

# Patroness, LLC

## TEST REPORT

**SCOPE OF WORK**

EMISSIONS TESTING – MODEL P003110

**REPORT NUMBER**

103842901BOX-013

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Non-Specific Radio Report Shell Rev. December 2017  
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# EMISSIONS TEST REPORT

(FULL COMPLIANCE)

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**Project Number:** G103842901

**Report Issue Date:** 09/04/2019

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Revision Date: 01/15/2020

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**Model(s) Tested:** P003110

**Model(s) Partially Tested:** None

**Model(s) Not Tested but declared equivalent by the client:** None

**Standards:** FCC 47CFR Part 95, Subpart M:09/2019

RSS-251 Issue 2: 07/2018

RSS Gen Issue 5 March 2019 Amendment 1

RSS-102 Issue 5 March 2015

Tested by:  
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Client:  
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USA

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## 1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

## 2 Test Summary

| Section | Test full name                                                                                                                                        | Result |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| 3       | Client Information                                                                                                                                    | --     |
| 4       | Description of Equipment Under Test and Variant Models                                                                                                | --     |
| 5       | System Setup and Method                                                                                                                               | ---    |
| 6       | Maximum Power and Human RF exposure<br>FCC 47CFR Part 95, Subpart M:09/2019<br>RSS-251 Issue 2: 07/2018, ANSI C63.10:2013, RSS-102 Issue 5 March 2015 | Pass   |
| 7       | Occupied Bandwidth<br>FCC 47CFR Part 95, Subpart M:09/2019<br>RSS-251 Issue 2: 07/2018, RSS Gen Issue 5 March 2019 Amendment 1,<br>ANSI C63.10:2013   | Pass   |
| 8       | Unwanted Emissions<br>FCC 47CFR Part 95, Subpart M:09/2019<br>RSS-251 Issue 2: 07/2018, RSS Gen Issue 5 March 2019 Amendment 1<br>, ANSI C63.10:2013  | Pass   |
| 9       | Frequency Stability<br>FCC 47CFR Part 95, Subpart M:09/2019<br>RSS-251 Issue 2: 07/2018, RSS Gen Issue 5 March 2019 Amendment 1,<br>ANSI C63.10:2013  | Pass   |
| 10      | Appendix A – Mixer/Horn Calibration Certificates                                                                                                      | --     |
| 11      | Revision History                                                                                                                                      | --     |

**3 Client Information****This EUT was tested at the request of:**

**Client:** Patroness, LLC  
101 Creekside Crossing  
Suite 1700 #244  
Brentwood, TX 37027  
USA

**Contact:** Jered Dean  
**Telephone:** 781-535-4736  
**Email:** jered@patroness.com

**4 Description of Equipment Under Test and Variant Models**

**Manufacturer:** Patroness, LLC  
101 Creekside Crossing  
Suite 1700 #244  
Brentwood, TX 37027  
USA

| Equipment Under Test                       |                |              |                                                                                    |
|--------------------------------------------|----------------|--------------|------------------------------------------------------------------------------------|
| Description                                | Manufacturer   | Model Number | Serial Number                                                                      |
| Radar module operating between 76 – 81 GHz | Patroness, LLC | P003110      | 0003 LF (Tx mode)<br>0004 LF (Idle mode)<br>0005 LF (Tx mode)<br>0008 LF (Tx mode) |
|                                            |                |              |                                                                                    |
|                                            |                |              |                                                                                    |

|                     |                        |
|---------------------|------------------------|
| Receive Date:       | 08/27/2019, 01/23/2020 |
| Received Condition: | Good                   |
| Type:               | Production             |

| Description of Equipment Under Test (provided by client) |
|----------------------------------------------------------|
| Radar module operating between 76 – 81 GHz               |

| Equipment Under Test Power Configuration |               |                 |                  |
|------------------------------------------|---------------|-----------------|------------------|
| Rated Voltage                            | Rated Current | Rated Frequency | Number of Phases |
| 5 Volts DC                               | 0.5 Amps      | N/A             | N/A              |

**Operating modes of the EUT:**

| No. | Descriptions of EUT Exercising |
|-----|--------------------------------|
| 1   | Tx mode (run mode)             |
|     |                                |

**Software used by the EUT:**

| No. | Descriptions of EUT Exercising |
|-----|--------------------------------|
| 1   | Proprietary Software           |
|     |                                |

| Radio/Receiver Characteristics |                                  |
|--------------------------------|----------------------------------|
| Frequency Band(s)              | 77 – 81 GHz                      |
| Modulation Type(s)             | FMCW                             |
| Maximum Output Power           | 15.69 dBm or 0.037068W (EIRP)    |
| Test Channels/Sweep Ranges     | 79 GHz (Sweep Ranges: 77-81 GHz) |
| Maximum Bandwidth              | 3.9 GHz                          |
| Equipment Type                 | Radio                            |
| Number of Tx/Rx antennas       | 4/3                              |
| Antenna Type and Gain          | Integrated antenna               |

**Variant Models:**

The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

None

**5 System Setup and Method**

| Cables |                                |            |                 |          |             |
|--------|--------------------------------|------------|-----------------|----------|-------------|
| ID     | Description                    | Length (m) | Shielding       | Ferrites | Termination |
| 1      | UUT Interface Cable (P002-129) | 13 in      | See Dwg.        | None     | -           |
| 2      | USB Cable                      | ~2 m       | Molex 887283402 | Yes*     | -           |

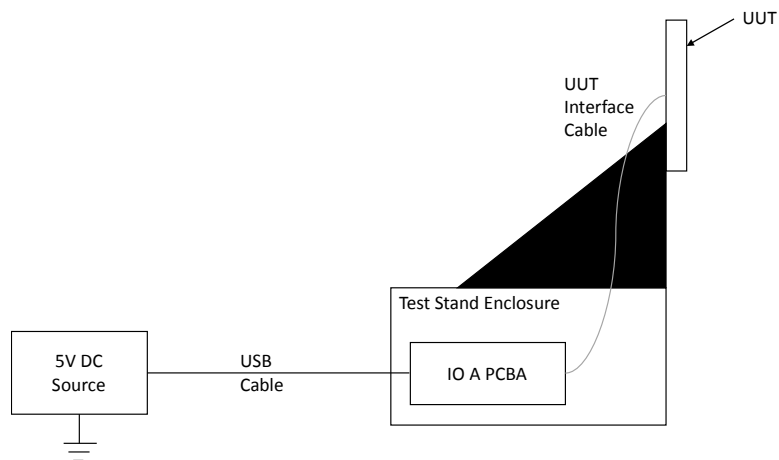
\*Ferrite was placed at cable exit from AC/DC converter to isolate any converter noise from actual EUT.

| Support Equipment |                |                      |               |
|-------------------|----------------|----------------------|---------------|
| Description       | Manufacturer   | Model Number         | Serial Number |
| Radar Test Stand  | Patroness, LLC | P003-114             | v 1.0         |
| IO A PCBA         | Patroness, LLC | P002-111             | v 2.0         |
| Battery pack      | Belkin         | F7U020 1INP11/66/110 | N/A           |

**5.1 Method:**

Configuration as required by Configuration as required by FCC 47CFR Part 95, Subpart M:09/2019, RSS-251 Issue 2: 07/2018, RSS Gen Issue 5 March 2019 Amendment 1, RSS-102 Issue 5 March 2015, ANSI C63.10:2013, ANSI C63.26:2015, AND FCC KDB 653005 D01 v01r01.

## 5.2 EUT Block Diagram:



## 6 Maximum Power and Human RF exposure

### 6.1 Method

The procedure described in Subclause 9.10 of ANSI C63.10-2013 and Subclause 5.5.4 (field strength method) of ANSI C63.26-2015 was utilized to determine maximum power and power density. Measurement was performed by using a radiated method. The EUT shall be transmitting at its maximum data rate.

- Connect the test antenna for the fundamental frequency band to a spectrum analyzer via an external mixer.
- Set spectrum analyzer RBW=1 MHz, VBW≥3 MHz.
- Set spectrum analyzer detector, span, and so on, to the proper values.
- Place the EUT 1.5 meters above the ground reference plane and in a continuous transmission mode.
- Perform handheld measurements by scanning the test antenna around all surfaces of the EUT.
- As the surfaces of the EUT are scanned, keep the test antenna pointed toward the EUT and slowly vary the test antenna polarization to cover all possible polarizations and orientations of the emission.
- Record the measured reading with the test antenna fixed at the maximized position, polarization, and orientation. Record the measurement distance.
- Repeat the preceding sequence for every operating configuration supported by the EUT (e.g., forward-looking, side-looking, and rear-looking configurations, with the vehicle at rest and in motion).

If necessary, the recorded reading(s) is adjusted by the conversion loss of the external mixer used at the frequency under investigation and the external mixer IF cable loss.

The maximum field strength of the emission at the measurement distance is calculated by using Equation (19) of ANSI C63.10-2013 and the adjusted/corrected power at the output of the test antenna.

The EIRP from the measured field strength is calculated by using Equation (22) of ANSI C63.10-2013 and convert to the linear form by using Equation (24) of ANSI C63.10-2013.

If measurements were made at any distance other than the distance specified by the limit, Equations (20) and (21) of ANSI C63.10-2013 were used to extrapolate the maximum measured field strength.

Far Field Distance ( $R_m$ ) Calculation

$$R_m = 2D^2/\lambda$$

Where: D = largest dimension of the antenna aperture in meters

$\lambda$  = wavelength of the emission under investigation  $[300/f_{\text{MHz}}]$  in meters

$$D = 0.031_{(m)}, \lambda = 300_{(m/s)} / 77.0135 \times 10^3_{(MHz)} = 0.003895_{(m)}, R_m = ((2 \times 0.031^2) / 0.003895) = 0.49_{(m)}$$

Measurements was made at 0.5 meter distance.

**TEST SITE: 10m ALSE**

**The 10m ALSE** is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

**Measurement Uncertainty**

| Measurement             | Frequency Range | Expanded Uncertainty (k=2) | Ucisprr |
|-------------------------|-----------------|----------------------------|---------|
| Radiated Emissions, 10m | 30-1000 MHz     | 5.6 dB                     | 6.3 dB  |
| Radiated Emissions, 3m  | 30-1000 MHz     | 4.9 dB                     | 6.3 dB  |
| Radiated Emissions, 3m  | 1-6 GHz         | 4.4 dB                     | 5.2 dB  |
| Radiated Emissions, 3m  | 6-15 GHz        | 4.9 dB                     | 5.5 dB  |
| Radiated Emissions, 3m  | 15-18 GHz       | 4.6 dB                     | 5.5 dB  |
| Radiated Emissions, 3m  | 18-40 GHz       | 4.6 dB                     | 5.5 dB  |

As shown in the table above our radiated emissions  $U_{lab}$  is less than the corresponding  $U_{CISPR}$  reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

## Test Equipment Used:

| Asset           | Description                        | Manufacturer         | Model  | Serial     | Cal Date   | Cal Due    |
|-----------------|------------------------------------|----------------------|--------|------------|------------|------------|
| DAV002'         | Weather Station                    | Davis Instruments    | 7400   | PE80519A93 | 06/13/2019 | 06/13/2020 |
| OML3'           | Mixer / Antenna                    | Oleson Microwave Lab | M12HWD | E21011-1   | 03/20/2019 | 03/20/2020 |
| ROS005-1'       | Signal and Spectrum Analyzer       | Rohde and Shwartz    | FSW43  | 100646     | 10/10/2019 | 10/10/2020 |
| CBLHF2012-2M-2' | 2m 9kHz-40GHz Coaxial Cable - SET2 | Huber & Suhner       | SF102  | 252675002  | 02/14/2019 | 02/14/2020 |

## Software Utilized:

| Name | Manufacturer | Version |
|------|--------------|---------|
| None | --           | --      |

## 6.2 Results:

The sample tested was found to Comply.

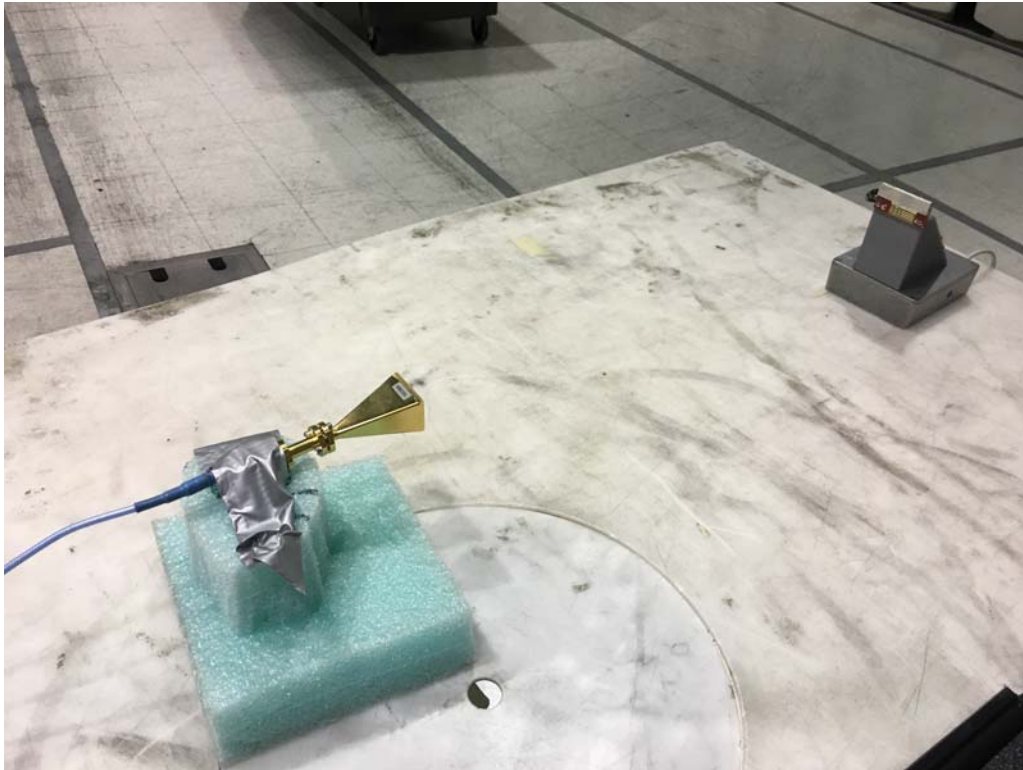
**§95.3367 76-81 GHz Band Radar Service radiated power limits.**

The fundamental radiated emission limits within the 76-81 GHz band are expressed in terms of Equivalent Isotropically Radiated Power (EIRP) and are as follows:

(a) The maximum power (EIRP) within the 76-81 GHz band shall not exceed 50 dBm based on measurements employing a power averaging detector with a 1 MHz Resolution Bandwidth (RBW).

(b) The maximum peak power (EIRP) within the 76-81 GHz band shall not exceed 55 dBm based on measurements employing a peak detector with a 1 MHz RBW.

**6.3 Setup Photograph:**

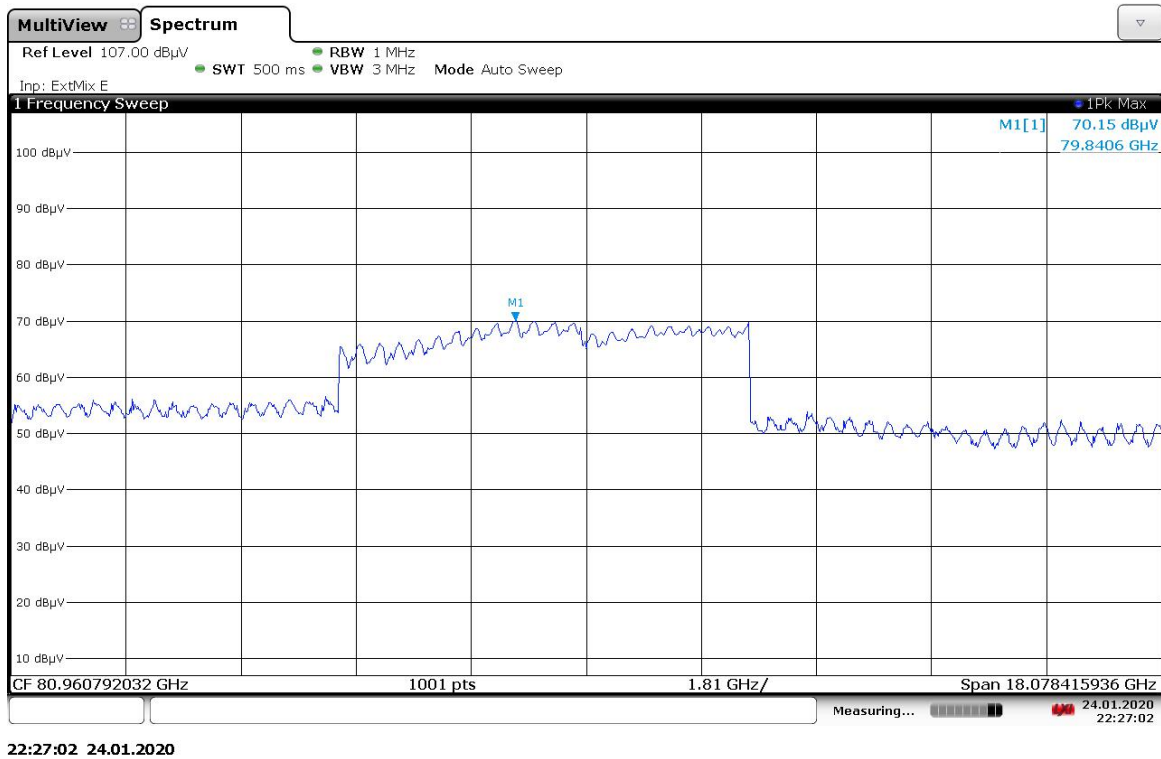


#### 6.4 Test Data:

| Antenna Pol.                                                                          | Detection | Frequency (GHz) | Raw Reading* @0.5m (dBuV/m) | Receiving Antenna Gain (dBi) | Antenna Correction Factor, AF (dB/m) | Cable Loss (dB) | EIRP Level @0.5m (dBuV/m) | EIRP Level (dBm) | EIRP Limit (dBm) | Margin (dB) |
|---------------------------------------------------------------------------------------|-----------|-----------------|-----------------------------|------------------------------|--------------------------------------|-----------------|---------------------------|------------------|------------------|-------------|
| V                                                                                     | Peak      | 79.84           | 70.51                       | 24                           | 44.24                                | 2.08            | 116.83                    | 6.04             | 55               | -48.96      |
| V                                                                                     | Average   | 79.84           | 44.76                       | 24                           | 44.24                                | 2.08            | 91.08                     | -19.71           | 50               | -69.71      |
| V                                                                                     | RMS       | 79.84           | 46.89                       | 24                           | 44.24                                | 2.08            | 93.21                     | -17.58           | 55               | -72.58      |
| Using integration method                                                              |           |                 |                             |                              |                                      |                 |                           |                  |                  |             |
| V                                                                                     | RMS       | 79.00           | 80.25                       | 24                           | 44.15                                | 2.08            | 126.48                    | 15.69            | 55               | -39.31      |
| *: the mixer conversion losses were compensated for in the instrument: 35.48 (79 GHz) |           |                 |                             |                              |                                      |                 |                           |                  |                  |             |

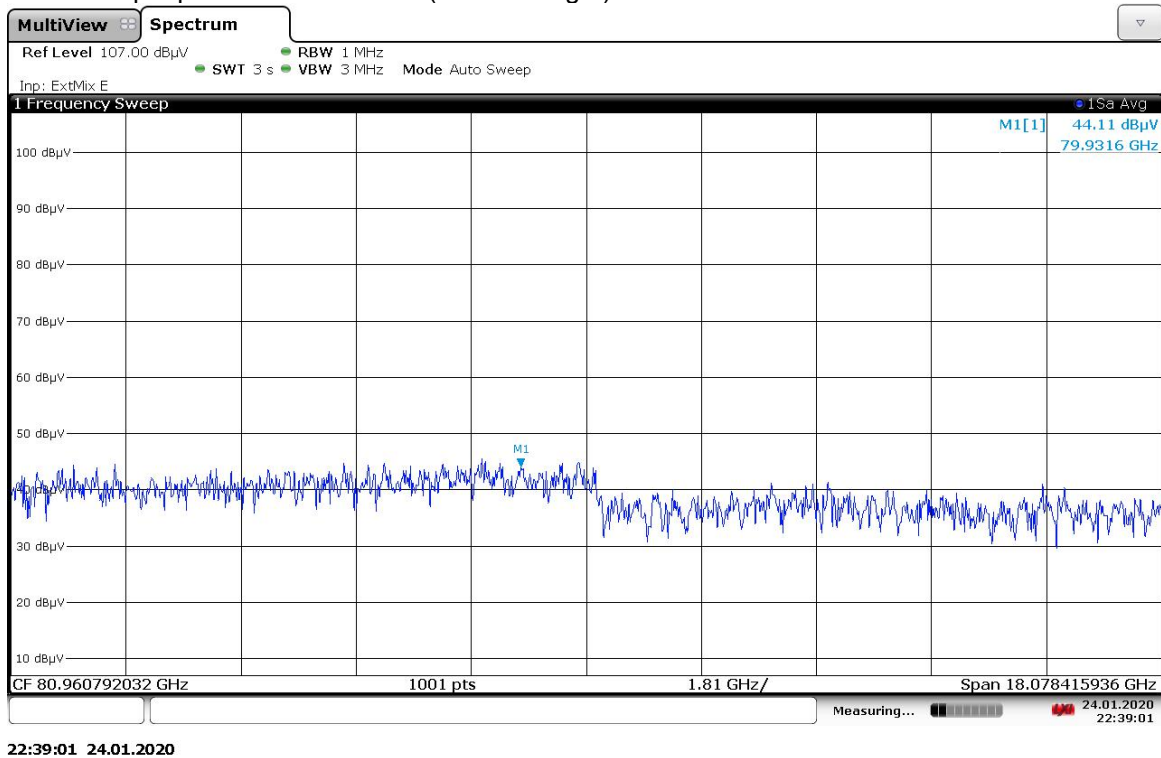
Note: Worst-case antenna polarization were recorded here.

