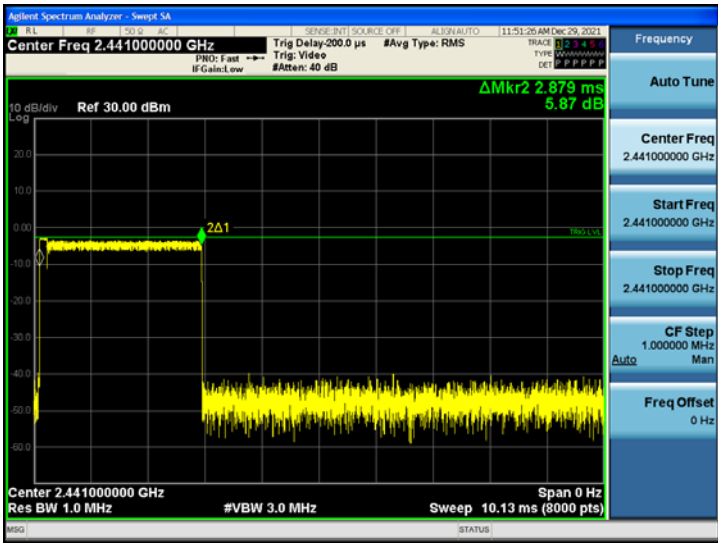
Pulse width – 2DH3



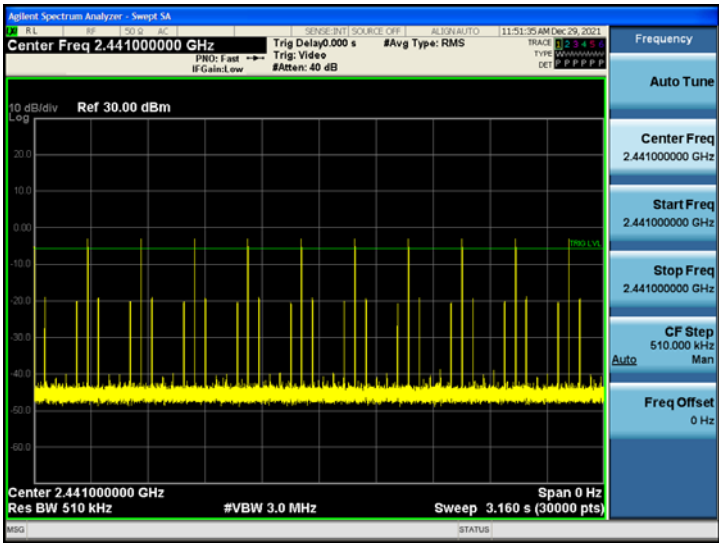
Number of pulses in 3.16 s – 2DH3



Pulse width – 2DH5

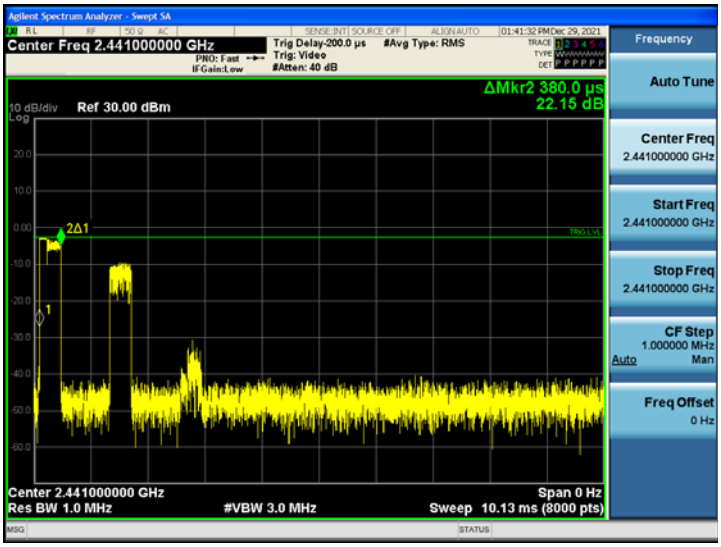


Number of pulses in 3.16 s – 2DH5

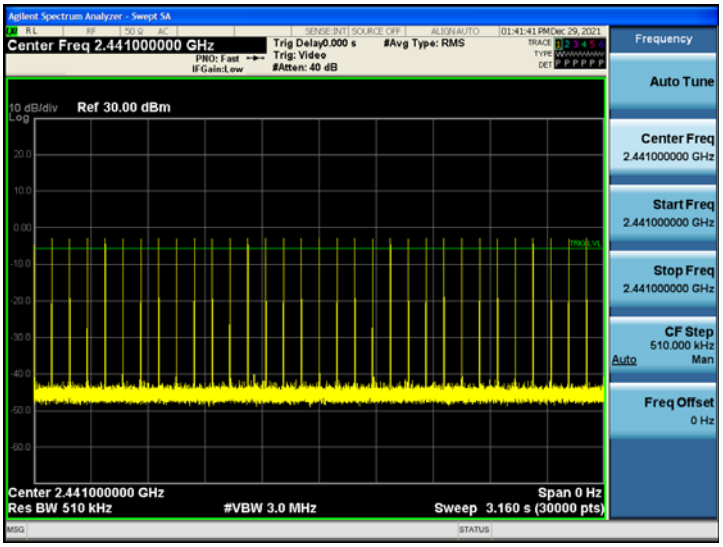


8DPSK - Average time of occupancy

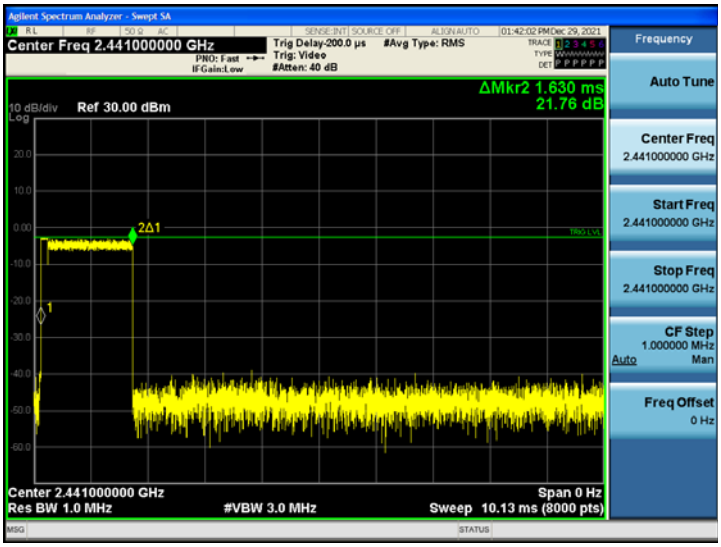
Pulse width – 3DH1



