TESTING LABORATORY
CERTIFICATE #4820.01

FCC PART 15.247

TEST REPORT

For

IDEAL TECHNOLOGY COMPANY LIMITED

NO.12 Xiangrong Road, Song mu Shan Dalang Town,Dongguan City,
Guangdong, China

FCC ID: 2AUUE-2000

Report Type:	**Product Name:**
Original Report	SMART SPEAKER

Report Number: RDG191009006-00A

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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
DECLARATIONS 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 7
SUMMARY OF TEST RESULTS **8**
FCC §15.247 (i) & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE) **9**
APPLICABLE STANDARD 9
FCC §15.203 - ANTENNA REQUIREMENT **11**
APPLICABLE STANDARD 11
ANTENNA CONNECTOR CONSTRUCTION 11
FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS **12**
APPLICABLE STANDARD 12
EUT SETUP 12
EMI TEST RECEIVER SETUP 12
TEST PROCEDURE 12
CORRECTED AMPLITUDE & MARGIN CALCULATION 13
TEST EQUIPMENT LIST AND DETAILS 13
TEST DATA 13
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS **16**
APPLICABLE STANDARD 16
EUT SETUP 16
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP 17
TEST PROCEDURE 17
TEST EQUIPMENT LIST AND DETAILS 17
CORRECTED AMPLITUDE & MARGIN CALCULATION 18
TEST DATA 18
FCC §15.247(a) (1) - CHANNEL SEPARATION TEST **24**
APPLICABLE STANDARD 24
TEST EQUIPMENT LIST AND DETAILS 24
TEST PROCEDURE 24
TEST DATA 24
FCC §15.247(a) (1) – 20 dB BANDWIDTH TESTING **30**
APPLICABLE STANDARD 30
TEST PROCEDURE 30

TEST EQUIPMENT LIST AND DETAILS....30
TEST DATA....30

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:		SMART SPEAKER
EUT Model:		IA-2000-001-EN
Multiple Models:		IA-2000-***-EN ("*" indicate blank or digit from 0 to 9 or letter from"A" to "Z")
Operation Frequency:		2402-2480MHz
Maximum Peak Output Power (Conducted):		0.52 dBm
Modulation Type:		GFSK, π/4-DQPSK, 8DPSK
Rated Input Voltage:		DC 15V from adapter
Adapter Information	**Model:**	IA-5000-001-EN, IA-5000-002-EN
	Input:	100-240Vac
	Output:	15Vdc 1.6A
Serial Number:		RDG191009007-RF-S1
EUT Received Date:		2019.10.9
EUT Received Status:		Good

*Note: This series products model: IA-2000-001-EN and IA-2000-***-EN ("*" indicate blank or digit from 0 to 9 or letter from"A" to "Z") are electrically identical. Model IA-2000-001-EN was selected for fully testing and the detailed information can be referred to the declaration.*

Note2: This series adapter model: IA-5000-002-EN and IA-5000-001-EN are electrically identical. Model IA-5000-002-EN was selected for fully testing and the detailed information can be referred to the declaration.

Objective

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

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

Related Submittal(s)/Grant(s)

FCC Part 15C DTS submissions with FCC ID: 2AUUE-2000

Test Methodology

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

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

Measurement Uncertainty

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.61dB
Power Spectral Density, conducted	±0.61 dB
Unwanted Emissions, radiated	30M~200MHz: 4.55 dB,200M~1GHz: 5.92 dB,1G~6GHz: 4.98 dB, 6G~18GHz: 5.89 dB,18G~26.5G:5.47 dB,26.5G~40G:5.63 dB
Unwanted Emissions, conducted	±1.5 dB
Temperature	±1℃
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)

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

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.

Declarations

BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with a triangle symbol "△ ". Customer model name, addresses, names, trademarks etc. are not considered data.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

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SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in engineering mode.

EUT Exercise Software

The 'BK32xx RF Test - V1.8.2_en ' command was used during test, which was provided by manufacturer.
The maximum power level was configured by the software as below table:

Mode	Channel	Frequency (MHz)	Power Level Setting
GFSK	Low	2402	3
	Middle	2441	3
	High	2480	3
π/4-DQPSK	Low	2402	3
	Middle	2441	3
	High	2480	3
8DPSK	Low	2402	3
	Middle	2441	3
	High	2480	3

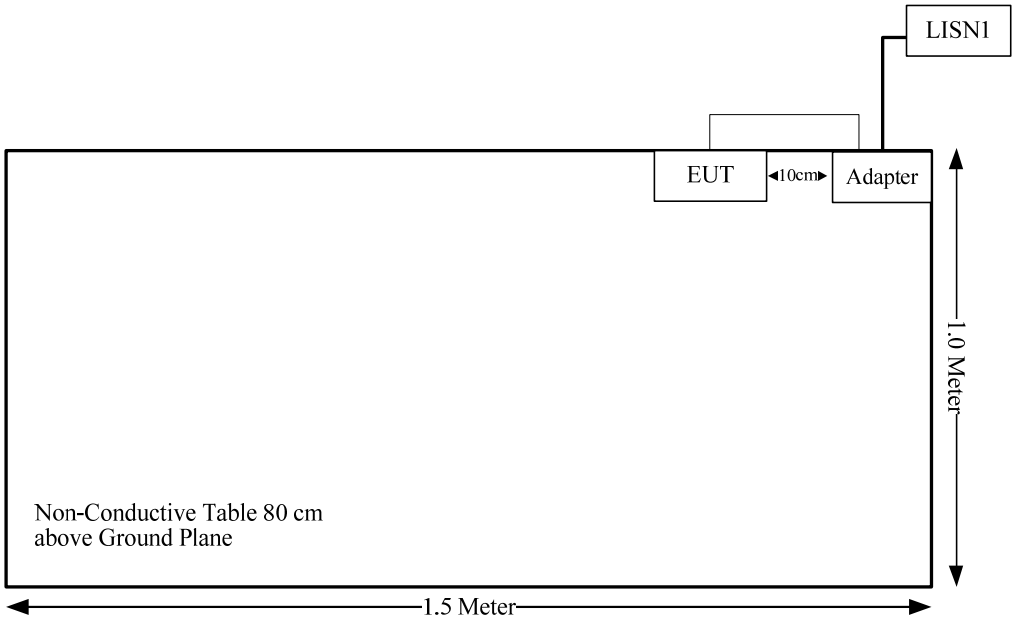
Equipment Modifications

No modification was made to the EUT.

Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
Adapter Cable	No	No	0.8	Adapter	EUT

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC 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)	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 & §2.1091- 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^2)**	**Averaging Time (minutes)**
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	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^2);
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);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Calculated Data:

Modes	Frequency (MHz)	Antenna Gain		Conducted output power including Tune-up Tolerance		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
Bluetooth BDR/EDR	2402-2480	0	1.00	1	1.2589	20.00	0.0003	1.0
Bluetooth LE	2402-2480	0	1.00	-2	0.6310	20.00	0.0001	1.0
Wi-Fi	2412-2462	0	1.00	24	251.19	20.00	0.0500	1.0

TheWi-Fi and Bluetooth can transmit simultaneously:

$$\sum_i \frac{S_i}{S_{Limit,i}}$$

$=S_{BT}/S_{limit\text{-}BT}+S_{Wi\text{-}Fi}/S_{limit\text{-}Wi\text{-}Fi}$

=0.0003/1+0.0500/1

=0.0503

< 1.0

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.

Antenna Connector Construction

The EUT has two internal antenna arrangement, fulfill the requirement of this section. Please refer to below information and the EUT photos:

Usage	Antenna Type	input impedance (Ohm)	Antenna Gain /Frequency Range
Bluetooth	PCB	50	0 dBi/2.4~2.5GHz
Wi-Fi	FPC	50	0 dBi/2.4~2.5GHz

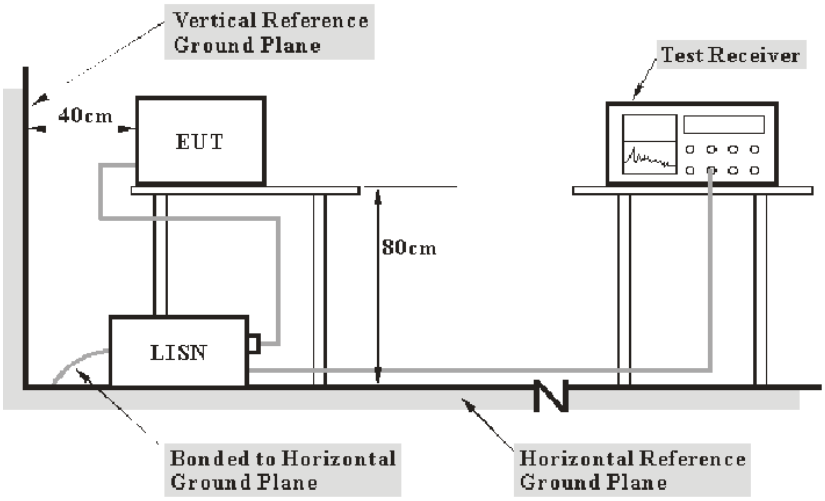
Result: Compliance.

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	2019-09-05	2020-09-05
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

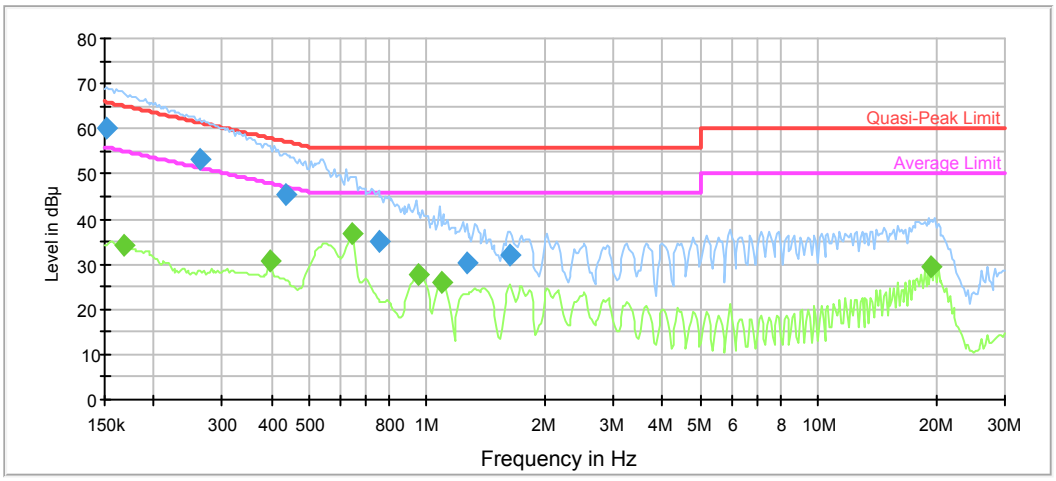
Environmental Conditions

Temperature:	25.9 °C
Relative Humidity:	42%
ATM Pressure:	101.2kPa
Test by:	Sern Xiang
Test Date:	2019-11-27

Test Result: Compliance

Test Mode: Transmitting

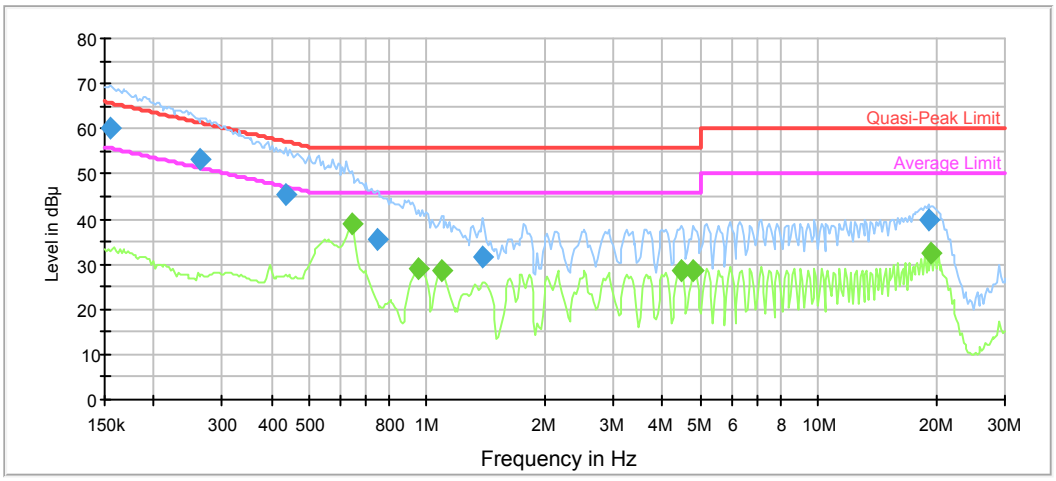
AC120V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.151500	60.1	9.000	L1	11.2	5.8	65.9
0.261872	53.1	9.000	L1	10.3	8.3	61.4
0.434989	45.3	9.000	L1	9.9	11.9	57.2
0.751890	35.2	9.000	L1	9.8	20.8	56.0
1.261437	30.3	9.000	L1	9.8	25.7	56.0
1.633884	31.9	9.000	L1	9.7	24.1	56.0

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.167350	34.3	9.000	L1	10.9	20.8	55.1
0.397728	30.6	9.000	L1	10.0	17.3	47.9
0.641227	36.7	9.000	L1	9.8	9.3	46.0
0.945248	27.9	9.000	L1	9.8	18.1	46.0
1.086538	26.0	9.000	L1	9.8	20.0	46.0
19.464503	29.5	9.000	L1	10.1	20.5	50.0

AC120V, 60 Hz, Neutral:



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.154545	60.1	9.000	N	11.1	5.7	65.8
0.264490	53.3	9.000	N	10.3	8.0	61.3
0.434989	45.4	9.000	N	9.9	11.8	57.2
0.744445	35.6	9.000	N	9.8	20.4	56.0
1.393411	31.5	9.000	N	9.8	24.5	56.0
19.080976	39.7	9.000	N	10.0	20.3	60.0

