

TEST REPORT

Product : Unified communications Speakerphone
Trade mark : VHD
Model/Type reference : VHD-M300, M300
Serial Number : N/A
Report Number : EED32M00308701
FCC ID : 2ATFO-M300
Date of Issue : Nov. 26, 2020
Test Standards : 47 CFR Part 15 Subpart C
Test result : PASS

Prepared for:

ValueHD Corporation
3/F, No.2, Honghui Industrial Park, Xin'an Street,
Bao'an District, Shenzhen, China

Prepared by:

Centre Testing International Group Co., Ltd.
Hongwei Industrial Zone, Bao'an 70 District,
Shenzhen, Guangdong, China
TEL: +86-755-3368 3668
FAX: +86-755-3368 3385

Compiled by:

Sunlight Sun

Sunlight Sun

Reviewed by:

Tom chen

Tom chen

Approved by:

Aaron Ma

Aaron Ma

Date:

Nov. 26, 2020



Check No.:4762161569

2 Version

Version No.	Date	Description
00	Nov. 26, 2020	Original

3 Test Summary

Test Item	Test Requirement	Test method	Result
Antenna Requirement	47 CFR Part 15, Subpart C Section 15.203/15.247 (c)	ANSI C63.10-2013	PASS
AC Power Line Conducted Emission	47 CFR Part 15, Subpart C Section 15.207	ANSI C63.10-2013	PASS
Conducted Peak Output Power	47 CFR Part 15, Subpart C Section 15.247 (b)(1)	ANSI C63.10-2013	PASS
20dB Occupied Bandwidth	47 CFR Part 15, Subpart C Section 15.247 (a)(1)	ANSI C63.10-2013	PASS
Carrier Frequencies Separation	47 CFR Part 15, Subpart C Section 15.247 (a)(1)	ANSI C63.10-2013	PASS
Hopping Channel Number	47 CFR Part 15, Subpart C Section 15.247 (b)	ANSI C63.10-2013	PASS
Dwell Time	47 CFR Part 15, Subpart C Section 15.247 (a)(1)	ANSI C63.10-2013	PASS
Pseudo random Frequency Hopping Sequence	47 CFR Part 15, Subpart C Section 15.247(b)(4)&TCB Exclusion List (7 July 2002)	ANSI C63.10-2013	PASS
RF Conducted Spurious Emissions	47 CFR Part 15, Subpart C Section 15.247(d)	ANSI C63.10-2013	PASS
Radiated Spurious emissions	47 CFR Part 15, Subpart C Section 15.205/15.209	ANSI C63.10-2013	PASS
Restricted bands around fundamental frequency (Radiated Emission)	47 CFR Part 15 Subpart C Section 15.205/15.209	ANSI C63.10-2013	PASS

Remark:

Test according to ANSI C63.4-2014 & ANSI C63.10-2013.

Company Name and Address shown on Report, the sample(s) and sample Information was/ were provided by the applicant who should be responsible for the authenticity which CTI hasn't verified.

Model No.: VHD-M300, M300

Only the model VHD-M300 was tested, since the electrical circuit design, layout, components used and internal wiring were identical for the above models, with difference being sales area, customer base and model name.

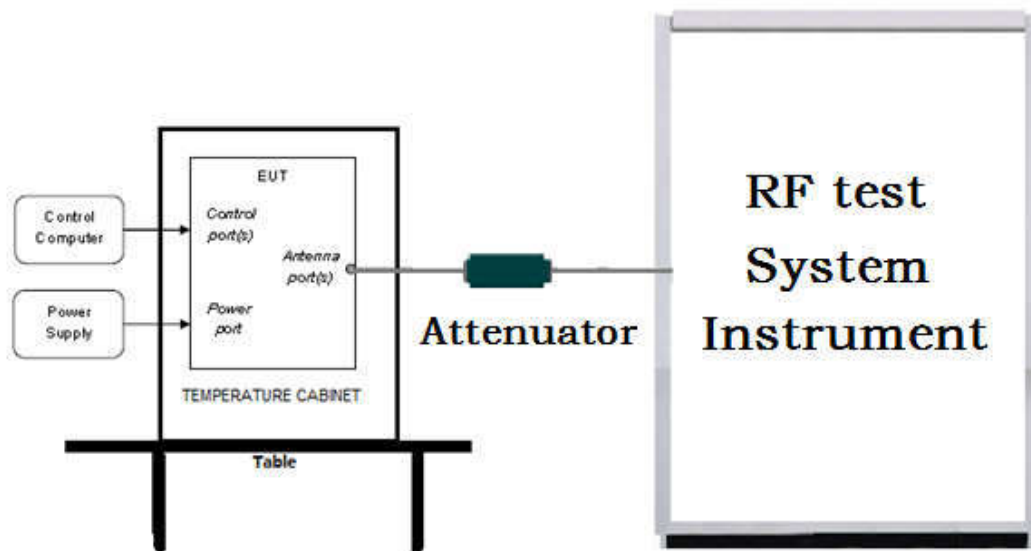
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5 Test Requirement

5.1 Test setup

5.1.1 For Conducted test setup



5.1.2 For Radiated Emissions test setup

Radiated Emissions setup:

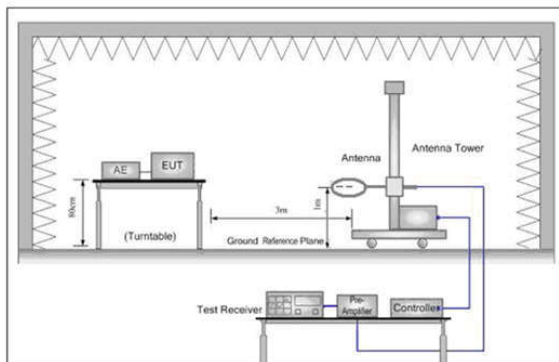


Figure 1. Below 30MHz

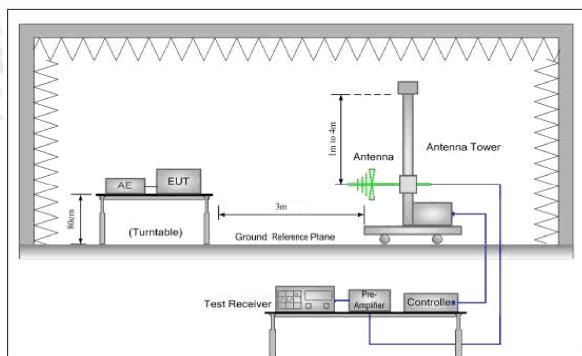


Figure 2. 30MHz to 1GHz

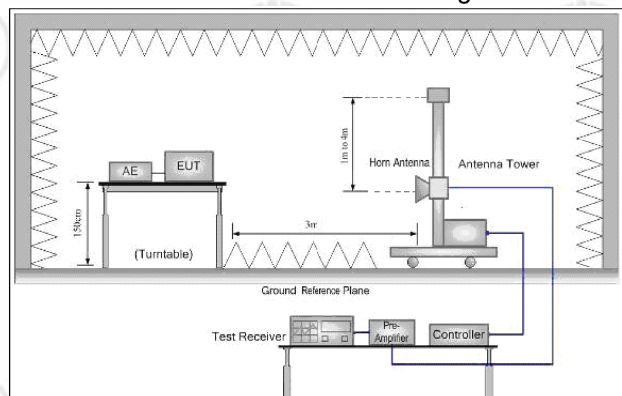
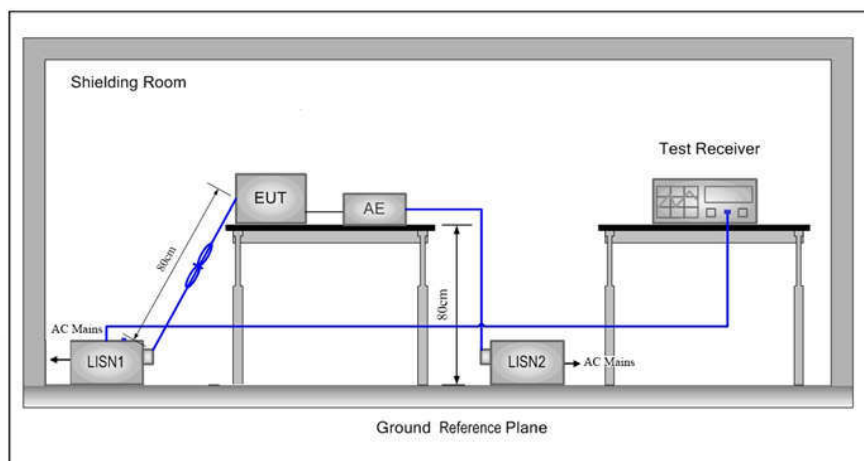


Figure 3. Above 1GHz

5.1.3 For Conducted Emissions test setup

Conducted Emissions setup



5.2 Test Environment

Operating Environment:	
Temperature:	24 °C
Humidity:	55 % RH
Atmospheric Pressure:	1010mbar

5.3 Test Condition

Test Mode	Tx/Rx	RF Channel		
		Low(L)	Middle(M)	High(H)
GFSK/π/4DQPSK/ 8DPSK(DH1,DH3,DH5)	2402MHz ~2480 MHz	Channel 0	Channel 39	Channel78
		2402MHz	2441MHz	2480MHz

6 General Information

6.1 Client Information

Applicant:	ValueHD Corporation
Address of Applicant:	3/F, No.2, Honghui Industrial Park, Xin'an Street, Bao'an District, Shenzhen, China
Manufacturer:	ValueHD Corporation
Address of Manufacturer:	3/F, No.2, Honghui Industrial Park, Xin'an Street, Bao'an District, Shenzhen, China
Factory:	ValueHD Corporation
Address of Factory:	3/F, No.2, Honghui Industrial Park, Xin'an Street, Bao'an District, Shenzhen, China

6.2 General Description of EUT

Product Name:	Unified communications Speakerphone
Model No.(EUT):	VHD-M300, M300
Test Mode No.:	VHD-M300
Trade mark:	VHD
EUT Supports Radios application	2402MHz to 2480MHz
Power Supply:	DC 5V
	Battery Model: SUN-INTE-308 Capacity: 6500mAh 23.4Wh Nominal Voltage: 3.6V Limited Charge Voltage: 4.2V
Sample Received Date:	Sep. 27, 2020
Sample tested Date:	Sep. 27, 2020 to Oct. 17, 2020

6.3 Product Specification subjective to this standard

Operation Frequency:	2402MHz~2480MHz
Bluetooth Version:	BT Classic
Modulation Technique:	Frequency Hopping Spread Spectrum(FHSS)
Modulation Type:	GFSK, $\pi/4$ DQPSK, 8DPSK
Number of Channel:	79
Hopping Channel Type:	Adaptive Frequency Hopping systems
Test Power Grade:	Default
Test Software of EUT:	FCC.exe
Antenna Type:	Internal antenna
Antenna Gain:	2.93dBi
Test Voltage:	DC 5V

Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
0	2402MHz	20	2422MHz	40	2442MHz	60	2462MHz
1	2403MHz	21	2423MHz	41	2443MHz	61	2463MHz
2	2404MHz	22	2424MHz	42	2444MHz	62	2464MHz
3	2405MHz	23	2425MHz	43	2445MHz	63	2465MHz
4	2406MHz	24	2426MHz	44	2446MHz	64	2466MHz
5	2407MHz	25	2427MHz	45	2447MHz	65	2467MHz
6	2408MHz	26	2428MHz	46	2448MHz	66	2468MHz
7	2409MHz	27	2429MHz	47	2449MHz	67	2469MHz
8	2410MHz	28	2430MHz	48	2450MHz	68	2470MHz
9	2411MHz	29	2431MHz	49	2451MHz	69	2471MHz
10	2412MHz	30	2432MHz	50	2452MHz	70	2472MHz
11	2413MHz	31	2433MHz	51	2453MHz	71	2473MHz
12	2414MHz	32	2434MHz	52	2454MHz	72	2474MHz
13	2415MHz	33	2435MHz	53	2455MHz	73	2475MHz
14	2416MHz	34	2436MHz	54	2456MHz	74	2476MHz
15	2417MHz	35	2437MHz	55	2457MHz	75	2477MHz
16	2418MHz	36	2438MHz	56	2458MHz	76	2478MHz
17	2419MHz	37	2439MHz	57	2459MHz	77	2479MHz
18	2420MHz	38	2440MHz	58	2460MHz	78	2480MHz
19	2421MHz	39	2441MHz	59	2461MHz		

6.4 Description of Support Units

The EUT has been tested with associated equipment below.