Plot 1: Output power measurement (Field Strength) – PEAK DETECTOR

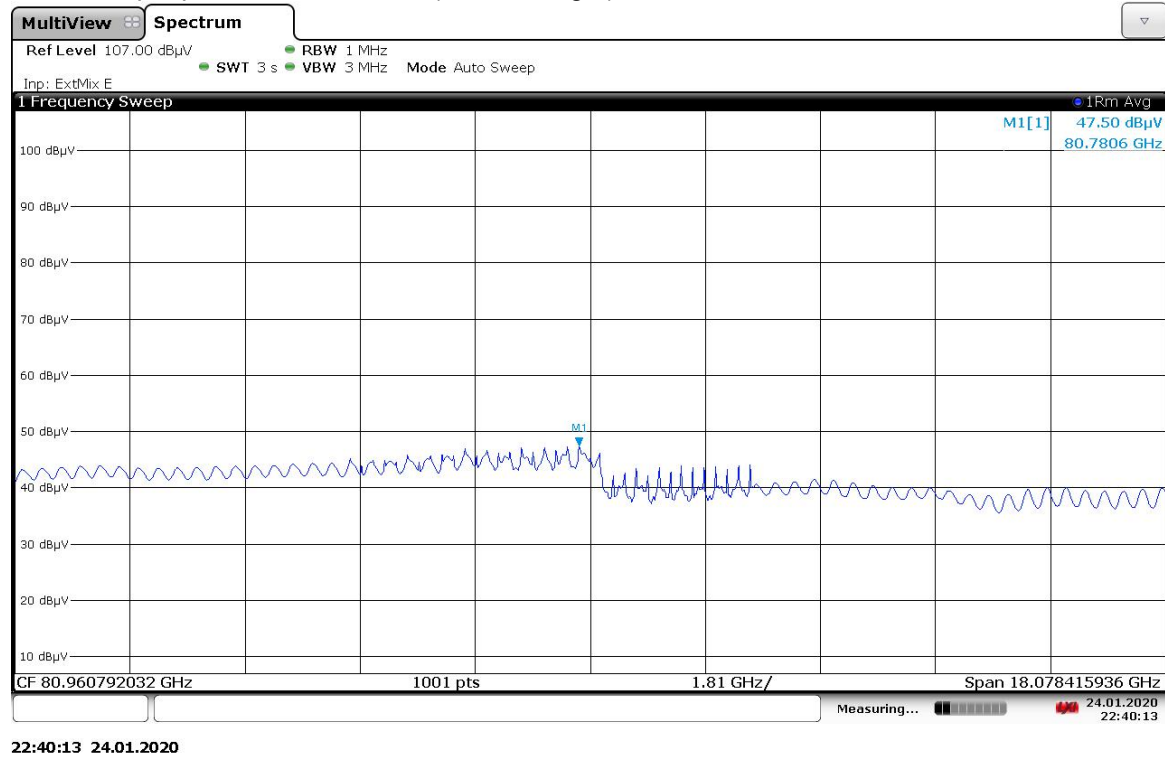


Note: Please see the sweep bandwidth in next section. Real signal and image are mixed in the above plot. This is the worst-case.

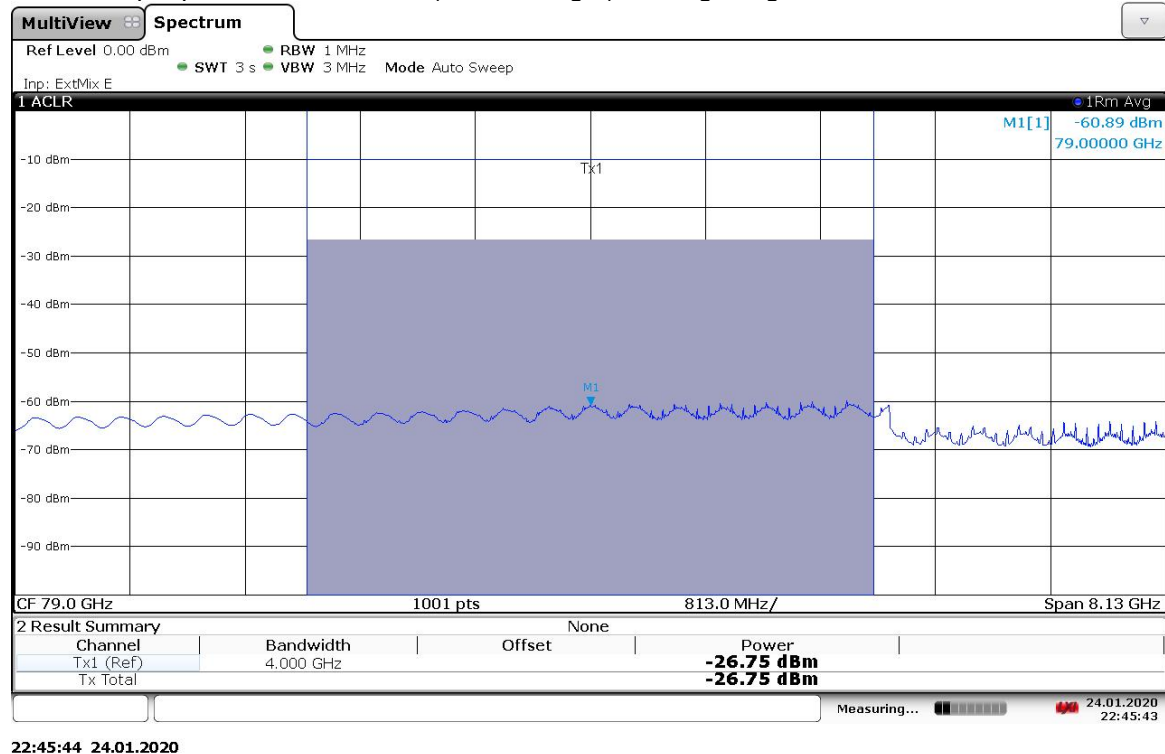
Plot 2: Output power measurement (Field Strength) – AVERAGE DETECTOR



Plot 3: Output power measurement (Field Strength) – RMS DETECTOR



Plot 4: Output power measurement (Field Strength) – Using Integration method with RMS DETECTOR



Note: Worst-case bandwidth of 4GHz was used.

Sample calculations:

Peak Power of low channel

Calculate the field strength from the radiated measurement

$$E = E_{\text{Meas}} (\text{display on SA}) + AF + \text{Mixer Conversion Loss} + \text{Cable Loss}$$

where

$E$  is the field strength of the emission at the measurement distance, in dB( $\mu$ V/m)

$AF$  is Antenna correction factor, in dB

Mixer Conversion Loss is from datasheet and it was included in transducer factor of spectrum analyzer

Cable loss in dBi

$E_{\text{Meas}}$  is the field strength of the emission at the measurement distance, in dB( $\mu$ V/m)

NOTE—The measurements were taken at 1 meter.

$$AF = 20 \cdot \log(F) - G + 30.2$$

Where

$AF$  is the antenna correction factor, in dB

$F$  is the frequency in GHz

$G$  is the gain of the test antenna, in dBi

$$F = 79.84 \text{ GHz}$$

$$G = 24.0$$

$$AF = 20 \cdot \log(79.84) - 24.0 + 30.2 = 44.24$$

$$AF = 44.24 \text{ dB/m}$$

$$\text{Cable loss} = 2.08 \text{ dB}$$

$$E_{\text{Meas}} = 70.51 \text{ dB}\mu\text{V/m}$$

$$E (\text{dB}\mu\text{V/m}) = 70.51 + 43.93 + 2.08 = 116.83 \text{ dB}(\mu\text{V/m}) \text{ at } 0.5 \text{ meter distance}$$

$$\begin{aligned} \text{EIRP (dBm)} &= E (\text{dB}\mu\text{V/m}) - 104.77 + 20 \cdot \log(d); \text{ where } d \text{ is a distance of measurement in m} \\ &= 116.83 - 104.77 - 6.02 = 6.04 \text{ dBm} \end{aligned}$$

## MPE Calculation

**§ 1.1310:** The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

### Part 1.1310 Limits for Maximum Permissible Exposure (MPE)

| Frequency range<br>(MHz)                                       | Electric field<br>strength<br>(V/m) | Magnetic field<br>strength<br>(A/m) | Power density<br>(mW/cm <sup>2</sup> ) | Averaging time<br>(minutes) |
|----------------------------------------------------------------|-------------------------------------|-------------------------------------|----------------------------------------|-----------------------------|
| <b>(A) Limits for Occupational/Controlled Exposures</b>        |                                     |                                     |                                        |                             |
| 0.3–3.0                                                        | 614                                 | 1.63                                | *(100)                                 | 6                           |
| 3.0–30                                                         | 1842/f                              | 4.89/f                              | *(900/f <sup>2</sup> )                 | 6                           |
| 30–300                                                         | 61.4                                | 0.163                               | 1.0                                    | 6                           |
| 300–1500                                                       |                                     |                                     | f/300                                  | 6                           |
| 1500–100,000                                                   |                                     |                                     | 5                                      | 6                           |
| <b>(B) Limits for General Population/Uncontrolled Exposure</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

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

## RSS-102 Issue 5 Exposure Limits:

**Table 4: RF Field Strength Limits for Devices Used by the General Public  
(Uncontrolled Environment)**

| Frequency Range (MHz)  | Electric Field (V/m rms)         | Magnetic Field (A/m rms)                        | Power Density (W/m <sup>2</sup> )  | Reference Period (minutes)      |
|------------------------|----------------------------------|-------------------------------------------------|------------------------------------|---------------------------------|
| 0.003-10 <sup>21</sup> | 83                               | 90                                              | -                                  | Instantaneous*                  |
| 0.1-10                 | -                                | 0.73/ <i>f</i>                                  | -                                  | 6**                             |
| 1.1-10                 | 87/ <i>f</i> <sup>0.5</sup>      | -                                               | -                                  | 6**                             |
| 10-20                  | 27.46                            | 0.0728                                          | 2                                  | 6                               |
| 20-48                  | 58.07/ <i>f</i> <sup>0.25</sup>  | 0.1540/ <i>f</i> <sup>0.25</sup>                | 8.944/ <i>f</i> <sup>0.5</sup>     | 6                               |
| 48-300                 | 22.06                            | 0.05852                                         | 1.291                              | 6                               |
| 300-6000               | 3.142 <i>f</i> <sup>0.3417</sup> | 0.008335 <i>f</i> <sup>0.3417</sup>             | 0.02619 <i>f</i> <sup>0.6834</sup> | 6                               |
| 6000-15000             | 61.4                             | 0.163                                           | 10                                 | 6                               |
| 15000-150000           | 61.4                             | 0.163                                           | 10                                 | 616000/ <i>f</i> <sup>1.2</sup> |
| 150000-300000          | 0.158 <i>f</i> <sup>0.5</sup>    | 4.21 x 10 <sup>-4</sup> <i>f</i> <sup>0.5</sup> | 6.67 x 10 <sup>-3</sup> <i>f</i>   | 616000/ <i>f</i> <sup>1.2</sup> |

Note: *f* is frequency in MHz.  
 \*Based on nerve stimulation (NS).  
 \*\* Based on specific absorption rate (SAR).

**1.1 Test Procedure**

An MPE evaluation for was performed in order to show that the device was compliant with §2.1091. The maximum power density was calculated for each transmitter at a separation distance of 20cm.

$$S = \frac{PG}{4\pi R^2} \quad (3)$$

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

or:

$$S = \frac{EIRP}{4\pi R^2} \quad (4)$$

where: EIRP = equivalent (or effective) isotropically radiated power

**1.2 Results:**

- EIRP = 15.69 dBm = 15.69 dBm or 37.068 mW

Power Density = 37.068 / 5025.6

Power Density = 0.007376 mW/cm<sup>2</sup>

Limit at 79GHz = 1mW/cm<sup>2</sup>

RSS-102 Issue 5 Exposure Limit at 79GHz = 10 W/m<sup>2</sup>

Power Density = 0.07376 W/m<sup>2</sup>

The calculated maximum power density at 20cm distance is less than the limit for general population / uncontrolled exposure.

Test Personnel: Vathana Ven  
Supervising/Reviewing  
Engineer:  
(Where Applicable) CFR47 FCC Part 95, Subpart M  
Product Standard: RSS-251, RSS-102  
Input Voltage: 5 VDC  
Pretest Verification w/  
Ambient Signals or  
BB Source: N/A

Test Date: 01/25/2020

Limit Applied: See report section 6.2

Ambient Temperature: 21 °C

Relative Humidity: 46 %

Atmospheric Pressure: 1007 mbars

Deviations, Additions, or Exclusions: None

## 7 Occupied Bandwidth (26 dB)

### 7.1 Method

#### 7.1 Method

The procedure described in Subclause 9.3 of ANSI C63.10-2013 and Subclause 5.4 of ANSI C63.26-2015 was utilized to determine occupied bandwidth. The EUT shall be transmitting at its maximum data rate.

- Set the center frequency of the instrument to the center frequency of the transmission
- Set span equal to approximately two times to three times the EBW, centered on the carrier frequency
- Set RBW = (CHAN) 5 MHz
- Set VBW = 10 MHz
- Sweep = Auto
- Detector = Peak
- Trace = Max Hold
- Allow the trace to stabilize
- Use the Occupied Bandwidth function of the spectrum analyzer to measure occupied bandwidth

#### TEST SITE: 10m ALSE

**The 10m ALSE** is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

#### Measurement Uncertainty

| Measurement             | Frequency Range | Expanded Uncertainty (k=2) | U <sub>CISPR</sub> |
|-------------------------|-----------------|----------------------------|--------------------|
| Radiated Emissions, 10m | 30-1000 MHz     | 5.6 dB                     | 6.3 dB             |
| Radiated Emissions, 3m  | 30-1000 MHz     | 4.9 dB                     | 6.3 dB             |
| Radiated Emissions, 3m  | 1-6 GHz         | 4.4 dB                     | 5.2 dB             |
| Radiated Emissions, 3m  | 6-15 GHz        | 4.9 dB                     | 5.5 dB             |
| Radiated Emissions, 3m  | 15-18 GHz       | 4.6 dB                     | 5.5 dB             |
| Radiated Emissions, 3m  | 18-40 GHz       | 4.6 dB                     | 5.5 dB             |

As shown in the table above our radiated emissions  $U_{lab}$  is less than the corresponding  $U_{CISPR}$  reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

**7.2 Test Equipment Used:**

| Asset           | Description                        | Manufacturer         | Model  | Serial     | Cal Date   | Cal Due    |
|-----------------|------------------------------------|----------------------|--------|------------|------------|------------|
| DAV002'         | Weather Station                    | Davis Instruments    | 7400   | PE80519A93 | 06/13/2019 | 06/13/2020 |
| OML3'           | Mixer / Antenna                    | Oleson Microwave Lab | M12HWD | E21011-1   | 03/20/2019 | 03/20/2020 |
| ROS005-1'       | Signal and Spectrum Analyzer       | Rohde and Shwartz    | FSW43  | 100646     | 10/10/2019 | 10/10/2020 |
| CBLHF2012-2M-2' | 2m 9kHz-40GHz Coaxial Cable - SET2 | Huber & Suhner       | SF102  | 252675002  | 02/14/2019 | 02/14/2020 |

**Software Utilized:**

| Name | Manufacturer | Version |
|------|--------------|---------|
| None | --           | --      |

**7.3 Results:**

The sample tested was found to Comply.

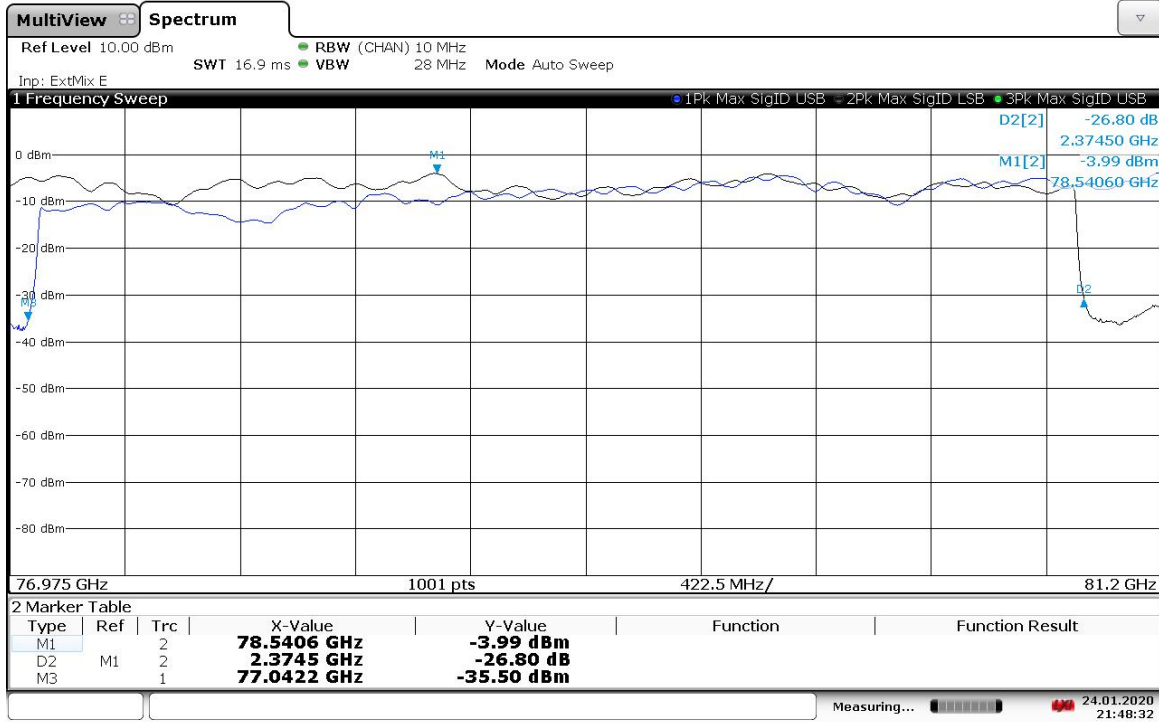
The radar device's occupied bandwidth (i.e., 99% emission bandwidth) shall be contained in the 76-81 GHz frequency band. The measured occupied bandwidth data under extreme temperature conditions are reported in the Frequency Stability section.

**7.4 Setup Photograph:**

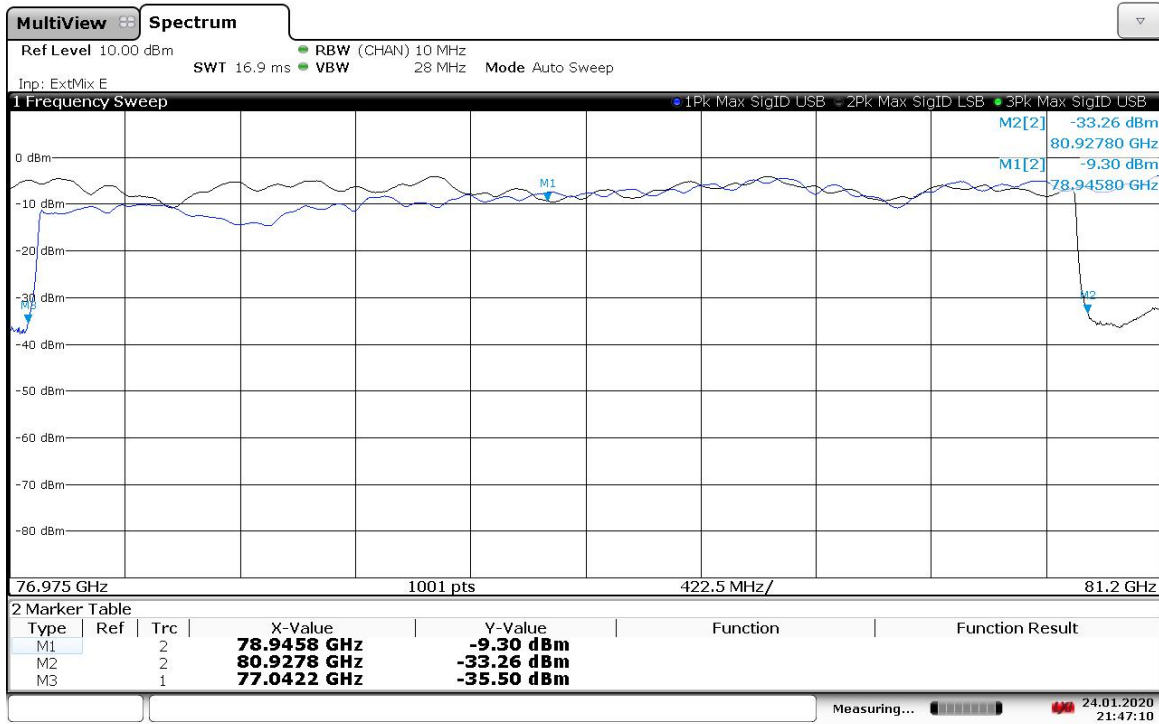


## 7.5 Plots/Data:

Occupied Bandwidth (26 dB), 3.9GHz



21:48:32 24.01.2020



21:47:10 24.01.2020

Report Number: 103842901BOX-013

Issued: 09/04/2019  
Revised date: 01/24/2020

Test Personnel: Vathana Ven *VSV*  
Supervising/Reviewing  
Engineer:  
(Where Applicable) N/A  
Product Standard: CFR47 FCC Part 95, Subpart M  
Input Voltage: RSS-251, RSS-102  
Pretest Verification w/  
Ambient Signals or  
BB Source: 5 VDC  
N/A

Test Date: 01/24/2020

Limit Applied: See report section 7.3

Ambient Temperature: 21 °C

Relative Humidity: 46 %

Atmospheric Pressure: 1007 mbars

Deviations, Additions, or Exclusions: None

## 8 Unwanted Emissions

### 8.1 Method

The procedure described in Subclauses 6.3-6.6 and 9.9 of ANSI C63.10-2013 and Subclause 5.5.4 (field strength method) of ANSI C63.26-2015 were utilized to determine unwanted emissions.

Radiated emission measurements are performed from 9 kHz to 231 GHz. Measurements for frequencies less than or equal to 1 GHz are made with an EMI receiver employing a CISPR quasi-peak detector. Measurements for frequencies above 1 GHz are made with an EMI receiver or a spectrum analyzer employing an average detector and a peak detector.

Quasi-peak measurements are performed for frequencies less than or equal to 1 GHz. The quasi-peak level of radiated emissions was measured with a resolution bandwidth (RBW) of 9 kHz for frequencies below 30 MHz and 120 kHz for frequencies between 30 MHz to 1 GHz.

Both Peak and Average measurements are performed for frequencies above 1 GHz. The peak level of radiated emissions was measured with a resolution bandwidth (RBW) of 1 MHz, a video bandwidth (VBW) of 3 MHz, and a peak detector. The average level of radiated emissions was measured with a resolution bandwidth (RBW) of 1 MHz, a video bandwidth (VBW) of 3 MHz, and an RMS detector with trace averaging.

Radiated emissions measurement is performed at 10 meters distance for frequencies below 1 GHz, 3 meters for frequency between 1 GHz and 18 GHz, and 1 meter for frequencies above 18 GHz. If the emission level is too low for measurement at that distance, a pre-amplifier is used and/or the test is performed at a closer distance.

The EUT is configured to transmit continuously at its maximum data rate. The EUT is placed 80 cm in height for frequencies below 1 GHz and 1.5 meters in height for frequency above 1 GHz. For portable or handheld devices, the EUT is manipulated through three orthogonal orientations.

For radiated emissions measurements Below 30 MHz, the measuring antenna is positioned with its plane perpendicular to the ground at the specified distance from the EUT. The lowest height of the measurement antenna is 1 m above the ground. During the test, the EUT is rotated 0° through 360° and the measuring antenna orientations are varied (parallel, perpendicular, and ground-parallel) during the search for maximum emission level. EMI receiver's resolution bandwidth is set at 9 kHz.

For radiated emissions measurements between 30 MHz to 18 GHz, measurements are performed with the EUT rotated from 0° to 360°, the measuring antenna height scanned between 1 to 4 meters, and the measuring antenna varied for both horizontal and vertical polarization, to determine the maximum emission level.

