



TESTING LABORATORY
CERTIFICATE #4820.01



FCC PART 15.247

TEST REPORT

For

Aukey Technology Co.,Ltd.

Room 102, Building P09, South China City, Electronic trading center, Longgang District, Shenzhen, China,
518111

FCC ID:2ATIH-EPN33

Report Type: Original Report	Product Name: Neckband Wireless Earbuds
Report Number: RDG200220005-00A	
Report Date: 2020-03-31	
Reviewed By:	Ivan Cao Assistant Manager 
Test Laboratory:	Bay Area Compliance Laboratories Corp. (Dongguan) No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China Tel: +86-769-86858888 Fax: +86-769-86858891 www.baclcorp.com.cn

TABLE OF CONTENTS

GENERAL INFORMATION.....	4
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	4
OBJECTIVE	4
RELATED SUBMITTAL(S)/GRANT(S)	4
TEST METHODOLOGY	4
MEASUREMENT UNCERTAINTY	5
TEST FACILITY	5
DECLARATIONS	5
SYSTEM TEST CONFIGURATION.....	6
DESCRIPTION OF TEST CONFIGURATION	6
EUT EXERCISE SOFTWARE	6
EQUIPMENT MODIFICATIONS	6
SUPPORT EQUIPMENT LIST AND DETAILS	6
SUPPORT CABLE LIST AND DETAILS	6
BLOCK DIAGRAM OF TEST SETUP	7
SUMMARY OF TEST RESULTS.....	8
FCC §15.247 (i) & §1.1310 & §2.1093- RF EXPOSURE.....	9
APPLICABLE STANDARD	9
FCC §15.203 - ANTENNA REQUIREMENT.....	10
APPLICABLE STANDARD	10
ANTENNA CONNECTOR CONSTRUCTION	10
FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS	11
APPLICABLE STANDARD	11
EUT SETUP	11
EMI TEST RECEIVER SETUP.....	11
TEST PROCEDURE	11
CORRECTED AMPLITUDE & MARGIN CALCULATION	12
TEST EQUIPMENT LIST AND DETAILS.....	12
TEST DATA	12
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS.....	15
APPLICABLE STANDARD	15
EUT SETUP	15
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP	16
TEST PROCEDURE	16
CORRECTED AMPLITUDE & MARGIN CALCULATION	16
TEST EQUIPMENT LIST AND DETAILS.....	17
TEST DATA	17
FCC §15.247(a) (1) - CHANNEL SEPARATION TEST	23
APPLICABLE STANDARD	23
TEST EQUIPMENT LIST AND DETAILS.....	23
TEST PROCEDURE	23
TEST DATA	23
FCC §15.247(a) (1) – 20 dB BANDWIDTH TESTING.....	29
APPLICABLE STANDARD	29
TEST PROCEDURE	29

TEST EQUIPMENT LIST AND DETAILS.....	29
TEST DATA	29
FCC §15.247(a) (1) (iii) - QUANTITY OF HOPPING CHANNEL TEST	35
APPLICABLE STANDARD	35
TEST PROCEDURE	35
TEST EQUIPMENT LIST AND DETAILS.....	35
TEST DATA	35
FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME).....	38
APPLICABLE STANDARD	38
TEST PROCEDURE	38
TEST EQUIPMENT LIST AND DETAILS.....	38
TEST DATA	38
FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT	44
APPLICABLE STANDARD	44
TEST PROCEDURE	44
TEST EQUIPMENT LIST AND DETAILS.....	44
TEST DATA	44
FCC §15.247(d) - BAND EDGES TESTING	46
APPLICABLE STANDARD	46
TEST PROCEDURE	46
TEST EQUIPMENT LIST AND DETAILS.....	46
TEST DATA	47

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:	Neckband Wireless Earbuds
EUT Model:	EP-N33
Operation Frequency:	2402-2480 MHz
Maximum Output Power (Conducted):	2.91 dBm
Modulation Type:	GFSK, $\pi/4$ -DQPSK, 8DPSK
Rated Input Voltage:	DC 3.7V from Battery or DC 5V from USB port
Serial Number:	RDG200220005-RF-S1
EUT Received Date:	2020.02.05
EUT Received Status:	Good

Objective

This report is prepared on behalf of **Aukey Technology 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)

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

Test Facility

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

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

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

Declarations

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

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

This report cannot be reproduced except in full, without prior written approval of the Company.

This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

This report must not be used by the customer to claim product certification, approval, or endorsement by A2LA, or any agency of the U.S. Government.

This report may contain data that are not covered by the accreditation scope and shall be marked with an asterisk “★”.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in RF Transmitting mode.

EUT Exercise Software

The software " BQB.exe "was used for testing and the maximum power was configured as below:

Test Software Version	BQB.exe		
Test Frequency	2402MHz	2441MHz	2480MHz
GFSK	default	default	default
$\pi/4$ -DQPSK	default	default	default
8DPSK	default	default	default

Equipment Modifications

No modification was made to the EUT.

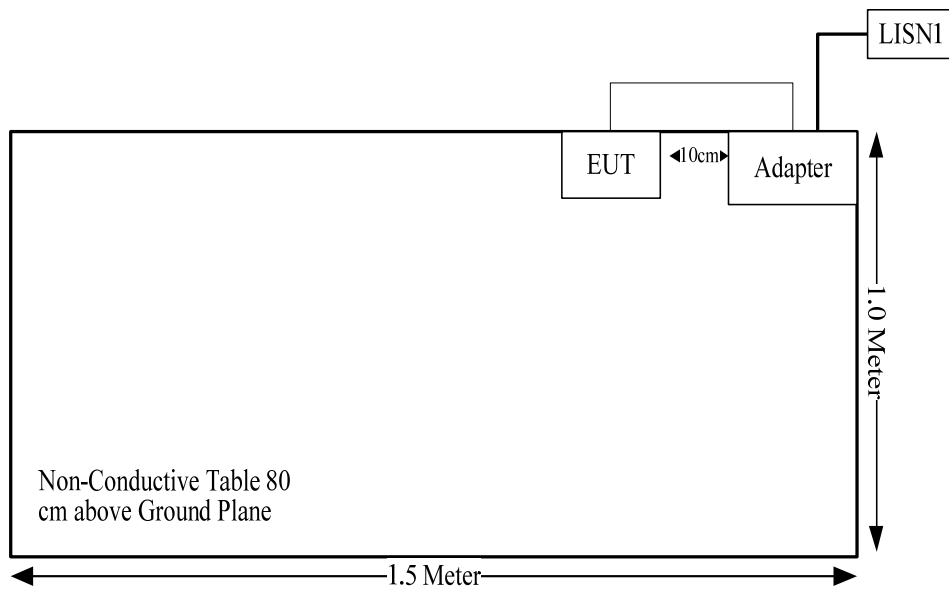
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Switching Adapter	Adapter	PS06C050K1000UU	006

Support Cable List and Details

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

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC§15.247 (i) & §1.1310 & §2.1093	RF Exposure	Compliance
§15.203	Antenna Requirement	Compliance
FCC §15.207(a)	AC line conducted emissions	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(1)	20 dB Bandwidth	Compliance
§15.247(a)(1)	Channel Separation Test	Compliance
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliance
§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliance
§15.247(b)(1)	Peak Output Power Measurement	Compliance
§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 3.0 dBm (2.0 mW).

$[(\text{max. power of channel, mW})/(\text{min. test separation distance, mm})][\sqrt{f(\text{GHz})}]$
 $= 2/5 \cdot (\sqrt{2.480}) = 0.6 < 3.0$

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, fulfill the requirement of this section. Please refer to below information and the EUT photos:

Antenna Type	input impedance (Ohm)	Antenna Gain /Frequency Range
Chip	50	0dBi/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	2019-09-05	2020-09-05
R&S	Test Software	EMC32	Version8.53.0	N/A	N/A
R&S	LISN	ENV 216	101614	2019-09-12	2020-09-12
R&S	EMI Test Receiver	ESCI	101121	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).

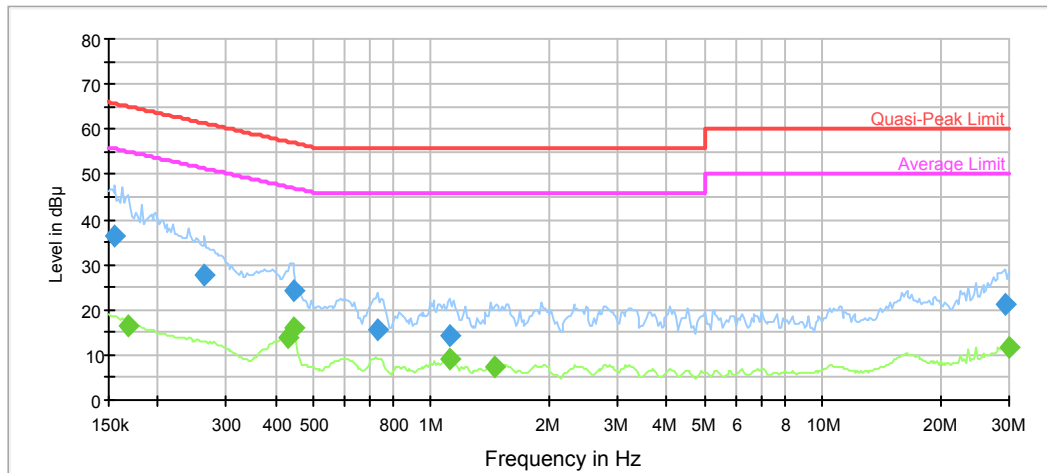
Test Data

Environmental Conditions

Temperature:	22.1 °C
Relative Humidity:	69%
ATM Pressure:	101.7kPa
Tester:	Sern Xiang
Test Date:	2020-02-25

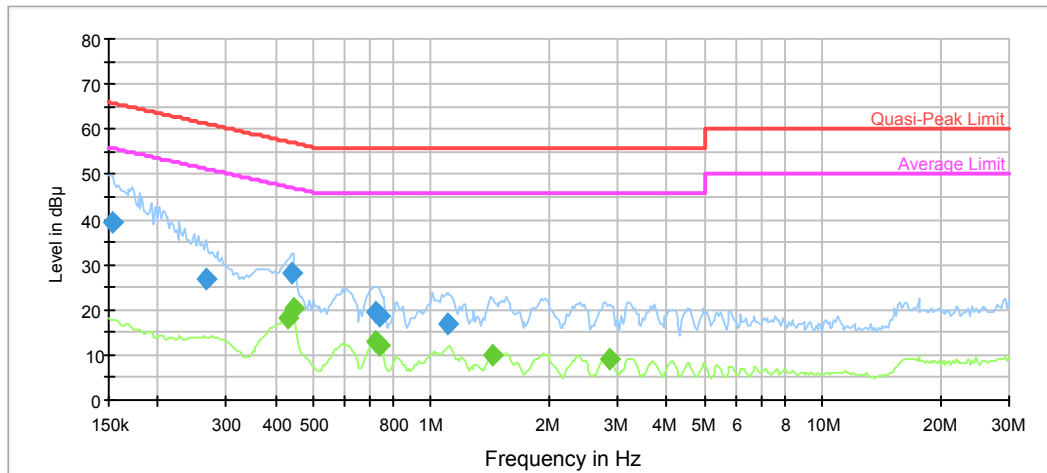
Test Result: Compliance

Test Mode: Transmitting

AC120V, 60 Hz, Line:

Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.156091	36.2	9.000	L1	9.7	29.5	65.7
0.264490	27.5	9.000	L1	9.7	33.8	61.3
0.443733	24.1	9.000	L1	9.7	32.9	57.0
0.729777	15.5	9.000	L1	9.7	40.5	56.0
1.119461	14.2	9.000	L1	9.7	41.8	56.0
29.269793	21.1	9.000	L1	10.2	38.9	60.0

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.167350	16.3	9.000	L1	9.7	38.8	55.1
0.430682	13.7	9.000	L1	9.7	33.5	47.2
0.443733	15.8	9.000	L1	9.7	31.2	47.0
1.119461	9.0	9.000	L1	9.7	37.0	46.0
1.449989	7.6	9.000	L1	9.7	38.4	46.0
29.858116	11.5	9.000	L1	10.3	38.5	50.0

AC120V, 60 Hz, Neutral:

Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.153015	39.5	9.000	N	9.7	26.3	65.8
0.267135	26.9	9.000	N	9.7	34.3	61.2
0.439339	28.0	9.000	N	9.6	29.1	57.1
0.722551	19.5	9.000	N	9.6	36.5	56.0
0.737074	18.5	9.000	N	9.6	37.5	56.0
1.097403	17.0	9.000	N	9.6	39.0	56.0

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.430682	18.3	9.000	N	9.6	28.9	47.2
0.443733	20.2	9.000	N	9.6	26.8	47.0
0.722551	13.0	9.000	N	9.6	33.0	46.0
0.737074	12.3	9.000	N	9.6	33.7	46.0
1.435633	10.1	9.000	N	9.6	35.9	46.0
2.852451	9.3	9.000	N	9.6	36.7	46.0

