RADIO TEST REPORT
FCC 47 CFR PART 15 SUBPART C

Test Standard	**FCC Part 15.247**
Product name	**Bluetooth v5.4 APTX LE Audio TX Module**
Brand Name	**CC&C**
Model No.	**BM-3086, BM-3086E**
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

Sehni Hu
Supervisor

Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	August 08, 2024	Initial Issue	ALL	Allison Chen
01	August 22, 2024	See the following Note Rev.(01)	P.4, 6, 11, 33	Allison Chen
02	September 16, 2024	See the following Note Rev.(02)	P.4, 6	Allison Chen
03	September 24, 2024	See the following Note Rev.(03)	P.4	Allison Chen

Note:

Rev.(01)

1. Modify model discrepancy, antenna information, support equipment list information in section 1.1, 1.4 and 1.8.
2. Modify test description in section 4.4.2.

Rev.(02)

1. Modify antenna type and serial number in section 1.1 and 1.4.

Rev.(03)

1. Modify serial number in section 1.1.

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1. GENERAL INFORMATION

1.1 EUT INFORMATION

Applicant	CC&C Technologies, Inc. 8F, No.150, Jian Yi Rd, Zhonghe District, New Taipei City, 235, Taiwan
Manufacturer	CC&C Technologies, Inc. 8F, No.150, Jian Yi Rd, Zhonghe District, New Taipei City, 235, Taiwan
Equipment	Bluetooth v5.4 APTX LE Audio TX Module
Brand Name	CC&C
Model No.	BM-3086, BM-3086E
Model Discrepancy	For detailed description of the differences between series models, please see the table below: **Model name** / **Difference** BM-3086 / Chip antenna BM-3086E / embedded antenna
Received Date	June 24, 2024
Date of Test	July 2 ~ 11, 2024
EUT Power Rating	Power from host device: DC 5V
H.W Version	0B
S.W Version	01
Serial Number	000272F14FD9 for Radiated [embedded antenna Configuration] 000272F14FDA for Conducted [chip antenna Configuration] 000272F14FD5 for Radiated [chip antenna Configuration]

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.
3. Disclaimer: The variant model numbers / trademarks are assessed as identical in hardware and software to each other, hence all variants are fully covered by the test results in this test report without further verification test.

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 system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

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 Specification

Model name:	BM-3086	BM-3086E
Antenna Type:	Chip Antenna	embedded antenna
Antenna Gain:	0.5 dBi	3.2 dBi
Antenna Brand:	ACX	LYNwave
Antenna Model:	AT3216-B2R7HAAT/LF	ALA120-051026-00
Connector:	N/A	IPEX

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.

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	Ben Yang	-
Radiation	Ray Li	-
RF Conducted	David Li	-

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

1.7 INSTRUMENT CALIBRATION

Conducted_FCC/NCC/IC(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
Signal Analyzer	KEYSIGHT	N9010B	MY55460167	2024-01-03	2025-01-02
Software	Radio Test Software Ver. 21				

966A_Radiated					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Signal Analyzer	KEYSIGHT	N9010A	MY52220817	2024-03-15	2025-03-14
Thermo-Hygro Meter	WISEWIND	1206	D07	2023-12-08	2024-12-07
Active Loop Antenna	SCHWARZBECK	FMZB 1513-60	1513-60-028	2023-12-13	2024-12-12
Bi-Log Antenna	Sunol Sciences	JB1	A052609	2024-02-02	2025-02-01
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	2024-06-12	2025-06-13
Horn Antenna	SCHWARZBECK	BBHA9170	1047	2023-12-13	2024-12-12
Pre-Amplifier	EMCI	EMC184045SE	980860	2023-12-12	2024-12-11
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
Software	e3 V9-210616c				

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

AC Mains Conduction					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
EMI Test Receiver	R&S	ESCI	100064	2024-06-14	2025-06-13
LISN	TESEQ	LN2-16N	22012	2024-02-29	2025-02-27
Cable	Woken	SFL402	185A	2024-07-08	2025-07-07
Software	e3 V6-110812				

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

1.8 SUPPORT AND EUT ACCESSORIES EQUIPMENT

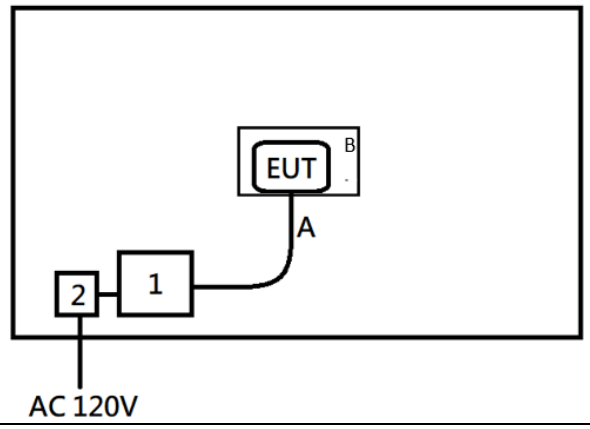
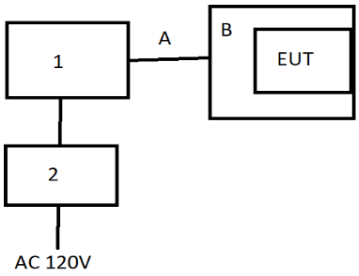
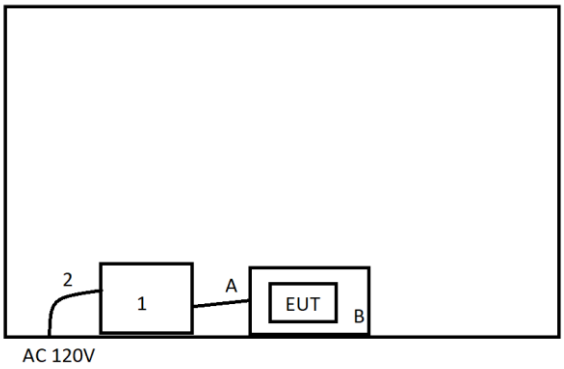
EUT Accessories Equipment						
No.	**Name of Equipment**	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
	N/A					

Support Unit List (RSE)						
No.	**Name of Equipment**	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
1	NB(D)	Lenovo	ThinkPad X260	N/A	N/A	N/A
2	Adapter	Lenovo	ADLX45DLC3A	N/A	N/A	N/A
A	Type-C to USB Cable	Dong Guan YCD Electronic Co., ltd	37G1E6300-00	N/A	N/A	N/A
B	Test fixture	CC&C	BM-3086 TEST BOARD	N/A	N/A	N/A

Support Unit List (Conducted)						
No.	**Name of Equipment**	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
1	NB(B)	Lenovo	T470	N/A	N/A	N/A
2	Adapter	Lenovo	ADLX45DLC3A	N/A	N/A	N/A
A	Type-C to USB Cable	Dong Guan YCD Electronic Co., ltd	37G1E6300-00	N/A	N/A	N/A
B	Test fixture	CC&C	BM-3086 TEST BOARD	N/A	N/A	N/A

Support Unit List (Conduction)						
No.	**Name of Equipment**	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
1	NB(D)	Lenovo	ThinkPad X260	N/A	N/A	N/A
2	Adapter	Lenovo	ADLX45DLC3A	N/A	N/A	N/A
A	Type-C to USB Cable	Dong Guan YCD Electronic Co., ltd	37G1E6300-00	N/A	N/A	N/A
B	Test fixture	CC&C	BM-3086 TEST BOARD	N/A	N/A	N/A

1.9 TEST SETUP DIAGRAM

RSE Setup	Conducted
	
Conduction	
	- -

1.10 TEST PROGRAM

This EUT uses "BlueTest3" software to set the frequency, modulation, and power to allow the sample to continuously transmit (including frequency hopping mode).

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 D01.

2. TEST SUMMARY

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

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.

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 (BM-3086) power by Host System** **Mode 2: EUT (BM-3086E) power by Host System**
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 (BM-3086) power by Host System** **Mode 2: EUT (BM-3086E) power by Host System**
Worst Mode	**☒ Mode 1 ☒ Mode 2 ☐ Mode 3 ☐ Mode 4**
Worst Position	**☐ Placed in fixed position.** **☒ Mode 1: Placed in fixed position at X-Plane (E2-Plane)** **☒ Mode 2: 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 (BM-3086) power by Host System** **Mode 2: EUT (BM-3086E) power by Host System**
Worst Mode	**☒ Mode 1 ☒ Mode 2 ☐ Mode 3 ☐ Mode 4**

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

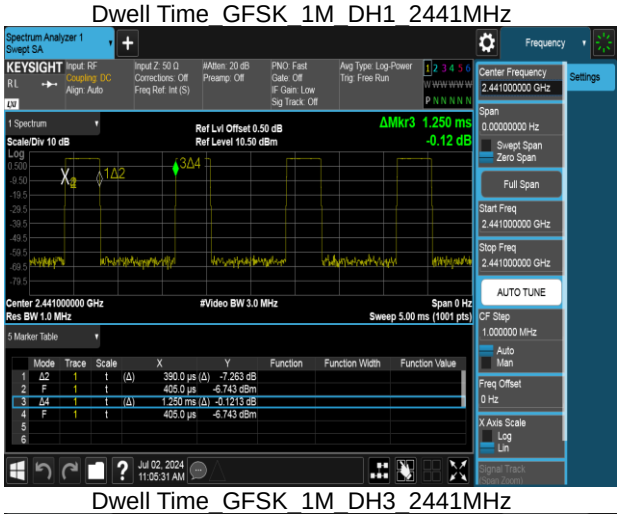
3.3 EUT DUTY CYCLE

Temperature: 23.6~24.4℃ **Test date:** July 2~3, 2024

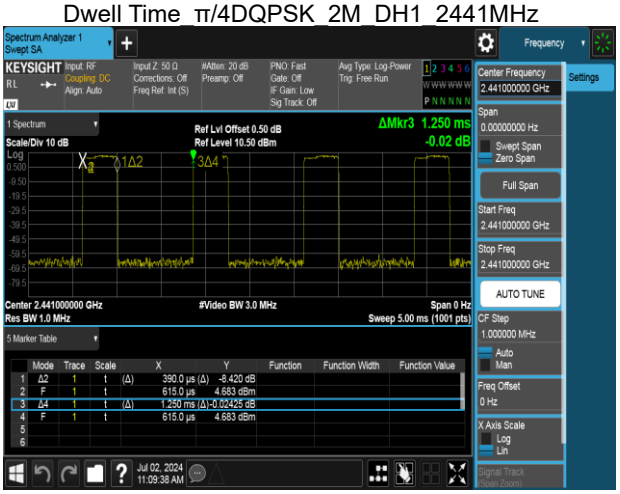
Humidity: 54~55% RH **Tested by:** David Li

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log (1/Duty Cycle)	1/T (kHz)	VBW setting (kHz)
DH1	31.20	5.06	2.56	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	76.80	1.15	0.35	1.00
3DH1	30.80	5.11	2.60	3.00
3DH3	65.20	1.86	0.61	1.00
3DH5	77.20	1.12	0.35	1.00