For radiated emissions measurements between 18 GHz to 231 GHz, handheld measurement is performed at a far field distance. As the surfaces of the EUT are scanned, the test antenna is kept pointed toward the EUT and the measuring antenna polarization is varied slowly to cover all possible polarizations and orientations of the emission(s).

Data included is representative of the worst-case configuration (the configuration which resulted in the highest emission levels). Plots below are corrected for distance, cables, preamp, filters, antenna factors, and conversion factors then compared to the limits.

#### TEST SITE: 10m ALSE

**The 10m ALSE** is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the

entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

### **Measurement Uncertainty**

| <b>Measurement</b>      | <b>Frequency Range</b> | <b>Expanded Uncertainty (k=2)</b> | <b>Ucisp</b> |
|-------------------------|------------------------|-----------------------------------|--------------|
| Radiated Emissions, 10m | 30-1000 MHz            | 5.6 dB                            | 6.3 dB       |
| Radiated Emissions, 3m  | 30-1000 MHz            | 4.9 dB                            | 6.3 dB       |
| Radiated Emissions, 3m  | 1-6 GHz                | 4.4 dB                            | 5.2 dB       |
| Radiated Emissions, 3m  | 6-15 GHz               | 4.9 dB                            | 5.5 dB       |
| Radiated Emissions, 3m  | 15-18 GHz              | 4.6 dB                            | 5.5 dB       |
| Radiated Emissions, 3m  | 18-40 GHz              | 4.6 dB                            | 5.5 dB       |

As shown in the table above our radiated emissions  $U_{lab}$  is less than the corresponding  $U_{CISPR}$  reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Far Field Distance ( $R_m$ ) Calculation for harmonic mixer at 170GHz:

$$R_m = 2D^2/\lambda$$

Where: D = largest dimension of the antenna aperture in meters

$\lambda$  = wavelength of the emission under investigation  $[300/f_{\text{MHz}}]$  in meters

$$D = 0.014_{(m)}, \lambda = 300_{(m/s)} / 170 \cdot 10^3_{(MHz)} = 0.0017647_{(m)}, R_m = ((2 \cdot 0.014^2))/0.0017647 = 0.22_{(m)}$$

Measurements was made at 0.22 meter distance.

**8.2 Test Equipment Used:**

| Asset      | Description                                | Manufacturer            | Model                | Serial     | Cal Date   | Cal Due    |
|------------|--------------------------------------------|-------------------------|----------------------|------------|------------|------------|
| DAV001'    | Weather Station                            | Davis Instruments       | 7400                 | PE80519A61 | 01/23/2019 | 01/23/2020 |
| 145128'    | EMI Receiver (20 Hz - 40 GHz)              | Rohde & Schwarz         | ESIB 40              | 839283/001 | 03/28/2019 | 03/28/2020 |
| 145-410'   | Cables 145-420 145-421 145-422 145-406     | Huber + Suhner          | 10m Track A Cables   | multiple   | 07/22/2019 | 07/22/2020 |
| PRE11'     | 50dB gain pre-amp                          | Keith H                 | PRE11                | PRE11      | 10/27/2018 | 10/27/2019 |
| 145145'    | Broadband Hybrid Antenna 30 MHz - 3 GHz    | Sunol Sciences Corp.    | JB3                  | A122313    | 06/12/2019 | 06/12/2020 |
| HORN3'     | HORN ANTENNA                               | EMCO                    | 3115                 | 9610-4980  | 05/30/2019 | 05/30/2020 |
| BON001'    | METER, POWER                               | Boonton                 | 4232A                | 55601      | 01/23/2019 | 01/23/2020 |
| REA008'    | band reject filter 2.4GHz                  | Reactel, Inc            | 12RX7-2441.75-x140 S | 17-01      | 07/11/2019 | 07/11/2020 |
| 145-416'   | Cables 145-420 145-423 145-425 145-408     | Huber + Suhner          | 3m Track B cables    | multiple   | 07/22/2019 | 07/22/2020 |
| EMC04'     | ANTENNA, RIDGED GUIDE, 18-40 GHZ           | EMCO                    | 3116                 | 2090       | 10/26/2018 | 10/26/2019 |
| OML2'      | Mixer / Antenna                            | Oleson Microwave Lab    | M08HWA               | F21011-1   | 03/20/2019 | 03/27/2020 |
| OML1'      | Mixer / Antenna                            | Oleson Microwave Lab    | M05HWA               | G21011-1   | 03/20/2019 | 03/27/2020 |
| CBLSHF102' | Cable, SMA - SMA, 9kHz-40GHz (Cable Kit 5) | Sucoflex (Huber Suhner) | 104PE                | CBLSHF102  | 08/25/2017 | 10/25/2019 |
| PRE8'      | PREAMPLIFIER 1- 40 GHz                     | MITEQ                   | NSP4000-NF           | 507145     | 10/25/2018 | 10/25/2019 |
| OML3'      | Mixer / Antenna                            | Oleson Microwave Lab    | M12HWD               | E21011-1   | 03/27/2019 | 03/27/2020 |
| ROS005-1'  | Signal and Spectrum Analyzer               | Rohde and Schwartz      | FSW43                | 100646     | 10/10/2019 | 10/15/2020 |
| CBLSHF103' | Cable, SMA - SMA, < 18GHz                  | Sucoflex (Huber Suhner) | 104PE                | CBLSHF103  | 11/15/2018 | 11/15/2019 |
| OML4'      | Mixer / Antenna                            | Oleson Microwave Lab    | M19HWA               | U21011-1   | 11/13/2016 | 04/29/2020 |
| OML5'      | Millimeter Wave Harmonic Generator         | Oleson Microwave Lab    | 40200WGS             | 21011-1    | 03/27/2019 | 03/27/2020 |
| OML6'      | WR-04 Horn antenna 22-24dBi, 170-260GHz    | OML                     | M04RH                | 19042901   | 04/29/2019 | 04/29/2020 |
| OML7'      | WR-04 Harmonic Mixer, 170-260GHz           | OML                     | M04HWD               | 190429-1   | 04/29/2019 | 04/29/2020 |

**Software Utilized:**

| Name               | Manufacturer | Version    |
|--------------------|--------------|------------|
| BAT-EMC            | Nexio        | 3.17.0.3   |
| EMI Boxborough.xls | Intertek     | 08/27/2010 |

**8.3 Results:**

The sample tested was found to Comply.

Unwanted emissions Limits (FCC Part 95 Subpart M):

| Frequency (MHz)          | Field strength (μV/m)               | Measurement distance (m) | Detector                |
|--------------------------|-------------------------------------|--------------------------|-------------------------|
| 0.009-0.490 <sup>1</sup> | 2400/F(kHz)                         | 300                      | Quasi-peak [see Note 1] |
| 0.490-1.705              | 24000/F(kHz)                        | 30                       | Quasi-peak              |
| 1.705-30.0               | 30                                  | 30                       | Quasi-peak              |
| 30-88                    | 100                                 | 3                        | Quasi-peak              |
| 88-216                   | 150                                 | 3                        | Quasi-peak              |
| 216-960                  | 200                                 | 3                        | Quasi-peak              |
| 960-40,000 <sup>2</sup>  | 500                                 | 3                        | Quasi-peak [see Note 2] |
| Frequency (GHz)          | Power density (pW/cm <sup>2</sup> ) | Measurement distance (m) | Detector                |
| 40-200                   | 600                                 | 3                        | Average                 |
| Above 200                | 1000                                | 3                        | Average                 |

Note 1: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.

Note 2: The emission limits for the frequencies above 1 GHz are based on measurements employing a linear average detector.

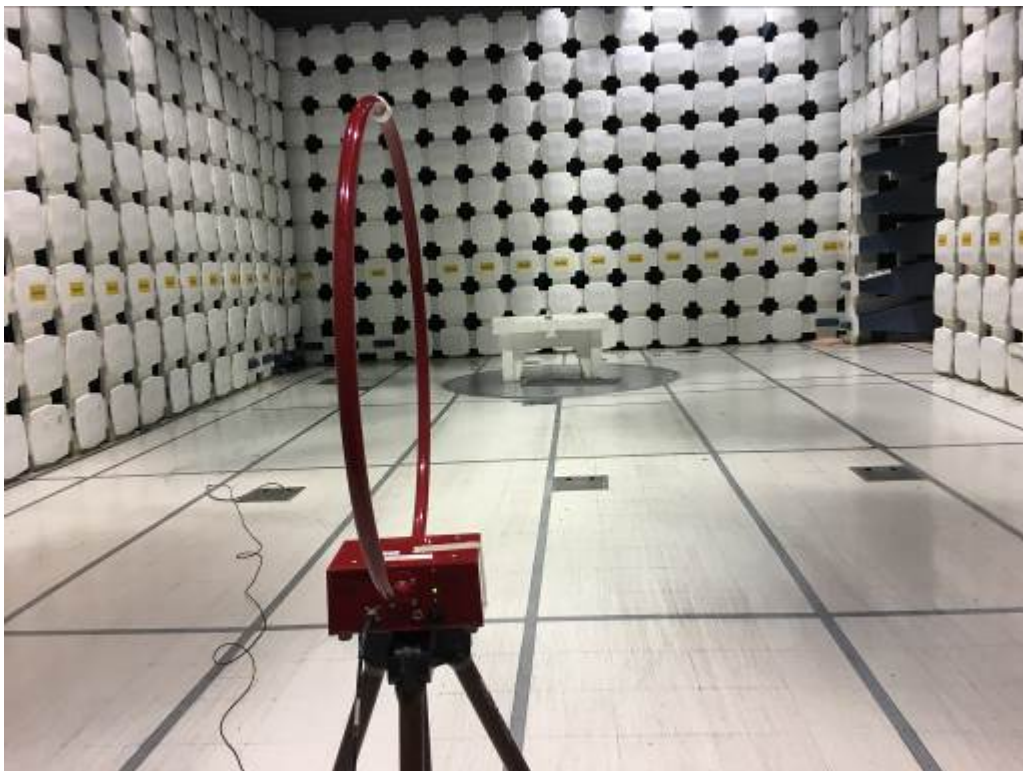
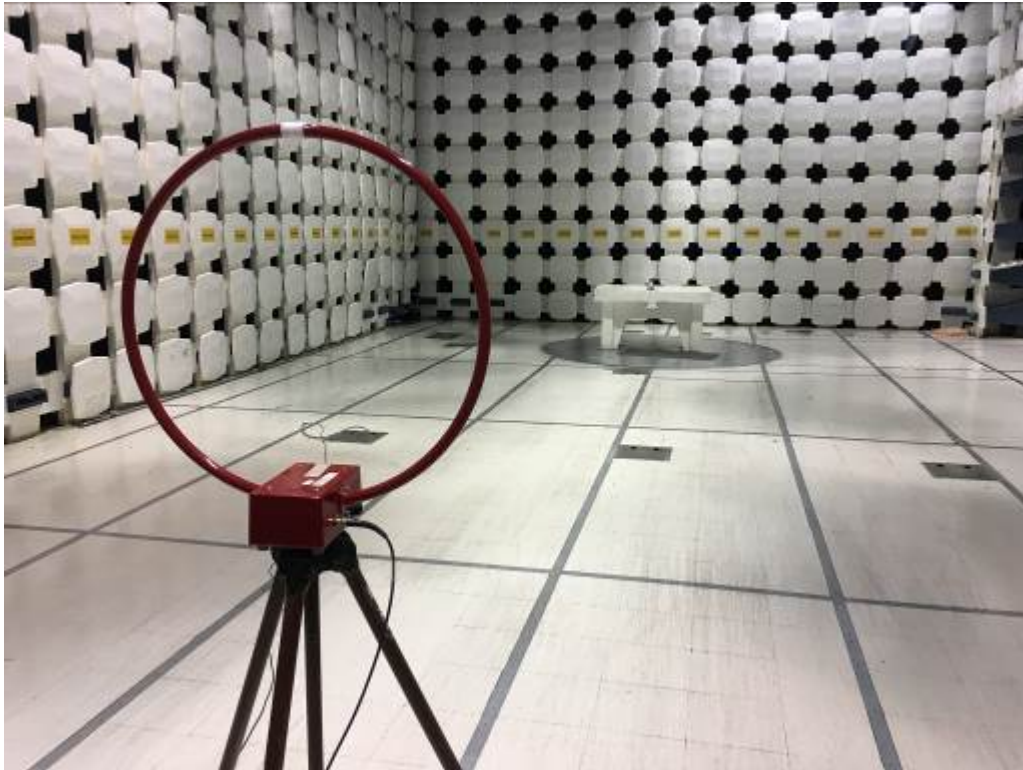
Unwanted emissions Limits (ISED RSS-251 Issue 2):

| Frequency (MHz)          | Magnetic field strength (μA/m) | Measurement distance (m) | Detector                |
|--------------------------|--------------------------------|--------------------------|-------------------------|
| 0.009-0.490 <sup>1</sup> | 6.37/F(kHz)                    | 300                      | Quasi-peak [see Note 1] |
| 0.490-1.705              | 63.7/F(kHz)                    | 30                       | Quasi-peak              |
| 1.705-30.0               | 0.08                           | 30                       | Quasi-peak              |
| Frequency (MHz)          | Field strength (μV/m)          | Measurement distance (m) | Detector                |
| 30-88                    | 100                            | 3                        | Quasi-peak              |
| 88-216                   | 150                            | 3                        | Quasi-peak              |
| 216-960                  | 200                            | 3                        | Quasi-peak              |
| 960-40,000 <sup>2</sup>  | 500                            | 3                        | Quasi-peak [see Note 2] |
| Frequency (GHz)          | Power density (dBm/MHz eirp)   | Measurement distance (m) | Detector                |
| 40-162 <sup>3</sup>      | -30                            | 3                        | RMS                     |

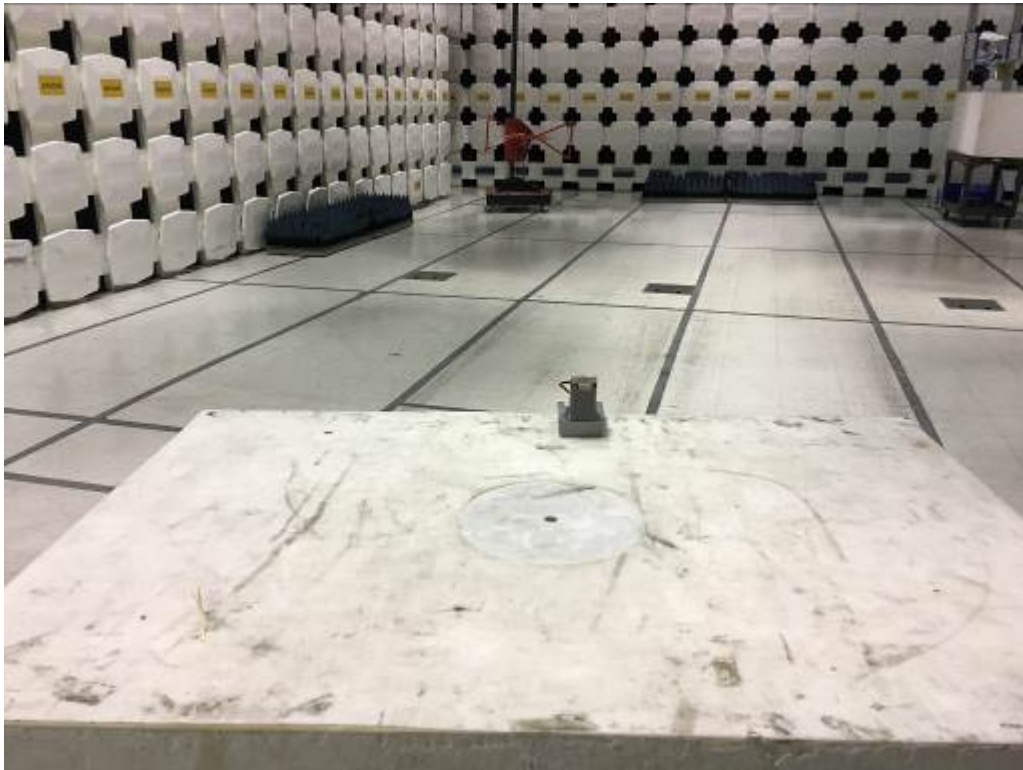
- Note 1: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.
- Note 2: The emission limits for the frequencies above 1 GHz are based on measurements employing a linear average detector.
- Note 3: For radar devices that operate solely in the 76-77 GHz band (i.e., the occupied bandwidth is entirely contained in the 76-77 GHz band), an unwanted emissions limit of 0 dBm/MHz shall apply for the unwanted emission that fall in the 73.5-76 GHz band. Outside of the 73.5-76 GHz band, the unwanted emission limits prescribed in this table shall apply. The emission limits for the frequencies above 1 GHz are based on measurements employing a linear average detector.

#### 8.4 Setup Photograph:

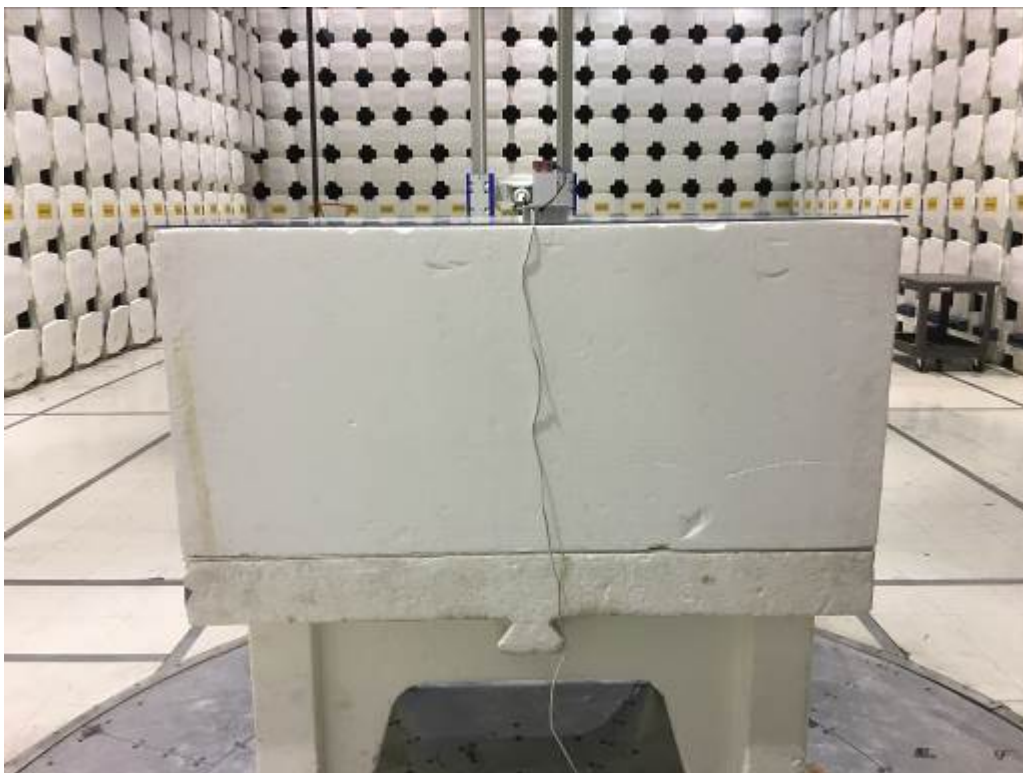
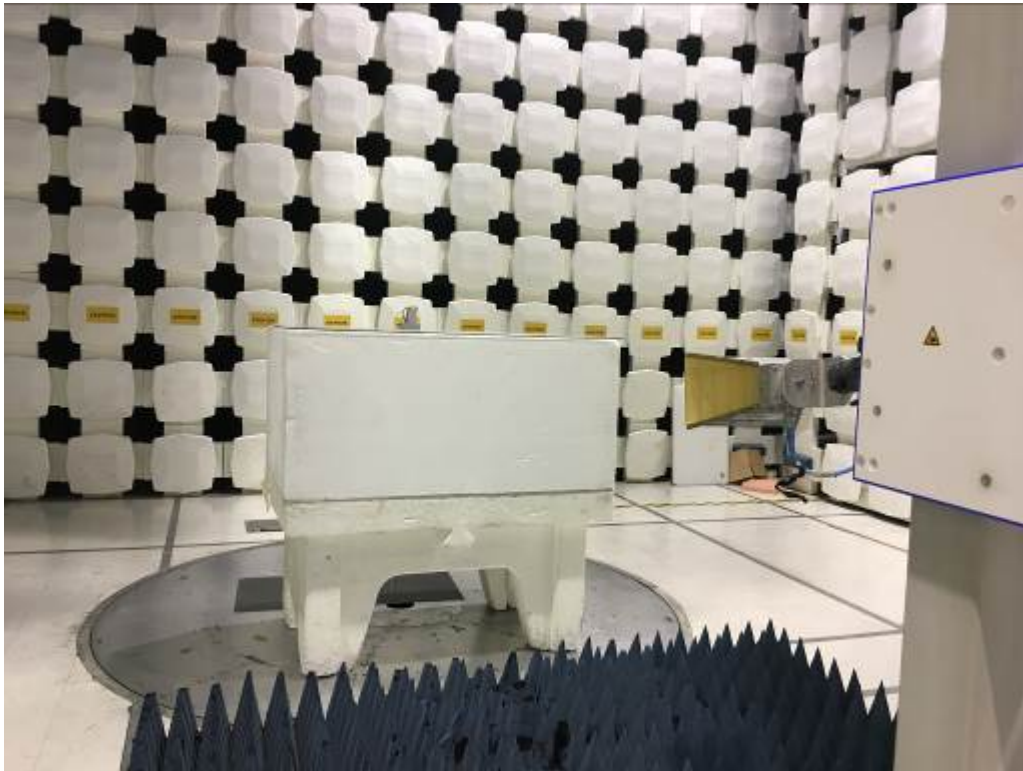
9kHz-30MHz



