FCC Part 15.247
RSS-247, ISSUE 3, August 2023
RSS-GEN, ISSUE 5, February 2021 Amendment 2
TEST REPORT

For

YEALINK(XIAMEN) NETWORK TECHNOLOGY CO.,LTD.

No.666 Hu'an Rd,Huli District Xiamen City, Fujian, P.R. China

FCC ID: T2C-BT51AV2
IC: 10741A-BT51AV2

Report Type:	**Product Type:**
Original Report	Bluetooth USB Dongle

Report Producer : Coco Lin

Report Number : RLK230922110RF01

Report Date : 2023-11-13

Reviewed By: Rory Cheng

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Revision History

Revision	No.	Report Number	Issue Date	Description	Author/ Revised by
0.0	RLK230922110	RLK230922110RF01	2023-11-13	Original Report	Coco Lin

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1. General Information

1.1. Product Description for Equipment under Test (EUT)

Manufacturer	YEALINK(XIAMEN) NETWORK TECHNOLOGY CO.,LTD.
	No.666 Hu'an Rd,Huli District Xiamen City, Fujian, P.R. China
Brand Name	Yealink
Product (Equipment)	Bluetooth USB Dongle
Main Model Name	BT51A
Frequency Range	2402~2480 MHz
Modulation Technique	BR Mode: GFSK EDR Mode: π/4-DQPSK
Peak Conducted Output Power	BR(GFSK) Mode: 10.26 dBm EDR(π/4-DQPSK) Mode: 10.28 dBm
Transmit Data Rate	BR(GFSK) Mode: 1 Mbps EDR(π/4-DQPSK) Mode: 2 Mbps
Power Operation (Voltage Range)	☐ AC 120V/60Hz ☐ Adapter ☐ By AC Power Cord ☐ PoE
	☒ DC Type ☐ Battery ☐ DC Power Supply ☒ External from USB 5V. ☐ External DC Adapter
	☐ Host System via Sever power
Received Date	2023/09/22
Date of Test	2023/09/27~11/10

*All measurement and test data in this report was gathered from production sample serial number: RLK230922110-01 (Assigned by BACL, Linkou Laboratory.).

1.2. Objective

This report is prepared on behalf of YEALINK(XIAMEN) NETWORK TECHNOLOGY CO.,LTD. in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communication Commission's 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.
KDB 558074 D01 15.247 Meas Guidance v05r02

1.5. Statement

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

The measurement results in this report were performed at Bay Area Compliance Laboratories Corp. (Linkou Laboratory)

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. (Linkou 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		±3.38 (dB)
RF output power, conducted		±3.74 (dB)
Power Spectral Density, conducted		±0.69 (dBm)
Occupied Bandwidth		±0.09 (%)
Unwanted Emissions, conducted		±1.13 (dB)
Emissions, radiated	30 MHz~1GHz	±5.34 (dB)
	1 GHz~18 GHz	±5.89 (dB)
	18 GHz~40 GHz	±5.52 (dB)
Temperature		±0.44 (%)
Humidity		±0.78 (℃)

1.7. Environmental Conditions

Test Site	Test Date	Temperature (℃)	Relative Humidity (%)	ATM Pressure (hPa)	Test Engineer
AC Line Conducted Emissions	2023/09/27	23.5	51	1010	Kevin
Radiation Spurious Emissions	2023/11/10	22.2	49	1010	Bruce
Conducted Spurious Emissions	2023/09/27	23.4	53	1010	Kevin
20 dB Emission Bandwidth	2023/09/27	23.4	53	1010	Kevin
Channel Separation Test	2023/09/27	23.4	53	1010	Kevin
Time of Occupancy	2023/09/27	23.4	53	1010	Kevin
Quantity of hopping channel	2023/09/27	23.4	53	1010	Kevin
Maximum Output Power	2023/09/27	23.4	53	1010	Kevin
100 kHz Bandwidth of Frequency Band Edge	2023/09/27	23.4	53	1010	Kevin

1.8. Test Facility

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

☒ No.6, Wende 2Rd., Guishan Dist., Taoyuan City 33382, Taiwan (R.O.C.).

Bay Area Compliance Laboratories Corp. (Linkou Laboratory) Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 3546) by Mutual Recognition Agreement (MRA). The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database. The FCC Registration No.: 0027578244. Designation No.: TW1119. The Test Firm Registration No.: 311381.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: TW3546.

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 "Realtek Bluetooth MP Kit".

Test Frequency		2402MHz	2441MHz	2480MHz
Power Level Setting	GFSK	61	61	61
	π/4-DQPSK	61	61	61

2.4. Support Equipment List and Details

Description	Manufacturer	Model Number	S/N
NB	DELL	ONS0ST0	8W66SM1

2.5. External Cable List and Details

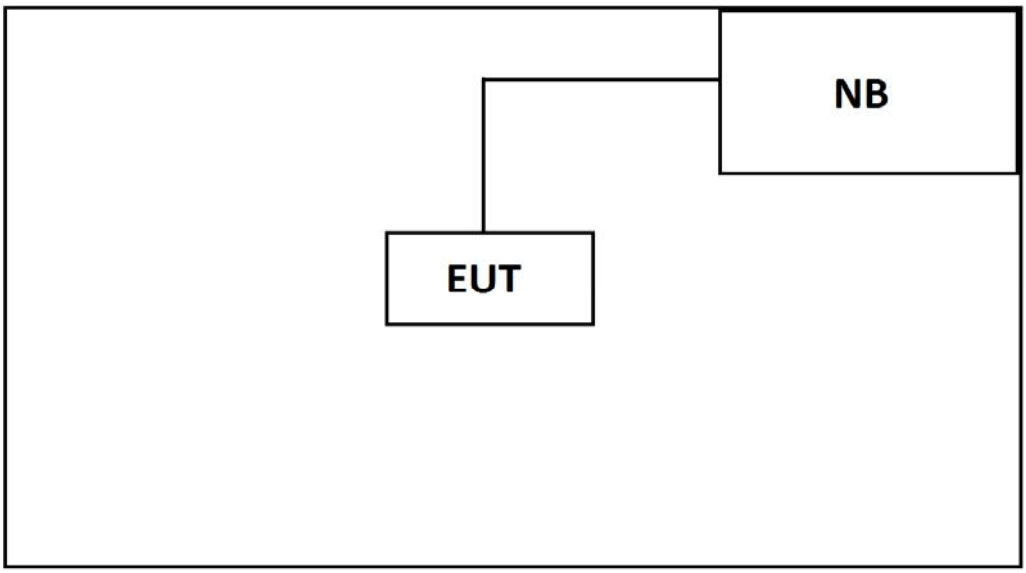
Cable Description	Length (m)	From	To
USB Cable	2m	Notebook	EUT

2.6. Block Diagram of Test Setup

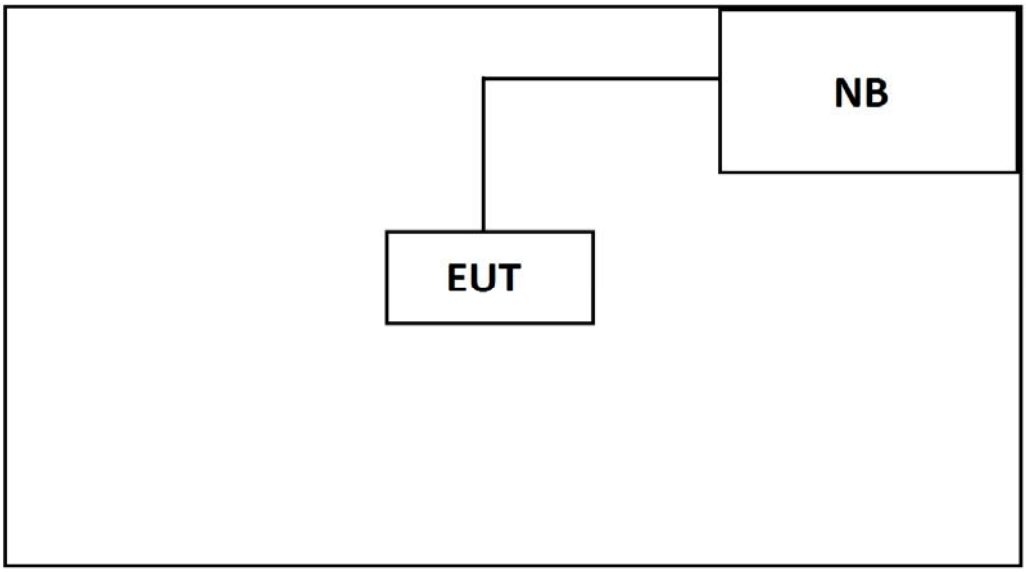
See test photographs attached in annex setup photos for the actual connections between EUT and support equipment.

Radiation:

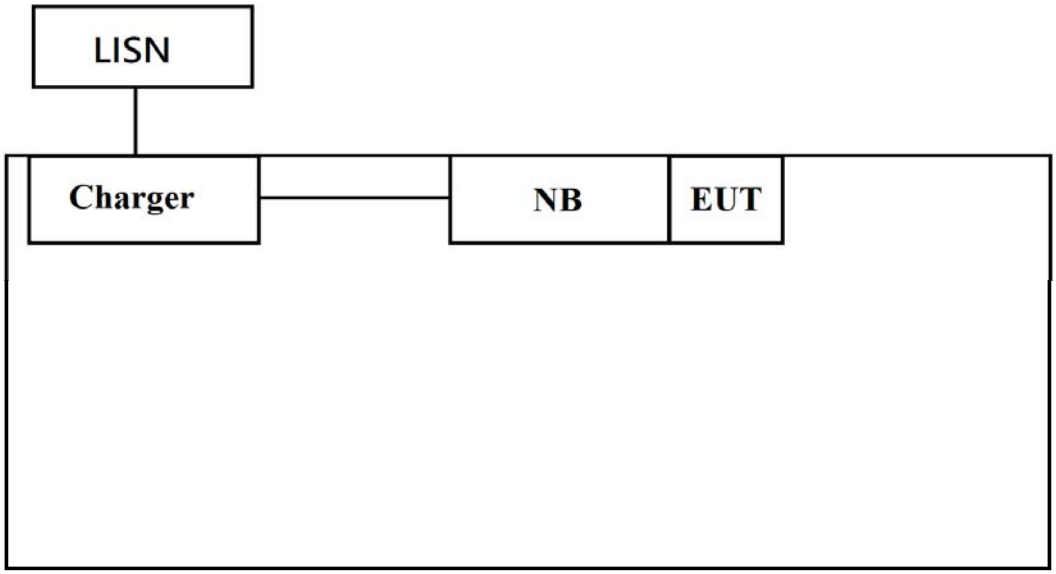
Below 1GHz:



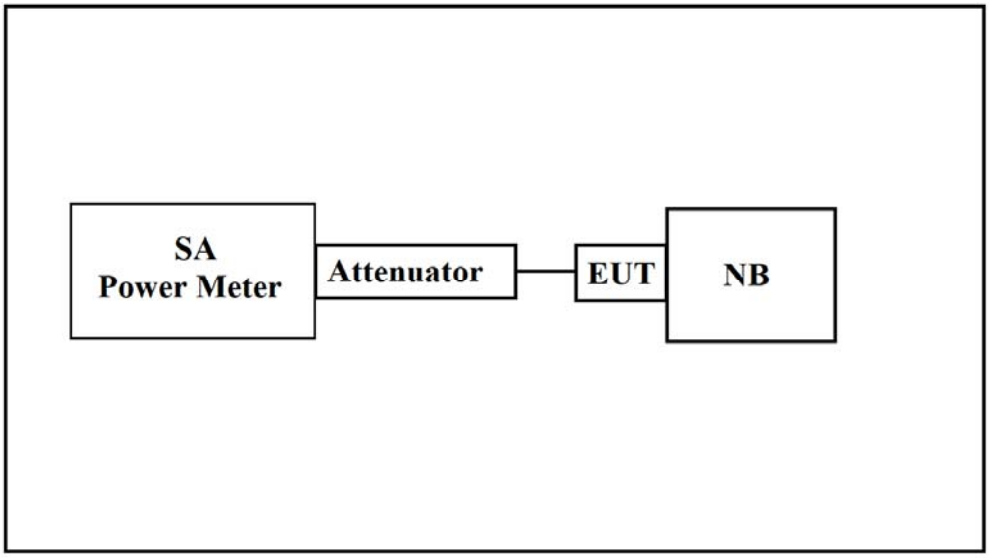
Above 1GHz:



Conduction:



Conducted:



3. Summary of Test Results

Rules	Description of Test	Results
§15.247(i), , §1.1310, § 2.1093	RF Exposure	Compliance
§15.203 RSS-GEN §6.8	Antenna Requirement	Compliance
§15.207(a) RSS-GEN §8.8	AC Line Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d) RSS-247 §5.5 RSS-GEN §8.9 RSS-GEN §8.10	Spurious Emissions	Compliance
§15.247(a)(1) RSS-247 §5.1 (b) RSS-GEN §6.7	20 dB Emission Bandwidth	Compliance
§15.247 (a)(1) RSS-247 §5.1 (b)	Channel Separation Test	Compliance
§15.247(a)(1)(iii) RSS-247 §5.1 (d)	Time of Occupancy (Dwell Time)	Compliance
§15.247(a)(1)(iii) RSS-247 §5.1 (d)	Quantity of hopping channel Test	Compliance
§15.247(b)(1) RSS-247 §5.1 (b)	Maximum Peak Output Power	Compliance
§15.247(d) RSS-247 §5.5	100 kHz Bandwidth of Frequency Band Edge	Compliance

4. Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due Date
AC Line Conduction Room (CON-A)					
Two-Line-V-Network	Rohde & Schwarz	ENV216	100037	2023/09/13	2024/09/11
EMI Test Receiver	Rohde & Schwarz	ESR3	102430	2022/09/29	2023/09/28
Pulse Limiter	SCHWARZBECK	VTSD 9561-F	00432	2023/08/14	2024/08/12
RF Cable	EMCI	EMCCFD300-BM-BM-3000	221013	2022/10/20	2023/10/19
Software	Audix	e3 v9	E3LK-03	N.C.R	N.C.R
Radiation 3M Room (966-A)					
Bilog Antenna with 6 dB Attenuator	SUNOL SCIENCES & EMCI	JB3 & N-6-06	A111513 & AT-N0668	2023/4/13	2024/4/11
Horn Antenna	ETS-Lindgren	3160-09	123852	2023/07/21	2024/07/19
Horn Antenna	EMCO	3115	2058	2023/03/25	2024/03/23
Preamplifier	A.H. Systems	PAM-1840VH	174	2023/3/24	2024/3/22
Preamplifier	A.H. Systems	PAM-0118P	470	2023/03/24	2024/03/22
ESR EMI Test Receiver	Rohde & Schwarz	ESR3	102759	2023/09/14	2024/09/12
Spectrum Analyzer	Rohde & Schwarz	FSV40	1321.3008K40-101940-YY	2022/12/14	2023/12/13
Microflex Cable (0.9m)	UTIFLEX	W6103	LKTE381	2023/06/26	2024/06/24
Microflex Cable (2m)	EMCI	EMC106-SM-SM-2000	180515	2023/08/03	2024/08/01
Microflex Cable (8m)	UTIFLEX	UFA210A-1-3149-300300	MFR 64639 232490-001	2023/08/03	2024/08/01
Software	AUDIX	E3 V9	E3LK-01	N.C.R	N.C.R
Conducted Room					
Spectrum Analyzer	Rohde & Schwarz	FSV40	101938	2022/12/7	2023/12/6
Cable	MTJ	MT40S	620620-MT40S-100	2022/12/23	2023/12/22
Power Sensor	KEYSIGHT	U2021XA	SGMY54080007	2023/09/14	2024/09/12
10dB Attenuator	MCL	BW-S10W5+	605	2023/03/22	2024/03/20

***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.

5. FCC §15.247(i), , §1.1310, § 2.1093 – RF EXPOSURE INFORMATION

5.1. Applicable Standard

According to subpart 15.247(i) and subpart §1.1310, § 2.1093.

5.2. RF Exposure Evaluation Result

Compliant, please refer to the SAR report RXZ230928135SA01.

6. FCC §15.203 / RSS-Gen §6.8– Antenna Requirements

6.1. Applicable Standard

According to § 15.203 and RSS-Gen 6.8: Transmit antenna

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
YEALINK(XIAMEN) NETWORK TECHNOLOGY CO.,LTD.	BT Antenna	Metal Antenna	0.01dBi

The EUT has one Internal Antenna arrangement, use of a permanently attached antenna, fulfill the requirement of this section. Please refer to EUT photos.

Result: Compliance

7. FCC §15.207(a) / RSS-Gen §8.8– 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.

According to RSS-GEN §8.8

Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in table 4, as measured using a 50 μH / 50 Ω line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

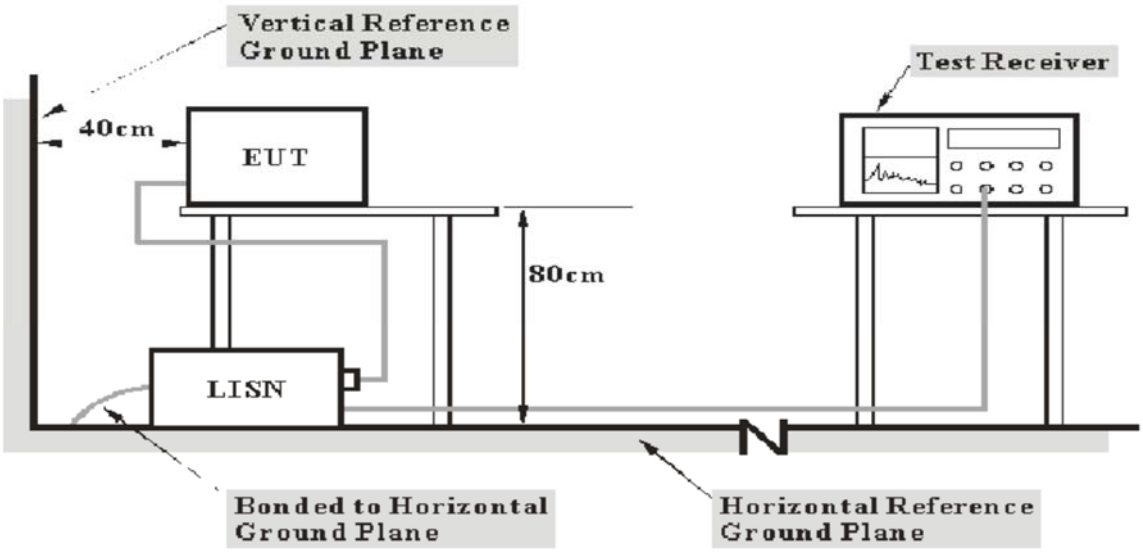
For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in table 4 shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

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

According to ANSI C63.10-2013, section 6.2

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:

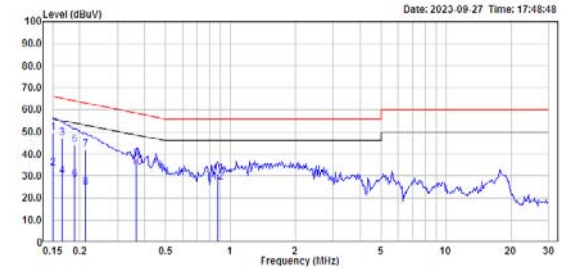
Over Limit = Level – Limit Line

7.6. Test Results

Test Mode: Transmitting

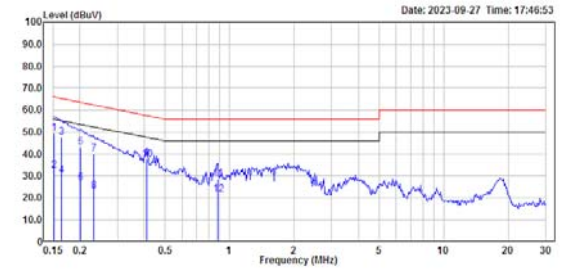
Main: AC120 V, 60 Hz

Line	Neutral



Site : Conduction
Condition: Line
Job No : RLK230922110
Test By : Kevin
Power : AC 120V/60Hz
Temp.(℃)/Hum.(%RH): 23.5℃/51%
Mode : BT

	Freq	Read Level	Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	
1	0.150	29.85	49.52	19.67	66.00	-16.48	QP
2	0.150	13.87	33.54	19.67	56.00	-22.46	Average
3	0.166	27.44	47.10	19.66	65.17	-18.07	QP
4	0.166	9.99	29.65	19.66	55.17	-25.52	Average
5	0.189	24.58	44.23	19.65	64.10	-19.87	QP
6	0.189	8.71	28.36	19.65	54.10	-25.74	Average
7	0.212	22.16	41.81	19.65	63.11	-21.30	QP
8	0.212	5.24	24.89	19.65	53.11	-28.22	Average
9	0.367	17.92	37.60	19.68	58.57	-20.97	QP
10	0.367	14.15	33.83	19.68	48.57	-14.74	Average
11	0.871	11.38	31.08	19.70	56.00	-24.92	QP
12	0.871	7.55	27.25	19.70	46.00	-18.75	Average



Site : Conduction
Condition: Neutral
Job No : RLK230922110
Test By : Kevin
Power : AC 120V/60Hz
Temp.(℃)/Hum.(%RH): 23.5℃/51%
Mode : BT

	Freq	Read Level	Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	
1	0.151	29.73	49.40	19.67	65.92	-16.52	QP
2	0.151	12.67	32.34	19.67	55.92	-23.58	Average
3	0.164	27.72	47.38	19.66	65.26	-17.88	QP
4	0.164	10.36	30.02	19.66	55.26	-25.24	Average
5	0.202	23.38	43.03	19.65	63.52	-20.49	QP
6	0.202	7.01	26.66	19.65	53.52	-26.86	Average
7	0.232	20.24	39.90	19.66	62.37	-22.47	QP
8	0.232	3.51	23.17	19.66	52.37	-29.20	Average
9	0.409	18.06	37.73	19.67	57.66	-19.93	QP
10	0.409	17.70	37.37	19.67	47.66	-10.29	Average
11	0.880	8.99	28.69	19.70	56.00	-27.31	QP
12	0.880	1.76	21.46	19.70	46.00	-24.54	Average

Note:
Result = Read Level + Factor
Over Limit = Result – Limit Line
Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

8. FCC §15.209, §15.205 , §15.247(d) / RSS-247 §5.5, RSS-GEN §8.9 & 8.10– 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 RSS-Gen 8.10,

Restricted frequency bands, identified in table 7, are designated primarily for safety-of-life services (distress calling and certain aeronautical activities), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following conditions related to the restricted frequency bands apply:

(a)The transmit frequency, including fundamental components of modulation, of licence-exempt radio apparatus shall not fall within the restricted frequency bands listed in table 7 except for apparatus compliant with RSS-287, Emergency Position Indicating Radio Beacons (EPIRB), Emergency Locator Transmitters (ELT), Personal Locator Beacons (PLB), and Maritime Survivor Locator Devices (MSLD).

