TESTING LABORATORY
CERTIFICATE #4820.01

FCC PART 15.247

TEST REPORT

For

Xstar Smart Power Co.,Limited

9B, Cheong Tai Commercil Building, 66 Wing Lok Street, Sheung Wan, Hong Kong

FCC ID: 2ARIR-1824B

Report Type:	**Product Type:**
Original Report	Mobile Phone

Report Number:	RDG190625007-00A
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TABLE OF CONTENTS

GENERAL INFORMATION **4**
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
SYSTEM TEST CONFIGURATION **6**
DESCRIPTION OF TEST CONFIGURATION 6
EUT EXERCISE SOFTWARE 6
EQUIPMENT MODIFICATIONS 6
SUPPORT CABLE LIST AND DETAILS 6
BLOCK DIAGRAM OF TEST SETUP 6
SUMMARY OF TEST RESULTS **7**
FCC §15.247 (i) & §1.1310 & §2.1093- RF EXPOSURE **8**
APPLICABLE STANDARD 8
FCC §15.203- ANTENNA REQUIREMENT **9**
APPLICABLE STANDARD 9
ANTENNA CONNECTOR CONSTRUCTION 9
FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS **10**
APPLICABLE STANDARD 10
EUT SETUP 10
EMI TEST RECEIVER SETUP 10
TEST PROCEDURE 10
CORRECTED AMPLITUDE & MARGIN CALCULATION 11
TEST EQUIPMENT LIST AND DETAILS 11
TEST DATA 11
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS **14**
APPLICABLE STANDARD 14
EUT SETUP 14
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP 15
TEST PROCEDURE 15
CORRECTED AMPLITUDE & MARGIN CALCULATION 15
TEST EQUIPMENT LIST AND DETAILS 16
TEST DATA 16
FCC §15.247(a) (1) - CHANNEL SEPARATION TEST **22**
APPLICABLE STANDARD 22
TEST EQUIPMENT LIST AND DETAILS 22
TEST PROCEDURE 22
TEST DATA 22
FCC §15.247(a) (1)–BANDWIDTH TESTING **29**
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 **36**

APPLICABLE STANDARD 36
TEST PROCEDURE 36
TEST EQUIPMENT LIST AND DETAILS.....36
TEST DATA 36

FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME).....39

APPLICABLE STANDARD 39
TEST PROCEDURE 39
TEST EQUIPMENT LIST AND DETAILS.....39
TEST DATA 39

FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT.....45

APPLICABLE STANDARD 45
TEST PROCEDURE 45
TEST EQUIPMENT LIST AND DETAILS.....45
TEST DATA 45

FCC §15.247(d)- BAND EDGES TESTING 47

APPLICABLE STANDARD 47
TEST PROCEDURE 47
TEST EQUIPMENT LIST AND DETAILS.....47
TEST DATA 48

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:		Mobile Phone
EUT Model:		X100
Operation Frequency:		2402-2480 MHz
Output Power(Conducted):		7.08 dBm
Modulation Type:		GFSK, π/4-DQPSK, 8-DPSK
Rated Input Voltage:		DC 3.7V from battery or DC 5V from adapter
Adapter Information	**Model:**	N/A
	Input:	AC 100V-240V 50/60Hz 150mA
	Output:	DC 5.0V, 500mA
External Dimension:		118.6mm(L)*50mm(W)*14.7mm(H)
Serial Number:		190625007
EUT Received Date:		2019-07-03

Objective

This report is prepared on behalf of *Xstar Smart Power 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 22H, 24E PCE submissions with FCC ID: 2ARIR-1824B
FCC Part 15B JBP submissions with FCC ID: 2ARIR-1824B

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℃
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 setting.

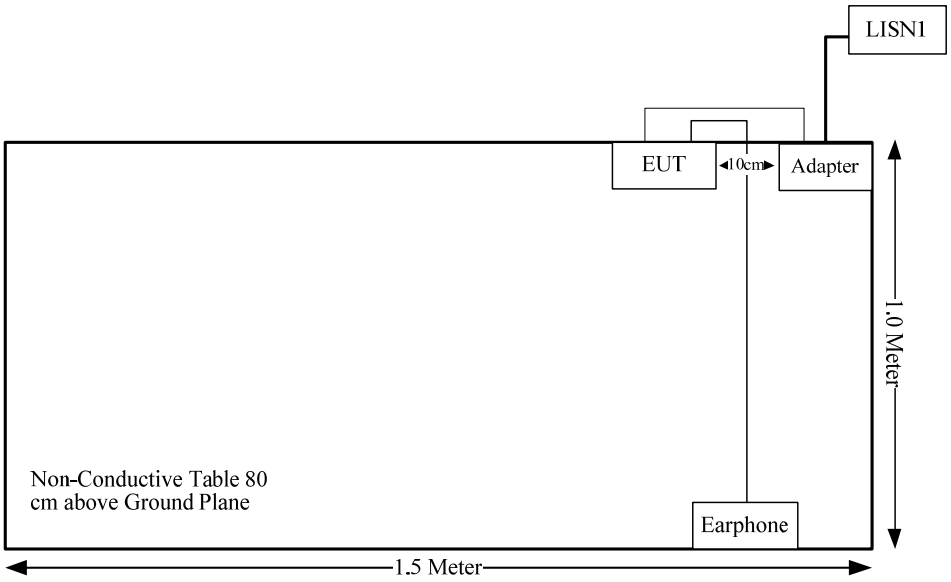
Equipment Modifications

No modification was made to the EUT.

Support Cable List and Details

Cable Description	Shielding Cable	Ferrite Core	Length (m)	From	To
Power Cable	yes	No	0.8	Adapter	EUT
Earphone Cable	No	No	1.0	EUT	Earphone

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

Rules	Description of Test	Result
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 ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- f(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 ≤ 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 7.5 dBm (5.62 mW).
[(max. power of channel, mW)/(min. test separation distance, mm)][√f(GHz)]
=5.62/5*(√2.480) = 1.8< 3.0

So the stand-alone SAR evaluation is not necessary.

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 antenna arrangement for BT, fulfill the requirement of this section. Please refer to the EUT photos.

Antenna Type	input impedance (Ohm)	Antenna Gain /Frequency Range
monopole	50	0.7 dBi/2.4~2.5GHz

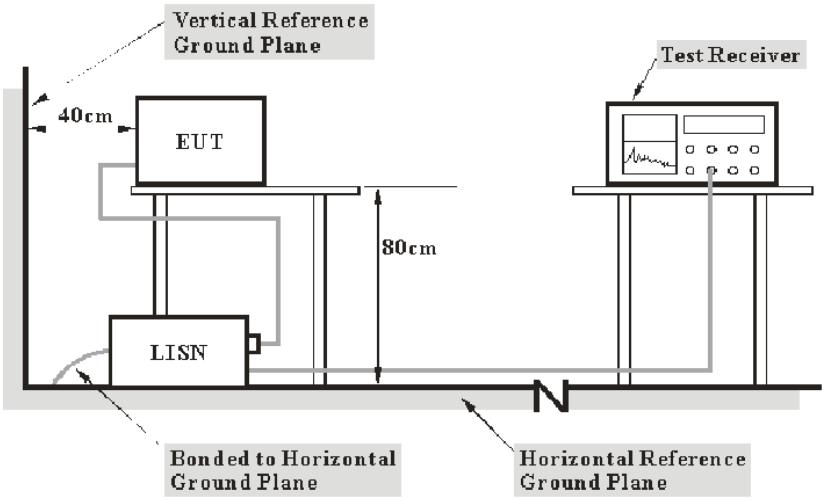
Result: Compliance.

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:

Margin = Limit – Corrected Amplitude

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
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
R&S	EMI Test Receiver	ESPI	100120	2019-05-09	2020-05-09

*** 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

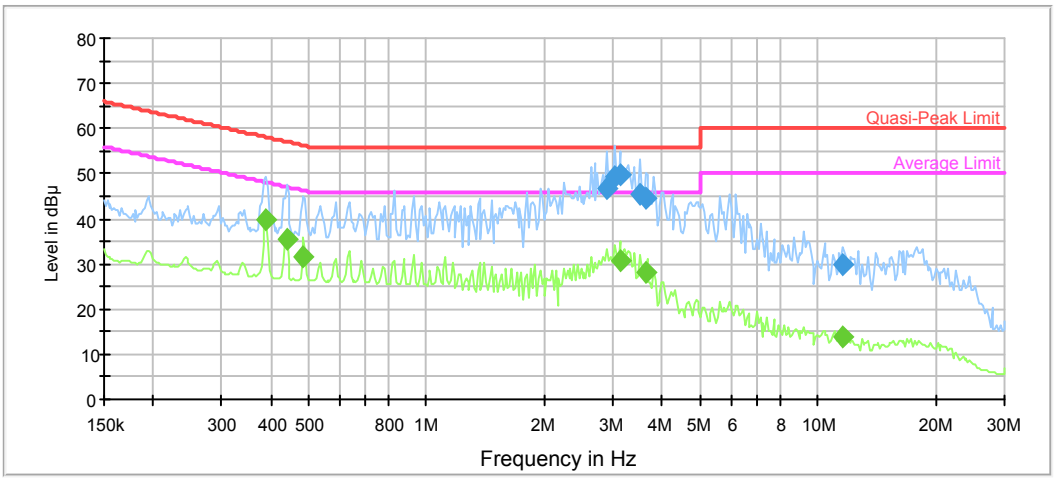
Environmental Conditions

Temperature:	28.2 °C
Relative Humidity:	58 %
ATM Pressure:	100.4kPa

The testing was performed by Lily Xie on 2019-07-09.

Test Mode: *Transmitting*

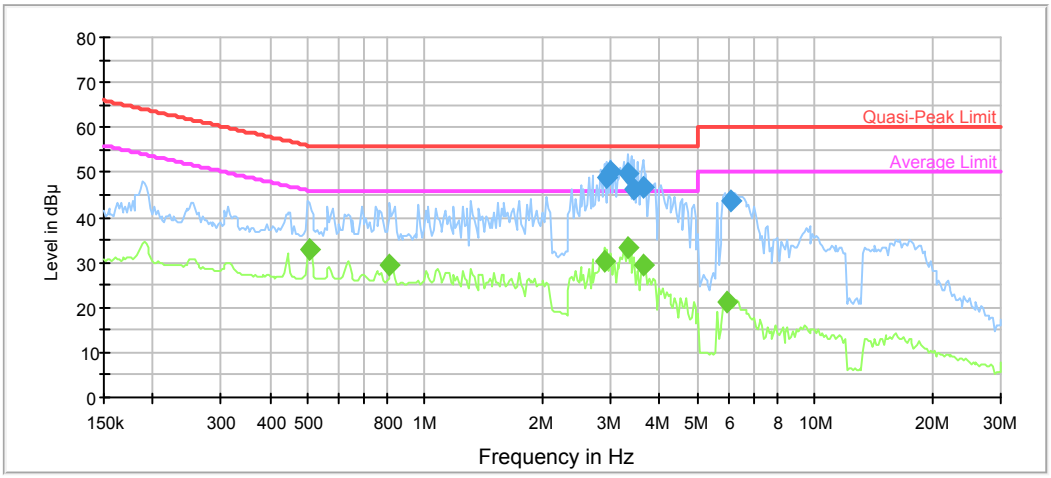
AC120V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
2.880975	46.8	9.000	L1	9.8	9.2	56.0
3.027934	49.4	9.000	L1	9.8	6.6	56.0
3.119684	49.8	9.000	L1	9.8	6.2	56.0
3.515338	45.4	9.000	L1	9.8	10.6	56.0
3.621856	44.6	9.000	L1	9.8	11.4	56.0
11.601974	29.9	9.000	L1	9.8	30.1	60.0

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.389891	39.9	9.000	L1	10.0	8.2	48.1
0.439339	35.5	9.000	L1	9.9	11.6	47.1
0.485304	31.4	9.000	L1	9.9	14.8	46.2
3.119684	30.7	9.000	L1	9.8	15.3	46.0
3.621856	28.0	9.000	L1	9.8	18.0	46.0
11.601974	13.9	9.000	L1	9.8	36.1	50.0

AC120V, 60 Hz, Neutral:



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
2.938883	48.9	9.000	N	9.8	7.1	56.0
2.997955	50.4	9.000	N	9.8	5.6	56.0
3.311607	49.7	9.000	N	9.8	6.3	56.0
3.446072	46.3	9.000	N	9.8	9.7	56.0
3.621856	46.8	9.000	N	9.8	9.2	56.0
6.076347	43.7	9.000	N	9.8	16.3	60.0

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.505009	33.1	9.000	N	9.9	12.9	46.0
0.814189	29.5	9.000	N	9.8	16.5	46.0
2.880975	30.4	9.000	N	9.8	15.6	46.0
3.311607	33.1	9.000	N	9.8	12.9	46.0
3.621856	29.5	9.000	N	9.8	16.5	46.0
5.956619	21.2	9.000	N	9.8	28.8	50.0

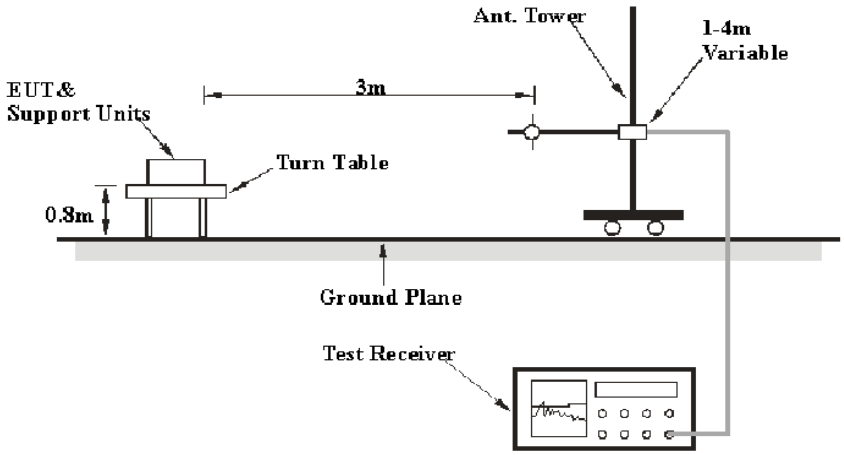
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

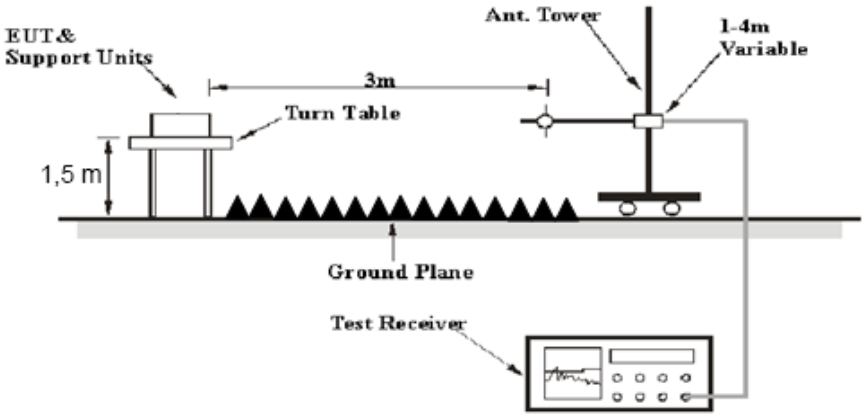
FCC §15.247 (d); §15.209; §15.205.

