



# TEST REPORT

Applicant Name : Bytech NY Inc.  
Address : 2585 West 13th Street Brooklyn NY 11223 USA  
Report Number : SZNS211209-63311E-RF-00  
FCC ID: 2AHN6-MCLB145

## Test Standard (s)

FCC PART 15.247

## Sample Description

Product Type: Color LED Bulb w/Remote  
Model No.: BY-MC-LB-145-WT  
Multiple Model(s) No.: N/A  
Trade Mark: **BYTECH**

Date Received: 2021/12/09  
Report Date: 2022/06/01

Test Result:	Pass*
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\* In the configuration tested, the EUT complied with the standards above.

## Prepared and Checked By:

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EMC Engineer

## Approved By:

Robert Li  
EMC Engineer

Note: This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "★".

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## **TABLE OF CONTENTS**

<b>GENERAL INFORMATION.....</b>	<b>4</b>
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT) .....	4
OBJECTIVE .....	4
TEST METHODOLOGY .....	4
MEASUREMENT UNCERTAINTY.....	5
TEST FACILITY .....	5
<b>SYSTEM TEST CONFIGURATION .....</b>	<b>6</b>
DESCRIPTION OF TEST CONFIGURATION .....	6
EUT EXERCISE SOFTWARE .....	6
SPECIAL ACCESSORIES.....	6
EQUIPMENT MODIFICATIONS .....	6
SUPPORT EQUIPMENT LIST AND DETAILS .....	6
EXTERNAL I/O CABLE.....	6
BLOCK DIAGRAM OF TEST SETUP .....	7
<b>SUMMARY OF TEST RESULTS .....</b>	<b>8</b>
<b>TEST EQUIPMENT LIST .....</b>	<b>9</b>
<b>FCC§15.247 (I), §1.1307 (B) (3) &amp;§2.1093 – RF EXPOSURE .....</b>	<b>11</b>
APPLICABLE STANDARD .....	11
<b>FCC §15.203 - ANTENNA REQUIREMENT.....</b>	<b>12</b>
APPLICABLE STANDARD .....	12
ANTENNA CONNECTOR CONSTRUCTION .....	12
<b>FCC §15.207 (A) – AC LINE CONDUCTED EMISSIONS .....</b>	<b>13</b>
APPLICABLE STANDARD .....	13
EUT SETUP .....	13
EMI TEST RECEIVER SETUP.....	13
TEST PROCEDURE .....	13
TRANSD FACTOR & MARGIN CALCULATION.....	14
TEST DATA .....	14
<b>FCC §15.205, §15.209 &amp; §15.247(D) – RADIATED EMISSIONS .....</b>	<b>17</b>
APPLICABLE STANDARD .....	17
EUT SETUP .....	17
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP .....	18
TEST PROCEDURE .....	18
FACTOR & MARGIN CALCULATION .....	18
TEST DATA .....	18
<b>FCC §15.247(A) (1)-CHANNEL SEPARATION TEST .....</b>	<b>24</b>
APPLICABLE STANDARD .....	24
TEST PROCEDURE .....	24
TEST DATA .....	24
<b>FCC §15.247(A) (1) – 20 DB EMISSION BANDWIDTH &amp; 99% OCCUPIED BANDWIDTH .....</b>	<b>28</b>
APPLICABLE STANDARD .....	28
TEST PROCEDURE .....	28
TEST DATA .....	29

<b>FCC §15.247(A) (1) (III)-QUANTITY OF HOPPING CHANNEL TEST .....</b>	<b>35</b>
APPLICABLE STANDARD .....	35
TEST PROCEDURE .....	35
TEST DATA .....	35
<b>FCC §15.247(A) (1) (III) - TIME OF OCCUPANCY (DWELL TIME).....</b>	<b>38</b>
APPLICABLE STANDARD .....	38
TEST PROCEDURE .....	38
TEST DATA .....	38
<b>FCC §15.247(B) (1) - PEAK OUTPUT POWER MEASUREMENT .....</b>	<b>49</b>
APPLICABLE STANDARD .....	49
TEST PROCEDURE .....	49
TEST DATA .....	49
<b>FCC §15.247(D) - BAND EDGES TESTING.....</b>	<b>55</b>
APPLICABLE STANDARD .....	55
TEST PROCEDURE .....	55
TEST DATA .....	55

## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

Frequency Range	Bluetooth: 2402~2480MHz
Maximum conducted Peak output power	Bluetooth: -1.99dBm
Modulation Technique	Bluetooth: GFSK, $\pi/4$ -DQPSK, 8DPSK
Antenna Specification*	-0.68dBi (provided by the applicant)
Voltage Range	AC 100-240V
Sample serial number	SZNS211209-63311E-RF-S1 for CE&RE SZNS211209-63311E-RF-S2 for RF Conducted Test (Assigned by ATC)
Sample/EUT Status	Good condition
SKU number	5485298
UPC number	805112085088
Lot Number	BY122521
P.O. No.	NJ.7753

### Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

### 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.

All emissions measurement was performed at Shenzhen Accurate Technology Co., Ltd. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Each test item follows test standards and with no deviation.

## Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		5%
RF output power, conducted		0.73dB
Unwanted Emission, conducted		1.6dB
AC Line Conducted emission		2.72dB
Emissions, Radiated	30MHz - 1GHz	4.28dB
	1GHz - 18GHz	4.98dB
	18GHz - 26.5GHz	5.06dB
Temperature		1 °C
Humidity		6%
Supply voltages		0.4%

*Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.*

## Test Facility

The test site used by Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the 1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China.

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, FCC Registration No.: 708358, the FCC Designation No.: CN1189. Accredited by American Association for Laboratory Accreditation (A2LA) The Certificate Number is 429 7.01.

Listed by Innovation, Science and Economic Development Canada (ISED), the Registration Number is 5077A.

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

The system was configured for testing in an engineering mode.

### EUT Exercise Software

“FCC\_assist\_1.0.2.2”\* exercise software was used, and the power level is 10\*. The software and power level was provided by the applicant.

### Special Accessories

No special accessory.

### Equipment Modifications

No modification was made to the EUT tested.

### Support Equipment List and Details

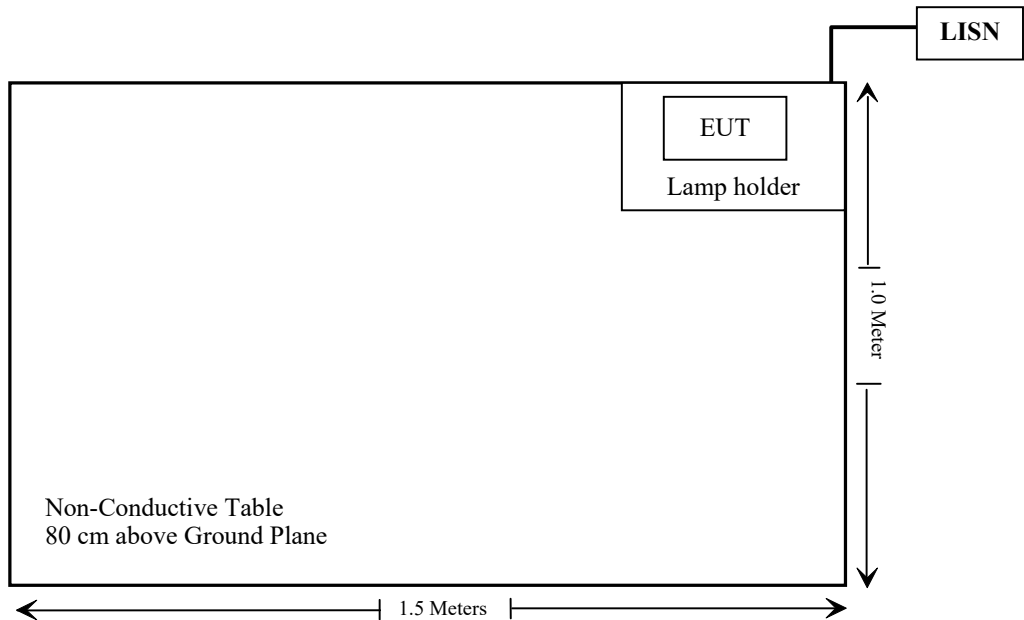
Manufacturer	Description	Model	Serial Number
Unknown	Lamp holder	Unknown	Lamp holder

### External I/O Cable

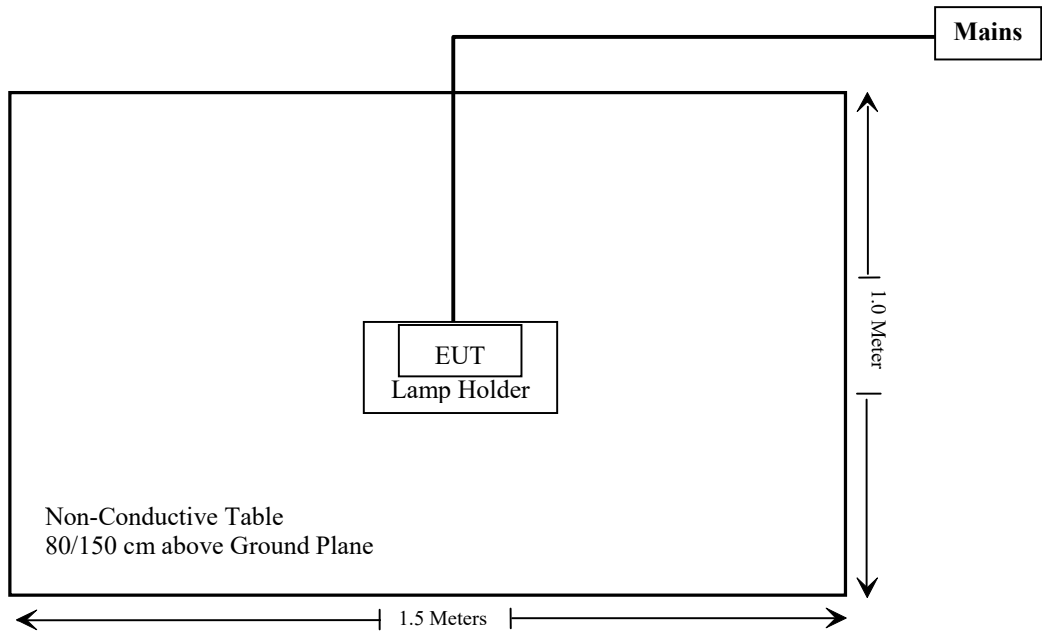
Cable Description	Length (m)	From Port	To
Un-shield detachable AC Cable	1.2	LISN	Lamp holder

Block Diagram of Test Setup

For Conducted Emission



For Radiated Emission



**SUMMARY OF TEST RESULTS**

FCC Rules	Description of Test	Result
FCC §1.1307(b) & §2.1093	RF EXPOSURE	Compliant
§15.203	Antenna Requirement	Compliant
§15.207(a)	AC Line Conducted Emissions	Compliant
§15.205, §15.209 & §15.247(d)	Radiated Emissions	Compliant
§15.247(a)(1)	20 dB Emission Bandwidth & 99% Occupied Bandwidth	Compliant
§15.247(a)(1)	Channel Separation Test	Compliant
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliant
§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliant
§15.247(b)(1)	Peak Output Power Measurement	Compliant
§15.247(d)	Band edges	Compliant



**TEST EQUIPMENT LIST**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde& Schwarz	EMI Test Receiver	ESCI	100784	2021/12/13	2022/12/12
Rohde & Schwarz	L.I.S.N.	ENV216	101314	2021/12/13	2022/12/12
Anritsu Corp	50 Coaxial Switch	MP59B	6100237248	2021/12/13	2022/12/12
Unknown	RF Coaxial Cable	No.17	N0350	2021/12/14	2022/12/13
Conducted Emission Test Software: e3 19821b (V9)					
Radiated Emissions Test					
Rohde& Schwarz	Test Receiver	ESR	102725	2021/12/13	2022/12/12
Rohde&Schwarz	Spectrum Analyzer	FSV40	101949	2021/12/13	2022/12/12
SONOMA INSTRUMENT	Amplifier	310 N	186131	2021/11/09	2022/11/08
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2021/11/09	2022/11/08
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2021/11/11	2022/11/10
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2020/01/05	2023/01/04
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2020/01/05	2023/01/04
Radiated Emission Test Software: e3 19821b (V9)					
Unknown	RF Coaxial Cable	No.10	N050	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.11	N1000	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.12	N040	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.13	N300	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.14	N800	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.15	N600	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.16	N650	2021/12/14	2022/12/13
Wainwright	High Pass Filter	WHKX3.6/18 G-10SS	5	2021/12/14	2022/12/13

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101948	2021/12/13	2022/12/12
WEINSCHEL	10dB Attenuator	5324	AU 3842	2021/12/14	2022/12/13
Unknown	RF Cable	Unknown	Unknown	Each time	

\* **Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

**FCC§15.247 (i), §1.1307 (b) (3) & §2.1093 – RF EXPOSURE****Applicable Standard**

According to FCC §2.1093 and §1.1307(b) (3), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB 447498 D04 Interim General RF Exposure Guidance

**1-mW Test Exemption:**

Per § 1.1307(b)(3)(i)(A), a single RF source is exempt RF device (from the requirement to show data demonstrating compliance to RF exposure limits, as previously mentioned) if the available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption applies to all operating configurations and exposure conditions, for the frequency range 100 kHz to 100 GHz, regardless of fixed, mobile, or portable device exposure conditions. This is a standalone exemption, and it cannot be applied in conjunction with any other test exemption.

**For worst case:**

Frequency (MHz)	Maximum Tune-up power		Exemption Limit (mW)	SAR Test Exclusion
	(dBm)	(mW)		
2402-2480	-1.5	0.71	1	Yes

**Result:** Compliant.

## **FCC §15.203 - ANTENNA REQUIREMENT**

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### **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. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
  - b. Antenna must use a unique type of connector to attach to the EUT.
- Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

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 exceeds 6 dBi.

### **Antenna Connector Construction**

The EUT has one internal antenna arrangement, which was permanently attached and the antenna gain is -0.68 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

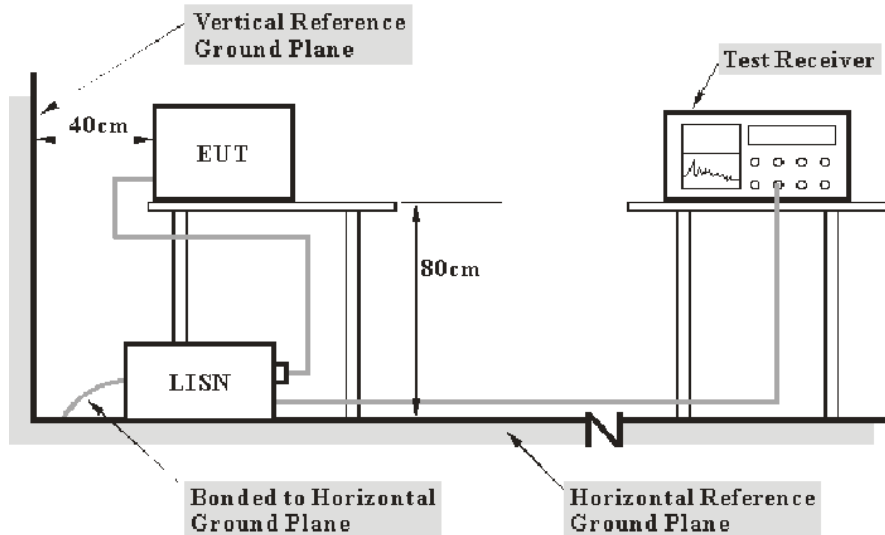
**Result:** Compliance.

## FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

### Applicable Standard

FCC§15.207

### 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.

The spacing between the peripherals was 10 cm.

### EMI Test Receiver Setup

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

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

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

### Test Procedure

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

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

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

## Transd Factor & Margin Calculation

The Transd factor is calculated by adding LISN VDF (Voltage Division Factor) and Cable Loss. The basic equation is as follows:

$$\text{Factor} = \text{LISN VDF} + \text{Cable Loss}$$

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 calculation is as follows:

$$\begin{aligned}\text{Over Limit} &= \text{Level} - \text{Limit} \\ \text{Level} &= \text{Read Level} + \text{Factor}\end{aligned}$$

## Test Data

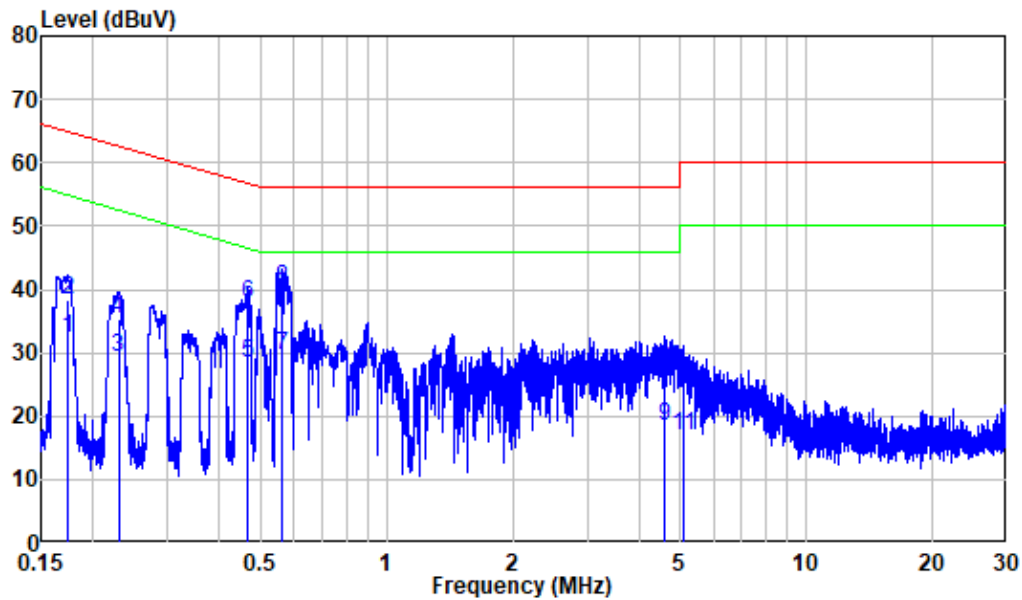
### Environmental Conditions

Temperature:	23 °C
Relative Humidity:	60 %
ATM Pressure:	101.0 kPa

*The testing was performed by Bin Duan on 2021-12-29.*

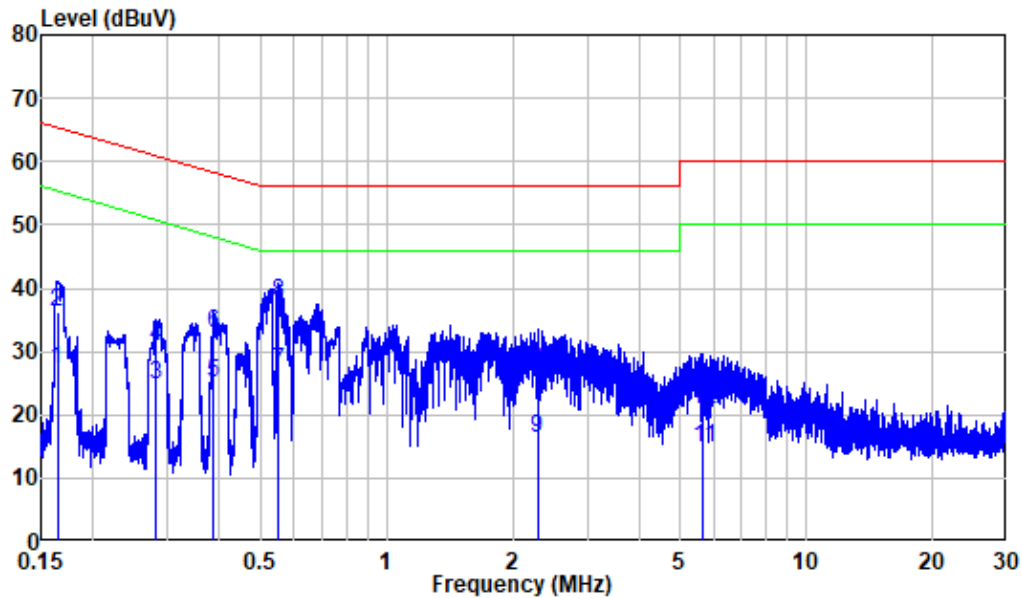
*EUT operation mode: Transmitting (worst case is 8DPSK Mode, Middle channel)*