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

Applicable Standard

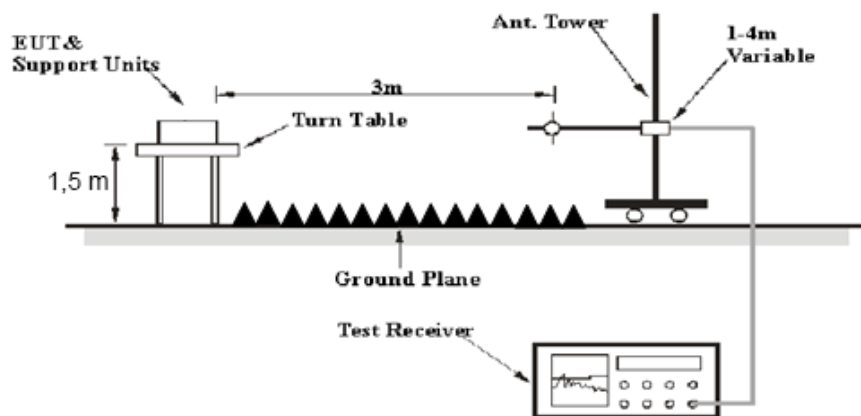
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1GHz:



Above 1GHz:



The radiated emission Below 1GHz tests were performed in the 3 meters chamber 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.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

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

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

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiation Below 1GHz					
R&S	EMI Test Receiver	ESR3	102453	2019-06-26	2020-06-26
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2020-11-10
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2019-09-05	2020-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2019-09-05	2020-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-1400-01	2019-05-06	2020-05-06
HP	Amplifier	8447D	2727A05902	2019-09-05	2020-09-05
Radiation Above 1GHz					
Agilent	Spectrum Analyzer	E4440A	SG43360054	2019-05-09	2020-05-09
ETS-Lindgren	Horn Antenna	3115	000 527 35	2018-10-12	2021-10-12
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2019-11-18	2022-11-18
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2019-09-05	2020-09-05
Unknown	Coaxial Cable	C-2.4J2.4J-50	C-0700-02	2019-06-27	2020-06-27
Mini-Circuit	Amplifier	ZVA-213-S+	54201245	2019-09-05	2020-09-05
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2019-06-27	2020-06-27
E-Microwave	Band-stop Filters	OBSF-2400-2483.5-S	OE01601525	2019-06-16	2020-06-16
Micro-tronics	High Pass Filter	HPM50111	S/N-G217	2019-06-16	2020-06-16

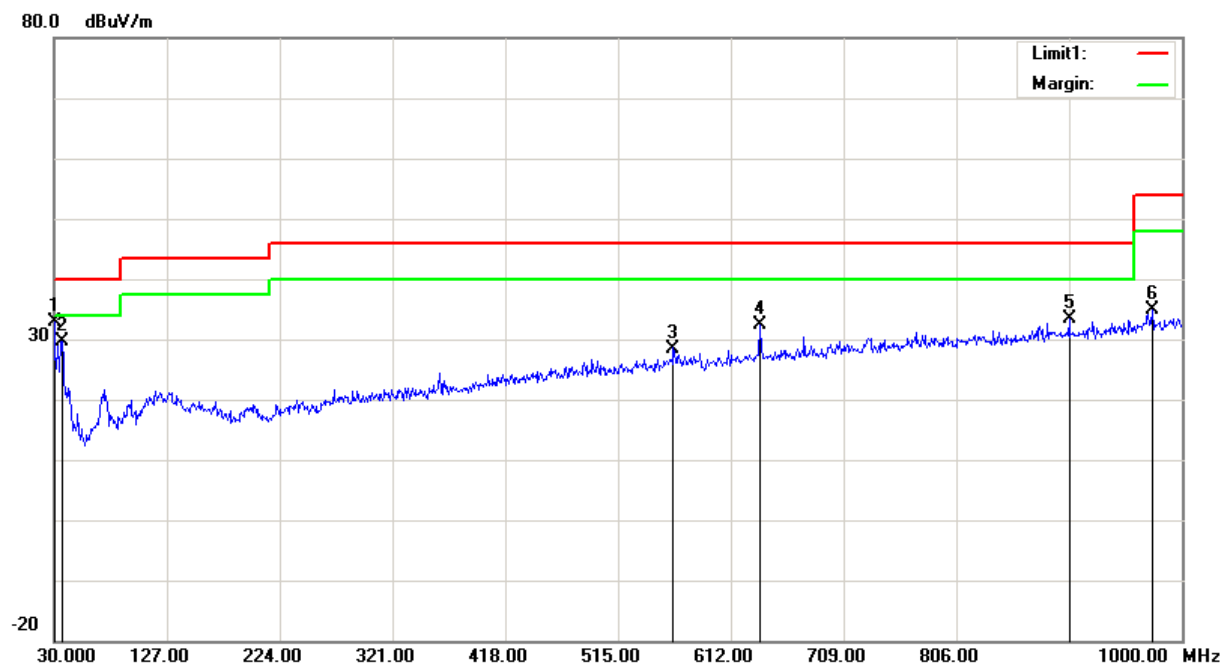
*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data**Environmental Conditions**

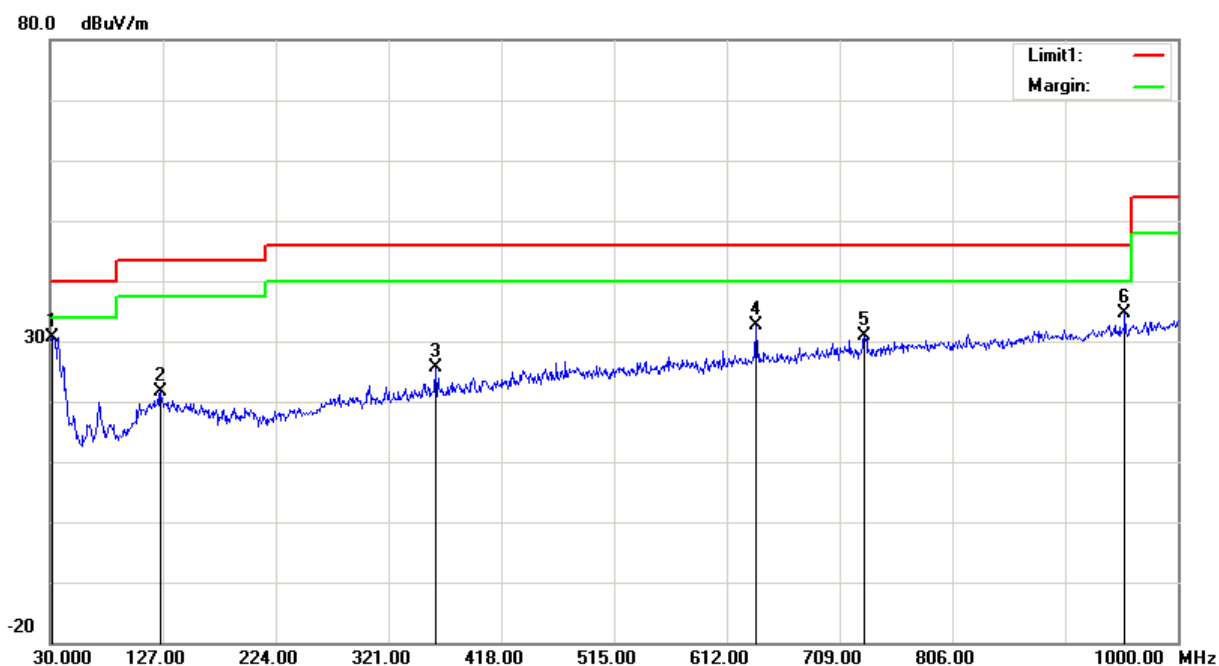
Test Items	Radiation Below 1GHz	Radiation Above 1GHz
Temperature:	25.1°C	24°C
Relative Humidity:	49%	58%
ATM Pressure:	100.8kPa	101.7kPa
Tester:	Vern Shen	Felix Wang
Test Date:	2020-03-21	2020-02-28

Test Mode: Transmitting

Please refer to following table and plots:

1) 30MHz-1GHz ($\pi/4$ -DQPSK Low channel was the worst)**Horizontal:**

Frequency (MHz)	Reading (dB μ V)	Detector	Corrected (dB/m)	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
30.0000	31.27	peak	1.72	32.99	40.00	7.01
36.7900	32.96	peak	-3.38	29.58	40.00	10.42
562.5300	27.75	peak	0.75	28.50	46.00	17.50
637.2200	30.12	peak	2.20	32.32	46.00	13.68
903.0000	33.21	peak	0.16	33.37	46.00	12.63
974.7800	33.63	peak	1.25	34.88	54.00	19.12

Vertical:

Frequency (MHz)	Reading (dB μ V)	Detector	Corrected (dB/m)	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
31.9400	30.49	peak	0.19	30.68	40.00	9.32
125.0600	26.36	peak	-4.64	21.72	43.50	21.78
361.7400	28.53	peak	-2.80	25.73	46.00	20.27
637.2200	30.43	peak	2.20	32.63	46.00	13.37
730.3400	27.61	peak	3.28	30.89	46.00	15.11
954.4100	33.85	peak	0.82	34.67	46.00	11.33

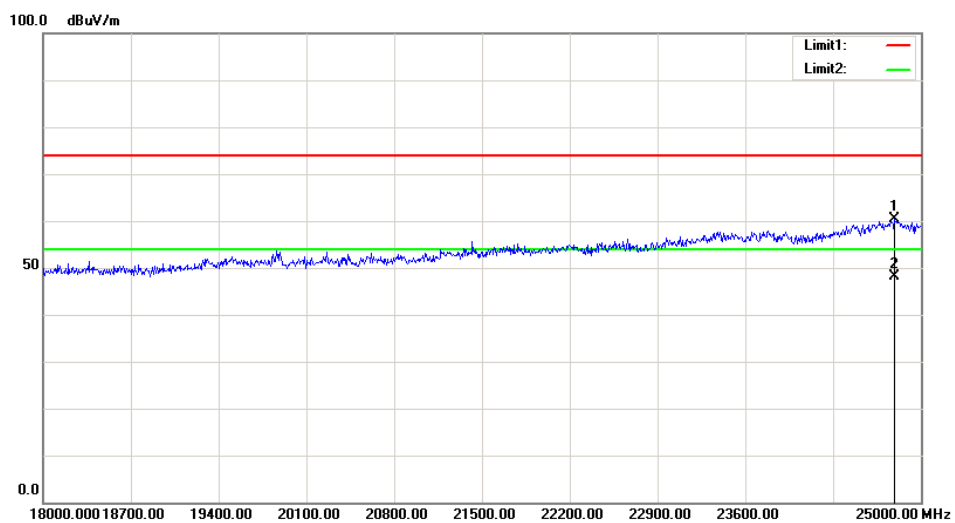
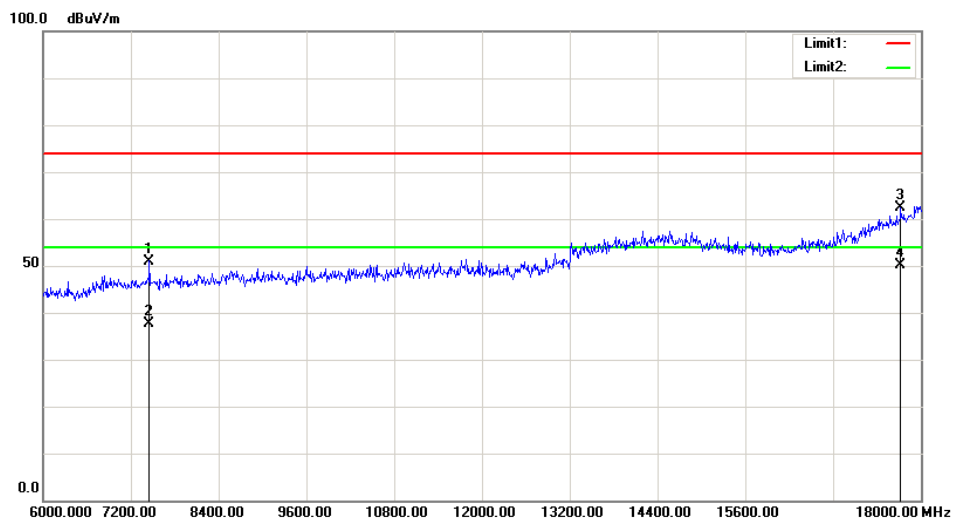
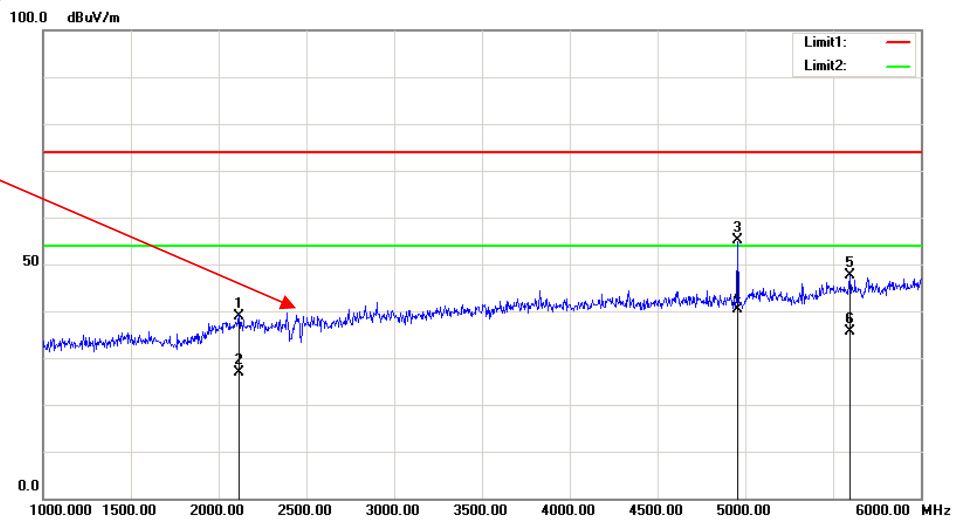
2)1GHz-25GHz:*EDR Mode ($\pi/4$ -DQPSK) was the worst*