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:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

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

Margin = Limit – Corrected Amplitude

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESR3	102453	2019-06-26	2020-06-26
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	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
ETS-Lindgren	Horn Antenna	3115	000 527 35	2018-10-12	2021-10-12
Ducommun Technolagies	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
MICRO-COAX	Coaxial Cable	UFA147-1-2362-100100	64639 231029-001	2019-02-24	2020-02-24
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	2019-06-16	2020-06-16
Micro-tronics	High Pass Filter	HPM50111	S/N-G217	2019-06-16	2020-06-16

*** 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

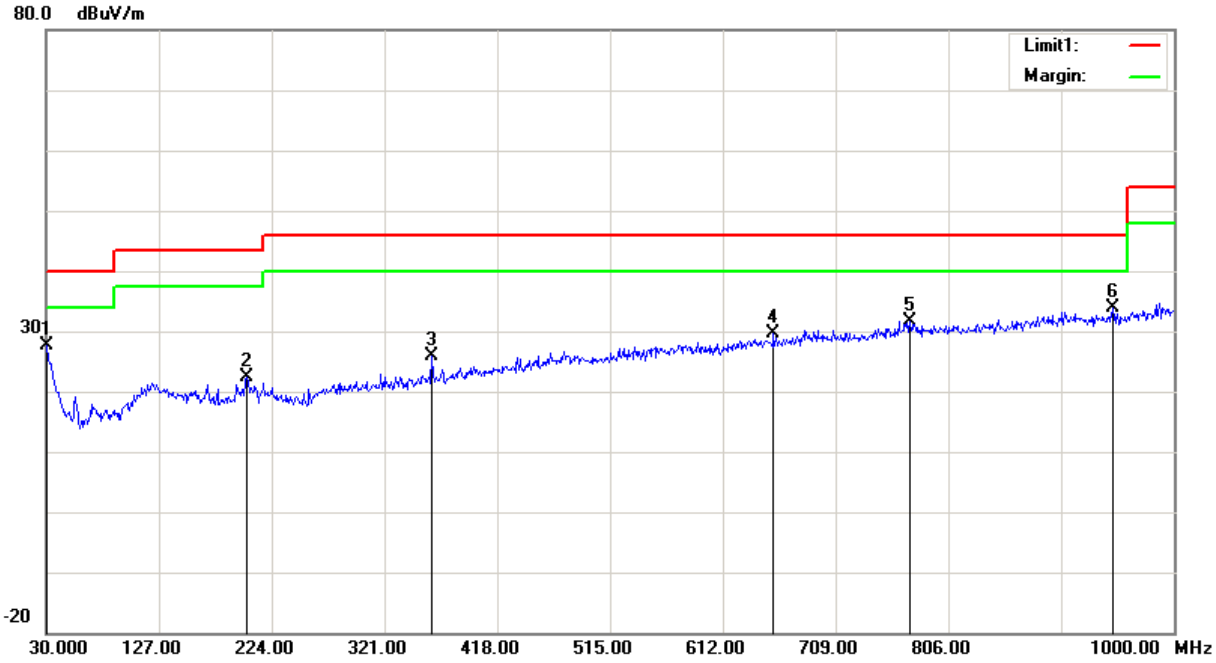
Temperature:	28.6~28.7 °C
Relative Humidity:	57~63%
ATM Pressure:	100.3~ 100.6kPa

** The testing was performed by Tyler Pan, Neil Liao on 2019-07-04 and 2019-07-05*

Test Mode: Transmitting

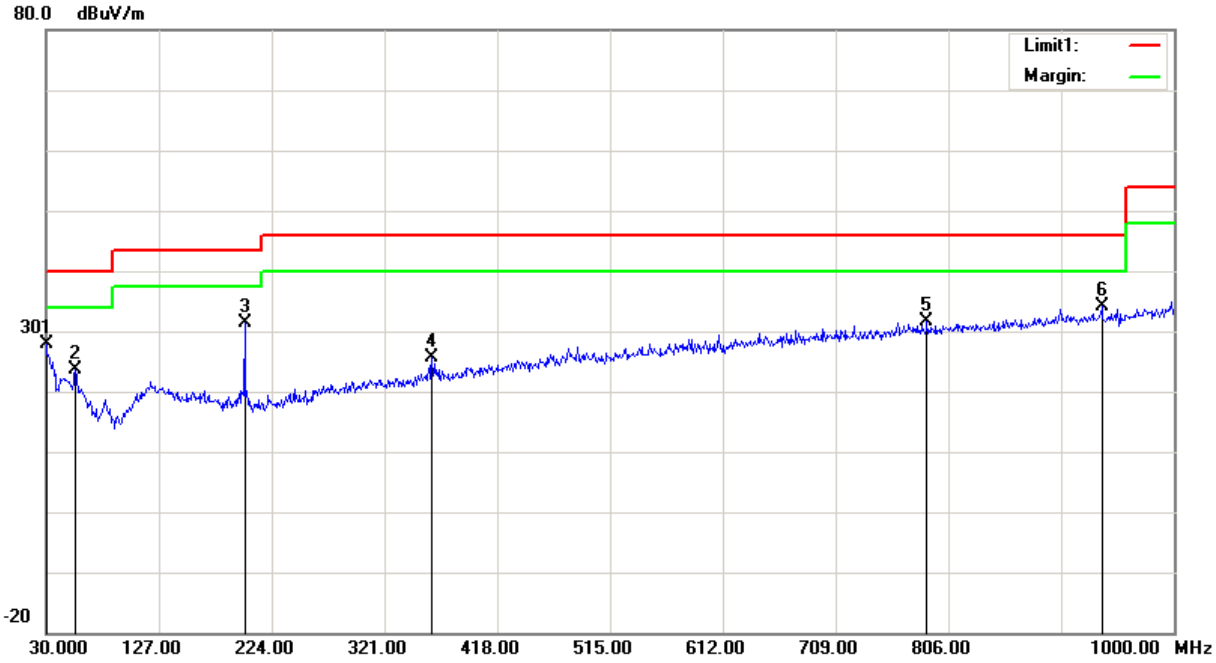
1) 30MHz-1GHz(GFSK Low channel was the worst)

Horizontal:



Frequency (MHz)	Receiver Reading (dBµV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30.97	26.63	peak	0.91	27.54	40	12.46
202.66	28.39	peak	-6.04	22.35	43.5	21.15
361.74	28.78	peak	-2.8	25.98	46	20.02
655.65	27.53	peak	2.07	29.6	46	16.4
773.02	27.35	peak	4.35	31.7	46	14.3
947.62	32.95	peak	0.83	33.78	46	12.22

Vertical:



Frequency (MHz)	Receiver Reading (dBµV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30.0000	26.04	peak	1.72	27.76	40.00	12.24
55.2200	35.63	peak	-12.10	23.53	40.00	16.47
200.7200	37.37	peak	-5.88	31.49	43.50	12.01
361.7400	28.45	peak	-2.80	25.65	46.00	20.35
787.5700	27.15	peak	4.40	31.55	46.00	14.45
937.9200	33.32	peak	0.74	34.06	46.00	11.94

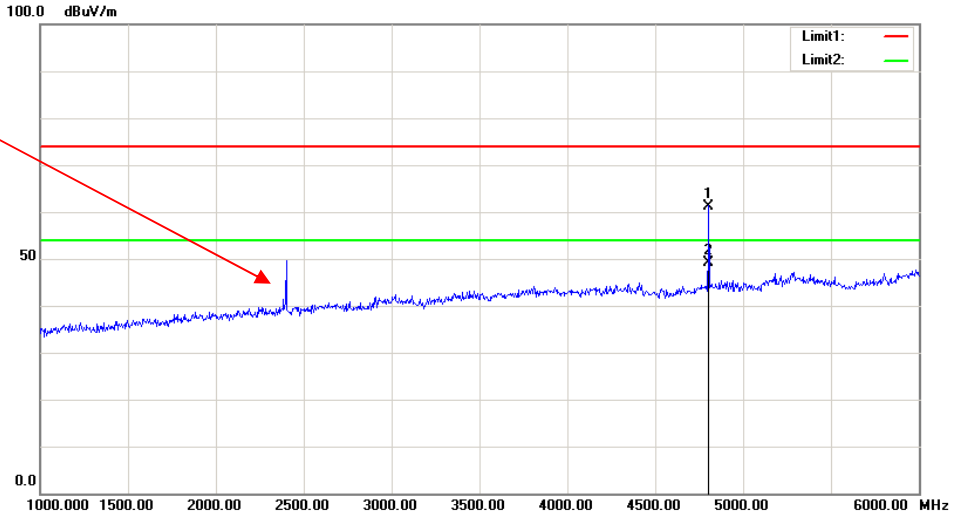
2) 1GHz-25GHz:

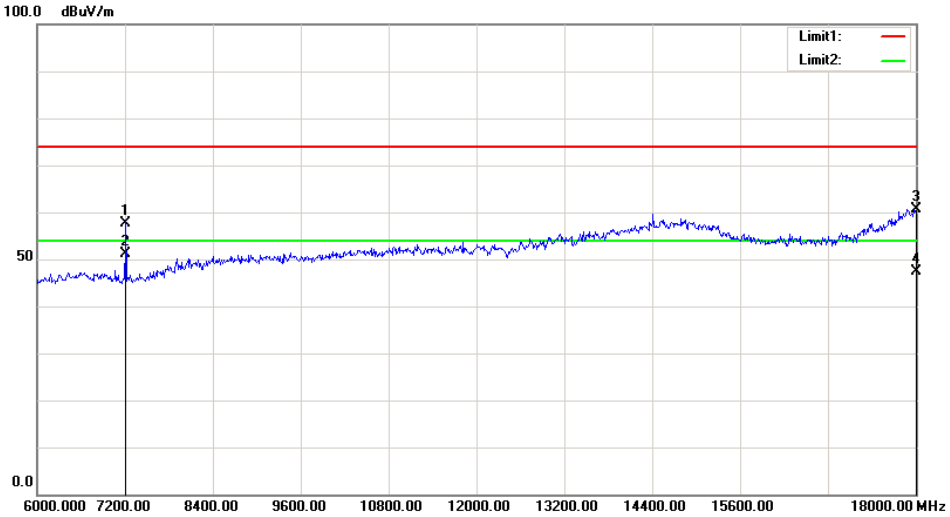
BDR Mode (GFSK) was worst

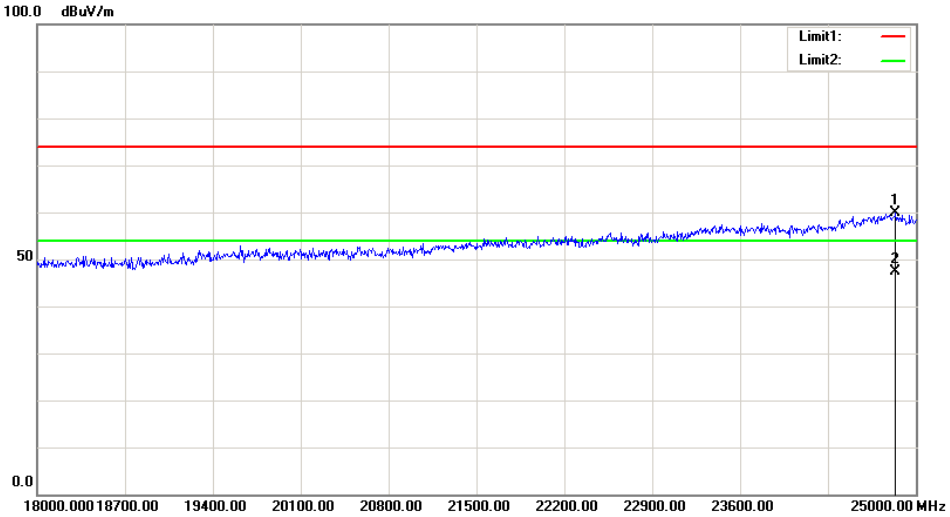
Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	Detector	Polar (H/V)	Factor (dB/m)					
Low Channel: 2402 MHz									
2390.00	26.53	PK	V	28.08	1.80	0.00	56.41	74.00	17.59
2390.00	13.29	AV	V	28.08	1.80	0.00	43.17	54.00	10.83
4804.00	67.14	PK	V	32.91	3.17	37.20	66.02	74.00	7.98
4804.00	52.79	AV	V	32.91	3.17	37.20	51.67	54.00	2.33
7206.00	57.55	PK	V	35.74	4.82	37.23	60.88	74.00	13.12
7206.00	44.36	AV	V	35.74	4.82	37.23	47.69	54.00	6.31
Middle Channel: 2441 MHz									
4882.00	66.19	PK	V	33.06	3.27	37.21	65.31	74.00	8.69
4882.00	51.98	AV	V	33.06	3.27	37.21	51.10	54.00	2.90
7323.00	56.16	PK	V	36.04	4.62	37.38	59.44	74.00	14.56
7323.00	43.71	AV	V	36.04	4.62	37.38	46.99	54.00	7.01
High Channel: 2480 MHz									
2483.50	32.82	PK	V	28.27	1.84	0.00	62.93	74.00	11.07
2483.50	13.91	AV	V	28.27	1.84	0.00	44.02	54.00	9.98
4960.00	65.46	PK	V	33.22	3.23	37.25	64.66	74.00	9.34
4960.00	51.12	AV	V	33.22	3.23	37.25	50.32	54.00	3.68
7440.00	56.45	PK	V	36.34	4.41	37.52	59.68	74.00	14.32
7440.00	43.36	AV	V	36.34	4.41	37.52	46.59	54.00	7.41

Worst plots (*GFSK Low channel*)
Horizontal

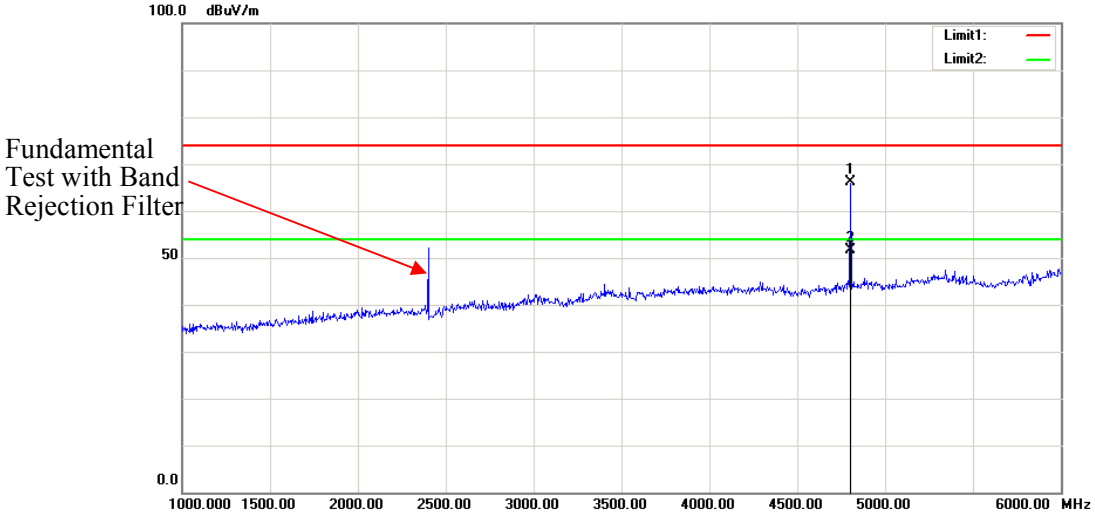
Fundamental Test with Band Rejection Filter