Associated equipment name		Manufacture	model	S/N serial number	Supplied by	Certification
AE1	Power Supply Unit	OPPO	Ak993JH	J51642000007	CTI	FCC

6.5 Test Location

All tests were performed at:

Centre Testing International Group Co., Ltd.

Building C, Hongwei Industrial Park Block 70, Bao'an District, Shenzhen, China

Telephone: +86 (0) 755 33683668 Fax: +86 (0) 755 33683385

No tests were sub-contracted.

FCC Designation No.: CN1164

6.6 Deviation from Standards

None.

6.7 Abnormalities from Standard Conditions

None.

6.8 Other Information Requested by the Customer

None.

6.9 Measurement Uncertainty(95% confidence levels, k=2)

No.	Item	Measurement Uncertainty
1	Radio Frequency	7.9×10^{-8}
2	RF power, conducted	0.46dB (30MHz-1GHz)
		0.55dB (1GHz-18GHz)
3	Radiated Spurious emission test	4.3dB (30MHz-1GHz)
		4.5dB (1GHz-12.75GHz)
4	Conduction emission	3.5dB (9kHz to 150kHz)
		3.1dB (150kHz to 30MHz)
5	Temperature test	0.64°C
6	Humidity test	3.8%
7	DC power voltages	0.026%

7 Equipment List

RF test system					
Equipment	Manufacturer	Mode No.	Serial Number	Cal. Date (mm-dd-yyyy)	Cal. Due date (mm-dd-yyyy)
Spectrum Analyzer	Keysight	N9010A	MY54510339	02-17-2020	02-16-2021
Signal Generator	Keysight	N5182B	MY53051549	02-17-2020	02-16-2021
Temperature/ Humidity Indicator	biaozhi	HM10	1804186	06-29-2020	06-28-2021
High-pass filter	Sinoscite	FL3CX03WG18NM 12-0398-002	---	---	---
High-pass filter	MICRO- TRONICS	SPA-F-63029-4	---	---	---
DC Power	Keysight	E3642A	MY56376072	02-17-2020	02-16-2021
PC-1	Lenovo	R4960d	---	---	---
BT&WI-FI Automatic control	R&S	OSP120	101374	02-17-2020	02-16-2021
RF control unit	JS Tonscend	JS0806-2	158060006	02-17-2020	02-16-2021
BT&WI-FI Automatic test software	JS Tonscend	JS1120-3	---	---	---

Conducted disturbance Test					
Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm-dd-yyyy)	Cal. Due date (mm-dd-yyyy)
Receiver	R&S	ESCI	100435	04-28-2020	04-27-2021
Temperature/ Humidity Indicator	Defu	TH128	/	---	---
LISN	R&S	ENV216	100098	03-05-2020	03-04-2021
Barometer	changchun	DYM3	1188	---	---

3M full-anechoic Chamber					
Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm-dd-yyyy)	Cal. Due date (mm-dd-yyyy)
RSE Automatic test software	JS Tonscend	JS36-RSE	10166	---	---
Receiver	Keysight	N9038A	MY57290136	03-05-2020	03-04-2021
Spectrum Analyzer	Keysight	N9020B	MY57111112	03-05-2020	03-04-2021
Spectrum Analyzer	Keysight	N9030B	MY57140871	03-05-2020	03-04-2021
TRILOG Broadband Antenna	Schwarzbeck	VULB 9163	9163-1148	04-25-2018	04-24-2021
Horn Antenna	Schwarzbeck	BBHA 9170	9170-832	04-25-2018	04-24-2021
Horn Antenna	ETS-LINDGREN	3117	00057407	07-10-2018	07-09-2021
Preamplifier	EMCI	EMC184055SE	980597	05-20-2020	05-19-2021
Preamplifier	EMCI	EMC001330	980563	04-22-2020	04-21-2021
Preamplifier	JS Tonscend	980380	EMC051845 SE	01-09-2020	01-08-2021
Temperature/Humidity Indicator	biaozhi	GM1360	EE1186631	04-27-2020	04-26-2021
Fully Anechoic Chamber	TDK	FAC-3	---	01-17-2018	01-16-2021
Filter bank	JS Tonscend	JS0806-F	188060094	04-10-2018	04-09-2021
Cable line	Times	SFT205-NMSM-2.50M	394812-0001	---	---
Cable line	Times	SFT205-NMSM-2.50M	394812-0002	---	---
Cable line	Times	SFT205-NMSM-2.50M	394812-0003	---	---
Cable line	Times	SFT205-NMSM-2.50M	393495-0001	---	---
Cable line	Times	EMC104-NMNM-1000	SN160710	---	---
Cable line	Times	SFT205-NMSM-3.00M	394813-0001	---	---
Cable line	Times	SFT205-NMNM-1.50M	381964-0001	---	---
Cable line	Times	SFT205-NMSM-7.00M	394815-0001	---	---
Cable line	Times	HF160-KMKM-3.00M	393493-0001	---	---

3M Semi/full-anechoic Chamber					
Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm-dd-yyyy)	Cal. Due date (mm-dd-yyyy)
3M Chamber & Accessory Equipment	TDK	SAC-3	---	05-24-2019	05-23-2022
TRILOG Broadband Antenna	Schwarzbeck	VULB9163	9163-618	05-16-2020	05-15-2021
Loop Antenna	Schwarzbeck	FMZB 1519B	1519B-076	04-25-2018	04-24-2021
Receiver	R&S	ESCI7	100938-003	10-21-2019	10-20-2020
Multi device Controller	maturo	NCD/070/10711 112	---	---	---
Temperature/ Humidity Indicator	Shanghai qixiang	HM10	1804298	06-29-2020	06-28-2021
Cable line	Fulai(7M)	SF106	5219/6A	---	---
Cable line	Fulai(6M)	SF106	5220/6A	---	---
Cable line	Fulai(3M)	SF106	5216/6A	---	---
Cable line	Fulai(3M)	SF106	5217/6A	---	---

8 Radio Technical Requirements Specification

Reference documents for testing:

No.	Identity	Document Title
1	FCC Part15C	Subpart C-Intentional Radiators
2	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

Test Results List:

Test requirement	Test method	Test item	Verdict	Note
Part15C Section 15.247 (a)(1)	ANSI 63.10	20dB Occupied Bandwidth	PASS	Appendix A)
Part15C Section 15.247 (a)(1)	ANSI 63.10	Carrier Frequencies Separation	PASS	Appendix B)
Part15C Section 15.247 (a)(1)	ANSI 63.10	Dwell Time	PASS	Appendix C)
Part15C Section 15.247 (b)	ANSI 63.10	Hopping Channel Number	N/A	Appendix D)
Part15C Section 15.247 (b)(1)	ANSI 63.10	Conducted Peak Output Power	N/A	Appendix E)
Part15C Section 15.247(d)	ANSI 63.10	Band-edge for RF Conducted Emissions	N/A	Appendix F)
Part15C Section 15.247(d)	ANSI 63.10	RF Conducted Spurious Emissions	PASS	Appendix G)
Part15C Section 15.247 (a)(1)	ANSI 63.10	Pseudo random Frequency Hopping Sequence	PASS	Appendix H)
Part15C Section 15.203/15.247 (c)	ANSI 63.10	Antenna Requirement	PASS	Appendix I)
Part15C Section 15.207	ANSI 63.10	AC Power Line Conducted Emission	PASS	Appendix J)
Part15C Section 15.205/15.209	ANSI 63.10	Restricted bands around fundamental frequency (Radiated) Emission)	PASS	Appendix K)
Part15C Section 15.205/15.209	ANSI 63.10	Radiated Spurious Emissions	PASS	Appendix L)

Appendix A): 20dB Occupied Bandwidth

Test Limit

According to §15.247(a) (1)

20 dB Bandwidth : For reporting purposes only.

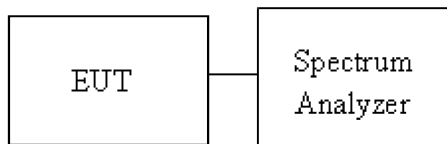
Occupied Bandwidth(99%) : For reporting purposes only.

Test Procedure

Test method Refer as Section 8.1 and ANSI C63.10: 2013 clause 7.8.7,

1. The EUT RF output connected to the spectrum analyzer by RF cable.
2. Setting maximum power transmit of EUT
3. SA set RBW =30kHz, VBW = 100kHz and Detector = Peak, to measurement 20dB Bandwidth.
4. SA set RBW = 1% ~ 5% OBW, VBW = three times the RBW and Detector = Peak, to measurement 99% Bandwidth.
5. Measure and record the result of 20 dB Bandwidth and 99% Bandwidth. in the test report.

