

# FCC PART 15.407 TEST REPORT

For

**Autel Robotics Co., Ltd.**

9th Floor, Bldg.B1, Zhiyuan, 1001 Xueyuan Rd., Xili, Nanshan, Shenzhen, China

**FCC ID: 2AGNTAC5809A**

|                                                                                                                                                                                                                                                                                                                 |                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| <b>Report Type:</b><br>Original Report                                                                                                                                                                                                                                                                          | <b>Product Type:</b><br>X-Star series |
| <b>Test Engineer:</b> Simon Wang                                                                                                                                                                                                                                                                                | <i>Simon wang</i>                     |
| <b>Report Number:</b> RSZ151118002-00A                                                                                                                                                                                                                                                                          |                                       |
| <b>Report Date:</b> 2015-12-16                                                                                                                                                                                                                                                                                  |                                       |
| Bell Hu                                                                                                                                                                                                                                                                                                         | <i>Bell Hu</i>                        |
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**Note:** This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp.

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## GENERAL INFORMATION

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

The *Autel Robotics Co., Ltd.*'s product, model number: *X-Star Premium (FCC ID: 2AGNTAC5809A)* or the "EUT" in this report was an *X-Star series*, which was measured approximately: 31.5 cm (L) x 16.7 cm (W) x 20.0 cm (H), rated with input voltage: DC 14.8V Li-Po battery.

*\*All measurement and test data in this report was gathered from production sample serial number: 1507133 (Assigned by BACL, Shenzhen). The EUT supplied by the applicant was received on 2015-11-18.*

### Objective

This type approval report is prepared on behalf of *Autel Robotics Co., Ltd.* in accordance with Part 2-Subpart J, Part 15-Subparts A, B and E of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart E, section 15.203, 15.205, 15.207, 15.209 and 15.407 rules.

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

FCC Part 15.247 DTS submissions with FCC ID: 2AGNTAC5809A.  
Part 15.407 NII submission with FCC ID: 2AGNTRC5809A.

### 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.

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

Measurement uncertainty with RF radiated emission is 5.91 dB for 30MHz-1GHz and 4.92 dB for above 1GHz, 1.95dB for conducted measurement.

### Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F, the 3<sup>rd</sup> Phase of WanLi Industrial Building, ShiHua Road, FuTian Free Trade Zone Shenzhen, Guangdong, China.

Test site at Bay Area Compliance Laboratories Corp. (Shenzhen) has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on October 31, 2013. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 382179. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

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

| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|---------|-----------------|
| 1       | 5727            | 26      | 5752            | 51      | 5777            |
| 2       | 5728            | 27      | 5753            | 52      | 5778            |
| 3       | 5729            | 28      | 5754            | 53      | 5779            |
| 4       | 5730            | 29      | 5755            | 54      | 5780            |
| 5       | 5731            | 30      | 5756            | 55      | 5781            |
| 6       | 5732            | 31      | 5757            | 56      | 5782            |
| 7       | 5733            | 32      | 5758            | 57      | 5783            |
| 8       | 5734            | 33      | 5759            | 58      | 5784            |
| 9       | 5735            | 34      | 5760            | 59      | 5785            |
| 10      | 5736            | 35      | 5761            | 60      | 5786            |
| 11      | 5737            | 36      | 5762            | 61      | 5787            |
| 12      | 5738            | 37      | 5763            | 62      | 5788            |
| 13      | 5739            | 38      | 5764            | 63      | 5789            |
| 14      | 5740            | 39      | 5765            | 64      | 5790            |
| 15      | 5741            | 40      | 5766            | 65      | 5791            |
| 16      | 5742            | 41      | 5767            | 66      | 5792            |
| 17      | 5743            | 42      | 5768            | 67      | 5793            |
| 18      | 5744            | 43      | 5769            | 68      | 5794            |
| 19      | 5745            | 44      | 5770            | 69      | 5795            |
| 20      | 5746            | 45      | 5771            | 70      | 5796            |
| 21      | 5747            | 46      | 5772            | 71      | 5797            |
| 22      | 5748            | 47      | 5773            | 72      | 5798            |
| 23      | 5749            | 48      | 5774            | 73      | 5799            |
| 24      | 5750            | 49      | 5775            |         |                 |
| 25      | 5751            | 50      | 5776            |         |                 |

EUT was tested with Channel 1, 34 and 73.

### EUT Exercise Software

No exercise software was used.

### Equipment Modifications

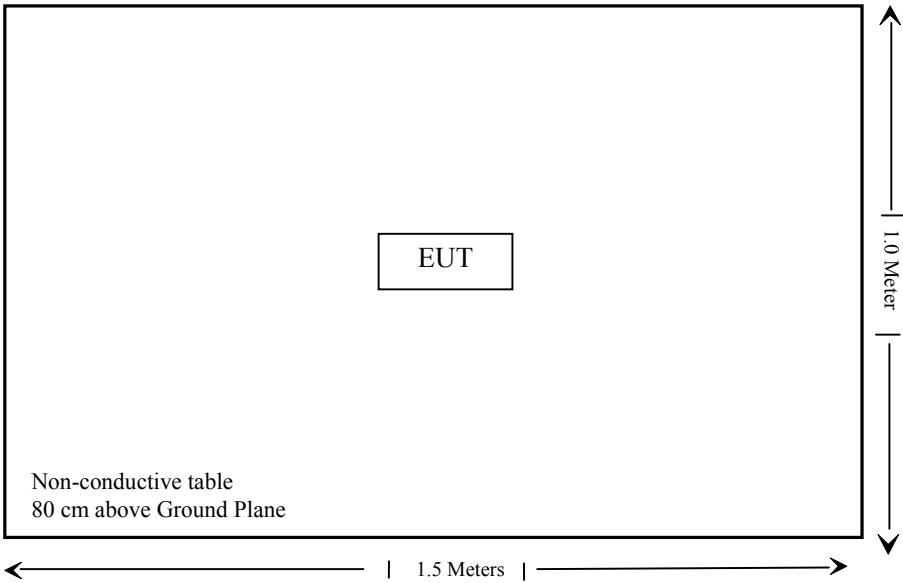
No modification was made to the EUT tested.

External I/O Cable

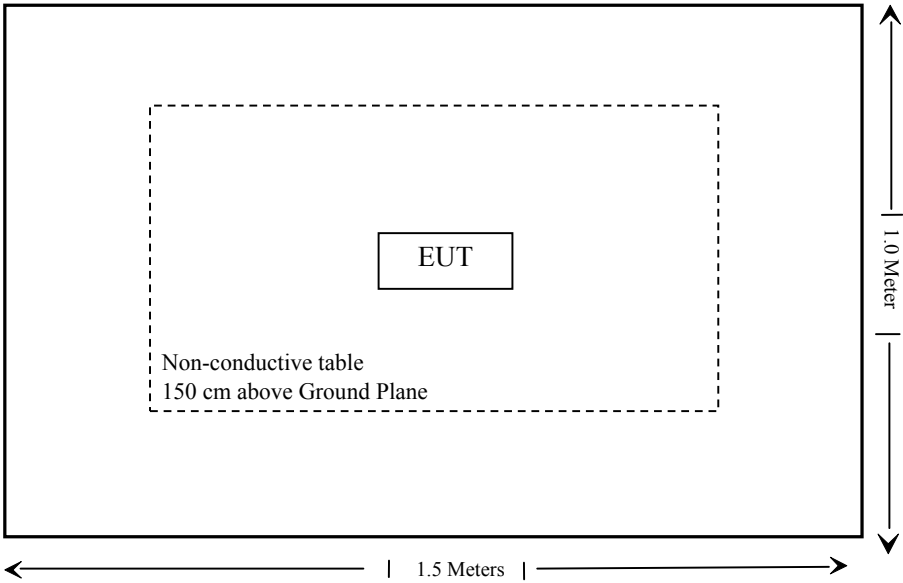
| Cable Description | Length (m) | From/Port | To |
|-------------------|------------|-----------|----|
| /                 | /          | /         | /  |

