

## FCC PART 15.247

## TEST REPORT

For

### The House of Marley.LLC

3000 Pontiac Trail, Commerce Township, Michigan 48390 United States

**FCC ID: PVB-EMDE011R**

|                                        |                                                                                                                                                                                                                                                       |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Report Type:</b><br>Original Report | <b>Product Name:</b><br>LIBERATE AIR                                                                                                                                                                                                                  |
| <b>Report Number:</b> RSZ190215801-00E |                                                                                                                                                                                                                                                       |
| <b>Report Date:</b> 2019-04-15         |                                                                                                                                                                                                                                                       |
| <b>Reviewed By:</b>                    | Jerry Zhang<br>EMC Manager                                                                                                                                                                                                                            |
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## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

|                                              |                               |
|----------------------------------------------|-------------------------------|
| <b>EUT Name:</b>                             | LIBERATE AIR                  |
| <b>EUT Model:</b>                            | EM-DE011                      |
| <b>Operation Frequency:</b>                  | 2402-2480 MHz                 |
| <b>Maximum Output Power<br/>(Conducted):</b> | 8.75 dBm                      |
| <b>Modulation Type:</b>                      | GFSK, $\pi/4$ -DQPSK, 8-DPSK  |
| <b>Rated Input Voltage:</b>                  | 3.7VDC from battery           |
| <b>External Dimension:</b>                   | 29.19mm(L)*15.48mm(W)*23mm(H) |
| <b>Serial Number:</b>                        | 190215801-2                   |
| <b>EUT Received Date:</b>                    | 2019.2.19                     |

### Objective

This report is prepared on behalf of **The House of Marley.LLC** 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: PVB-EMDE011R.  
Part of system with FCC ID: PVB-EMDE011

### Test Methodology

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

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

**Measurement Uncertainty**

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

**Test Facility**

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

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

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

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

The system was configured for testing in engineering mode.

### EUT Exercise Software

The software: 'Blue Test 3' was used during test, which was provided by manufacturer. The maximum power level was configured by the software as below table:

| Test Software Version | BlueTest 3 |         |         |
|-----------------------|------------|---------|---------|
| Test Frequency        | 2402MHz    | 2441MHz | 2480MHz |
| GFSK                  | 60         | 60      | 60      |
| $\pi/4$ -DQPSK        | 60         | 60      | 60      |
| 8-DPSK                | 60         | 60      | 60      |

### Equipment Modifications

No modification was made to the EUT.

### Local Support Equipment List and Details

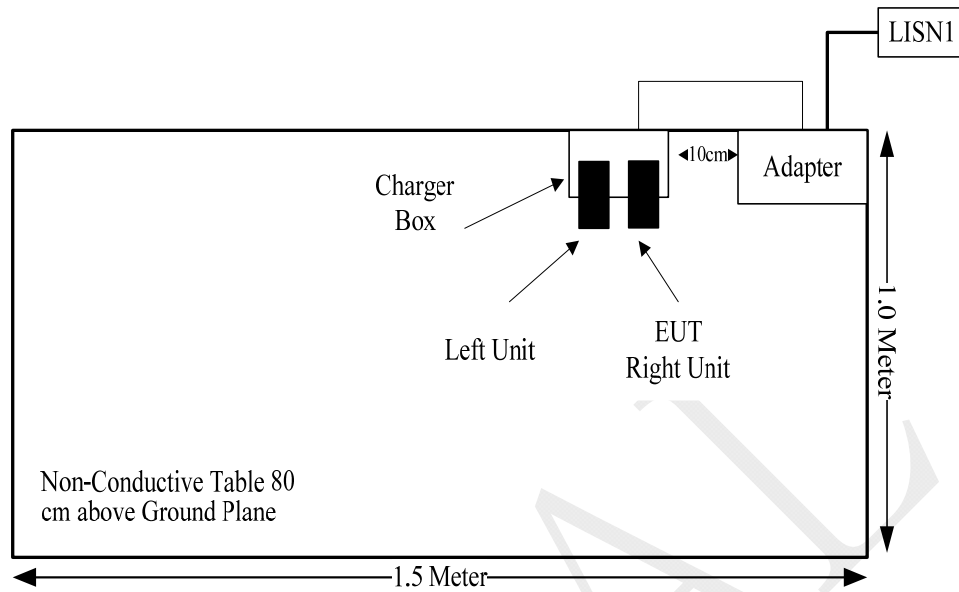
| Manufacturer            | Description | Model    | Serial Number |
|-------------------------|-------------|----------|---------------|
| SUNNY                   | Adapter     | SN-003   | /             |
| The House of Marley.LLC | Left Unit   | EM-DE011 | 190215801-1   |
| The House of Marley.LLC | Charger Box | /        | 190215801-3   |

### Support Cable List and Details

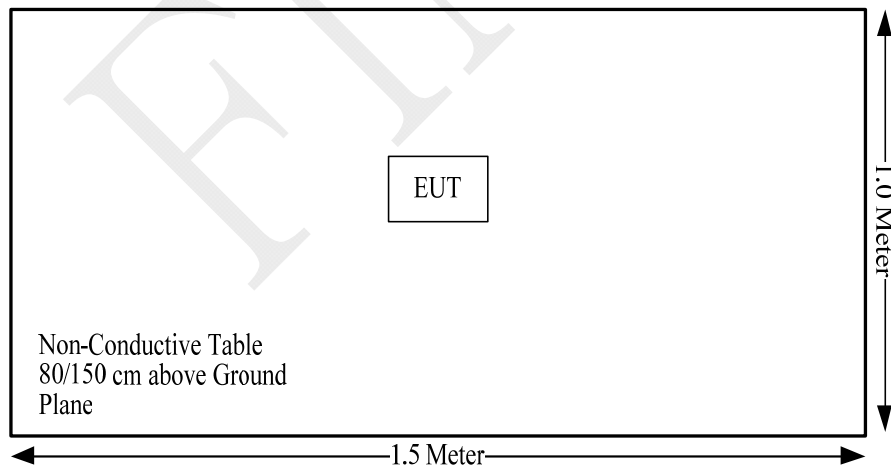
| Cable Description | Shielding Type | Ferrite Core | Length (m) | From Port | To  |
|-------------------|----------------|--------------|------------|-----------|-----|
| USB               | Yes            | No           | 0.3        | Adapter   | EUT |

## Block Diagram of Test Setup

*AC Line Conducted Test:*



*Radiated Emissions:*



**SUMMARY OF TEST RESULTS**

| FCC Rules                          | Description of Test              | Result     |
|------------------------------------|----------------------------------|------------|
| FCC§15.247 (i) & §1.1310 & §2.1093 | RF Exposure                      | Compliance |
| §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 |

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

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**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  $\leq 50$  mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f}(\text{GHz})]$   
 $\leq 3.0$  for 1-g SAR and  $\leq 7.5$  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  $\leq 50$  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**

Result: Compliance. Please refer to the SAR report: RSZ190215801-20B.

## 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 |
|--------------|-----------------------|-------------------------------|
| PIFA         | 50                    | -1.56 dBi/2.4~2.5GHz          |

**Result:** Compliance.

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

### Applicable Standard

FCC§15.207(a)

### EUT Setup



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

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

The spacing between the peripherals was 10 cm.

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

### EMI Test Receiver Setup

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

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

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

### Test Procedure

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

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

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

## Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$$V_C = V_R + A_C + VDF$$

Herein,

$V_C$ : corrected voltage amplitude

$V_R$ : reading voltage amplitude

$A_C$ : attenuation caused by cable loss

$VDF$ : voltage division factor of AMN or ISN

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

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

## Test Equipment List and Details

| Manufacturer | Description        | Model     | Serial Number | Calibration Date | Calibration Due Date |
|--------------|--------------------|-----------|---------------|------------------|----------------------|
| R&S          | EMI Test Receiver  | ESCS 30   | 830245/006    | 2018-12-10       | 2019-12-10           |
| Unknown      | Coaxial Cable      | C-NJNJ-50 | C-0200-01     | 2018-09-05       | 2019-09-05           |
| R&S          | Test Software      | EMC32     | Version8.53.0 | N/A              | N/A                  |
| R&S          | Two-line V-network | ENV 216   | 101614        | 2018-12-10       | 2019-12-10           |

\* **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

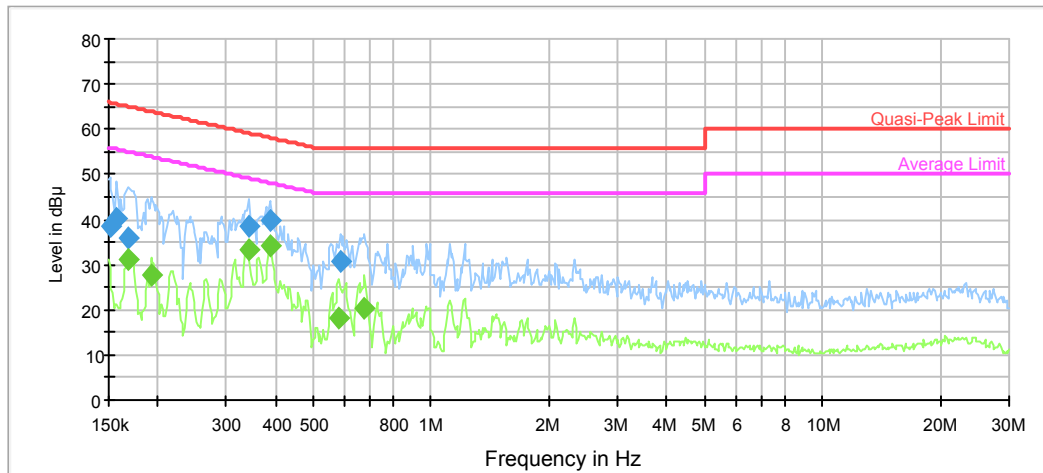
### Environmental Conditions

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 25.9 °C   |
| <b>Relative Humidity:</b> | 52 %      |
| <b>ATM Pressure:</b>      | 101.1 kPa |

*The testing was performed by Ade Xiao on 2019-03-04*

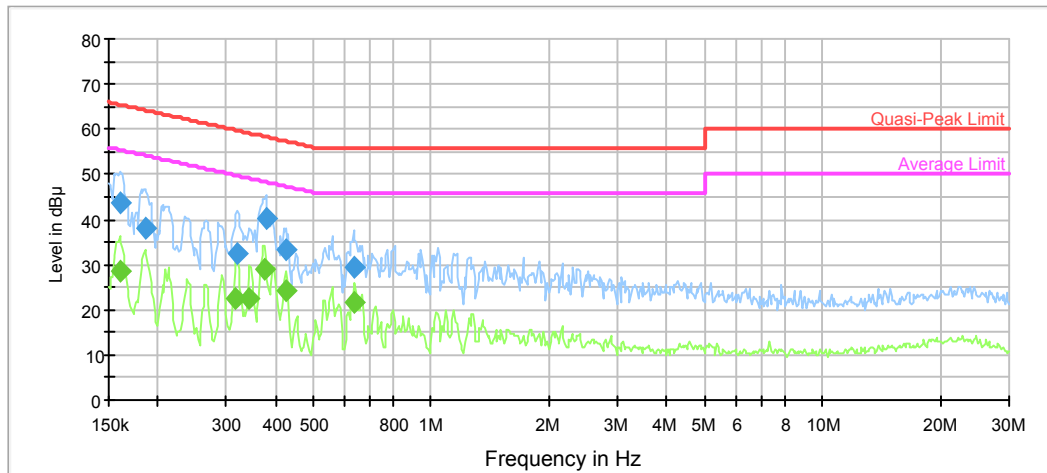
**Test Result:** Compliance

**Test Mode:** Charging

**AC120V, 60 Hz, Line:**

| Frequency (MHz) | QuasiPeak (dBμV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin (dB) | Limit (dBμV) |
|-----------------|------------------|-----------------|------|------------|-------------|--------------|
| 0.151200        | 38.3             | 9.000           | L1   | 11.2       | 27.6        | 65.9         |
| 0.157346        | 40.2             | 9.000           | L1   | 11.1       | 25.4        | 65.6         |
| 0.169044        | 36.0             | 9.000           | L1   | 10.9       | 29.0        | 65.0         |
| 0.340821        | 38.6             | 9.000           | L1   | 10.1       | 20.6        | 59.2         |
| 0.387164        | 39.9             | 9.000           | L1   | 10.0       | 18.2        | 58.1         |
| 0.585926        | 30.6             | 9.000           | L1   | 9.8        | 25.4        | 56.0         |

| Frequency (MHz) | Average (dBμV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin (dB) | Limit (dBμV) |
|-----------------|----------------|-----------------|------|------------|-------------|--------------|
| 0.167702        | 31.0           | 9.000           | L1   | 10.9       | 24.1        | 55.1         |
| 0.192030        | 27.8           | 9.000           | L1   | 10.7       | 26.1        | 53.9         |
| 0.340821        | 33.3           | 9.000           | L1   | 10.1       | 15.9        | 49.2         |
| 0.387164        | 34.3           | 9.000           | L1   | 10.0       | 13.8        | 48.1         |
| 0.581275        | 18.3           | 9.000           | L1   | 9.8        | 27.7        | 46.0         |
| 0.676289        | 20.5           | 9.000           | L1   | 9.8        | 25.5        | 46.0         |