## AC 120V/60 Hz, Line



Site : Shielding Room  
 Condition: Line  
 Mode : BT  
 Model : BY-MC-LB-145-WT  
 Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.173	9.85	22.31	32.16	54.82	-22.66	Average
2	0.173	9.85	28.60	38.45	64.82	-26.37	QP
3	0.229	9.80	19.36	29.16	52.47	-23.31	Average
4	0.229	9.80	25.44	35.24	62.47	-27.23	QP
5	0.467	9.80	18.57	28.37	46.56	-18.19	Average
6	0.467	9.80	27.81	37.61	56.56	-18.95	QP
7	0.562	9.81	19.67	29.48	46.00	-16.52	Average
8	0.562	9.81	30.33	40.14	56.00	-15.86	QP
9	4.601	9.98	8.56	18.54	46.00	-27.46	Average
10	4.601	9.98	17.38	27.36	56.00	-28.64	QP
11	5.085	9.99	6.79	16.78	50.00	-33.22	Average
12	5.085	9.99	14.61	24.60	60.00	-35.40	QP

**AC 120V/60 Hz, Neutral**

Site : Shielding Room  
 Condition: Neutral  
 Mode : BT  
 Model : BY-MC-LB-145-WT  
 Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.164	9.93	17.29	27.22	55.26	-28.04	Average
2	0.164	9.93	26.24	36.17	65.26	-29.09	QP
3	0.280	9.96	14.81	24.77	50.80	-26.03	Average
4	0.280	9.96	20.78	30.74	60.80	-30.06	QP
5	0.387	9.93	15.02	24.95	48.12	-23.17	Average
6	0.387	9.93	22.98	32.91	58.12	-25.21	QP
7	0.551	9.91	16.88	26.79	46.00	-19.21	Average
8	0.551	9.91	27.80	37.71	56.00	-18.29	QP
9	2.283	9.94	6.35	16.29	46.00	-29.71	Average
10	2.283	9.94	17.16	27.10	56.00	-28.90	QP
11	5.680	10.06	4.84	14.90	50.00	-35.10	Average
12	5.680	10.06	10.62	20.68	60.00	-39.32	QP



## FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS

### Applicable Standard

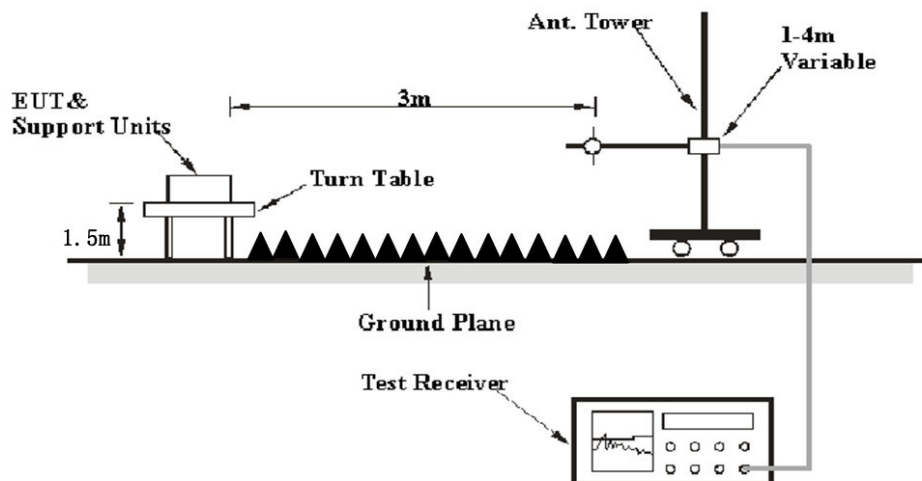
FCC §15.205; §15.209; §15.247(d)

### EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209 and FCC 15.247 limits.

## EMI Test Receiver & Spectrum Analyzer Setup

The EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1 MHz	3 MHz	/	PK
	1 MHz	10 Hz	/	Average

## Test Procedure

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

All final data was recorded in Quasi-peak detection mode for frequency range of 30 MHz -1 GHz and peak and Average detection modes for frequencies above 1 GHz.

## Factor & Margin Calculation

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

$$\text{Factor} = \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

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

$$\begin{aligned} \text{Over Limit/Margin} &= \text{Level / Corrected Amplitude} - \text{Limit} \\ \text{Level / Corrected Amplitude} &= \text{Read Level} + \text{Factor} \end{aligned}$$

## Test Data

### Environmental Conditions

Temperature:	25~25.8 °C
Relative Humidity:	51~64 %
ATM Pressure:	101.0 kPa

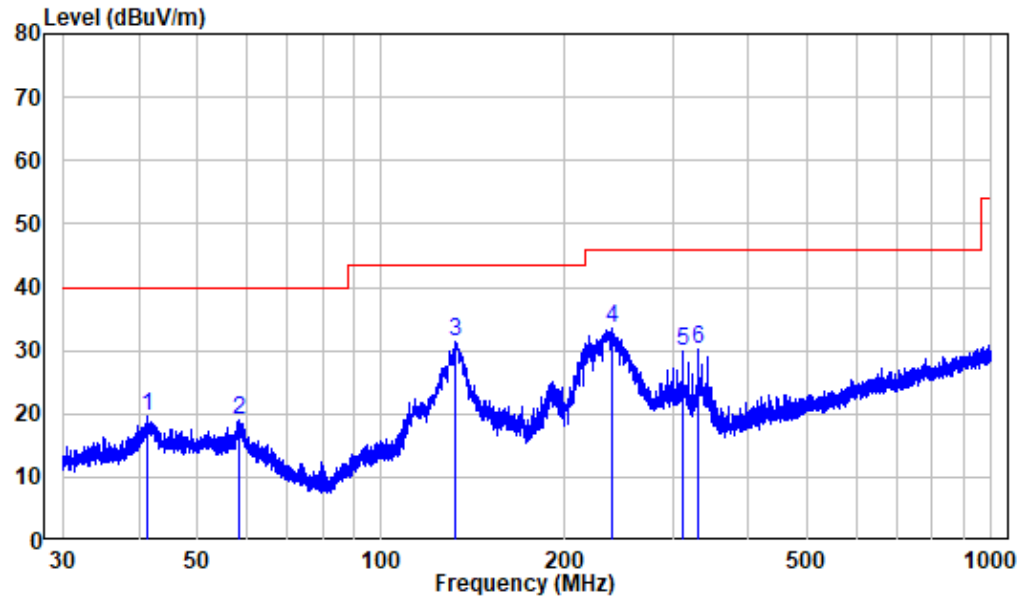
The testing was performed by Bin Duan on 2021-12-29 for below 1GHz, Bin Duan and Amy Cao on 2021-12-21 and 2021-12-29 for above 1GHz.

EUT operation mode: Transmitting (Pre-scan in the X, Y and Z axes of orientation, the worst case X-axes of orientation was recorded)

**30MHz-1GHz:** (worst case is 8DPSK Mode, Middle channel)

Note: When the test result of peak was less than the limit of QP more than 6dB, just peak value were recorded.

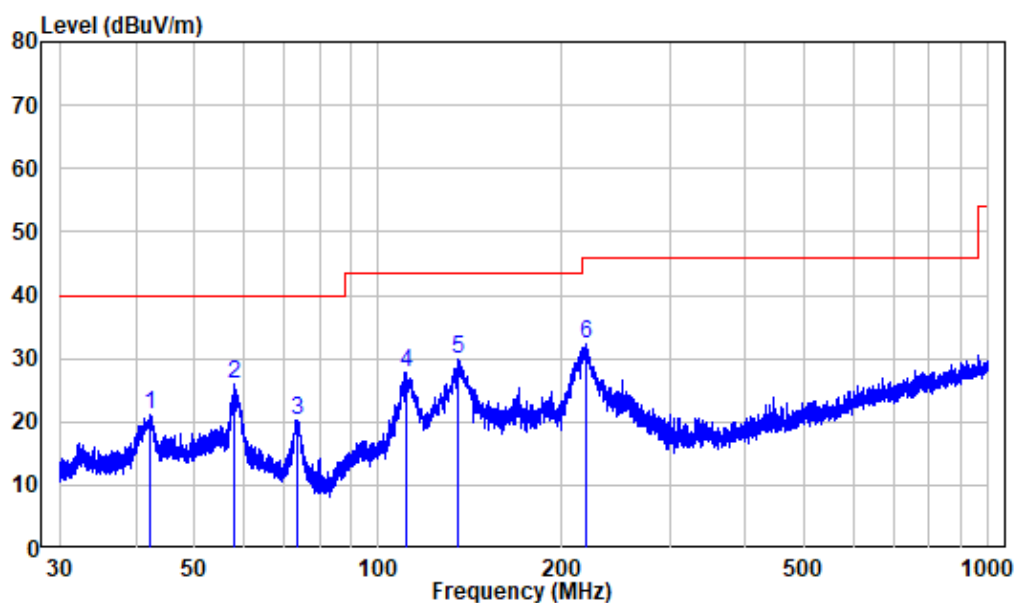
**Horizontal:**



Site : chamber  
Condition: 3m HORIZONTAL  
Job No. : SZNS211209-63311E-RF  
Test Mode: BT

Freq Factor		Read Level	Level	Limit Line	Over Limit	Remark
MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	41.277	-10.14	29.70	19.56	40.00	-20.44 Peak
2	58.484	-10.07	29.08	19.01	40.00	-20.99 Peak
3	132.569	-14.98	46.38	31.40	43.50	-12.10 Peak
4	238.728	-10.93	44.46	33.53	46.00	-12.47 Peak
5	312.043	-8.82	38.80	29.98	46.00	-16.02 Peak
6	330.050	-8.00	38.20	30.20	46.00	-15.80 Peak

## Vertical



Site : chamber  
 Condition: 3m VERTICAL  
 Job No. : SZNS211209-63311E-RF  
 Test Mode: BT

	Freq	Factor	Read Level	Level	Limit	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	42.321	-10.00	30.98	20.98	40.00	-19.02	Peak
2	58.203	-9.97	35.84	25.87	40.00	-14.13	Peak
3	73.746	-16.01	36.31	20.30	40.00	-19.70	Peak
4	110.860	-12.08	39.81	27.73	43.50	-15.77	Peak
5	135.328	-15.04	44.79	29.75	43.50	-13.75	Peak
6	218.596	-11.49	43.82	32.33	46.00	-13.67	Peak

**Above 1GHz:** (worst case is 8DPSK Mode)

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/AV		Height (m)	Polar (H/V)				
Low Channel									
2310	67.59	PK	27	1.1	H	-7.25	60.34	74	-13.66
2310	52.96	AV	27	1.1	H	-7.25	45.71	54	-8.29
2390	68.02	PK	231	2.4	H	-7.23	60.79	74	-13.21
2390	54.26	AV	231	2.4	H	-7.23	47.03	54	-6.97
2310	67.15	PK	313	1.4	V	-7.25	59.9	74	-14.1
2310	52.97	AV	313	1.4	V	-7.25	45.72	54	-8.28
2390	68.51	PK	12	1.1	V	-7.23	61.28	74	-12.72
2390	54.12	AV	12	1.1	V	-7.23	46.89	54	-7.11
4804	57.85	PK	17	2.5	H	-3.51	54.34	74	-19.66
4804	49.34	AV	17	2.5	H	-3.51	45.83	54	-8.17
4804	56.42	PK	245	1.1	V	-3.51	52.91	74	-21.09
4804	44.14	AV	245	1.1	V	-3.51	40.63	54	-13.37
Middle Channel									
4882	59.62	PK	191	1.4	H	-3.28	56.34	74	-17.66
4882	50.4	PK	191	1.4	H	-3.28	47.12	54	-6.88
4882	56.6	PK	338	1.8	V	-3.28	53.32	74	-20.68
4882	45.4	AV	338	1.8	V	-3.28	42.12	54	-11.88
High Channel									
2483.5	69.42	PK	38	2.3	H	-7.18	62.24	74	-11.76
2483.5	55.22	AV	38	2.3	H	-7.18	48.04	54	-5.96
2500	68.81	PK	345	2.3	H	-7.18	61.63	74	-12.37
2500	54.25	AV	345	2.3	H	-7.18	47.07	54	-6.93
2483.5	68.43	PK	45	1.2	V	-7.18	61.25	74	-12.75
2483.5	55.09	AV	45	1.2	V	-7.18	47.91	54	-6.09
2500	68.28	PK	151	1.2	V	-7.18	61.1	74	-12.9
2500	54.32	AV	151	1.2	V	-7.18	47.14	54	-6.86
4960	59.56	PK	239	1	H	-3.04	56.52	74	-17.48
4960	50.49	AV	239	1	H	-3.04	47.45	54	-6.55
4960	56.49	PK	55	2.2	V	-3.04	53.45	74	-20.55
4960	45.76	AV	55	2.2	V	-3.04	42.72	54	-11.28

**Note:**

Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

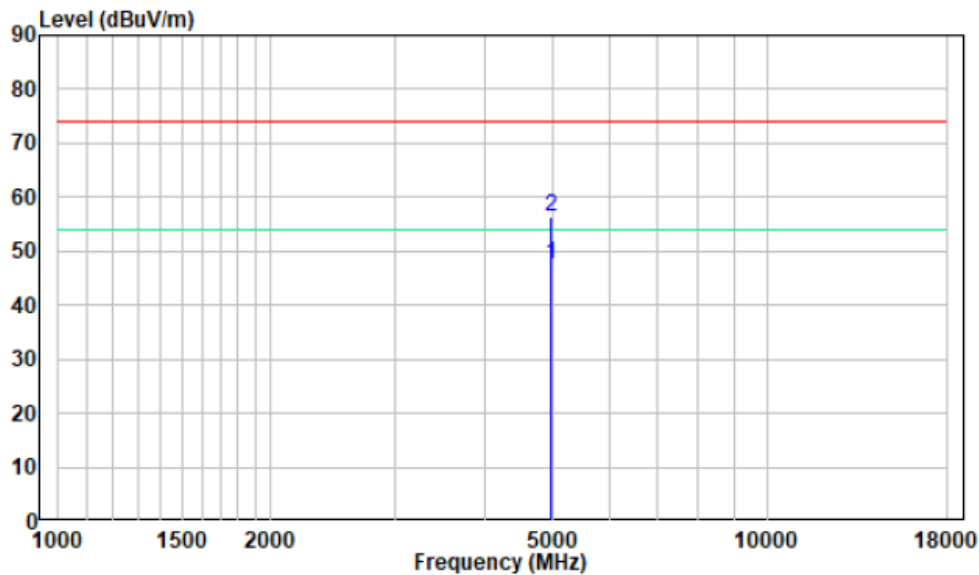
Margin = Corrected. Amplitude - Limit

The other spurious emission which is in the noise floor level was not recorded.

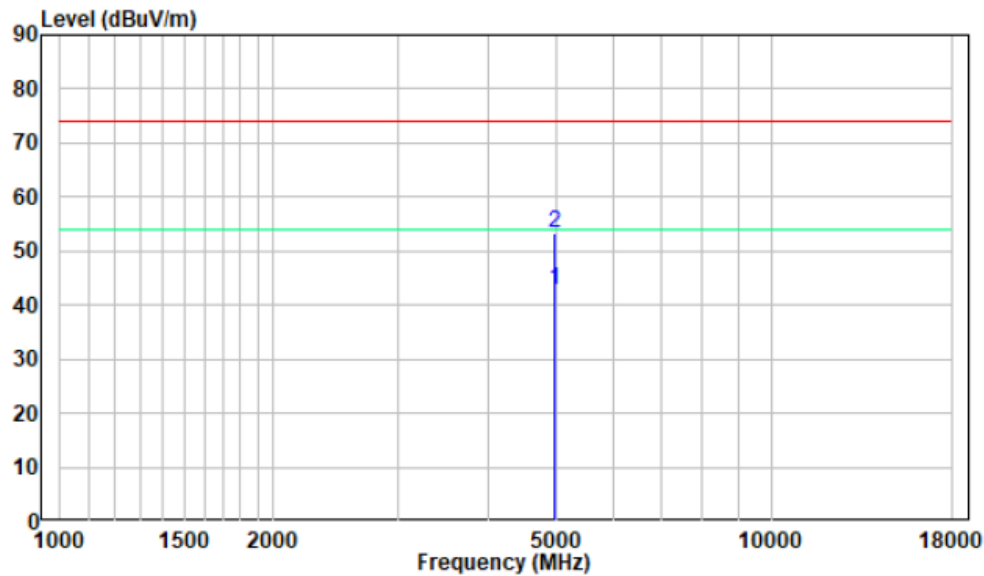
1-18GHz

Pre-scan for High channel

Horizontal:



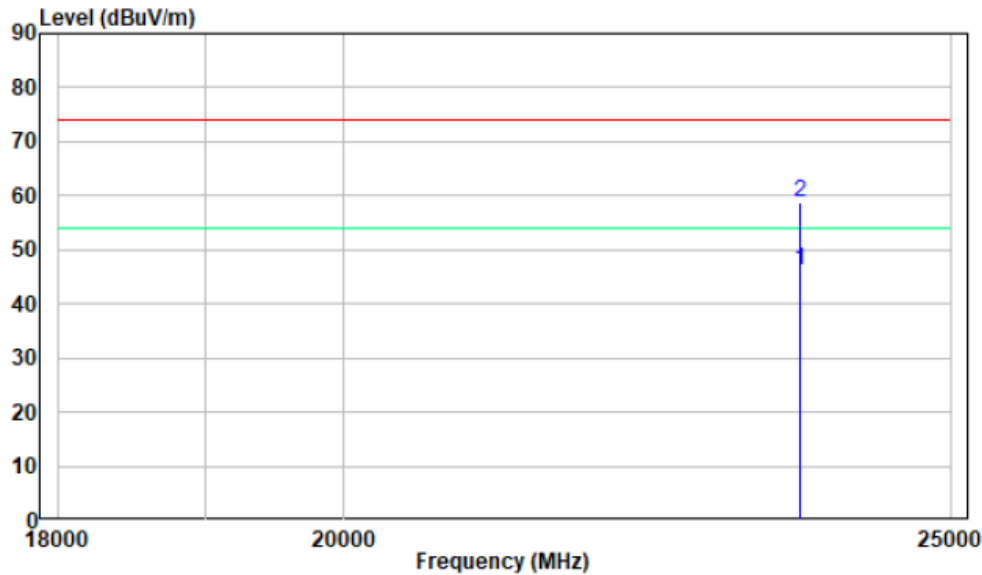
Vertical:



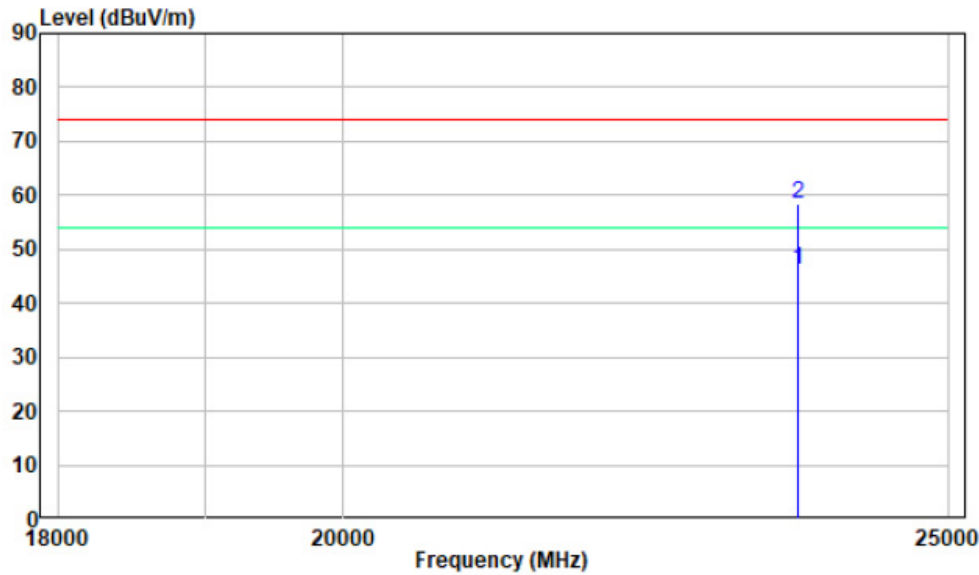
18-25GHz

Pre-scan for High channel

Horizontal:



Vertical:



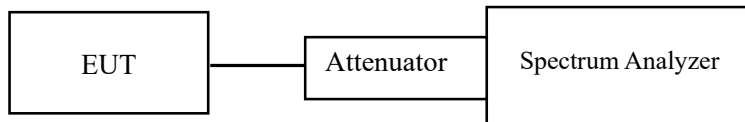
## FCC §15.247(a) (1)-CHANNEL SEPARATION TEST

### Applicable Standard

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.

