



TESTING LABORATORY  
CERTIFICATE #4820.01



FCC PART 15.247

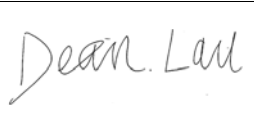
## TEST REPORT

For

**AKUVOX (XIAMEN) NETWORKS CO., LTD.**

10/F, No.56, Software Park II , Xiamen, China

**FCC ID: 2AHCR-IT83X**

<b>Report Type:</b> Original Report	<b>Product Name:</b> Indoor Monitor
<b>Report Number:</b> <u>RXM190124053-00B</u>	
<b>Report Date:</b> <u>2019-06-10</u>	
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## GENERAL INFORMATION

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

<b>EUT Name:</b>	Indoor Monitor
<b>EUT Model:</b>	IT83AR
<b>Multiple Models:</b>	IT83W,IT83A
<b>Operation Frequency:</b>	2402-2480 MHz
<b>Output Power(Conducted):</b>	6.88dBm
<b>Modulation Type:</b>	GFSK, $\pi/4$ -DQPSK, 8-DPSK
<b>Rated Input Voltage:</b>	DC12V from DC port or DC48V from POE port
<b>External Dimension:</b>	251mm(L)* 182.5mm(W)*23mm(H)
<b>Serial Number:</b>	190124053
<b>EUT Received Date:</b>	2019.01.28

*Notes: Model IT83AR was selected for fully testing, the detailed information about the difference among IT83W,IT83A and model IT83AR can be referred to the declaration letter which was stated and guaranteed by the manufacturer*

### Objective

This report is prepared on behalf of *AKUVOX (XIAMEN) NETWORKS CO., LTD.* 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: 2AHCR-IT83X

### 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
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.

### EUT Exercise Software

The Engineering Mode configured the maximum power level as default with DOS command.

### Equipment Modifications

No modification was made to the EUT.

### Local Support Equipment List and Details

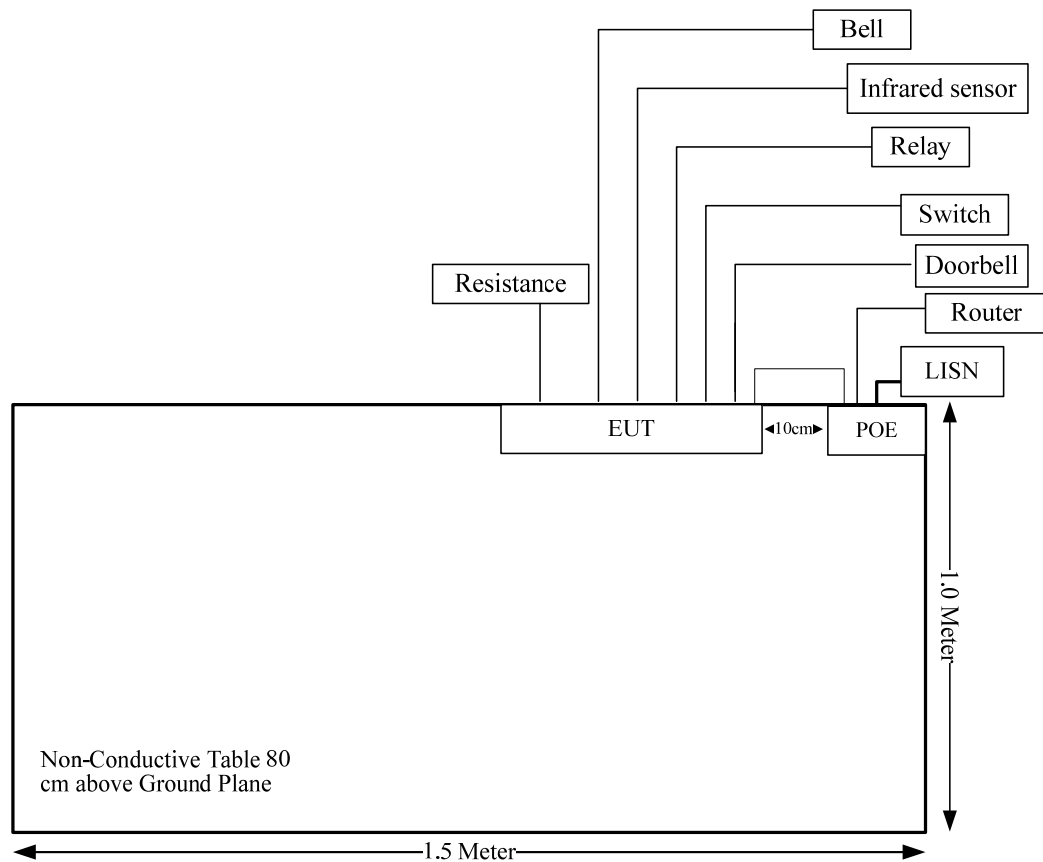
Manufacturer	Description	Model	Serial Number
Channel Well Technology	Adapter	2ABB018F EU	N/A
HUAWEI	SWITCHING POWER ADAPTER	PoE35-54A	N/A
SIEMENS	Bell	5TD0102-1CC1	N/A
SALENS	Infrared sensor	RE200B	N/A
Schneider	Relay	RXM2LB2BD	N/A
AKUVOX	Doorbell	E10R	P1M40WMJ00299
TP-LINK	Switch	TL-SF1008P	114A297001782
xinsheng	Resistance	BX8-13	N/A
URSALINK	Router	UR75	621273906928

**Support Cable List and Details**

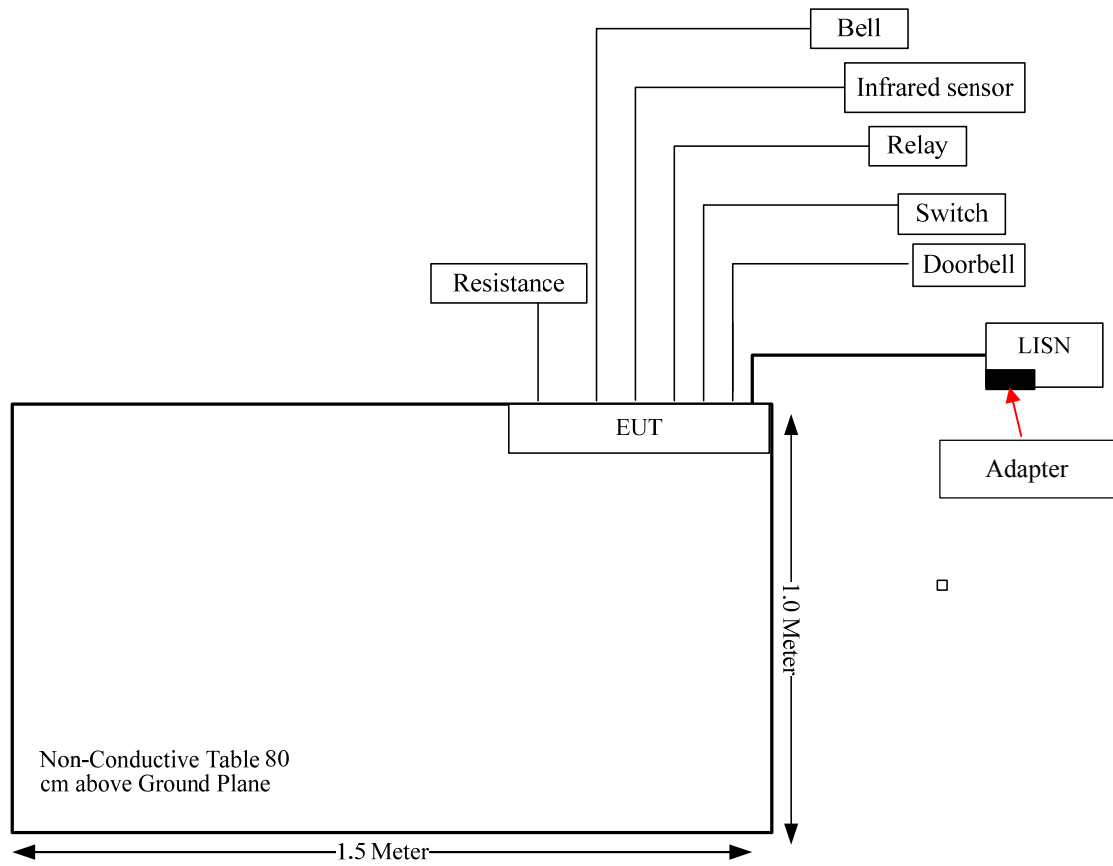
Cable Description	Shielding Type	Ferrite Core	Length (m)	From	To
RJ45 Cable	No	No	5	RJ45 Port of EUT	Doorbell
Signal Cable*8	No	No	5	IO Port of EUT	Infrared sensor
Signal Cable	No	No	5	BELL Port of EUT	Bell
Signal Cable	No	No	5	RS485 Port of EUT	Switch
Signal Cable	No	No	5	Relay Port of EUT	Relay
Signal Cable	No	No	5	12V_OUT Port of EUT	Resistance
RJ45 Cable	No	No	5	POE Port of EUT	Router
Adapter Cable	No	No	1.3	Adapter	EUT
RJ45 Cable	No	No	1	POE Port of EUT	SWITCHING POWER ADAPTER

**Block Diagram of Test Setup**

POE supply



Adapter supply





**SUMMARY OF TEST RESULTS**

Rules	Description of Test	Result
FCC §15.247 (i) & §1.1310 & §2.1091	Maximum Permissible Exposure (MPE)	Compliance
FCC§15.203	Antenna Requirement	Compliance
FCC§15.207 (a)	Conducted Emissions	Compliance
FCC§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
FCC§15.247 (a)(1)	Bandwidth Test	Compliance
FCC§15.247(a)(1)	Channel Separation Test	Compliance
FCC§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliance
FCC§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliance
FCC§15.247(b)(1)	Peak Output Power Measurement	Compliance
FCC§15.247(d)	Band Edges	Compliance

## FCC §15.247 (i) & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

### Applicable Standard

According to subpart 15.247(i) and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) 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;

According to §1.1310 and §2.1091 RF exposure is calculated.

### Calculation formula:

Prediction of power density at the distance of the applicable MPE limit

$S = PG/4\pi R^2$  = 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);

### Calculated Data:

Mode	Frequency (MHz)	Antenna Gain		Conducted output power including Tune-up Tolerance		Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )
		(dBi)	(numeric)	(dBm)	(mW)			
Wi-Fi	2412-2462	1.2	1.32	24	251.19	20	0.0659	1.0
Bluetooth LE	2402-2480	1.2	1.32	7	5.01	20	0.0013	1.0
Bluetooth	2402-2480	1.2	1.32	7	5.01	20	0.0013	1.0

Note: All modes can't transmit simultaneously.

**Result:** The device meet FCC MPE at 20 cm distance

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

### **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.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

### **Antenna Connector Construction**

The EUT has one internal FPC antenna arrangement for BT/WLAN, fulfill the requirement of this section. Please refer to the EUT photos.

<b>Antenna Type</b>	<b>input impedance (Ohm)</b>	<b>Antenna Gain /Frequency Range</b>
FPC	50	1.2 dBi/2.4~2.5GHz

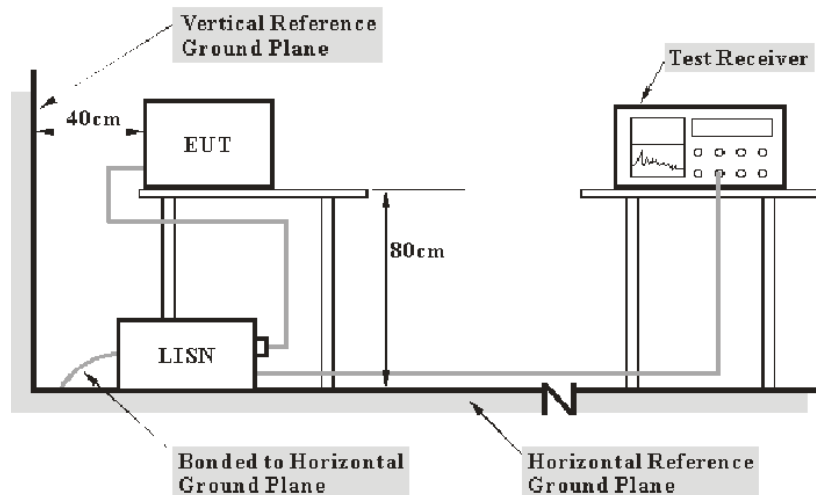
**Result:** Compliance.

## 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.

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

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

## 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	EMI Test Receiver	ESCS 30	830245/006	2018-12-10	2019-12-10
Unknown	Coaxial Cable	C-NJNJ-50	C-0200-01	2018-09-05	2019-09-05
R&S	Test Software	EMC32	Version8.53.0	N/A	N/A
R&S	Two-line V-network	ENV 216	101614	2018-12-10	2019-12-10

\* **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>	23.8 °C
<b>Relative Humidity:</b>	32 %
<b>ATM Pressure:</b>	100.5 kPa

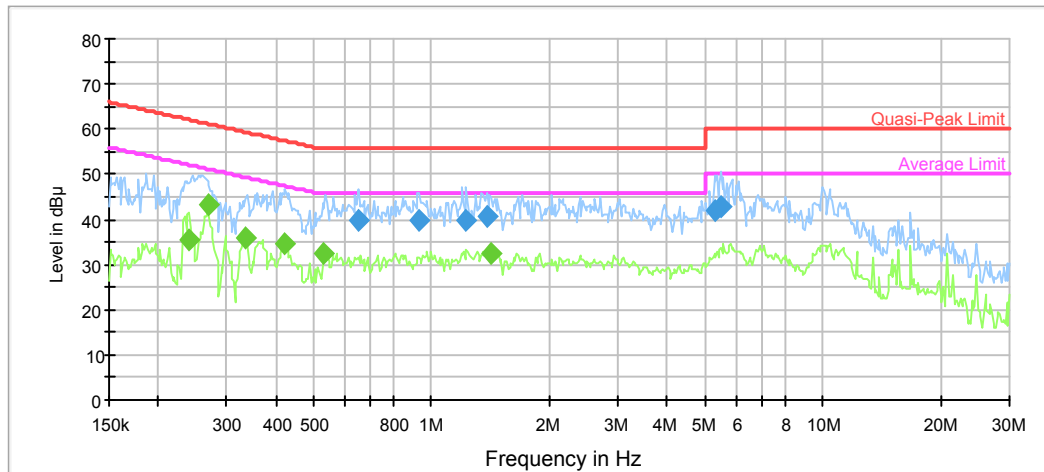
*The testing was performed by Ade Xiao on 2019-02-18*