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	66.27	PK	H	28.10	1.80	0.00	96.17	N/A	N/A
2402.00	50.89	AV	H	28.10	1.80	0.00	80.79	N/A	N/A
2402.00	59.45	PK	V	28.10	1.80	0.00	89.35	N/A	N/A
2402.00	43.78	AV	V	28.10	1.80	0.00	73.68	N/A	N/A
2390.00	26.79	PK	H	28.08	1.80	0.00	56.67	74.00	17.33
2390.00	13.38	AV	H	28.08	1.80	0.00	43.26	54.00	10.74
4804.00	39.85	PK	H	32.91	3.17	25.60	50.33	74.00	23.67
4804.00	26.21	AV	H	32.91	3.17	25.60	36.69	54.00	17.31
7206.00	36.29	PK	H	35.74	4.82	25.60	51.25	74.00	22.75
7206.00	22.82	AV	H	35.74	4.82	25.60	37.78	54.00	16.22
Middle Channel: 2441 MHz									
2441.00	68.50	PK	H	28.18	1.82	0.00	98.50	N/A	N/A
2441.00	52.73	AV	H	28.18	1.82	0.00	82.73	N/A	N/A
2441.00	64.82	PK	V	28.18	1.82	0.00	94.82	N/A	N/A
2441.00	49.48	AV	V	28.18	1.82	0.00	79.48	N/A	N/A
4882.00	42.66	PK	H	33.06	3.27	25.66	53.33	74.00	20.67
4882.00	27.23	AV	H	33.06	3.27	25.66	37.90	54.00	16.10
7323.00	35.97	PK	H	36.04	4.62	25.73	50.90	74.00	23.10
7323.00	22.90	AV	H	36.04	4.62	25.73	37.83	54.00	16.17
High Channel: 2480 MHz									
2480.00	69.18	PK	H	28.26	1.84	0.00	99.28	N/A	N/A
2480.00	53.98	AV	H	28.26	1.84	0.00	84.08	N/A	N/A
2480.00	62.86	PK	V	28.26	1.84	0.00	92.96	N/A	N/A
2480.00	47.64	AV	V	28.26	1.84	0.00	77.74	N/A	N/A
2483.50	27.76	PK	H	28.27	1.84	0.00	57.87	74.00	16.13
2483.50	13.95	AV	H	28.27	1.84	0.00	44.06	54.00	9.94
4960.00	44.32	PK	H	33.22	3.23	25.63	55.14	74.00	18.86
4960.00	29.61	AV	H	33.22	3.23	25.63	40.43	54.00	13.57
7440.00	36.05	PK	H	36.34	4.41	25.85	50.95	74.00	23.05
7440.00	22.71	AV	H	36.34	4.41	25.85	37.61	54.00	16.39

Worst plots ($\pi/4$ -DQPSK High channel was the worst)

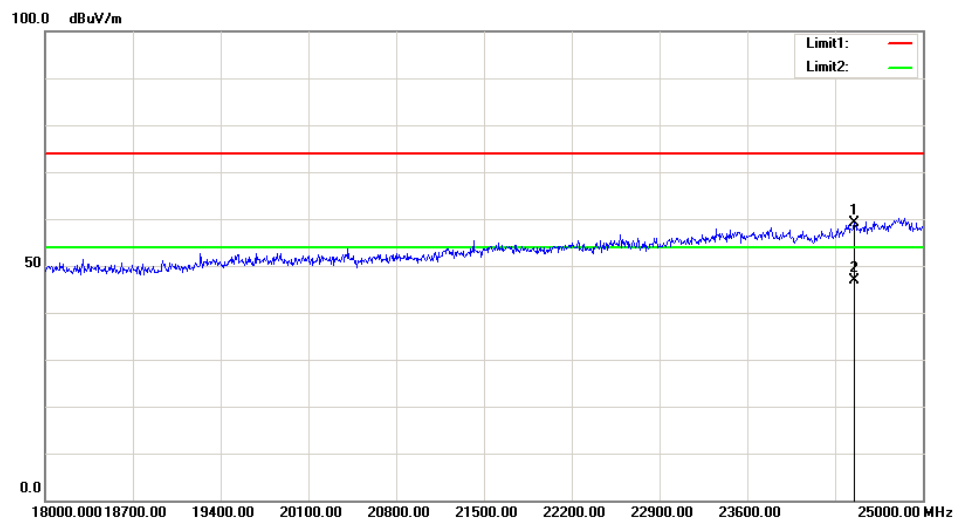
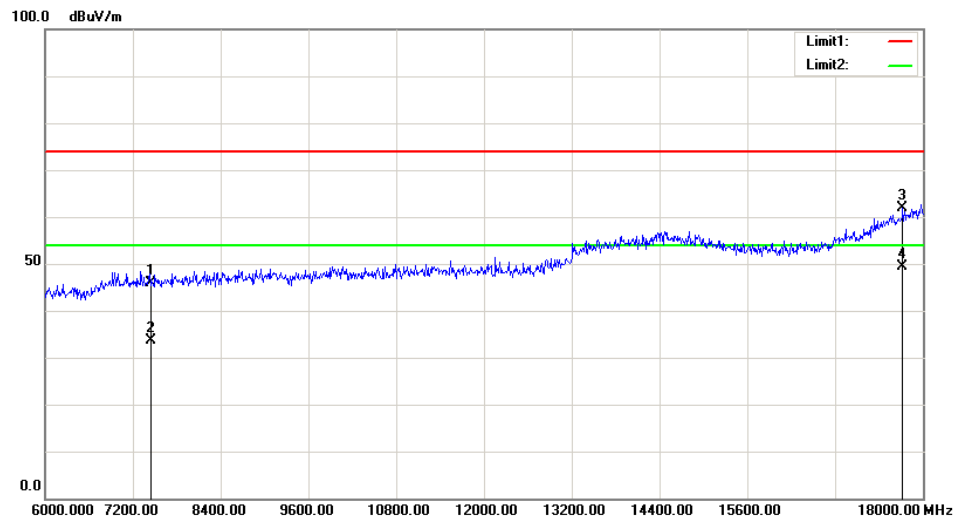
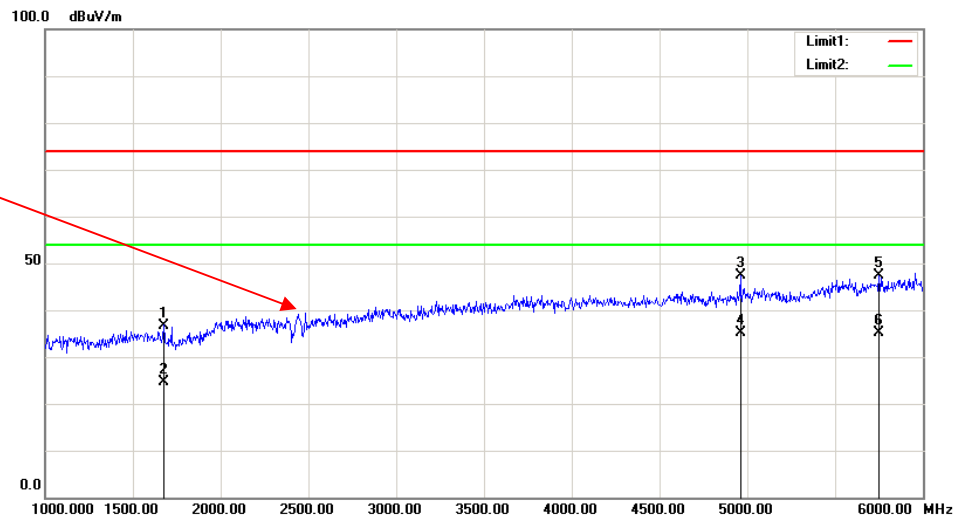
Horizontal:

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	EMI Test Receiver	ESPI	100120	2019-05-09	2020-05-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/03	Each time	N/A

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

Test Procedure

1. Set the EUT in transmitting mode, spectrum Bandwidth was set at 30 kHz, maxhold the channel.
2. Set the adjacent channel of the EUT maxhold another trace.
3. Measure the channel separation.

Test Data**Environmental Conditions**

Temperature:	21.1°C
Relative Humidity:	47%
ATM Pressure:	102.1kPa
Tester:	Chris Mo
Test Date:	2020-02-25

Test Result: Compliance.

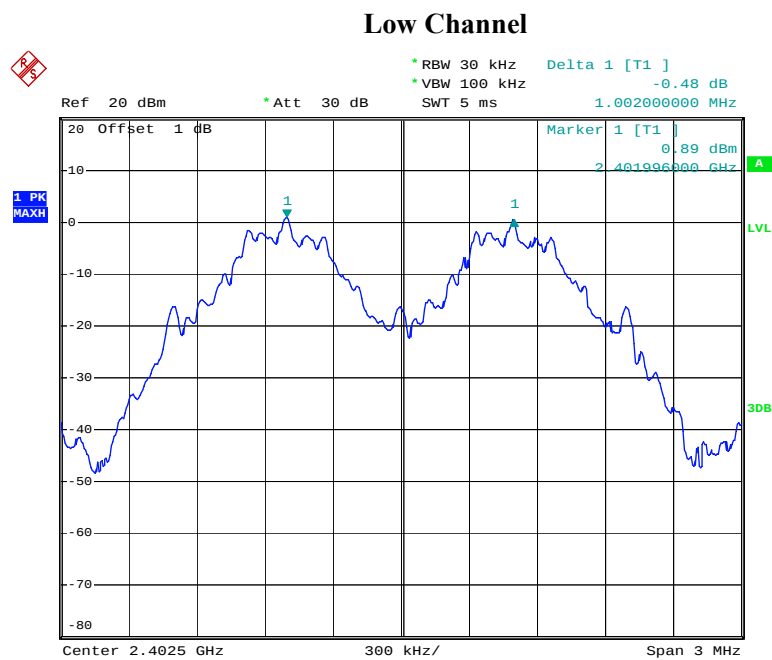
Please refer to following tables and plots

Test Mode: Transmitting

Mode	Channel	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)
GFSK	Low	2402-2403	1.002	0.7
	Middle	2441-2442	1.002	0.7
	High	2480-2479	1.002	0.7
$\pi/4$ -DQPSK	Low	2402-2403	1.002	0.79
	Middle	2441-2442	1.002	0.79
	High	2480-2479	1.002	0.79
8DPSK	Low	2402-2403	1.002	0.83
	Middle	2441-2442	1.002	0.79
	High	2480-2479	1.008	0.79

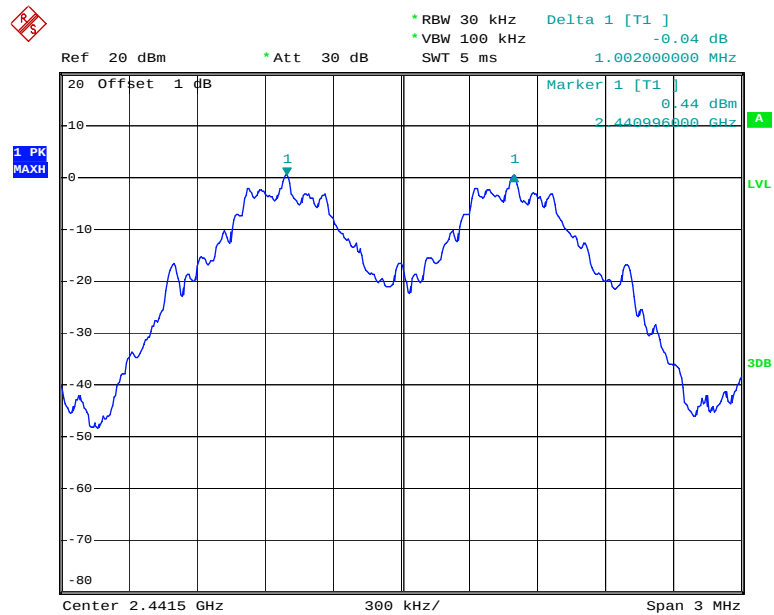
Note: Limit= (2/3) × 20dB bandwidth

GFSK:



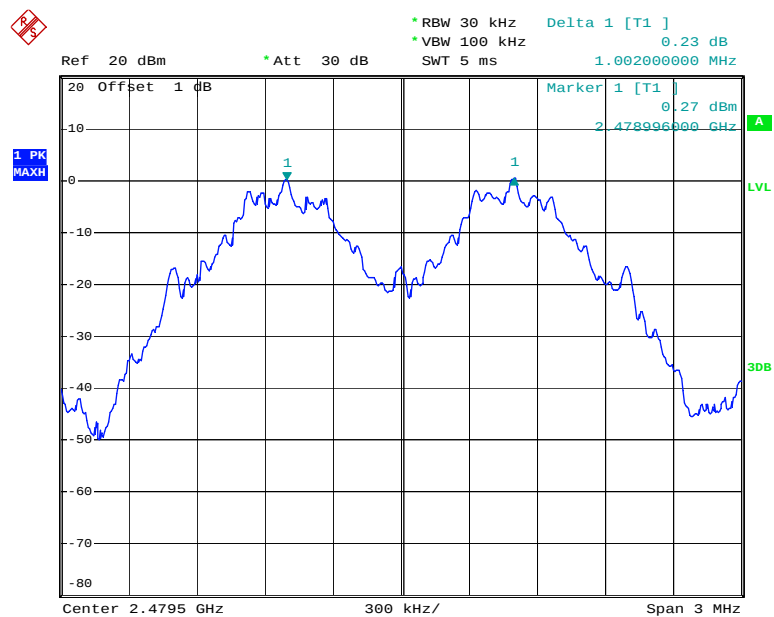
Date: 25.FEB.2020 16:38:52

Middle Channel



Date: 25.FEB.2020 16:40:03

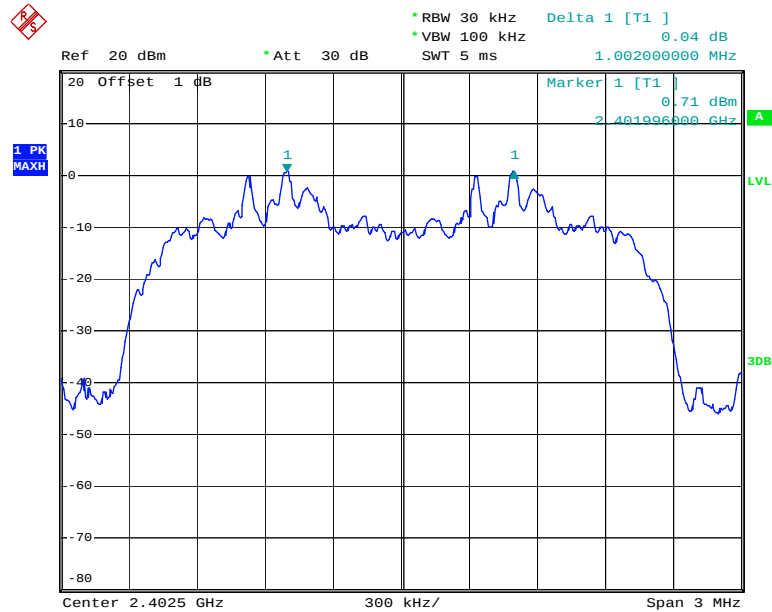
High Channel



Date: 25.FEB.2020 16:40:47

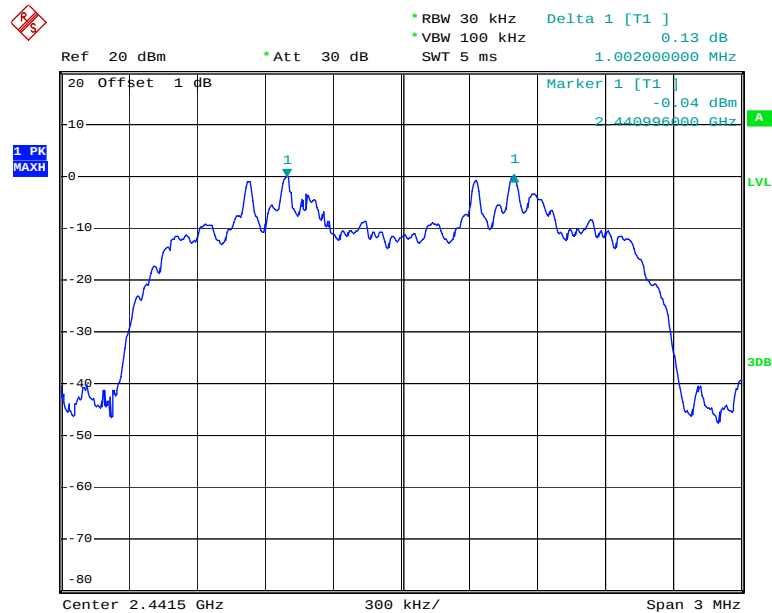
$\pi/4$ -DQPSK:

Low Channel



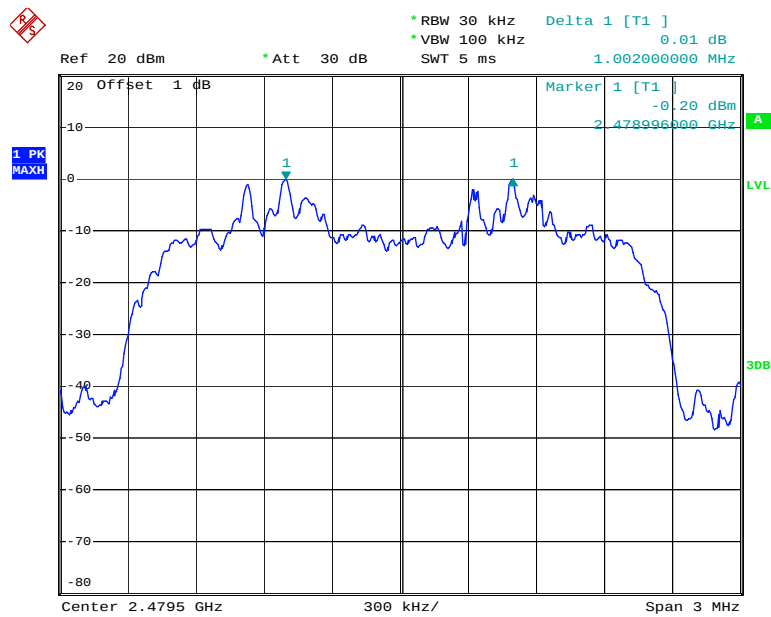
Date: 25.FEB.2020 16:37:24

Middle Channel



Date: 25.FEB.2020 16:36:33

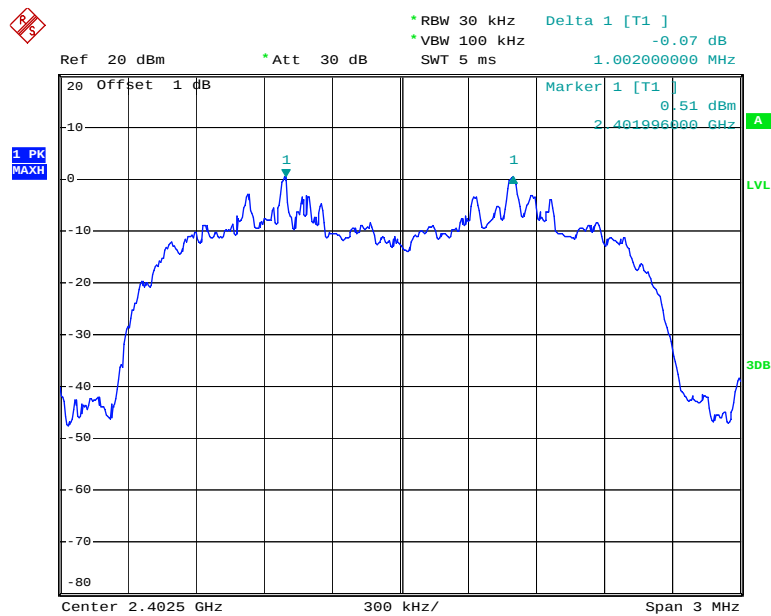
High Channel



Date: 25.FEB.2020 16:35:27

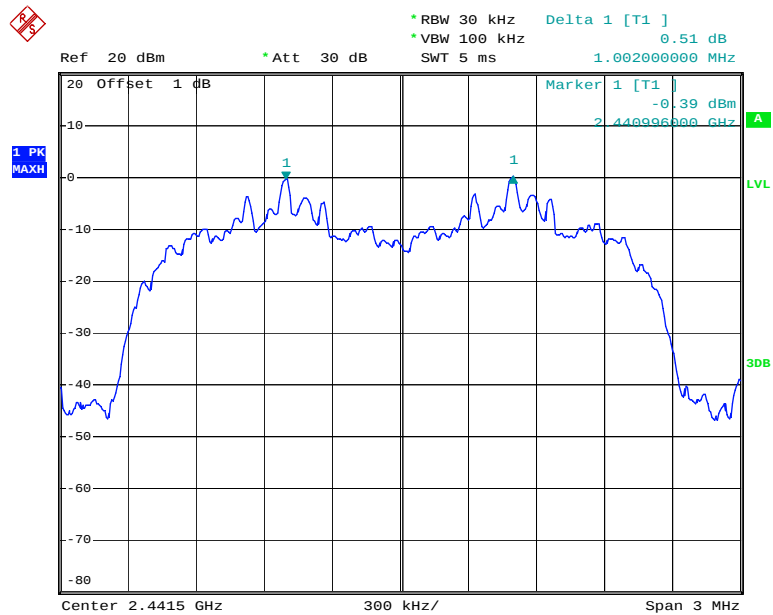
8DPSK:

Low Channel



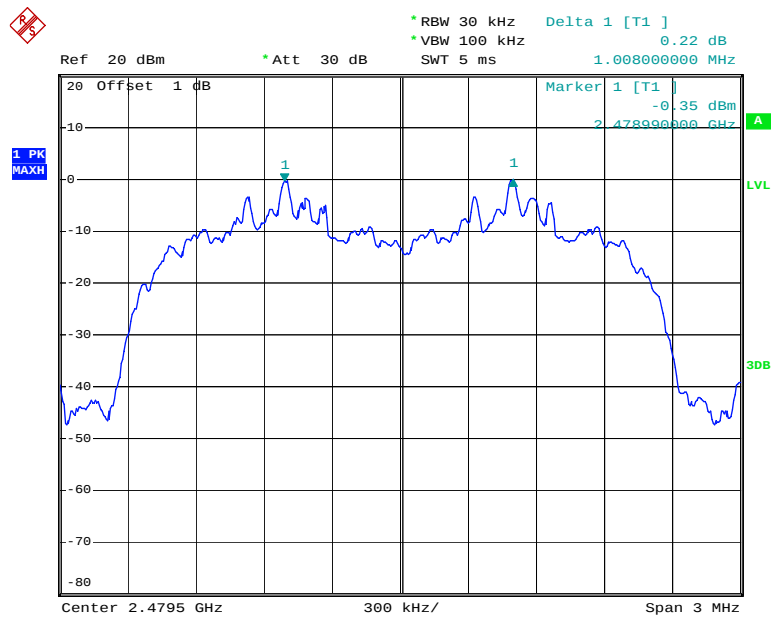
Date: 25.FEB.2020 16:32:48

Middle Channel



Date: 25.FEB.2020 16:33:40

High Channel



Date: 25.FEB.2020 16:34:26

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	EMI Test Receiver	ESPI	100120	2019-05-09	2020-05-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/03	Each time	N/A

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

Test Data**Environmental Conditions**

Temperature:	23°C
Relative Humidity:	52%
ATM Pressure:	101.7kPa
Tester:	Chris Mo
Test Date:	2020-02-25

Test Result: Compliance.

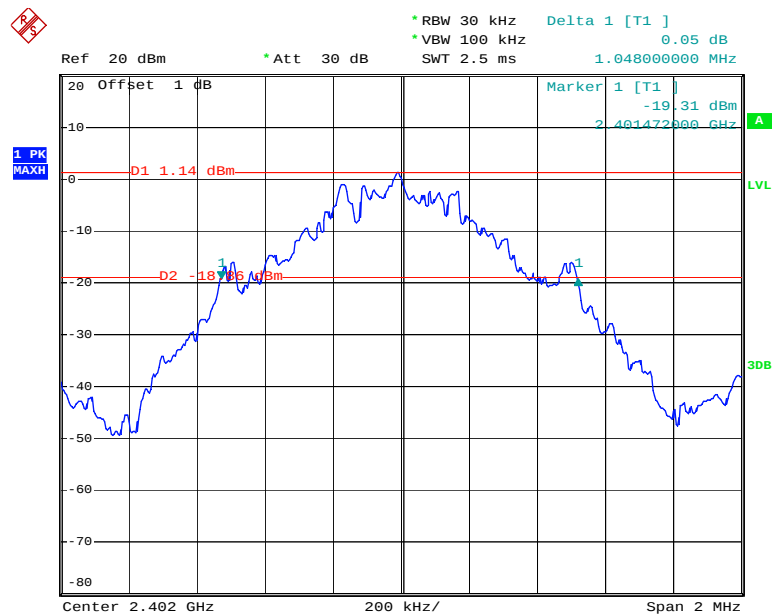
Please refer to following tables and plots

Test Mode: Transmitting

Mode	Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
GFSK	Low	2402	1.048
	Middle	2441	1.044
	High	2480	1.044
$\pi/4$ -DQPSK	Low	2402	1.188
	Middle	2441	1.188
	High	2480	1.184
8DPSK	Low	2402	1.244
	Middle	2441	1.192
	High	2480	1.188

