



# FCC PART 15.247 TEST REPORT

For

## Zeeva International Limited

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Hong Kong

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<b>Report Type:</b> Original Report	<b>Product Type:</b> BT MINI CYLINDER SPKR
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## TABLE OF CONTENTS

<b>GENERAL INFORMATION.....</b>	<b>4</b>
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT).....	4
OBJECTIVE.....	4
RELATED SUBMITTAL(S)/GRANT(S).....	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) &amp; §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE).....</b>	<b>10</b>
APPLICABLE STANDARD.....	10
RESULT.....	10
<b>FCC §15.203 – ANTENNA REQUIREMENT.....</b>	<b>11</b>
APPLICABLE STANDARD.....	11
ANTENNA CONNECTOR CONSTRUCTION.....	11
<b>FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS.....</b>	<b>12</b>
APPLICABLE STANDARD.....	12
EUT SETUP.....	12
EMI TEST RECEIVER SETUP.....	12
TEST PROCEDURE.....	12
CORRECTED FACTOR & MARGIN CALCULATION.....	13
TEST DATA.....	13
<b>FCC §15.205, §15.209 &amp; §15.247(d) – RADIATED EMISSIONS.....</b>	<b>16</b>
APPLICABLE STANDARD.....	16
EUT SETUP.....	16
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP.....	17
TEST PROCEDURE.....	17
CORRECTED AMPLITUDE & MARGIN CALCULATION.....	17
TEST DATA.....	17
<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.....</b>	<b>27</b>
APPLICABLE STANDARD.....	27

TEST PROCEDURE .....27  
 TEST DATA .....27

**FCC §15.247(a) (1) (iii)-QUANTITY OF HOPPING CHANNEL TEST .....33**  
 APPLICABLE STANDARD .....33  
 TEST PROCEDURE .....33  
 TEST DATA .....33

**FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME).....36**  
 APPLICABLE STANDARD .....36  
 TEST PROCEDURE .....36  
 TEST DATA .....36

**FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT .....47**  
 APPLICABLE STANDARD .....47  
 TEST PROCEDURE .....47  
 TEST DATA .....47

**FCC §15.247(d) - BAND EDGES TESTING .....48**  
 APPLICABLE STANDARD .....48  
 TEST PROCEDURE .....48  
 TEST DATA .....48

## GENERAL INFORMATION

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

Product	BT MINI CYLINDER SPKR
Tested Model	SP-0902
UPC No.	192234062975
SKU No.	3358371
Frequency Range	Bluetooth: 2402~2480MHz
Peak Conducted Output Power	Bluetooth: 2.87dBm
Modulation Technique	Bluetooth: GFSK, $\pi/4$ -DQPSK, 8DPSK
Antenna Specification	1.2 dBi
Voltage Range	DC 3.7 V from battery
Date of Test	2020-07-21 to 2020-07-23
Sample serial number	RSZ200715831-S1(Assigned by BAACL, Shenzhen)
Received date	2020-07-15
Sample/EUT Status	Good condition

### Objective

This test report is prepared on behalf of Zeeva International Limited in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commissions 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.

### Related Submittal(s)/Grant(s)

No related submittal(s).

### 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.

For Radiated Emissions testing, please refer to DA 00-705 Released March 30, 2000, Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

## Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
RF Output Power with Power meter		±0.73dB
RF conducted test with spectrum		±1.6dB
AC Power Lines Conducted Emissions		±1.95dB
Emissions, Radiated	Below 1GHz	±4.75dB
	Above 1GHz	±4.88dB
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 Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, 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.: 342867, the FCC Designation No.: CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

## SYSTEM TEST CONFIGURATION

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### Description of Test Configuration

The system was configured for testing in an engineering mode.

### EUT Exercise Software

“BT\_Tool V1.1.0” exercise software was used and the power level is 7.

### Special Accessories

No special accessory.

### Equipment Modifications

No modification was made to the EUT tested.

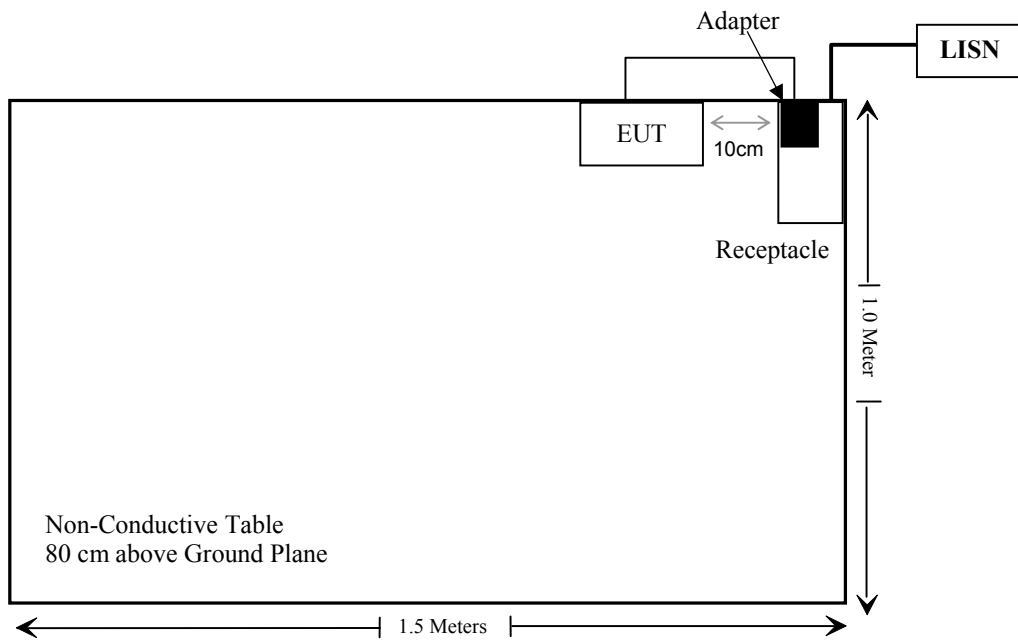
### Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Dongguan Aohai Power Technology Co.,Ltd.	Adapter	A8-501000	A1906034835

### External I/O Cable

Cable Description	Length (m)	From Port	To
Un-shielding Detachable USB Cable	0.3	EUT	Adapter

### Block Diagram of Test Setup



**SUMMARY OF TEST RESULTS**

<b>FCC Rules</b>	<b>Description of Test</b>	<b>Result</b>
§15.247 (i), §2.1091	Maximum Permissible Exposure(MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207(a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209 & §15.247(d)	Radiated Emissions	Compliance
§15.247(a)(1)	20 dB Emission Bandwidth	Compliance
§15.247(a)(1)	Channel Separation Test	Compliance
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliance
§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliance
§15.247(b)(1)	Peak Output Power Measurement	Compliance
§15.247(d)	Band edges	Compliance



**TEST EQUIPMENT LIST**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
<b>Conducted Emissions Test</b>					
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2020/7/9	2021/7/8
Rohde & Schwarz	LISN	ENV216	101613	2020/1/22	2021/1/21
Rohde & Schwarz	Transient Limiter	ESH3Z2	DE25985	2019/11/29	2020/11/28
Unknown	CE Cable	CE Cable	UF A210B-1-0720-504504	2019/11/29	2020/11/28
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
<b>Radiated Emission Test</b>					
R&S	EMI Test Receiver	ESR3	102455	2020/7/9	2021/7/8
Sonoma instrument	Pre-amplifier	310 N	186238	2020/4/20	2021/4/20
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017/12/22	2020/12/21
Unknown	Cable 2	RF Cable 2	F-03-EM197	2019/11/29	2020/11/28
Unknown	Cable	Chamber Cable 1	F-03-EM236	2019/11/29	2020/11/28
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2019/08/04	2020/08/03
COM-POWER	Pre-amplifier	PA-122	181919	2019/11/29	2020/11/28
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2019/11/29	2020/11/28
Sunol Sciences	Horn Antenna	DRH-118	A052604	2017/12/22	2020/12/21
Insulted Wire Inc.	RF Cable	SPS-2503-3150	02222010	2019/11/29	2020/11/28
Unknown	RF Cable	W1101-EQ1 OUT	F-19-EM005	2019/11/29	2020/11/28
SNSD	Band Reject filter	BSF2402-2480MN-0898-001	2.4G filter	2020/4/20	2021/4/20
Ducommun Technologies	Horn antenna	ARH-4223-02	1007726-021304	2017/12/6	2020/12/5
<b>RF Conducted Test</b>					
Agilent	USB Wideband Power Sensor	U2021XA	MY54250003	2020/7/10	2021/7/9
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200120	2020/3/2	2021/3/1
WEINSCHL	3dB Attenuator	Unknown	Unknown	2019/11/29	2020/11/28
Unknown	RF Cable	Unknown	2301 276	2019/11/29	2020/11/28

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) 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) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)**

**Applicable Standard**

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Averaging Time (Minutes)
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz

\* = Plane-wave equivalent power density

**Result**

**Calculated Formulary:**

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm<sup>2</sup>)

P = power input to the antenna (in appropriate units, e.g., mW).

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

Frequency (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )
	(dBi)	(numeric)	(dBm)	(mW)			
2402-2480	1.2	1.32	3.0	2.0	20	0.0005	1

Note: To maintain compliance with the FCC’s RF exposure guidelines, place the equipment at least 20cm from nearby persons.

**Result: Compliance**

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## **FCC §15.203 – ANTENNA REQUIREMENT**

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### **Applicable Standard**

According to FCC § 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 use of a standard antenna jack or electrical connector is prohibited.

### **Antenna Connector Construction**

The EUT has one internal PCB antenna arrangement, which was permanently attached and the antenna gain is 1.2dBi, fulfill the requirement of this section. Please refer to the EUT photos.

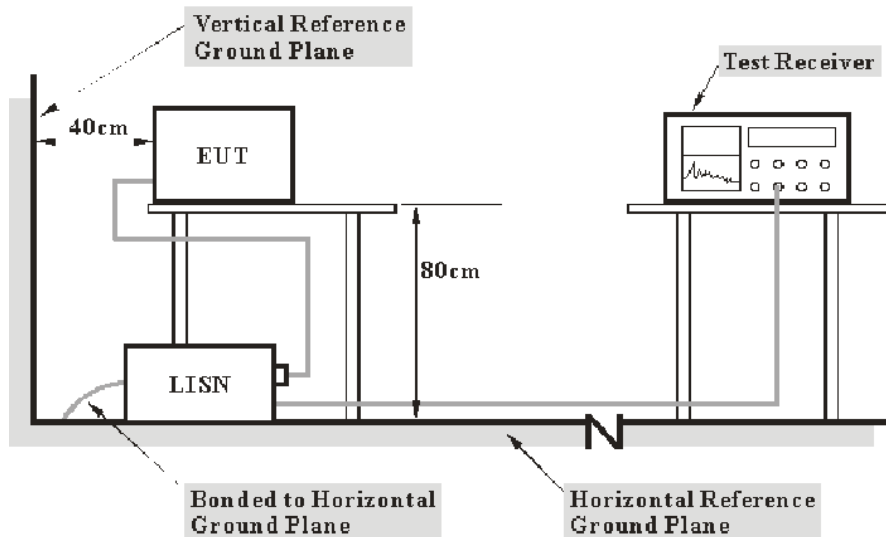
**Result: Pass**

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

**Applicable Standard**

FCC §15.207(a)

**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 measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

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**

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.

## Corrected Factor & Margin Calculation

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

$$\text{Correction Factor} = \text{LISN VDF} + \text{Cable Loss} + \text{Transient Limiter Attenuation}$$

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:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

## Test Data

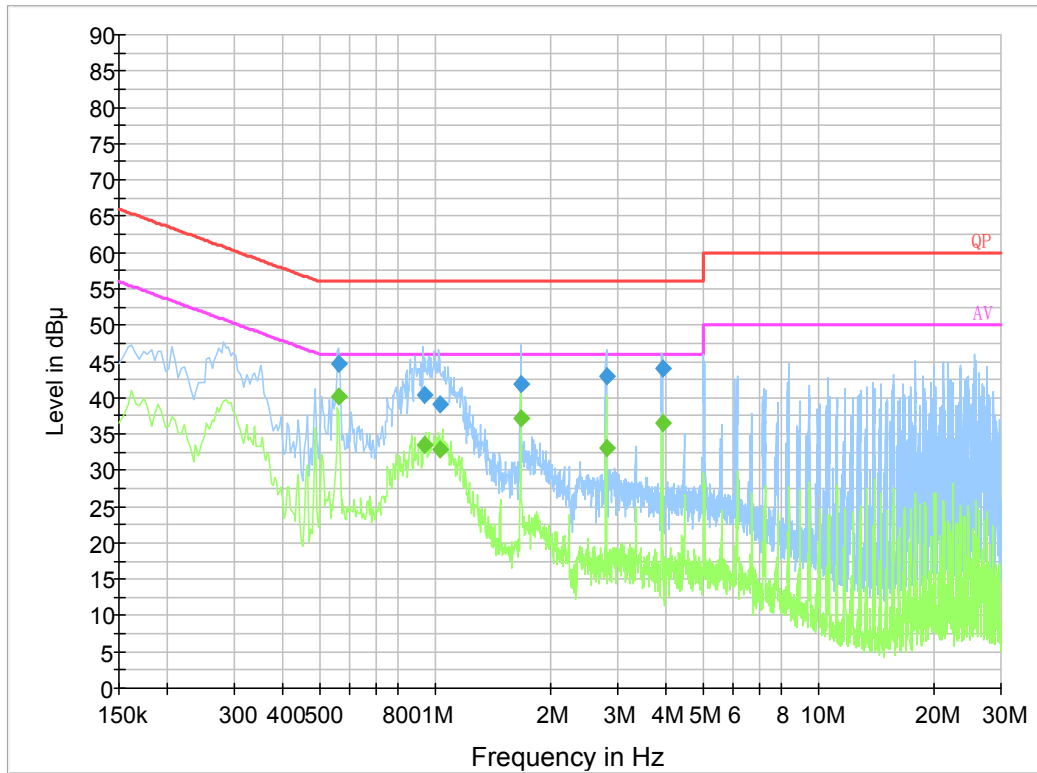
### Environmental Conditions

<b>Temperature:</b>	25 °C
<b>Relative Humidity:</b>	65 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Haiguo Li on 2020-07-22.*