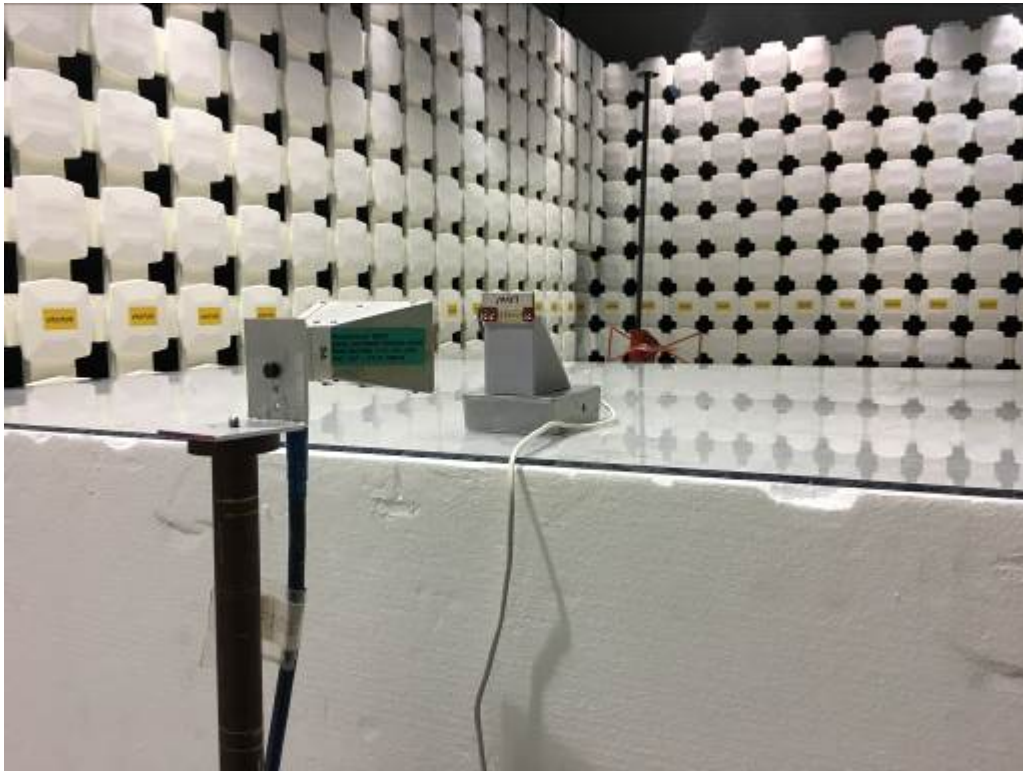
30-1000MHz



1-18 GHz



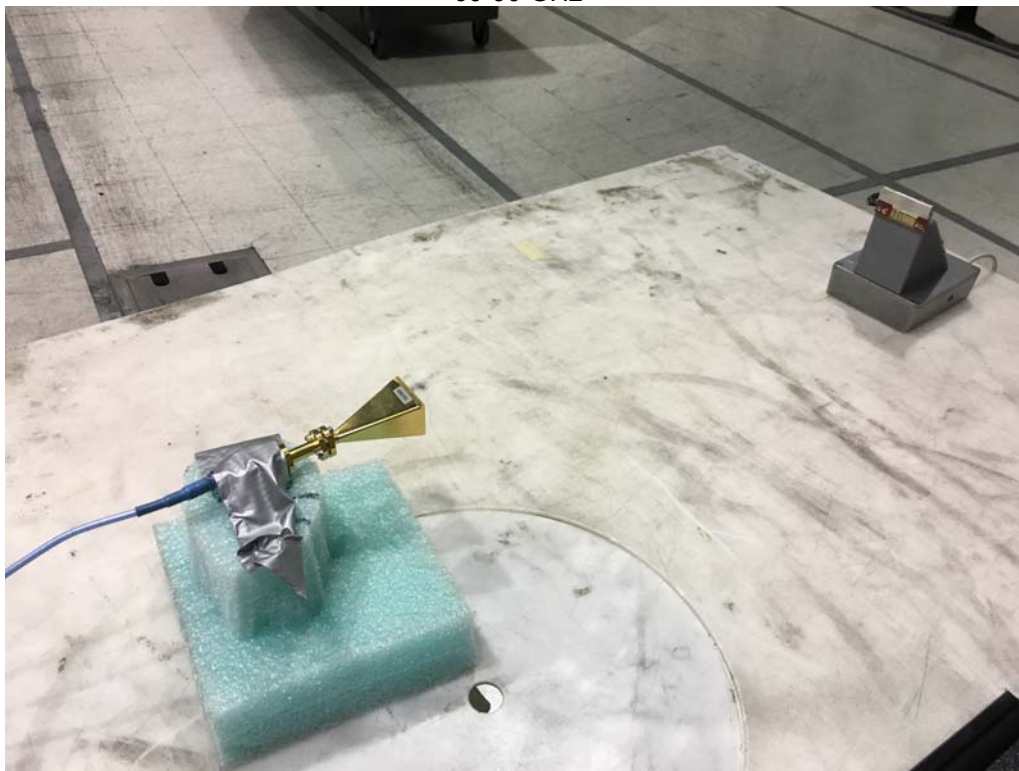
18-40 GHz



40-60 GHz



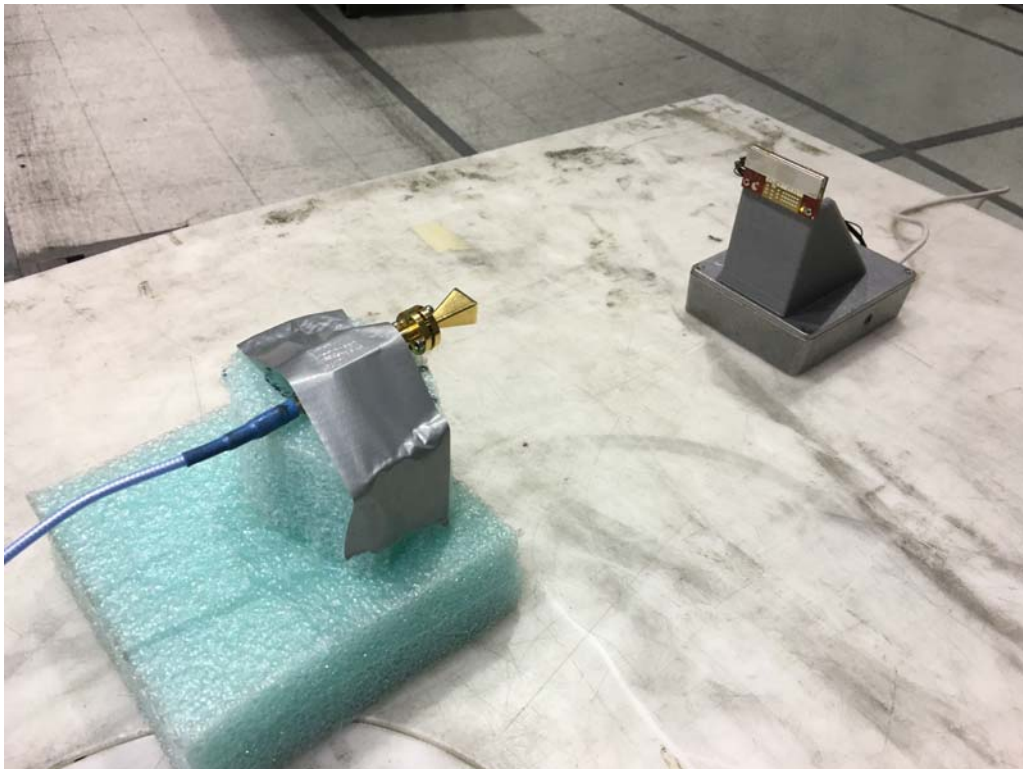
60-90 GHz



90-140 GHz



140-220 GHz



220-231 GHz



## 8.5 Plots/Data:

### 9kHz – 30MHz Special Radiated Emissions

Company: Patroness  
Model #: P003110  
Serial #: 0

Antenna & Cables: LF Bands: N, LF, HF, SHF  
Antenna: ETS003\_06-17-2020.txt ETS003\_06-17-2020.txt  
Cable(s): 145-416\_7-22-2020.txt NONE

Engineers: Vathana Ven Location: 10M Barometer: DAV001 Filter: NONE

Project #: G103842901 Date(s): 08/29/19

Standard: FCC Part 95, Subpart M/RSS-251 Temp/Humidity/Pressure: 24 deg C 41% 755 mB

Receiver: R&S FSW (ROS005-1) 10-15-2019 Limit Distance (m): 10

PreAmp: PRE8\_10\_25\_2019.txt Test Distance (m): 10

PreAmp Used? (Y or N): N Voltage/Frequency: 5VDC Frequency Range: 9kHz-30MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

| Detector<br>Type                                                     | Ant.<br>Pol.<br>(V/H) | Frequency<br>MHz | Reading<br>dB(uV) | Antenna<br>Factor<br>dB(1/m) | Cable<br>Loss<br>dB | Pre-amp<br>Factor<br>dB | Distance<br>Factor<br>dB | Net<br>dB(uV/m) | Limit<br>dB(uV/m) | Margin<br>dB | Bandwidth |
|----------------------------------------------------------------------|-----------------------|------------------|-------------------|------------------------------|---------------------|-------------------------|--------------------------|-----------------|-------------------|--------------|-----------|
| No emissions were detected above the measuring equipment noise floor |                       |                  |                   |                              |                     |                         |                          |                 |                   |              |           |

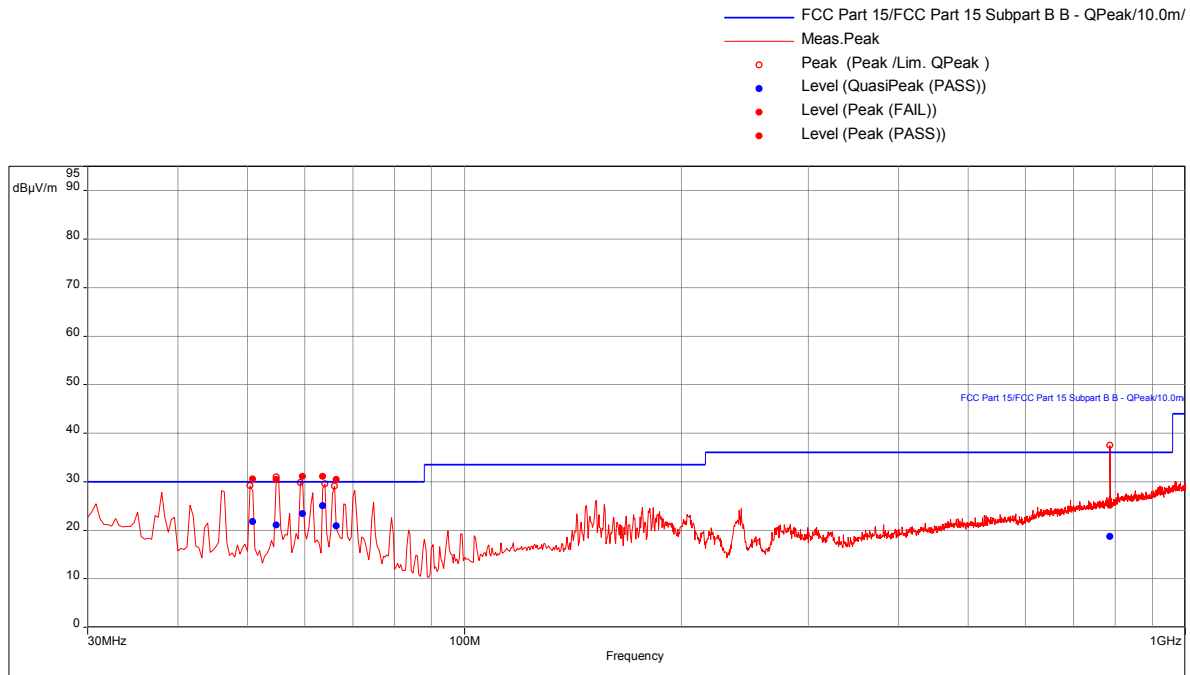
FCC IC

**Low Channel, 30-1000 MHz**

**Test Information:**

|                           |                                |
|---------------------------|--------------------------------|
| Date and Time             | 8/29/2019 6:38:19 PM           |
| Client and Project Number | Patroness                      |
| Engineer                  | Vathana Ven                    |
| Temperature               | 24 deg C                       |
| Humidity                  | 41%                            |
| Atmospheric Pressure      | 755 mbar                       |
| Comments                  | 30-1000MHz_Tx mode_Low Channel |

**Graph:**



**Results:**

**QuasiPeak (PASS) (6)**

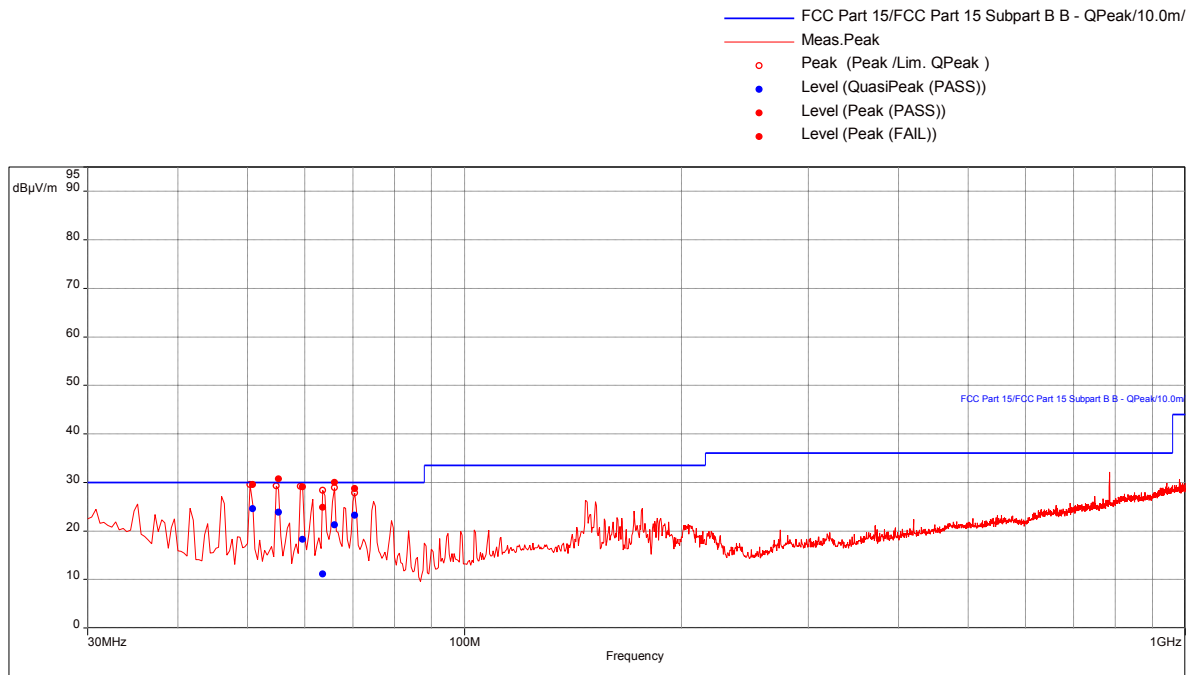
| Frequency (MHz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. (dB)  | RBW (dB)  | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|-----------|-----------------|
| 50.81052632     | 21.81          | 30.00          | -8.19       | 342.00      | 2.35       | Vertical   | 120000.00 | -25.15          |
| 54.92631579     | 21.08          | 30.00          | -8.92       | 305.00      | 3.70       | Vertical   | 120000.00 | -25.68          |
| 59.61052632     | 23.38          | 30.00          | -6.62       | 321.00      | 2.25       | Vertical   | 120000.00 | -25.47          |
| 63.77894737     | 25.04          | 30.00          | -4.96       | 355.00      | 1.74       | Vertical   | 120000.00 | -25.11          |
| 66.25263158     | 20.87          | 30.00          | -9.13       | 305.00      | 2.34       | Vertical   | 120000.00 | -24.94          |
| 786.5894737     | 18.73          | 36.00          | -17.27      | 77.00       | 2.53       | Horizontal | 120000.00 | -7.98           |

**Mid Channel, 30-1000 MHz**

**Test Information:**

|                           |                                |
|---------------------------|--------------------------------|
| Date and Time             | 8/29/2019 6:33:50 PM           |
| Client and Project Number | Patroness                      |
| Engineer                  | Vathana Ven                    |
| Temperature               | 24 deg C                       |
| Humidity                  | 41%                            |
| Atmospheric Pressure      | 755 mbar                       |
| Comments                  | 30-1000MHz_Tx mode_Mid Channel |

**Graph:**



**Results:**

**QuasiPeak (PASS) (6)**

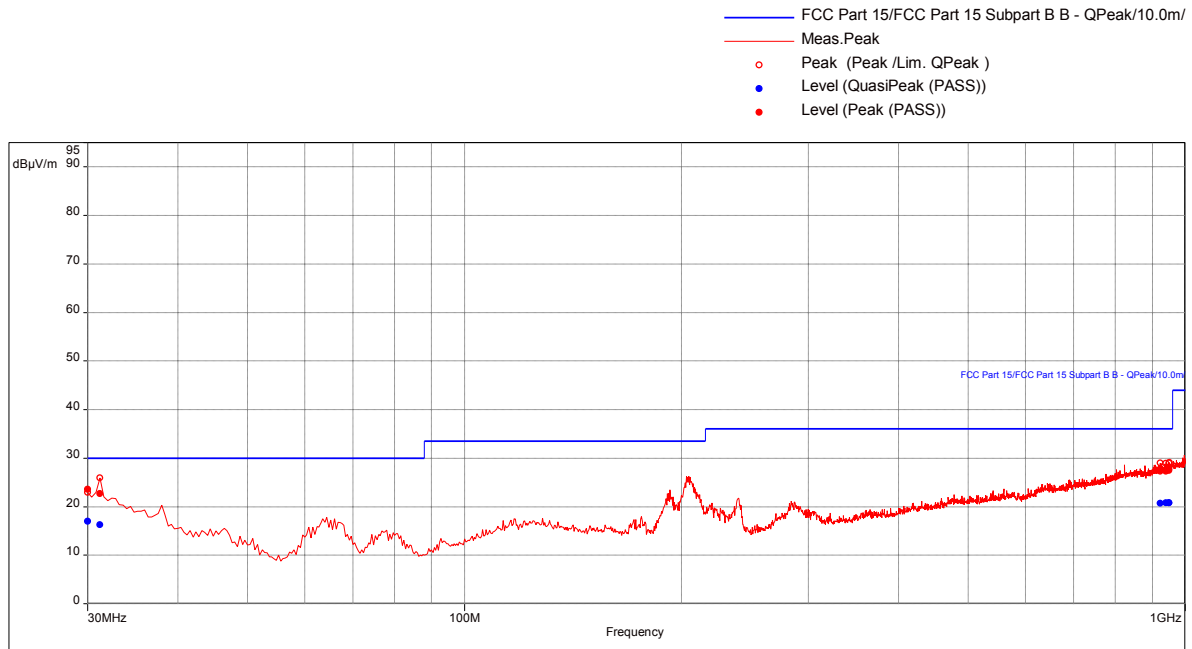
| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Azimuth (°) (dB) | Height (m) (dB) | Pol. (dB) | RBW (dB)  | Correction (dB) |
|-----------------|----------------|----------------|-------------|------------------|-----------------|-----------|-----------|-----------------|
| 50.62105263     | 24.55          | 30.00          | -5.45       | 284.00           | 2.02            | Vertical  | 120000.00 | -25.10          |
| 55.17894737     | 23.86          | 30.00          | -6.14       | 253.00           | 1.96            | Vertical  | 120000.00 | -25.67          |
| 59.64210526     | 18.22          | 30.00          | -11.78      | 290.00           | 3.95            | Vertical  | 120000.00 | -25.47          |
| 63.50526316     | 11.11          | 30.00          | -18.89      | 349.00           | 2.28            | Vertical  | 120000.00 | -25.14          |
| 65.93684211     | 21.23          | 30.00          | -8.77       | 282.00           | 1.61            | Vertical  | 120000.00 | -24.97          |
| 70.4            | 23.21          | 30.00          | -6.79       | 40.00            | 2.26            | Vertical  | 120000.00 | -24.73          |

High Channel, 30-1000 MHz

**Test Information:**

|                           |                                            |
|---------------------------|--------------------------------------------|
| Date and Time             | 8/29/2019 5:05:54 PM                       |
| Client and Project Number | Patroness                                  |
| Engineer                  | Vathana Ven                                |
| Temperature               | 24 deg C                                   |
| Humidity                  | 41%                                        |
| Atmospheric Pressure      | 755 mbar                                   |
| Comments                  | 30-1000MHz_Tx mode_High Channel_Final scan |

**Graph:**



**Results:**

QuasiPeak (PASS) (6)

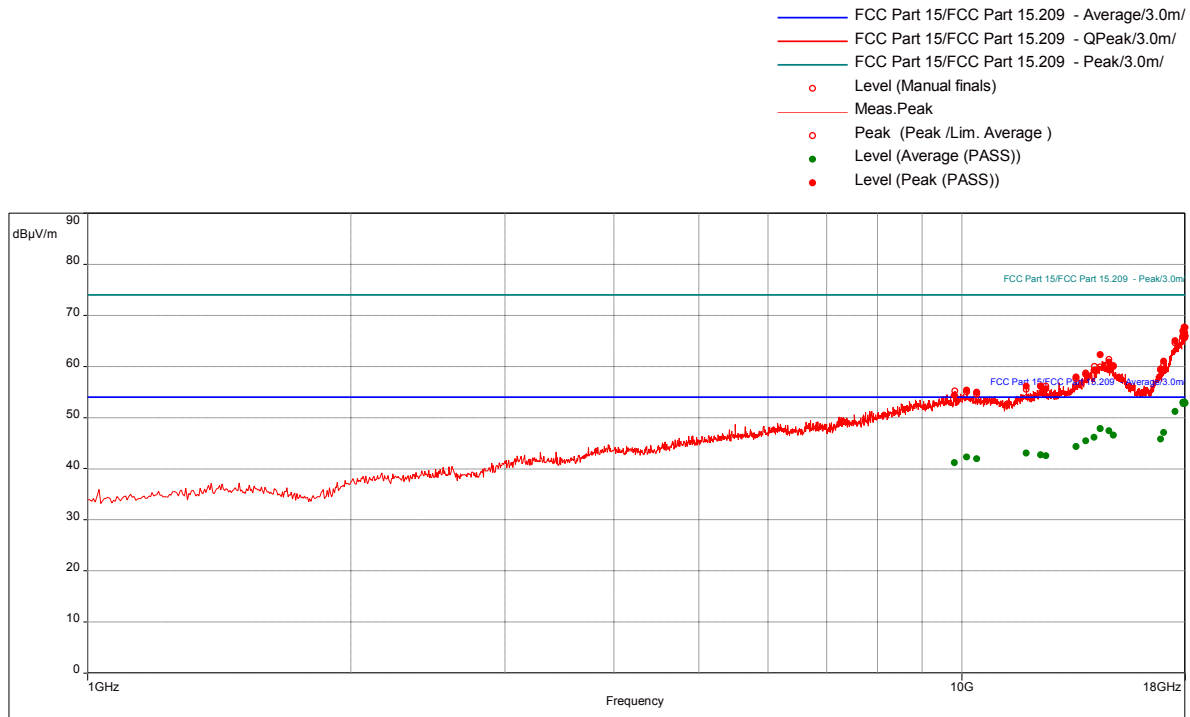
| Frequency (MHz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. (dB)  | RBW (dB)  | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|-----------|-----------------|
| 30              | 17.00          | 30.00          | -13.00      | 32.00       | 1.59       | Vertical   | 120000.00 | -12.45          |
| 31.32631579     | 16.30          | 30.00          | -13.70      | 128.00      | 2.05       | Horizontal | 120000.00 | -13.15          |
| 923.2315789     | 20.70          | 36.00          | -15.30      | 32.00       | 2.35       | Vertical   | 120000.00 | -5.53           |
| 940.7473684     | 20.77          | 36.00          | -15.23      | 77.00       | 1.74       | Vertical   | 120000.00 | -5.47           |
| 949.0105263     | 20.78          | 36.00          | -15.22      | 313.00      | 3.95       | Vertical   | 120000.00 | -5.24           |
| 950.0526316     | 20.78          | 36.00          | -15.22      | 232.00      | 3.09       | Vertical   | 120000.00 | -5.23           |

