



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: | <u>RDG200220005-00A</u> |
| Report Date: | <u>2020-03-31</u> |
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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.

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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.

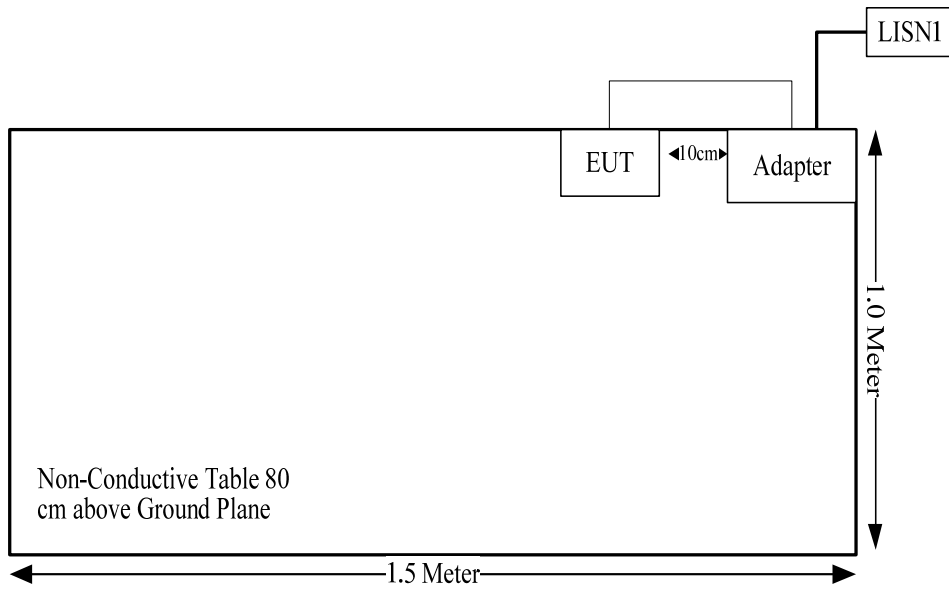
Support Equipment List and Details

| 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).

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

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 |

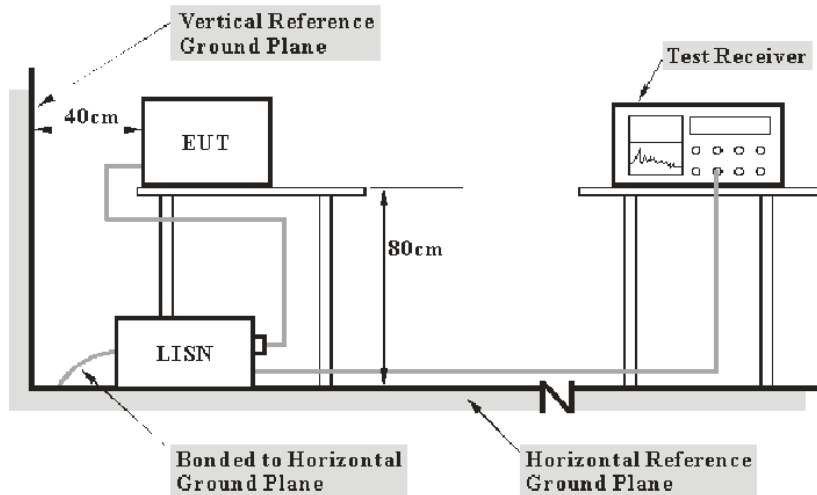
Result: Compliance.

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

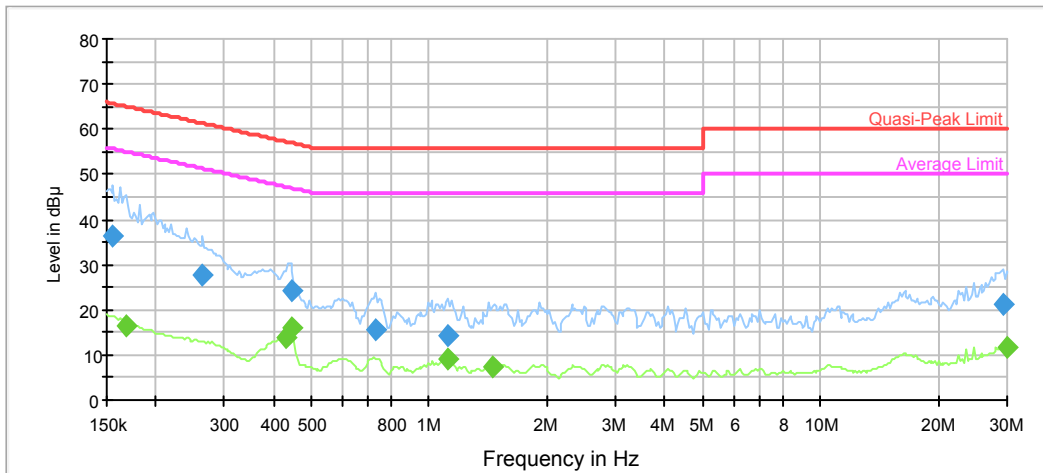
Environmental Conditions

| | |
|---------------------------|------------|
| 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

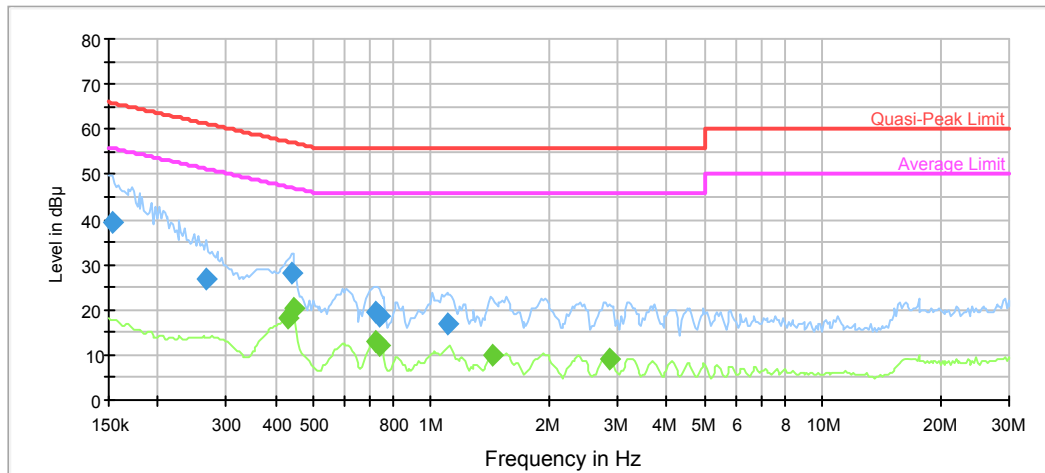
AC120V, 60 Hz, Line:



| 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 |

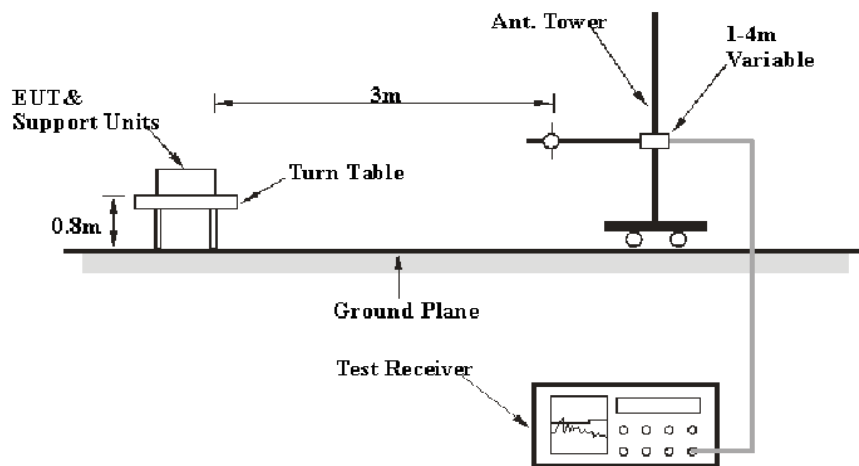
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

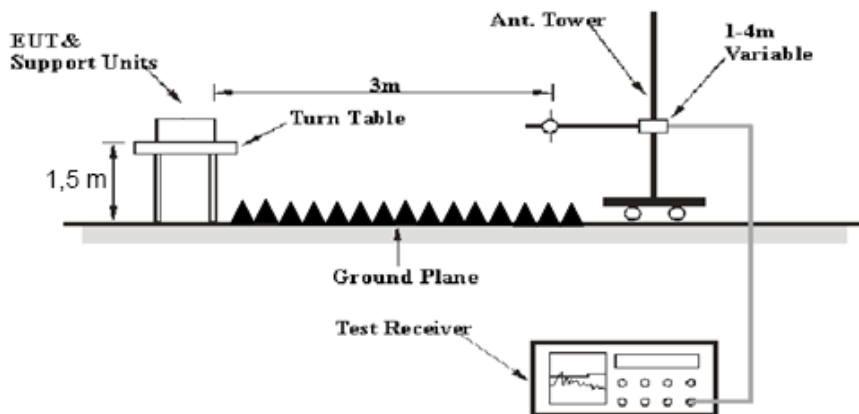
FCC §15.247 (d); §15.209; §15.205;

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**

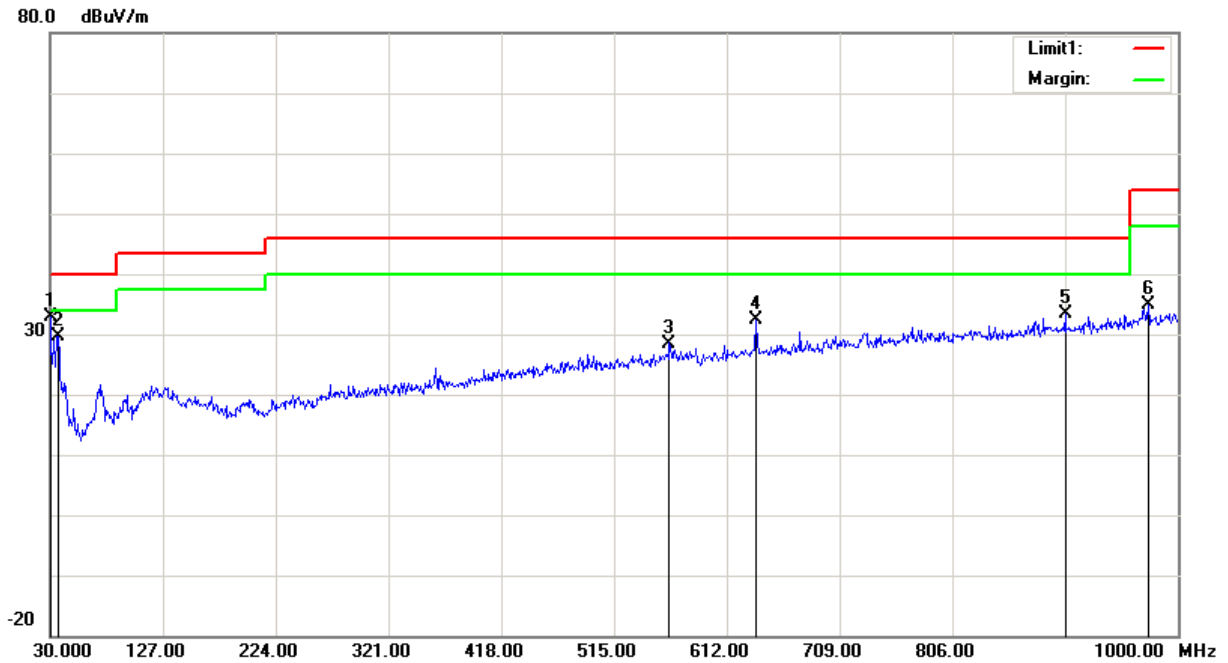
| Test Items | Radiation Below 1GHz | Radiation Above 1GHz |
|---------------------------|----------------------|----------------------|
| Temperature: | 25.1°C | 24°C |
| Relative Humidity: | 49% | 58% |
| ATM Pressure: | 100.8kPa | 101.7kPa |
| Tester: | Vern Shen | Felix Wang |
| Test Date: | 2020-03-21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

