



FCC PART 15.247
TEST REPORT

For

Shenzhen Kingsun Enterprises Co., Ltd.

25/F, CEC Information Building, Xinwen Rd., Shenzhen, Guangdong, China

FCC ID: 2AAPKAP-0225

Report Type: Original Report	Product Name: TRUE WIRELESS FREEDOM
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:	TRUE WIRELESS FREEDOM
EUT Model:	AP-0225
Multiple Model:	AP-0227,XBE9-0112,PBE9-0112,XBE9-0107,PBE9-0107
Operation Frequency:	2402-2480MHz
Maximum Output Power (Conducted):	3.50dBm
Modulation Type:	GFSK, $\pi/4$ -DQPSK, 8-DPSK
Rated Input Voltage:	DC 3.7V from battery or charging from DC 5V from Charger Box
External Dimension:	47mm(L)*19 mm(W)* 18mm(H) (Ear) 67.5mm(L)*54.5mm(W)* 22mm(H) (Charger box)
Serial Number:	190702006-1(Left Ear) 190702006-2(Right Ear) 190702006-3(Charger Box)
EUT Received Date:	2019-07-04

Note 1: the Left Ear and Right Ear is identical, RF test only performed at Left Ear.

Note 2: Model AP-0225 was selected for fully testing, the detailed information about the difference among AP-0227,XBE9-0112,PBE9-0112,XBE9-0107,PBE9-0107 and model AP-0225 can be referred to the declaration letter which was stated and guaranteed by the manufacturer.

Objective

This report is prepared on behalf of **Shenzhen Kingsun Enterprises Co., Ltd.** in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communications Commission's rules

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

Related Submittal(s)/Grant(s)

No related submittal.

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.

EUT Exercise Software

The software: 'BK32xxRF Test-V1.8.2_en(Mar 14 2019)' was used during test, which was provided by manufacturer. The maximum power level was configured by the software as below table:

Test Software Version	BK32xxRF Test-V1.8.2_en(Mar 14 2019)		
Test Frequency	2402MHz	2441MHz	2480MHz
GFSK	3	3	3
$\pi/4$ -DQPSK	3	3	3
8-DPSK	3	3	3

Equipment Modifications

No modification was made to the EUT.

Local Support Equipment List and Details

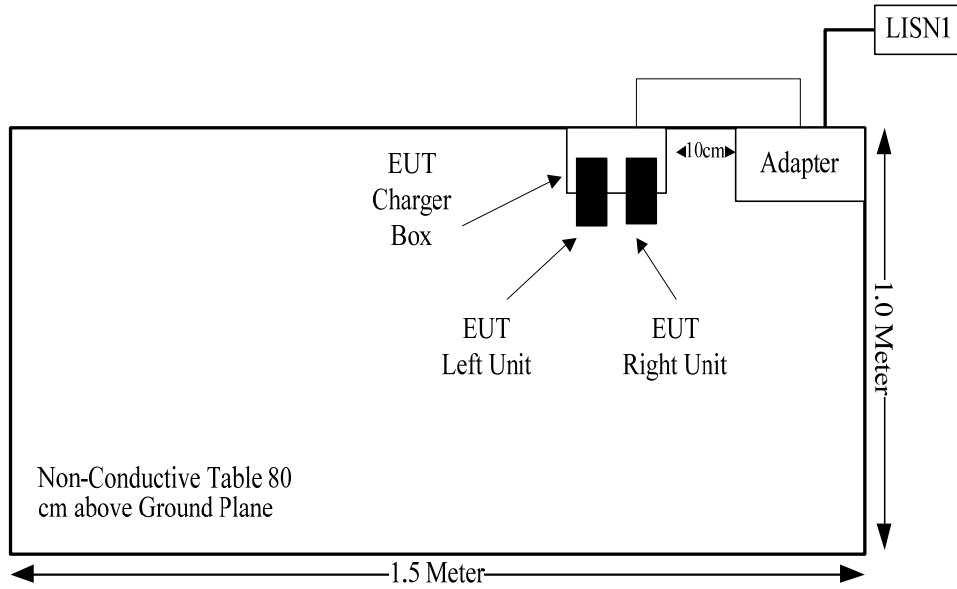
Manufacturer	Description	Model	Serial Number
Unknown	Adapter	M4	/

Support Cable List and Details

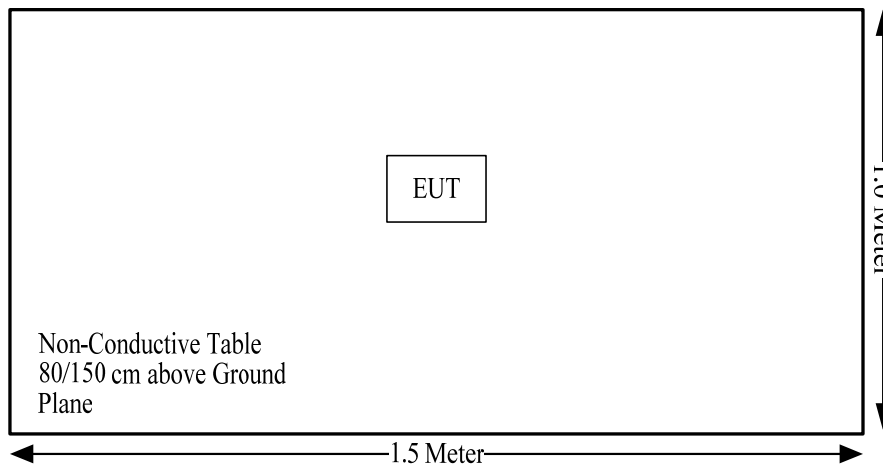
Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
USB Cable	Yes	No	0.3	Adapter	Charger Box

Block Diagram of Test Setup

AC Line Conducted Test:



Radiated Emissions:



SUMMARY OF TEST RESULTS

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

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

Applicable Standard

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

According to KDB447498 D01 General RF Exposure Guidance v06:

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

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

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

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

Measurement Result

The max conducted power including tune-up tolerance is 4.0 dBm (2.51 mW).

$[(\text{max. power of channel, mW})/(\text{min. test separation distance, mm})][\sqrt{f(\text{GHz})}]$
 $= 2.51/5 \cdot (\sqrt{2.480}) = 0.8 < 3.0$

So the stand-alone SAR evaluation is not necessary.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Antenna Connector Construction

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

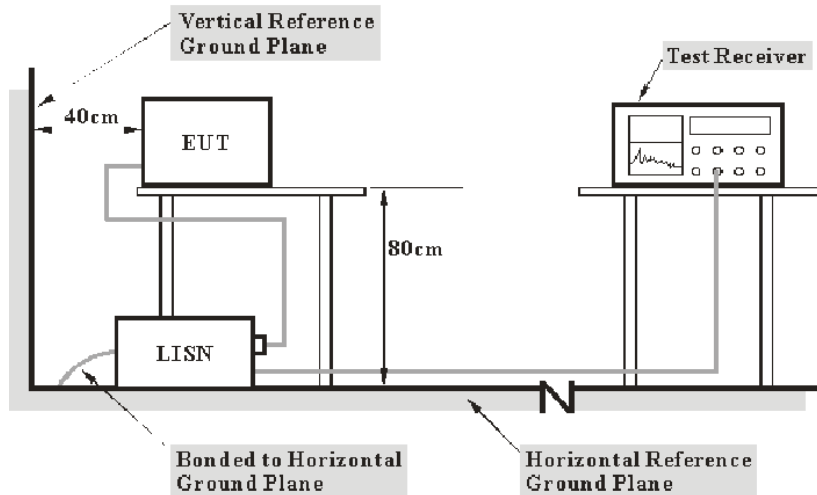
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207(a)

EUT Setup



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

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

The spacing between the peripherals was 10 cm.

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

EMI Test Receiver Setup

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

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

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

Test Procedure

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

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

* **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

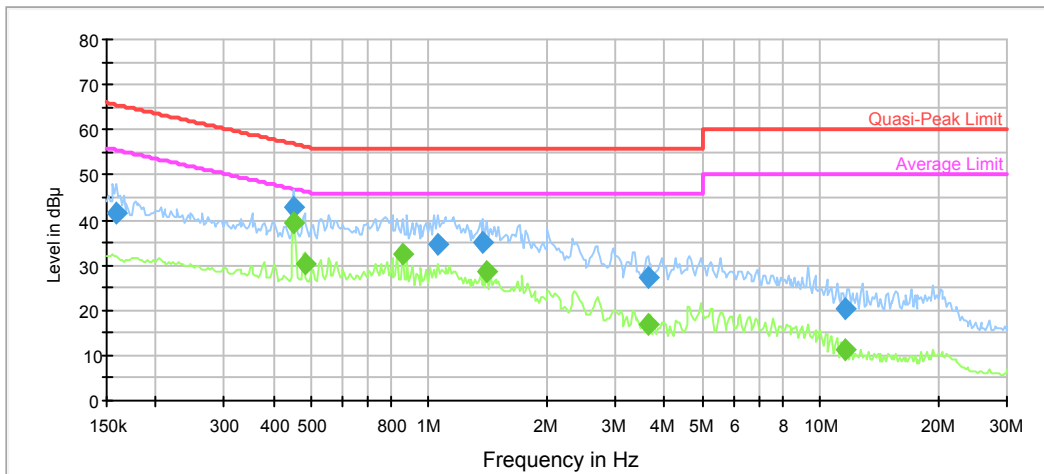
Environmental Conditions

Temperature:	29.2 °C
Relative Humidity:	63%
ATM Pressure:	100.4kPa
Test by:	<i>Lily Xie</i>
Test Date:	2019-07-12

Test Result: Compliance

Test Mode: Charging

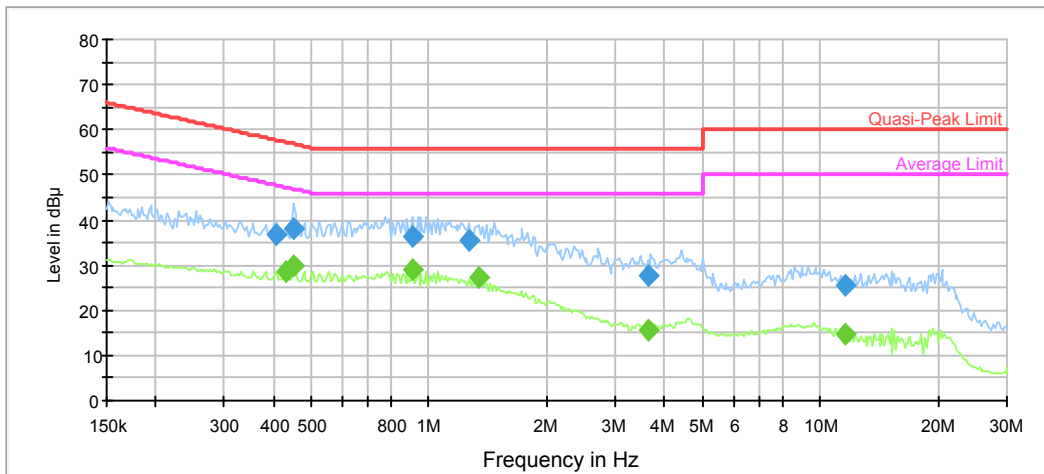
AC120V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.159228	41.4	9.000	L1	11.1	24.1	65.5
0.452652	42.6	9.000	L1	9.9	14.2	56.8
1.054583	34.5	9.000	L1	9.8	21.5	56.0
1.379615	35.2	9.000	L1	9.8	20.8	56.0
3.621856	27.3	9.000	L1	9.8	28.7	56.0
11.601974	20.1	9.000	L1	9.8	38.9	60.0