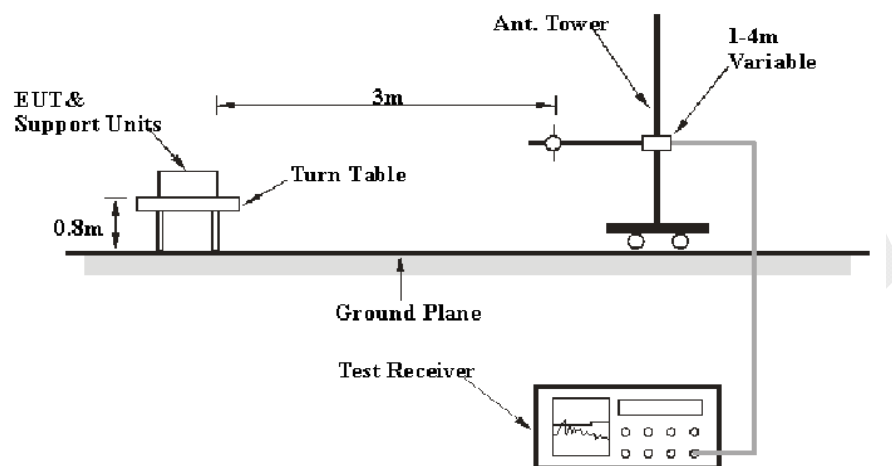
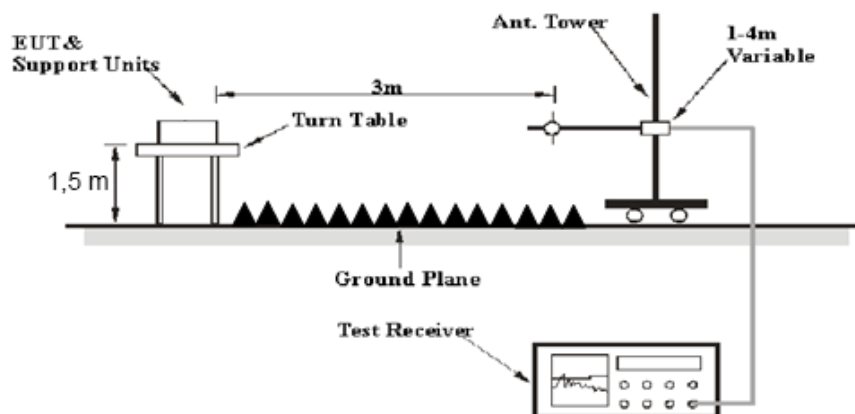
**AC120V, 60 Hz, Neutral:**

| Frequency (MHz) | QuasiPeak (dBμV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin (dB) | Limit (dBμV) |
|-----------------|------------------|-----------------|------|------------|-------------|--------------|
| 0.159873        | 43.7             | 9.000           | N    | 11.0       | 21.8        | 65.5         |
| 0.186006        | 38.0             | 9.000           | N    | 10.7       | 26.2        | 64.2         |
| 0.319773        | 32.3             | 9.000           | N    | 10.1       | 27.4        | 59.7         |
| 0.378019        | 40.2             | 9.000           | N    | 10.0       | 18.1        | 58.3         |
| 0.426011        | 33.3             | 9.000           | N    | 9.9        | 24.0        | 57.3         |
| 0.634524        | 29.2             | 9.000           | N    | 9.8        | 26.8        | 56.0         |

| Frequency (MHz) | Average (dBμV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin (dB) | Limit (dBμV) |
|-----------------|----------------|-----------------|------|------------|-------------|--------------|
| 0.159873        | 28.4           | 9.000           | N    | 11.0       | 27.1        | 55.5         |
| 0.317235        | 22.4           | 9.000           | N    | 10.1       | 27.4        | 49.8         |
| 0.343548        | 22.5           | 9.000           | N    | 10.0       | 26.6        | 49.1         |
| 0.375019        | 29.1           | 9.000           | N    | 10.0       | 19.3        | 48.4         |
| 0.426011        | 24.3           | 9.000           | N    | 9.9        | 23.0        | 47.3         |
| 0.639600        | 21.4           | 9.000           | N    | 9.8        | 24.6        | 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 10 meters chamber, above 1GHz tests were performed in the 3 meters chamber A, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

## EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

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

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

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

## Test Procedure

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

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

## Test Equipment List and Details

| Manufacturer          | Description       | Model                | Serial Number      | Calibration Date | Calibration Due Date |
|-----------------------|-------------------|----------------------|--------------------|------------------|----------------------|
| R&S                   | EMI Test Receiver | ESCI                 | 100224             | 2018-12-10       | 2019-12-10           |
| Farad                 | Test Software     | EZ-EMC               | V1.1.4.2           | N/A              | N/A                  |
| Sunol Sciences        | Antenna           | JB3                  | A060611-1          | 2017-11-10       | 2020-11-10           |
| Unknown               | Coaxial Cable     | C-NJNJ-50            | C-0400-01          | 2018-09-05       | 2019-09-05           |
| Unknown               | Coaxial Cable     | C-NJNJ-50            | C-0075-01          | 2018-09-05       | 2019-09-05           |
| Unknown               | Coaxial Cable     | C-NJNJ-50            | C-1400-01          | 2018-05-06       | 2019-05-06           |
| Sonoma                | Amplifier         | 310N                 | 185914             | 2018-10-13       | 2019-10-13           |
| R&S                   | Spectrum Analyzer | FSP 38               | 100478             | 2018-12-10       | 2019-12-10           |
| TDK RF                | Horn Antenna      | HRN-0118             | 130 084            | 2018-10-12       | 2021-10-12           |
| Ducommun Technologies | Horn Antenna      | ARH-4223-02          | 1007726-01<br>1304 | 2016-11-18       | 2019-11-18           |
| MICRO-COAX            | Coaxial Cable     | UFA147-1-2362-100100 | 64639 231029-001   | 2019-02-24       | 2020-02-24           |
| Mini                  | Pre-amplifier     | ZVA-183-S+           | 5969001149         | 2018-09-05       | 2019-09-05           |
| Quinstar              | Amplifier         | QLW-18405536-JO      | 15964001001        | 2018-06-27       | 2019-06-27           |
| E-Microwave           | Band-stop Filters | OBSF-2400-2483.5-S   | OE01601525         | 2018-06-16       | 2019-06-16           |
| Micro-tronics         | High Pass Filter  | HPM50111             | S/N-G217           | 2018-06-16       | 2019-06-16           |

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

## Corrected Amplitude & Margin Calculation

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

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

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

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

## Test Data

### Environmental Conditions

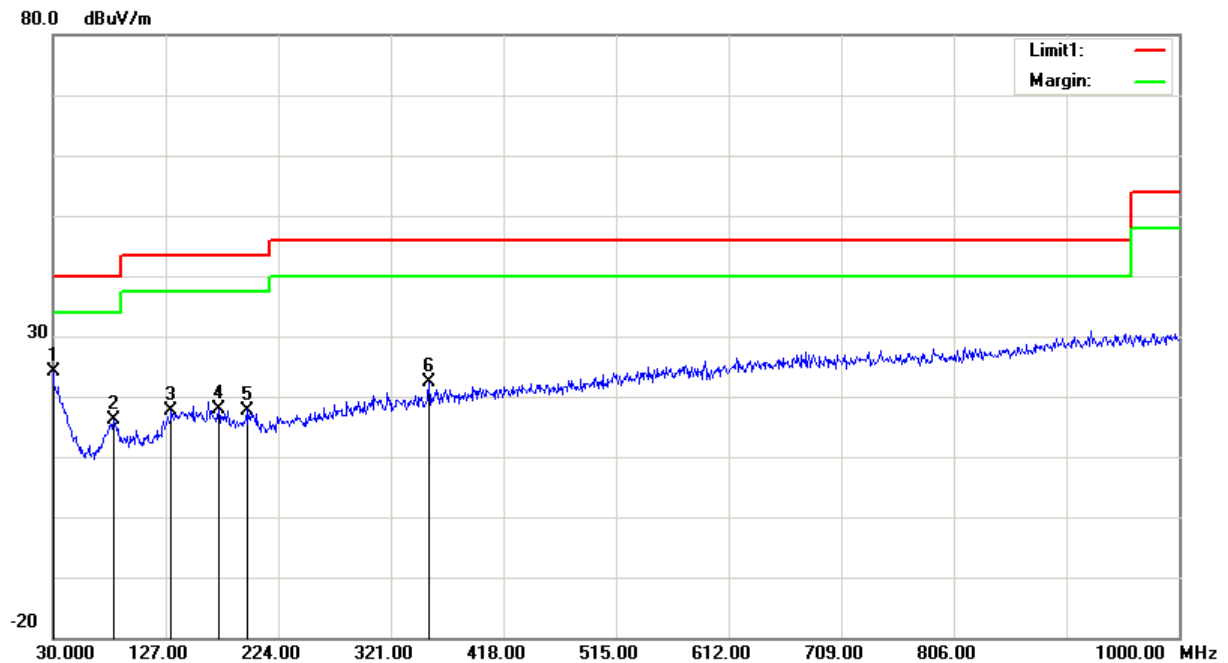
|                           |                 |
|---------------------------|-----------------|
| <b>Temperature:</b>       | 23~26.8 °C      |
| <b>Relative Humidity:</b> | 52~59 %         |
| <b>ATM Pressure:</b>      | 100.5~101.3 kPa |

\* The testing was performed by Tyler Pan, Sunny Cen on 2019-02-28 & 2019-04-02.

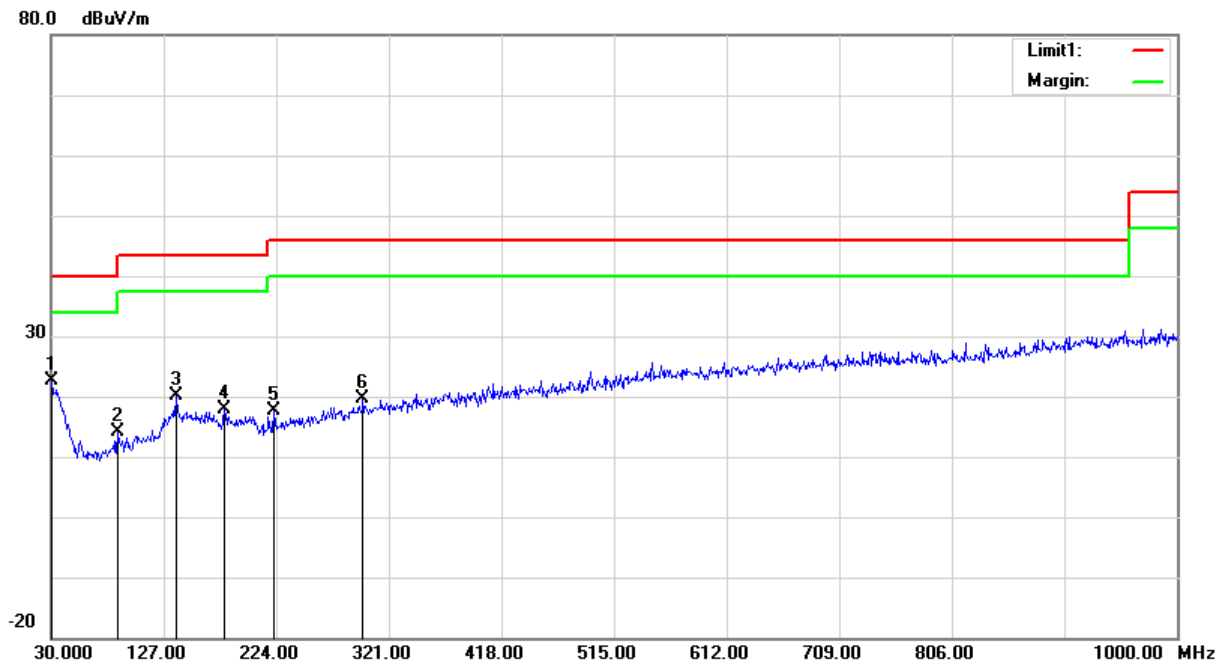
Test Mode: Transmitting

## 1) 30MHz-1GHz (8-DPSK Middle 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         | 28.36                   | peak   | -4.33                    | 24.03               | 40.00          | 15.97       |
| 82.3800         | 31.98                   | peak   | -15.82                   | 16.16               | 40.00          | 23.84       |
| 131.8500        | 27.39                   | peak   | -9.81                    | 17.58               | 43.50          | 25.92       |
| 172.5900        | 27.68                   | peak   | -9.82                    | 17.86               | 43.50          | 25.64       |
| 196.8400        | 27.31                   | peak   | -9.56                    | 17.75               | 43.50          | 25.75       |
| 353.9800        | 28.78                   | peak   | -6.48                    | 22.30               | 46.00          | 23.70       |

