



TESTING LABORATORY  
CERTIFICATE #4820.01



## FCC PART 15.247

### TEST REPORT

For

## WTS Positioning Solutions AB

Wallingatan 18, Stockholm, Sweden, 111 24

**FCC ID: 2AR8M-TRAX3G**

|                                        |                                                                                                                                                                                                                                                       |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Report Type:</b><br>Original Report | <b>Product Name:</b><br>Trax G+                                                                                                                                                                                                                       |
| <b>Report Number:</b> RDG180906015-00A |                                                                                                                                                                                                                                                       |
| <b>Report Date:</b> 2018-12-25         |                                                                                                                                                                                                                                                       |
| <b>Reviewed By:</b>                    | Jerry Zhang<br>EMC Manager<br><i>Jerry Zhang</i>                                                                                                                                                                                                      |
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**Note:** This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Dongguan). This report must not be used by the customer to claim product certification, approval, or endorsement by A2LA\* or any agency of the Federal Government. \* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk “\*”.

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## GENERAL INFORMATION

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

|                                               |                                        |
|-----------------------------------------------|----------------------------------------|
| <b>EUT Name:</b>                              | Trax G+                                |
| <b>EUT Model:</b>                             | Trax 3.1                               |
| <b>Operation Frequency:</b>                   | 2402-2480 MHz                          |
| <b>Maximum Peak Output Power (Conducted):</b> | 3.43 dBm                               |
| <b>Modulation Type:</b>                       | GFSK                                   |
| <b>Rated Input Voltage:</b>                   | DC 3.7V or charged by wireless charger |
| <b>External Dimension:</b>                    | 55mm(L)*38mm(W)*10.7mm(H)              |

### Objective

This report is prepared on behalf of *WTS Positioning Solutions AB* 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 compliance of the EUT with FCC Rules Part 15-Subpart C, section 15.203, 15.205, 15.207, 15.209, 15.247 rules.

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

FCC Part 22H, 24E PCB submissions with FCC ID:2AR8M-TRAX3G

### Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and KDB 558074 D01 15.247 Meas Guidance v05.

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,<br>1G~6GHz: 4.98 dB, 6G~18GHz: 5.89 dB,<br>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.

This device supports BLE 1Mbps and 2Mbps modes, For Bluetooth LE mode, 40 channels are provided for testing:

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|
| 0       | 2402            | 20      | 2442            |
| 1       | 2404            | ...     | ...             |
| ...     | ...             | ...     | ...             |
| ...     | ...             | ...     | ...             |
| ..      | ...             | 38      | 2478            |
| 19      | 2440            | 39      | 2480            |

EUT was tested with channel 0, 19 and 39.

### Equipment Modifications

No modification was made to the EUT tested.

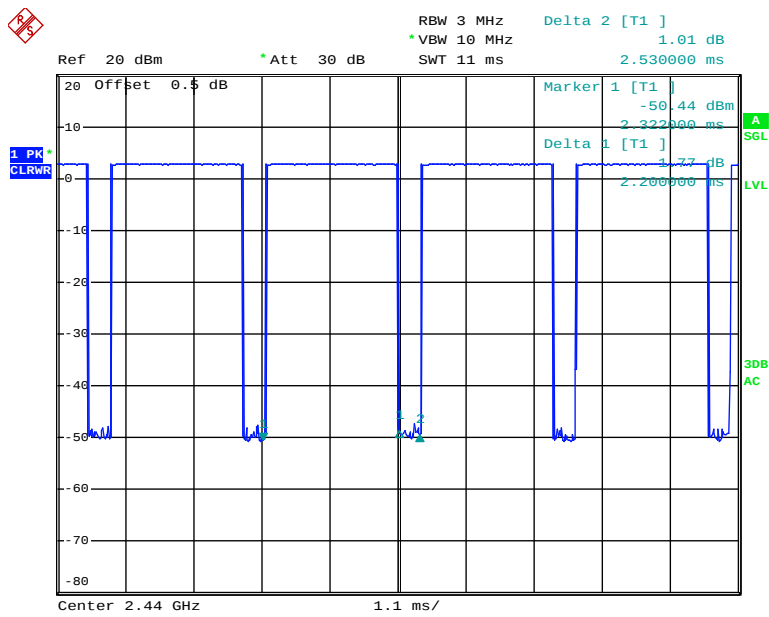
### EUT Exercise Software

No software was used during test, the device was configured to engineering mode by manufacturer, the system configured maximum power level as default setting, test modes switched by key.

The duty cycle as below:

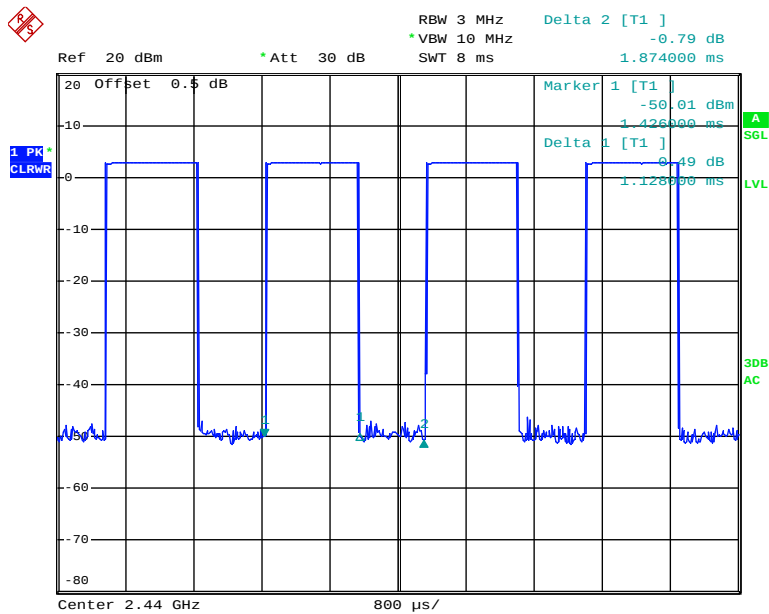
| Mode        | T <sub>on</sub> (ms) | T <sub>on+off</sub> (ms) | Duty Cycle (%) |
|-------------|----------------------|--------------------------|----------------|
| BLE (1Mbps) | 2.20                 | 2.53                     | 87             |
| BLE (2Mbps) | 1.13                 | 1.87                     | 60             |

### 1Mbps



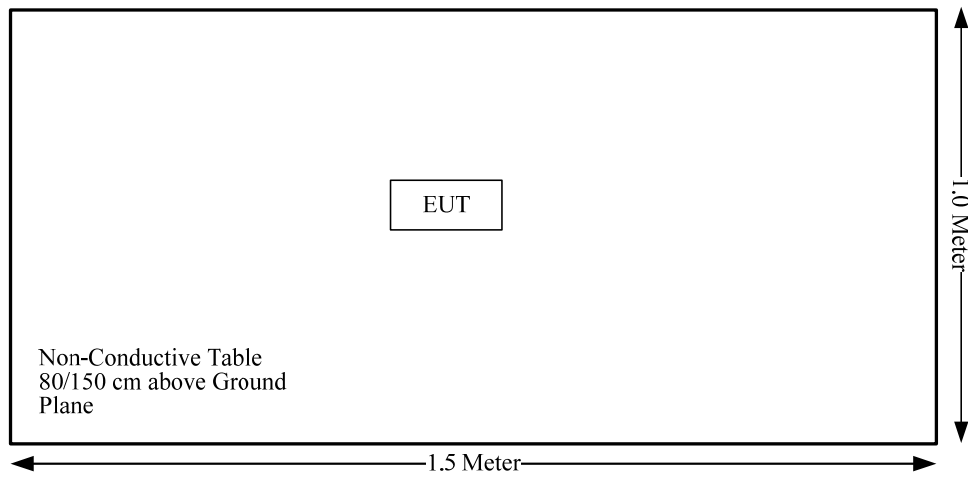
Date: 15.DEC.2018 15:56:07

### 2Mbps



Date: 15.DEC.2018 15:57:17

## Block Diagram of Test Setup



**SUMMARY OF TEST RESULTS**

| FCC Rules                           | Description of Test                      | Result         |
|-------------------------------------|------------------------------------------|----------------|
| FCC §15.247 (i) & §1.1310 & §2.1093 | RF Exposure                              | Compliance     |
| §15.203                             | Antenna Requirement                      | Compliance     |
| §15.207 (a)                         | AC Line Conducted Emissions              | Not Applicable |
| §15.205, §15.209, §15.247(d)        | Spurious Emissions                       | Compliance     |
| §15.247 (a)(2)                      | 6 dB Bandwidth                           | Compliance     |
| §15.247(b)(3)                       | Maximum Conducted Output Power           | Compliance     |
| §15.247(d)                          | 100 kHz Bandwidth of Frequency Band Edge | Compliance     |
| §15.247(e)                          | Power Spectral Density                   | Compliance     |

Not Applicable: the device was powered by battery when operation.

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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.

When an antenna qualifies for the standalone SAR test exclusion of 4.3.1 and also transmits simultaneously with other antennas, the standalone SAR value must be estimated according to the following to determine the simultaneous transmission SAR test exclusion criteria:  $[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}/x]$  W/kg, for test separation distances  $\leq 50$  mm; where  $x = 7.5$  for 1-g SAR and  $x = 18.75$  for 10-g SAR.

**Measurement Result**

| Operation modes | Frequency (MHz) | Maximum Power (dBm) | Duty Cycle (%) | Time based average Power (mW) | Separated distance from user (mm) | Calculated value | Exempt from Test? (Yes/No) |
|-----------------|-----------------|---------------------|----------------|-------------------------------|-----------------------------------|------------------|----------------------------|
| GSM 850         | 824-849         | 32                  | 0.175          | 2.77                          | 0                                 | 0.51             | Yes                        |
| PCS 1900        | 1850-1910       | 27                  | 0.175          | 0.88                          | 0                                 | 0.24             | Yes                        |
| WCDMA Band II   | 1850-1910       | 23                  | 0.02188        | 0.04                          | 0                                 | 0.01             | Yes                        |
| WCDMA Band V    | 824-849         | 23                  | 0.02188        | 0.04                          | 0                                 | 0.01             | Yes                        |
| BLE             | 2402-2480       | 4                   | 100.00         | 2.51                          | 0                                 | 0.79             | Yes                        |

The maximum transmission rate when active is once every 10 second and the data consist of 140bytes.

In 2G network(GPRS/EDGE), At the lowest data rate 8 kbit/s every transmission will last for less than 0,0175s with a resulting dutycycle of <0.175%.

In 3G network, At the lowest data rate 64 kbit/s every transmission will last for less than 0,002188s with a resulting dutycycle of <0.02188%.

