中认信通
CHINA CERTIFICATION ICT CO., LTD (DONGGUAN)

ACCREDITED
TESTING LABORATORY
CERTIFICATE # 6356.01

# TEST REPORT

**Applicant:** **Oculii Corp.**

Address: 829 Space Dr., Beavercreek, Ohio 45434, United States of America

**FCC ID:** **2AXVNEAGLE**

**Product Name:** **Eagle**

**Model Number:** **V1**

**Standard(s):** **47 CFR Part 95, Subpart M**
**ANSI C63.26-2015**
**KDB 653005 D01 76-81 GHz Radars v01r02**

The above equipment has been tested and found compliant with the requirement of the relative standards by China Certification ICT Co., Ltd (Dongguan)

**Report Number:** **CR22020003-00**

**Date Of Issue:** **2022-07-10**

**Reviewed By:** **Sun Zhong**

Sun Zhong

Title: Manager

**Test Laboratory:** **China Certification ICT Co., Ltd (Dongguan)**
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## Test Facility

The Test site used by China Certification ICT Co., Ltd (Dongguan) to collect test data is located on the No. 113, Pingkang Road, Dalang Town, Dongguan, Guangdong, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 442868, the FCC Designation No. : CN1314.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0123.

## Declarations

China Certification ICT Co., Ltd (Dongguan) is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with a triangle symbol "▲". Customer model name, addresses, names, trademarks etc. are not considered data.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

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# 1. GENERAL INFORMATION

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

### 1.1.1 General:

| | |
|---|---|
| **EUT Name:** | Eagle |
| **EUT Model:** | V1 |
| **Operation Frequency:** | 76.69GHz |
| **Maximum Average Output Power (Radiated):** | 35.22 dBm |
| **Modulation Type:** | FMCW |
| **Sweep Period:** | 83ms |
| **Sweep Bandwidth▲:** | 375MHz(76.5-76.875GHz) |
| **Chirp Time▲:** | 44μs |
| **Antenna Number:** | 6TX8RX |
| **Rated Input Voltage:** | DC 12V |
| **Serial Number:** | CR22020003-RF-S1 |
| **EUT Received Date:** | 2022.4.6 |
| **EUT Received Status:** | Good |

### 1.1.2 Antenna Information Detail▲:

| Antenna Manufacturer | Antenna Type | input impedance (Ohm) | Antenna Gain /Frequency Range |
|---|---|---|---|
| Oculii Corp. | Microstrip Array | Unknow | 16.70dBi/76~78GHz |

### 1.1.3 Accessory Information:

| Accessory Description | Manufacturer | Model | Parameters |
|---|---|---|---|
| Cable | Unknown | Unknown | Shield, 3.0 m |

## 1.2 Description of Test Configuration

### 1.2.1 EUT Operation Condition:

| | |
|---|---|
| **EUT Operation Mode:** | The system was configured for testing in Engineering Mode, which was provided by the manufacturer.<br>The device has 2 set of 3T4R MIMO modes. per pretest, 2 radars (with 6TX) simultaneously transmit mode was the worst mode and reported. |
| **Equipment Modifications:** | No |
| **EUT Exercise Software:** | No |
| Engineering Mode was provided by manufacturer▲. The maximum power was configured default setting. | |

### 1.2.2 Support Equipment List and Details

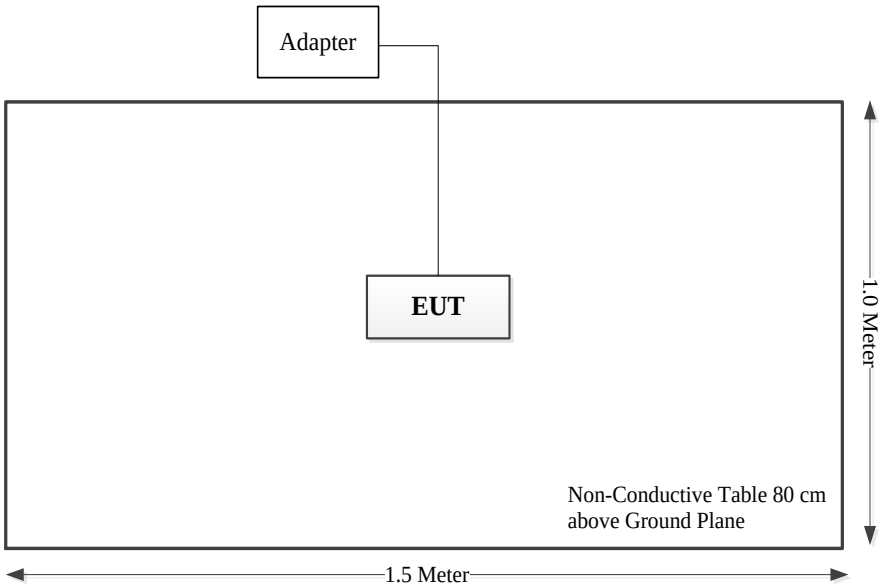
| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| UGREEN | Adapter | CD139 | 20359 |

### 1.2.3 Support Cable List and Details

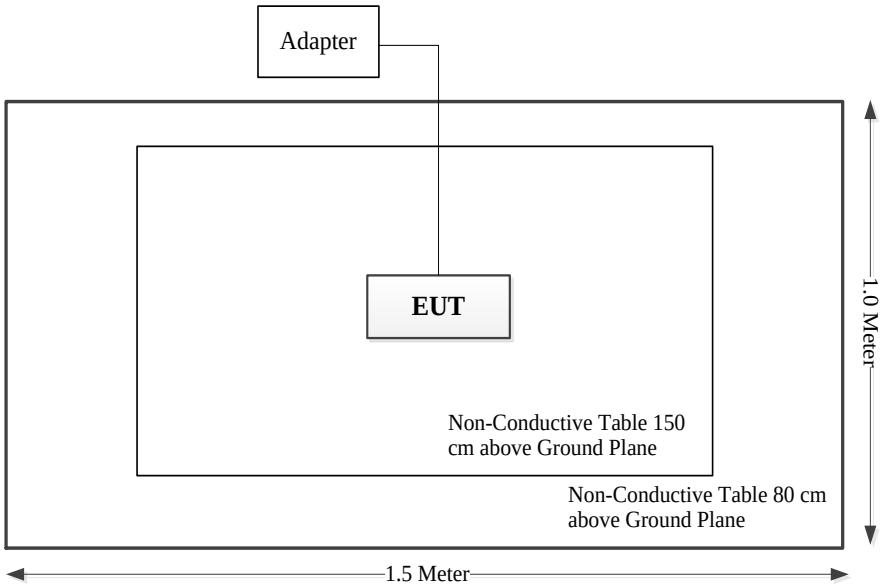
| Cable Description | Shielding Type | Ferrite Core | Length (m) | From Port | To |
|---|---|---|---|---|---|
| / | / | / | / | / | / |

### 1.2.4 Block Diagram of Test Setup

Unwanted Emissions:
Below 1GHz:




Above 1GHz:



## 1.3 Measurement Uncertainty

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

| Parameter | Measurement Uncertainty |
|---|---|
| Occupied Channel Bandwidth | ±5 % |
| Radiated Emissions | 9kHz~30MHz: 4.12dB<br>30M~200MHz: 4.15 dB,200M~1GHz: 5.61 dB,1G~6GHz: 5.14 dB, 6G~18GHz: 5.93 dB,18G~26.5G: 5.47 dB, 26.5G~40G:5.63 dB, 40~60G: 4.83dB, 60G~90G: 4.94dB, 90G-140G: 5.46dB, 140G-220G: 6.00dB, 220G-325G: 7.35dB |
| Temperature | ±1℃ |
| Humidity | ±5% |
| DC and low frequency voltages | ±0.4% |
| AC Power Lines Conducted Emission | 2.8 dB (150 kHz to 30 MHz) |

# 2. SUMMARY OF TEST RESULTS

| Standard(s) Section | Test Items | Result |
|---|---|---|
| FCC §2.1046, §95.3367 | Radiated Power | Compliant |
| FCC §2.1053, §95.3379 | Unwanted Emissions | Compliant |
| FCC §2.1055(d), §95.3379 | Frequency Stability | Compliant |
| FCC §2.1049 | Occupied Bandwidth | Compliant |
| FCC §95.3385, §1.1307 | RF Exposure Evaluation | Compliant |

# 3. REQUIREMENTS AND TEST PROCEDURES

## 3.1 Radiated Power

### 3.1.1 Applicable Standard

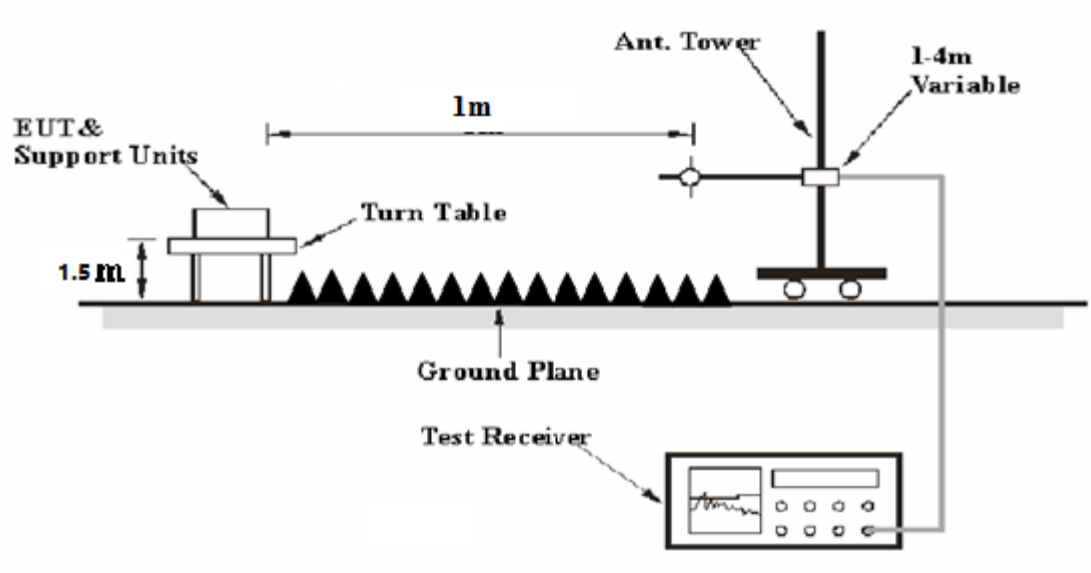
FCC §2.1046, §95.3367;

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.

### 3.2.2 EUT Setup



### 3.2.3 Test Procedure

Refer to ANSI C63.26-2015 Clause 5.2.7

Connect the test antenna for the fundamental frequency band to a spectrum analyzer via an external mixer.

Set spectrum analyzer RBW, VBW, detector, span, and so on, to the proper values.

Maximize the fundamental emission, noting that multiple peaks may be found at different beam orientations and/or polarizations

Calculate the EIRP from the measured field strength using equation as follows:

$$EIRP\ (dBm) = E\ (dB\mu V/m) + 20\log(D) - 104.8$$

EIRP is the equivalent isotropically radiated power
E is the field strength of the emission at the measurement distance
D is the measurement distance

## 3.2 Unwanted Emissions

### 3.2.1 Applicable Standard

FCC §2.1053 and §95.3379;

(a) The power density of any emissions outside the 76-81 GHz band shall consist solely of spurious emissions and shall not exceed the following:

(1) Radiated emissions below 40 GHz shall not exceed the field strength as shown in the following emissions table.

| Frequency (MHz) | Field strength (microvolts/meter) | Measurement distance (meters) |
|---|---|---|
| 0.009-0.490 | 2400/F(kHz) | 300 |
| 0.490-1.705 | 24000/F(kHz) | 30 |
| 1.705-30.0 | 30 | 30 |
| 30-88 | 100 | 3 |
| 88-216 | 150 | 3 |
| 216-960 | 200 | 3 |
| Above 960 | 500 | 3 |

(i) In the emissions table in paragraph (a)(1) of this section, the tighter limit applies at the band edges.

(ii) The limits in the table in paragraph (a)(1) of this section are based on the frequency of the unwanted emissions and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(iii) The emissions limits shown in the table in paragraph (a)(1) of this section are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9.0-90.0 kHz, 110.0-490.0 kHz, and above 1000 MHz. Radiated emissions limits in these three bands are based on measurements employing an average detector with a 1 MHz RBW.

(2) The power density of radiated emissions outside the 76-81 GHz band above 40.0 GHz shall not exceed the following, based on measurements employing an average detector with a 1 MHz RBW:

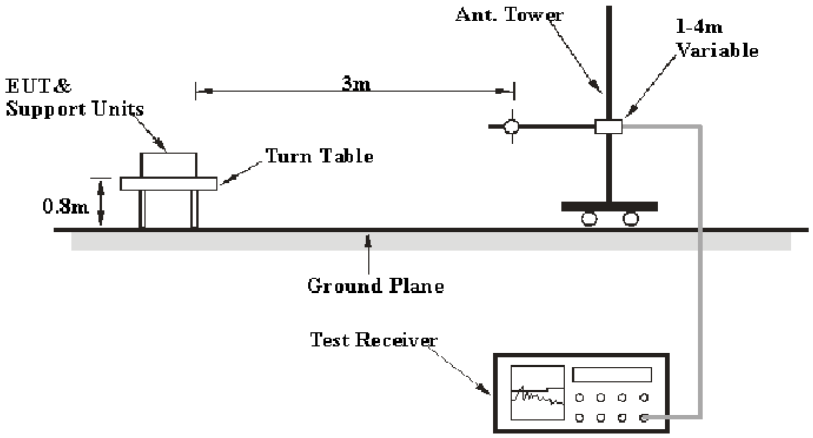
(i) For radiated emissions outside the 76-81 GHz band between 40 GHz and 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 600 pW/cm$^2$ at a distance of 3 meters from the exterior surface of the radiating structure.