**Vertical:**

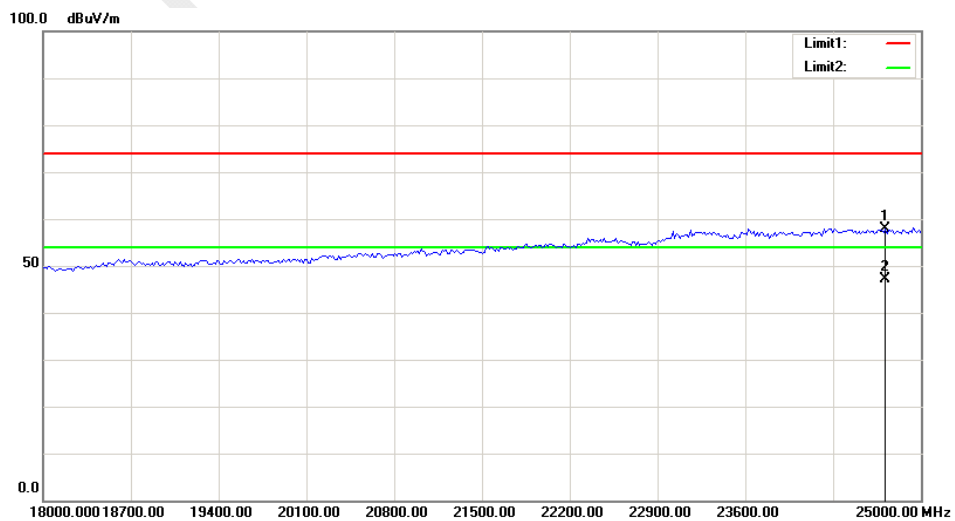
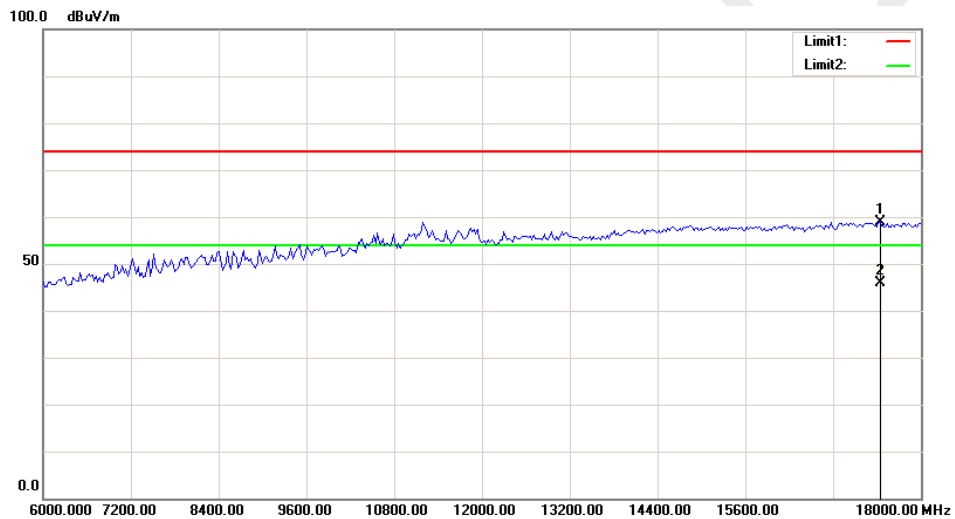
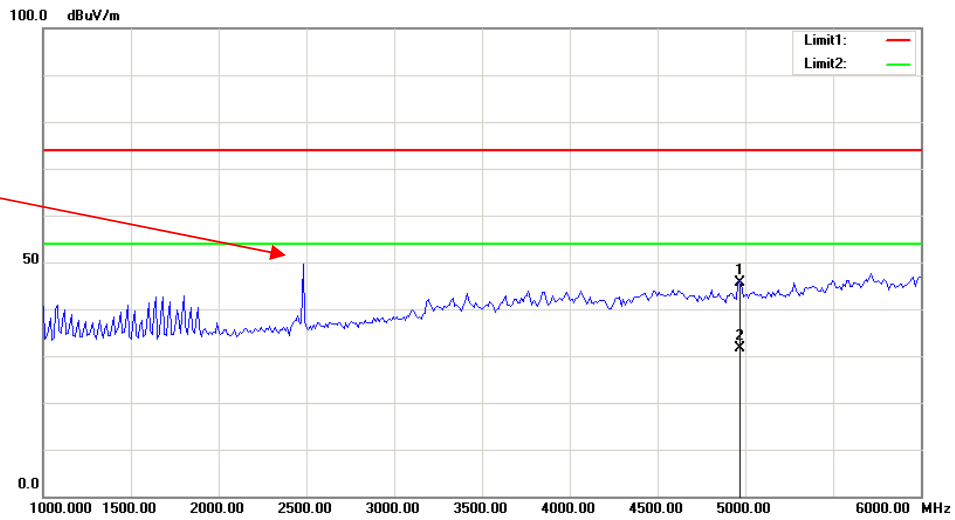
| Frequency (MHz) | Receiver Reading (dB $\mu$ V) | Remark | Correction Factor (dB/m) | Cord. Amp. (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|-------------------------------|--------|--------------------------|---------------------------|----------------------|-------------|
| 30.9700         | 27.57                         | peak   | -4.88                    | 22.69                     | 40.00                | 17.31       |
| 87.2300         | 29.38                         | peak   | -15.31                   | 14.07                     | 40.00                | 25.93       |
| 137.6700        | 29.75                         | peak   | -9.53                    | 20.22                     | 43.50                | 23.28       |
| 179.3800        | 27.82                         | peak   | -10.01                   | 17.81                     | 43.50                | 25.69       |
| 222.0600        | 28.65                         | peak   | -10.98                   | 17.67                     | 46.00                | 28.33       |
| 298.6900        | 27.26                         | peak   | -7.51                    | 19.75                     | 46.00                | 26.25       |

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

| Frequency<br>(MHz)       | Receiver          |        | Rx Antenna     |                  | Cable<br>loss<br>(dB) | Amplifier<br>Gain<br>(dB) | Corrected<br>Amplitude<br>(dBμV/m) | Limit<br>(dBμV/m) | Margin<br>(dB) |
|--------------------------|-------------------|--------|----------------|------------------|-----------------------|---------------------------|------------------------------------|-------------------|----------------|
|                          | Reading<br>(dBμV) | Remark | Polar<br>(H/V) | Factor<br>(dB/m) |                       |                           |                                    |                   |                |
| Low Channel: 2402 MHz    |                   |        |                |                  |                       |                           |                                    |                   |                |
| 2390.00                  | 25.94             | PK     | H              | 24.80            | 3.33                  | 0.00                      | 54.07                              | 74.00             | 19.93          |
| 2390.00                  | 13.02             | AV     | H              | 24.80            | 3.33                  | 0.00                      | 41.15                              | 54.00             | 12.85          |
| 4804.00                  | 38.81             | PK     | H              | 29.71            | 4.58                  | 27.36                     | 45.74                              | 74.00             | 28.26          |
| 4804.00                  | 25.61             | AV     | H              | 29.71            | 4.58                  | 27.36                     | 32.54                              | 54.00             | 21.46          |
| 7206.00                  | 40.76             | PK     | H              | 33.93            | 5.59                  | 27.19                     | 53.09                              | 74.00             | 20.91          |
| 7206.00                  | 27.82             | AV     | H              | 33.93            | 5.59                  | 27.19                     | 40.15                              | 54.00             | 13.85          |
| Middle Channel: 2441 MHz |                   |        |                |                  |                       |                           |                                    |                   |                |
| 4882.00                  | 38.06             | PK     | H              | 29.86            | 4.56                  | 27.56                     | 44.92                              | 74.00             | 29.08          |
| 4882.00                  | 24.24             | AV     | H              | 29.86            | 4.56                  | 27.56                     | 31.10                              | 54.00             | 22.90          |
| 7323.00                  | 40.40             | PK     | H              | 34.12            | 5.69                  | 27.26                     | 52.95                              | 74.00             | 21.05          |
| 7323.00                  | 27.19             | AV     | H              | 34.12            | 5.69                  | 27.26                     | 39.74                              | 54.00             | 14.26          |
| High Channel: 2480 MHz   |                   |        |                |                  |                       |                           |                                    |                   |                |
| 2483.50                  | 30.23             | PK     | H              | 24.97            | 3.38                  | 0.00                      | 58.58                              | 74.00             | 15.42          |
| 2483.50                  | 19.40             | AV     | H              | 24.97            | 3.38                  | 0.00                      | 47.75                              | 54.00             | 6.25           |
| 4960.00                  | 38.50             | PK     | H              | 30.02            | 4.58                  | 27.37                     | 45.73                              | 74.00             | 28.27          |
| 4960.00                  | 24.50             | AV     | H              | 30.02            | 4.58                  | 27.37                     | 31.73                              | 54.00             | 22.27          |
| 7440.00                  | 40.67             | PK     | H              | 34.30            | 5.79                  | 27.22                     | 53.54                              | 74.00             | 20.46          |
| 7440.00                  | 27.55             | AV     | H              | 34.30            | 5.79                  | 27.22                     | 40.42                              | 54.00             | 13.58          |

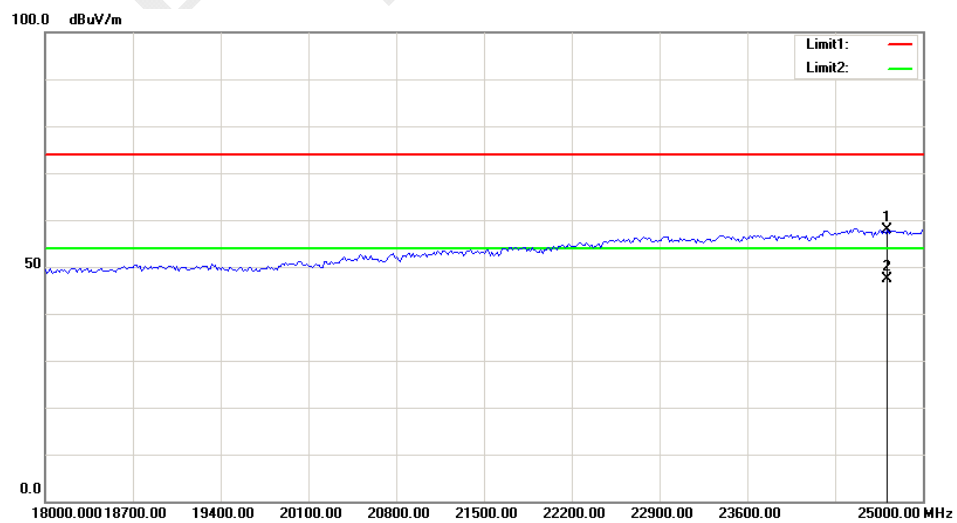
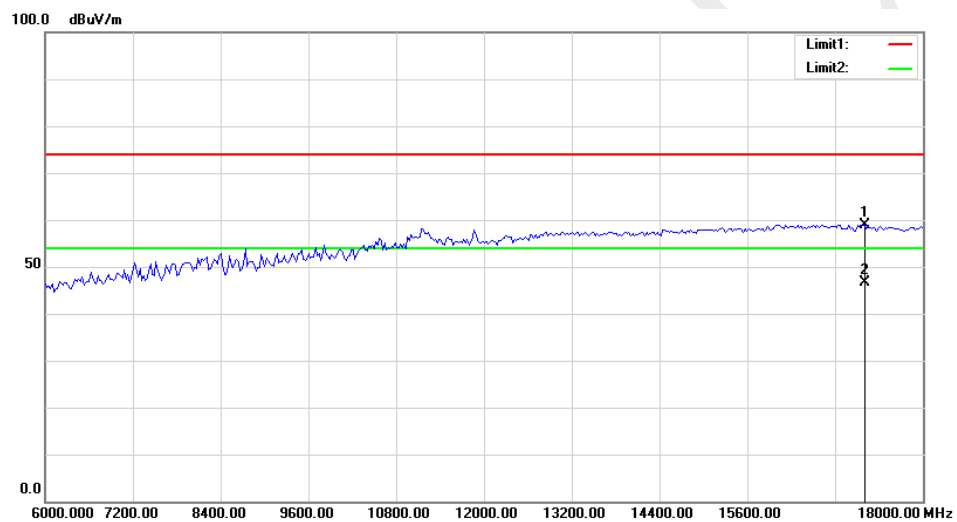
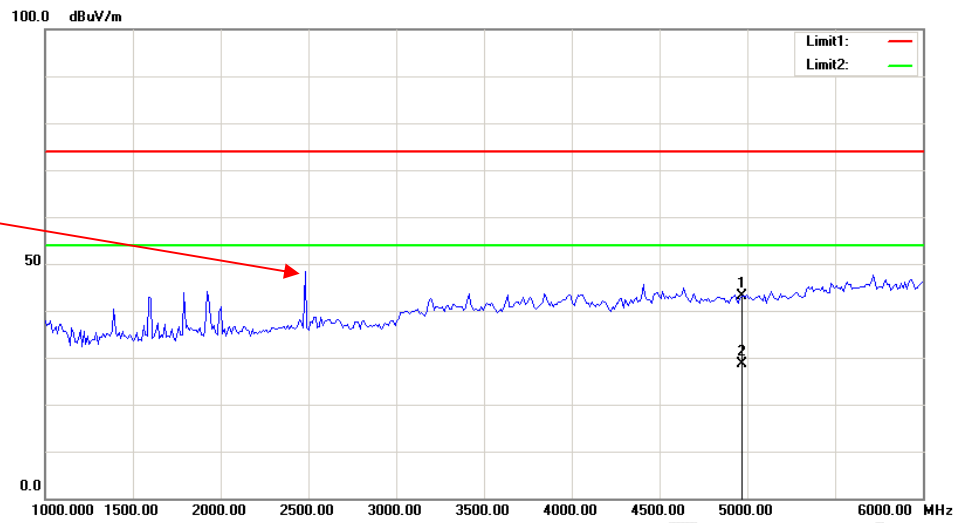
# **Worst plots(8-DPSK High Channel)** **Horizontal**

Fundamental  
Test with Band  
Rejection Filter



# Vertical

Fundamental  
Test with Band  
Rejection Filter



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

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

**Test Equipment List and Details**

| Manufacturer | Description       | Model       | Serial Number | Calibration Date | Calibration Due Date |
|--------------|-------------------|-------------|---------------|------------------|----------------------|
| R&S          | Spectrum Analyzer | FSU 26      | 200256        | 2019-01-04       | 2020-01-04           |
| 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**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 26.5 °C   |
| <b>Relative Humidity:</b> | 55 %      |
| <b>ATM Pressure:</b>      | 100.6 kPa |

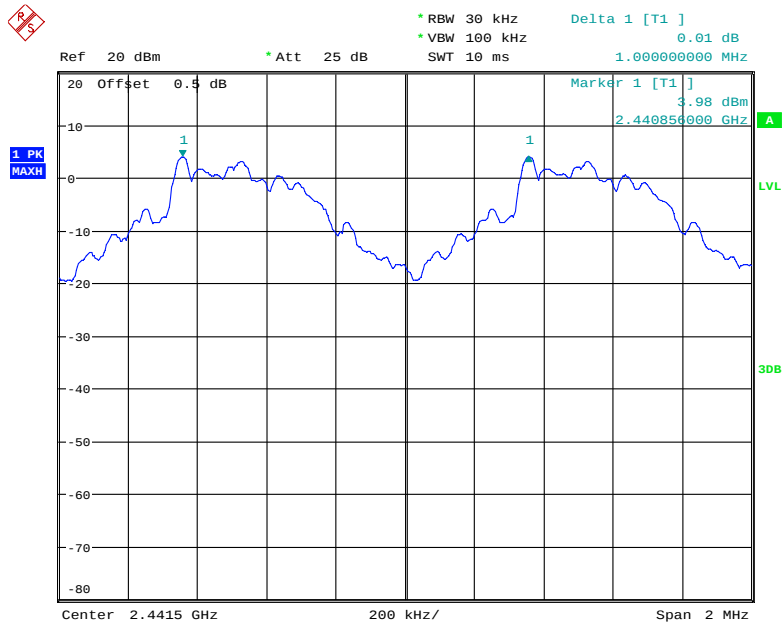
*The testing was performed by Tiago Huang on 2019-03-29*

