# TEST REPORT

| | |
|---|---|
| **Product Name:** | RUGGED |
| **Trade Mark:** | VIX |
| **Model No.:** | RUGGED-AACA-R01 |
| **HVIN:** | RUGGED-AACA-R01 |
| **Report Number:** | 2209071437RFC-1 |
| **Test Standards:** | FCC 47 CFR Part 15 Subpart C<br>RSS-210 Issue 10<br>RSS-Gen Issue 5 |
| **FCC ID:** | 2AIKG-RUGGED |
| **IC:** | 25270-RUGGED |
| **Test Result:** | PASS |
| **Date of Issue:** | December 21, 2022 |

Prepared for:

**Vix Technology (Aust) Pty Ltd**
**Level 1, 50 St Georges Tce Perth, 6000 Australia**

Prepared by:

**Shenzhen UnionTrust Quality and Technology Co., Ltd.**
**Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and technology park, Longhua district, Shenzhen, China**
**TEL: +86-755-2823 0888**
**FAX: +86-755-2823 0886**

| | | | |
|---|---|---|---|
| Prepared by: | Kieron Luo<br>Project Engineer | Reviewed by: | Henry Lu<br>Team Leader |
| Approved by: | Kevin Wang<br>Assistant Manager | Date: | December 21, 2022 |

# Version

| Version No. | Date | Description |
|---|---|---|
| V1.0 | December 21, 2022 | Original |

# CONTENTS

# 1. GENERAL INFORMATION

## 1.1 CLIENT INFORMATION

| | |
|---|---|
| **Applicant:** | Vix Technology (Aust) Pty Ltd |
| **Address of Applicant:** | Level 1, 50 St Georges Tce Perth, 6000 Australia |
| **Manufacturer:** | Vix Technology (Aust) Pty Ltd |
| **Address of Manufacturer:** | Level 1, 50 St Georges Tce Perth, 6000 Australia |

## 1.2 EUT INFORMATION

### 1.2.1 General Description of EUT

| | | |
|---|---|---|
| **Product Name:** | RUGGED | |
| **Model No.:** | RUGGED-AACA-R01 | |
| **Add. Model No.:** | See Note | |
| **HVIN** | RUGGED-AACA-R01 | |
| **Trade Mark:** | VIX | |
| **DUT Stage:** | Identical Prototype | |
| **EUT Supports Function:** (Provided by the customer) | NFC: | 13.553 MHz to 13.567 MHz |
| **Sample Received Date:** | September 1, 2022 | |
| **Sample Tested Date:** | September 21, 2022 to October 17, 2022 | |

**Note:** The following is a breakdown of the EUT part numbers:

RUGGED - * * * * - * * *
1 2 3 4 5 6

1: Defines the product name, in this case **RUGGED** for Rugged Validator.
2: Defines the mechanical configuration of the device. There is currently only one configuration available:
- **A:** Pole Mount

3: Defines the type of memory for the device. There is currently only one memory type available:
- **A:** 1GB DDR3L SDRAM and 2GB NAND Flash

4: Defines the optional features (Bar Code & QR Reader / 4G & 3G & 2G / 2.4GHz WiFi & Bluetooth) available in the model. Currently the following options are available:
- **A:** With Bar Code & QR Reader
- **B:** No added optional features (but no Touch Screen)
- **C:** With Bar Code & QR Reader / 4G & 3G & 2G / 2.4GHz WiFi & Bluetooth
- **D:** No added optional features (Standard model)
- **E:** With 2.4GHz WiFi & Bluetooth
- **F:** With 4G & 3G & 2G / 2.4GHz WiFi & Bluetooth
- **G:** With Bar Code & QR Reader / 2.4GHz WiFi & Bluetooth

*Note: Different combinations may be added in the future, but their included features will still be within the ones available in the fully featured C variant listed above (i.e. Touch Screen / Bar code & QR reader / 4G & 3G & 2G / 2.4GHz WiFi & Bluetooth).*

5: Defines the aesthetics and artwork for the device. Currently the following options are available:
- **A:** Standard Front Casing / Standard Rear Casing / Standard Glass Artwork
- **B:** Standard Front Casing / Standard Rear Casing / Custom-01 Glass Artwork

*Note: Different options may be added in the future based on customer requirement.*

6: Defines the device version number.
- **R01:** Revision 1

The test device is the RUGGED-AACA-R01 model, which includes all optional electronics peripheral features. The test data is gathered from a production sample (RUGGED-AACA-R01), provided by the manufacturer.

**Manufacturer discrepancy declaration letter:**

Assure Rugged Validator Model Variations Declaration

## Assure Rugged Validator Model Variations Declaration

We hereby confirm that the test report covers all the model numbers fall under ***RUGGED-****-****
Where the detailed explanation of the model number breakdown is as follows:

| RUGGED | - | * | * | * | * | - | * | * | * |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 2 | 3 | 4 | 5 | | 6 | | |

**1:** Defines the product name, in this case **RUGGED** for Rugged Validator.

**2:** Defines the mechanical configuration of the device. There is currently only one configuration available:
- **A:** Pole Mount

**3:** Defines the type of memory for the device. There is currently only one memory type available:
- **A:** 1GB DDR3L SDRAM and 2GB NAND Flash

**4:** Defines the optional features (Bar Code & QR Reader / 4G & 3G & 2G / 2.4GHz WiFi & Bluetooth) available in the model. Currently the following options are available:
- **A:** With Bar Code & QR Reader
- **B:** No added optional features (but no Touch Screen)
- **C:** With Bar Code & QR Reader / 4G & 3G & 2G / 2.4GHz WiFi & Bluetooth
- **D:** No added optional features (Standard model)
- **E:** With 2.4GHz WiFi & Bluetooth
- **F:** With 4G & 3G & 2G / 2.4GHz WiFi & Bluetooth
- **G:** With Bar Code & QR Reader / 2.4GHz WiFi & Bluetooth

*Note: Different combinations may be added in the future, but their included features will still be within the ones available in the fully featured C variant listed above (i.e. Touch Screen / Bar code & QR reader / 4G & 3G & 2G / 2.4GHz WiFi & Bluetooth).*

**5:** Defines the aesthetics and artwork for the device. Currently the following options are available:
- **A:** Standard Front Casing / Standard Rear Casing / Standard Glass Artwork
- **B:** Standard Front Casing / Standard Rear Casing / Custom-01 Glass Artwork

*Note: Different options may be added in the future based on customer requirement.*

**6:** Defines the device version number.
- **R01:** Revision 1

The device used for the compliance testing is the **RUGGED-AACA-R01** model, which covers all the optional electronics peripheral features that are available to the Rugged Validator. There may be different model variants added in the future, but as per mentioned in the above detailed part number explanation, their optional electronics peripheral features will still be within the options included in the **RUGGED-AACA-R01** model.

Should you have any questions or comments regarding this matter, please have my best attention.

Sincerely,

Jiali (Carrie) Huang
***Senior Hardware Engineer***

*Vix Technology (Aust) Pty Ltd*
*Level 1, 50 St Georges Tce Perth, 6000 Australia*
*steven.yeh@vixtechnology.com*
*+61 8 6180 4600*

Date: 21/11/2022

DPU-00158
Revision 1.0

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### 1.2.2 Description of Accessories

None.

## 1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

| | |
|---|---|
| **Frequency Band:** | 13.110 MHz to 14.010 MHz |
| **Nominal Operating Frequency:** | 13.56 MHz |
| **Work in Modes:** | ☐ Card Emulation |
| | ☑ Reader/Writer |
| | ☐ Peer-to-Peer |
| **NFC Type:** | ☑ NFC A Type |
| | ☑ NFC B Type |
| | ☑ NFC F Type |
| | ☑ NFC VType |
| **Max. Data Rates:** | 848 Kbps |
| **Type of Modulation:** | ASK |
| **Number of Channels:** | 1 |
| **Antenna Type:** | PCB Antenna |
| **Maximum Field Strength:** | 72.61 dBμV/m at 3 meter |
| **Normal Test Voltage:** | 24 Vdc |
| **Extreme Test Voltage:** | 9 to 39 Vdc |
| **Extreme Test Temperature:** | -30 °C to +55 °C |

## 1.4 OTHER INFORMATION

None

## 1.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested with associated equipment below.

1) Support Equipment

| Description | Manufacturer | Model No. | Serial Number | Supplied by |
|---|---|---|---|---|
| Notebook | Lenovo | E450 | SL10G10780 | UnionTrust |
| Mouse | DELL | MS111 | CN-011D3V-738 | UnionTrust |
| Wireless Router | ASUA | RT-AC2200 | 2019AJ4850 | UnionTrust |
| Docking station | UGREEN | N/A | N/A | UnionTrust |
| Power over Ethernet Injector | Cisco | MA-INJ-4 | QS-6593-01N A02 | Applicant |

2) Support Cable

| Cable No. | Description | Connector | Length(Meter) | Supplied by |
|---|---|---|---|---|
| 1 | Ethernet Cable | RJ45 | 1.5 Unshielded without ferrite | UnionTrust |
| 2 | Ethernet Cable | RJ45 | 2.0 Unshielded without ferrite | UnionTrust |
| 3 | Ethernet Cable | RJ45 | 5.0 Shielded without ferrite | UnionTrust |
| 4 | Cable | RS-232 | 1.8 Shielded with two ferrite | UnionTrust |

## 1.6 TEST LOCATION

**Shenzhen UnionTrust Quality and Technology Co., Ltd.**

Address: Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and technology park, Longhua district, Shenzhen, China, China 518109
Telephone: +86 (0) 755 2823 0888
Fax: +86 (0) 755 2823 0886

## 1.7 TEST FACILITY

The test facility is recognized, certified, or accredited by the following organizations:

**CNAS-Lab Code: L9069**
The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

**A2LA-Lab Certificate No.: 4312.01**
Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

**ISED Wireless Device Testing Laboratories**
CAB identifier: CN0032

**FCC Accredited Lab.**
Designation Number: CN1194
Test Firm Registration Number: 259480

## 1.8 DEVIATION FROM STANDARDS

None.

