Certificate #4312.01

# TEST REPORT

| | |
|---|---|
| **Product Name:** | 8 Unmanaged 2.5G Multi-Gigabit Port and 1 SFP+ Port Switch |
| **Trade Mark:** | GRANDSTREAM |
| **Model No. / HVIN:** | GWN7701M |
| **Add. Model No. / HVIN:** | N/A |
| **Report Number:** | 2303154437EMC-1 |
| **Test Standards:** | FCC 47 CFR Part 15 Subpart B<br>ICES-003 Issue 7 |
| **FCC ID:** | YZZGWN7701M |
| **Test Result:** | PASS |
| **Date of Issue:** | April 3, 2023 |

Prepared for:

**Grandstream Networks, Inc.**
**126 Brookline Ave., 3rd Floor Boston, MA 02215, USA**

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**
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Prepared by: Dylan Zhang — Reviewed by: Henry Lu

Dylan Zhang
Senior Project Engineer

Henry Lu
Team Leader

Approved by: Kevin Liang — Date: April 3, 2023

Assistant Manager

# Version

| Version No. | Date | Description |
|---|---|---|
| V1.0 | April 3, 2023 | Original |

# CONTENTS

# 1. GENERAL INFORMATION

## 1.1 CLIENT INFORMATION

| | |
|---|---|
| **Applicant:** | Grandstream Networks, Inc. |
| **Address of Applicant:** | 126 Brookline Ave., 3rd Floor Boston, MA 02215, USA |
| **Manufacturer:** | Grandstream Networks, Inc. |
| **Address of Manufacturer:** | 126 Brookline Ave., 3rd Floor Boston, MA 02215, USA |

## 1.2 EUT INFORMATION

### 1.2.1 General Description of EUT

| | |
|---|---|
| **Product Name:** | 8 Unmanaged 2.5G Multi-Gigabit Port and 1 SFP+ Port Switch |
| **Model No. / HVIN:** | GWN7701M |
| **Add. Model No. / HVIN:** | N/A |
| **Trade Mark:** | GRANDSTREAM |
| **DUT Stage:** | Identical Prototype |
| **Rated Voltage:** | 12V ⎓ 1 A |
| **Classification of digital devices:** | Class B |
| **Highest Internal Frequency:** | 10.3125 GHz |
| **Sample Received Date:** | March 15, 2023 |
| **Sample Tested Date:** | March 17, 2023 to March 21, 2023 |

**Remark:** The above EUT's information was provided by customer. Please refer to the specifications or user's manual for more detailed description.

### 1.2.2 Description of Accessories

| **Adapter (1)** | |
|---|---|
| **Model No.:** | GQ12-120100-AU |
| **Input:** | 100-240 V~50/60 Hz 0.4 A Max |
| **Output:** | 12V ⎓ 1.0 A |
| **DC Cable:** | 2.5 Meter, Unshielded without ferrite |

| **Adapter (2)** | |
|---|---|
| **Model No.:** | UES12LU-120100SPA |
| **Input:** | 100-240 V~50/60 Hz 0.5 A |
| **Output:** | 12.0 V ⎓ 1.0 A 12.0W |
| **DC Cable:** | 1.5 Meter, Unshielded without ferrite |

| **Adapter (3)** | |
|---|---|
| **Model No.:** | F12US1200100A |
| **Input:** | AC100-240 V 50/60 Hz 0.5 A max |
| **Output:** | 12V ⎓ 1.0 A |
| **DC Cable:** | 2.5 Meter, Unshielded without ferrite |

## 1.3 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 Computer | Lenovo | E450 | SL10G10780 | UnionTrust |
| Network Analyst | Xtramus | nustreams-600 | 0JNS600C0013 | UnionTrust |
| USB Mouse | Founder | 20-1AN03Y105 | MA0KZA39 | UnionTrust |
| Photoelectric conversion module | 10Gtek | ASF-10G2-T | N/A | UnionTrust |

2).Support Cable

| Cable No. | Description | Connector | Length | Supplied by |
|---|---|---|---|---|
| 1 | Ethernet Cable*9 | RJ45 | 1.5 Unshielded without ferrite | UnionTrust |
| 2 | Ethernet Cable*1 | RJ45 | 2.0 Unshielded without ferrite | UnionTrust |

## 1.4 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
Telephone: +86 (0) 755 2823 0888
Fax: +86 (0) 755 2823 0886

## 1.5 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

## 1.6 DEVIATION FROM STANDARDS

None.

## 1.7 ABNORMALITIES FROM STANDARD CONDITIONS

None.

## 1.8 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

## 1.9 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 | ± 4.6 dB |
| 5 | Radiated emission 1GHz-18GHz | ± 4.4 dB |
| 6 | Radiated emission 18GHz-26GHz | ± 4.6 dB |
| 7 | Radiated emission 26GHz-40GHz | ± 4.6 dB |

## 2. TEST SUMMARY

| FCC 47 CFR Part 15 Subpart B Test Cases | | | |
|---|---|---|---|
| **Test Item** | **Test Requirement** | **Test Method** | **Result** |
| Conducted Emission | FCC 47 CFR Part 15.107<br>ICES-003 Issue 7 Section 3.2.1 | ANSI C63.4-2014 | PASS |
| Radiated Emission | FCC 47 CFR Part 15.109<br>ICES-003 Issue 7 Section 3.2.2 | ANSI C63.4-2014 | PASS |

# 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. 3, 2022 | Nov. 2, 2023 |
| ☒ | Broadband Antenna | ETS-LINDGREN | 3142E | 00201566 | Dec.13, 2021 | Dec.12, 2023 |
| ☒ | 6dB Attenuator | Talent | RA6A5-N-18 | 18103001 | Dec.13, 2021 | Dec.12, 2023 |
| ☒ | Preamplifier | HP | 8447F | 2805A02960 | Nov. 1, 2022 | Oct. 31, 2023 |
| ☒ | Multi device Controller | ETS-LINDGREN | 7006-001 | 00160105 | N/A | N/A |
| ☒ | Double-Ridged Waveguide Horn Antenna (Pre-amplifier) | ETS-LINDGREN | 3117-PA | 00201541 | Apr. 17, 2022 | Apr. 16, 2024 |
| ☒ | Double-Ridged Waveguide Horn Antenna | ETS-Lindgren | 3116C | 00200180 | Apr. 17, 2022 | Apr. 16, 2024 |
| ☒ | Double-Ridged Waveguide Horn Antenna (Pre-amplifier) | ETS-Lindgren | 3116C-PA | 00202652 | Nov. 21, 2022 | Nov. 20, 2023 |
| ☒ | Pre-amplifier | ETS-Lindgren | 00118385 | 00201874 | Nov. 01, 2022 | Oct. 31, 2023 |
| ☒ | 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 | 1316.3003K07-101181-K3 | Nov. 1, 2022 | Oct. 31, 2023 |
| ☒ | Pulse Limiter | R&S | ESH3-Z2 | 0357.8810.54 | Nov. 1, 2022 | Oct. 31, 2023 |
| ☒ | LISN | R&S | ESH2-Z5 | 860014/024 | Nov. 1, 2022 | Oct. 31, 2023 |
| ☒ | LISN | ETS-Lindgren | 3816/2SH | 00201088 | Nov. 1, 2022 | Oct. 31, 2023 |
| ☒ | Test Software | Audix | e3 | Software Version: 9.20151119i | | |

# 4. TEST CONFIGURATION

## 4.1 ENVIRONMENTAL CONDITIONS FOR TESTING

### 4.1.1 Normal or Extreme Test Conditions

| Environment Parameter | Selected Values During Tests | | |
|---|---|---|---|
| Test Condition | Ambient | | |
| | Temperature (°C) | Voltage (V) | Relative Humidity (%) |
| NV/NT | +15 to +35 | 1: AC 120V/60Hz<br>2: AC 240V/50Hz | 20 to 75 |
| **Remark:**<br>1) NV: Normal Voltage; NT: Normal Temperature | | | |

### 4.1.2 Record of Normal Environment and Test sample

| Test Item | Temperature (°C) | Relative Humidity (%) | Pressure (kPa) | Sample No. | Tested by |
|---|---|---|---|---|---|
| Conducted Emission | 23.8 | 60.0 | 100.2 | S202303151210-ZJA01/2 | Lucas Ouyang |
| Radiated Emission | 19.9 | 51.2 | 99.9 | | Andy Lin |

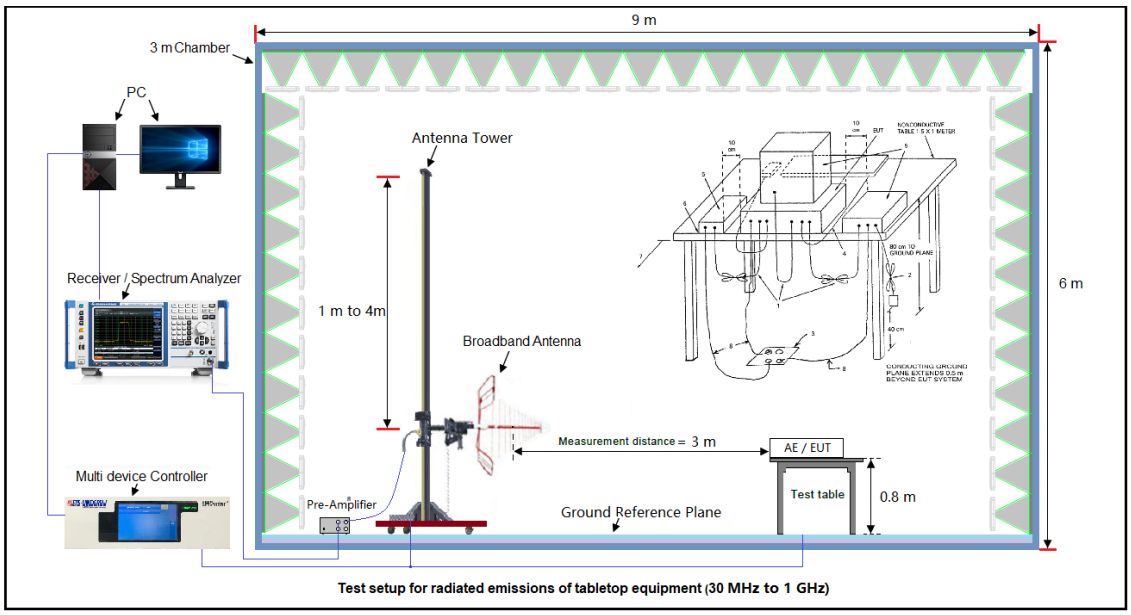
## 4.2 TEST MODES

| Test Item | EMI Test Modes |
|---|---|
| Radiated Emission | Test Mode 1: AC120V/60Hz (Adaptor1) + Ethernet Ports Loop transmission+ SFP+ port Transmission<br>Test Mode 2: AC240V/50Hz (Adaptor1) + Ethernet Ports Loop transmission+ SFP+ port Transmission<br>**Test Mode 3: worse from TM1~TM2& Adapter 2**<br>Test Mode 4: worse from TM1~TM2& Adapter 3 |
| Conducted Emission | Test Mode 1: AC120V/60Hz (Adaptor1) + Ethernet Ports Loop transmission+ SFP+ port Transmission<br>Test Mode 2: AC240V/50Hz (Adaptor1) + Ethernet Ports Loop transmission+ SFP+ port Transmission<br>**Test Mode 3: worse from TM1~TM2& Adapter 2**<br>Test Mode 4: worse from TM1~TM2& Adapter 3 |
| Remark: The above test modes in boldface were the worst cases. | |

