# FCC 47 CFR PART 15 SUBPART C

## TEST REPORT

## For

## BiopticRR20 RFID module

## Model No.:
## STMB003-B, STMB003-BXXXXXXXXXXXXXXXXXXXX (Which "X" can be any character)

## Trade Name: BiOptic inc.

*Issued to*

**BiOptic Inc.**
**(23141) 4F., No.108-3, Minquan Rd., Xindian District., New Taipei City, Taiwan (R.O.C.)**

*Issued by*

**Compliance Certification Services Inc.**
**Wugu Laboratory**
**No.11, Wugong 6th Rd., Wugu Dist.,**
**New Taipei City 24891, Taiwan. (R.O.C.)**
**Issued Date: October 29, 2019**

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.
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# Revision History

| Rev. | | Issue Date | | Revisions | Effect Page | Revised By |
|---|---|---|---|---|---|---|
| 00 | | October 16, 2019 | | Initial Issue | ALL | May Lin |
| 01 | | October 29, 2019 | | See the following Note Rev. (01) | P.9, P.14, P.19-22 | May Lin |
| 02 | | November 01, 2019 | | See the following Note Rev. (02) | P.28 | May Lin |

*Rev (01):*
1. *Added the test summary.*
2. *Revised the section 8.1 and Remark.*

*Rev (02):*
1. *Revised the test data.*

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# 1. TEST RESULT CERTIFICATION

**Applicant:** BiOptic Inc.
(23141) 4F., No.108-3, Minquan Rd., Xindian District., New Taipei City, Taiwan (R.O.C.)

**Manufacturer**: BiOptic Inc.
(23141) 4F., No.108-3, Minquan Rd., Xindian District., New Taipei City, Taiwan (R.O.C.)

**Equipment Under Test:** BiopticRR20 RFID module

**Trade Name:** BiOptic inc.

**Model No.:** STMB003-B, STMB003-BXXXXXXXXXXXXXXXXXXXX
(Which "X" can be any character)

**Date of Test:** September 06 ~ 09, 2019

| APPLICABLE STANDARDS | |
|---|---|
| **STANDARD** | **TEST RESULT** |
| FCC 47 CFR Part 15 Subpart C | No non-compliance noted |

| Statements of Conformity |
|---|
| Determination of compliance is based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty. |

## We hereby certify that:

The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10: 2013 and the energy emitted by the sample tested as described in this report is in compliance with the requirements of FCC Rules Part 15.225.

The test results of this report relate only to the tested sample identified in this report.

*Approved by:*

Kevin Tsai
Deputy Manager
Compliance Certification Services Inc.

*Tested by:*

Dally Hong
Engineer
Compliance Certification Services Inc.

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# 2. EUT DESCRIPTION

| | |
|---|---|
| **Product** | BiopticRR20 RFID module |
| **Model No.** | STMB003-B, STMB003-BXXXXXXXXXXXXXXXXXXXX (Which "X" can be any character) |
| **Model Discrepancy** | All the above models are identical except for the designation of model numbers. The suffix of (Which "X" can be any character) on model number is just for marketing purpose only. |
| **Trade** | BiOptic inc. |
| **Received Date** | August 28, 2019 |
| **Power Supply** | Powered from host device |
| **Frequency Range** | 13.56MHz |
| **Modulation Technique** | ASK |
| **Number of Channels** | 1 Channel |

***Remark:***

1. *The sample selected for test was engineering sample that approximated to production product and was provided by manufacturer.*

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# 3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10: 2013 and FCC CFR 47 Part 15.207, 15.209, 15.225.

## 3.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

## 3.2 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090 - 0.110 | 16.42 - 16.423 | 399.9 - 410 | 4.5 - 5.15 |
| [1]0.495 - 0.505 | 16.69475 - 16.69525 | 608 - 614 | 5.35 - 5.46 |
| 2.1735 - 2.1905 | 16.80425 - 16.80475 | 960 - 1240 | 7.25 - 7.75 |
| 4.125 - 4.128 | 25.5 - 25.67 | 1300 - 1427 | 8.025 - 8.5 |
| 4.17725 - 4.17775 | 37.5 - 38.25 | 1435 - 1626.5 | 9.0 - 9.2 |
| 4.20725 - 4.20775 | 73 - 74.6 | 1645.5 - 1646.5 | 9.3 - 9.5 |
| 6.215 - 6.218 | 74.8 - 75.2 | 1660 - 1710 | 10.6 - 12.7 |
| 6.26775 - 6.26825 | 108 - 121.94 | 1718.8 - 1722.2 | 13.25 - 13.4 |
| 6.31175 - 6.31225 | 123 - 138 | 2200 - 2300 | 14.47 - 14.5 |
| 8.291 - 8.294 | 149.9 - 150.05 | 2310 - 2390 | 15.35 - 16.2 |
| 8.362 - 8.366 | 156.52475 - | 2483.5 - 2500 | 17.7 - 21.4 |
| 8.37625 - 8.38675 | 156.52525 | 2655 - 2900 | 22.01 - 23.12 |
| 8.41425 - 8.41475 | 156.7 - 156.9 | 3260 - 3267 | 23.6 - 24.0 |
| 12.29 - 12.293 | 162.0125 - 167.17 | 3332 - 3339 | 31.2 - 31.8 |
| 12.51975 - 12.52025 | 167.72 - 173.2 | 3345.8 - 3358 | 36.43 - 36.5 |
| 12.57675 - 12.57725 | 240 - 285 | 3600 - 4400 | ([2]) |
| 13.36 - 13.41 | 322 - 335.4 | | |

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

[2] Above 38.6

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(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

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## 3.3 DESCRIPTION OF TEST MODES

The EUT had been tested under engineering test mode condition and the EUT staying in continuous transmitting mode.

All modes and data rates were investigated and it was determined that ISO 14443A/B and ISO 18092 Type y, 106/212/424/848 kbps.

All data rates were investigated and it was determined that 106 Kbps was considered worst-case. Therefore, all testing was performed in 106 Kbps mode.

