TEST REPORT

Dt&C Co., Ltd.
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Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRTFCC2307-0098(1)

2. Customer

- Name (FCC) : Point Mobile Co., LTD. / Name (IC) : POINTMOBILE CO.,LTD
- Address (FCC) : B-9F Kabul Great Valley, 32, Digital-ro 9-gil, Geumcheon-gu, Seoul, South Korea, 08512
  Address (IC) : B-9F Kabul Great Valley, 32, Digital-ro 9-gil, Geumcheon-gu Seoul Korea (Republic Of)

3. Use of Report : FCC & IC Certification

4. Product Name / Model Name : MOBILE COMPUTER / PM86W
   FCC ID : V2X-PM86W
   IC : 10664A-PM86W

5. FCC Regulation(s): Part 15.247
   IC Standard(s): RSS-247 Issue 2, RSS-Gen Issue 5
   Test Method used: KDB558074 D01v05r02, ANSI C63.10-2013

6. Date of Test : 2023.05.26 ~ 2023.07.13

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.
This test report is not related to KOLAS accreditation.

Affirmation	Tested by Name : SeungMin Gil (Signature)	Technical Manager Name : JaeJin Lee (Signature)

2023 . 07 . 27 .

Dt&C Co., Ltd.

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
DRTFCC2307-0098	Jul. 20, 2023	Initial issue	SeungMin Gil	JaeJin Lee
DRTFCC2307-0098(1)	Jul. 27, 2023	Revised the section 1.1	SeungMin Gil	JaeJin Lee

Table of Contents

1. General Information

1.1. Explanations for Reference Test Data

1.1.1. Introduction

This report includes the Bluetooth test data of FCC ID: V2X-PM86 / IC: 10664A-PM86 with reference to KDB 484596 D01v01. The applicant takes full responsibility that the test data as reference section below represents compliance for FCC ID: V2X-PM86W / IC: 10664A-PM86W.

Reference FCC ID / IC	Exhibit type	Separated FCC ID / IC
FCC ID: V2X-PM86 / IC: 10664A-PM86	Original Grant / New Single Certification	FCC ID: V2X-PM86W / IC: 10664A-PM86W

1.1.2. Explain the Differences

FCC ID: V2X-PM86W / IC: 10664A-PM86W is same the internal printed circuit board with FCC ID: V2X-PM86 / IC: 10664A-PM86. For FCC ID: V2X-PM86W / IC: 10664-PM86W, WWAN transmitter has been removed. (It does not changed the SW/HW component of Bluetooth.)

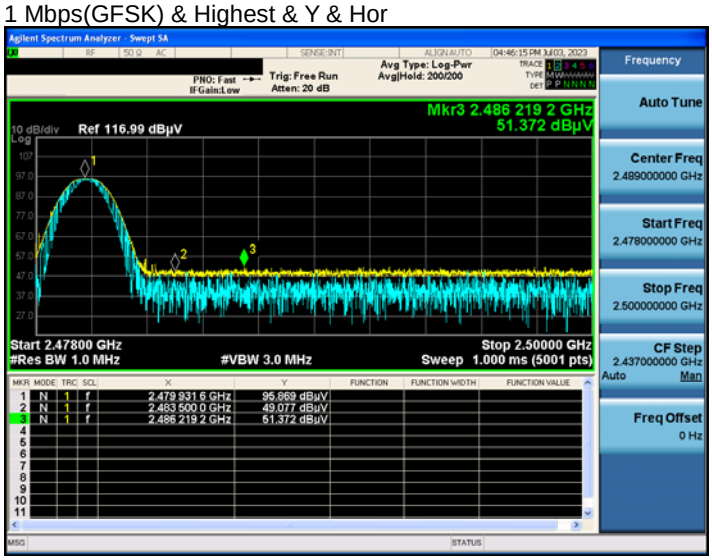
1.1.3. Spot Check Verification Data

Test data from the variant device(FCC ID: V2X-PM86W / IC: 10664A-PM86W)

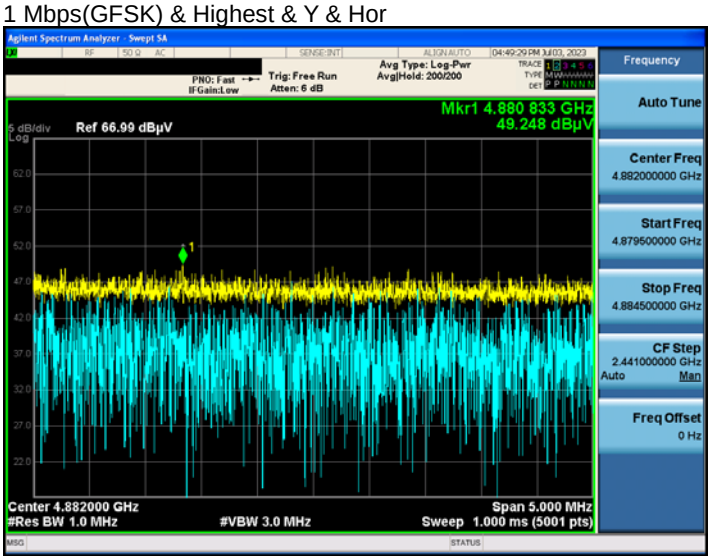
Test item	Mode	TX Freq. (MHz)	Detector Mode	Frequency (MHz)	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
Radiated Band edge	1Mbps	2 480	Peak	2 486.22	51.37	5.66	NA	NA	57.03	74.00	16.97
Radiated Spurious emission	1Mbps	2 441	Peak	4880.83	49.25	2.36	NA	NA	51.61	74.00	22.39

Note: Sample Calculation.
Margin = Limit – Result / Result = Reading + TF+ DCCF + DCF / TF = AF + CL + HL + AL – AG
Where, TF = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain, HL = High pass filter Loss,
AL = Attenuator Loss, DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor

Radiated Band edge (Plot: Reading Value)
1 Mbps(GFSK) & Highest & Y & Hor



Radiated Spurious emission (Plot: Reading Value)
1 Mbps(GFSK) & Highest & Y & Hor



Comparison results between reference device and variant device

Equipment Class (capability)	FCC Part/ RSS Std.	Mode	TX Freq. (MHz)	Test item	Detector Mode	Reference FCC ID: V2X-PM86 / IC: 10664A-PM86		Separated FCC ID: V2X-PM86W / IC: 10664A-PM86W		Limit (dBuV/m)	Deviation (dB)
						Frequency (MHz)	Result (dBuV/m)	Frequency (MHz)	Result (dBuV/m)		
DSS (Bluetooth)	15.247 / RSS-247	1Mbps	2 480	Radiated Band edge	Peak	2 483.54	58.95	2 486.22	57.03	74.00	-1.92
		1Mbps	2 441	Radiated Spurious emission	Peak	4 882.28	52.33	4 880.83	51.61	74.00	-0.72

Note1: The spot check were performed based on worst-case results reported in the original test report.
The spot check test results show good correlation between two products.

1.1.4. Reference Section

Reference FCC ID: V2X-PM86 / IC: 10664A-PM86

Equipment Class	FCC Part/ RSS Std.	Capability	Band(MHz)	Exhibit type	Report title	Reference Sections
DSS	15.247 / RSS-247	Bluetooth	2 402 ~ 2 480	Original Grant/ New Single Certification	DSS	All

1.2. Description of EUT

Equipment Class	Part 15 Spread Spectrum Transmitter (DSS)
Product Name	MOBILE COMPUTER
Model Name	PM86W
Add Model Name	-
Firmware Version Identification Number	86.00
EUT Serial Number (Reference product) Note1	Conducted: 23070A0067, Radiated: 23070A0126
EUT Serial Number (Separated product) Note2	Radiated: 23070A0070
Power Supply	DC 3.8 V
Frequency Range	2 402 MHz ~ 2 480 MHz
Max. RF Output Power	5.74 dBm (0.004 W)
Modulation Technique (Data rate)	GFSK(1 Mbps), π/4DQPSK(2 Mbps), 8DPSK(3 Mbps)
Number of Channels	79
Antenna Specification	Antenna Type: LDS Antenna Gain: 3.9 dBi (PK)

Note1: Reference FCC ID: V2X-PM86 / IC: 10664A-PM86
Note2: Separated FCC ID: V2X-PM86W / IC: 10664A-PM86W

1.3. Declaration by the applicant / manufacturer

- NA

1.4. 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 Part 2.948 according to ANSI C63.4-2014. **- FCC & IC MRA Designation No. : KR0034** **- ISED#: 5740A**		
www.dtnc.net		
Telephone	:	+ 82-31-321-2664
FAX	:	+ 82-31-321-1664

1.5. Testing Environment

Ambient Condition	
▪ Temperature	+21 ℃ ~ +24 ℃
▪ Relative Humidity	40 % ~ 43 %

1.6. 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.

Parameter	Measurement uncertainty
Antenna-port conducted emission	1.0 dB (The confidence level is about 95 %, k = 2)
AC power-line conducted emission	3.4 dB (The confidence level is about 95 %, k = 2)
Radiated emission (1 GHz Below)	4.8 dB (The confidence level is about 95 %, k = 2)
Radiated emission (1 GHz ~ 18 GHz)	5.0 dB (The confidence level is about 95 %, k = 2)
Radiated emission (18 GHz Above)	5.2 dB (The confidence level is about 95 %, k = 2)

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 transmit ted 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. Conclusion of worst-case and operation mode

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

Therefore all applicable requirements were tested with all the modulations.

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

Note: This transmitter have a variable power settings. High power setting and Low power setting were investigated.

Test Mode 1(TM1): High power setting

Test Mode 2(TM2): Low power setting

EUT Operation test setup

The following firmware was installed on the EUT and Bluetooth tester was used to control the transmit parameters during test.

High power setting: BCM4362A2_001.003.006.1093.1177_test_class 1

Low power setting: BCM4362A2_001.003.006.1093.1177_test_class2

Tested frequency information

- Hopping Function : Enable

	Tested Frequency (MHz)
Hopping Band	2 402 ~ 2 480

- Hopping Function : Disable

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

1.9. Test Equipment List

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	22/06/24	23/06/24	MY46471622
			23/06/23	24/06/23	
Spectrum Analyzer	Agilent Technologies	N9020A	22/12/16	23/12/16	MY48011700
Spectrum Analyzer	Agilent Technologies	N9020A	22/06/24	23/06/24	US47360812
			23/06/23	24/06/23	
DC Power Supply	Agilent Technologies	66332A	22/06/24	23/06/24	US37474125
			23/06/23	24/06/23	
Multimeter	FLUKE	17B+	22/12/16	23/12/16	36390701WS
BlueTooth Tester	TESCOM	TC-3000C	22/06/24	23/06/24	3000C000563
			23/06/23	24/06/23	
Power Splitter	Anritsu	K241B	22/06/24	23/06/24	020611
			23/06/23	24/06/23	
Signal Generator	Rohde Schwarz	SMBV100A	22/12/16	23/12/16	255571
Signal Generator	ANRITSU	MG3695C	22/12/16	23/12/16	173501
Thermohygrometer	BODYCOM	BJ5478	22/12/16	23/12/16	120612-1
Thermohygrometer	BODYCOM	BJ5478	22/12/16	23/12/16	120612-2
Thermohygrometer	BODYCOM	BJ5478	22/06/24	23/06/24	N/A
			23/06/23	24/06/23	
Loop Antenna	ETS-Lindgren	6502	22/04/22	24/04/22	00203480
Hybrid Antenna	Schwarzbeck	VULB 9160	22/12/16	23/12/16	3362
Horn Antenna	ETS-Lindgren	3117	22/06/24	23/06/24	00143278
			23/06/23	24/06/23	
Horn Antenna	A.H.Systems Inc.	SAS-574	22/06/24	23/06/24	155
			23/06/23	24/06/23	
PreAmplifier	tsj	MLA-0118-B01-40	22/12/16	23/12/16	1852267
PreAmplifier	tsj	MLA-1840-J02-45	22/06/24	23/06/24	16966-10728
			23/06/23	24/06/23	
PreAmplifier	H.P	8447D	22/12/16	23/12/16	2944A07774
High Pass Filter	Wainwright Instruments	WHKX12-935-1000-15000-40SS	22/06/24	23/06/24	8
			23/06/23	24/06/23	
High Pass Filter	Wainwright Instruments	WHKX10-2838-3300-18000-60SS	22/06/24	23/06/24	1
			23/06/23	24/06/23	
High Pass Filter	Wainwright Instruments	WHNX8.0/26.5-6SS	22/06/24	23/06/24	3
			23/06/23	24/06/23	
Attenuator	Hefei Shunze	SS5T2.92-10-40	22/06/24	23/06/24	16012202
			23/06/23	24/06/23	
Attenuator	Aeroflex/Weinschel	56-3	22/06/24	23/06/24	Y2370
			23/06/23	24/06/23	
Attenuator	SMAJK	SMAJK-2-3	22/06/24	23/06/24	3
			23/06/23	24/06/23	
Attenuator	SMAJK	SMAJK-2-3	22/06/24	23/06/24	2
			23/06/23	24/06/23	
Attenuator	Aeroflex/Weinschel	86-10-11	22/06/24	23/06/24	408
			23/06/23	24/06/23	
Power Meter & Wide Bandwidth Sensor	Anritsu	ML2496A MA2411B	22/12/16	23/12/16	1338004 1911481
EMI Test Receiver	ROHDE&SCHWARZ	ESCI7	23/01/31	24/01/31	100910
PULSE LIMITER	Rohde Schwarz	ESH3-Z2	22/08/22	23/08/22	101333
LISN	SCHWARZBECK	NSLK 8128 RC	22/10/26	23/10/26	8128 RC-387
Thermo Hygro Meter	TESTO	608-H1	23/01/13	24/01/13	45084791
Cable	Dt&C	Cable	23/01/04	24/01/04	G-2
Cable	HUBER+SUHNER	SUCOFLEX 100	23/01/04	24/01/04	G-3
Cable	Dt&C	Cable	23/01/04	24/01/04	G-4
Cable	OMT	YSS21S	23/01/04	24/01/04	G-5
Cable	Junkosha	MWX241	23/01/03	24/01/03	mmW-1
Cable	Junkosha	MWX241	23/01/03	24/01/03	mmW-4
Cable	HUBER+SUHNER	SUCOFLEX100	23/01/04	24/01/04	M-01
Cable	HUBER+SUHNER	SUCOFLEX100	23/01/04	24/01/04	M-02
Cable	JUNKOSHA	MWX241/B	23/01/04	24/01/04	M-03
Cable	JUNKOSHA	J12J101757-00	23/01/04	24/01/04	M-07
Cable	HUBER+SUHNER	SUCOFLEX106	23/01/04	24/01/04	M-09
Cable	Radiall	TESTPRO3	23/01/04	24/01/04	RFC-70
Test Software	tsj	Radiated Emission Measurement	NA	NA	Version 2.00.0147
Test Software	tsj	Noise Terminal Measurement	NA	NA	Version 2.00.0185

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.

2. Antenna Requirement

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions.

Conclusion: Comply

The antenna is attached on the device by means of unique coupling method.
Therefore this E.U.T complies with the requirement of Part 15.203

3. Summary of Test Results

FCC part section(s)	RSS section(s)	Test Description	Limit (Using in 2 400~ 2 483.5 MHz)	Test Condition	Status Note 1
15.247(a) 15.247(b)	RSS-247[5.1] RSS-247[5.4]	Maximum Peak Conducted Output Power	**For FCC** =< 0.125 W(conducted) **For IC** =< 0.125 W(conducted) =< 4 Watt(e.i.r.p)	Conducted	**C**
15.247(a)	RSS-247[5.1]	20 dB Bandwidth	NA		**C**
		Carrier Frequency Separation	>= 25 kHz or >= Two thirds of the 20 dB BW, whichever is greater.		**C**
		Number of Hopping Channels	>= 15 hops		**C**
		Time of Occupancy	=< 0.4 seconds		**C**
-	RSS-Gen[6.7]	Occupied Bandwidth (99 %)	NA		**C**
15.247(d)	RSS-247[5.5]	Unwanted Emissions (Conducted)	The radiated emission to any 100 kHz of out-band shall be at least 20 dB below the highest in-band spectral density.		**C**
15.247(d) 15.205 15.209	RSS-247[5.5] RSS-Gen[8.9] RSS-Gen[8.10]	Unwanted Emissions (Radiated)	Part 15.209 Limits (Refer to section 9)	Radiated	**C** Note3
15.207	RSS-Gen[8.8]	AC Power-Line Conducted Emissions	Part 15.207 Limits (Refer to section 10)	AC Line Conducted	**C**
15.203	-	Antenna Requirement	Part 15.203 (Refer to section 2)	-	**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 three orthogonal EUT positions and the worst case data was reported.

4. Maximum Peak Conducted Output Power

4.1. Test Setup

Refer to the APPENDIX I.