Test Setup

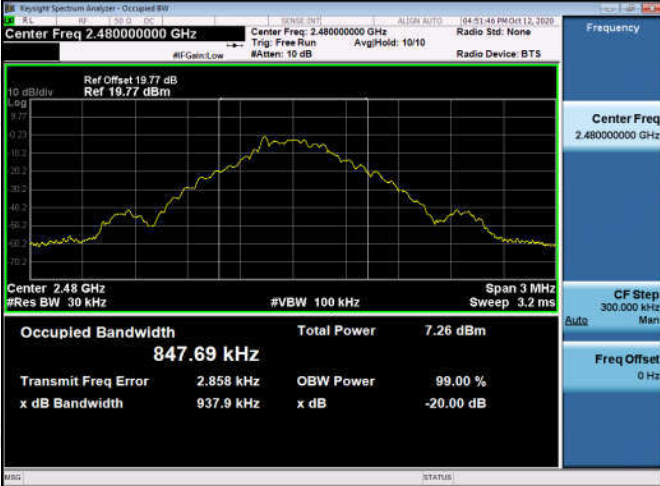
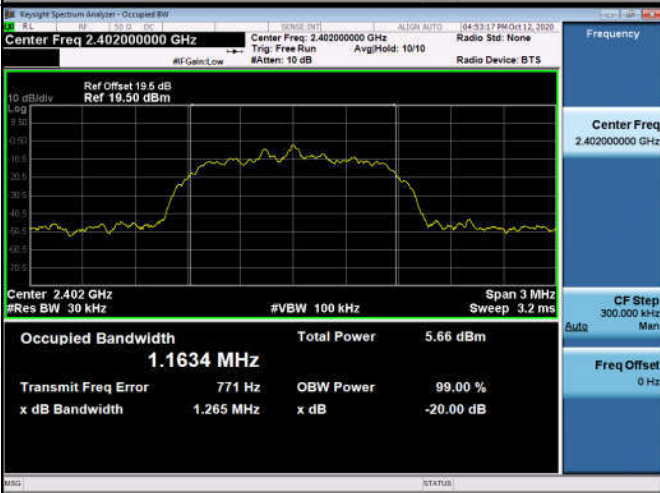
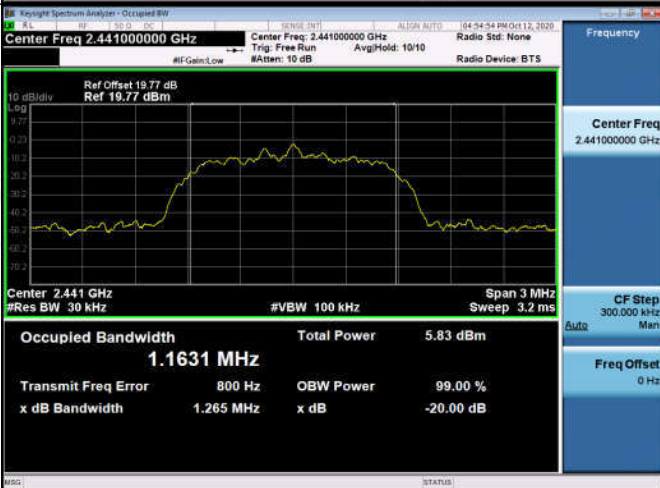


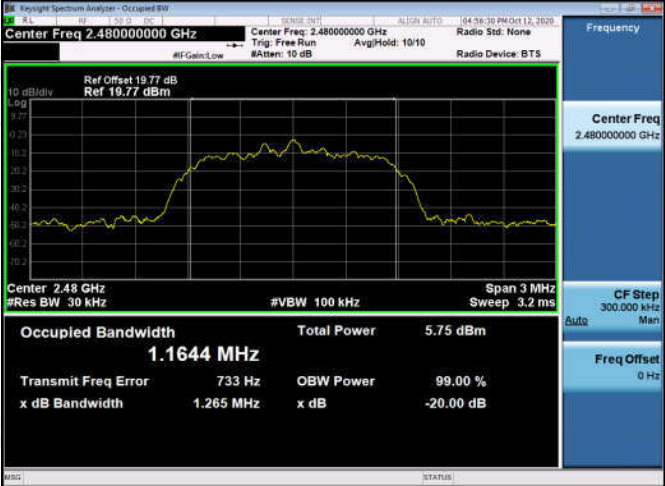
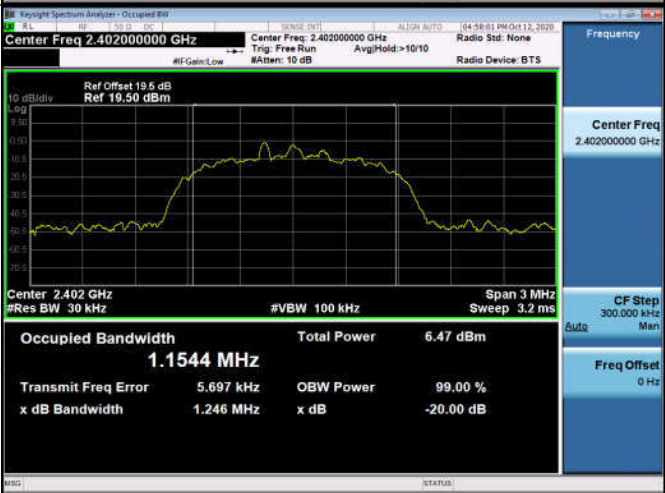
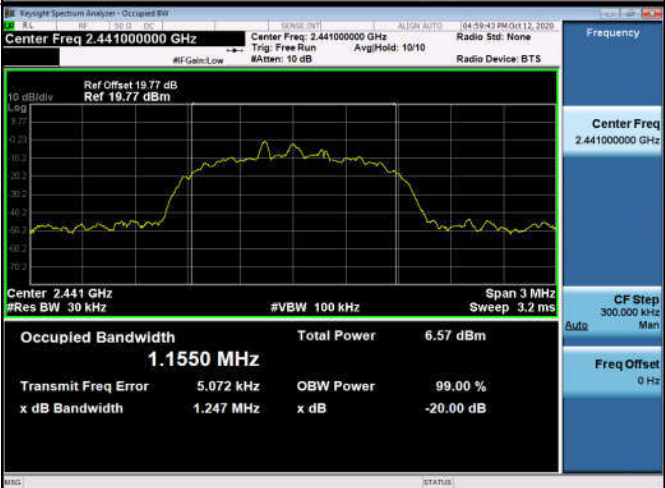
Test Result

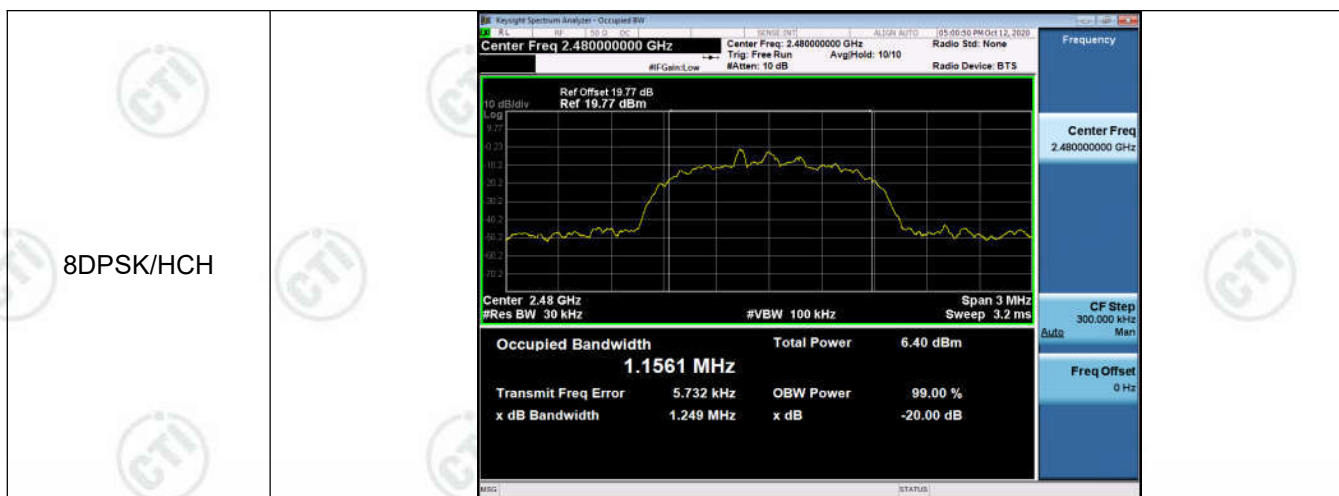
Mode	Channel.	20dB Bandwidth [MHz]	99% OBW [MHz]	Verdict
GFSK	LCH	0.9397	0.84868	PASS
GFSK	MCH	0.9386	0.84800	PASS
GFSK	HCH	0.9379	0.84769	PASS
π /4DQPSK	LCH	1.265	1.1634	PASS
π /4DQPSK	MCH	1.265	1.1631	PASS
π /4DQPSK	HCH	1.265	1.1644	PASS
8DPSK	LCH	1.246	1.1544	PASS
8DPSK	MCH	1.247	1.1550	PASS
8DPSK	HCH	1.249	1.1561	PASS

Test Graph



GFSK/HCH	 Keyight Spectrum Analyzer - Occupied BW Center Freq 2.480000000 GHz Ref Offset 19.77 dB Ref 19.77 dBm Center 2.48 GHz #Res BW 30 kHz #VBW 100 kHz Span 3 MHz Sweep 3.2 ms Occupied Bandwidth 847.69 kHz Total Power 7.26 dBm Transmit Freq Error 2.858 kHz OBW Power 99.00 % x dB Bandwidth 937.9 kHz x dB -20.00 dB Frequency Center Freq 2.480000000 GHz CF Step 300.000 kHz Freq Offset 0 Hz
π /4DQPSK/LCH	 Keyight Spectrum Analyzer - Occupied BW Center Freq 2.402000000 GHz Ref Offset 19.50 dB Ref 19.50 dBm Center 2.402 GHz #Res BW 30 kHz #VBW 100 kHz Span 3 MHz Sweep 3.2 ms Occupied Bandwidth 1.1634 MHz Total Power 5.66 dBm Transmit Freq Error 771 Hz OBW Power 99.00 % x dB Bandwidth 1.265 MHz x dB -20.00 dB Frequency Center Freq 2.402000000 GHz CF Step 300.000 kHz Freq Offset 0 Hz
π /4DQPSK/MCH	 Keyight Spectrum Analyzer - Occupied BW Center Freq 2.441000000 GHz Ref Offset 19.77 dB Ref 19.77 dBm Center 2.441 GHz #Res BW 30 kHz #VBW 100 kHz Span 3 MHz Sweep 3.2 ms Occupied Bandwidth 1.1631 MHz Total Power 5.83 dBm Transmit Freq Error 800 Hz OBW Power 99.00 % x dB Bandwidth 1.265 MHz x dB -20.00 dB Frequency Center Freq 2.441000000 GHz CF Step 300.000 kHz Freq Offset 0 Hz

$\pi/4$DQPSK/HCH	 Key parameters from the screenshot: - Center Freq: 2.480000000 GHz - Ref Offset: 19.77 dB - Ref: 19.77 dBm - Center: 2.48 GHz - Res BW: 30 kHz #VBW: 100 kHz - Span: 3 MHz - Sweep: 3.2 ms - Occupied Bandwidth: 1.1644 MHz - Total Power: 5.75 dBm - Transmit Freq Error: 733 Hz - OBW Power: 99.00 % - x dB Bandwidth: 1.265 MHz - x dB: -20.00 dB
8DPSK/LCH	 Key parameters from the screenshot: - Center Freq: 2.402000000 GHz - Ref Offset: 19.50 dB - Ref: 19.50 dBm - Center: 2.402 GHz - Res BW: 30 kHz #VBW: 100 kHz - Span: 3 MHz - Sweep: 3.2 ms - Occupied Bandwidth: 1.1544 MHz - Total Power: 6.47 dBm - Transmit Freq Error: 5.697 kHz - OBW Power: 99.00 % - x dB Bandwidth: 1.246 MHz - x dB: -20.00 dB
8DPSK/MCH	 Key parameters from the screenshot: - Center Freq: 2.441000000 GHz - Ref Offset: 19.77 dB - Ref: 19.77 dBm - Center: 2.441 GHz - Res BW: 30 kHz #VBW: 100 kHz - Span: 3 MHz - Sweep: 3.2 ms - Occupied Bandwidth: 1.1550 MHz - Total Power: 6.57 dBm - Transmit Freq Error: 5.072 kHz - OBW Power: 99.00 % - x dB Bandwidth: 1.247 MHz - x dB: -20.00 dB