### 3.3.1 The worst mode of measurement

| Radiated Emission Measurement | |
|---|---|
| **Test Condition** | **Band edge, Emission for Unwanted and Fundamental** |
| **Power supply Mode** | **Mode 1: EUT power by NB USB (DC 5V)** |
| **Worst Mode** | ☒ **Mode 1** ☐ **Mode 2** ☐ **Mode 3** ☐ **Mode 4** |
| **Position** | ☐ **P**laced in fixed position.<br>☐ **P**laced in fixed position at X-Plane (E2-Plane)<br>☐ **P**laced in fixed position at Y-Plane (E1-Plane)<br>☒ **P**laced in fixed position at Z-Plane (H-Plane) |

| Radiated Emission Measurement Below 1G | |
|---|---|
| **Test Condition** | **Radiated Emission Below 1G** |
| **Power supply Mode** | **Mode 1: EUT power by NB USB (DC 5V)** |
| **Worst Mode** | ☒ **Mode 1** ☐ **Mode 2** ☐ **Mode 3** ☐ **Mode 4** |

*Remark:*
*1. The worst mode was record in this test report.*
*2. EUT pre-scanned in three axis, X, Y, Z and two polarity. The worst case(Z-Plane) were recorded in this report*

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# 4. TEST SUMMARY

| FCC Standard Sec. | Chapter | Test Item | Result |
|---|---|---|---|
| 15.203 | 2 | Antenna Requirement | Pass |
| 15.215 | 8.1 | Occupied Bandwidth (99%) and 20dB Bandwidth | Pass |
| 15.209 | 8.2 | Radiated Emissions | Pass |
| 15.225 | 8.3 | Frequency Stability | Pass |
| 15.207 | 8.4 | AC Power-line Conducted Emission | N/A |

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# 5. INSTRUMENT CALIBRATION

## 5.1 MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

## 5.2 MEASUREMENT EQUIPMENT USED

**Equipment Used for Emissions Measurement**

| Conducted Emissions Test Site | | | | | |
|---|---|---|---|---|---|
| **Name of Equipment** | **Manufacturer** | **Model** | **S/N** | **Calibration Date** | **Calibration Due** |
| Signal Analyzer | R&S | FSV 40 | 101073 | 09/27/2018 | 09/26/2019 |
| Thermostatic/ Humidity Chamber | TAICHY | MHG-150LF | 930619 | 10/08/2018 | 10/07/2019 |
| Software | N/A | | | | |

| Wugu 966 Chamber A | | | | | |
|---|---|---|---|---|---|
| **Name of Equipment** | **Manufacturer** | **Model** | **S/N** | **Calibration Date** | **Calibration Due** |
| Bilog Antenna | Sunol Sciences | JB3 | A030105 | 07/26/2019 | 07/25/2020 |
| Cable | HUBER SUHNER | SUCOFLEX 104PEA | 20995 | 02/26/2019 | 02/25/2020 |
| Digital Thermo-Hygro Meter | WISEWIND | 1206 | D07 | 01/30/2019 | 01/29/2020 |
| Loop Ant | COM-POWER | AL-130 | 121051 | 03/22/2019 | 03/21/2020 |
| Pre-Amplifier | EMEC | EM330 | 060609 | 02/26/2019 | 02/25/2020 |
| PSA Series Spectrum Analyzer | Agilent | E4446A | MY46180323 | 05/29/2019 | 05/28/2020 |
| Antenna Tower | CCS | CC-A-1F | N/A | N.C.R | N.C.R |
| Controller | CCS | CC-C-1F | N/A | N.C.R | N.C.R |
| Turn Table | CCS | CC-T-1F | N/A | N.C.R | N.C.R |
| Software | EZ-EMC (CCS-3A1RE) | | | | |

| AC Conducted Emissions Test Site | | | | | |
|---|---|---|---|---|---|
| **Name of Equipment** | **Manufacturer** | **Model** | **S/N** | **Calibration Date** | **Calibration Due** |
| N/A | | | | | |

***Remark:***

*1. Each piece of equipment is scheduled for calibration once a year and Precision Dipole is scheduled for calibration once three years.*

*2. N.C.R. = No Calibration Request.*

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## 5.3 MEASUREMENT UNCERTAINTY

| PARAMETER | UNCERTAINTY |
|---|---|
| AC Powerline Conducted Emission | +/- 1.2575 |
| Emission bandwidth, 20dB bandwidth | +/- 0.0014 |
| RF output power, conducted | +/- 1.14 |
| Power density, conducted | +/- 1.40 |
| 3M Semi Anechoic Chamber / 30M~200M | +/- 4.12 |
| 3M Semi Anechoic Chamber / 200M~1000M | +/- 4.68 |
| 3M Semi Anechoic Chamber / 1G~8G | +/- 5.18 |
| 3M Semi Anechoic Chamber / 8G~18G | +/- 5.47 |
| 3M Semi Anechoic Chamber / 18G~26G | +/- 3.81 |
| 3M Semi Anechoic Chamber / 26G~40G | +/- 3.87 |

***Remark**: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.*

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# 6. FACILITIES AND ACCREDITATIONS

## 6.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

☐ No.199, Chunghsen Road, Hsintien City, Taipei Hsien, Taiwan, R.O.C.
Tel: 886-2-2217-0894 / Fax: 886-2-2217-1029

☒ No.11, Wugong 6th Rd., Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.)
Tel: 886-2-2299-9720 / Fax: 886-2-2298-4045

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.10: 2013 and CISPR Publication 22.

## 6.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, bucolical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

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# 7. SETUP OF EQUIPMENT UNDER TEST

## 7.1 SETUP CONFIGURATION OF EUT

See test photographs attached in Appendix I for the actual connections between EUT and support equipment.

## 7.2 SUPPORT EQUIPMENT

| No. | Device Type | Brand | Model | Series No. | FCC ID | Data Cable | Power Cord |
|---|---|---|---|---|---|---|---|
| 1. | NB(J) | TOSHIBA | PT345T-00L002 | N/A | PD97260H | N/A | N/A |

***Remark:***

1. *All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.*
2. *Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.*

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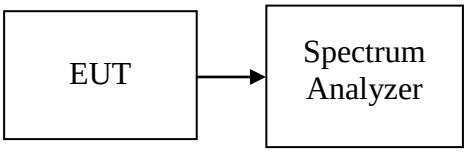
# 8. FCC PART 15.225 REQUIREMENTS

## 8.1 OCCUPIED BANDWIDTH (99%) AND 20 dB BANDWIDTH

### TEST LIMIT

According to §15.215(c),

### TEST CONFIGURATION




### TEST PROCEDURE

Test method Refer as ANSI C63.10-2013, 6.9.2 and ANSI C63.10-2013, 6.9.3,

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. SA set RBW =1kHz, VBW = 3kHz and Detector = Peak, to measurement 20dB Bandwidth.
4. SA set RBW = 1% ~ 5% OBW, VBW = three times the RBW and Detector = Peak, to measurement 99% Bandwidth.
5. Record the max. reading.

