FCC Part 15.247

TEST REPORT

For

Hangzhou Demax Industry Co.,Ltd.

17D-E Richful trade plaza,258 Middle Zhonghe Road, Hangzhou,China

FCC ID: 2AL7C78220

Report Type: Original Report	**Product Type:** Headband earmuff with Bluetooth/FM radio

Report Producer : Eva Kao

Report Number : RXZ220614004RF01

Report Date : 2022-08-04

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Revision History

Revision	No.	Report Number	Issue Date	Description	Author/ Revised by
0.0	RXZ220614004	RXZ220614004RF01	2022-08-04	Original Report	Eva Kao

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1. General Information

1.1. Product Description for Equipment under Test (EUT)

Manufacturer	Hangzhou Demax Industry Co.,Ltd. 17D-E Richful trade plaza,258 Middle Zhonghe Road, Hangzhou,China
Brand(Trade) Name	N/A
Product (Equipment)	Headband earmuff with Bluetooth/FM radio
Main Model Name	78220
Series Model Name	78219
Model Discrepancy	78220 includes Bluetooth and FM, 78219 includes Bluetooth only. The model 78220 is the testing sample, and the final test data are shown on this test report.
Frequency Range	2402 ~ 2480 MHz
Transmit Power	2.78 dBm
Modulation Technique	BR Mode: GFSK EDR Mode: π/4-DQPSK
Transmit Data Rate	BR(GFSK) Mode: 1 Mbps EDR(π/4-DQPSK) Mode: 2 Mbps
Power Operation (Voltage Range)	4.5Vdc from AAA Battery*3
Received Date	2022/6/15
Date of Test	2022/6/25 ~ 2022/8/3

*All measurement and test data in this report was gathered from production sample serial number: RXZ220614004-01 (Assigned by BACL, New Taipei Laboratory).

1.2. Objective

This report is prepared on behalf of *Hangzhou Demax Industry Co.,Ltd.* in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communication Commission's rules.
The tests were performed in order to determine the Bluetooth BR and EDR mode of EUT compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

1.3. Related Submittal(s)/Grant(s)

N/A.

1.4. Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

1.5. Statement

Decision Rule: No, (The test results do not include MU judgment)

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Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.
Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.
The determination of the test results does not require consideration of the uncertainty of the measurement, unless the assessment is required by customer agreement, regulation or standard document specification.
Bay Area Compliance Laboratories Corp. (New Taipei Laboratory) is not responsible for the authenticity of the information provided by the applicant that affects the test results.

1.6. Measurement Uncertainty

Parameter		Uncertainty
AC Mains		±2.36 (dB)
RF output power, conducted		±0.93 (dB)
Power Spectral Density, conducted		±0.92 (dBm/kHz)
Occupied Bandwidth		±0.35 (MHz)
Unwanted Emissions, conducted		±1.69 (dB)
Emissions, radiated	30 MHz~1GHz	±5.22(dB)
	1 GHz~18 GHz	±6.12(dB)
	18 GHz~40 GHz	±4.99(dB)
Temperature		+/- 1.27 °C
Humidity		+/- 3 %

1.7. Environmental Conditions

Test Site	Test Date	Temperature (℃)	Relative Humidity (%)	ATM Pressure (hPa)	Test Engineer
AC Line Conducted Emissions	2022/7/6	23.8	44	1010	Andy Cheng
Radiation Spurious Emissions	2022/6/28	23.8	61	1010	Jim Chen
Conducted Spurious Emissions	2022/8/3	25.4	51	1010	Boris Kao
20 dB Emission Bandwidth	2022/8/3	25.4	51	1010	Boris Kao
Channel Separation Test	2022/8/3	25.4	51	1010	Boris Kao
Time of Occupancy	2022/8/3	25.4	51	1010	Boris Kao
Quantity of hopping channel	2022/8/3	25.4	51	1010	Boris Kao
Maximum Output Power	2022/8/3	25.4	51	1010	Boris Kao
100 kHz Bandwidth of Frequency Band Edge	2022/8/3	25.4	51	1010	Boris Kao

1.8. Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (New Taipei Laboratory) to collect test data is located on

☒70, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

Bay Area Compliance Laboratories Corp. (New Taipei Laboratory) is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 3732) and the FCC designation No.TW3732 under the Mutual Recognition Agreement (MRA) in FCC Test.

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2. System Test Configuration

2.1. Description of Test Configuration

For BT mode, 79 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	40	2442
1	2403	--	--
2	2404	76	2478
3	2405	77	2479
--	--	78	2480
39	2441	/	/

For BT Modes were tested with channel 0, 39 and 78.

The system was configured for testing in engineering mode, which was provided by manufacturer.

2.2. Equipment Modifications

No modification was made to the EUT.

2.3. EUT Exercise Software

The test software was used “FCC_assist_1.0.1.2”

Test Frequency		2402MHz	2441MHz	2480MHz
Power Level Setting	GFSK	6	6	6
	π/4-DQPSK	6	6	6

2.4. Test Mode

Model 1: 78220 for all test item.

2.5. Support Equipment List and Details

No.	Description	Manufacturer	Model	FCC	S/N
A	NB	DELL	E6410	DOC	8N7PXN1
B	Fixture	Waveshare	FT232	N/A	N/A

2.6. External Cable List and Details

No.	Description	Length	From	To
1	Data Cable	0.1m	NB	Fixture

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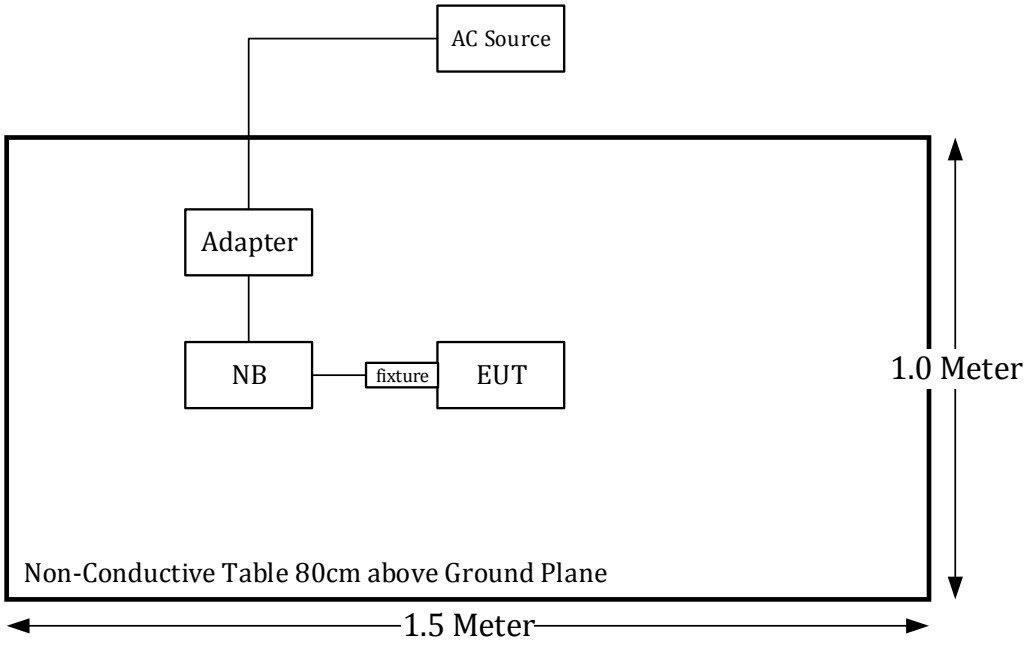
2.7. Block Diagram of Test Setup

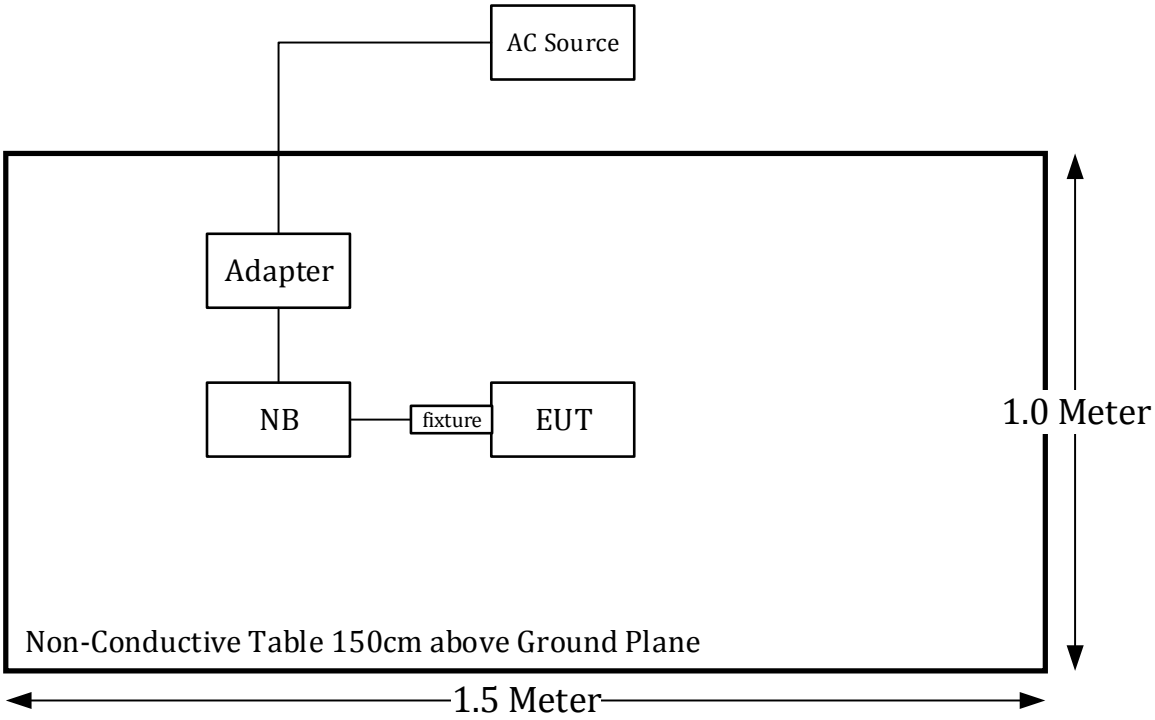
See test photographs attached in annex setup photos for the actual connections between EUT and support equipment.

Radiation:

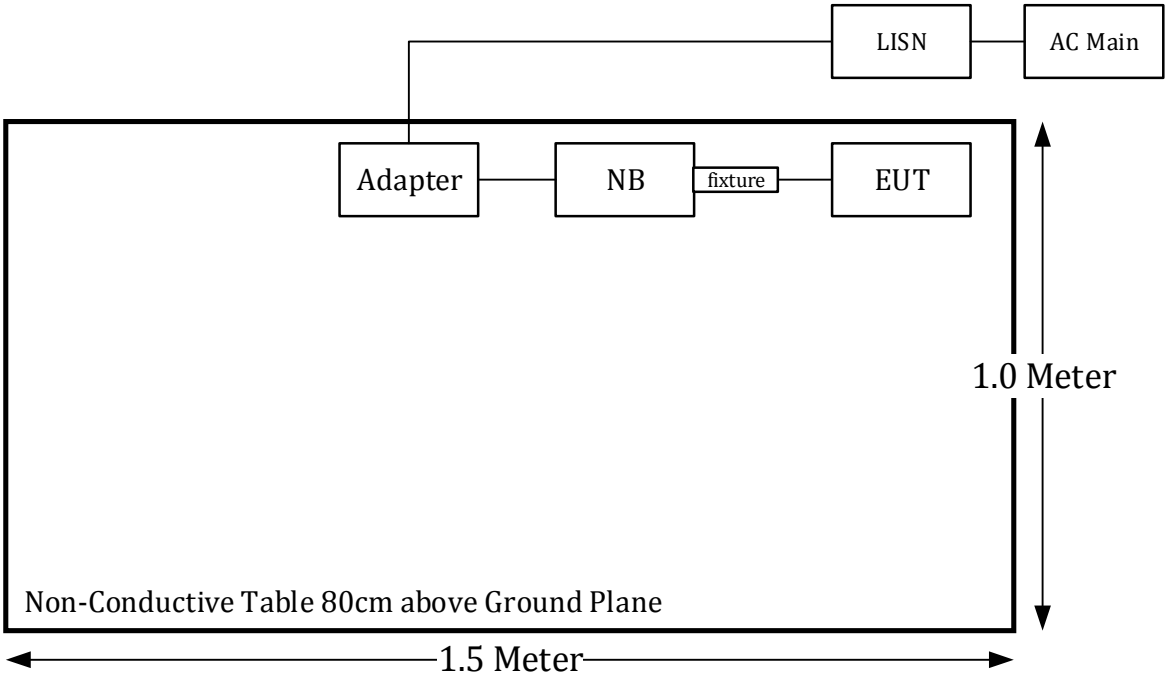
Below 1GHz:



Above 1GHz:



Conduction:


LISN
AC Main
Adapter
NB
fixture
EUT
1.0 Meter
Non-Conductive Table 80cm above Ground Plane
1.5 Meter

3. Summary of Test Results

FCC Rules	Description of Test	Results
§15.247(i), §1.1307(b)(3)(i)	RF Exposure	Compliance
§15.203	Antenna Requirement	Compliance
§15.207(a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247(a)(1)	20 dB Emission Bandwidth	Compliance
§15.247 (a)(1)	Channel Separation Test	Compliance
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliance
§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliance
§15.247(b)(1)	Maximum Peak Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance

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4. Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due Date
AC Line Conduction Room (CON-A)					
LISN	Rohde & Schwarz	ENV216	101612	2022/01/14	2023/01/13
EMI Test Receiver	Rohde & Schwarz	ESW8	100947	2021/7/23	2022/7/22
Pulse Limiter	Rohde & Schwarz	ESH3Z2	TXZEM104	2021/7/29	2022/7/28
RF Cable	EMEC	EM-CB5D	1	2022/6/7	2023/6/6
Software	AUDIX	E3	V9.150826k	N.C.R	N.C.R
Radiation 3M Room (966-A)					
Bilog Antenna with 6 dB Attenuator	SUNOL SCIENCES & MINI-CIRCUITS	JB6/UNAT-6+	A050115/15542_01	2022/02/14	2023/02/13
Horn Antenna	EMCO	3115	9809-55583	2021/8/26	2022/8/25
Horn Antenna	ETS-Lindgren	3116	62638	2021/8/11	2022/8/10
Preamplifier	Sonoma	310N	130602	2022/6/8	2023/6/7
Preamplifier	A.H. system Inc.	PAM-0118P	466	2021/11/4	2022/11/3
Microware Preamplifier	EM Electronics Corporation	EM18G40G	60656	2021/12/27	2022/12/26
Spectrum Analyzer	Rohde & Schwarz	FSV40	101435	2021/12/27	2022/12/26
EMI Test Receiver	Rohde & Schwarz	ESR7	101419	2021/11/9	2022/11/8
Micro flex Cable	UTIFLEX	UFB197C-1-2362-70U-70U	225757-001	2022/1/24	2023/1/23
Coaxial Cable	COMMATE	PEWC	8Dr	2021/12/24	2022/12/23
Coaxial Cable	UTIFLEX	UFB311A-Q-1440-300300	220490-006	2022/1/24	2023/1/23
Coaxial Cable	JUNFLON	J12J102248-00-B-5	AUG-07-15-044	2021/12/24	2022/12/23
Cable	EMC	EMC105-SM-SM-10000	201003	2022/1/24	2023/1/23
Coaxial Cable	ROSNOL	K1K50-UP0264-K1K50-450CM	160309-1	2022/1/24	2023/1/23
Coaxial Cable	ROSNOL	K1K50-UP0264-K1K50-50CM	15120-1	2022/1/18	2023/1/17
Software	Audix	e3	18621a bacl	N.C.R	N.C.R

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Conducted Room					
Spectrum Analyzer	Rohde & Schwarz	FSV40	101435	2022/1/13	2023/1/12
Cable	UTIFLEX	UFA210A	9435	2021/10/5	2022/10/4
Power Sensor	KEYSIGHT	U2021XA	MY54080018	2022/01/24	2023/01/23

***Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to the SI System of Units via the R.O.C. Center for Measurement Standards of the Electronics Testing Center, Taiwan (ETC) or to another internationally recognized National Metrology Institute (NMI), and were compliant with the current Taiwan Accreditation Foundation (TAF) requirements

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5. FCC §15.247(i), §1.1307(b)(3)(i) - RF Exposure

5.1. Applicable Standard

According to subpart 15.247(i) and subpart §1.1307(b)(3)(i), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

For single RF sources (*i.e.*, any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2) of this section): A single RF source is exempt if:

(A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

(B) Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold *Pth* (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). *Pth* is given by:

$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \text{cm})^x & d \le 20\ \text{cm} \\ ERP_{20\ cm} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20\ cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases}$$

5.2. RF Exposure Evaluation Result

Band	Freq (MHz)	Tune-up Power (dBm)	Ant Gain (dBi)	Distances (mm)	Tune-up Power (mW)	ERP (dBm)	ERP (mW)
BT	2480	3	0	5	2.00	0.85	1.22

Option A

The available maximum time-averaged power is no more than 1 mW

Band	Freq (MHz)	Result Option A
BT	2480	not exempt

Option B

The available maximum time-averaged power or effective radiated power (ERP), whichever is greater.

This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive).

Band	Freq (MHz)	Pth (mW)	X	ERP 20cm (mW)	Ratio	Result Option B
BT	2480	2.72	1.905	3060	0.73	exempt

Result: The EUT meets exemption requirement.

6. FCC §15.203 – Antenna Requirements

6.1. Applicable Standard

According to § 15.203,

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 of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna does not exceed 6dBi.

6.2. Antenna Information

Manufacturer	Model	Type	Antenna Gain
N/A	N/A	PCB Antenna	0 dBi

Result: Compliance

7. FCC §15.207(a) – AC Line Conducted Emissions

7.1. Applicable Standard

According to §15.207

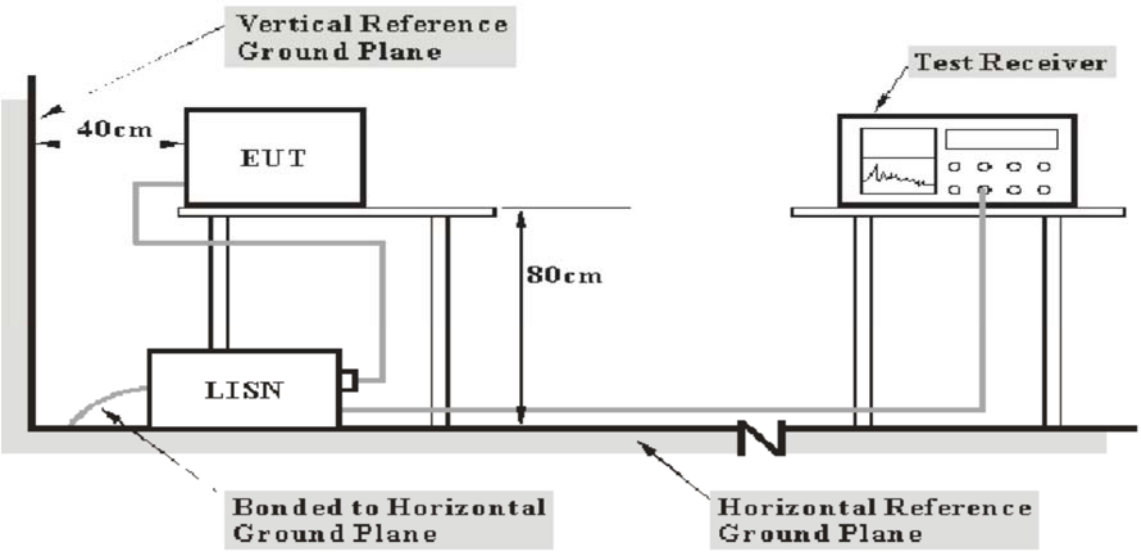
For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 Note 1	56 to 46 Note 2
0.5-5	56	46
5-30	60	50

Note 1: Decreases with the logarithm of the frequency.

