RADIO TEST REPORT
FCC 47 CFR PART 15 SUBPART C

Test Standard	**FCC Part 15.247**
Product name	**802.11b/g/n + BT 5.4 Module**
Brand Name	**USI**
Model No.	**WM-CW-26**
Test Result	**Pass**
Statements of Conformity	**Determination of compliance is based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.**

The test Result was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were given in ANSI C63.10: 2013 and compliance standards.

The test results of this report relate only to the tested sample (EUT) identified in this report.
The test Report of full or partial shall not copy. Without written approval of Compliance Certification Services Inc.(Wugu Laboratory)

Approved by:

Sehni Hu
Supervisor

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.
除非另有說明，此報告結果僅對測試之樣品負責，同時此樣品僅保留90天。本報告未經本公司書面許可，不可部份複製。
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Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	June 17, 2024	Initial Issue	ALL	Peggy Tsai
01	July 3, 2024	See the following Note Rev.(01)	P.8, 10, 11, 23, 30, 32, 36, 38, 43, 46, 79, 80, A-2, A-3	Peggy Tsai
02	July 10, 2024	See the following Note Rev.(02)	P. 14, 31, A-3-A-5	Peggy Tsai

Note:
Rev.(01)
1. Modify instrument calibration in section 1.7.
2. Modify support and EUT accessories equipment in section 1.8.
3. Modify test set up diagram in section 1.9.
4. Modify test program in section 1.10.
5. Modify test setup in section 4.2.3, 4.3.3, 4.4.3, 4.5.3, 4.6.3 and 4.7.3.
6. Modify test result in section 4.7.4.
7. Modify test result in section 4.8.4.
8. Modify test photo in appendix-A.

Rev.(02)
1. Modify the worst mode of measurement in section 3.2.
2. Modify test result in section 4.3.4.
3. Modify test photo in appendix-A.

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1. GENERAL INFORMATION

1.1 EUT INFORMATION

Applicant	Universal Global Scientific Industrial Co., Ltd. No. 141, Lane 351, Sec.1, Taiping Road, Tsaotuen, Nantou County, 542007, Taiwan
Manufacturer	Universal Global Scientific Industrial Co., Ltd. No. 141, Lane 351, Sec.1, Taiping Road, Tsaotuen, Nantou County, 542007, Taiwan
Equipment	802.11b/g/n + BT 5.4 Module
Model No.	WM-CW-26
Model Discrepancy	N/A
Trade Name	USI
Received Date	May 3, 2024
Date of Test	May 13 ~ 24, 2024
Power Operation	Power from Power supply: DC 3.6V
EUT Serial #	850160081201240307000010 32
HW Version	v1.0
FW Version	v7.95.55

Remark:
1. For more details, please refer to the User's manual of the EUT.
2. Disclaimer: Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.

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1.2 INFORMATION ABOUT THE FHSS CHARACTERISTICS

1.2.1 Pseudorandom Frequency Hopping Sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master. The channel is divided into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The nominal hop rate is 1 600 hops/s.

1.2.2 Equal Hopping Frequency Use

The channels of this system will be used equally over the long-term distribution of the hopsets.

1.2.3 Example of a 79 hopping sequence in data mode:

02, 05, 31, 24, 20, 10, 43, 36, 30, 23, 40, 06, 21, 50, 44, 09, 71, 78, 01, 13, 73, 07, 70, 72, 35, 62, 42, 11, 41, 08, 16, 29, 60, 15, 34, 61, 58, 04, 67, 12, 22, 53, 57, 18, 27, 76, 39, 32, 17, 77, 52, 33, 56, 46, 37, 47, 64, 49, 45, 38, 69, 14, 51, 26, 79, 19, 28, 65, 75, 54, 48, 03, 25, 66, 05, 16, 68, 74, 59, 63, 55

1.2.4 System Receiver Input Bandwidth

Each channel bandwidth is 1MHz.
The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

1.2.5 Equipment Description

The Rx input bandwidths shift frequencies in synchronization with the transmitted signals.
In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in standard when the transmitter is presented with a continuous data (or information) system.
In accordance with the Bluetooth Industry Standard, the system does not coordinate it 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.

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1.3 EUT CHANNEL INFORMATION

Frequency Range	2402MHz-2480MHz
Modulation Type	1. GFSK for BDR-1Mbps 2. π/4-DQPSK for EDR-2Mbps 3. 8DPSK for EDR-3Mbps
Number of channel	79 Channels

Remark:
Refer as ANSI C63.10: 2013 clause 5.6.1 Table 4 for test channels

Number of frequencies to be tested		
Frequency range in which device operates	**Number of frequencies**	**Location in frequency range of operation**
☐ 1 MHz or less	1	Middle
☐ 1 MHz to 10 MHz	2	1 near top and 1 near bottom
☒ More than 10 MHz	3	1 near top, 1 near middle, and 1 near bottom

1.4 ANTENNA INFORMATION

Antenna Type	☐ PIFA ☐ PCB ☐ Dipole ☒ Ceramic Chip Antenna
Antenna Gain	Yageo / ANT3216LL11R2400A Gain: 3.68 dBi
Antenna Connector	N/A

Notes:
1.The antenna(s) of the EUT are permanently attached and there are no provisions for connection to an external antenna. So the EUT complies with the requirements of §15.203.

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1.5 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
AC Powerline Conducted Emission	± 2.213 dB
Channel Bandwidth	± 2.7 %
RF output power (Power Meter + Power sensor)	± 0.243 dB
Power Spectral density	± 2.739 dB
Conducted Bandedge	± 2.739 dB
Conducted Spurious Emission	± 2.742 dB
Radiated Emission_9kHz-30MHz	± 3.761 dB
Radiated Emission_30MHz-200MHz	± 3.473 dB
Radiated Emission_200MHz-1GHz	± 3.946 dB
Radiated Emission_1GHz-6GHz	± 4.797 dB
Radiated Emission_6GHz-18GHz	± 4.803 dB
Radiated Emission_18GHz-26GHz	± 3.459 dB
Radiated Emission_26GHz-40GHz	± 3.297 dB

Remark:
1.This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2
2. ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report.

1.6 FACILITIES AND TEST LOCATION

All measurement facilities used to collect the measurement data are located at

☒ No.11, Wugong 6th Rd., Wugu Dist., New Taipei City, Taiwan.

CAB identifier: TW1309

Test site	Test Engineer	Remark
AC Conduction Room	Czerny Lin	-
Radiation	Tony Chao、Ray Li	-
RF Conducted	Marco Chan	-

Remark: The lab has been recognized as the FCC accredited lab. under the KDB 974614 D01 and is listed in the FCC pubic Access Link (PAL) database, FCC Registration No. :444940, the FCC Designation No.:TW1309

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1.7 INSTRUMENT CALIBRATION

Conducted_FCC/IC/NCC (All)					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Power Sensor	Anritsu	MA2411B	1911387	2023-07-25	2024-07-24
Power Meter	Anritsu	ML2496A	2136002	2023-11-16	2024-11-15
Cable	Woken	WC12	CC003	2023-06-27	2024-06-26
EXA Signal Analyzer	Keysight	N9030B	MY62291089	2023-10-13	2024-10-12
Power Supply	ABM	GPC-3030D	8070184	2023-10-02	2024-10-01
Software	Radio Test Software Ver. 21				

966A_Radiated					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Signal Analyzer	KEYSIGHT	N9010A	MY54200716	2023-10-13	2024-10-12
Thermo-Hygro Meter	WISEWIND	1206	D07	2023-12-08	2024-12-07
Loop Antenna	COM-POWER	AL-130	121051	2023-05-23	2024-05-22
Bi-Log Antenna	Sunol Sciences	JB3	A030105	2023-08-08	2024-08-07
Preamplifier	EMEC	EM330	060609	2024-02-21	2025-02-20
Cable	Huber+Suhner	104PEA	20995+21000+182330	2024-02-21	2025-02-20
Horn Antenna	ETC	MCTD 1209	DRH13M02003	2023-12-28	2024-12-27
Preamplifier	HP	8449B	3008A00965	2023-12-22	2024-12-21
Cable	EMCI	EMC101G	221213+221011+221012	2023-10-17	2024-10-16
Attenuator	Mini-Circuits	BW-S9W5	BWS9W5-09-966A-01	2024-02-07	2025-02-06
High Pass Filters	Titan Microwave	T04H30001800070S01	22011402-4	2023-06-17	2024-06-16
Horn Antenna	SCHWARZBECK	BBHA9170	1047	2023-12-13	2024-12-12
Pre-Amplifier	EMCI	EMC184045SE	980860	2023-12-12	2024-12-11
DC Power Supply	ABM	9603D	D011314	2023-10-02	2024-10-01
Turn Table	CCS	CC-T-1F	N/A	N.C.R	N.C.R
Controller	CCS	CC-C-1F	N/A	N.C.R	N.C.R
Antenna Tower	CCS	CC-A-1F	N/A	N.C.R	N.C.R
Site Validation	CCS	966A	N/A	2023-07-10	2024-07-09
Software	e3 V9-210616c				

Remark:
1. Each piece of equipment is scheduled for calibration once a year.
2. N.C.R. = No Calibration Required.

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AC Mains Conduction					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
EMI Test Receiver	R&S	ESCI	100064	2023-06-07	2024-06-06
LISN	TESEQ	LN2-16N	22012	2024-02-29	2025-02-27
Cable	EMCI	CFD300-NL	CERF	2023-06-27	2024-06-26
Power Supply	GWINISTEK	SPS-3610	GPE880163	2023-10-16	2024-10-15
Software	e3 V6-110812				

Remark:
1. Each piece of equipment is scheduled for calibration once a year.
2. N.C.R. = No Calibration Required.

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1.8 SUPPORT AND EUT ACCESSORIES EQUIPMENT

EUT Accessories Equipment						
No.	Equipment	Brand	Model	Series No.	FCC ID	IC
A	Test Kitting	USI	WM-BN-BM-26_A_EVB	N/A	N/A	N/A

Support Equipment (Conducted)					
No.	Equipment	Brand	Model	Series No.	FCC ID
1	NB(L)	Lenovo	X260	N/A	N/A
2	Adapter	Lenovo	ADLX45DLC3A	N/A	N/A
3	Mini USB	RS Pro	2369084	N/A	N/A
4	DC Cable	MISUMI	MCR3S-RE	N/A	N/A

Support Equipment (RSE, Co-Location)					
No.	Equipment	Brand	Model	Series No.	FCC ID
1	NB(D)	Lenovo	ThinkPad X260	N/A	N/A
2	Adapter	Lenovo	ADLX45DLC3A	N/A	N/A
3	Mini USB	RS Pro	2369084	N/A	N/A
4	Micro USB	StarTech.	UUSBHAUB3M	N/A	N/A
B	SDIO adapter card	USI	USB TO SDIO CARD	N/A	N/A

Support Equipment (Conduction)					
No.	Equipment	Brand	Model	Series No.	FCC ID
1	NB(D)	Lenovo	ThinkPad X260	N/A	N/A
2	Adapter	Lenovo	ADLX45DLC3A	N/A	N/A
3	Mini USB	RS Pro	2369084	N/A	N/A
4	DC Cable	MISUMI	MCR3S-RE	N/A	N/A

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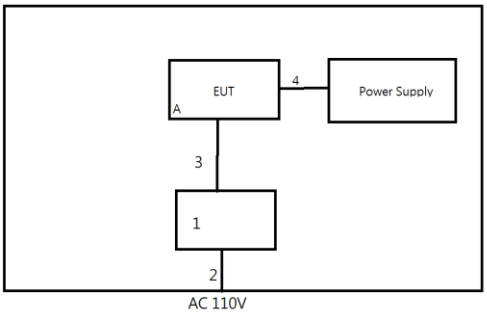
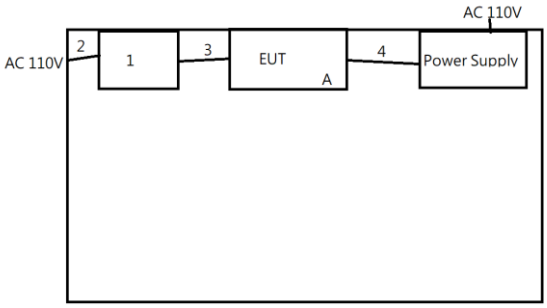
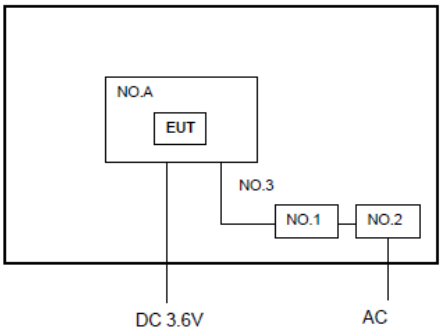
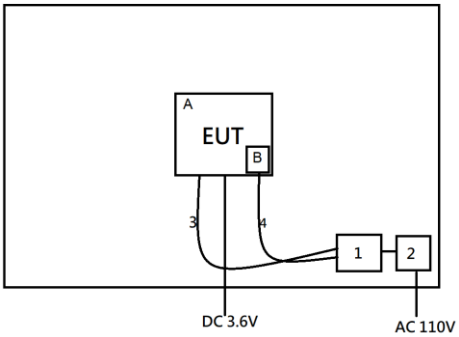
1.9 TEST SET UP DIAGRAM

Conducted	Conduction
	
RSE	**Co-Location**
	

1.10 TEST PROGRAM

The EUT connection corresponds to the surrounding fixture control board.
This EUT uses the Linux system setup command to set the frequency, modulation, and power to allow the sample to continuously transmit (including frequency hopping mode and Co-Location).