### Test Procedure

- c. Set the EUT in transmitting mode, maxhold the channel.
- d. Set the adjacent channel of the EUT and maxhold another trace.
- e. Measure the channel separation.



### Test Data

#### Environmental Conditions

Temperature:	26 °C
Relative Humidity:	57 %
ATM Pressure:	102.4 kPa

*The testing was performed by Black Ding on 2021-12-20.*

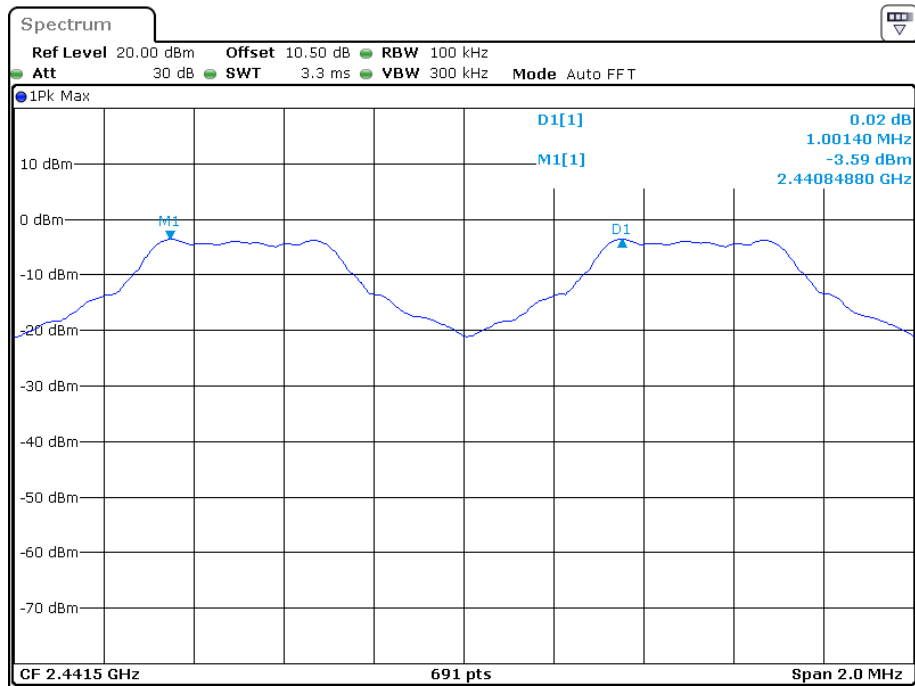
*EUT operation mode: Transmitting*

*Test Result: Compliance. Please refer to following table and plots.*

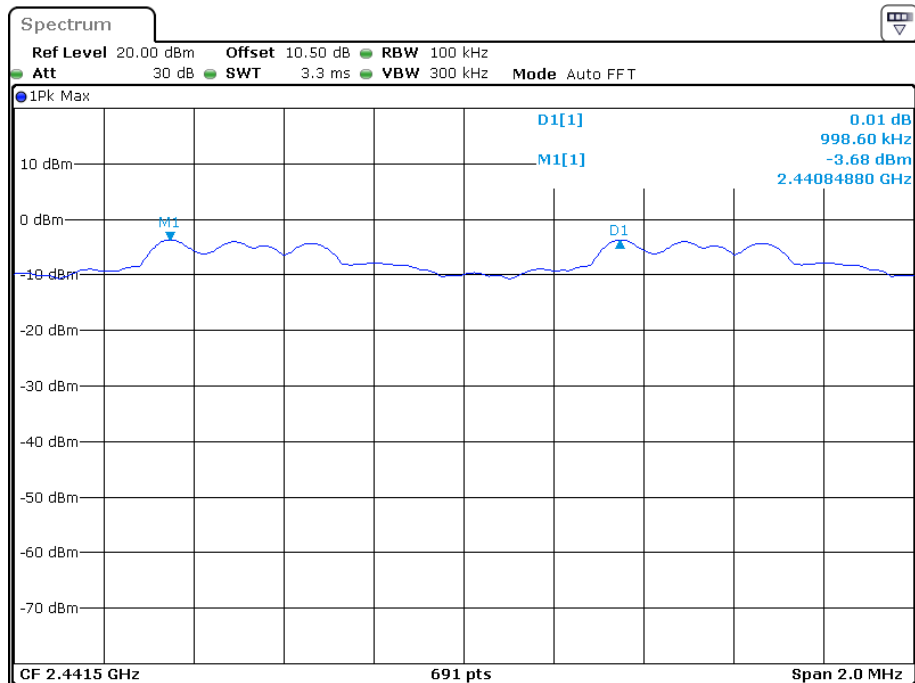


Test Mode	Channel Separation (MHz)	20 dBc BW (MHz)	Two-thirds of the 20 dB bandwidth (MHz)	Channel Separation Limit	Result
<b>BDR(GFSK)</b>					
Hopping	1.001	0.886	0.591	> two-thirds of the 20 dB bandwidth	Compliance
<b>EDR(<math>\pi/4</math>-DQPSK)</b>					
Hopping	0.999	1.253	0.835	> two-thirds of the 20 dB bandwidth	Compliance
<b>EDR(8DPSK)</b>					
Hopping	1.007	1.216	0.811	> two-thirds of the 20 dB bandwidth	Compliance

Please refer to the following plots.

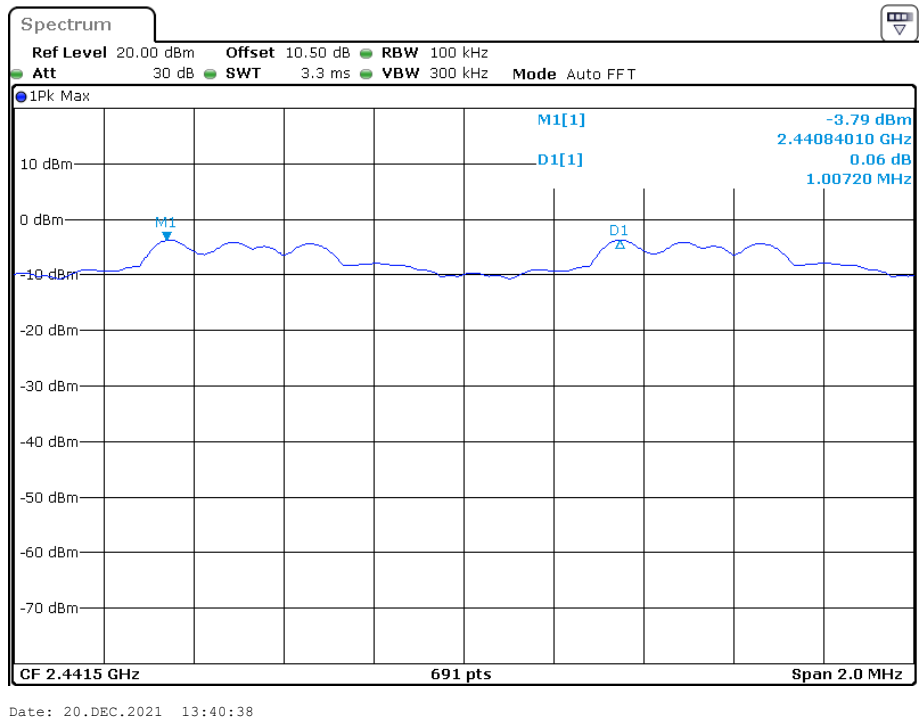
**BDR (GFSK)**

Date: 20.DEC.2021 13:38:20

**EDR ( $\pi/4$ -DQPSK)**

Date: 20.DEC.2021 13:39:51

EDR (8DPSK)



## FCC §15.247(a) (1) – 20 dB EMISSION BANDWIDTH & 99% OCCUPIED BANDWIDTH

### Applicable Standard

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.

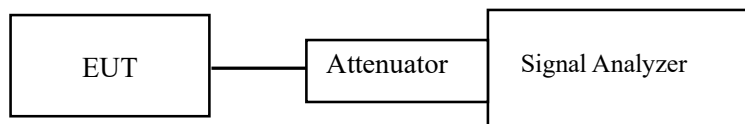
### Test Procedure

The following conditions shall be observed for measuring the occupied bandwidth and 20 dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / 20 dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / 20 dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

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).



**Test Data****Environmental Conditions**

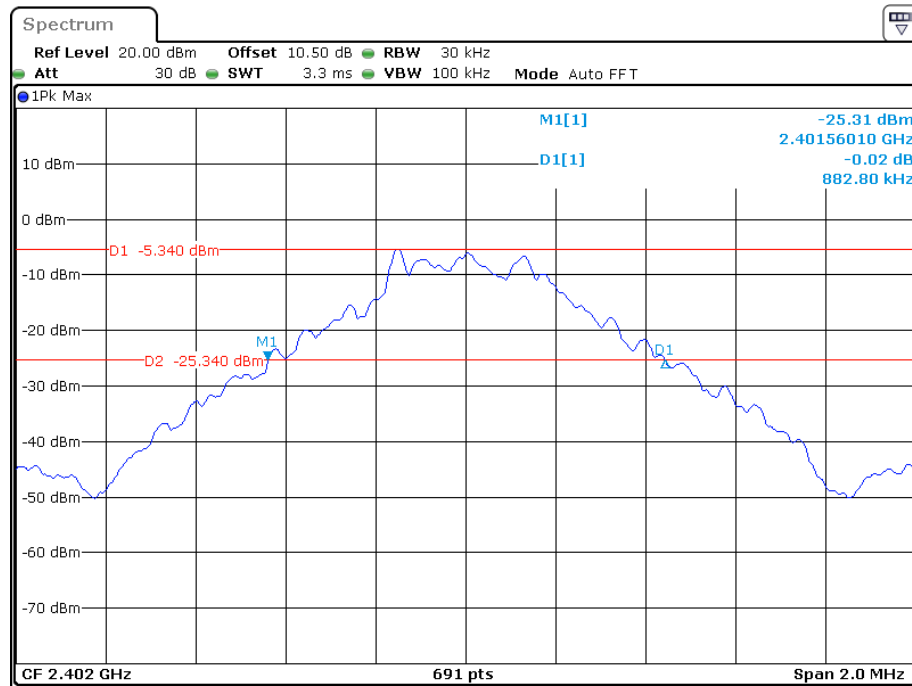
<b>Temperature:</b>	26 °C
<b>Relative Humidity:</b>	57 %
<b>ATM Pressure:</b>	102.4 kPa

*The testing was performed by Black Ding on 2021-12-20 and 2022-06-01.*

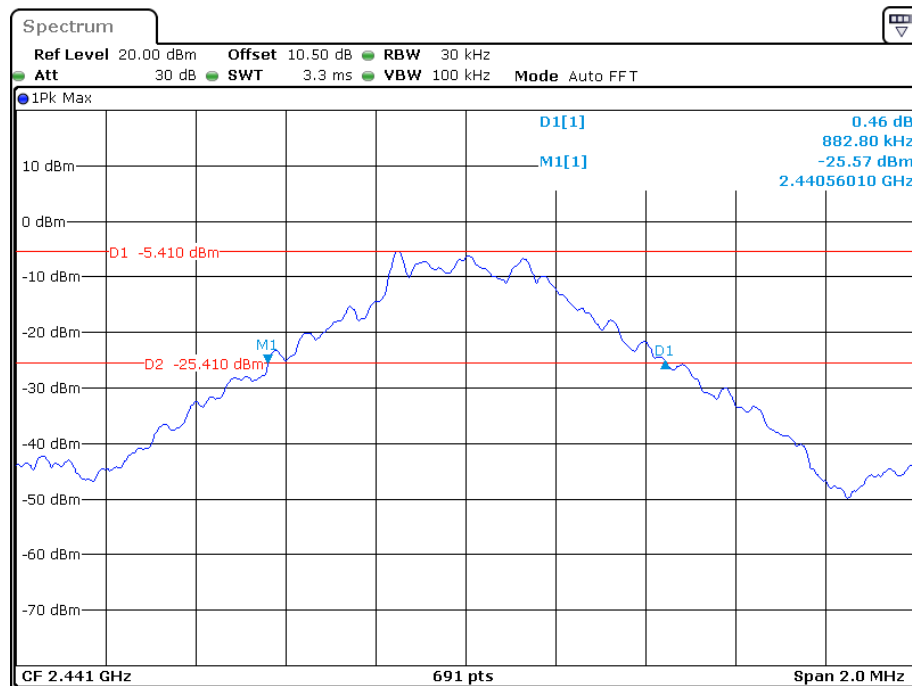
*EUT operation mode: Transmitting*

*Test Result: Compliance. Please refer to following table and plots.*

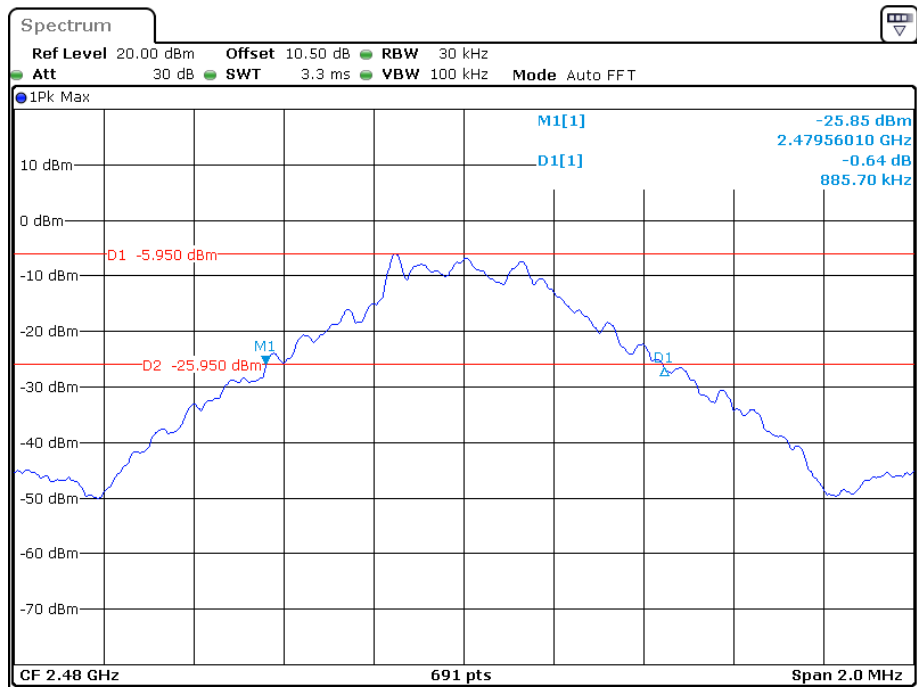
<b>Mode</b>	<b>Channel</b>	<b>Frequency (MHz)</b>	<b>20 dB Emission Bandwidth (MHz)</b>
<b>BDR (GFSK)</b>	Low	2402	0.883
	Middle	2441	0.883
	High	2480	0.886
<b>EDR (<math>\pi/4</math>-DQPSK)</b>	Low	2402	1.250
	Middle	2441	1.253
	High	2480	1.250
<b>EDR (8DPSK)</b>	Low	2402	1.213
	Middle	2441	1.216
	High	2480	1.213