**Test Result:** Compliance.

Please refer to following tables and plots

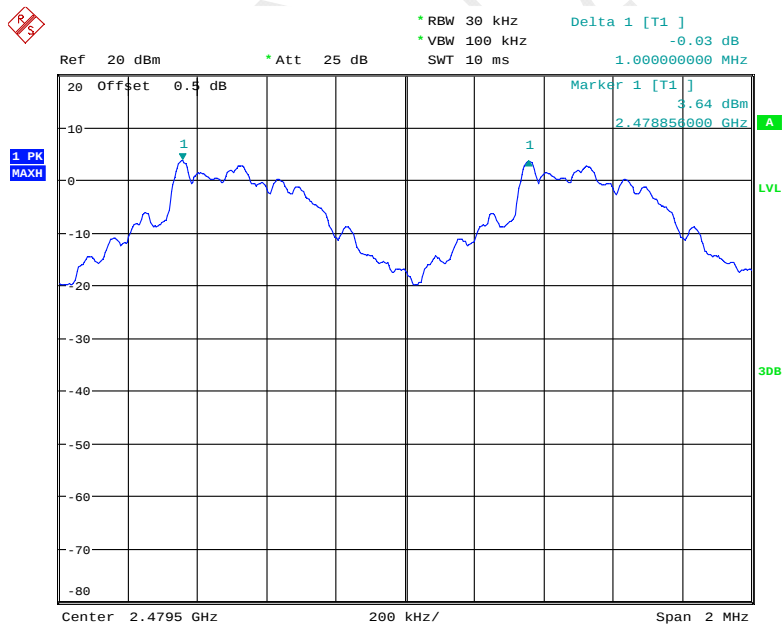


### Middle Channel

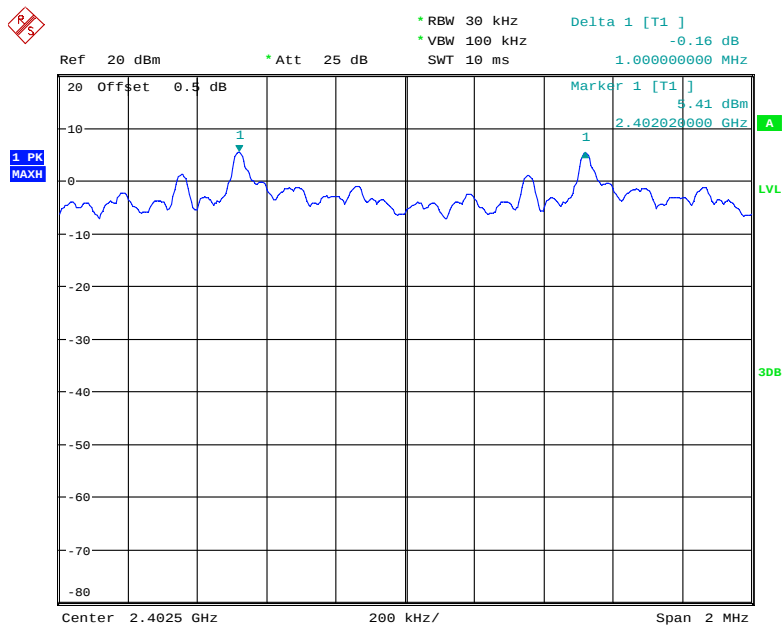


Date: 29.MAR.2019 20:18:57

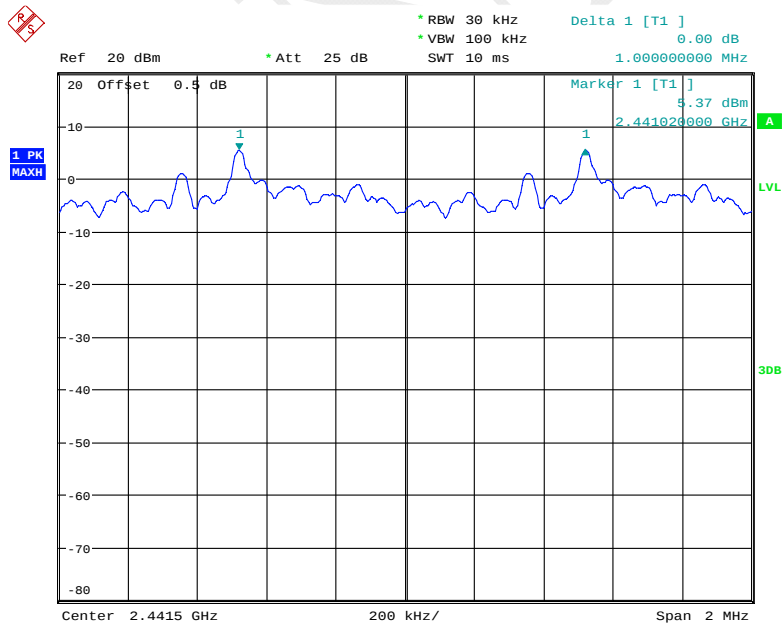
### High Channel



Date: 29.MAR.2019 20:19:57

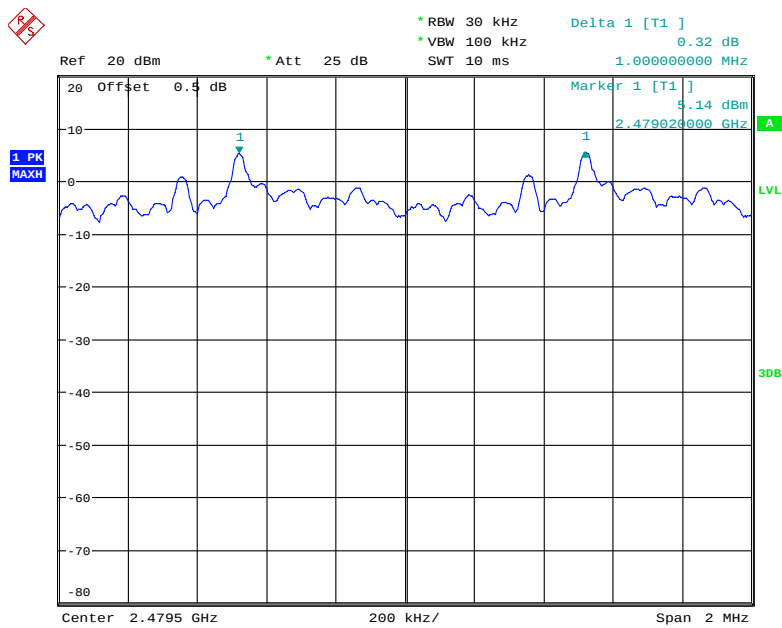
*EDR Mode ( $\pi/4$ -DQPSK):***Low Channel**

Date: 29.MAR.2019 20:23:15

**Middle Channel**

Date: 29.MAR.2019 20:25:43

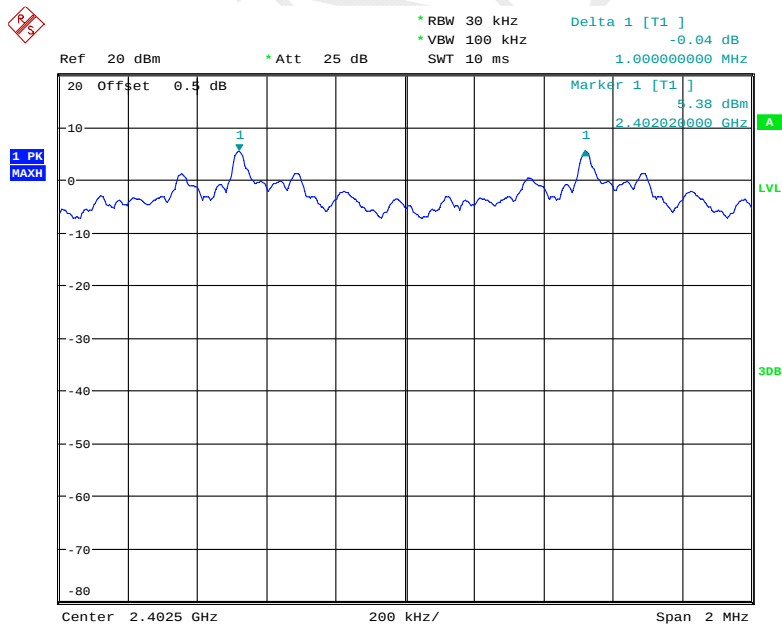
### High Channel



Date: 29.MAR.2019 20:27:06

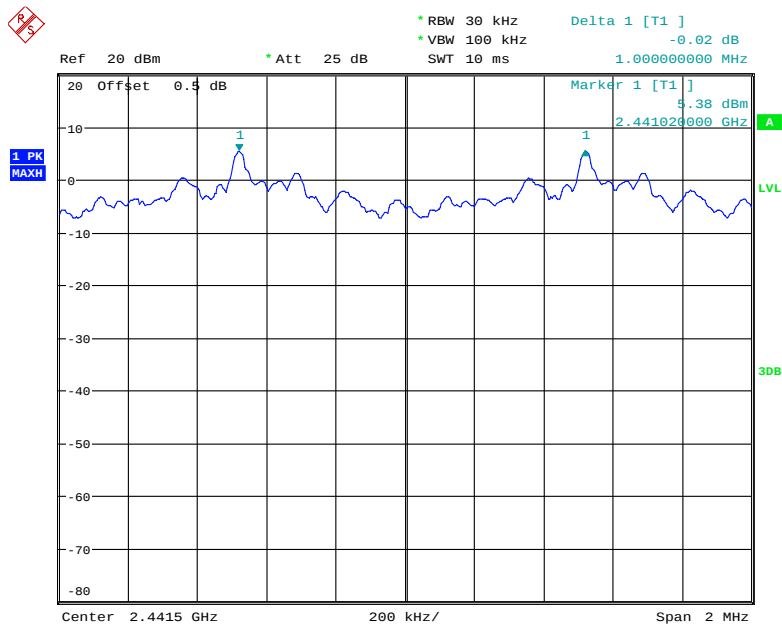
EDR Mode (8-DPSK):

### Low Channel



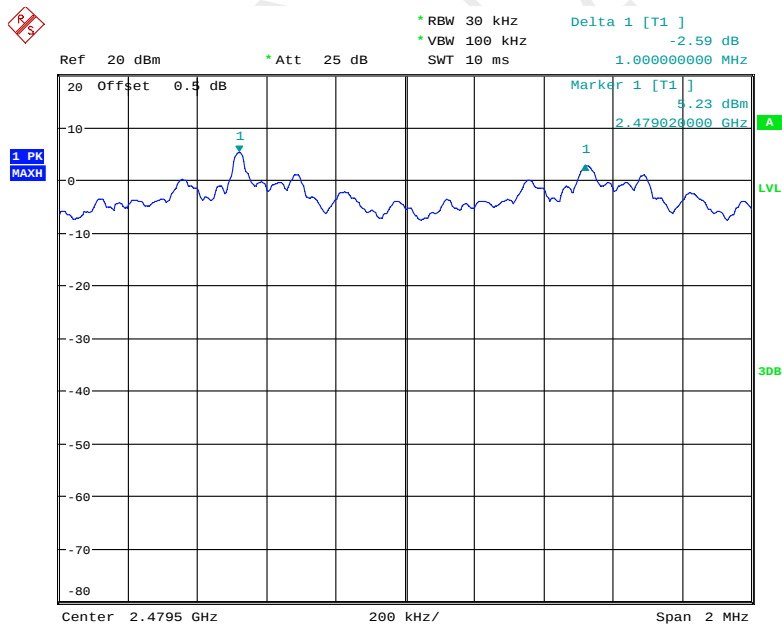
Date: 29.MAR.2019 20:28:45

### Middle Channel



Date: 29.MAR.2019 20:30:04

### High Channel



Date: 29.MAR.2019 20:33:29

**FCC §15.247(a) (1) – 20 dB BANDWIDTH TESTING****Applicable Standard**

Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

**Test Procedure**

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on the test table without connection to measurement instrument. Turn on the EUT. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

**Test Equipment List and Details**

| Manufacturer | Description       | Model       | Serial Number | Calibration Date | Calibration Due Date |
|--------------|-------------------|-------------|---------------|------------------|----------------------|
| R&S          | Spectrum Analyzer | FSU 26      | 200256        | 2019-01-04       | 2020-01-04           |
| 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**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 26.5 °C   |
| <b>Relative Humidity:</b> | 55 %      |
| <b>ATM Pressure:</b>      | 100.6 kPa |

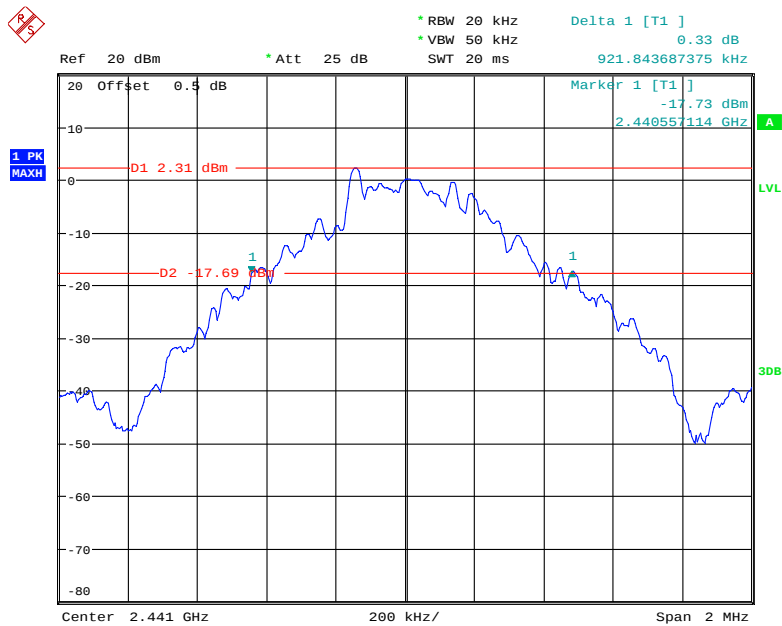
*The testing was performed by Tiago Huang on 2019-03-29*

