



TESTING LABORATORY  
CERTIFICATE #4820.01



FCC PART 15.247

TEST REPORT

For

**MPOW TECHNOLOGY CO., LIMITED**

FLAT/RM 605 6/F FA YUEN COMMERCIAL BUILDING 75-77 FA YUEN STREET  
MONGKOK KL HONG KONG

**FCC ID: 2AMH2-BH361A**

<b>Report Type:</b> Original Report	<b>Product Name:</b> MPOW 059 PLUS ANC WIRELESS HEADPHONES
<b>Report Number:</b>	<u>RDG200721001-00B</u>
<b>Report Date:</b>	<u>2020-08-25</u>
<b>Reviewed By:</b>	Ivan Cao Assistant Manager 
<b>Test Laboratory:</b>	Bay Area Compliance Laboratories Corp. (Dongguan) No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China Tel: +86-769-86858888 Fax: +86-769-86858891 <a href="http://www.baclcorp.com.cn">www.baclcorp.com.cn</a>

## 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
EQUIPMENT MODIFICATIONS.....	6
BLOCK DIAGRAM OF TEST SETUP.....	7
<b>SUMMARY OF TEST RESULTS.....</b>	<b>8</b>
<b>FCC §15.247 (i) &amp; §1.1310 &amp; §2.1093- RF EXPOSURE.....</b>	<b>9</b>
APPLICABLE STANDARD.....	9
<b>FCC §15.203 - ANTENNA REQUIREMENT.....</b>	<b>10</b>
APPLICABLE STANDARD.....	10
ANTENNA CONNECTOR CONSTRUCTION.....	10
<b>FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS.....</b>	<b>11</b>
APPLICABLE STANDARD.....	11
EUT SETUP.....	11
EMI TEST RECEIVER SETUP.....	11
TEST PROCEDURE.....	12
CORRECTED AMPLITUDE & MARGIN CALCULATION.....	12
TEST EQUIPMENT LIST AND DETAILS.....	12
TEST DATA.....	13
<b>FCC §15.209, §15.205 &amp; §15.247(d) - SPURIOUS EMISSIONS.....</b>	<b>15</b>
APPLICABLE STANDARD.....	15
EUT SETUP.....	15
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP.....	16
TEST PROCEDURE.....	16
TEST EQUIPMENT LIST AND DETAILS.....	16
CORRECTED AMPLITUDE & MARGIN CALCULATION.....	17
TEST DATA.....	17
<b>FCC §15.247(a) (1) - CHANNEL SEPARATION TEST.....</b>	<b>23</b>
APPLICABLE STANDARD.....	23
TEST EQUIPMENT LIST AND DETAILS.....	23
TEST PROCEDURE.....	23
TEST DATA.....	23
<b>FCC §15.247(a) (1) – 20 dB BANDWIDTH TESTING.....</b>	<b>29</b>
APPLICABLE STANDARD.....	29
TEST PROCEDURE.....	29
TEST EQUIPMENT LIST AND DETAILS.....	29
TEST DATA.....	29

**FCC §15.247(a) (1) (iii) - QUANTITY OF HOPPING CHANNEL TEST .....35**  
 APPLICABLE STANDARD .....35  
 TEST PROCEDURE .....35  
 TEST EQUIPMENT LIST AND DETAILS.....35  
 TEST DATA .....35

**FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME).....38**  
 APPLICABLE STANDARD .....38  
 TEST PROCEDURE .....38  
 TEST EQUIPMENT LIST AND DETAILS.....38  
 TEST DATA .....38

**FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT .....44**  
 APPLICABLE STANDARD .....44  
 TEST PROCEDURE .....44  
 TEST EQUIPMENT LIST AND DETAILS.....44  
 TEST DATA .....44

**FCC §15.247(d) - BAND EDGES TESTING .....46**  
 APPLICABLE STANDARD .....46  
 TEST PROCEDURE .....46  
 TEST EQUIPMENT LIST AND DETAILS.....46  
 TEST DATA .....47

## GENERAL INFORMATION

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

<b>EUT Name:</b>	MPOW 059 PLUS ANC WIRELESS HEADPHONES
<b>EUT Model:</b>	BH361A
<b>Operation Frequency:</b>	2402-2480MHz
<b>Maximum Output Power (Conducted):</b>	1.90 dBm
<b>Modulation Type:</b>	GFSK, $\pi/4$ -DQPSK, 8DPSK
<b>Rated Input Voltage:</b>	DC 3.7V from battery or DC 5V from USB port
<b>Serial Number:</b>	RDG200721001-RF-S1
<b>EUT Received Date:</b>	2020.07.23
<b>EUT Received Status:</b>	Good

### Objective

This report is prepared on behalf of MPOW TECHNOLOGY CO.,LIMITED in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communications Commission's rules

The tests were performed in order to determine the Bluetooth BDR and EDR mode of EUT compliance with FCC Rules Part 15, Subpart C, and section 15.203, 15.205,15.207,15.209 and 15.247 rules.

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

FCC Part 15C DTS submissions with FCC ID: 2AMH2-BH361A.

### Test Methodology

All measurements detailed in this Test Report were performed in accordance with ANSI C63.10-2013 "American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices".

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan).

### Measurement Uncertainty

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.61dB
Power Spectral Density, conducted	±0.61 dB
Unwanted Emissions, radiated	30M~200MHz: 4.55 dB,200M~1GHz: 5.92 dB,1G~6GHz: 4.98 dB, 6G~18GHz: 5.89 dB,18G~26.5G:5.47 dB,26.5G~40G:5.63 dB
Unwanted Emissions, conducted	±1.5 dB
Temperature	±1 °C
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%
AC Power Lines Conducted Emission	3.12 dB (150 kHz to 30 MHz)

### Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 897218, the FCC Designation No. : CN1220.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0022.

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

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

### EUT Exercise Software

The 'Bluetest 3' was used during test, which was provided by manufacturer. The maximum power level was configured by the software as below table:

Mode	Channel	Frequency (MHz)	Power Level Setting
GFSK	Low	2402	default
	Middle	2441	default
	High	2480	default
$\pi/4$ -DQPSK	Low	2402	default
	Middle	2441	default
	High	2480	default
8DPSK	Low	2402	default
	Middle	2441	default
	High	2480	default

### Equipment Modifications

No modification was made to the EUT.

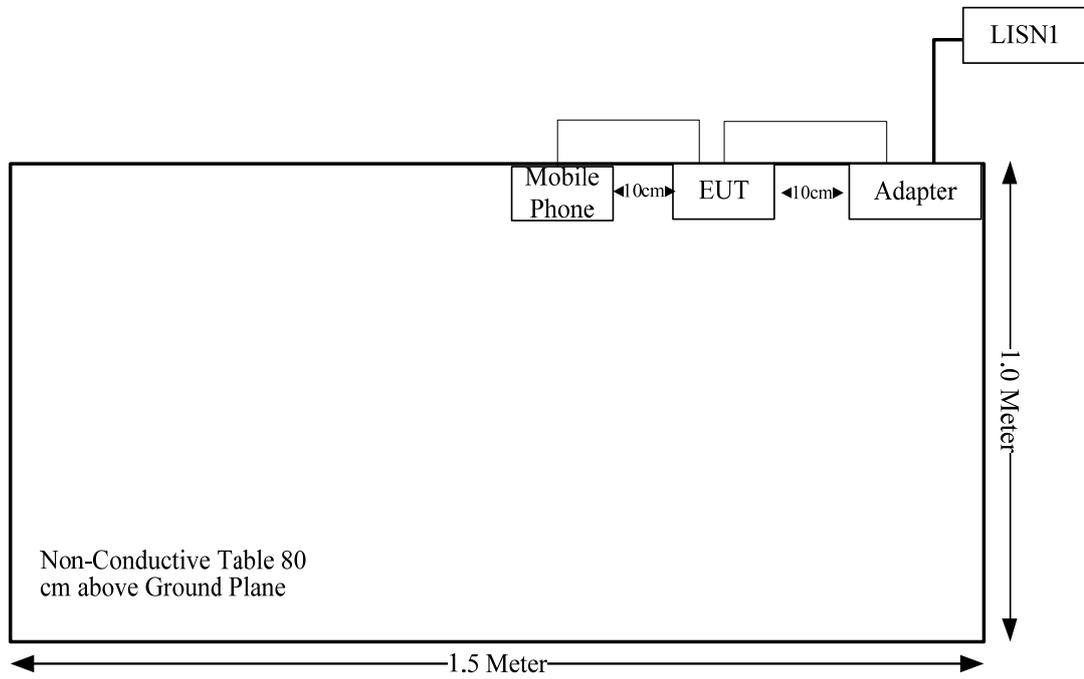
### Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Switching Power Supply	adapter	HB05M-0501501SPA	7376088
Apple	iPhone	A1863	2017011606002400

### Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
USB Cable	yes	No	0.8	Adapter	EUT
Audio Line	Yes	No	0.8	iPhone	EUT

### Block Diagram of Test Setup



**SUMMARY OF TEST RESULTS**

<b>FCC Rules</b>	<b>Description of Test</b>	<b>Result</b>
FCC§15.247 (i) & §1.1310 & §2.1093	RF Exposure	Compliance
FCC §15.203	Antenna requirement	Compliance
FCC §15.207(a)	AC line conducted emissions	Compliance
FCC §15.205, §15.209, §15.247(d)	Spurious emissions	Compliance
FCC §15.247(a)(1)	Channel separation	Compliance
FCC §15.247(a)(1)	20 dB bandwidth	Compliance
FCC §15.247(a)(1)(iii)	Quantity of hopping channel test	Compliance
FCC §15.247(a)(1)(iii)	Time of occupancy (dwell time)	Compliance
FCC §15.247(b)(1)	Peak output power measurement	Compliance
FCC §15.247(d)	Band edges	Compliance

## **FCC §15.247 (i) & §1.1310 & §2.1093- RF EXPOSURE**

### **Applicable Standard**

According to §15.247(i) and §1.1310, 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 KDB447498 D01 General RF Exposure Guidance v06:

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances  $\leq 50$  mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}]$   
 $\leq 3.0$  for 1-g SAR and  $\leq 7.5$  for 10-g extremity SAR, where

- $f(\text{GHz})$  is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

The test exclusions are applicable only when the minimum test separation distance is  $\leq 50$  mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is  $< 5$  mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

### **Measurement Result**

The max conducted power including tune-up tolerance is 2.0 dBm (1.58 mW).  
 $[(\text{max. power of channel, mW})/(\text{min. test separation distance, mm})][\sqrt{f(\text{GHz})}]$   
 $= 1.58/5 \cdot (\sqrt{2.480}) = 0.5 < 3.0$

**So the stand-alone SAR evaluation is not necessary.**

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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 FPC antenna arrangement for BT, and the antenna gain is 0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

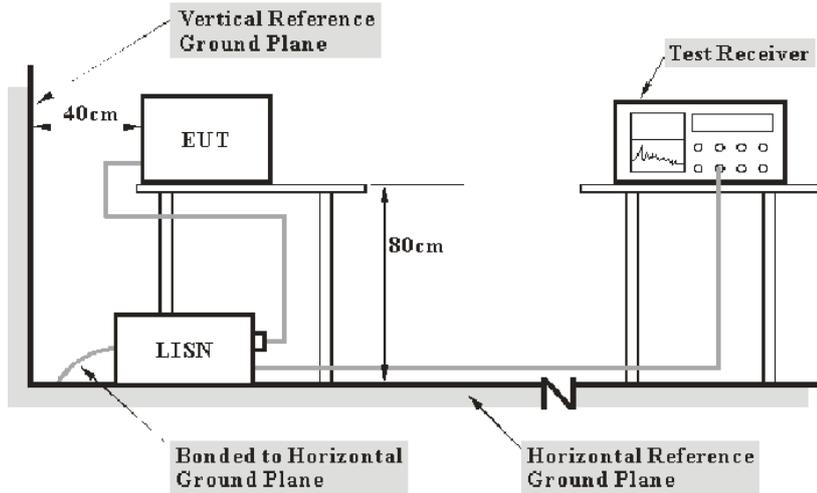
**Result:** Compliance.

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

**Applicable Standard**

FCC§15.207(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 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.

The adapter was connected to the main LISN with a 120 V/60 Hz AC power source.

**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 adapter was connected to the outlet of the first LISN.

The frequency and amplitude of the six highest ac power-line conducted emissions relative to the limit, measured over all the current-carrying conductors of the EUT power cords, and the operating frequency or frequency to which the EUT is tuned (if appropriate), should be reported, unless such emissions are more than 20 dB below the limit. AC power-line conducted emissions measurements are to be separately carried out only on each of the phase (“hot”) line(s) and (if used) on the neutral line(s), but not on the ground [protective earth] line(s). If less than six emission frequencies are within 20 dB of the limit, then the noise level of the measuring instrument at representative frequencies should be reported. The specific conductor of the power-line cord for each of the reported emissions should be identified. Measure the six highest emissions with respect to the limit on each current-carrying conductor of each power cord associated with the EUT (but not the power cords of associated or peripheral equipment that are part of the test configuration). Then, report the six highest emissions with respect to the limit from among all the measurements identifying the frequency and specific current-carrying conductor identified with the emission. The six highest emissions should be reported for each of the current-carrying conductors, or the six highest emissions may be reported over all the current-carrying conductors.

## Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$$V_C = V_R + A_C + VDF$$

Herein,

$V_C$ : corrected voltage amplitude

$V_R$ : reading voltage amplitude

$A_C$ : attenuation caused by cable loss

$VDF$ : voltage division factor of AMN or ISN

The “**Margin**” column of the following data tables indicates the degree of compliance within 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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	LISN	ENV 216	101614	2019-09-12	2020-09-12
R&S	EMI Test Receiver	ESCI	101121	2020-05-09	2021-05-09
Unknown	Coaxial Cable	C-NJNJ-50	C-0200-01	2019-09-05	2020-09-05
R&S	Test Software	EMC32	Version8.53.0	N/A	N/A

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

**Test Data**

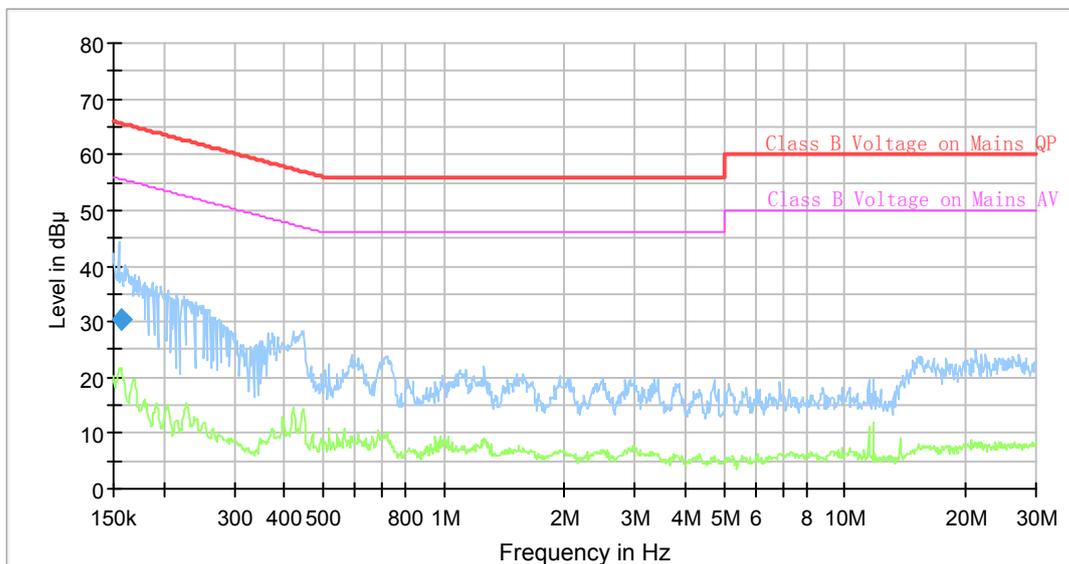
**Environmental Conditions**

<b>Temperature:</b>	26.6 °C
<b>Relative Humidity:</b>	68%
<b>ATM Pressure:</b>	100.7kPa
<b>Tester:</b>	Leo Long
<b>Test Date:</b>	2020-08-05

**Test Result:** Compliance

**Test Mode:** Transmitting

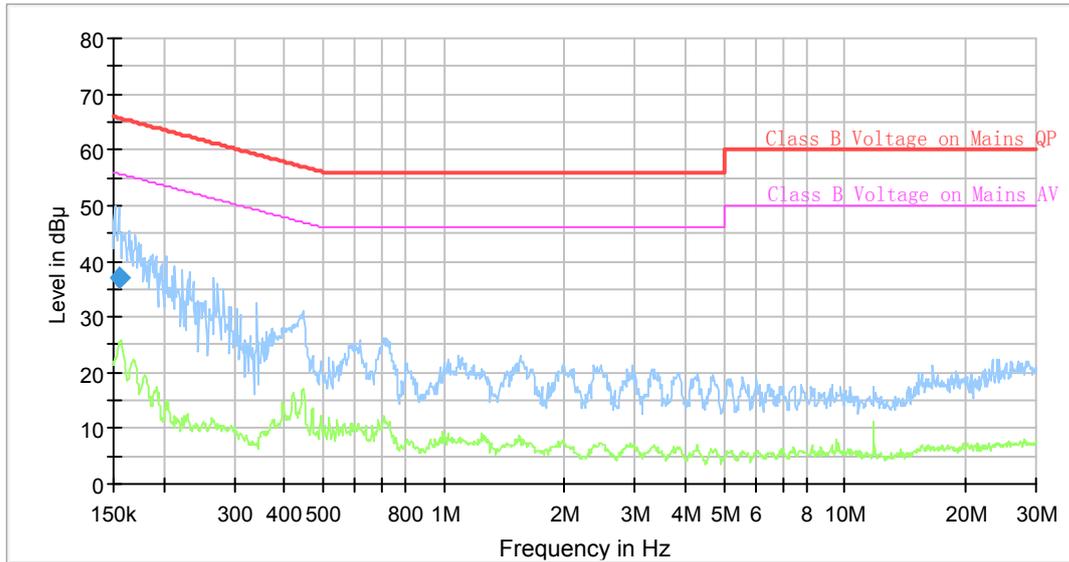
**AC120V, 60 Hz, Line:**



**Final Result**

Frequency (MHz)	QuasiPeak (dB µV)	Average (dB µV)	Limit (dB µV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.156887	30.26	---	65.63	35.37	9.000	L1	9.6

**AC120V, 60 Hz, Neutral:**



**Final Result**

Frequency (MHz)	QuasiPeak (dB µ V)	Average (dB µ V)	Limit (dB µ V)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.154557	37.13	---	65.75	28.62	9.000	N	9.6

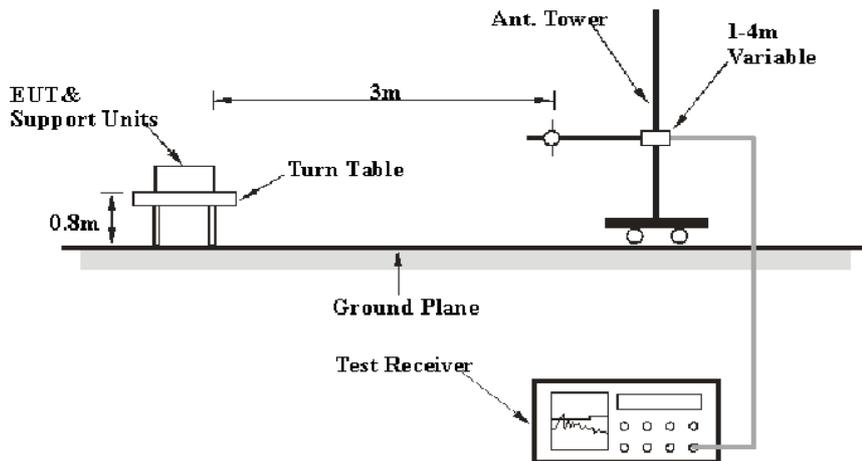
## FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

### Applicable Standard

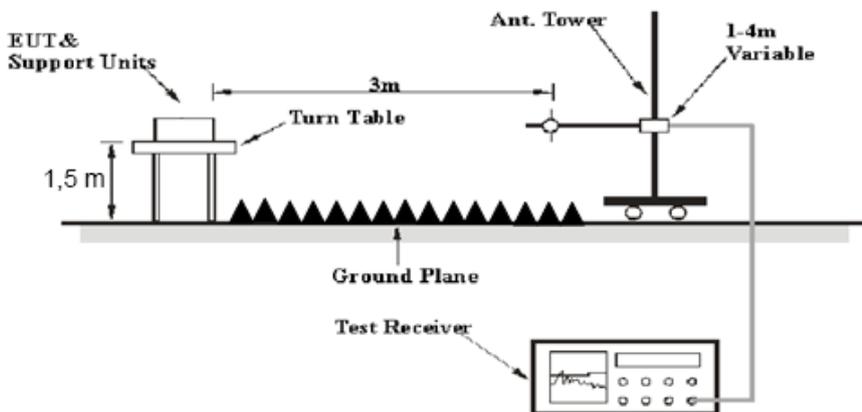
FCC §15.247 (d); §15.209; §15.205;

### EUT Setup

#### Below 1GHz:



#### Above 1GHz:



The radiated emission below 1GHz tests were performed in the 3 meters chamber A, above 1GHz tests were performed in the 3 meters chamber B, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

## EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

According to FCC public notice: DA-00-705, during the radiated emission test, 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	120 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	AV

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

## Test Procedure

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

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz - 1 GHz, peak and average detection modes for frequencies above 1 GHz.

## Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiation Below 1GHz					
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2020-11-10
R&S	EMI Test Receiver	ESR3	102453	2019-09-12	2020-09-12
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2019-09-05	2020-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2019-09-05	2020-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-1400-01	2020-05-06	2021-05-06
HP	Amplifier	8447D	2727A05902	2019-09-05	2020-09-05
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
Radiation Above 1GHz					
ETS-Lindgren	Horn Antenna	3115	000 527 35	2018-10-12	2021-10-12
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2017-12-06	2020-12-05
Agilent	Spectrum Analyzer	E4440A	SG43360054	2020-07-07	2021-07-07
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2019-09-05	2020-09-05
Unknown	Coaxial Cable	C-2.4J2.4J-50	C-0700-02	2020-06-27	2021-06-27
Mini-Circuit	Amplifier	ZVA-213-S+	54201245	2019-09-05	2020-09-05
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2020-06-27	2021-06-27
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
E-Microwave	Band-stop Filters	OBSF-2400-2483.5-S	OE01601525	2020-06-16	2021-06-16
Micro-tronics	High Pass Filter	HPM50111	S/N-G217	2020-06-16	2021-06-16

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

## 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

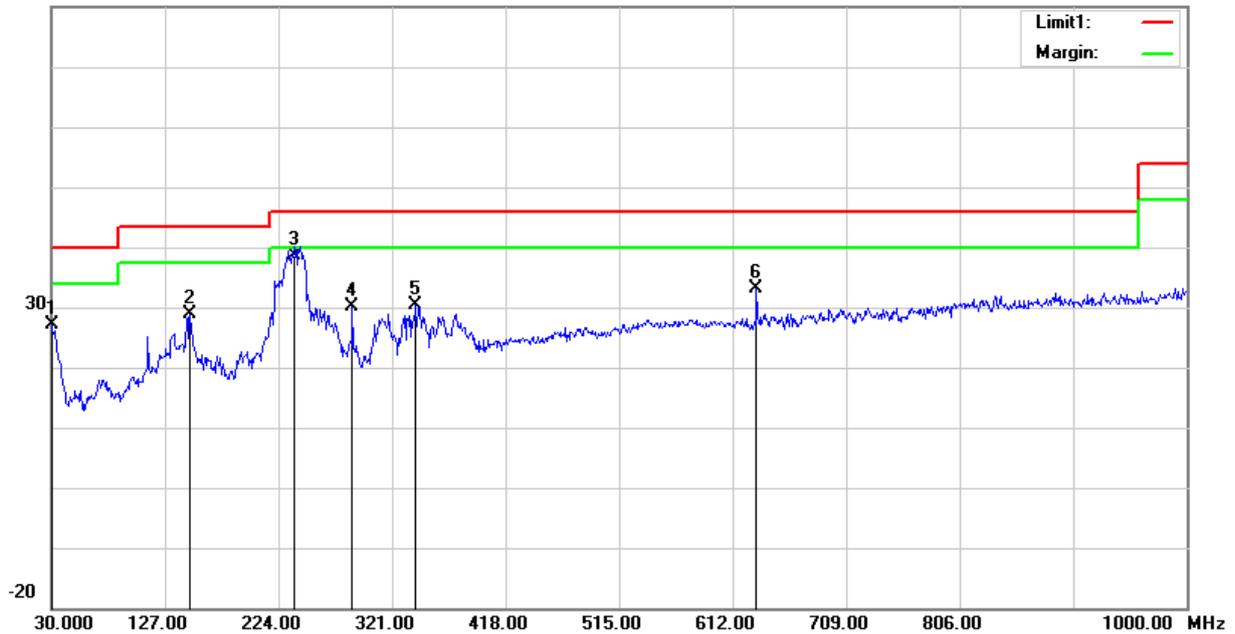
Test Items	Radiation Below 1GHz	Radiation Above 1GHz
Temperature:	27.9C	28°C
Relative Humidity:	43%	50%
ATM Pressure:	100.7kPa	100.7kPa
Tester:	Jalon Liu	Joker Chen
Test Date:	2020-08-05	2020-08-05

*Test Mode: Transmitting*

1) 30MHz-1GHz (BDR High channel was the worst)

Horizontal:

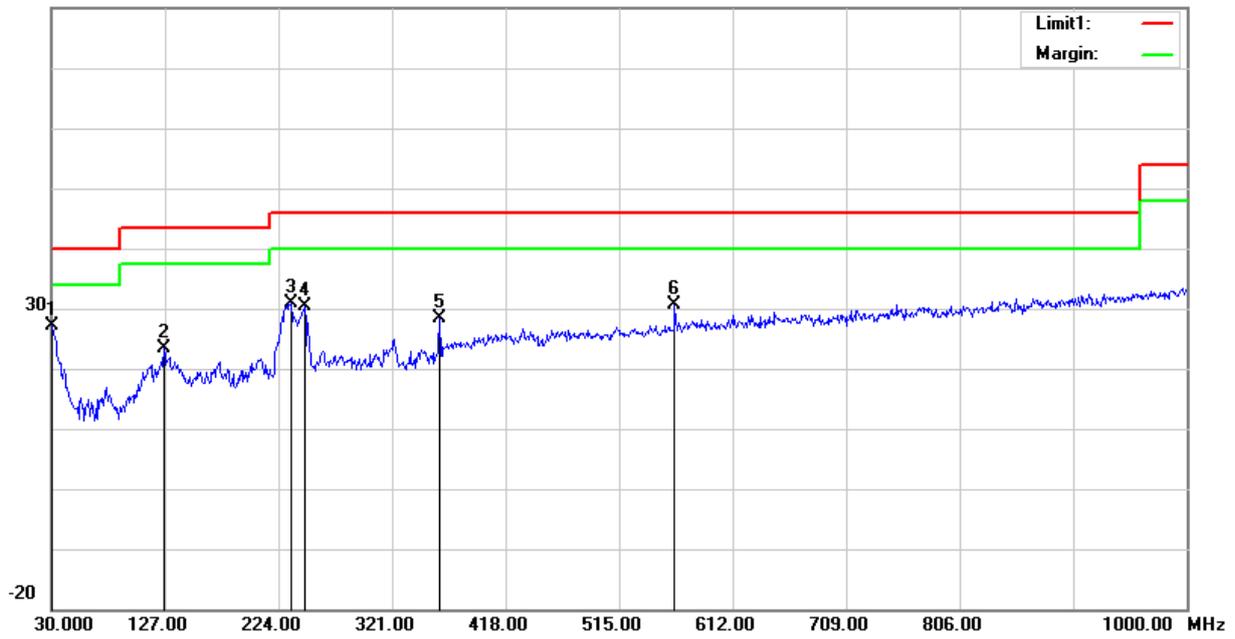
80.0 dBuV/m



Frequency (MHz)	Receiver Reading (dBµV)	Remark	Correction Factor (dB/m)	Cord. Amp. (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30.0000	25.64	peak	1.46	27.10	40.00	12.90
148.3400	35.02	peak	-6.22	28.80	43.50	14.70
237.5800	44.76	QP	-6.12	38.64	46.00	7.36
287.0500	33.91	peak	-3.89	30.02	46.00	15.98
341.3700	33.66	peak	-3.33	30.33	46.00	15.67
632.3700	31.40	peak	1.81	33.21	46.00	12.79

