TESTING LABORATORY
CERTIFICATE #4820.01

# FCC PART 15.247

# TEST REPORT

For

# MAXWEST COMMUNICATION LIMITED

ROOM 1802B FORTRESS TOWER, 250 KING'S ROAD, NORTH POINT, HONG KONG

## FCC ID:2ASP8ASTRO5PRO

| Report Type: | Product Name: |
|---|---|
| Original Report | PHONE |

| | |
|---|---|
| **Report Number:** | RDG200918005-00A |
| **Report Date:** | 2020-11-10 |
| **Reviewed By:** | Ivan Cao<br>Assistant Manager |
| **Test Laboratory:** | Bay Area Compliance Laboratories Corp. (Dongguan)<br>No.69 Pulongcun, Puxinhu Industry Area,<br>Tangxia, Dongguan, Guangdong, China<br>Tel: +86-769-86858888<br>Fax: +86-769-86858891<br>www.baclcorp.com.cn |

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# GENERAL INFORMATION

## Product Description for Equipment under Test (EUT)

| | | |
|---|---|---|
| **EUT Name:** | | PHONE |
| **EUT Model:** | | ASTRO 5 PRO |
| **Operation Frequency:** | | 2402-2480 MHz |
| **Maximum Peak Output Power (Conducted):** | | 6.05 dBm |
| **Modulation Type:** | | GFSK, π/4-DQPSK, 8DPSK |
| **Antenna Gain△:** | | 1.23 dBi |
| **Rated Input Voltage:** | | DC 3.8V from battery or DC 5V from adapter |
| **Adapter Information** | **Model:** | ASTRO 5 PRO |
| | **Input:** | AC 100-240V,50/60 Hz, 0.5A |
| | **Output:** | DC 5.0V, 1000mA |
| **Serial Number:** | | RDG200918005-RF-S1 |
| **EUT Received Date:** | | 2020.09.19 |
| **EUT Received Status:** | | Good |

## Objective

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

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

## Related Submittal(s)/Grant(s)

FCC Part 15C DTS submissions with FCC ID: 2ASP8ASTRO5PRO
FCC Part 22H, 24E, 27 PCE submissions with FCC ID: 2ASP8ASTRO5PRO

## Test Methodology

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

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

## Measurement Uncertainty

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

## 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 "Δ". Customer model name, addresses, names, trademarks etc. are not considered data.

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

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# SYSTEM TEST CONFIGURATION

## Description of Test Configuration

The system was configured for testing in engineering mode, which was provided by manufacturer.

## EUT Exercise Software

The ' engineering mode ' was used during test, which was provided by manufacturer. The maximum power level was configured by the software as below table^:

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

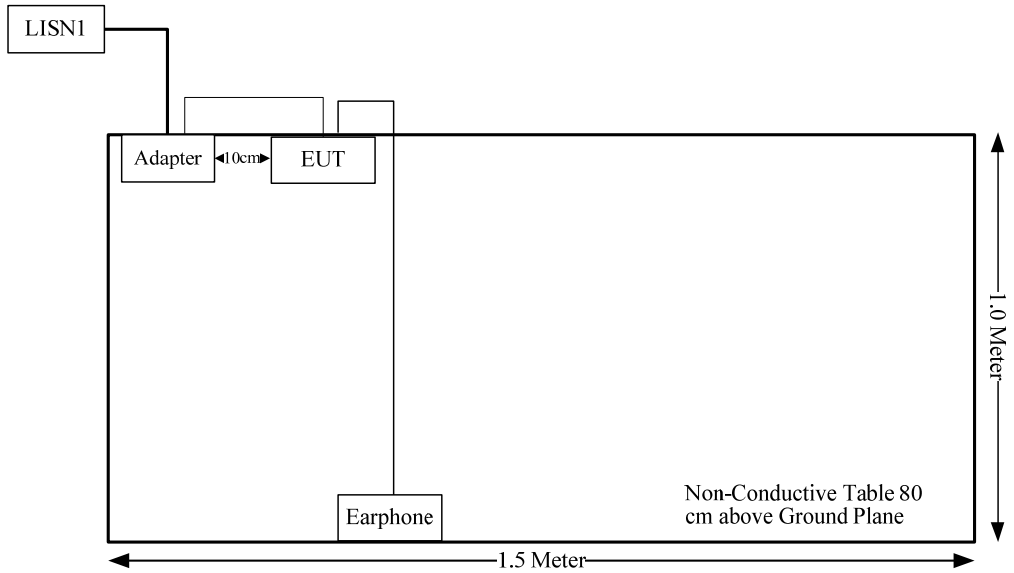
## Equipment Modifications

No modification was made to the EUT.

## Support Cable List and Details

| Cable Description | Shielding Type | Ferrite Core | Length (m) | From Port | To |
|---|---|---|---|---|---|
| USB Cable | No | No | 1.0 | Adapter | EUT |
| Earphone Cable | No | No | 1.2 | EUT | Earphone |

## 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 |
| FCC §15.203 | Antenna requirement | Compliance |
| FCC §15.207(a) | AC line conducted emissions | Compliance |
| FCC §15.205, §15.209, §15.247(d) | Spurious emissions | Compliance |
| FCC §15.247(a)(1) | Channel separation | Compliance |
| FCC §15.247(a)(1) | 20 dB bandwidth | Compliance |
| FCC §15.247(a)(1)(iii) | Quantity of hopping channel test | Compliance |
| FCC §15.247(a)(1)(iii) | Time of occupancy (dwell time) | Compliance |
| FCC §15.247(b)(1) | Peak output power measurement | Compliance |
| FCC §15.247(d) | Band edges | Compliance |

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

## Applicable Standard

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

According to KDB447498 D01 General RF Exposure Guidance v06:

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- f(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 6.2 dBm (4.2 mW).
[(max. power of channel, mW)/(min. test separation distance, mm)][√f(GHz)]
=4.2/5*(√2.480) = 1.3< 3.0

**So the stand-alone SAR evaluation is not necessary.**

# FCC §15.203 - ANTENNA REQUIREMENT

## Applicable Standard

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

## Antenna Connector Construction

The EUT has one internal FPC antennas arrangement, fulfill the requirement of this section. Please refer to the EUT photos.

| Antenna Type | input impedance (Ohm) | Antenna Gain /Frequency Range |
|---|---|---|
| FPC | 50 | 1.23 dBi/2.4~2.5GHz |

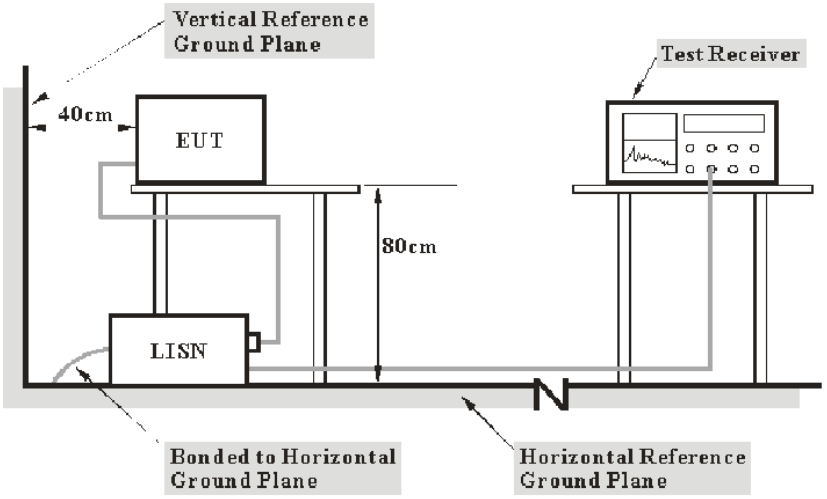
**Result:** Compliance.

# FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

## Applicable Standard

FCC§15.207(a)

## EUT Setup




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

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

The spacing between the peripherals was 10 cm.

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

## EMI Test Receiver Setup

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

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

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

## Test Procedure

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

The frequency and amplitude of the six highest ac power-line conducted emissions relative to the limit, measured over all the current-carrying conductors of the EUT power cords, and the operating frequency or frequency to which the EUT is tuned (if appropriate), should be reported, unless such emissions are more than 20 dB below the limit. AC power-line conducted emissions measurements are to be separately carried out only on each of the phase ("hot") line(s) and (if used) on the neutral line(s), but not on the ground [protective earth] line(s). If less than six emission frequencies are within 20 dB of the limit, then the noise level of the measuring instrument at representative frequencies should be reported. The specific conductor of the power-line cord for each of the reported emissions should be identified. Measure the six highest emissions with respect to the limit on each current-carrying conductor of each power cord associated with the EUT (but not the power cords of associated or peripheral equipment that are part of the test configuration). Then, report the six highest emissions with respect to the limit from among all the measurements identifying the frequency and specific current-carrying conductor identified with the emission. The six highest emissions should be reported for each of the current-carrying conductors, or the six highest emissions may be reported over all the current-carrying conductors.

## Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$V_C = V_R + A_C + VDF$

Herein,
$V_C$: corrected voltage amplitude
$V_R$: reading voltage amplitude
$A_c$: attenuation caused by cable loss
VDF: voltage division factor of AMN or ISN

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

Margin = Limit – Corrected Amplitude

## Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| R&S | LISN | ENV 216 | 101614 | 2020-09-12 | 2021-09-12 |
| R&S | EMI Test Receiver | ESCI | 101121 | 2020-07-07 | 2021-07-07 |
| MICRO-COAX | Coaxial Cable | C-NJNJ-50 | C-0200-01 | 2020-09-05 | 2021-09-05 |
| R&S | Test Software | EMC32 | Version 9.10.00 | N/A | 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

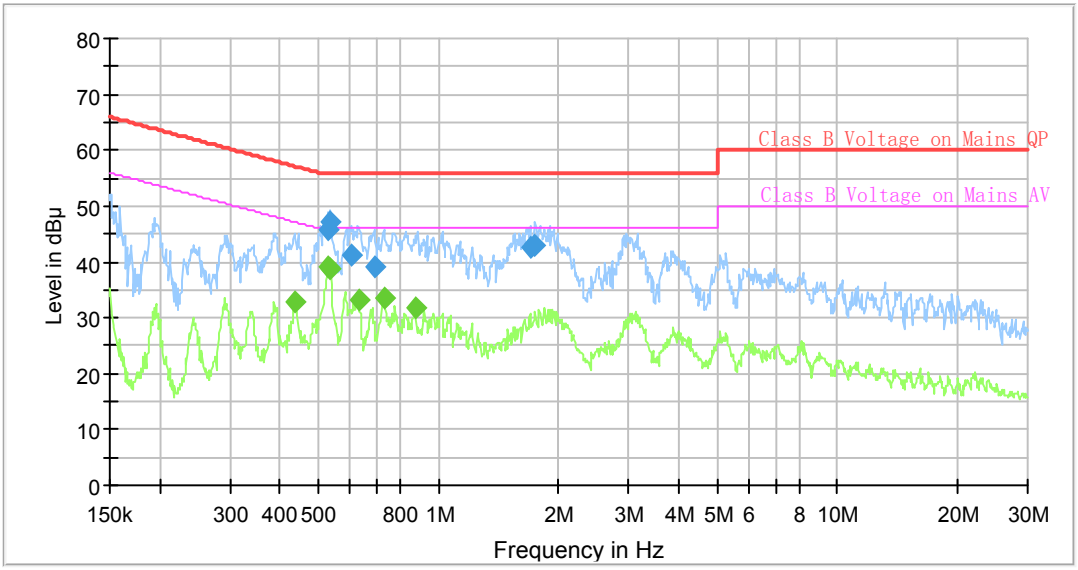
**Environmental Conditions**

| | |
|---|---|
| **Temperature:** | 22.9℃ |
| **Relative Humidity:** | 51% |
| **ATM Pressure:** | 101.4 kPa |
| **Tester:** | Barry Yang |
| **Test Date:** | 2020-11-02 |

**Test Result:** Compliance

**Test Mode:** Transmitting

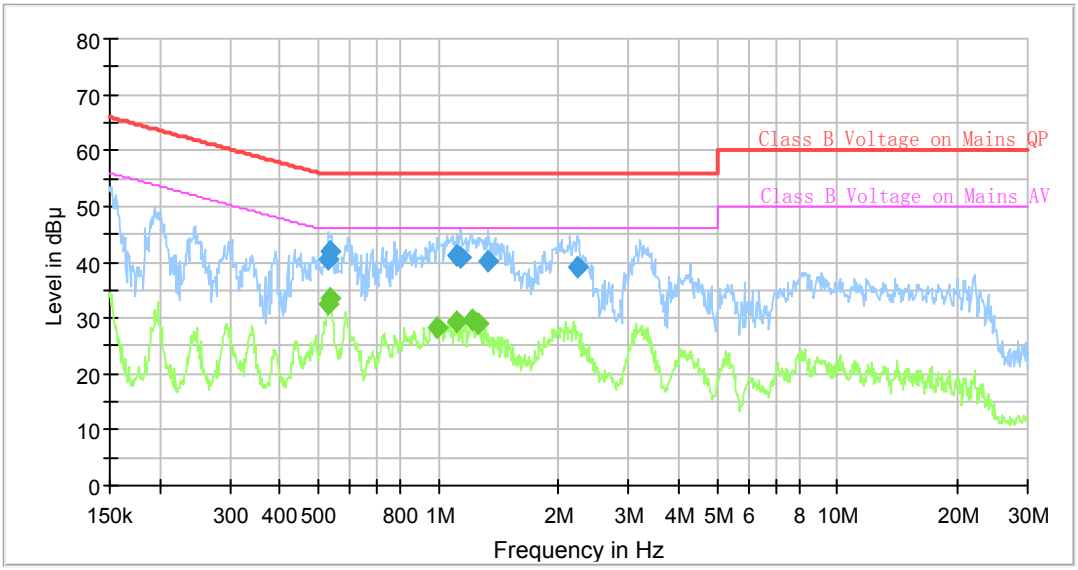
**AC120V, 60 Hz, Line:**




## Final_Result

| Frequency (MHz) | QuasiPeak (dB µ V) | Average (dB µ V) | Limit (dB µ V) | Margin (dB) | Bandwidth (kHz) | Line | Corr. (dB) |
|---|---|---|---|---|---|---|---|
| 0.436143 | --- | 32.75 | 47.13 | 14.38 | 9.000 | L1 | 9.6 |
| 0.529791 | --- | 39.00 | 46.00 | 7.00 | 9.000 | L1 | 9.6 |
| 0.529791 | 45.79 | --- | 56.00 | 10.21 | 9.000 | L1 | 9.6 |
| 0.535103 | --- | 38.68 | 46.00 | 7.32 | 9.000 | L1 | 9.6 |
| 0.535103 | 46.99 | --- | 56.00 | 9.01 | 9.000 | L1 | 9.6 |
| 0.603146 | 41.07 | --- | 56.00 | 14.93 | 9.000 | L1 | 9.6 |
| 0.630837 | --- | 33.29 | 46.00 | 12.71 | 9.000 | L1 | 9.6 |
| 0.690091 | 39.23 | --- | 56.00 | 16.77 | 9.000 | L1 | 9.6 |
| 0.729009 | --- | 33.60 | 46.00 | 12.40 | 9.000 | L1 | 9.7 |
| 0.872391 | --- | 31.83 | 46.00 | 14.17 | 9.000 | L1 | 9.7 |
| 1.702015 | 42.60 | --- | 56.00 | 13.40 | 9.000 | L1 | 9.7 |
| 1.744993 | 42.92 | --- | 56.00 | 13.08 | 9.000 | L1 | 9.7 |