**Test Result:** Compliance.

Please refer to following tables and plots

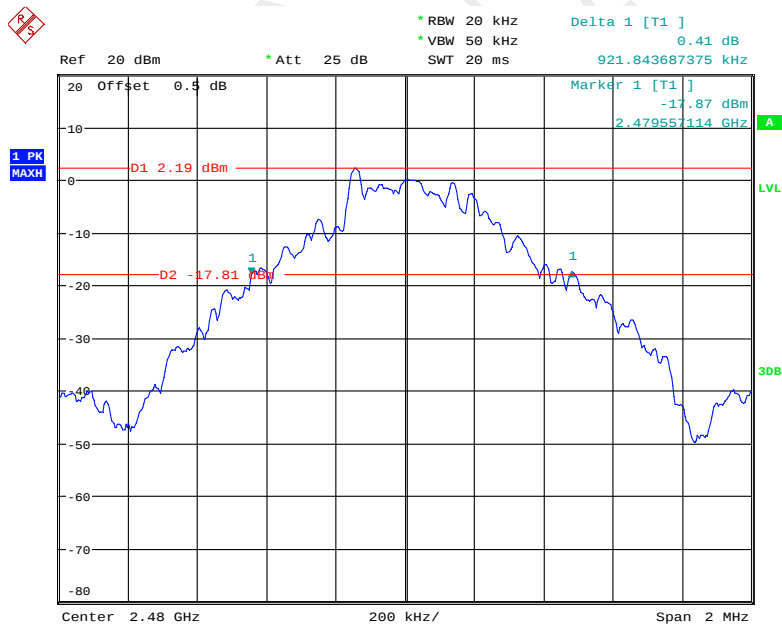


### Middle Channel

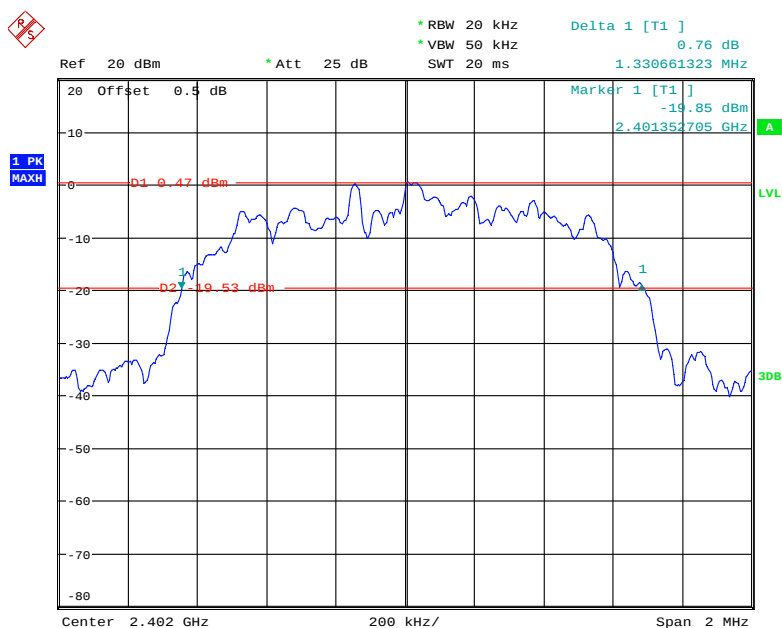


Date: 29.MAR.2019 18:06:23

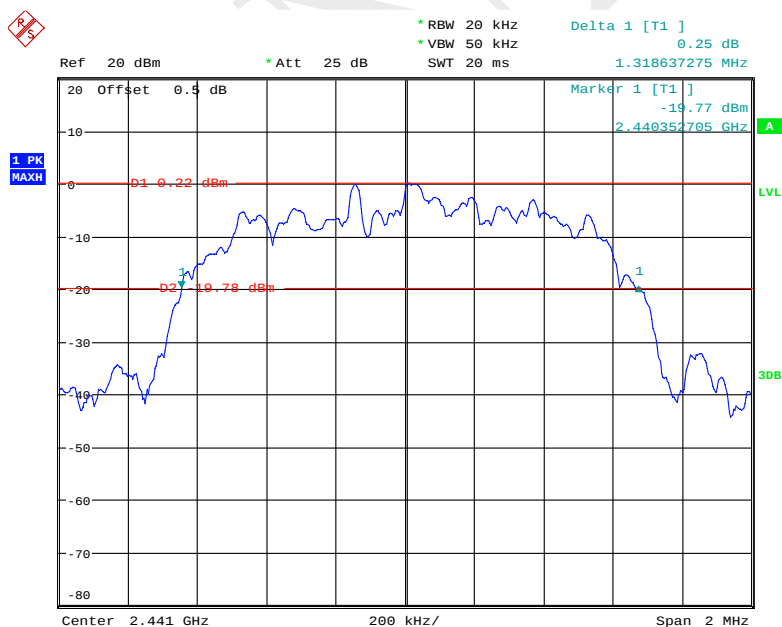
### High Channel



Date: 29.MAR.2019 18:13:55

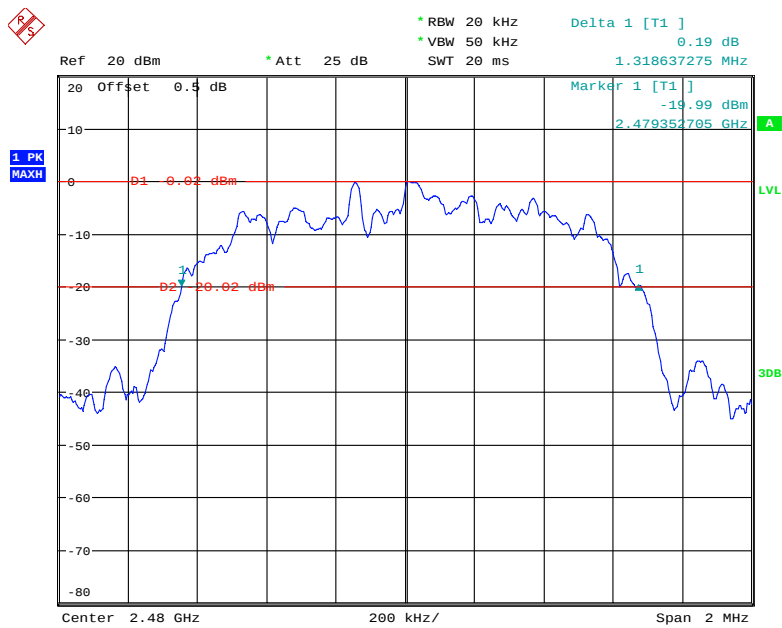
*EDR Mode ( $\pi/4$ -DQPSK):***Low Channel**

Date: 29.MAR.2019 18:19:38

**Middle Channel**

Date: 29.MAR.2019 18:22:36

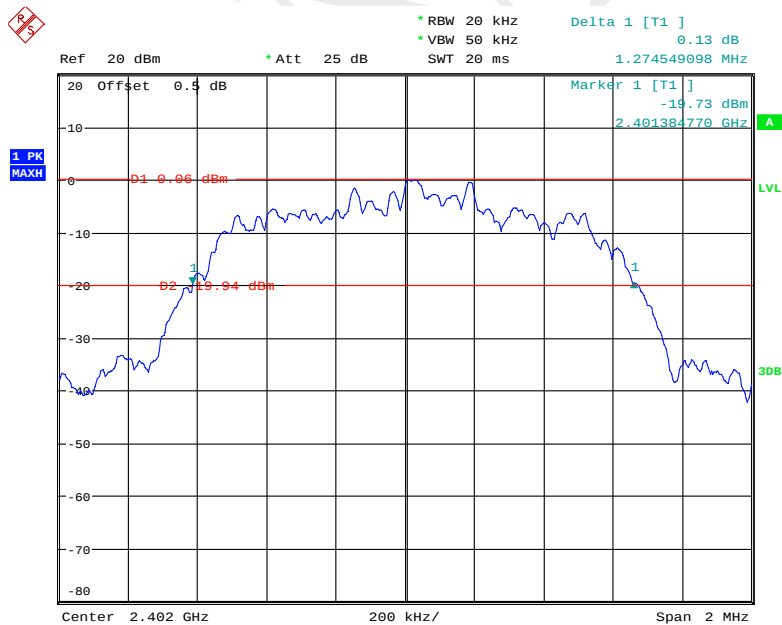
### High Channel



Date: 29.MAR.2019 18:25:26

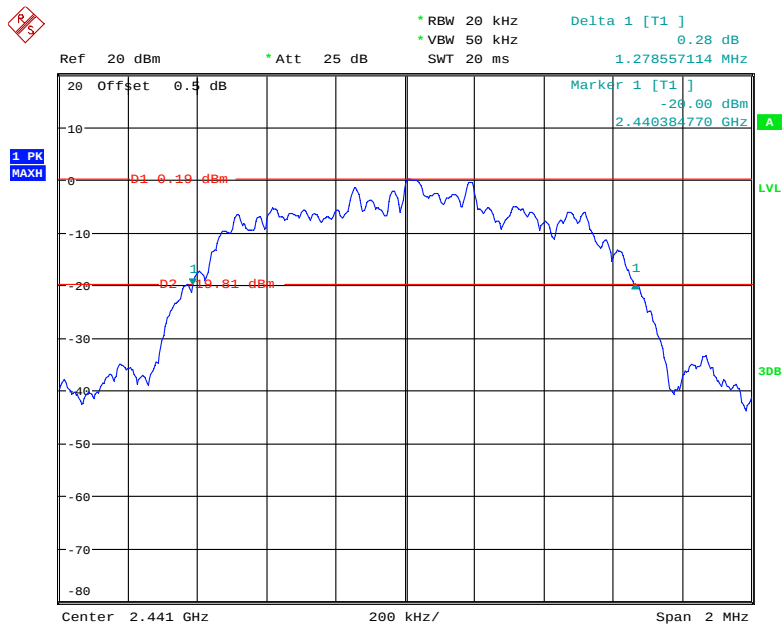
EDR Mode (8-DPSK):

### Low Channel



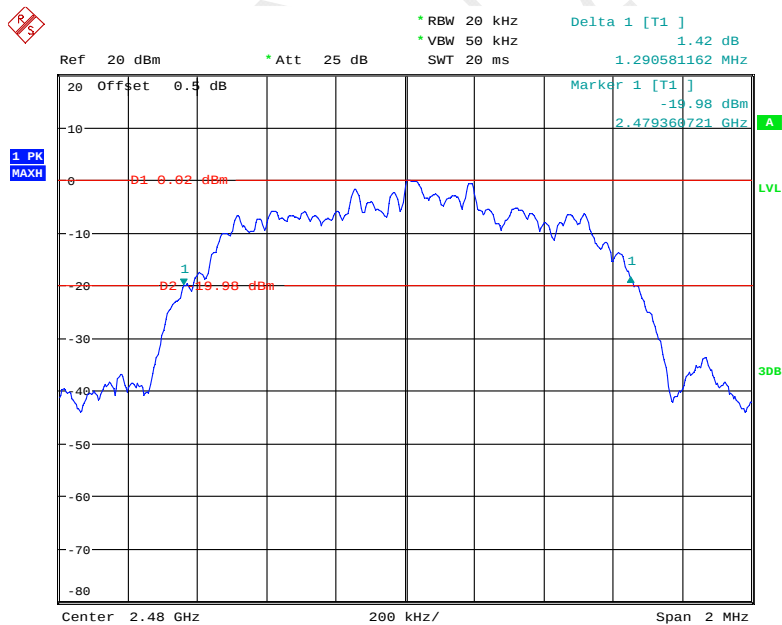
Date: 29.MAR.2019 18:29:41

## Middle Channel



Date: 29.MAR.2019 18:32:39

## High Channel



Date: 29.MAR.2019 18:35:40

**FCC §15.247(a) (1) (iii) - QUANTITY OF HOPPING CHANNEL TEST****Applicable Standard**

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

**Test Procedure**

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Set the EUT in hopping mode from first channel to last.
3. By using the Max-Hold function record the Quantity of the channel.

**Test Equipment List and Details**

| Manufacturer | Description       | Model       | Serial Number | Calibration Date | Calibration Due Date |
|--------------|-------------------|-------------|---------------|------------------|----------------------|
| R&S          | Spectrum Analyzer | FSU 26      | 200256        | 2019-01-04       | 2020-01-04           |
| 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**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 26.3 °C   |
| <b>Relative Humidity:</b> | 60 %      |
| <b>ATM Pressure:</b>      | 100.8 kPa |

*The testing was performed by Tiago Huang on 2019-03-29*

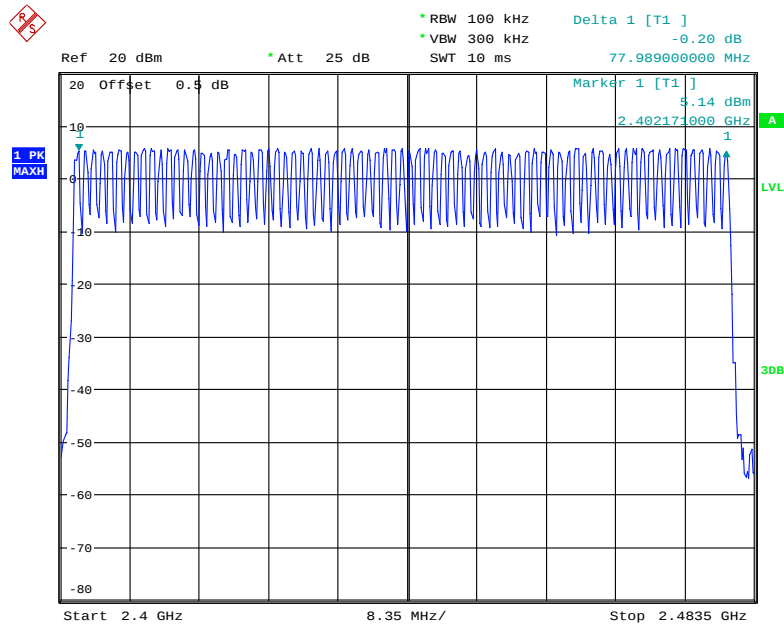
**Test Result:** Compliance.