Block Diagram of Test Setup

Below 1GHz:



Above 1GHz:



**SUMMARY OF TEST RESULTS**

| <b>FCC Rules</b>                               | <b>Description of Test</b>            | <b>Result</b>  |
|------------------------------------------------|---------------------------------------|----------------|
| §15.407 (f), §2.1091                           | Maximum Permissible Exposure (MPE)    | Compliance     |
| §15.203                                        | Antenna Requirement                   | Compliance     |
| §15.407(b)(6) & §15.207(a)                     | Conducted Emissions                   | Not Applicable |
| FCC §15.205 & §15.209 & §15.407(b) (4),(6),(7) | Undesirable Emission                  | Compliance     |
| §15.407(b) (4)                                 | Band edge                             | Compliance     |
| §15.407(a) (1),(5),(e)                         | 99% Occupied & 6dB Emission Bandwidth | Compliance     |
| §15.407(a) (3)                                 | Conducted Transmitter Output Power    | Compliance     |
| §15.407 (a) (3)                                | Power Spectral Density                | Compliance     |

Not Applicable: The EUT was powered by battery.

## **FCC §15.407 (f) & §2.1091 – MAXIMUM PERMISSIBLE EXPOSURE (MPE)**

### **Applicable Standard**

According to FCC §2.1091 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.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

| <b>(B) Limits for General Population/Uncontrolled Exposure</b> |                                      |                                      |                                          |                                 |
|----------------------------------------------------------------|--------------------------------------|--------------------------------------|------------------------------------------|---------------------------------|
| <b>Frequency Range (MHz)</b>                                   | <b>Electric Field Strength (V/m)</b> | <b>Magnetic Field Strength (A/m)</b> | <b>Power Density (mW/cm<sup>2</sup>)</b> | <b>Averaging Time (minutes)</b> |
| 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;

According to §1.1310 and §2.1091 RF exposure is calculated.

### **Calculated Formulary:**

Predication of MPE limit at a given distance

$S = PG/4\pi R^2$  = 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);

### **Calculated Data:**

| <b>Frequency (MHz)</b> | <b>Antenna Gain</b> |                  | <b>Max tune –up Conducted Power</b> |             | <b>Evaluation Distance (cm)</b> | <b>Power Density (mW/cm<sup>2</sup>)</b> | <b>MPE Limit (mW/cm<sup>2</sup>)</b> |
|------------------------|---------------------|------------------|-------------------------------------|-------------|---------------------------------|------------------------------------------|--------------------------------------|
|                        | <b>(dBi)</b>        | <b>(numeric)</b> | <b>(dBm)</b>                        | <b>(mW)</b> |                                 |                                          |                                      |
| 5727-5799              | 2.5                 | 1.78             | 16.00                               | 39.8        | 20                              | 0.0141                                   | 1.0                                  |

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

### **Result: Compliance**

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## **FCC §15.203 – ANTENNA REQUIREMENT**

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### **Applicable Standard**

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
- b. Antenna must use a unique type of connector to attach to the EUT.

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 15.407 (a), if the transmitting antennas of directional gain greater than 6dBi are used, the transmit power and power spectral density 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 internal antenna arrangement, which was permanently attached and the antenna gain is 2.5 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

**Result:** Compliance.

**FCC §15.205 & §15.209 & §15.407(B) (4),(6),(7) – UNDESIRABLE EMISSION****Applicable Standard**

FCC §15.407 (b) (4), (6), (7); §15.205; §15.209;

For transmitters operating in the 5.725–5.825 GHz band: all emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an EIRP of –17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an EIRP of –27 dBm/MHz.

Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209.

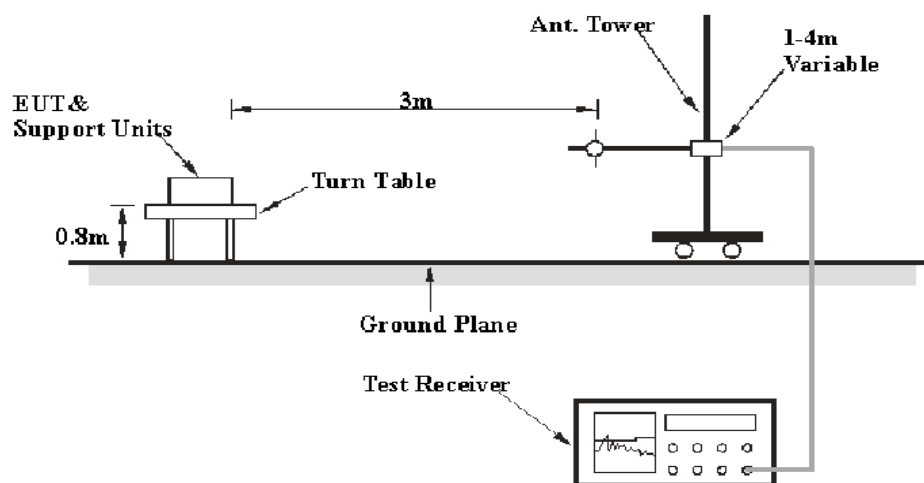
**Measurement Uncertainty**

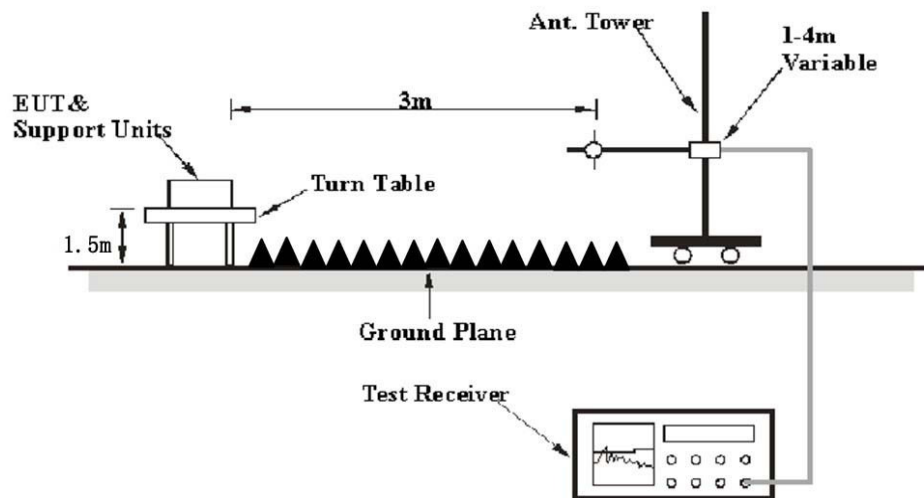
All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of radiation emissions at Bay Area Compliance Laboratories Corp. (Shenzhen) is 5.91 dB for 30MHz-1GHz and 4.92 dB for above 1GHz, 1.95dB for conducted measurement at antenna port. And the uncertainty will not be taken into consideration for the test data recorded in the report

**EUT Setup**

**Below 1GHz:**



**Above 1GHz:**

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.209 limits.

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

**EMI Test Receiver & Spectrum Analyzer Setup**

The system was investigated from 30 MHz to 40 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  | Detector |
|-------------------|---------|-----------|---------|----------|
| 30 MHz – 1000 MHz | 100 kHz | 300 kHz   | 120 kHz | QP       |
| Above 1 GHz       | 1 MHz   | 3 MHz     | /       | PK       |
|                   | 1 MHz   | 10 Hz     | /       | Ave.     |

**Test Procedure****Radiated Spurious Emission**

During the radiated emission test, the adapter was connected to the AC floor outlet.

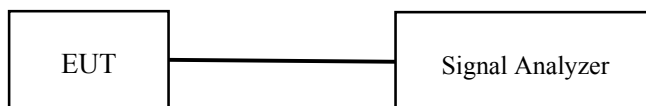
Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all the installation combinations.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-40GHz, peak and Average detection modes for frequencies above 1GHz.