**AC120V, 60 Hz, Neutral:**




## Final_Result

| Frequency (MHz) | QuasiPeak (dB µ V) | Average (dB µ V) | Limit (dB µ V) | Margin (dB) | Bandwidth (kHz) | Line | Corr. (dB) |
|---|---|---|---|---|---|---|---|
| 0.529791 | --- | 32.59 | 46.00 | 13.41 | 9.000 | N | 9.6 |
| 0.529791 | 40.48 | --- | 56.00 | 15.52 | 9.000 | N | 9.6 |
| 0.535103 | --- | 33.46 | 46.00 | 12.54 | 9.000 | N | 9.6 |
| 0.535103 | 41.85 | --- | 56.00 | 14.15 | 9.000 | N | 9.6 |
| 0.998148 | --- | 28.26 | 46.00 | 17.74 | 9.000 | N | 9.6 |
| 1.113905 | 41.05 | --- | 56.00 | 14.95 | 9.000 | N | 9.6 |
| 1.113905 | --- | 29.30 | 46.00 | 16.70 | 9.000 | N | 9.6 |
| 1.136351 | 40.78 | --- | 56.00 | 15.22 | 9.000 | N | 9.6 |
| 1.212470 | --- | 29.56 | 46.00 | 16.44 | 9.000 | N | 9.6 |
| 1.255549 | --- | 28.99 | 46.00 | 17.01 | 9.000 | N | 9.6 |
| 1.332988 | 40.16 | --- | 56.00 | 15.84 | 9.000 | N | 9.6 |
| 2.228079 | 39.05 | --- | 56.00 | 16.95 | 9.000 | N | 9.6 |

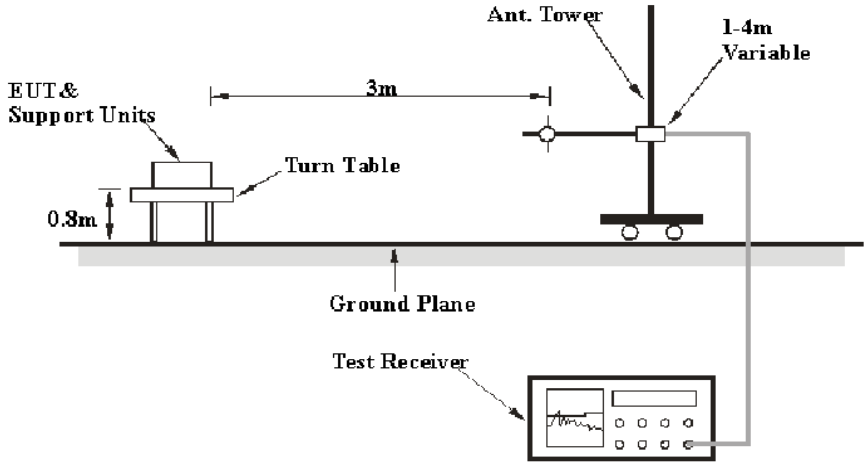
# FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

## Applicable Standard

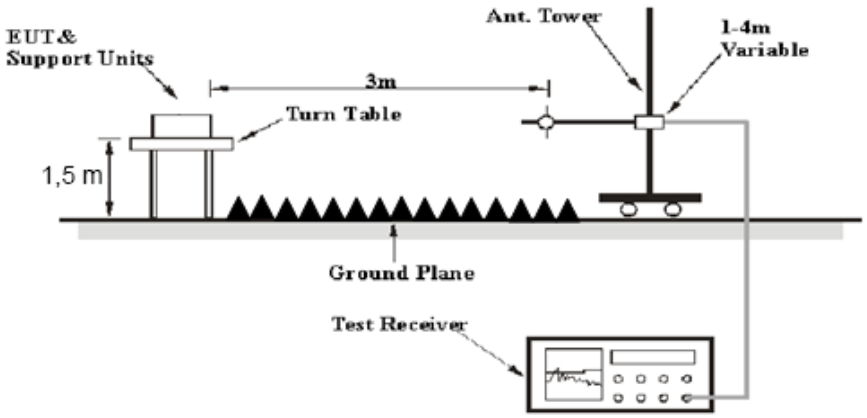
FCC §15.247 (d); §15.209; §15.205;

## EUT Setup

**Below 1GHz:**




**Above 1GHz:**




The radiated emission below 1GHz tests were performed in the 10 meters chamber, 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 26.5 GHz.

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

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

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

## Test Procedure

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

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

## Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| Radiation Below 1GHz | | | | | |
| Sunol Sciences | Antenna | JB3 | A060611-2 | 2020-08-25 | 2023-08-25 |
| R&S | EMI Test Receiver | ESCI | 100224 | 2020-09-12 | 2021-09-12 |
| Unknown | Coaxial Cable | C-NJNJ-50 | C-1000-01 | 2020-09-05 | 2021-09-05 |
| Unknown | Coaxial Cable | C-NJNJ-50 | C-0400-02 | 2020-09-05 | 2021-09-05 |
| Unknown | Coaxial Cable | C-NJNJ-50 | C-0530-01 | 2020-09-24 | 2021-09-24 |
| Sonoma | Amplifier | 310N | 185914 | 2020-10-13 | 2021-10-13 |
| Farad | Test Software | EZ-EMC | V1.1.4.2 | N/A | N/A |
| Radiation Above 1GHz | | | | | |
| ETS-Lindgren | Horn Antenna | 3115 | 000 527 35 | 2018-10-12 | 2021-10-12 |
| Ducommun Technolagies | Horn Antenna | ARH-4223-02 | 1007726-01 1304 | 2017-12-06 | 2020-12-05 |
| Agilent | Spectrum Analyzer | E4440A | SG43360054 | 2020-07-07 | 2021-07-07 |
| Unknown | Coaxial Cable | C-SJSJ-50 | C-0800-01 | 2020-09-05 | 2021-09-05 |
| Unknown | Coaxial Cable | C-2.4J2.4J-50 | C-0700-02 | 2020-06-27 | 2021-06-27 |
| Mini-Circuit | Amplifier | ZVA-213-S+ | 54201245 | 2020-09-05 | 2021-09-05 |
| Quinstar | Amplifier | QLW-18405536-JO | 15964001001 | 2020-06-27 | 2021-06-27 |
| Farad | Test Software | EZ-EMC | V1.1.4.2 | N/A | N/A |
| E-Microwave | Band-stop Filters | OBSF-2400-2483.5-S | OE01601525 | 2020-06-16 | 2021-06-16 |
| Micro-tronics | High Pass Filter | HPM50111 | S/N-G217 | 2020-06-16 | 2021-06-16 |

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

## Corrected Amplitude & Margin Calculation

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

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

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

Margin = Limit – Corrected Amplitude

## Test Data

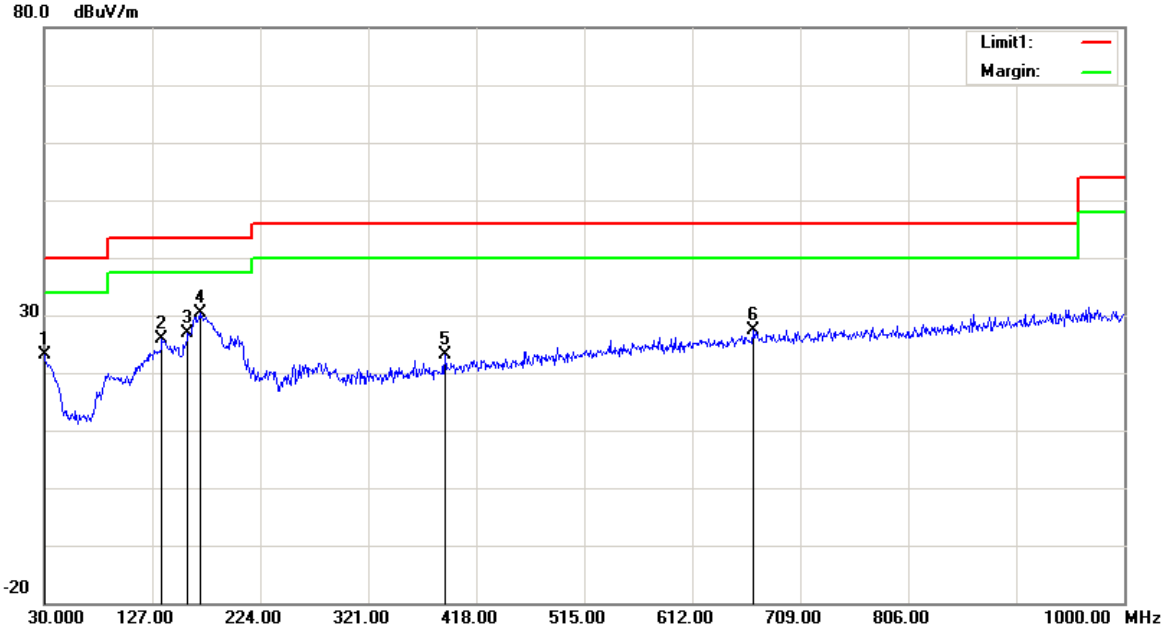
### Environmental Conditions

| Test Items | Radiation Below 1GHz | Radiation Above 1GHz |
|---|---|---|
| Temperature: | 27.4 °C | 28 °C |
| Relative Humidity: | 41 % | 41 % |
| ATM Pressure: | 101.3kPa | 100.7kPa |
| Tester: | Jalon Liu | Bond Qin |
| Test Date: | 2020-11-05 | 2020-09-27 |

*Test Mode: Transmitting*

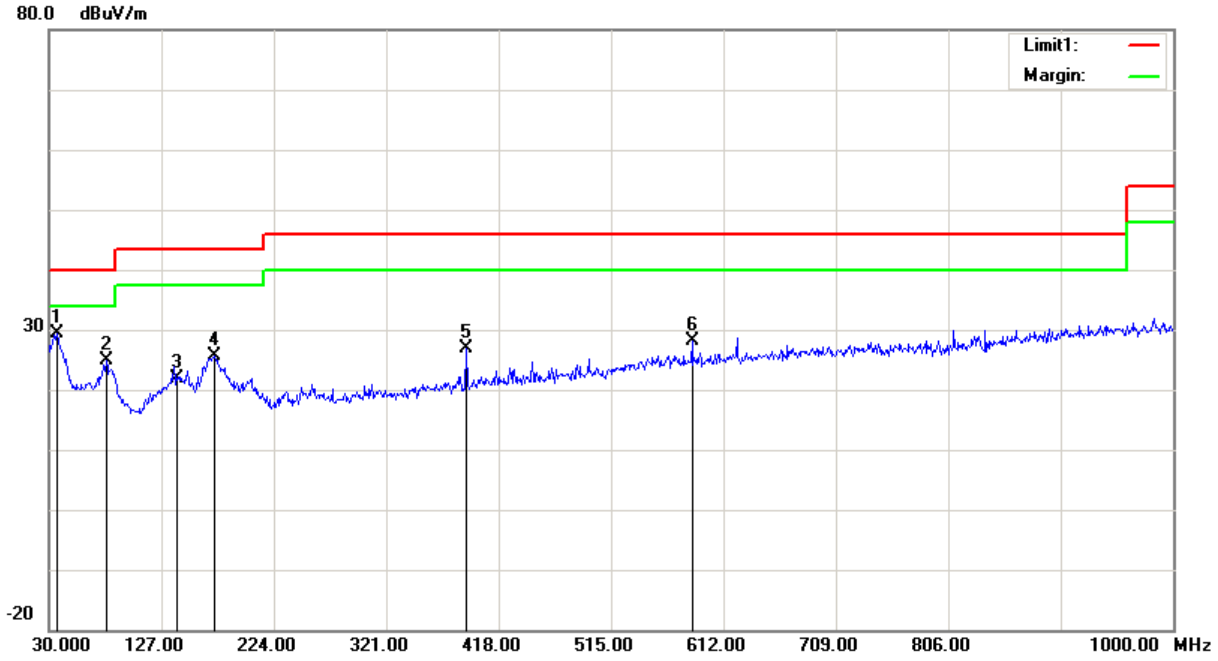
**1) 30MHz-1GHz** (BDR High channel was the worst)

**Horizontal:**




| Frequency (MHz) | Receiver Reading (dBµV) | Remark | Correction Factor (dB/m) | Cord. Amp. (dBµV/m) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 30.0000 | 27.13 | peak | -4.10 | 23.03 | 40.00 | 16.97 |
| 135.7300 | 35.14 | peak | -9.31 | 25.83 | 43.50 | 17.67 |
| 159.0100 | 36.24 | peak | -9.39 | 26.85 | 43.50 | 16.65 |
| 169.6800 | 39.82 | peak | -9.53 | 30.29 | 43.50 | 13.21 |
| 389.8700 | 28.65 | peak | -5.54 | 23.11 | 46.00 | 22.89 |
| 666.3200 | 27.38 | peak | -0.12 | 27.26 | 46.00 | 18.74 |

**Vertical:**




| Frequency (MHz) | Receiver Reading (dBµV) | Remark | Correction Factor (dB/m) | Cord. Amp. (dBµV/m) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 36.7900 | 37.01 | peak | -7.63 | 29.38 | 40.00 | 10.62 |
| 79.4700 | 40.87 | peak | -15.90 | 24.97 | 40.00 | 15.03 |
| 140.5800 | 31.13 | peak | -9.22 | 21.91 | 43.50 | 21.59 |
| 172.5900 | 35.14 | peak | -9.53 | 25.61 | 43.50 | 17.89 |
| 389.8700 | 32.35 | peak | -5.54 | 26.81 | 46.00 | 19.19 |
| 584.8400 | 29.57 | peak | -1.49 | 28.08 | 46.00 | 17.92 |