(ii) For radiated emissions above 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 1000 pW/cm2 at a distance of 3 meters from the exterior surface of the radiating structure.

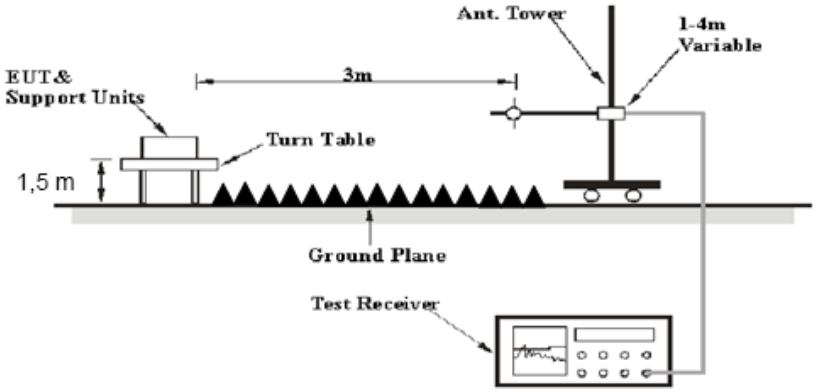
(3) For field disturbance sensors and radar systems operating in the 76-81 GHz band, the spectrum shall be investigated up to 231.0 GHz.

### 3.2.2 EUT Setup

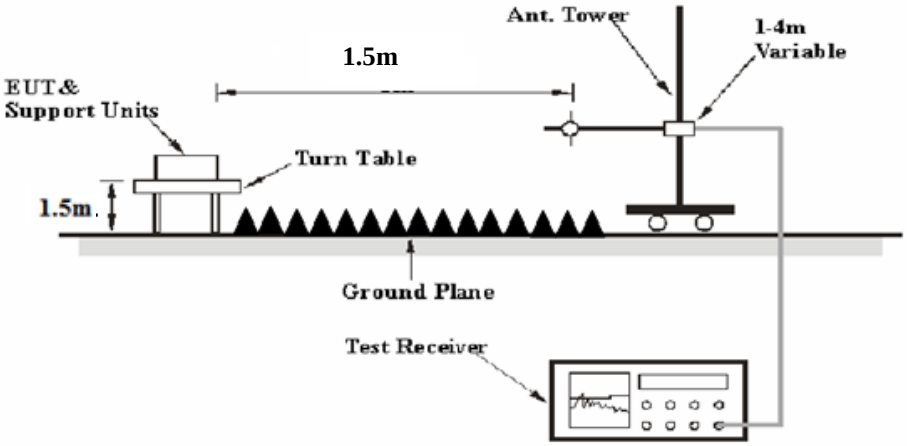
**Below 1GHz:**



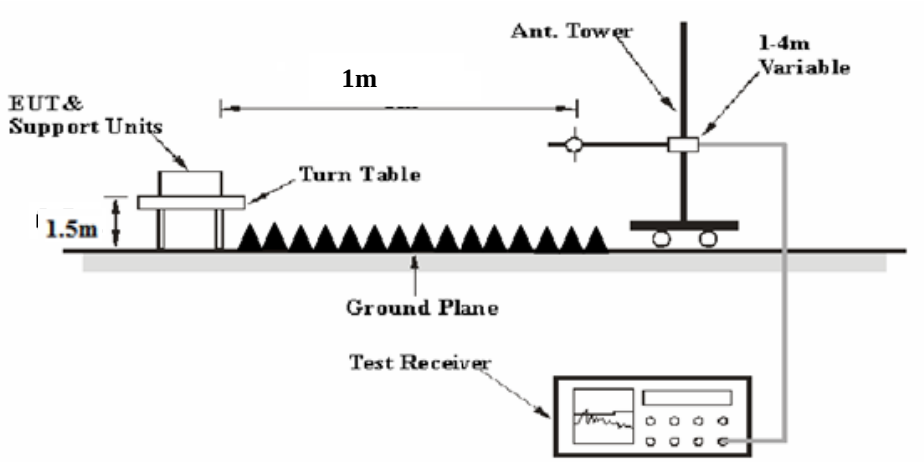

**1-26.5 GHz:**



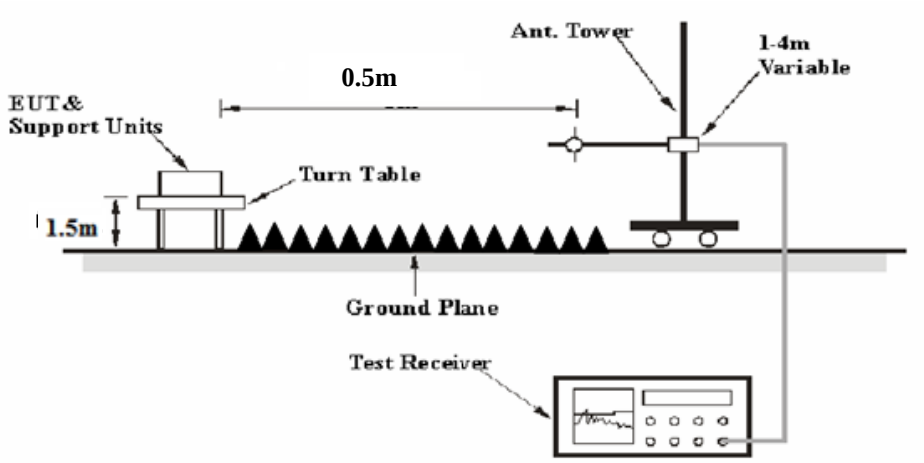

**26.5-40 GHz:**



**40-90 GHz:**




**90-231 GHz:**




The radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.26-2015. The specification used was the FCC 95.3379 limits.

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

The spacing between the peripherals was 10 cm.

### 3.2.3 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 231 GHz.

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

| Frequency Range | RBW | Video B/W | IF B/W | Measurement |
|---|---|---|---|---|
| 9 kHz – 150 kHz | 200 Hz | 1 kHz | 200 Hz | QP/Average |
| 150 kHz – 30 MHz | 9 kHz | 30 kHz | 9 kHz | QP/Average |
| 30 MHz – 1000 MHz | 120 kHz | 300 kHz | 120 kHz | QP |
| 1-40 GHz | 1MHz | 3 MHz | / | PK |
| | 1MHz | 10 Hz | / | Average |
| Above 40 GHz | 1MHz | 3 MHz | / | Average |

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

### 3.2.4 Test Procedure

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

According to C63.26, the 26.5- 40GHz test result shall be extrapolated to the specified distance using an extrapolation factor of 20dB/decade from 3m to 1.5m

For 26.5-40GHz
Distance extrapolation factor =20 log (specific distance [3m]/test distance [1.5m]) dB=6.02dB

For above 40GHz, external harmonic mixers are utilized. The antenna is scanned around the entire perimeter surface of the EUT, in both horizontal and vertical polarizations. The Mixers and it`s RF cables is compose a system for calibration, the conversion factor was added into the test Spectrum Analyzer in testing.

The far-field boundary is given in ANSI C63.26-2015:

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

Where:
D is the largest dimension of the antenna aperture in m and
$\lambda$ is the free-space wavelength in m at the frequency of measurement.

The minimum test distance for the frequency range 40GHz-231GHz determine as below:

| Model | Frequency Range (GHz) | Largest Dimension of the Horn Antenna (mm) | Minimum Test Distance $R_m$ (m) |
|---|---|---|---|
| M19RH | 40-60 | 46.3 | 0.57 |
| M12RH | 60-90 | 30.02 | 0.36 |
| M08RH | 90-140 | 19.7 | 0.23 |
| M05RH | 140-220 | 12.5 | 0.15 |
| M03RH | 220-325 | 8.36 | 0.10 |

Note: the test distances used were 1.0 m from 40 GHz to 90 GHz, and 0.5 m from 90 GHz to 231GHz, it can be seen that the EUT was always in the Far-field of the Receive Antenna during all Radiated Emissions Tests.

### 3.2.5 Corrected Amplitude & Margin Calculation

The basic equation is as follows:

Factor = Antenna Factor + Cable Loss- Amplifier Gain

For 30MHz-26.5GHz:
Result = Reading + Factor

For 26.5GHz-40GHz
Result = Reading + Factor-Distance extrapolation Factor

The "Margin" column of the following data tables indicates the degree of compliance within the applicable limit. The equation for margin calculation is as follows:

Margin = Limit – Result

## 3.3 Frequency Stability:

### 3.3.1 Applicable Standard

FCC §95.3379 (b)

(b) 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.

### 3.3.3 Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external power supply and the RF output was connected to Test equipment via feed-through attenuators. The EUT was placed inside the temperature chamber. The power leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the Frequency Counter.

Frequency Stability vs. Voltage:

1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

The output frequency was recorded for each voltage.

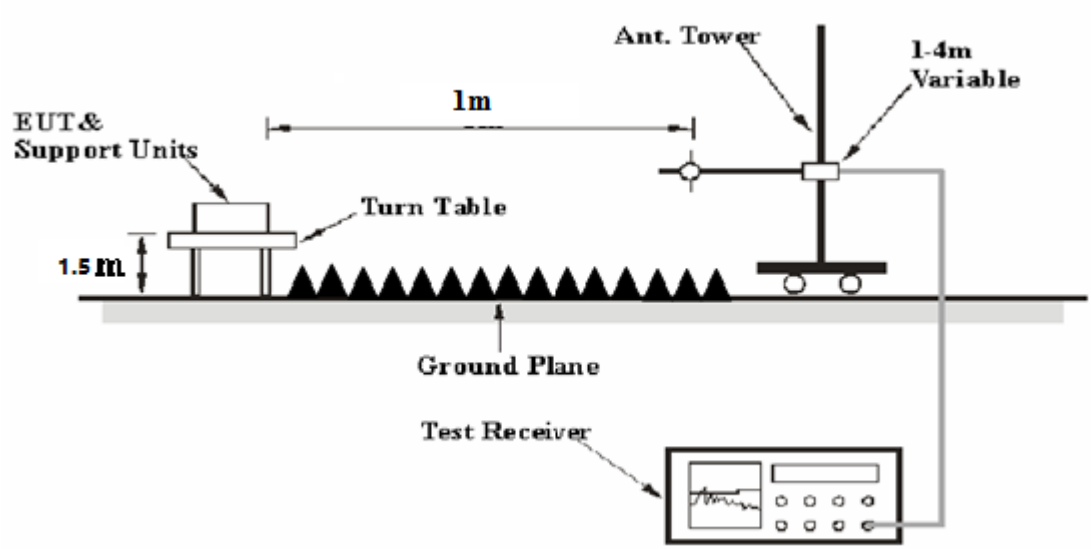
## 3.4 Occupied Bandwidth:

### 3.4.1 Applicable Standard

FCC §2.1049

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured.

### 3.4.2 EUT Setup




### 3.4.3Test Procedure

The following procedure shall be used for measuring (99%) power bandwidth:

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (typically a span of 1.5 ×OBW is sufficient).

b) The nominal IF filter 3 dB bandwidth (RBW) shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set ⩾ 3 × RBW.

c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation.

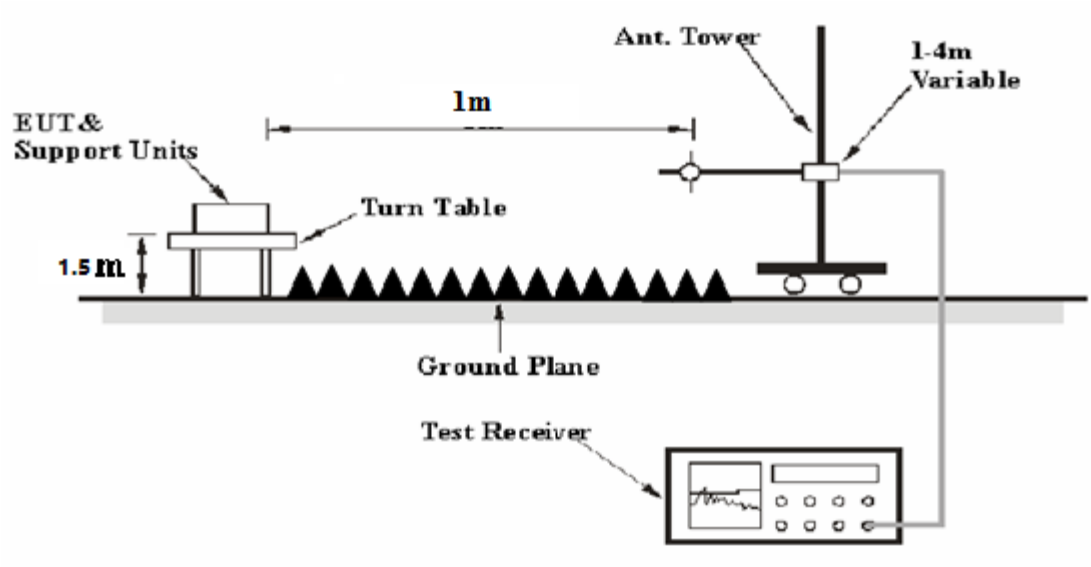
NOTE—Step a), step b), and step c) may require iteration to adjust within the specified tolerances.

d) Set the detection mode to peak, and the trace mode to max-hold.

e) The OBW shall be reported and plot(s) of the measuring instrument display shall be provided with the test report. The frequency and amplitude axis and scale shall be clearly labeled. Tabular data can be reported in addition to the plot(s).