Test Mode: Transmitting

Please refer to following table and plots:

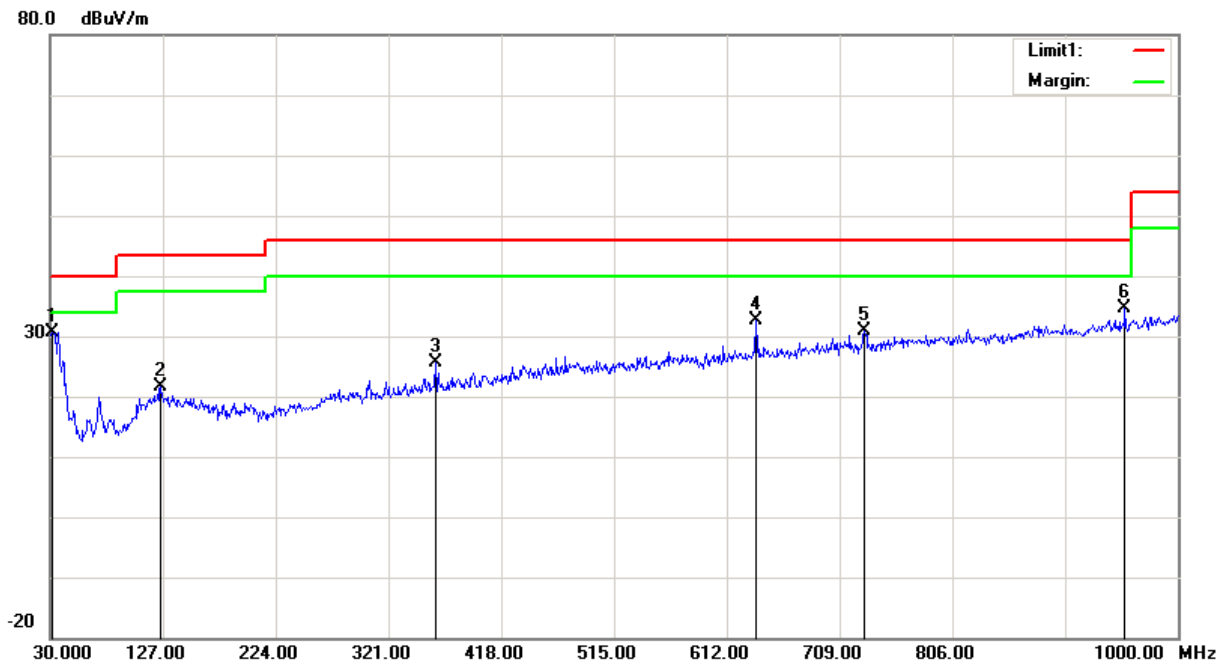
1) 30MHz-1GHz ($\pi/4$ -DQPSK Low channel was the worst)

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 (dBμV) | Detector | Corrected (dB/m) | Result (dBμV/m) | Limit (dBμV/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 |

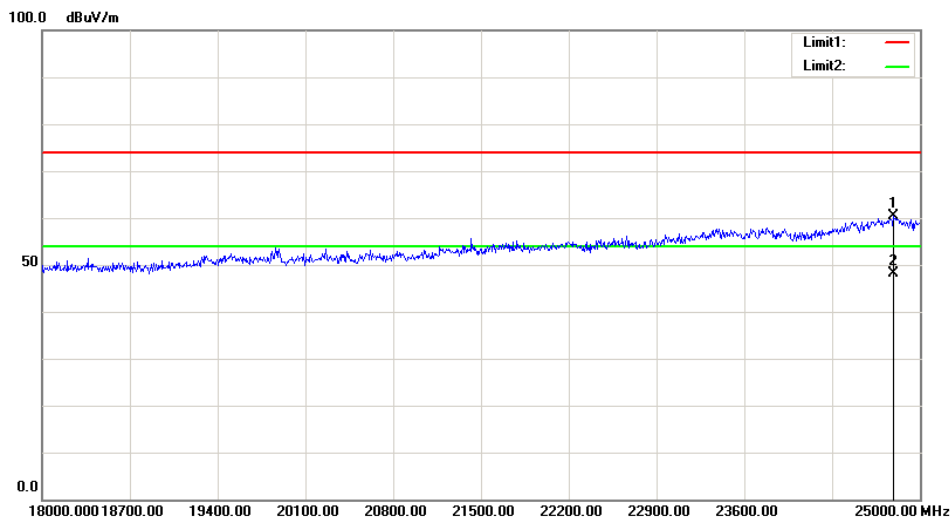
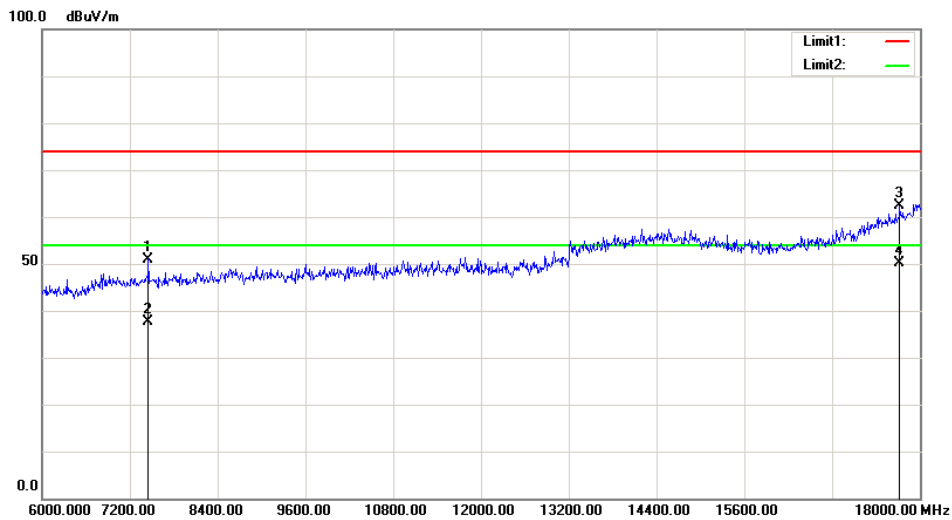
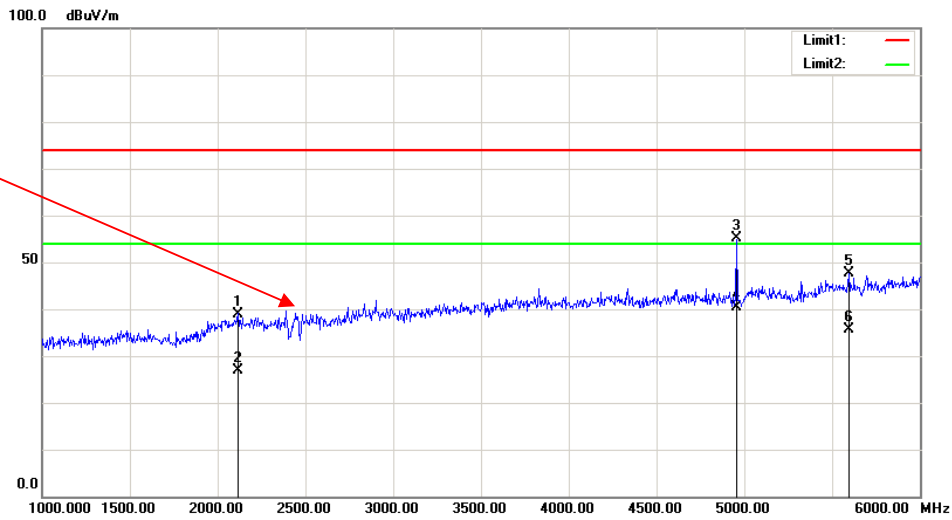
2)1GHz-25GHz:*EDR Mode ($\pi/4$ -DQPSK) was the worst*

| Frequency (MHz) | Receiver | | Rx Antenna | | Cable loss (dB) | Amplifier Gain (dB) | Corrected Amplitude (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 | 66.27 | 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)

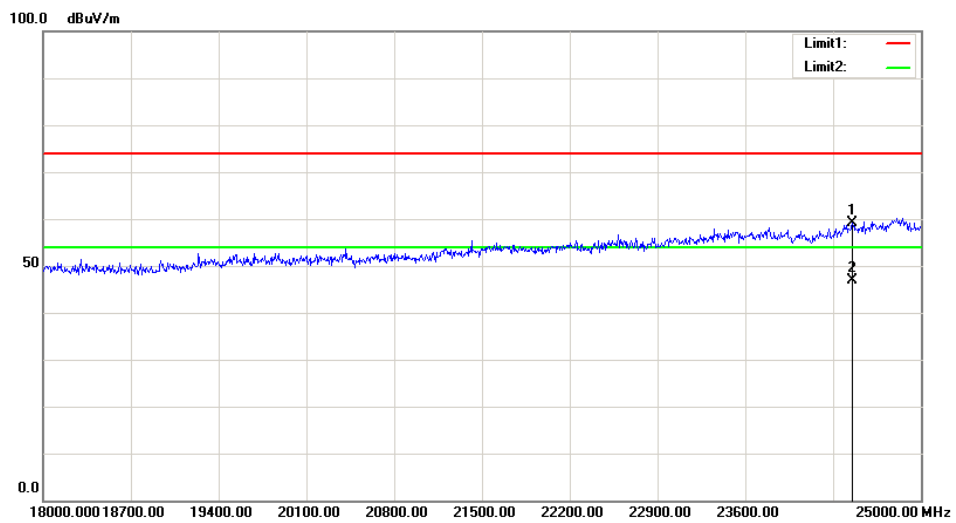
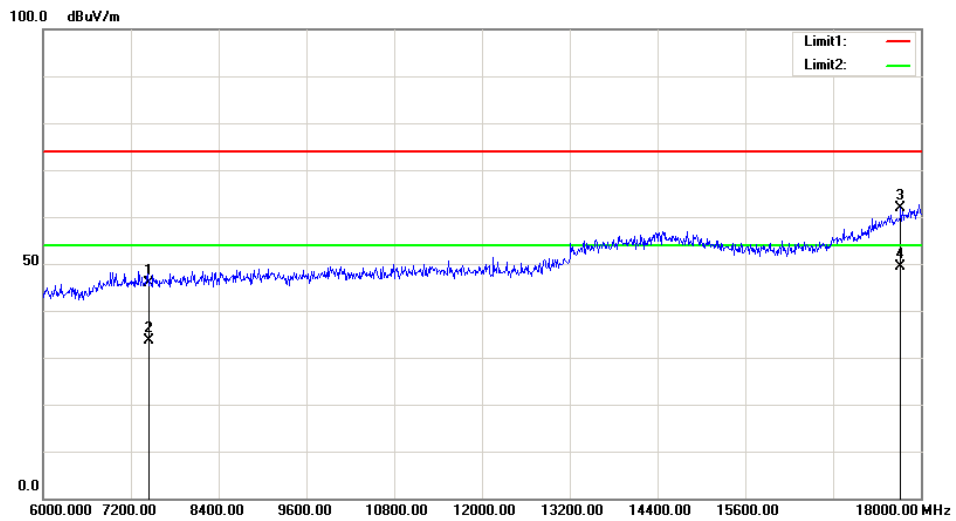
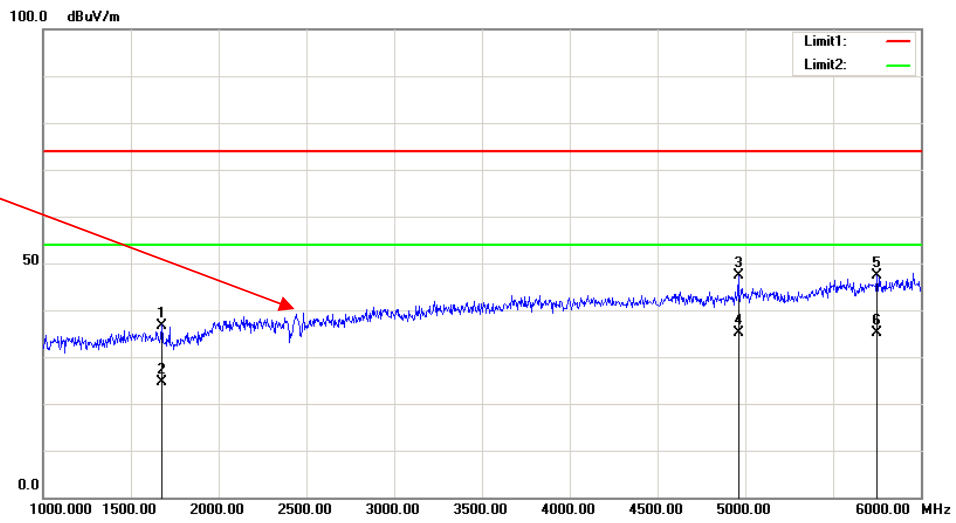
Horizontal:

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.

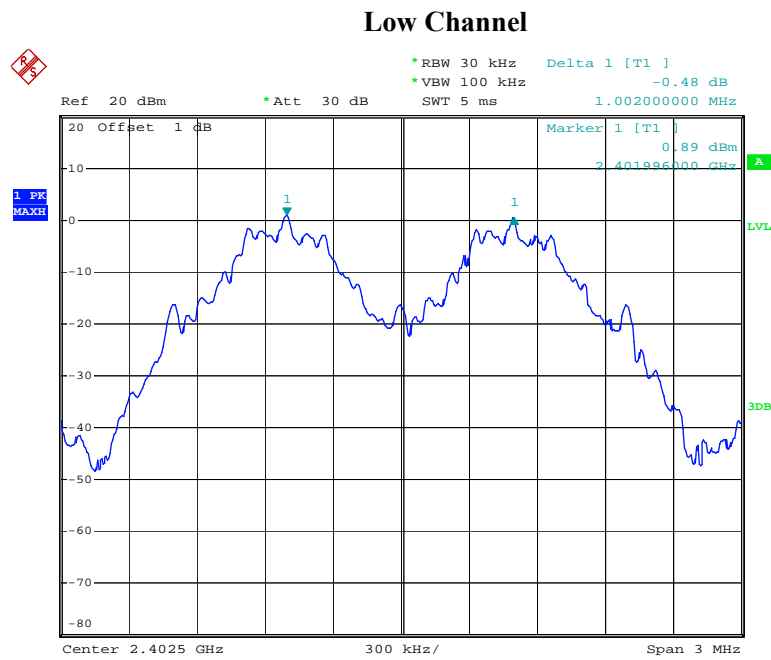
Please refer to following tables and plots

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 |

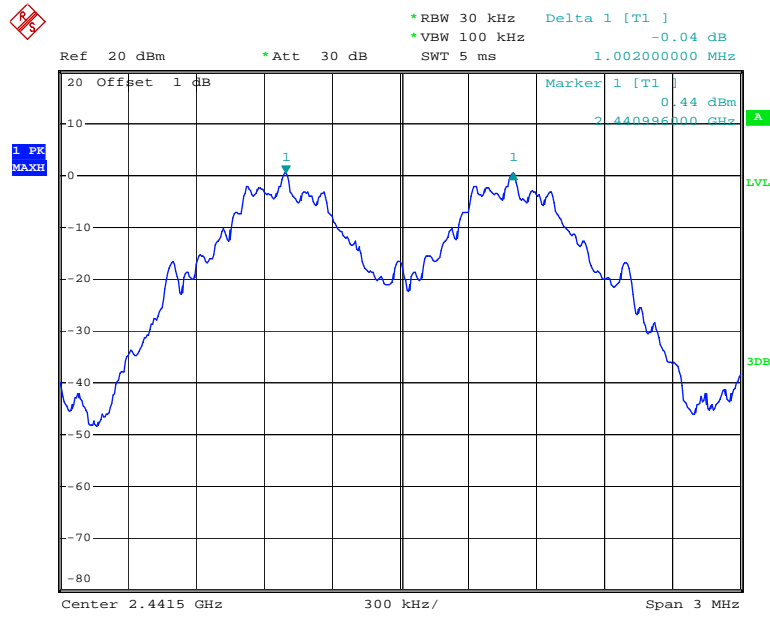
Note: Limit= (2/3) × 20dB bandwidth

GFSK:



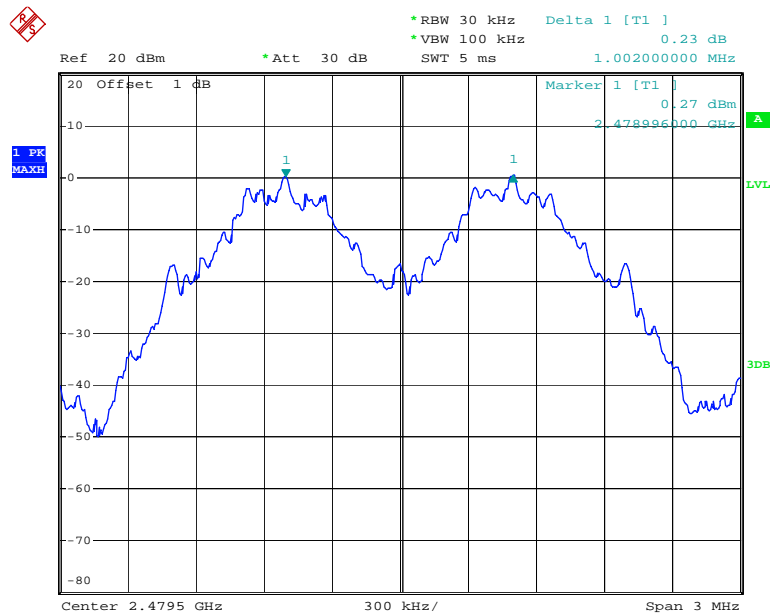
Date: 25.FEB.2020 16:38:52

Middle Channel



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

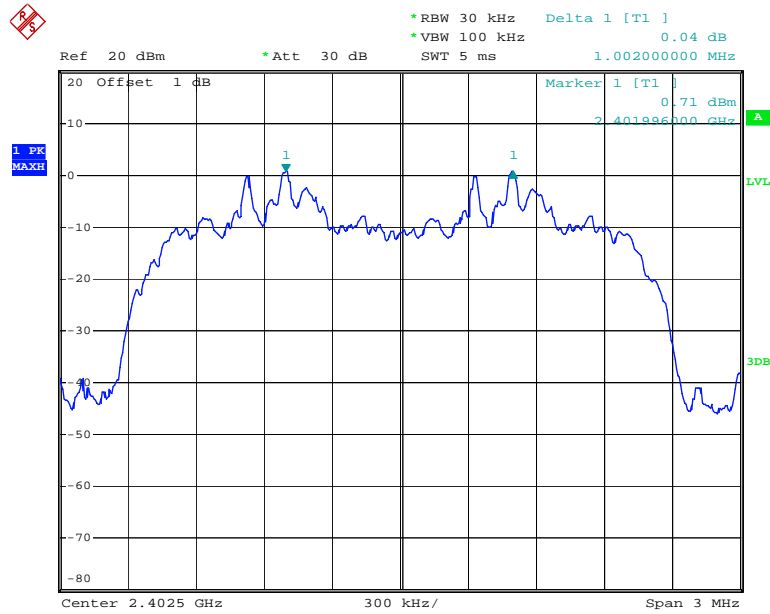
High Channel



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

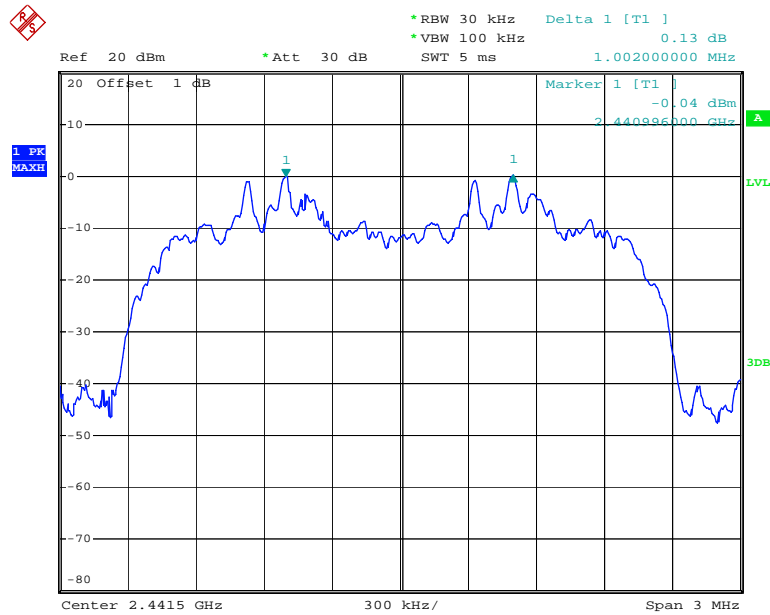
$\pi/4$ -DQPSK:

Low Channel



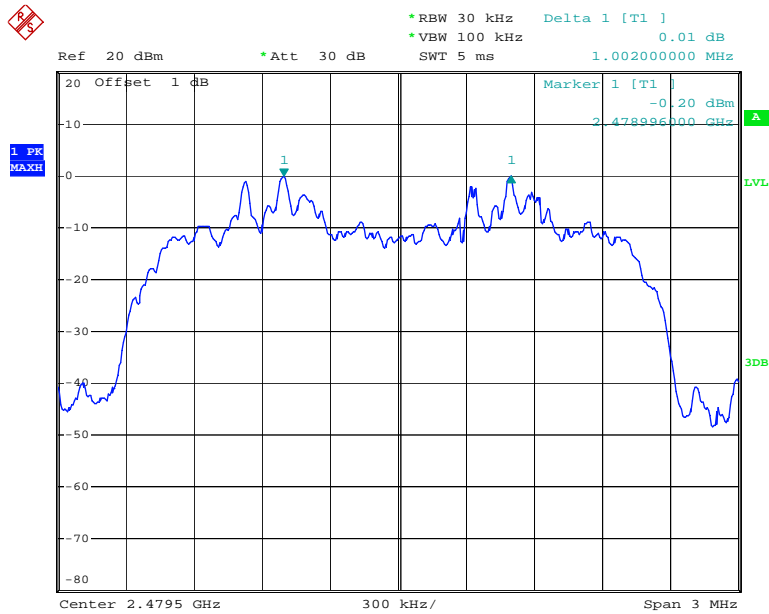
Date: 25.FEB.2020 16:37:24

Middle Channel



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

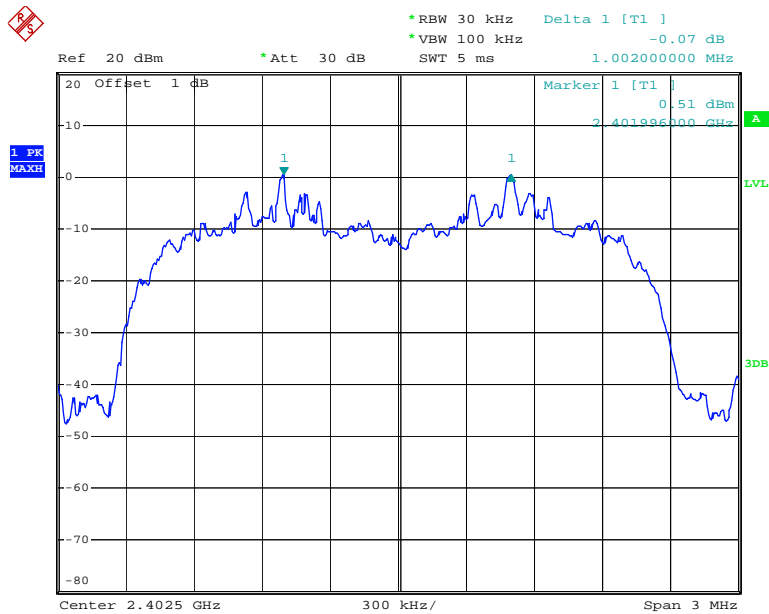
High Channel



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

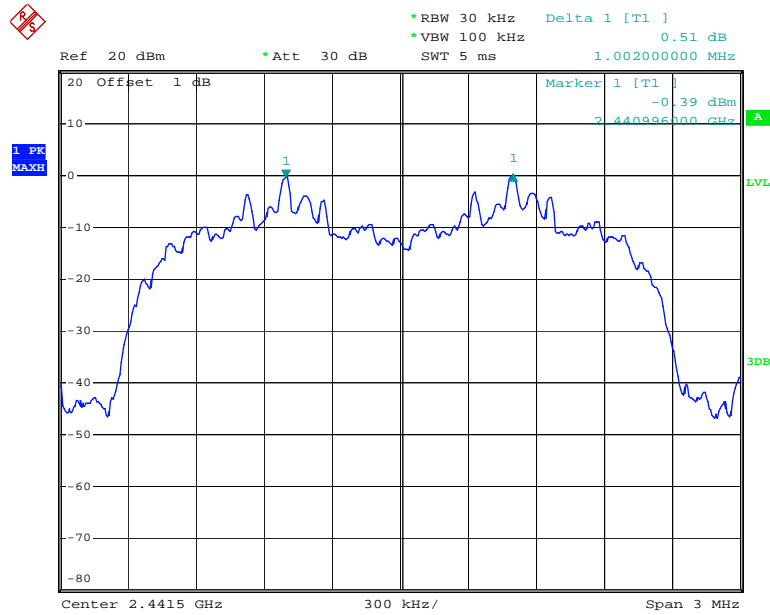
8DPSK:

Low Channel



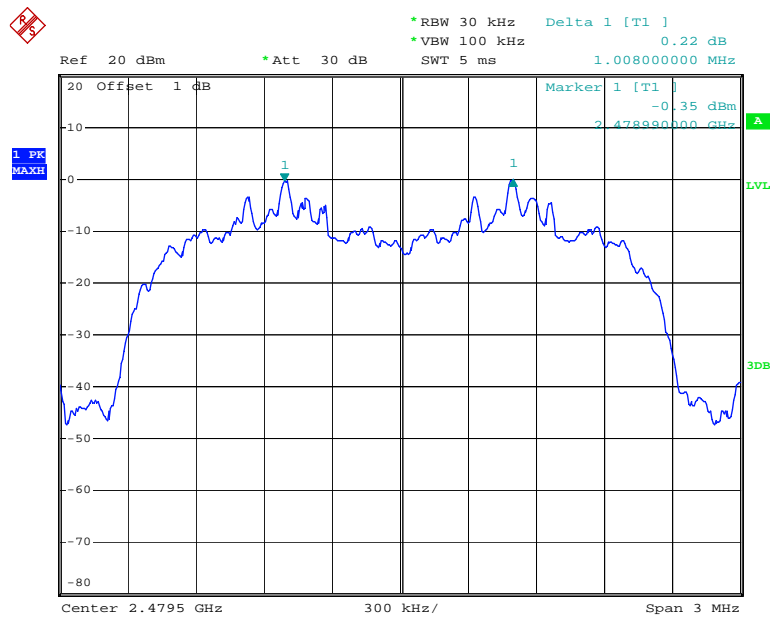
Date: 25.FEB.2020 16:32:48

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.

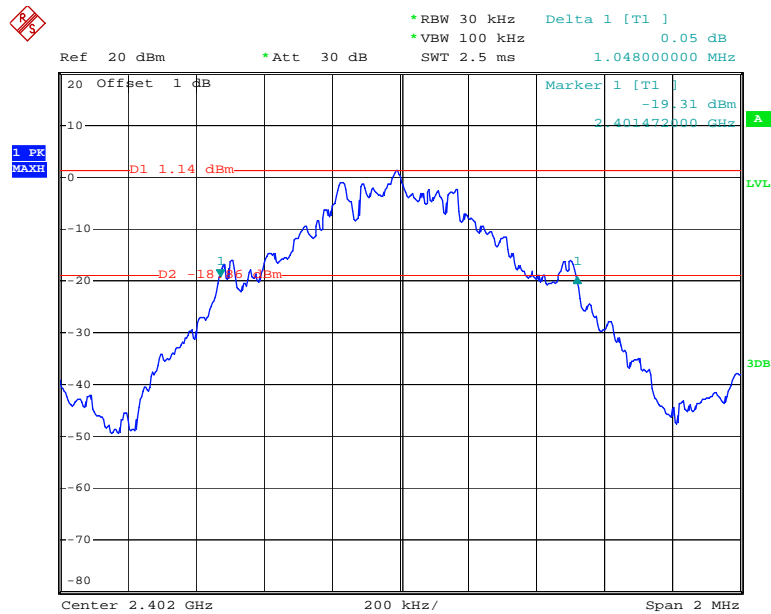
Please refer to following tables and plots

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 |

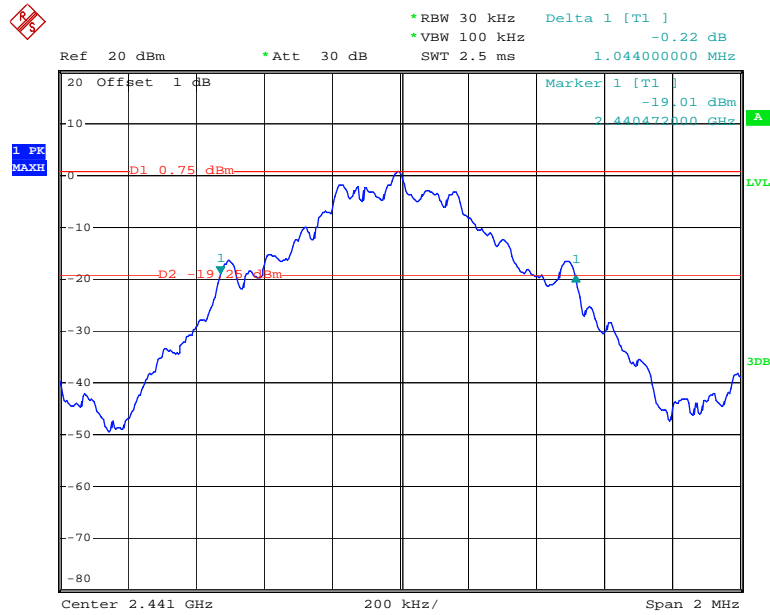
GFSK:

Low Channel



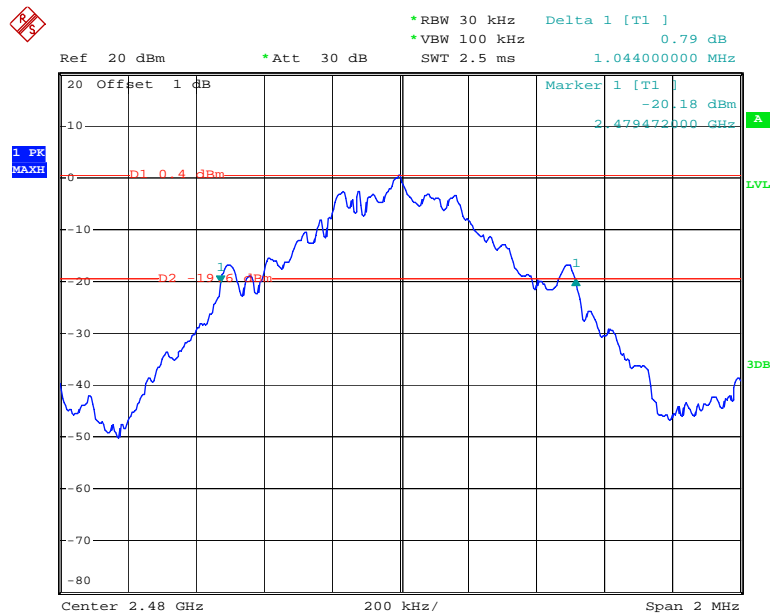
Date: 25.FEB.2020 16:00:14

Middle Channel



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

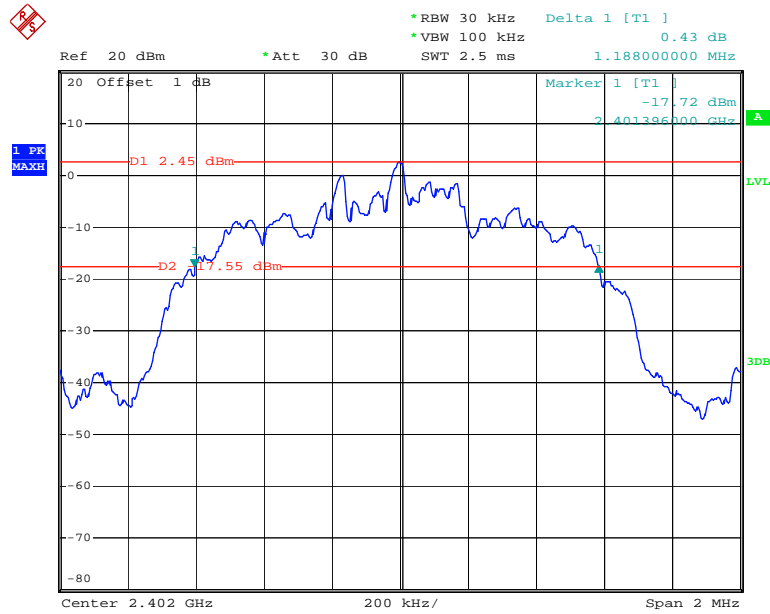
High Channel



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

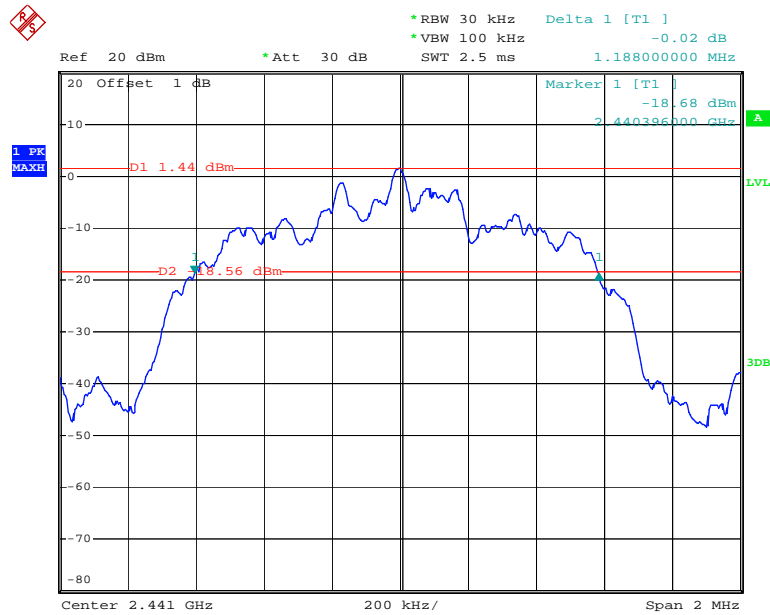
$\pi/4$ -DQPSK:

Low Channel



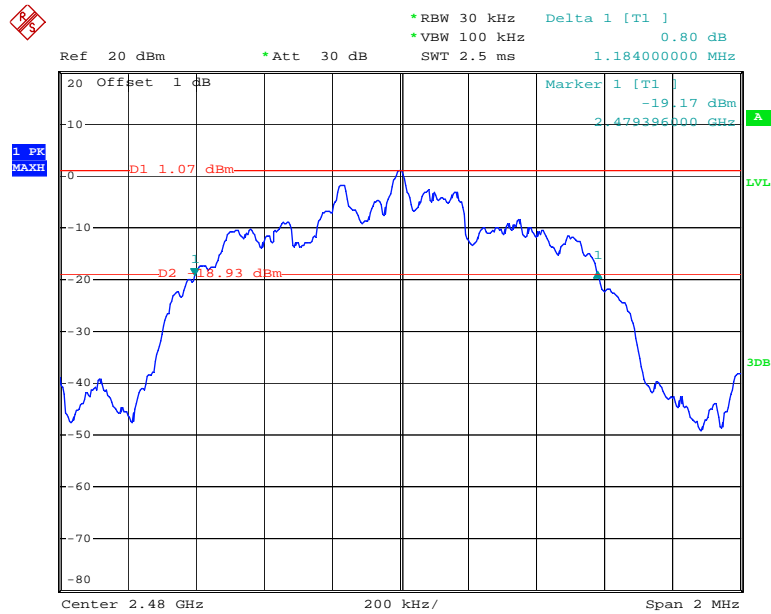
Date: 25.FEB.2020 16:09:04

Middle Channel



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

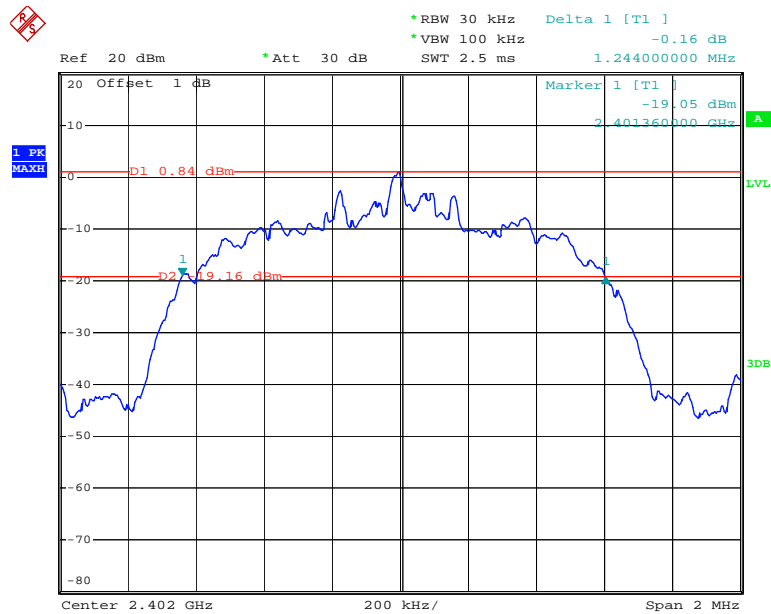
High Channel



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

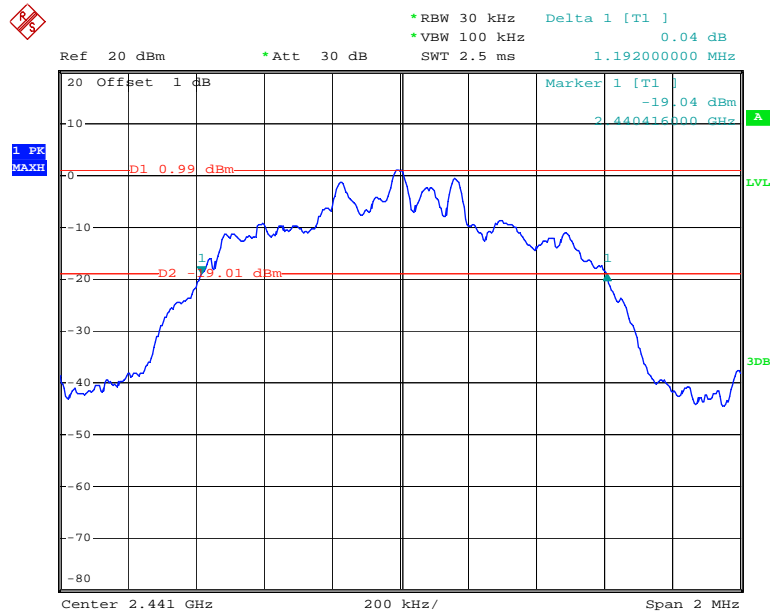
8DPSK:

Low Channel



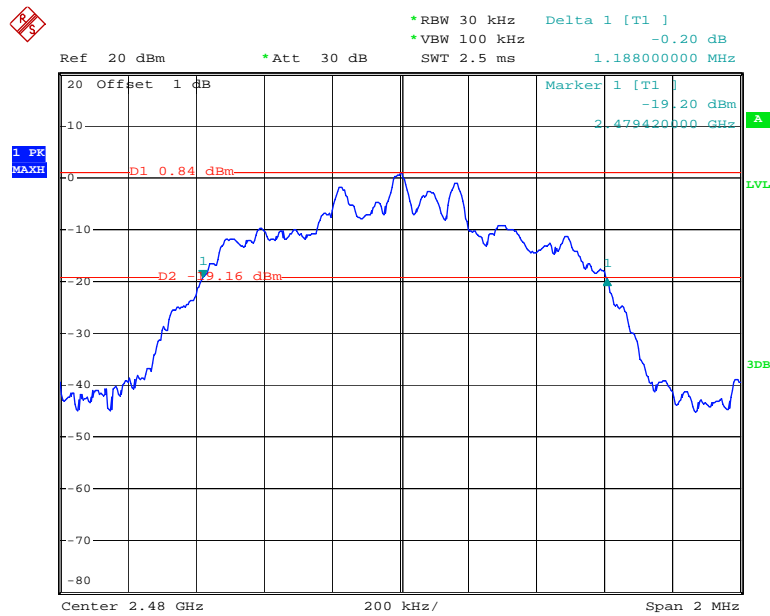
Date: 25.FEB.2020 16:31:24

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 |

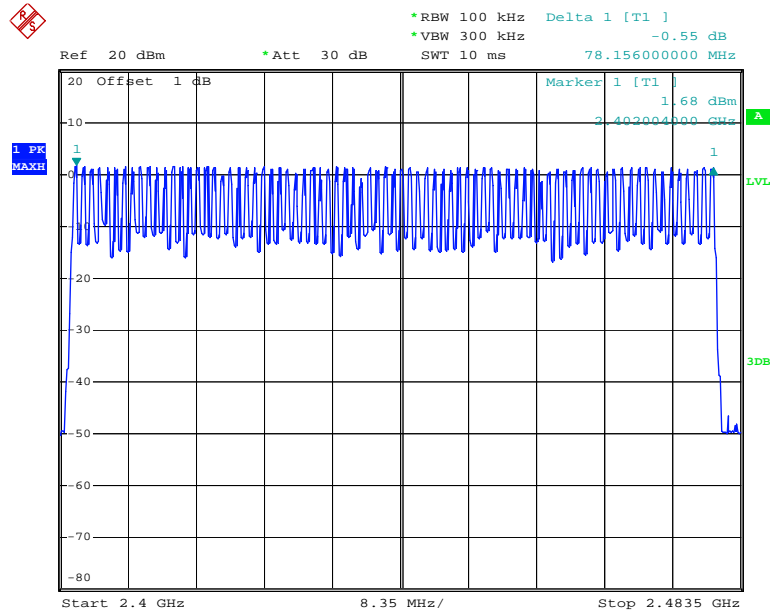
Test Result: Compliance.

Please refer to following tables and plots

Test Mode: Transmitting

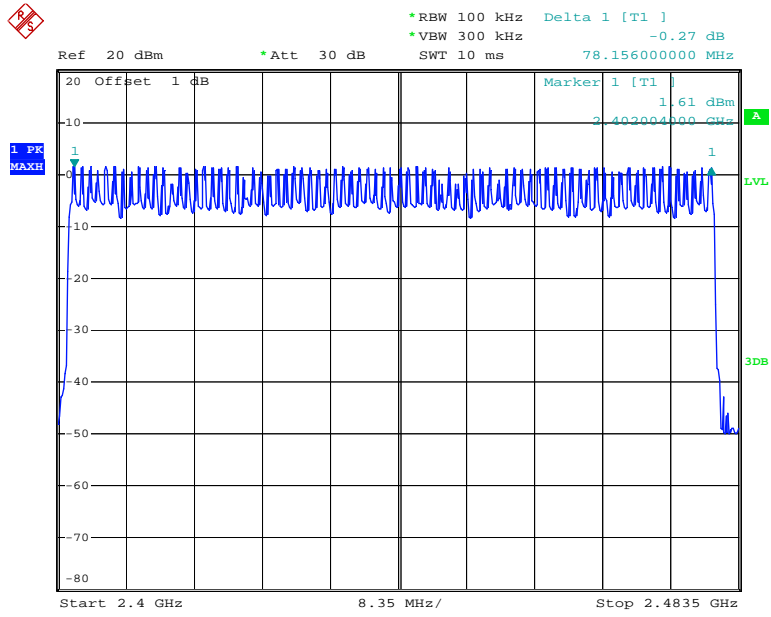
| Test mode | Frequency Range (MHz) | Number of Hopping Channel | Limit |
|----------------|-----------------------|---------------------------|-------|
| GFSK | 2400-2483.5 | 79 | ≥15 |
| $\pi/4$ -DQPSK | 2400-2483.5 | 79 | ≥15 |
| 8-DPSK | 2400-2483.5 | 79 | ≥15 |