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.641227	38.8	9.000	N	9.8	7.2	46.0
0.954700	28.9	9.000	N	9.8	17.1	46.0
1.086538	28.5	9.000	N	9.8	17.5	46.0
4.463546	28.6	9.000	N	9.8	17.4	46.0
4.785525	28.5	9.000	N	9.8	17.5	46.0
19.464503	32.6	9.000	N	10.0	17.4	50.0

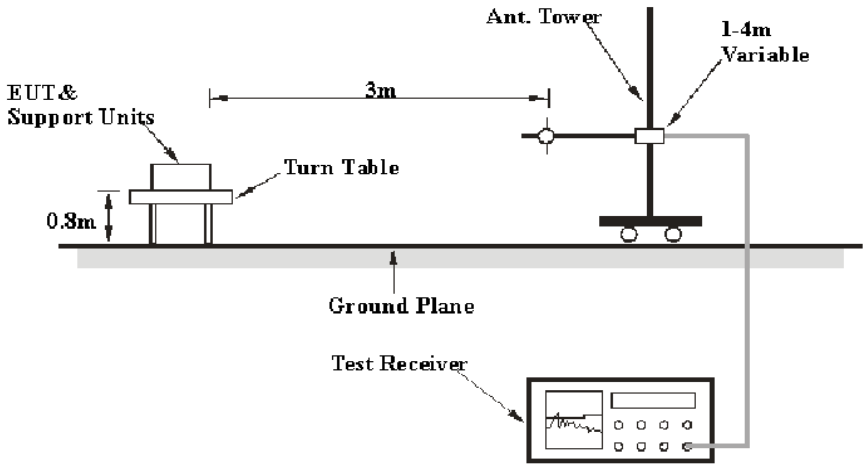
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

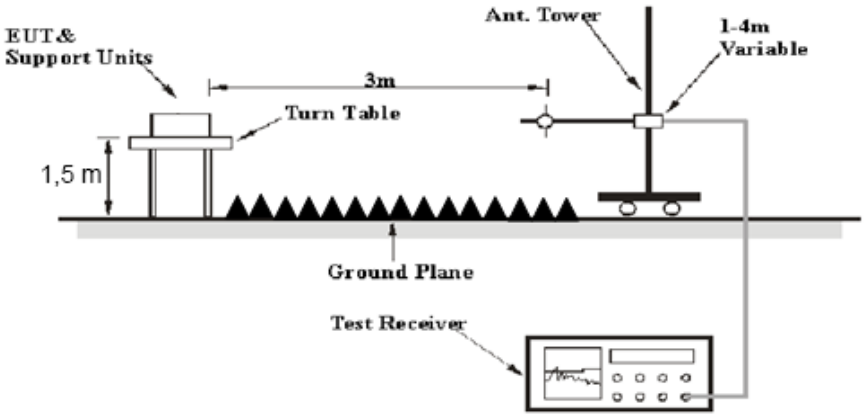
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1GHz:



Above 1GHz:



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

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

The spacing between the peripherals was 10 cm.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

According to FCC public notice: DA-00-705, during the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

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

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

Test Procedure

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

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiation Below 1GHz					
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	2019-09-05	2020-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2019-09-05	2020-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-1400-01	2019-05-06	2020-05-06
HP	Amplifier	8447D	2727A05902	2019-09-05	2020-09-05
Radiation Above 1GHz					
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 Technolagies	Horn Antenna	ARH-4223-02	1007726-01 1304	2016-11-18	2019-11-18
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2019-09-05	2020-09-05
Unknown	Coaxial Cable	C-2.4J2.4J-50	C-0700-02	2019-06-27	2020-06-27
MITEQ	Amplifier	AFS42-00101800-25-S-42	2001271	2019-09-05	2020-09-05
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2019-06-27	2020-06-27
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).

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 Data

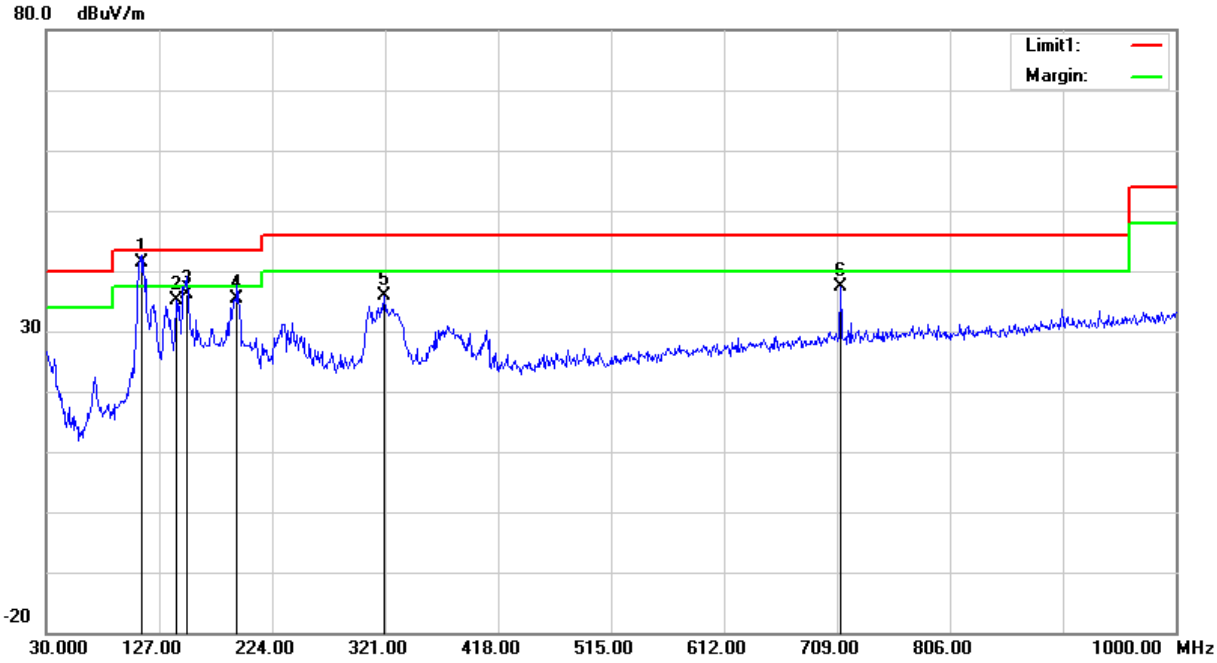
Environmental Conditions

Test Items	Radiation Below 1GHz	Radiation Above 1GHz
Temperature:	24.8°C	27.4°C
Relative Humidity:	44%	51 %
ATM Pressure:	101.4 kPa	100.7 kPa
Tester:	Tyler Pan	Tyler Pan
Test Date:	2019-11-28	2019-10-15

Test Mode: Transmitting

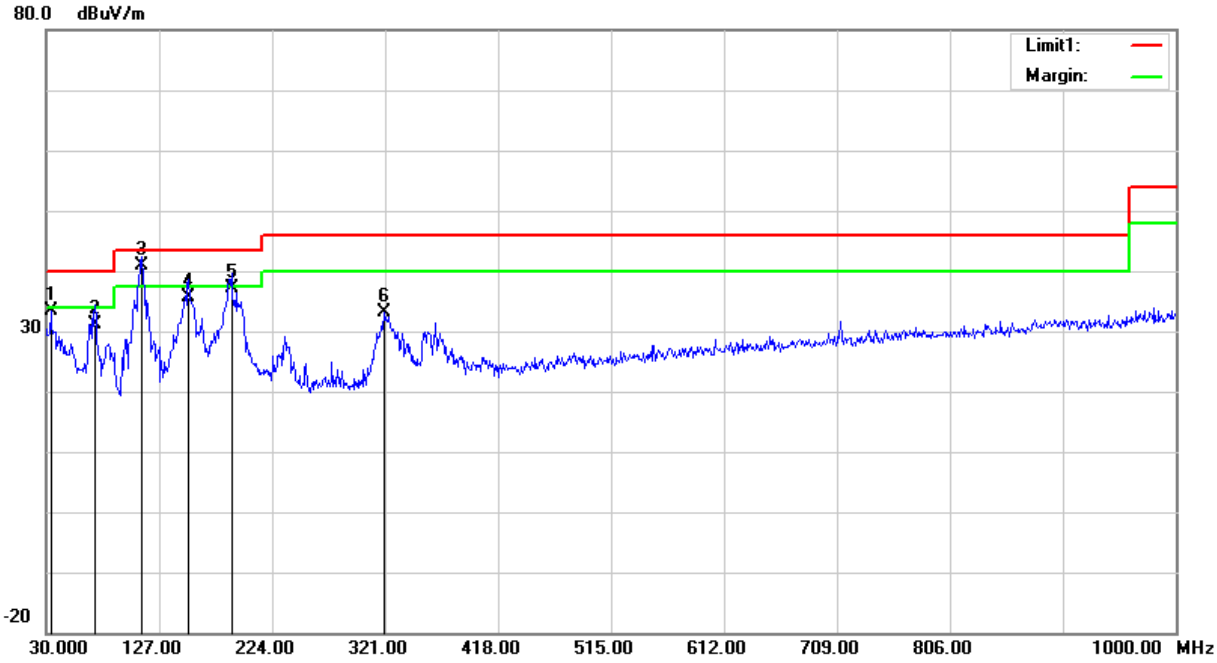
1) 30MHz-1GHz (BDR Low channel was the worst)

Horizontal:



Frequency (MHz)	Receiver Reading (dBµV)	Remark	Correction Factor (dB/m)	Cord. Amp. (dBµV/m)	Limit (dBµV/m)	Margin (dB)
111.4800	47.35	QP	-6.03	41.32	43.50	2.18
141.5500	40.96	peak	-5.85	35.11	43.50	8.39
151.2500	41.99	QP	-5.98	36.01	43.50	7.49
193.9300	42.11	QP	-6.80	35.31	43.50	8.19
320.0300	39.43	peak	-3.45	35.98	46.00	10.02
711.9100	34.13	peak	3.19	37.32	46.00	8.68

Vertical:



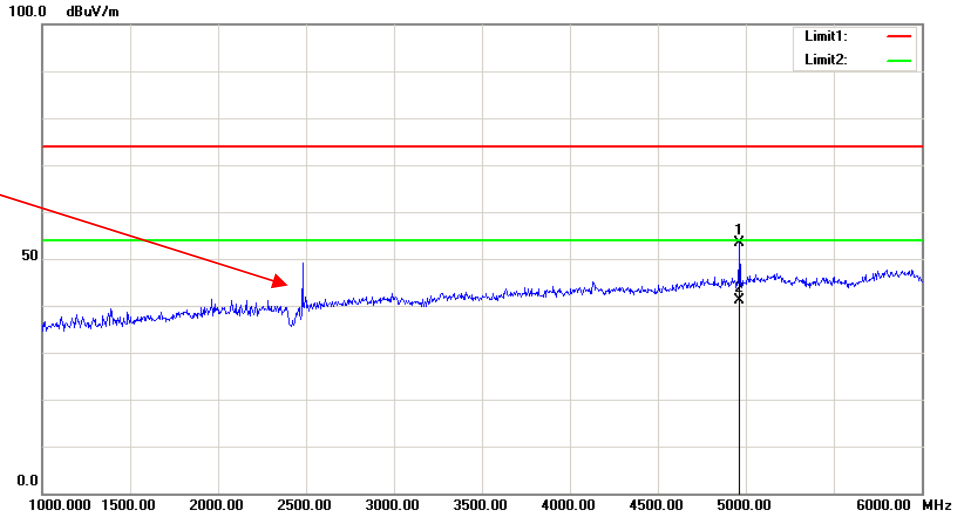
Frequency (MHz)	Receiver Reading (dBµV)	Remark	Correction Factor (dB/m)	Cord. Amp. (dBµV/m)	Limit (dBµV/m)	Margin (dB)
33.8800	34.75	peak	-1.29	33.46	40.00	6.54
71.7100	42.28	QP	-11.06	31.22	40.00	8.78
111.4800	46.98	QP	-6.03	40.95	43.50	2.55
152.2200	41.68	QP	-5.97	35.71	43.50	7.79
189.0800	44.25	QP	-7.17	37.08	43.50	6.42
320.0300	36.66	peak	-3.45	33.21	46.00	12.79