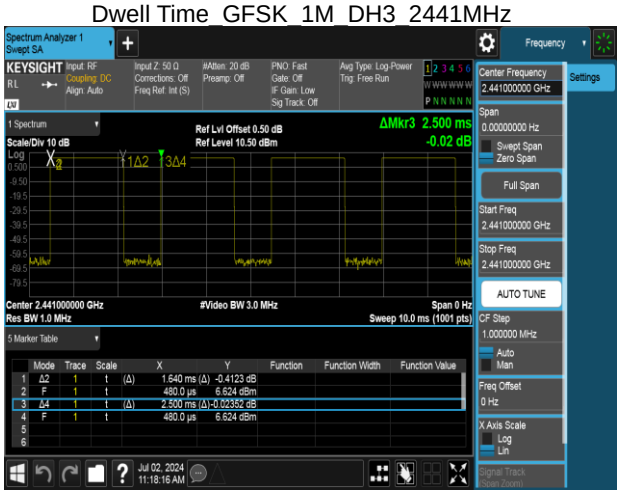
Dwell Time_GFSK_1M_DH1_2441MHz



Dwell Time_π/4DQPSK_2M_DH1_2441MHz



Dwell Time_GFSK_1M_DH3_2441MHz



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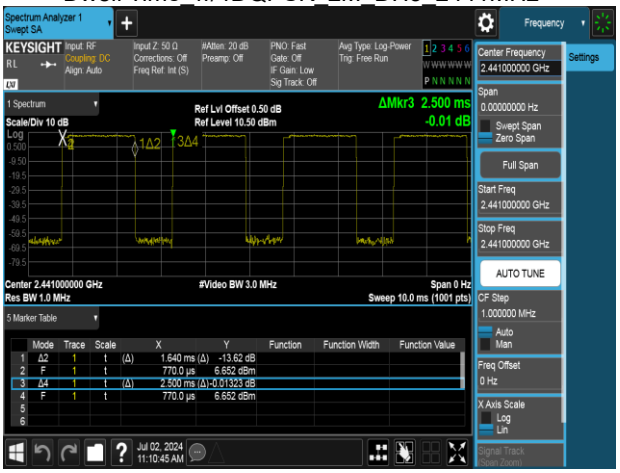
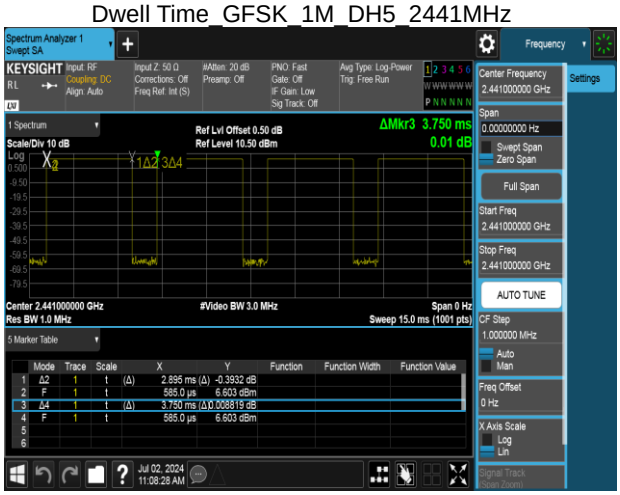
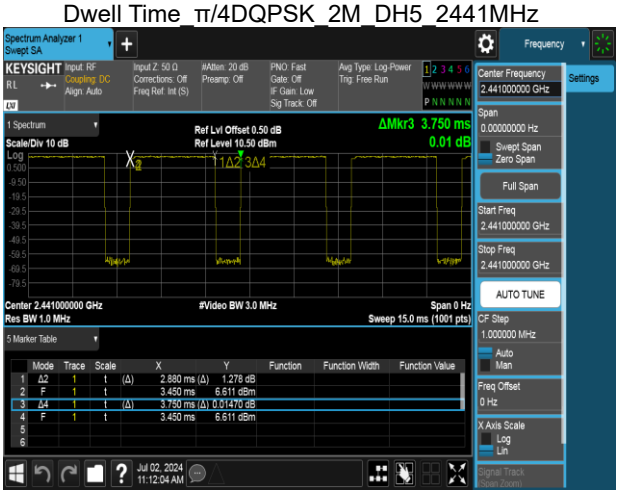


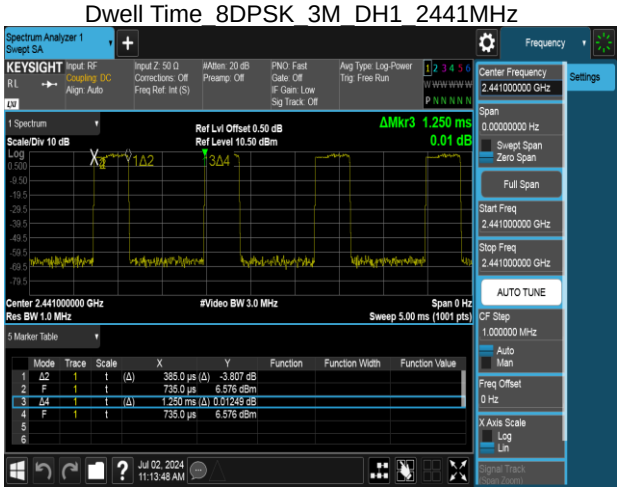
Dwell Time_GFSK_1M_DH5_2441MHz



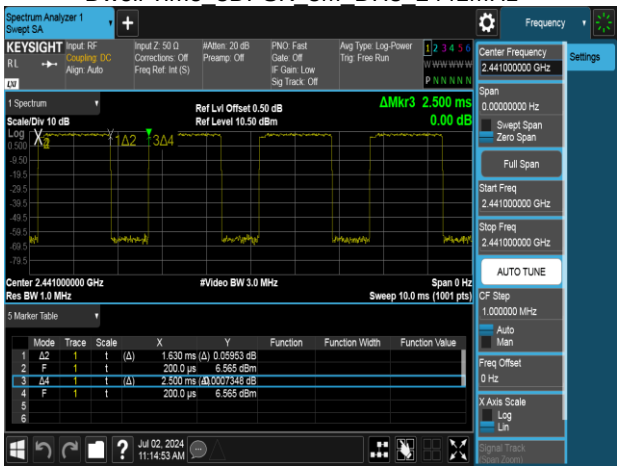
Dwell Time_π/4DQPSK_2M_DH5_2441MHz



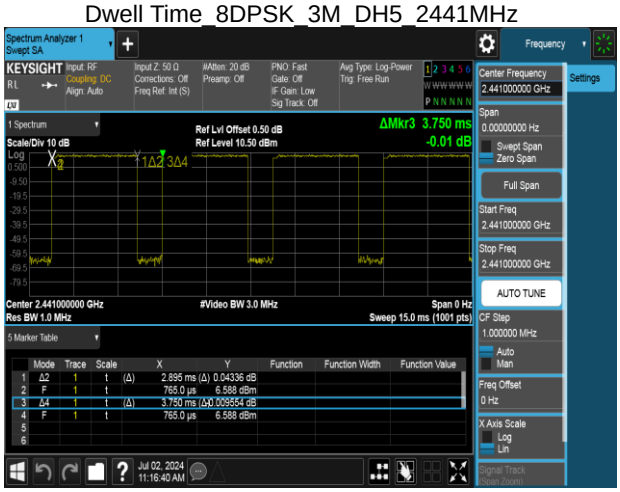
Dwell Time_8DPSK_3M_DH1_2441MHz



Dwell Time_8DPSK_3M_DH3_2441MHz



Dwell Time_8DPSK_3M_DH5_2441MHz



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

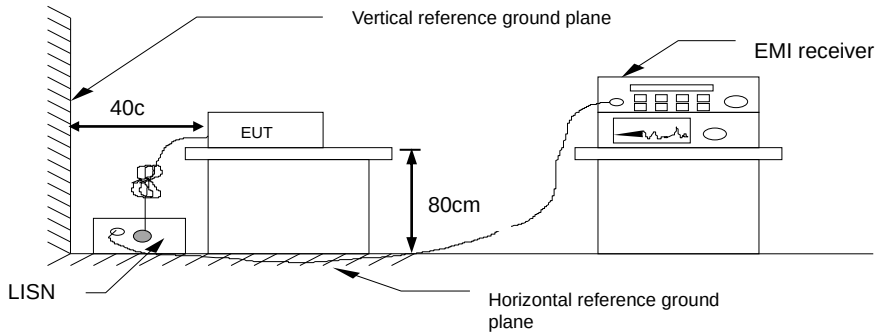
* Decreases with the logarithm of the frequency.

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

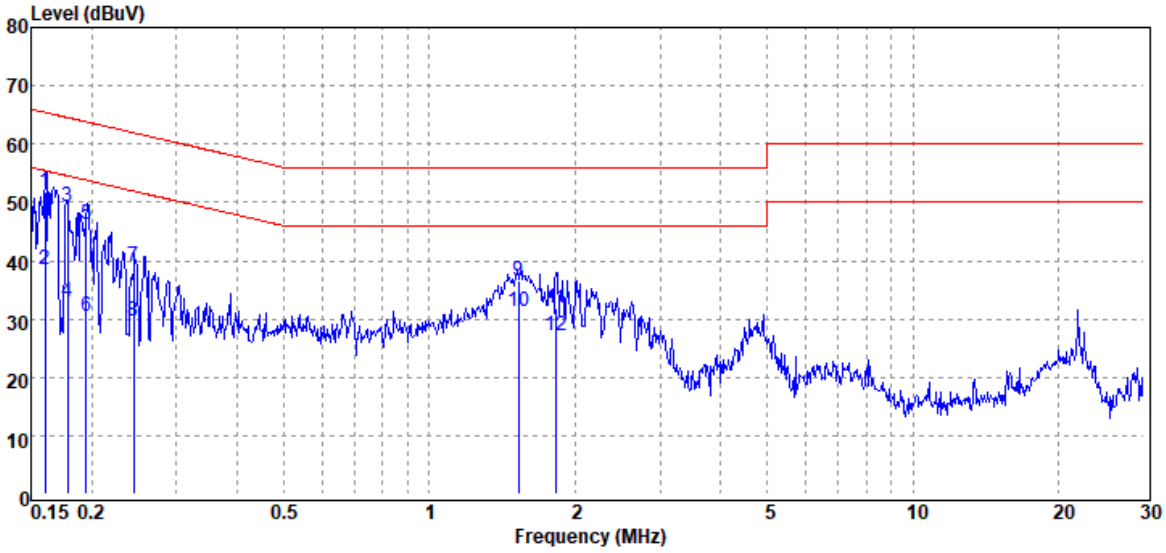


4.1.4 Test Result

PASS

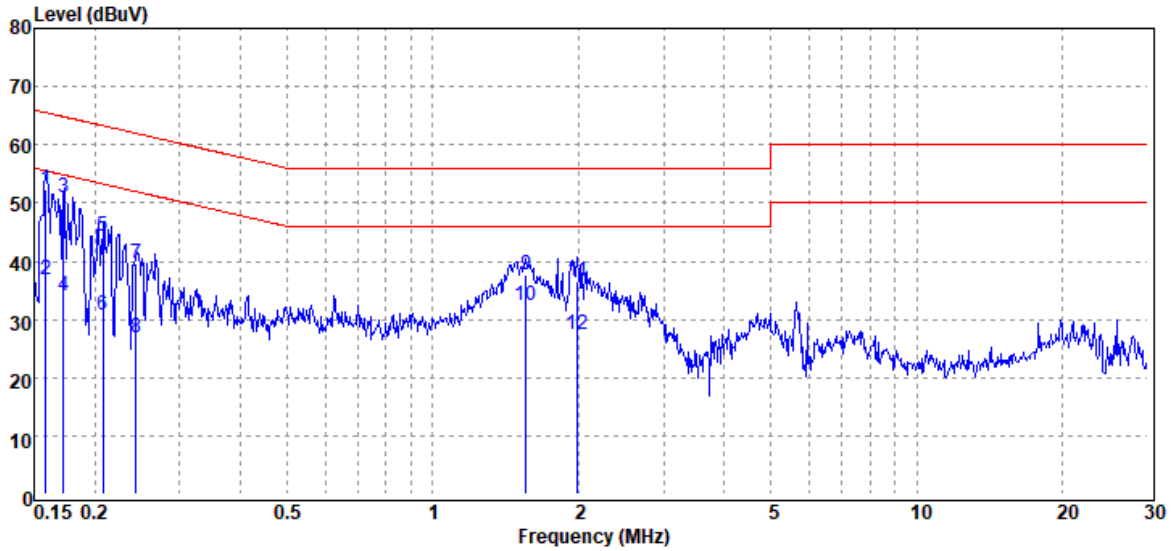
Test Data

Project No	: TM-2406000276P	Test Date	: 2024-07-11
Operation Mode	: BT	Temp./Humi.	: 23.4°C / 54%
Test Chamber	: Conduction	Engineer	: Ben Yang
Probe	: LINE	Test Voltage	: AC 120V/60Hz
Note	: Mode 1		