Note 2: A linear average detector is required

7.2. EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

7.3. EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150kHz to 30MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations

Frequency Range	IF B/W
150kHz – 30MHz	9kHz

7.4. Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

7.5. Corrected Factor & Margin Calculation

The factor is calculated by adding LISN/ISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

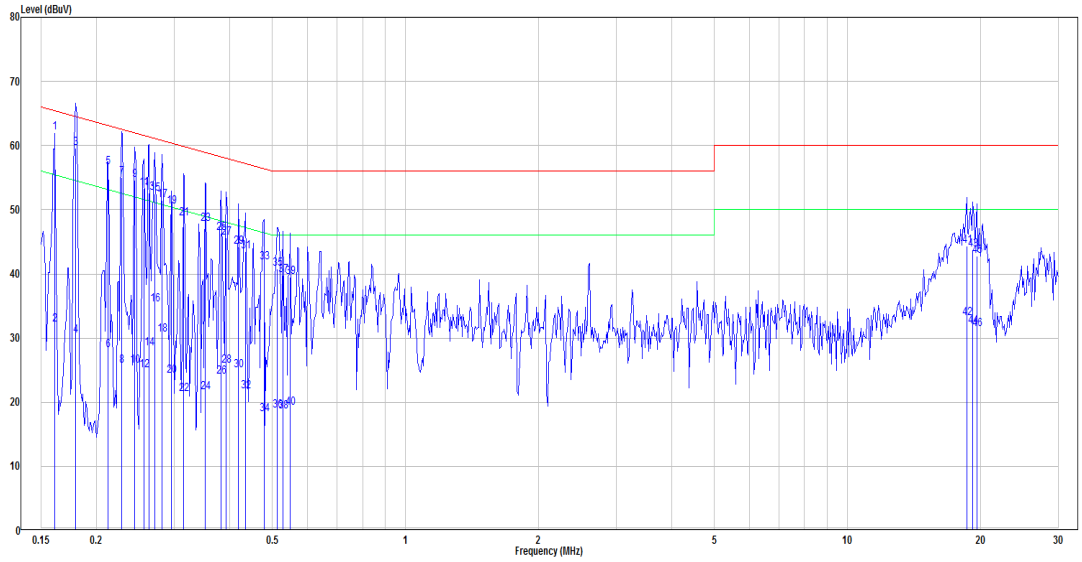
The “Over Limit” column of the following data tables indicates the degree of compliance with the applicable limit. For example, an over limit of -7 dB means the emission is 7 dB below the limit. The equation for Over Limit calculation is as follows:

Over Limit = Level – Limit Line

7.6. Test Results

Test Mode: Transmitting

Main: AC120 V, 60 Hz, Line



No.	Frequency	Reading	Correct	Result	Limit	Over limit	Remark	Phase
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)		
1	0.161	42.52	19.52	62.04	65.43	-3.39	QP	Line
2	0.161	12.63	19.52	32.15	55.43	-23.28	Average	Line
3	0.180	40.02	19.52	59.54	64.50	-4.97	QP	Line
4	0.180	10.89	19.52	30.41	54.50	-24.10	Average	Line
5	0.213	37.11	19.52	56.63	63.10	-6.47	QP	Line
6	0.213	8.61	19.52	28.13	53.10	-24.96	Average	Line
7	0.228	35.56	19.52	55.08	62.52	-7.44	QP	Line
8	0.228	6.22	19.52	25.74	52.52	-26.78	Average	Line
9	0.244	35.14	19.52	54.66	61.95	-7.29	QP	Line
10	0.244	6.20	19.52	25.72	51.95	-26.23	Average	Line
11	0.256	33.75	19.52	53.27	61.56	-8.28	QP	Line
12	0.256	5.48	19.52	25.00	51.56	-26.55	Average	Line
13	0.263	33.06	19.52	52.59	61.34	-8.75	QP	Line
14	0.263	8.84	19.52	28.36	51.34	-22.98	Average	Line
15	0.272	32.93	19.52	52.46	61.07	-8.61	QP	Line
16	0.272	15.65	19.52	35.17	51.07	-15.90	Average	Line
17	0.282	31.91	19.52	51.43	60.76	-9.33	QP	Line
18	0.282	11.02	19.52	30.54	50.76	-20.22	Average	Line
19	0.296	30.90	19.52	50.42	60.37	-9.95	QP	Line

20	0.296	4.54	19.52	24.06	50.37	-26.30	Average	Line
21	0.315	29.14	19.52	48.66	59.84	-11.18	QP	Line
22	0.315	1.72	19.52	21.25	49.84	-28.59	Average	Line
23	0.352	28.25	19.53	47.78	58.91	-11.14	QP	Line
24	0.352	1.97	19.53	21.50	48.91	-27.42	Average	Line
25	0.383	26.81	19.53	46.34	58.21	-11.87	QP	Line
26	0.383	4.40	19.53	23.92	48.21	-24.29	Average	Line
27	0.393	26.09	19.53	45.62	57.99	-12.37	QP	Line
28	0.393	6.08	19.53	25.60	47.99	-22.39	Average	Line
29	0.419	24.72	19.53	44.25	57.46	-13.22	QP	Line
30	0.419	5.46	19.53	24.99	47.46	-22.47	Average	Line
31	0.435	24.01	19.53	43.54	57.15	-13.62	QP	Line
32	0.435	2.10	19.53	21.63	47.15	-25.52	Average	Line
33	0.479	22.31	19.53	41.84	56.36	-14.52	QP	Line
34	0.479	-1.38	19.53	18.15	46.36	-28.21	Average	Line
35	0.513	21.26	19.53	40.80	56.00	-15.20	QP	Line
36	0.513	-0.85	19.53	18.68	46.00	-27.32	Average	Line
37	0.529	20.22	19.53	39.76	56.00	-16.24	QP	Line
38	0.529	-1.03	19.53	18.50	46.00	-27.50	Average	Line
39	0.549	20.01	19.53	39.55	56.00	-16.45	QP	Line
40	0.549	-0.46	19.53	19.08	46.00	-26.92	Average	Line
41	18.622	24.52	19.83	44.36	60.00	-15.64	QP	Line
42	18.622	13.20	19.83	33.04	50.00	-16.96	Average	Line
43	19.224	23.89	19.84	43.73	60.00	-16.27	QP	Line
44	19.224	11.95	19.84	31.79	50.00	-18.21	Average	Line
45	19.635	22.91	19.84	42.74	60.00	-17.26	QP	Line
46	19.635	11.52	19.84	31.36	50.00	-18.64	Average	Line

Note:

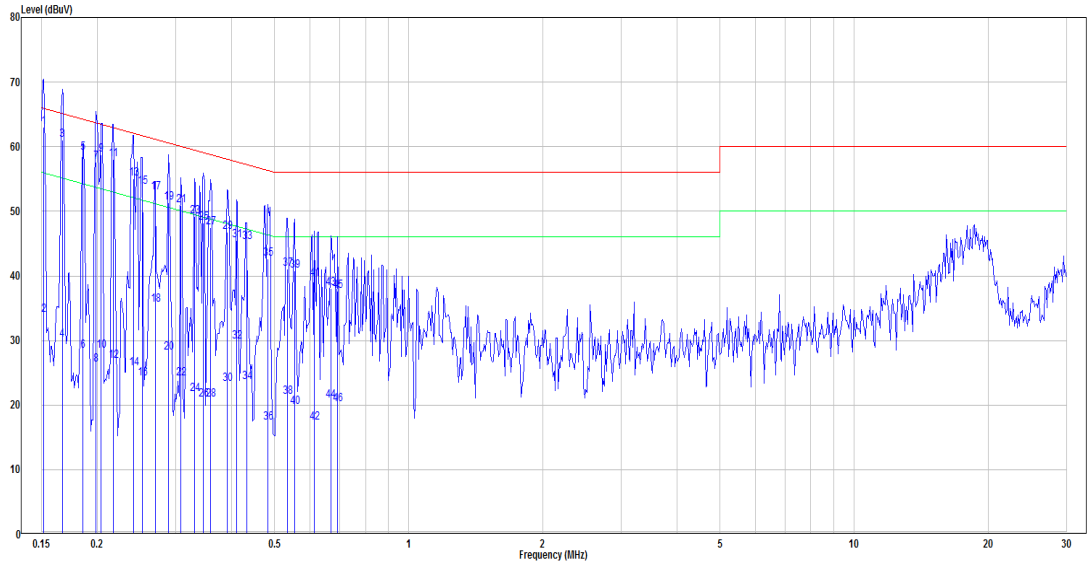
Level = Read Level + Factor

Over Limit = Level – Limit Line

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

Note: It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (New Taipei Laboratory)

Main: AC120 V, 60 Hz, Neutral



No.	Frequency	Reading	Correct	Result	Limit	Over limit	Remark	Phase
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)		
1	0.152	43.47	19.51	62.98	65.91	-2.93	QP	Neutral
2	0.152	14.38	19.51	33.90	55.91	-22.02	Average	Neutral
3	0.167	41.52	19.51	61.03	65.12	-4.09	QP	Neutral
4	0.167	10.56	19.51	30.08	55.12	-25.04	Average	Neutral
5	0.185	39.48	19.51	58.99	64.24	-5.25	QP	Neutral
6	0.185	8.83	19.51	28.34	54.24	-25.90	Average	Neutral
7	0.199	38.08	19.51	57.59	63.67	-6.07	QP	Neutral
8	0.199	6.77	19.51	26.28	53.67	-27.39	Average	Neutral
9	0.204	39.22	19.51	58.73	63.45	-4.72	QP	Neutral
10	0.204	8.82	19.51	28.33	53.45	-25.12	Average	Neutral
11	0.217	38.49	19.51	58.00	62.92	-4.92	QP	Neutral
12	0.217	7.34	19.51	26.85	52.92	-26.07	Average	Neutral
13	0.242	35.48	19.51	55.00	62.04	-7.04	QP	Neutral
14	0.242	6.22	19.51	25.74	52.04	-26.30	Average	Neutral
15	0.252	34.25	19.51	53.76	61.69	-7.92	QP	Neutral
16	0.252	4.58	19.51	24.09	51.69	-27.59	Average	Neutral
17	0.270	33.35	19.52	52.87	61.12	-8.25	QP	Neutral
18	0.270	16.03	19.52	35.55	51.12	-15.57	Average	Neutral
19	0.289	31.85	19.52	51.37	60.54	-9.18	QP	Neutral
20	0.289	8.63	19.52	28.14	50.54	-22.40	Average	Neutral

Note: It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (New Taipei Laboratory)

21	0.308	31.43	19.52	50.95	60.02	-9.07	QP	Neutral
22	0.308	4.64	19.52	24.16	50.02	-25.85	Average	Neutral
23	0.330	29.70	19.52	49.23	59.44	-10.22	QP	Neutral
24	0.330	2.11	19.52	21.63	49.44	-27.82	Average	Neutral
25	0.346	28.70	19.52	48.23	59.05	-10.82	QP	Neutral
26	0.346	1.29	19.52	20.81	49.05	-28.24	Average	Neutral
27	0.360	27.92	19.52	47.44	58.74	-11.30	QP	Neutral
28	0.360	1.35	19.52	20.87	48.74	-27.87	Average	Neutral
29	0.391	27.18	19.53	46.70	58.03	-11.33	QP	Neutral
30	0.391	3.67	19.53	23.19	48.03	-24.84	Average	Neutral
31	0.410	25.94	19.53	45.47	57.64	-12.17	QP	Neutral
32	0.410	10.32	19.53	29.84	47.64	-17.79	Average	Neutral
33	0.433	25.75	19.53	45.28	57.20	-11.92	QP	Neutral
34	0.433	4.05	19.53	23.58	47.20	-23.62	Average	Neutral
35	0.484	23.08	19.53	42.61	56.27	-13.66	QP	Neutral
36	0.484	-2.30	19.53	17.23	46.27	-29.05	Average	Neutral
37	0.535	21.55	19.53	41.08	56.00	-14.92	QP	Neutral
38	0.535	1.67	19.53	21.20	46.00	-24.80	Average	Neutral
39	0.555	21.24	19.53	40.77	56.00	-15.23	QP	Neutral
40	0.555	0.21	19.53	19.74	46.00	-26.26	Average	Neutral
41	0.614	20.03	19.53	39.56	56.00	-16.44	QP	Neutral
42	0.614	-2.28	19.53	17.25	46.00	-28.75	Average	Neutral
43	0.668	18.56	19.53	38.10	56.00	-17.90	QP	Neutral
44	0.668	1.14	19.53	20.68	46.00	-25.32	Average	Neutral
45	0.694	18.08	19.53	37.61	56.00	-18.39	QP	Neutral
46	0.694	0.61	19.53	20.15	46.00	-25.85	Average	Neutral

Note:

Level = Read Level + Factor

Over Limit = Level – Limit Line

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

Note: It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (New Taipei Laboratory)

8. FCC §15.209, §15.205 , §15.247(d) – Spurious Emissions

8.1. Applicable Standard

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1MHz.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	608 – 614	4. 5 – 5. 15
0.495 – 0.505	16.69475 – 16.69525	960 – 1240	5. 35 – 5. 46
2.1735 – 2.1905	16.80425 – 16.80475	1300 – 1427	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1435 – 1626.5	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1645.5 – 1646.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1660 – 1710	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1718.8 – 1722.2	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	2200 – 2300	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2310 – 2390	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2483.5 – 2500	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2690 – 2900	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	3260 – 3267	22.01 – 23.12
8.41425 – 8.41475	162.0125 –167.17	3.332 – 3.339	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3 3458 – 3 358	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3.600 – 4.400	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4		Above 38.6
13.36 – 13.41	399.9 – 410		

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

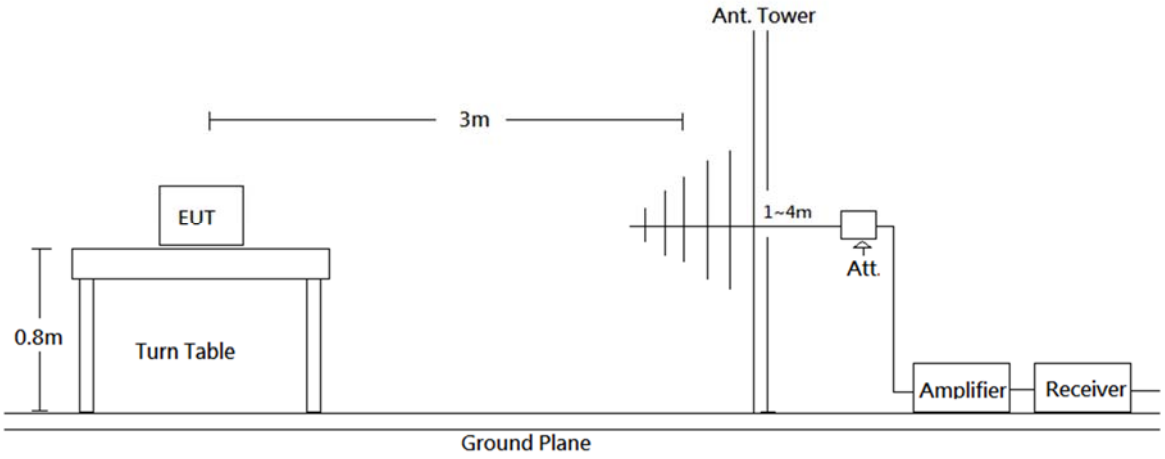
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this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

As per FCC §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains

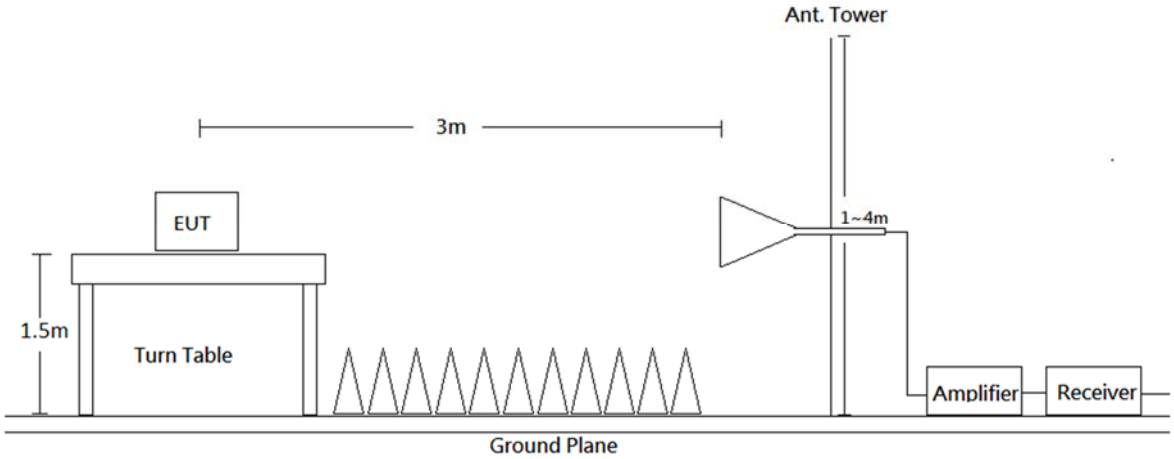
the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c).

8.2. EUT Setup

Below 1 GHz:



Above 1 GHz:



Radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC Part 15.209 and FCC 15.247 Limits.

8.3. EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 26.5 GHz. During the radiated emission test, the EMI test receiver was set with the following configurations measurement method 6.3 in ANSI C63.10.

Frequency Range	RBW	VBW	Measurement method
30-1000 MHz	120 kHz	/	QP
Above 1 GHz	1 MHz	3 MHz	PK
	1 MHz	10 Hz	Ave

8.4. Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All data was recorded in the Quasi-peak detector mode from 30 MHz to 1 GHz and PK and average detector modes for frequencies above 1 GHz.

8.5. Corrected Factor & Margin Calculation

The Correct Factor is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

Margin = Result – Limit

Note: It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (New Taipei Laboratory)

8.6. Test Results

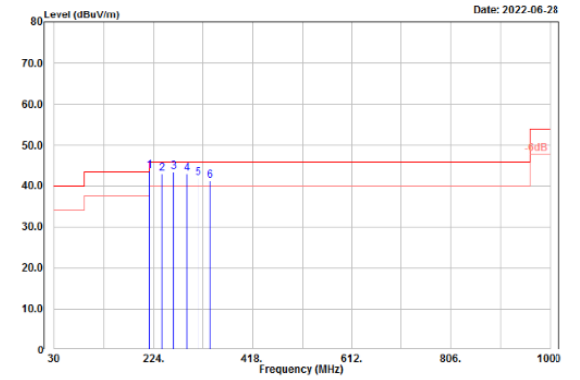
Test Mode: Transmitting

(Pre-scan with three orthogonal axis, and worse case as X axis.)

(worst case is BR (GFSK) mode high channel)

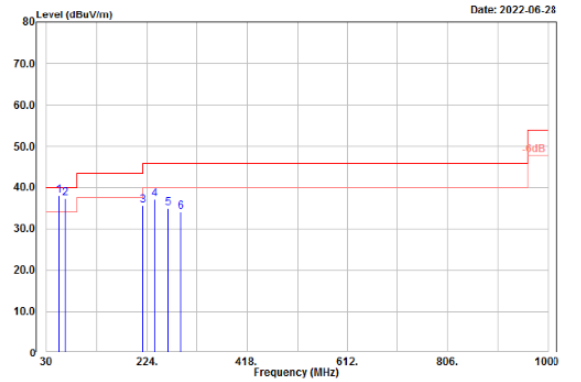
30MHz-1GHz:

Horizontal



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
216.240	55.62	-11.82	43.80	46.00	-2.20	100	167	QP
240.490	53.64	-10.57	43.07	46.00	-2.93	100	180	QP
262.800	53.25	-9.61	43.64	46.00	-2.36	100	182	QP
288.020	51.53	-8.46	43.07	46.00	-2.93	100	155	QP
311.300	49.94	-7.79	42.15	46.00	-3.85	100	176	QP
334.580	48.75	-7.32	41.43	46.00	-4.57	100	192	QP

Vertical



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
53.280	54.35	-16.43	37.92	40.00	-2.08	100	84	QP
65.890	53.23	-15.97	37.26	40.00	-2.74	100	128	QP
215.270	47.51	-11.89	35.62	43.50	-7.88	100	118	QP
238.550	47.76	-10.64	37.12	46.00	-8.88	100	115	QP
263.770	44.38	-9.46	34.92	46.00	-11.08	100	109	QP
288.020	42.51	-8.46	34.05	46.00	-11.95	100	106	QP

Level (Result) = Reading + Factor.

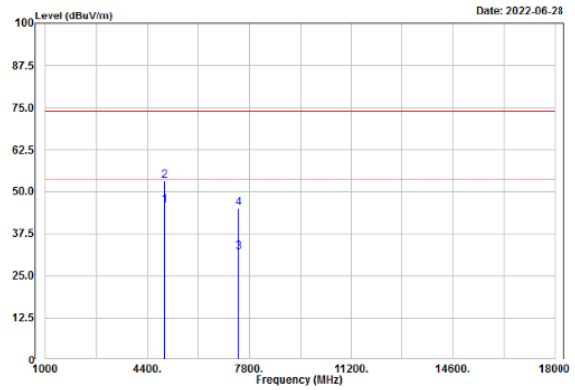
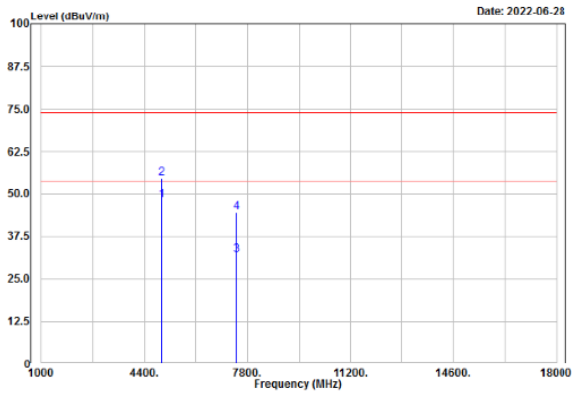
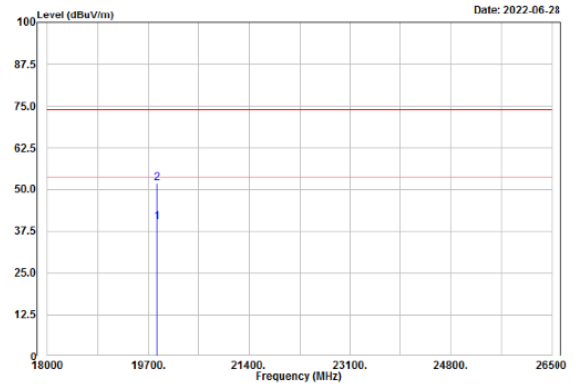
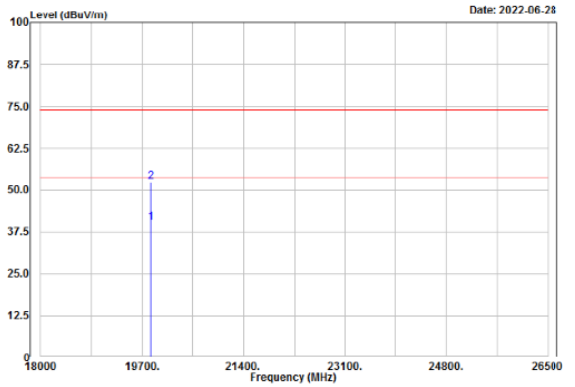
Margin = Level – Limit.

Factor = Antenna Factor + Cable Loss – Amplifier Gain.

Spurious emissions more than 20 dB below the limit were not reported.

