# FCC Test Report

**Report No:** WD-RF-R-230316-E0

| | | |
|---|---|---|
| **Product Name** | **:** | Doorbell |
| **Model Name** | **:** | DR40 |
| **FCC ID** | **:** | 2AZ3JDR40 |
| **Applicant** | **:** | Rhombus Systems, Inc. |
| **Received Date** | **:** | Sep. 01, 2023 |
| **Tested Date** | **:** | Sep. 11, 2023 ~ Oct. 16, 2023 |
| **Applicable Standard** | **:** | 47 CFR FCC Part 15, Subpart C (Section 15.225)<br>ANSI C63.10 : 2013 |

Testing Laboratory
2965

## Wendell Industrial Co., Ltd
## Wendell EMC & RF Laboratory

**Caution:**
This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted.
The test results shown in the test report are traceable to the national/international standard through the calibration report of the equipment.
Please note that the measurement uncertainty are provided for informational purpose only and are not used in determining the Pass/Fail results.
This report must not be used to claim product endorsement by TAF or any agency of the government.
The test report shall not be reproduced without the written approval of Wendell Industrial Co., Ltd..

# Test Report

Issued Date: October 16, 2023

Project No.: 22Q090502

| | |
|---|---|
| **Product Name** | Doorbell |
| **Trade Name** | rhombus |
| **Brand Trademark** | rhombus |
| **Model Name** | DR40 |
| **FCC ID** | 2AZ3JDR40 |
| **Applicant** | Rhombus Systems, Inc. |
| **Manufacturer** | Dynacolor Inc. |
| **EUT Rated Voltage** | DC 12V ~ 28V、POE 42.5V ~ 57V |
| **EUT Test Voltage** | AC 120V / 60Hz |
| **EUT Supports Radios Application** | WLAN 802.11a/b/g、WLAN 802.11n (HT20/HT40)<br>WLAN 802.11ac (VHT20/VHT40/VHT80)<br>Bluetooth BR/EDR/LE、NFC 13.56 MHz |
| **Applicable Standard** | 47 CFR FCC Part 15, Subpart C (Section 15.225)<br>ANSI C63.10 : 2013 |
| **Test Result** | Complied |

**Documented :** Emma Lu

( Specialist / Emma Lu )

**Technical Engineer :** Jack Chang

( Section Manager / Jack Chang )

**Approved :** Gary Wu

( Project Manager / Gary Wu )

# Table of Contents

# Document Revision History

| Report No. | Issue date | Description |
|---|---|---|
| WD-RF-R-230316-E0 | October 16, 2023 | Initial report |

# Summary of Test Result

| Ref. Std. Clause | Test Items | Result |
|---|---|---|
| 15.203 | Antenna Requirement | Pass |
| 15.215(c) | 20dB Spectrum Bandwidth | Pass |
| 15.225(e) | Frequency Stability | Pass |
| 15.225 (a)(b)(c) | Field Strength of Fundamental Emissions | Pass |
| 15.225(d) | Radiated Spurious Emissions | Pass |
| 15.207 | AC Conducted Emission | Pass |

# 1 Generation Information

## 1.1 Applicant

Rhombus Systems, Inc.
1920 20th St, Sacramento, CA 95811

## 1.2 Manufacturer

Dynacolor Inc.
NO. 116 JOU TZ STREET, NEIHU, TAIPEI 114, TAIWAN

## 1.3 Description of Equipment under Test

| | |
|---|---|
| **Product Name** | Doorbell |
| **Model No.** | DR40 |
| **FCC ID** | 2AZ3JDR40 |
| **Frequency Range** | 13.56 MHz |
| **Type of Modulation** | ASK |
| **Antenna Information** | Refer to the table “Antenna List” |
| **EUT Supports Radios Application** | WLAN 802.11a/b/g<br>WLAN 802.11n (HT20/HT40)<br>WLAN 802.11ac (VHT20/VHT40/VHT80)<br>Bluetooth BR/EDR/LE<br>NFC 13.56 MHz |
| **EUT Rated Voltage** | DC 12V ~ 28V、POE 42.5V ~ 57V |
| **EUT Test Voltage** | AC 120V / 60Hz |

**Antenna List**

| No. | Manufacturer | Model No. | Antenna Type | Peak Gain |
|---|---|---|---|---|
| 1 | INPAQ | RFNFC363006IMFB301 | PCB Antenna | N/A |

**Channel List**

| Channel | Frequency (MHz) |
|---|---|
| 01 | 13.56 |

**Test Frequencies in each operating band**

| Frequency range over which the device operates in each operating band (Note 1) | Number of test frequencies required | Location of test frequencies inside the operating frequency range (Note 1,2) |
|---|---|---|
| ≤ 1 MHz | 1 | near centre |
| > 1 MHz and ≤ 10 MHz | 2 | 1 near high end,<br>1 near low end |
| > 10 MHz | 3 | 1 near high end, 1 near centre,<br>and 1 near low end |

**Note 1:** The frequency range over which the device operates in a given operating band is the difference between the highest and lowest frequencies on which the device can be tuned within that given operating band. The frequency range can be smaller than or equal to the operating band, but cannot be greater than the operating band.

**Note 2:** In the third column of table 1, "near" means as close as possible to or at the centre / low end / high end of the frequency range over which the device operates.

**Firmware / Software Version**

| | | |
|---|---|---|
| **1** | **Product Name** | Doorbell |
| **2** | **Model No.** | DR40 |
| **3** | **Test SW Version** | Putty_Ver.0.63 |
| **4** | **RF power setting in TEST SW** | ☒ RF power setting was not able to alter during testing.<br>☐ RF power setting was able to alter during testing.<br>(See the following table) |

**Parameters of test software setting**

| Type of Modulation | Channel | Frequency (MHz) | Set Value |
|---|---|---|---|
| ASK | 01 | 13.56 | Default |

**The EUT has the following different power supply. After laboratory evaluation, the worst mode must be found by pre-test results of radiation 30M-1GHz.The EUT has been pre-tested under the following test modes, and test mode A was the worst case for final test.**

**Pretest Mode**

| |
|---|
| Mode A：PoE Mode |
| Mode B：DC Mode |

**The EUT has the following different codes. After laboratory evaluation, the worst mode must be found by pre-test results of radiation 30M-1GHz.The EUT has been pre-tested under the following test modes, and test mode D was the worst case for final test.**

**Pretest Mode**

| |
|---|
| Mode C：NFC-A_106k |
| Mode D：NFC-B_106k |
| Mode E：NFC-F_212k |
| Mode F：NFC-F_424k |

**Test Mode**

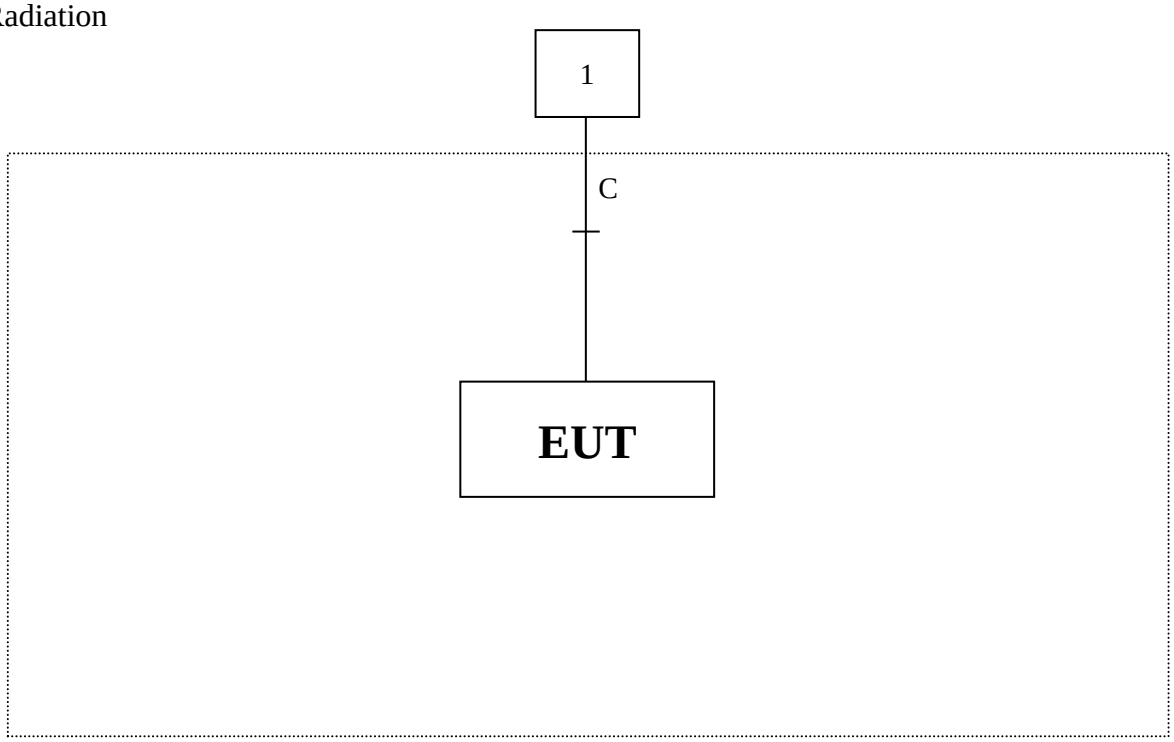
| |
|---|
| Mode 1：Transmit |

Note:

1. This device is a Doorbell with a built-in Wi-Fi、Bluetooth and NFC transceiver.
2. These tests were performed on a sample of equipment to demonstrate compliance with 47 CFR FCC Part 15, Subpart C (Section 15.225).
3. The radiation measurements are performed in X, Y, Z axis positioning. Only the X axis worst case is shown in the report.

