

TEST REPORT

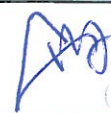


DT&C Co., Ltd.

42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042
Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRTFCC2007-0194(2)
2. Customer
 - Name : LG Electronics USA, Inc.
 - Address : 111 Sylvan Avenue, North Building Englewood Cliffs, NJ 07632
3. Use of Report : FCC Original Grant
4. Product Name / Model Name : Mobile Phone / LM-G910EMW
FCC ID : ZNFG910EMW
5. Test Method Used : KDB558074 D01v05r02, ANSI C63.10-2013
Test Specification : FCC Part 15.247
6. Date of Test : 2020.04.16 ~ 2020.05.15, 2020.06.11 ~ 2020.07.01
7. Location of Test : ☒ Permanent Testing Lab ☐ On Site Testing
8. Testing Environment : See appended test report.
9. Test Result : Refer to the attached Test Result

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.

Affirmation	Tested by	Reviewed by
	Name : JungWoo Kim 	Name : GeunKi Son  (Signature)

2020 . 07 . 10 .

DT&C Co., Ltd.

Not abided by KS Q ISO / IEC 17025 and KOLAS accreditation.

If this report is required to confirmation of authenticity, please contact to report@dtnc.net

Test Report Version

Test Report No.	Date	Description	Revised by	Reviewed by
DRTFCC2007-0194	Jul. 03, 2020	Initial issue	InHee Bae	GeunKi Son
DRTFCC2007-0194(1)	Jul. 09, 2020	Revised Section 1	JungWoo Kim	GeunKi Son
DRTFCC2007-0194(2)	Jul. 10, 2020	Revised Section 1	JungWoo Kim	GeunKi Son

Table of Contents

1. General Information	4
1.1 Explanations for Reference Test Data	4
1.1.1 Introduction.....	4
1.1.2 Explain the Differences	4
1.1.3 Spot Check Verification Data.....	4
1.1.4 Refer Section	4
1.2 Testing Laboratory	5
1.3 Testing Environment	5
1.4 Measurement Uncertainty	5
1.4 Details of Applicant	6
1.5 Description of EUT	6
1.6 Declaration by the applicant / manufacturer	6
1.7 Information about the FHSS characteristics	7
1.8 Test Equipment List.....	8
1.9 Summary of Test Results.....	10
1.10 Conclusion of worst-case and operation mode.....	11
2. Maximum Peak Output Power Measurement	12
2.1 Test Setup	12
2.2 Limit.....	12
2.3 Test Procedure.....	12
2.4 Test Results	13
3. 20 dB BW	19
3.1 Test Setup	19
3.2 Limit.....	19
3.3 Test Procedure.....	19
3.4 Test Results	19
4. Carrier Frequency Separation	25
4.1 Test Setup	25
4.2 Limit.....	25
4.3 Procedure.....	25
4.4 Test Results	25
5. Number of Hopping Frequencies	30
5.1 Test Setup	30
5.2 Limit.....	30
5.3 Procedure.....	30
5.4 Test Results	30
6. Time of Occupancy (Dwell Time).....	36
6.1 Test Setup	36
6.2 Limit.....	36
6.3 Test Procedure.....	36
6.4 Test Results	36
7. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission	41
7.1 Test Setup	41
7.2 Limit.....	41
7.3. Test Procedures.....	42
7.3.1. Test Procedures for Radiated Spurious Emissions	42
7.3.2. Test Procedures for Conducted Spurious Emissions.....	43
7.4. Test Results	44
7.4.1. Radiated Emissions.....	44
7.4.2. Conducted Spurious Emissions	47
8. Transmitter AC Power Line Conducted Emission	71
8.1 Test Setup	71
8.2 Limit.....	71
8.3 Test Procedures.....	71
8.4 Test Results	72
9. Antenna Requirement.....	74
APPENDIX I.....	75
APPENDIX II.....	76

1. General Information

1.1 Explanations for Reference Test Data

1.1.1 Introduction

This report includes the DSS test data of FCC ID: ZNFG910HMMW with reference to KDB 484596 D01v01. The applicant takes full responsibility that the test data as reference section below represents compliance for FCC ID: ZNFG910EMW.

Reference FCC ID	Exhibit type	Separated FCC ID
ZNFG910HMMW	Original Grant	ZNFG910EMW

1.1.2 Explain the Differences

FCC ID: ZNFG910EMW is same the internal printed circuit board with FCC ID: ZNFG910HMMW. Two products differ only the depopulation of components for the purposes of adding or removing frequency bands of operating in non US. (It does not changed the SW/HW component of DSS)

Change Bands(Frequency) Information

FCC ID	ZNFG910EMW	ZNFG910HMMW
LTE	B1,2,3,4,5,7,8,12,13,17,20,28,32,38,39,40,41,66	B1,2,3,4,5,7,8,12,13,17,20,25,26,28,38,40,41,66

Component changes information

REF.	ZNFG910EMW	ZNFG910HMMW	Changes(vs ZNFG910HMMW)
U1201	EAN64893201	EAN64996301	MB L-PAMID
FL1360	EAM64393501	DNI	B32 PRx SAW added (B32 is supported)
FL1301	EAN64973501	DNI	B32 DRx module added (B32 is supported)
FL5610	EAM62491401	DNI	GPS Extractor (for B32) added
FL5602	DNI	EAM65742901	GPS SAW deleted
FL1201	EAM64390401	DNI	B39 PRx SAW added (B39 is supported)

1.1.3 Spot Check Verification Data

Equipment Class (capability)	FCC Part	Mode	TX Freq. (MHz)	Test item	Test note	Detector Mode	Reference FCC ID: ZNFG910HMMW		Separated FCC ID: ZNFG910EMW		Limit (dBuV/m)	Deviation (dB)
							Frequency (MHz)	Result (dBuV/m)	Frequency (MHz)	Result (dBuV/m)		
DSS (Bluetooth)	15.247	3Mbps	2 480	Radiated Band edge	With DD	Peak	2 483.57	58.48	2 483.57	57.73	74.00	-0.75
		3Mbps	2 480	Radiated Spurious emission	With DD+WCP	Peak	7 440.44	56.89	7 440.15	55.48	74.00	-1.41

Note1: The spot check were performed based on worst-case results reported in the original test report.

The spot check test results are within 3dB and two products shows a good correlation. It also complies with the FCC limit.

1.1.4 Refer Section

Reference FCC ID: ZNFG910HMMW

Equipment Class	FCC Part	Capability	Band(MHz)	Exhibit type	Report title	Reference Sections
DSS	Part 15.247	Bluetooth	2 402 ~ 2 480	Original Grant	DSS	All

1.2 Testing Laboratory

DT&C Co., Ltd.		
The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. The test site complies with the requirements of § 2.948 according to ANSI C63.4-2014.		
- FCC MRA Accredited Test Firm No. : KR0034		
www.dtnc.net		
Telephone	:	+ 82-31-321-2664
FAX	:	+ 82-31-321-1664

1.3 Testing Environment

Ambient Condition	
▪ Temperature	+20 °C ~ +25 °C
▪ Relative Humidity	35 % ~ 45 %

1.4 Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C63.4-2014 and ANSI C63.10-2013. All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95 % level of confidence.

Test items	Measurement uncertainty
Transmitter Output Power	0.9 dB (The confidence level is about 95 %, $k = 2$)
Conducted spurious emission	0.9 dB (The confidence level is about 95 %, $k = 2$)
AC conducted emission	3.6 dB (The confidence level is about 95 %, $k=2$)
Radiated spurious emission (1 GHz Below)	4.9 dB (The confidence level is about 95 %, $k = 2$)
Radiated spurious emission (1 GHz ~ 18 GHz)	5.0 dB (The confidence level is about 95 %, $k = 2$)
Radiated spurious emission (18 GHz Above)	5.3 dB (The confidence level is about 95 %, $k = 2$)

1.4 Details of Applicant

Applicant : LG Electronics USA, Inc
Address : 111 Sylvan Avenue, North Building Englewood Cliffs, NJ 07632
Contact person : Kyung-Su Han

1.5 Description of EUT

EUT	Mobile Phone
Model Name	LM-G910EMW
Add Model Name	LMG910EMW, G910EMW
Serial Number	Identical prototype
Power Supply	DC 3.87 V
Frequency Range	2 402 MHz ~ 2 480 MHz
Modulation Technique	GFSK, $\pi/4$ DQPSK, 8DPSK
Number of Channels	79
Antenna Type	PIFA Antenna
Antenna Gain	PK : -2.43 dBi

1.6 Declaration by the applicant / manufacturer

- NA

1.7 Information about the FHSS characteristics

- This Bluetooth module has been tested by a Bluetooth Qualification Lab, and we confirm the following :

A) The hopping sequence is pseudorandom

Note 1 : Pseudorandom Frequency Hopping Sequence Table as below:

Channel: 08, 24, 40, 56, 42, 54, 72, 09, 01, 11, 33, 41, 34, 42, 65, 73, 53, 69, 06, 22, 04,
20, 36, 52, 38, 46, 70, 78, 68, 76, 21, 29, 10, 26, 41, 58, 44, 60, 76, 13, 03, 11,
35, 43, 37, 45, 69, 77, 52, 71, 08, 24, 06, 24, 48, 56, 45, 46, 70, 01, 72, 06, 25,
33, 12, 28, 49, 60, 45, 58, 74, 13, 05, 18, 37, 49 etc

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

B) All channels are used equally on average

C) The receiver input bandwidth equals the transmit bandwidth

D) The receiver hops in sequenc e with the transmit signal

- 15.247(g) : In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.
- 15.247(h) : In accordance with the Bluetooth Industry Standard, the system does not coordinate its channels selection / hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.
- 15.247(h) : The EUT employs Adaptive Frequency Hopping (AFH) which identifies sources of interference namely devices operating in 802.11 WLAN and excludes them from the list of available channels. The process of re-mapping reduces the number of test channels from 79 channels to a minimum number of 20 channels.

1.8 Test Equipment List

Date of Test(original test): 2020.04.16 ~ 2020.05.15

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	19/12/16	20/12/16	MY50410357
Spectrum Analyzer	Agilent Technologies	N9020A	19/12/16	20/12/16	MY48011700
Spectrum Analyzer	Agilent Technologies	N9020A	19/12/16	20/12/16	MY48010133
DC Power Supply	Agilent Technologies	66332A	19/06/25	20/06/25	MY43000211
Multimeter	FLUKE	17B	19/12/16	20/12/16	26030065WS
Signal Generator	Rohde Schwarz	SMBV100A	19/12/16	20/12/16	255571
Signal Generator	ANRITSU	MG3695C	19/12/16	20/12/16	173501
Thermohygrometer	BODYCOM	BJ5478	19/12/18	20/12/18	120612-1
Thermohygrometer	BODYCOM	BJ5478	19/12/18	20/12/18	120612-2
Thermohygrometer	BODYCOM	BJ5478	19/09/18	20/09/18	N/A
HYGROMETER	TESTO	608-H1	20/01/21	21/01/21	34862883
Loop Antenna	Schwarzbeck	FMZB1513	20/02/19	22/02/19	1513-128
BILOG ANTENNA	Schwarzbeck	VULB 9160	19/04/23	21/04/23	9160-3362
Horn Antenna	ETS-Lindgren	3115	20/01/30	22/01/30	6419
Horn Antenna	A.H.Systems Inc.	SAS-574	19/07/03	21/07/03	155
PreAmplifier	tsj	MLA-0118-B01-40	19/12/16	20/12/16	1852267
PreAmplifier	tsj	MLA-1840-J02-45	19/06/27	20/06/27	16966-10728
PreAmplifier	H.P	8447D	19/12/16	20/12/16	2944A07774
BlueTooth Tester	TESCOM	TC-3000B	19/12/16	20/12/16	3000B770243
Power Splitter	Anritsu	K241B	19/06/25	20/06/25	1701061
High Pass Filter	Wainwright Instruments	WHKX12-935-1000-15000-40SS	19/06/26	20/06/26	8
High Pass Filter	Wainwright Instruments	WHKX10-2838-3300-18000-60SS	19/06/26	20/06/26	1
High Pass Filter	Wainwright Instruments	WHNX8.0/26.5-6SS	19/06/27	20/06/27	3
Attenuator	Hefei Shunze	SS5T2.92-10-40	19/06/27	20/06/27	16012202
Attenuator	SRTechnology	F01-B0606-01	19/06/27	20/06/27	13092403
Attenuator	Aeroflex/Weinschel	20515	19/06/27	20/06/27	Y2370
Attenuator	SMAJK	SMAJK-2-3	19/06/27	20/06/27	2
Attenuator	SMAJK	SMAJK-50-10	19/08/07	20/08/07	15081901
Power Meter & Wide Bandwidth Sensor	Anritsu	ML2488B	20/01/02	21/01/02	0846002
		MA2491A	20/01/02	21/01/02	0845295
EMI Receiver	ROHDE&SCHWARZ	ESW44	19/07/30	20/07/30	101645
HYGROMETER	TESTO	608-H1	20/01/21	21/01/21	34862883
EMI Test Receiver	Rohde Schwarz	ESCI7	20/01/20	21/01/20	100910
PULSE LIMITER	Rohde Schwarz	ESH3-Z2	19/09/17	20/09/17	101333
LISN	SCHWARZBECK	NNLK 8121	19/05/23	20/05/23	6183
Cable	Junkosha	MWX241	20/01/13	21/01/13	G-04
Cable	Junkosha	MWX241	20/01/13	21/01/13	G-07
Cable	DT&C	Cable	20/01/13	21/01/13	G-13
Cable	DT&C	Cable	20/01/13	21/01/13	G-14
Cable	HUBER+SUHNER	SUCOFLEX 104	20/01/13	21/01/13	G-15
Cable	Radiall	TESTPRO3	20/01/16	21/01/16	M-01
Cable	Junkosha	MWX315	20/01/16	21/01/16	M-05
Cable	Junkosha	MWX221	20/01/16	21/01/16	M-06
Cable	DT&C	Cable	20/01/16	21/01/16	RF-82

Note1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017

Note2: The cable is not a regular calibration item, so it has been calibrated by DT & C itself.

Date of Test(Spot check verificaiton): 2020.06.11 ~ 2020.07.01

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	19/12/16	20/12/16	MY48011700
DC Power Supply	Agilent Technologies	66332A	19/06/25	20/06/25	MY43000211
			20/06/24	20/06/24	
Multimeter	FLUKE	17B	19/12/16	20/12/16	26030065WS
Signal Generator	Rohde Schwarz	SMBV100A	19/12/16	20/12/16	255571
Signal Generator	ANRITSU	MG3695C	19/12/16	20/12/16	173501
Thermohygrometer	BODYCOM	BJ5478	19/09/18	20/09/18	N/A
Horn Antenna	ETS-Lindgren	3115	20/01/30	22/01/30	6419
PreAmplifier	tsj	MLA-0118-B01-40	19/12/16	20/12/16	1852267
BlueTooth Tester	TESCOM	TC-3000B	19/12/16	20/12/16	3000B770243
Power Splitter	Anritsu	K241B	19/06/25	20/06/25	020611
			20/06/24	21/06/24	
High Pass Filter	Wainwright Instruments	WHKX12-935-1000-15000-40SS	19/06/26	20/06/26	8
			20/06/24	21/06/24	
High Pass Filter	Wainwright Instruments	WHKX10-2838-3300-18000-60SS	19/06/26	20/06/26	1
			20/06/24	21/06/24	
Attenuator	Hefei Shunze	SS5T2.92-10-40	19/06/27	20/06/27	16012202
			20/06/24	21/06/24	
Attenuator	SRTechnology	F01-B0606-01	19/06/27	20/06/27	13092403
			20/06/24	21/06/24	
Attenuator	Aeroflex/Weinschel	20515	19/06/27	20/06/27	Y2370
			20/06/24	21/06/24	
Attenuator	SMAJK	SMAJK-2-3	19/06/27	20/06/27	2
			20/06/24	21/06/24	
Power Meter & Wide Bandwidth Sensor	Anritsu	ML2488B MA2491A	20/01/02	21/01/02	0846002 0845295
Cable	Junkosha	MWX241	20/01/13	21/01/13	G-04
Cable	Junkosha	MWX241	20/01/13	21/01/13	G-07
Cable	DT&C	Cable	20/01/13	21/01/13	G-13
Cable	DT&C	Cable	20/01/13	21/01/13	G-14
Cable	HUBER+SUHNER	SUCOFLEX 104	20/01/13	21/01/13	G-15

Note1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017

Note2: The cable is not a regular calibration item, so it has been calibrated by DT & C itself.

1.9 Summary of Test Results

FCC Part RSS Std.	Parameter	Limit (Using in 2400~ 2483.5 MHz)	Test Condition	Status Note 1
15.247(a) RSS-247(5.1)	Carrier Frequency Separation	>= 25 kHz or >= Two thirds of the 20 dB BW, whichever is greater.	Conducted	C
	Number of Hopping Frequencies	>= 15 hops		C
	20 dB Bandwidth	N/A		C
	Dwell Time	=< 0.4 seconds		C
15.247(b) RSS-247(5.4)	Transmitter Output Power	For FCC =< 1 Watt , if CHs >= 75 Others =< 0.125 W For IC if CHs >= 75 =< 1 Watt For Conducted Power =< 4 Watt For e.i.r.p, Others =< 0.125 W For Conducted Power. =< 0.5 Watt For e.i.r.p		C
15.247(d) RSS-247(5.5)	Conducted Spurious Emissions	The radiated emission to any 100 kHz of out-band shall be at least 20 dB below the highest in-band spectral density.	Radiated	C
RSS Gen(6.7)	Occupied Bandwidth (99 %)	N/A		NA
15.247(d) 15.205 & 209 RSS-247(5.5) RSS-Gen (8.9 & 8.10)	Radiated Spurious Emissions	FCC 15.209 Limits	Radiated	C Note3,4
15.207 RSS-Gen(8.8)	AC Conducted Emissions	FCC 15.207 Limits	AC Line Conducted	C
15.203	Antenna Requirements	FCC 15.203	-	C

Note 1 : C = Comply NC = Not Comply NT = Not Tested NA = Not Applicable

Note 2 : For radiated emission tests below 30 MHz were performed on semi-anechoic chamber which is correlated With OATS.

Note 3 : This test item was performed in each axis and the worst case data was reported.

Note 4 : This device supports wireless charging capability & Can use Dual Screen.

So per KDB648474 D03v01r04, the radiated test items were performed all not charging, charging and Dual Screen conditions. For wireless charging condition, the handset is placed on the representative charging pad under normal conditions and in a simulated call configuration.

1.10 Conclusion of worst-case and operation mode

The EUT has three types of modulation (GFSK, $\pi/4$ DQPSK and 8DPSK).

Therefore all applicable requirements were tested with all the modulations.

And packet type was tested at the worst case (DH5).

The field strength of spurious emission was measured in three orthogonal EUT positions (X-axis, Y-axis and Z-axis).

Tested frequency information,

- Hopping Function : Enable

	TX Frequency (MHz)	RX Frequency (MHz)
Hopping Band	2 402 ~ 2 480	2 402 ~ 2 480

- Hopping Function : Disable

	TX Frequency (MHz)	RX Frequency (MHz)
Lowest Channel	2 402	2 402
Middle Channel	2 441	2 441
Highest Channel	2 480	2 480

2. Maximum Peak Output Power Measurement

2.1 Test Setup

Refer to the APPENDIX I.

2.2 Limit

■ FCC Requirements

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

1. §15.247(a)(1), 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 2 400 MHz - 2 483.5 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.
2. §15.247(b)(1), For frequency hopping systems operating in the 2400 – 2483.5 MHz employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725 MHz – 5 805 MHz band : 1 Watt. For all other frequency hopping systems in the 2 400 MHz – 2 483.5 MHz band: 0.125 watts.

■ IC Requirements

1. RSS-247(5.4) (b), For FHSS operating in the band 2 400 MHz – 2 483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels, the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p shall not exceed 4 W, except as provided in section 5.4(e)

2.3 Test Procedure

1. The RF output power was measured with a spectrum analyzer connected to the RF Antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency, A spectrum analyzer was used to record the shape of the transmit signal.
2. The peak output power of the fundamental frequency was measured with the spectrum analyzer using ;
Span = approximately 5 times of the 20 dB bandwidth, centered on a hopping channel
RBW $\geq$ 20 dB BW
VBW $\geq$ RBW
Sweep = auto
Detector function = peak
Trace = max hold

2.4 Test Results

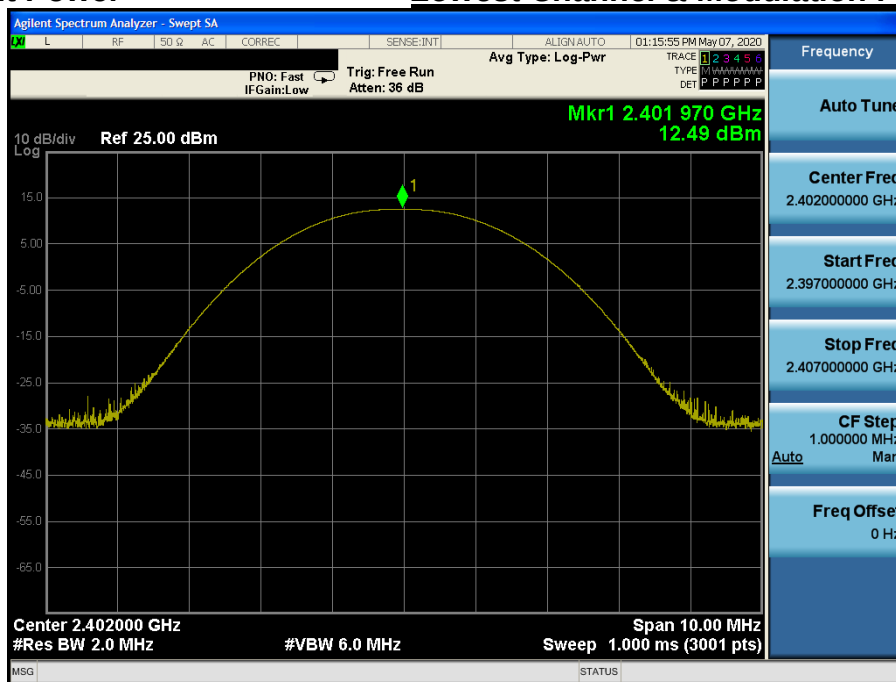
Modulation	Tested Channel	Burst Average Output Power		Peak Output Power	
		dBm	mW	dBm	mW
<u>GFSK</u>	Lowest	12.14	16.37	12.49	17.74
	Middle	11.87	15.38	12.24	16.75
	Highest	11.49	14.09	11.81	15.17
<u>$\pi/4$DQPSK</u>	Lowest	11.45	13.96	13.57	22.75
	Middle	11.30	13.49	13.45	22.13
	Highest	9.99	9.98	11.97	15.74
<u>8DPSK</u>	Lowest	11.44	13.93	13.70	23.44
	Middle	11.31	13.52	13.58	22.80
	Highest	10.00	10.00	12.21	16.63

Note 1: The burst average output power was tested using an average power meter for reference only.

Note 2: See next pages for actual measured spectrum plots.

