



TESTING LABORATORY  
CERTIFICATE # 4821.01



FCC PART 15.247

## TEST REPORT

For

**Shenzhen Rakwireless Technology Co., Ltd.**

Room 506, Bldg B, New Compark, Pingshan First Road, Taoyuan Street, XiLi town Nanshan  
District, Shenzhen, China

**FCC ID: 2AF6B-RAK7431**

|                                                                                                                                                                                                                                                                                                                             |                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| <b>Report Type:</b><br>Original Report                                                                                                                                                                                                                                                                                      | <b>Product Type:</b><br>RS485 to LoRaWAN Converter |
| <b>Report Number:</b> RSZ200511003-00A                                                                                                                                                                                                                                                                                      |                                                    |
| <b>Report Date:</b> 2020-06-17                                                                                                                                                                                                                                                                                              |                                                    |
| Jacob Kong                                                                                                                                                                                                                                                                                                                  |                                                    |
| <b>Reviewed By:</b> RF Engineer                                                                                                                                                                                                                                                                                             | <i>Jacob Kong</i>                                  |
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## **TABLE OF CONTENTS**

|                                                                               |           |
|-------------------------------------------------------------------------------|-----------|
| <b>GENERAL INFORMATION.....</b>                                               | <b>3</b>  |
| PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT) .....                      | 3         |
| OBJECTIVE .....                                                               | 3         |
| RELATED SUBMITTAL(S)/GRANT(S).....                                            | 3         |
| TEST METHODOLOGY .....                                                        | 3         |
| MEASUREMENT UNCERTAINTY.....                                                  | 4         |
| TEST FACILITY .....                                                           | 4         |
| <b>SYSTEM TEST CONFIGURATION.....</b>                                         | <b>5</b>  |
| DESCRIPTION OF TEST CONFIGURATION .....                                       | 5         |
| EQUIPMENT MODIFICATIONS .....                                                 | 5         |
| EUT EXERCISE SOFTWARE .....                                                   | 5         |
| SUPPORT EQUIPMENT LIST AND DETAILS .....                                      | 6         |
| EXTERNAL I/O CABLE.....                                                       | 6         |
| BLOCK DIAGRAM OF TEST SETUP .....                                             | 6         |
| <b>SUMMARY OF TEST RESULTS.....</b>                                           | <b>7</b>  |
| <b>TEST EQUIPMENT LIST .....</b>                                              | <b>8</b>  |
| <b>FCC §15.247 (i) &amp; §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE).....</b> | <b>9</b>  |
| APPLICABLE STANDARD .....                                                     | 9         |
| RESULT .....                                                                  | 9         |
| <b>FCC §15.203 - ANTENNA REQUIREMENT.....</b>                                 | <b>10</b> |
| APPLICABLE STANDARD .....                                                     | 10        |
| ANTENNA CONNECTOR CONSTRUCTION .....                                          | 10        |
| <b>FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS .....</b>                    | <b>11</b> |
| APPLICABLE STANDARD .....                                                     | 11        |
| EUT SETUP .....                                                               | 11        |
| EMI TEST RECEIVER SETUP.....                                                  | 11        |
| TEST PROCEDURE .....                                                          | 11        |
| CORRECTED FACTOR & MARGIN CALCULATION .....                                   | 12        |
| TEST RESULTS SUMMARY .....                                                    | 12        |
| TEST DATA .....                                                               | 12        |
| <b>FCC §15.209, §15.205 &amp; §15.247(d) - SPURIOUS EMISSIONS.....</b>        | <b>17</b> |
| APPLICABLE STANDARD .....                                                     | 17        |
| EUT SETUP .....                                                               | 17        |
| EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP .....                             | 18        |
| TEST PROCEDURE .....                                                          | 18        |
| CORRECTED AMPLITUDE & MARGIN CALCULATION .....                                | 18        |
| TEST RESULTS SUMMARY .....                                                    | 18        |
| TEST DATA .....                                                               | 18        |

## GENERAL INFORMATION

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

|                                        |                                                                                        |
|----------------------------------------|----------------------------------------------------------------------------------------|
| Product                                | RS485 to LoRaWAN Converter                                                             |
| Tested Model                           | RAK7431                                                                                |
| Frequency Range                        | 902.3-914.9 MHz                                                                        |
| Maximum Conducted Average Output Power | 5.38dBm                                                                                |
| Technique                              | Hybrid System                                                                          |
| Antenna Specification                  | 3.0dBi                                                                                 |
| Voltage Range                          | DC 5V from mirco USB port or DC 8-48V from DC input port                               |
| Date of Test                           | 2020-05-20 to 2020-06-03                                                               |
| Sample serial number                   | RSZ200511003-RF-S1 (Assigned by BACL, Shenzhen)                                        |
| Received date                          | 2020-05-11                                                                             |
| Sample/EUT Status                      | Good condition                                                                         |
| Adapter information                    | Model: PSY2400300<br>Input: AC 100-240V, 50/60Hz, 0.6A Max<br>Output: DC 24.0V, 300 mA |

### Objective

This report is prepared on behalf of *Shenzhen Rakwireless Technology Co., Ltd.* in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

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

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

Part 15.247 DTS submissions with FCC ID: 2AF6B-RAK7431.

### 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 v05r02.

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

**Measurement Uncertainty**

| Parameter                    |            | uncertainty |
|------------------------------|------------|-------------|
| Occupied Channel Bandwidth   |            | ±5%         |
| RF output power, conducted   |            | ±0.73dB     |
| Unwanted Emission, conducted |            | ±1.95dB     |
| Radiated Emissions           | Below 1GHz | ±4.75dB     |
|                              | Above 1GHz | ±4.88dB     |
| Temperature                  |            | ±1 °C       |
| Supply voltages              |            | ±0.4%       |

*Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.*

**Test Facility**

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 342867, the FCC Designation No. : CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

The system was configured for testing in engineering mode.

| No. | Freq.(MHz) | No. | Freq.(MHz) | No. | Freq.(MHz) | No. | Freq.(MHz) |
|-----|------------|-----|------------|-----|------------|-----|------------|
| 1   | 902.3      | 17  | 905.5      | 33  | 908.7      | 49  | 911.9      |
| 2   | 902.5      | 18  | 905.7      | 34  | 908.9      | 50  | 912.1      |
| 3   | 902.7      | 19  | 905.9      | 35  | 909.1      | 51  | 912.3      |
| 4   | 902.9      | 20  | 906.1      | 36  | 909.3      | 52  | 912.5      |
| 5   | 903.1      | 21  | 906.3      | 37  | 909.5      | 53  | 912.7      |
| 6   | 903.3      | 22  | 906.5      | 38  | 909.7      | 54  | 912.9      |
| 7   | 903.5      | 23  | 906.7      | 39  | 909.9      | 55  | 913.1      |
| 8   | 903.7      | 24  | 906.9      | 40  | 910.1      | 56  | 913.3      |
| 9   | 903.9      | 25  | 907.1      | 41  | 910.3      | 57  | 913.5      |
| 10  | 904.1      | 26  | 907.3      | 42  | 910.5      | 58  | 913.7      |
| 11  | 904.3      | 27  | 907.5      | 43  | 910.7      | 59  | 913.9      |
| 12  | 904.5      | 28  | 907.7      | 44  | 910.9      | 60  | 914.1      |
| 13  | 904.7      | 29  | 907.9      | 45  | 911.1      | 61  | 914.3      |
| 14  | 904.9      | 30  | 908.1      | 46  | 911.3      | 62  | 914.5      |
| 15  | 905.1      | 31  | 908.3      | 47  | 911.5      | 63  | 914.7      |
| 16  | 905.3      | 32  | 908.5      | 48  | 911.7      | 64  | 914.9      |

Channel 1, 33 and 64 were tested.

