



TESTING LABORATORY  
CERTIFICATE#4323.01



## FCC PART 15.247 TEST REPORT

For

### SHANGHAI MERIT TECHNOLOGY CORP.

1058 TAOGAN RD., SHESHAN TOWN, SONGJIANG DISTRICT, SHANGHAI, China

**FCC ID: XJ6MT-602-1**

|                                           |                                                                                                                                                                                                                               |
|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Report Type:</b><br>Original Report    | <b>Product Type:</b><br>6 CH 2.4GHz FHSS RADIO<br>CONTROL SYSTEM                                                                                                                                                              |
| <b>Test Engineer:</b> Chris Wang          | <i>Chris. Wang</i>                                                                                                                                                                                                            |
| <b>Report Number:</b> RSHA180202002-00A   |                                                                                                                                                                                                                               |
| <b>Report Date:</b> 2018-03-29            |                                                                                                                                                                                                                               |
| <b>Reviewed By:</b> Oscar Ye<br>RF Leader | <i>Oscar. Ye</i>                                                                                                                                                                                                              |
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## GENERAL INFORMATION

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

|              |                                                |
|--------------|------------------------------------------------|
| Applicant    | SHANGHAI MERIT TECHNOLOGY CORP.                |
| Tested Model | MT-602                                         |
| Product Type | 6 CH 2.4GHz FHSS RADIO CONTROL SYSTEM          |
| Dimension    | 166mm(L)×204 mm(W)×83 mm(H)                    |
| Power Supply | DC 6.0V from batteries or DC 6.0V from adapter |

*\*All measurement and test data in this report was gathered from production sample serial number: 20180202002. (Assigned by the BACL. The EUT supplied by the applicant was received on 2018-02-02)*

### Objective

This test report is prepared on behalf of SHANGHAI MERIT TECHNOLOGY CORP. in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

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

No Related Submittal(s)/Grant(s).

### 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 DA 00-705 March 30, 2000.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

**Measurement Uncertainty**

| Item                               |             | Uncertainty |
|------------------------------------|-------------|-------------|
| AC Power Lines Conducted Emissions |             | 3.19dB      |
| RF conducted test with spectrum    |             | 0.9dB       |
| RF Output Power with Power meter   |             | 0.5dB       |
| Radiated emission                  | 30MHz~1GHz  | 6.11dB      |
|                                    | 1GHz~6GHz   | 4.45dB      |
|                                    | 6GHz~18GHz  | 5.23dB      |
|                                    | 18GHz~40GHz | 5.65dB      |
| Occupied Bandwidth                 |             | 0.5kHz      |
| Temperature                        |             | 1.0°C       |
| Humidity                           |             | 6%          |

**Test Facility**

The test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

Bay Area Compliance Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01) and the FCC designation No. CN1185 under the FCC KDB 974614 D01. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

Channel list for FHSS (GFSK) Modulation:

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|
| 1       | 2405            | 27      | 2431            |
| 2       | 2406            | 28      | 2432            |
| 3       | 2407            | 29      | 2433            |
| 4       | 2408            | 30      | 2434            |
| 5       | 2409            | 31      | 2435            |
| 6       | 2410            | 32      | 2436            |
| 7       | 2411            | 33      | 2437            |
| 8       | 2412            | 34      | 2438            |
| 9       | 2413            | 35      | 2439            |
| 10      | 2414            | 36      | 2440            |
| 11      | 2415            | 37      | 2441            |
| 12      | 2416            | 38      | 2442            |
| 13      | 2417            | 39      | 2443            |
| 14      | 2418            | 40      | 2444            |
| 15      | 2419            | 41      | 2445            |
| 16      | 2420            | 42      | 2446            |
| 17      | 2421            | 43      | 2447            |
| 18      | 2422            | 44      | 2448            |
| 19      | 2423            | 45      | 2449            |
| 20      | 2424            | 46      | 2450            |
| 21      | 2425            | 47      | 2451            |
| 22      | 2426            | 48      | 2452            |
| 23      | 2427            | 49      | 2453            |
| 24      | 2428            | 50      | 2454            |
| 25      | 2429            | 51      | 2455            |
| 26      | 2430            | /       | /               |

EUT was tested with Channel 1, 26 and 51.

**EUT Exercise Software**

The EUT was tested in the engineering mode; EUT can be setup for fixed channel mode and hopping mode.

**Special Accessories**

No special accessory.

**Equipment Modifications**

No modification was made to the EUT tested.

**Support Equipment List and Details**

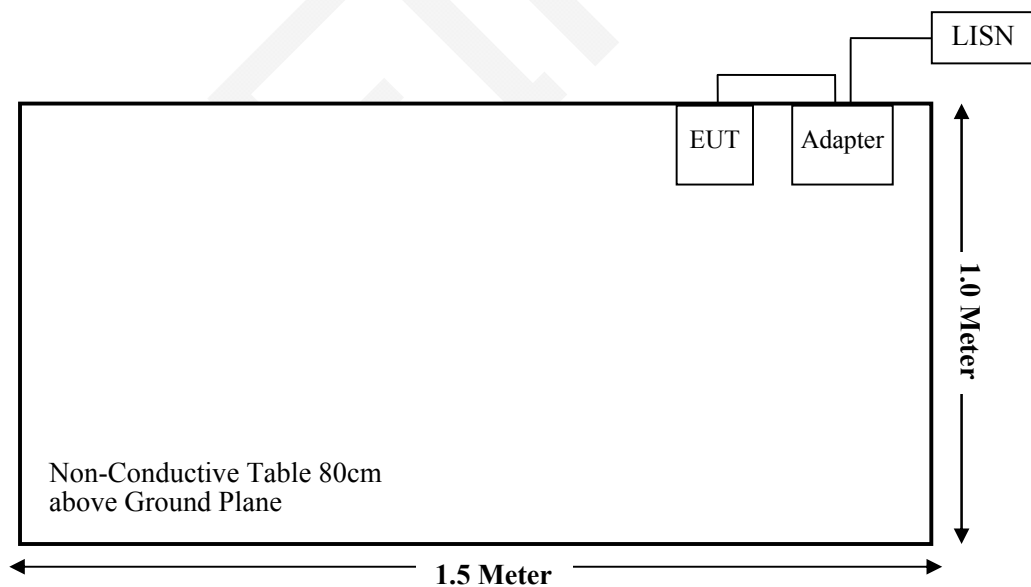
| Manufacturer | Description            | Model | Serial Number |
|--------------|------------------------|-------|---------------|
| MERIT        | Adapter (DC6.0V; 60mA) | /     | /             |

**External I/O Cable**

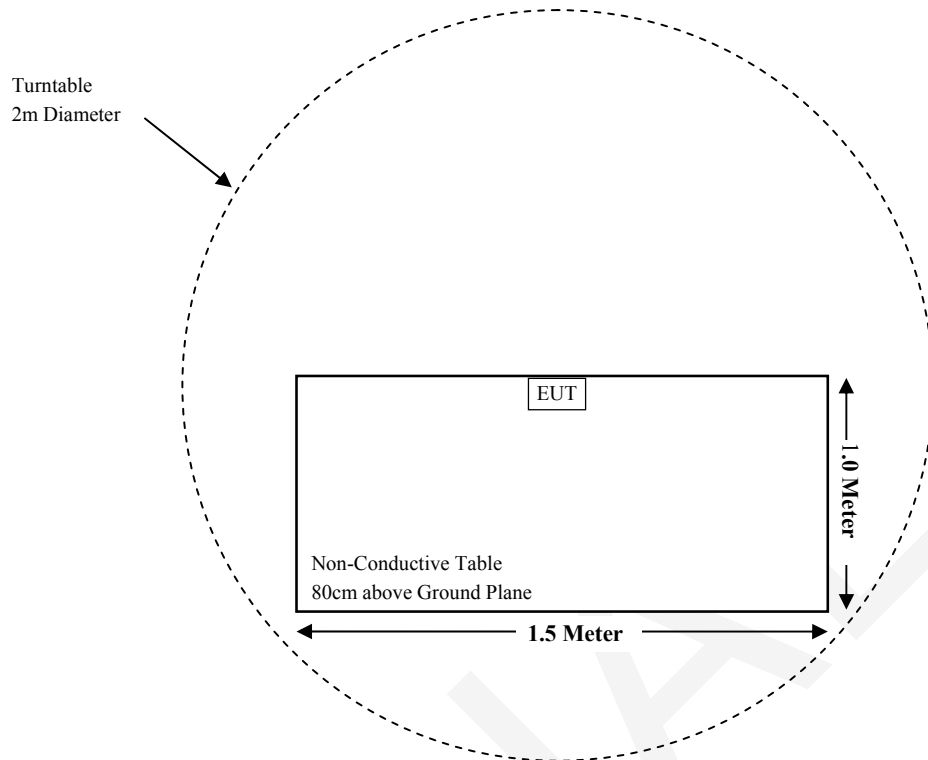
| Cable Description | Shielding Type | Length (m) | From Port | To |
|-------------------|----------------|------------|-----------|----|
| /                 | /              | /          | /         | /  |

**Block Diagram of Test Setup**

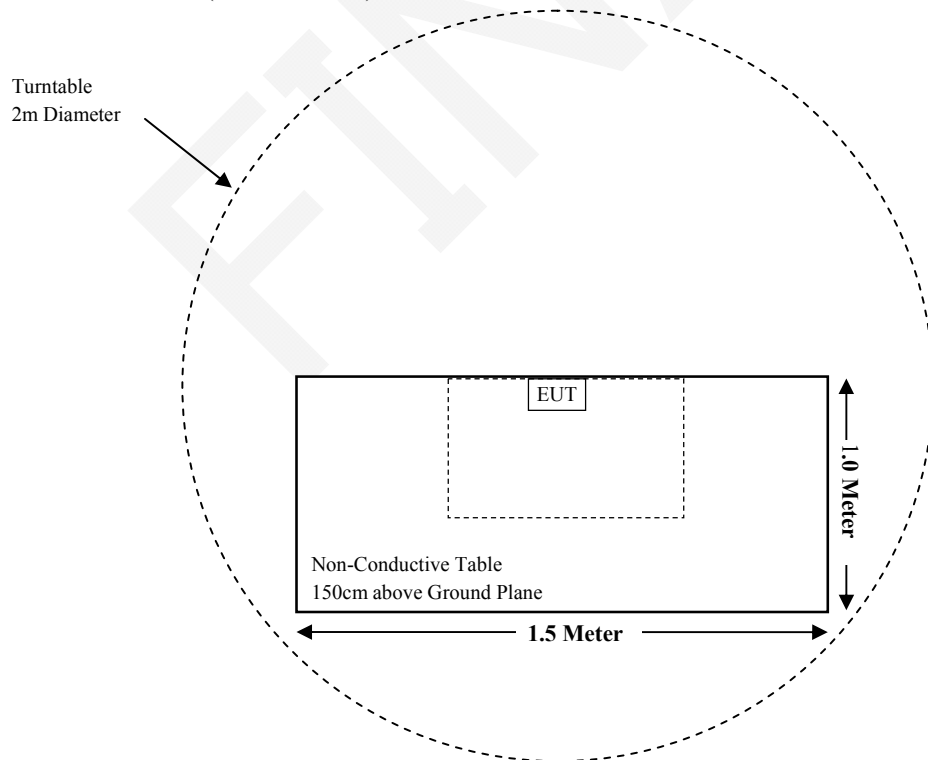
For Conducted Emissions:



For Radiated Emissions (Below 1GHz):



For Radiated Emissions (Above 1GHz):



**SUMMARY OF TEST RESULTS**

| FCC Rules                     | Description of Test              | Result     |
|-------------------------------|----------------------------------|------------|
| §15.247 (i)§1.1310 & §2.1093  | RF Exposure                      | Compliance |
| §15.203                       | Antenna Requirement              | Compliance |
| §15.207(a)                    | AC Line Conducted Emissions      | Compliance |
| §15.205, §15.209 & §15.247(d) | Radiated Emissions               | Compliance |
| §15.247(a)(1)                 | 20 dB Emission 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 |

**TEST EQUIPMENT LIST**

| Manufacturer                               | Description        | Model           | Serial Number | Calibration Date | Calibration Due Date |
|--------------------------------------------|--------------------|-----------------|---------------|------------------|----------------------|
| <b>Radiated Emission Test (Chamber 1#)</b> |                    |                 |               |                  |                      |
| Rohde & Schwarz                            | EMI Test Receiver  | ESCI            | 100195        | 2017-11-12       | 2018-11-11           |
| Sunol Sciences                             | Broadband Antenna  | JB3             | A090413-1     | 2016-12-26       | 2019-12-25           |
| Sonoma Instrument                          | Pre-amplifier      | 310N            | 171205        | 2017-08-15       | 2018-08-14           |
| Rohde & Schwarz                            | Auto test Software | EMC32           | 100361        | /                | /                    |
| MICRO-COAX                                 | Coaxial Cable      | Cable-8         | 008           | 2017-08-15       | 2018-08-14           |
| MICRO-COAX                                 | Coaxial Cable      | Cable-9         | 009           | 2017-08-15       | 2018-08-14           |
| MICRO-COAX                                 | Coaxial Cable      | Cable-10        | 010           | 2017-08-15       | 2018-08-14           |
| <b>Radiated Emission Test (Chamber 2#)</b> |                    |                 |               |                  |                      |
| Rohde & Schwarz                            | EMI Test Receiver  | ESU40           | 100207        | 2017-08-27       | 2018-08-26           |
| ETS-LINDGREN                               | Horn Antenna       | 3115            | 6229          | 2016-01-11       | 2019-01-10           |
| ETS-LINDGREN                               | Horn Antenna       | 3116            | 00084159      | 2016-10-18       | 2019-10-17           |
| Narda                                      | Pre-amplifier      | AFS42-00101800  | 2001270       | 2017-12-22       | 2018-12-21           |
| QuinStar                                   | Amplifier          | QLW-18405536-J0 | 15964001009   | 2017-12-22       | 2018-12-21           |
| MICRO-TRONICS                              | Band Reject Filter | BRM50702        | /             | 2017-08-05       | 2018-08-04           |
| Narda                                      | Attenuator/10dB    | 10dB            | /             | 2017-08-15       | 2018-08-14           |
| Rohde & Schwarz                            | Auto test Software | EMC32           | 100361        | /                | /                    |
| MICRO-COAX                                 | Coaxial Cable      | Cable-6         | 006           | 2017-08-15       | 2018-08-14           |
| MICRO-COAX                                 | Coaxial Cable      | Cable-11        | 011           | 2017-08-15       | 2018-08-14           |
| MICRO-COAX                                 | Coaxial Cable      | Cable-12        | 012           | 2017-08-15       | 2018-08-14           |
| MICRO-COAX                                 | Coaxial Cable      | Cable-13        | 013           | 2017-08-15       | 2018-08-14           |
| <b>RF Conducted Test</b>                   |                    |                 |               |                  |                      |
| Rohde & Schwarz                            | Signal Analyzer    | FSV40           | 101116        | 2017-07-22       | 2018-07-21           |
| Rohde & Schwarz                            | Signal Analyzer    | FSIQ26          | 836131/009    | 2017-09-21       | 2018-09-20           |
| Narda                                      | Attenuator/2dB     | 2dB             | /             | /                | /                    |
| MERIT                                      | RF Cable           | /               | /             | /                | /                    |
| <b>Conducted Emission Test</b>             |                    |                 |               |                  |                      |
| Rohde & Schwarz                            | EMI Test Receiver  | ESCS30          | 834115/007    | 2017-11-12       | 2018-11-11           |
| Rohde & Schwarz                            | LISN               | ESH3-Z5         | 862770/011    | 2017-11-12       | 2018-11-11           |
| BACL                                       | Auto test Software | BACL-EMC        | CE001         | /                | /                    |
| Narda                                      | Attenuator/6dB     | 10690812-2      | 26850-6       | 2018-01-10       | 2019-01-09           |
| MICRO-COAX                                 | Coaxial Cable      | Cable-15        | 015           | 2017-08-15       | 2018-08-14           |

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

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**FCC§15.247 (I), §1.1310 &§2.1093 –RF EXPOSURE**

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**Applicable Standard**

According to §2.1093 and §1.1307(b)(1), 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 KDB 447498 D01 General RF Exposure Guidance

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:

**$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f \text{ (GHz)}}] \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR, where}$**

1.  $f$  (GHz) is the RF channel transmit frequency in GHz.
2. Power and distance are rounded to the nearest mW and mm before calculation.
3. The result is rounded to one decimal place for comparison.
4. When the minimum test separation distance is  $< 5$  mm, a distance of 5 mm is applied to determine SAR test Exclusion.

**Measurement Result****For worst case:**

| Mode | Frequency Range<br>(MHz) | Max Tune-up<br>Conducted Power |       | Calculated<br>Distance<br>(mm) | Calculated<br>Value | Threshold<br>(10-g SAR) | SAR Test<br>Exclusion |
|------|--------------------------|--------------------------------|-------|--------------------------------|---------------------|-------------------------|-----------------------|
|      |                          | (dBm)                          | (mW)  |                                |                     |                         |                       |
| FHSS | 2405-2455                | 18.00                          | 63.10 | 78                             | 0.016               | 7.5                     | Yes                   |

**Conclusion:** The device meets the exemption requirement.

Note: This is a handheld device.

**FCC §15.203 – ANTENNA REQUIREMENT**

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**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 Information**

The EUT has a dipole antenna, which the antenna gain is 2.0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

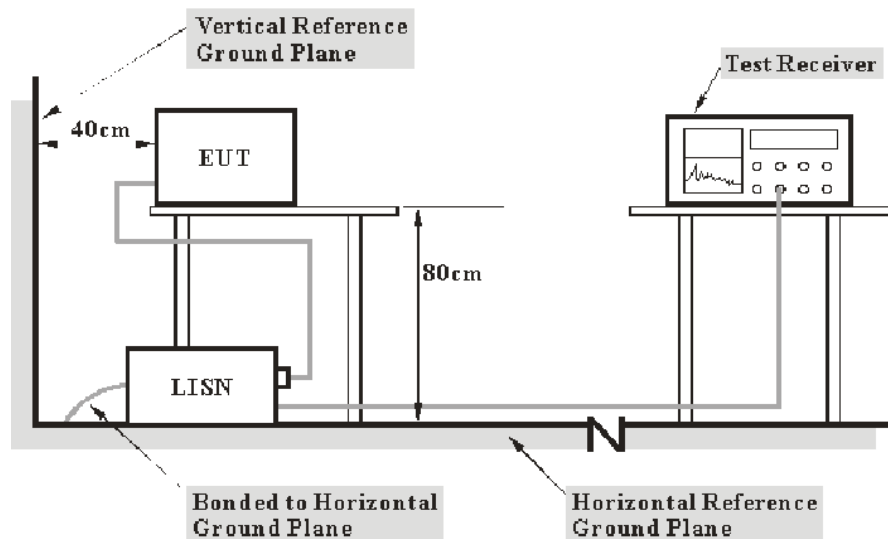
**Result:** Compliance.

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

### Applicable Standard

FCC§15.207

### 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.

### 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 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 Factor & Margin Calculation

The Corrected factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

$$\text{Corrected Factor} = \text{LISN VDF} + \text{Cable Loss}$$

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

$$\text{Margin} = \text{Limit} - \text{Reading}$$

### Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207.

#### Test Data

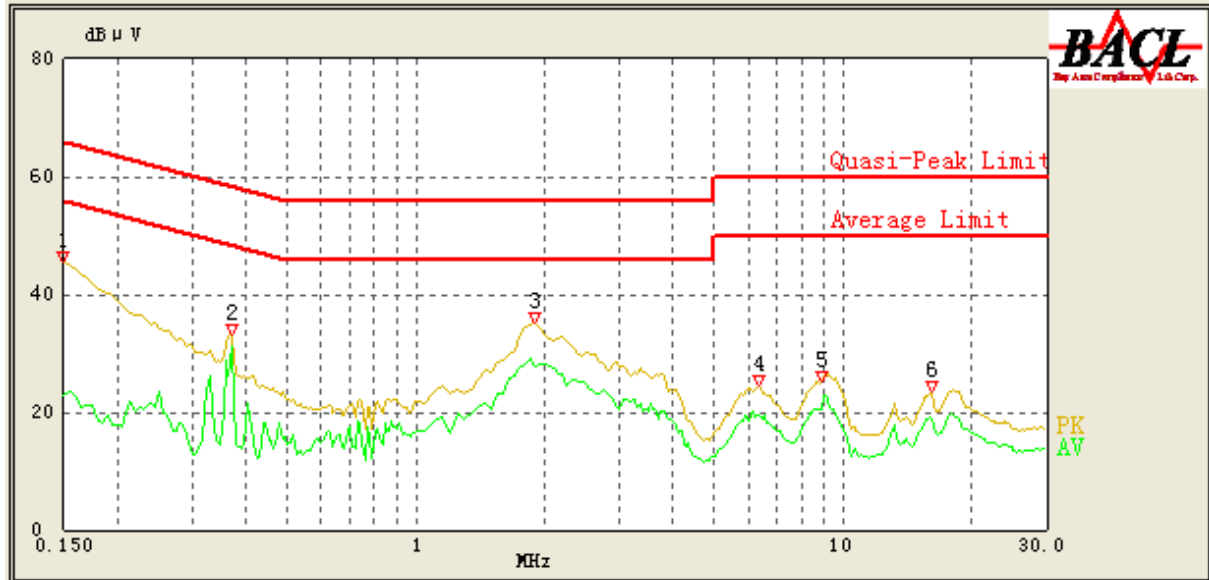
##### Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 21.2 °C   |
| Relative Humidity: | 52 %      |
| ATM Pressure:      | 101.1 kPa |