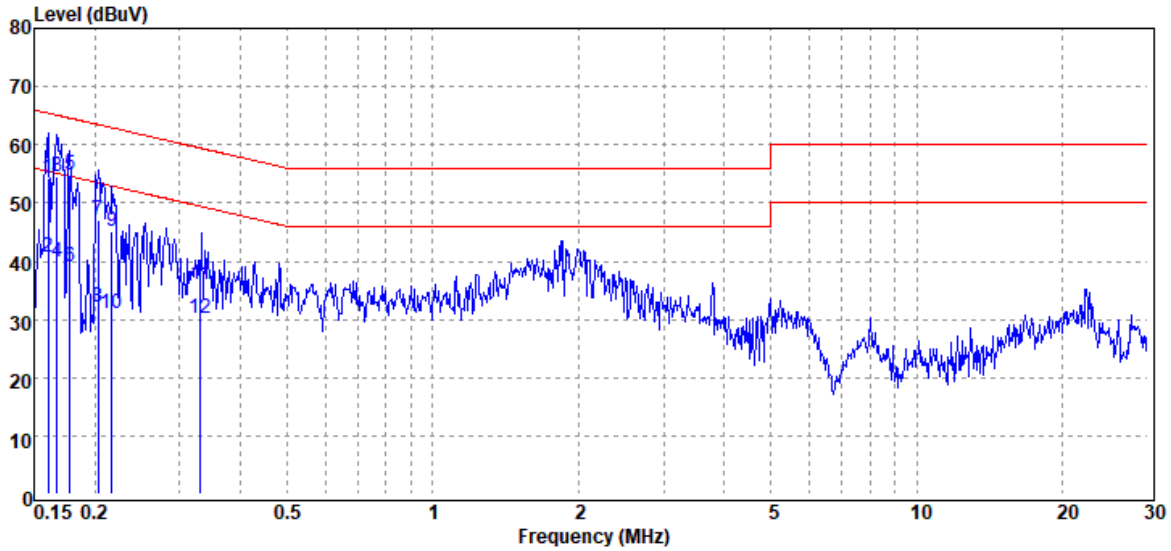
Freq.	Detector Mode	Spectrum Read Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV	dBµV	dB
0.160	QP	51.52	0.18	51.70	65.45	-13.75
0.160	Average	38.27	0.18	38.45	55.45	-17.00
0.178	QP	48.97	0.28	49.25	64.56	-15.31
0.178	Average	32.58	0.28	32.86	54.56	-21.70
0.195	QP	45.99	0.37	46.36	63.80	-17.44
0.195	Average	30.21	0.37	30.58	53.80	-23.22
0.245	QP	38.63	0.39	39.02	61.93	-22.91
0.245	Average	29.24	0.39	29.63	51.93	-22.30
1.526	QP	36.29	0.18	36.47	56.00	-19.53
1.526	Average	31.06	0.18	31.24	46.00	-14.76
1.828	QP	31.71	0.18	31.89	56.00	-24.11
1.828	Average	27.07	0.18	27.25	46.00	-18.75

Project No	: TM-2406000276P	Test Date	: 2024-07-11
Operation Mode	: BT	Temp./Humi.	: 23.4°C / 54%
Test Chamber	: Conduction	Engineer	: Ben Yang
Probe	: NEUTRAL	Test Voltage	: AC 120V/60Hz
Note	: Mode 1		



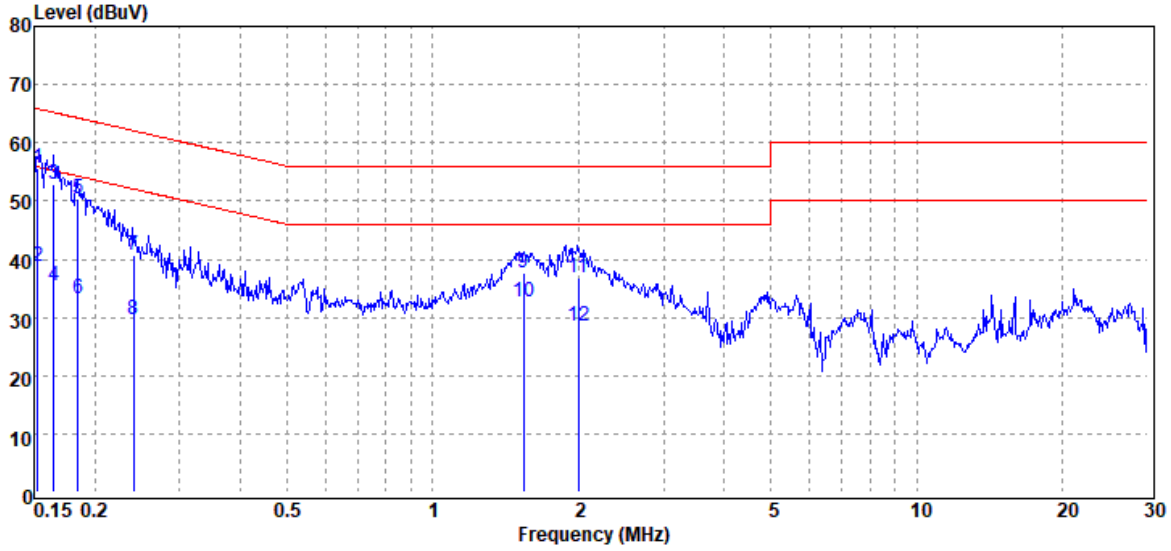
Freq.	Detector Mode	Spectrum Read Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV	dBµV	dB
0.158	QP	52.29	0.16	52.45	65.55	-13.10
0.158	Average	36.71	0.16	36.87	55.55	-18.68
0.172	QP	50.82	0.23	51.05	64.85	-13.80
0.172	Average	33.69	0.23	33.92	54.85	-20.93
0.208	QP	43.87	0.36	44.23	63.27	-19.04
0.208	Average	30.38	0.36	30.74	53.27	-22.53
0.243	QP	39.20	0.36	39.56	61.98	-22.42
0.243	Average	26.43	0.36	26.79	51.98	-25.19
1.558	QP	37.38	0.15	37.53	56.00	-18.47
1.558	Average	32.17	0.15	32.32	46.00	-13.68
1.989	QP	36.42	0.16	36.58	56.00	-19.42
1.989	Average	27.27	0.16	27.43	46.00	-18.57

Project No	: TM-2406000276P	Test Date	: 2024-07-11
Operation Mode	: BT	Temp./Humi.	: 23.4°C / 54%
Test Chamber	: Conduction	Engineer	: Ben Yang
Probe	: LINE	Test Voltage	: AC 120V/60Hz
Note	: Mode 2		



Freq.	Detector Mode	Spectrum Read Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV	dBµV	dB
0.160	QP	54.08	0.18	54.26	65.44	-11.18
0.160	Average	40.46	0.18	40.64	55.44	-14.80
0.167	QP	54.45	0.22	54.67	65.09	-10.42
0.167	Average	39.75	0.22	39.97	55.09	-15.12
0.178	QP	54.47	0.28	54.75	64.59	-9.84
0.178	Average	38.64	0.28	38.92	54.59	-15.67
0.204	QP	46.70	0.39	47.09	63.46	-16.37
0.204	Average	31.68	0.39	32.07	53.46	-21.39
0.217	QP	44.62	0.39	45.01	62.92	-17.91
0.217	Average	30.51	0.39	30.90	52.92	-22.02
0.331	QP	35.60	0.38	35.98	59.43	-23.45
0.331	Average	29.86	0.38	30.24	49.43	-19.19

Project No	: TM-2406000276P	Test Date	: 2024-07-11
Operation Mode	: BT	Temp./Humi.	: 23.4°C / 54%
Test Chamber	: Conduction	Engineer	: Ben Yang
Probe	: NEUTRAL	Test Voltage	: AC 120V/60Hz
Note	: Mode 2		



Freq.	Detector Mode	Spectrum Read Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV	dBµV	dB
0.152	QP	55.64	0.12	55.76	65.86	-10.10
0.152	Average	38.70	0.12	38.82	55.86	-17.04
0.165	QP	52.62	0.18	52.80	65.22	-12.42
0.165	Average	35.18	0.18	35.36	55.22	-19.86
0.185	QP	49.99	0.29	50.28	64.27	-13.99
0.185	Average	33.02	0.29	33.31	54.27	-20.96
0.241	QP	40.42	0.36	40.78	62.05	-21.27
0.241	Average	29.25	0.36	29.61	52.05	-22.44
1.543	QP	37.40	0.15	37.55	56.00	-18.45
1.543	Average	32.65	0.15	32.80	46.00	-13.20
2.000	QP	36.62	0.16	36.78	56.00	-19.22
2.000	Average	28.32	0.16	28.48	46.00	-17.52

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

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.

4.2.4 Test Result

Temperature:	23.6~24.4℃	**Test date:**	July 2~3, 2024
Humidity:	54~55% RH	**Tested by:**	David Li

20dB BANDWIDTH

GFSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	0.9621	0.64
Mid	0.9646	0.64
High	0.962	0.64

π/4-DQPSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.333	0.89
Mid	1.334	0.89
High	1.333	0.89

8-DPSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.313	0.88
Mid	1.314	0.88
High	1.312	0.87

BANDWIDTH 99%

GFSK

CH	99% BW (MHz)
Low	0.87431
Mid	0.87762
High	0.87438

π/4-DQPSK

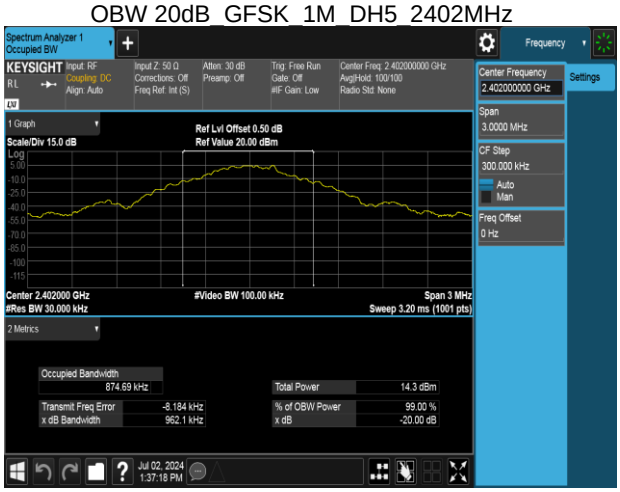
CH	99% BW (MHz)
Low	1.1868
Mid	1.1878
High	1.1874