### Equipment Modifications

No modification was made to the EUT tested.

### EUT Exercise Software

“UART Assist” was made to the EUT tested and the power level is 20.

### Special Accessories

No special accessory.

### Equipment Modifications

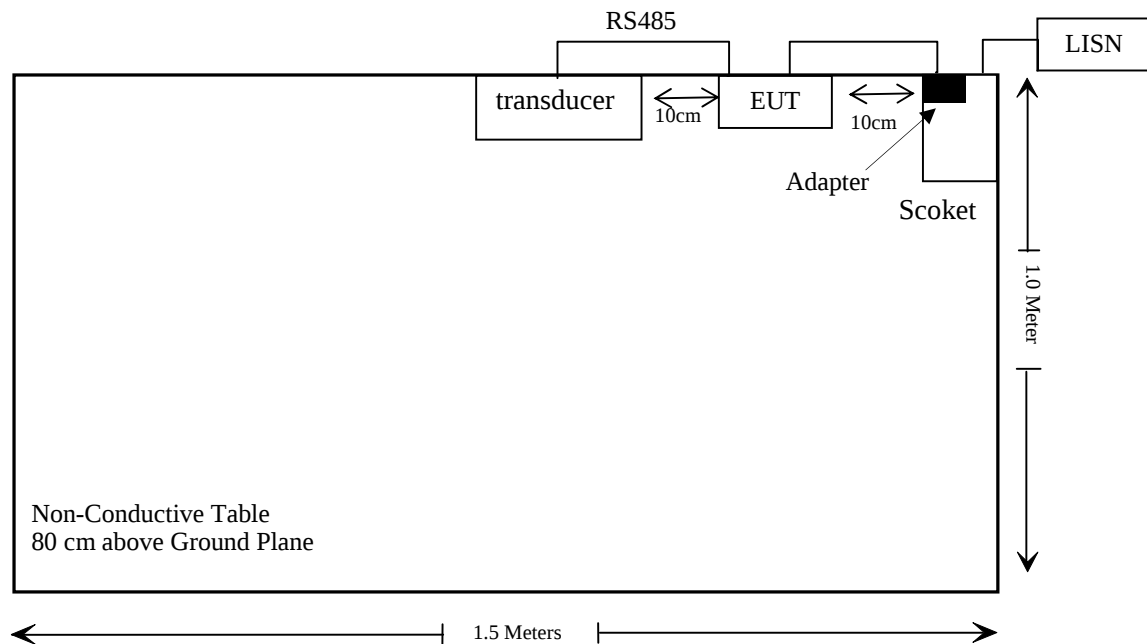
No modification was made to the EUT tested.

**Support Equipment List and Details**

| Manufacturer  | Description | Model   | Serial Number |
|---------------|-------------|---------|---------------|
| SWITCHING     | Adapter     | SW-1772 | Unknown       |
| BULL          | Socket      | GN-415K | 5503290068073 |
| Guangzhu avvR | transducer  | HTS40L  | Unknown       |

**External I/O Cable**

| Cable Description                   | Length (m) | From/Port | To         |
|-------------------------------------|------------|-----------|------------|
| Un-shielding Detachable USB Cable   | 1.0        | EUT       | Adapter    |
| Un-shielding Detachable DC Cable    | 1.0        | EUT       | Adapter    |
| Un-shielding Detachable RS485 Cable | 1.0        | EUT       | transducer |

**Block Diagram of Test Setup**

**SUMMARY OF TEST RESULTS**

| FCC Rules                     | Description of Test               | Result      |
|-------------------------------|-----------------------------------|-------------|
| §15.247 (i), §2.1091          | Maximum Permissible Exposure(MPE) | 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)(i)              | Channel Separation Test           | Compliance* |
| §15.247(f)                    | Time of Occupancy (Dwell Time)    | Compliance* |
| §15.247(b)(3)                 | Peak Output Power Measurement     | Compliance* |
| §15.247(d)                    | Band edges                        | Compliance* |
| §15.247(f)                    | Power Spectral Density            | Compliance* |

Compliance\*: This device contains a certified module (model No.: RAK4200(H), FCC ID: 2AF6B-RAK4200H), please refer to the module test report No. RGMA190904002-00A which was tested by Bay Area Compliance Laboratories Corp. (Shenzhen).

**TEST EQUIPMENT LIST**

| Manufacturer                    | Description        | Model                   | Serial Number          | Calibration Date | Calibration Due Date |
|---------------------------------|--------------------|-------------------------|------------------------|------------------|----------------------|
| <b>Conducted Emissions Test</b> |                    |                         |                        |                  |                      |
| Rohde & Schwarz                 | EMI Test Receiver  | ESCI                    | 101120                 | 2019/7/9         | 2020/7/8             |
| Rohde & Schwarz                 | LISN               | ENV216                  | 101613                 | 2020/1/22        | 2021/1/21            |
| Rohde & Schwarz                 | Transient Limiter  | ESH3Z2                  | DE25985                | 2019/11/29       | 2020/11/28           |
| Unknown                         | CE Cable           | CE Cable                | UF A210B-1-0720-504504 | 2019/11/29       | 2020/11/28           |
| Rohde & Schwarz                 | CE Test software   | EMC 32                  | V8.53.0                | NCR              | NCR                  |
| <b>Radiated Emission Test</b>   |                    |                         |                        |                  |                      |
| R&S                             | EMI Test Receiver  | ESR3                    | 102455                 | 2019/7/9         | 2020/7/8             |
| Sonoma instrument               | Pre-amplifier      | 310 N                   | 186238                 | 2020/4/20        | 2021/4/20            |
| Sunol Sciences                  | Broadband Antenna  | JB1                     | A040904-1              | 2017/12/22       | 2020/12/21           |
| Unknown                         | Cable 2            | RF Cable 2              | F-03-EM197             | 2019/11/29       | 2020/11/28           |
| Unknown                         | Cable 1            | Chamber Cable 1         | F-03-EM236             | 2019/11/29       | 2020/11/28           |
| Rohde & Schwarz                 | Auto test software | EMC 32                  | V9.10                  | NCR              | NCR                  |
| Rohde & Schwarz                 | Spectrum Analyzer  | FSV40-N                 | 102259                 | 2019/7/22        | 2020/07/21           |
| COM-POWER                       | Pre-amplifier      | PA-122                  | 181919                 | 2019/11/29       | 2020/11/28           |
| Sunol Sciences                  | Horn Antenna       | DRH-118                 | A052604                | 2017/12/22       | 2020/12/21           |
| Insulted Wire Inc.              | RF Cable           | SPS-2503-3150           | 02222010               | 2019/11/29       | 2020/11/28           |
| Unknown                         | RF Cable           | W1101-EQ1 OUT           | F-19-EM005             | 2019/11/29       | 2020/11/28           |
| SNSD                            | Band Reject filter | BSF2402-2480MN-0898-001 | 2.4G filter            | 2020/4/20        | 2021/4/20            |
| Quinstar                        | Amplifier          | QLW-18405536-J0         | 15964001002            | 2019/11/29       | 2020/11/28           |
| Ducommun Technologies           | Horn antenna       | ARH-4223-02             | 1007726-021304         | 2017/12/6        | 2020/12/5            |

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

## FCC §15.247 (i) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

### Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

#### Limits for General Population/Uncontrolled Exposure

| Limits for General Population/Uncontrolled Exposure |                               |                               |                                     |                          |
|-----------------------------------------------------|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| Frequency Range (MHz)                               | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (mW/cm <sup>2</sup> ) | Averaging Time (Minutes) |
| 0.3-1.34                                            | 614                           | 1.63                          | *(100)                              | 30                       |
| 1.34-30                                             | 824/f                         | 2.19/f                        | *(180/f <sup>2</sup> )              | 30                       |
| 30-300                                              | 27.5                          | 0.073                         | 0.2                                 | 30                       |
| 300-1500                                            | /                             | /                             | f/1500                              | 30                       |
| 1500-100,000                                        | /                             | /                             | 1.0                                 | 30                       |

f = frequency in MHz

\* = Plane-wave equivalent power density

### Result

#### Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm<sup>2</sup>)

P = power input to the antenna (in appropriate units, e.g., mW).