4.2. 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 2 400 – 2 483.5 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[5.1] (b), For FHSs 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, FHSs operating in the band 2 400-2 483.5 MHz 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 that the systems operate with an output power no greater than 0.125 W.
2. 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)

4.3. 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 ≥ 20 dB BW
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold

4.4. Test Results

Test Mode 1

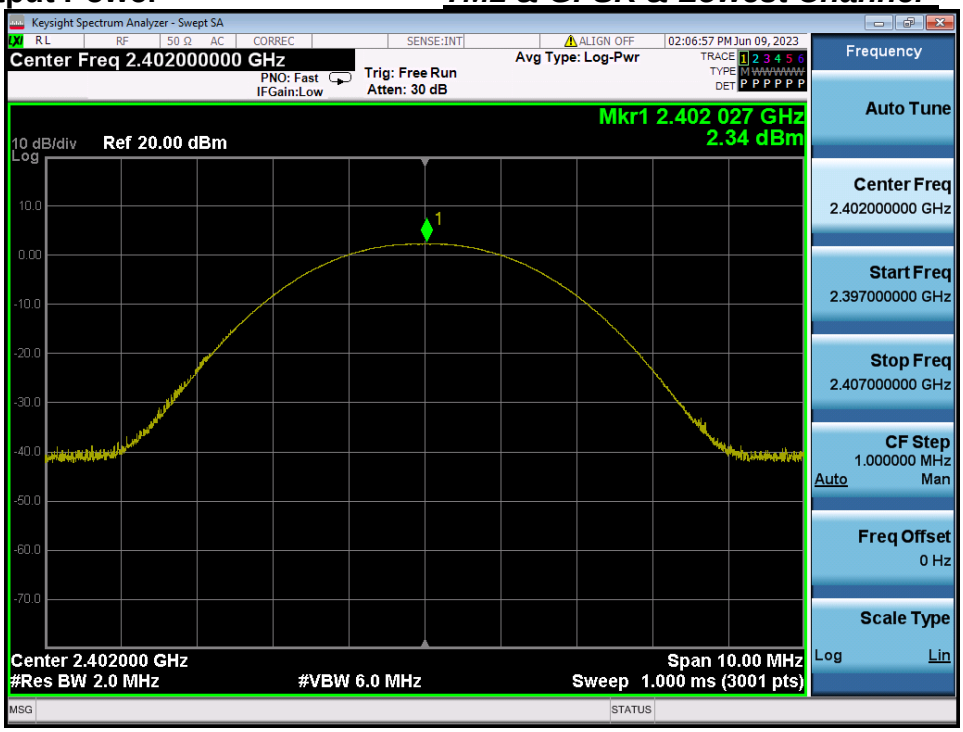
Modulation	Tested Channel	Burst Average Output Power		Peak Output Power		Antenna Gain	e.i.r.p[Note3]
		dBm	mW	dBm	mW	(dBi)	(dBm)
GFSK	**Lowest**	2.31	1.70	2.34	1.71	3.90	6.24
	Middle	2.67	1.85	2.69	1.86	3.90	6.59
	Highest	3.59	2.29	3.69	2.34	3.90	7.59
π/4DQPSK	**Lowest**	1.87	1.54	3.57	2.28	3.90	7.47
	Middle	3.64	2.31	5.05	3.20	3.90	8.95
	Highest	3.94	2.48	5.40	3.47	3.90	9.30
8DPSK	**Lowest**	1.88	1.54	4.03	2.53	3.90	7.93
	Middle	3.63	2.31	5.48	3.53	3.90	9.38
	Highest	3.94	2.48	**5.74**	**3.75**	3.90	9.64

Test Mode 2

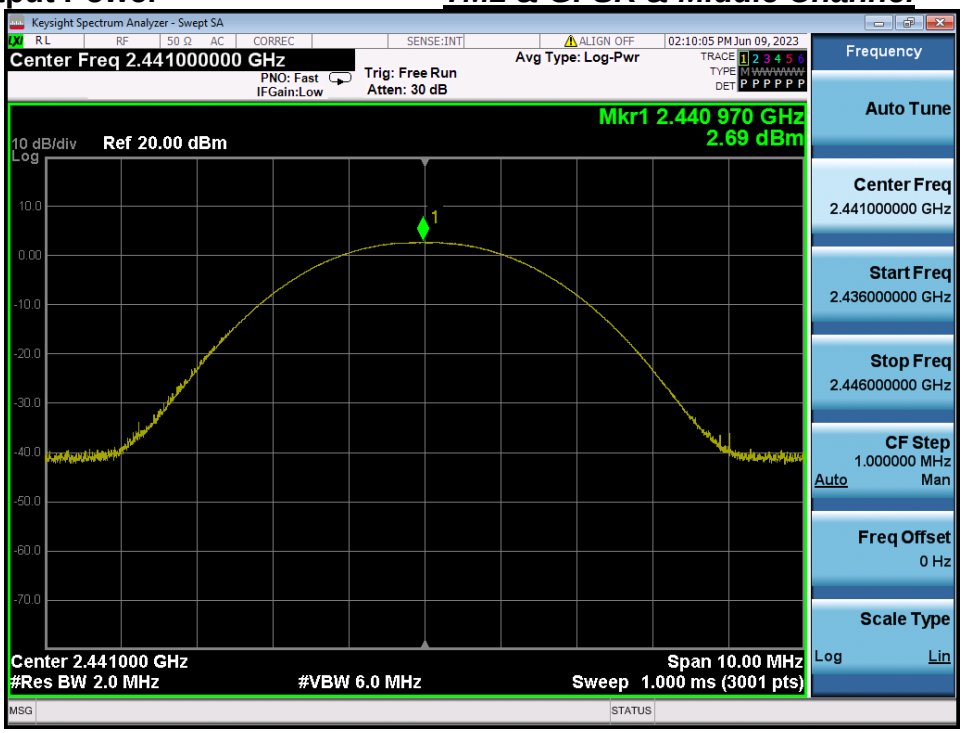
Modulation	Tested Channel	Burst Average Output Power		Peak Output Power		Antenna Gain	e.i.r.p[Note3]
		dBm	mW	dBm	mW	(dBi)	(dBm)
GFSK	**Lowest**	-0.54	0.88	-0.38	0.92	3.90	3.52
	Middle	-0.51	0.89	-0.25	0.94	3.90	3.65
	Highest	0.51	1.12	0.62	1.15	3.90	4.52
π/4DQPSK	**Lowest**	-0.73	0.85	1.88	1.54	3.90	5.78
	Middle	-0.33	0.93	2.06	1.61	3.90	5.96
	Highest	-0.23	0.95	1.54	1.43	3.90	5.44
8DPSK	**Lowest**	-0.72	0.85	2.25	1.68	3.90	6.15
	Middle	-0.32	0.93	2.66	1.85	3.90	6.56
	Highest	-0.24	0.95	2.03	1.60	3.90	5.93

Note 1: The average output power was tested using an average power meter for reference only.
Note 2: See next pages for actual measured spectrum plots.
Note 3: e.i.r.p = P_{cond} + G_{EUT}
P_{cond} = measured power at feedpoint of the EUT antenna, in dBm (Peak Conducted Output Power)
G_{EUT} = gain of the EUT radiating element (antenna), in dBi

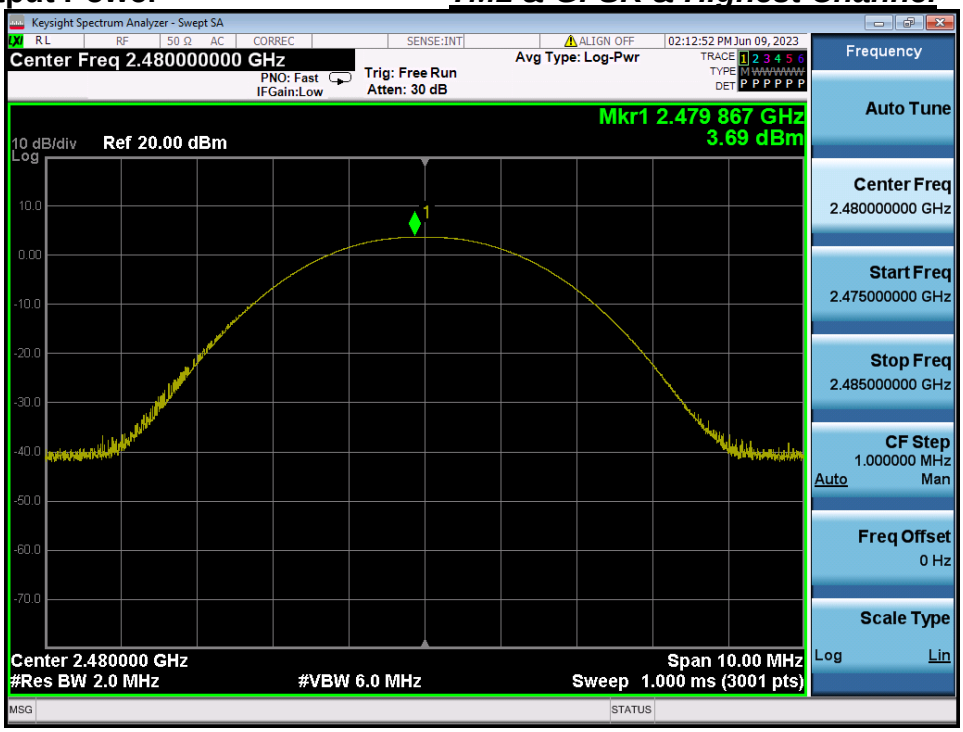
Peak Output Power *TM1 & GFSK & Lowest Channel*



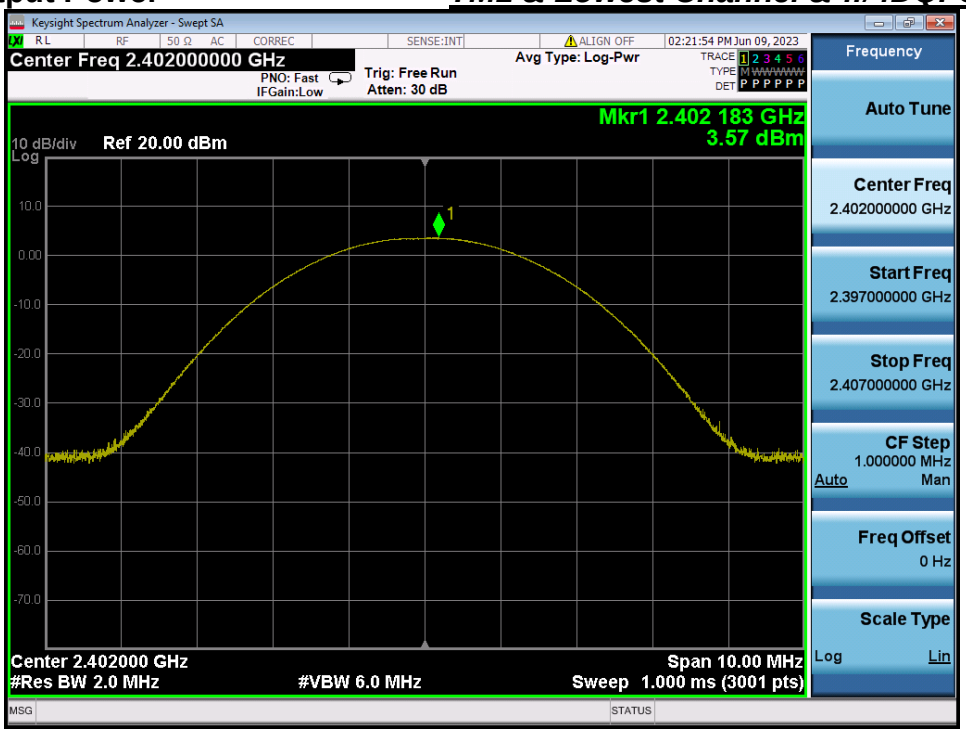
Peak Output Power *TM1 & GFSK & Middle Channel*



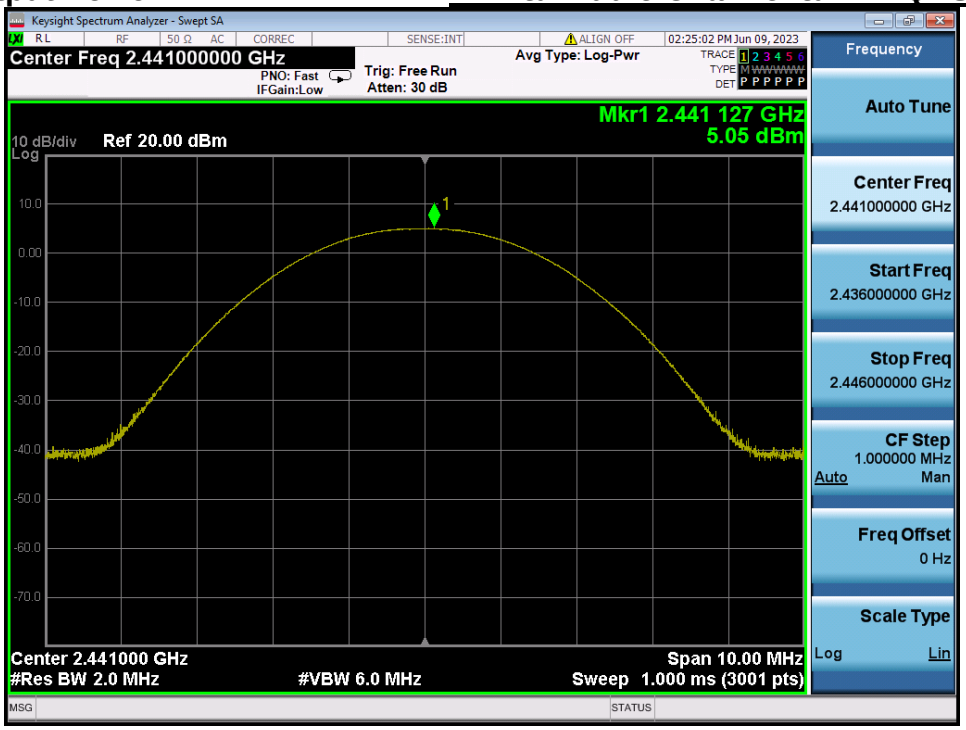
Peak Output Power *TM1 & GFSK & Highest Channel*



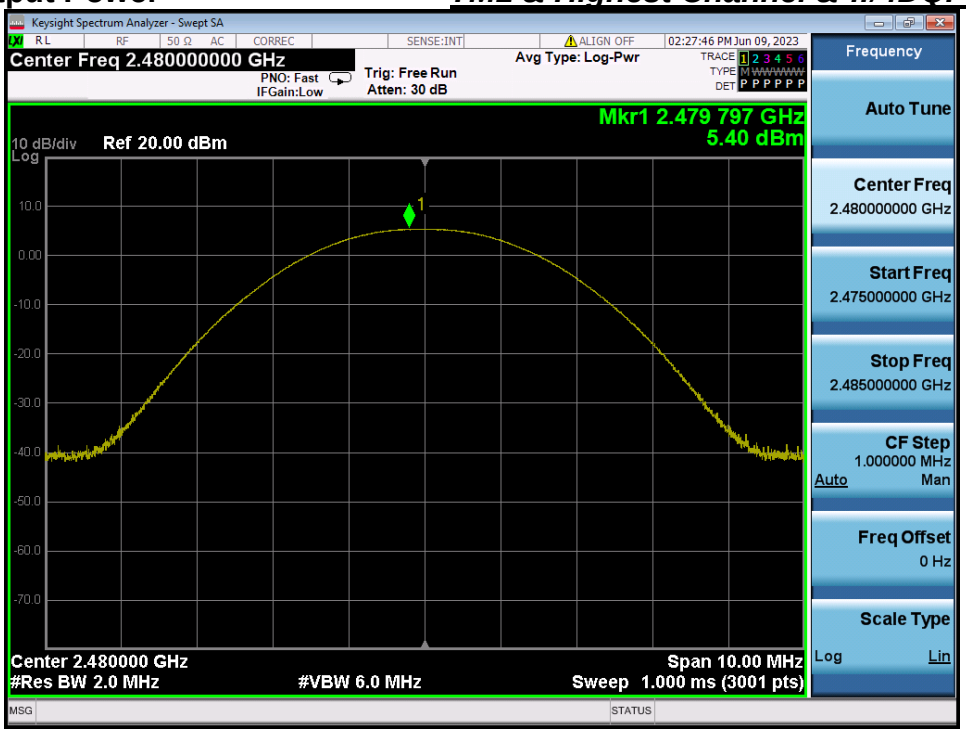
Peak Output Power *TM1 & Lowest Channel & π/4DQPSK*



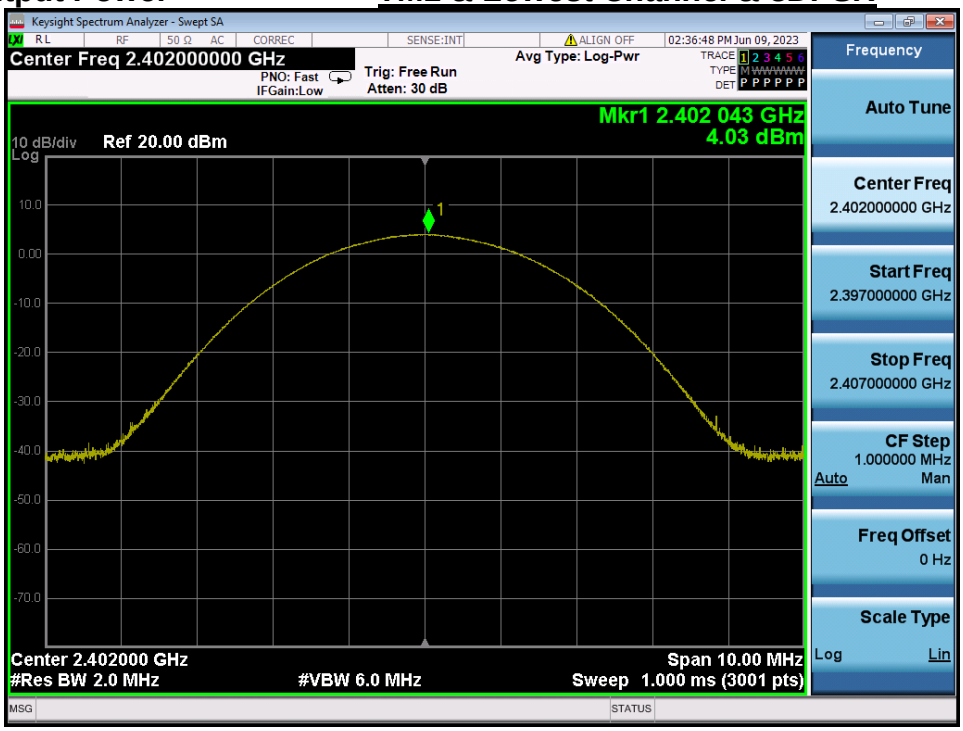
Peak Output Power *TM1 & Middle Channel & π/4DQPSK*