*Pre-scan all models, IT83AR was the worst case*

**Test Mode:** Transmitting (GFSK low channel was the worst case)

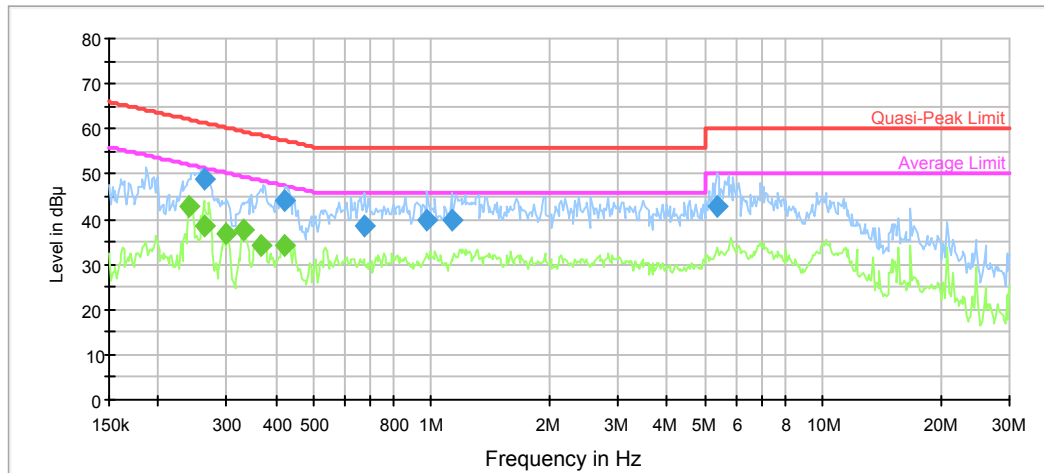
Mode: POE supply

**AC120V, 60 Hz, Line:**



Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.649874	39.9	9.000	L1	9.8	16.1	56.0
0.930151	40.0	9.000	L1	9.8	16.0	56.0
1.229340	39.9	9.000	L1	9.8	16.1	56.0
1.385415	40.5	9.000	L1	9.8	15.5	56.0
5.283837	42.0	9.000	L1	9.8	18.0	60.0
5.498599	43.0	9.000	L1	9.8	17.0	60.0

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.240029	35.6	9.000	L1	10.4	16.5	52.1
0.268355	43.2	9.000	L1	10.2	7.9	51.2
0.335433	35.9	9.000	L1	10.1	13.4	49.3
0.422630	34.6	9.000	L1	9.9	12.8	47.4
0.532496	32.5	9.000	L1	9.9	13.5	46.0
1.418932	32.5	9.000	L1	9.8	13.5	46.0

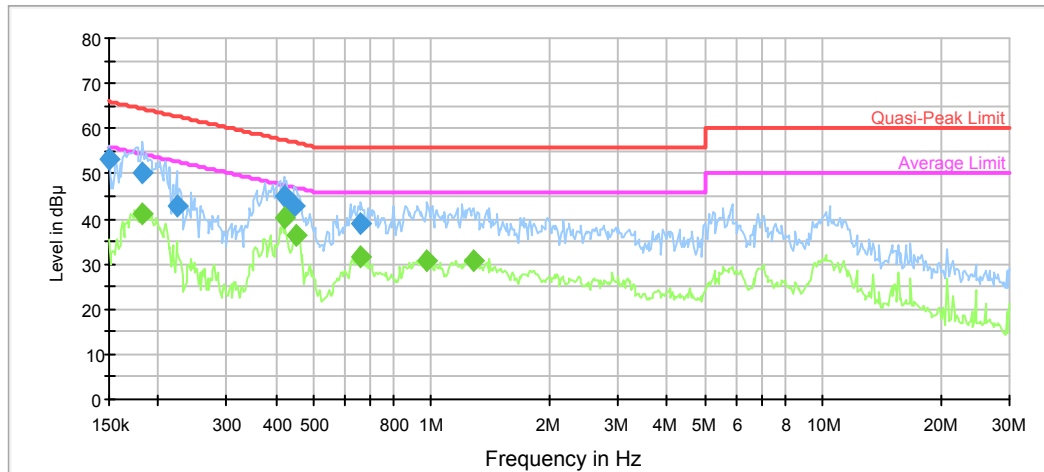
**AC120V, 60 Hz, Neutral:**

Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.264113	48.7	9.000	N	10.3	12.6	61.3
0.422630	44.2	9.000	N	9.9	13.2	57.4
0.676289	38.3	9.000	N	9.8	17.7	56.0
0.975701	39.9	9.000	N	9.8	16.1	56.0
1.126176	39.9	9.000	N	9.8	16.1	56.0
5.368716	42.9	9.000	N	9.8	17.1	60.0

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.240029	42.7	9.000	N	10.4	9.4	52.1
0.262017	38.6	9.000	N	10.3	12.8	51.4
0.300025	37.0	9.000	N	10.1	13.2	50.2
0.330129	37.7	9.000	N	10.1	11.7	49.4
0.366160	33.9	9.000	N	10.0	14.7	48.6
0.422630	34.2	9.000	N	9.9	13.2	47.4

Adapter supply

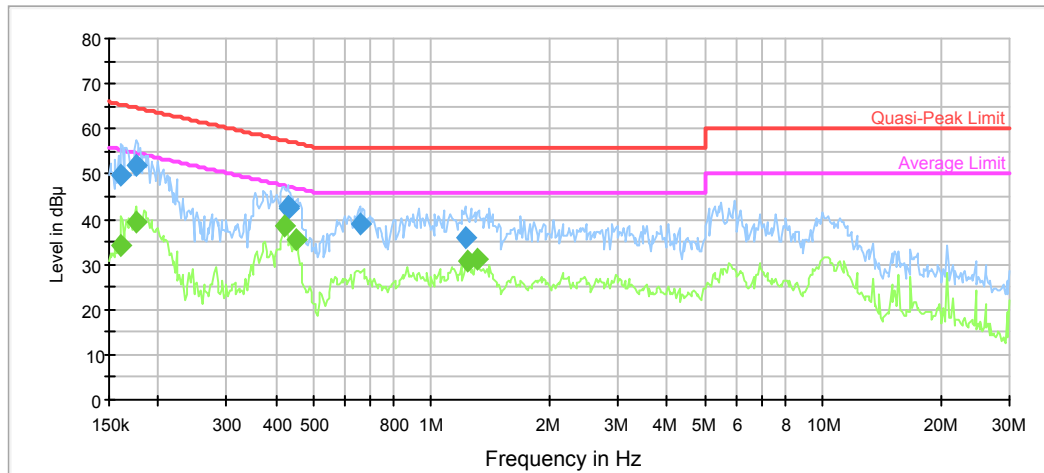
AC120V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	53.2	9.000	L1	11.2	12.8	66.0
0.183065	50.2	9.000	L1	10.8	14.1	64.3
0.223418	42.6	9.000	L1	10.5	20.1	62.7
0.419276	45.1	9.000	L1	9.9	12.4	57.5
0.446873	42.9	9.000	L1	9.9	14.0	56.9
0.660314	38.8	9.000	L1	9.8	17.2	56.0

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.183065	41.1	9.000	L1	10.8	13.2	54.3
0.422630	40.1	9.000	L1	9.9	7.3	47.4
0.450448	36.3	9.000	L1	9.9	10.6	46.9
0.660314	31.7	9.000	L1	9.8	14.3	46.0
0.975701	30.9	9.000	L1	9.8	15.1	46.0
1.279307	30.9	9.000	L1	9.8	15.1	46.0



**AC120V, 60 Hz, Neutral:**

Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.161152	49.7	9.000	N	11.0	15.7	65.4
0.175915	51.8	9.000	N	10.8	12.9	64.7
0.429420	42.9	9.000	N	9.9	14.4	57.3
0.432855	42.4	9.000	N	9.9	14.8	57.2
0.655073	38.7	9.000	N	9.8	17.3	56.0
1.219583	36.0	9.000	N	9.8	20.0	56.0

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.161152	34.0	9.000	N	11.0	21.4	55.4
0.175915	39.2	9.000	N	10.8	15.5	54.7
0.422630	38.3	9.000	N	9.9	9.1	47.4
0.450448	35.3	9.000	N	9.9	11.6	46.9
1.239175	30.8	9.000	N	9.8	15.2	46.0
1.310256	31.3	9.000	N	9.8	14.7	46.0

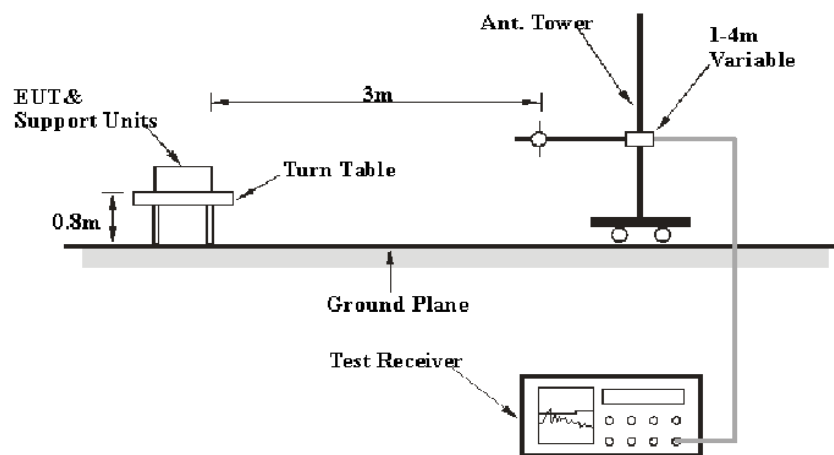
## FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

### Applicable Standard

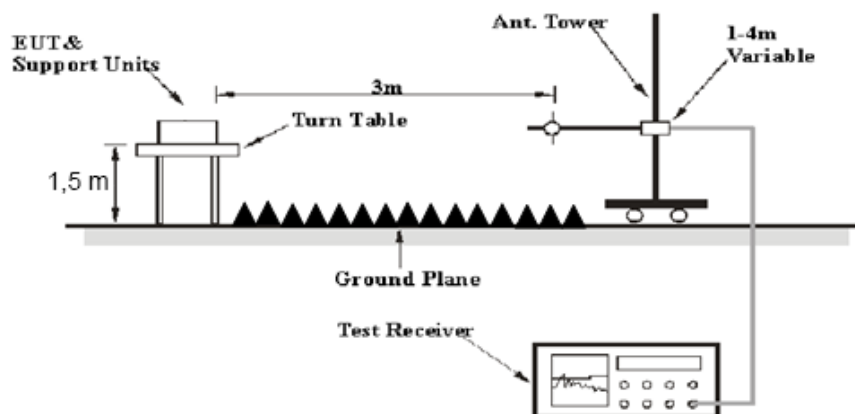
FCC §15.247 (d); §15.209; §15.205.

### EUT Setup

#### Below 1GHz:



#### Above 1GHz:



The radiated emission below 1GHz tests were performed in the 3 meters chamber test site A, above 1GHz tests were performed in the 3 meters chamber test site 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.

## 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 Equipment List and Details**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2018-12-10	2019-12-10
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2020-11-10
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2018-09-05	2019-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2018-09-05	2019-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-1400-01	2018-05-06	2019-05-06
Unknown	Coaxial Cable	C-NJNJ-50	C-1400-01	2019-05-06	2020-05-06
HP	Amplifier	8447D	2727A05902	2018-09-05	2019-09-05
Agilent	Spectrum Analyzer	E4440A	SG43360054	2019-05-09	2020-05-09
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
ETS-Lindgren	Horn Antenna	3115	000 527 35	2018-10-12	2021-10-12
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2016-11-18	2019-11-18
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2018-09-05	2019-09-05
Unknown	Coaxial Cable	C-2.4J2.4J-50	C-0700-02	2018-06-27	2019-06-27
MITEQ	Amplifier	AFS42-00101800-25-S-42	2001271	2018-09-05	2019-09-05
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2018-06-27	2019-06-27
E-Microwave	Band-stop Filters	OBSF-2400-2483.5-S	OE01601525	2018-06-16	2019-06-16

\* **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).

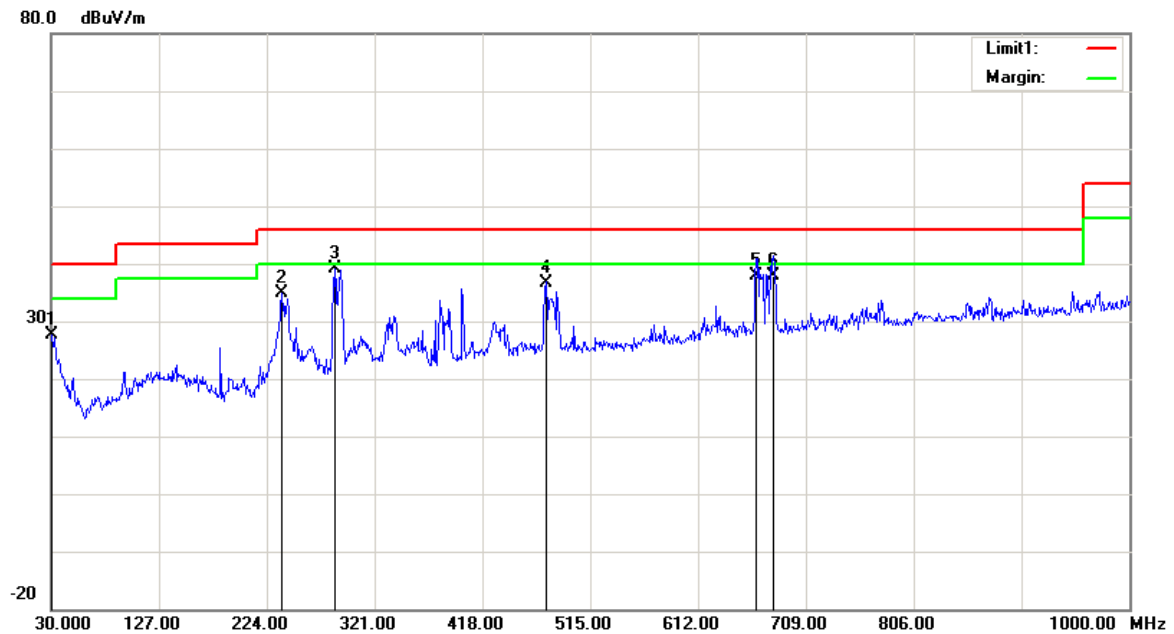
**Test Data****Environmental Conditions**

<b>Temperature:</b>	23.8~24.3 °C
<b>Relative Humidity:</b>	32~67%
<b>ATM Pressure:</b>	100.5~ 100.6kPa

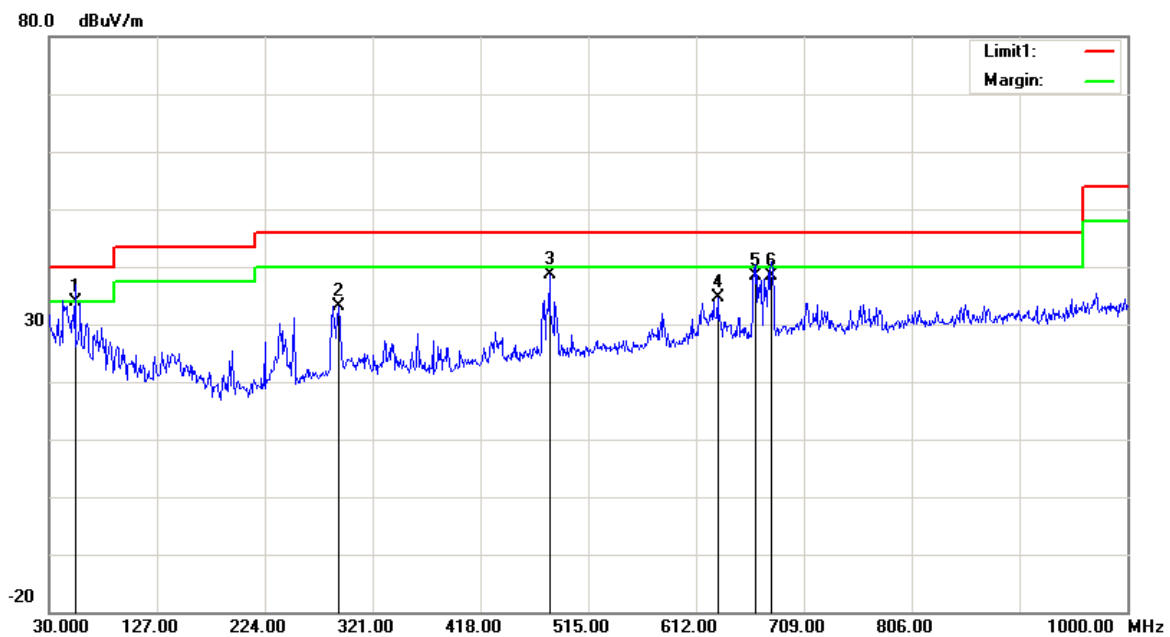
\* The testing was performed by Vern Shen& Neil Liao on 2019-02-19 to 2019-05-30