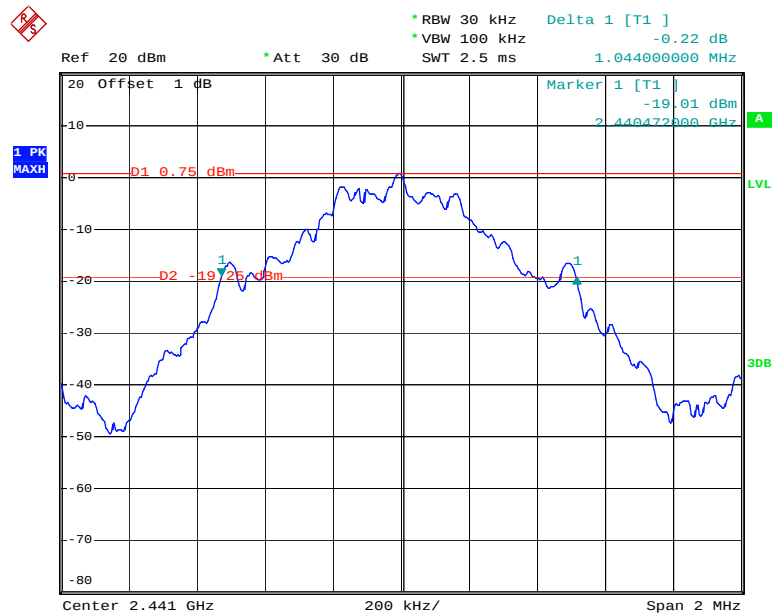
GFSK:

Low Channel



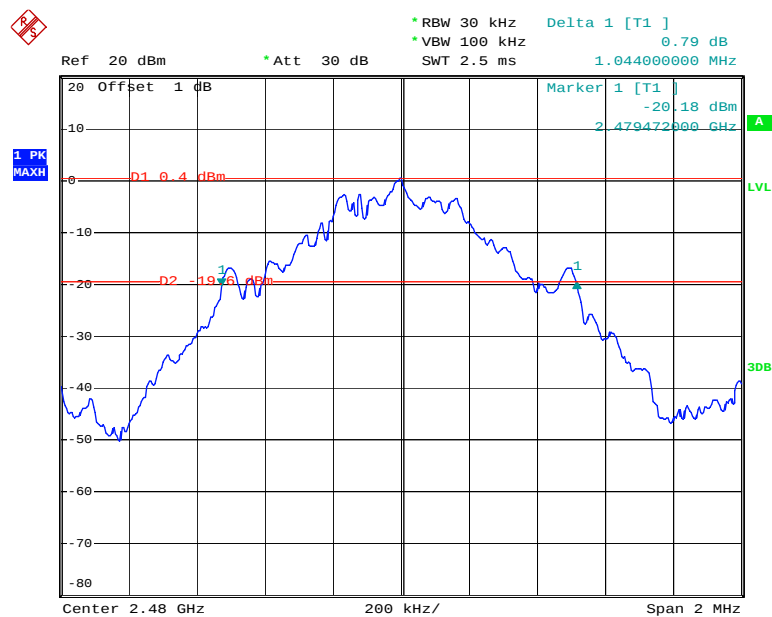
Date: 25.FEB.2020 16:00:14

Middle Channel



Date: 25.FEB.2020 16:02:02

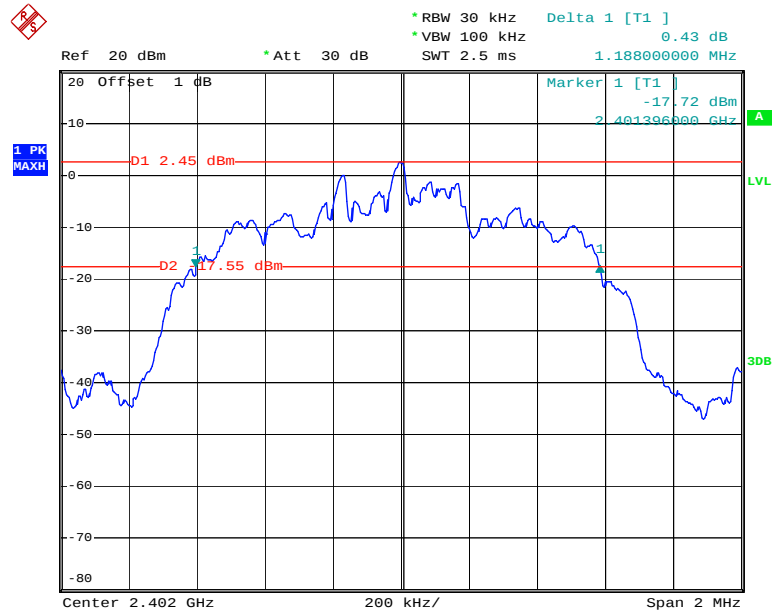
High Channel



Date: 25.FEB.2020 16:03:57

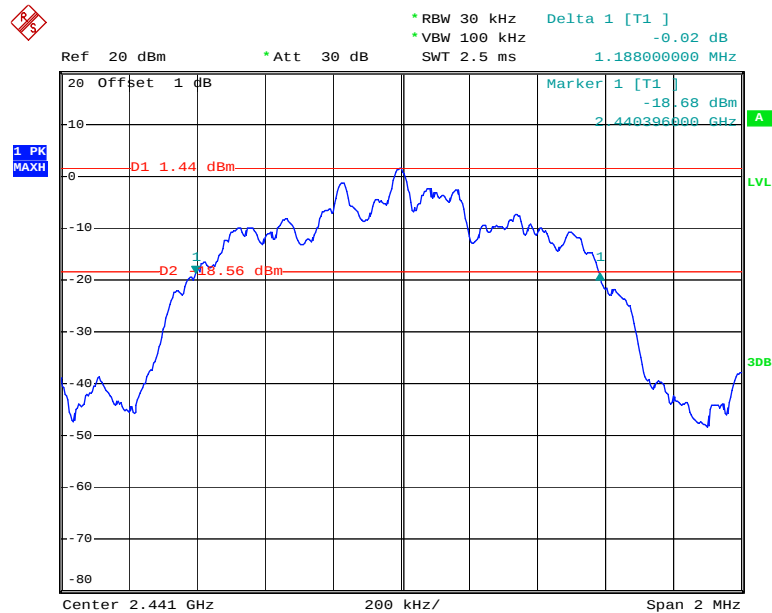
$\pi/4$ -DQPSK:

Low Channel



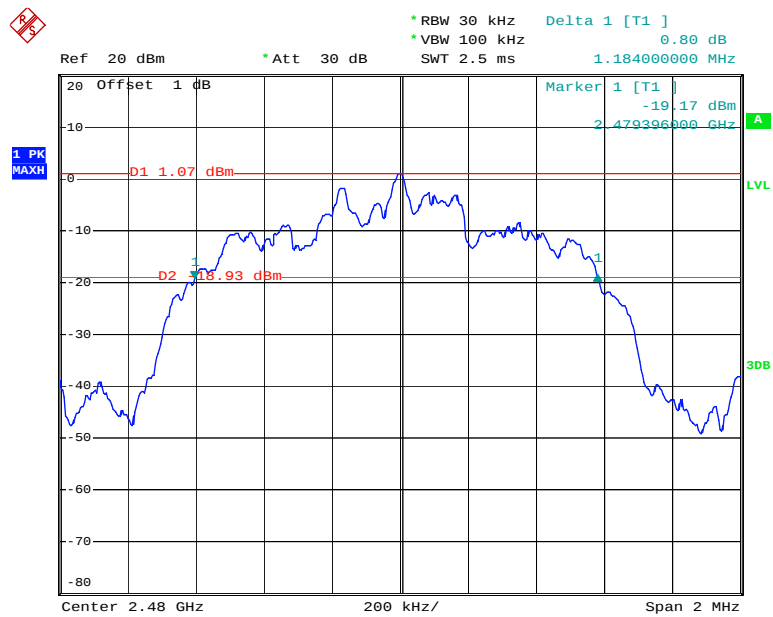
Date: 25.FEB.2020 16:09:04

Middle Channel



Date: 25.FEB.2020 16:10:14

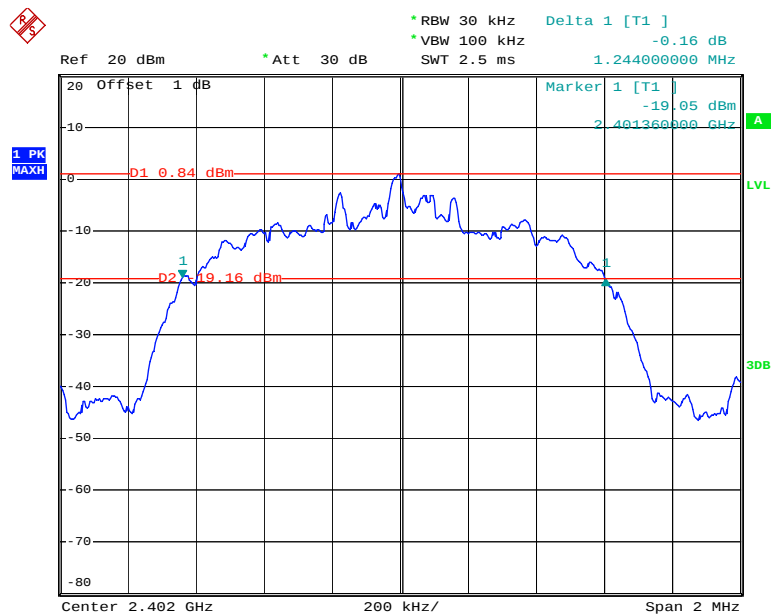
High Channel



Date: 25.FEB.2020 16:11:09

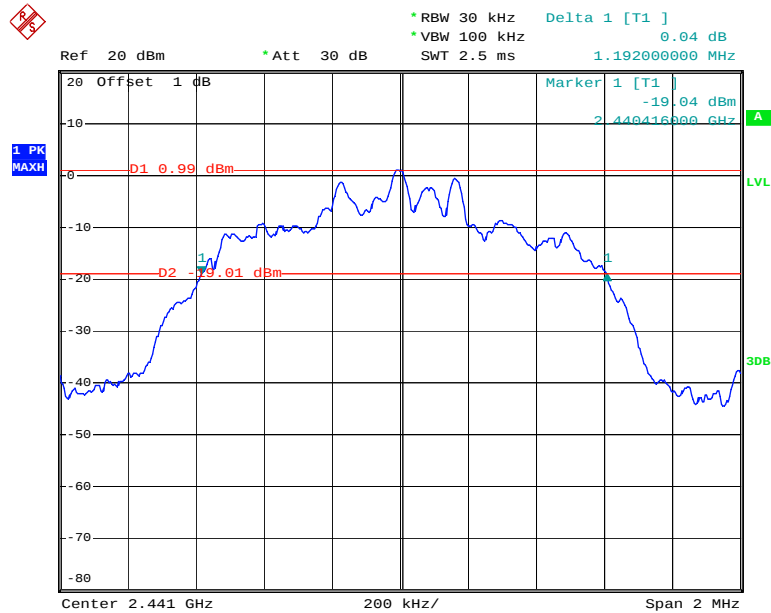
8DPSK:

Low Channel



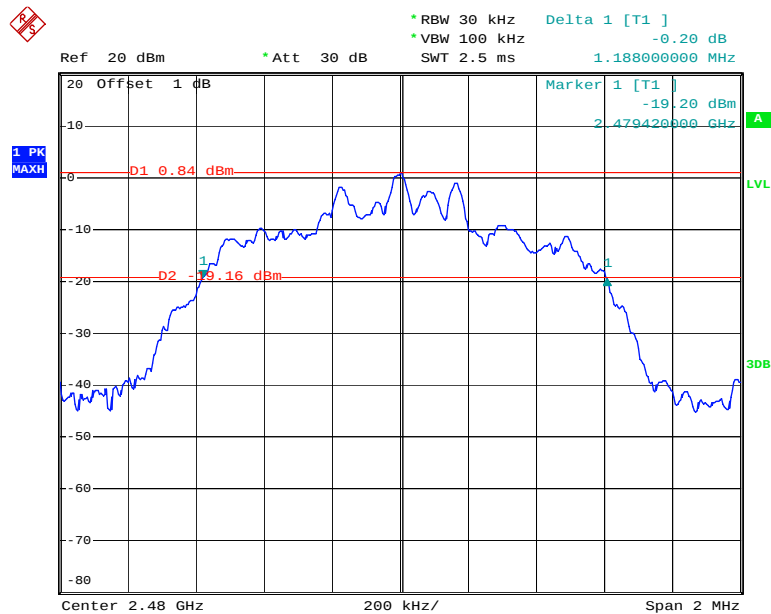
Date: 25.FEB.2020 16:31:24

Middle Channel



Date: 25.FEB.2020 16:13:30

High Channel



Date: 25.FEB.2020 16:12:17

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	EMI Test Receiver	ESPI	100120	2019-05-09	2020-05-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/03	Each time	N/A

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

Test Data**Environmental Conditions**

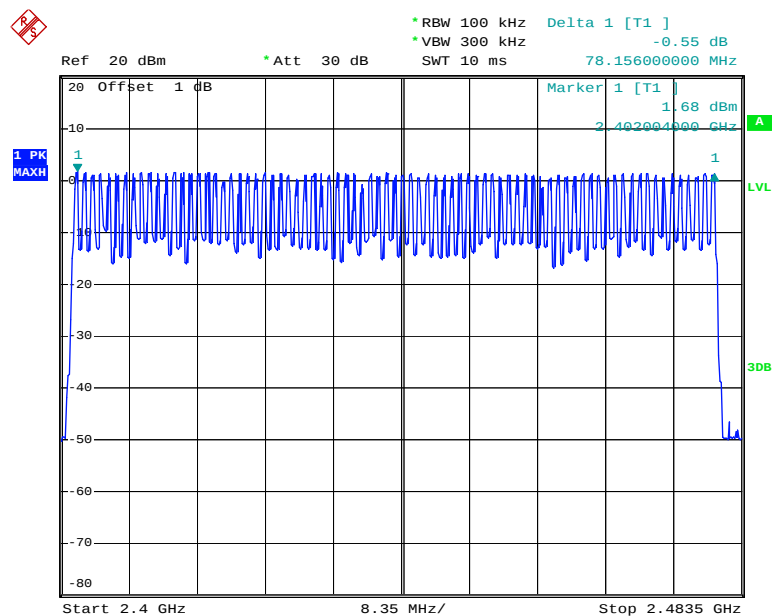
Temperature:	23°C
Relative Humidity:	52%
ATM Pressure:	101.7kPa
Tester:	Chris Mo
Test Date:	2020-02-25

Test Result: Compliance.