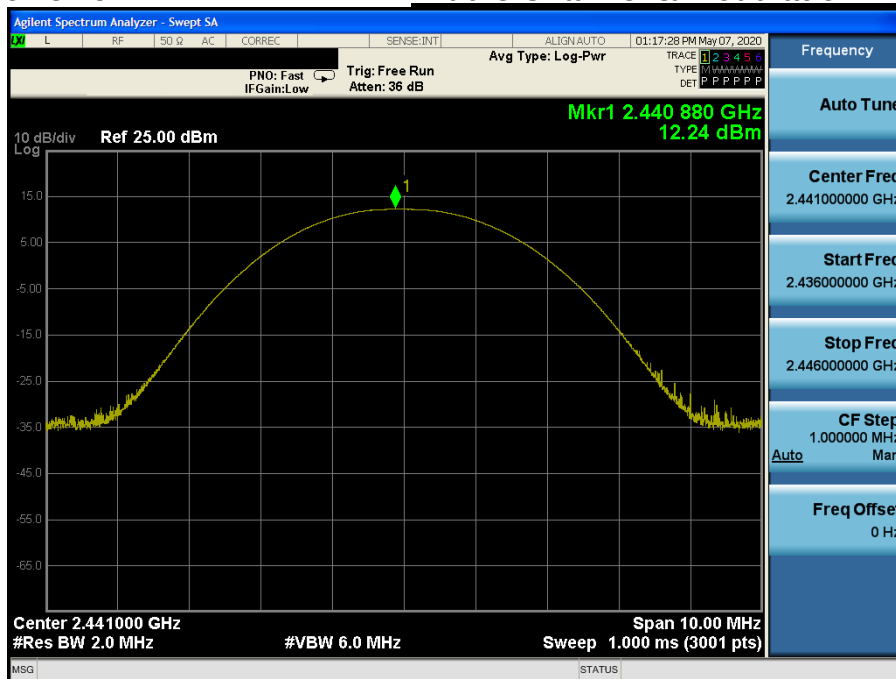
Peak Output Power

Lowest Channel & Modulation : GFSK



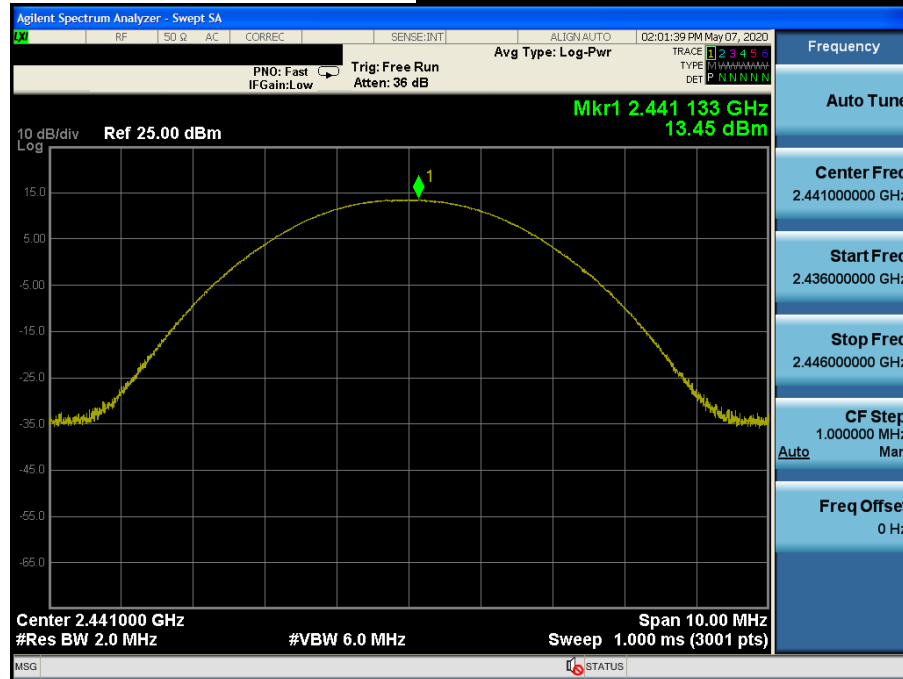
Peak Output Power

Middle Channel & Modulation : GFSK



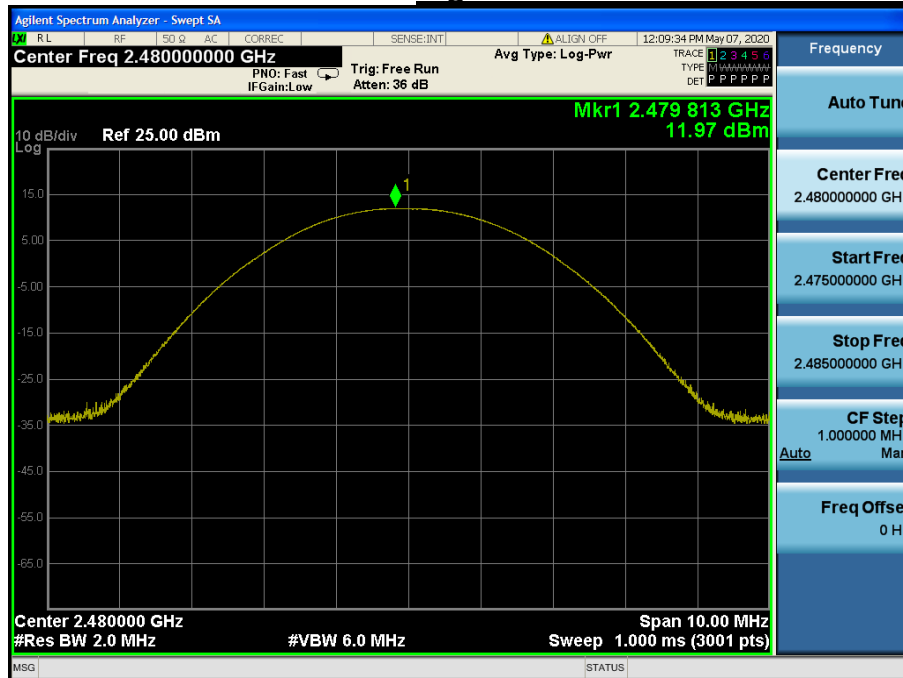
Peak Output Power

Middle Channel & Modulation : $\pi/4$ DQPSK



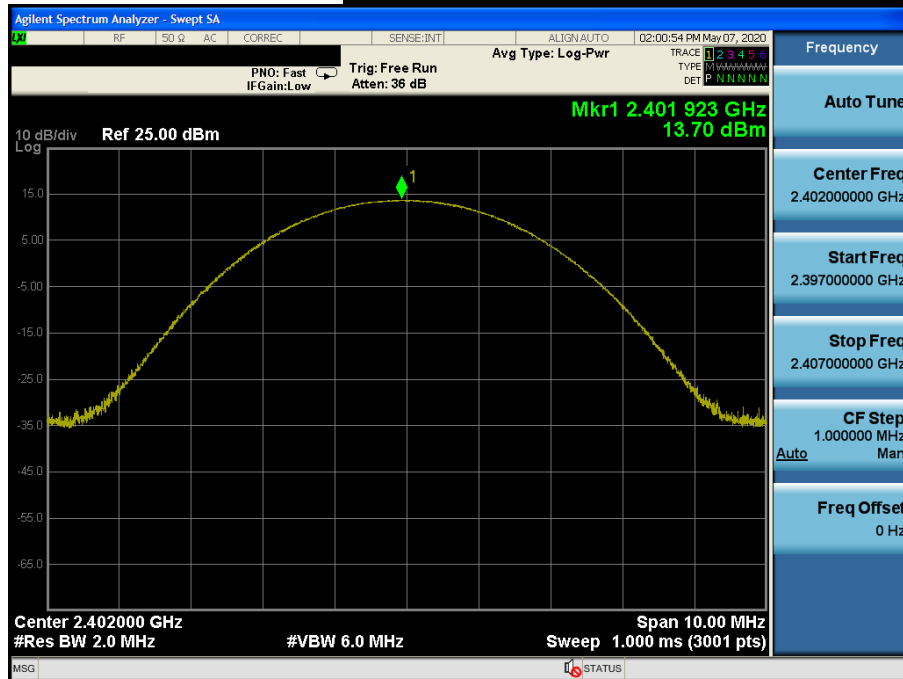
Peak Output Power

Highest Channel & Modulation : $\pi/4$ DQPSK



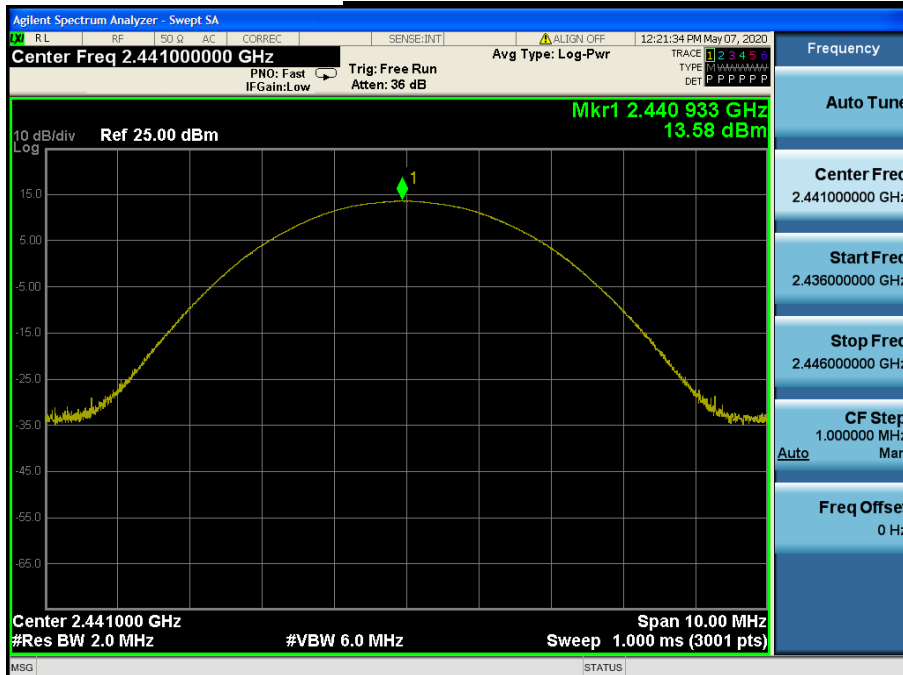
Peak Output Power

Lowest Channel & Modulation : 8DPSK



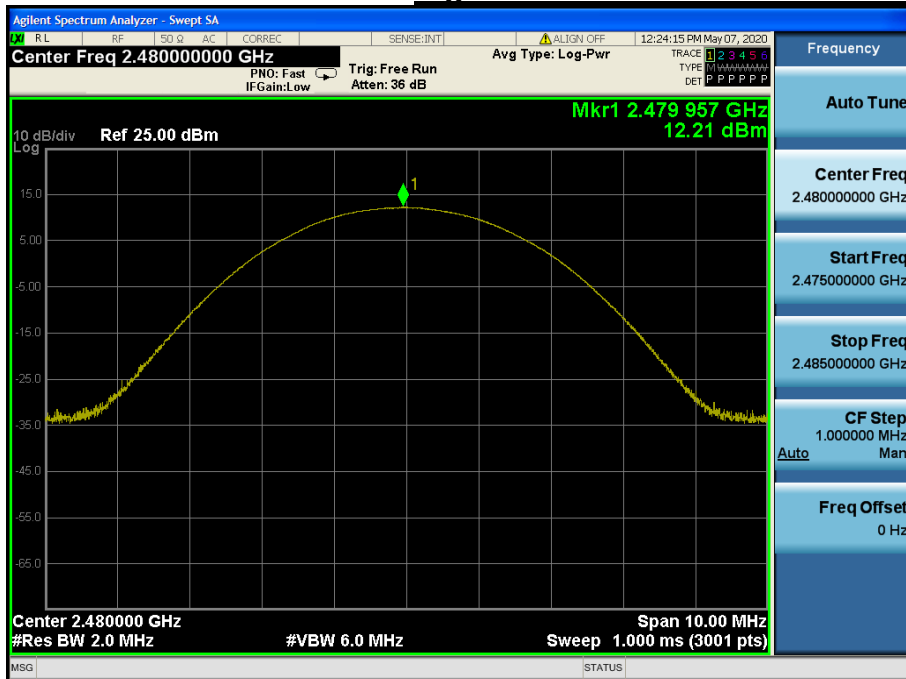
Peak Output Power

Middle Channel & Modulation : 8DPSK



Peak Output Power

Highest Channel & Modulation : 8DPSK



3. 20 dB BW

3.1 Test Setup

Refer to the APPENDIX I.

3.2 Limit

Limit : Not Applicable

3.3 Test Procedure

1. The 20 dB bandwidth & Occupied bandwidth were measured with a spectrum analyzer connected to RF antenna Connector(conducted measurement) while EUT was operating in transmit mode. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using below setting:
RBW = 1 % to 5 % of the 20 dB BW & Occupied BW
VBW $\geq 3 \times$ RBW
Span = between two times and five times the 20 dB bandwidth & Occupied BW
Sweep = auto
Detector function = peak
Trace = max hold

3.4 Test Results

Modulation	Tested Channel	20 dB BW (MHz)
<u>GFSK</u>	Lowest	0.880
	Middle	0.880
	Highest	0.880
<u>$\pi/4$DQPSK</u>	Lowest	1.320
	Middle	1.320
	Highest	1.310
<u>8DPSK</u>	Lowest	1.300
	Middle	1.290
	Highest	1.290

20 dB BW

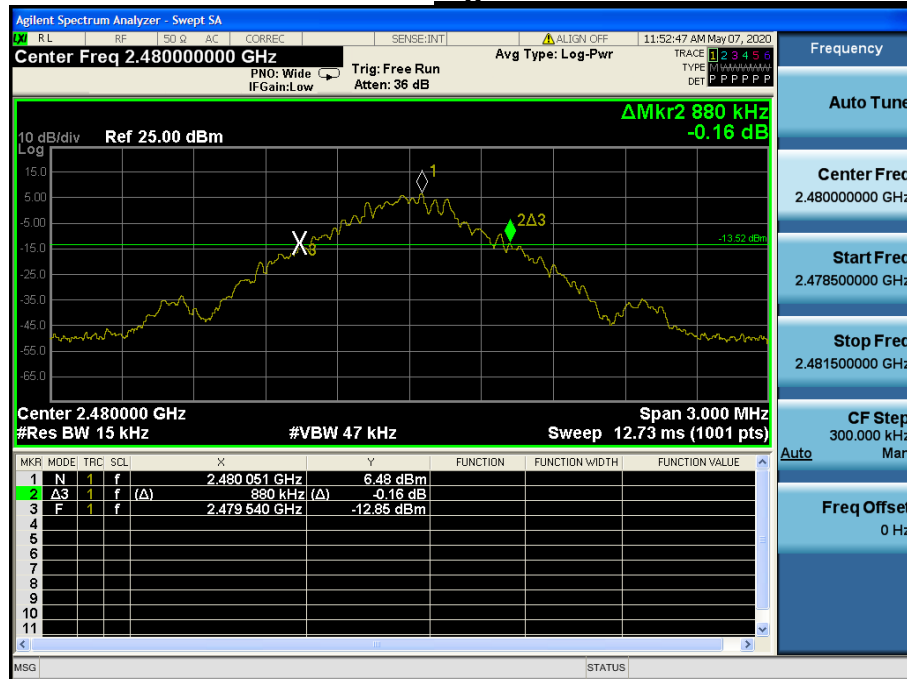
Lowest Channel & Modulation : GFSK

20 dB BW

Middle Channel & Modulation : GFSK

20 dB BW

Highest Channel & Modulation : GFSK



20 dB BW

Lowest Channel & Modulation : $\pi/4$ DQPSK



20 dB BW

Middle Channel & Modulation : $\pi/4$ DQPSK



20 dB BW

Highest Channel & Modulation : $\pi/4$ DQPSK



20 dB BW

Lowest Channel & Modulation : 8DPSK

20 dB BW

Middle Channel & Modulation : 8DPSK

20 dB BW

Highest Channel & Modulation : 8DPSK



4. Carrier Frequency Separation

4.1 Test Setup

Refer to the APPENDIX I.

4.2 Limit

Limit : ≥ 25 kHz or $\geq$ Two-Thirds of the 20 dB BW whichever is greater.

4.3 Procedure

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

After the trace being stable, the reading value between the peaks of the adjacent channels using the marker-delta function was recorded as the measurement results.

The spectrum analyzer is set to :

Span = wide enough to capture the peaks of two adjacent channels

RBW = Start with the RBW set to approximately 30 % of the channel spacing; adjust as necessary to best identify the center of each individual channel.

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

4.4 Test Results

FH mode

Hopping Mode	Modulation	Peak of center channel (MHz)	Peak of adjacent Channel (MHz)	Test Result (MHz)
Enable	GFSK	2 440.988	2 441.990	1.002
	$\pi/4$ DQPSK	2 440.987	2 441.990	1.003
	8DPSK	2 440.988	2 441.987	0.999

AFH mode

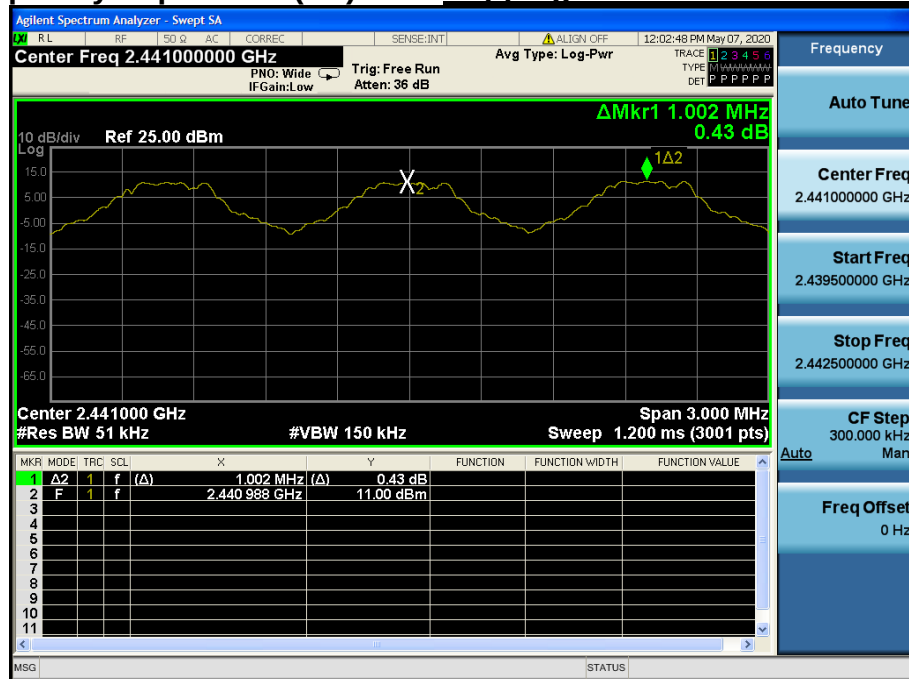
Hopping Mode	Modulation	Peak of center channel (MHz)	Peak of adjacent Channel (MHz)	Test Result (MHz)
Enable	GFSK	2 440.986	2 441.988	1.002
	$\pi/4$ DQPSK	2 440.991	2 441.989	0.998
	8DPSK	2 440.988	2 441.989	1.001

Note 1 : See next pages for actual measured spectrum

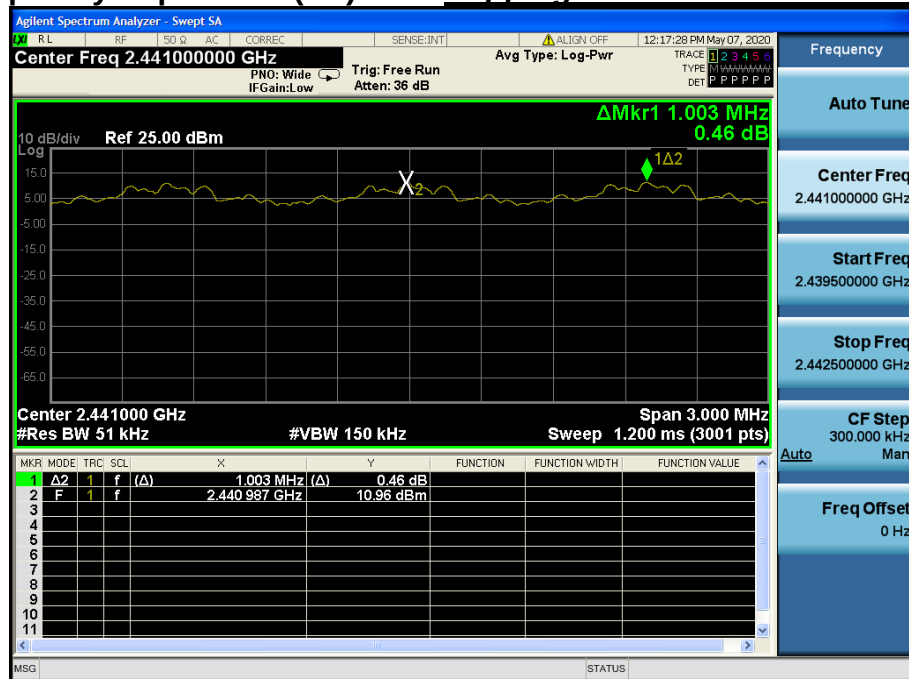
- Minimum Standard :

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 2 400 MHz – 2 483.5 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

Carrier Frequency Separation (FH)

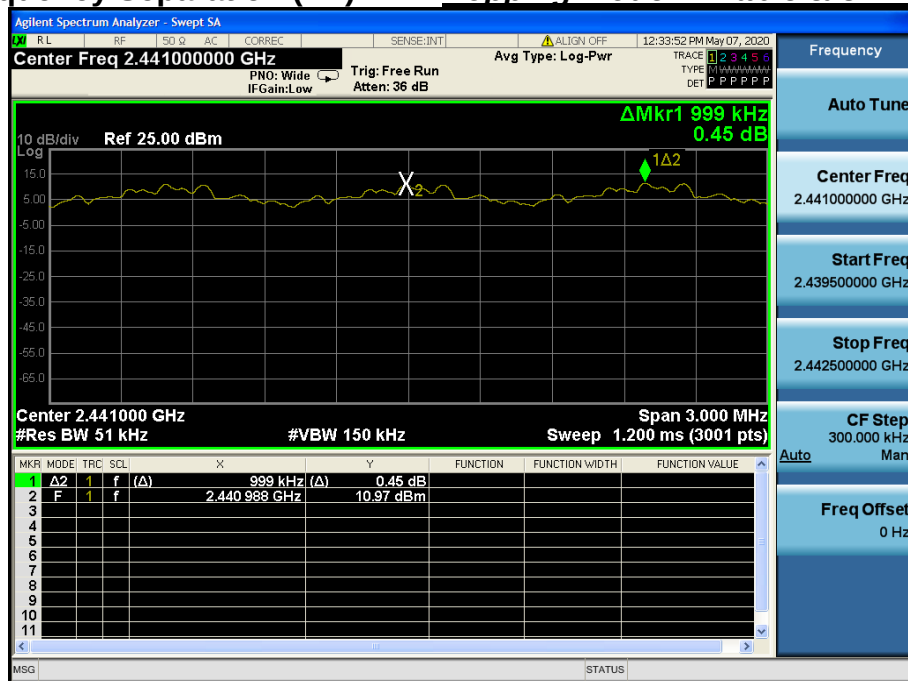
Hopping mode : Enable & GFSK

Carrier Frequency Separation (FH)

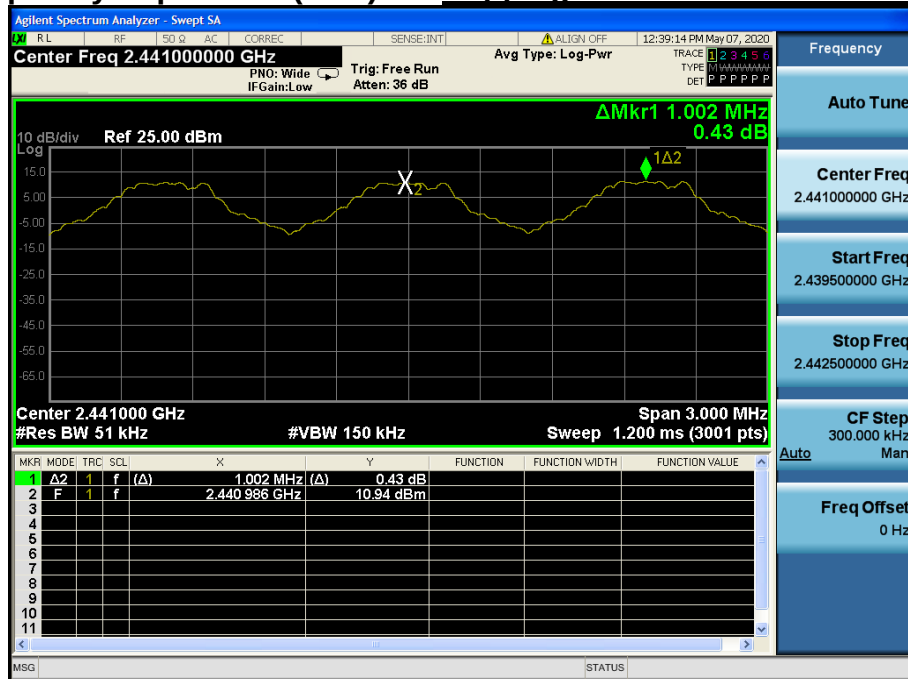
Hopping mode : Enable & $\pi/4$ DQPSK

Carrier Frequency Separation (FH)

Hopping mode : Enable & 8DPSK



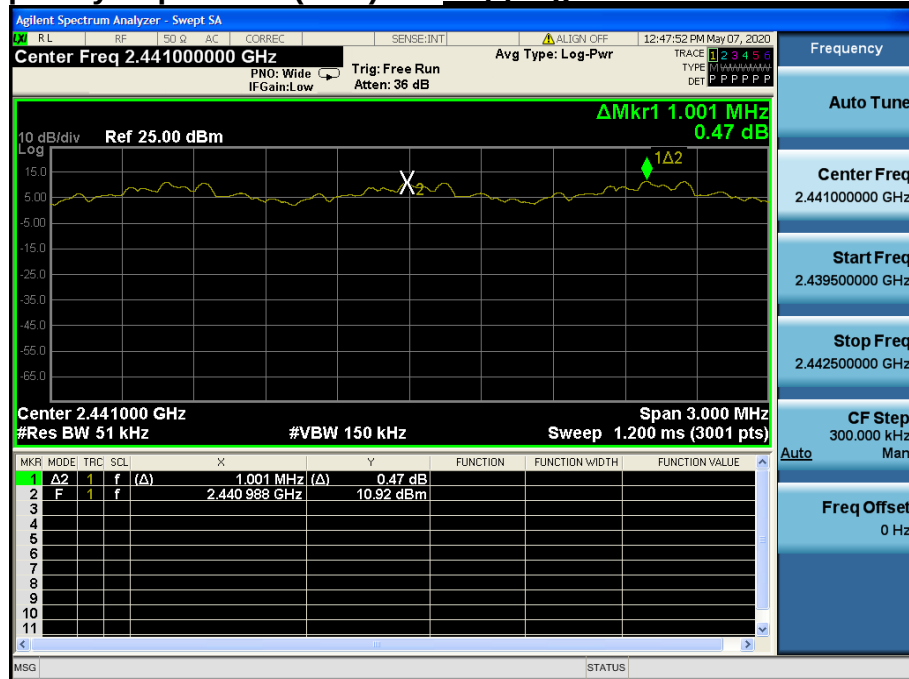
Carrier Frequency Separation (AFH) *Hopping mode : Enable & GFSK*



Carrier Frequency Separation (AFH) *Hopping mode : Enable & π/4DQPSK*



Carrier Frequency Separation (AFH) *Hopping mode : Enable & 8DPSK*



5. Number of Hopping Frequencies

5.1 Test Setup

Refer to the APPENDIX I.

5.2 Limit

Limit : ≥ 15 hops

5.3 Procedure

The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

To get higher resolution, two frequency ranges for FH mode within the 2 400 MHz ~ 2 483.5 MHz were examined.