Test Mode: Transmitting

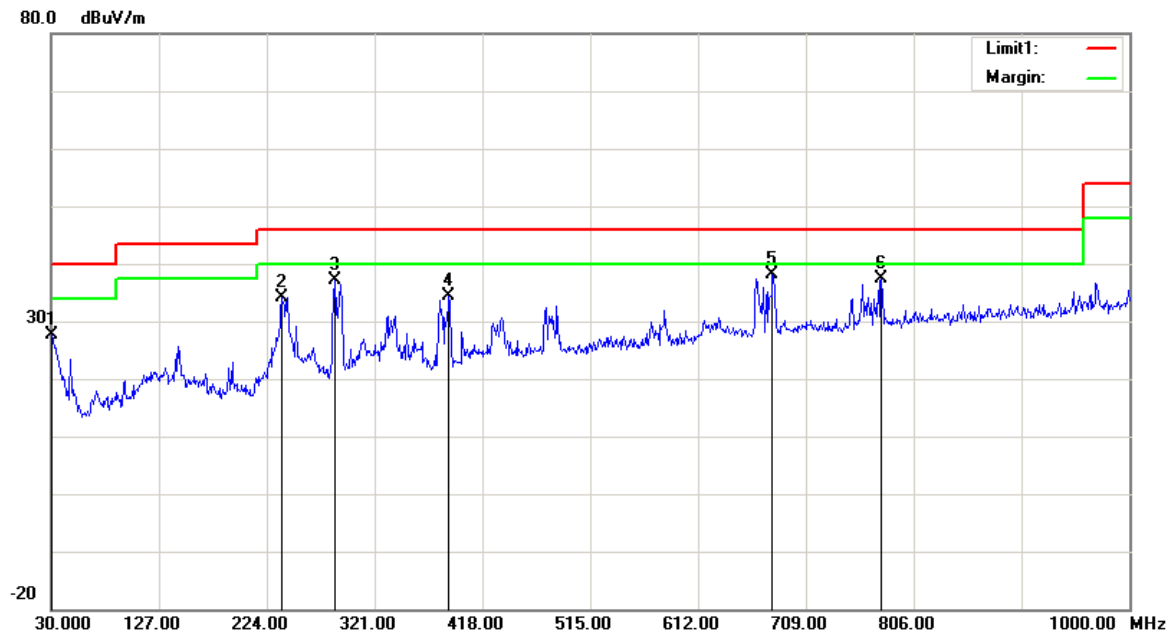
Pre-scan all models, IT83AR was the worst case.

**1) 30MHz-1GHz (8-DPSK Low channel was the worst)***Mode: POE supply***Horizontal:**

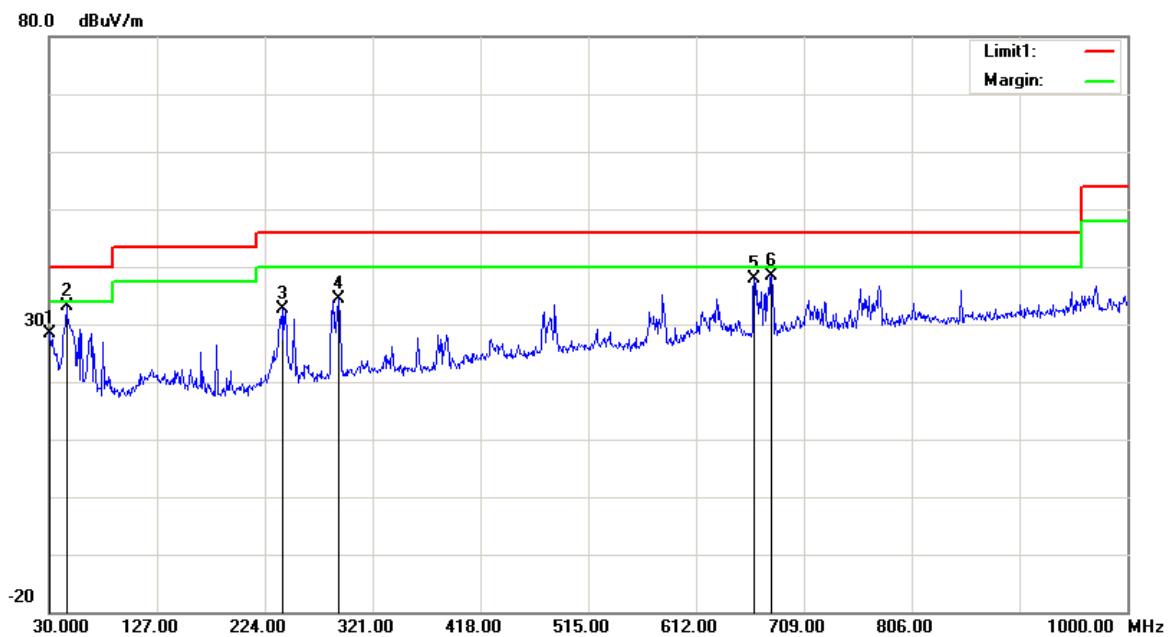
Frequency (MHz)	Receiver Reading (dBμV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)
53.2800	45.76	QP	-11.96	33.80	40.00	6.20
290.9300	37.18	peak	-3.98	33.20	46.00	12.80
480.0800	38.94	peak	-0.27	38.67	46.00	7.33
631.4000	32.54	peak	2.05	34.59	46.00	11.41
665.3500	36.15	QP	2.25	38.40	46.00	7.60
679.9000	35.74	QP	2.66	38.40	46.00	7.60

**Vertical:**

Frequency (MHz)	Receiver Reading (dB $\mu$ V)	Detector	Correction Factor (dB/m)	Cord. Amp. (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)
53.2800	45.76	QP	-11.96	33.80	40.00	6.20
290.9300	37.18	peak	-3.98	33.20	46.00	12.80
480.0800	38.94	peak	-0.27	38.67	46.00	7.33
631.4000	32.54	peak	2.05	34.59	46.00	11.41
665.3500	36.15	QP	2.25	38.40	46.00	7.60
679.9000	35.74	QP	2.66	38.40	46.00	7.60

*Mode: Adapter supply***Horizontal:**

Frequency (MHz)	Receiver Reading (dBμV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)
30.9700	26.65	peak	0.91	27.56	40.00	12.44
237.5800	40.38	peak	-6.14	34.24	46.00	11.76
285.1100	41.04	peak	-4.03	37.01	46.00	8.99
387.9300	36.73	peak	-2.36	34.37	46.00	11.63
678.9300	35.59	peak	2.63	38.22	46.00	7.78
776.9000	32.91	peak	4.37	37.28	46.00	8.72

**Vertical:**

Frequency (MHz)	Receiver Reading (dB $\mu$ V)	Detector	Correction Factor (dB/m)	Cord. Amp. (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)
30.9700	27.41	peak	0.91	28.32	40.00	11.68
45.5200	42.60	peak	-9.44	33.16	40.00	6.84
239.5200	38.68	peak	-6.02	32.66	46.00	13.34
289.9600	38.25	peak	-3.94	34.31	46.00	11.69
664.3800	35.54	peak	2.23	37.77	46.00	8.23
679.9000	35.68	peak	2.66	38.34	46.00	7.66

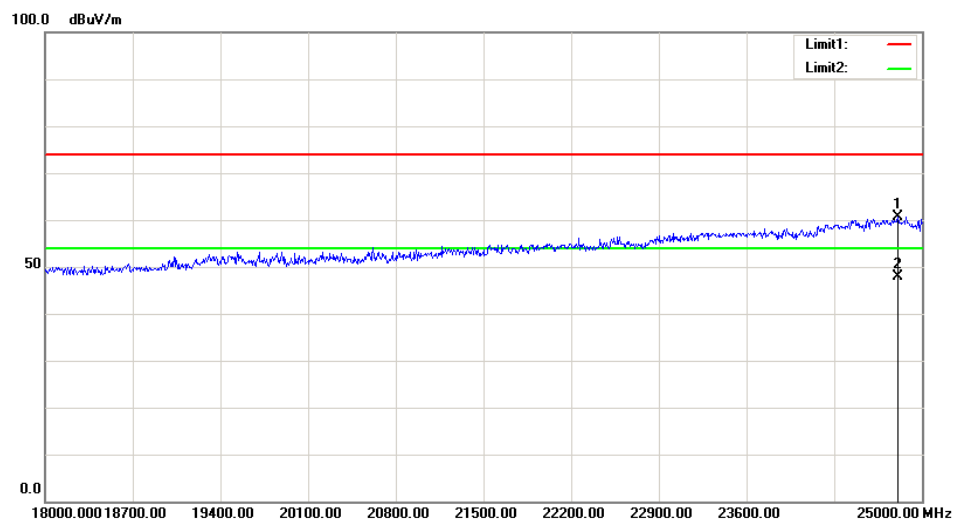
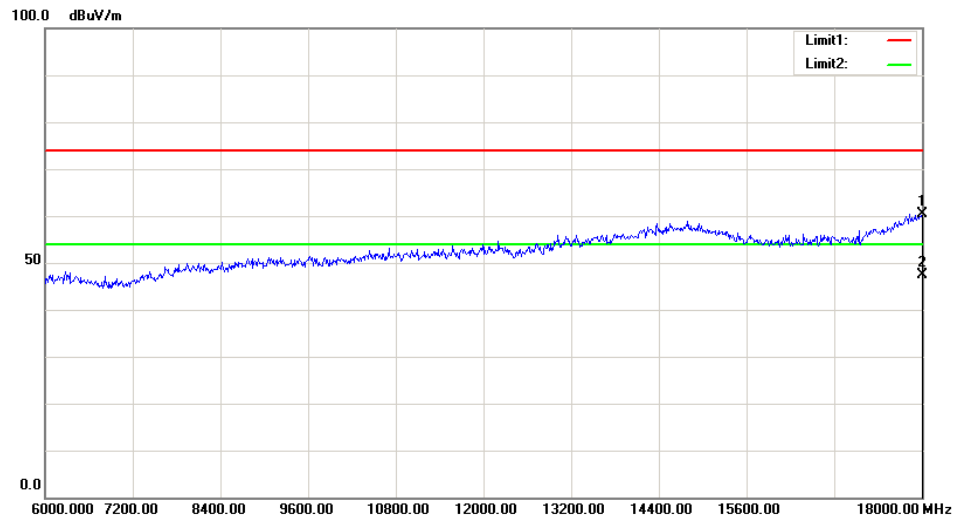
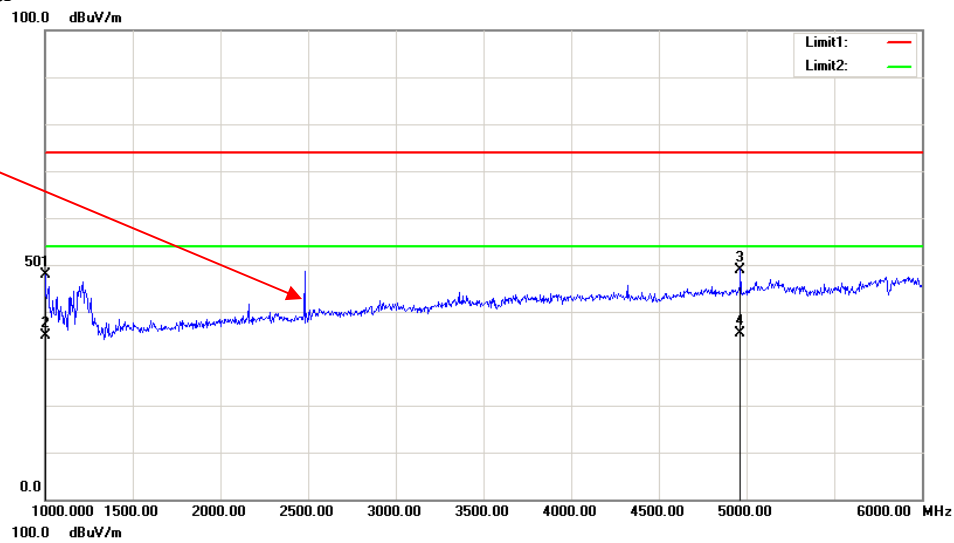


**2) 1GHz-25GHz:***3EDR Mode (8-DPSK) was worst*

Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)					
Low Channel: 2402 MHz									
2402.00	69.16	PK	H	28.10	1.80	0.00	99.06	N/A	N/A
2402.00	55.74	AV	H	28.10	1.80	0.00	85.64	N/A	N/A
2402.00	61.47	PK	V	28.10	1.80	0.00	91.37	N/A	N/A
2402.00	47.69	AV	V	28.10	1.80	0.00	77.59	N/A	N/A
2390.00	24.57	PK	H	28.08	1.80	0.00	54.45	74.00	19.55
2390.00	13.28	AV	H	28.08	1.80	0.00	43.16	54.00	10.84
4804.00	48.64	PK	H	32.91	3.17	37.20	47.52	74.00	26.48
4804.00	35.39	AV	H	32.91	3.17	37.20	34.27	54.00	19.73
7206.00	46.68	PK	H	35.74	4.82	37.23	50.01	74.00	23.99
7206.00	32.82	AV	H	35.74	4.82	37.23	36.15	54.00	17.85
Middle Channel: 2441 MHz									
2441.00	68.91	PK	H	28.18	1.82	0.00	98.91	N/A	N/A
2441.00	55.10	AV	H	28.18	1.82	0.00	85.10	N/A	N/A
2441.00	60.27	PK	V	28.18	1.82	0.00	90.27	N/A	N/A
2441.00	47.55	AV	V	28.18	1.82	0.00	77.55	N/A	N/A
4882.00	48.96	PK	H	33.06	3.27	37.21	48.08	74.00	25.92
4882.00	35.76	AV	H	33.06	3.27	37.21	34.88	54.00	19.12
7323.00	46.73	PK	H	36.04	4.62	37.38	50.01	74.00	23.99
7323.00	33.04	AV	H	36.04	4.62	37.38	36.32	54.00	17.68
High Channel: 2480 MHz									
2480.00	67.63	PK	H	28.26	1.84	0.00	97.73	N/A	N/A
2480.00	54.69	AV	H	28.26	1.84	0.00	84.79	N/A	N/A
2480.00	59.72	PK	V	28.26	1.84	0.00	89.82	N/A	N/A
2480.00	46.83	AV	V	28.26	1.84	0.00	76.93	N/A	N/A
2483.50	29.70	PK	H	28.27	1.84	0.00	59.81	74.00	14.19
2483.50	14.29	AV	H	28.27	1.84	0.00	44.40	54.00	9.60
4960.00	50.29	PK	H	33.22	3.23	37.25	49.49	74.00	24.51
4960.00	37.32	AV	H	33.22	3.23	37.25	36.52	54.00	17.48
7440.00	46.24	PK	H	36.34	4.41	37.52	49.47	74.00	24.53
7440.00	33.13	AV	H	36.34	4.41	37.52	36.36	54.00	17.64