**BDR (GFSK): Low Channel**

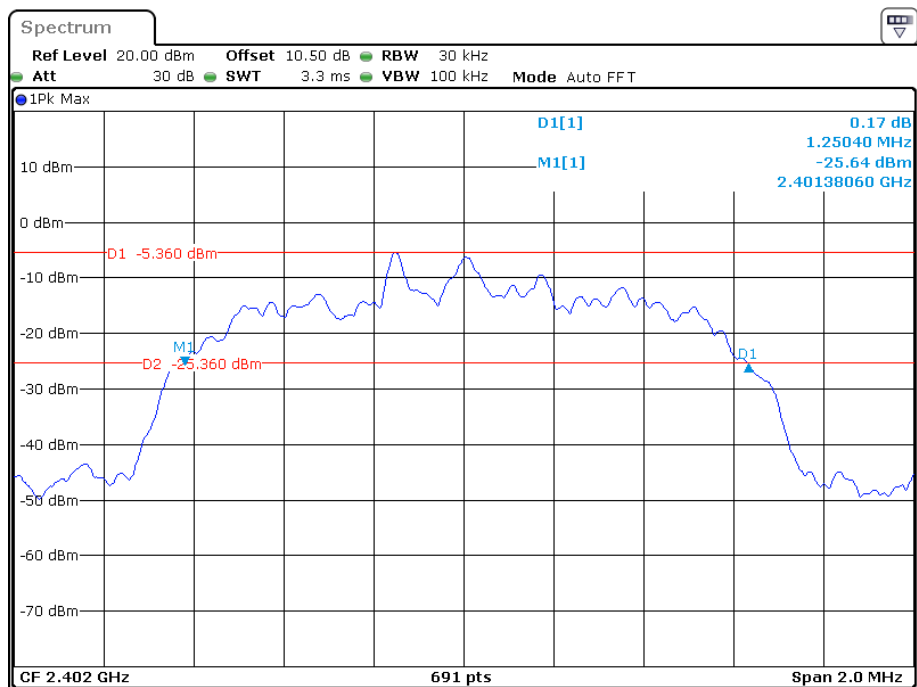
Date: 20.DEC.2021 13:19:10

**BDR (GFSK): Middle Channel**

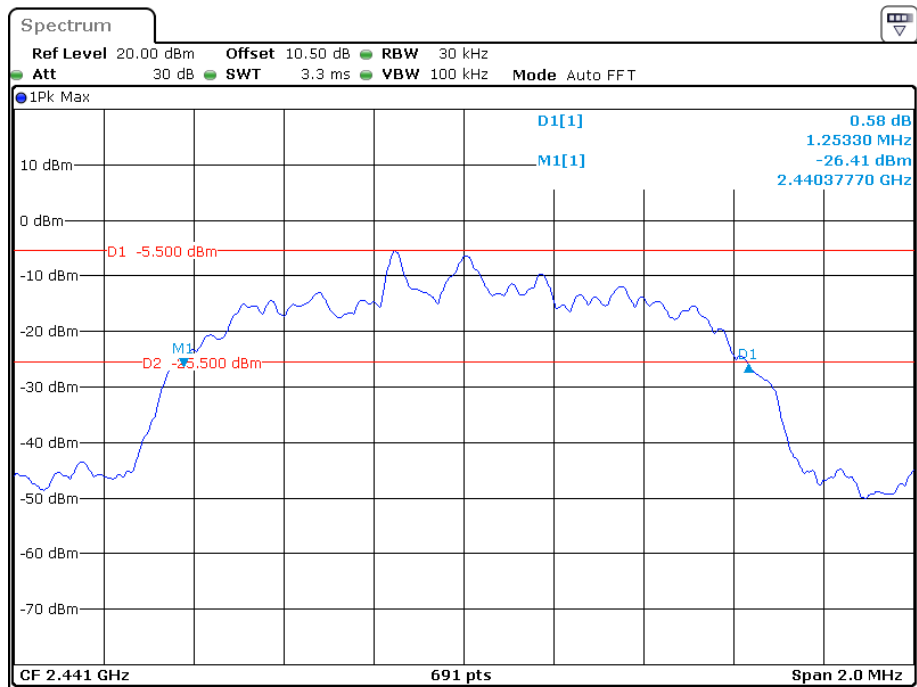
Date: 20.DEC.2021 13:21:27

**BDR (GFSK): High Channel**

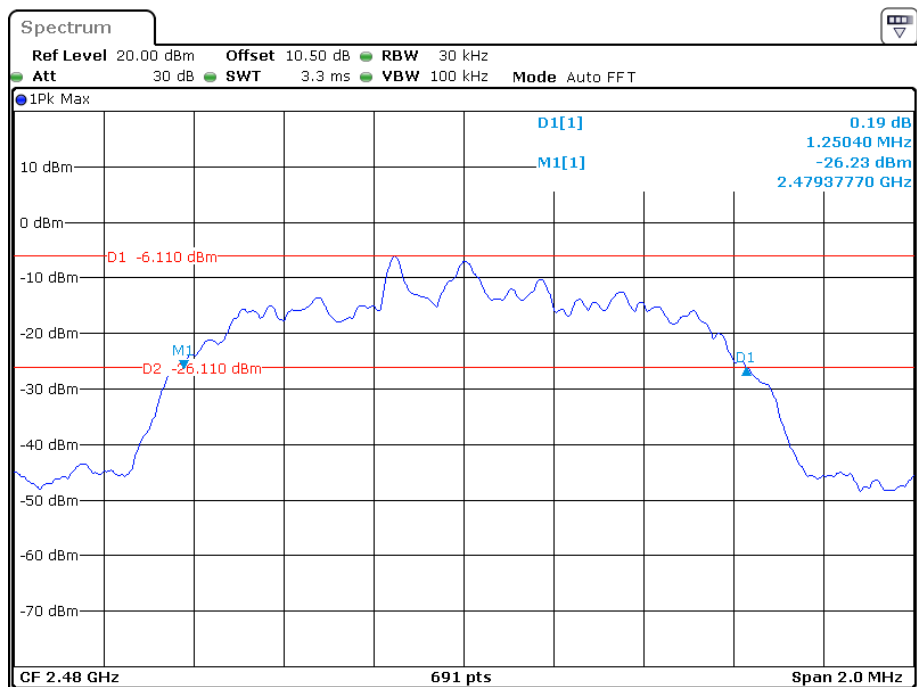
Date: 20.DEC.2021 13:22:59

**EDR ( $\pi/4$ -DQPSK): Low Channel**

Date: 20.DEC.2021 13:27:44

**EDR ( $\pi/4$ -DQPSK): Middle Channel**

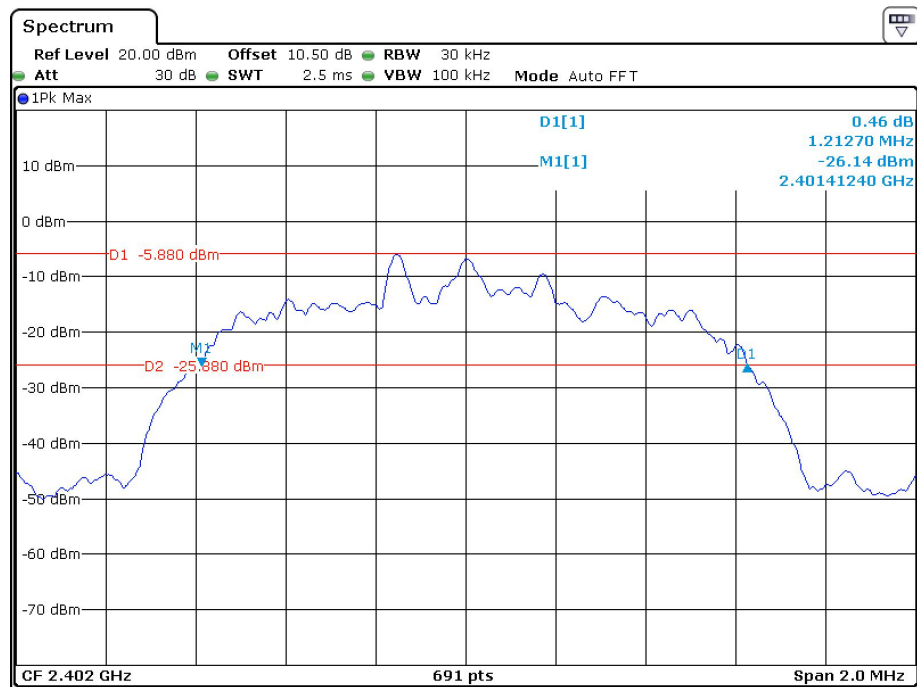
Date: 20.DEC.2021 13:26:46

**EDR ( $\pi/4$ -DQPSK): High Channel**

Date: 20.DEC.2021 13:23:45

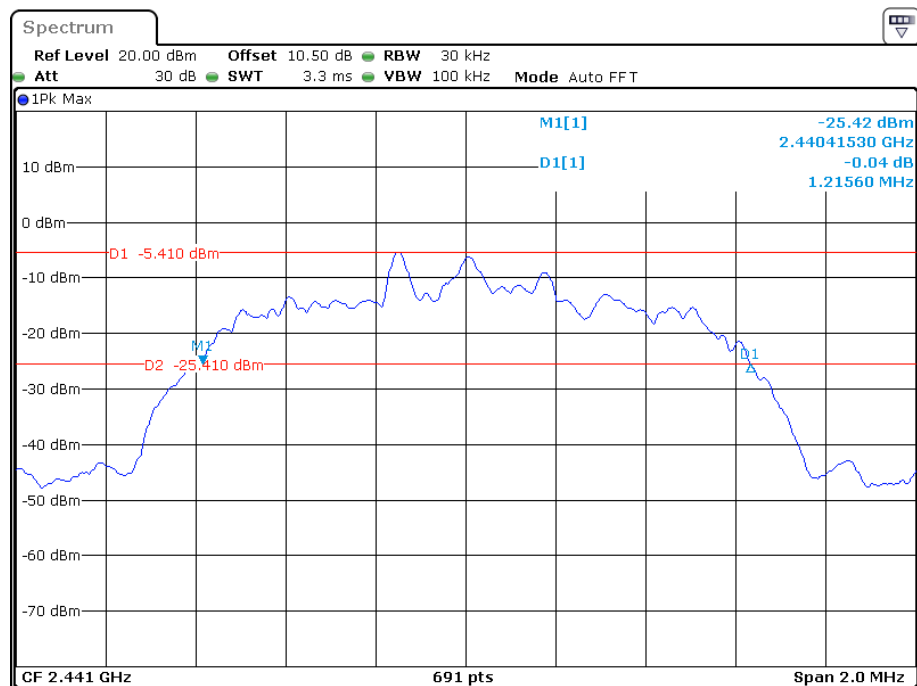


### EDR (8DPSK): Low Channel



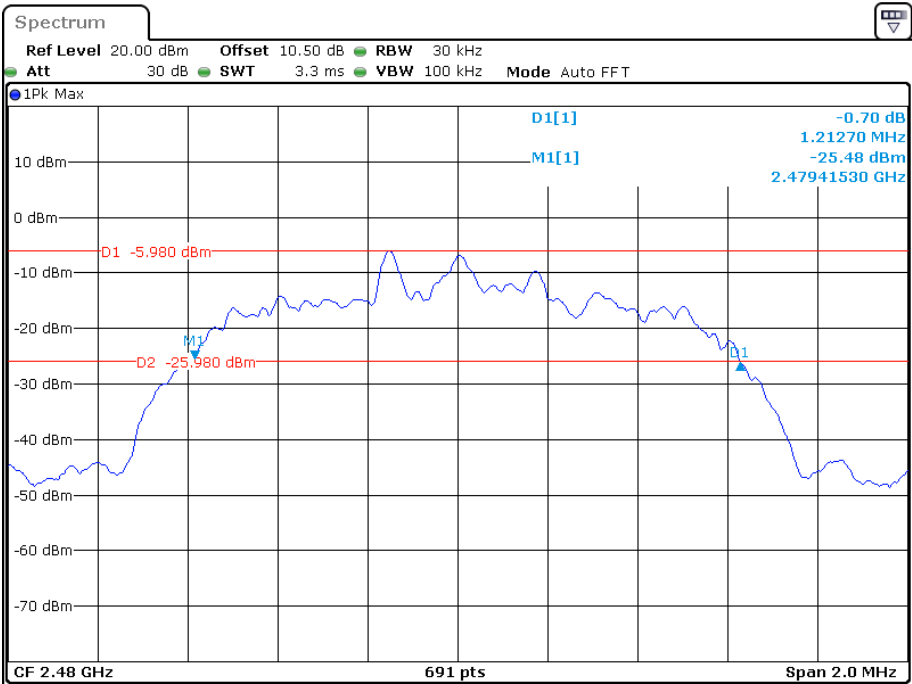
Date: 1.JUN.2022 09:17:48

### EDR (8DPSK): Middle Channel



Date: 20.DEC.2021 13:30:17

EDR (8DPSK): High Channel



Date: 20.DEC.2021 13:31:25

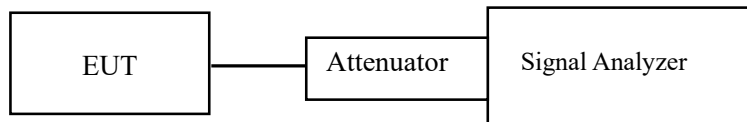
## FCC §15.247(a) (1) (iii)-QUANTITY OF HOPPING CHANNEL TEST

### Applicable Standard

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.

### Test Procedure

- f. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- g. Set the EUT in hopping mode from first channel to last.
- h. By using the max-hold function record the quantity of the channel.



### Test Data

#### Environmental Conditions

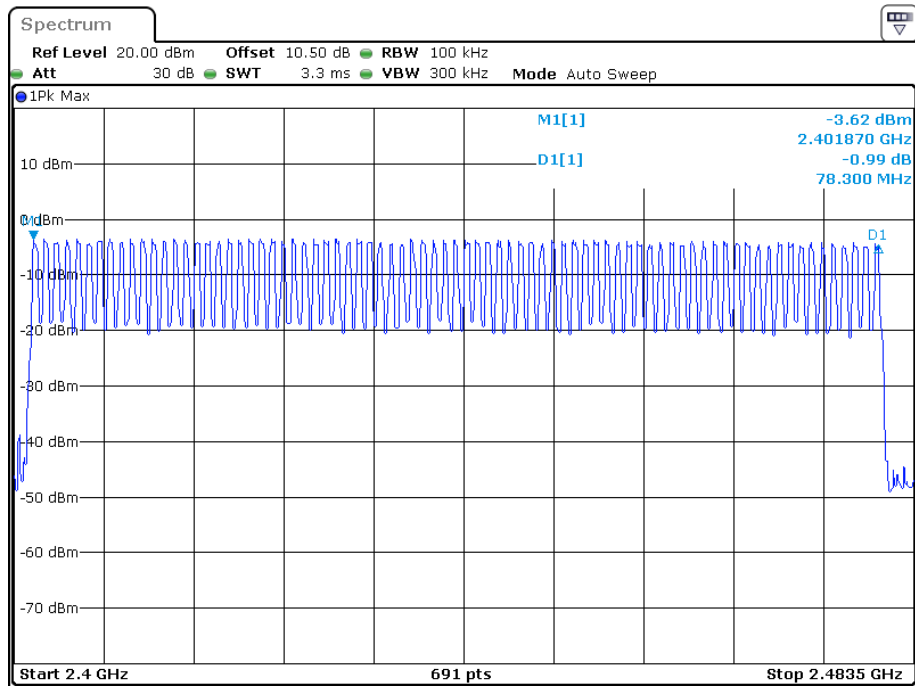
Temperature:	26 °C
Relative Humidity:	57 %
ATM Pressure:	102.4 kPa

The testing was performed by Black Ding on 2021-12-20.

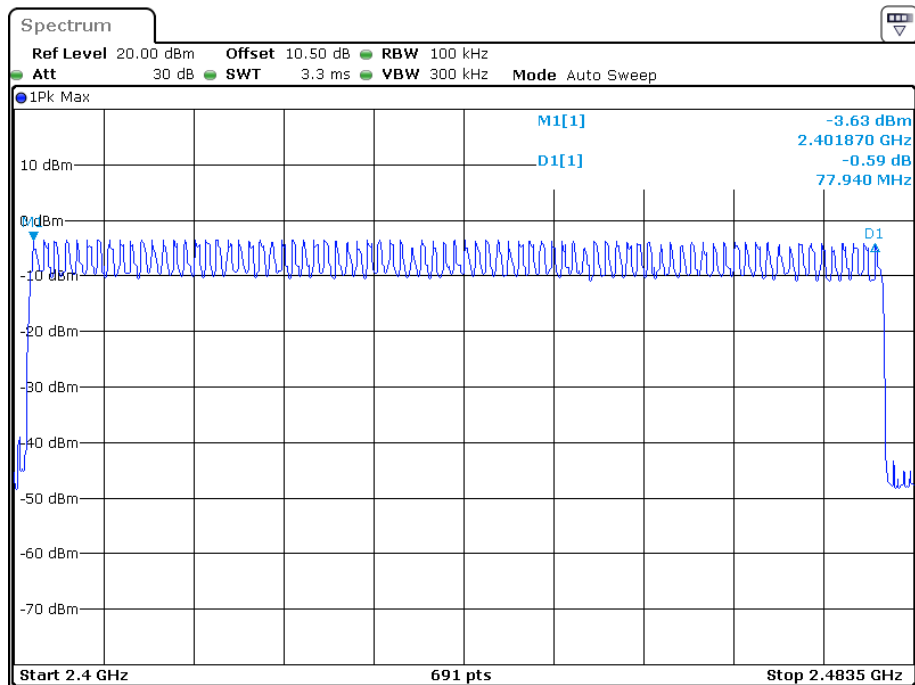
EUT operation mode: Transmitting

Test Result: Compliance. Please refer to following table and plots.

Mode	Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)
BDR (GFSK)	2400-2483.5	79	≥15
EDR (π/4-DQPSK)	2400-2483.5	79	≥15
EDR (8DPSK)	2400-2483.5	79	≥15

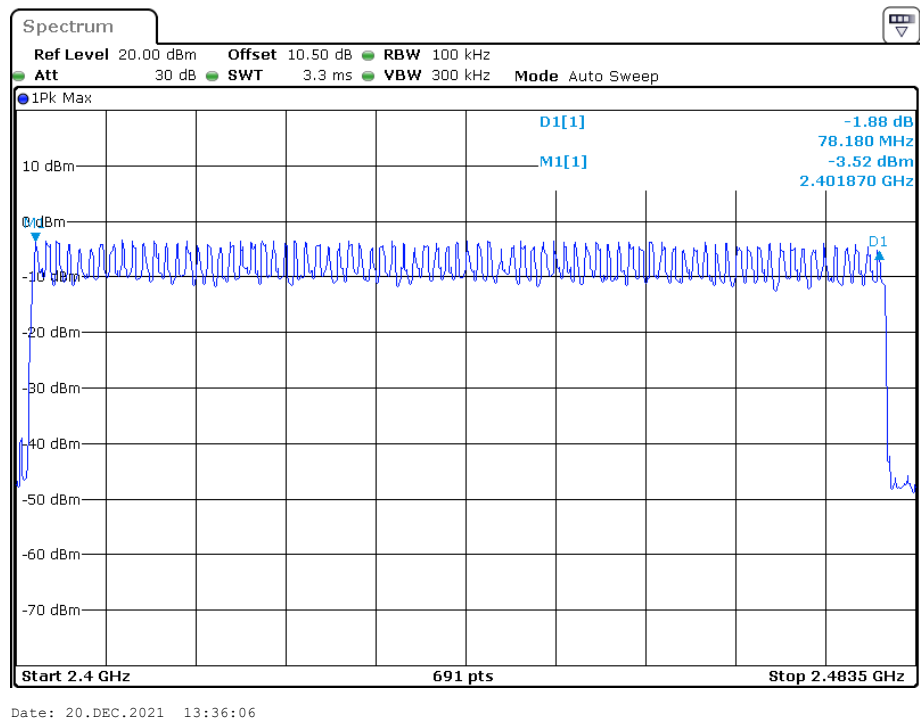
**BDR (GFSK): Number of Hopping Channels**

Date: 20.DEC.2021 13:33:36

**EDR ( $\pi/4$ -DQPSK): Number of Hopping Channels**

Date: 20.DEC.2021 13:34:55

EDR (8DPSK): Number of Hopping Channels

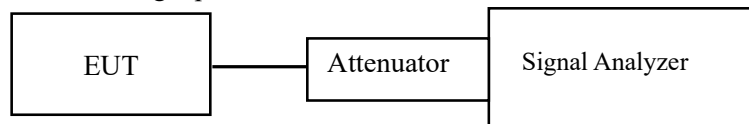


**FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME)****Applicable Standard**

Frequency hopping systems in the 2400-2483.5 MHz 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.

**Test Procedure**

- i. The EUT was worked in channel hopping.
- j. Set the RBW to: 1MHz.
- k. Set the VBW  $\geq 3 \times$  RBW.
- l. Set the span to 0Hz.
- m. Detector = peak.
- n. Sweep time = auto couple.
- o. Trace mode = max hold.
- p. Allow trace to fully stabilize.
- q. Recorded the time of single pulses

**Test Data****Environmental Conditions**

Temperature:	26 °C
Relative Humidity:	57 %
ATM Pressure:	102.4 kPa

*The testing was performed by Black Ding on 2021-12-20.*

*EUT operation mode: Transmitting*

*EUT operation mode: Transmitting*

*Test Result: Compliance. Please refer to following table and plots*

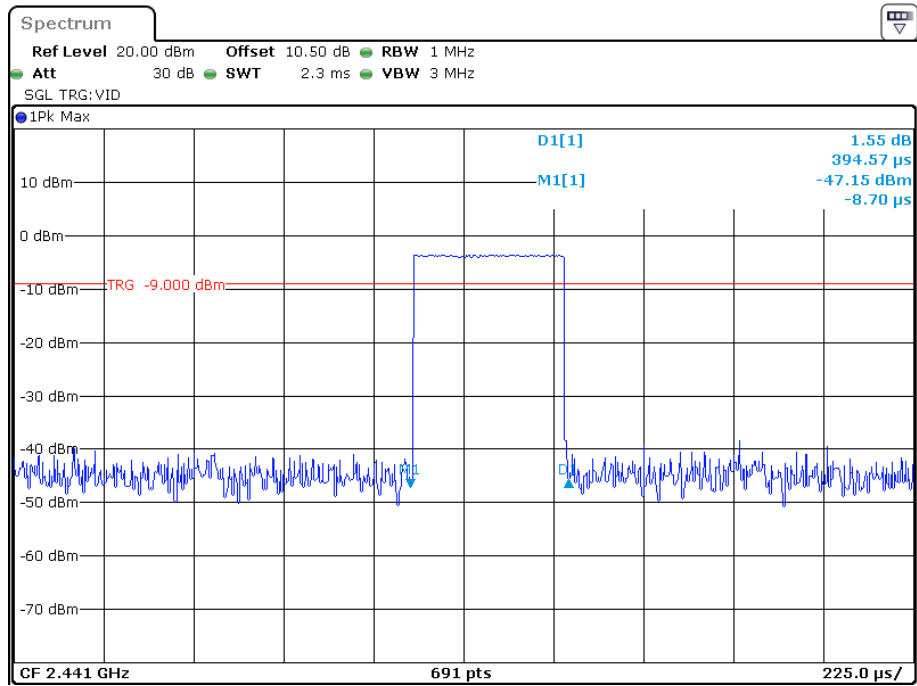
Test Mode	Channel	Pulse Time [ms]	Total Hops [Num]	Result[s]	Limit[s]	Verdict
DH1	Hop	0.39	320	0.125	$\leq 0.4$	PASS
DH3	Hop	1.64	170	0.279	$\leq 0.4$	PASS
DH5	Hop	2.91	130	0.378	$\leq 0.4$	PASS
2DH1	Hop	0.42	320	0.134	$\leq 0.4$	PASS
2DH3	Hop	1.66	170	0.282	$\leq 0.4$	PASS
2DH5	Hop	2.91	120	0.349	$\leq 0.4$	PASS
3DH1	Hop	0.40	320	0.128	$\leq 0.4$	PASS
3DH3	Hop	1.66	160	0.266	$\leq 0.4$	PASS
3DH5	Hop	2.92	130	0.380	$\leq 0.4$	PASS

Note 1: A period time= $0.4 \times 79 = 31.6$ (S), Result= Pulse Time \*Total hops

