



TESTING LABORATORY
CERTIFICATE #4820.01



FCC PART 15.247

TEST REPORT

For

Delta Electronics Incorporated

3 Tungyuan Road Chungli Industrial Zone Taoyuan County 32063, Taiwan

FCC ID: H79Z1H

Report Type: Original Report	Product Name: HD Pocket Projector
Report Number: RDG190705015-00B	
Report Date: 2019-08-06	
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:		HD Pocket Projector
EUT Model:		Z1H
Multiple Models:		Z1HC, Z1H+, Z1HB, Z1, Z1+
Operation Frequency:		Radio 1:2402-2480MHz Radio 2: 2402-2480MHz
Maximum Output Power (Conducted):		Radio 1:4.53dBm Radio 2: -2.79dBm
Modulation Type:		Radio 1:GFSK, $\pi/4$ -DQPSK, 8-DPSK Radio 2: GFSK, $\pi/4$ -DQPSK
Rated Input Voltage:		DC 7.4V from battery or DV 12V charging from adapter
Adapter Information	Model:	ADP-36PH A
	Input:	AC100-240V
	Output:	DC 12V 3A
External Dimension:		86x86x136mm
Serial Number:		190705015
EUT Received Date:		2019-07-05

Note: The series product model Z1HC, Z1H+, Z1HB, Z1, Z1+ is electrically identical with model Z1H, we selected Z1H for fully testing, the differences details was explained in the declaration letter.

Objective

This report is prepared on behalf of **Delta Electronics Incorporated** 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: H79Z1H.

Test Methodology

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

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

Measurement Uncertainty

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

Test Facility

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

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

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

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in engineering mode. The device built in two Radio, Radio 1 employs Bluetooth and Wifi, Radio 2 employs Bluetooth only.

EUT Exercise Software

For Radio 1:

The software: 'RTLBTAPP' 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	5
	Middle	2441	5
	High	2480	5
$\pi/4$ DQPSK	Low	2402	5
	Middle	2441	5
	High	2480	5
8DPSK	Low	2402	5
	Middle	2441	5
	High	2480	5

For Radio 2:

The software: 'FCCAssist 2.4' 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	10
	Middle	2441	10
	High	2480	10
$\pi/4$ DQPSK	Low	2402	10
	Middle	2441	10
	High	2480	10

Equipment Modifications

No modification was made to the EUT.

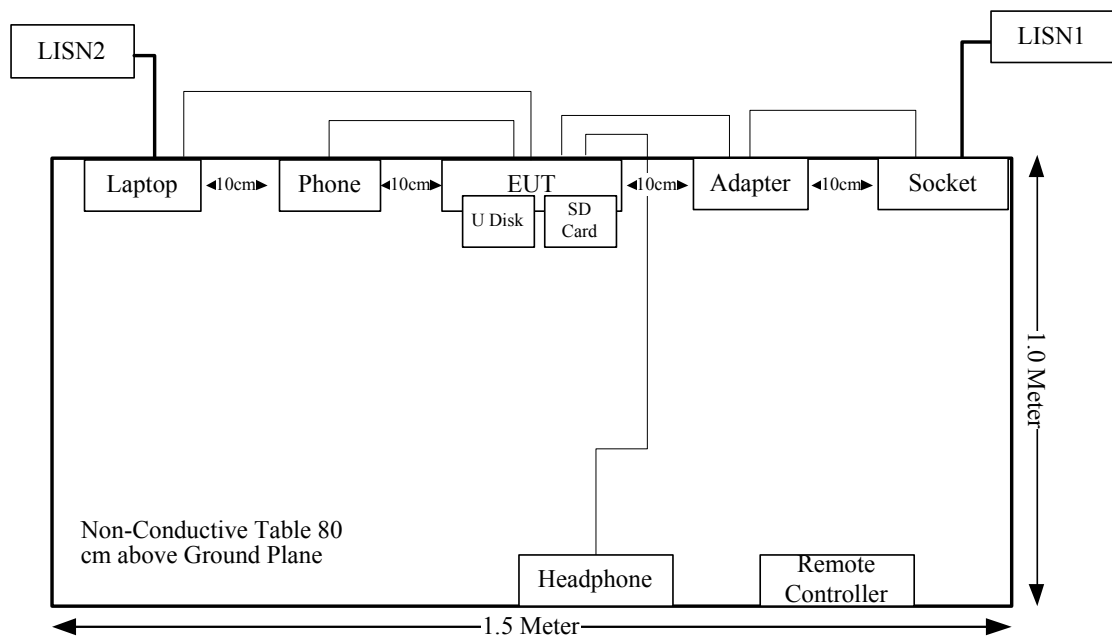
Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
DELL	Laptop	PP11L	1CVM0C1
Kingston	U Disk	4G	/
Kingston	SD Card	16G	/
Huawei	Smartphone	EVR-AL00	A000009E3F501E
Ipro	Earphone	Black	/

Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
Earphone Cable	No	No	1.17	EUT	Earphone
HDMI Cable	Yes	No	1.2	Laptop	EUT
Type-C Cable	Yes	No	1.0	Smartphone	EUT
DC Cable	Yes	Yes	1.2	Adapter	EUT

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§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/cm²);

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:

Radio	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)			
Radio 1	Wifi	2412-2462	0.5	1.12	14	25.12	20.00	0.0056	1.0
	BDR/EDR	2402-2480	0.5	1.12	5	3.16	20.00	0.0007	1.0
	BLE	2402-2480	0.5	1.12	4	2.51	20.00	0.0006	1.0
Radio 2	BDR/EDR	2402-2480	0.5	1.12	-2	0.63	20.00	0.0001	1.0
	BLE	2402-2480	0.5	1.12	0	1.00	20.00	0.0002	1.0

The Radio 1 and Radio 2 can transmit simultaneously:

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

$$= S_{Radio\ 1} / S_{limit-Radio\ 1} + S_{Radio\ 2} / S_{limit-Radio\ 2}$$

$$= 0.0056 / 1 + 0.0002 / 1$$

$$= 0.0058$$

$$< 1.0$$

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:

Radio	Antenna Type	input impedance (Ohm)	Antenna Gain /Frequency Range
1	FPC	50	0.5 dBi/2.4~2.5GHz
2	FPC	50	0.5 dBi/2.4~2.5GHz

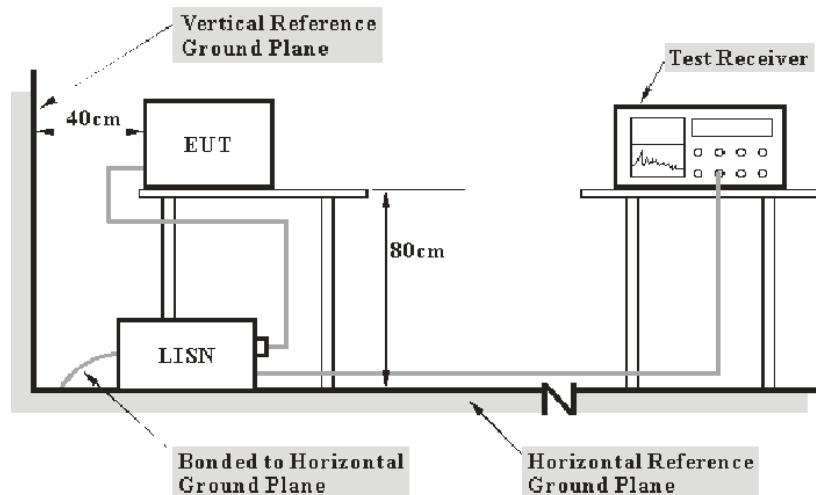
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207(a)

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

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

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the first LISN.

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

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

Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$$V_C = V_R + A_C + VDF$$

Herein,

V_C : corrected voltage amplitude

V_R : reading voltage amplitude

A_C : attenuation caused by cable loss

VDF : voltage division factor of AMN or ISN

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

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
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
R&S	L.I.S.N	ESH2-Z5	892107/021	2018-09-19	2019-09-19

* **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).

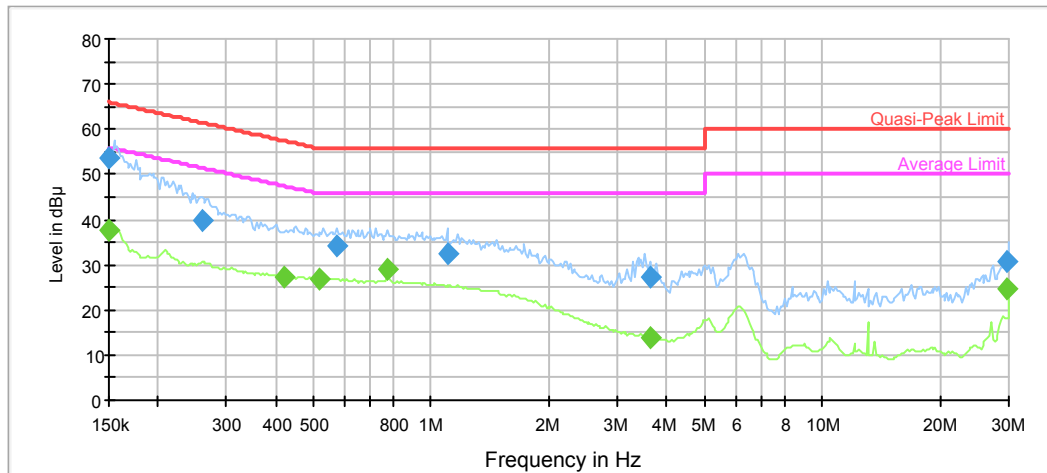
Test Data

Environmental Conditions

Temperature:	28.2 °C
Relative Humidity:	58 %
ATM Pressure:	100.4kPa
Tester:	Lily Xie
Test Date:	2019-07-16

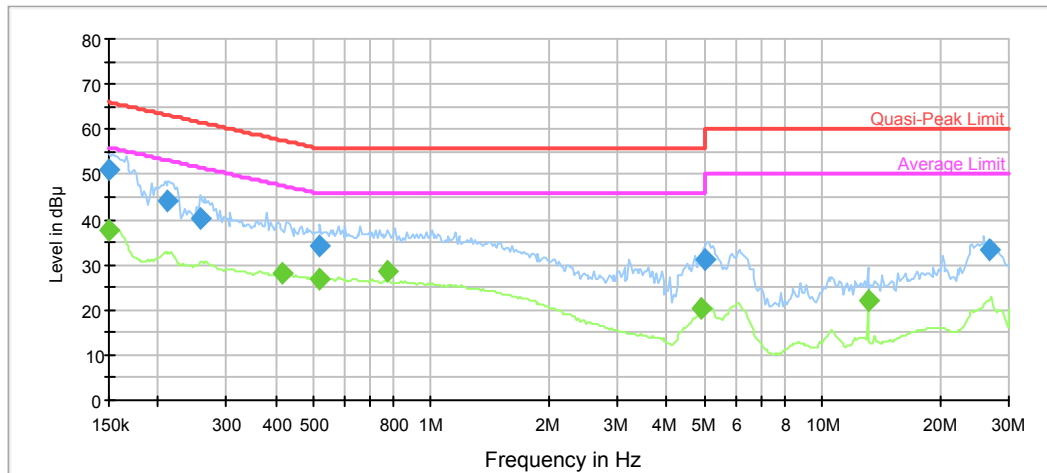
Test Result: Compliance

Test Mode: Transmitting(Radio 1 8-DPSK Low channel was the worst)

AC120V, 60 Hz, Line:

Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	53.5	9.000	L1	11.2	12.5	66.0
0.259279	39.8	9.000	L1	10.3	21.7	61.5
0.574747	34.0	9.000	L1	9.8	22.0	56.0
1.097403	32.5	9.000	L1	9.8	23.5	56.0
3.621856	27.3	9.000	L1	9.8	28.7	56.0
29.601974	30.6	9.000	L1	9.8	29.4	60.0

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	37.4	9.000	L1	11.2	18.6	56.0
0.422196	27.3	9.000	L1	9.9	20.1	47.4
0.520311	26.8	9.000	L1	9.9	19.2	46.0
0.774673	29.0	9.000	L1	9.8	17.0	46.0
3.621856	13.7	9.000	L1	9.8	32.3	46.0
29.801974	24.8	9.000	L1	9.8	25.2	50.0

AC120V, 60 Hz, Neutral:

Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	51.1	9.000	N	11.2	14.9	66.0
0.212491	44.1	9.000	N	10.5	19.0	63.1
0.256712	40.3	9.000	N	10.3	21.2	61.5
0.520311	34.0	9.000	N	9.9	22.0	56.0
4.992412	31.1	9.000	N	9.8	24.9	56.0
26.762414	33.1	9.000	N	9.8	26.9	60.0

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	37.6	9.000	N	11.2	18.4	56.0
0.418016	27.9	9.000	N	9.9	19.6	47.5
0.515160	26.8	9.000	N	9.9	19.2	46.0
0.774673	28.6	9.000	N	9.8	17.4	46.0
4.921856	20.5	9.000	N	9.8	26.5	46.0
13.071424	21.9	9.000	N	9.8	28.1	50.0

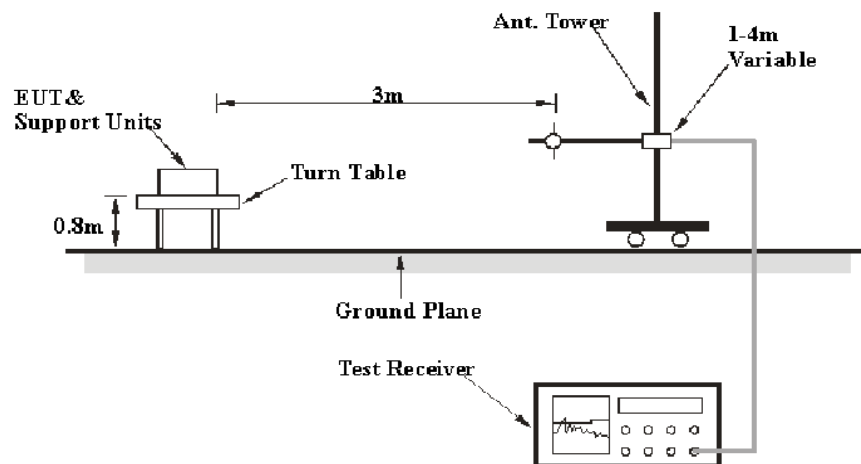
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

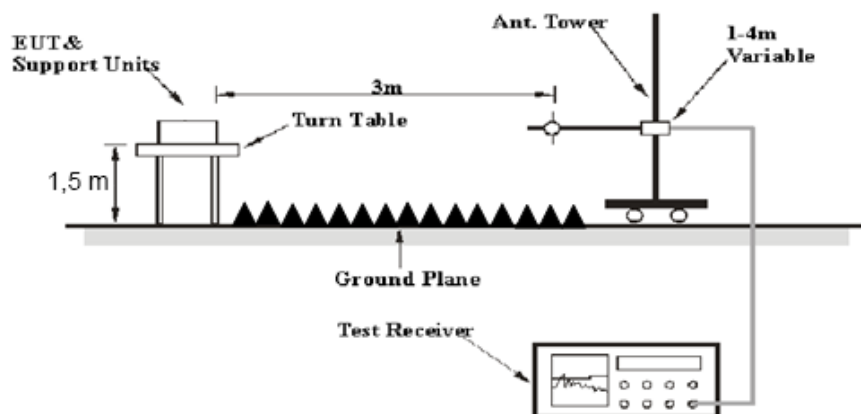
FCC §15.247 (d); §15.209; §15.205;

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
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 Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2016-11-18	2019-11-18
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2018-09-05	2019-09-05
Unknown	Coaxial Cable	C-2.4J2.4J-50	C-0700-02	2019-06-27	2020-06-27
MITEQ	Amplifier	AFS42-00101800-25-S-42	2001271	2018-09-05	2019-09-05
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:

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

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

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

Test Data

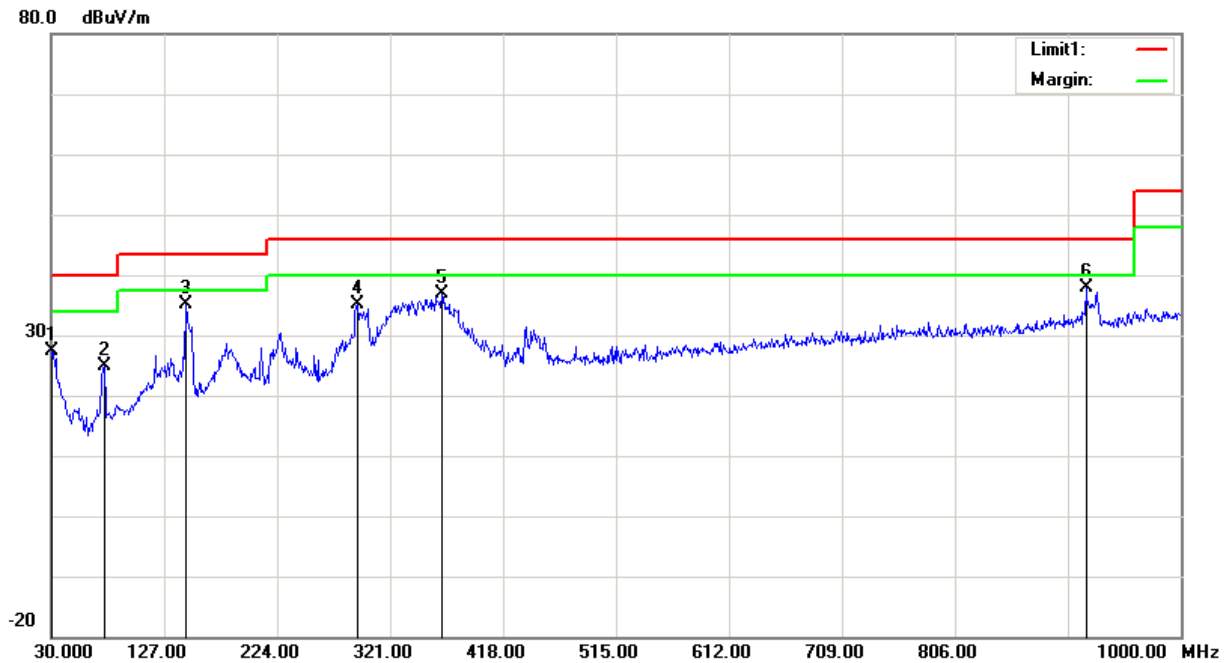
Environmental Conditions

Test Items	Radiation Below 1GHz	Radiation Above 1GHz
Temperature:	28.7 °C	28.9 °C
Relative Humidity:	55%	68 %
ATM Pressure:	100.4 kPa	100.2 kPa
Tester:	Tyler Pan	Lucy Lu
Test Date:	2019-07-22	2019-07-18

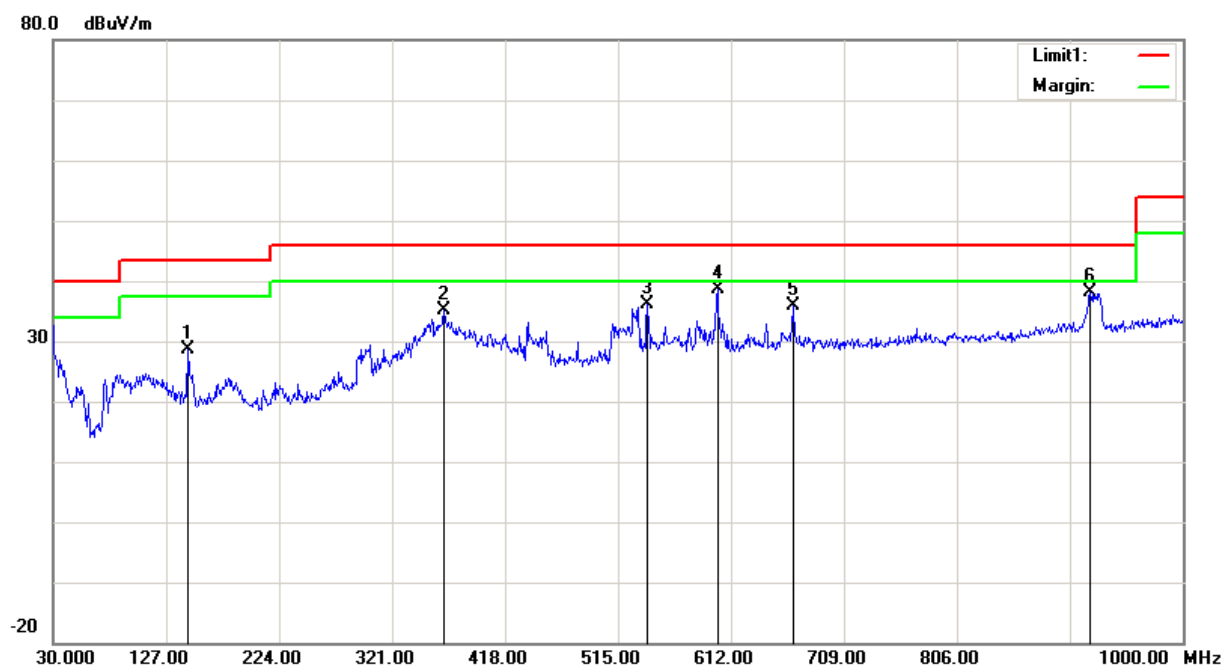
Test Mode: Transmitting

1) 30MHz-1GHz (Radio 1 8-DPSK Low channel was the worst)