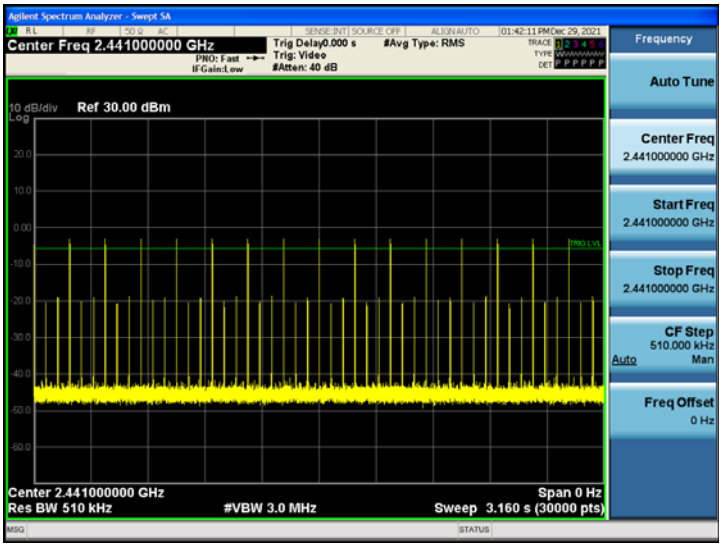
Number of pulses in 3.16 s – 3DH1



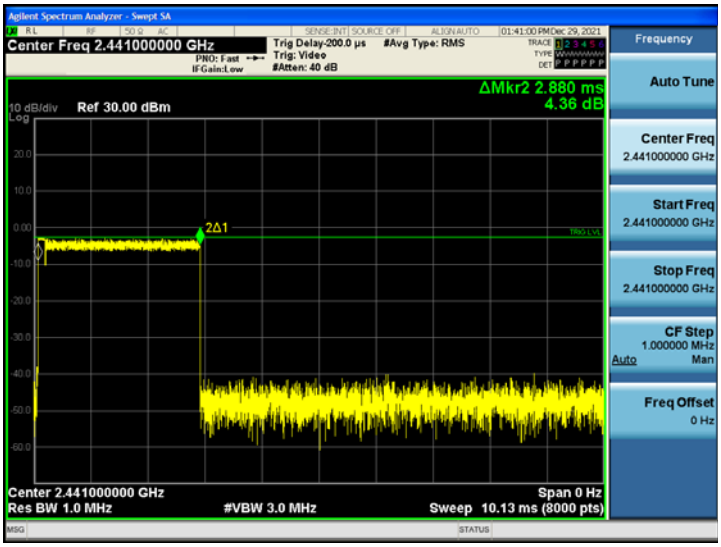
Pulse width – 3DH3



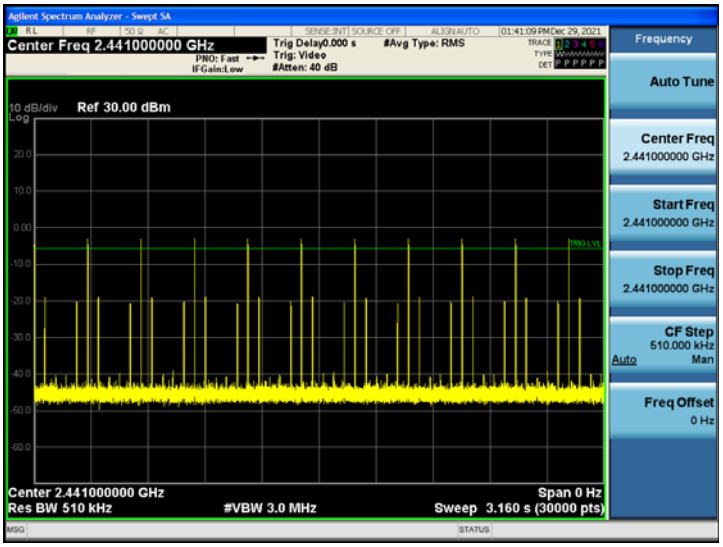
Number of pulses in 3.16 s – 3DH3



Pulse width – 3DH5



Number of pulses in 3.16 s – 3DH5

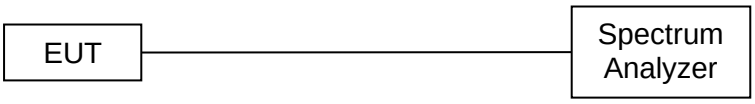


5.7 Number of hopping channels

5.7.1 Limit