## 3.5 Duty Cycle:

### 3.5.1 EUT Setup




### 3.5.2 Test Procedure

According to ANSI C63.26-2015 Section 5.2.4.3.4

An oscilloscope with a diode detector that combined have sufficiently short response time to permit accurate measurements of the on and off times. A fundamental condition for all average power compliance measurements are that they be performed with the EUT transmitting continuously (duty cycle ⩾ 98%) at maximum output power level. However, in those cases where this condition cannot be realized, then one of the alternative procedures must be selected based on whether the EUT transmitter exhibits a constant or a non-constant duty cycle. The measurement of transmitter duty cycle shall be performed using one of the following techniques:
a) Off times of the transmitted signal.
b) The zero-span mode on a spectrum analyzer if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal.

# 4. Test DATA AND RESULTS

## 4.1 Radiated Power

| | | | |
|---|---|---|---|
| Serial Number: | CR22020003-RF-S1 | Test Date: | 2022.4.29 |
| Test Site: | 966-1 | Test Mode: | Transmitting |
| Tester: | Tommy Luo | Test Result: | Pass |

| **Environmental Conditions:** | | | | | |
|---|---|---|---|---|---|
| Temperature: (℃) | 21.5 | Relative Humidity: (%) | 61 | ATM Pressure: (kPa) | 101.1 |

**Test Equipment List and Details:**

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| OML | Harmonic Mixer | WR12/M12HWD | E60119-1 | 2020-10-17 | 2023-10-16 |
| OML | Horn Antenna | M12RH | E60119-2 | 2020-10-18 | 2023-10-17 |
| R&S | Spectrum Analyzer | FSV40 | 101943 | 2021-10-10 | 2022-10-09 |

** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

**Test Data:**

| Frequency (GHz) | Receiver | | Polar (H/V) | Factor (dB/m) | EIRP (dBm) |
|---|---|---|---|---|---|
| | Reading (dBμV) | Detector | | | |
| 76.69 | 94.48 | PK | V | 43.46 | 33.14 |
| 76.69 | 96.56 | AV | V | 43.46 | 35.22 |

*Factor = Antenna Factor*
*EIRP = Reading + Factor + 20log(Measurement distance) - 104.8*
*Measurement distance = 1m*

| Detector | EIRP (dBm) | Chirps Correction Factor (dB) | Result (dBm) | Limit (dBm) | Margin (dBm) |
|---|---|---|---|---|---|
| Peak | 33.14 | 5.9 | 39.04 | 55 | 15.96 |
| Average | 35.22 | / | 35.22 | 50 | 14.78 |

*Result = EIRP + Chirps Correction Factor*
*Refer to Application Note 1EF107-1E Rohde &Schwarz Peak and Mean Power measurements on wideband FMCW radar signals.The chirps correction factor was calculated using the formula:*

$$CF_{chirp} = 5 * \log\left(1 + K * \left(\frac{Span}{t * RBW^2}\right)^2\right)$$

*K = a correction factor for the settling process of the gaussian shaped filter (0.1947)*
*t = the length of the chirp*
$CF_{chirp} = 5 * \log(1 + 0.1947 * (375/(44*1^2))^2 = 5.90dB$

## 4.2 Radiation Spurious Emissions

| | | | |
|---|---|---|---|
| Serial Number: | CR22020003-RF-S1 | Test Date: | 2022-04-29~2022-07-07 |
| Test Site: | 966-1, 966-2 | Test Mode: | Transmitting |
| Tester: | Veyo Zhang, Tommy Luo, Mack Huang | Test Result: | Pass |

| **Environmental Conditions:** | | | | | |
|---|---|---|---|---|---|
| Temperature: (℃) | 21.8~25.1 | Relative Humidity: (%) | 51~71 | ATM Pressure: (kPa) | 100.2~101.1 |

**Test Equipment List and Details:**

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| ETS-Lindgren | Horn Antenna | 3115 | 9912-5985 | 2020-10-13 | 2023-10-12 |
| R&S | Spectrum Analyzer | FSV40 | 101591 | 2021-07-22 | 2022-07-21 |
| MICRO-COAX | Coaxial Cable | UFA210A-1-1200-70U300 | 217423-008 | 2021-08-08 | 2022-08-07 |
| MICRO-COAX | Coaxial Cable | UFA210A-1-2362-300300 | 235780-001 | 2021-08-08 | 2022-08-07 |
| Mini | Pre-amplifier | ZVA-183-S+ | 5969001149 | 2021-11-10 | 2022-11-09 |
| Audix | Test Software | E3 | 201021 (V9) | N/A | N/A |
| PASTERNACK | Horn Antenna | PE9852/2F-20 | 112002 | 2021-02-05 | 2024-02-04 |
| AH | Preamplifier | PAM-1840VH | 190 | 2021-11-19 | 2022-11-18 |
| MICRO-COAX | Coaxial Cable | UFB142A-1-2362-200200 | 235772-001 | 2021-08-08 | 2022-08-07 |
| PASTERNACK | Horn Antenna | PE9850/2F-20 | 072001 | 2021-02-05 | 2024-02-04 |
| OML | Harmonic Mixer | WR19/M19HWD | U60314-1 | 2020-10-16 | 2023-10-15 |
| OML | Horn Antenna | M19RH | 11648-03 | 2020-10-16 | 2023-10-15 |
| OML | Harmonic Mixer | WR12/M12HWD | E60119-1 | 2020-10-17 | 2023-10-16 |
| OML | Horn Antenna | M12RH | E60119-2 | 2020-10-18 | 2023-10-17 |
| OML | Harmonic Mixer | WR08/M08HWD | F60315-1 | 2020-10-22 | 2023-10-21 |
| OML | Horn Antenna | M08RH | F60315-2 | 2020-10-24 | 2023-10-23 |
| OML | Harmonic Mixer | WR05/M05HWD | G60107-1 | 2020-10-25 | 2023-10-24 |
| OML | Horn Antenna | M05RH | G60107-2 | 2020-10-26 | 2023-10-25 |
| OML | Harmonic Mixer | WR03/M03HWD | H60122-1 | 2020-11-10 | 2023-11-09 |
| OML | Horn Antenna | M03RH | H60122-2 | 2020-11-06 | 2023-11-05 |
| R&S | Spectrum Analyzer | FSV40 | 101943 | 2021-10-10 | 2022-10-09 |
| TESEQ | HF Loop Antenna | HLA6120 | 33561 | 2021-02-03 | 2024-02-02 |
| Sunol Sciences | Antenna | JB6 | A082520-5 | 2020-10-19 | 2023-10-18 |
| R&S | EMI Test Receiver | ESR3 | 102724 | 2021-07-22 | 2022-07-21 |
| TIMES MICROWAVE | Coaxial Cable | LMR-600-UltraFlex | C-0470-02 | 2021-07-18 | 2022-07-17 |

| | | | | | |
|---|---|---|---|---|---|
| TIMES MICROWAVE | Coaxial Cable | LMR-600-UltraFlex | C-0780-01 | 2021-07-18 | 2022-07-17 |
| Sonoma | Amplifier | 310N | 186165 | 2021-07-18 | 2022-07-17 |

** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

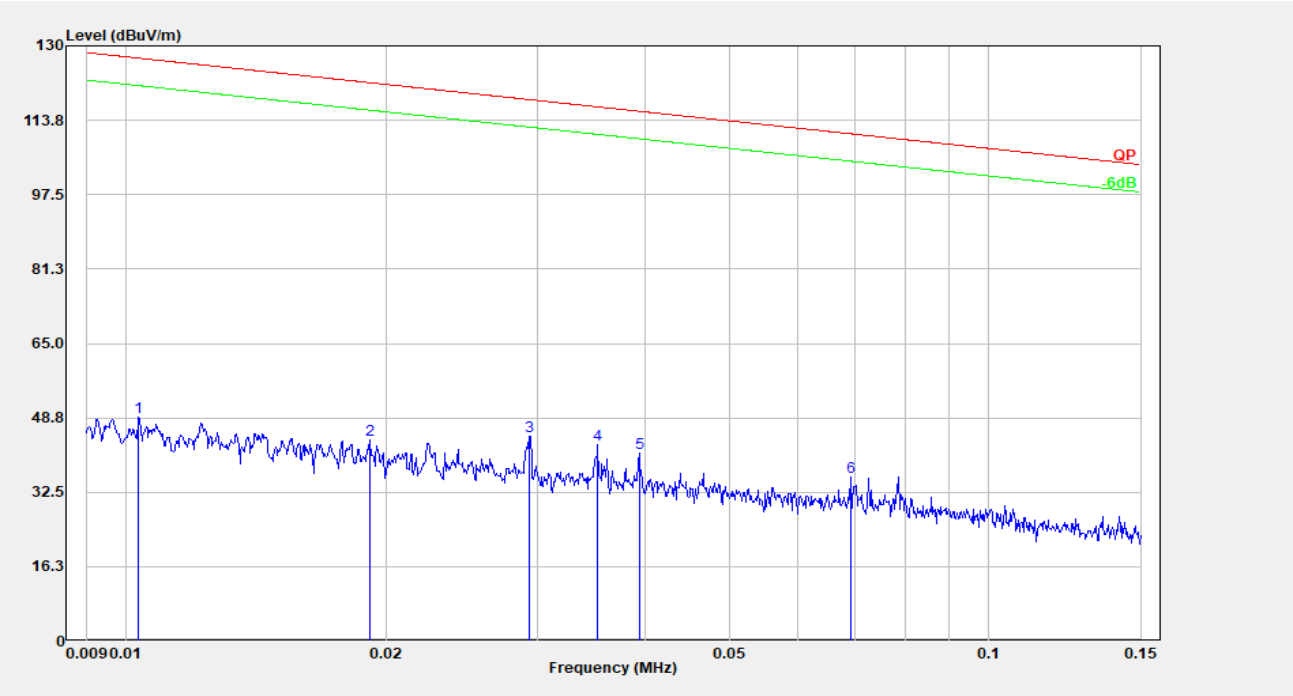
**Test Data:**

Please refer to the below table and plots.

Note: The device can be mounted in multiple orientations, test was performed with X,Y, Z Axis, the worst orientation was photographed and it`s data was recorded.