Please refer to the attention letter for more detail.

WWAN and Bluetooth can transmit Simultaneously:

| Operation modes | Frequency (MHz) | Maximum Power (dBm) | Duty Cycle (%) | Time based average Power (mW) | Separated distance from user (mm) | SAR estimation (W/kg) |
|-----------------|-----------------|---------------------|----------------|-------------------------------|-----------------------------------|-----------------------|
| GSM 850         | 824-849         | 32                  | 0.175          | 2.77                          | 0                                 | 0.07                  |
| PCS 1900        | 1850-1910       | 27                  | 0.175          | 0.88                          | 0                                 | 0.03                  |
| WCDMA Band II   | 1850-1910       | 23                  | 0.02188        | 0.04                          | 0                                 | 0.0016                |
| WCDMA Band V    | 824-849         | 23                  | 0.02188        | 0.04                          | 0                                 | 0.0011                |
| BLE             | 2402-2480       | 4                   | 100.00         | 2.51                          | 0                                 | 0.11                  |

SAR estimation=

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})/x}] \text{ W/kg}$ , for test separation distances  $\leq 50 \text{ mm}$ ; where  $x = 7.5$  for 1-g SAR and  $x = 18.75$  for 10-g SAR.

$\Sigma \text{SAR} = 0.07 + 0.11 = 0.18 \text{ W/kg} < 1.6 \text{ W/kg}$

So the SAR test is not necessary.

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**FCC §15.203 - ANTENNA REQUIREMENT**

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**Applicable Standard**

According to § 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 user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
- b. Antenna must use a unique type of connector to attach to the EUT.
- c. Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

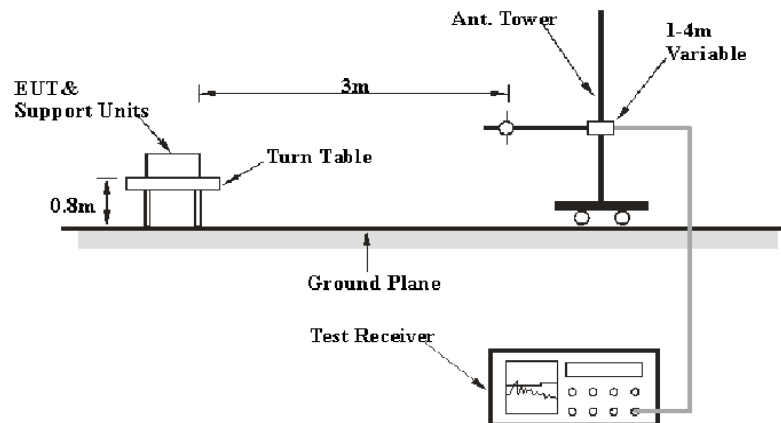
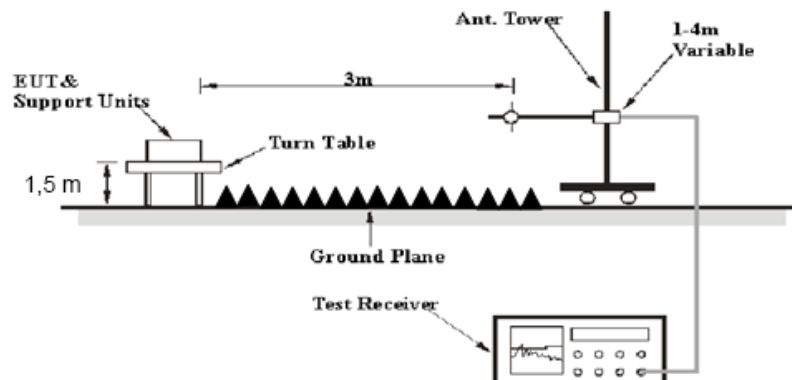
**Antenna Information And Connector Construction**

The EUT has one Chip antenna arrangement for BT, and the antenna gain is -8.9 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

**Result:** Compliance.

**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 tests were performed in the 3 meters chamber test site A for the range 30MHz to 1GHz and the 3 meters chamber B test site for above 1GHz, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

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.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

30MHz-1000MHz:

| Measurement | RBW     | Video B/W | IF B/W |
|-------------|---------|-----------|--------|
| QP          | 120 kHz | 300 kHz   | 120kHz |

Above 1GHz:

| Measurement | Duty cycle | RBW  | Video B/W |
|-------------|------------|------|-----------|
| PK          | Any        | 1MHz | 3 MHz     |
| Ave.        | >98%       | 1MHz | 10 Hz     |
|             | <98%       | 1MHz | 1/T       |

Note: T is minimum transmission duration, eg. For this EUT BLE 1Mbps test: T=2.20ms, 1/T=0.45k, Set VBW=1kHz

If the maximized peak measured value complies with the limit, then it is unnecessary to perform an QP/Average measurement

## Test Procedure

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

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

## Corrected Amplitude & Margin Calculation

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

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

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

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

**Test Equipment List and Details**

| Manufacturer          | Description       | Model                      | Serial Number      | Calibration Date | Calibration Due Date |
|-----------------------|-------------------|----------------------------|--------------------|------------------|----------------------|
| R&S                   | EMI Test Receiver | ESCI                       | 100224             | 2017-12-11       | 2018-12-11           |
| 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-1000-01          | 2018-09-05       | 2019-09-05           |
| HP                    | Amplifier         | 8447D                      | 2727A05902         | 2018-09-05       | 2019-09-05           |
| Agilent               | Spectrum Analyzer | E4440A                     | SG43360054         | 2018-01-04       | 2019-01-04           |
| ETS-Lindgren          | Horn Antenna      | 3115                       | 000 527 35         | 2016-01-05       | 2019-01-04           |
| Ducommun Technologies | Horn Antenna      | ARH-4223-02                | 1007726-01<br>1304 | 2016-11-18       | 2019-11-18           |
| Unknown               | Coaxial Cable     | C-SJSJ-50                  | C-0800-01          | 2018-09-05       | 2019-09-05           |
| Unknown               | Coaxial Cable     | C-2.4J2.4J-50              | C-0700-02          | 2018-06-27       | 2019-06-27           |
| MITEQ                 | Amplifier         | AFS42-00101800-<br>25-S-42 | 2001271            | 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-<br>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).

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

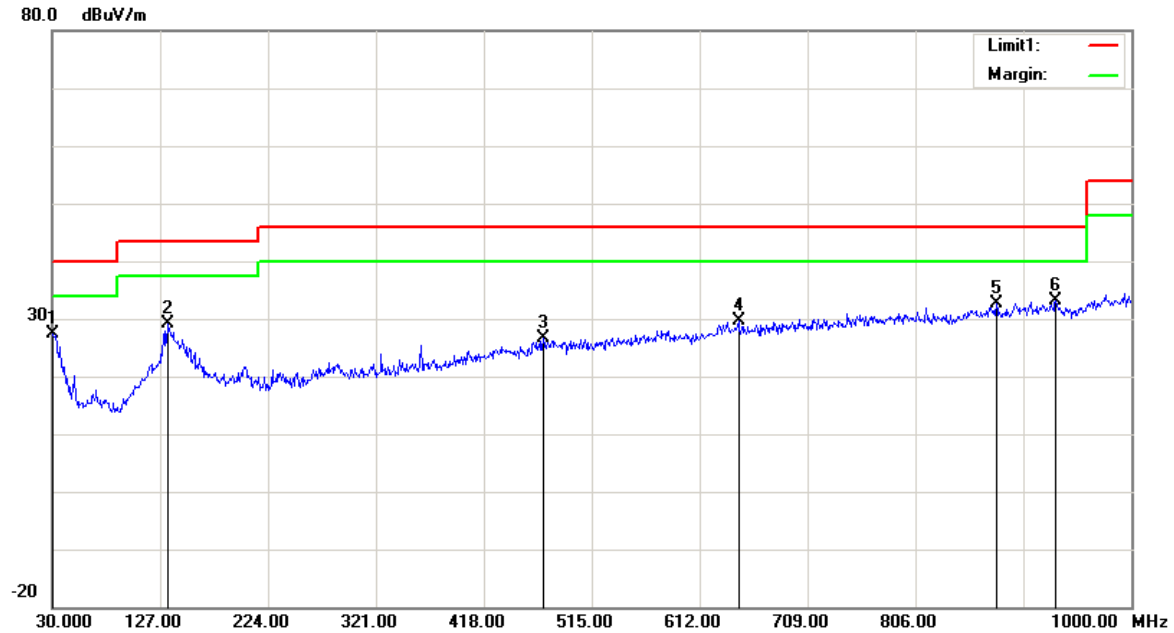
|                           |                |
|---------------------------|----------------|
| <b>Temperature:</b>       | 23~27°C        |
| <b>Relative Humidity:</b> | 43~44%         |
| <b>ATM Pressure:</b>      | 99.8~100.5 kPa |

\* The testing was performed by Neil Liao & Kami Zhou on 2018-12-06 and 2018-12-10.

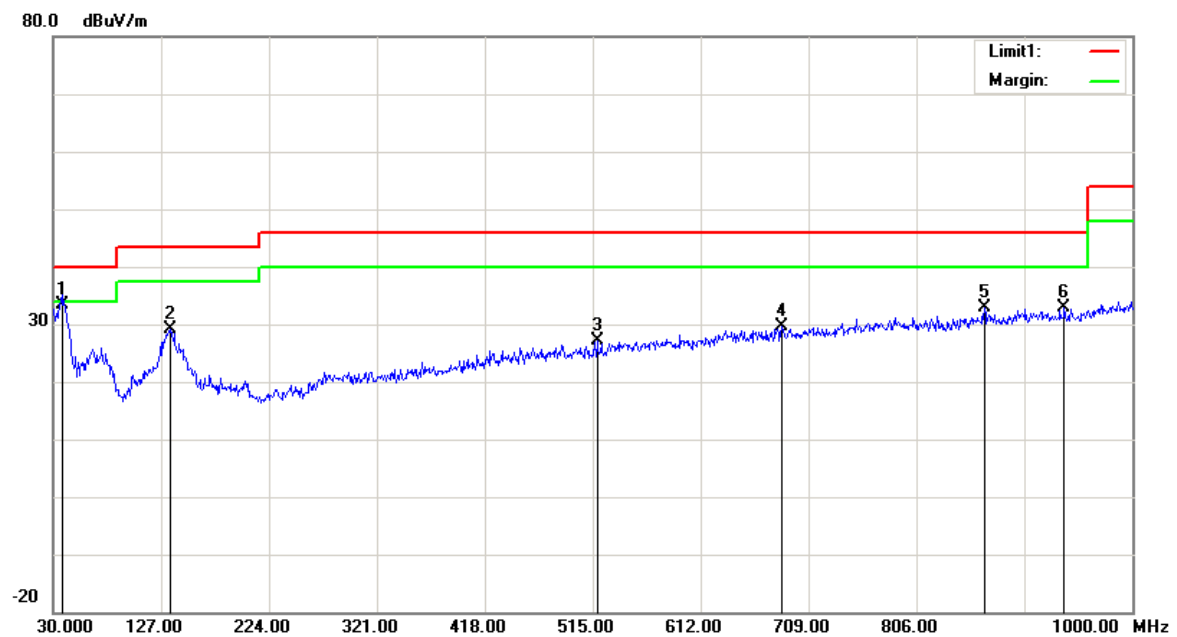
Test Mode: Transmitting

1) 30MHz-1GHz (2M High Channel was the worst):