Low Channel, 1-18 GHz

**Test Information:**

|                           |                             |
|---------------------------|-----------------------------|
| Date and Time             | 8/27/2019 9:11:18 PM        |
| Client and Project Number | Patroness                   |
| Engineer                  | Vathana Ven                 |
| Temperature               | 24 deg C                    |
| Humidity                  | 41%                         |
| Atmospheric Pressure      | 755 mbar                    |
| Comments                  | 1 to 18 GHz_ Tx Low Channel |

**Graph:**



**Results:**

**Peak (PASS) (21)**

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Azimuth (°) (dB) | Height (m) (dB) | Pol. (dB)  | RBW (dB)   | Correction (dB) |
|-----------------|----------------|----------------|-------------|------------------|-----------------|------------|------------|-----------------|
| 9807.105263     | 54.36          | 74.00          | -19.64      | 341.00           | 1.40            | Horizontal | 1000000.00 | -0.09           |
| 10127.89474     | 55.39          | 74.00          | -18.61      | 231.00           | 3.30            | Horizontal | 1000000.00 | 0.68            |
| 10396.05263     | 54.89          | 74.00          | -19.11      | 92.00            | 1.80            | Vertical   | 1000000.00 | 0.70            |
| 11845           | 56.12          | 74.00          | -17.88      | 25.00            | 2.15            | Horizontal | 1000000.00 | 2.96            |
| 12309.47368     | 56.13          | 74.00          | -17.87      | 238.00           | 3.74            | Vertical   | 1000000.00 | 3.38            |
| 12478.42105     | 55.61          | 74.00          | -18.39      | 195.00           | 1.85            | Vertical   | 1000000.00 | 3.41            |
| 13511.31579     | 57.94          | 74.00          | -16.06      | 113.00           | 2.60            | Horizontal | 1000000.00 | 5.74            |
| 13861.57895     | 58.42          | 74.00          | -15.58      | 268.00           | 1.65            | Vertical   | 1000000.00 | 7.15            |
| 14171.57895     | 59.18          | 74.00          | -14.82      | 92.00            | 2.10            | Horizontal | 1000000.00 | 8.69            |
| 14400.52632     | 62.25          | 74.00          | -11.75      | 18.00            | 3.39            | Horizontal | 1000000.00 | 9.49            |
| 14725           | 60.80          | 74.00          | -13.20      | 246.00           | 3.39            | Vertical   | 1000000.00 | 9.39            |
| 14893.15789     | 60.14          | 74.00          | -13.86      | 357.00           | 1.50            | Vertical   | 1000000.00 | 8.86            |
| 16870.26316     | 59.43          | 74.00          | -14.57      | 121.00           | 1.65            | Horizontal | 1000000.00 | 6.81            |
| 17019.47368     | 61.04          | 74.00          | -12.96      | 47.00            | 2.40            | Horizontal | 1000000.00 | 8.15            |
| 17528.15789     | 65.03          | 74.00          | -8.97       | 55.00            | 2.15            | Vertical   | 1000000.00 | 12.14           |
| 17893.94737     | 66.91          | 74.00          | -7.09       | 202.00           | 2.10            | Vertical   | 1000000.00 | 14.16           |
| 17923.15789     | 66.33          | 74.00          | -7.67       | 32.00            | 2.25            | Vertical   | 1000000.00 | 14.27           |
| 17943.42105     | 66.96          | 74.00          | -7.04       | 0.00             | 2.00            | Vertical   | 1000000.00 | 14.35           |
| 17953.15789     | 67.68          | 74.00          | -6.32       | 239.00           | 1.35            | Horizontal | 1000000.00 | 14.39           |
| 17980.78947     | 66.57          | 74.00          | -7.43       | 157.00           | 1.70            | Vertical   | 1000000.00 | 14.51           |
| 18000           | 67.62          | 74.00          | -6.38       | 292.00           | 1.05            | Vertical   | 1000000.00 | 14.59           |

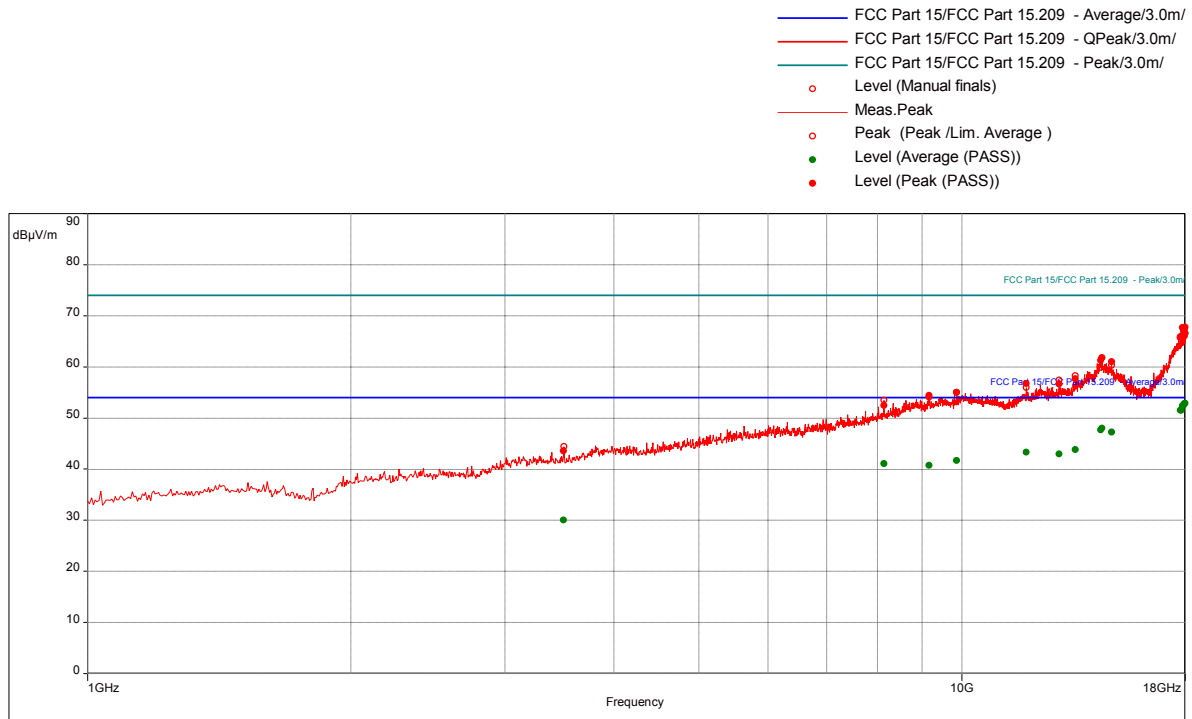
**Average (PASS) (21)**

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Azimuth (°) (dB) | Height (m) (dB) | Pol. (dB)  | RBW (dB)   | Correction (dB) |
|-----------------|----------------|----------------|-------------|------------------|-----------------|------------|------------|-----------------|
| 9807.105263     | 41.14          | 54.00          | -12.86      | 341.00           | 1.40            | Horizontal | 1000000.00 | -0.09           |
| 10127.89474     | 42.28          | 54.00          | -11.72      | 231.00           | 3.30            | Horizontal | 1000000.00 | 0.68            |
| 10396.05263     | 41.94          | 54.00          | -12.06      | 92.00            | 1.80            | Vertical   | 1000000.00 | 0.70            |
| 11845           | 43.07          | 54.00          | -10.93      | 25.00            | 2.15            | Horizontal | 1000000.00 | 2.96            |
| 12309.47368     | 42.71          | 54.00          | -11.29      | 238.00           | 3.74            | Vertical   | 1000000.00 | 3.38            |
| 12478.42105     | 42.52          | 54.00          | -11.48      | 195.00           | 1.85            | Vertical   | 1000000.00 | 3.41            |
| 13511.31579     | 44.36          | 54.00          | -9.64       | 113.00           | 2.60            | Horizontal | 1000000.00 | 5.74            |
| 13861.57895     | 45.40          | 54.00          | -8.60       | 268.00           | 1.65            | Vertical   | 1000000.00 | 7.15            |
| 14171.57895     | 46.13          | 54.00          | -7.87       | 92.00            | 2.10            | Horizontal | 1000000.00 | 8.69            |
| 14400.52632     | 47.85          | 54.00          | -6.15       | 18.00            | 3.39            | Horizontal | 1000000.00 | 9.49            |
| 14725           | 47.43          | 54.00          | -6.57       | 246.00           | 3.39            | Vertical   | 1000000.00 | 9.39            |
| 14893.15789     | 46.57          | 54.00          | -7.43       | 357.00           | 1.50            | Vertical   | 1000000.00 | 8.86            |
| 16870.26316     | 45.80          | 54.00          | -8.20       | 121.00           | 1.65            | Horizontal | 1000000.00 | 6.81            |
| 17019.47368     | 47.10          | 54.00          | -6.90       | 47.00            | 2.40            | Horizontal | 1000000.00 | 8.15            |
| 17528.15789     | 51.13          | 54.00          | -2.87       | 55.00            | 2.15            | Vertical   | 1000000.00 | 12.14           |
| 17893.94737     | 52.93          | 54.00          | -1.07       | 202.00           | 2.10            | Vertical   | 1000000.00 | 14.16           |
| 17923.15789     | 52.68          | 54.00          | -1.32       | 32.00            | 2.25            | Vertical   | 1000000.00 | 14.27           |
| 17943.42105     | 52.88          | 54.00          | -1.12       | 0.00             | 2.00            | Vertical   | 1000000.00 | 14.35           |
| 17953.15789     | 52.96          | 54.00          | -1.04       | 239.00           | 1.35            | Horizontal | 1000000.00 | 14.39           |
| 17980.78947     | 52.96          | 54.00          | -1.04       | 157.00           | 1.70            | Vertical   | 1000000.00 | 14.51           |
| 18000           | 52.83          | 54.00          | -1.17       | 292.00           | 1.05            | Vertical   | 1000000.00 | 14.59           |

## Mid Channel, 1-18 GHz

**Test Information:**

|                           |                                 |
|---------------------------|---------------------------------|
| Date and Time             | 8/27/2019 6:42:09 PM            |
| Client and Project Number | Patroness                       |
| Engineer                  | Vathana Ven                     |
| Temperature               | 24 deg C                        |
| Humidity                  | 41%                             |
| Atmospheric Pressure      | 755 mbar                        |
| Comments                  | 1 to 18 GHz _ Trx @ Mid channel |

**Graph:**

**Results:**

## Peak (PASS) (16)

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Azimuth (°) (dB) | Height (m) (dB) | Pol. (dB)  | RBW (dB)   | Correction (dB) |
|-----------------|----------------|----------------|-------------|------------------|-----------------|------------|------------|-----------------|
| 3500.789474     | 43.52          | 74.00          | -30.48      | 166.00           | 1.65            | Horizontal | 1000000.00 | -15.91          |
| 8142.368421     | 52.43          | 74.00          | -21.57      | 62.00            | 1.70            | Horizontal | 1000000.00 | -3.96           |
| 9168.421053     | 54.42          | 74.00          | -19.58      | 180.00           | 3.15            | Vertical   | 1000000.00 | -1.59           |
| 9863.421053     | 55.00          | 74.00          | -19.00      | 26.00            | 2.25            | Vertical   | 1000000.00 | 0.04            |
| 11838.94737     | 56.74          | 74.00          | -17.26      | 39.00            | 1.85            | Vertical   | 1000000.00 | 2.94            |
| 12915.26316     | 56.68          | 74.00          | -17.32      | 320.00           | 2.85            | Horizontal | 1000000.00 | 3.93            |
| 13483.68421     | 57.71          | 74.00          | -16.29      | 313.00           | 3.34            | Horizontal | 1000000.00 | 5.65            |
| 14403.15789     | 61.29          | 74.00          | -12.71      | 172.00           | 2.80            | Vertical   | 1000000.00 | 9.50            |
| 14460           | 61.80          | 74.00          | -12.20      | 239.00           | 3.79            | Horizontal | 1000000.00 | 9.60            |
| 14828.15789     | 61.02          | 74.00          | -12.98      | 54.00            | 2.40            | Vertical   | 1000000.00 | 9.09            |
| 17764.73684     | 65.87          | 74.00          | -8.13       | 277.00           | 2.00            | Vertical   | 1000000.00 | 13.67           |
| 17819.73684     | 65.52          | 74.00          | -8.48       | 99.00            | 3.00            | Vertical   | 1000000.00 | 13.86           |
| 17885.26316     | 67.67          | 74.00          | -6.33       | 39.00            | 3.34            | Horizontal | 1000000.00 | 14.12           |
| 17928.42105     | 67.32          | 74.00          | -6.68       | 54.00            | 3.84            | Vertical   | 1000000.00 | 14.29           |
| 17956.84211     | 67.16          | 74.00          | -6.84       | 143.00           | 1.25            | Vertical   | 1000000.00 | 14.40           |
| 17995.65789     | 67.73          | 74.00          | -6.27       | 328.00           | 1.60            | Vertical   | 1000000.00 | 14.57           |

## Average (PASS) (16)

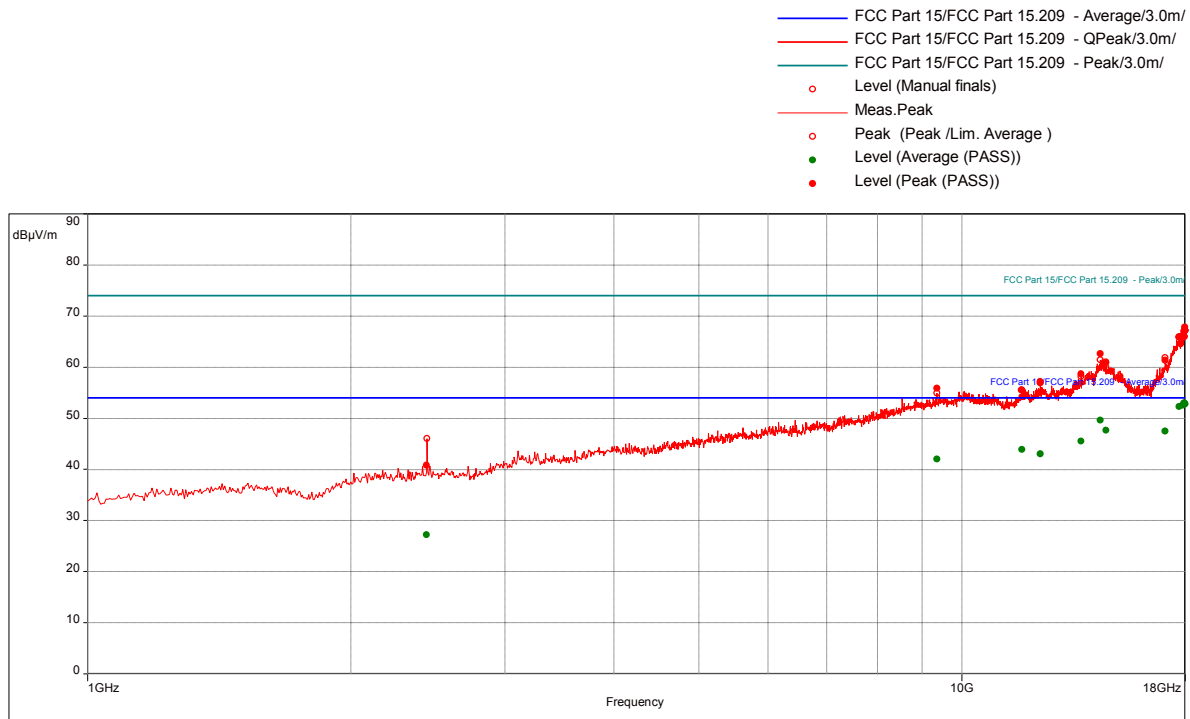
| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Azimuth (°) (dB) | Height (m) (dB) | Pol. (dB)  | RBW (dB)   | Correction (dB) |
|-----------------|----------------|----------------|-------------|------------------|-----------------|------------|------------|-----------------|
| 3500.789474     | 30.06          | 54.00          | -23.94      | 166.00           | 1.65            | Horizontal | 1000000.00 | -15.91          |
| 8142.368421     | 41.09          | 54.00          | -12.91      | 62.00            | 1.70            | Horizontal | 1000000.00 | -3.96           |
| 9168.421053     | 40.77          | 54.00          | -13.23      | 180.00           | 3.15            | Vertical   | 1000000.00 | -1.59           |
| 9863.421053     | 41.65          | 54.00          | -12.35      | 26.00            | 2.25            | Vertical   | 1000000.00 | 0.04            |
| 11838.94737     | 43.31          | 54.00          | -10.69      | 39.00            | 1.85            | Vertical   | 1000000.00 | 2.94            |
| 12915.26316     | 42.91          | 54.00          | -11.09      | 320.00           | 2.85            | Horizontal | 1000000.00 | 3.93            |
| 13483.68421     | 43.83          | 54.00          | -10.17      | 313.00           | 3.34            | Horizontal | 1000000.00 | 5.65            |
| 14403.15789     | 47.68          | 54.00          | -6.32       | 172.00           | 2.80            | Vertical   | 1000000.00 | 9.50            |
| 14460           | 47.98          | 54.00          | -6.02       | 239.00           | 3.79            | Horizontal | 1000000.00 | 9.60            |
| 14828.15789     | 47.27          | 54.00          | -6.73       | 54.00            | 2.40            | Vertical   | 1000000.00 | 9.09            |
| 17764.73684     | 51.53          | 54.00          | -2.47       | 277.00           | 2.00            | Vertical   | 1000000.00 | 13.67           |
| 17819.73684     | 51.55          | 54.00          | -2.45       | 99.00            | 3.00            | Vertical   | 1000000.00 | 13.86           |
| 17885.26316     | 52.33          | 54.00          | -1.67       | 39.00            | 3.34            | Horizontal | 1000000.00 | 14.12           |
| 17928.42105     | 52.53          | 54.00          | -1.47       | 54.00            | 3.84            | Vertical   | 1000000.00 | 14.29           |
| 17956.84211     | 52.80          | 54.00          | -1.20       | 143.00           | 1.25            | Vertical   | 1000000.00 | 14.40           |
| 17995.65789     | 52.88          | 54.00          | -1.12       | 328.00           | 1.60            | Vertical   | 1000000.00 | 14.57           |

High Channel, 1-18 GHz

**Test Information:**

|                           |                                 |
|---------------------------|---------------------------------|
| Date and Time             | 8/27/2019 5:40:01 PM            |
| Client and Project Number | Patroness                       |
| Engineer                  | Vathana Ven                     |
| Temperature               | 24 deg C                        |
| Humidity                  | 41%                             |
| Atmospheric Pressure      | 755 mbar                        |
| Comments                  | 1 to 18 GHz_ Trx @ High channel |

**Graph:**



**Results:****Peak (PASS) (14)**

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol.       | RBW (Hz)   | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|------------|-----------------|
| 2441.315789     | 40.82          | 74.00          | -33.18      | 291.00      | 3.98       | Vertical   | 1000000.00 | -19.70          |
| 9358.684211     | 55.90          | 74.00          | -18.10      | 349.00      | 1.00       | Horizontal | 1000000.00 | -1.01           |
| 11705           | 55.53          | 74.00          | -18.47      | 194.00      | 2.20       | Horizontal | 1000000.00 | 2.50            |
| 12291.31579     | 57.16          | 74.00          | -16.84      | 246.00      | 2.15       | Vertical   | 1000000.00 | 3.36            |
| 13683.15789     | 58.70          | 74.00          | -15.30      | 0.00        | 3.49       | Vertical   | 1000000.00 | 6.22            |
| 14399.73684     | 62.65          | 74.00          | -11.35      | 269.00      | 1.05       | Vertical   | 1000000.00 | 9.49            |
| 14610.52632     | 60.84          | 74.00          | -13.16      | 32.00       | 3.15       | Vertical   | 1000000.00 | 9.70            |
| 17072.36842     | 61.36          | 74.00          | -12.64      | 99.00       | 2.75       | Vertical   | 1000000.00 | 8.60            |
| 17706.31579     | 65.85          | 74.00          | -8.15       | 25.00       | 2.60       | Vertical   | 1000000.00 | 13.51           |
| 17881.84211     | 66.17          | 74.00          | -7.83       | 224.00      | 1.90       | Vertical   | 1000000.00 | 14.11           |
| 17944.47368     | 66.97          | 74.00          | -7.03       | 267.00      | 1.50       | Horizontal | 1000000.00 | 14.35           |
| 17964.21053     | 67.05          | 74.00          | -6.95       | 120.00      | 2.30       | Vertical   | 1000000.00 | 14.44           |
| 17991.31579     | 67.84          | 74.00          | -6.16       | 115.00      | 1.05       | Vertical   | 1000000.00 | 14.55           |
| 17998.02632     | 67.20          | 74.00          | -6.80       | 328.00      | 3.10       | Vertical   | 1000000.00 | 14.58           |

**Average (PASS) (14)**

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol.       | RBW (Hz)   | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|------------|-----------------|
| 2441.315789     | 27.22          | 54.00          | -26.78      | 291.00      | 3.98       | Vertical   | 1000000.00 | -19.70          |
| 9358.684211     | 42.05          | 54.00          | -11.95      | 349.00      | 1.00       | Horizontal | 1000000.00 | -1.01           |
| 11705           | 43.89          | 54.00          | -10.11      | 194.00      | 2.20       | Horizontal | 1000000.00 | 2.50            |
| 12291.31579     | 43.03          | 54.00          | -10.97      | 246.00      | 2.15       | Vertical   | 1000000.00 | 3.36            |
| 13683.15789     | 45.48          | 54.00          | -8.52       | 0.00        | 3.49       | Vertical   | 1000000.00 | 6.22            |
| 14399.73684     | 49.60          | 54.00          | -4.40       | 269.00      | 1.05       | Vertical   | 1000000.00 | 9.49            |
| 14610.52632     | 47.65          | 54.00          | -6.35       | 32.00       | 3.15       | Vertical   | 1000000.00 | 9.70            |
| 17072.36842     | 47.49          | 54.00          | -6.51       | 99.00       | 2.75       | Vertical   | 1000000.00 | 8.60            |
| 17706.31579     | 52.28          | 54.00          | -1.72       | 25.00       | 2.60       | Vertical   | 1000000.00 | 13.51           |
| 17881.84211     | 52.51          | 54.00          | -1.49       | 224.00      | 1.90       | Vertical   | 1000000.00 | 14.11           |
| 17944.47368     | 52.94          | 54.00          | -1.06       | 267.00      | 1.50       | Horizontal | 1000000.00 | 14.35           |
| 17964.21053     | 52.94          | 54.00          | -1.06       | 120.00      | 2.30       | Vertical   | 1000000.00 | 14.44           |
| 17991.31579     | 52.90          | 54.00          | -1.10       | 115.00      | 1.05       | Vertical   | 1000000.00 | 14.55           |
| 17998.02632     | 52.77          | 54.00          | -1.23       | 328.00      | 3.10       | Vertical   | 1000000.00 | 14.58           |

18-231 GHz

Radiated Emissions

Company: Patroness  
Model #: P003110  
Serial #: 0003 LF, 0004 LF, 0005 LF, 0008 LF  
Engineers: Vathana Ven  
Project #: G103842901  
Standard: FCC Part 95, Subpart M/RSS-251  
Receiver: R&S FSW (ROS005-1) 10-15-2019  
PreAmp: PRE8\_10\_25\_2019.txt  
PreAmp Used? (Y or N): Y (18-40GHz)  
Voltage/Frequency: 5VDC  
Frequency Range: 18-40 GHz  
Antenna & Cables: SHF  
Antenna: EMC04\_1MV\_10-26-2019.txt  
Cable(s): CBLSHF102\_9\_13\_19.txt  
Barometer: DAV001  
Filter: NONE  
Bands: N, LF, HF, SHF  
OML-1  
OML-2  
OML-3  
OML-4, OM  
Location: 10M  
Date(s): 08/28/19  
Temp/Humidity/Pressure: 23 deg C 56% 1001 mB  
Limit Distance (m): 3  
Test Distance (m): 0.2  
Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)  
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

| Detector Type         | Ant. Pol. (V/H) | Frequency MHz | Reading dB(uV) | Antenna Factor dB(1/m) | Cable Loss dB | Pre-amp Factor dB | Distance Factor dB | Net dB(uV/m) | Limit dB(uV/m) | Margin dB | Bandwidth | FCC | IC |
|-----------------------|-----------------|---------------|----------------|------------------------|---------------|-------------------|--------------------|--------------|----------------|-----------|-----------|-----|----|
| Tx mode, Low Channel  |                 |               |                |                        |               |                   |                    |              |                |           |           |     |    |
| PK                    | V               | 19265.700     | 44.75          | 45.42                  | 12.54         | 18.68             | 23.52              | 60.50        | 74.00          | -13.50    | 1/3 MHz   | RB  | RB |
| AVG                   | V               | 19265.700     | 26.20          | 45.42                  | 12.54         | 18.68             | 23.52              | 41.95        | 54.00          | -12.05    | 1/3 MHz   |     |    |
| Tx mode, Mid Channel  |                 |               |                |                        |               |                   |                    |              |                |           |           |     |    |
| PK                    | V               | 19671.300     | 45.34          | 45.42                  | 12.62         | 18.76             | 23.52              | 61.10        | 74.00          | -12.90    | 1/3 MHz   | RB  | RB |
| AVG                   | V               | 19671.300     | 27.00          | 45.42                  | 12.62         | 18.76             | 23.52              | 42.76        | 54.00          | -11.24    | 1/3 MHz   |     |    |
| Tx mode, High Channel |                 |               |                |                        |               |                   |                    |              |                |           |           |     |    |
| PK                    | V               | 20240.800     | 41.90          | 45.23                  | 12.91         | 18.28             | 23.52              | 58.24        | 74.00          | -15.76    | 1/3 MHz   | RB  | RB |
| AVG                   | V               | 20240.800     | 26.90          | 45.23                  | 12.91         | 18.28             | 23.52              | 43.24        | 54.00          | -10.76    | 1/3 MHz   |     |    |

No other emissions were detected above the measuring equipment noise floor.