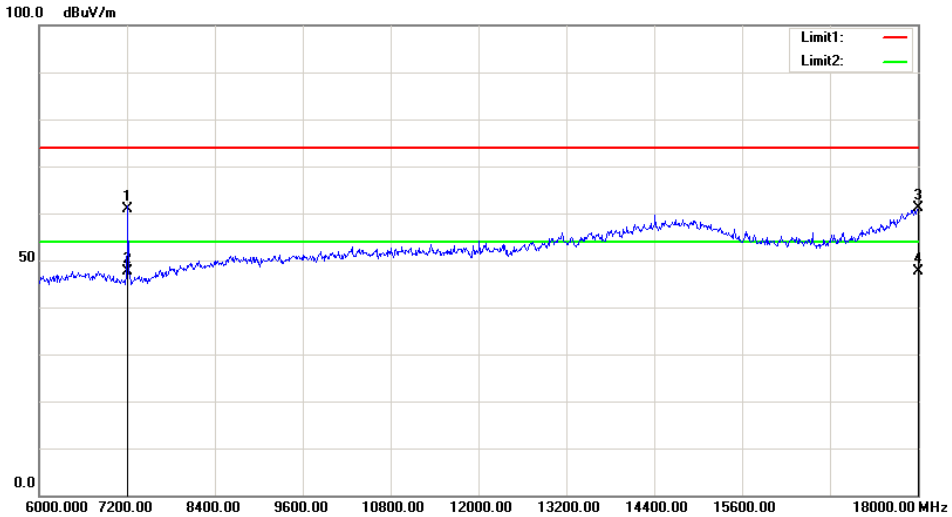






Vertical


Fundamental
Test with Band
Rejection Filter
100.0 dBuV/m
Limit1:
Limit2:
50
0.0
1000.000 1500.00 2000.00 2500.00 3000.00 3500.00 4000.00 4500.00 5000.00 6000.00 MHz


100.0 dBuV/m
Limit1:
Limit2:
50
0.0
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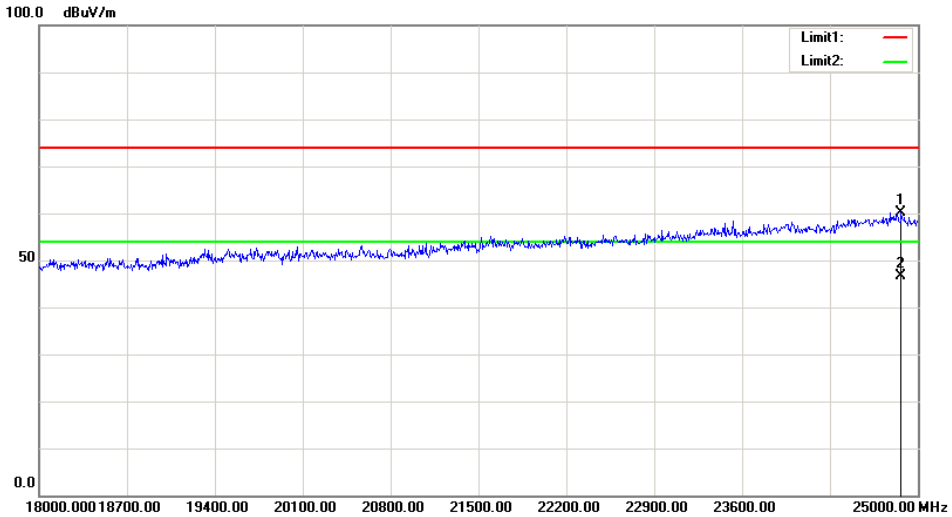

100.0 dBuV/m
Limit1:
Limit2:
50
0.0
18000.000 18700.00 19400.00 20100.00 20800.00 21500.00 22200.00 22900.00 23600.00 25000.00 MHz

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

Applicable Standard

According to FCC §15.247(a) (1)

Frequency hopping systems shall have hoping 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	FSV40	101474	2019-01-09	2020-01-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/03	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:	28.9 °C
Relative Humidity:	56%
ATM Pressure:	100.6kPa

** The testing was performed by Carrie He on 2019-07-05.*

Test Result: Compliance.

Please refer to following tables and plots

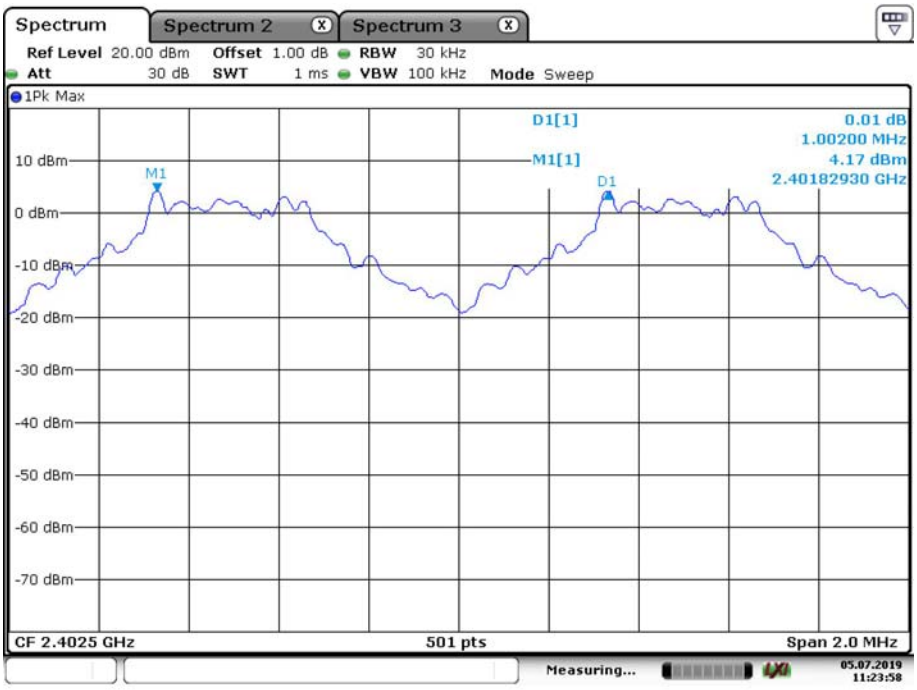
Test Mode: Transmitting

Mode	Channel	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)
BDR (GFSK)	Low	2402-2403	1.002	0.62
	Middle	2441-2442	1.002	0.63
	High	2480-2479	1.002	0.63
EDR (π/4-DQPSK)	Low	2402-2403	1.002	0.83
	Middle	2441-2442	1.002	0.84
	High	2480-2479	1.002	0.84
EDR (8-DPSK)	Low	2402-2403	0.998	0.84
	Middle	2441-2442	0.998	0.84
	High	2480-2479	0.998	0.84

Note: Limit= (2/3) × 20dB bandwidth

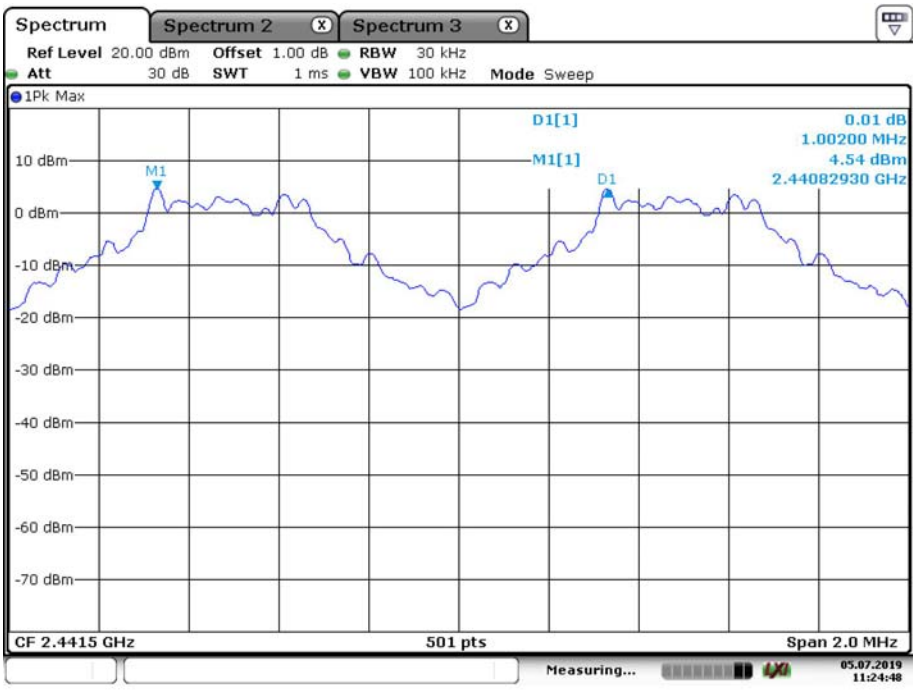
BDR Mode (GFSK):

Low Channel



Date: 5.JUL.2019 11:23:59

Middle Channel



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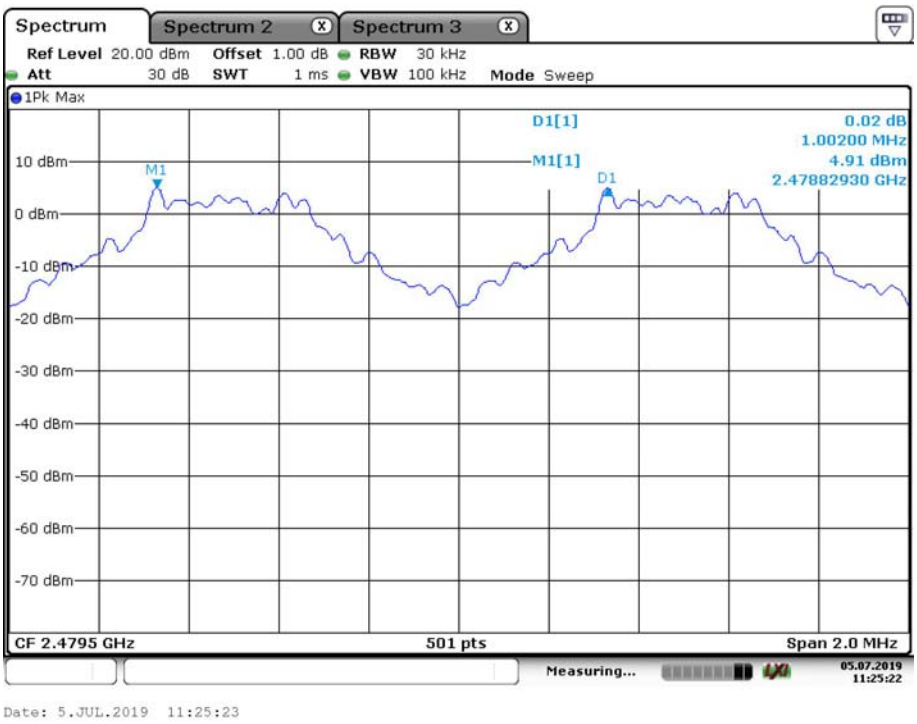
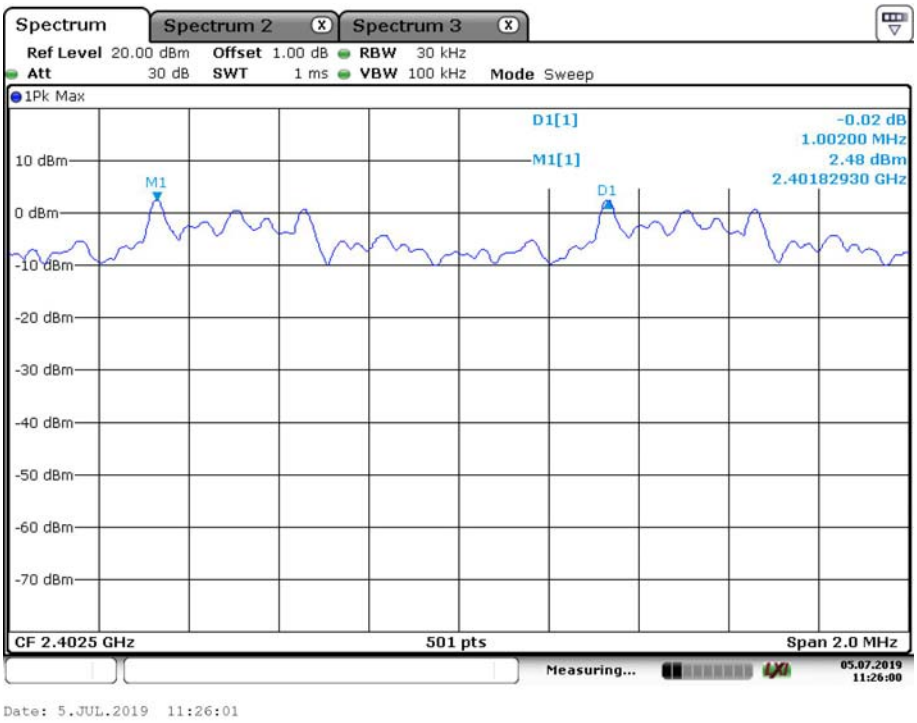
High Channel

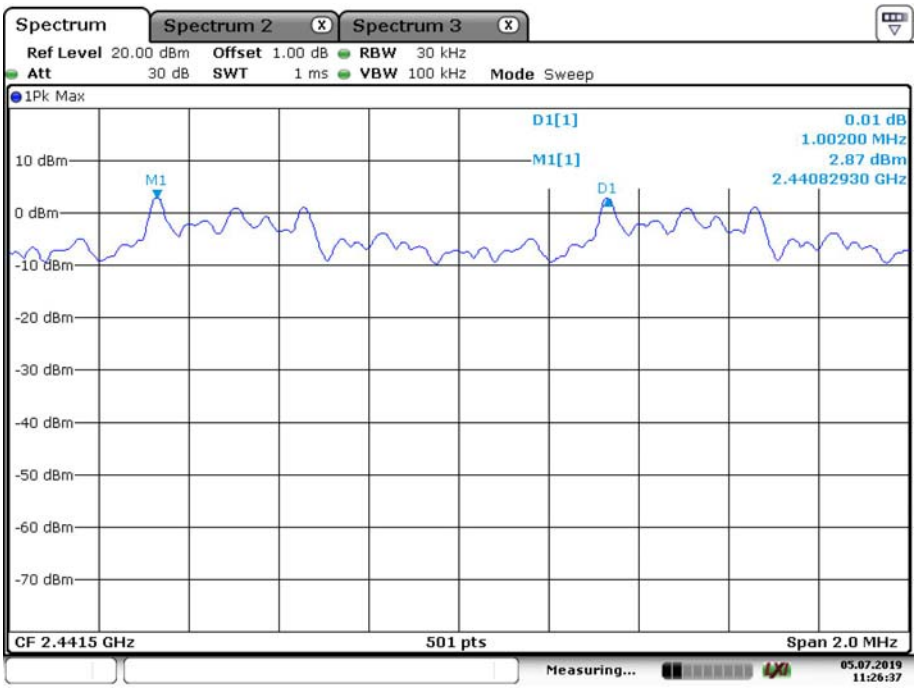


EDR Mode (π/4-DQPSK):