Horizontal:



| Frequency (MHz) | Receiver Reading (dBuV) | Detector | Correction Factor (dB/m) | Cord. Amp. (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|-----------------|-------------------------|----------|--------------------------|---------------------|----------------|-------------|
| 30.9700         | 26.52                   | peak     | 0.95                     | 27.47               | 40.00          | 12.53       |
| 133.7900        | 34.14                   | peak     | -5.05                    | 29.09               | 43.50          | 14.41       |
| 471.3500        | 27.16                   | peak     | -0.41                    | 26.75               | 46.00          | 19.25       |
| 646.9200        | 27.40                   | peak     | 2.19                     | 29.59               | 46.00          | 16.41       |
| 878.7500        | 36.99                   | peak     | -4.29                    | 32.70               | 46.00          | 13.30       |
| 932.1000        | 36.49                   | peak     | -3.47                    | 33.02               | 46.00          | 12.98       |

**Vertical:**

| Frequency (MHz) | Receiver Reading (dBuV) | Detector | Correction Factor (dB/m) | Cord. Amp. (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|-----------------|-------------------------|----------|--------------------------|---------------------|----------------|-------------|
| 38.7300         | 38.33                   | QP       | -4.90                    | 33.43               | 40.00          | 6.57        |
| 135.7300        | 34.29                   | peak     | -5.14                    | 29.15               | 43.50          | 14.35       |
| 518.8800        | 27.00                   | peak     | 0.06                     | 27.06               | 46.00          | 18.94       |
| 684.7500        | 26.99                   | peak     | 2.67                     | 29.66               | 46.00          | 16.34       |
| 867.1100        | 31.12                   | peak     | 1.67                     | 32.79               | 46.00          | 13.21       |
| 938.8900        | 36.30                   | peak     | -3.42                    | 32.88               | 46.00          | 13.12       |

**2) 1-25GHz:**

1Mbps

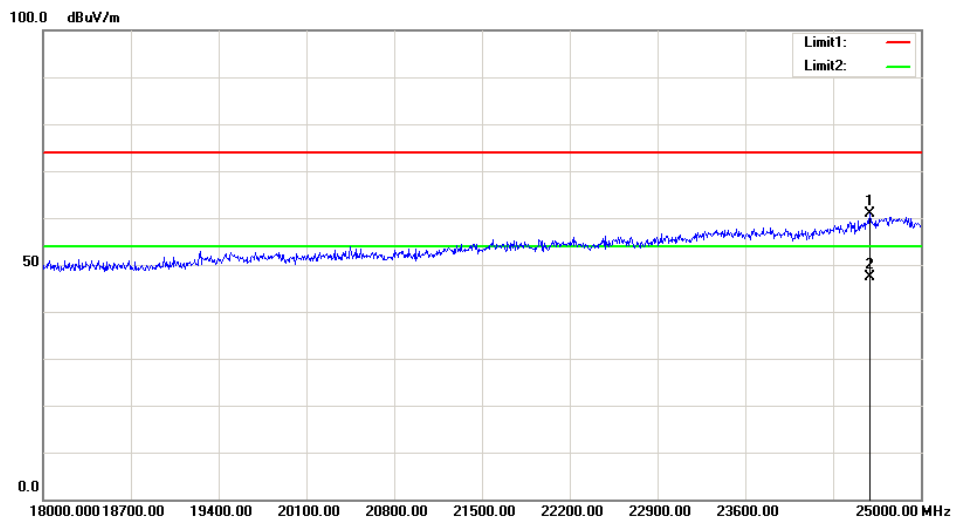
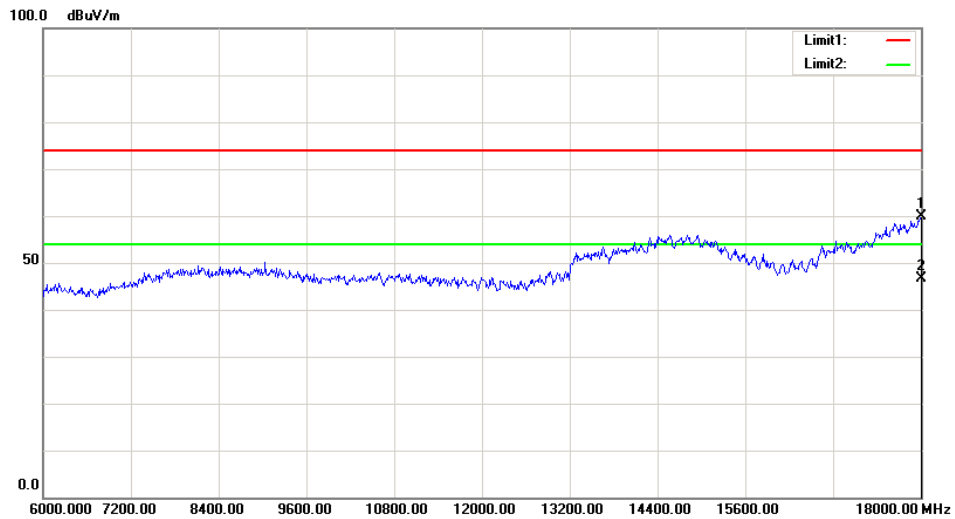
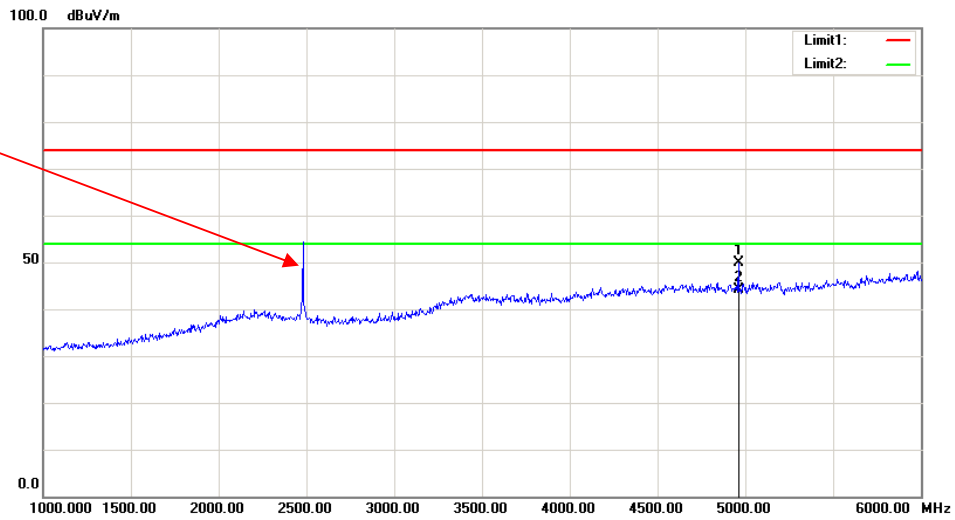
| Frequency<br>(MHz)       | Receiver          |                        | Rx Antenna     |                  | Cable<br>loss<br>(dB) | Amplifier<br>Gain<br>(dB) | Corrected<br>Amplitude<br>(dBμV/m) | Limit<br>(dBμV/m) | Margin<br>(dB) |
|--------------------------|-------------------|------------------------|----------------|------------------|-----------------------|---------------------------|------------------------------------|-------------------|----------------|
|                          | Reading<br>(dBμV) | Detector<br>(PK/QP/AV) | Polar<br>(H/V) | Factor<br>(dB/m) |                       |                           |                                    |                   |                |
| Low Channel: 2402 MHz    |                   |                        |                |                  |                       |                           |                                    |                   |                |
| 2402.00                  | 52.45             | PK                     | H              | 28.10            | 1.80                  | 0.00                      | 82.35                              | N/A               | N/A            |
| 2402.00                  | 50.64             | AV                     | H              | 28.10            | 1.80                  | 0.00                      | 80.54                              | N/A               | N/A            |
| 2402.00                  | 54.61             | PK                     | V              | 28.10            | 1.80                  | 0.00                      | 84.51                              | N/A               | N/A            |
| 2402.00                  | 52.39             | AV                     | V              | 28.10            | 1.80                  | 0.00                      | 82.29                              | N/A               | N/A            |
| 2390.00                  | 26.81             | PK                     | V              | 28.08            | 1.80                  | 0.00                      | 56.69                              | 74.00             | 17.31          |
| 2390.00                  | 13.26             | AV                     | V              | 28.08            | 1.80                  | 0.00                      | 43.14                              | 54.00             | 10.86          |
| 4804.00                  | 51.89             | PK                     | V              | 32.91            | 3.17                  | 37.20                     | 50.77                              | 74.00             | 23.23          |
| 4804.00                  | 46.25             | AV                     | V              | 32.91            | 3.17                  | 37.20                     | 45.13                              | 54.00             | 8.87           |
| 7206.00                  | 46.11             | PK                     | V              | 35.74            | 4.82                  | 37.23                     | 49.44                              | 74.00             | 24.56          |
| 7206.00                  | 33.74             | AV                     | V              | 35.74            | 4.82                  | 37.23                     | 37.07                              | 54.00             | 16.93          |
| Middle Channel: 2440 MHz |                   |                        |                |                  |                       |                           |                                    |                   |                |
| 2440.00                  | 53.84             | PK                     | H              | 28.18            | 1.82                  | 0.00                      | 83.84                              | N/A               | N/A            |
| 2440.00                  | 51.46             | AV                     | H              | 28.18            | 1.82                  | 0.00                      | 81.46                              | N/A               | N/A            |
| 2440.00                  | 55.60             | PK                     | V              | 28.18            | 1.82                  | 0.00                      | 85.60                              | N/A               | N/A            |
| 2440.00                  | 53.16             | AV                     | V              | 28.18            | 1.82                  | 0.00                      | 83.16                              | N/A               | N/A            |
| 4880.00                  | 53.78             | PK                     | V              | 33.06            | 3.27                  | 37.21                     | 52.90                              | 74.00             | 21.10          |
| 4880.00                  | 49.56             | AV                     | V              | 33.06            | 3.27                  | 37.21                     | 48.68                              | 54.00             | 5.32           |
| 7320.00                  | 46.02             | PK                     | V              | 36.03            | 4.62                  | 37.37                     | 49.30                              | 74.00             | 24.70          |
| 7320.00                  | 33.42             | AV                     | V              | 36.03            | 4.62                  | 37.37                     | 36.70                              | 54.00             | 17.30          |
| High Channel: 2480 MHz   |                   |                        |                |                  |                       |                           |                                    |                   |                |
| 2480.00                  | 55.56             | PK                     | H              | 28.26            | 1.84                  | 0.00                      | 85.66                              | N/A               | N/A            |
| 2480.00                  | 53.61             | AV                     | H              | 28.26            | 1.84                  | 0.00                      | 83.71                              | N/A               | N/A            |
| 2480.00                  | 57.48             | PK                     | V              | 28.26            | 1.84                  | 0.00                      | 87.58                              | N/A               | N/A            |
| 2480.00                  | 55.12             | AV                     | V              | 28.26            | 1.84                  | 0.00                      | 85.22                              | N/A               | N/A            |
| 2483.50                  | 26.52             | PK                     | V              | 28.27            | 1.84                  | 0.00                      | 56.63                              | 74.00             | 17.37          |
| 2483.50                  | 13.45             | AV                     | V              | 28.27            | 1.84                  | 0.00                      | 43.56                              | 54.00             | 10.44          |
| 4960.00                  | 56.18             | PK                     | V              | 33.22            | 3.23                  | 37.25                     | 55.38                              | 74.00             | 18.62          |
| 4960.00                  | 50.28             | AV                     | V              | 33.22            | 3.23                  | 37.25                     | 49.48                              | 54.00             | 4.52           |
| 7440.00                  | 46.45             | PK                     | V              | 36.34            | 4.41                  | 37.52                     | 49.68                              | 74.00             | 24.32          |
| 7440.00                  | 33.61             | AV                     | V              | 36.34            | 4.41                  | 37.52                     | 36.84                              | 54.00             | 17.16          |