The spectrum analyzer is set to :

Span for FH mode = 50 MHz	Start Frequency = 2 391.5 MHz, Stop Frequency = 2 441.5 MHz
	Start Frequency = 2 441.5 MHz, Stop Frequency = 2 491.5 MHz
Span for AFH mode = 30 MHz	Start Frequency = 2 426.0 MHz, Stop Frequency = 2 456.0 MHz
RBW = To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.	
VBW $\geq$ RBW	Sweep = auto
Detector function = peak	Trace = max hold

5.4 Test Results

FH mode

Hopping mode	Modulation	Test Result (Total Hops)
Enable	GFSK	79
	$\pi/4$ DQPSK	79
	8DPSK	79

AFH mode

Hopping mode	Modulation	Test Result (Total Hops)
Enable	GFSK	20
	$\pi/4$ DQPSK	20
	8DPSK	20

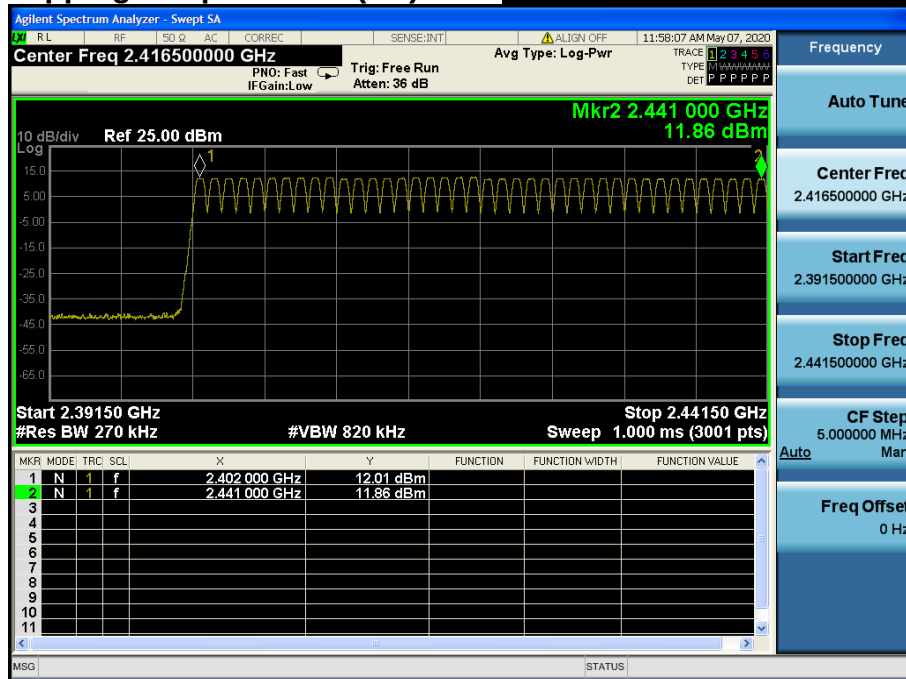
Note 1 : See next pages for actual measured spectrum plots.

- Minimum Standard :

At least 15 hops

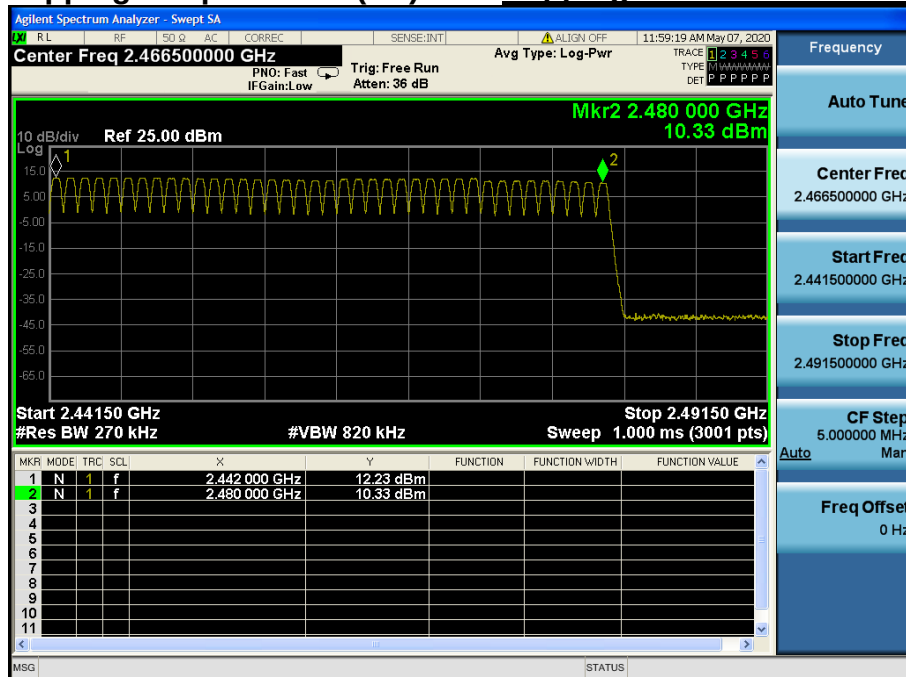
Number of Hopping Frequencies 1(FH)

Hopping mode : Enable & GFSK



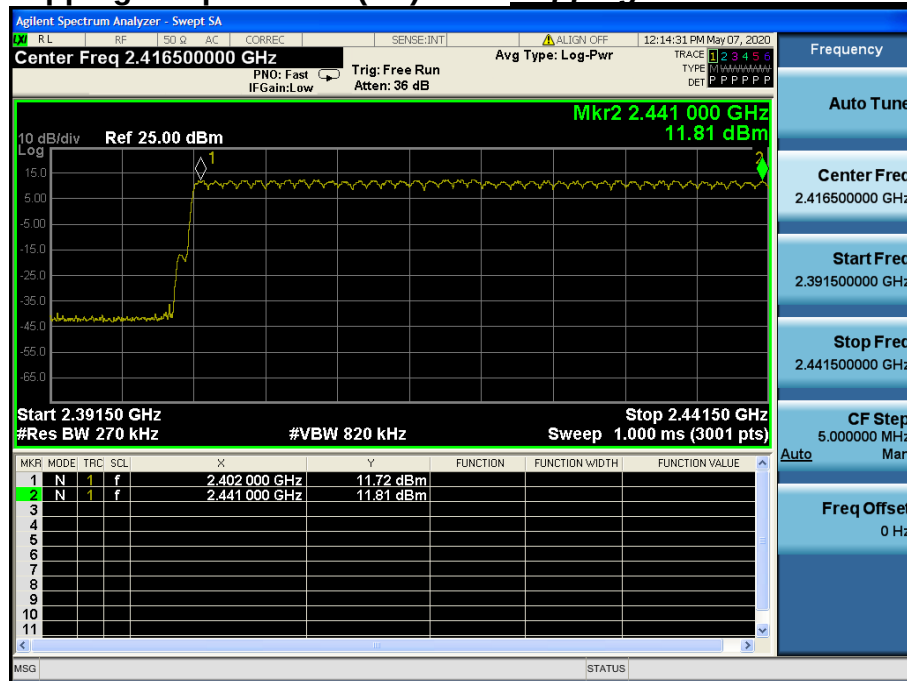
Number of Hopping Frequencies 2(FH)

Hopping mode : Enable & GFSK



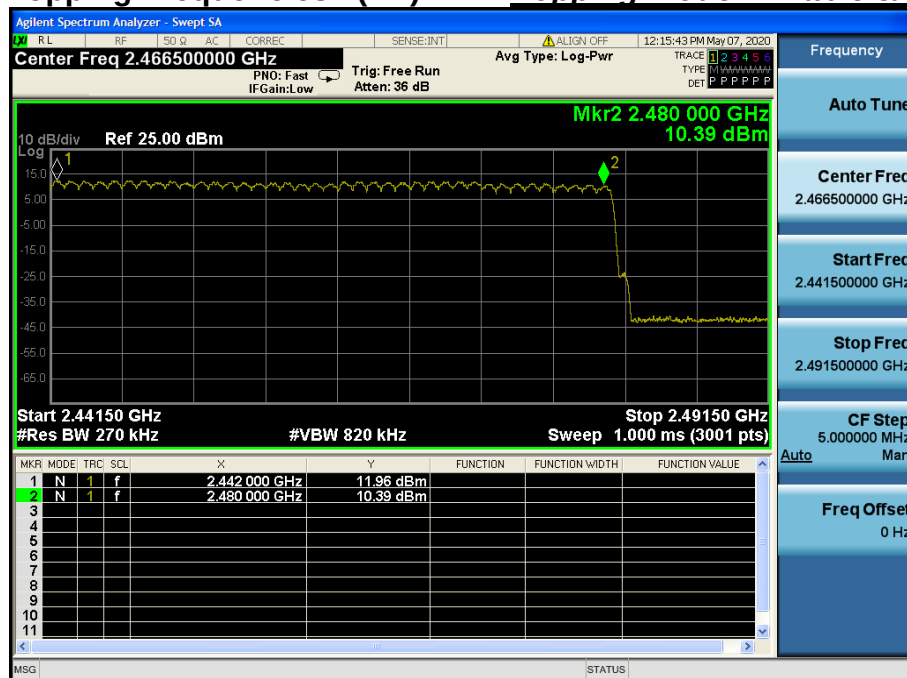
Number of Hopping Frequencies 1(FH)

Hopping mode : Enable & $\pi/4$ DQPSK



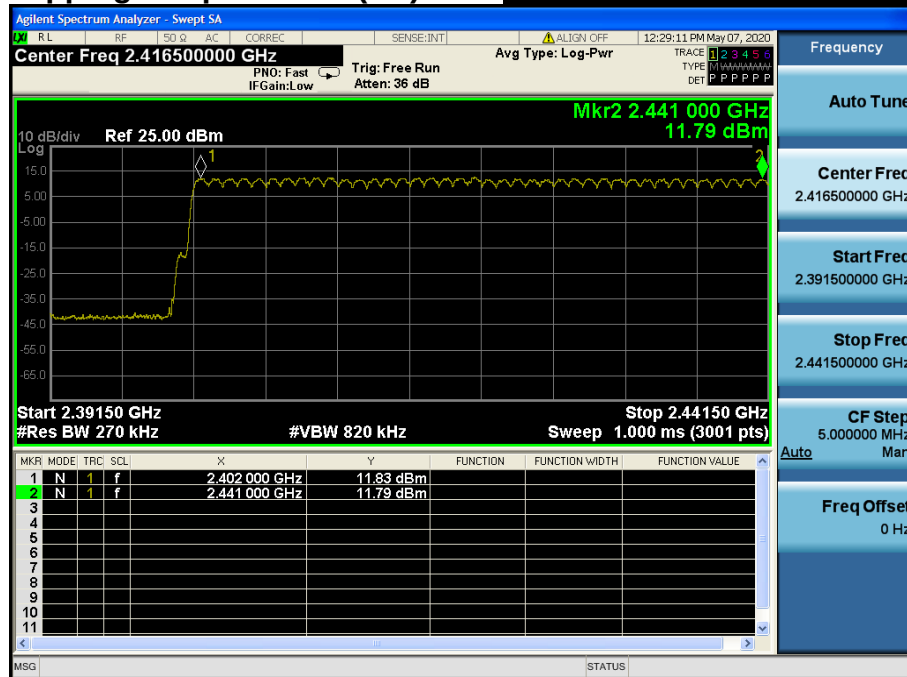
Number of Hopping Frequencies 2(FH)

Hopping mode : Enable & $\pi/4$ DQPSK



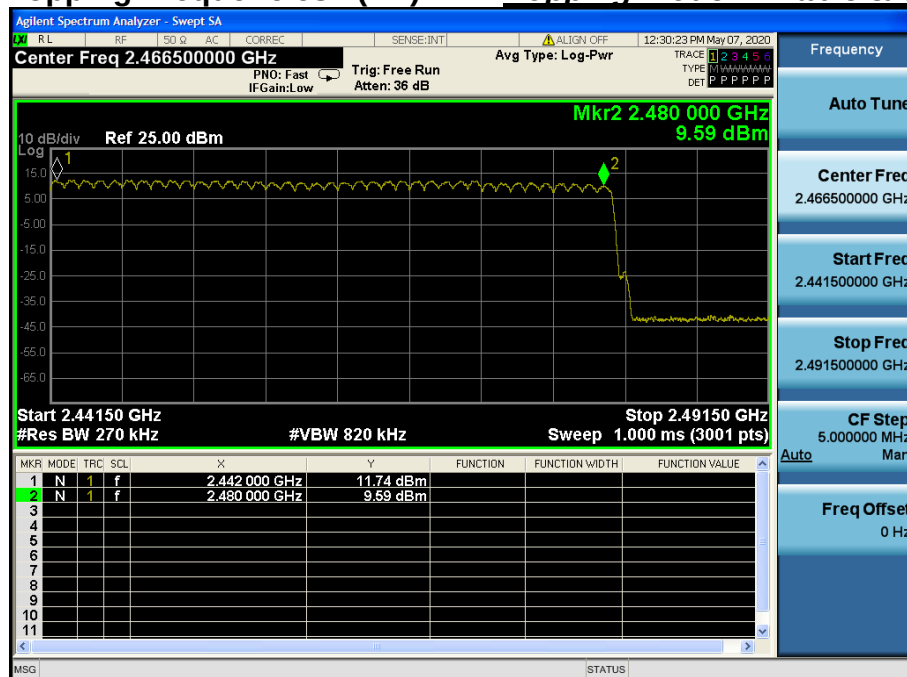
Number of Hopping Frequencies 1(FH)

Hopping mode : Enable & 8DPSK

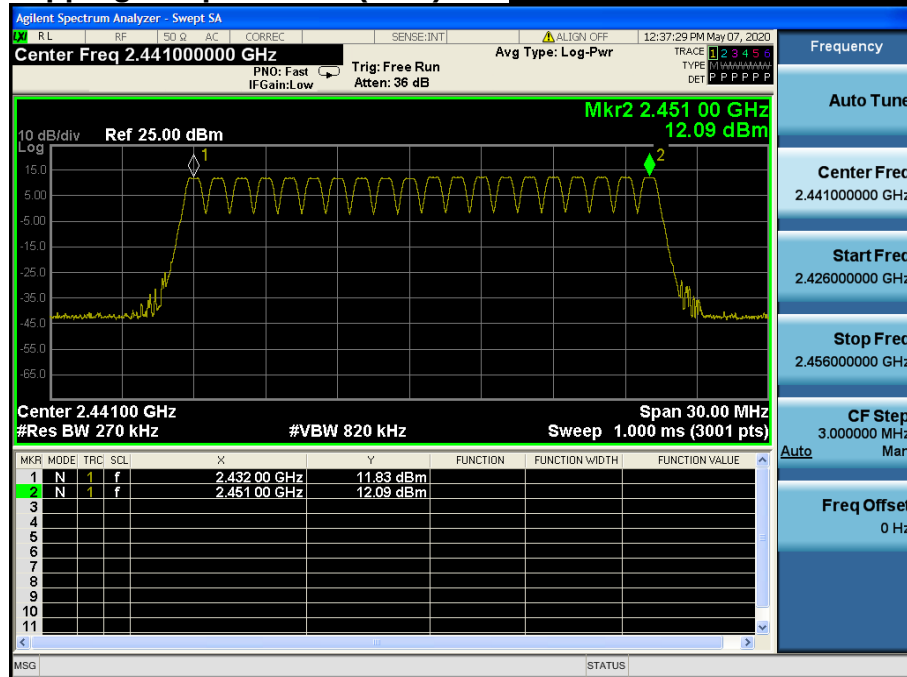


Number of Hopping Frequencies 2(FH)

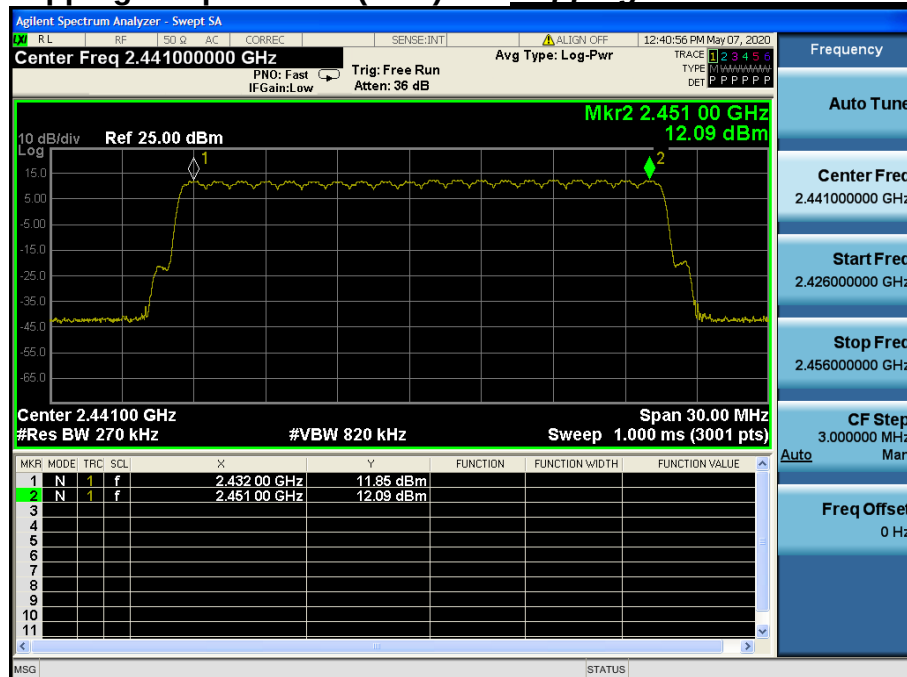
Hopping mode : Enable & 8DPSK



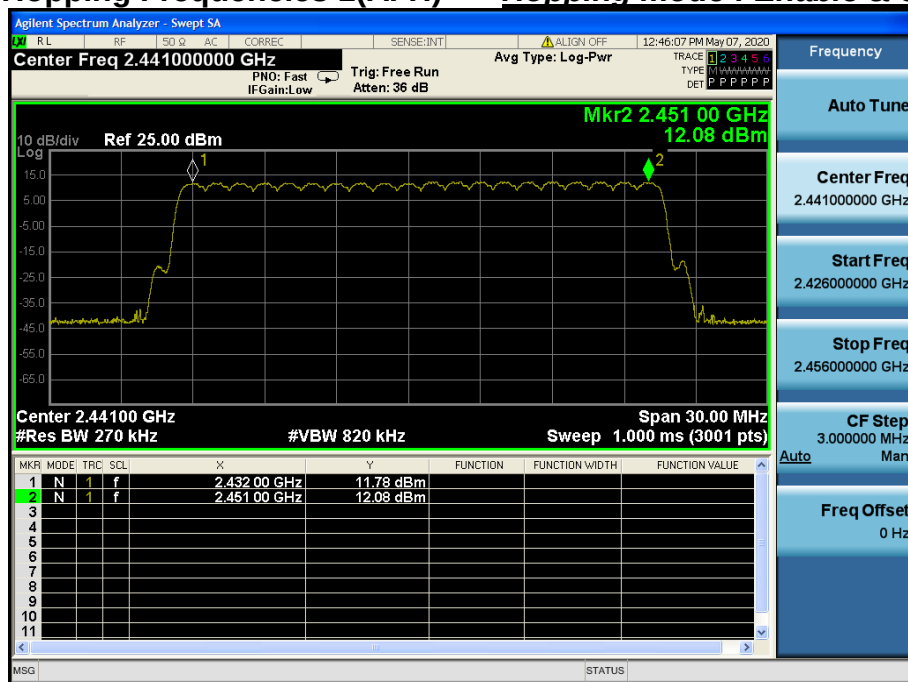
Number of Hopping Frequencies 1(AFH) Hopping mode : Enable & GFSK



Number of Hopping Frequencies 1(AFH) Hopping mode : Enable & $\pi/4$ DQPSK



Number of Hopping Frequencies 1(AFH) *Hopping mode : Enable & 8DPSK*



6. Time of Occupancy (Dwell Time)

6.1 Test Setup

Refer to the APPENDIX I.

6.2 Limit

The maximum permissible time of occupancy is 400 ms within a period of 400 ms multiplied by the number of hopping channels employed.

6.3 Test Procedure

The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

The spectrum analyzer is set to :

Center frequency = 2 441 MHz

Span = zero

RBW = 1 MHz (RBW shall be $\leq$ channel spacing and where possible RBW should be set $\gg 1 / T$, where T is the expected dwell time per channel)

VBW $\geq$ RBW

Detector function = peak

Trace = max hold

6.4 Test Results

FH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
Enable	DH 5	79	2.880	3.750	0.307
	2 DH 5	79	2.880	3.750	0.307
	3 DH 5	79	2.880	3.750	0.307

AFH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
Enable	DH 5	20	2.880	3.750	0.154
	2 DH 5	20	2.880	3.750	0.154
	3 DH 5	20	2.880	3.750	0.154

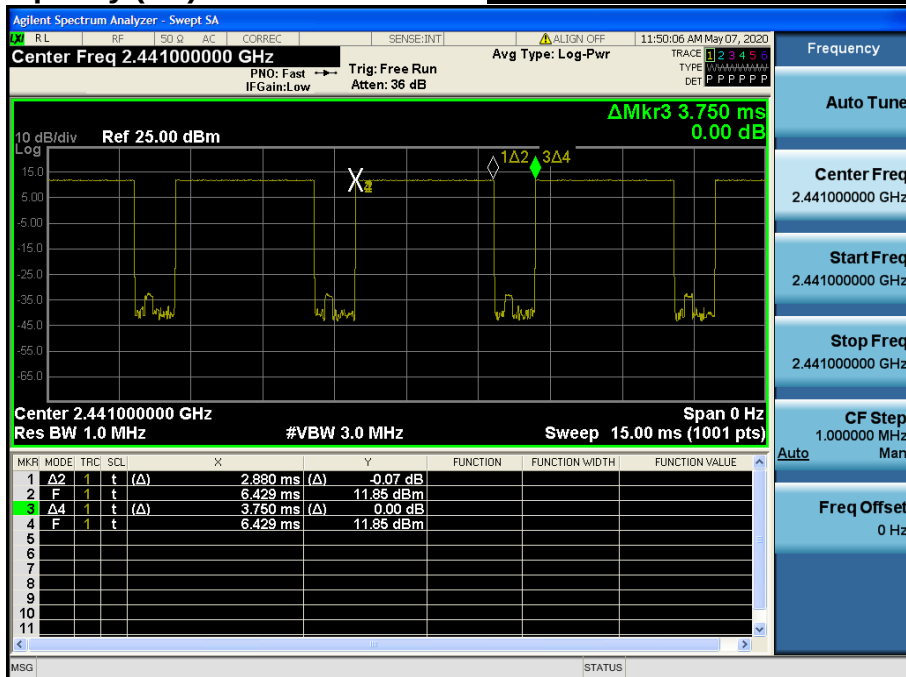
Note 1 : Dwell Time = $0.4 \times \text{Hopping channel} \times \text{Burst ON time} \times ((\text{Hopping rate} \div \text{Time slots}) \div \text{Hopping channel})$

- Time slots for DH5 = 6 slots (TX = 5 slot / RX = 1 slot)
- Hopping Rate = 1600 for FH mode & 800 for AFH mode

Note 2 : See next pages for actual measured spectrum plots.