Horizontal:



Frequency (MHz)	Receiver Reading (dBuV)	Remark	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.0000	25.75	peak	1.72	27.47	40.00	12.53
75.5900	35.98	peak	-11.05	24.93	40.00	15.07
145.4300	41.15	peak	-6.01	35.14	43.50	8.36
292.8700	39.05	peak	-3.97	35.08	46.00	10.92
365.6200	39.73	peak	-2.81	36.92	46.00	9.08
918.5200	37.46	peak	0.31	37.77	46.00	8.23

Vertical:

Frequency (MHz)	Receiver Reading (dB μ V)	Remark	Correction Factor (dB/m)	Cord. Amp. (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
145.4300	34.63	peak	-6.01	28.62	43.50	14.88
365.6200	37.87	peak	-2.81	35.06	46.00	10.94
540.2200	35.91	peak	0.31	36.22	46.00	9.78
600.3600	37.50	peak	1.03	38.53	46.00	7.47
665.3500	33.56	peak	2.25	35.81	46.00	10.19
920.4600	37.75	peak	0.37	38.12	46.00	7.88

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

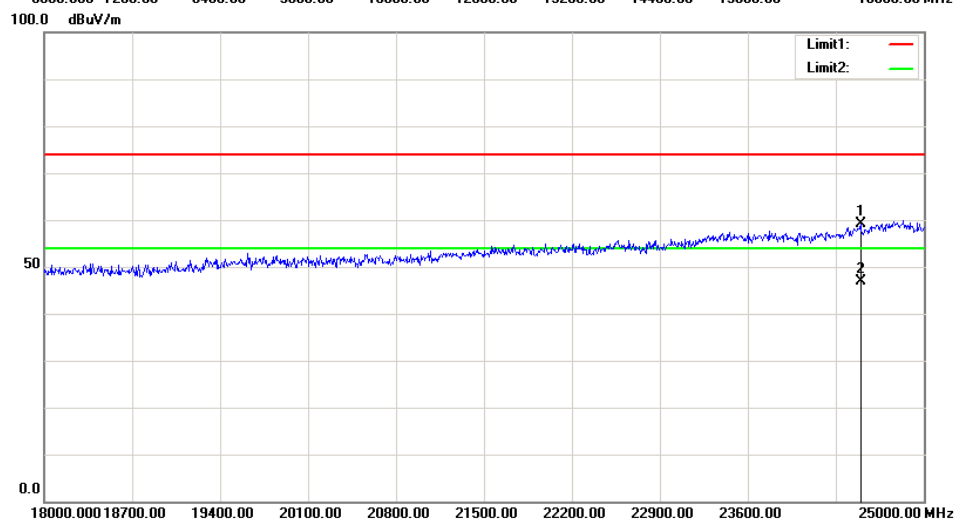
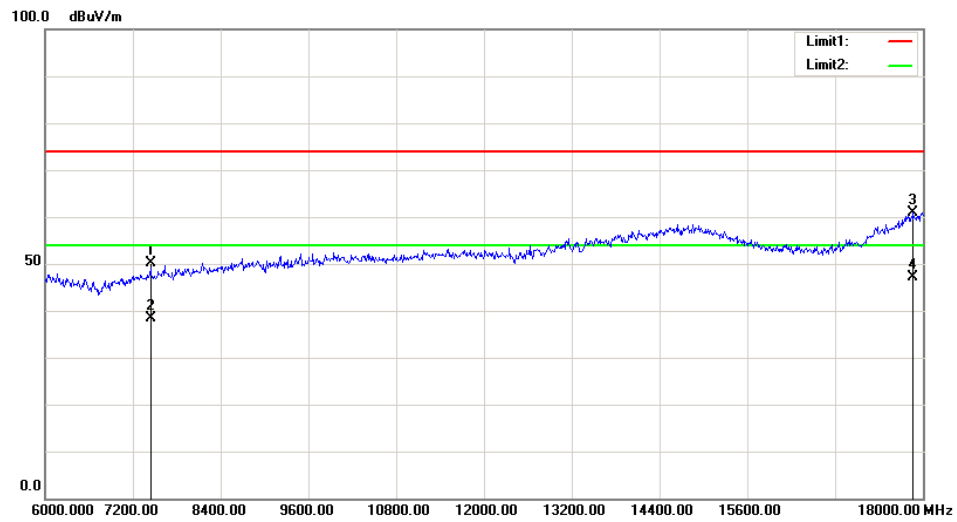
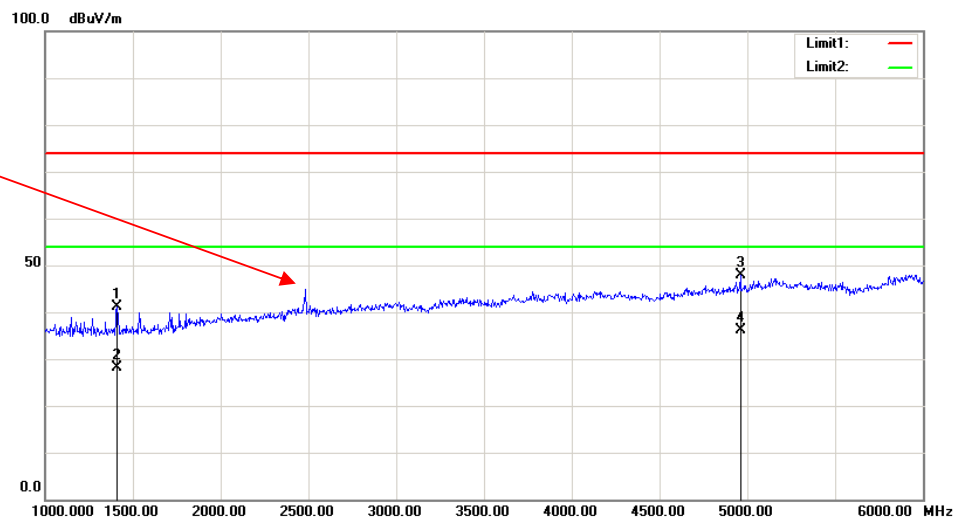
Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Remark	Polar (H/V)	Factor (dB/m)					
Low Channel: 2402 MHz									
2402.00	67.04	PK	H	28.10	1.80	0.00	96.94	N/A	N/A
2402.00	56.43	AV	H	28.10	1.80	0.00	86.33	N/A	N/A
2402.00	64.94	PK	V	28.10	1.80	0.00	94.84	N/A	N/A
2402.00	54.24	AV	V	28.10	1.80	0.00	84.14	N/A	N/A
2390.00	26.82	PK	H	28.08	1.80	0.00	56.70	74.00	17.30
2390.00	13.41	AV	H	28.08	1.80	0.00	43.29	54.00	10.71
4804.00	47.58	PK	H	32.91	3.17	37.20	46.46	74.00	27.54
4804.00	33.95	AV	H	32.91	3.17	37.20	32.83	54.00	21.17
7206.00	46.54	PK	H	35.74	4.82	37.23	49.87	74.00	24.13
7206.00	33.14	AV	H	35.74	4.82	37.23	36.47	54.00	17.53
Middle Channel: 2441 MHz									
2441.00	66.64	PK	H	28.18	1.82	0.00	96.64	N/A	N/A
2441.00	55.78	AV	H	28.18	1.82	0.00	85.78	N/A	N/A
2441.00	64.48	PK	V	28.18	1.82	0.00	94.48	N/A	N/A
2441.00	53.67	AV	V	28.18	1.82	0.00	83.67	N/A	N/A
4882.00	46.84	PK	H	33.06	3.27	37.21	45.96	74.00	28.04
4882.00	33.84	AV	H	33.06	3.27	37.21	32.96	54.00	21.04
7323.00	45.87	PK	H	36.04	4.62	37.38	49.15	74.00	24.85
7323.00	32.87	AV	H	36.04	4.62	37.38	36.15	54.00	17.85
High Channel: 2480 MHz									
2480.00	65.36	PK	H	28.26	1.84	0.00	95.46	N/A	N/A
2480.00	54.58	AV	H	28.26	1.84	0.00	84.68	N/A	N/A
2480.00	63.15	PK	V	28.26	1.84	0.00	93.25	N/A	N/A
2480.00	52.17	AV	V	28.26	1.84	0.00	82.27	N/A	N/A
2483.50	27.24	PK	H	28.27	1.84	0.00	57.35	74.00	16.65
2483.50	14.06	AV	H	28.27	1.84	0.00	44.17	54.00	9.83
4960.00	47.10	PK	H	33.22	3.23	37.25	46.30	74.00	27.70
4960.00	33.92	AV	H	33.22	3.23	37.25	33.12	54.00	20.88
7440.00	45.91	PK	H	36.34	4.41	37.52	49.14	74.00	24.86
7440.00	32.85	AV	H	36.34	4.41	37.52	36.08	54.00	17.92

Radio 2:*BDR Mode (GFSK) was the worst*

Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Remark	Polar (H/V)	Factor (dB/m)					
Low Channel: 2402 MHz									
2402.00	54.74	PK	H	28.10	1.80	0.00	84.64	N/A	N/A
2402.00	43.93	AV	H	28.10	1.80	0.00	73.83	N/A	N/A
2402.00	56.55	PK	V	28.10	1.80	0.00	86.45	N/A	N/A
2402.00	45.87	AV	V	28.10	1.80	0.00	75.77	N/A	N/A
2390.00	26.72	PK	V	28.08	1.80	0.00	56.60	74.00	17.40
2390.00	12.93	AV	V	28.08	1.80	0.00	42.81	54.00	11.19
4804.00	51.85	PK	V	32.91	3.17	37.20	50.73	74.00	23.27
4804.00	39.27	AV	V	32.91	3.17	37.20	38.15	54.00	15.85
7206.00	48.90	PK	V	35.74	4.82	37.23	52.23	74.00	21.77
7206.00	36.94	AV	V	35.74	4.82	37.23	40.27	54.00	13.73
Middle Channel: 2441 MHz									
2441.00	55.35	PK	H	28.18	1.82	0.00	85.35	N/A	N/A
2441.00	44.57	AV	H	28.18	1.82	0.00	74.57	N/A	N/A
2441.00	56.92	PK	V	28.18	1.82	0.00	86.92	N/A	N/A
2441.00	46.25	AV	V	28.18	1.82	0.00	76.25	N/A	N/A
4882.00	52.15	PK	V	33.06	3.27	37.21	51.27	74.00	22.73
4882.00	39.77	AV	V	33.06	3.27	37.21	38.89	54.00	15.11
7323.00	49.24	PK	V	36.04	4.62	37.38	52.52	74.00	21.48
7323.00	37.31	AV	V	36.04	4.62	37.38	40.59	54.00	13.41
High Channel: 2480 MHz									
2480.00	55.48	PK	H	28.26	1.84	0.00	85.58	N/A	N/A
2480.00	44.83	AV	H	28.26	1.84	0.00	74.93	N/A	N/A
2480.00	57.26	PK	V	28.26	1.84	0.00	87.36	N/A	N/A
2480.00	46.69	AV	V	28.26	1.84	0.00	76.79	N/A	N/A
2483.50	27.18	PK	V	28.27	1.84	0.00	57.29	74.00	16.71
2483.50	14.20	AV	V	28.27	1.84	0.00	44.31	54.00	9.69
4960.00	51.35	PK	V	33.22	3.23	37.25	50.55	74.00	23.45
4960.00	39.28	AV	V	33.22	3.23	37.25	38.48	54.00	15.52
7440.00	49.56	PK	V	36.34	4.41	37.52	52.79	74.00	21.21
7440.00	37.49	AV	V	36.34	4.41	37.52	40.72	54.00	13.28

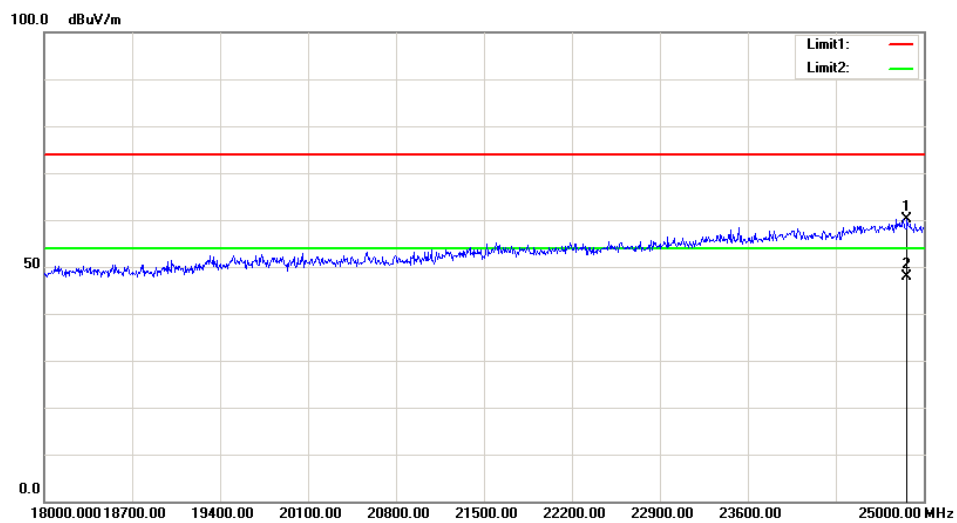
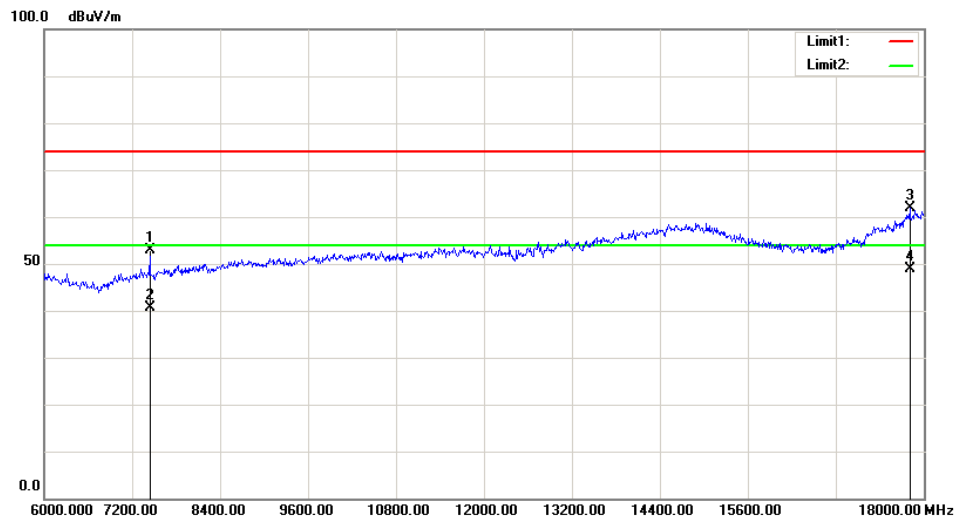
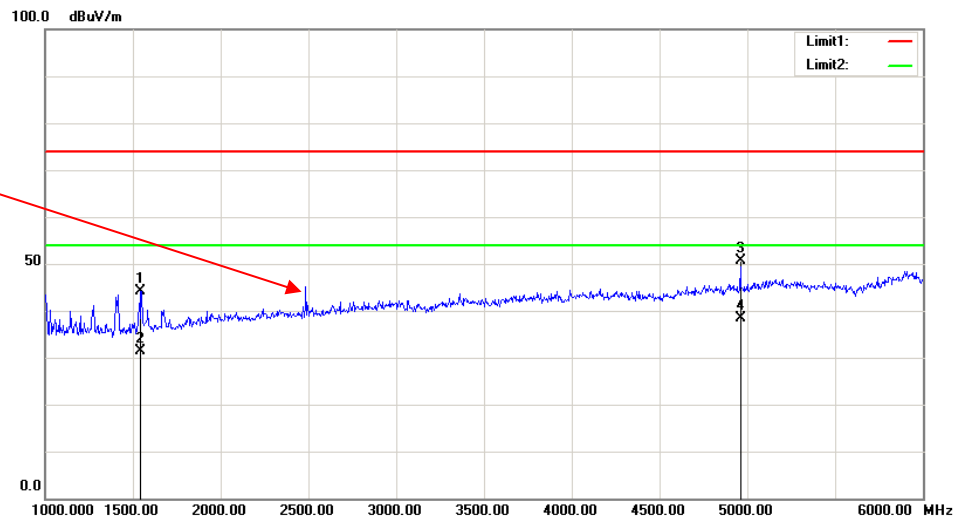
Worst plots (Radio 2, GFSK High channel was the worst)
Horizontal

Fundamental
Test with Band
Rejection Filter



Vertical

Fundamental
Test with Band
Rejection Filter



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

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2018-12-10	2019-12-10
R&S	Spectrum Analyzer	FSV40	101474	2019-01-09	2020-01-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

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

Test 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:	29.9 °C
Relative Humidity:	57 %
ATM Pressure:	100.1 kPa
Tester:	Carrie He
Test Date:	2019-07-16

Test Result: Compliance.

Please refer to following tables and plots

Test Mode: Transmitting

Radio 1:

Mode	Channel	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)
BDR (GFSK)	Low	2402	0.998	0.70
	Middle	2441	0.998	0.70
	High	2480	1.002	0.70
EDR ($\pi/4$ -DQPSK)	Low	2402	0.998	0.91
	Middle	2441	1.002	0.91
	High	2480	1.002	0.91
EDR (8-DPSK)	Low	2402	0.998	0.87
	Middle	2441	0.998	0.87
	High	2480	1.002	0.87

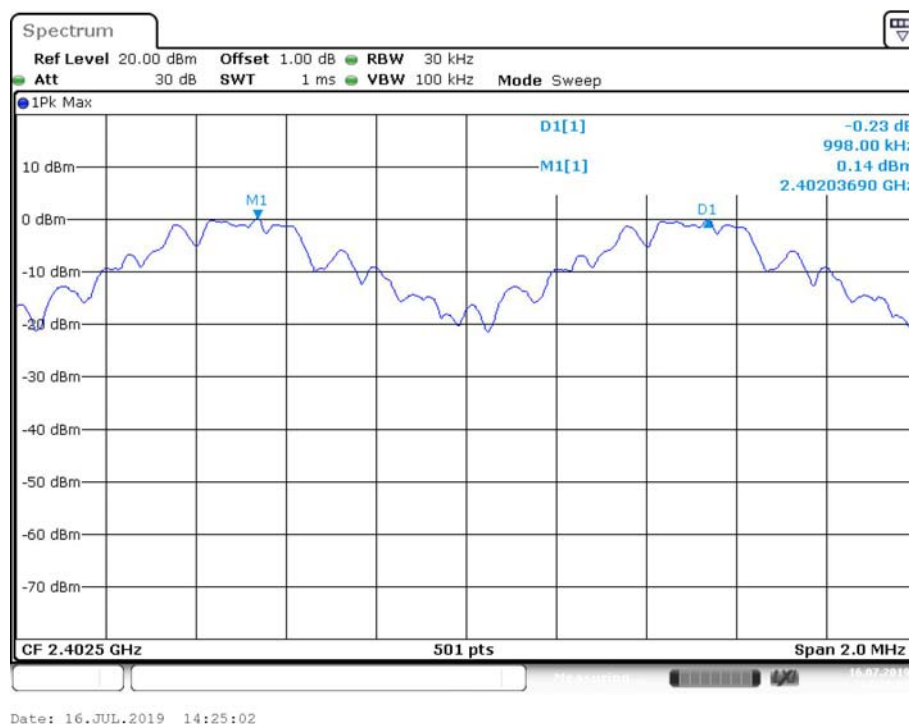
Radio 2:

Mode	Channel	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)
BDR (GFSK)	Low	2402	1.000	0.58
	Middle	2441	1.000	0.58
	High	2480	1.000	0.58
EDR ($\pi/4$ -DQPSK)	Low	2402	1.000	0.82
	Middle	2441	1.000	0.82
	High	2480	1.004	0.82

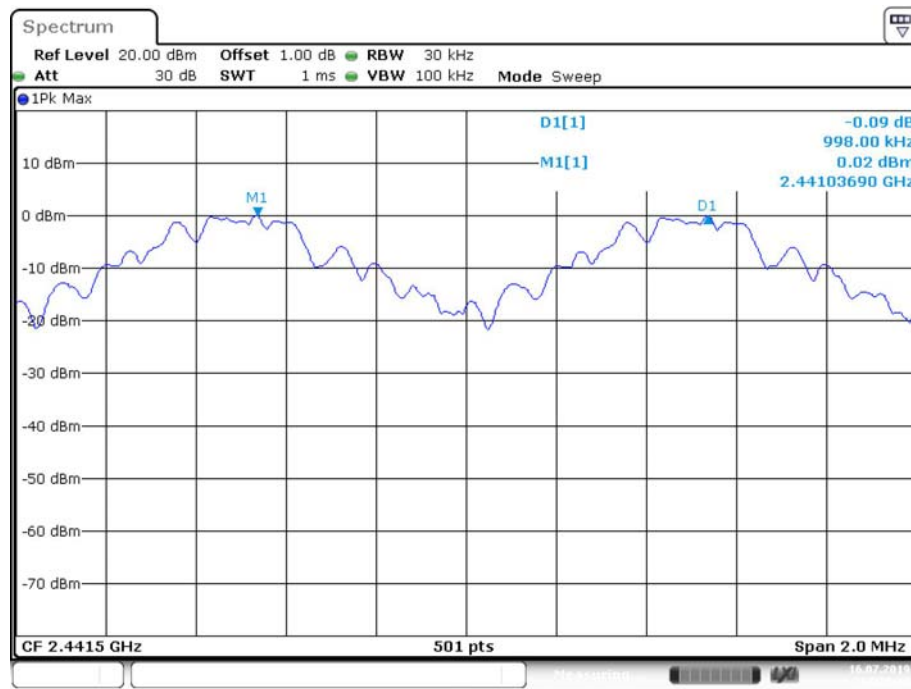
Note: Limit = $(2/3) \times 20\text{dB bandwidth}$