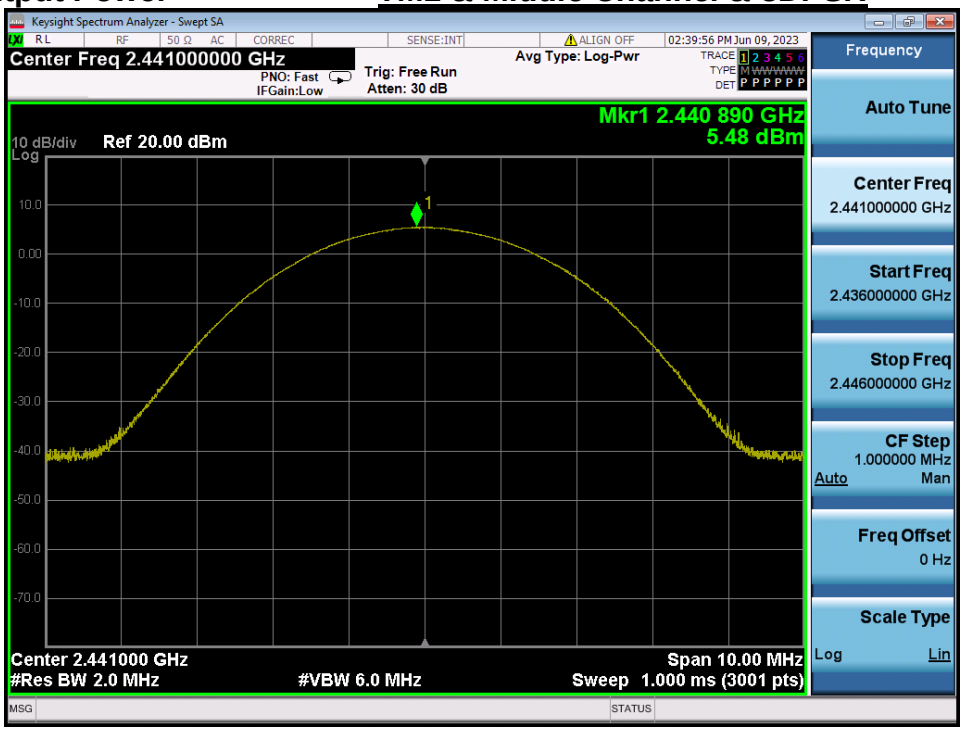
Peak Output Power *TM1 & Highest Channel & π/4DQPSK*



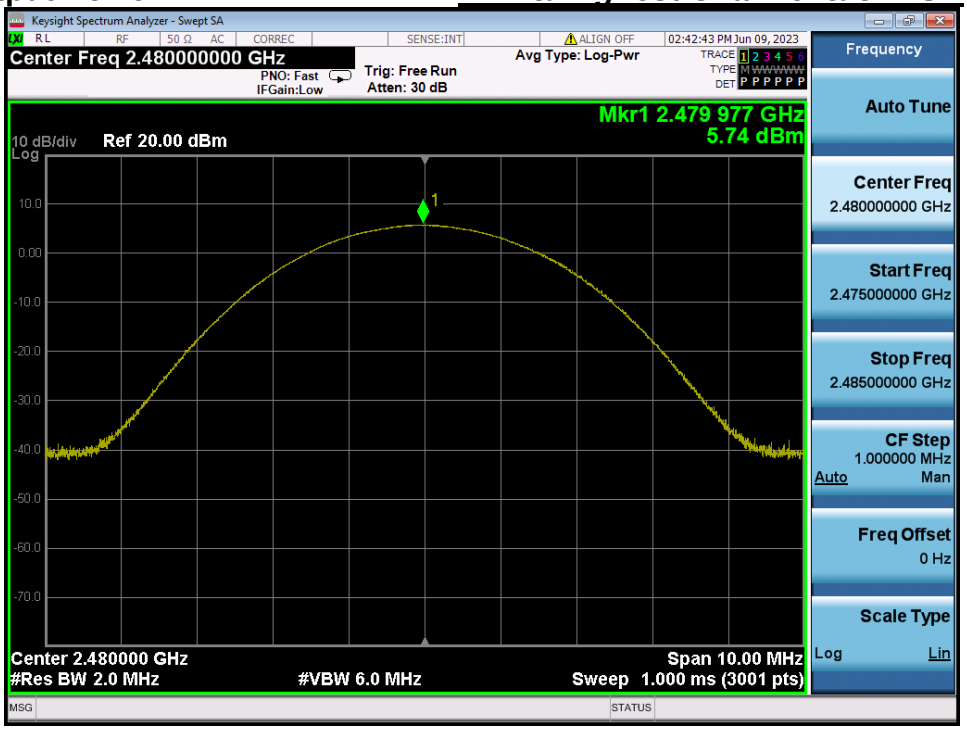
Peak Output Power *TM1 & Lowest Channel & 8DPSK*



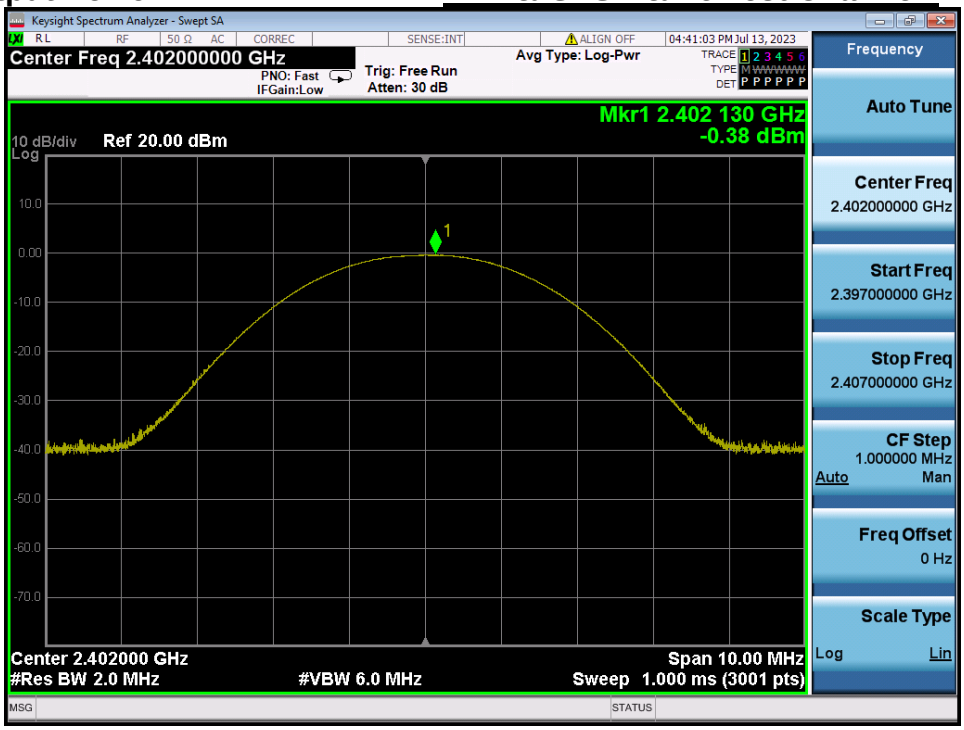
Peak Output Power *TM1 & Middle Channel & 8DPSK*



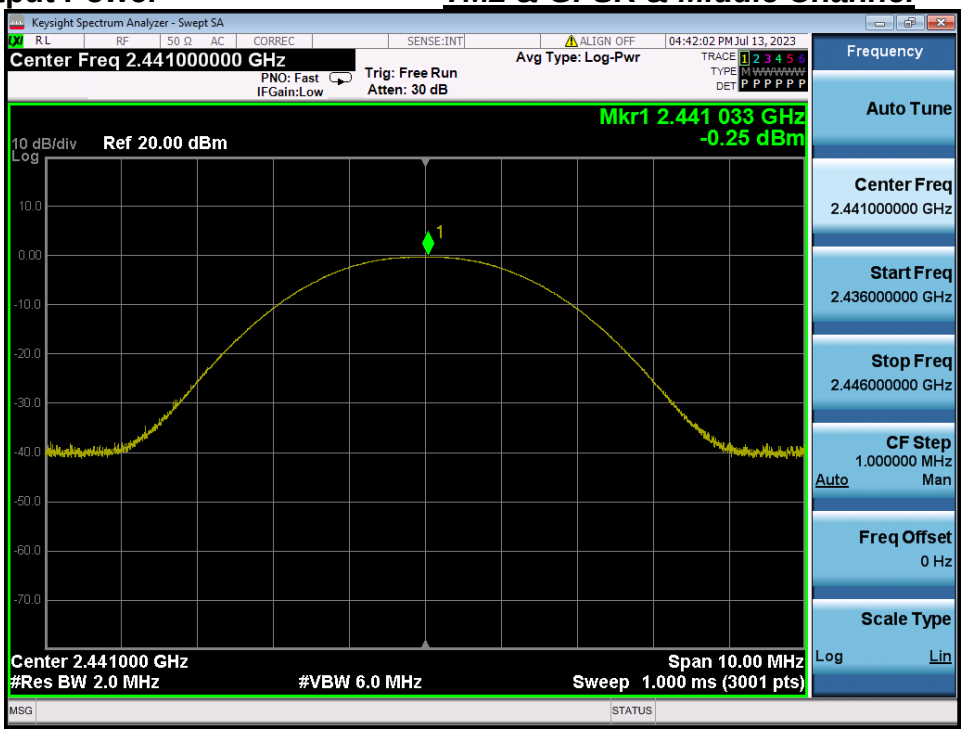
Peak Output Power ***TM1 & Highest Channel & 8DPSK***



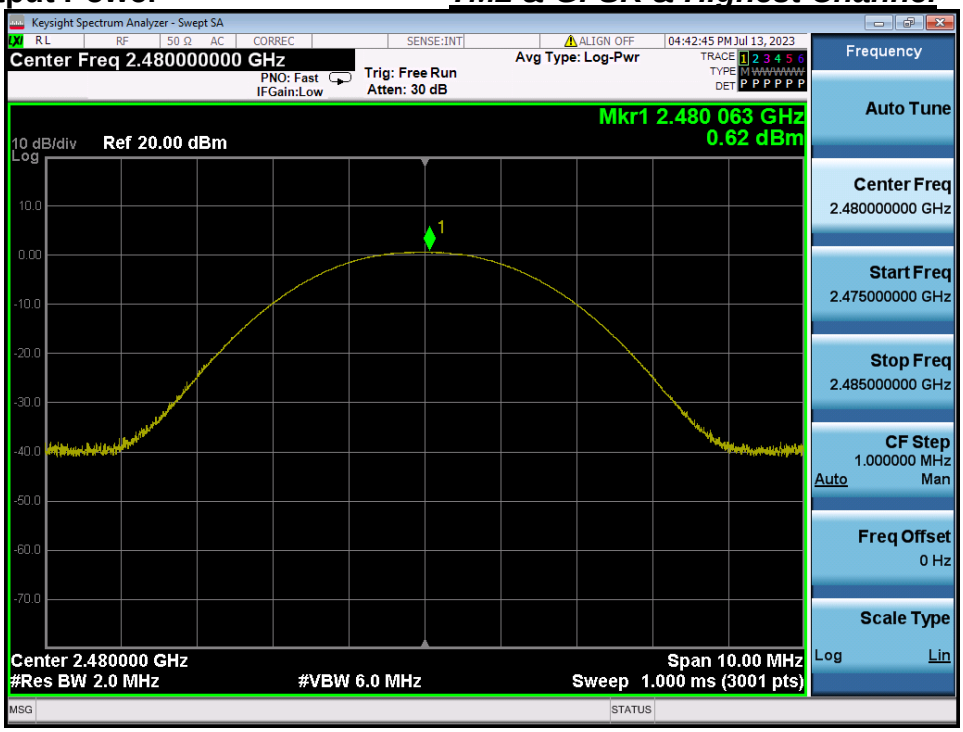
Peak Output Power *TM2 & GFSK & Lowest Channel*



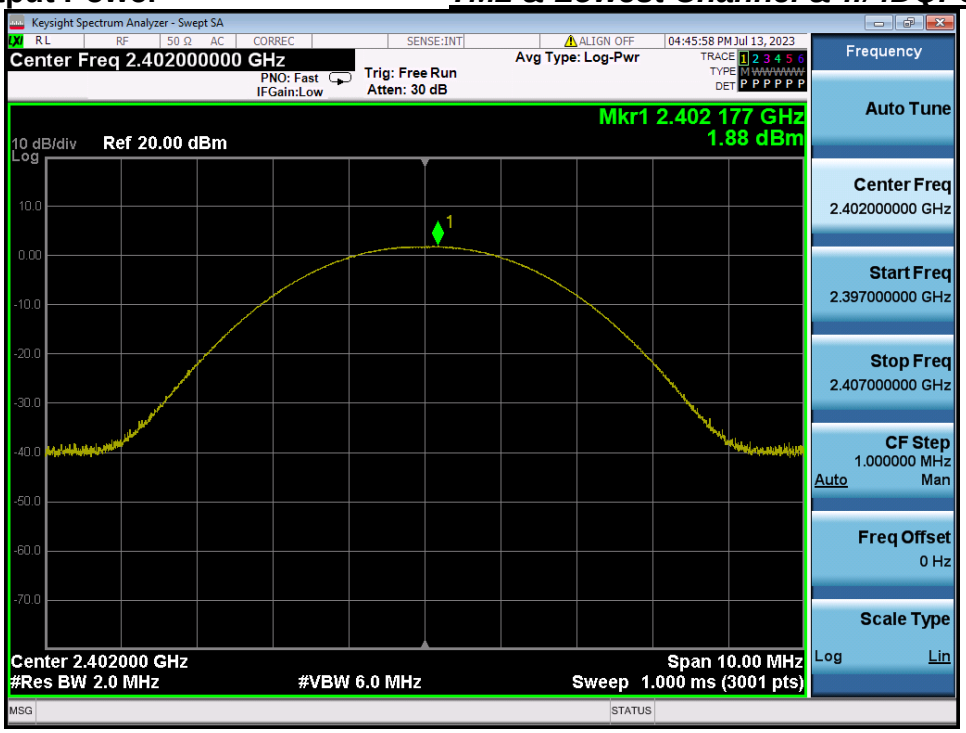
Peak Output Power *TM2 & GFSK & Middle Channel*



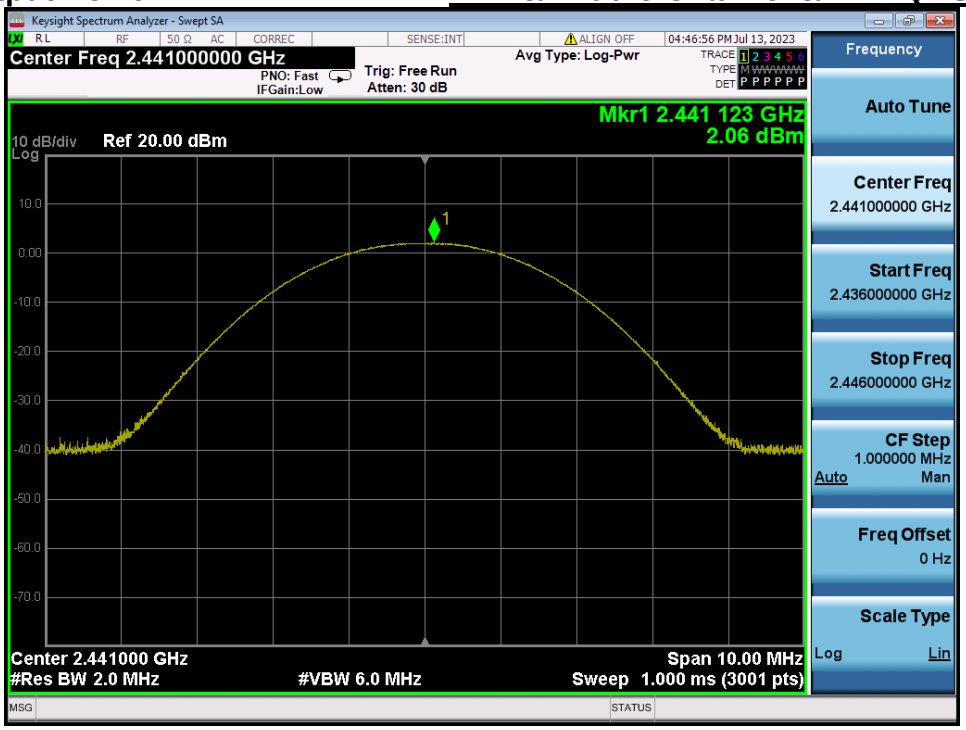
Peak Output Power *TM2 & GFSK & Highest Channel*



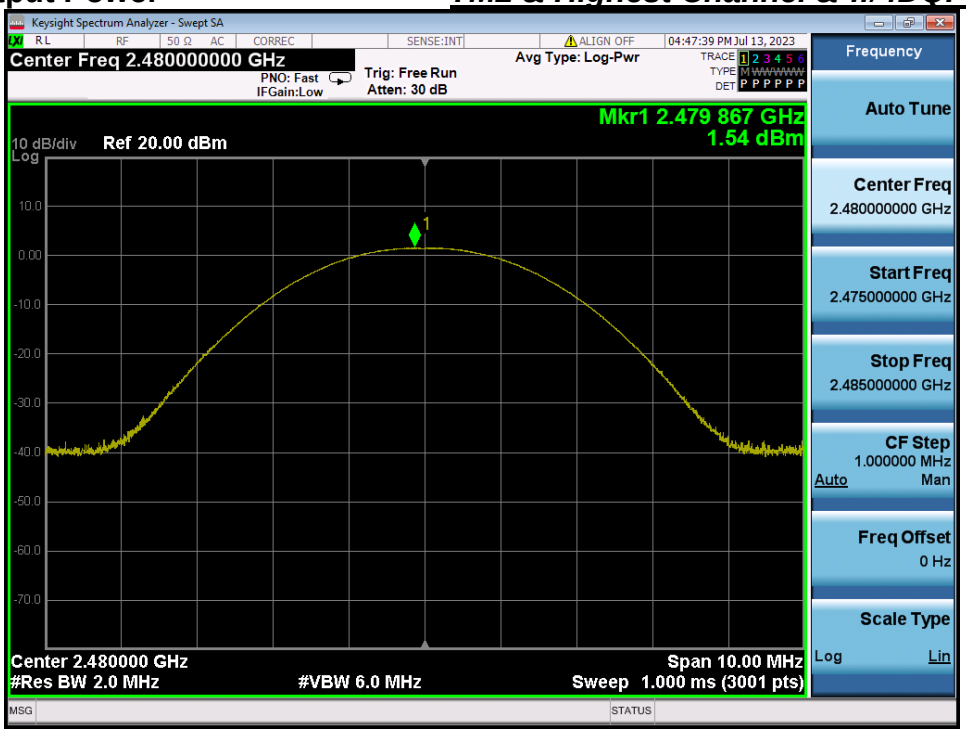
Peak Output Power *TM2 & Lowest Channel & π/4DQPSK*



