# MEASUREMENT REPORT

## FCC PART15.256

| | |
|---|---|
| **FCC ID:** | 2ACSOGDRD87 |
| **APPLICANT:** | Beijing GODA Instruments Co., LTD. |
| **Application Type:** | Certification |
| **Product:** | 80G Radar Level Meter |
| **Model No.:** | GDRD81, GDRD82, GDRD83, GDRD84, GDRD85, GDRD87, GDRD88, GDRD89 |
| **Brand Name:** | GODA |
| **FCC Classification:** | LPR - Level Probing Radar |
| **FCC Rule Part(s):** | FCC PART15.256 |
| **Test Procedure(s):** | KDB890966 D01 Meas level Probing Radars v01r01<br>TR14-1007 Measurement of FMCW |
| **Test Date:** | January 29 ~ March 01, 2019 |

Reviewed By: Sunny Sun
(Sunny Sun)

Approved By: Robin Wu
( Robin Wu )

The test results relate only to the samples tested.
This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in KDB890966 D01 v01r01. Test results reported herein relate only to the item(s) tested.
The test report shall not be reproduced except in full without the written approval of MRT Technology (Suzhou) Co., Ltd.

# Revision History

| Report No. | Version | Description | Issue Date | Note |
|---|---|---|---|---|
| 1901RSU029-U1 | Rev. 01 | Initial Report | 03-26-2019 | Valid |
| | | | | |

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## §2.1033 General Information

| | |
|---|---|
| **Applicant:** | Beijing GODA Instruments Co., LTD. |
| **Applicant Address:** | Hongfu Enterprise Incubation Yard 10,No.2 Workshop 2-4, Chang Ping Dist.Beijing,102209 China |
| **Manufacturer:** | Beijing GODA Instruments Co., LTD. |
| **Manufacturer Address:** | Hongfu Enterprise Incubation Yard 10,No.2 Workshop 2-4, Chang Ping Dist.Beijing,102209 China |
| **Test Site:** | MRT Technology (Suzhou) Co., Ltd |
| **Test Site Address:** | D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China |
| **FCC Registration No.:** | 893164 |
| **Test Device Serial No.:** | N/A ☐ Production ☒ Pre-Production ☐ Engineering |

### Test Facility / Accreditations

**Measurements were performed at MRT Laboratory located in Tian'edang Rd., Suzhou, China.**

- **MRT facility is a FCC registered (MRT Reg. No. 893164) test facility with the site description report on file and has met all the requirements specified in ANSI C63.4-2014.**
- **MRT facility is an IC registered (MRT Reg. No. 11384A-1) test laboratory with the site description on file at Industry Canada.**
- **MRT facility is a VCCI registered (R-20025, G-20034, C-20020, T-20020) test laboratory with the site description on file at VCCI Council.**
- **MRT Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (A2LA) under the American Association for Laboratory Accreditation Program (A2LA Cert. No. 3628.01) in EMC, Telecommunications, Radio and SAR testing.**

Accredited Laboratory

A2LA has accredited

MRT TECHNOLOGY (SUZHOU) CO., LTD.

Suzhou, Jiangsu, People's Republic of China

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

Presented this 24th day of July 2018.

President and CEO
For the Accreditation Council
Certificate Number 3628.01
Valid to August 31, 2020

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

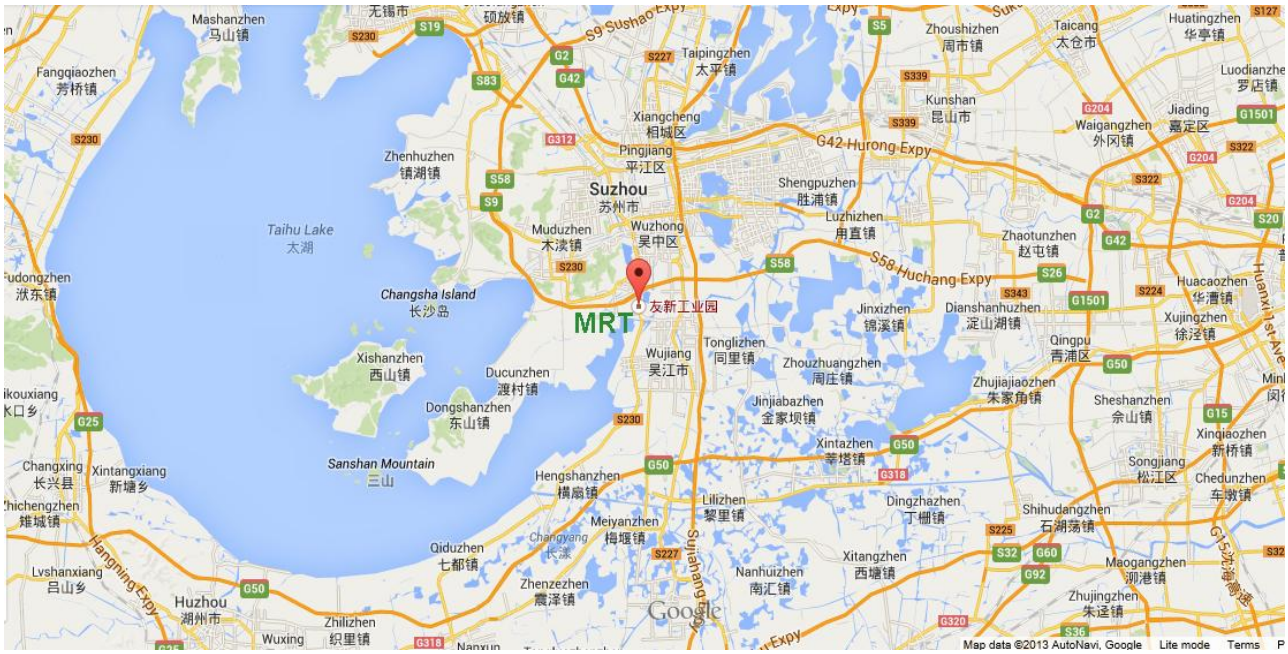
# 1. INTRODUCTION

## 1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

## 1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taihu Lake. These measurement tests were conducted at the MRT Technology (Suzhou) Co., Ltd. Facility located at D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China. The measurement facility compliant with the test site requirements specified in ANSI C63.4-2014.