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.452652	39.4	9.000	L1	9.9	7.4	46.8
0.480499	30.3	9.000	L1	9.9	16.0	46.3
0.855721	32.2	9.000	L1	9.8	13.8	46.0
1.407345	28.6	9.000	L1	9.8	17.4	46.0
3.621856	16.7	9.000	L1	9.8	29.3	46.0
11.601974	11.3	9.000	L1	9.8	38.7	50.0

AC120V, 60 Hz, Neutral:



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.405722	36.6	9.000	N	10.0	21.1	57.7
0.452652	38.2	9.000	N	9.9	18.6	56.8
0.908365	36.4	9.000	N	9.8	19.6	56.0
1.261437	35.6	9.000	N	9.8	20.4	56.0
3.621856	27.9	9.000	N	9.8	28.1	56.0
11.601974	25.3	9.000	N	9.8	34.7	60.0

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.430682	28.3	9.000	N	9.9	18.9	47.2
0.452652	29.6	9.000	N	9.9	17.2	46.8
0.908365	29.1	9.000	N	9.8	16.9	46.0
1.339041	27.3	9.000	N	9.8	18.7	46.0
3.621856	15.8	9.000	N	9.8	30.2	46.0
11.601974	14.6	9.000	N	9.8	35.4	50.0

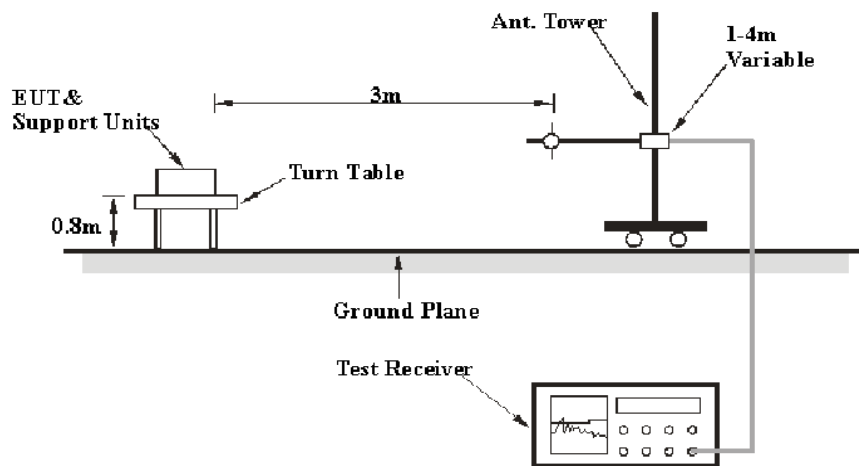
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

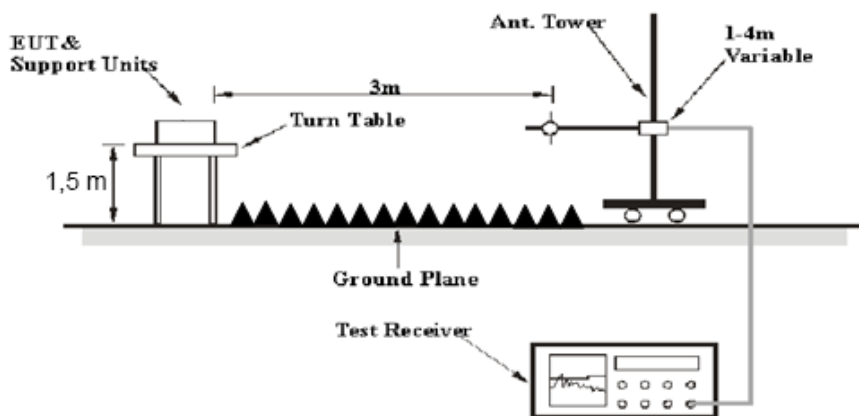
FCC §15.247 (d); §15.209; §15.205;

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
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
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2018-08-03	2019-08-03
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
TDK RF	Horn Antenna	HRN-0118	130 084	2018-10-12	2021-10-12
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2016-11-18	2019-11-18
MICRO-COAX	Coaxial Cable	UFA147-1-2362-100100	64639 231029-001	2019-02-24	2020-02-24
Mini	Pre-amplifier	ZVA-183-S+	5969001149	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

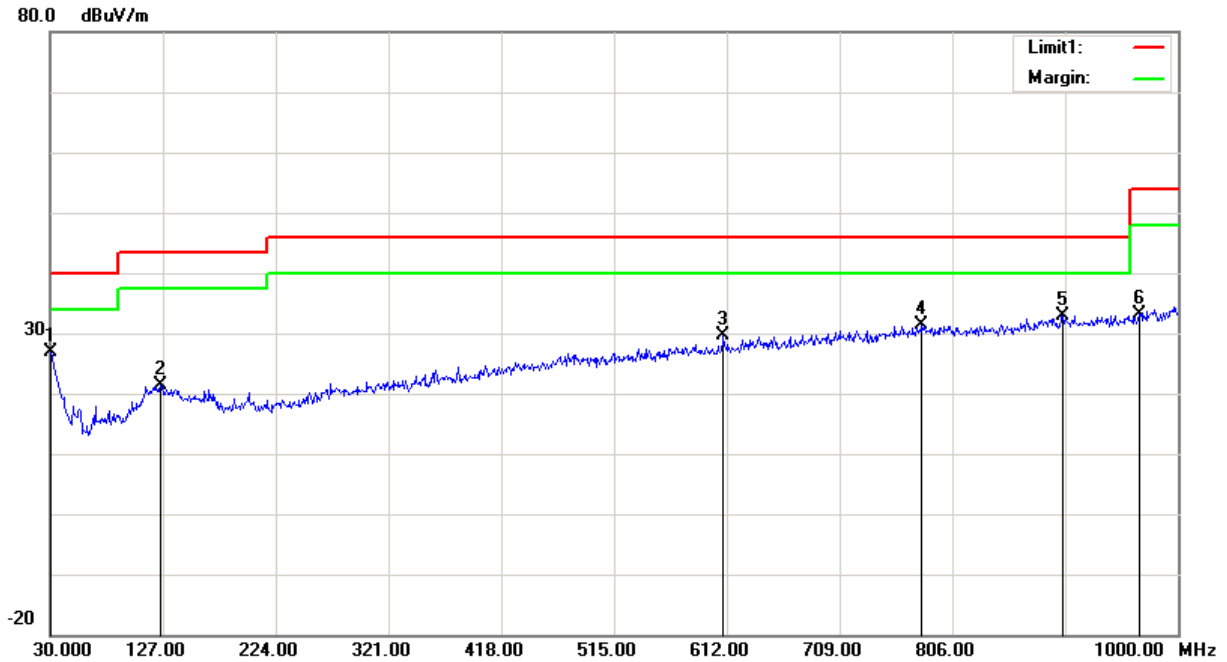
Environmental Conditions

Test Items	Radiation Below 1GHz	Radiation Above 1GHz
Temperature:	28.6 °C	29.1 °C
Relative Humidity:	55%	68 %
ATM Pressure:	100.4 kPa	100.2 kPa
Tester:	Tyler Pan	Tyler Pan
Test Date:	2019-07-09	2019-07-16

Test Mode: Transmitting

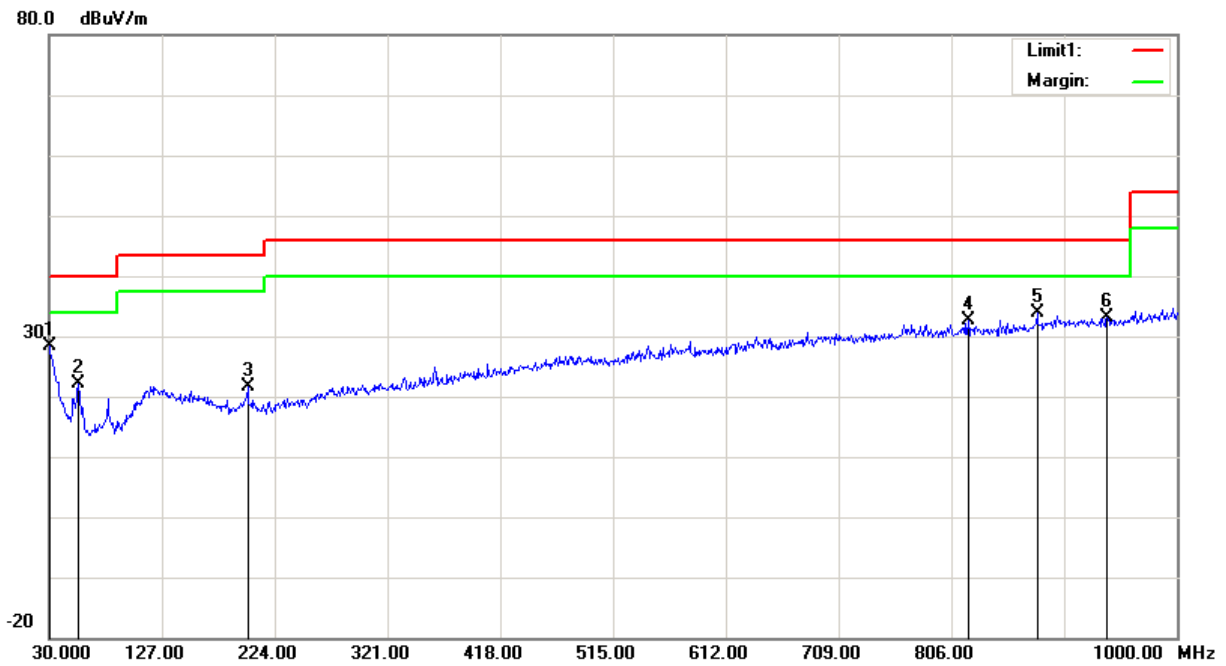
1) 30MHz-1GHz (BDR high channel was the worst)

Horizontal:



Frequency (MHz)	Receiver Reading (dBμV)	Remark	Correction Factor (dB/m)	Cord. Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)
30.9700	26.02	peak	0.91	26.93	40.00	13.07
125.0600	25.92	peak	-4.64	21.28	43.50	22.22
609.0900	28.40	peak	1.11	29.51	46.00	16.49
779.8100	27.05	peak	4.37	31.42	46.00	14.58
901.0600	32.71	peak	0.14	32.85	46.00	13.15
967.0200	32.05	peak	1.10	33.15	54.00	20.85

Vertical:



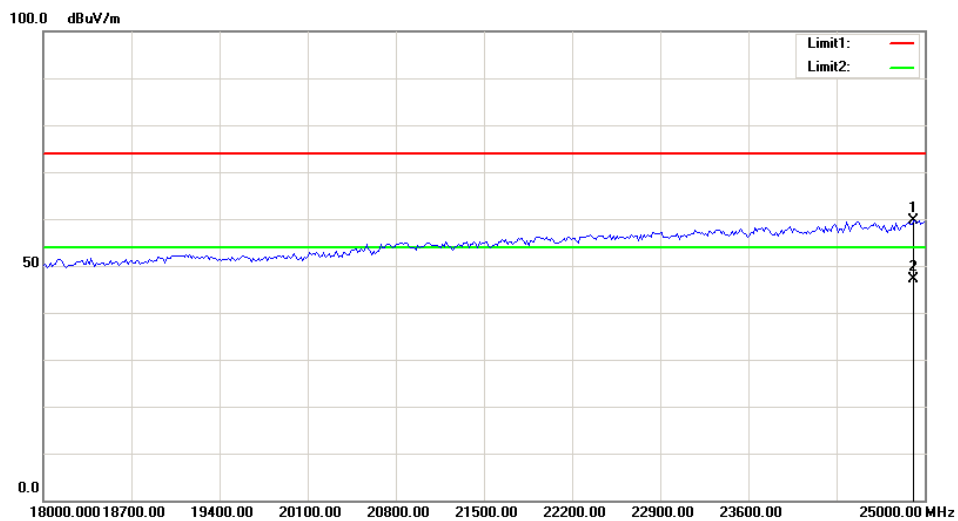
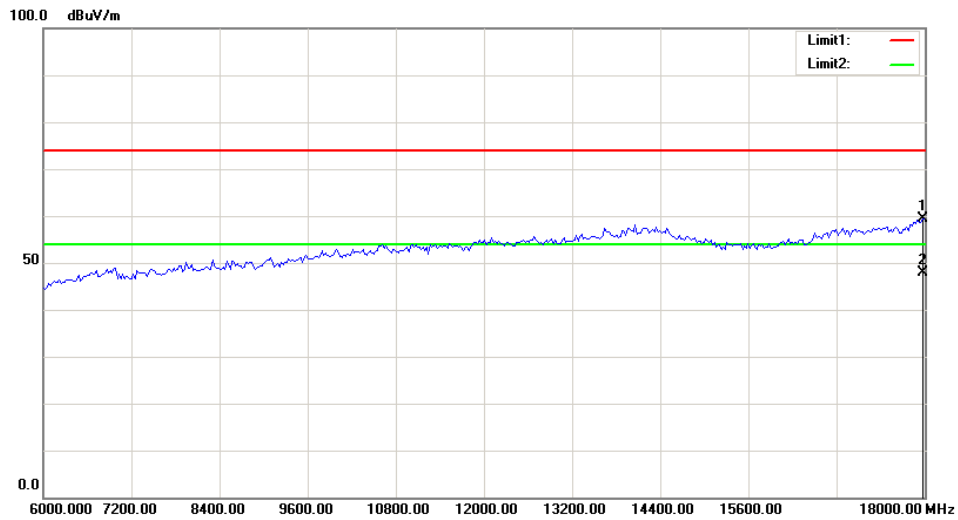
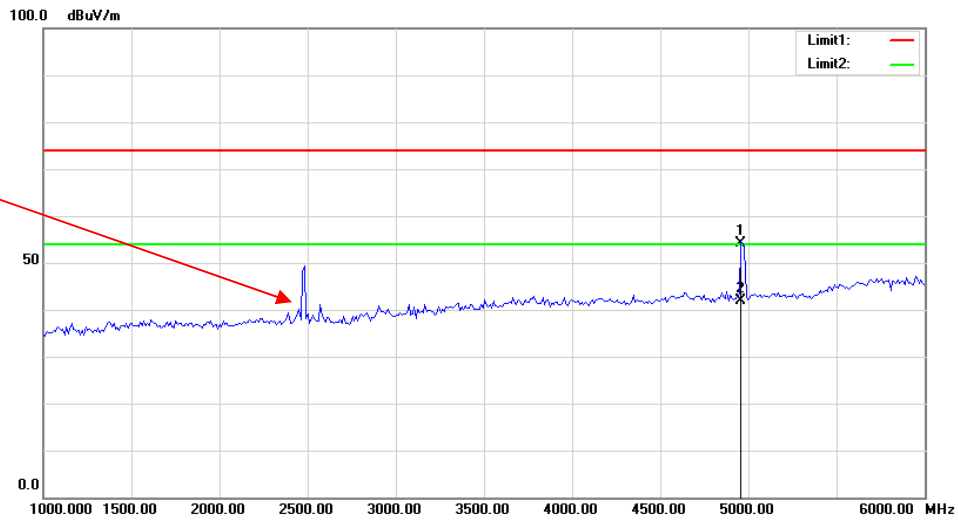
Frequency (MHz)	Receiver Reading (dBµV)	Remark	Correction Factor (dB/m)	Cord. Amp. (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30.0000	26.64	peak	1.72	28.36	40.00	11.64
55.2200	34.35	peak	-12.10	22.25	40.00	17.75
200.7200	27.50	peak	-5.88	21.62	43.50	21.88
820.5500	27.82	peak	4.90	32.72	46.00	13.28
879.7200	34.35	peak	-0.47	33.88	46.00	12.12
939.8600	32.36	peak	0.73	33.09	46.00	12.91

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

Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
	Reading (dB μ V)	Remark	Polar (H/V)	Factor (dB/m)					
Low Channel: 2402 MHz									
2402.00	66.61	PK	H	24.82	3.34	0.00	94.77	N/A	N/A
2402.00	54.46	AV	H	24.82	3.34	0.00	82.62	N/A	N/A
2402.00	61.54	PK	V	24.82	3.34	0.00	89.70	N/A	N/A
2402.00	49.50	AV	V	24.82	3.34	0.00	77.66	N/A	N/A
2390.00	29.51	PK	H	24.80	3.33	0.00	57.64	74.00	16.36
2390.00	13.54	AV	H	24.80	3.33	0.00	41.67	54.00	12.33
4804.00	46.37	PK	H	29.71	4.58	27.36	53.30	74.00	20.70
4804.00	34.10	AV	H	29.71	4.58	27.36	41.03	54.00	12.97
7206.00	38.55	PK	H	33.93	5.59	27.19	50.88	74.00	23.12
7206.00	26.13	AV	H	33.93	5.59	27.19	38.46	54.00	15.54
Middle Channel: 2441 MHz									
2441.00	66.63	PK	H	24.89	3.36	0.00	94.88	N/A	N/A
2441.00	54.57	AV	H	24.89	3.36	0.00	82.82	N/A	N/A
2441.00	61.47	PK	V	24.89	3.36	0.00	89.72	N/A	N/A
2441.00	49.30	AV	V	24.89	3.36	0.00	77.55	N/A	N/A
4882.00	46.80	PK	H	29.86	4.56	27.56	53.66	74.00	20.34
4882.00	34.55	AV	H	29.86	4.56	27.56	41.41	54.00	12.59
7323.00	37.90	PK	H	34.12	5.69	27.26	50.45	74.00	23.55
7323.00	25.63	AV	H	34.12	5.69	27.26	38.18	54.00	15.82
High Channel: 2480 MHz									
2480.00	68.65	PK	H	24.96	3.38	0.00	96.99	N/A	N/A
2480.00	56.43	AV	H	24.96	3.38	0.00	84.77	N/A	N/A
2480.00	63.43	PK	V	24.96	3.38	0.00	91.77	N/A	N/A
2480.00	51.35	AV	V	24.96	3.38	0.00	79.69	N/A	N/A
2483.50	40.40	PK	H	24.97	3.38	0.00	68.75	74.00	5.25
2483.50	17.06	AV	H	24.97	3.38	0.00	45.41	54.00	8.59
4960.00	47.65	PK	H	30.02	4.58	27.37	54.88	74.00	19.12
4960.00	34.97	AV	H	30.02	4.58	27.37	42.20	54.00	11.80
7440.00	37.86	PK	H	34.30	5.79	27.22	50.73	74.00	23.27
7440.00	25.34	AV	H	34.30	5.79	27.22	38.21	54.00	15.79

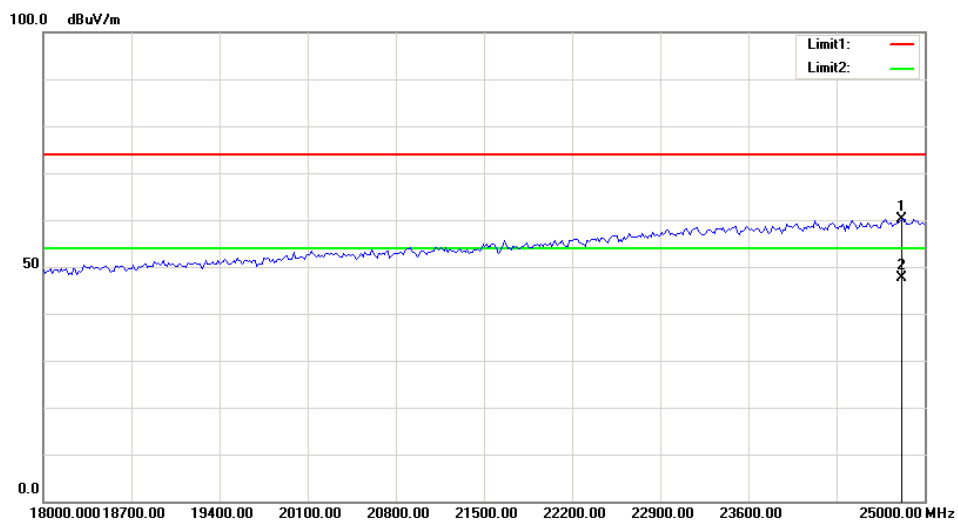
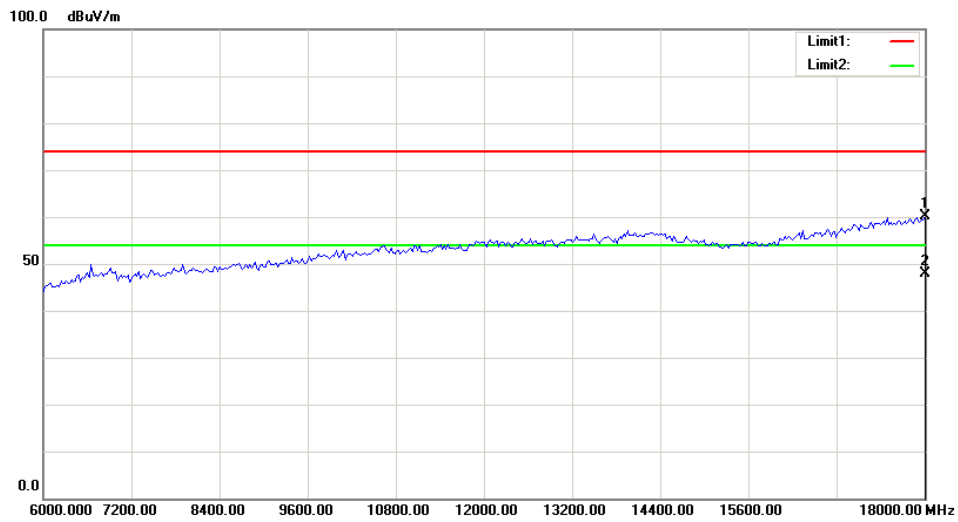
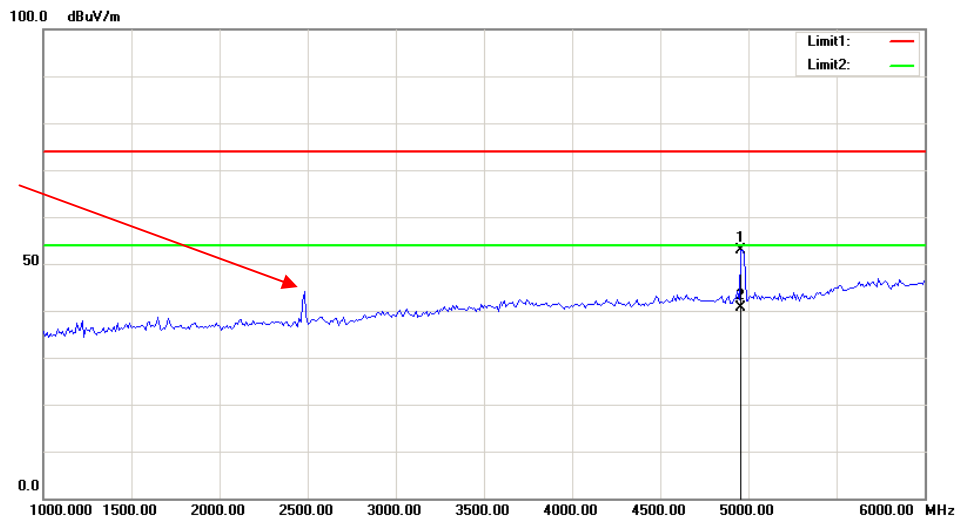
Worst plots (BDR high channel was the worst)
Horizontal

Fundamental
Test with Band
Rejection Filter



Vertical

Fundamental
Test with Band
Rejection Filter



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

Applicable Standard

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU 26	200256	2019-05-09	2020-05-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

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

Test 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:	29.1°C
Relative Humidity:	52 %
ATM Pressure:	100.3 kPa
Test by:	Elena Lei
Test Date:	2019-07-17

Test Result: Compliance.