2Mbps:

| 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) | Detector<br>(PK/QP/AV) | Polar<br>(H/V) | Factor<br>(dB/m) |                       |                           |                                    |                   |                |
| Low Channel: 2402 MHz    |                   |                        |                |                  |                       |                           |                                    |                   |                |
| 2402.00                  | 54.16             | PK                     | H              | 28.10            | 1.80                  | 0.00                      | 84.06                              | N/A               | N/A            |
| 2402.00                  | 50.24             | AV                     | H              | 28.10            | 1.80                  | 0.00                      | 80.14                              | N/A               | N/A            |
| 2402.00                  | 56.84             | PK                     | V              | 28.10            | 1.80                  | 0.00                      | 86.74                              | N/A               | N/A            |
| 2402.00                  | 51.62             | AV                     | V              | 28.10            | 1.80                  | 0.00                      | 81.52                              | N/A               | N/A            |
| 2390.00                  | 26.35             | PK                     | V              | 28.08            | 1.80                  | 0.00                      | 56.23                              | 74.00             | 17.77          |
| 2390.00                  | 13.42             | AV                     | V              | 28.08            | 1.80                  | 0.00                      | 43.30                              | 54.00             | 10.70          |
| 4804.00                  | 55.05             | PK                     | V              | 32.91            | 3.17                  | 37.20                     | 53.93                              | 74.00             | 20.07          |
| 4804.00                  | 46.53             | AV                     | V              | 32.91            | 3.17                  | 37.20                     | 45.41                              | 54.00             | 8.59           |
| 7206.00                  | 46.26             | PK                     | V              | 35.74            | 4.82                  | 37.23                     | 49.59                              | 74.00             | 24.41          |
| 7206.00                  | 33.19             | AV                     | V              | 35.74            | 4.82                  | 37.23                     | 36.52                              | 54.00             | 17.48          |
| Middle Channel: 2440 MHz |                   |                        |                |                  |                       |                           |                                    |                   |                |
| 2440.00                  | 54.16             | PK                     | H              | 28.18            | 1.82                  | 0.00                      | 84.16                              | N/A               | N/A            |
| 2440.00                  | 49.51             | AV                     | H              | 28.18            | 1.82                  | 0.00                      | 79.51                              | N/A               | N/A            |
| 2440.00                  | 57.45             | PK                     | V              | 28.18            | 1.82                  | 0.00                      | 87.45                              | N/A               | N/A            |
| 2440.00                  | 52.36             | AV                     | V              | 28.18            | 1.82                  | 0.00                      | 82.36                              | N/A               | N/A            |
| 4880.00                  | 55.61             | PK                     | V              | 33.06            | 3.27                  | 37.21                     | 54.73                              | 74.00             | 19.27          |
| 4880.00                  | 45.69             | AV                     | V              | 33.06            | 3.27                  | 37.21                     | 44.81                              | 54.00             | 9.19           |
| 7320.00                  | 45.81             | PK                     | V              | 36.03            | 4.62                  | 37.37                     | 49.09                              | 74.00             | 24.91          |
| 7320.00                  | 32.56             | AV                     | V              | 36.03            | 4.62                  | 37.37                     | 35.84                              | 54.00             | 18.16          |
| High Channel: 2480 MHz   |                   |                        |                |                  |                       |                           |                                    |                   |                |
| 2480.00                  | 55.40             | PK                     | H              | 28.26            | 1.84                  | 0.00                      | 85.50                              | N/A               | N/A            |
| 2480.00                  | 50.16             | AV                     | H              | 28.26            | 1.84                  | 0.00                      | 80.26                              | N/A               | N/A            |
| 2480.00                  | 59.25             | PK                     | V              | 28.26            | 1.84                  | 0.00                      | 89.35                              | N/A               | N/A            |
| 2480.00                  | 54.16             | AV                     | V              | 28.26            | 1.84                  | 0.00                      | 84.26                              | N/A               | N/A            |
| 2483.50                  | 26.05             | PK                     | V              | 28.27            | 1.84                  | 0.00                      | 56.16                              | 74.00             | 17.84          |
| 2483.50                  | 13.74             | AV                     | V              | 28.27            | 1.84                  | 0.00                      | 43.85                              | 54.00             | 10.15          |
| 4960.00                  | 57.34             | PK                     | V              | 33.22            | 3.23                  | 37.25                     | 56.54                              | 74.00             | 17.46          |
| 4960.00                  | 47.52             | AV                     | V              | 33.22            | 3.23                  | 37.25                     | 46.72                              | 54.00             | 7.28           |
| 7440.00                  | 46.16             | PK                     | V              | 36.34            | 4.41                  | 37.52                     | 49.39                              | 74.00             | 24.61          |
| 7440.00                  | 33.64             | AV                     | V              | 36.34            | 4.41                  | 37.52                     | 36.87                              | 54.00             | 17.13          |

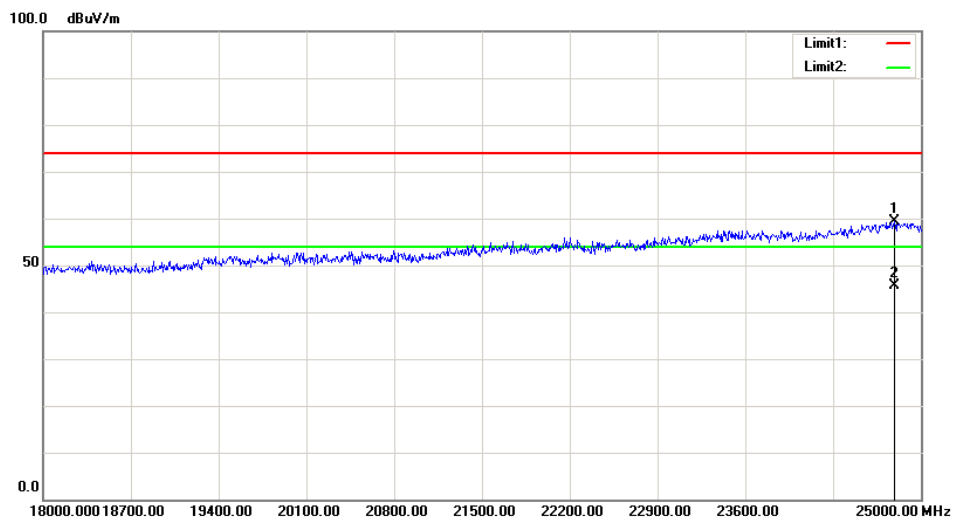
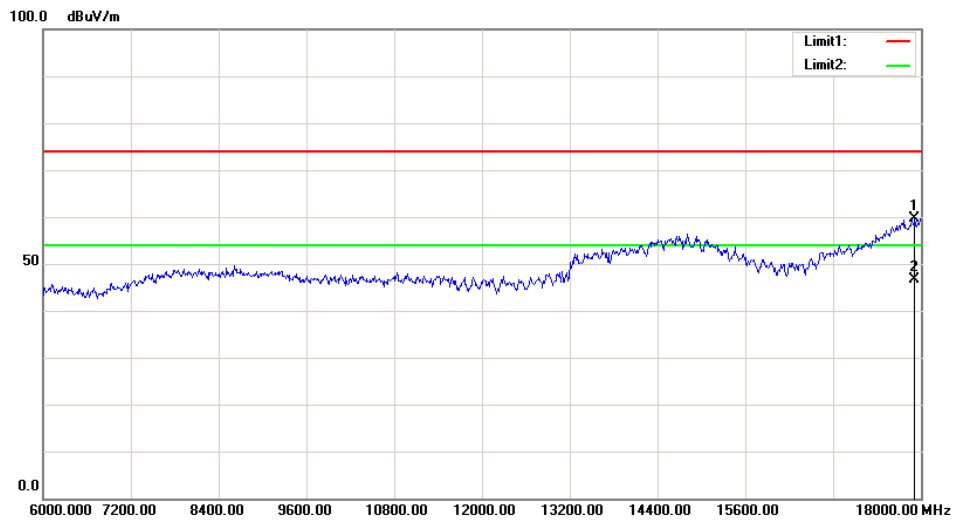
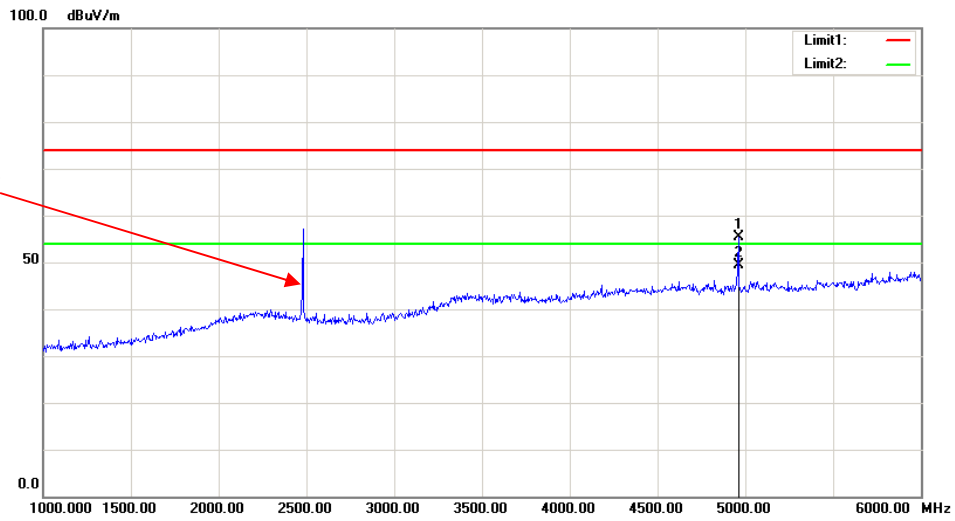
# **Worst plots (1Mbps High Channel)** **Horizontal**