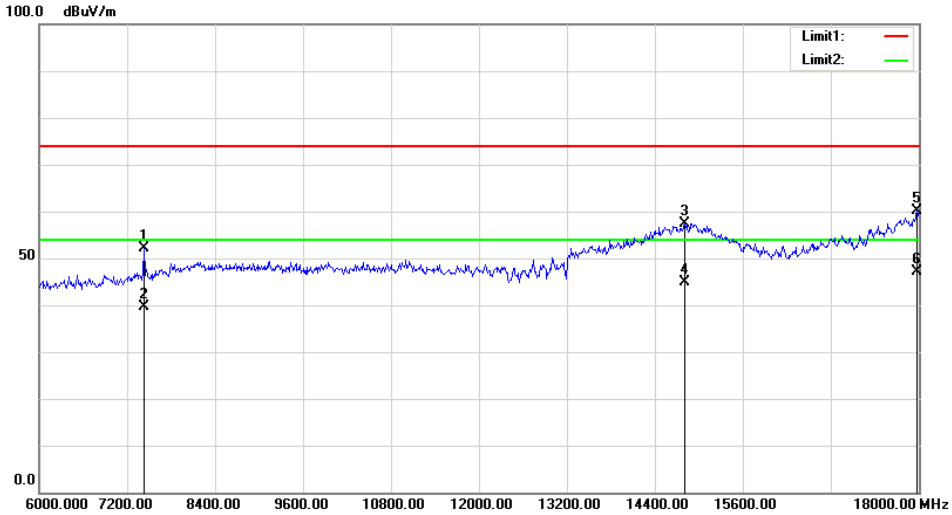
2)1GHz-25GHz *(*BDR was the worst*):*

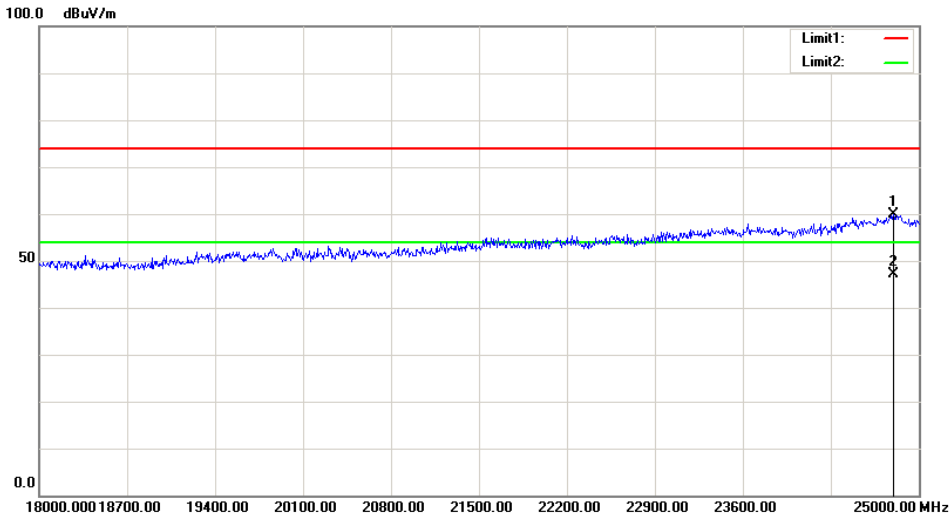
Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Remark	Polar (H/V)	Factor (dB/m)					
Low Channel: 2402 MHz									
2402.00	58.32	PK	H	28.10	1.80	0.00	88.22	N/A	N/A
2402.00	47.50	AV	H	28.10	1.80	0.00	77.40	N/A	N/A
2402.00	59.86	PK	V	28.10	1.80	0.00	89.76	N/A	N/A
2402.00	48.68	AV	V	28.10	1.80	0.00	78.58	N/A	N/A
2390.00	26.54	PK	V	28.08	1.80	0.00	56.42	74.00	17.58
2390.00	13.24	AV	V	28.08	1.80	0.00	43.12	54.00	10.88
4804.00	56.13	PK	V	32.91	3.17	37.20	55.01	74.00	18.99
4804.00	43.76	AV	V	32.91	3.17	37.20	42.64	54.00	11.36
7206.00	50.96	PK	V	35.74	4.82	37.23	54.29	74.00	19.71
7206.00	38.45	AV	V	35.74	4.82	37.23	41.78	54.00	12.22
Middle Channel: 2441 MHz									
2441.00	57.99	PK	H	28.18	1.82	0.00	87.99	N/A	N/A
2441.00	46.80	AV	H	28.18	1.82	0.00	76.80	N/A	N/A
2441.00	59.71	PK	V	28.18	1.82	0.00	89.71	N/A	N/A
2441.00	48.34	AV	V	28.18	1.82	0.00	78.34	N/A	N/A
4882.00	56.34	PK	V	33.06	3.27	37.21	55.46	74.00	18.54
4882.00	43.88	AV	V	33.06	3.27	37.21	43.00	54.00	11.00
7323.00	50.87	PK	V	36.04	4.62	37.38	54.15	74.00	19.85
7323.00	38.24	AV	V	36.04	4.62	37.38	41.52	54.00	12.48
High Channel: 2480 MHz									
2480.00	58.76	PK	H	28.26	1.84	0.00	88.86	N/A	N/A
2480.00	47.65	AV	H	28.26	1.84	0.00	77.75	N/A	N/A
2480.00	60.25	PK	V	28.26	1.84	0.00	90.35	N/A	N/A
2480.00	49.37	AV	V	28.26	1.84	0.00	79.47	N/A	N/A
2483.50	30.84	PK	V	28.27	1.84	0.00	60.95	74.00	13.05
2483.50	14.51	AV	V	28.27	1.84	0.00	44.62	54.00	9.38
4960.00	56.99	PK	V	33.22	3.23	37.25	56.19	74.00	17.81
4960.00	44.87	AV	V	33.22	3.23	37.25	44.07	54.00	9.93
7440.00	52.04	PK	V	36.34	4.41	37.52	55.27	74.00	18.73
7440.00	39.85	AV	V	36.34	4.41	37.52	43.08	54.00	10.92

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

Fundamental Test with Band Rejection Filter

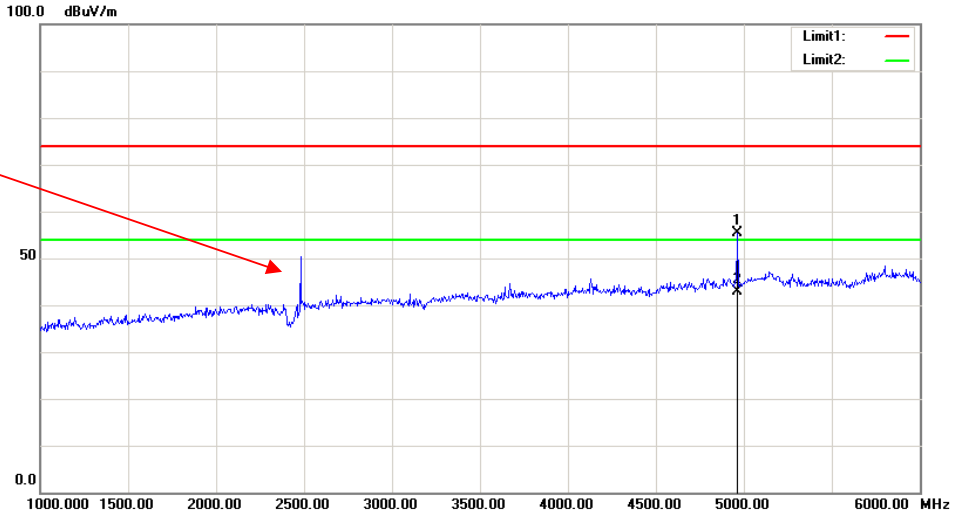


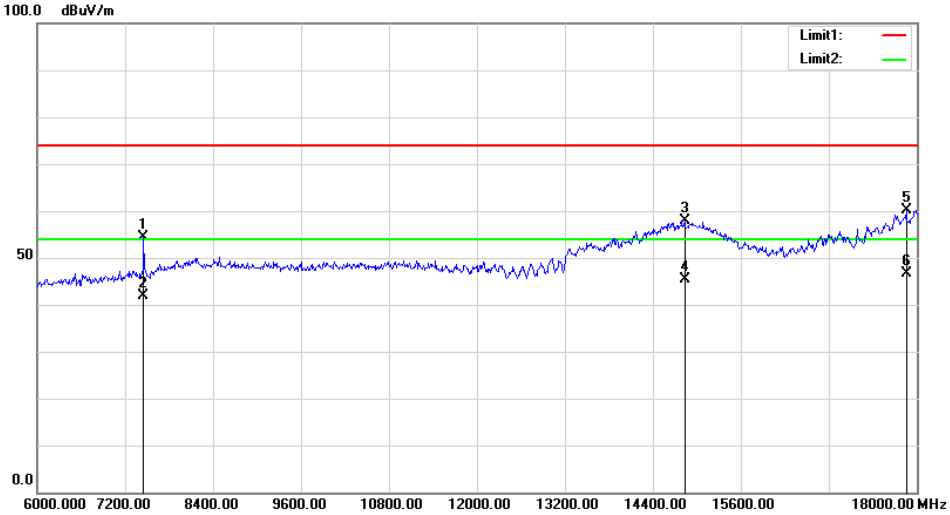


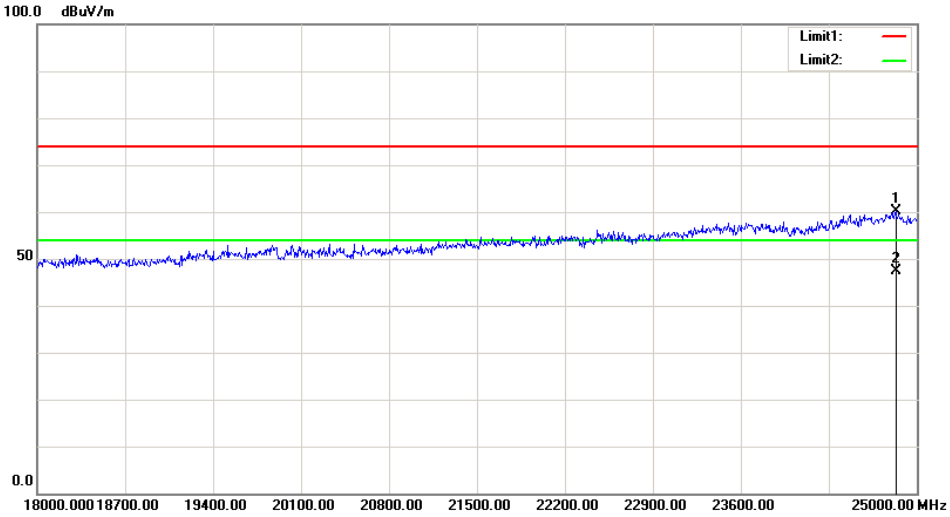


Vertical

Fundamental Test with Band Rejection Filter







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

Applicable Standard

Frequency hopping systems shall have 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	FSP 38	100478	2019-05-09	2020-05-09
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:	27.8°C
Relative Humidity:	63%
ATM Pressure:	100.4 kPa
Test by:	Severn Zhu
Test Date:	2019-10-11

Test Result: Compliance.

Please refer to following tables and plots

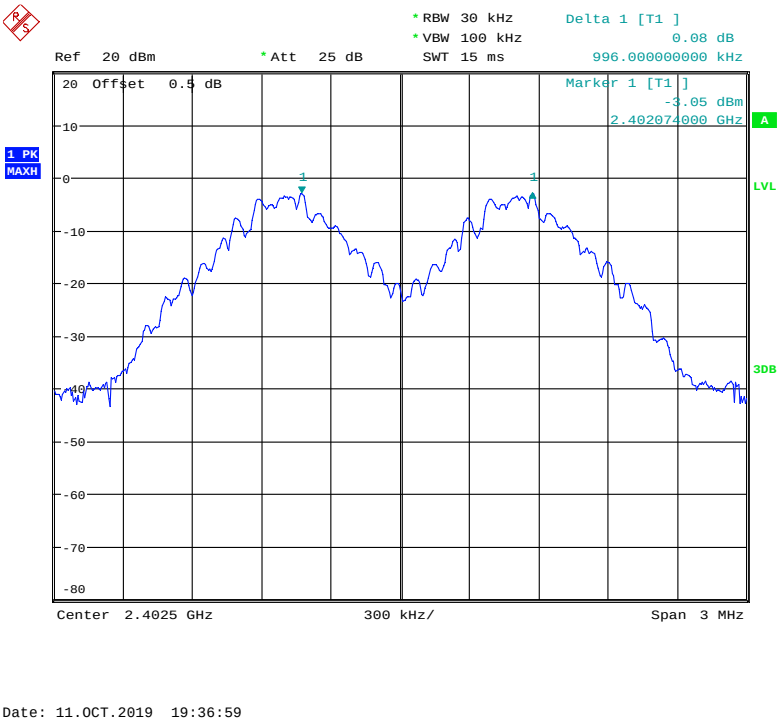
Test Mode: Transmitting

Mode	Channel	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)
BDR (GFSK)	Low	2402	0.996	0.64
	Middle	2441	1.002	0.64
	High	2480	1.002	0.64
EDR (π/4-DQPSK)	Low	2402	1.002	0.9
	Middle	2441	1.002	0.9
	High	2480	1.002	0.9
EDR (8DPSK)	Low	2402	0.996	0.9
	Middle	2441	1.014	0.9
	High	2480	1.020	0.89

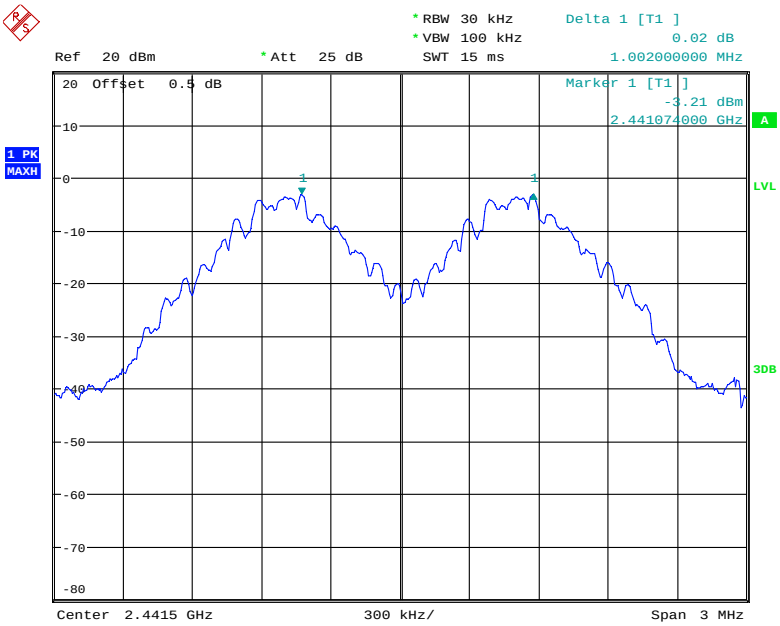
Note: Limit= (2/3) × 20dB bandwidth

BDR Mode (GFSK):