Low Channel

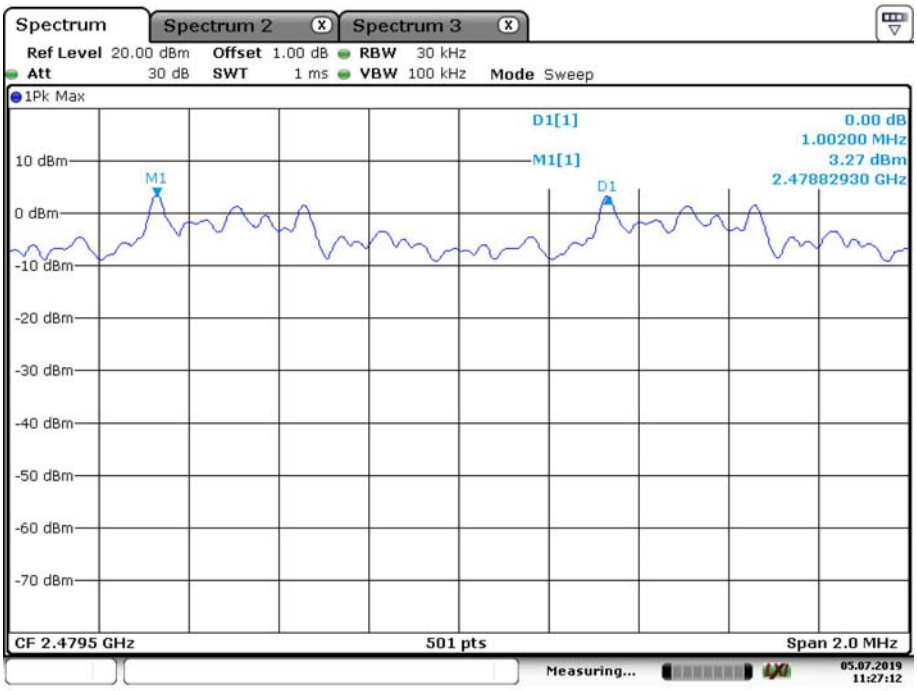


Middle Channel



Date: 5.JUL.2019 11:26:38

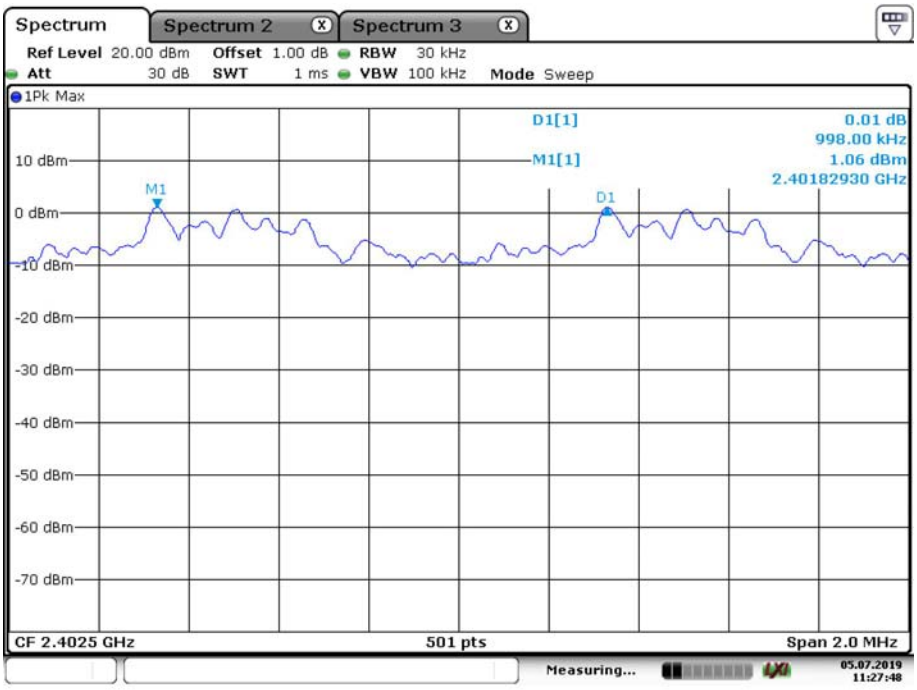
High Channel



Date: 5.JUL.2019 11:27:13

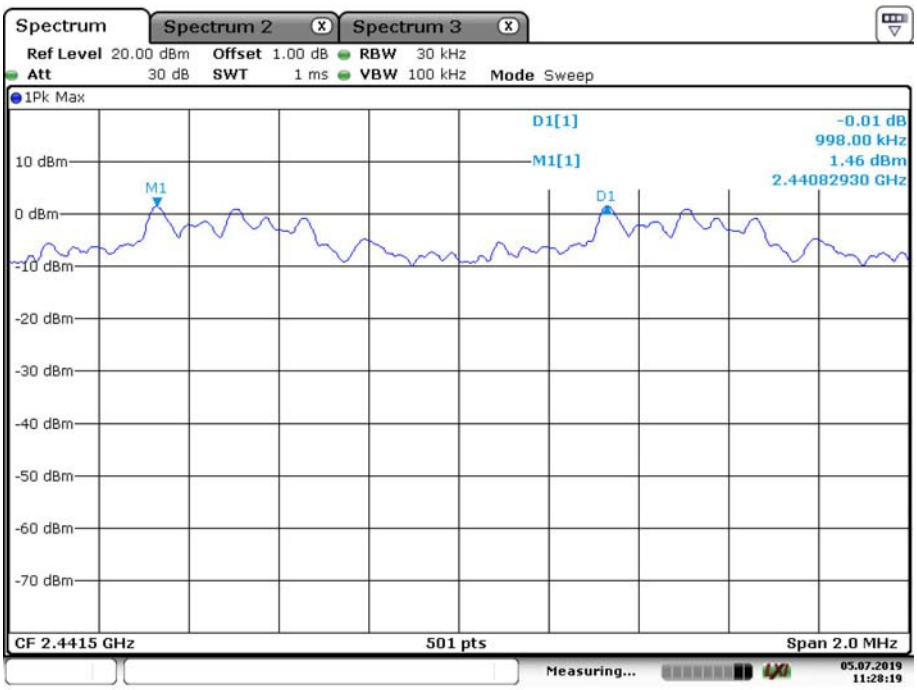
EDR Mode (8-DPSK):

Low Channel



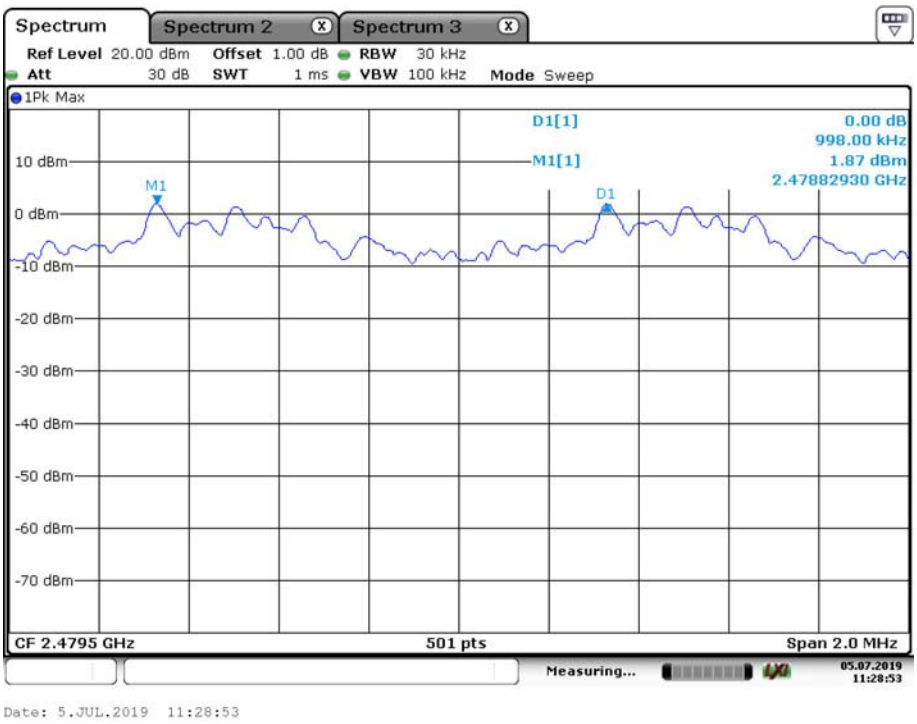
Date: 5.JUL.2019 11:27:48

Middle Channel



Date: 5.JUL.2019 11:28:20

High Channel



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	FSV40	101474	2019-01-09	2020-01-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/03	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:	28.9 °C
Relative Humidity:	56%
ATM Pressure:	100.6kPa

** The testing was performed by Carrie He on 2019-07-05.*

Test Result: Compliance.

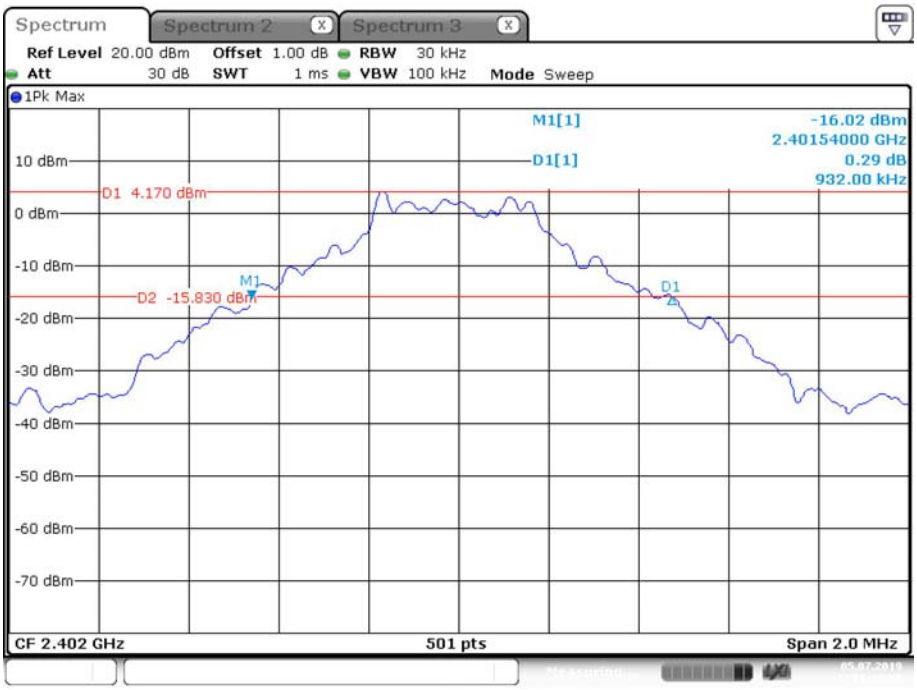
Please refer to following tables and plots

Test Mode: Transmitting

Mode	Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
BDR Mode (GFSK)	Low	2402	0.932
	Middle	2441	0.940
	High	2480	0.944
EDR Mode (π/4-DQPSK)	Low	2402	1.252
	Middle	2441	1.256
	High	2480	1.256
EDR Mode (8-DPSK)	Low	2402	1.260
	Middle	2441	1.260
	High	2480	1.260

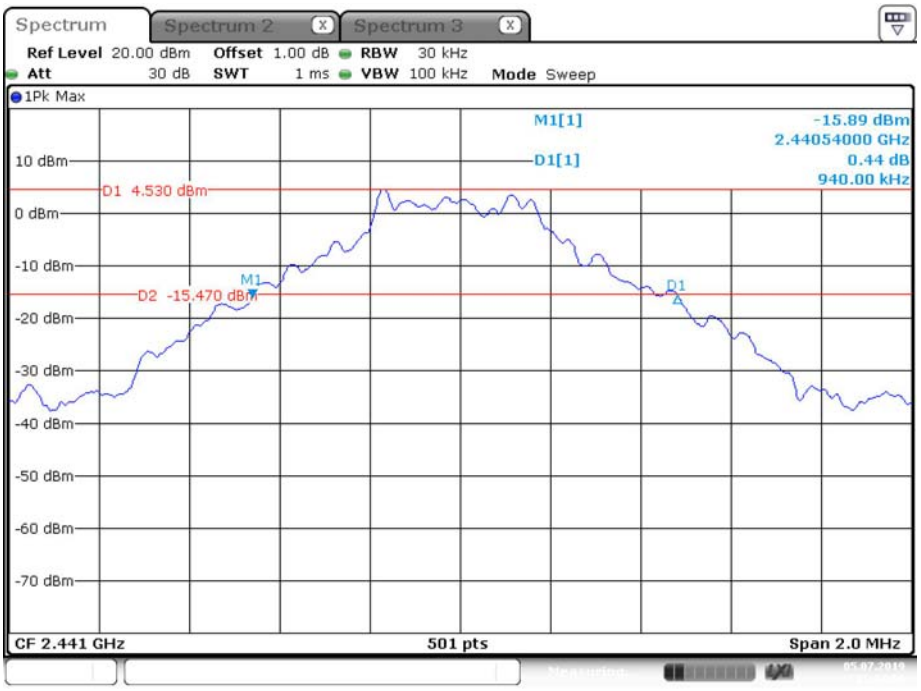
BDR Mode (GFSK):

Low Channel



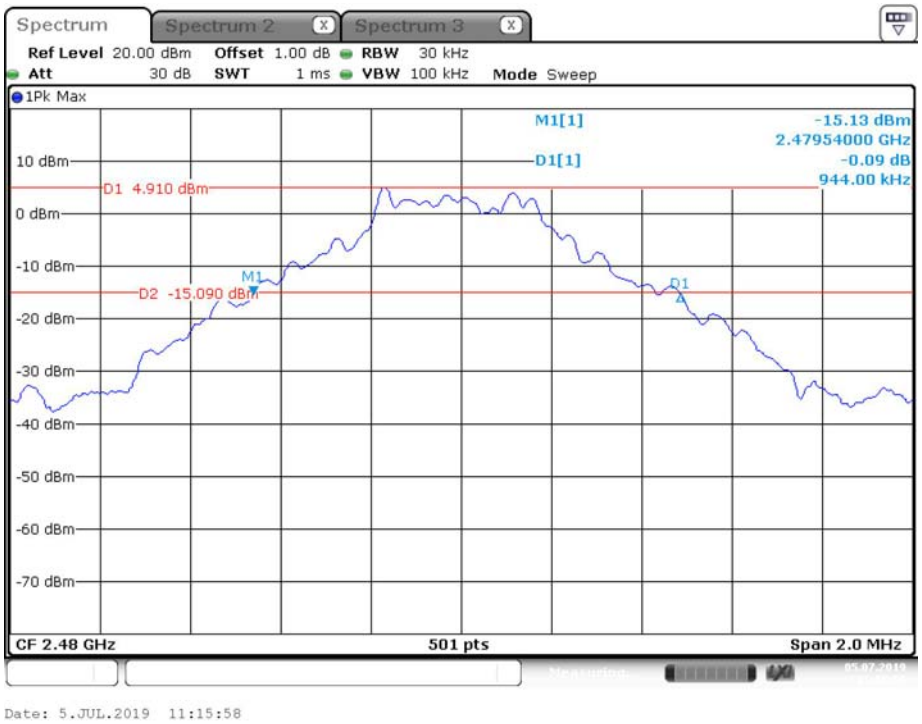
Date: 5.JUL.2019 11:13:59

Middle Channel



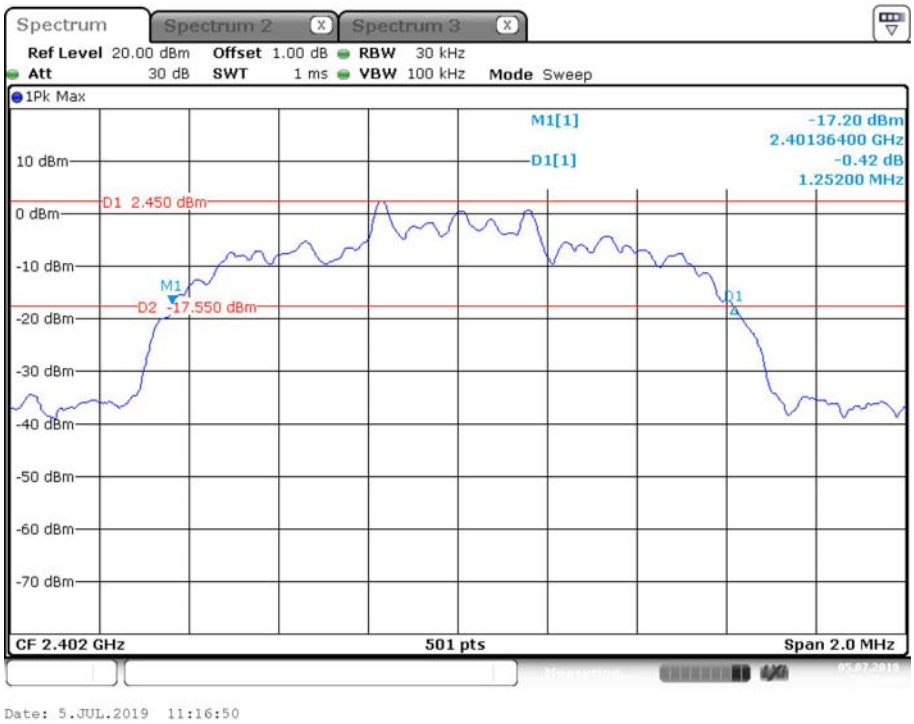
Date: 5.JUL.2019 11:14:56

High Channel

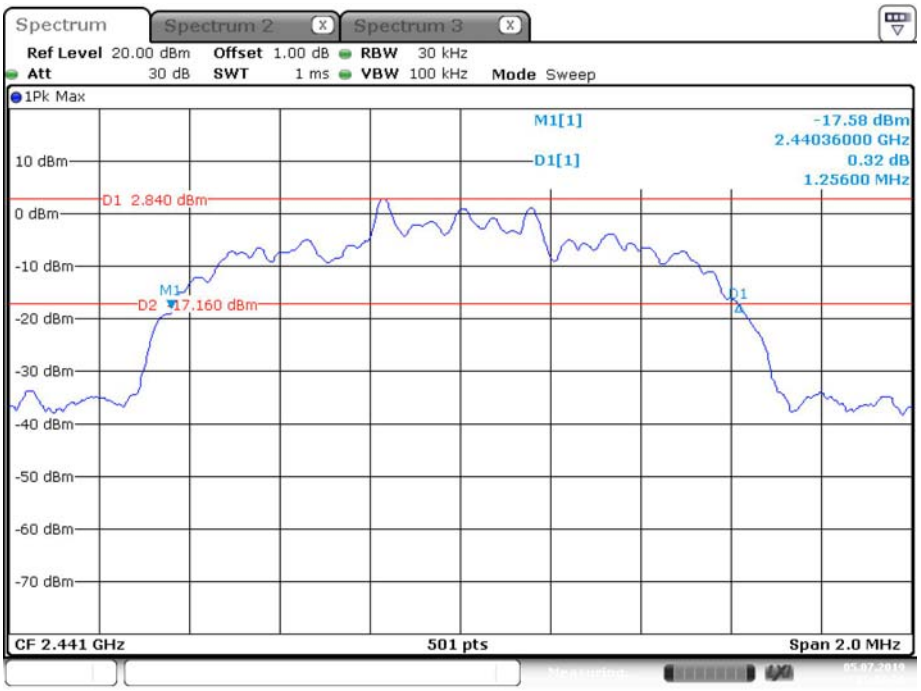


EDR Mode (π/4-DQPSK):