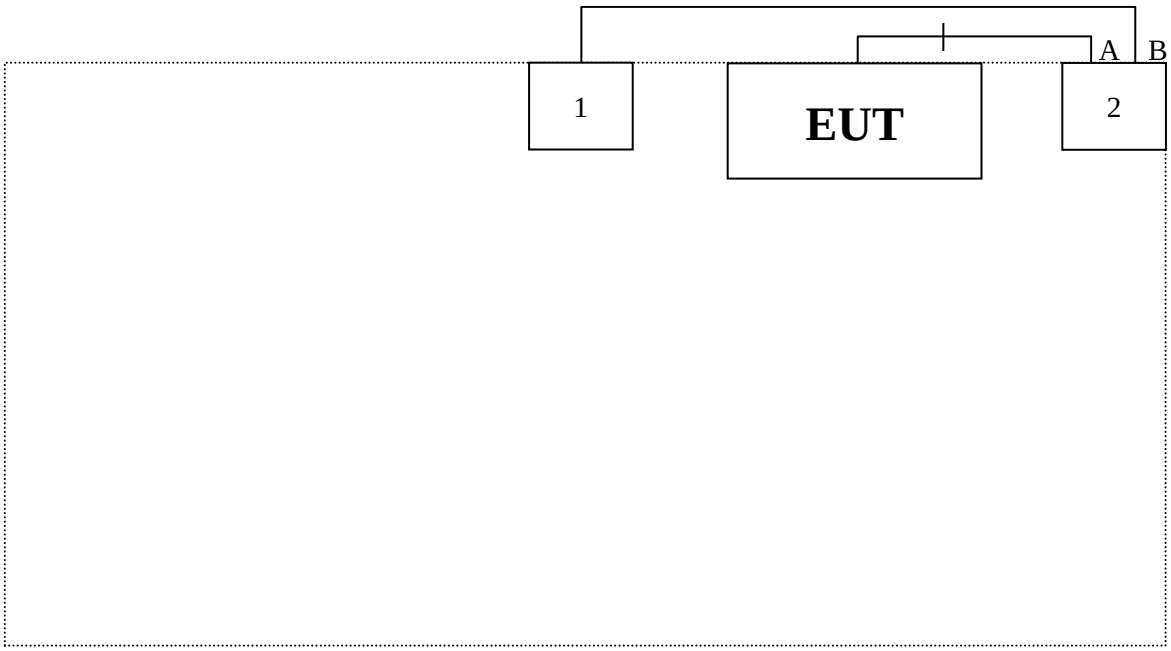
## 1.4 Configuration of Tested System

Radiation




Test Table

AC Conduction




Test Table

## 1.5 EUT Exercise Software

1. Setup the EUT as shown in Section 1.4
2. Turn on the power of all equipment.
3. Using tag to trigger RFID continuous transmission.
4. Verify that the EUT works properly.

## 1.6 Tested System Details

The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards) are:

| No. | Product | Manufacturer | Model No. | Serial No. | Power Cord |
|---|---|---|---|---|---|
| 1 | Notebook PC | acer | N16Q1 | NXVF4TA023742254147600 | N/A |
| 2 | POE | CERIO | POE-S48V2 | N/A | N/A |

| No. | Signal Cable Type | Signal cable Description |
|---|---|---|
| A | LAN Cable | Non-shielded, Non-Core, 1.5m |
| B | LAN Cable | Non-shielded, Non-Core, 1.6m |

## 1.7 Test Facility

| Items | Required (IEC 60068-1) |
|---|---|
| Temperature (°C) | 15-35 |
| Humidity (% RH) | 25-75 |
| Barometric pressure (mbar) | 860-1060 |

**Description:** Accredited by TAF
Accredited Number: 2965

**Issued by:** Wendell Industrial Co., Ltd

**Company Address:** 6F/6F-1, No.188, Baoqiao Rd., Xindian Dist.,
New Taipei City 23145, Taiwan R.O.C

**Test Lab:** Wendell EMC & RF Laboratory

**Lab Address:** 5F-1, No.188, Baoqiao Rd., Xindian Dist.,
New Taipei City 23145, Taiwan R.O.C

**Test Location:** No. 119, Wugong 3rd Rd., Wugu Dist.,
New Taipei City 248, Taiwan (R.O.C.)

**Designation Number:** TW0025

**Test Firm Registration Number:** 665221

## 1.8 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence (level based on a coverage factor K=2)

| Measurement Project | Condition | Expended Uncertainty |
|---|---|---|
| AC Conducted Emission | 0.150 ~ 30 MHz | ± 2.64 dB |
| Radiated Emission | 0.009 ~ 30 MHz | ± 3.7 dB |
| | 30 ~ 1000 MHz | ± 3.9 dB |
| | 1000 ~ 18000 MHz | ± 4.5 dB |
| | 18000 ~ 40000 MHz | ± 4.3 dB |
| RF Power, Conducted | Conducted Measuring | ± 0.75 dB |
| Occupied Bandwidth | Conducted Measuring | ± 2.4 % |
| Power Density | Conducted Measuring | ± 1.2 dB |
| Duty Cycle and Dwell Time | Conducted Measuring | ± 0.9 % |
| Conducted Unwanted Emission Strength | Conducted Measuring | ± 1.4 dB |
| DC Power Supply | -- | ± 2.0 % |
| Temperature | -- | ± 0.55 ℃ |
| Humidity | -- | ± 3.1 % |

**Note:** Please note that the measurement uncertainty are provided for informational purpose only and are not used in determining the Pass/Fail results.

## 1.9 List of Test Equipment

**For Conducted measurements / W08-Conducted Measurement**

| Equipment | | Manufacturer | Model No. | Serial No. | Cal. Date | Due Date |
|---|---|---|---|---|---|---|
| ✓ | Spectrum analyzer | Keysight | N9010A | SG50420005 | 2023/08/08 | 2024/08/07 |
| | Wideband Peak Power Meter | Anritsu | ML2495A | 1733007 | 2023/09/07 | 2024/09/06 |
| | Pulse Power Sensor + Precision Adaptor | Anritsu | MA2411B | 1726022 | 2023/09/07 | 2024/09/06 |
| ✓ | Temperature Chamber | TAICHY | MHK-225LK | 1061121 | 2023/04/24 | 2024/04/23 |
| | Wireless Connectivity Tester | R&S | CMW270 | 101307 | 2023/05/29 | 2024/05/28 |
| | Attenuator | MVE | MVE2211-10 | CT-9-056 | 2022/08/10 | 2024/08/09 |
| | Attenuator | MVE | MVE2211-20 | CT-9-057 | 2022/08/10 | 2024/08/09 |
| | Attenuator | MVE | MVE2211-30 | CT-9-058 | 2022/08/10 | 2024/08/09 |
| | Power Divider | MVE | MVE8546 | 170826003 | 2022/08/10 | 2024/08/09 |
| | Power Splitter | MVE | MVE8547 | 170302047 | 2022/08/11 | 2024/08/10 |
| | DC Power Supply | GW INSTEK | GPC-3060D | GER817636 | 2023/08/11 | 2024/08/10 |

Remark:

1. The equipments are calibrated every one year.
2. The Attenuator/ Divider/ Splitter are calibrated every two year.
3. The test instruments marked with "✓" are used to measure the final test results.