Please refer to following tables and plots

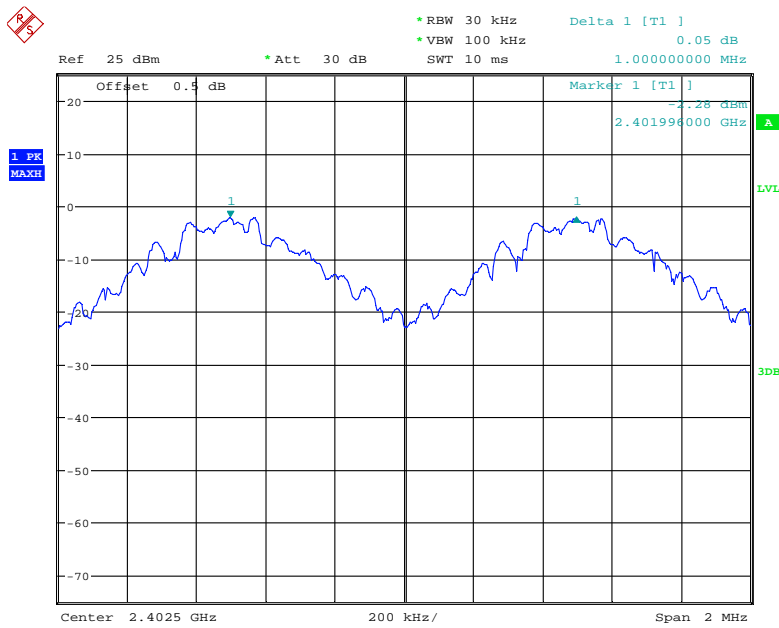
Test Mode: Transmitting

Mode	Channel	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)
BDR (GFSK)	Low	2402	1.000	0.63
	Middle	2441	1.000	0.63
	High	2480	1.004	0.63
EDR ($\pi/4$ -DQPSK)	Low	2402	1.004	0.9
	Middle	2441	1.000	0.9
	High	2480	1.000	0.9
EDR (8-DPSK)	Low	2402	1.000	0.89
	Middle	2441	0.988	0.89
	High	2480	1.004	0.89

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

BDR Mode (GFSK):

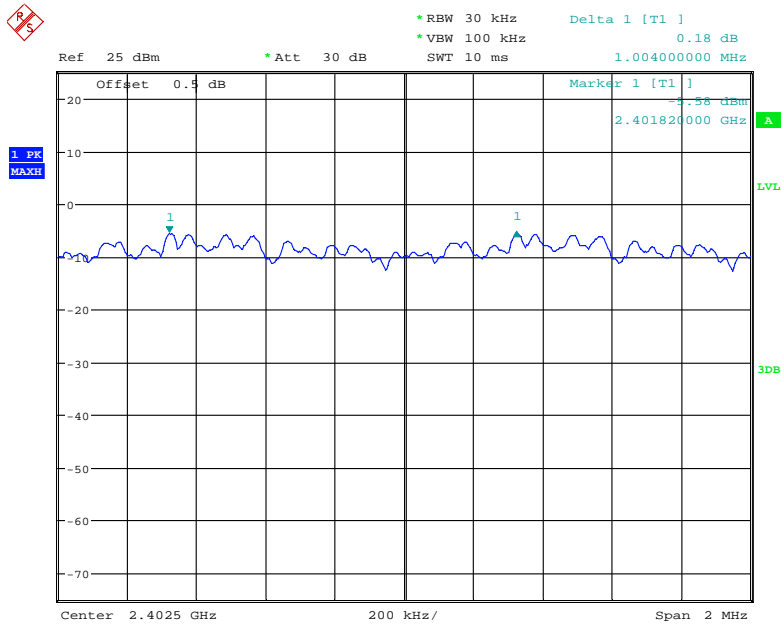
Low Channel



Date: 17.JUL.2019 11:59:52

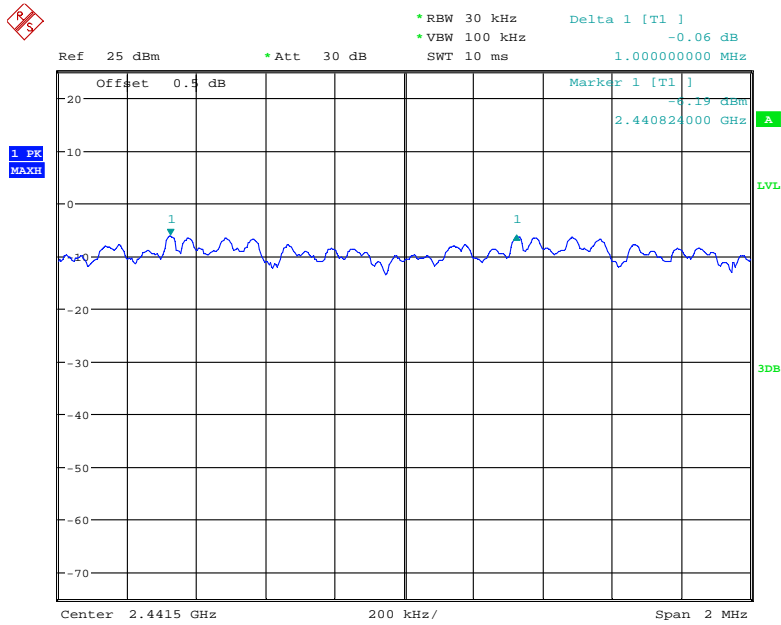
EDR Mode ($\pi/4$ -DQPSK):

Low Channel



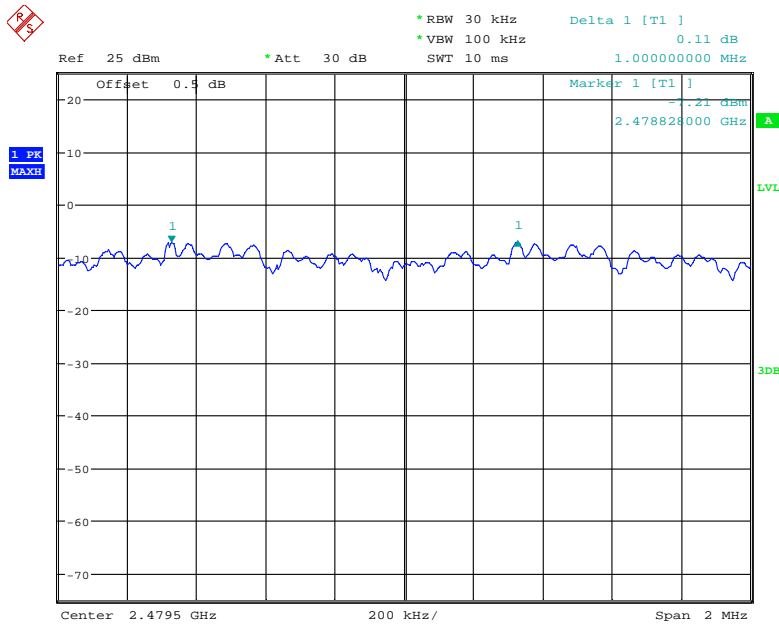
Date: 17.JUL.2019 11:57:16

Middle Channel



Date: 17.JUL.2019 11:57:44

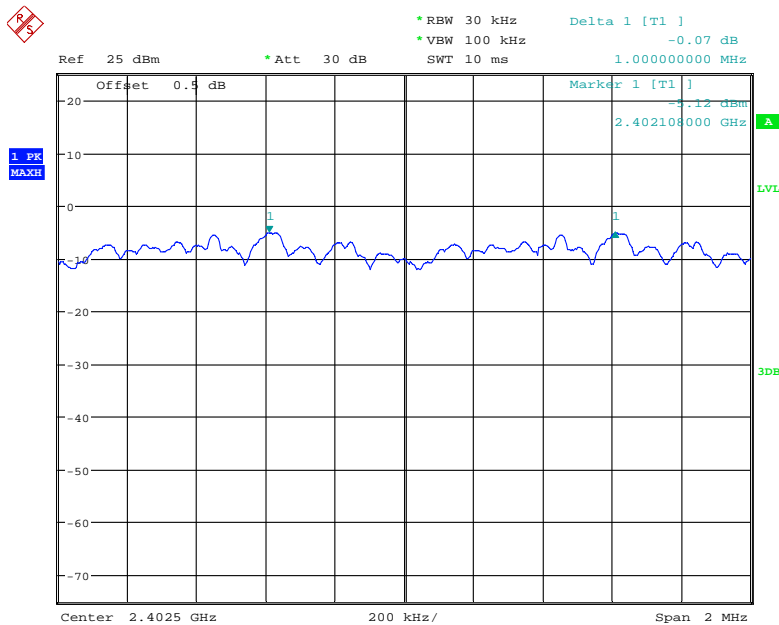
High Channel



Date: 17.JUL.2019 11:58:15

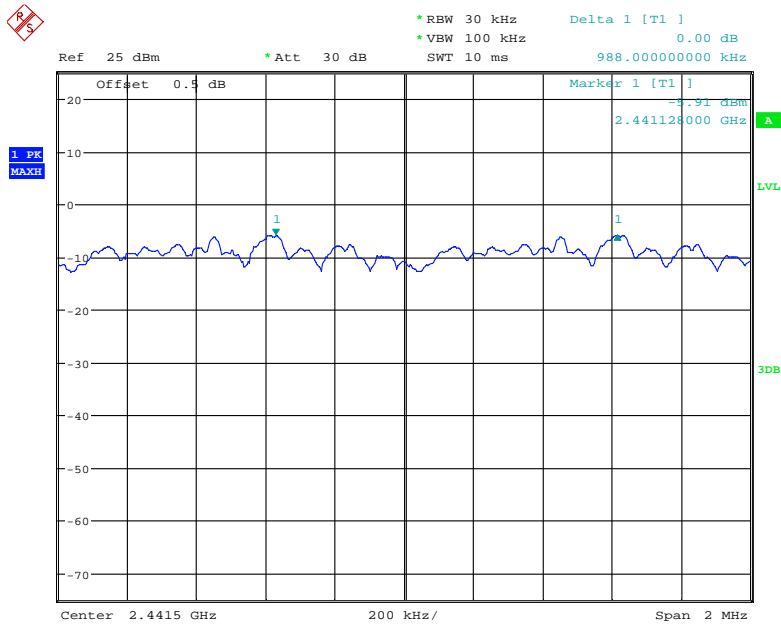
8-DPSK:

Low Channel



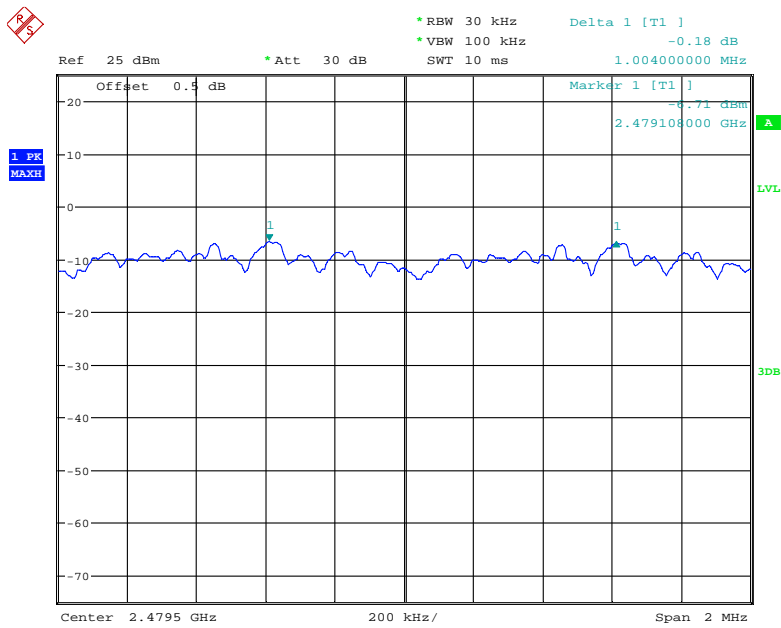
Date: 17.JUL.2019 11:56:43

Middle Channel



Date: 17.JUL.2019 11:56:13

High Channel



Date: 17.JUL.2019 11:55:45

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	FSU 26	200256	2019-05-09	2020-05-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

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

Test Data

Environmental Conditions

Temperature:	29.1°C
Relative Humidity:	52 %
ATM Pressure:	100.3 kPa
Test by:	Elena Lei
Test Date:	2019-07-17

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	0.946
	Middle	2441	0.946
	High	2480	0.946
EDR Mode ($\pi/4$ -DQPSK)	Low	2402	1.347
	Middle	2441	1.347
	High	2480	1.347
EDR (8-DPSK)	Low	2402	1.335
	Middle	2441	1.335
	High	2480	1.339

BDR Mode (GFSK):

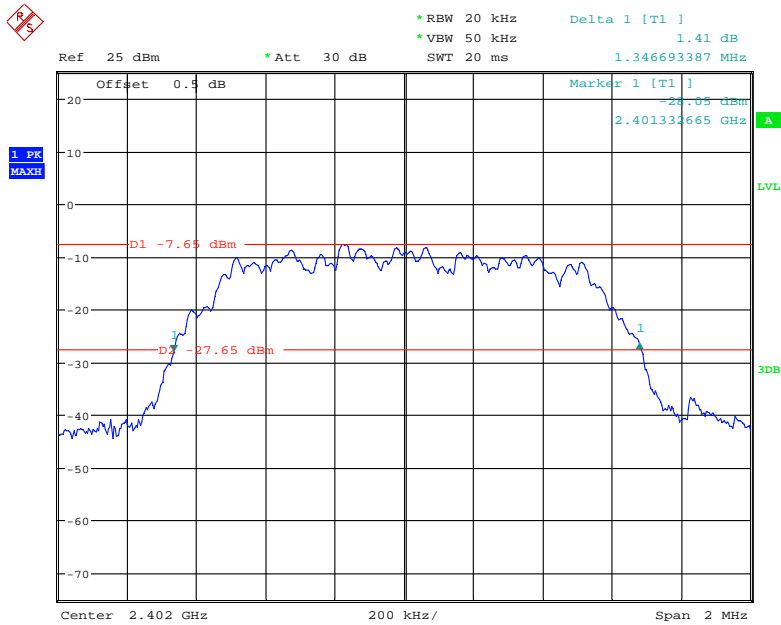
Low Channel



Date: 17.JUL.2019 11:40:16

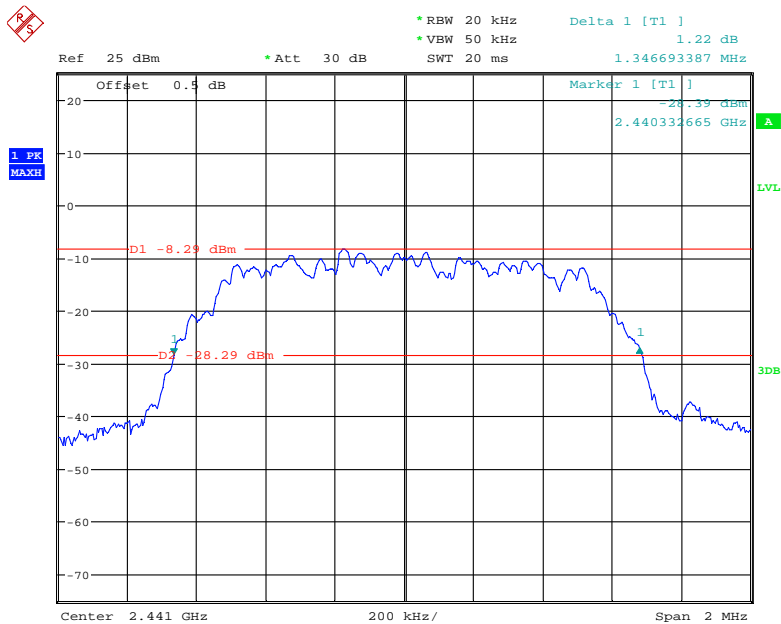
EDR Mode ($\pi/4$ -DQPSK):

Low Channel



Date: 17.JUL.2019 11:46:42

Middle Channel



Date: 17.JUL.2019 11:48:37

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	FSU 26	200256	2019-05-09	2020-05-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

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

Test Data

Environmental Conditions

Temperature:	29.1°C
Relative Humidity:	52 %
ATM Pressure:	100.3 kPa
Test by:	Elena Lei
Test Date:	2019-07-17

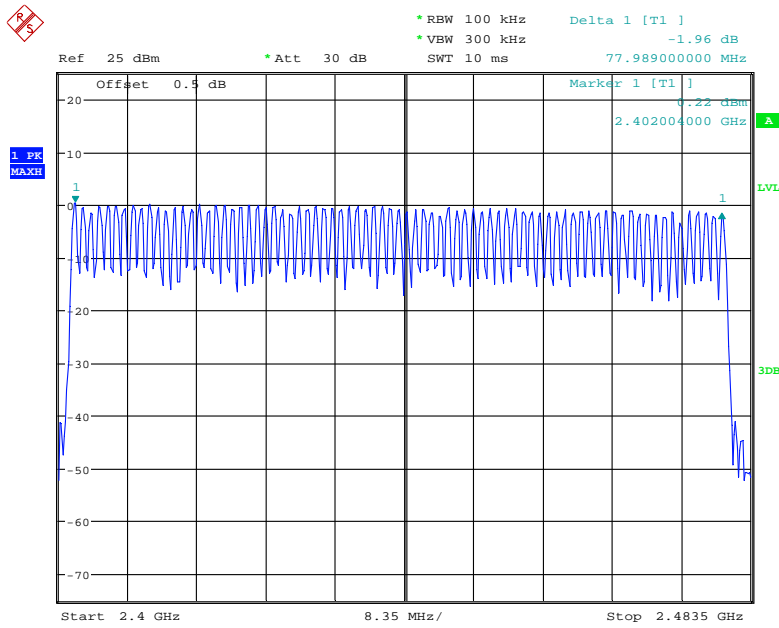
Test Result: Compliance.

Please refer to following tables and plots

Test Mode: Transmitting

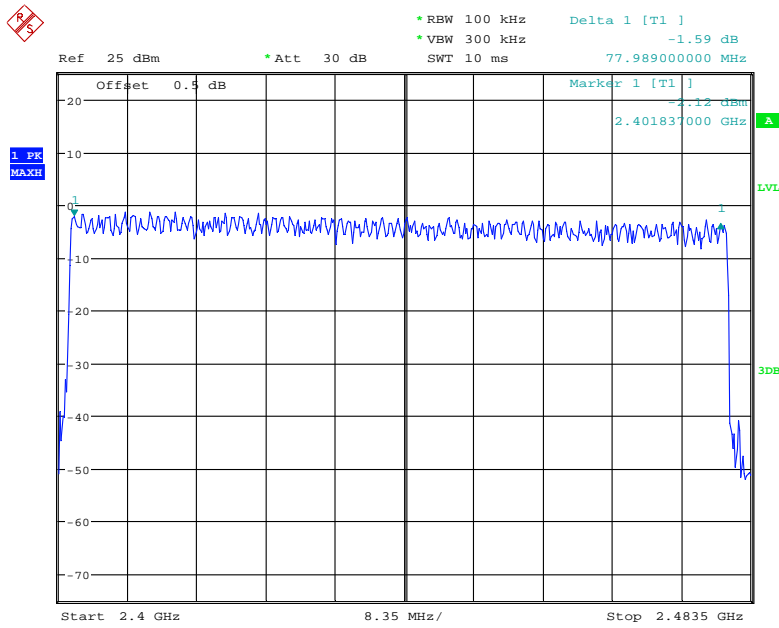
Test mode	Frequency Range (MHz)	Number of Hopping Channel	Limit
GFSK	2400-2483.5	79	≥15
π/4-DQPSK	2400-2483.5	79	≥15
8-DPSK	2400-2483.5	79	≥15

BDR Mode (GFSK)



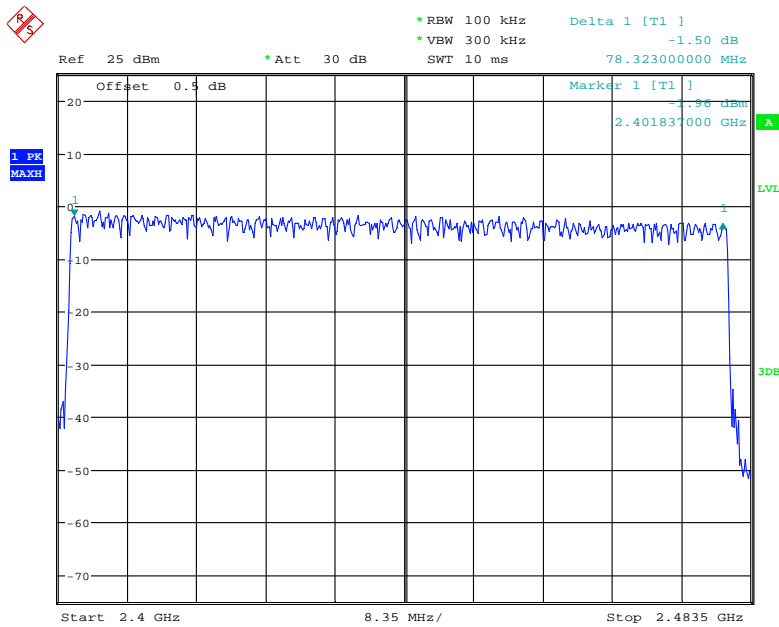
Date: 17.JUL.2019 13:13:50

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



Date: 17.JUL.2019 13:12:21

EDR Mode (8-DPSK)



Date: 17.JUL.2019 13:10:48

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	FSU 26	200256	2019-05-09	2020-05-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

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

Test Data

Environmental Conditions

Temperature:	29.1°C
Relative Humidity:	52 %
ATM Pressure:	100.3 kPa
Test by:	Elena Lei
Test Date:	2019-07-17

Test Result: Compliance.