Radio 1:

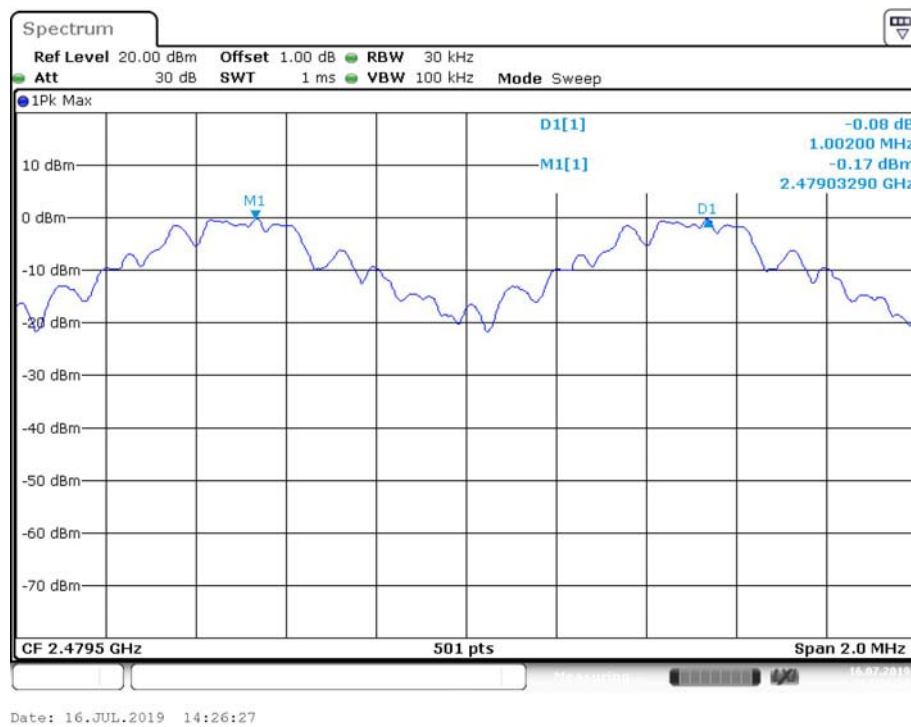
BDR Mode (GFSK):

Low Channel

Middle Channel



High Channel

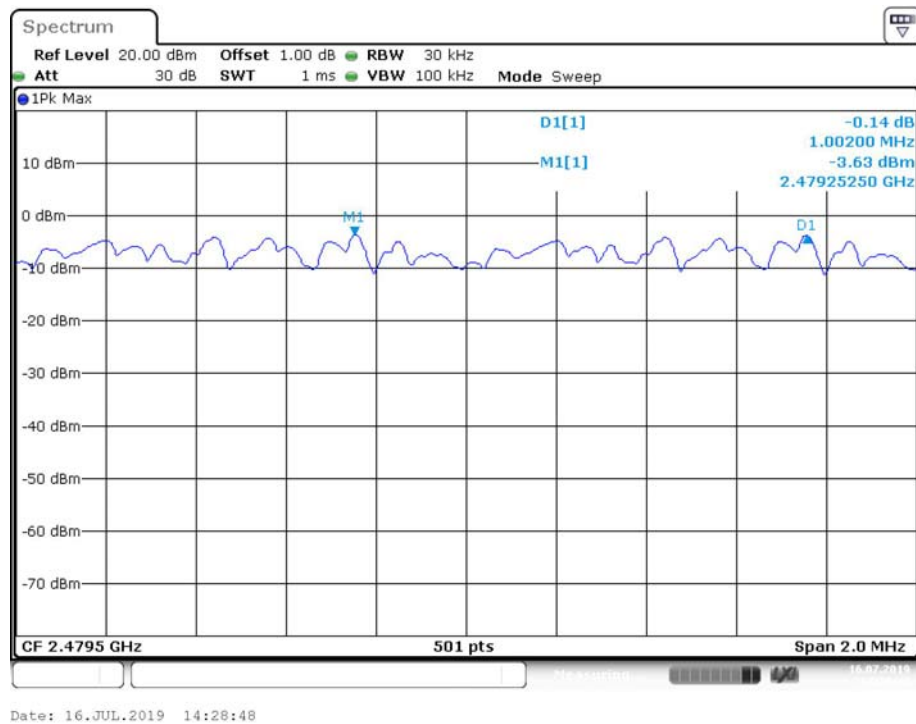


Low Channel



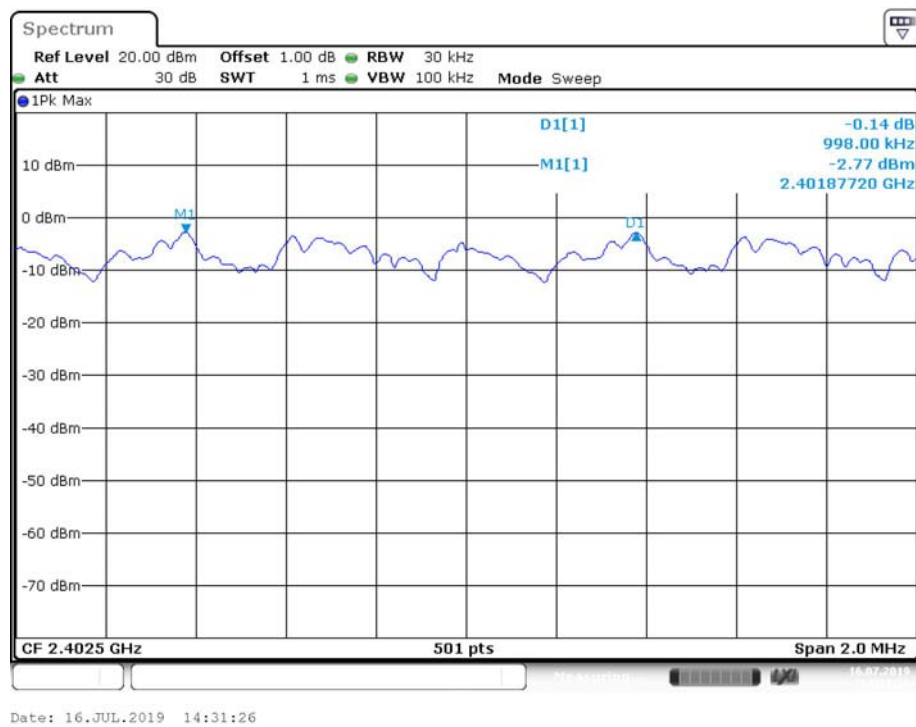
Date: 16.JUL.2019 14:28:09

High Channel

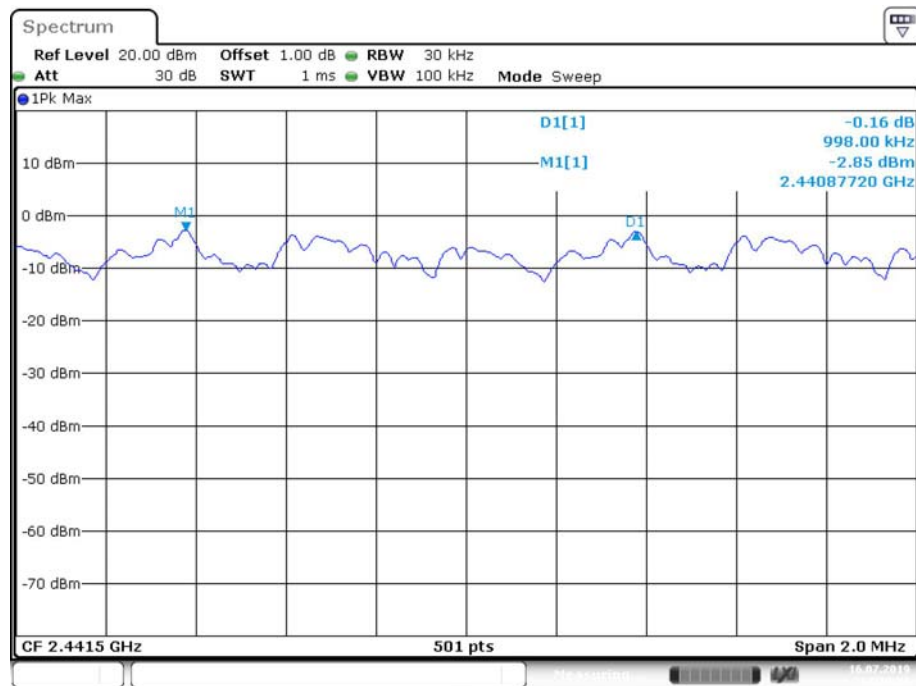


EDR(8-DPSK):

Low Channel

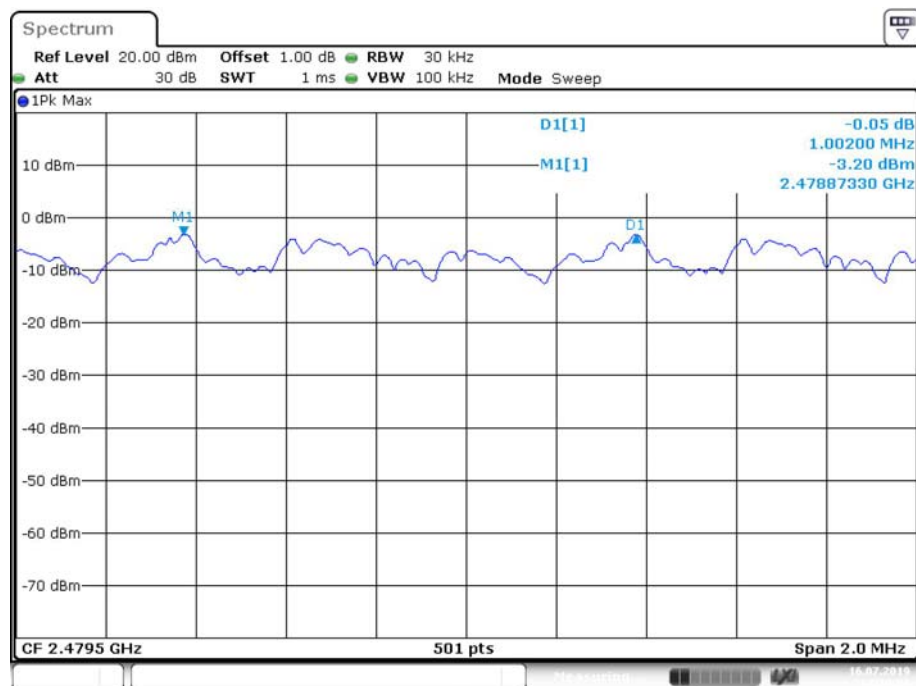


Middle_Channel



Date: 16.JUL.2019 14:30:50

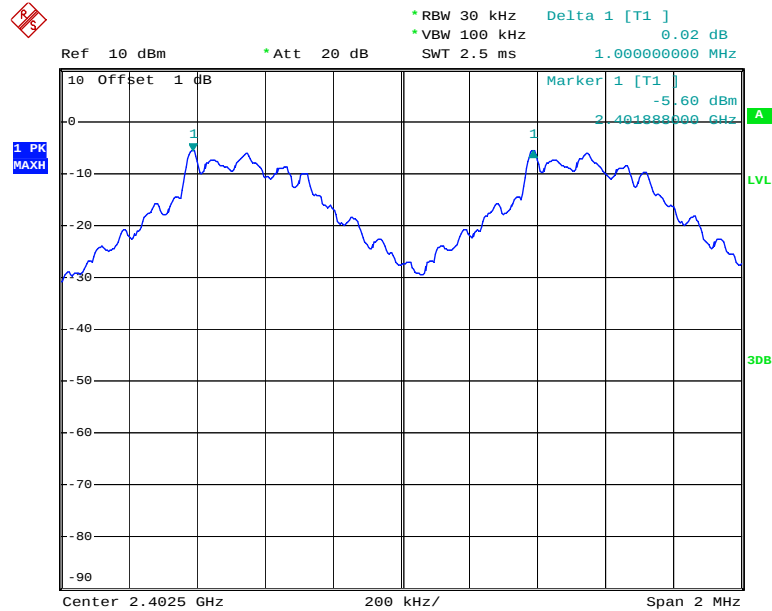
High_Channel



Date: 16.JUL.2019 14:30:00

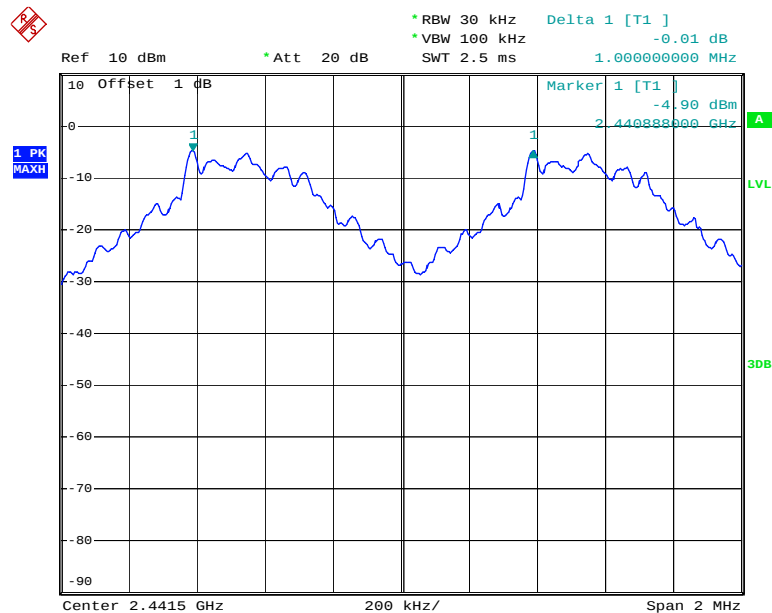
Radio 2:
BDR Mode (GFSK):

Low Channel

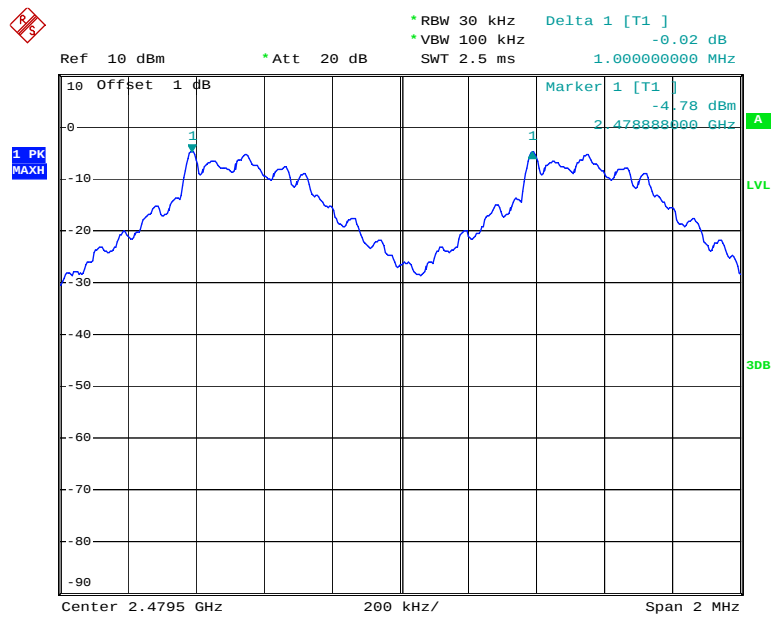


Date: 16.JUL.2019 17:11:51

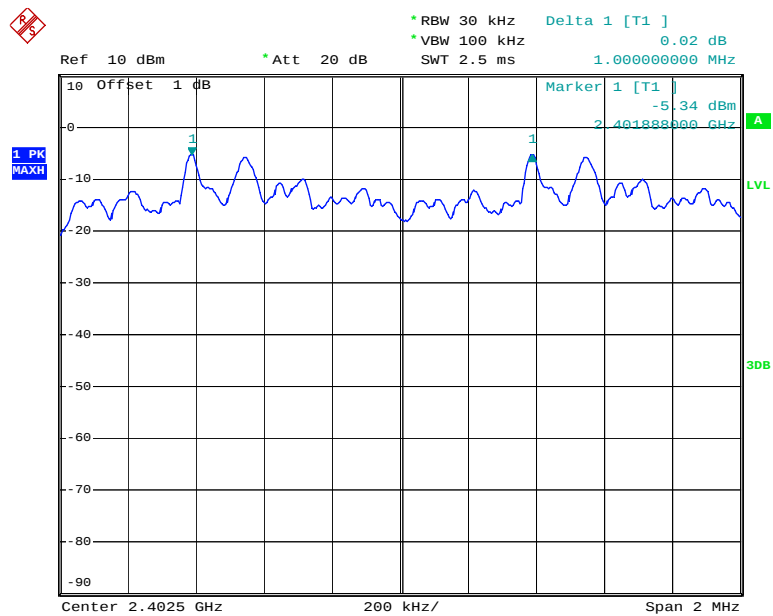
Middle Channel



Date: 16.JUL.2019 17:15:29

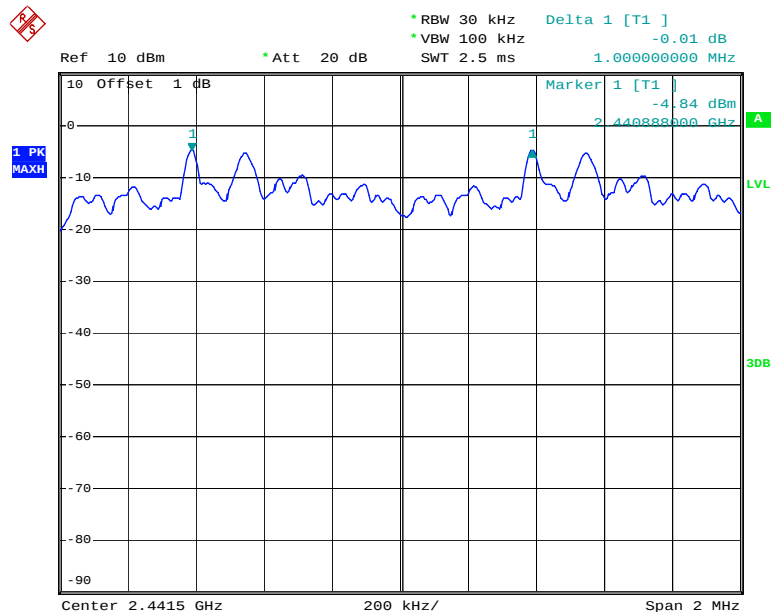
High Channel

Date: 16.JUL.2019 17:17:33

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

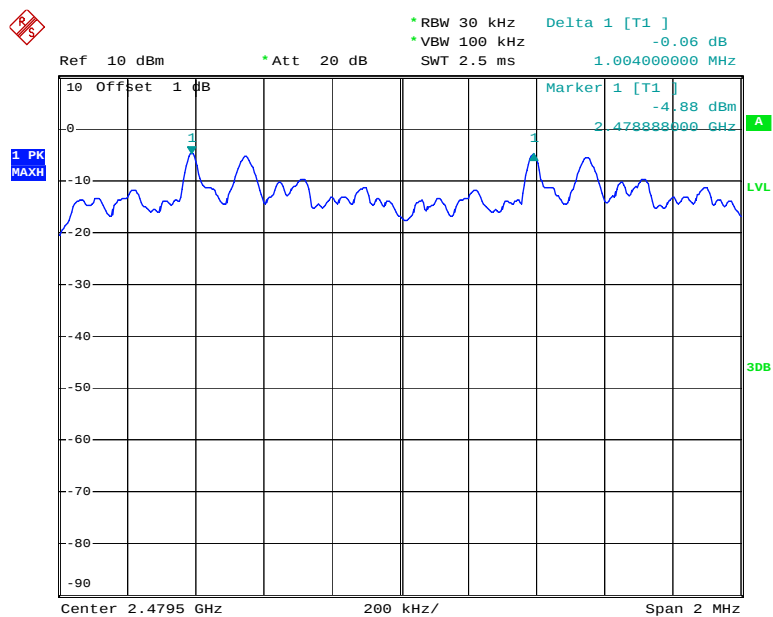
Date: 16.JUL.2019 17:25:30

Middle Channel



Date: 16.JUL.2019 17:27:09

High Channel



Date: 16.JUL.2019 17:30:15

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	2018-12-10	2019-12-10
R&S	Spectrum Analyzer	FSV40	101474	2019-01-09	2020-01-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

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

Test Data

Environmental Conditions

Temperature:	29.9 °C
Relative Humidity:	57 %
ATM Pressure:	100.1 kPa
Tester:	Carrie He
Test Date:	2019-07-16