8-DPSK

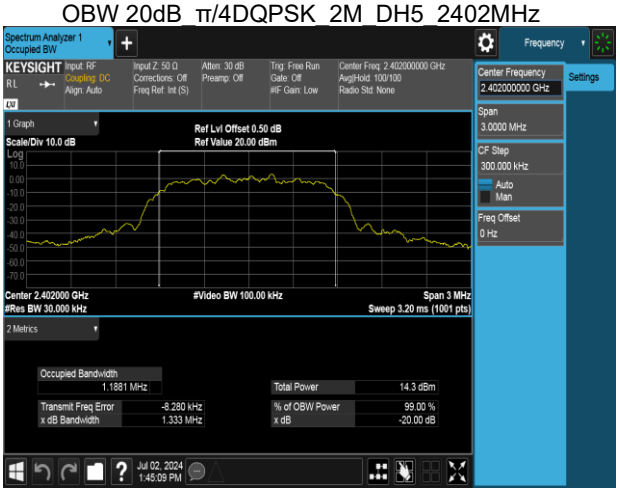
CH	99% BW (MHz)
Low	1.1899
Mid	1.1904
High	1.1908

Test Data
20dB BANDWIDTH

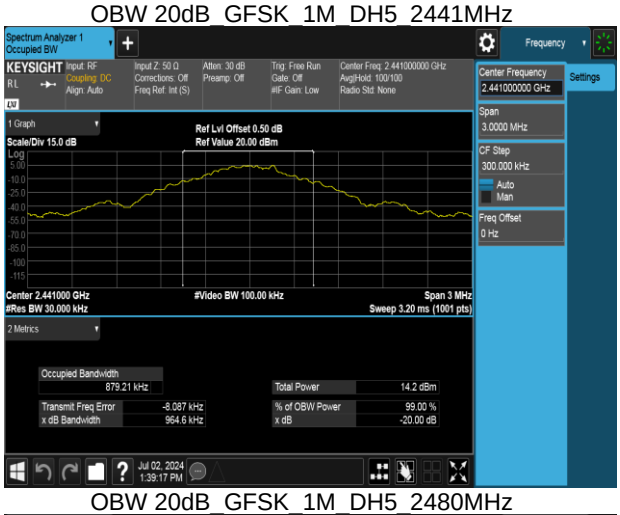
OBW 20dB_GFSK_1M_DH5_2402MHz



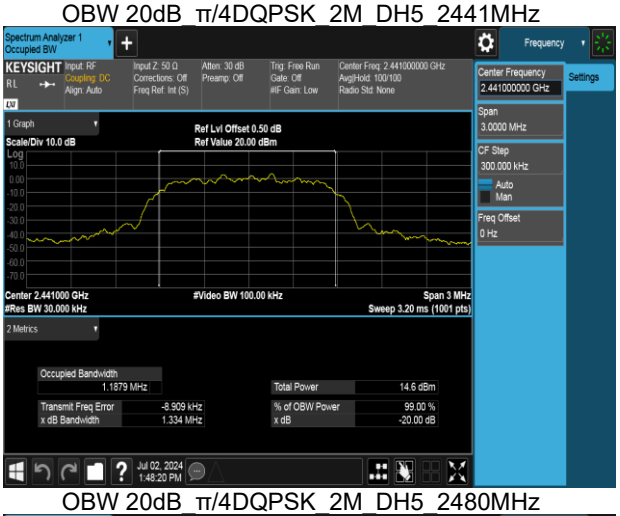
OBW 20dB_π/4DQPSK_2M_DH5_2402MHz



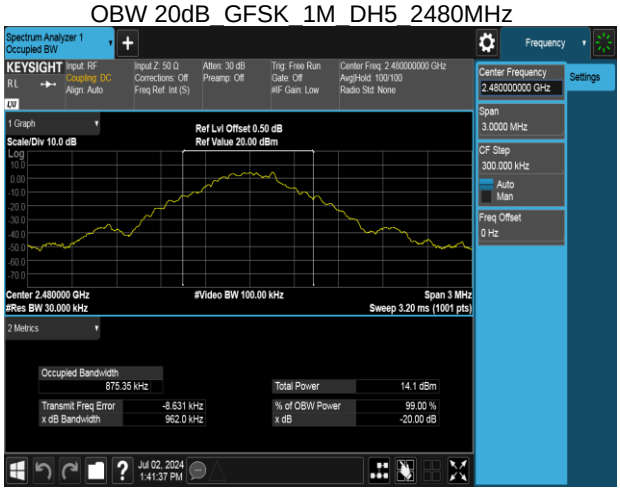
OBW 20dB_GFSK_1M_DH5_2441MHz



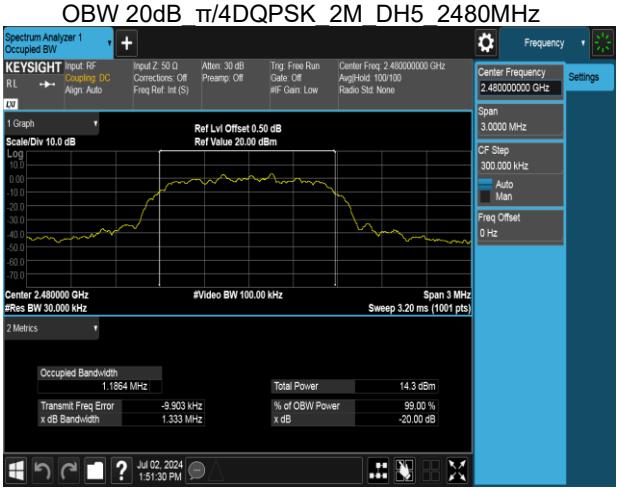
OBW 20dB_π/4DQPSK_2M_DH5_2441MHz



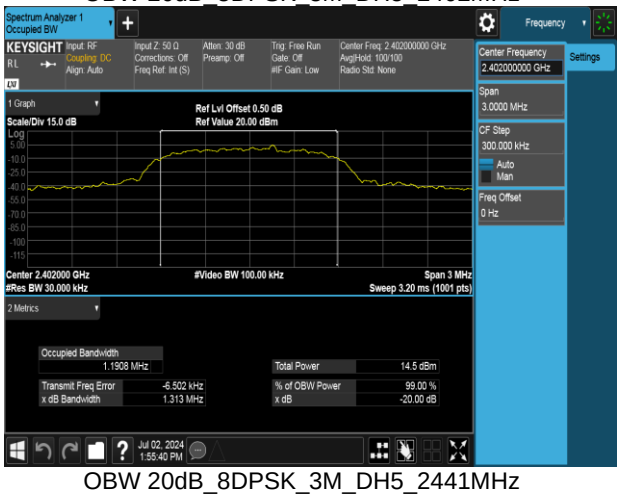
OBW 20dB_GFSK_1M_DH5_2480MHz



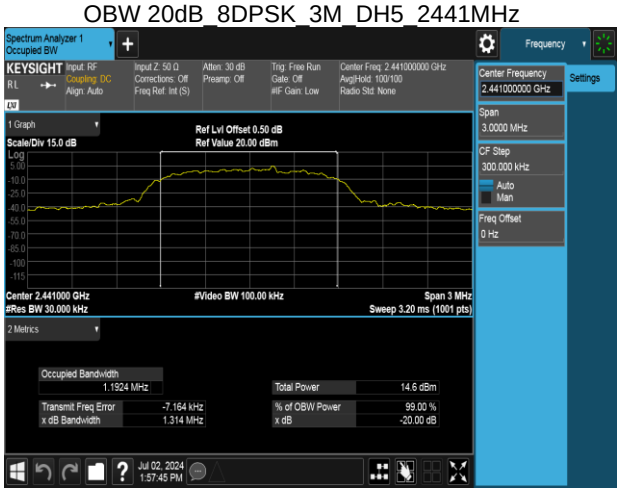
OBW 20dB_π/4DQPSK_2M_DH5_2480MHz



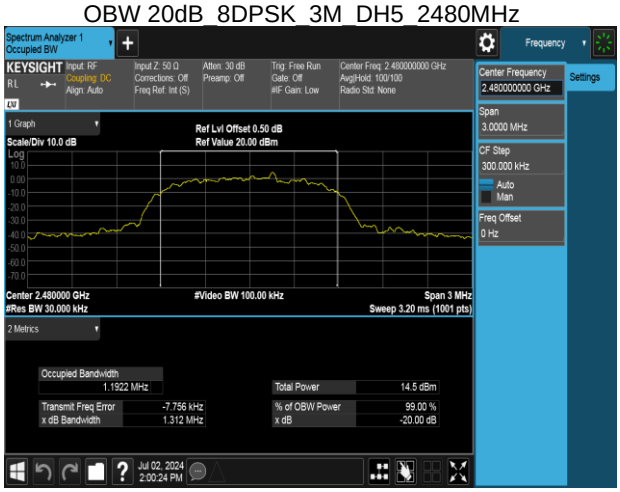
OBW 20dB_8DPSK_3M_DH5_2402MHz



OBW 20dB_8DPSK_3M_DH5_2441MHz



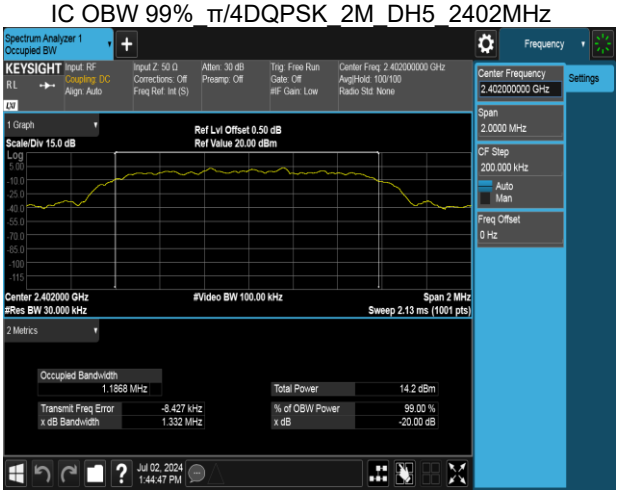
OBW 20dB_8DPSK_3M_DH5_2480MHz



Test Data
BANDWIDTH 99%

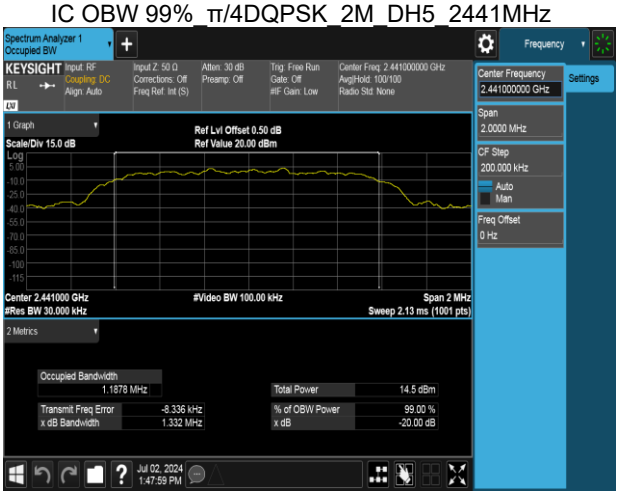
IC OBW 99%_GFSK_1M_DH5_2402MHz

IC OBW 99%_π/4DQPSK_2M_DH5_2402MHz

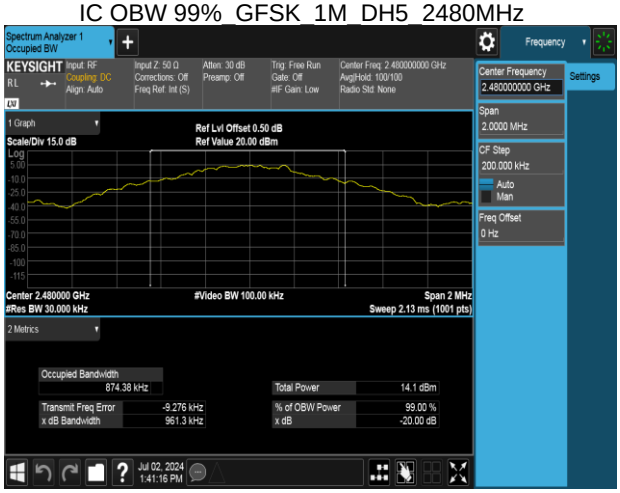


IC OBW 99%_GFSK_1M_DH5_2441MHz

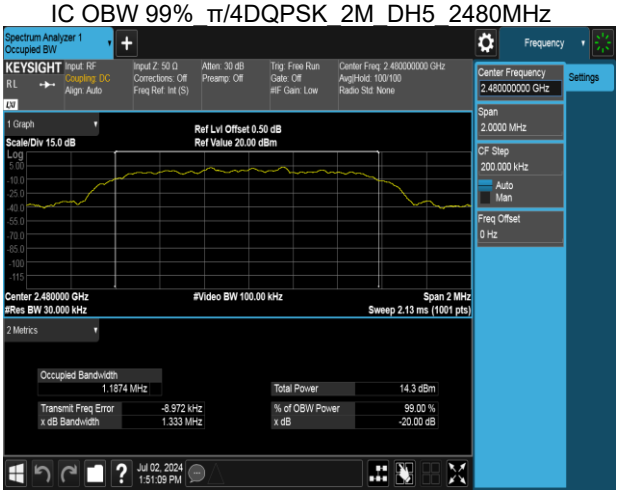
IC OBW 99%_π/4DQPSK_2M_DH5_2441MHz



IC OBW 99%_GFSK_1M_DH5_2480MHz

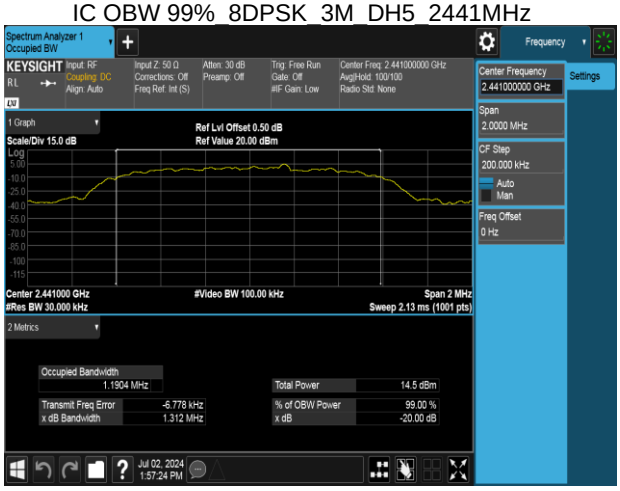


IC OBW 99%_π/4DQPSK_2M_DH5_2480MHz

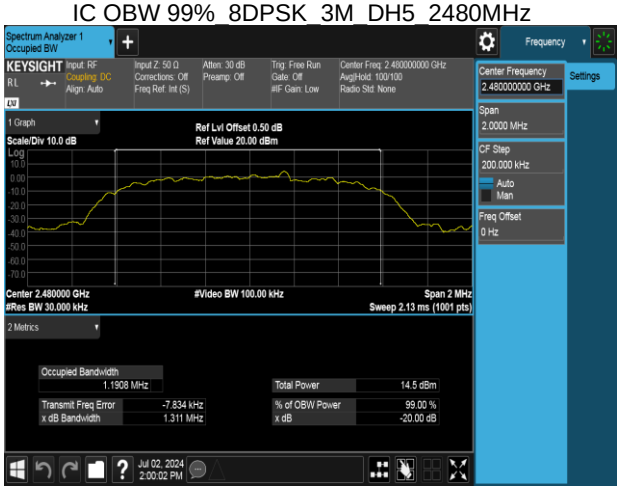


IC OBW 99%_8DPSK_3M_DH5_2402MHz

IC OBW 99%_8DPSK_3M_DH5_2441MHz



IC OBW 99%_8DPSK_3M_DH5_2480MHz



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.

4.3.4 Test Result

Temperature: 23.6~24.4℃ **Test date:** July 2~3, 2024

Humidity: 54~55% RH **Tested by:** David Li

Peak & Average output power：

1M BR mode (Peak):

CH	Freq. (MHz)	Power Setting	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	6	6.66	4.634	125
Mid	2441	7	6.79	4.775	125
High	2480	7	**6.90**	4.898	125

1M BR mode (Average):