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

5.7.2 Test setup



5.7.3 Test procedure

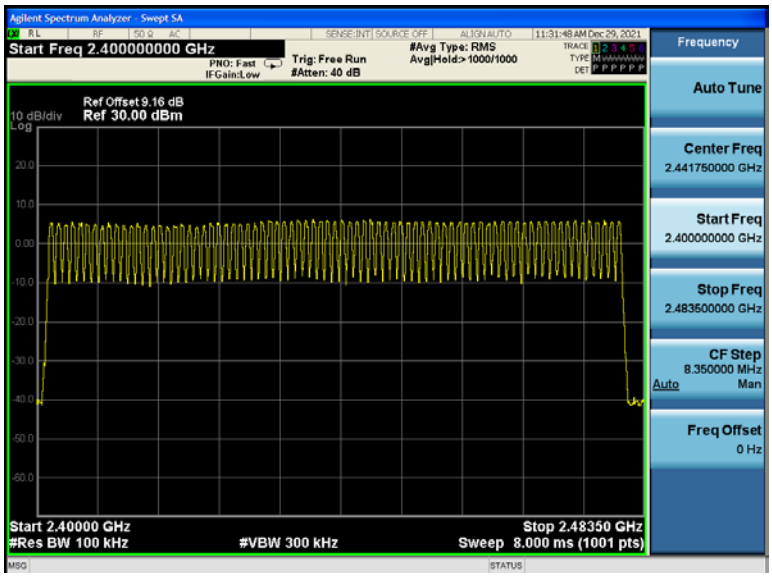
a) Test method: ANSI C63.10-2013 Section 7.8.3
b) The EUT was set to hopping mode during the test.
c) The tranistter output of EUT is connneted to the specturm analyzer.
d) Spectrum analyzer setting: RBW = 100 kHz, VBW = 300 klHz, Detector = Peak.