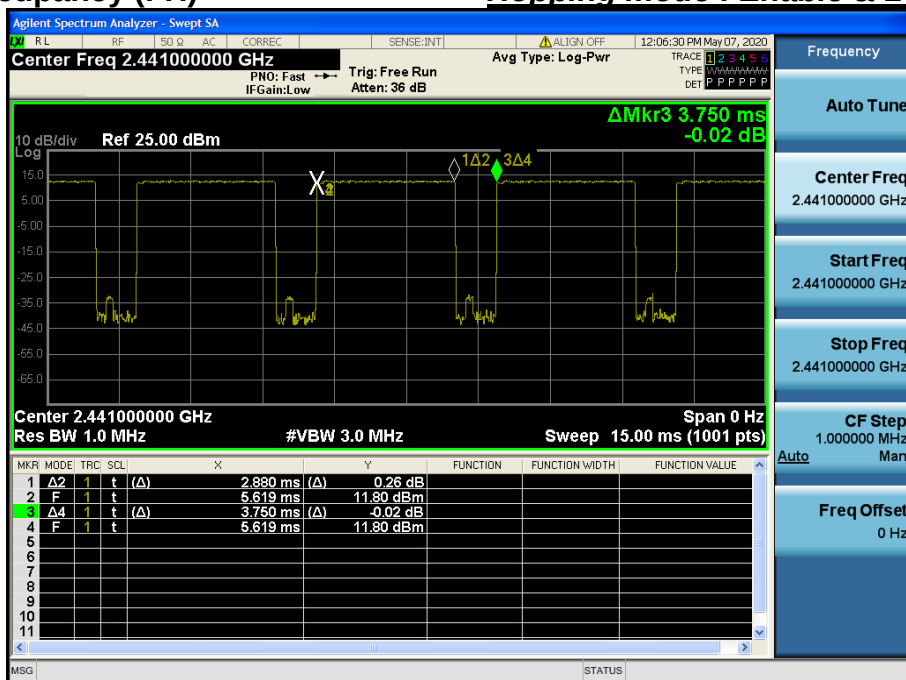
Time of Occupancy (FH)

Hopping mode : Enable & DH5

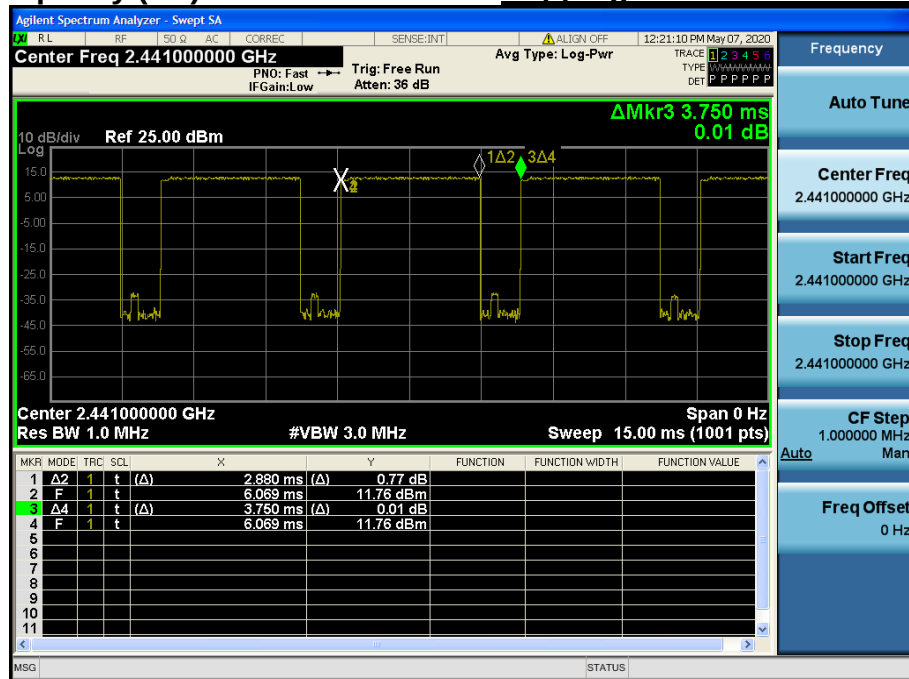


Time of Occupancy (FH)

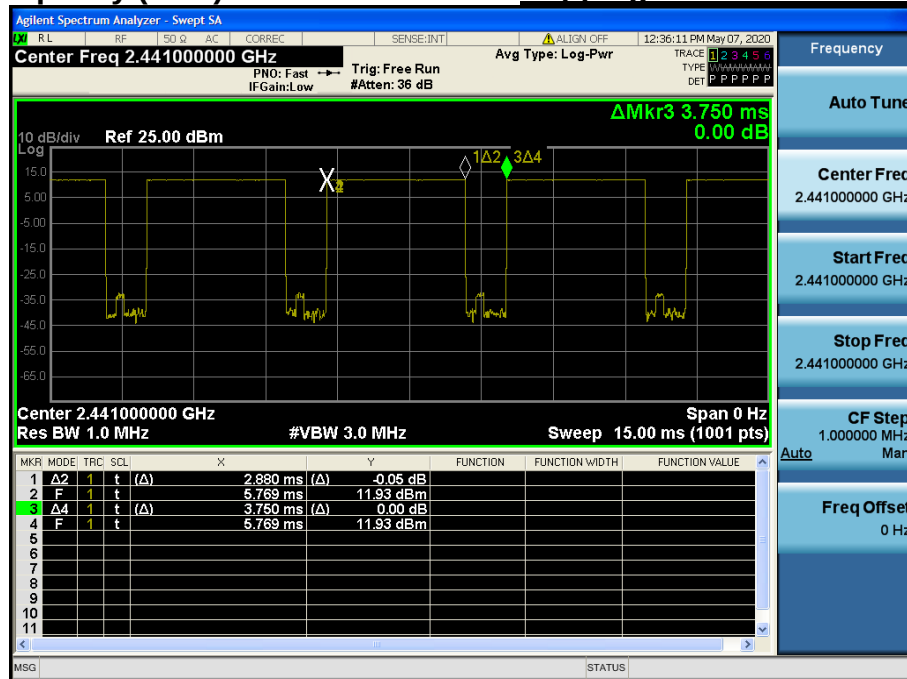
Hopping mode : Enable & 2-DH5



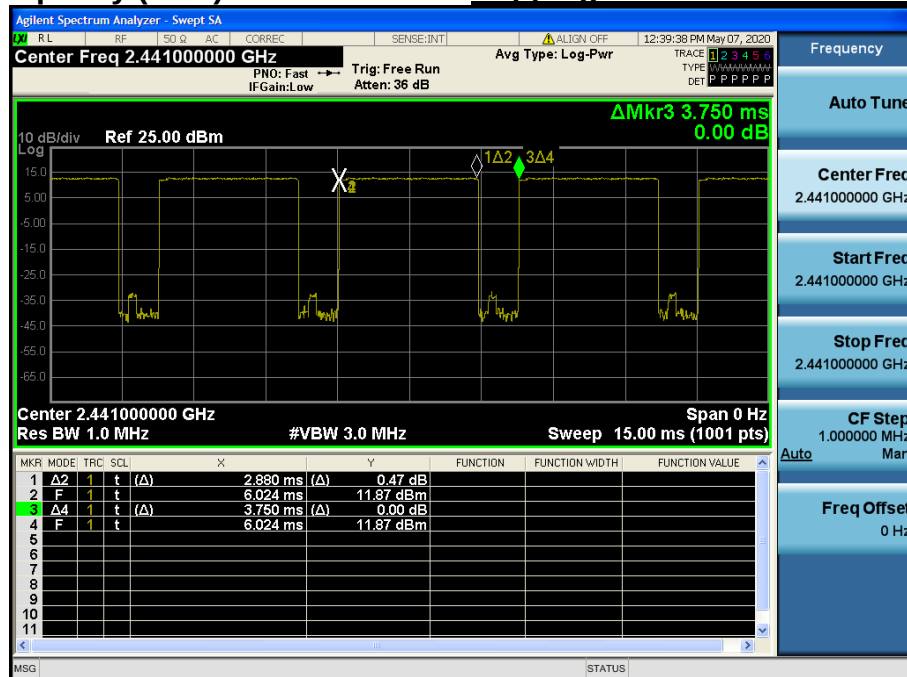
Time of Occupancy (FH)

Hopping mode : Enable & 3-DH5

Time of Occupancy (AFH)

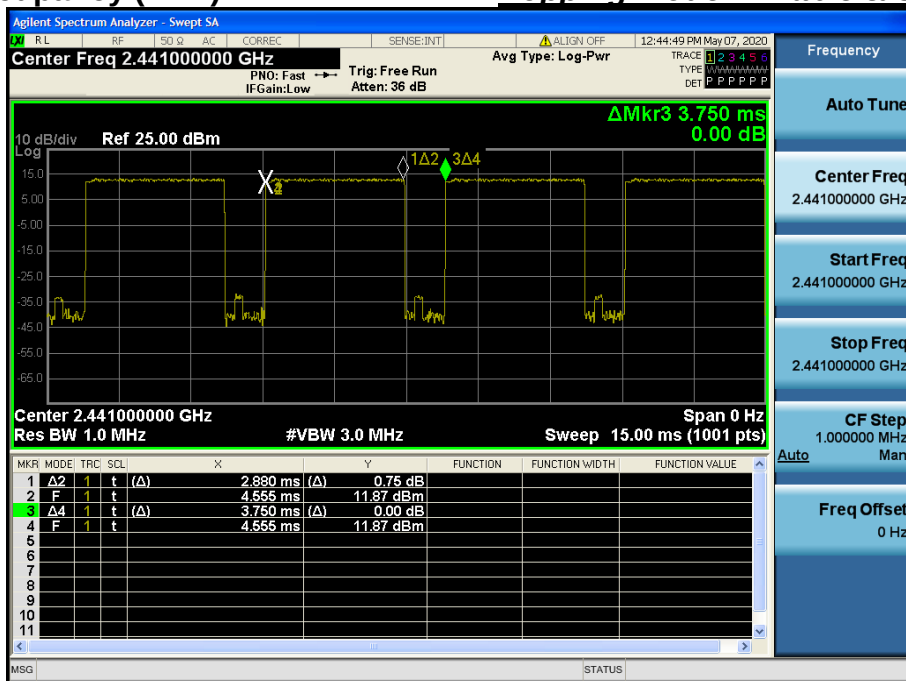
Hopping mode : Enable & DH5

Time of Occupancy (AFH)

Hopping mode : Enable & 2-DH5

Time of Occupancy (AFH)

Hopping mode : Enable & 3-DH5



7. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission

7.1 Test Setup

Refer to the APPENDIX I.

7.2 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 section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

According to § 15.209(a), except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Limit (uV/m)	Measurement Distance (meter)
0.009 ~ 0.490	2400/F (kHz)	300
0.490 ~ 1705	24000/F (kHz)	30
1705 ~ 30.0	30	30
30 ~ 88	100 **	3
88 ~ 216	150 **	3
216 ~ 960	200 **	3
Above 960	500	3

** Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 MHz - 72 MHz, 76 MHz - 88 MHz, 174 MHz - 216 MHz or 470 - 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

According to § 15.205(a) and (b), only spurious emissions are permitted in any of the frequency bands listed below :

MHz	MHz	MHz	MHz	GHz	GHz
0.009 ~ 0.110	8.414 25 ~ 8.414 75	108 ~ 121.94	1 300 ~ 1 427	4.5 ~ 5.15	14.47 ~ 14.5
0.495 ~ 0.505	12.29 ~ 12.293	123 ~ 138	1 435 ~ 1 626.5	5.35 ~ 5.46	15.35 ~ 16.2
2.173 5 ~ 2.190 5	12.519 75 ~ 12.520 25	149.9 ~ 150.05	1 645.5 ~ 1 646.5	7.25 ~ 7.75	17.7 ~ 21.4
4.125 ~ 4.128	12.576 75 ~ 12.577 25	156.524 75 ~ 156.525 25	1 660 ~ 1 710	8.025 ~ 8.5	22.01 ~ 23.12
4.177 25 ~ 4.177 75	13.36 ~ 13.41	156.7 ~ 156.9	1 718.8 ~ 1 722.2	9.0 ~ 9.2	23.6 ~ 24.0
4.207 25 ~ 4.207 75	16.42 ~ 16.423	162.012 5 ~ 167.17	2 200 ~ 2 300	9.3 ~ 9.5	31.2 ~ 31.8
6.215 ~ 6.218	16.694 75 ~ 16.695 25	167.72 ~ 173.2	2 310 ~ 2 390	10.6 ~ 12.7	36.43 ~ 36.5
6.267 75 ~ 6.268 25	16.804 25 ~ 16.804 75	240 ~ 285	2 483.5 ~ 2 500	13.25 ~ 13.4	Above 38.6
6.311 75 ~ 6.312 25	25.5 ~ 25.67	322 ~ 335.4	2 655 ~ 2 900		
8.291 ~ 8.294	37.5 ~ 38.25	399.90 ~ 410	3 260 ~ 3 267		
8.362 ~ 8.366	73 ~ 74.6	608 ~ 614	3 332 ~ 3 339		
8.376 25 ~ 8.386 75	74.8 ~ 75.2	960 ~ 1 240	3 345.8 ~ 3 358		
			3 600 ~ 4 400		

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1 000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

7.3. Test Procedures

7.3.1. Test Procedures for Radiated Spurious Emissions

1. The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m.
The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 1 or 3 meter away from the interference-receiving antenna.
3. For measurements above 1 GHz absorbers are placed on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1 GHz, the absorbers are removed.
4. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
5. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
6. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
7. If the emission level of the EUT in peak mode was 10 dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Measurement Instrument Setting

- Frequencies less than or equal to 1 000 MHz
The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
- Frequencies above 1 000 MHz
The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz.
The result of Average measurement is calculated using PK result and duty correction factor.

7.3.2. Test Procedures for Conducted Spurious Emissions

1. The transmitter output was connected to the spectrum analyzer.
2. The **reference level** of the fundamental frequency was measured with the spectrum analyzer using RBW = 100 kHz, VBW = 300 kHz.
3. The conducted spurious emission was tested each ranges were set as below.

Frequency range : 9 kHz ~ 30 MHz

RBW = 100 kHz, VBW = 300 kHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SWEEP POINT : 40 001

Frequency range : 30 MHz ~ 10 GHz, 10 GHz ~ 25 GHz

RBW = 1 MHz, VBW = 3 MHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SWEEP POINT : 40 001

LIMIT LINE = 20 dB below of the reference level of above measurement procedure Step 2. (RBW = 100 kHz, VBW = 300 kHz)

If the emission level with above setting was close to the limit (ie, less than 3 dB margin) then zoom scan is required using RBW = 100 kHz, VBW = 300 kHz, SPAN = 100 MHz and BINS = 2 001 to get accurate emission level within 100 kHz BW.

Also the path loss for conducted measurement setup was used as described on the Appendix I of this test report.

7.4. Test Results

7.4.1. Radiated Emissions

▪ Test Notes.

- The radiated emissions were investigated 9 kHz to 25 GHz. And no other spurious and harmonic emissions were found below listed frequencies.
- Information of Distance Factor
For finding emissions, the test distance might be reduced from 3m to 1m. In this case, the distance factor(-9.54dB) is applied to the result.
- Calculation of distance factor = $20 \log(\text{applied distance} / \text{required distance}) = 20 \log(1 \text{ m} / 3 \text{ m}) = -9.54 \text{ dB}$
When distance factor is "N/A", the distance is 3 m and distance factor is not applied.
- D.C.F Calculation. (D.C.F = Duty Cycle Correction Factor)
- Time to cycle through all channels = $\Delta t = T [\text{ms}] \times 20 \text{ minimum hopping channels}$, where T = pulse width = **2.88 ms**
- $100 \text{ ms} / \Delta t [\text{ms}] = H \rightarrow$ Round up to next highest integer, to account for worst case, $H' = 100 / (2.88 \times 20) = 1.74 \approx 2$
- The Worst Case Dwell Time = $T [\text{ms}] \times H' = 2.88 \text{ ms} \times 2 = 5.76 \text{ ms}$
- D.C.F = $20 \log(\text{The Worst Case Dwell Time} / 100 \text{ ms}) \text{ dB} = 20 \log(5.76 / 100) = -24.79 \text{ dB}$
- Sample Calculation.
Margin = Limit – Result / Result = Reading + T.F + D.C.F / T.F = AF + CL – AG
Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain.

9 kHz ~ 25 GHz Data (Modulation : GFSK)

▪ Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 389.86	V	Y	PK	51.85	4.80	N/A	N/A	56.65	74.00	17.35
2 389.86	V	Y	AV	51.85	4.80	-24.79	N/A	31.86	54.00	22.14
4 803.51	H	Z	PK	49.61	0.78	N/A	N/A	50.39	74.00	23.61
4 803.51	H	Z	AV	49.61	0.78	-24.79	N/A	25.60	54.00	28.40

▪ Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4 882.34	H	Z	PK	50.18	1.36	N/A	N/A	51.54	74.00	22.46
4 882.34	H	Z	AV	50.18	1.36	-24.79	N/A	26.75	54.00	27.25

▪ Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 484.18	V	Y	PK	51.80	5.26	N/A	N/A	57.06	74.00	16.94
2 484.18	V	Y	AV	51.80	5.26	-24.79	N/A	32.27	54.00	21.73
4 960.32	H	Z	PK	49.92	1.61	N/A	N/A	51.53	74.00	22.47
4 960.32	H	Z	AV	49.92	1.61	-24.79	N/A	26.74	54.00	27.26

9 kHz ~ 25 GHz Data (Modulation : $\pi/4$ DQPSK)

▪ Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 389.78	H	X	PK	50.75	4.80	N/A	N/A	55.55	74.00	18.45
2 389.78	H	X	AV	50.75	4.80	-24.79	N/A	30.76	54.00	23.24
4 803.65	H	Z	PK	49.41	0.78	N/A	N/A	50.19	74.00	23.81
4 803.65	H	Z	AV	49.41	0.78	-24.79	N/A	25.40	54.00	28.60

▪ Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4 882.19	H	Z	PK	49.72	1.36	N/A	N/A	51.08	74.00	22.92
4 882.19	H	Z	AV	49.72	1.36	-24.79	N/A	26.29	54.00	27.71

▪ Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 484.27	H	X	PK	52.08	5.26	N/A	N/A	57.34	74.00	16.66
2 484.27	H	X	AV	52.08	5.26	-24.79	N/A	32.55	54.00	21.45
4 960.23	H	Z	PK	49.32	1.61	N/A	N/A	50.93	74.00	23.07
4 960.23	H	Z	AV	49.32	1.61	-24.79	N/A	26.14	54.00	27.86

9 kHz ~ 25 GHz Data (Modulation : 8DPSK)

▪ Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 389.76	H	X	PK	50.96	4.80	N/A	N/A	55.76	74.00	18.24
2 389.76	H	X	AV	50.96	4.80	-24.79	N/A	30.97	54.00	23.03
4 804.40	H	Z	PK	49.07	0.78	N/A	N/A	49.85	74.00	24.15
4 804.40	H	Z	AV	49.07	0.78	-24.79	N/A	25.06	54.00	28.94

▪ Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4 882.28	H	Z	PK	49.96	1.36	N/A	N/A	51.32	74.00	22.68
4 882.28	H	Z	AV	49.96	1.36	-24.79	N/A	26.53	54.00	27.47

▪ Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 483.57	H	X	PK	52.98	5.25	N/A	N/A	58.23	74.00	15.77
2 483.57	H	X	AV	52.98	5.25	-24.79	N/A	33.44	54.00	20.56
4 959.80	H	Z	PK	49.82	1.61	N/A	N/A	51.43	74.00	22.57
4 959.80	H	Z	AV	49.82	1.61	-24.79	N/A	26.64	54.00	27.36

9 kHz ~ 25 GHz Data (Modulation : 8DPSK) With Wireless Charging

▪ Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 483.78	H	X	PK	51.53	5.26	N/A	N/A	56.79	74.00	17.21
2 483.78	H	X	AV	51.53	5.26	-24.79	N/A	32.00	54.00	22.00
4 959.86	V	X	PK	49.61	1.61	N/A	N/A	51.22	74.00	22.78
4 959.86	V	X	AV	49.61	1.61	-24.79	N/A	26.43	54.00	27.57

9 kHz ~ 25 GHz Data (Modulation : 8DPSK) With Dual Display

▪ Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 483.57	H	X	PK	53.23	5.25	N/A	N/A	58.48	74.00	15.52
2 483.57	H	X	AV	53.23	5.25	-24.79	N/A	33.69	54.00	20.31
4 959.84	H	X	PK	49.15	1.61	N/A	N/A	50.76	74.00	23.24
4 959.84	H	X	AV	49.15	1.61	-24.79	N/A	25.97	54.00	28.03
7 440.37	H	X	PK	46.80	9.18	N/A	N/A	55.98	74.00	18.02
7 440.37	H	X	AV	46.80	9.18	-24.79	N/A	31.19	54.00	22.81

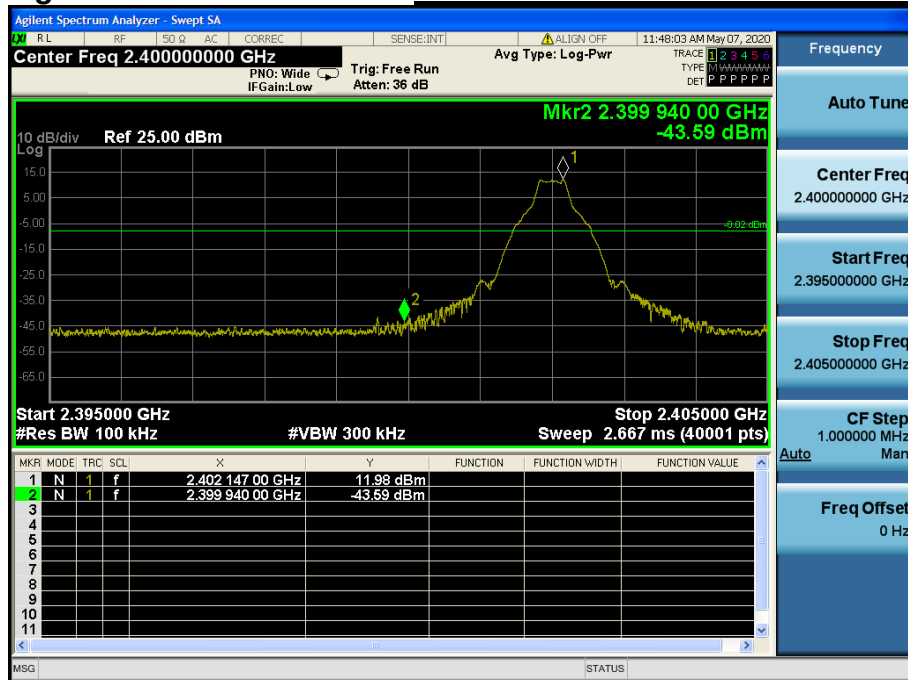
9 kHz ~ 25 GHz Data (Modulation : 8DPSK) With Dual Display+WPC

▪ Highest Channel

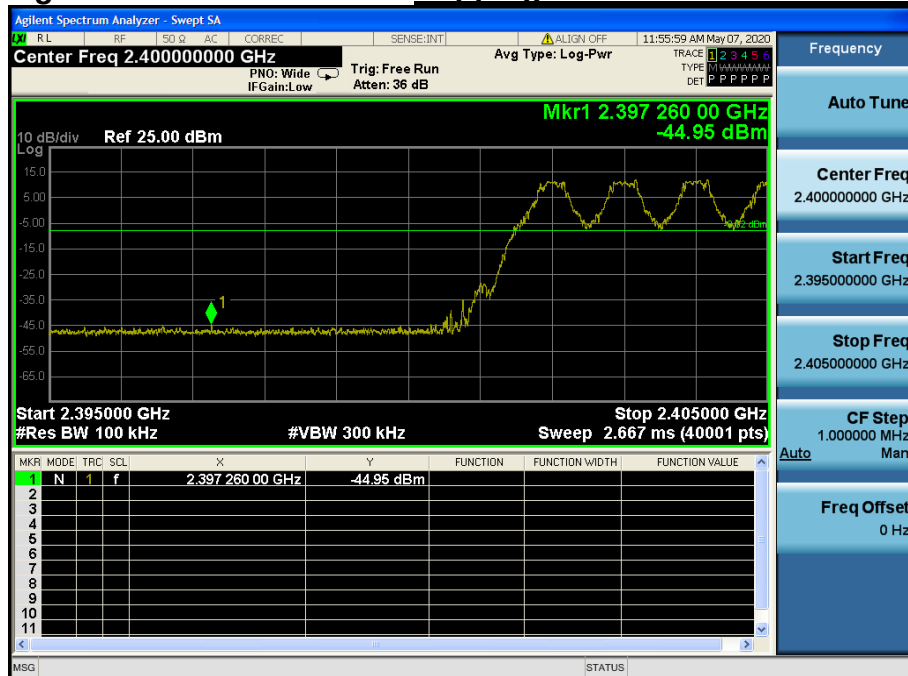
Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 483.82	H	X	PK	51.90	5.25	N/A	N/A	57.15	74.00	16.85
2 483.82	H	X	AV	51.90	5.25	-24.79	N/A	32.36	54.00	21.64
4 959.76	H	X	PK	49.09	1.61	N/A	N/A	50.70	74.00	23.30
4 959.76	H	X	AV	49.09	1.61	-24.79	N/A	25.91	54.00	28.09
7 440.44	H	X	PK	47.71	9.18	N/A	N/A	56.89	74.00	17.11
7 440.44	H	X	AV	47.71	9.18	-24.79	N/A	32.10	54.00	21.90

7.4.2. Conducted Spurious Emissions

Low Band-edge

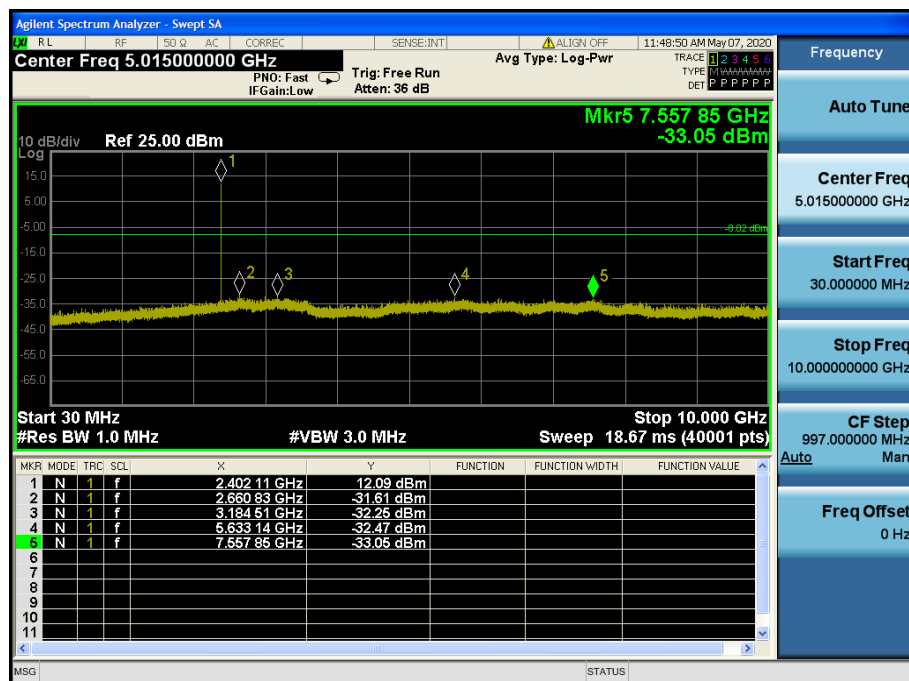
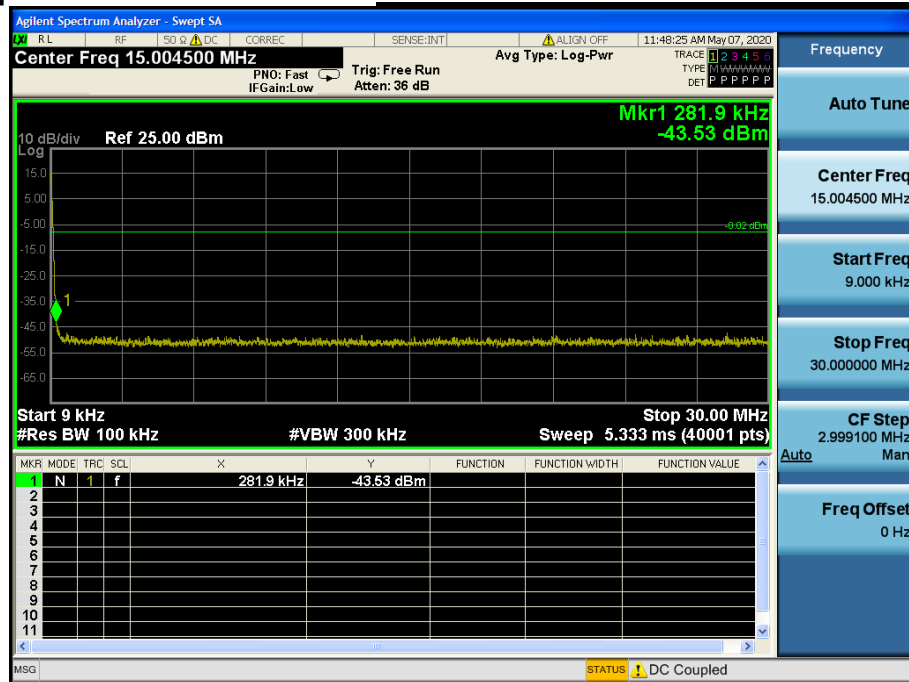
Lowest Channel & Modulation : GFSK