CH	Freq. (MHz)	Power Setting	Avg. Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	6	6.56	4.533	125
Mid	2441	7	6.67	4.649	125
High	2480	7	6.78	4.769	125

2M EDR mode (Peak):

CH	Freq. (MHz)	Power Setting	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	10	9.26	8.433	125
Mid	2441	10	9.34	8.590	125
High	2480	10	**9.51**	8.933	125

2M EDR mode (Average):

CH	Freq. (MHz)	Power Setting	Avg. Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	10	6.63	4.599	125
Mid	2441	10	6.71	4.684	125
High	2480	10	6.89	4.882	125

3M EDR mode (Peak):

CH	Freq. (MHz)	Power Setting	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	10	9.73	9.397	125
Mid	2441	10	9.80	9.550	125
High	2480	10	**9.91**	9.795	125

3M EDR mode (Average):

CH	Freq. (MHz)	Power Setting	Avg. Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	10	6.62	4.596	125
Mid	2441	10	6.67	4.649	125
High	2480	10	6.81	4.802	125

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.

4.4.4 Test Result

Temperature: 23.6~24.4℃ **Test date:** July 2~3, 2024

Humidity: 54~55% RH **Tested by:** David Li

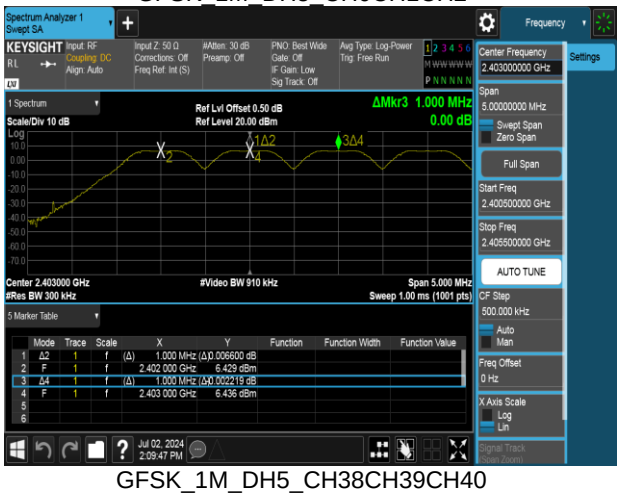
Test mode: GFSK_BDR-1Mbps mode / 2402-2480 MHz				
Channel	**Frequency (MHz)**	**Channel Separation (MHz)**	**Channel Separation Limits (MHz)**	**Result**
Low	2402	1.000	0.64	PASS
Mid	2441	1.000	0.64	PASS
High	2480	1.000	0.64	PASS

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	0.89	PASS
Mid	2441	1.000	0.89	PASS
High	2480	1.000	0.89	PASS

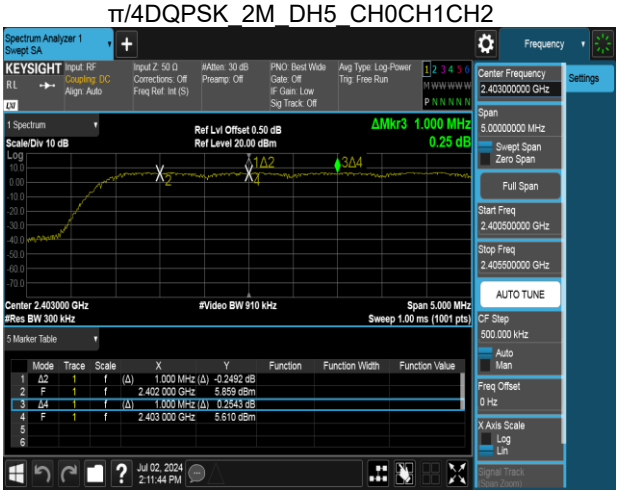
Test mode: 8DPSK_EDR-3Mbps mode / 2402-2480 MHz				
Channel	**Frequency (MHz)**	**Channel Separation (MHz)**	**Channel Separation Limits (MHz)**	**Result**
Low	2402	1.000	0.88	PASS
Mid	2441	1.000	0.88	PASS
High	2480	1.000	0.87	PASS