### TEST RESULTS

*No non-compliance noted*

| Test Condition | Frequency (MHz) | Occupied Bandwidth 99% (kHz) | 20 dB Bandwidth (kHz) |
|---|---|---|---|
| NFC | 13.56 | 2.1128 | 2.489 |

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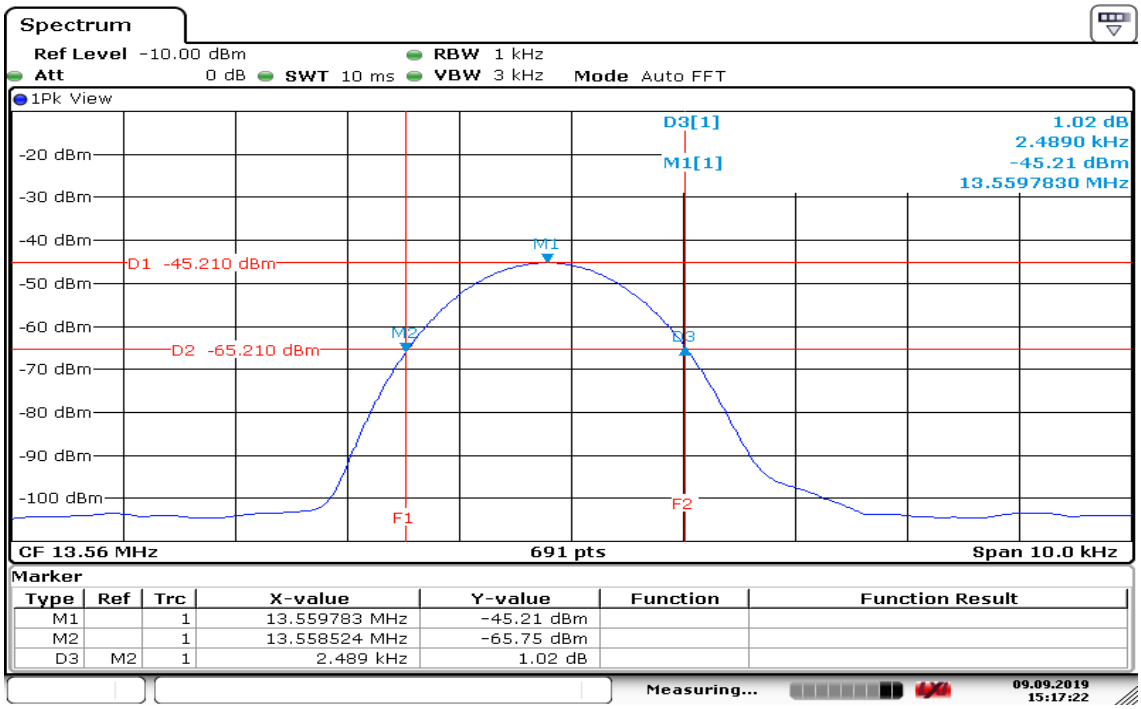
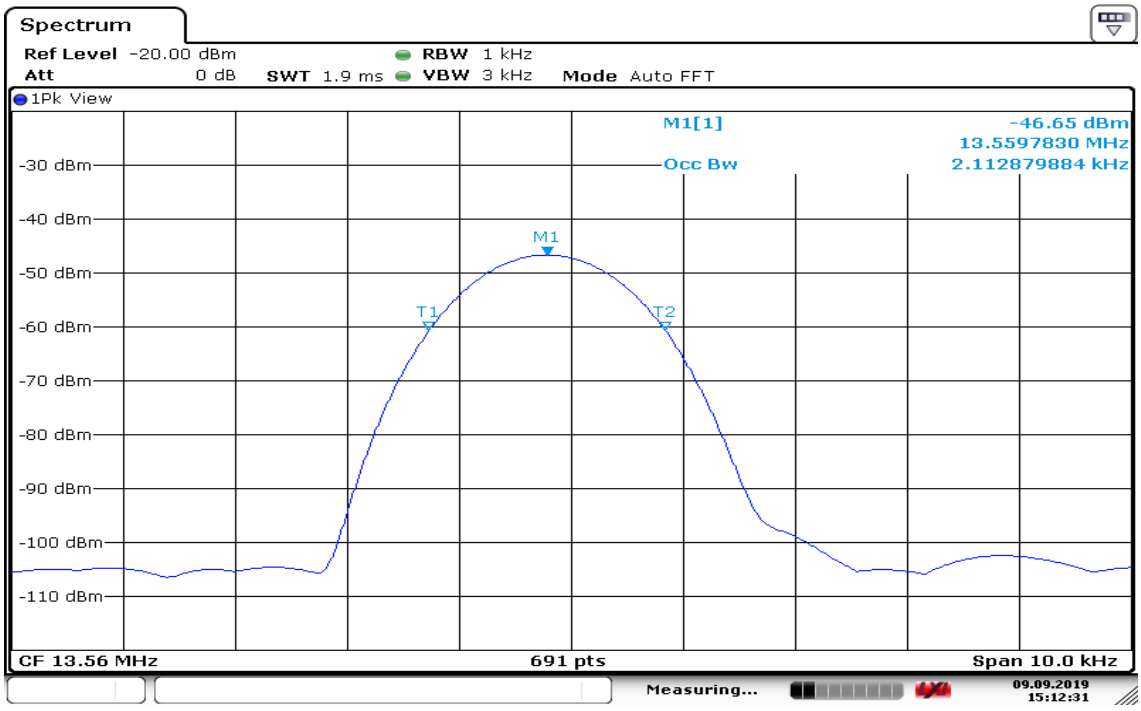
## Test Plot

### 20 dB BANDWIDTH




Date: 9.SEP.2019 15:17:23

### BANDWIDTH (99%)




Date: 9.SEP.2019 15:12:31

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## 8.2 RADIATED EMISSIONS

### LIMIT

According to §15.225

(a) The field strength of any emissions within the band 13.553 – 13.567 MHz shall not exceed 15,848 microvolts / meter at 30 meters.

(b) Within the bands 13.410 – 13.553 MHz and 13.567 -13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts / meter at 30 meters.

(c) Within the bands 13.110 – 13.410 MHz and 13.710 – 14.010 MHz the field strength of any emissions shall not exceed 106 microvolts / meter at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110 – 14.010 MHz and shall not exceed the general radiated emission limits in §15.209.

According to §15.225, except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field Strength (μV/m at meter) | Measurement Distance (meter) |
|---|---|---|
| 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 |

*** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.*

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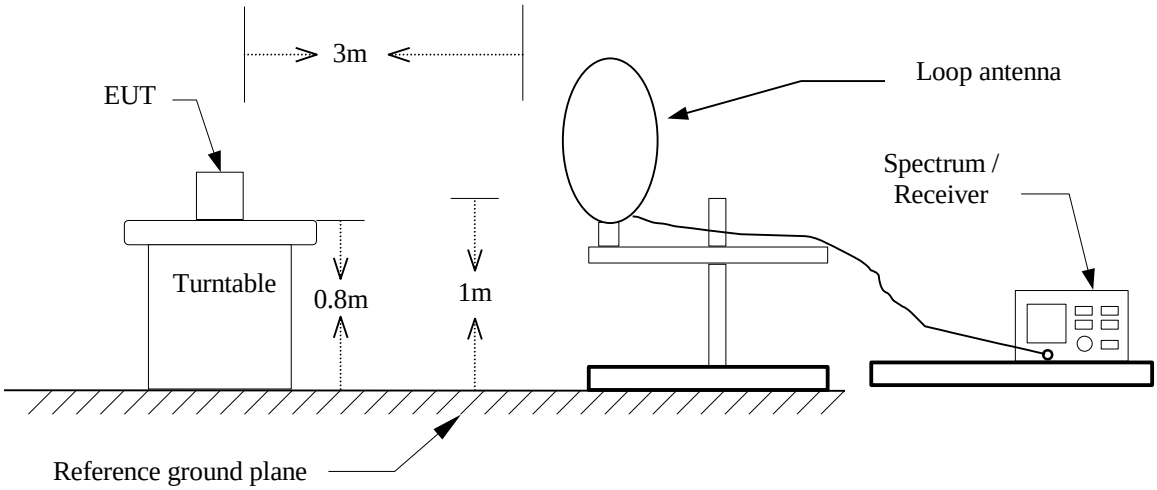
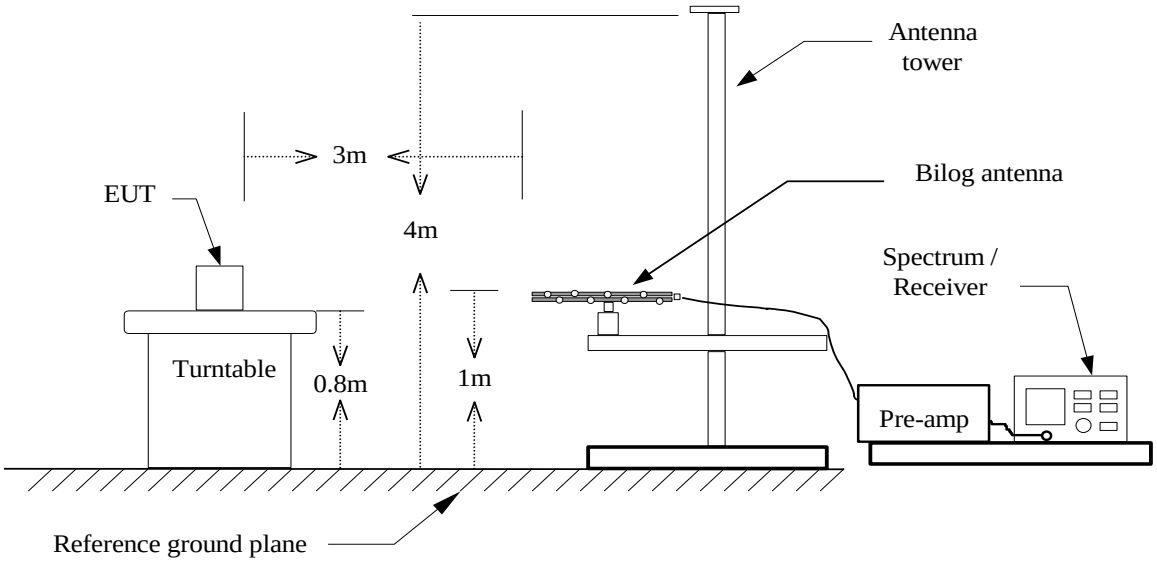
## Test Configuration

### 9kHz ~ 30MHz




### 30MHz ~ 1GHz

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## TEST PROCEDURE

**For 9kHz ~ 30MHz**

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, The center of the loop shall be 1 m above the ground then to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. Set the spectrum analyzer in the following setting as:
   9KHz-490KHz : RBW=200Hz / VBW=1kHz / Sweep=AUTO
   490KHz-30MHz : RBW=10kHz / VBW=30kHz / Sweep=AUTO
6. Repeat above procedures until the measurements for all frequencies are complete.

**For 30MHz ~ 1GHz**

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving
   antenna both horizontal and vertical.
6. Set the spectrum analyzer in the following setting as:
   RBW=100kHz / VBW=300kHz / Sweep=AUTO
7. Repeat above procedures until the measurements for all frequencies are complete.

*Remark :*
*Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open are test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.*

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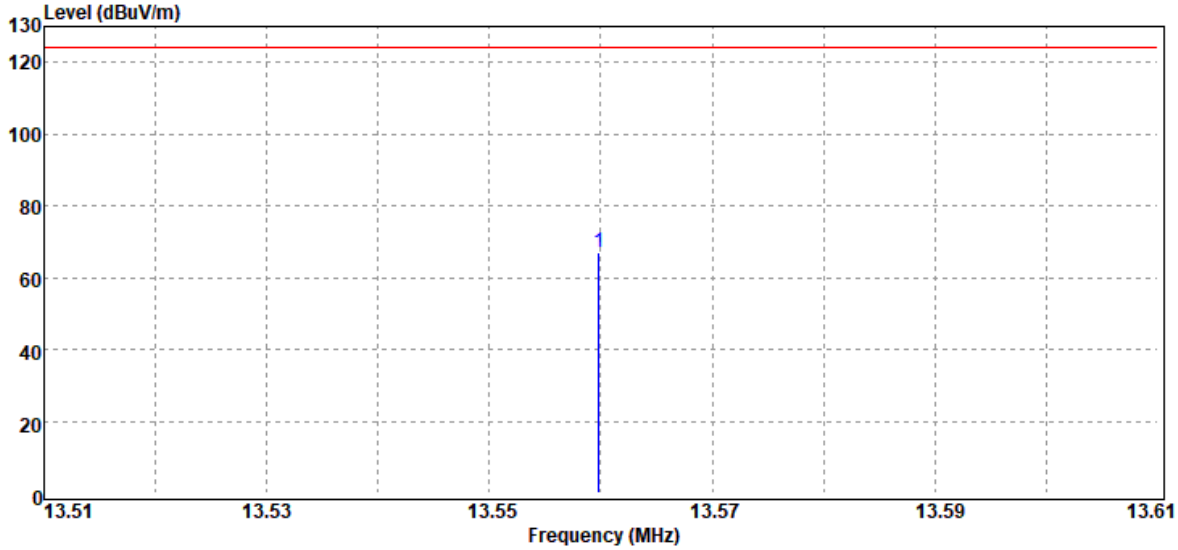
| | | | |
|---|---|---|---|
| **Operation Mode:** | TX mode | **Test Date:** | September 06, 2019 |
| **Temperature:** | 29.3°C | **Tested by:** | Jerry Lu |
| **Humidity:** | 49 % RH | **Polarity:** | Ver. |




| No. | Frequency | Reading | Correct | Result | Limit | Margin | Remark |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB) | |
| 1 | 13.56 | 51.03 | 15.91 | 66.94 | 124.00 | -57.06 | Peak |

***Remark:***

1. *Radiated emissions measured were made with an instrument using peak detector mode.*
2. *Margin (dB) = Result (dBuV/m) – Limit (dBuV/m).*