The EUT is set 3.0 meter away from the testing antenna, which is varied from 1-4 meters, and the EUT is placed on a turntable, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

**Conducted Spurious Emission at Antenna Port**

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. The Resolution bandwidth is set to 1MHz, The Video bandwidth is set to  $\geq 1$ MHz, report the peak value out of the operating band.
3. Repeat above procedures until all frequencies measured were complete.

**Corrected Amplitude & Margin Calculation**

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

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

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

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

**Test Equipment List and Details**

| Manufacturer              | Description       | Model           | Serial Number | Calibration Date | Calibration Due Date |
|---------------------------|-------------------|-----------------|---------------|------------------|----------------------|
| HP                        | Amplifier         | HP8447E         | 1937A01046    | 2015-05-06       | 2016-05-06           |
| Rohde & Schwarz           | EMI Test Receiver | ESCI            | 101120        | 2015-11-03       | 2016-11-03           |
| Sunol Sciences            | Bi-log Antenna    | JB1             | A040904-2     | 2014-12-07       | 2017-12-06           |
| Mini                      | Amplifier         | ZVA-183-S+      | 5969001149    | 2015-04-23       | 2016-04-23           |
| A.H. System               | Horn Antenna      | SAS-200/571     | 135           | 2015-08-18       | 2018-08-17           |
| Rohde & Schwarz           | Signal Analyzer   | FSIQ26          | 8386001028    | 2015-12-11       | 2016-12-11           |
| DUCOMMUN                  | Pre-amplifier     | ALN-22093530-01 | 991373-01     | 2015-08-03       | 2016-08-03           |
| Agilent                   | Spectrum Analyzer | 8564E           | 3943A01781    | 2013-05-09       | 2016-05-08           |
| the electro-Mechanics Co. | Horn Antenna      | 3116            | 9510-2270     | 2013-10-14       | 2016-10-13           |

\* **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).

## 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 15.407, the worst margin reading as below:

**0.32 dB at 5724.75 MHz in the Vertical polarization for Left Side Band.**

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level is in compliance with the limit if

$$L_m + U_{(Lm)} \leq L_{lim} + U_{cispr}$$

In BACL,  $U_{(Lm)}$  is less than  $U_{cispr}$ , if  $L_m$  is less than  $L_{lim}$ , it implies that the EUT complies with the limit.

## Test Data

### Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 26 °C     |
| Relative Humidity: | 53 %      |
| ATM Pressure:      | 101.0 kPa |

*The testing was performed by Simon Wang on 2015-12-12.*

*EUT operation mode: Transmitting*

**30 MHz-40 GHz:**

| Frequency                        | Receiver          |                        | Turntable | Rx Antenna    |                  | Corrected      | Corrected             | FCC Part 15.407   |                |
|----------------------------------|-------------------|------------------------|-----------|---------------|------------------|----------------|-----------------------|-------------------|----------------|
| (MHz)                            | Reading<br>(dBμV) | Detector<br>(PK/QP/AV) | Degree    | Height<br>(m) | Polar<br>(H / V) | Factor<br>(dB) | Amplitude<br>(dBμV/m) | Limit<br>(dBμV/m) | Margin<br>(dB) |
| <b>Low Channel (5727 MHz)</b>    |                   |                        |           |               |                  |                |                       |                   |                |
| 256.8                            | 44.15             | QP                     | 201       | 1.2           | H                | -13.9          | 30.25                 | 46                | 15.75          |
| 5727.00                          | 62.16             | PK                     | 301       | 2.0           | H                | 42.48          | 104.64                | /                 | /              |
| 5727.00                          | 48.78             | Ave.                   | 301       | 2.0           | H                | 42.48          | 91.26                 | /                 | /              |
| 5727.00                          | 65.37             | PK                     | 89        | 1.3           | V                | 42.48          | 107.85                | /                 | /              |
| 5727.00                          | 51.29             | Ave.                   | 89        | 1.3           | V                | 42.48          | 93.77                 | /                 | /              |
| 11454.00                         | 35.08             | PK                     | 320       | 2.3           | H                | 27.36          | 62.44                 | 74                | 11.56          |
| 11454.00                         | 18.34             | Ave.                   | 320       | 2.3           | H                | 27.36          | 45.70                 | 54                | 8.30           |
| 11454.00                         | 32.19             | PK                     | 101       | 1.7           | V                | 27.36          | 59.55                 | 74                | 14.45          |
| 11454.00                         | 17.45             | Ave.                   | 101       | 1.7           | V                | 27.36          | 44.81                 | 54                | 9.19           |
| <b>Middle Channel (5760 MHz)</b> |                   |                        |           |               |                  |                |                       |                   |                |
| 256.8                            | 44.52             | QP                     | 201       | 1.2           | H                | -13.9          | 30.62                 | 46                | 15.38          |
| 5760.00                          | 67.95             | PK                     | 71        | 1.1           | H                | 42.39          | 110.34                | /                 | /              |
| 5760.00                          | 53.71             | Ave.                   | 71        | 1.1           | H                | 42.39          | 96.10                 | /                 | /              |
| 5760.00                          | 73.06             | PK                     | 179       | 2.3           | V                | 42.39          | 115.45                | /                 | /              |
| 5760.00                          | 59.54             | Ave.                   | 179       | 2.3           | V                | 42.39          | 101.93                | /                 | /              |
| 11520.00                         | 33.72             | PK                     | 50        | 1.6           | H                | 27.36          | 61.08                 | 74                | 12.92          |
| 11520.00                         | 17.00             | Ave.                   | 50        | 1.6           | H                | 27.36          | 44.36                 | 54                | 9.64           |
| 11520.00                         | 37.21             | PK                     | 234       | 1.9           | V                | 27.36          | 64.57                 | 74                | 9.43           |
| 11520.00                         | 20.52             | Ave.                   | 234       | 1.9           | V                | 27.36          | 47.88                 | 54                | <b>6.12</b>    |
| <b>High Channel (5799 MHz)</b>   |                   |                        |           |               |                  |                |                       |                   |                |
| 256.8                            | 44.44             | QP                     | 201       | 1.2           | H                | -13.9          | 30.54                 | 46                | 15.46          |
| 5799.00                          | 61.87             | PK                     | 75        | 2.1           | H                | 42.39          | 104.26                | /                 | /              |
| 5799.00                          | 48.24             | Ave.                   | 75        | 2.1           | H                | 42.39          | 90.63                 | /                 | /              |
| 5799.00                          | 62.81             | PK                     | 304       | 1.7           | V                | 42.39          | 105.20                | /                 | /              |
| 5799.00                          | 48.78             | Ave.                   | 304       | 1.7           | V                | 42.39          | 91.17                 | /                 | /              |
| 11598.00                         | 32.61             | PK                     | 50        | 1.8           | H                | 28.49          | 61.10                 | 74                | 12.90          |
| 11598.00                         | 17.11             | Ave.                   | 50        | 1.8           | H                | 28.49          | 45.60                 | 54                | 8.40           |
| 11598.00                         | 34.53             | PK                     | 92        | 1.9           | V                | 28.49          | 63.02                 | 74                | 10.98          |
| 11598.00                         | 18.35             | Ave.                   | 92        | 1.9           | V                | 28.49          | 46.84                 | 54                | 7.16           |