Appendix B): Carrier Frequency Separation

Test Limit

According to §15.247(a)(1),

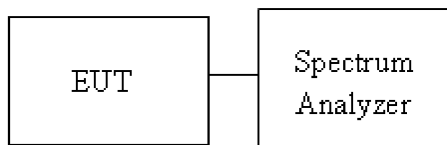
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Limit	> two-thirds of the 20 dB bandwidth
-------	-------------------------------------

Test Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. EUT RF output port connected to the SA by RF cable.
3. Set the spectrum analyzer as RBW = 100kHz, VBW = 300kHz, Sweep = auto.
Max hold, mark 3 peaks of hopping channel and record the 3 peaks frequency

Test Setup

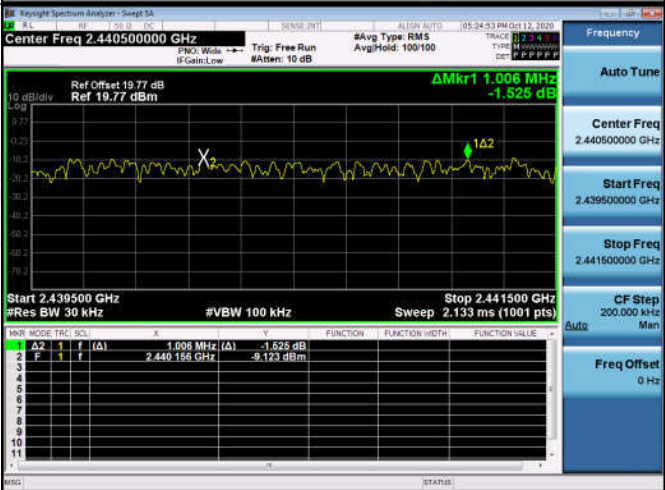


Result Table

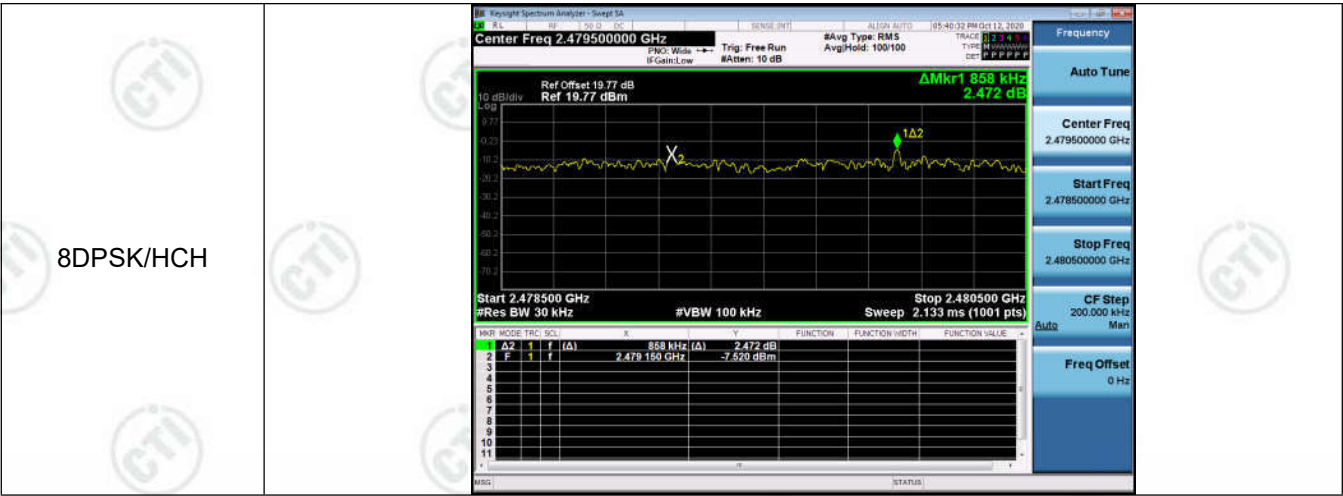
Mode	Channel.	Carrier Frequency Separation [MHz]	Verdict
GFSK	LCH	1.118	PASS
GFSK	MCH	1.150	PASS
GFSK	HCH	1.234	PASS
$\pi/4$ DQPSK	LCH	0.976	PASS
$\pi/4$ DQPSK	MCH	1.006	PASS
$\pi/4$ DQPSK	HCH	0.958	PASS
8DPSK	LCH	1.034	PASS
8DPSK	MCH	1.010	PASS
8DPSK	HCH	0.858	PASS

Test Graph



GFSK/HCH	
$\pi/4$ DQPSK/LCH	
$\pi/4$ DQPSK/MCH	

$\pi/4$DQPSK/HCH	
8DPSK/LCH	
8DPSK/MCH	



Appendix C): Dwell Time

Test Limit

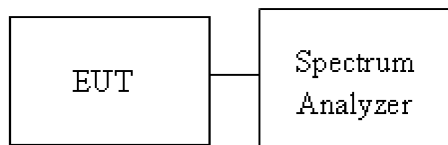
According to §15.247(a)(1)(iii),

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.

Test Procedure

1. EUT RF output port connected to the SA by RF cable.
2. Set center frequency of spectrum analyzer = operating frequency.
3. *Set the spectrum analyzer as RBW, VBW=1MHz, Sweep = 1 ms*