Please refer to following tables and plots

Test Mode: Transmitting  
BDR Mode (GFSK):

| Frequency Range (MHz) | Number of Hopping Channel | Limit |
|-----------------------|---------------------------|-------|
| 2400-2483.5           | 79                        | ≥15   |

### Number of Hopping Channels

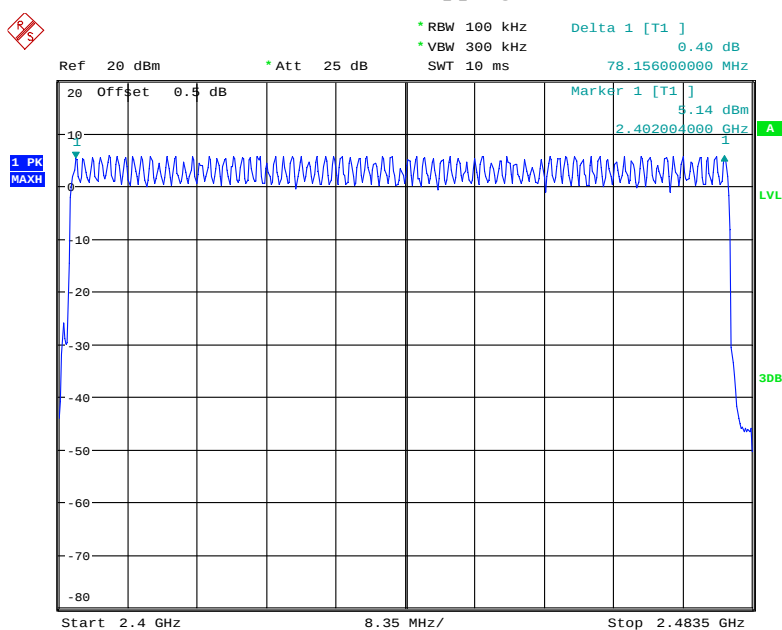


Date: 29.MAR.2019 19:53:07

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

| Frequency Range (MHz) | Number of Hopping Channel | Limit     |
|-----------------------|---------------------------|-----------|
| 2400-2483.5           | 79                        | $\geq 15$ |

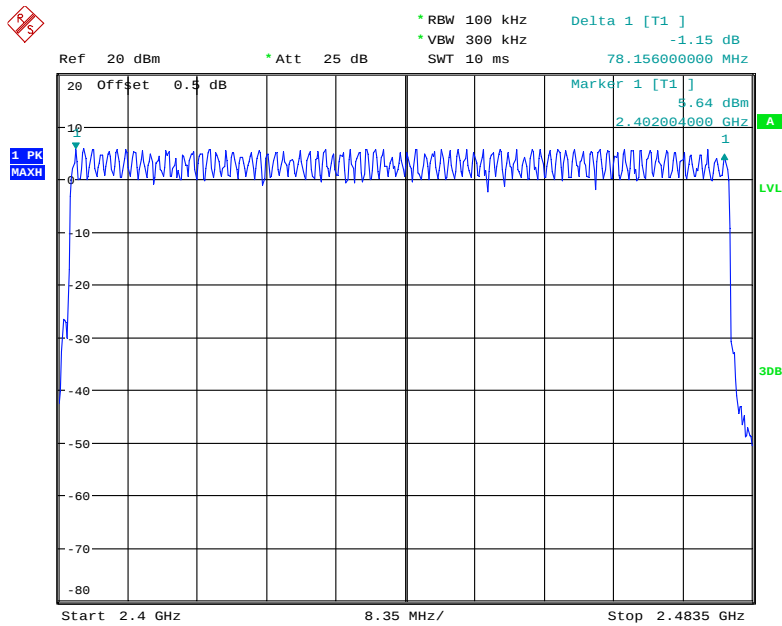
### Number of Hopping Channels



Date: 29.MAR.2019 19:57:24

*EDR Mode (8-DPSK):*

| Frequency Range<br>(MHz) | Number of<br>Hopping Channel | Limit |
|--------------------------|------------------------------|-------|
| 2400-2483.5              | 79                           | ≥15   |

**Number of Hopping Channels**

Date: 29.MAR.2019 20:01:52

**FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME)****Applicable Standard**

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

**Test Procedure**

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

**Test Equipment List and Details**

| Manufacturer | Description       | Model       | Serial Number | Calibration Date | Calibration Due Date |
|--------------|-------------------|-------------|---------------|------------------|----------------------|
| R&S          | Spectrum Analyzer | FSU 26      | 200256        | 2019-01-04       | 2020-01-04           |
| Unknown      | Coaxial Cable     | C-SJ00-0010 | C0010/02      | 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**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 26.3 °C   |
| <b>Relative Humidity:</b> | 60 %      |
| <b>ATM Pressure:</b>      | 100.8 kPa |

*The testing was performed by Tiago Huang on 2019-03-29*

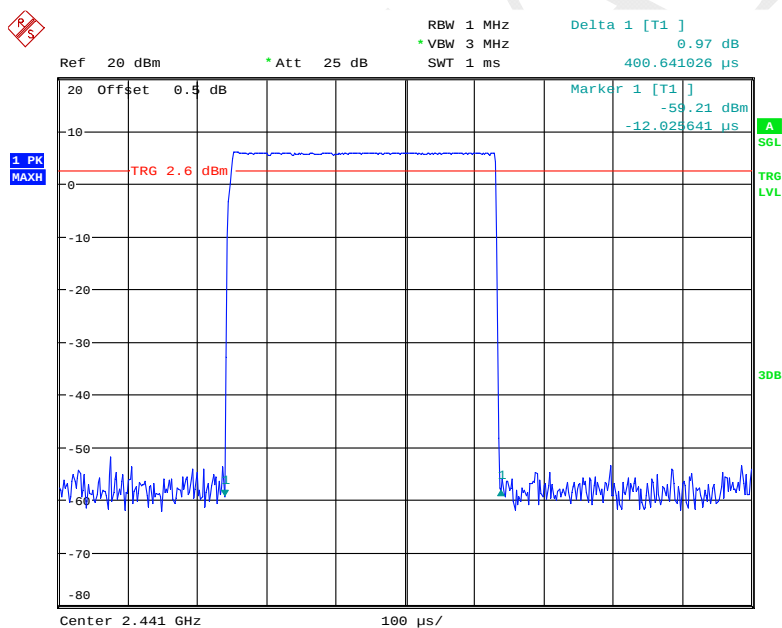
**Test Result:** Compliance.

Please refer to following tables and plots

*Test Mode: Transmitting*

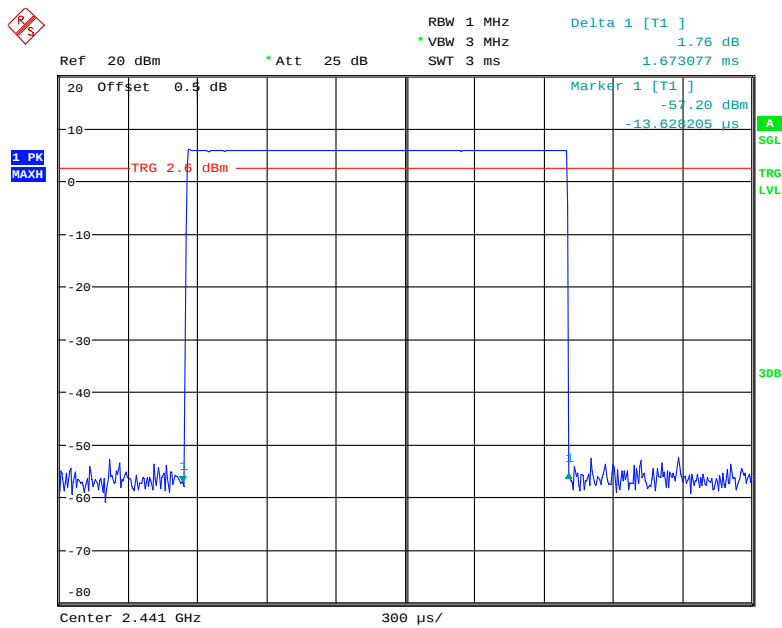
| Mode          | Packet type | Channel | Frequency (MHz) | Pulse width (ms) | Result (s) | Limit (s) |
|---------------|-------------|---------|-----------------|------------------|------------|-----------|
| GFSK          | DH1         | Middle  | 2441            | 0.401            | 0.128      | 0.4       |
|               | DH3         | Middle  | 2441            | 1.673            | 0.268      |           |
|               | DH5         | Middle  | 2441            | 2.923            | 0.312      |           |
| $\pi/4$ DQPSK | 2DH1        | Middle  | 2441            | 0.409            | 0.131      |           |
|               | 2DH3        | Middle  | 2441            | 1.673            | 0.268      |           |
|               | 2DH5        | Middle  | 2441            | 2.931            | 0.313      |           |
| 8DPSK         | 3DH1        | Middle  | 2441            | 0.409            | 0.131      |           |
|               | 3DH3        | Middle  | 2441            | 1.673            | 0.268      |           |
|               | 3DH5        | Middle  | 2441            | 2.931            | 0.313      |           |

Note:

DH1:Dwell time=Pulse time (ms)  $\times$  (1600/2/79)  $\times$  31.6 sDH3:Dwell time=Pulse time (ms)  $\times$  (1600/4/79)  $\times$  31.6 sDH5:Dwell time=Pulse time (ms)  $\times$  (1600/6/79)  $\times$  31.6 s*BDR Mode (GFSK):***DH1: Middle Channel**

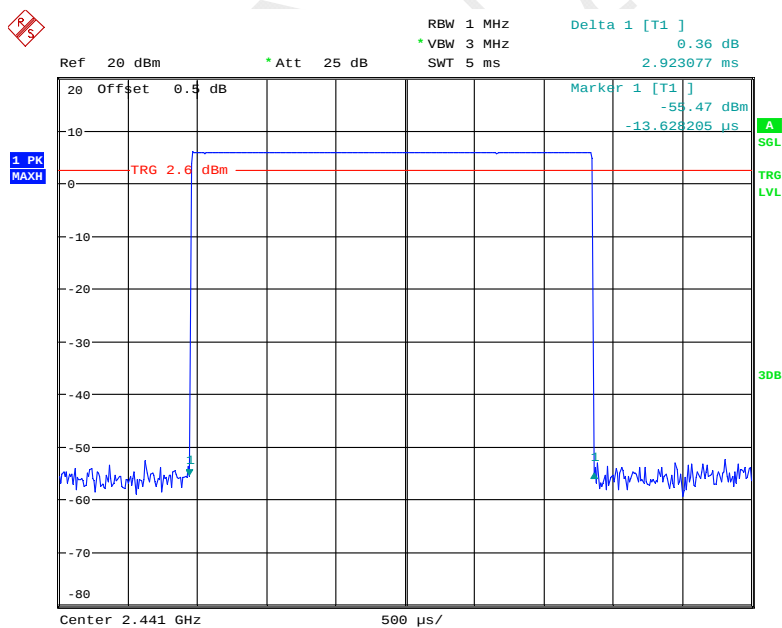
Date: 29.MAR.2019 20:37:03

### DH3: Middle Channel



Date: 29.MAR.2019 20:39:17

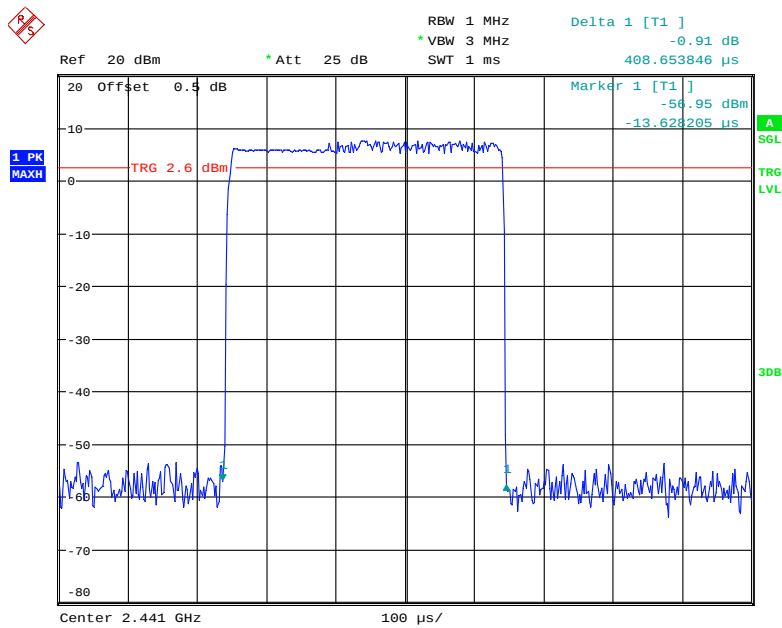
### DH5: Middle Channel



Date: 29.MAR.2019 20:40:47

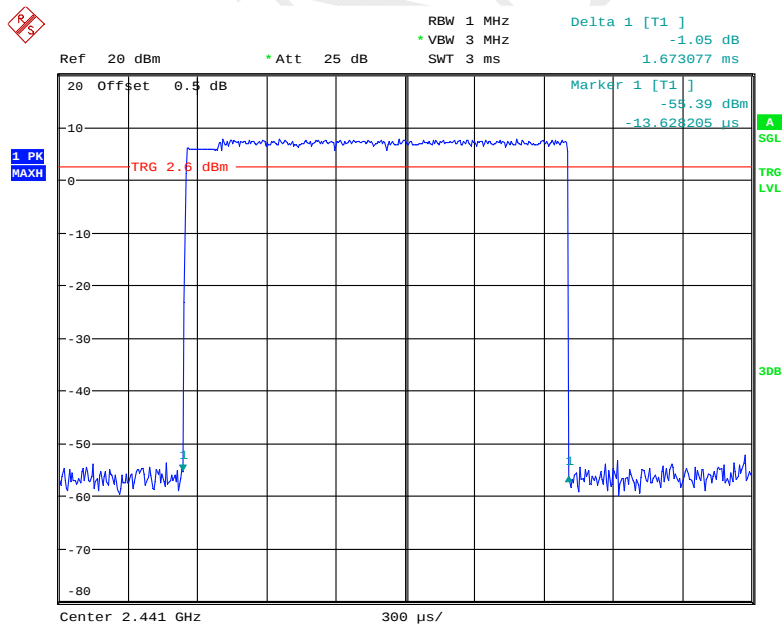
EDR Mode ( $\pi/4$ -DQPSK):