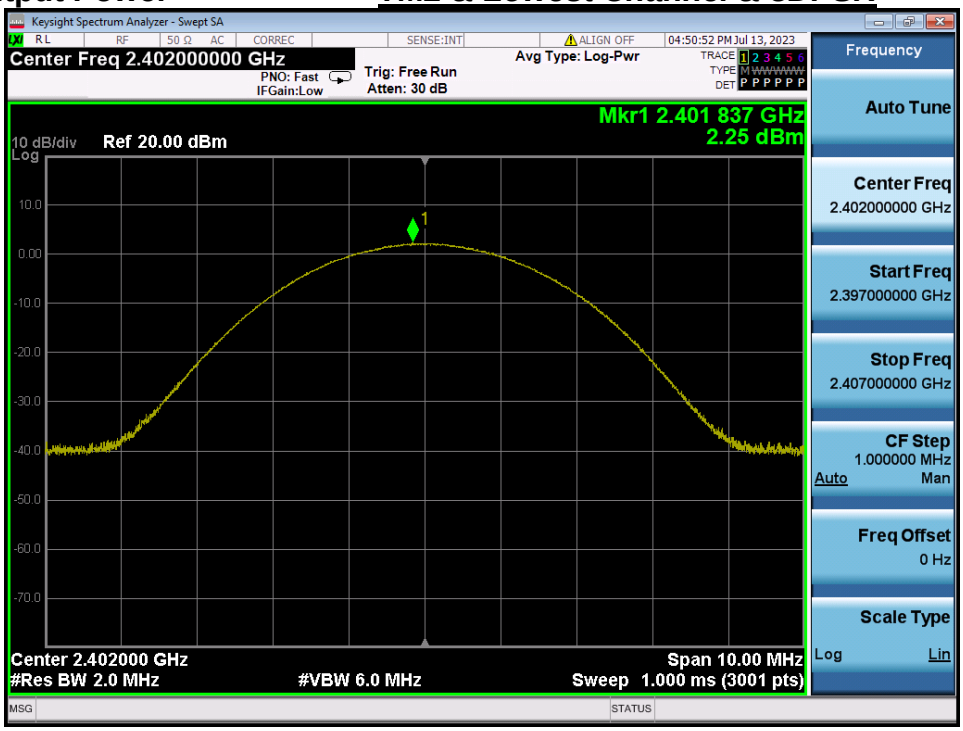
Peak Output Power ***TM2 & Middle Channel & π/4DQPSK***



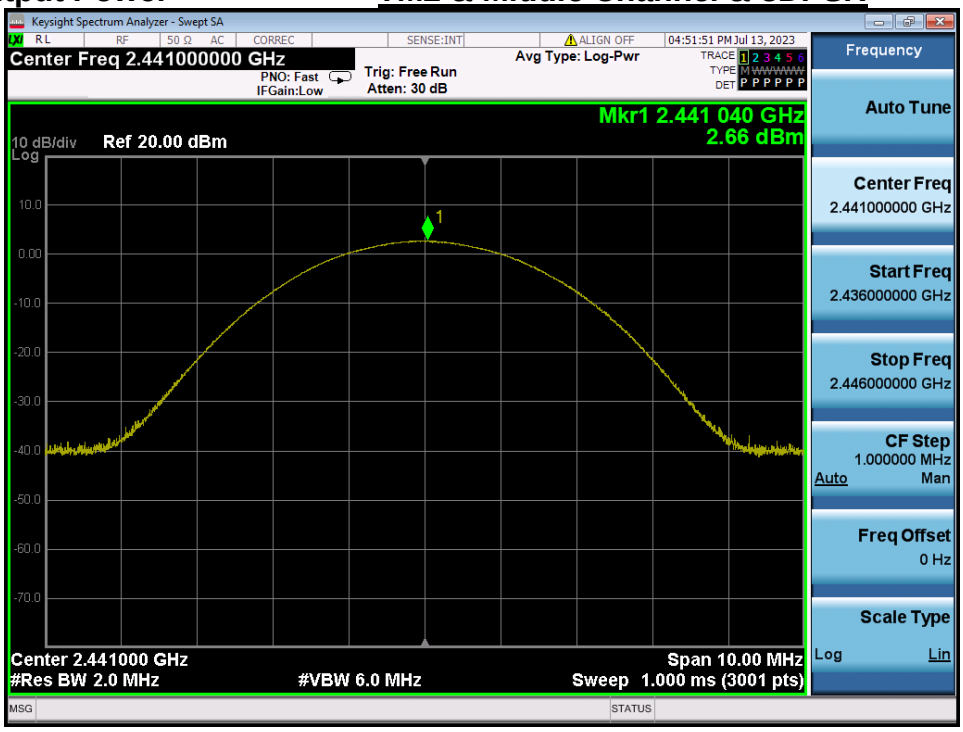
Peak Output Power ***TM2 & Highest Channel & π/4DQPSK***



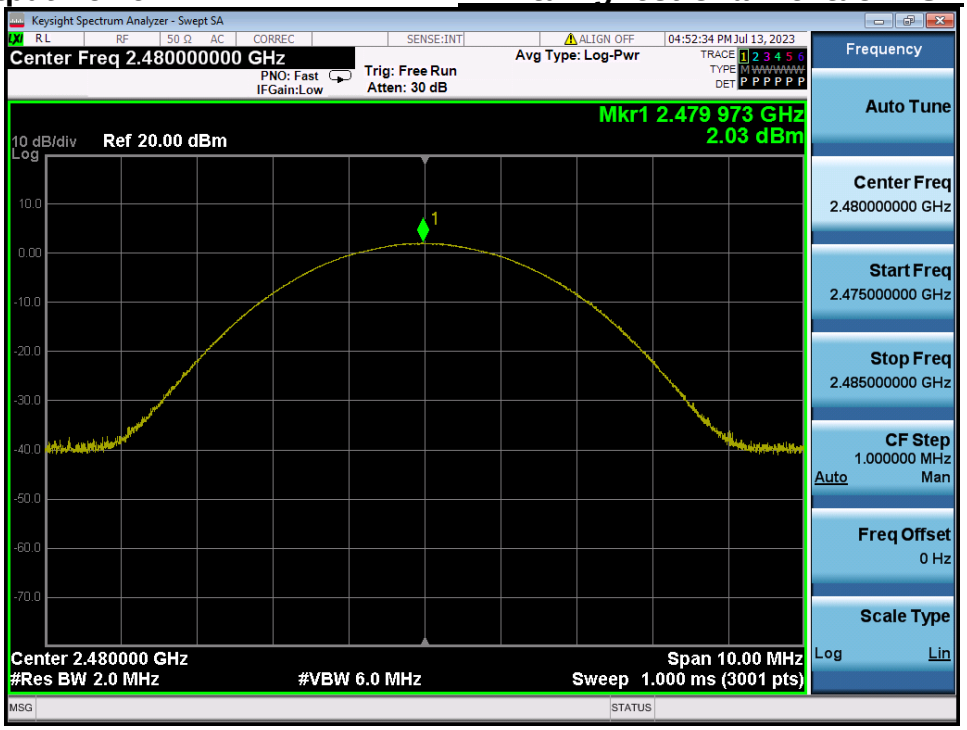
Peak Output Power *TM2 & Lowest Channel & 8DPSK*



Peak Output Power *TM2 & Middle Channel & 8DPSK*



Peak Output Power ***TM2 & Highest Channel & 8DPSK***



5. 20 dB BW & Occupied BW

5.1. Test Setup

Refer to the APPENDIX I.

5.2. Limit

Limit : Not Applicable

5.3. Test Procedure

1. The 20 dB bandwidth was 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 ≥ 3 × RBW
   Span = between two times and five times the 20 dB bandwidth & Occupied BW
   Sweep = auto
   Detector function = peak
   Trace = max hold

5.4. Test Results

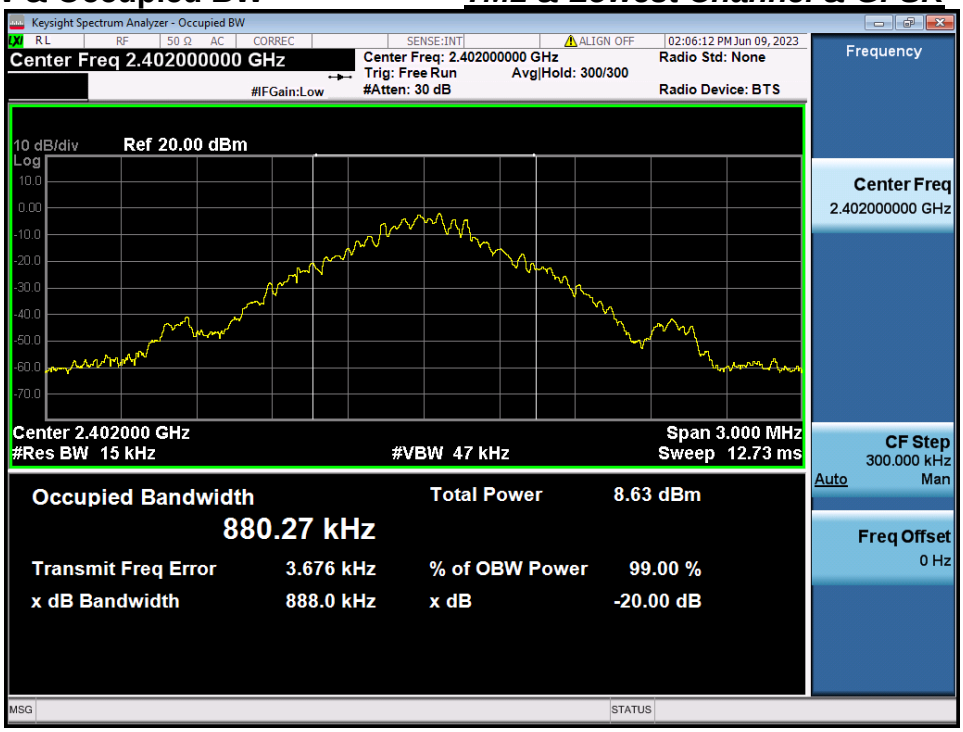
Test Mode 1

Modulation	Tested Channel	20 dB BW (MHz)	Occupied BW (MHz)
GFSK	**Lowest**	0.888	0.880
	Middle	0.888	0.882
	Highest	0.888	0.886
π/4DQPSK	**Lowest**	1.340	1.196
	Middle	1.342	1.200
	Highest	1.347	1.206
8DPSK	**Lowest**	1.343	1.206
	Middle	1.342	1.210
	Highest	1.342	1.213

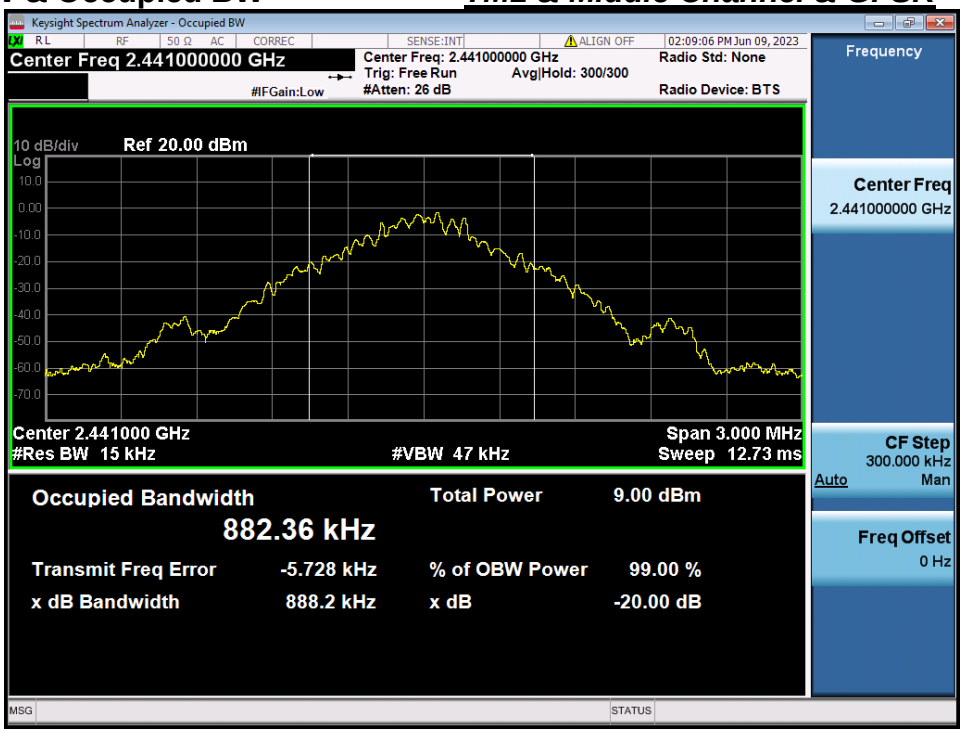
Test Mode 2

Modulation	Tested Channel	20 dB BW (MHz)	Occupied BW (MHz)
GFSK	**Lowest**	0.923	0.882
	Middle	0.889	0.884
	Highest	0.889	0.880
π/4DQPSK	**Lowest**	1.341	1.199
	Middle	1.340	1.199
	Highest	1.342	1.201
8DPSK	**Lowest**	1.343	1.207
	Middle	1.344	1.208
	Highest	1.342	1.211

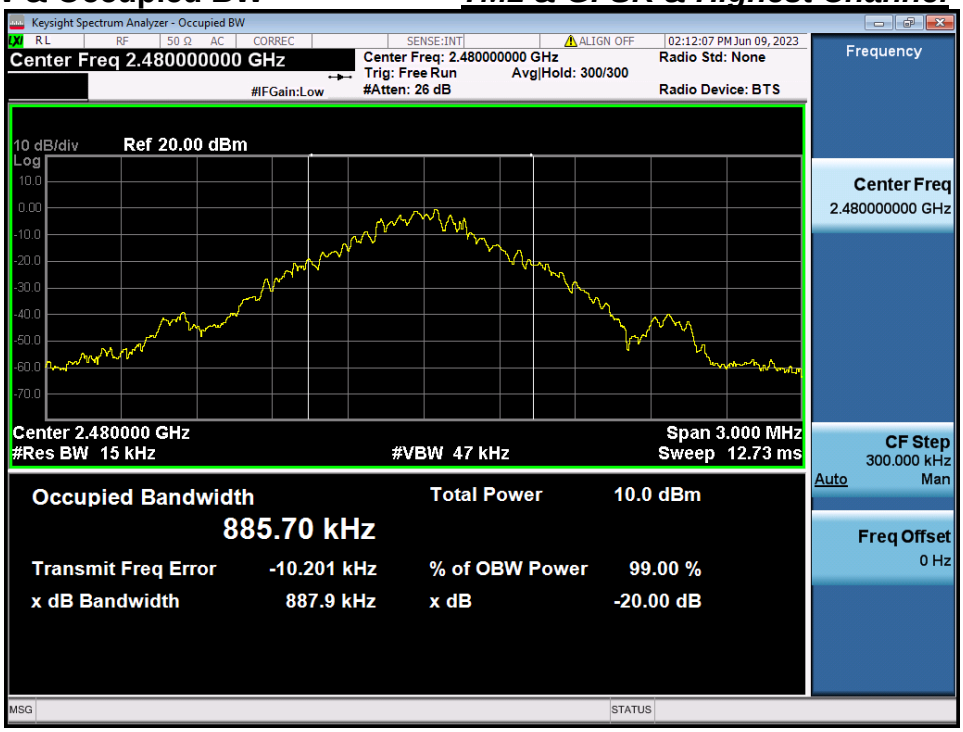
20 dB BW & Occupied BW *TM1 & Lowest Channel & GFSK*



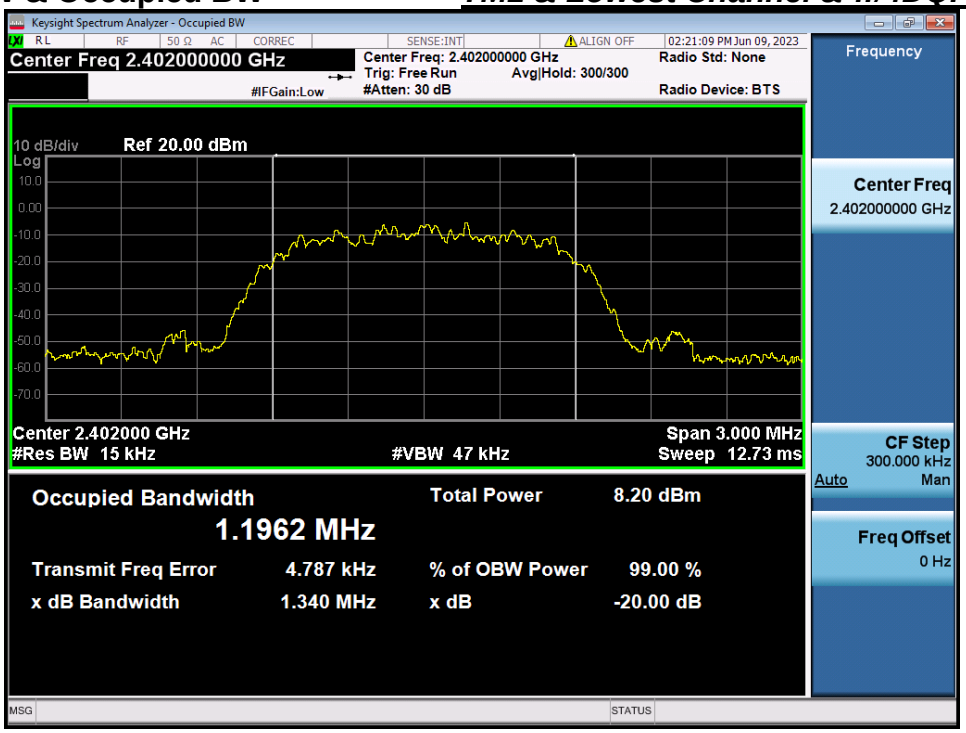
20 dB BW & Occupied BW *TM1 & Middle Channel & GFSK*