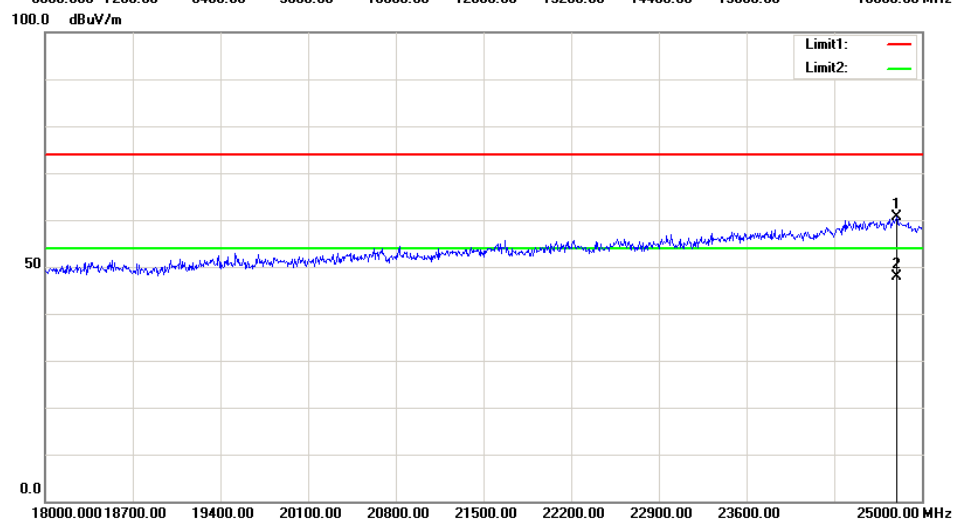
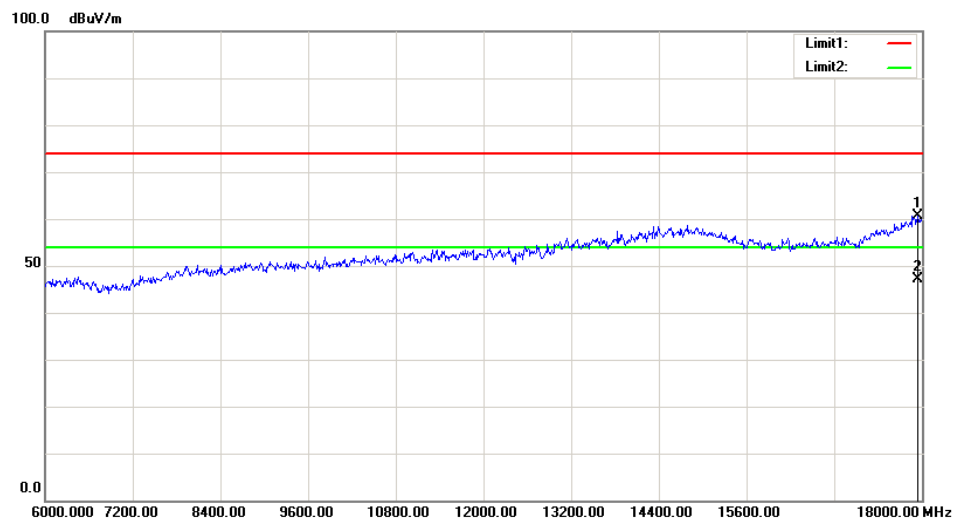
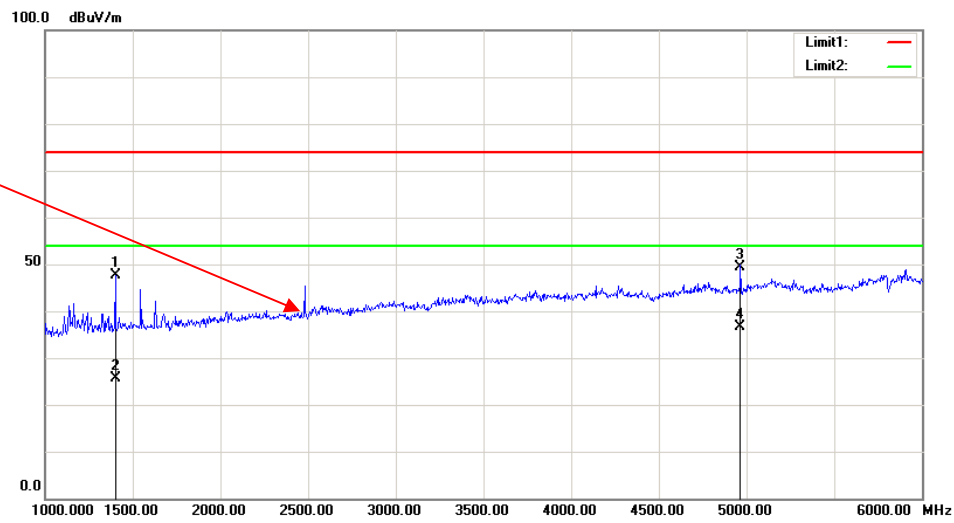
**Worst plots ((8-DPSK High channel)  
Horizontal**

Fundamental  
Test with Band  
Rejection Filter



**Vertical**

Fundamental  
Test with Band  
Rejection Filter



**FCC §15.247(a) (1) - CHANNEL SEPARATION TEST****Applicable Standard**

According to FCC §15.247(a) (1)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 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	Spectrum Analyzer	FSU 26	200256	2019-01-04	2020-01-04
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**

Temperature:	26.6~28.5 °C
Relative Humidity:	54~58%
ATM Pressure:	101.1~101.5kPa

\* The testing was performed by Carrie He on 2019-03-26 to 2019-05-28

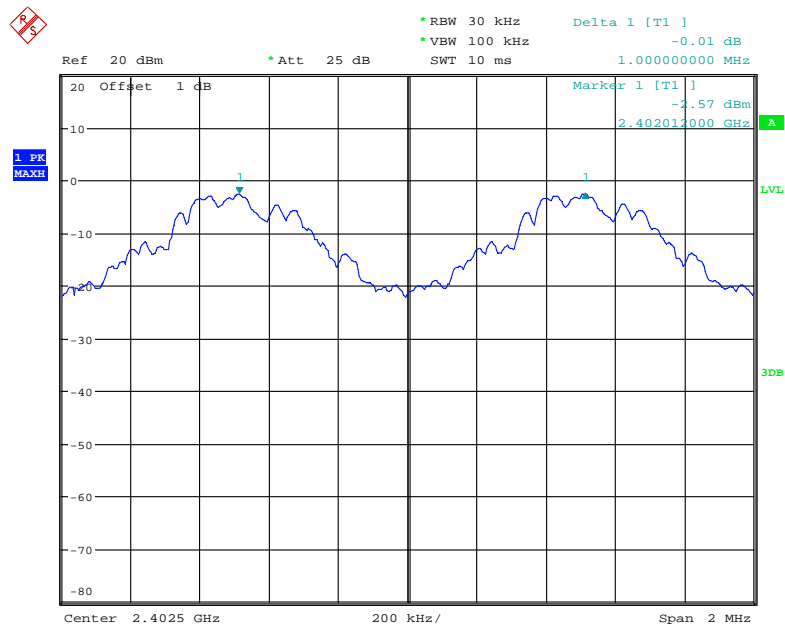
**Test Result:** Compliance.

Please refer to following tables and plots

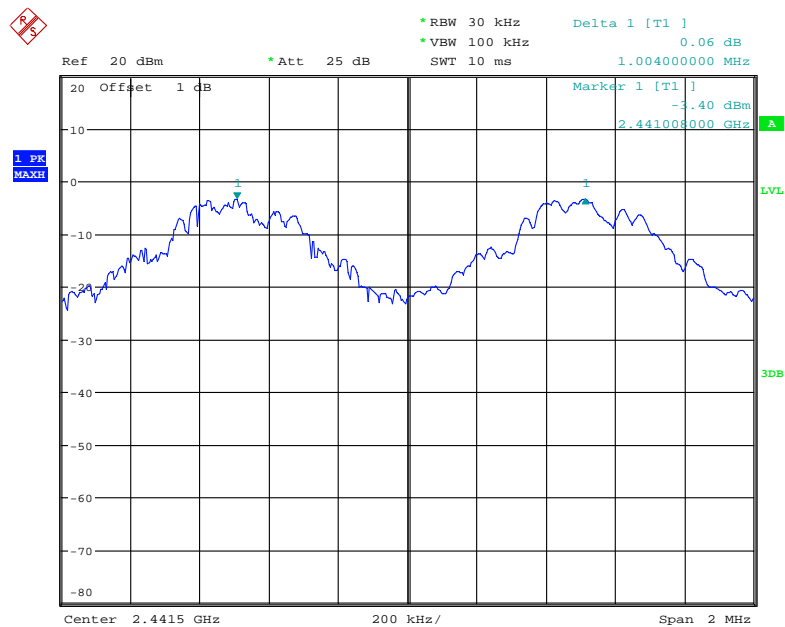
*Test Mode: Transmitting*

Mode	Channel	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)
<i>BDR</i> ( <i>GFSK</i> )	Low	2402	1.000	0.71
	Middle	2441	1.004	0.71
	High	2480	1.000	0.71
EDR ( $\pi/4$ -DQPSK)	Low	2402	1.000	0.88
	Middle	2441	1.000	0.88
	High	2480	1.000	0.89
<i>EDR</i> ( <i>8-DPSK</i> )	Low	2402	1.008	0.84
	Middle	2441	1.000	0.84
	High	2480	1.008	0.86

*Note: Limit= (2/3) × 20dB bandwidth*

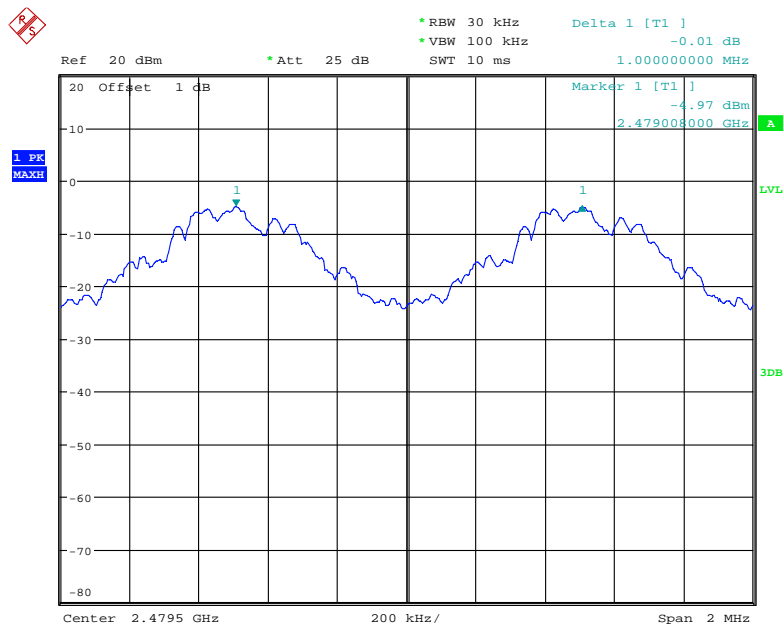
*BDR Mode (GFSK):***Low Channel**

Date: 28.MAY.2019 19:53:45

**Middle Channel**

Date: 28.MAY.2019 19:54:30

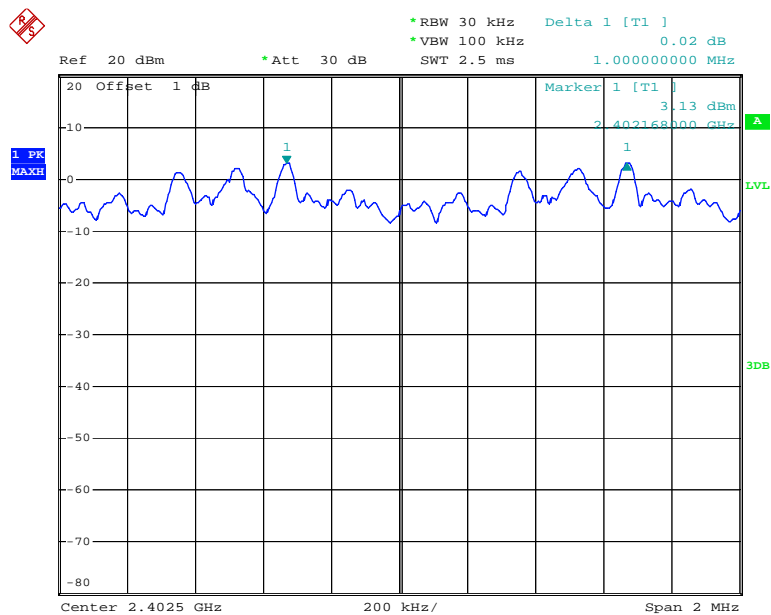
## High Channel



Date: 28.MAY.2019 19:55:07

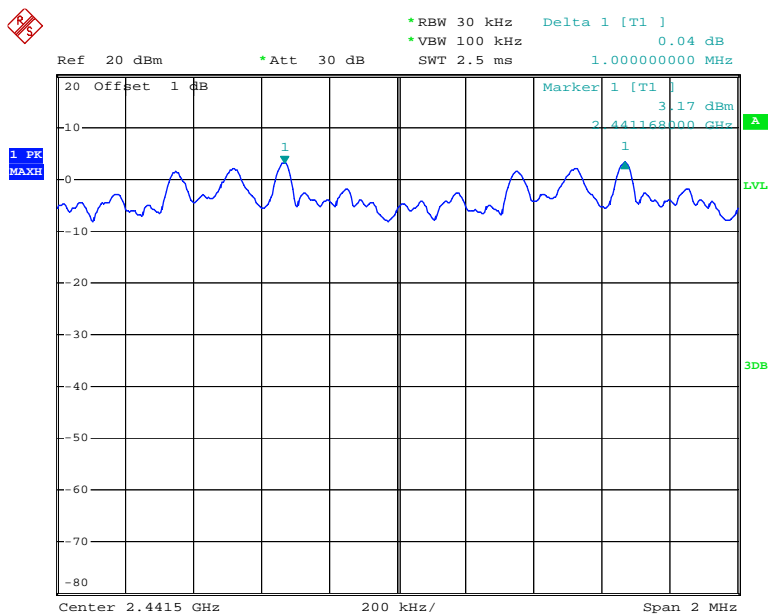
EDR Mode ( $\pi/4$ -DQPSK):