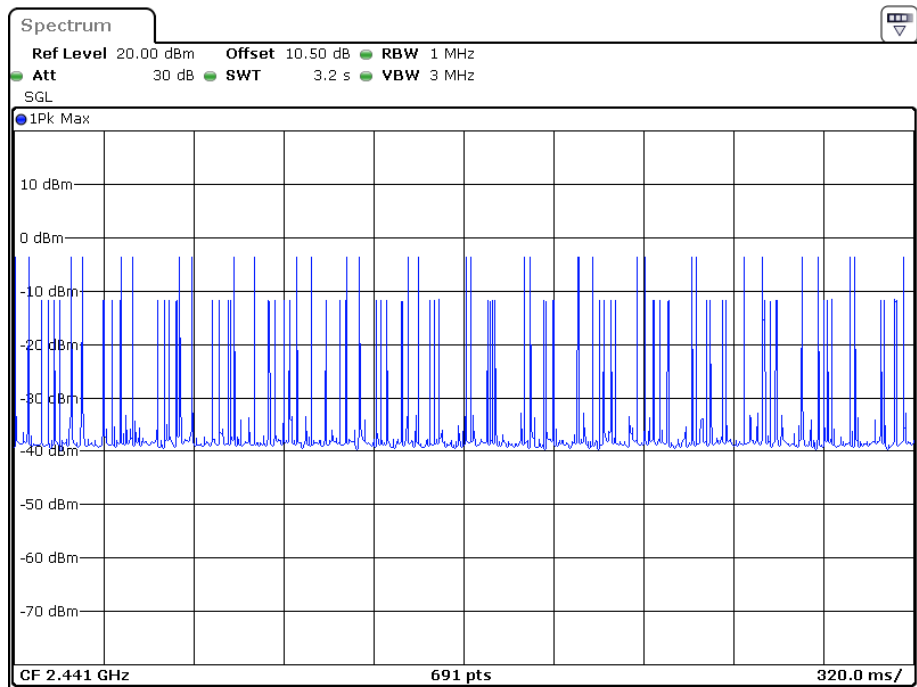
Note 2: Total hops=Hopping Number in  $3.16s \times 10$

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

**BDR (GFSK):**  
**Pulse time, DH1**



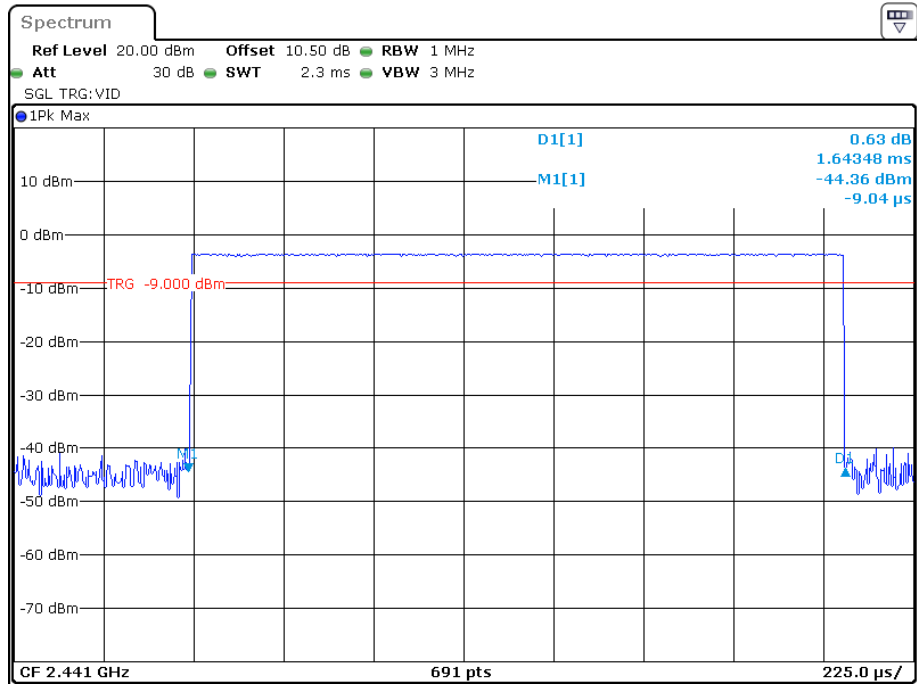
Date: 20.DEC.2021 13:43:15



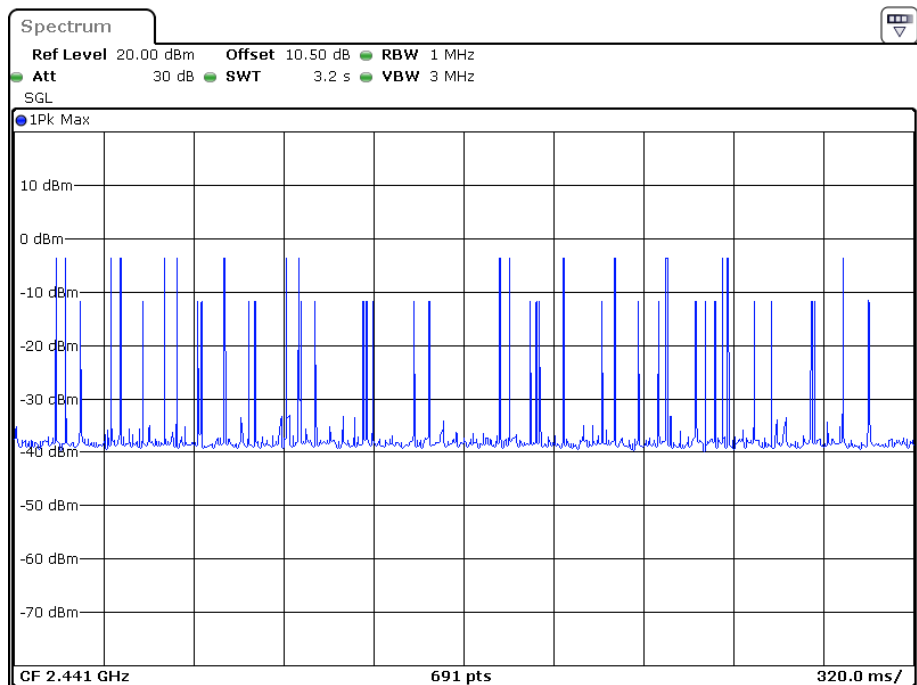
Date: 20.DEC.2021 14:02:36



## Pulse time, DH3

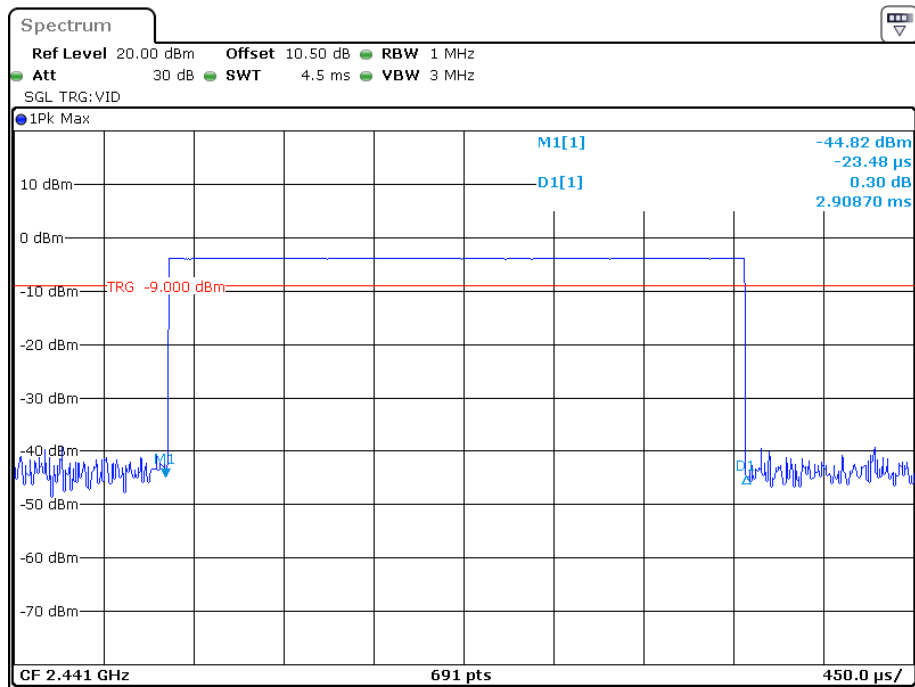


Date: 20.DEC.2021 13:45:05



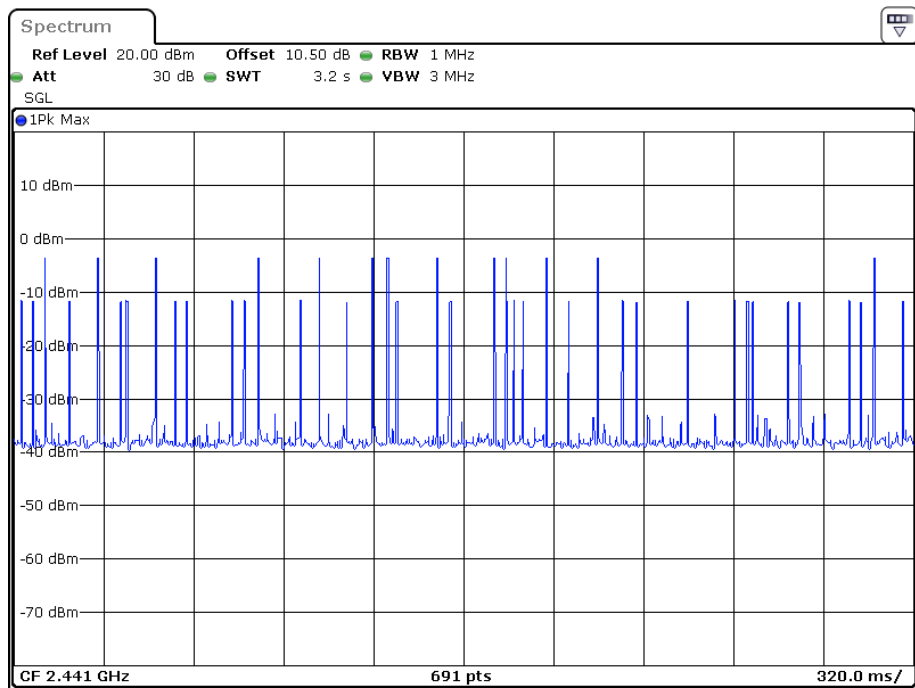
Date: 20.DEC.2021 14:03:28

## Pulse time, DH5



Date: 20.DEC.2021 14:01:18

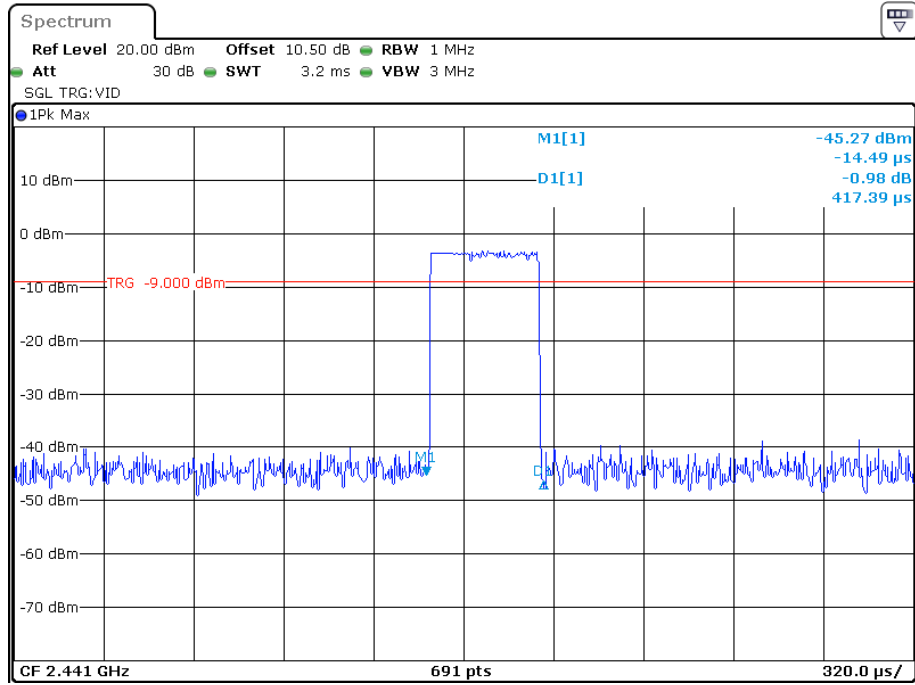
## Pulse time, High Channel, DH5



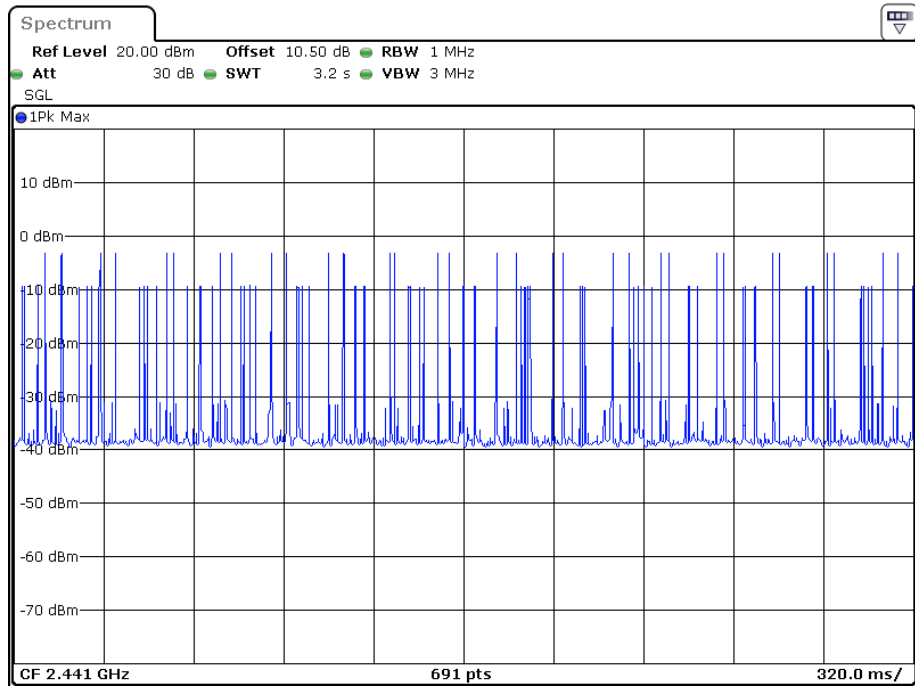
Date: 20.DEC.2021 14:04:04

EDR ( $\pi/4$ -DQPSK):