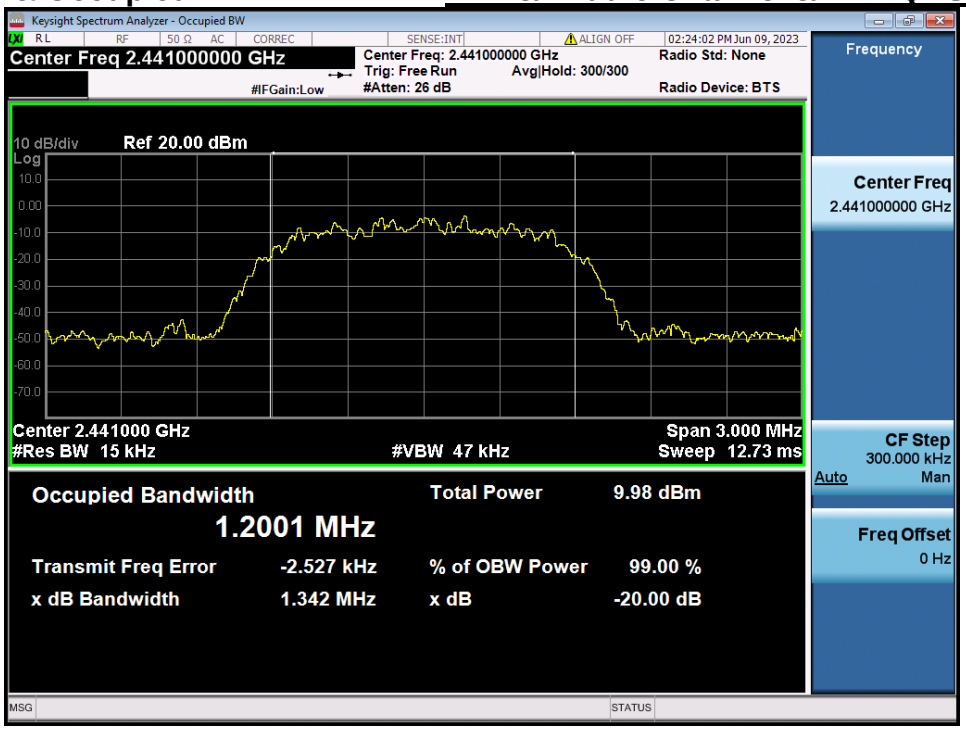
20 dB BW & Occupied BW ***TM1 & GFSK & Highest Channel***



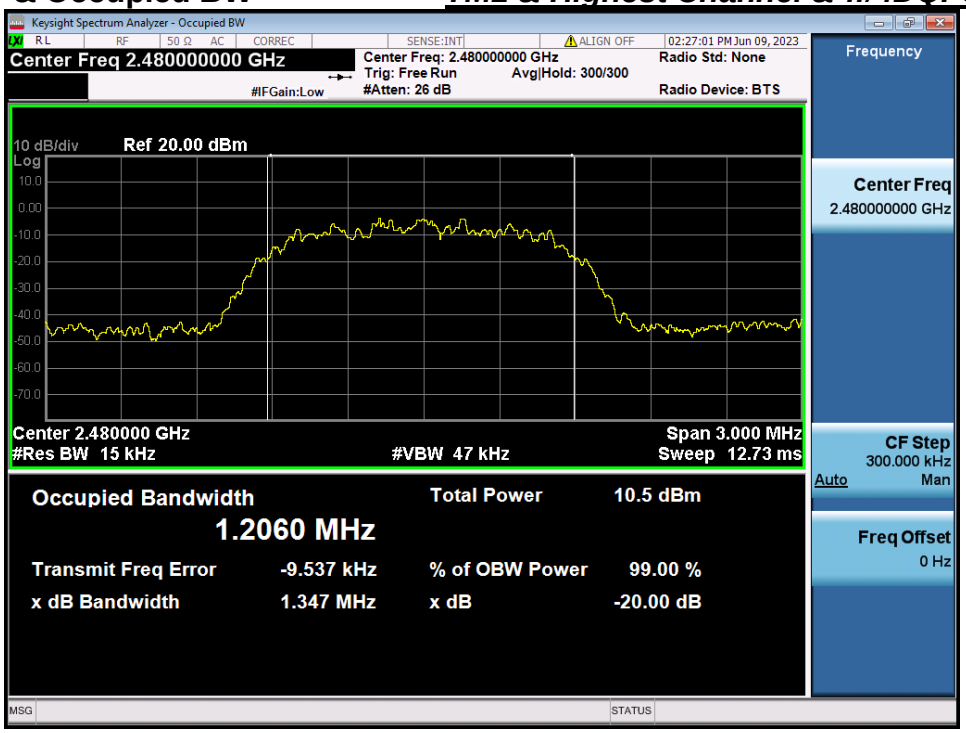
20 dB BW & Occupied BW ***TM1 & Lowest Channel & π/4DQPSK***



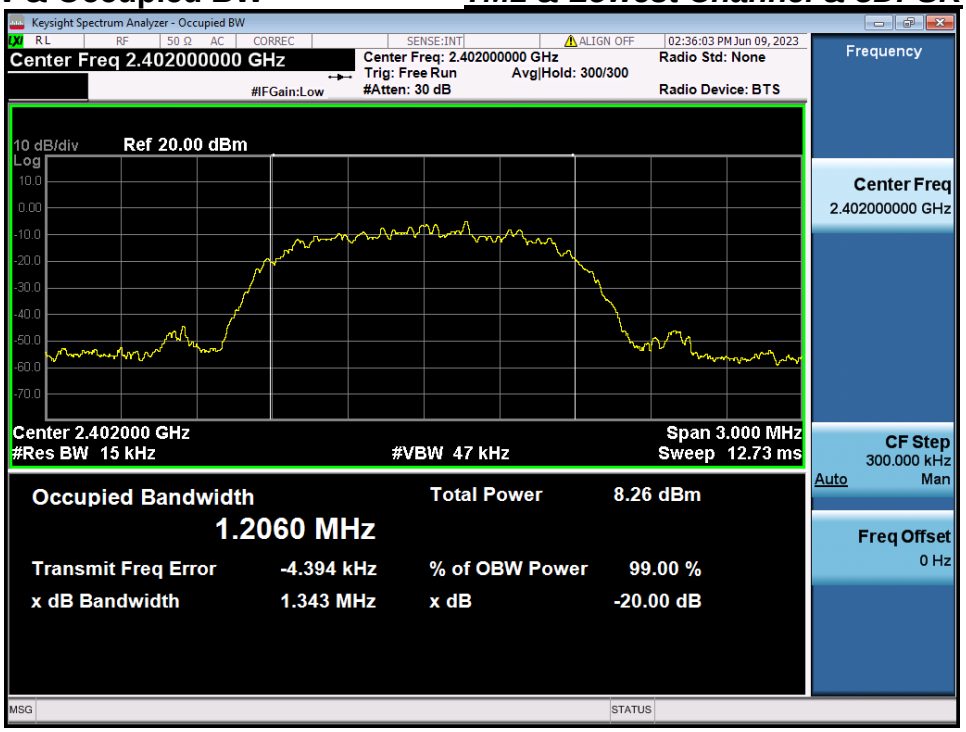
20 dB BW & Occupied BW ***TM1 & Middle Channel & π/4DQPSK***



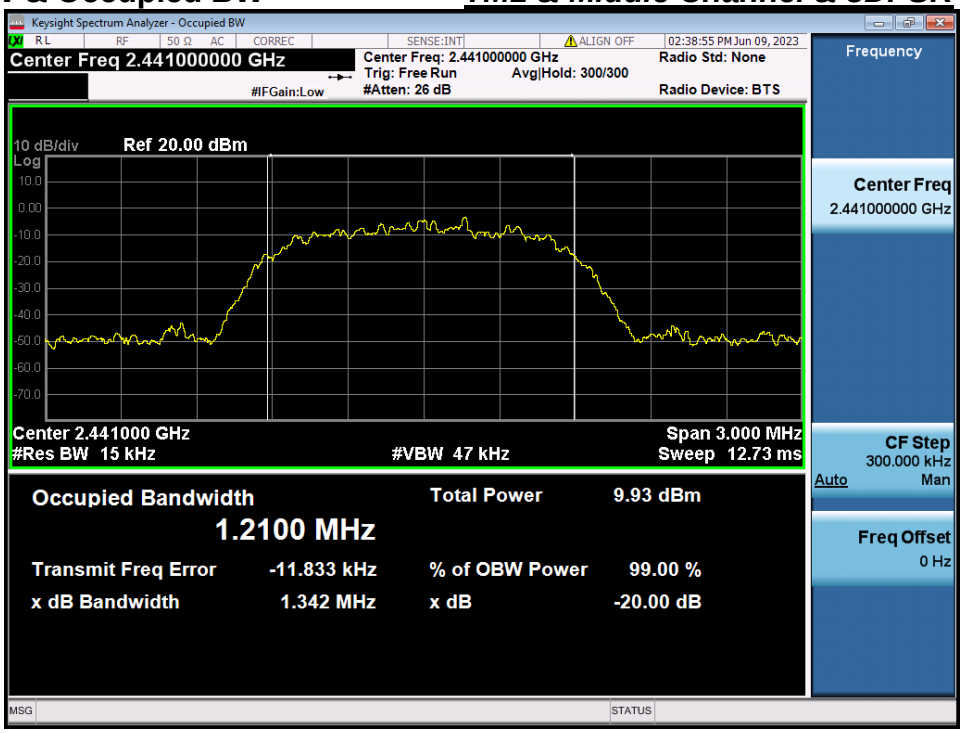
20 dB BW & Occupied BW ***TM1 & Highest Channel & π/4DQPSK***



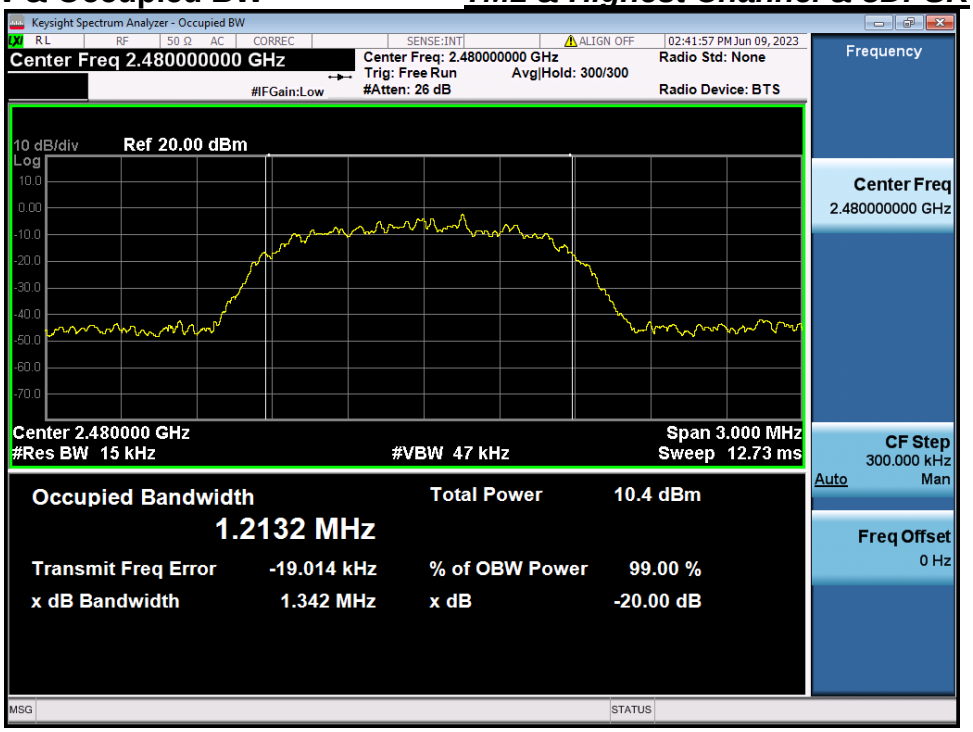
20 dB BW & Occupied BW *TM1 & Lowest Channel & 8DPSK*



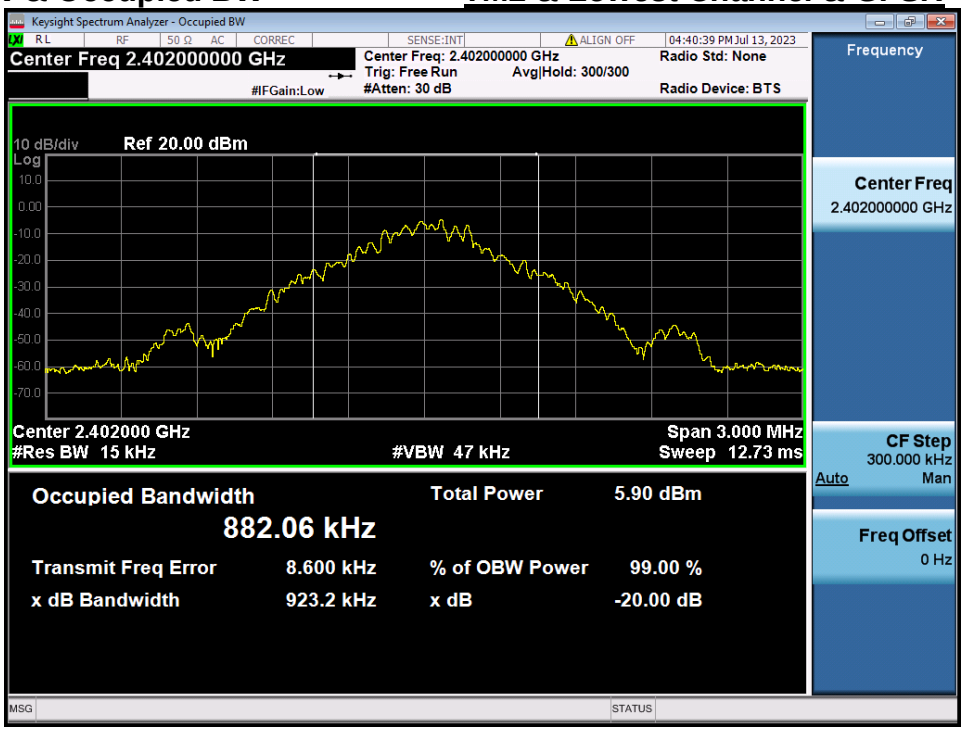
20 dB BW & Occupied BW *TM1 & Middle Channel & 8DPSK*



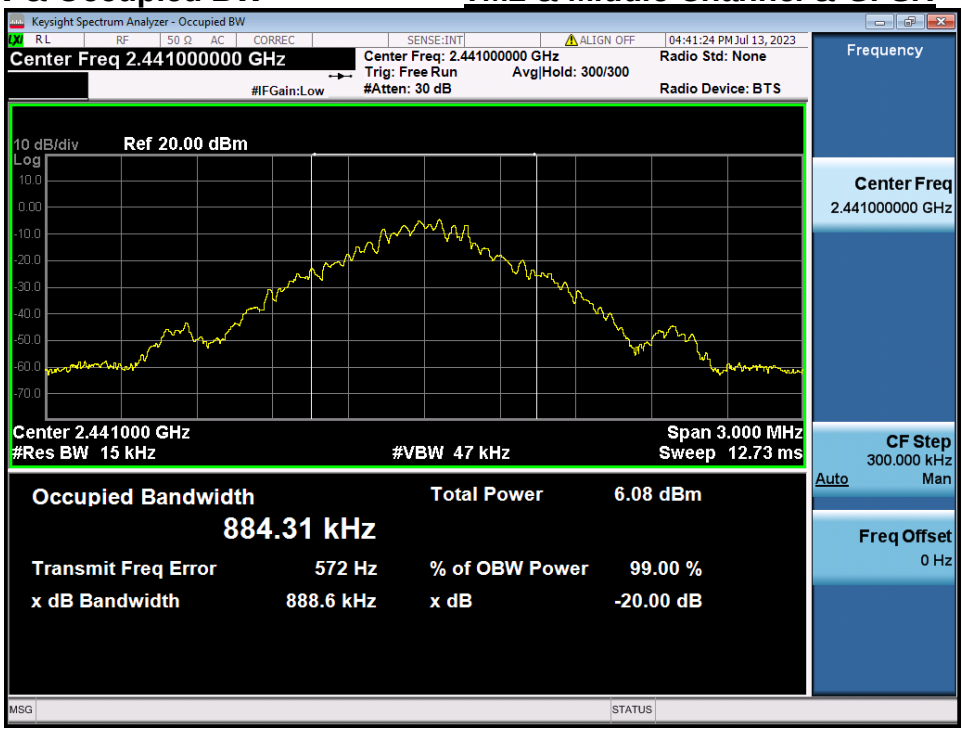
20 dB BW & Occupied BW *TM1 & Highest Channel & 8DPSK*