Note: It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (New Taipei Laboratory)

1GHz-26.5GHz

Horizontal (1GHz-18GHz)	Vertical (1GHz-18GHz)
	
Horizontal (18GHz – 26.5GHz)	**Vertical (18GHz – 26.5GHz)**
	

Above 1GHz

BR (GFSK)

Horizontal

Low channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2379.400	49.46	-9.61	39.85	54.00	-14.15	157	356	Average
2379.400	61.17	-9.61	51.56	74.00	-22.44	157	356	Peak
2402.000	93.55	-9.54	84.01			157	356	Average
2402.000	106.91	-9.54	97.37			157	356	Peak
4804.000	48.19	-2.47	45.72	54.00	-8.28	147	18	Average
4804.000	55.12	-2.47	52.65	74.00	-21.35	147	18	Peak
7206.000	28.93	3.03	31.96	54.00	-22.04	154	219	Average
7206.000	43.45	3.03	46.48	74.00	-27.52	154	219	Peak

Middle channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4882.000	47.90	-2.24	45.66	54.00	-8.34	145	19	Average
4882.000	54.07	-2.24	51.83	74.00	-22.17	145	19	Peak
7323.000	28.36	3.34	31.70	54.00	-22.30	152	308	Average
7323.000	41.51	3.34	44.85	74.00	-29.15	152	308	Peak

High channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2480.000	93.97	-8.87	85.10			160	358	Average
2480.000	107.70	-8.87	98.83			160	358	Peak
2483.500	58.85	-8.82	50.03	54.00	-3.97	160	358	Average
2483.500	73.18	-8.82	64.36	74.00	-9.64	160	358	Peak
4960.000	47.96	-2.04	45.92	54.00	-8.08	155	24	Average
4960.000	55.56	-2.04	53.52	74.00	-20.48	155	24	Peak
7440.000	28.66	3.38	32.04	54.00	-21.96	153	176	Average
7440.000	41.53	3.38	44.91	74.00	-29.09	153	176	Peak

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Vertical

Low channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2378.100	51.50	-9.61	41.89	54.00	-12.11	152	326	Average
2378.100	63.43	-9.61	53.82	74.00	-20.18	152	326	Peak
2402.000	96.34	-9.54	86.80			152	326	Average
2402.000	110.36	-9.54	100.82			152	326	Peak
4804.000	50.36	-2.47	47.89	54.00	-6.11	149	64	Average
4804.000	56.43	-2.47	53.96	74.00	-20.04	149	64	Peak
7206.000	29.13	3.03	32.16	54.00	-21.84	146	16	Average
7206.000	48.08	3.03	51.11	74.00	-22.89	146	16	Peak

Middle channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4882.000	49.72	-2.24	47.48	54.00	-6.52	151	18	Average
4882.000	57.10	-2.24	54.86	74.00	-19.14	151	18	Peak
7323.000	28.73	3.34	32.07	54.00	-21.93	148	73	Average
7323.000	41.28	3.34	44.62	74.00	-29.38	148	73	Peak

High channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2480.000	95.78	-8.87	86.91			156	347	Average
2480.000	109.98	-8.87	101.11			156	347	Peak
2483.500	60.95	-8.82	52.13	54.00	-1.87	156	347	Average
2483.500	75.60	-8.82	66.78	74.00	-7.22	156	347	Peak
4960.000	49.88	-2.04	47.84	54.00	-6.16	153	11	Average
4960.000	56.79	-2.04	54.75	74.00	-19.25	153	11	Peak
7440.000	28.61	3.38	31.99	54.00	-22.01	146	290	Average
7440.000	40.97	3.38	44.35	74.00	-29.65	146	290	Peak

Level (Result) = Reading + Factor.

Margin = Level – Limit.

Factor = Antenna Factor + Cable Loss – Amplifier Gain.

Spurious emissions more than 20 dB below the limit were not reported.

Note: It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (New Taipei Laboratory)

EDR (π/4-DQPSK)

Horizontal

Low channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2378.200	47.04	-9.61	37.43	54.00	-16.57	154	352	Average
2378.200	61.54	-9.61	51.93	74.00	-22.07	154	352	Peak
2402.000	91.45	-9.54	81.91			154	352	Average
2402.000	107.62	-9.54	98.08			154	352	Peak
4804.000	45.27	-2.47	42.80	54.00	-11.20	152	67	Average
4804.000	54.18	-2.47	51.71	74.00	-22.29	152	67	Peak
7206.000	29.24	3.03	32.27	54.00	-21.73	154	156	Average
7206.000	43.39	3.03	46.42	74.00	-27.58	154	156	Peak

Middle channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4882.000	45.01	-2.24	42.77	54.00	-11.23	155	18	Average
4882.000	54.39	-2.24	52.15	74.00	-21.85	155	18	Peak
7323.000	28.72	3.34	32.06	54.00	-21.94	153	305	Average
7323.000	40.94	3.34	44.28	74.00	-29.72	153	305	Peak

High channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2480.000	91.82	-8.87	82.95			203	355	Average
2480.000	108.11	-8.87	99.24			203	355	Peak
2483.500	58.10	-8.82	49.28	54.00	-4.72	203	355	Average
2483.500	73.35	-8.82	64.53	74.00	-9.47	203	355	Peak
4960.000	45.23	-2.04	43.19	54.00	-10.81	152	23	Average
4960.000	52.93	-2.04	50.89	74.00	-23.11	152	23	Peak
7440.000	28.71	3.38	32.09	54.00	-21.91	153	101	Average
7440.000	40.75	3.38	44.13	74.00	-29.87	153	101	Peak

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Vertical

Low channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2378.200	49.14	-9.61	39.53	54.00	-14.47	172	231	Average
2378.200	63.07	-9.61	53.46	74.00	-20.54	172	231	Peak
2402.000	93.22	-9.54	83.68			172	231	Average
2402.000	109.82	-9.54	100.28			172	231	Peak
4804.000	45.02	-2.47	42.55	54.00	-11.45	148	108	Average
4804.000	54.84	-2.47	52.37	74.00	-21.63	148	108	Peak
7206.000	30.31	3.03	33.34	54.00	-20.66	154	31	Average
7206.000	46.13	3.03	49.16	74.00	-24.84	154	31	Peak

Middle channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4882.000	45.92	-2.24	43.68	54.00	-10.32	155	21	Average
4882.000	55.97	-2.24	53.73	74.00	-20.27	155	21	Peak
7323.000	28.82	3.34	32.16	54.00	-21.84	148	197	Average
7323.000	42.07	3.34	45.41	74.00	-28.59	148	197	Peak

High channel

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2480.000	93.80	-8.87	84.93			134	234	Average
2480.000	110.77	-8.87	101.90			134	234	Peak
2483.530	60.37	-8.82	51.55	54.00	-2.45	134	234	Average
2483.530	75.96	-8.82	67.14	74.00	-6.86	134	234	Peak
4960.000	46.78	-2.04	44.74	54.00	-9.26	146	12	Average
4960.000	55.91	-2.04	53.87	74.00	-20.13	146	12	Peak
7440.000	28.71	3.38	32.09	54.00	-21.91	149	121	Average
7440.000	41.47	3.38	44.85	74.00	-29.15	149	121	Peak

Level (Result) = Reading + Factor.

Margin = Level – Limit.

Factor = Antenna Factor + Cable Loss – Amplifier Gain.

Spurious emissions more than 20 dB below the limit were not reported.

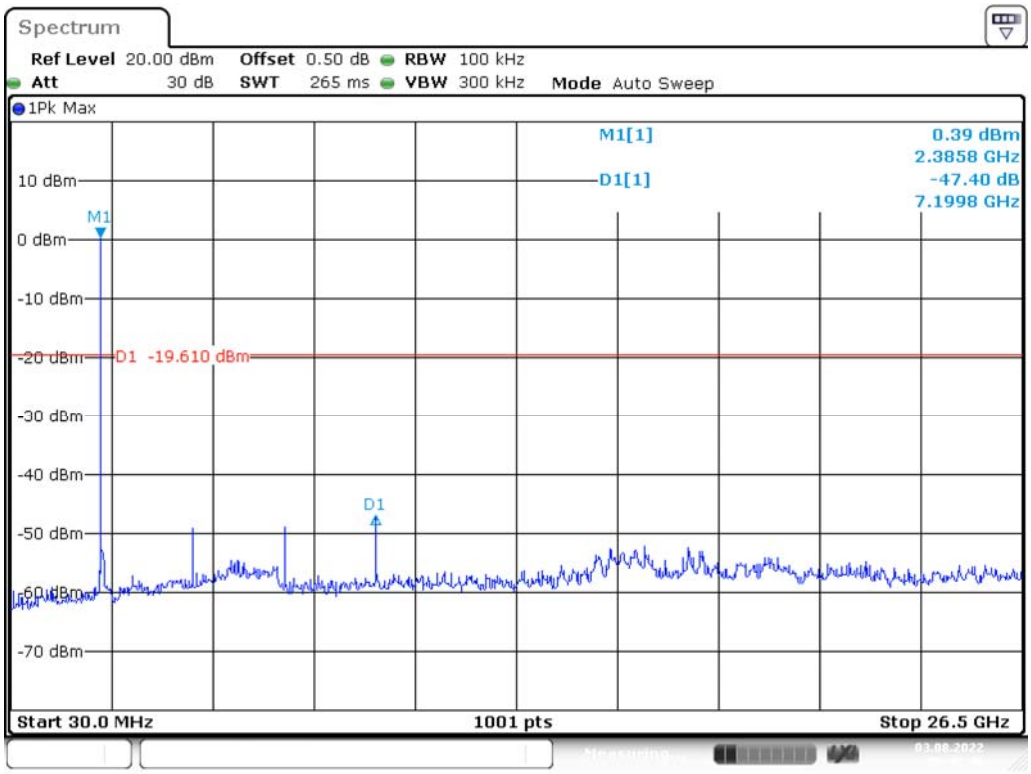
Conducted Spurious Emissions:

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BR Mode (GFSK)				
Low	2402	47.40	≥ 20	PASS
Mid	2441	45.00	≥ 20	PASS
High	2480	44.71	≥ 20	PASS
EDR Mode (π/4-DQPSK):				
Low	2402	46.44	≥ 20	PASS
Mid	2441	45.91	≥ 20	PASS
High	2480	44.38	≥ 20	PASS

Note: It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (New Taipei Laboratory)

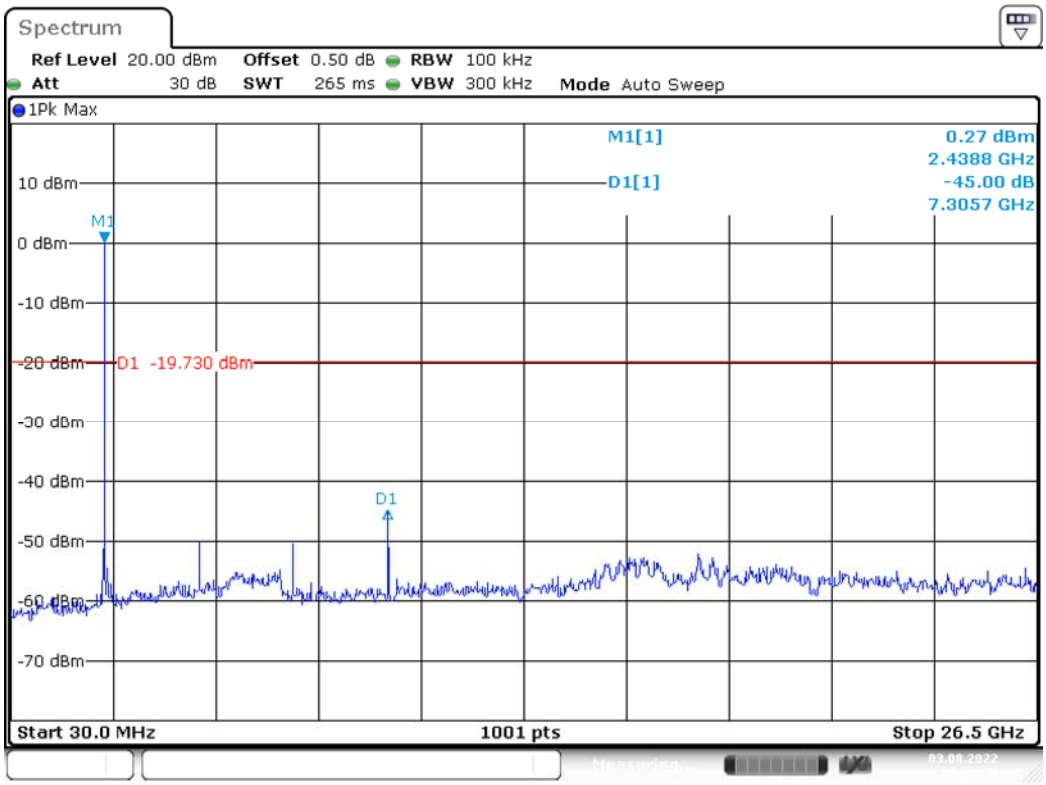
BR Mode (GFSK)

Low Channel



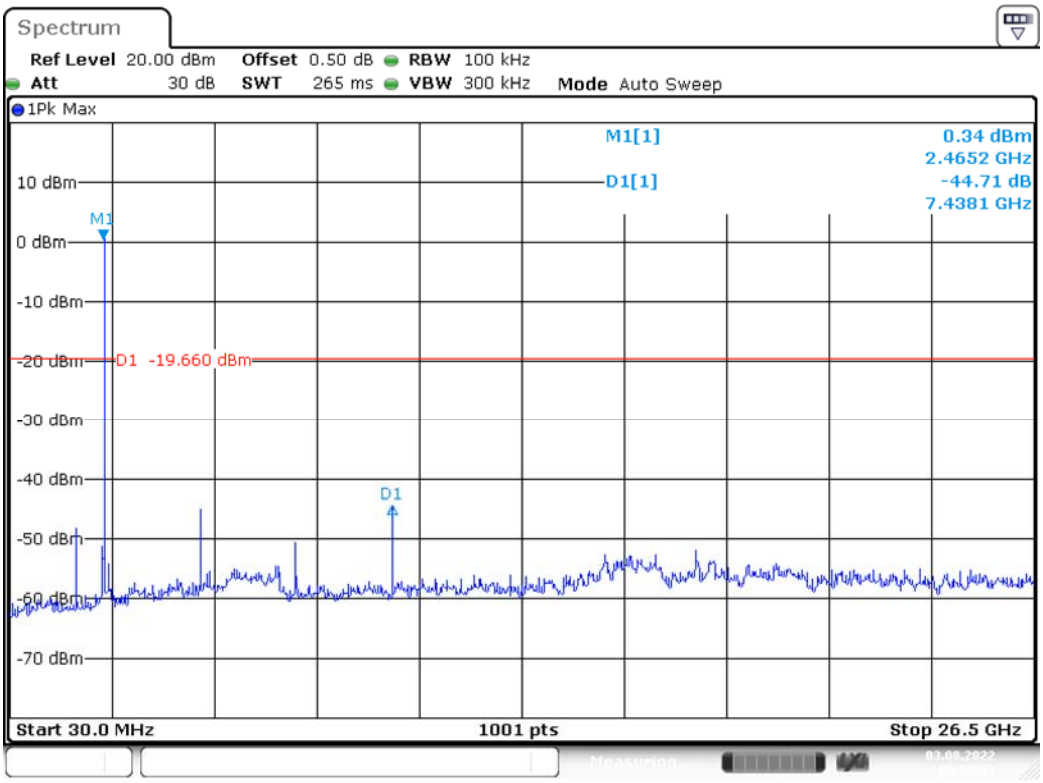
Date: 3.AUG.2022 09:48:48

Middle Channel



Date: 3.AUG.2022 09:50:26

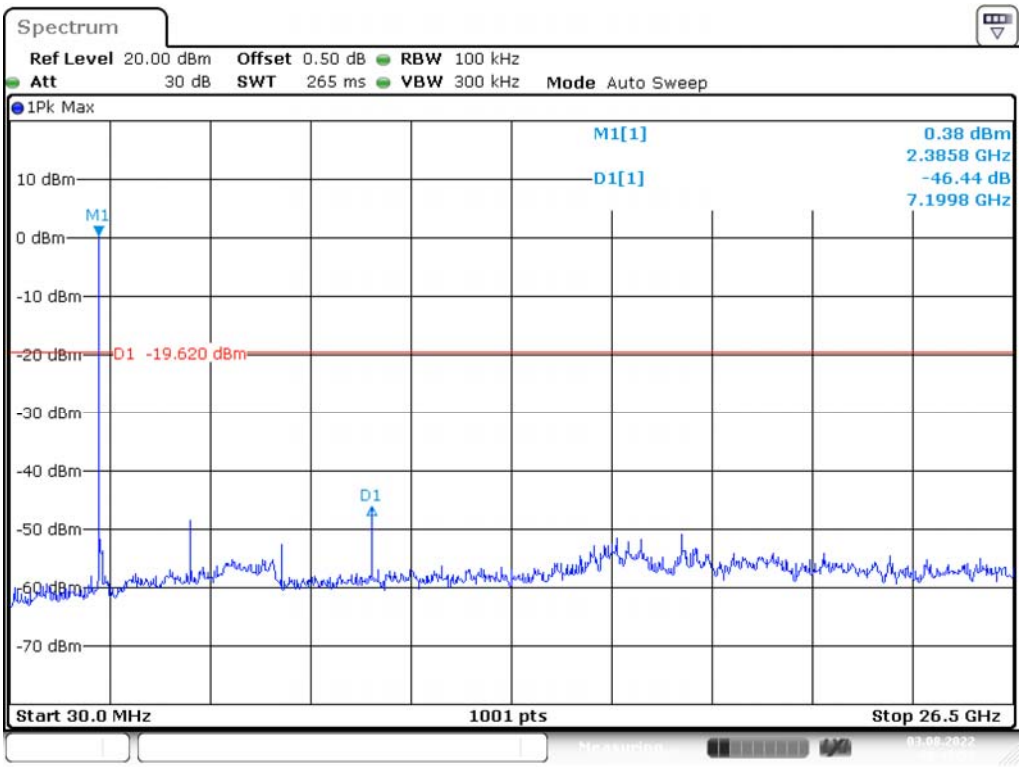
High Channel



Date: 3.AUG.2022 09:52:03

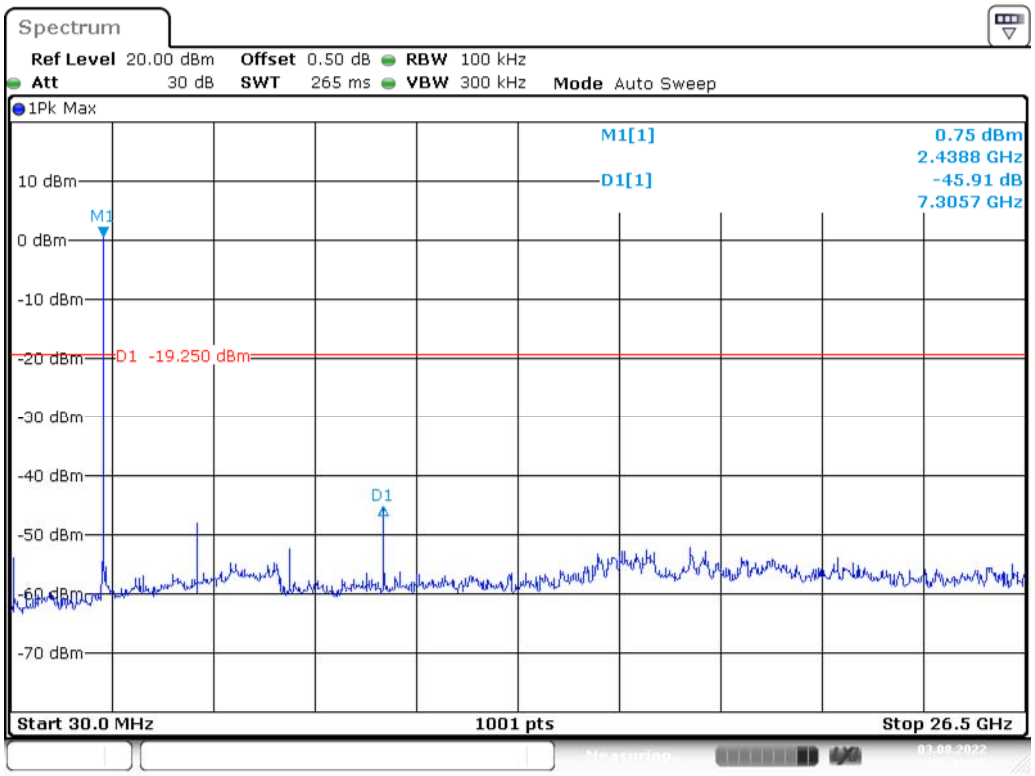
EDR Mode (π/4-DQPSK)

Low Channel



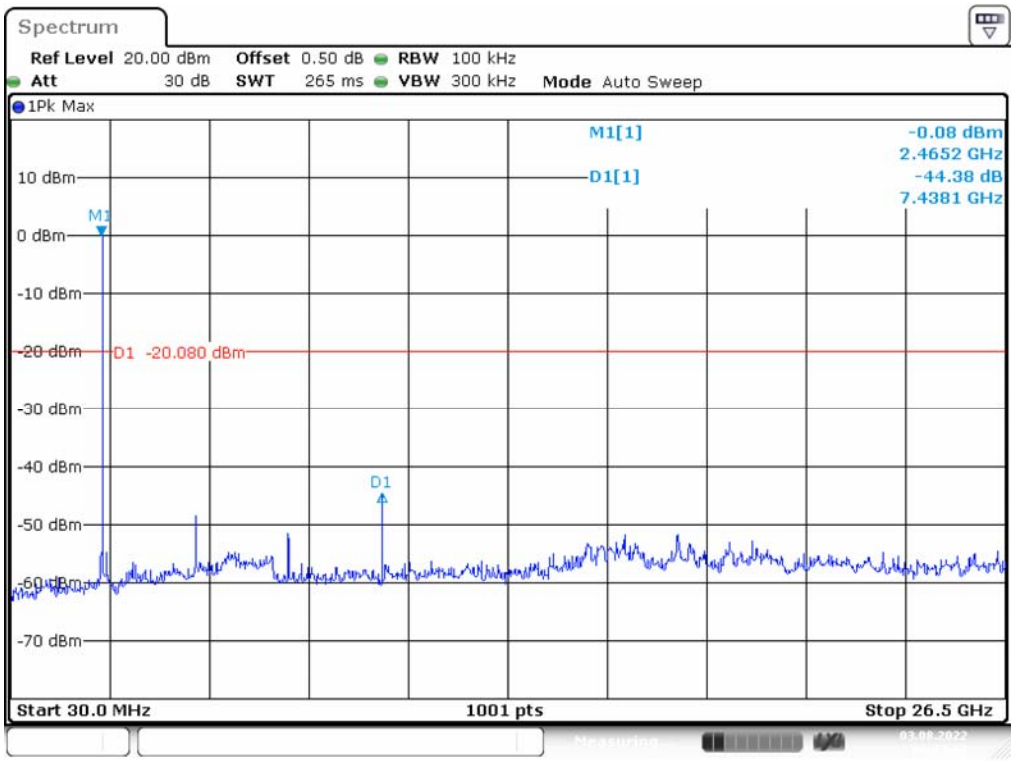
Date: 3.AUG.2022 09:13:51

Middle Channel



Date: 3.AUG.2022 09:10:35

High Channel



Date: 3.AUG.2022 09:13:17

9. FCC §15.247(a)(1) – 20 dB Emission Bandwidth

9.1. Applicable Standard

According to FCC §15.247(a) (1) the maximum 20 dB bandwidth of the hopping channel shall be presented.