**Vertical:**

80.0 dB $\mu$ V/m



Frequency (MHz)	Receiver Reading (dB $\mu$ V)	Remark	Correction Factor (dB/m)	Cord. Amp. (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)
30.9700	26.34	peak	0.74	27.08	40.00	12.92
126.0300	28.28	peak	-4.86	23.42	43.50	20.08
234.6700	37.13	peak	-6.25	30.88	46.00	15.12
246.3100	36.25	peak	-5.89	30.36	46.00	15.64
361.7400	31.09	peak	-2.76	28.33	46.00	17.67
562.5300	30.25	peak	0.49	30.74	46.00	15.26

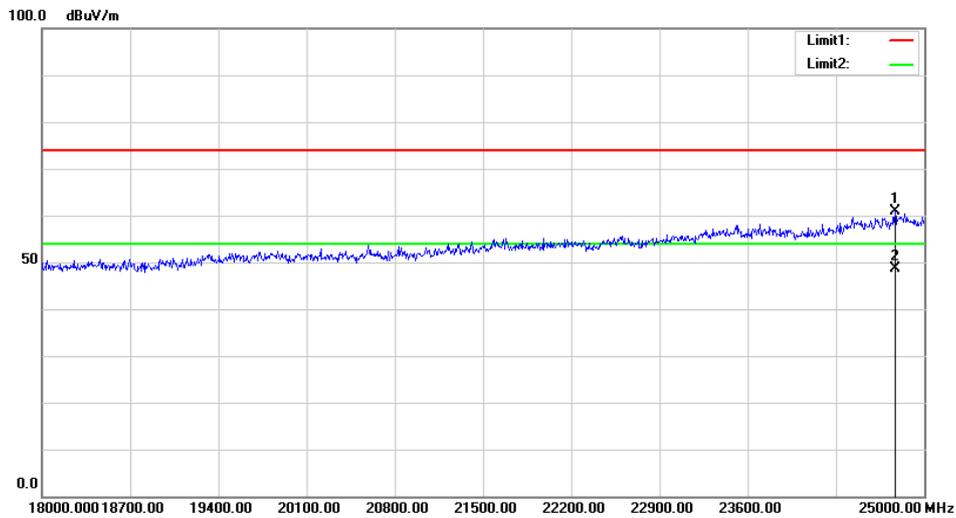
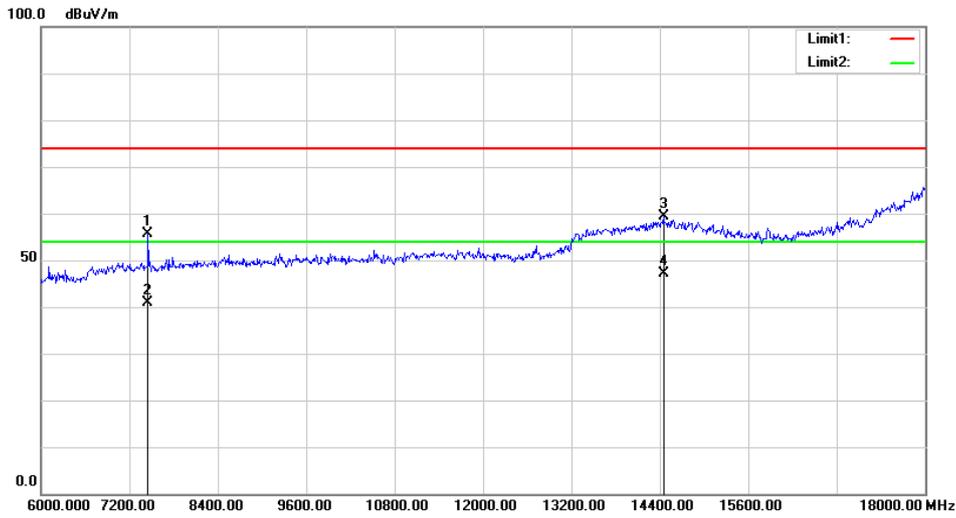
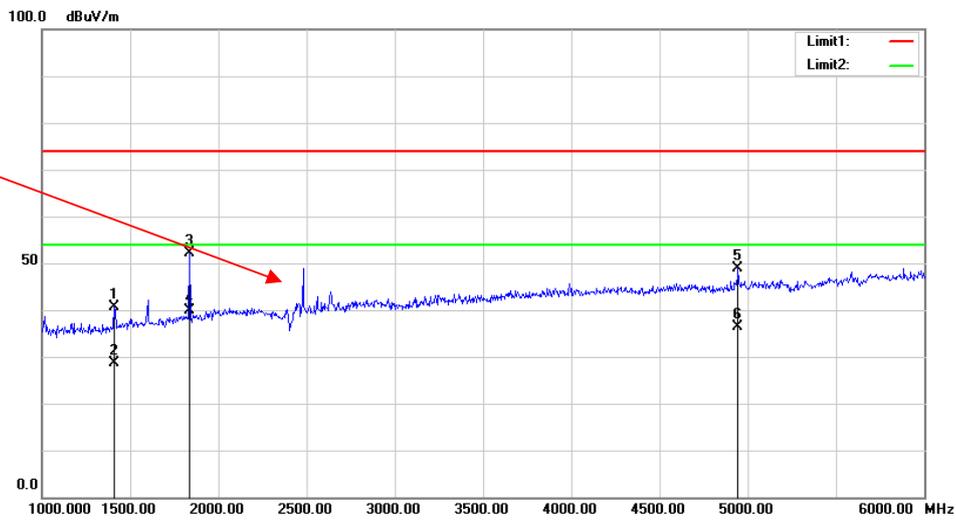
**2)1GHz-25GHz:**

*BDR Mode(GFSK) was the worst:*

Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	Remark	Polar (H/V)	Factor (dB/m)					
Low Channel: 2402 MHz									
2402.00	65.36	PK	H	28.10	1.80	0.00	95.26	N/A	N/A
2402.00	54.78	AV	H	28.10	1.80	0.00	84.68	N/A	N/A
2402.00	63.12	PK	V	28.10	1.80	0.00	93.02	N/A	N/A
2402.00	52.61	AV	V	28.10	1.80	0.00	82.51	N/A	N/A
2390.00	30.77	PK	H	28.08	1.80	0.00	60.65	74.00	13.35
2390.00	13.48	AV	H	28.08	1.80	0.00	43.36	54.00	10.64
4804.00	36.68	PK	H	32.91	3.17	25.60	47.16	74.00	26.84
4804.00	23.23	AV	H	32.91	3.17	25.60	33.71	54.00	20.29
7206.00	35.36	PK	H	35.74	4.82	25.60	50.32	74.00	23.68
7206.00	22.74	AV	H	35.74	4.82	25.60	37.70	54.00	16.30
Middle Channel: 2441 MHz									
2441.00	65.76	PK	H	28.18	1.82	0.00	95.76	N/A	N/A
2441.00	55.12	AV	H	28.18	1.82	0.00	85.12	N/A	N/A
2441.00	63.51	PK	V	28.18	1.82	0.00	93.51	N/A	N/A
2441.00	53.02	AV	V	28.18	1.82	0.00	83.02	N/A	N/A
4882.00	36.64	PK	H	33.06	3.27	25.66	47.31	74.00	26.69
4882.00	23.02	AV	H	33.06	3.27	25.66	33.69	54.00	20.31
7323.00	35.58	PK	H	36.04	4.62	25.73	50.51	74.00	23.49
7323.00	22.70	AV	H	36.04	4.62	25.73	37.63	54.00	16.37
High Channel: 2480 MHz									
2480.00	65.86	PK	H	28.26	1.84	0.00	95.96	N/A	N/A
2480.00	54.93	AV	H	28.26	1.84	0.00	85.03	N/A	N/A
2480.00	64.66	PK	V	28.26	1.84	0.00	94.76	N/A	N/A
2480.00	53.94	AV	V	28.26	1.84	0.00	84.04	N/A	N/A
2483.50	42.31	PK	H	28.27	1.84	0.00	72.42	74.00	1.58
2483.50	14.11	AV	H	28.27	1.84	0.00	44.22	54.00	9.78
4960.00	40.08	PK	H	33.22	3.23	25.63	50.90	74.00	23.10
4960.00	26.44	AV	H	33.22	3.23	25.63	37.26	54.00	16.74
7440.00	38.83	PK	H	36.34	4.41	25.85	53.73	74.00	20.27
7440.00	26.26	AV	H	36.34	4.41	25.85	41.16	54.00	12.84

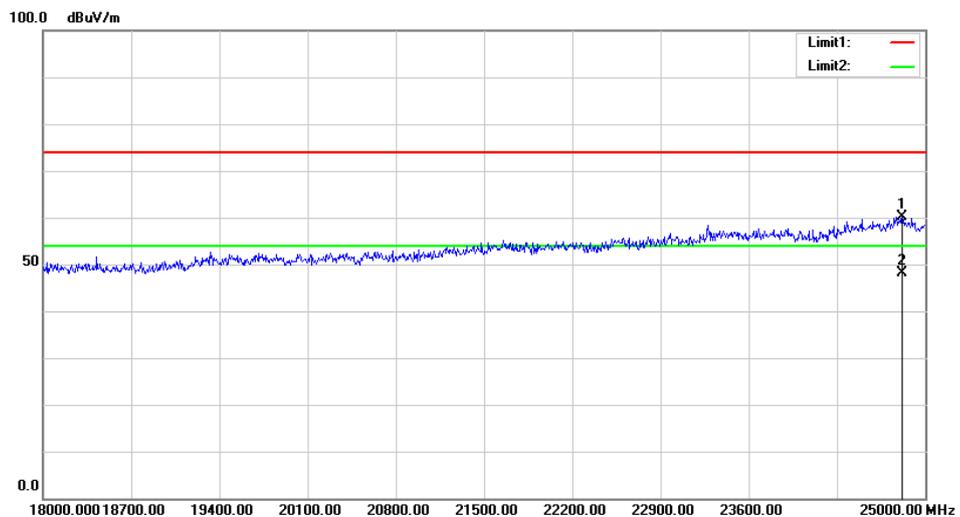
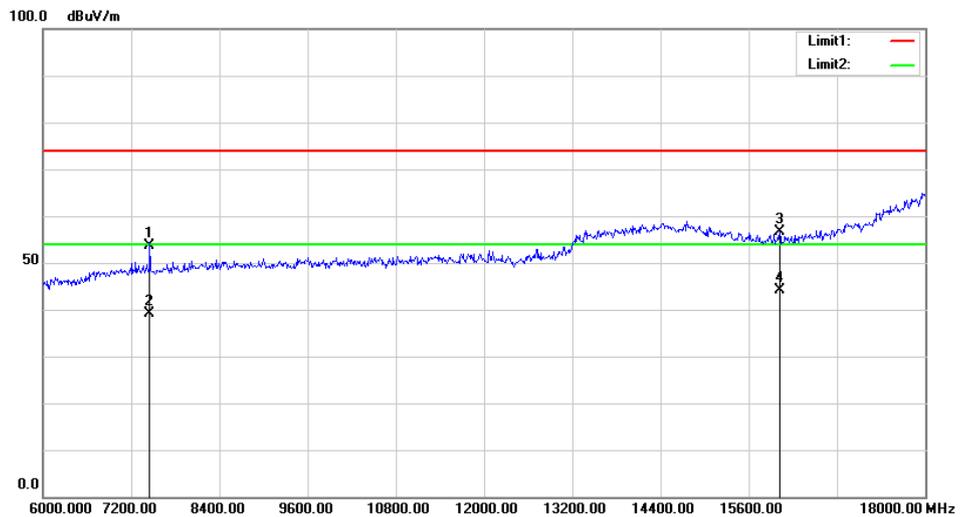
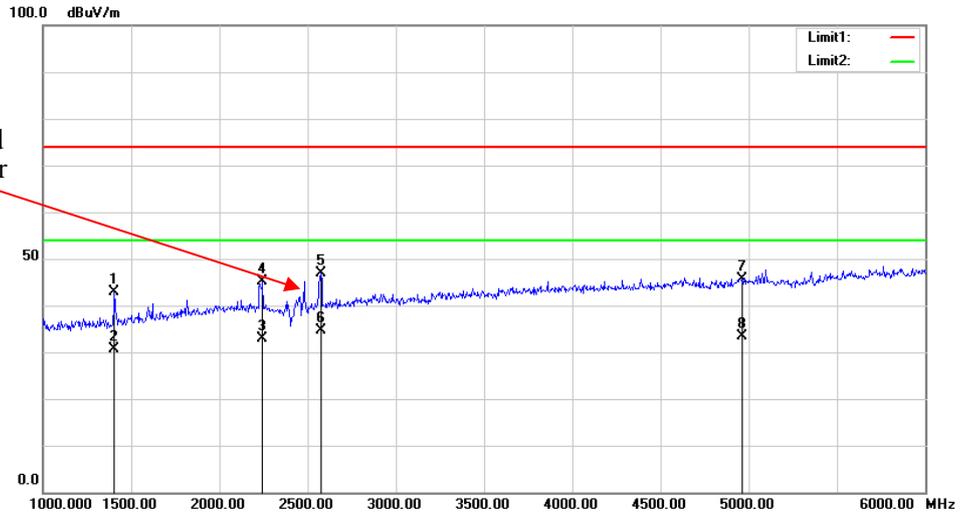
**Worst plots (BDR high channel was the worst)**  
**Horizontal**

Fundamental  
Test with Band  
Rejection Filter



Vertical

Fundamental  
Test with Band  
Rejection Filter



## 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 20dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.50 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW.

### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100035	2019-09-19	2020-09-19
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

### Test Procedure

1. Set the EUT in transmitting mode, spectrum Bandwidth was set at 30 kHz, maxhold the channel.
2. Set the adjacent channel of the EUT maxhold another trace.
3. Measure the channel separation.