1.11 TEST METHODOLOGY AND APPLIED STANDARDS

The test methodology, setups and results comply with all requirements in accordance with ANSI C63.10:2013, FCC Part 2, FCC Part 15.247, KDB 558074.

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2. TEST SUMMERY

FCC Standard Section	Report Section	Test Item	Result
15.203	1.3	Antenna Requirement	Pass
15.207(a)	4.1	AC Conducted Emission	Pass
15.247(a)(1)	4.2	20 dB Bandwidth	Pass
-	4.2	Occupied Bandwidth (99%)	Pass
15.247(b)(1)	4.3	Output Power Measurement	Pass
15.247(a)(1)	4.4	Frequency Separation	Pass
15.247(a)(1)(iii)	4.5	Number of Hopping	Pass
15.247(d)	4.6	Conducted Band Edge	Pass
15.247(d)	4.6	Conducted Spurious Emission	Pass
15.247(a)(1)(iii)	4.7	Time of Occupancy	Pass
15.247(d) 15.205, 15.209	4.8	Radiation Band Edge	Pass
15.247(d) 15.205, 15.209	4.8	Radiation Spurious Emission	Pass

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3. DESCRIPTION OF TEST MODES

3.1 THE WORST MODE OF OPERATING CONDITION

Operation mode	GFSK for BDR-1Mbps (DH5) π/4-DQPSK for 2Mbps (2DH5) 8DPSK for EDR-3Mbps (3DH5)
Test Channel Frequencies	**GFSK for BDR-1Mbps:** 1.Lowest Channel: 2402MHz 2.Middle Channel: 2441MHz 3.Highest Channel: 2480MHz **π/4-DQPSK for 2Mbps:** 1.Lowest Channel: 2402MHz 2.Middle Channel: 2441MHz 3.Highest Channel: 2480MHz **8DPSK for EDR-3Mbps:** 1.Lowest Channel: 2402MHz 2.Middle Channel: 2441MHz 3.Highest Channel: 2480MHz

Remark:
1. EUT pre-scanned data rate of output power for each mode, the worst data rate were recorded in this report.
2.The system support GFSK ,π/4 DQPSK ,8DPSK , the π/4 DQPSK were reduced since the identical parameters with 8dpsk. In the following test items, number of hopping, conducted bandedge, radiated band edge and spurious emissions.

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3.2 THE WORST MODE OF MEASUREMENT

AC Power Line Conducted Emission	
Test Condition	AC Power line conducted emission for line and neutral
Power supply Mode	Mode 1: EUT Power by DC power Supply
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4

AC Power Line Conducted Emission [co-location]	
Test Condition	Radiated Emission [co-location]
Power supply Mode	Mode 1: Wi-Fi 2.4G+ BT BR
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4

Radiated Emission Measurement Above 1G	
Test Condition	Radiated Emission Above 1G
Power supply Mode	Mode 1: EUT power by Power supply
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4
Worst Position	☐ Placed in fixed position. ☒ Placed in fixed position at X-Plane (E2-Plane) ☐ Placed in fixed position at Y-Plane (E1-Plane) ☐ Placed in fixed position at Z-Plane (H-Plane)

Radiated Emission Measurement Below 1G	
Test Condition	Radiated Emission Below 1G
Power supply Mode	Mode 1: EUT power by Power supply
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4

Radiated Emission Measurement [co-location]	
Test Condition	Radiated Emission [co-location]
Power supply Mode	Mode 1: Wi-Fi 2.4G+ BT BR
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4

Remark:

1. The worst mode was record in this test report.
2. AC power line conducted emission and for below 1G radiation emission were performed the EUT transmit at the highest output power channel as worse case.
3. EUT pre-scanned in three axis ,X,Y, Z and two polarity, for radiated measurement. The worst case(X-Plane) were recorded in this report

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3.3 EUT DUTY CYCLE

Temperature: 23.5℃ **Test date:** May 13, 2024
Humidity: 59% RH **Tested by:** Marco Chan

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log (1/Duty Cycle)	1/T (kHz)	VBW setting (kHz)
DH1	30.40	5.17	2.63	3.00
DH3	65.60	1.83	0.61	1.00
DH5	77.20	1.12	0.35	1.00
2DH1	31.20	5.06	2.56	3.00
2DH3	65.60	1.83	0.61	1.00
2DH5	77.20	1.12	0.35	1.00
3DH1	31.20	5.06	2.56	3.00
3DH3	66.00	1.80	0.61	1.00
3DH5	76.80	1.15	0.35	1.00

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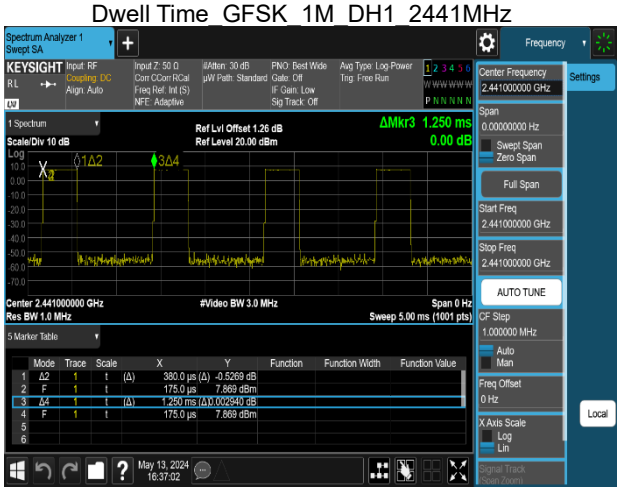
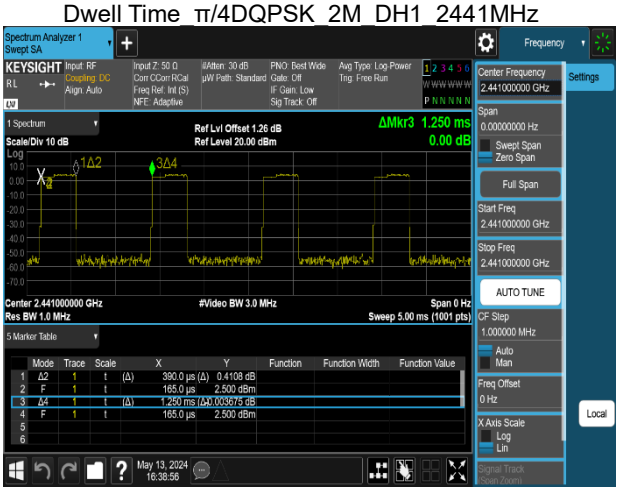
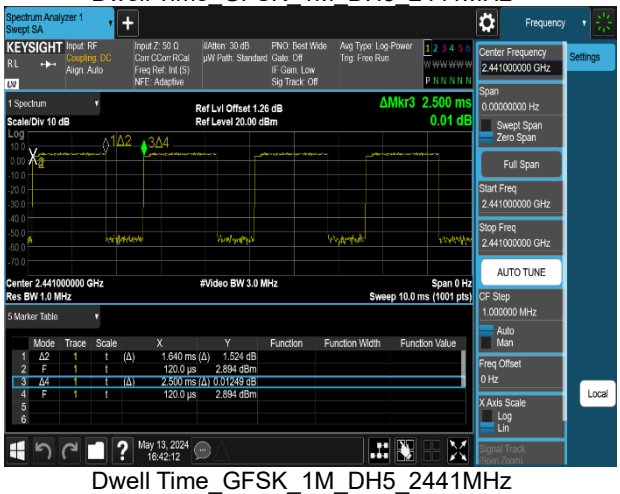
Dwell Time_GFSK_1M_DH1_2441MHz