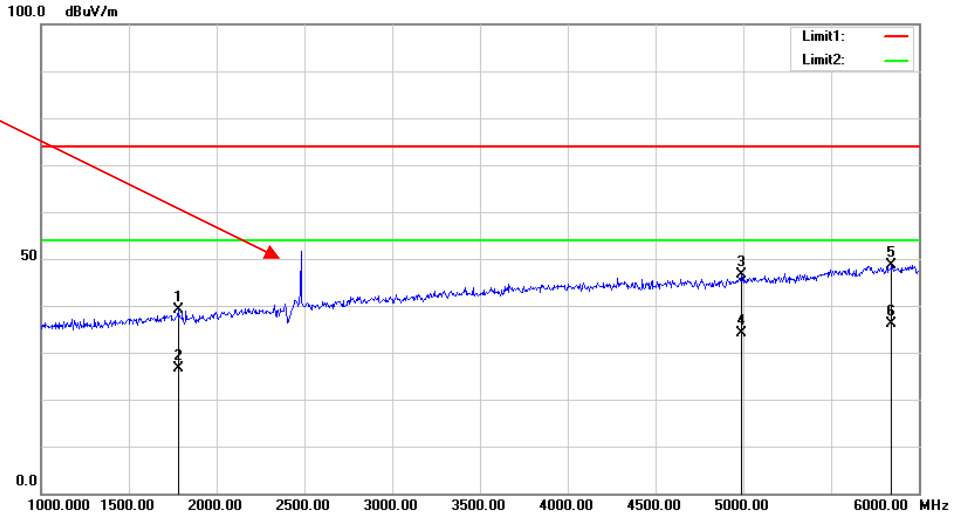
**2)1GHz-25GHz:**

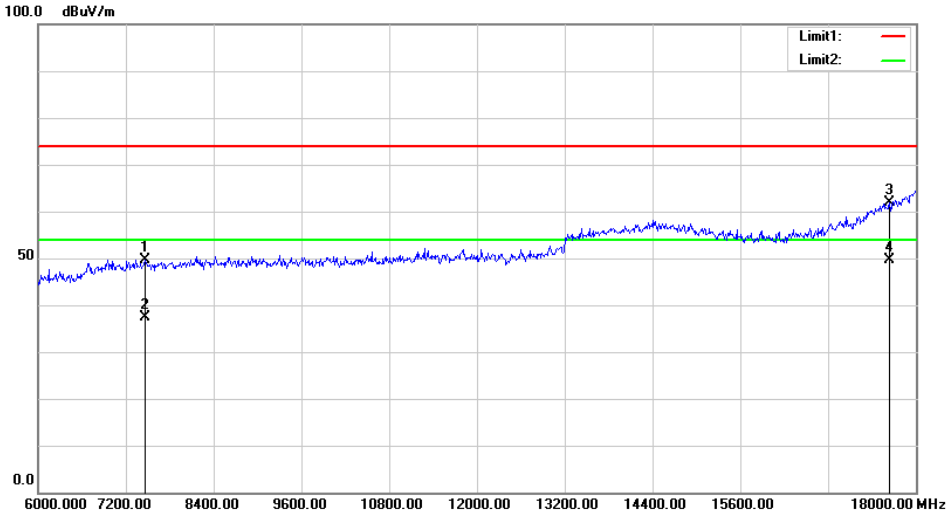
*BDR Mode(GFSK) was the worst:*

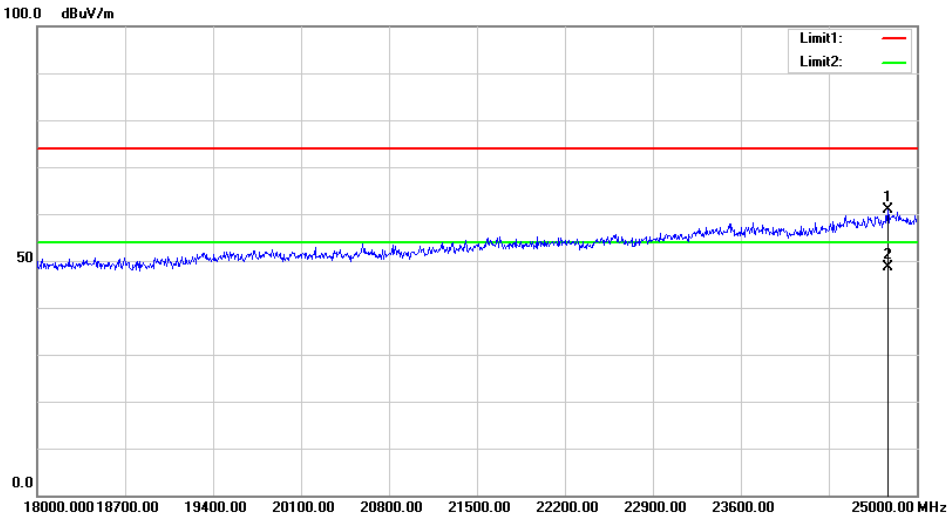
| Frequency (MHz) | Receiver | | Rx Antenna | | Cable loss (dB) | Amplifier Gain (dB) | Corrected Amplitude (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| | Reading (dBμV) | Remark | Polar (H/V) | Factor (dB/m) | | | | | |
| Low Channel: 2402 MHz | | | | | | | | | |
| 2402.00 | 68.11 | PK | H | 28.10 | 1.80 | 0.00 | 98.01 | N/A | N/A |
| 2402.00 | 57.80 | AV | H | 28.10 | 1.80 | 0.00 | 87.70 | N/A | N/A |
| 2402.00 | 64.61 | PK | V | 28.10 | 1.80 | 0.00 | 94.51 | N/A | N/A |
| 2402.00 | 54.46 | AV | V | 28.10 | 1.80 | 0.00 | 84.36 | N/A | N/A |
| 2390.00 | 25.79 | PK | H | 28.08 | 1.80 | 0.00 | 55.67 | 74.00 | 18.33 |
| 2390.00 | 13.46 | AV | H | 28.08 | 1.80 | 0.00 | 43.34 | 54.00 | 10.66 |
| 4804.00 | 36.04 | PK | H | 32.91 | 3.17 | 25.60 | 46.52 | 74.00 | 27.48 |
| 4804.00 | 23.52 | AV | H | 32.91 | 3.17 | 25.60 | 34.00 | 54.00 | 20.00 |
| 7206.00 | 35.64 | PK | H | 35.74 | 4.82 | 25.60 | 50.60 | 74.00 | 23.40 |
| 7206.00 | 23.45 | AV | H | 35.74 | 4.82 | 25.60 | 38.41 | 54.00 | 15.59 |
| Middle Channel: 2441 MHz | | | | | | | | | |
| 2441.00 | 68.37 | PK | H | 28.18 | 1.82 | 0.00 | 98.37 | N/A | N/A |
| 2441.00 | 58.01 | AV | H | 28.18 | 1.82 | 0.00 | 88.01 | N/A | N/A |
| 2441.00 | 64.36 | PK | V | 28.18 | 1.82 | 0.00 | 94.36 | N/A | N/A |
| 2441.00 | 54.02 | AV | V | 28.18 | 1.82 | 0.00 | 84.02 | N/A | N/A |
| 4882.00 | 36.62 | PK | H | 33.06 | 3.27 | 25.66 | 47.29 | 74.00 | 26.71 |
| 4882.00 | 24.25 | AV | H | 33.06 | 3.27 | 25.66 | 34.92 | 54.00 | 19.08 |
| 7323.00 | 36.01 | PK | H | 36.04 | 4.62 | 25.73 | 50.94 | 74.00 | 23.06 |
| 7323.00 | 23.36 | AV | H | 36.04 | 4.62 | 25.73 | 38.29 | 54.00 | 15.71 |
| High Channel: 2480 MHz | | | | | | | | | |
| 2480.00 | 67.07 | PK | H | 28.26 | 1.84 | 0.00 | 97.17 | N/A | N/A |
| 2480.00 | 56.89 | AV | H | 28.26 | 1.84 | 0.00 | 86.99 | N/A | N/A |
| 2480.00 | 63.25 | PK | V | 28.26 | 1.84 | 0.00 | 93.35 | N/A | N/A |
| 2480.00 | 53.01 | AV | V | 28.26 | 1.84 | 0.00 | 83.11 | N/A | N/A |
| 2483.50 | 27.17 | PK | H | 28.27 | 1.84 | 0.00 | 57.28 | 74.00 | 16.72 |
| 2483.50 | 15.01 | AV | H | 28.27 | 1.84 | 0.00 | 45.12 | 54.00 | 8.88 |
| 4960.00 | 36.02 | PK | H | 33.22 | 3.23 | 25.63 | 46.84 | 74.00 | 27.16 |
| 4960.00 | 23.01 | AV | H | 33.22 | 3.23 | 25.63 | 33.83 | 54.00 | 20.17 |
| 7440.00 | 35.89 | PK | H | 36.34 | 4.41 | 25.85 | 50.79 | 74.00 | 23.21 |
| 7440.00 | 23.59 | AV | H | 36.34 | 4.41 | 25.85 | 38.49 | 54.00 | 15.51 |

**Worst plots (**GFSK High channel was the worst**)**
**Horizontal**

Fundamental Test with Band Rejection Filter

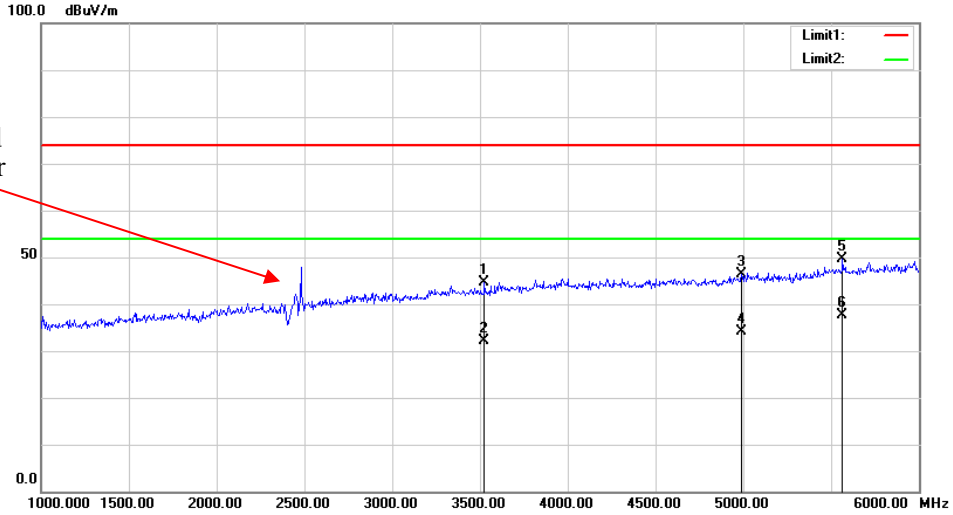


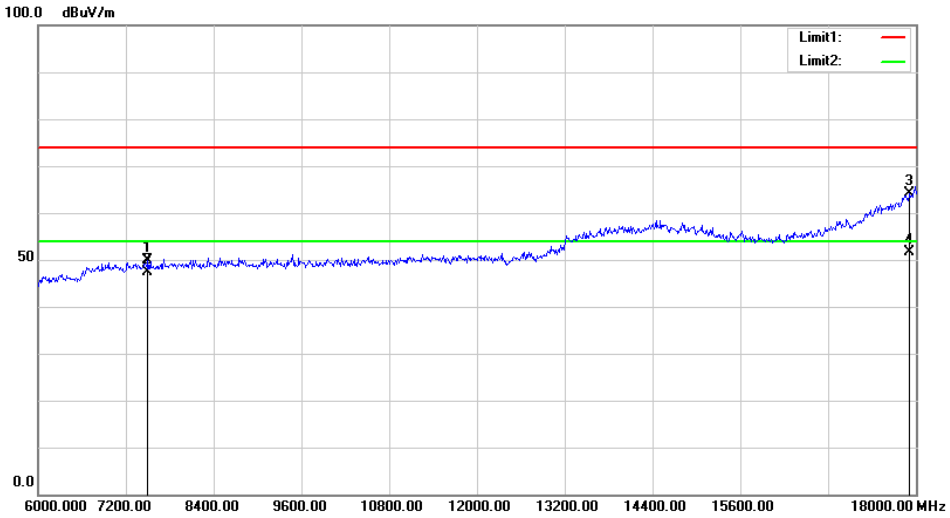



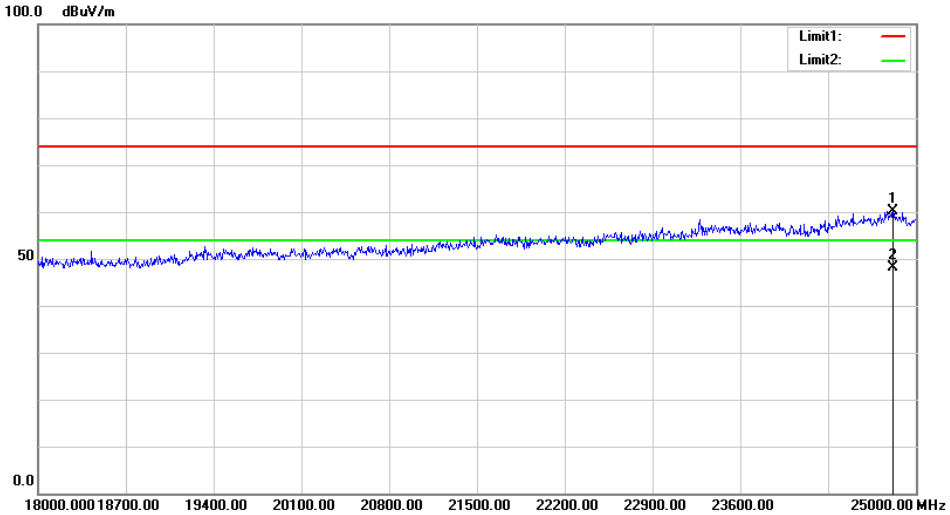



**Vertical**

Fundamental Test with Band Rejection Filter



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

## Applicable Standard

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

## Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| R&S | Spectrum Analyzer | FSU 26 | 200256 | 2020-07-07 | 2021-07-07 |
| Unknown | Coaxial Cable | C-SJ00-0010 | C0010/01 | Each time | N/A |

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

## Test Procedure

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

## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 27.6 °C |
| **Relative Humidity:** | 50 % |
| **ATM Pressure:** | 100.8kPa |
| **Test by:** | Billy Li |
| **Test Date:** | 2020-10-08 |