Test Data

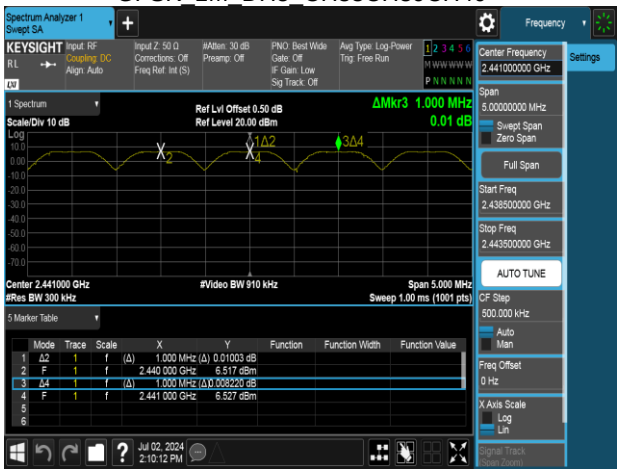
GFSK_1M_DH5_CH0CH1CH2



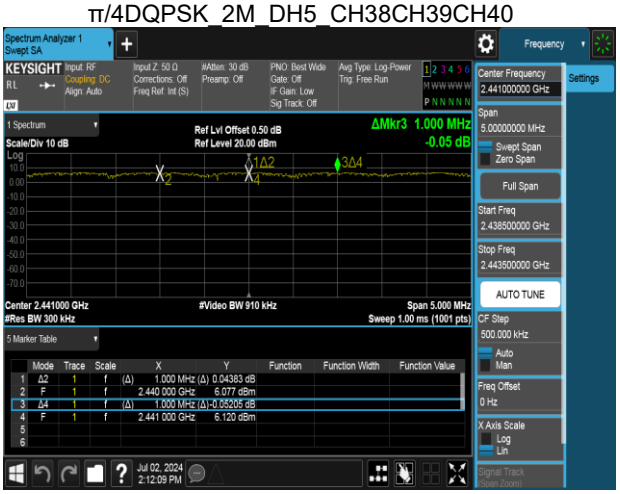
π/4DQPSK_2M_DH5_CH0CH1CH2



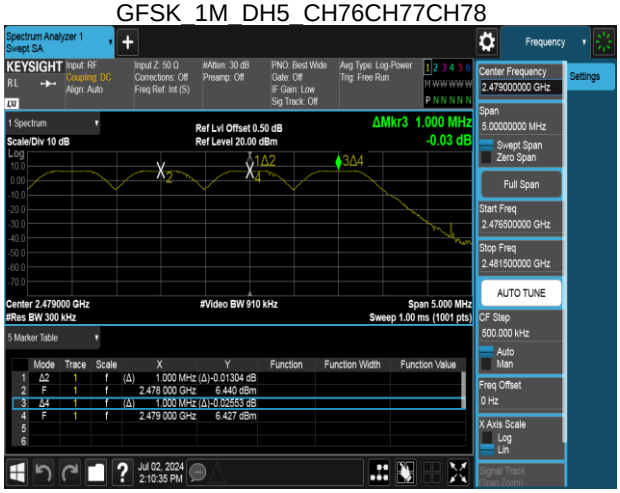
GFSK_1M_DH5_CH38CH39CH40



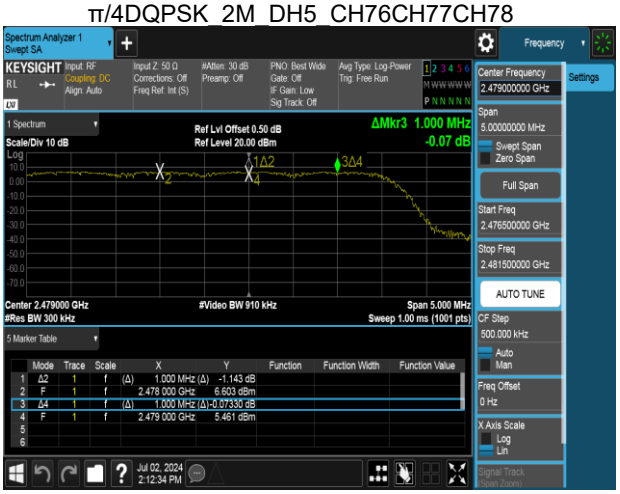
π/4DQPSK_2M_DH5_CH38CH39CH40



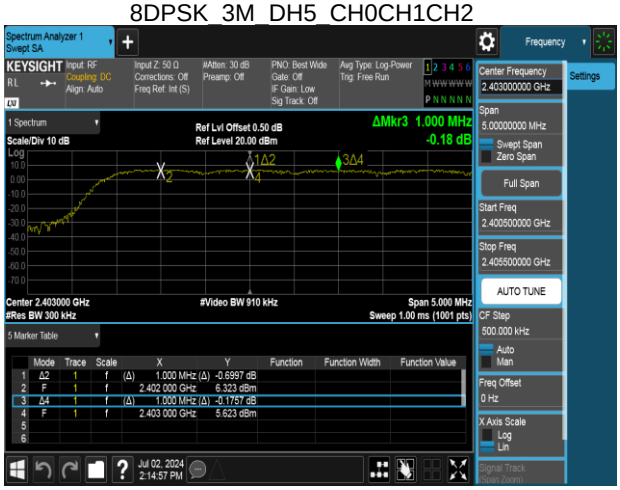
GFSK_1M_DH5_CH76CH77CH78



π/4DQPSK_2M_DH5_CH76CH77CH78

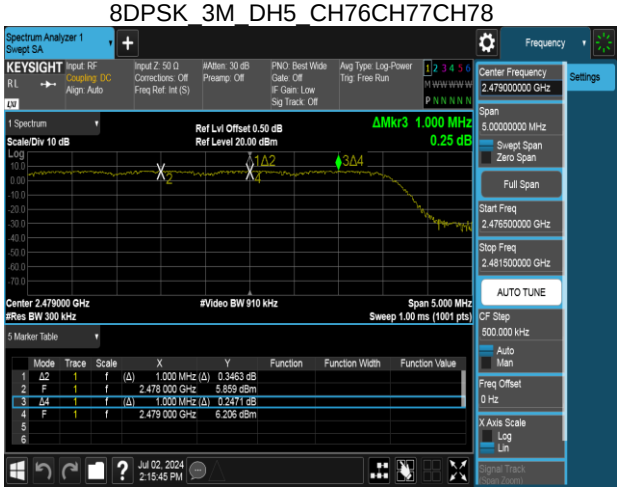


8DPSK_3M_DH5_CH0CH1CH2



8DPSK_3M_DH5_CH38CH39CH40

8DPSK_3M_DH5_CH76CH77CH78



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.

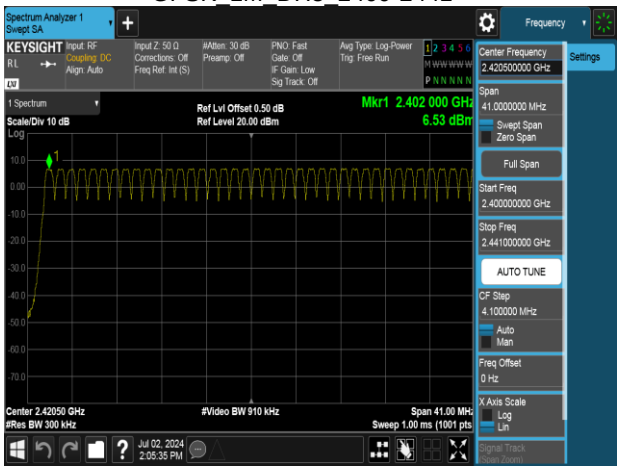
4.5.4 Test Result

Temperature:	23.6~24.4℃	**Test date:**	July 2~3, 2024
Humidity:	54~55% RH	**Tested by:**	David Li

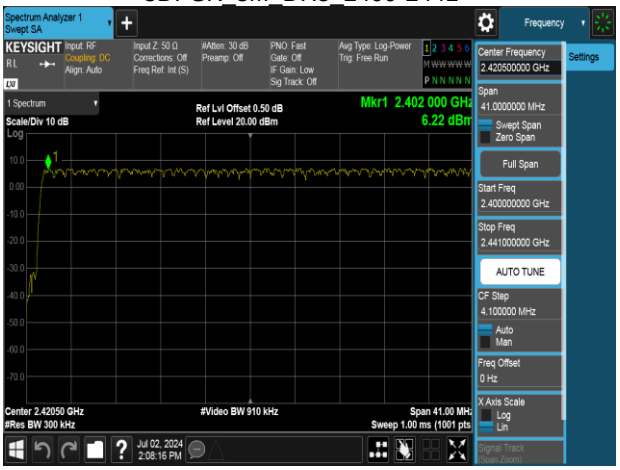
Number of Hopping				
Mode	**Frequency (MHz)**	**Hopping Channel Number**	**Hopping Channel Number Limits**	**Result**
BDR-1Mbps	2402-2480	79	15	Pass
EDR-3Mbps	2402-2480	79	15	

Test Data

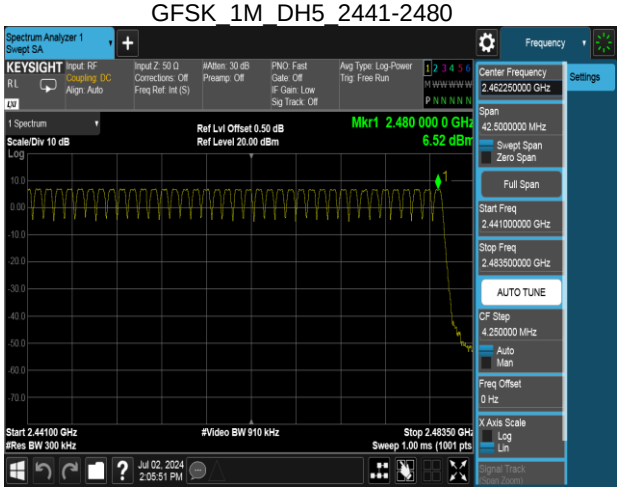
GFSK_1M_DH5_2400-2441



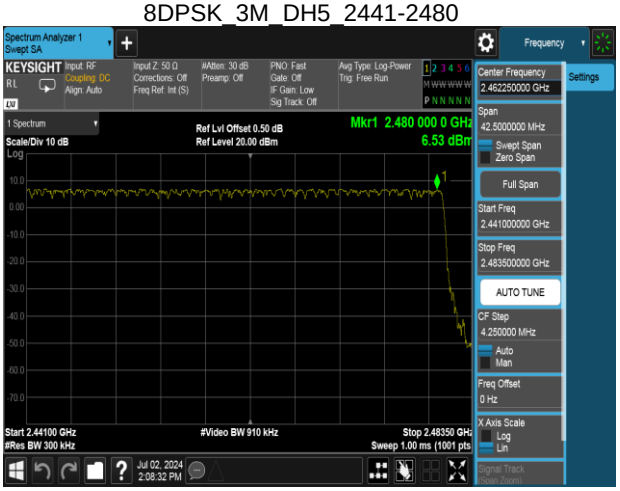
8DPSK_3M_DH5_2400-2441



GFSK_1M_DH5_2441-2480



8DPSK_3M_DH5_2441-2480



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:	23.6~24.4℃	**Test date:**	July 2~3, 2024
Humidity:	54~55% RH	**Tested by:**	David Li