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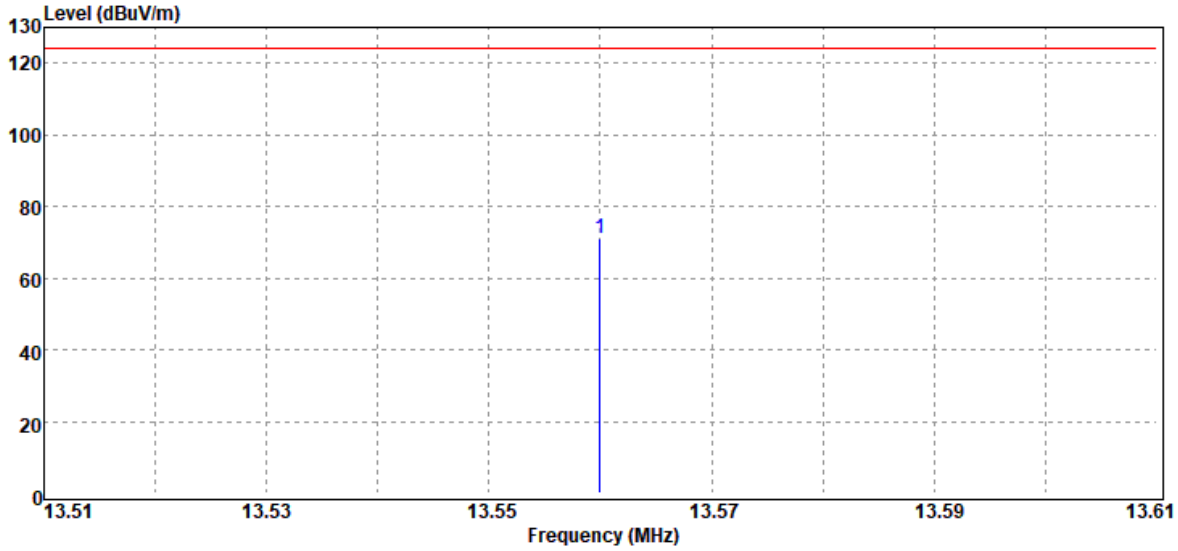
| | | | |
|---|---|---|---|
| **Operation Mode:** | TX mode | **Test Date:** | September 06, 2019 |
| **Temperature:** | 29.3°C | **Tested by:** | Jerry Lu |
| **Humidity:** | 49 % RH | **Polarity:** | Hor. |




| No. | Frequency | Reading | Correct | Result | Limit | Margin | Remark |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB) | |
| 1 | 13.56 | 55.31 | 15.91 | 71.22 | 124.00 | -52.78 | Peak |

***Remark:***

1. *Radiated emissions measured were made with an instrument using peak detector mode.*
2. *Margin (dB) = Result (dBuV/m) – Limit (dBuV/m).*

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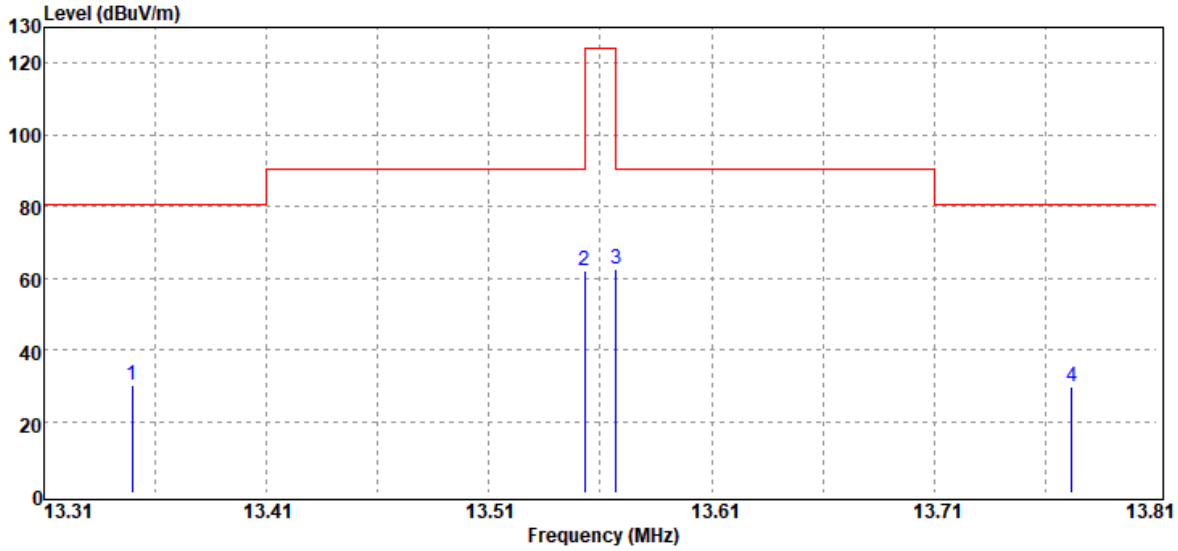
| | | | |
|---|---|---|---|
| **Operation Mode:** | TX mode | **Test Date:** | September 06, 2019 |
| **Temperature:** | 29.3°C | **Tested by:** | Jerry Lu |
| **Humidity:** | 49 % RH | **Polarity:** | Ver. |




| No. | Frequency | Reading | Correct | Result | Limit | Margin | Remark |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB) | |
| 1 | 13.35 | 14.27 | 15.92 | 30.19 | 80.50 | -50.31 | Peak |
| 2 | 13.55 | 46.36 | 15.91 | 62.27 | 90.47 | -28.20 | Peak |
| 3 | 13.57 | 46.42 | 15.91 | 62.33 | 90.47 | -28.14 | Peak |
| 4 | 13.77 | 13.85 | 15.90 | 29.75 | 80.50 | -50.75 | Peak |

***Remark:***

1. *Radiated emissions measured were made with an instrument using peak detector mode.*
2. *Margin (dB) = Result (dBuV/m) – Limit (dBuV/m).*

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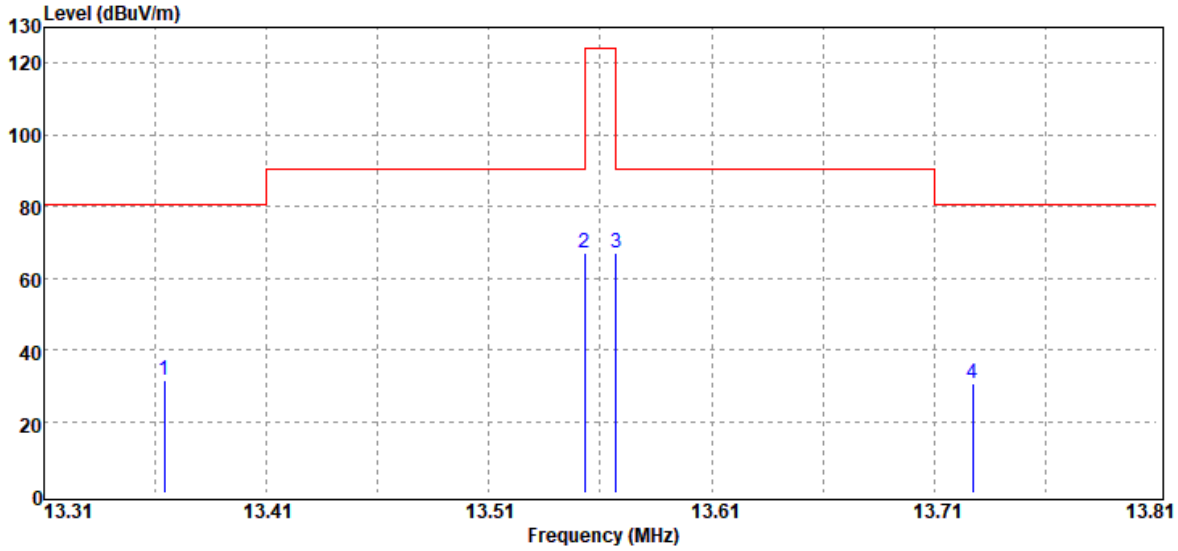
| | | | |
|---|---|---|---|
| **Operation Mode:** | TX mode | **Test Date:** | September 06, 2019 |
| **Temperature:** | 29.3°C | **Tested by:** | Jerry Lu |
| **Humidity:** | 49 % RH | **Polarity:** | Hor. |