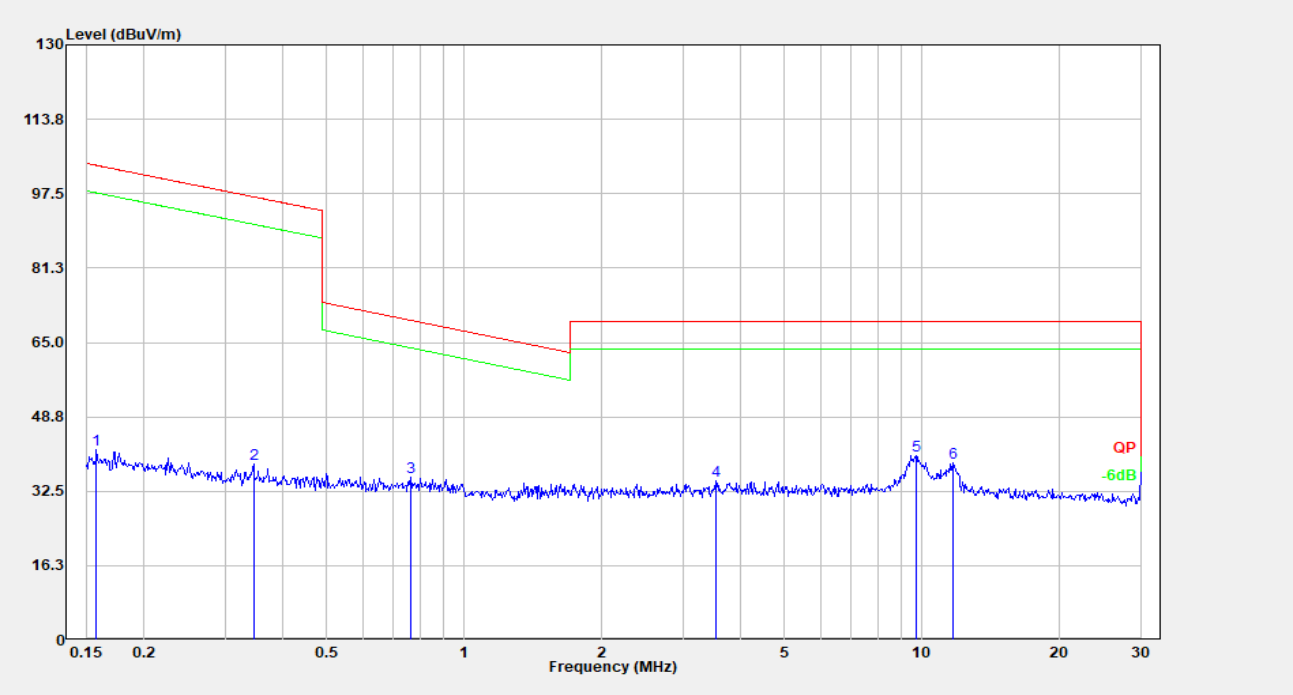
**1) 9kHz-30MHz**

Parallel:
Horizontal



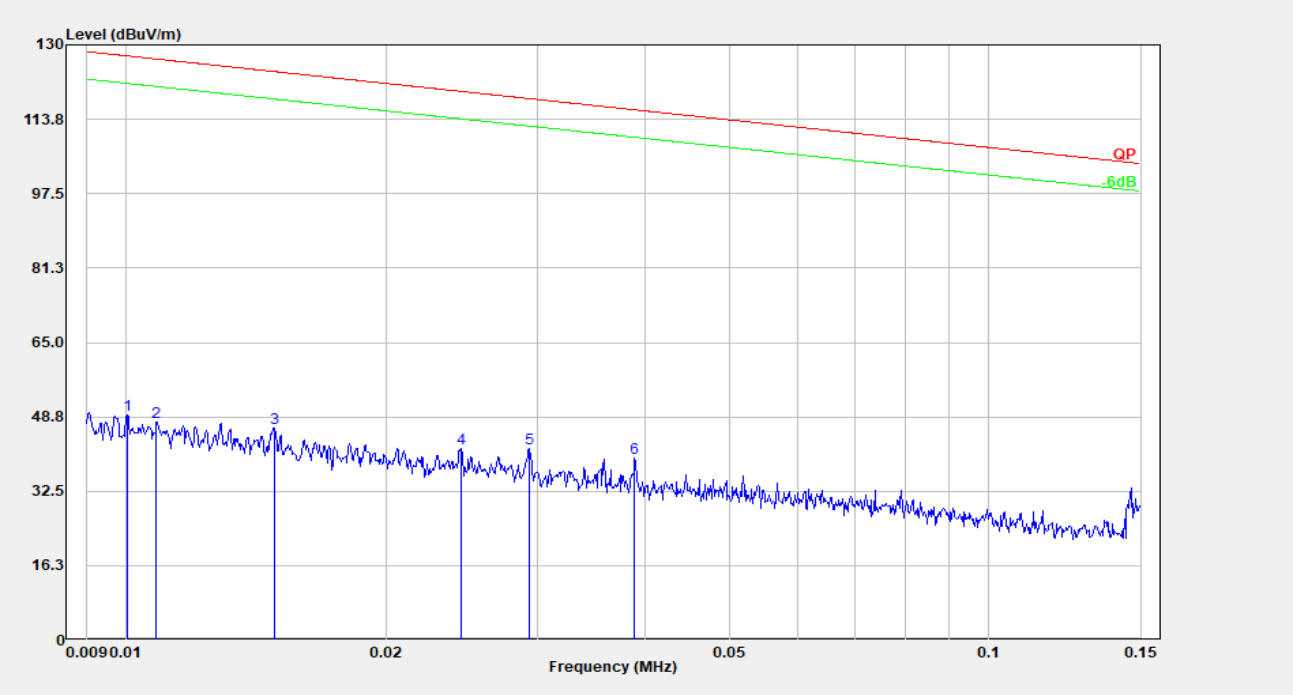

| No. | Frequency (MHz) | Reading (dBµV) | Factor (dB/m) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 0.010 | 28.48 | 20.51 | 48.99 | 127.32 | 78.33 | Peak |
| 2 | 0.019 | 23.33 | 20.51 | 43.84 | 121.97 | 78.13 | Peak |
| 3 | 0.029 | 24.41 | 20.41 | 44.82 | 118.26 | 73.44 | Peak |
| 4 | 0.035 | 22.43 | 20.41 | 42.84 | 116.67 | 73.83 | Peak |
| 5 | 0.039 | 20.73 | 20.41 | 41.14 | 115.71 | 74.58 | Peak |
| 6 | 0.069 | 15.53 | 20.42 | 35.95 | 110.80 | 74.85 | Peak |

Horizontal



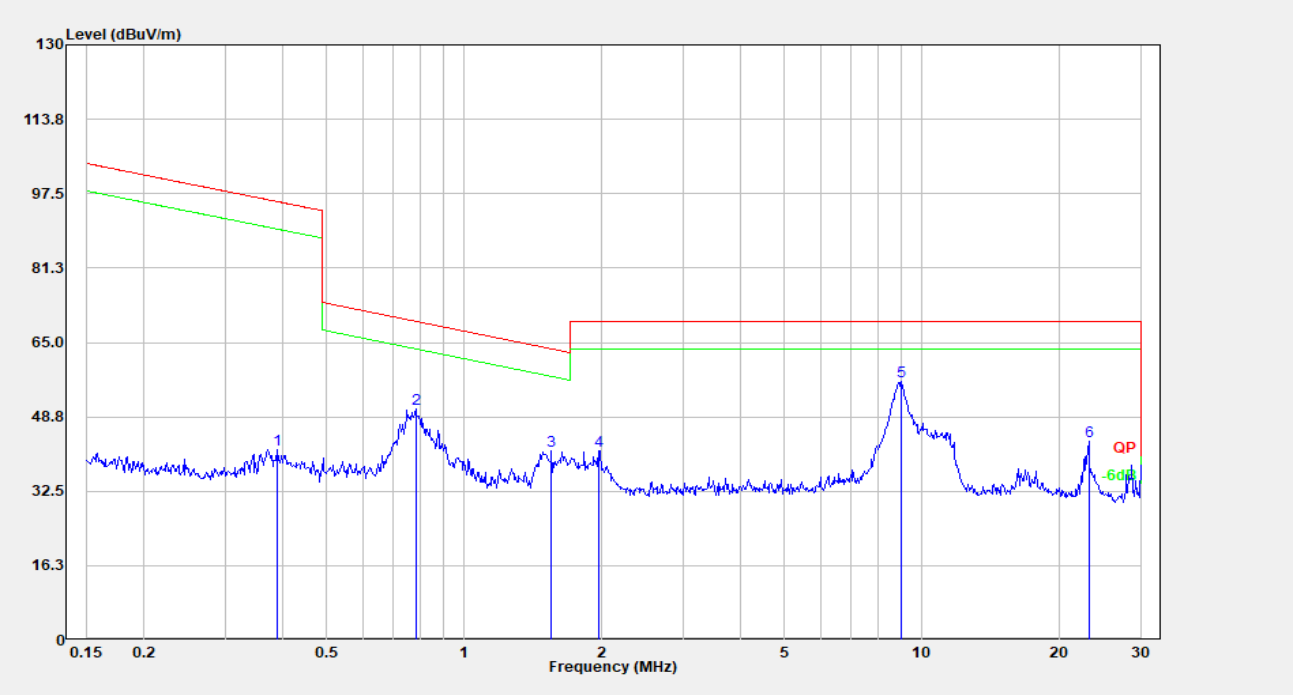

| No. | Frequency (MHz) | Reading (dBµV) | Factor (dB/m) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 0.157 | 21.33 | 20.22 | 41.55 | 103.67 | 62.12 | Peak |
| 2 | 0.346 | 18.28 | 20.10 | 38.38 | 96.81 | 58.44 | Peak |
| 3 | 0.763 | 15.44 | 20.03 | 35.47 | 69.87 | 34.40 | Peak |
| 4 | 3.547 | 14.73 | 19.99 | 34.72 | 69.54 | 34.82 | Peak |
| 5 | 9.705 | 20.06 | 20.27 | 40.33 | 69.54 | 29.21 | Peak |
| 6 | 11.683 | 18.39 | 20.34 | 38.73 | 69.54 | 30.81 | Peak |

Perpendicular:
Horizontal



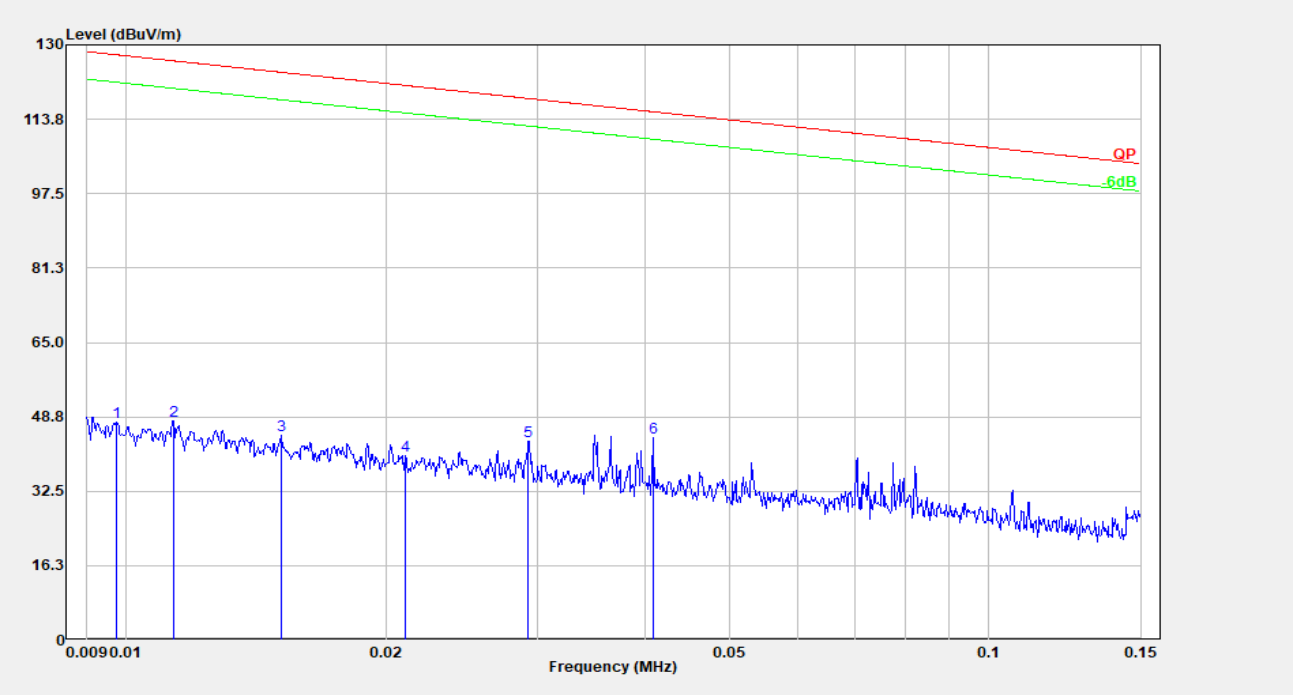

| No. | Frequency (MHz) | Reading (dBµV) | Factor (dB/m) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 0.010 | 28.55 | 20.51 | 49.06 | 127.59 | 78.53 | Peak |
| 2 | 0.011 | 26.99 | 20.51 | 47.50 | 126.91 | 79.40 | Peak |
| 3 | 0.015 | 25.87 | 20.51 | 46.38 | 124.17 | 77.79 | Peak |
| 4 | 0.024 | 21.45 | 20.42 | 41.87 | 119.84 | 77.97 | Peak |
| 5 | 0.029 | 21.33 | 20.41 | 41.74 | 118.26 | 76.51 | Peak |
| 6 | 0.039 | 19.42 | 20.41 | 39.83 | 115.81 | 75.98 | Peak |