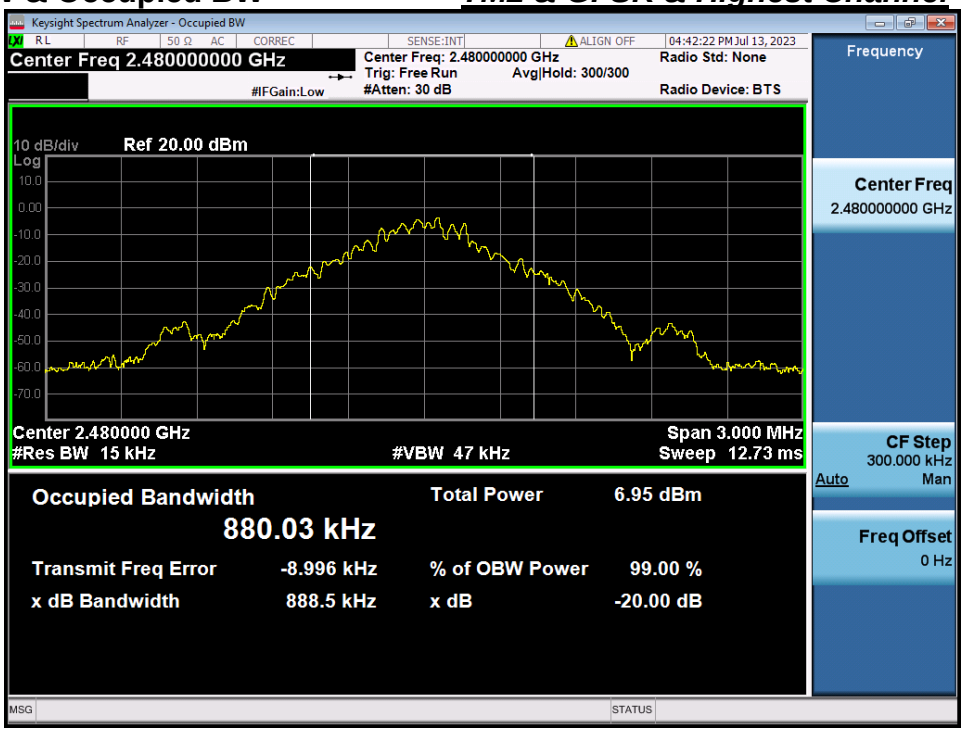
20 dB BW & Occupied BW *TM2 & Lowest Channel & GFSK*



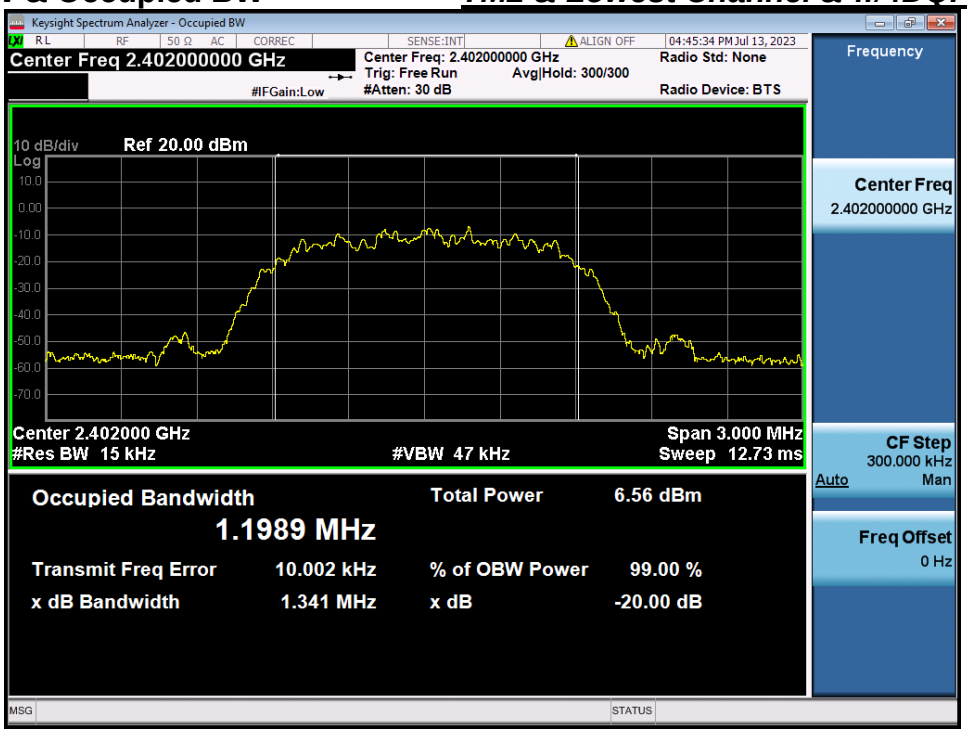
20 dB BW & Occupied BW *TM2 & Middle Channel & GFSK*



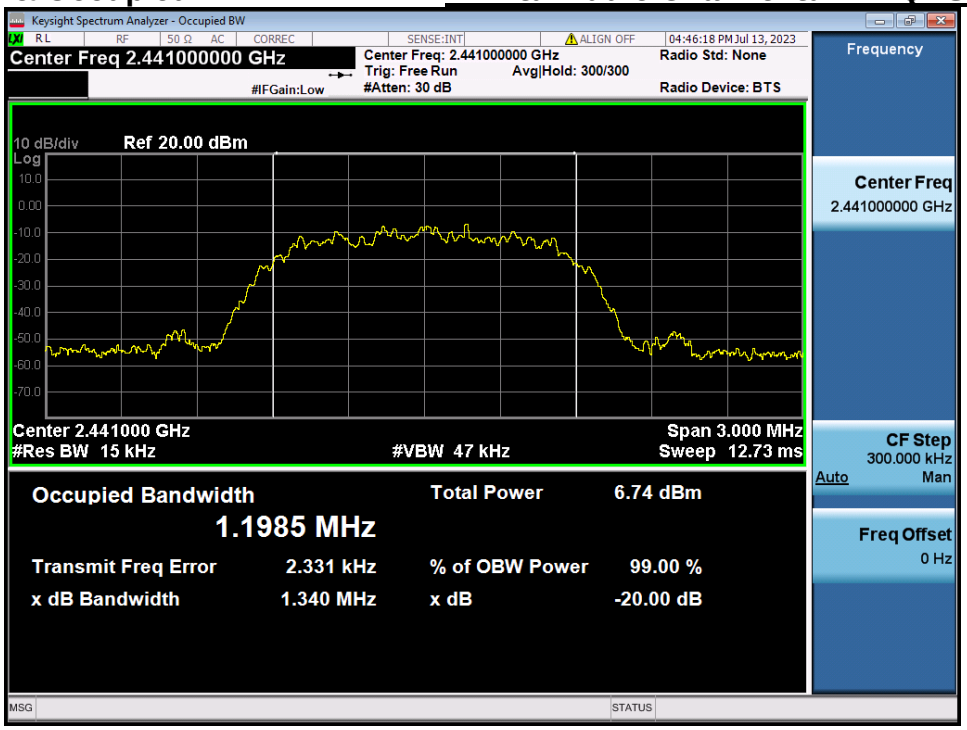
20 dB BW & Occupied BW ***TM2 & GFSK & Highest Channel***



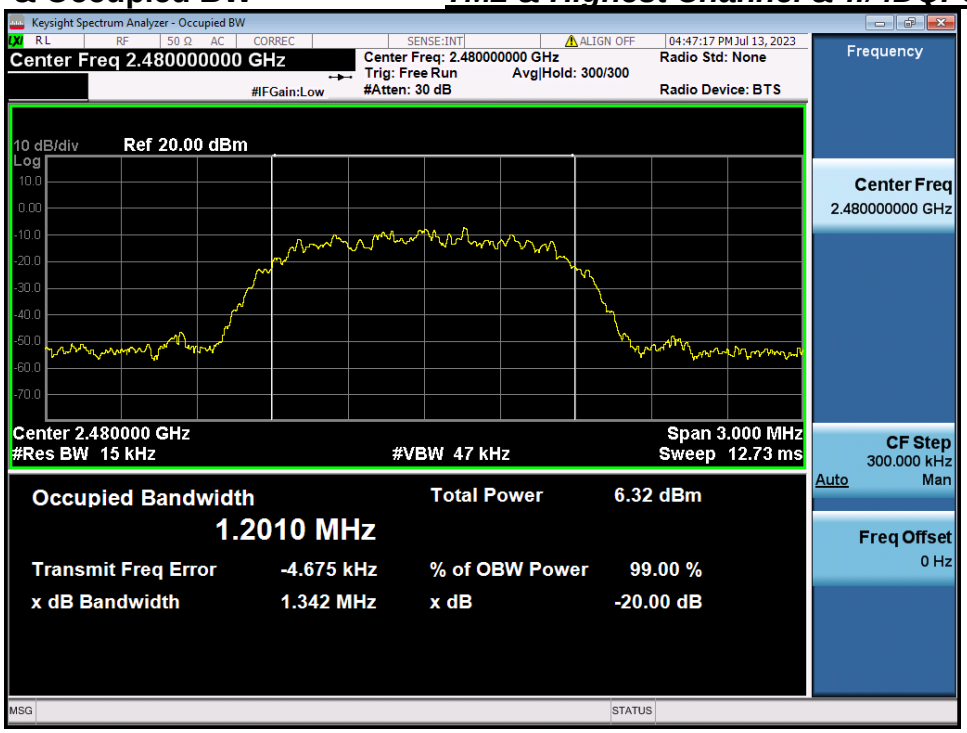
20 dB BW & Occupied BW ***TM2 & Lowest Channel & π/4DQPSK***



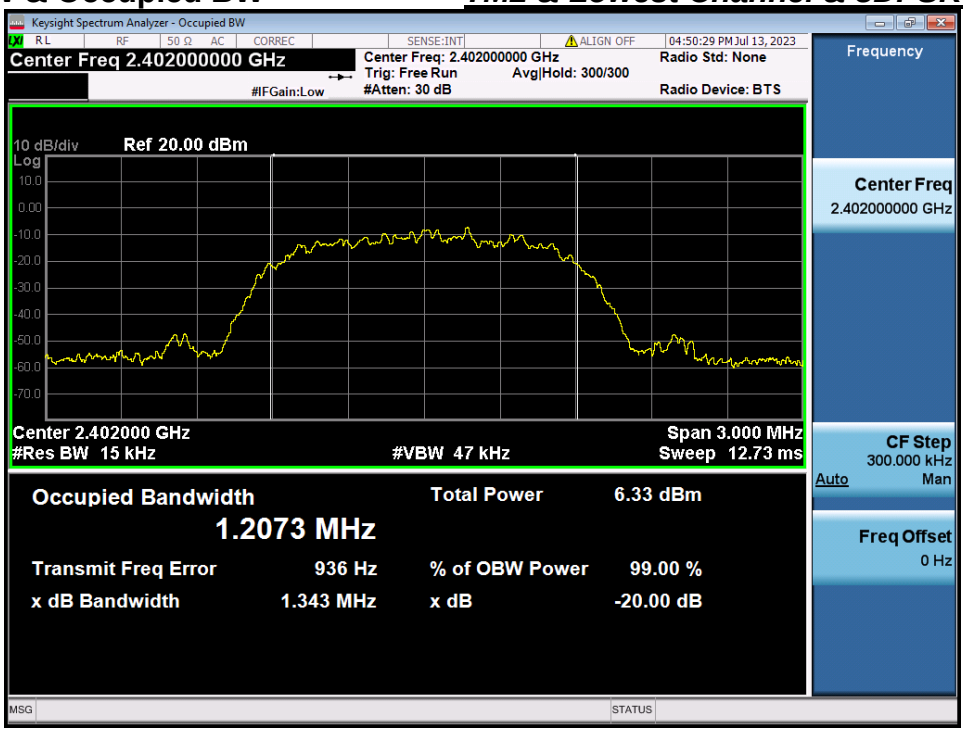
20 dB BW & Occupied BW ***TM2 & Middle Channel & π/4DQPSK***



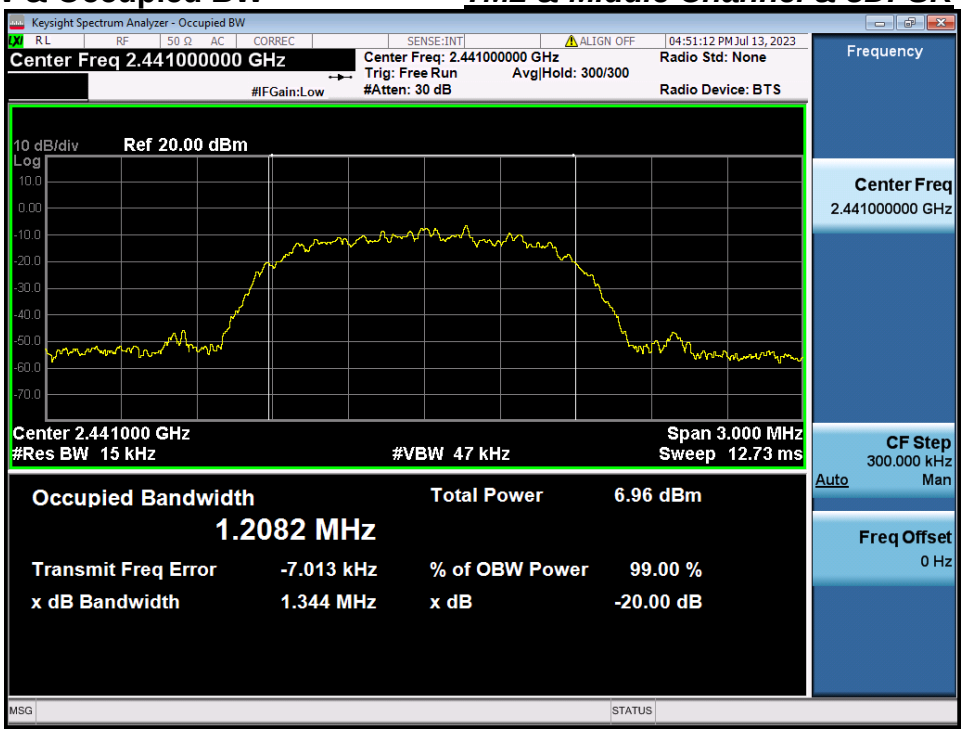
20 dB BW & Occupied BW ***TM2 & Highest Channel & π/4DQPSK***



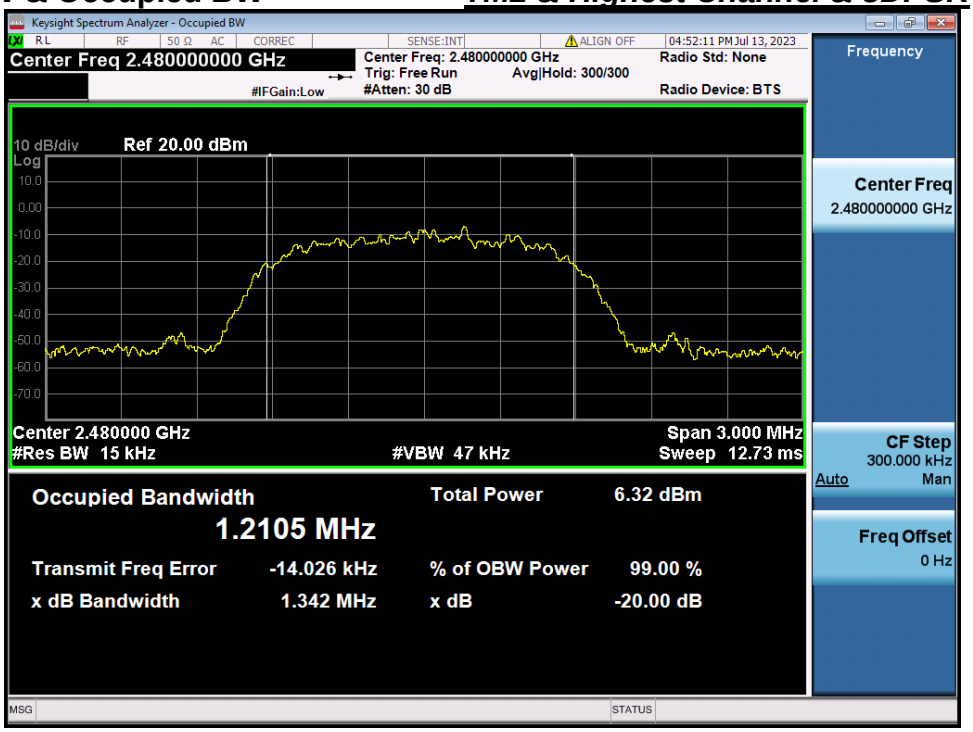
20 dB BW & Occupied BW *TM2 & Lowest Channel & 8DPSK*



20 dB BW & Occupied BW *TM2 & Middle Channel & 8DPSK*



20 dB BW & Occupied BW *TM2 & Highest Channel & 8DPSK*



6. Carrier Frequency Separation

6.1. Test Setup

Refer to the APPENDIX I.