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

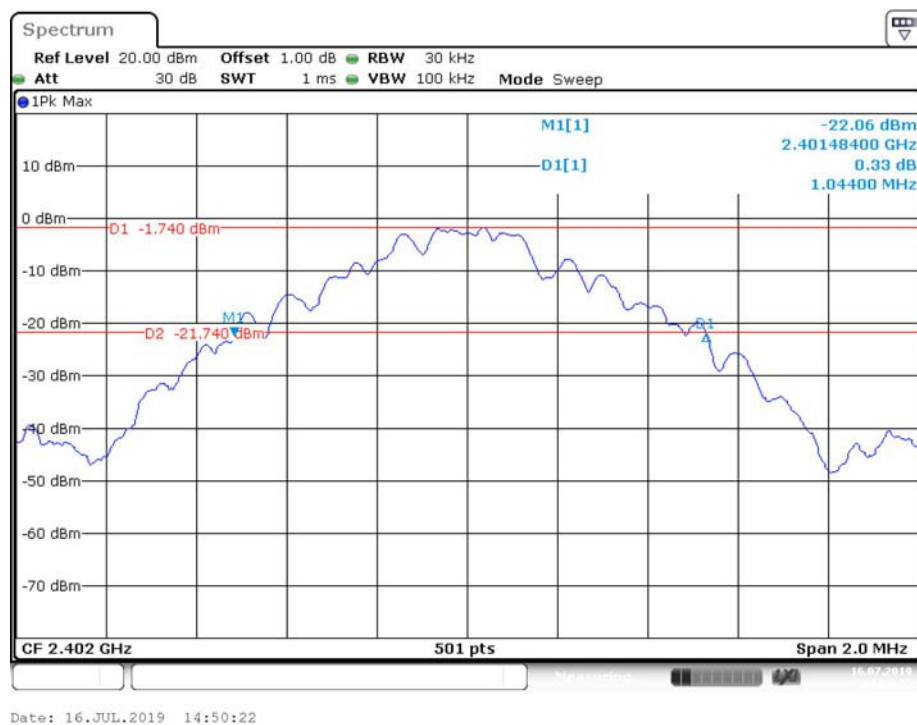
Test Mode: Transmitting

Radio 1:

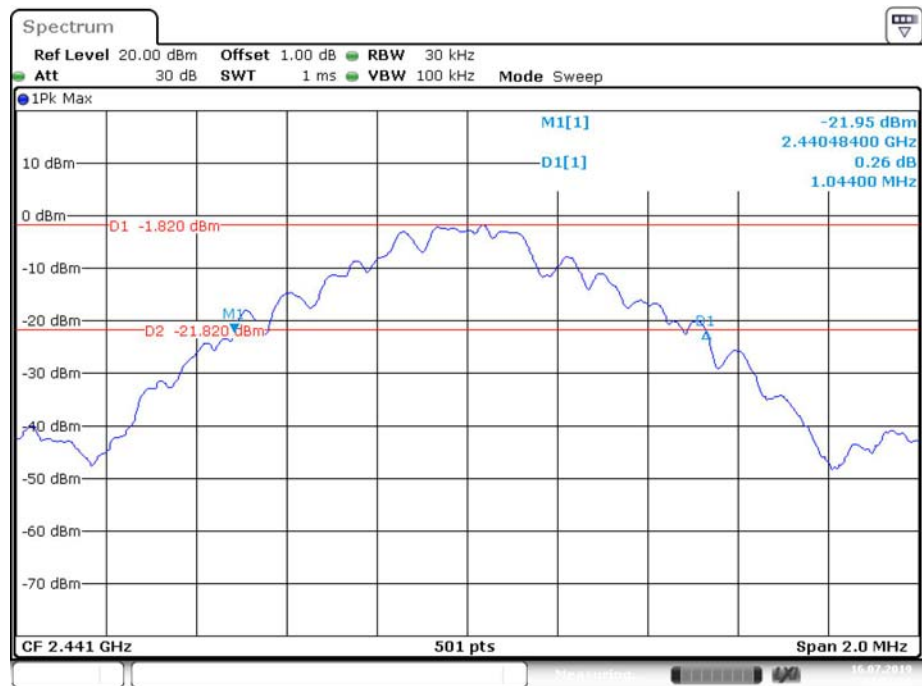
Mode	Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
BDR (GFSK)	Low	2402	1.044
	Middle	2441	1.044
	High	2480	1.044
EDR ($\pi/4$ -DQPSK)	Low	2402	1.360
	Middle	2441	1.360
	High	2480	1.364
EDR (8-DPSK)	Low	2402	1.304
	Middle	2441	1.304
	High	2480	1.304

Radio 2:

Mode	Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
BDR (GFSK)	Low	2402	0.864
	Middle	2441	0.876
	High	2480	0.876
EDR ($\pi/4$ -DQPSK)	Low	2402	1.232
	Middle	2441	1.232
	High	2480	1.232

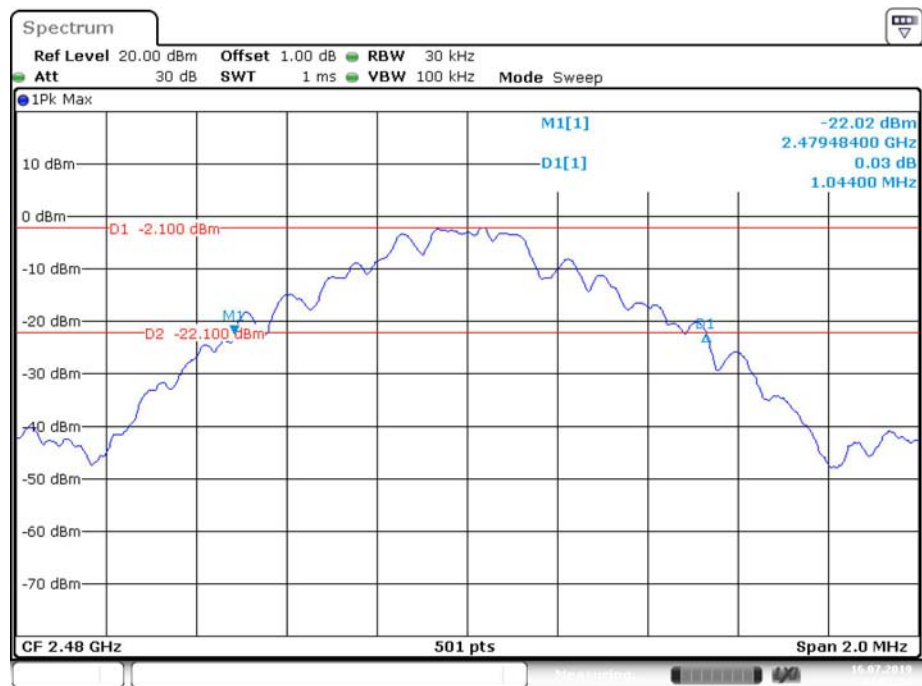
Radio 1:*BDR Mode (GFSK):***Low Channel**

Middle Channel



Date: 16.JUL.2019 14:51:08

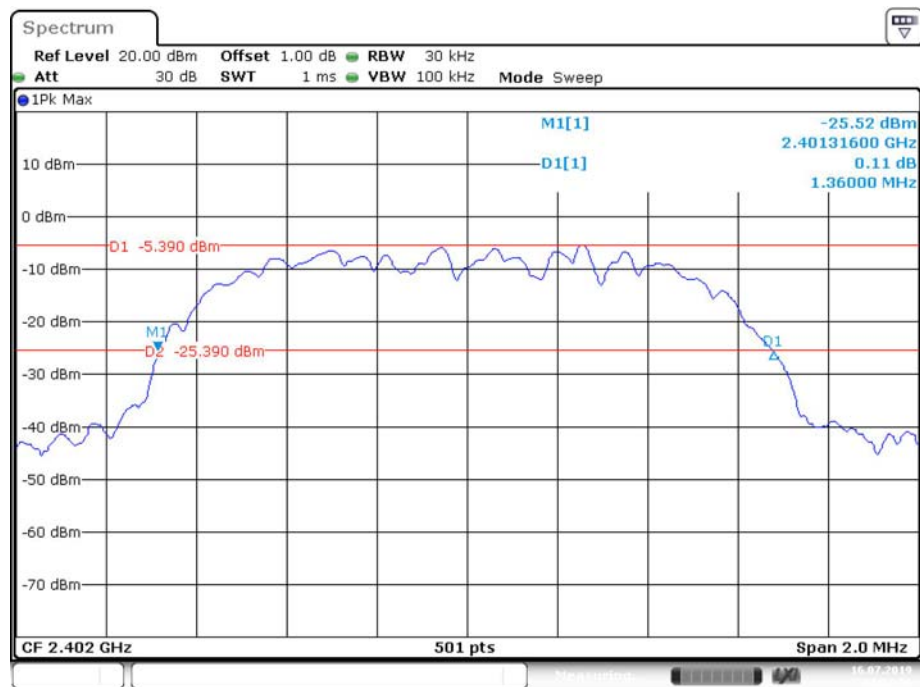
High Channel



Date: 16.JUL.2019 14:51:55

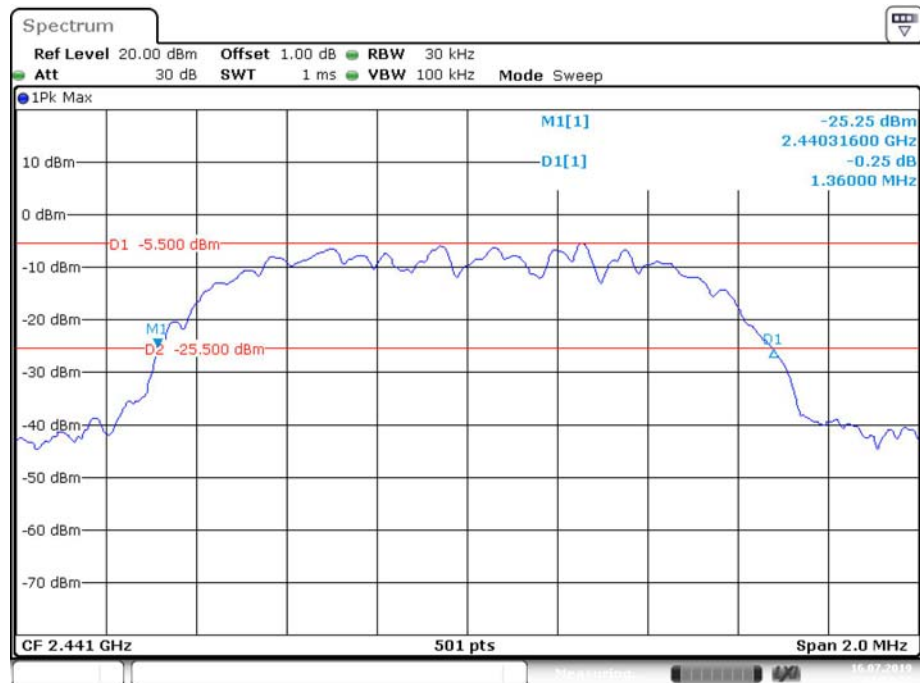
EDR Mode ($\pi/4$ -DQPSK):

Low Channel

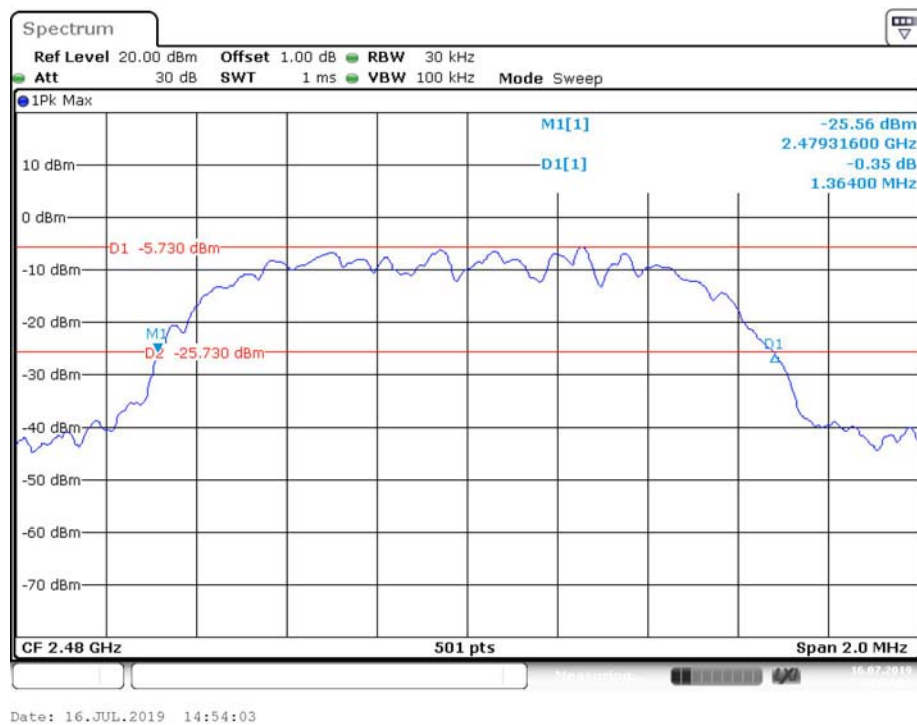
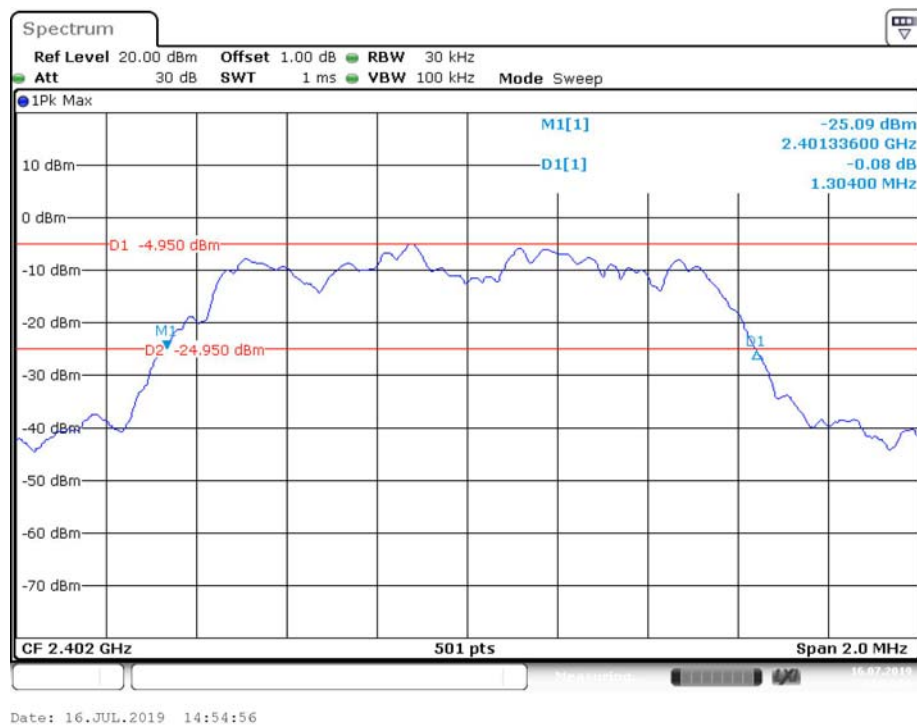


Date: 16.JUL.2019 14:52:36

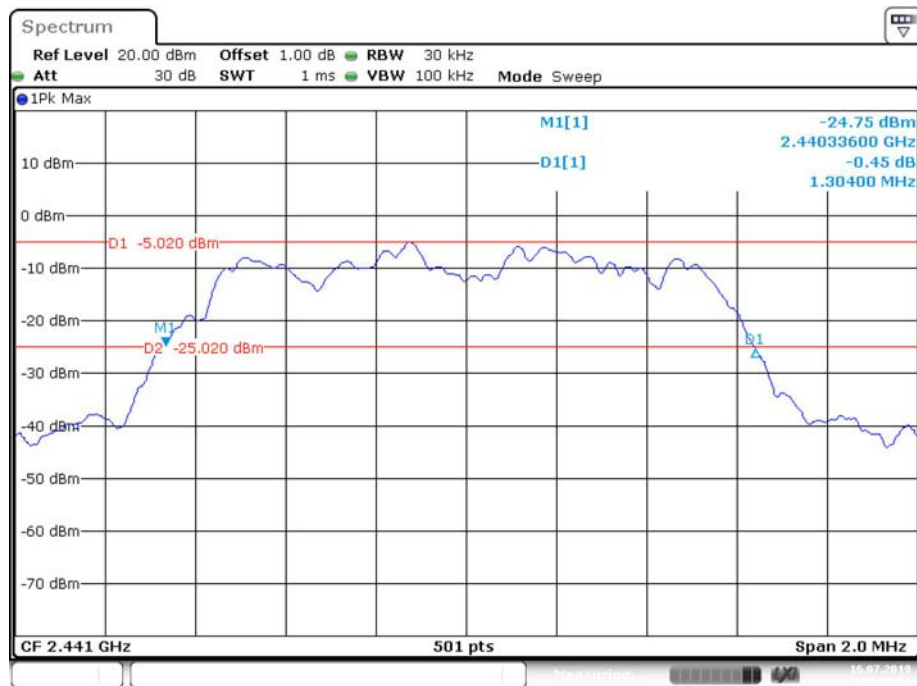
Middle Channel



Date: 16.JUL.2019 14:53:21

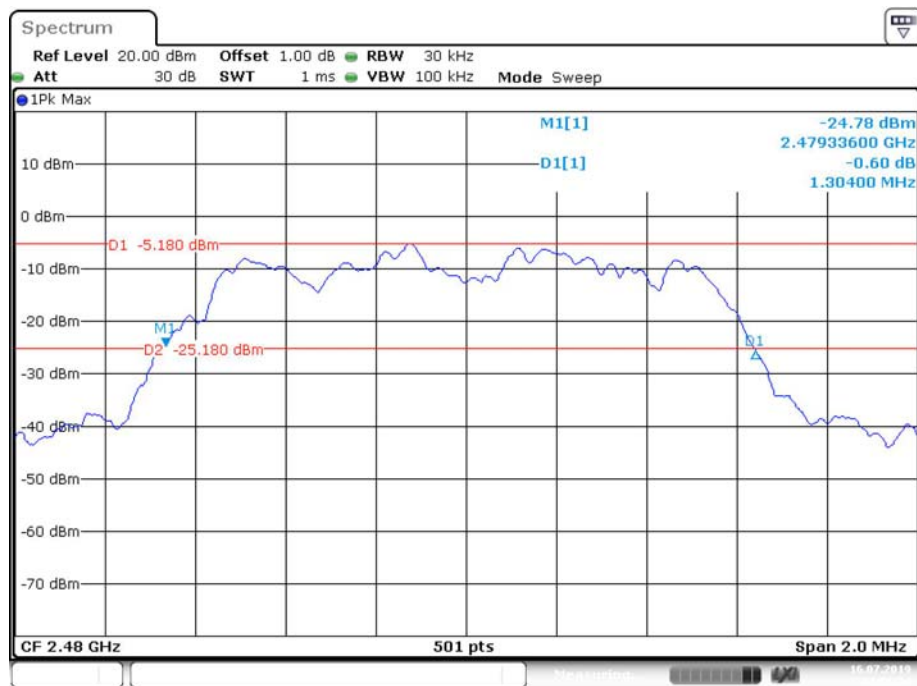
High Channel*EDR Mode (8DPSK):***Low Channel**