### 2DH1: Middle Channel



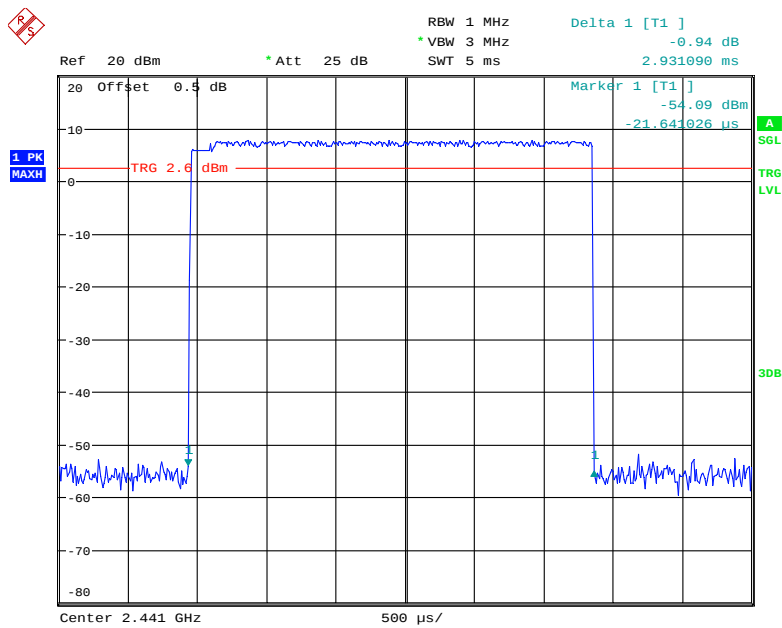
Date: 29.MAR.2019 20:37:35

### 2DH3: Middle Channel



Date: 29.MAR.2019 20:39:38

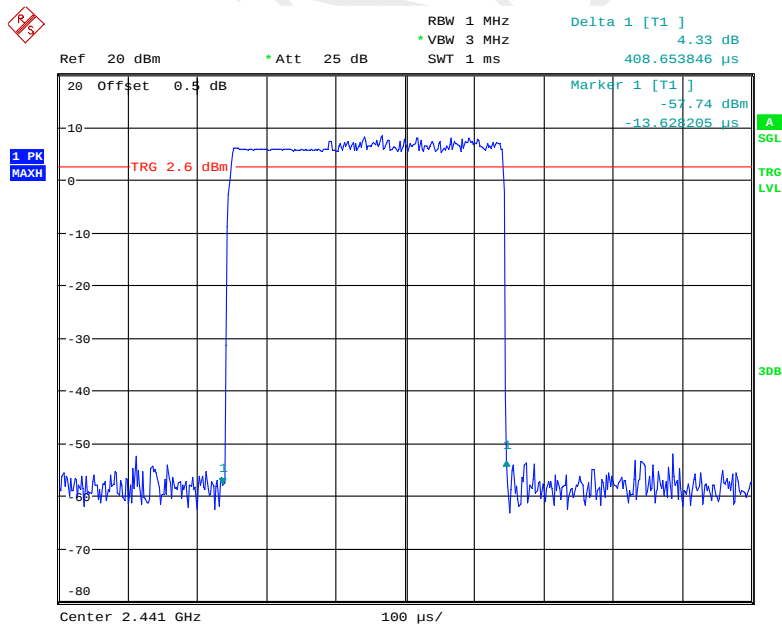
### 2DH5: Middle Channel



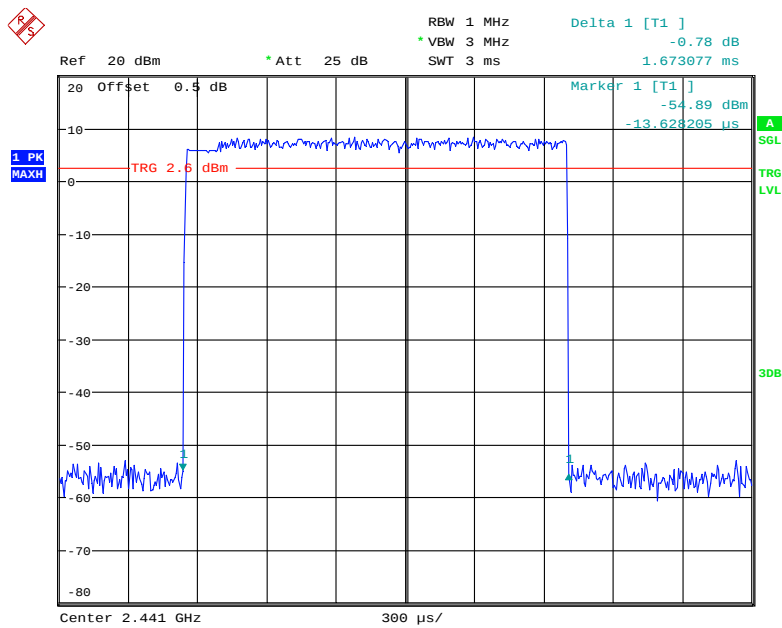
Date: 29.MAR.2019 20:41:48

EDR Mode (8DPSK):

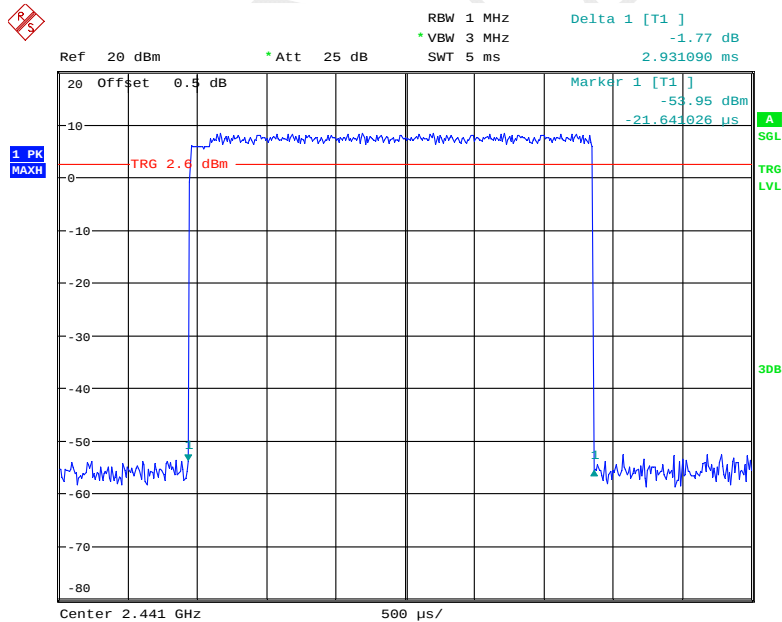
### 3DH1: Middle Channel



Date: 29.MAR.2019 20:38:38

**3DH3: Middle Channel**

Date: 29.MAR.2019 20:40:01

**3DH5: Middle Channel**

Date: 29.MAR.2019 20:42:09

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

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

**Test Procedure**

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

**Test Equipment List and Details**

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

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

**Test Data****Environmental Conditions**

|                    |           |
|--------------------|-----------|
| Temperature:       | 26.3 °C   |
| Relative Humidity: | 60 %      |
| ATM Pressure:      | 100.8 kPa |

*The testing was performed by Tiago Huang on 2019-03-30*

**Test Result:** Compliance.

*Test Mode: Transmitting*

| Mode                       | Frequency (MHz) | Peak Conducted Output power (dBm) | Limit (dBm) |
|----------------------------|-----------------|-----------------------------------|-------------|
| BDR Mode (GFSK)            | 2402            | 5.79                              | 21          |
|                            | 2441            | 5.80                              | 21          |
|                            | 2480            | 5.68                              | 21          |
| EDR Mode ( $\pi/4$ -DQPSK) | 2402            | 8.10                              | 21          |
|                            | 2441            | 8.03                              | 21          |
|                            | 2480            | 7.54                              | 21          |
| EDR Mode (8-DPSK)          | 2402            | 8.55                              | 21          |
|                            | 2441            | 8.75                              | 21          |
|                            | 2480            | 8.43                              | 21          |

Note: The data above was tested in conducted mode.

## FCC §15.247(d) - BAND EDGES TESTING

### Applicable Standard

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

### Test Procedure

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

### Test Equipment List and Details

| Manufacturer | Description       | Model       | Serial Number | Calibration Date | Calibration Due Date |
|--------------|-------------------|-------------|---------------|------------------|----------------------|
| R&S          | Spectrum Analyzer | FSU 26      | 200256        | 2019-01-04       | 2020-01-04           |
| 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**

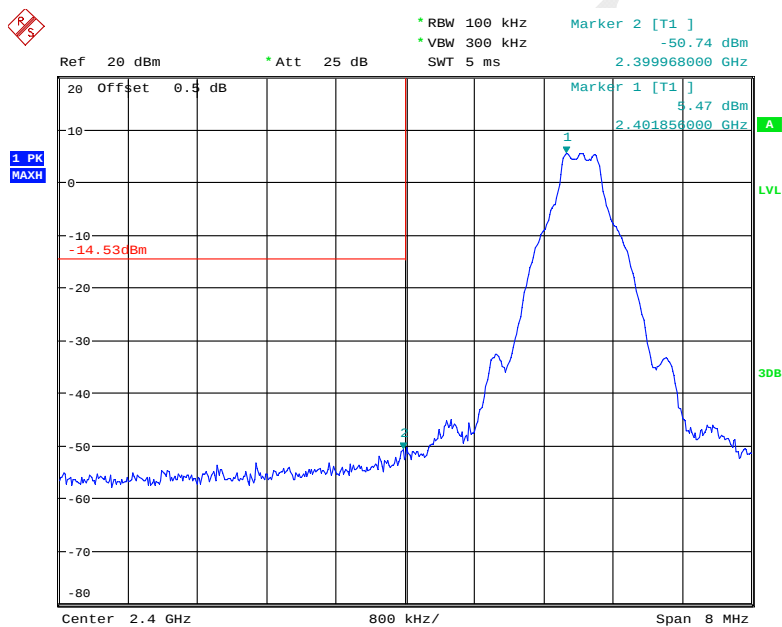
|                    |           |
|--------------------|-----------|
| Temperature:       | 26.3 °C   |
| Relative Humidity: | 48 %      |
| ATM Pressure:      | 100.8 kPa |

The testing was performed by Tiago Huang on 2019-03-29

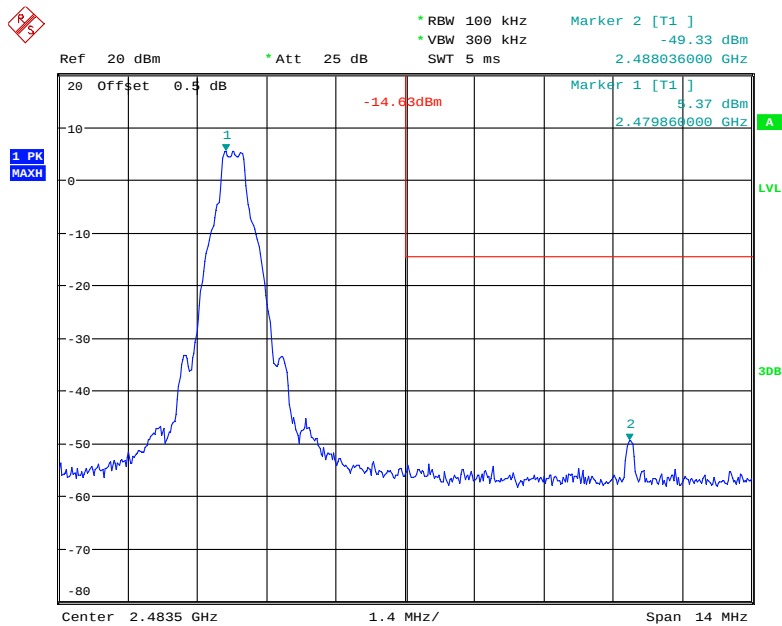
**Test Result: Compliance**

Single Channel Mode

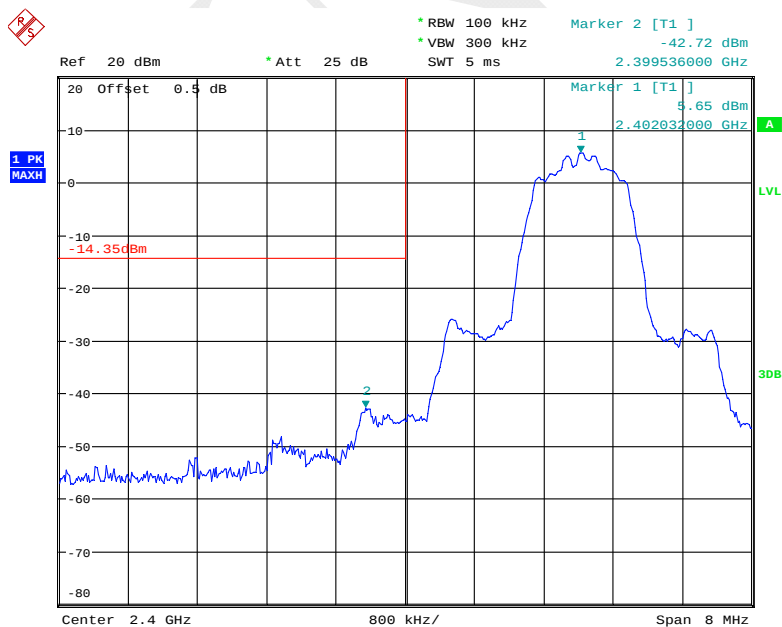
BDR Mode (GFSK):