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

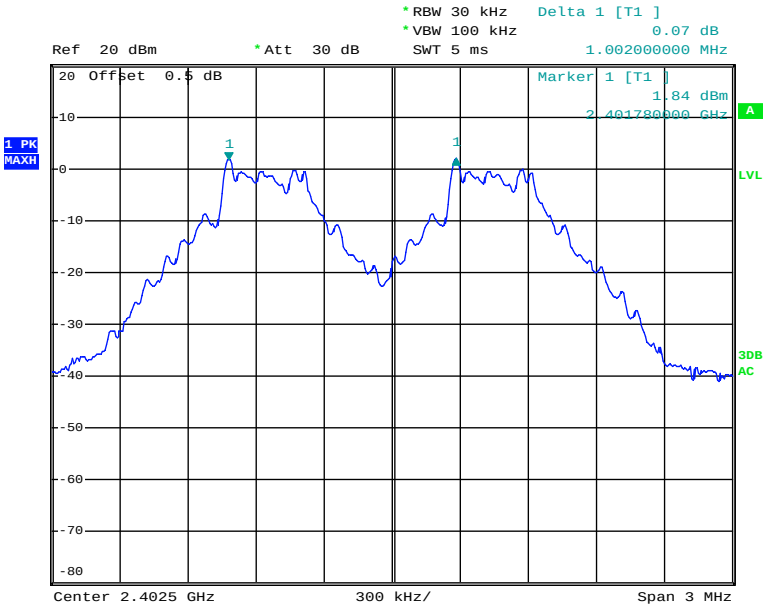
*Test Mode: Transmitting*

| Mode | Channel | Frequency (MHz) | Channel Separation (MHz) | Limit (MHz) |
|---|---|---|---|---|
| BDR (GFSK) | Low | 2402 | 1.002 | 0.58 |
| | Middle | 2441 | 1.002 | 0.58 |
| | High | 2480 | 1.002 | 0.58 |
| EDR (π/4-DQPSK) | Low | 2402 | 1.008 | 0.84 |
| | Middle | 2441 | 0.996 | 0.84 |
| | High | 2480 | 1.002 | 0.84 |
| EDR (8DPSK) | Low | 2402 | 0.996 | 0.82 |
| | Middle | 2441 | 1.002 | 0.82 |
| | High | 2480 | 1.002 | 0.82 |

*Note: Limit= (2/3) × 20dB bandwidth*

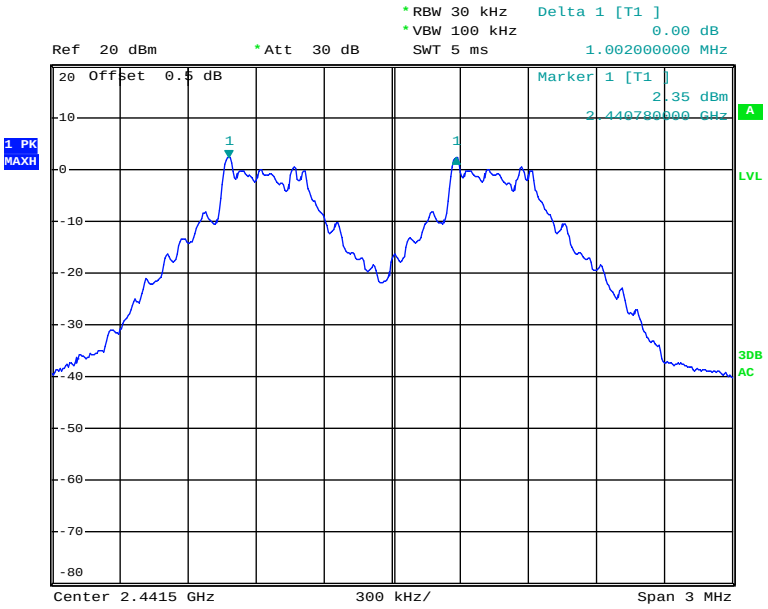
*BDR Mode (GFSK):*

**Low Channel**



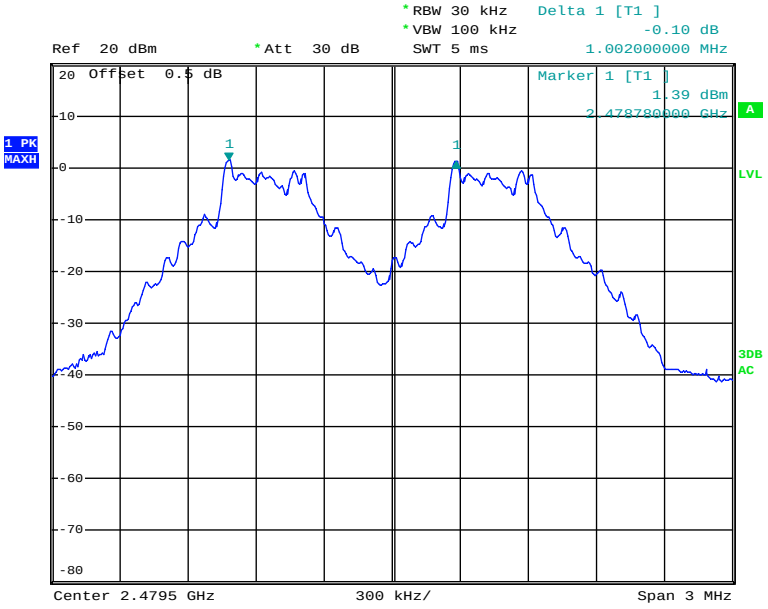

Date: 8.OCT.2020 13:09:10

## Middle Channel




Date: 8.OCT.2020 13:11:08

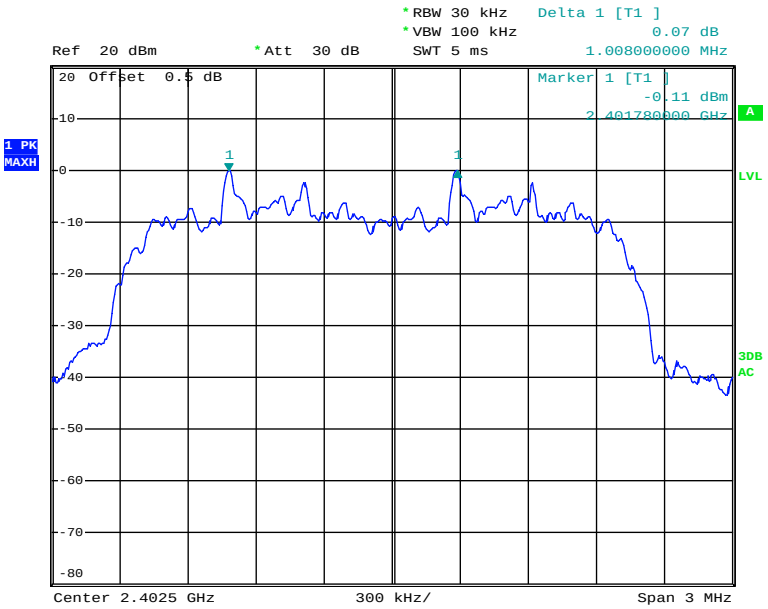
## High Channel




Date: 8.OCT.2020 13:13:51

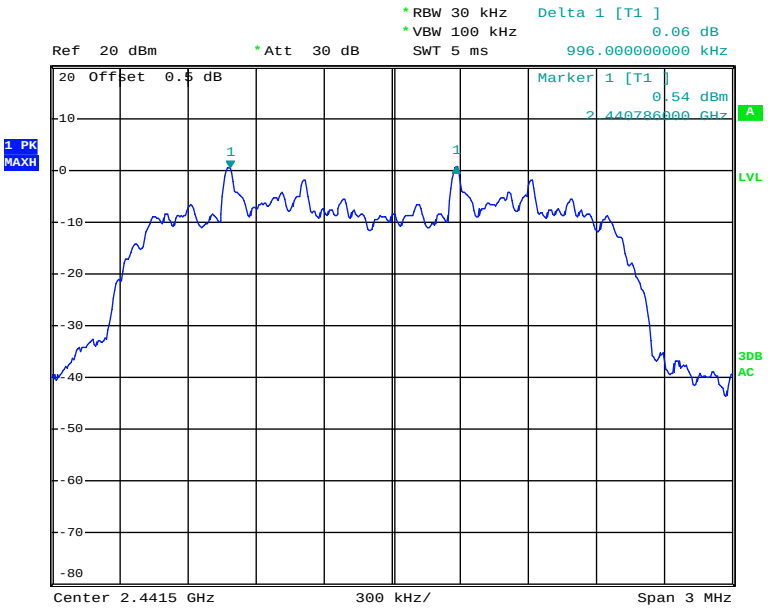
*EDR Mode (π/4-DQPSK):*

**Low Channel**



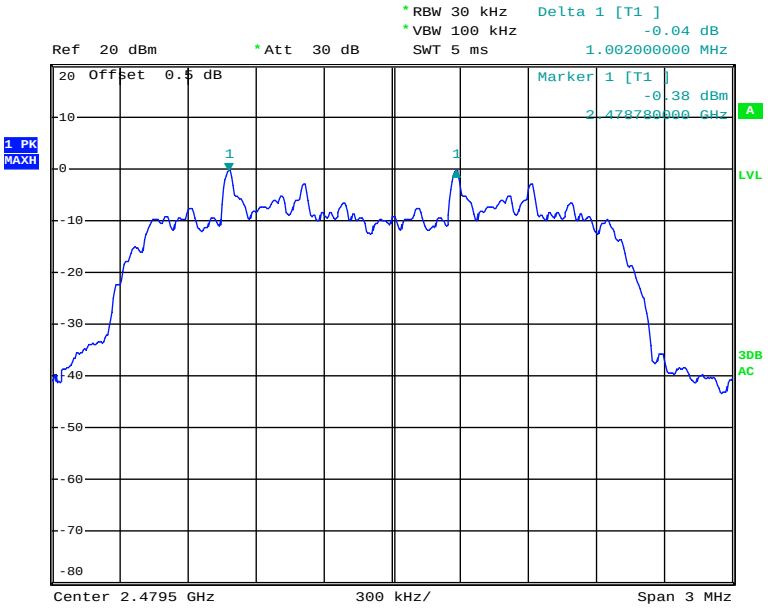

Date: 8.OCT.2020 13:20:56

**Middle Channel**




Date: 8.OCT.2020 13:18:58

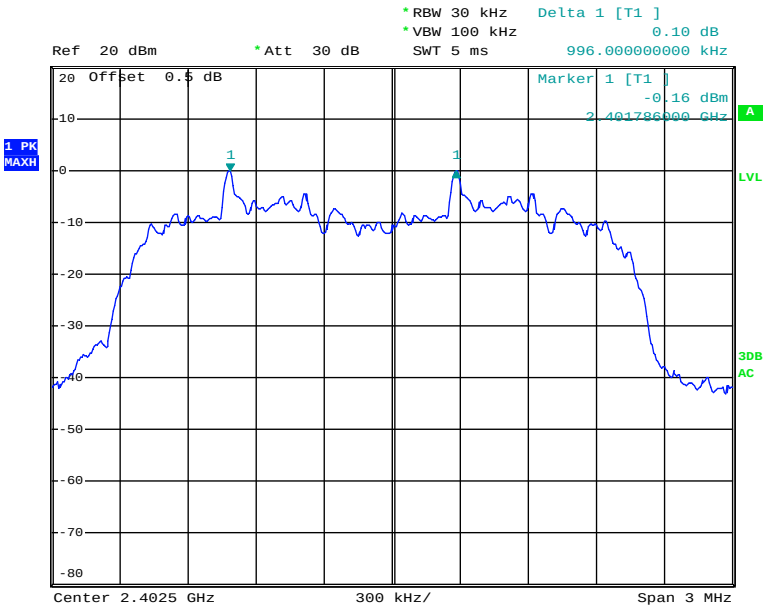
**High Channel**




Date: 8.OCT.2020 13:17:08

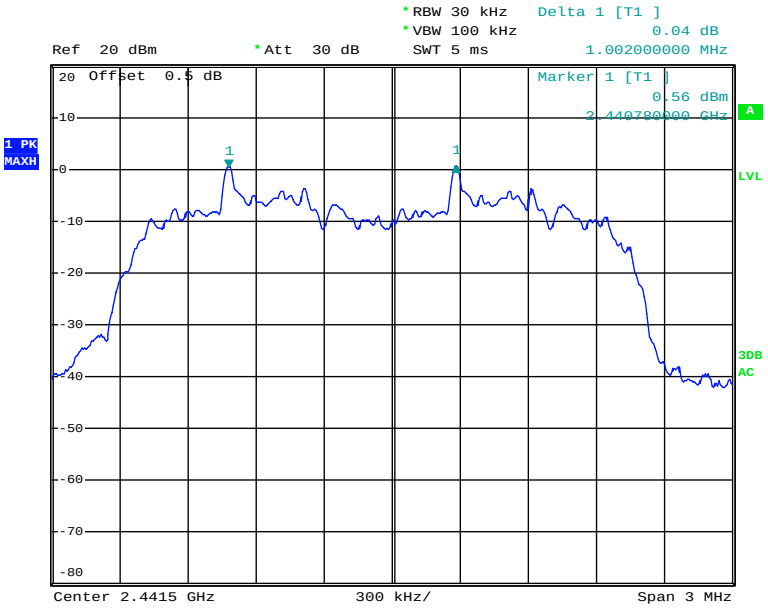
*EDR Mode (8DPSK):*

**Low Channel**



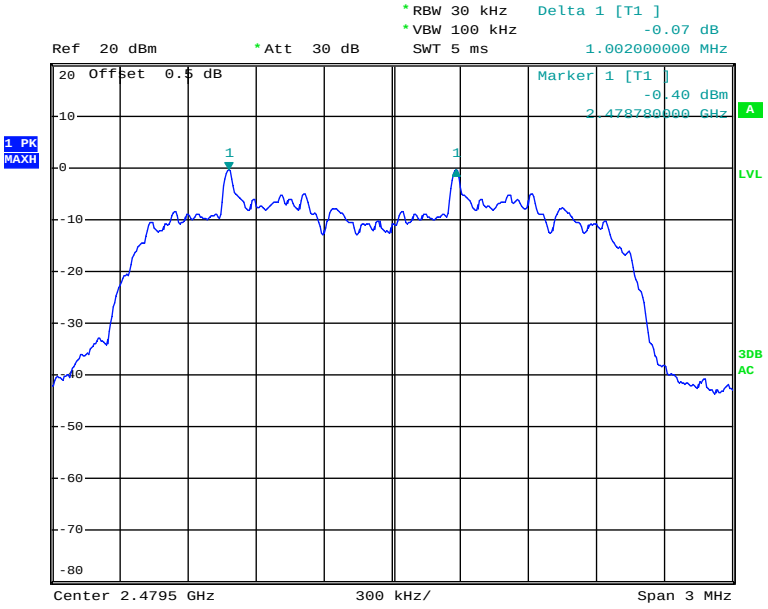

Date: 8.OCT.2020 13:22:58

## Middle Channel




Date: 8.OCT.2020 13:28:04

## High Channel




Date: 8.OCT.2020 13:35:26

# 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 | Spectrum Analyzer | FSU 26 | 200256 | 2020-07-07 | 2021-07-07 |
| Unknown | Coaxial Cable | C-SJ00-0010 | C0010/01 | Each time | N/A |