(b)Unwanted emissions that fall into restricted frequency bands listed in table 7 shall comply with the limits specified in table 5 and table 6.

(c)Unwanted emissions that do not fall within the restricted frequency bands listed in table 7 shall comply either with the limits specified in the applicable RSS or with those specified in table 5 and table 6.

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.

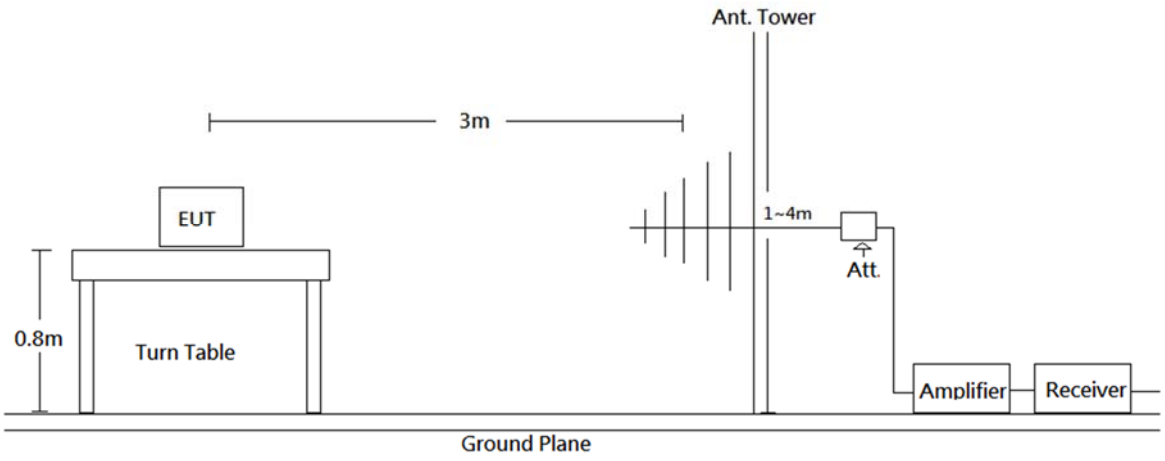
As per FCC §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the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

As per RSS-247 5.5,

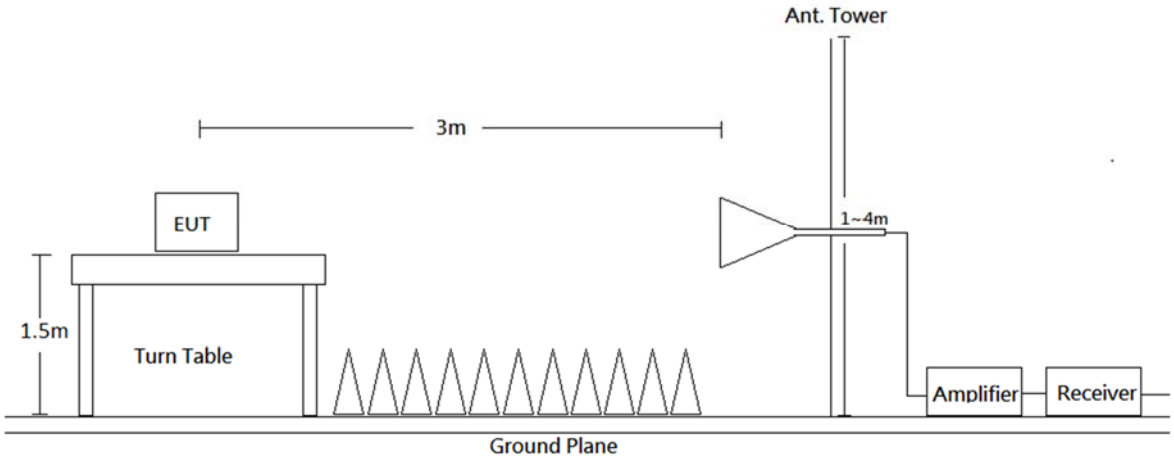
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

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:

Level = Read Level + Factor

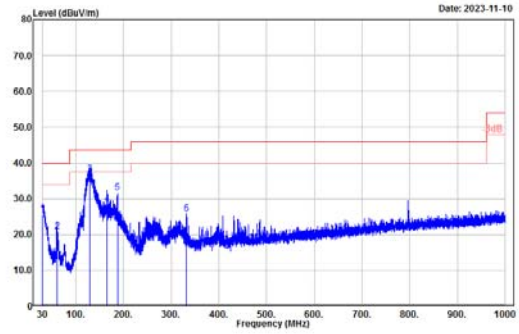
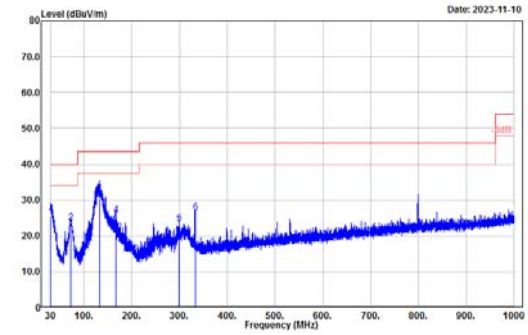
8.6. Test Results

Test Mode: Transmitting

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

(worst case is GFSK mode high channel)

30MHz-1GHz:

Horizontal	Vertical
	

Site : LK-966A
Condition: 3m horizontal
Mode : BT 1M-TX-2480MHz
Note : Temp/RH:22.2°C/49%
Tester: Bruce

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	30.194	25.58	40.00	-14.42	33.63	-8.05	QP
2	60.749	20.79	40.00	-19.21	43.80	-23.01	QP
3	129.231	36.76	43.50	-6.74	55.29	-18.53	QP
4	165.897	28.49	43.50	-15.01	48.80	-20.31	QP
5	187.431	31.62	43.50	-11.88	52.63	-21.01	QP
6	331.961	25.85	46.00	-20.15	44.64	-18.79	QP

Site : LK-966A
Condition: 3m vertical
Mode : BT 1M-TX-2480MHz
Note : Temp/RH:22.2°C/49%
Tester: Bruce

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	30.776	25.33	40.00	-14.67	33.80	-8.47	QP
2	72.777	23.58	40.00	-16.42	47.09	-23.51	QP
3	132.529	30.28	43.50	-13.22	49.03	-18.75	QP
4	166.479	25.74	43.50	-17.76	46.07	-20.33	QP
5	298.690	23.39	46.00	-22.61	42.89	-19.50	QP
6	333.028	26.35	46.00	-19.65	45.10	-18.75	QP

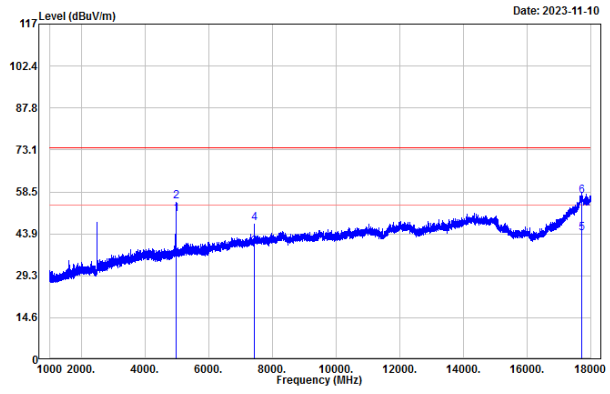
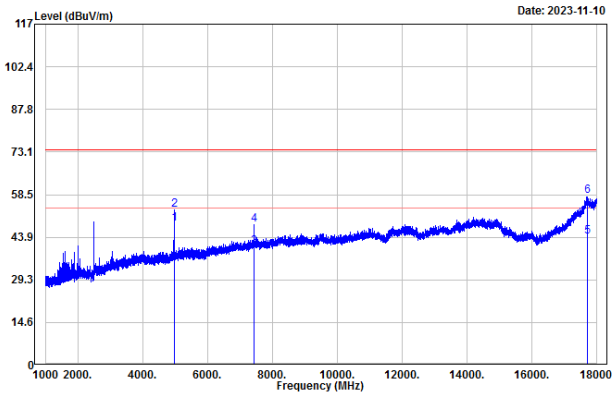
Level = Reading + Factor.

Over Limit = Level – Limit

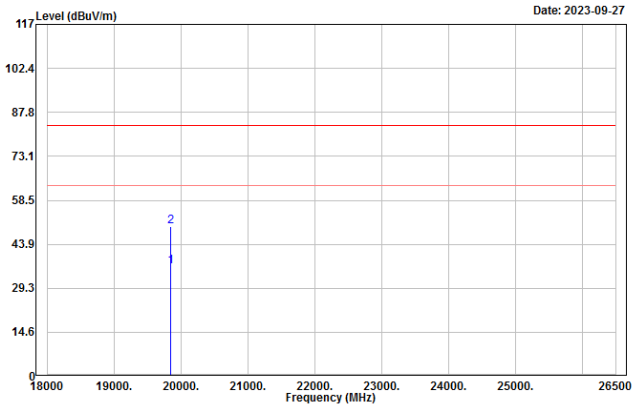
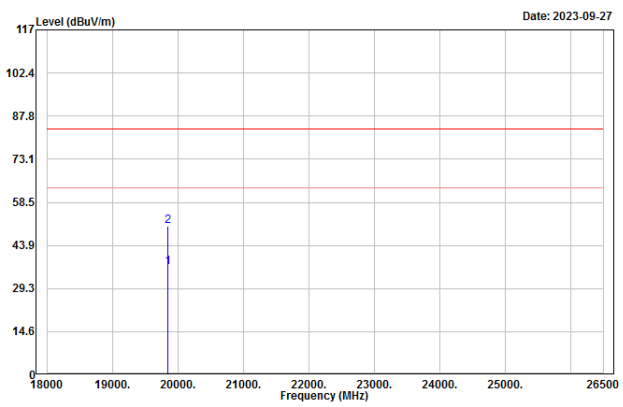
Factor = Antenna Factor + Cable Loss – Amplifier Gain.

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

1GHz-18GHz:

Horizontal	Vertical
	

18GHz-26.5GHz:

Horizontal	Vertical
	

Above 1GHz

BR (GFSK)

Horizontal

Low channel

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	2322.920	29.61	54.00	-24.39	38.58	-8.97	Average
2	2322.920	43.85	74.00	-30.15	52.82	-8.97	Peak
3	2402.000	88.35	------	------	96.92	-8.57	Average
4	2402.000	105.12	------	------	113.69	-8.57	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	4804.000	42.02	54.00	-11.98	43.99	-1.97	Average
2	4804.000	50.78	74.00	-23.22	52.75	-1.97	Peak
3	7206.000	35.26	54.00	-18.74	31.18	4.08	Average
4	7206.000	46.11	74.00	-27.89	42.03	4.08	Peak

Middle channel

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	2441.000	91.10	------	------	99.47	-8.37	Average
2	2441.000	105.74	------	------	114.11	-8.37	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	4882.000	42.41	54.00	-11.59	44.04	-1.63	Average
2	4882.000	50.53	74.00	-23.47	52.16	-1.63	Peak
3	7323.000	35.38	54.00	-18.62	30.92	4.46	Average
4	7323.000	46.98	74.00	-27.02	42.52	4.46	Peak

High channel

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	2480.000	92.06	------	------	100.23	-8.17	Average
2	2480.000	106.13	------	------	114.30	-8.17	Peak
3	2487.985	30.50	54.00	-23.50	38.63	-8.13	Average
4	2487.985	44.11	74.00	-29.89	52.24	-8.13	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	4960.000	41.47	54.00	-12.53	42.75	-1.28	Average
2	4960.000	49.79	74.00	-24.21	51.07	-1.28	Peak
3	7440.000	36.50	54.00	-17.50	31.85	4.65	Average
4	7440.000	47.25	74.00	-26.75	42.60	4.65	Peak

Level = Reading + Factor.

Margin = Level – 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	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	2382.520	36.55	54.00	-17.45	45.21	-8.66	Average
2	2382.520	59.92	74.00	-14.08	68.58	-8.66	Peak
3	2402.000	89.86	------	------	98.43	-8.57	Average
4	2402.000	107.10	------	------	115.67	-8.57	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	4804.000	41.96	54.00	-12.04	43.93	-1.97	Average
2	4804.000	51.39	74.00	-22.61	53.36	-1.97	Peak
3	7206.000	38.13	54.00	-15.87	34.05	4.08	Average
4	7206.000	48.33	74.00	-25.67	44.25	4.08	Peak

Middle channel

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	2441.000	92.46	------	------	100.83	-8.37	Average
2	2441.000	107.52	------	------	115.89	-8.37	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	4882.000	45.68	54.00	-8.32	47.31	-1.63	Average
2	4882.000	54.72	74.00	-19.28	56.35	-1.63	Peak
3	7323.000	38.08	54.00	-15.92	33.62	4.46	Average
4	7323.000	49.14	74.00	-24.86	44.68	4.46	Peak

High channel

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	2480.000	94.09	------	------	102.26	-8.17	Average
2	2480.000	108.23	------	------	116.40	-8.17	Peak
3	2485.318	35.94	54.00	-18.06	44.08	-8.14	Average
4	2485.318	50.32	74.00	-23.68	58.46	-8.14	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	4960.000	45.74	54.00	-8.26	47.02	-1.28	Average
2	4960.000	55.06	74.00	-18.94	56.34	-1.28	Peak
3	7440.000	38.13	54.00	-15.87	33.48	4.65	Average
4	7440.000	48.27	74.00	-25.73	43.62	4.65	Peak

Level = Reading + Factor.

Margin = Level – Limit.

Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain.

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

EDR (π/4-DQPSK)

Horizontal

Low channel

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	2340.560	29.67	54.00	-24.33	38.54	-8.87	Average
2	2340.560	43.65	74.00	-30.35	52.52	-8.87	Peak
3	2402.000	89.84	------	------	98.41	-8.57	Average
4	2402.000	105.86	------	------	114.43	-8.57	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	4804.000	36.71	54.00	-17.29	38.68	-1.97	Average
2	4804.000	49.50	74.00	-24.50	51.47	-1.97	Peak
3	7206.000	30.13	54.00	-23.87	26.05	4.08	Average
4	7206.000	43.11	74.00	-30.89	39.03	4.08	Peak

Middle channel

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	2441.000	88.43	------	------	96.80	-8.37	Average
2	2441.000	106.06	------	------	114.43	-8.37	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	4882.000	37.57	54.00	-16.43	39.20	-1.63	Average
2	4882.000	50.58	74.00	-23.42	52.21	-1.63	Peak
3	7323.000	30.33	54.00	-23.67	25.87	4.46	Average
4	7323.000	44.19	74.00	-29.81	39.73	4.46	Peak

High channel

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	2480.000	89.20	------	------	97.37	-8.17	Average
2	2480.000	107.14	------	------	115.31	-8.17	Peak
3	2485.669	34.72	54.00	-19.28	42.86	-8.14	Average
4	2485.669	50.77	74.00	-23.23	58.91	-8.14	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	4960.000	34.80	54.00	-19.20	36.08	-1.28	Average
2	4960.000	47.75	74.00	-26.25	49.03	-1.28	Peak
3	7440.000	31.00	54.00	-23.00	26.35	4.65	Average
4	7440.000	44.80	74.00	-29.20	40.15	4.65	Peak

Level = Reading + Factor.

Margin = Level – 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	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	2317.930	29.66	54.00	-24.34	38.66	-9.00	Average
2	2317.930	42.65	74.00	-31.35	51.65	-9.00	Peak
3	2402.000	89.17	------	------	97.74	-8.57	Average
4	2402.000	106.04	------	------	114.61	-8.57	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	4804.000	39.74	54.00	-14.26	41.71	-1.97	Average
2	4804.000	52.60	74.00	-21.40	54.57	-1.97	Peak
3	7206.000	32.52	54.00	-21.48	28.44	4.08	Average
4	7206.000	46.48	74.00	-27.52	42.40	4.08	Peak

Middle channel

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	2441.000	88.40	------	------	96.77	-8.37	Average
2	2441.000	106.53	------	------	114.90	-8.37	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	4882.000	38.19	54.00	-15.81	39.82	-1.63	Average
2	4882.000	51.60	74.00	-22.40	53.23	-1.63	Peak
3	7323.000	33.28	54.00	-20.72	28.82	4.46	Average
4	7323.000	47.57	74.00	-26.43	43.11	4.46	Peak

High channel

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	2480.000	90.16	------	------	98.33	-8.17	Average
2	2480.000	107.98	------	------	116.15	-8.17	Peak
3	2483.500	37.15	54.00	-16.85	45.31	-8.16	Average
4	2483.500	54.54	74.00	-19.46	62.70	-8.16	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	4960.000	40.84	54.00	-13.16	42.12	-1.28	Average
2	4960.000	54.00	74.00	-20.00	55.28	-1.28	Peak
3	7440.000	35.25	54.00	-18.75	30.60	4.65	Average
4	7440.000	49.08	74.00	-24.92	44.43	4.65	Peak

Level = Reading + Factor.

Margin = Level – Limit.

Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain.

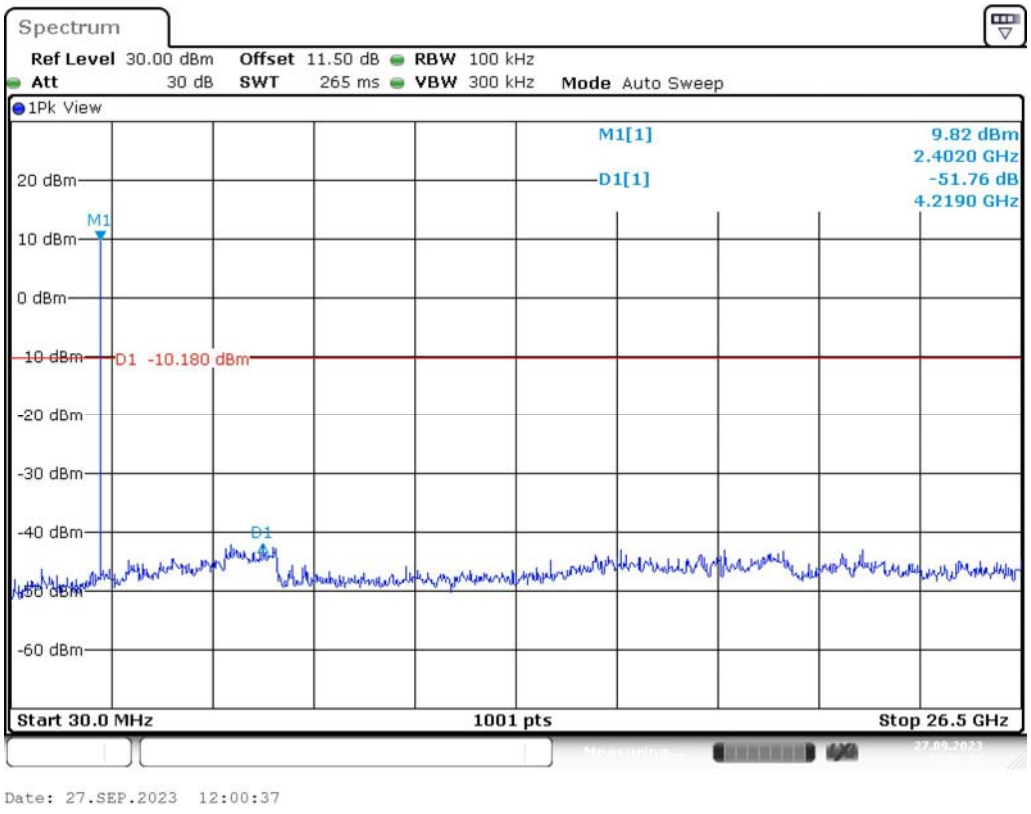
Spurious emissions more than 20 dB below the limit were not reported.