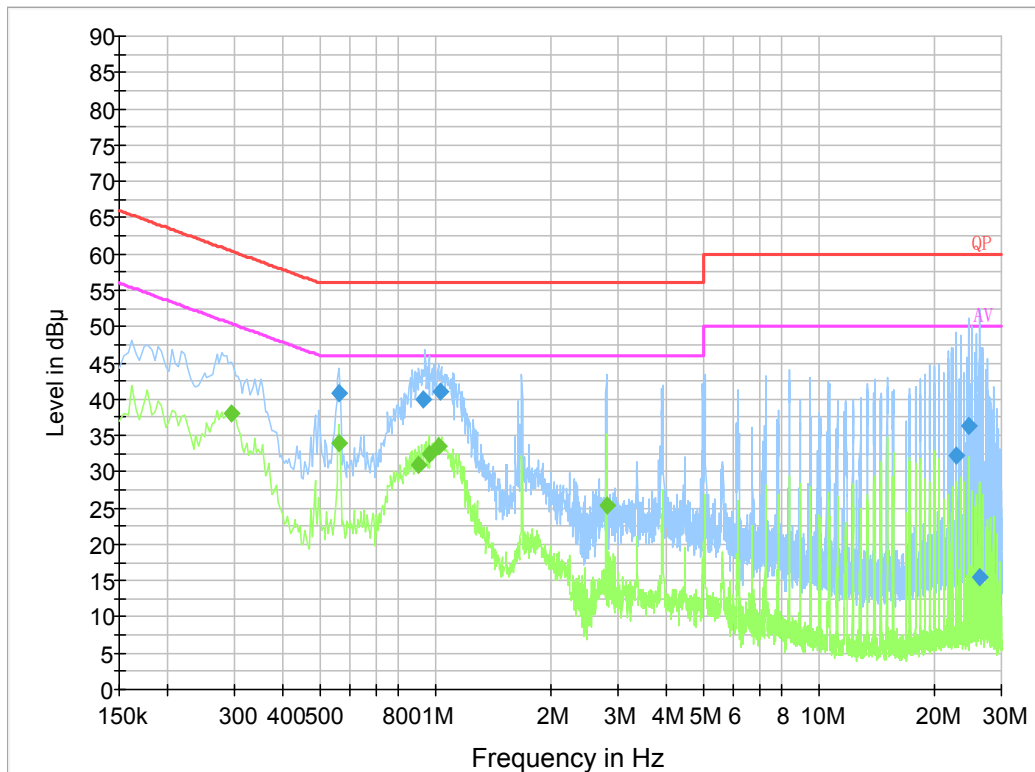
*EUT operation mode: Charging & Transmitting*

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



Frequency (MHz)	Corrected Amplitude (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Detector (PK/Ave./QP)
0.561570	44.8	19.8	56.0	11.2	QP
0.935990	40.3	19.8	56.0	15.7	QP
1.030610	39.0	19.9	56.0	17.0	QP
1.676830	41.8	19.9	56.0	14.2	QP
2.812030	43.1	19.9	56.0	12.9	QP
3.923290	44.0	19.9	56.0	12.0	QP
0.561570	40.1	19.8	46.0	5.9	Ave.
0.935990	33.5	19.8	46.0	12.5	Ave.
1.030610	32.8	19.9	46.0	13.2	Ave.
1.676830	37.1	19.9	46.0	8.9	Ave.
2.812030	33.1	19.9	46.0	12.9	Ave.
3.923290	36.6	19.9	46.0	9.4	Ave.

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



Frequency (MHz)	Corrected Amplitude (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Detector (PK/Ave./QP)
0.561570	40.7	19.8	56.0	15.3	QP
0.931870	39.9	19.8	56.0	16.1	QP
1.034670	40.9	19.8	56.0	15.1	QP
22.918110	32.2	20.3	60.0	27.8	QP
24.617450	36.3	20.3	60.0	23.7	QP
26.371710	15.5	20.2	60.0	44.5	QP
0.294000	38.0	19.7	50.4	12.4	Ave.
0.562000	34.0	19.8	46.0	12.0	Ave.
0.906000	30.9	19.7	46.0	15.1	Ave.
0.962000	32.5	19.8	46.0	13.5	Ave.
1.018000	33.4	19.8	46.0	12.6	Ave.
2.798000	25.4	19.9	46.0	20.6	Ave.

**Note:**

- 1) Correction Factor = LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
- 2) Corrected Amplitude = Reading + Correction Factor
- 3) Margin = Limit - Corrected Amplitude

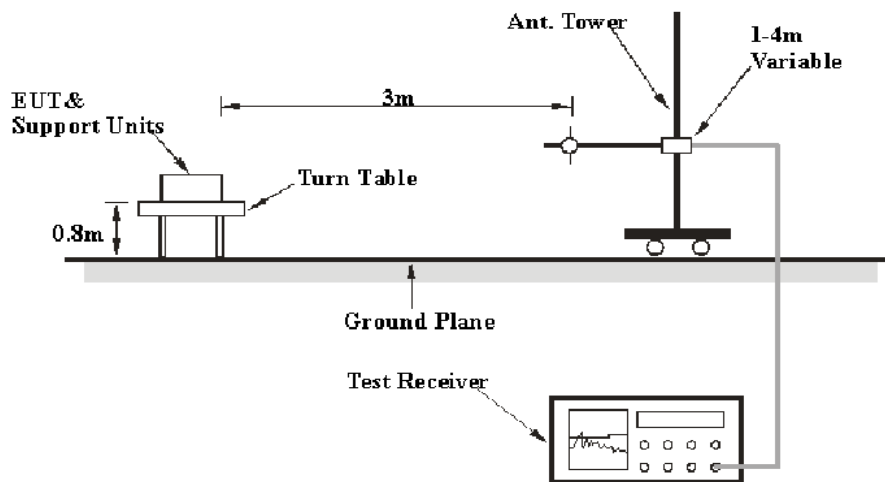
## FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS

### Applicable Standard

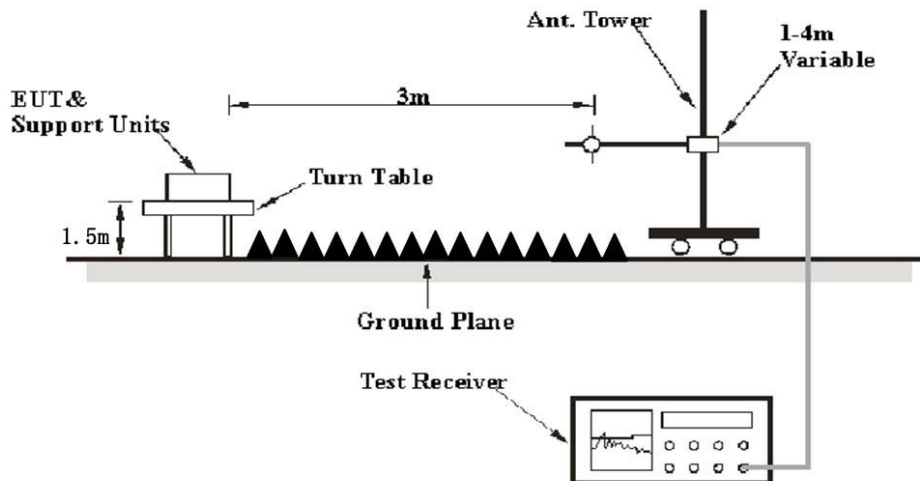
FCC §15.205; §15.209; §15.247(d)

### 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 system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, according to the DA 00-705 Released March 30, 2000, 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.

## Corrected Amplitude & Margin Calculation

The Corrected Amplitude 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:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

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

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

## Test Data

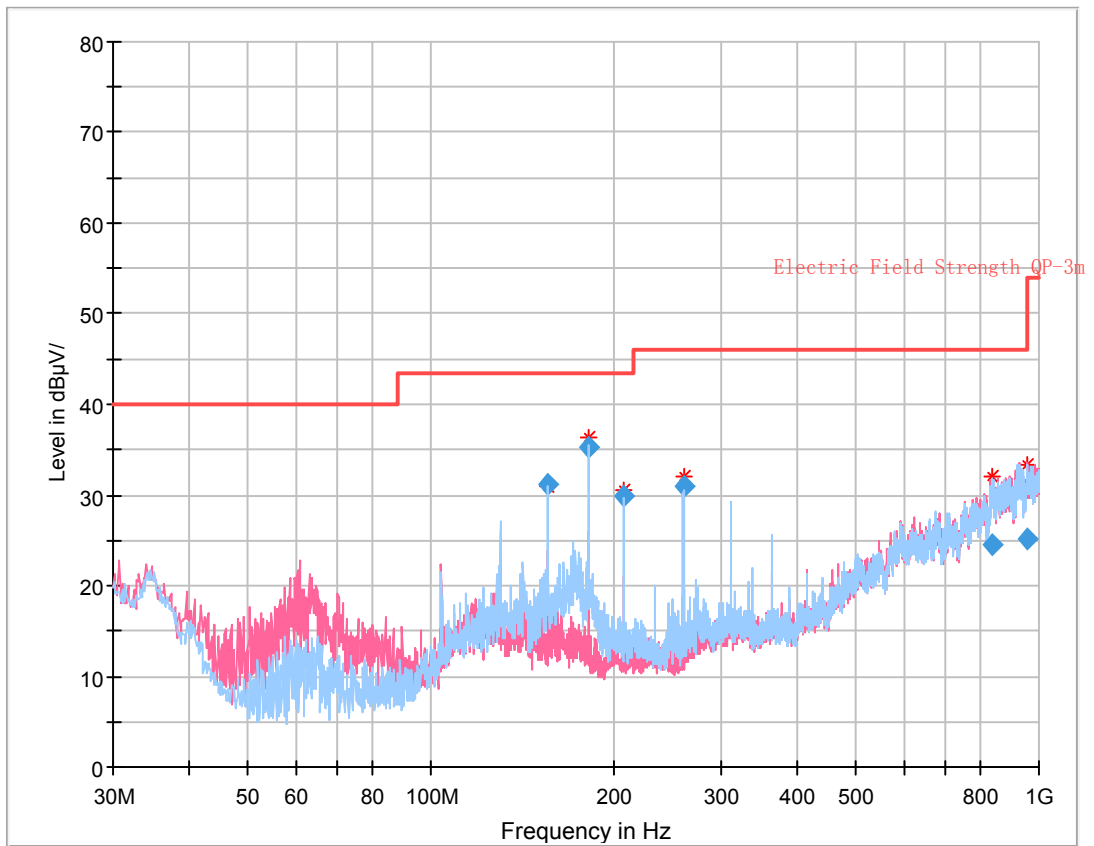
### Environmental Conditions

<b>Temperature:</b>	23~25 °C
<b>Relative Humidity:</b>	55~60 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Holland Yang on 2020-07-21 for below 1GHz and by Charlie Cha on 2020-07-23 for above 1GHz.*

*EUT operation mode: Transmitting*

**30 MHz~1 GHz:** (the worst case is 8DPSK mode, Low channel)



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
155.997750	31.15	223.0	H	29.0	-14.3	43.50	11.35
182.006375	35.31	184.0	H	13.0	-15.2	43.50	8.19
207.994125	29.84	149.0	H	208.0	-13.9	43.50	13.66
260.004750	30.89	103.0	H	246.0	-13.4	46.00	15.11
838.106000	24.49	372.0	H	289.0	2.8	46.00	21.51
956.255375	25.10	126.0	V	324.0	5.2	46.00	20.90

**1 GHz - 25 GHz:** (Scan with GFSK,  $\pi/4$ -DQPSK, 8DPSK mode, the worst case is in 8DPSK Mode)

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)
	Reading (dB $\mu$ V)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2402 MHz)									
2389.12	28.87	PK	97	1.8	H	31.87	60.74	74	13.26
2389.12	13.73	Ave.	97	1.8	H	31.87	45.60	54	8.40
2484.65	28.65	PK	15	2.0	H	32.13	60.78	74	13.22
2484.65	13.62	Ave.	15	2.0	H	32.13	45.75	54	8.25
4804.00	45.98	PK	336	2.3	H	6.28	52.26	74	21.74
4804.00	31.21	Ave.	336	2.3	H	6.28	37.49	54	16.51
7206.00	50.49	PK	215	1.8	H	11.93	62.42	74	11.58
7206.00	41.23	Ave.	215	1.8	H	11.93	53.16	54	0.84
Middle Channel (2441 MHz)									
4882.00	45.12	PK	20	1.7	H	6.76	51.88	74	22.12
4882.00	30.59	Ave.	20	1.7	H	6.76	37.35	54	16.65
7323.00	47.21	PK	266	1.9	H	11.66	58.87	74	15.13
7323.00	35.89	Ave.	266	1.9	H	11.66	47.55	54	6.45
High Channel (2480 MHz)									
2382.22	28.82	PK	155	1.9	H	31.87	60.69	74	13.31
2382.22	13.74	Ave.	155	1.9	H	31.87	45.61	54	8.39
2488.49	28.91	PK	24	2.5	H	32.13	61.04	74	12.96
2488.49	13.82	Ave.	24	2.5	H	32.13	45.95	54	8.05
4960.00	44.89	PK	220	1.7	H	6.80	51.69	74	22.31
4960.00	30.21	Ave.	220	1.7	H	6.80	37.01	54	16.99
7440.00	44.69	PK	203	2.2	H	12.39	57.08	74	16.92
7440.00	33.21	Ave.	203	2.2	H	12.39	45.60	54	8.40

**Note:**

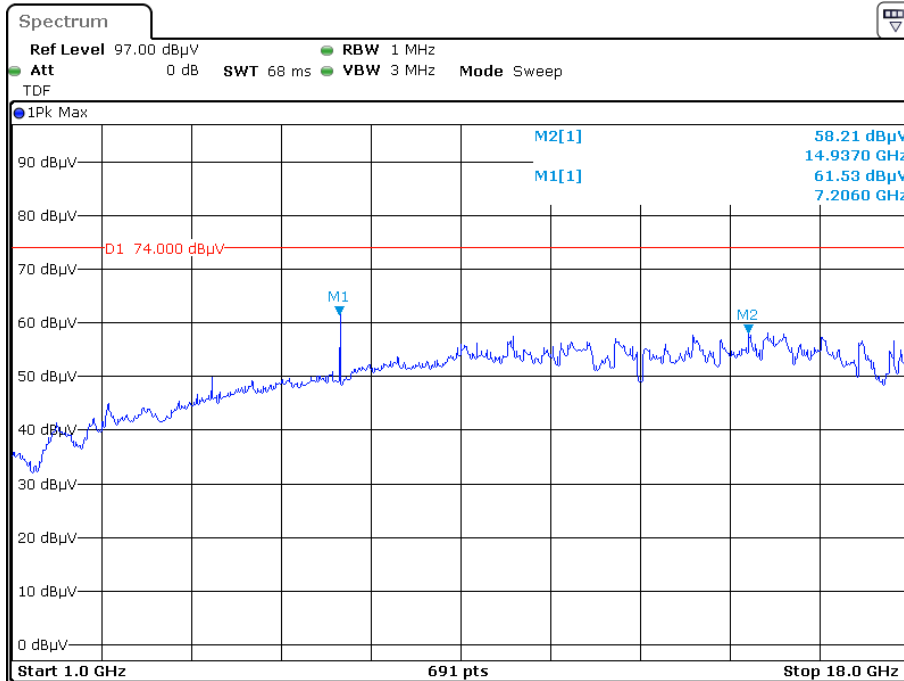
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

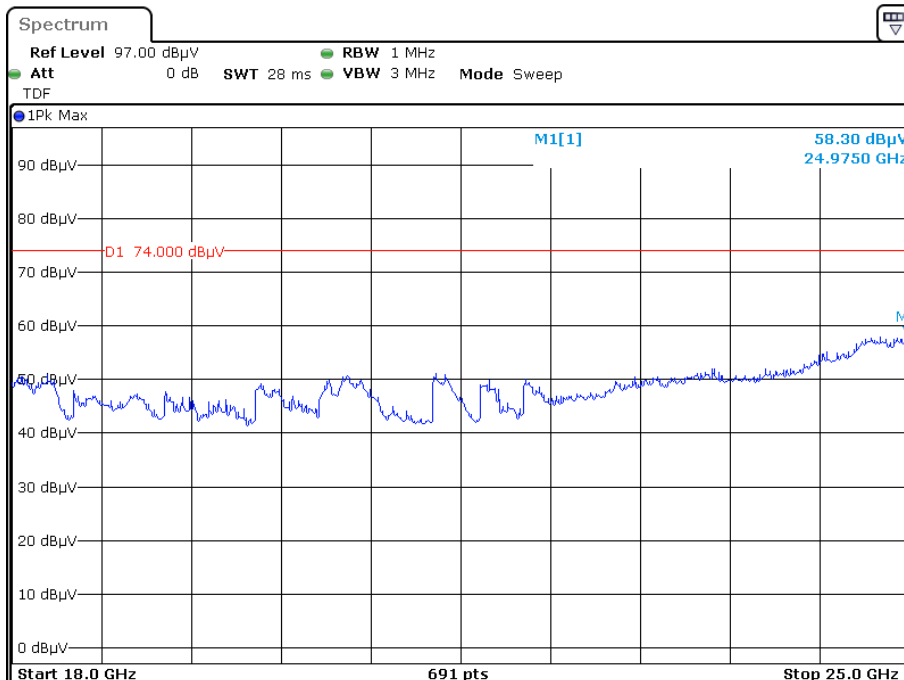
Margin = Limit - Corrected. Amplitude

The other spurious emission which is 20dB to the limit was not recorded.