### Test Data

#### Environmental Conditions

<b>Temperature:</b>	25.3~25.7 °C
<b>Relative Humidity:</b>	50~69%
<b>ATM Pressure:</b>	100.4~101kPa
<b>Test by:</b>	Chris Mo
<b>Test Date:</b>	2020-08-03 & 2020-08-06

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

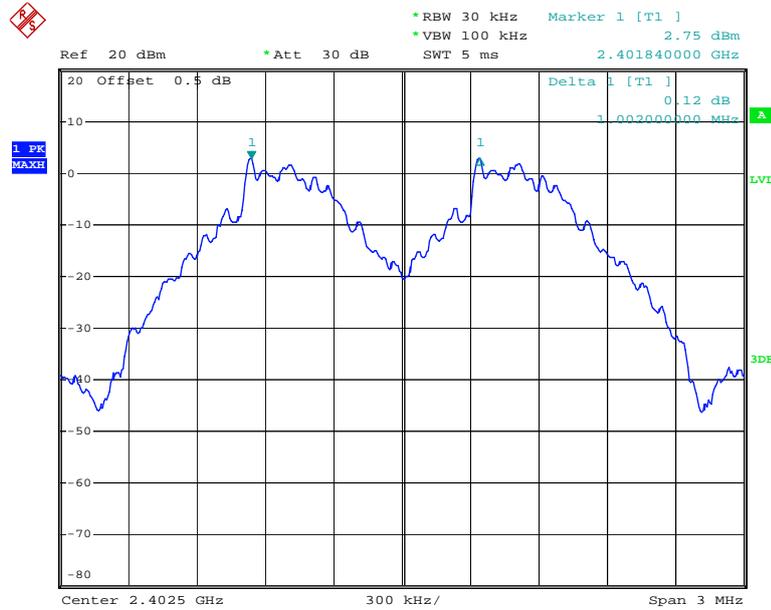
Test Mode: Transmitting

Mode	Channel	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)
BDR (GFSK)	Low	2402	1.002	0.62
	Middle	2441	1.002	0.62
	High	2480	1.008	0.61
EDR ( $\pi/4$ -DQPSK)	Low	2402	1.002	0.88
	Middle	2441	1.002	0.88
	High	2480	1.002	0.89
EDR (8DPSK)	Low	2402	1.002	0.85
	Middle	2441	1.002	0.85
	High	2480	1.002	0.85

Note: Limit =  $(2/3) \times 20\text{dB bandwidth}$

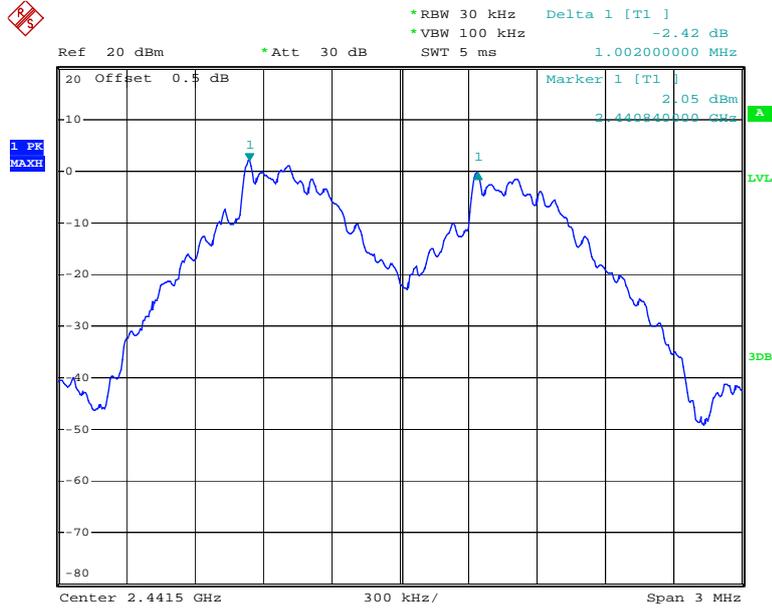
BDR Mode (GFSK):

Low Channel



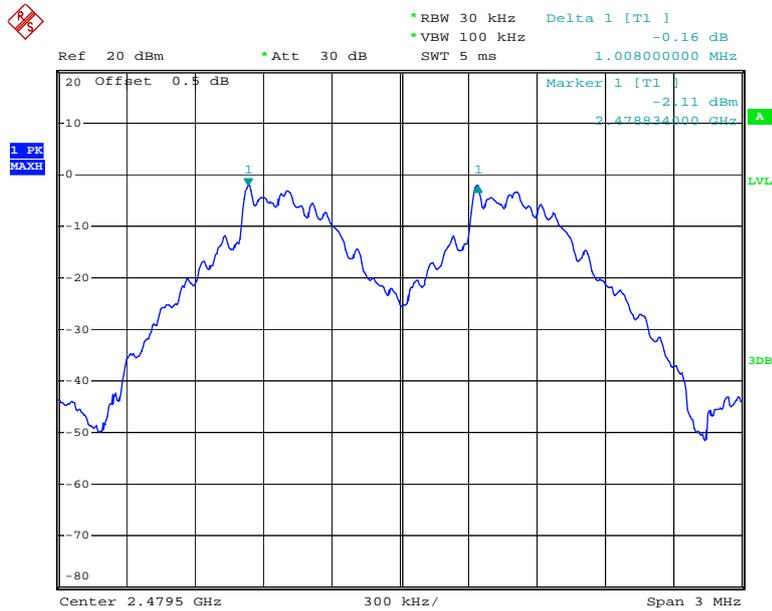
Date: 3.AUG.2020 16:07:33

### Middle Channel



Date: 3.AUG.2020 16:08:31

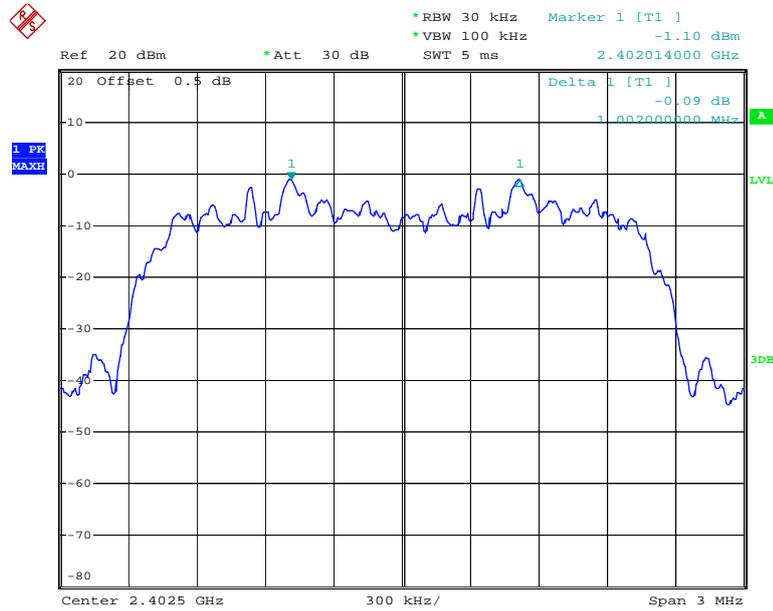
### High Channel



Date: 3.AUG.2020 16:09:34

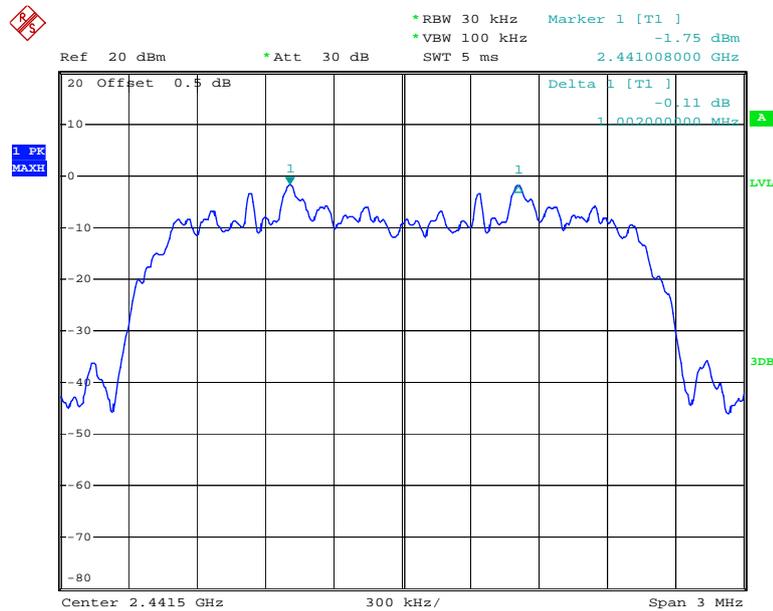
EDR Mode ( $\pi/4$ -DQPSK):

### Low Channel



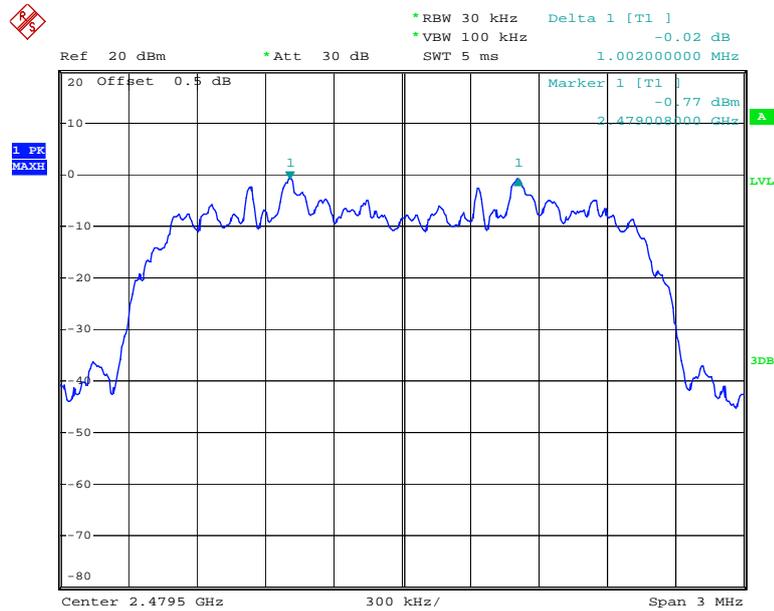
Date: 3.AUG.2020 17:00:07

### Middle Channel



Date: 3.AUG.2020 16:28:30

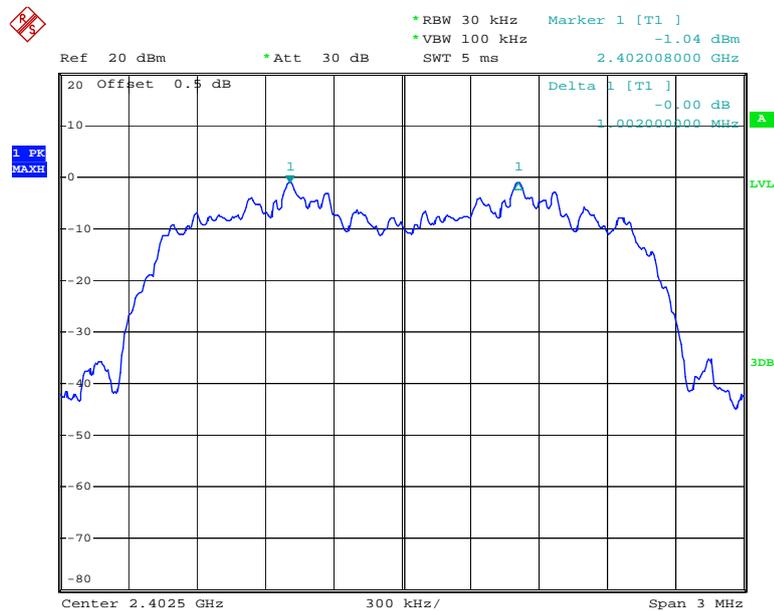
### High Channel



Date: 6.AUG.2020 14:30:07

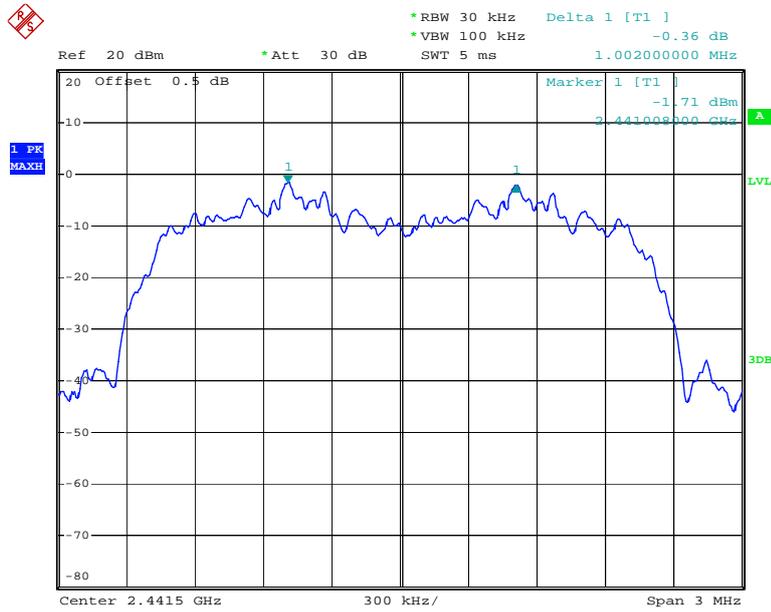
EDR Mode (8DPSK):