# 2. PRODUCT INFORMATION

## 2.1. Equipment Description

| | |
|---|---|
| Product Name: | 80G Radar Level Meter |
| Model No.: | GDRD81, GDRD82, GDRD83, GDRD84, GDRD85, GDRD87, GDRD88, GDRD89 |
| Brand Name: | GODA |
| Frequency Range: | 76 ~ 81GHz |
| Modulation Type: | FMCW |
| Antenna Type: | Horn Antenna |
| Input Power: | DC 24V |

| Model Difference | | | | | |
|---|---|---|---|---|---|
| Model No. | Classification | Shell material | Antenna Material | Installation | Max. Antenna Gain |
| GDRD81 | Liquid | Plastic / Aluminium alloy / Stainless steel | FEP / PP | Thread | 32 dBi |
| GDRD82 | Liquid | Plastic / Aluminium alloy / Stainless steel | 316L+PTFE | Flange | 32 dBi |
| GDRD83 | Liquid | Plastic / Aluminium alloy / Stainless steel | FEP / 316L+PTFE | Thread | 15 dBi |
| GDRD84 | Liquid | Plastic / Aluminium alloy / Stainless steel | PP | Hanging | 32 dBi |
| GDRD85 | Health | Stainless steel | PTFE | Clamped connection | 23 dBi |
| GDRD87 | Solid | Plastic / Aluminium alloy / Stainless steel | Aluminium+PP, 316L+PTFE / PP | Flange | 34 dBi |
| GDRD88 | Protection | PA66 | PP | Hanging | 23 dBi |
| GDRD89 | Marine | Stainless steel | 316L+PTFE | Flange | 32 dBi |

Note: The products are made up of electronic part, housing part, process connection part, installation accessories part and antenna. All electronic parts including RF circuit are same within these models, and differences of other parts such as Shell Material, Installation method etc. can not affect RF performance of the product. Only the differences of antennas can affect the RF performance and we selected the sample with the largest antenna gain for all RF testing. The following table is the information of our RF test sample.

| Model No. | Shell material | Antenna Material | Installation | Max. Antenna Gain |
|---|---|---|---|---|
| GDRD87 | Stainless steel | 316L+PP | Flange | 34 dBi |

## 2.2. Test Mode

The engineer test sample was provided by the manufacturer, it was configured into continuous transmit status after power on.

## 2.3. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

## 2.4. Labeling Requirements

Per 2.1074 & 15.19; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase. However, when the device is so small wherein placement of the label with specified statement is not practical, only the FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

# 3. DESCRIPTION of TEST

## 3.1. Evaluation Procedure

The measurement procedures described in the American National Standard for Testing Unlicensed Wireless Devices (KDB890966 D01 Meas level Probing Radars v01r01), and the requirement provided in FCC Part 15.256 were used in the measurement of the EUT.

**Deviation from measurement procedure…….....None**

## 3.2. AC Line Conducted Emissions

The line-conducted facility is located inside an 8'x4'x4' shielded enclosure. A 1m x 2m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50uH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference ground-plane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the receiver and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The receiver was scanned from 150kHz to 30MHz. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was also maximized by varying: power lines, the mode of operation or data exchange speed, or support equipment whichever determined the worst-case emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions are used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

An extension cord was used to connect to a single LISN which powered by EUT. The extension cord was calibrated with LISN, the impedance and insertion loss are compliance with the requirements as stated in ANSI C63.10-2013.

### 3.3. Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. For measurements above 1GHz absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1GHz, the absorbers are removed. A MF Model 210SS turntable is used for radiated measurement. It is a continuously rotatable, remote controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm high PVC support structure is placed on top of the turntable.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up for frequencies below 1GHz was placed on top of the 0.8 meter high, 1 x 1.5 meter table; and test set-up for frequencies 1-40GHz was placed on top of the 1.5 meter high, 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, if applicable, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions. According to 3dB Beam-Width of horn antenna, the horn antenna should be always directed to the EUT when rising height.

# 4. ANTENNA REQUIREMENTS

**Excerpt from §15.203 of the FCC Rules/Regulations:**

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

- The antenna of the **80G Radar Level Meter** is **permanently attached.**
- There are no provisions for connection to an external antenna.

**Conclusion:**

The unit complies with the requirement of §15.203.

# 5. TEST EQUIPMENT CALIBRATION DATE

Radiated Emission - AC1

| Instrument | Manufacturer | Type No. | Asset No. | Cali. Interval | Cali. Due Date |
|---|---|---|---|---|---|
| EMI Test Receiver | R&S | ESR7 | MRTSUE06001 | 1 year | 2019/08/14 |
| Signal Analyzer | R&S | FSV40 | MRTSUE06218 | 1 year | 2019/04/20 |
| EXA Signal Analyzer | Keysight | N9010B | MRTSUE06452 | 1 year | 2019/07/20 |
| Loop Antenna | Schwarzbeck | FMZB 1519 | MRTSUE06025 | 1 year | 2019/11/09 |
| Bilog Period Antenna | Schwarzbeck | VULB 9168 | MRTSUE06172 | 1 year | 2019/04/12 |
| Broad-Band Horn Antenna | Schwarzbeck | BBHA9120D | MRTSUE06023 | 1 year | 2019/10/20 |
| Broad Band Horn Antenna | Schwarzbeck | BBHA 9170 | MRTSUE06024 | 1 year | 2019/12/17 |
| Micro-Wave Antenna | MI-WWAVE | 261U-25 | MRTSUE06273 | N/A | N/A |
| Micro-Wave Antenna | MI-WWAVE | 261E-25 | MRTSUE06276 | N/A | N/A |
| Micro-Wave Antenna | MI-WWAVE | 261F-25 | MRTSUE06275 | N/A | N/A |
| Micro-Wave Antenna | MI-WWAVE | 261G | MRTSUE06274 | N/A | N/A |
| RF Signal Generator | Keysight | E8257D | MRTSUE06453 | N/A | N/A |
| Millimeter wave signal source frequency expander | Keysight | E8257DV15 | MRTSUE06456 | N/A | N/A |
| Millimeter wave signal source frequency expander | Keysight | E8257DV10 | MRTSUE06458 | N/A | N/A |
| USB wideband power sensor | Keysight | U8489A | MRTSUE06448 | 1 year | 2019/07/24 |
| Standard Gain Horn Antenna | A-INFOMW | LB-10-25-A | MRTSUE06410 | N/A | N/A |
| Standard Gain Horn Antenna | A-INFOMW | LB-15-25-A | MRTSUE06409 | N/A | N/A |
| Waveguide Harmonic Mixer | Keysight | M1970V | MRTSUE06271 | N/A | N/A |
| Waveguide Harmonic Mixer | Keysight | M1970W | MRTSUE06272 | N/A | N/A |
| SA Extension Module | Keysight | N9029AV06 | MRTSUE06368 | N/A | N/A |
| SA Extension Module | Keysight | N9029AV05 | MRTSUE06367 | N/A | N/A |
| Microwave System Amplifier | Agilent | 83017A | MRTSUE06076 | 1 year | 2019/11/16 |
| Hygrothermograph | Testo | 608-H1 | MRTSUE06403 | 1 year | 2019/08/15 |
| Anechoic Chamber | TDK | Chamber-AC1 | MRTSUE06212 | 1 year | 2019/05/02 |