**Pre-scan with low channel Peak  
Horizontal**



Date: 23.JUL.2020 08:38:34

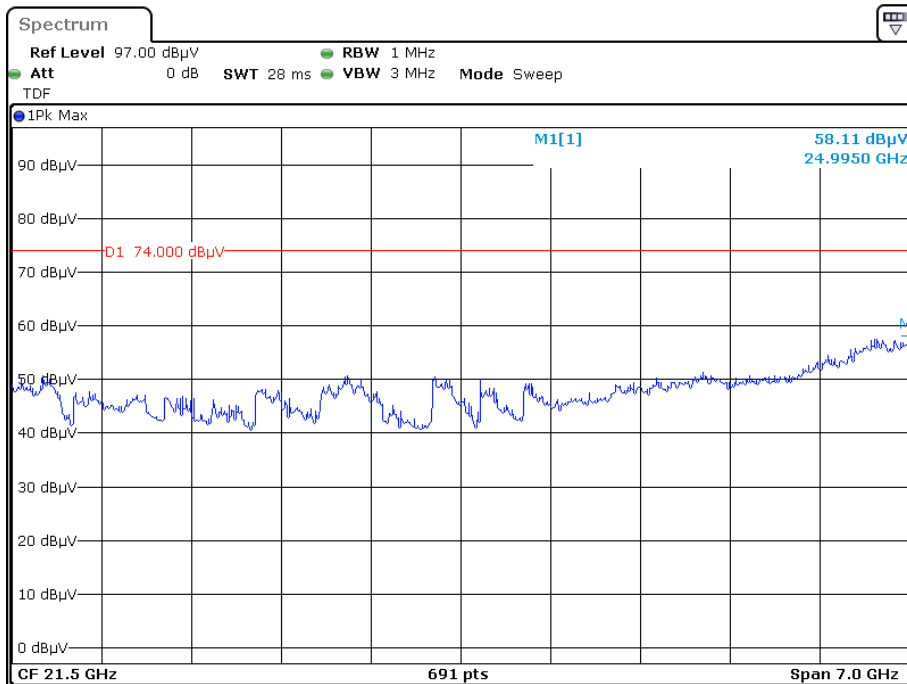


Date: 23.JUL.2020 09:29:22

Vertical

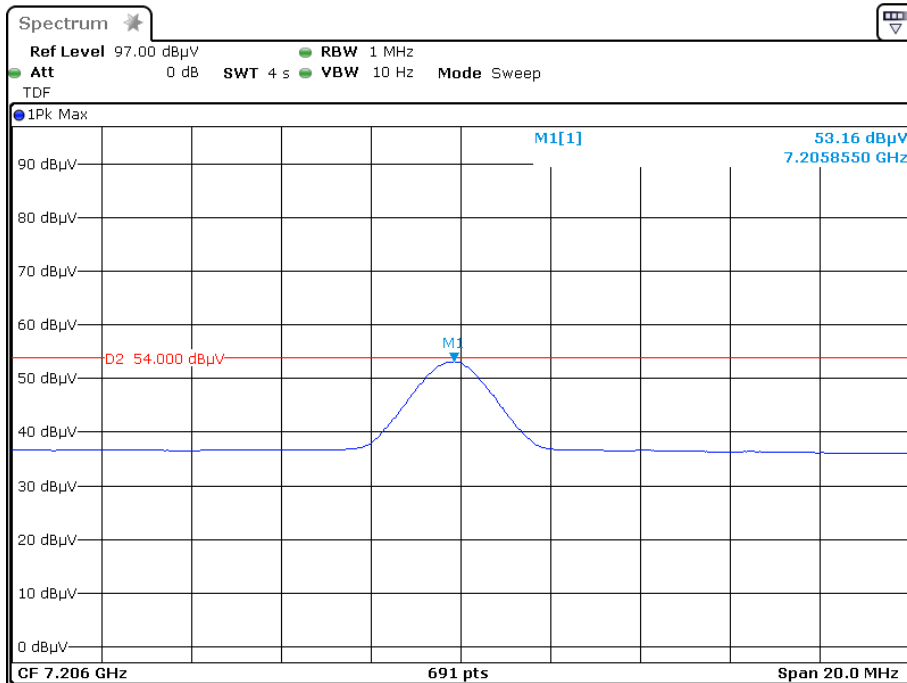


Date: 23.JUL.2020 08:49:12

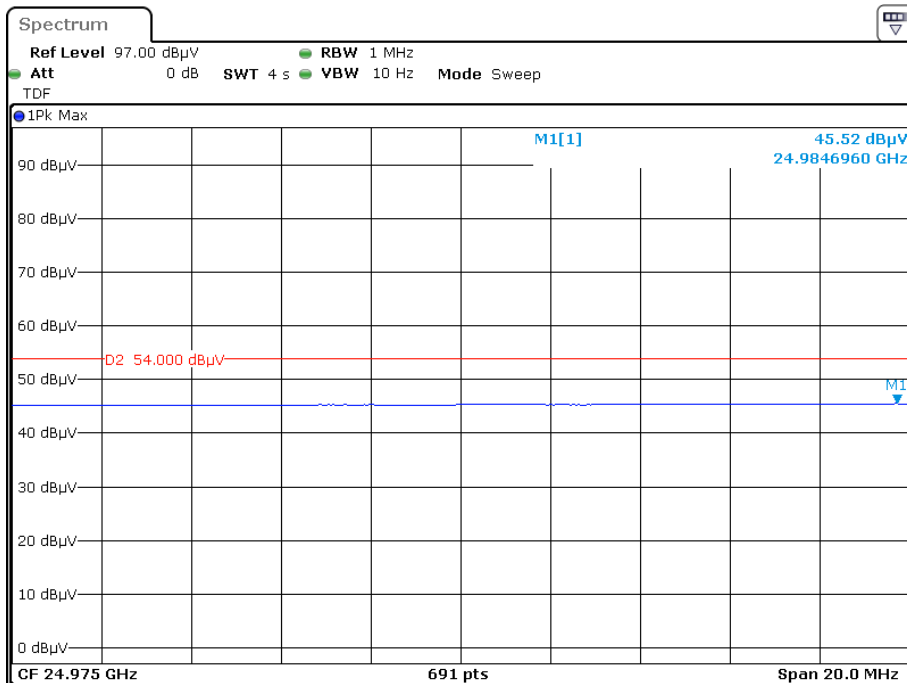


Date: 23.JUL.2020 09:23:55

### Pre-scan for Average Horizontal

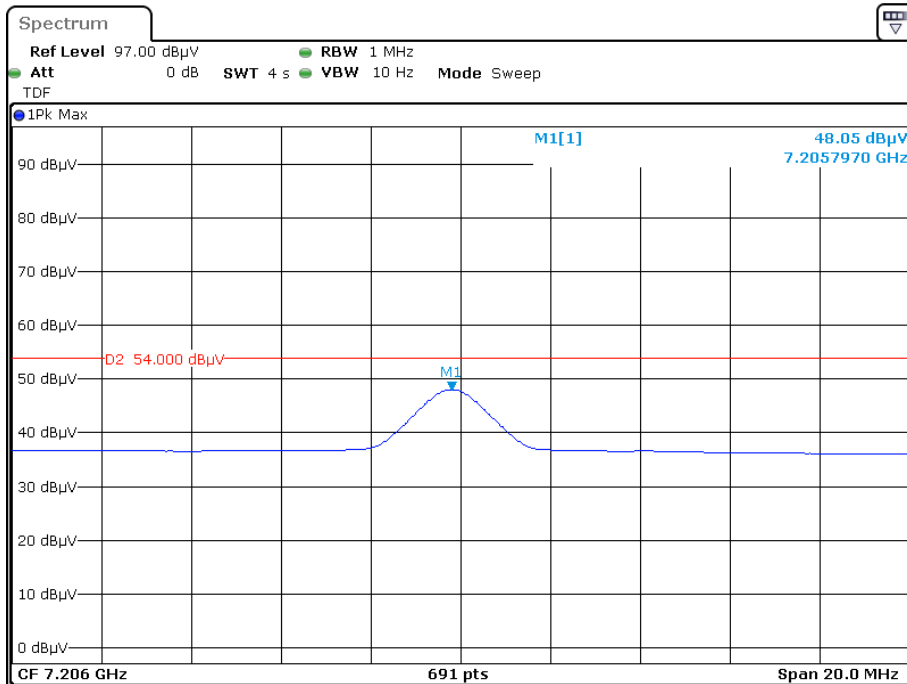


Date: 23.JUL.2020 08:43:42

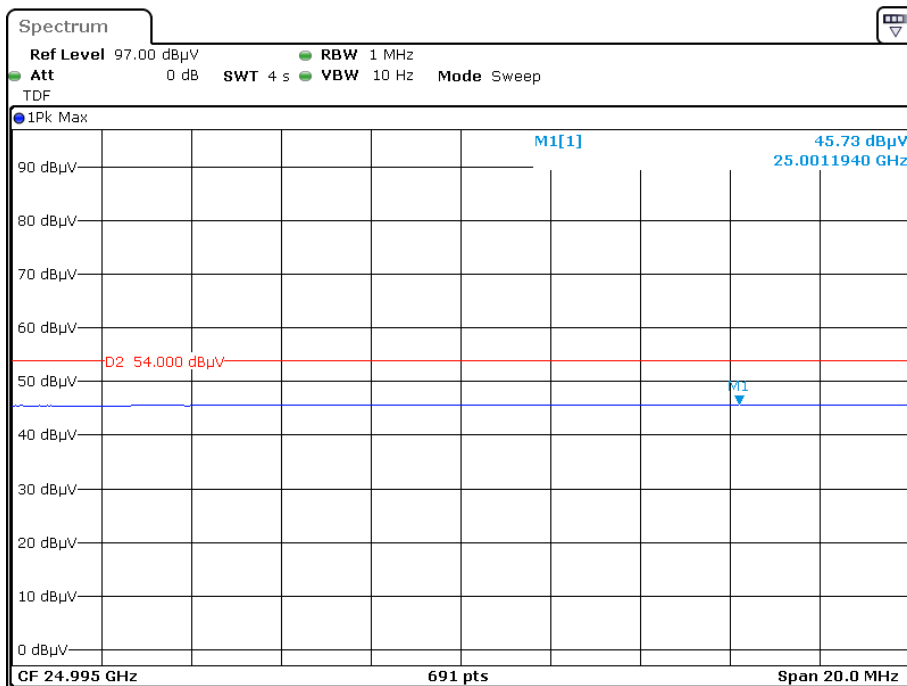


Date: 23.JUL.2020 09:32:07

Vertical



Date: 23.JUL.2020 08:53:49



Date: 23.JUL.2020 09:26:19

## 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

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

### Test Data

#### Environmental Conditions

<b>Temperature:</b>	24 °C
<b>Relative Humidity:</b>	50 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Blaker Zhang on 2020-07-23.*

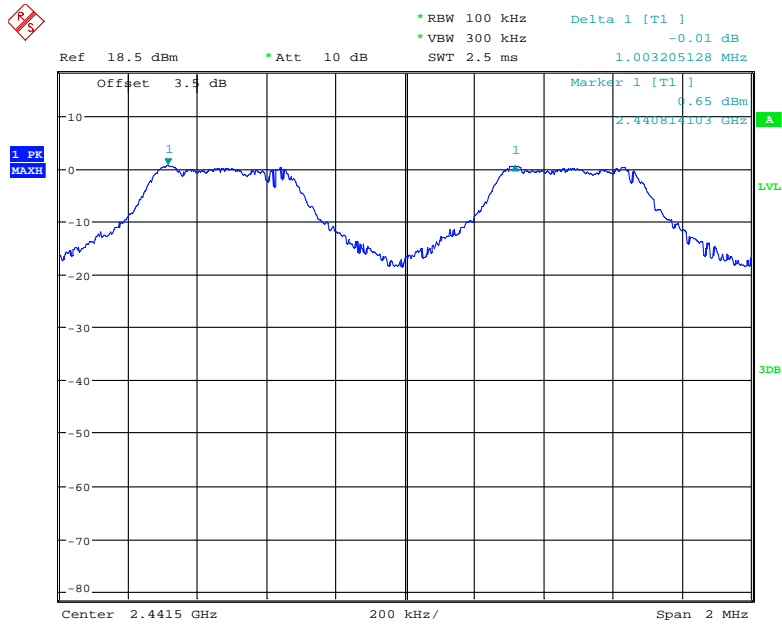
*EUT operation mode: Transmitting*

*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	1.003	0.904	0.603	> two-thirds of the 20 dB bandwidth	Compliance
<b>EDR(<math>\pi/4</math>-DQPSK)</b>					
Hopping	1.010	1.248	0.832	> two-thirds of the 20 dB bandwidth	Compliance
<b>EDR(8DPSK)</b>					
Hopping	1.013	1.226	0.817	> two-thirds of the 20 dB bandwidth	Compliance



### BDR (GFSK)



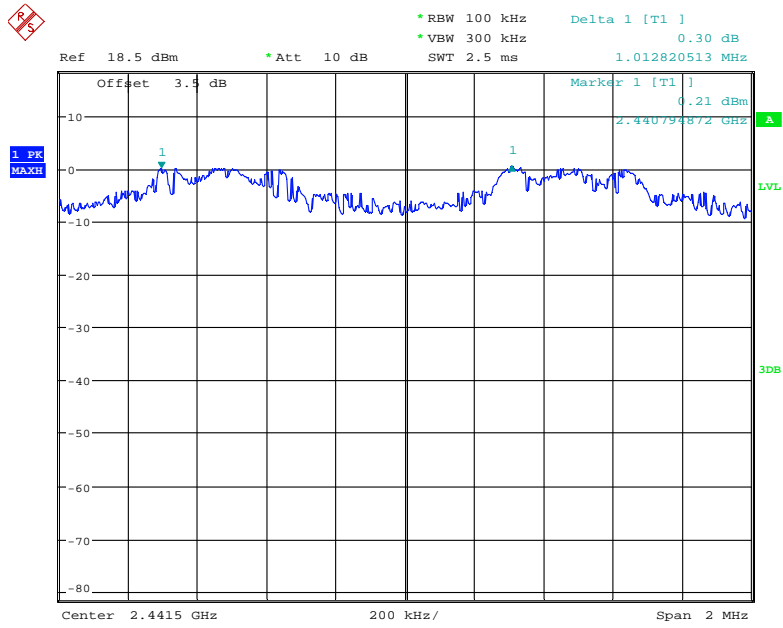
Date: 23.JUL.2020 10:22:57

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



Date: 23.JUL.2020 10:25:06

### EDR (8DPSK)



Date: 23.JUL.2020 10:27:49

## FCC §15.247(a) (1) – 20 dB EMISSION 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

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.