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

| Frequency (MHz) | Antenna Gain |           | Tune up conducted power |      | Evaluation Distance (cm) | Power Density (mW/cm <sup>2</sup> ) | MPE Limit (mW/cm <sup>2</sup> ) |
|-----------------|--------------|-----------|-------------------------|------|--------------------------|-------------------------------------|---------------------------------|
|                 | (dBi)        | (numeric) | (dBm)                   | (mW) |                          |                                     |                                 |
| 902.3-914.9     | 3.0          | 2.0       | 6.0                     | 3.98 | 20                       | 0.0016                              | 0.60                            |

Note: To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

### Result: Compliance

## **FCC §15.203 - ANTENNA REQUIREMENT**

---

### **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.
- Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### **Antenna Connector Construction**

The EUT has an external antenna with unique antenna connector and the antenna gain is 3.0dBi, fulfill the requirement of this section. Please refer to the EUT photos.

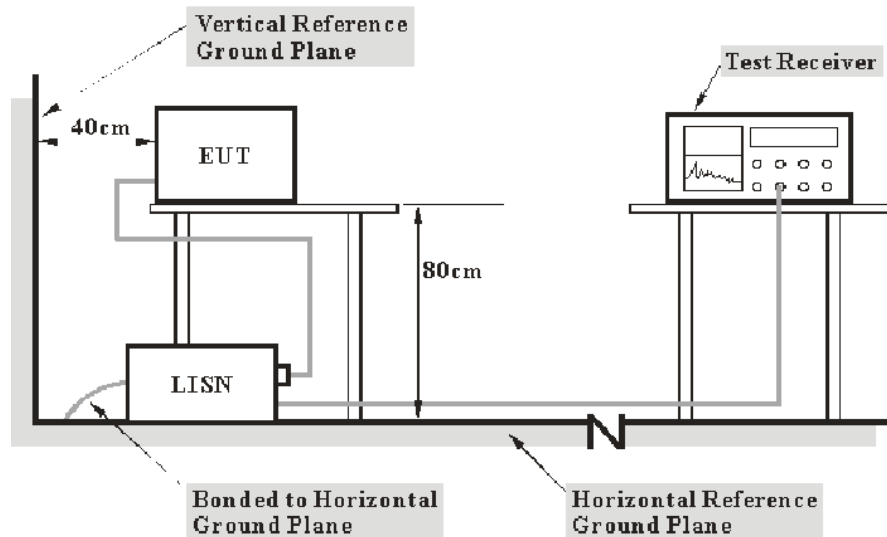
**Result:** Compliance.

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

### Applicable Standard

FCC §15.207(a)

### EUT Setup



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

The measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

The spacing between the peripherals was 10 cm.

### 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 final 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:

$$\text{Correction Factor} = \text{LISN VDF} + \text{Cable Loss} + \text{Transient Limiter Attenuation}$$

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:

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

### Test Results Summary

According to the EUT complied with the FCC Part 15.207,

### Test Data

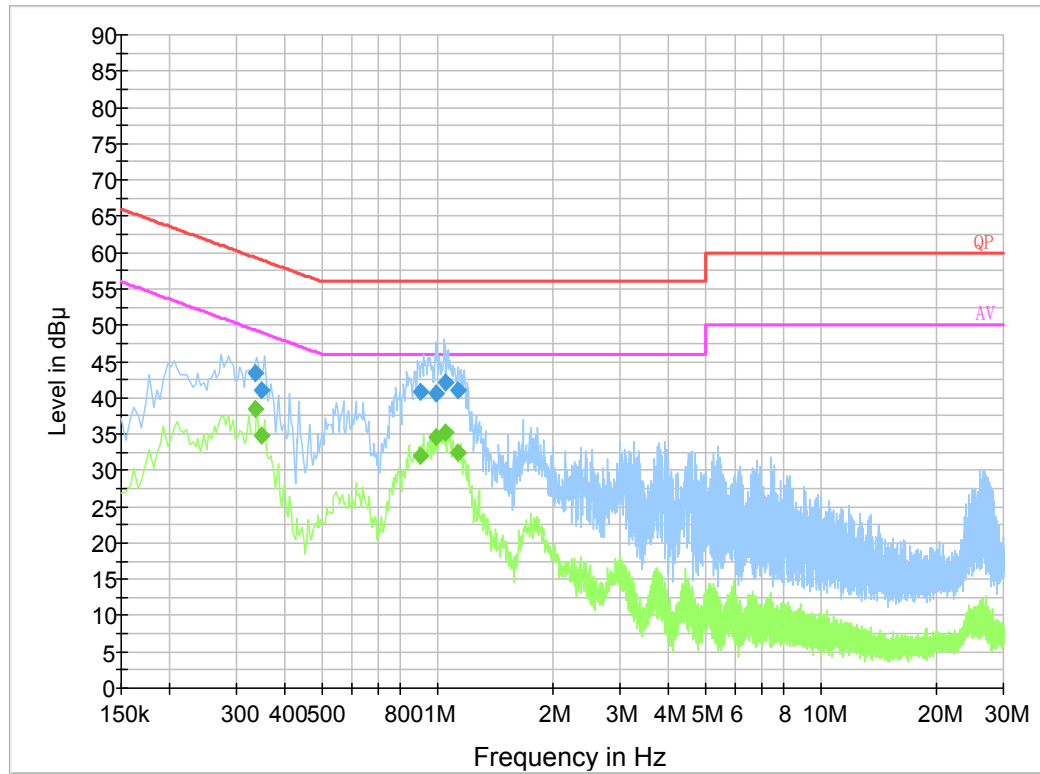
#### Environmental Conditions

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 25 °C     |
| <b>Relative Humidity:</b> | 65 %      |
| <b>ATM Pressure:</b>      | 101.0 kPa |

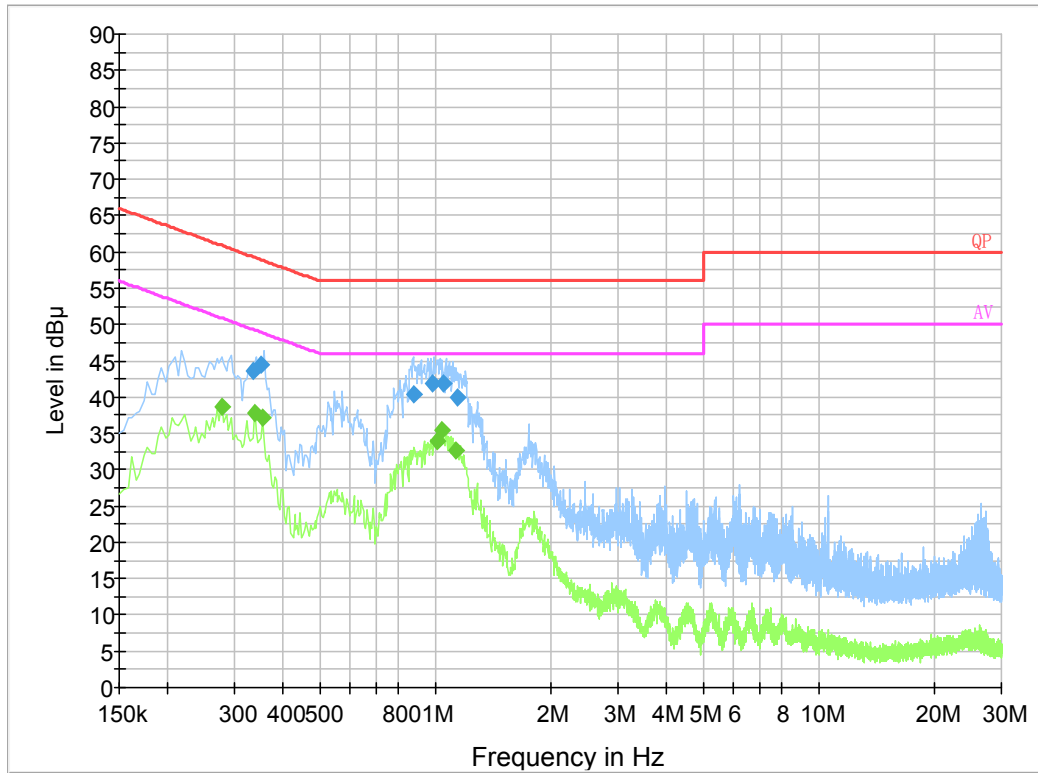
*The testing was performed by Haiguo Li on 2020-05-21.*