**For AC Conduction measurements / W08-CE**

| | Equipment | Manufacturer | Model No. | Serial No. | Cal. Date | Due Date |
|---|---|---|---|---|---|---|
| ✓ | EMI Test Receiver | R&S | ESR3 | 102309 | 2023/06/19 | 2024/06/18 |
| ✓ | 2-Line V-Network LISN | R&S | ENV216 | 101185 | 2023/06/16 | 2024/06/15 |
| ✓ | LISN | SCHWARZBECK | NSLK 8127RC | 05028 | 2023/06/16 | 2024/06/15 |
| ✓ | Transient Limiter | EM Electronics Corporation | EM-7600 | 857 | 2023/06/17 | 2024/06/16 |
| ✓ | 50ohm Cable | EMCI | EMCCFD300-BM-BM-5000 | 170612 | 2023/06/17 | 2024/06/16 |
| ✓ | 50 ohm terminal impedance | HUBER+SUHNER | 50 ohm terminal impedance | CT-1-109-1 | 2023/06/16 | 2024/06/15 |

Remark:

1. All equipments are calibrated every one year.
2. The test instruments marked with "✓" are used to measure the final test results.
3. Test Software version: FARAD EZ-EMC Ver.EMC-CON 3A1

**For Radiated measurements / W08-996-2**

| Equipment | | Manufacturer | Model No. | Serial No. | Cal. Date | Due Date |
|---|---|---|---|---|---|---|
| ✓ | EMI Receiver | Keysight | N9038A | MY51210173 | 2023/08/18 | 2024/08/17 |
| ✓ | Spectrum Analyzer | Keysight | N9010A | MY52220228 | 2023/08/18 | 2024/08/17 |
| ✓ | Active Loop Antenna | Schwarzbeck | FMZB 1513-60B | 00033 | 2023/05/08 | 2024/05/07 |
| ✓ | TRILOG super broad Antenna | Schwarzbeck | VULB 9168 | VULB 9168-700 & 20E03 | 2023/07/31 | 2024/07/30 |
| | Horn Antenna | Schwarzbeck | BBHA 9120D | 01767 | 2023/08/17 | 2024/08/16 |
| | Horn Antenna | Schwarzbeck | BBHA 9170 | 703 | 2023/08/21 | 2024/08/20 |
| ✓ | Pre-Amplifier | EMEC | EMC330 | 060774 | 2023/08/22 | 2024/08/21 |
| | Pre-Amplifier | EMEC | EM01G18G | 060648 | 2023/08/22 | 2024/08/21 |
| | Pre-Amplifier | JPT | JPA0118-55-303K | 1910001800055003 | 2023/08/22 | 2024/08/21 |
| | Pre-Amplifier | EMCI | EMC184045SE | 980515 | 2023/08/22 | 2024/08/21 |
| ✓ | Cable | EMEC | EM-CB400 | 105060103 | 2023/08/22 | 2024/08/21 |
| ✓ | Cable | EMEC | EM-CB400 | 105060102 | 2023/08/22 | 2024/08/21 |
| ✓ | Cable | EMEC | EM-CB400 | 105060101 | 2023/08/22 | 2024/08/21 |
| | RF Cable | HUBER+SUHNER | SF102 | MY2752/2 | 2023/08/22 | 2024/08/21 |
| | RF Cable | MVE | 280280.LL266.1200 | B60028C | 2023/08/22 | 2024/08/21 |
| | RF Cable | EMCI | EMC102-KM-KM-600 | 190646 | 2023/08/22 | 2024/08/21 |
| | RF Cable | MVE | 140140.LL404.700 | B90014C | 2023/08/22 | 2024/08/21 |
| | RF Cable | MVE | 140140.LL404.300 | B90006C | 2023/08/22 | 2024/08/21 |
| | RF Filter | EMEC | BRF-2400-2500 | 002 | 2022/08/17 | 2024/08/16 |
| | RF Filter | EMEC | BRF-5150-5350 | 104 | 2022/08/17 | 2024/08/16 |
| | RF Filter | EMEC | BRF-5470-5725 | 092 | 2022/08/17 | 2024/08/16 |
| | RF Filter | EMEC | BRF-5725-5875 | 091 | 2022/08/17 | 2024/08/16 |
| | RF Filter | EMEC | HPF-2800 | 002 | 2022/08/17 | 2024/08/16 |
| | RF Filter | EMEC | HPF-5850 | 059 | 2022/08/17 | 2024/08/16 |
| | SMA Notch Filter | MVE | MFN-902.928.S1 | 190604001 | 2022/08/17 | 2024/08/16 |

Remark:

1. The equipments are calibrated every one year.
2. The Filter calibrated every two year.
3. The test instruments marked with "✓" are used to measure the final test results.
4. Test Software version: FARAD EZ-EMC Ver.WD-03A1-1

# 2 Test Result

## 2.1 Antenna Requirement

### 2.1.1 Applicable Standard

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

### 2.1.2 Antenna Connected Construction

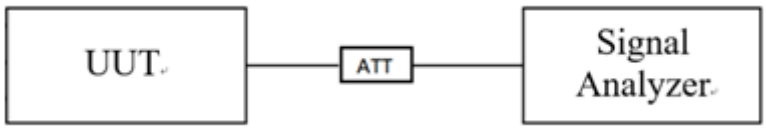
Non-standard antenna connector is used.

## 2.2 20dB Spectrum Bandwidth Measurement

### 2.2.1 Limit

Intentional radiators must be designed to ensure that the 20dB emission bandwidth in the specific band 13.553~13.567MHz.

### 2.2.2 Test Setup



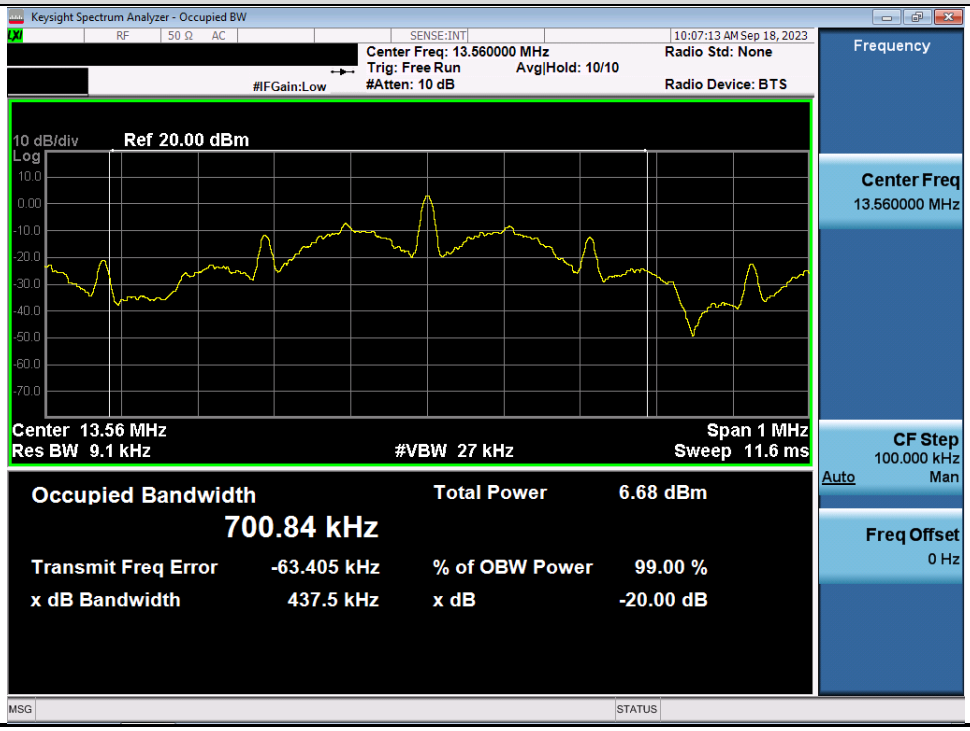

### 2.2.3 Test Procedure

Refer to ANSI C63.10 : 2013 clause 6.9

## 2.2.4 Test Result

**Operating Frequency Band**：13.553~13.567 MHz

**20dB Bandwidth**

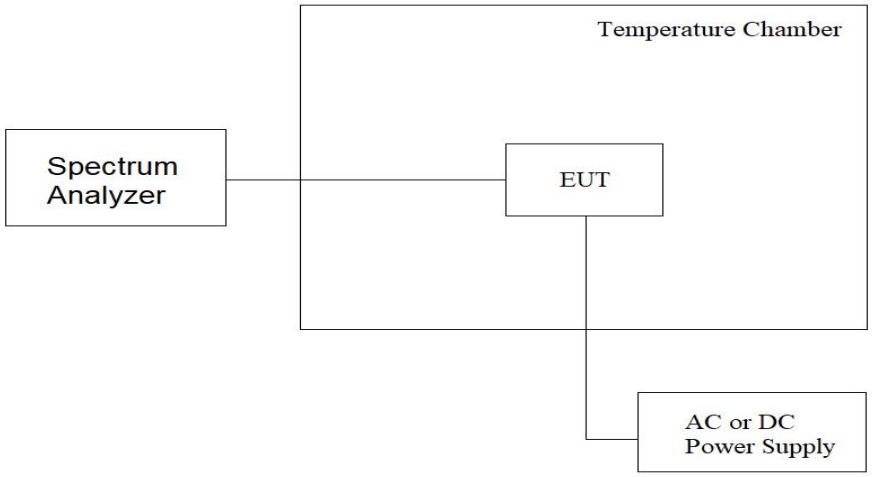


## 2.3 Frequency Stability Measurement

### 2.3.1 Limit

The frequency tolerance of the carrier signal shall be maintained within ± 0.01% (100ppm) of the operating frequency over a temperature variation of -20℃ to +50℃ 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 ℃.

### 2.3.2 Test Setup




### 2.3.3 Test Procedure

1. Set the spectrum analyzer span to view the entire emissions bandwidth.
2. The fc is declaring of channel frequency. Then the frequency error formula is (fc-f)/fc × $10^6$ ppm and the limit is less than ±100ppm.
3. Extreme temperature rule is -20°C~50°C.