**Note:**

Corrected Amplitude = Corrected Factor + Reading

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

Margin = Limit- Corr. Amplitude

**BAND EDGE:**

| Frequency              | Receiver          |                        | Turntable | Rx Antenna    |                  | Corrected      | Corrected             | FCC Part 15.407   |                |
|------------------------|-------------------|------------------------|-----------|---------------|------------------|----------------|-----------------------|-------------------|----------------|
| (MHz)                  | Reading<br>(dBμV) | Detector<br>(PK/QP/AV) | Degree    | Height<br>(m) | Polar<br>(H / V) | Factor<br>(dB) | Amplitude<br>(dBμV/m) | Limit<br>(dBμV/m) | Margin<br>(dB) |
| <b>Left Side Band</b>  |                   |                        |           |               |                  |                |                       |                   |                |
| 5724.75                | 45.12             | PK                     | 125       | 1.7           | H                | 15.54          | 60.66                 | 74                | 13.34          |
| 5724.75                | 37.71             | Ave.                   | 125       | 1.7           | H                | 15.54          | 53.25                 | 54                | 0.75           |
| 5724.75                | 46.53             | PK                     | 89        | 1.5           | V                | 15.54          | 62.07                 | 74                | 11.93          |
| 5724.75                | 38.14             | Ave.                   | 89        | 1.5           | V                | 15.54          | 53.68                 | 54                | <b>0.32</b>    |
| <b>Right Side Band</b> |                   |                        |           |               |                  |                |                       |                   |                |
| 5856.37                | 30.45             | PK                     | 177       | 1.7           | H                | 15.23          | 45.68                 | 74                | 28.32          |
| 5856.37                | 25.86             | Ave.                   | 177       | 1.7           | H                | 15.23          | 41.09                 | 54                | 12.91          |
| 5856.37                | 31.52             | PK                     | 204       | 1.5           | V                | 15.23          | 46.75                 | 74                | 27.25          |
| 5856.37                | 26.37             | Ave.                   | 204       | 1.5           | V                | 15.23          | 41.6                  | 54                | 12.40          |

**Note:**

Corrected Amplitude = Corrected Factor + Reading

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

Margin = Limit- Corr. Amplitude

**FCC §15.407(a) (1) – 99% OCCUPIED & 6dB EMISSION BANDWIDTH****Applicable Standard**

The maximum power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements in the 5.725-5.85 GHz band are made over a reference bandwidth of 500 kHz or the 26 dB emission bandwidth of the device, whichever is less. Measurements in the 5.15-5.25 GHz, 5.25-5.35 GHz, and the 5.47-5.725 GHz bands are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full reference bandwidth.

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

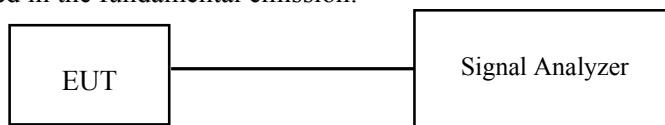
**Test Procedure****1. Emission Bandwidth (EBW)**

- Set RBW = approximately 1% of the emission bandwidth.
- Set the VBW > RBW.
- Detector = Peak.
- Trace mode = max hold.
- Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

**2. Minimum Emission Bandwidth for the band 5.725-5.85 GHz**

Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 KHz for the band 5.715-5.85 GHz. The following procedure shall be used for measuring this bandwidth:

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

**Test Equipment List and Details**

| Manufacturer    | Description     | Model  | Serial Number | Calibration Date | Calibration Due Date |
|-----------------|-----------------|--------|---------------|------------------|----------------------|
| Rohde & Schwarz | Signal Analyzer | FSIQ26 | 8386001028    | 2015-12-11       | 2016-12-11           |

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

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

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 26 °C     |
| <b>Relative Humidity:</b> | 51 %      |
| <b>ATM Pressure:</b>      | 101.0 kPa |

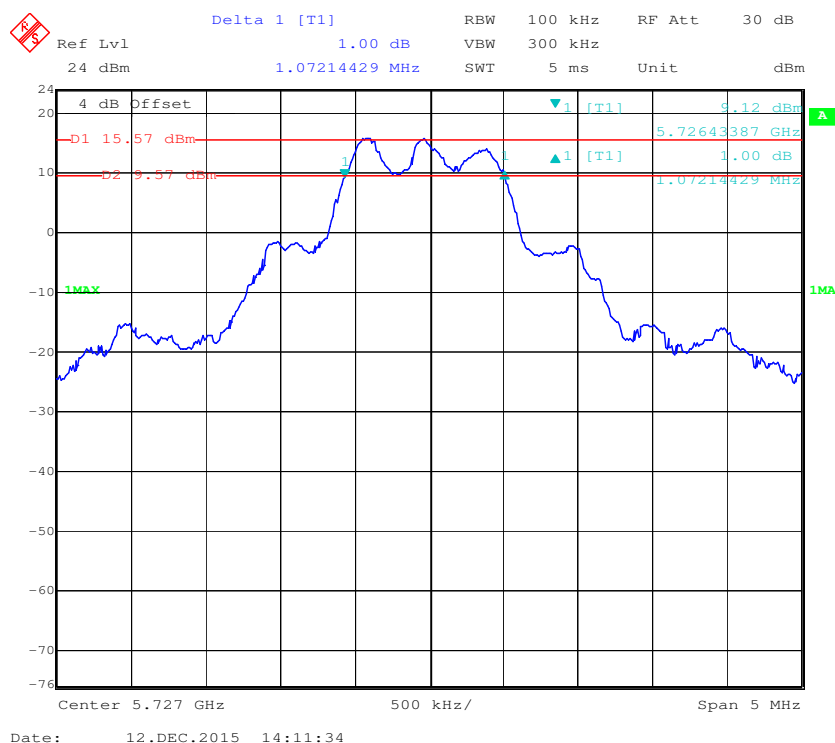
The testing was performed by Simon Wang on 2015-12-12 and 2015-12-22.

EUT operation mode: Transmitting

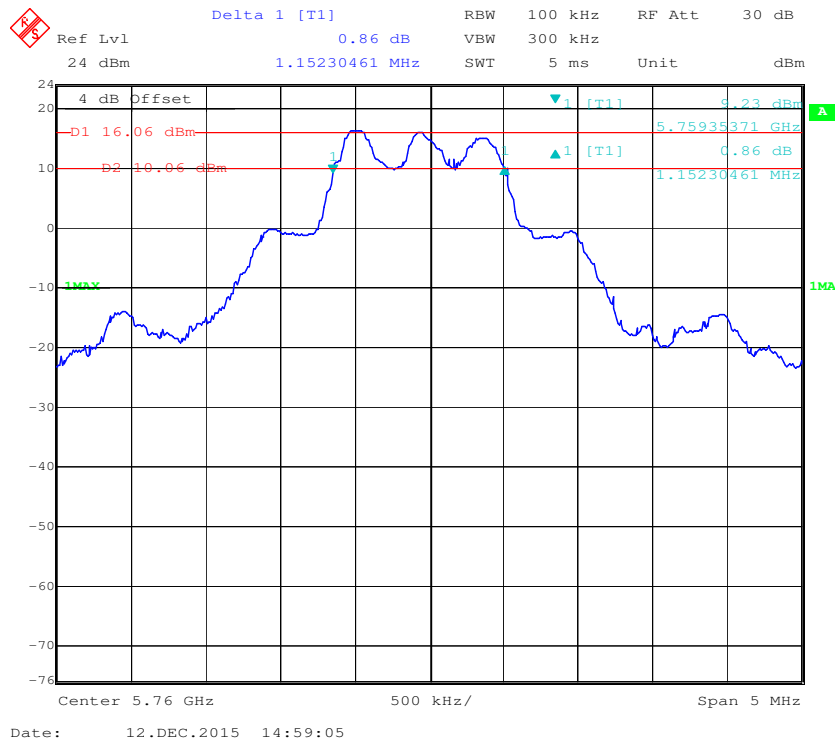
**Test Result:** Pass

Please refer to the following tables and plots.