*EUT operation mode: Transmitting (the worst case is Middle channel)*

**Powered from mirco USB port:  
AC 120V/60 Hz, Line**

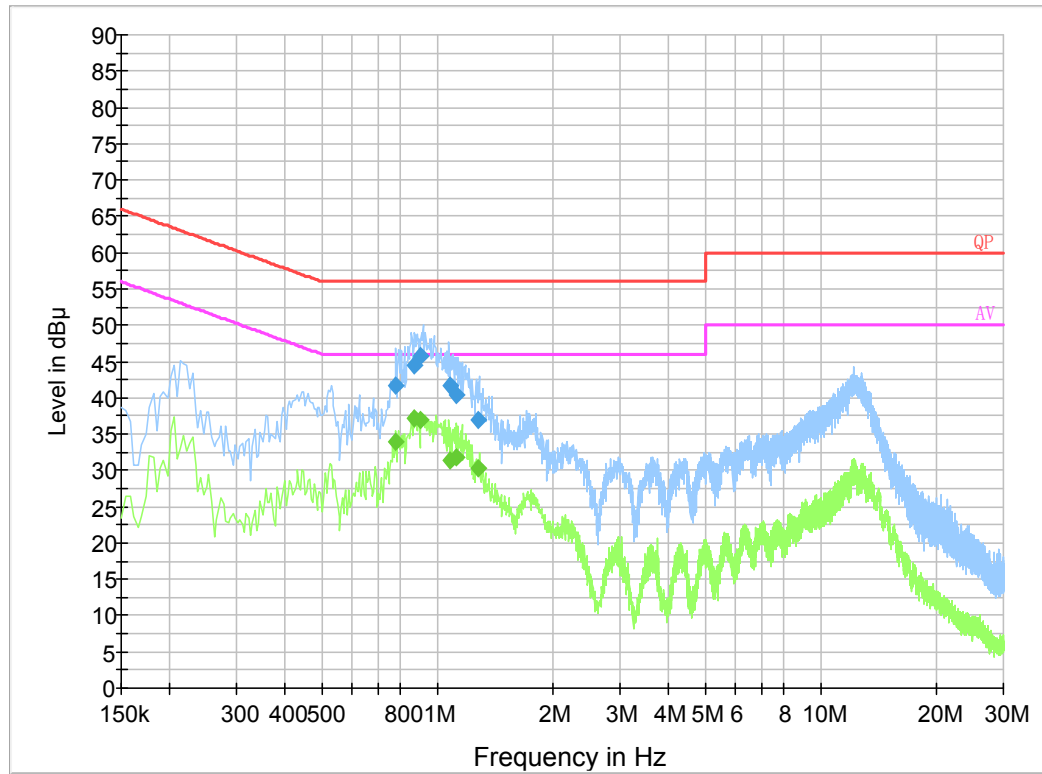


| Frequency (MHz) | Corrected Amplitude (dBμV) | Correction Factor (dB) | Limit (dBμV) | Margin (dB) | Detector (PK/Ave./QP) |
|-----------------|----------------------------|------------------------|--------------|-------------|-----------------------|
| 0.336930        | 43.3                       | 19.8                   | 59.3         | 16.0        | QP                    |
| 0.348690        | 41.1                       | 19.9                   | 59.0         | 17.9        | QP                    |
| 0.903350        | 40.9                       | 19.8                   | 56.0         | 15.1        | QP                    |
| 0.995150        | 40.6                       | 19.9                   | 56.0         | 15.4        | QP                    |
| 1.050310        | 42.0                       | 19.9                   | 56.0         | 14.0        | QP                    |
| 1.132930        | 41.1                       | 19.8                   | 56.0         | 14.9        | QP                    |
| 0.336930        | 38.5                       | 19.8                   | 49.3         | 10.8        | Ave.                  |
| 0.348690        | 34.8                       | 19.9                   | 49.0         | 14.2        | Ave.                  |
| 0.903350        | 32.1                       | 19.8                   | 46.0         | 13.9        | Ave.                  |
| 0.995150        | 34.7                       | 19.9                   | 46.0         | 11.3        | Ave.                  |
| 1.050310        | 35.2                       | 19.9                   | 46.0         | 10.8        | Ave.                  |
| 1.132930        | 32.5                       | 19.8                   | 46.0         | 13.5        | Ave.                  |