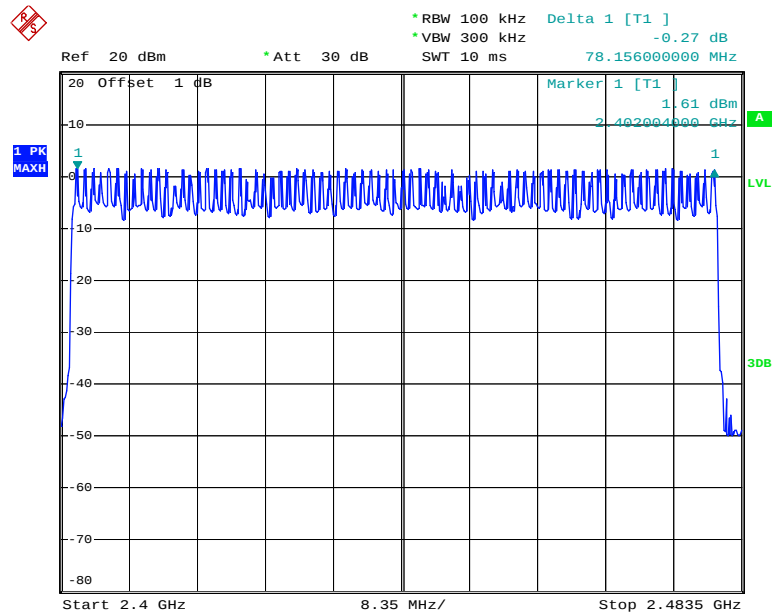
Please refer to following tables and plots

Test Mode: Transmitting

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

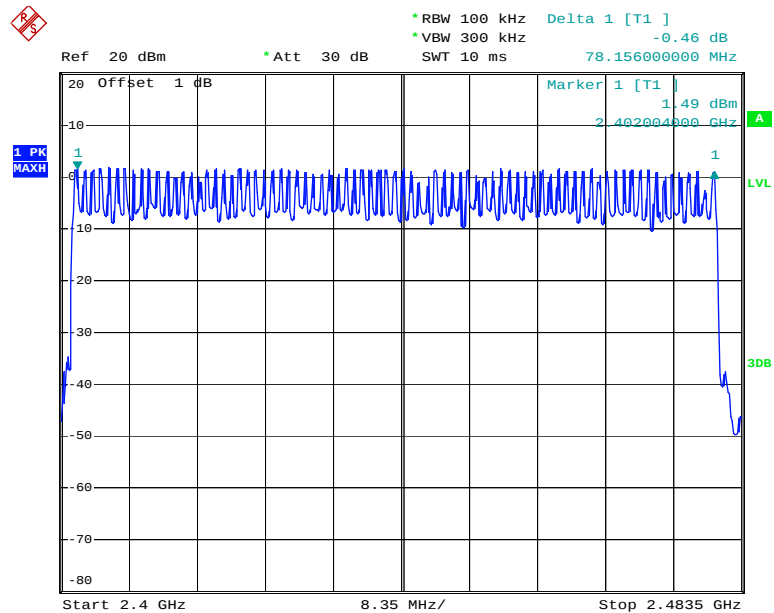
GFSK

Date: 25.FEB.2020 16:44:28

$\pi/4$ -DQPSK

Date: 25.FEB.2020 16:49:06

8DPSK



Date: 25.FEB.2020 16:53:05

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	EMI Test Receiver	ESPI	100120	2019-05-09	2020-05-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/03	Each time	N/A

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

Test Data**Environmental Conditions**

Temperature:	25°C
Relative Humidity:	56%
ATM Pressure:	101.7kPa
Tester:	Chris Mo
Test Date:	2020-02-26

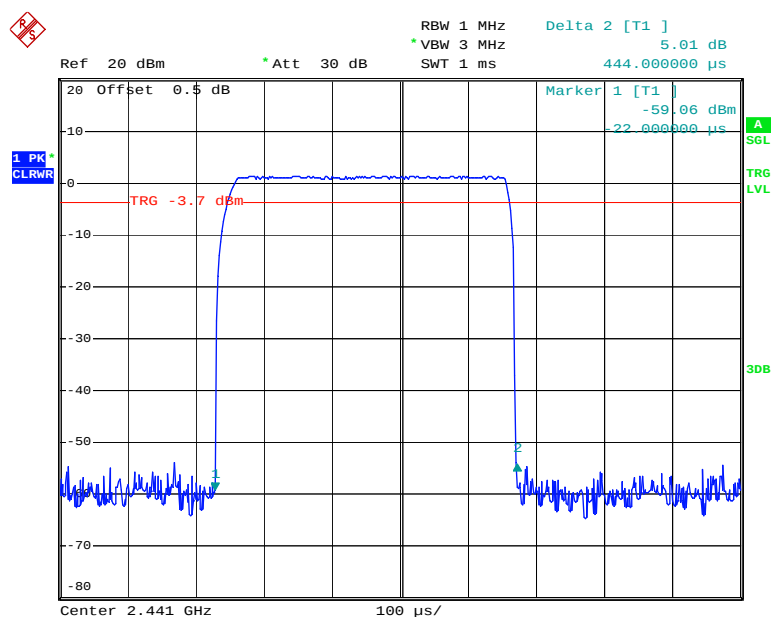
Test Result: Compliance.

Please refer to following tables and plots

Test Mode: Transmitting

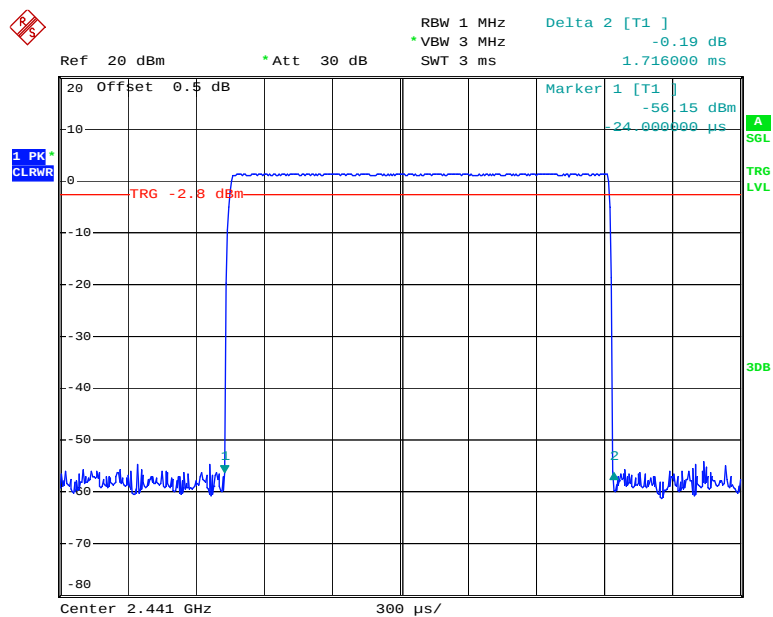
Mode	Packet type	Channel	Frequency (MHz)	Pulse width (ms)	Result (s)	Limit (s)
GFSK	DH1	Middle	2441	0.444	0.142	0.4
	DH3	Middle	2441	1.716	0.275	
	DH5	Middle	2441	2.970	0.317	
$\pi/4$ -DQPSK	DH1	Middle	2441	0.454	0.145	
	DH3	Middle	2441	1.722	0.276	
	DH5	Middle	2441	2.980	0.318	
8DPSK	DH1	Middle	2441	0.456	0.146	
	DH3	Middle	2441	1.722	0.276	
	DH5	Middle	2441	2.980	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