### Test Data

#### Environmental Conditions

<b>Temperature:</b>	24 °C
<b>Relative Humidity:</b>	50 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Blaker Zhang on 2020-07-23.*

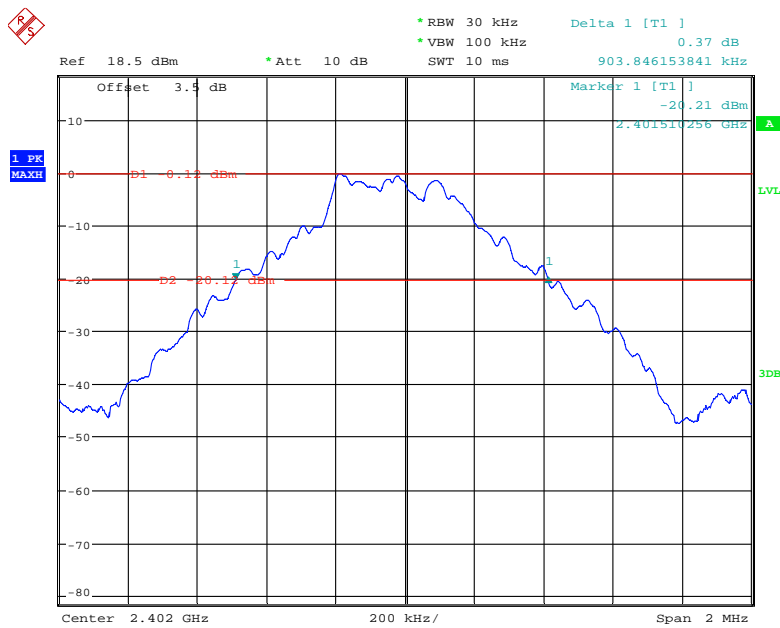
*EUT operation mode: Transmitting*

#### Test Result: Pass

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

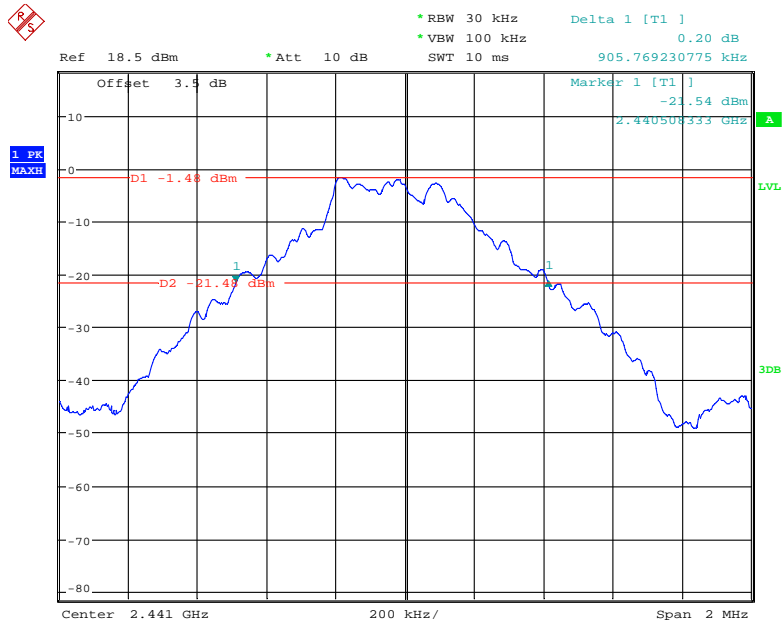
Mode	Channel	Frequency (MHz)	20 dB Emission Bandwidth (MHz)
<b>BDR (GFSK)</b>	Low	2402	0.904
	Middle	2441	0.906
	High	2480	0.909
<b>EDR (<math>\pi/4</math>-DQPSK)</b>	Low	2402	1.251
	Middle	2441	1.248
	High	2480	1.254
<b>EDR (8DPSK)</b>	Low	2402	1.226
	Middle	2441	1.229
	High	2480	1.248

**BDR (GFSK): Low Channel**



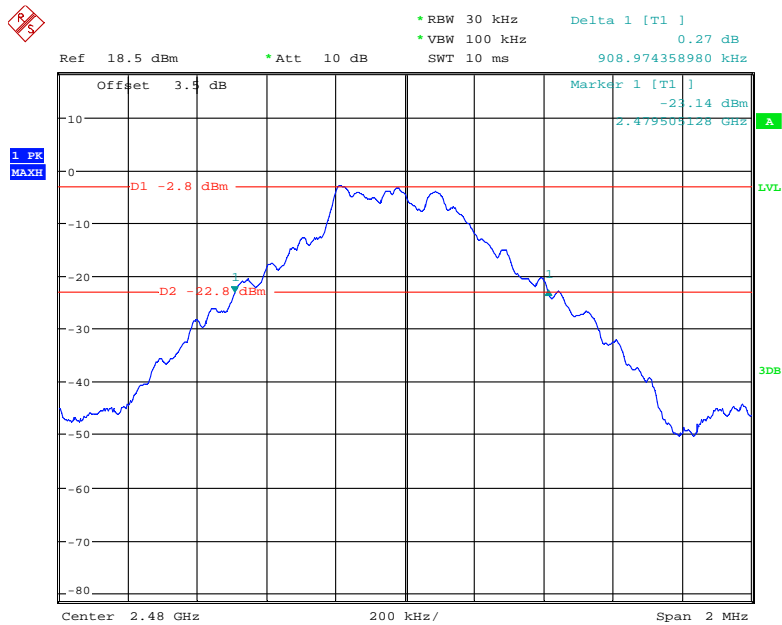
Date: 23.JUL.2020 11:05:57

### BDR (GFSK): Middle Channel



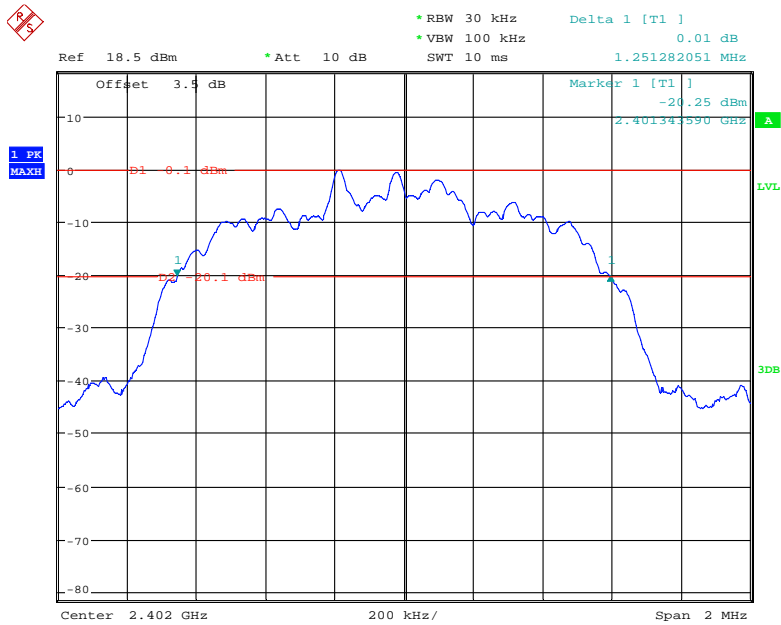
Date: 23.JUL.2020 11:03:51

### BDR (GFSK): High Channel



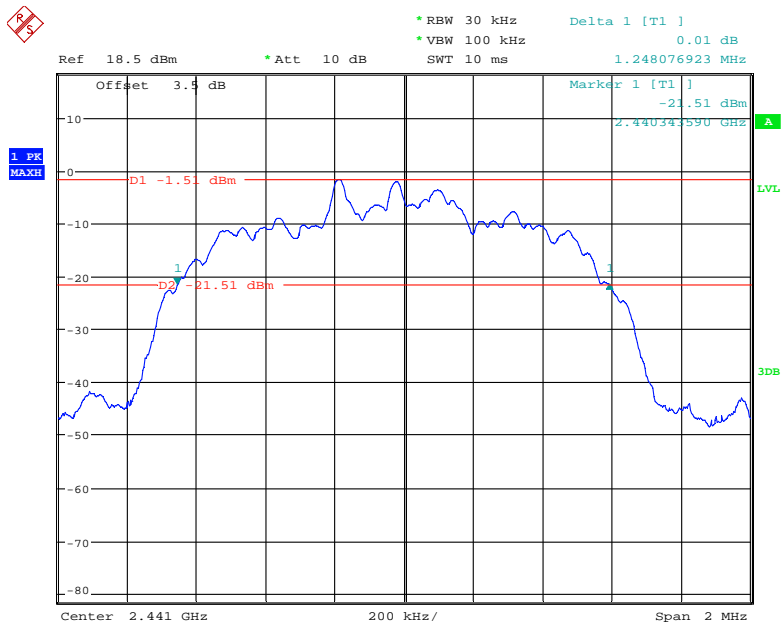
Date: 23.JUL.2020 10:52:40

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



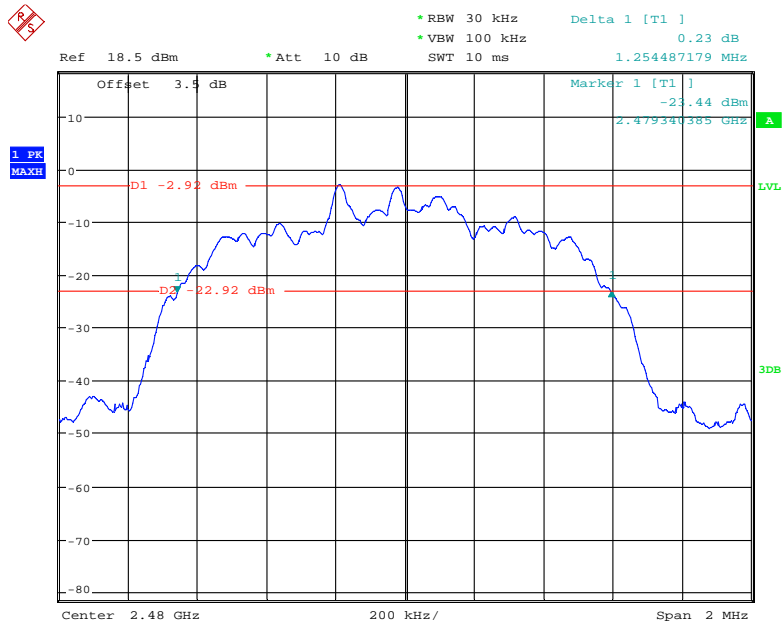
Date: 23.JUL.2020 11:07:28

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



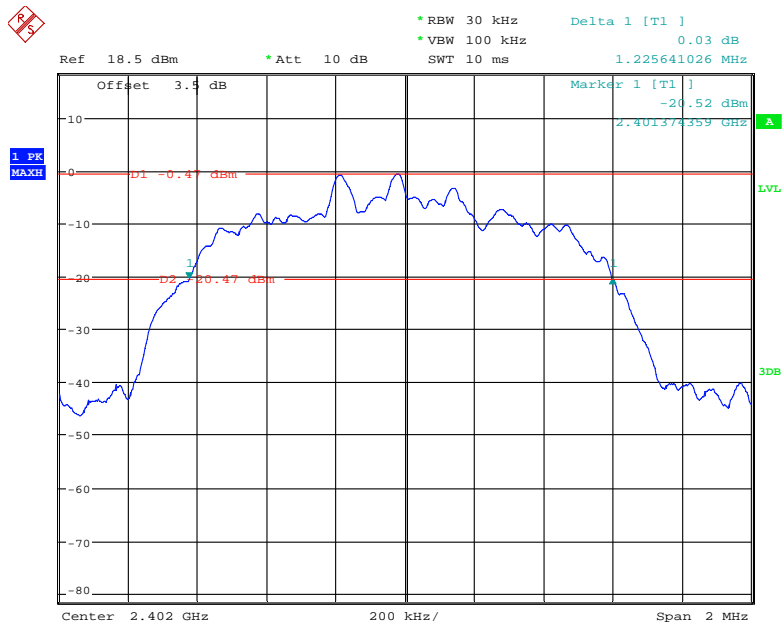
Date: 23.JUL.2020 11:02:16

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



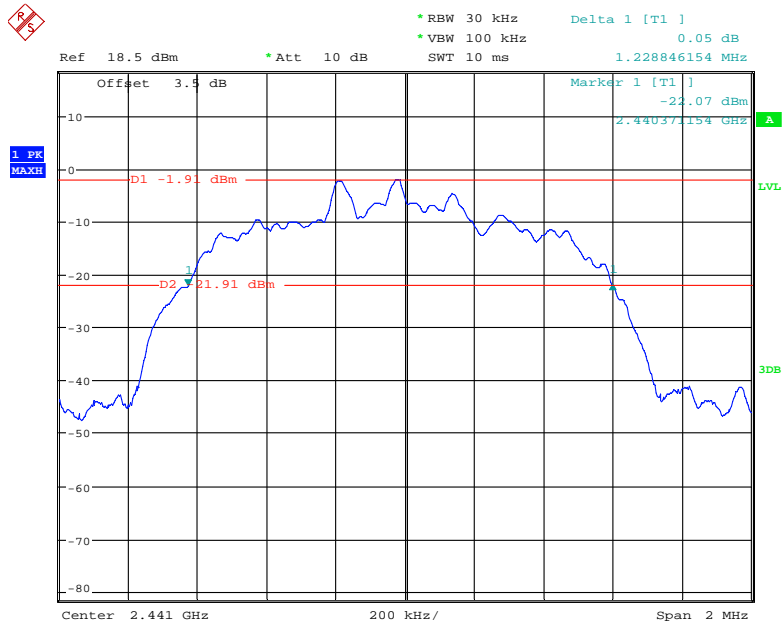
Date: 23.JUL.2020 10:55:49

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



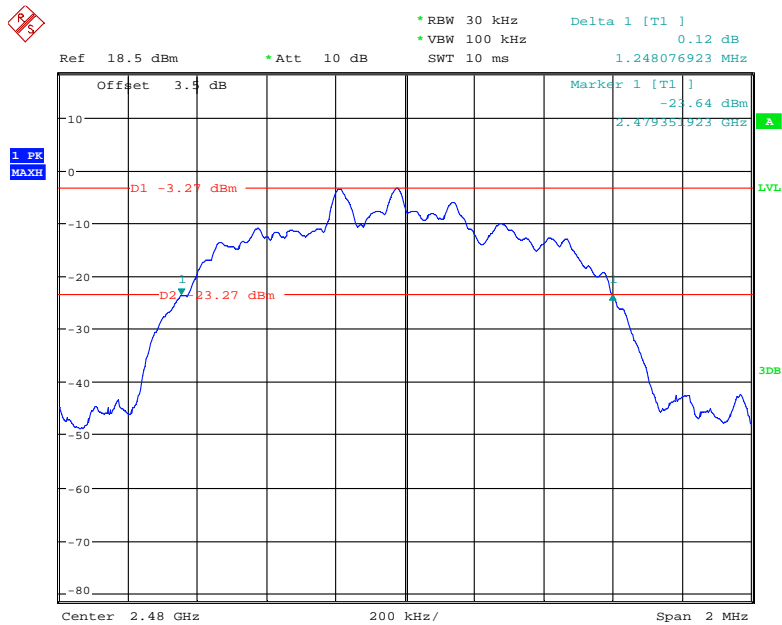
Date: 23.JUL.2020 11:09:18

### EDR (8DPSK): Middle Channel



Date: 23.JUL.2020 11:00:47

### EDR (8DPSK): High Channel



Date: 23.JUL.2020 10:58:09



## **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**

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.