Conducted Spurious Emissions:

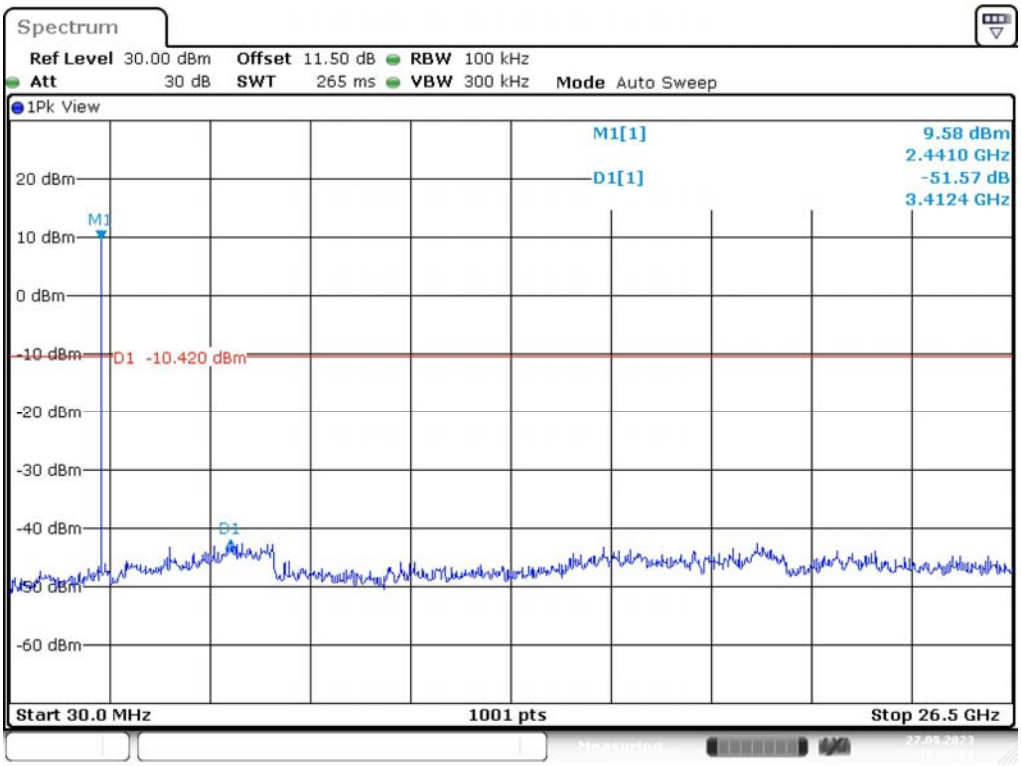
Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BR Mode (GFSK)				
Low	2402	51.76	≥ 20	PASS
Mid	2441	51.57	≥ 20	PASS
High	2480	51.81	≥ 20	PASS
EDR Mode (π/4-DQPSK):				
Low	2402	48.39	≥ 20	PASS
Mid	2441	50.47	≥ 20	PASS
High	2480	47.81	≥ 20	PASS

BR Mode (GFSK)

Low Channel



Middle Channel



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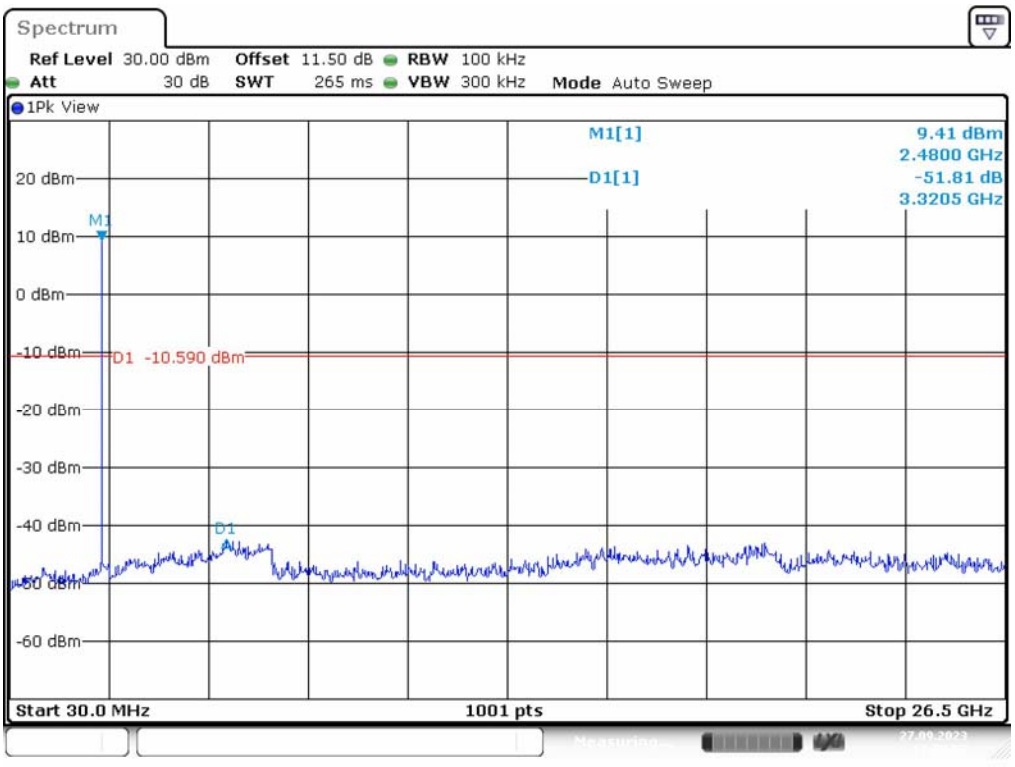
High Channel



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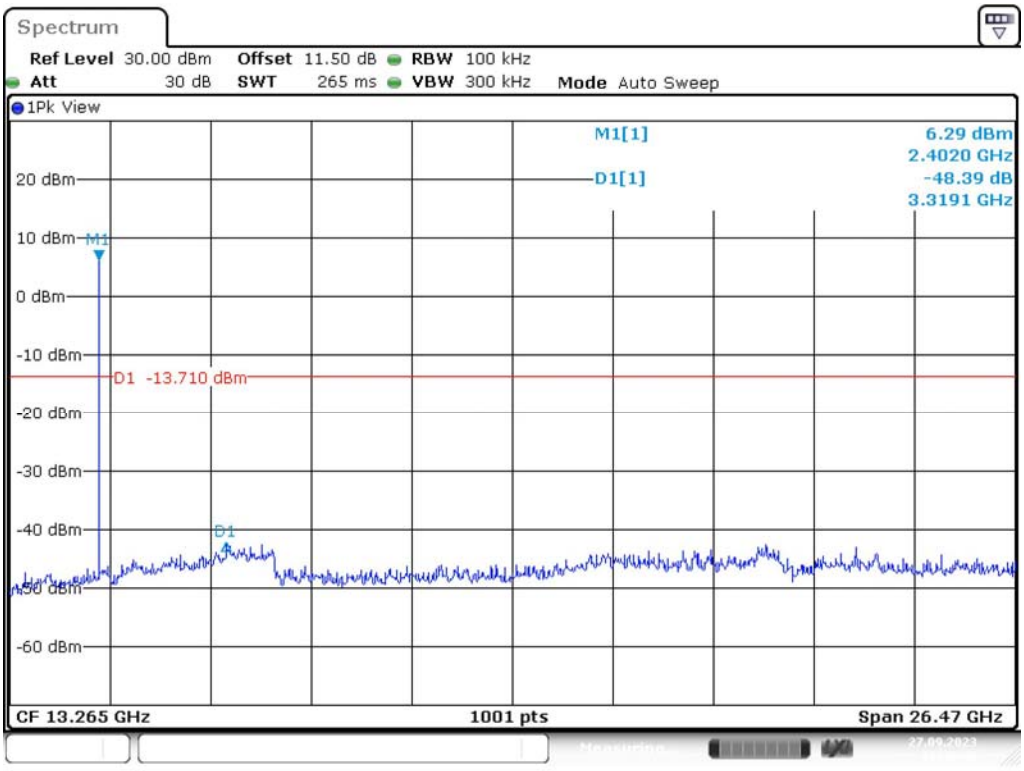
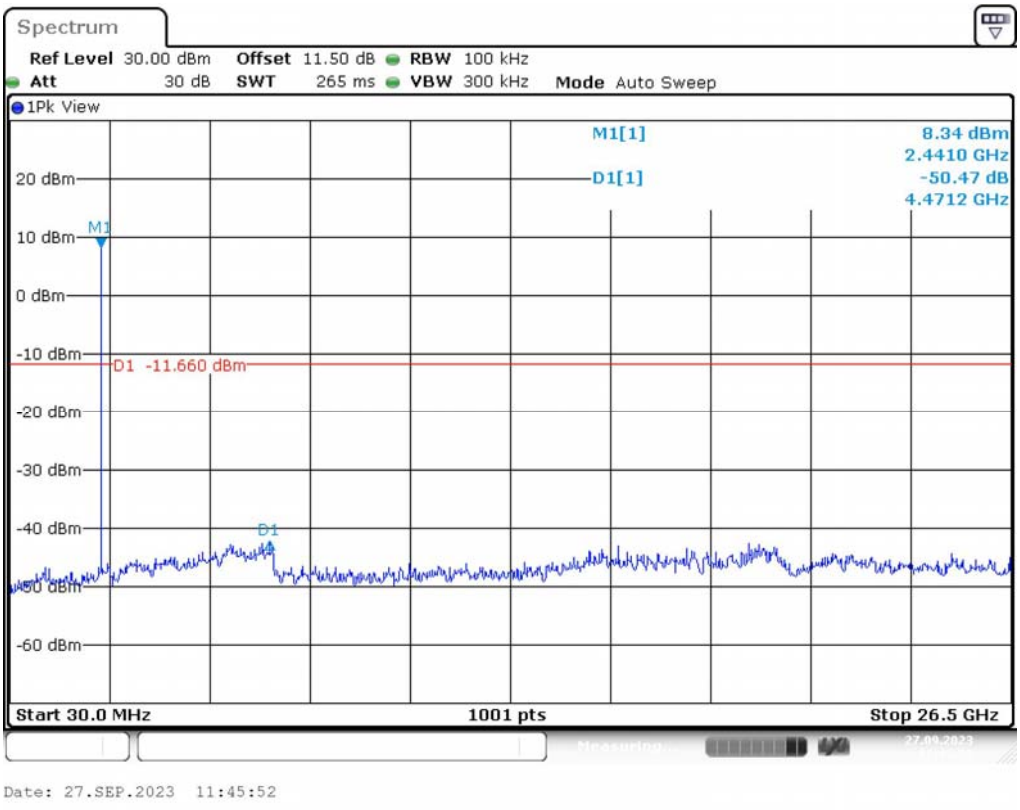
EDR Mode (π/4-DQPSK)

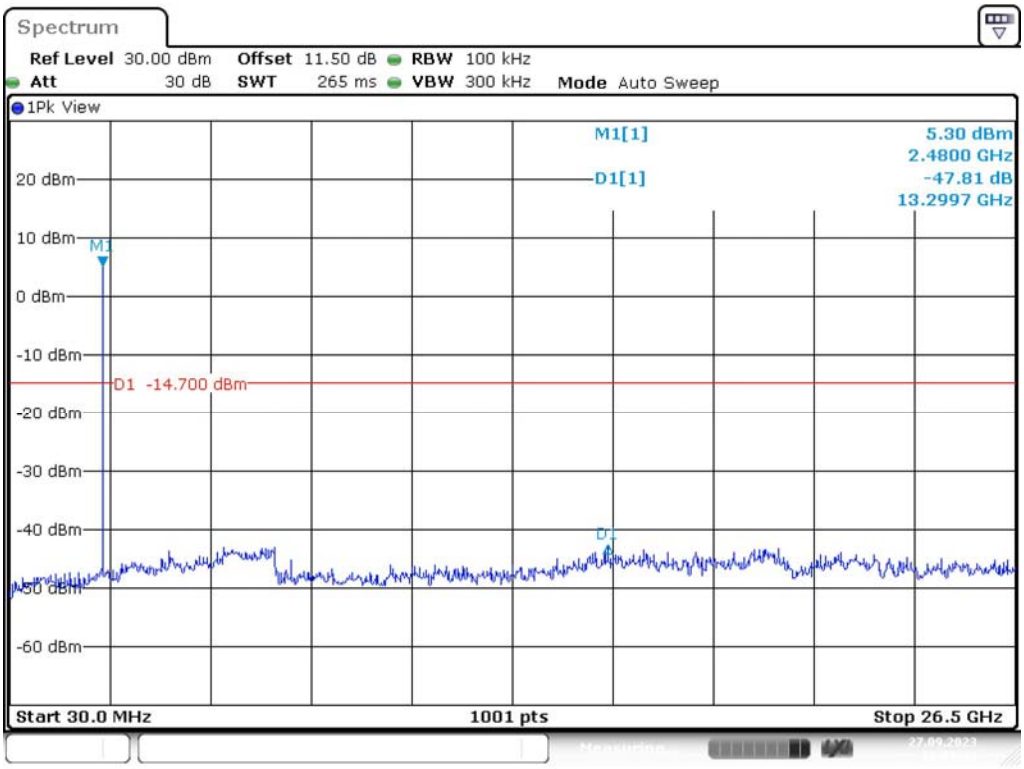
Low Channel



Middle Channel



High Channel



9. FCC §15.247(a)(1) / RSS-247 §5.1(b) & RSS-GEN §6.7– 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.

According to RSS-247 §5.1(b)

FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.

According to RSS-GEN §6.7

The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

9.2. Test Procedure

According to ANSI C63.10-2013, section 7.8.7

20 dB Emission Bandwidth

(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.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

9.3. Test Results

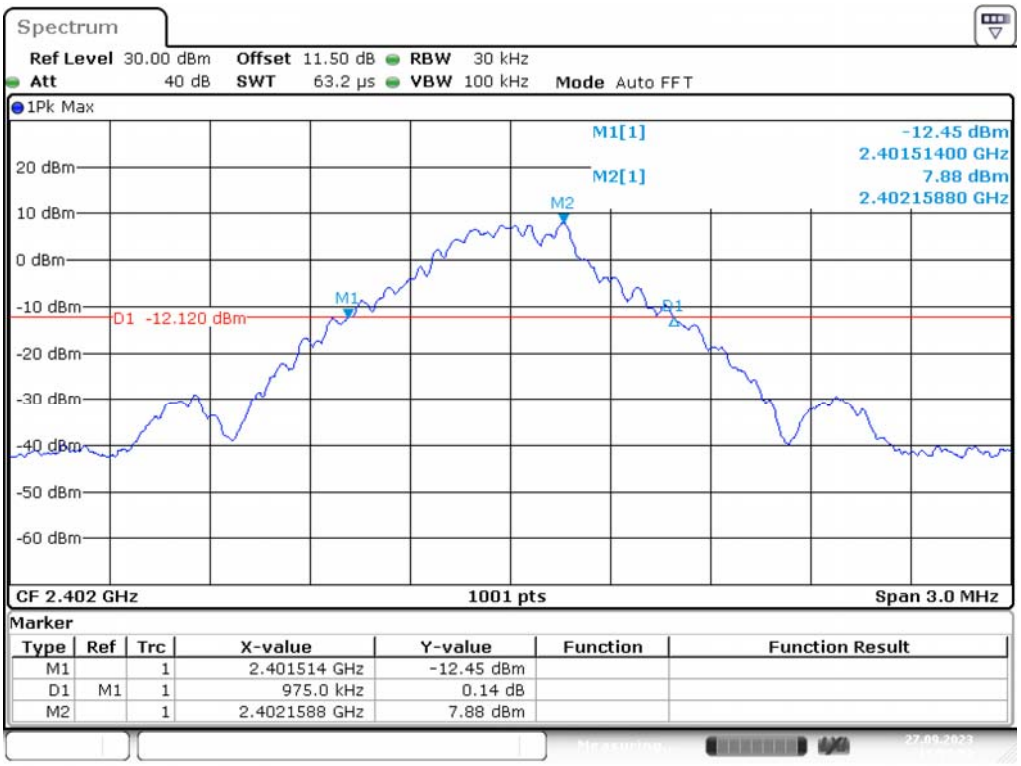
Channel	Frequency (MHz)	20 dBc BW (MHz)	99% Bandwidth (MHz)
BR Mode (GFSK)			
Low	2402	0.98	0.89
Middle	2441	1.02	0.89
High	2480	1.02	0.89
EDR Mode (π/4-DQPSK)			
Low	2402	1.25	1.16
Middle	2441	1.26	1.16
High	2480	1.26	1.17

Please refer to the following plots

20 dB Emission Bandwidth

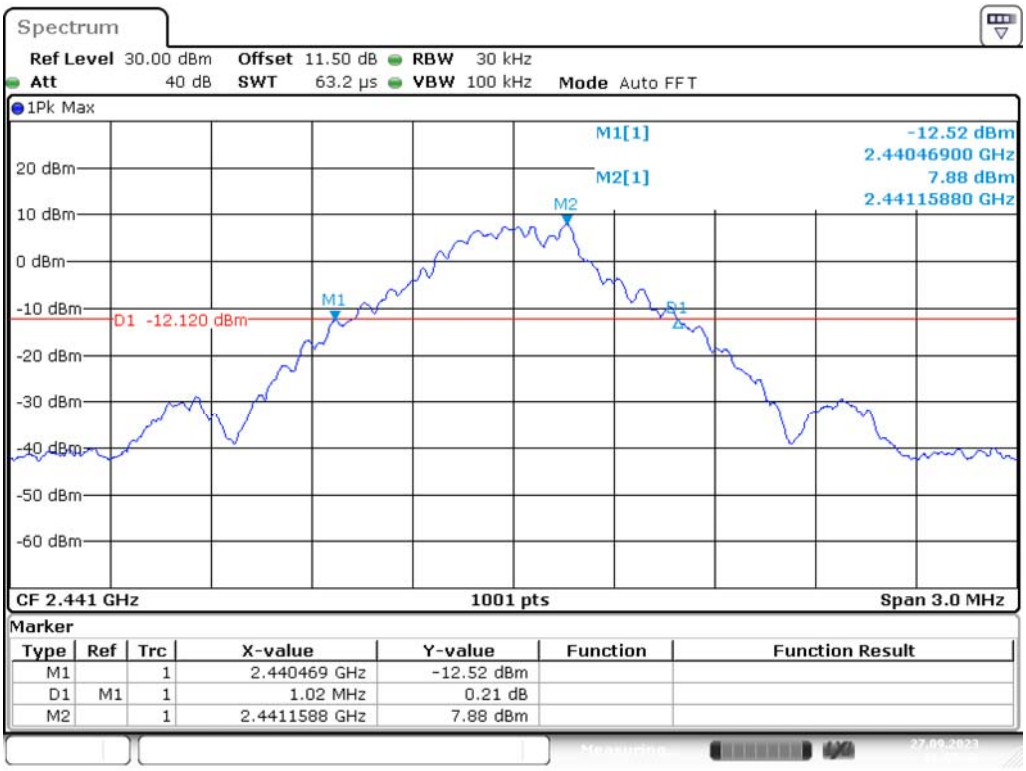
BR Mode (GFSK)

Low Channel



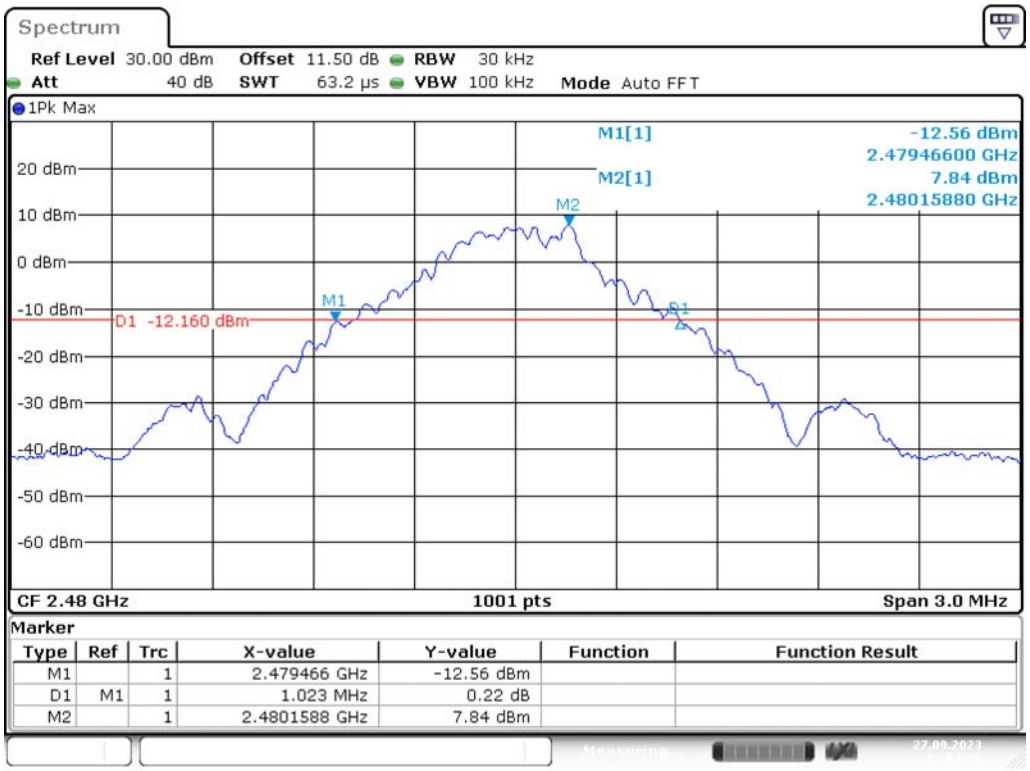
Date: 27.SEP.2023 11:53:53

Middle Channel



Date: 27.SEP.2023 11:57:49

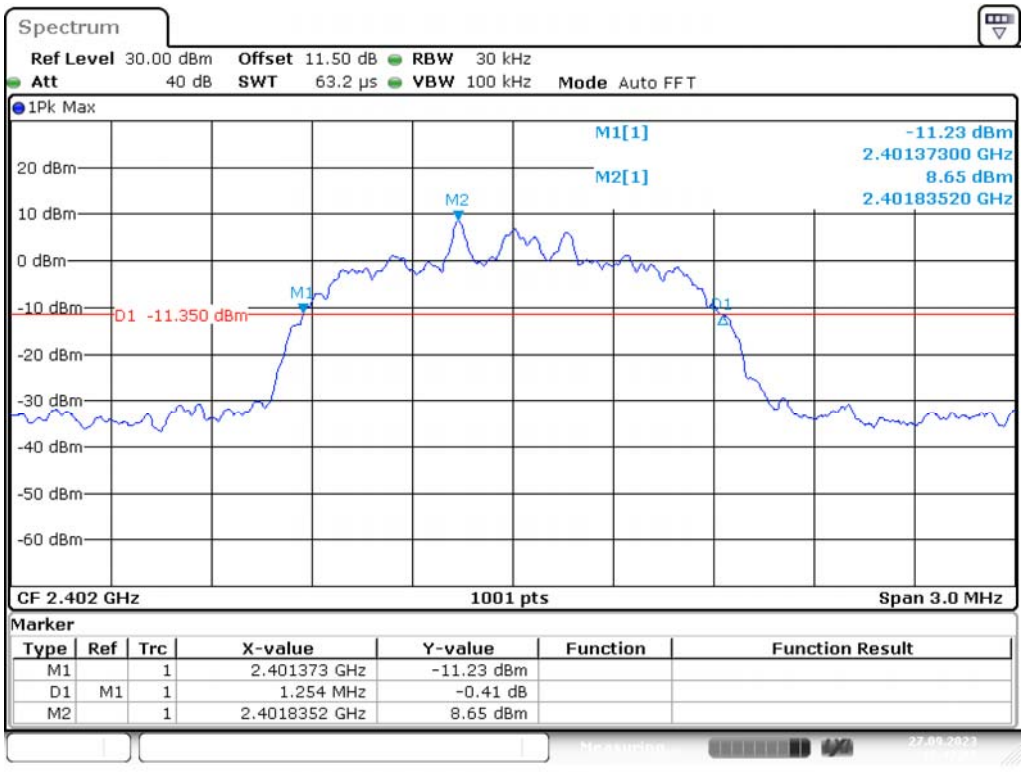
High Channel



Date: 27.SEP.2023 12:04:32

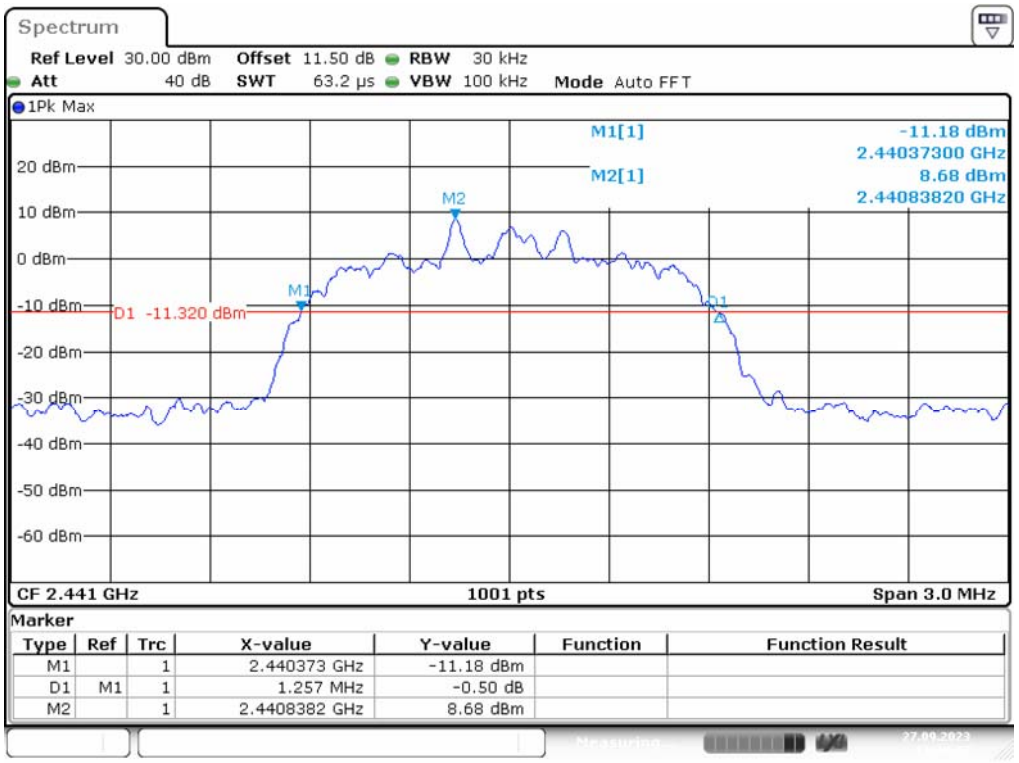
EDR Mode (π/4-DQPSK)