5.7.4 Test results

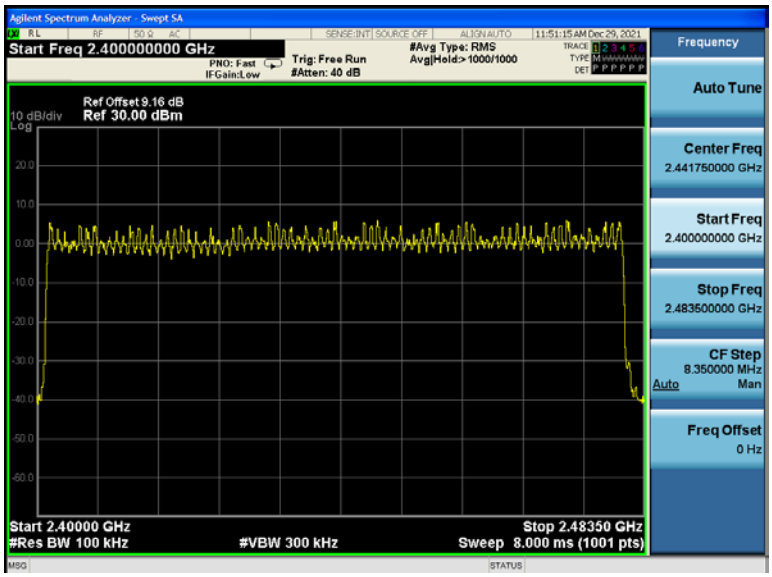
Mode	Quantity of Hopping Channel	Limit	Results
GFSK	79	≥15	Pass
π/4-DQPSK	79	≥15	Pass
8DPSK	79	≥15	Pass

Number of hopping channels

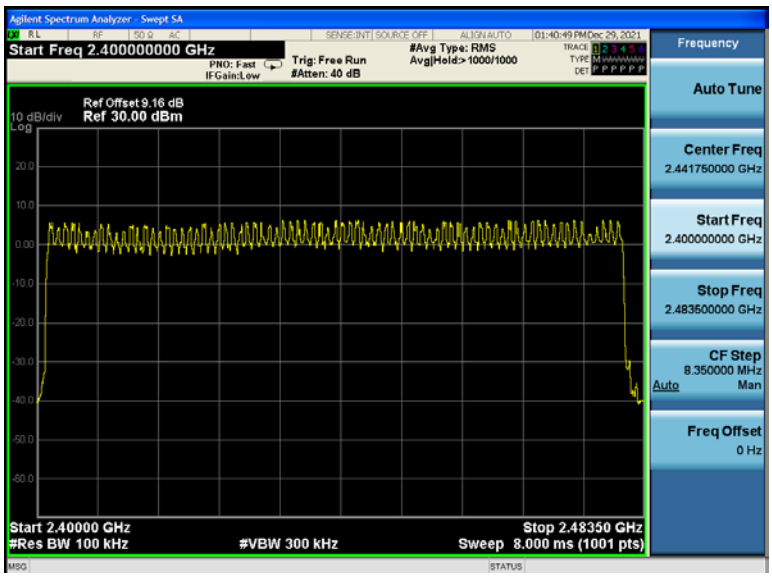
GFSK



π/4-DQPSK



8DPSK

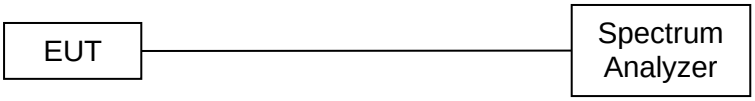


5.8 Conducted emissions at the band edge

5.8.1 Limits

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)).

5.8.2 Test setup



5.8.3 Test procedure

a) Test method: ANSI C63.10-2013 Section 6.10.4
b) The EUT was set to non-hopping mode & hopping mode during the test.
c) The transmitter output of EUT is connected to the spectrum analyzer.
d) Spectrum analyzer setting: RBW = 100 kHz, VBW = 300 kHz, Detector = Peak.

5.8.4 Test results