Middle Channel

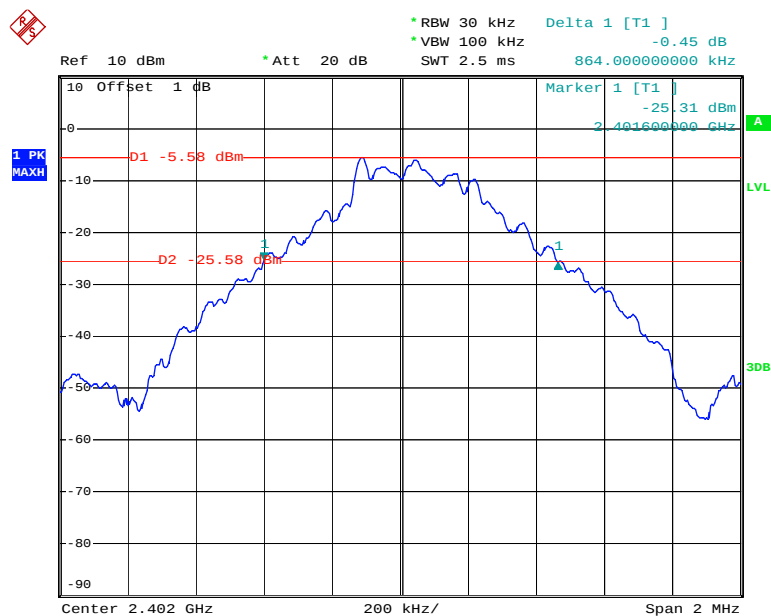


Date: 16.JUL.2019 14:55:39

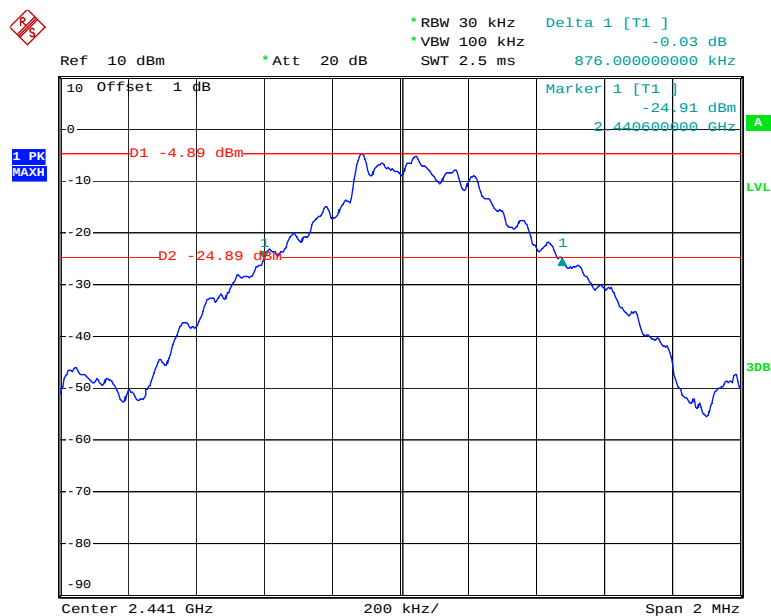
High Channel



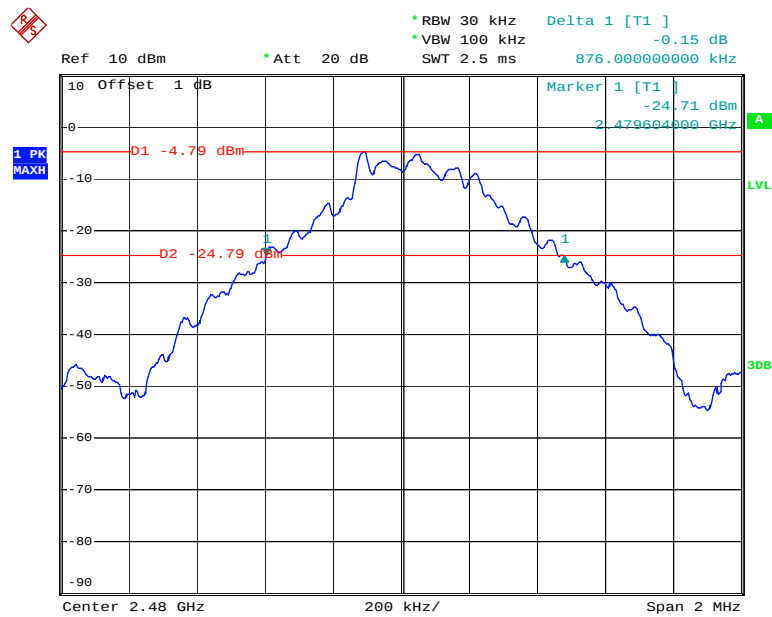
Date: 16.JUL.2019 14:56:24

Radio 2:
*BDR Mode (GFSK):***Low Channel**

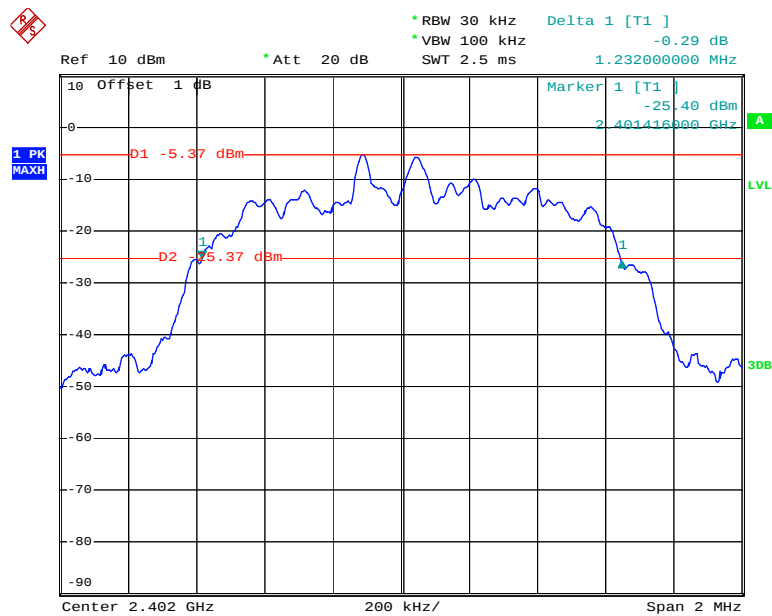
Date: 16.JUL.2019 17:10:14

Middle Channel

Date: 16.JUL.2019 17:13:57

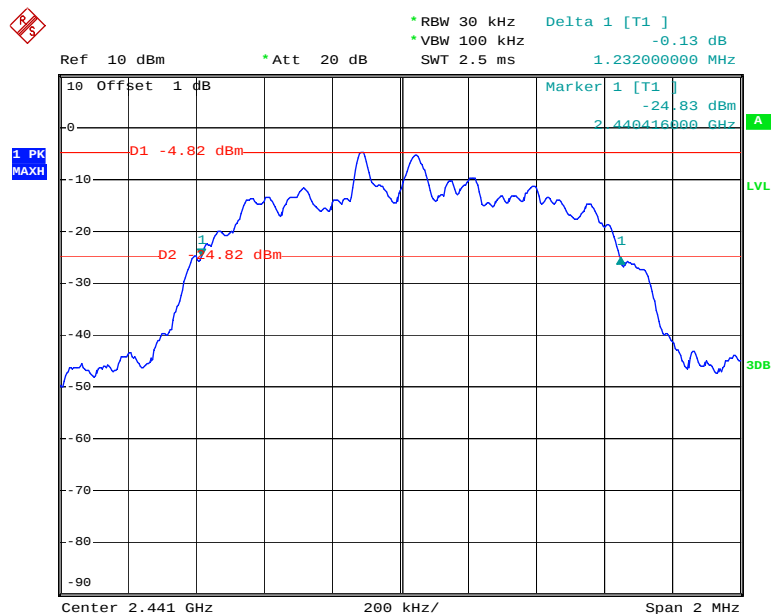
High Channel

Date: 16.JUL.2019 17:16:11

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

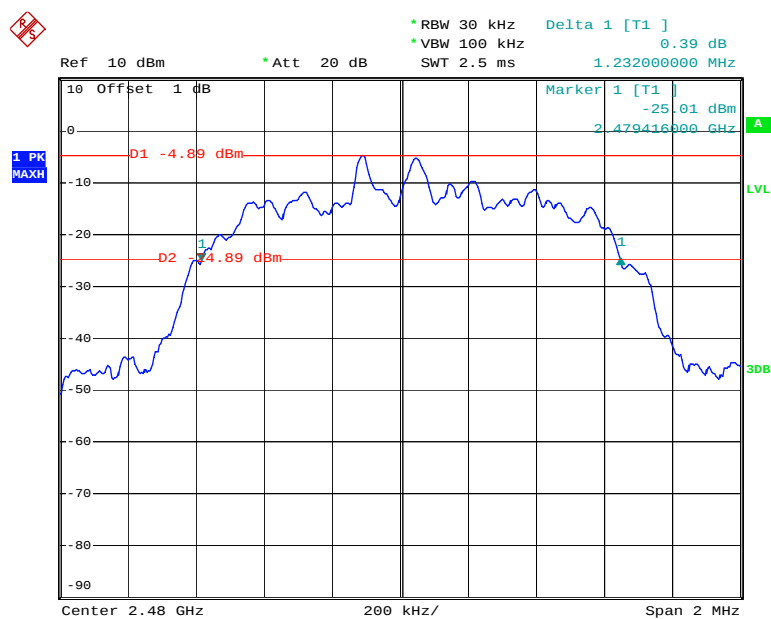
Date: 16.JUL.2019 17:23:51

Middle Channel



Date: 16.JUL.2019 17:26:04

High Channel



Date: 16.JUL.2019 17:27:47

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	2018-12-10	2019-12-10
R&S	Spectrum Analyzer	FSV40	101474	2019-01-09	2020-01-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

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

Test Data

Environmental Conditions

Temperature:	29.9 °C
Relative Humidity:	57 %
ATM Pressure:	100.1 kPa
Tester:	Carrie He
Test Date:	2019-07-16

Test Result: Compliance.

Please refer to following tables and plots

Test Mode: Transmitting

Radio 1:

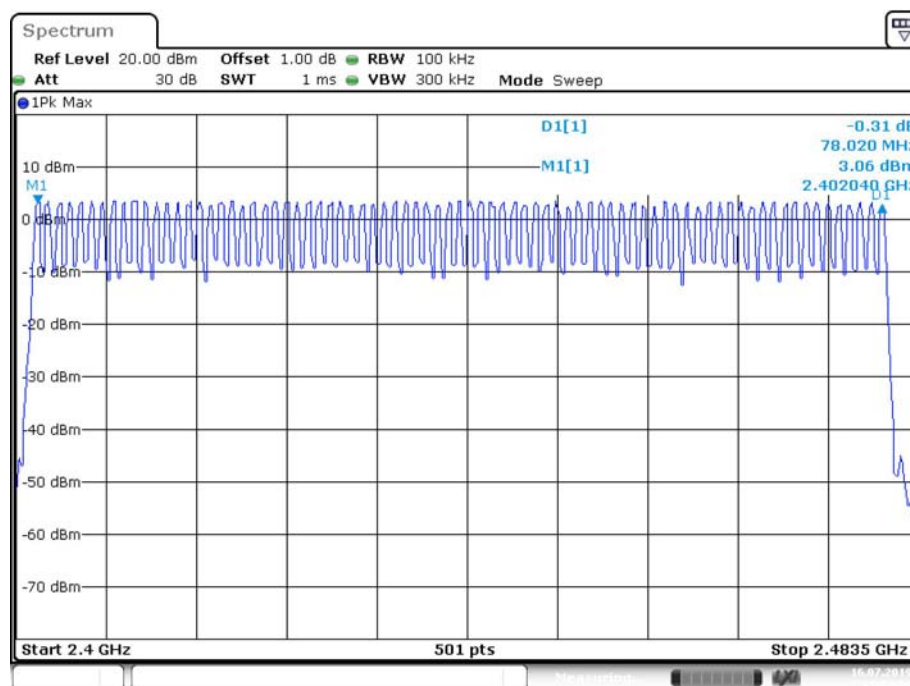
Test mode	Frequency Range (MHz)	Number of Hopping Channel	Limit
GFSK	2400-2483.5	79	≥15
$\pi/4$ -DQPSK	2400-2483.5	79	≥15
8-DPSK	2400-2483.5	79	≥15

Radio 2:

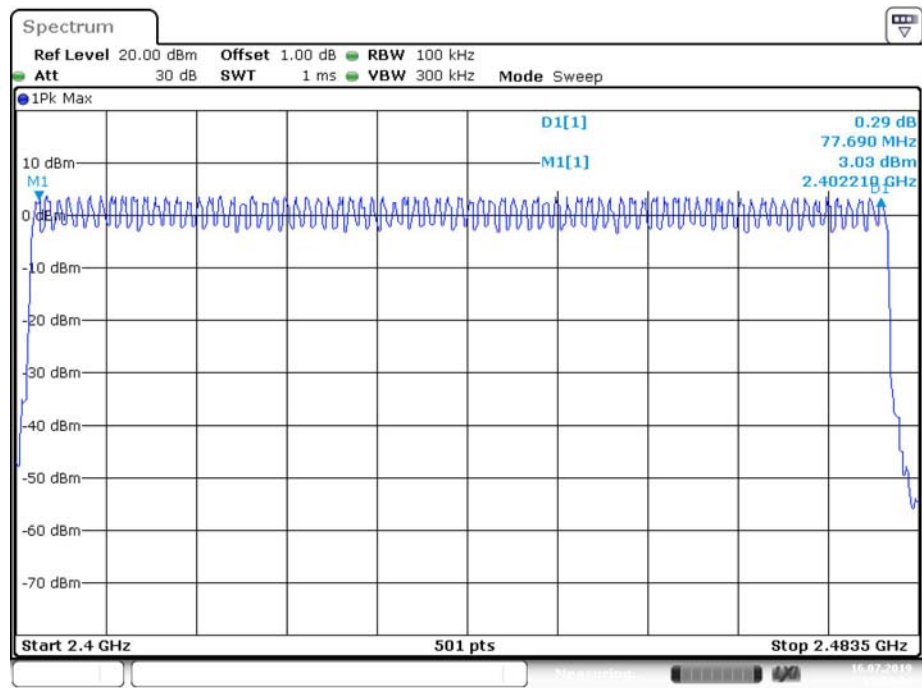
Test mode	Frequency Range (MHz)	Number of Hopping Channel	Limit
GFSK	2400-2483.5	79	≥15
$\pi/4$ -DQPSK	2400-2483.5	79	≥15

Radio 1:

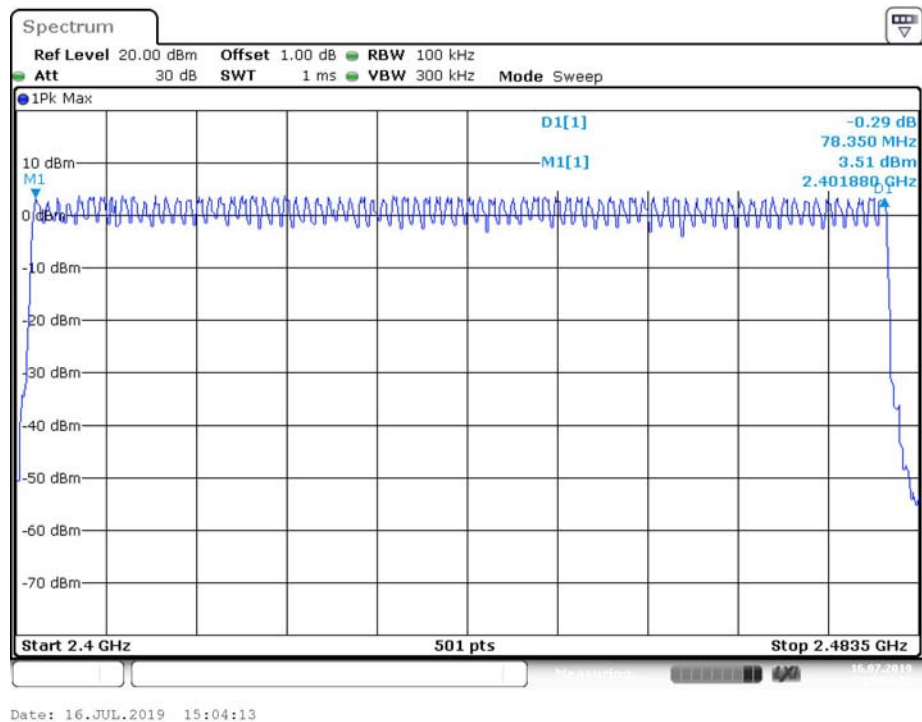
GFSK



Date: 16.JUL.2019 15:03:01

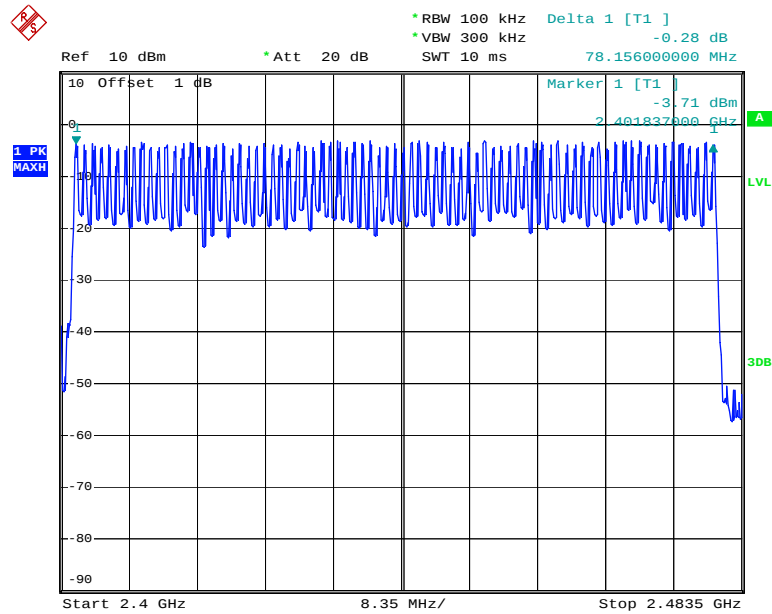
$\pi/4$ -DQPSK

8-DPSK

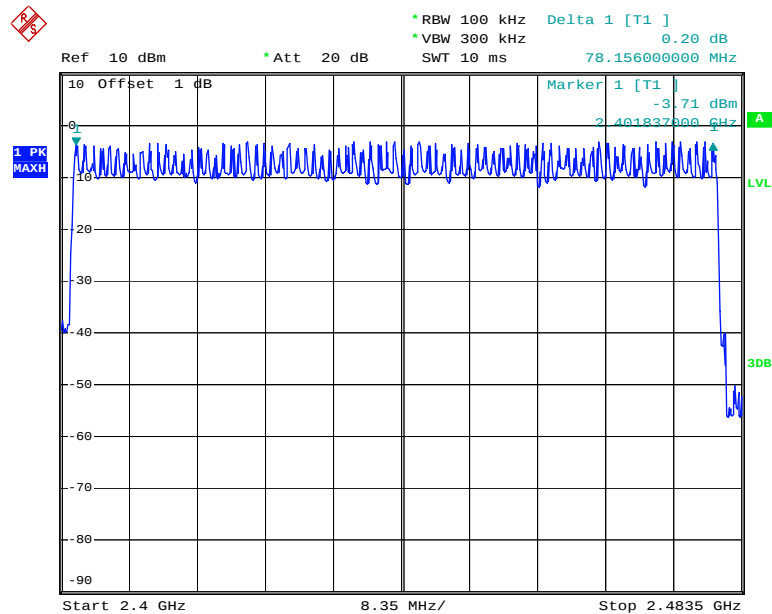


Radio 2:

GFSK



Date: 16.JUL.2019 17:41:17

 $\pi/4$ -DQPSK

Date: 16.JUL.2019 17:37:55

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	2018-12-10	2019-12-10
R&S	Spectrum Analyzer	FSV40	101474	2019-01-09	2020-01-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

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

Test Data**Environmental Conditions**

Temperature:	29.9 °C
Relative Humidity:	57 %
ATM Pressure:	100.1 kPa
Tester:	Carrie He
Test Date:	2019-07-16

Test Result: Compliance.