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

## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 27.6 °C |
| **Relative Humidity:** | 50 % |
| **ATM Pressure:** | 100.8kPa |
| **Test by:** | Billy Li |
| **Test Date:** | 2020-10-08 |

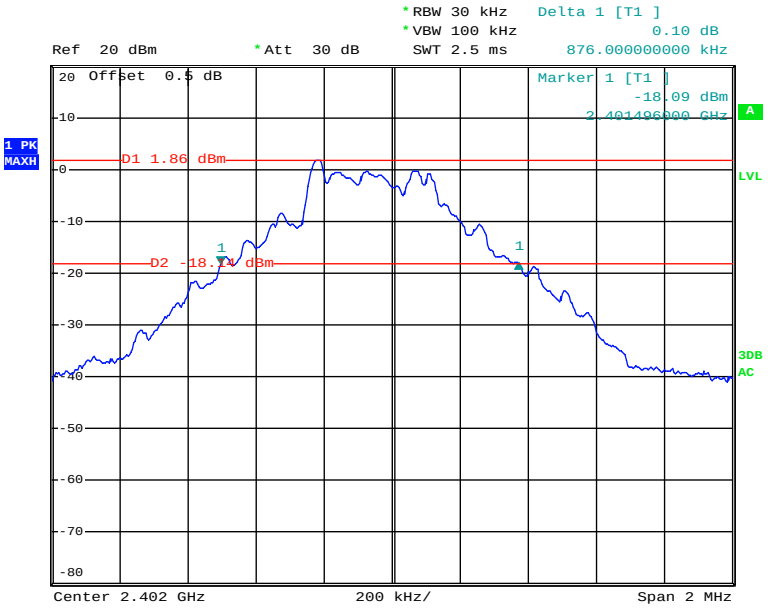
**Test Result:** Compliance. Please refer to following tables and plots

*Test Mode: Transmitting*

| Mode | Channel | Frequency (MHz) | 20 dB Bandwidth (MHz) |
|---|---|---|---|
| BDR Mode (GFSK) | Low | 2402 | 0.876 |
| | Middle | 2441 | 0.876 |
| | High | 2480 | 0.876 |
| EDR Mode (π/4-DQPSK) | Low | 2402 | 1.256 |
| | Middle | 2441 | 1.260 |
| | High | 2480 | 1.264 |
| EDR Mode (8DPSK) | Low | 2402 | 1.228 |
| | Middle | 2441 | 1.224 |
| | High | 2480 | 1.224 |

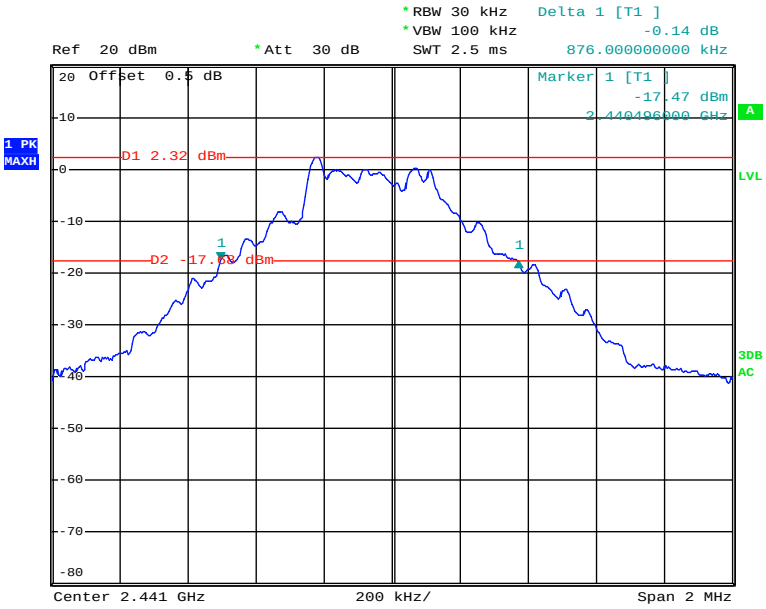
*BDR Mode (GFSK):*

**Low Channel**



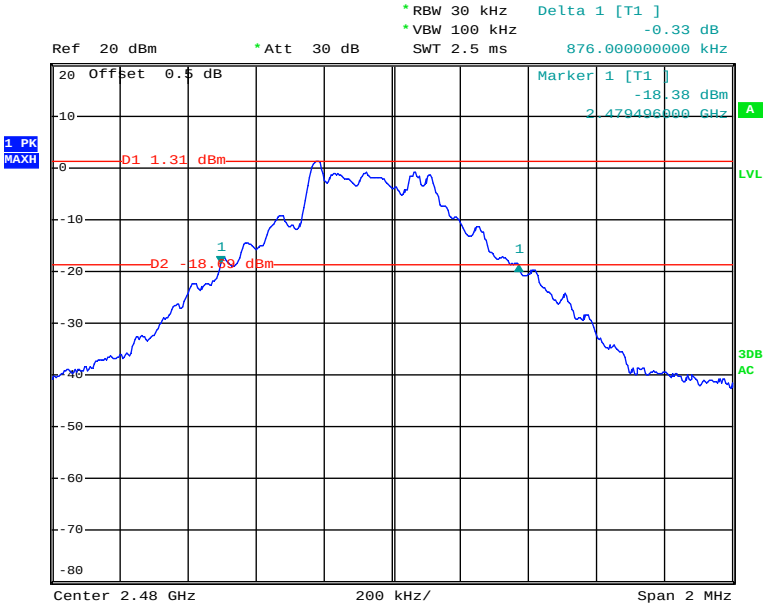

Date: 8.OCT.2020 13:07:58

## Middle Channel




Date: 8.OCT.2020 13:10:20

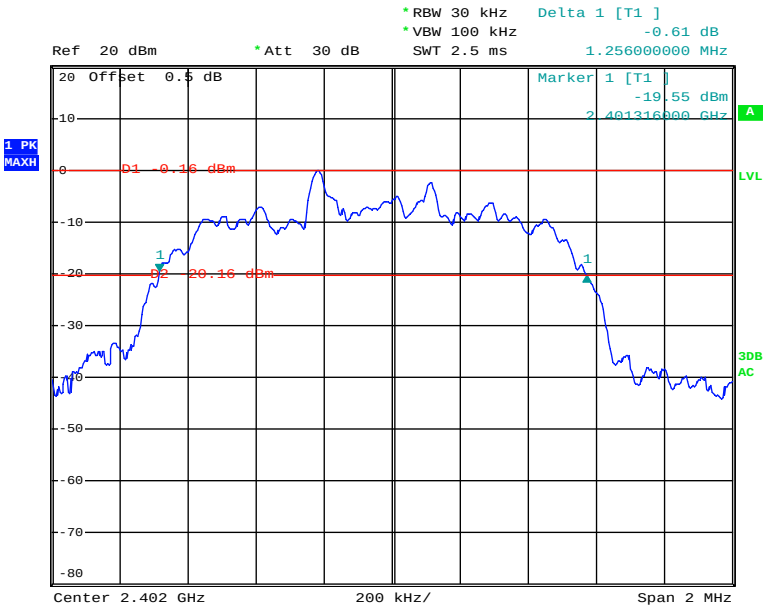
## High Channel




Date: 8.OCT.2020 13:12:47

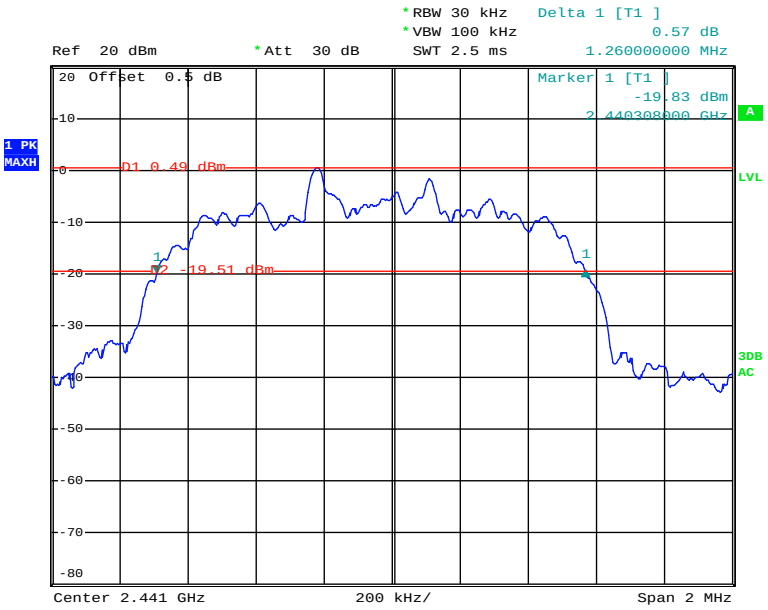
*EDR Mode (π/4-DQPSK):*

**Low Channel**



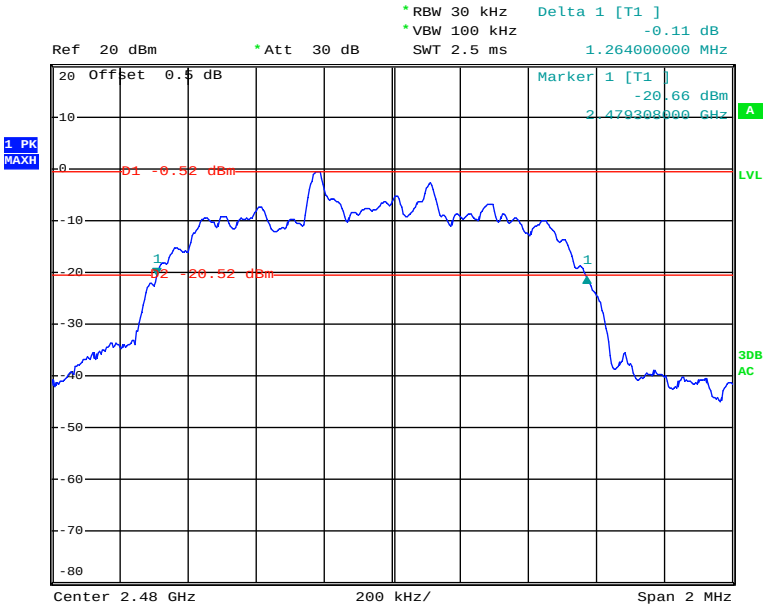

Date: 8.OCT.2020 13:19:29

**Middle Channel**




Date: 8.OCT.2020 13:17:55

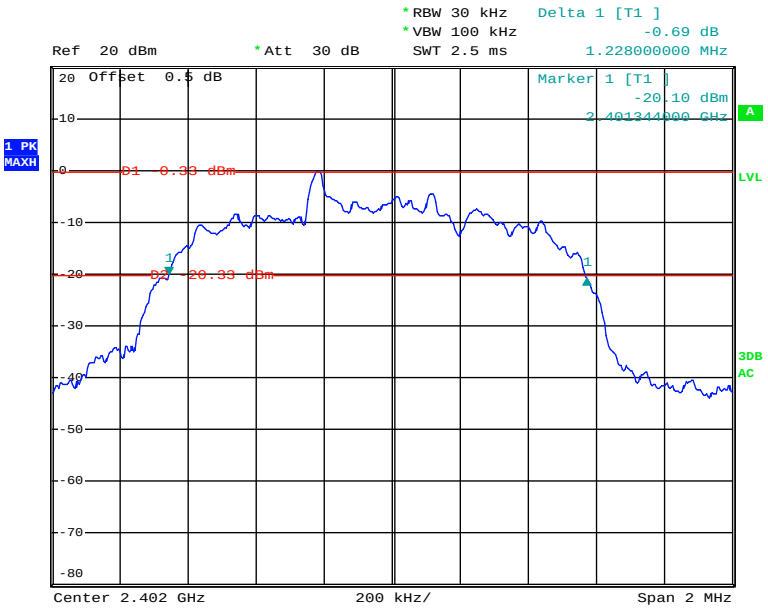
**High Channel**




Date: 8.OCT.2020 13:14:46

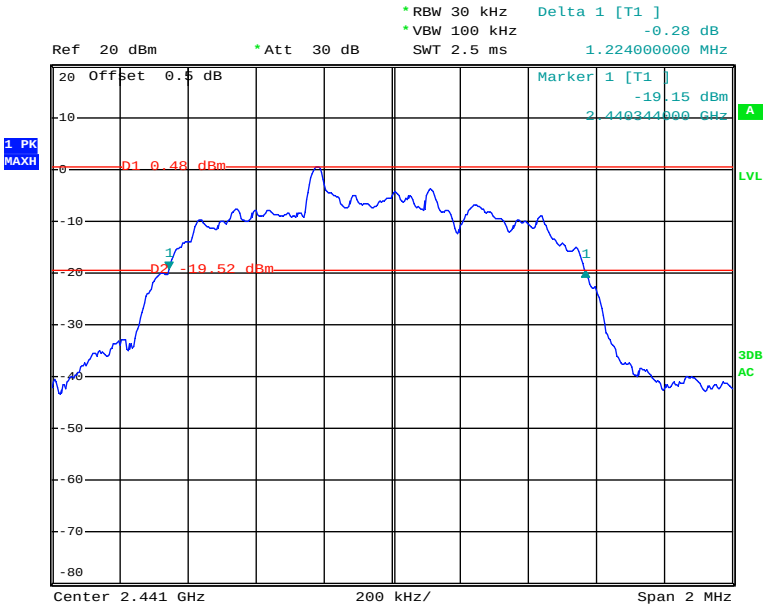
*EDR Mode (8DPSK):*

**Low Channel**



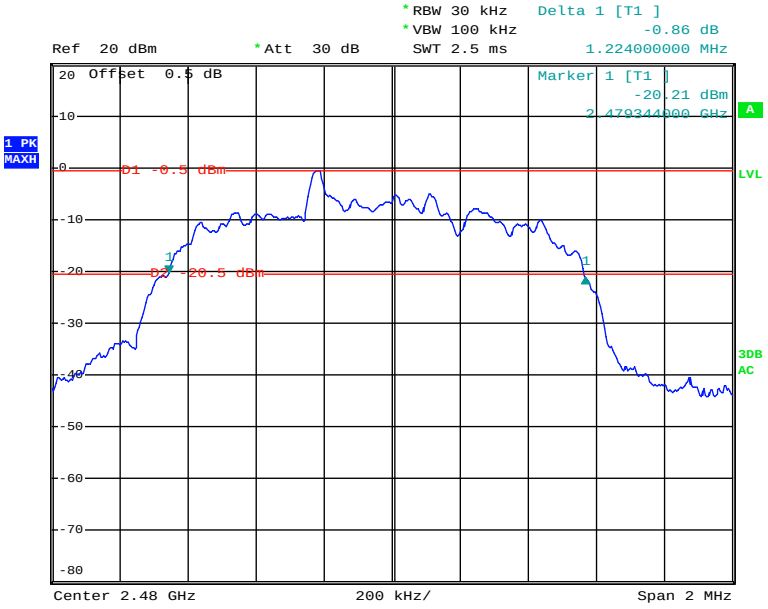

Date: 8.OCT.2020 13:21:45

## Middle Channel




Date: 8.OCT.2020 13:23:29

## High Channel




Date: 8.OCT.2020 13:34:08

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

## Applicable Standard

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

## Test Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.

2. Set the EUT in hopping mode from first channel to last.

3. By using the Max-Hold function record the Quantity of the channel.

## Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| R&S | Spectrum Analyzer | FSU 26 | 200256 | 2020-07-07 | 2021-07-07 |
| Unknown | Coaxial Cable | C-SJ00-0010 | C0010/01 | Each time | N/A |