## 4.3 TEST SETUP

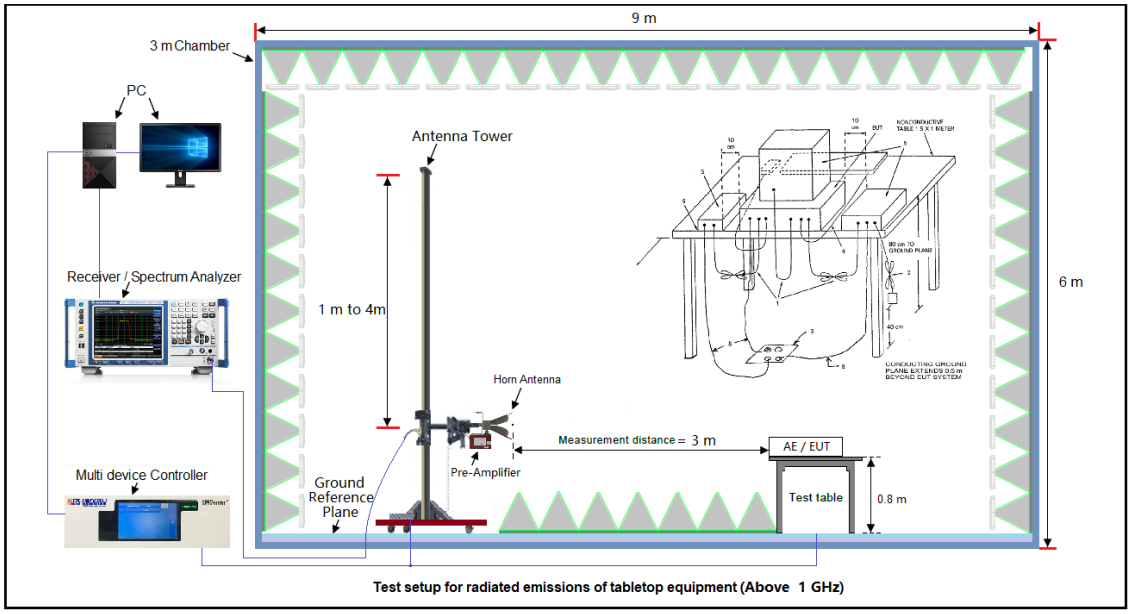
### 4.3.1 For Radiated Emissions test setup

Figure 1. 30MHz to 1GHz




Test setup for radiated emissions of tabletop equipment (30 MHz to 1 GHz)

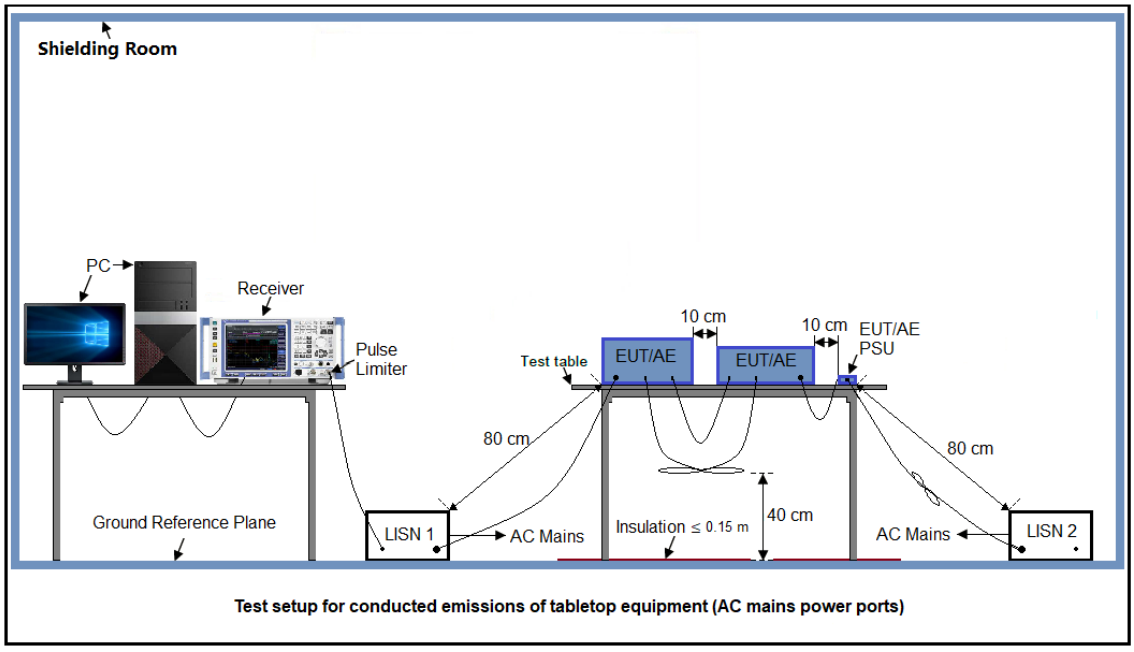
Figure 2. Above 1GHz




Test setup for radiated emissions of tabletop equipment (Above 1 GHz)

### 4.3.2 For Conducted Emissions test setup

Figure 3. Conducted Emissions setup




Test setup for conducted emissions of tabletop equipment (AC mains power ports)

## 4.4 SYSTEM TEST CONFIGURATION

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 1000MHz. The resolution is 1 MHz or greater for frequencies above 1000MHz. 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 (according to KDB 896810 D02 SDoC FAQ v01r01) of the highest fundamental frequency or to 40 GHz, whichever is lower.

# 5. REFERENCE DOCUMENTS FOR TESTING

| No. | Identity | Document Title |
|---|---|---|
| 1 | FCC 47 CFR Part15 Subpart B | Unintentional Radiators |
| 2 | ICES-003 Issue 7 | Information Technology Equipment (Including Digital Apparatus) |
| 3 | ANSI C63.4-2014 | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz |
| 4 | KDB 174176 D01 Line Conducted FAQ v01r01 | AC power-line conducted emission frequency asked questions |
| 5 | KDB 896810 D02 SDoC FAQ v01r02 | Supplier's Declaration of Conformity frequency asked questions |

# 6. EMC REQUIREMENTS SPECIFICATION

## 6.1 RADIATED EMISSION

**Test Requirement:** FCC 47 CFR Part 15.109
ICES-003 Issue 7 Clause 3.2.2

**Test Method:** ANSI C63.4-2014

**Receiver Setup:**

| Frequency: (f) (MHz) | Detector type | Measurement receiver bandwidth | |
|---|---|---|---|
| | | RBW | VBW |
| 30 ≤ f ≤ 1 000 | Quasi Peak | 120 kHz | 300 kHz |
| f ≥1000 | Peak | 1 MHz | 3 MHz |
| | Average | 1 MHz | 3 MHz |

**Measured frequency range**

| Highest frequency generated or used in the device or on which the device operates or tunes (MHz) | Upper frequency of measurement range (MHz) |
|---|---|
| Below 1.705 | 30. |
| 1.705-108 | 1000. |
| 108-500 | 2000. |
| 500-1000 | 5000. |
| Above 1000 | 5th harmonic of the highest frequency or 40 GHz, whichever is lower. |

**Limits:**

Limits for Class B devices

**FCC 47 CFR Part 15 Subpart B**

| Frequency (MHz) | limits at 3m (dBμV/m) | | |
|---|---|---|---|
| | QP Detector | PK Detector | AV Detector |
| 30 – 88 | 40.0 | -- | -- |
| 88 – 216 | 43.5 | -- | -- |
| 216 – 960 | 46.0 | | |
| 960 – 1000 | 54.0 | -- | -- |
| Above 1000 | -- | 74.0 | 54.0 |

**ICES-003 Issue 7**

| Frequency (MHz) | limits at 3m (dBμV/m) | | |
|---|---|---|---|
| | QP Detector | PK Detector | AV Detector |
| 30 – 88 | 40.0 | -- | -- |
| 88 – 216 | 43.5 | -- | -- |
| 216 – 230 | 46.0 | | |

| | | | |
|---|---|---|---|
| 230 – 960 | 47.0 | -- | -- |
| 960 – 1000 | 54.0 | -- | -- |
| Above 1000 | -- | 74.0 | 54.0 |

**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.

**Test Setup:** Refer to section 4.3.1 for details.

**Test Procedures:**

1. From 30 MHz to 1GHz test procedure as below:

1) The Product was placed on the non-conductive turntable 0.8 m above the ground at a chamber.
2) Set the spectrum analyzer/receiver in Peak detector, Max Hold mode, and 120 kHz RBW. Record the maximum field strength of all the pre-scan process in the full band when the antenna is varied between 1~4 m in both horizontal and vertical, and the turntable is rotated from 0 to 360 degrees.
3) For each frequency whose maximum record was higher or close to limit, measure its QP value: vary the antenna's height and rotate the turntable from 0 to 360 degrees to find the height and degree where Product radiated the maximum emission, then set the test frequency analyzer/receiver to QP Detector and specified bandwidth with Maximum Hold Mode, and record the maximum value.

2. Above 1GHz test procedure as below:

1) The Product was placed on the non-conductive turntable 0.8 m above the ground at a chamber.
2) Set the spectrum analyzer/receiver in Peak detector, Max Hold mode, and 1MHz RBW. Record the maximum field strength of all the pre-scan process in the full band when the antenna is varied in both horizontal and vertical, and the turntable is rotated from 0 to 360 degrees.
3) For each frequency whose maximum record was higher or close to limit, measure its AV value: rotate the turntable from 0 to 360 degrees to find the degree where Product radiated the maximum emission, then set the test frequency analyzer/receiver to AV value and specified bandwidth with Maximum Hold Mode, and record the maximum value.