Please refer to following tables and plots

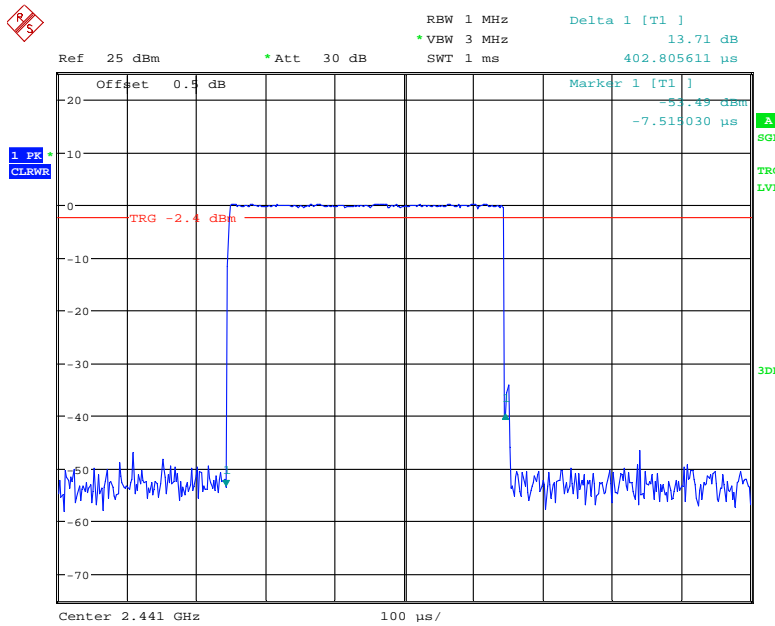
Test Mode: Transmitting

Mode	Packet type	Channel	Frequency (MHz)	Pulse width (ms)	Result (s)	Limit (s)
GFSK	DH1	Middle	2441	0.403	0.129	0.4
	DH3	Middle	2441	1.695	0.271	
	DH5	Middle	2441	2.966	0.316	
$\pi/4$ DQPSK	2DH1	Middle	2441	0.403	0.129	
	2DH3	Middle	2441	1.695	0.271	
	2DH5	Middle	2441	2.966	0.316	
8-DPSK	3DH1	Middle	2441	0.385	0.123	
	3DH3	Middle	2441	1.695	0.271	
	3DH5	Middle	2441	2.966	0.316	

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

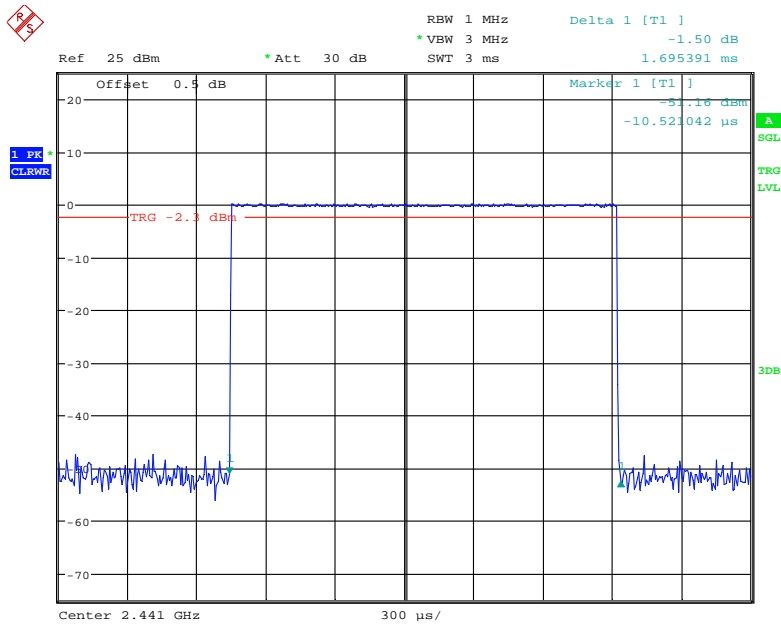
BDR Mode (GFSK):

DH1: Middle Channel



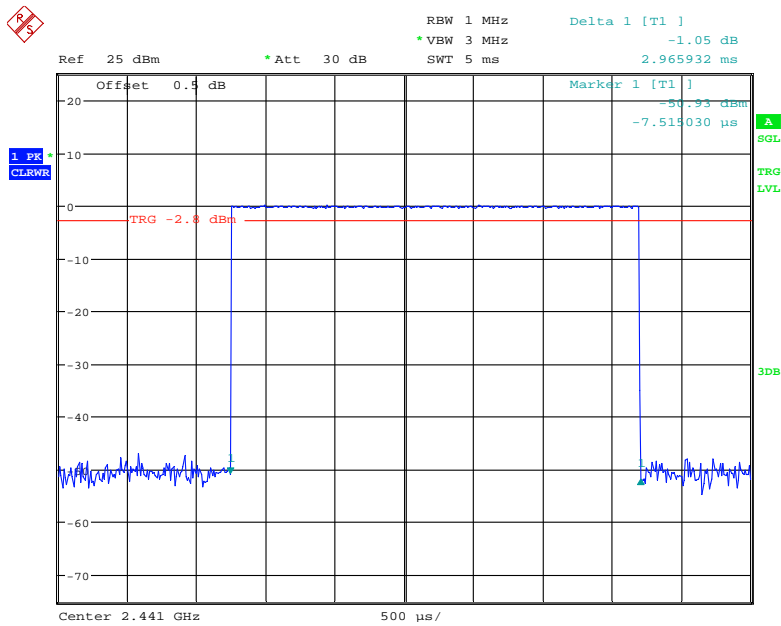
Date: 17.JUL.2019 13:02:29

DH3: Middle Channel



Date: 17.JUL.2019 13:02:59

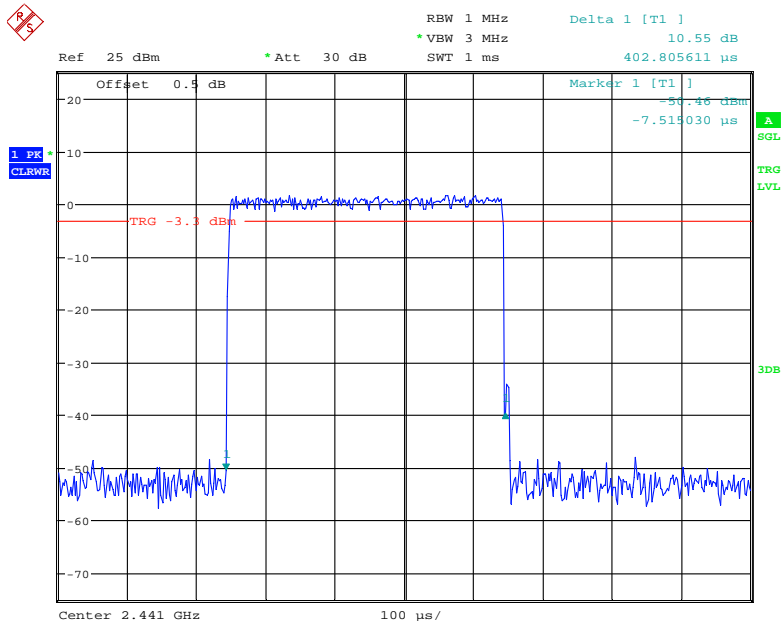
DH5: Middle Channel



Date: 17.JUL.2019 13:04:00

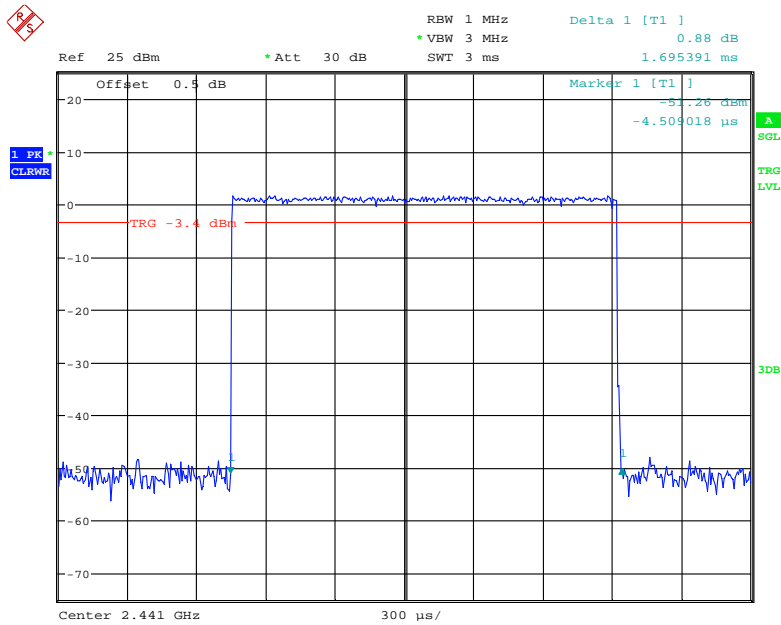
EDR Mode ($\pi/4$ -DQPSK):