Low Channel

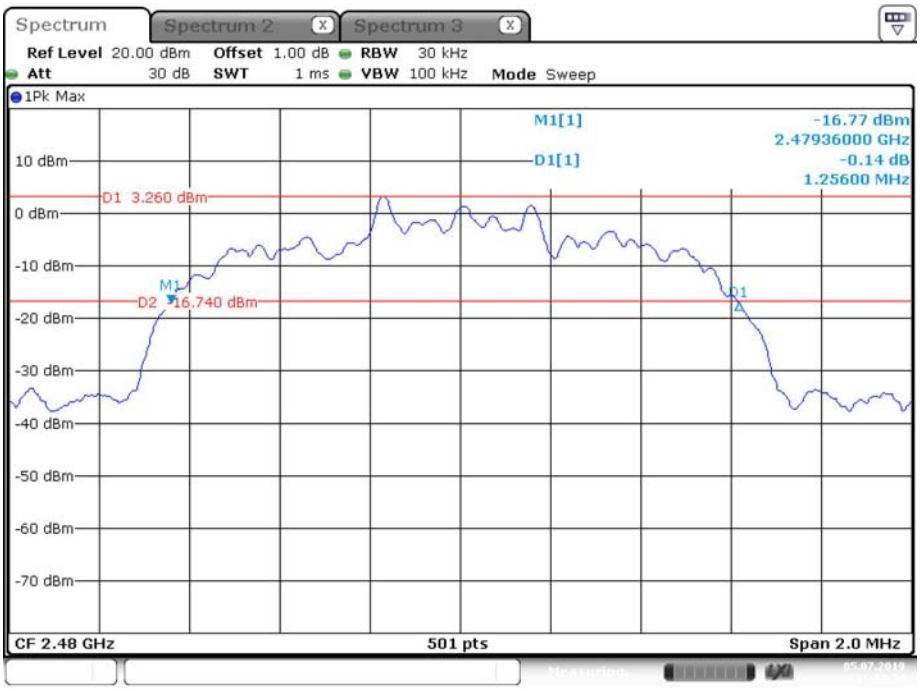


Middle Channel



Date: 5.JUL.2019 11:17:39

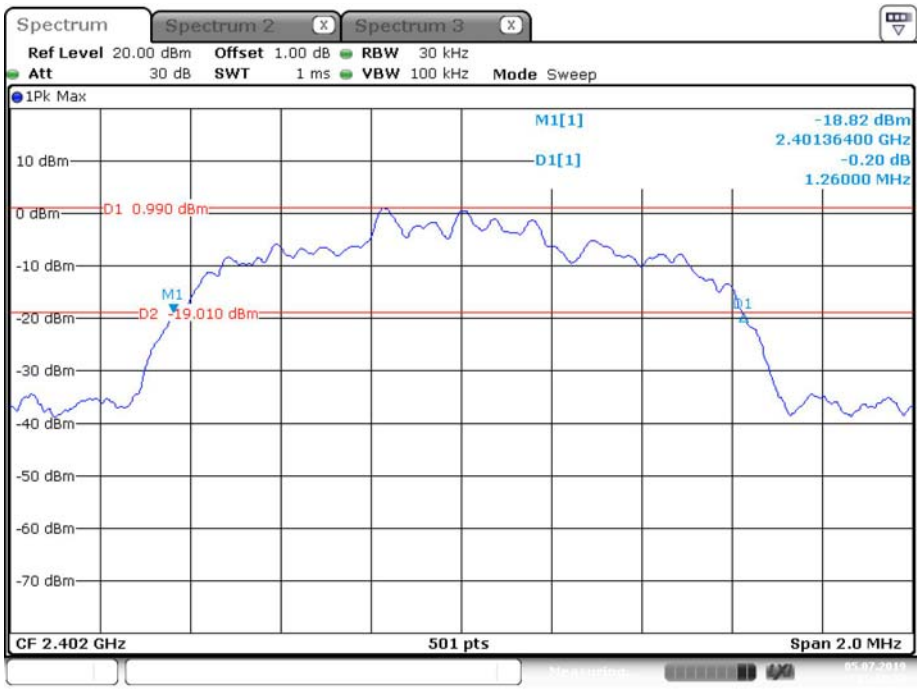
High Channel



Date: 5.JUL.2019 11:18:25

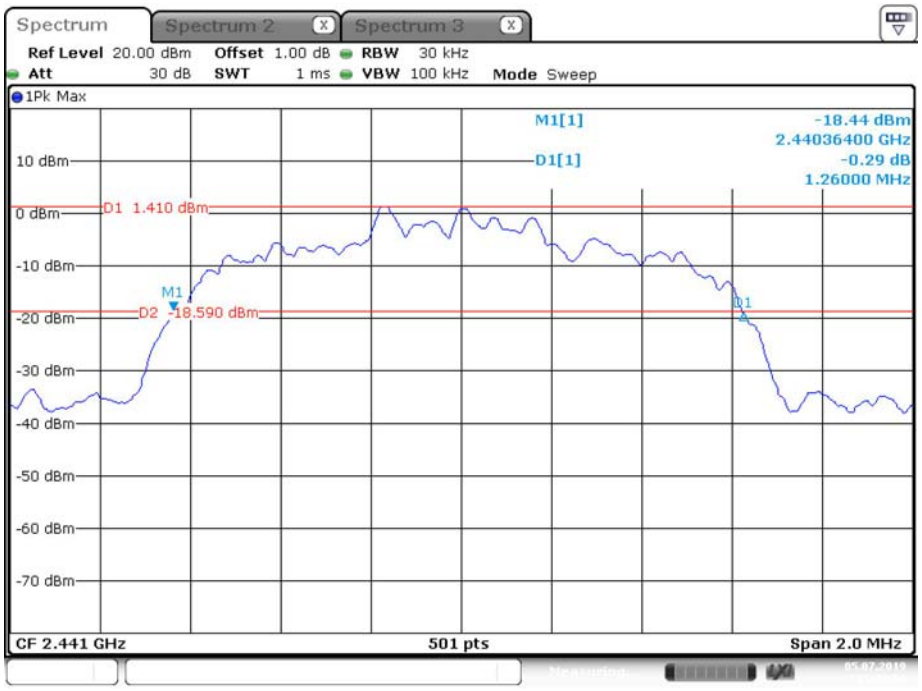
EDR Mode (8-DPSK):

Low Channel



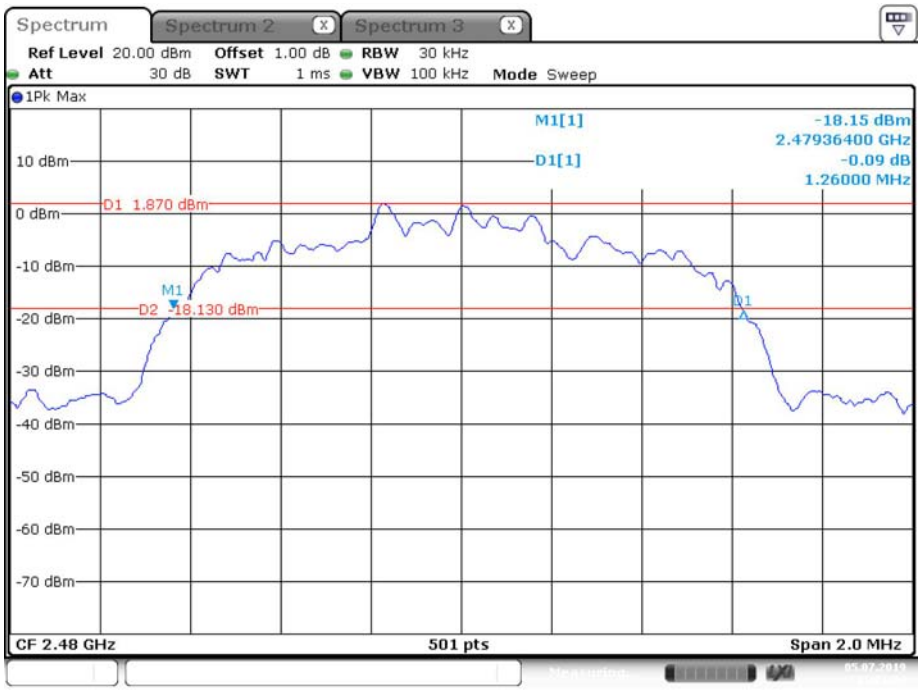
Date: 5.JUL.2019 11:19:18

Middle Channel



Date: 5.JUL.2019 11:20:10

High Channel



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	FSV40	101474	2019-01-09	2020-01-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/03	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:	28.9 °C
Relative Humidity:	56%
ATM Pressure:	100.6kPa

** The testing was performed by Carrie He on 2019-07-05.*

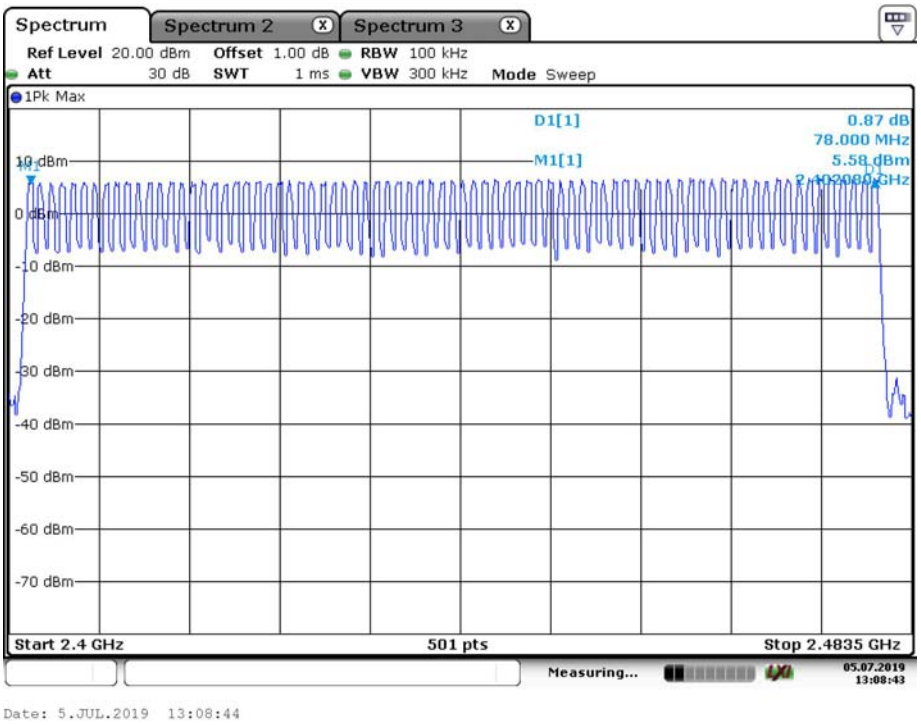
Test Result: Compliance.

Please refer to following tables and plots

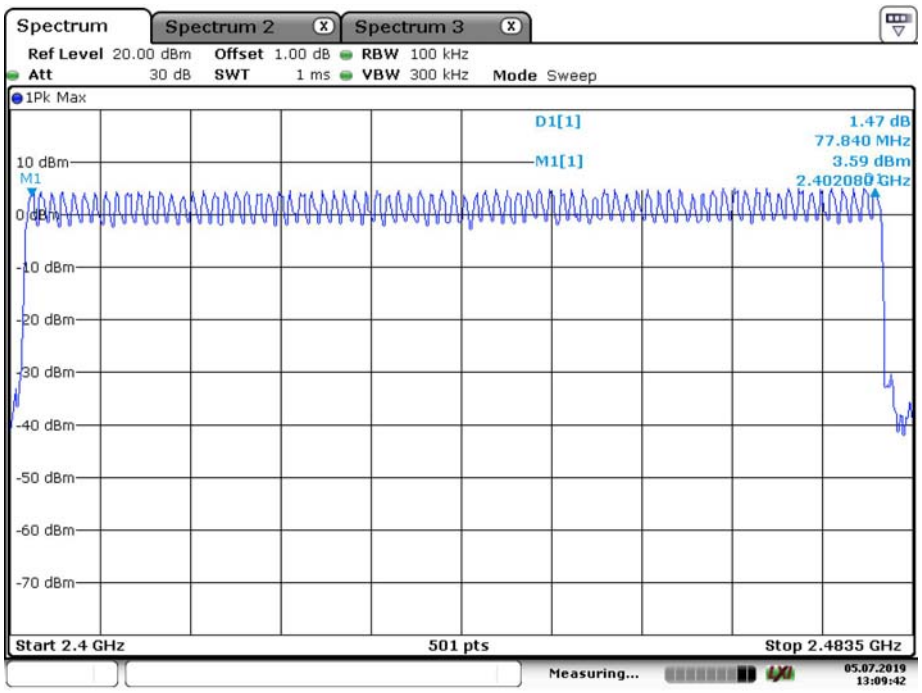
Test Mode: Transmitting

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

BDR Mode (GFSK):Number of Hopping Channels

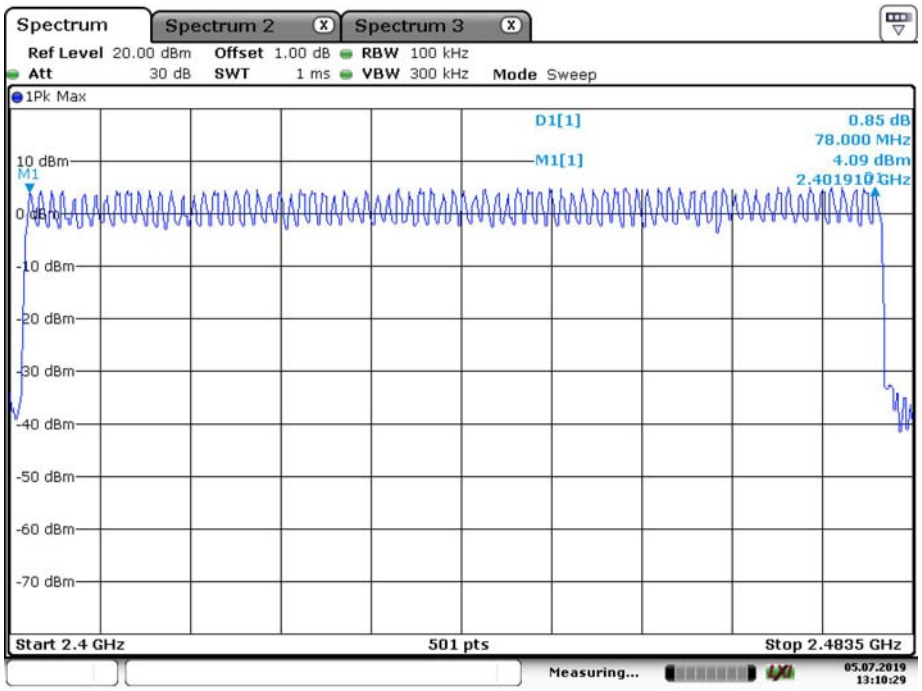


EDR Mode (π/4-DQPSK): Number of Hopping Channels



Date: 5.JUL.2019 13:09:42

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



Date: 5.JUL.2019 13:10:30

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	FSV40	101474	2019-01-09	2020-01-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/03	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:	28.9 °C
Relative Humidity:	56%
ATM Pressure:	100.6kPa

** The testing was performed by Carrie He on 2019-07-05.*

Test Result: Compliance.