### **Test Data**

#### **Environmental Conditions**

<b>Temperature:</b>	24 °C
<b>Relative Humidity:</b>	50 %
<b>ATM Pressure:</b>	101.0 kPa

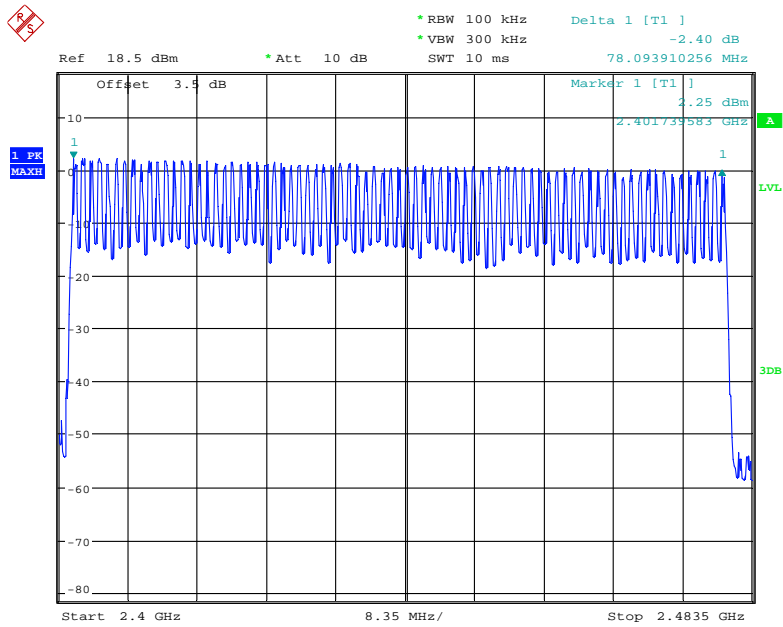
*The testing was performed by Blaker Zhang on 2020-07-23.*

*EUT operation mode: Transmitting*

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

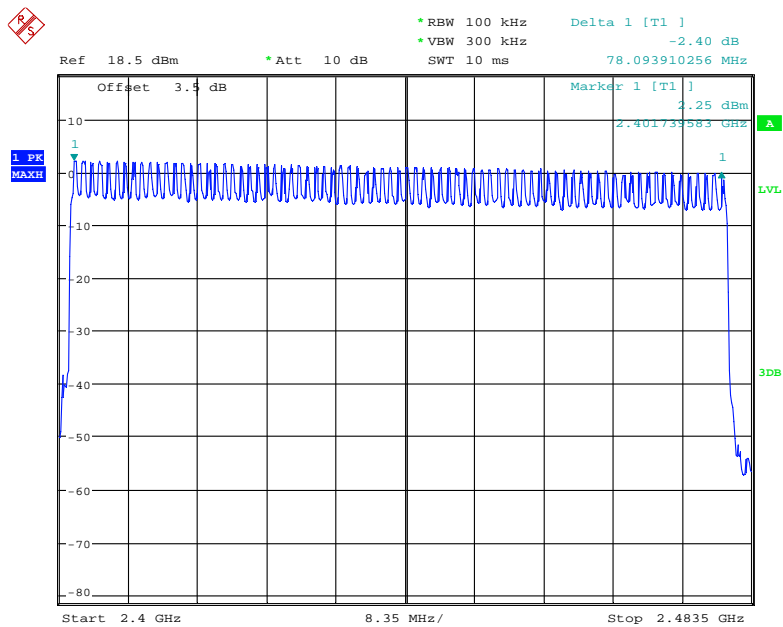
<b>Mode</b>	<b>Frequency Range (MHz)</b>	<b>Number of Hopping Channel (CH)</b>	<b>Limit (CH)</b>
BDR (GFSK)	2400-2483.5	79	≥15
EDR (π/4-DQPSK)	2400-2483.5	79	≥15
EDR (8DPSK)	2400-2483.5	79	≥15

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



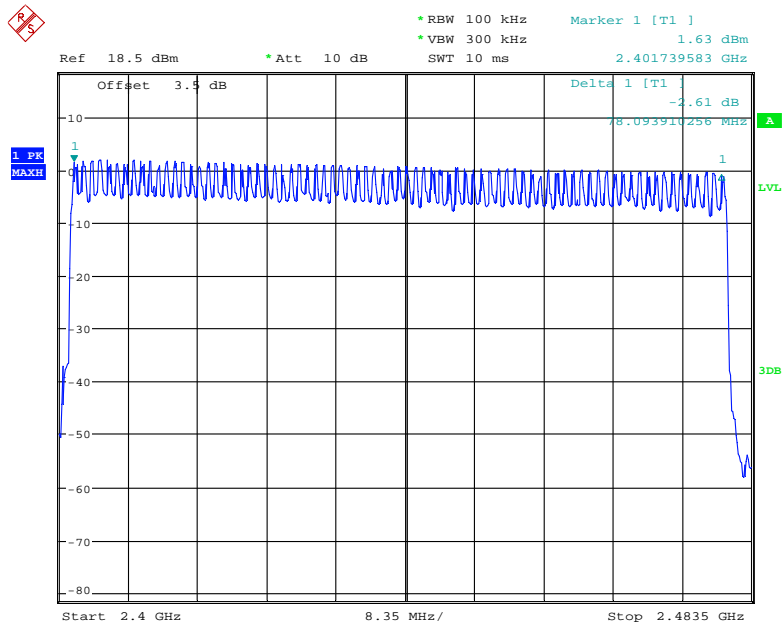
Date: 23.JUL.2020 08:48:59

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



Date: 23.JUL.2020 09:02:13

### EDR (8DPSK): Number of Hopping Channels



Date: 23.JUL.2020 09:14:24

**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**

1. The EUT was worked in channel hopping.
2. Set the RBW to: 1MHz.
3. Set the VBW  $\geq 3 \times$ RBW.
4. Set the span to 0Hz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Recorded the time of single pulses

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

<b>Temperature:</b>	24 °C
<b>Relative Humidity:</b>	50 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Blaker Zhang from 2020-07-21 to 2020-07-23.*

*EUT operation mode: Transmitting*

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

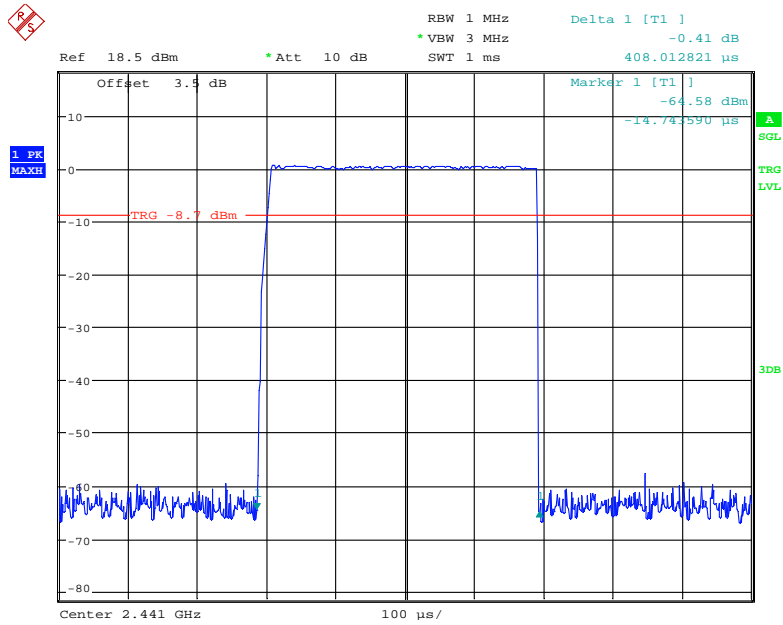
Test Mode	Channel	Pulse Time (ms)	Total Hops	Period Time (s)	Dwell Time (ms)	Limit (ms)	Result
Test mode: BDR mode(GFSK)							
<b>DH 1</b>	Hop	0.408	320	31.6	130.56	400	Pass
<b>DH 3</b>	Hop	1.683	140	31.6	235.62	400	Pass
<b>DH 5</b>	Hop	2.955	100	31.6	295.50	400	Pass
Test mode: EDR mode( $\pi/4$ -DQPSK)							
<b>2DH 1</b>	Hop	0.419	300	31.6	125.70	400	Pass
<b>2DH 3</b>	Hop	1.687	140	31.6	236.18	400	Pass
<b>2DH 5</b>	Hop	2.947	100	31.6	294.70	400	Pass
Test mode: EDR mode(8 DPSK)							
<b>3DH 1</b>	Hop	0.430	300	31.6	129.00	400	Pass
<b>3DH 3</b>	Hop	1.688	140	31.6	236.32	400	Pass
<b>3DH 5</b>	Hop	2.947	120	31.6	353.64	400	Pass

Note 1: A period time=0.4\*79=31.6(S), Dwell Time= Pulse Time\* Total Hops

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

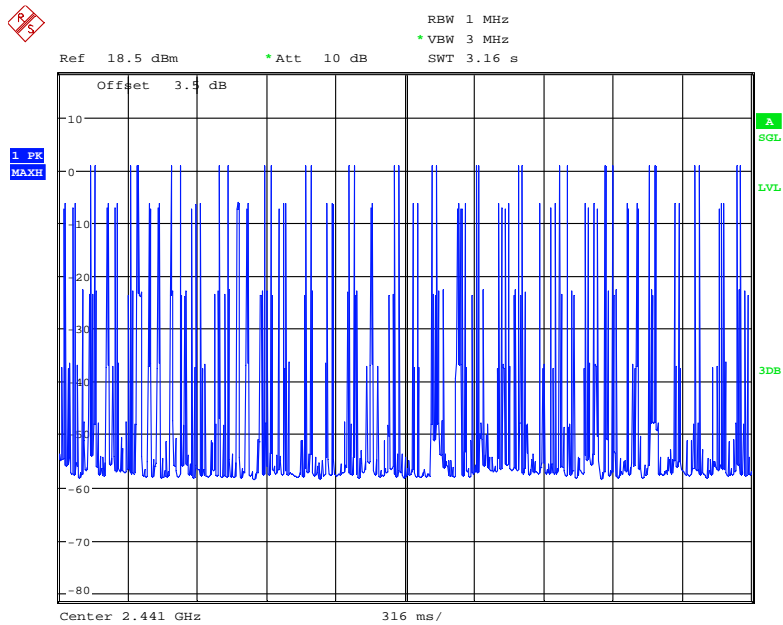
Note 3: Hopping Number in 3.16s = Total of highest signals in 3.16s (Second high signals were other channel)