### Low Channel



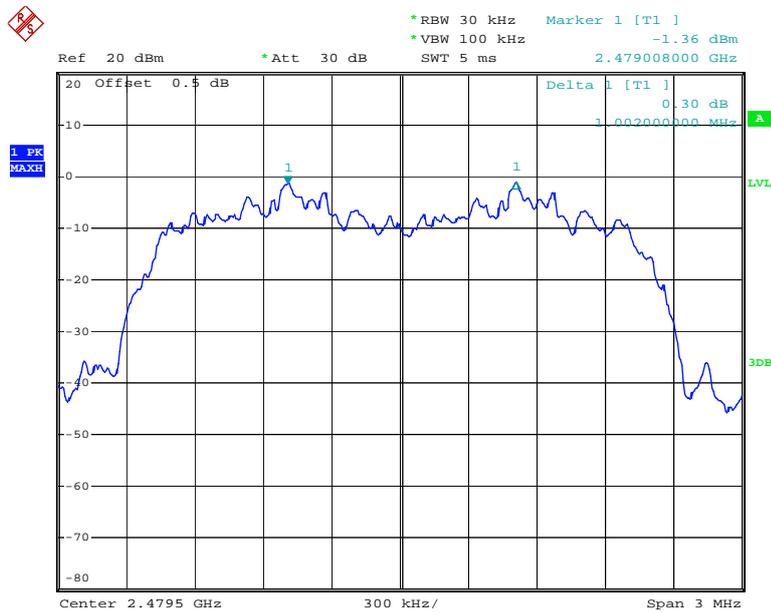
Date: 3.AUG.2020 16:38:36

### Middle Channel



Date: 3.AUG.2020 16:40:04

### High Channel



Date: 6.AUG.2020 14:32:52

## FCC §15.247(a) (1) – 20 dB BANDWIDTH TESTING

### 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 on the test table without connection to measurement instrument. Turn on the EUT. 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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100035	2019-09-19	2020-09-19
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

### Test Data

#### Environmental Conditions

<b>Temperature:</b>	25.7 °C
<b>Relative Humidity:</b>	50%
<b>ATM Pressure:</b>	100.4kPa
<b>Test by:</b>	Chris Mo
<b>Test Date:</b>	2020-08-03

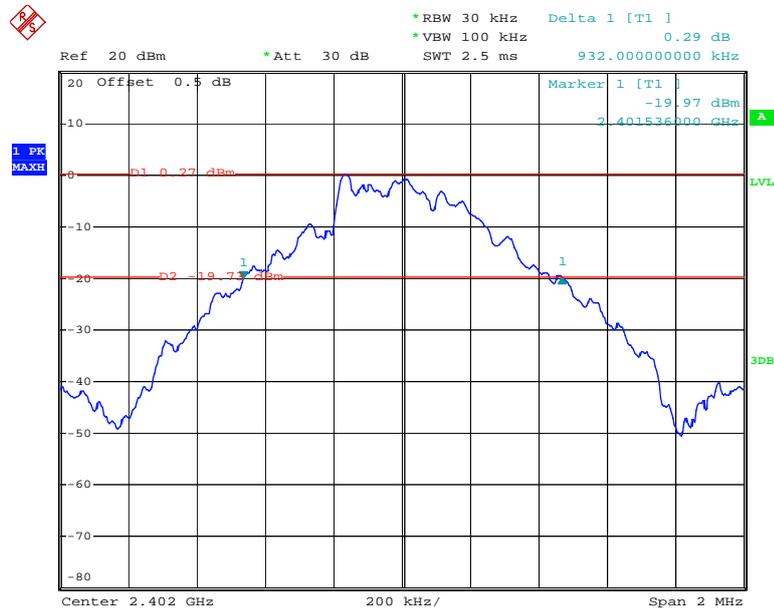
**Test Result:** Compliance. Please refer to following tables and plots

Test Mode: Transmitting

Mode	Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
BDR Mode (GFSK)	Low	2402	0.932
	Middle	2441	0.924
	High	2480	0.920
EDR Mode ( $\pi/4$ -DQPSK)	Low	2402	1.320
	Middle	2441	1.324
	High	2480	1.328
EDR Mode (8DPSK)	Low	2402	1.268
	Middle	2441	1.272
	High	2480	1.276

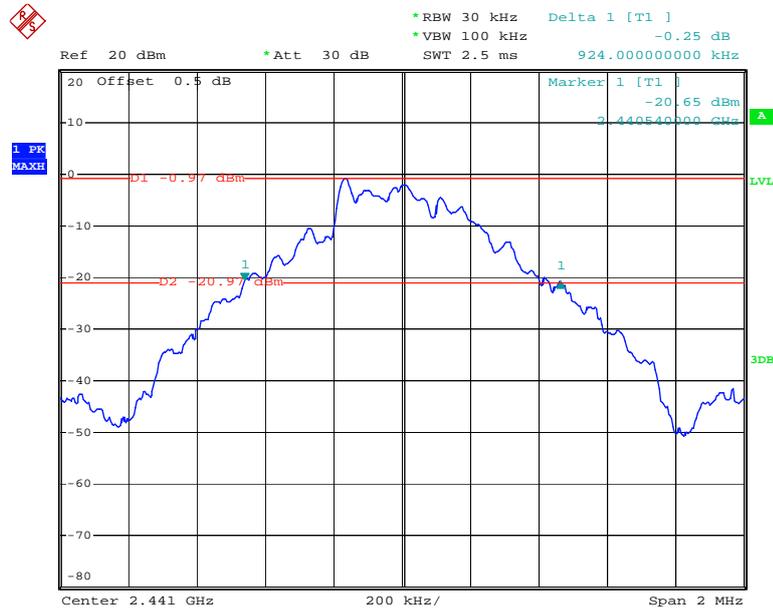
BDR Mode (GFSK):

Low Channel



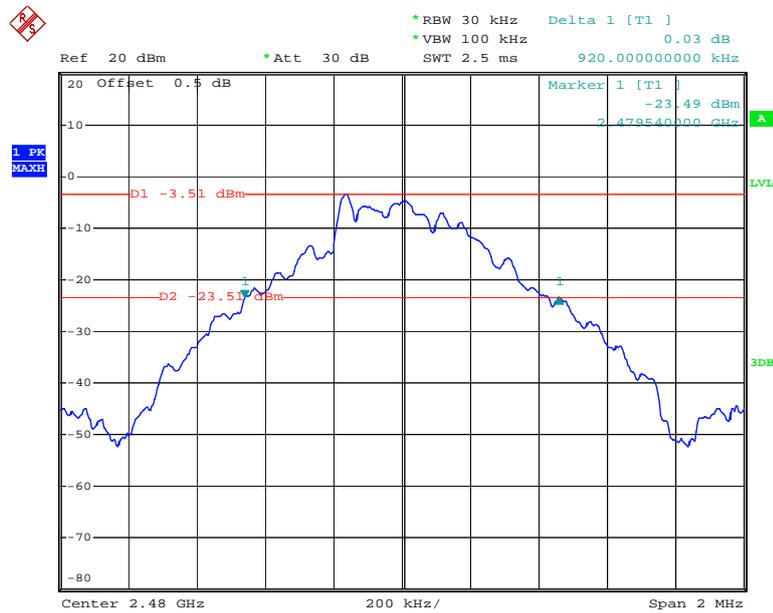
Date: 3.AUG.2020 13:37:31

### Middle Channel



Date: 3.AUG.2020 13:39:00

### High Channel



Date: 3.AUG.2020 13:40:21

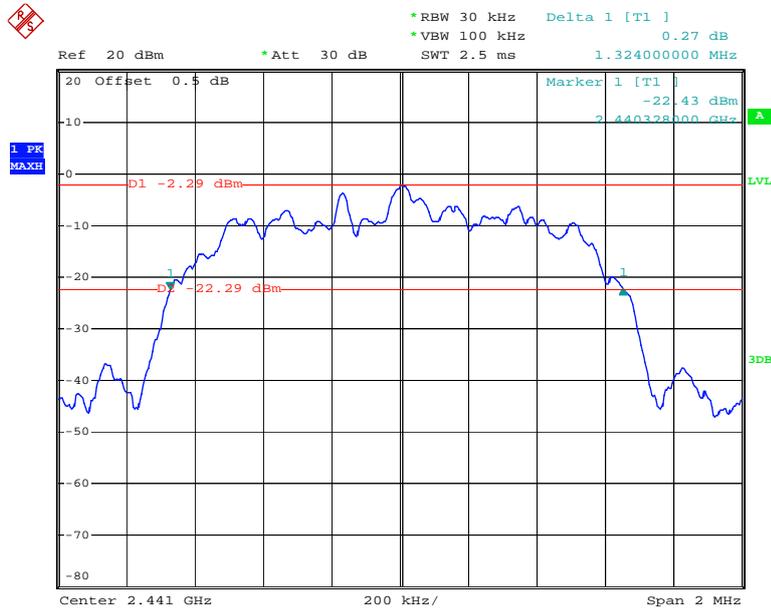
EDR Mode ( $\pi/4$ -DQPSK):

### Low Channel



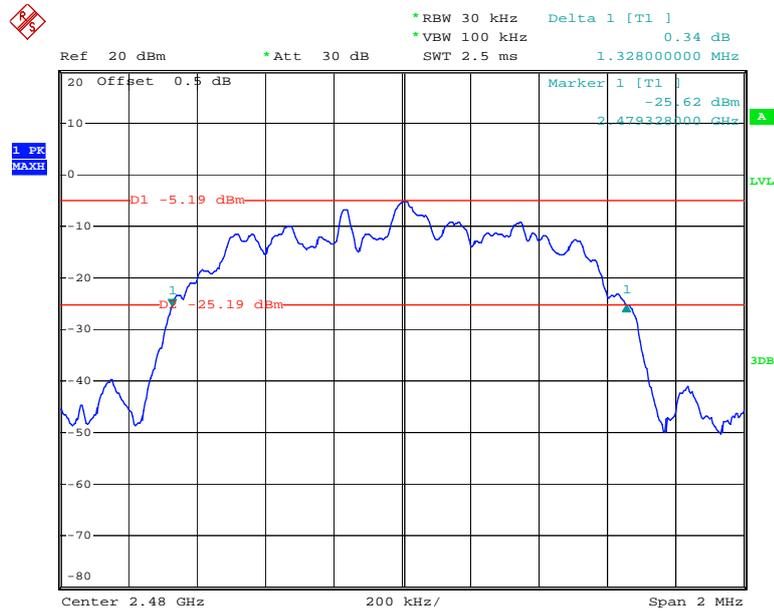
Date: 3.AUG.2020 14:05:34

### Middle Channel



Date: 3.AUG.2020 14:06:49

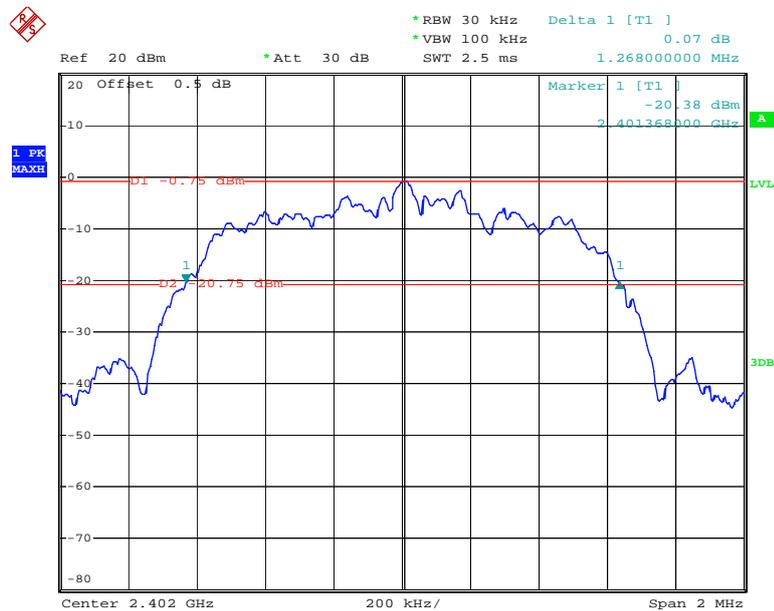
### High Channel



Date: 3.AUG.2020 14:11:53

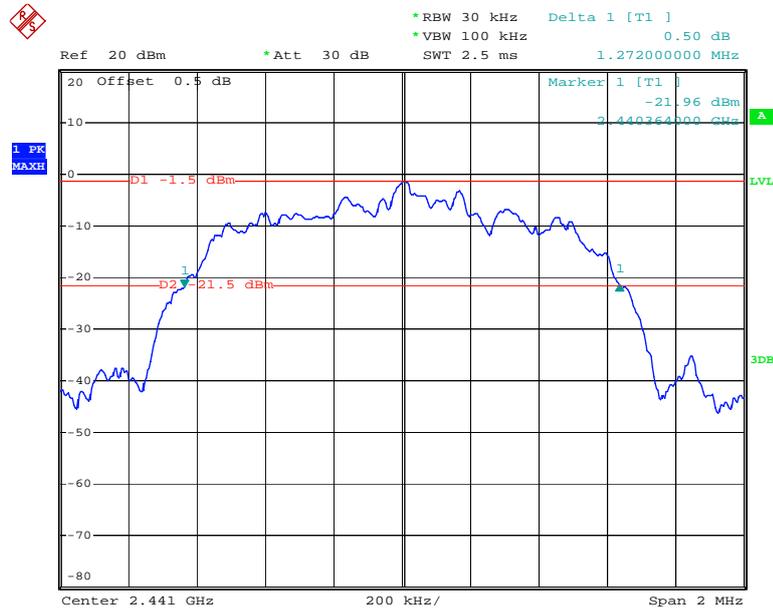
EDR Mode (8DPSK):

### Low Channel



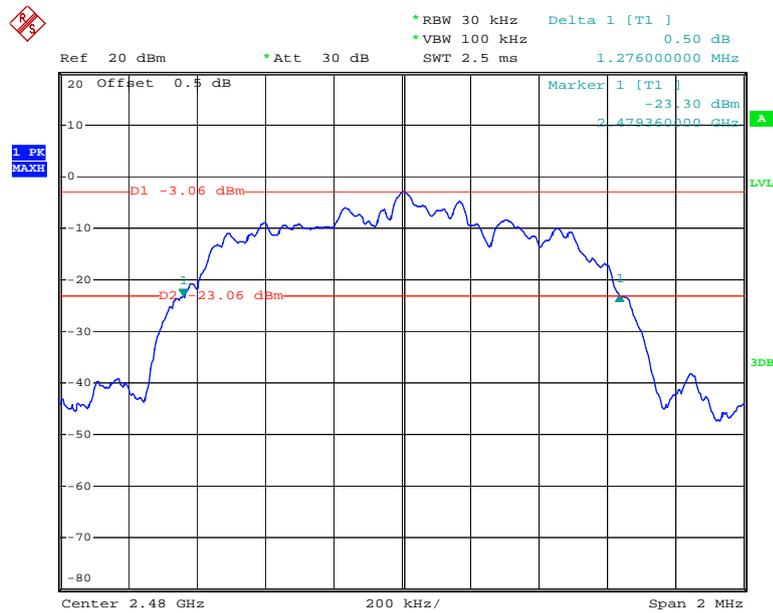
Date: 3.AUG.2020 14:13:33

### Middle Channel



Date: 3.AUG.2020 14:28:06

### High Channel



Date: 3.AUG.2020 14:28:55

## 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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100035	2019-09-19	2020-09-19
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