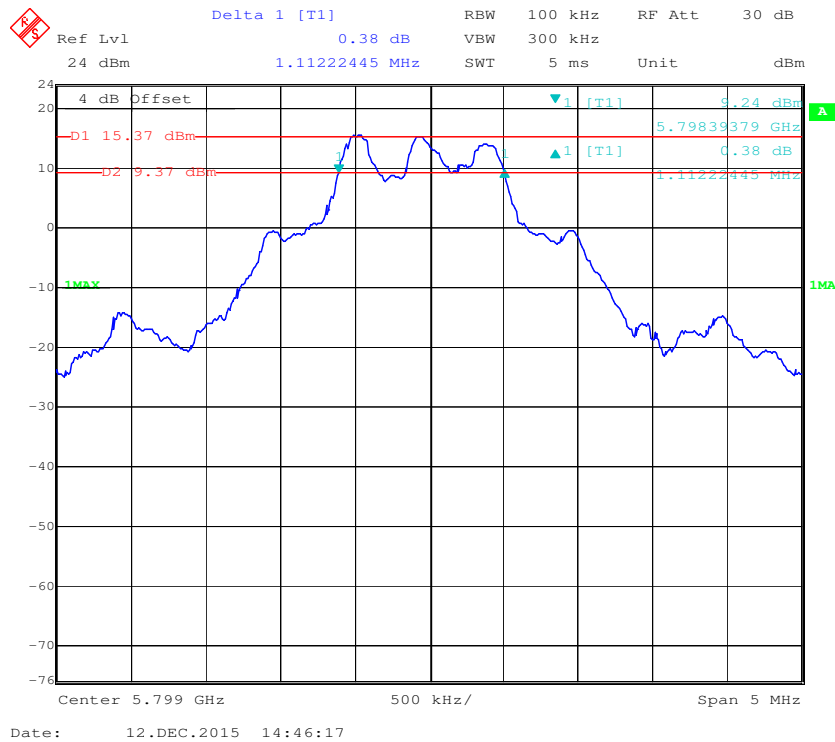
| Channel | Frequency (MHz) | Occupied Bandwidth (MHz) | 6dB Bandwidth (MHz) | Limit (kHz) |
|---------|-----------------|--------------------------|---------------------|-------------|
| Low     | 5727            | 1.703                    | 1.072               | ≥500        |
| Middle  | 5760            | 1.874                    | 1.152               | ≥500        |
| High    | 5799            | 1.804                    | 1.112               | ≥500        |

**6dB Emission Bandwidth, Low Channel**

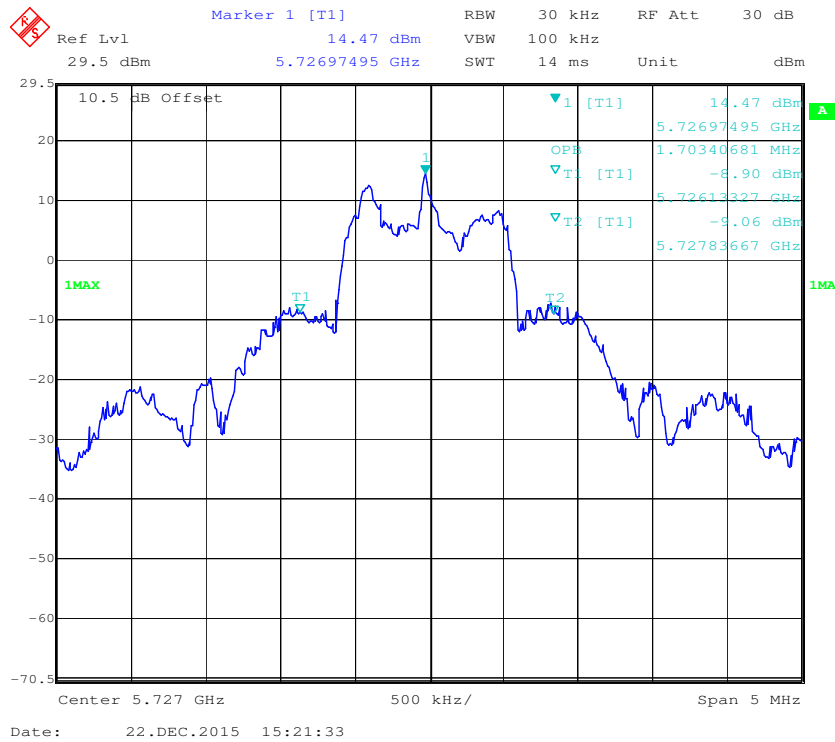
### 6dB Emission Bandwidth, Middle Channel



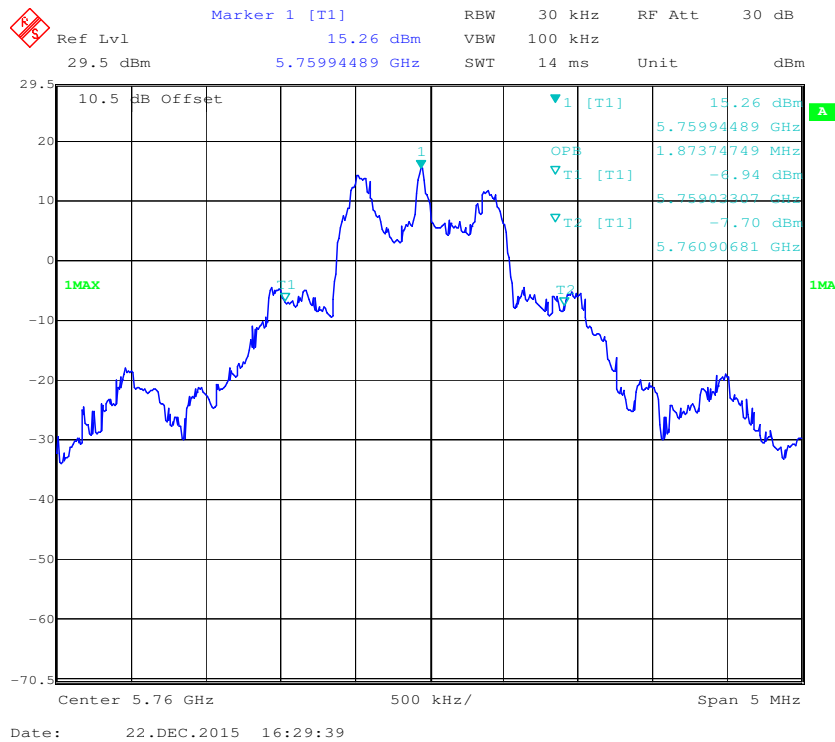
### 6dB Emission Bandwidth, High Channel



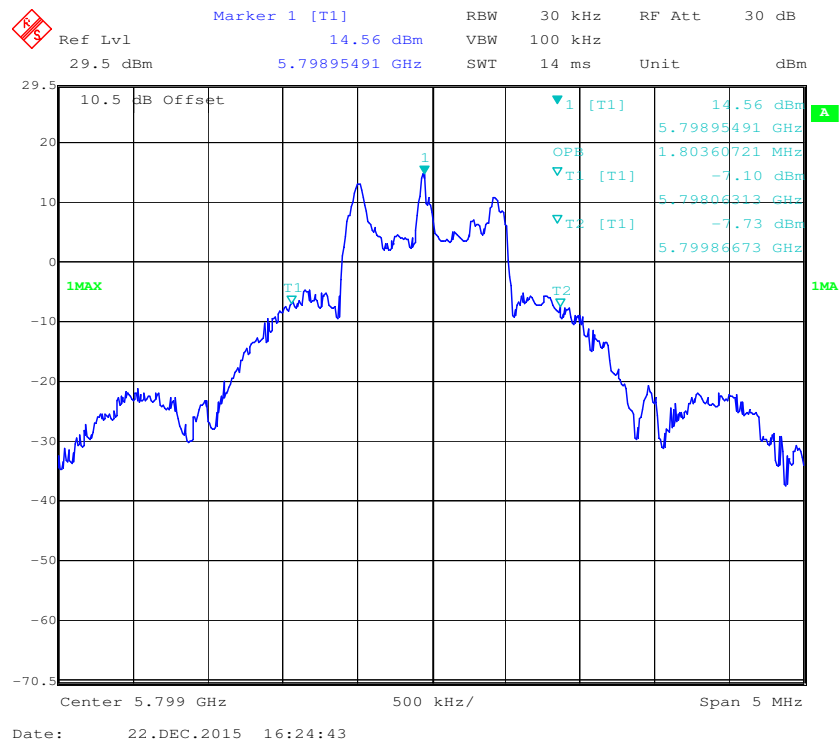
## 99% Occupied Bandwidth, Low Channel



## 99% Occupied Bandwidth, Middle Channel



99% Occupied Bandwidth, High Channel



## FCC §15.407(a) (3) – CONDUCTED TRANSMITTER OUTPUT POWER

### Applicable Standard

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

### Test Procedure

Set span to encompass the entire EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.