Conducted Emissions - SR2

| Instrument | Manufacturer | Type No. | Asset No. | Cali. Interval | Cali. Due Date |
|---|---|---|---|---|---|
| EMI Test Receiver | R&S | ESR3 | MRTSUE06185 | 1 year | 2019/04/20 |
| Two-Line V-Network | R&S | ENV216 | MRTSUE06002 | 1 year | 2019/06/15 |
| Two-Line V-Network | R&S | ENV216 | MRTSUE06003 | 1 year | 2019/06/15 |
| Thermohygrometer | Testo | 608-H1 | MRTSUE06404 | 1 year | 2019/08/14 |
| Shielding Anechoic Chamber | MIX-BEP | Chamber-SR2 | MRTSUE06214 | N/A | N/A |

| Software | Version | Function |
|---|---|---|
| e3 | v 8.3.5 | EMI Test Software |

# 6. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k = 2.

| Radiated Emission Measurement - AC1 |
|---|
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>9kHz ~ 1GHz: 4.18dB<br>1GHz ~ 18GHz: 4.76dB |
| AC Conducted Emission Measurement - SR2 |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>150kHz~30MHz: ± 3.46dB |

# 7. TEST RESULT

## 7.1. Summary

**Company Name:** **Beijing GODA Instruments Co., LTD.**

**FCC ID:** **2ACSOGDRD87**

| FCC Part Section(s) | Test Description | Test Limit | Test Condition | Test Result | Reference |
|---|---|---|---|---|---|
| 15.256(f) | Fundamental Bandwidth | Within the frequency band 75-85GHz | Radiated | Pass | Section 7.2 |
| 15.256(g) | Fundamental Emissions | Refer to Section 7.3 | | Pass | Section 7.3 |
| 15.256(h) | Unwanted Emissions | < FCC 15.209 limits | | Pass | Section 7.4 |
| 15.256(i)(B) 15.256(j) | Antenna Requirements | Refer to Section 7.5 | -- | Pass | Section 7.5 |
| 15.255(f)(2) 15.215(c) | Frequency stability | Within the frequency band 75-85GHz | Radiated | Pass | Section 7.6 |
| 15.207 | AC Conducted Emissions 150kHz - 30MHz | < FCC 15.207 limits | Line Conducted | N/A | Section 7.7 |

**Notes:**

1. The radiation measurements are performed in X, Y, Z axis positioning. Only the worst case data is shown in the report.
2. “N/A” means that the test item is not applicable, and the detailed information refers to relevant section.

## 7.2. Fundmental Bandwidth

### 7.2.1. Test Limit

The fundamental bandwidth of an LPR emission is defined as the width of the signal between two points, one below and one above the center frequency, outside of which all emissions are attenuated by at least 10 dB relative to the maximum transmitter output power when measured in an equivalent resolution bandwidth.

(1) The minimum fundamental emission bandwidth shall be 50 MHz for LPR operation under the provisions of this section.

(2) LPR devices operating under this section must confine their fundamental emission bandwidth within the 75-85 GHz bands under all conditions of operation.

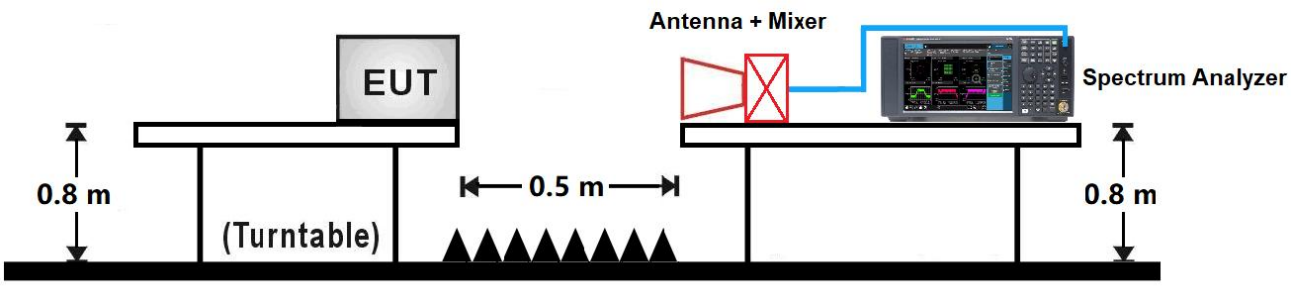
### 7.2.2. Test Procedure used

KDB890966 D01 Meas level Probing Radars v01r01 Section D.

### 7.2.3. Test Setting

1. Observe fundamental emission on the spectrum analyzer with a peak detector, 1 MHz RBW and at least 3 MHz VBW.
2. Activate any frequency sweep, step or hop function of the EUT and select “Max Hold” function on the spectrum analyzer.
3. Perform multiple sweeps until the amplitude stabilizes.
4. Determine the 10 dB emission bandwidth.