Low Band-edge

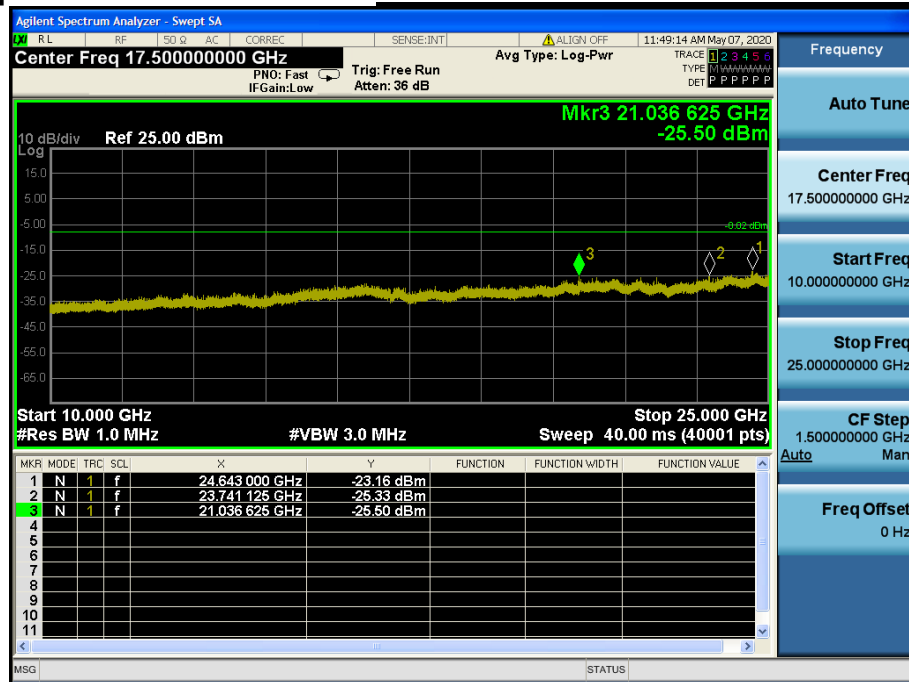
Hopping mode & Modulation : GFSK

Conducted Spurious Emissions

Lowest Channel & Modulation : GFSK



Conducted Spurious Emissions Lowest Channel & Modulation : GFSK



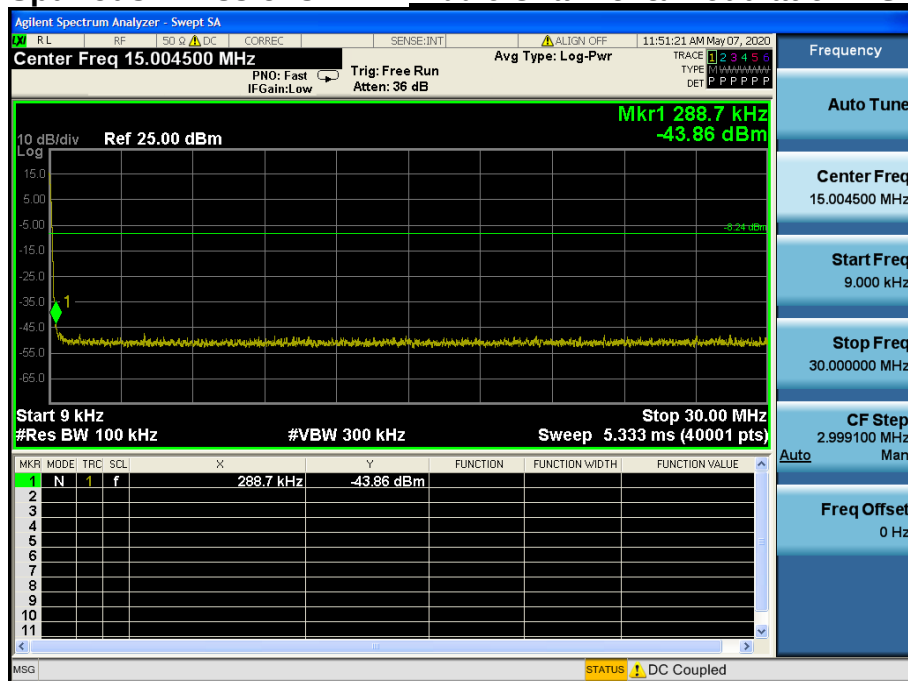
Reference for limit

Middle Channel & Modulation : GFSK



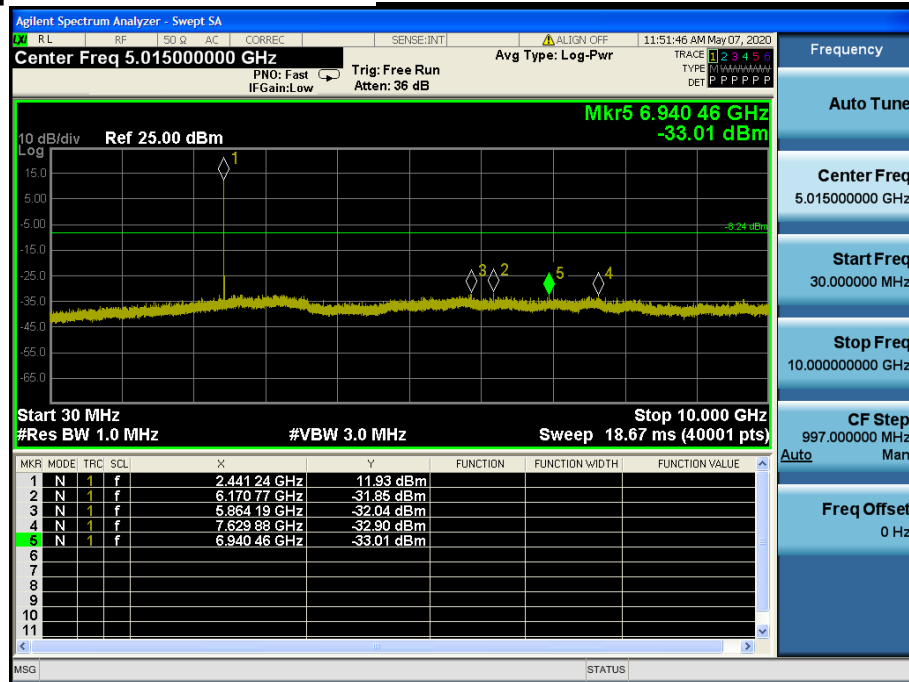
Conducted Spurious Emissions

Middle Channel & Modulation : GFSK



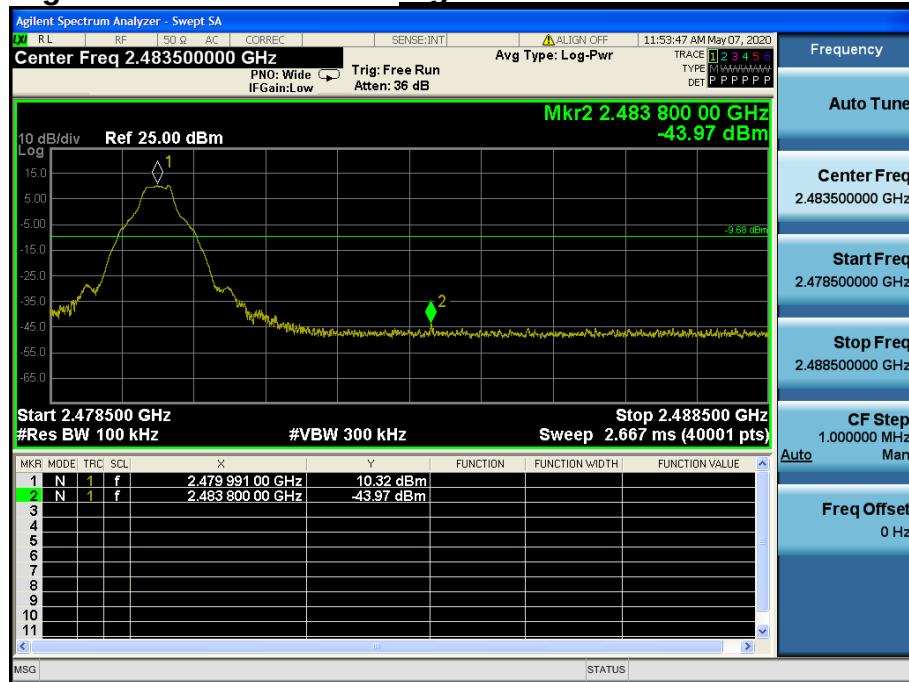
Conducted Spurious Emissions

Middle Channel & Modulation : GFSK



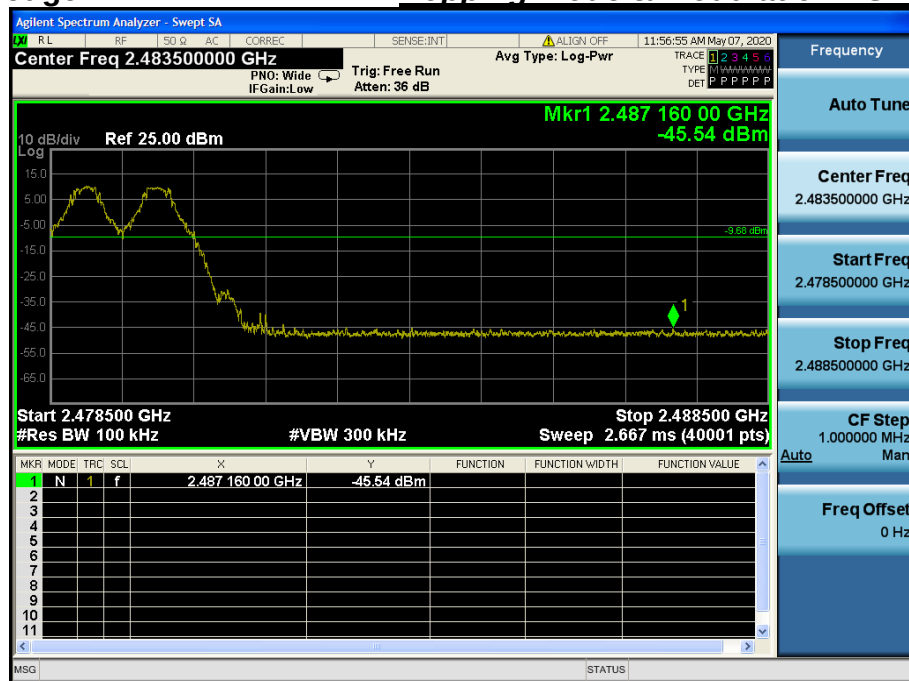
High Band-edge

Highest Channel & Modulation : GFSK



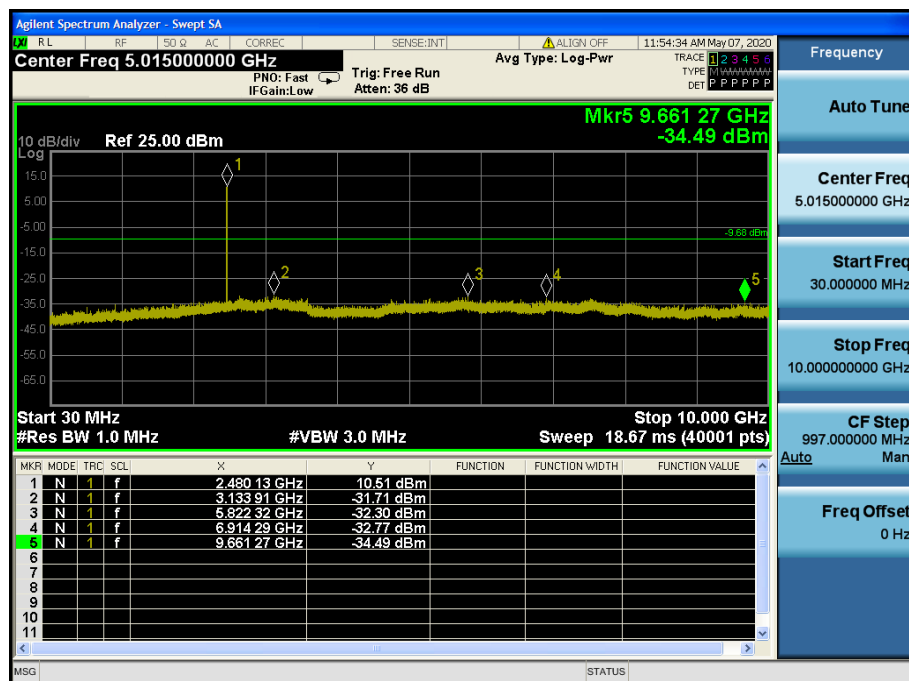
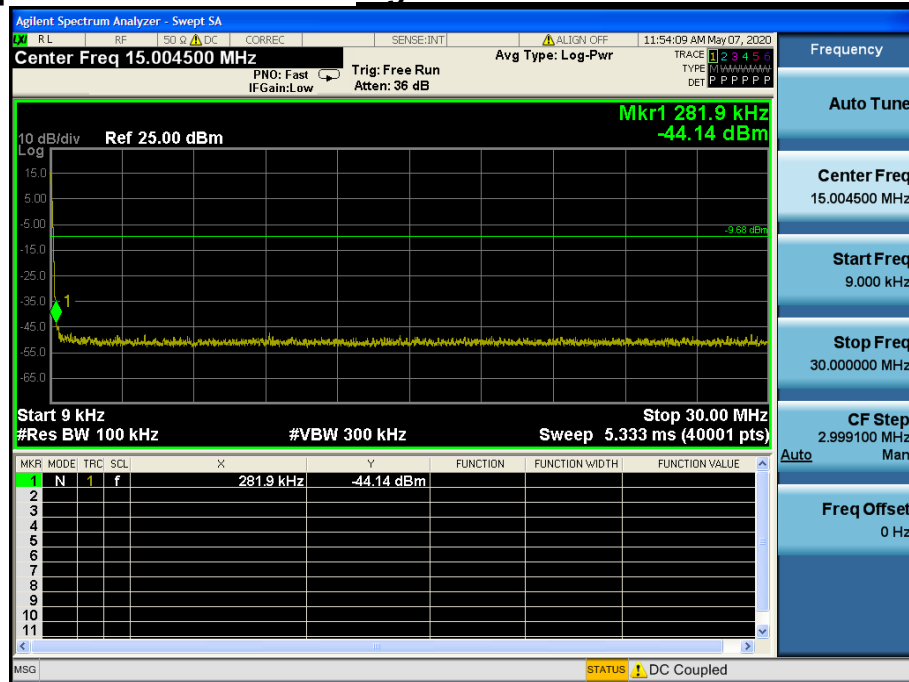
High Band-edge

Hopping mode & Modulation : GFSK



Conducted Spurious Emissions

Highest Channel & Modulation : GFSK

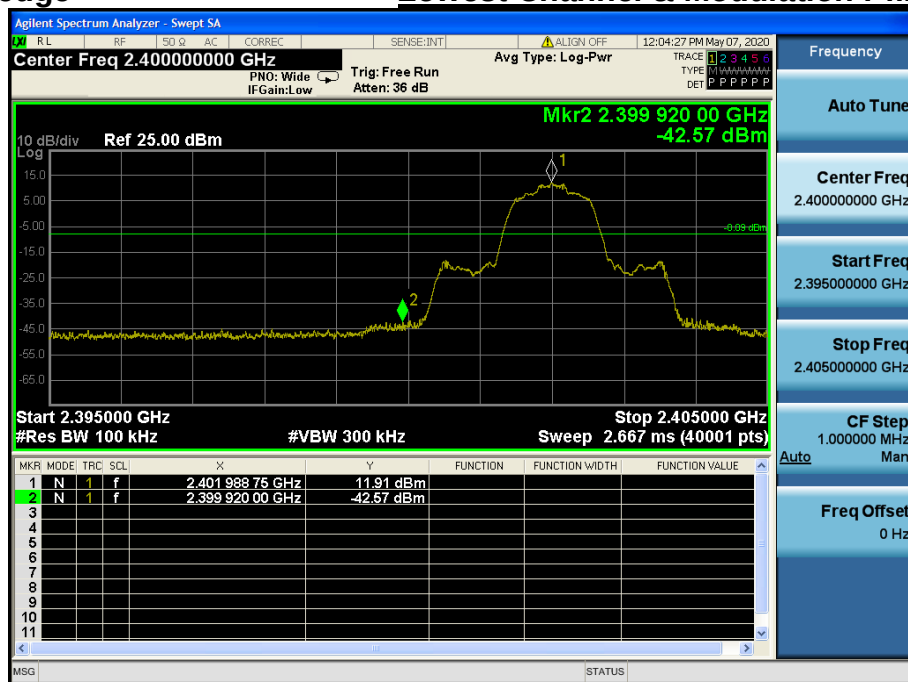


Conducted Spurious Emissions *Highest Channel & Modulation : GFSK*



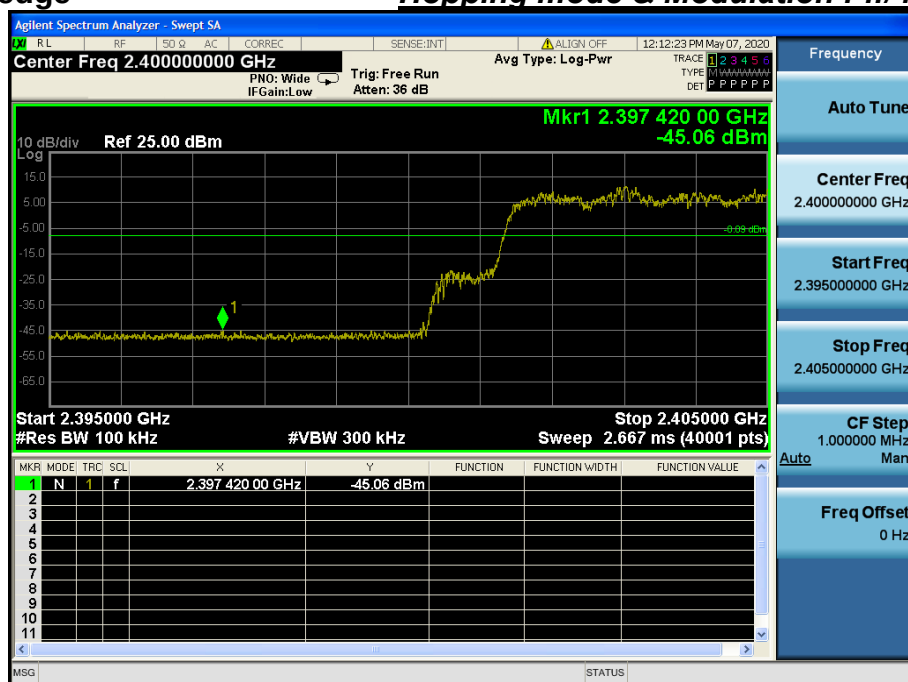
Low Band-edge

Lowest Channel & Modulation : $\pi/4$ DQPSK



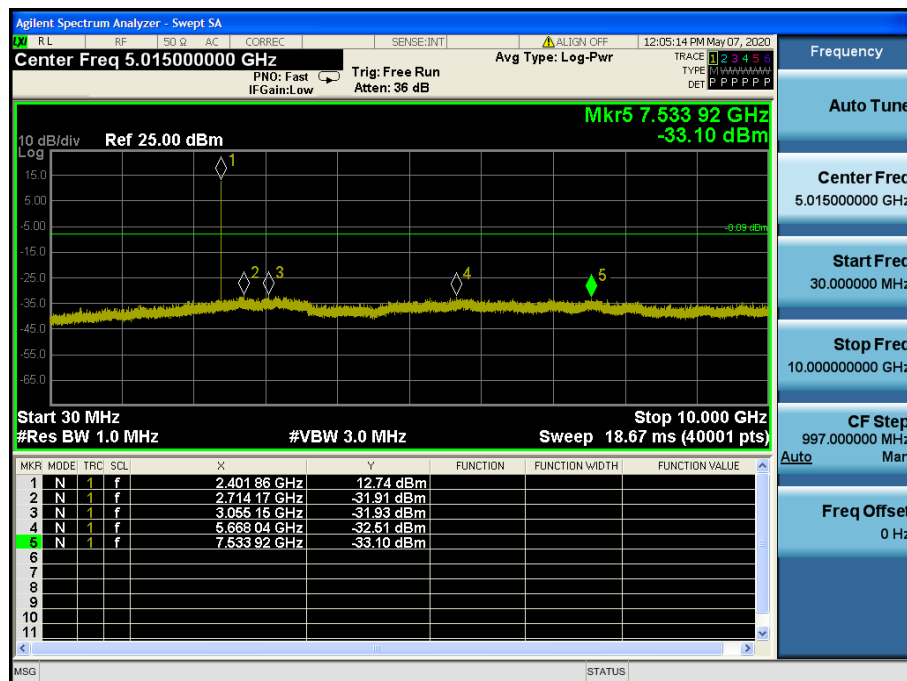
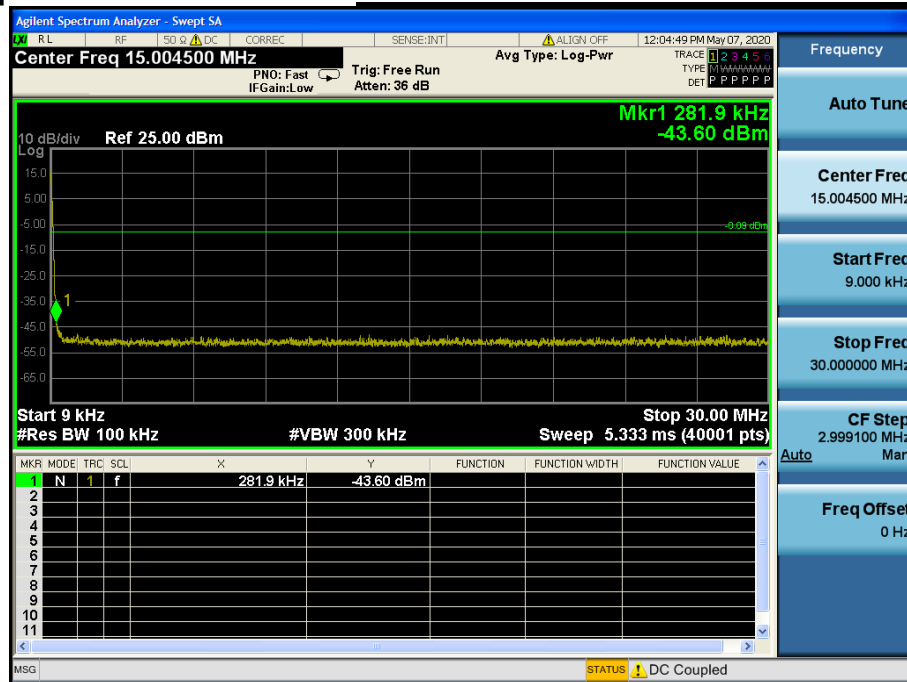
Low Band-edge