Low Channel

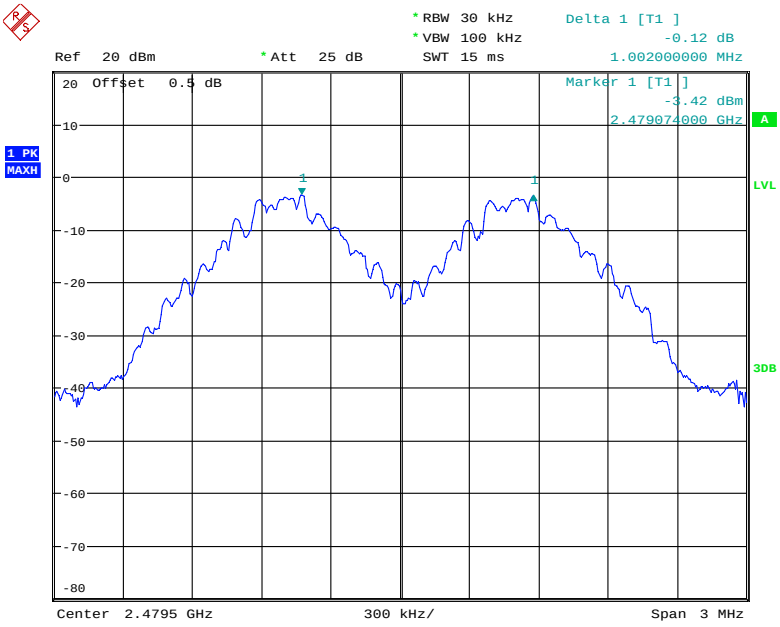


Middle Channel



Date: 11.OCT.2019 19:37:45

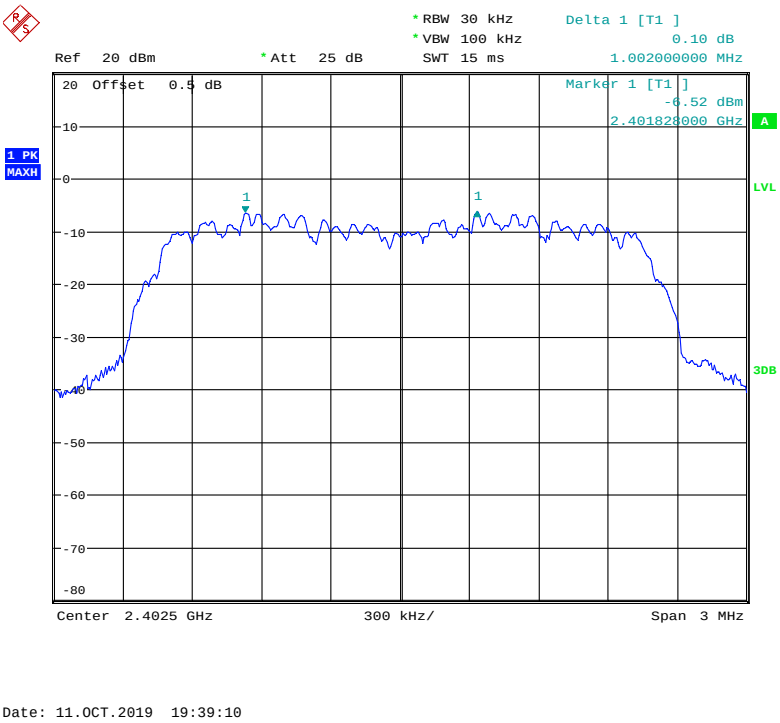
High Channel



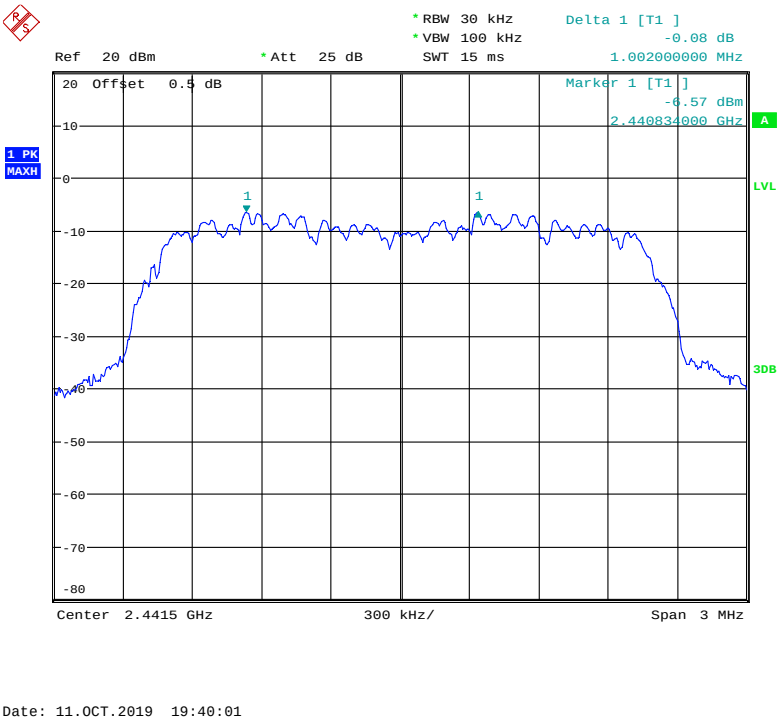
Date: 11.OCT.2019 19:38:27

EDR Mode (π/4-DQPSK):

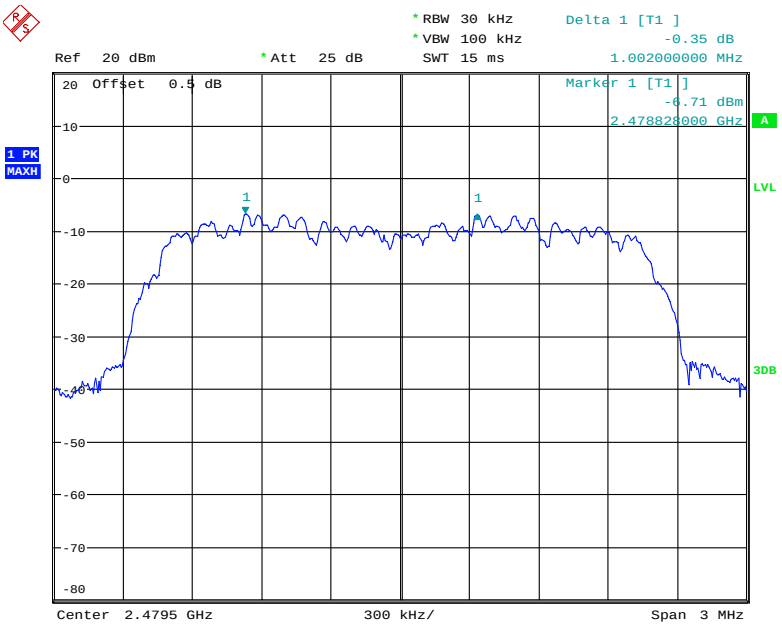
Low Channel



Middle Channel



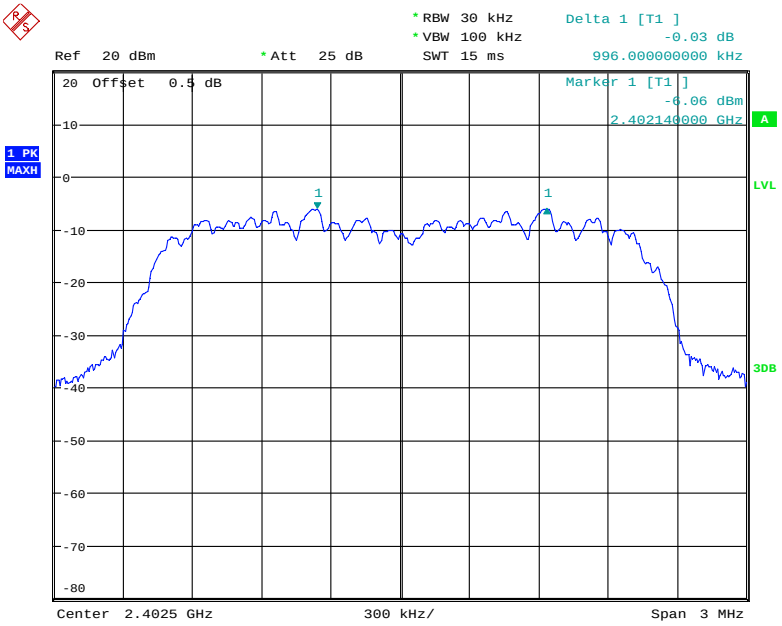
High Channel



Date: 11.OCT.2019 19:40:59

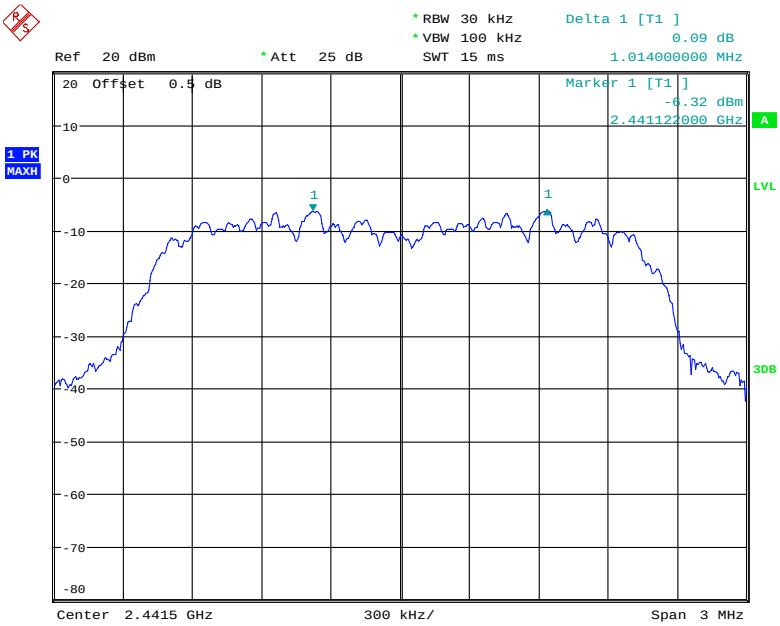
EDR Mode (8DPSK):

Low Channel



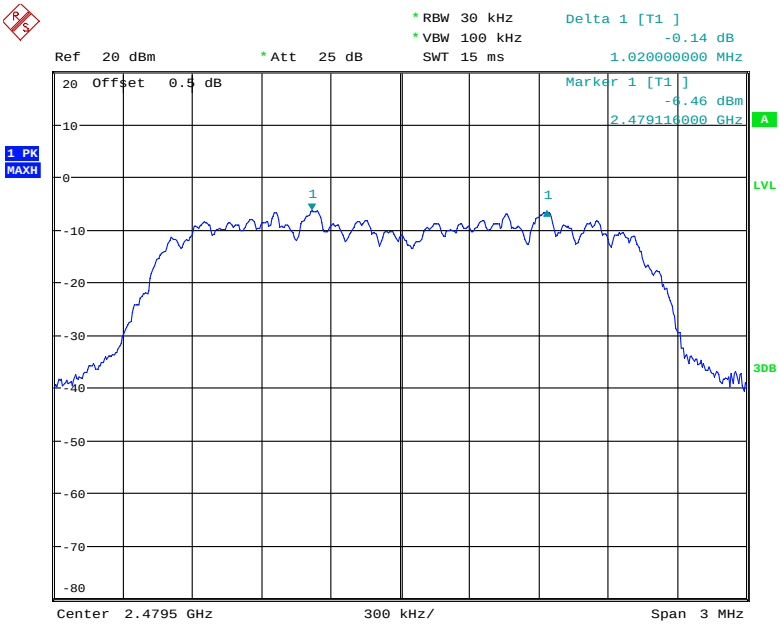
Date: 11.OCT.2019 19:41:46

Middle Channel



Date: 11.OCT.2019 19:42:18

High Channel



Date: 11.OCT.2019 19:43:10

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

Applicable Standard

Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on the test table without connection to measurement instrument. Turn on the EUT. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2019-05-09	2020-05-09
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:	27.8°C
Relative Humidity:	63%
ATM Pressure:	100.4 kPa
Test by:	Severn Zhu
Test Date:	2019-10-11

Test Result: Compliance.