Please refer to following tables and plots

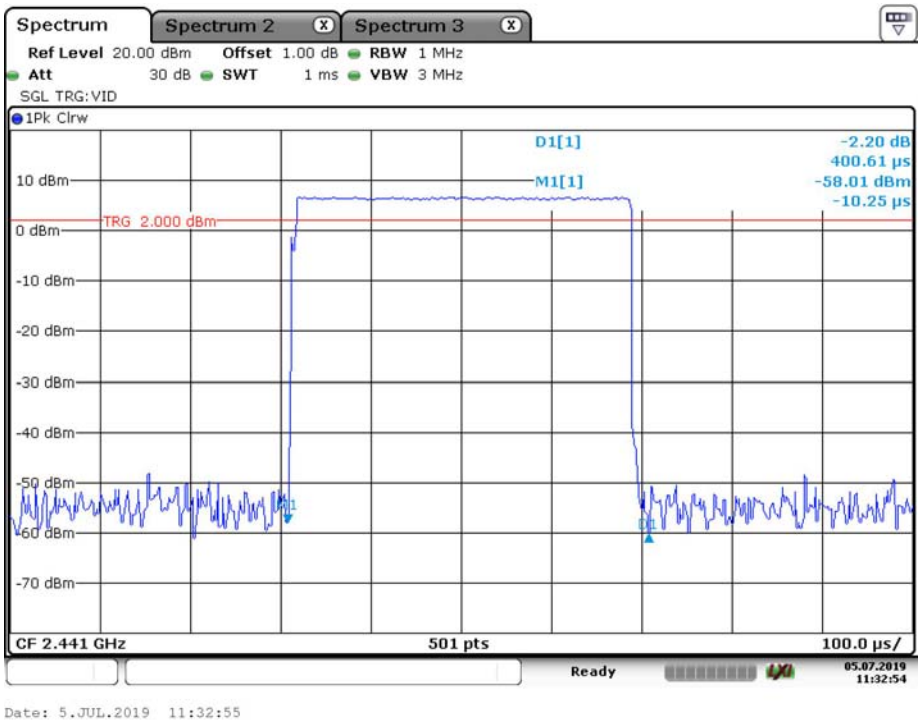
Test Mode: Transmitting

Mode	Packet type	Channel	Frequency (MHz)	Puse width (ms)	Result (s)	Limit (s)
GFSK	DH1	Middle	2441	0.401	0.128	0.4
	DH3	Middle	2441	1.659	0.265	
	DH5	Middle	2441	2.919	0.311	
π/4-DQPSK	2DH1	Middle	2441	0.401	0.128	
	2DH3	Middle	2441	1.658	0.265	
	2DH5	Middle	2441	2.943	0.314	
8-DPSK	3DH1	Middle	2441	0.401	0.128	
	3DH3	Middle	2441	1.662	0.266	
	3DH5	Middle	2441	2.904	0.310	

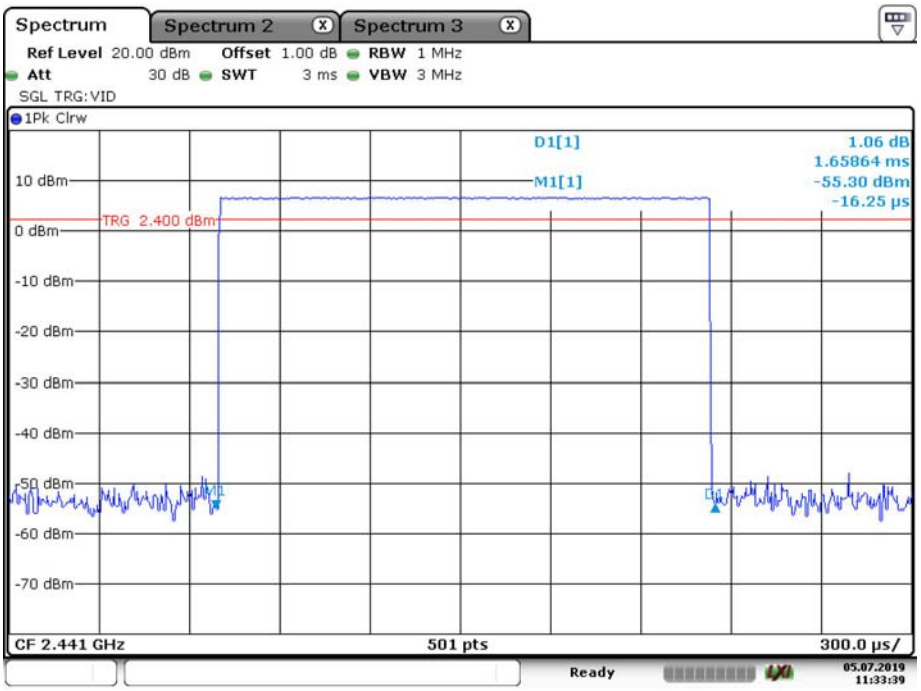
Note:
DH1:Dwell time=Pulse time (ms) × (1600/2/79) ×31.6 s
DH3:Dwell time=Pulse time (ms) × (1600/4/79) ×31.6 s
DH5:Dwell time=Pulse time (ms) × (1600/6/79) ×31.6 s

BDR Mode (GFSK):

DH1: Middle Channel

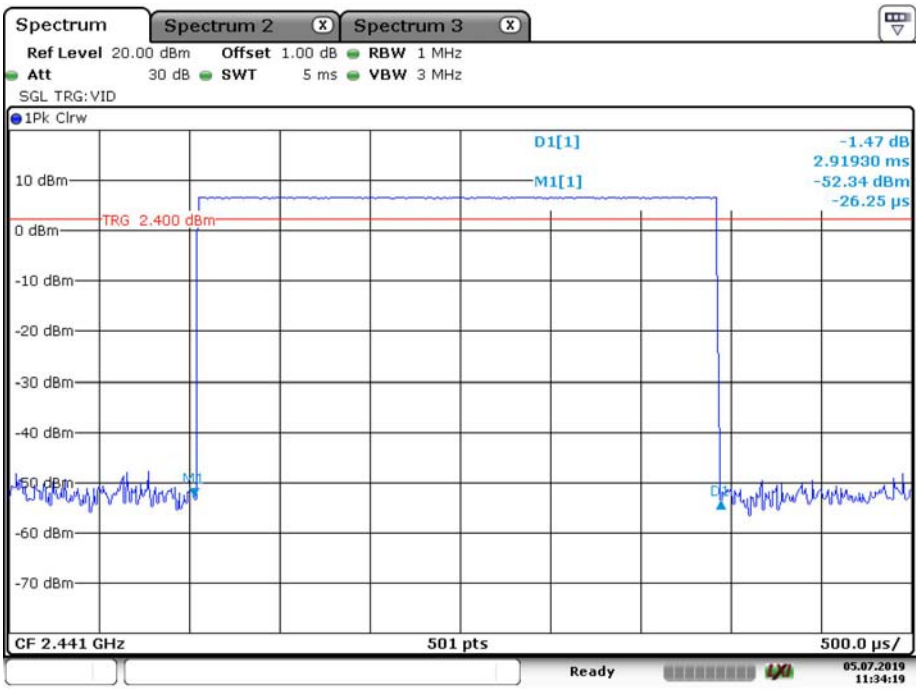


DH3: Middle Channel



Date: 5.JUL.2019 11:33:40

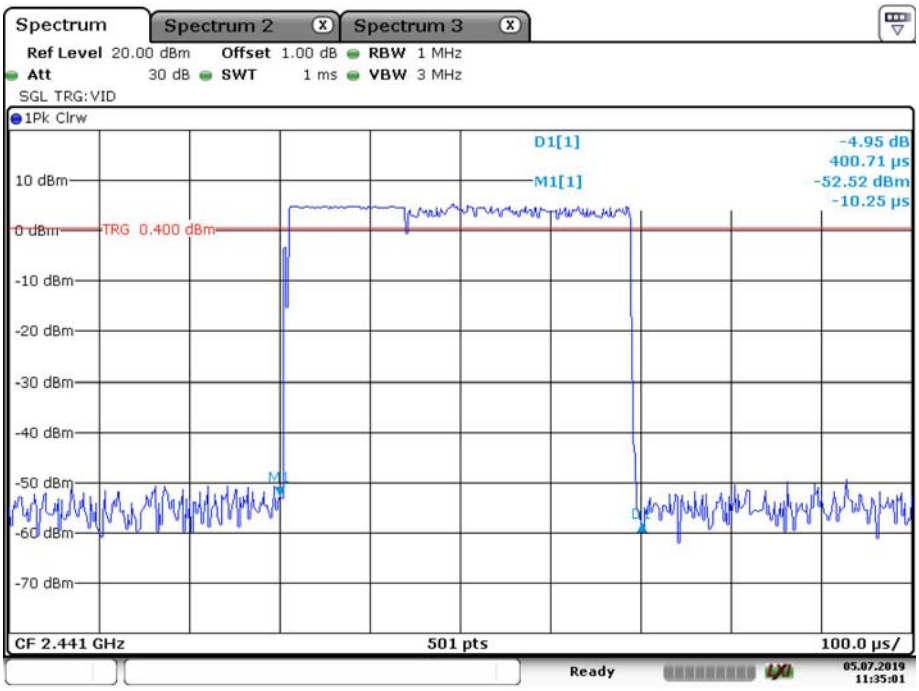
DH5: Middle Channel



Date: 5.JUL.2019 11:34:20

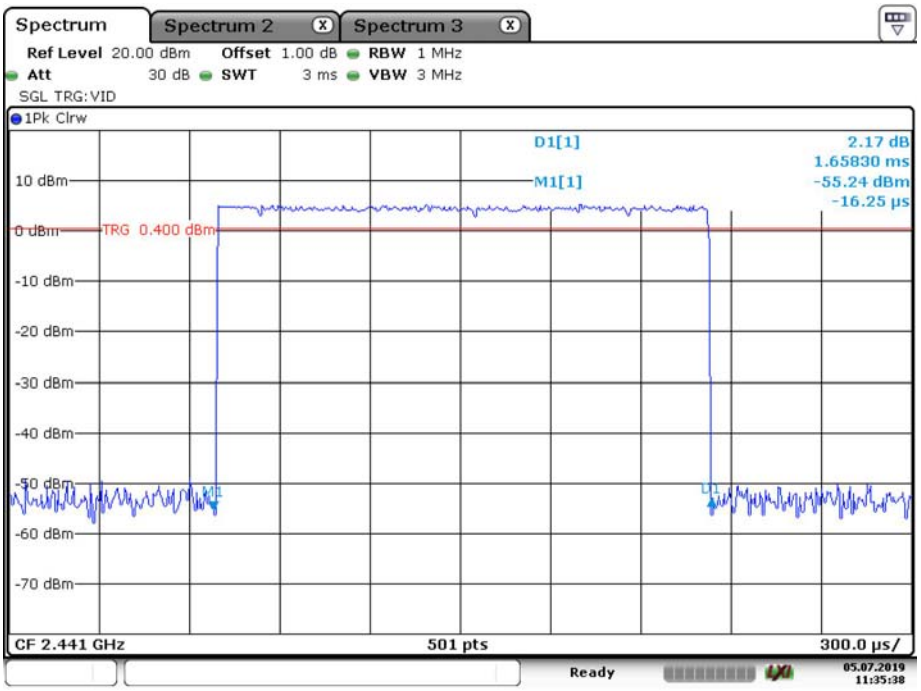
EDR Mode (π/4-DQPSK):