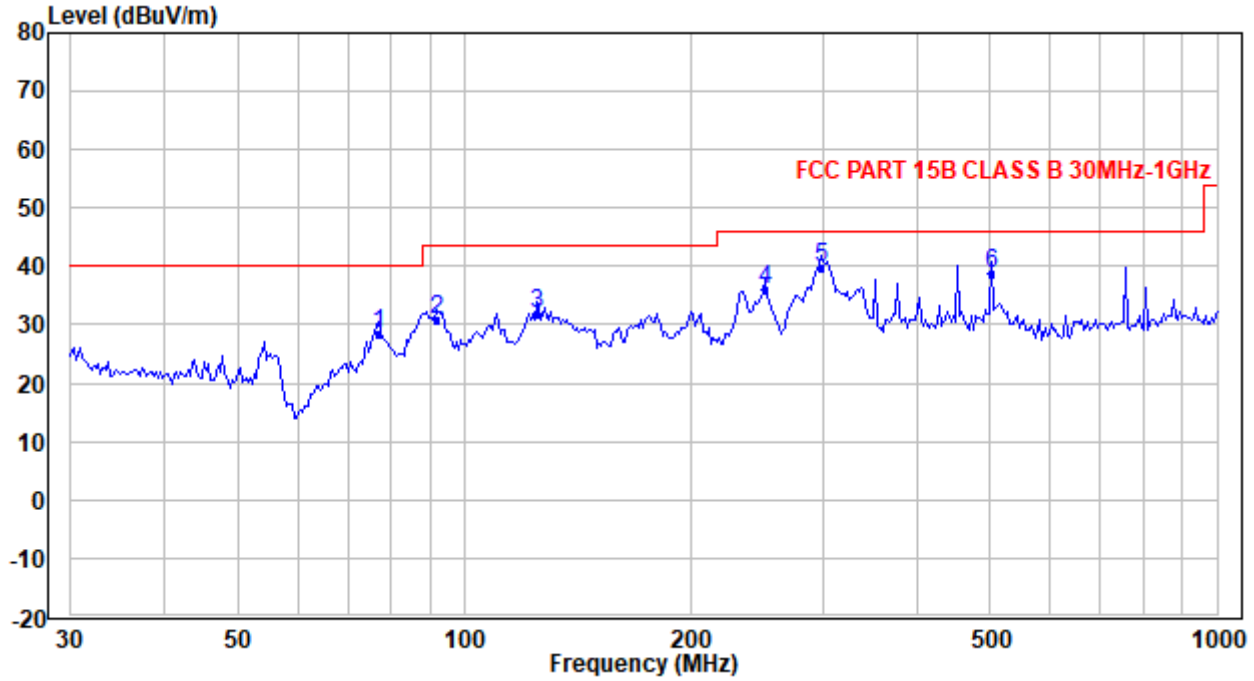
**Equipment Used:** Refer to section 3 for details.

**Test Result:** Pass

**The measurement data as follows:**

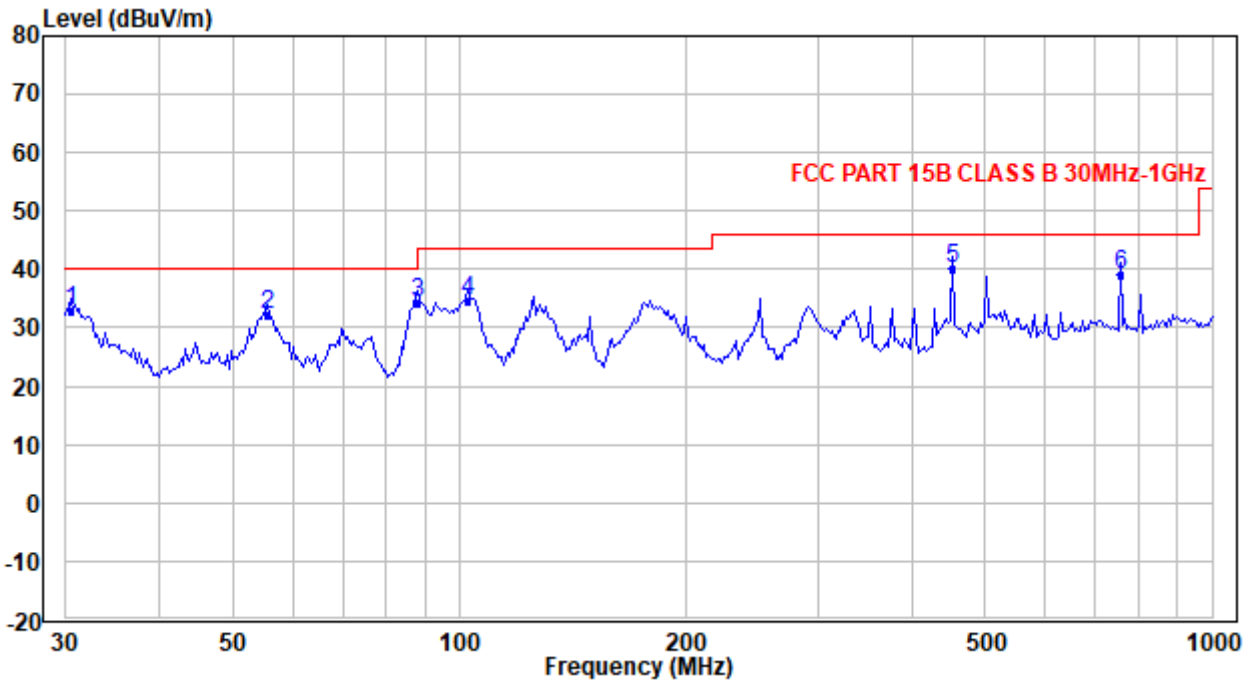
**The measurement data for FCC 47 CFR Part 15 Subpart B as follows:**

**Below 1GHz(Quasi Peak):**
**Test Mode1**
**Adapter 1**
**Horizontal**



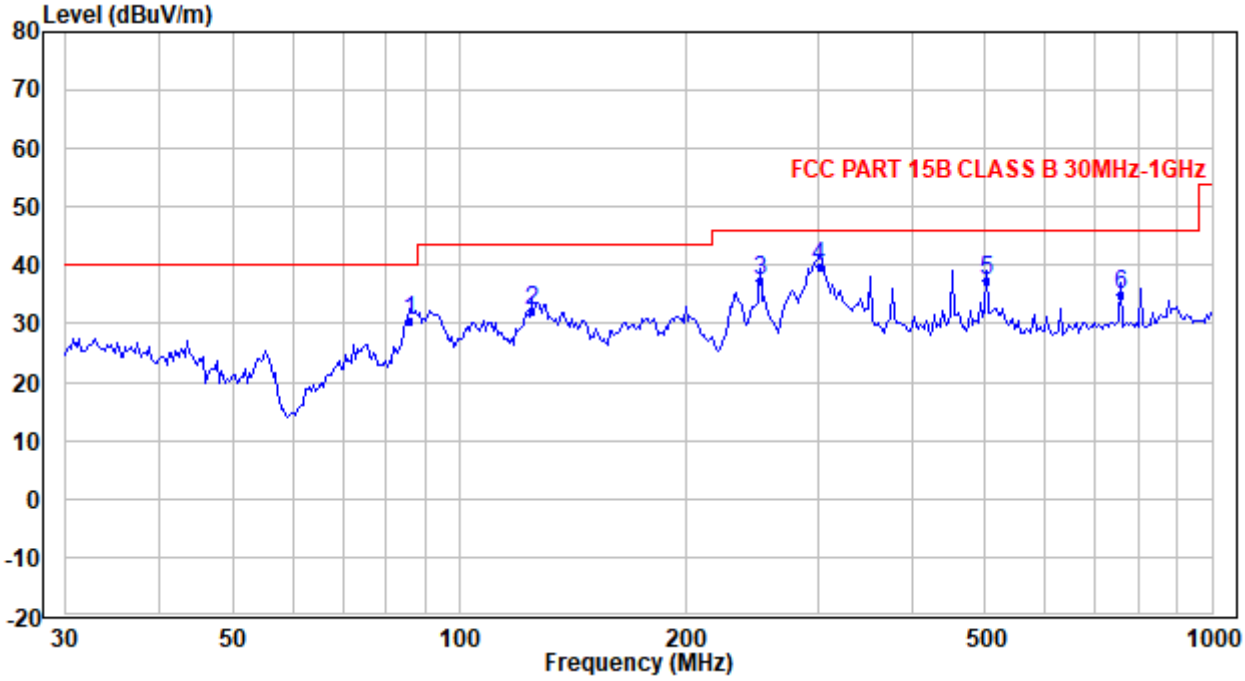

| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB/m ) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 76.926 | 45.59 | -17.16 | 28.43 | 40.00 | -11.57 | QP |
| 2 | 91.700 | 46.59 | -15.90 | 30.69 | 43.50 | -12.81 | QP |
| 3 | 124.925 | 47.62 | -15.79 | 31.83 | 43.50 | -11.67 | QP |
| 4 | 250.486 | 44.50 | -8.52 | 35.98 | 46.00 | -10.02 | QP |
| 5 | 298.593 | 46.32 | -6.55 | 39.77 | 46.00 | -6.23 | QP |
| 6 | 502.247 | 40.71 | -1.92 | 38.79 | 46.00 | -7.21 | QP |