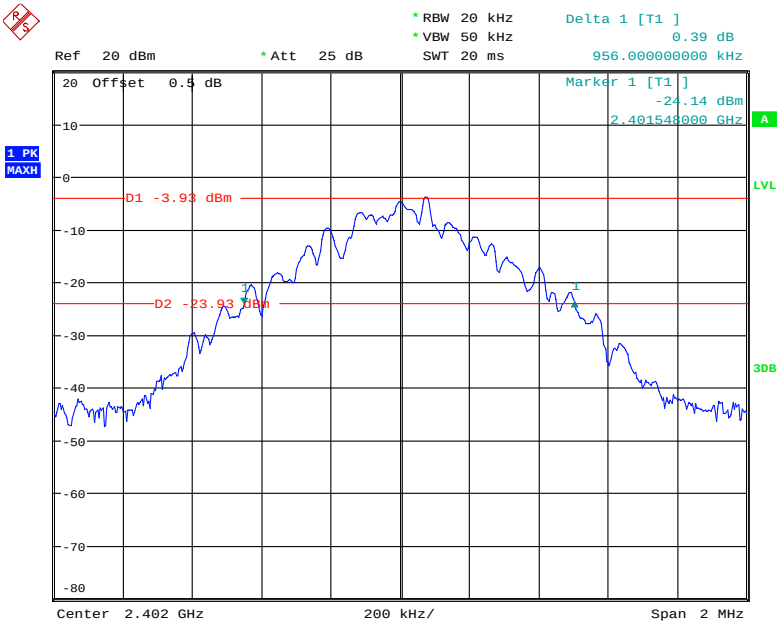
Please refer to following tables and plots

Test Mode: Transmitting

Mode	Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
BDR Mode (GFSK)	Low	2402	0.956
	Middle	2441	0.956
	High	2480	0.956
EDR Mode (π/4-DQPSK)	Low	2402	1.352
	Middle	2441	1.352
	High	2480	1.352
EDR Mode (8DPSK)	Low	2402	1.344
	Middle	2441	1.348
	High	2480	1.340

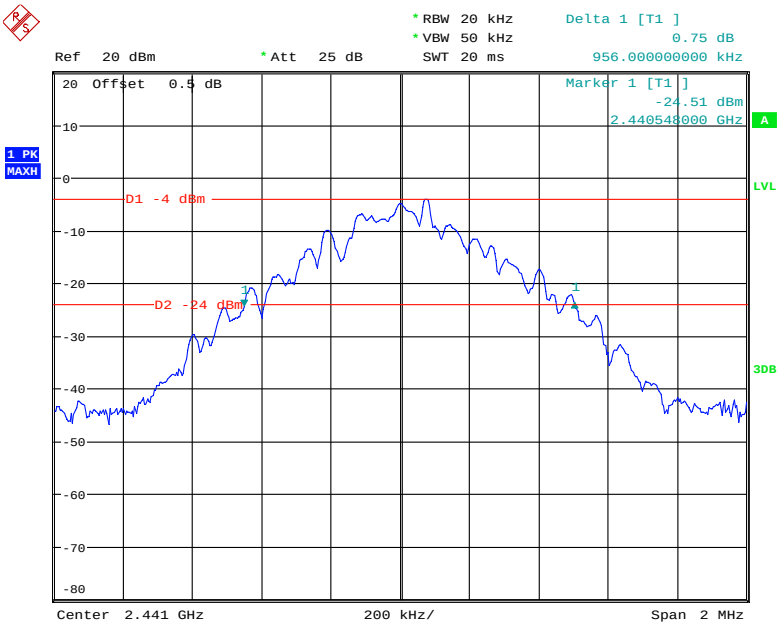
BDR Mode (GFSK):

Low Channel



Date: 11.OCT.2019 19:21:43

Middle Channel



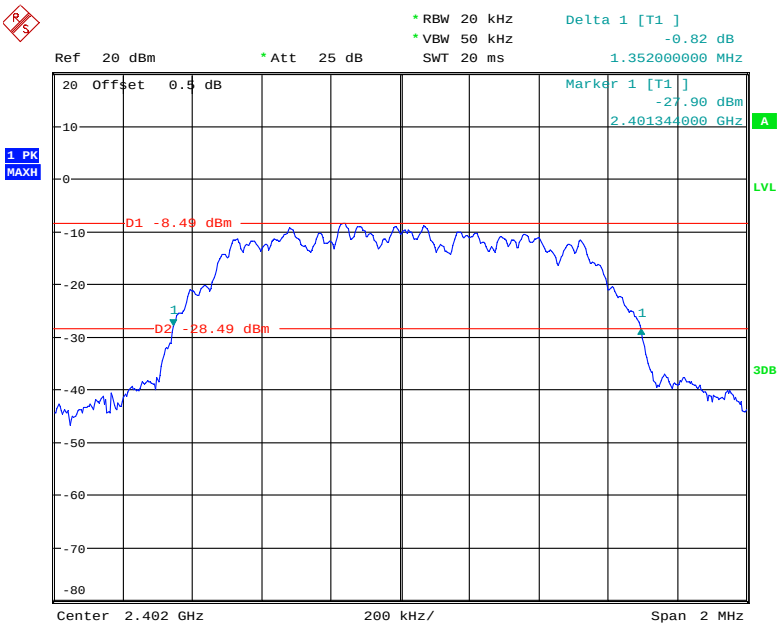
Date: 11.OCT.2019 19:22:43

High Channel

Date: 11.OCT.2019 19:23:53

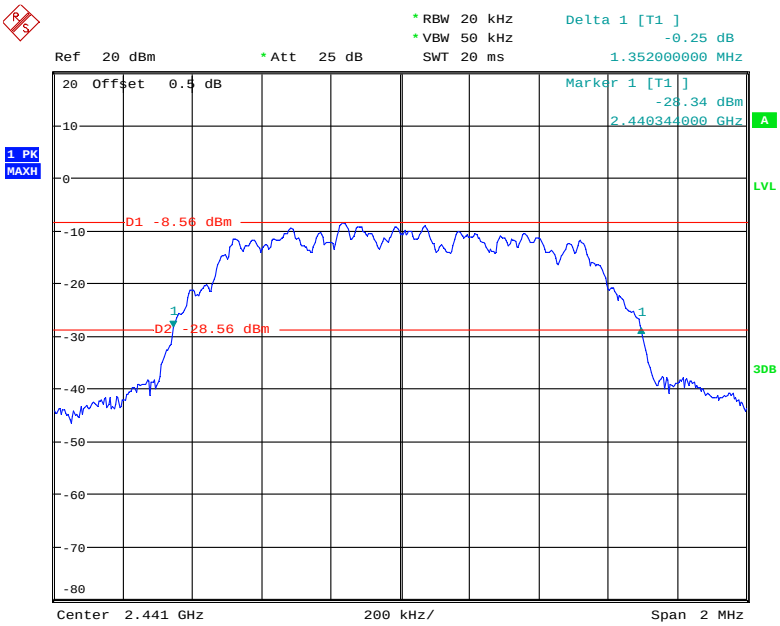
EDR Mode (π/4-DQPSK):

Low Channel



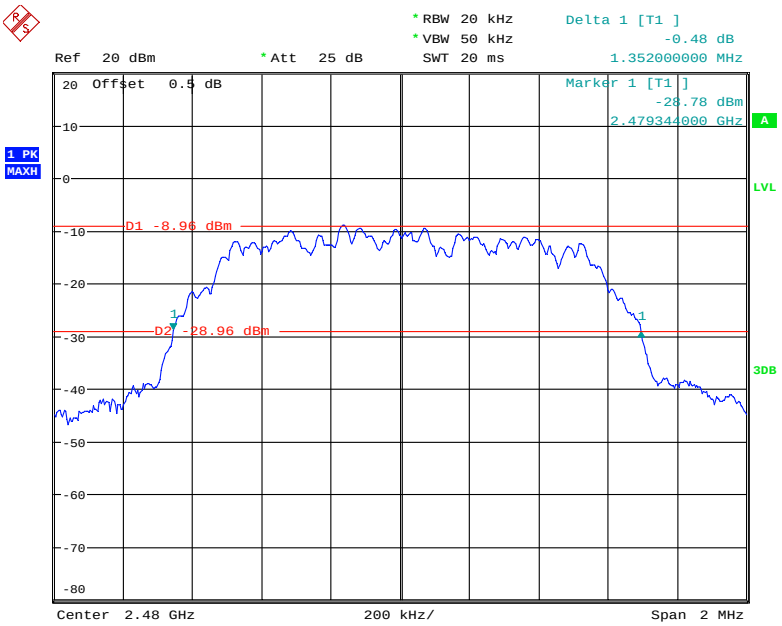
Date: 11.OCT.2019 19:26:32

Middle Channel



Date: 11.OCT.2019 19:28:05

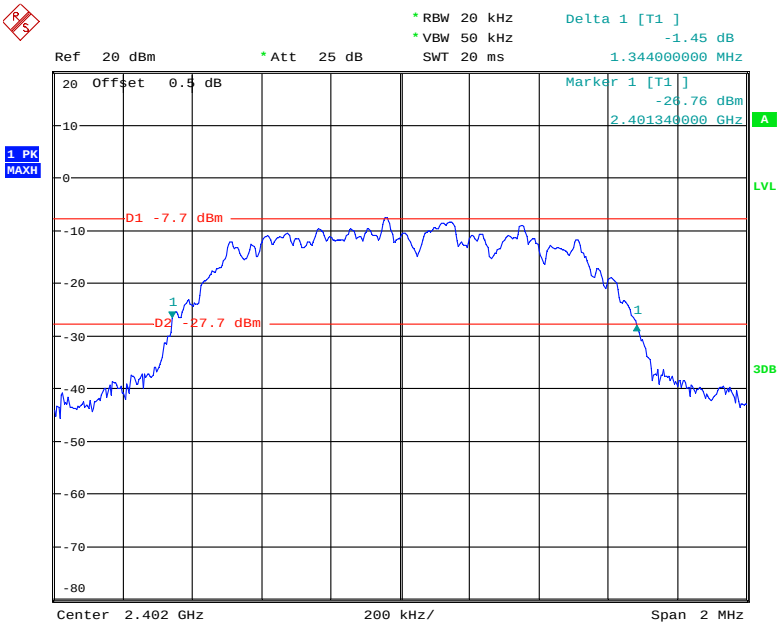
High Channel



Date: 11.OCT.2019 19:29:01

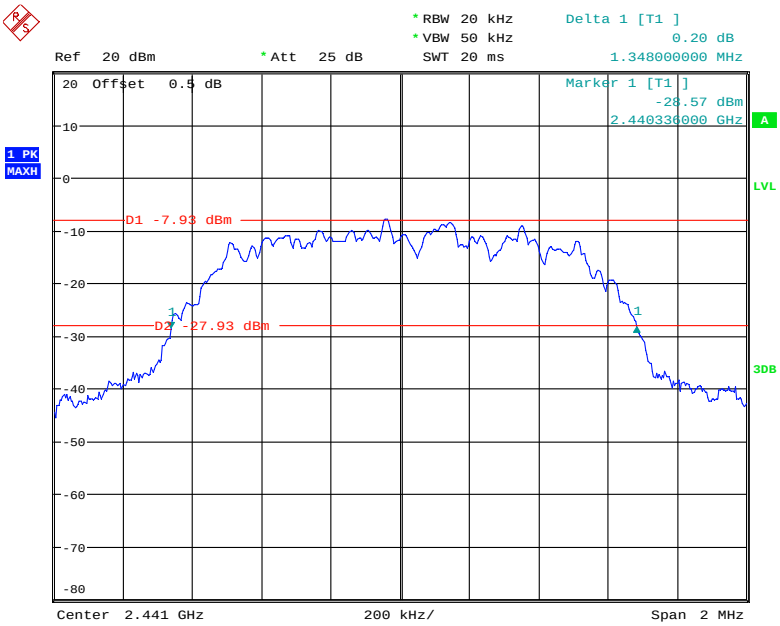
EDR Mode (8DPSK):

Low Channel



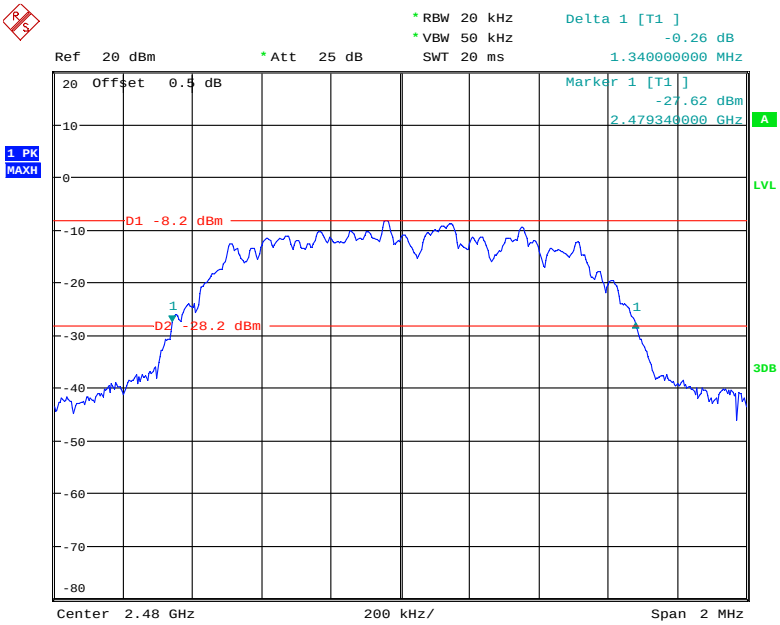
Date: 11.OCT.2019 19:31:47

Middle Channel



Date: 11.OCT.2019 19:33:53

High Channel



Date: 11.OCT.2019 19:34:46

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

Applicable Standard

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

Test Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Set the EUT in hopping mode from first channel to last.
3. By using the Max-Hold function record the Quantity of the channel.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2019-05-09	2020-05-09
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:	27.8°C
Relative Humidity:	63%
ATM Pressure:	100.4 kPa
Test by:	Severn Zhu
Test Date:	2019-10-11

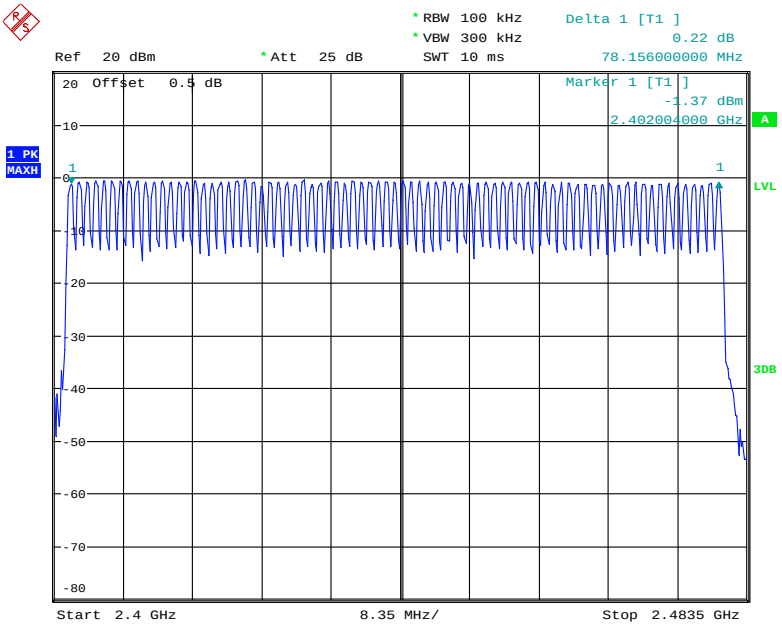
Test Result: Compliance.