### 2.3.4 Test Result

| Temperature (°C) | Voltage | Observe Time | Frequency | Delta Frequency (Hz) | Delta Frequency (%) | Limit (%) | Result |
|---|---|---|---|---|---|---|---|
| 20 | Normal | start | 13.559275 | -725 | -0.0053 | ±0.01% | Pass |
| | | 2 min | 13.560208 | 208 | 0.0015 | ±0.01% | Pass |
| | | 5 min | 13.560535 | 535 | 0.0039 | ±0.01% | Pass |
| | | 10 min | 13.560655 | 655 | 0.0048 | ±0.01% | Pass |
| 20 | High(+15%) | start | 13.560598 | 598 | 0.0044 | ±0.01% | Pass |
| | | 2 min | 13.560918 | 918 | 0.0068 | ±0.01% | Pass |
| | | 5 min | 13.560102 | 101 | 0.0007 | ±0.01% | Pass |
| | | 10 min | 13.560056 | 56 | 0.0004 | ±0.01% | Pass |
| 20 | Low(-15%) | start | 13.560159 | 159 | 0.0012 | ±0.01% | Pass |
| | | 2 min | 13.559210 | -790 | -0.0058 | ±0.01% | Pass |
| | | 5 min | 13.560168 | 167 | 0.0012 | ±0.01% | Pass |
| | | 10 min | 13.560821 | 821 | 0.0061 | ±0.01% | Pass |
| 50 | Normal | start | 13.560218 | 218 | 0.0016 | ±0.01% | Pass |
| | | 2 min | 13.560060 | 60 | 0.0004 | ±0.01% | Pass |
| | | 5 min | 13.560948 | 948 | 0.0070 | ±0.01% | Pass |
| | | 10 min | 13.559823 | -177 | -0.0013 | ±0.01% | Pass |
| 40 | Normal | start | 13.559000 | -1000 | -0.0074 | ±0.01% | Pass |
| | | 2 min | 13.559216 | -784 | -0.0058 | ±0.01% | Pass |
| | | 5 min | 13.559015 | -985 | -0.0073 | ±0.01% | Pass |
| | | 10 min | 13.560361 | 361 | 0.0027 | ±0.01% | Pass |
| 30 | Normal | Start | 13.560353 | 353 | 0.0026 | ±0.01% | Pass |
| | | 2 min | 13.560338 | 338 | 0.0025 | ±0.01% | Pass |
| | | 5 min | 13.559586 | -414 | -0.0031 | ±0.01% | Pass |
| | | 10 min | 13.560069 | 69 | 0.0005 | ±0.01% | Pass |
| 10 | Normal | Start | 13.560306 | 306 | 0.0023 | ±0.01% | Pass |
| | | 2 min | 13.560286 | 286 | 0.0021 | ±0.01% | Pass |
| | | 5 min | 13.560085 | 85 | 0.0006 | ±0.01% | Pass |
| | | 10 min | 13.560939 | 939 | 0.0069 | ±0.01% | Pass |
| 0 | Normal | start | 13.559519 | -481 | -0.0036 | ±0.01% | Pass |
| | | 2 min | 13.560864 | 864 | 0.0064 | ±0.01% | Pass |
| | | 5 min | 13.560325 | 325 | 0.0024 | ±0.01% | Pass |
| | | 10 min | 13.560672 | 671 | 0.0050 | ±0.01% | Pass |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| -10 | Normal | start | 13.560212 | 212 | 0.0016 | ±0.01% | Pass |
| | | 2 min | 13.559054 | -946 | -0.0070 | ±0.01% | Pass |
| | | 5 min | 13.560864 | 864 | 0.0064 | ±0.01% | Pass |
| | | 10 min | 13.560644 | 644 | 0.0048 | ±0.01% | Pass |
| -20 | Normal | star | 13.560480 | 480 | 0.0035 | ±0.01% | Pass |
| | | 2 min | 13.560877 | 877 | 0.0065 | ±0.01% | Pass |
| | | 5 min | 13.559926 | -74 | -0.0005 | ±0.01% | Pass |
| | | 10 min | 13.559041 | -959 | -0.0071 | ±0.01% | Pass |

## 2.4 Field Strength of Fundamental Emissions Measurement

### 2.4.1 Limit

| Rules and specifications | FCC Part 15 Subpart C Paragraph 15.225 Limits | | |
|---|---|---|---|
| Freq. of Emission (MHz) | Field Strength (μV/m) at 30m | Field Strength (dBμV/m) at 30m | Field Strength (dBμV/m) at 3m |
| 13.553~13.567 | 15848 | 84.0 | 124.0 |
| 13.410 – 13.553 and 13.567 – 13.710 | 334 | 50.5 | 90.5 |
| 13.110 – 13.410 and 13.710 – 14.010 | 106 | 40.5 | 80.5 |
| Outside of the 13.110 – 14.010 | See 15.209 Limits | | |

Remark:

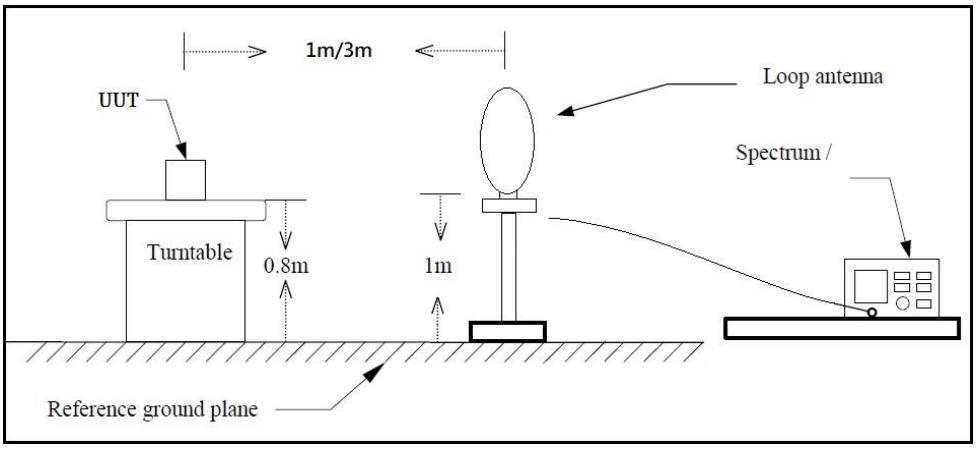
1. Emission level (dBμV/m) = 20 log Emission level (μV/m)
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.
3. The emission limit in this paragraph is based on measurement instrumentation employing an quasi-peak detector.

| FCC Part 15 Subpart C Paragraph 15.209 Limits | | |
|---|---|---|
| **Frequency (MHz)** | **Field Strength (μV/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 – 88 | 100 | 3 |
| 88 – 216 | 150 | 3 |
| 216 - 960 | 200 | 3 |
| Above 960 | 500 | 3 |

Remark:

1. Emission level (dBμV/m) = 20 log Emission level (μV/m)
2. In the Above Table, the tighter limit applies at the band edges.
3. The emission limit in this paragraph is based on a measurement frequency below 1GHz instrumentation employing a quasi-peak detector.

## 2.4.2 Test Setup

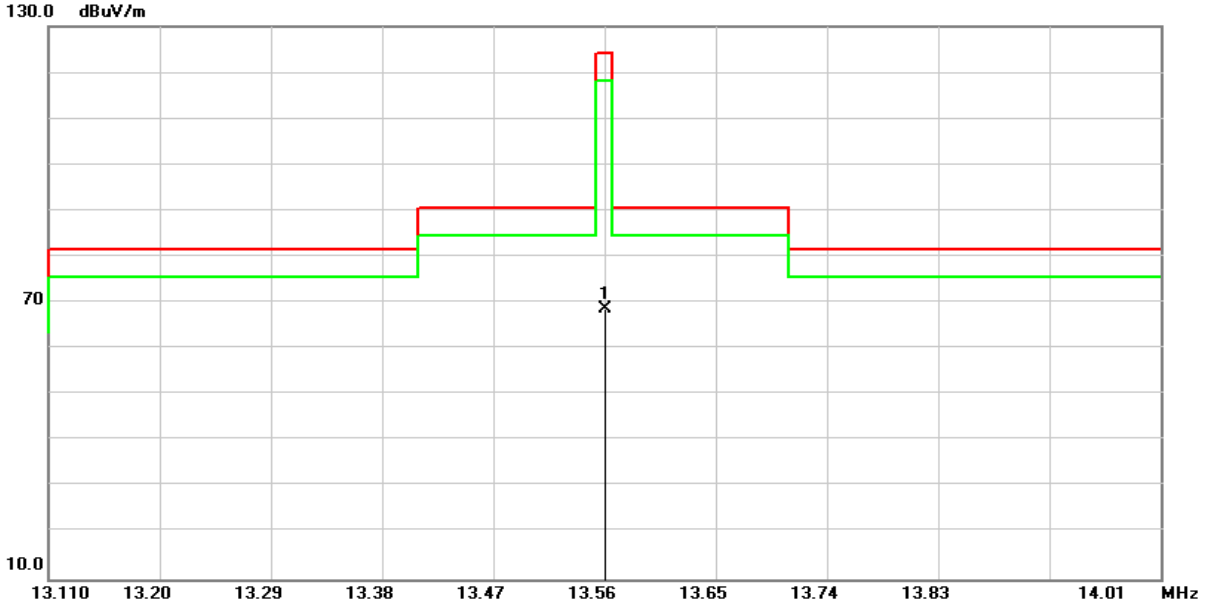



## 2.4.3 Test Procedure

1. For Fundamental emissions, use the receiver to measure QP reading.
2. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.
4. Compliance with the spectrum mask is tested with RBW = 9kHz.