Horizontal



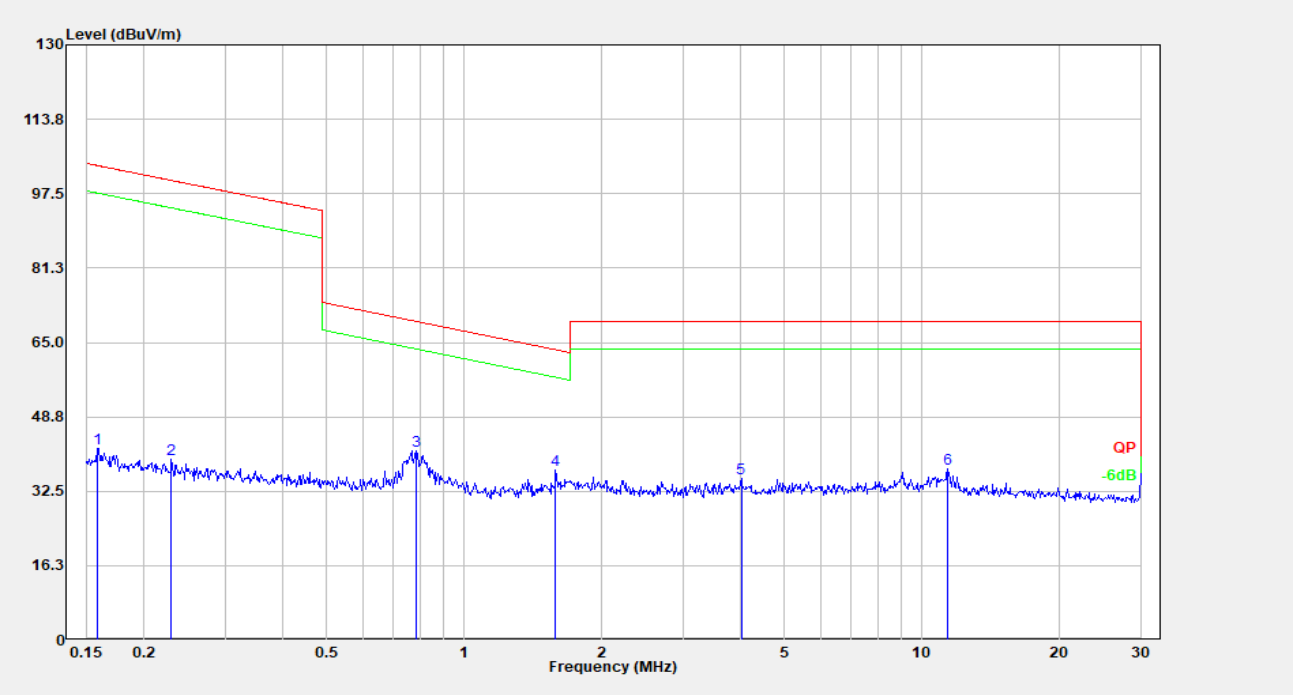

| No. | Frequency (MHz) | Reading (dBµV) | Factor (dB/m) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 0.391 | 21.65 | 20.07 | 41.72 | 95.75 | 54.03 | Peak |
| 2 | 0.783 | 30.38 | 20.03 | 50.41 | 69.64 | 19.22 | Peak |
| 3 | 1.552 | 21.41 | 19.95 | 41.36 | 63.57 | 22.22 | Peak |
| 4 | 1.970 | 21.28 | 19.96 | 41.23 | 69.54 | 28.31 | Peak |
| 5 | 9.011 | 36.32 | 20.21 | 56.54 | 69.54 | 13.00 | Peak |
| 6 | 23.140 | 23.23 | 20.29 | 43.52 | 69.54 | 26.02 | Peak |

Ground-Parallel:
Horizontal




| No. | Frequency (MHz) | Reading (dBµV) | Factor (dB/m) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 0.010 | 26.97 | 20.51 | 47.48 | 127.84 | 80.36 | Peak |
| 2 | 0.011 | 27.26 | 20.51 | 47.77 | 126.52 | 78.74 | Peak |
| 3 | 0.015 | 24.17 | 20.51 | 44.68 | 124.02 | 79.35 | Peak |
| 4 | 0.021 | 19.90 | 20.49 | 40.39 | 121.14 | 80.75 | Peak |
| 5 | 0.029 | 22.89 | 20.41 | 43.30 | 118.28 | 74.98 | Peak |
| 6 | 0.041 | 23.92 | 20.41 | 44.33 | 115.40 | 71.07 | Peak |

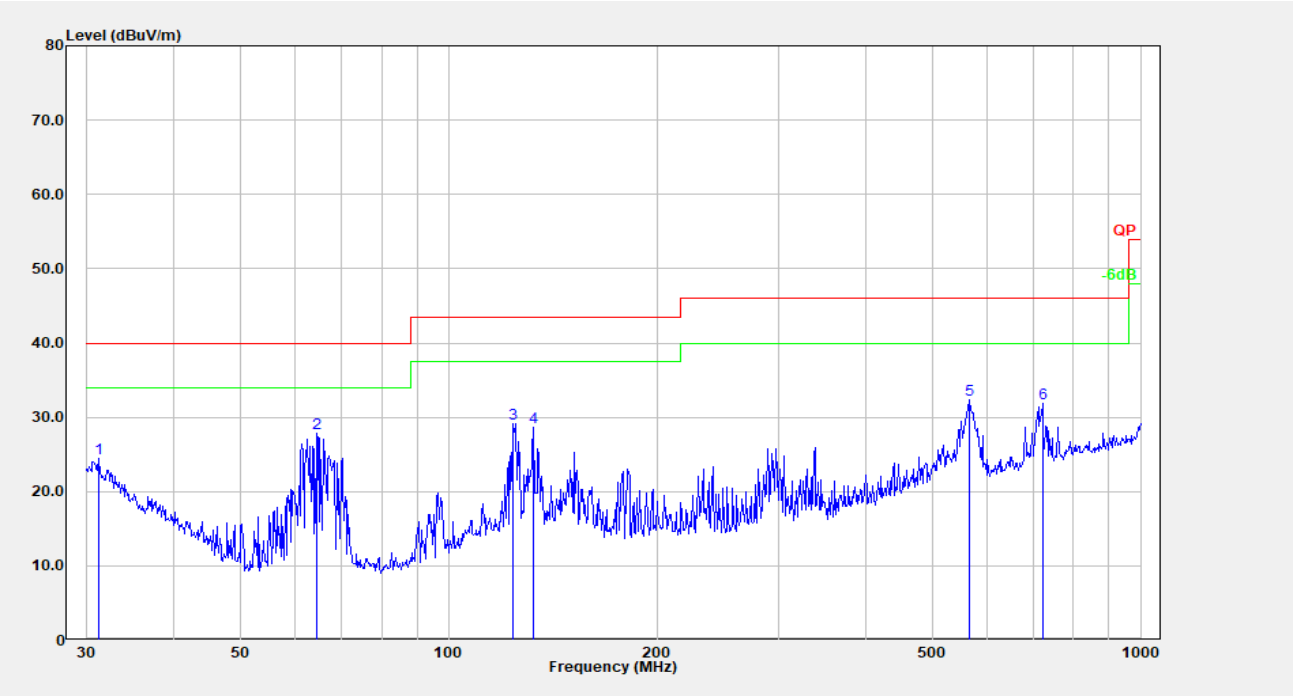
Horizontal




| No. | Frequency (MHz) | Reading (dBµV) | Factor (dB/m) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 0.158 | 21.63 | 20.22 | 41.85 | 103.62 | 61.77 | Peak |
| 2 | 0.229 | 19.26 | 20.16 | 39.43 | 100.40 | 60.98 | Peak |
| 3 | 0.783 | 21.36 | 20.03 | 41.39 | 69.64 | 28.25 | Peak |
| 4 | 1.585 | 17.15 | 19.95 | 37.10 | 63.39 | 26.29 | Peak |
| 5 | 4.027 | 15.34 | 20.00 | 35.34 | 69.54 | 34.20 | Peak |
| 6 | 11.377 | 17.02 | 20.33 | 37.35 | 69.54 | 32.19 | Peak |

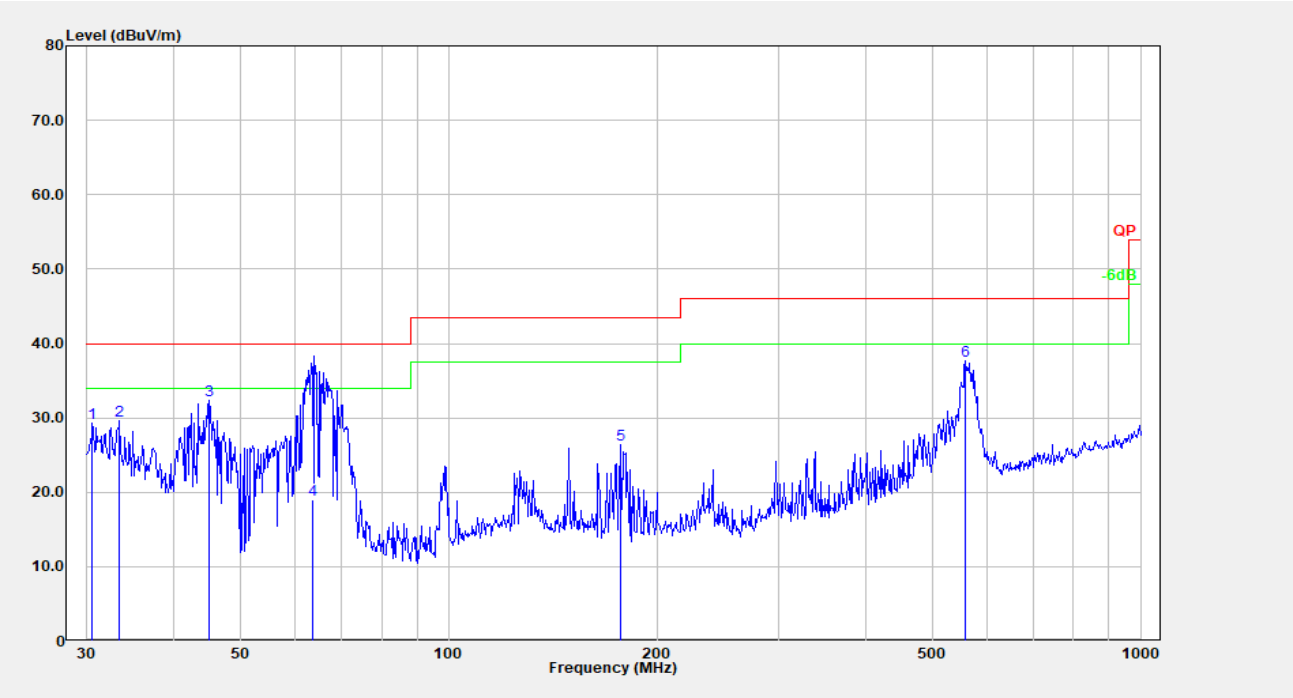
**2) 30MHz-1GHz**

**Horizontal:**




| No. | Frequency (MHz) | Reading (dBµV) | Factor (dB/m) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 31.180 | 29.15 | -4.70 | 24.45 | 40.00 | 15.55 | Peak |
| 2 | 64.433 | 45.04 | -17.23 | 27.81 | 40.00 | 12.19 | Peak |
| 3 | 123.699 | 40.73 | -11.63 | 29.10 | 43.50 | 14.40 | Peak |
| 4 | 132.685 | 40.42 | -11.73 | 28.68 | 43.50 | 14.82 | Peak |
| 5 | 566.622 | 38.25 | -5.85 | 32.40 | 46.00 | 13.60 | Peak |
| 6 | 721.726 | 35.28 | -3.49 | 31.80 | 46.00 | 14.20 | Peak |

**Vertical:**




| No. | Frequency (MHz) | Reading (dBµV) | Factor (dB/m) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 30.531 | 33.51 | -4.20 | 29.31 | 40.00 | 10.69 | Peak |
| 2 | 33.445 | 36.10 | -6.45 | 29.65 | 40.00 | 10.35 | Peak |
| 3 | 45.058 | 46.91 | -14.48 | 32.43 | 40.00 | 7.57 | Peak |
| 4 | 63.489 | 36.35 | -17.31 | 19.04 | 40.00 | 20.96 | QP |
| 5 | 177.509 | 40.00 | -13.65 | 26.36 | 43.50 | 17.14 | Peak |
| 6 | 558.730 | 43.49 | -5.90 | 37.59 | 46.00 | 8.41 | Peak |

**3) 1GHz-40GHz:**

| Frequency (MHz) | Receiver | | Polar (H/V) | Factor (dB/m) | Result (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| | Reading (dBμV) | Detector | | | | | |
| 5984.00 | 34.60 | PK | H | 13.29 | 47.89 | 74.00 | 26.11 |
| 5984.00 | 22.49 | AV | H | 13.29 | 35.78 | 54.00 | 18.22 |
| 5878.00 | 34.69 | PK | V | 13.16 | 47.85 | 74.00 | 26.15 |
| 5878.00 | 22.46 | AV | V | 13.16 | 35.62 | 54.00 | 18.38 |
| 23515.00 | 39.60 | PK | H | 11.94 | 51.54 | 74.00 | 22.46 |
| 23515.00 | 27.41 | AV | H | 11.94 | 39.35 | 54.00 | 14.65 |
| 19163.00 | 53.35 | PK | V | 6.06 | 59.41 | 74.00 | 14.59 |
| 19163.00 | 34.48 | AV | V | 6.06 | 40.54 | 54.00 | 13.46 |
| 38250.00 | 48.90 | PK | H | 20.29 | 63.17 | 74.00 | 10.83 |
| 38250.00 | 31.08 | AV | H | 20.29 | 45.35 | 54.00 | 8.65 |
| 28798.00 | 47.29 | PK | V | 15.50 | 56.77 | 74.00 | 17.23 |
| 28798.00 | 42.40 | AV | V | 15.50 | 51.88 | 54.00 | 2.12 |
| 38250.00 | 51.66 | PK | V | 20.29 | 65.93 | 74.00 | 8.07 |
| 38250.00 | 33.52 | AV | V | 20.29 | 47.79 | 54.00 | 6.21 |

*Note:*
*For 26.5-40GHz:*
*Result = Reading + Factor- Distance extrapolation Factor*
*Distance extrapolation Factor =20 log (specific distance [3m]/test distance [1.5m]) dB= 6.02 dB*