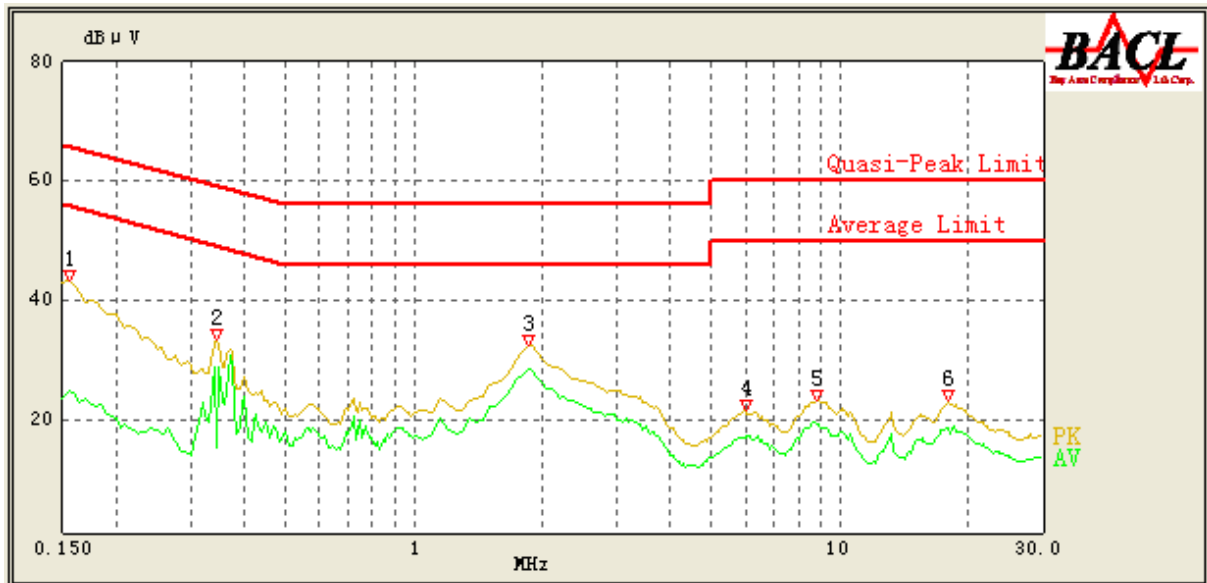
*The testing was performed by Max Min on 2018-03-29.*

EUT operation mode: Charging

AC 120V/60 Hz, Line



| Frequency (MHz) | Reading (dBμV) | Detector (PK/AV/QP) | Bandwidth (kHz) | Line | Corrected Factor (dB) | Limit (dBμV) | Margin (dB) | Comment    |
|-----------------|----------------|---------------------|-----------------|------|-----------------------|--------------|-------------|------------|
| 0.150           | 45.59          | QP                  | 9.000           | L1   | 16.06                 | 66.00        | 20.41       | Compliance |
| 0.150           | 22.94          | AV                  | 9.000           | L1   | 16.06                 | 56.00        | 33.06       | Compliance |
| 0.370           | 33.16          | QP                  | 9.000           | L1   | 16.05                 | 59.71        | 26.55       | Compliance |
| 0.370           | 31.06          | AV                  | 9.000           | L1   | 16.05                 | 49.71        | 18.65       | Compliance |
| 1.900           | 35.09          | QP                  | 9.000           | L1   | 15.85                 | 56.00        | 20.91       | Compliance |
| 1.900           | 27.86          | AV                  | 9.000           | L1   | 15.85                 | 46.00        | 18.14       | Compliance |
| 6.350           | 24.54          | QP                  | 9.000           | L1   | 15.94                 | 60.00        | 35.46       | Compliance |
| 6.350           | 19.59          | AV                  | 9.000           | L1   | 15.94                 | 50.00        | 30.41       | Compliance |
| 8.900           | 25.24          | QP                  | 9.000           | L1   | 16.03                 | 60.00        | 34.76       | Compliance |
| 8.900           | 20.58          | AV                  | 9.000           | L1   | 16.03                 | 50.00        | 29.42       | Compliance |
| 16.150          | 23.57          | QP                  | 9.000           | L1   | 16.26                 | 60.00        | 36.43       | Compliance |
| 16.200          | 18.96          | AV                  | 9.000           | L1   | 16.27                 | 50.00        | 31.04       | Compliance |

**AC 120V/60 Hz, Neutral**

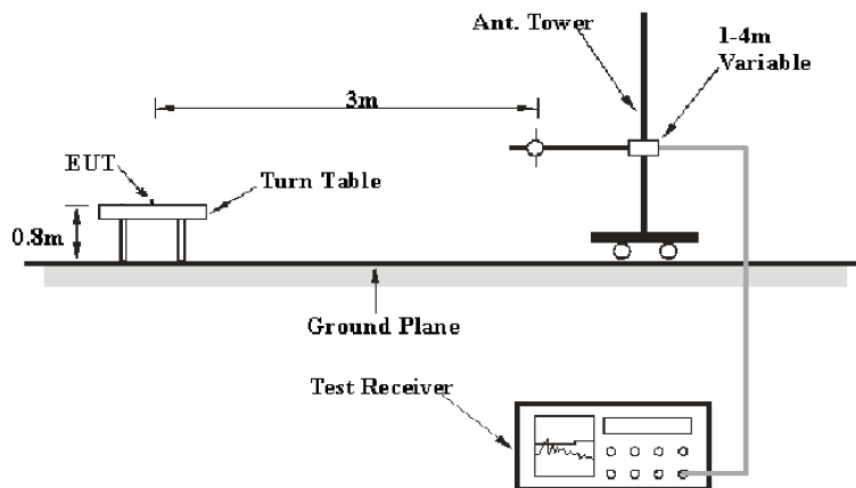
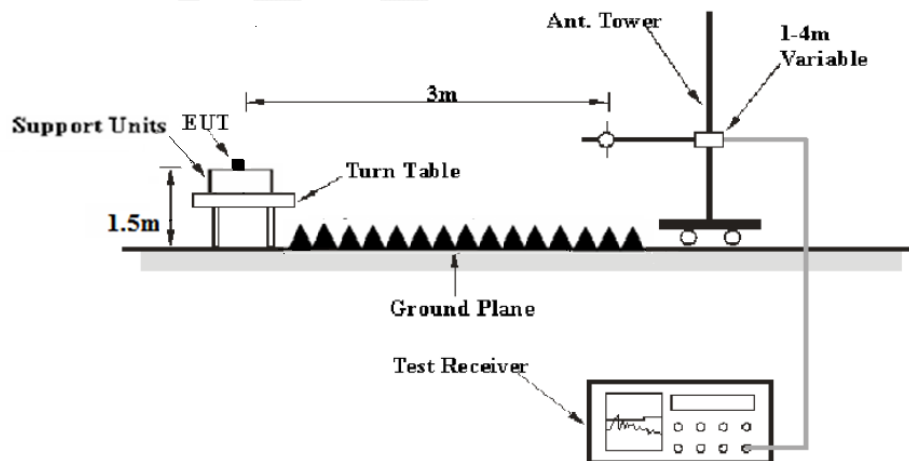
| Frequency (MHz) | Reading (dBμV) | Detector (PK/AV/QP) | Bandwidth (kHz) | Line | Corrected Factor (dB) | Limit (dBμV) | Margin (dB) | Comment    |
|-----------------|----------------|---------------------|-----------------|------|-----------------------|--------------|-------------|------------|
| 0.155           | 43.34          | QP                  | 9.000           | N    | 16.06                 | 65.86        | 22.52       | Compliance |
| 0.155           | 24.72          | AV                  | 9.000           | N    | 16.06                 | 55.86        | 31.14       | Compliance |
| 0.345           | 33.44          | QP                  | 9.000           | N    | 16.08                 | 60.43        | 26.99       | Compliance |
| 0.345           | 15.39          | AV                  | 9.000           | N    | 16.08                 | 50.43        | 35.04       | Compliance |
| 1.850           | 32.59          | QP                  | 9.000           | N    | 15.91                 | 56.00        | 23.41       | Compliance |
| 1.850           | 28.41          | AV                  | 9.000           | N    | 15.91                 | 46.00        | 17.59       | Compliance |
| 6.000           | 21.55          | QP                  | 9.000           | N    | 15.90                 | 60.00        | 38.45       | Compliance |
| 6.000           | 17.11          | AV                  | 9.000           | N    | 15.90                 | 50.00        | 32.89       | Compliance |
| 8.850           | 23.13          | QP                  | 9.000           | N    | 15.96                 | 60.00        | 36.87       | Compliance |
| 8.850           | 19.34          | AV                  | 9.000           | N    | 15.96                 | 50.00        | 30.66       | Compliance |
| 17.950          | 23.08          | QP                  | 9.000           | N    | 16.10                 | 60.00        | 36.92       | Compliance |
| 17.900          | 18.74          | AV                  | 9.000           | N    | 16.10                 | 50.00        | 31.26       | Compliance |

**Note:**

1. Corrected Factor = LISN VDF (Voltage Division Factor) + Cable Loss  
 Margin = Limit – Reading

**FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS****Applicable Standard**

FCC §15.205; §15.209; §15.247(d)

**EUT Setup****Below 1 GHz:****Above 1GHz:**

The radiated emission tests were performed in the 3 meters, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209 and FCC 15.247 limits.

## EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

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

| Frequency Range   | RBW     | Video B/W | IF B/W  | Detector |
|-------------------|---------|-----------|---------|----------|
| 30 MHz – 1000 MHz | 120 kHz | 300 kHz   | 120 kHz | QP       |
| Above 1GHz        | 1MHz    | 3 MHz     | /       | PK       |
|                   | 1MHz    | 3 MHz     | /       | Ave      |

## Test Procedure

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

All final data was recorded in Quasi-peak detection mode for frequency range of 30 MHz -1 GHz and 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 Results Summary

According to the recorded data in following table, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247.