9.2. Test Procedure

(1) Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
(2) Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
(3) Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
(4) Repeat above procedures until all frequencies measured were complete.

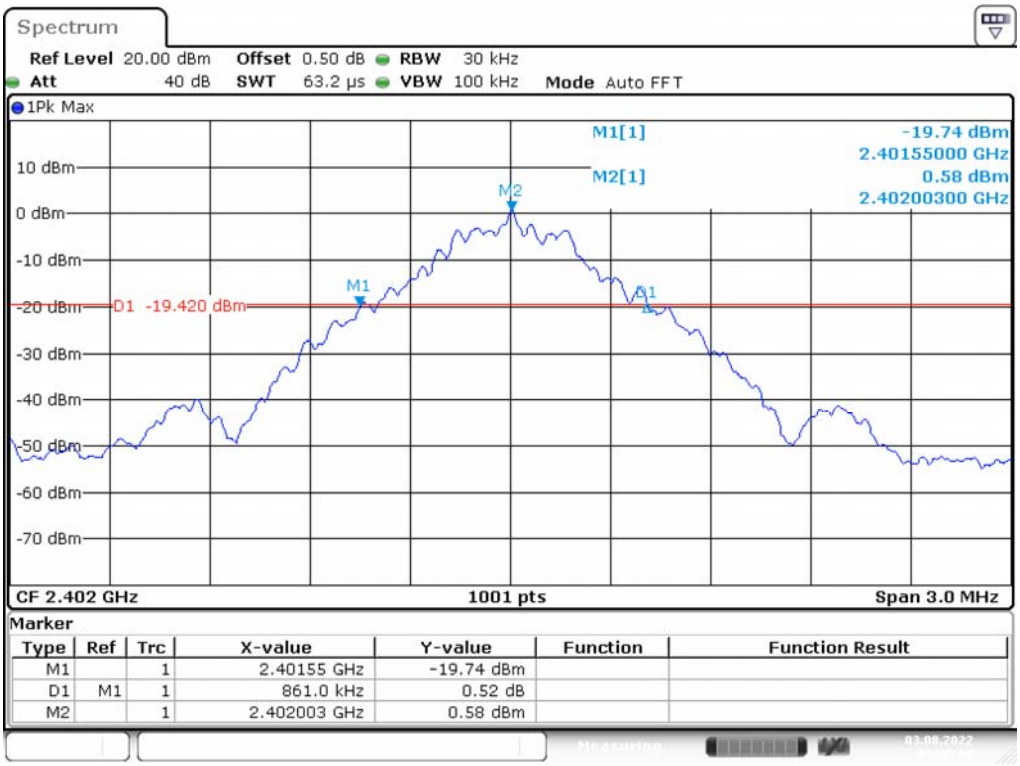
9.3. Test Results

Channel	Frequency (MHz)	20 dBc BW (MHz)
BR Mode (GFSK)		
Low	2402	0.86
Middle	2441	0.86
High	2480	0.86
EDR Mode (π/4-DQPSK)		
Low	2402	1.23
Middle	2441	1.23
High	2480	1.23

Please refer to the following plots

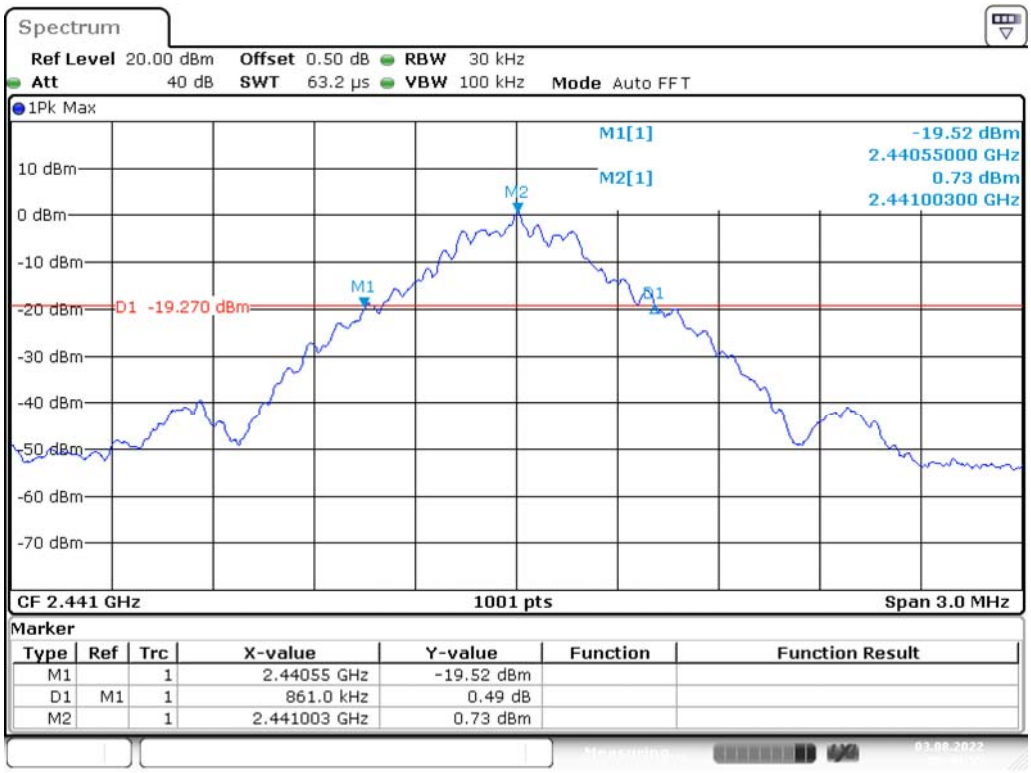
BR Mode (GFSK)

Low Channel



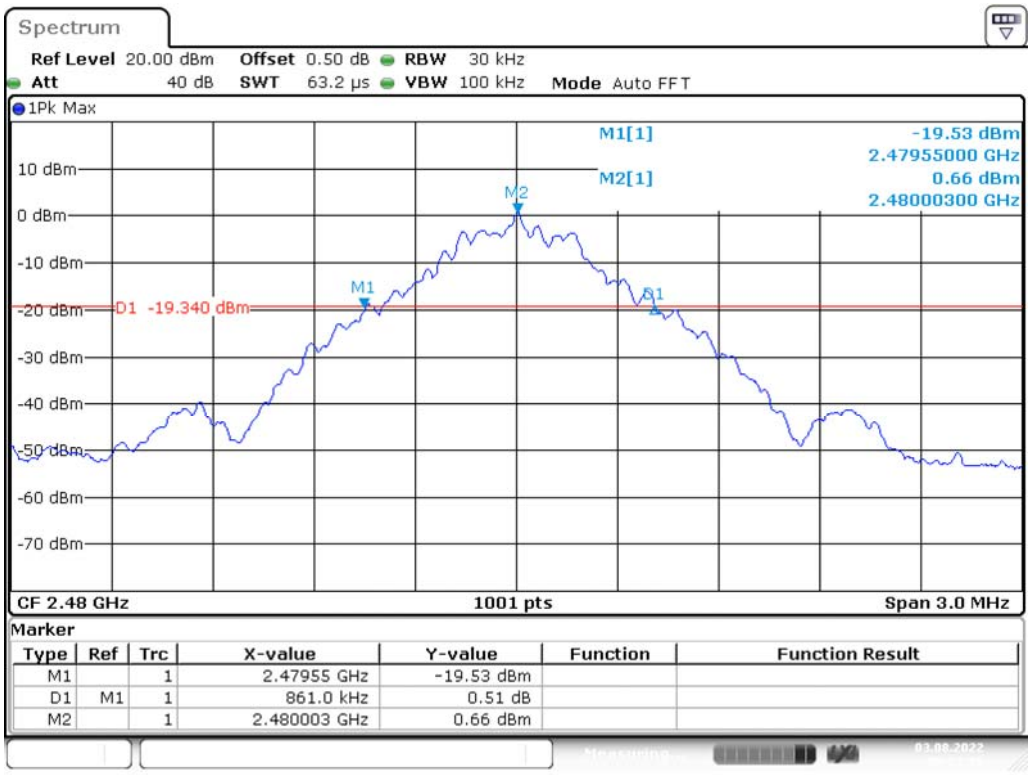
Date: 3.AUG.2022 09:48:02

Middle Channel



Date: 3.AUG.2022 09:49:55

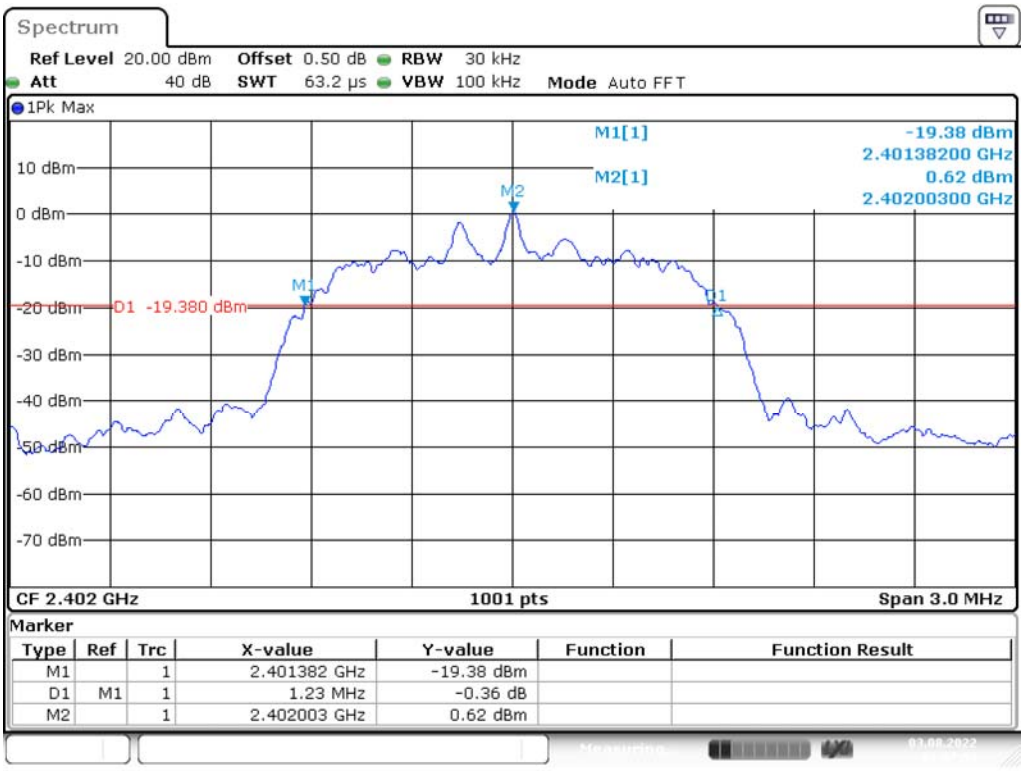
High Channel



Date: 3.AUG.2022 09:51:17

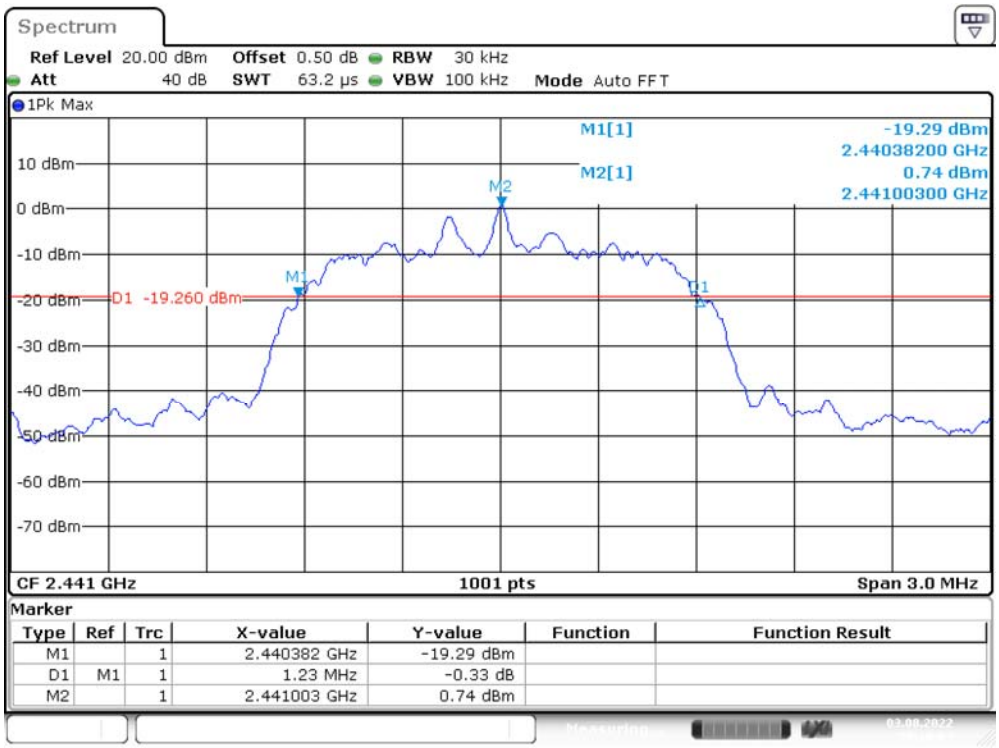
EDR Mode (π/4-DQPSK)

Low Channel



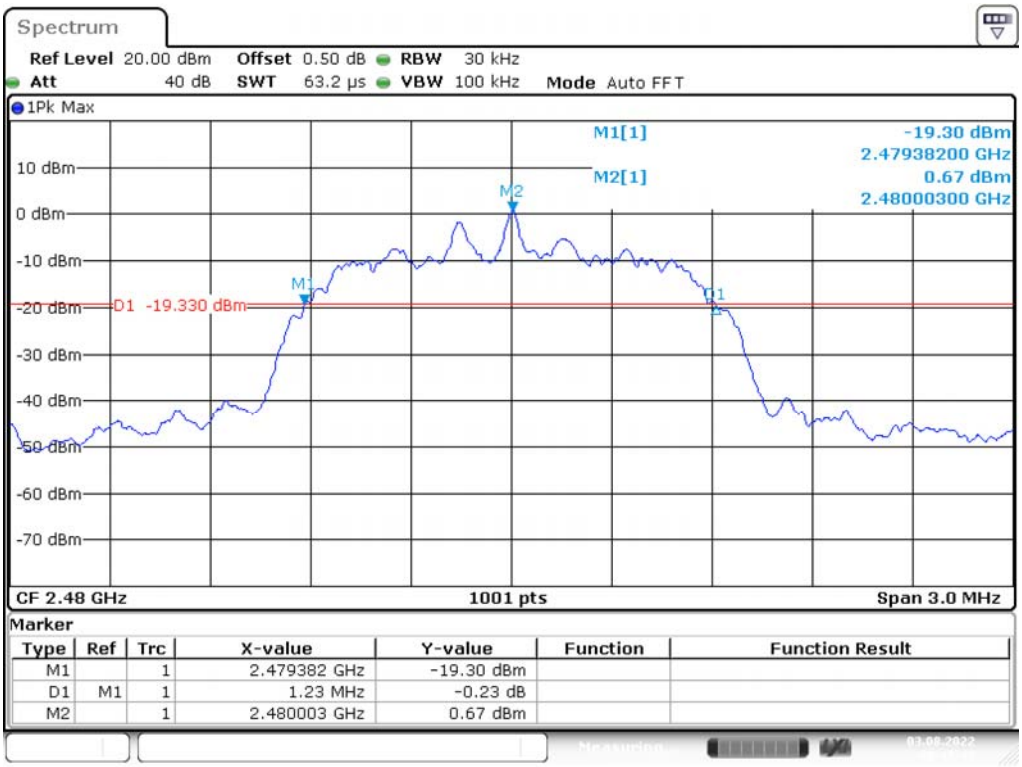
Date: 3.AUG.2022 09:07:53

Middle Channel



Date: 3.AUG.2022 09:10:04

High Channel



Date: 3.AUG.2022 09:11:15

10. FCC §15.247(a)(1) – Channel Separation Test

10.1. Applicable Standard

According to FCC §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 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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. 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.

10.2. Test Procedure

1. Set the EUT in transmitting mode, max hold the channel.
2. Set the adjacent channel of the EUT and max hold another trace.
3. Measure the channel separation.

10.3. Test Results

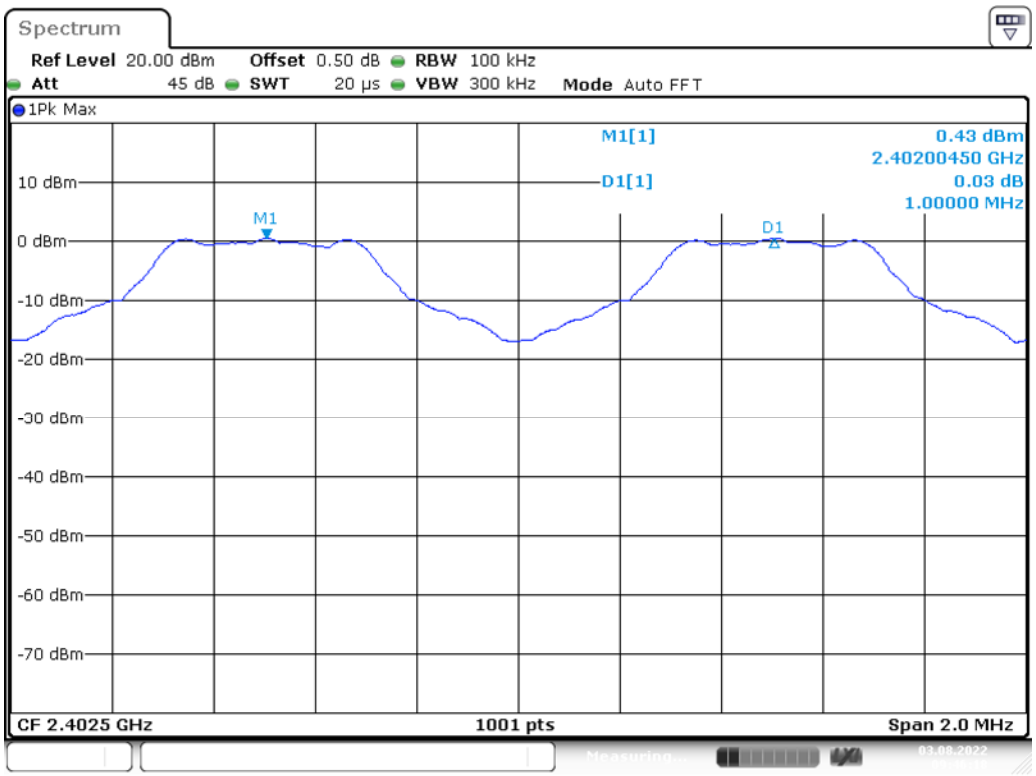
Channel	Channel Separation (MHz)	20 dBc BW (MHz)	Two-thirds of the 20 dB bandwidth (MHz)	Channel Separation Limit	Result
BR Mode (GFSK)					
Low	1.00	0.86	0.574	>two-thirds of the 20 dB bandwidth	Compliance
Middle	1.00	0.86	0.574	>two-thirds of the 20 dB bandwidth	Compliance
High	1.00	0.86	0.574	>two-thirds of the 20 dB bandwidth	Compliance
EDR Mode (π/4-DQPSK)					
Low	1.00	1.23	0.820	>two-thirds of the 20 dB bandwidth	Compliance
Middle	1.00	1.23	0.820	>two-thirds of the 20 dB bandwidth	Compliance
High	1.00	1.23	0.820	>two-thirds of the 20 dB bandwidth	Compliance

Please refer to the following plots.