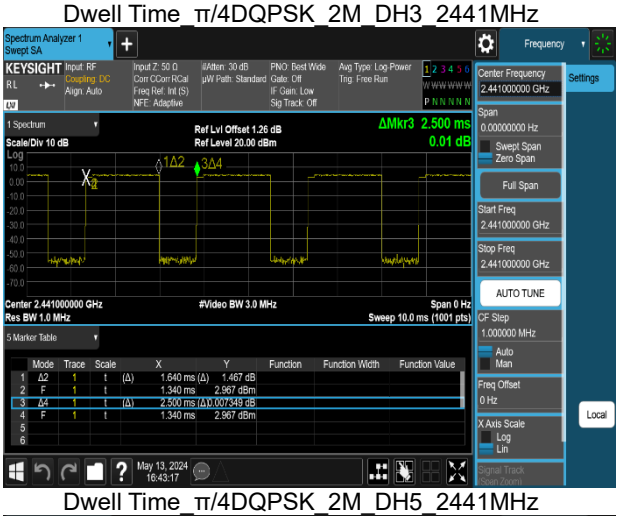
Dwell Time_π/4DQPSK_2M_DH1_2441MHz



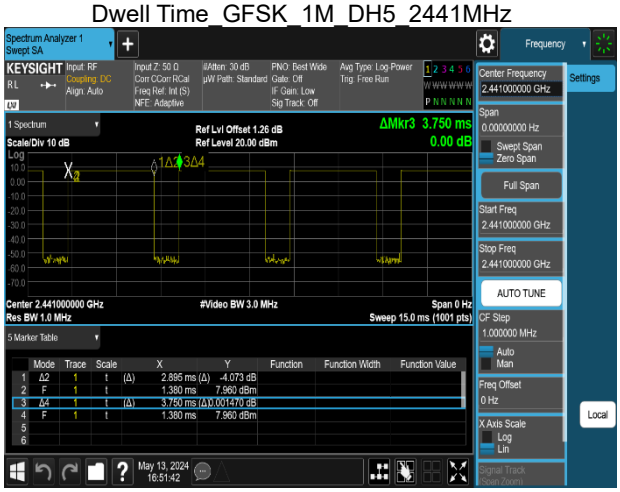
Dwell Time_GFSK_1M_DH3_2441MHz



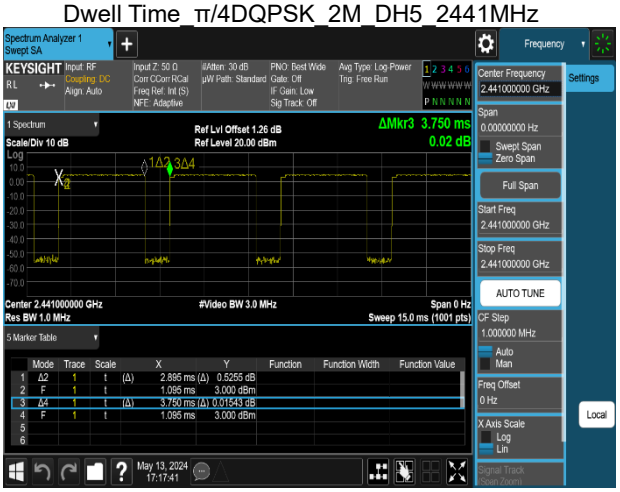
Dwell Time_π/4DQPSK_2M_DH3_2441MHz



Dwell Time_GFSK_1M_DH5_2441MHz



Dwell Time_π/4DQPSK_2M_DH5_2441MHz



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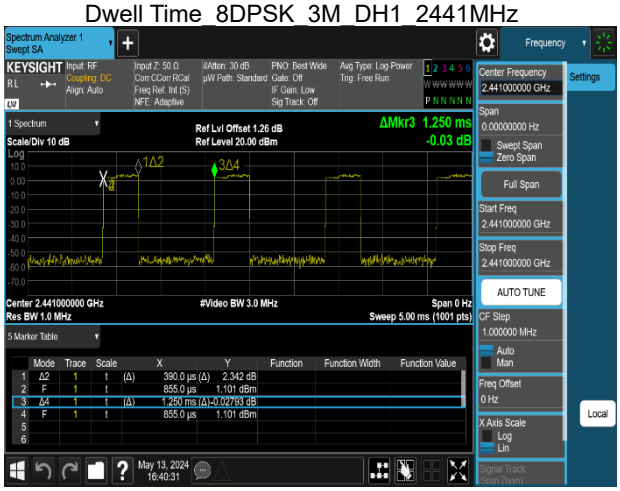
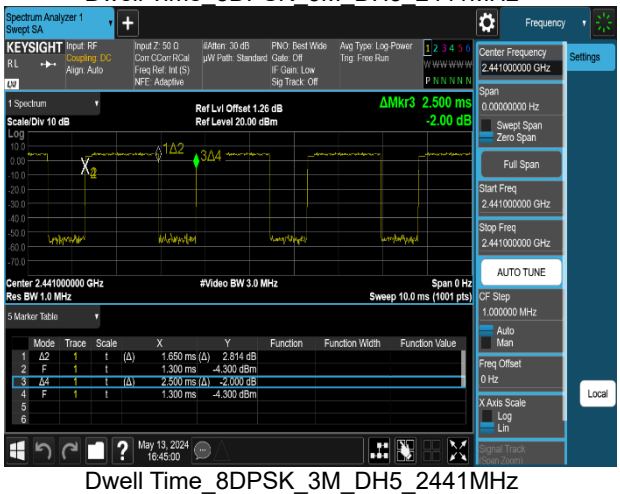
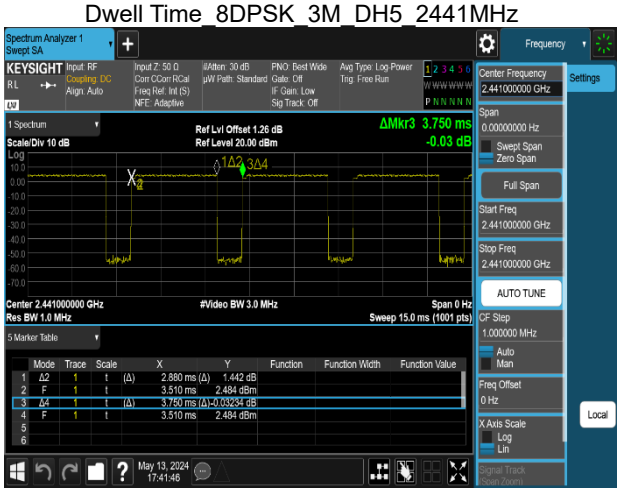
Dwell Time_8DPSK_3M_DH1_2441MHz



Dwell Time_8DPSK_3M_DH3_2441MHz



Dwell Time_8DPSK_3M_DH5_2441MHz



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4. TEST RESULT

4.1 AC POWER LINE CONDUCTED EMISSION

4.1.1 Test Limit

According to §15.207(a),

Frequency Range (MHz)	Limits(dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

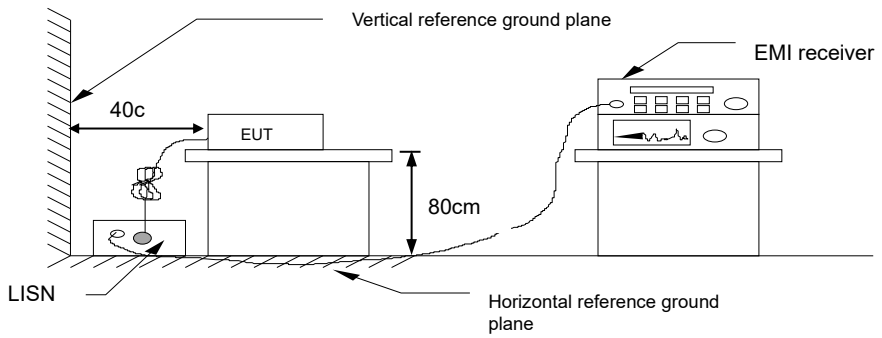
* Decreases with the logarithm of the frequency.

4.1.2 Test Procedure

Test method Refer as ANSI C63.10: 2013 clause 6.2,

1. The EUT was placed on a non-conducted table, which is 0.8m above horizontal ground plane and 0.4m above vertical ground plane.
2. EUT connected to the line impedance stabilization network (LISN)
3. Receiver set RBW of 9kHz and Detector Peak, and note as quasi-peak and average.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. Recorded Line for Neutral and Line.

4.1.3 Test Setup



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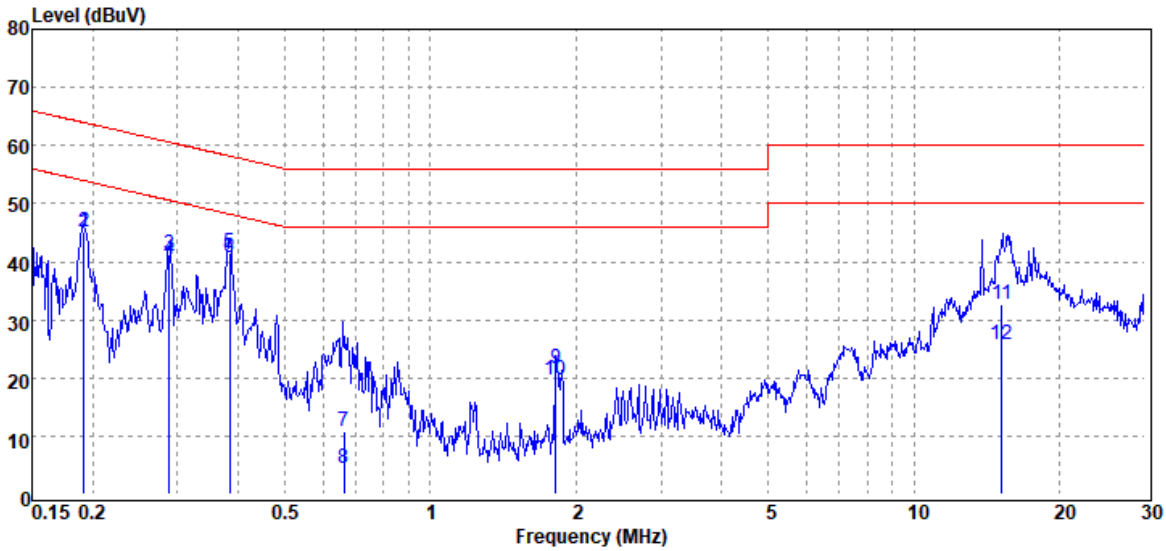
4.1.4 Test Result

Project No	: TM-2405000018P	Test Date	: 2024-05-24
Operation Mode	: BT	Temp./Humi.	: 24.1°C / 55%
Test Chamber	: Conduction	Engineer	: Czerny Lin
Probe	: LINE	Test Voltage	: AC 120V/60Hz
Note	:		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV	Limit dBµV	Margin dB
0.192	QP	45.10	0.15	45.25	63.94	-18.69
0.192	Average	44.85	0.15	45.00	53.94	-8.94
0.288	QP	41.18	0.15	41.33	60.58	-19.25
0.288	Average	40.30	0.15	40.45	50.58	-10.13
0.384	QP	41.32	0.15	41.47	58.19	-16.72
0.384	Average	40.43	0.15	40.58	48.19	-7.61
0.662	QP	10.71	0.16	10.87	56.00	-45.13
0.662	Average	4.27	0.16	4.43	46.00	-41.57
1.816	QP	21.38	0.21	21.59	56.00	-34.41
1.816	Average	19.58	0.21	19.79	46.00	-26.21
15.163	QP	32.09	0.45	32.54	60.00	-27.46
15.163	Average	25.31	0.45	25.76	50.00	-24.24

Note: 1. Actual FS= Spectrum Read Level + Factor
Note: 2. Margin= Actual FS - Limit

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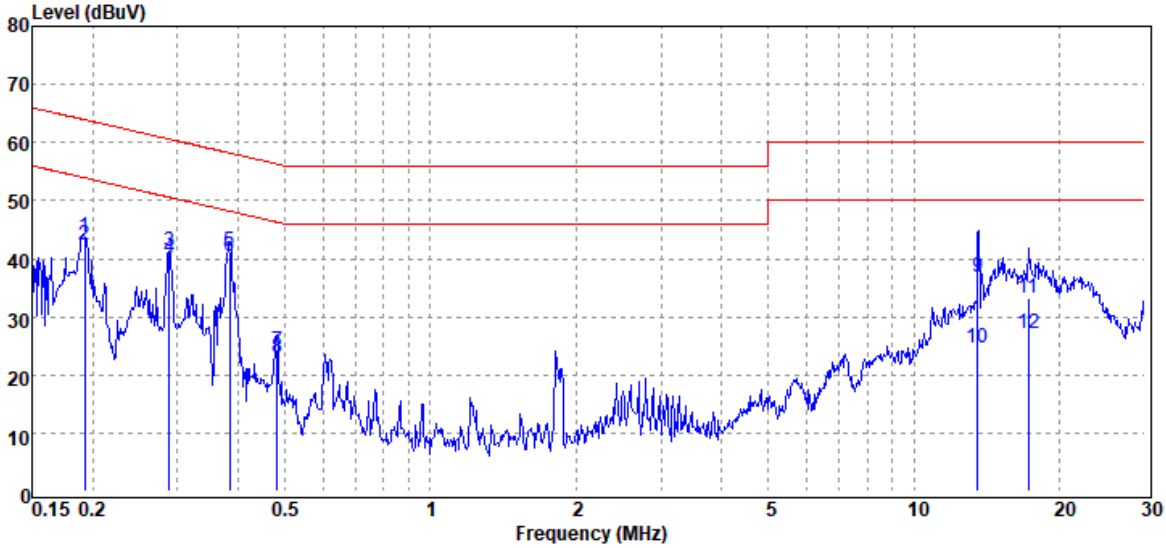
Project No	: TM-2405000018P	Test Date	: 2024-05-24
Operation Mode	: BT	Temp./Humi.	: 24.1°C / 55%
Test Chamber	: Conduction	Engineer	: Czerny Lin
Probe	: NEUTRAL	Test Voltage	: AC 120V/60Hz
Note	:		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV	Limit dBµV	Margin dB
0.193	QP	43.41	0.19	43.60	63.92	-20.32
0.193	Average	42.17	0.19	42.36	53.92	-11.56
0.288	QP	40.94	0.19	41.13	60.58	-19.45
0.288	Average	39.94	0.19	40.13	50.58	-10.45
0.384	QP	41.07	0.19	41.26	58.19	-16.93
0.384	Average	40.35	0.19	40.54	48.19	-7.65
0.483	QP	23.98	0.19	24.17	56.29	-32.12
0.483	Average	22.89	0.19	23.08	46.29	-23.21
13.560	QP	36.39	0.44	36.83	60.00	-23.17
13.560	Average	24.32	0.44	24.76	50.00	-25.24
17.268	QP	32.86	0.49	33.35	60.00	-26.65
17.268	Average	26.63	0.49	27.12	50.00	-22.88

Note: 1. Actual FS= Spectrum Read Level + Factor
Note: 2. Margin= Actual FS - Limit