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

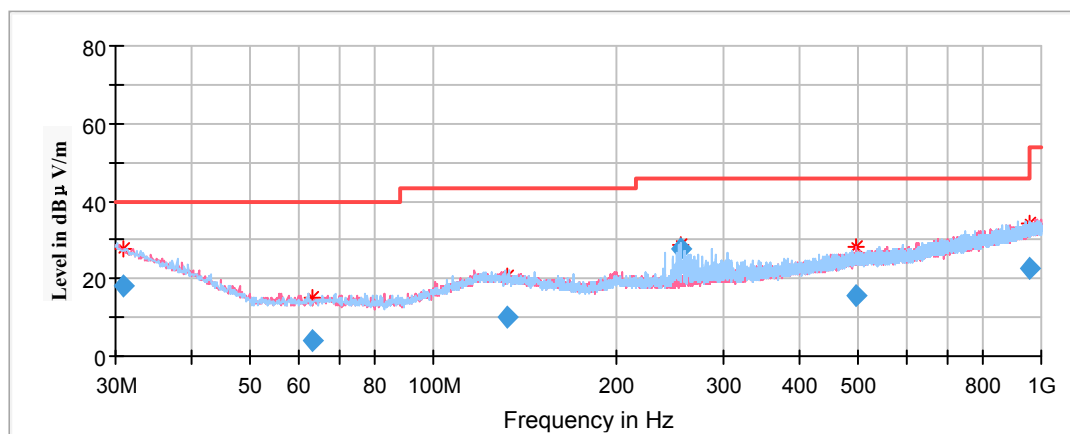
|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 24.2 °C   |
| <b>Relative Humidity:</b> | 50%       |
| <b>ATM Pressure:</b>      | 101.2 kPa |

The testing was performed by Chris Wang on 2018-03-09.

EUT operation mode: Transmitting

**Spurious Emission Test:****30MHz-1GHz:**

Pre-Scan with low, middle and high channels in the X,Y and Z axes of orientation, the worst case **low channel in X-axis of orientation** was recorded



| Frequency (MHz) | Corrected Amplitude | Rx Antenna  |             | Turntable Degree | Corrected Factor (dB/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|---------------------|-------------|-------------|------------------|-------------------------|----------------|-------------|
|                 | QuasiPeak (dBμV/m)  | Height (cm) | Polar (H/V) |                  |                         |                |             |
| 30.925701       | 18.02               | 101.0       | H           | 153.0            | -5.0                    | 40.00          | 21.98       |
| 63.112300       | 4.03                | 101.0       | H           | 246.0            | -18.2                   | 40.00          | 35.97       |
| 131.822600      | 10.12               | 101.0       | H           | 359.0            | -12.1                   | 43.50          | 33.38       |
| 256.013900      | 27.71               | 101.0       | H           | 75.0             | -12.4                   | 46.00          | 18.29       |
| 496.455550      | 15.83               | 199.0       | V           | 262.0            | -6.2                    | 46.00          | 30.17       |
| 955.784050      | 22.56               | 101.0       | H           | 64.0             | 1.3                     | 46.00          | 23.44       |

**1GHz-18GHz:**

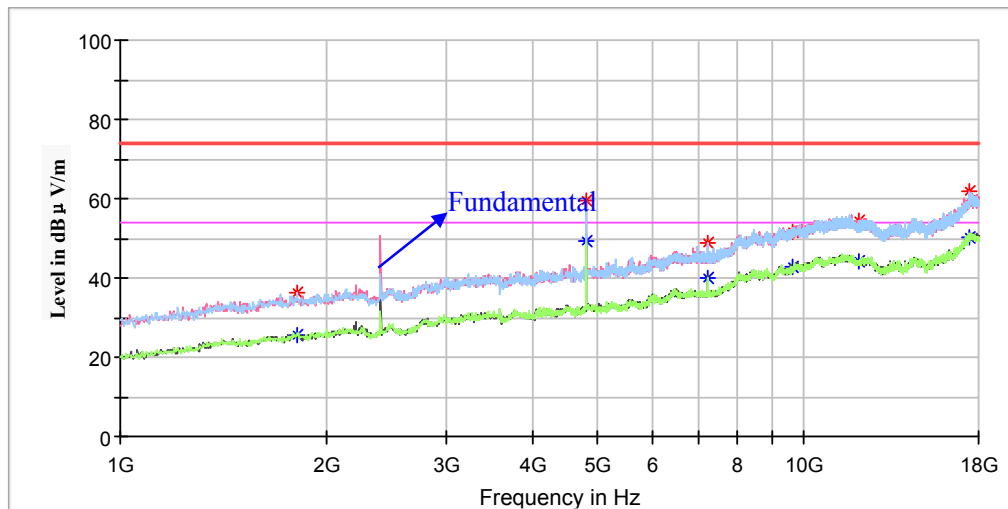
Pre-Scan in the X,Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded

Note:

1. This test was performed with the 2.4-2.4835GHz band reject filter.
2. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor  
Corrected Amplitude = Corrected Factor + Reading  
Margin = Limit - Corrected. Amplitude

**Low Channel: 2405 MHz**

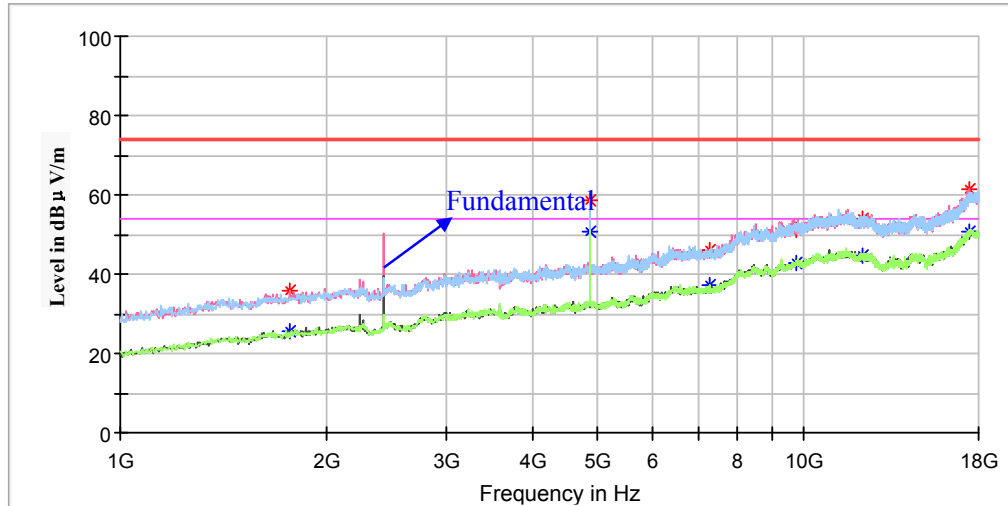
Full Spectrum



| Frequency (MHz) | Corrected Amplitude |                   | Rx Antenna  |             | Turntable Degree | Corrected Factor (dB/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|---------------------|-------------------|-------------|-------------|------------------|-------------------------|----------------|-------------|
|                 | MaxPeak (dBμV /m)   | Average (dBμV /m) | Height (cm) | Polar (H/V) |                  |                         |                |             |
| 1812.600000     | ---                 | 25.53             | 200.0       | H           | 275.0            | -6.7                    | 54.00          | 28.47       |
| 1812.600000     | 36.13               | ---               | 200.0       | H           | 275.0            | -6.7                    | 74.00          | 37.87       |
| 4810.000000     | ---                 | 49.09             | 100.0       | H           | 308.0            | 2.5                     | 54.00          | 4.91        |
| 4810.000000     | 59.44               | ---               | 100.0       | H           | 308.0            | 2.5                     | 74.00          | 14.56       |
| 7215.000000     | 48.85               | ---               | 150.0       | H           | 80.0             | 9.8                     | 74.00          | 25.15       |
| 7215.000000     | ---                 | 39.97             | 150.0       | H           | 80.0             | 9.8                     | 54.00          | 14.03       |
| 9622.400000     | 51.84               | ---               | 250.0       | H           | 116.0            | 14.9                    | 74.00          | 22.16       |
| 9622.400000     | ---                 | 42.77             | 250.0       | H           | 116.0            | 14.9                    | 54.00          | 11.23       |
| 12022.800000    | 54.35               | ---               | 200.0       | H           | 38.0             | 16.5                    | 74.00          | 19.65       |
| 12022.800000    | ---                 | 44.32             | 200.0       | H           | 38.0             | 16.5                    | 54.00          | 9.68        |
| 17503.600000    | 61.82               | ---               | 100.0       | V           | 63.0             | 23.7                    | 74.00          | 12.18       |
| 17503.600000    | ---                 | 50.15             | 100.0       | V           | 63.0             | 23.7                    | 54.00          | 3.85        |