Please refer to following tables and plots

Test Mode: Transmitting

Radio 1:

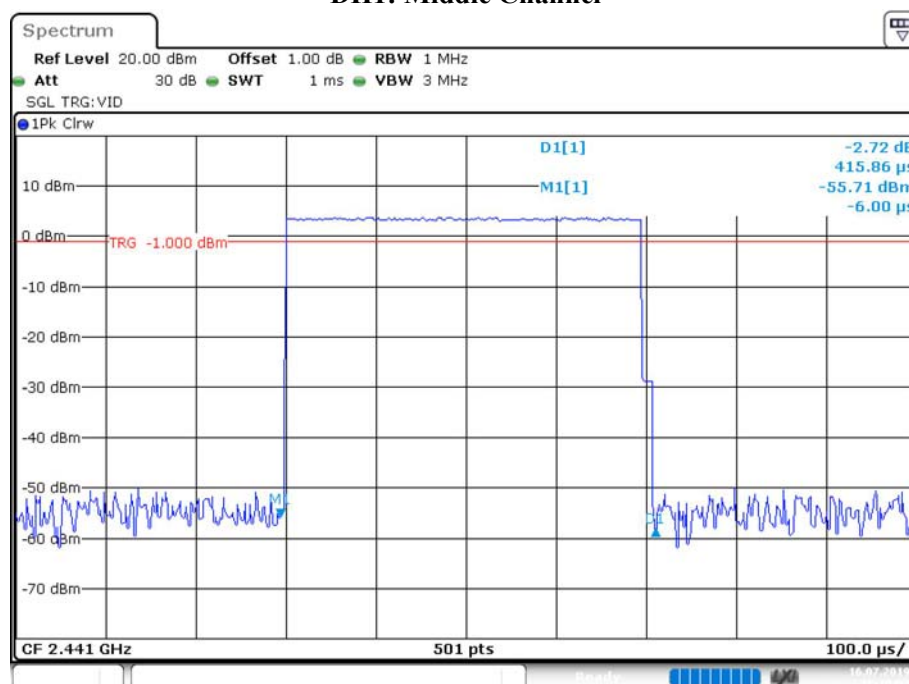
Mode	Packet type	Channel	Frequency (MHz)	Puse width (ms)	Result (s)	Limit (s)
GFSK	DH1	Middle	2441	0.416	0.133	0.4
	DH3	Middle	2441	1.680	0.269	
	DH5	Middle	2441	2.955	0.315	
$\pi/4$ -DQPSK	2DH1	Middle	2441	0.423	0.135	
	2DH3	Middle	2441	1.700	0.272	
	2DH5	Middle	2441	2.935	0.313	
8-DPSK	3DH1	Middle	2441	0.424	0.136	
	3DH3	Middle	2441	1.691	0.271	
	3DH5	Middle	2441	2.979	0.318	
Note: DH1:Dwell time=Pulse time (ms) $\times$ (1600/2/79) $\times$ 31.6 s DH3:Dwell time=Pulse time (ms) $\times$ (1600/4/79) $\times$ 31.6 s DH5:Dwell time=Pulse time (ms) $\times$ (1600/6/79) $\times$ 31.6 s						

Radio 2:

Mode	Packet type	Channel	Frequency (MHz)	Puse width (ms)	Result (s)	Limit (s)
GFSK	DH1	Middle	2441	0.388	0.124	0.4
	DH3	Middle	2441	1.662	0.266	
	DH5	Middle	2441	2.910	0.310	
$\pi/4$ DQPSK	2DH1	Middle	2441	0.398	0.127	
	2DH3	Middle	2441	1.662	0.266	
	2DH5	Middle	2441	2.920	0.311	
Note: DH1:Dwell time=Pulse time (ms) $\times$ (1600/2/79) $\times$ 31.6 s DH3:Dwell time=Pulse time (ms) $\times$ (1600/4/79) $\times$ 31.6 s DH5:Dwell time=Pulse time (ms) $\times$ (1600/6/79) $\times$ 31.6 s						

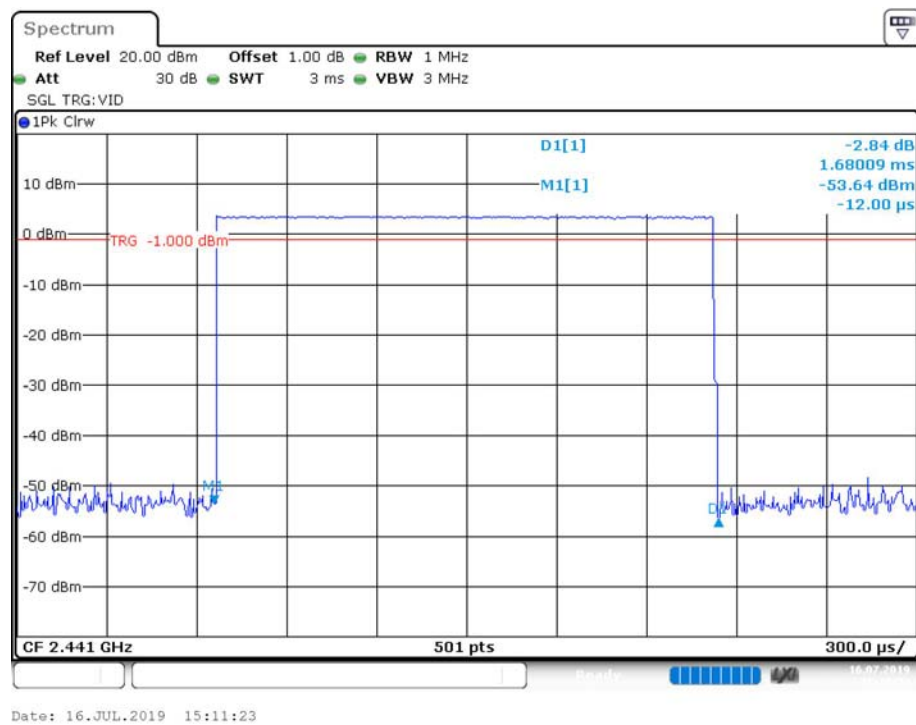
BDR Mode (GFSK):

DH1: Middle Channel

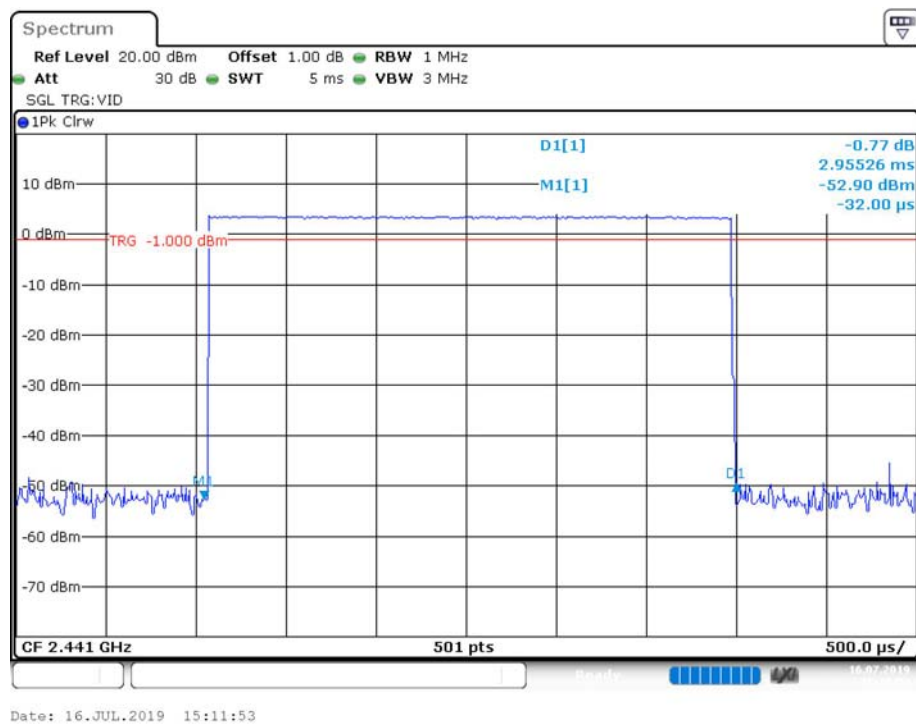


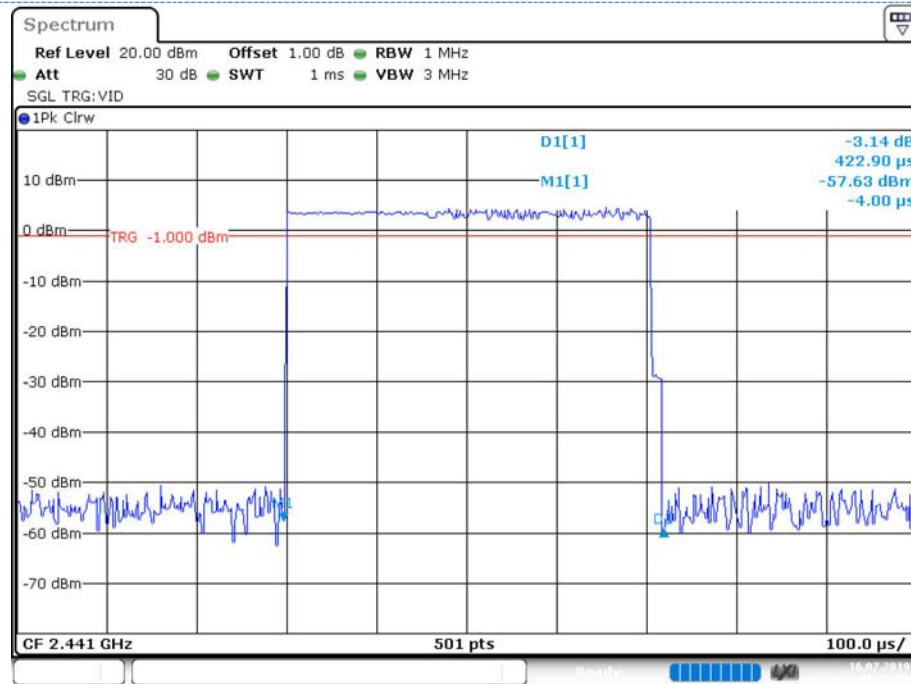
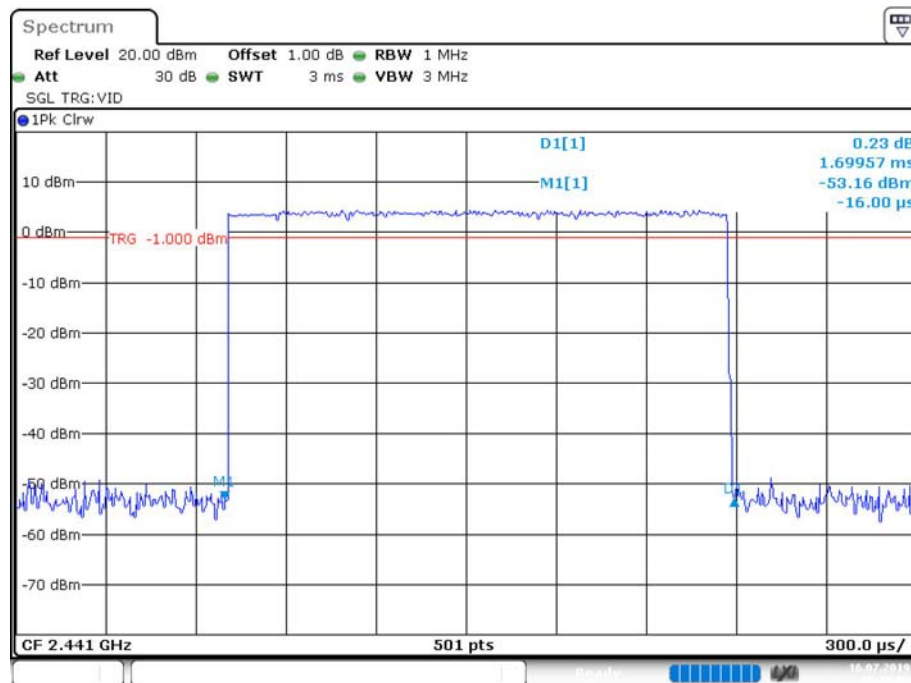
Date: 16.JUL.2019 15:10:34

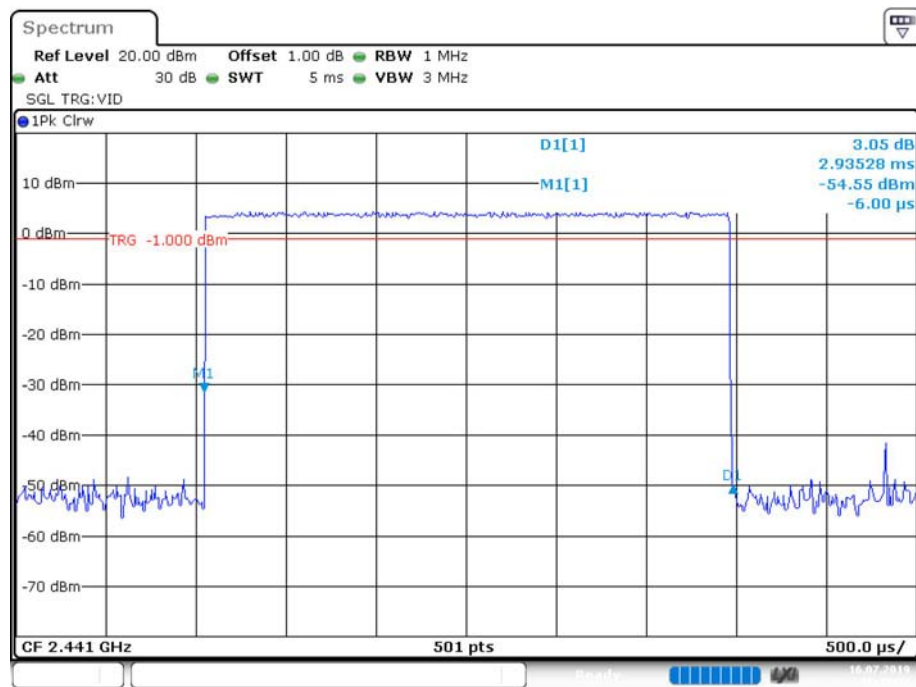
DH3: Middle Channel



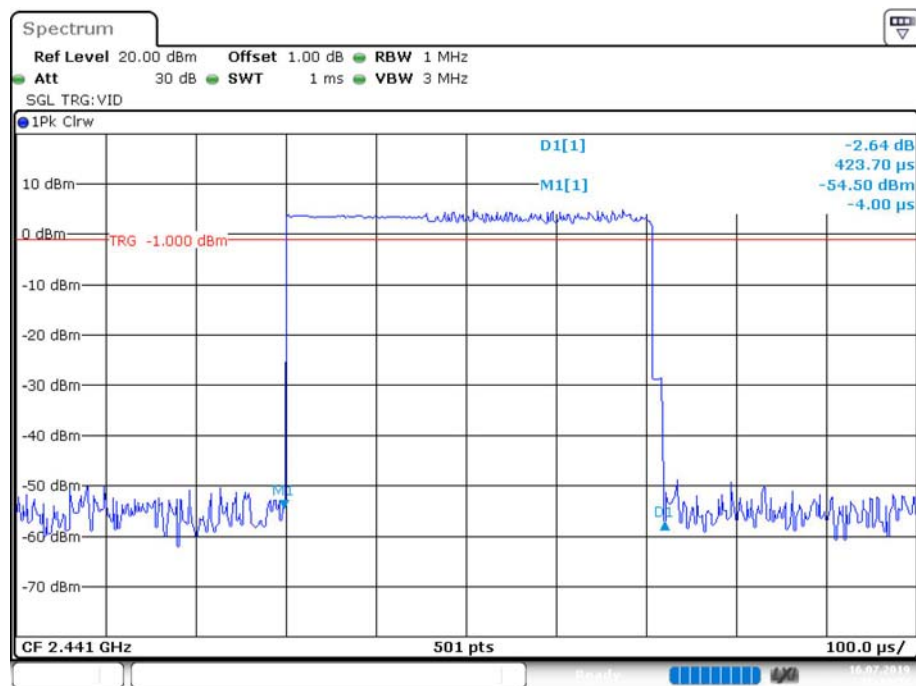
DH5: Middle Channel



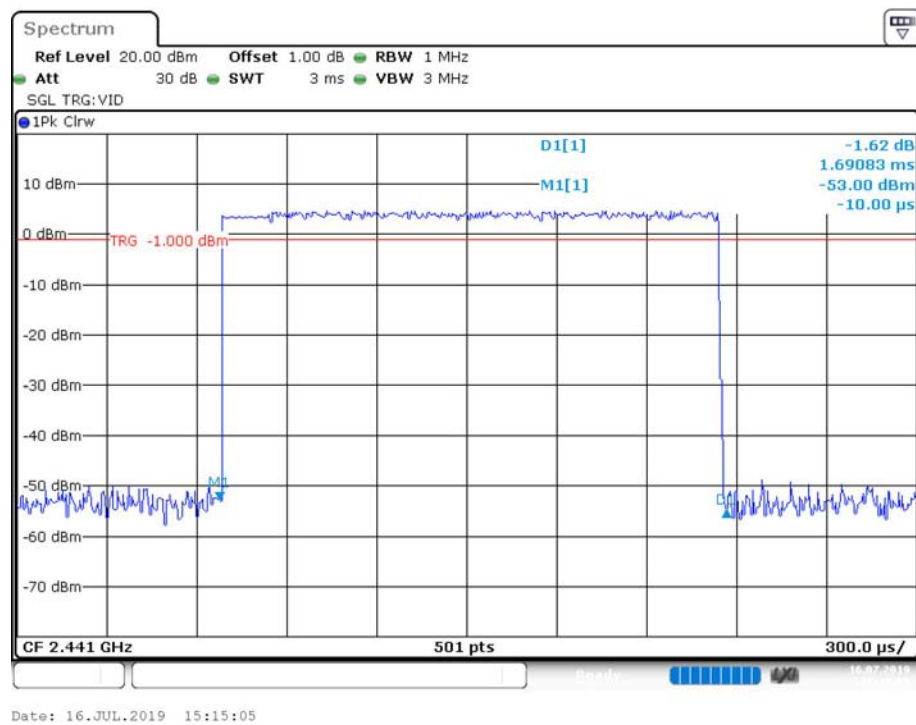
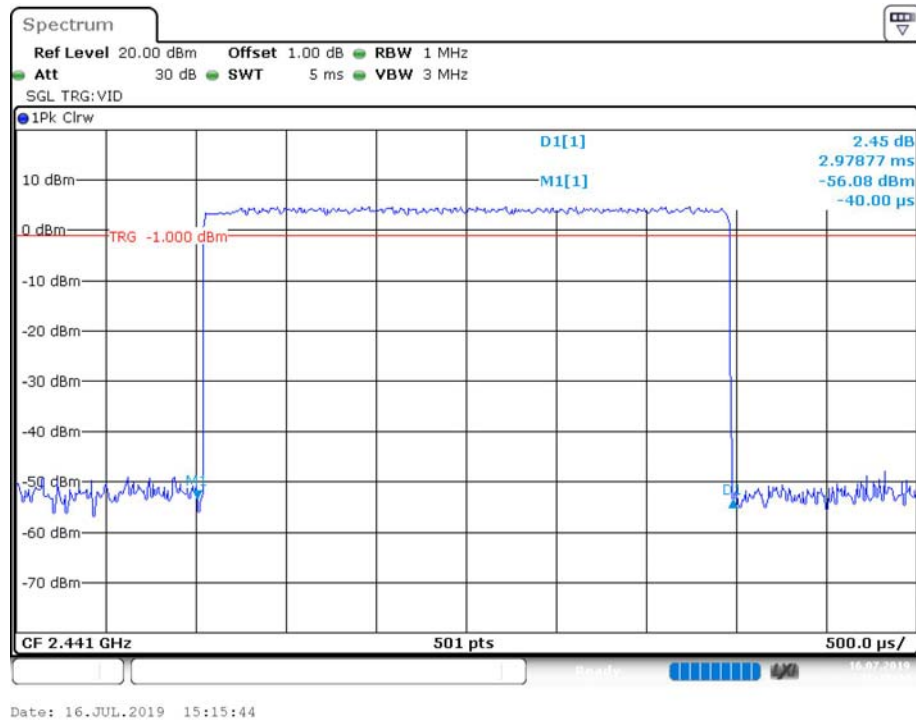
EDR Mode ($\pi/4$ -DQPSK):**2DH1: Middle Channel****2DH3: Middle Channel**

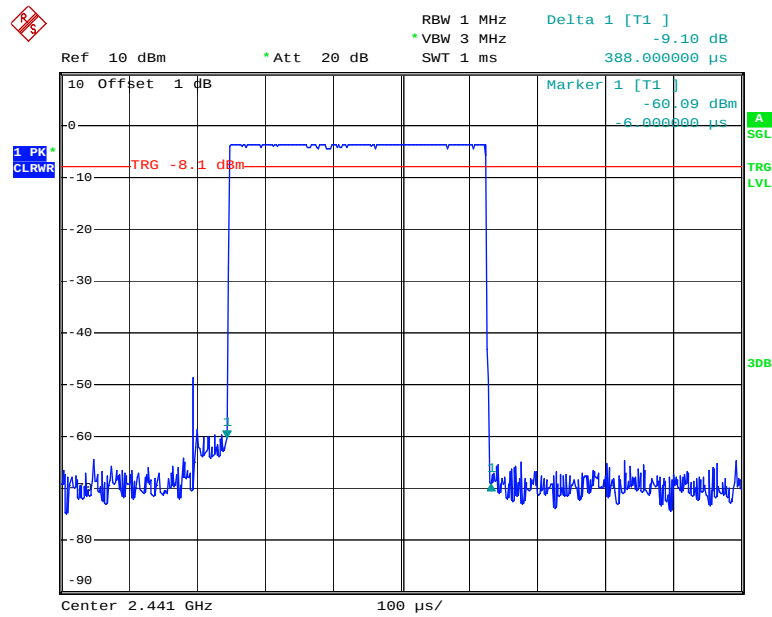
2DH5: Middle Channel

Date: 16.JUL.2019 15:13:38

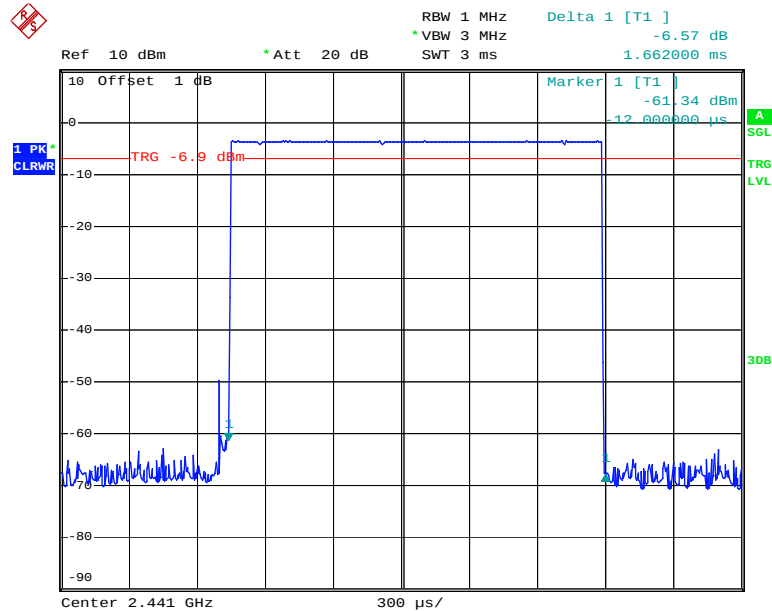
*EDR Mode (8-DPSK):***3DH1: Middle Channel**