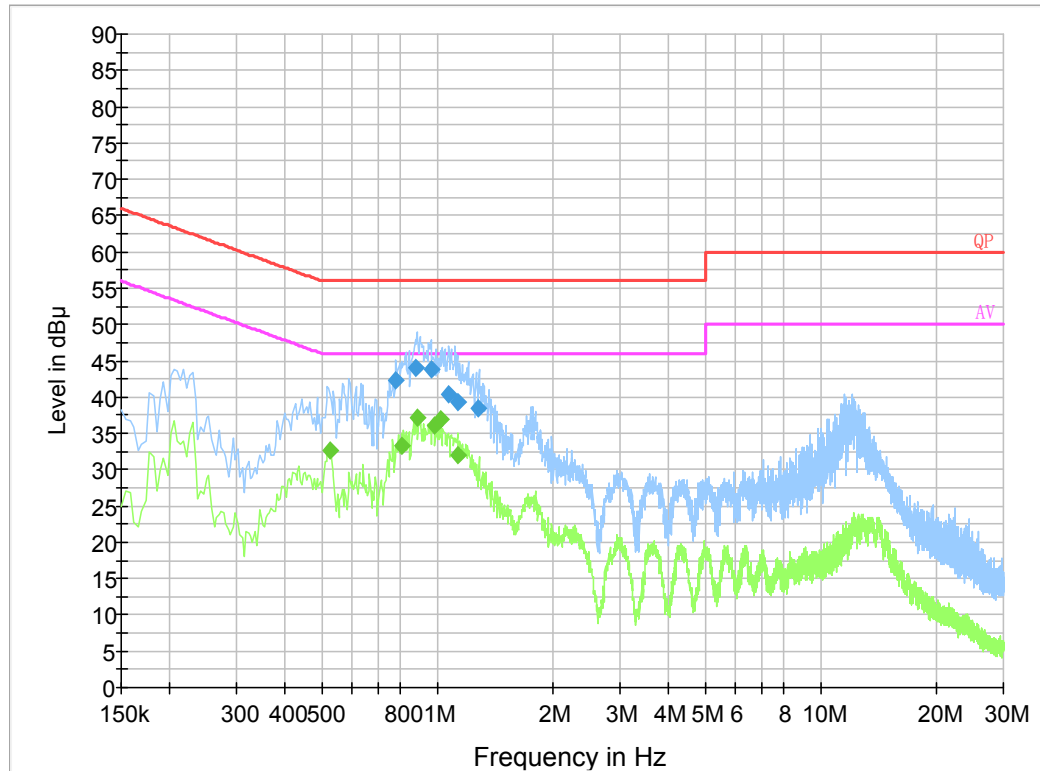
**AC 120V/60 Hz, Neutral**

| Frequency (MHz) | Corrected Amplitude (dBμV) | Correction Factor (dB) | Limit (dBμV) | Margin (dB) | Detector (PK/Ave./QP) |
|-----------------|----------------------------|------------------------|--------------|-------------|-----------------------|
| 0.336870        | 43.6                       | 19.8                   | 59.3         | 15.7        | QP                    |
| 0.352630        | 44.4                       | 19.9                   | 58.9         | 14.5        | QP                    |
| 0.876830        | 40.4                       | 19.7                   | 56.0         | 15.6        | QP                    |
| 0.983150        | 41.8                       | 19.8                   | 56.0         | 14.2        | QP                    |
| 1.053950        | 41.8                       | 19.8                   | 56.0         | 14.2        | QP                    |
| 1.140930        | 39.9                       | 19.8                   | 56.0         | 16.1        | QP                    |
| 0.278000        | 38.7                       | 19.7                   | 50.9         | 12.2        | Ave.                  |
| 0.338000        | 37.8                       | 19.8                   | 49.3         | 11.5        | Ave.                  |
| 0.354000        | 37.2                       | 19.9                   | 48.9         | 11.6        | Ave.                  |
| 1.010000        | 34.0                       | 19.8                   | 46.0         | 12.0        | Ave.                  |
| 1.046000        | 35.4                       | 19.8                   | 46.0         | 10.6        | Ave.                  |
| 1.134000        | 32.6                       | 19.8                   | 46.0         | 13.4        | Ave.                  |

**Powered from DC input port:  
AC 120V/60 Hz, Line**



| Frequency (MHz) | Corrected Amplitude (dBμV) | Correction Factor (dB) | Limit (dBμV) | Margin (dB) | Detector (PK/Ave./QP) |
|-----------------|----------------------------|------------------------|--------------|-------------|-----------------------|
| 0.782270        | 41.7                       | 19.8                   | 56.0         | 14.3        | QP                    |
| 0.869130        | 44.4                       | 19.8                   | 56.0         | 11.6        | QP                    |
| 0.908230        | 45.7                       | 19.8                   | 56.0         | 10.3        | QP                    |
| 1.081890        | 41.7                       | 19.9                   | 56.0         | 14.3        | QP                    |
| 1.120930        | 40.3                       | 19.8                   | 56.0         | 15.7        | QP                    |
| 1.278710        | 36.9                       | 19.8                   | 56.0         | 19.1        | QP                    |
| 0.782270        | 33.9                       | 19.8                   | 46.0         | 12.1        | Ave.                  |
| 0.869130        | 37.1                       | 19.8                   | 46.0         | 8.9         | Ave.                  |
| 0.908230        | 37.0                       | 19.8                   | 46.0         | 9.0         | Ave.                  |
| 1.081890        | 31.3                       | 19.9                   | 46.0         | 14.7        | Ave.                  |
| 1.120930        | 31.7                       | 19.8                   | 46.0         | 14.3        | Ave.                  |
| 1.278710        | 30.4                       | 19.8                   | 46.0         | 15.6        | Ave.                  |

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

| Frequency (MHz) | Corrected Amplitude (dBμV) | Correction Factor (dB) | Limit (dBμV) | Margin (dB) | Detector (PK/Ave./QP) |
|-----------------|----------------------------|------------------------|--------------|-------------|-----------------------|
| 0.782270        | 42.3                       | 19.8                   | 56.0         | 13.7        | QP                    |
| 0.876710        | 44.1                       | 19.7                   | 56.0         | 11.9        | QP                    |
| 0.963570        | 43.8                       | 19.8                   | 56.0         | 12.2        | QP                    |
| 1.069890        | 40.4                       | 19.8                   | 56.0         | 15.6        | QP                    |
| 1.133050        | 39.3                       | 19.8                   | 56.0         | 16.7        | QP                    |
| 1.278710        | 38.4                       | 19.8                   | 56.0         | 17.6        | QP                    |
| 0.526000        | 32.7                       | 19.8                   | 46.0         | 13.3        | Ave.                  |
| 0.810000        | 33.2                       | 19.8                   | 46.0         | 12.8        | Ave.                  |
| 0.886000        | 37.1                       | 19.7                   | 46.0         | 8.9         | Ave.                  |
| 0.982000        | 36.1                       | 19.8                   | 46.0         | 9.9         | Ave.                  |
| 1.022000        | 36.9                       | 19.8                   | 46.0         | 9.1         | Ave.                  |
| 1.134000        | 31.9                       | 19.8                   | 46.0         | 14.1        | Ave.                  |

**Note:**

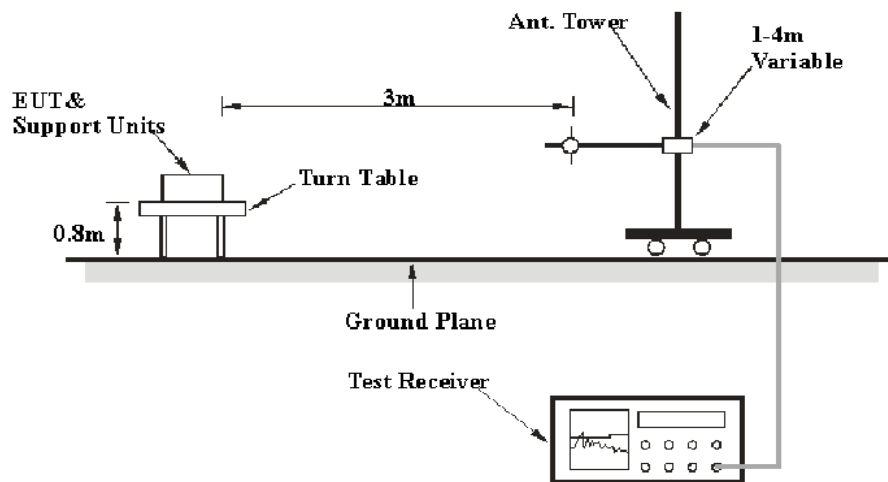
- 1) Correction Factor = LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
- 2) Corrected Amplitude = Reading + Correction Factor
- 3) Margin = Limit – Corrected Amplitude

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

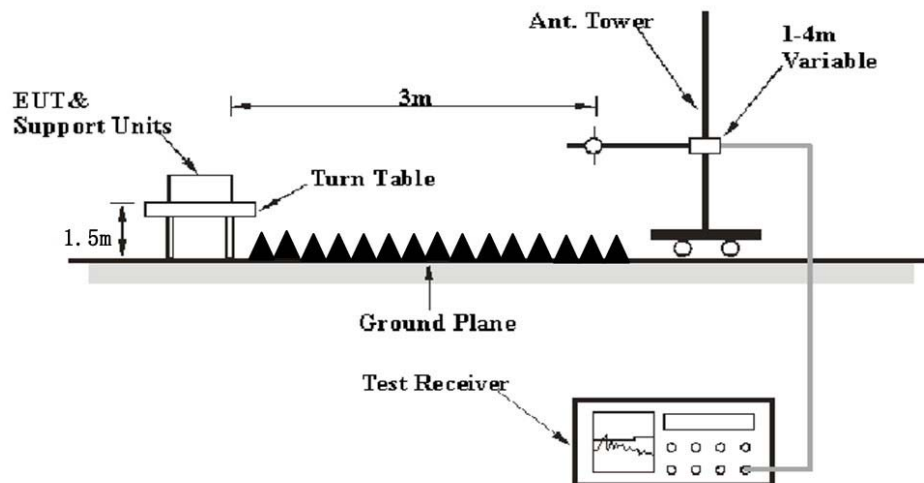
FCC §15.247 (d); §15.209; §15.205;

**EUT Setup**

**Below 1 GHz:**



**Above 1GHz:**



The radiated emission tests were performed in the 3 meters test site, 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 10 GHz.