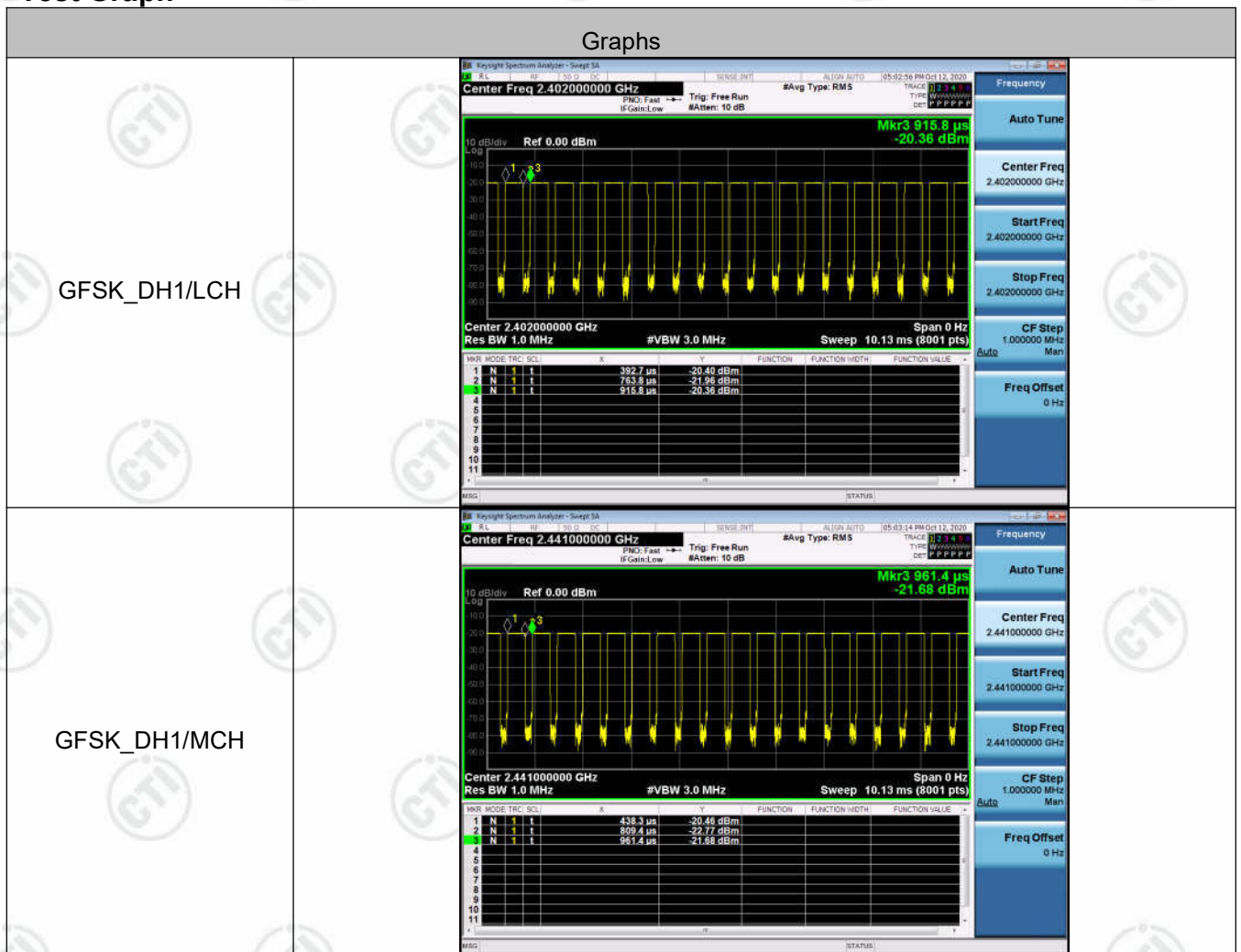
Test Setup

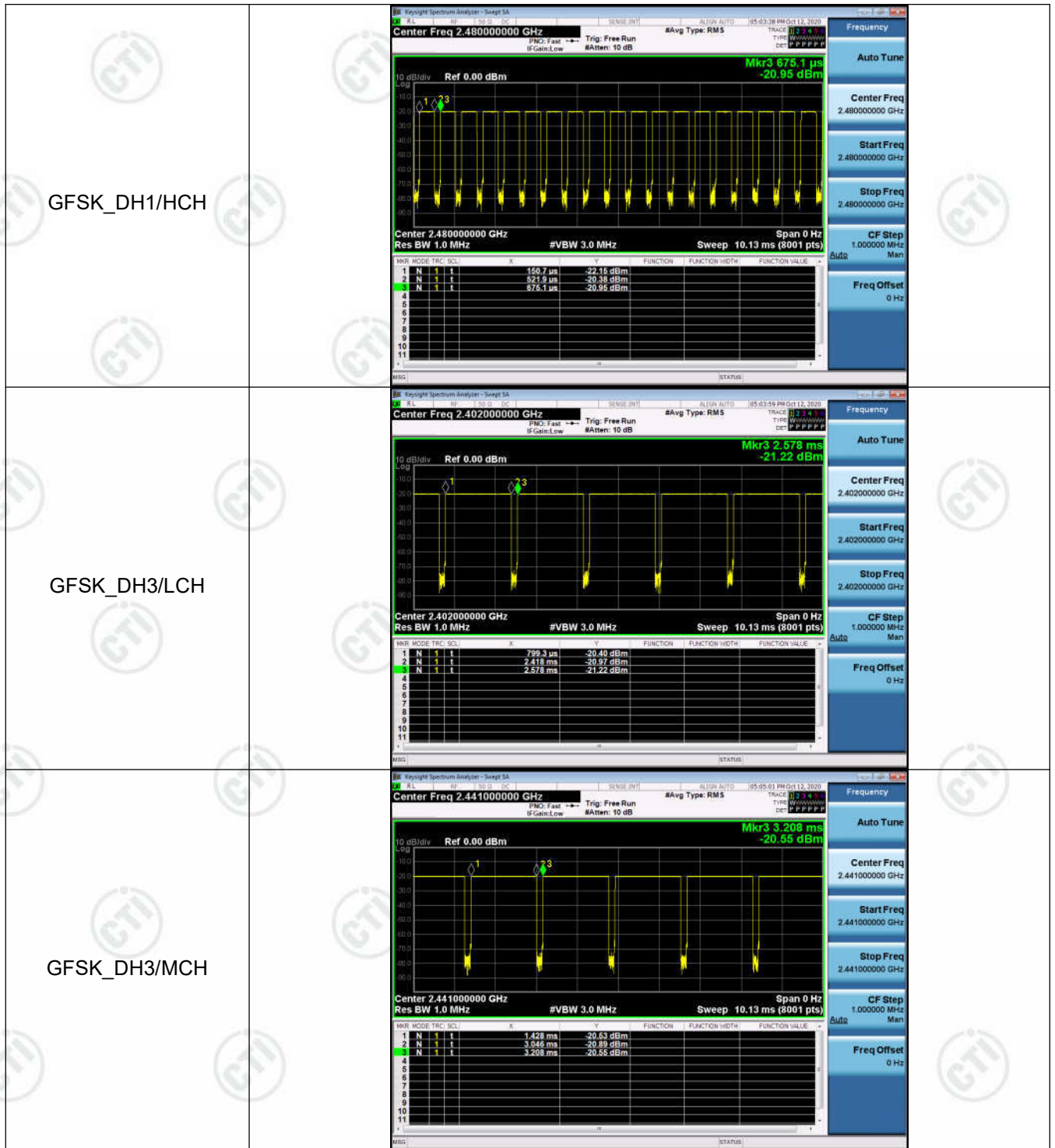


Result Table

Mode	Packet	Channel	Burst Width [ms/hop/ch]	Total Hops[hop*ch]	Dwell Time[s]	Duty Cycle [%]	Verdict
GFSK	DH1	LCH	0.371133	320	0.119	0.71	PASS
GFSK	DH1	MCH	0.371133	320	0.119	0.71	PASS
GFSK	DH1	HCH	0.371134	320	0.119	0.71	PASS
GFSK	DH3	LCH	1.618803	160	0.259	0.91	PASS
GFSK	DH3	MCH	1.61880	160	0.259	0.91	PASS
GFSK	DH3	HCH	1.620070	160	0.259	0.91	PASS
GFSK	DH5	LCH	2.8520	106.7	0.304	0.94	PASS
GFSK	DH5	MCH	2.8428	106.7	0.303	0.94	PASS
GFSK	DH5	HCH	2.8520	106.7	0.304	0.94	PASS

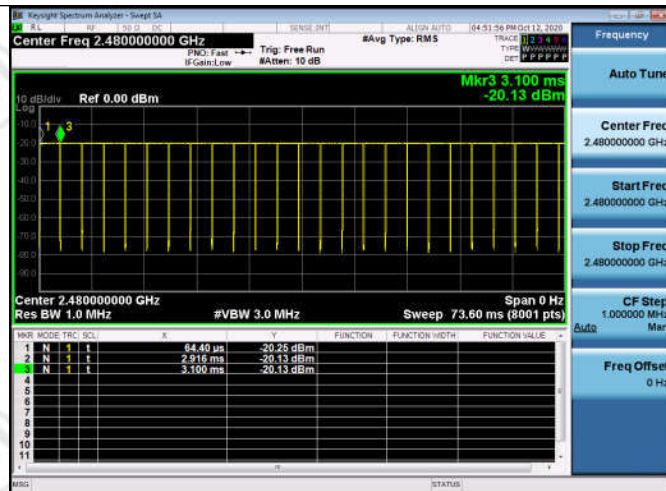
Test Graph





GFSK_DH3/HCH	Keyight Spectrum Analyzer - Sweep SA Center Freq 2.480000000 GHz Trig: Free Run #Avg Type: RMS 10 dB/div Ref 0.00 dBm Mkr3 3.430 ms -20.65 dBm Center 2.480000000 GHz Res BW 1.0 MHz #VBW 3.0 MHz Sweep 10.13 ms (8001 pts) Span 0 Hz <table><thead><tr><th>MNR</th><th>MODE</th><th>TRC</th><th>SCL</th><th>X</th><th>Y</th><th>FUNCTION</th><th>FUNCTION WIDTH</th><th>FUNCTION VALUE</th></tr></thead><tbody><tr><td>1</td><td>N</td><td>1</td><td>1</td><td>1.649 ms</td><td>-22.68 dBm</td><td></td><td></td><td></td></tr><tr><td>2</td><td>N</td><td>1</td><td>1</td><td>3.269 ms</td><td>-22.42 dBm</td><td></td><td></td><td></td></tr><tr><td>3</td><td>N</td><td>1</td><td>1</td><td>3.430 ms</td><td>-20.65 dBm</td><td></td><td></td><td></td></tr></tbody></table> Frequency Auto Tune Center Freq 2.480000000 GHz Start Freq 2.480000000 GHz Stop Freq 2.480000000 GHz CF Step 1.000000 MHz Freq Offset 0 Hz	MNR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	1	N	1	1	1.649 ms	-22.68 dBm				2	N	1	1	3.269 ms	-22.42 dBm				3	N	1	1	3.430 ms	-20.65 dBm			
MNR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE																													
1	N	1	1	1.649 ms	-22.68 dBm																																
2	N	1	1	3.269 ms	-22.42 dBm																																
3	N	1	1	3.430 ms	-20.65 dBm																																
GFSK_DH5/LCH	Keyight Spectrum Analyzer - Sweep SA Center Freq 2.402000000 GHz Trig: Free Run #Avg Type: RMS 10 dB/div Ref 0.00 dBm Mkr3 4.278 ms -19.94 dBm Center 2.402000000 GHz Res BW 1.0 MHz #VBW 3.0 MHz Sweep 73.60 ms (8001 pts) Span 0 Hz <table><thead><tr><th>MNR</th><th>MODE</th><th>TRC</th><th>SCL</th><th>X</th><th>Y</th><th>FUNCTION</th><th>FUNCTION WIDTH</th><th>FUNCTION VALUE</th></tr></thead><tbody><tr><td>1</td><td>N</td><td>1</td><td>1</td><td>1.251 ms</td><td>-19.93 dBm</td><td></td><td></td><td></td></tr><tr><td>2</td><td>N</td><td>1</td><td>1</td><td>4.103 ms</td><td>-19.94 dBm</td><td></td><td></td><td></td></tr><tr><td>3</td><td>N</td><td>1</td><td>1</td><td>4.278 ms</td><td>-19.94 dBm</td><td></td><td></td><td></td></tr></tbody></table> Frequency Auto Tune Center Freq 2.402000000 GHz Start Freq 2.402000000 GHz Stop Freq 2.402000000 GHz CF Step 1.000000 MHz Freq Offset 0 Hz	MNR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	1	N	1	1	1.251 ms	-19.93 dBm				2	N	1	1	4.103 ms	-19.94 dBm				3	N	1	1	4.278 ms	-19.94 dBm			
MNR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE																													
1	N	1	1	1.251 ms	-19.93 dBm																																
2	N	1	1	4.103 ms	-19.94 dBm																																
3	N	1	1	4.278 ms	-19.94 dBm																																
GFSK_DH5/MCH	Keyight Spectrum Analyzer - Sweep SA Center Freq 2.441000000 GHz Trig: Free Run #Avg Type: RMS 10 dB/div Ref 0.00 dBm Mkr3 5.327 ms -20.03 dBm Center 2.441000000 GHz Res BW 1.0 MHz #VBW 3.0 MHz Sweep 73.60 ms (8001 pts) Span 0 Hz <table><thead><tr><th>MNR</th><th>MODE</th><th>TRC</th><th>SCL</th><th>X</th><th>Y</th><th>FUNCTION</th><th>FUNCTION WIDTH</th><th>FUNCTION VALUE</th></tr></thead><tbody><tr><td>1</td><td>N</td><td>1</td><td>1</td><td>2.300 ms</td><td>-20.03 dBm</td><td></td><td></td><td></td></tr><tr><td>2</td><td>N</td><td>1</td><td>1</td><td>5.143 ms</td><td>-20.05 dBm</td><td></td><td></td><td></td></tr><tr><td>3</td><td>N</td><td>1</td><td>1</td><td>5.327 ms</td><td>-20.03 dBm</td><td></td><td></td><td></td></tr></tbody></table> Frequency Auto Tune Center Freq 2.441000000 GHz Start Freq 2.441000000 GHz Stop Freq 2.441000000 GHz CF Step 1.000000 MHz Freq Offset 0 Hz	MNR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	1	N	1	1	2.300 ms	-20.03 dBm				2	N	1	1	5.143 ms	-20.05 dBm				3	N	1	1	5.327 ms	-20.03 dBm			
MNR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE																													
1	N	1	1	2.300 ms	-20.03 dBm																																
2	N	1	1	5.143 ms	-20.05 dBm																																
3	N	1	1	5.327 ms	-20.03 dBm																																

GFSK_DH5/HCH



Appendix D): Hopping Channel Number

Test Limit

According to §15.247(a)(1)(iii)

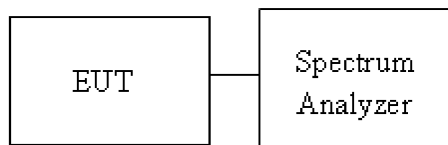
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

Test Procedure

Test method Refer as ANSI C63.10: 2013 clause 7.8.3

1. Place the EUT on the table and set it in transmitting mode.
2. EUT RF output port connected to the SA by RF cable.
3. Set spectrum analyzer Start Freq. = 2400 MHz, Stop Freq. = 2483.5 MHz,
RBW = 100KHz, VBW = 300KHz.
4. Max hold, view and count how many channel in the band.