### Test Data

#### Environmental Conditions

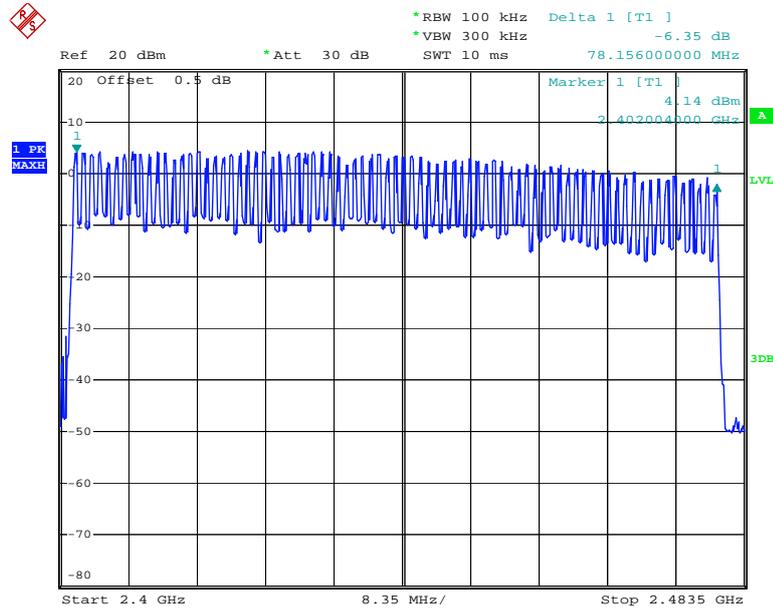
<b>Temperature:</b>	25.7 °C
<b>Relative Humidity:</b>	50%
<b>ATM Pressure:</b>	100.4kPa
<b>Test by:</b>	Chris Mo
<b>Test Date:</b>	2020-08-03

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

*Test Mode: Transmitting*

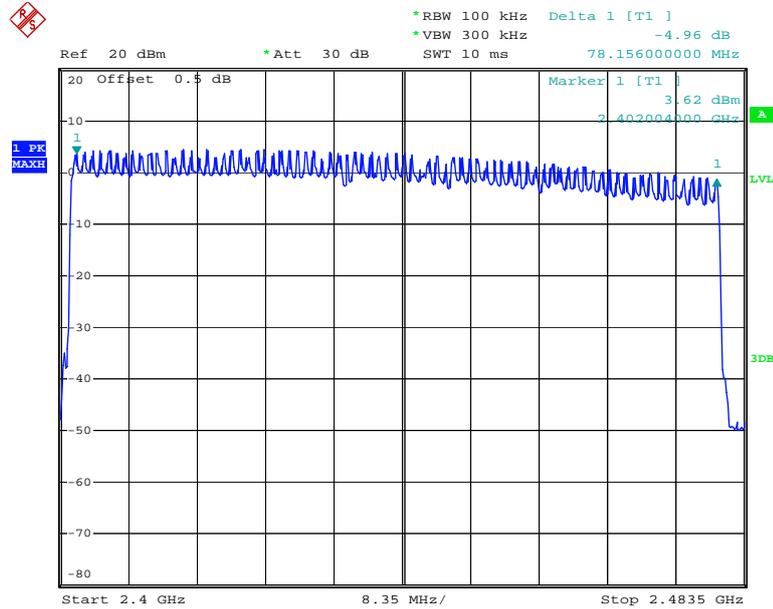
Test mode	Frequency Range (MHz)	Number of Hopping Channel	Limit
GFSK	2400-2483.5	79	≥15
$\pi/4$ -DQPSK	2400-2483.5	79	≥15
8DPSK	2400-2483.5	79	≥15

### BDR Mode (GFSK)



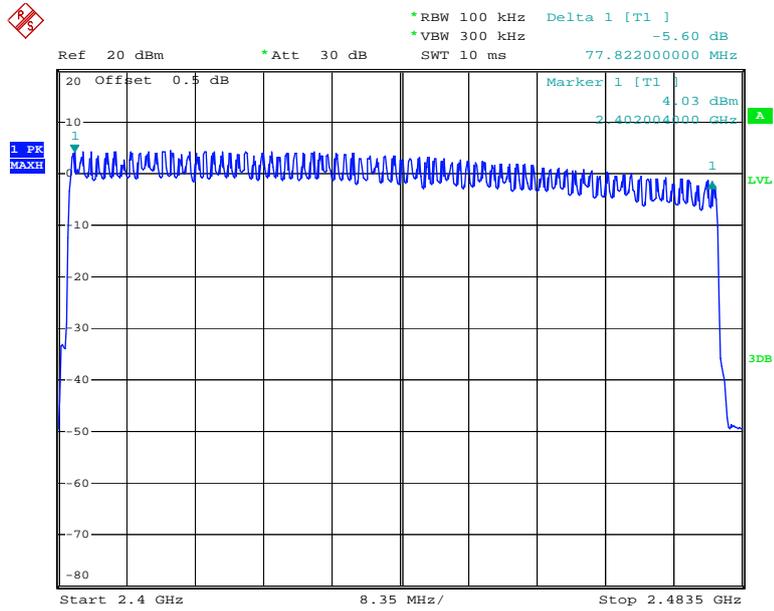
Date: 3.AUG.2020 14:52:56

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



Date: 3.AUG.2020 14:58:39

### EDR Mode (8DPSK)



Date: 3.AUG.2020 15:07:04

## **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**

The EUT was worked in channel hopping; the time of single pulses was tested.

### **Test Equipment List and Details**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100035	2019-09-19	2020-09-19
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

### **Test Data**

#### **Environmental Conditions**

<b>Temperature:</b>	25.7 °C
<b>Relative Humidity:</b>	50%
<b>ATM Pressure:</b>	100.4kPa
<b>Test by:</b>	Chris Mo
<b>Test Date:</b>	2020-08-03

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

Test Mode: Transmitting

Mode	Packet type	Channel	Frequency (MHz)	Pulse width (ms)	Result (s)	Limit (s)
GFSK	DH1	Middle	2441	0.404	0.129	0.4
	DH3	Middle	2441	1.676	0.268	
	DH5	Middle	2441	2.946	0.314	
π/4-DQPSK	2DH1	Middle	2441	0.416	0.133	
	2DH3	Middle	2441	1.694	0.271	
	2DH5	Middle	2441	2.954	0.315	
8DPSK	3DH1	Middle	2441	0.416	0.133	
	3DH3	Middle	2441	1.676	0.268	
	3DH5	Middle	2441	2.946	0.314	

Note:

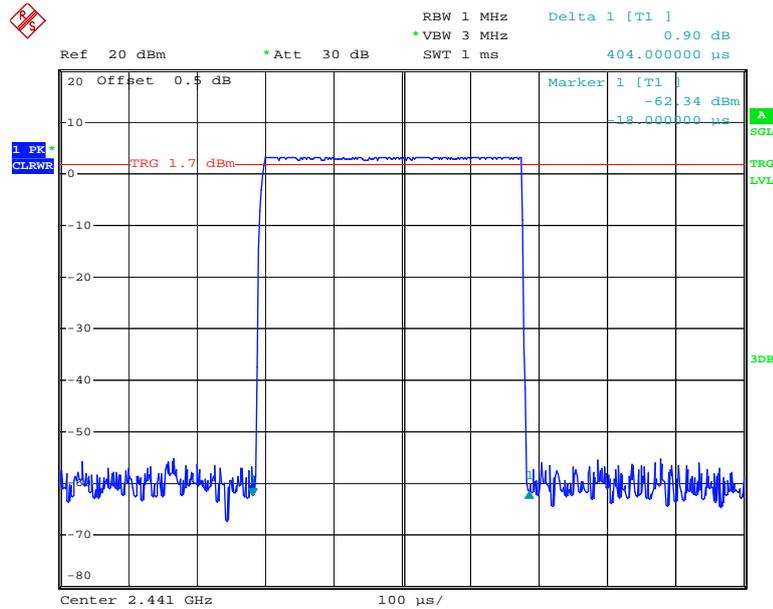
DH1:Dwell time=Pulse time (ms) × (1600/2/79) ×31.6 s

DH3:Dwell time=Pulse time (ms) × (1600/4/79) ×31.6 s

DH5:Dwell time=Pulse time (ms) × (1600/6/79) ×31.6 s

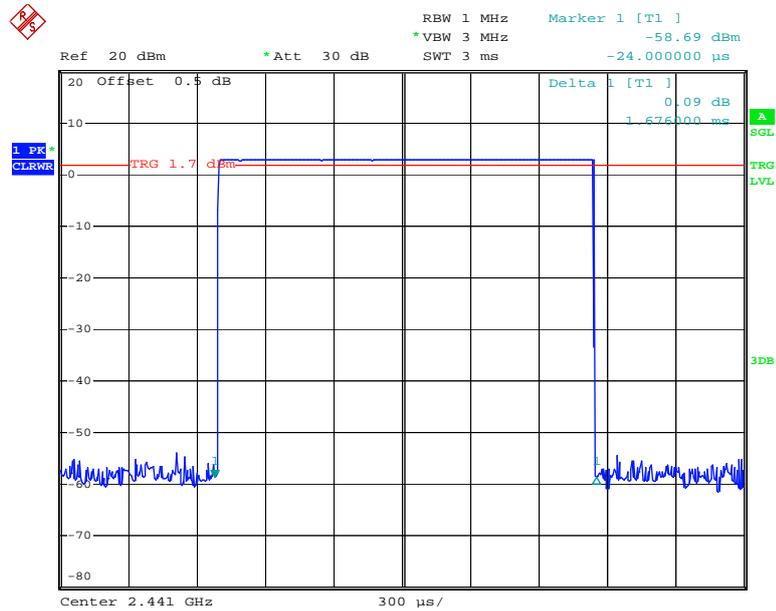
BDR Mode (GFSK):

DH1: Middle Channel



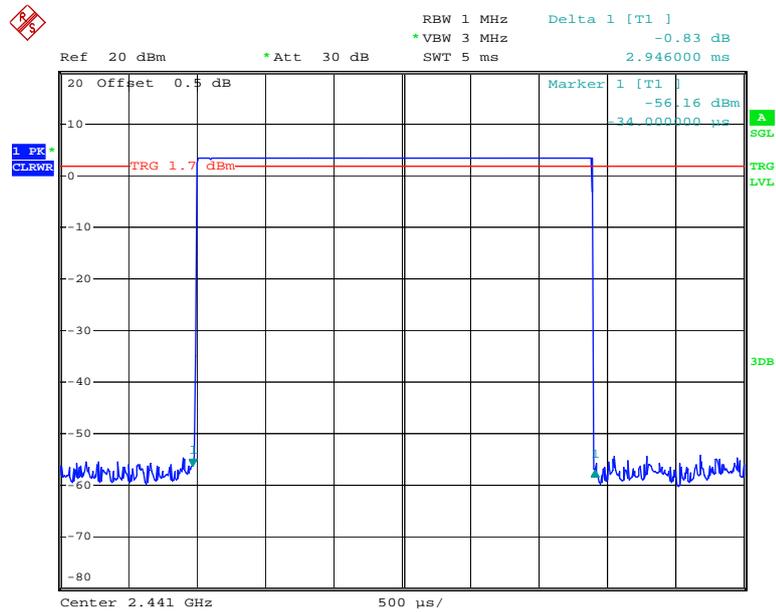
Date: 3.AUG.2020 15:12:21

### DH3: Middle Channel



Date: 3.AUG.2020 15:13:58

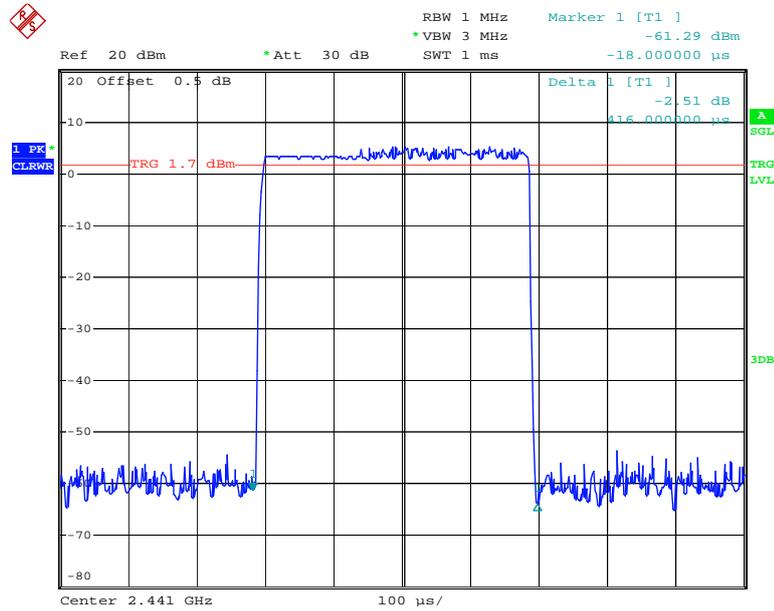
### DH5: Middle Channel



Date: 3.AUG.2020 15:17:28

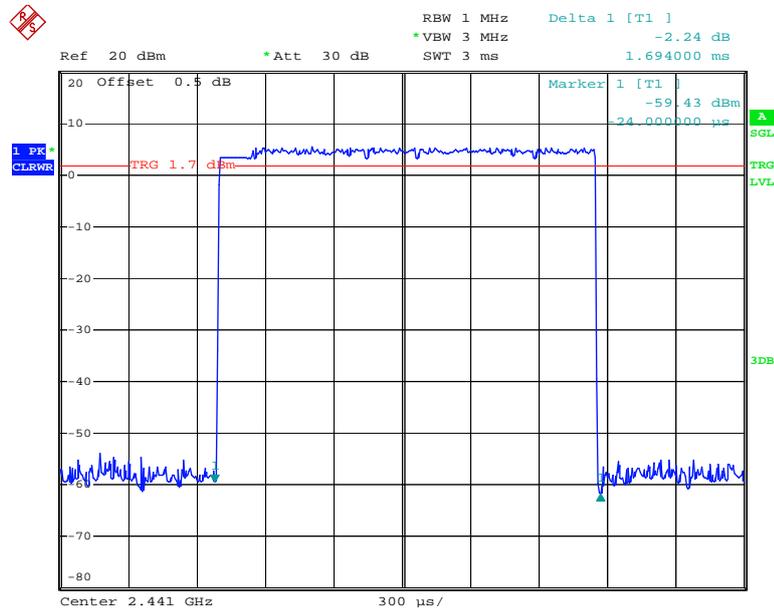
EDR Mode ( $\pi/4$ -DQPSK):