2DH1: Middle Channel



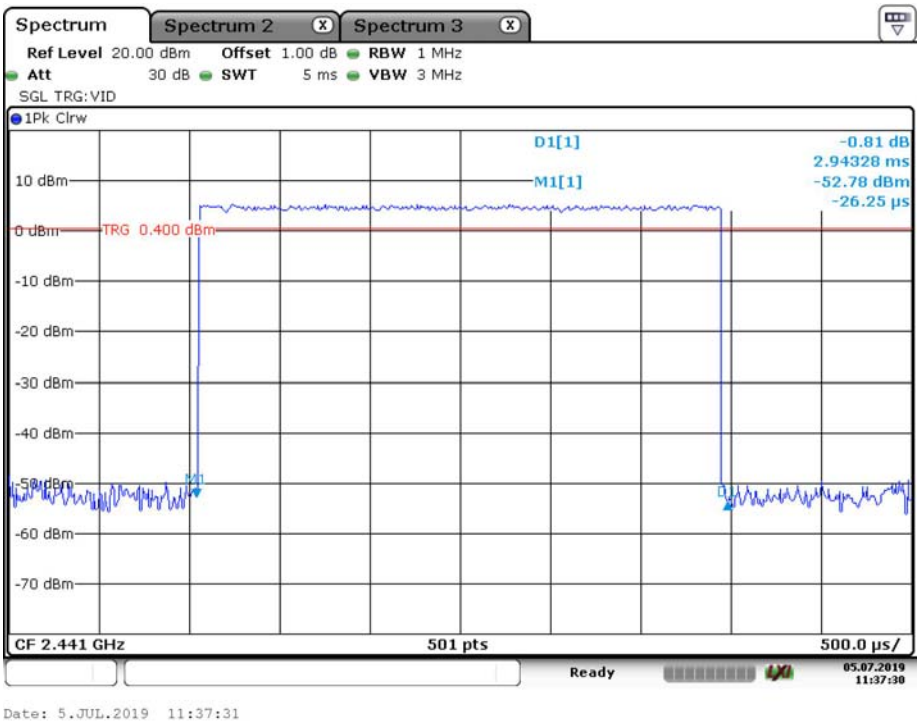
Date: 5.JUL.2019 11:35:02

2DH3: Middle Channel



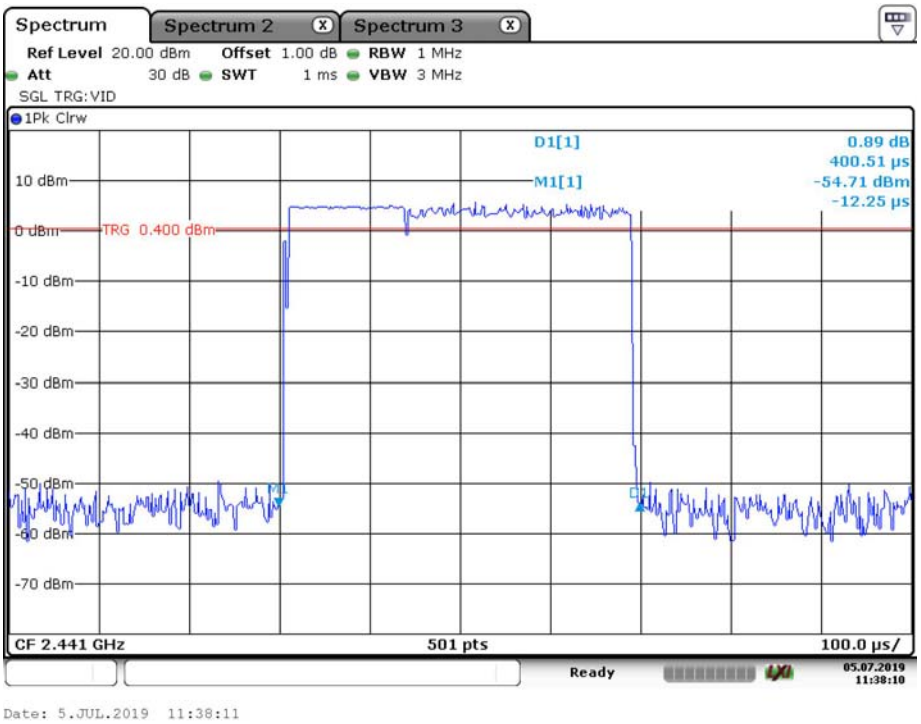
Date: 5.JUL.2019 11:35:39

2DH5: Middle Channel

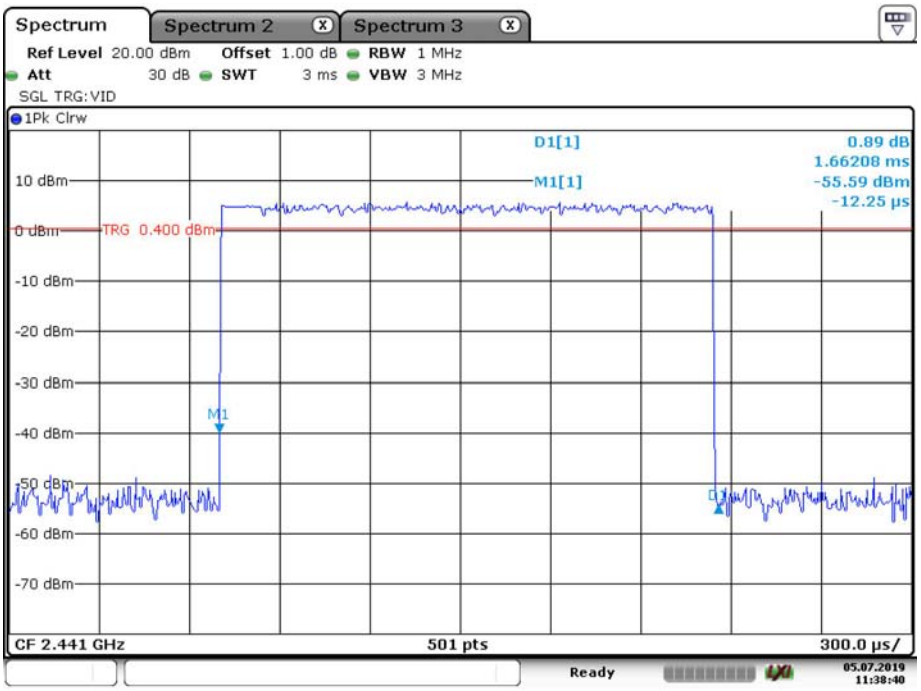


EDR Mode (8-DPSK):

3DH1: Middle Channel

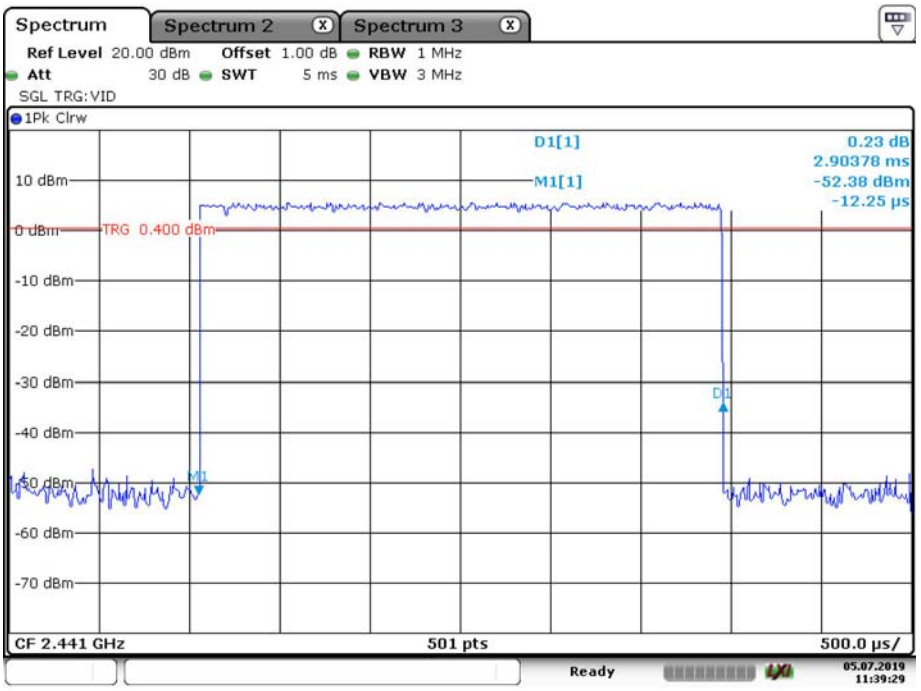


3DH3: Middle Channel



Date: 5.JUL.2019 11:38:41

3DH5: Middle Channel



Date: 5.JUL.2019 11:39:30

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
R&S	Spectrum Analyzer	FSV40	101474	2019-01-09	2020-01-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/03	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:	28.9 °C
Relative Humidity:	56%
ATM Pressure:	100.6kPa

** The testing was performed by Carrie He on 2019-07-05.*

Test Result: Compliance.

Test Mode: Transmitting

Mode	Frequency (MHz)	Peak Conducted Output power (dBm)	Limit (dBm)
BDR Mode (GFSK)	2402	6.26	21
	2441	6.65	21
	2480	7.08	21
EDR Mode (π/4-DQPSK)	2402	5.40	21
	2441	5.76	21
	2480	6.15	21
EDR Mode (8-DPSK)	2402	5.73	21
	2441	6.13	21
	2480	6.59	21

Note: The data above was tested in conducted mode

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	FSV40	101474	2019-01-09	2020-01-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/03	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

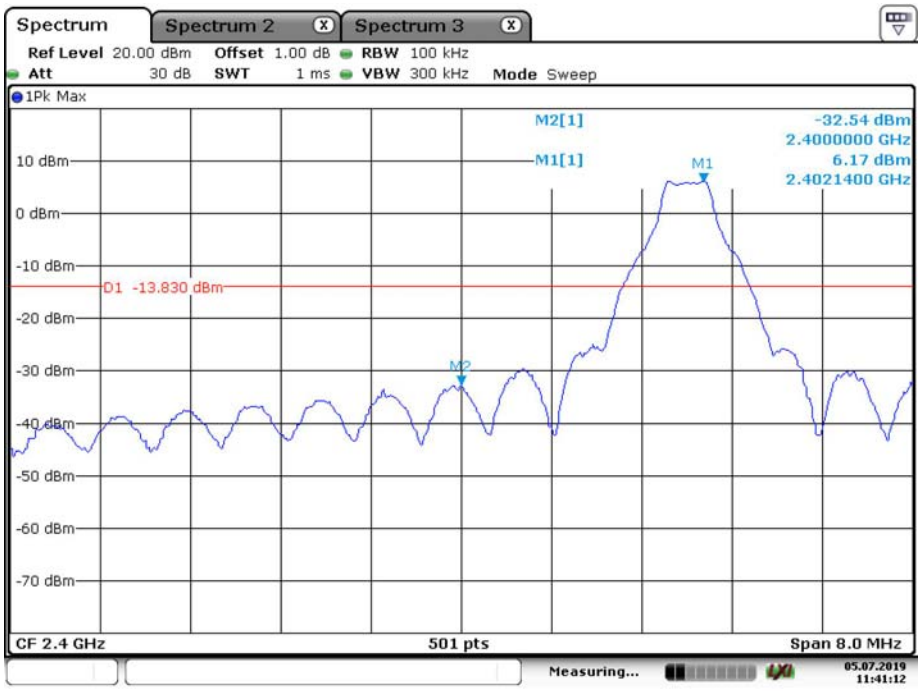
Temperature:	28.9 °C
Relative Humidity:	56%
ATM Pressure:	100.6kPa

** The testing was performed by Carrie He on 2019-07-05*

Test Result: Compliance

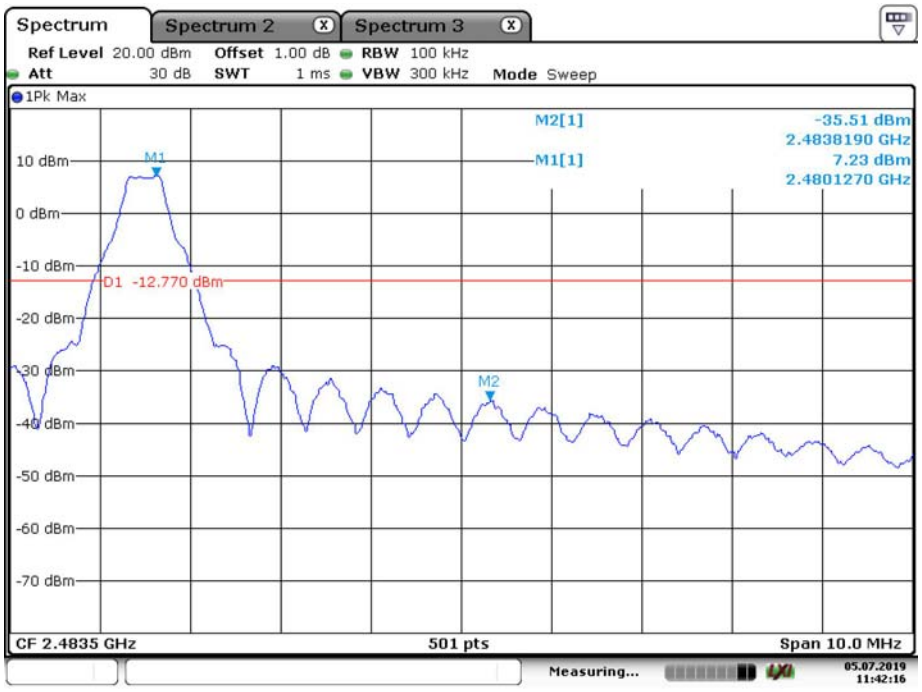
Single mode:
BDR Mode (GFSK):

Band Edge, Left Side



Date: 5.JUL.2019 11:41:12

Band Edge, Right Side



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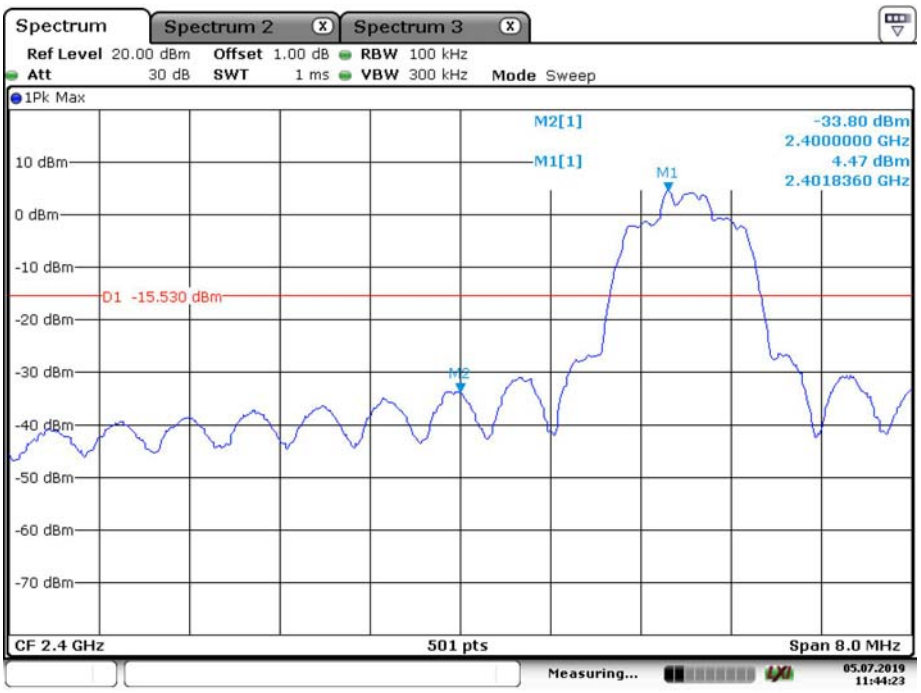
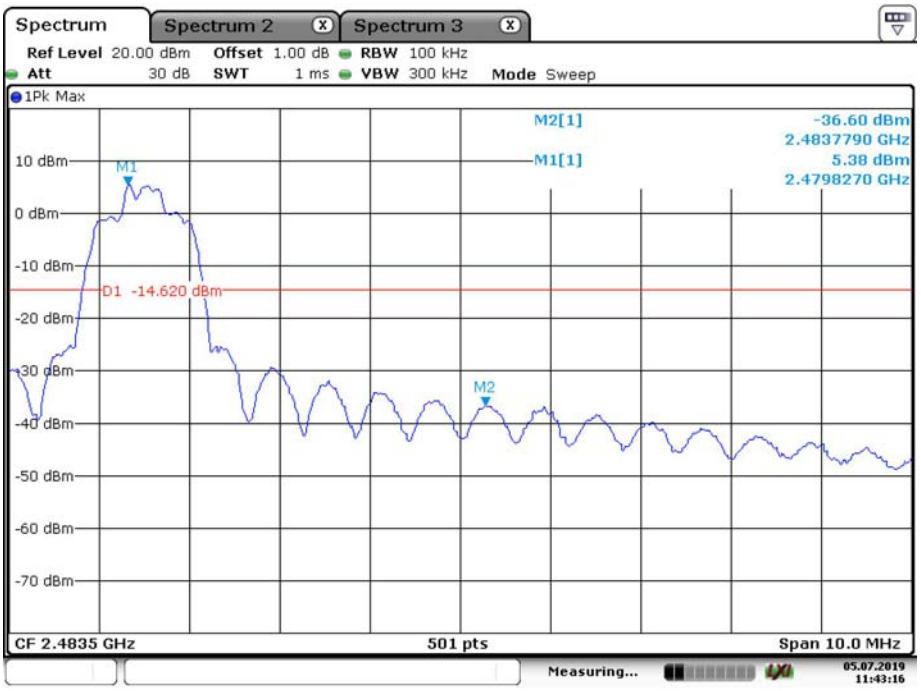
EDR Mode (π/4-DQPSK):