(ii) Set RBW = 1 MHz.

(iii) Set VBW  $\geq$  3 MHz.

(iv) Number of points in sweep  $\geq$  2 Span / RBW. (This ensures that bin-to-bin spacing is  $\leq$  RBW/2, so that narrowband signals are not lost between frequency bins.)

(v) Manually set sweep time  $\geq$  10 \* (number of points in sweep) \* (symbol period of the transmitted signal), but not less than the automatic default sweep time.

(vi) Set detector = RMS.

(vii) The EUT shall be operated at 100 percent duty cycle.

(viii) Perform a single sweep.

(ix) Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument's band power measurement function with band limits set equal to the EBW (or occupied bandwidth) band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at 1 MHz intervals extending across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the spectrum.

### Test Equipment List and Details

| Manufacturer    | Description     | Model  | Serial Number | Calibration Date | Calibration Due Date |
|-----------------|-----------------|--------|---------------|------------------|----------------------|
| Rohde & Schwarz | Signal Analyzer | FSIQ26 | 8386001028    | 2015-12-11       | 2016-12-11           |

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

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

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 23 °C     |
| <b>Relative Humidity:</b> | 50 %      |
| <b>ATM Pressure:</b>      | 101.0 kPa |

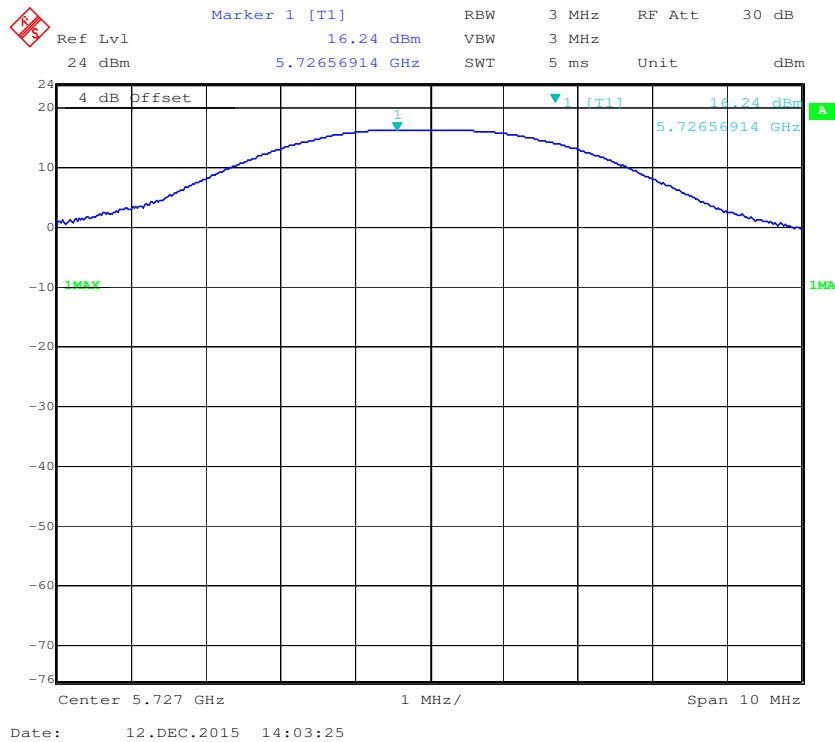
*The testing was performed by Simon Wang on 2015-12-12.*

*EUT operation mode: Transmitting*

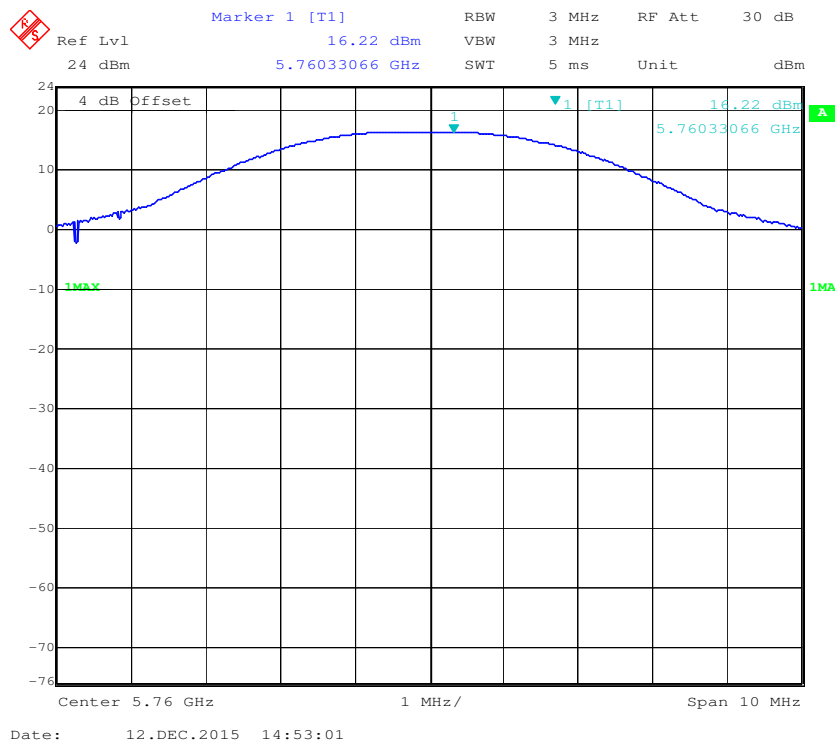
**Test Result:** Pass

| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>Max Conducted<br/>Peak Output Power<br/>(dBm)</b> | <b>Max Conducted<br/>Average Output<br/>Power<br/>(dBm)</b> | <b>Limit<br/>(dBm)</b> |
|----------------|----------------------------|------------------------------------------------------|-------------------------------------------------------------|------------------------|
| Low            | 5727                       | 16.24                                                | 15.47                                                       | 30                     |
| Middle         | 5760                       | 16.22                                                | 15.81                                                       | 30                     |
| High           | 5799                       | 15.42                                                | 15.08                                                       | 30                     |

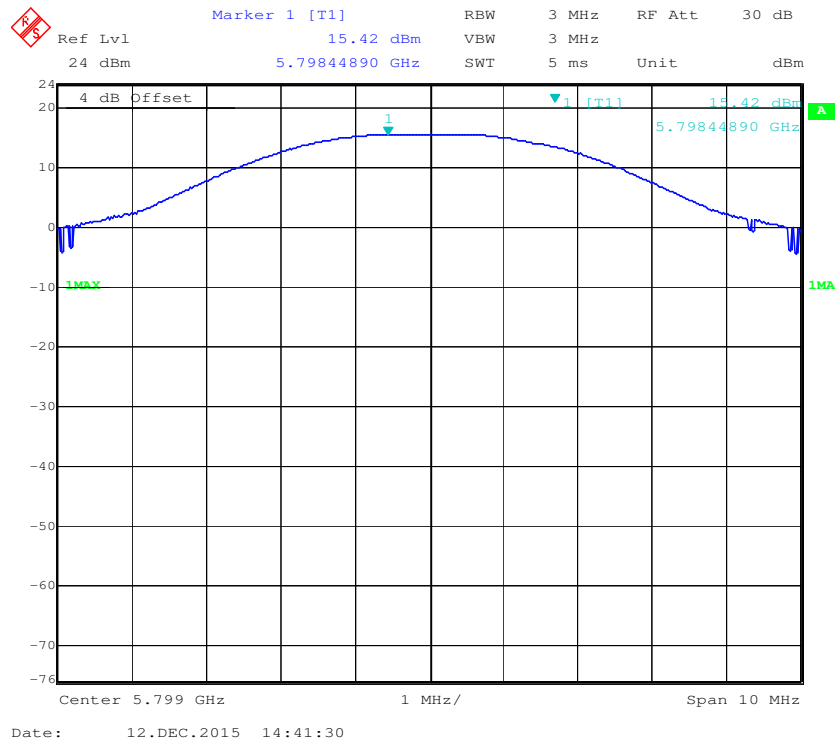
### Peak Conducted Output Power, Low Channel