**Middle Channel: 2430MHz**

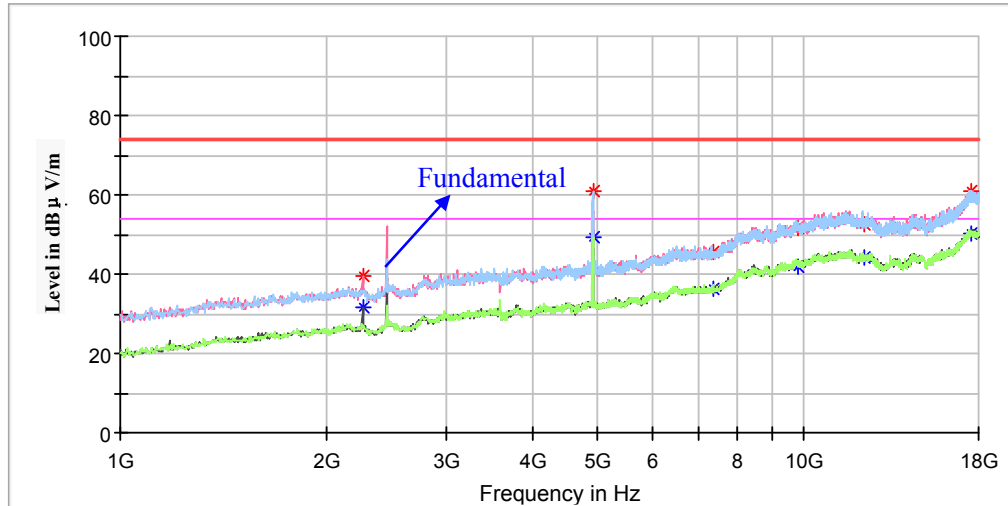
Full Spectrum



| Frequency (MHz) | Corrected Amplitude     |                         | Rx Antenna  |             | Turntable Degree | Corrected Factor (dB/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|-------------------------|-------------------------|-------------|-------------|------------------|-------------------------|----------------------|-------------|
|                 | MaxPeak (dB $\mu$ V /m) | Average (dB $\mu$ V /m) | Height (cm) | Polar (H/V) |                  |                         |                      |             |
| 1768.400000     | 35.85                   | ---                     | 150.0       | V           | 116.0            | -6.9                    | 74.00                | 38.15       |
| 1768.400000     | ---                     | 25.59                   | 150.0       | V           | 116.0            | -6.9                    | 54.00                | 28.41       |
| 4860.000000     | 58.72                   | ---                     | 100.0       | H           | 7.0              | 2.6                     | 74.00                | 15.28       |
| 4860.000000     | ---                     | 50.63                   | 100.0       | H           | 7.0              | 2.6                     | 54.00                | 3.37        |
| 7290.000000     | 45.99                   | ---                     | 200.0       | H           | 110.0            | 9.9                     | 74.00                | 28.01       |
| 7290.000000     | ---                     | 37.01                   | 200.0       | H           | 110.0            | 9.9                     | 54.00                | 16.99       |
| 9721.000000     | 51.15                   | ---                     | 150.0       | H           | 313.0            | 14.9                    | 74.00                | 22.85       |
| 9721.000000     | ---                     | 42.61                   | 150.0       | H           | 313.0            | 14.9                    | 54.00                | 11.39       |
| 12152.000000    | 53.92                   | ---                     | 250.0       | H           | 125.0            | 16.7                    | 74.00                | 20.08       |
| 12152.000000    | ---                     | 44.55                   | 250.0       | H           | 125.0            | 16.7                    | 54.00                | 9.45        |
| 17496.800000    | ---                     | 50.78                   | 150.0       | V           | 348.0            | 23.7                    | 54.00                | 3.22        |
| 17496.800000    | 61.21                   | ---                     | 150.0       | V           | 348.0            | 23.7                    | 74.00                | 12.79       |

**High Channel: 2455MHz**

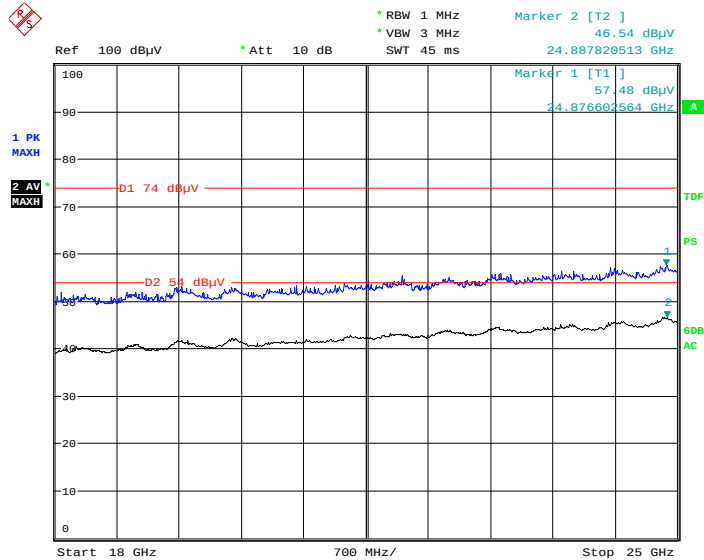
Full Spectrum



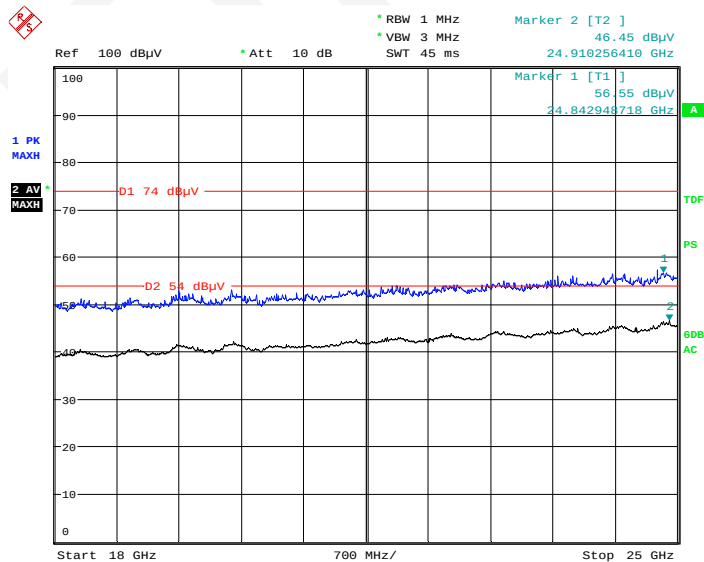
| Frequency (MHz) | Corrected Amplitude     |                         | Rx Antenna  |             | Turntable Degree | Corrected Factor (dB/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|-------------------------|-------------------------|-------------|-------------|------------------|-------------------------|----------------------|-------------|
|                 | MaxPeak (dB $\mu$ V /m) | Average (dB $\mu$ V /m) | Height (cm) | Polar (H/V) |                  |                         |                      |             |
| 2261.400000     | ---                     | 31.59                   | 150.0       | V           | 102.0            | -5.3                    | 54.00                | 22.41       |
| 2261.400000     | 39.74                   | ---                     | 150.0       | V           | 102.0            | -5.3                    | 74.00                | 34.26       |
| 4910.000000     | 60.71                   | ---                     | 250.0       | H           | 180.0            | 2.7                     | 74.00                | 13.29       |
| 4910.000000     | ---                     | 49.42                   | 250.0       | H           | 180.0            | 2.7                     | 54.00                | 4.58        |
| 7365.000000     | ---                     | 36.47                   | 150.0       | H           | 117.0            | 10.0                    | 54.00                | 17.53       |
| 7365.000000     | 45.54                   | ---                     | 150.0       | H           | 117.0            | 10.0                    | 74.00                | 28.46       |
| 9819.600000     | 51.70                   | ---                     | 200.0       | H           | 196.0            | 14.9                    | 74.00                | 22.30       |
| 9819.600000     | ---                     | 41.95                   | 200.0       | H           | 196.0            | 14.9                    | 54.00                | 12.05       |
| 12274.400000    | ---                     | 44.02                   | 150.0       | H           | 164.0            | 16.9                    | 54.00                | 9.98        |
| 12274.400000    | 52.61                   | ---                     | 150.0       | H           | 164.0            | 16.9                    | 74.00                | 21.39       |
| 17575.000000    | ---                     | 50.38                   | 200.0       | H           | 341.0            | 23.7                    | 54.00                | 3.62        |
| 17575.000000    | 61.15                   | ---                     | 200.0       | H           | 341.0            | 23.7                    | 74.00                | 12.85       |

**18GHz-25GHz:**

Pre-Scan with low, middle and high channels in the X,Y and Z axes of orientation, the worst case **low channel in X-axis of orientation** was recorded

**Horizontal**

Date: 9.MAR.2018 15:24:20

**Vertical**

Date: 9.MAR.2018 15:48:45

**Fundamental Test & Restricted Bands Emissions:**

*Pre-Scan in the X, Y and Z axes of orientation, the worst case X-axis of orientation was recorded*

Note:

1. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

Margin = Limit - Corrected. Amplitude

| Frequency<br>(MHz)      | Corrected Amplitude  |                      | Rx Antenna     |                | Turntable<br>Degree | Corrected<br>Factor<br>(dB/m) | Limit<br>(dBμV/m) | Margin<br>(dB) |
|-------------------------|----------------------|----------------------|----------------|----------------|---------------------|-------------------------------|-------------------|----------------|
|                         | MaxPeak<br>(dBμV /m) | Average<br>(dBμV /m) | Height<br>(cm) | Polar<br>(H/V) |                     |                               |                   |                |
| Low Channel: 2405MHz    |                      |                      |                |                |                     |                               |                   |                |
| 2390.000000             | ---                  | 35.07                | 200.0          | H              | 151.0               | -4.9                          | 54.00             | 18.93          |
| 2390.000000             | 58.46                | ---                  | 200.0          | H              | 151.0               | -4.9                          | 74.00             | 15.54          |
| 2405.000000             | ---                  | 105.90               | 150.0          | H              | 196.0               | -4.9                          | /                 | /              |
| 2405.000000             | 108.74               | ---                  | 150.0          | H              | 196.0               | -4.9                          | /                 | /              |
| Middle Channel: 2430MHz |                      |                      |                |                |                     |                               |                   |                |
| 2430.000000             | ---                  | 105.92               | 200.0          | H              | 325.0               | -4.8                          | /                 | /              |
| 2430.000000             | 108.37               | ---                  | 200.0          | H              | 325.0               | -4.8                          | /                 | /              |
| High Channel: 2455MHz   |                      |                      |                |                |                     |                               |                   |                |
| 2455.000000             | ---                  | 106.57               | 200.0          | H              | 60.0                | -4.8                          | /                 | /              |
| 2455.000000             | 109.02               | ---                  | 200.0          | H              | 69.0                | -4.8                          | /                 | /              |
| 2483.500000             | ---                  | 28.63                | 150.0          | H              | 194.0               | -4.7                          | 54.00             | 25.37          |
| 2483.500000             | 49.15                | ---                  | 150.0          | H              | 194.0               | -4.7                          | 74.00             | 24.85          |

**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 20 dB bandwidth of the hopping channel, whichever is greater. 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. Set the EUT in transmitting mode, maxhold the channel.
2. Set the adjacent channel of the EUT and maxhold another trace.
3. Measure the channel separation.