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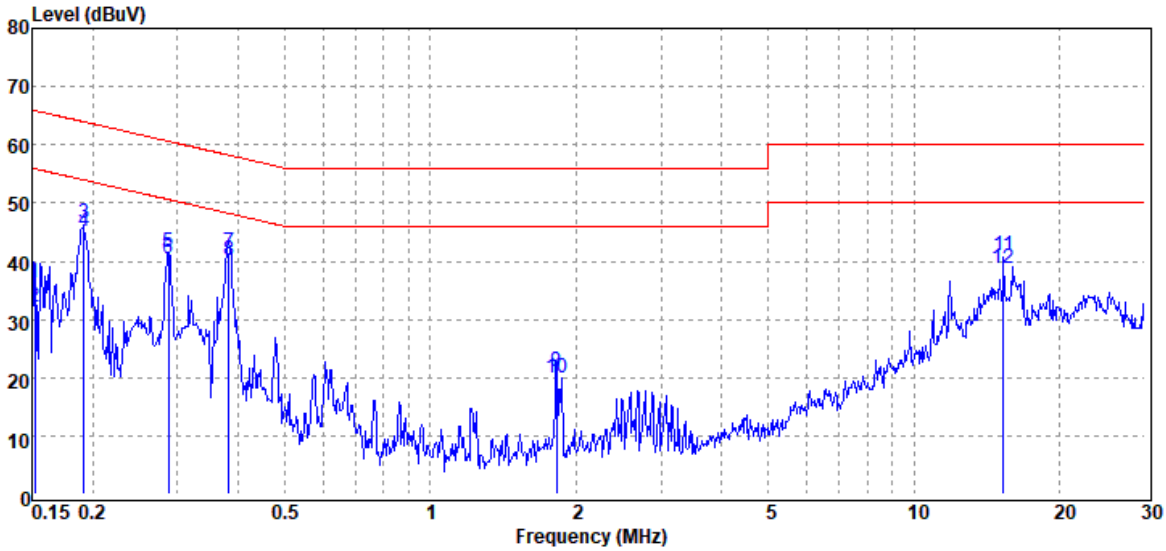
Co-Location

Project No	: TM-2405000018P	Test Date	: 2024-05-24
Operation Mode	: Wi-Fi+BT Co-Location	Temp./Humi.	: 24.1°C / 55%
Test Chamber	: Conduction	Engineer	: Czerny Lin
Probe	: LINE	Test Voltage	: AC 120V/60Hz
Note	:		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV	Limit dBµV	Margin dB
0.152	QP	36.16	0.15	36.31	65.90	-29.59
0.152	Average	31.88	0.15	32.03	55.90	-23.87
0.192	QP	46.31	0.15	46.46	63.95	-17.49
0.192	Average	45.11	0.15	45.26	53.95	-8.69
0.288	QP	41.26	0.15	41.41	60.59	-19.18
0.288	Average	40.38	0.15	40.53	50.59	-10.06
0.383	QP	41.48	0.15	41.63	58.22	-16.59
0.383	Average	39.94	0.15	40.09	48.22	-8.13
1.823	QP	20.96	0.21	21.17	56.00	-34.83
1.823	Average	19.66	0.21	19.87	46.00	-26.13
15.280	QP	40.42	0.45	40.87	60.00	-19.13
15.280	Average	38.18	0.45	38.63	50.00	-11.37

Note: 1. Actual FS= Spectrum Read Level + Factor
Note: 2. Margin= Actual FS - Limit

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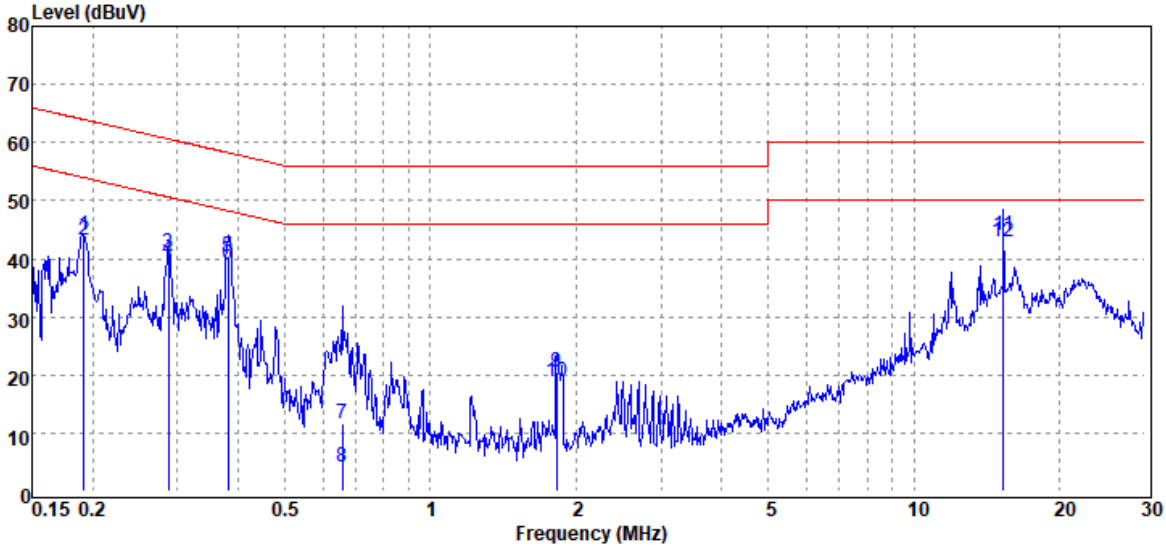
Project No	: TM-2405000018P	Test Date	: 2024-05-24
Operation Mode	: Wi-Fi+BT Co-Location	Temp./Humi.	: 24.1°C / 55%
Test Chamber	: Conduction	Engineer	: Czerny Lin
Probe	: NEUTRAL	Test Voltage	: AC 120V/60Hz
Note	:		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV	Limit dBµV	Margin dB
0.192	QP	43.86	0.19	44.05	63.95	-19.90
0.192	Average	43.07	0.19	43.26	53.95	-10.69
0.287	QP	40.79	0.19	40.98	60.61	-19.63
0.287	Average	39.67	0.19	39.86	50.61	-10.75
0.382	QP	40.16	0.19	40.35	58.24	-17.89
0.382	Average	38.73	0.19	38.92	48.24	-9.32
0.658	QP	11.49	0.21	11.70	56.00	-44.30
0.658	Average	4.05	0.21	4.26	46.00	-41.74
1.825	QP	20.31	0.25	20.56	56.00	-35.44
1.825	Average	18.68	0.25	18.93	46.00	-27.07
15.280	QP	43.49	0.47	43.96	60.00	-16.04
15.280	Average	42.39	0.47	42.86	50.00	-7.14

Note: 1. Actual FS= Spectrum Read Level + Factor
Note: 2. Margin= Actual FS - Limit

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4.2 20dB BANDWIDTH AND OCCUPIED BANDWIDTH (99%)

4.2.1 Test Limit

According to §15.247(a) (1),

20 dB Bandwidth ：For reporting purposes only.

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

4.2.2 Test Procedure

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

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

4.2.3 Test Setup

Refer to section 1.9.

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4.2.4 Test Result

Temperature:	23.5℃	**Test date:**	May 13, 2024
Humidity:	59% RH	**Tested by:**	Marco Chan

20dB BANDWIDTH

GFSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.033	0.69
Mid	1.031	0.69
High	1.034	0.69

π/4-DQPSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.358	0.91
Mid	1.358	0.91
High	1.358	0.91

8-DPSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.323	0.88
Mid	1.325	0.88
High	1.324	0.88

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BANDWIDTH 99%

GFSK

CH	99% BW (MHz)
Low	0.94811
Mid	0.95114
High	0.95036

π/4-DQPSK

CH	99% BW (MHz)
Low	1.2038
Mid	1.2033
High	1.2016

8-DPSK

CH	99% BW (MHz)
Low	1.2061
Mid	1.2067
High	1.2064

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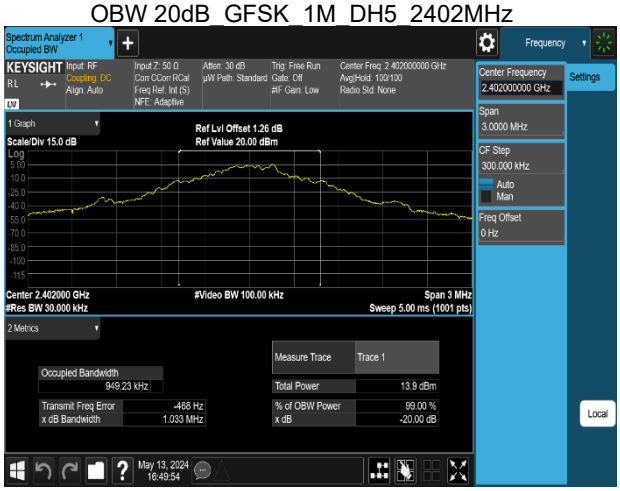
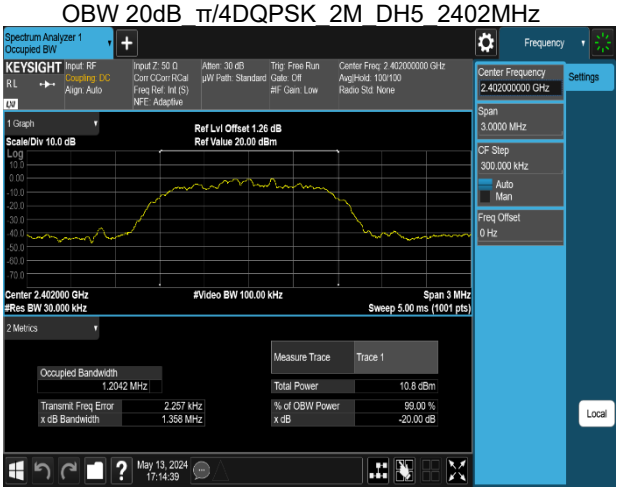
Test Data