## Pulse time, 2DH1

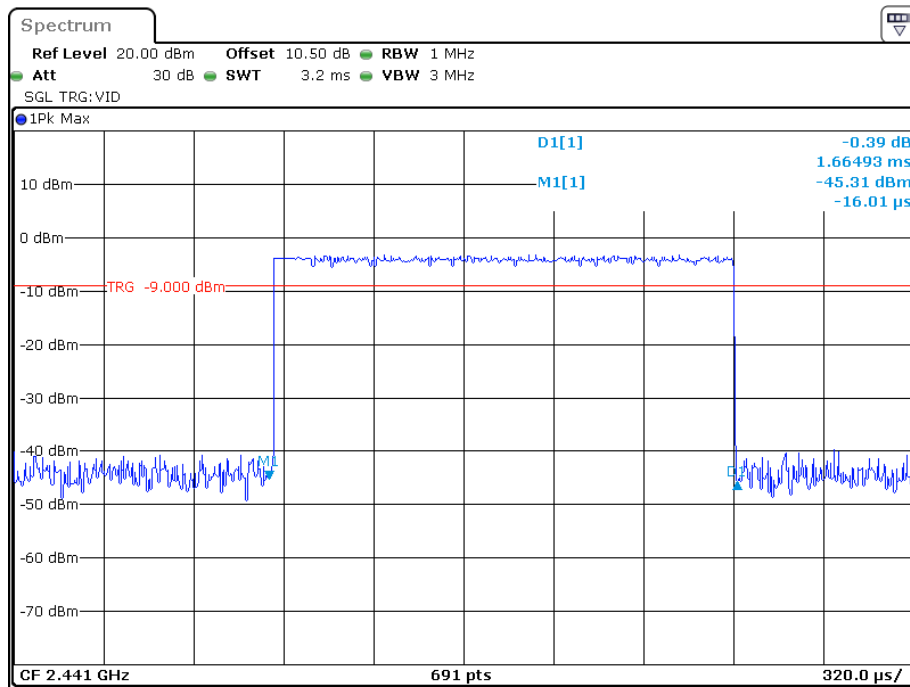


Date: 20.DEC.2021 13:47:39

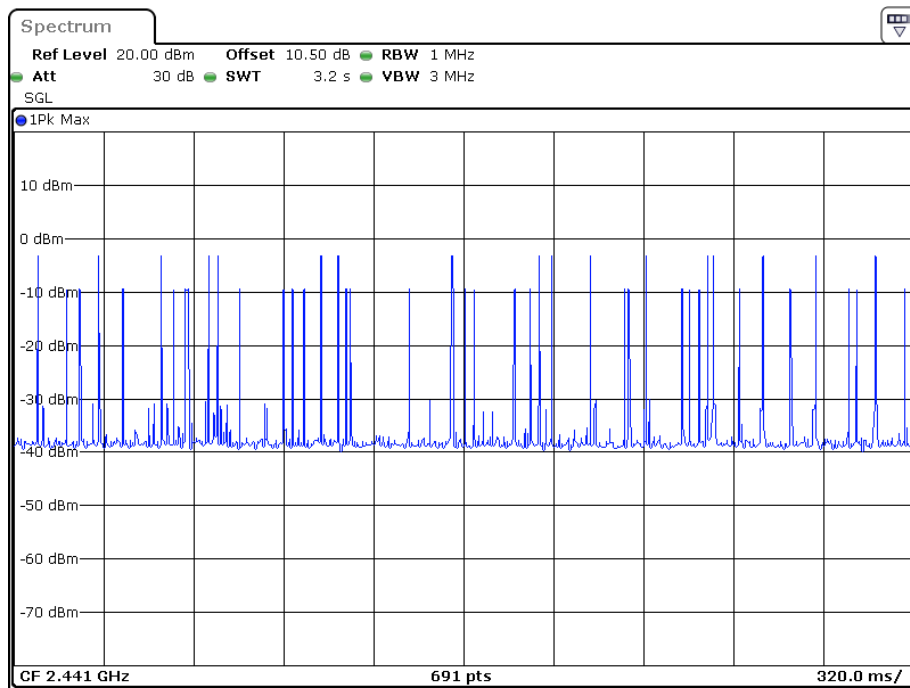


Date: 20.DEC.2021 14:04:36

## Pulse time, 2DH3

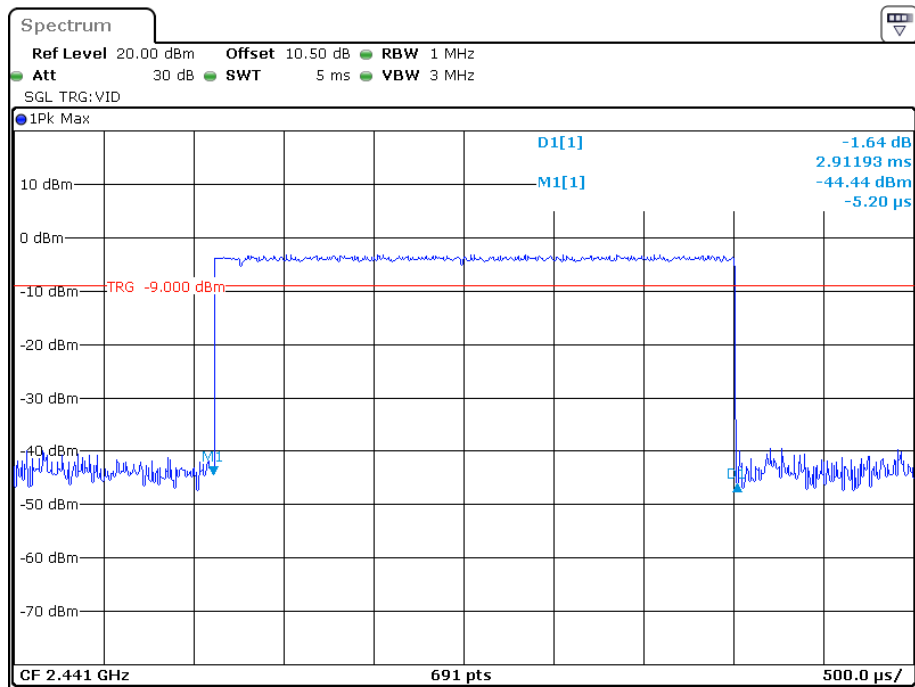


Date: 20.DEC.2021 13:49:12

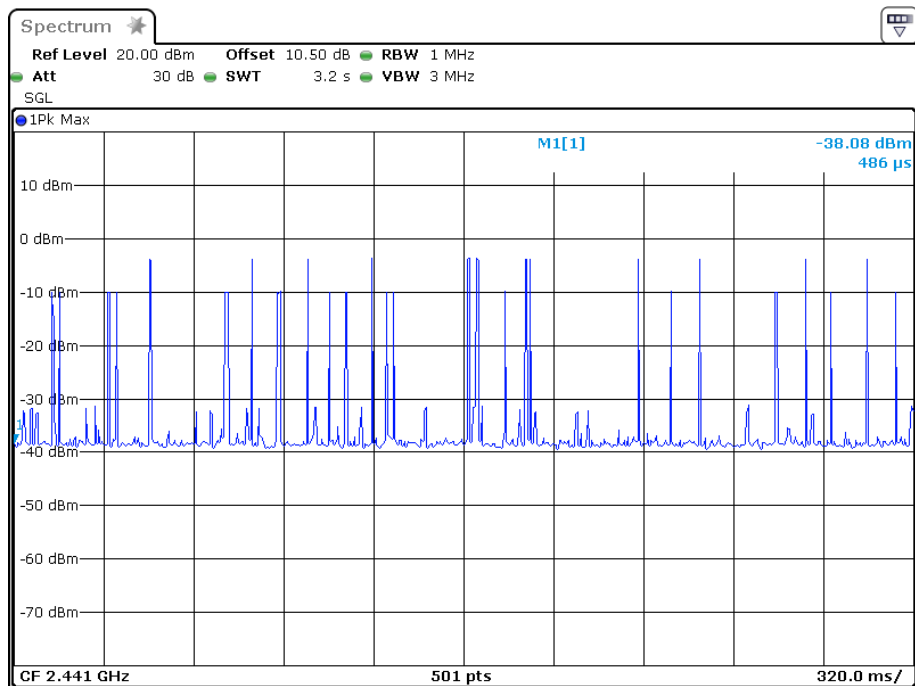


Date: 20.DEC.2021 14:05:14

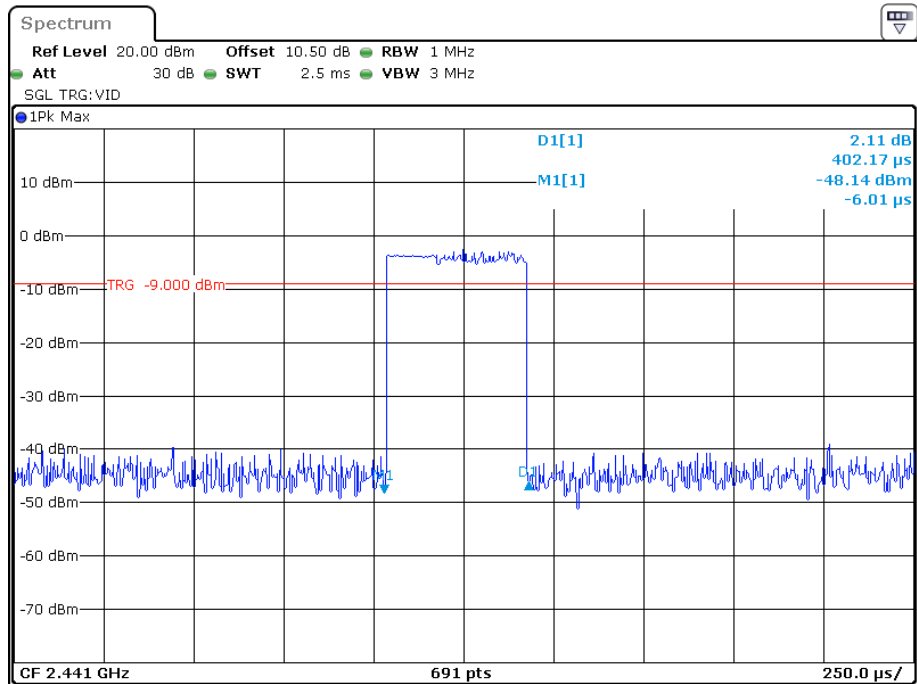
## Pulse time, 2DH5



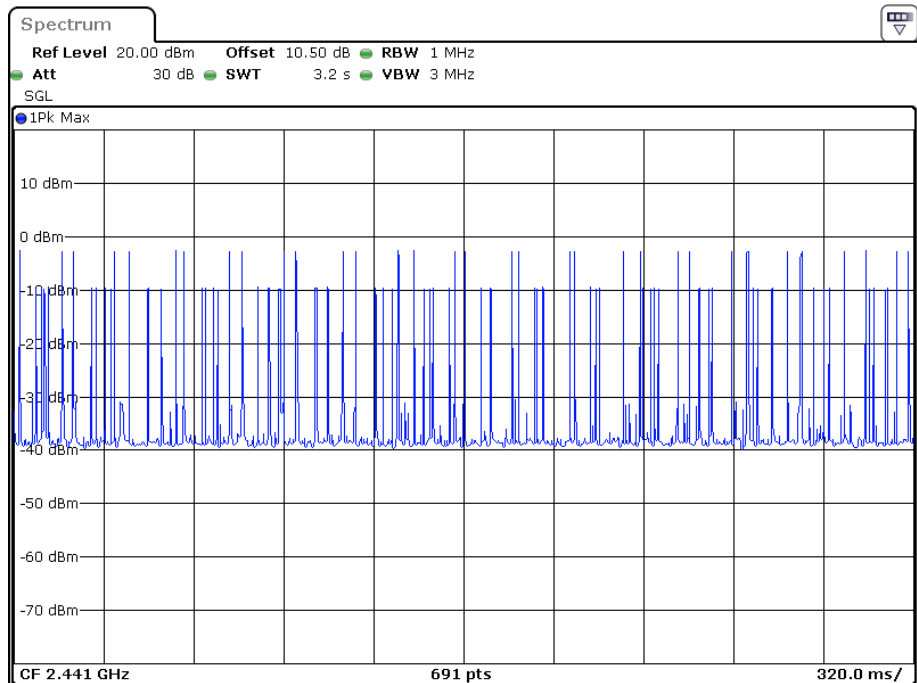
Date: 20.DEC.2021 13:56:50



Date: 20.DEC.2021 17:21:25

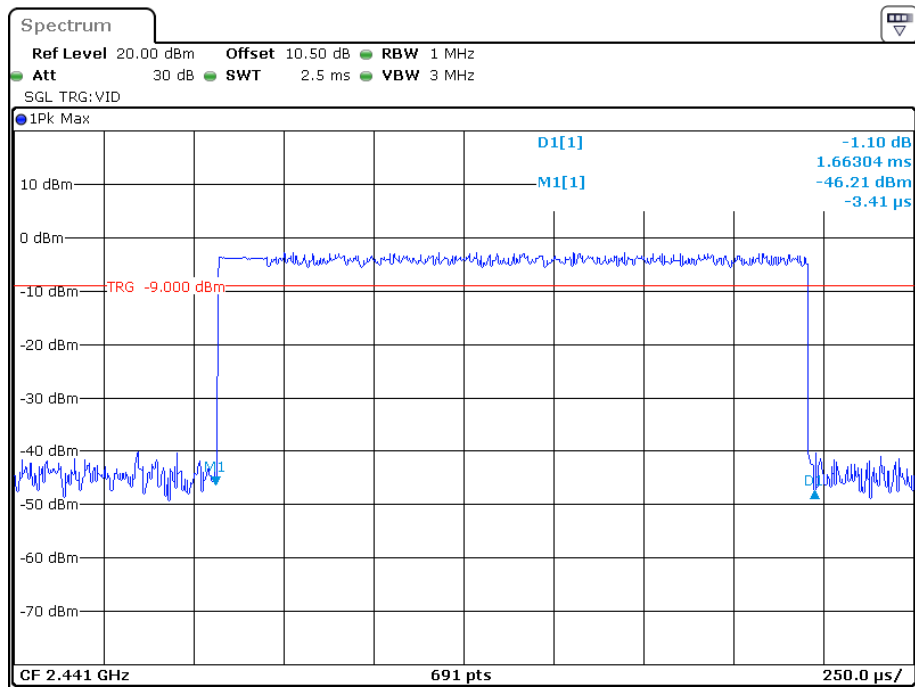
**EDR (8DPSK):  
Pulse time, 3DH1**

Date: 20.DEC.2021 13:52:00

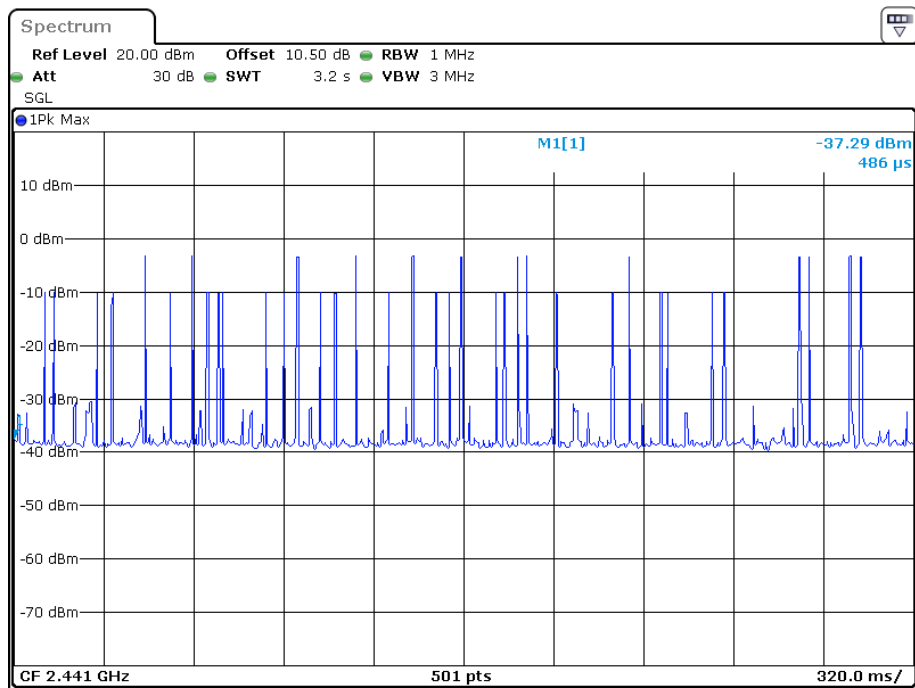


Date: 20.DEC.2021 14:07:32

## Pulse time, 3DH3

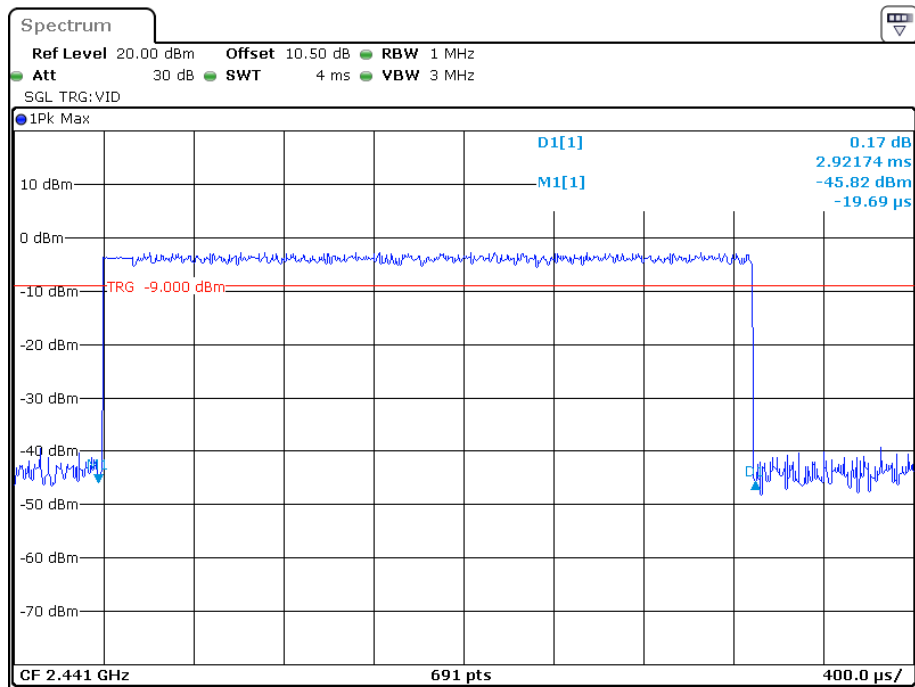


Date: 20.DEC.2021 13:52:50

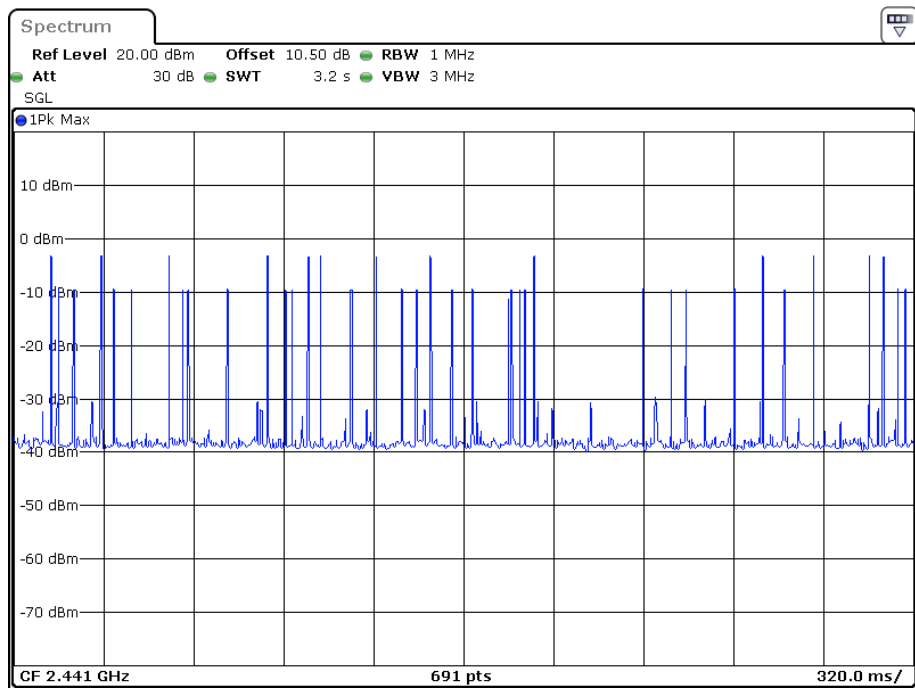


Date: 20.DEC.2021 17:23:19

## Pulse time, 3DH5



Date: 20.DEC.2021 13:55:51



Date: 20.DEC.2021 14:06:56



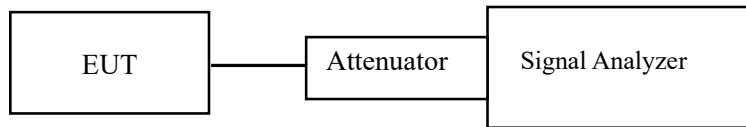
## FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT

### Applicable Standard

According to §15.247(b) (1), for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. And for all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

### Test Procedure

1. Place the EUT on a bench and set in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.



### Test Data

#### Environmental Conditions

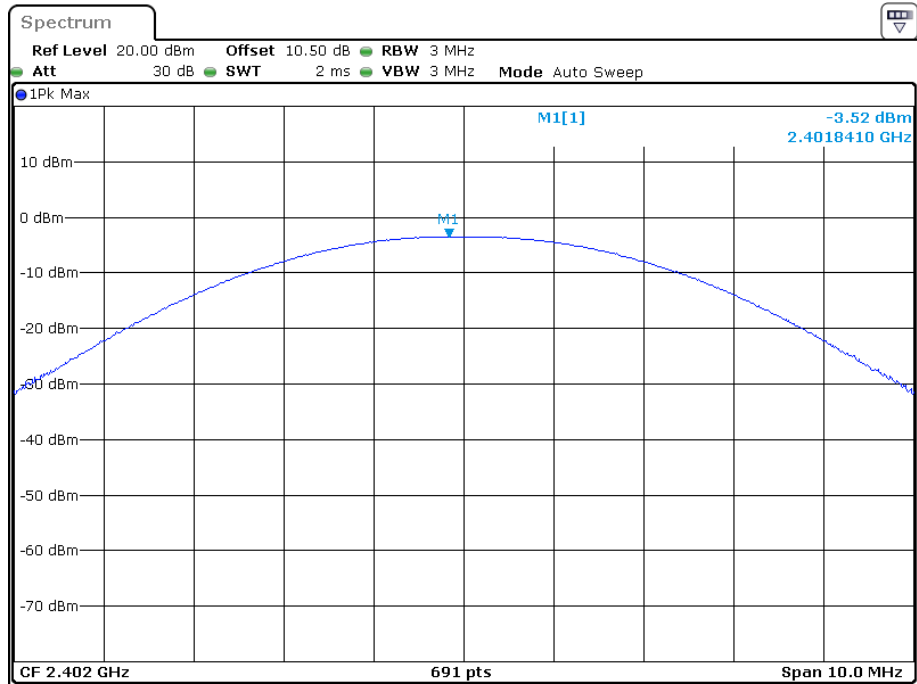
Temperature:	26 °C
Relative Humidity:	57 %
ATM Pressure:	102.4 kPa

The testing was performed by Black Ding on 2021-12-20.

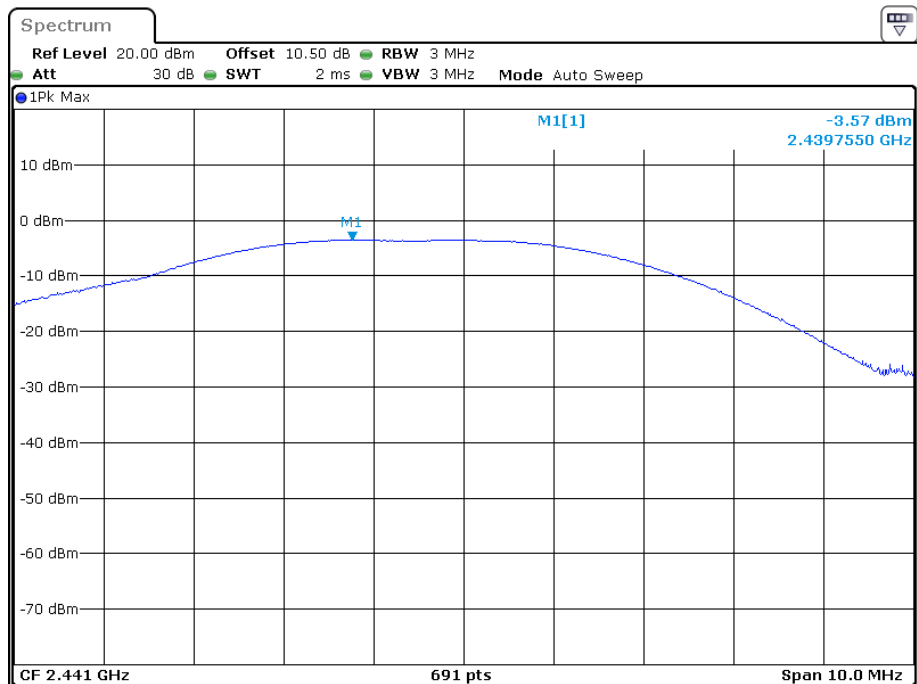
EUT operation mode: Transmitting

Test Result: Compliance. Please refer to following table.