Hopping mode & Modulation : $\pi/4$ DQPSK



Conducted Spurious Emissions

Lowest Channel & Modulation : $\pi/4$ DQPSK

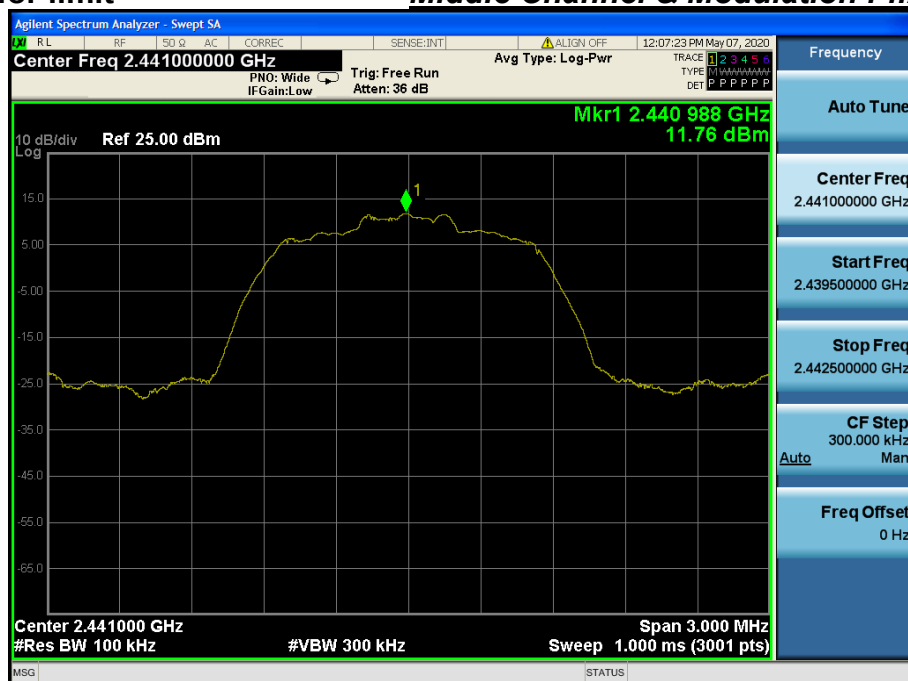


Conducted Spurious Emissions *Lowest Channel & Modulation : $\pi/4$ DQPSK*



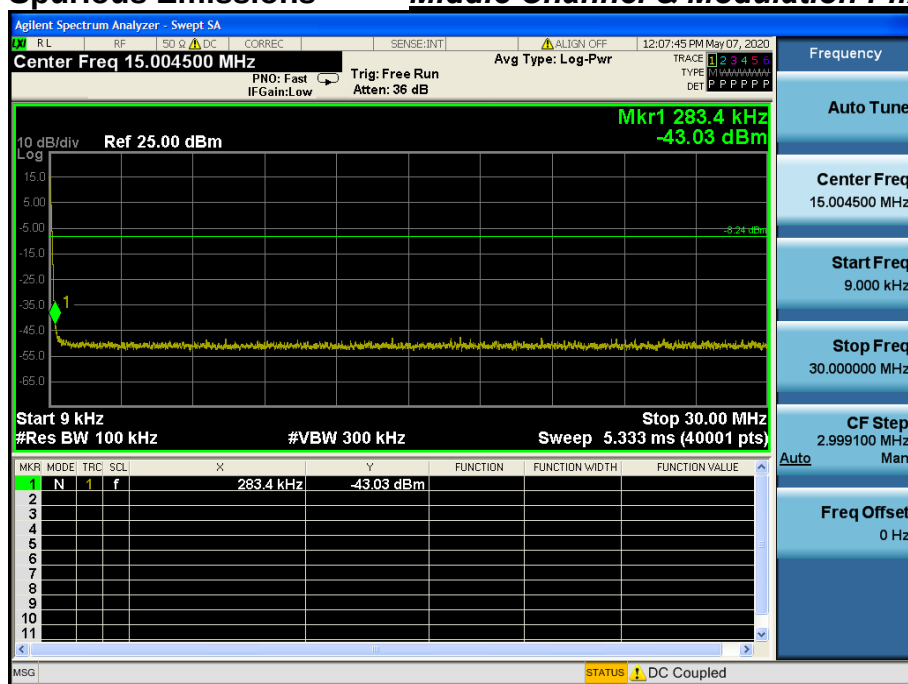
Reference for limit

Middle Channel & Modulation : $\pi/4$ DQPSK



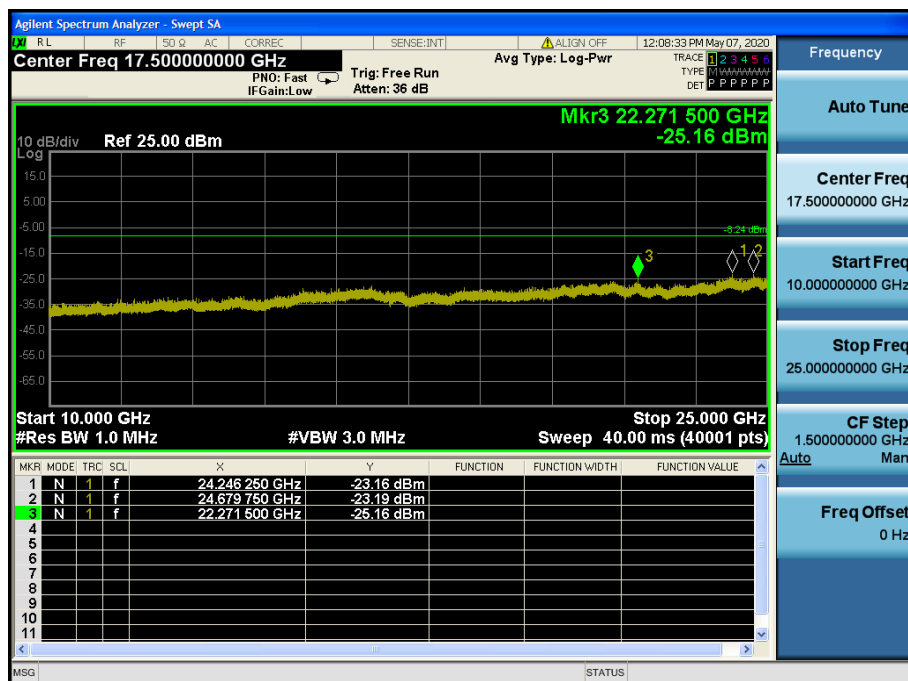
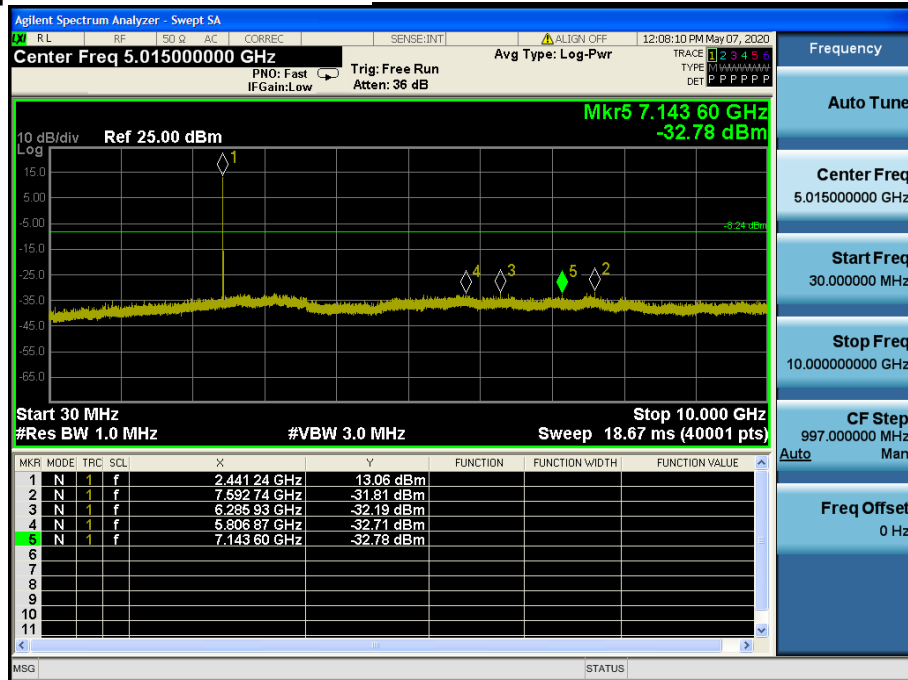
Conducted Spurious Emissions

Middle Channel & Modulation : $\pi/4$ DQPSK



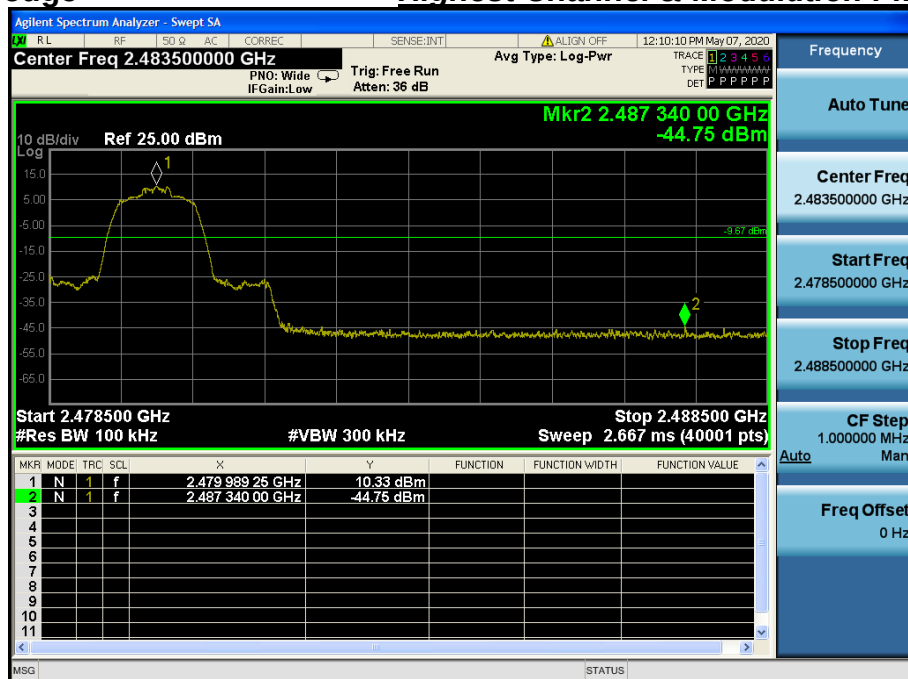
Conducted Spurious Emissions

Middle Channel & Modulation : $\pi/4$ DQPSK



High Band-edge

Highest Channel & Modulation : $\pi/4$ DQPSK



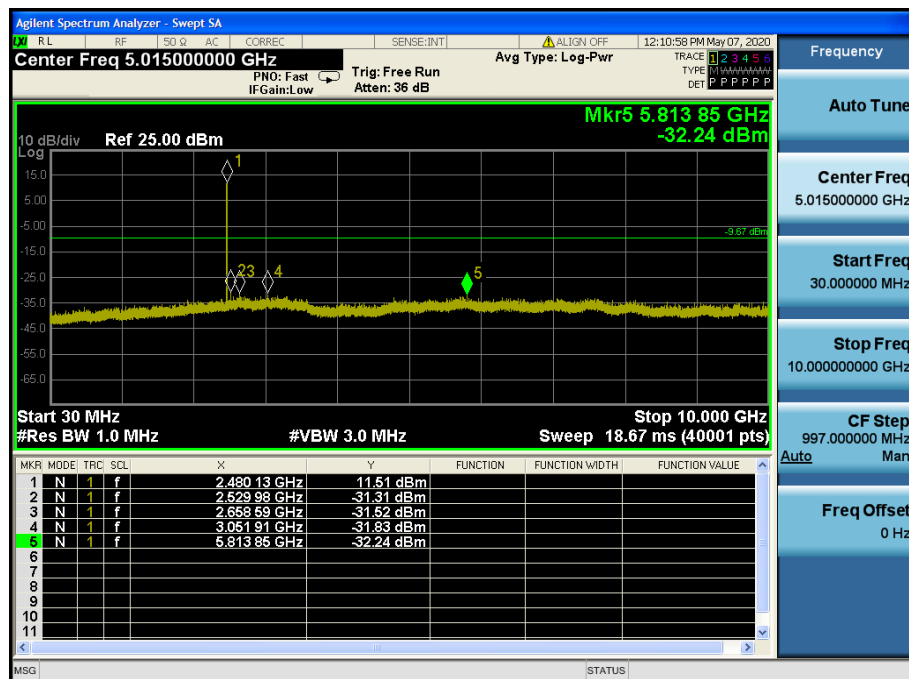
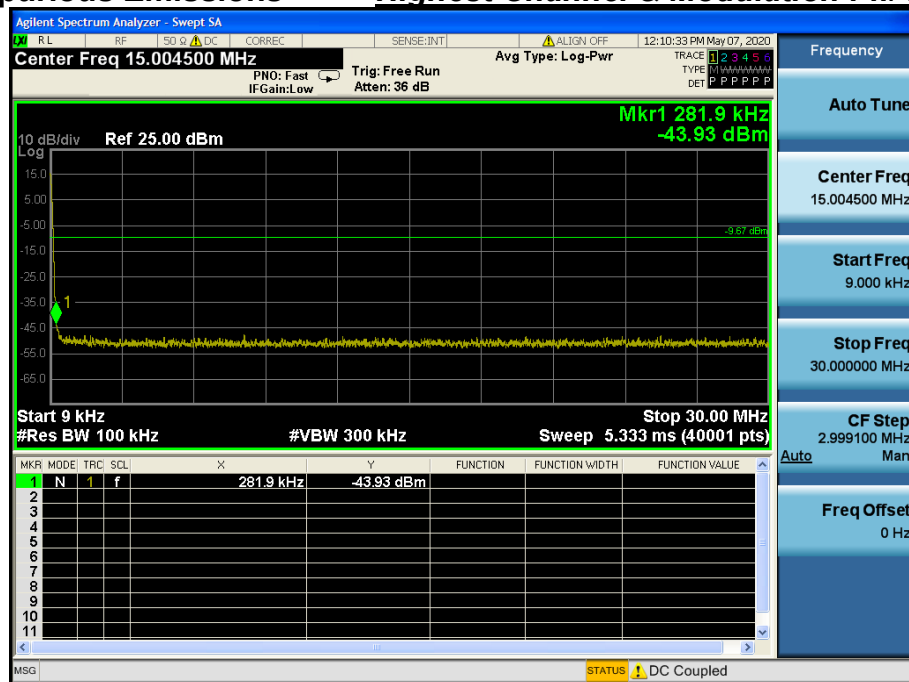
High Band-edge

Hopping mode & Modulation : $\pi/4$ DQPSK



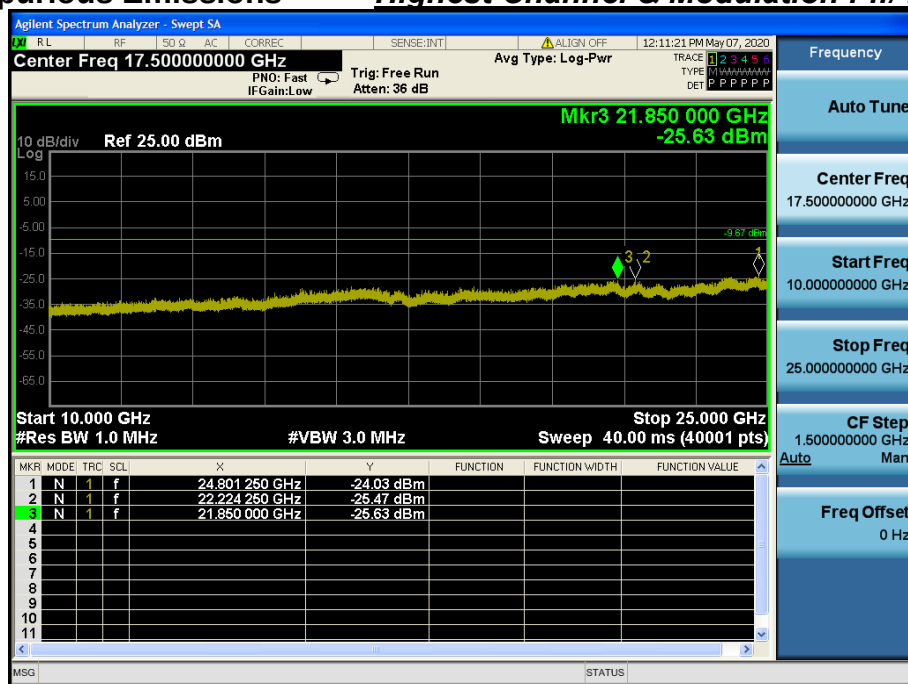
Conducted Spurious Emissions

Highest Channel & Modulation : $\pi/4$ DQPSK



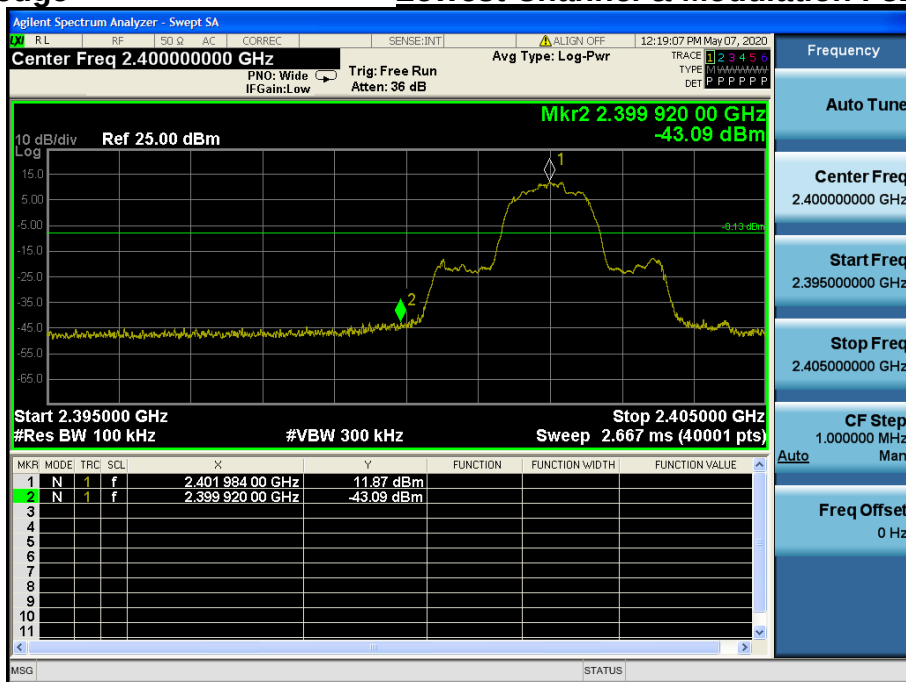
Conducted Spurious Emissions

Highest Channel & Modulation : $\pi/4$ DQPSK



Low Band-edge

Lowest Channel & Modulation : 8DPSK



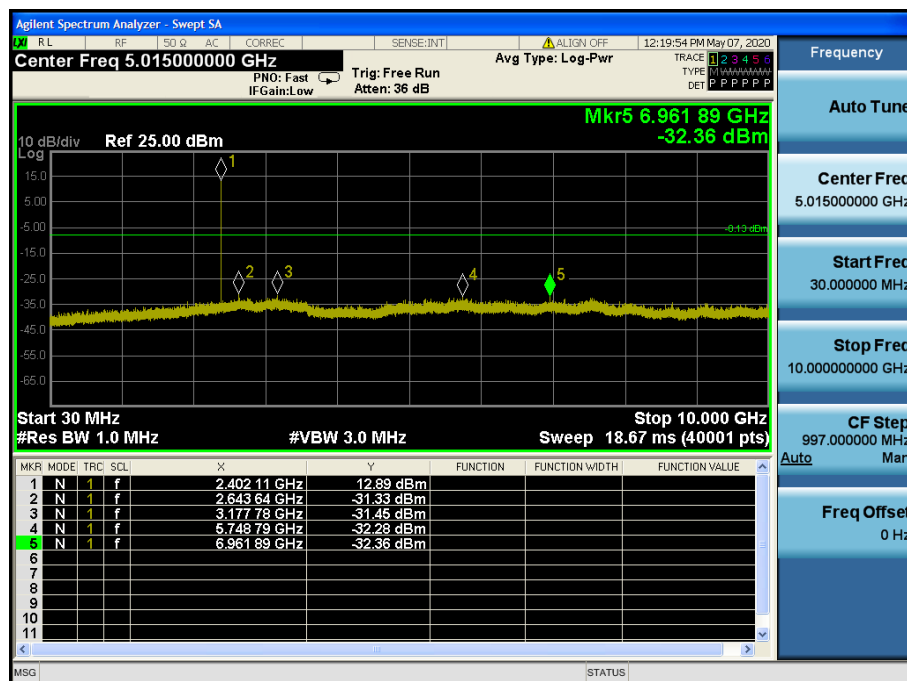
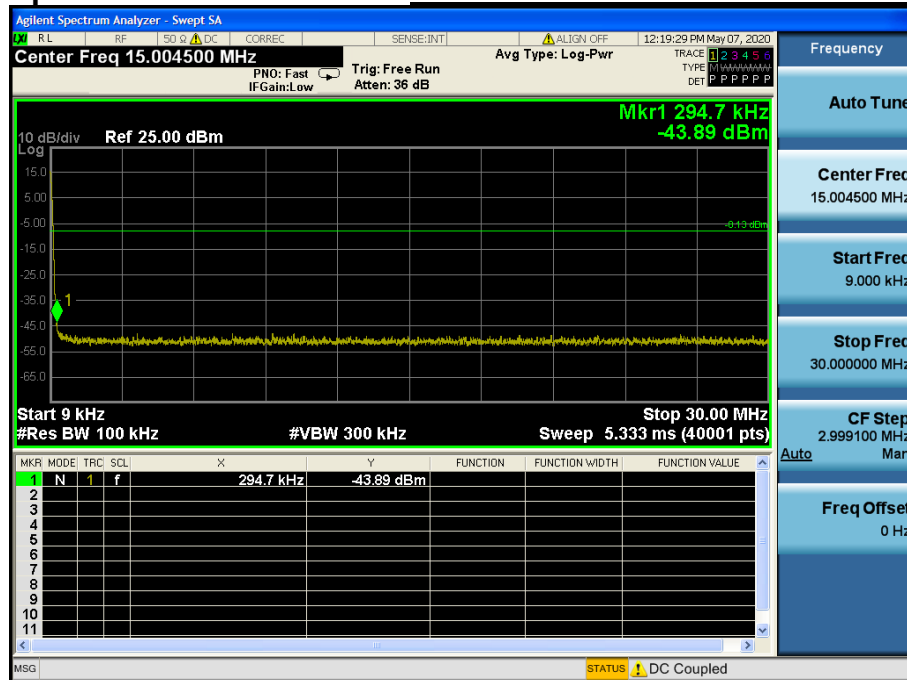
Low Band-edge

Hopping mode & Modulation : 8DPSK



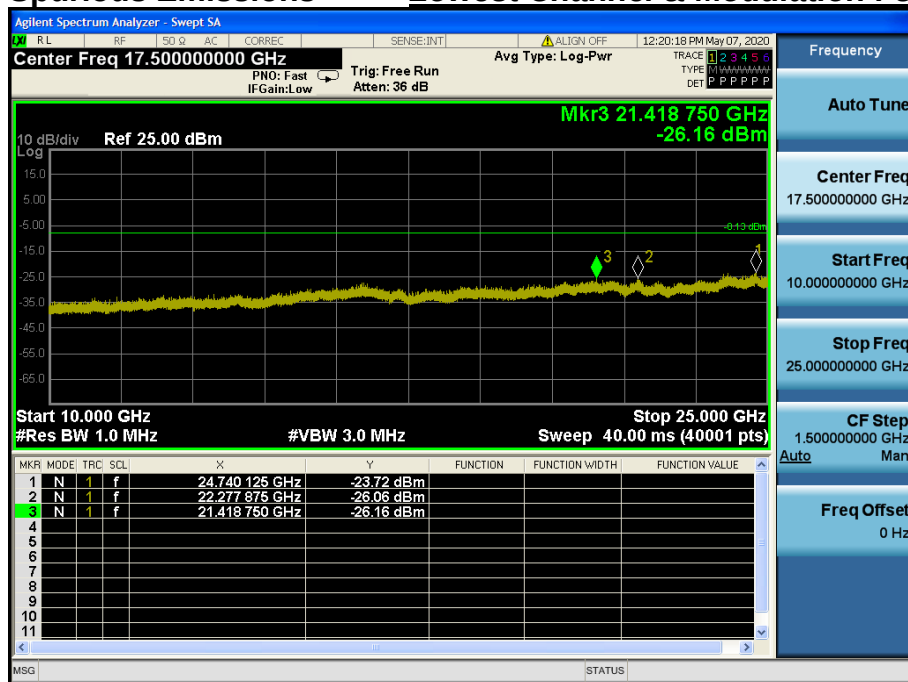
Conducted Spurious Emissions

Lowest Channel & Modulation : 8DPSK



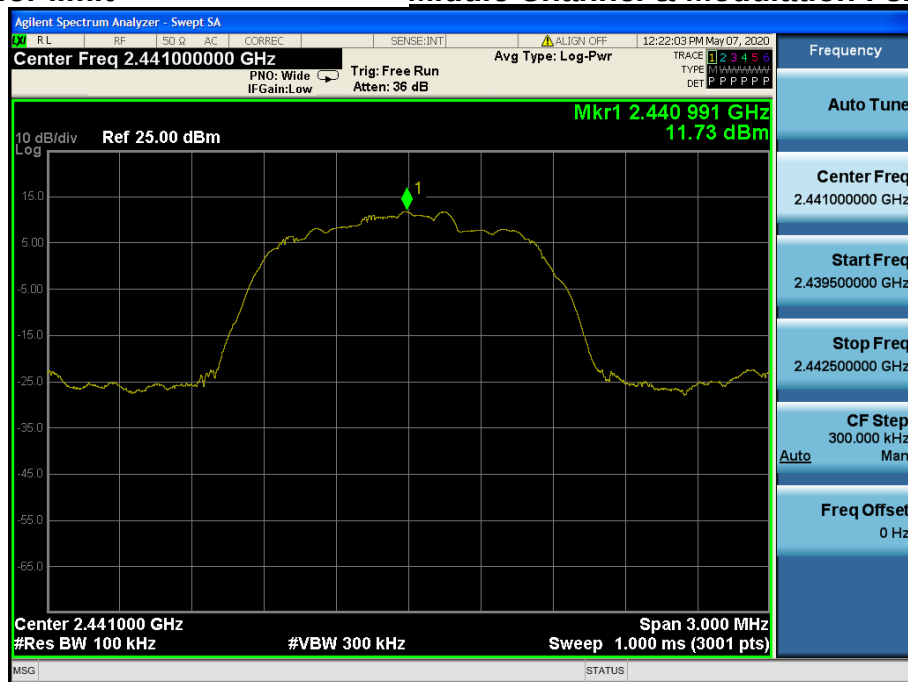
Conducted Spurious Emissions

Lowest Channel & Modulation : 8DPSK



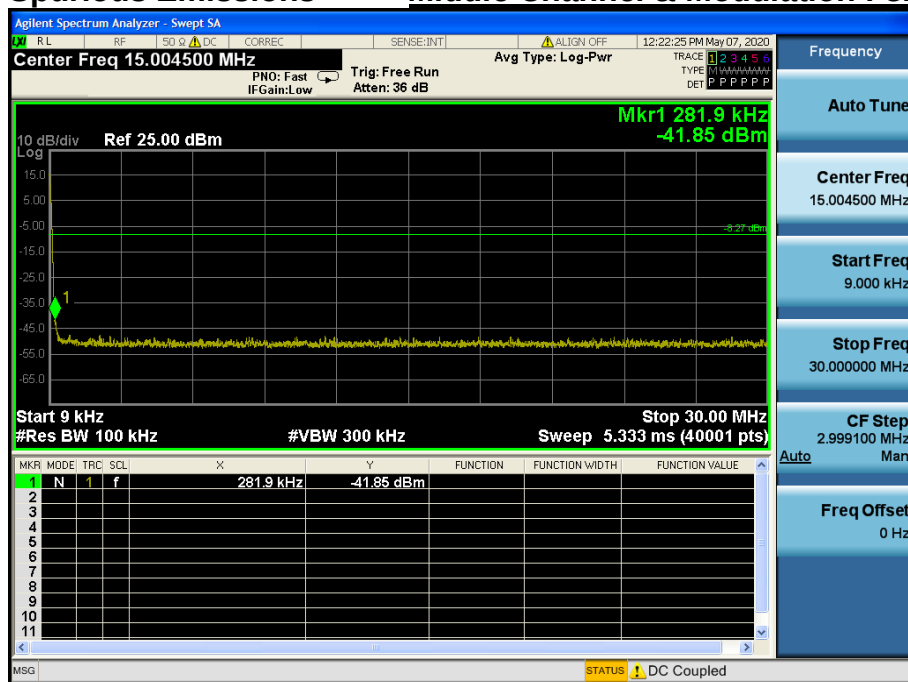
Reference for limit

Middle Channel & Modulation : 8DPSK



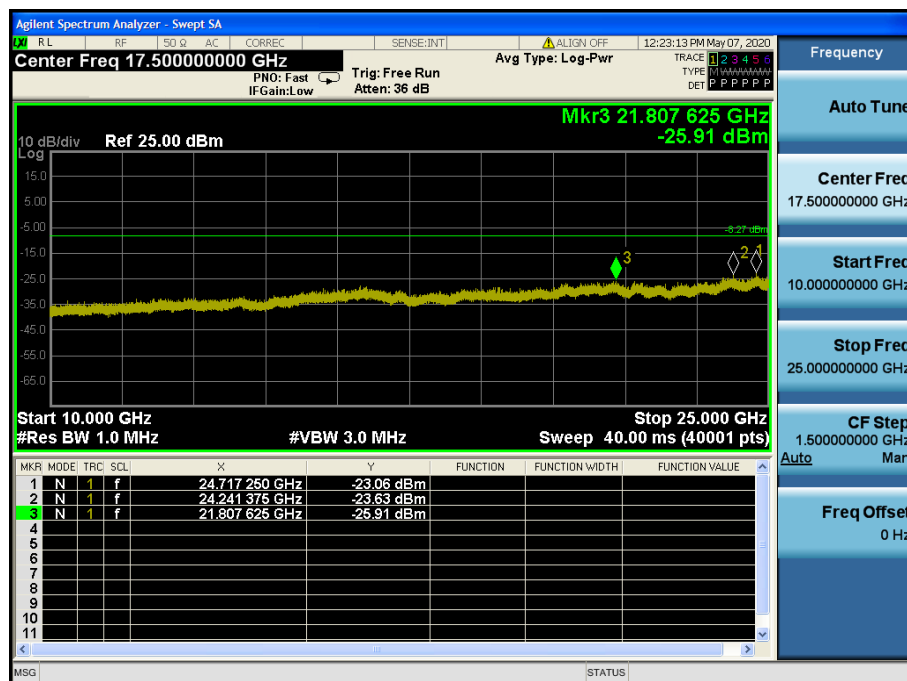
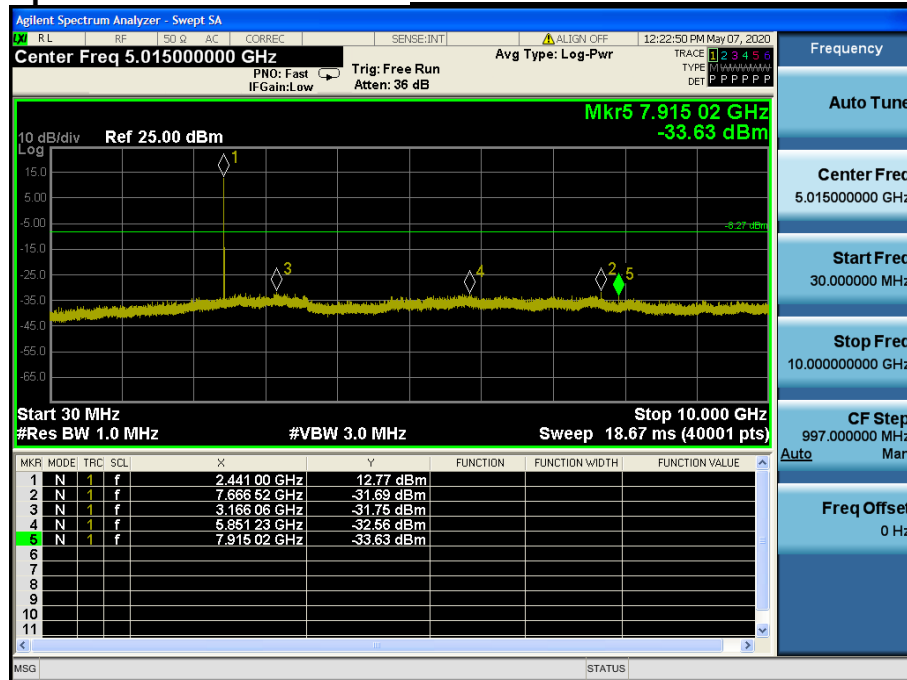
Conducted Spurious Emissions