2DH1: Middle Channel



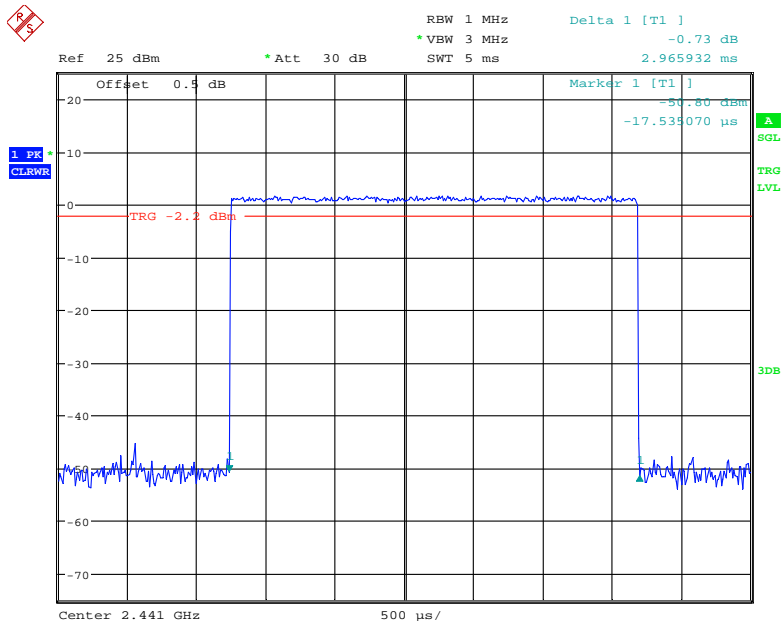
Date: 17.JUL.2019 13:04:33

2DH3: Middle Channel



Date: 17.JUL.2019 13:05:00

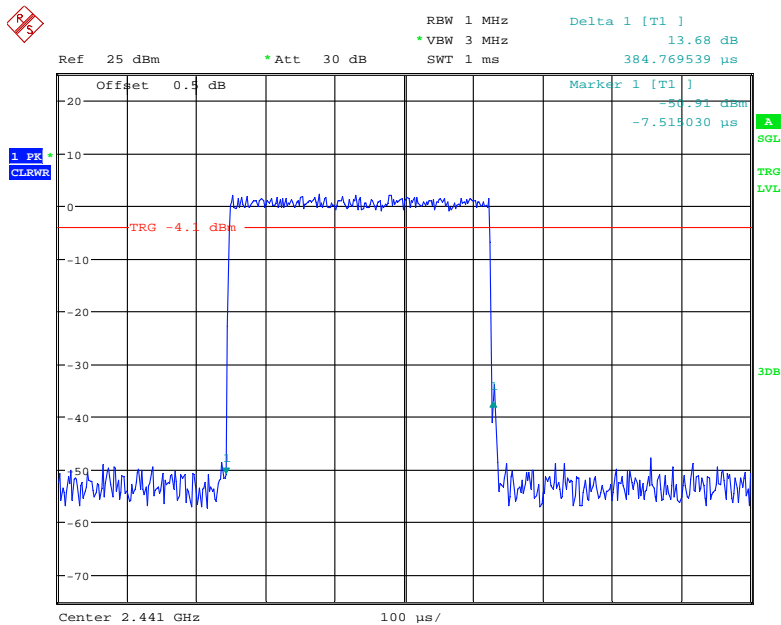
2DH5: Middle Channel



Date: 17.JUL.2019 13:05:33

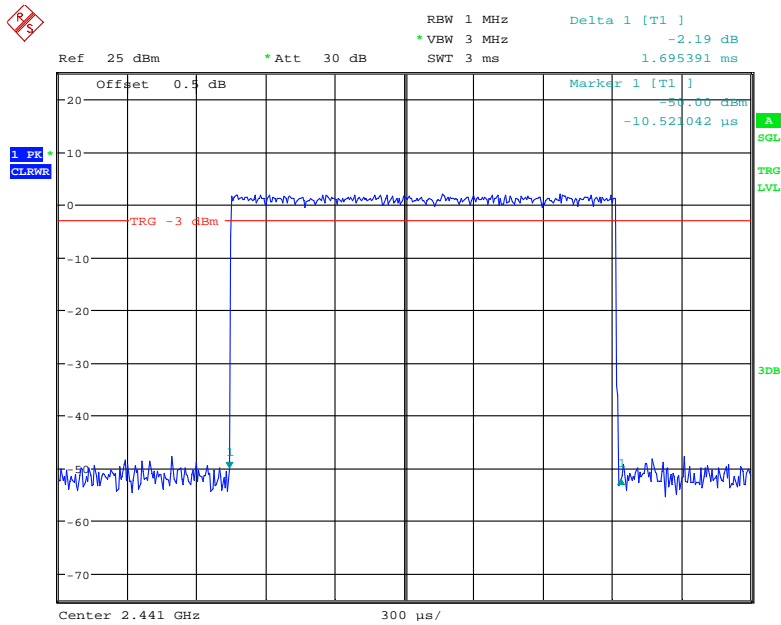
EDR Mode (8-DPSK):

3DH1: Middle Channel



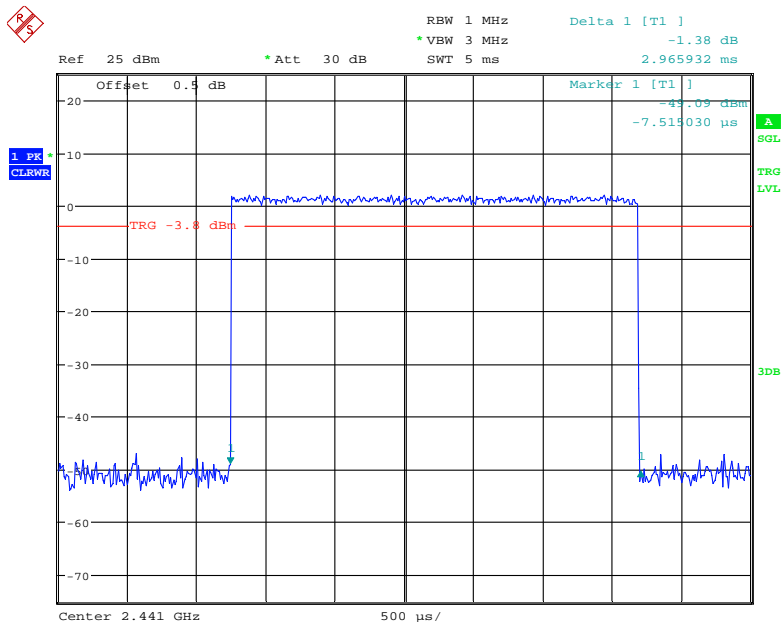
Date: 17.JUL.2019 13:08:21

3DH3: Middle Channel



Date: 17.JUL.2019 13:07:20

3DH5: Middle Channel



Date: 17.JUL.2019 13:06:29

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:	29.1°C
Relative Humidity:	52 %
ATM Pressure:	100.3 kPa
Test by:	Elena Lei
Test Date:	2019-07-17

Test Result: Compliance.

Test Mode: Transmitting

Mode	Frequency (MHz)	Peak Conducted Output power (dBm)	Limit (dBm)
BDR Mode (GFSK)	2402	1.06	21
	2441	0.32	21
	2480	-0.68	21
EDR Mode ($\pi/4$ -DQPSK)	2402	3.22	21
	2441	2.48	21
	2480	1.48	21
EDR Mode (8-DPSK)	2402	3.50	21
	2441	2.67	21
	2480	1.84	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	FSU 26	200256	2019-05-09	2020-05-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

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

Test Data

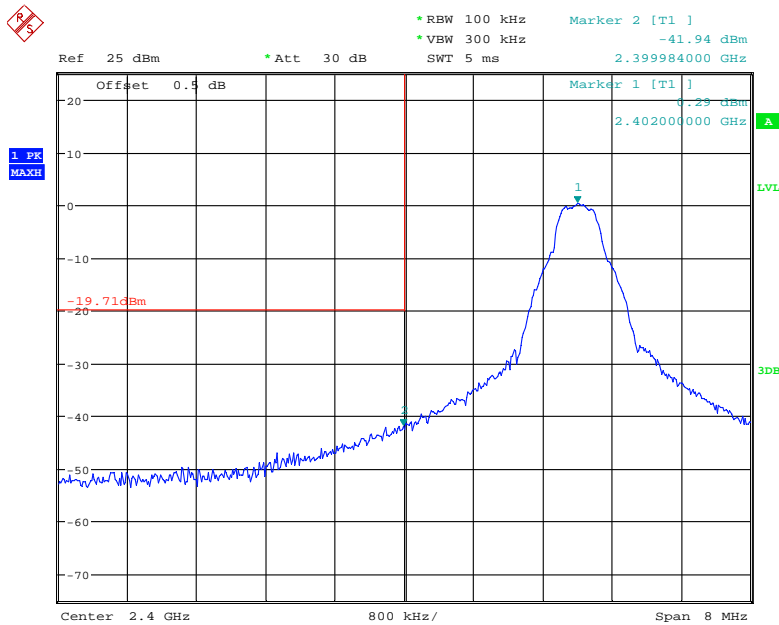
Environmental Conditions

Temperature:	29.1°C
Relative Humidity:	52 %
ATM Pressure:	100.3 kPa
Test by:	Elena Lei
Test Date:	2019-07-17

Test Result: Compliance

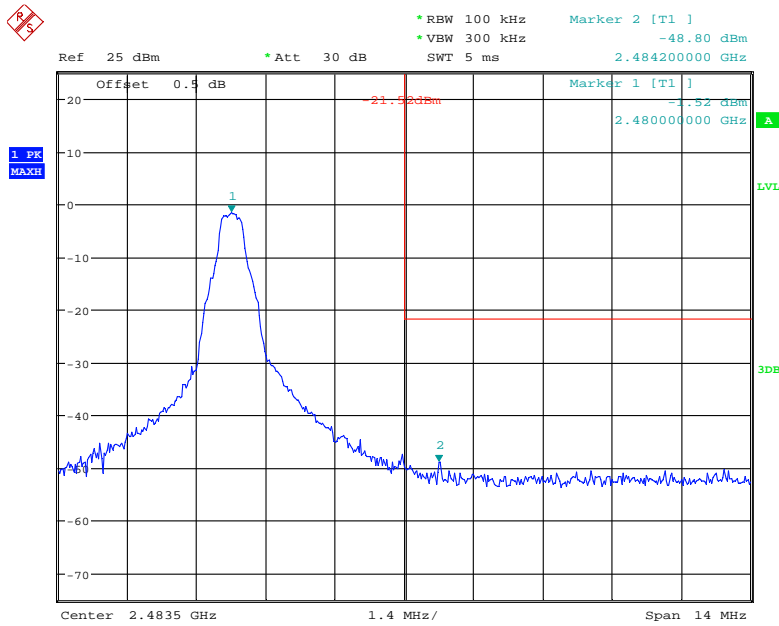
Single Channel Mode,
BDR Mode (GFSK):

Band Edge, Left Side



Date: 17.JUL.2019 11:41:14

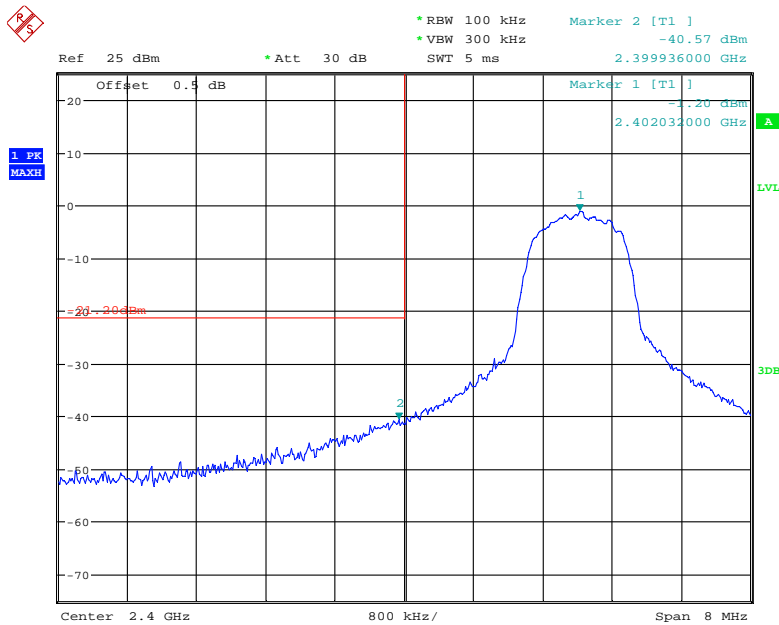
Band Edge, Right Side



Date: 17.JUL.2019 11:44:24

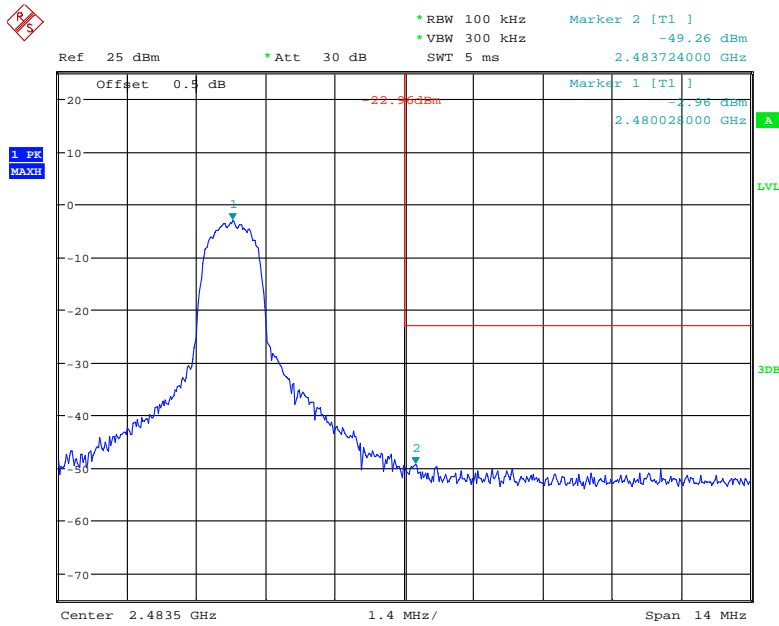
EDR Mode ($\pi/4$ -DQPSK):