Please refer to following tables and plots

Test Mode: Transmitting

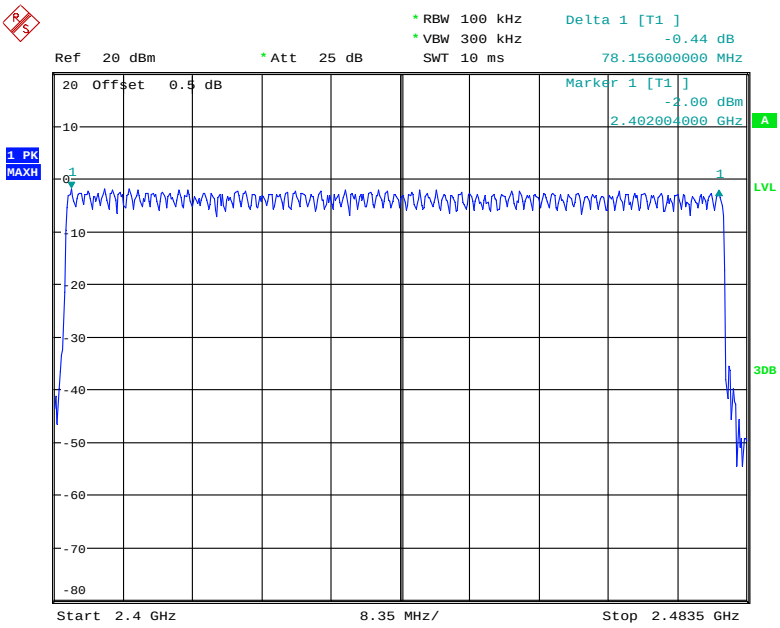
Test mode	Frequency Range (MHz)	Number of Hopping Channel	Limit
GFSK	2400-2483.5	79	≥15
π/4-DQPSK	2400-2483.5	79	≥15
8DPSK	2400-2483.5	79	≥15

BDR Mode (GFSK)



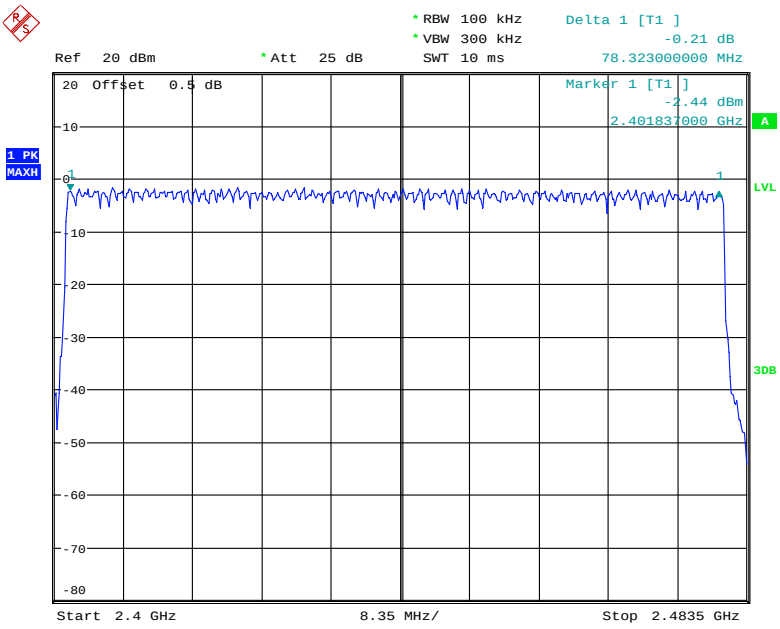
Date: 11.OCT.2019 19:47:35

EDR Mode (π/4-DQPSK)



Date: 11.OCT.2019 19:51:11

EDR Mode (8DPSK)



Date: 11.OCT.2019 19:58:29

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

Applicable Standard

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

Test Procedure

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2019-05-09	2020-05-09
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:	26.7°C
Relative Humidity:	50%
ATM Pressure:	101.4 kPa
Test by:	Severn Zhu
Test Date:	2019-11-04

Test Result: Compliance.

Please refer to following tables and plots

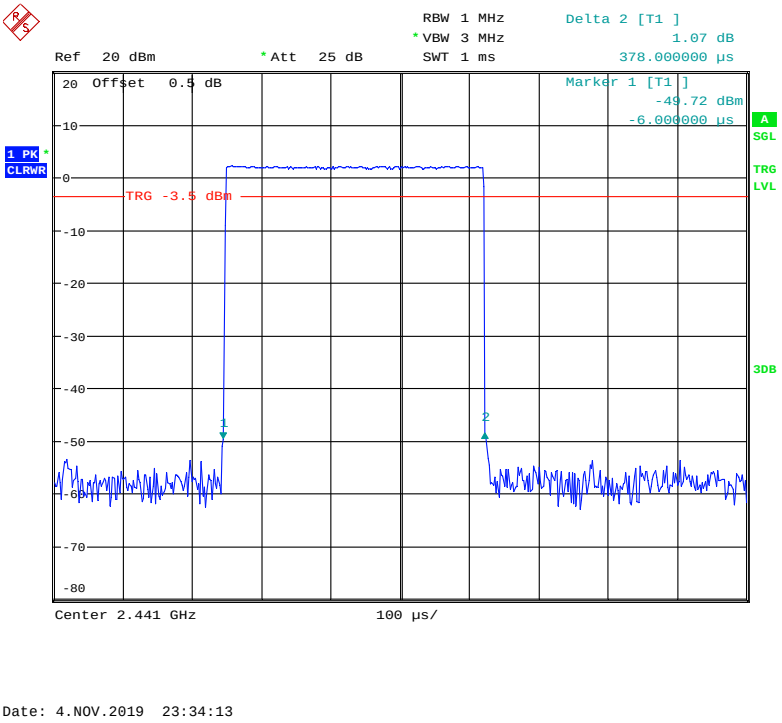
Test Mode: Transmitting

Mode	Packet type	Channel	Frequency (MHz)	Puse width (ms)	Result (s)	Limit (s)
GFSK	DH1	Middle	2441	0.378	0.121	0.4
	DH3	Middle	2441	1.644	0.263	
	DH5	Middle	2441	2.900	0.309	
π/4-DQPSK	2DH1	Middle	2441	0.386	0.124	
	2DH3	Middle	2441	1.650	0.264	
	2DH5	Middle	2441	2.910	0.310	
8DPSK	3DH1	Middle	2441	0.388	0.124	
	3DH3	Middle	2441	1.656	0.265	
	3DH5	Middle	2441	2.910	0.310	

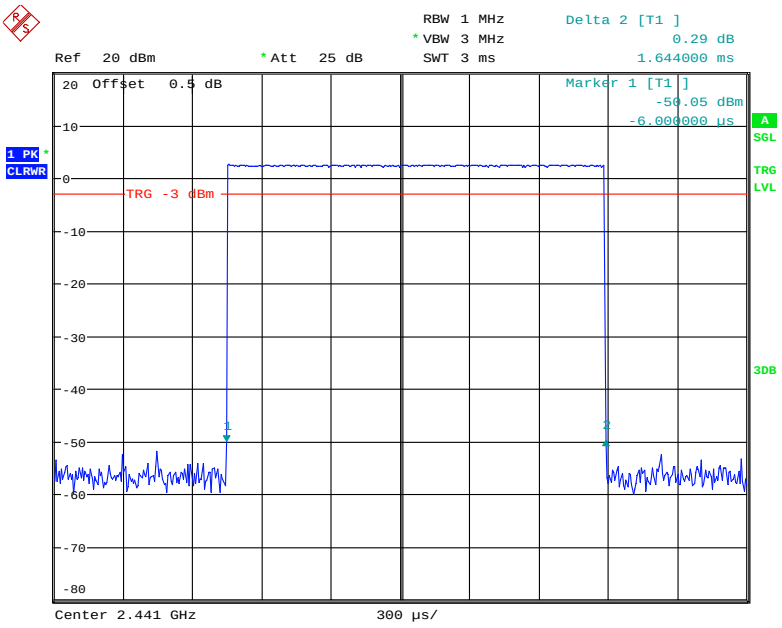
Note:
DH1:Dwell time=Pulse time (ms) × (1600/2/79) ×31.6 s
DH3:Dwell time=Pulse time (ms) × (1600/4/79) ×31.6 s
DH5:Dwell time=Pulse time (ms) × (1600/6/79) ×31.6 s

BDR Mode (GFSK):

DH1: Middle Channel

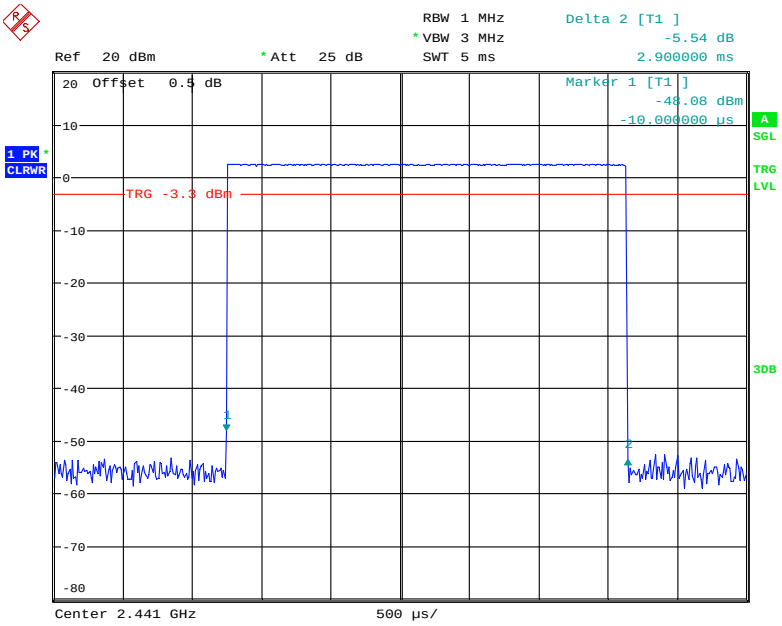


DH3: Middle Channel



Date: 4.NOV.2019 23:35:01

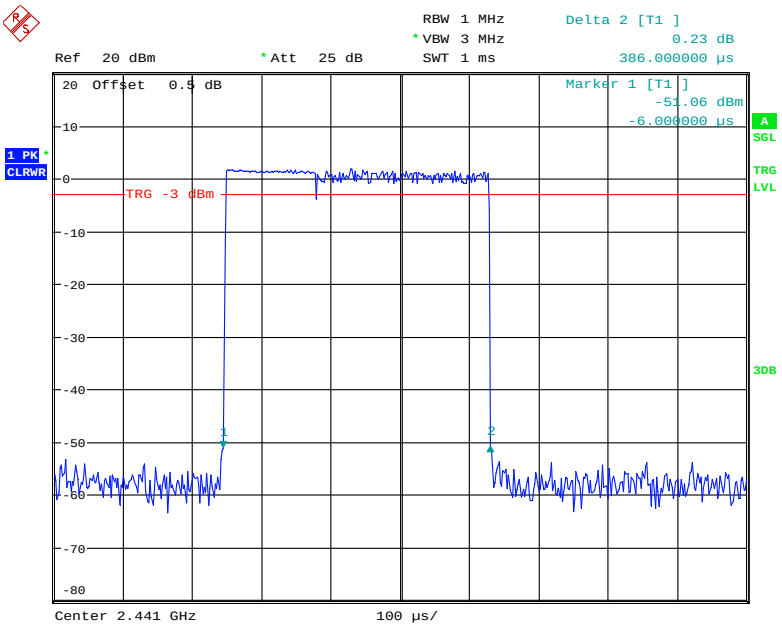
DH5: Middle Channel



Date: 4.NOV.2019 23:35:40

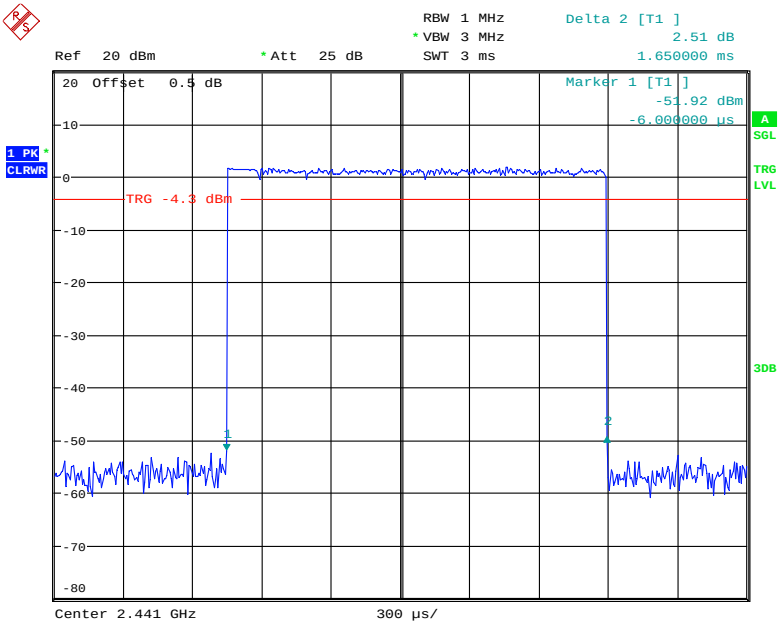
EDR Mode (π/4-DQPSK):