Middle Channel & Modulation : 8DPSK



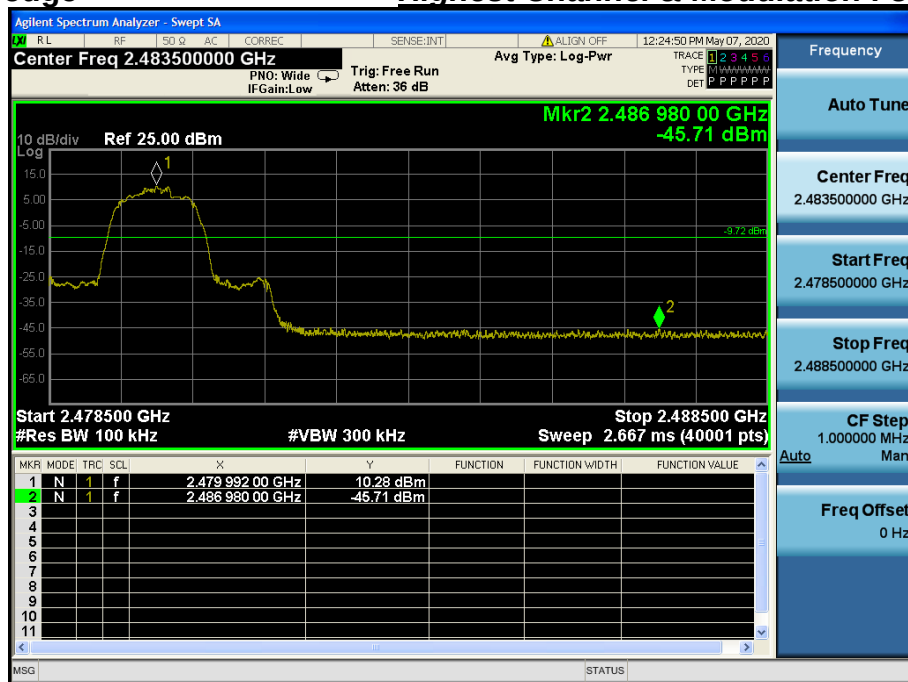
Conducted Spurious Emissions

Middle Channel & Modulation : 8DPSK



High Band-edge

Highest Channel & Modulation : 8DPSK



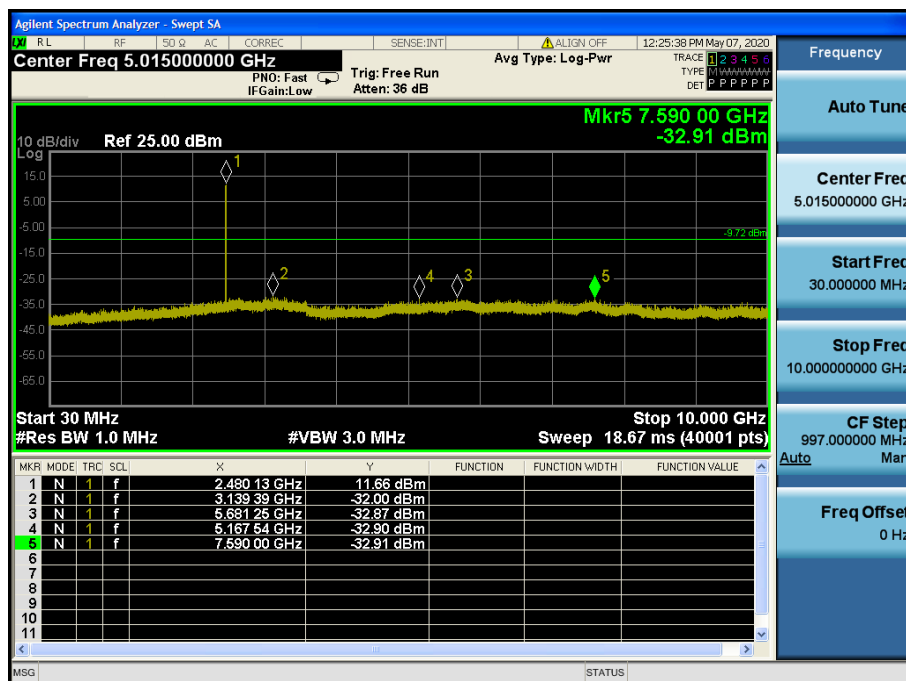
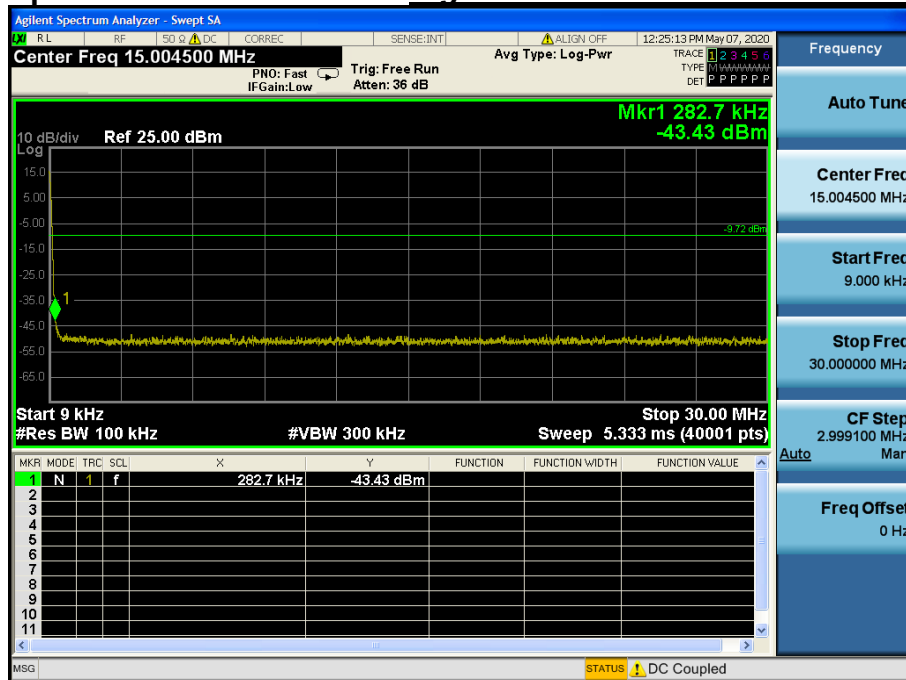
High Band-edge

Hopping mode & Modulation : 8DPSK



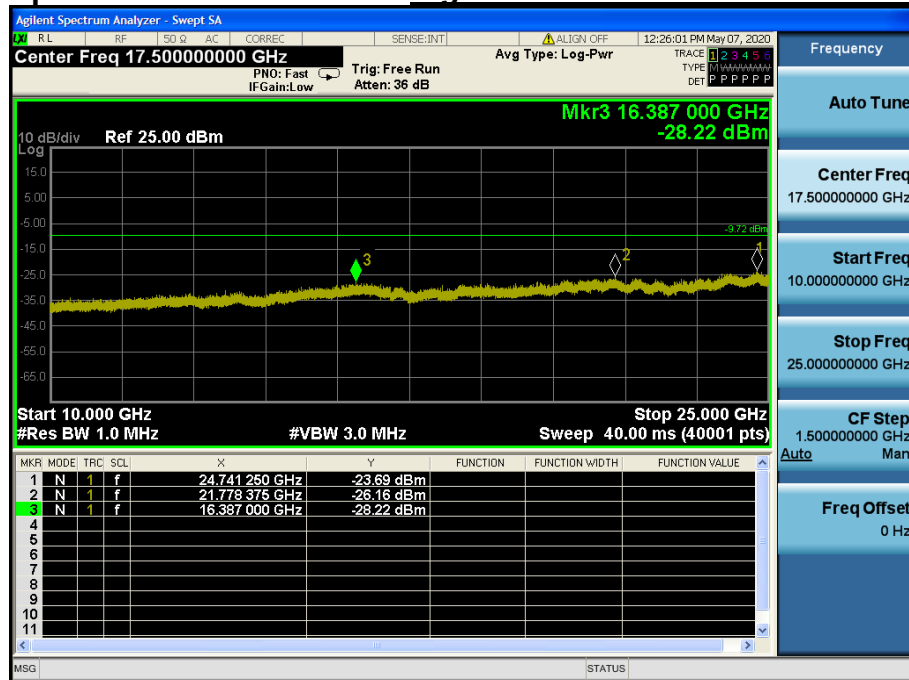
Conducted Spurious Emissions

Highest Channel & Modulation : 8DPSK



Conducted Spurious Emissions

Highest Channel & Modulation : 8DPSK



8. Transmitter AC Power Line Conducted Emission

8.1 Test Setup

See test photographs for the actual connections between EUT and support equipment.

8.2 Limit

According to §15.207(a) for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 uH/50 ohm line impedance stabilization network (LISN).

Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency

8.3 Test Procedures

Conducted emissions from the EUT were measured according to the ANSI C63.10.

1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

8.4 Test Results

AC Line Conducted Emissions (Graph) = Modulation : 8DPSK

Results of Conducted Emission

DTNC

Date 2020-05-08

Order No.
Model No.
Serial No.
Test Condition

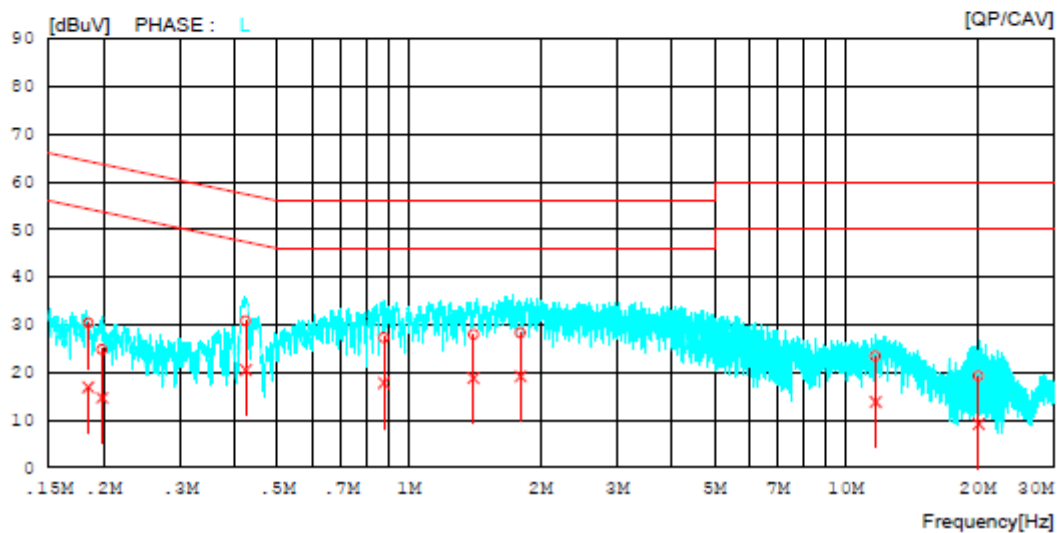
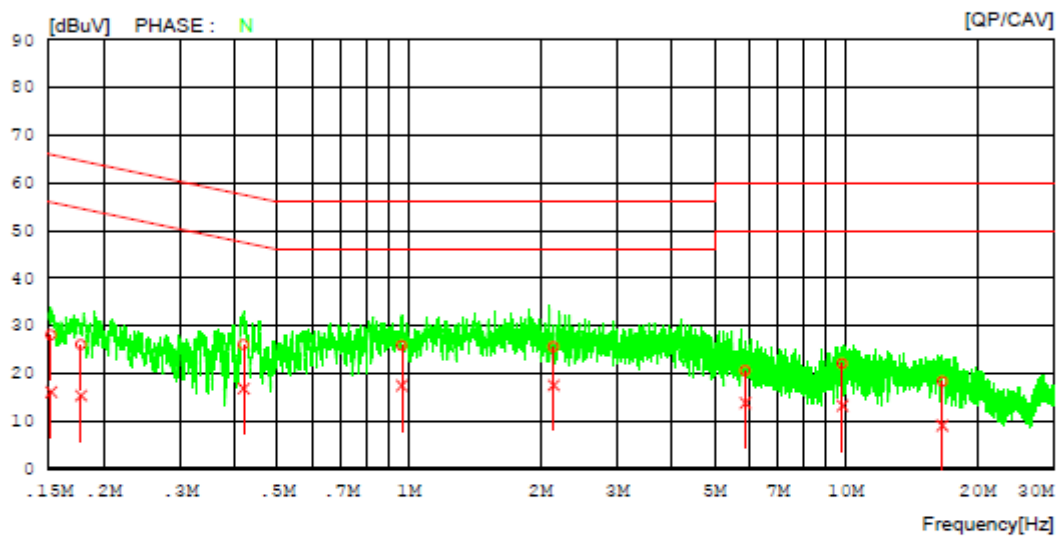
DTNC2004-03119
LM-G910HMMW
BT

Reference No.
Power Supply
Temp/Humi.
Operator

120 V, 60 Hz
23 'C / 42 %
InHee Bae

Memo

LIMIT : FCC P15.207 QP
FCC P15.207 AV



AC Line Conducted Emissions (List) = Modulation : 8DPSK

Results of Conducted Emission

DTNC

Date 2020-05-08

Order No. DTNC2004-03119
Model No. LM-G910HMW
Serial No.
Test Condition BT

Reference No.
Power Supply 120 V, 60 Hz
Temp/Humi. 23 'C / 42 %
Operator InHee Bae

Memo

LIMIT : FCC P15.207 QP
FCC P15.207 AV

NO	FREQ [MHz]	READING		C. FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	CAV [dBuV]		QP [dBuV]	CAV [dBuV]	QP [dBuV]	CAV [dBuV]	QP [dBuV]	CAV [dBuV]	
1	0.18175	18.12	6.08	10.00	28.12	16.08	65.90	55.90	37.78	39.82	N
2	0.17761	16.05	5.32	10.02	26.07	15.34	64.60	54.60	38.53	39.26	N
3	0.41871	15.96	6.74	10.06	26.02	16.80	57.47	47.47	31.45	30.67	N
4	0.96330	15.79	7.39	10.06	25.85	17.45	56.00	46.00	30.15	28.55	N
5	2.14536	15.44	7.39	10.11	25.55	17.50	56.00	46.00	30.45	28.50	N
6	5.89104	10.37	3.51	10.24	20.61	13.75	60.00	50.00	39.39	36.25	N
7	9.82797	11.72	2.87	10.35	22.07	13.22	60.00	50.00	37.93	36.78	N
8	16.63487	7.83	-1.39	10.47	18.30	9.08	60.00	50.00	41.70	40.92	N
9	0.18450	20.25	6.85	10.01	30.26	16.86	64.28	54.28	34.02	37.42	L
10	0.19858	14.74	4.58	10.02	24.76	14.60	63.67	53.67	38.91	39.07	L
11	0.42328	20.67	10.43	10.04	30.71	20.47	57.38	47.38	26.67	26.91	L
12	0.87615	17.24	7.64	10.05	27.29	17.69	56.00	46.00	28.71	28.31	L
13	1.40681	17.87	8.66	10.08	27.95	18.74	56.00	46.00	28.05	27.26	L
14	1.80180	18.20	8.95	10.11	28.31	19.06	56.00	46.00	27.69	26.94	L
15	11.69742	13.03	3.38	10.37	23.40	13.75	60.00	50.00	36.60	36.25	L
16	20.14105	8.65	-1.42	10.50	19.15	9.08	60.00	50.00	40.85	40.92	L

9. Antenna Requirement

Describe how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT.

Conclusion: Comply

**The antenna is attached on the device by means of unique coupling method (Spring Tension).
Therefore this E.U.T Complies with the requirement of §15.203**

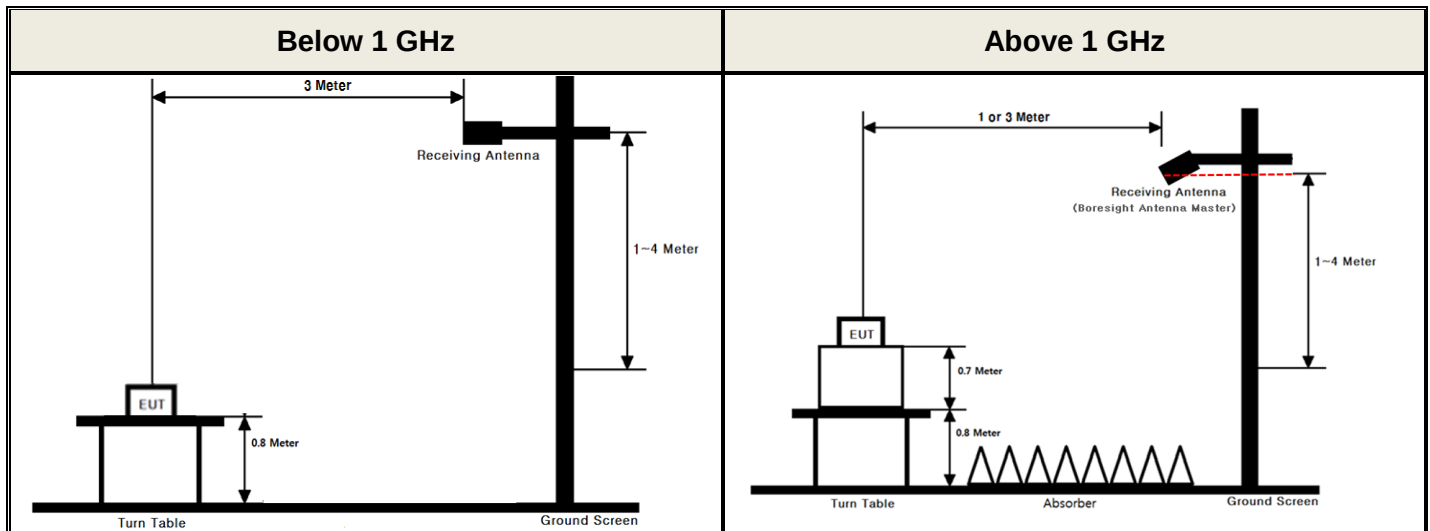
- Minimum Standard :

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.

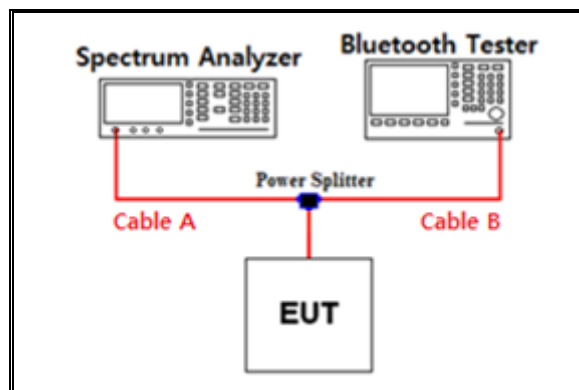
APPENDIX I

Test set up diagrams

▪ Radiated Measurement



▪ Conducted Measurement



Path loss information

Frequency (GHz)	Path Loss (dB)	Frequency (GHz)	Path Loss (dB)
0.03	6.41	15	11.32
1	6.82	20	13.16
2.402 & 2.440 & 2.480	7.65	25	13.95
5	8.50	-	-
10	9.12	-	-

Note 1 : The path loss from EUT to Spectrum analyzer were measured and used for test.