## Low Channel



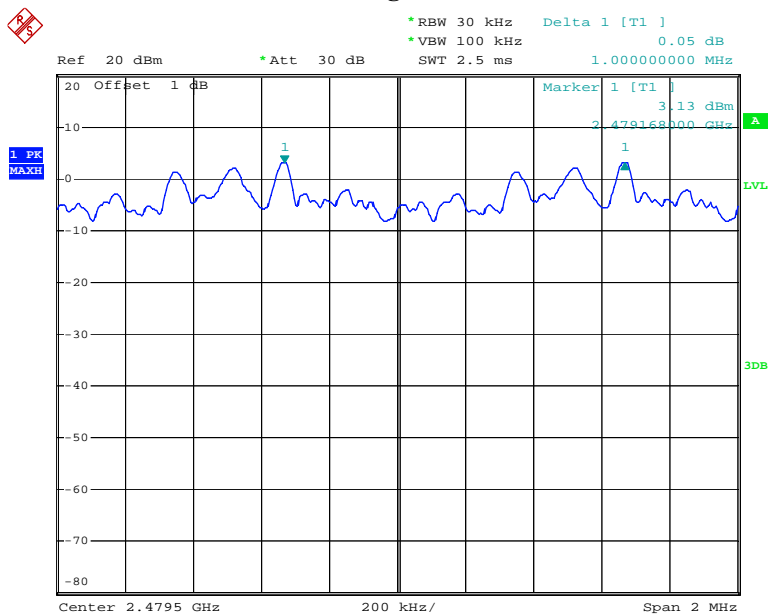
Date: 6.MAR.2019 15:33:08

### Middle Channel



Date: 6.MAR.2019 15:34:53

### High Channel

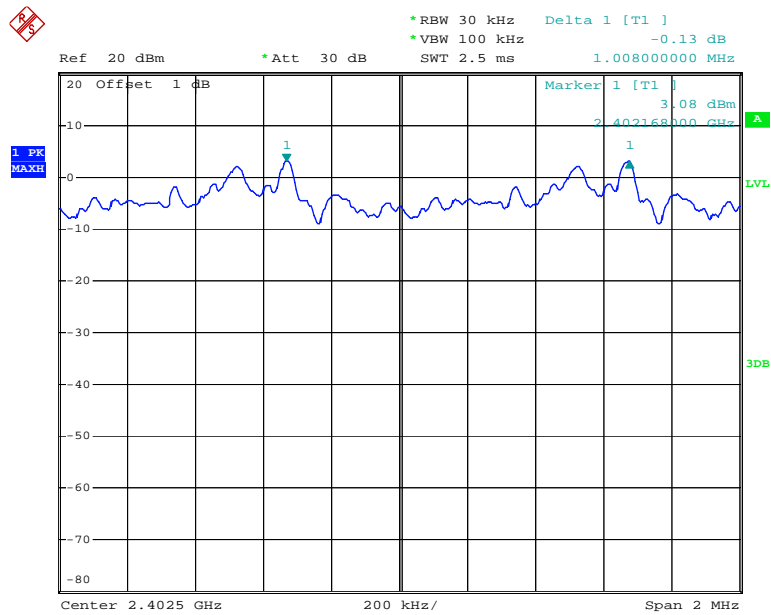


Date: 6.MAR.2019 15:36:57



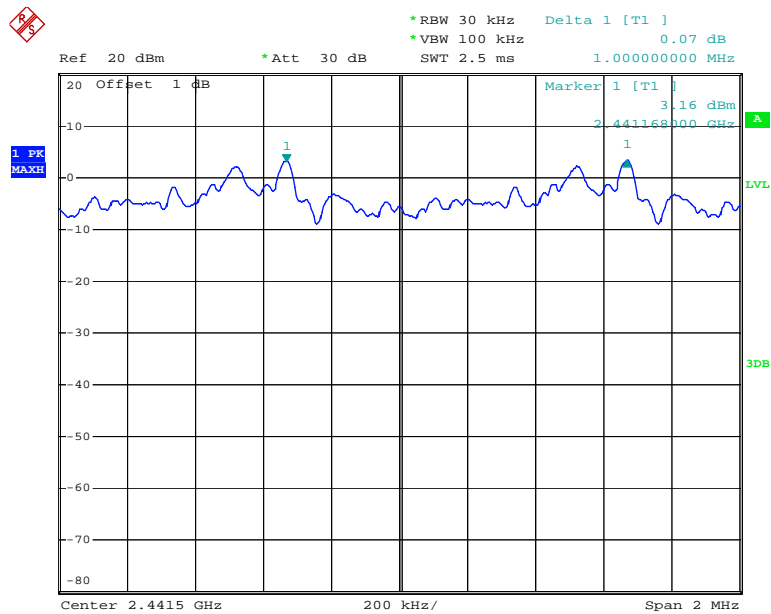
EDR Mode (8-DPSK):

### Low Channel



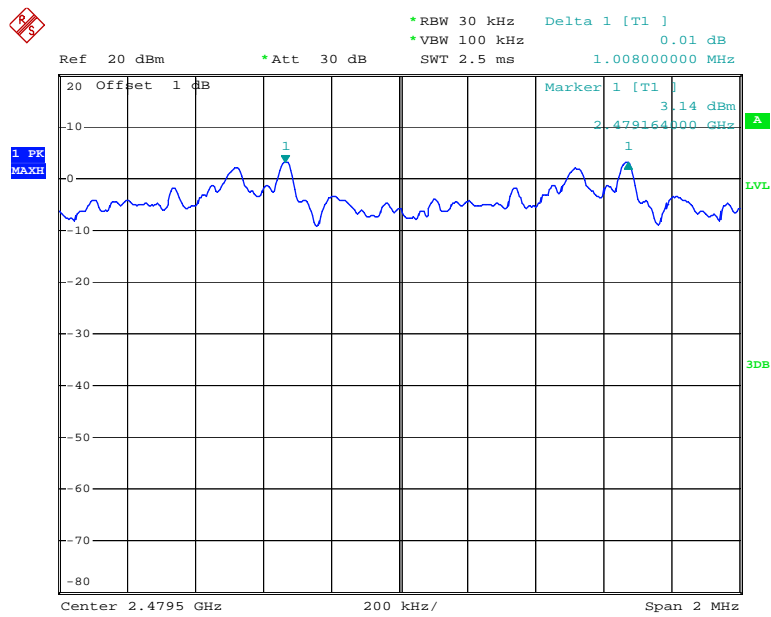
Date: 6.MAR.2019 15:39:11

### Middle Channel



Date: 6.MAR.2019 15:40:56

### High Channel



Date: 6.MAR.2019 15:43:34

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

### Applicable Standard

According to FCC §15.247(a) (1):

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	Spectrum Analyzer	FSU 26	200256	2019-01-04	2020-01-04
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>	26.6~28.5 °C
<b>Relative Humidity:</b>	54~58%
<b>ATM Pressure:</b>	101.1~101.5kPa

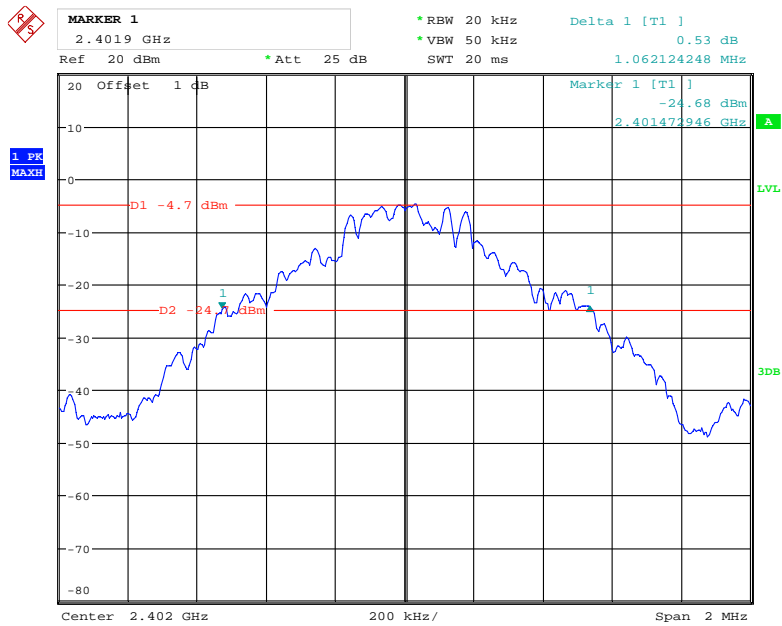
\* The testing was performed by Carrie He on 2019-03-06 to 2019-05-28

**Test Result:** Compliance.

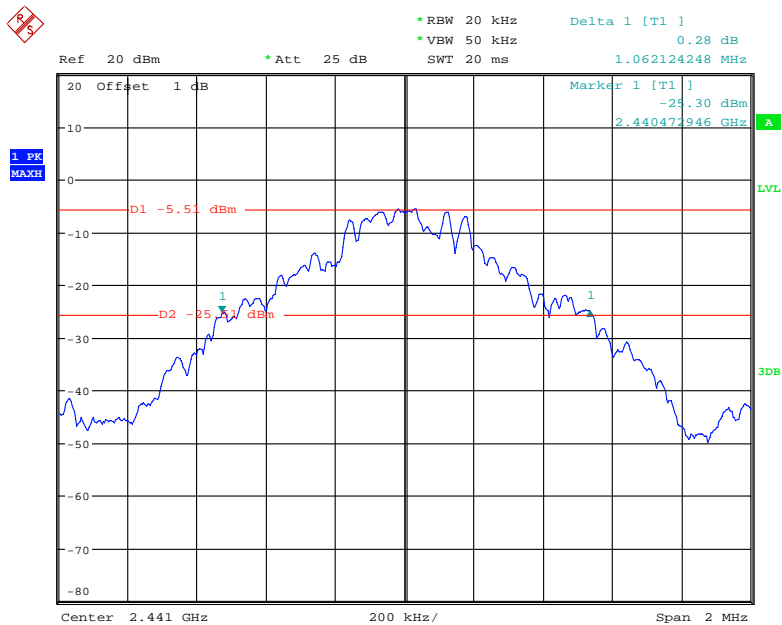
Please refer to following tables and plots

*Test Mode: Transmitting*

Mode	Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
BDR Mode (GFSK)	Low	2402	1.062
	Middle	2441	1.062
	High	2480	1.062
EDR Mode ( $\pi/4$ -DQPSK)	Low	2402	1.320
	Middle	2441	1.320
	High	2480	1.336
EDR Mode (8-DPSK)	Low	2402	1.260
	Middle	2441	1.260
	High	2480	1.288

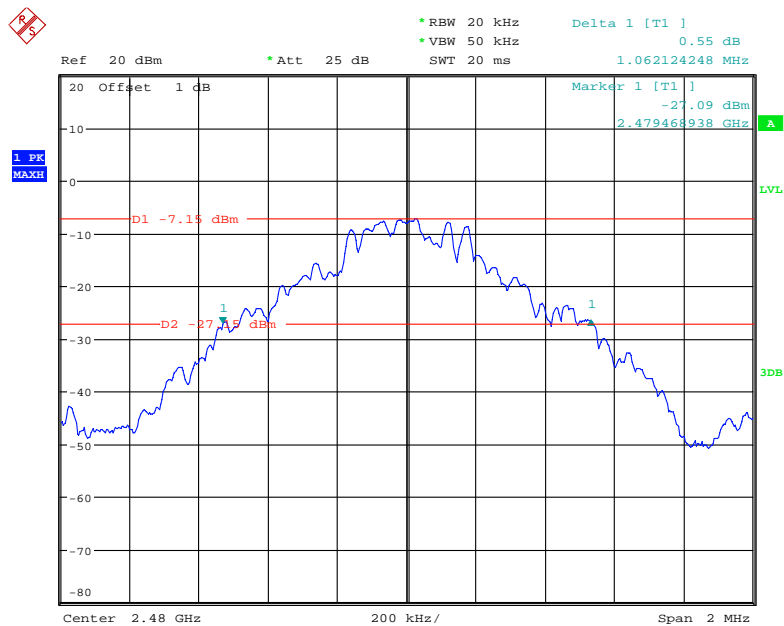
*BDR Mode (GFSK):***Low Channel**

Date: 28.MAY.2019 19:48:24

**Middle Channel**

Date: 28.MAY.2019 19:52:12

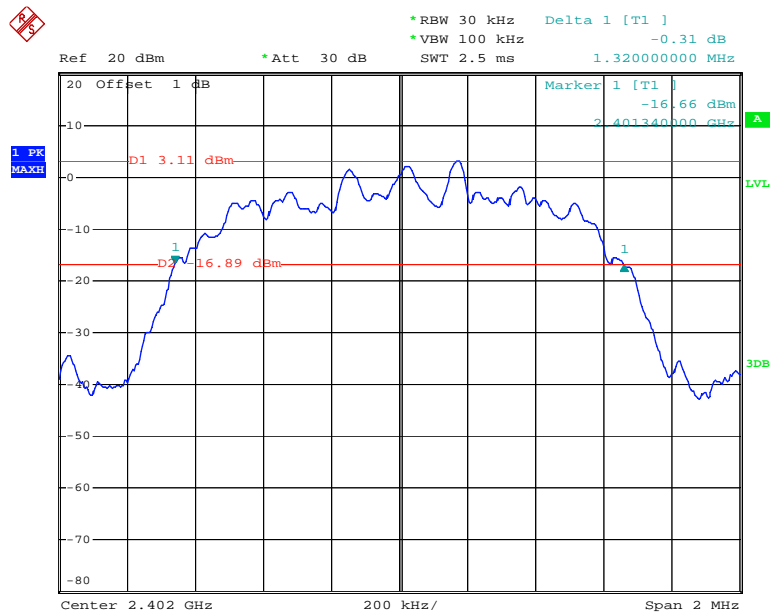
## High Channel



Date: 28.MAY.2019 19:50:32

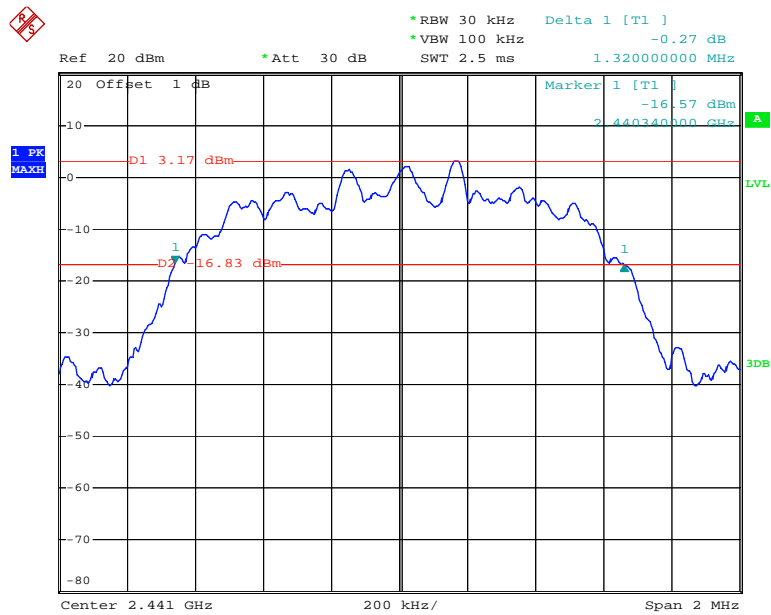
EDR Mode ( $\pi/4$ -DQPSK):