### 7.2.4. Test Setup

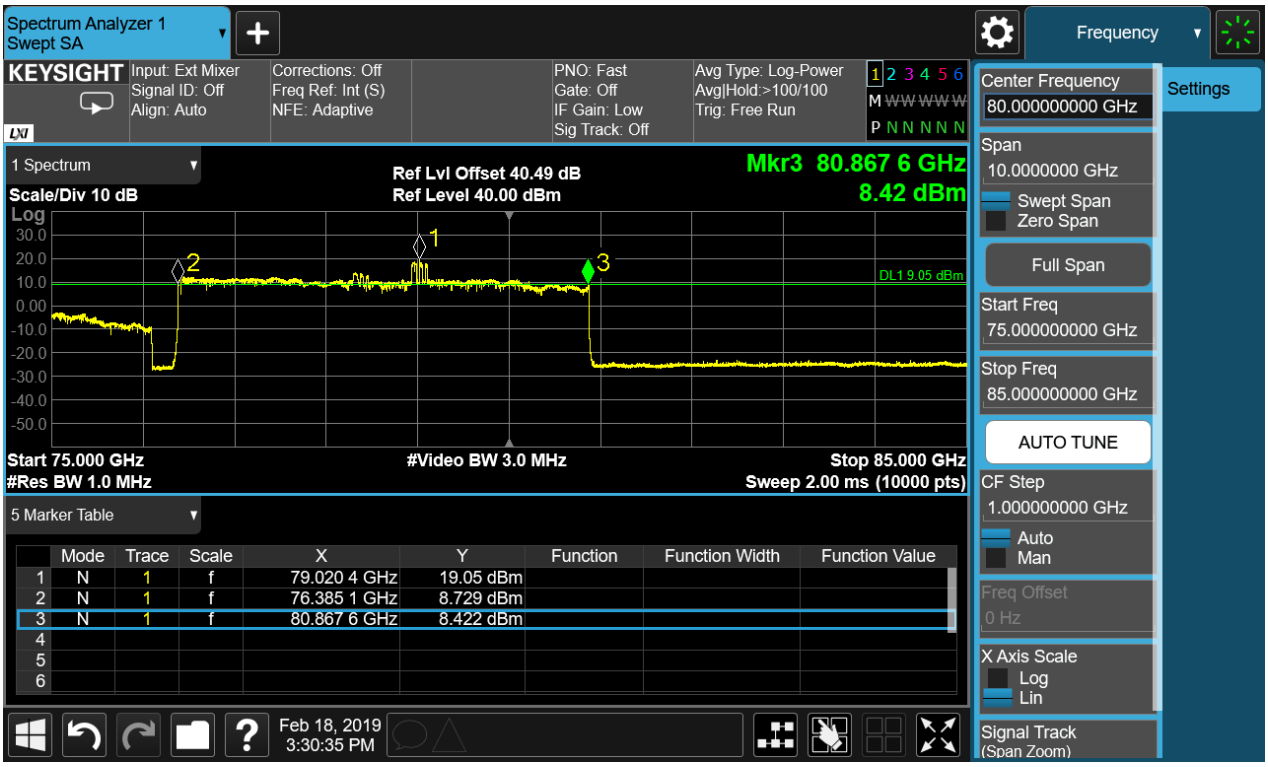


### 7.2.5. Test Result

| | | | |
|---|---|---|---|
| Product | 80G Radar Level Meter | Temperature | 24°C |
| Test Engineer | Vincent Yu | Relative Humidity | 54% |
| Test Site | AC1 | Test Date | 2019/02/18 |

| 10dB Bandwidth | | Limit |
|---|---|---|
| $F_L$ (GHz) | 76.3851 | > 75 GHz |
| $F_H$ (GHz) | 80.8676 | < 85 GHz |
| Bandwidth (GHz) | 4.4825 | > 50 MHz |
| Result | | Pass |

10dB Bandwidth



## 7.3. Fundamental Emissions

### 7.3.1.Test Limit

| LPR EIRP Emission Limits | | |
|---|---|---|
| Frequency band of operation | Average emission limit (EIRP in dBm measured in 1 MHz) | Peak emission limit (EIRP in dBm measured in 50 MHz) |
| 75 ~ 85GHz | -3 | 34 |
| Note: For a RBW less than 50 MHz, the peak EIRP limit (in dBm) is reduced by 20 log(RBW/50) dB where RBW is the resolution bandwidth in megahertz. For FMCW modulation the correction should not be applied since these signals are narrowband signals with full power within the resolution bandwidth of the SA. | | |

### 7.3.2.Test Procedure used

KDB890966 D01 Meas level Probing Radars v01r01 Section F.

TR14-1007 Measurement of FMCW

### 7.3.3.Test Setting

1. For radiated emission measurements, locate the receive test antenna at a far field distance boresighted on the LPR transmit antenna. Adjust the LPR and the test antenna for maximum main beam coupling.
2. Set the spectrum analyzer frequency span to enable viewing the entire sweep frequency span of the LPR signal.
3. Set the spectrum analyzer frequency span to enable viewing the entire sweep frequency span of the LPR signal.
4. Calculate the dwell time, $T_D$, of the sweep frequency signal per MHz of the sweep frequency span

   $$T_D = T_S/\Delta F$$

   Where:

   $T_S$ is the signal sweep frequency time in seconds

   $\Delta F$ is the signal sweep frequency span in MHz
5. Set the detector to peak mode.
6. Set the RBW to 1 MHz.
7. Perform sufficient multiple scans on the spectrum analyzer in maximum hold with a sweep time suitable for displaying the variation in the signal level over the frequency span.
8. Record the maximum signal level. This is the peak value of the LPR signal.

9. Calculate the average factor

$$\text{Average factor} = (T_D) / \text{cycle time}$$

Where:

Cycle time is the total time for a complete cycle of the signal including retrace and any other latency times.

10. Determine the average by multiplying the maximum signal level obtained in Step 8 by the average factor.

According to the manufacturer's declaration, the parameter of the FMCW modulation as below:

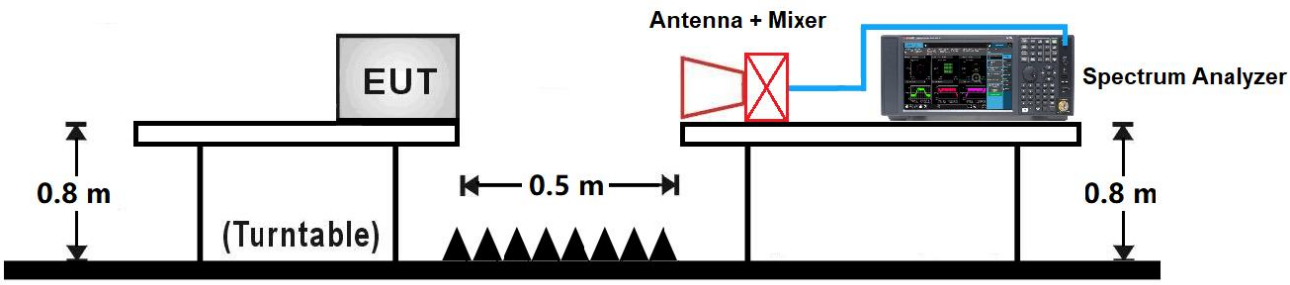
| Chirp Bandwidth (ΔF) | Frequency sweep time ($T_S$) | Cycle time |
|---|---|---|
| 4GHz | 165us | 185us |

Therefore:

$T_D = T_S/\Delta F = 0.04125$us/MHz

Average factor = 10*log[($T_D$) / cycle time] = 10*log(0.04125/185) = -36.52 (dB)