**Vertical**



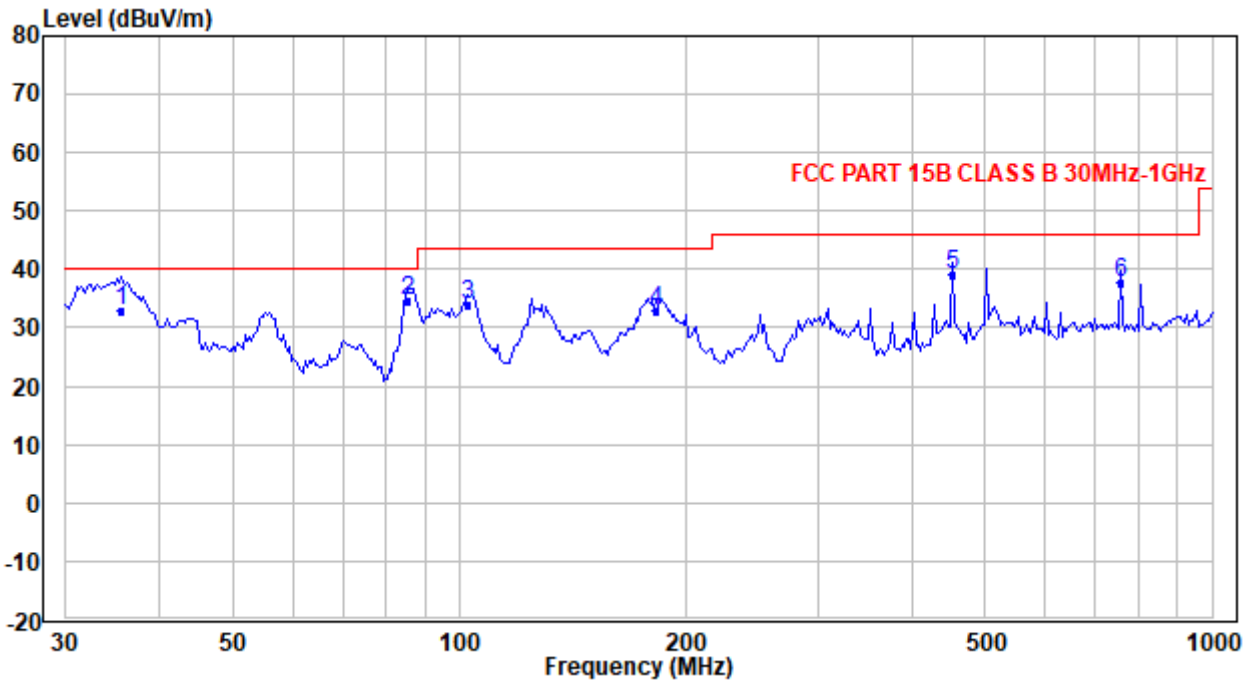

| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB/m ) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 30.425 | 37.76 | -4.85 | 32.91 | 40.00 | -7.09 | QP |
| 2 | 55.678 | 48.95 | -16.88 | 32.07 | 40.00 | -7.93 | QP |
| 3 | 87.914 | 50.53 | -16.17 | 34.36 | 40.00 | -5.64 | QP |
| 4 | 102.612 | 49.96 | -15.30 | 34.66 | 43.50 | -8.84 | QP |
| 5 | 452.001 | 43.55 | -3.35 | 40.20 | 46.00 | -5.80 | QP |
| 6 | 754.963 | 36.72 | 2.48 | 39.20 | 46.00 | -6.80 | QP |

**Below 1GHz(Quasi Peak):**
**Test Mode3**
**Adapter 2**
**Horizontal**



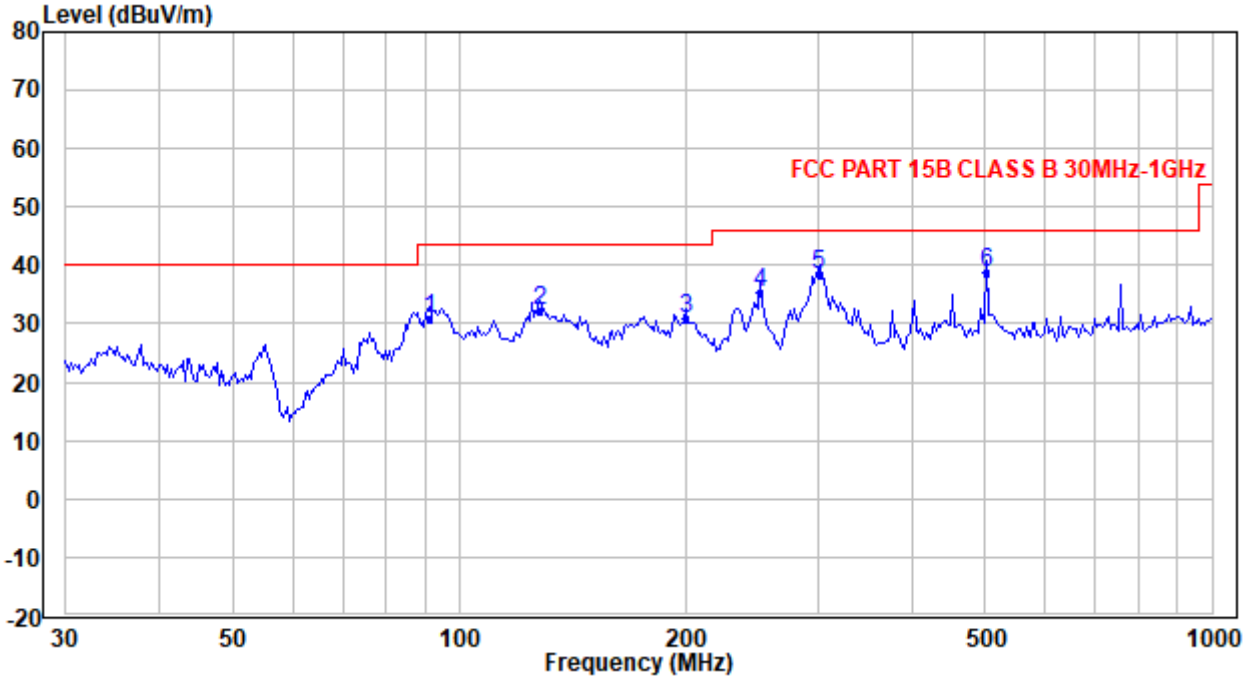

| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB/m ) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 86.080 | 46.74 | -16.18 | 30.56 | 40.00 | -9.44 | QP |
| 2 | 124.925 | 48.02 | -15.79 | 32.23 | 43.50 | -11.27 | QP |
| 3 | 250.486 | 46.05 | -8.52 | 37.53 | 46.00 | -8.47 | QP |
| 4 | 300.699 | 46.35 | -6.41 | 39.94 | 46.00 | -6.06 | QP |
| 5 | 502.247 | 39.14 | -1.92 | 37.22 | 46.00 | -8.78 | QP |
| 6 | 754.963 | 32.61 | 2.48 | 35.09 | 46.00 | -10.91 | QP |

**Vertical**



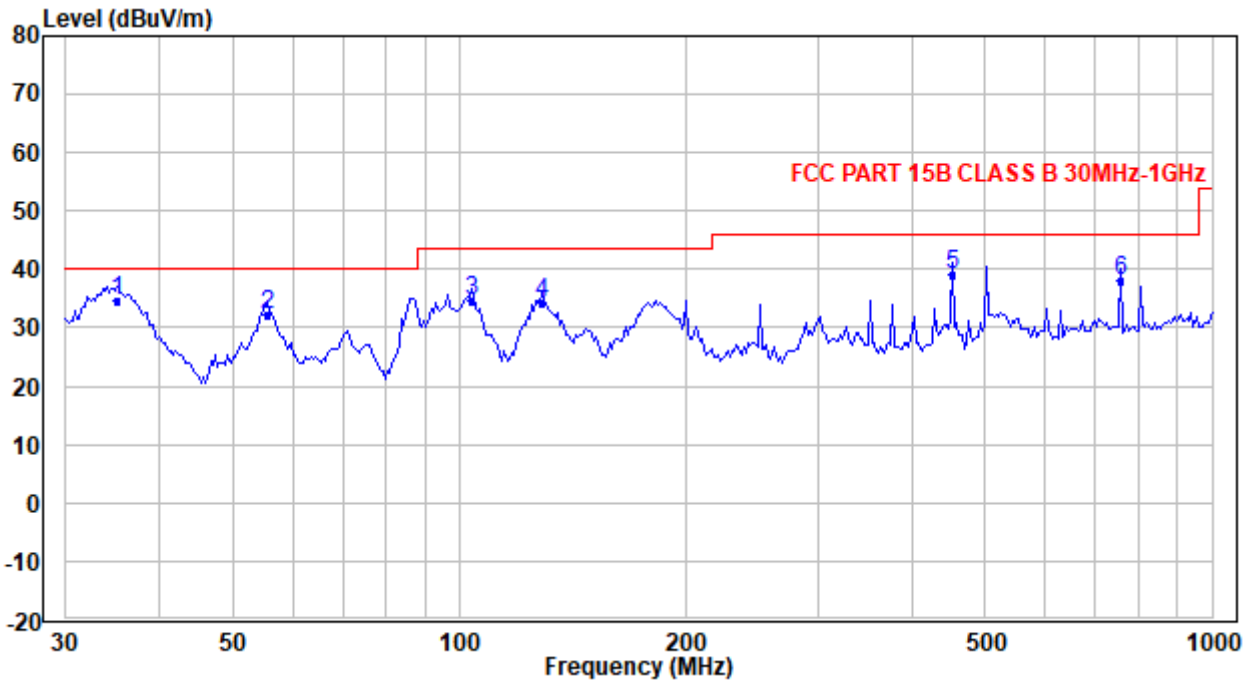

| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB/m ) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 35.511 | 38.50 | -5.58 | 32.92 | 40.00 | -7.08 | QP |
| 2 | 85.477 | 51.12 | -16.33 | 34.79 | 40.00 | -5.21 | QP |
| 3 | 102.612 | 49.12 | -15.30 | 33.82 | 43.50 | -9.68 | QP |
| 4 | 182.578 | 42.70 | -9.72 | 32.98 | 43.50 | -10.52 | QP |
| 5 | 452.001 | 42.39 | -3.35 | 39.04 | 46.00 | -6.96 | QP |
| 6 | 754.963 | 35.20 | 2.48 | 37.68 | 46.00 | -8.32 | QP |

**Below 1GHz(Quasi Peak):**
**Test Mode4**
**Adapter 3**
**Horizontal**




| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB/m ) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 91.057 | 46.70 | -15.91 | 30.79 | 43.50 | -12.71 | QP |
| 2 | 127.586 | 47.42 | -15.32 | 32.10 | 43.50 | -11.40 | QP |
| 3 | 200.043 | 40.83 | -10.14 | 30.69 | 43.50 | -12.81 | QP |
| 4 | 250.486 | 44.01 | -8.52 | 35.49 | 46.00 | -10.51 | QP |
| 5 | 300.699 | 44.69 | -6.41 | 38.28 | 46.00 | -7.72 | QP |
| 6 | 502.247 | 40.68 | -1.92 | 38.76 | 46.00 | -7.24 | QP |