## 2.4.4 Test Result

| | | | |
|---|---|---|---|
| **Test Mode :** | Mode 1：Transmit | **Test Date :** | 2023/09/18 |
| **Test Frequency :** | 13.56 MHz | **Temperature :** | 24.6 °C |
| **Polarization :** | Horizontal ; X axis | **Relative Humidity :** | 53 % |




| No. | Frequency (MHz) | Reading (dBuV/m) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 13.5600 | 47.43 | 21.29 | 68.72 | 124.00 | -55.28 | peak |

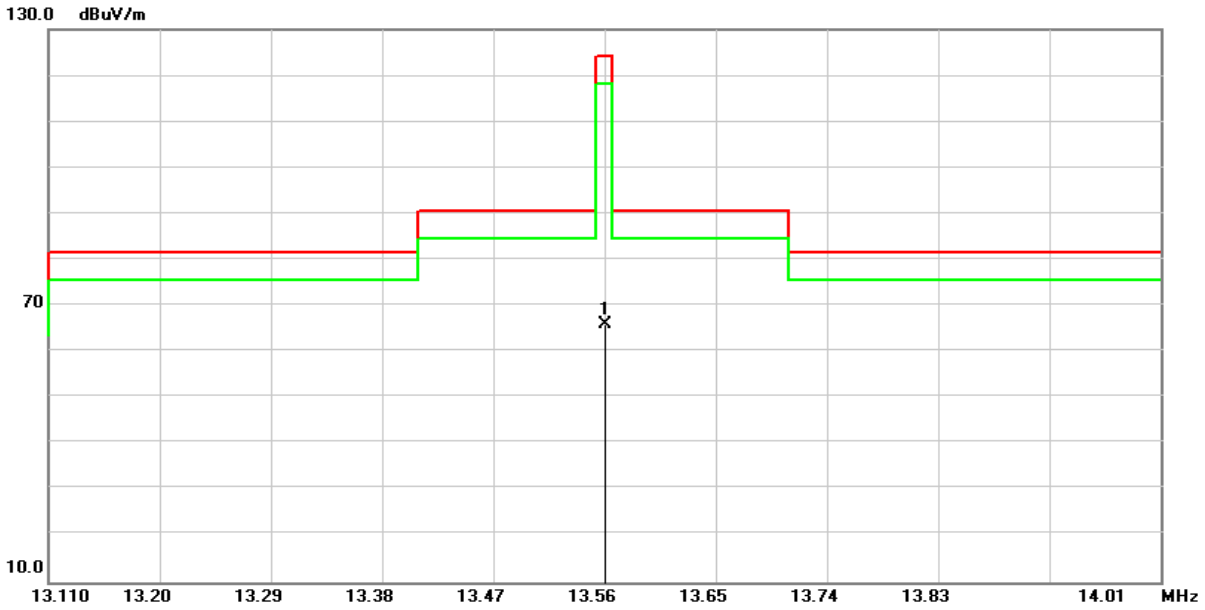
**Remark：**

(1) Correction Factor = Antenna factor + Cable loss – Amplifier gain

(2) Result Value = Reading Level + Correct Factor

(3) Margin Level = Measurement Value – Limit Value

| Test Mode : | Mode 1：Transmit | Test Date : | 2023/09/18 |
|---|---|---|---|
| Test Frequency : | 13.56 MHz | Temperature : | 24.6 °C |
| Polarization : | Vertical ; X axis | Relative Humidity : | 53 % |




| No. | Frequency (MHz) | Reading (dBuV/m) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 13.5600 | 44.59 | 21.29 | 65.88 | 124.00 | -58.12 | peak |

**Remark：**

(1) Correction Factor = Antenna factor + Cable loss – Amplifier gain

(2) Result Value = Reading Level + Correct Factor

(3) Margin Level = Measurement Value – Limit Value

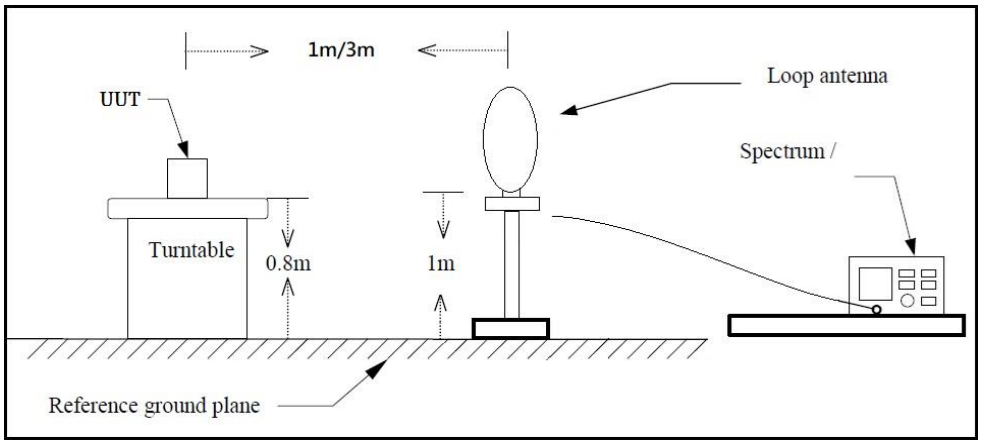
## 2.5 Radiated Emissions Measurement

### 2.5.1 Limit

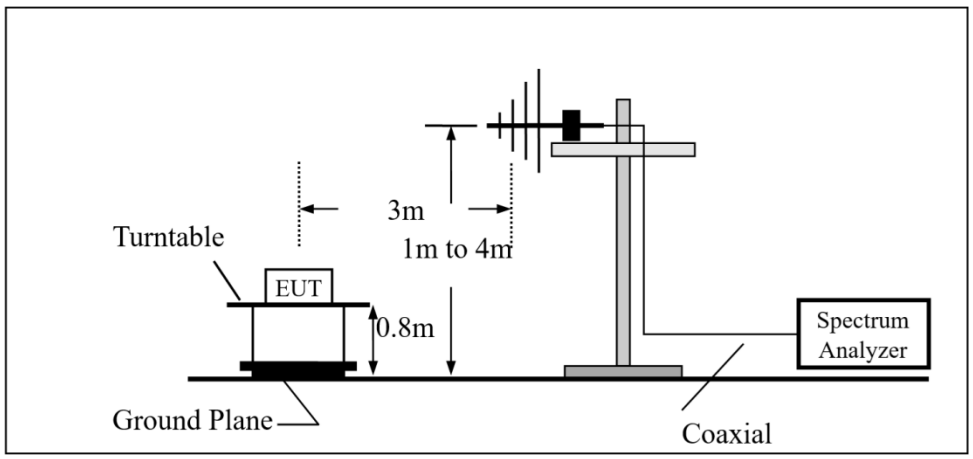
The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in Section 15.209. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205, must also comply with the radiated emission limits specified in Section 15.209

### 2.5.2 Test Setup

**Below 30MHz**




**Above 30MHz**



### 2.5.3 Test Procedure

The EUT was setup according to ANSI C63.10, 2013 for compliance to FCC 47CFR 15.225 requirements.

**For Radiated emission below 30MHz**

(1) The EUT was placed on the top of a rotating table 0.8 meters above the ground in a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.

(2) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

(3) Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.

(4) For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

(5) The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

**For Radiated emission Above 30MHz**

(1) The EUT was placed on the top of a rotating table 0.8 meters above the ground at 3 meter chamber room for the test. The table was rotated 360 degrees to determine the position of the highest radiation.

(2) The EUT was set 3 meters away from the interference-receiving antenna, the height of the antenna is varied from 1 meter to 4 meters above the ground to determine the maximum value of the field strength.

(3) Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.