**7.3.4.Test Setup**



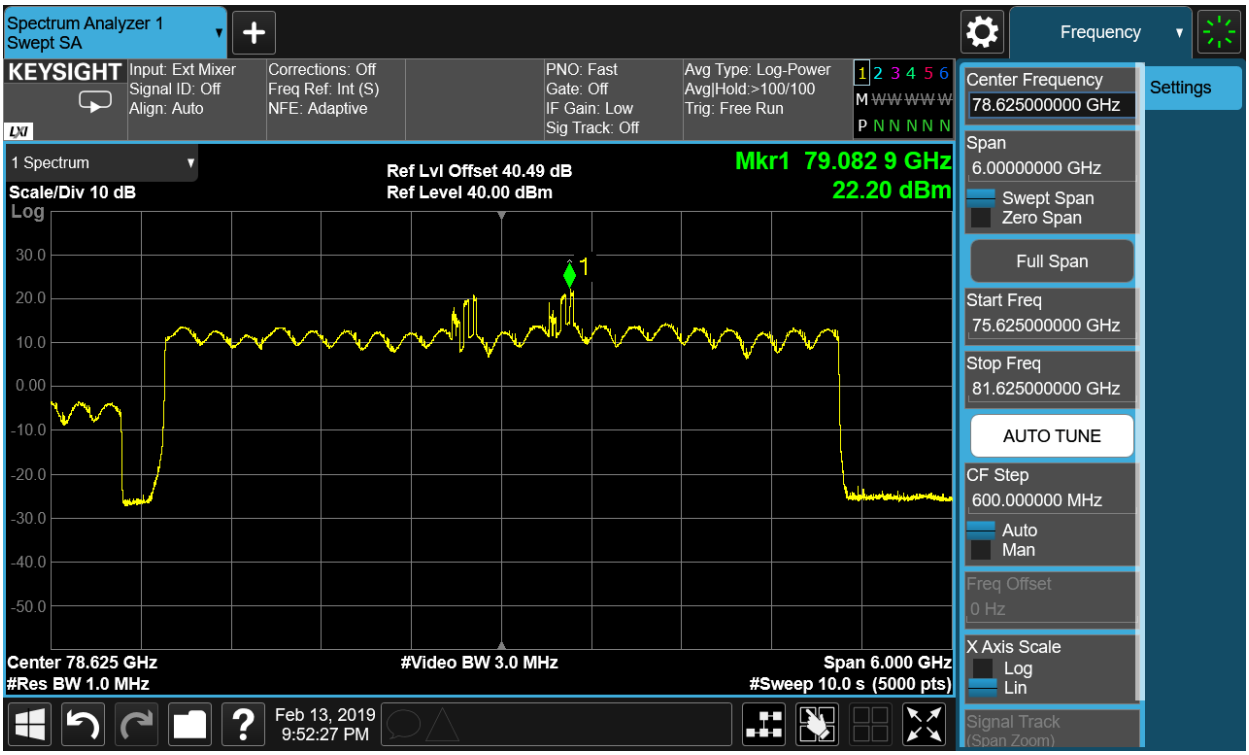
### 7.3.5.Test Results

| | | | |
|---|---|---|---|
| Product | 80G Radar Level Meter | Temperature | 23°C |
| Test Engineer | Vincent Yu | Relative Humidity | 54% |
| Test Site | AC1 | Test Date | 2019/02/13 |

| Frequency (GHz) | Average Factor (dB) | EIRP (dBm) | | Limit (dBm) | | Result |
|---|---|---|---|---|---|---|
| | | Peak | Average | Peak | Average | |
| 80 | -36.52 | 22.20 | -14.32 | 34 | -3 | Pass |

Note: Average EIRP (dBm) = Peak EIRP (dBm) + Average Factor (dB)

Peak EIRP



## 7.4. Unwanted Emissions

### 7.4.1.Test Limit

Unwanted emissions from LPR devices shall not exceed the general emission limit in §15.209.

| FCC Part 15.209 Limit | | |
|---|---|---|
| Frequency (MHz) | Field Strength (uV/m) | Measurement Distance (m) |
| 0.009 ~ 0.490 | 2400/F(kHz) | 300 |
| 0.490 ~ 1.705 | 24000/F(kHz) | 30 |
| 1.705 ~ 30.0 | 30 | 30 |
| 30 ~ 80 | 100** | 3 |
| 80 ~ 216 | 150** | 3 |
| 216 ~ 960 | 200** | 3 |
| Above 960 | 500 | 3 |

Note 1: The lower limit shall apply at the transition frequency.
Note 2: Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.
Note 3: E field strength (dBuV/m) = 20 log E field strength (uV/m).
Note 4: The provisions in §15.35(b) and (c) of this part that require emissions to be averaged over a 100 millisecond period and that limits the peak power to 20 dB above the average limit do not apply to devices operating under paragraphs (a) through (l) of §15.256.

### 7.4.2.Test Procedure used

KDB890966 D01 Meas level Probing Radars v01r01 Section D.

ANSI C63.10 Section 6.3 to 6.6

### 7.4.3.Test Procedure

**Measurement of harmonic and spurious emissions below 40 GHz**

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = as specified in Table 1
3. VBW ≥ 3 x RBW
4. Detector: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
5. Sweep time = auto couple
6. Trace mode = max hold, trace was allowed to stabilize

**Measurement of harmonic and spurious emissions above 40 GHz**

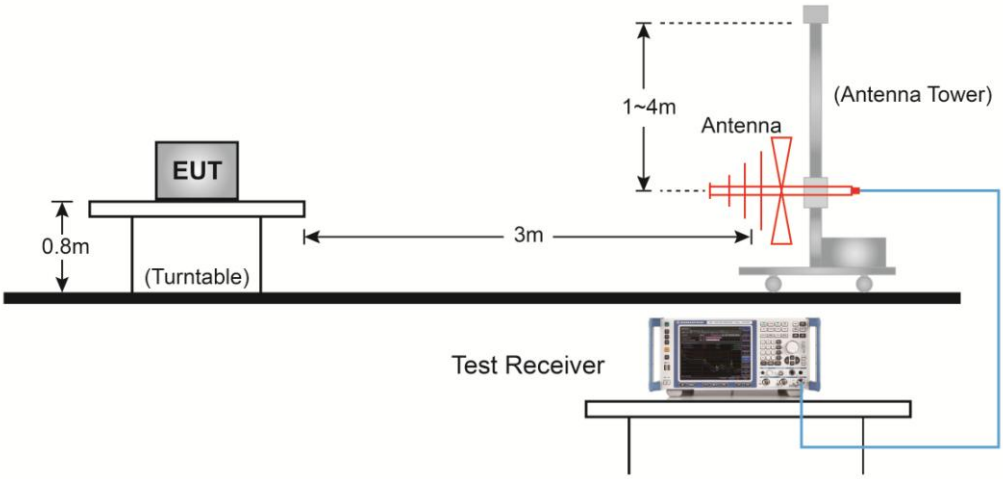
1. Connect the test antenna covering the appropriate frequency range to a spectrum analyzer via an external mixer.
2. Set spectrum analyzer RBW = 1MHz, VBW = 3MHz, average detector.
3. Maximize all observed emissions. Note the maximum power indicated on the spectrum analyzer. Adjust this reading, if necessary, by the conversion loss of the external mixer used at the frequency under investigation and the external mixer IF cable loss.
4. Calculate the maximum field strength of the emission at the measurement distance
5. Repeat the preceding sequence for every emission observed in the frequency band under investigation.