Note: It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (New Taipei Laboratory)

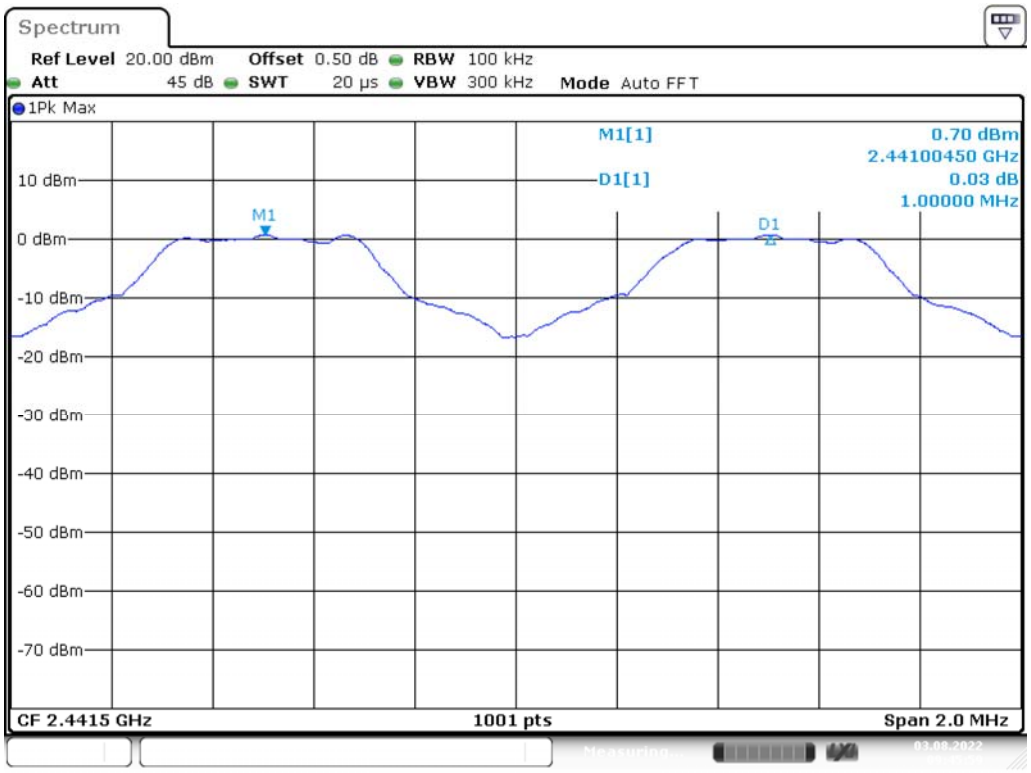
BR Mode (GFSK)

Low Channel



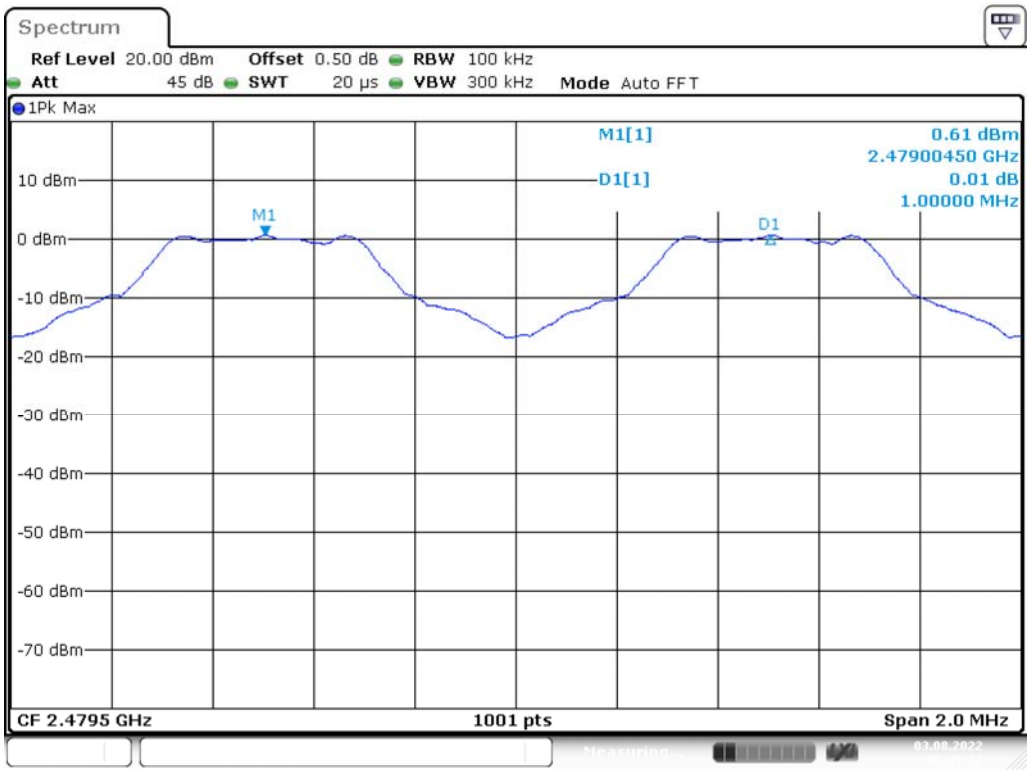
Date: 3.AUG.2022 09:46:19

Middle Channel



Date: 3.AUG.2022 09:45:59

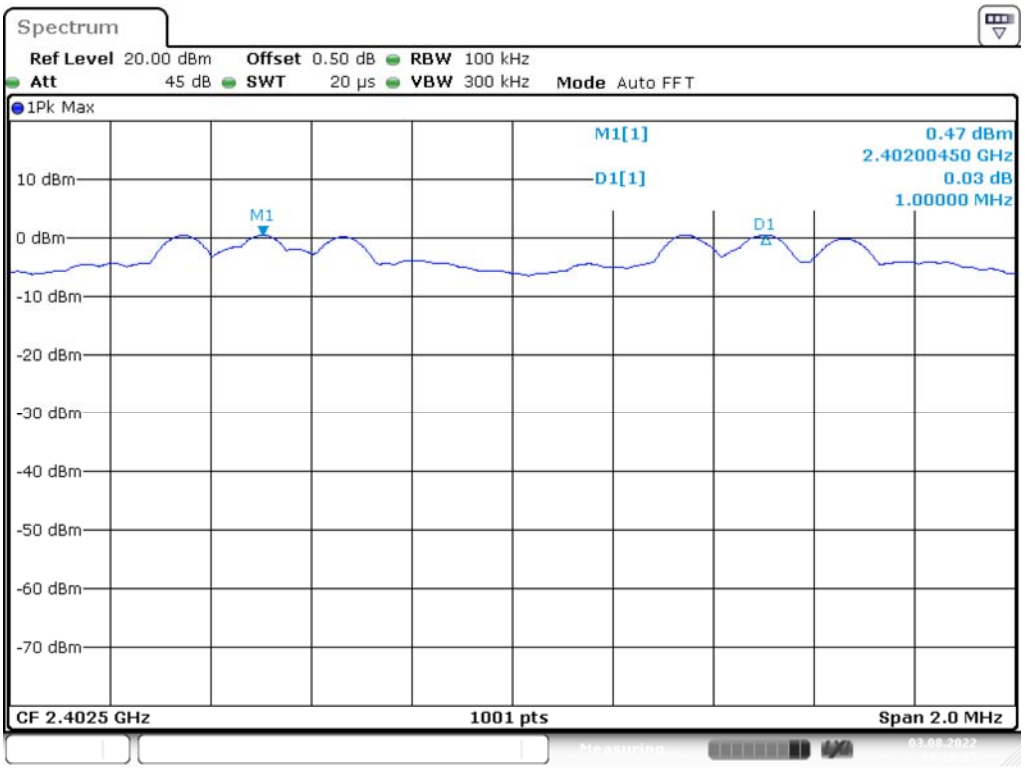
High Channel



Date: 3.AUG.2022 09:45:22

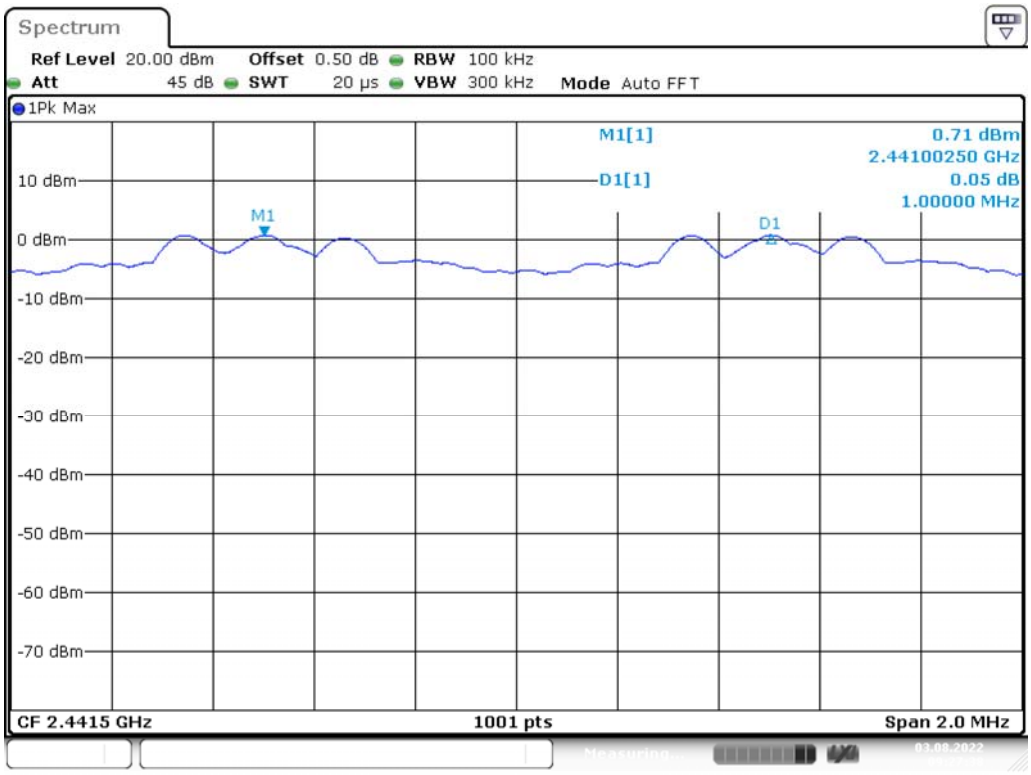
EDR Mode (π/4-DQPSK)

Low Channel



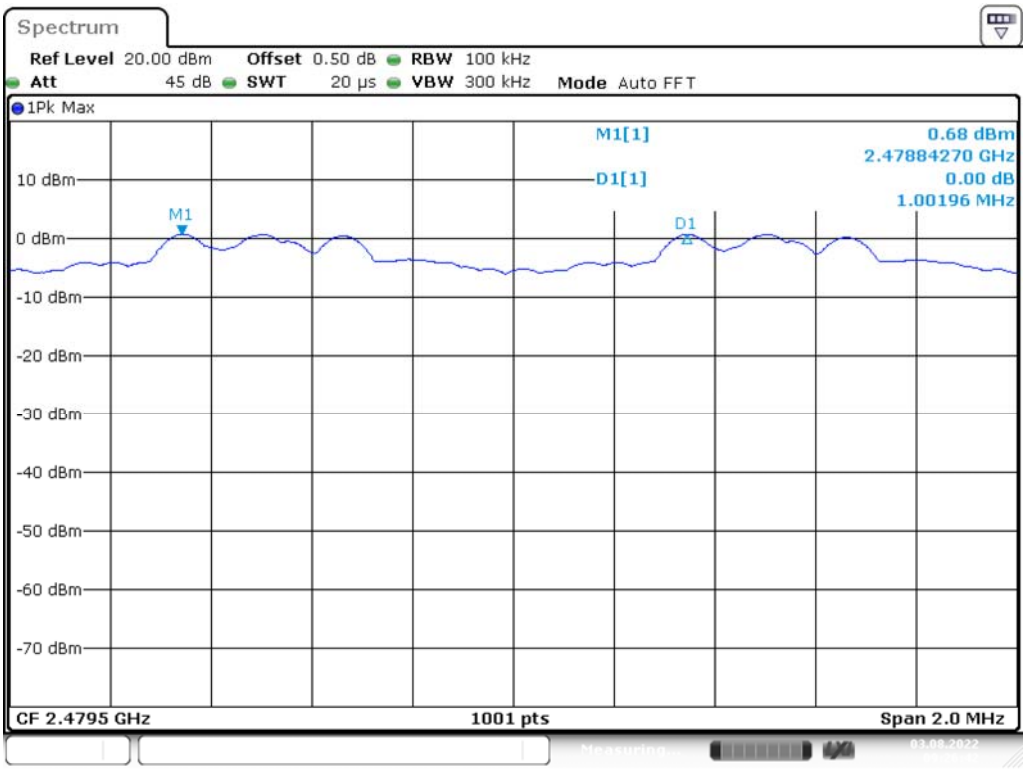
Date: 3.AUG.2022 09:28:05

Middle Channel



Date: 3.AUG.2022 09:27:38

High Channel



Date: 3.AUG.2022 09:26:42

11. FCC§15.247(a)(1)(iii) –Time of Occupancy (Dwell Time)

11.1. Applicable Standard

According to FCC §15.247(a) (1) (iii).

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

11.2. Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel RBW ≤ channel spacing and where possible RBW should be set >> 1/T, where T is the expected dwell time per channel Sweep = as necessary to capture the entire dwell time per hopping channel Detector function = peak Trace = max hold

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements.

Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

(Number of hops in the period specified in the requirements) = (number of hops on spectrum analyzer) x (period specified in the requirements / analyzer sweep time)

The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.

Note: It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (New Taipei Laboratory)

11.3. Test Results

Test mode: BR mode / 2402 ~ 2480MHz (GFSK)						
Mode	**Pulse Time (ms)**	**Hopping Number**	**Period Time (s)**	**Total of Dwell (ms)**	**Limit (ms)**	**Result**
DH1	0.42	320	31.6	133.44	<400	PASS
DH3	1.68	150	31.6	252.15	<400	PASS
DH5	2.921	90	31.6	262.89	<400	PASS
Test mode: EDR mode / 2402 ~ 2480MHz (π/4-DQPSK)						
Mode	**Pulse Time (ms)**	**Hopping Number**	**Period Time (s)**	**Total of Dwell (ms)**	**Limit (ms)**	**Result**
2DH1	0.43	320	31.6	137.28	<400	PASS
2DH3	1.68	160	31.6	268.64	<400	PASS
2DH5	2.92	110	31.6	322.19	<400	PASS

Note 1: A period time = 0.4*79 = 31.6 (s), Total of Dwell=Pulse Time * Hopping Number

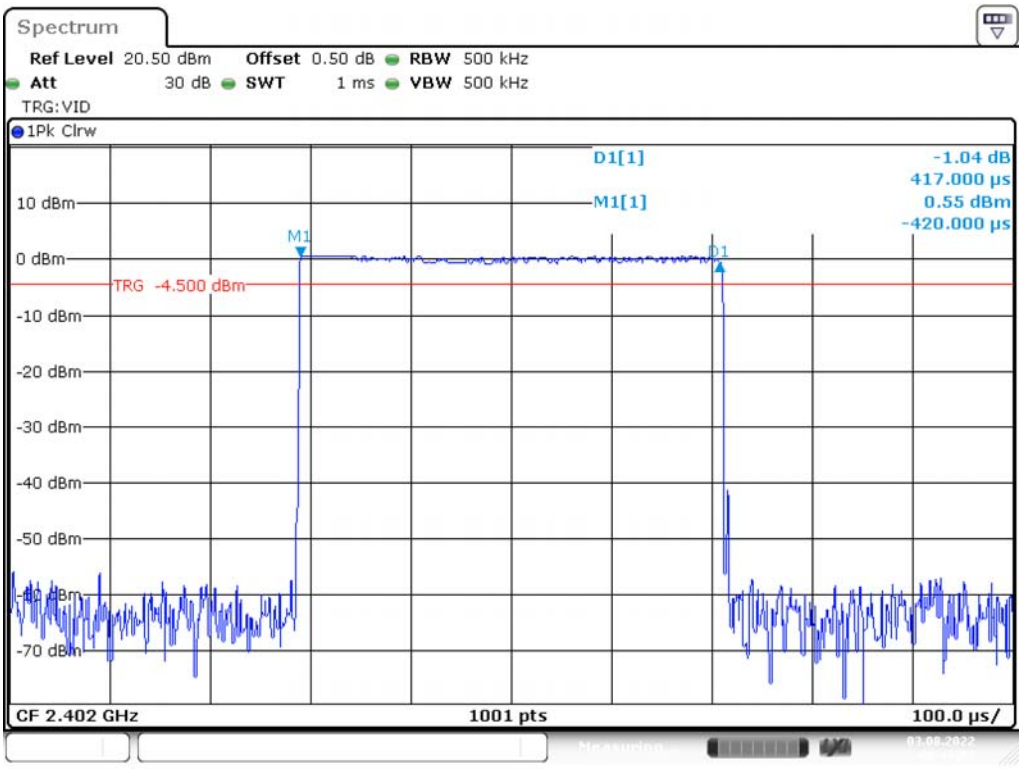
Note 2: Hopping Number = Hopping Number/10 * 10

Note 3: Hopping Number/10 = Total of highest signals in 3.16s. (Second high signals were other channel)

Please refer to the following plots

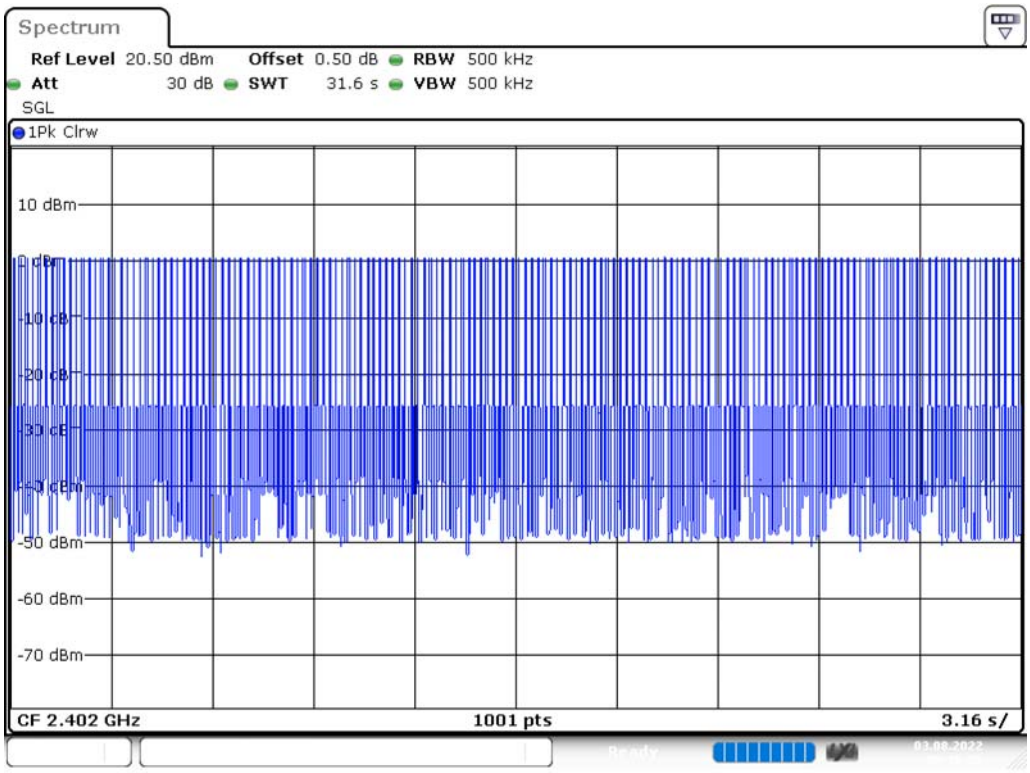
BR Mode (GFSK)