### 2DH1: Middle Channel



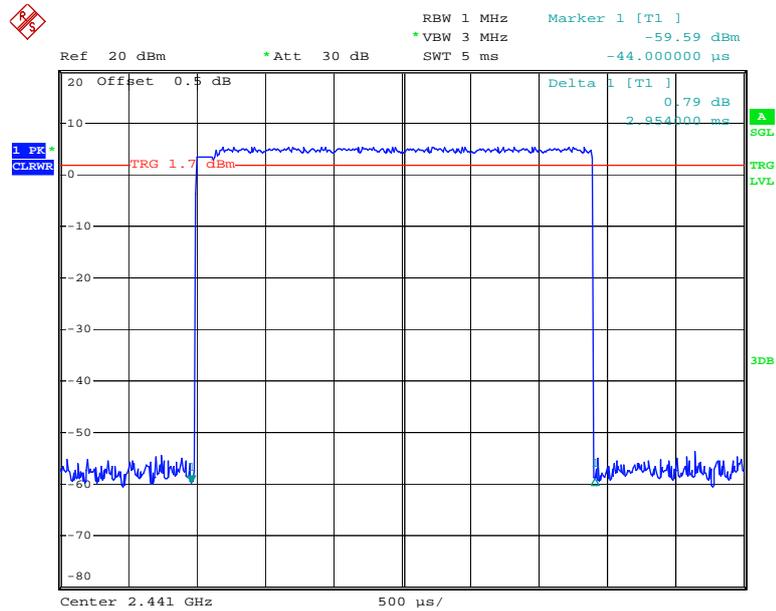
Date: 3.AUG.2020 15:18:53

### 2DH3: Middle Channel



Date: 3.AUG.2020 15:20:03

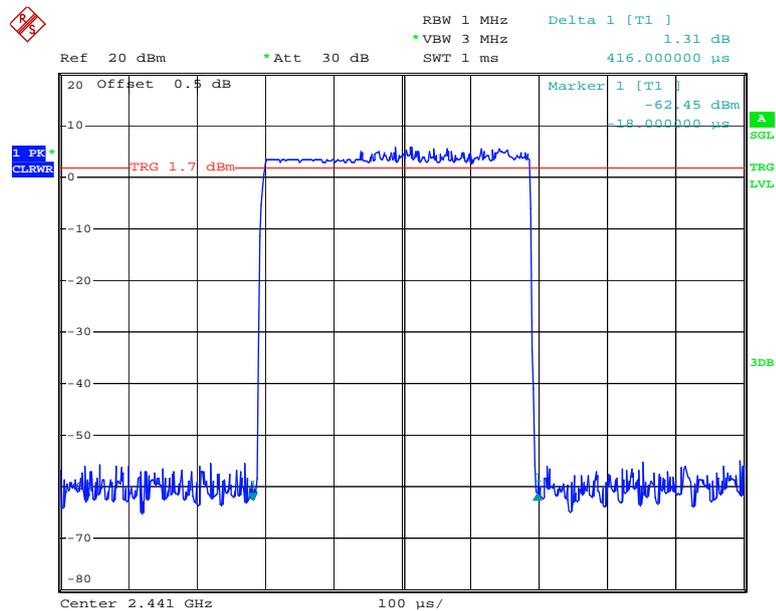
### 2DH5: Middle Channel



Date: 3.AUG.2020 15:21:05

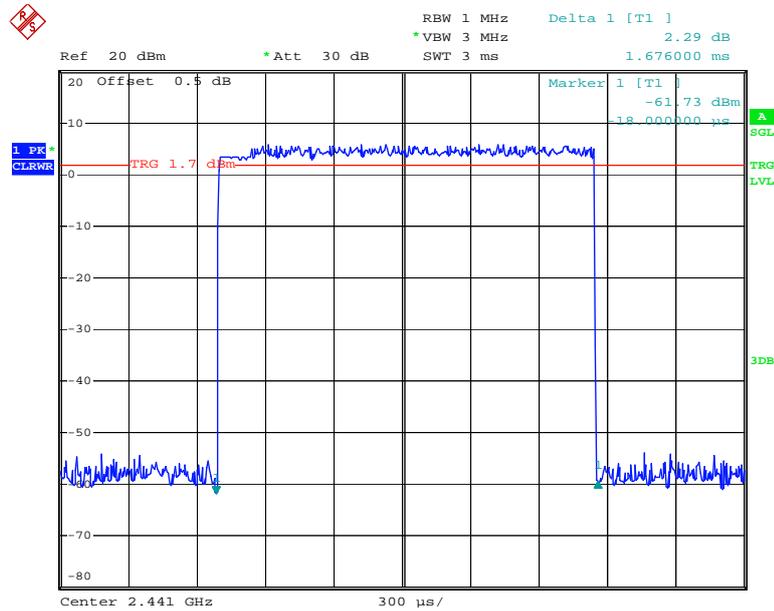
EDR Mode (8DPSK):

### 3DH1: Middle Channel



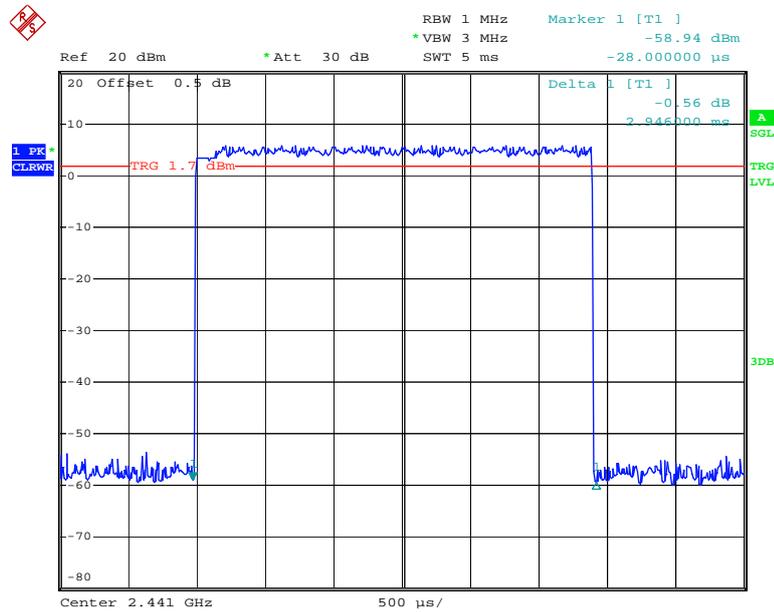
Date: 3.AUG.2020 15:22:07

### 3DH3: Middle Channel



Date: 3.AUG.2020 15:24:08

### 3DH5: Middle Channel



Date: 3.AUG.2020 15:25:02

## 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. 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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Agilent	USB Wideband Power Sensor	U2021XA	MY5425009	2020-05-09	2021-05-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

### Test Data

#### Environmental Conditions

Temperature:	25.7 °C
Relative Humidity:	50%
ATM Pressure:	100.4kPa
Test by:	Chris Mo
Test Date:	2020-08-03

**Test Result:** Compliance.

*Test Mode: Transmitting*

<b>Mode</b>	<b>Frequency (MHz)</b>	<b>Peak Conducted Output power (dBm)</b>	<b>Limit (dBm)</b>
BDR Mode (GFSK)	2402	1.90	21
	2441	0.38	21
	2480	-1.61	21
EDR Mode ( $\pi/4$ -DQPSK)	2402	1.63	21
	2441	0.28	21
	2480	-1.82	21
EDR Mode (8DPSK)	2402	1.54	21
	2441	0.31	21
	2480	-1.82	21

Note: The data above was tested in conducted mode.

## 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/ VBW of spectrum analyzer to 100/300 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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100035	2019-09-19	2020-09-19
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

**Test Data**

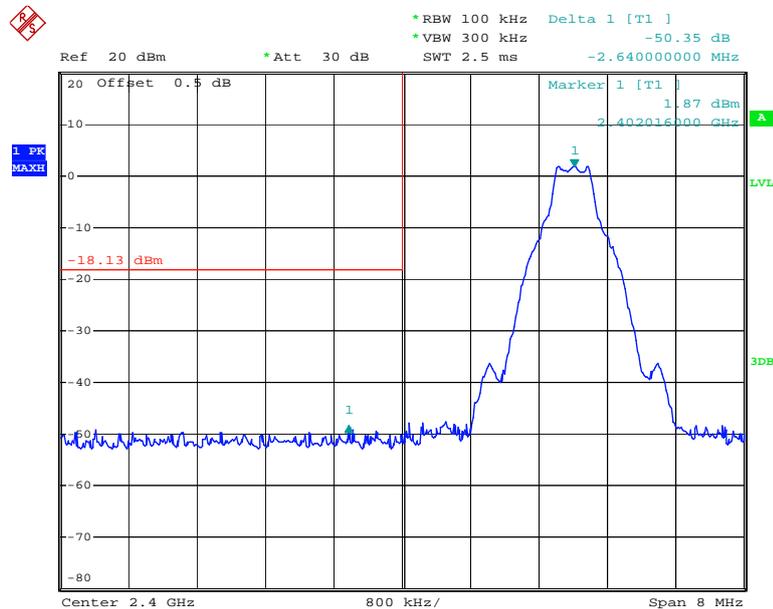
**Environmental Conditions**

<b>Temperature:</b>	25.7 °C
<b>Relative Humidity:</b>	50%
<b>ATM Pressure:</b>	100.4kPa
<b>Test by:</b>	Chris Mo
<b>Test Date:</b>	2020-08-03

**Test Result: Compliance**

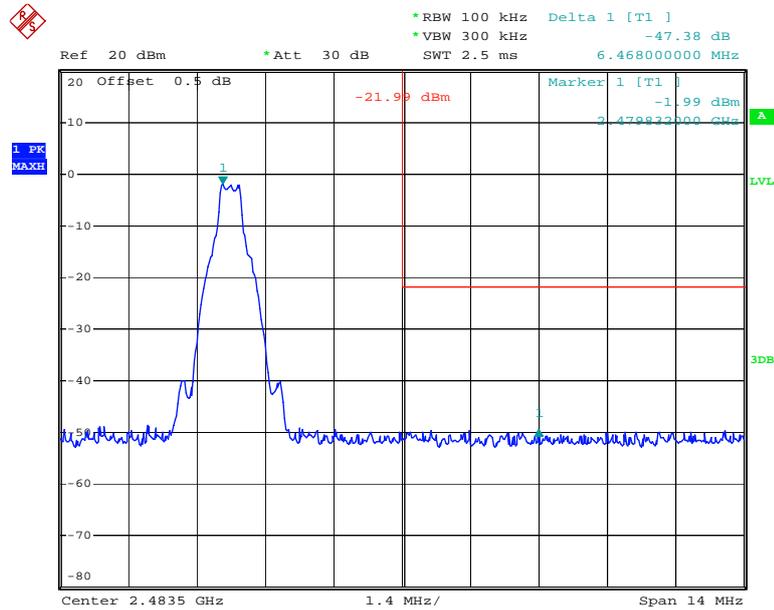
Single Channel Mode,  
BDR Mode (GFSK):

**Band Edge, Left Side**



Date: 3.AUG.2020 13:37:57

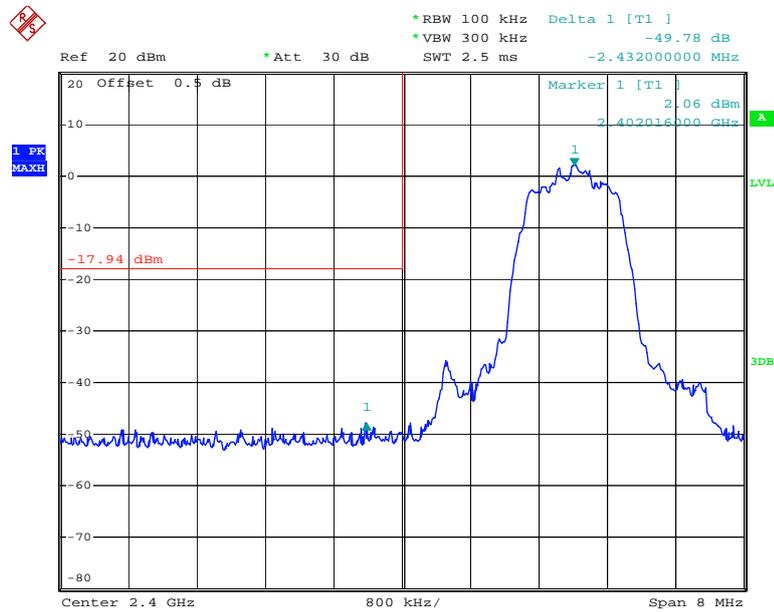
### Band Edge, Right Side



Date: 3.AUG.2020 13:40:47

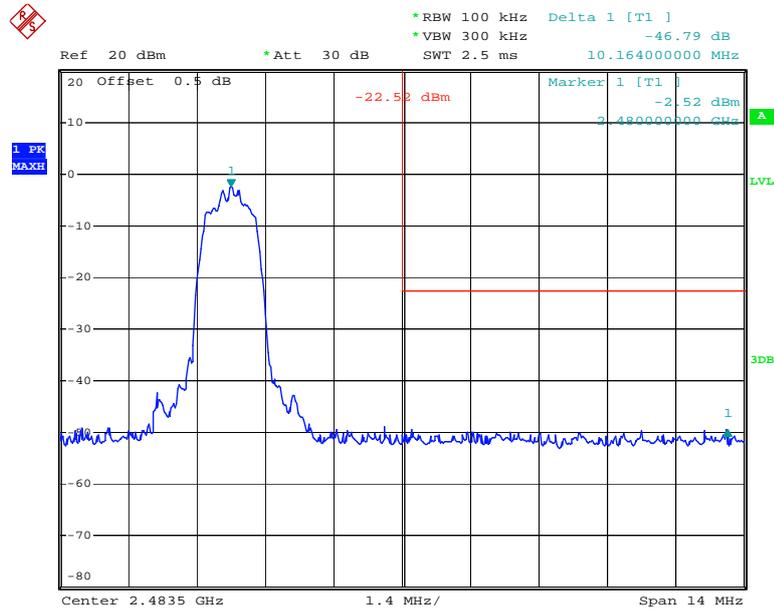
EDR Mode ( $\pi/4$ -DQPSK):