**Table 1 - RBW as a function of frequency**

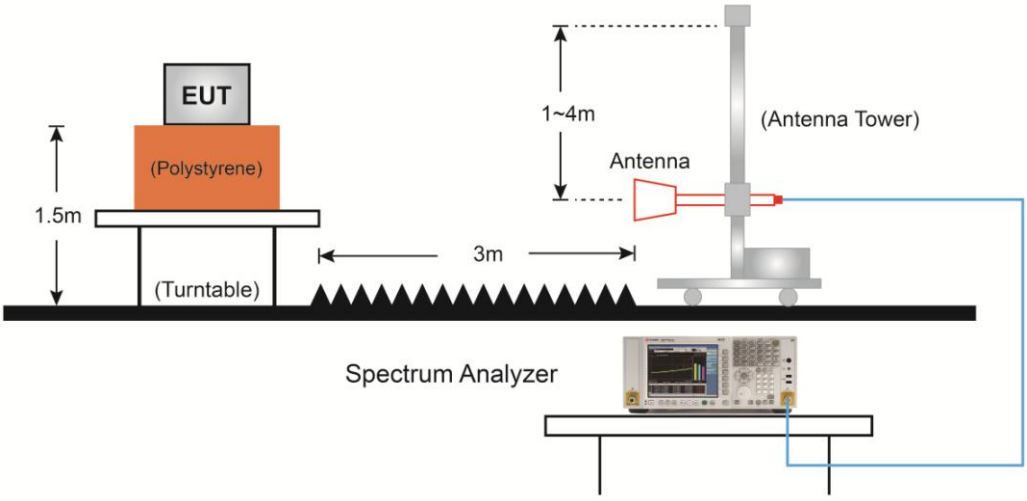
| Frequency | RBW |
|---|---|
| 9 ~ 150 kHz | 200 ~ 300 Hz |
| 0.15 ~ 30 MHz | 9 ~ 10 kHz |
| 30 ~ 1000 MHz | 100 ~ 120 kHz |
| > 1000 MHz | 1 MHz |

### 7.4.4.Test Setup

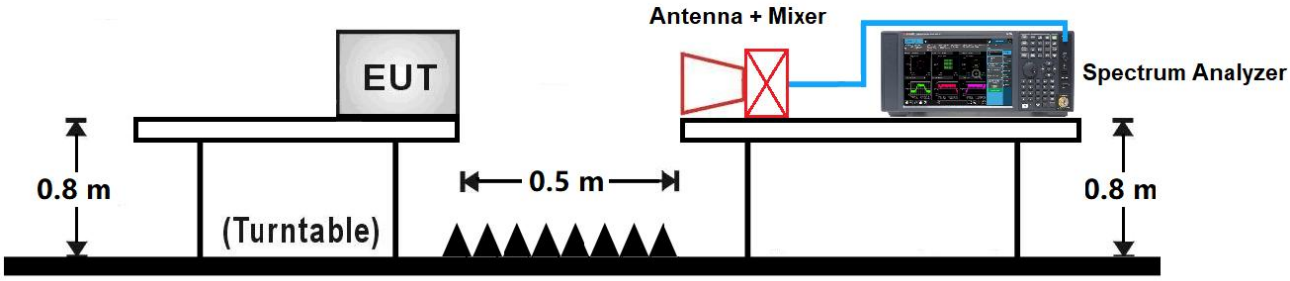
30MHz ~ 1GHz Test Setup:



1GHz ~ 40GHz Test Setup:




Above 40GHz Test Setup:



### 7.4.5.Test Result

| | | | |
|---|---|---|---|
| Product | 80G Radar Level Meter | Temperature | 23°C |
| Test Engineer | Vincent Yu | Relative Humidity | 54% |
| Test Site | AC1 | Test Date | 2019/01/29 |
| Test Range | Below 40GHz | | |

| Frequency (MHz) | Reading Level (dBμV) | Factor (dB) | Measure Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Detector | Polarization |
|---|---|---|---|---|---|---|---|
| 720.2 | 12.7 | 22.4 | 35.1 | 46.0 | -10.9 | QP | Horizontal |
| 760.4 | 19.0 | 22.9 | 41.9 | 46.0 | -4.1 | QP | Horizontal |
| 840.4 | 15.6 | 23.7 | 39.3 | 46.0 | -6.7 | QP | Horizontal |
| 920.5 | 13.4 | 24.7 | 38.1 | 46.0 | -7.9 | QP | Horizontal |
| 560.1 | 6.9 | 19.7 | 26.6 | 46.0 | -19.4 | QP | Vertical |
| 760.4 | 11.6 | 22.9 | 34.5 | 46.0 | -11.5 | QP | Vertical |
| 840.4 | 10.0 | 23.7 | 33.7 | 46.0 | -12.3 | QP | Vertical |
| 890.4 | 12.5 | 24.3 | 36.8 | 46.0 | -9.2 | QP | Vertical |
| 1119.0 | 36.8 | -5.4 | 31.4 | 54.0 | -22.6 | AV | Horizontal |
| 2215.5 | 30.7 | -0.6 | 30.1 | 54.0 | -23.9 | AV | Horizontal |
| 5207.5 | 26.8 | 6.4 | 33.2 | 54.0 | -20.8 | AV | Horizontal |
| 8012.5 | 26.2 | 13.7 | 39.9 | 54.0 | -14.1 | AV | Horizontal |
| 1365.5 | 40.7 | -3.9 | 36.8 | 54.0 | -17.2 | AV | Vertical |
| 2283.5 | 38.5 | -0.5 | 38.0 | 54.0 | -16.0 | AV | Vertical |
| 4706.0 | 34.8 | 5.5 | 40.3 | 54.0 | -13.7 | AV | Vertical |
| 8786.0 | 33.4 | 13.3 | 46.7 | 54.0 | -7.3 | AV | Vertical |
| 18055.0 | 25.9 | 8.4 | 34.3 | 54.0 | -19.7 | AV | Horizontal |
| 26668.0 | 23.9 | 12.3 | 36.2 | 54.0 | -17.8 | AV | Horizontal |
| 30573.0 | 25.8 | 12.1 | 37.9 | 54.0 | -16.1 | AV | Horizontal |
| 34456.0 | 24.2 | 14.6 | 38.8 | 54.0 | -15.2 | AV | Horizontal |
| 18077.0 | 24.9 | 8.5 | 33.4 | 54.0 | -20.6 | AV | Vertical |
| 19936.0 | 25.9 | 7.9 | 33.8 | 54.0 | -20.2 | AV | Vertical |
| 26690.0 | 23.1 | 11.7 | 34.8 | 54.0 | -19.2 | AV | Vertical |
| 34005.0 | 23.2 | 14.1 | 37.3 | 54.0 | -16.7 | AV | Vertical |