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

| Frequency Range   | RBW     | Video B/W | IF B/W  | Measurements |
|-------------------|---------|-----------|---------|--------------|
| 30 MHz – 1000 MHz | 100 kHz | 300 kHz   | 120 kHz | QP           |
| Above 1 GHz       | 1MHz    | 3 MHz     | /       | PK           |
|                   | 1MHz    | 10 Hz     | /       | Ave.         |

## 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 Results Summary

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

## Test Data

### Environmental Conditions

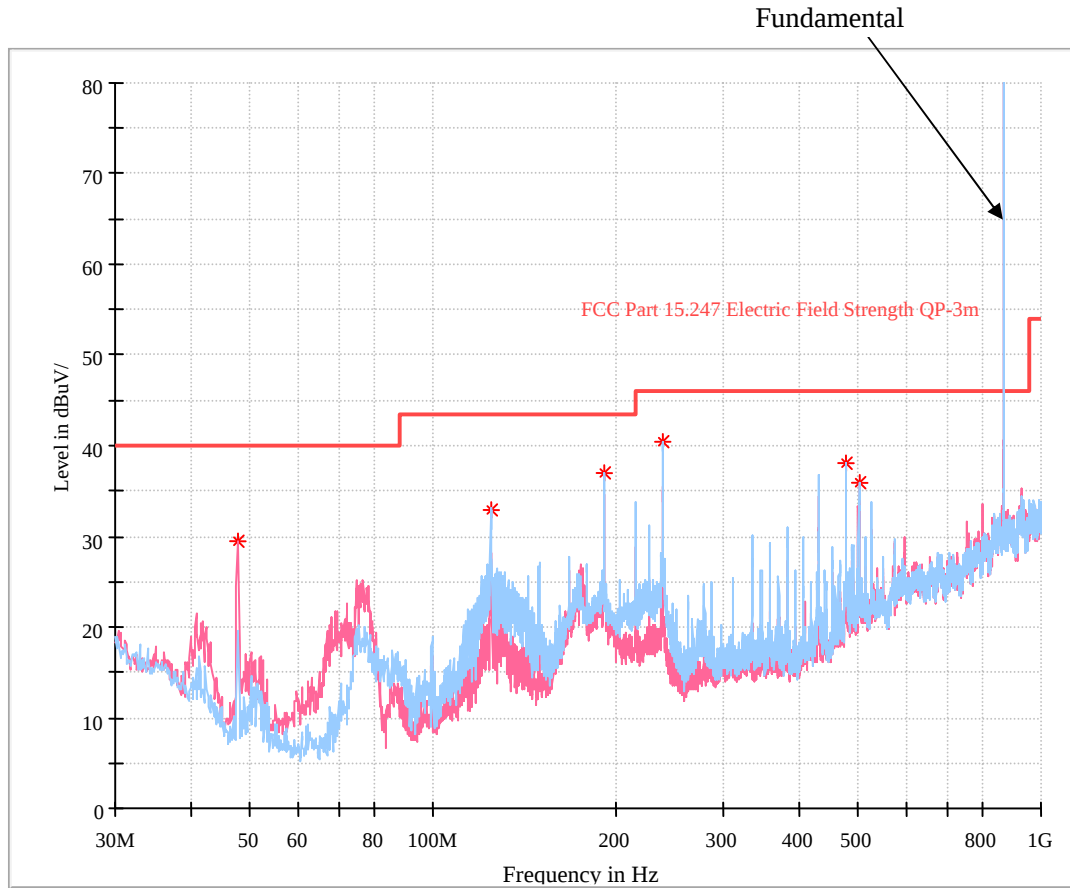
|                    |           |
|--------------------|-----------|
| Temperature:       | 26 °C     |
| Relative Humidity: | 65 %      |
| ATM Pressure:      | 101.0 kPa |

*The testing was performed by Hams He from 2020-05-29 to 2020-06-03 for below 1GHz and Leo Huang on 2020-05-20 for above 1GHz.*

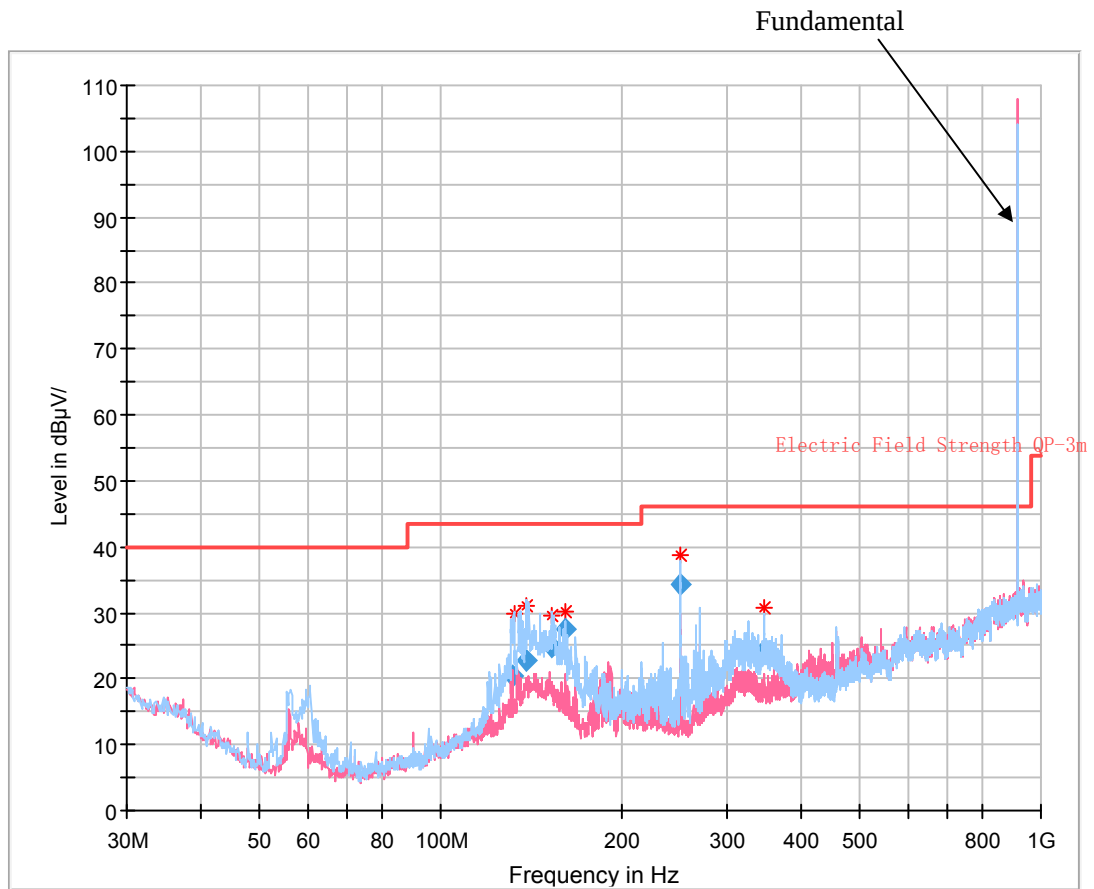
EUT operation mode: Transmitting (worst case)