Date: 16.JUL.2019 15:14:28

3DH3: Middle Channel**3DH5: Middle Channel**

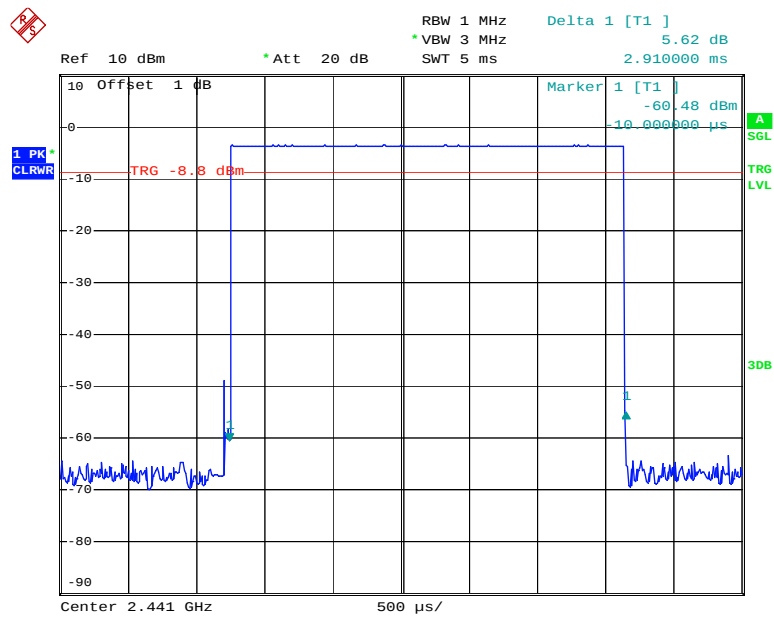
Radio 2: BDR Mode (GFSK):**DH1: Middle Channel**

Date: 16.JUL.2019 17:41:48

DH3: Middle Channel

Date: 16.JUL.2019 17:42:14

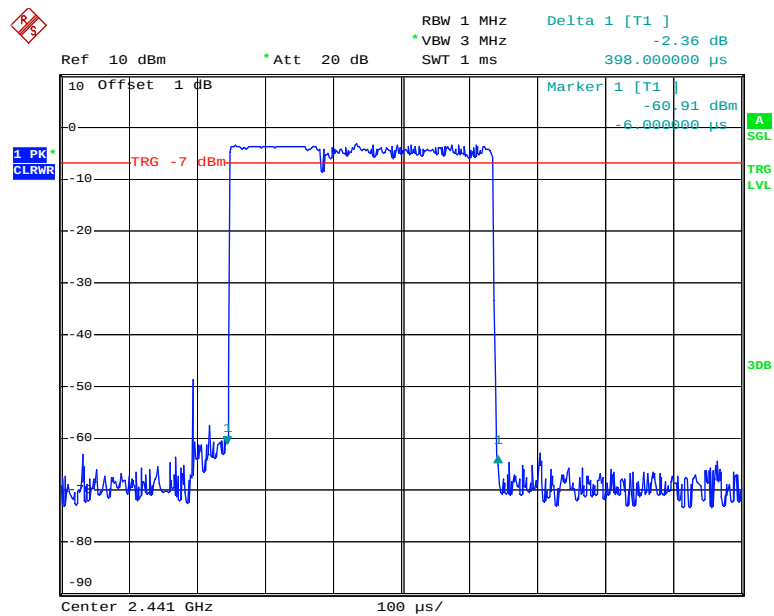
DH5: Middle Channel



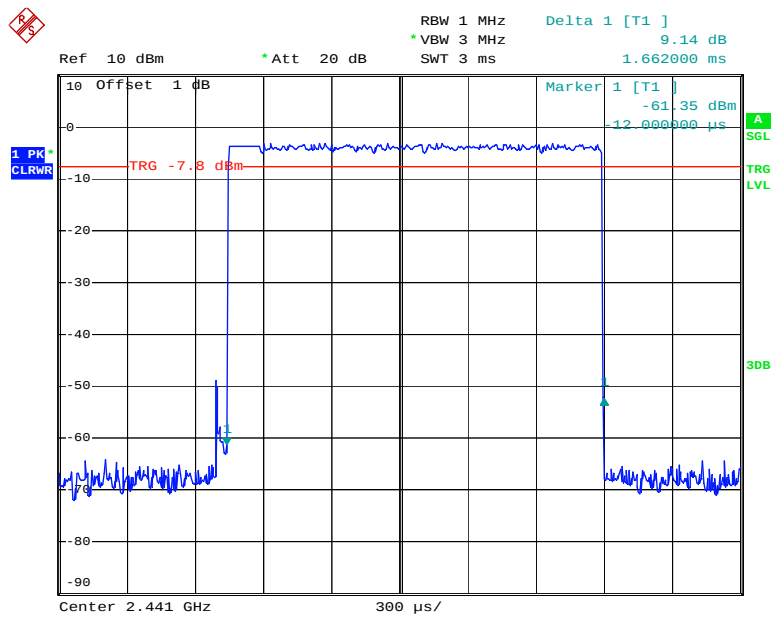
Date: 16.JUL.2019 17:42:41

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

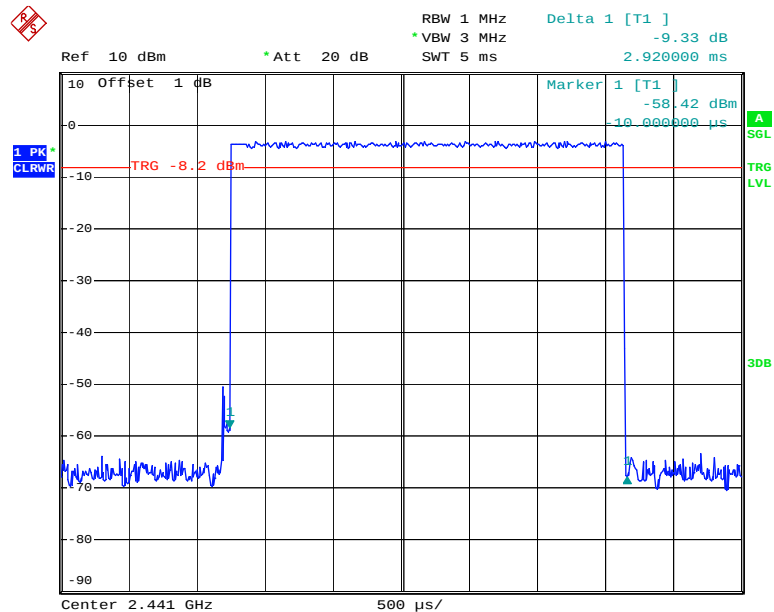
2DH1: Middle Channel



Date: 16.JUL.2019 17:43:08

2DH3: Middle Channel

Date: 16.JUL.2019 17:43:38

2DH5: Middle Channel

Date: 16.JUL.2019 17:44:04

FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT**Applicable Standard**

According to §15.247(b) (1), for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts

Test Procedure

1. Place the EUT on a bench and set in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Agilent	USB Wideband Power Sensor	U2022XA	MY5417006	2018-12-10	2019-12-10
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

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

Test Data**Environmental Conditions**

Temperature:	29.9 °C
Relative Humidity:	57 %
ATM Pressure:	100.1 kPa
Tester:	Carrie He
Test Date:	2019-07-16

Test Result: Compliance.

*Test Mode: Transmitting***Radio 1:**

Mode	Frequency (MHz)	Peak Conducted Output power (dBm)	Limit (dBm)
BDR Mode (GFSK)	2402	3.11	21
	2441	3.07	21
	2480	2.70	21
EDR Mode ($\pi/4$ -DQPSK)	2402	4.37	21
	2441	4.26	21
	2480	4.11	21
EDR Mode (8-DPSK)	2402	4.53	21
	2441	4.46	21
	2480	4.31	21

Radio 2:

Mode	Frequency (MHz)	Peak Conducted Output power (dBm)	Limit (dBm)
BDR Mode (GFSK)	2402	-4.22	21
	2441	-3.52	21
	2480	-3.40	21
EDR Mode ($\pi/4$ -DQPSK)	2402	-3.25	21
	2441	-2.79	21
	2480	-2.85	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.

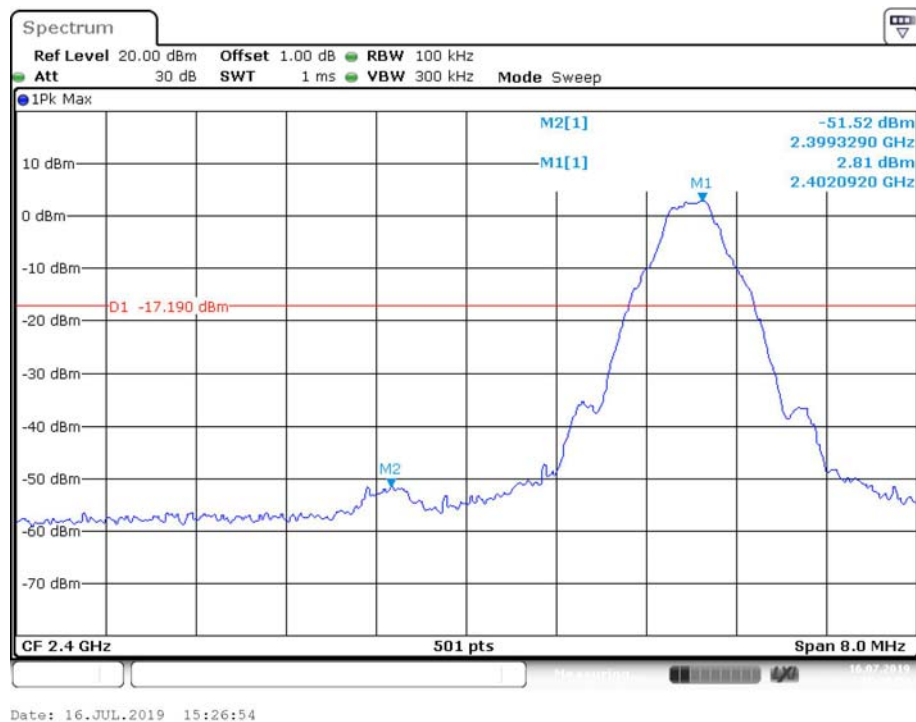
Test Equipment List and Details

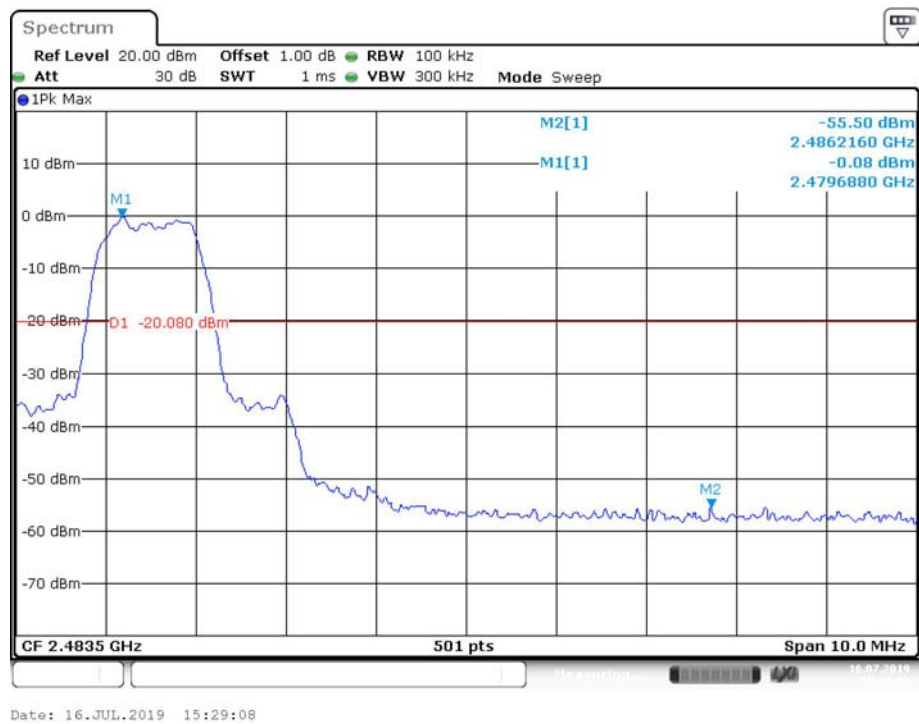
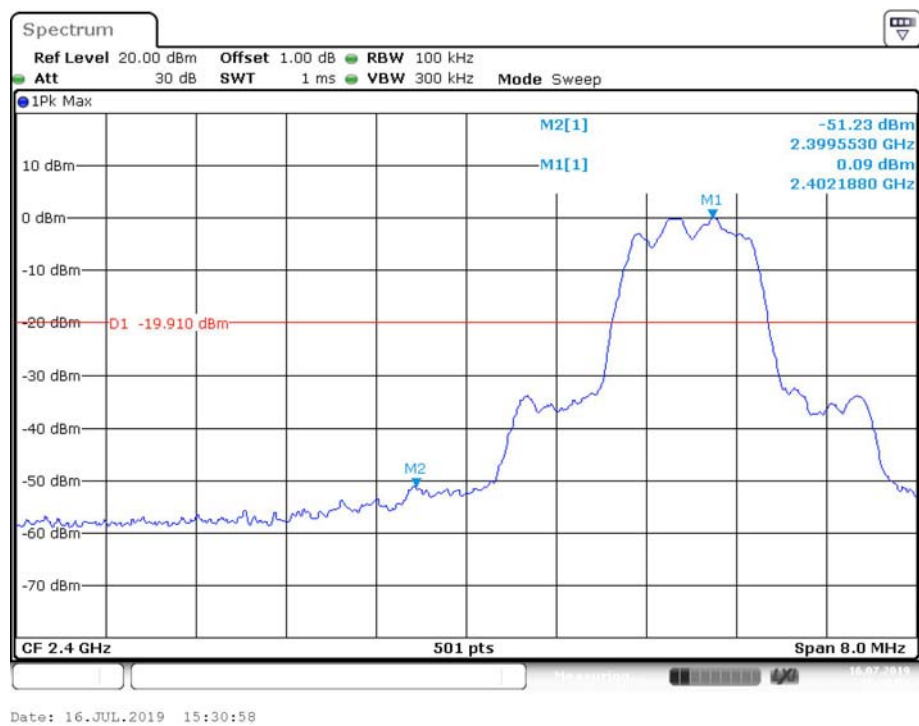
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2018-12-10	2019-12-10
R&S	Spectrum Analyzer	FSV40	101474	2019-01-09	2020-01-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

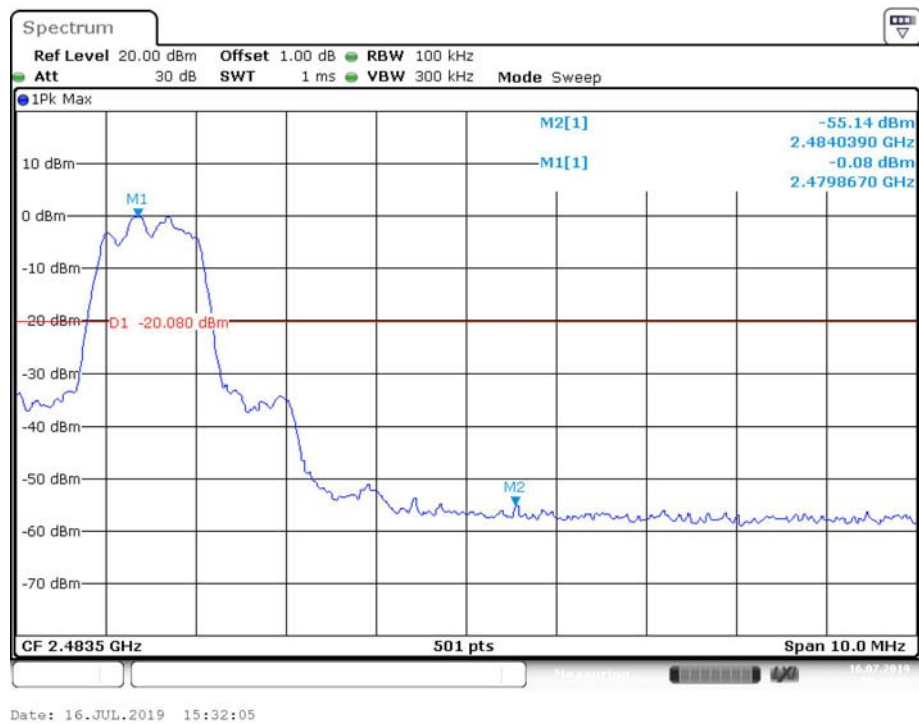
* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data**Environmental Conditions**

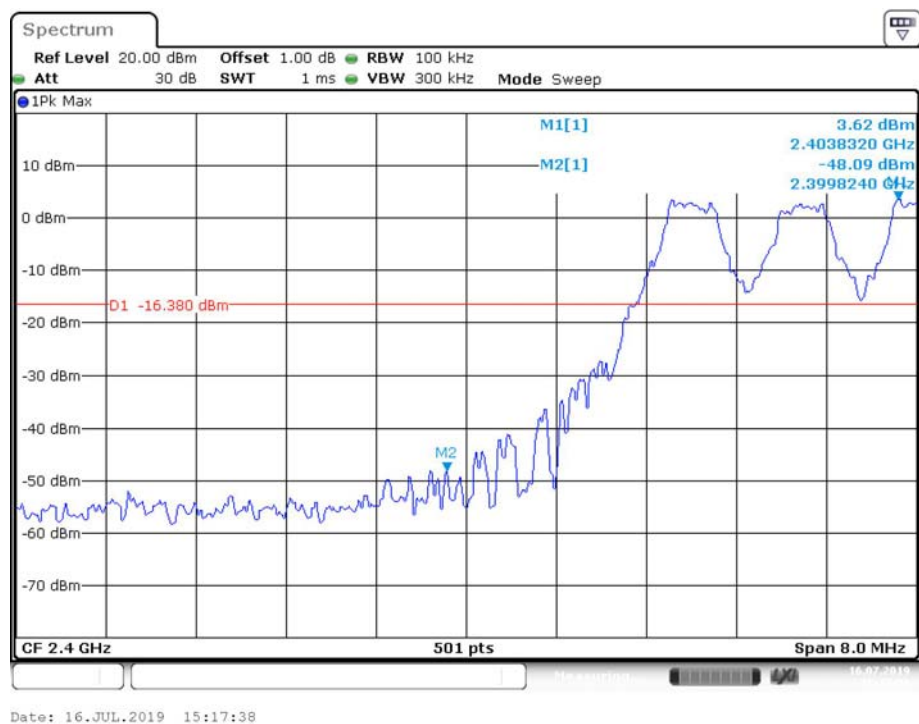
Temperature:	29.9 °C
Relative Humidity:	57 %
ATM Pressure:	100.1 kPa
Tester:	Carrie He
Test Date:	2019-07-16

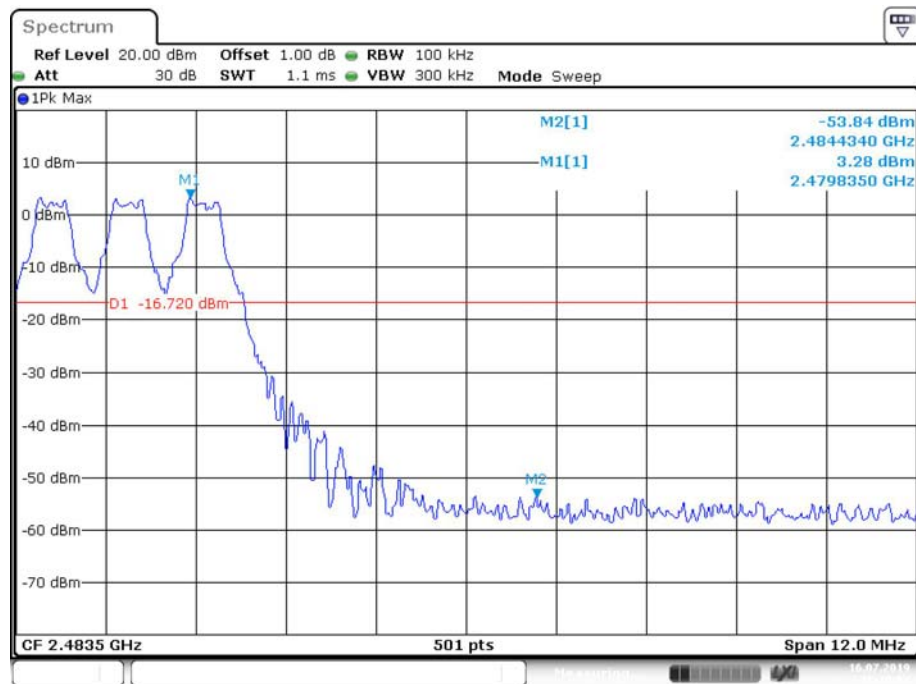
Test Result: Compliance**Radio 1:****Single Channel:***EDR Mode (GFSK):***Band Edge, Left Side**