6.2. Limit

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

6.3. Test 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 ≥ RBW Sweep = auto
Detector function = peak Trace = max hold

6.4. Test Results

FH mode

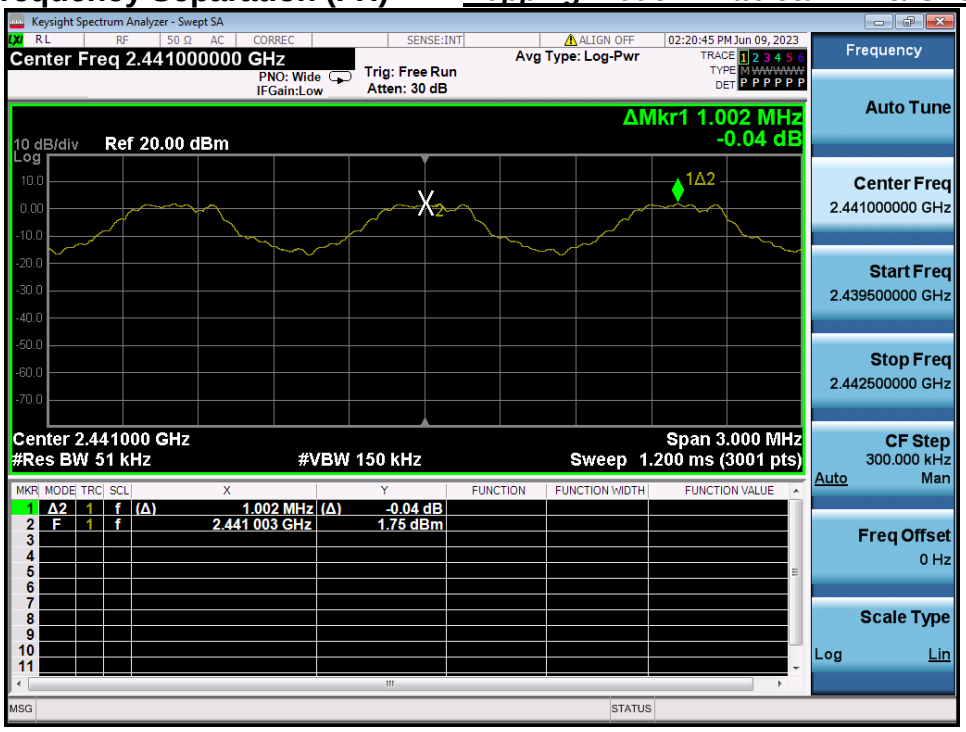
Hopping Mode	Modulation	Peak of reference channel(MHz)	Peak of adjacent Channel(MHz)	Test Result (MHz)
Enable	GFSK	2 441.003	2 442.005	1.002
	π/4DQPSK	2 441.002	2 442.006	1.004
	8DPSK	2 441.003	2 442.004	1.001

AFH mode

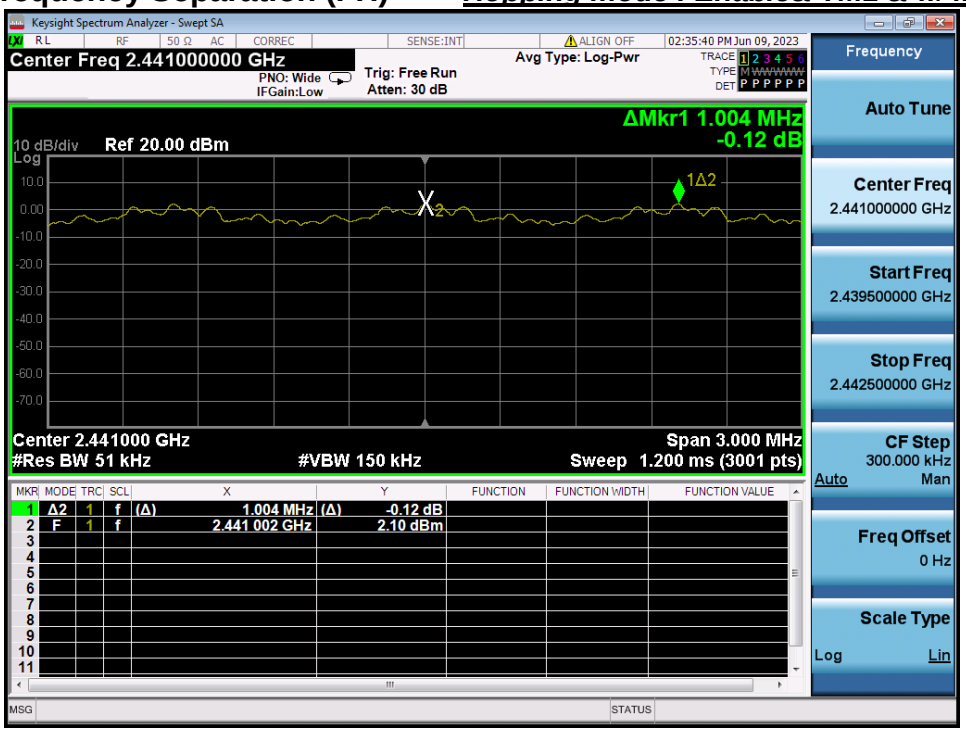
Hopping Mode	Modulation	Peak of reference channel(MHz)	Peak of adjacent Channel(MHz)	Test Result (MHz)
Enable	GFSK	2 441.005	2 442.001	0.996
	π/4DQPSK	2 441.002	2 442.002	1.000
	8DPSK	2 441.002	2 442.002	1.000

Note 1 : See next pages for actual measured spectrum

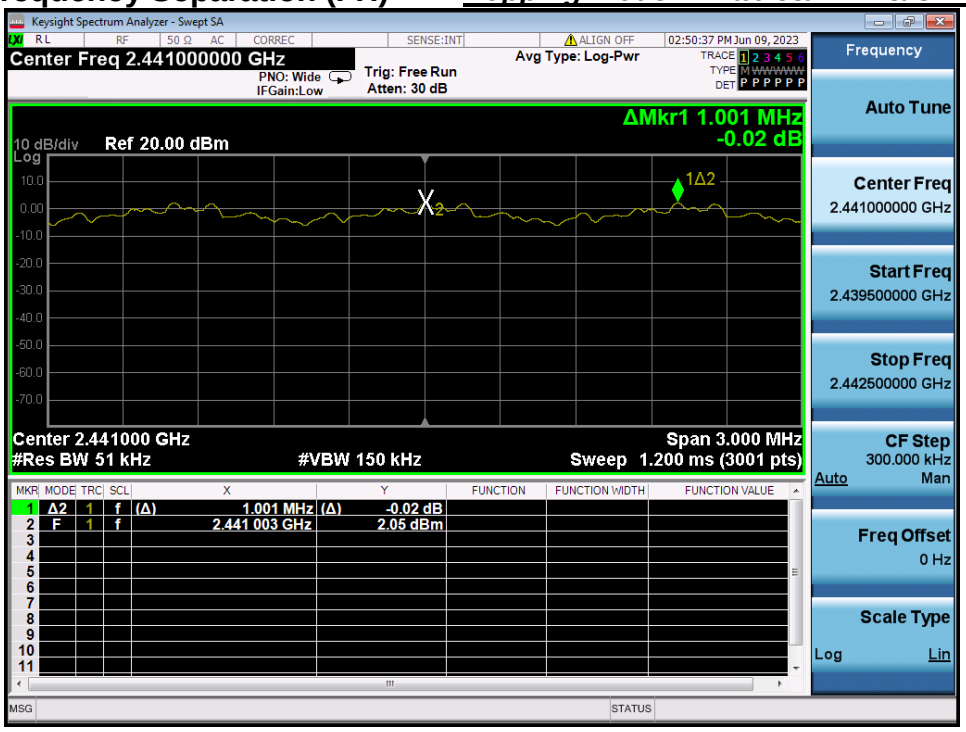
Carrier Frequency Separation (FH) ***Hopping mode : Enable& TM1 & GFSK***



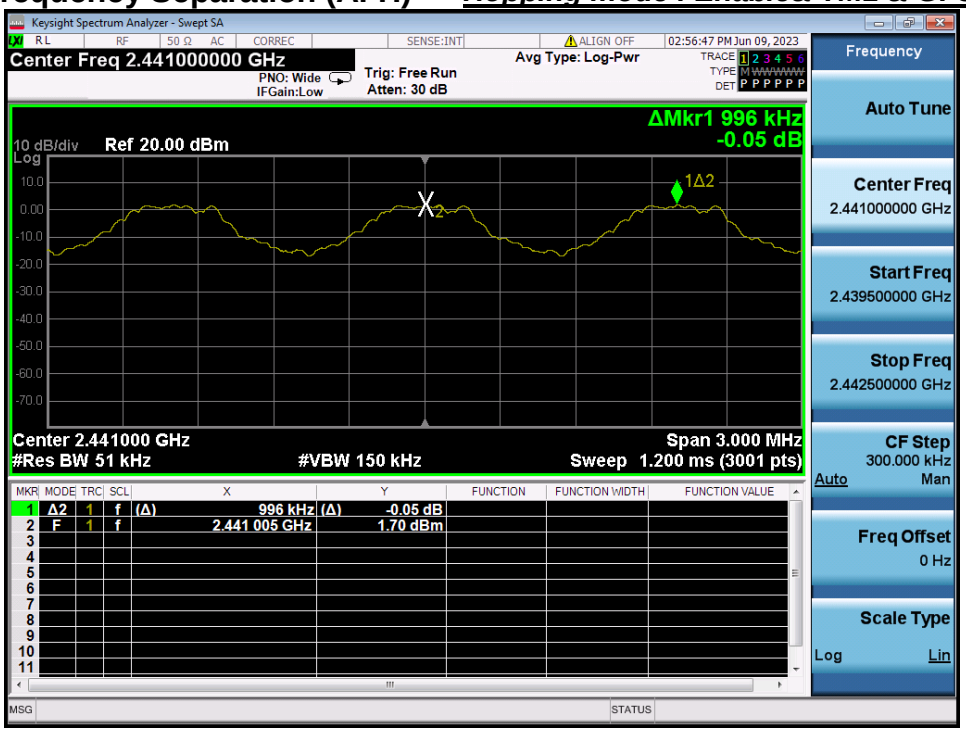
Carrier Frequency Separation (FH) ***Hopping mode : Enable& TM1 & π/4DQPSK***



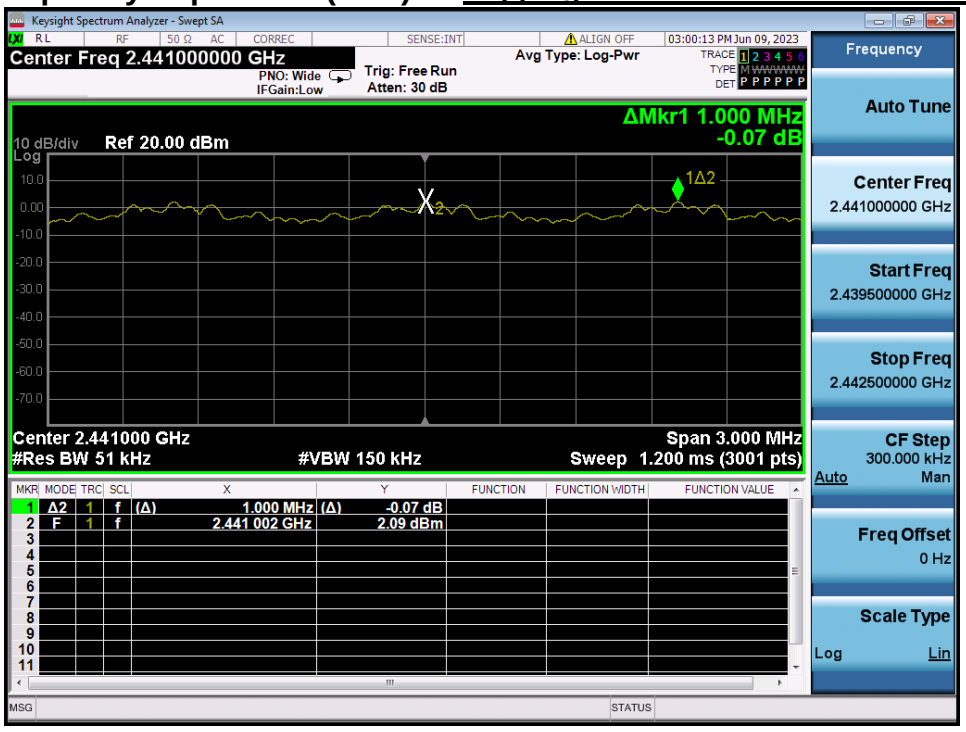
Carrier Frequency Separation (FH) ***Hopping mode : Enable& TM1 & 8DPSK***



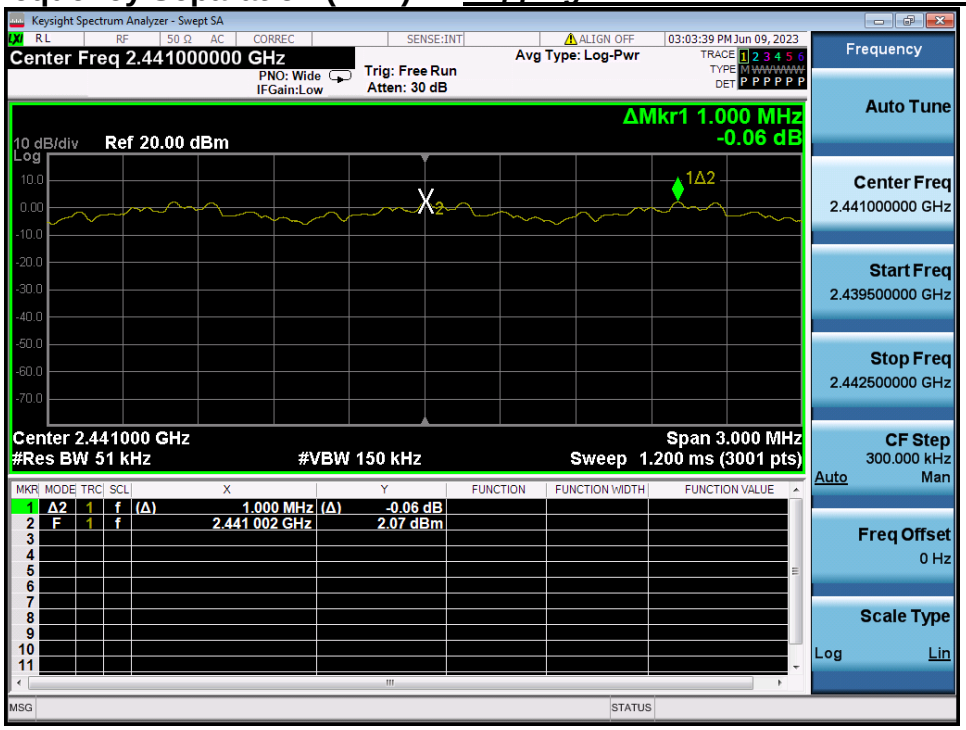
Carrier Frequency Separation (AFH) ***Hopping mode : Enable& TM1 & GFSK***



Carrier Frequency Separation (AFH) ***Hopping mode : Enable& TM1 & π/4DQPSK***



Carrier Frequency Separation (AFH) ***Hopping mode : Enable& TM1 & 8DPSK***



7. Number of Hopping Channels

7.1. Test Setup

Refer to the APPENDIX I.

7.2. Limit

Limit : >= 15 hops

7.3. Test 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 ≥ RBW Sweep = auto
Detector function = peak Trace = max hold

7.4. Test Results

FH mode

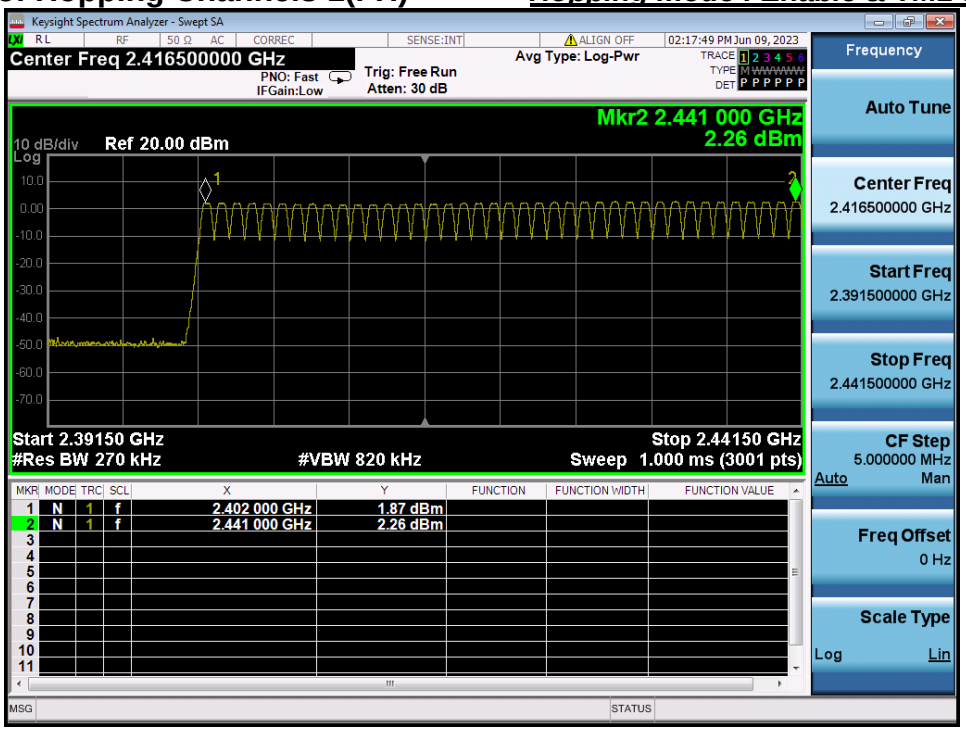
Hopping mode	Modulation	Test Result (Total Hops)
Enable	GFSK	79
	π/4DQPSK	79
	8DPSK	79

AFH mode

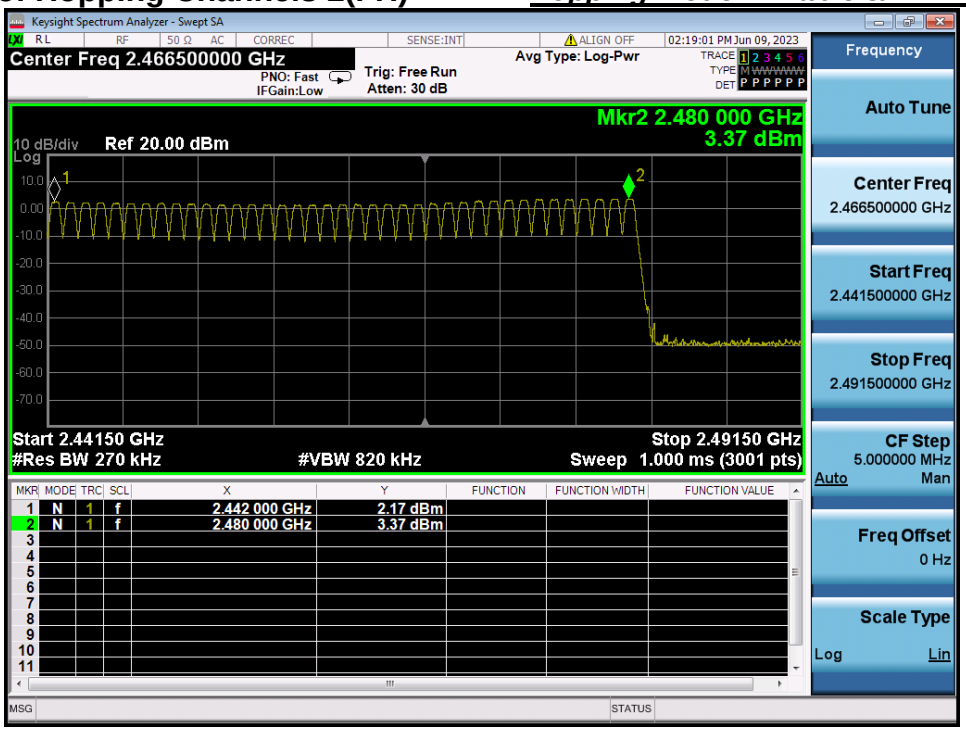
Hopping mode	Modulation	Test Result (Total Hops)
Enable	GFSK	20
	π/4DQPSK	20
	8DPSK	20