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

## Test Data

### Environmental Conditions

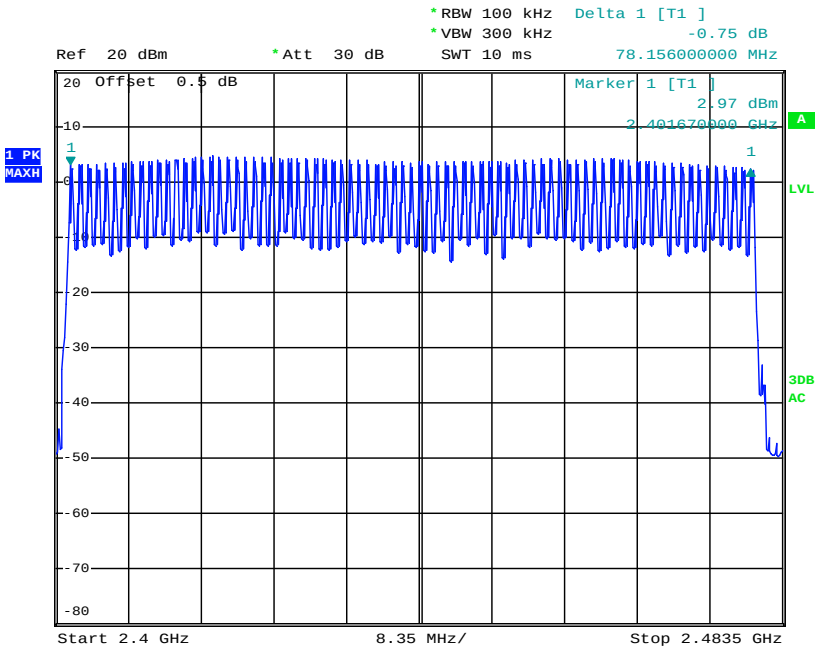
| | |
|---|---|
| **Temperature:** | 27.6 °C |
| **Relative Humidity:** | 50 % |
| **ATM Pressure:** | 100.8kPa |
| **Test by:** | Billy Li |
| **Test Date:** | 2020-10-08 |

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

*Test Mode: Transmitting*

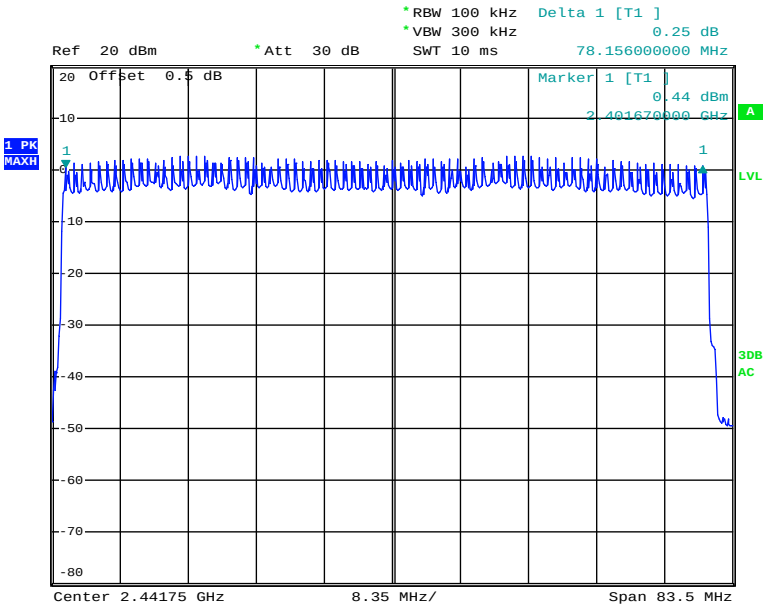
| Test mode | Frequency Range (MHz) | Number of Hopping Channel | Limit |
|---|---|---|---|
| GFSK | 2400-2483.5 | 79 | ≥15 |
| π/4-DQPSK | 2400-2483.5 | 79 | ≥15 |
| 8DPSK | 2400-2483.5 | 79 | ≥15 |

**BDR Mode (GFSK)**



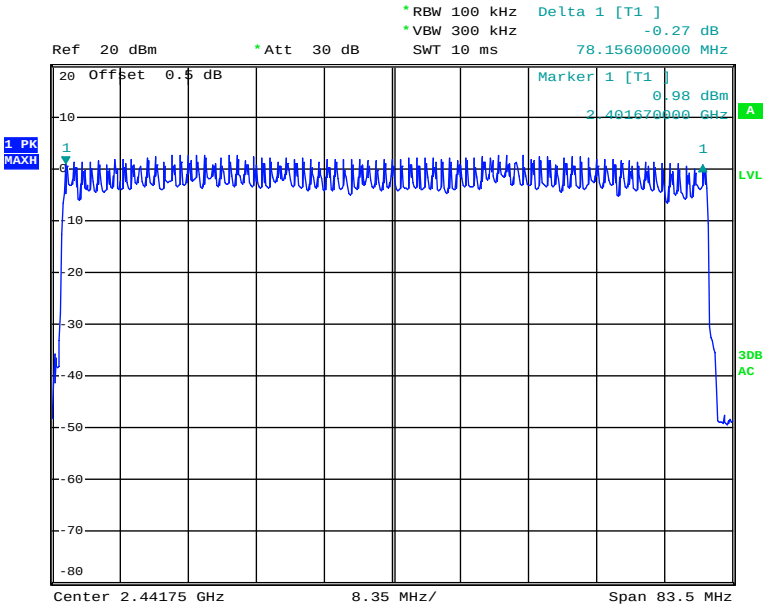

Date: 8.OCT.2020 14:01:28

## EDR Mode (π/4-DQPSK)




Date: 8.OCT.2020 14:04:51

## EDR Mode (8DPSK)




Date: 8.OCT.2020 14:09:23

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

## Applicable Standard

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

## Test Procedure

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

## Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| R&S | Spectrum Analyzer | FSU 26 | 200256 | 2020-07-07 | 2021-07-07 |
| Unknown | Coaxial Cable | C-SJ00-0010 | C0010/01 | Each time | N/A |

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

## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 27.6 °C |
| **Relative Humidity:** | 50 % |
| **ATM Pressure:** | 100.8kPa |
| **Test by:** | Billy Li |
| **Test Date:** | 2020-10-08 |

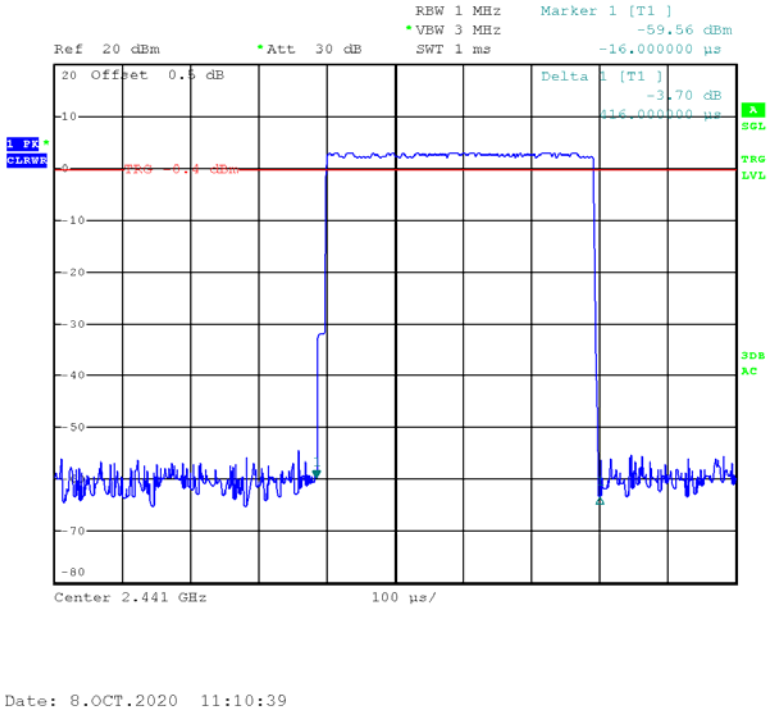
**Test Result:** Compliance. Please refer to following tables and plots

*Test Mode: Transmitting*

| Mode | Packet type | Channel | Frequency (MHz) | Puse width (ms) | Result (s) | Limit (s) |
|---|---|---|---|---|---|---|
| GFSK | DH1 | Middle | 2441 | 0.416 | 0.133 | 0.4 |
| | DH3 | Middle | 2441 | 1.690 | 0.27 | |
| | DH5 | Middle | 2441 | 2.942 | 0.314 | |
| π/4-DQPSK | 2DH1 | Middle | 2441 | 0.410 | 0.131 | |
| | 2DH3 | Middle | 2441 | 1.684 | 0.269 | |
| | 2DH5 | Middle | 2441 | 2.942 | 0.314 | |
| 8DPSK | 3DH1 | Middle | 2441 | 0.406 | 0.13 | |
| | 3DH3 | Middle | 2441 | 1.678 | 0.268 | |
| | 3DH5 | Middle | 2441 | 2.952 | 0.315 | |
| Note:<br>DH1:Dwell time=Pulse time (ms) × (1600/2/79) ×31.6 s<br>DH3:Dwell time=Pulse time (ms) × (1600/4/79) ×31.6 s<br>DH5:Dwell time=Pulse time (ms) × (1600/6/79) ×31.6 s | | | | | | |