Low Channel



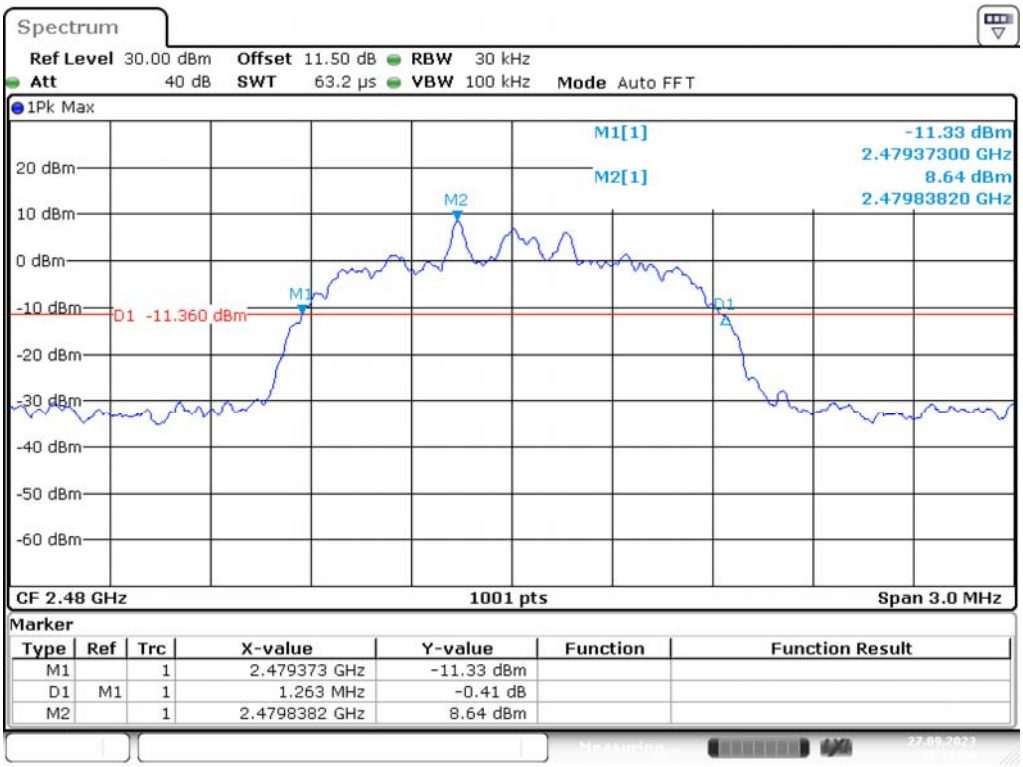
Date: 27.SEP.2023 11:47:27

Middle Channel



Date: 27.SEP.2023 11:44:18

High Channel

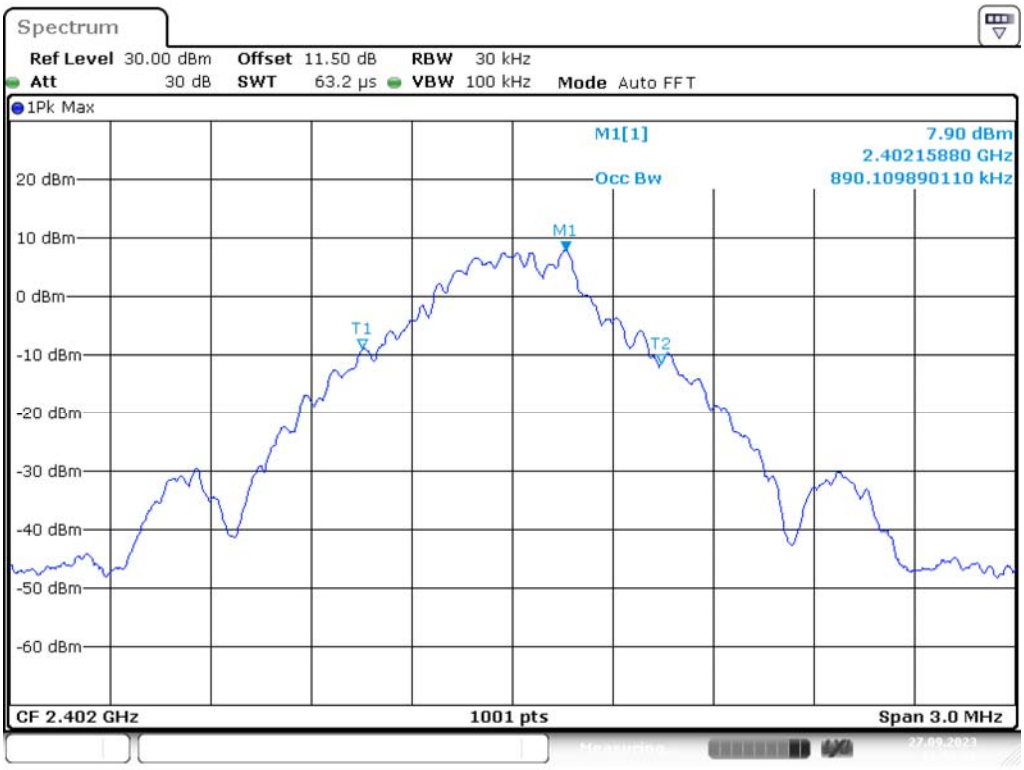


Date: 27.SEP.2023 11:35:51

99% Bandwidth

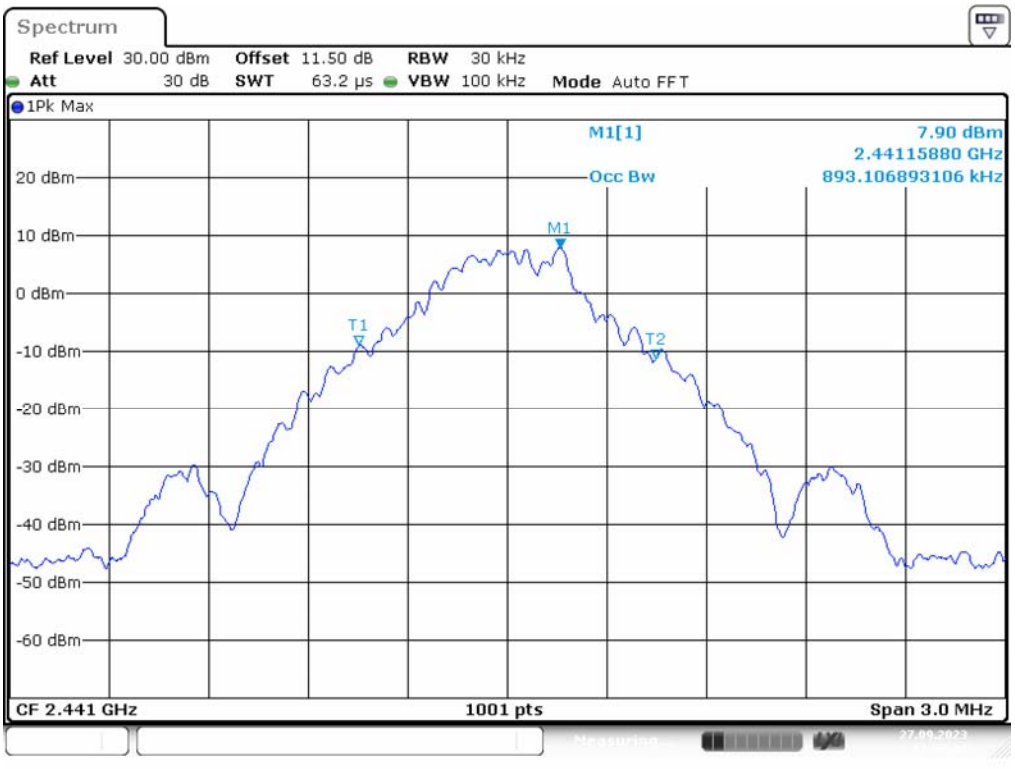
BR Mode (GFSK)

Low Channel



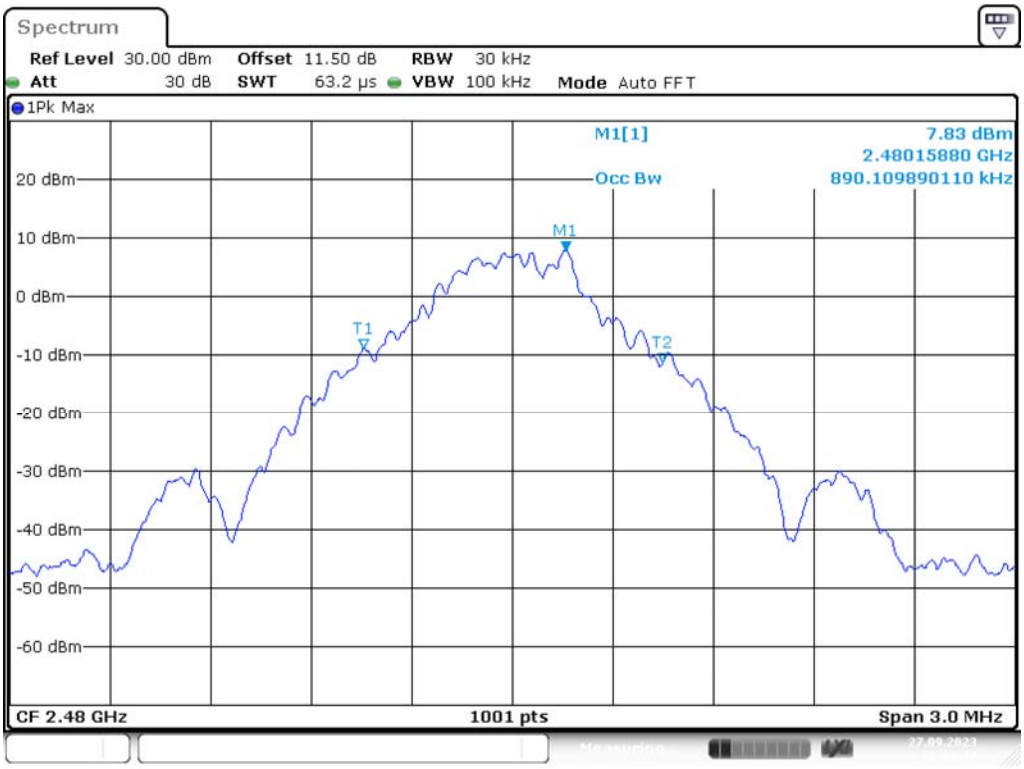
Date: 27.SEP.2023 11:54:08

Middle Channel



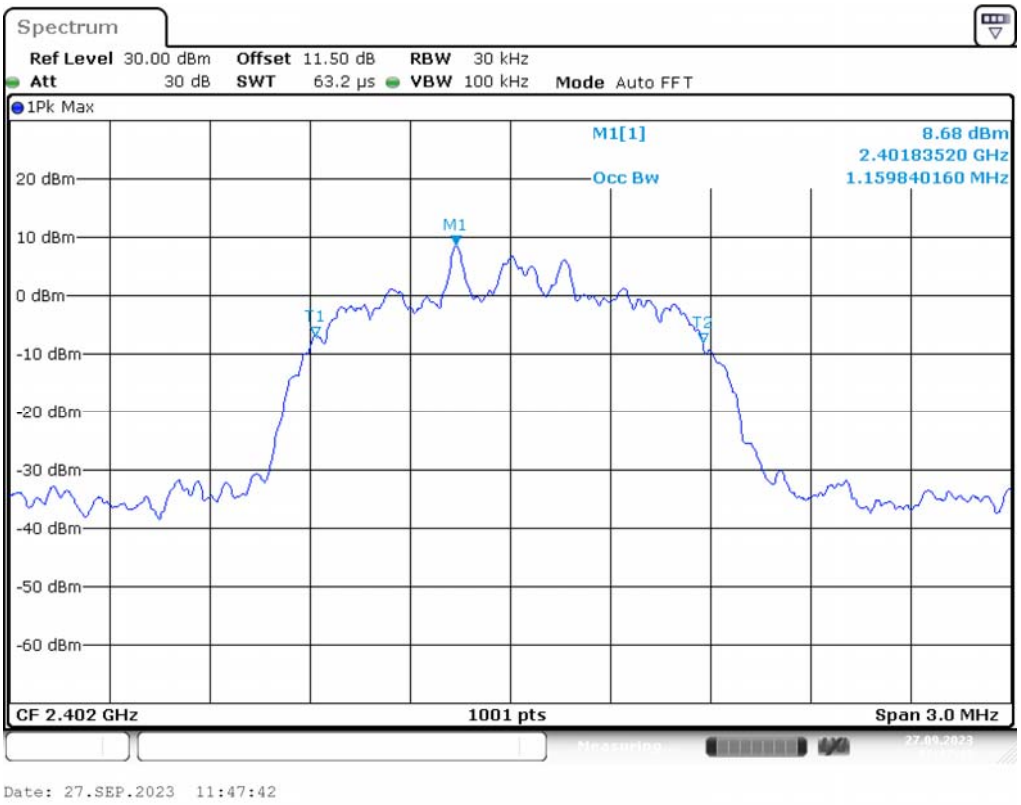
Date: 27.SEP.2023 11:58:04

High Channel

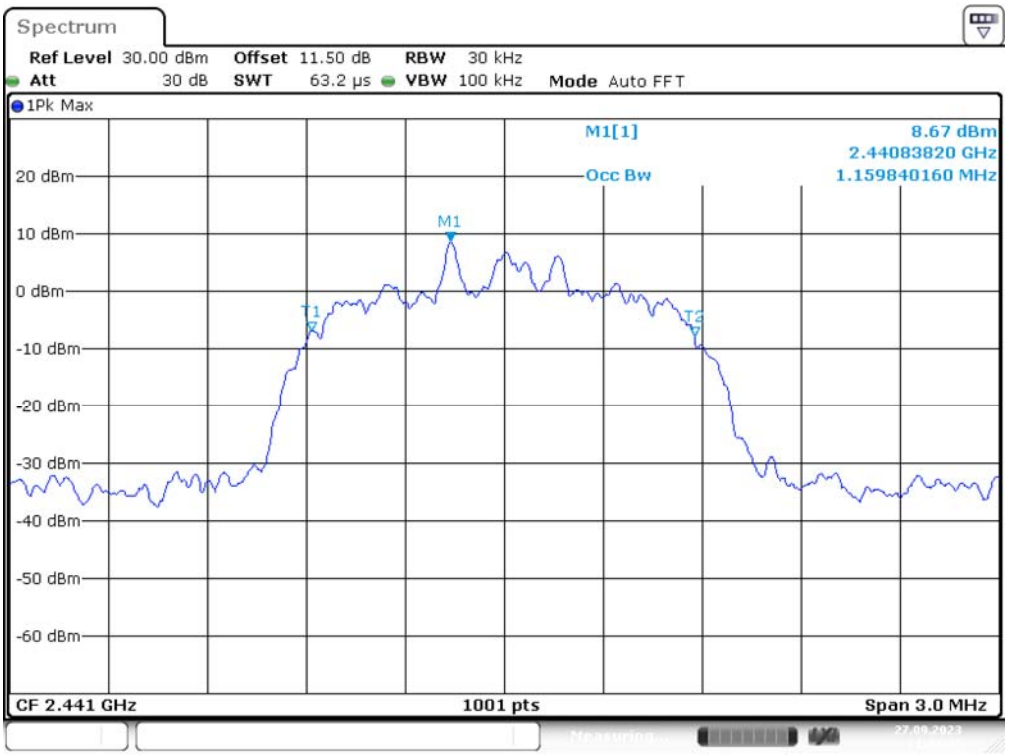


EDR Mode (π/4-DQPSK)

Low Channel

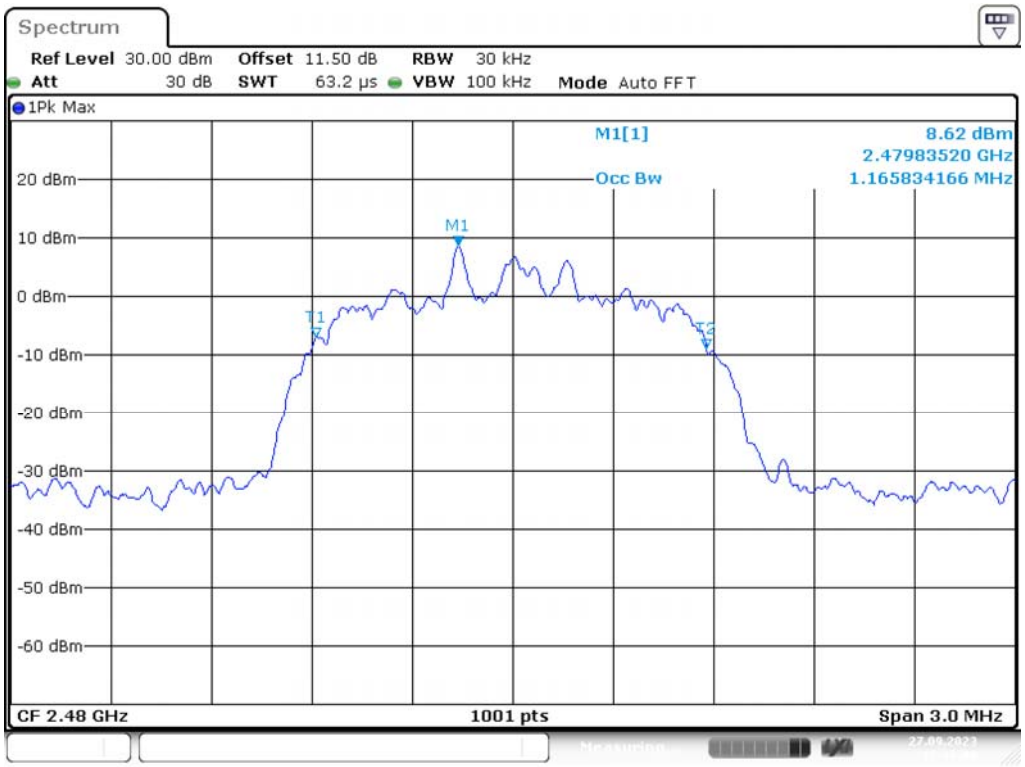


Middle Channel



Date: 27.SEP.2023 11:44:33

High Channel



Date: 27.SEP.2023 11:36:06

10. FCC §15.247(a)(1) / RSS-247 §5.1(b)– 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.

According to RSS-247 §5.1(b)

FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.

10.2. Test Procedure

According to ANSI C63.10-2013, section 7.8.2

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.

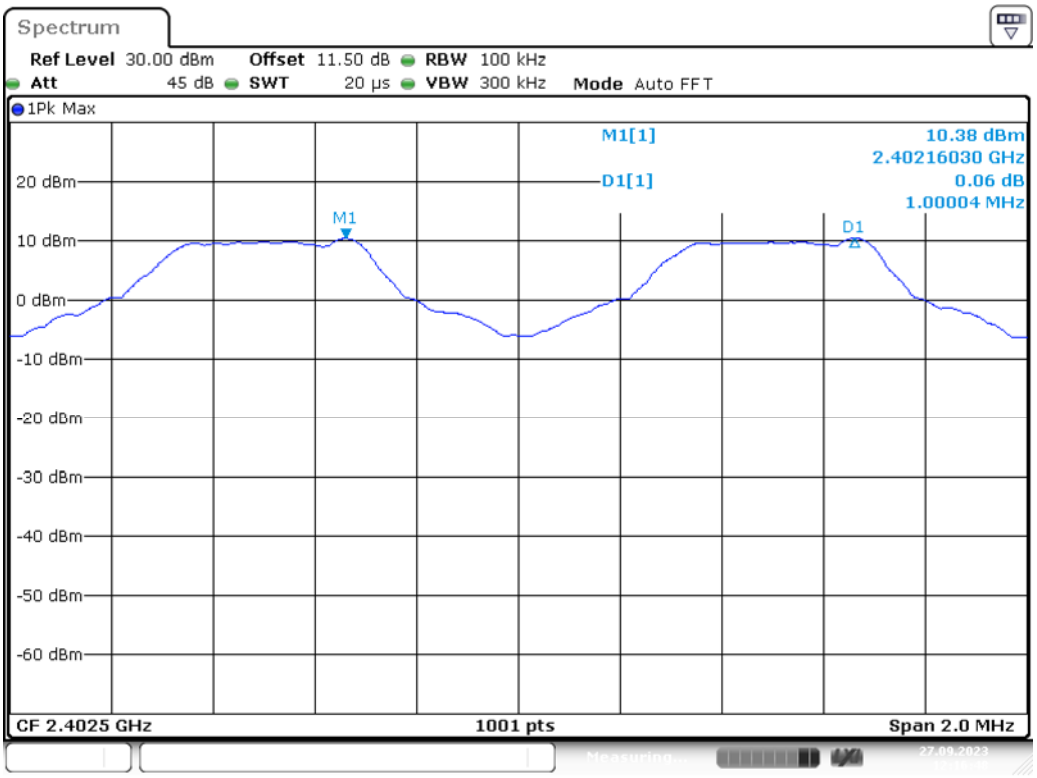
10.3. Test Results

Channel	Channel Separation (MHz)	20 dBc BW (MHz)	Two-thirds of the 20 dB bandwidth (MHz)	Channel Separation Limit	Result
BR Mode (GFSK)					
Low	1.000	0.98	0.650	>two-thirds of the 20 dB bandwidth	Compliance
Middle	1.000	1.02	0.680	>two-thirds of the 20 dB bandwidth	Compliance
High	1.000	1.02	0.682	>two-thirds of the 20 dB bandwidth	Compliance
EDR Mode (π/4-DQPSK)					
Low	1.000	1.25	0.836	>two-thirds of the 20 dB bandwidth	Compliance
Middle	1.000	1.26	0.838	>two-thirds of the 20 dB bandwidth	Compliance
High	1.000	1.26	0.842	>two-thirds of the 20 dB bandwidth	Compliance

Please refer to the following plots.