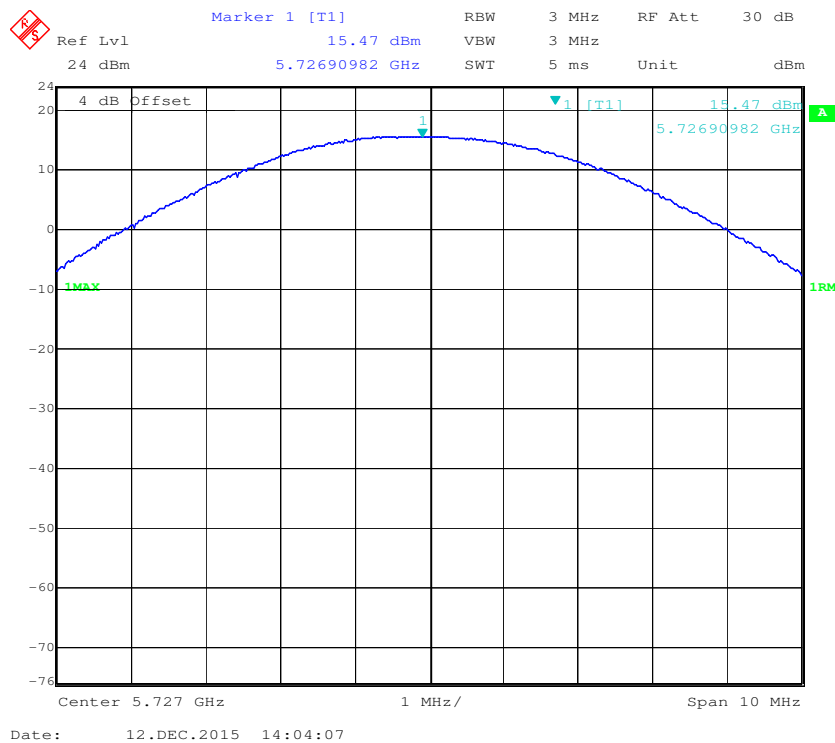
### Peak Conducted Output Power, Middle Channel



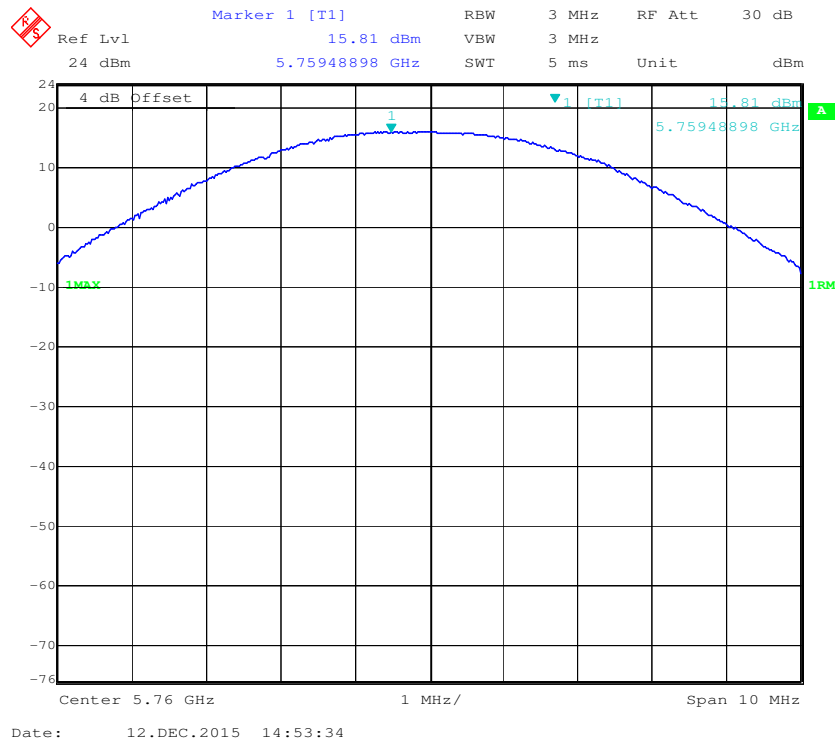
### Peak Conducted Output Power, High Channel



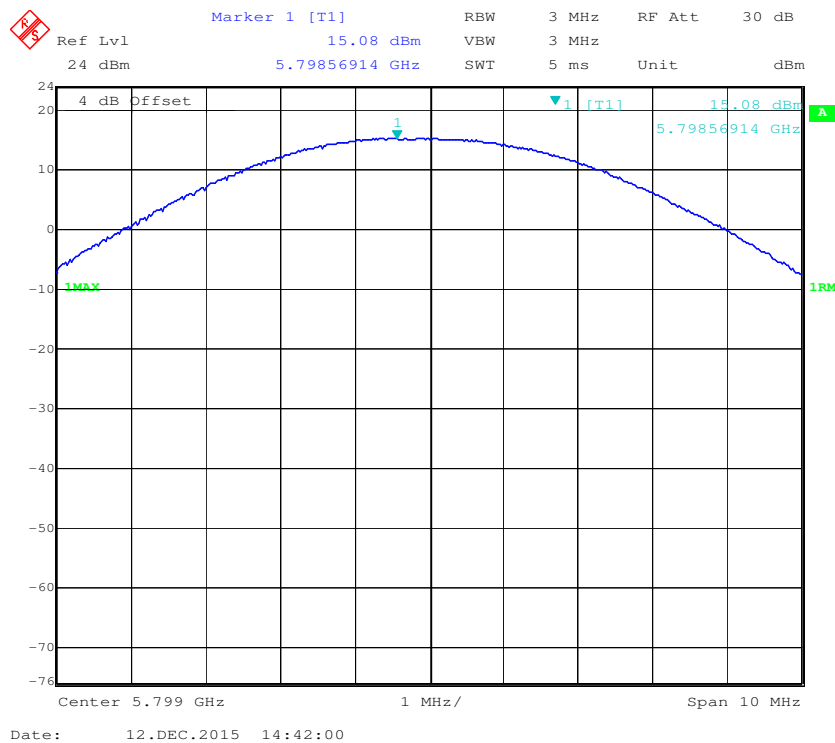
### Average Conducted Output Power, Low Channel



### Average Conducted Output Power, Middle Channel



### Average Conducted Output Power, High Channel



## FCC §15.407(a) (3) – POWER SPECTRAL DENSITY

### Applicable Standard

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple colocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

### Test Procedure

For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in § 15.407(a)(5). For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 MHz, or 500 kHz, “provided that the measured power is integrated over the full reference bandwidth” to show the total power over the specified measurement bandwidth (i.e., 1 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500 KHz bandwidth, the following adjustments to the procedures apply:

- Set  $RBW \geq 1/T$ , where T is defined in section II.B.1.a).
- Set  $VBW \geq 3 RBW$ .
- If measurement bandwidth of Maximum PSD is specified in 500 kHz, add  $10\log(500\text{kHz}/RBW)$  to the measured result, whereas  $RBW (< 500 \text{ KHz})$  is the reduced resolution bandwidth of the spectrum analyzer set during measurement.
- If measurement bandwidth of Maximum PSD is specified in 1 MHz, add  $10\log(1\text{MHz}/RBW)$  to the measured result, whereas  $RBW (< 1 \text{ MHz})$  is the reduced resolution bandwidth of spectrum analyzer set during measurement.
- Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

Note: As a practical matter, it is recommended to use reduced RBW of 100 KHz for the sections 5.c) and 5.d) above, since  $RBW=100 \text{ KHz}$  is available on nearly all spectrum analyzers.