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

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 24.2 °C   |
| <b>Relative Humidity:</b> | 50%       |
| <b>ATM Pressure:</b>      | 101.2 kPa |

*The testing was performed by Chris Wang on 2018-03-05.*

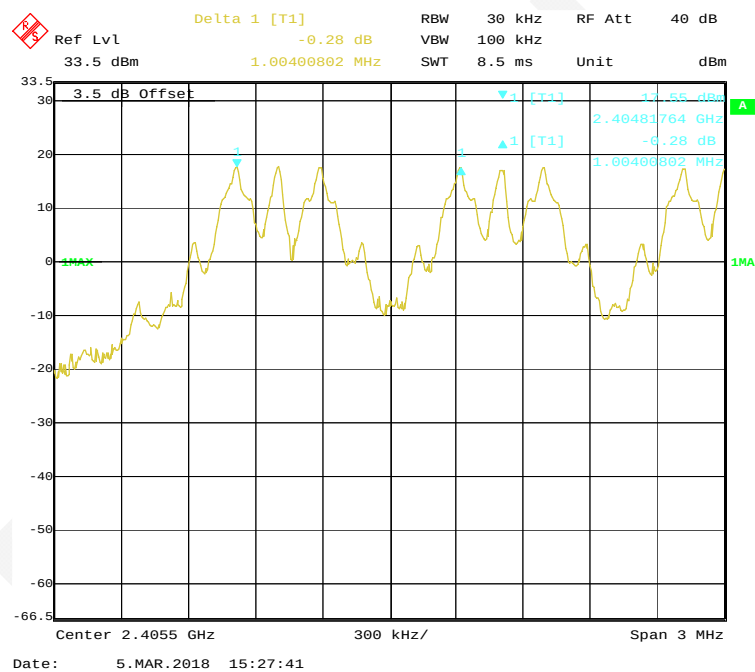
*EUT operation mode: Hopping*

*Test Result: Compliance.*

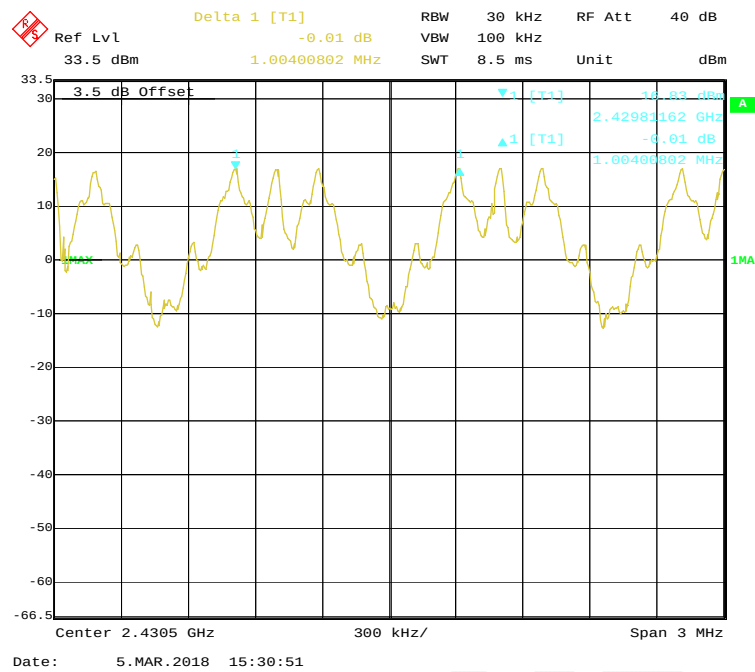
| Modulation | Channel  | Frequency (MHz) | Channel Separation (kHz) | Limit (kHz) | Result |
|------------|----------|-----------------|--------------------------|-------------|--------|
| GFSK       | Low      | 2405.0          | 1004.008                 | 525.050     | Pass   |
|            | Adjacent | 2406.0          |                          |             |        |
|            | Middle   | 2430.0          | 1004.008                 | 525.050     | Pass   |
|            | Adjacent | 2431.0          |                          |             |        |
|            | Adjacent | 2454.0          | 1004.008                 | 525.050     | Pass   |
|            | High     | 2455.0          |                          |             |        |

The limit = 20dB Bandwidth\*2/3

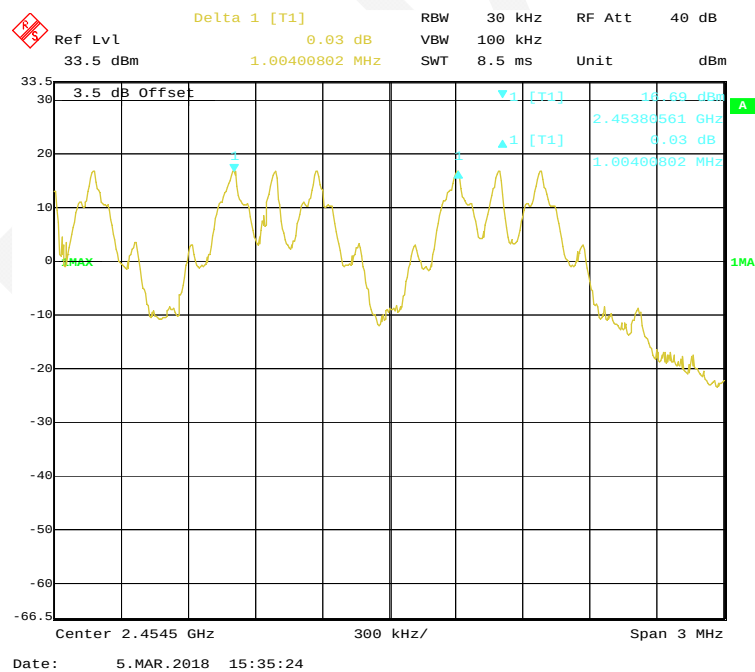
### Low Channel



### Middle Channel



### High Channel



**FCC §15.247(a) (1) – 20 dB EMISSION BANDWIDTH****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 without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. 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 Data****Environmental Conditions**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 24.2 °C   |
| <b>Relative Humidity:</b> | 50%       |
| <b>ATM Pressure:</b>      | 101.2 kPa |

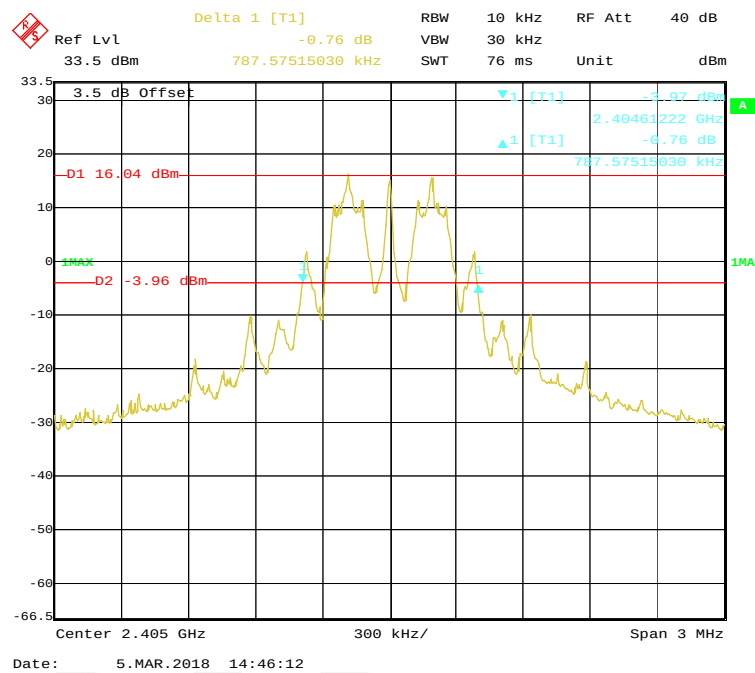
*The testing was performed by Chris Wang on 2018-03-05.*

*EUT operation mode: Transmitting*

*Test Result: Compliance.*

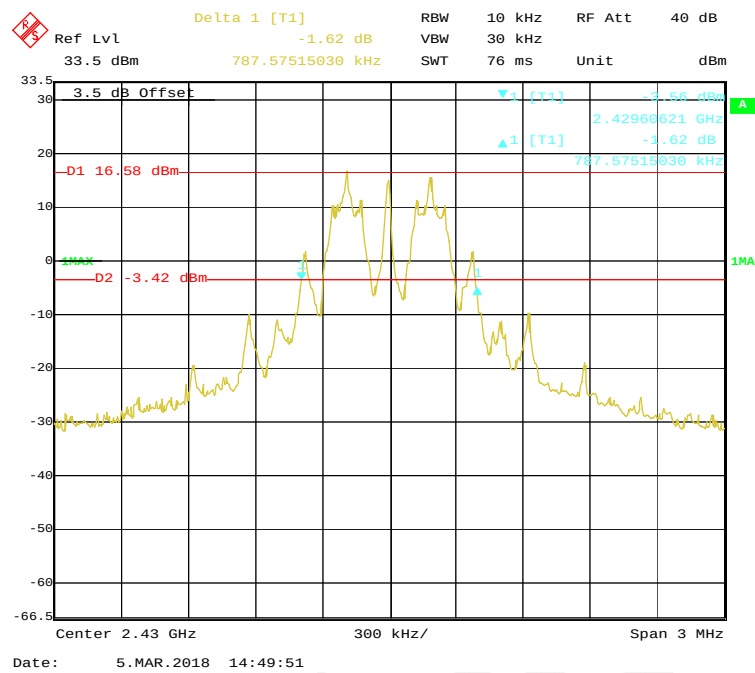
| Modulation | Channel | Frequency (MHz) | 20 dB Emission Bandwidth (kHz) |
|------------|---------|-----------------|--------------------------------|
| GFSK       | Low     | 2405            | 787.575                        |
|            | Middle  | 2430            | 787.575                        |
|            | High    | 2455            | 787.575                        |

## Low Channel

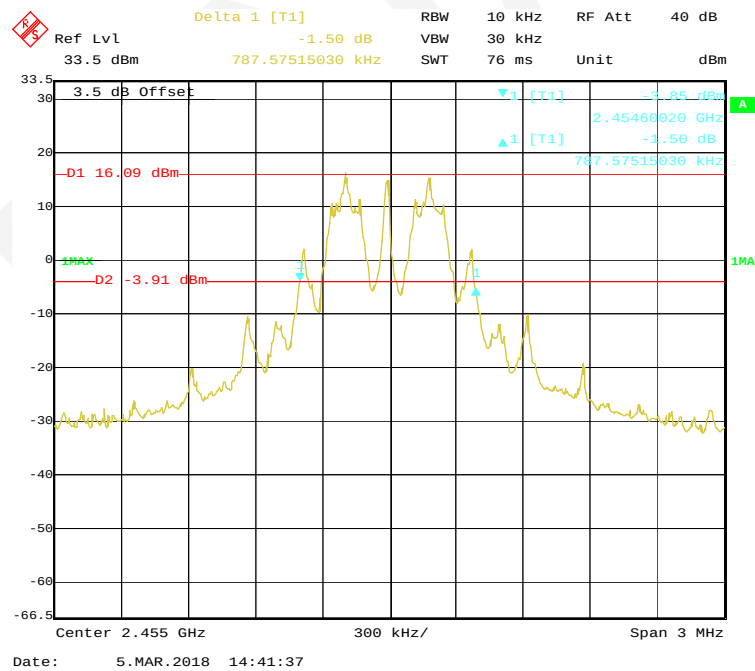


Date: 5.MAR.2018 14:46:12

## Middle Channel



## High Channel



**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 Data****Environmental Conditions**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 24.2 °C   |
| <b>Relative Humidity:</b> | 50%       |
| <b>ATM Pressure:</b>      | 101.2 kPa |