## Low Channel



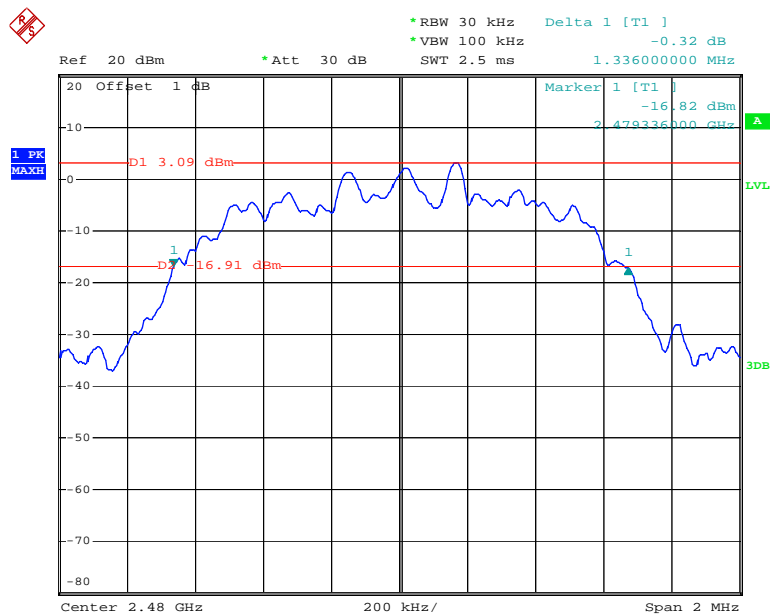
Date: 6.MAR.2019 15:31:36

### Middle Channel



Date: 6.MAR.2019 15:33:44

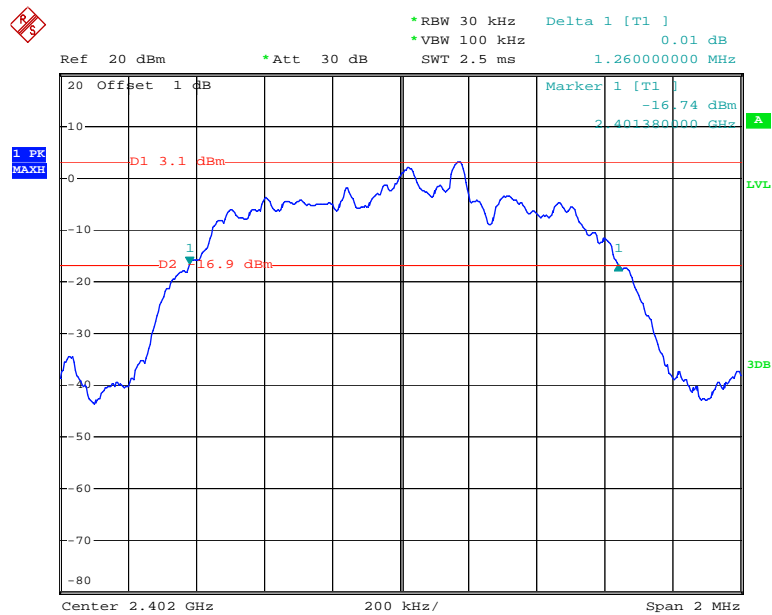
### High Channel



Date: 6.MAR.2019 15:48:15

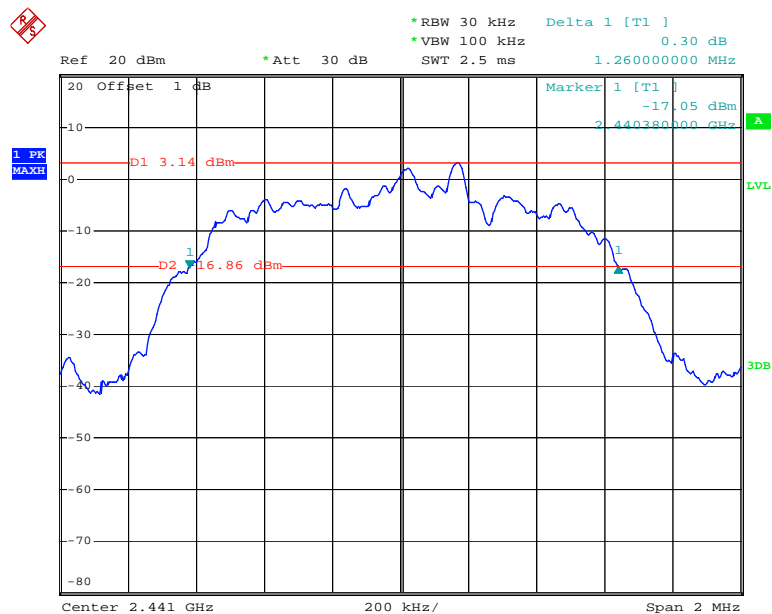
EDR Mode (8-DPSK):

## Low Channel



Date: 6.MAR.2019 15:37:35

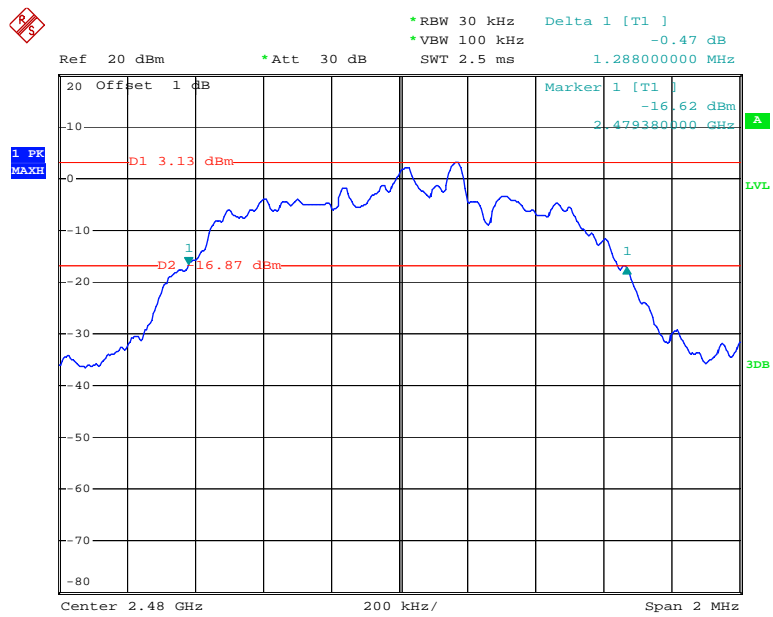
## Middle Channel



Date: 6.MAR.2019 15:39:44



# High Channel



Date: 6.MAR.2019 15:47:17

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

### Applicable Standard

According to FCC §15.247(a) (1) (iii)

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

### 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	Spectrum Analyzer	FSU 26	200256	2019-01-04	2020-01-04
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:	26.6~28.5 °C
Relative Humidity:	54~58%
ATM Pressure:	101.1~101.5kPa

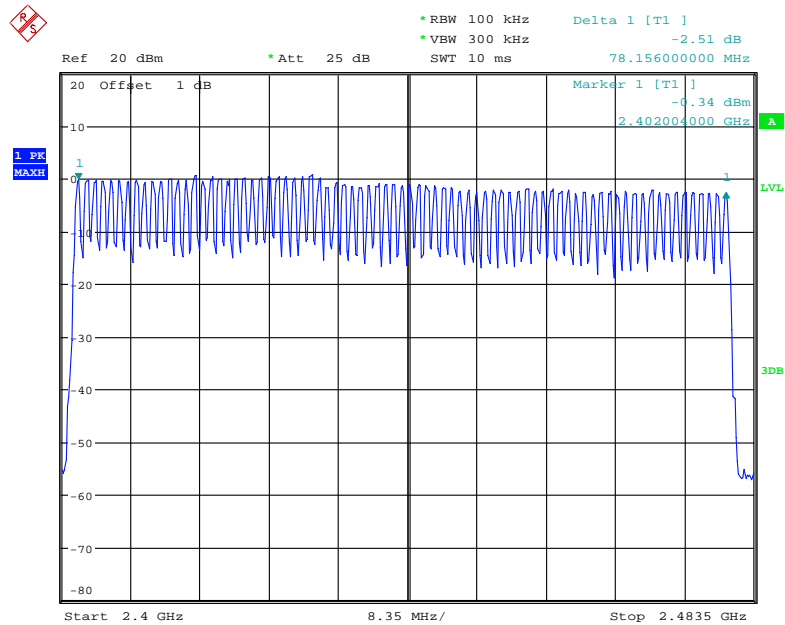
\* The testing was performed by Carrie He on 2019-03-06 to 2019-05-28

**Test Result:** Compliance.

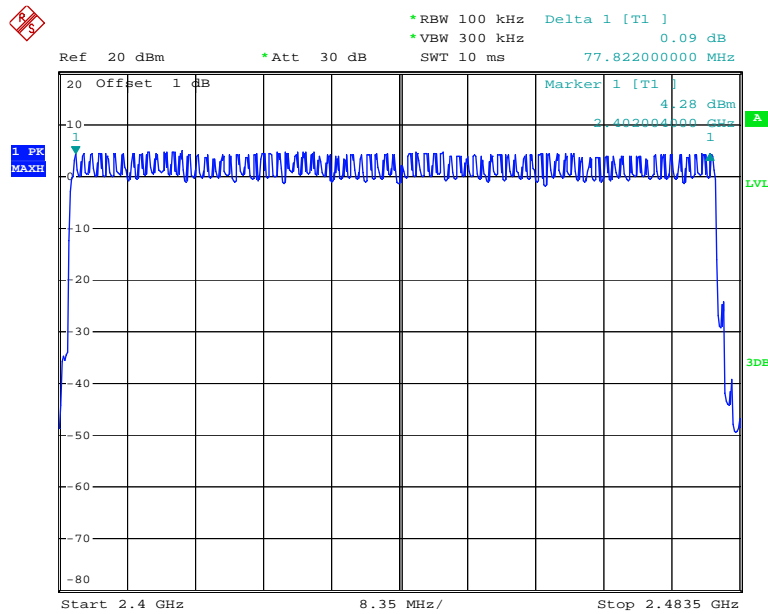
Please refer to following tables and plots

*Test Mode: Transmitting*

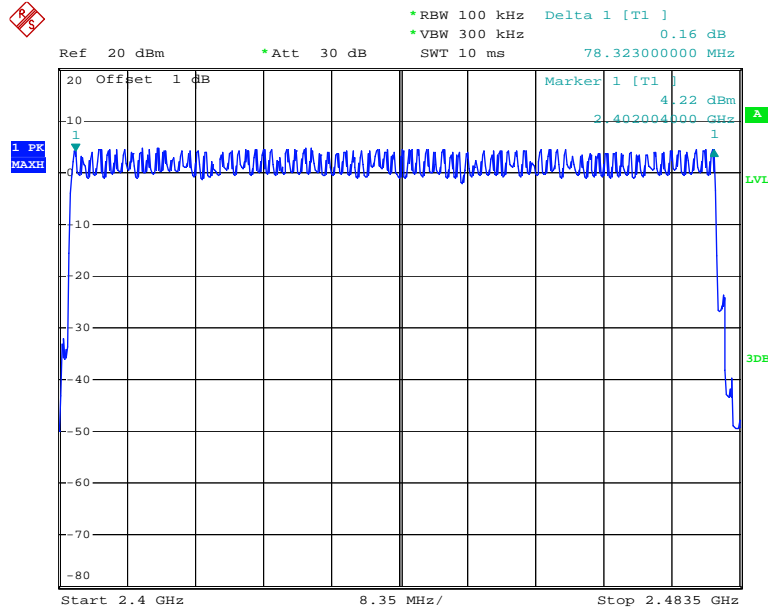
Mode	Frequency Range (MHz)	Number of Hopping Channel	Limit
GFSK	2400-2483.5	79	≥15
$\pi/4$ -DQPSK	2400-2483.5	79	≥15
8-DPSK	2400-2483.5	79	≥15

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

Date: 28.MAY.2019 19:57:42

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

Date: 6.MAR.2019 16:15:01

**EDR Mode (8-DPSK): Number of Hopping Channels**

Date: 6.MAR.2019 16:19:30

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

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

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	Spectrum Analyzer	FSU 26	200256	2019-01-04	2020-01-04
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>	26.6~28.5 °C
<b>Relative Humidity:</b>	54~58%
<b>ATM Pressure:</b>	101.1~101.5kPa

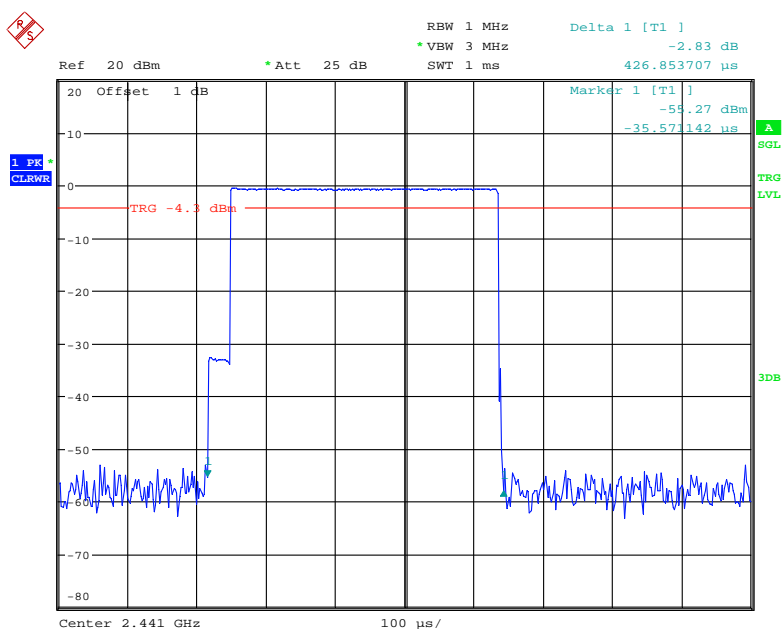
\* The testing was performed by Carrie He on 2019-03-07 to 2019-05-28

**Test Result:** Compliance.

Please refer to following tables and plots

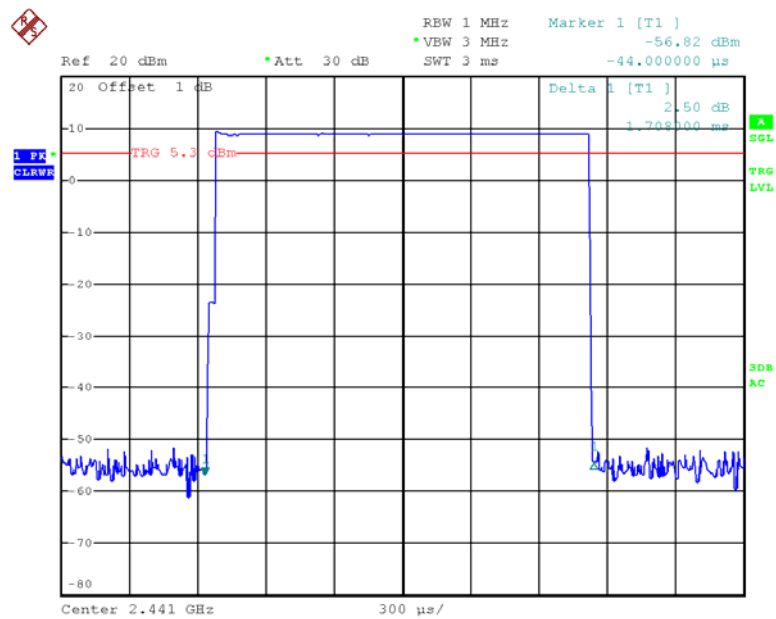
*Test Mode: Transmitting*

Mode	Packet type	Channel	Frequency (MHz)	Pulse width (ms)	Result (s)	Limit (s)
GFSK	DH1	Middle	2441	0.427	0.137	0.4
	DH3	Middle	2441	1.708	0.273	
	DH5	Middle	2441	2.948	0.314	
$\pi/4$ -DQPSK	2DH1	Middle	2441	0.434	0.139	
	2DH3	Middle	2441	1.712	0.274	
	2DH5	Middle	2441	2.962	0.316	
8-DPSK	3DH1	Middle	2441	0.436	0.140	
	3DH3	Middle	2441	1.714	0.274	
	3DH5	Middle	2441	2.964	0.316	
Note: DH1:Dwell time=Pulse time (ms) $\times$ (1600/2/79) $\times$ 31.6 s DH3:Dwell time=Pulse time (ms) $\times$ (1600/4/79) $\times$ 31.6 s DH5:Dwell time=Pulse time (ms) $\times$ (1600/6/79) $\times$ 31.6 s						