**3) 40GHz-231GHz:**

| Frequency (GHz) | Receiver Reading (dBμV) | Polar (H/V) | Factor (dB/m) | Field Strength (dBμV/m) | Power Density (pW/cm$^2$) | Limit (pW/cm$^2$) |
|---|---|---|---|---|---|---|
| 48.523 | 51.10 | H | 40.12 | 91.22 | 38.77 | 600.00 |
| 48.523 | 50.69 | V | 40.12 | 90.81 | 35.28 | 600.00 |
| 72.503 | 58.17 | H | 43.86 | 102.03 | 467.25 | 600.00 |
| 72.471 | 58.18 | V | 43.86 | 102.04 | 468.33 | 600.00 |
| 87.638 | 56.99 | H | 44.81 | 101.80 | 443.15 | 600.00 |
| 87.656 | 56.51 | V | 44.82 | 101.33 | 397.69 | 600.00 |
| 95.640 | 61.05 | H | 45.80 | 100.83 | 354.44 | 600.00 |
| 90.350 | 61.05 | V | 45.15 | 100.18 | 305.17 | 600.00 |
| 191.690 | 56.63 | H | 51.16 | 101.77 | 440.10 | 600.00 |
| 191.690 | 56.61 | V | 51.16 | 101.75 | 438.07 | 600.00 |
| 228.201 | 47.72 | H | 52.75 | 94.45 | 81.57 | 1000.00 |
| 230.110 | 47.39 | V | 52.84 | 94.21 | 77.19 | 1000.00 |

*Factor = Antenna Factor*
*Field Strength = Reading + Factor*
*EIRP (dBm) = Field Strength (dBμV/m) + 20log(D) − 104.8*

*D is the measurement distance*

$$\mathrm{EIRP}_{\mathrm{Linear}} = 10^{\left[\left(\mathrm{EIRP}_{\mathrm{Log}} - 30\right)/10\right]}$$

where

$\mathrm{EIRP}_{\mathrm{Linear}}$ is the equivalent isotropically radiated power, in watts
$\mathrm{EIRP}_{\mathrm{Log}}$ is the equivalent isotropically radiated power, in dBm

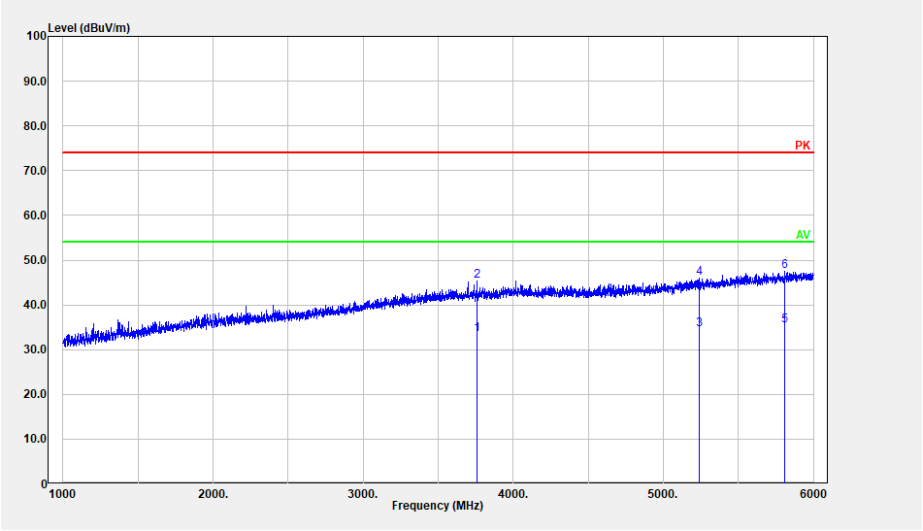
$$\mathrm{PD} = \frac{\mathrm{EIRP}_{\mathrm{Linear}}}{4\pi d^2}$$

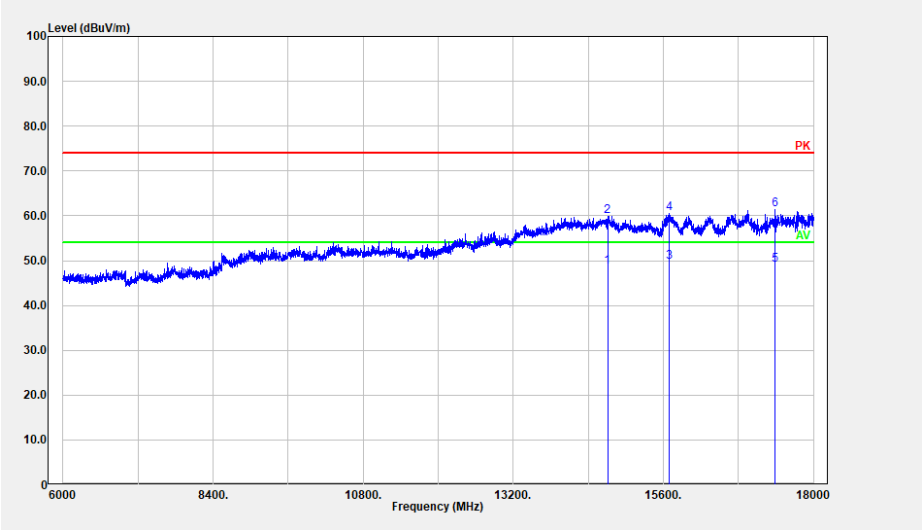
where

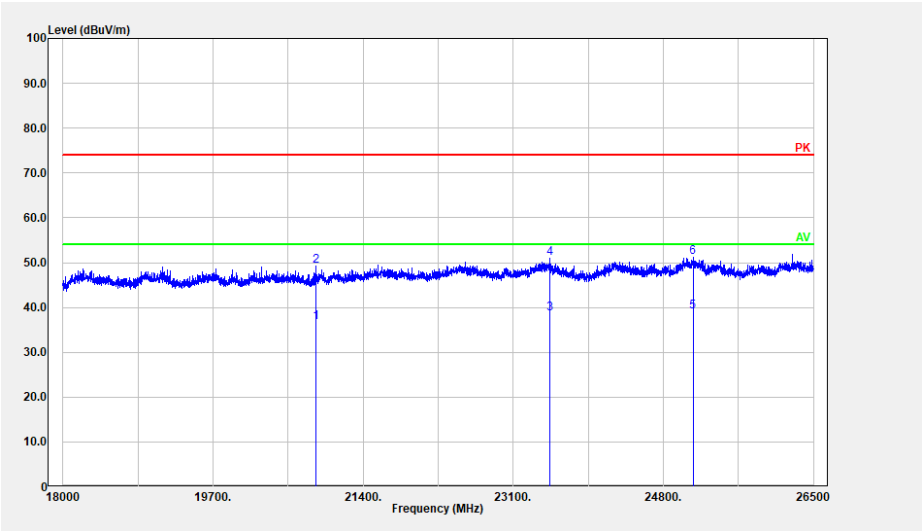
PD is the power density at the distance specified by the limit, in W/m$^2$
$\mathrm{EIRP}_{\mathrm{Linear}}$ is the equivalent isotropically radiated power, in watts
$d$ is the distance at which the power density limit is specified, in m

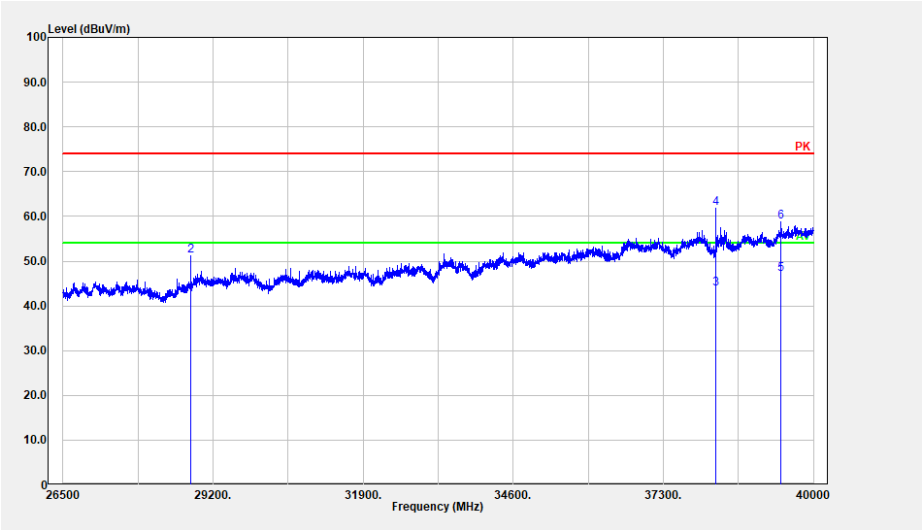
*The Specified distance is 3m.*

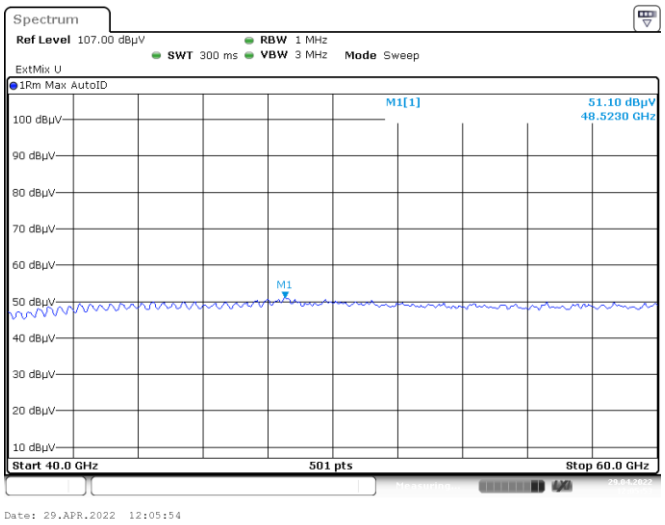
**Test plots**
**Horizontal:**

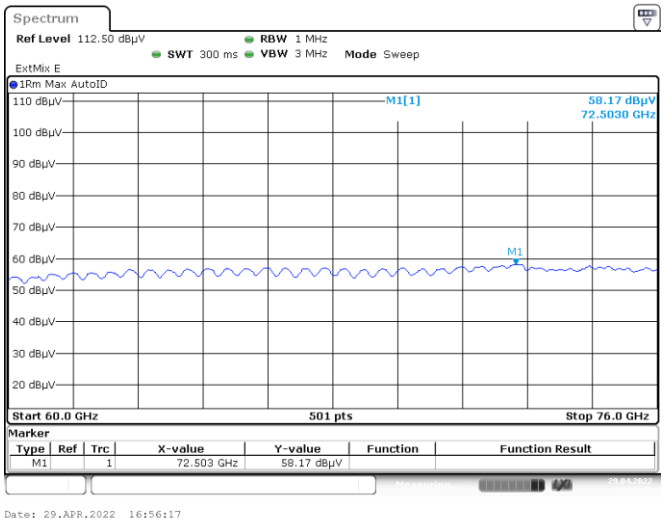


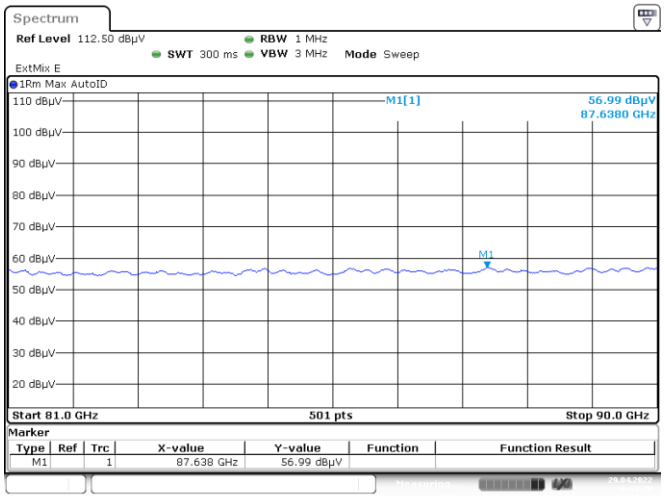



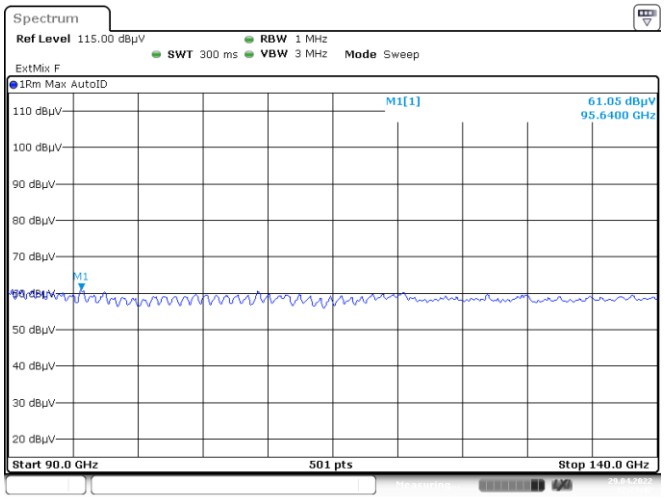

Level (dBuV/m)
100
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
PK
AV
2
3
4
5
6
26500
29200.
31900.
34600.
37300.
40000
Frequency (MHz)


Spectrum
Ref Level 107.00 dBµV
RBW 1 MHz
SWT 300 ms
VBW 3 MHz
Mode Sweep
ExtMix U
1Rm Max AutoID
M1[1]
51.10 dBµV
48.5230 GHz
M1
100 dBµV
90 dBµV
80 dBµV
70 dBµV
60 dBµV
50 dBµV
40 dBµV
30 dBµV
20 dBµV
10 dBµV
Start 40.0 GHz
501 pts
Stop 60.0 GHz
Date: 29.APR.2022 12:05:54