Mode	Channel	Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)
<b>BDR (GFSK)</b>	Low	2402	-3.52	21
	Middle	2441	-3.57	21
	High	2480	-4.16	21
<b>EDR (<math>\pi/4</math>-DQPSK)</b>	Low	2402	-2.64	21
	Middle	2441	-3.05	21
	High	2480	-3.30	21
<b>EDR (8DPSK)</b>	Low	2402	-1.99	21
	Middle	2441	-2.65	21
	High	2480	-3.24	21

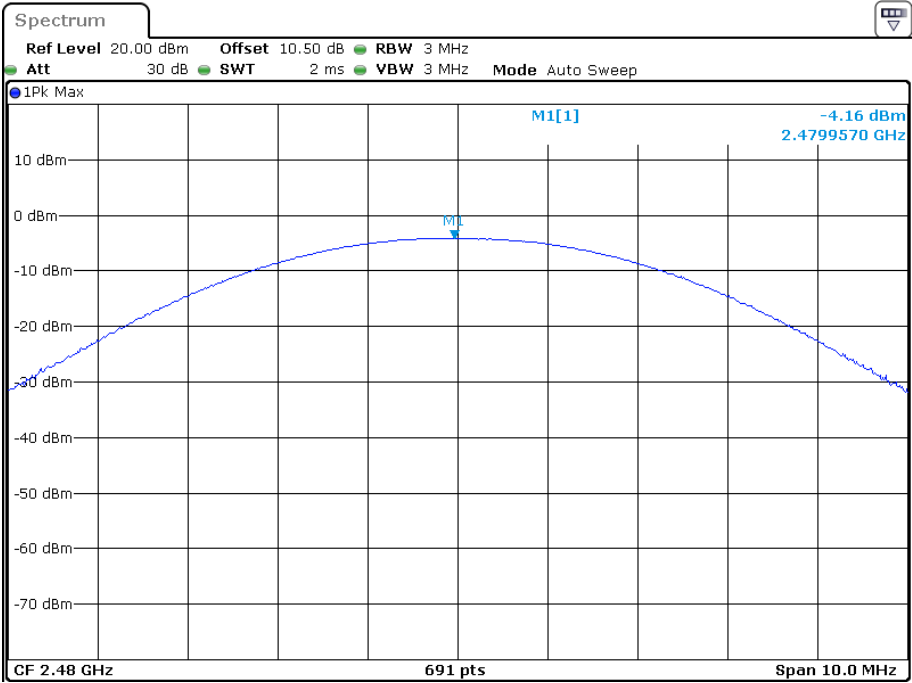
**BDR (GFSK): Low Channel**

Date: 20.DEC.2021 11:34:31

**BDR (GFSK): Middle Channel**

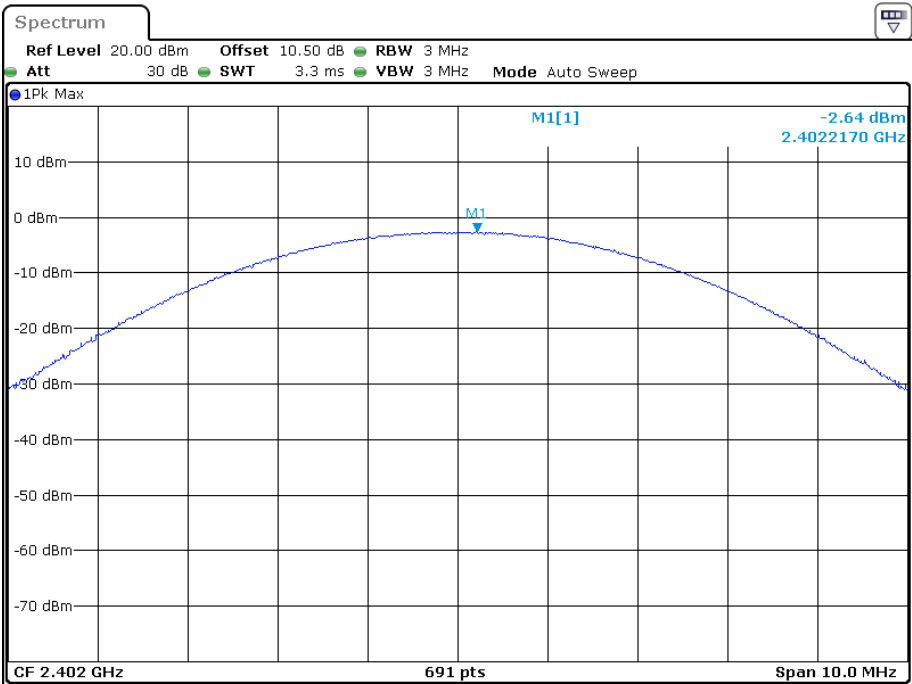
Date: 20.DEC.2021 11:35:46

BDR (GFSK): High Channel

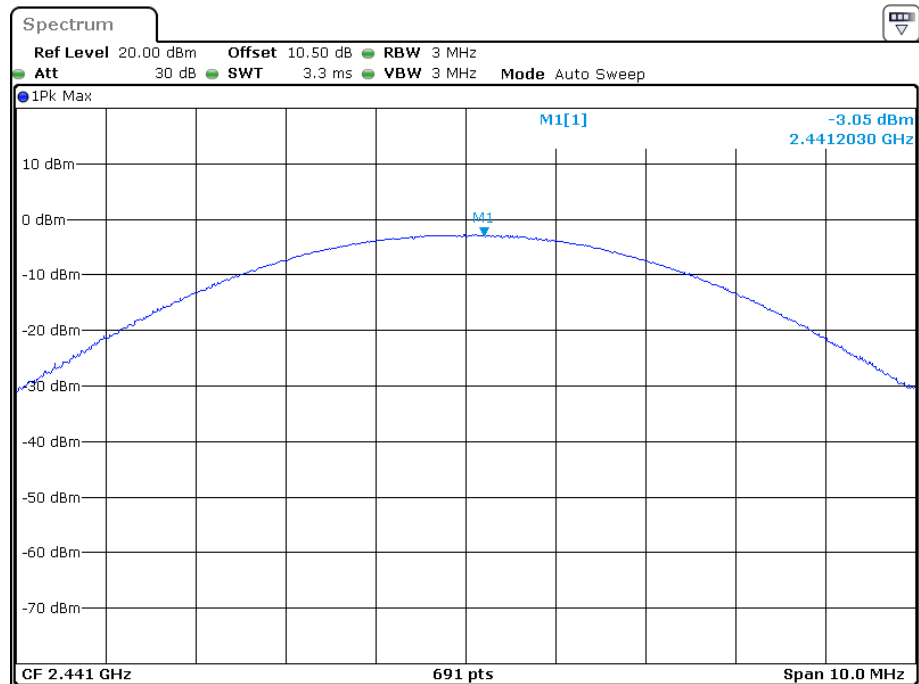


Date: 20.DEC.2021 11:36:20

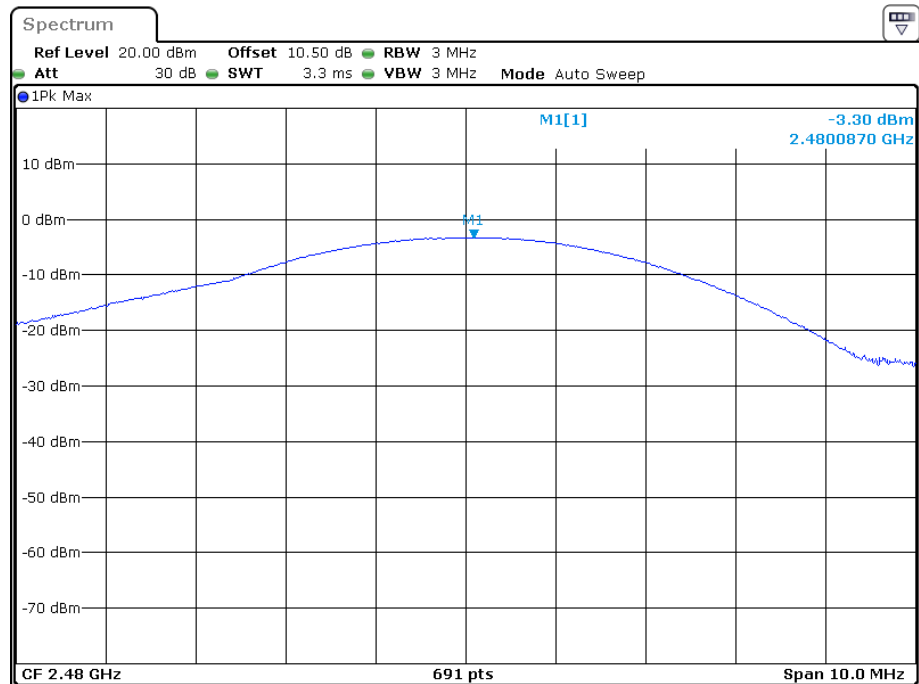
EDR ( $\pi/4$ -DQPSK): Low Channel



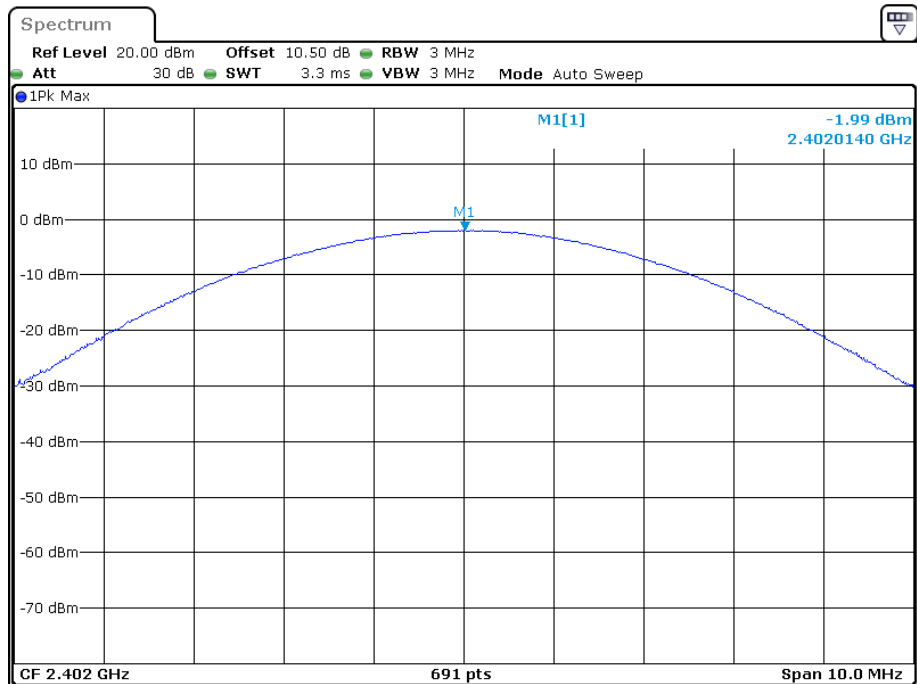
Date: 20.DEC.2021 11:44:15

EDR ( $\pi/4$ -DQPSK): Middle Channel

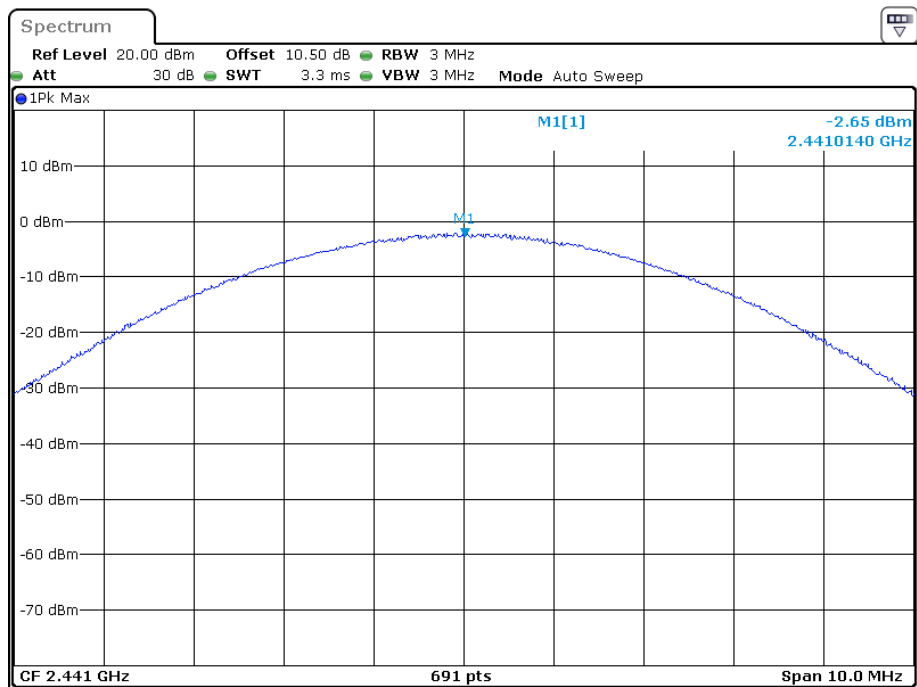
Date: 20.DEC.2021 11:44:55

EDR ( $\pi/4$ -DQPSK): High Channel

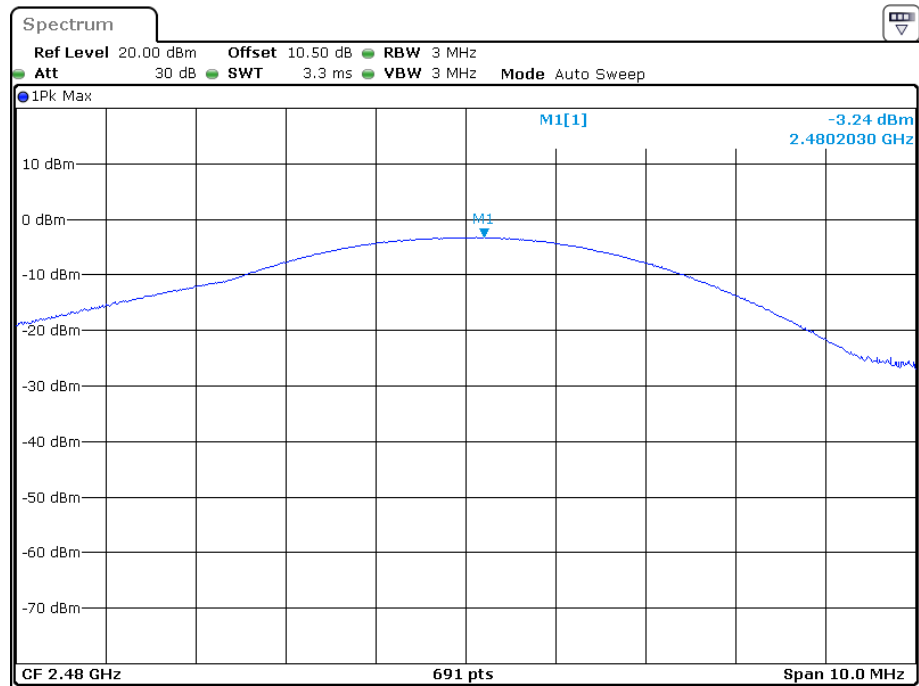
Date: 20.DEC.2021 11:45:36

**EDR (8DPSK): Low Channel**

Date: 20.DEC.2021 11:47:21

**EDR (8DPSK): Middle Channel**

Date: 20.DEC.2021 11:46:40

**EDR (8DPSK): High Channel**

Date: 20.DEC.2021 11:46:10

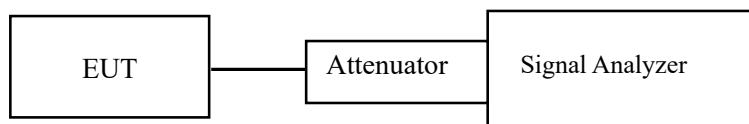
## FCC §15.247(d) - BAND EDGES TESTING

### Applicable Standard

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)).

### Test Procedure

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
- Set RBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
- Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
- Repeat above procedures until all measured frequencies were complete.



### Test Data

#### Environmental Conditions

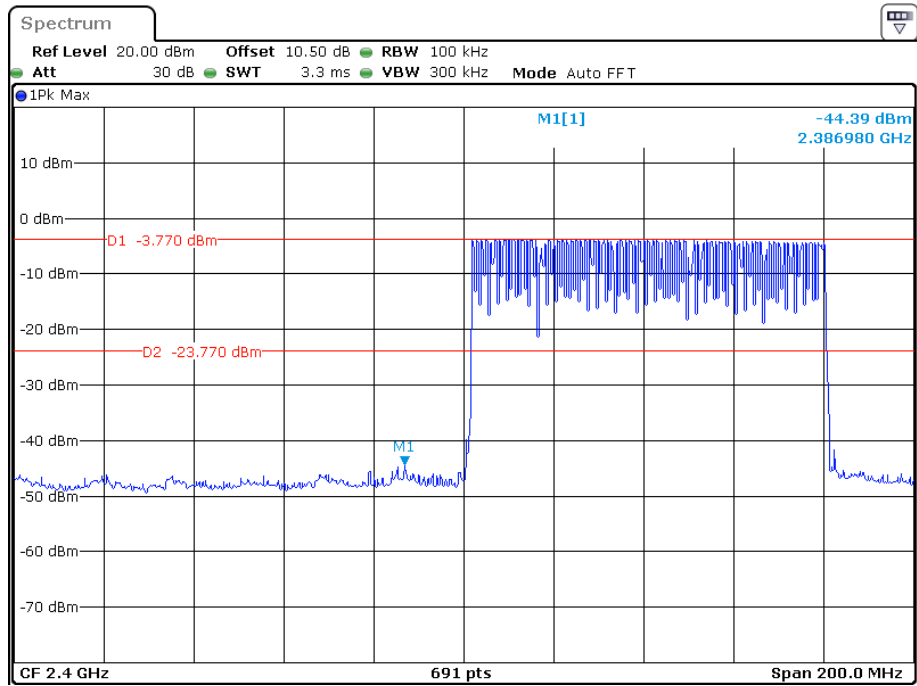
Temperature:	26 °C
Relative Humidity:	57 %
ATM Pressure:	102.4 kPa

The testing was performed by Black Ding on 2021-12-20.

EUT operation mode: Transmitting

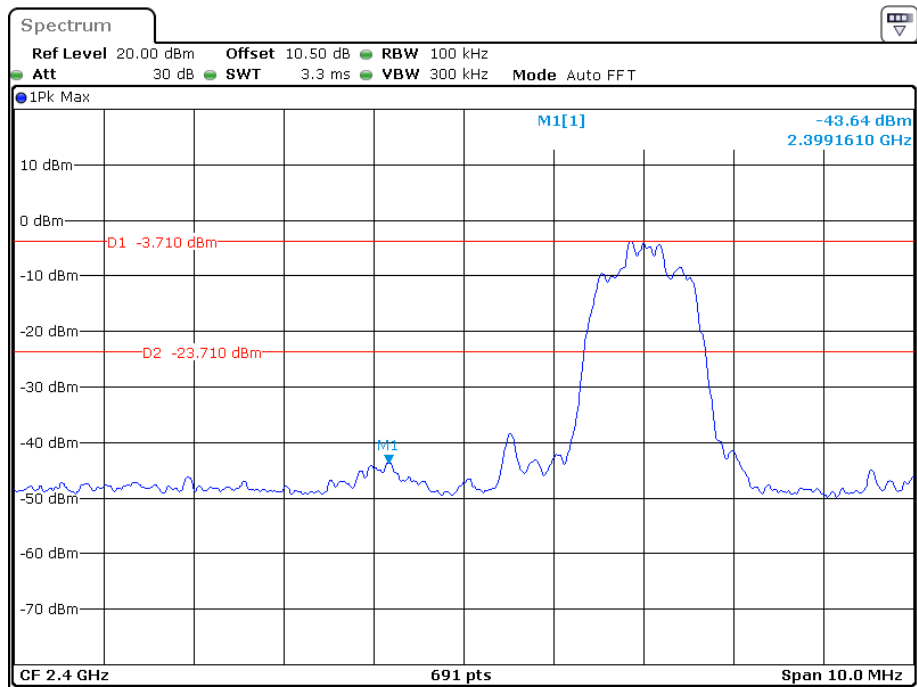
Test Result: Compliance. Please refer to following plots.