### Test Equipment List and Details

| Manufacturer    | Description     | Model  | Serial Number | Calibration Date | Calibration Due Date |
|-----------------|-----------------|--------|---------------|------------------|----------------------|
| Rohde & Schwarz | Signal Analyzer | FSIQ26 | 8386001028    | 2015-12-11       | 2016-12-11           |

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

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

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 26 °C     |
| <b>Relative Humidity:</b> | 51 %      |
| <b>ATM Pressure:</b>      | 101.0 kPa |

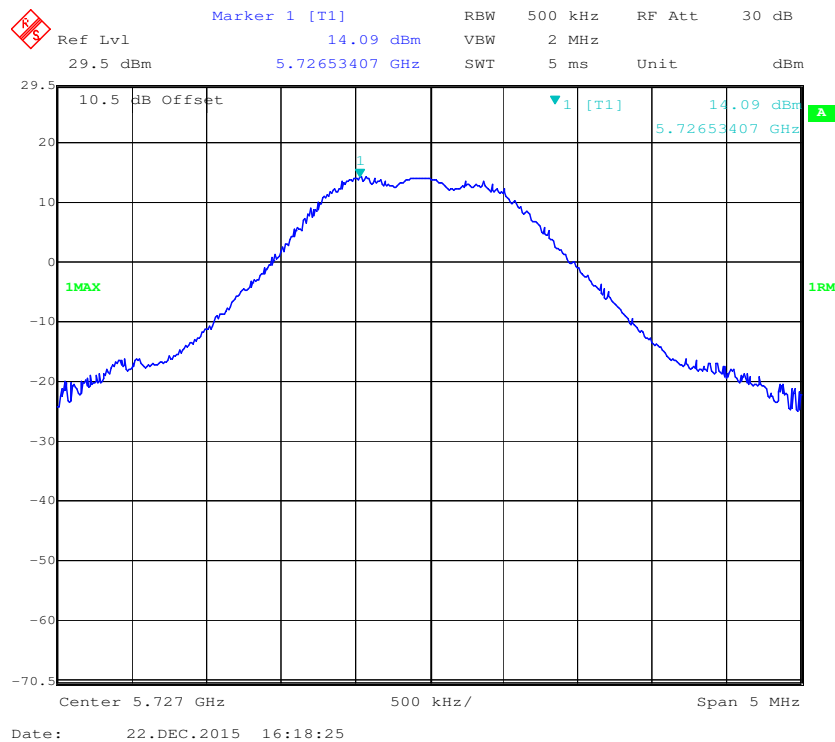
The testing was performed by Simon Wang from 2015-12-22.

EUT operation mode: Transmitting

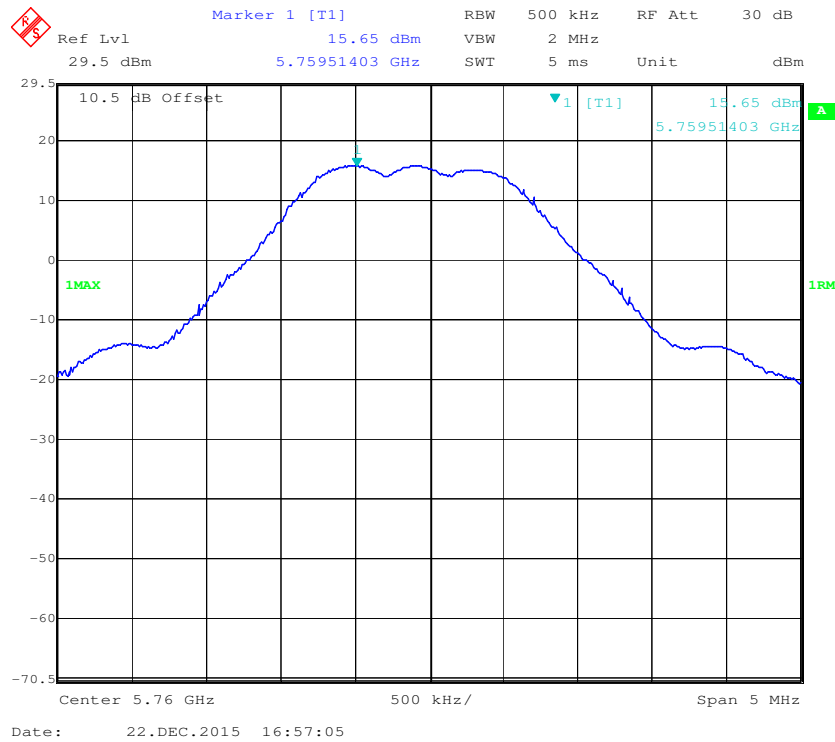
**Test Result:** Pass

Please refer to the following tables and plots.

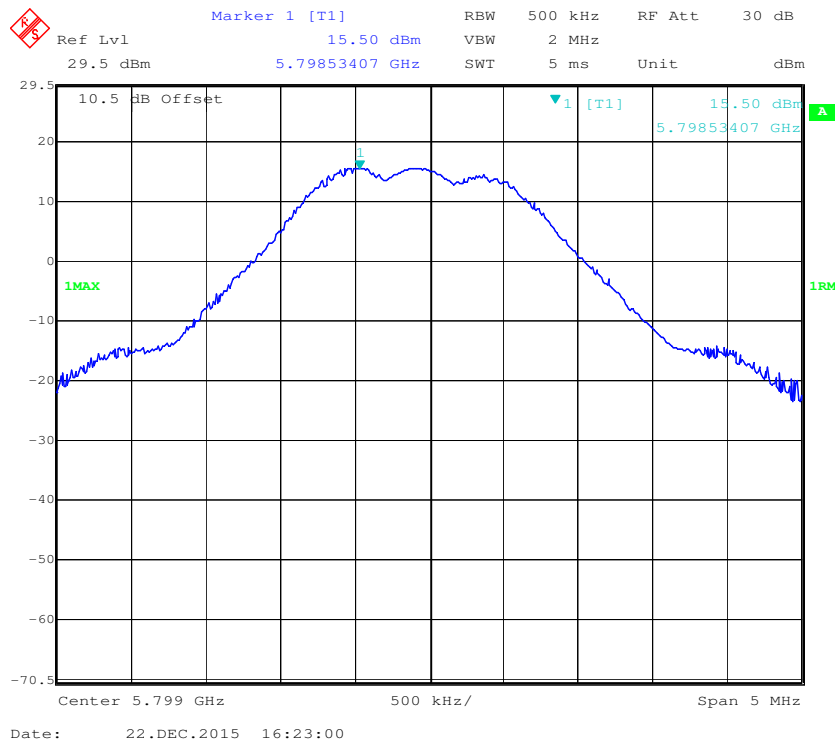
| Channel | Frequency | PSD          | Limit        |
|---------|-----------|--------------|--------------|
|         | (MHz)     | (dBm/500kHz) | (dBm/500kHz) |
| Low     | 5727      | 14.09        | $\leq 30$    |
| Middle  | 5760      | 15.65        | $\leq 30$    |
| High    | 5799      | 15.50        | $\leq 30$    |

**Power Spectral Density, Low Channel**

### Power Spectral Density, Middle Channel



### Power Spectral Density, High Channel



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