Band Edge, Left Side



Date: 17.JUL.2019 11:47:58

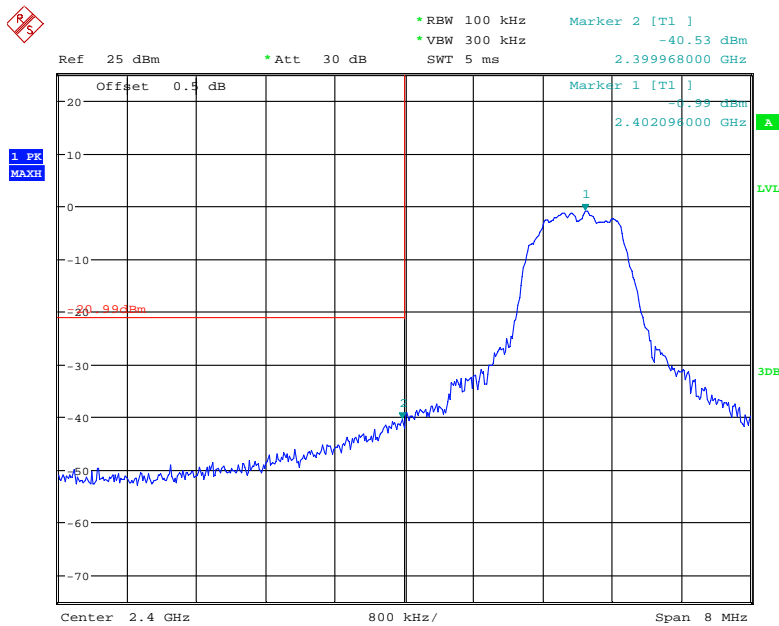
Band Edge, Right Side



Date: 17.JUL.2019 11:46:06

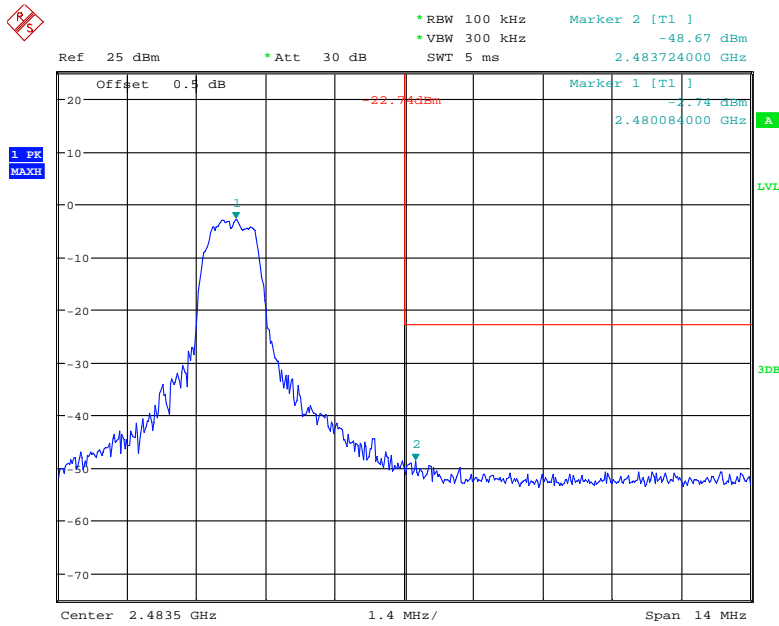
EDR Mode (8-DPSK):

Band Edge, Left Side



Date: 17.JUL.2019 11:53:28

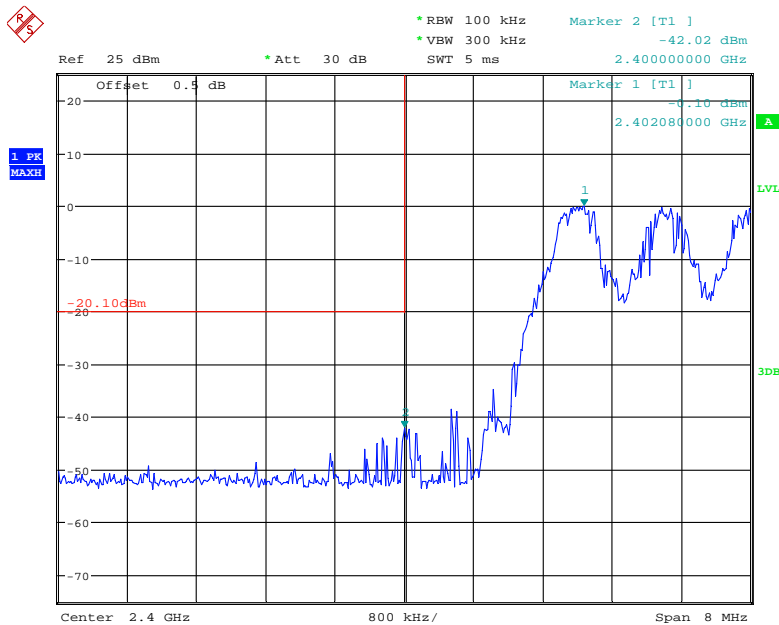
Band Edge, Right Side



Date: 17.JUL.2019 11:55:12

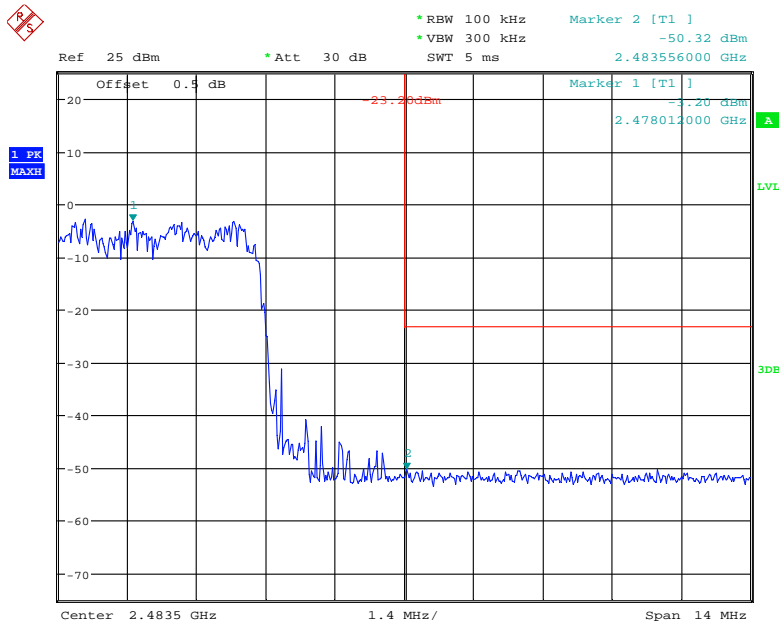
*Hopping Mode,
BDR Mode (GFSK):*

Band Edge, Left Side



Date: 17.JUL.2019 13:15:56

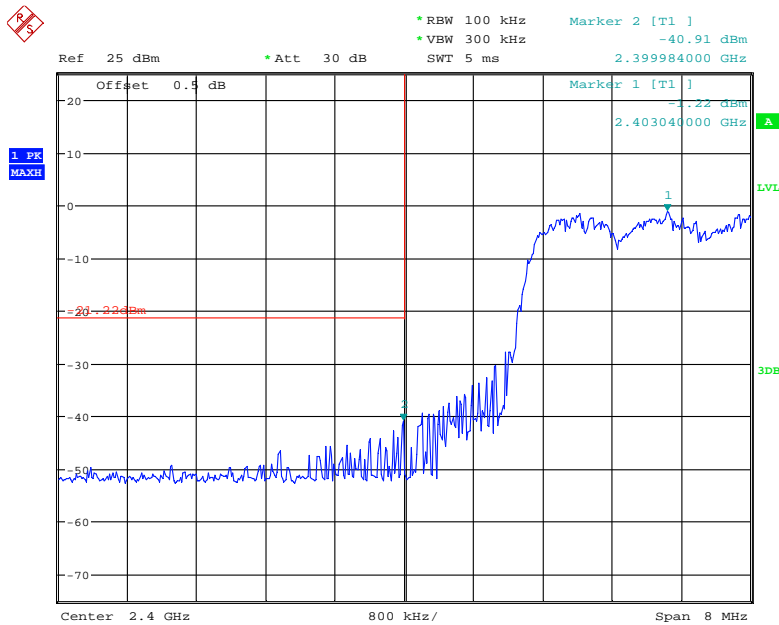
Band Edge, Right Side



Date: 17.JUL.2019 13:19:02

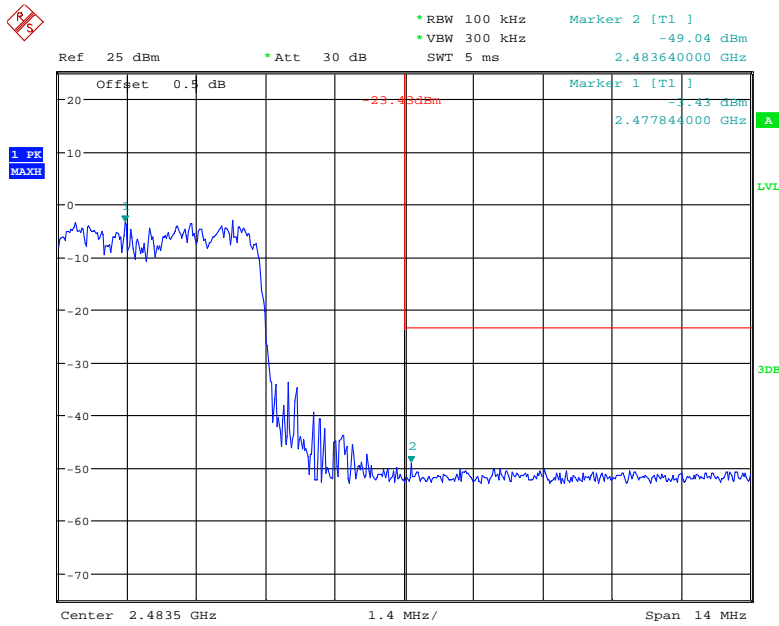
EDR Mode (8-DPSK):

Band Edge, Left Side



Date: 17.JUL.2019 13:21:34

Band Edge, Right Side



Date: 17.JUL.2019 13:23:25

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