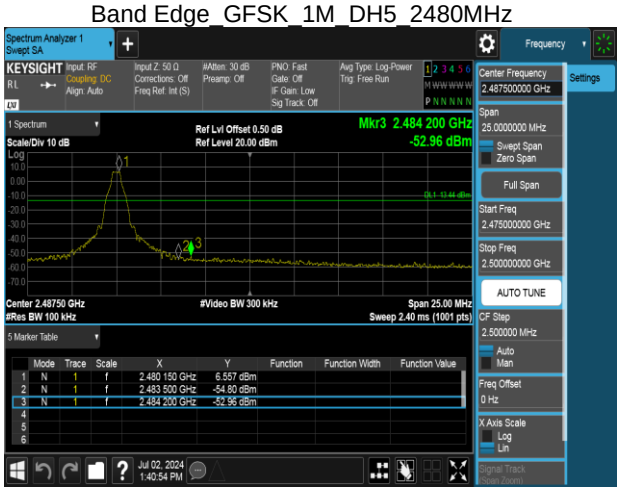
Test Data

Bandedge

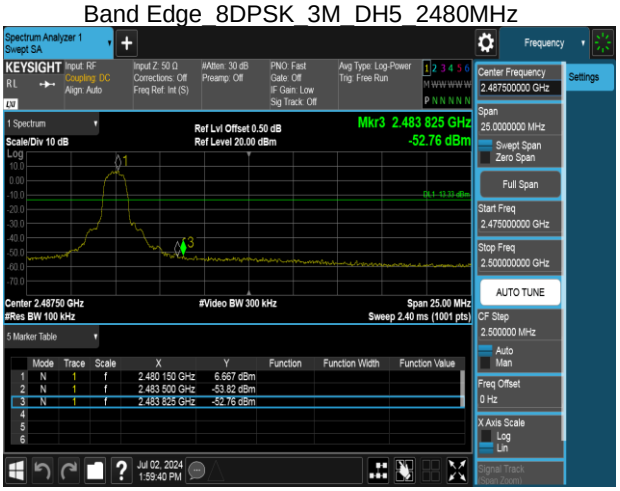
Band Edge_GFSK_1M_DH5_2402MHz

Band Edge_8DPSK_3M_DH5_2402MHz

Band Edge_GFSK_1M_DH5_2480MHz



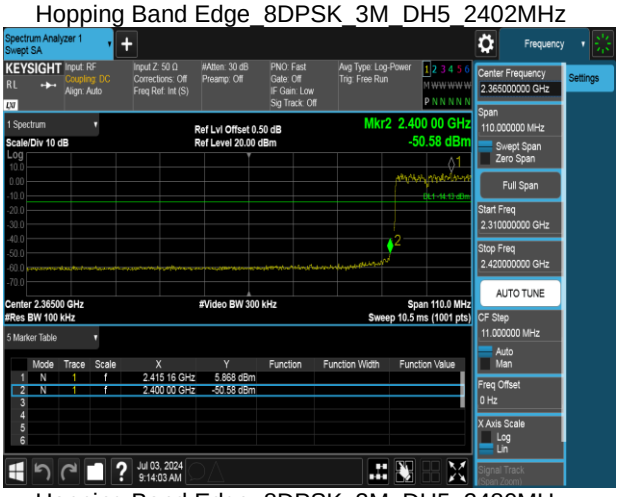
Band Edge_8DPSK_3M_DH5_2480MHz



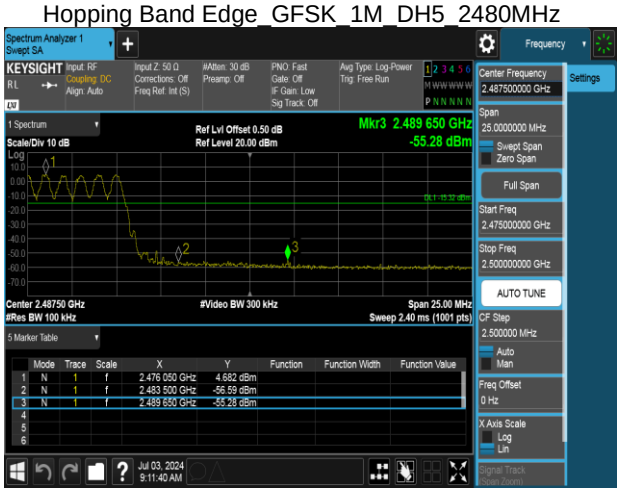
Hopping mode

Hopping Band Edge_GFSK_1M_DH5_2402MHz

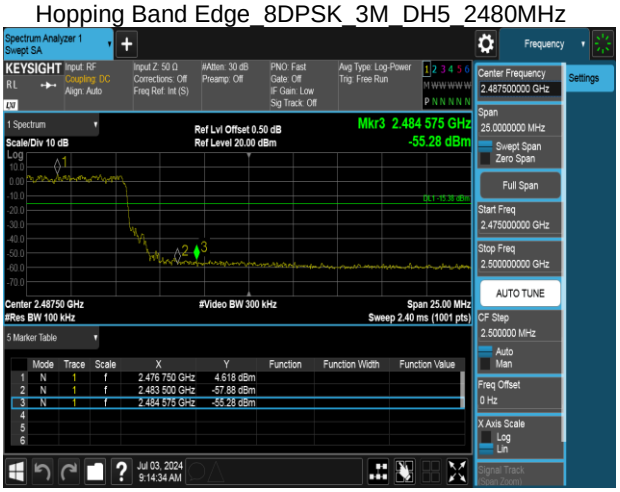
Hopping Band Edge_8DPSK_3M_DH5_2402MHz



Hopping Band Edge_GFSK_1M_DH5_2480MHz

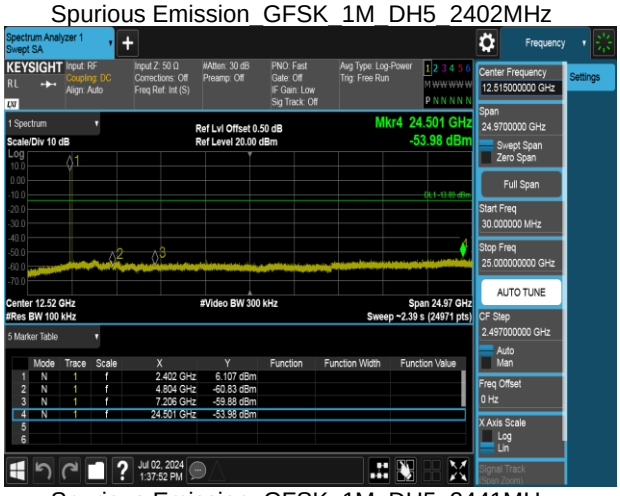


Hopping Band Edge_8DPSK_3M_DH5_2480MHz

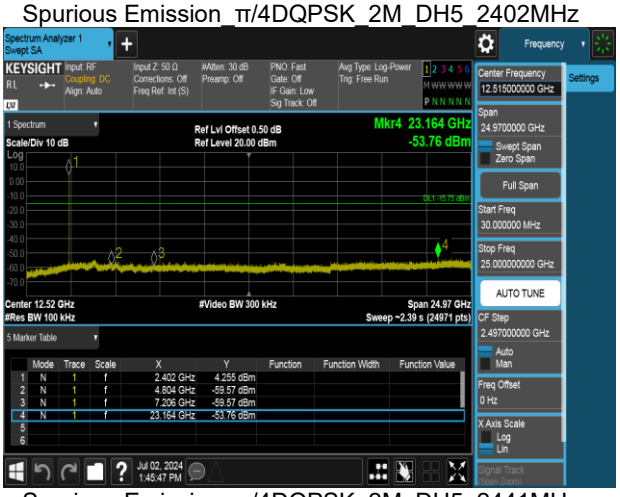


Spurious Emission

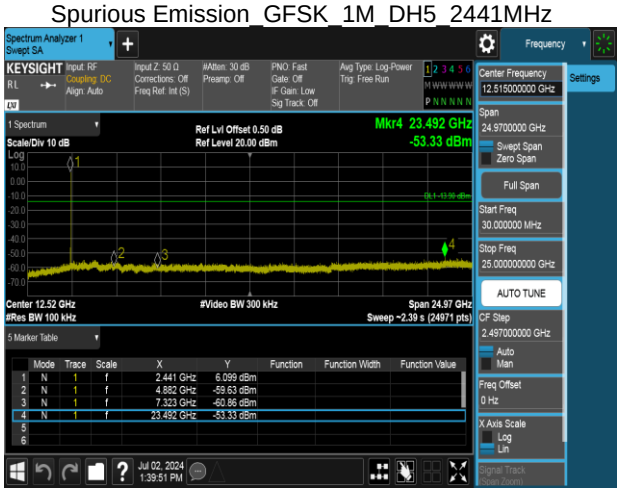
Spurious Emission_GFSK_1M_DH5_2402MHz



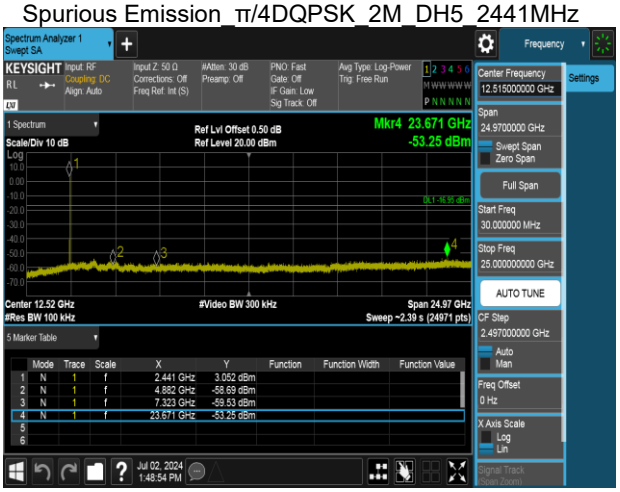
Spurious Emission_π/4DQPSK_2M_DH5_2402MHz



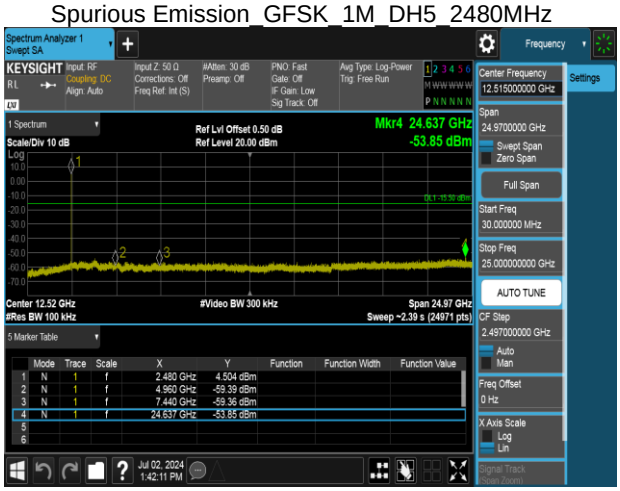
Spurious Emission_GFSK_1M_DH5_2441MHz



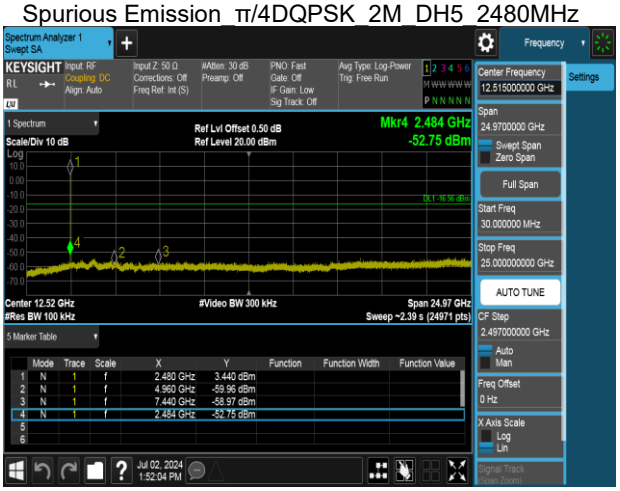
Spurious Emission_π/4DQPSK_2M_DH5_2441MHz



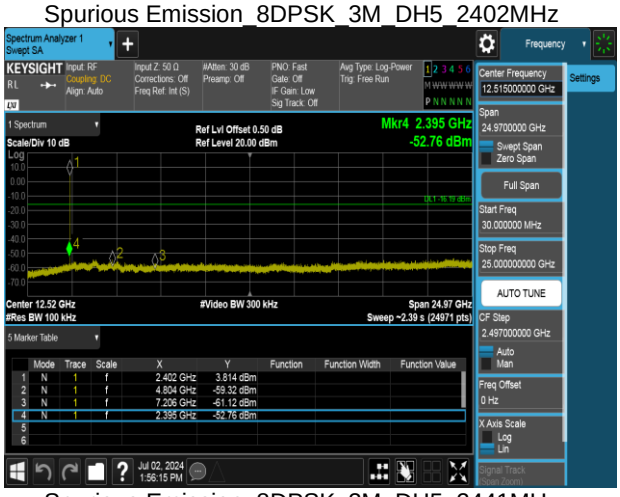
Spurious Emission_GFSK_1M_DH5_2480MHz



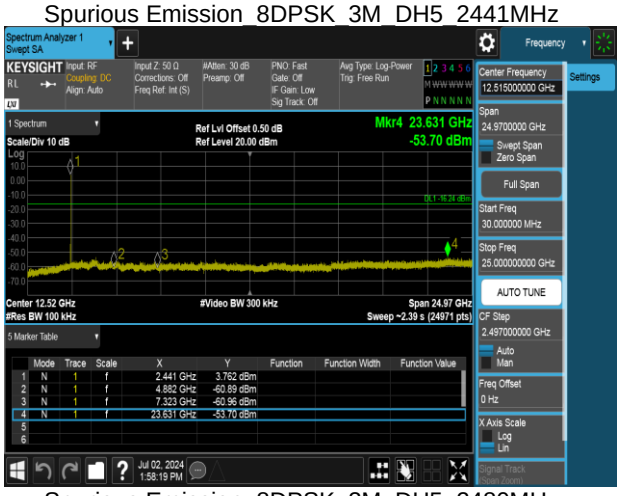
Spurious Emission_π/4DQPSK_2M_DH5_2480MHz



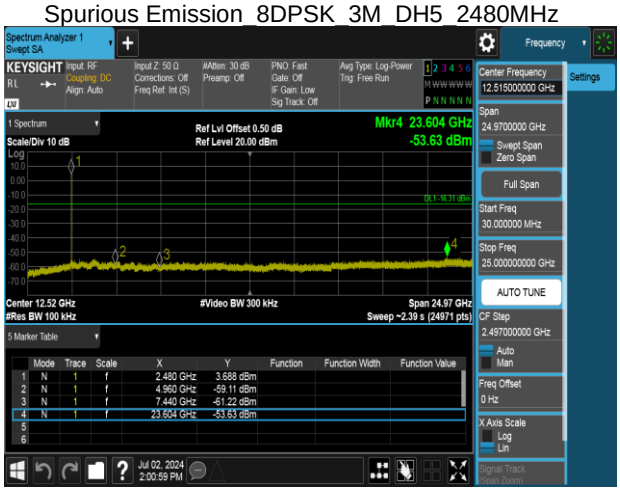
Spurious Emission_8DPSK_3M_DH5_2402MHz



Spurious Emission_8DPSK_3M_DH5_2441MHz



Spurious Emission_8DPSK_3M_DH5_2480MHz



4.7 TIME OF OCCUPANCY (DWELL TIME)

4.7.1 Test Limit

According to §15.247(a)(1)(iii)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

4.7.2 Test Procedure

1. EUT RF output port connected to the SA by RF cable.

2. Set center frequency of spectrum analyzer = operating frequency.

3. Set the spectrum analyzer as RBW=1MHz, VBW=3MHz, Sweep = 5 ms ~15ms (Depends on signal characteristics)

4.7.3 Test Setup

Refer to section 1.9.