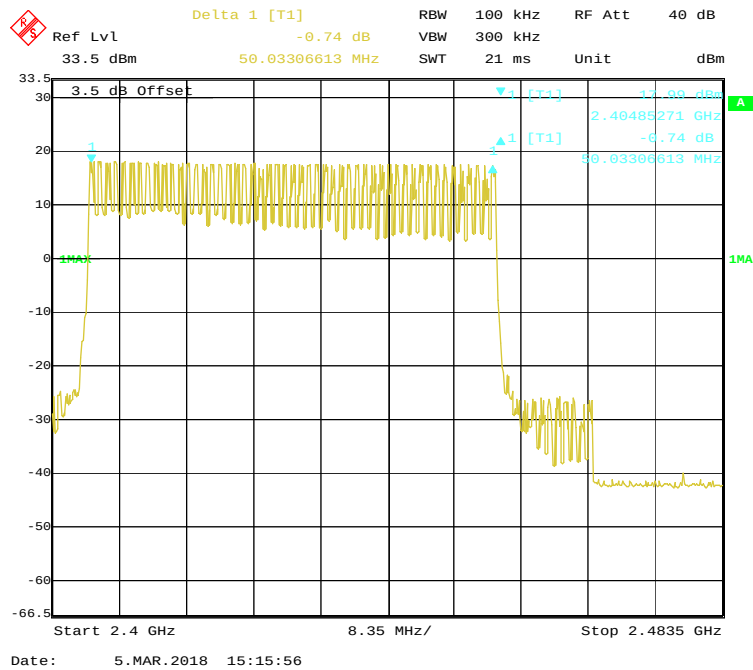
*The testing was performed by Chris Wang on 2018-03-05.*

*EUT operation mode: Hopping*

*Test Result: Compliance.*

| Modulation | Frequency Range (MHz) | Number of Hopping Channel (CH) | Limit (CH) |
|------------|-----------------------|--------------------------------|------------|
| GFSK       | 2400-2483.5           | 51                             | ≥15        |

### Number of Hopping Channels



## **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; Spectrum SPAN was set as 0. Sweep was set as 0.4 X channel no. (s), the quantity of pulse was get from single sweep. In addition, the time of single pulses was tested.

### **Test Data**

#### **Environmental Conditions**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 24.2 °C   |
| <b>Relative Humidity:</b> | 50%       |
| <b>ATM Pressure:</b>      | 101.2 kPa |

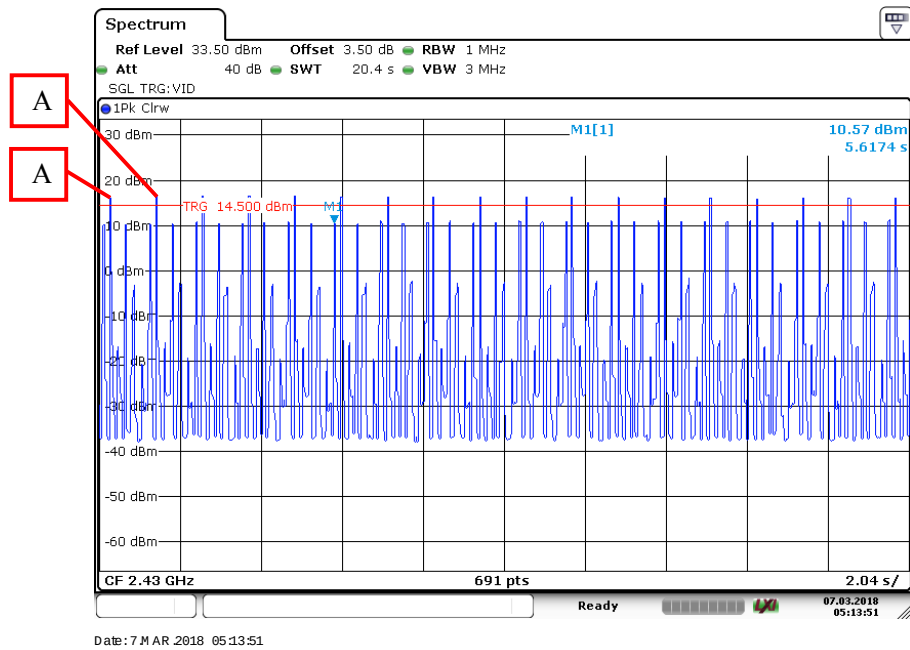
The testing was performed by Chris Wang on 2018-03-07.

EUT operation mode: Hopping

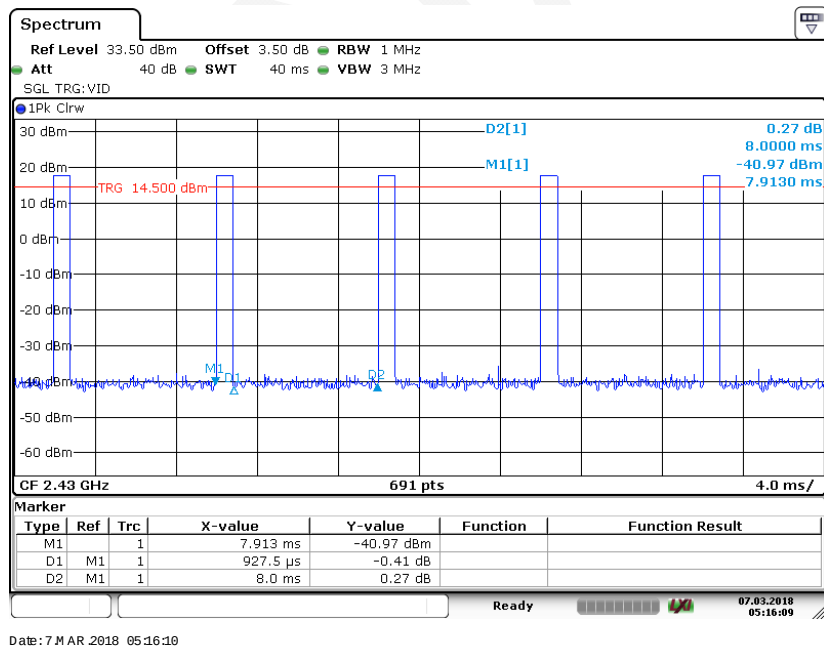
Test Result: Compliance.

| Modulation | Channel                                                                                | Pulse Width | Pulse Number | Dwell Time | Limit | Result |
|------------|----------------------------------------------------------------------------------------|-------------|--------------|------------|-------|--------|
|            |                                                                                        | (ms)        |              | (s)        | (s)   |        |
| GFSK       | Middle                                                                                 | 0.843       | 18*5         | 0.076      | ≤0.4  | Pass   |
|            | Note: Dwell time = Pulse time*N<br>Observed time = 0.4s* hopping number= 0.4s*51=20.4s |             |              |            |       |        |

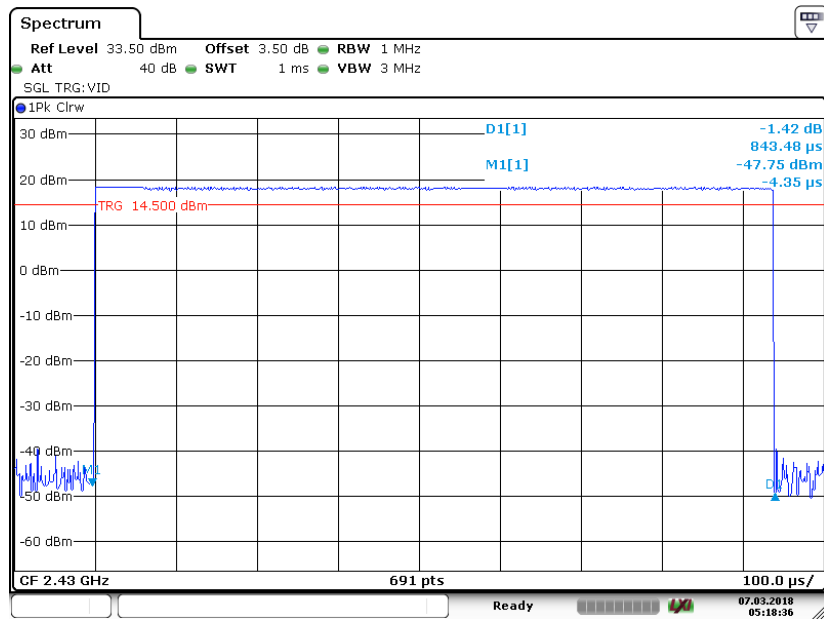
# Number of Pulses



# Zoom in A



# Single Pulse



Date: 7 MAR 2018 05:18:37

## **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. And 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 Data**

#### **Environmental Conditions**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 24.2 °C   |
| <b>Relative Humidity:</b> | 50%       |
| <b>ATM Pressure:</b>      | 101.2 kPa |

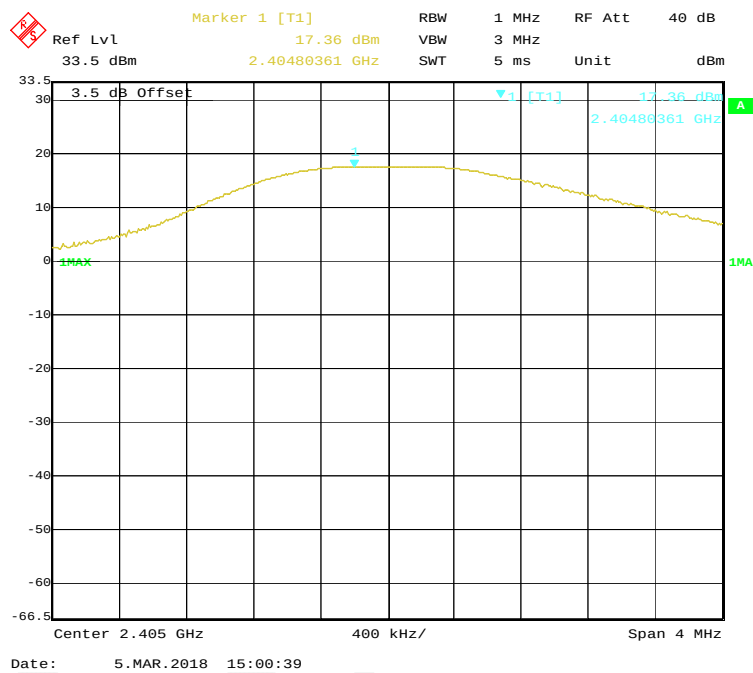
*The testing was performed by Chris Wang on 2018-03-05.*