### BDR (GFSK): Band Edge-Left Side Hopping



Date: 20.DEC.2021 11:57:45

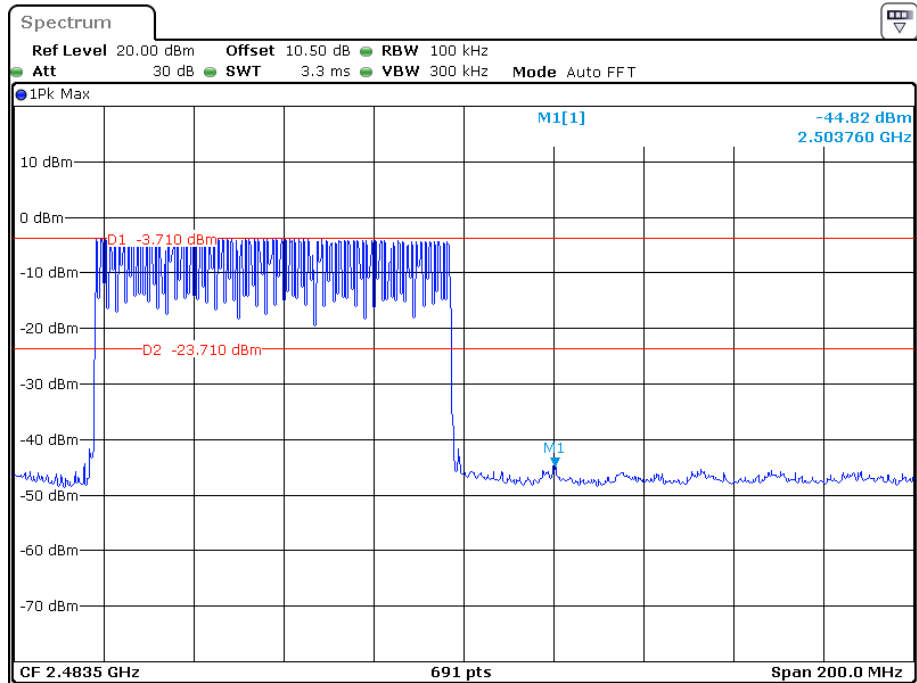
### Single



Date: 20.DEC.2021 11:48:42

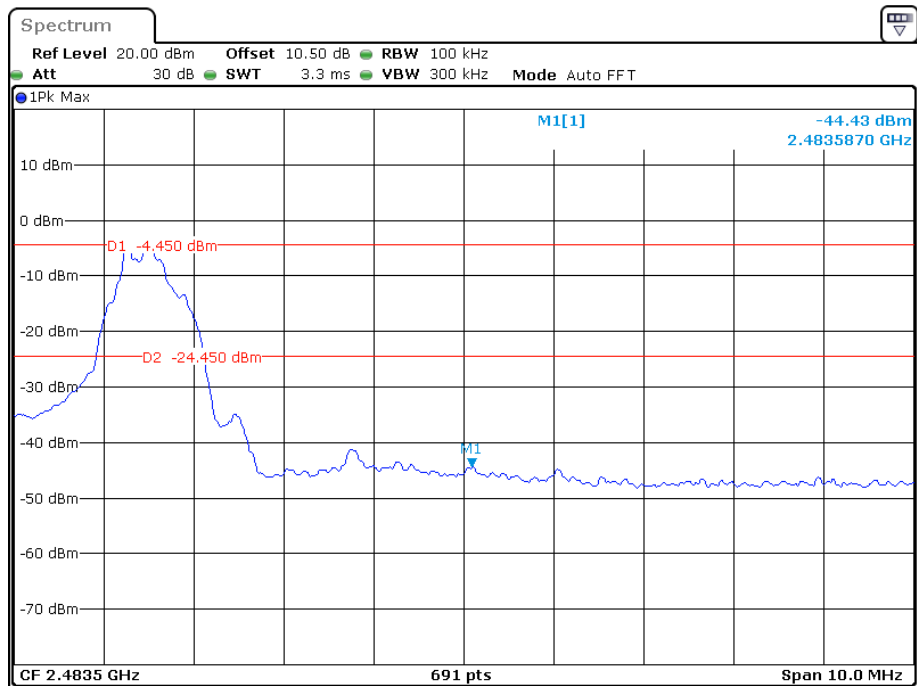


### BDR (GFSK): Band Edge-Right Side Hopping



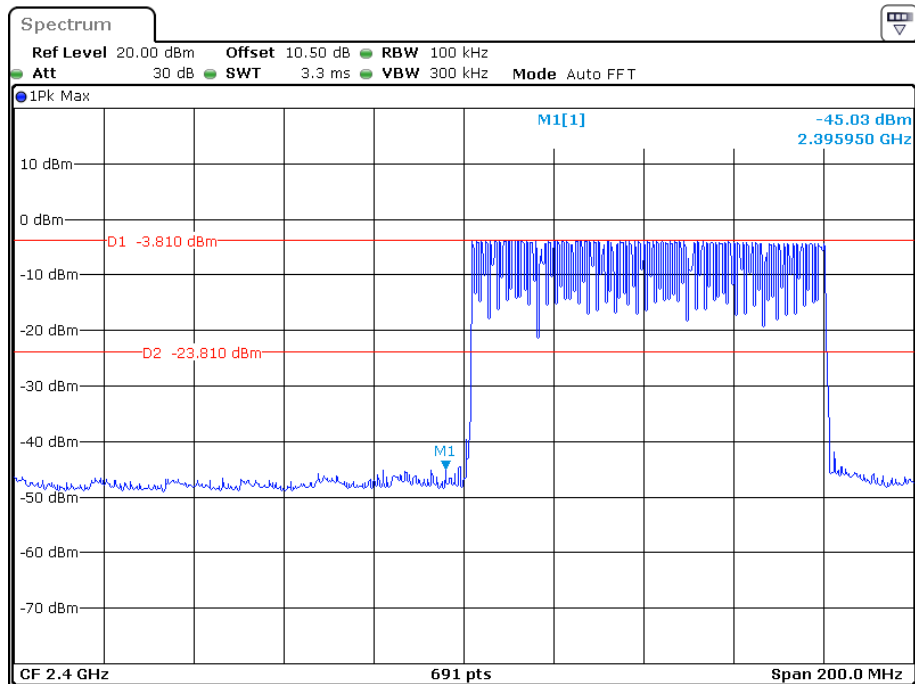
Date: 20.DEC.2021 11:58:40

### Single



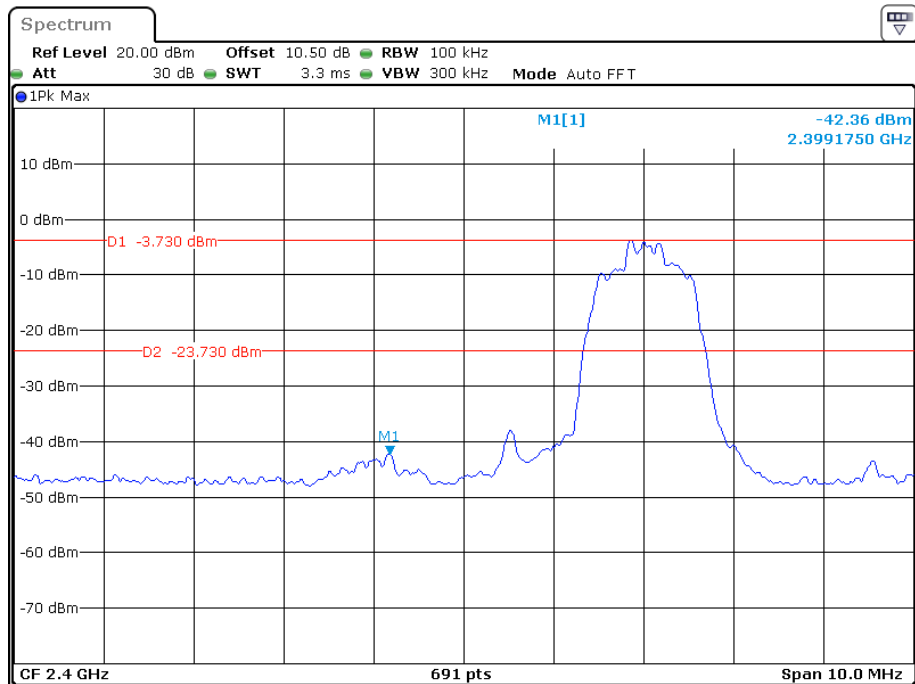
Date: 20.DEC.2021 11:50:04

### EDR ( $\pi/4$ -DQPSK): Band Edge-Left Side Hopping



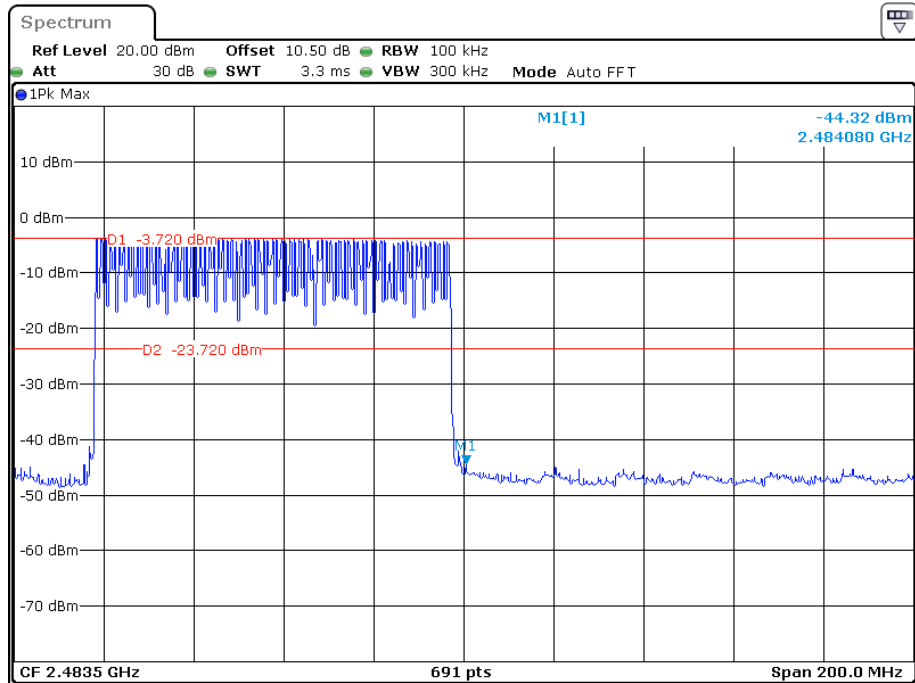
Date: 20.DEC.2021 12:00:16

### Single



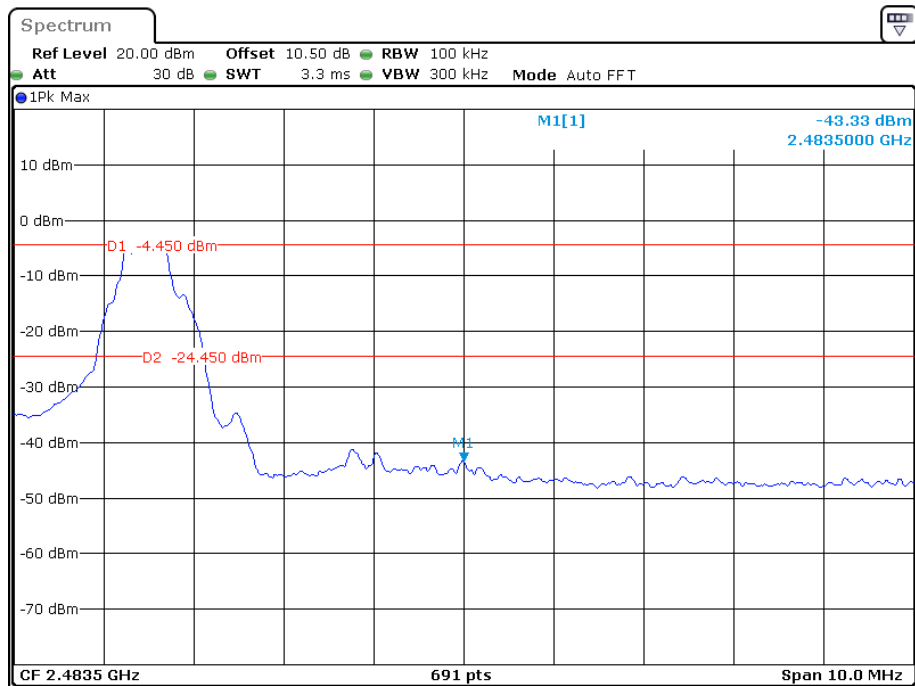
Date: 20.DEC.2021 11:52:06

### EDR ( $\pi/4$ -DQPSK): Band Edge-Right Side Hopping



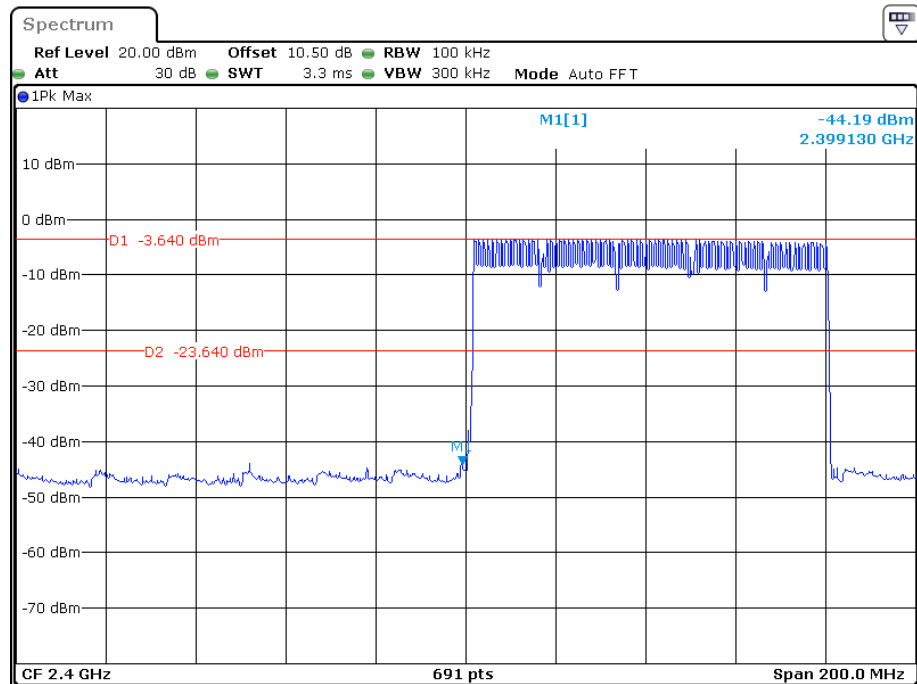
Date: 20.DEC.2021 11:59:24

### Single



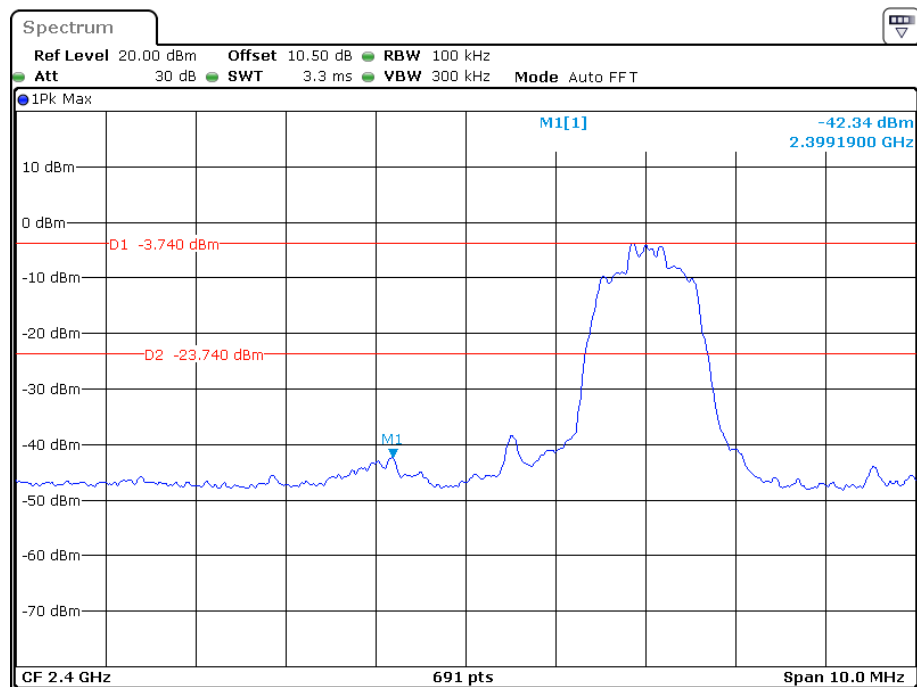
Date: 20.DEC.2021 11:50:42

### EDR (8DPSK): Band Edge-Left Side Hopping

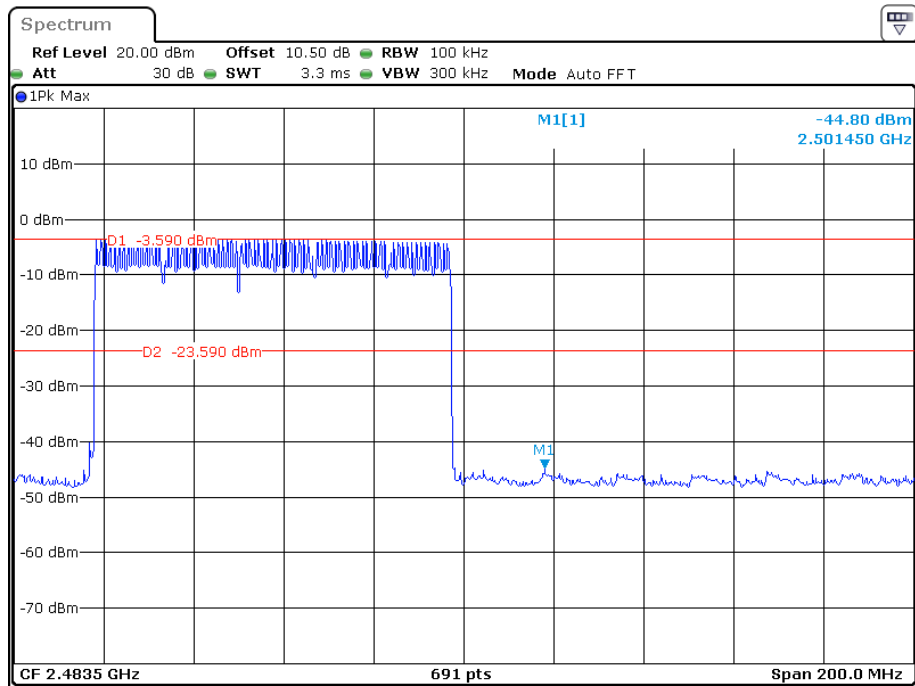


Date: 20.DEC.2021 13:14:56

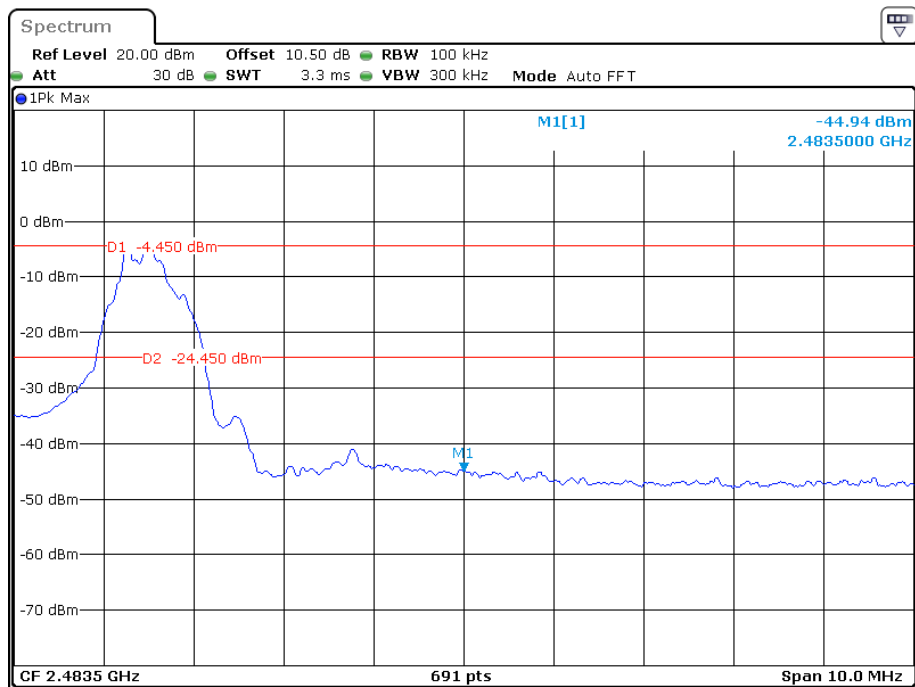
### Single



Date: 20.DEC.2021 11:52:50

**EDR (8DPSK): Band Edge-Right Side****Hopping**

Date: 20.DEC.2021 13:16:04

**Single**

Date: 20.DEC.2021 11:54:05

**\*\*\*\*\* END OF REPORT \*\*\*\*\***