## 1.9 ABNORMALITIES FROM STANDARD CONDITIONS

None.

## 1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

## 1.11 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product 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.

| No. | Item | Measurement Uncertainty |
|---|---|---|
| 1 | Conducted emission 9KHz-150KHz | ±3.2 dB |
| 2 | Conducted emission 150KHz-30MHz | ±2.7 dB |
| 3 | Radiated emission 9KHz-30MHz | ± 4.7 dB |
| 4 | Radiated emission 30MHz-1GHz | ± 4.9 dB |
| 5 | Radiated emission 1GHz-18GHz | ± 4.8 dB |
| 6 | Radiated emission 18GHz-26GHz | ± 5.1 dB |
| 7 | Radiated emission 26GHz-40GHz | ± 5.1 dB |
| 8 | Occupied Bandwidth | ± 1.86 % |

## 2. TEST SUMMARY

| FCC 47 CFR Part 15 Subpart C Test Cases | | | |
|---|---|---|---|
| **Test Item** | **Test Requirement** | **Test Method** | **Result** |
| **Antenna Requirement** | FCC 47 CFR Part 15 Subpart C Section 15.203<br>RSS-Gen Issue 5, Section 6.8 | N/A | PASS |
| **AC Power Line Conducted Emission** | FCC 47 CFR Part 15 Subpart C Section 15.207<br>RSS-Gen Issue 5, Section 8.8 | ANSI C63.10-2013 Clause 6.2 | PASS |
| **The field strength of any emissions appearing outside of the 13.110-14.010 MHz band** | FCC 47 CFR Part 15 Subpart C Section 15.225(d) /15.209<br>RSS-210 Issue 10, Annex B.6<br>RSS-Gen Issue 5, section 8.9 | ANSI C63.10-2013 Section 6.3/ 6.4/ 6.5 | PASS |
| **Fundamental Field Strength and Emission Mask 13.110 MHz to 14.010 MHz** | FCC 47 CFR Part 15 Subpart C Section 15.227(a) (b) (c) /15.205<br>RSS-210 Issue 10, Annex B.6<br>RSS-Gen Issue 5, section 8.9 | ANSI C63.10-2013 Section 6.3/ 6.4 | PASS |
| **99% & 20DB Bandwidth** | FCC 47 CFR Part 15 Subpart C Section 15.215(c)<br>RSS-Gen Issue 5, section 6.7 | ANSI C63.10-2013 Section 6.9 | Pass |
| **Frequency Tolerance** | FCC 47 CFR Part 15 Subpart C Section 15.225(e)<br>RSS-210 Issue 10, Annex B.6 | ANSI C63.10-2013 Section 6.8 | Pass |
| **Note:**<br>1) N/A: In this whole report not applicable. | | | |

# 3. EQUIPMENT LIST

| Radiated Emission Test Equipment List | | | | | | |
|---|---|---|---|---|---|---|
| **Used** | **Equipment** | **Manufacturer** | **Model No.** | **Serial Number** | **Cal. date (mm dd, yyyy)** | **Cal. Due date (mm dd, yyyy)** |
| ☒ | 3m SAC | ETS-LINDGREN | 3m | Euroshiedpn-CT001270-1317 | Jan. 22, 2021 | Jan. 21, 2024 |
| ☒ | Receiver | R&S | ESIB26 | 100114 | Nov. 05, 2021 | Nov. 04, 2022 |
| ☒ | Loop Antenna | ETS-LINDGREN | 6502 | 00202525 | Nov. 11, 2021 | Nov. 10, 2023 |
| ☒ | Broadband Antenna | ETS-LINDGREN | 3142E | 00201566 | Nov. 11, 2021 | Nov. 10, 2023 |
| ☒ | 6dB Attenuator | Talent | RA6A5-N-18 | 18103001 | Nov. 11, 2021 | Nov. 10, 2023 |
| ☒ | Preamplifier | HP | 8447F | 2805A02960 | Nov. 05, 2021 | Nov. 04, 2022 |
| ☒ | Multi device Controller | ETS-LINDGREN | 7006-001 | 00160105 | N/A | N/A |
| ☒ | Test Software | Audix | e3 | Software Version: 9.160323 | | |

| Conducted Emission Test Equipment List | | | | | | |
|---|---|---|---|---|---|---|
| **Used** | **Equipment** | **Manufacturer** | **Model No.** | **Serial Number** | **Cal. date (mm dd, yyyy)** | **Cal. Due date (mm dd, yyyy)** |
| ☒ | Receiver | R&S | ESR7 | 101181 | Nov. 05, 2021 | Nov. 04, 2022 |
| ☒ | Pulse Limiter | R&S | ESH3-Z2 | 0357.8810.54 | Nov. 05, 2021 | Nov. 04, 2022 |
| ☒ | LISN | R&S | ESH2-Z5 | 860014/024 | Nov. 05, 2021 | Nov. 04, 2022 |
| ☒ | LISN | ETS-Lindgren | 3816/2SH | 00201088 | Nov. 05, 2021 | Nov. 04, 2022 |
| ☒ | Test Software | Audix | e3 | Software Version: 9.160323 | | |

| Conducted RF test Equipment List | | | | | | |
|---|---|---|---|---|---|---|
| **Used** | **Equipment** | **Manufacturer** | **Model No.** | **Serial Number** | **Cal. date (mm dd, yyyy)** | **Cal. Due date (mm dd, yyyy)** |
| ☒ | Spectrum analyzer | R&S | FSV40-N | 101653 | Apr. 15, 2022 | Apr. 14, 2023 |
| ☒ | DC Source | KIKUSUI | PWR400L | LK003024 | N/A | N/A |
| ☒ | Digital multimeter | FLUKE | 15B+ | 30701460WS15 | Nov. 12, 2021 | Nov. 11, 2022 |
| ☒ | Temp & Humidity chamber | Votisch | VT4002 | 58566133290020 | Apr. 15, 2022 | Apr. 14, 2023 |

# 4. TEST CONFIGURATION

## 4.1 ENVIRONMENTAL CONDITIONS FOR TESTING

### 4.1.1 Normal or Extreme Test Conditions

| Test Environment | Selected Values During Tests | | |
|---|---|---|---|
| Test Condition | Ambient | | |
| | Temperature (°C) | Voltage (V) | Relative Humidity (%) |
| TN/VN | +15 to +35 | 24 | 20 to 75 |
| TL/VL | -30 | 9 | 20 to 75 |
| TH/VL | +55 | 9 | 20 to 75 |
| TL/VH | -30 | 39 | 20 to 75 |
| TH/VH | +55 | 39 | 20 to 75 |

**Remark:**

1) The EUT just work in such extreme temperature of -30 °C to +55 °C and the extreme voltage of 9 V to 39 V, so here the EUT is tested in the temperature of -30 °C to +55 °C and the voltage of 9 V to 39 V.
2) VN: Normal Voltage; TN: Normal Temperature;
TL: Low Extreme Test Temperature; TH: High Extreme Test Temperature;
VL: Low Extreme Test Voltage; VH: High Extreme Test Voltage.