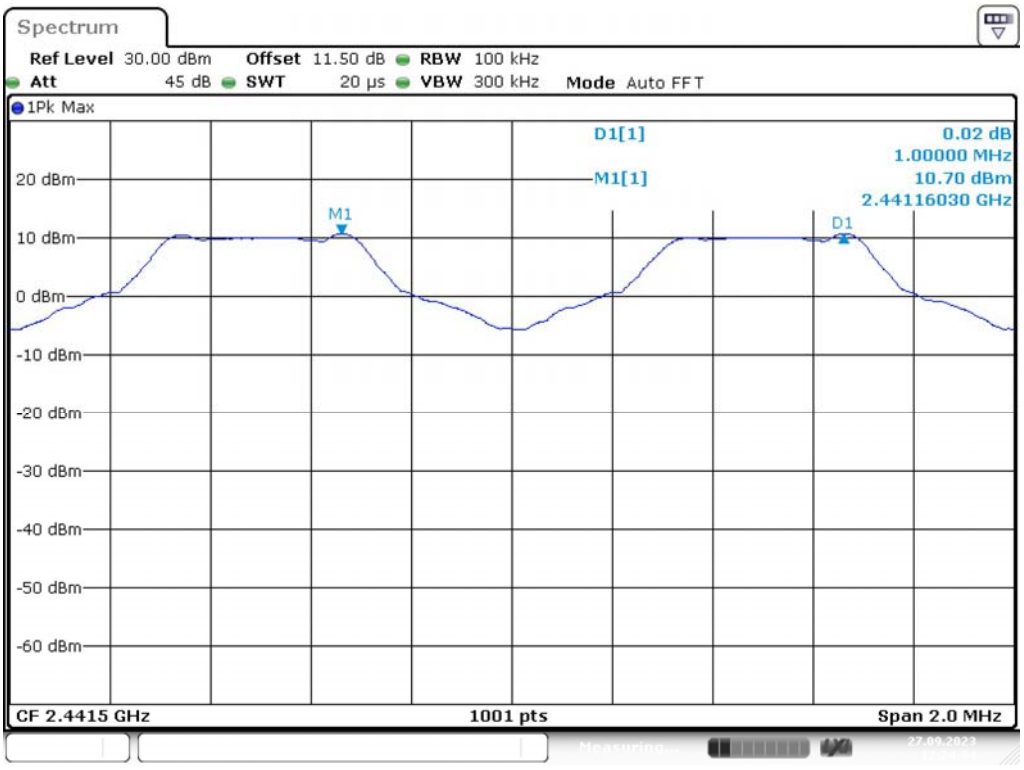
BR Mode (GFSK)

Low Channel



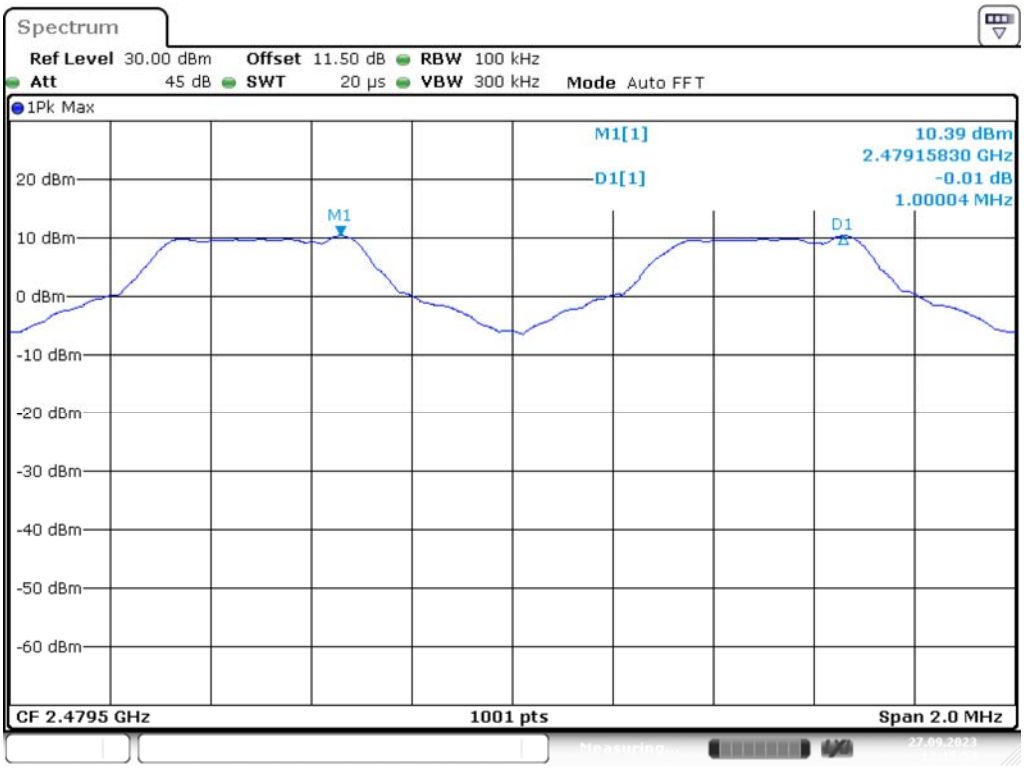
Date: 27.SEP.2023 12:16:49

Middle Channel



Date: 27.SEP.2023 12:24:05

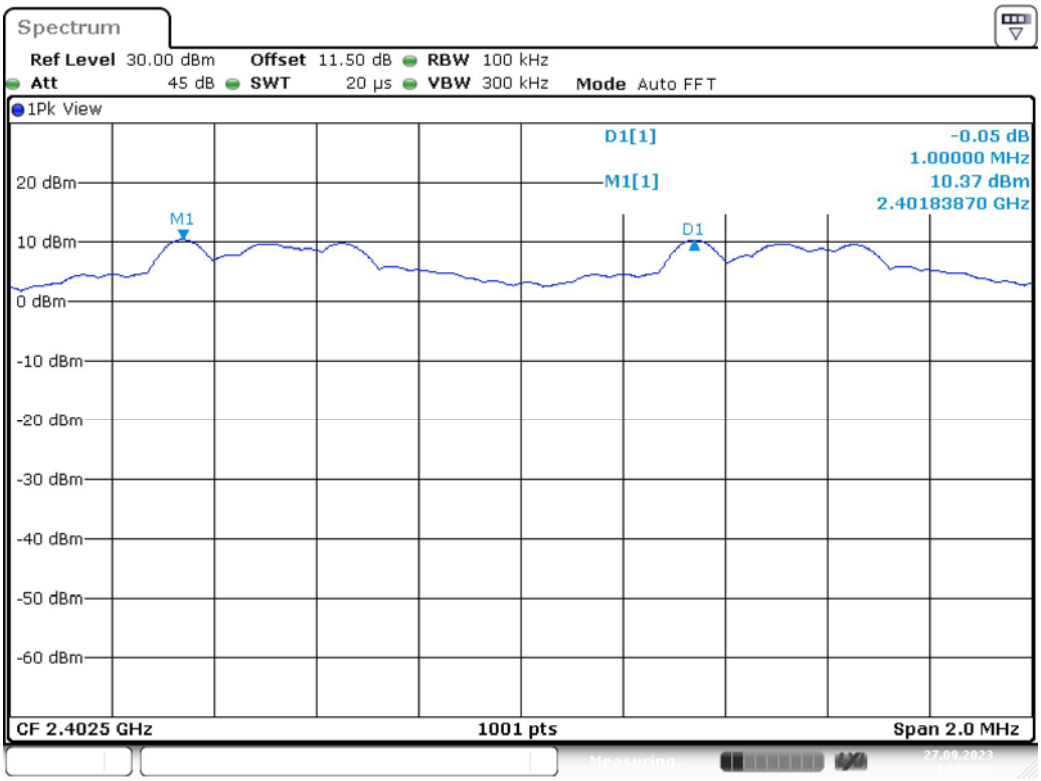
High Channel



Date: 27.SEP.2023 12:15:55

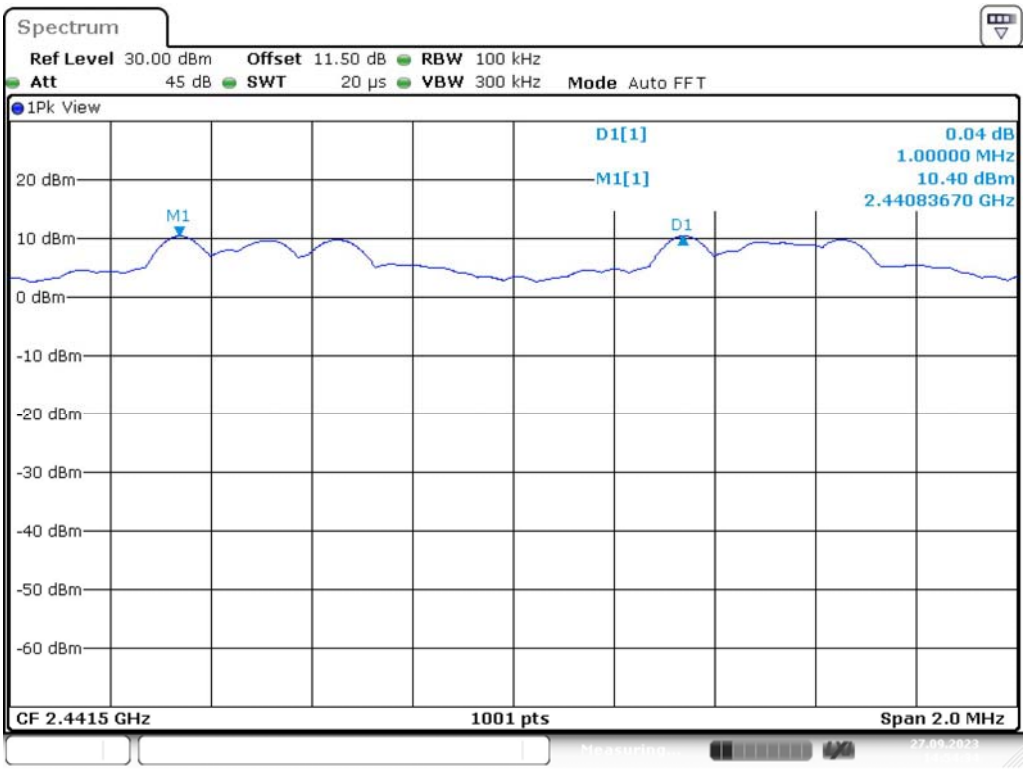
EDR Mode (π/4-DQPSK)

Low Channel



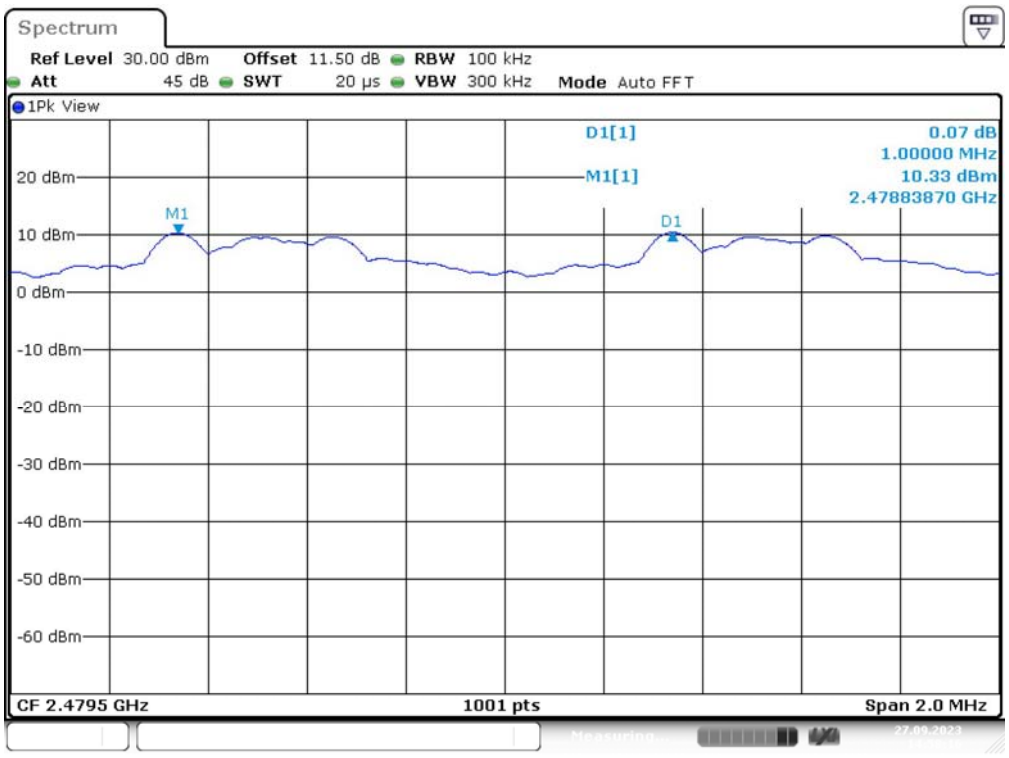
Date: 27.SEP.2023 14:56:09

Middle Channel



Date: 27.SEP.2023 14:54:34

High Channel



Date: 27.SEP.2023 14:58:16

11. FCC§15.247(a)(1)(iii) / RSS-247 §5.1 (d)–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.

According to RSS-247 §5.1 (d).

FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping 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. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

11.2. Test Procedure

According to ANSI C63.10-2013, section 7.8.4

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.

11.3. Test Results

BR mode (GFSK)						
Mode	Pulse Time (ms)	Hopping Number	Period Time (s)	Total of Dwell (ms)	Limit (ms)	Result
DH1	0.372	320	31.6	119.04	<400	PASS
DH3	1.623	160	31.6	259.68	<400	PASS
DH5	2.865	110	31.6	315.15	<400	PASS
EDR mode (π/4-DQPSK)						
Mode	Pulse Time (ms)	Hopping Number	Period Time (s)	Total of Dwell (ms)	Limit (ms)	Result
2DH1	0.375	320	31.6	120.00	<400	PASS
2DH3	1.629	160	31.6	260.64	<400	PASS
2DH5	2.86	100	31.6	286.00	<400	PASS

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

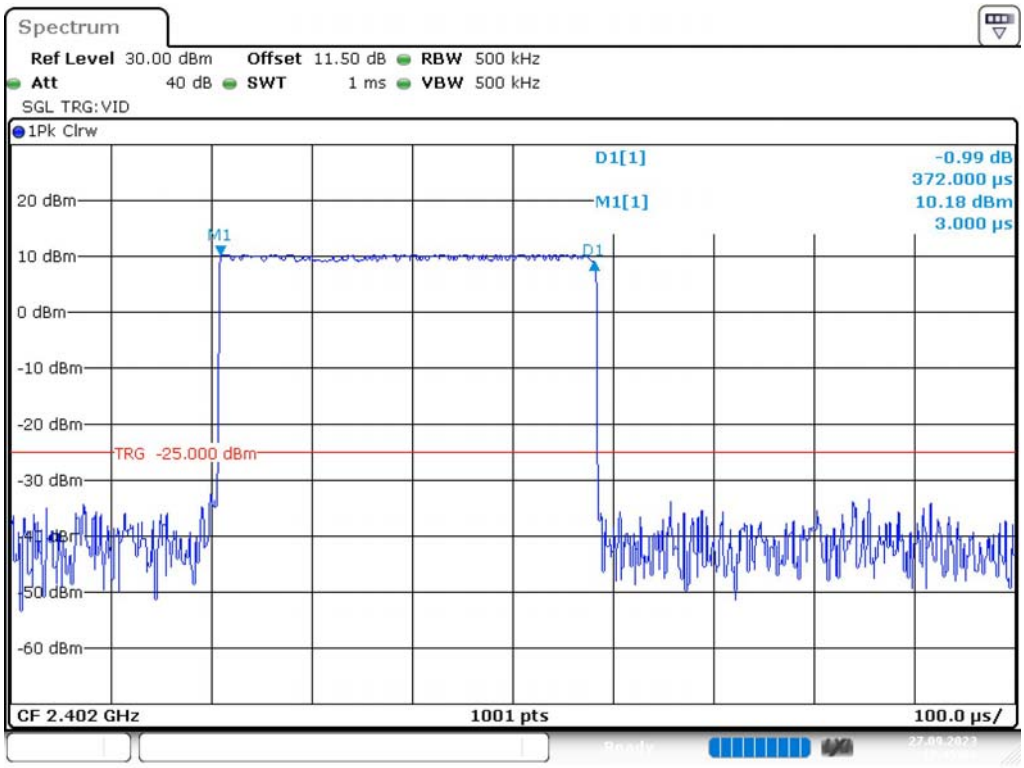
Note 2: Hopping Number = Hopping Number/10 * 10

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

Please refer to the following plots

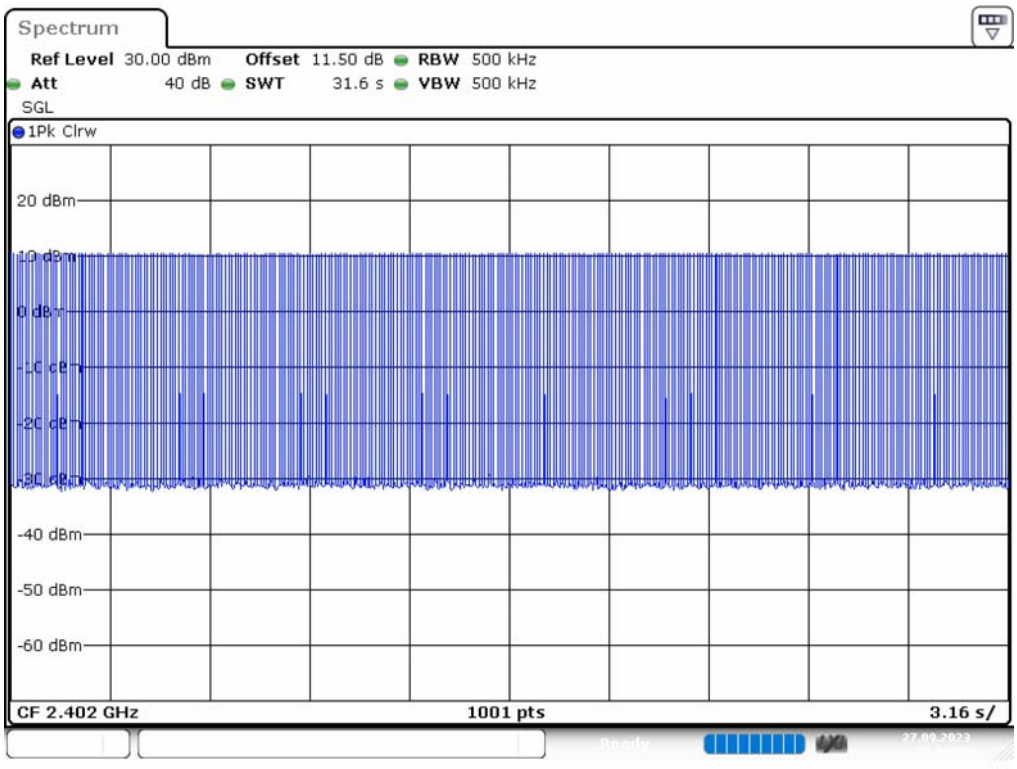
BR Mode (GFSK)