20dB BANDWIDTH

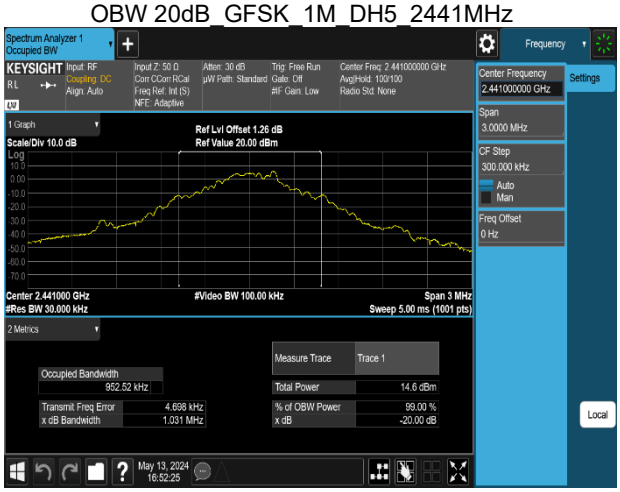
OBW 20dB_GFSK_1M_DH5_2402MHz



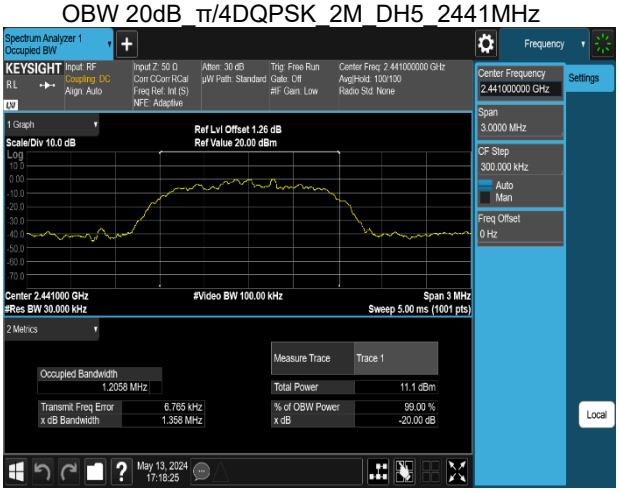
OBW 20dB_π/4DQPSK_2M_DH5_2402MHz



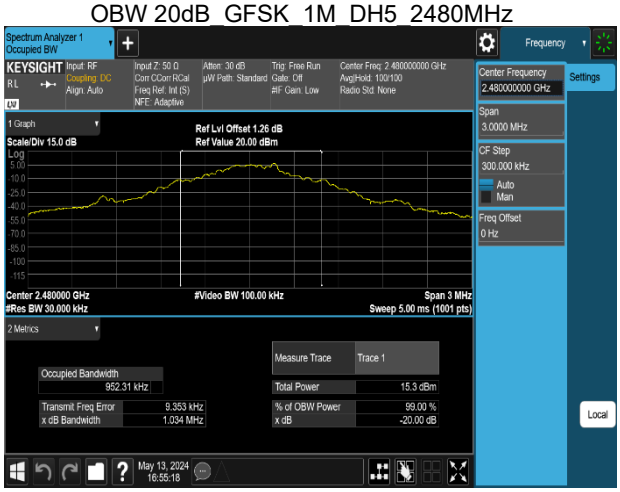
OBW 20dB_GFSK_1M_DH5_2441MHz



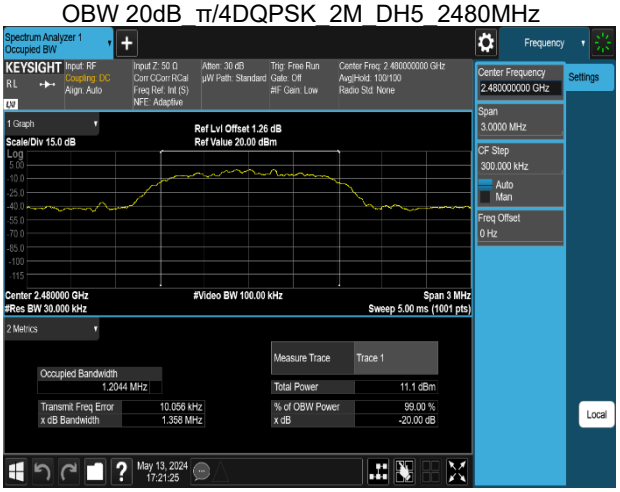
OBW 20dB_π/4DQPSK_2M_DH5_2441MHz



OBW 20dB_GFSK_1M_DH5_2480MHz



OBW 20dB_π/4DQPSK_2M_DH5_2480MHz



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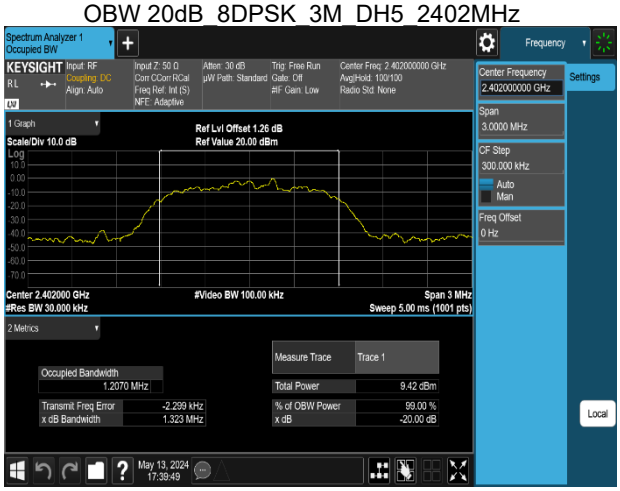
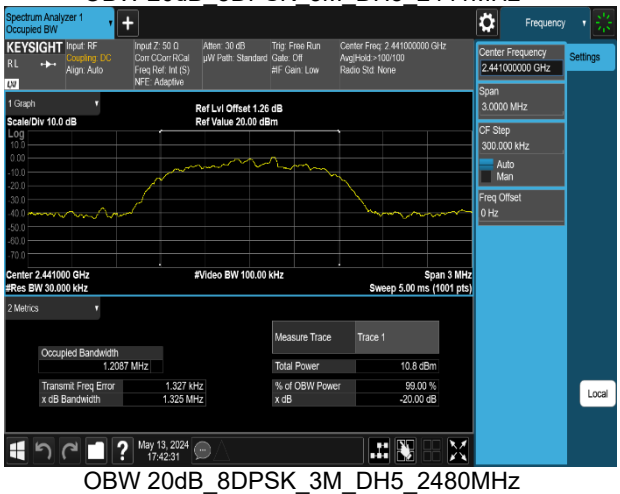
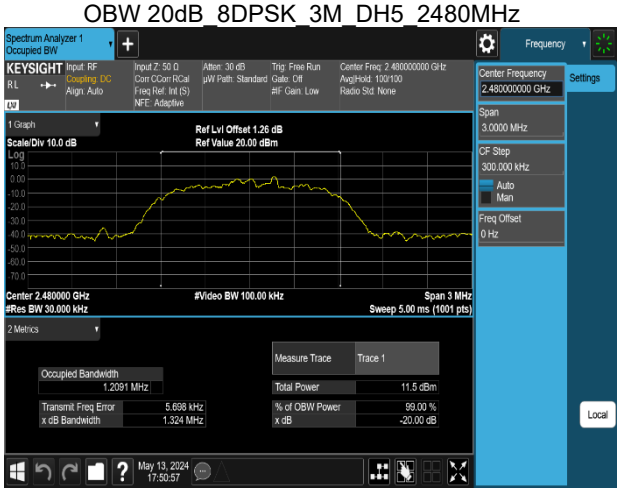
OBW 20dB_8DPSK_3M_DH5_2402MHz



OBW 20dB_8DPSK_3M_DH5_2441MHz



OBW 20dB_8DPSK_3M_DH5_2480MHz



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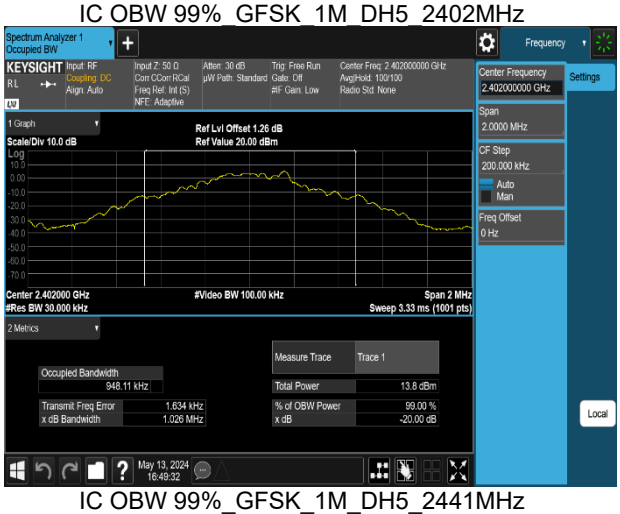
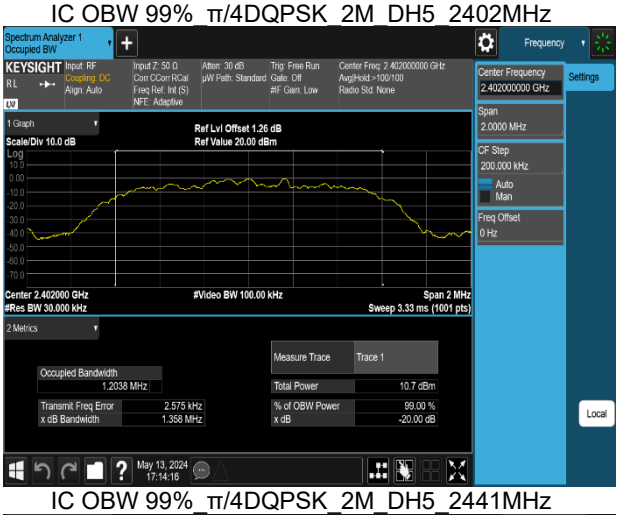
BANDWIDTH 99%