### 4.1.2 Record of Normal Environment and Test Sample

| Test Item | Temperature (°C) | Relative Humidity (%) | Pressure (kPa) | Sample No. | Tested by |
|---|---|---|---|---|---|
| Conducted Emission | 23.5 | 37.9 | 99.75 | S202209014 26-ZJA01/1 | David Zhang |
| The field strength of any emissions appearing outside of the 13.110-14.010 MHz band | 25.1 | 58.3 | 100.1 | | Fire Huo |
| Fundamental Field Strength and Emission Mask 13.110 MHz to 14.010 MHz | 25.1 | 58.3 | 100.1 | | |
| 99%&20DB Bandwidth | 25.1 | 58.3 | 100.1 | | |

## 4.2 TEST CHANNELS

| Frequency | Test RF Channel |
|---|---|
| 13.56 MHz | Channel 1 |
| | 13.56 MHz |

## 4.3 EUT TEST STATUS

| Frequency | Tx Function | Description |
|---|---|---|
| 13.56 MHz | 1Tx | 1. Keep the EUT in continuously transmitting during the test. |

## 4.4 PRE-SCAN

### 4.4.1 Used for testing of worst-case data rates

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, work in modes and data rates. Selected for the final test as listed below.

| Frequency | Work in Modes | Type | Data Rate (Kbps) |
|---|---|---|---|
| 13.56 MHz | ☐ Card Emulation<br>☑ Reader/Writer<br>☐ Peer-to-Peer | ☑ A<br>☐ B<br>☐ F<br>☐ V | ☐ 106<br>☐ 212<br>☐ 424<br>☑ 848 |
| **Remark:**<br>The mark"☑" means is chosen for testing;<br>The mark"☐" means is not chosen for testing. | | | |

## 4.5 TEST SETUP

### 4.5.1 For Radiated Emissions test setup

**Figure 1. Below 30MHz**

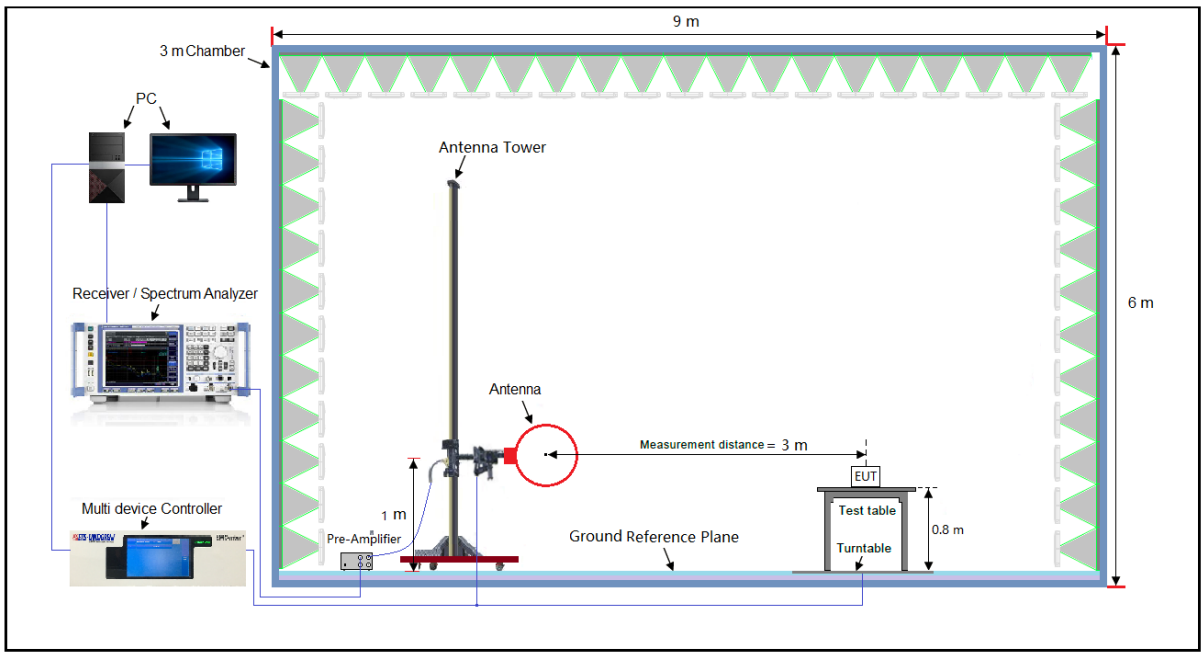
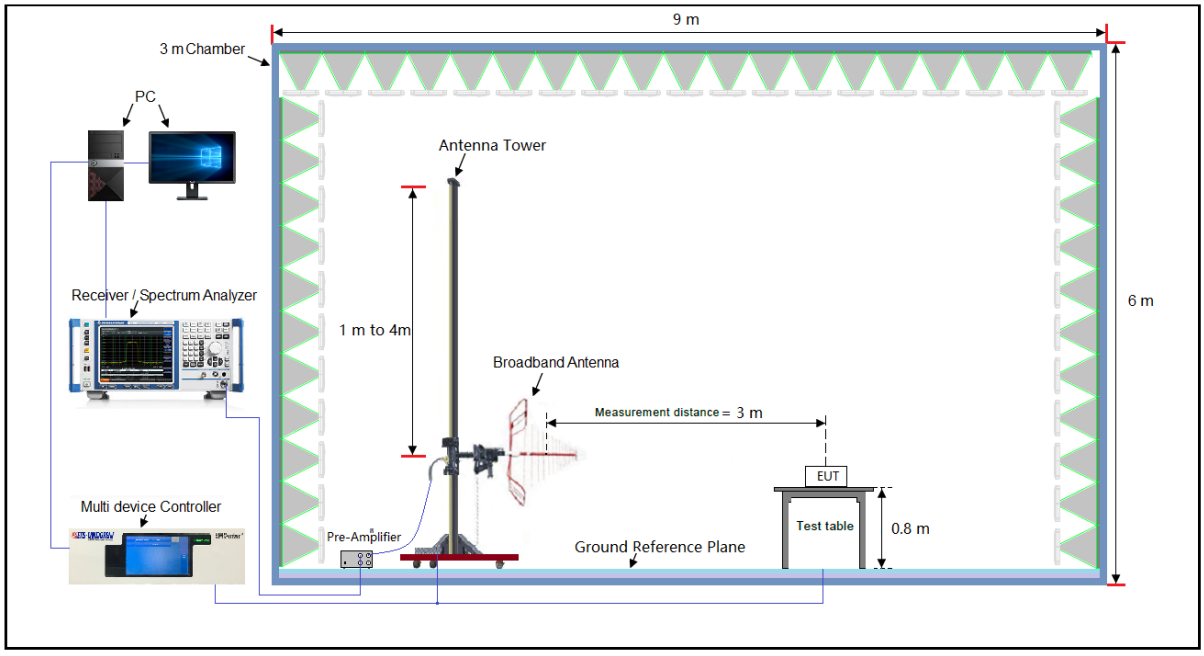
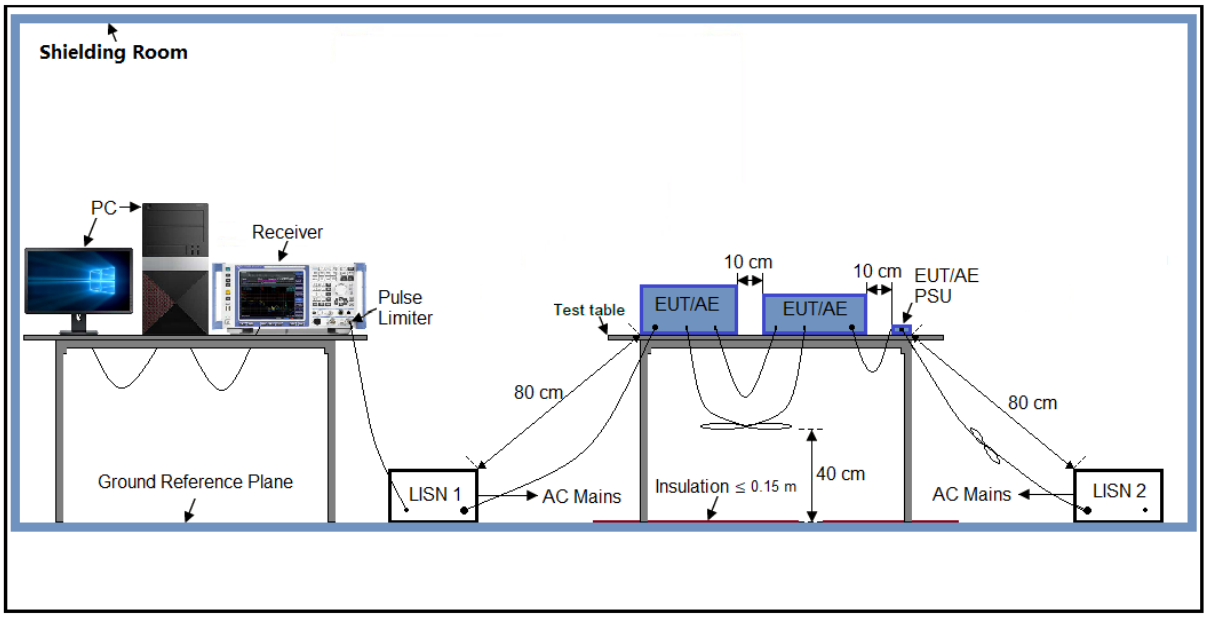