DH1: Pulse Width



Date: 27.SEP.2023 12:45:20

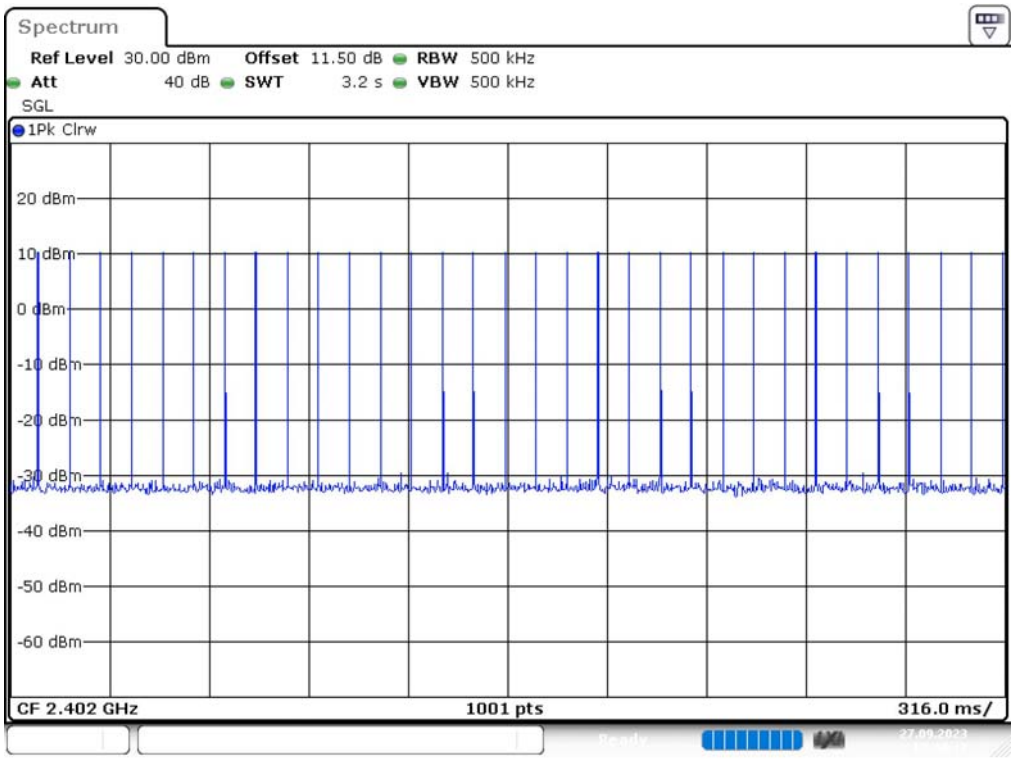
DH1: Hopping Number



Date: 27.SEP.2023 12:34:08

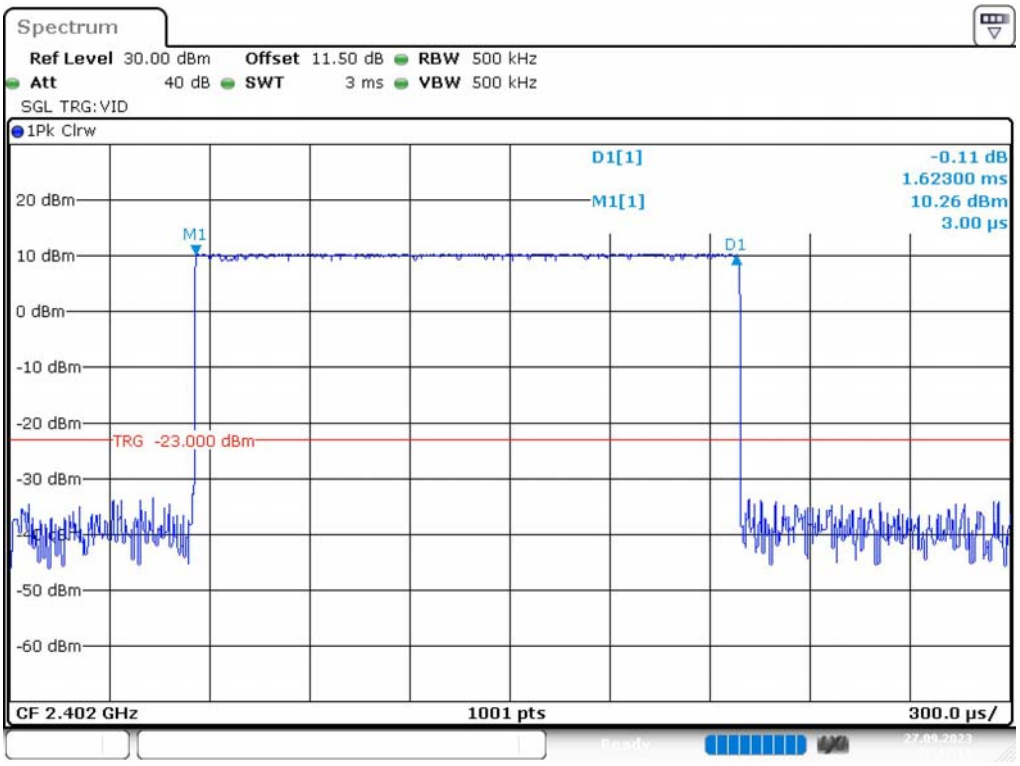
DH1: Hopping Number /10

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



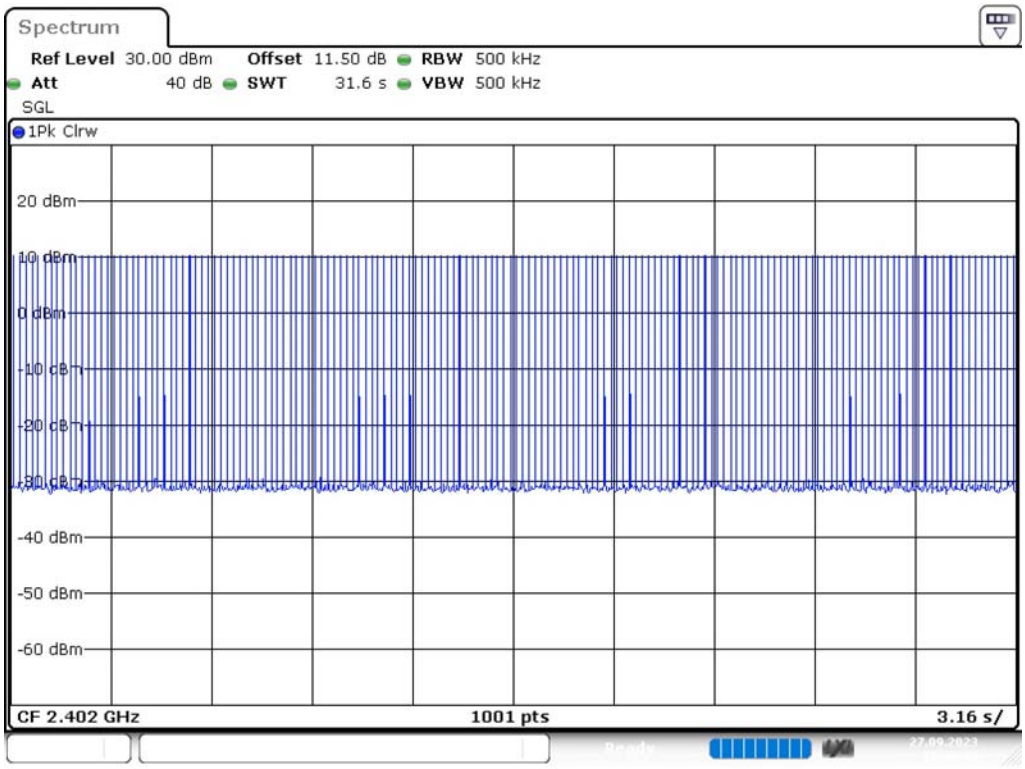
Date: 27.SEP.2023 12:44:17

DH3: Pulse Width



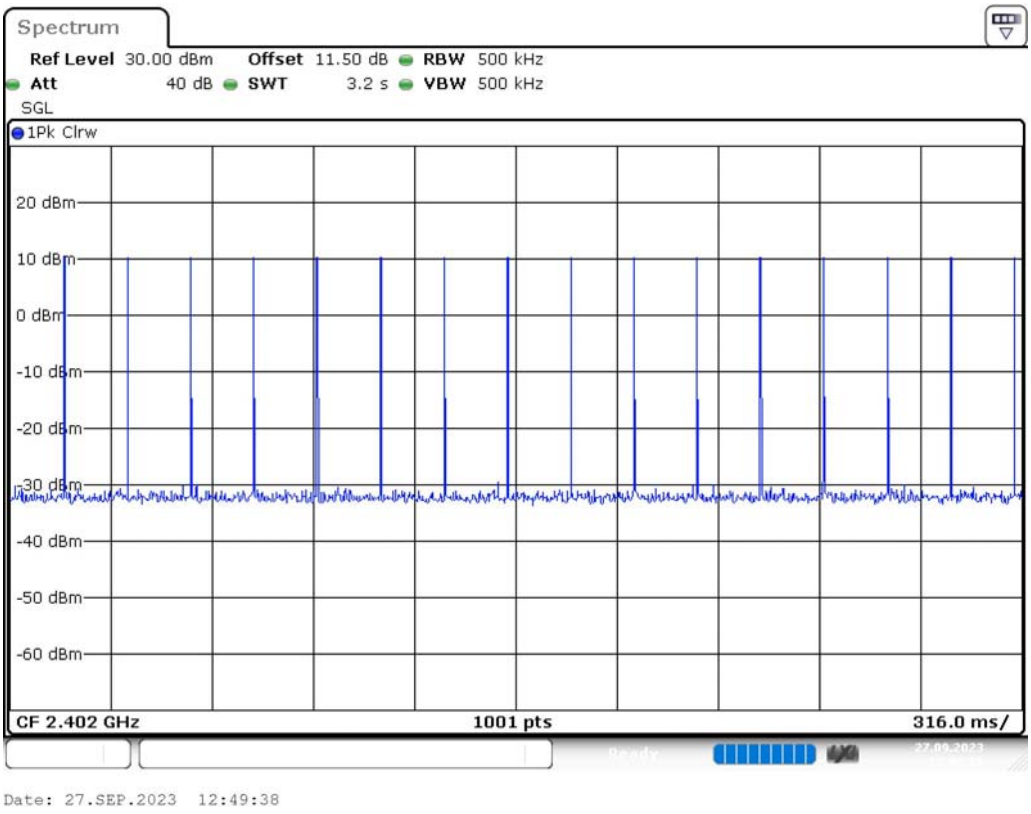
Date: 27.SEP.2023 12:47:18

DH3: Hopping Number

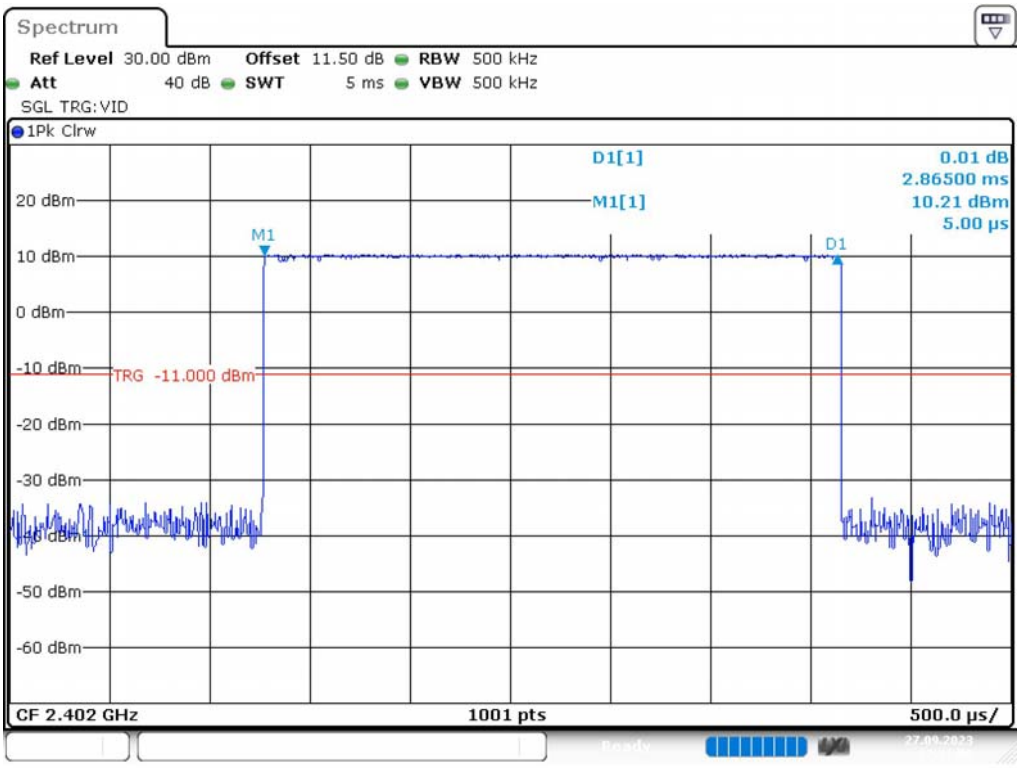


DH3: Hopping Number /10

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

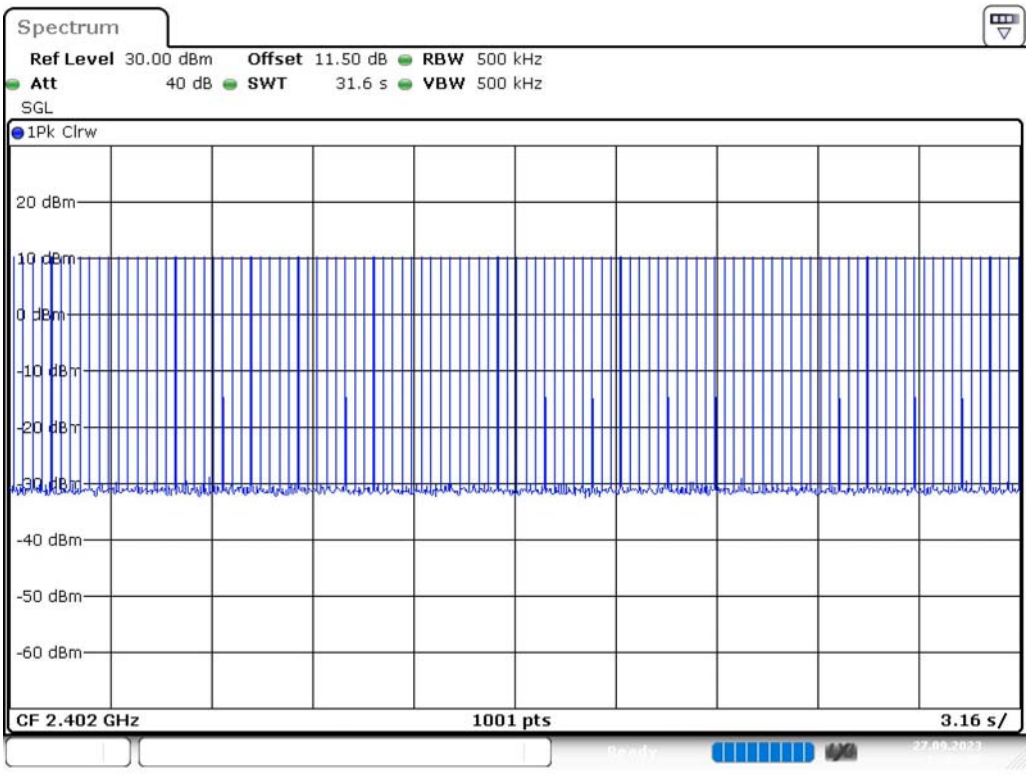


DH5: Pulse Width



Date: 27.SEP.2023 12:51:10

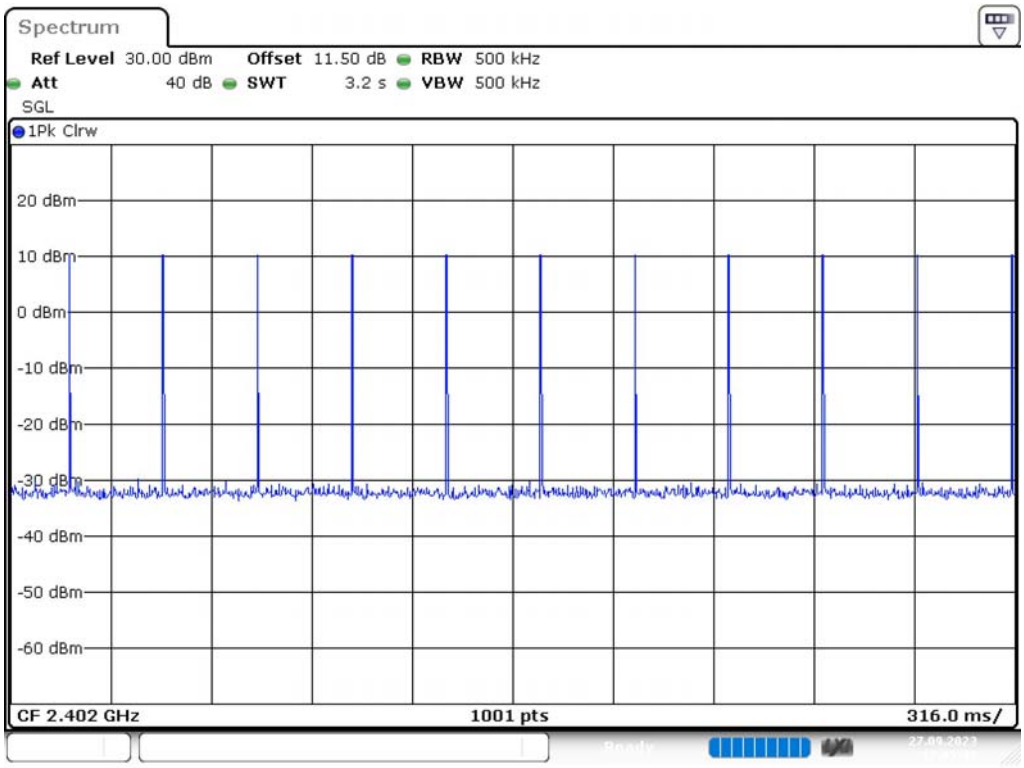
DH5: Hopping Number



Date: 27.SEP.2023 12:53:57

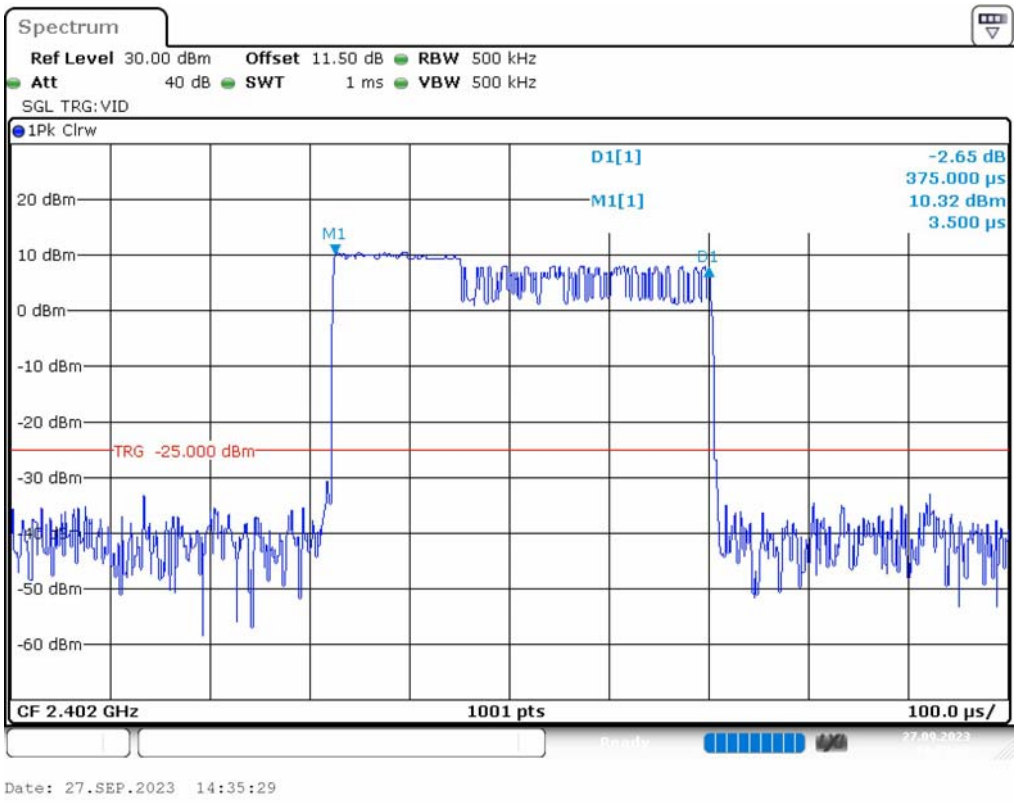
DH5: Hopping Number /10

(Hopping Number = 11 in 1/10 period of highest signals, Second High signals were other channel)

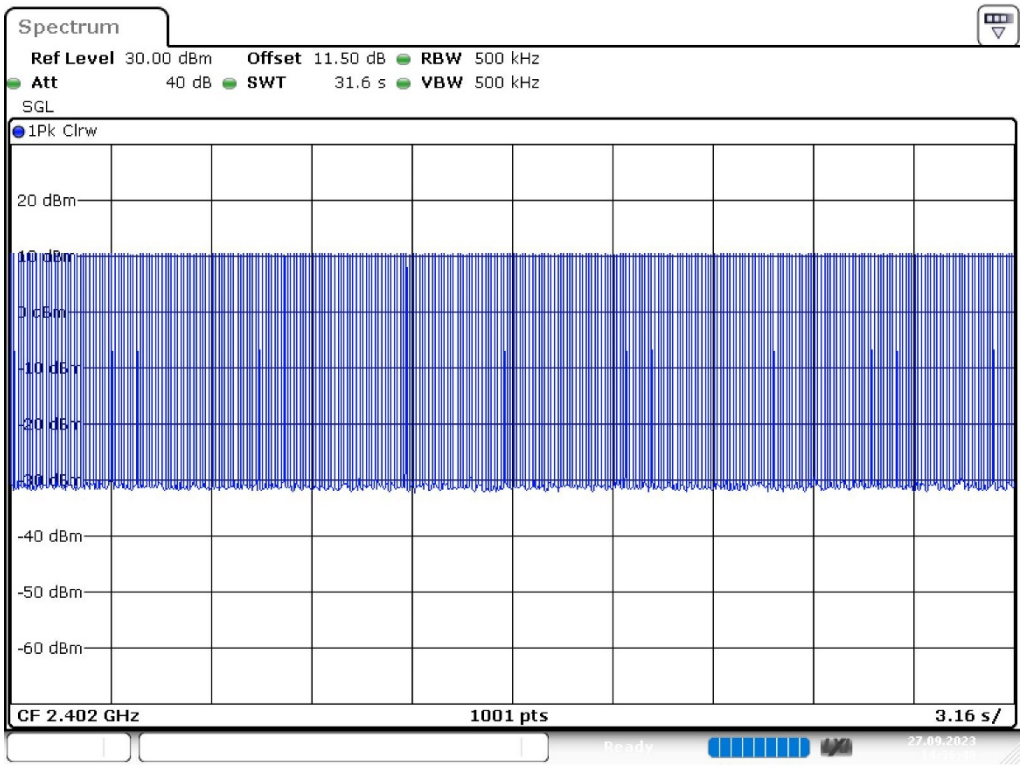


EDR Mode (π/4-DQPSK)