| No. | Frequency | Reading | Correct | Result | Limit | Margin | Remark |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB) | |
| 1 | 13.36 | 15.52 | 15.92 | 31.44 | 80.50 | -49.06 | Peak |
| 2 | 13.55 | 51.06 | 15.91 | 66.97 | 90.47 | -23.50 | Peak |
| 3 | 13.57 | 51.17 | 15.91 | 67.08 | 90.47 | -23.39 | Peak |
| 4 | 13.73 | 14.84 | 15.90 | 30.74 | 80.50 | -49.76 | Peak |

***Remark:***

1. *Radiated emissions measured were made with an instrument using peak detector mode.*
2. *Margin (dB) = Result (dBuV/m) – Limit (dBuV/m).*

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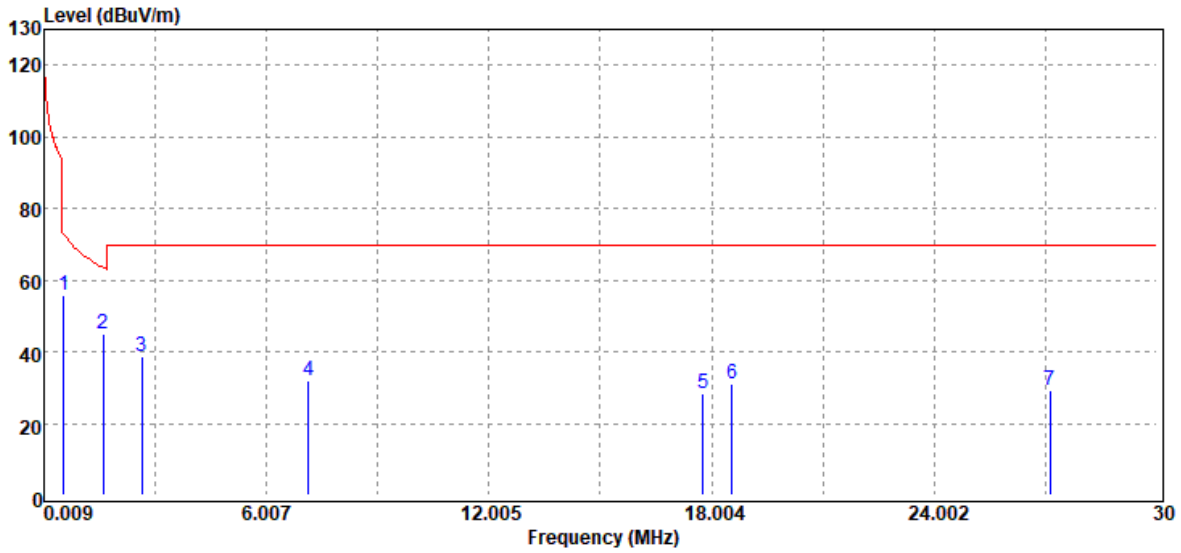
**9kHz ~ 30MHz**

| | | | |
|---|---|---|---|
| **Operation Mode:** | TX mode | **Test Date:** | September 06, 2019 |
| **Temperature:** | 29.3°C | **Tested by:** | Jerry Lu |
| **Humidity:** | 49 % RH | **Polarity:** | Ver. |




| Frequency (MHz) | Reading (dBuV) | Correction Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector Mode (PK/QP/AVG) |
|---|---|---|---|---|---|---|
| 0.55 | 41.50 | 14.42 | 55.92 | 72.82 | -16.90 | Peak |
| 1.60 | 30.01 | 14.86 | 44.87 | 63.53 | -18.66 | Peak |
| 2.65 | 23.75 | 15.03 | 38.78 | 69.54 | -30.76 | Peak |
| 7.15 | 16.29 | 15.77 | 32.06 | 69.54 | -37.48 | Peak |
| 17.76 | 12.84 | 15.68 | 28.52 | 69.54 | -41.02 | Peak |
| 18.54 | 15.34 | 15.65 | 30.99 | 69.54 | -38.55 | Peak |
| 27.12 | 14.88 | 14.16 | 29.04 | 69.54 | -40.50 | Peak |

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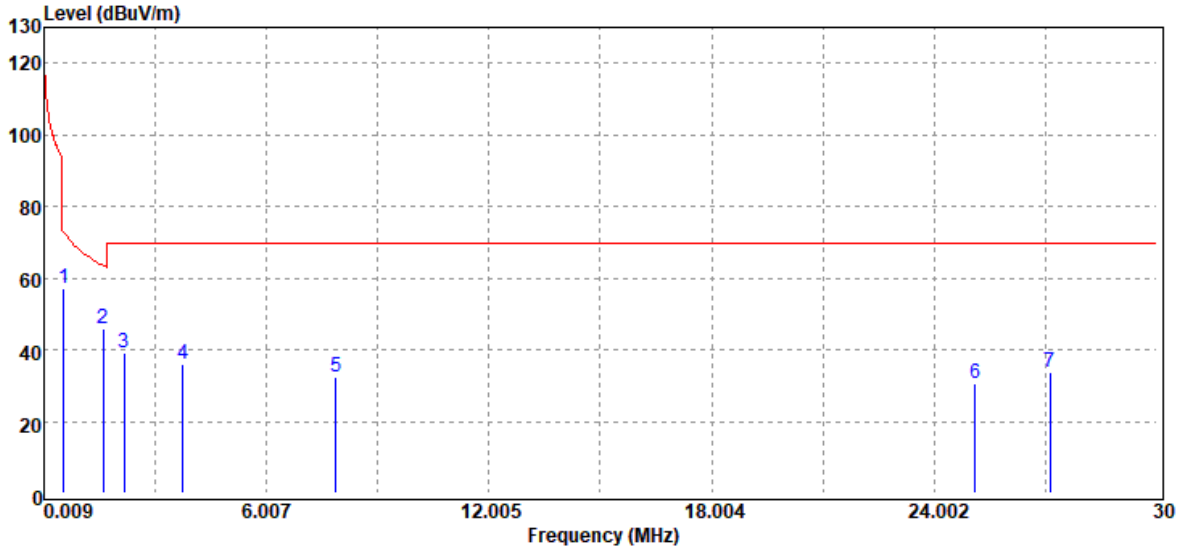
| | | | |
|---|---|---|---|
| **Operation Mode:** | TX mode | **Test Date:** | September 06, 2019 |
| **Temperature:** | 29.3°C | **Tested by:** | Jerry Lu |
| **Humidity:** | 49 % RH | **Polarity:** | Hor. |