### Band Edge, Left Side



Date: 3.AUG.2020 14:06:03

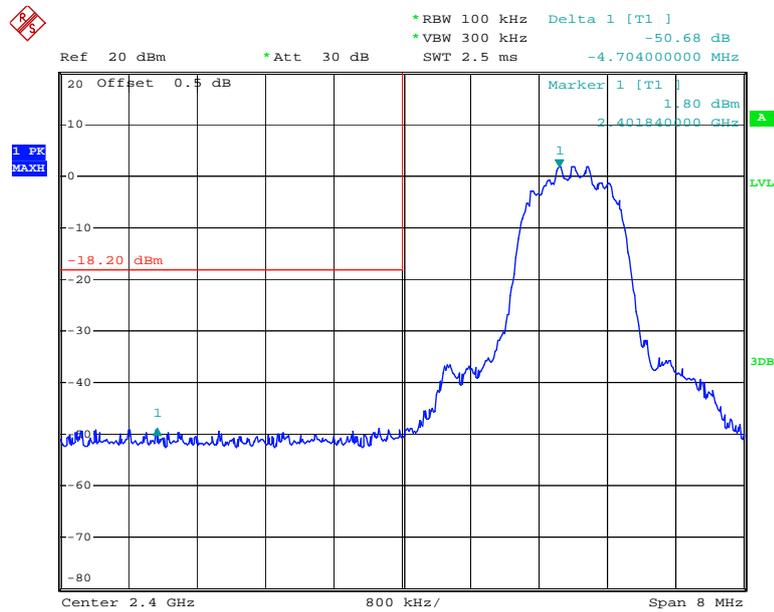
### Band Edge, Right Side



Date: 3.AUG.2020 14:12:18

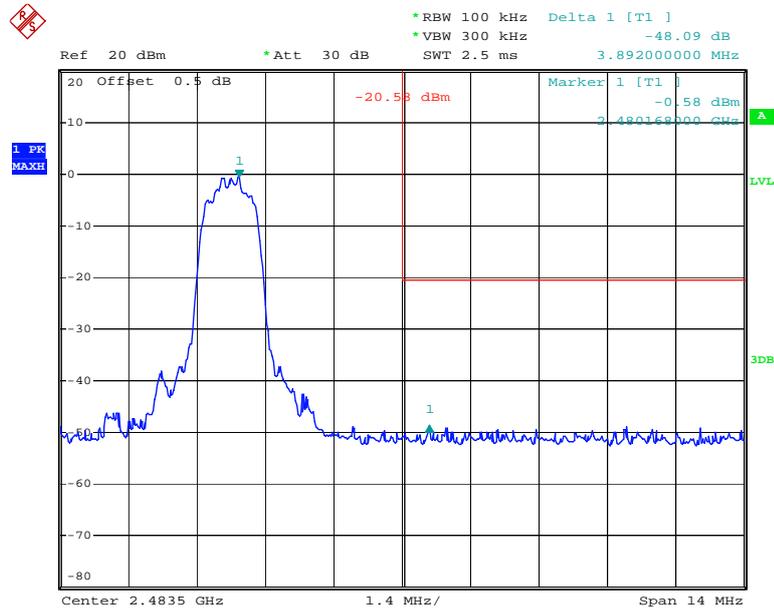
EDR Mode (8DPSK):

### Band Edge, Left Side



Date: 3.AUG.2020 14:14:01

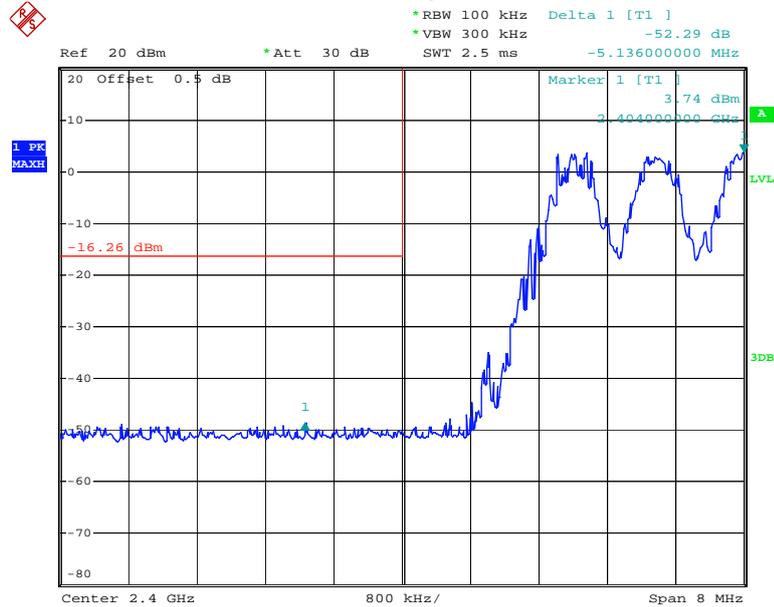
**Band Edge, Right Side**



Date: 3.AUG.2020 14:29:24

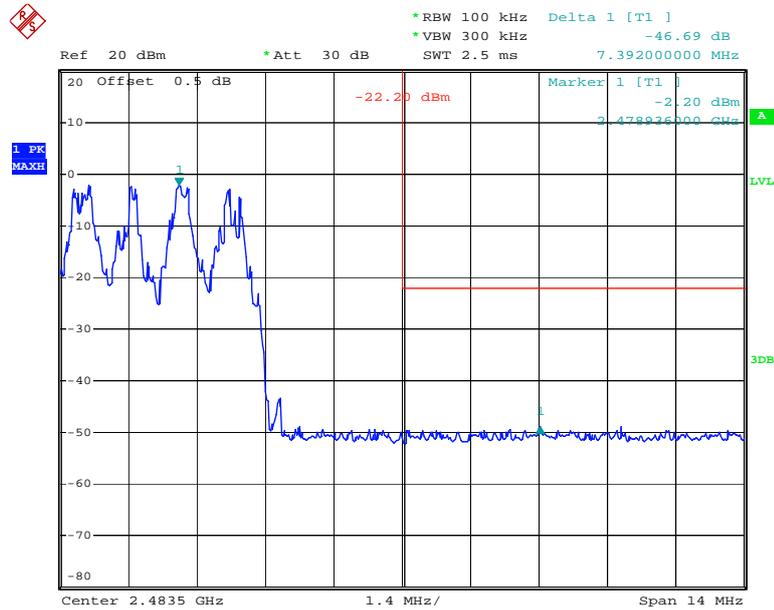
*Hopping Mode,  
 BDR Mode (GFSK):*

**Band Edge, Left Side**



Date: 3.AUG.2020 15:28:09

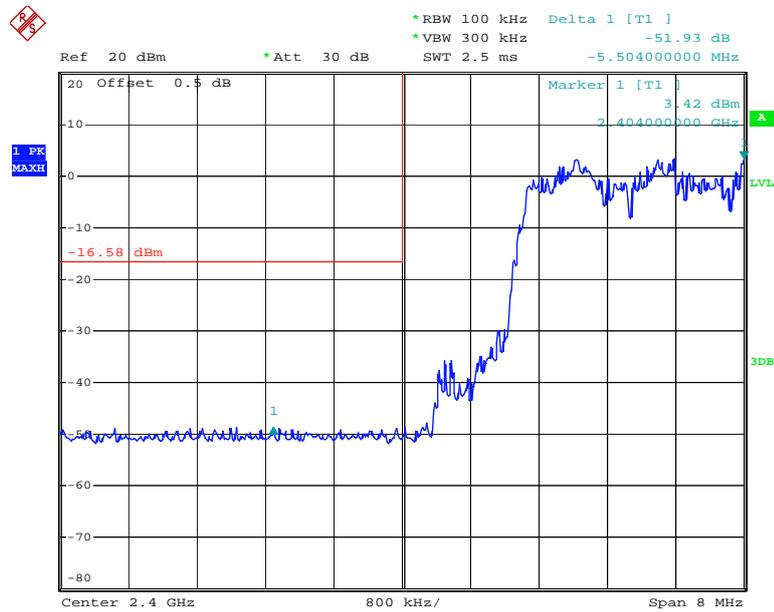
### Band Edge, Right Side



Date: 3.AUG.2020 15:28:51

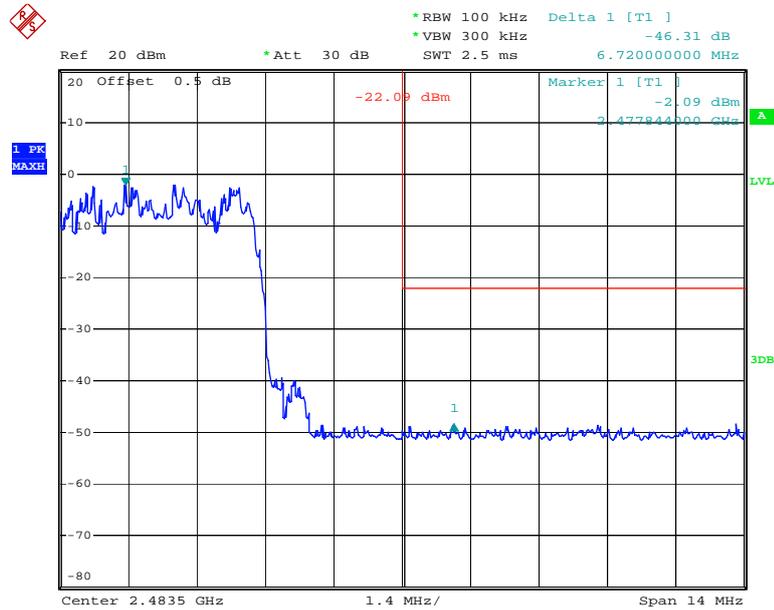
EDR Mode ( $\pi/4$ -DQPSK):

### Band Edge, Left Side



Date: 3.AUG.2020 15:30:51

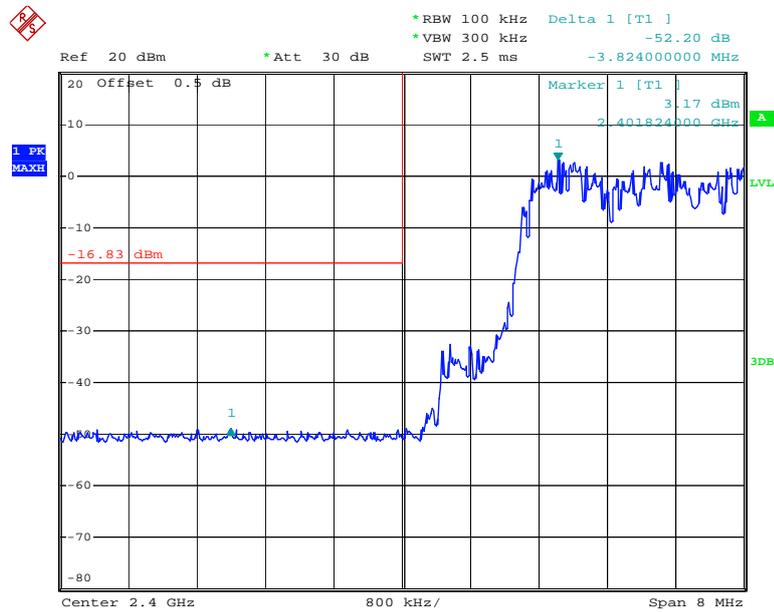
### Band Edge, Right Side



Date: 3.AUG.2020 15:31:47

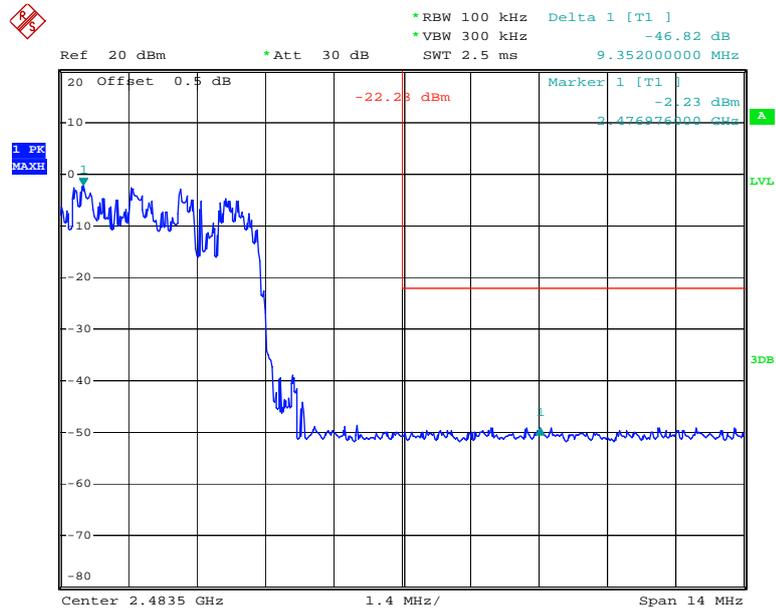
EDR Mode (8DPSK):

### Band Edge, Left Side



Date: 3.AUG.2020 15:33:37

### Band Edge, Right Side



Date: 3.AUG.2020 15:34:22

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