Band Edge, Left Side



Date: 5.JUL.2019 11:44:24

Band Edge, Right Side



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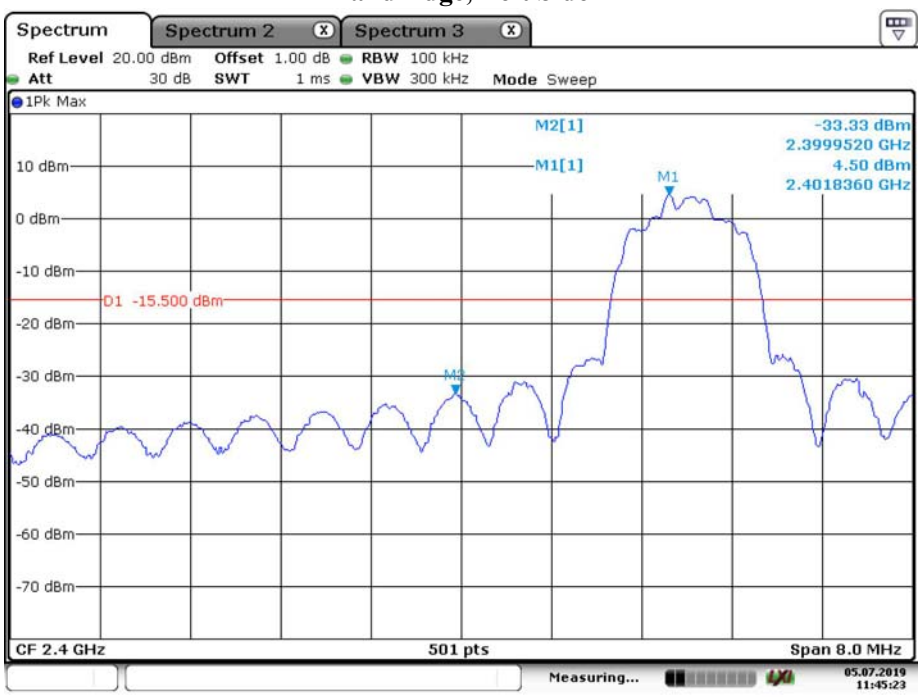
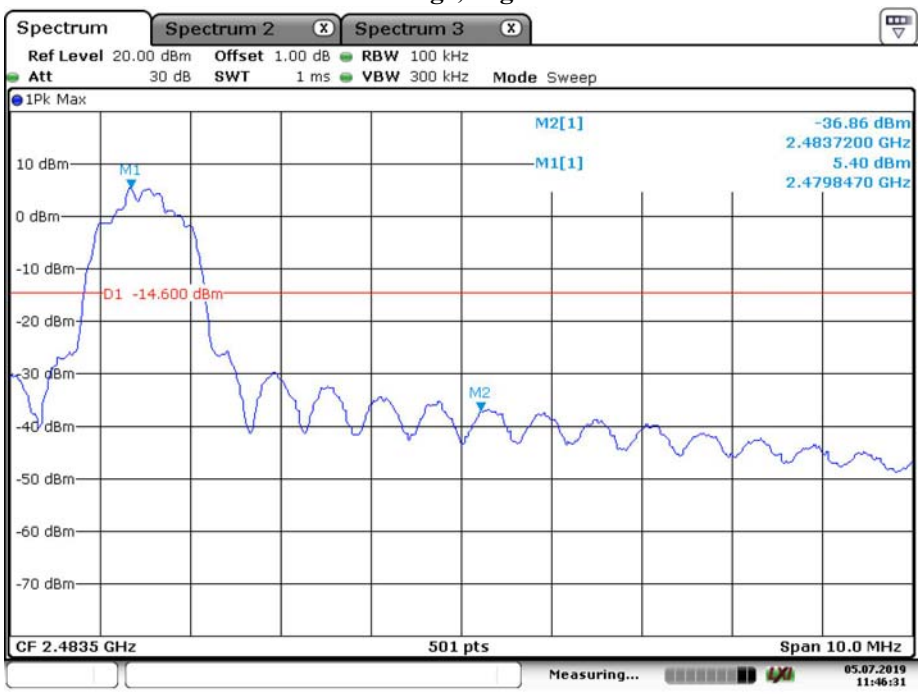
EDR Mode (8-DPSK):

Band Edge, Left Side



Date: 5.JUL.2019 11:45:24

Band Edge, Right Side



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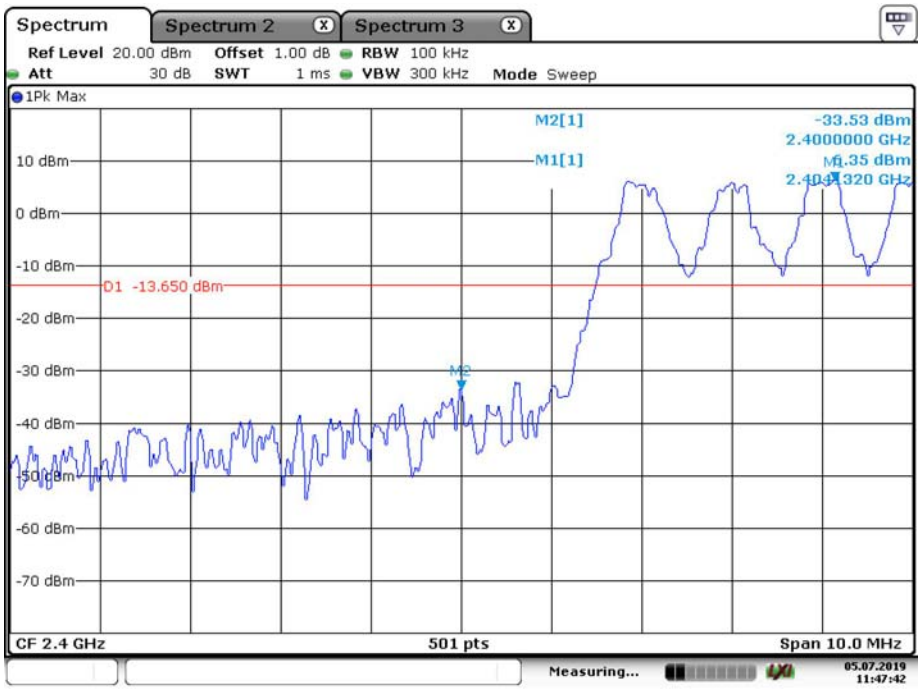
Hopping mode:
BDR Mode (GFSK):

Band Edge, Left Side



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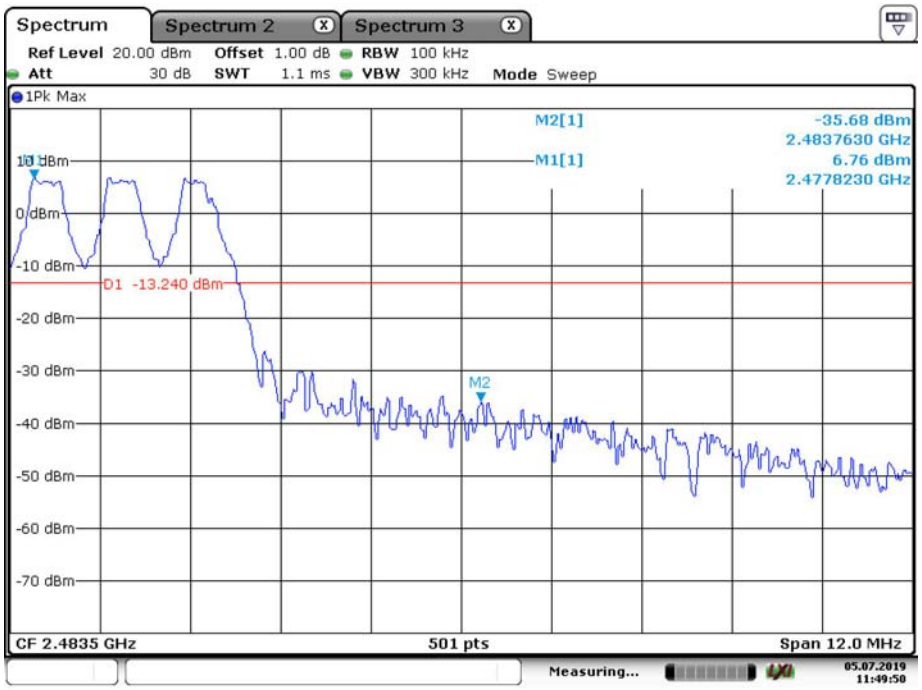
Band Edge, Right Side



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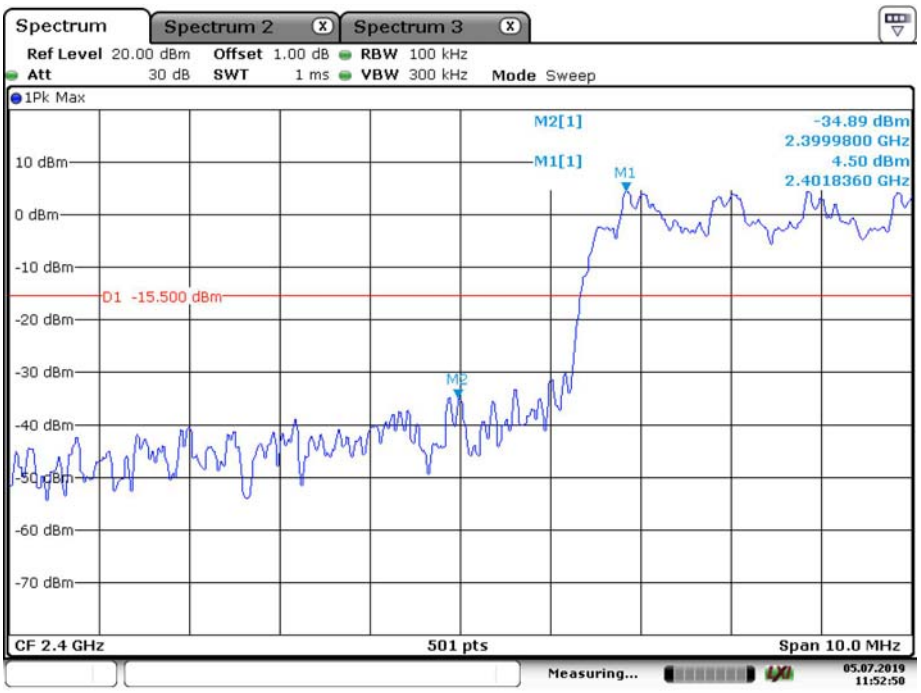
EDR Mode (π/4-DQPSK):

Band Edge, Left Side



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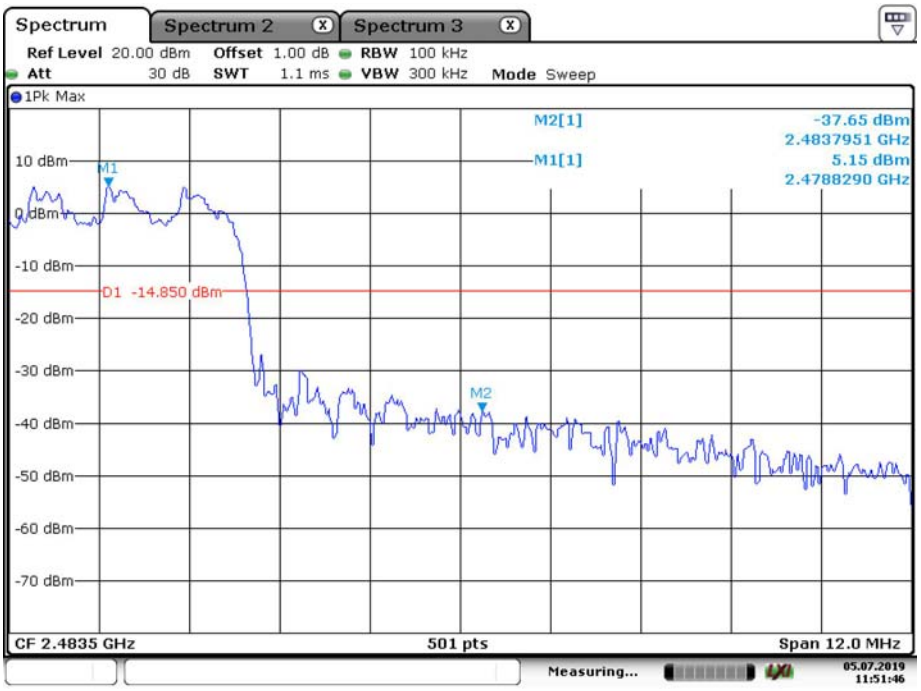
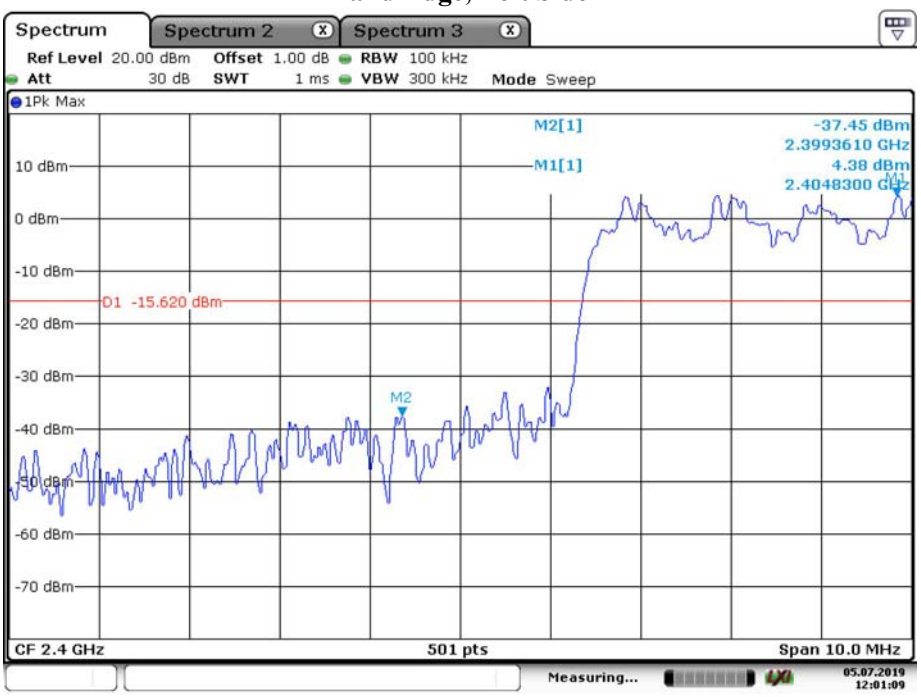
Band Edge, Right Side



Date: 5.JUL.2019 11:51:47

EDR Mode (8-DPSK):

Band Edge, Left Side



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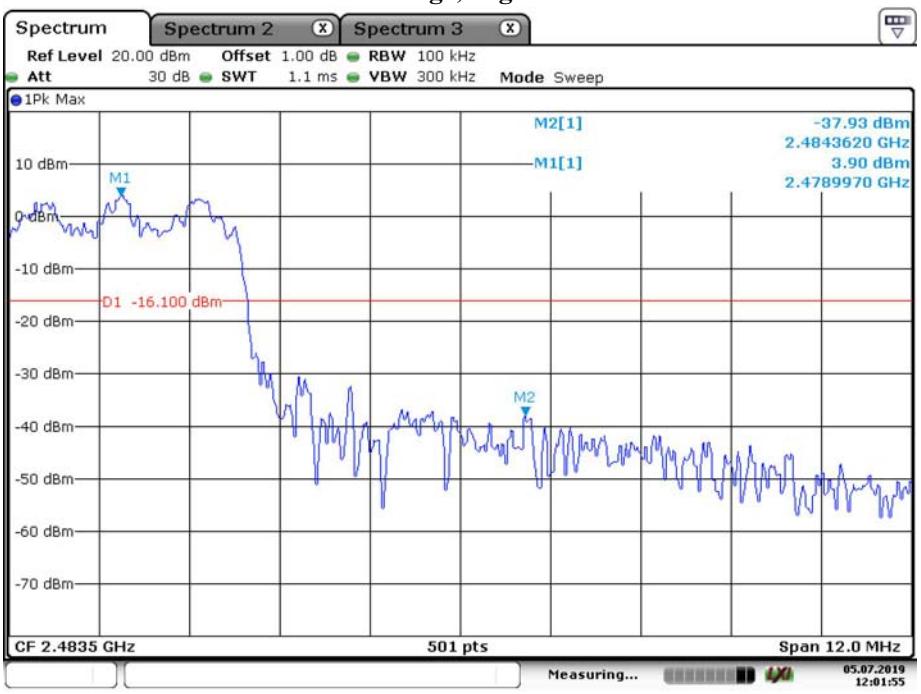
Band Edge, Right Side



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