2DH1: Pulse Width



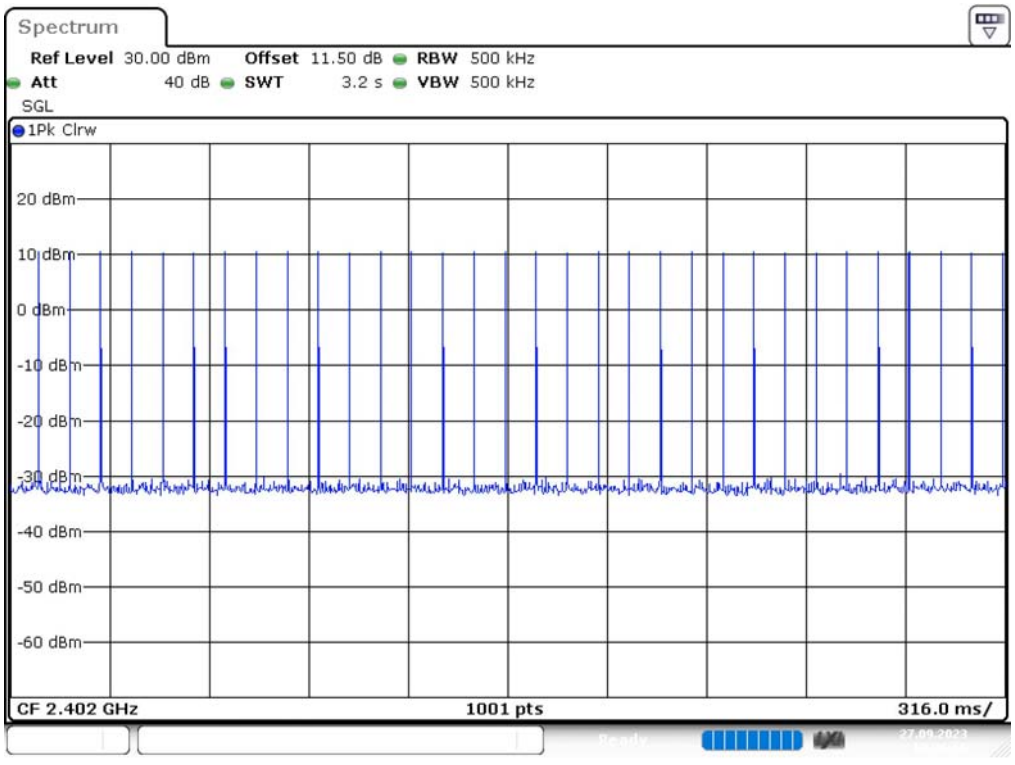
2DH1: Hopping Number



Date: 27.SEP.2023 14:36:41

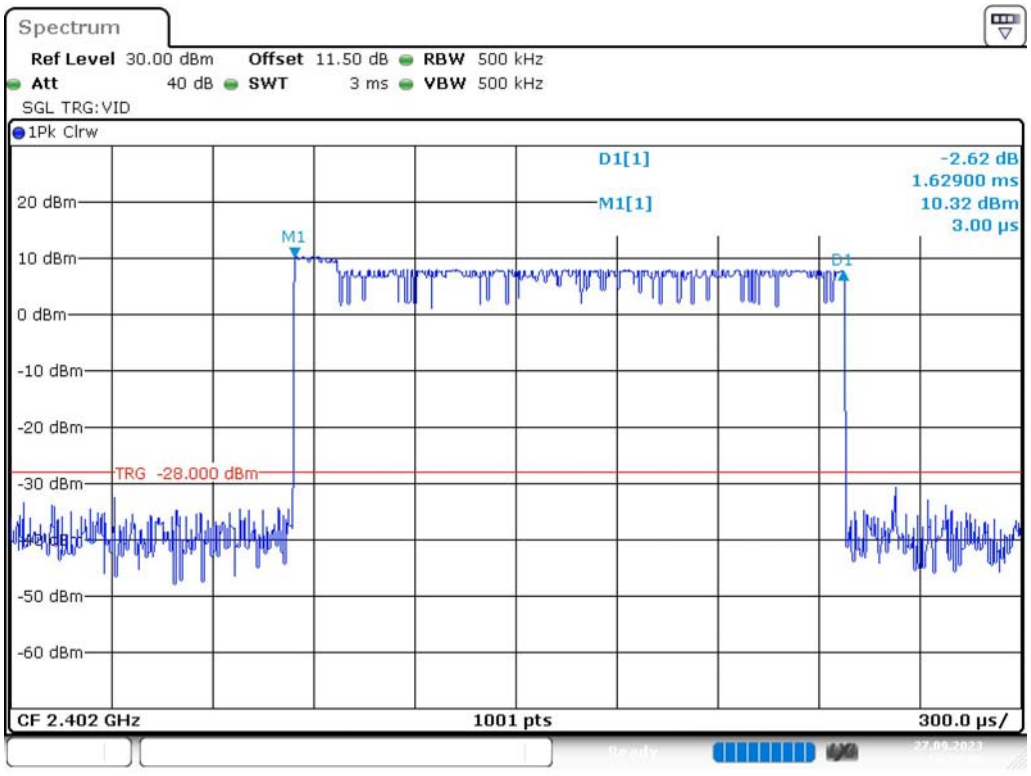
2DH1: Hopping Number /10

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



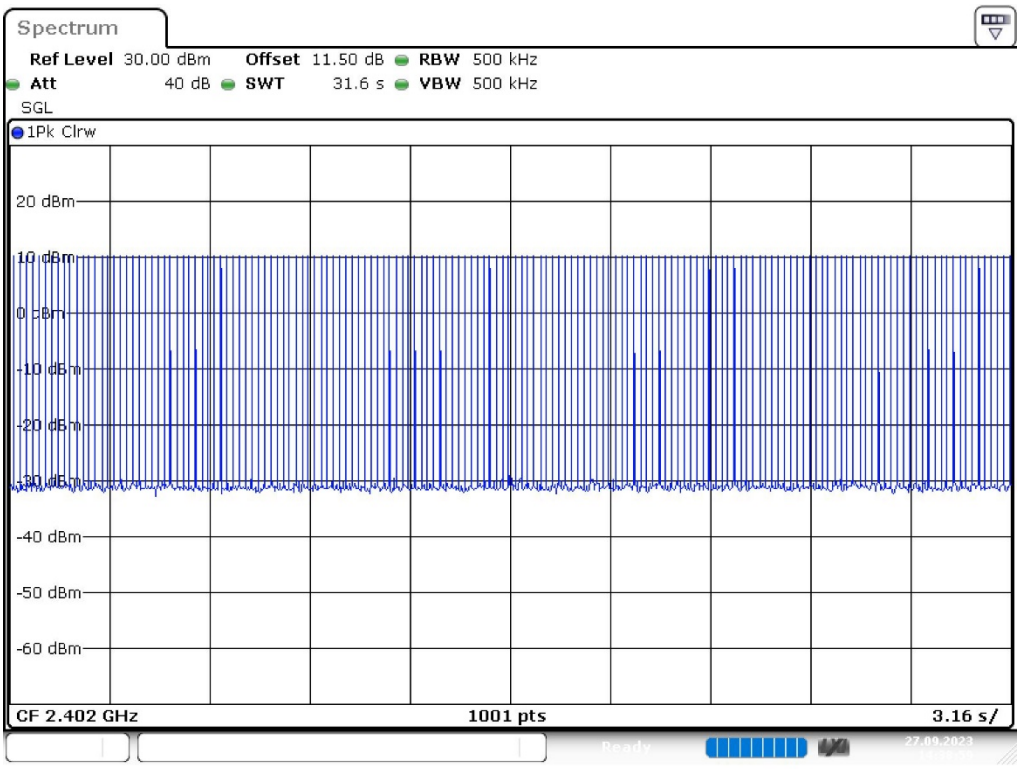
Date: 27.SEP.2023 14:36:56

2DH3: Pulse Width



Date: 27.SEP.2023 14:38:06

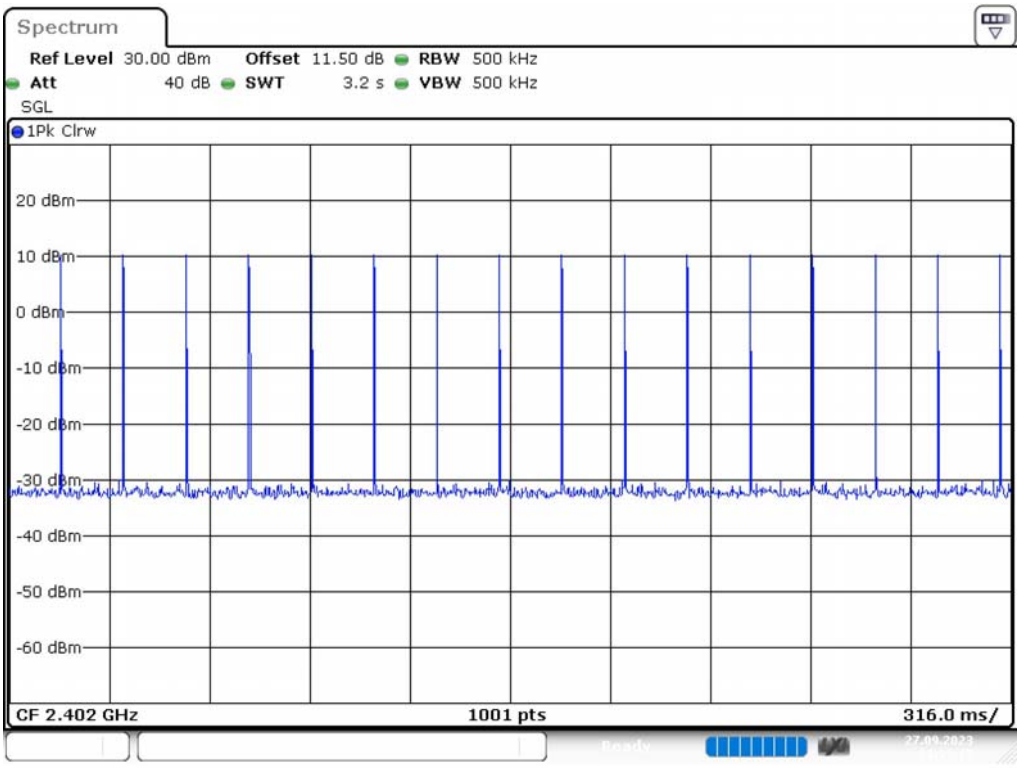
2DH3: Hopping Number



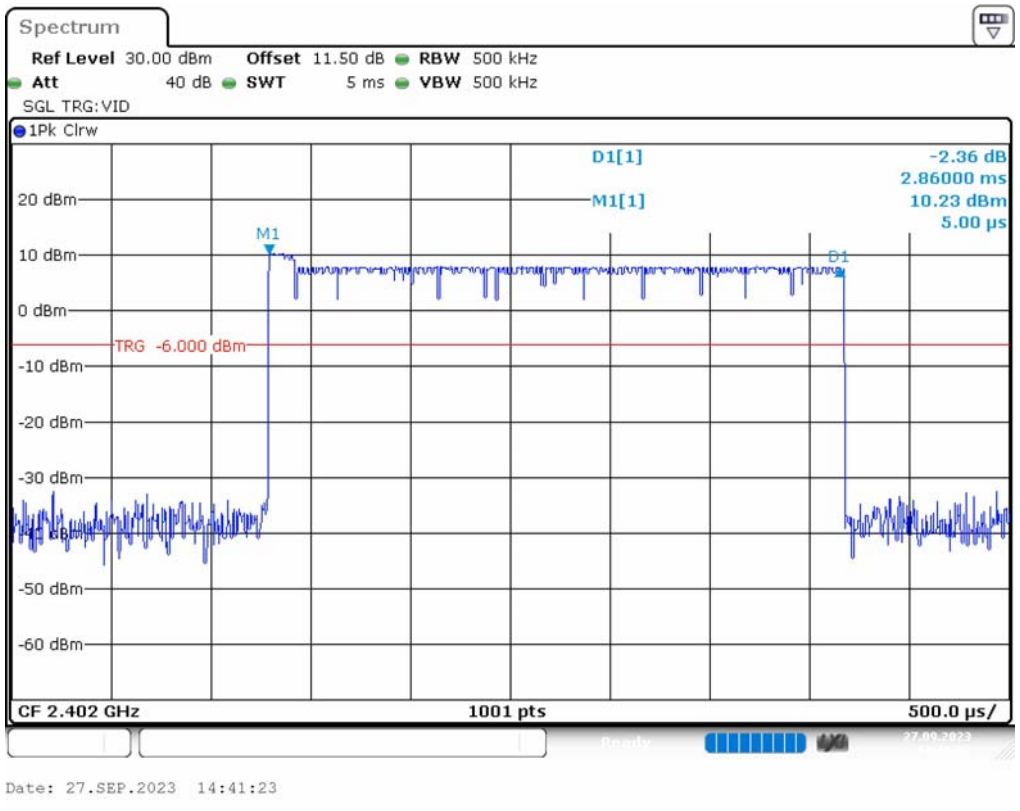
Date: 27.SEP.2023 14:38:59

2DH3: Hopping Number /10

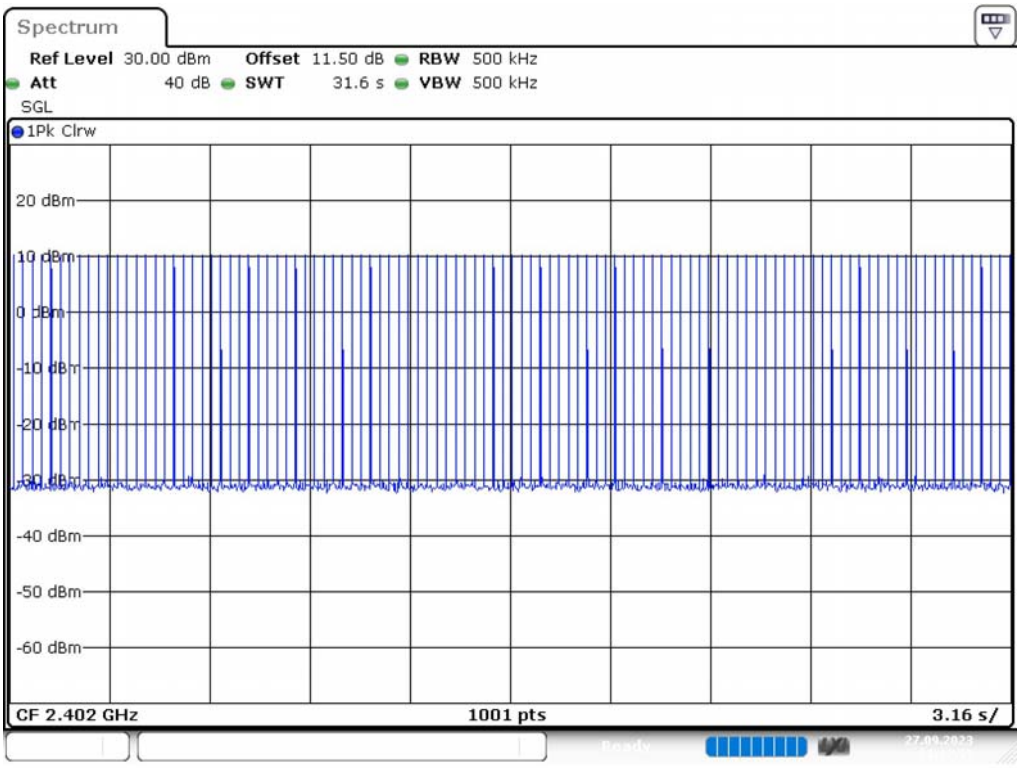
(Hopping Number = 16 in 1/10 period of highest signals, Second High signals were other channel)



2DH5: Pulse Width

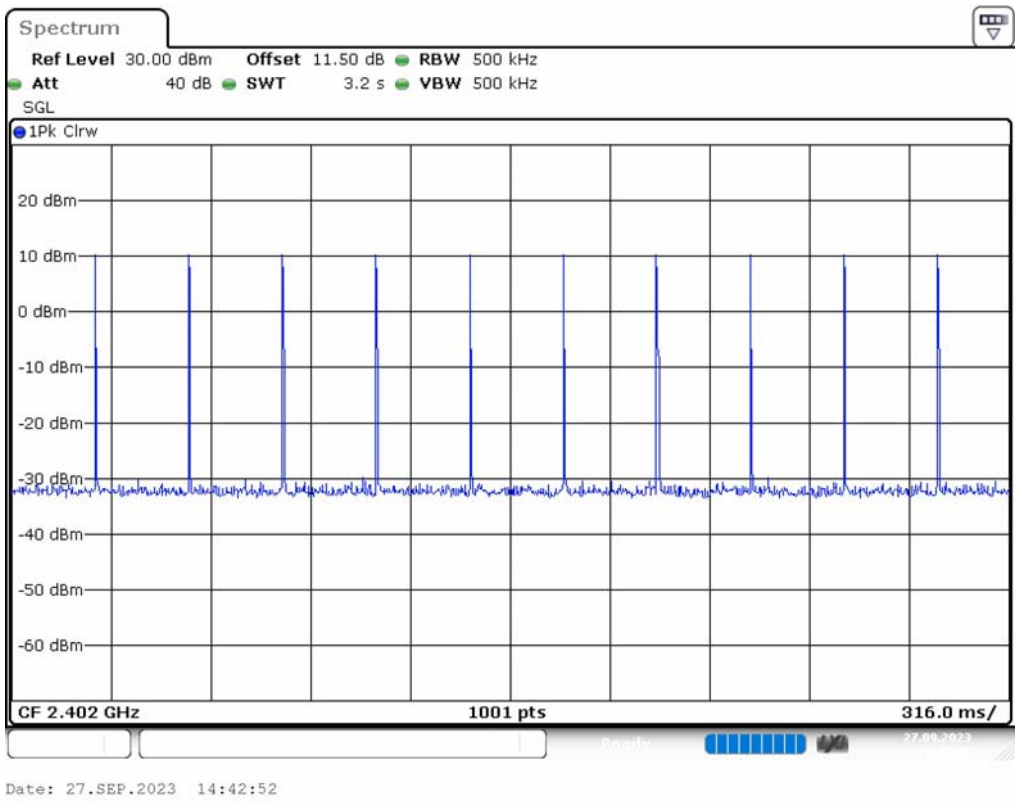


2DH5: Hopping Number



2DH5: Hopping Number /10

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



12. FCC §15.247(a)(1)(iii) / RSS-247 §5.1(d)–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.

According to RSS-247 §5.1(d).

FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping 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. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

12.2. Test Procedure

According to ANSI C63.10-2013, section 7.8.3

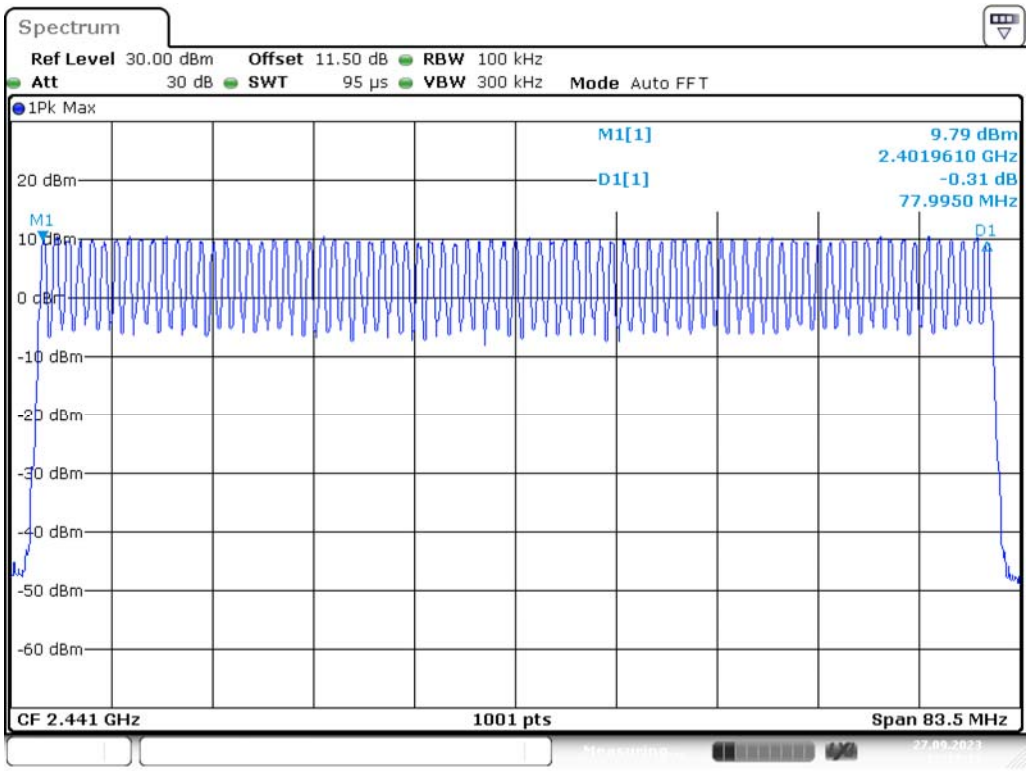
1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Set the EUT in hopping mode from first channel to last.
3. By using the Max-Hold function record the Quantity of the channel.

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

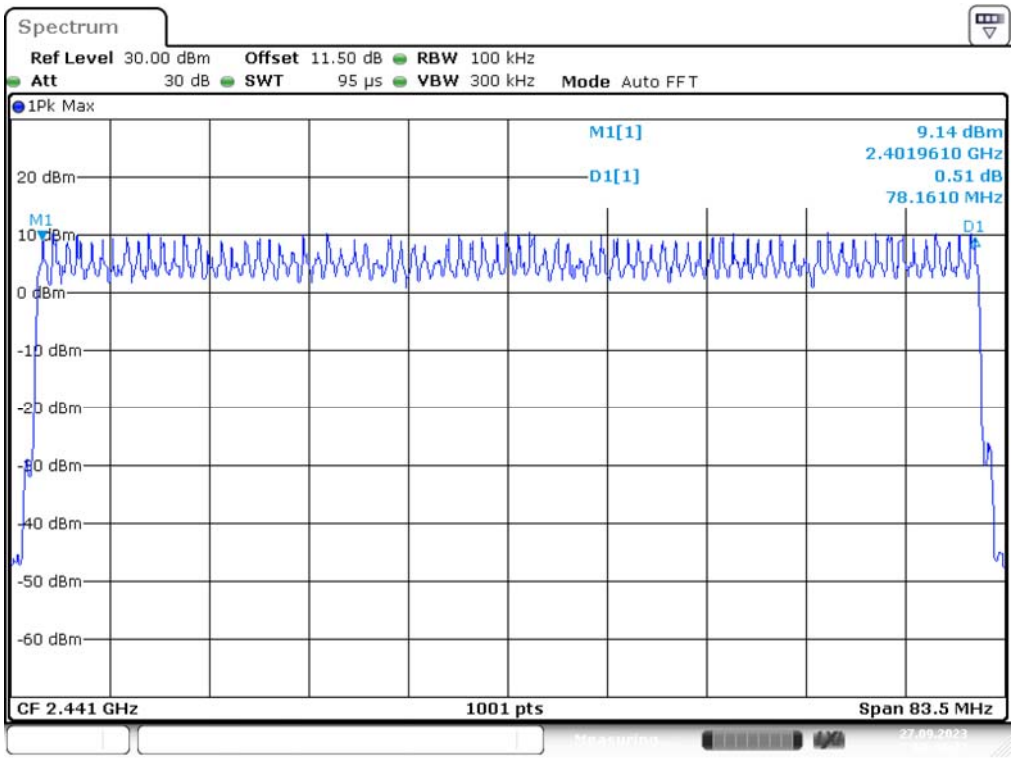
Please refer to the following plots

BR Mode (GFSK)



Date: 27.SEP.2023 12:17:11

EDR Mode (π/4-DQPSK)



Date: 27.SEP.2023 14:48:32

13. FCC §15.247(b)(1) / RSS-247 §5.4 (b)– 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.

According to RSS-247 §5.4(b).