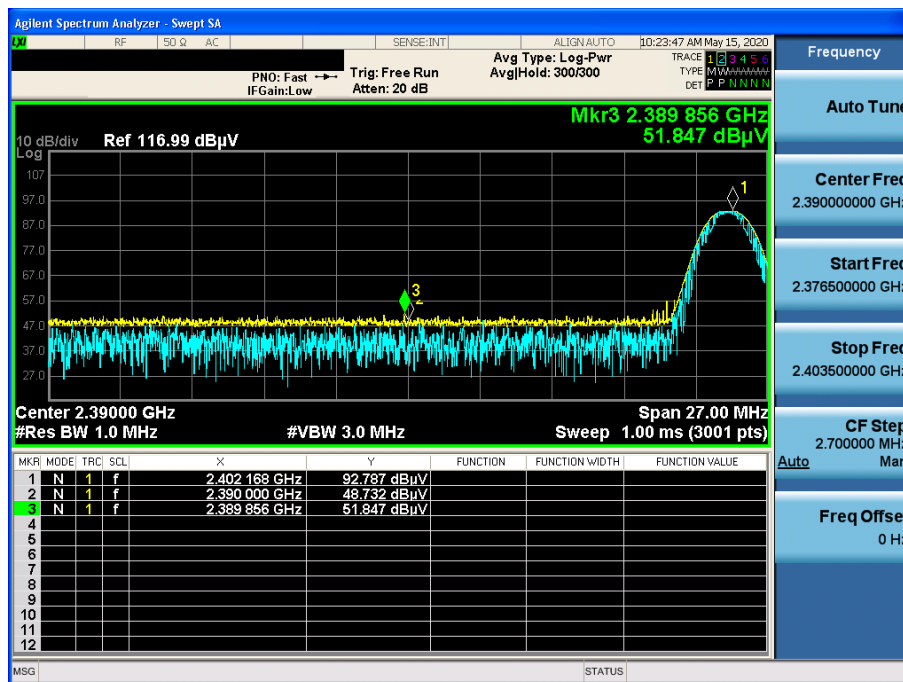
Path loss (S/A's Correction factor) = Cable A + Power splitter

APPENDIX II

Unwanted Emissions (Radiated) Test Plot

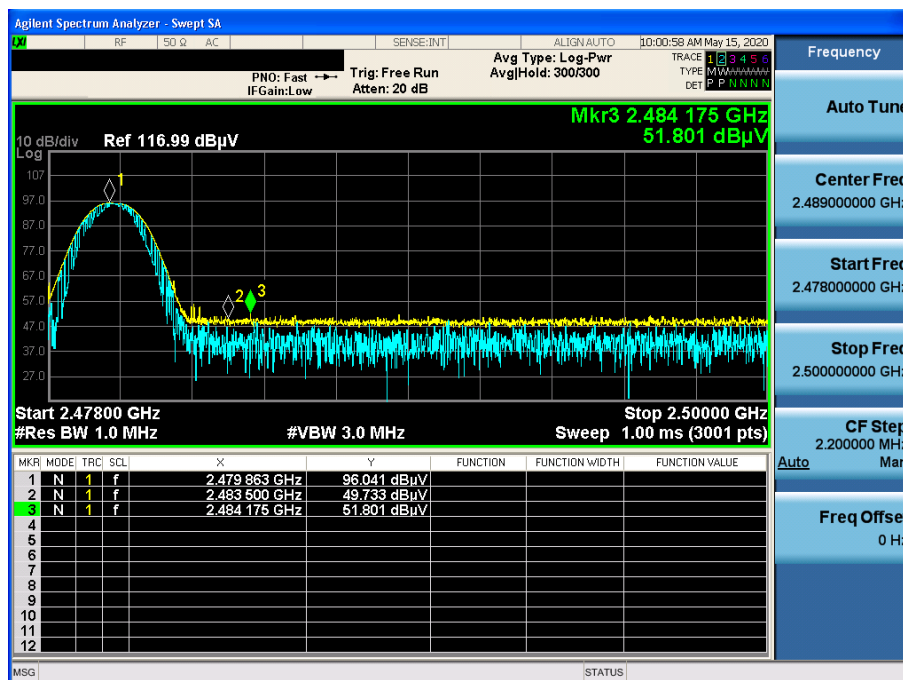
GFSK & Lowest & Y & Ver

Detector Mode : PK



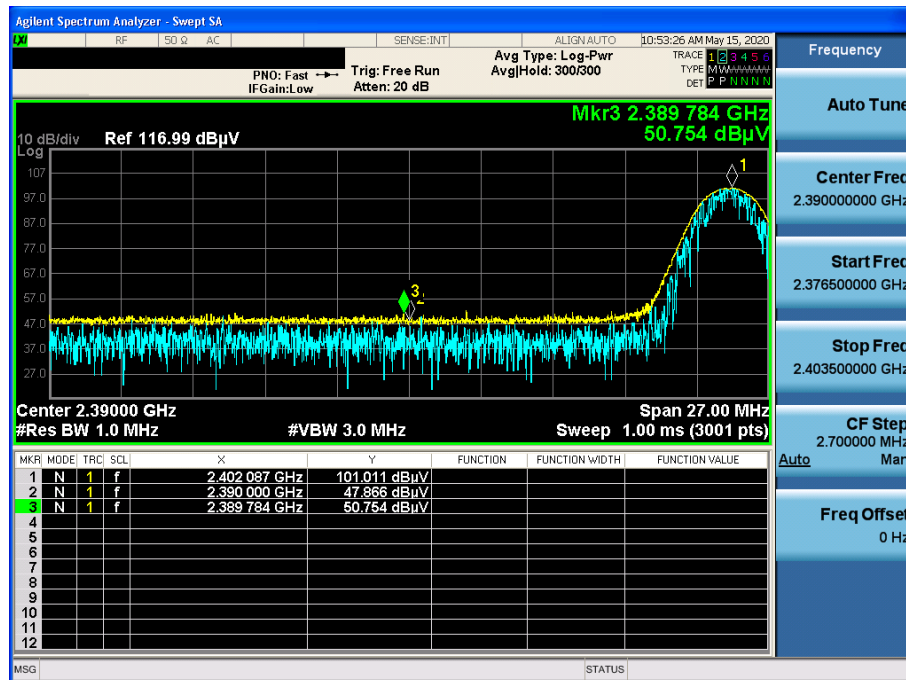
GFSK & Highest & Y & Ver

Detector Mode : PK



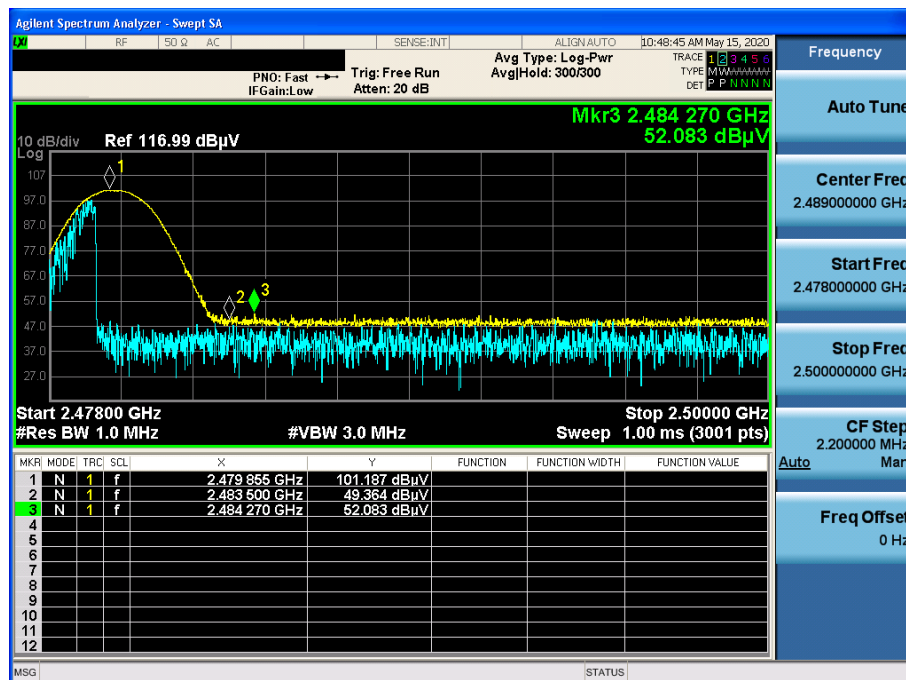
$\pi/4$ DQPSK & Lowest & X & Hor

Detector Mode : PK



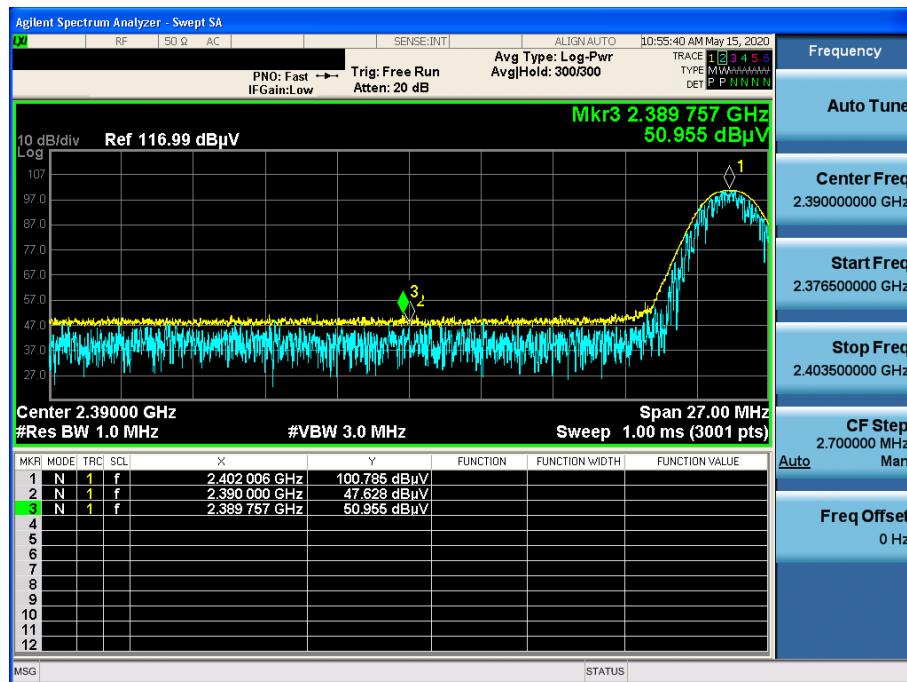
$\pi/4$ DQPSK & Highest & X & Hor

Detector Mode : PK



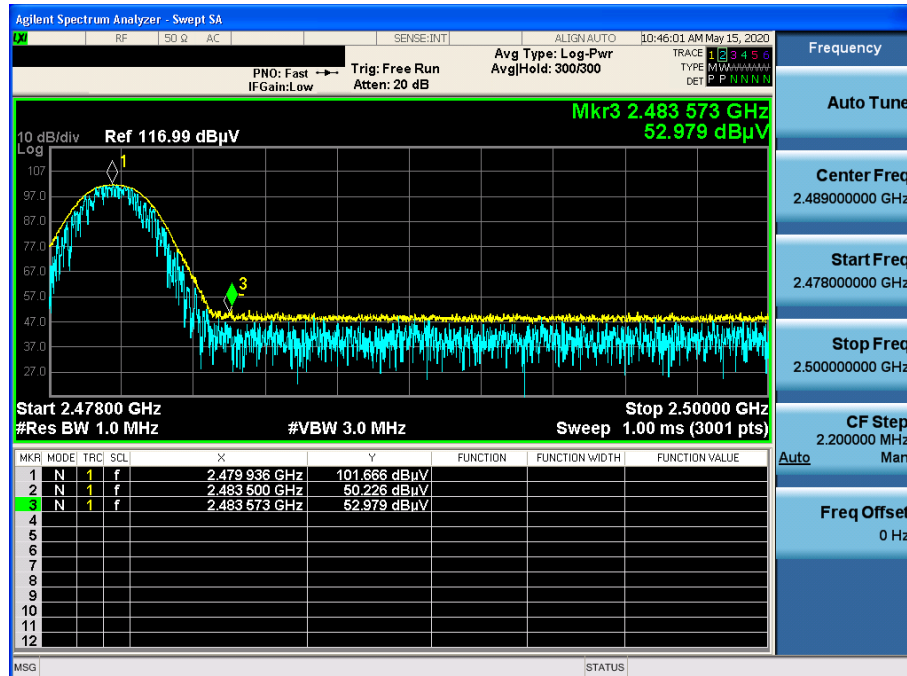
8DPSK & Lowest & X & Hor

Detector Mode : PK



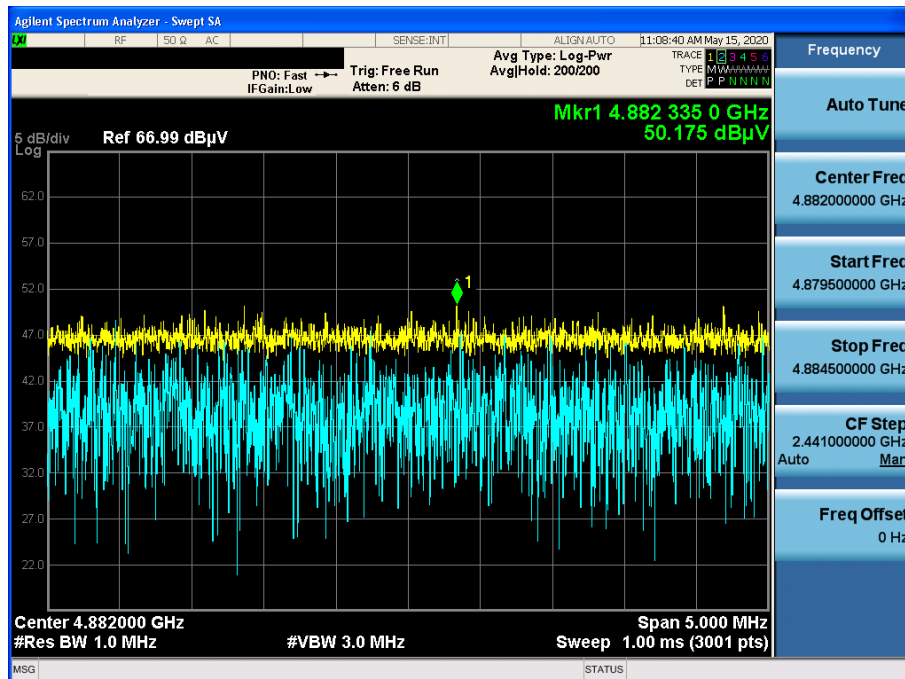
8DPSK & Highest & X & Hor

Detector Mode : PK



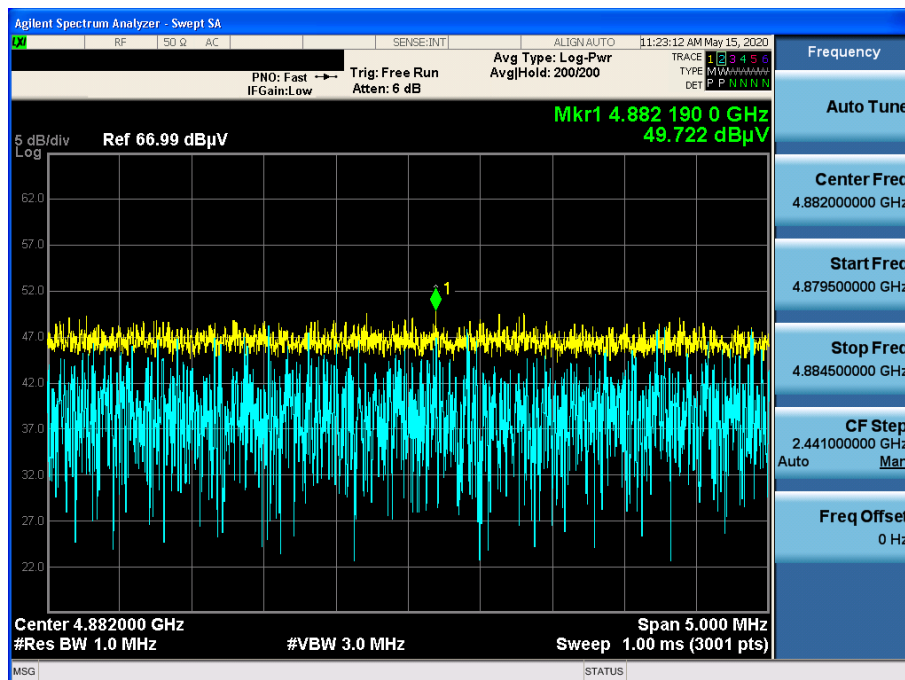
GFSK & Middle & Z & Hor

Detector Mode : PK



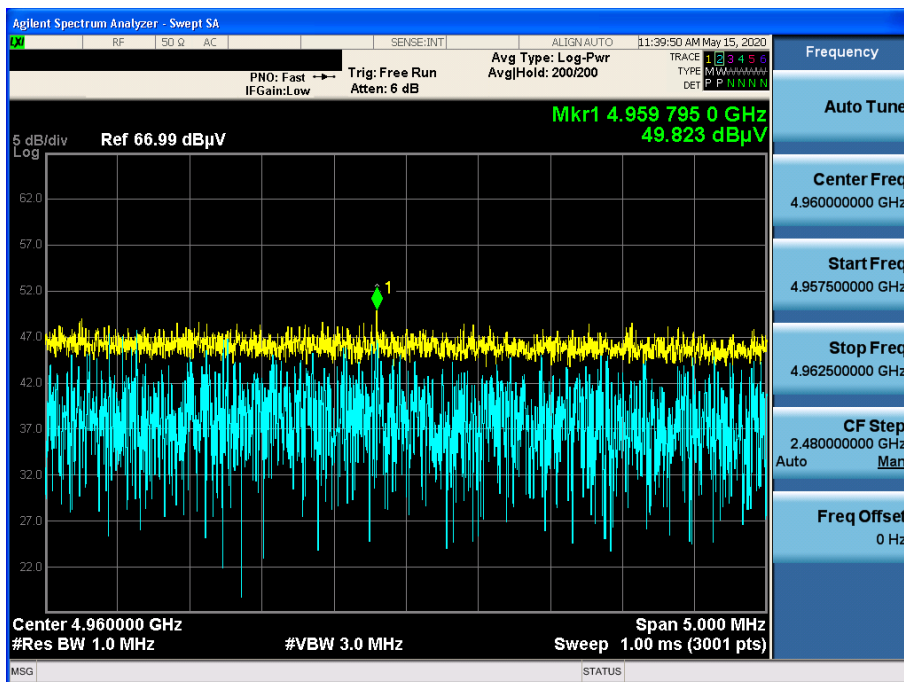
$\pi/4$ DQPSK & Middle & Z & Hor

Detector Mode : PK



8DPSK & Highest & Z & Hor

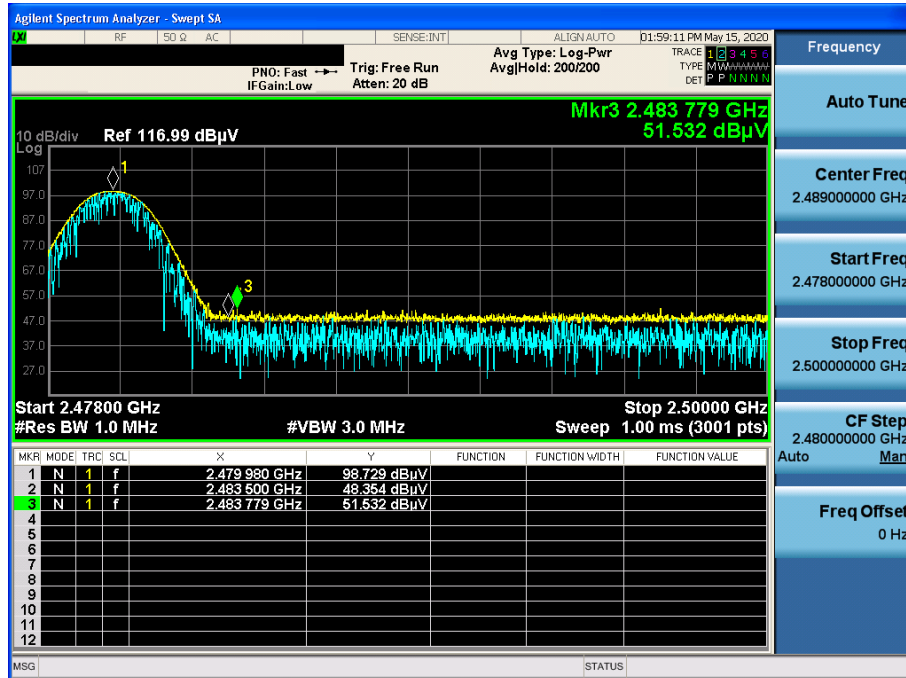
Detector Mode : PK



Unwanted Emissions (Radiated) Test Plot _ Wireless Charging

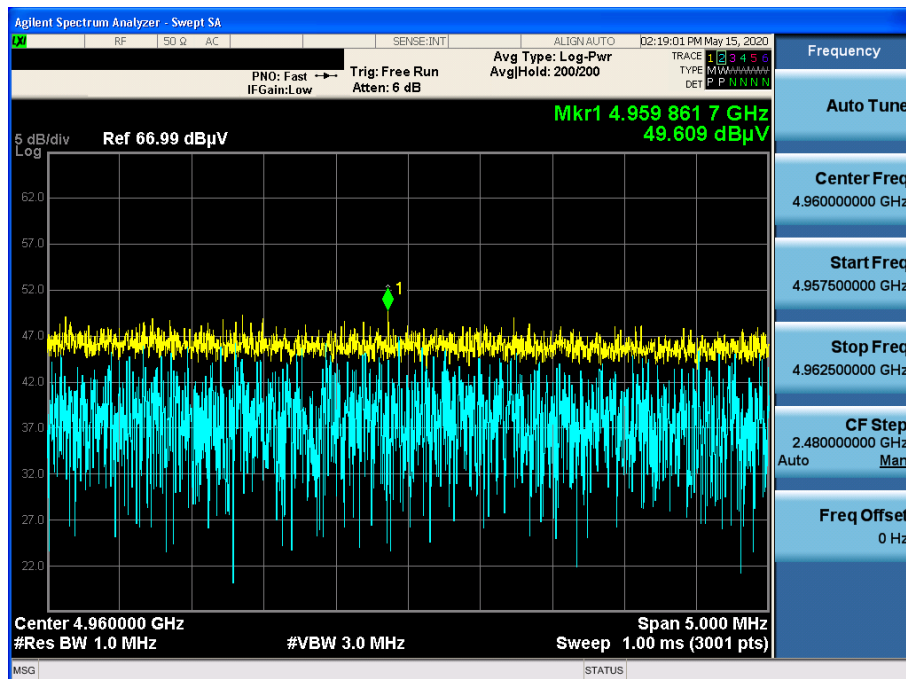
8DPSK & Middle & X & Hor

Detector Mode : PK



8DPSK & Middle & X & Ver

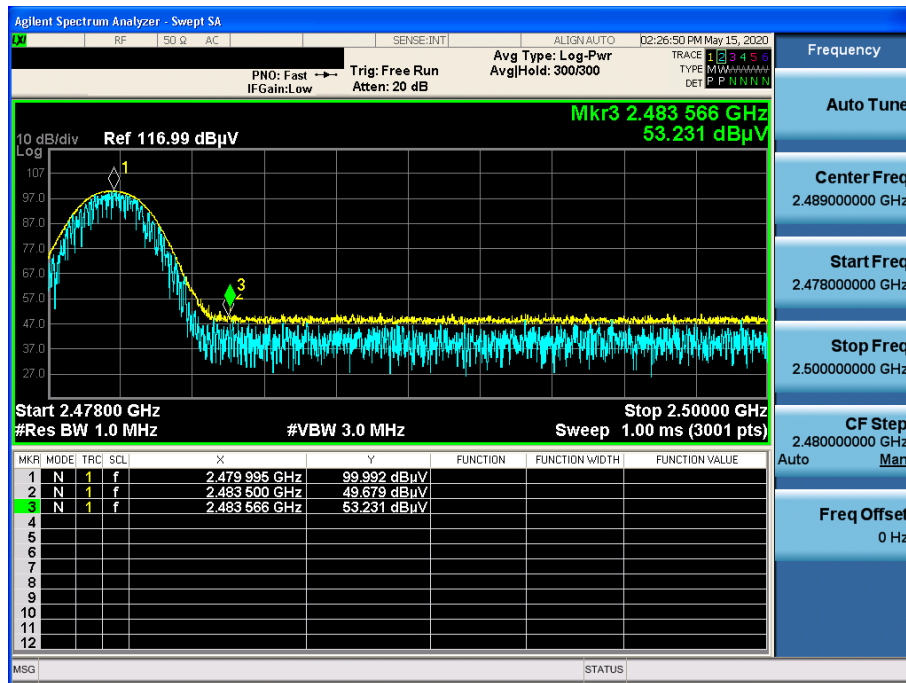
Detector Mode : PK



Unwanted Emissions (Radiated) Test Plot _ With Dual Display

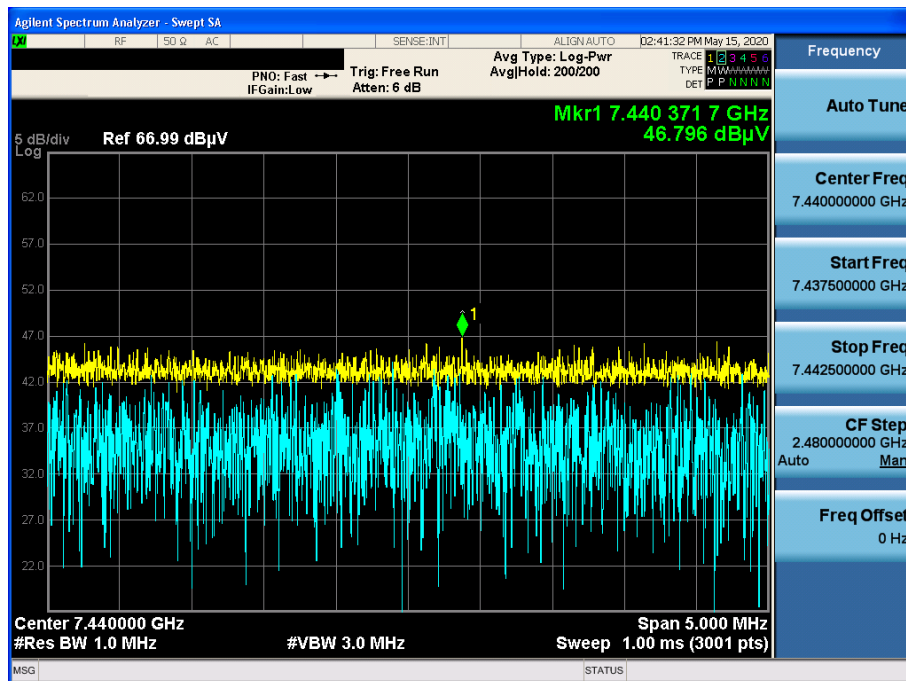
8DPSK & Highest & X & Hor

Detector Mode : PK



8DPSK & Highest & X & Hor

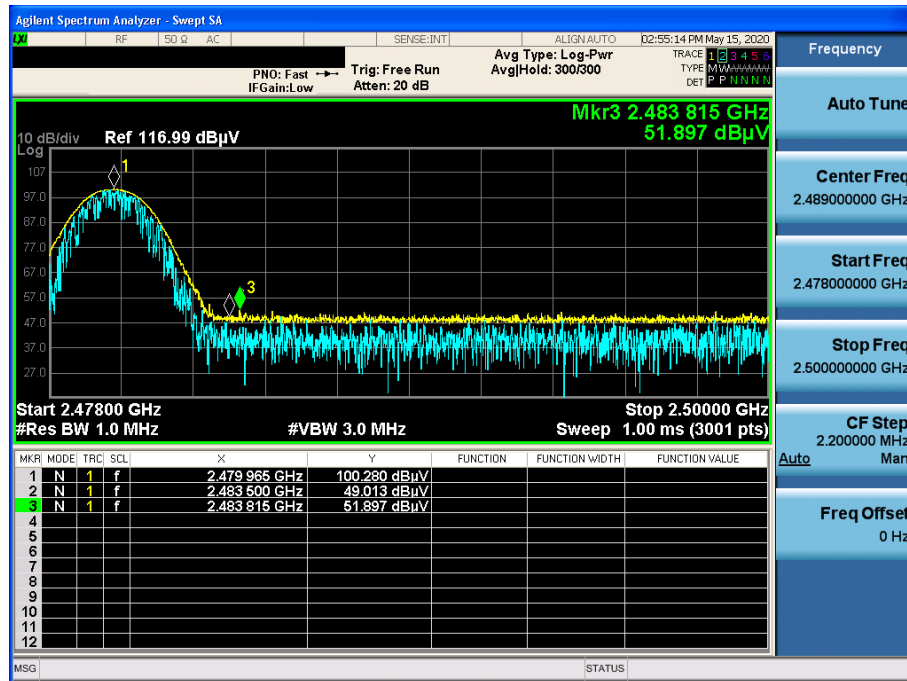
Detector Mode : PK



Unwanted Emissions (Radiated) Test Plot _ With Dual Display+WPC

8DPSK & Highest & X & Hor

Detector Mode : PK



8DPSK & Highest & X & Hor

Detector Mode : PK