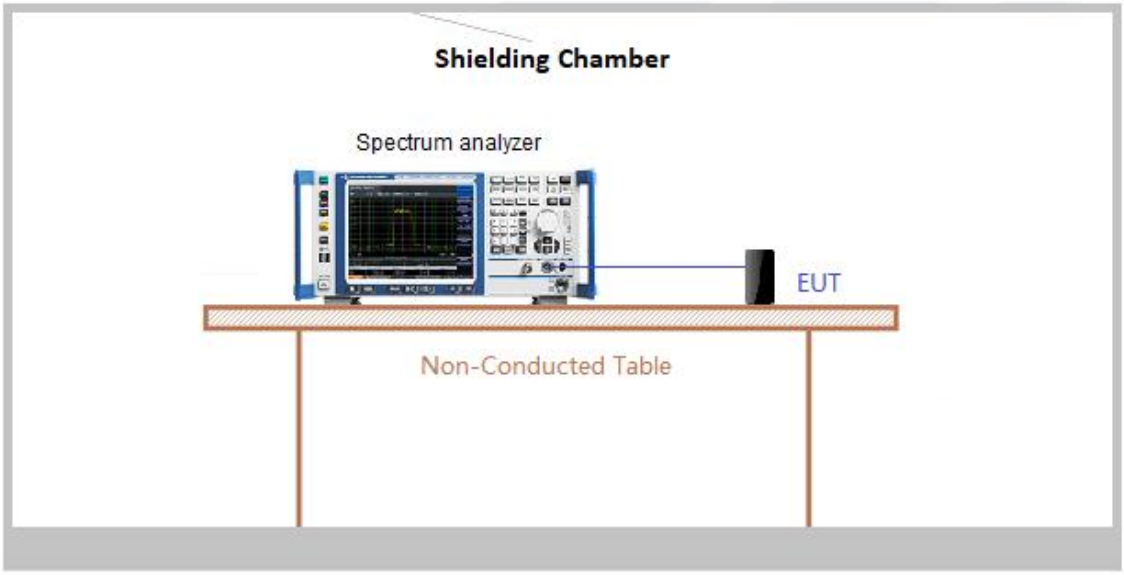

**Figure 2. 30MHz to 1GHz**



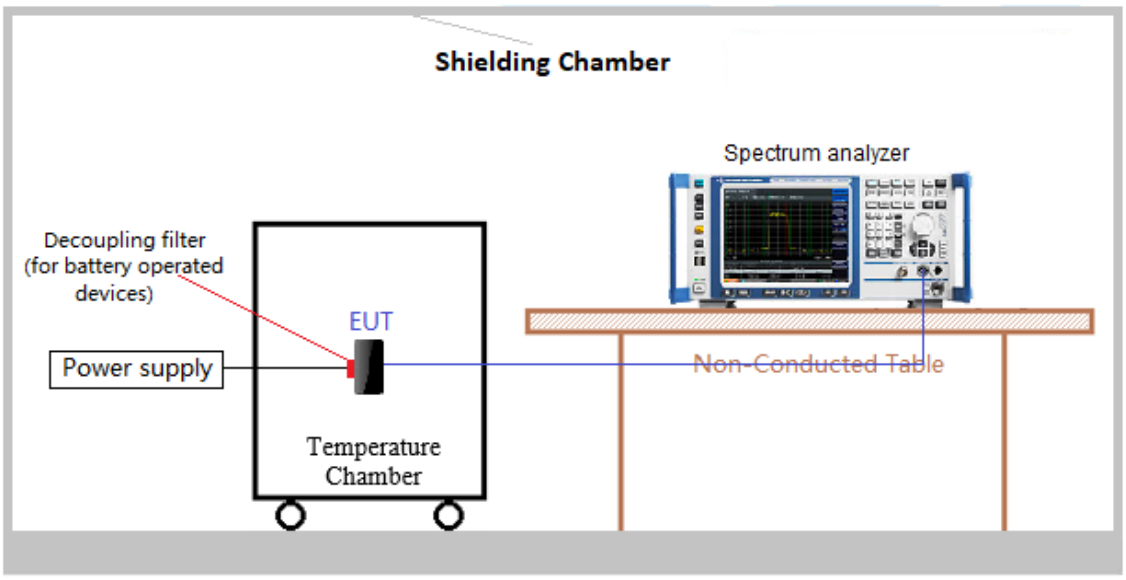
### 4.5.2 For Conducted Emissions test setup




### 4.5.3 For Conducted RF test setup




Normal Environment




Extreme Environment

## 4.6 SYSTEM TEST CONFIGURATION

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, radiated emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.Only the worst case data were recorded in this test report.

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000 MHz. The resolution is 1 MHz or greater for frequencies above 1000 MHz. The spurious emissions more than 20 dB below the permissible value are not reported.

Radiated emission measurement were performed from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

# 5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION

## 5.1 REFERENCE DOCUMENTS FOR TESTING

| No. | Identity | Document Title |
|---|---|---|
| 1 | FCC 47 CFR Part 15 | Radio Frequency Devices |
| 2 | ANSI C63.10-2013 | American National Standard for Testing Unlicesed Wireless Devices |
| 3 | RSS-Gen Issue 5 | General Requirements for Compliance of Radio Apparatus |
| 4 | RSS-210 Issue 10 | Licence-Exempt Radio Apparatus: Category I Equipment |

## 5.2 ANTENNA REQUIREMENT

| Standard Requirement |
|---|
| **15.203& requirement:**<br>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, 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.<br>**RSS-Gen Issue 5, Section 6.8 requirement:**<br>According to RSS-Gen Issue 5, Section 6.8, a transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. |
| **EUT Antenna:** |
| This product has a permanent antenna, fulfill the requirement of this section. |

## 5.3 99% & 20DB BANDWIDTH

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.215(c)
RSS-Gen Issue 5, section 6.7

**Test Method:** ANSI C63.10-2013 Section 6.9

**Limit:** Operation within the band 13.110 MHz to 14.010 MHz

**Requirement :** Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that 20dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equip compliance with the 20dB attenuation specification may base on measurement at the intentional radiator's antenna output terminal unless the intentional radiator uses a permanently attached antenna, in which case compliance shall be. Demonstrated by measuring the radiated emissions.

**Test Procedure:** Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
Use the following spectrum analyzer settings:

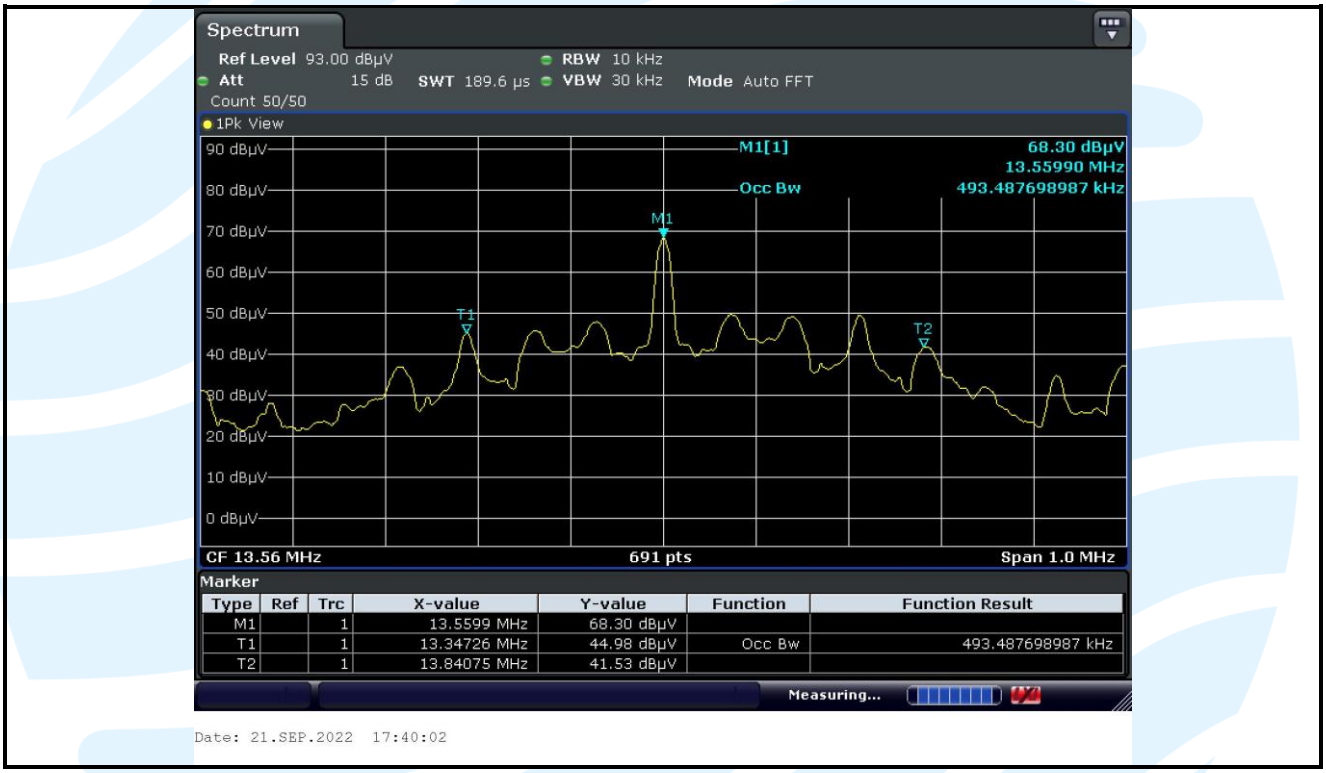
a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency
b) Span = approximately 2 to 5 times the OBW
c) RBW = 1% to 5%of the OBW
d) VBW ≥ 3*RBW
e) Sweep = auto;
f) Detector function = peak
g) Trace = max hold
h) All the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission, use the marker-delta function to measure and record the 20dB down bandwidth of the emission.