DH1: Pulse Width



Date: 3.AUG.2022 09:36:25

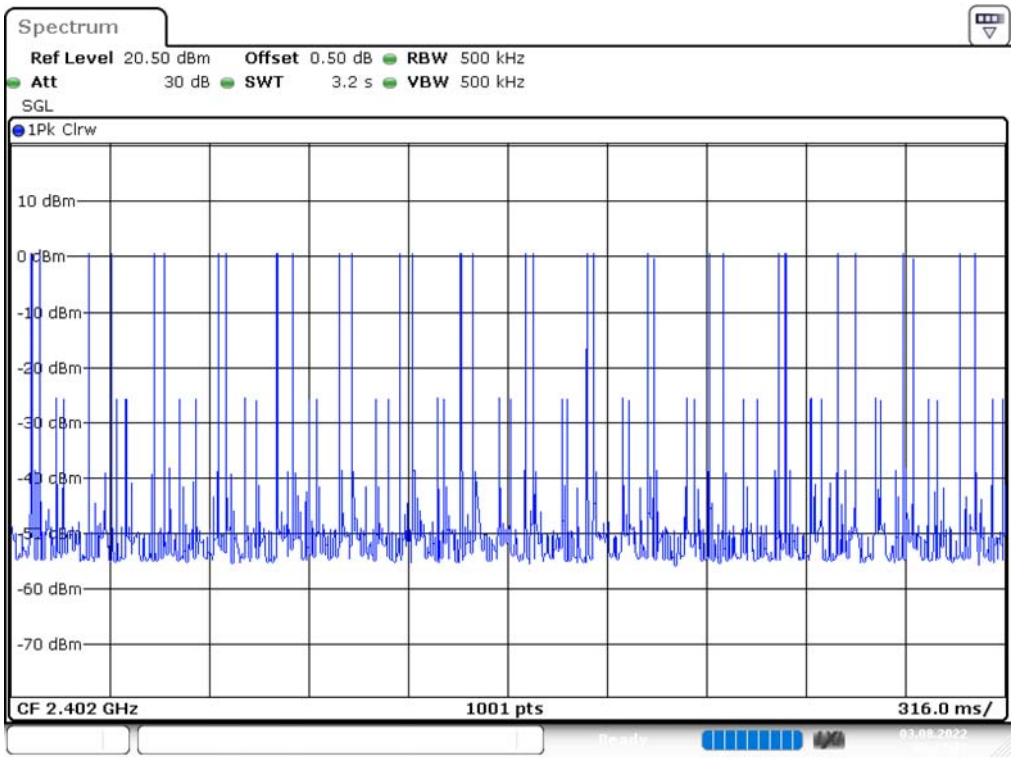
DH1: Hopping Number



Date: 3.AUG.2022 09:36:57

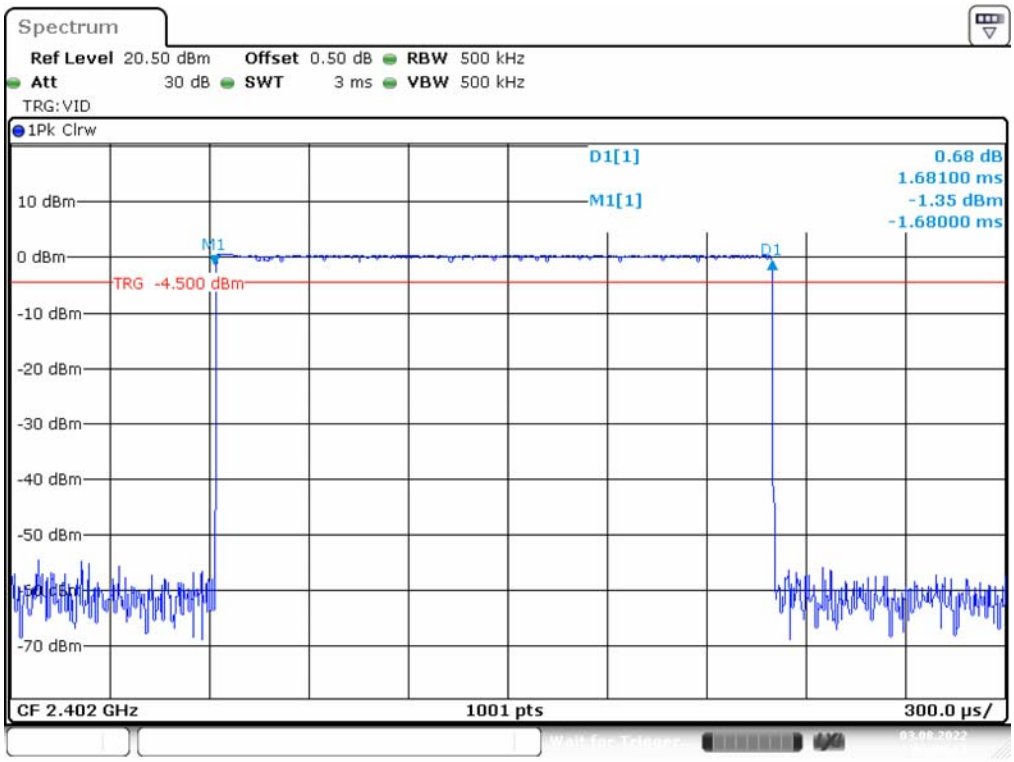
DH1: Hopping Number /10

(Hopping Number = 32 in 1/10 period of highest signals, Second High signals were other channel)



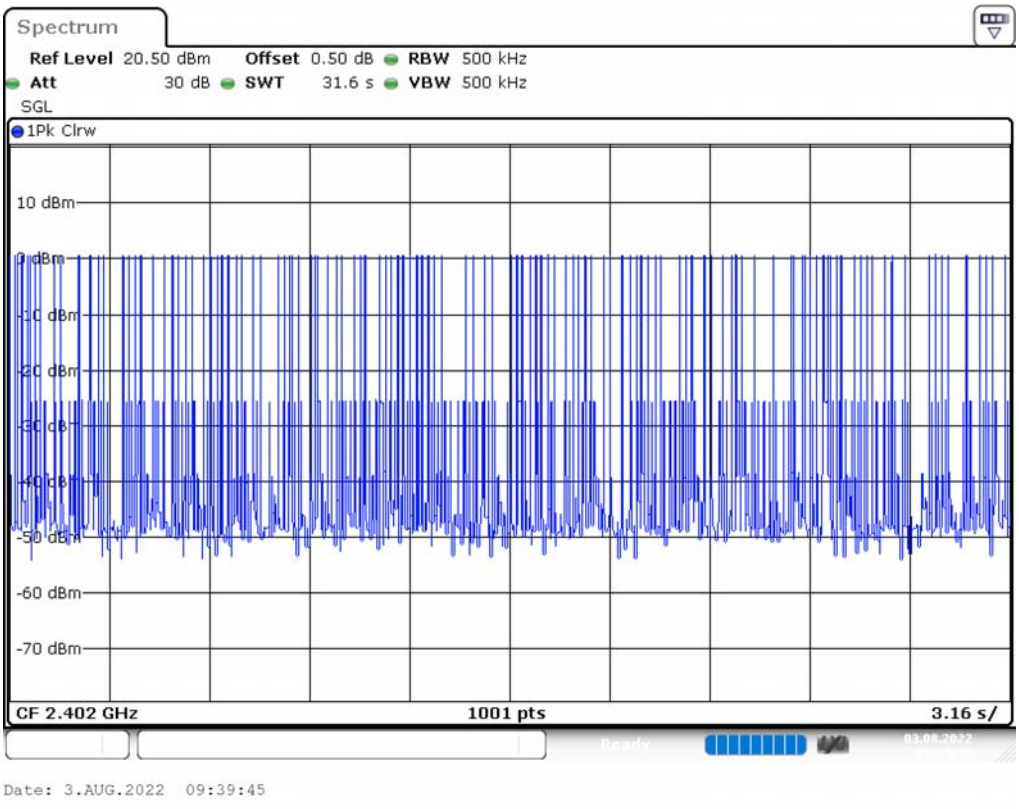
Date: 3.AUG.2022 09:37:29

DH3: Pulse Width



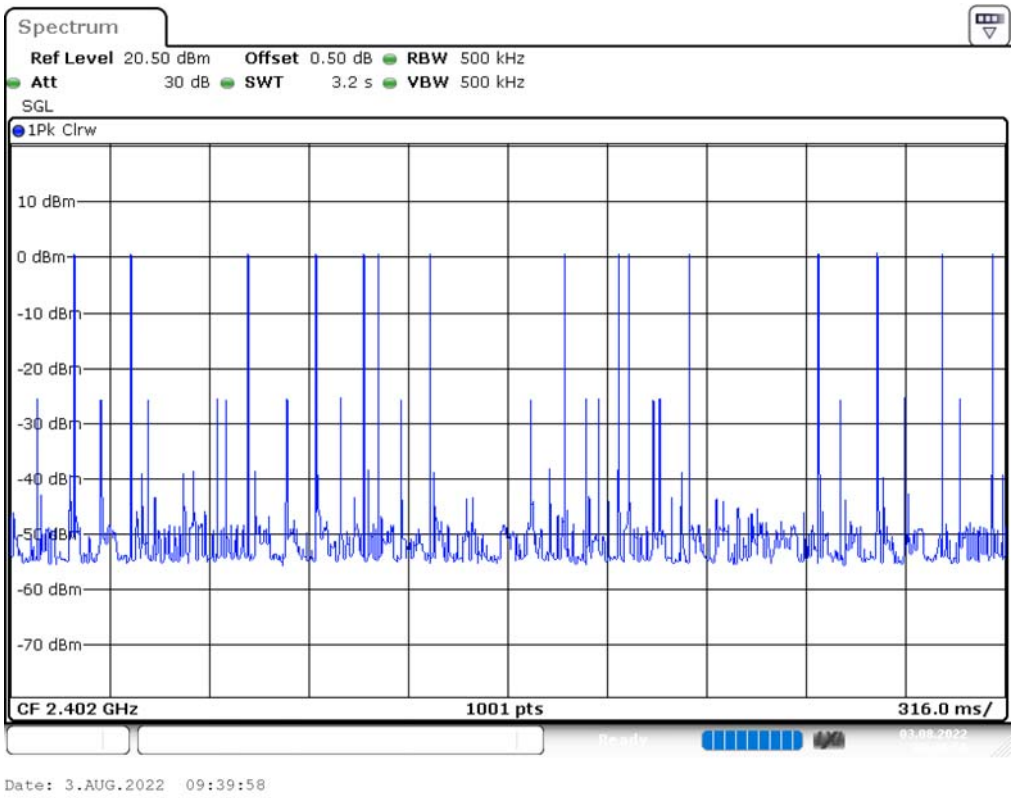
Date: 3.AUG.2022 09:39:13

DH3: Hopping Number

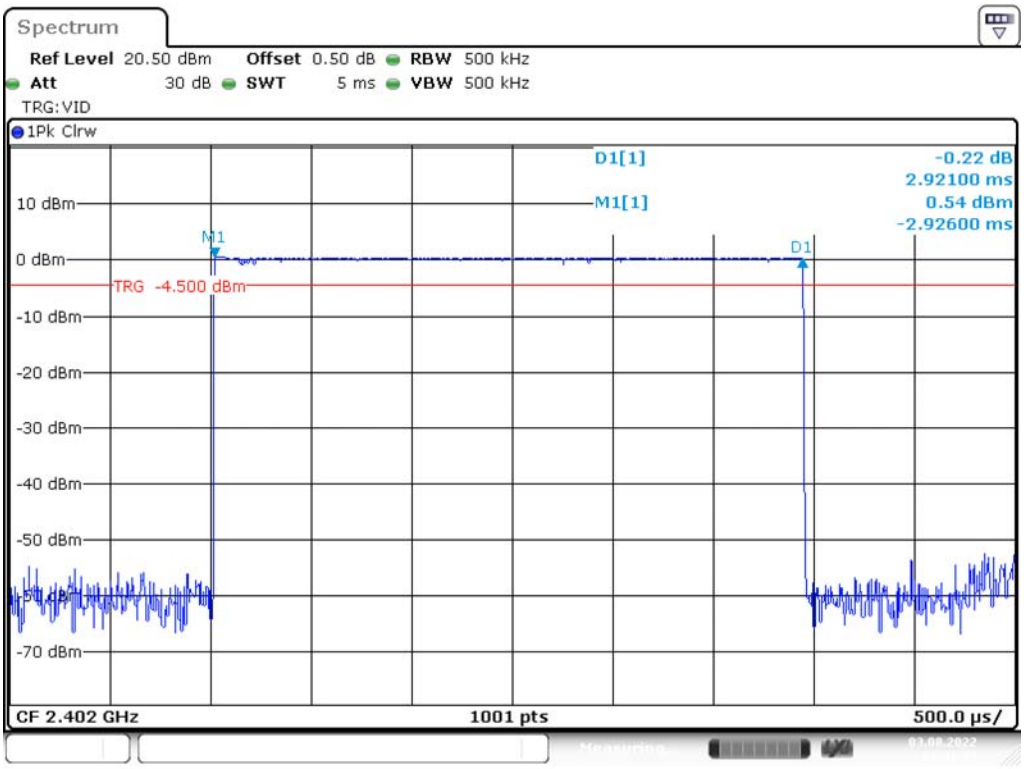


DH3: Hopping Number /10

(Hopping Number = 15 in 1/10 period of highest signals, Second High signals were other channel)

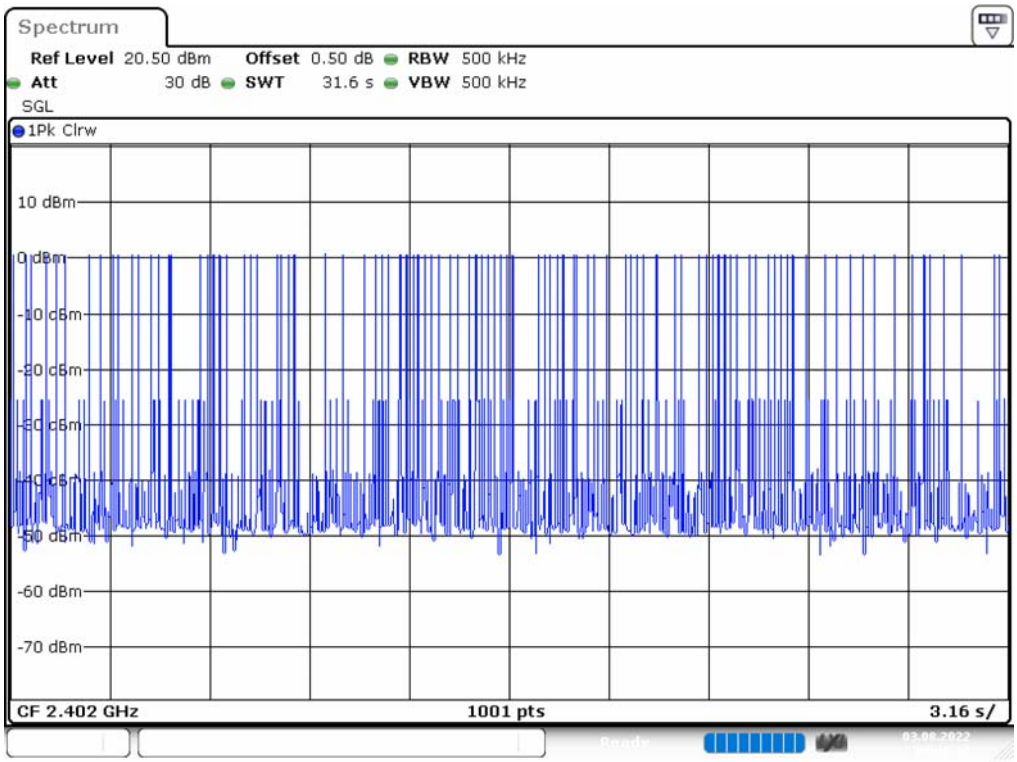


DH5: Pulse Width



Date: 3.AUG.2022 09:41:05

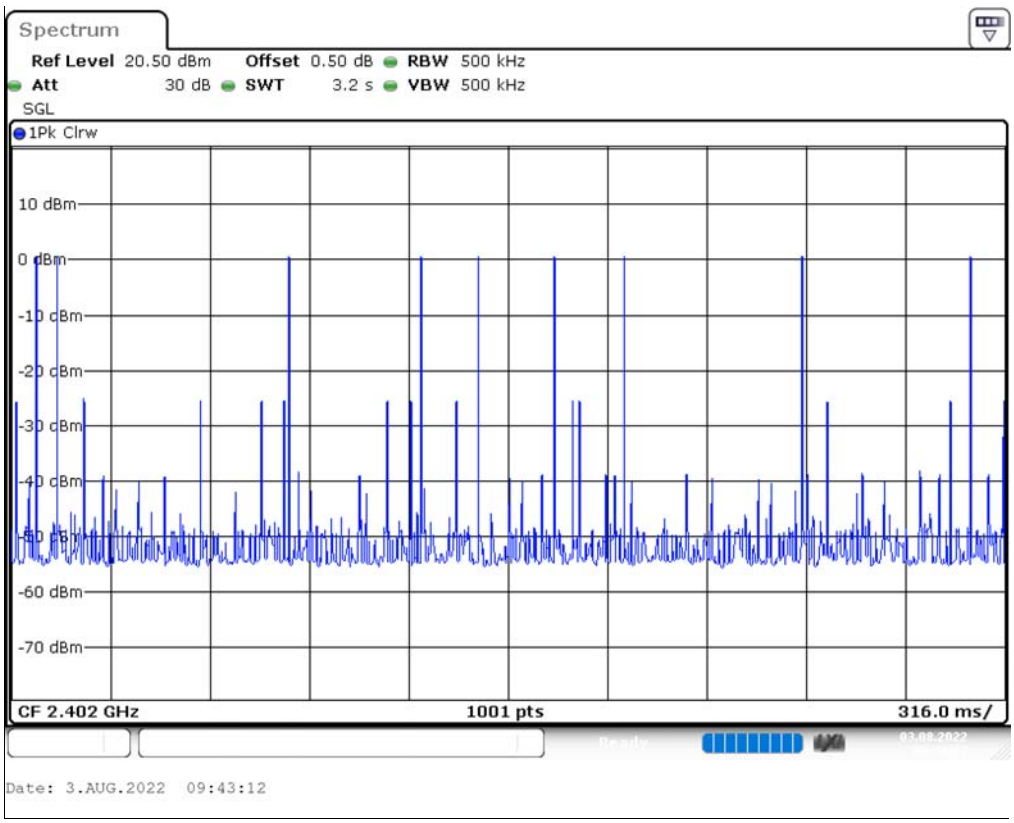
DH5: Hopping Number



Date: 3.AUG.2022 09:41:37

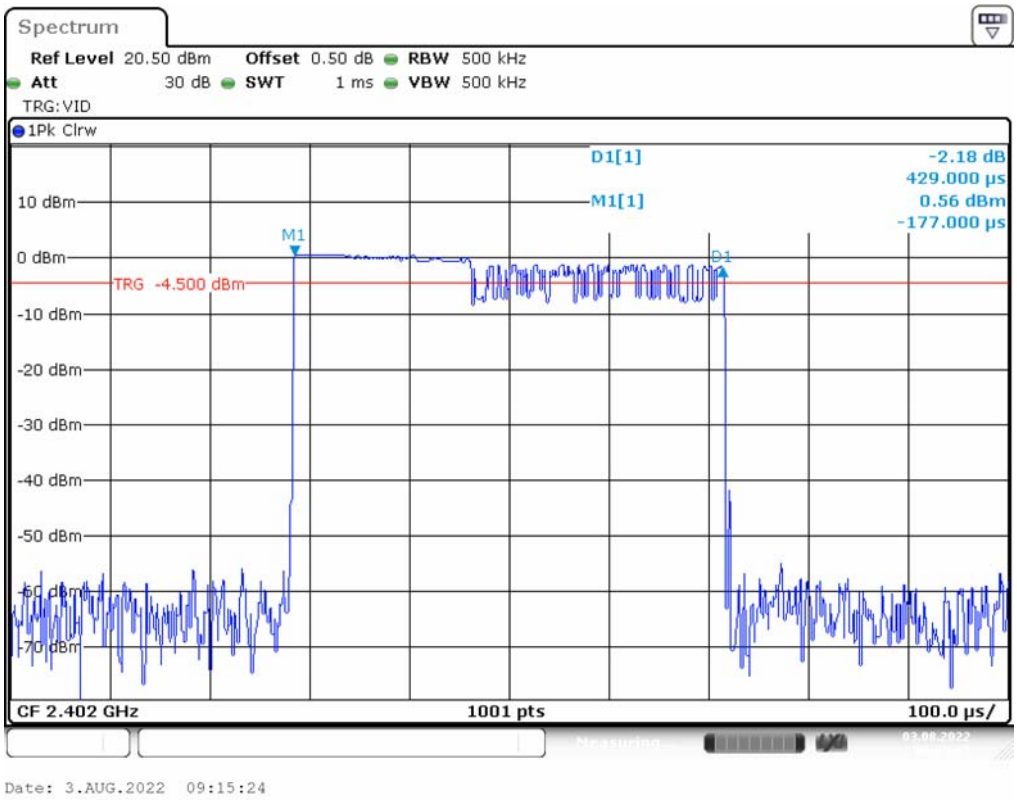
DH5: Hopping Number /10

(Hopping Number = 9 in 1/10 period of highest signals, Second High signals were other channel)

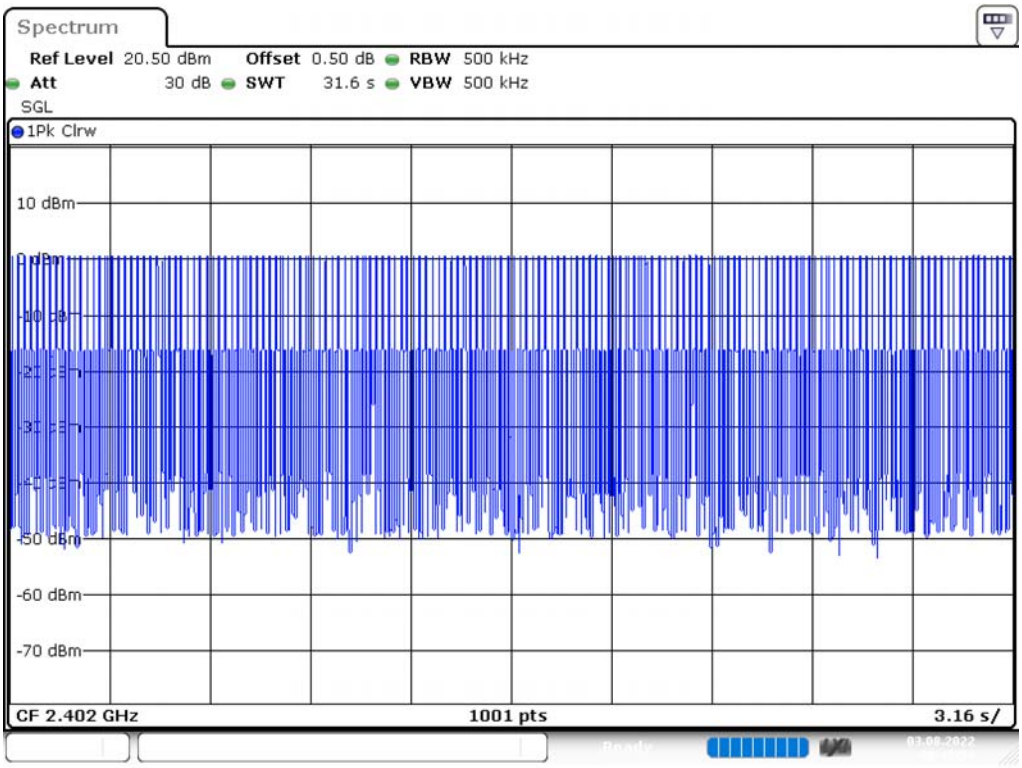


EDR Mode (π/4-DQPSK)