### Pulse time, Middle Channel, DH1



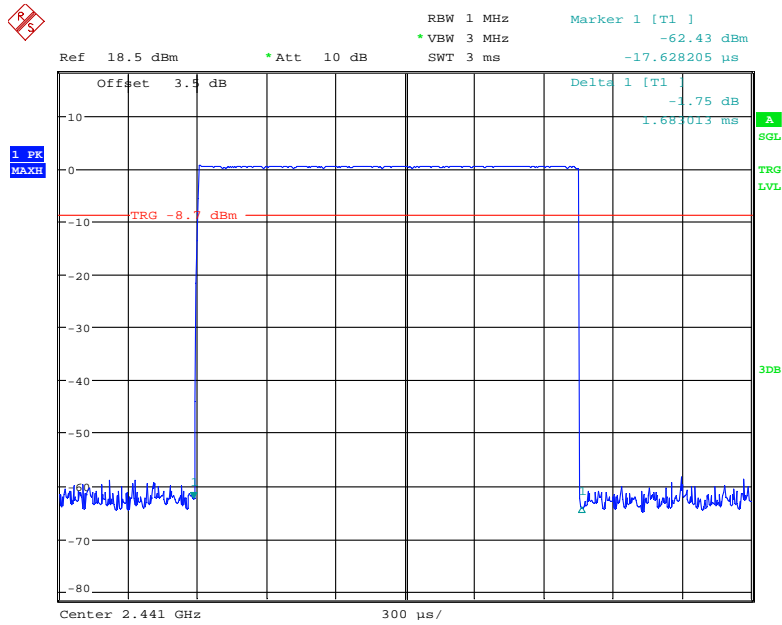
Date: 23.JUL.2020 10:35:53

### Hopping Number in 3.16s



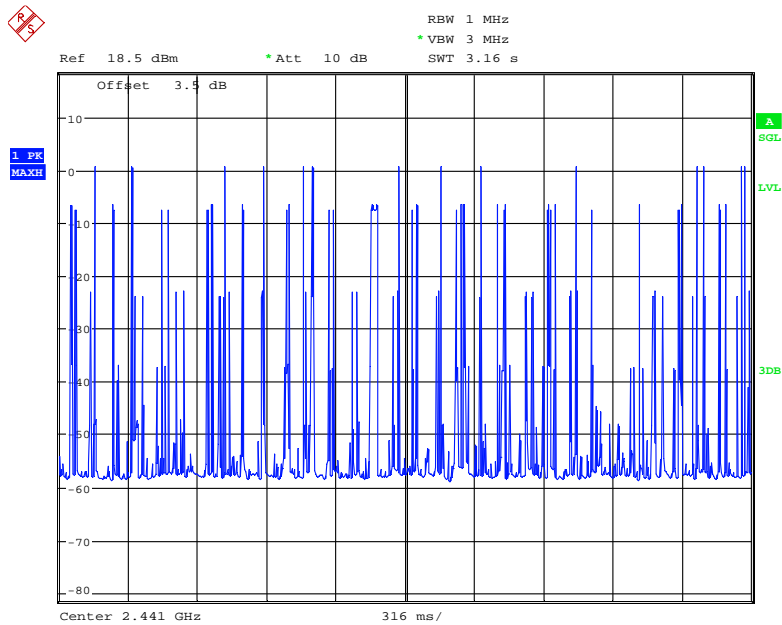
Date: 23.JUL.2020 11:32:14

### Pulse time, Middle Channel, DH3



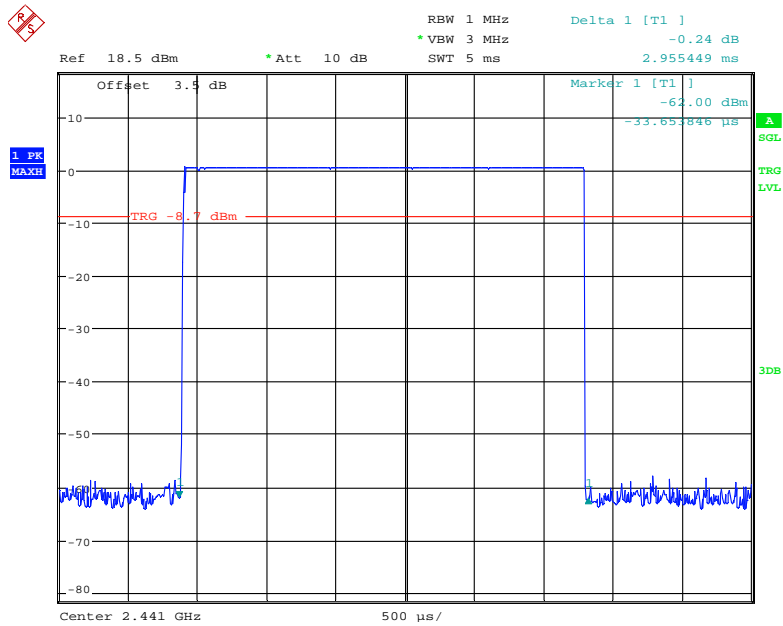
Date: 23.JUL.2020 10:37:45

### Hopping Number in 3.16s



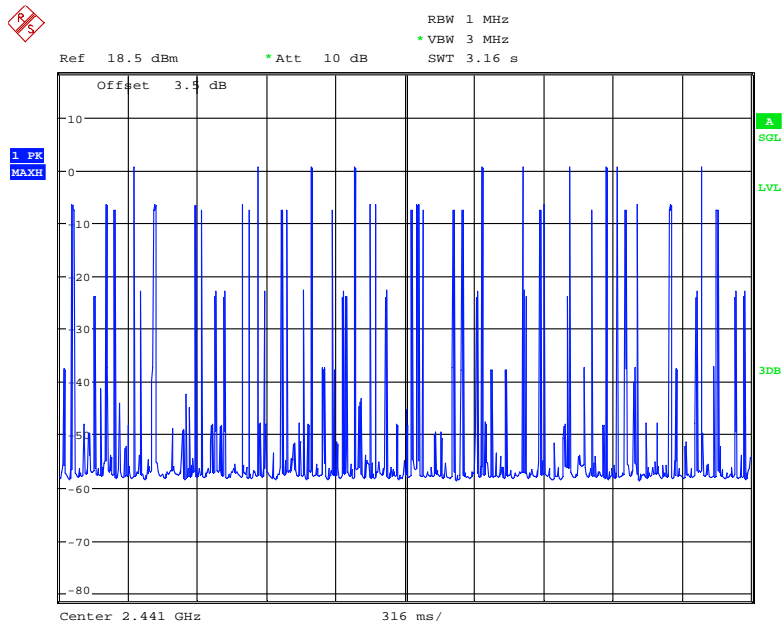
Date: 23.JUL.2020 10:49:03

### Pulse time, Middle Channel, DH5



Date: 23.JUL.2020 10:39:34

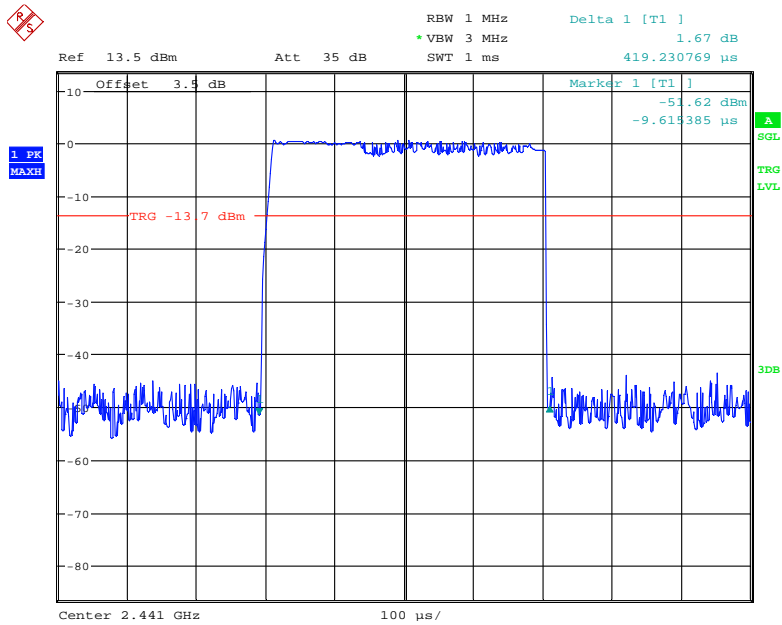
### Hopping Number in 3.16s



Date: 23.JUL.2020 10:48:03

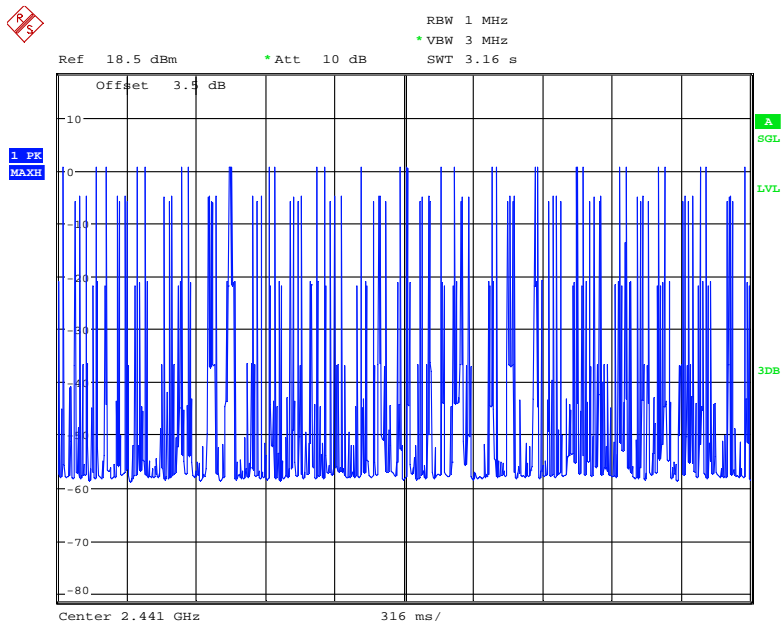


### Pulse time, Middle Channel, 2DH1



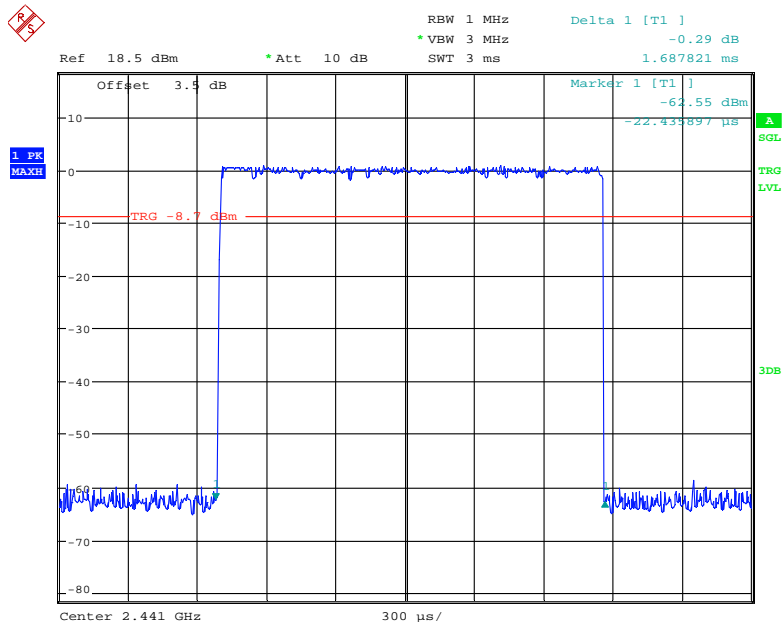
Date: 21.JUL.2020 13:27:09

### Hopping Number in 3.16s



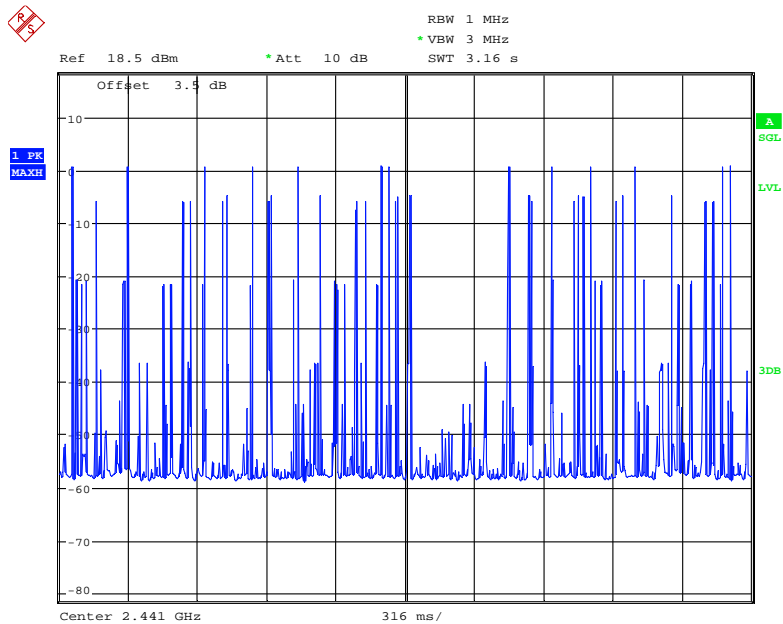
Date: 23.JUL.2020 10:45:52

### Pulse time, Middle Channel, 2DH3



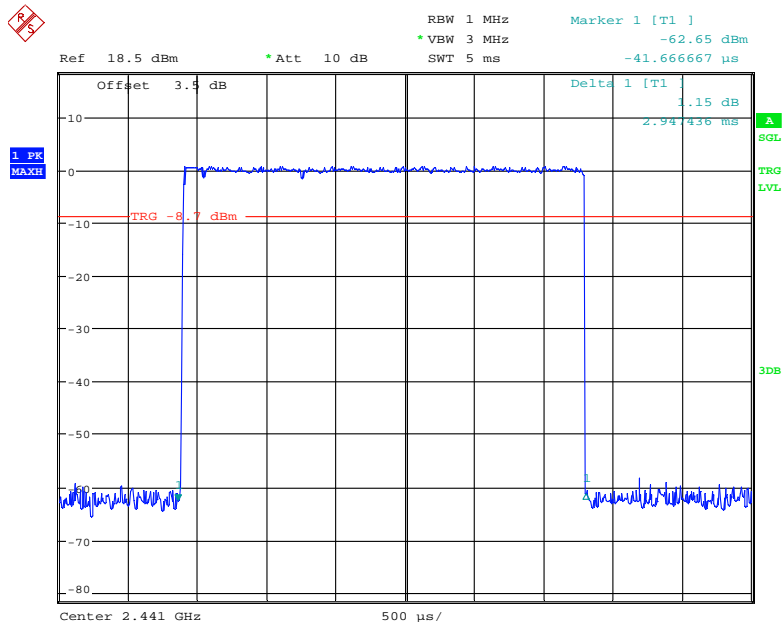
Date: 23.JUL.2020 10:42:39

### Hopping Number in 3.16s



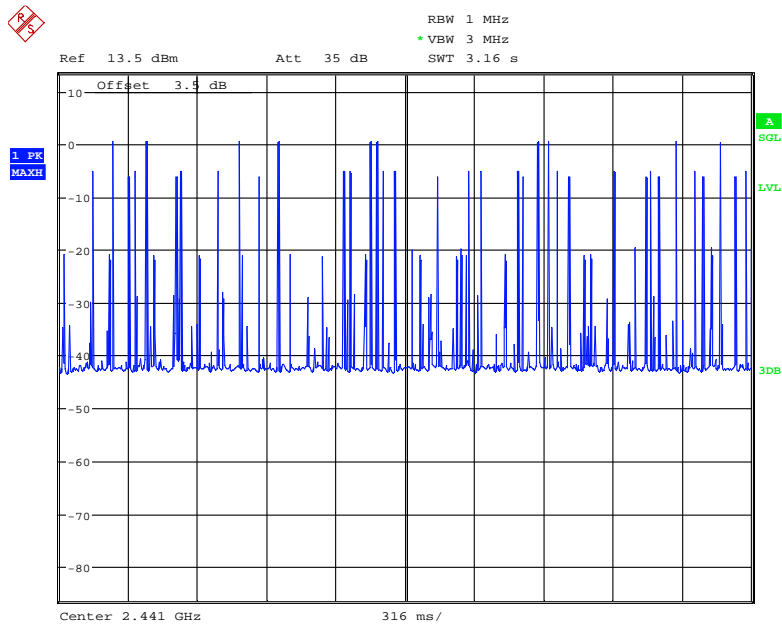
Date: 23.JUL.2020 10:44:27

### Pulse time, Middle Channel, 2DH5



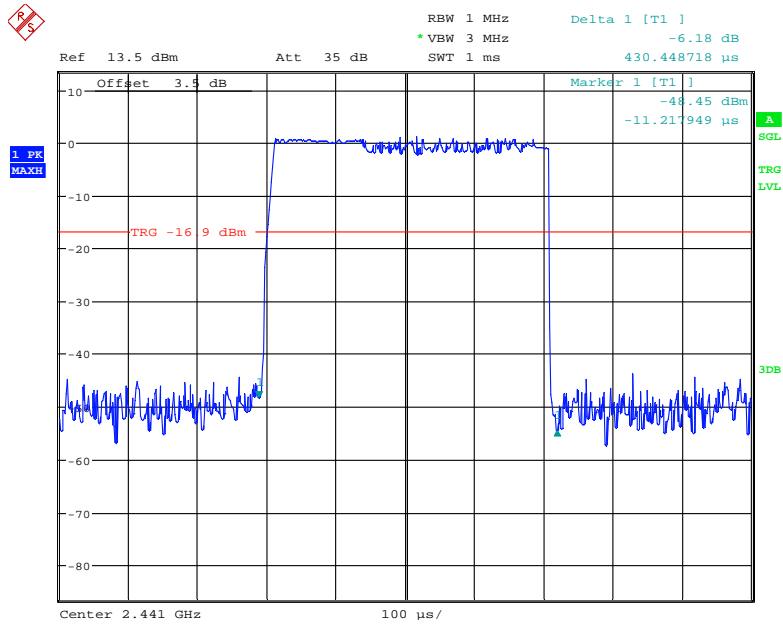
Date: 23.JUL.2020 10:41:39

### Hopping Number in 3.16s



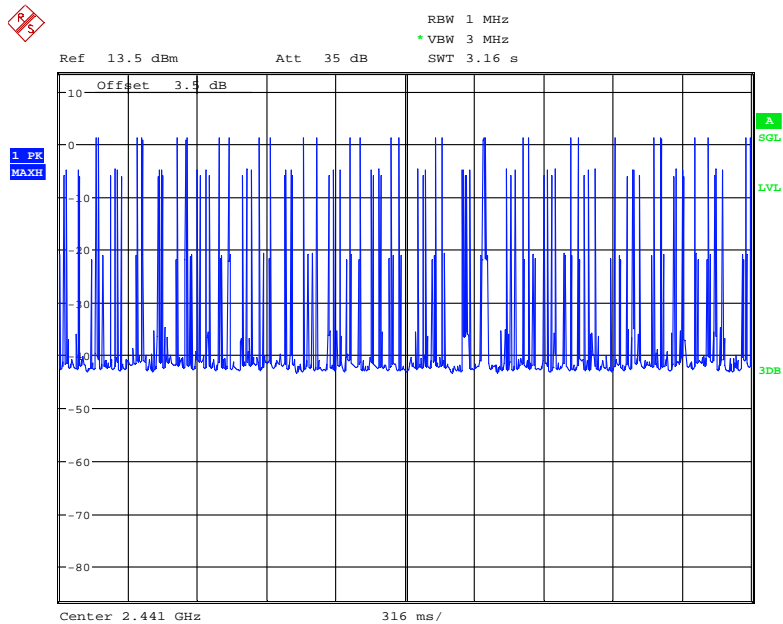
Date: 21.JUL.2020 13:25:31

### Pulse time, Middle Channel, 3DH1



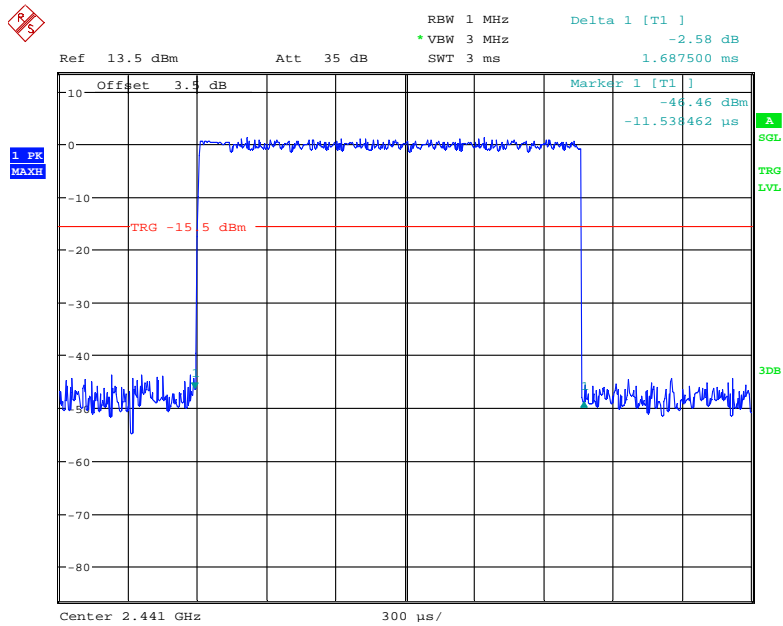
Date: 21.JUL.2020 12:30:10

### Hopping Number in 3.16s



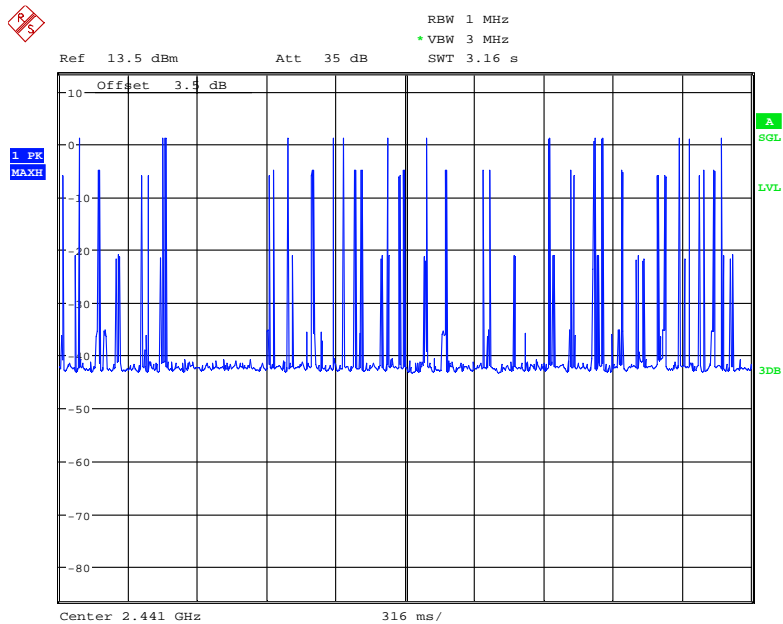
Date: 21.JUL.2020 12:32:10