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

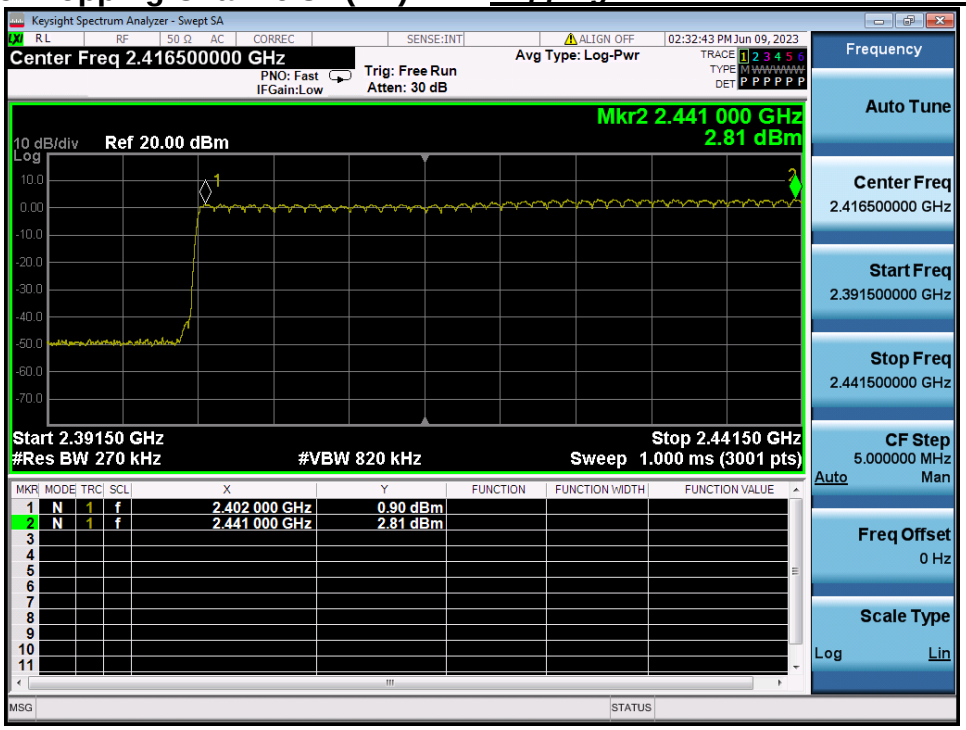
Number of Hopping Channels 1(FH) ***Hopping mode : Enable & TM1 & GFSK***



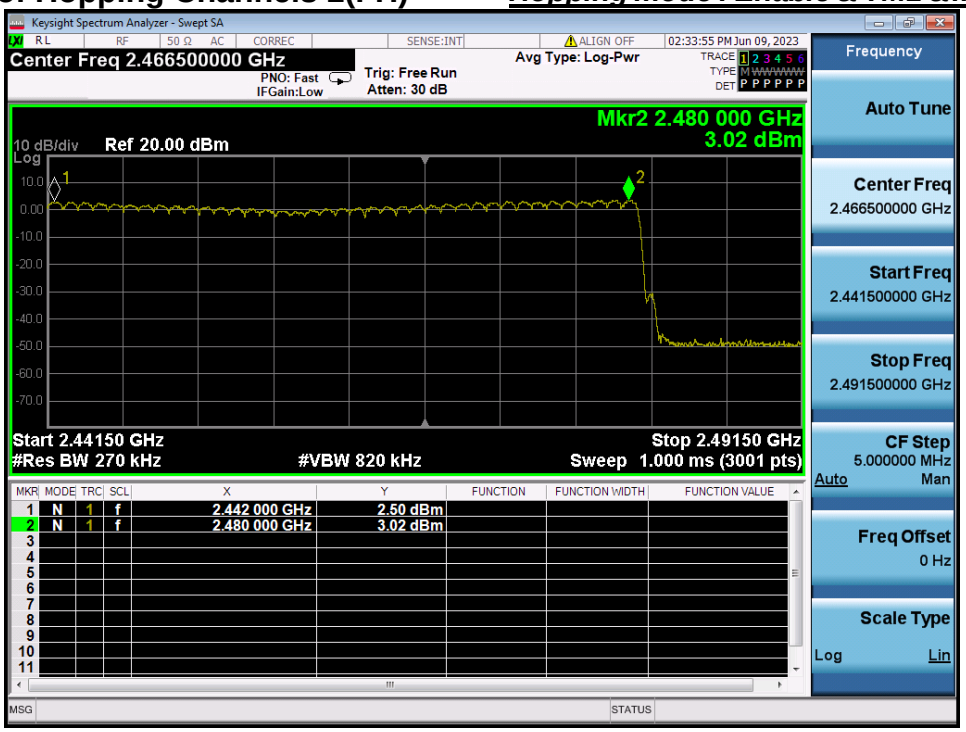
Number of Hopping Channels 2(FH) ***Hopping mode : Enable & TM1 & GFSK***



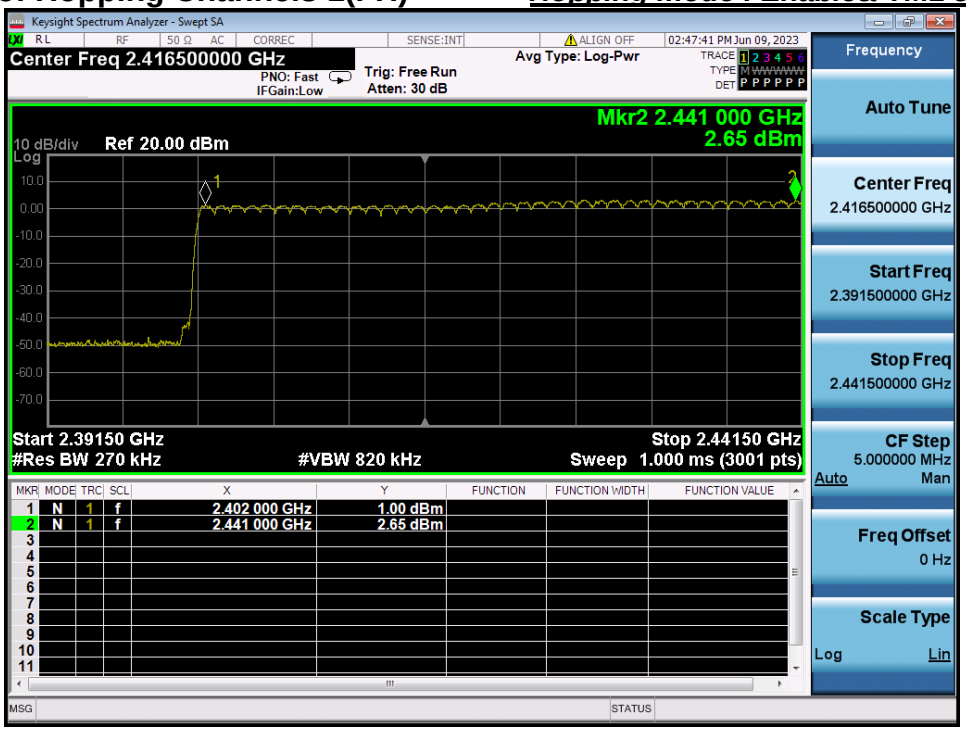
Number of Hopping Channels 1(FH) ***Hopping mode : Enable & TM1 & π/4DQPSK***



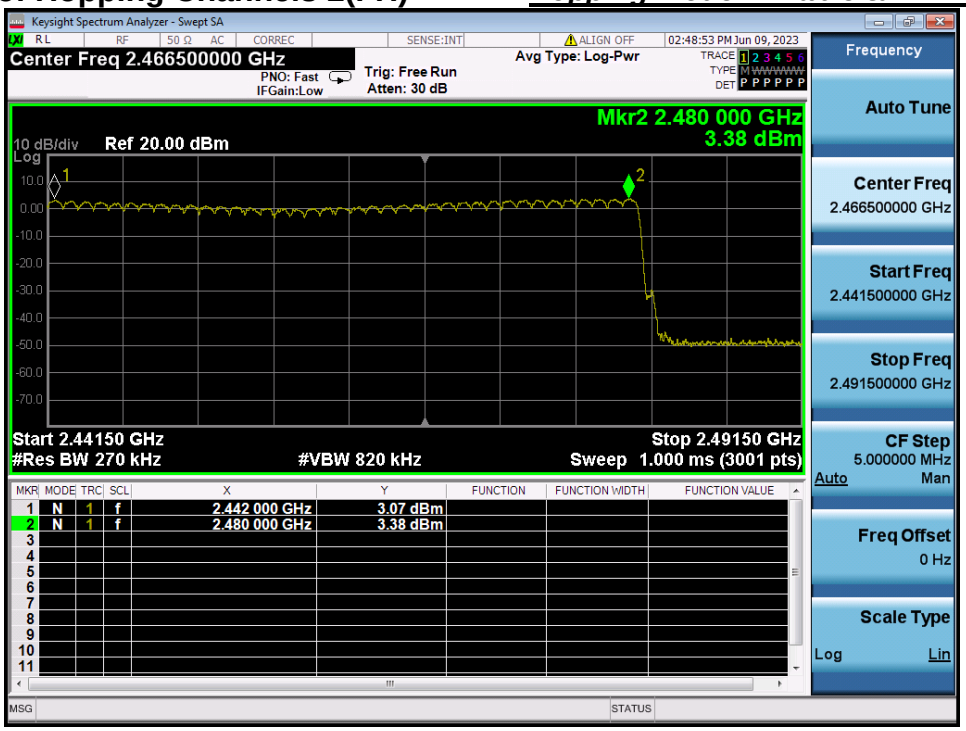
Number of Hopping Channels 2(FH) ***Hopping mode : Enable & TM1 &π/4DQPSK***



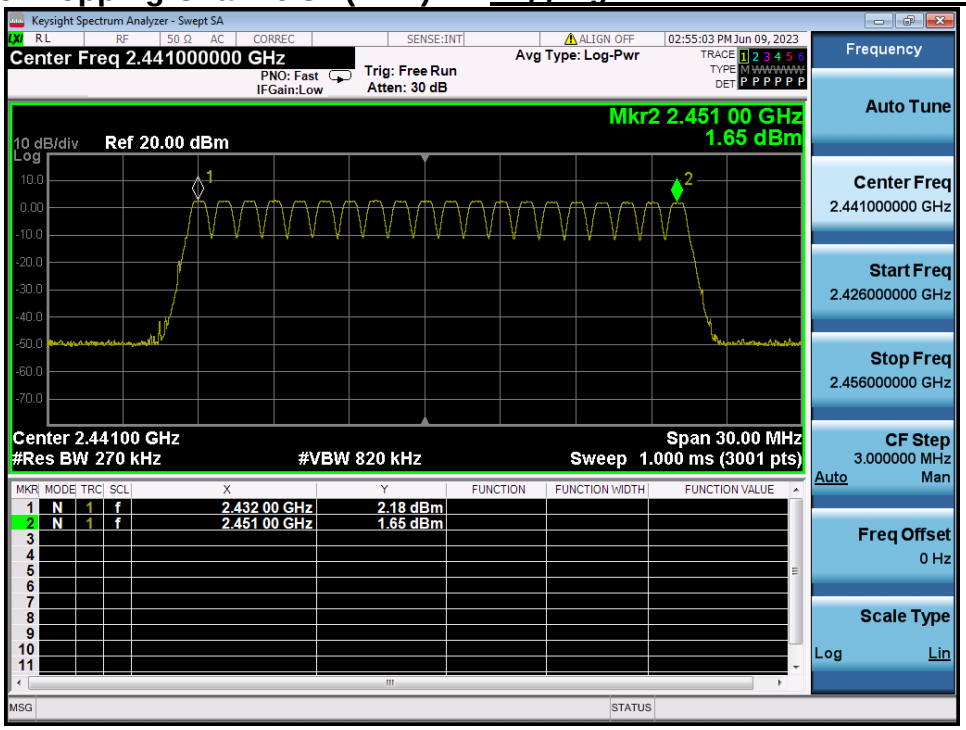
Number of Hopping Channels 1(FH) ***Hopping mode : Enable& TM1 &8DPSK***



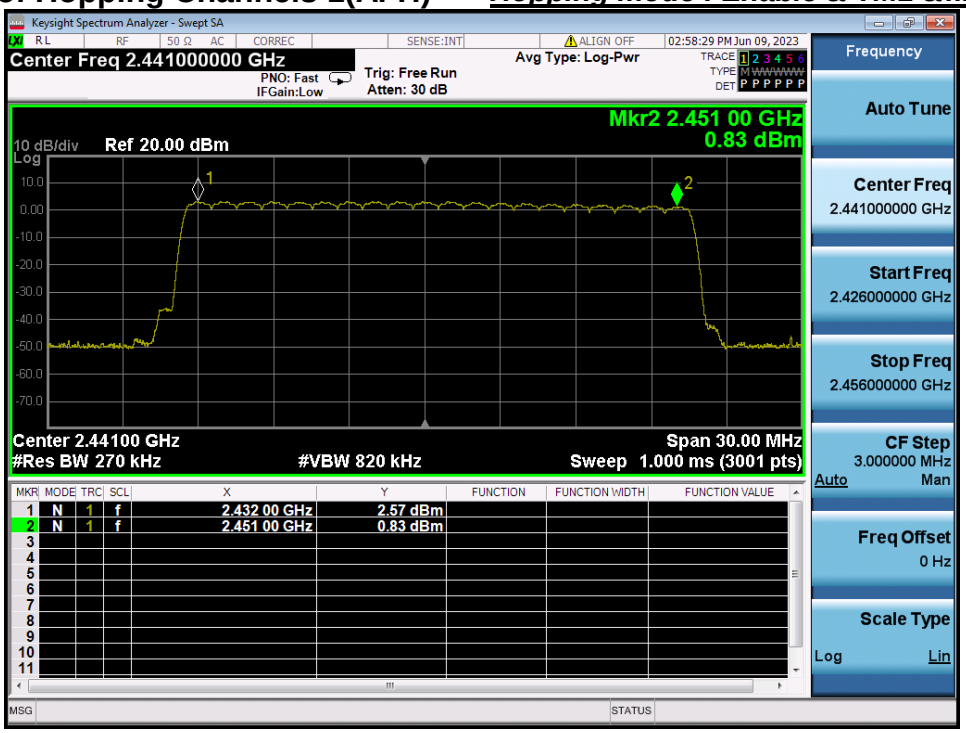
Number of Hopping Channels 2(FH) ***Hopping mode : Enable & TM1 & 8DPSK***



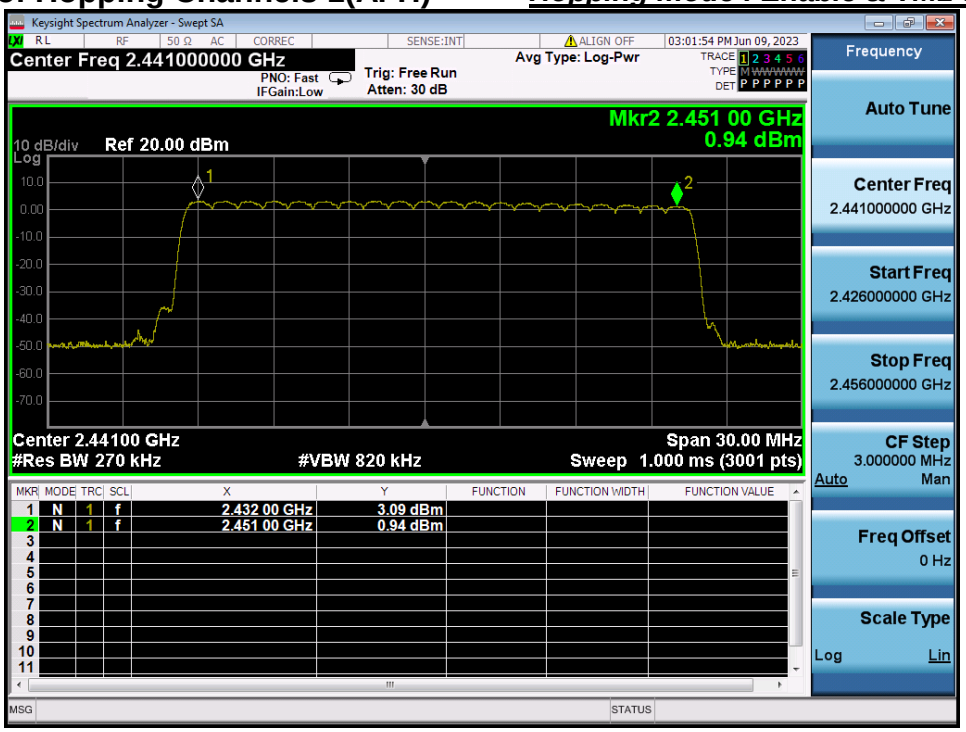
Number of Hopping Channels 1(AFH) ***Hopping mode : Enable & TM1 &GFSK***



Number of Hopping Channels 1(AFH) ***Hopping mode : Enable & TM1 &π/4DQPSK***



Number of Hopping Channels 1(AFH) ***Hopping mode : Enable & TM1 & 8DPSK***



8. Time of Occupancy

8.1. Test Setup

Refer to the APPENDIX I.

8.2. Limit

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

8.3. 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 ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel)

VBW ≥ RBW Detector function = peak

Trace = max hold

8.4. 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 × Hopping channel × Burst ON time ×
((Hopping rate ÷ Time slots) ÷ Hopping channel)

- Time slots for DH5 = 6 slots (TX = 5 slots / RX = 1 slot)
- Hopping Rate = 1 600 for FH mode & 800 for AFH mode

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