**Vertical**

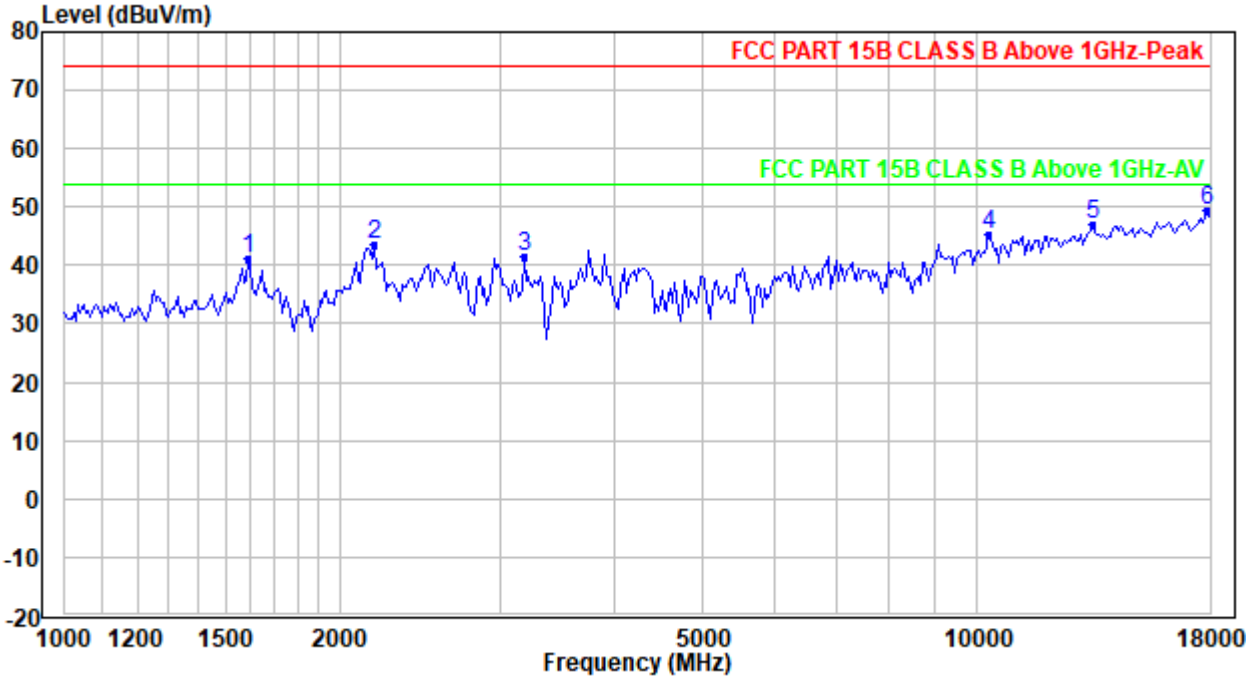



| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB/m ) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 35.016 | 40.22 | -5.49 | 34.73 | 40.00 | -5.27 | QP |
| 2 | 55.678 | 49.19 | -16.88 | 32.31 | 40.00 | -7.69 | QP |
| 3 | 104.064 | 49.82 | -15.16 | 34.66 | 43.50 | -8.84 | QP |
| 4 | 128.486 | 49.44 | -15.27 | 34.17 | 43.50 | -9.33 | QP |
| 5 | 452.001 | 42.46 | -3.35 | 39.11 | 46.00 | -6.89 | QP |
| 6 | 754.963 | 35.66 | 2.48 | 38.14 | 46.00 | -7.86 | QP |

Remark:

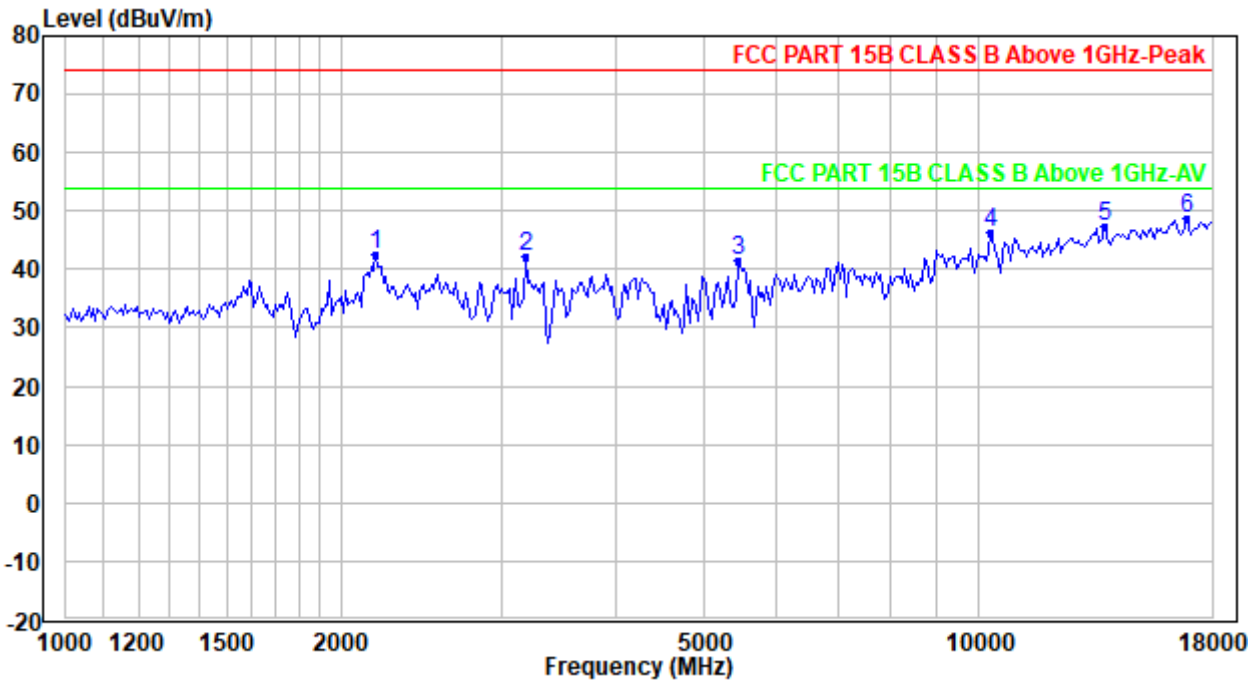
1. Correct Factor = Antenna Factor + Cable Loss - Amplifier Gain, the value was added to Original Receiver Reading by the software automatically.
2. Result = Reading + Correct Factor.
3. Margin = Result – Limit
4. All possible modes of operation were investigated, and testing at two nominal voltages of 240V/50Hz and 120V/60Hz, only the worst case emissions reported.
5. The limit of ICES-003 in the 230MHz to 960MHz band is higher than that of FCC Part 15B, so the radiation emission test data conform to the limit of ICES-003.

**Above 1GHz(Peak & Average)**
**Test Mode1**
**Adapter1**
**Horizontal**



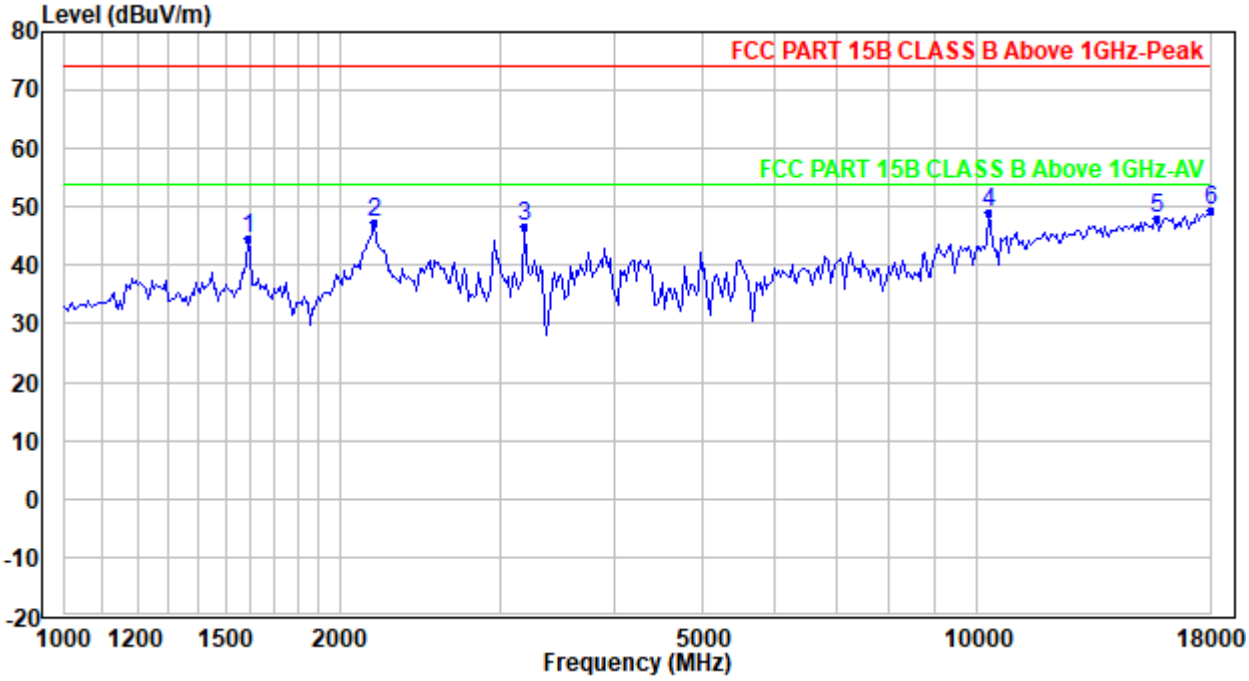

| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB/m ) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 1589.447 | 53.32 | -12.00 | 41.32 | 74.00 | -32.68 | Peak |
| 2 | 2185.761 | 52.71 | -9.15 | 43.56 | 74.00 | -30.44 | Peak |
| 3 | 3185.042 | 47.40 | -6.00 | 41.40 | 74.00 | -32.60 | Peak |
| 4 | 10322.320 | 39.16 | 6.11 | 45.27 | 74.00 | -28.73 | Peak |
| 5 | 13396.090 | 35.46 | 11.70 | 47.16 | 74.00 | -26.84 | Peak |
| 6 | 17896.040 | 34.21 | 15.05 | 49.26 | 74.00 | -24.74 | Peak |