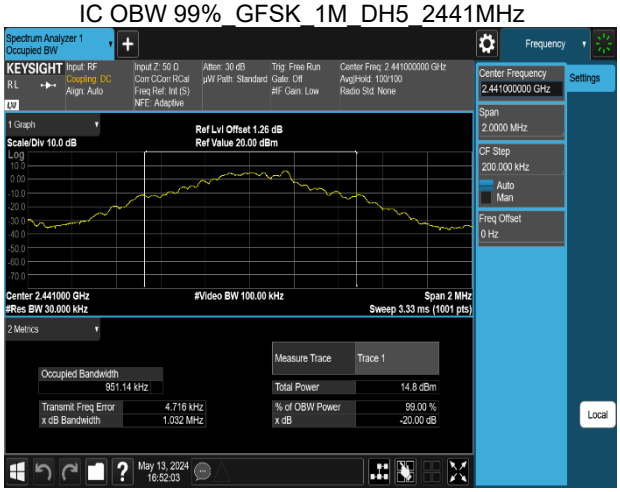
IC OBW 99% GFSK 1M DH5 2402MHz



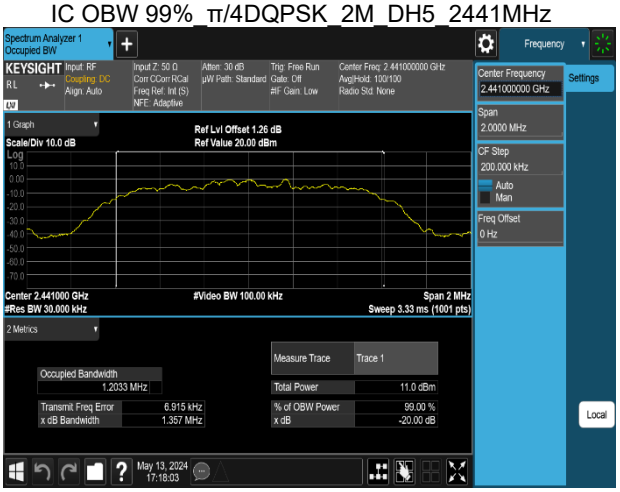
IC OBW 99% π/4DQPSK 2M DH5 2402MHz



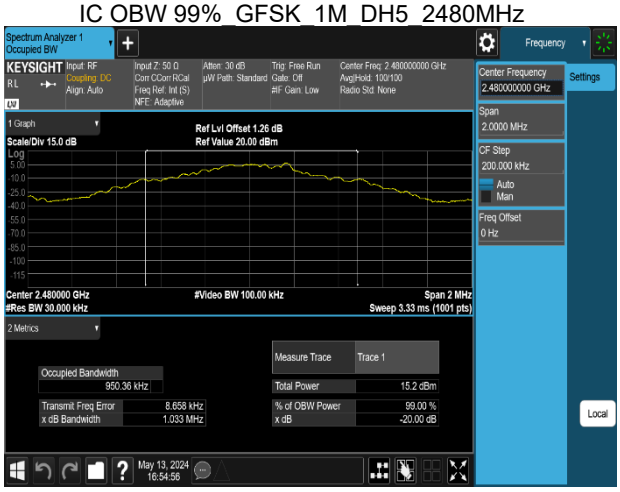
IC OBW 99% GFSK 1M DH5 2441MHz



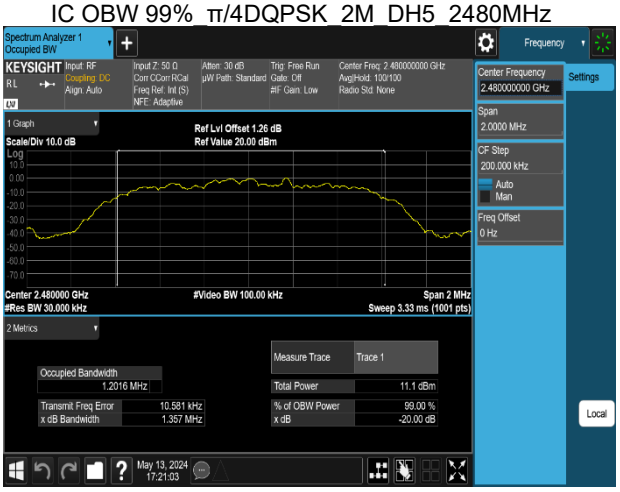
IC OBW 99% π/4DQPSK 2M DH5 2441MHz



IC OBW 99% GFSK 1M DH5 2480MHz



IC OBW 99% π/4DQPSK 2M DH5 2480MHz



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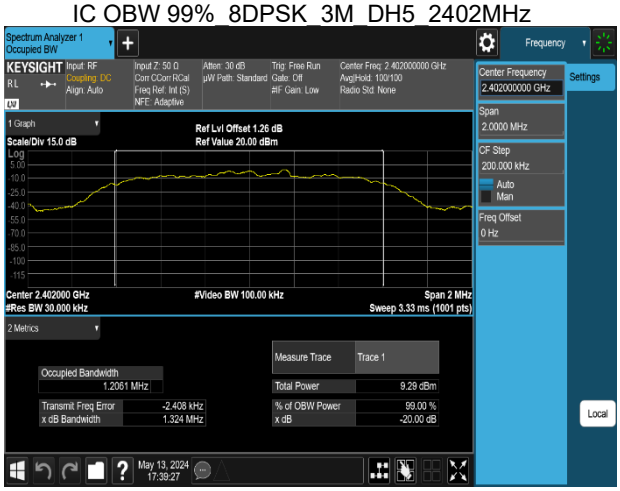
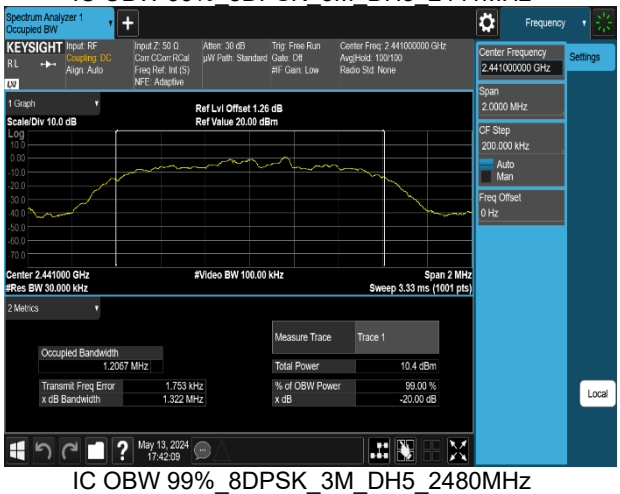
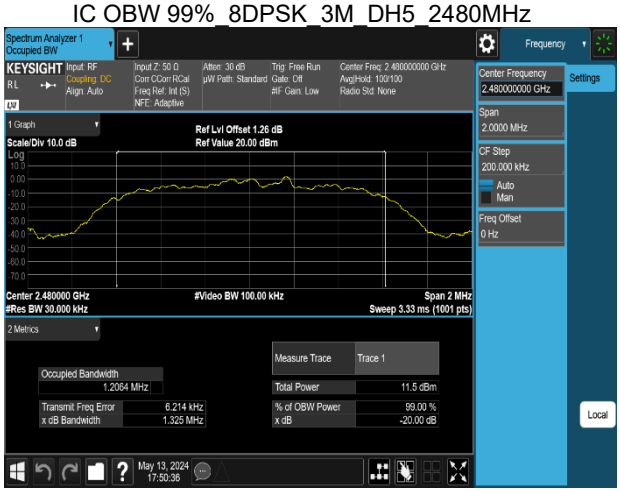
IC OBW 99%_8DPSK_3M_DH5_2402MHz



IC OBW 99%_8DPSK_3M_DH5_2441MHz



IC OBW 99%_8DPSK_3M_DH5_2480MHz



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4.3 OUTPUT POWER MEASUREMENT

4.3.1 Test Limit

According to §15.247(a)(1),

Peak output power：

FCC

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

Average output power：For reporting purposes only.

4.3.2 Test Procedure

1. The EUT RF output connected to the power meter by RF cable.
2. Setting maximum power transmit of EUT.
3. The path loss was compensated to the results for each measurement.
4. Measure and record the result of Peak output power and Average output power. in the test report.

4.3.3 Test Setup

Refer to section 1.9.

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4.3.4 Test Result

Temperature: 23.5℃ **Test date:** May 13, 2024

Humidity: 59% RH **Tested by:** Marco Chan

Peak & Average output power：

1M BR mode (Peak):

CH	Freq. (MHz)	Power Setting	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	0	8.45	6.998	125
Mid	2441	0	9.07	8.072	125
High	2480	0	**9.58**	9.078	125

1M BR mode (Average):

CH	Freq. (MHz)	Power Setting	Avg. Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	0	8.10	6.462	125
Mid	2441	0	8.60	7.251	125
High	2480	0	8.95	7.859	125

2M EDR mode (Peak):

CH	Freq. (MHz)	Power Setting	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	0	7.51	5.636	125
Mid	2441	0	7.94	6.223	125
High	2480	0	**8.48**	7.047	125

2M EDR mode (Average):

CH	Freq. (MHz)	Power Setting	Avg. Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	0	5.26	3.360	125
Mid	2441	0	5.98	3.966	125
High	2480	0	6.85	4.846	125

3M EDR mode (Peak):

CH	Freq. (MHz)	Power Setting	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	0	7.71	5.902	125
Mid	2441	0	8.07	6.412	125
High	2480	0	**8.61**	7.261	125

3M EDR mode (Average):

CH	Freq. (MHz)	Power Setting	Avg. Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	0	5.36	3.433	125
Mid	2441	0	6.06	4.033	125
High	2480	0	6.89	4.882	125

Note: Measured by power meter, cable loss + Duty cycle factor has been offseted to the power meter for Avg. power and cable loss has been offseted for Peak power measurement.

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4.4 FREQUENCY SEPARATION

4.4.1 Test Limit

According to §15.247(a)(1),

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

Limit	> two-thirds of the 20 dB bandwidth

4.4.2 Test Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. EUT RF output port connected to the SA by RF cable.
3. Set the spectrum analyzer as RBW = 300kHz, VBW = 910kHz, Sweep = auto. Max hold, mark 3 peaks of hopping channel and record the 3 peaks frequency

4.4.3 Test Setup

Refer to section 1.9.

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4.4.4 Test Result

Temperature: 23.5℃ **Test date:** May 13, 2024

Humidity: 59% RH **Tested by:** Marco Chan

Test mode: GFSK_BDR-1Mbps mode / 2402-2480 MHz				
Channel	**Frequency (MHz)**	**Channel Separation (MHz)**	**Channel Separation Limits (MHz)**	**Result**
Low	2402	1.000	0.69	PASS
Mid	2441	1.000	0.69	PASS
High	2480	1.000	0.69	PASS

Test mode: π/4-DQPSK_2Mbps mode / 2402-2480 MHz				
Channel	**Frequency (MHz)**	**Channel Separation (MHz)**	**Channel Separation Limits (MHz)**	**Result**
Low	2402	1.000	0.91	PASS
Mid	2441	1.000	0.91	PASS
High	2480	1.000	0.91	PASS

Test mode: 8DPSK_EDR-3Mbps mode / 2402-2480 MHz				
Channel	**Frequency (MHz)**	**Channel Separation (MHz)**	**Channel Separation Limits (MHz)**	**Result**
Low	2402	1.000	0.88	PASS
Mid	2441	1.000	0.88	PASS
High	2480	1.000	0.88	PASS

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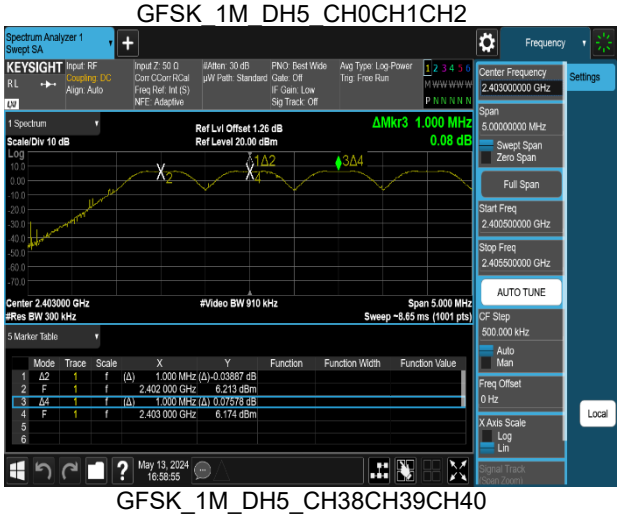
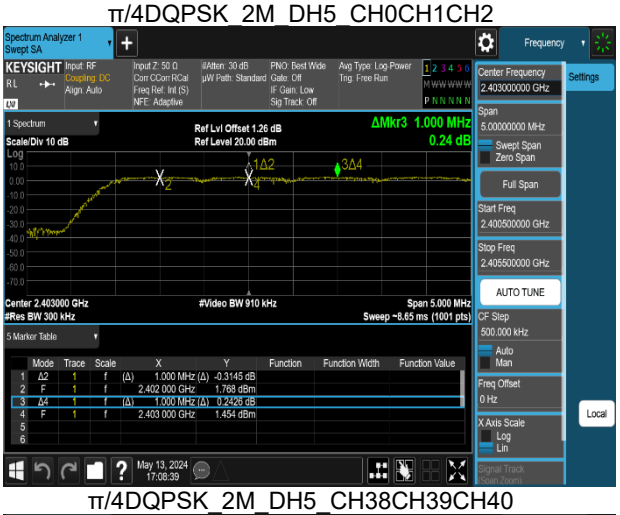
Test Data