| Frequency (MHz) | Reading (dBuV) | Correction Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector Mode (PK/QP/AVG) |
|---|---|---|---|---|---|---|
| 0.55 | 42.87 | 14.42 | 57.29 | 72.82 | -15.53 | Peak |
| 1.60 | 30.82 | 14.86 | 45.68 | 63.53 | -17.85 | Peak |
| 2.17 | 24.36 | 14.96 | 39.32 | 69.54 | -30.22 | Peak |
| 3.76 | 21.00 | 15.20 | 36.20 | 69.54 | -33.34 | Peak |
| 7.87 | 16.47 | 15.89 | 32.36 | 69.54 | -37.18 | Peak |
| 25.11 | 16.09 | 14.52 | 30.61 | 69.54 | -38.93 | Peak |
| 27.12 | 19.62 | 14.16 | 33.78 | 69.54 | -35.76 | Peak |

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**30MHz ~ 1GHz**

| | | | |
|---|---|---|---|
| **Operation Mode:** | TX mode | **Test Date:** | September 06, 2019 |
| **Temperature:** | 29.3°C | **Tested by:** | Jerry Lu |
| **Humidity:** | 49 % RH | | |

| Frequency (MHz) | Reading (dBuV) | Correction Factor (dB/m) | Result (dBuV/m) | Limit 3m (dBuV/m) | Margin (dB) | Detector Mode (PK/QP/AVG) |
|---|---|---|---|---|---|---|
| 105.66 | 42.84 | -11.02 | 31.82 | 43.50 | -11.68 | Peak |
| 240.49 | 43.68 | -10.25 | 33.43 | 46.00 | -12.57 | Peak |
| 408.30 | 37.68 | -5.28 | 32.40 | 46.00 | -13.60 | Peak |
| 516.94 | 41.45 | -2.64 | 38.81 | 46.00 | -7.19 | Peak |
| 527.61 | 42.29 | -2.38 | 39.91 | 46.00 | -6.09 | Peak |
| 539.25 | 39.76 | -2.25 | 37.51 | 46.00 | -8.49 | Peak |
| 42.61 | 41.75 | -11.25 | 30.50 | 40.00 | -9.50 | Peak |
| 105.66 | 41.80 | -11.02 | 30.78 | 43.50 | -12.72 | Peak |
| 408.30 | 35.37 | -5.28 | 30.09 | 46.00 | -15.91 | Peak |
| 479.11 | 41.04 | -2.98 | 38.06 | 46.00 | -7.94 | Peak |
| 492.69 | 39.36 | -2.97 | 36.39 | 46.00 | -9.61 | Peak |
| 516.94 | 38.35 | -2.64 | 35.71 | 46.00 | -10.29 | Peak |

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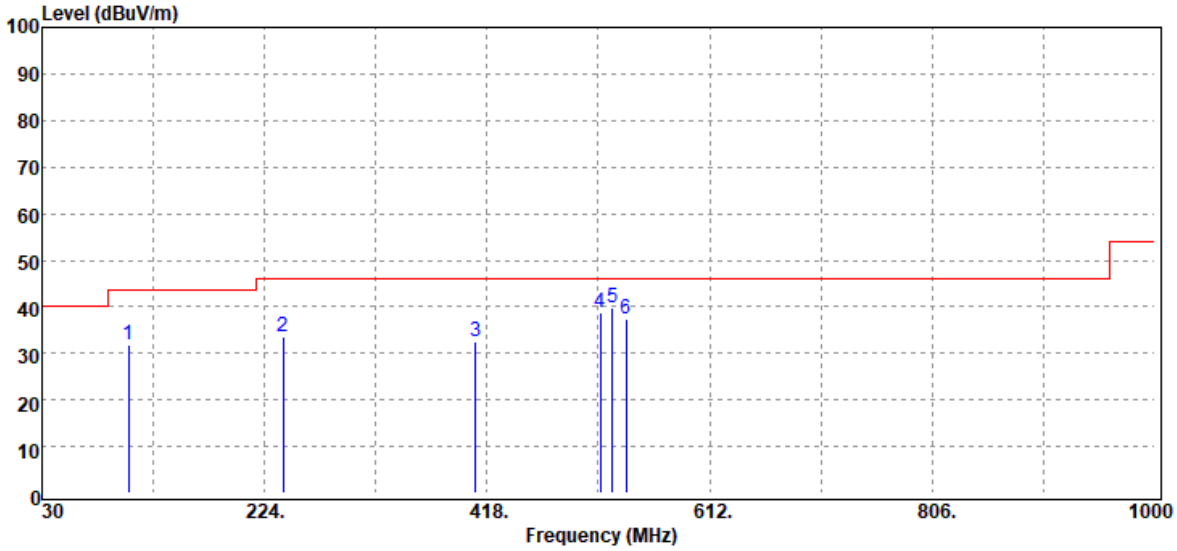
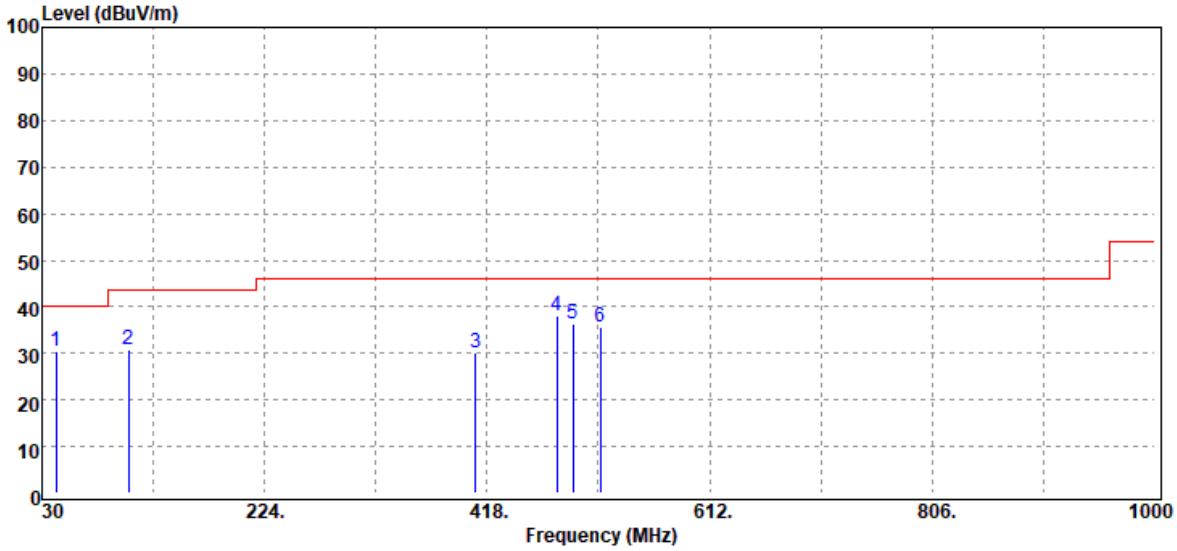
## Vertical