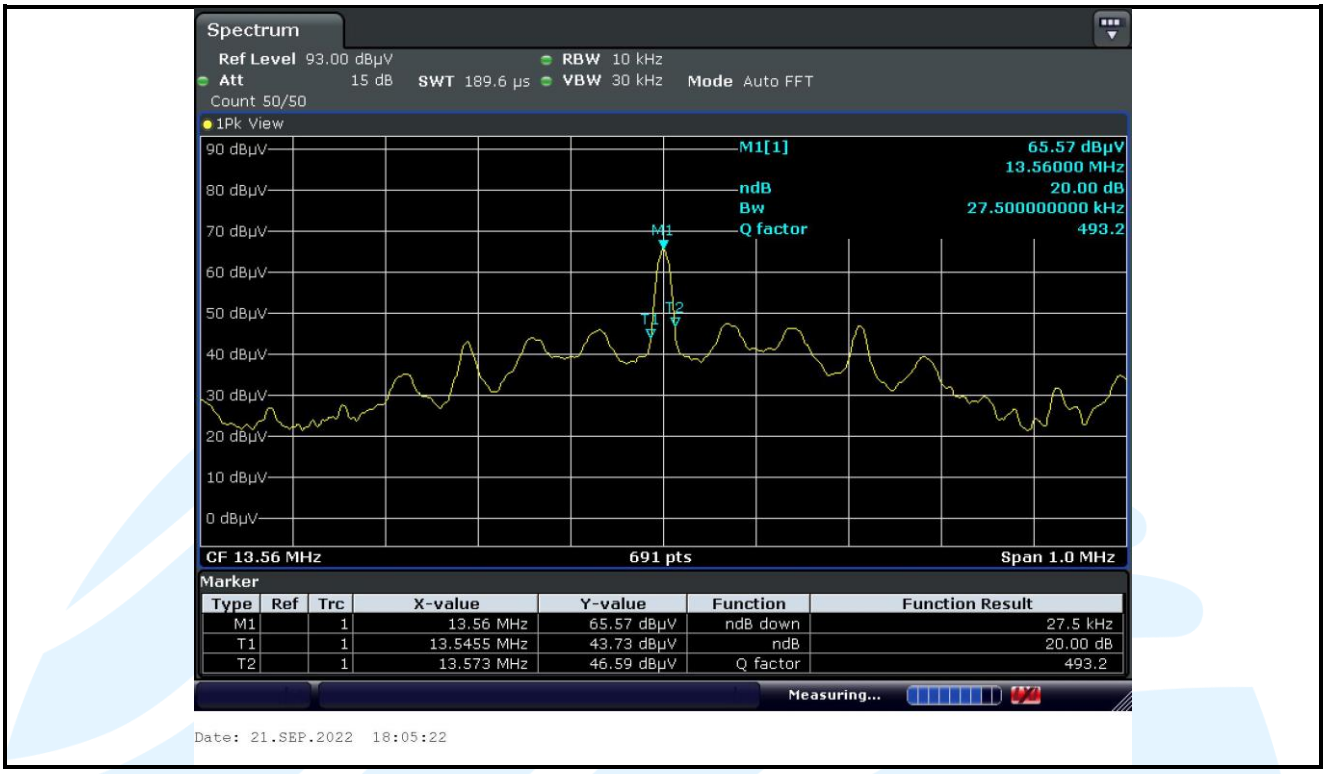
Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

**Test Setup:** Refer to section 4.5.3 for details.
**Instruments Used:** Refer to section 3 for details
**Test Mode:** Transmitter mode
**Test Results:** Pass
**Test Data:**

| Frequency (MHz) | 20 dB Bandwidth (kHz) | 99% dB Bandwidth (kHz) | Limit | Pass / Fail |
|---|---|---|---|---|
| 13.56 MHz | 27.5 | 493.49 | Operation within the band 13.110 MHz to 14.010 MHz | Pass |

**The test plot as follows:**




Spectrum
Ref Level 93.00 dBµV
RBW 10 kHz
Att 15 dB
SWT 189.6 µs
VBW 30 kHz
Mode Auto FFT
Count 50/50
1Pk View
M1[1]
65.57 dBµV
13.56000 MHz
ndB
20.00 dB
Bw
27.500000000 kHz
Q factor
493.2
90 dBµV
80 dBµV
70 dBµV
60 dBµV
50 dBµV
40 dBµV
30 dBµV
20 dBµV
10 dBµV
0 dBµV
M1
T1
T2
CF 13.56 MHz
691 pts
Span 1.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 13.56 MHz 65.57 dBµV ndB down 27.5 kHz
T1 1 13.5455 MHz 43.73 dBµV ndB 20.00 dB
T2 1 13.573 MHz 46.59 dBµV Q factor 493.2
Measuring...
Date: 21.SEP.2022 18:05:22

## 5.4 THE FIELD STRENGTH OF ANY EMISSIONS APPEARING OUTSIDE OF THE 13.110-14.010 MHZ BAND

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.225(d) /15.209
RSS-210 Issue 10, Annex B.6
RSS-Gen Issue 5, section 8.9

**Test Method:** ANSI C63.10-2013 Section 6.3/ 6.4/ 6.5

**Receiver Setup:**

| Frequency | RBW |
|---|---|
| 0.009 MHz-0.150 MHz | 200/300 kHz |
| 0.150 MHz -30 MHz | 9/10 kHz |
| 30 MHz-1 GHz | 100/120 kHz |
| Above 1 GHz | 1 MHz |

**Limits:**

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 §15.209.

**Spurious Emissions**

| Frequency | Field strength (microvolt/meter) | Limit (dBμV/m ) | Remark | Measurement distance (m) |
|---|---|---|---|---|
| 0.009 MHz-0.490 MHz | 2400/F(kHz) | -- | -- | 300 |
| 0.490 MHz-1.705 MHz | 24000/F(kHz) | -- | -- | 30 |
| 1.705 MHz-30 MHz | 30 | -- | -- | 30 |
| 30 MHz-88 MHz | 100 | 40.0 | Quasi-peak | 3 |
| 88 MHz-216 MHz | 150 | 43.5 | Quasi-peak | 3 |
| 216 MHz-960 MHz | 200 | 46.0 | Quasi-peak | 3 |
| 960MHz-1GHz | 500 | 54.0 | Quasi-peak | 3 |
| Above 1 GHz | 500 | 54.0 | Average | 3 |

**Remark:**

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBμV/m) = 20 log Emission level (μV/m).
3. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.
4. For Below 30MHz, the measured field strength was extrapolated to distance 30 meters, using the formula that the limit of field strength varies as the inverse distance square (40dB per decade of distance)

   **Example:**

   Field strength limit for 13.56MHz = 15848 μV/m at 30m
   = 84 dBμV/m at 30m
   = 84 dBμV/m + 40log(30/3) dB at 3m
   = 124 dBμV/m at 3m

**Test Setup:** Refer to section 4.5.1 for details.

**Test Procedures:**

1) The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. 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) The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4) For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to

heights 1 meter) and the rota table table was turned from 0 degrees to 360 degrees to find the maximum reading.