Company: Patroness  
Model #: P003110  
Serial #: 0003 LF, 0004 LF, 0005 LF, 0008 LF  
Engineers: Vathana Ven  
Project #: G103842901  
Standard: FCC Part 95M  
Receiver: R&S FSW (ROS005-1) 10-10-2020  
PreAmp: PRE8\_10\_25\_2019.txt  
PreAmp Used? (Y or N): N  
Voltage/Frequency: 5VDC  
Frequency Range: 40-231 GHz  
Antenna & Cables: SHF  
Antenna: M05HWD  
Cable(s): CBLHF2012-2M-2\_2-14-2020 Factors.txt  
Barometer: DAV001  
Filter: NONE  
Bands: N, LF, HF, SHF  
M05HWD  
Location: 10M  
Date(s): 01/14/20  
Temp/Humidity/Pressure: 23 deg C 30% 996 mB  
Limit Distance (m): 3  
Test Distance (m): 0.22  
Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)  
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

| Detector Type                                                                                      | Ant. Pol. (V/H) | Frequency GHz | Reading dB(uV) | Antenna Factor dB(1/m) | Cable Loss dB | Distance Factor dB | Net EIRP dB(m) | Net Power Density (pw/cm2) | Limit Power Density (pw/cm2) | Margin (pw/cm2) | Bandwidth |             |
|----------------------------------------------------------------------------------------------------|-----------------|---------------|----------------|------------------------|---------------|--------------------|----------------|----------------------------|------------------------------|-----------------|-----------|-------------|
| Tx mode, E(dBuV/m) = P(dBm) + 104.77 - 20*LOG(d); where d is the distance of measurement in meters |                 |               |                |                        |               |                    |                |                            |                              |                 |           |             |
| RMS                                                                                                | V               | 154.020       | 51.20          | 49.94                  | 0.84          | 22.69              | -15.93         | 22.55020                   | 600.00                       | -577.45         | 1/3 MHz   | Noise Floor |
| Tx mode, E(dBuV/m) = P(dBm) + 104.77 - 20*LOG(d); where d is the distance of measurement in meters |                 |               |                |                        |               |                    |                |                            |                              |                 |           |             |
| RMS                                                                                                | V               | 157.000       | 64.50          | 50.10                  | 0.84          | 22.69              | -2.47          | 500.20782                  | 600.00                       | -99.79          | 1/3 MHz   | Noise Floor |
| Tx mode, E(dBuV/m) = P(dBm) + 104.77 - 20*LOG(d); where d is the distance of measurement in meters |                 |               |                |                        |               |                    |                |                            |                              |                 |           |             |
| RMS                                                                                                | V               | 161.580       | 64.30          | 50.35                  | 0.84          | 22.69              | -2.42          | 505.99996                  | 600.00                       | -94.00          | 1/3 MHz   | Noise Floor |
| Tx mode, E(dBuV/m) = P(dBm) + 104.77 - 20*LOG(d); where d is the distance of measurement in meters |                 |               |                |                        |               |                    |                |                            |                              |                 |           |             |
| AVG                                                                                                | V               | 154.020       | 50.50          | 49.94                  | 0.84          | 22.69              | -16.63         | 19.19334                   | 600.00                       | -580.81         | 1/3 MHz   | Noise Floor |
| Tx mode, E(dBuV/m) = P(dBm) + 104.77 - 20*LOG(d); where d is the distance of measurement in meters |                 |               |                |                        |               |                    |                |                            |                              |                 |           |             |
| AVG                                                                                                | V               | 157.000       | 62.50          | 50.10                  | 0.84          | 22.69              | -4.47          | 315.60980                  | 600.00                       | -284.39         | 1/3 MHz   | Noise Floor |
| Tx mode, E(dBuV/m) = P(dBm) + 104.77 - 20*LOG(d); where d is the distance of measurement in meters |                 |               |                |                        |               |                    |                |                            |                              |                 |           |             |
| AVG                                                                                                | V               | 161.580       | 61.56          | 50.35                  | 0.84          | 22.69              | -5.16          | 269.24676                  | 600.00                       | -330.75         | 1/3 MHz   | Noise Floor |

Note: Hand scans were performed at a close distance around the EUT

|                                                       |                                     |                       |                               |
|-------------------------------------------------------|-------------------------------------|-----------------------|-------------------------------|
| Test Personnel:                                       | <u>Vathana Ven <i>VSV</i></u>       | Test Date:            | <u>08/28/2019</u>             |
| Supervising/Reviewing Engineer:                       |                                     |                       | <u>08/29/2019</u>             |
| (Where Applicable)                                    | <u>N/A</u>                          |                       | <u>11/18/2019</u>             |
| Product Standard:                                     | <u>CFR47 FCC Part 95, Subpart M</u> |                       | <u>01/14/2020</u>             |
| Input Voltage:                                        | <u>RSS-251, RSS-GEN</u>             | Limit Applied:        | <u>See report section 8.3</u> |
|                                                       | <u>5 VDC</u>                        |                       |                               |
| Pretest Verification w/ Ambient Signals or BB Source: | <u>N/A</u>                          | Ambient Temperature:  | <u>23, 24, 30 °C</u>          |
|                                                       |                                     | Relative Humidity:    | <u>56, 41, 30 %</u>           |
|                                                       |                                     | Atmospheric Pressure: | <u>1001, 755, 996 mbars</u>   |

Deviations, Additions, or Exclusions: None

## 9 Frequency Stability

### 9.1 Method

The procedure described in Subclause 9.14 of ANSI C63.10-2013 and Subclause 5.6 of ANSI C63.26-2015 was utilized. The EUT shall be transmitting at its maximum data rate.

**TEST SITE:** Safety Lab

### 9.2 Test Equipment Used:

#### Equipment Used For Radiated Measurement

| Asset      | Description                        | Manufacturer          | Model  | Serial     | Cal Date   | Cal Due    |
|------------|------------------------------------|-----------------------|--------|------------|------------|------------|
| DAV040'    | Weather Station                    | Davis Instruments     | 7400   | PE80519A61 | 01/23/2019 | 01/23/2020 |
| OML3'      | Mixer / Antenna                    | Oleson Microwave Lab  | M12HWD | E21011-1   | 03/27/2019 | 03/27/2020 |
| ROS005-1'  | Signal and Spectrum Analyzer       | Rohde and Schwartz    | FSW43  | 100646     | 10/15/2018 | 10/15/2019 |
| CBLSHF103' | Cable, SMA - SMA, < 18GHz          | Sucoflex (Huber Suhb) | 104PE  | CBLSHF103  | 11/15/2018 | 11/15/2019 |
| SAF187'    | Small Temperature/Humidity Chamber | Bryant Manufacturing  | TH-5S  | 1207       | 01/29/2019 | 01/29/2020 |

#### Software Utilized:

| Name | Manufacturer | Version |
|------|--------------|---------|
| None | --           | --      |

### 9.3 Results:

The sample tested was found to Comply.

Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range -20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

The radar device's occupied bandwidth (i.e. 99% emission bandwidth) shall be maintained within the 76-81 GHz frequency band while subjected to all conditions of operation specified in RSS-Gen.

Testing was performed at a nominal voltage of 5 Volts. The following is the client's justification.

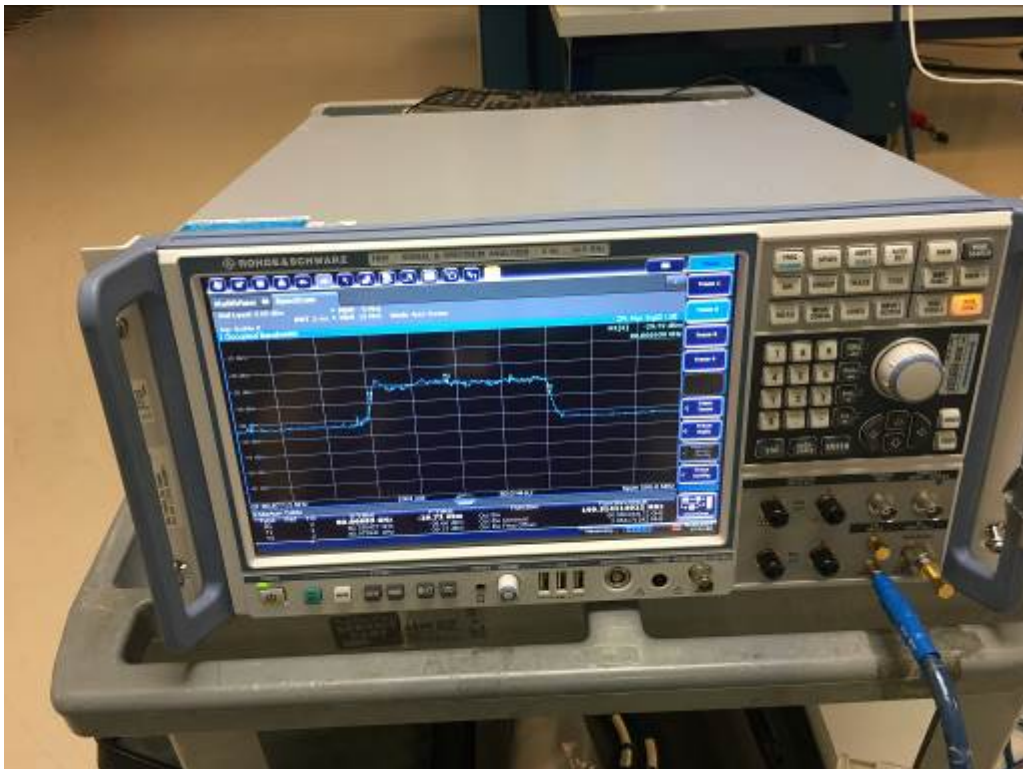
"The requirements for the frequency tolerance testing state that "an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise."

The following points summarize our justification for testing at a nominal 5 Volts:

- Our input voltage is based on the 5 Volt USB input spec. The stated range would equate to a voltage range of 4.25 Volts to 5.75 Volts which is outside the USB spec of 5 Volts +.25/- .6 Volts.
- Additionally, with our module construction, the LP87524JRNFRQ1 PMIC, which regulates voltage, maintains a constant voltage to the RF circuitry and will turn off or burn out if the input is under or over voltage to a point that it cannot maintain the correct output voltages. This blocks any variation of the digital and RF circuitry power input."

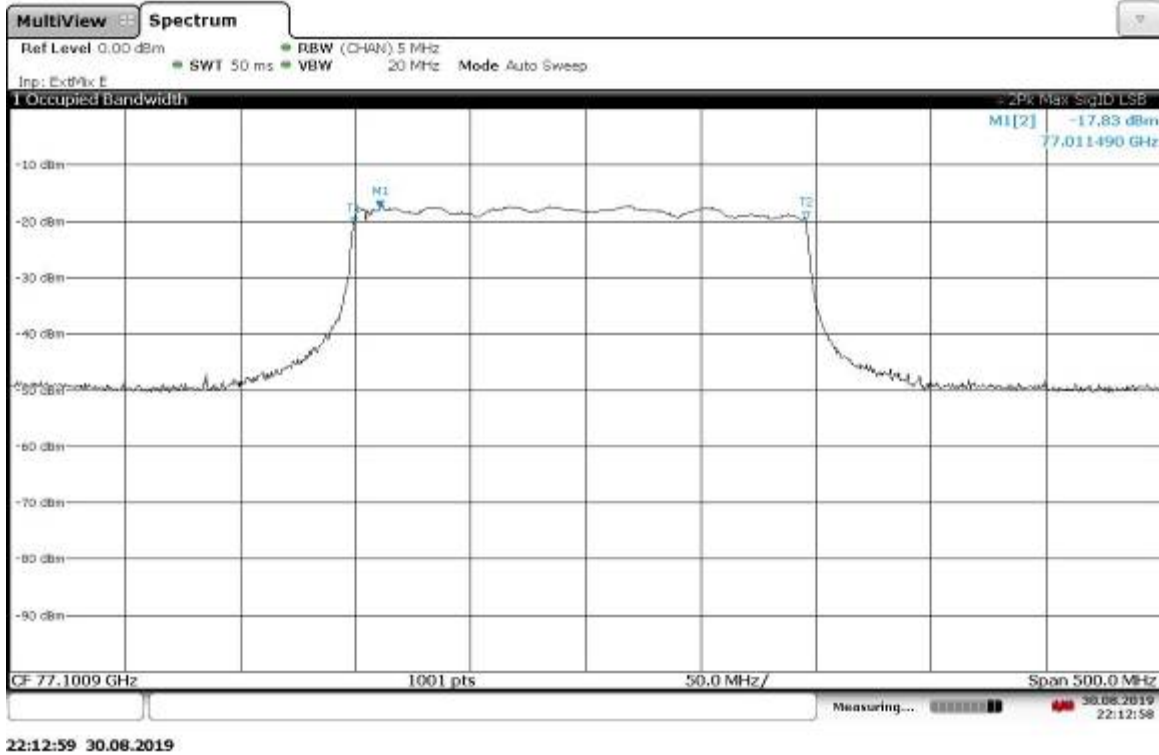
#### 9.4 Setup Photograph:

Frequency stability Test Setup

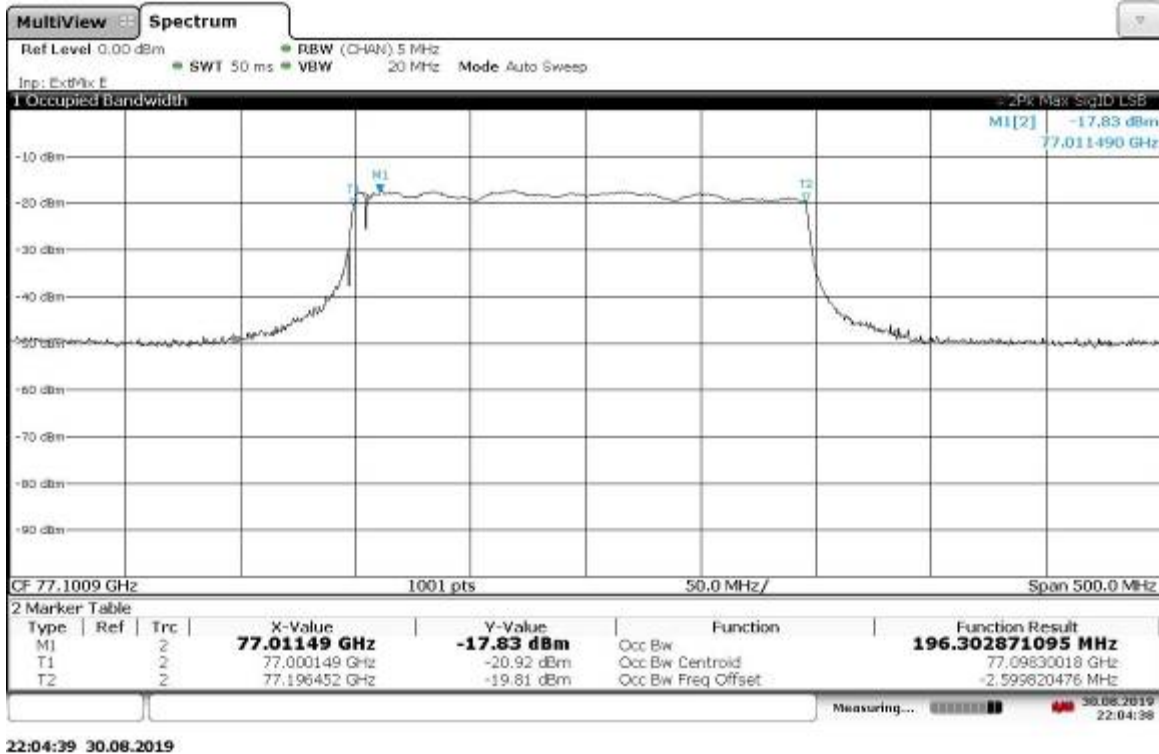


## 9.5 Plots/Data:

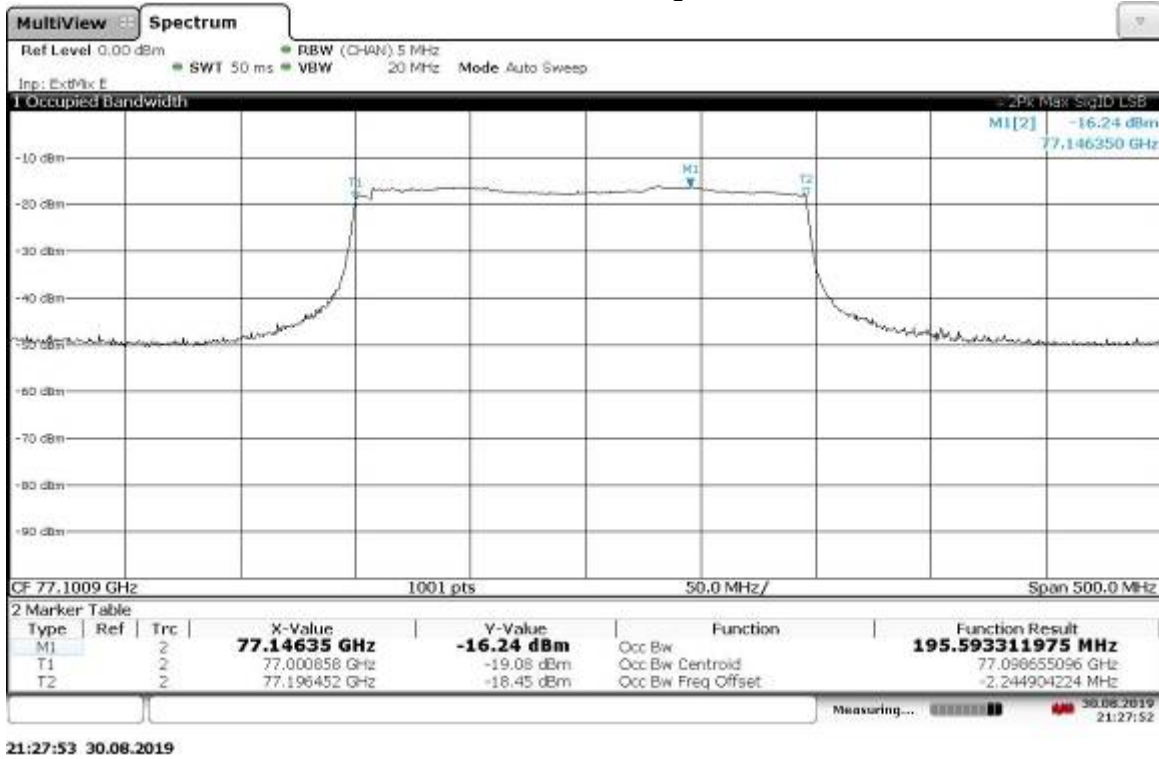
Low Channel -20 deg C



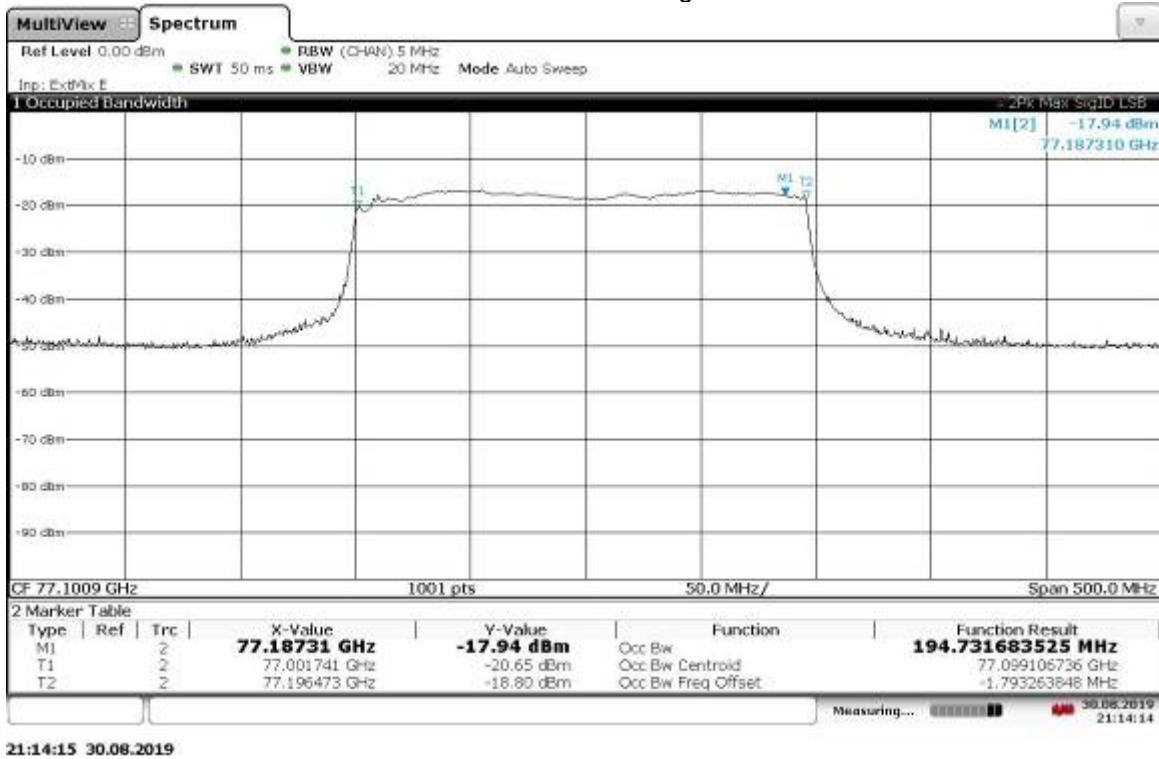
Low Channel -10 deg C



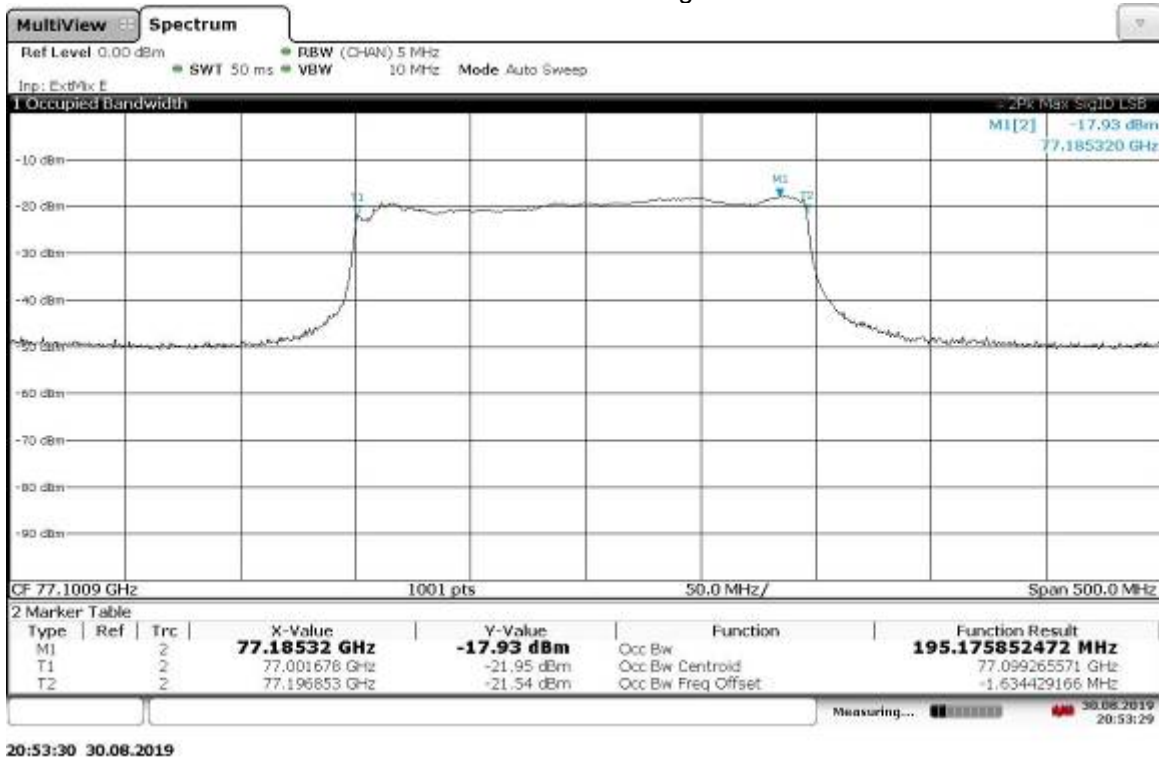
## Low Channel 0 deg C



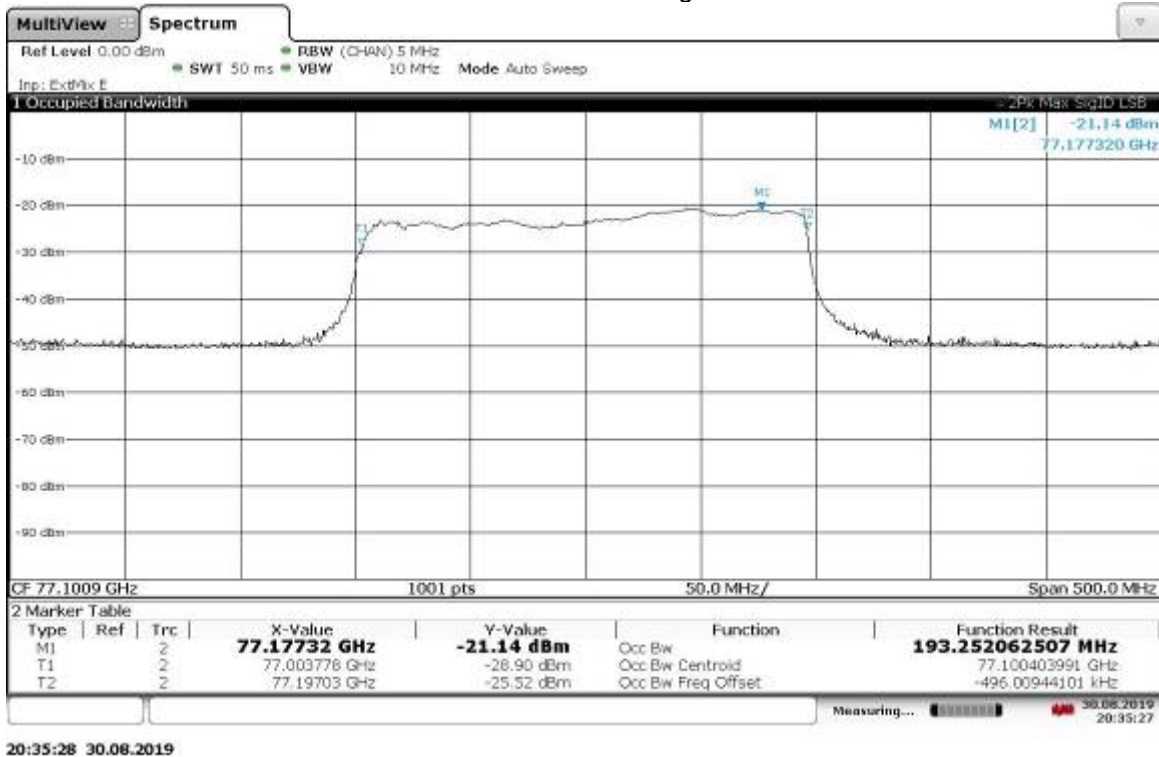
## Low Channel 10 deg C



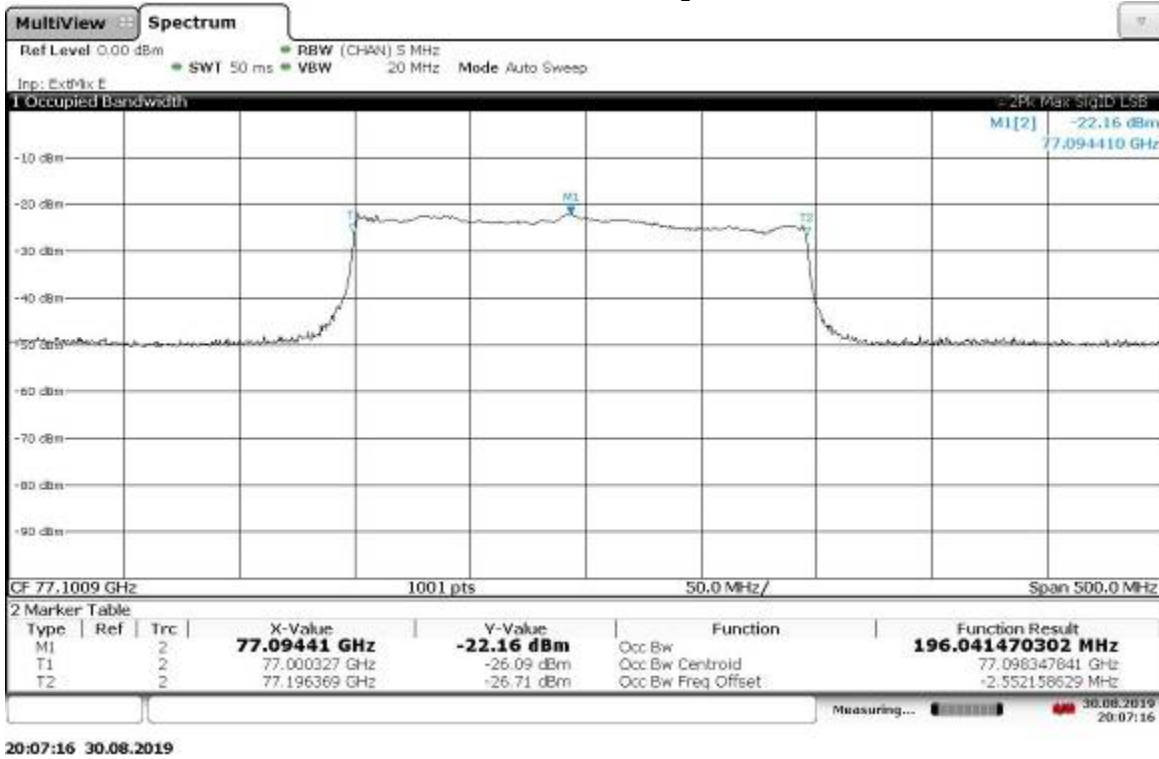
## Low Channel 20 deg C



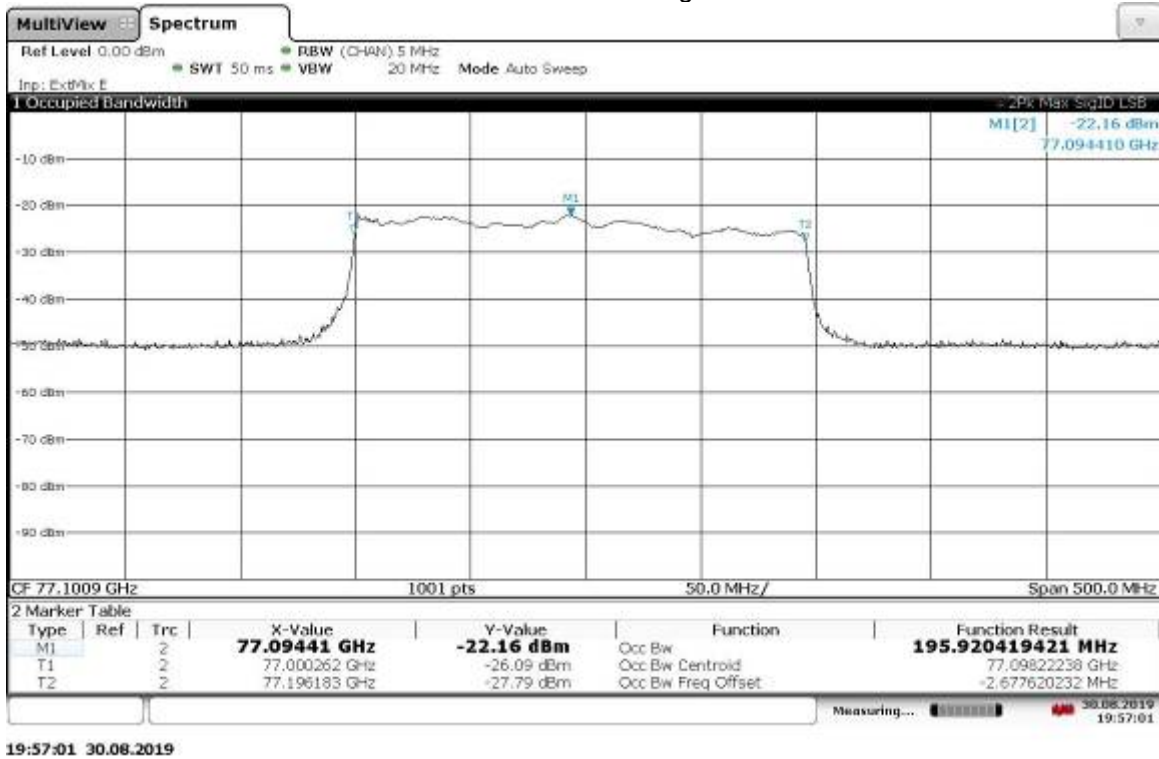
## Low Channel 30 deg C



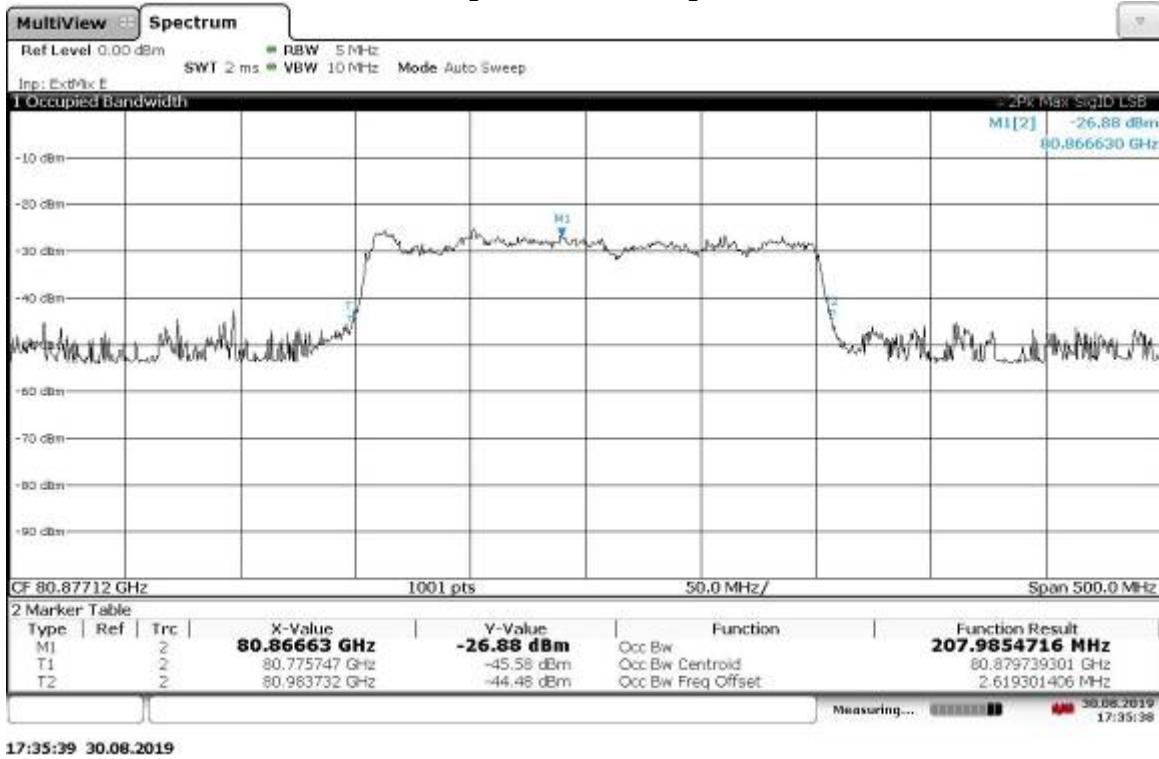
Low Channel 40 deg C



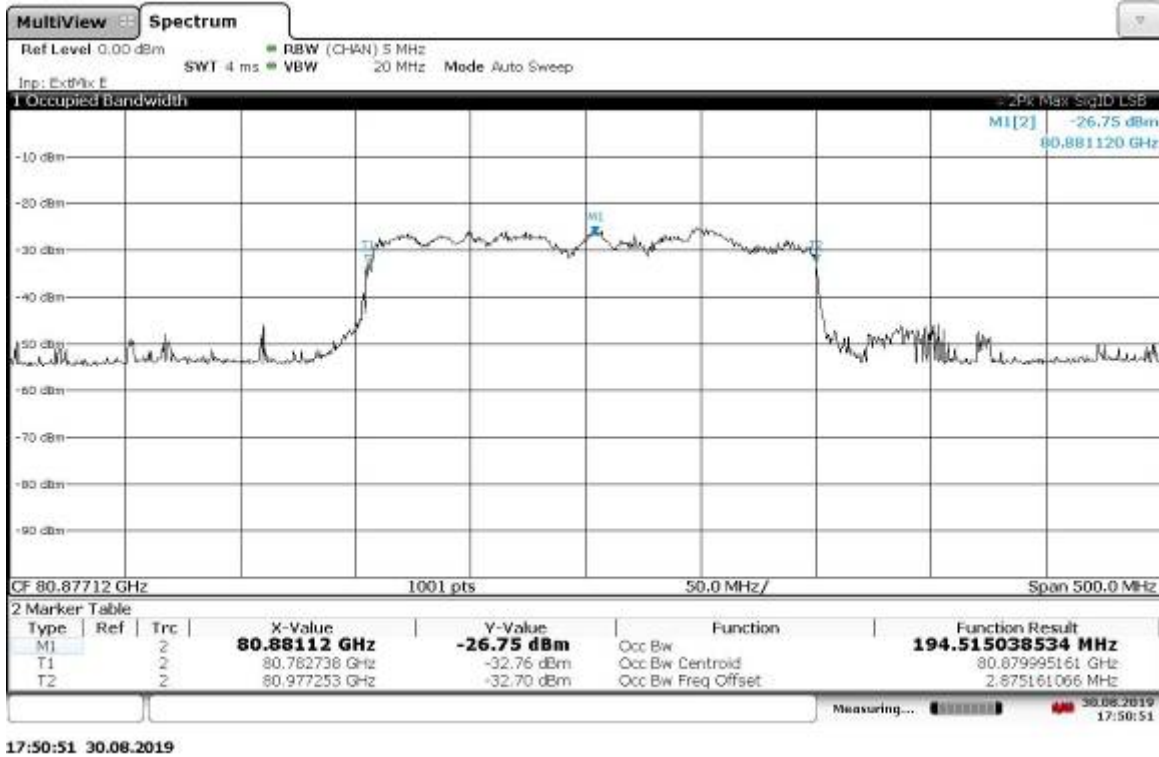
Low Channel 50 deg C



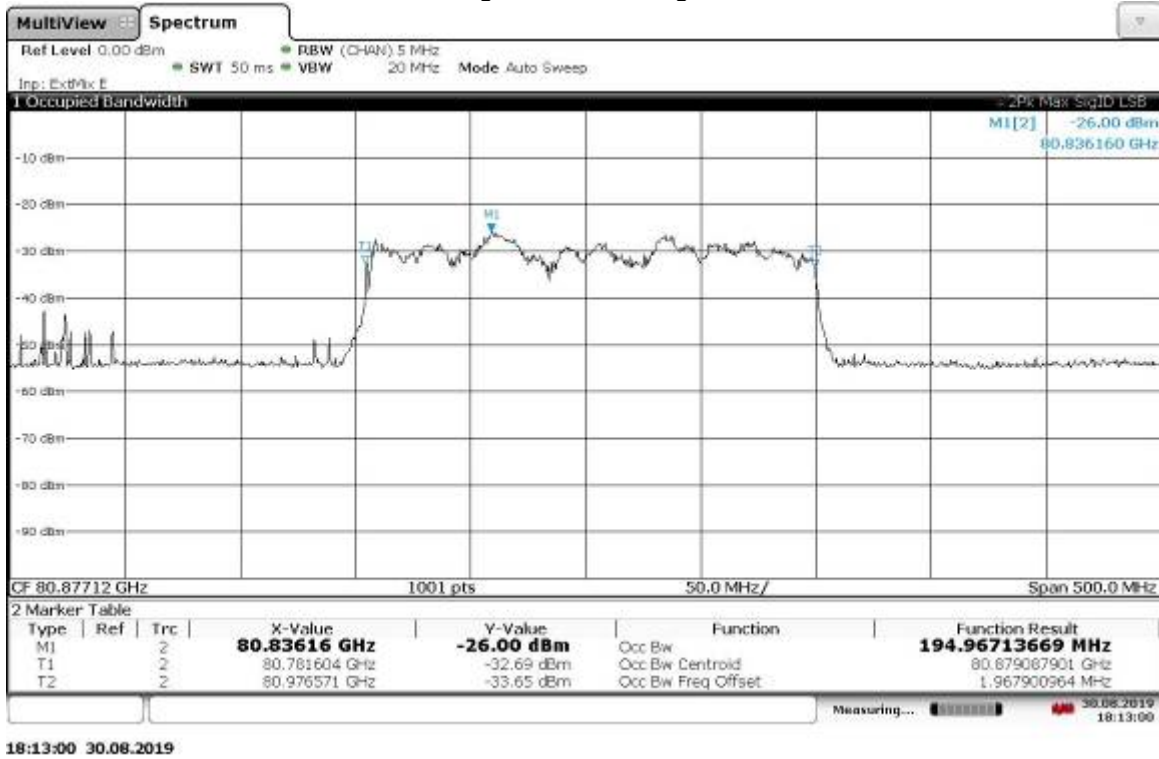
## High Channel -20 deg C



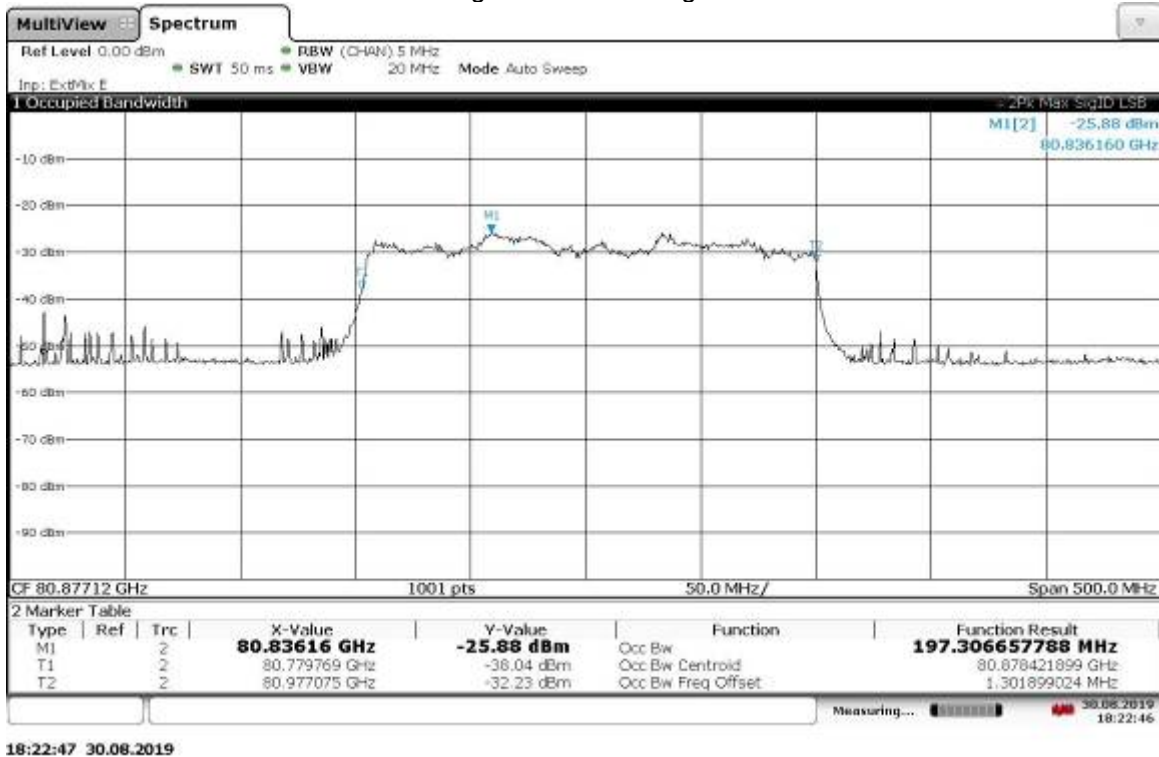
## High Channel -10 deg C



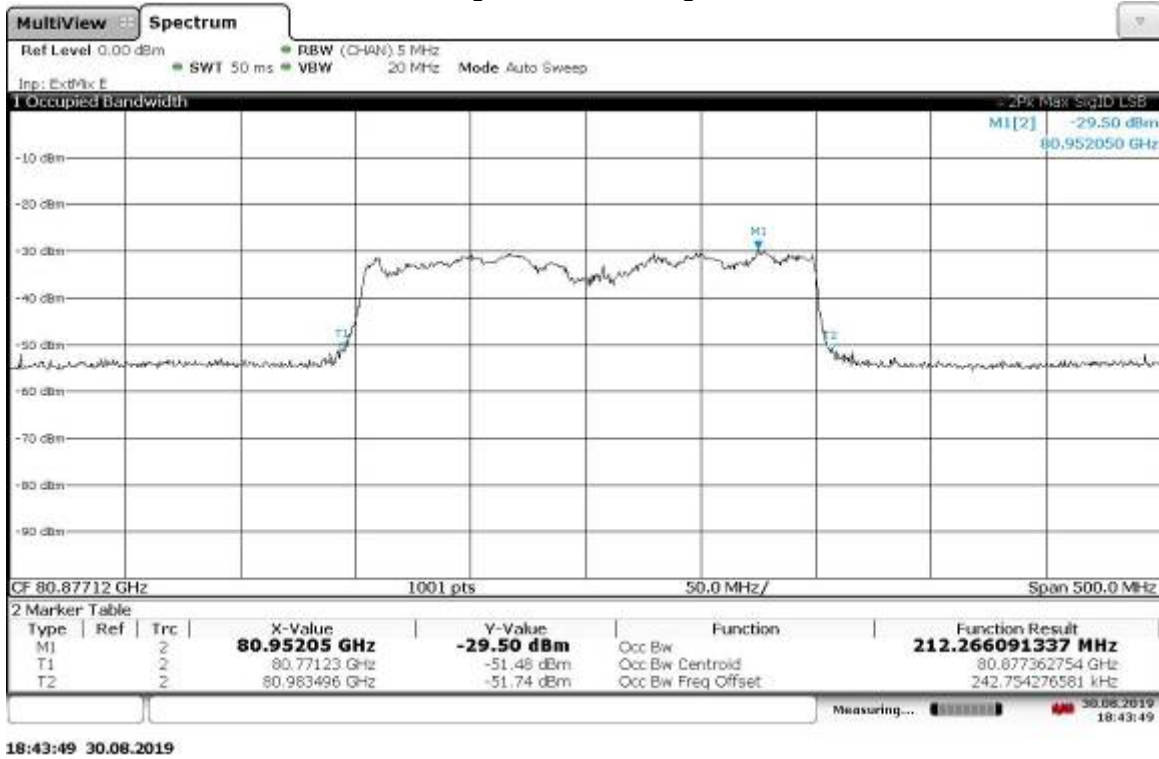
High Channel 0 deg C



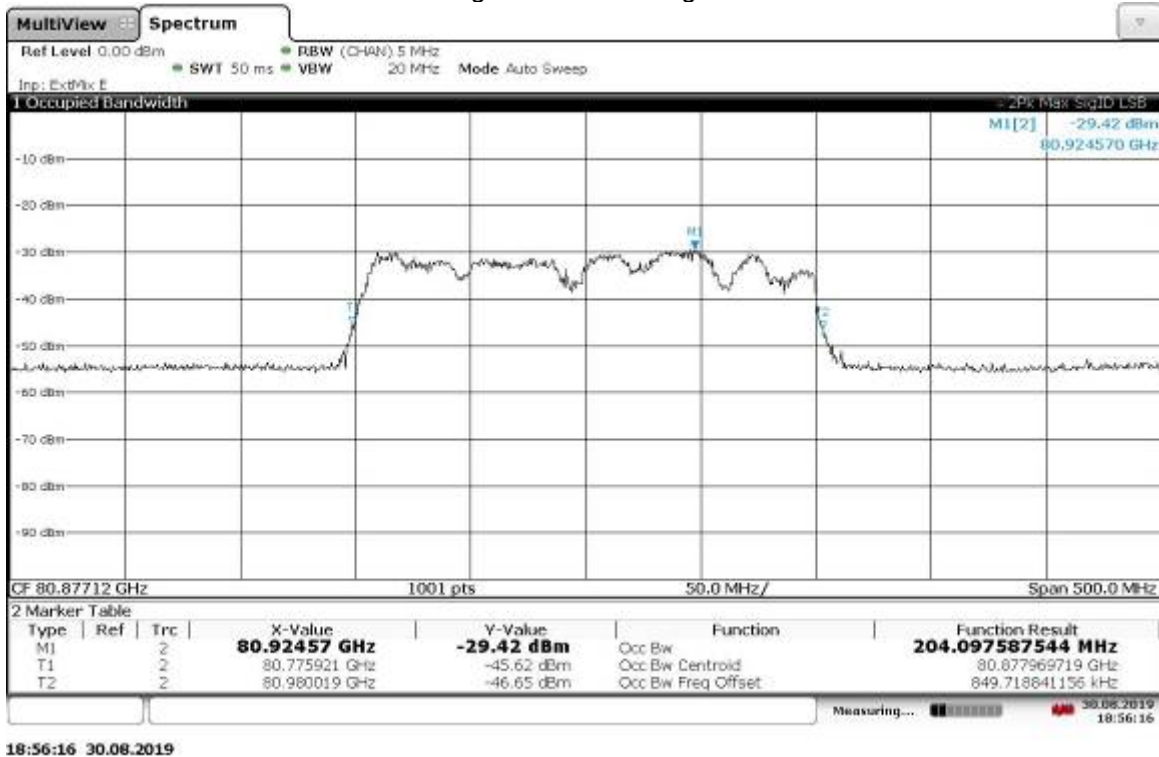
High Channel 10 deg C



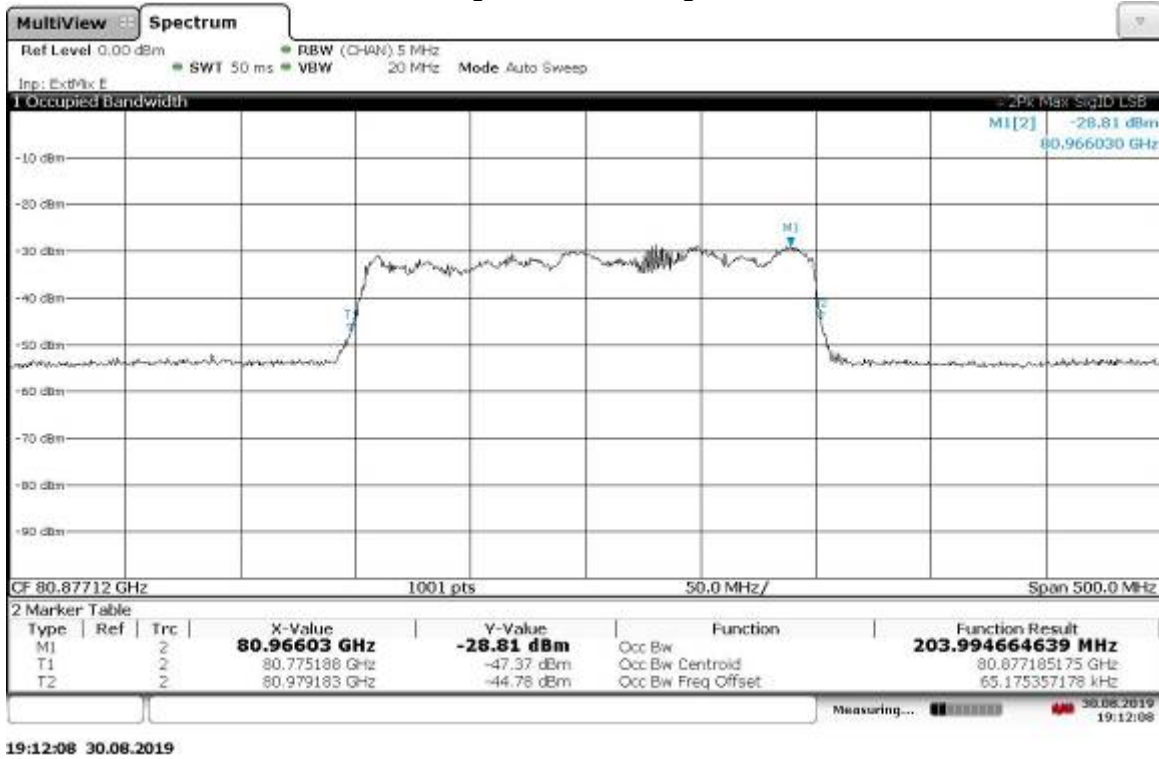
High Channel 20 deg C



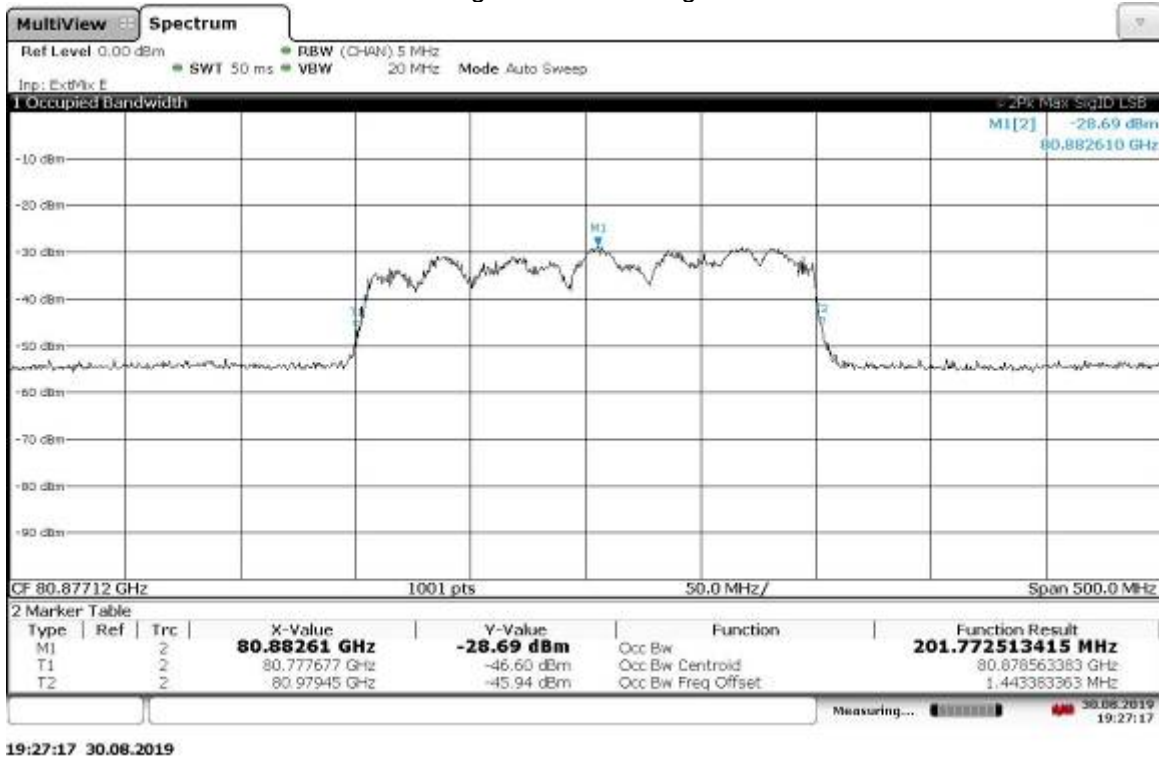
High Channel 30 deg C



High Channel 40 deg C



High Channel 50 deg C



Test Personnel: Vathana Ven *VSV*  
Supervising/Reviewing  
Engineer:  
(Where Applicable) N/A  
Product Standard: CFR47 FCC Part 95, Subpart M  
Input Voltage: RSS-251  
5VDC  
Pretest Verification w/  
Ambient Signals or  
BB Source: BB Source

Test Date: 08/30/2019Limit Applied: See report section 9.3Ambient Temperature: 21 °CRelative Humidity: 57 %Atmospheric Pressure: 1005 mbars

Deviations, Additions, or Exclusions: Testing was performed at normal and extreme temperature.

## 10 Appendix A – Mixer/Horn Calibration Certificates

*Certificate of Compliance***Certificate No:** 6205419E-21011-1**Manufacturer:** OML, Inc.**Model/Part No:** 40200WGS**Serial/ID No:** 21011-1**Description:** Harmonic Generator, 40 to 200+ GHz**Date of Test:** March 25, 2019**Temperature:** (23 +/- 5) deg C**Humidity:** 20 to 65% RH**Procedure:**

This certifies that the above product was tested in compliance with OML specifications using applicable OML's procedures.

**As Received :** Physical Condition: Good  
Within Tolerance: Yes

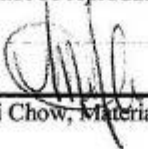
**As Shipped:** At the completion of the test, the product COMPLIED with the performance capability.

**Remarks:** Functional Verification Service

**Traceability Information:** Traceability is to national standards administered by U.S. NIST, NRC Canada, Euromet members (NPL, PTB, BNM, etc.) or other recognized standards laboratories. Some measurements are traceable to natural physical constants, consensus standards or ratio type measurements. Supporting documentation relative to traceability is available for review by appointment.

In the absence of power standards above 110 GHz, power measurements and conversion loss measurements above 110 GHz are to confirm operation functionality and traceable only to OML.

This certificate shall not be reproduced, except in full, without the written approval of OML.

  
\_\_\_\_\_  
Mitzi Chow, Material Manager

03/27/2019

\_\_\_\_\_  
Date

OML Inc.

\_\_\_\_\_  
300 Digital Drive, Morgan Hill, CA 95037 USA Tel. (408) 779 2698 Fax (408) 778 0491

## Certificate of Compliance

**Certificate No:** 6205419A-U21011-1

**Manufacturer:** OML, Inc.

**Model/Part No:** M19HWD

**Serial/ID No:** U21011-1

**Description:** WR-19 Harmonic Mixer, 40 to 60 GHz

**Date of Test:** March 20, 2019

**Temperature:** (23 +/- 5) deg C

**Humidity:** 20 to 65% RH

**Procedure:**

This certifies that the above product was tested in compliance with OML specifications using applicable OML's procedures.

**As Received :** Physical Condition: Fair  
Within Tolerance: Yes

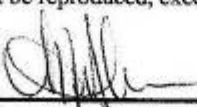
**As Shipped:** At the completion of the test, the product COMPLIED with the performance capability.

**Remarks:** Functional Verification Service

**Traceability Information:** Traceability is to national standards administered by U.S. NIST, NRC Canada, Euromet members (NPL, PTB, BNM, etc.) or other recognized standards laboratories. Some measurements are traceable to natural physical constants, consensus standards or ratio type measurements. Supporting documentation relative to traceability is available for review by appointment.

In the absence of power standards above 110 GHz, power measurements and conversion loss measurements above 110 GHz are to confirm operation functionality and traceable only to OML.

This certificate shall not be reproduced, except in full, without the written approval of OML.

  
Mitzi Chow, Material Manager

03/27/2019

Date

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## Certificate of Compliance

**Certificate No:** 6205419B-E21011-1

**Manufacturer:** OML, Inc.

**Model/Part No:** M12HWD

**Serial/ID No:** E21011-1

**Description:** WR-12 Harmonic Mixer, 60 to 90 GHz

**Date of Test:** March 20, 2019

**Temperature:** (23 +/- 5) deg C

**Humidity:** 20 to 65% RH

**Procedure:**

This certifies that the above product was tested in compliance with OML specifications using applicable OML's procedures.

**As Received :** Physical Condition: Fair  
Within Tolerance: Yes

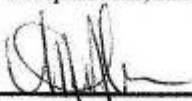
**As Shipped:** At the completion of the test, the product COMPLIED with the performance capability.

**Remarks:** Functional Verification Service

**Traceability Information:** Traceability is to national standards administered by U.S. NIST, NRC Canada, Euromet members (NPL, PTB, BNM, etc.) or other recognized standards laboratories. Some measurements are traceable to natural physical constants, consensus standards or ratio type measurements. Supporting documentation relative to traceability is available for review by appointment.

In the absence of power standards above 110 GHz, power measurements and conversion loss measurements above 110 GHz are to confirm operation functionality and traceable only to OML.