Fundamental  
Test with Band  
Rejection Filter



Vertical

Fundamental  
Test with Band  
Rejection Filter



## FCC §15.247(a) (2) –6 dB EMISSION BANDWIDTH

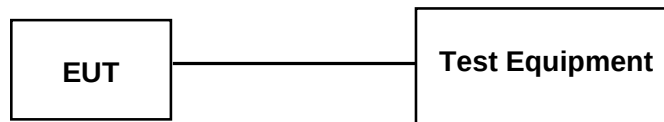
### Applicable Standard

According to FCC §15.247(a) (2)

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### Test Procedure

- Set RBW = 100 kHz.
- Set the video bandwidth (VBW)  $\geq 3 \times \text{RBW}$ .
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.



### Test Equipment List and Details

| Manufacturer | Description       | Model       | Serial Number | Calibration Date | Calibration Due Date |
|--------------|-------------------|-------------|---------------|------------------|----------------------|
| R&S          | EMI Test Receiver | ESCI        | 101121        | 2018-03-23       | 2019-03-23           |
| 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:       | 24.1 °C  |
| Relative Humidity: | 40 %     |
| ATM Pressure:      | 99.8 kPa |

\* The testing was performed by Elena Lei on 2018-12-15.

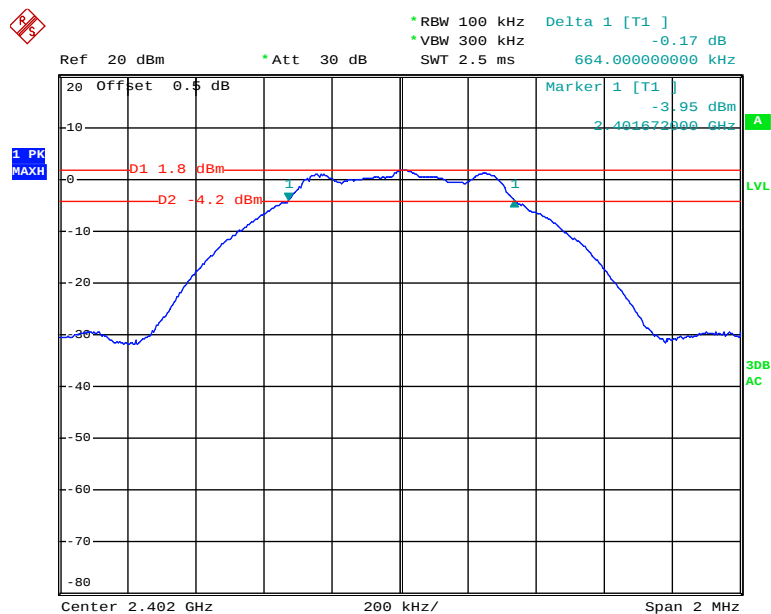
Test Mode: Transmitting

Test Result: Compliance. Please refer to the following table and plots.

| Mode        | Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Limit (MHz) |
|-------------|---------|-----------------|----------------------|-------------|
| BLE (1Mbps) | Low     | 2402            | 0.664                | $\geq 0.5$  |
|             | Middle  | 2440            | 0.664                | $\geq 0.5$  |
|             | High    | 2480            | 0.668                | $\geq 0.5$  |
| BLE (2Mbps) | Low     | 2402            | 1.144                | $\geq 0.5$  |
|             | Middle  | 2440            | 1.168                | $\geq 0.5$  |
|             | High    | 2480            | 1.160                | $\geq 0.5$  |

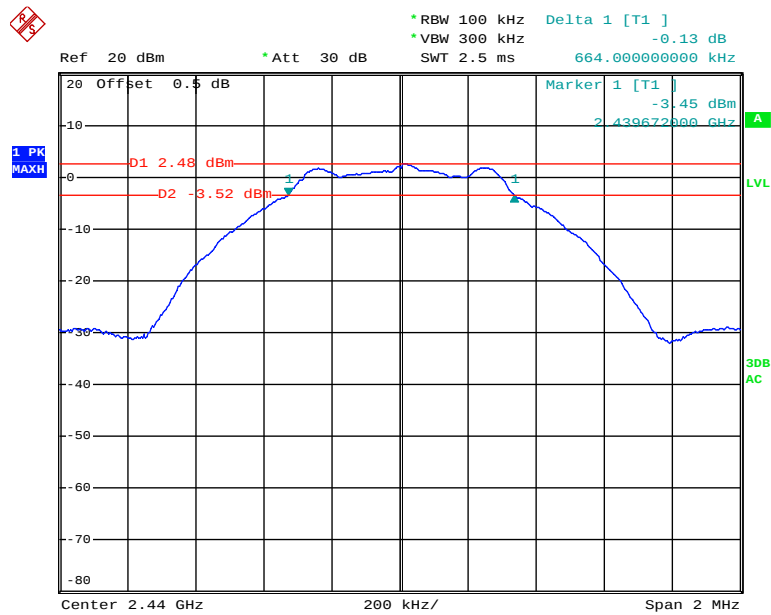
1Mbps

### Low Channel



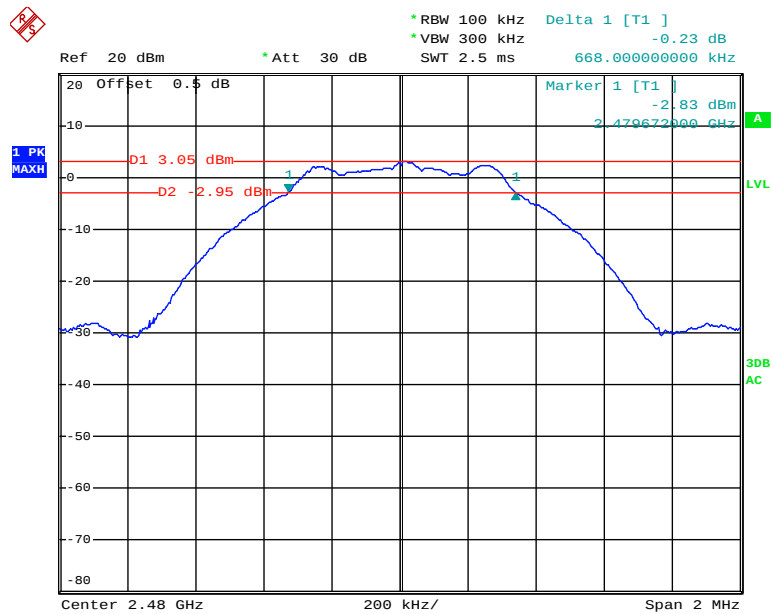
Date: 15.DEC.2018 15:52:16

## Middle Channel



Date: 15.DEC.2018 15:51:01

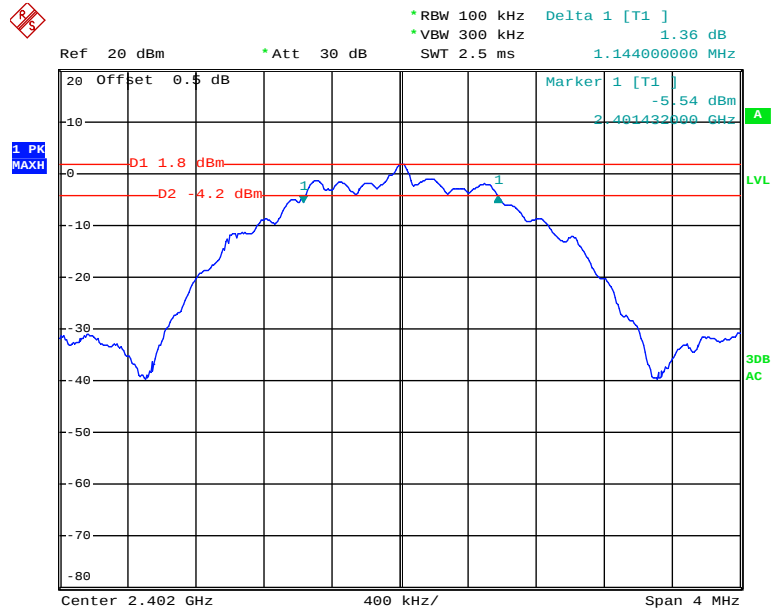
## High Channel



Date: 15.DEC.2018 15:54:02

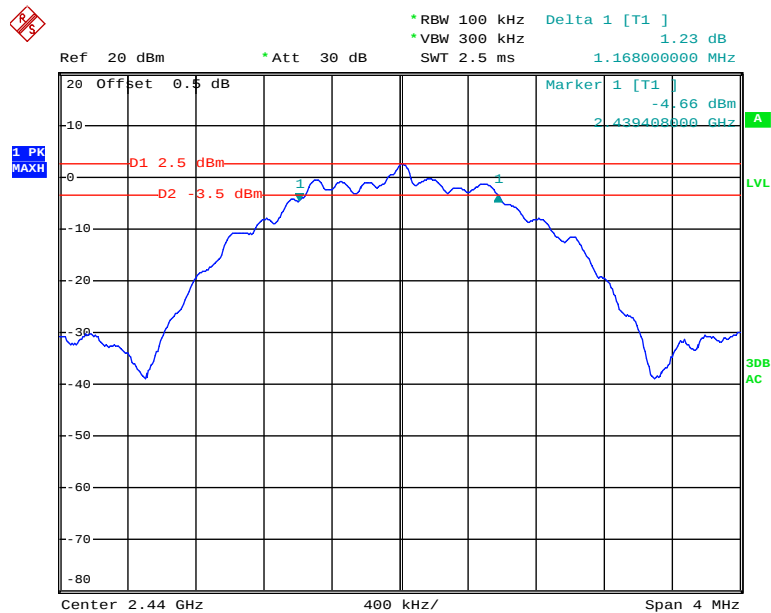
2Mbps:

### Low Channel



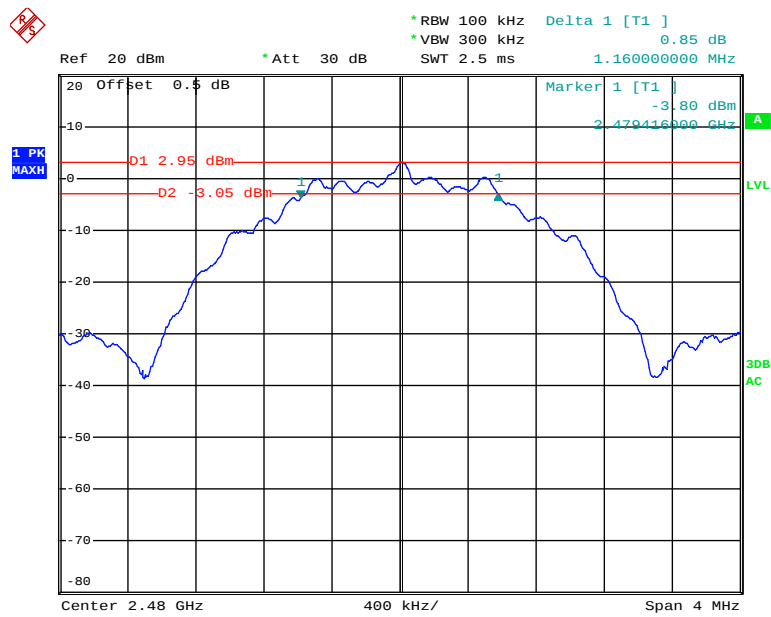
Date: 15.DEC.2018 16:07:24

### Middle Channel



Date: 15.DEC.2018 16:08:20

## High Channel



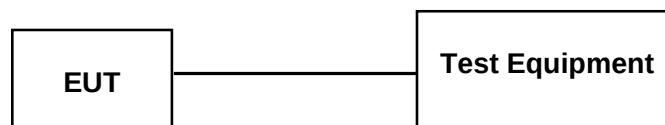
Date: 15.DEC.2018 16:06:14

**FCC §15.247(b) (3) - MAXIMUM PEAK CONDUCTED OUTPUT POWER****Applicable Standard**

According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

**Test Procedure**

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to test equipment.
3. Add a correction factor to the display.
4. Set the power Meter to test Peak output power, record the result as peak power.
5. Set the power meter to test average output power, record the result as average power.

**Test Equipment List and Details**

| Manufacturer | Description       | Model       | Serial Number | Calibration Date | Calibration Due Date |
|--------------|-------------------|-------------|---------------|------------------|----------------------|
| R&S          | EMI Test Receiver | ESCI        | 101121        | 2018-03-23       | 2019-03-23           |
| 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:       | 24.1 °C  |
| Relative Humidity: | 40 %     |
| ATM Pressure:      | 99.8 kPa |

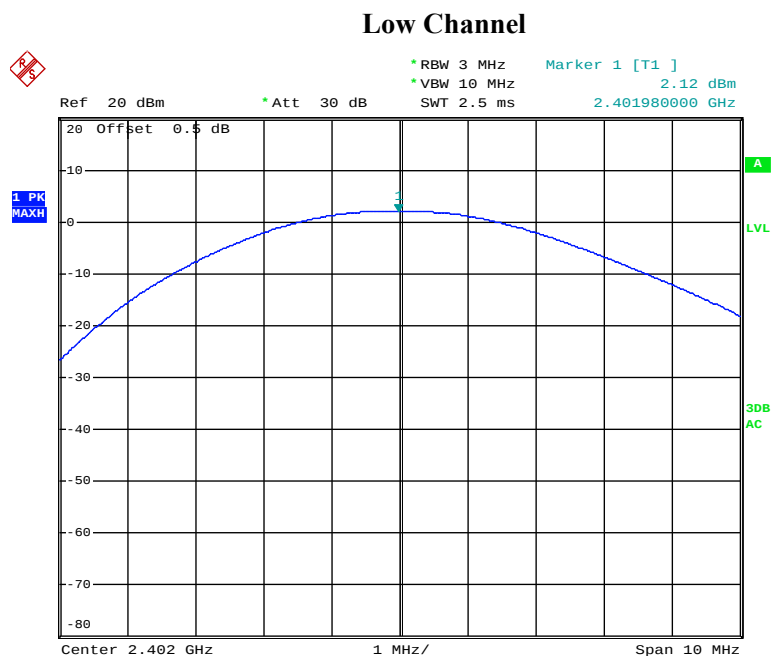
\* The testing was performed by Elena Lei on 2018-12-15.

Test Mode: Transmitting

Test Result: Compliance. Please refer to the following table.

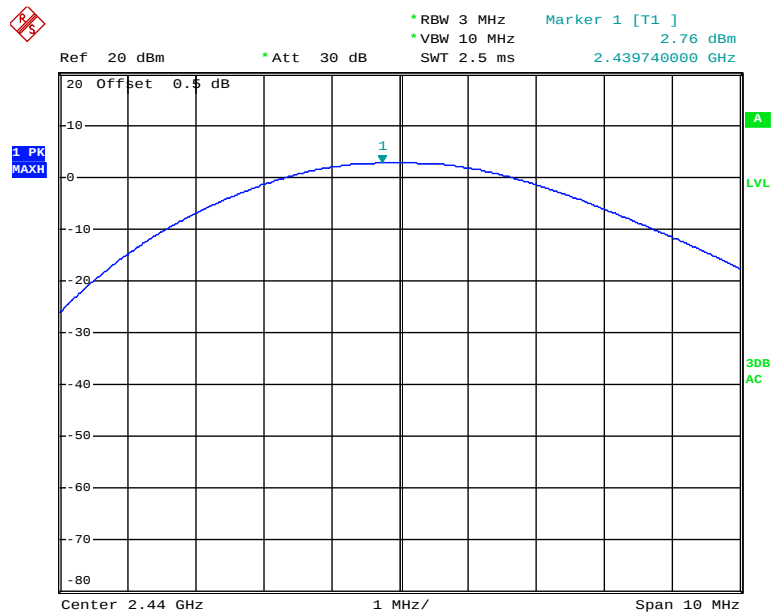
| Mode        | Channel | Frequency (MHz) | Max Peak Conducted Output Power (dBm) | Limit (dBm) |
|-------------|---------|-----------------|---------------------------------------|-------------|
| BLE (1Mbps) | Low     | 2402            | 2.12                                  | 30          |
|             | Middle  | 2440            | 2.76                                  | 30          |
|             | High    | 2480            | 3.27                                  | 30          |
| BLE (2Mbps) | Low     | 2402            | 2.27                                  | 30          |
|             | Middle  | 2440            | 2.91                                  | 30          |
|             | High    | 2480            | 3.43                                  | 30          |

1Mbps:



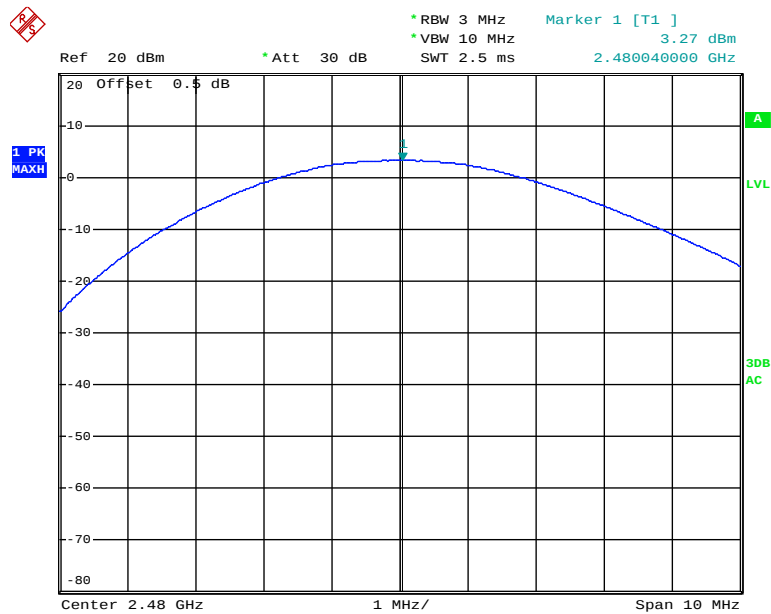
Date: 15.DEC.2018 15:52:42

### Middle Channel



Date: 15.DEC.2018 15:51:30

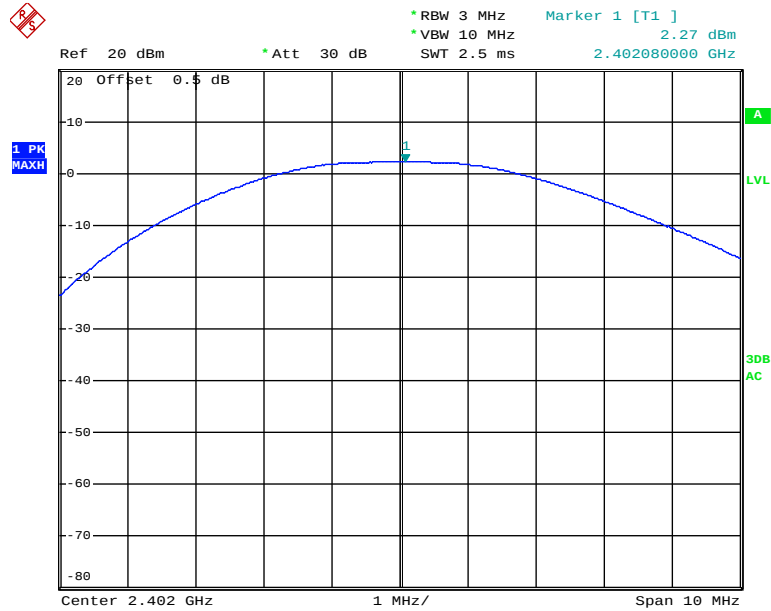
### High Channel



Date: 15.DEC.2018 15:54:28

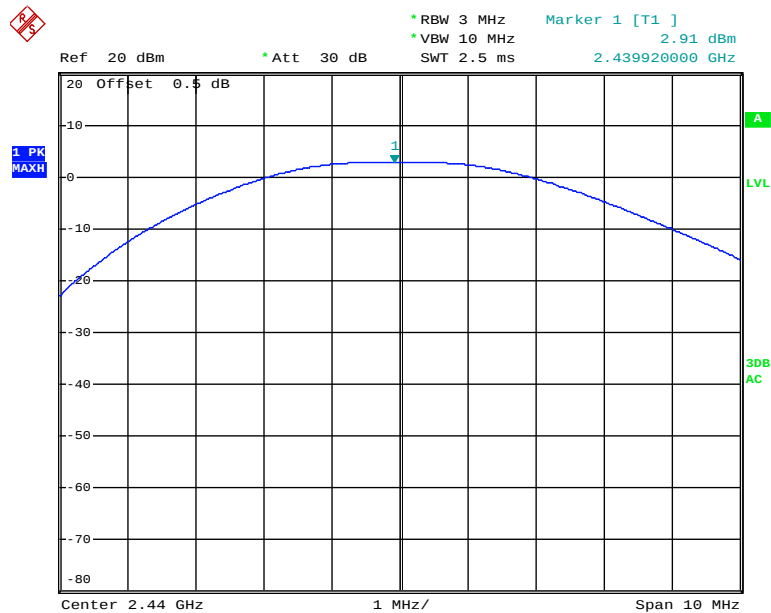
2Mbps

### Low Channel



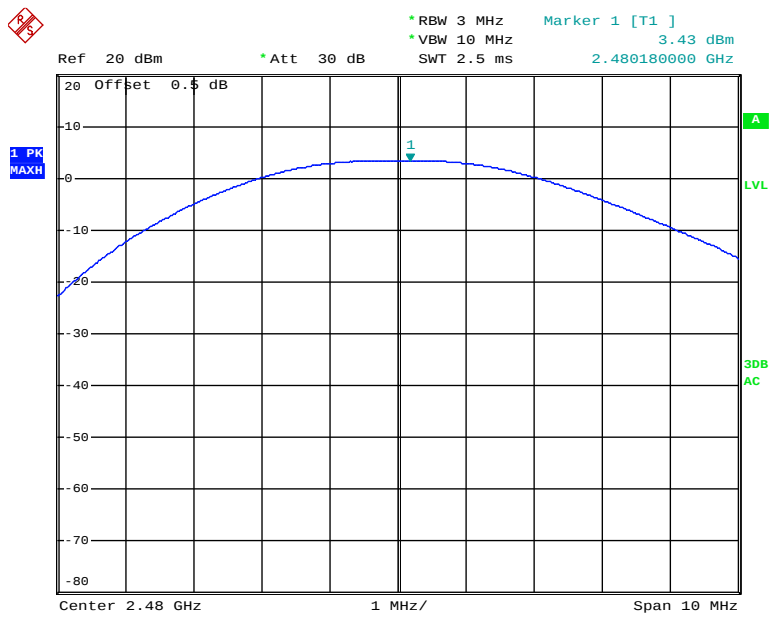
Date: 15.DEC.2018 16:04:42

### Middle Channel



Date: 15.DEC.2018 16:03:53

### High Channel



Date: 15.DEC.2018 16:05:08

## FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

### Applicable Standard

According to FCC§15.247(d): 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. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

### Test Equipment List and Details

| Manufacturer | Description       | Model       | Serial Number | Calibration Date | Calibration Due Date |
|--------------|-------------------|-------------|---------------|------------------|----------------------|
| R&S          | EMI Test Receiver | ESCI        | 101121        | 2018-03-23       | 2019-03-23           |
| 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:       | 24.1 °C  |
| Relative Humidity: | 40 %     |
| ATM Pressure:      | 99.8 kPa |

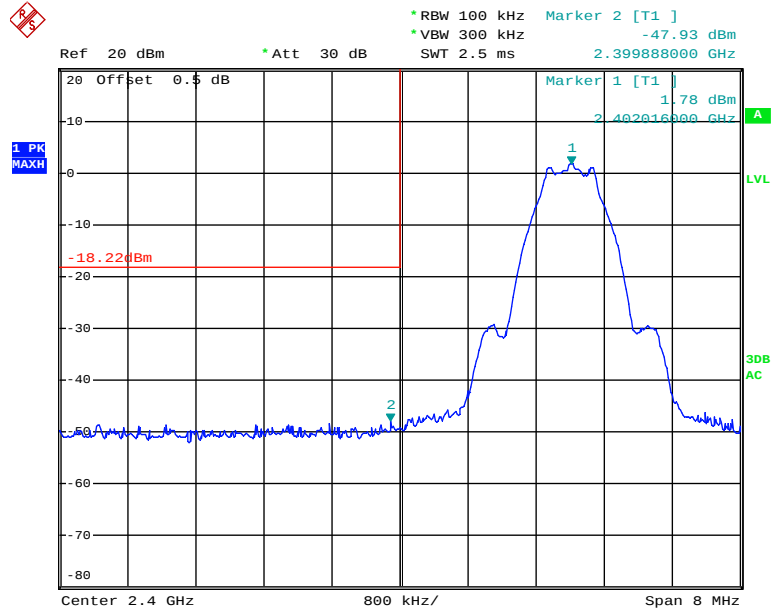
\* The testing was performed by Elena Lei on 2018-12-15.

Test mode: Transmitting

Test Result: Compliance. Please refer to following plots.

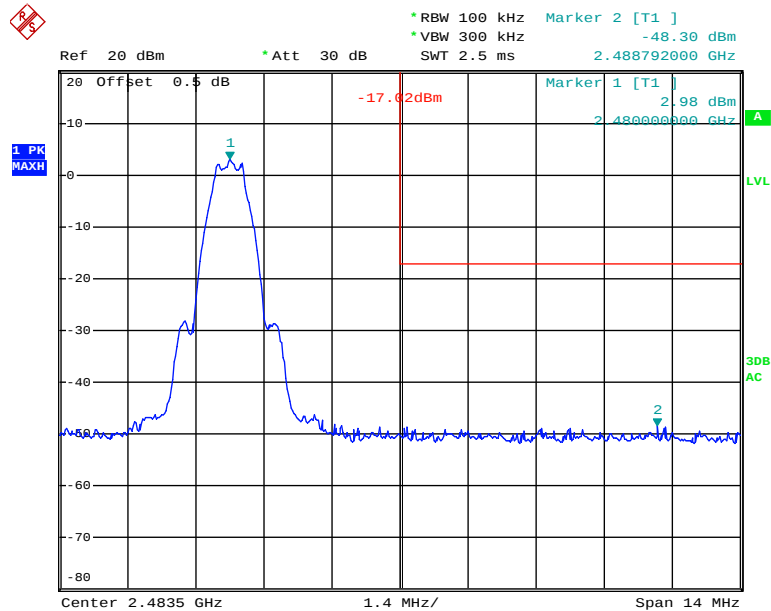
1Mbps

### Band Edge, Left Side



Date: 15.DEC.2018 15:53:29

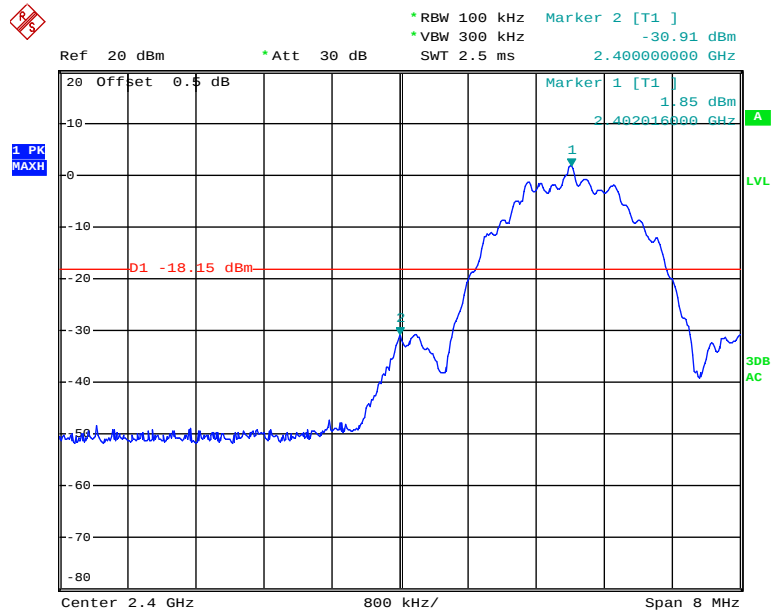
### Band Edge, Right Side



Date: 15.DEC.2018 15:55:03

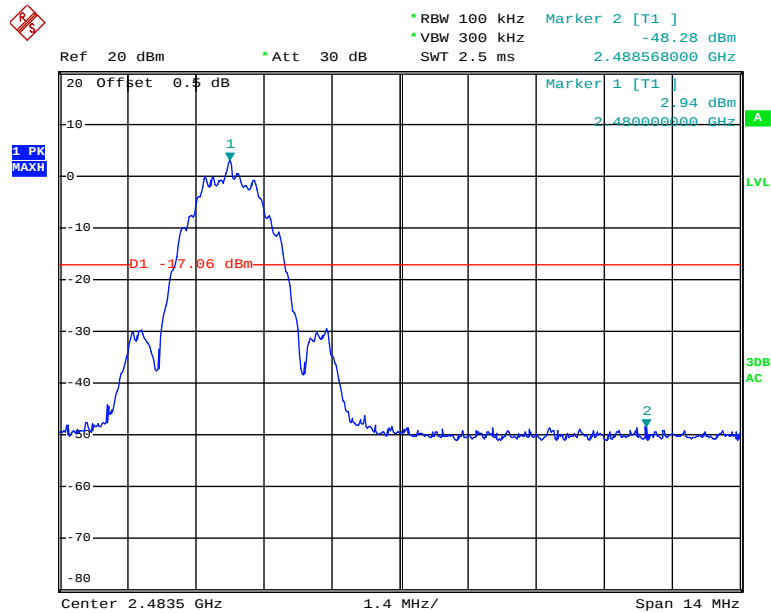
2Mbps

### Band Edge, Left Side



Date: 15.DEC.2018 16:23:30

### Band Edge, Right Side



Date: 15.DEC.2018 16:22:32

**FCC §15.247(e) - POWER SPECTRAL DENSITY****Applicable Standard**

According to FCC§15.247(e):For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

**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 was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set the RBW = 3 kHz, VBW = 10 kHz, Set the span to 1.5 times the DTS bandwidth.
4. Use the peak marker function to determine the maximum amplitude level.