## Horizontal

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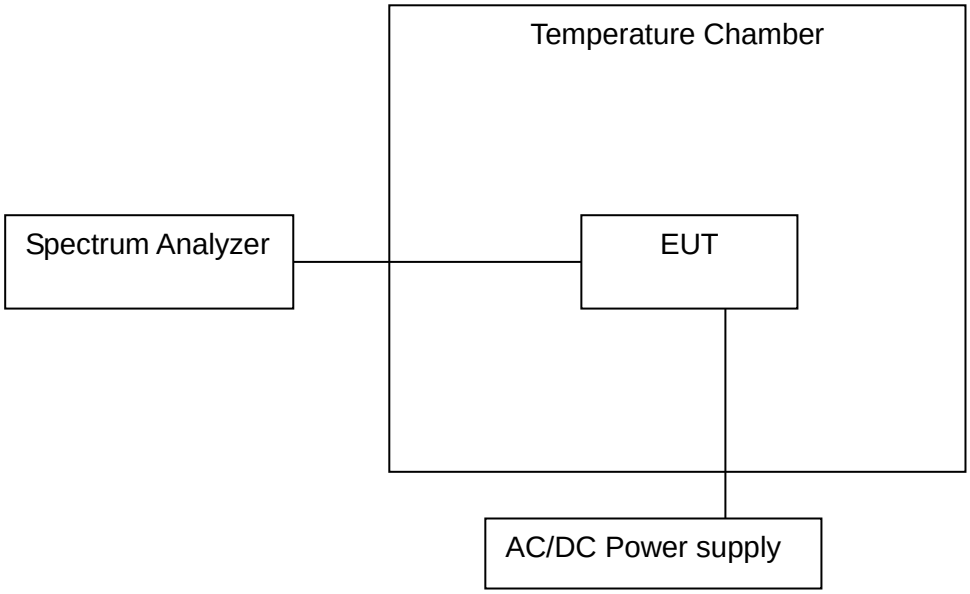
## 8.3 FREQUENCY STABILITY

### LIMIT

According to §15.225(e), the frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of –20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

### Test Configuration

**Temperature and Voltage Measurement (under normal and extreme test conditions)**

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## TEST PROCEDURE

1. Turn the EUT off, and place it inside the environmental temperature chamber.
2. Set the temperature control on the chamber to the highest specified in the regulatory requirements for the type of device and allow the oscillator heater and the chamber temperature to stabilize.
3. Set the spectrum analyzer as RBW=1kHz, VBW = RBW, Span = 200kHz, Sweep = auto.
4. Turn the EUT on and record the operating frequency at startup and two, five, and ten minutes after the EUT is energized.
5. Switch off the EUT and Lower the chamber temperature by not more than 10 °C and allow the temperature inside the chamber to stabilize.
6. Mark the peak frequency and measure the frequency tolerance using frequency counter function.
7. Repeat step 4 through step 6 down to the lowest specified temperature.

## TEST RESULTS

*No non-compliance noted.*

## TEST DATA

| Condition | | | Frequency Error (ppm) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature | Modulation Mode | Test Freq. | 0 min | 2 min | 5 min | 10 min | 0 min | 2 min | 5 min | 10 min | Limit (ppm) | Result |
| | | | Normal | | | | | | | | | |
| $T_{20°C}$Vmax | CW | 13.56 | 13.559797 | 13.559797 | 13.559797 | 13.559797 | -14.97 | -14.97 | -14.97 | -14.97 | 100 | Pass |
| $T_{20°C}$Vmin | CW | 13.56 | 13.559797 | 13.559797 | 13.559797 | 13.559797 | -14.97 | -14.97 | -14.97 | -14.97 | | Pass |
| | | | Extreme | | | | | | | | | |
| $T_{50°C}$Vnom | CW | 13.56 | 13.559783 | 13.559797 | 13.559797 | 13.559783 | -16.00 | -14.97 | -14.97 | -16.00 | 100 | Pass |
| $T_{40°C}$Vnom | CW | 13.56 | 13.559783 | 13.559783 | 13.559783 | 13.559783 | -16.00 | -16.00 | -16.00 | -16.00 | | Pass |
| $T_{30°C}$Vnom | CW | 13.56 | 13.559797 | 13.559783 | 13.559797 | 13.559783 | -14.97 | -16.00 | -14.97 | -16.00 | | Pass |
| $T_{20°C}$Vnom | CW | 13.56 | 13.559797 | 13.559797 | 13.559797 | 13.559797 | -14.97 | -14.97 | -14.97 | -14.97 | | Pass |
| $T_{10°C}$Vnom | CW | 13.56 | 13.559812 | 13.559812 | 13.559812 | 13.559812 | -13.86 | -13.86 | -13.86 | -13.86 | | Pass |
| $T_{0°C}$Vnom | CW | 13.56 | 13.559812 | 13.559812 | 13.559872 | 13.559872 | -13.86 | -13.86 | -9.44 | -9.44 | | Pass |
| $T_{-10°C}$Vnom | CW | 13.56 | 13.559910 | 13.559910 | 13.559922 | 13.559922 | -6.64 | -6.64 | -5.75 | -5.75 | | Pass |
| $T_{-20°C}$Vnom | CW | 13.56 | 13.559981 | 13.559981 | 13.559978 | 13.559978 | -1.40 | -1.40 | -1.62 | -1.62 | | Pass |

Remark: Vnom: 5
Vmax: 5.75
Vmin: 4.25

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## 8.4 POWERLINE CONDUCTED EMISSIONS

### LIMIT

According to §15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

| Frequency Range (MHz) | Limits (dBµV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 to 0.50 | 66 to 56* | 56 to 46* |
| 0.50 to 5 | 56 | 46 |
| 5 to 30 | 60 | 50 |

***** *Decreases with the logarithm of the frequency.*

### TEST PROCEDURE

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

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## TEST RESULTS

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

## TEST DATA

***Not applicable, because EUT not connect to AC Main Source direct.***

***--End of Test Report--***

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