Band Edge, Right Side*EDR Mode (8-DPSK):***Band Edge, Left Side**

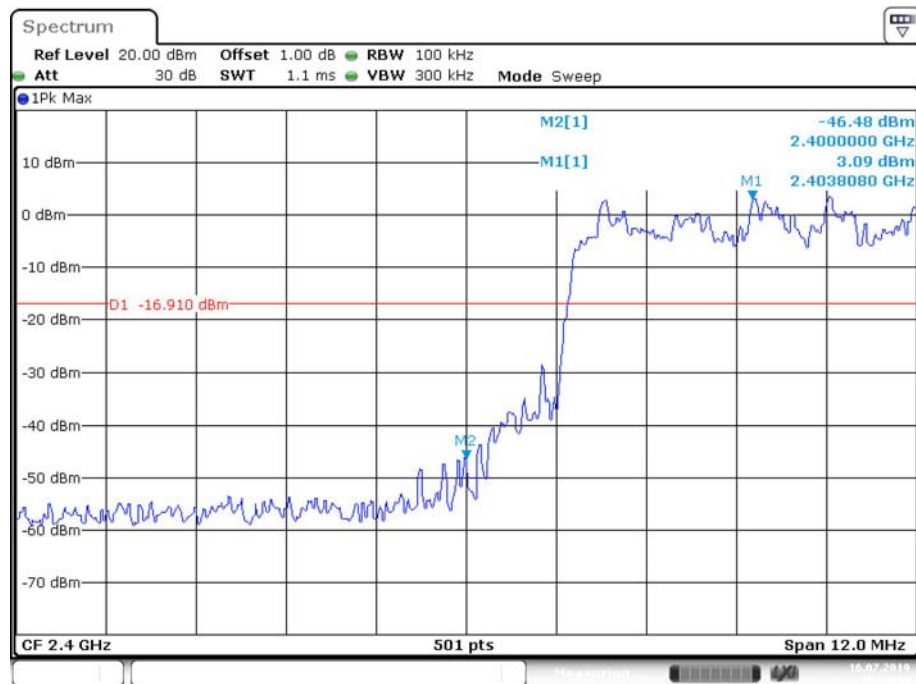
Band Edge, Right Side

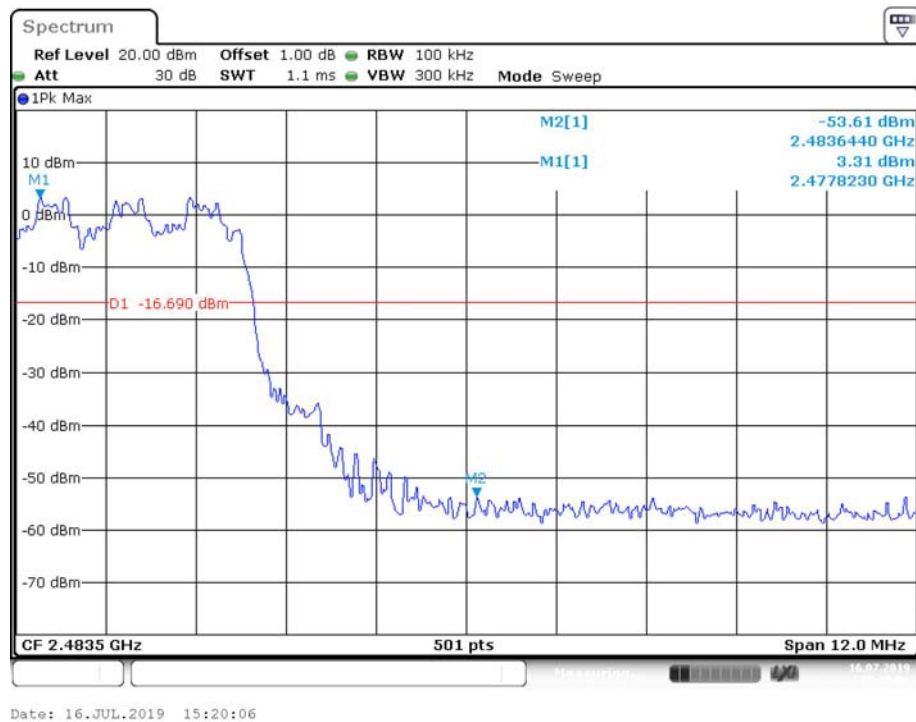
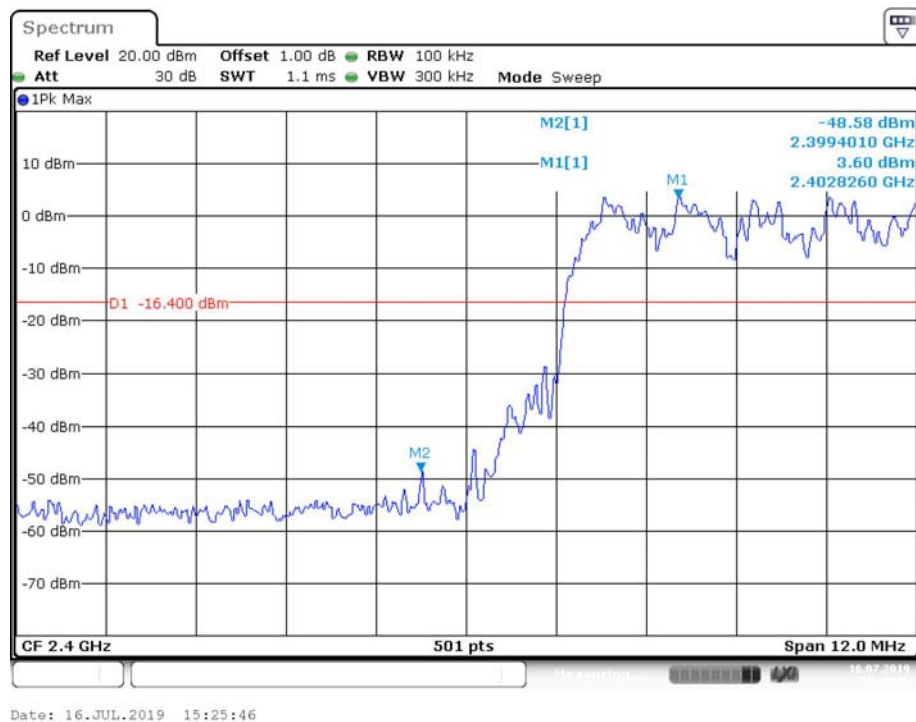
Hopping Channel:
BDR Mode (GFSK):

Band Edge, Left Side

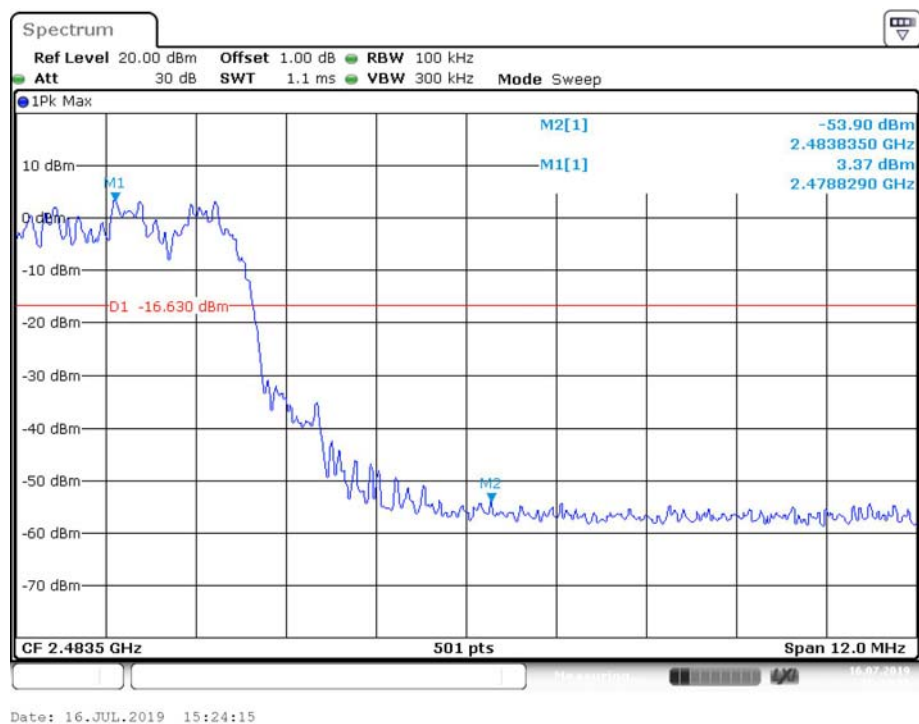
Band Edge, Right Side

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

Band Edge, Left Side

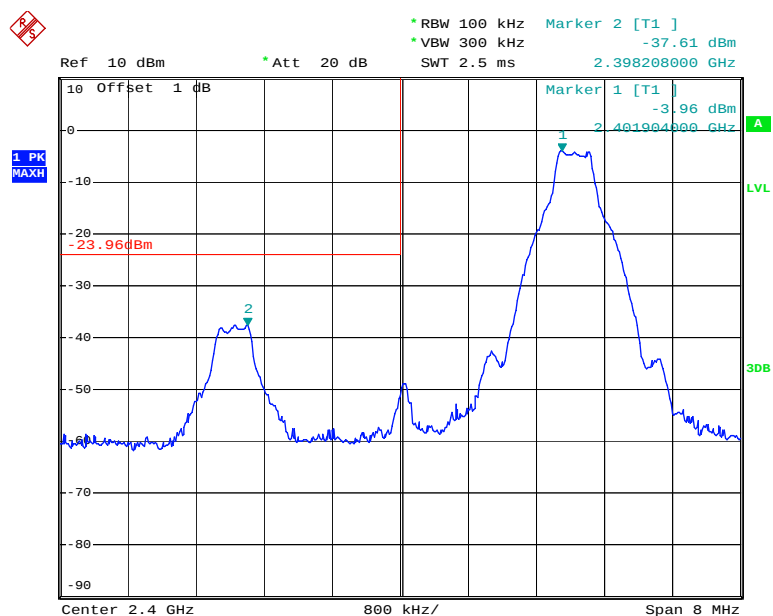
Band Edge, Right Side*EDR Mode (8-DPSK):***Band Edge, Left Side**

Band Edge, Right Side

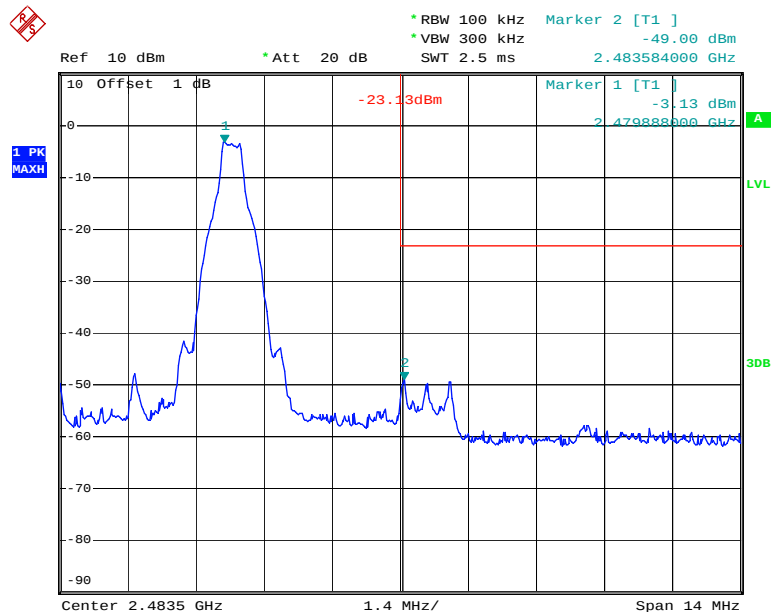


Radio 2:
Single Channel:
BDR Mode (GFSK):

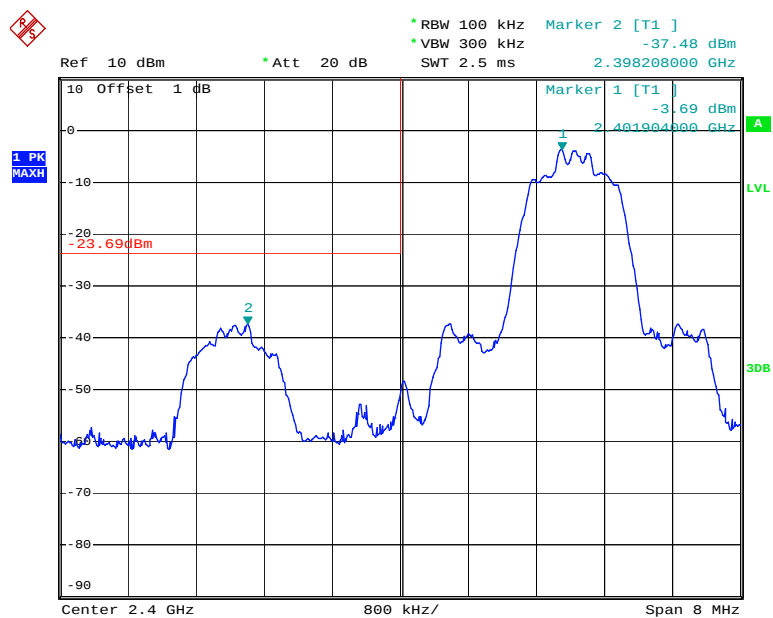
Band Edge, Left Side



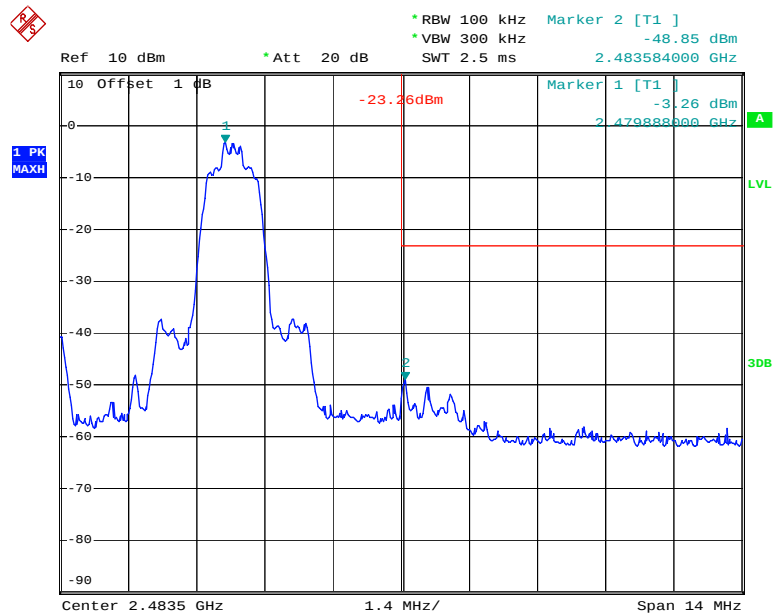
Date: 16.JUL.2019 17:11:13

Band Edge, Right Side

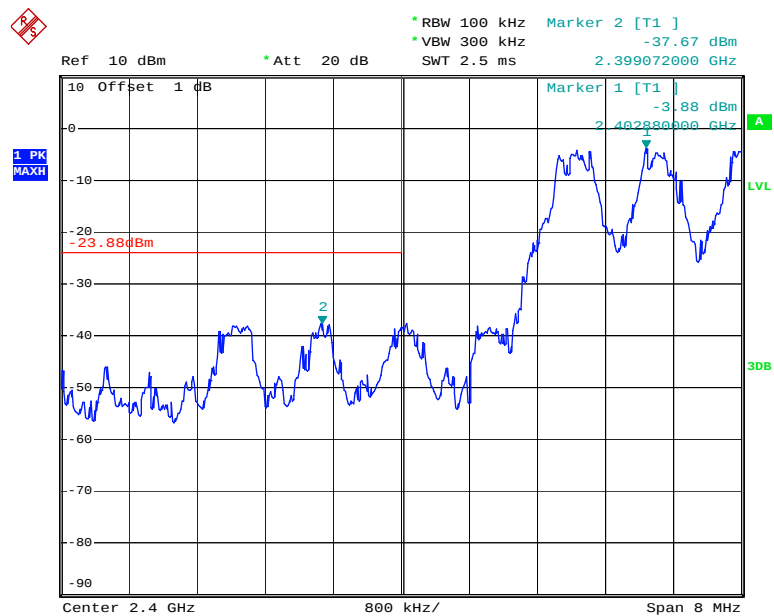
Date: 16.JUL.2019 17:17:07

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

Date: 16.JUL.2019 17:24:49

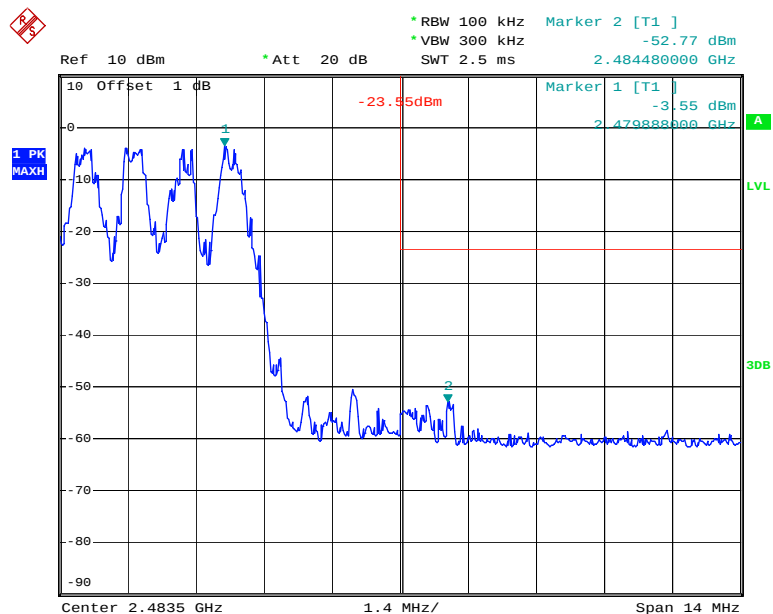
Band Edge, Right Side

Date: 16.JUL.2019 17:28:40

Hopping Channel:
*BDR Mode (GFSK):***Band Edge, Left Side**

Date: 16.JUL.2019 17:32:58

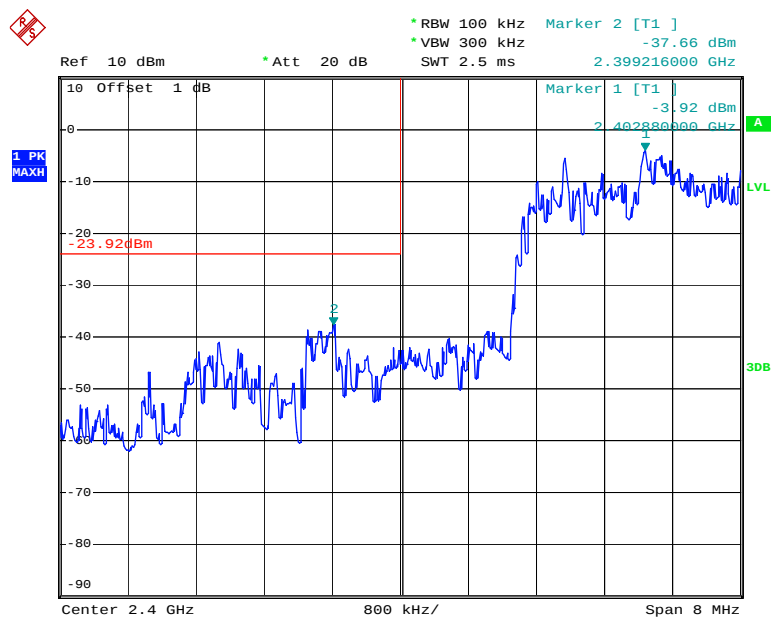
Band Edge, Right Side



Date: 16.JUL.2019 17:33:46

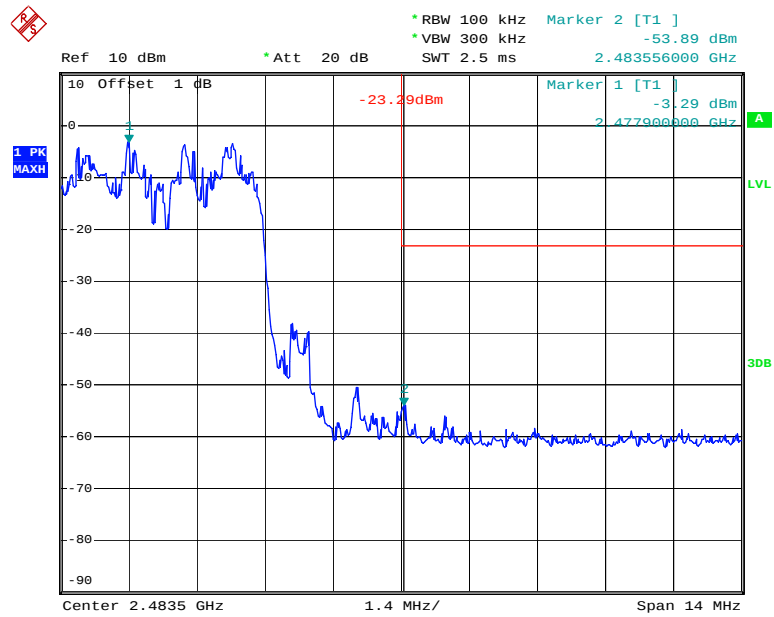
BDR Mode ($\pi/4$ DQPSK):

Band Edge, Left Side



Date: 16.JUL.2019 17:34:35

Band Edge, Right Side



Date: 16.JUL.2019 17:35:11

**** END OF REPORT ****