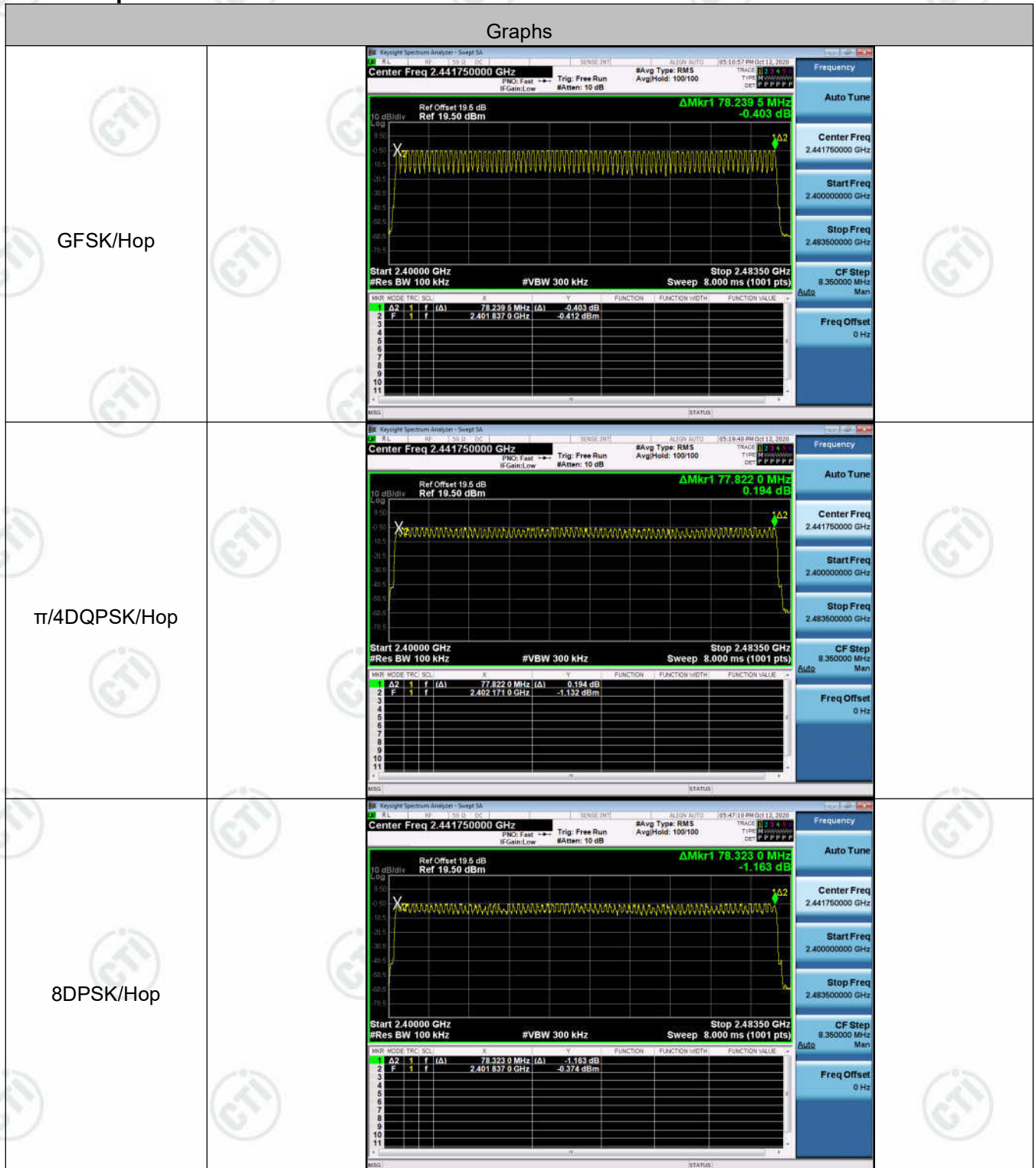
Test Setup



Result Table

Mode	Channel.	Number of Hopping Channel	Verdict
GFSK	Hop	79	PASS
$\pi/4$ DQPSK	Hop	79	PASS
8DPSK	Hop	79	PASS

Test Graph



Appendix E): Conducted Peak Output Power

Test Limit

According to §15.247(b)(1).

Peak output power :

FCC

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, provided the systems operate with an output power no greater than 125 mW.

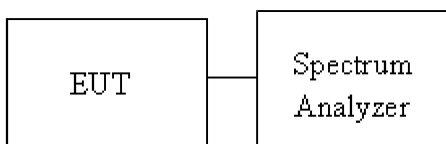
Limit	☒ Antenna not exceed 6 dBi : 21dBm ☐ Antenna with DG greater than 6 dBi : 21dBm [Limit = 30 – (DG – 6)]
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Average output power : For reporting purposes only.

Test Procedure

1. The EUT RF output connected to the spectrum analyzer by RF cable.
2. Setting maximum power transmit of EUT.
3. Spectrum analyzer settings are as follows :
 - a) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
 - b) RBW > 20 dB bandwidth of the emission being measured.
 - c) VBW ≥ RBW.
 - d) Sweep: Auto.
 - e) Detector function: Peak.
 - f) Trace: Max hold.
 - g) Allow trace to stabilize.
 - h) Use the marker-to-peak function to set the marker to the peak of the emission
4. Measure and record the result in the test report.

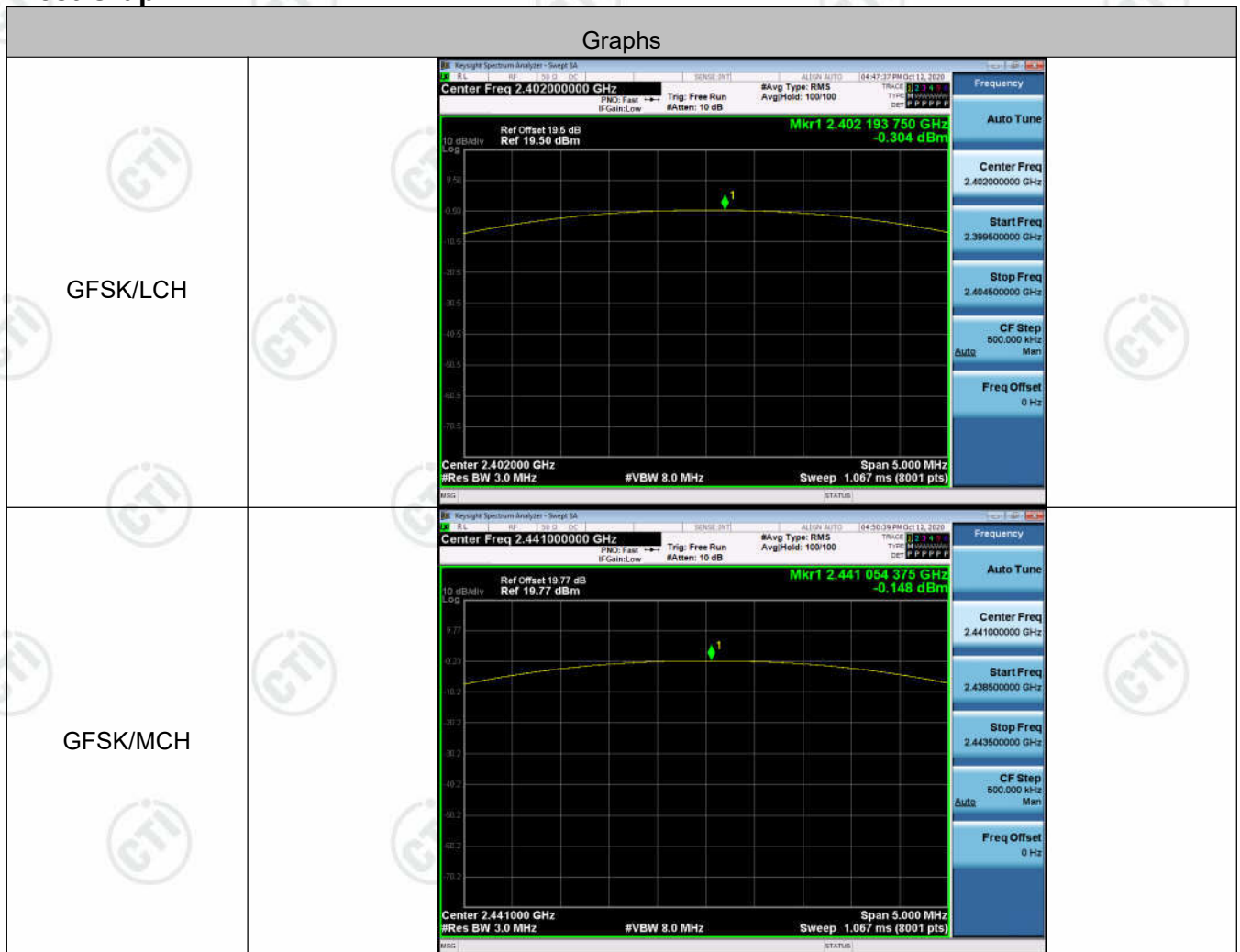
Test Setup

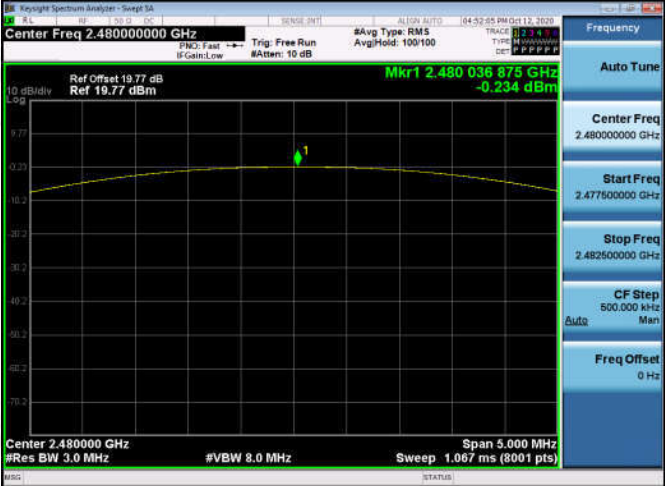
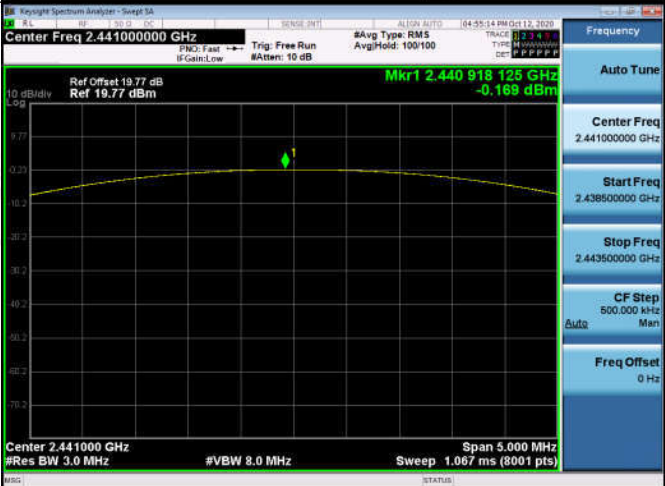


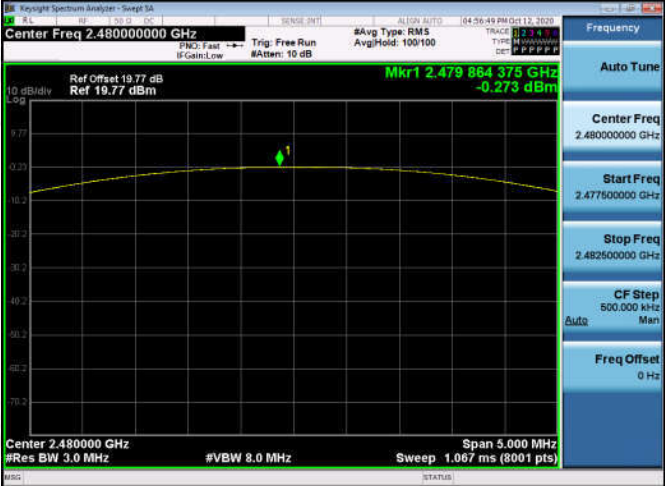
Result Table

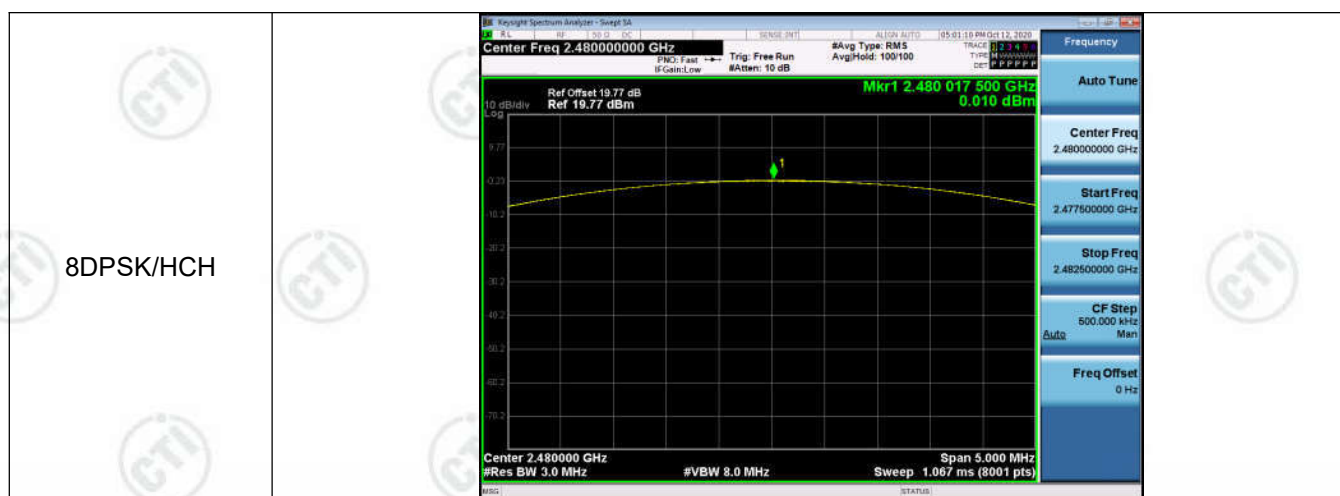
Mode	Channel.	Maximum Peak Output Power [dBm]	Verdict
GFSK	LCH	-0.304	PASS
GFSK	MCH	-0.148	PASS
GFSK	HCH	-0.234	PASS
$\pi/4$ DQPSK	LCH	-0.334	PASS
$\pi/4$ DQPSK	MCH	-0.169	PASS
$\pi/4$ DQPSK	HCH	-0.273	PASS
8DPSK	LCH	-0.028	PASS
8DPSK	MCH	0.119	PASS
8DPSK	HCH	0.010	PASS