30 MHz~1 GHz:

Powered from mirco USB port:



| Frequency (MHz) | Corrected Amplitude (dBμV/m) | Antenna height (cm) | Antenna Polarity | Turntable position (degree) | Correction Factor (dB/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|------------------------------|---------------------|------------------|-----------------------------|--------------------------|----------------|-------------|
| 47.702500       | 29.46                        | 105.0               | V                | 119.0                       | -18.6                    | 40.00          | 10.54       |
| 124.332500      | 32.95                        | 205.0               | H                | 0.0                         | -14.0                    | 43.50          | 10.55       |
| 191.141250      | 37.01                        | 205.0               | H                | 305.0                       | -15.0                    | 43.50          | 6.49        |
| 239.156250      | 40.37                        | 105.0               | H                | 101.0                       | -14.1                    | 46.00          | 5.63        |
| 478.261250      | 38.04                        | 105.0               | H                | 179.0                       | -6.5                     | 46.00          | 7.96        |
| 501.783750      | 35.99                        | 205.0               | V                | 222.0                       | -5.2                     | 46.00          | 10.01       |

**Powered from DC input port:**

| Frequency (MHz) | Corrected Amplitude (dBμV/m) | Antenna height (cm) | Antenna Polarity | Turntable position (degree) | Correction Factor (dB/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|------------------------------|---------------------|------------------|-----------------------------|--------------------------|----------------|-------------|
| 131.785125      | 20.32                        | 331.0               | H                | 130.0                       | -13.8                    | 43.50          | 23.18       |
| 138.680000      | 22.91                        | 200.0               | H                | 312.0                       | -14.2                    | 43.50          | 20.59       |
| 153.395375      | 24.77                        | 196.0               | H                | 257.0                       | -14.3                    | 43.50          | 18.73       |
| 161.130125      | 27.45                        | 153.0               | H                | 111.0                       | -14.5                    | 43.50          | 16.05       |
| 251.374000      | 34.37                        | 111.0               | H                | 316.0                       | -14.0                    | 46.00          | 11.63       |
| 345.094250      | 24.26                        | 149.0               | H                | 272.0                       | -10.8                    | 46.00          | 21.74       |

**1 GHz - 10 GHz:**

| Frequency<br>(MHz) | Receiver          |                          | Turntable<br>Degree | Rx Antenna    |                | Corrected<br>Factor<br>(dB) | Corrected<br>Amplitude<br>(dBμV/m) | FCC Part<br>15.247/205/209 |                |
|--------------------|-------------------|--------------------------|---------------------|---------------|----------------|-----------------------------|------------------------------------|----------------------------|----------------|
|                    | Reading<br>(dBμV) | Detector<br>(PK/QP/Ave.) |                     | Height<br>(m) | Polar<br>(H/V) |                             |                                    | Limit<br>(dBμV/m)          | Margin<br>(dB) |
| 902.3MHz           |                   |                          |                     |               |                |                             |                                    |                            |                |
| 1804.60            | 55.47             | PK                       | 252                 | 1.3           | H              | -1.65                       | 53.82                              | 74                         | 20.18          |
| 1804.60            | 42.52             | Ave.                     | 252                 | 1.3           | H              | -1.65                       | 40.87                              | 54                         | 13.13          |
| 1804.60            | 54.19             | PK                       | 46                  | 1.5           | V              | -1.65                       | 52.54                              | 74                         | 21.46          |
| 1804.60            | 47.88             | Ave.                     | 46                  | 1.5           | V              | -1.65                       | 46.23                              | 54                         | 7.77           |
| 2706.90            | 50.14             | PK                       | 248                 | 2.5           | H              | 1.09                        | 51.23                              | 74                         | 22.77          |
| 2706.90            | 33.00             | Ave.                     | 248                 | 2.5           | H              | 1.09                        | 34.09                              | 54                         | 19.91          |
| 2706.90            | 46.97             | PK                       | 340                 | 1.7           | V              | 1.09                        | 48.06                              | 74                         | 25.94          |
| 2706.90            | 31.45             | Ave.                     | 340                 | 1.7           | V              | 1.09                        | 32.54                              | 54                         | 21.46          |
| 908.7MHz           |                   |                          |                     |               |                |                             |                                    |                            |                |
| 1817.40            | 54.77             | PK                       | 344                 | 1.0           | H              | -1.55                       | 53.22                              | 74                         | 20.78          |
| 1817.40            | 42.78             | Ave.                     | 344                 | 1.0           | H              | -1.55                       | 41.23                              | 54                         | 12.77          |
| 1817.40            | 54.18             | PK                       | 124                 | 1.2           | V              | -1.55                       | 52.63                              | 74                         | 21.37          |
| 1817.40            | 44.16             | Ave.                     | 124                 | 1.2           | V              | -1.55                       | 42.61                              | 54                         | 11.39          |
| 2726.10            | 50.26             | PK                       | 216                 | 1.8           | H              | 1.19                        | 51.45                              | 74                         | 22.55          |
| 2726.10            | 33.82             | Ave.                     | 216                 | 1.8           | H              | 1.19                        | 35.01                              | 54                         | 18.99          |
| 2726.10            | 46.95             | PK                       | 302                 | 2.2           | V              | 1.19                        | 48.14                              | 74                         | 25.86          |
| 2726.10            | 31.42             | Ave.                     | 302                 | 2.2           | V              | 1.19                        | 32.61                              | 54                         | 21.39          |
| 914.9MHz           |                   |                          |                     |               |                |                             |                                    |                            |                |
| 1829.80            | 52.76             | PK                       | 83                  | 2.0           | H              | -1.55                       | 51.21                              | 74                         | 22.79          |
| 1829.80            | 42.24             | Ave.                     | 83                  | 2.0           | H              | -1.55                       | 40.69                              | 54                         | 13.31          |
| 1829.80            | 53.87             | PK                       | 292                 | 2.2           | V              | -1.55                       | 52.32                              | 74                         | 21.68          |
| 1829.80            | 43.70             | Ave.                     | 292                 | 2.2           | V              | -1.55                       | 42.15                              | 54                         | 11.85          |
| 2744.70            | 49.74             | PK                       | 88                  | 2.2           | H              | 1.19                        | 50.93                              | 74                         | 23.07          |
| 2744.70            | 36.61             | Ave.                     | 88                  | 2.2           | H              | 1.19                        | 37.80                              | 54                         | 16.20          |
| 2744.70            | 46.52             | PK                       | 179                 | 1.1           | V              | 1.19                        | 47.71                              | 74                         | 26.29          |
| 2744.70            | 30.49             | Ave.                     | 179                 | 1.1           | V              | 1.19                        | 31.68                              | 54                         | 22.32          |