2DH1: Pulse Width



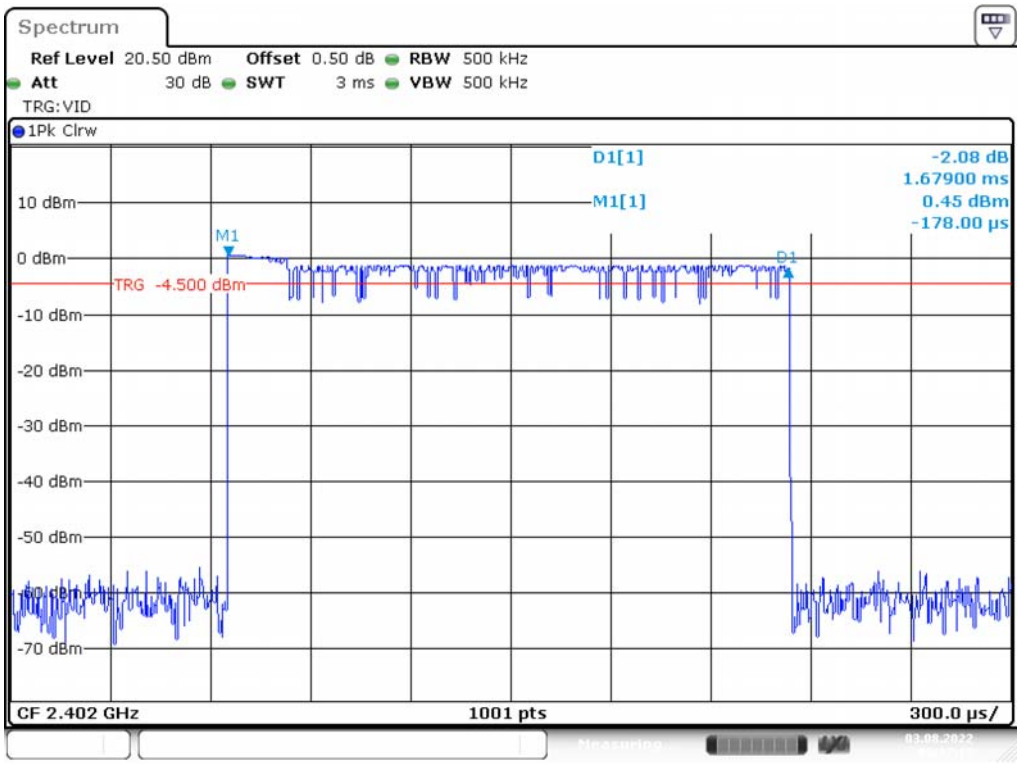
2DH1: Hopping Number



Date: 3.AUG.2022 09:15:56

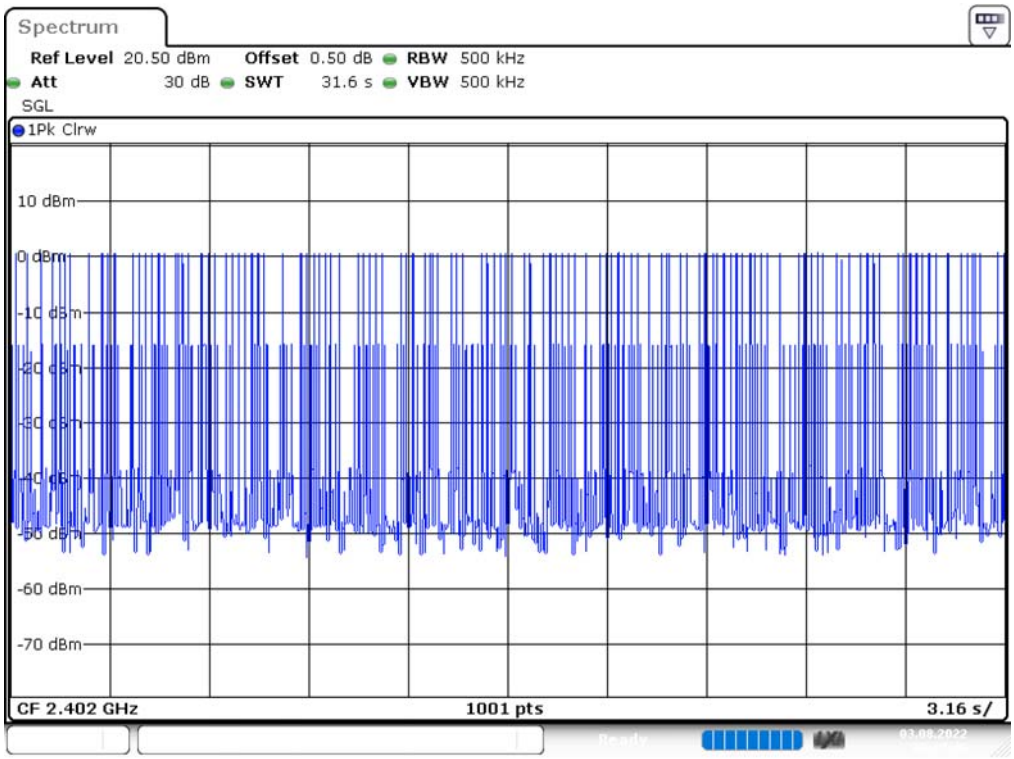
2DH1: Hopping Number /10

(Hopping Number = 32 in 1/10 period of highest signals, Second High signals were other channel)



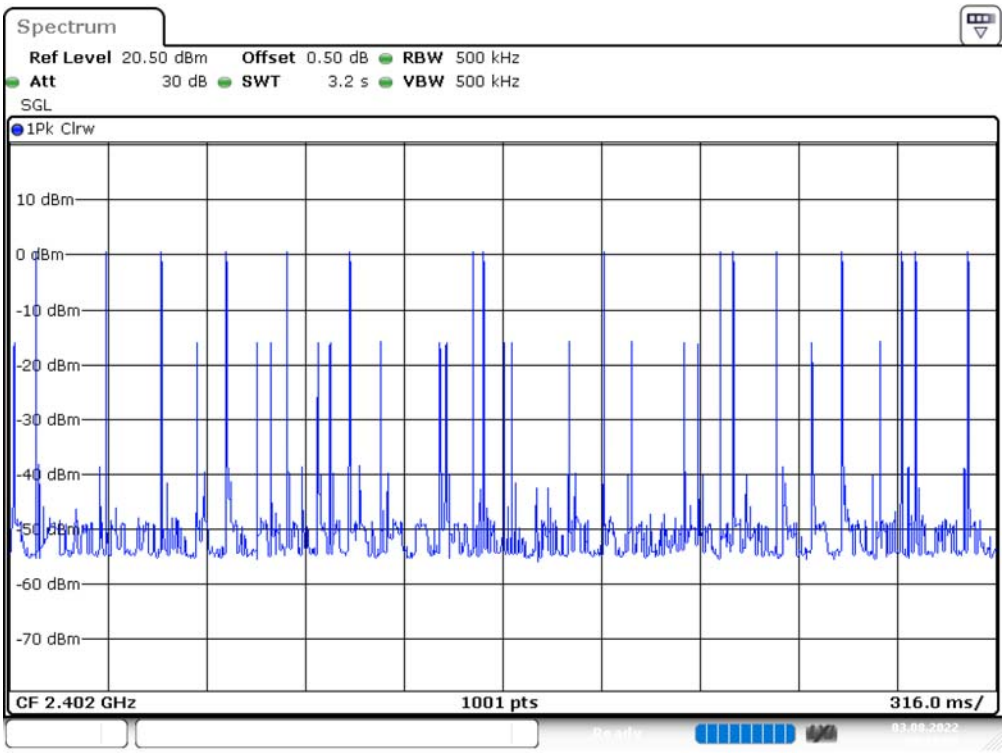
Date: 3.AUG.2022 09:17:13

2DH3: Pulse Width



Date: 3.AUG.2022 09:17:46

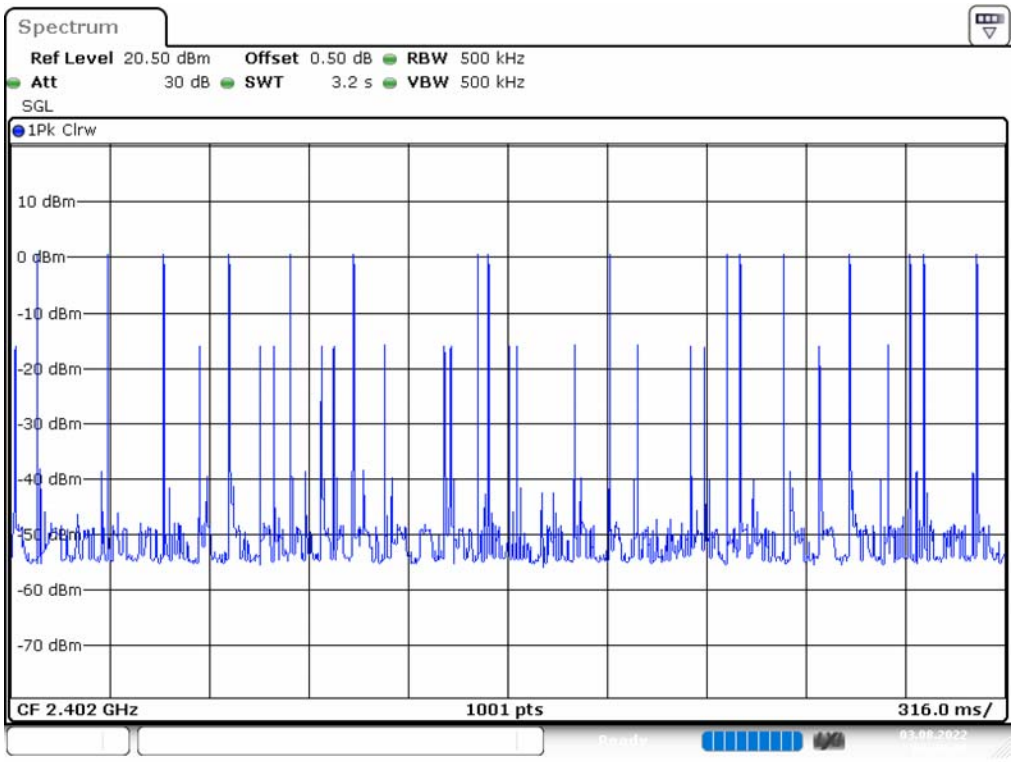
2DH3: Hopping Number



Date: 3.AUG.2022 09:18:00

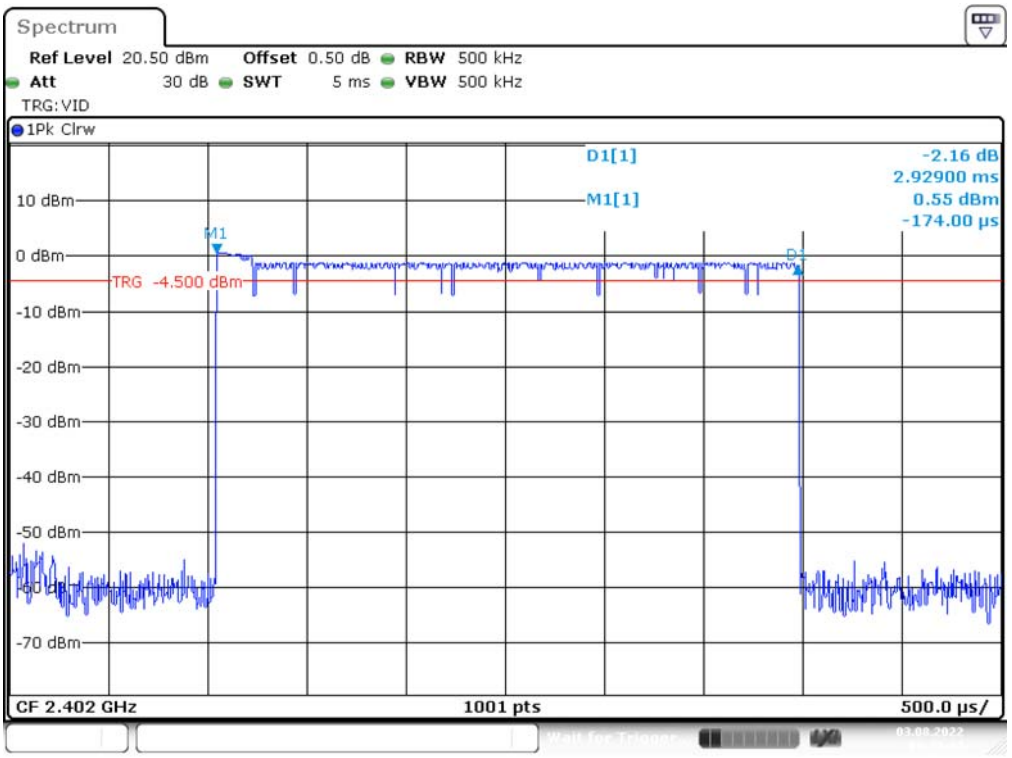
2DH3: Hopping Number /10

(Hopping Number = 16 in 1/10 period of highest signals, Second High signals were other channel)



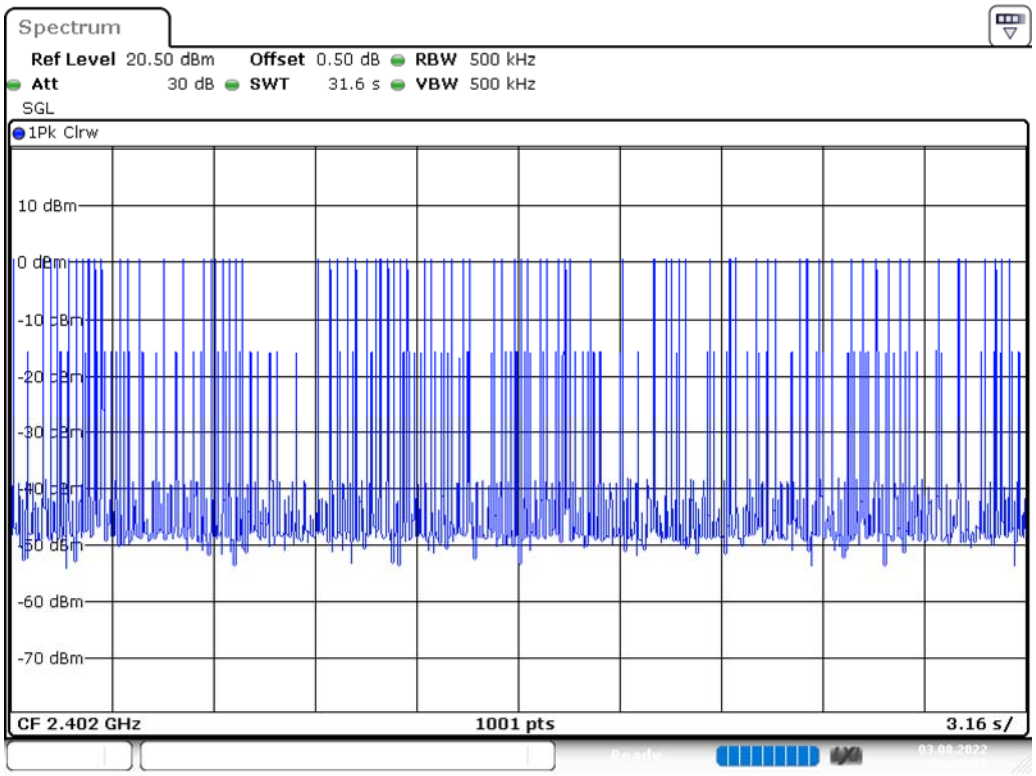
Date: 3.AUG.2022 09:18:00

2DH5: Pulse Width



Date: 3.AUG.2022 09:19:34

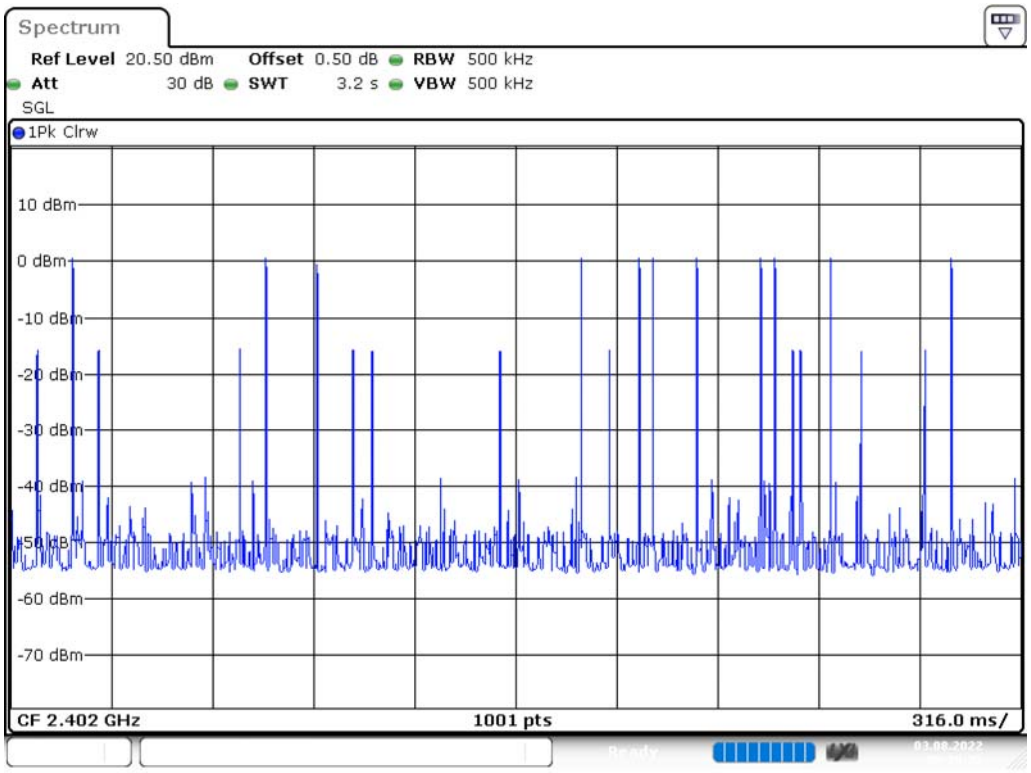
2DH5: Hopping Number



Date: 3.AUG.2022 09:20:07

2DH5: Hopping Number /10

(Hopping Number = 13 in 1/10 period of highest signals, Second High signals were other channel)



Date: 3.AUG.2022 09:20:22

12. FCC §15.247(a)(1)(iii) –Quantity of hopping channel Test

12.1. Applicable Standard

According to FCC §15.247(a) (1) (iii).

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

12.2. Test Procedure

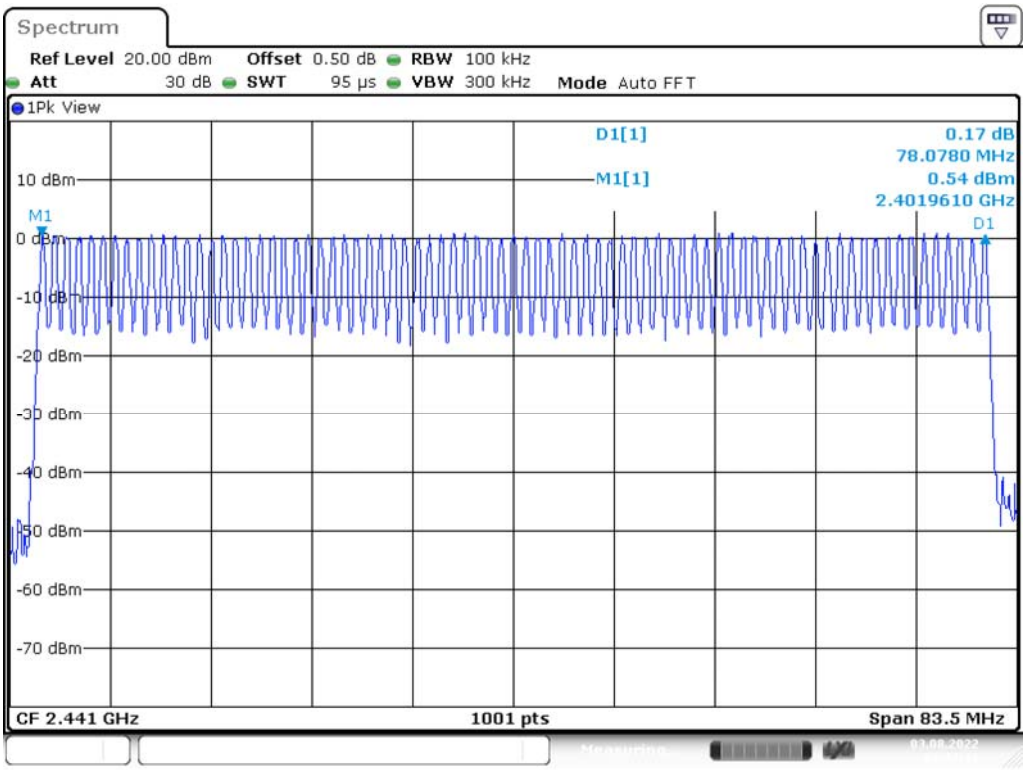
1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Set the EUT in hopping mode from first channel to last.
3. By using the Max-Hold function record the Quantity of the channel.