**Vertical**



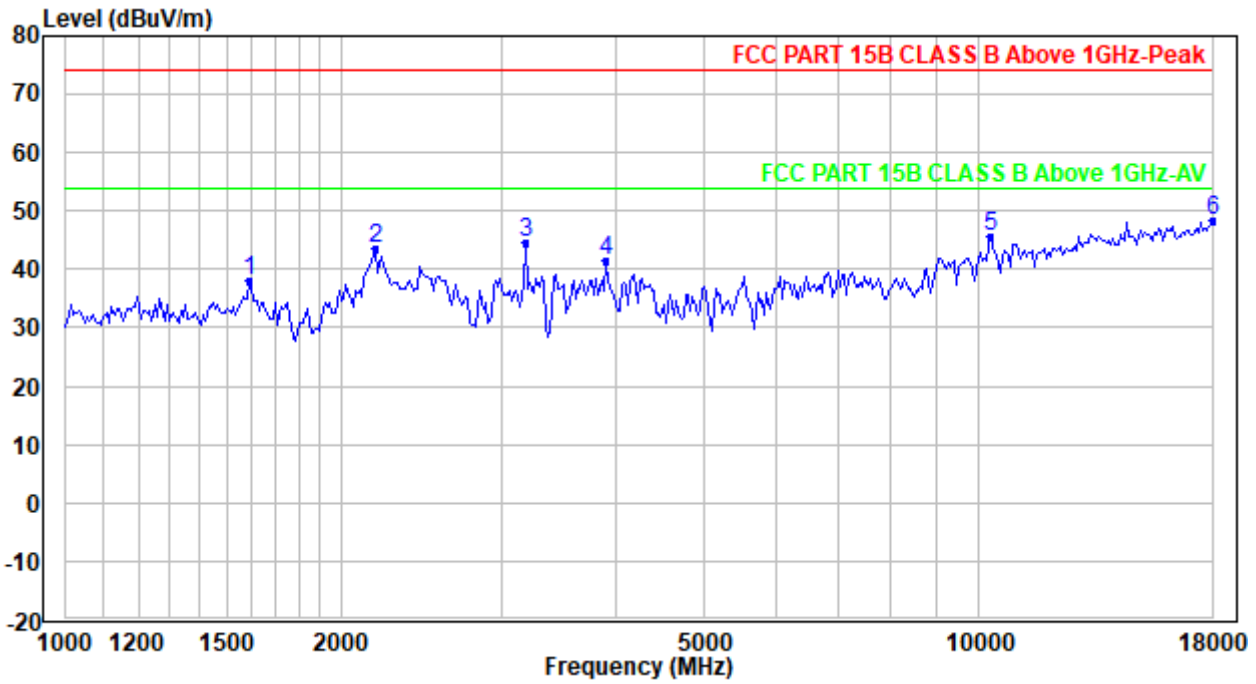

| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB/m ) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2185.761 | 51.72 | -9.15 | 42.57 | 74.00 | -31.43 | Peak |
| 2 | 3185.042 | 48.06 | -6.00 | 42.06 | 74.00 | -31.94 | Peak |
| 3 | 5458.380 | 41.82 | -0.45 | 41.37 | 74.00 | -32.63 | Peak |
| 4 | 10322.320 | 40.11 | 6.11 | 46.22 | 74.00 | -27.78 | Peak |
| 5 | 13710.090 | 35.57 | 11.95 | 47.52 | 74.00 | -26.48 | Peak |
| 6 | 16888.890 | 36.10 | 12.58 | 48.68 | 74.00 | -25.32 | Peak |

**Above 1GHz(Peak & Average)**
**Test Mode3**
**Adapter2**
**Horizontal**



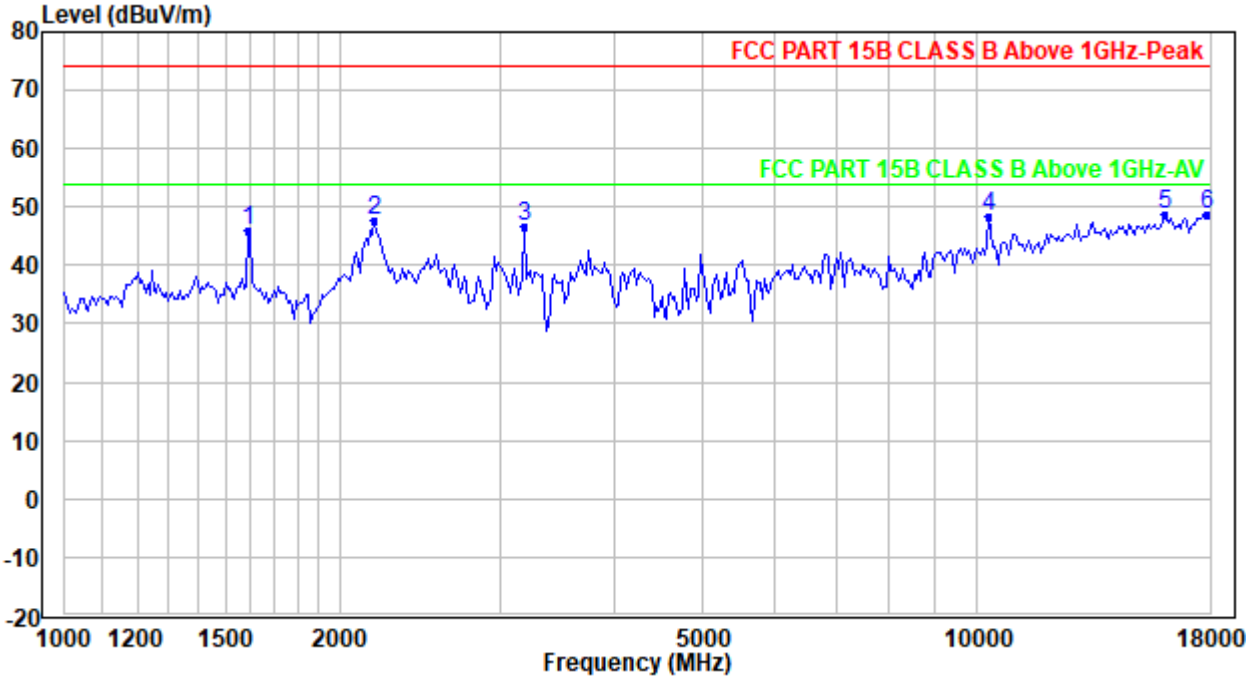

| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB/m ) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 1589.447 | 56.68 | -12.00 | 44.68 | 74.00 | -29.32 | Peak |
| 2 | 2185.761 | 56.64 | -9.15 | 47.49 | 74.00 | -26.51 | Peak |
| 3 | 3185.042 | 52.69 | -6.00 | 46.69 | 74.00 | -27.31 | Peak |
| 4 | 10322.320 | 43.12 | 6.11 | 49.23 | 74.00 | -24.77 | Peak |
| 5 | 15754.850 | 36.40 | 11.67 | 48.07 | 74.00 | -25.93 | Peak |
| 6 | 18000.000 | 34.02 | 15.41 | 49.43 | 74.00 | -24.57 | Peak |

**Vertical**



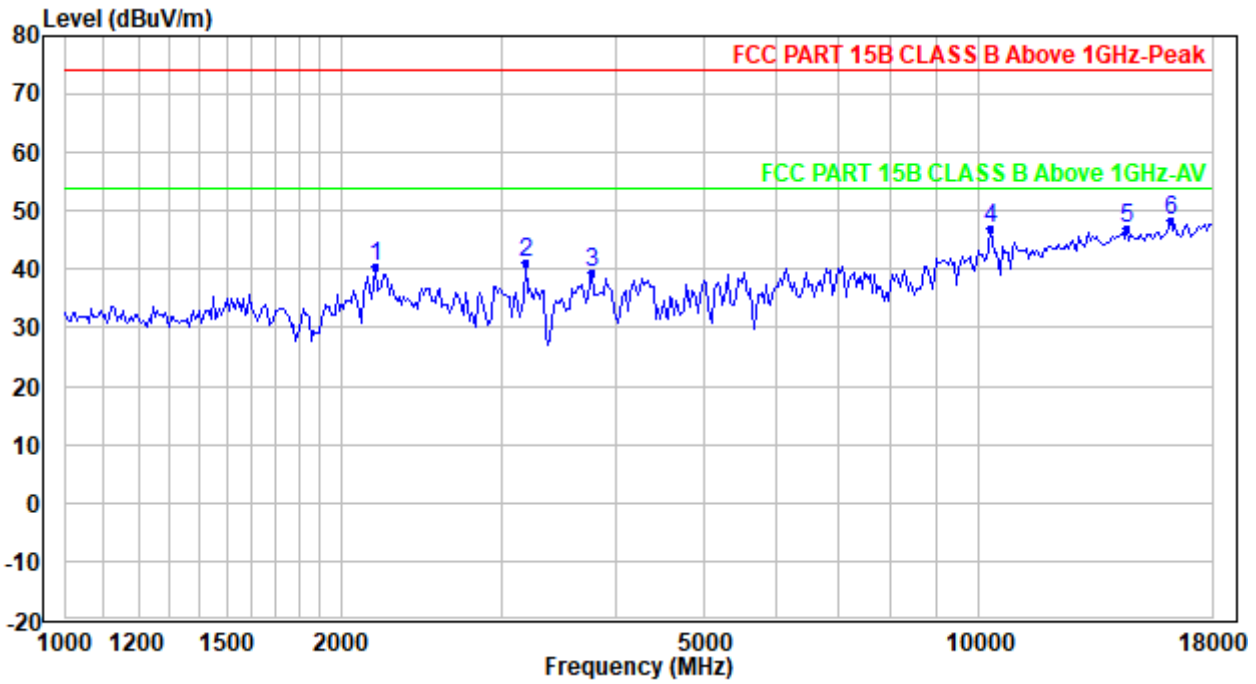

| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB/m ) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 1589.447 | 50.15 | -12.00 | 38.15 | 74.00 | -35.85 | Peak |
| 2 | 2185.761 | 52.81 | -9.15 | 43.66 | 74.00 | -30.34 | Peak |
| 3 | 3185.042 | 50.44 | -6.00 | 44.44 | 74.00 | -29.56 | Peak |
| 4 | 3900.860 | 44.93 | -3.47 | 41.46 | 74.00 | -32.54 | Peak |
| 5 | 10322.320 | 39.69 | 6.11 | 45.80 | 74.00 | -28.20 | Peak |
| 6 | 18000.000 | 32.81 | 15.41 | 48.22 | 74.00 | -25.78 | Peak |

**Above 1GHz(Peak & Average)**
**Test Mode4**
**Adapter3**
**Horizontal**




| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB/m ) | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 1589.447 | 58.08 | -12.00 | 46.08 | 74.00 | -27.92 | Peak |
| 2 | 2185.761 | 56.88 | -9.15 | 47.73 | 74.00 | -26.27 | Peak |
| 3 | 3185.042 | 52.50 | -6.00 | 46.50 | 74.00 | -27.50 | Peak |
| 4 | 10322.320 | 42.13 | 6.11 | 48.24 | 74.00 | -25.76 | Peak |
| 5 | 16031.010 | 36.84 | 11.85 | 48.69 | 74.00 | -25.31 | Peak |
| 6 | 17896.040 | 33.66 | 15.05 | 48.71 | 74.00 | -25.29 | Peak |

**Vertical**




| No. | Frequency (MHz) | Reading (dBμV) | Correction factor (dB/m ) | Result (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2185.761 | 49.72 | -9.15 | 40.57 | 74.00 | -33.43 | Peak |
| 2 | 3185.042 | 47.32 | -6.00 | 41.32 | 74.00 | -32.68 | Peak |
| 3 | 3767.619 | 43.19 | -3.83 | 39.36 | 74.00 | -34.64 | Peak |
| 4 | 10322.320 | 40.86 | 6.11 | 46.97 | 74.00 | -27.03 | Peak |
| 5 | 14527.680 | 34.82 | 12.17 | 46.99 | 74.00 | -27.01 | Peak |
| 6 | 16217.810 | 36.31 | 12.02 | 48.33 | 74.00 | -25.67 | Peak |

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
4. All possible modes of operation were investigated, and testing at two nominal voltages of 240V/50Hz and 120V/60Hz, only the worst case emissions reported.
5. For Radiated Emission above 18GHz, there was not any unwanted emission detected.
6. As shown in this section, for frequencies above 1GHz, the field strength limits are based on average limits. 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. So, only the peak measurements were shown in the report.