*EUT operation mode: Transmitting*

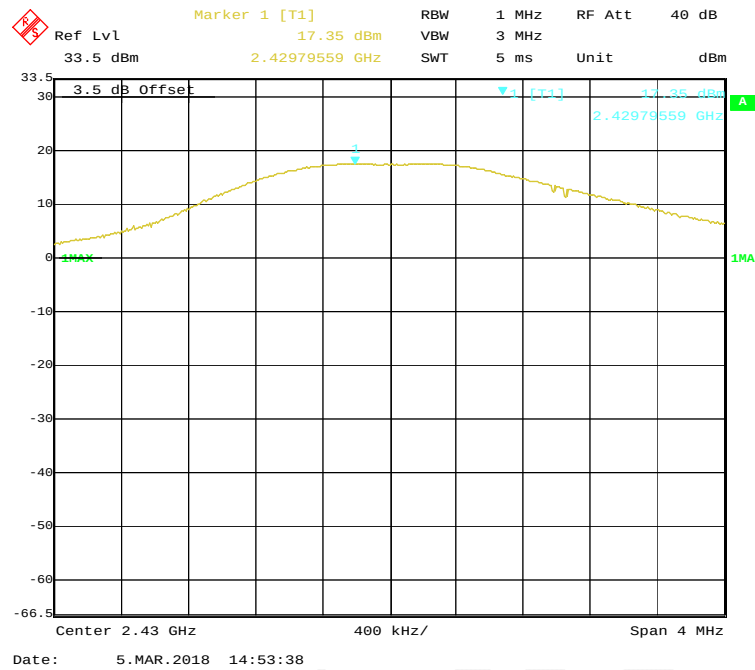
*Test Result: Compliance.*

| Modulation | Channel | Frequency (MHz) | Output Power |       | Limit (mW) |
|------------|---------|-----------------|--------------|-------|------------|
|            |         |                 | (dBm)        | (mW)  |            |
| GFSK       | Low     | 2405            | 17.36        | 54.45 | 125        |
|            | Middle  | 2430            | 17.35        | 54.33 | 125        |
|            | High    | 2455            | 17.28        | 53.46 | 125        |

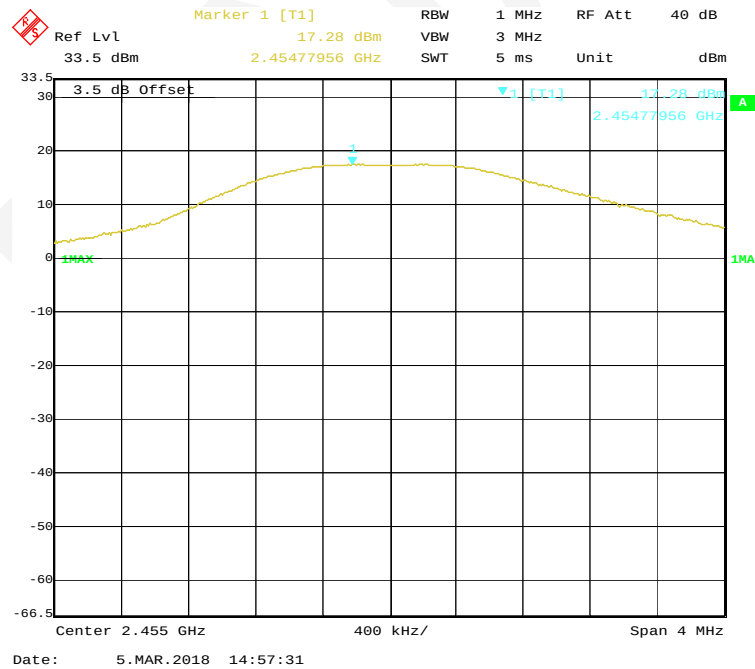
### Low Channel



### Middle Channel



### High Channel



## 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 of spectrum analyzer to 100 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 Data

#### Environmental Conditions

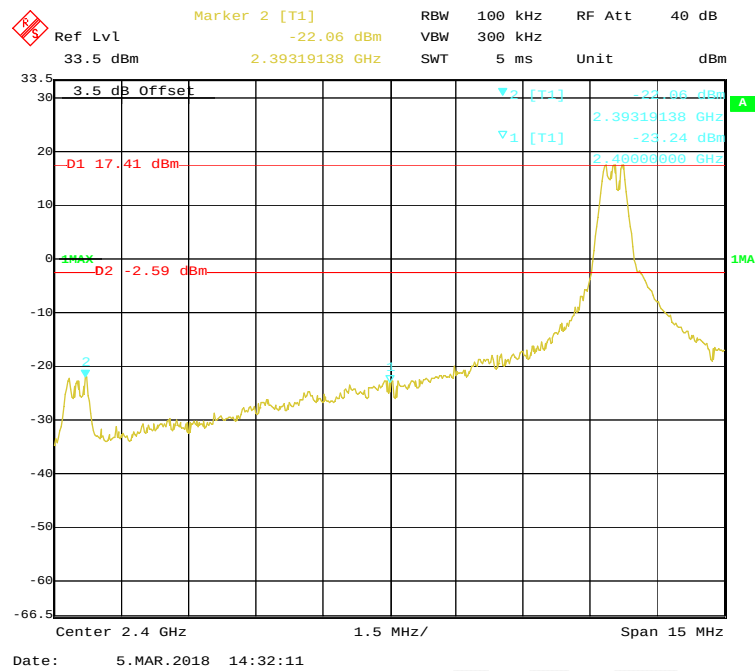
|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 24.2 °C   |
| <b>Relative Humidity:</b> | 50%       |
| <b>ATM Pressure:</b>      | 101.2 kPa |

*The testing was performed by Chris Wang on 2018-03-05.*

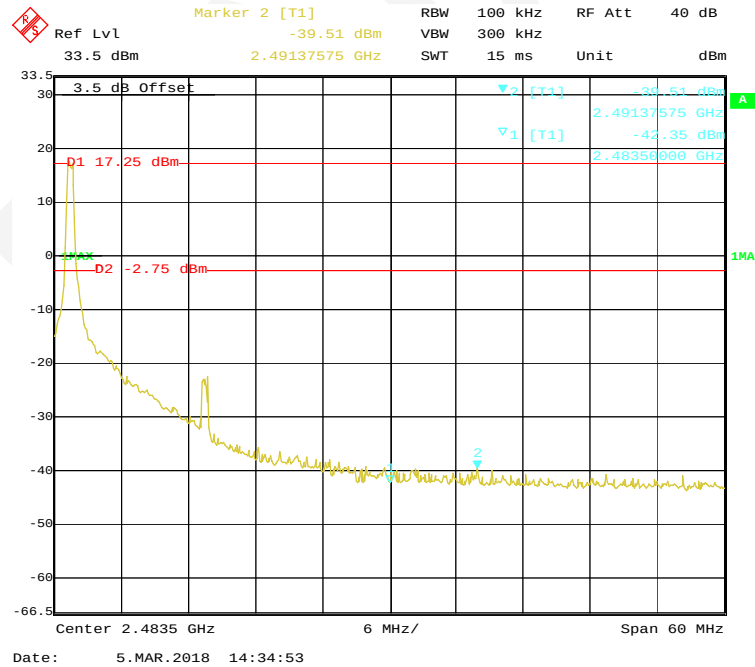
*EUT operation mode: Transmitting & Hopping*

*Test Result: Compliance.*

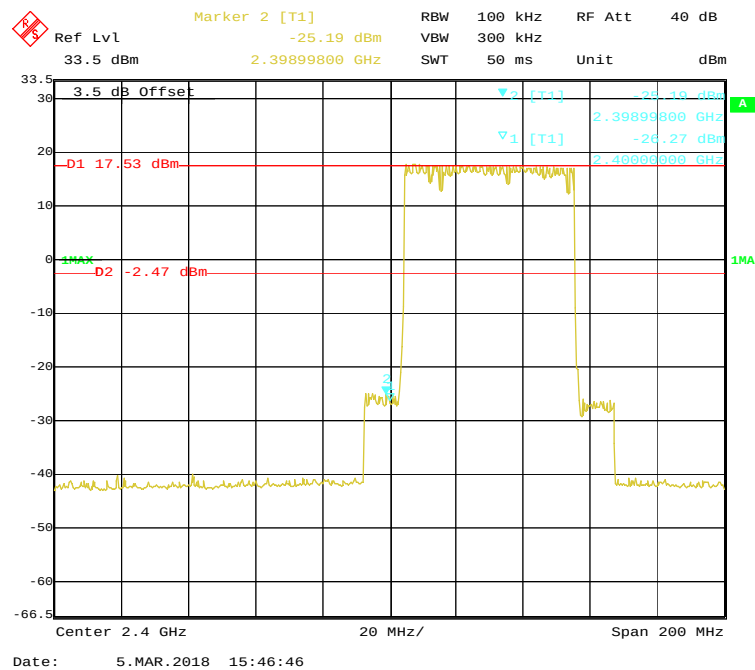
### Left Side



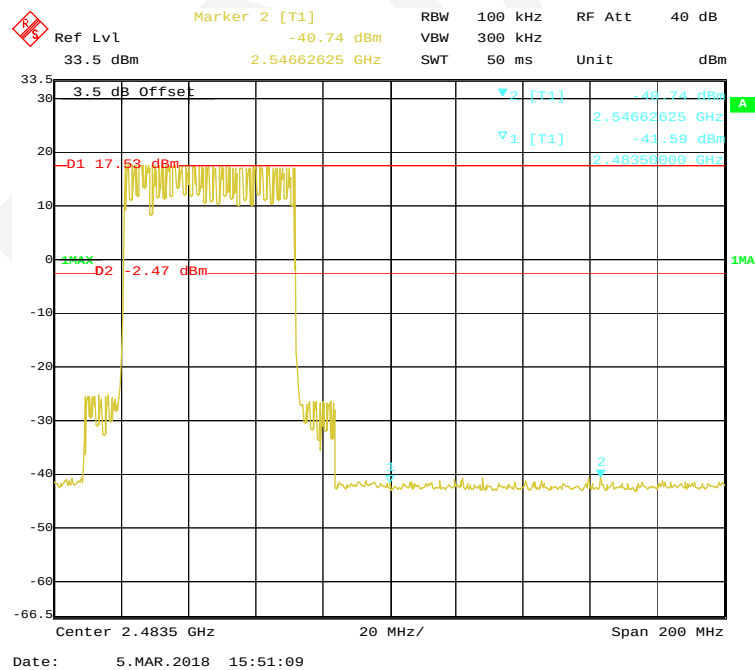
## Right Side



### Left Side-Hopping



### Right Side-Hopping



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