**Band Edge, Left Side**

Date: 29.MAR.2019 18:05:44

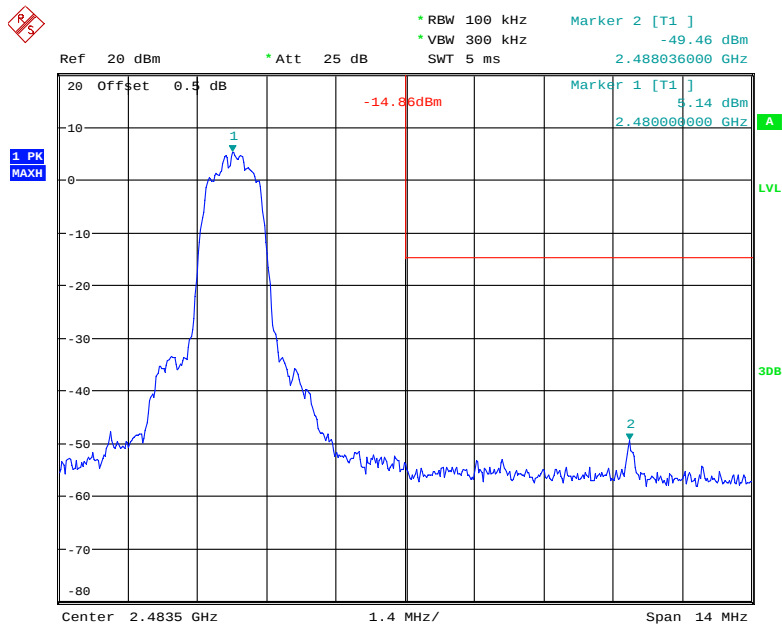
**Band Edge, Right Side**

Date: 29.MAR.2019 18:16:06

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

Date: 29.MAR.2019 18:21:24

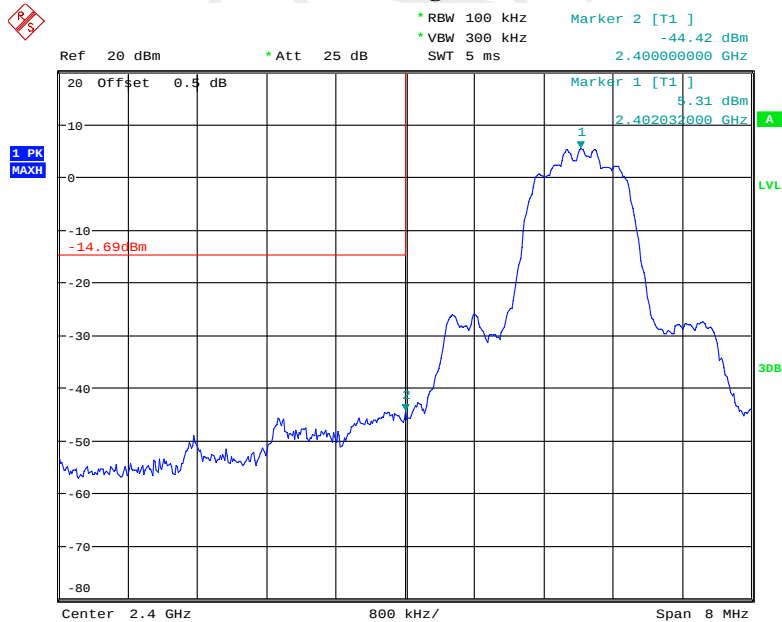
### Band Edge, Right Side



Date: 29.MAR.2019 18:27:41

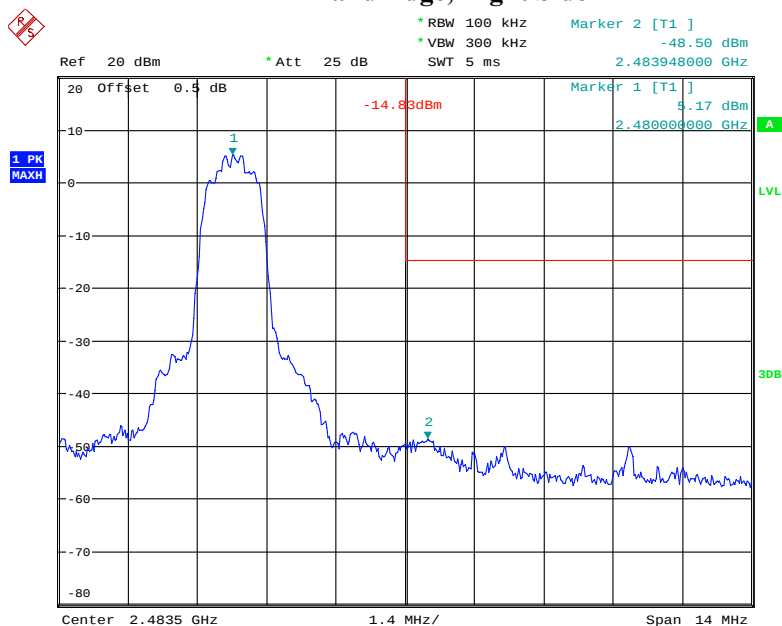
EDR Mode (8-DPSK):

### Band Edge, Left Side



Date: 29.MAR.2019 18:31:43

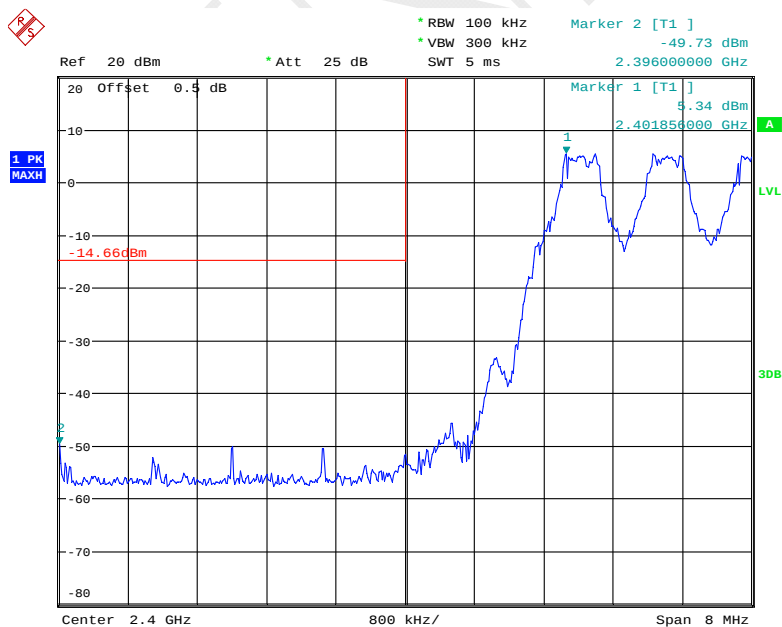
## Band Edge, Right Side



Date: 29.MAR.2019 18:37:46

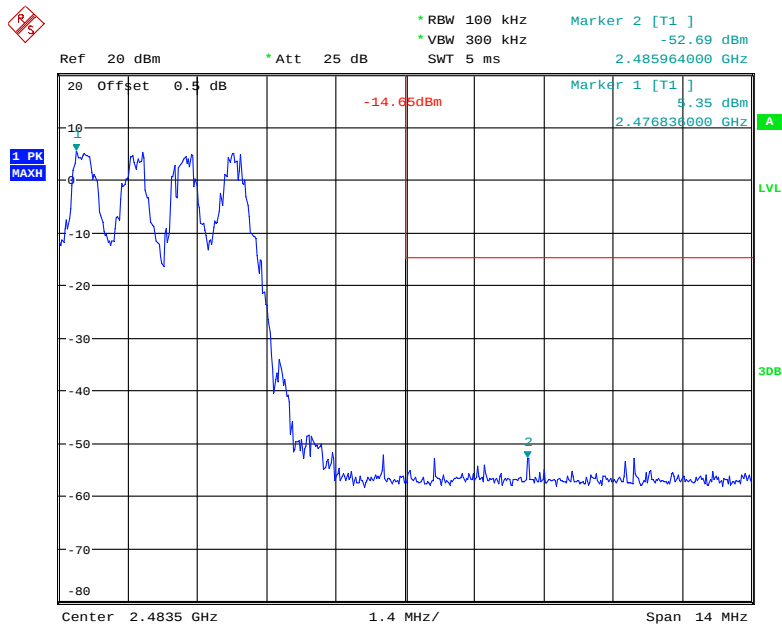
Hopping Mode,  
BDR Mode (GFSK):

## Band Edge, Left Side



Date: 29.MAR.2019 20:10:43

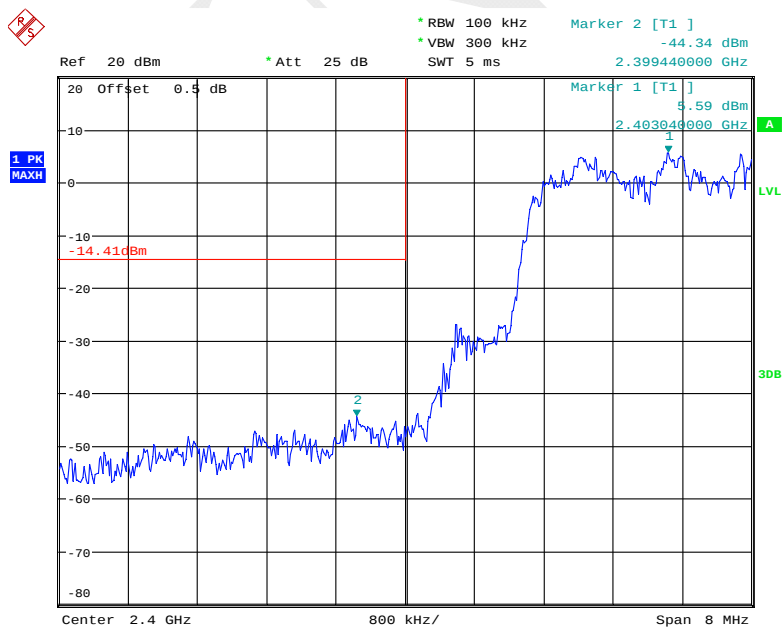
### Band Edge, Right Side



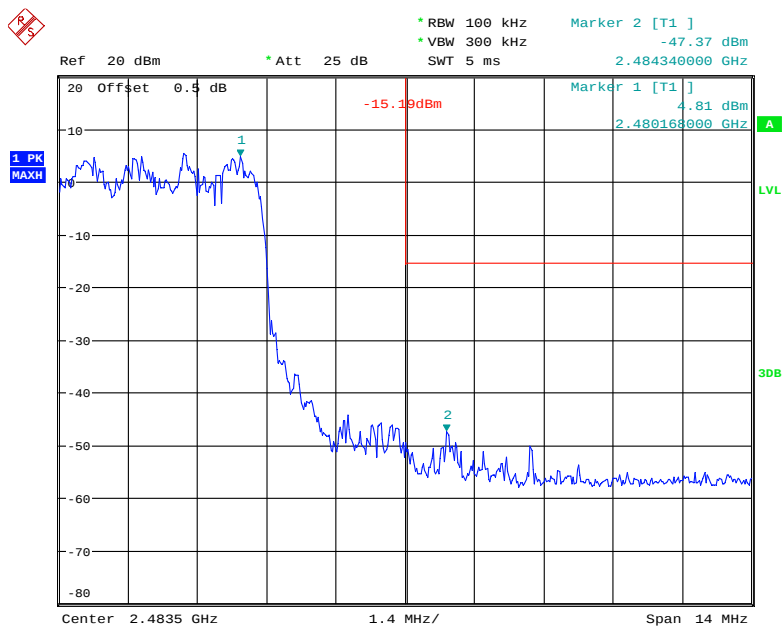
Date: 29.MAR.2019 20:12:30

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

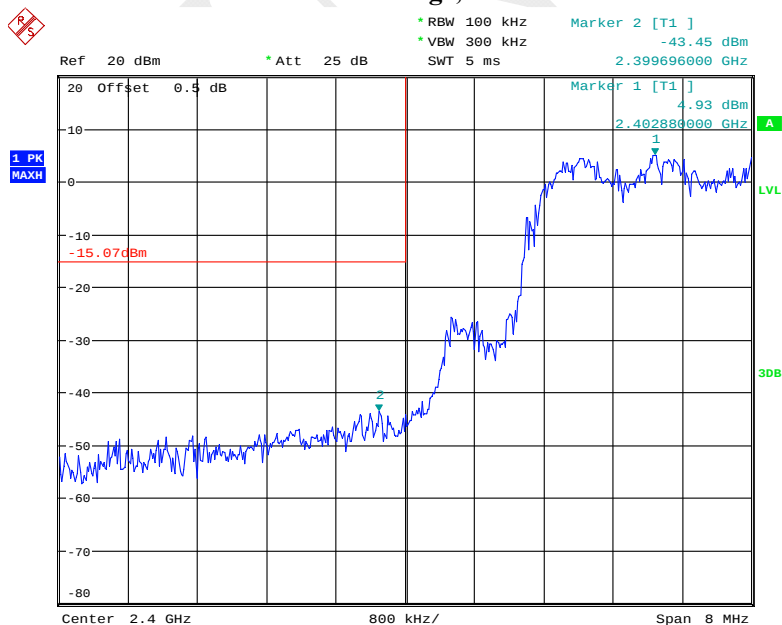
### Band Edge, Left Side



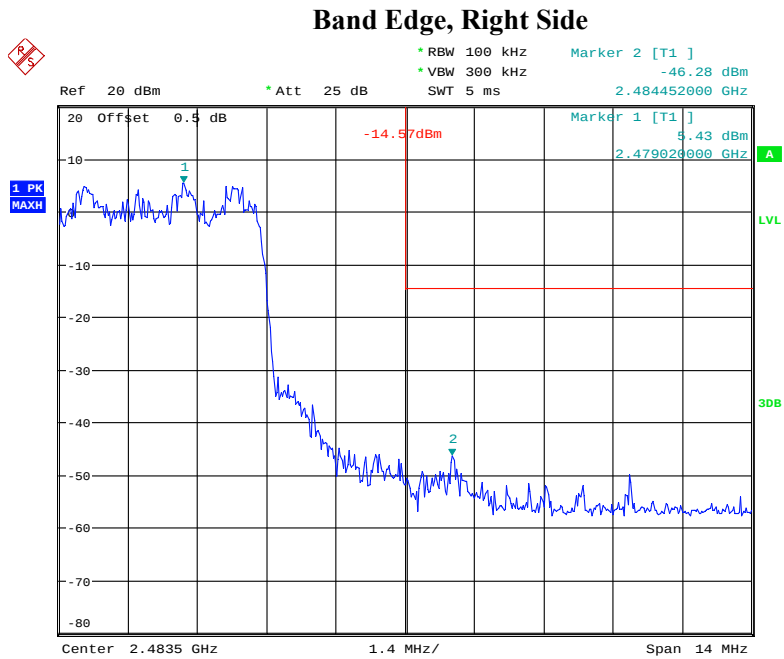
Date: 29.MAR.2019 20:14:03

**Band Edge, Right Side**

Date: 29.MAR.2019 20:15:40

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

Date: 29.MAR.2019 20:03:19



Date: 29.MAR.2019 20:05:14

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