## 6.2 CONDUCTED EMISSION

**Test Requirement:** FCC 47 CFR Part 15.107
ICES-003 Issue 7 Section 3.2.1

**Test Method:** ANSI C63.4-2014

**Limits:**

Limits for Class B devices

| 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 4.3.2 for details.

**Test Procedures:**

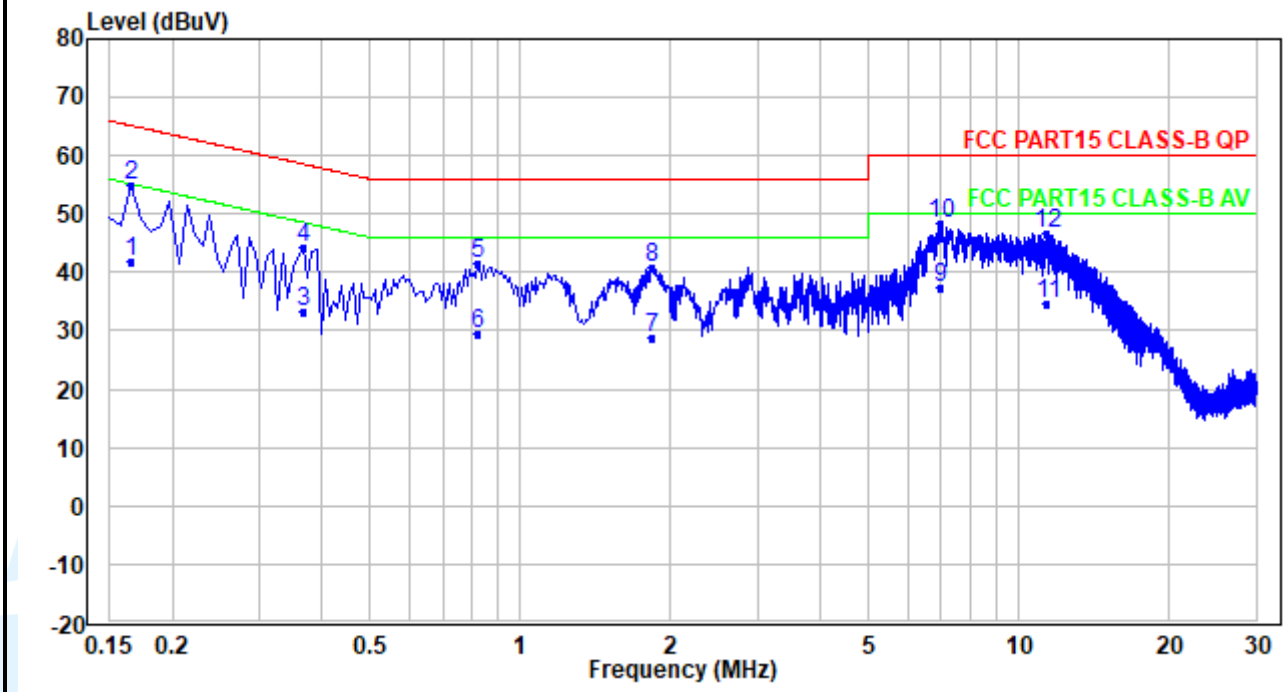
1) The Product was placed on a nonconductive table 0.8 m above the horizontal ground reference plane, and 0.4 m from the vertical ground reference plane, and connected to the main through Line Impedance Stability Network (L.I.S.N).
2) The RBW of the receiver was set at 9 kHz in 150 kHz ~ 30MHz with Peak and AVG detector in Max Hold mode. Run the receiver's pre-scan to record the maximum disturbance generated from Product in all power lines in the full band.
3) For each frequency whose maximum record was higher or close to limit, measure its QP and AVG values and record.

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

**Test Result:** Pass

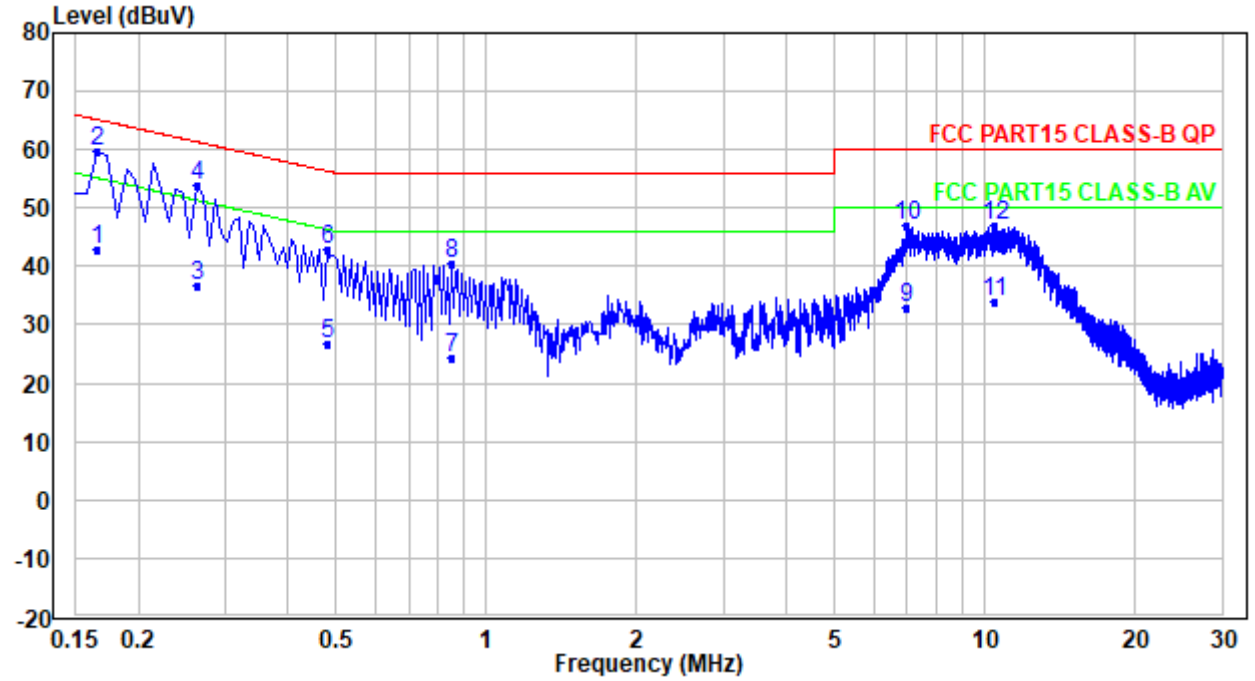
**The measurement data as follows:**
**Quasi Peak and Average:**
**Adapter 1**
**Test Mode2**

**Live Line**




| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB) | Result (dBµV) | Limit (dBµV) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 0.166 | 31.77 | 10.03 | 41.80 | 55.16 | -13.36 | Average |
| 2 | 0.166 | 44.77 | 10.03 | 54.80 | 65.16 | -10.36 | QP |
| 3 | 0.366 | 23.08 | 10.04 | 33.12 | 48.59 | -15.47 | Average |
| 4 | 0.366 | 34.08 | 10.04 | 44.12 | 58.59 | -14.47 | QP |
| 5 | 0.822 | 31.54 | 10.06 | 41.60 | 56.00 | -14.40 | Average |
| 6 | 0.822 | 19.54 | 10.06 | 29.60 | 46.00 | -16.40 | QP |
| 7 | 1.846 | 18.85 | 10.12 | 28.97 | 46.00 | -17.03 | Average |
| 8 | 1.846 | 30.85 | 10.12 | 40.97 | 56.00 | -15.03 | QP |
| 9 | 6.965 | 26.90 | 10.43 | 37.33 | 50.00 | -12.67 | Average |
| 10 | 6.965 | 37.90 | 10.43 | 48.33 | 60.00 | -11.67 | QP |
| 11 | 11.420 | 24.10 | 10.63 | 34.73 | 50.00 | -15.27 | Average |
| 12 | 11.420 | 36.10 | 10.63 | 46.73 | 60.00 | -13.27 | QP |