**Test Equipment List and Details**

| Manufacturer | Description       | Model       | Serial Number | Calibration Date | Calibration Due Date |
|--------------|-------------------|-------------|---------------|------------------|----------------------|
| R&S          | EMI Test Receiver | ESCI        | 101121        | 2018-03-23       | 2019-03-23           |
| 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:       | 24.1 °C  |
| Relative Humidity: | 40 %     |
| ATM Pressure:      | 99.8 kPa |

\* The testing was performed by Elena Lei on 2018-12-15.

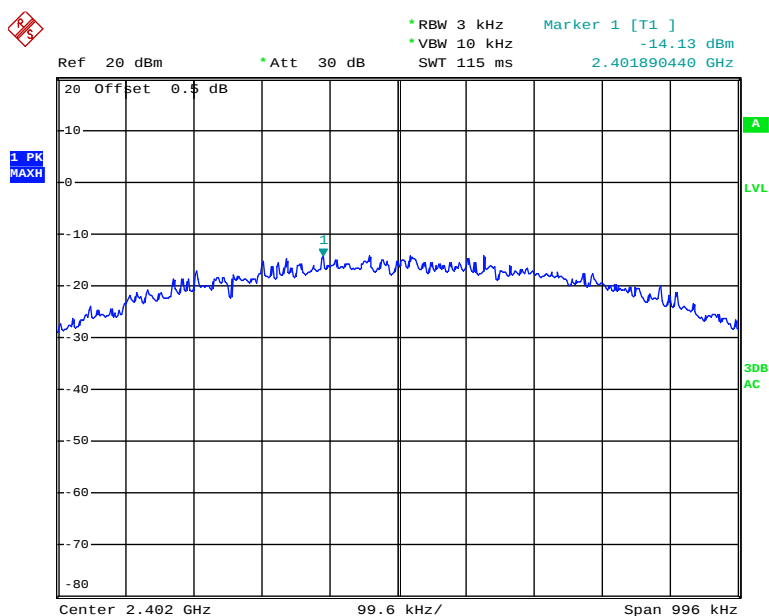
Test Mode: Transmitting

Test Result: Compliance. Please refer to the following table and plots

| Mode        | Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) |
|-------------|---------|-----------------|----------------|------------------|
| BLE (1Mbps) | Low     | 2402            | -14.13         | ≤8               |
|             | Middle  | 2440            | -12.80         | ≤8               |
|             | High    | 2480            | -13.27         | ≤8               |
| BLE (2Mbps) | Low     | 2402            | -15.38         | ≤8               |
|             | Middle  | 2440            | -14.04         | ≤8               |
|             | High    | 2480            | -15.20         | ≤8               |

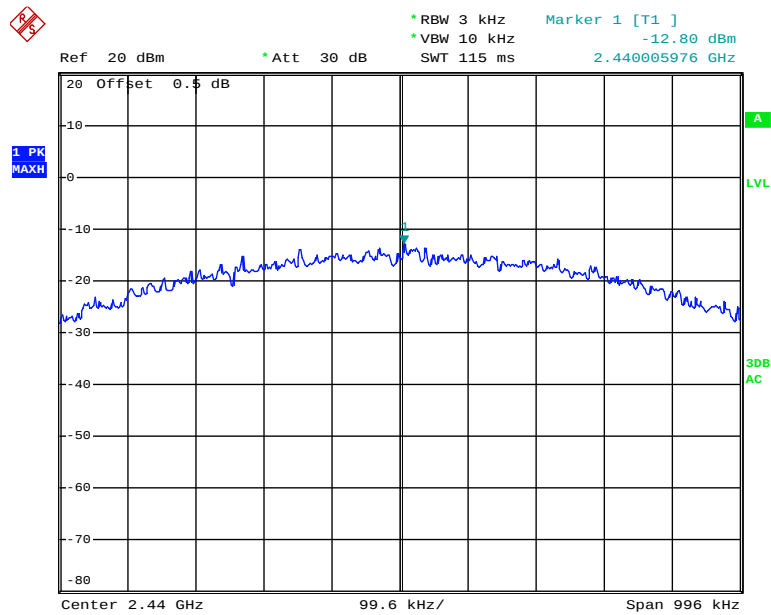
1Mbps

### Power Spectral Density, Low Channel



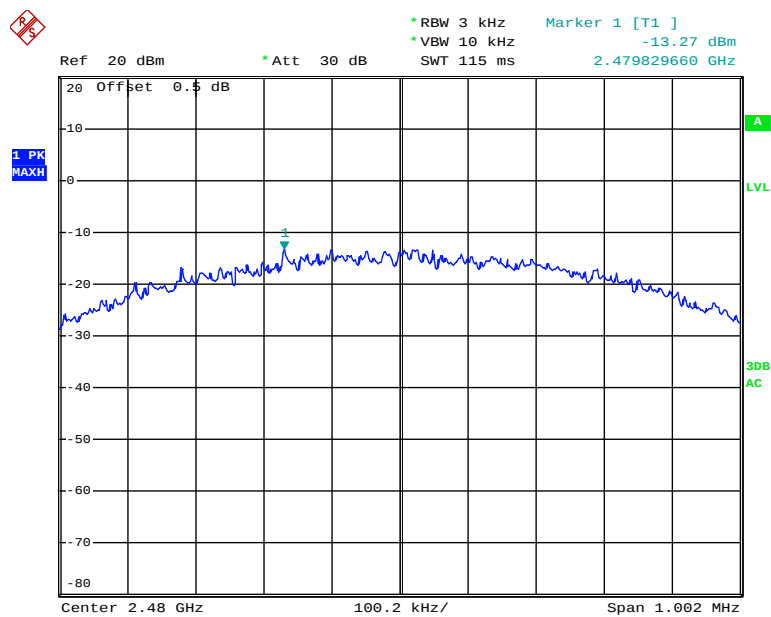
Date: 15.DEC.2018 15:52:54

### Power Spectral Density, Middle Channel



Date: 15.DEC.2018 15:51:43

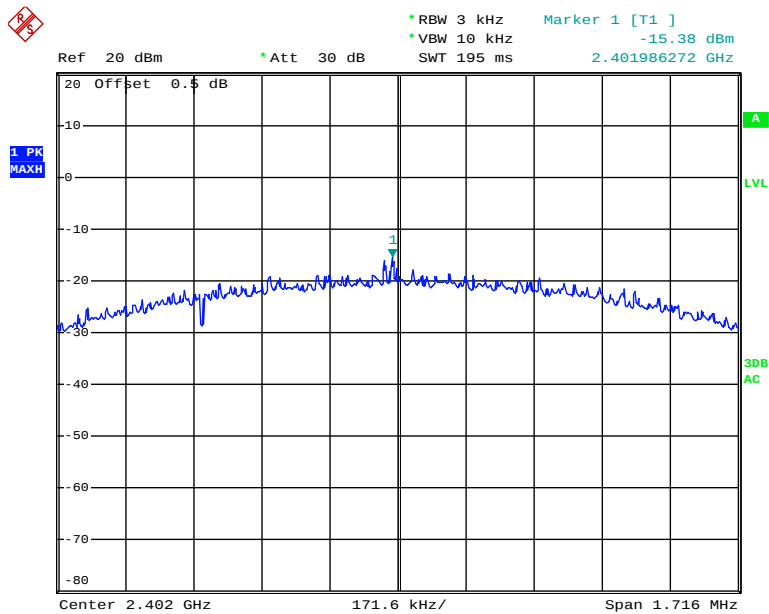
### Power Spectral Density, High Channel



Date: 15.DEC.2018 15:54:40

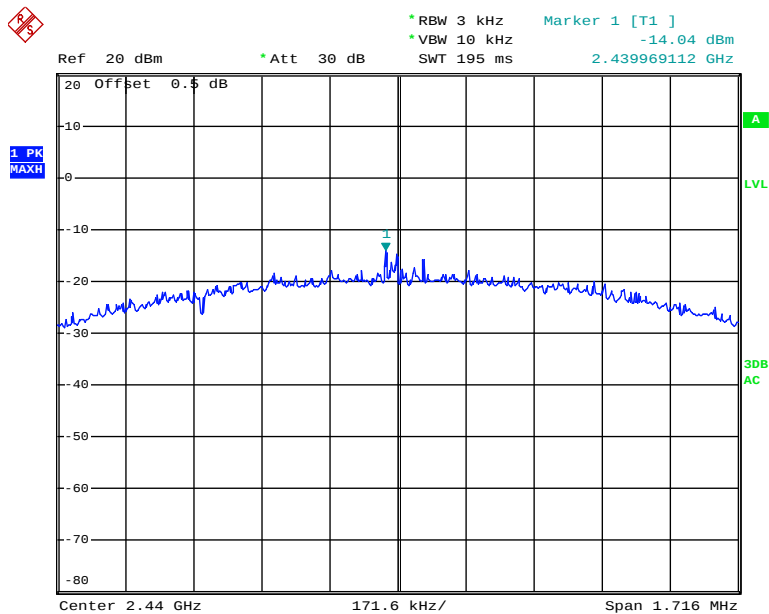
2Mbps

### Power Spectral Density, Low Channel



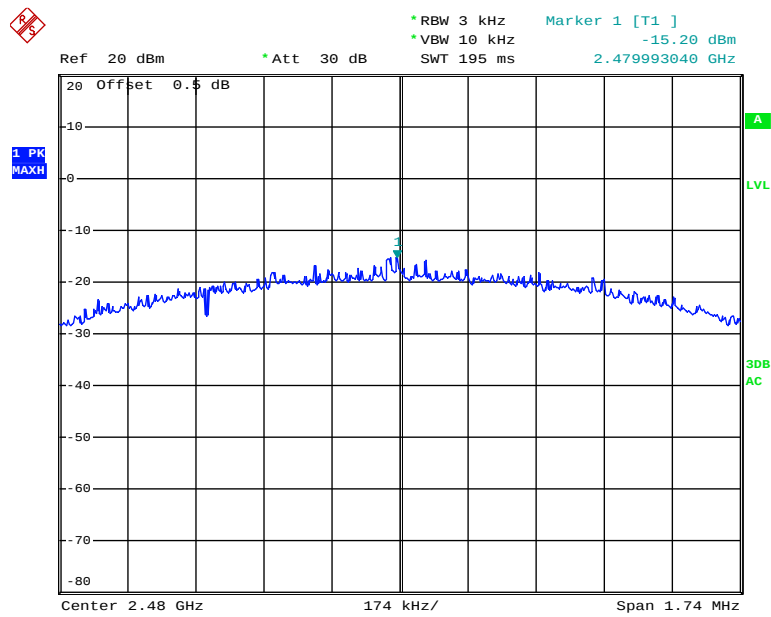
Date: 15.DEC.2018 16:28:14

### Power Spectral Density, Middle Channel



Date: 15.DEC.2018 16:28:54

### Power Spectral Density, High Channel



Date: 15.DEC.2018 16:27:19

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