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

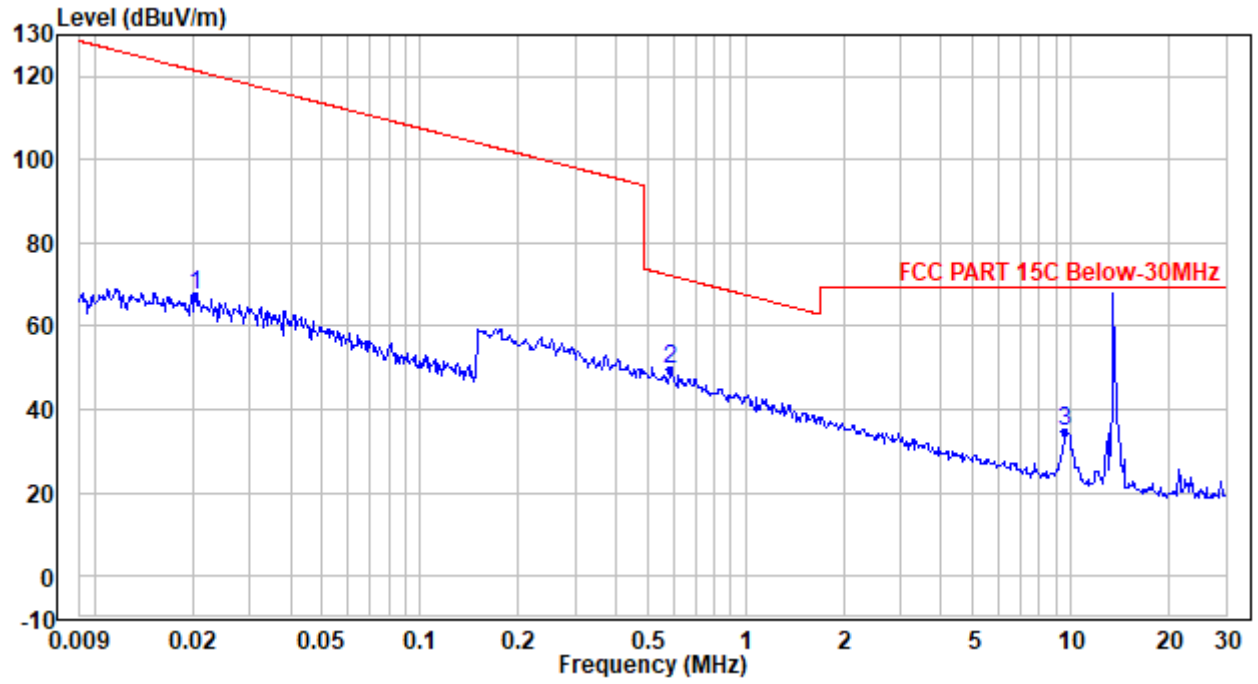
6) If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

7) The radiation measurements are performed in X, Y, Z axis positioning. And found the Y axis positioning which it is worse case, only the test worst case mode is recorded in the report.(for portable and mobile devices)

**Equipment Used:** Refer to section 3 for details.

**Test Result:** Pass

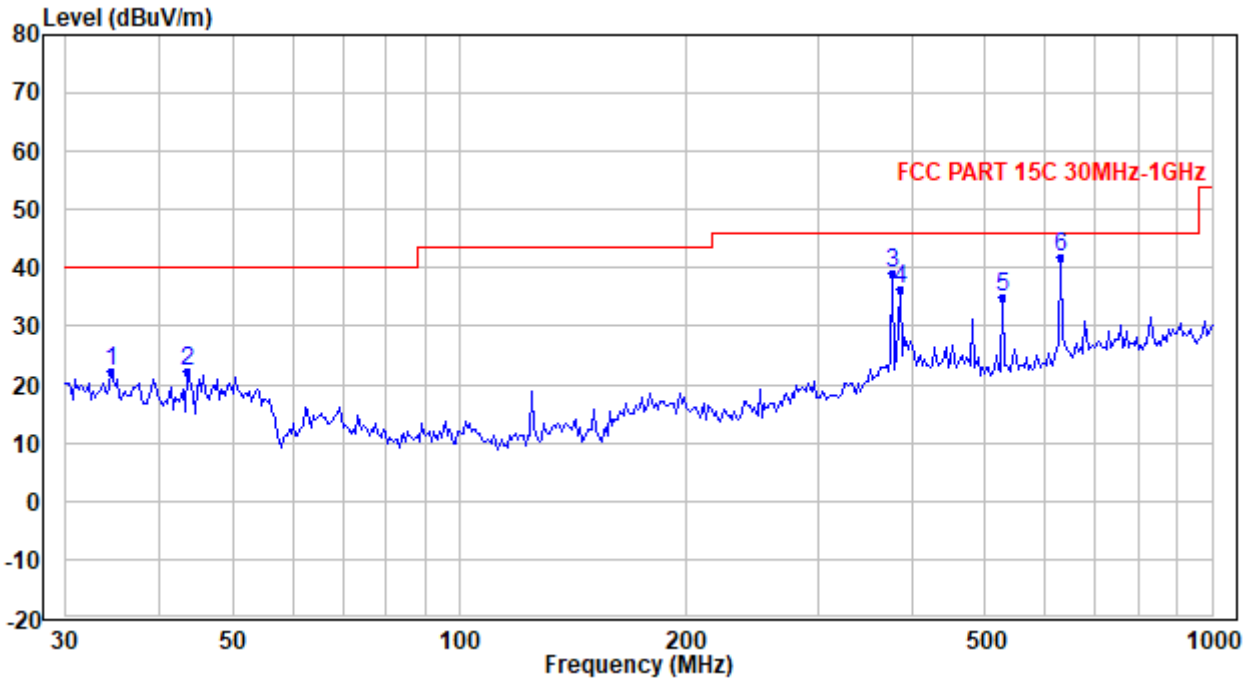
**Radiated Emission Test Data (9 KHz ~ 30 MHz):**




| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB/m ) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 0.020 | 80.06 | -12.59 | 67.47 | 121.40 | -53.93 | Peak |
| 2 | 0.590 | 66.40 | -16.97 | 49.43 | 72.17 | -22.74 | Peak |
| 3 | 9.632 | 52.03 | -17.08 | 34.95 | 69.50 | -34.55 | Peak |

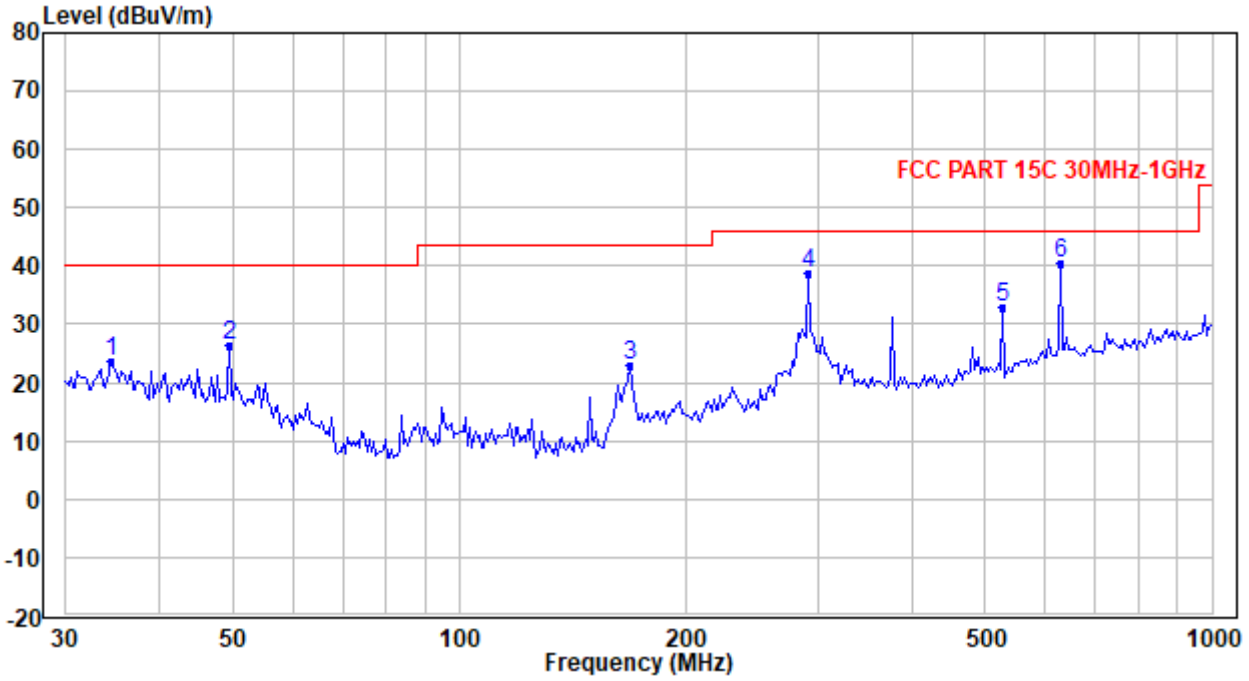
**Radiated Emission Test Data (30 MHz ~ 1 GHz):**

**Horizontal**




| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB/m ) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 34.527 | 26.77 | -4.60 | 22.17 | 40.00 | -17.83 | QP |
| 2 | 43.538 | 32.31 | -10.12 | 22.19 | 40.00 | -17.81 | QP |
| 3 | 376.523 | 44.39 | -5.26 | 39.13 | 46.00 | -6.87 | QP |
| 4 | 384.545 | 41.31 | -4.81 | 36.50 | 46.00 | -9.50 | QP |
| 5 | 527.571 | 37.28 | -2.42 | 34.86 | 46.00 | -11.14 | QP |
| 6 | 628.894 | 41.98 | -0.23 | 41.75 | 46.00 | -4.25 | QP |

**Vertical**




| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB/m ) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 34.527 | 28.25 | -4.60 | 23.65 | 40.00 | -16.35 | QP |
| 2 | 49.409 | 40.47 | -14.23 | 26.24 | 40.00 | -13.76 | QP |
| 3 | 168.997 | 34.68 | -11.75 | 22.93 | 43.50 | -20.57 | QP |
| 4 | 290.317 | 45.40 | -6.76 | 38.64 | 46.00 | -7.36 | QP |
| 5 | 527.571 | 35.24 | -2.42 | 32.82 | 46.00 | -13.18 | QP |
| 6 | 628.894 | 40.87 | -0.23 | 40.64 | 46.00 | -5.36 | QP |

Remark:

1. Correct Factor = Antenna Factor + Cable Loss - Amplifier Gain, the value was added to Original Receiver Reading by the software automatically.
2. Result = Reading + Correct Factor.
3. Margin = Result – Limit

b) All the above radiated emission data, the NFC fundamental frequency is not marked, it may exceed the limit, please ignore it.