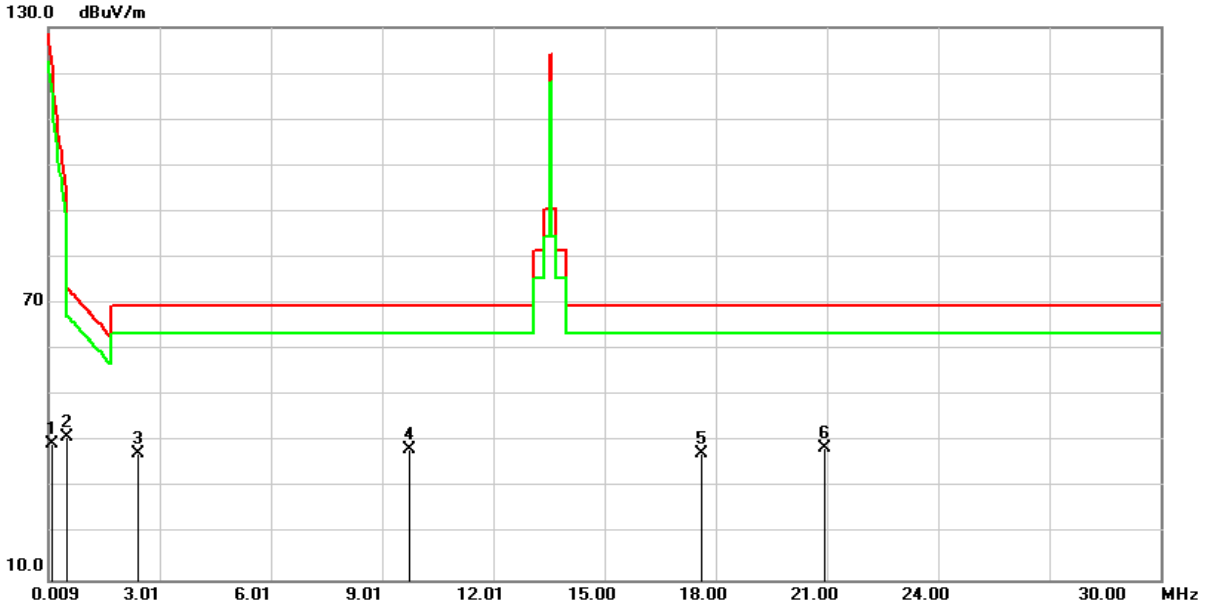
(4) For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

(5) The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

## 2.5.4 Test Result

**Below 30 MHz Data**

| | | | |
|---|---|---|---|
| **Test Mode :** | Mode 1：Transmit | **Test Date :** | 2023/09/18 |
| **Test Frequency :** | 13.56 MHz | **Temperature :** | 24.6 °C |
| **Polarization :** | Horizontal ; X axis | **Relative Humidity :** | 53 % |




| No. | Frequency (MHz) | Reading (dBuV/m) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 0.1064 | 20.62 | 18.83 | 39.45 | 107.07 | -67.62 | QP |
| 2 | 0.5082 | 21.88 | 19.31 | 41.19 | 73.48 | -32.29 | QP |
| 3 | 2.4186 | 18.16 | 19.24 | 37.40 | 69.54 | -32.14 | QP |
| 4 | 9.7020 | 17.36 | 21.06 | 38.42 | 69.54 | -31.12 | QP |
| 5 | 17.6421 | 15.06 | 22.26 | 37.32 | 69.54 | -32.22 | QP |
| 6 | 20.9553 | 16.54 | 22.19 | 38.73 | 69.54 | -30.81 | QP |

**Remark：**

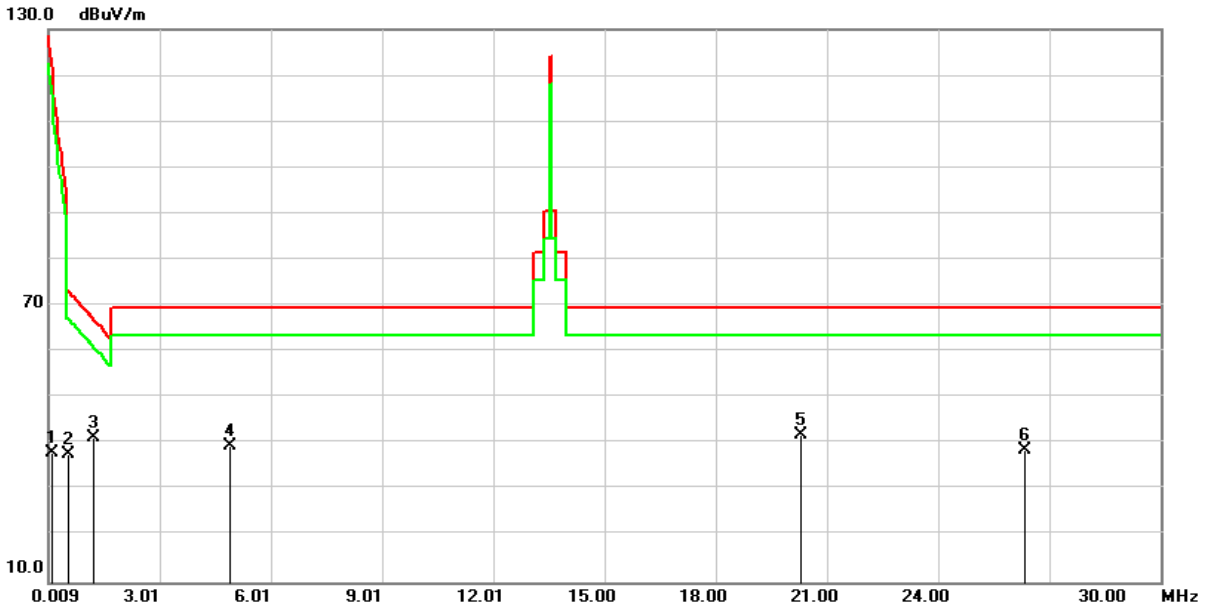
(1) Correction Factor = Antenna factor + Cable loss – Amplifier gain

(2) Result Value = Reading Level + Correct Factor

(3) Margin Level = Measurement Value – Limit Value

(4) The other emission levels were very low against the limit

| Test Mode : | Mode 1：Transmit | Test Date : | 2023/09/18 |
|---|---|---|---|
| Test Frequency : | 13.56 MHz | Temperature : | 24.6 ℃ |
| Polarization : | Vertical ; X axis | Relative Humidity : | 53 % |




| No. | Frequency (MHz) | Reading (dBuV/m) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 0.1070 | 19.36 | 18.83 | 38.19 | 107.02 | -68.83 | QP |
| 2 | 0.5328 | 18.50 | 19.31 | 37.81 | 73.07 | -35.26 | QP |
| 3 | 1.1947 | 21.93 | 19.32 | 41.25 | 66.06 | -24.81 | QP |
| 4 | 4.8961 | 19.75 | 19.67 | 39.42 | 69.54 | -30.12 | QP |
| 5 | 20.2987 | 19.54 | 22.38 | 41.92 | 69.54 | -27.62 | QP |
| 6 | 26.3285 | 15.91 | 22.72 | 38.63 | 69.54 | -30.91 | QP |

**Remark：**

(1) Correction Factor = Antenna factor + Cable loss – Amplifier gain

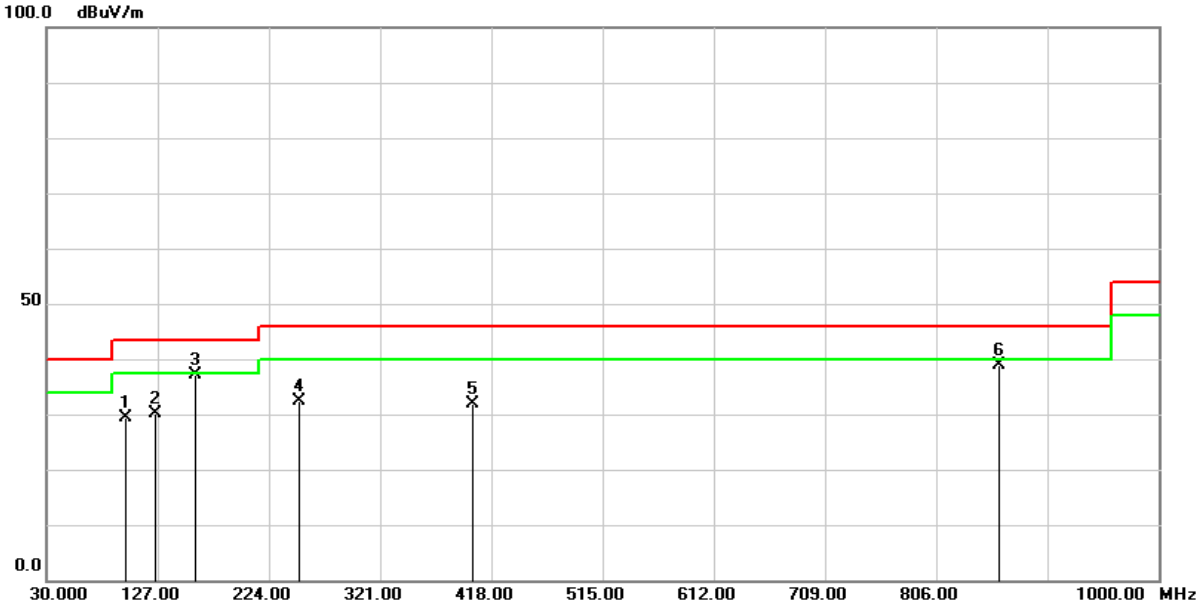
(2) Result Value = Reading Level + Correct Factor