*GFSK:***DH1: Middle Channel**

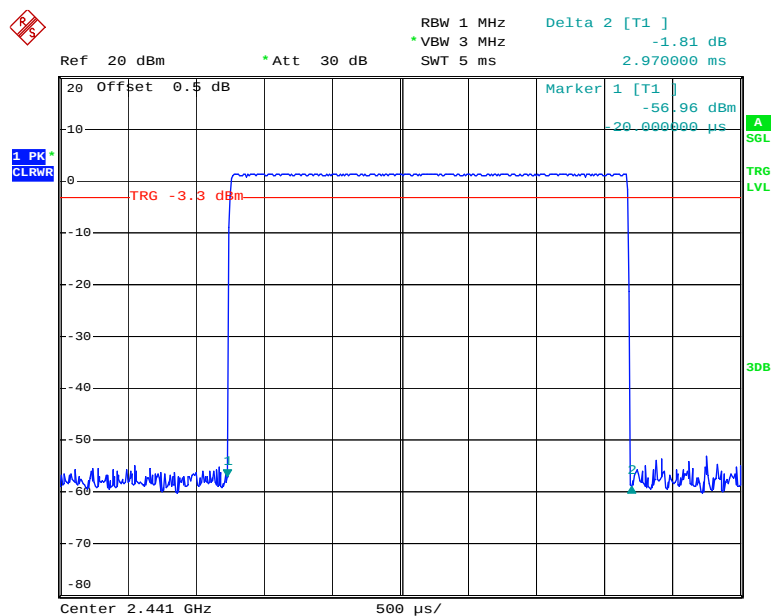
Date: 26.FEB.2020 20:09:39

DH3: Middle Channel

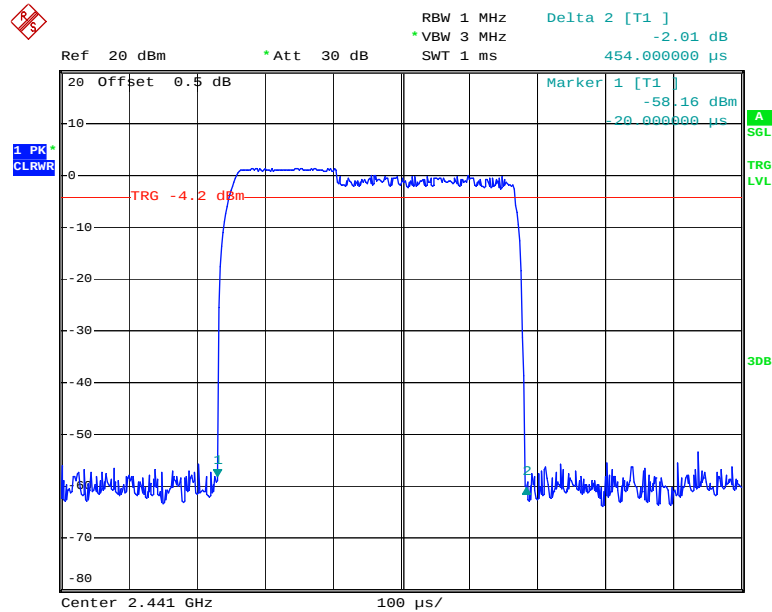


Date: 26.FEB.2020 20:11:44

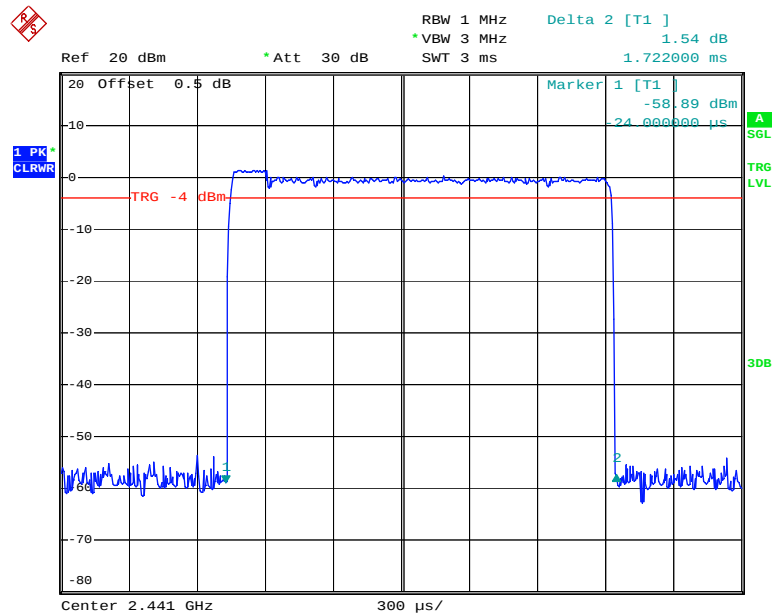
DH5: Middle Channel



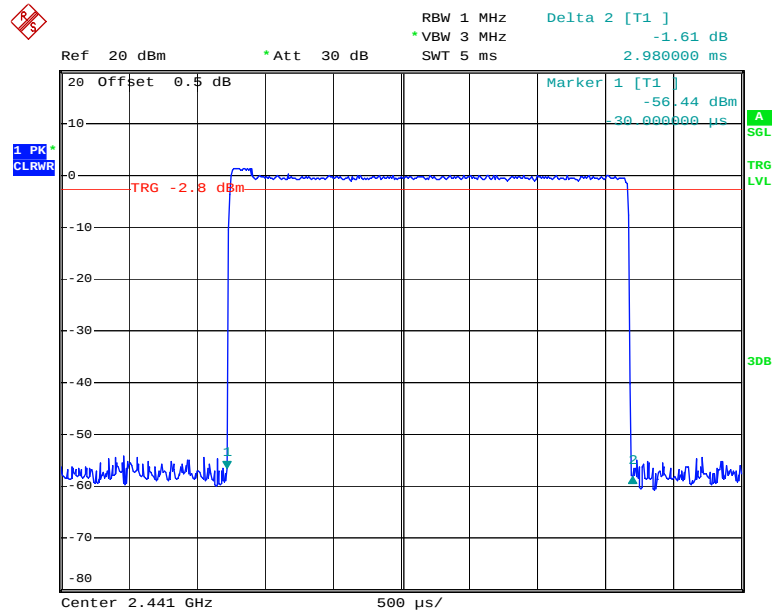
Date: 26.FEB.2020 20:12:28

$\pi/4$ -DQPSK:**2DH1: Middle Channel**

Date: 26.FEB.2020 20:10:02

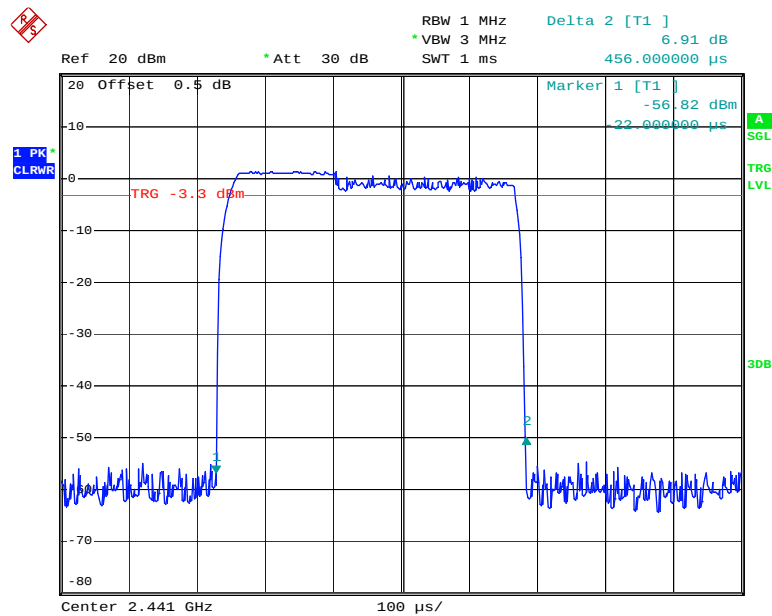
2DH3: Middle Channel

Date: 26.FEB.2020 20:10:54

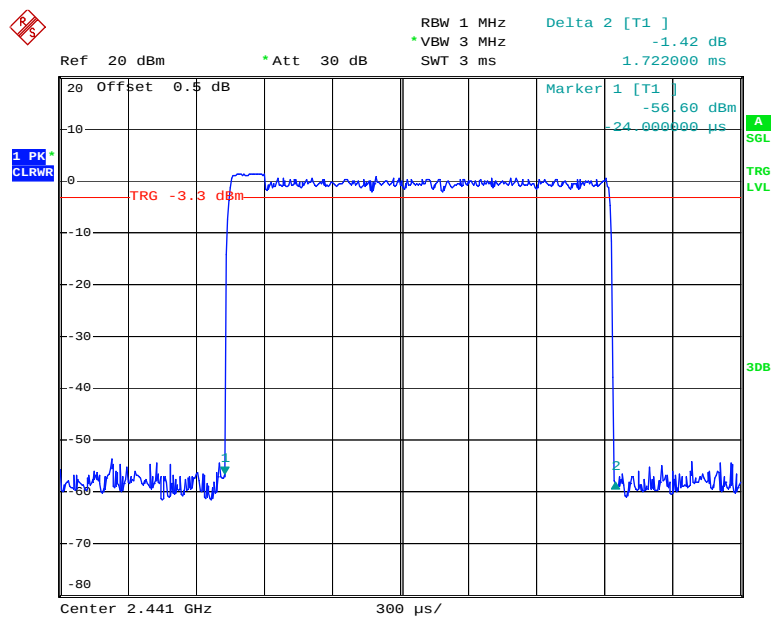
2DH5: Middle Channel

Date: 26.FEB.2020 20:12:48

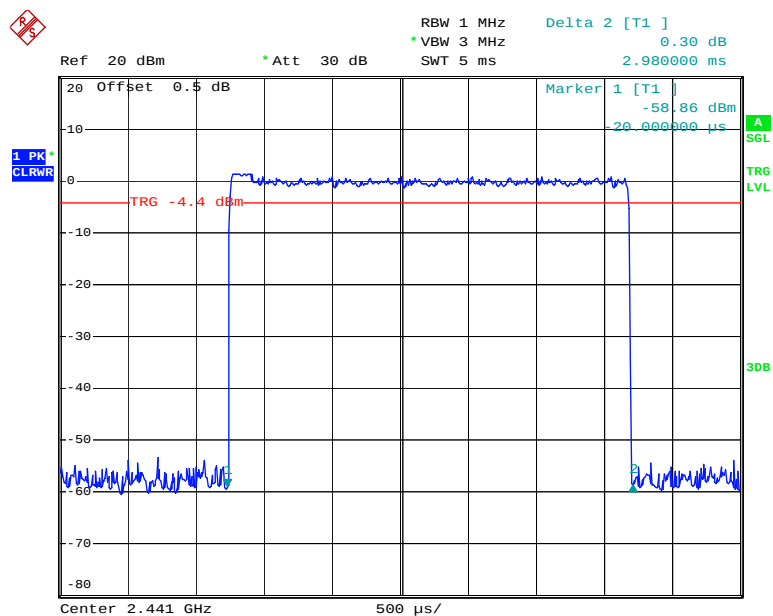
8DPSK:

3DH1: Middle Channel

Date: 26.FEB.2020 20:10:18

3DH3: Middle Channel

Date: 26.FEB.2020 20:11:13

3DH5: Middle Channel

Date: 26.FEB.2020 20:13:10

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

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

Test Procedure

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Unknown	Coaxial Cable	C-SJ00-0010	C0010/03	Each time	N/A
Agilent	USB Wideband Power Sensor	U2021XA	MY5425009	2019-05-09	2020-05-09

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

Test Data**Environmental Conditions**

Temperature:	23°C
Relative Humidity:	52%
ATM Pressure:	101.7kPa
Tester:	Chris Mo
Test Date:	2020-02-25

Test Result: Compliance.

Test Mode: Transmitting

Mode	Frequency (MHz)	Peak Conducted Output power (dBm)	Limit (dBm)
GFSK	2402	2.24	21
	2441	1.47	21
	2480	1.08	21
$\pi/4$ -DQPSK	2402	2.91	21
	2441	2.27	21
	2480	1.78	21
8DPSK	2402	1.57	21
	2441	2.18	21
	2480	1.63	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.

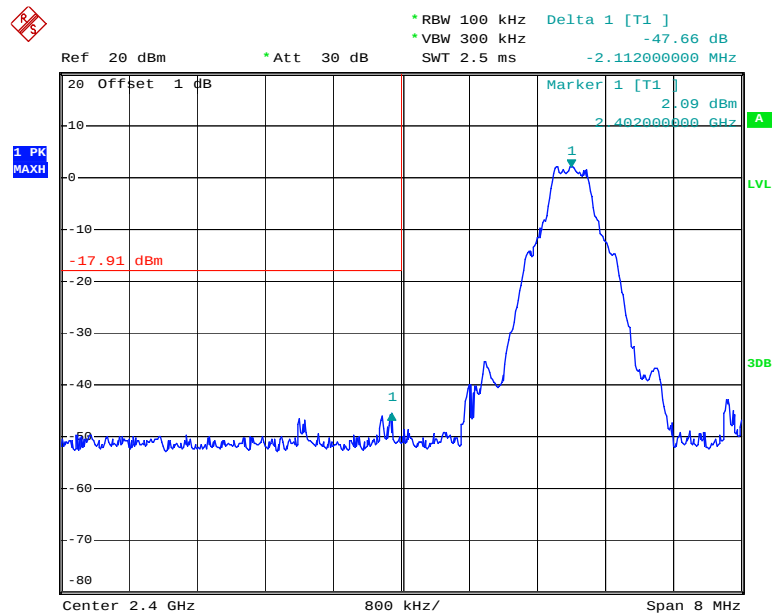
Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESPI	100120	2019-05-09	2020-05-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/03	Each time	N/A

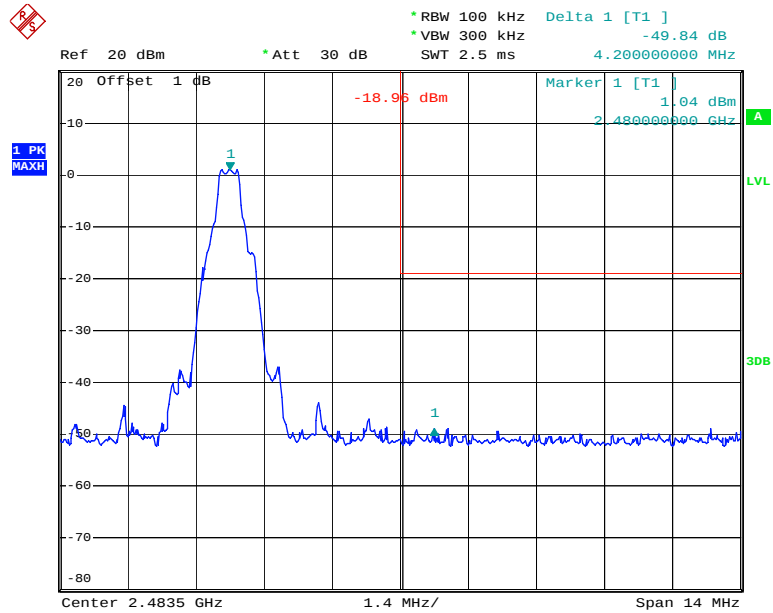
* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data**Environmental Conditions**

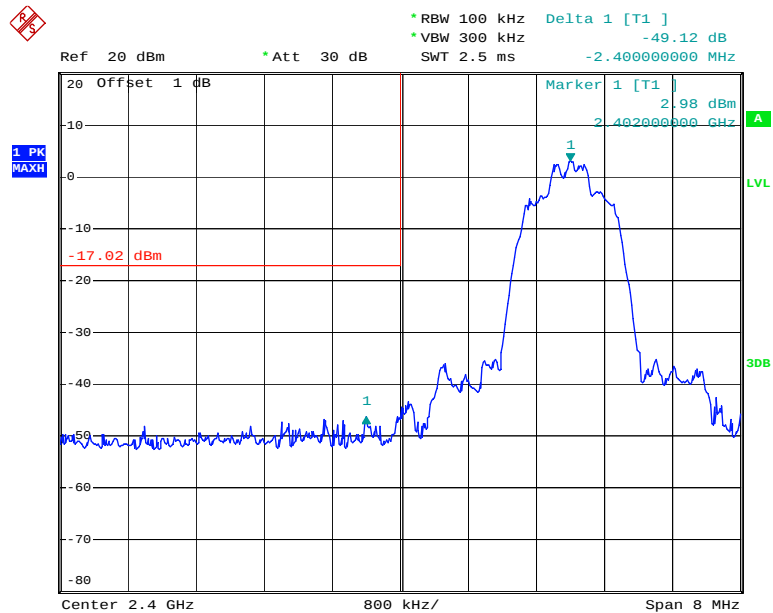
Temperature:	23°C
Relative Humidity:	52%
ATM Pressure:	101.7kPa
Tester:	Chris Mo
Test Date:	2020-02-25

Test Result: Compliance*Single Channel:**GFSK:***Band Edge, Left Side**

Date: 25.FEB.2020 16:00:58

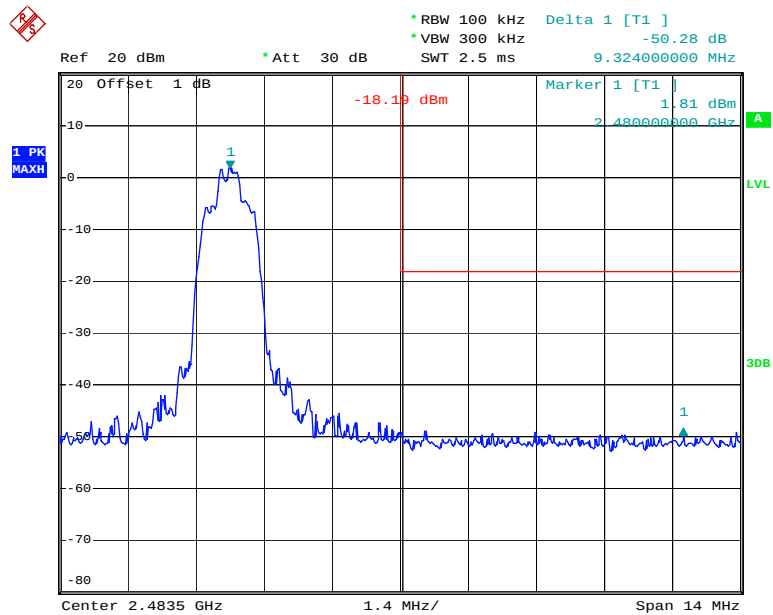


Date: 25.FEB.2020 16:04:43

 $\pi/4$ -DQPSK:

Date: 25.FEB.2020 16:09:51

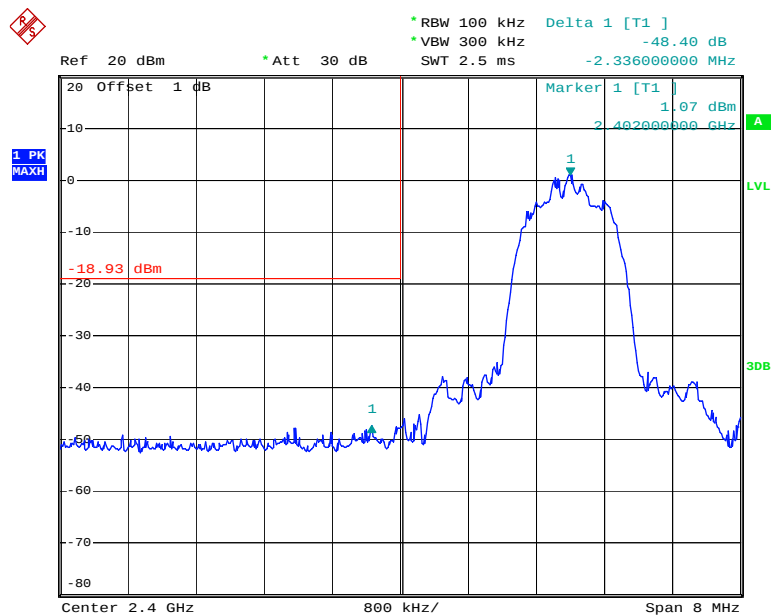
Band Edge, Right Side



Date: 25.FEB.2020 16:11:56

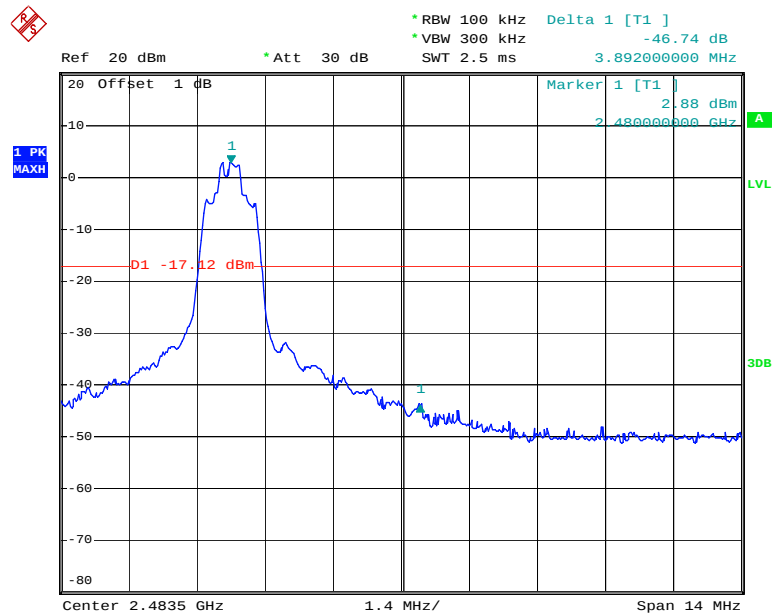
8DPSK

Band Edge, Left Side



Date: 25.FEB.2020 16:32:09

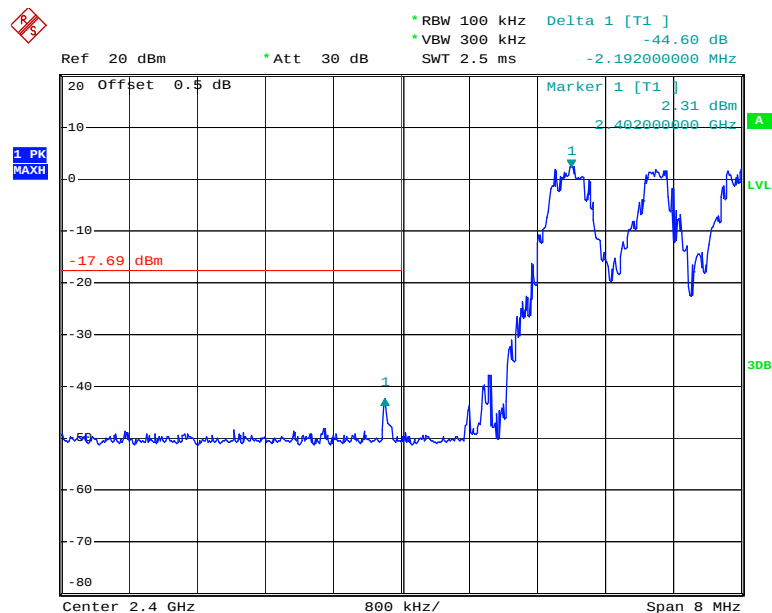
Band Edge, Right Side



Date: 23.MAR.2020 15:52:58

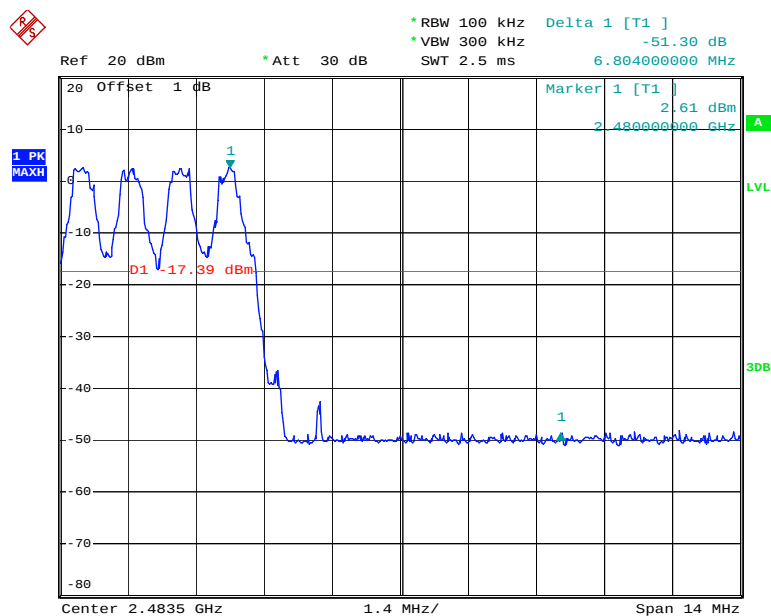
*Hopping Mode,
GFSK:*

Band Edge, Left Side



Date: 26.FEB.2020 20:05:25

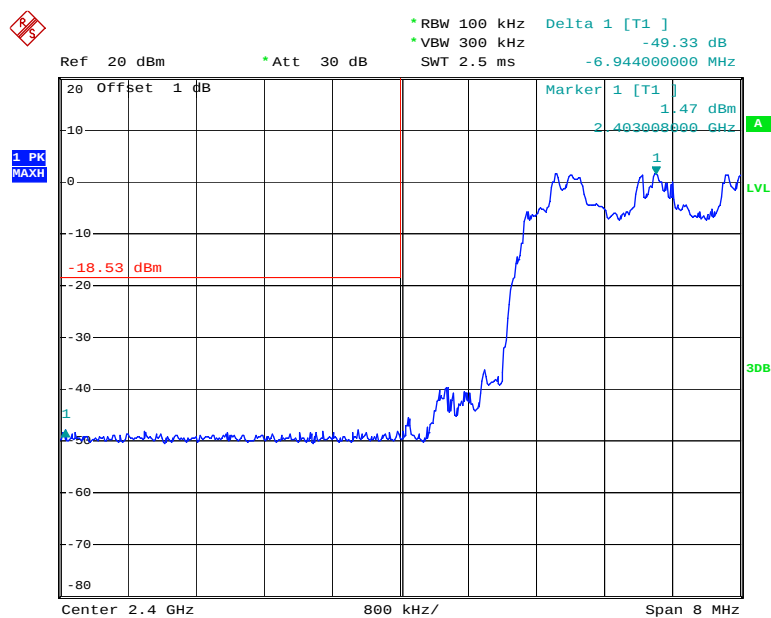
Band Edge, Right Side



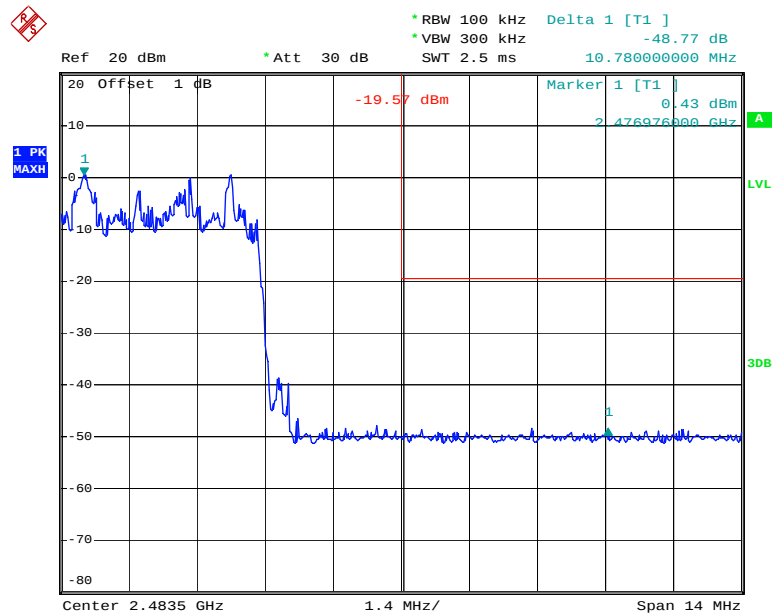
Date: 23.MAR.2020 15:58:15

 $\pi/4$ -DQPSK:

Band Edge, Left Side

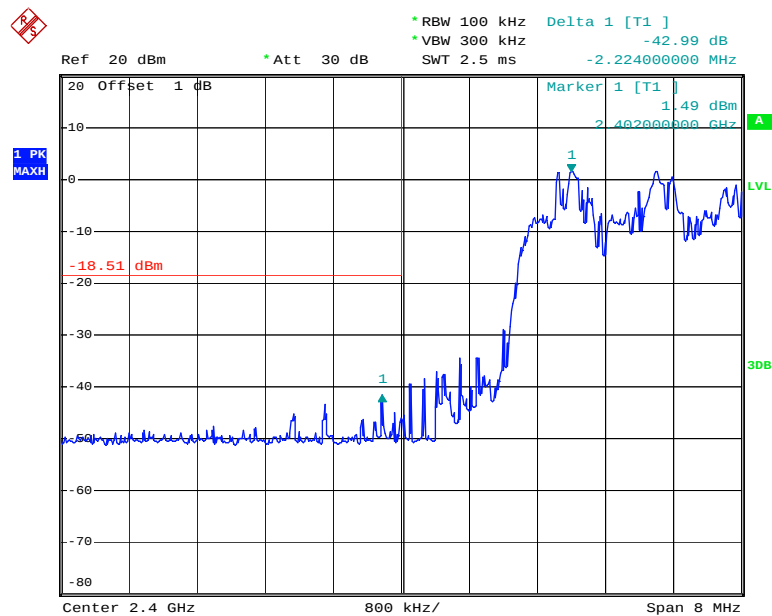


Date: 25.FEB.2020 17:05:41

Band Edge, Right Side

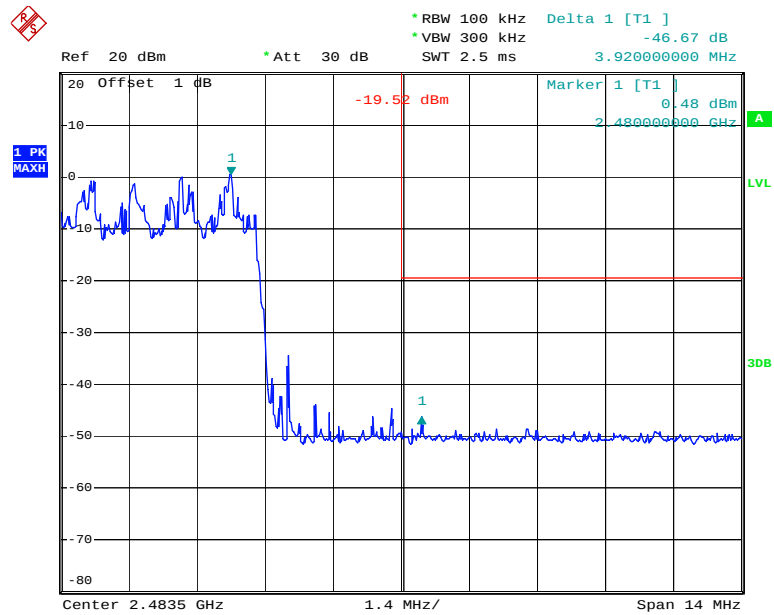
Date: 25.FEB.2020 16:58:00

8DPSK:

Band Edge, Left Side

Date: 25.FEB.2020 16:55:25

Band Edge, Right Side



Date: 25.FEB.2020 16:56:23

**** END OF REPORT ****