### Pulse time, Middle Channel, 3DH3



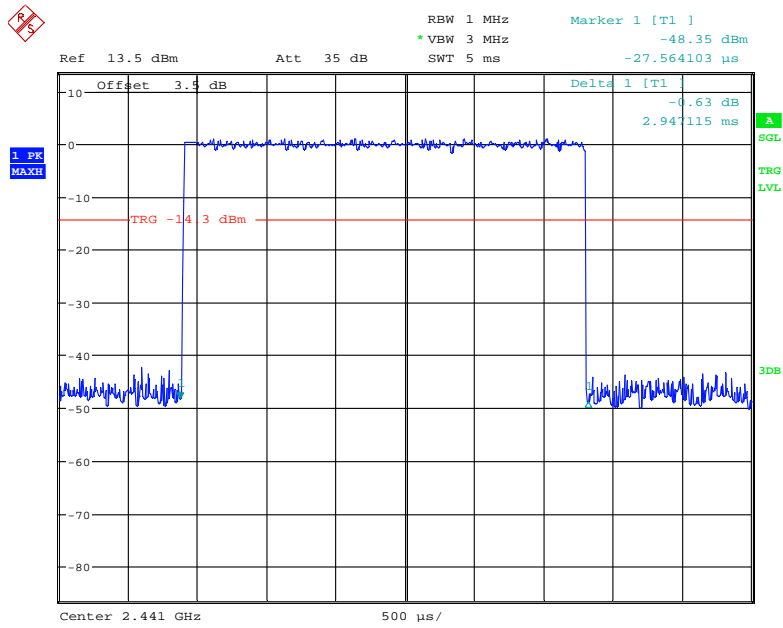
Date: 21.JUL.2020 13:11:41

### Hopping Number in 3.16s



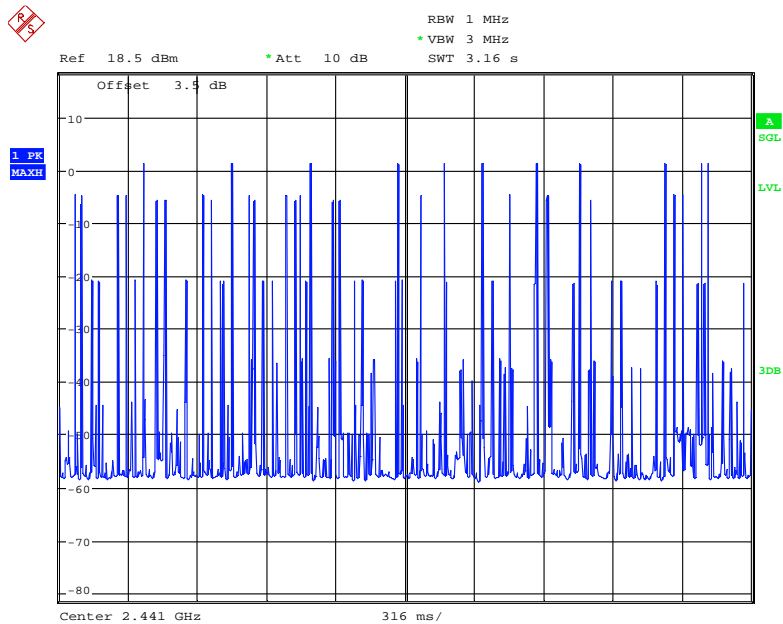
Date: 21.JUL.2020 12:33:21

### Pulse time, Middle Channel, 3DH5



Date: 21.JUL.2020 13:13:57

### Hopping Number in 3.16s



Date: 23.JUL.2020 11:25:33

## 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

<b>Temperature:</b>	24 °C
<b>Relative Humidity:</b>	50 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Blaker Zhang from 2020-07-21 to 2020-07-23.*

*EUT operation mode: Transmitting*

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

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)	Limit (dBm)
<b>BDR (GFSK)</b>	Low	2402	2.26	20.97
	Middle	2441	0.70	20.97
	High	2480	-0.34	20.97
<b>EDR (<math>\pi/4</math>-DQPSK)</b>	Low	2402	2.36	20.97
	Middle	2441	1.17	20.97
	High	2480	0.14	20.97
<b>EDR (8DPSK)</b>	Low	2402	2.87	20.97
	Middle	2441	1.67	20.97
	High	2480	0.69	20.97

## 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

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. 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.
3. Set RBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. 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.
5. Repeat above procedures until all measured frequencies were complete.

### Test Data

#### Environmental Conditions

<b>Temperature:</b>	24 °C
<b>Relative Humidity:</b>	50 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Blaker Zhang on 2020-07-23.*