(3) Margin Level = Measurement Value – Limit Value

(4) The other emission levels were very low against the limit

## Above 30MHz Data

| Test Mode : | Mode 1：Transmit | Test Date : | 2023/09/18 |
|---|---|---|---|
| Test Frequency : | 13.56 MHz | Temperature : | 24.6 °C |
| Polarization : | Horizontal | Relative Humidity : | 53 % |




| No. | Frequency (MHz) | Reading (dBuV/m) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 98.8700 | 45.16 | -15.90 | 29.26 | 43.50 | -14.24 | QP |
| 2 | 125.0600 | 43.38 | -13.15 | 30.23 | 43.50 | -13.27 | QP |
| 3 | 159.7450 | 48.15 | -10.92 | 37.23 | 43.50 | -6.27 | QP |
| 4 | 250.1900 | 44.45 | -12.11 | 32.34 | 46.00 | -13.66 | QP |
| 5 | 401.5100 | 38.96 | -7.17 | 31.79 | 46.00 | -14.21 | QP |
| 6 | 860.3200 | 36.39 | 2.61 | 39.00 | 46.00 | -7.00 | QP |

**Remark：**

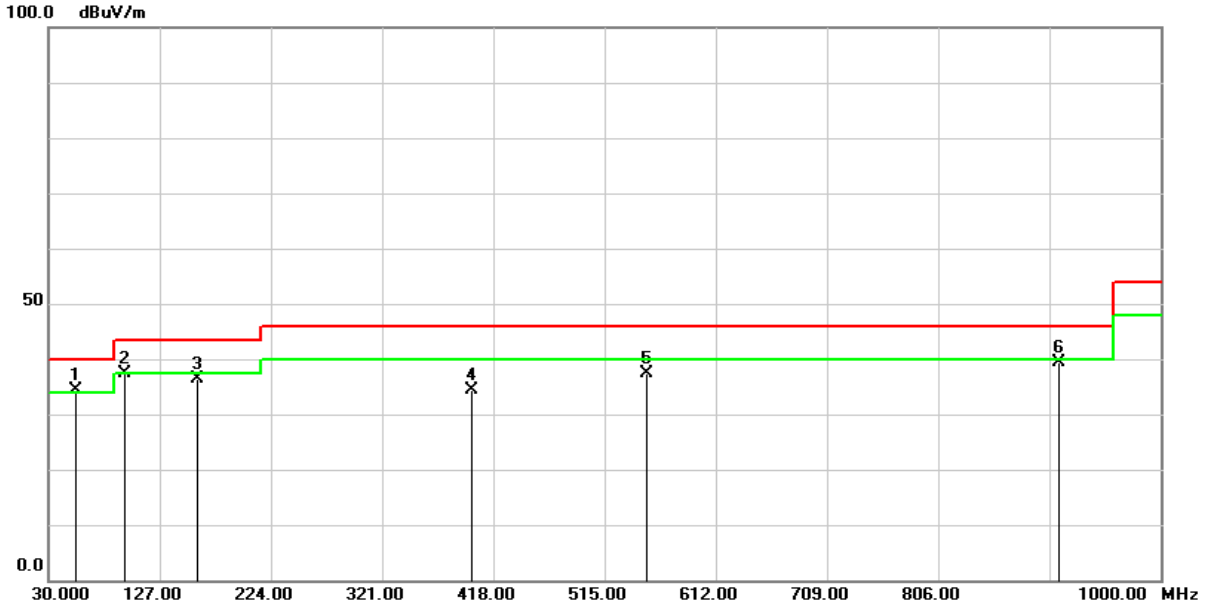
(1) Correction Factor = Antenna factor + Cable loss – Amplifier gain

(2) Result Value = Reading Level + Correct Factor

(3) Margin Level = Measurement Value –Limit Value

(4) The other emission levels were very low against the limit

| Test Mode : | Mode 1：Transmit | Test Date : | 2023/09/18 |
|---|---|---|---|
| Test Frequency : | 13.56 MHz | Temperature : | 24.6 °C |
| Polarization : | Vertical | Relative Humidity : | 53 % |




| No. | Frequency (MHz) | Reading (dBuV/m) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 54.2200 | 45.03 | -10.53 | 34.50 | 40.00 | -5.50 | QP |
| 2 | 95.9600 | 53.59 | -16.29 | 37.30 | 43.50 | -6.20 | QP |
| 3 | 159.9800 | 47.20 | -10.92 | 36.28 | 43.50 | -7.22 | QP |
| 4 | 398.6000 | 41.66 | -7.28 | 34.38 | 46.00 | -11.62 | QP |
| 5 | 551.8600 | 40.94 | -3.65 | 37.29 | 46.00 | -8.71 | QP |
| 6 | 912.0015 | 39.38 | 0.00 | 39.38 | 46.00 | -6.62 | QP |

**Remark：**

(1) Correction Factor = Antenna factor + Cable loss – Amplifier gain

(2) Result Value = Reading Level + Correct Factor

(3) Margin Level = Measurement Value –Limit Value

(4) The other emission levels were very low against the limit

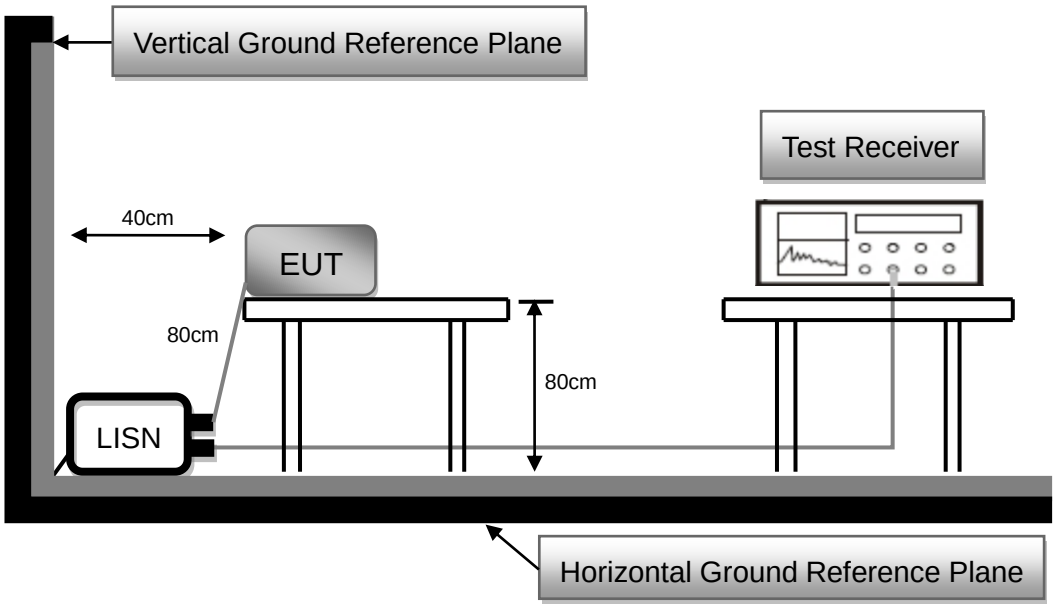
## 2.6 AC Conducted Emissions Measurement

### 2.6.1 Limit

| Frequency (MHz) | FCC Part 15 Subpart C Paragraph 15.207 (dBμV) Limit | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 to 0.5 | 66 to 56* | 56 to 46* |
| 0.50 to 5.0 | 56 | 46 |
| 5.0 to 30.0 | 60 | 50 |