4.7.4 Test Result

Temperature: 23.6~24.4℃ **Test date:** July 2~3, 2024

Humidity: 54~55% RH **Tested by:** David Li

GFSK (1Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)
Mid	DH1	124.80	400
	DH3	262.40	400
	DH5	308.80	400

π/4 DQPSK (2Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)
Mid	2DH1	124.80	400
	2DH3	262.40	400
	2DH5	307.20	400

8-DPSK (3Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)
Mid	3DH1	123.20	400
	3DH3	260.80	400
	3DH5	308.80	400

GFSK (1Mbps):

CH Mid	DH1 time slot	=	0.390	*	(1600/2/79)	*	31.6	=	124.80 (ms)
	DH3 time slot	=	1.640	*	(1600/4/79)	*	31.6	=	262.40 (ms)
	DH5 time slot	=	2.895	*	(1600/6/79)	*	31.6	=	308.80 (ms)

π/4 -DQPSK (2Mbps):

CH Mid	2DH1 time slot	=	0.390	*	(1600/2/79)	*	31.6	=	124.80 (ms)
	2DH3 time slot	=	1.640	*	(1600/4/79)	*	31.6	=	262.40 (ms)
	2DH5 time slot	=	2.880	*	(1600/6/79)	*	31.6	=	307.20 (ms)

8-DPSK (3Mbps):

CH Mid	3DH1 time slot	=	0.385	*	(1600/2/79)	*	31.6	=	123.20 (ms)
	3DH3 time slot	=	1.630	*	(1600/4/79)	*	31.6	=	260.80 (ms)
	3DH5 time slot	=	2.895	*	(1600/6/79)	*	31.6	=	308.80 (ms)

A period time = 0.4 (s) * 79 = 31.6 (s)

GFSK (1Mbps) for AFH Mode			
Hopping Channel Number	**PACKET TYPE**	**Measurement Result (ms)**	**Limit (ms)**
20	DH5	154.40	400
π/4 DQPSK (2Mbps) for AFH Mode			
Hopping Channel Number	**PACKET TYPE**	**Measurement Result (ms)**	**Limit (ms)**
20	2DH5	153.60	400
8-DPSK (3Mbps) for AFH Mode			
Hopping Channel Number	**PACKET TYPE**	**Measurement Result (ms)**	**Limit (ms)**
20	3DH5	154.40	400

GFSK (1Mbps):
DH5 time slot = 2.895 (ms) * (800/6/20) * 8 = 154.40 (ms)

π/4 -DQPSK (2Mbps):
2DH5 time slot = 2.880 (ms) * (800/6/20) * 8 = 153.60 (ms)

8-DPSK (3Mbps):
3DH5 time slot = 2.895 (ms) * (800/6/20) * 8 = 154.40 (ms)

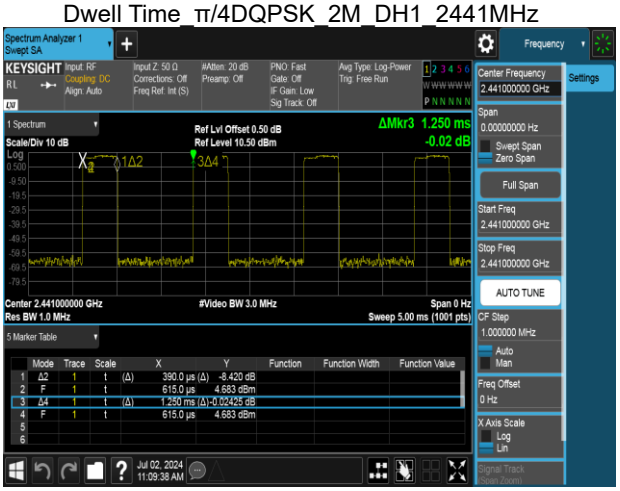
A period time = 0.4 (s) * 20 = 8 (s)

Note: Based on normal hopping, the DH5 type has worse results than DH1, so only DH5 is recorded.

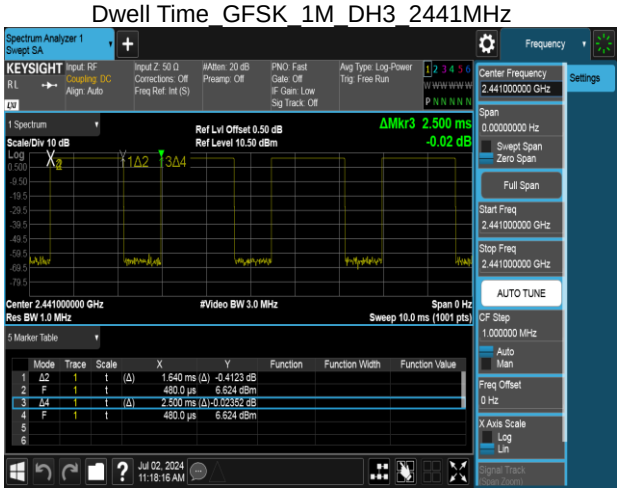
Test Data

Dwell Time_GFSK_1M_DH1_2441MHz

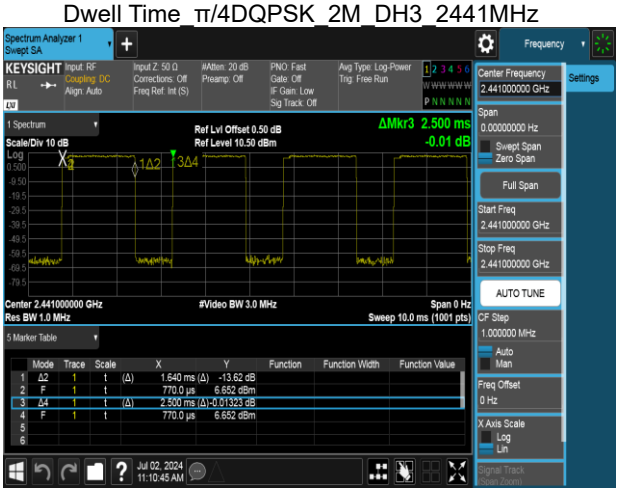
Dwell Time_π/4DQPSK_2M_DH1_2441MHz



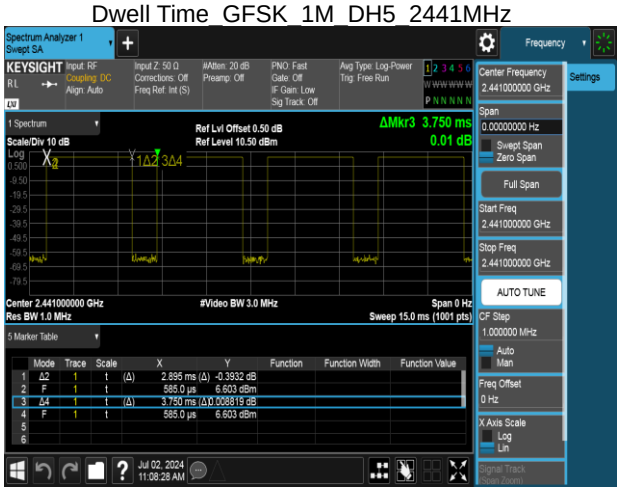
Dwell Time_GFSK_1M_DH3_2441MHz



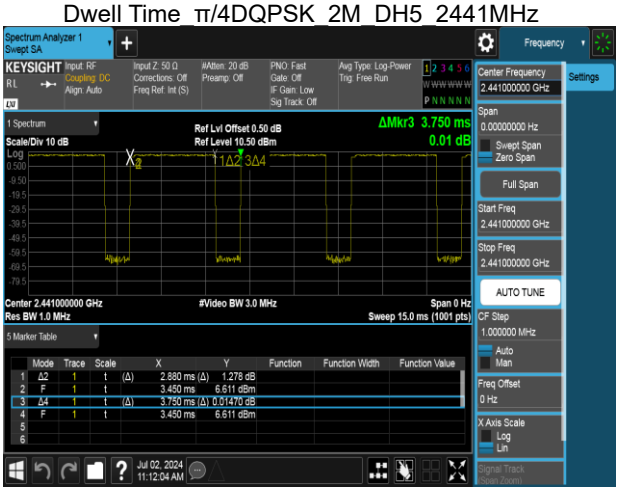
Dwell Time_π/4DQPSK_2M_DH3_2441MHz



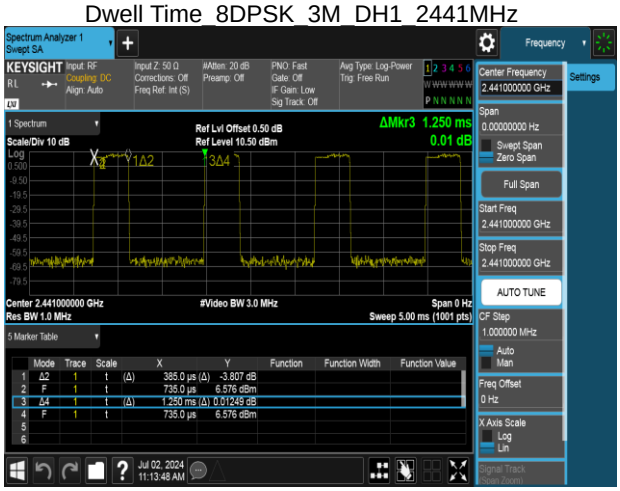
Dwell Time_GFSK_1M_DH5_2441MHz



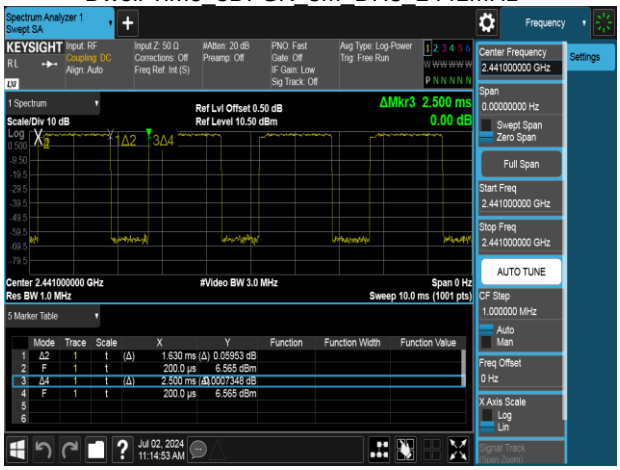
Dwell Time_π/4DQPSK_2M_DH5_2441MHz



Dwell Time_8DPSK_3M_DH1_2441MHz



Dwell Time_8DPSK_3M_DH3_2441MHz



Dwell Time_8DPSK_3M_DH5_2441MHz