## 5.5 FUNDAMENTAL FIELD STRENGTH AND EMISSION MASK 13.110 MHZ TO 14.010 MHZ

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.227(a) (b) (c) /15.205
RSS-210 Issue 10, Annex B.6
RSS-Gen Issue 5, section 8.9

**Test Method:** ANSI C63.10-2013 Section 6.3/ 6.4

**Limits:**

(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.

**Remark:**

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBμV/m) = 20 log Emission level (μV/m).
3. For Below 30MHz, the measured field strength was extrapolated to distance 30 meters, using the formula that the limit of field strength varies as the inverse distance square (40dB per decade of distance)

**Example:**

Field strength limit for 13.56MHz = 15848 μV/m at 30m
= 84 dBμV/m at 30m
= 84 dBμV/m + 40log(30/3) dB at 3m
= 124 dBμV/m at 3m

**Test Setup:** Refer to section 4.5.1 for details.

**Test Procedures:**

As the radiation test, set the RBW=10kHz VBW=30kHz, observed the outside band of 13.110 MHz to 14.010 MHz, than mark the higher-level emission for comparing with the FCC rules.

**Equipment Used:** Refer to section 3 for details.

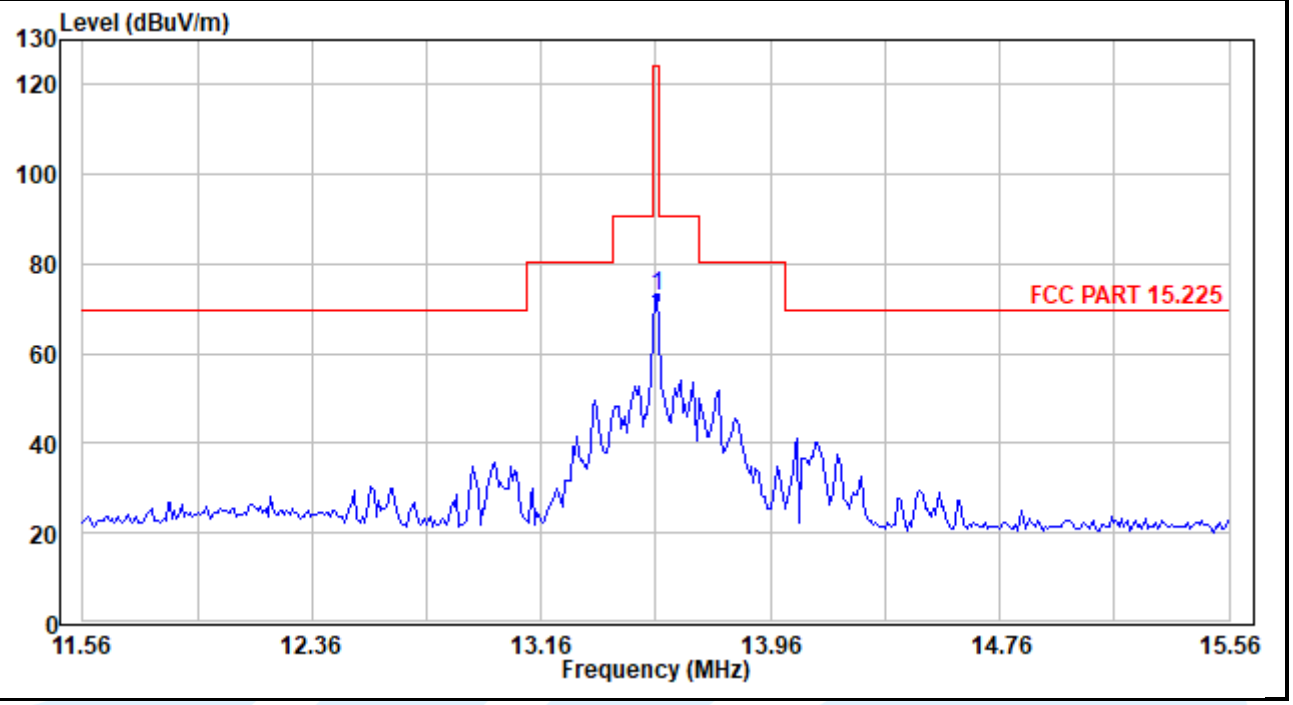
**Test Result:** Pass

**Maximum Field Strength:**

| Fundamental frequency | Polari-zation | Detector | Result at 3m (dBμV/m) | Limit at 3m (dBμV/m) | Margin (dB) |
|---|---|---|---|---|---|
| 13.56 MHz | Y | Peak | 72.61 | 124 | 51.39 |

**Emission Mask:**

**The worst case test plots as below.**



## 5.6 FREQUENCY TOLERANCE

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.225(e)
RSS-210 Issue 10, Annex B.6

**Test Method:** ANSI C63.10-2013 Section 6.8

**Limits:**

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 Setup:** Refer to section 4.5.3 for details.

**Test Procedures:**

1) The EUT was placed inside the environmental test chamber and powered by nominal DC voltage.
2) Turn the EUT on and couple its output to a spectrum analyzer.
3) Turn the EUT off and set the chamber to the highest temperature specified.
4) Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT on and measure the operating frequency after 2, 5, and 10 minutes.
5) Repeat step c) and d) with the temperature chamber set to the lowest temperature.
6) The test chamber was allowed to stabilize at +20 degree C for a minimum of 30 minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.

**Equipment Used:** Refer to section 3 for details.

**Test Result:** Pass

| Frequency Tolerance VS Temperature and Voltage | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Temp.(°C) | Voltage | Test time (minutes) | | | | | | | |
| | | 0 | 2 | 5 | 10 | 0 | 2 | 5 | 10 |
| | | Measured Frequency (MHz) | | | | Frequency Drift (%) | | | |
| 50 | VN | 13.56014 | 13.5603 | 13.56022 | 13.56011 | 0.0010 | 0.0022 | 0.0016 | 0.0008 |
| 40 | VN | 13.56026 | 13.56061 | 13.56022 | 13.56034 | 0.0019 | 0.0045 | 0.0016 | 0.0025 |
| 30 | VN | 13.56056 | 13.56002 | 13.56002 | 13.56056 | 0.0041 | 0.0001 | 0.0001 | 0.0041 |
| 20 | VN | 13.56004 | 13.56038 | 13.56025 | 13.56032 | 0.0003 | 0.0028 | 0.0018 | 0.0024 |
| | VL | 13.56045 | 13.56002 | 13.56032 | 13.56008 | 0.0033 | 0.0001 | 0.0024 | 0.0006 |
| | VH | 13.56033 | 13.56034 | 13.56012 | 13.56014 | 0.0024 | 0.0025 | 0.0009 | 0.0010 |
| 10 | VN | 13.56002 | 13.56018 | 13.56056 | 13.56022 | 0.0001 | 0.0013 | 0.0041 | 0.0016 |
| 0 | VN | 13.56034 | 13.56042 | 13.56032 | 13.56057 | 0.0025 | 0.0031 | 0.0024 | 0.0042 |
| -10 | VN | 13.56018 | 13.56013 | 13.56046 | 13.56012 | 0.0013 | 0.0010 | 0.0034 | 0.0009 |
| -20 | VN | 13.56014 | 13.56061 | 13.56008 | 13.56015 | 0.0010 | 0.0045 | 0.0006 | 0.0011 |
| **Limit:** ±0.01 % | | | | | | | | | |

## 5.7 AC POWER LINE CONDUCTED EMISSION

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.207
RSS-Gen Issue 5, Section 8.8

**Test Method:** ANSI C63.10-2013 Clause 6.2

**Limits:**

| Frequency range (MHz) | Limits (dB(μV)) | |
|---|---|---|
| | 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 |

**Remark:**

1. The lower limit shall apply at the transition frequencies.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 to 0.50 MHz.