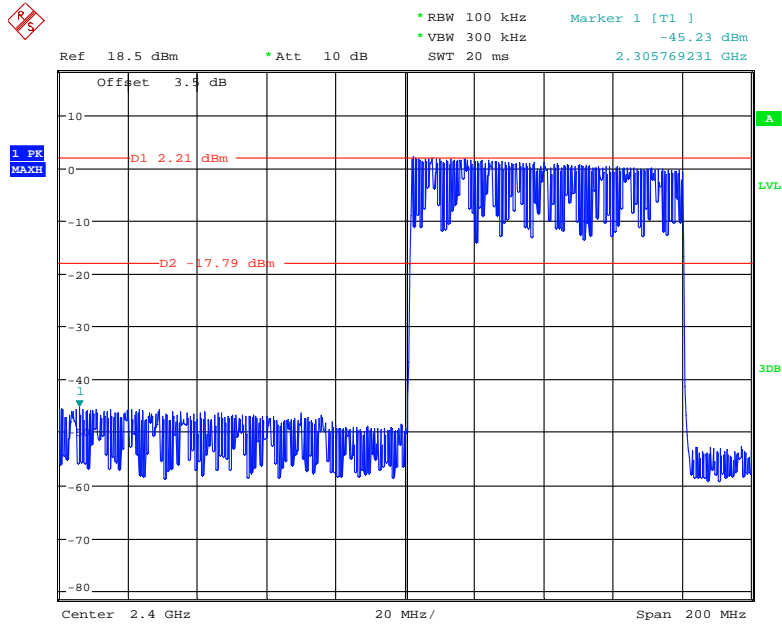
*EUT operation mode: Transmitting*

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



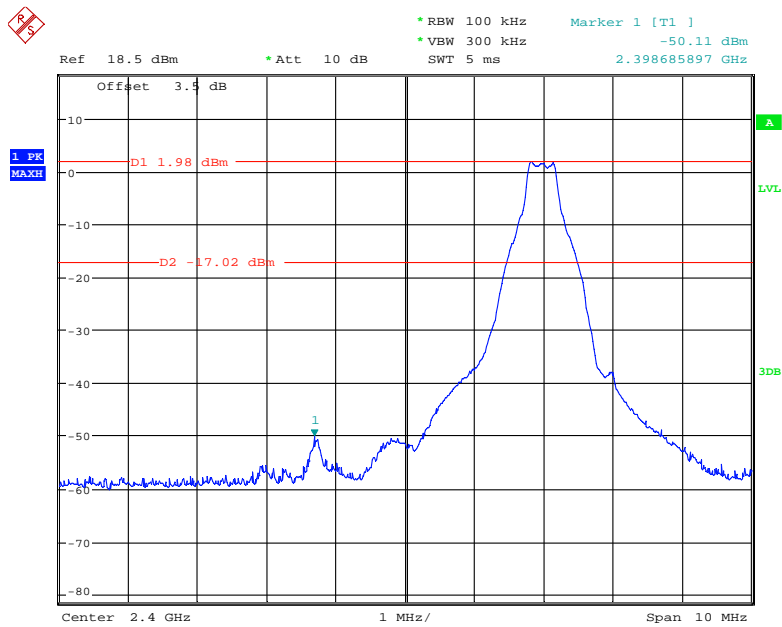
### BDR (GFSK): Band Edge-Left Side

#### Hopping



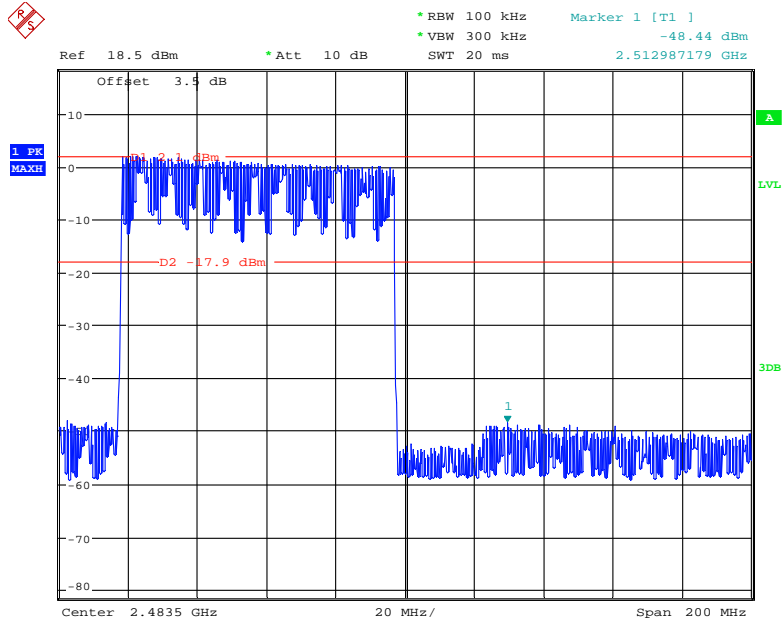
Date: 23.JUL.2020 09:42:29

#### Single



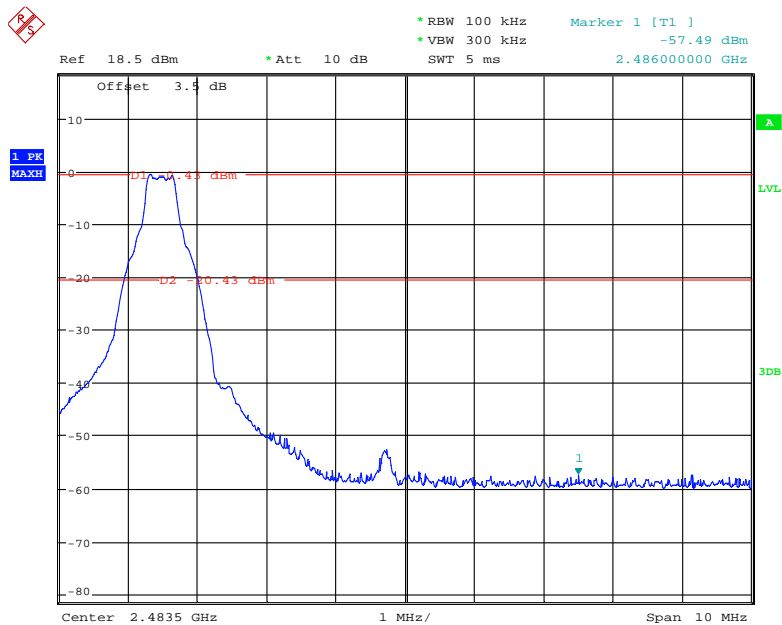
Date: 23.JUL.2020 09:57:44

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



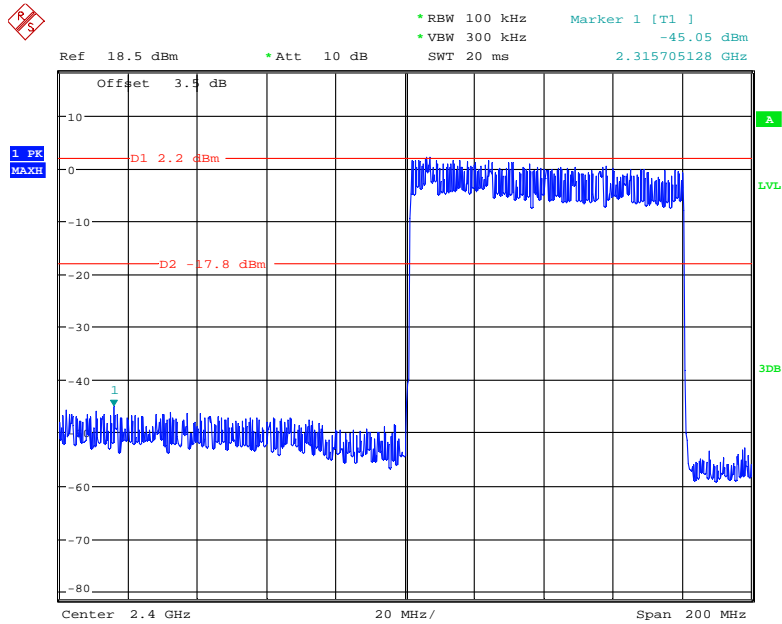
Date: 23.JUL.2020 09:45:34

### Single



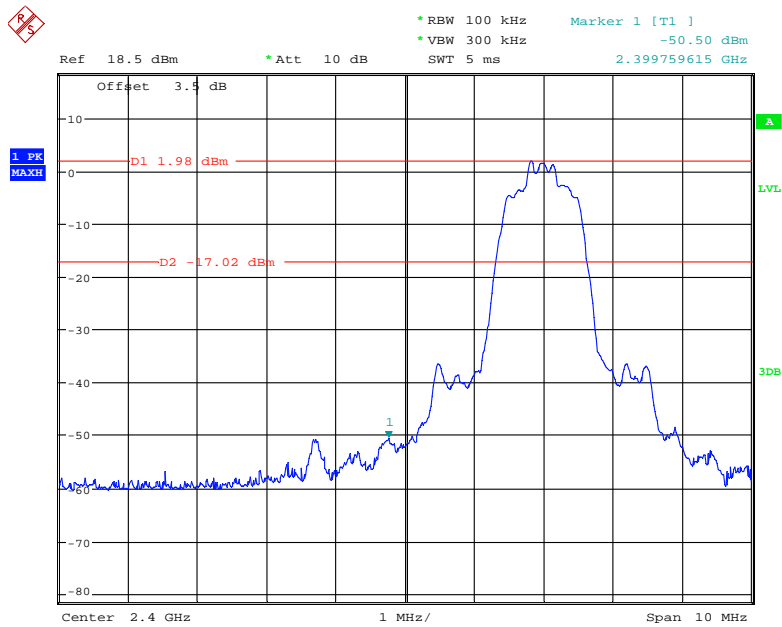
Date: 23.JUL.2020 09:47:38

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



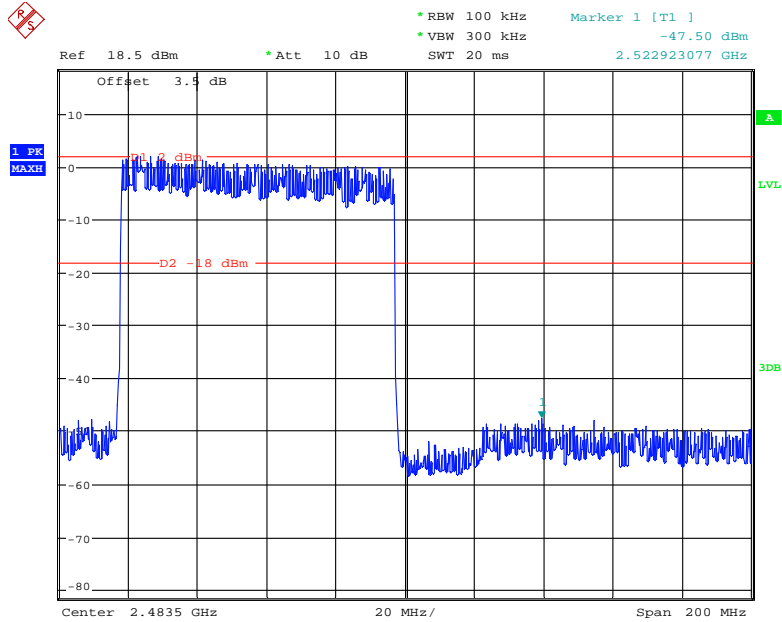
Date: 23.JUL.2020 09:35:45

### Single



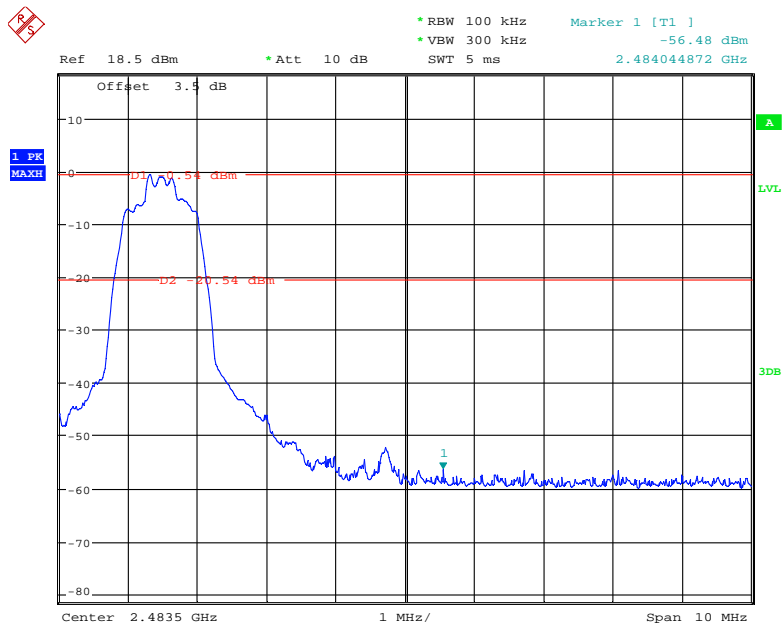
Date: 23.JUL.2020 09:55:20

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



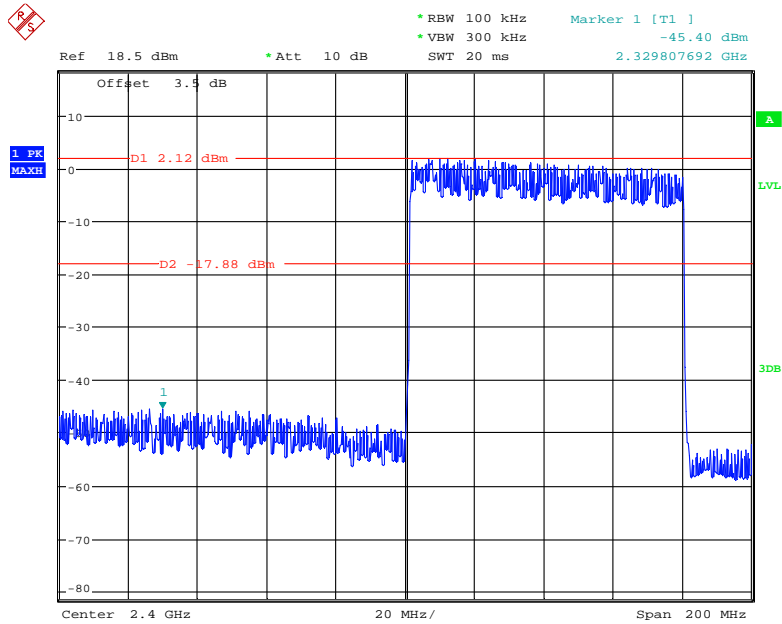
Date: 23.JUL.2020 09:32:27

### Single



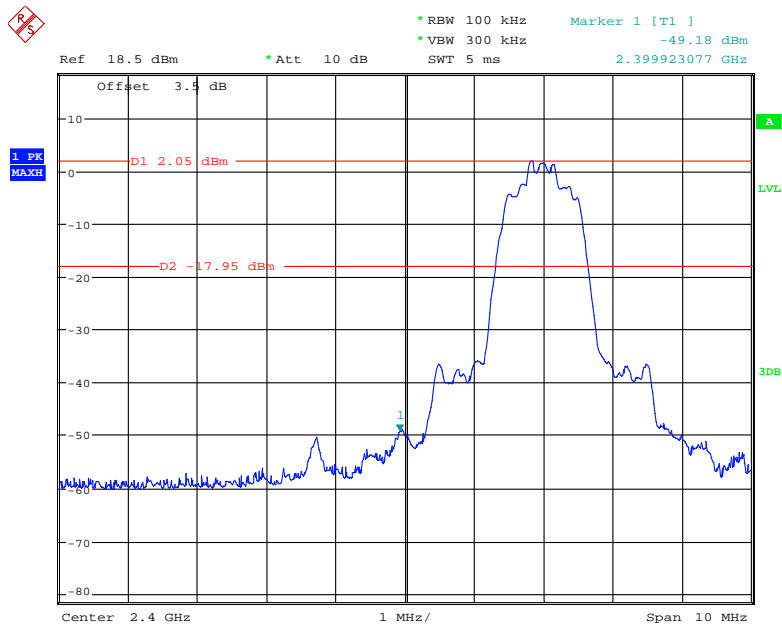
Date: 23.JUL.2020 09:50:34

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



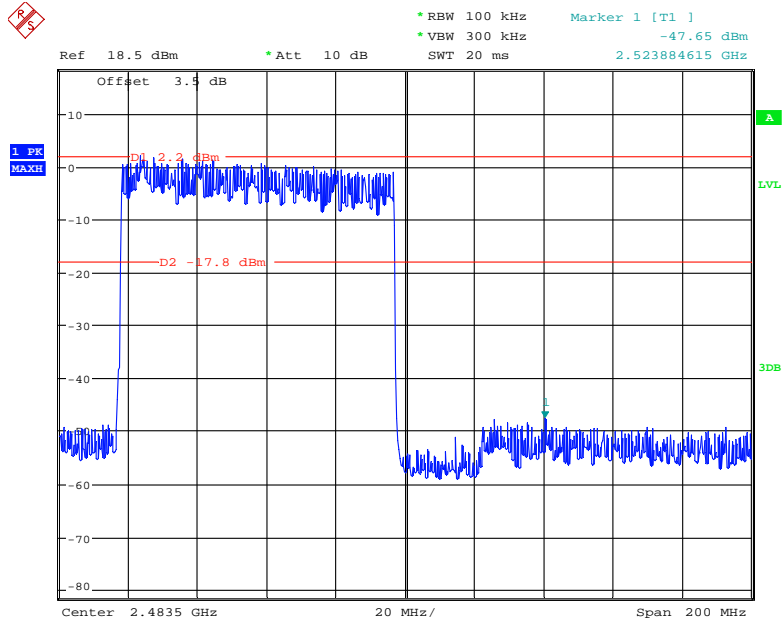
Date: 23.JUL.2020 09:25:00

### Single



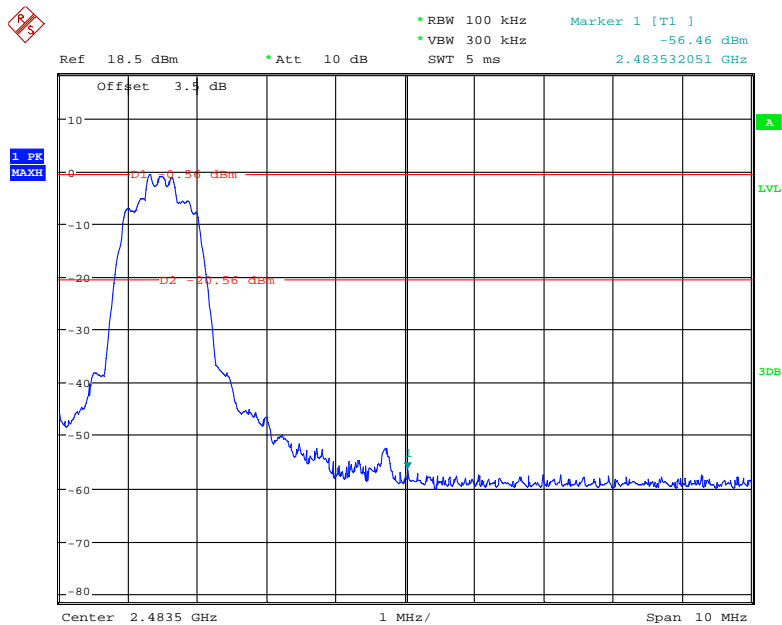
Date: 23.JUL.2020 09:54:04

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



Date: 23.JUL.2020 09:29:42

### Single



Date: 23.JUL.2020 09:52:18

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