Test Graph



GFSK/HCH	
$\pi/4$ DQPSK/LCH	
$\pi/4$ DQPSK/MCH	

$\pi/4$DQPSK/HCH	
8DPSK/LCH	
8DPSK/MCH	



Appendix F): Band-edge for RF Conducted Emissions

Test Limit

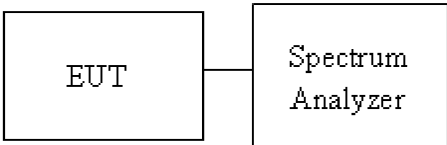
According to §15.247(d),

Limit	-20 dBc
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Test Procedure

- EUT RF output port connected to the SA by RF cable, and the path loss was compensated to result.
- SA setting, RBW=100kHz, VBW=300kHz, Detector=Peak, Trace mode = max hold, SWT = Auto.
- The Band Edge at 2.4GHz and 2.4835GHz are investigated with normal hopping mode.

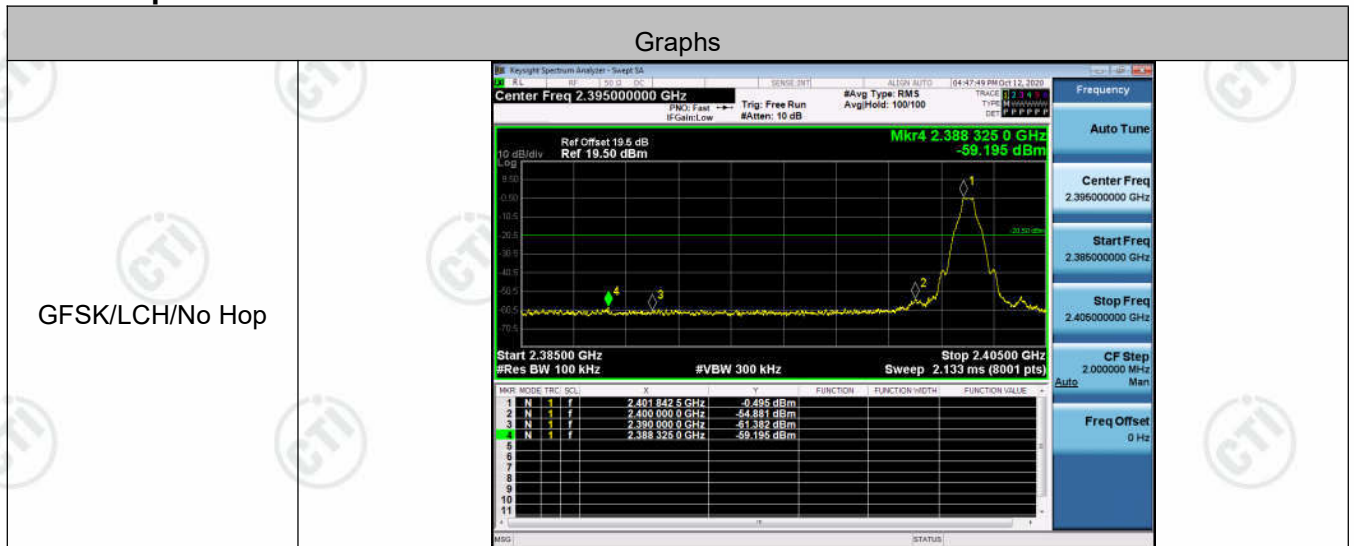
Test Setup

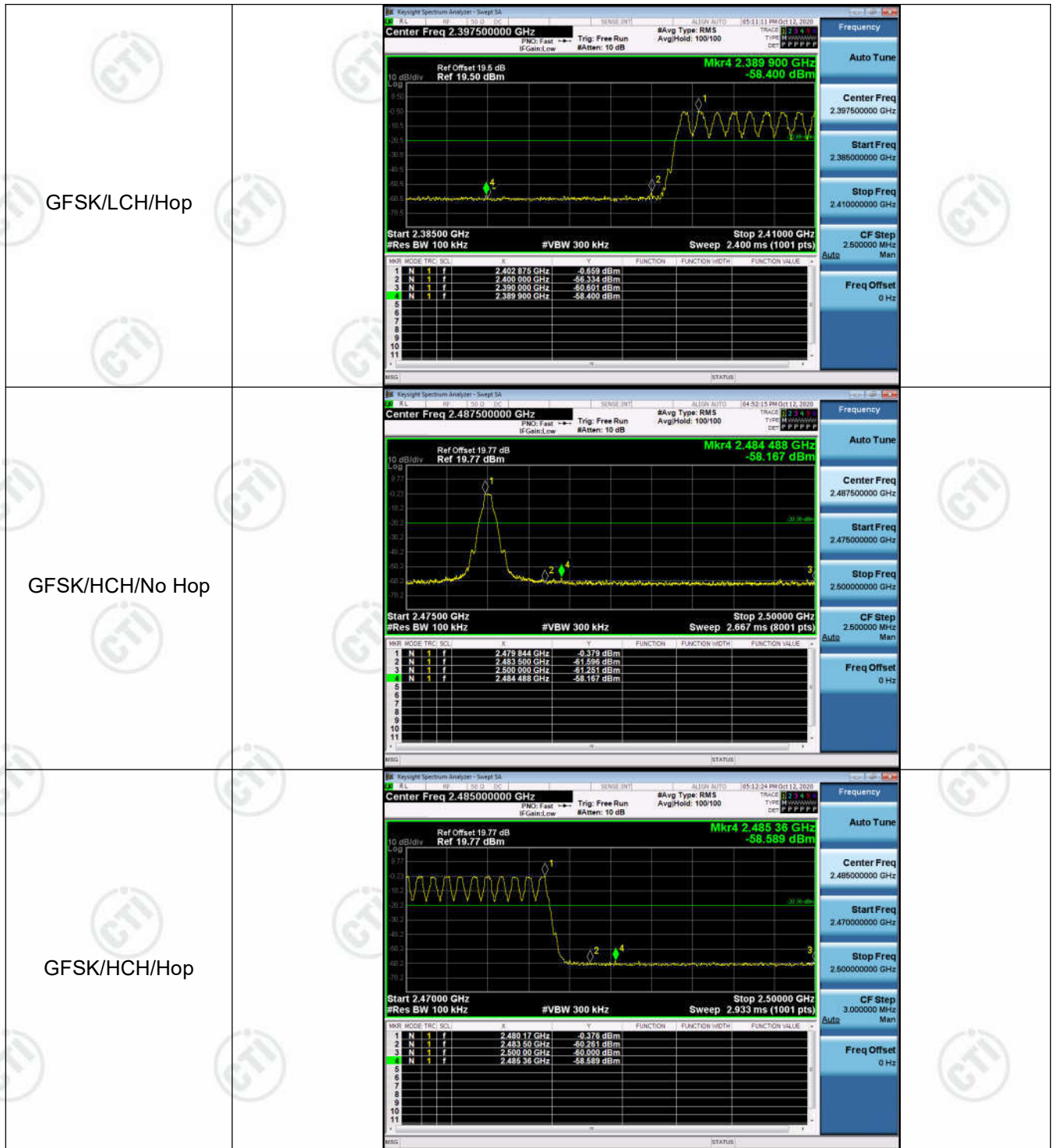


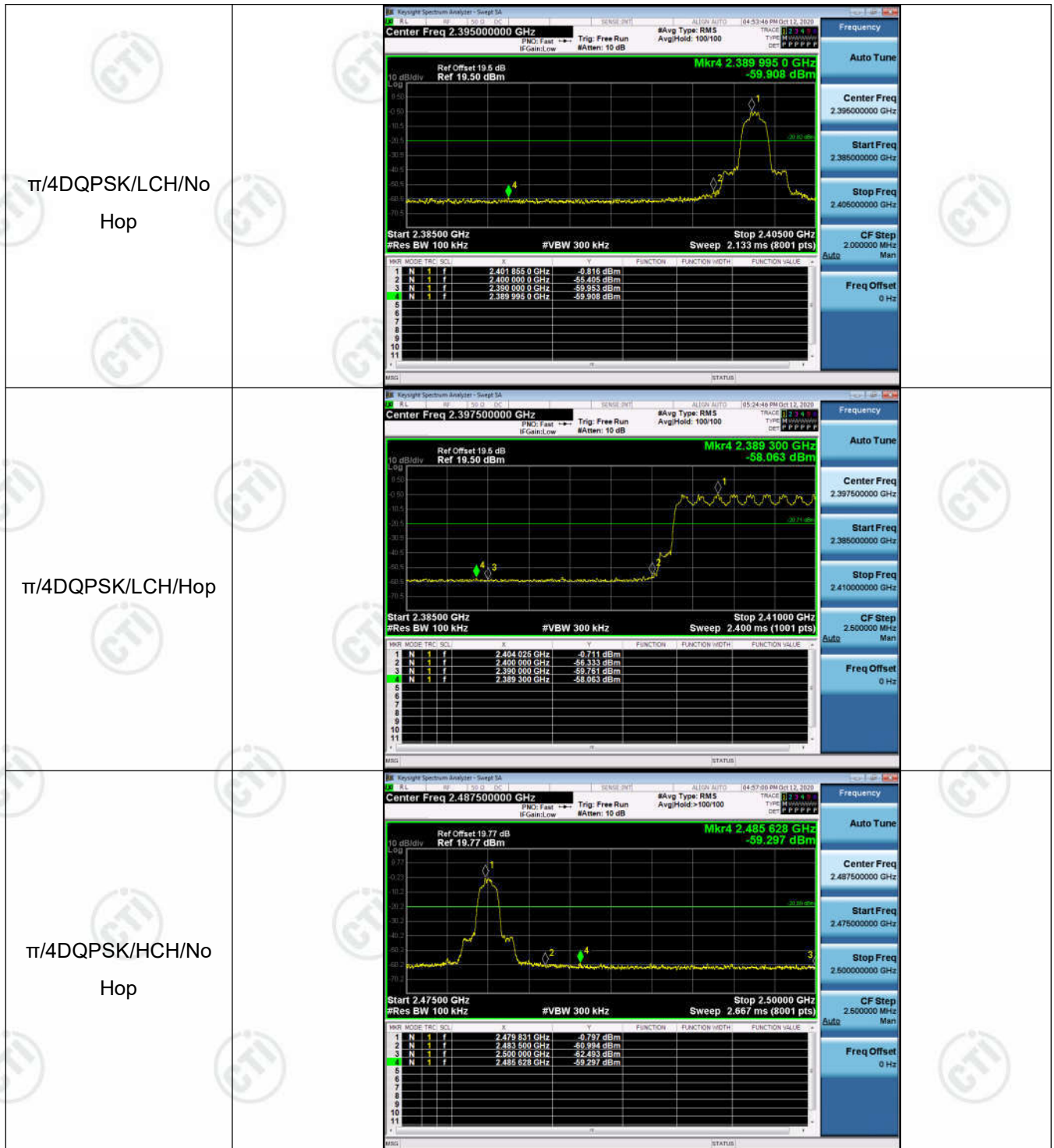
Result Table

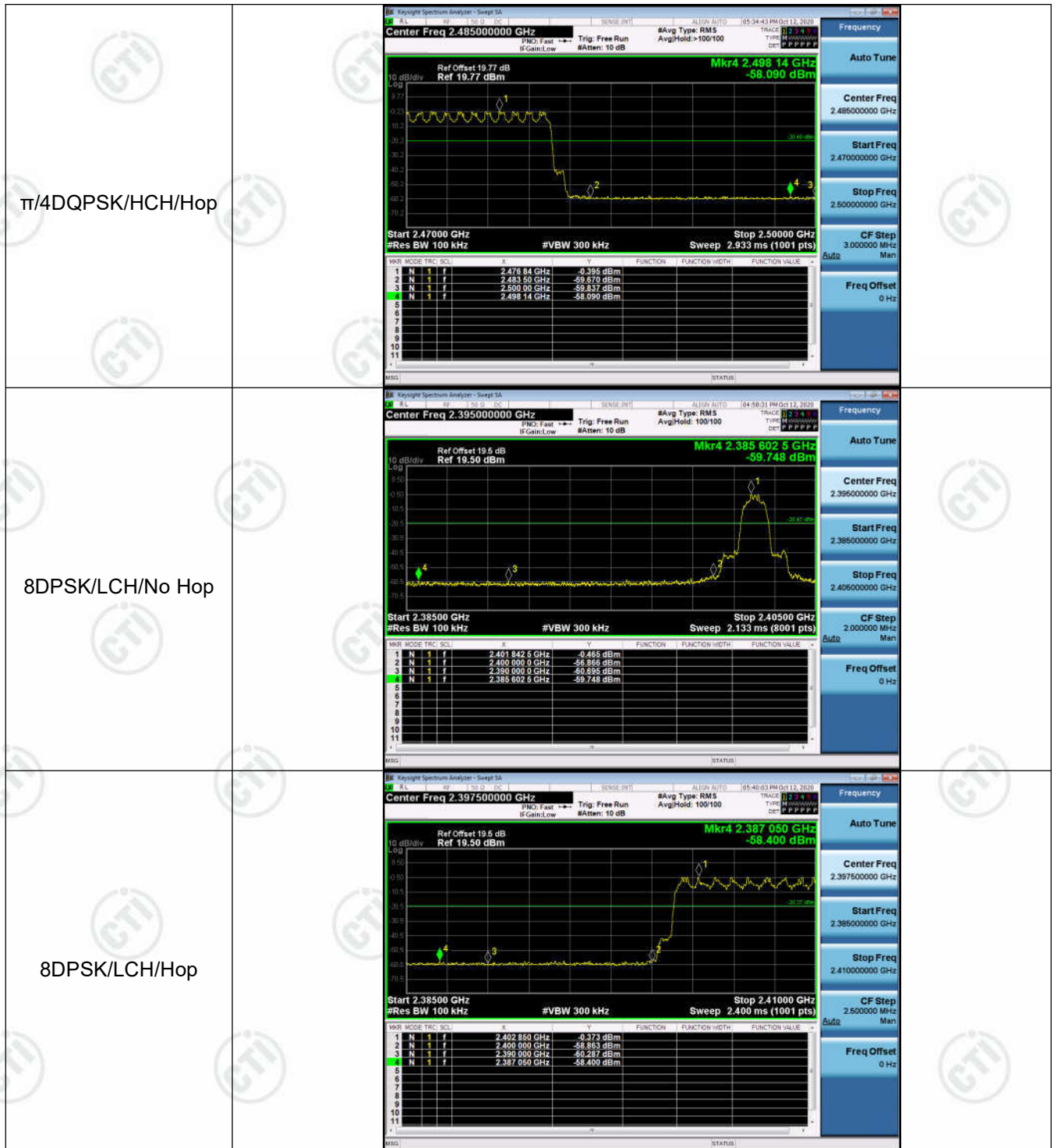
Mode	Channel	Carrier Frequency [MHz]	Carrier Power [dBm]	Frequency Hopping	Max Spurious Level [dBm]	Limit [dBm]	Verdict
GFSK	LCH	2402	-0.495	Off	-59.195	-20.5	PASS
			-0.659	On	-58.400	-20.66	PASS
GFSK	HCH	2480	-0.379	Off	-58.167	-20.38	PASS
			-0.376	On	-58.589	-20.38	PASS
$\pi/4$ DQPSK	LCH	2402	-0.816	Off	-59.908	-20.82	PASS