*BDR Mode (GFSK):***DH1: Middle Channel**

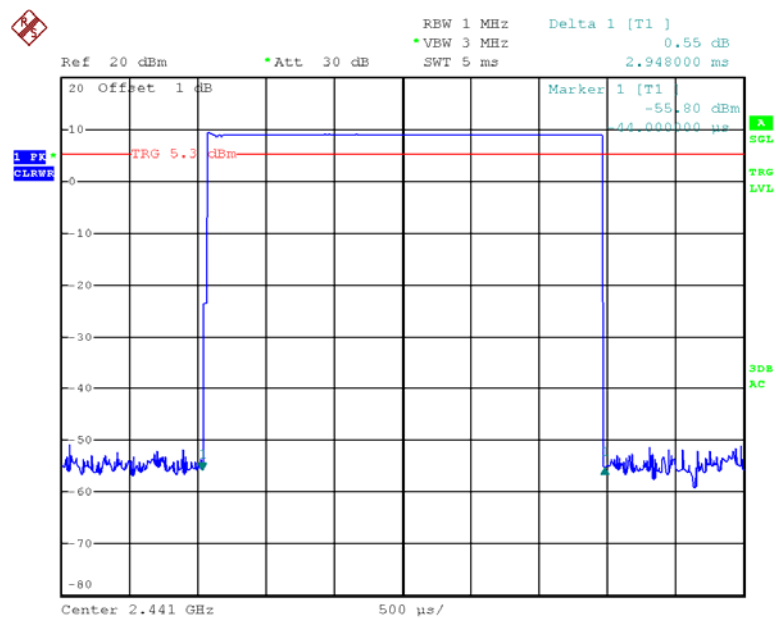
Date: 28.MAY.2019 19:58:33

### DH3: Middle Channel



Date: 7.MAR.2019 10:06:25

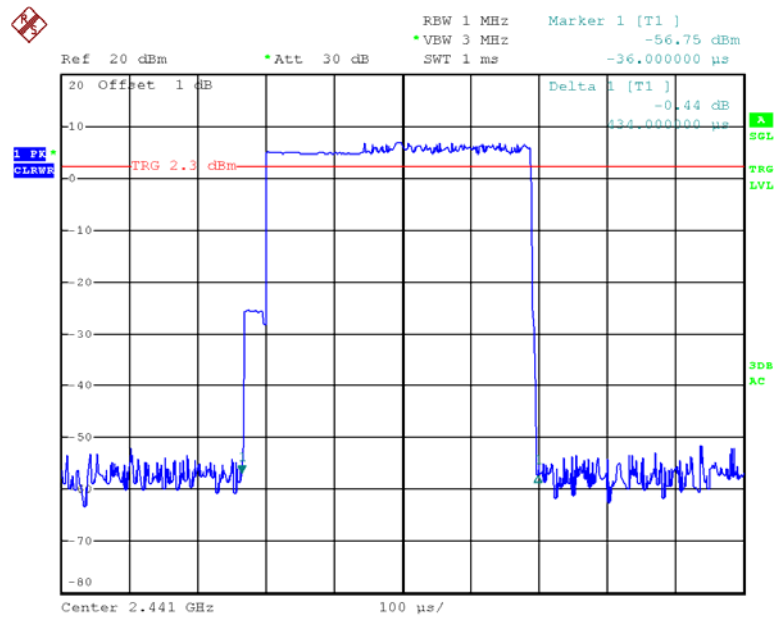
### DH5: Middle Channel



Date: 7.MAR.2019 10:07:42

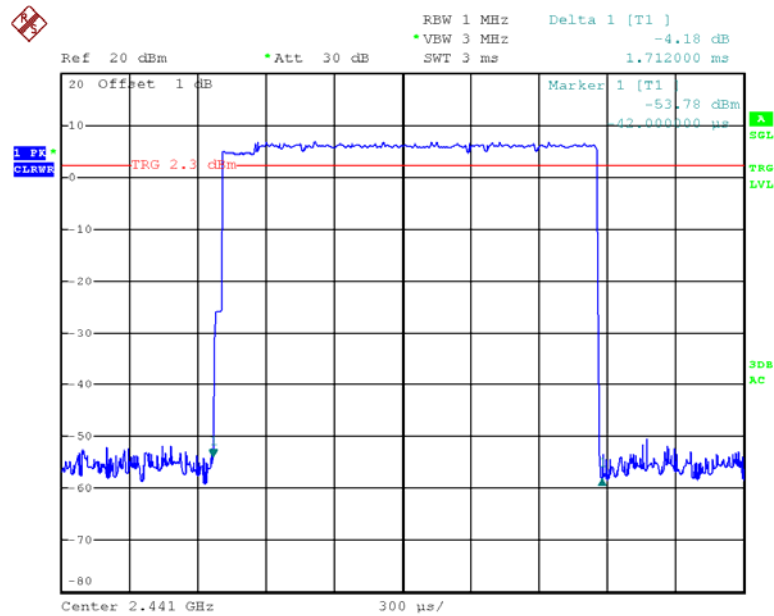
EDR Mode ( $\pi/4$ -DQPSK):

### 2DH1: Middle Channel



Date: 7.MAR.2019 10:09:09

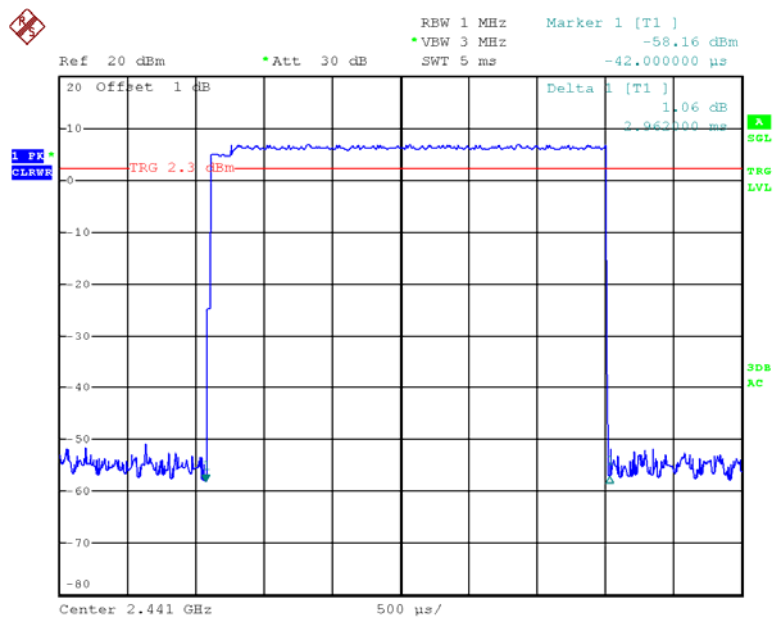
### 2DH3: Middle Channel



Date: 7.MAR.2019 10:10:03



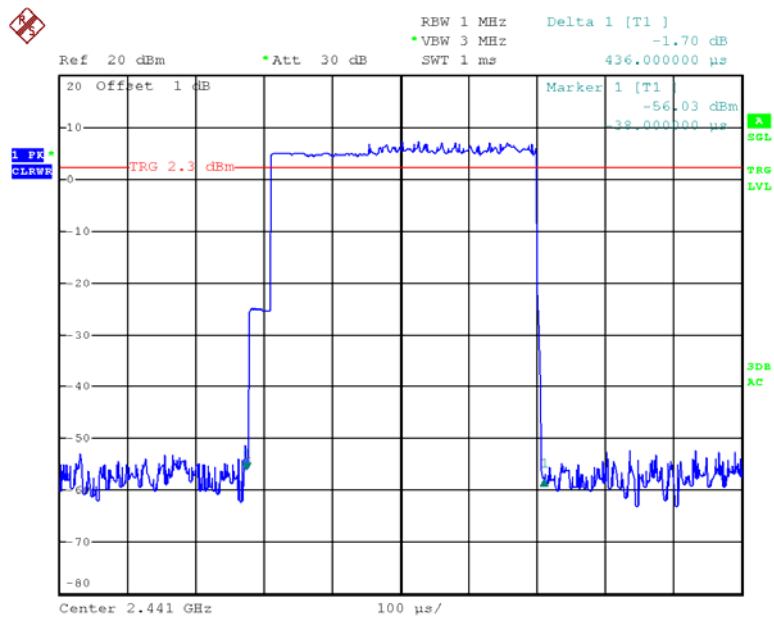
### 2DH5: Middle Channel



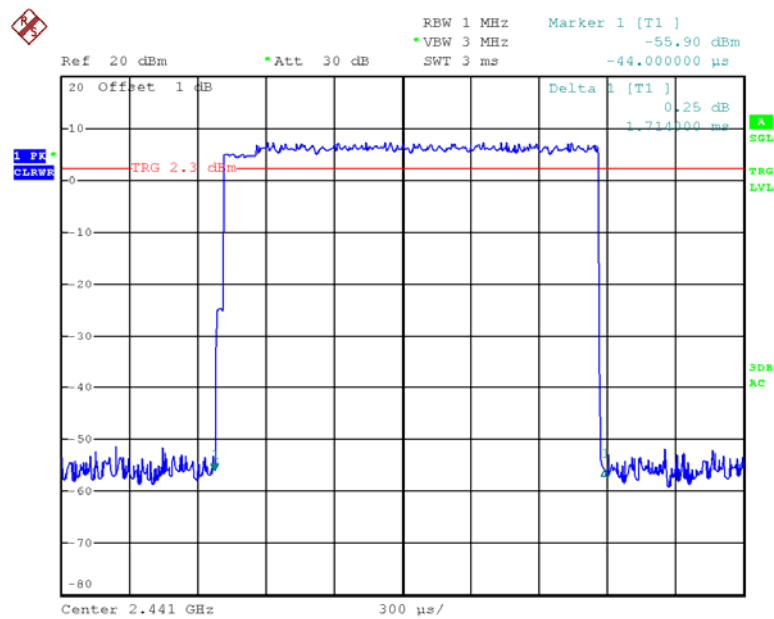
Date: 7.MAR.2019 10:10:47

EDR Mode (8-DPSK):

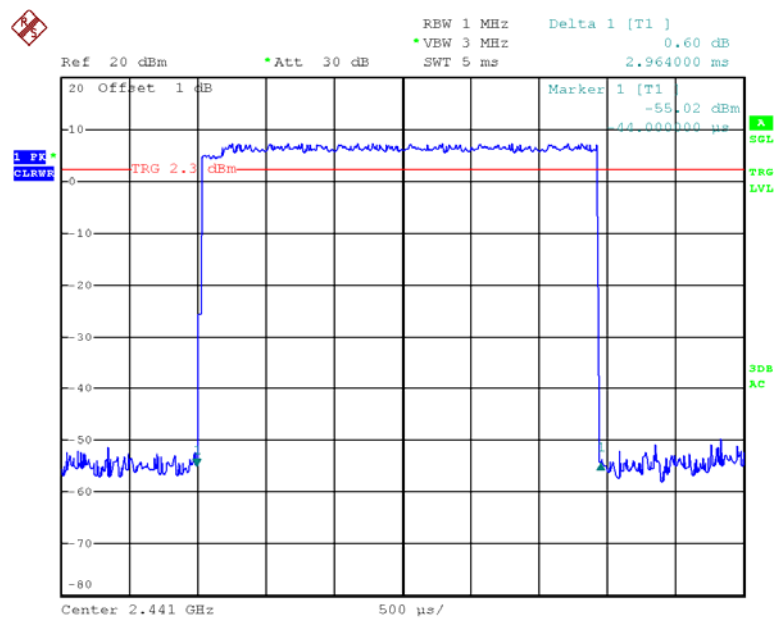
### 3DH1: Middle Channel



Date: 7.MAR.2019 10:11:43

**3DH3: Middle Channel**

Date: 7.MAR.2019 10:12:23

**3DH5: Middle Channel**

Date: 7.MAR.2019 10:12:59

**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
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A
Agilent	USB Wideband Power Sensor	U2022XA	MY5417006	2018-12-10	2019-12-10

\* **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:	26.6~28.5 °C
Relative Humidity:	54~58%
ATM Pressure:	101.1~101.5kPa

\* The testing was performed by Carrie He on 2019-03-26 to 2019-05-28

**Test Result:** Compliance.

*Test Mode: Transmitting*

Mode	Frequency (MHz)	Peak Conducted Output power (dBm)	Limit (dBm)
BDR Mode (GFSK)	2402	0.35	21
	2441	-0.42	21
	2480	-2.03	21
EDR Mode ( $\pi/4$ -DQPSK)	2402	6.45	21
	2441	6.39	21
	2480	6.11	21
EDR Mode (8-DPSK)	2402	6.88	21
	2441	6.82	21
	2480	6.45	21

## FCC §15.247(d)- BAND EDGES TESTING

### Applicable Standard

According to FCC §15.247(d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### 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	Spectrum Analyzer	FSU 26	200256	2019-01-04	2020-01-04
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

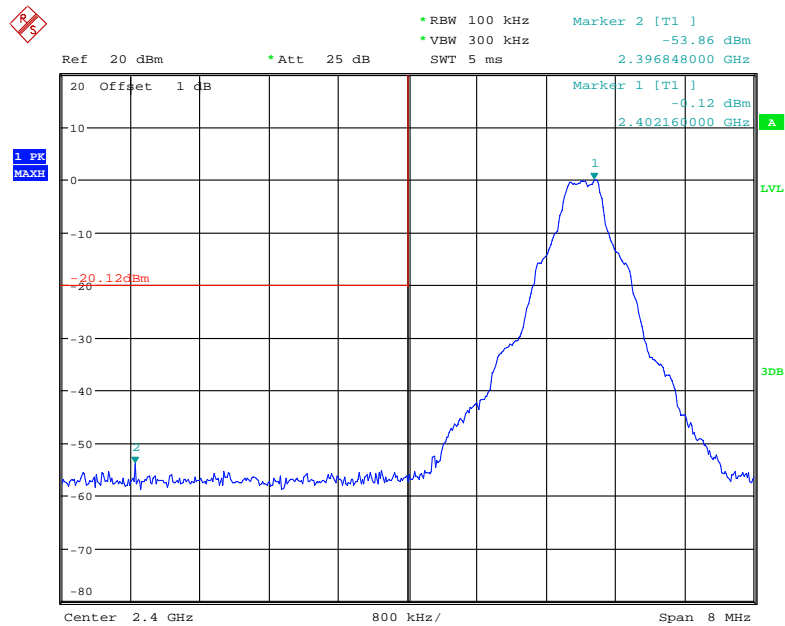
\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