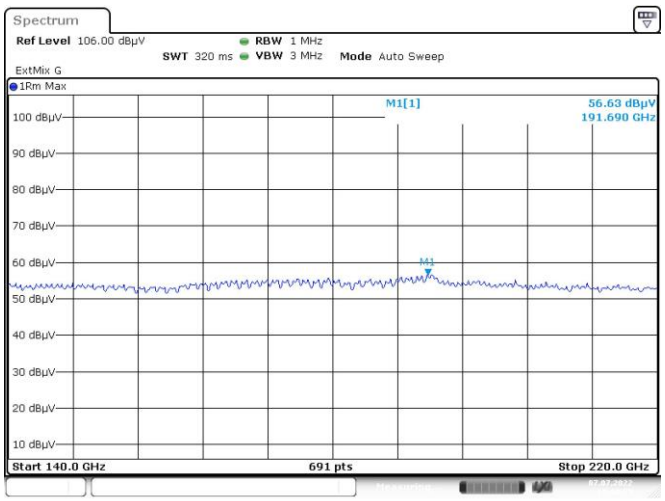

Spectrum
Ref Level 112.50 dBµV
RBW 1 MHz
SWT 300 ms
VBW 3 MHz
Mode Sweep
ExtMix E
1Rm Max AutoID
M1[1]
58.17 dBµV
72.5030 GHz
M1
110 dBµV
100 dBµV
90 dBµV
80 dBµV
70 dBµV
60 dBµV
50 dBµV
40 dBµV
30 dBµV
20 dBµV
Start 60.0 GHz
501 pts
Stop 76.0 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 72.503 GHz 58.17 dBµV
Date: 29.APR.2022 16:56:17



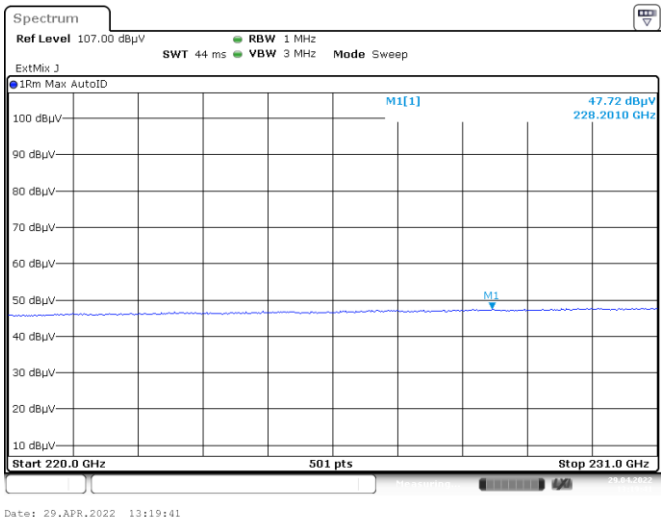

Date: 29.APR.2022 16:54:29



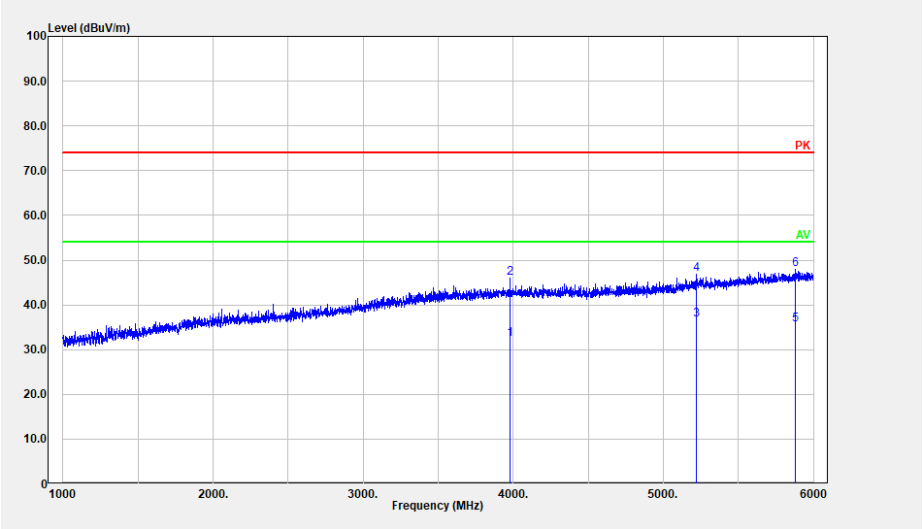

Date: 29.APR.2022 12:23:42

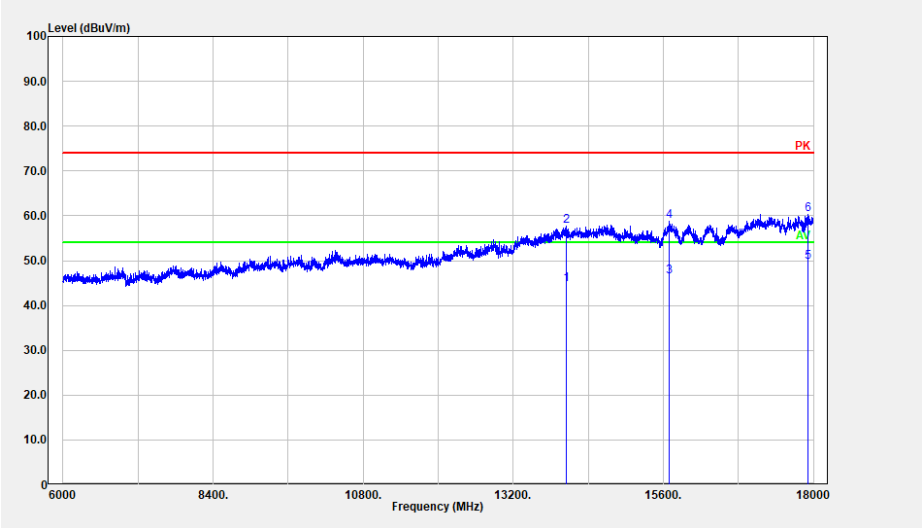


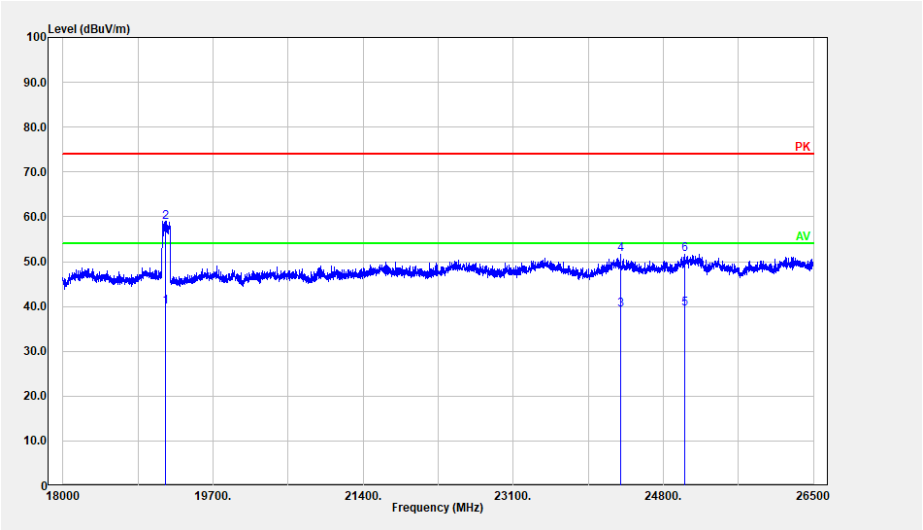

Date: 7.JUL.2022 10:44:56

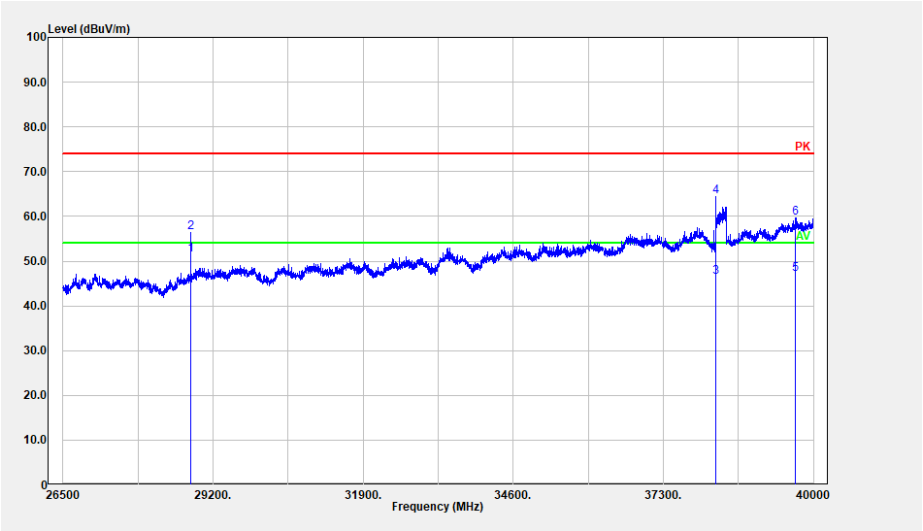

Spectrum
Ref Level 107.00 dBµV
RBW 1 MHz
SWT 44 ms
VBW 3 MHz
Mode Sweep
ExtMix J
1Rm Max AutoID
M1[1]
47.72 dBµV
228.2010 GHz
100 dBµV
90 dBµV
80 dBµV
70 dBµV
60 dBµV
50 dBµV
40 dBµV
30 dBµV
20 dBµV
10 dBµV
M1
Start 220.0 GHz
501 pts
Stop 231.0 GHz
Date: 29.APR.2022 13:19:41

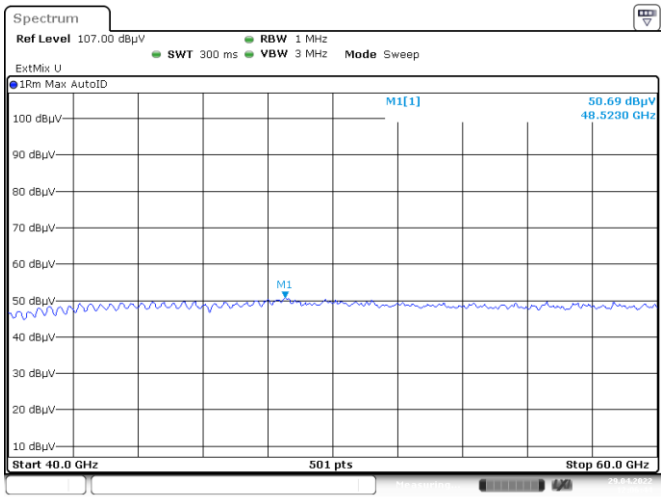
**Vertical:**

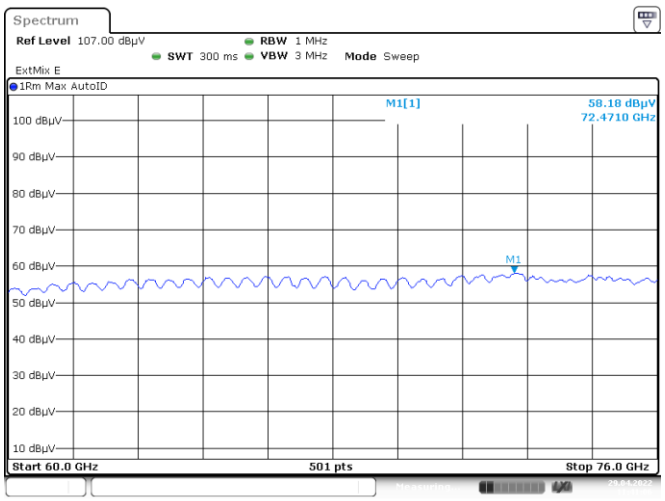

Level (dBuV/m)
100
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
PK
AV
1000
2000.
3000.
4000.
5000.
6000
Frequency (MHz)

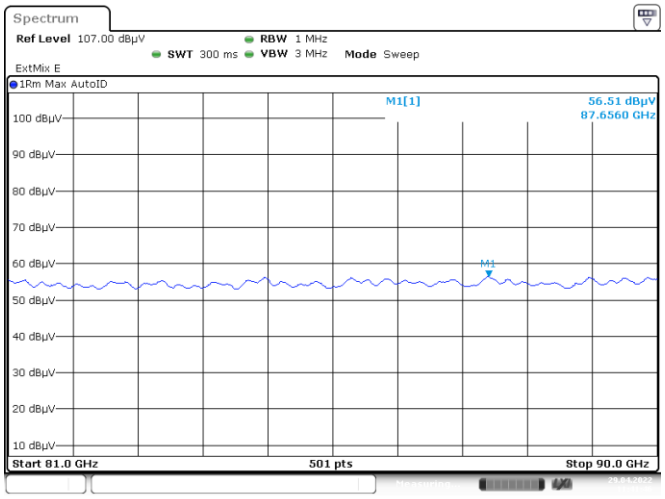

Level (dBuV/m)
100
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
PK
AV
6000
8400.
10800.
13200.
15600.
18000
Frequency (MHz)


Level (dBuV/m)
100
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
PK
AV
18000
19700.
21400.
23100.
24800.
26500
Frequency (MHz)