This certificate shall not be reproduced, except in full, without the written approval of OML.

  
Mitzi Chow, Material Manager

03/27/2019

Date

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## Certificate of Compliance

**Certificate No:** 6205419C-F21011-1**Manufacturer:** OML, Inc.**Model/Part No:** M08HWD**Serial/ID No:** F21011-1**Description:** WR-08 Harmonic Mixer, 90 to 140 GHz**Date of Test:** March 20, 2019**Temperature:** (23 +/- 5) deg C**Humidity:** 20 to 65% RH**Procedure:**

This certifies that the above product was tested in compliance with OML specifications using applicable OML's procedures.

**As Received :** Physical Condition: Fair  
Within Tolerance: Yes

**As Shipped:** At the completion of the test, the product COMPLIED with the performance capability.

**Remarks:** Functional Verification Service

**Traceability Information:** Traceability is to national standards administered by U.S. NIST, NRC Canada, Euromet members (NPL, PTB, BNM, etc.) or other recognized standards laboratories. Some measurements are traceable to natural physical constants, consensus standards or ratio type measurements. Supporting documentation relative to traceability is available for review by appointment.

In the absence of power standards above 110 GHz, power measurements and conversion loss measurements above 110 GHz are to confirm operation functionality and traceable only to OML.

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\_\_\_\_\_  
Mitzi Chow, Material Manager

03/27/2019

\_\_\_\_\_  
Date

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\_\_\_\_\_  
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## Certificate of Compliance

**Certificate No:** 6205419D-G21011-1

**Manufacturer:** OML, Inc.

**Model/Part No:** M05HWD

**Serial/ID No:** G21011-1

**Description:** WR-05 Harmonic Mixer, 140 to 220 GHz

**Date of Test:** March 20, 2019

**Temperature:** (23 +/- 5) deg C

**Humidity:** 20 to 65% RH

**Procedure:**

This certifies that the above product was tested in compliance with OML specifications using applicable OML's procedures.

**As Received :** Physical Condition: Fair  
Within Tolerance: Yes

**As Shipped:** At the completion of the test, the product COMPLIED with the performance capability.

**Remarks:** Functional Verification Service

**Traceability Information:** Traceability is to national standards administered by U.S. NIST, NRC Canada, Euromet members (NPL, PTB, BNM, etc.) or other recognized standards laboratories. Some measurements are traceable to natural physical constants, consensus standards or ratio type measurements. Supporting documentation relative to traceability is available for review by appointment.

In the absence of power standards above 110 GHz, power measurements and conversion loss measurements above 110 GHz are to confirm operation functionality and traceable only to OML.

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Mitzi Chow, Material Manager

03/27/2019

Date

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## Certificate of Compliance

**Certificate No:** 4207419A-190429-1

**Manufacturer:** OML, Inc.

**Model/Part No:** M04HWD

**Serial/ID No:** 190429-1

**Description:** WR-04 Harmonic Mixer, 170 to 260 GHz

**Date of Test:** April 29, 2019

**Temperature:** (23 +/- 5) deg C

**Humidity:** 20 to 65% RH

**Procedure:**

This certifies that the above product was tested in compliance with OML specifications using applicable OML's procedures.

**As Received :** Factory Tested - No incoming data available.

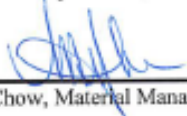
**As Shipped:** At the completion of the test, the product COMPLIED with the performance capability.

**Remarks:**

**Traceability Information:** Traceability is to national standards administered by U.S. NIST, NRC Canada, Euromet members (NPL, PTB, BNM, etc.) or other recognized standards laboratories. Some measurements are traceable to natural physical constants, consensus standards or ratio type measurements. Supporting documentation relative to traceability is available for review by appointment.

In the absence of power standards above 110 GHz, power measurements and conversion loss measurements above 110 GHz are to confirm operation functionality and traceable only to OML.

This certificate shall not be reproduced, except in full, without the written approval of OML.

  
Mitzi Chow, Material Manager

05/01/2019

Date

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**11 Revision History**

| Revision Level | Date       | Report Number    | Prepared By    | Reviewed By    | Notes                                                                          |
|----------------|------------|------------------|----------------|----------------|--------------------------------------------------------------------------------|
| 0              | 09/04/2019 | 103842901BOX-013 | VFV <i>VFV</i> | KPS <i>KPS</i> | Original Issue                                                                 |
| 1              | 10/16/2019 | 103842901BOX-013 | VFV <i>VFV</i> | KPS <i>KPS</i> | Corrected typos, adding mixer calibration certificate                          |
| 2              | 01/15/2020 | 103842901BOX-013 | VFV <i>VFV</i> | KPS <i>KPS</i> | Added noise floor readings and fixed calculations                              |
| 3              | 01/24/2020 | 103842901BOX-013 | VFV <i>VFV</i> | KPS <i>KPS</i> | Remeasured output power, Emissions bandwidth, and rechecked spurious emissions |
|                |            |                  |                |                |                                                                                |
|                |            |                  |                |                |                                                                                |