**Note:**

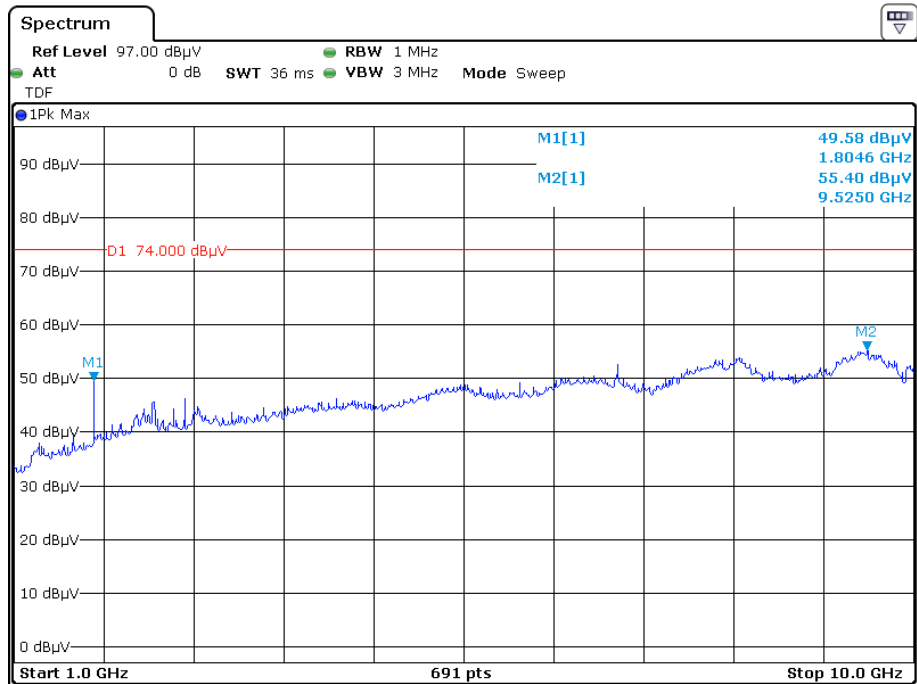
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

Margin = Limit - Corrected. Amplitude

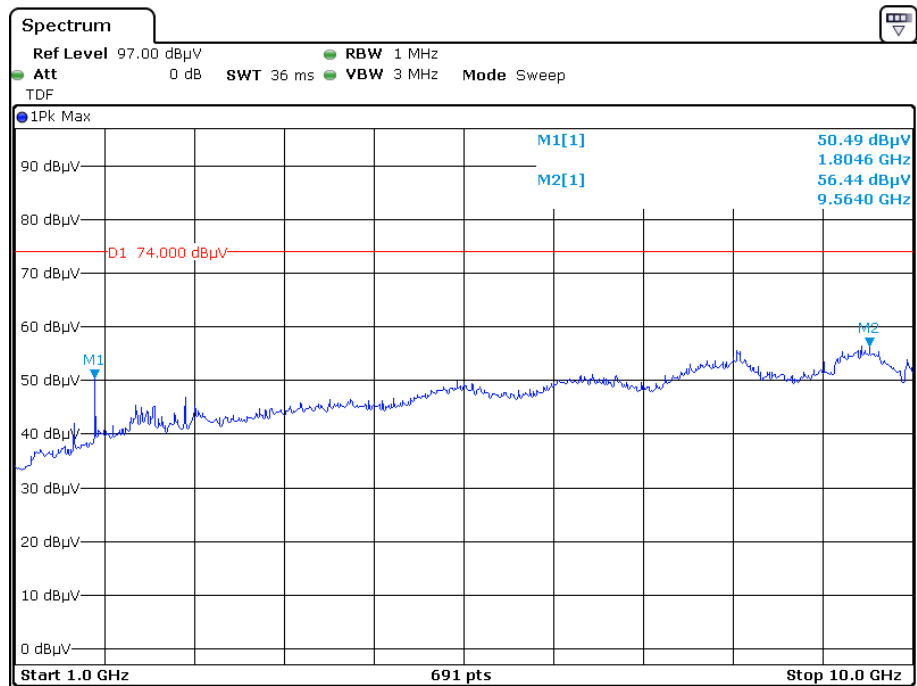
The other spurious emission which is 20dB to the limit was not recorded.

### Pre-scan with low channel Peak Horizontal

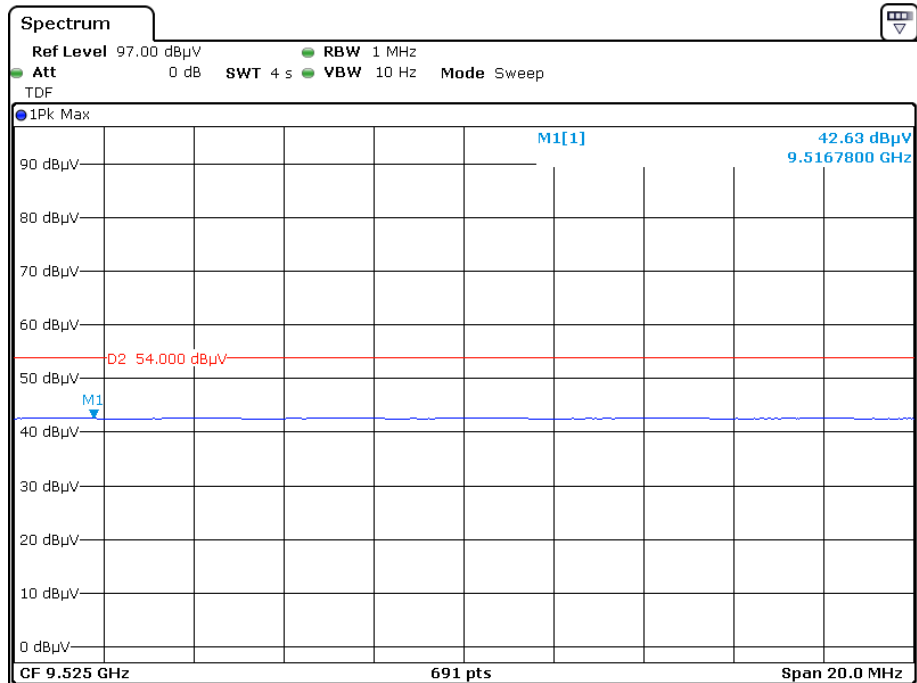


Date: 20.MAY.2020 19:53:09

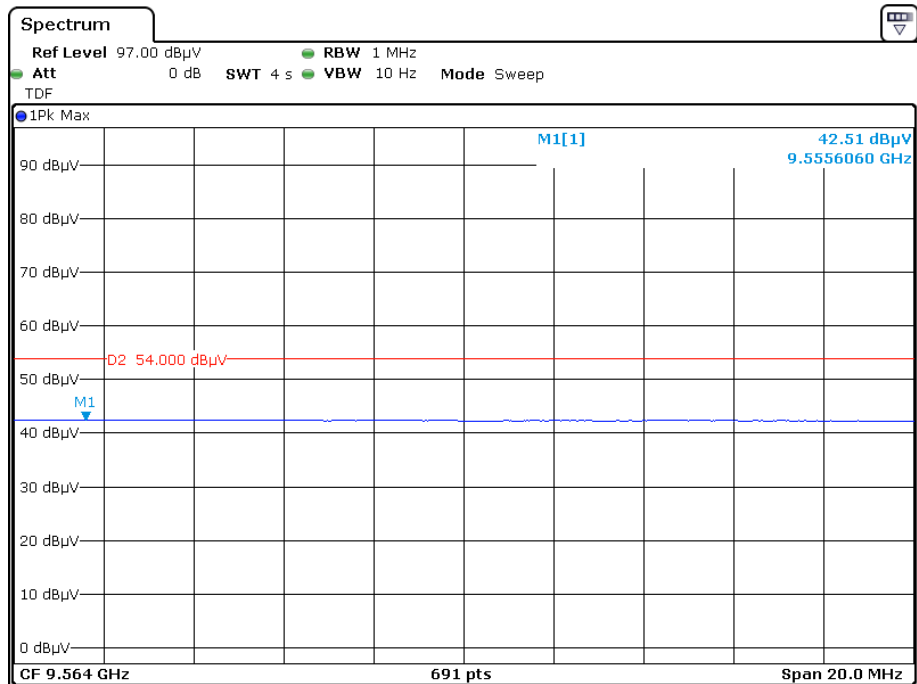
### Vertical



Date: 20.MAY.2020 20:09:25

**Pre-scan for Average  
Horizontal**

Date: 20.MAY.2020 19:59:46

**Vertical**

Date: 20.MAY.2020 20:12:07

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