Note: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) - Pre_Amplifier Gain (dB)

| | | | |
|---|---|---|---|
| Product | 80G Radar Level Meter | Temperature | 23°C |
| Test Engineer | Vincent Yu | Relative Humidity | 54% |
| Test Site | AC1 | Test Date | 2019/03/01 |
| Test Range | Above 40GHz | | |

| Frequency (GHz) | Reading Level @ 0.5m (dBμV) | Factor (dB) | Measure Level @ 0.5m (dBμV/m) | Measure Level @ 3m (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Detector | Result |
|---|---|---|---|---|---|---|---|---|
| 40.2 | 9.5 | 44.6 | 54.1 | 38.5 | 54.0 | -15.5 | AV | Pass |
| 41.6 | 11.0 | 44.9 | 55.9 | 40.3 | 54.0 | -13.7 | AV | Pass |
| 45.7 | 12.1 | 45.2 | 57.3 | 41.7 | 54.0 | -12.3 | AV | Pass |
| 49.1 | 14.0 | 45.8 | 59.8 | 44.2 | 54.0 | -9.8 | AV | Pass |
| 50.4 | 24.0 | 41.1 | 65.1 | 49.5 | 54.0 | -4.5 | AV | Pass |
| 134.5 | 4.9 | 57.4 | 62.3 | 46.7 | 54.0 | -7.3 | AV | Pass |
| 164.9 | 4.3 | 60.0 | 64.3 | 48.7 | 54.0 | -5.3 | AV | Pass |
| 194.3 | 3.9 | 61.4 | 65.3 | 49.7 | 54.0 | -4.3 | AV | Pass |

Note:

1. Measure Level @ 0.5m = Reading Level @0.5m + Factor

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) + Mixer Conversion Loss (dB)

2. Measure Level @ 3m = Measure Level @ 0.5m + 20 * log(0.5m / 3m)

## 7.5. Antenna Requirements

### 7.5.1. Test Limit

1. Antenna beamwidth: LPR devices operating under the provisions of this section within the 75-85 GHz band must use an antenna with a -3 dB beamwidth no greater than 8 degrees.
2. Antenna side lobe gain: LPR devices operating under the provisions of this section must limit the side lobe antenna gain relative to the main beam gain for off-axis angles from the main beam of greater than 60 degrees to the levels provided in below table.

| Antenna Side Lobe Gain Limit | |
|---|---|
| Frequency range (GHz) | Antenna sidelobe gain limit relative to main beam gain (dB) |
| 75 ~ 85 | -38 |

### 7.5.2. Test Procedure used

The antenna parameters of the LPR are declared by the manufacturer. No test needs to be conducted.

### 7.5.3. Test Setting

N/A

### 7.5.4. Test Setup

N/A

### 7.5.5. Test Result

According to the declaration of manufacturer, the parameter of the antennas is shown as below table:

| Model No. | Max. Side lobe gain (dB) | Max. Beamwidth (°) | Antenna Side Lobe Gain Limit (dB) | Max. Beamwidth Limit (°) |
|---|---|---|---|---|
| GDRD81 | -45.2 | 6 | -38 | 8 |
| GDRD82 | -45.8 | 6 | -38 | 8 |
| GDRD83 | -39.1 | 8 | -38 | 8 |
| GDRD84 | -53.1 | 3 | -38 | 8 |
| GDRD85 | -45.6 | 6 | -38 | 8 |
| GDRD87 | -55.2 | 3 | -38 | 8 |
| GDRD88 | -46.1 | 6 | -38 | 8 |
| GDRD89 | -52.9 | 3 | -38 | 8 |

Therefore, it complies with the antenna requirement.

## 7.6. Frequency Stability

### 7.6.1.Test Limit

1. As specified in Section 15.256(f)(2), LPR devices operating under this section must confine their fundamental emission bandwidth within the 75-85 GHz bands under all conditions of operation.
2. As specified in Section 15.215(c), the bandwidth of the fundamental emission must be contained within the frequency band over the temperature range -20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage. Frequency stability is to be measured according to Section 2.1055 at the highest and lowest frequency of operation and with the modulation that produces the widest emission bandwidth.