2DH1: Middle Channel



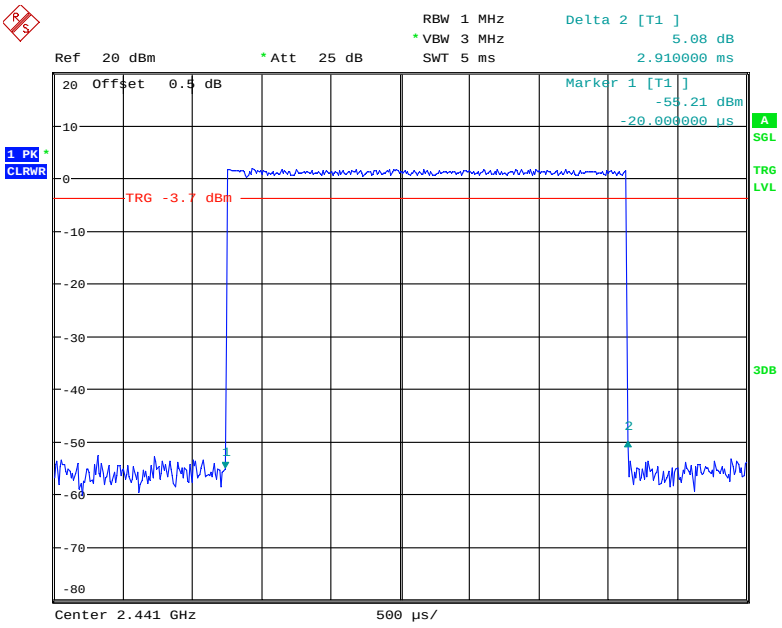
Date: 4.NOV.2019 23:36:01

2DH3: Middle Channel



Date: 4.NOV.2019 23:36:26

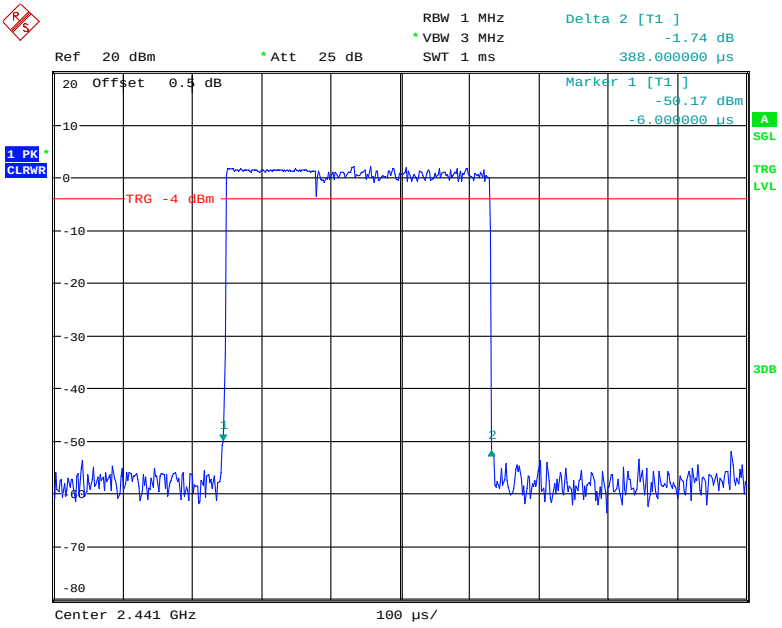
2DH5: Middle Channel



Date: 4.NOV.2019 23:36:50

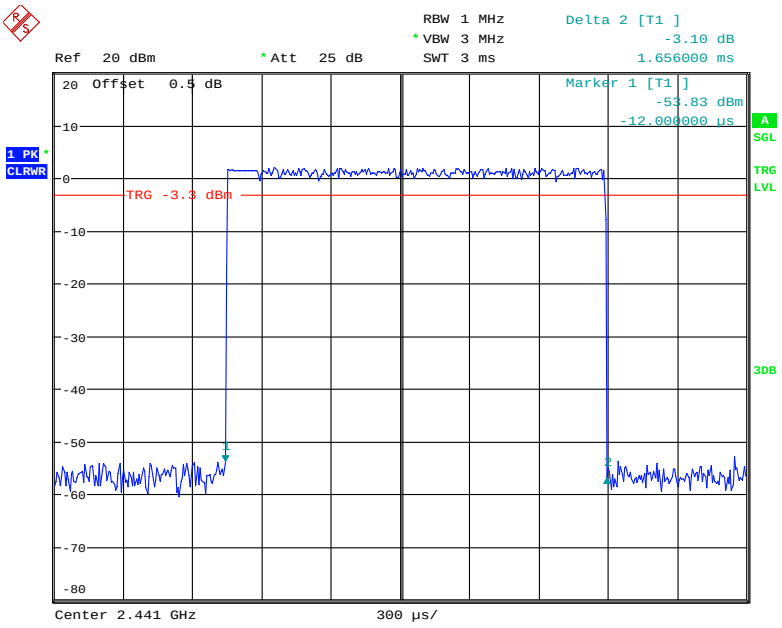
EDR Mode 8DPSK):

3DH1: Middle Channel



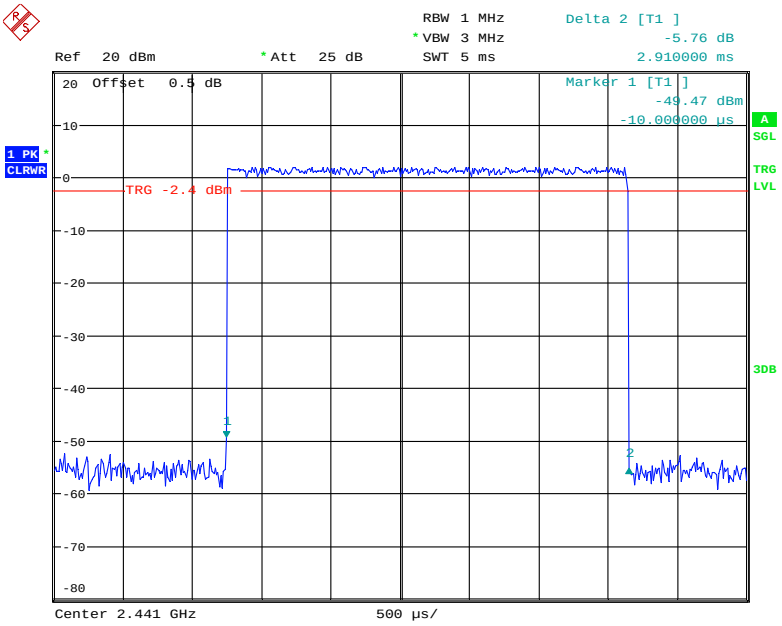
Date: 4.NOV.2019 23:37:13

3DH3: Middle Channel



Date: 4.NOV.2019 23:37:34

3DH5: Middle Channel



Date: 4.NOV.2019 23:37:57

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	C0010/03	Each time	N/A
Agilent	USB Wideband Power Sensor	U2021XA	MY5425009	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:	27.8°C
Relative Humidity:	63%
ATM Pressure:	100.4 kPa
Test by:	Severn Zhu
Test Date:	2019-10-11

Test Result: Compliance.

Test Mode: Transmitting

Mode	Frequency (MHz)	Peak Conducted Output power (dBm)	Limit (dBm)
BDR Mode (GFSK)	2402	0.52	21
	2441	0.25	21
	2480	-0.17	21
EDR Mode (π/4-DQPSK)	2402	0.5	21
	2441	0.19	21
	2480	-0.22	21
EDR Mode (8DPSK)	2402	0.46	21
	2441	0.17	21
	2480	0.46	21

Note: The data above was tested in conducted mode.

FCC §15.247(d) - BAND EDGES TESTING

Applicable Standard

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

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW/ VBW of spectrum analyzer to 100/300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2019-05-09	2020-05-09
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

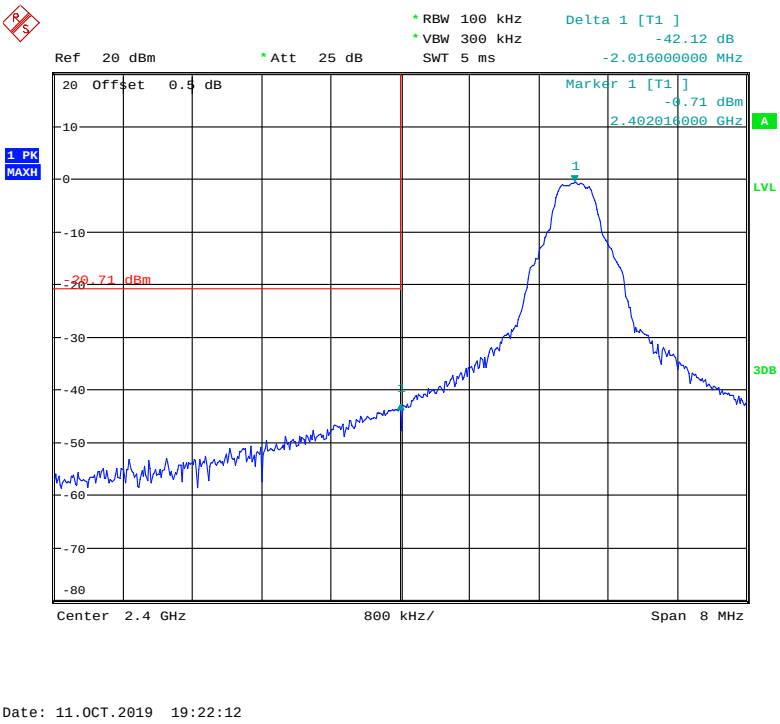
Environmental Conditions

Temperature:	27.8°C
Relative Humidity:	63%
ATM Pressure:	100.4 kPa
Test by:	Severn Zhu
Test Date:	2019-10-11

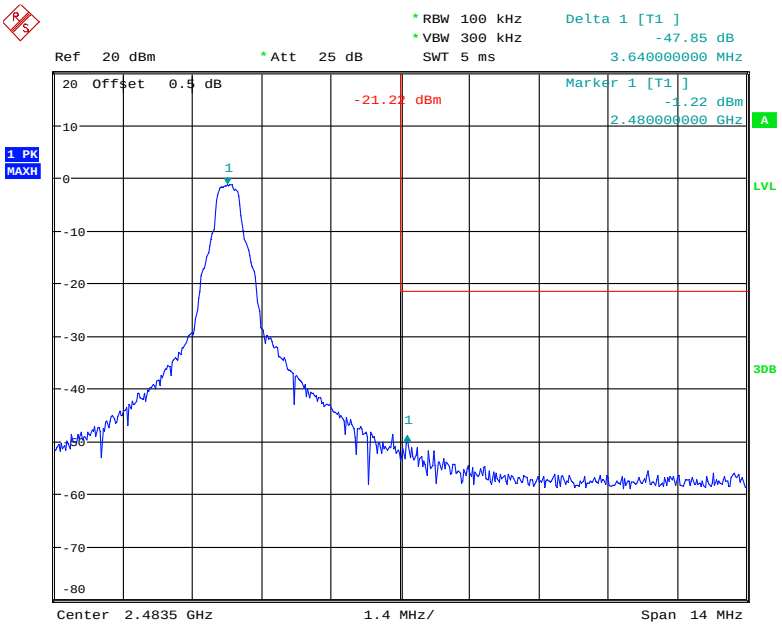
Test Result: Compliance

Single Channel Mode,
BDR Mode (GFSK):

Band Edge, Left Side



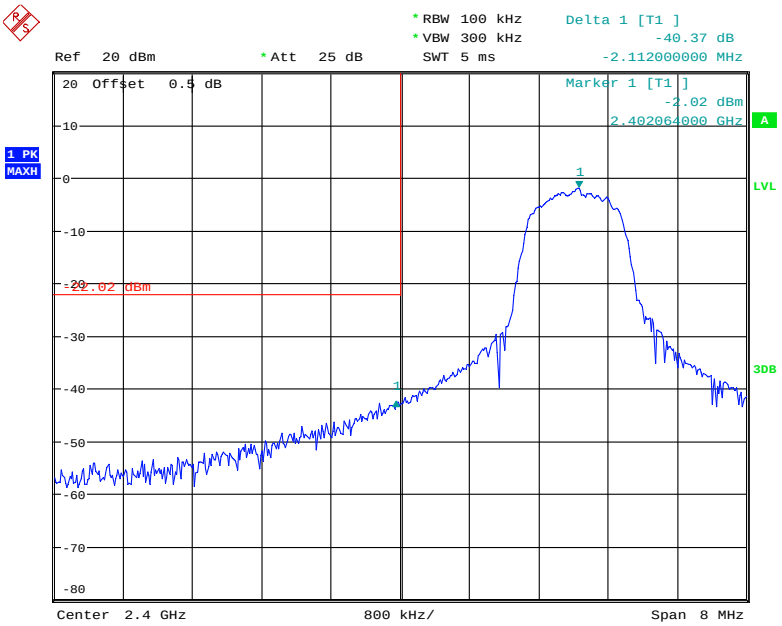
Band Edge, Right Side



Date: 11.OCT.2019 19:24:25

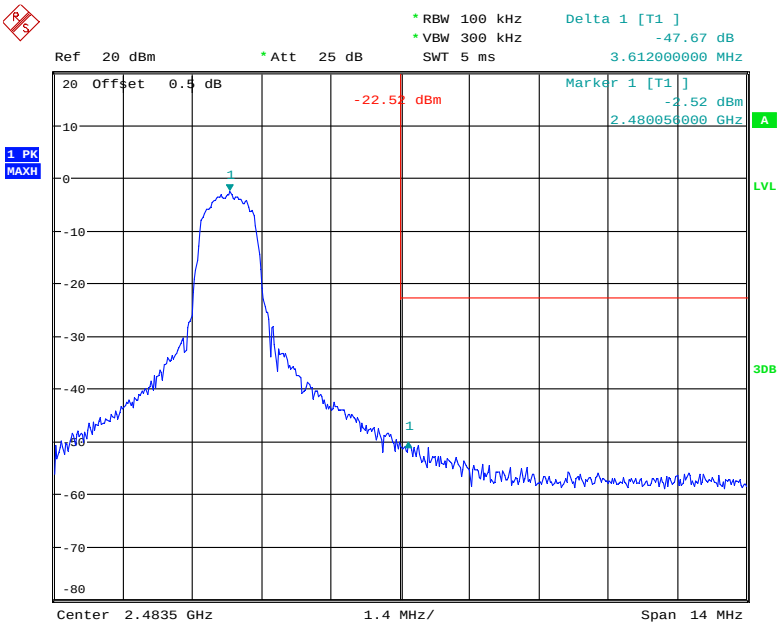
EDR Mode (π/4-DQPSK):