GFSK



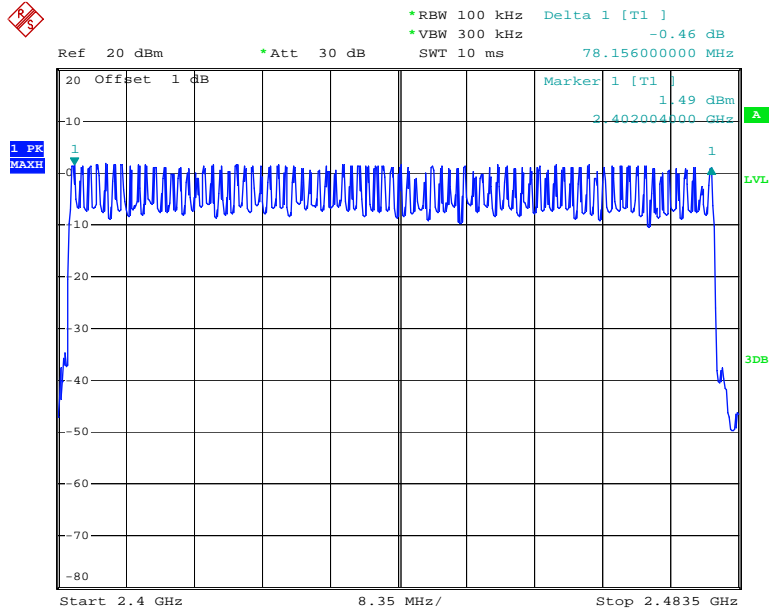
Date: 25.FEB.2020 16:44:28

$\pi/4$ -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

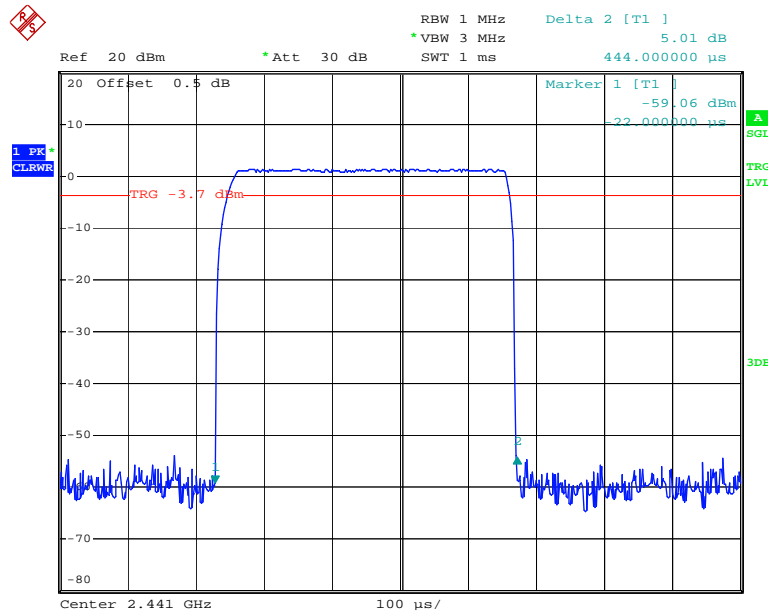
Test Mode: Transmitting

| 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) × (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

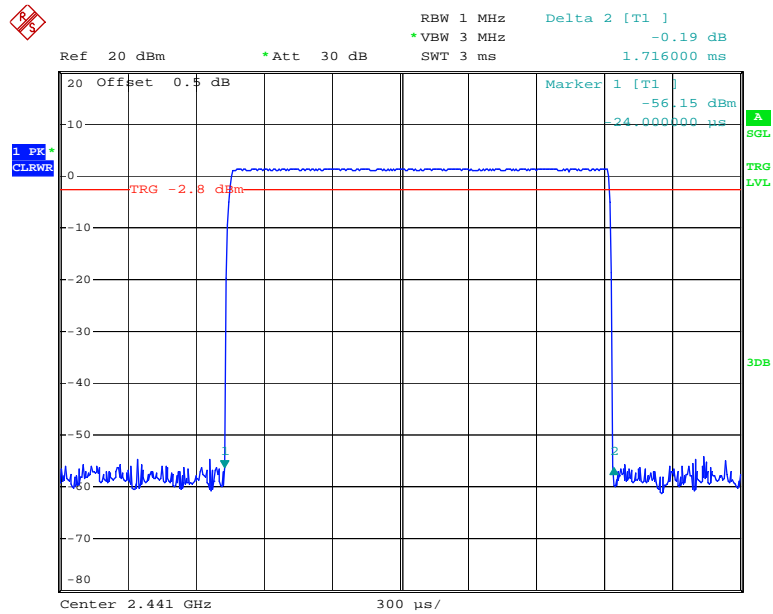
GFSK:

DH1: Middle Channel



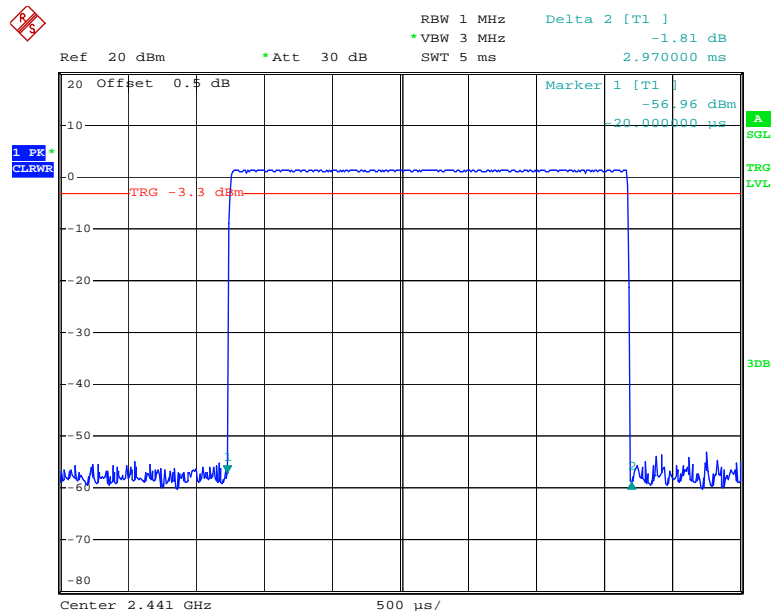
Date: 26.FEB.2020 20:09:39

DH3: Middle Channel



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

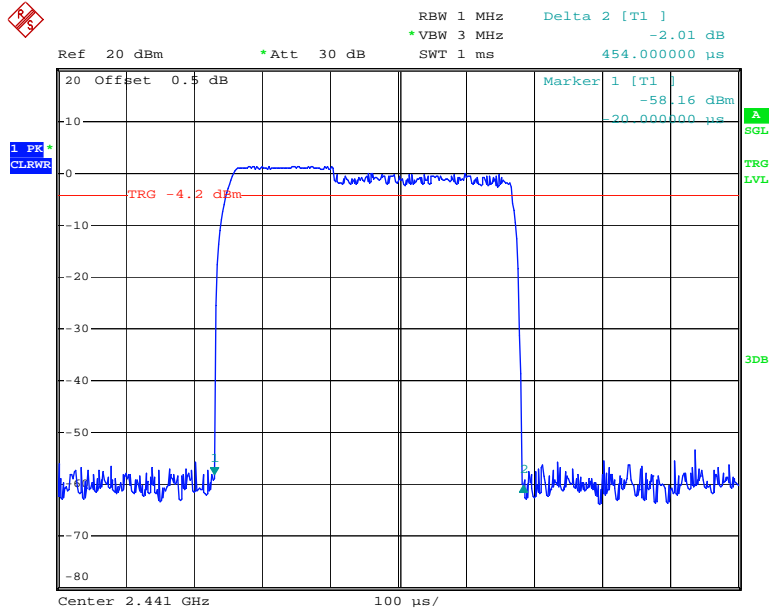
DH5: Middle Channel



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

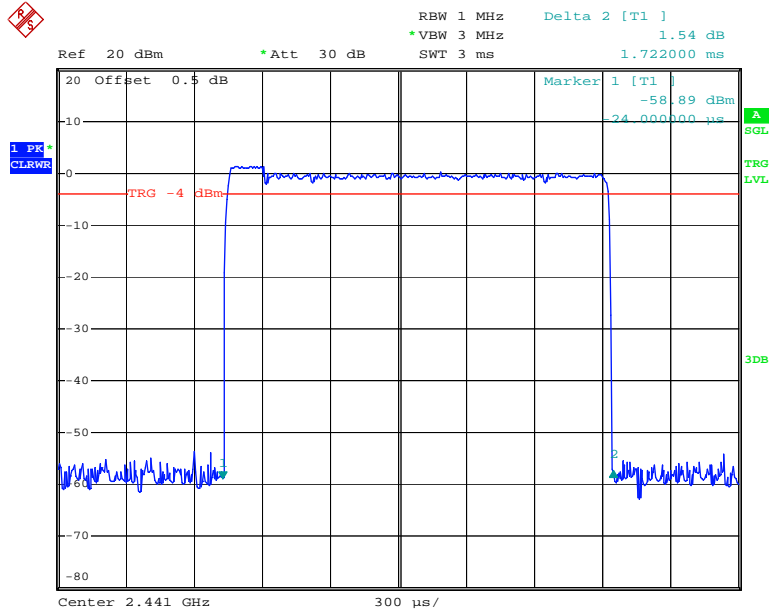
$\pi/4$ -DQPSK:

2DH1: Middle Channel



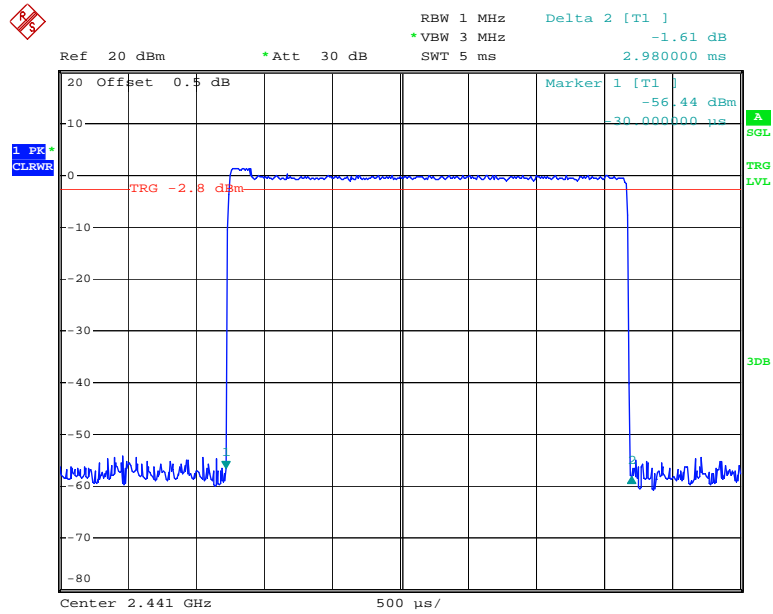
Date: 26.FEB.2020 20:10:02

2DH3: Middle Channel



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

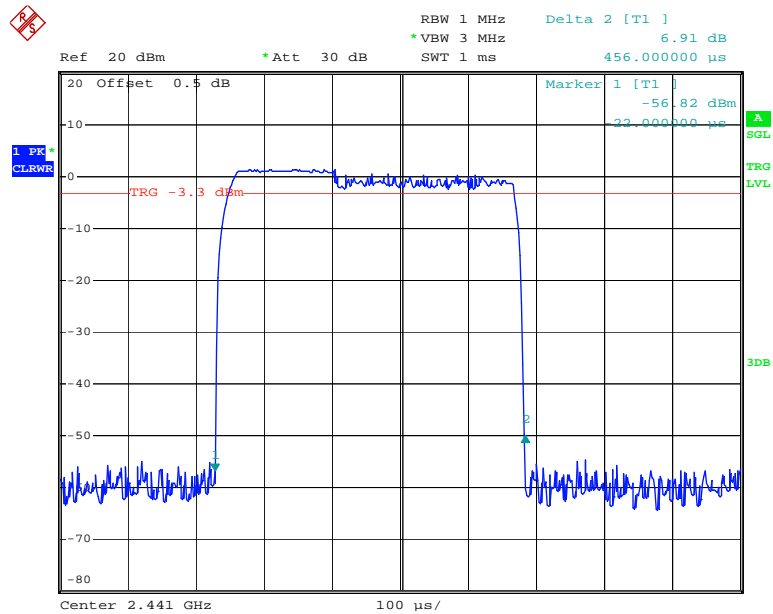
2DH5: Middle Channel



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

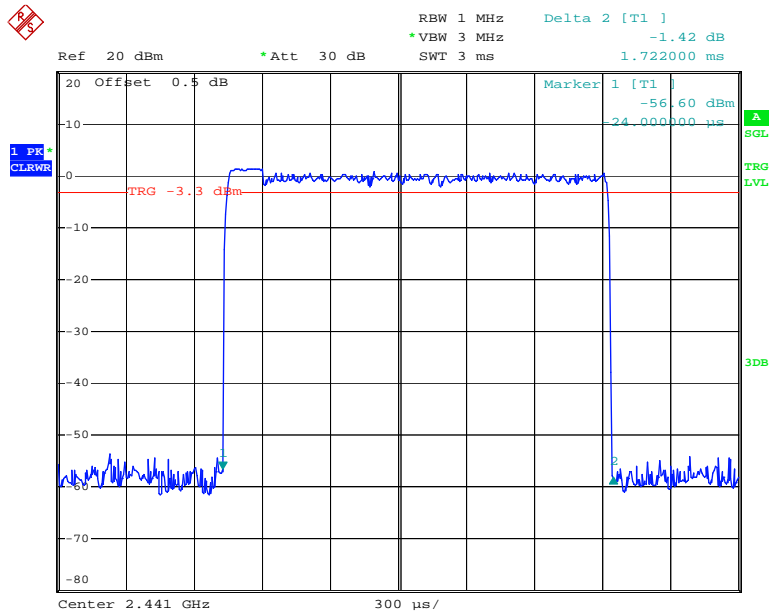
8DPSK:

3DH1: Middle Channel



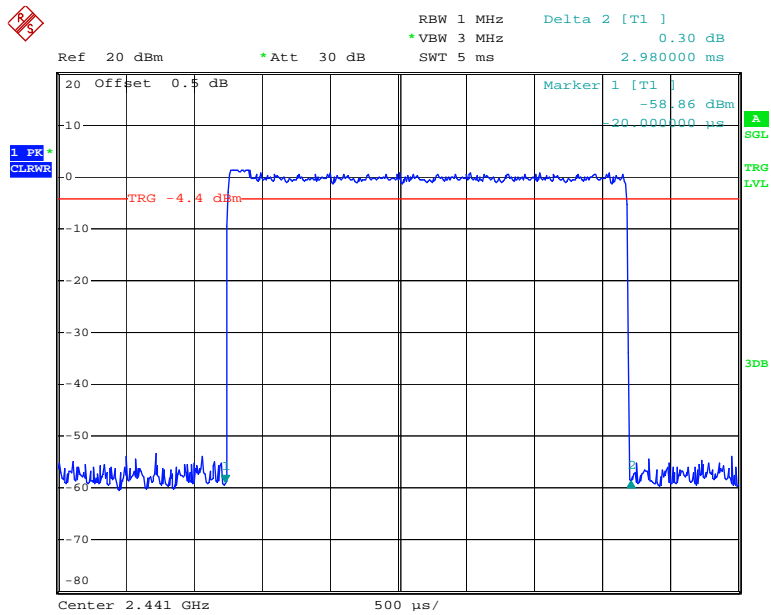
Date: 26.FEB.2020 20:10:18

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

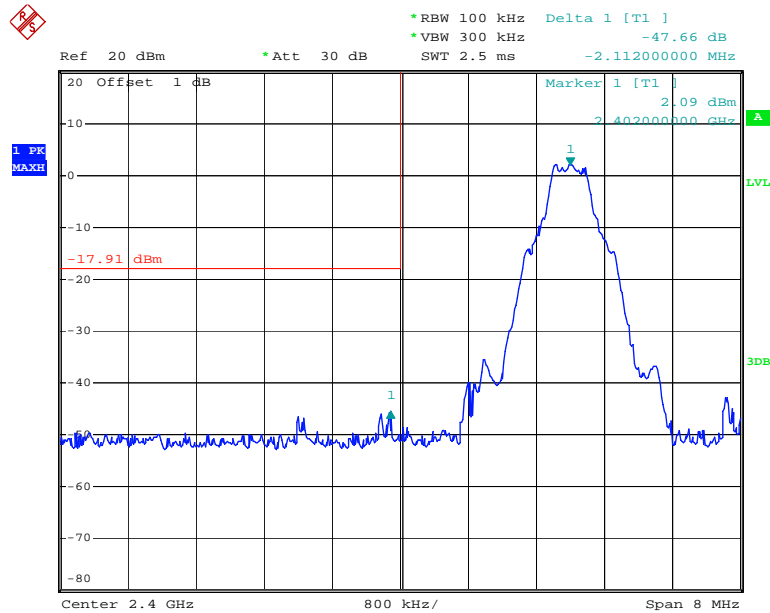
| | |
|---------------------------|------------|
| Temperature: | 23°C |
| Relative Humidity: | 52% |
| ATM Pressure: | 101.7kPa |
| Tester: | Chris Mo |
| Test Date: | 2020-02-25 |

Test Result: Compliance

Single Channel:

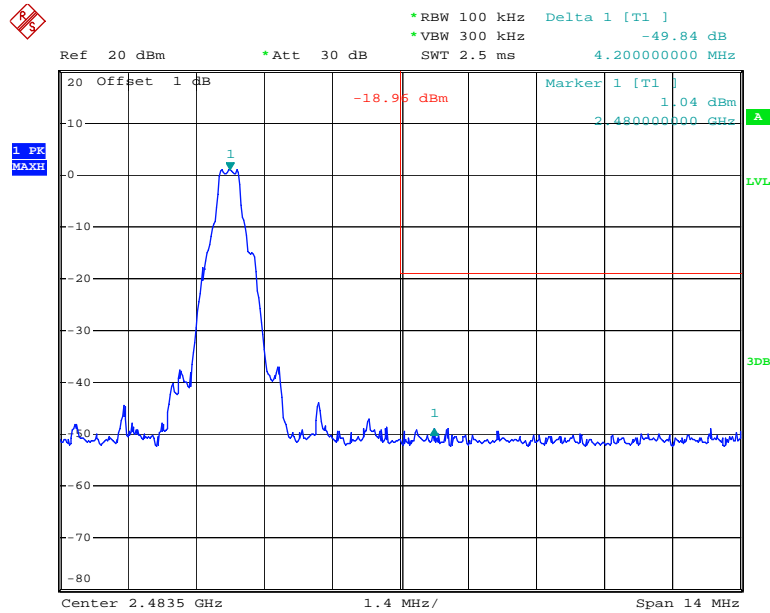
GFSK:

Band Edge, Left Side



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

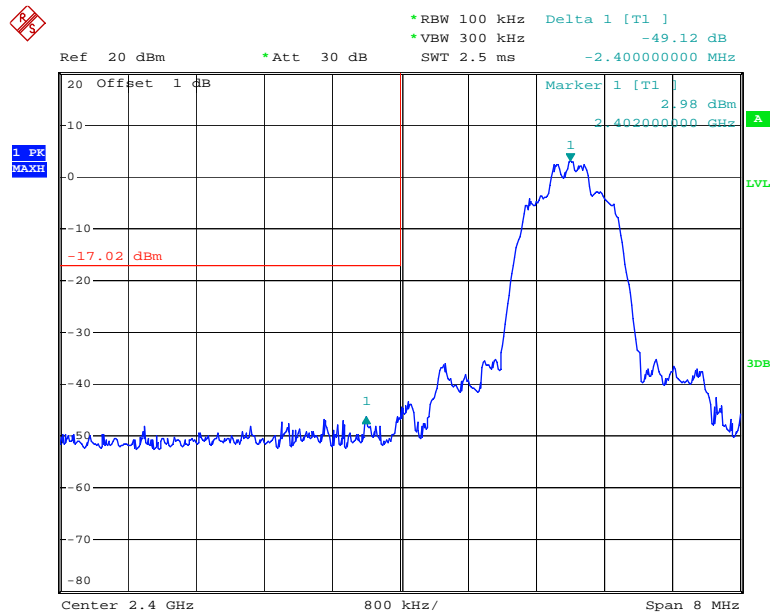
Band Edge, Right Side



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

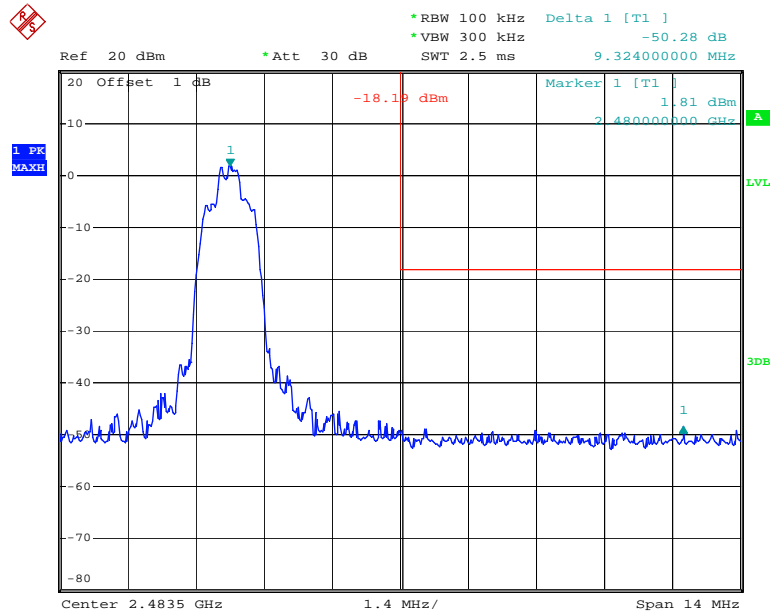
$\pi/4$ -DQPSK:

Band Edge, Left Side



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

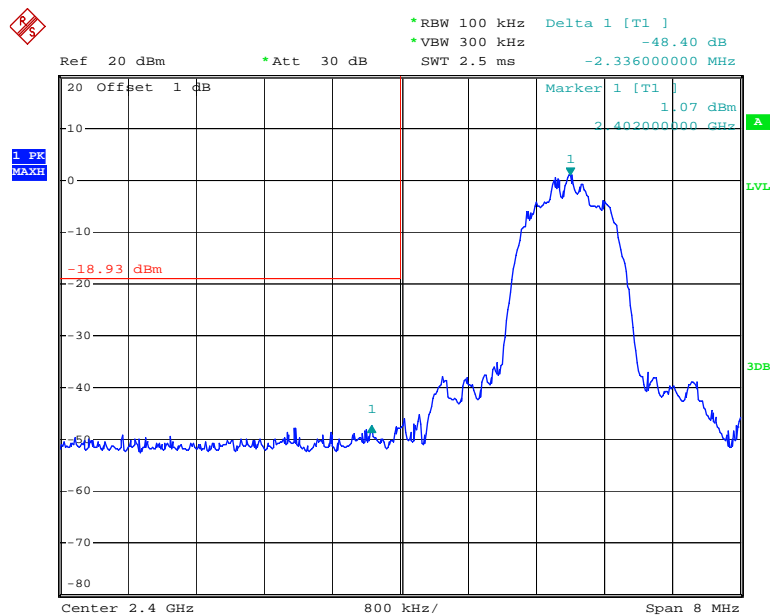
Band Edge, Right Side



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

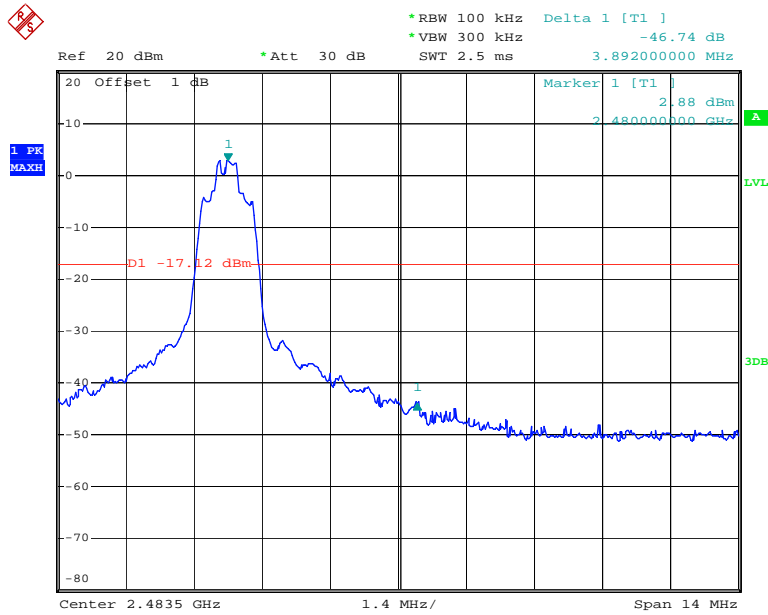
8DPSK

Band Edge, Left Side



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

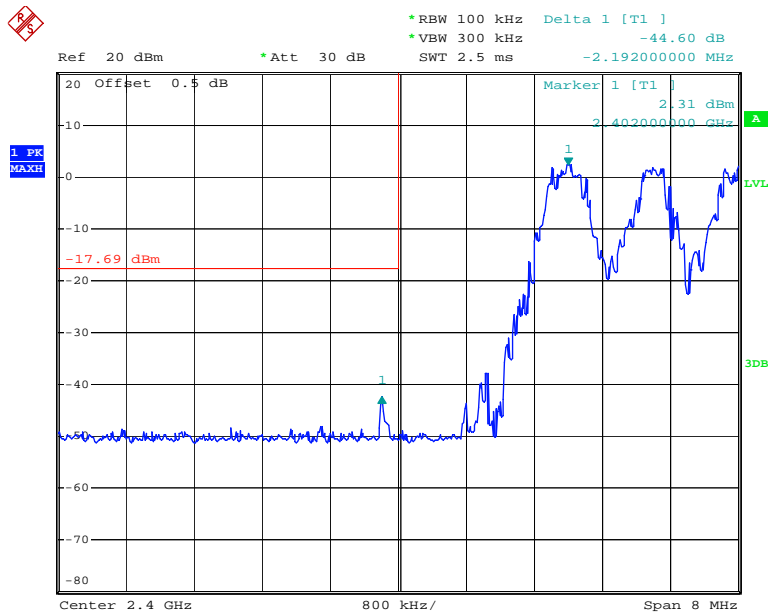
Band Edge, Right Side



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

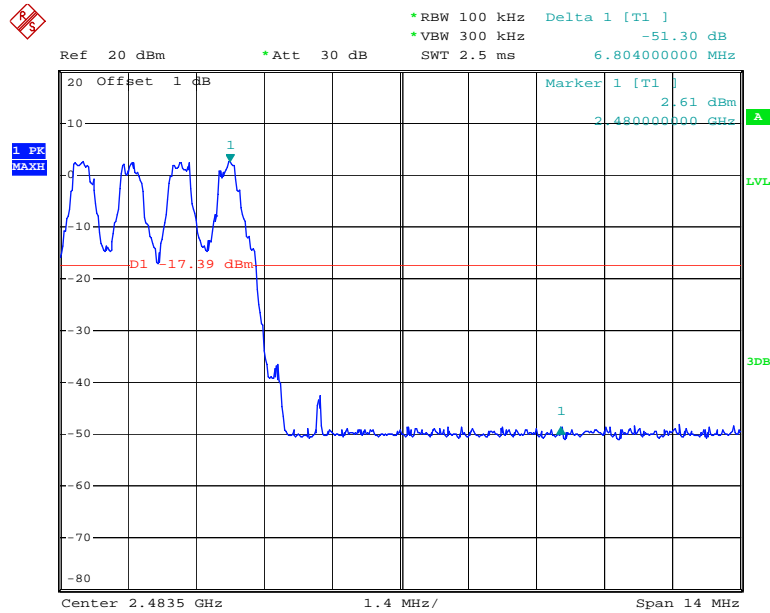
*Hopping Mode,
GFSK:*

Band Edge, Left Side



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

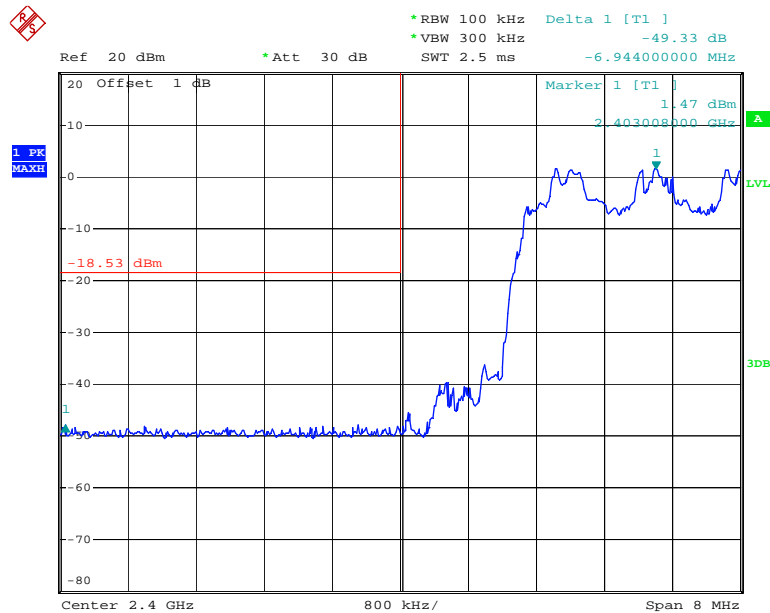
Band Edge, Right Side



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

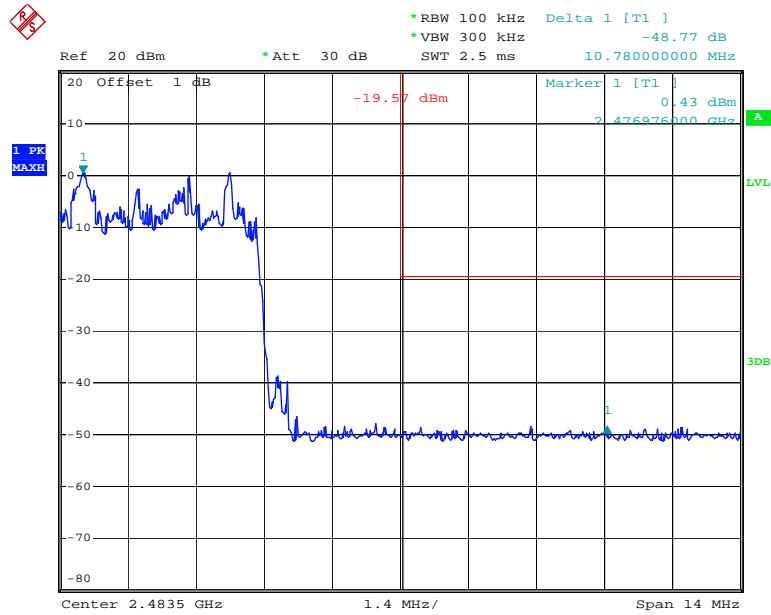
$\pi/4$ -DQPSK:

Band Edge, Left Side



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

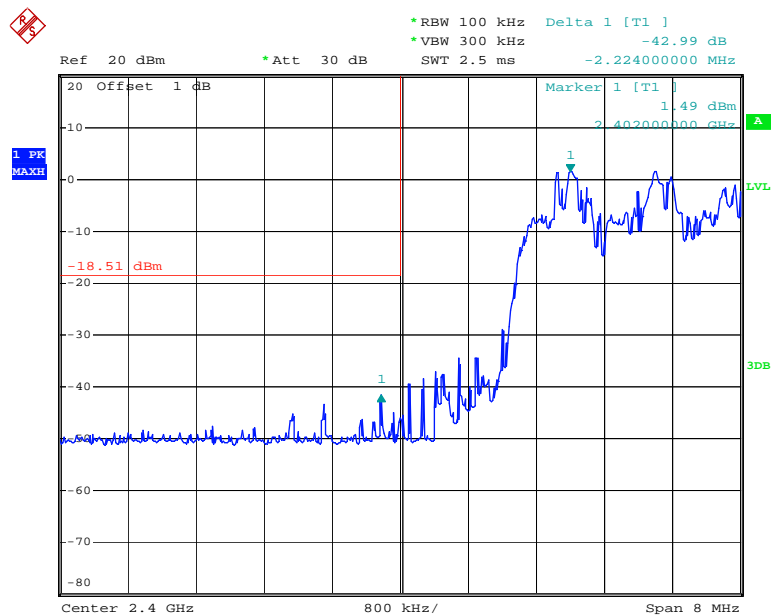
Band Edge, Right Side



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

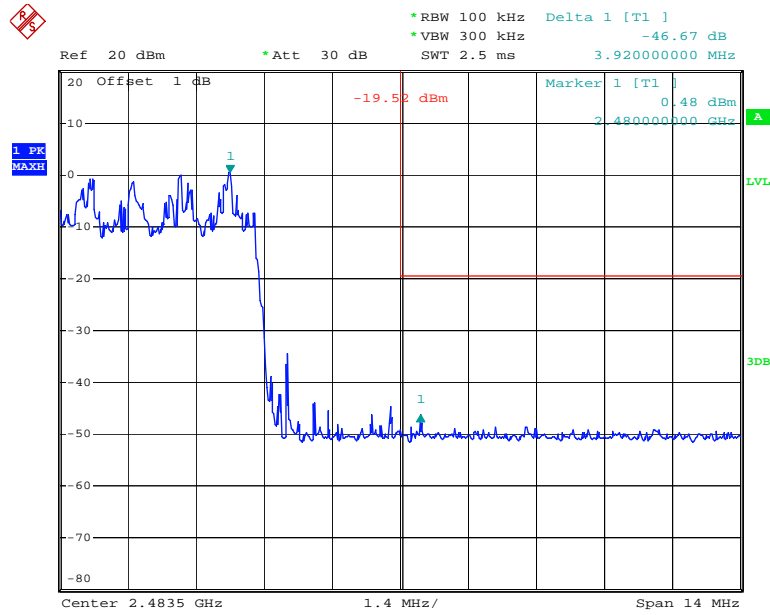
8DPSK:

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 ****