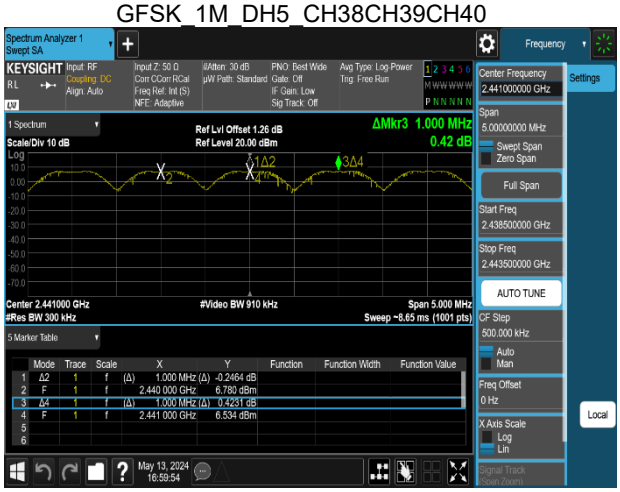
GFSK_1M_DH5_CH0CH1CH2



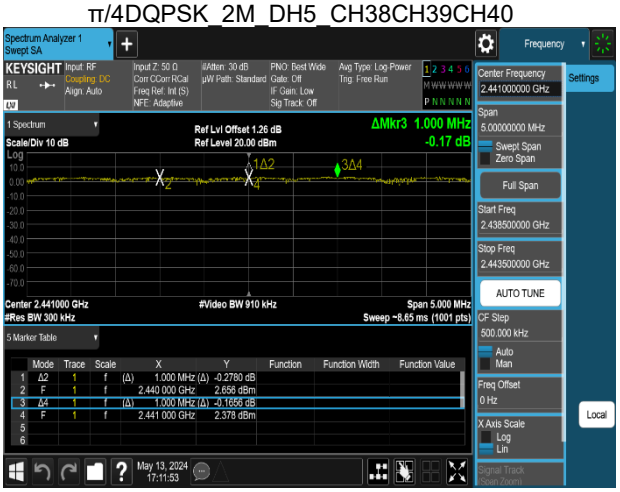
π/4DQPSK_2M_DH5_CH0CH1CH2



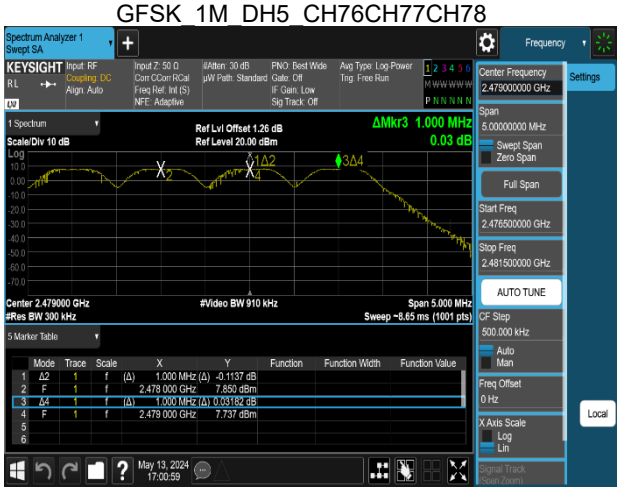
GFSK_1M_DH5_CH38CH39CH40



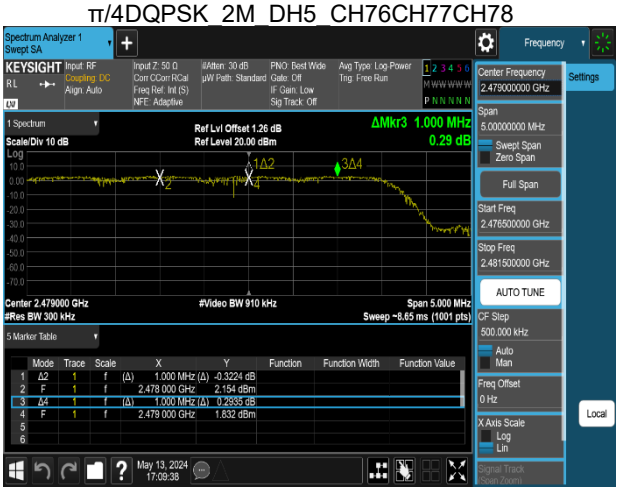
π/4DQPSK_2M_DH5_CH38CH39CH40



GFSK_1M_DH5_CH76CH77CH78



π/4DQPSK_2M_DH5_CH76CH77CH78



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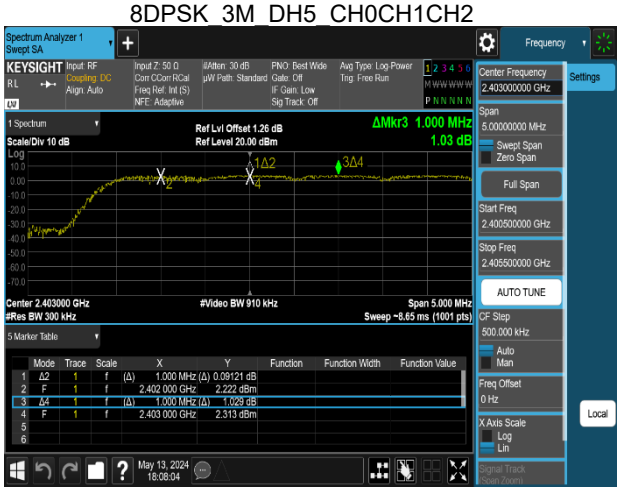
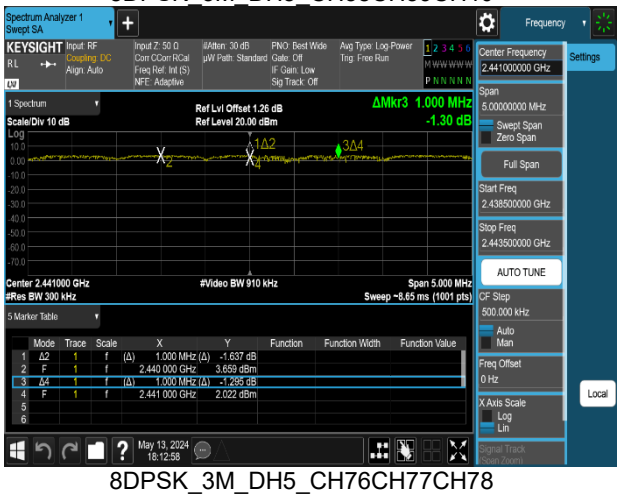
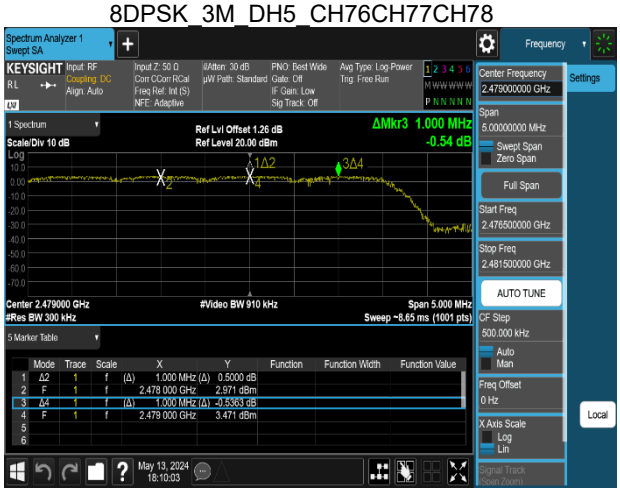
8DPSK_3M_DH5_CH0CH1CH2



8DPSK_3M_DH5_CH38CH39CH40



8DPSK_3M_DH5_CH76CH77CH78



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4.5 NUMBER OF HOPPING

4.5.1 Test Limit

According to §15.247(a)(1)(iii),

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

4.5.2 Test Procedure

Test method Refer as ANSI C63.10: 2013 clause 7.8.3
1. Place the EUT on the table and set it in transmitting mode.
2. EUT RF output port connected to the SA by RF cable.
3. Set spectrum analyzer Start Freq. = 2400 MHz, Stop Freq. = 2441 MHz, RBW=300KHz, VBW =910kHz for left half.
4. Set spectrum analyzer Start Freq. = 2441 MHz, Stop Freq. = 2483.5 MHz, RBW=300KHz, VBW =910kHz for right half.
5. Max hold, view and count how many channel in the band.

4.5.3 Test Setup

Refer to section 1.9.

4.5.4 Test Result

Temperature:	23.5℃	**Test date:**	May 13, 2024
Humidity:	59% RH	**Tested by:**	Marco Chan

Number of Hopping				
Mode	**Frequency (MHz)**	**Hopping Channel Number**	**Hopping Channel Number Limits**	**Result**
BDR-1Mbps	2402-2480	79	15	Pass
EDR-3Mbps	2402-2480	79	15	

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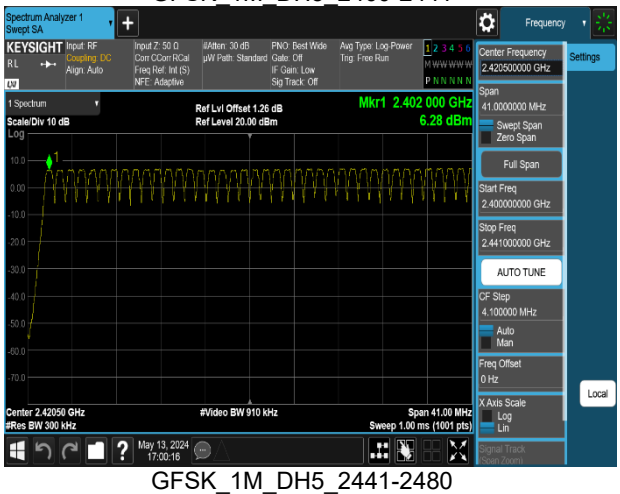
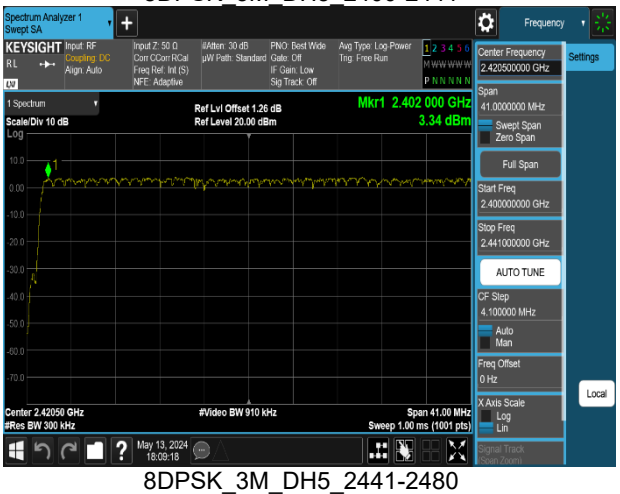
Test Data

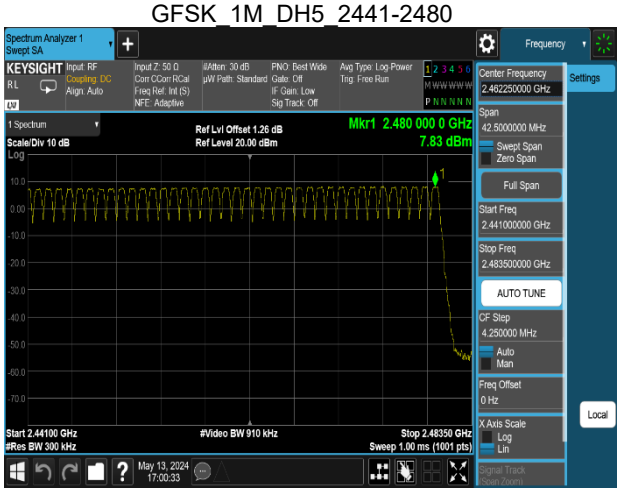
GFSK_1M_DH5_2400-2441



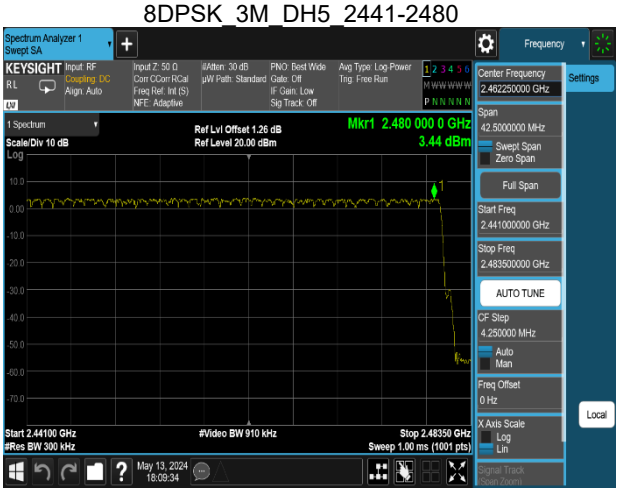
8DPSK_3M_DH5_2400-2441



GFSK_1M_DH5_2441-2480



8DPSK_3M_DH5_2441-2480



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4.6 CONDUCTED BANDEDGE AND SPURIOUS EMISSION

4.6.1 Test Limit

According to §15.247(d),

Limit	-20 dBc

4.6.2 Test Procedure

1. EUT RF output port connected to the SA by RF cable, and the path loss was compensated to result.

2. SA setting, RBW=100kHz, VBW=300kHz, Detector=Peak, Trace mode = max hold, SWT = Auto.

3. The Band Edge at 2.4GHz and 2.4835GHz are investigated with both hopping “ON” and “OFF” modes “.

4.6.3 Test Setup

Refer to section 1.9.

4.6.4 Test Result

Temperature:	23.5℃	**Test date:**	May 13, 2024
Humidity:	59% RH	**Tested by:**	Marco Chan

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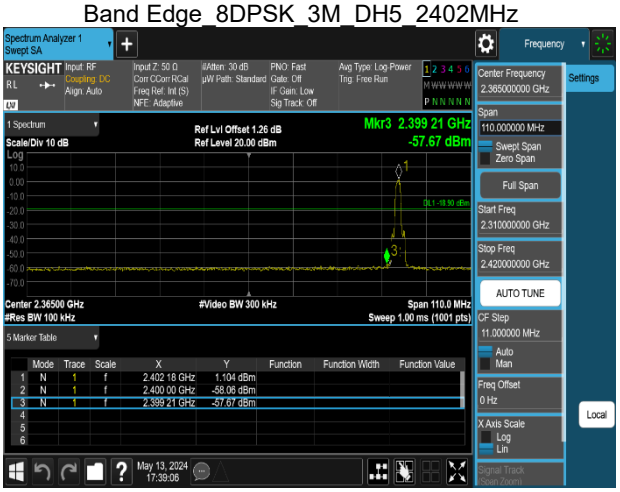
Test Data