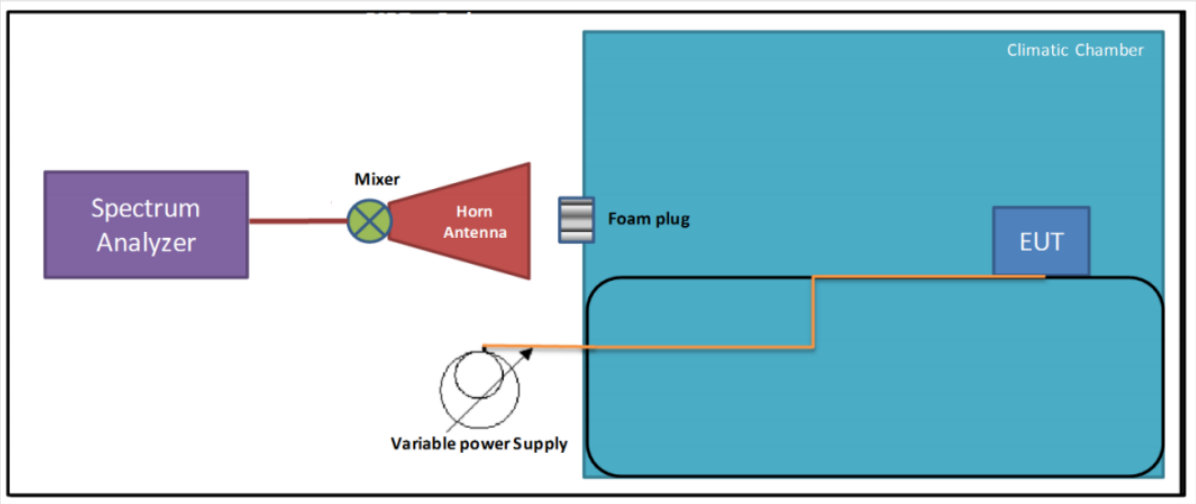
### 7.6.2.Test Procedure used

ANSI C63.10 Section 6.8

### 7.6.3.Test Procedure

1. Arrange EUT and test equipment according Section 7.6.4.
2. With the EUT at ambient temperature (20 °C) and voltage source set to the EUT nominal operating voltage (24VDC, 100%)
3. RBW = 1MHz, VBW = 3MHz
4. Detector = Peak
5. Trace Mode = Max Hold
6. Record the Low and high frequencies ($f_L$ and $f_H$) of the fundamental frequency emission which is defined as the width of the signal between two points, one below and one above the center frequency, outside of which all emissions are attenuated by at least 10 dB relative to the maximum transmitter output power.
7. Vary EUT power supply between 85% and 115% of nominal, and record the frequency excursion of the EUT emission mask.
8. Set the power supply to 100% nominal setting, and raise EUT operating temperature to 50 °C.
9. Record the $f_L$ and $f_H$ of the fundamental frequency emission.
10. Repeat step 9 at each 10°C increment down to -20 °C.

### 7.6.4.Test Setup



### 7.6.5.Test Result

| | | | |
|---|---|---|---|
| Test Engineer | Vincent Yu | Temperature | -20 ~ 50°C |
| Test Time | 2019/02/18 ~ 2019/02/20 | Relative Humidity | 52%RH |
| Test Mode | Mode 1 | Test Site | TR3 |

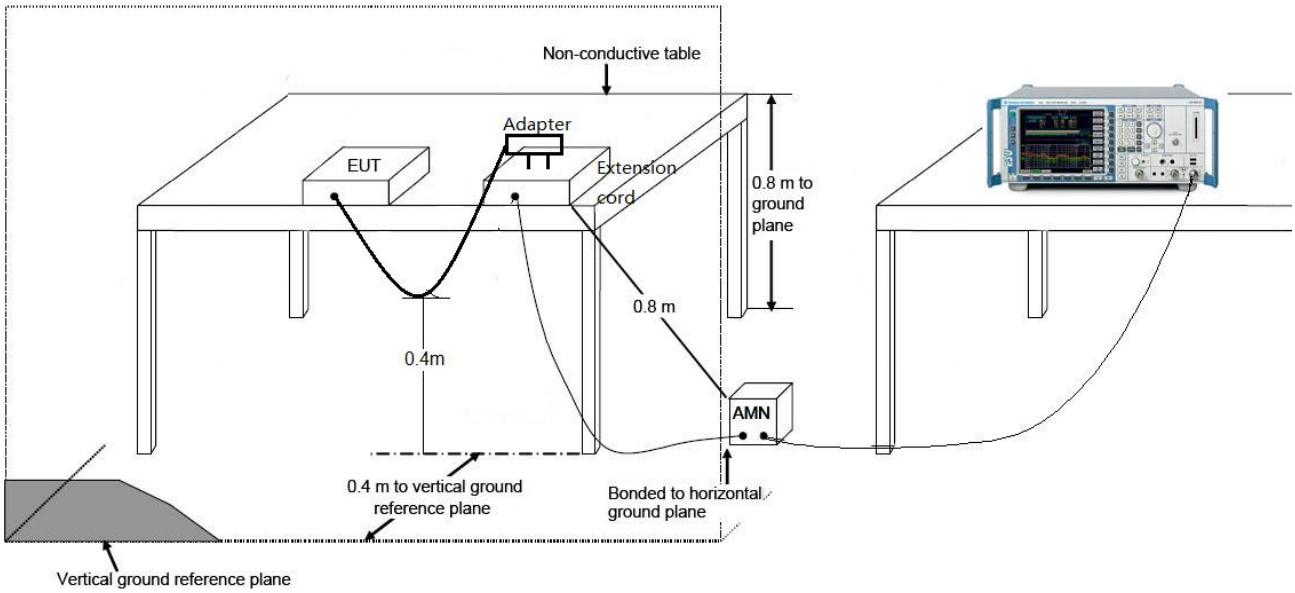
| Voltage (%) | Power (VDC) | Temp (℃) | $f_L$ (GHz) | $f_H$ (GHz) | Limit (GHz) | Result |
|---|---|---|---|---|---|---|
| 100% | 24.0 | - 20 | 76.3842 | 80.8683 | 75 ~ 85 | Pass |
| | | - 10 | 76.3844 | 80.8681 | 75 ~ 85 | Pass |
| | | 0 | 76.3845 | 80.8682 | 75 ~ 85 | Pass |
| | | + 10 | 76.3847 | 80.8679 | 75 ~ 85 | Pass |
| | | + 20 (Ref) | 76.3851 | 80.8676 | 75 ~ 85 | Pass |
| | | + 30 | 76.3851 | 80.8673 | 75 ~ 85 | Pass |
| | | + 40 | 76.3852 | 80.8675 | 75 ~ 85 | Pass |
| | | + 50 | 76.3855 | 80.8676 | 75 ~ 85 | Pass |
| 115% | 27.6 | + 20 | 76.3852 | 80.8677 | 75 ~ 85 | Pass |
| 85% | 20.4 | + 20 | 76.3851 | 80.8678 | 75 ~ 85 | Pass |

## 7.7. AC Conducted Emissions Measurement

### 7.7.1.Test Limit

| FCC 15.207 Limits | | |
|---|---|---|
| Frequency (MHz) | QP (dBuV) | AV (dBuV) |
| 0.15 ~ 0.50 | 66 ~ 56 | 56 ~ 46 |
| 0.50 ~ 5.0 | 56 | 46 |
| 5.0 ~ 30 | 60 | 50 |
| Note 1: The lower limit shall apply at the transition frequencies.<br>Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz. | | |

### 7.7.2.Test Setup




### 7.7.3.Test Result

The EUT is powered by DC source, so this requirement doesn't apply.

# 8. CONCLUSION

The data collected relate only the item(s) tested and show that the **80G Radar Level Meter** is in compliance with Part 15C of the FCC Rules.

The End

# Appendix A - Test Setup Photograph

Refer to “1901RSU029-UT” file.

# Appendix B - EUT Photograph

Refer to “1901RSU029-UE” file.