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

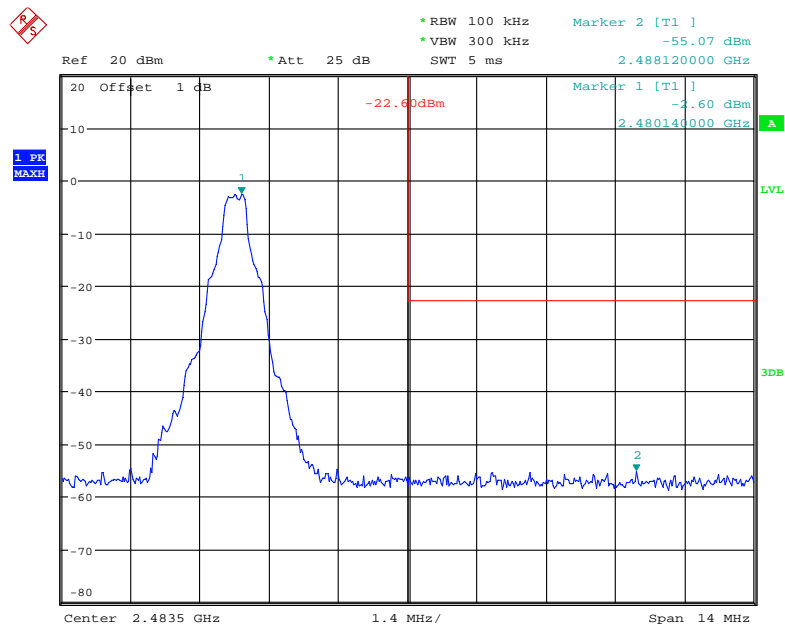
<b>Temperature:</b>	26.6~28.5 °C
<b>Relative Humidity:</b>	54~58%
<b>ATM Pressure:</b>	101.1~101.5kPa

*\* The testing was performed by Carrie He on 2019-03-26 to 2019-05-28*

**Test Result:** Compliance

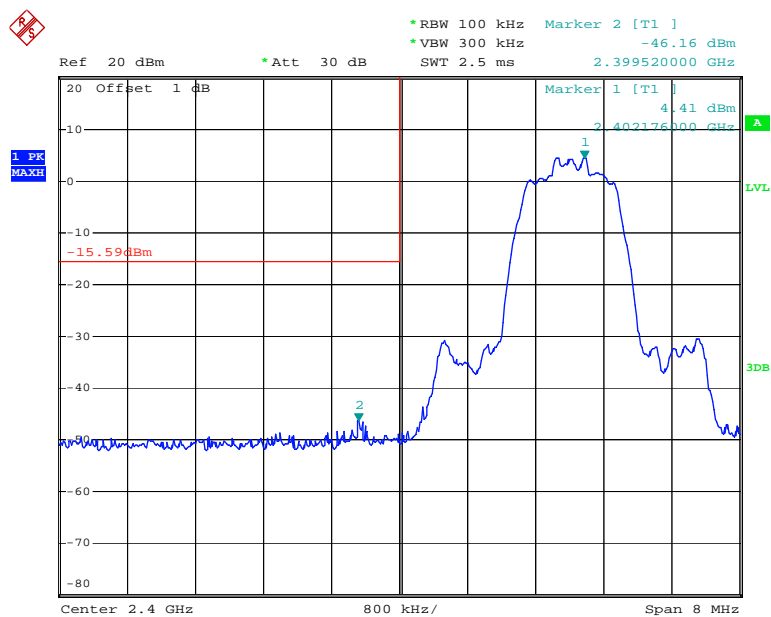
*Single mode:**BDR Mode (GFSK):***Band Edge, Left Side**

Date: 28.MAY.2019 19:49:20

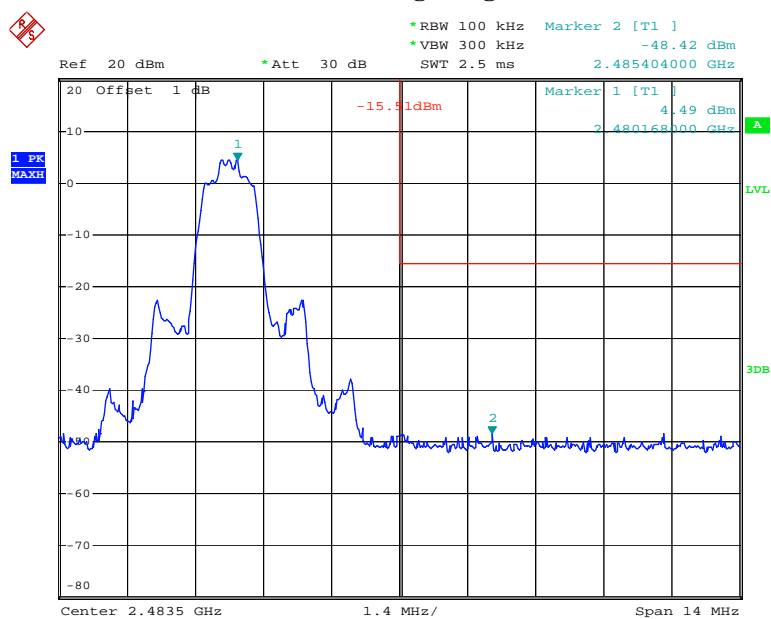
**Band Edge, Right Side**

Date: 28.MAY.2019 19:51:35

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

**Band Edge, Left Side**

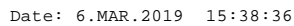
Date: 6.MAR.2019 15:32:37

**Band Edge, Right Side**

Date: 6.MAR.2019 15:36:26



### Band Edge, Left Side



\*RBW 100 kHz  
 \*VBW 300 kHz  
 SWT 2.5 ms

Ref 20 dBm  
 \*Att 30 dB

Marker 2 [T1]  
 -47.46 dBm  
 2.486748000 GHz

20 Offset 1 dB  
 -15.54 dBm  
 1 [T1]  
 4.46 dBm  
 2.480168000 GHz

1 PK  
 MAXH

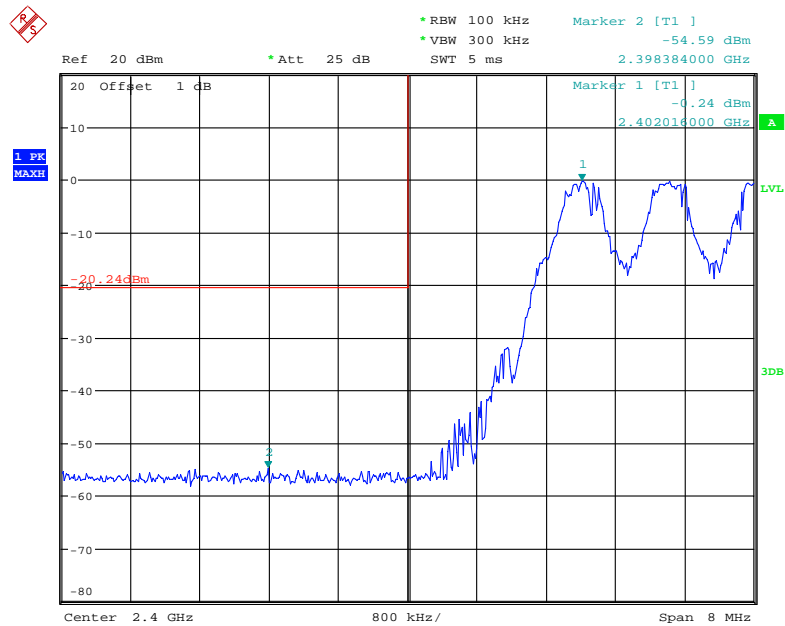
Center 2.4835 GHz  
 1.4 MHz/  
 Span 14 MHz

Date: 6.MAR.2019 15:43:05

Hopping mode:

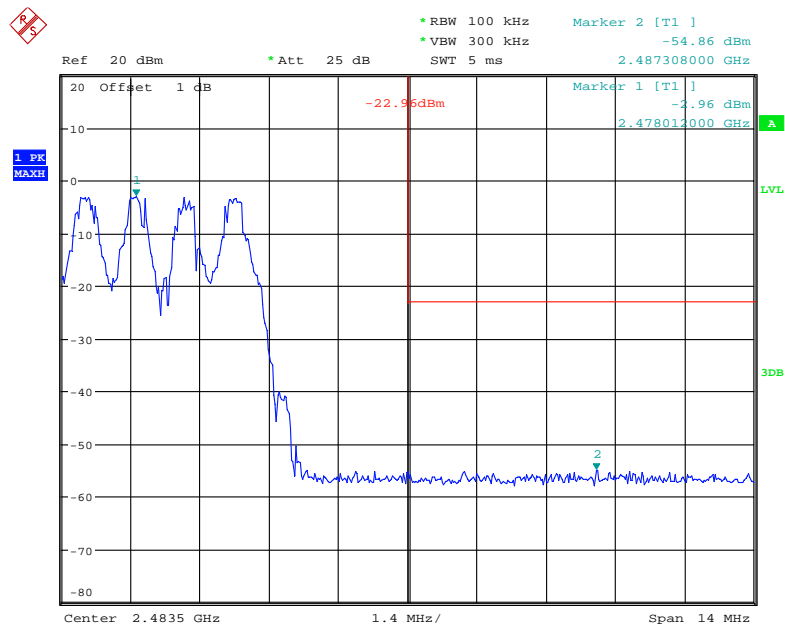
BDR Mode (GFSK):

### Band Edge, Left Side

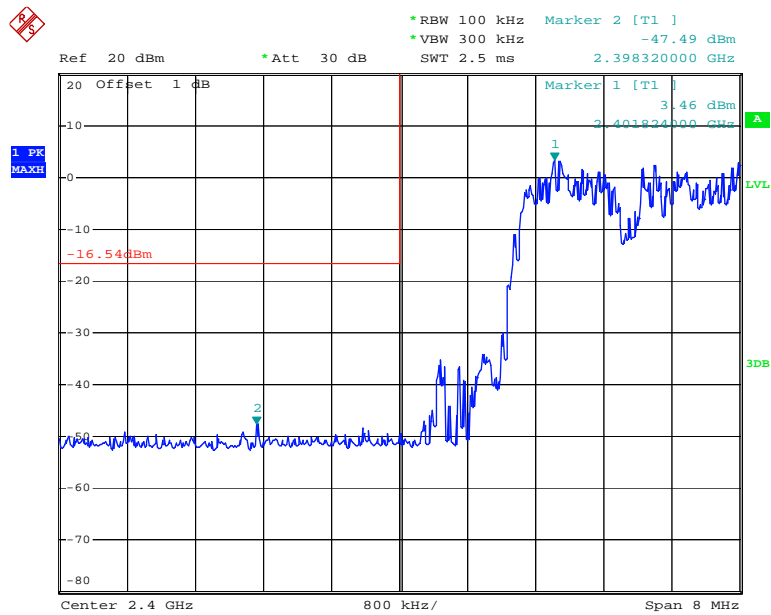


Date: 28.MAY.2019 20:00:45

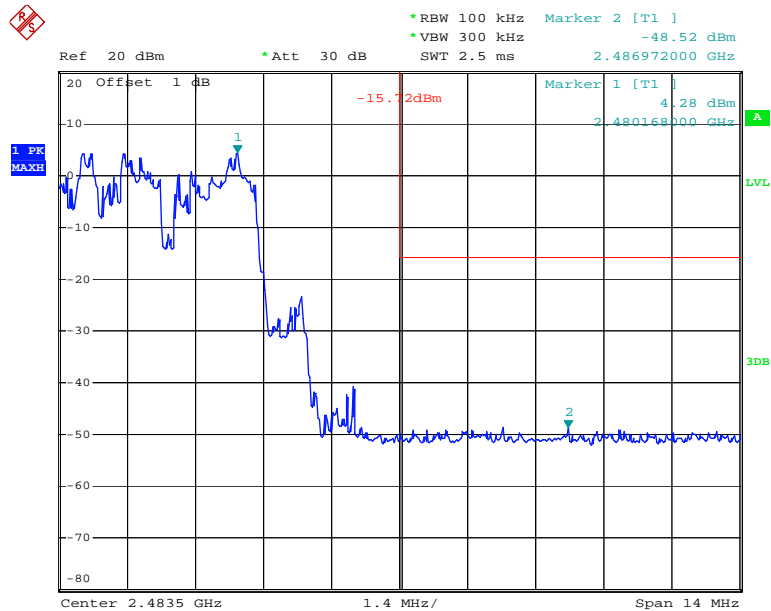
### Band Edge, Right Side



Date: 28.MAY.2019 20:02:42

*EDR Mode ( $\pi/4$ -DQPSK):***Band Edge, Left Side**

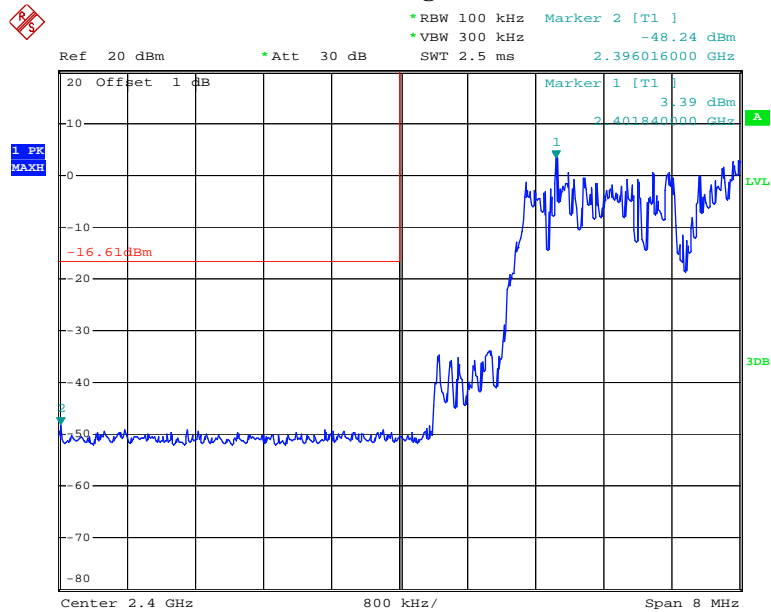
Date: 6.MAR.2019 16:24:19

**Band Edge, Right Side**

Date: 6.MAR.2019 16:25:05

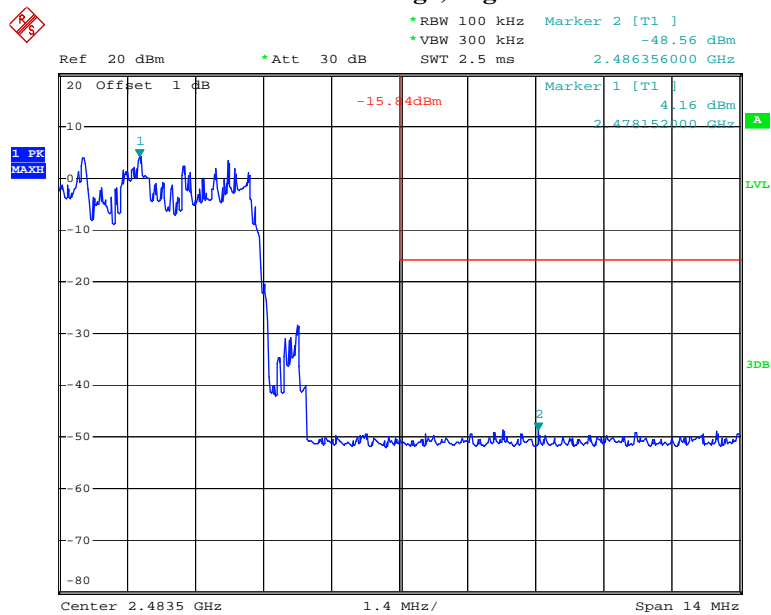
EDR Mode (8-DPSK):

### Band Edge, Left Side



Date: 6.MAR.2019 16:25:54

### Band Edge, Right Side



Date: 6.MAR.2019 16:27:13

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