			-0.711	On	-58.063	-20.71	PASS
$\pi/4$ DQPSK	HCH	2480	-0.797	Off	-59.297	-20.8	PASS
			-0.395	On	-58.090	-20.4	PASS
8DPSK	LCH	2402	-0.465	Off	-59.748	-20.47	PASS
			-0.373	On	-58.400	-20.37	PASS
8DPSK	HCH	2480	-0.366	Off	-59.352	-20.37	PASS
			-0.364	On	-57.898	-20.36	PASS

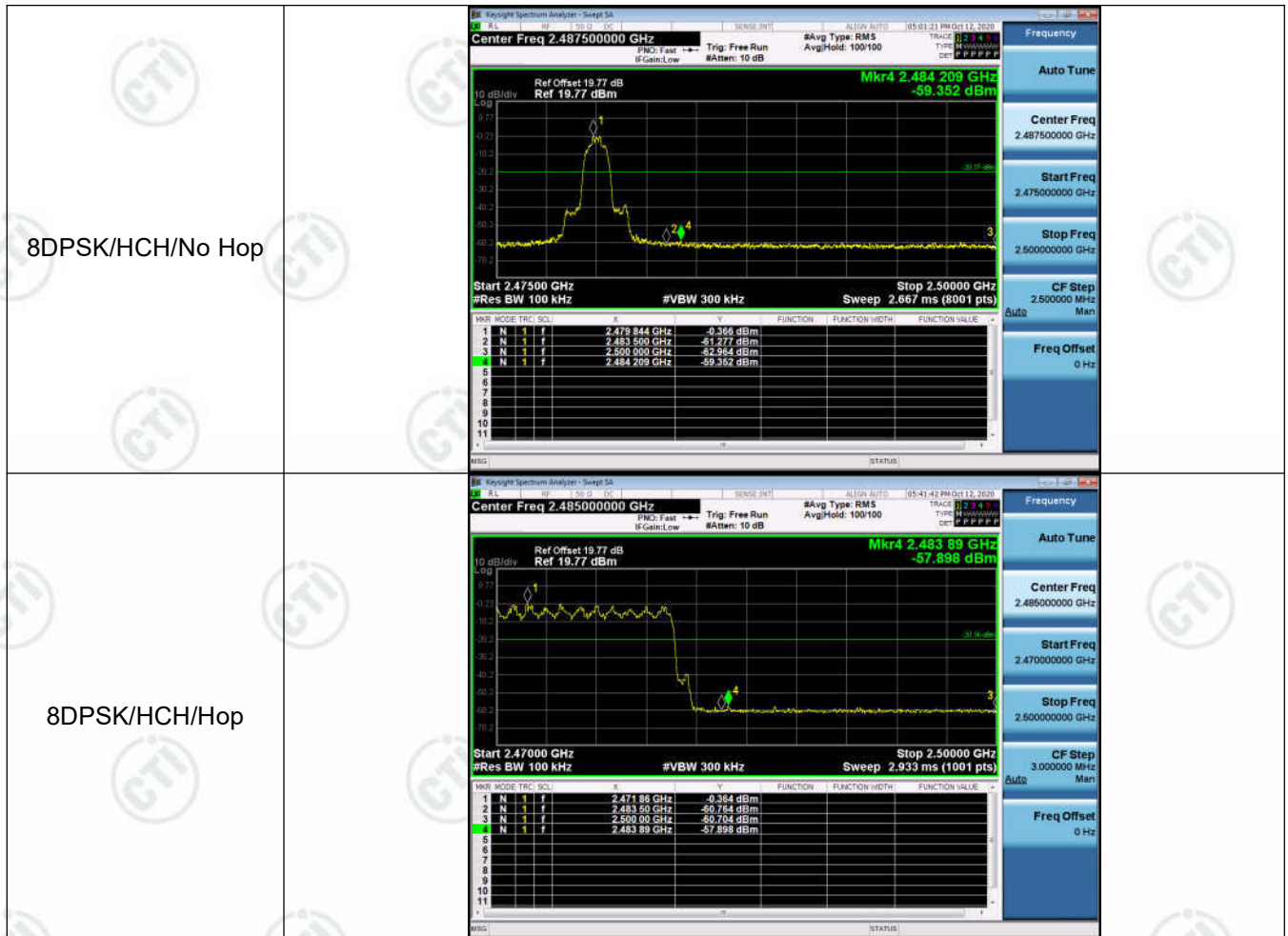
Test Graph











Appendix G): RF Conducted Spurious Emissions

Test Limit

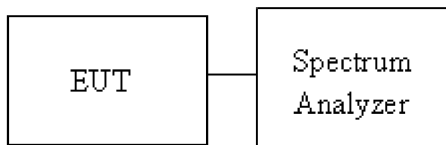
According to §15.247(d),

Limit	-20 dBc
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Test Procedure

1. EUT RF output port connected to the SA by RF cable, and the path loss was compensated to result.
2. SA setting, RBW=100kHz, VBW=300kHz, Detector=Peak, Trace mode = max hold, SWT = Auto.

Test Setup



Result Table

Mode	Channel	Pref [dBm]	Puw[dBm]	Verdict
GFSK	LCH	-0.47	<Limit	PASS
GFSK	MCH	-0.31	<Limit	PASS
GFSK	HCH	-0.415	<Limit	PASS
$\pi/4$ DQPSK	LCH	-0.785	<Limit	PASS
$\pi/4$ DQPSK	MCH	-0.479	<Limit	PASS
$\pi/4$ DQPSK	HCH	-0.547	<Limit	PASS
8DPSK	LCH	-0.45	<Limit	PASS
8DPSK	MCH	-0.289	<Limit	PASS
8DPSK	HCH	-0.451	<Limit	PASS

Test Graph