12.3. Test Results

Mode	Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)	Result
GFSK	2402-2480	79	>15	Compliance
π/4-DQPSK	2402-2480	79	>15	Compliance

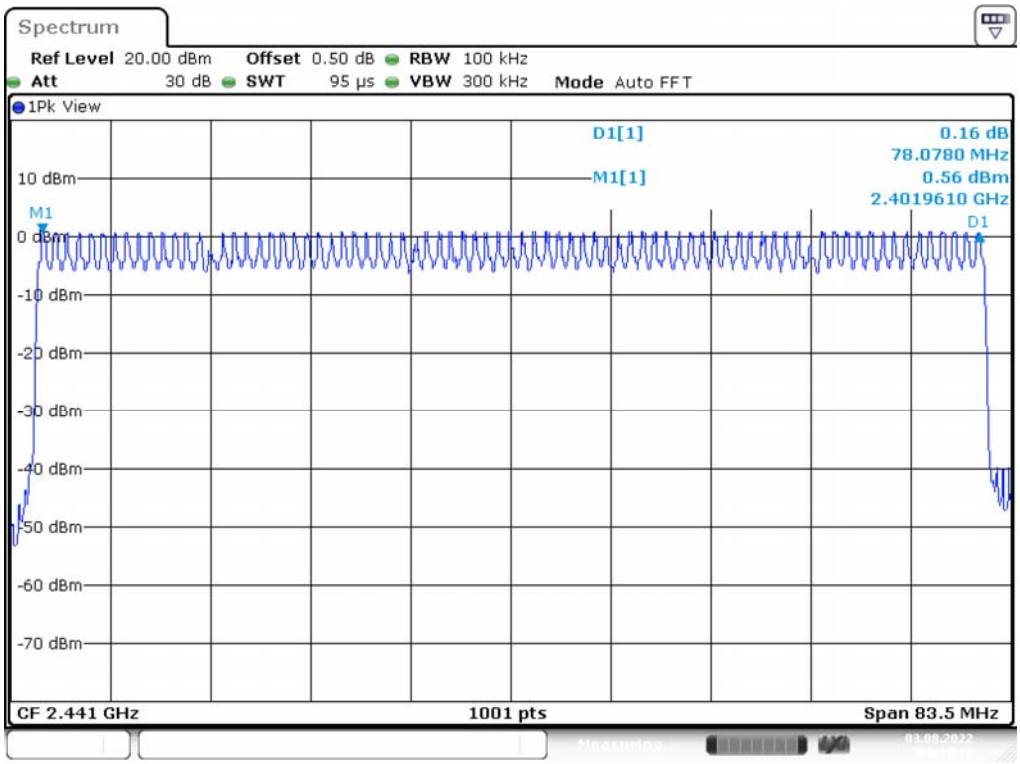
Please refer to the following plots

BR Mode (GFSK)



Date: 3.AUG.2022 09:47:12

EDR Mode (π/4-DQPSK)



Date: 3.AUG.2022 09:34:12

13. FCC §15.247(b)(1) – Maximum Output Power

13.1. Applicable Standard

According to FCC §15.247(b) (1).

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.

13.2. Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to measuring equipment.

13.3. Test Results

Channel	Frequency (MHz)	Peak Conducted Output Power		Limit (W)	Result
		(dBm)	(W)		
BR Mode (GFSK)					
Low	2402	1.64	0.001	0.125	Compliance
Middle	2441	1.84	0.002	0.125	Compliance
High	2480	1.92	0.002	0.125	Compliance
EDR Mode (π/4-DQPSK)					
Low	2402	2.51	0.002	0.125	Compliance
Middle	2441	2.76	0.002	0.125	Compliance
High	2480	2.78	0.002	0.125	Compliance

Note: It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (New Taipei Laboratory)

14. FCC §15.247(d) – 100 kHz Bandwidth of Frequency Band Edge

14.1. Applicable Standard

According to FCC §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emissions limits specified in §15.209(a) see §15.205(c).

14.2. Test Procedure

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.

RBW = 100 kHz VBW = 300 kHz

Sweep = coupled

Detector function = peak Trace = max hold

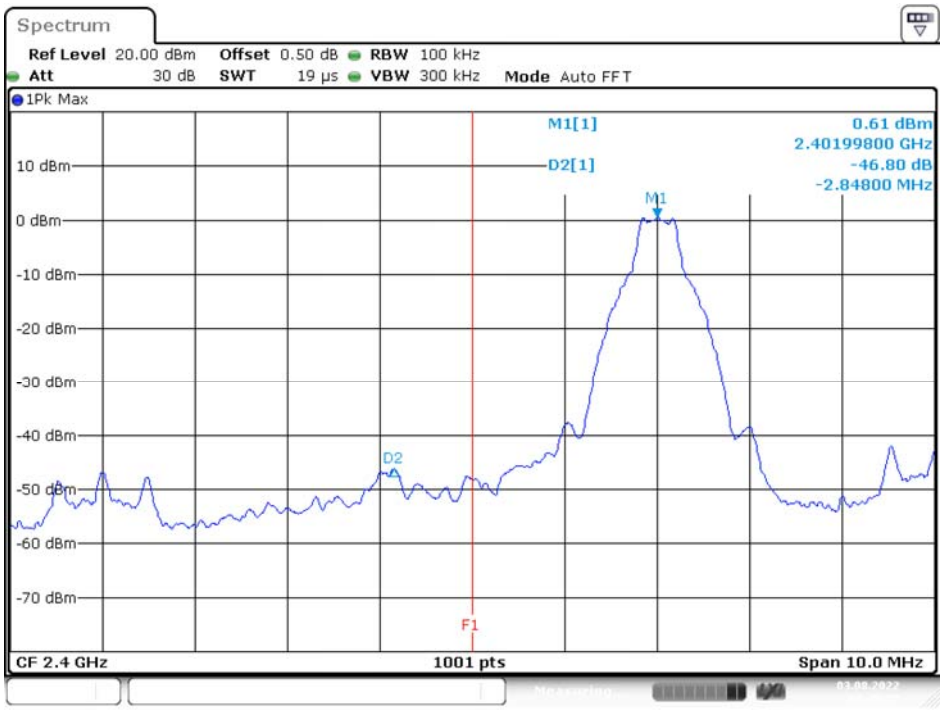
14.3. Test Results

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BR Mode (GFSK)				
Low	2402	46.80	≥ 20	PASS
High	2480	42.52	≥ 20	PASS
BR Hopping Mode (GFSK)				
Low	2402-2480	47.52	≥ 20	PASS
High	2402-2480	42.78	≥ 20	PASS
EDR Mode (π/4-DQPSK)				
Low	2402	46.41	≥ 20	PASS
High	2480	42.34	≥ 20	PASS
EDR Hopping Mode (π/4-DQPSK)				
Low	2402-2480	46.60	≥ 20	PASS
High	2402-2480	42.56	≥ 20	PASS

Please refer to the following plots.

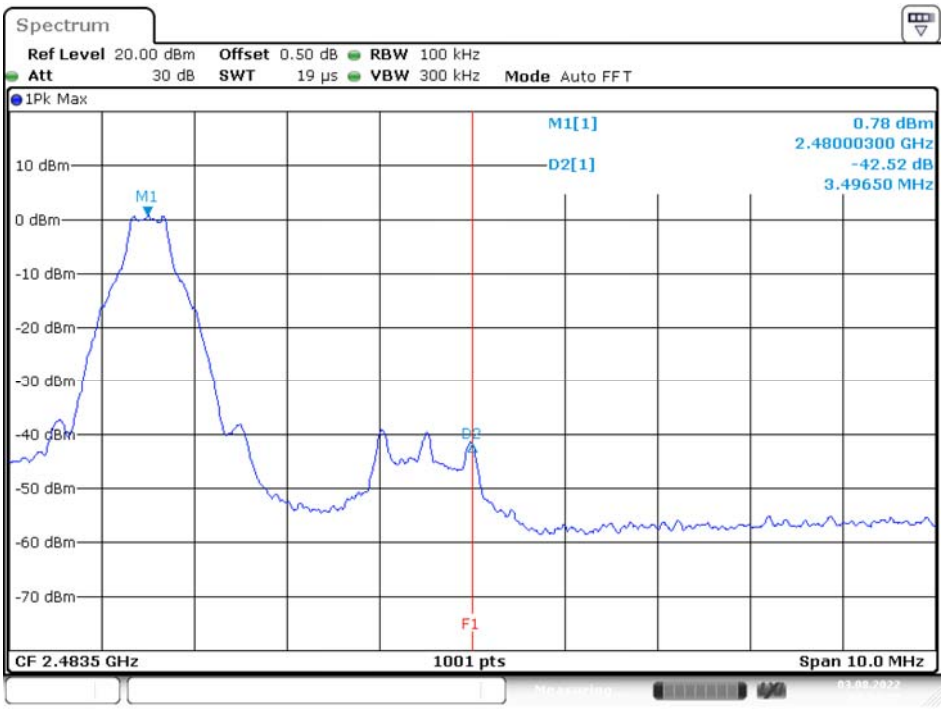
BR Mode (GFSK)

Band Edge, CH Low



Date: 3.AUG.2022 09:48:33

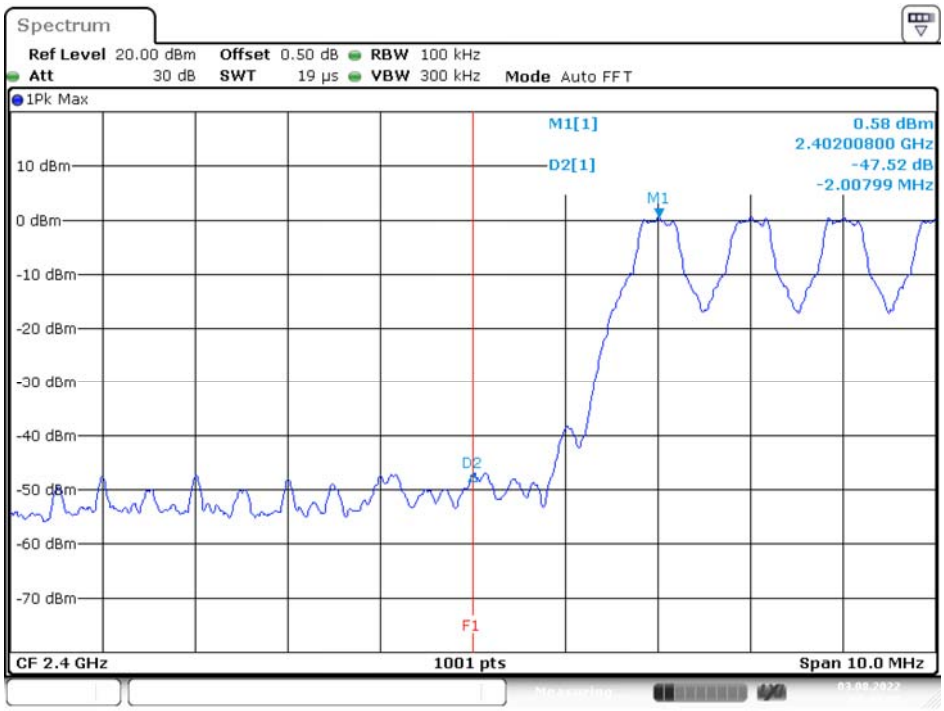
Band Edge, CH High



Date: 3.AUG.2022 09:51:47

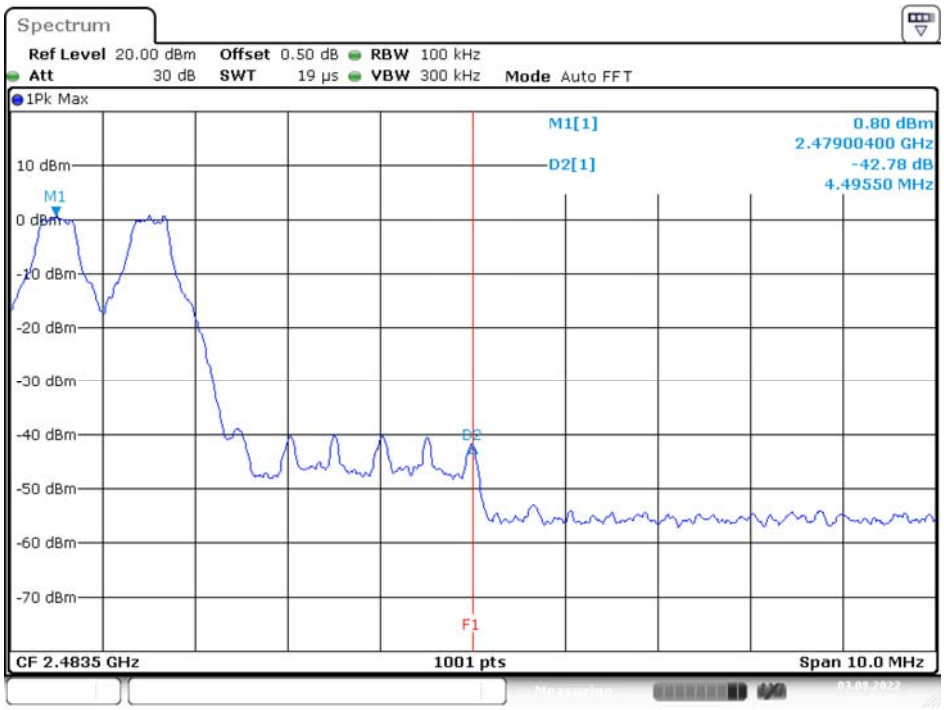
BR Hopping Mode (GFSK)

Band Edge, CH Low



Date: 3.AUG.2022 09:44:40

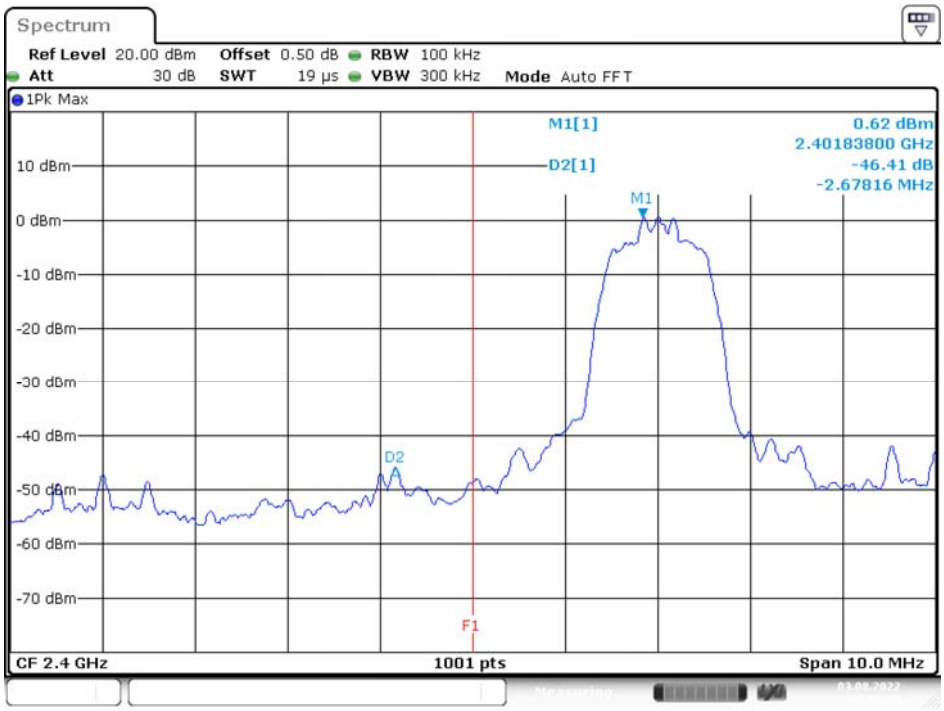
Band Edge, CH High



Date: 3.AUG.2022 09:44:56

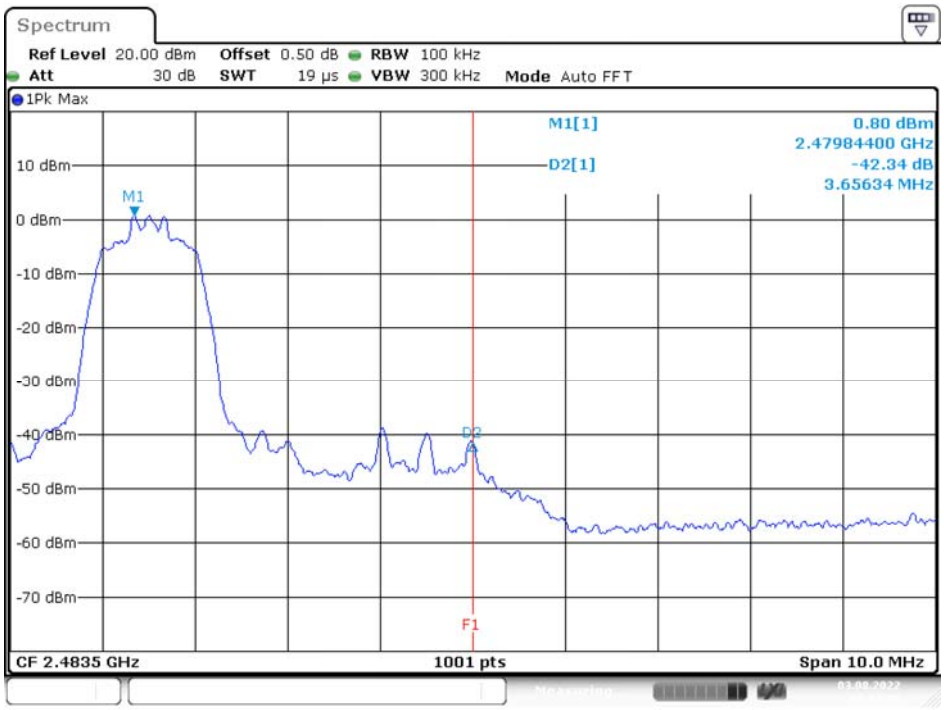
EDR Mode (π/4-DQPSK)

Band Edge, CH Low



Date: 3.AUG.2022 09:08:24

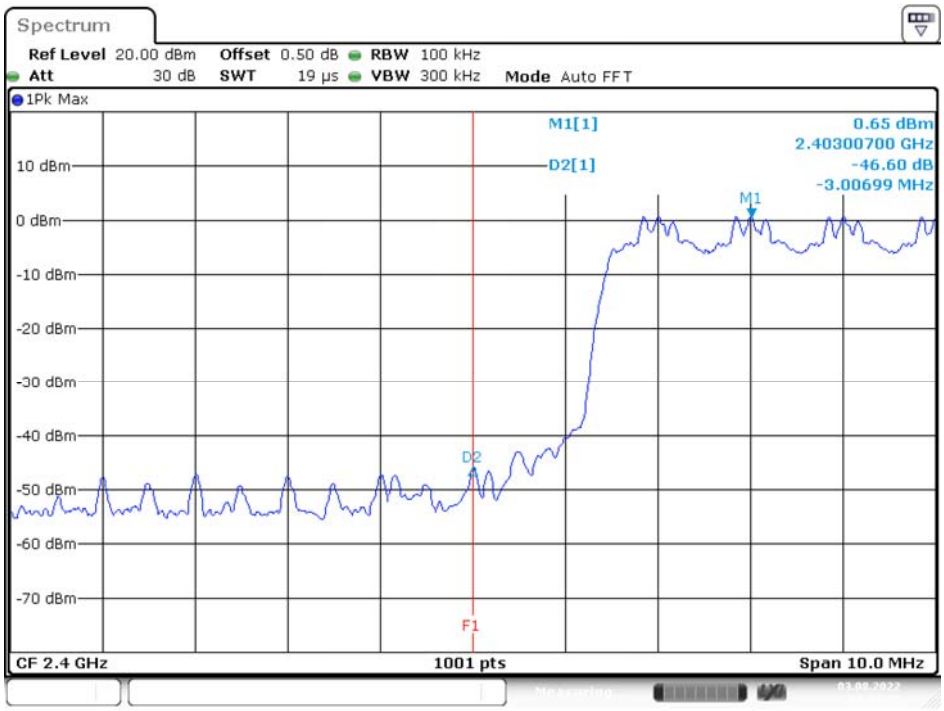
Band Edge, CH High



Date: 3.AUG.2022 09:11:46

EDR Hopping Mode (π/4-DQPSK)

Band Edge, CH Low



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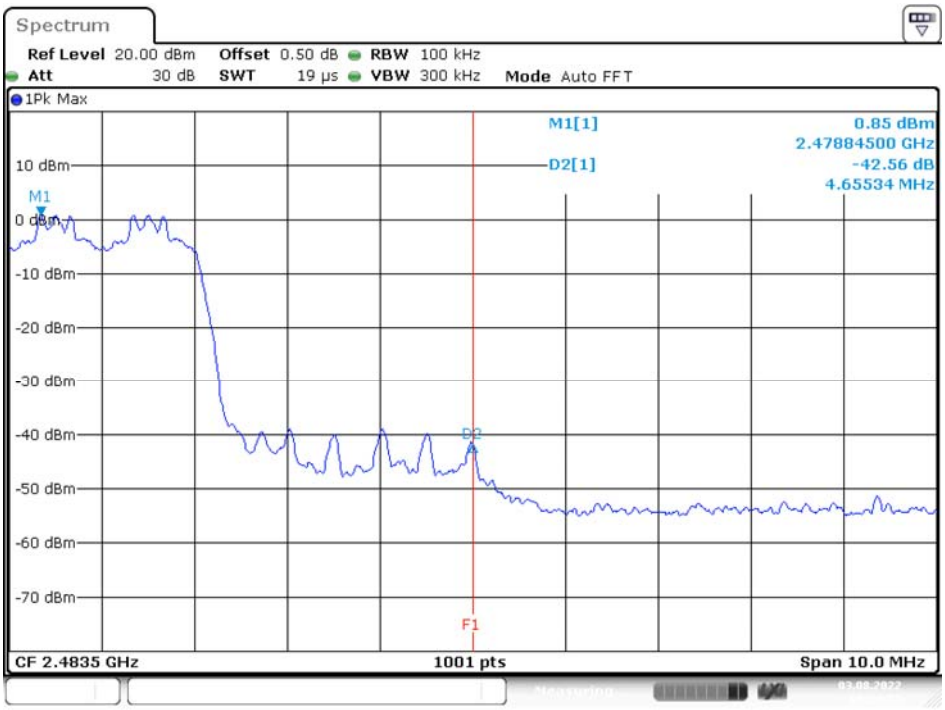
Band Edge, CH High



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