*Decreases with the logarithm of the frequency

### 2.6.2 Test Setup



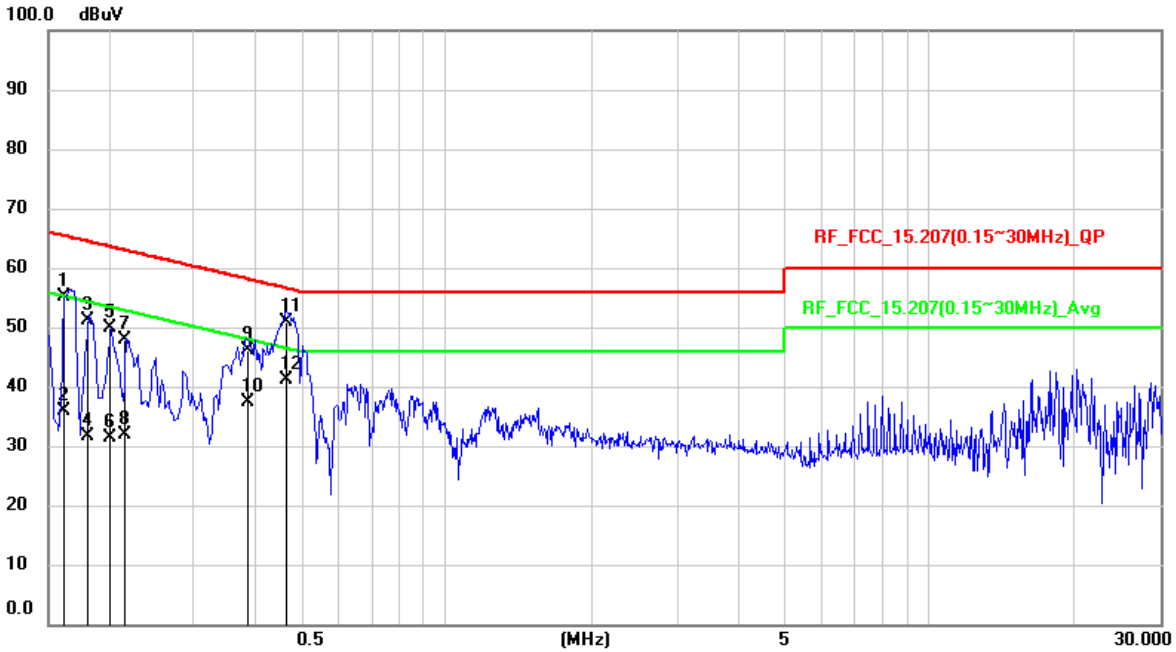
### 2.6.3 Test Procedure

1. The EUT was placed 0.8 meter height wooden table from the horizontal ground plane with EUT being connected to power source through a line impedance stabilization network (LISN). The LISN at least be 80 cm from nearest chassis of EUT.
2. The line impedance stabilization network (LISN) provides 50 ohm/50uH of coupling impedance for the measuring instrument. All other support equipments powered from additional LISN(s).
3. Interrelating cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle. All I/O cables were positioned to simulate typical usage.
4. All I/O cables that are not connected to a peripheral shall be bundle in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
5. The EMI test receiver connected to LISN powering the EUT. The actual test configuration, please refer to EUT test photos.
6. The receiver scanned from 150kHz to 30MHz for emissions in each of test modes. Conducted emissions were invested over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9kHz. A scan was taken on both power lines, Line and Neutral, recording at least six highest emissions.
7. The EUT and cable configuration of the above highest emission levels were recorded. The Test Data of the worst case was recorded.

Note: For a device with a permanent or detachable antenna operating at or below 30 MHz, the FCC will accept measurements performed with a suitable dummy load in lieu of the antenna.

## 2.6.4 Test Result

| | | | |
|---|---|---|---|
| **Test Voltage :** | 110Vac, 60Hz | **Frequency Range:** | 0.15-30 MHz |
| **Test Mode :** | Mode 1：Transmit | **6dB Bandwidth :** | 9 kHz |
| **Test Date :** | 2023/09/18 | **Phase :** | L |
| **Temperature :** | 24.6℃ | **Humidity :** | 42 % |

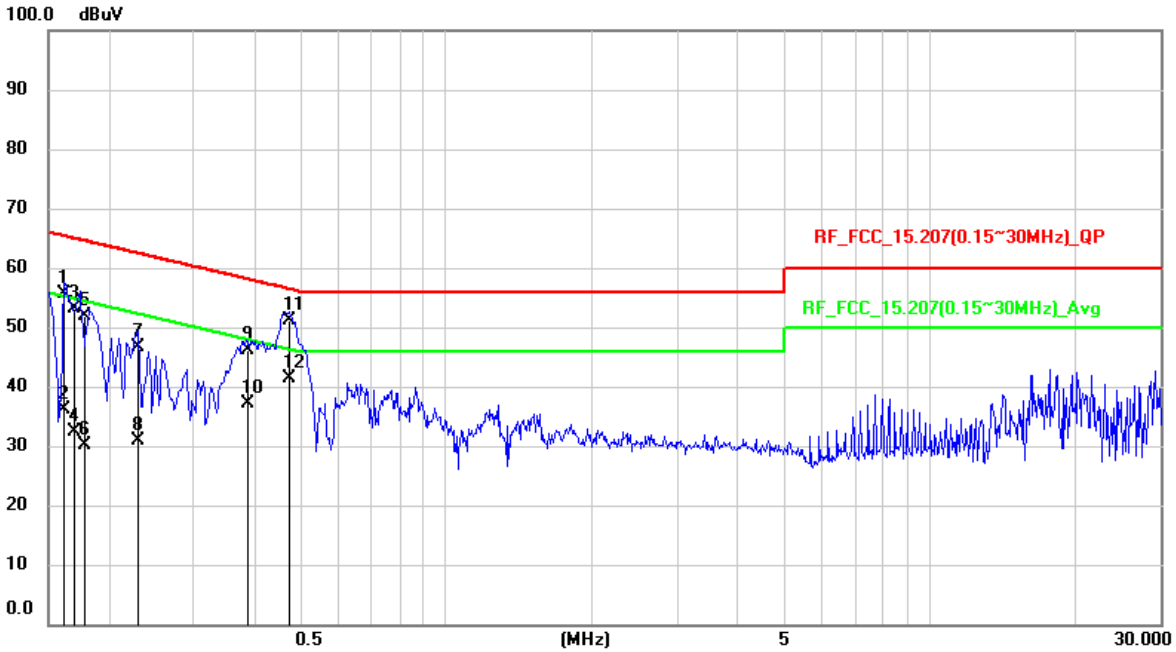



| No. | Frequency (MHz) | Reading Level (dBuV) | Correct Factor (dB) | Measurement (dBuV) | Limit (dBuV) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 0.1614 | 45.32 | 9.84 | 55.16 | 65.39 | -10.23 | QP |
| 2 | 0.1614 | 26 | 9.84 | 35.84 | 55.39 | -19.55 | AVG |
| 3 | 0.1802 | 41.41 | 9.82 | 51.23 | 64.48 | -13.25 | QP |
| 4 | 0.1802 | 21.77 | 9.82 | 31.59 | 54.48 | -22.89 | AVG |
| 5 | 0.2003 | 40.08 | 9.82 | 49.9 | 63.6 | -13.7 | QP |
| 6 | 0.2003 | 21.44 | 9.82 | 31.26 | 53.6 | -22.34 | AVG |
| 7 | 0.2147 | 38.13 | 9.82 | 47.95 | 63.02 | -15.07 | QP |
| 8 | 0.2147 | 21.99 | 9.82 | 31.81 | 53.02 | -21.21 | AVG |
| 9 | 0.3898 | 36.24 | 9.84 | 46.08 | 58.07 | -11.99 | QP |
| 10 | 0.3898 | 27.47 | 9.84 | 37.31 | 48.07 | -10.76 | AVG |
| 11 | 0.4686 | 41.16 | 9.84 | 51 | 56.54 | -5.54 | QP |
| 12 | 0.4686 | 31.41 | 9.84 | 41.25 | 46.54 | -5.29 | AVG |
| 13 | 0.1614 | 45.32 | 9.84 | 55.16 | 65.39 | -10.23 | QP |

Remark:

1. QP = Quasi Peak, AVG = Average
2. Correction Factor = Insertion loss of LISN + Cable loss
3. Measurement Value = Reading Level + Correct Factor
4. Margin Level = Measurement Value –Limit Value
5. * = The test frequency 13.56MHz is RF Tx

| | | | |
|---|---|---|---|
| **Test Voltage :** | 110Vac, 60Hz | **Frequency Range:** | 0.15-30 MHz |
| **Test Mode :** | Mode 1：Transmit | **6dB Bandwidth :** | 9 kHz |
| **Test Date :** | 2023/09/18 | **Phase :** | N |
| **Temperature :** | 24.6℃ | **Humidity :** | 42 % |




| No. | Frequency (MHz) | Reading Level (dBuV) | Correct Factor (dB) | Measurement (dBuV) | Limit (dBuV) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 0.162 | 45.87 | 9.84 | 55.71 | 65.36 | -9.65 | QP |
| 2 | 0.162 | 26.32 | 9.84 | 36.16 | 55.36 | -19.2 | AVG |
| 3 | 0.17 | 43.3 | 9.84 | 53.14 | 64.96 | -11.82 | QP |
| 4 | 0.17 | 22.58 | 9.84 | 32.42 | 54.96 | -22.54 | AVG |
| 5 | 0.1784 | 42.04 | 9.83 | 51.87 | 64.56 | -12.69 | QP |
| 6 | 0.1784 | 20.36 | 9.83 | 30.19 | 54.56 | -24.37 | AVG |
| 7 | 0.229 | 36.77 | 9.83 | 46.6 | 62.49 | -15.89 | QP |
| 8 | 0.229 | 20.96 | 9.83 | 30.79 | 52.49 | -21.7 | AVG |
| 9 | 0.3881 | 36.23 | 9.84 | 46.07 | 58.1 | -12.03 | QP |
| 10 | 0.3881 | 27.3 | 9.84 | 37.14 | 48.1 | -10.96 | AVG |
| 11 | 0.4718 | 41.33 | 9.84 | 51.17 | 56.48 | -5.31 | QP |
| 12 | 0.4718 | 31.55 | 9.84 | 41.39 | 46.48 | -5.09 | AVG |
| 13 | 0.162 | 45.87 | 9.84 | 55.71 | 65.36 | -9.65 | QP |

Remark:

1. QP = Quasi Peak, AVG = Average
2. Correction Factor = Insertion loss of LISN + Cable loss
3. Measurement Value = Reading Level + Correct Factor
4. Margin Level = Measurement Value –Limit Value
5. * = The test frequency 13.56MHz is RF Tx

**--- END ---**