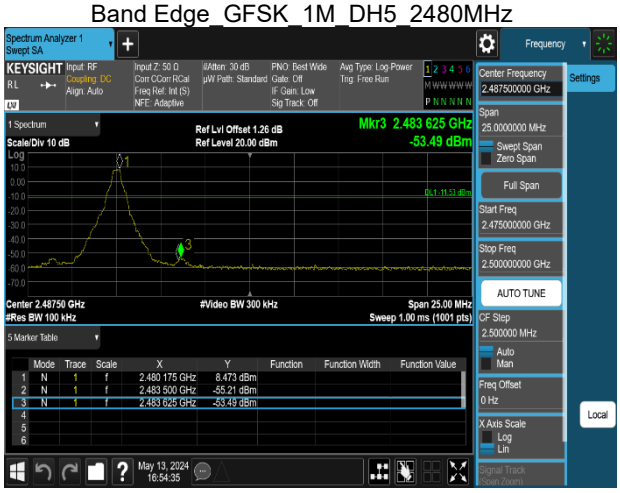
Band Edge

Band Edge_GFSK_1M_DH5_2402MHz

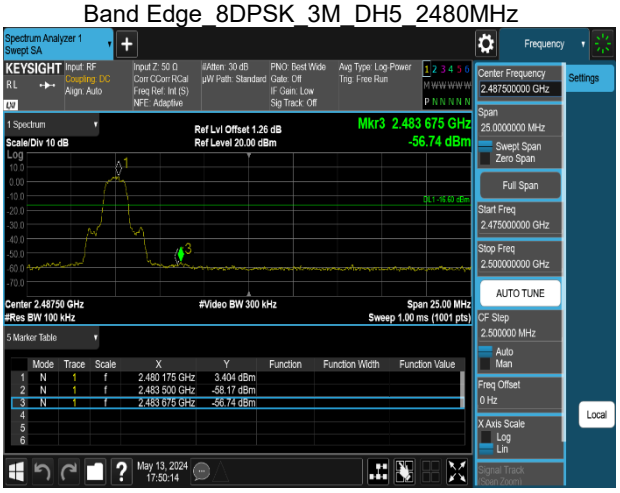
Band Edge_8DPSK_3M_DH5_2402MHz



Band Edge_GFSK_1M_DH5_2480MHz



Band Edge_8DPSK_3M_DH5_2480MHz



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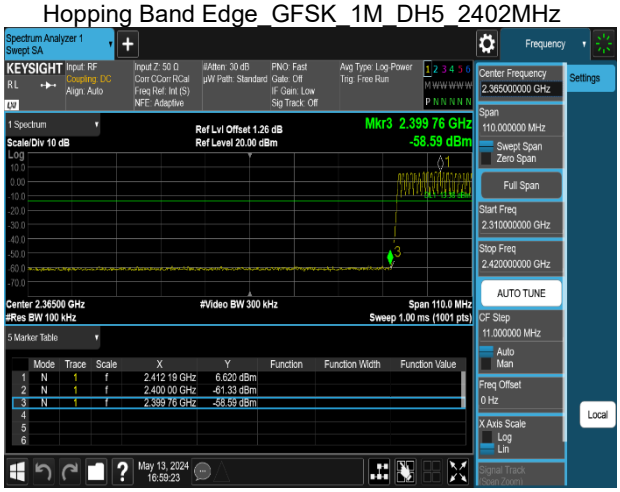
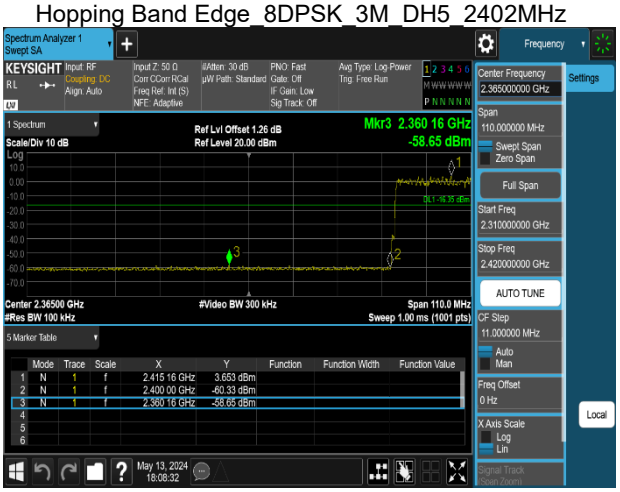
Hopping mode

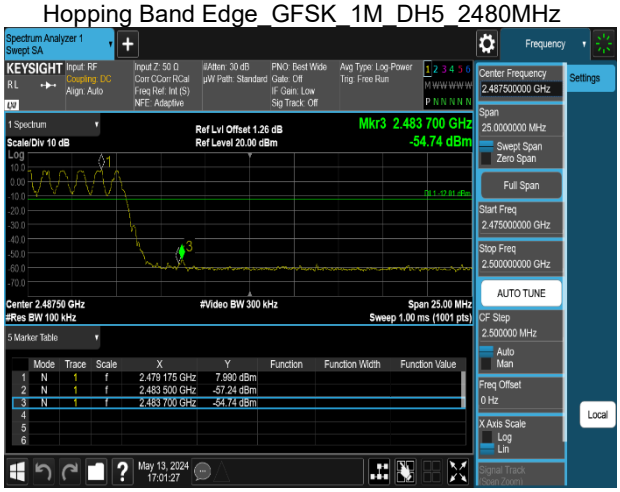
Hopping Band Edge_GFSK_1M_DH5_2402MHz



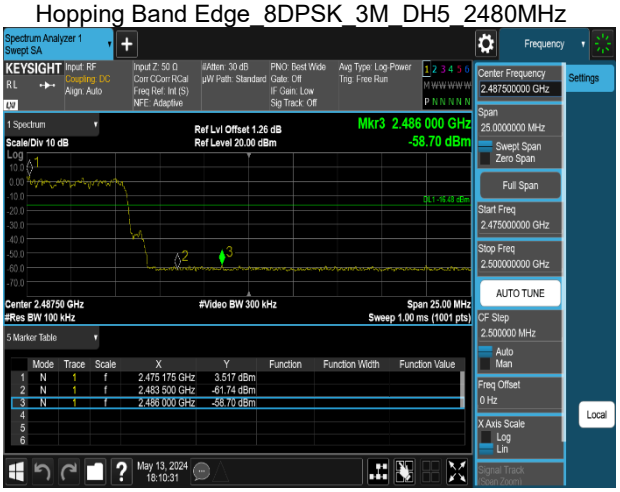
Hopping Band Edge_8DPSK_3M_DH5_2402MHz



Hopping Band Edge_GFSK_1M_DH5_2480MHz



Hopping Band Edge_8DPSK_3M_DH5_2480MHz



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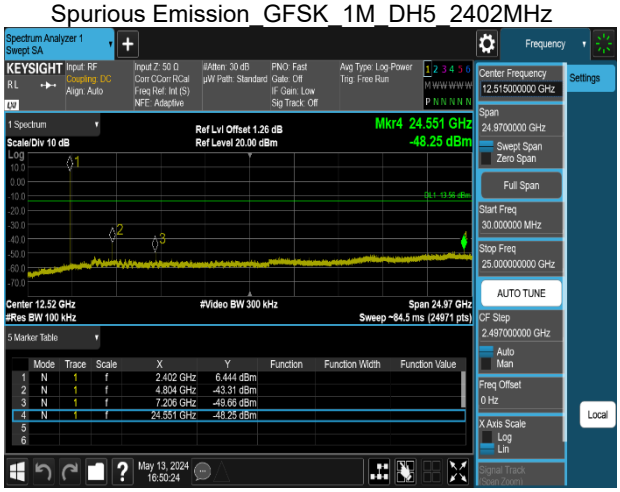
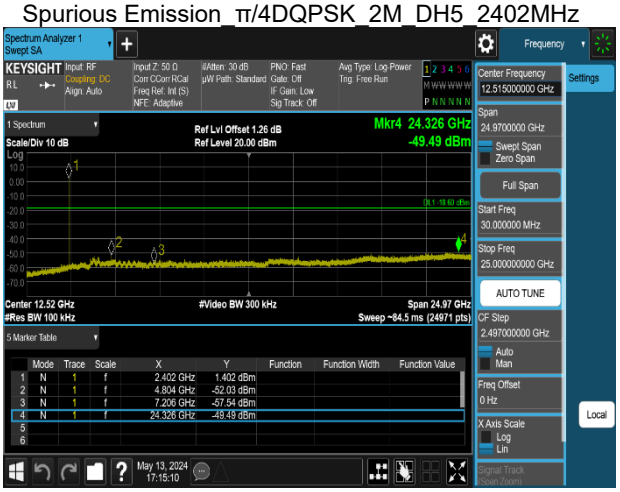
Spurious Emission

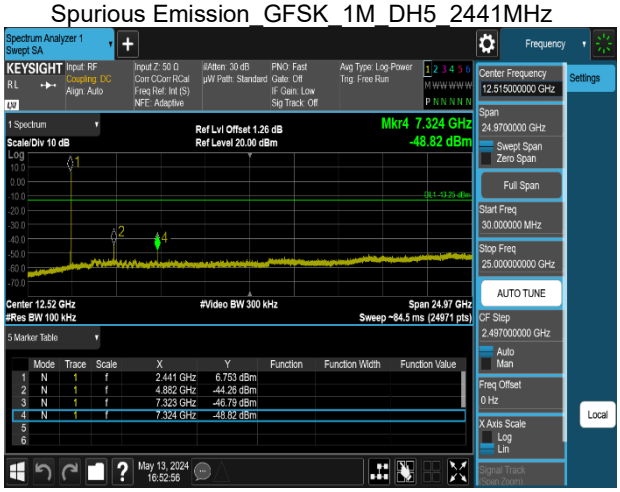
Spurious Emission_GFSK_1M_DH5_2402MHz



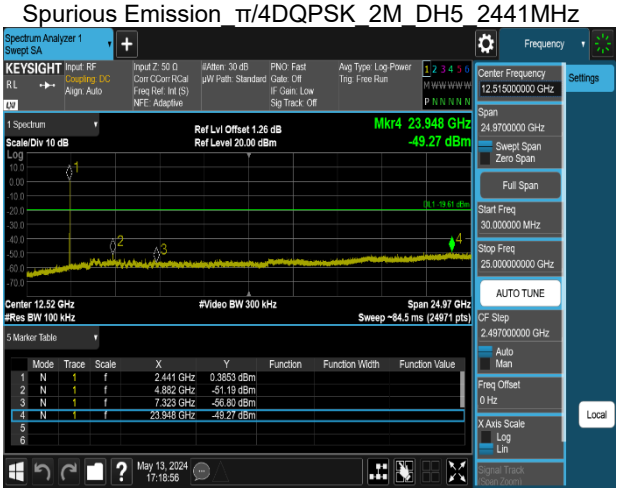
Spurious Emission_π/4DQPSK_2M_DH5_2402MHz



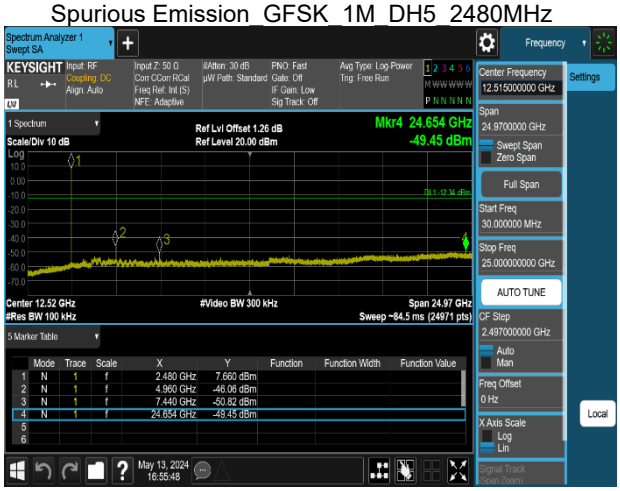
Spurious Emission_GFSK_1M_DH5_2441MHz



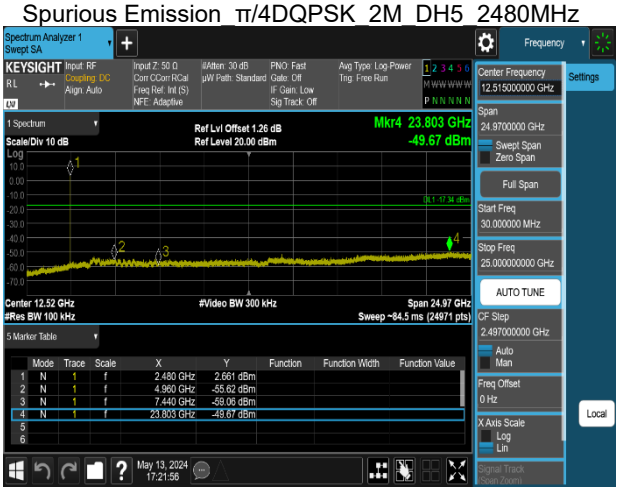
Spurious Emission_π/4DQPSK_2M_DH5_2441MHz



Spurious Emission_GFSK_1M_DH5_2480MHz



Spurious Emission_π/4DQPSK_2M_DH5_2480MHz



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