Band Edge, Left Side



Date: 11.OCT.2019 19:27:01

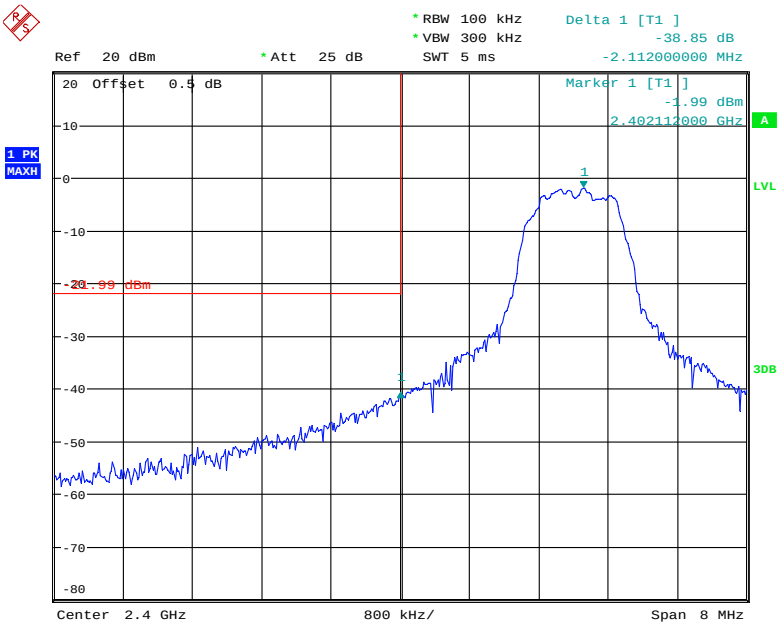
Band Edge, Right Side



Date: 11.OCT.2019 19:29:36

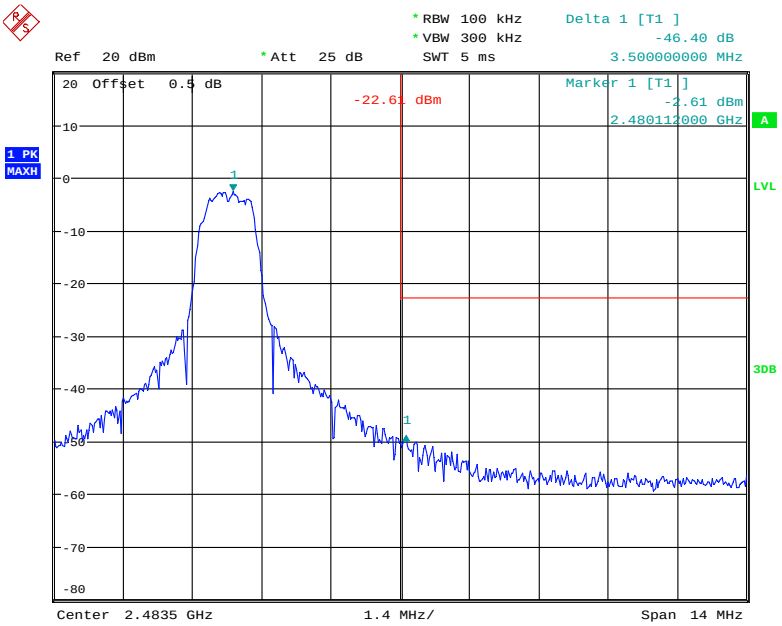
EDR Mode (8DPSK):

Band Edge, Left Side



Date: 11.OCT.2019 19:32:18

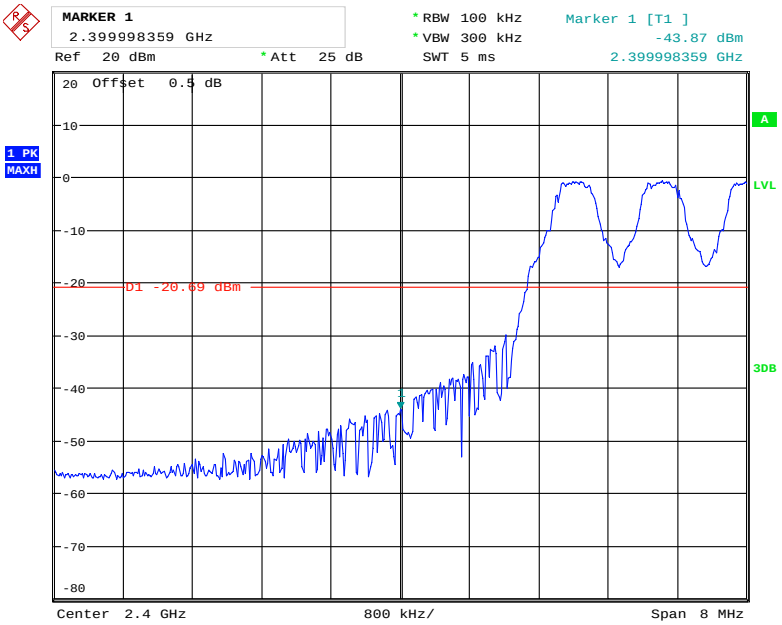
Band Edge, Right Side



Date: 11.OCT.2019 19:35:18

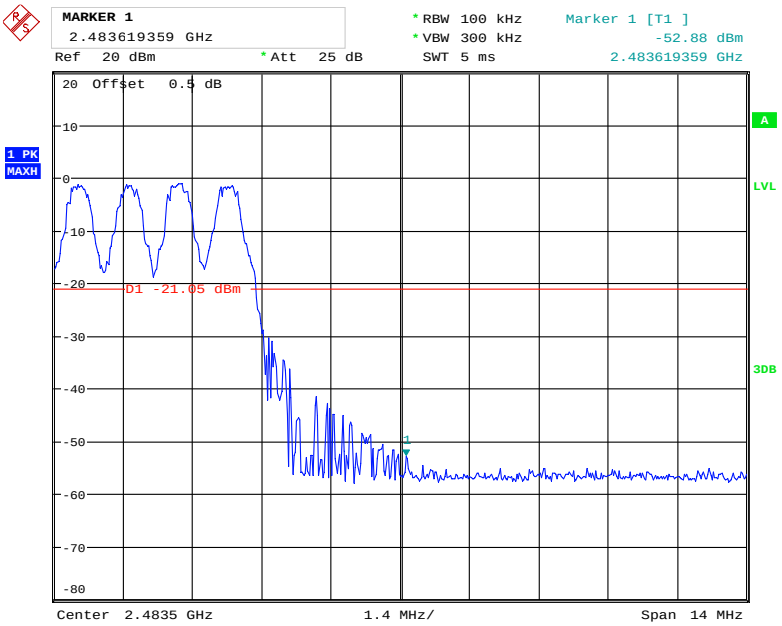
Hopping Mode,
BDR Mode (GFSK):

Band Edge, Left Side



Date: 11.OCT.2019 20:25:55

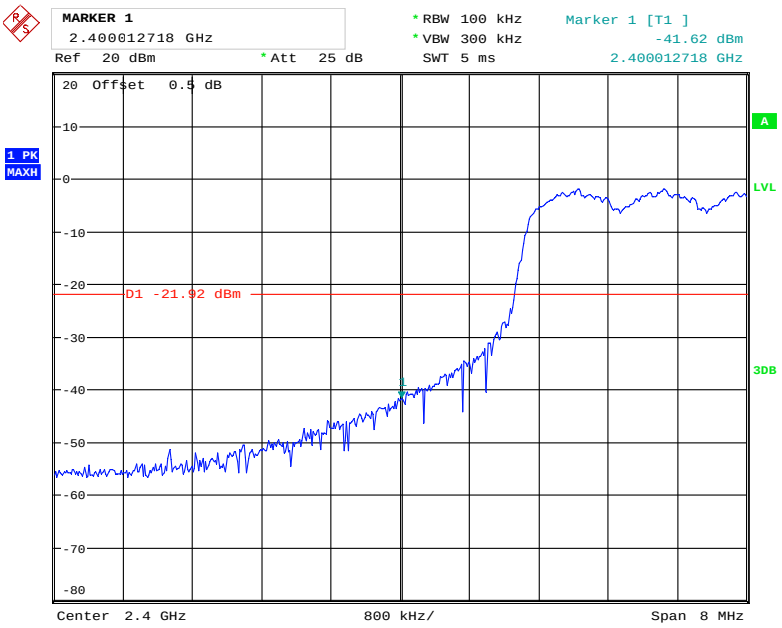
Band Edge, Right Side



Date: 11.OCT.2019 20:29:40

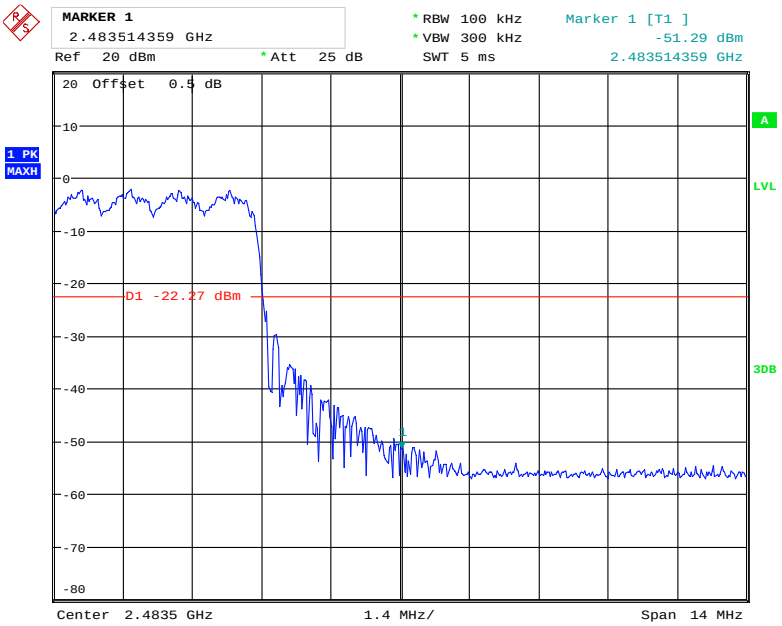
EDR Mode (π/4-DQPSK):

Band Edge, Left Side



Date: 11.OCT.2019 20:42:39

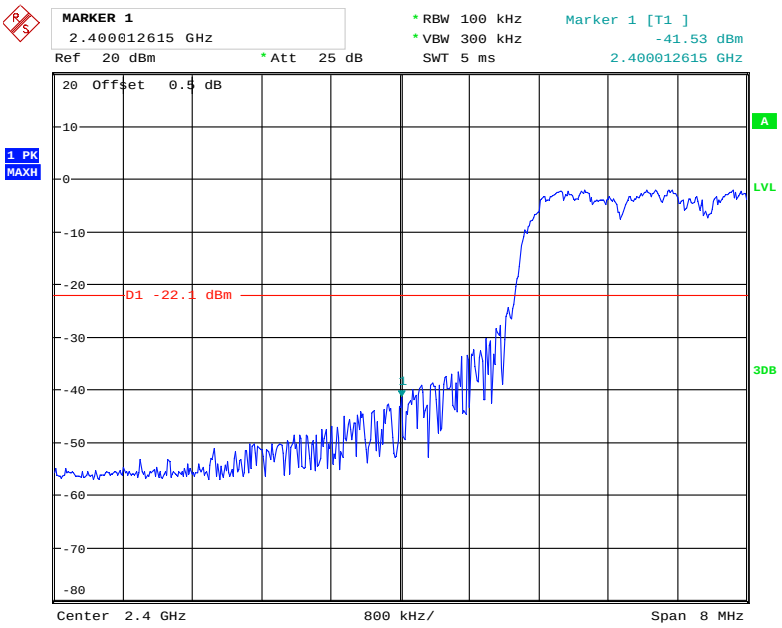
Band Edge, Right Side



Date: 11.OCT.2019 20:49:50

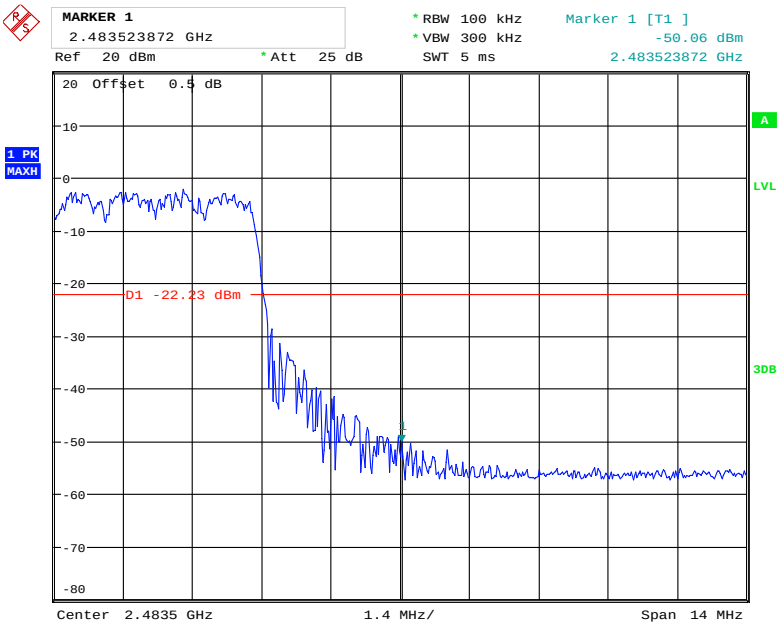
EDR Mode (8DPSK):

Band Edge, Left Side



Date: 11.OCT.2019 20:54:58

Band Edge, Right Side



Date: 11.OCT.2019 20:59:41

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