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

13.2. Test Procedure

According to ANSI C63.10-2013, section 7.8.5

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)	Average	Antenna Gain (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)
		(dBm)	(W)		(dBm)			
BR Mode (GFSK)								
Low	2402	10.21	0.010	0.125	10.12	0.01	10.13	36
Middle	2441	10.26	0.011	0.125	10.18	0.01	10.19	36
High	2480	10.15	0.010	0.125	10.06	0.01	10.07	36
EDR Mode (π/4-DQPSK)								
Low	2402	10.24	0.011	0.125	8.06	0.01	8.07	36
Middle	2441	10.28	0.011	0.125	8.14	0.01	8.15	36
High	2480	10.16	0.010	0.125	8.03	0.01	8.04	36

14. FCC §15.247(d) / RSS-247 §5.5– 100 kHz Bandwidth of Frequency Band Edge

14.1. Applicable Standard

According to FCC §15.247(d)

For 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).

According to RSS-247 §5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

14.2. Test Procedure

According to ANSI C63.10-2013, section 7.8.6

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

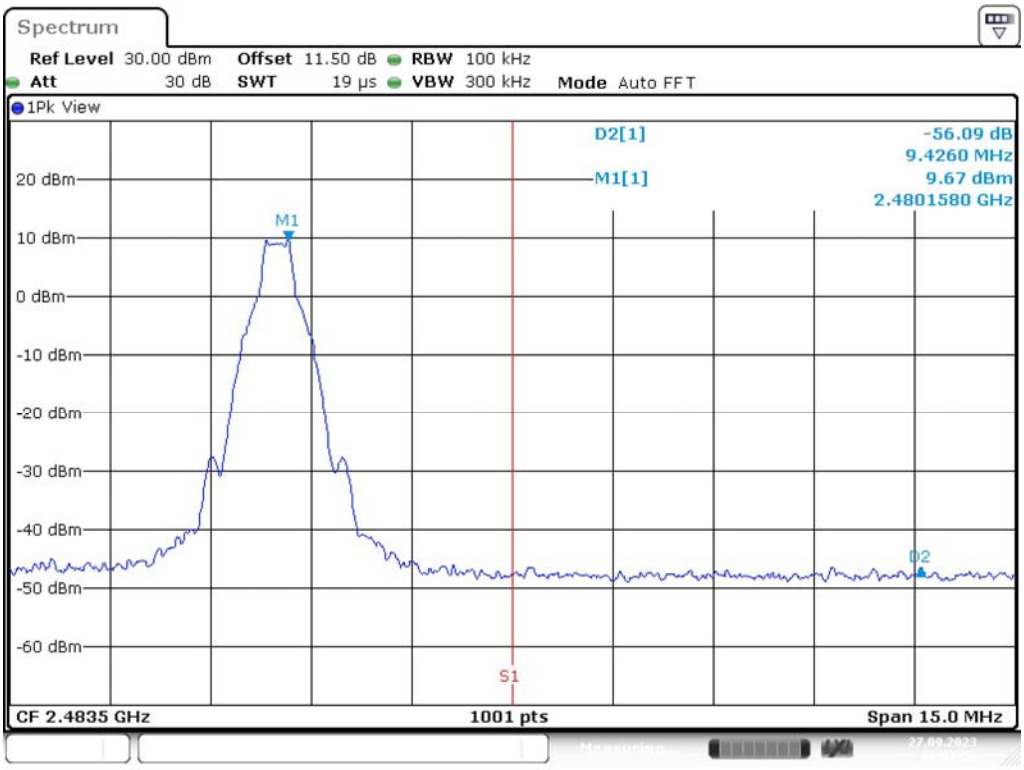
14.3. Test Results

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BR Mode (GFSK)				
Low	2402	54.36	≥ 20	PASS
High	2480	56.09	≥ 20	PASS
BR Hopping Mode (GFSK)				
Low	2402-2480	56.16	≥ 20	PASS
High	2402-2480	55.56	≥ 20	PASS
EDR Mode (π/4-DQPSK)				
Low	2402	52.67	≥ 20	PASS
High	2480	56.04	≥ 20	PASS
EDR Hopping Mode (π/4-DQPSK)				
Low	2402-2480	54.35	≥ 20	PASS
High	2402-2480	55.06	≥ 20	PASS

Please refer to the following plots.

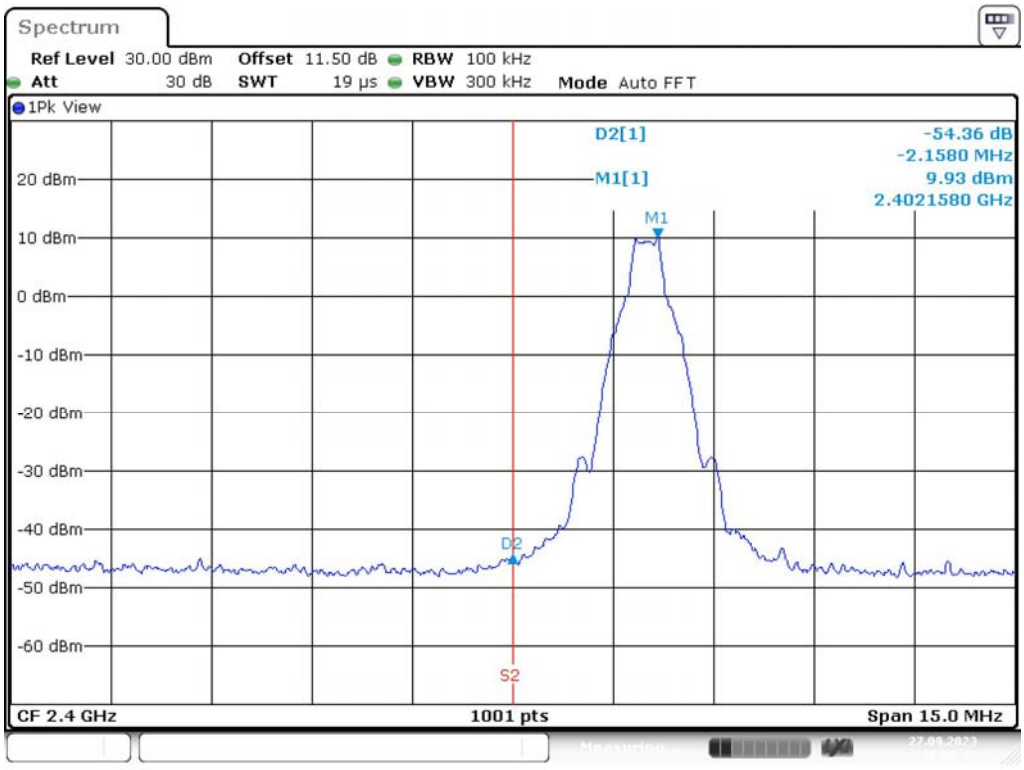
BR Mode (GFSK)

Band Edge, CH Low



Date: 27.SEP.2023 11:58:51

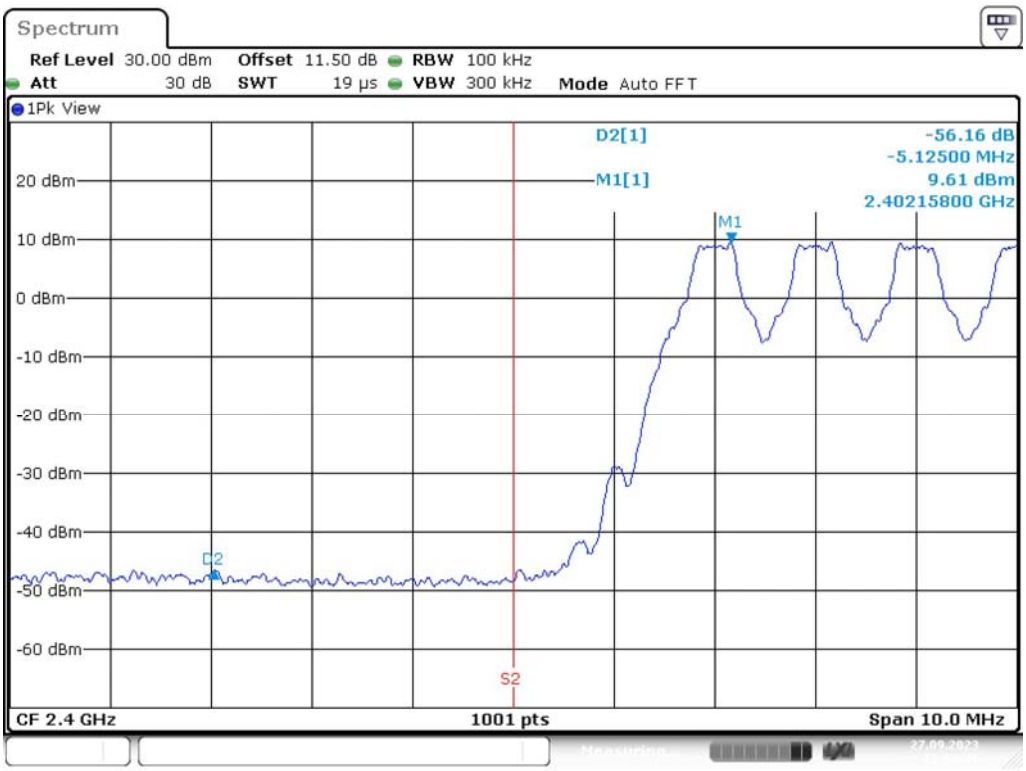
Band Edge, CH High



Date: 27.SEP.2023 11:57:16

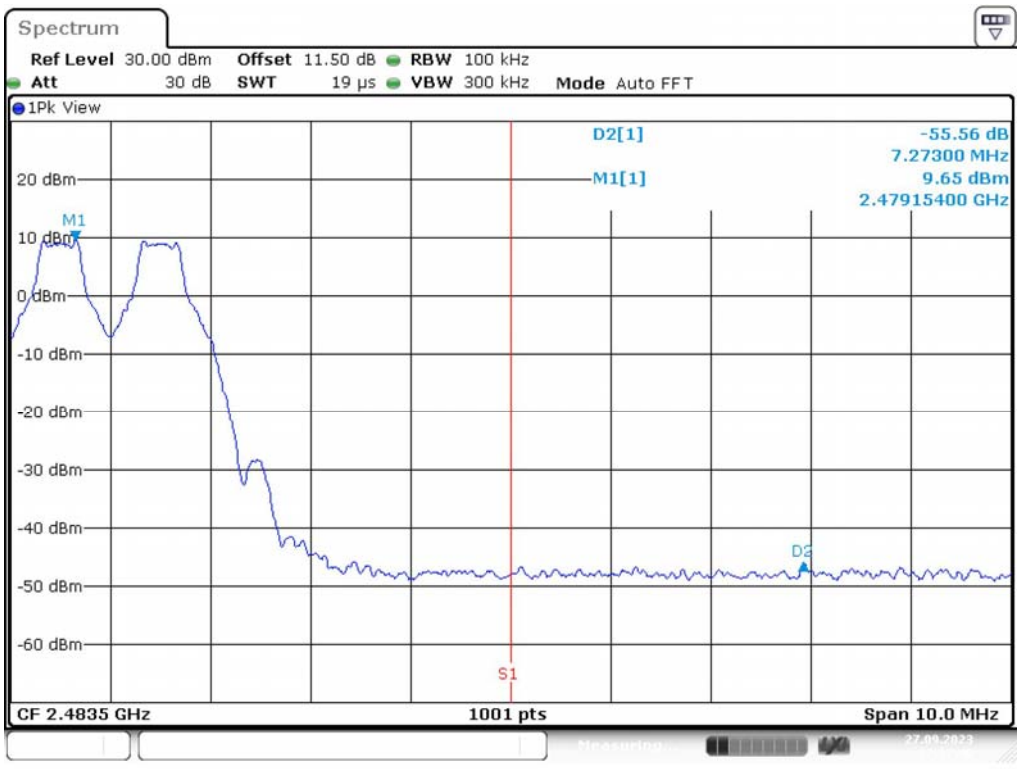
BR Hopping Mode (GFSK)

Band Edge, CH Low



Date: 27.SEP.2023 12:08:38

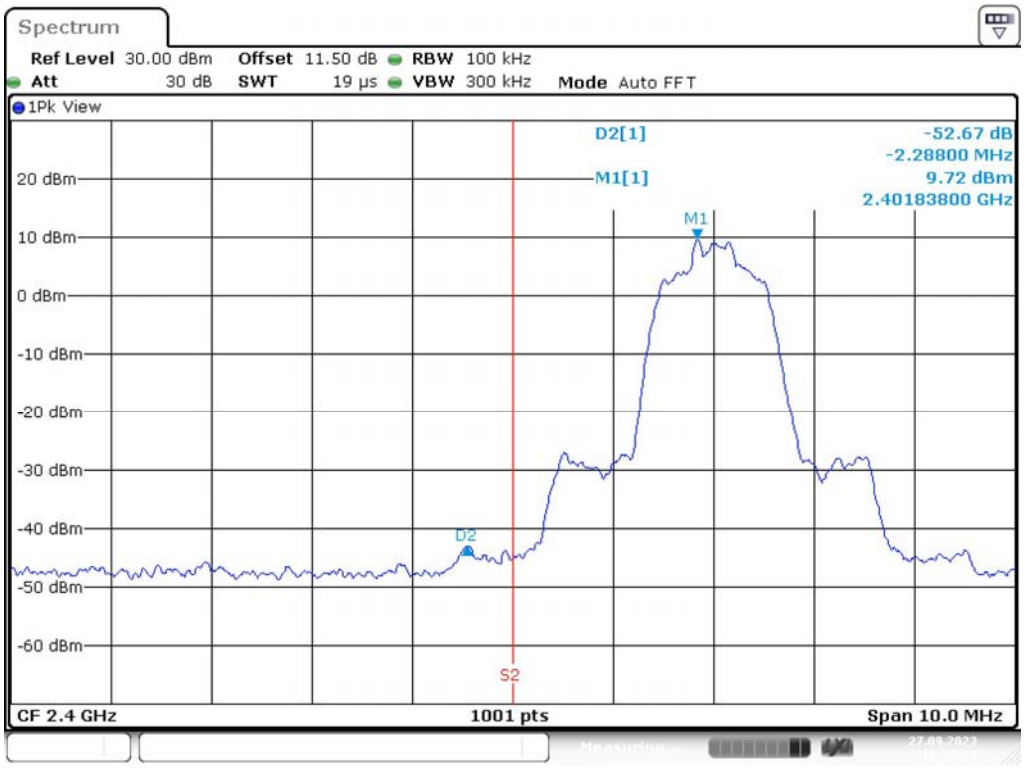
Band Edge, CH High



Date: 27.SEP.2023 12:07:46

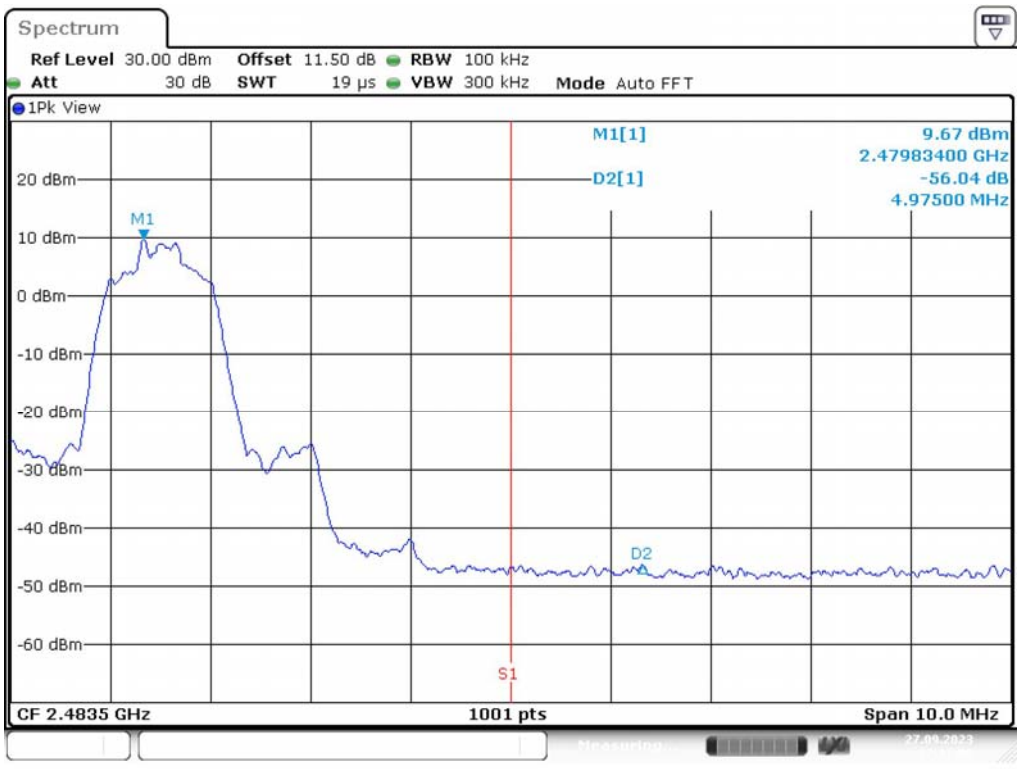
EDR Mode (π/4-DQPSK)

Band Edge, CH Low



Date: 27.SEP.2023 12:17:52

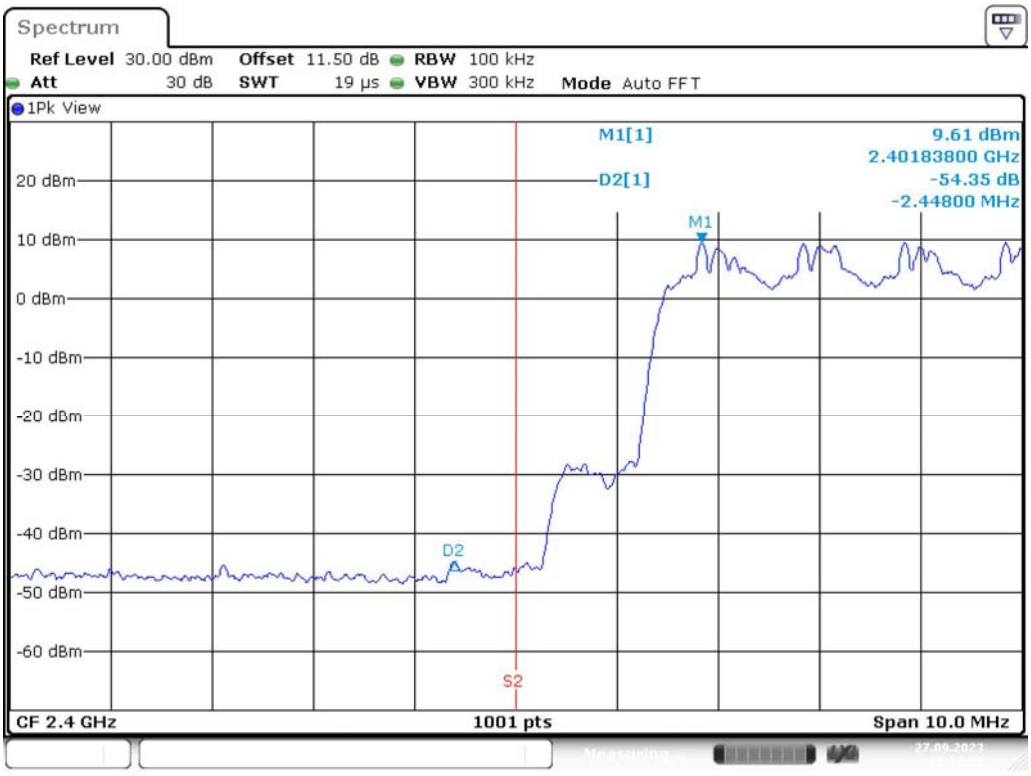
Band Edge, CH High



Date: 27.SEP.2023 12:17:03

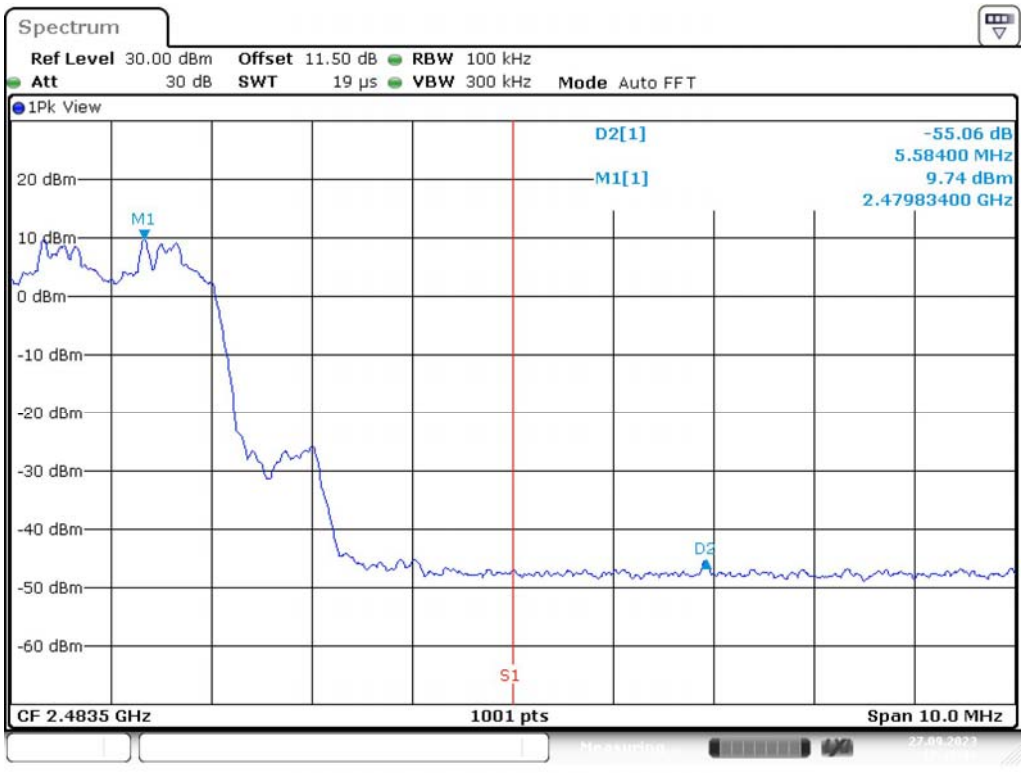
EDR Hopping Mode (π/4-DQPSK)

Band Edge, CH Low



Date: 27.SEP.2023 12:19:22

Band Edge, CH High



Date: 27.SEP.2023 12:15:36

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