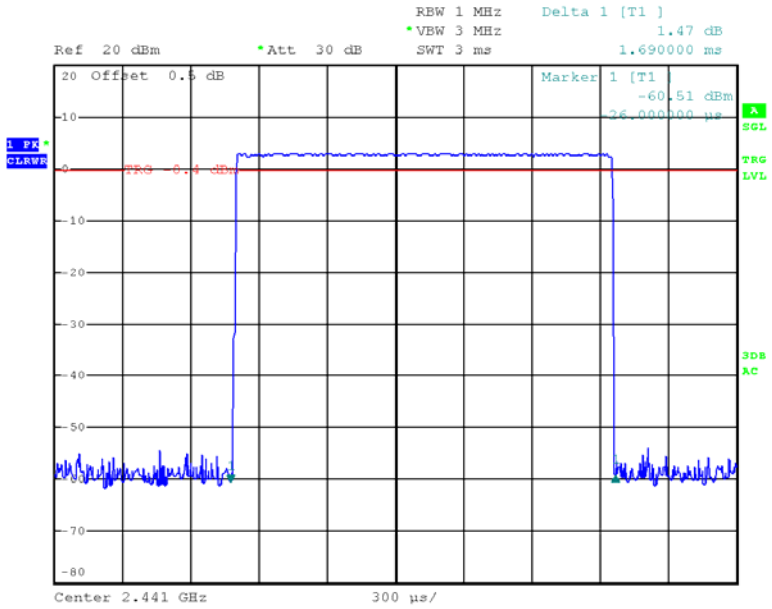
*BDR Mode (GFSK):*

**DH1: Middle Channel**



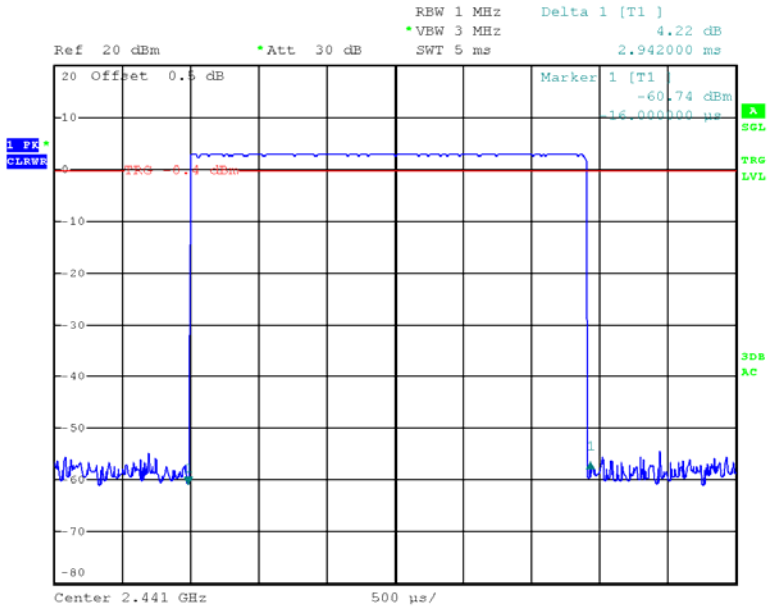

Date: 8.OCT.2020 11:10:39

**DH3: Middle Channel**




Date: 8.OCT.2020 11:09:52

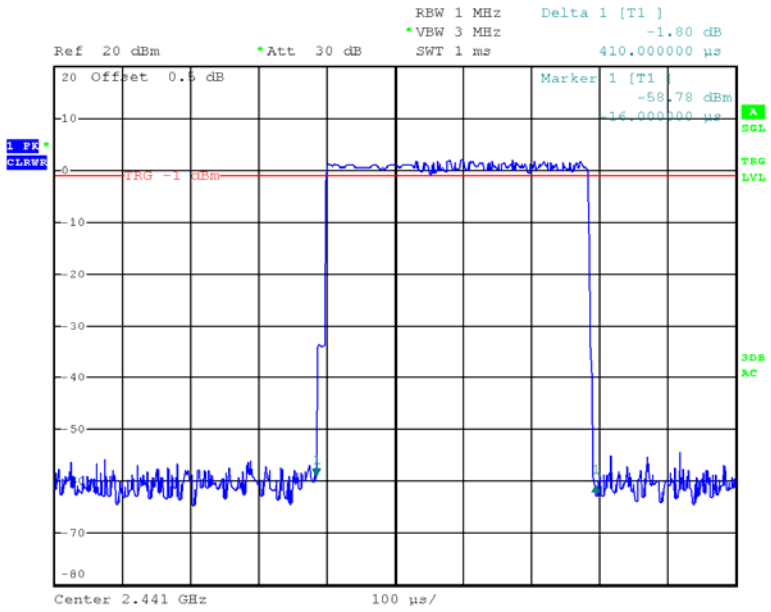
**DH5: Middle Channel**




Date: 8.OCT.2020 11:06:42

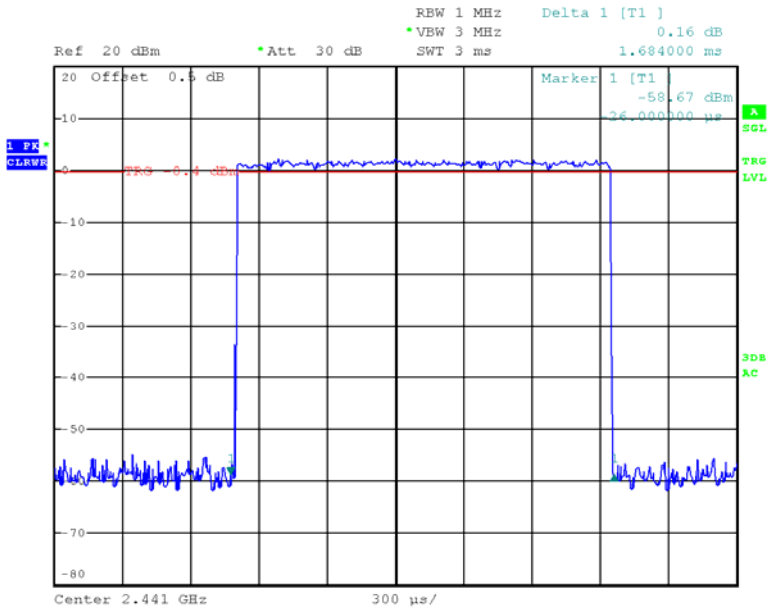
*EDR Mode (π/4-DQPSK):*

**2DH1: Middle Channel**



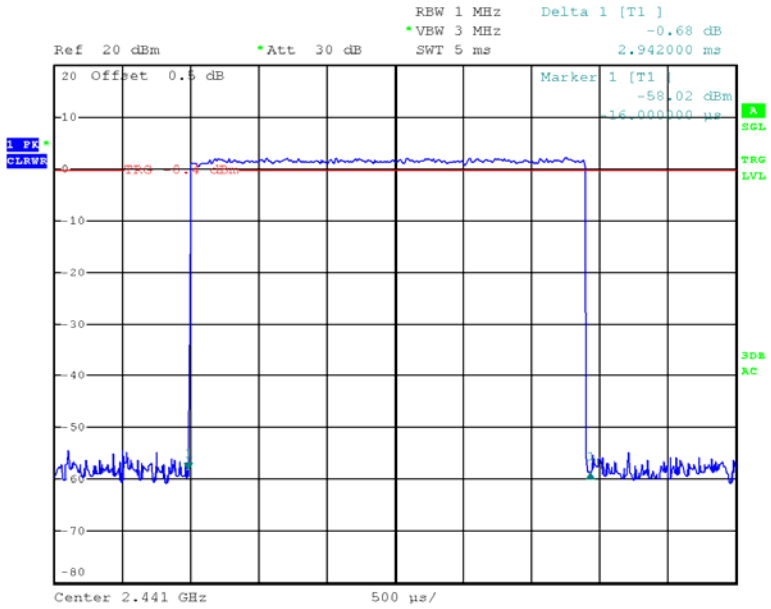

Date: 8.OCT.2020 11:11:26

**2DH3: Middle Channel**




Date: 8.OCT.2020 11:09:20

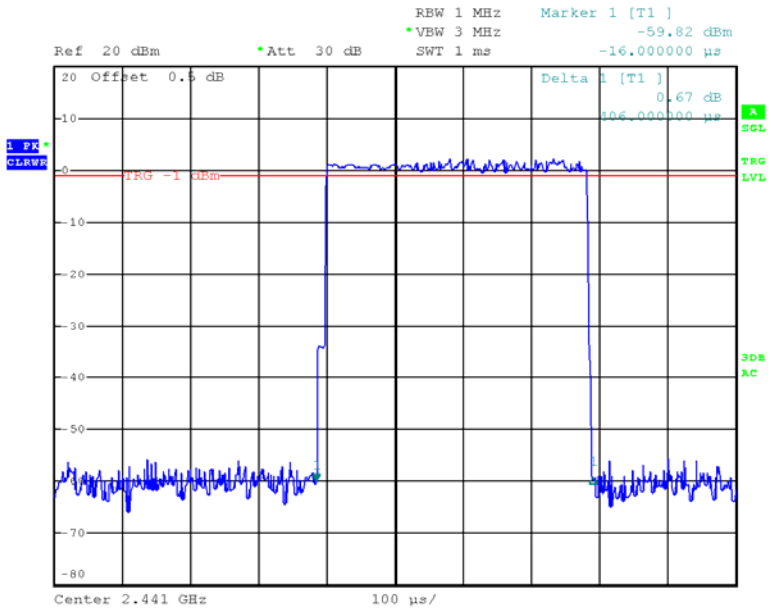
**2DH5: Middle Channel**




Date: 8.OCT.2020 11:07:44

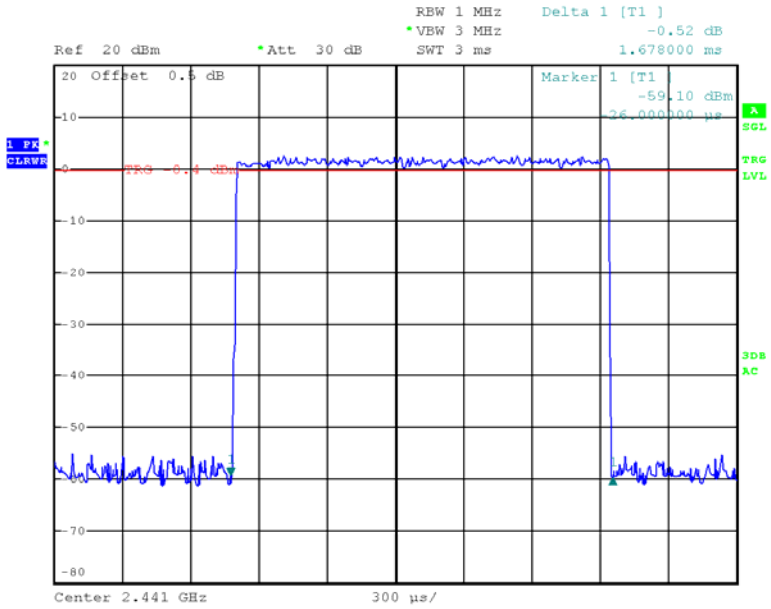
*EDR Mode (8DPSK):*

**3DH1: Middle Channel**



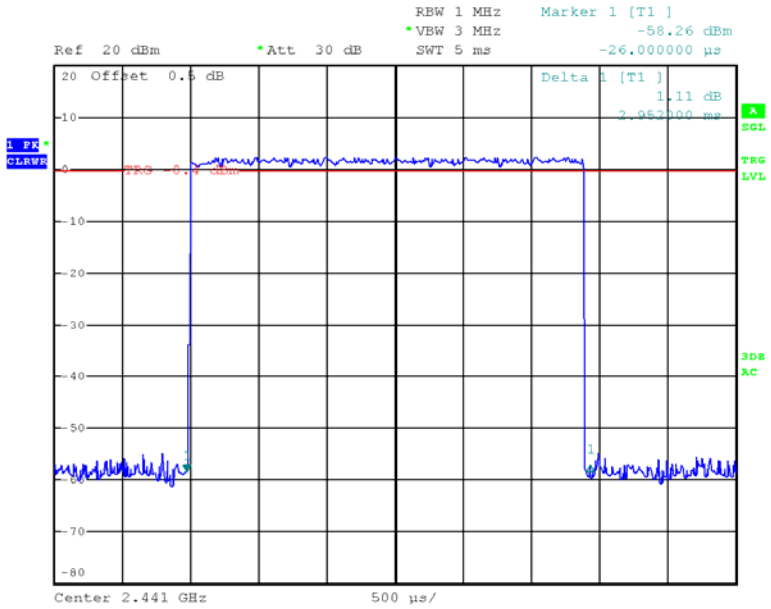

Date: 8.OCT.2020 11:12:01

**3DH3: Middle Channel**




Date: 8.OCT.2020 11:08:54

**3DH5: Middle Channel**




Date: 8.OCT.2020 11:08:14

# FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT

## Applicable Standard

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

## Test Procedure

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

## Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| Agilent | USB Wideband Power Sensor | U2022XA | MY5417006 | 2020-09-12 | 2021-09-12 |
| ESPEC | Constant temperature and humidity Tester | ESX-4CA | 018 463 | 2020-03-10 | 2021-03-09 |

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

## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 27.6 °C |
| **Relative Humidity:** | 50 % |
| **ATM Pressure:** | 100.8kPa |
| **Test by:** | Billy Li |
| **Test Date:** | 2020-10-08 |

**Test Result:** Compliance.

*Test Mode: Transmitting*

| Mode | Test Frequency (MHz) | Peak Conducted Output Power (dBm) | Limit (dBm) |
|---|---|---|---|
| BDR Mode (GFSK) | 2402 | 5.40 | 21 |
| | 2441 | **6.05** | 21 |
| | 2480 | 5.16 | 21 |
| EDR Mode (π/4-DQPSK) | 2402 | 3.47 | 21 |
| | 2441 | 4.40 | 21 |
| | 2480 | 3.51 | 21 |
| EDR Mode (8DPSK) | 2402 | 3.56 | 21 |
| | 2441 | 4.39 | 21 |
| | 2480 | 3.52 | 21 |

Note: The data above was tested in conducted mode.

# FCC §15.247(d) - BAND EDGES TESTING

## Applicable Standard

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

## Test Procedure

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

## Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| R&S | Spectrum Analyzer | FSU 26 | 200256 | 2020-07-07 | 2021-07-07 |
| Unknown | Coaxial Cable | C-SJ00-0010 | C0010/01 | Each time | N/A |

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

## Test Data

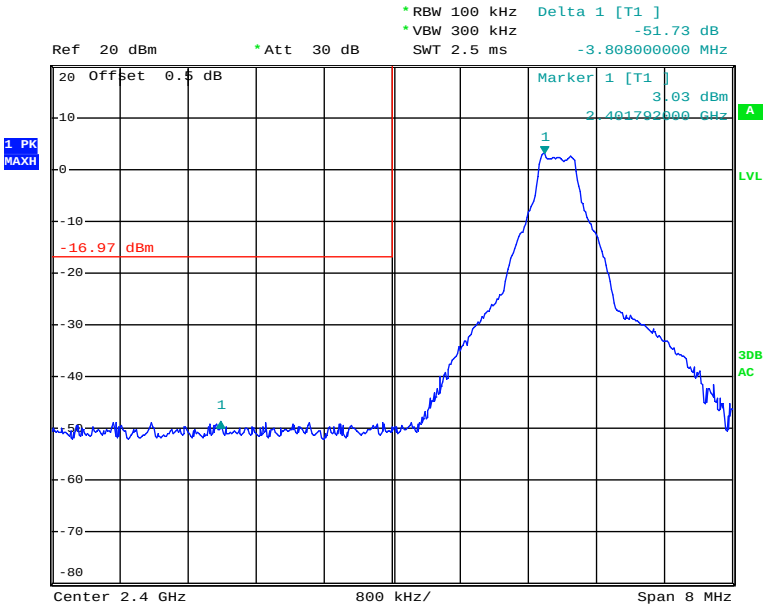
### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 27.6 °C |
| **Relative Humidity:** | 50 % |
| **ATM Pressure:** | 100.8kPa |
| **Test by:** | Billy Li |
| **Test Date:** | 2020-10-08 |

**Test Result:** Compliance

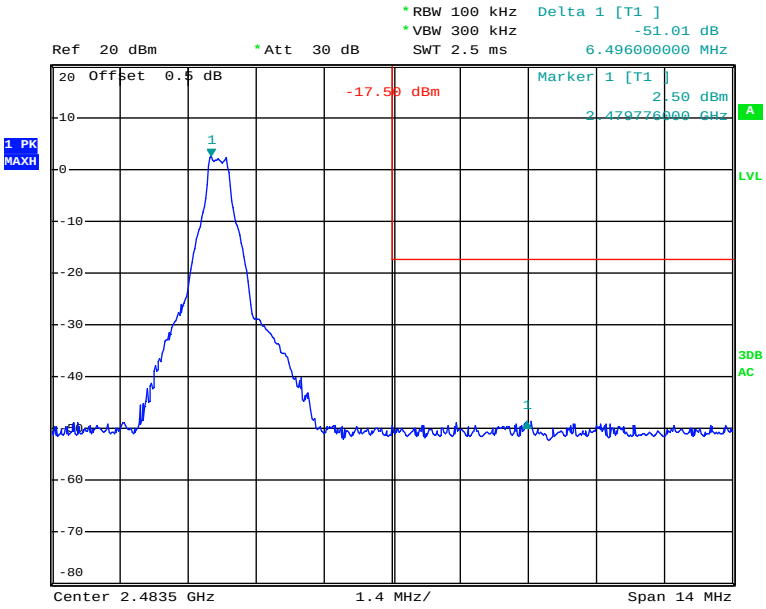
*Single Channel Mode,*
*BDR Mode (GFSK):*