**Test Setup:** Refer to section 4.5.2 for details.

**Test Procedures:**

Test frequency range :150KHz-30MHz

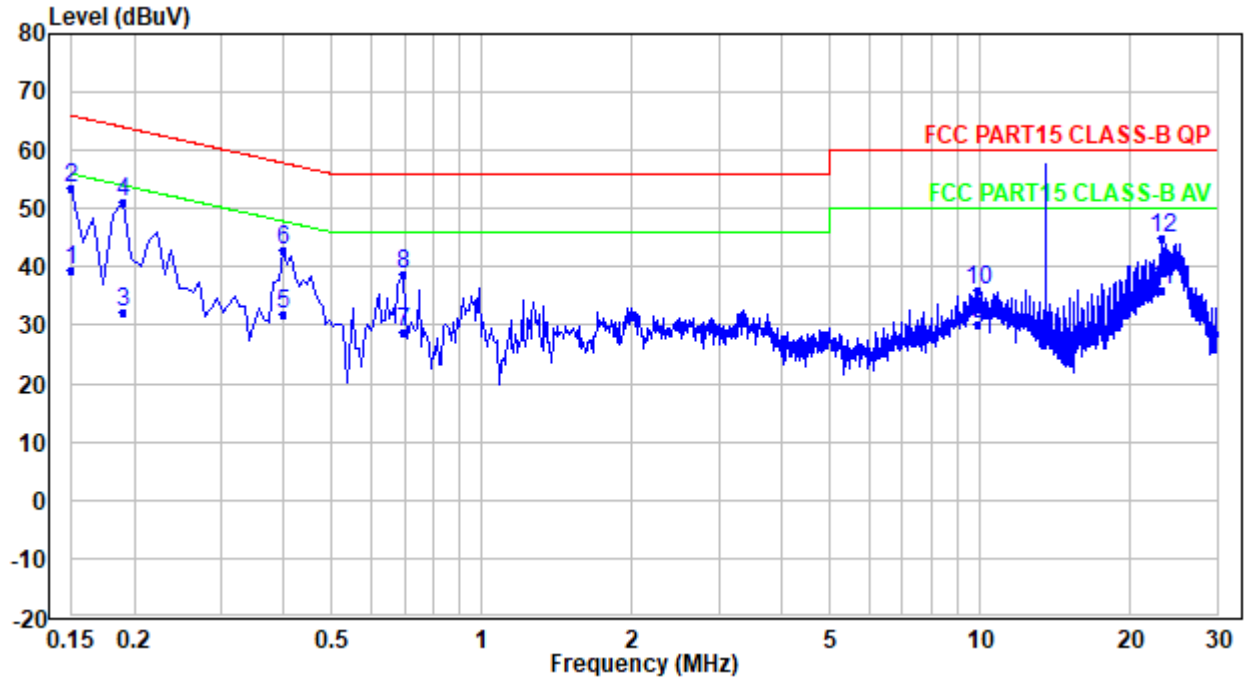
7) The mains terminal disturbance voltage test was conducted in a shielded room.
8) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
9) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
10) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
11) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

**Equipment Used:** Refer to section 3 for details.

**Test Result:** Pass

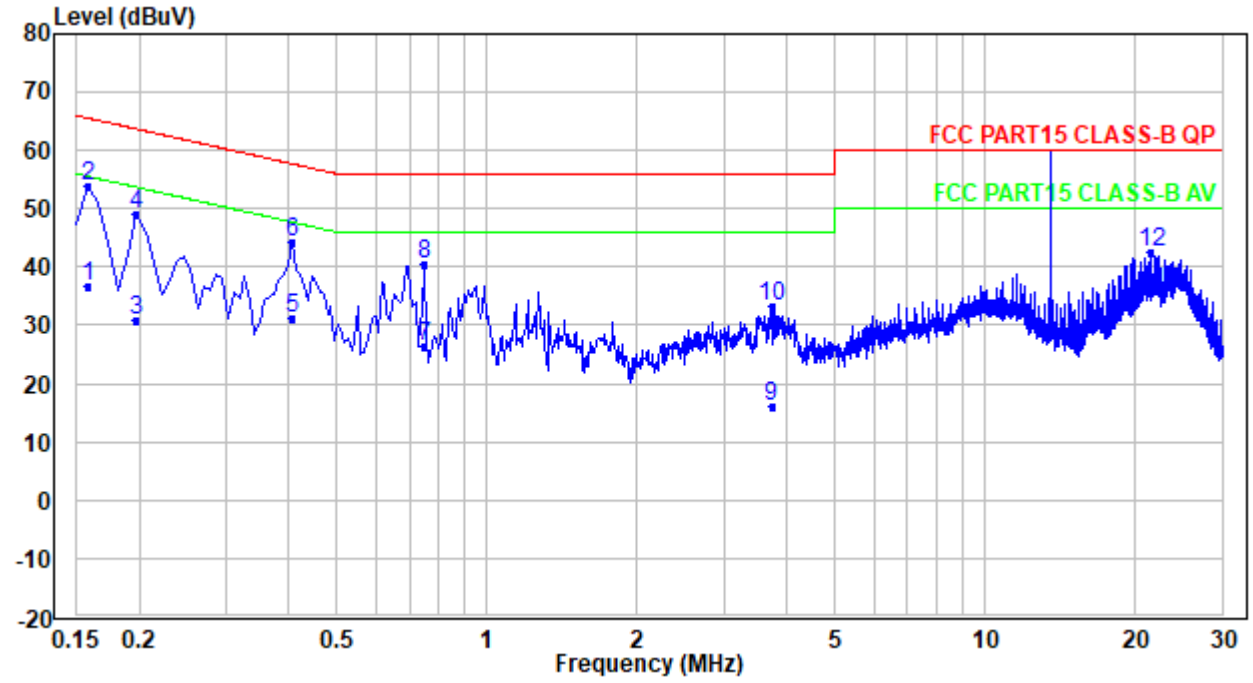
**The measurement data as follows:**
**Quasi Peak and Average:**
**Mode: NFC LINK**

**Live Line**




| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB/m ) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 0.150 | 29.36 | 10.12 | 39.48 | 56.00 | -16.52 | Average |
| 2 | 0.150 | 43.36 | 10.12 | 53.48 | 66.00 | -12.52 | QP |
| 3 | 0.190 | 22.13 | 10.12 | 32.25 | 54.04 | -21.79 | Average |
| 4 | 0.190 | 41.13 | 10.12 | 51.25 | 64.04 | -12.79 | QP |
| 5 | 0.398 | 21.89 | 10.12 | 32.01 | 47.90 | -15.89 | Average |
| 6 | 0.398 | 32.89 | 10.12 | 43.01 | 57.90 | -14.89 | QP |
| 7 | 0.694 | 18.63 | 10.17 | 28.80 | 46.00 | -17.20 | Average |
| 8 | 0.694 | 28.63 | 10.17 | 38.80 | 56.00 | -17.20 | QP |
| 9 | 9.892 | 19.60 | 10.58 | 30.18 | 50.00 | -19.82 | Average |
| 10 | 9.892 | 25.60 | 10.58 | 36.18 | 60.00 | -23.82 | QP |
| 11 | 23.209 | 25.10 | 10.96 | 36.06 | 50.00 | -13.94 | Average |
| 12 | 23.209 | 34.10 | 10.96 | 45.06 | 60.00 | -14.94 | QP |

**Neutral Line**




| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB/m ) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 0.158 | 26.71 | 10.12 | 36.83 | 55.57 | -18.74 | Average |
| 2 | 0.158 | 43.71 | 10.12 | 53.83 | 65.57 | -11.74 | QP |
| 3 | 0.198 | 20.85 | 10.11 | 30.96 | 53.69 | -22.73 | Average |
| 4 | 0.198 | 38.85 | 10.11 | 48.96 | 63.69 | -14.73 | QP |
| 5 | 0.406 | 21.15 | 10.12 | 31.27 | 47.73 | -16.46 | Average |
| 6 | 0.406 | 34.15 | 10.12 | 44.27 | 57.73 | -13.46 | QP |
| 7 | 0.750 | 16.35 | 10.14 | 26.49 | 46.00 | -19.51 | Average |
| 8 | 0.750 | 30.35 | 10.14 | 40.49 | 56.00 | -15.51 | QP |
| 9 | 3.733 | 5.79 | 10.31 | 16.10 | 46.00 | -29.90 | Average |
| 10 | 3.733 | 22.79 | 10.31 | 33.10 | 56.00 | -22.90 | QP |
| 11 | 21.674 | 24.62 | 10.96 | 35.58 | 50.00 | -14.42 | Average |
| 12 | 21.674 | 31.62 | 10.96 | 42.58 | 60.00 | -17.42 | QP |

Remark:

1. Correct Factor = LISN Factor + Cable Loss + Pulse Limiter Factor, the value was added to Original Receiver Reading by the software automatically.
2. Result = Reading + Correct Factor.
3. Margin = Result - Limit
4. An initial pre-scan was performed on the Phase and neutral lines with peak detector. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.
5. All the above conducted emission data, the NFC fundamental frequency is not marked, it may exceed the limit, please ignore it.

# APPENDIX 1 PHOTOS OF TEST SETUP

See test photos attached in Appendix 1 for the actual connections between Product and support equipment.

# APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS

Refer to Appendix 2 for EUT external and internal photos.

*** End of Report ***

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The test report is effective only with both signature and specialized stamp. The result(s) shown in this report refer only to the sample(s) tested. Without written approval of UnionTrust, this report can't be reproduced except in full.

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