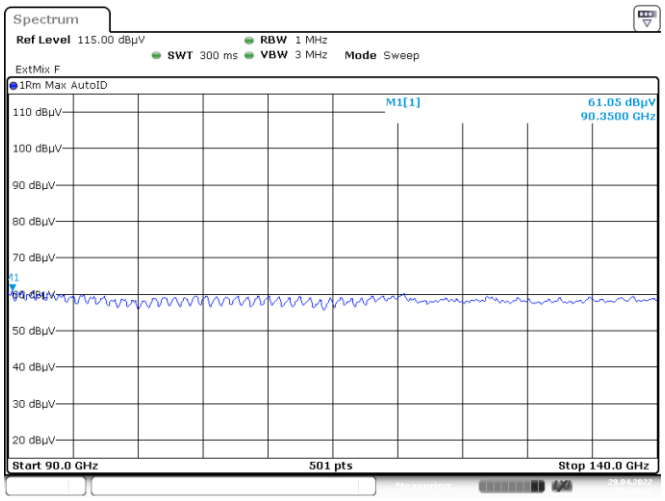

Level (dBuV/m)
100
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
PK
AV
2
3
4
5
6
26500
29200.
31900.
34600.
37300.
40000
Frequency (MHz)


Spectrum
Ref Level 107.00 dBµV
RBW 1 MHz
SWT 300 ms
VBW 3 MHz
Mode Sweep
ExtMix U
1Rm Max AutoID
M1[1]
50.69 dBµV
48.5230 GHz
M1
100 dBµV
90 dBµV
80 dBµV
70 dBµV
60 dBµV
50 dBµV
40 dBµV
30 dBµV
20 dBµV
10 dBµV
Start 40.0 GHz
501 pts
Stop 60.0 GHz
Date: 29.APR.2022 12:06:44

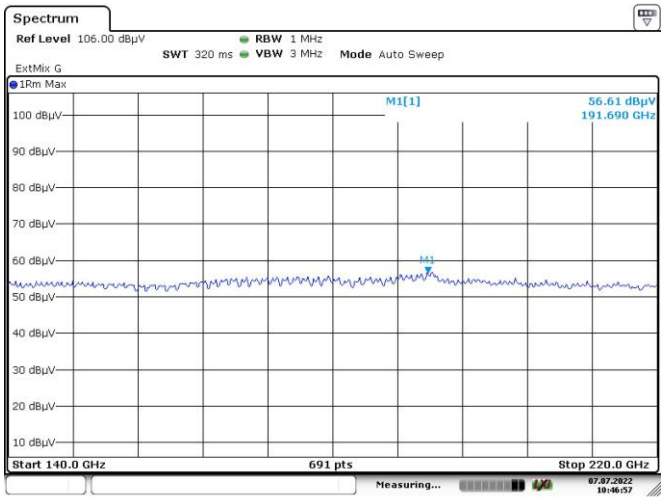

Spectrum
Ref Level 107.00 dBµV
RBW 1 MHz
SWT 300 ms
VBW 3 MHz
Mode Sweep
ExtMix E
1Rm Max AutoID
M1[1]
58.18 dBµV
72.4710 GHz
M1
100 dBµV
90 dBµV
80 dBµV
70 dBµV
60 dBµV
50 dBµV
40 dBµV
30 dBµV
20 dBµV
10 dBµV
Start 60.0 GHz
501 pts
Stop 76.0 GHz
Date: 29.APR.2022 11:41:07



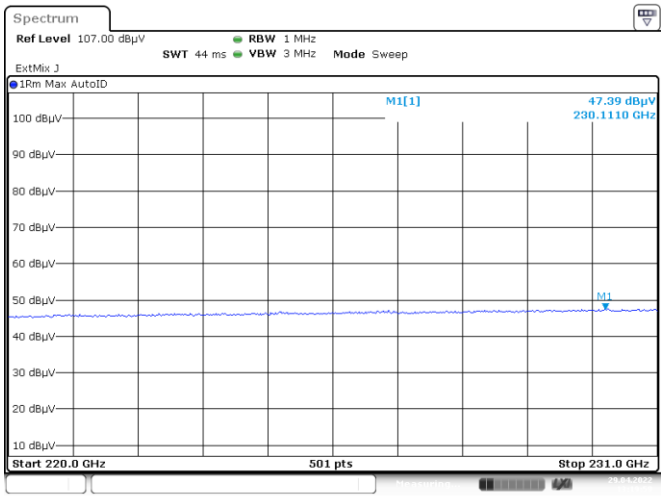

Date: 29.APR.2022 11:41:46




Date: 29.APR.2022 12:26:32




Date: 7.JUL.2022 10:46:57




Date: 29.APR.2022 13:20:00

## 4.3 Frequency Stability:

| | | | |
|---|---|---|---|
| Serial Number: | CR22020003-RF-S1 | Test Date: | 2022.4.29 |
| Test Site: | RF | Test Mode: | Transmitting |
| Tester: | Tommy Luo | Test Result: | Pass |

| **Environmental Conditions:** | | | | | |
|---|---|---|---|---|---|
| Temperature: (℃) | 22.5 | Relative Humidity: (%) | 63 | ATM Pressure: (kPa) | 101.1 |

**Test Equipment List and Details:**

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| R&S | Spectrum Analyzer | FSV40 | 101943 | 2021-10-10 | 2022-10-09 |
| OML | Harmonic Mixer | WR12/M12HWD | E60119-1 | 2020-10-17 | 2023-10-16 |
| OML | Horn Antenna | M12RH | E60119-2 | 2020-10-18 | 2023-10-17 |
| BACL | TEMP&HUMI Test Chamber | BTH-150 | 30026 | 2021-07-22 | 2022-07-21 |
| UNI-T | Multimeter | UT39A+ | C210582554 | 2021-09-30 | 2022-09-29 |

** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

**Test Data:**

| **Temperature** | **Voltage** | **Frequency (GHz)** | | | |
|---|---|---|---|---|---|
| **℃** | **$V_{DC}$** | **$f_L$** | **$f_H$** | **$f_L$ Limit** | **$f_H$ Limit** |
| -20 | 12 | 76.48540 | 76.87464 | 76 | 81 |
| -10 | 12 | 76.48861 | 76.87771 | 76 | 81 |
| 0 | 12 | 76.48841 | 76.87763 | 76 | 81 |
| 10 | 12 | 76.48842 | 76.87763 | 76 | 81 |
| 20 | 12 | 76.48840 | 76.87762 | 76 | 81 |
| 30 | 12 | 76.48843 | 76.87751 | 76 | 81 |
| 40 | 12 | 76.48842 | 76.87750 | 76 | 81 |
| 50 | 12 | 76.48841 | 76.87751 | 76 | 81 |
| 20 | 10.2 | 76.48843 | 76.87753 | 76 | 81 |
| 20 | 13.8 | 76.48842 | 76.87716 | 76 | 81 |

## 4.4 Occupied Bandwidth:

| | | | |
|---|---|---|---|
| Serial Number: | CR22020003-RF-S1 | Test Date: | 2022.4.29 |
| Test Site: | 966-1 | Test Mode: | Transmitting |
| Tester: | Tommy Luo | Test Result: | Pass |

| **Environmental Conditions:** | | | | | |
|---|---|---|---|---|---|
| Temperature: (℃) | 21.5 | Relative Humidity: (%) | 61 | ATM Pressure: (kPa) | 101.1 |

**Test Equipment List and Details:**

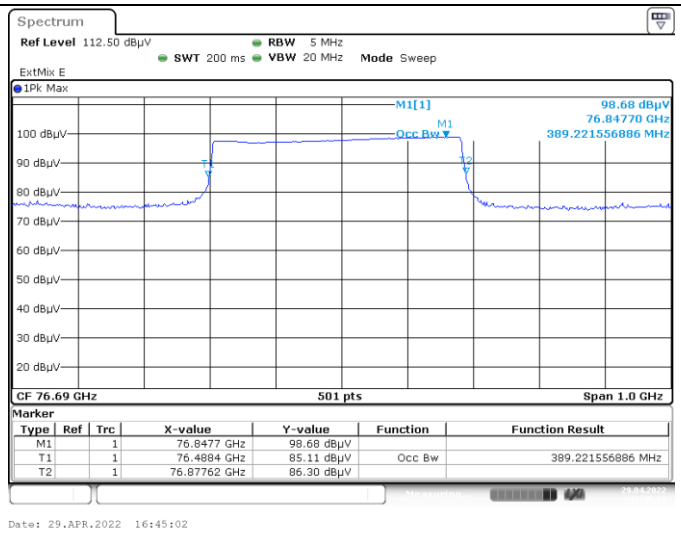
| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| R&S | Spectrum Analyzer | FSV40 | 101943 | 2021-10-10 | 2022-10-09 |
| OML | Harmonic Mixer | WR12/M12HWD | E60119-1 | 2020-10-17 | 2023-10-16 |
| OML | Horn Antenna | M12RH | E60119-2 | 2020-10-18 | 2023-10-17 |

** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

**Test Data:**

| Test Frequency (MHz) | 99% Occupied Bandwidth (MHz) |
|---|---|
| 76.69 | 389.222 |

## 99% Emission Bandwidth



## 4.5 Duty Cycle:

| | | | |
|---|---|---|---|
| Serial Number: | CR22050022-RF-S1 | Test Date: | 2022.7.9 |
| Test Site: | 966-1 | Test Mode: | Transmitting |
| Tester: | Mack Huang | Test Result: | N/A |

| **Environmental Conditions:** | | | | | |
|---|---|---|---|---|---|
| Temperature: (℃) | 24.2 | Relative Humidity: (%) | 53 | ATM Pressure: (kPa) | 100.0 |

**Test Equipment List and Details:**

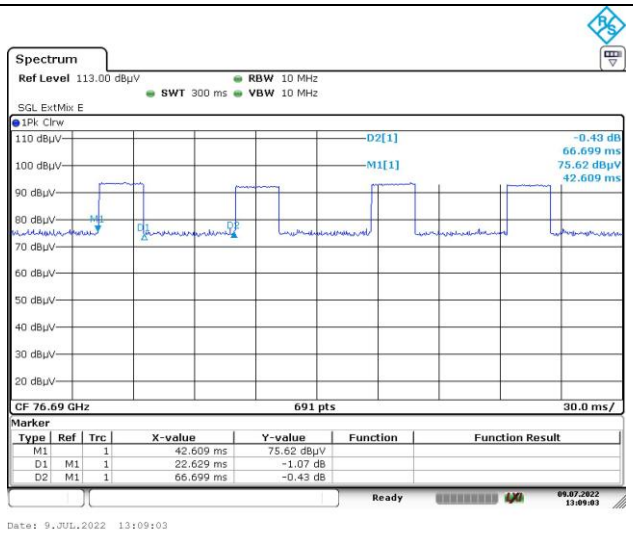
| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| R&S | Spectrum Analyzer | FSV40 | 101943 | 2021-10-10 | 2022-10-09 |
| OML | Harmonic Mixer | WR12/M12HWD | E60119-1 | 2020-10-17 | 2023-10-16 |
| OML | Horn Antenna | M12RH | E60119-2 | 2020-10-18 | 2023-10-17 |

** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

**Test Data:**

| Test Frequency (GHz) | Ton (ms) | Ton+off (ms) | Duty cycle (%) |
|---|---|---|---|
| 76.69 | 22.629 | 66.699 | 33.93 |

## Duty Cycle


Spectrum
Ref Level 113.00 dBµV
RBW 10 MHz
SWT 300 ms
VBW 10 MHz
SGL ExtMix E
1Pk Clrw
110 dBµV
100 dBµV
90 dBµV
80 dBµV
70 dBµV
60 dBµV
50 dBµV
40 dBµV
30 dBµV
20 dBµV
D2[1]
M1[1]
-0.43 dB
66.699 ms
75.62 dBµV
42.609 ms
CF 76.69 GHz
691 pts
30.0 ms/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 42.609 ms 75.62 dBµV
D1 M1 1 22.629 ms -1.07 dB
D2 M1 1 66.699 ms -0.43 dB
Ready
09.07.2022
13:09:03
Date: 9.JUL.2022 13:09:03

# 5. RF EXPOSURE EVALUATION

## 5.1 Applicable Standard

FCC §95.3385 & §1.1307(b)

Regardless of the power density levels permitted under this subpart, devices operating under the provisions of this subpart are subject to the radiofrequency radiation exposure requirements specified in §§1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

## 5.2 Procedure

According to §1.1307(b)(3)(i)

(C) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where $\lambda$ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Table 1 to §1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

| RF Source frequency (MHz) | Threshold ERP (watts) |
|---|---|
| 0.3-1.34 | 1,920 $R^2$. |
| 1.34-30 | 3,450 $R^2/f^2$. |
| 30-300 | 3.83 $R^2$. |
| 300-1,500 | 0.0128 $R^2f$. |
| 1,500-100,000 | 19.2$R^2$. |

## 5.3 Measurement Result

| Frequency (GHz) | λ /2Π (mm) | Distance (mm) | Exemption ERP (mW) | Maximum Conducted Power including Tune-up Tolerance (dBm) | Antenna Gain (dBi) | ERP | | MPE-Based Exemption |
|---|---|---|---|---|---|---|---|---|
| | | | | | | dBm | mW | |
| 76-77 | 0.63 | 400 | 3072 | 19 | 16.70 | 33.55 | 2264.64 | Compliant |

**Result: The device compliant the MPE-Based Exemption at 40cm distances.**

**===== END OF REPORT =====**