**Band Edge, Left Side**




Date: 8.OCT.2020 13:08:33

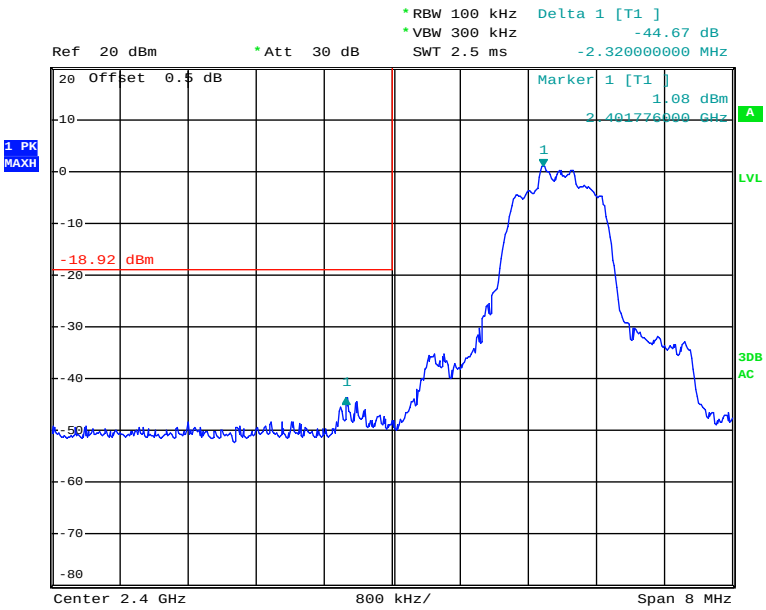
**Band Edge, Right Side**




Date: 8.OCT.2020 13:13:18

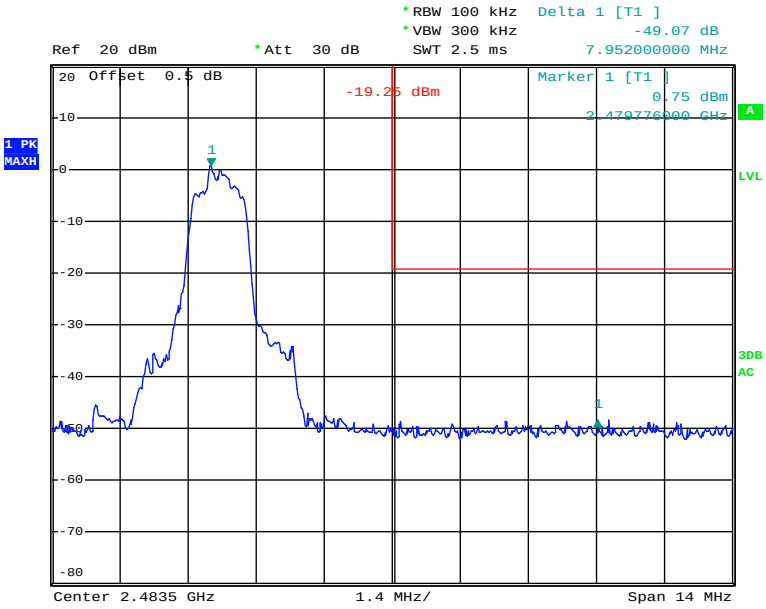
*EDR Mode (π/4-DQPSK):*

**Band Edge, Left Side**




Date: 8.OCT.2020 13:20:01

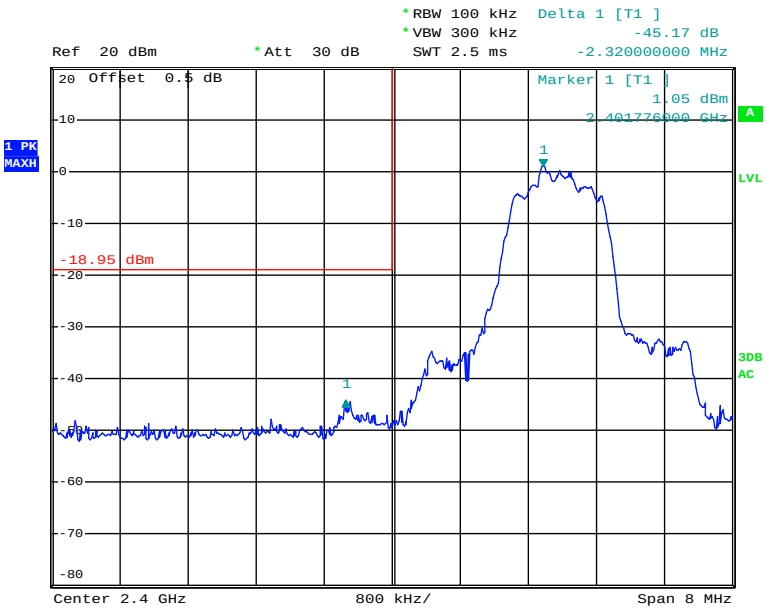
**Band Edge, Right Side**




Date: 8.OCT.2020 13:15:18

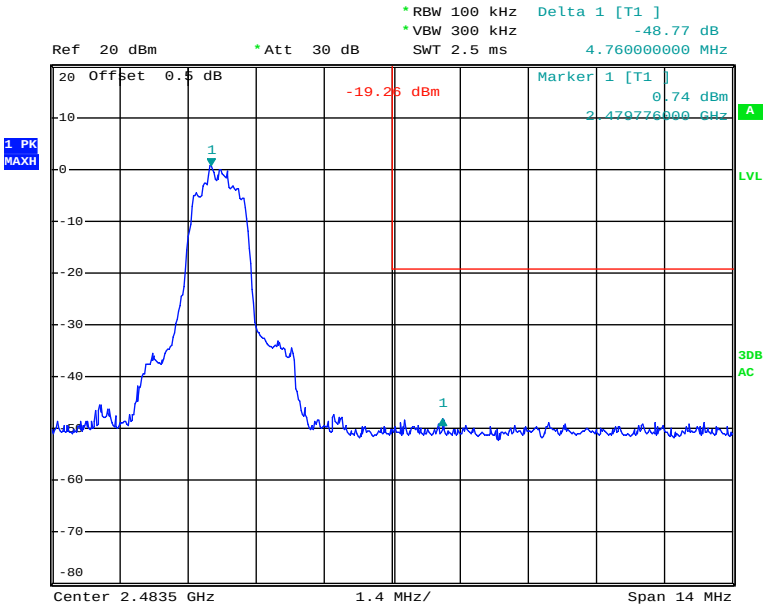
*EDR Mode (8DPSK):*

**Band Edge, Left Side**




Date: 8.OCT.2020 13:22:17

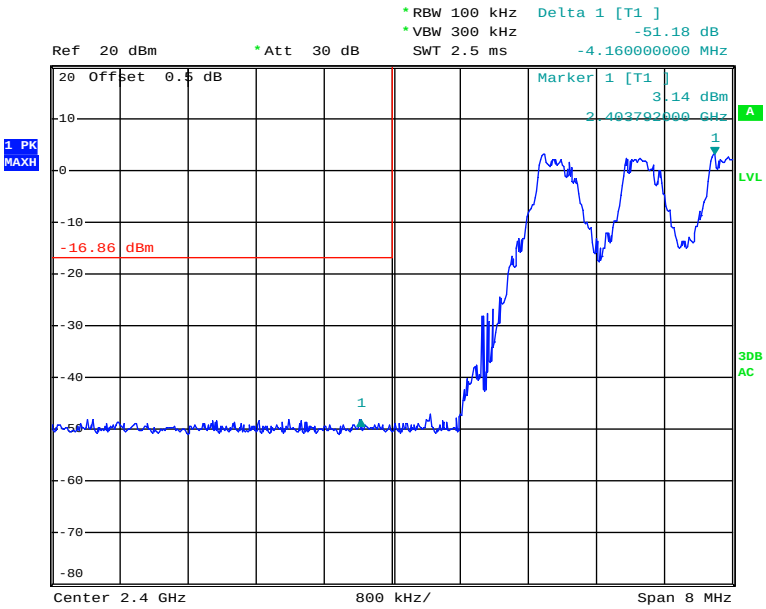
**Band Edge, Right Side**




Date: 8.OCT.2020 13:34:40

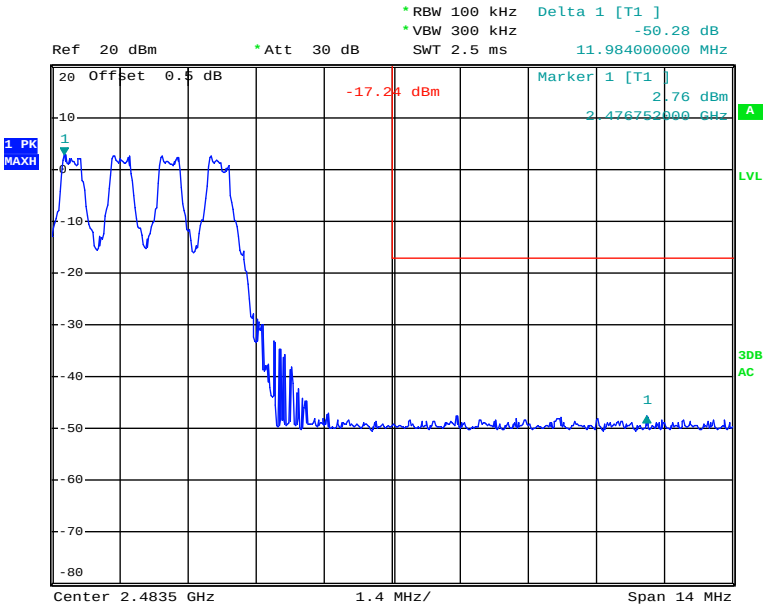
*Hopping Mode,*
*BDR Mode (GFSK):*

**Band Edge, Left Side**




Date: 8.OCT.2020 13:57:23

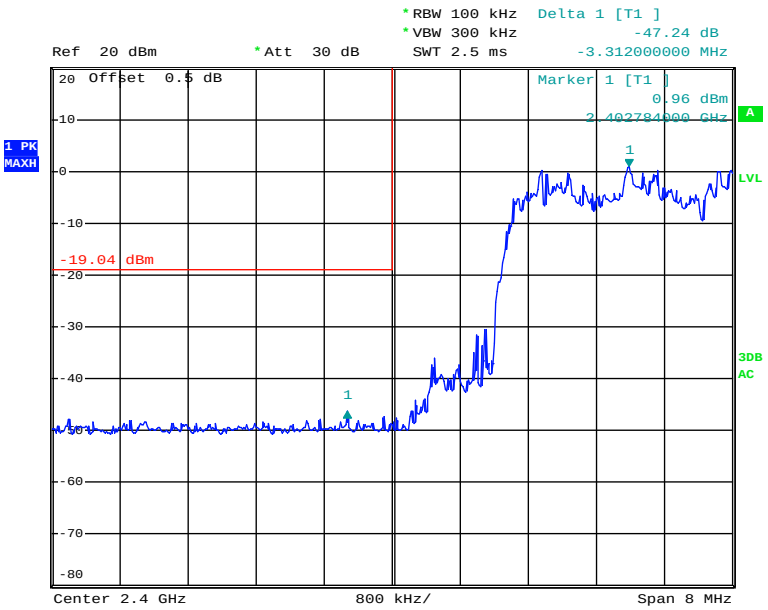
**Band Edge, Right Side**




Date: 8.OCT.2020 13:56:07

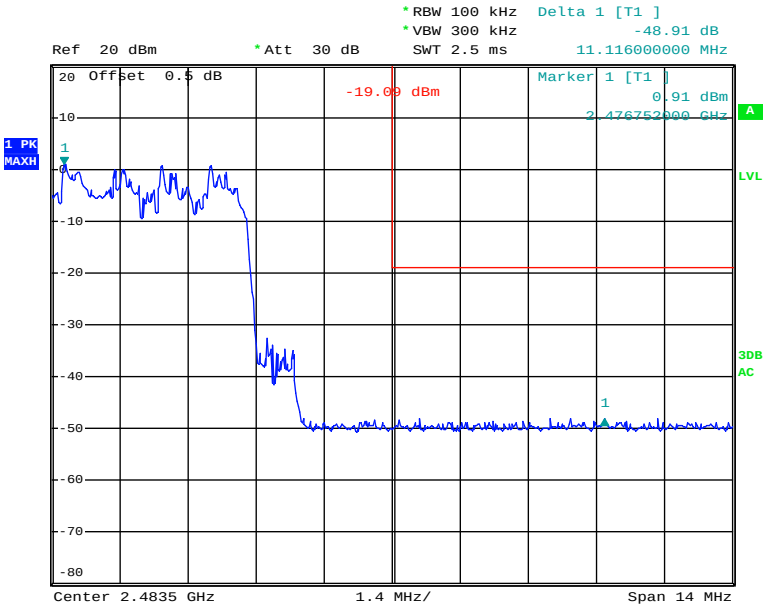
*EDR Mode (π/4-DQPSK):*

**Band Edge, Left Side**




Date: 8.OCT.2020 13:51:59

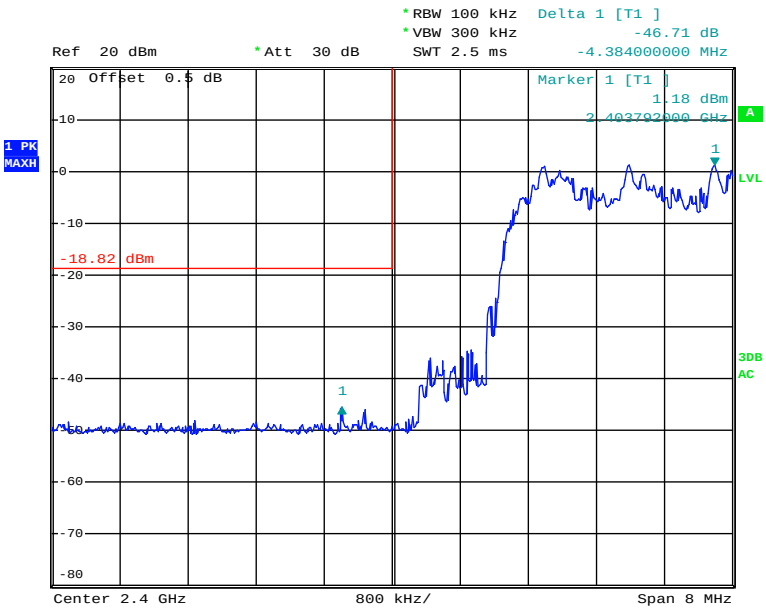
**Band Edge, Right Side**




Date: 8.OCT.2020 13:53:25

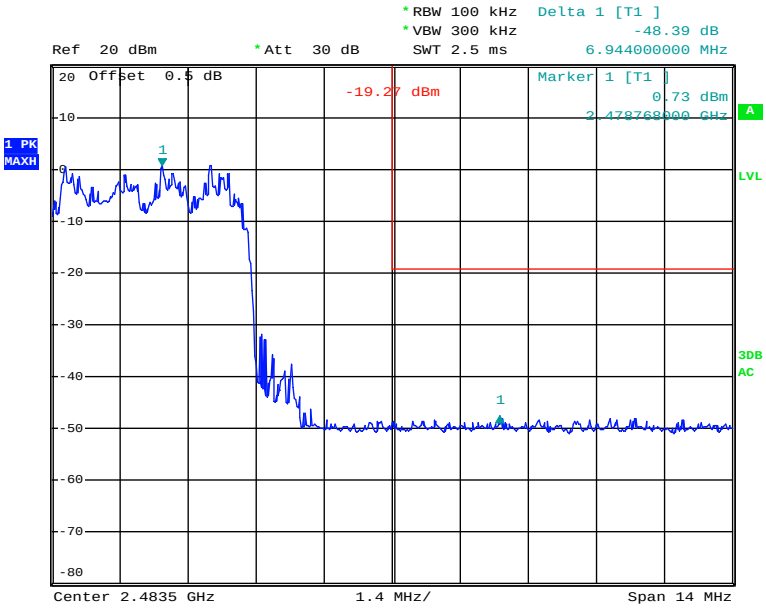
*EDR Mode (8DPSK):*

**Band Edge, Left Side**




Date: 8.OCT.2020 13:38:26

## Band Edge, Right Side




Date: 8.OCT.2020 13:36:47

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