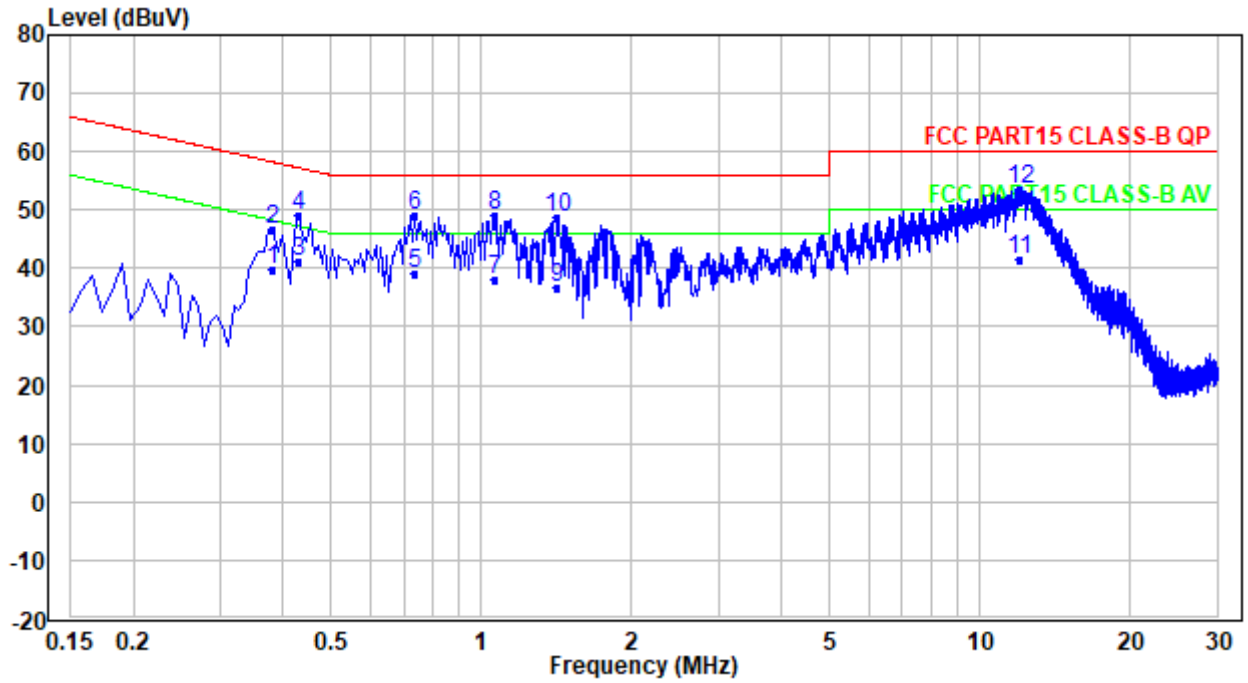
**Neutral Line**




| No. | Frequency (MHz) | Reading (dBμV) | Correction factor (dB) | Result (dBμV) | Limit (dBμV) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 0.166 | 32.79 | 10.02 | 42.81 | 55.16 | -12.35 | Average |
| 2 | 0.166 | 49.79 | 10.02 | 59.81 | 65.16 | -5.35 | QP |
| 3 | 0.262 | 26.80 | 10.01 | 36.81 | 51.37 | -14.56 | Average |
| 4 | 0.262 | 43.80 | 10.01 | 53.81 | 61.37 | -7.56 | QP |
| 5 | 0.478 | 16.76 | 10.03 | 26.79 | 46.37 | -19.58 | Average |
| 6 | 0.478 | 32.76 | 10.03 | 42.79 | 56.37 | -13.58 | QP |
| 7 | 0.854 | 14.32 | 10.05 | 24.37 | 46.00 | -21.63 | Average |
| 8 | 0.854 | 30.32 | 10.05 | 40.37 | 56.00 | -15.63 | QP |
| 9 | 6.989 | 22.50 | 10.40 | 32.90 | 50.00 | -17.10 | Average |
| 10 | 6.989 | 36.50 | 10.40 | 46.90 | 60.00 | -13.10 | QP |
| 11 | 10.452 | 23.50 | 10.52 | 34.02 | 50.00 | -15.98 | Average |
| 12 | 10.452 | 36.50 | 10.52 | 47.02 | 60.00 | -12.98 | QP |

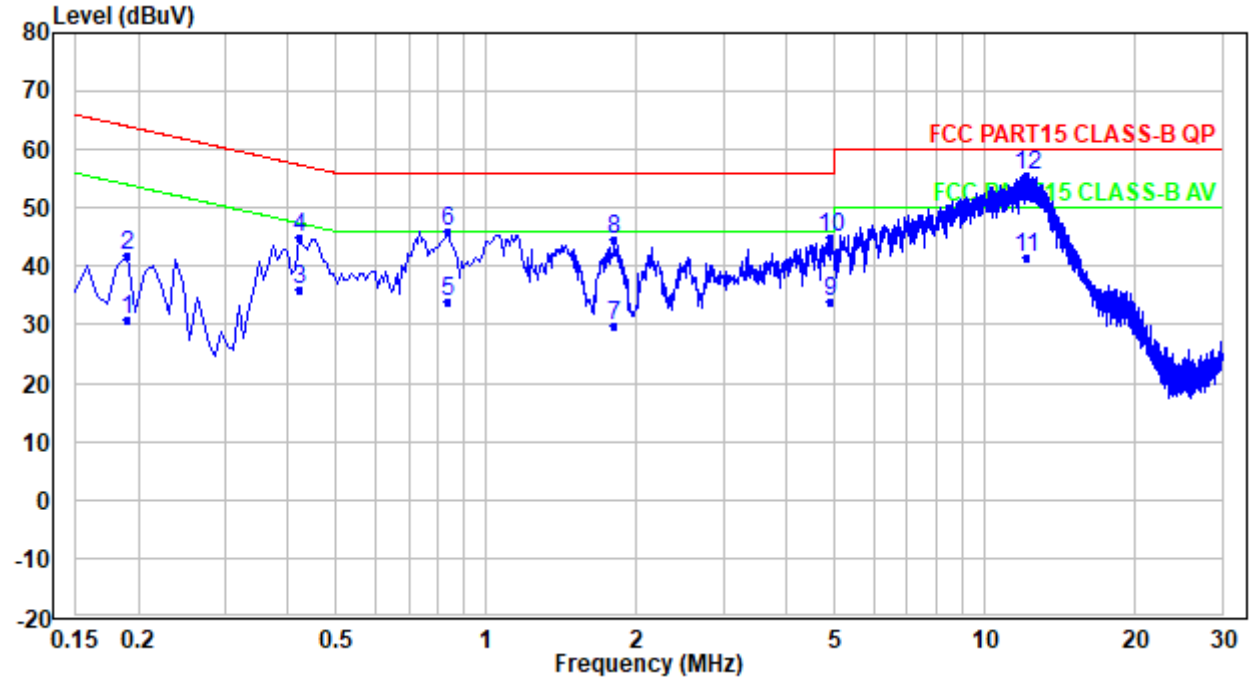
**Quasi Peak and Average:**
**Adapter 2**
**Test Mode3**

**Live Line**




| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB) | Result (dBµV) | Limit (dBµV) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 0.382 | 29.63 | 10.04 | 39.67 | 48.24 | -8.57 | Average |
| 2 | 0.382 | 36.63 | 10.04 | 46.67 | 58.24 | -11.57 | QP |
| 3 | 0.430 | 31.19 | 10.04 | 41.23 | 47.25 | -6.02 | Average |
| 4 | 0.430 | 39.19 | 10.04 | 49.23 | 57.25 | -8.02 | QP |
| 5 | 0.734 | 29.17 | 10.05 | 39.22 | 46.00 | -6.78 | Average |
| 6 | 0.734 | 39.17 | 10.05 | 49.22 | 56.00 | -6.78 | QP |
| 7 | 1.062 | 28.10 | 10.06 | 38.16 | 46.00 | -7.84 | Average |
| 8 | 1.062 | 39.10 | 10.06 | 49.16 | 56.00 | -6.84 | QP |
| 9 | 1.414 | 26.74 | 10.09 | 36.83 | 46.00 | -9.17 | Average |
| 10 | 1.414 | 38.74 | 10.09 | 48.83 | 56.00 | -7.17 | QP |
| 11 | 12.012 | 30.92 | 10.65 | 41.57 | 50.00 | -8.43 | Average |
| 12 | 12.012 | 42.92 | 10.65 | 53.57 | 60.00 | -6.43 | QP |

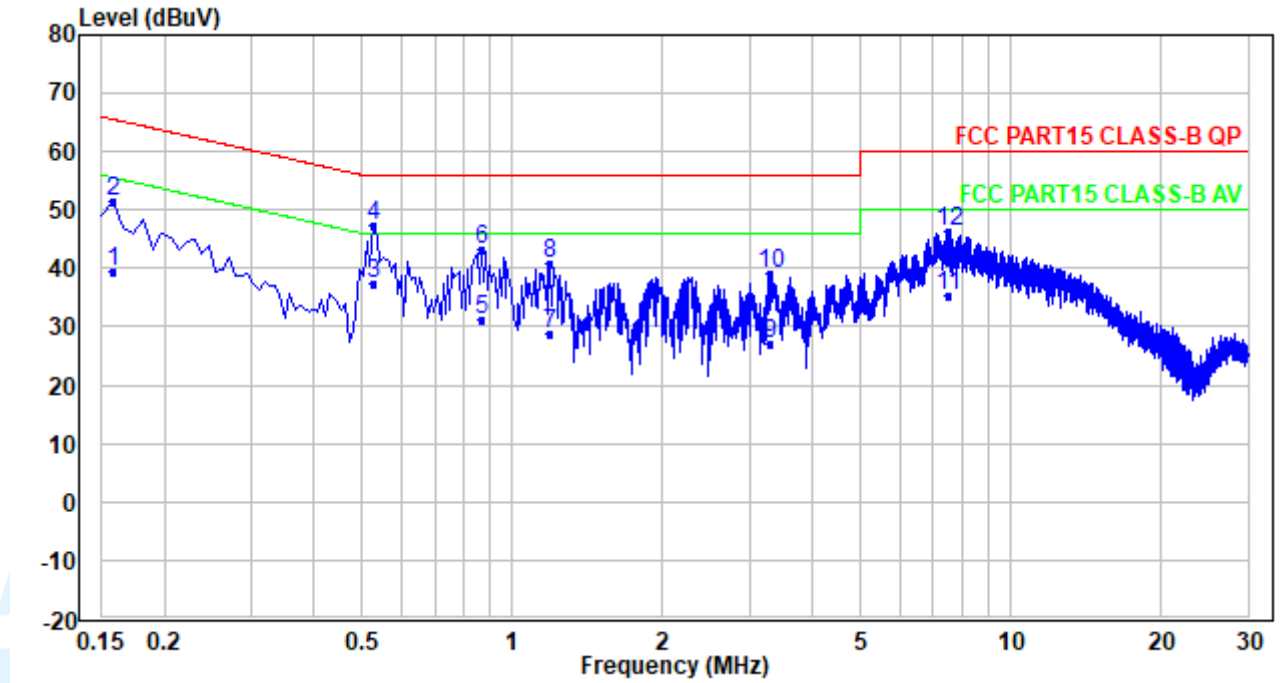
**Neutral Line**




| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB) | Result (dBµV) | Limit (dBµV) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 0.190 | 20.77 | 10.00 | 30.77 | 54.04 | -23.27 | Average |
| 2 | 0.190 | 31.77 | 10.00 | 41.77 | 64.04 | -22.27 | QP |
| 3 | 0.422 | 25.87 | 10.02 | 35.89 | 47.41 | -11.52 | Average |
| 4 | 0.422 | 34.87 | 10.02 | 44.89 | 57.41 | -12.52 | QP |
| 5 | 0.838 | 23.93 | 10.04 | 33.97 | 46.00 | -12.03 | Average |
| 6 | 0.838 | 35.93 | 10.04 | 45.97 | 56.00 | -10.03 | QP |
| 7 | 1.806 | 19.62 | 10.09 | 29.71 | 46.00 | -16.29 | Average |
| 8 | 1.806 | 34.62 | 10.09 | 44.71 | 56.00 | -11.29 | QP |
| 9 | 4.901 | 23.72 | 10.32 | 34.04 | 46.00 | -11.96 | Average |
| 10 | 4.901 | 34.72 | 10.32 | 45.04 | 56.00 | -10.96 | QP |
| 11 | 12.148 | 30.86 | 10.64 | 41.50 | 50.00 | -8.50 | Average |
| 12 | 12.148 | 44.86 | 10.64 | 55.50 | 60.00 | -4.50 | QP |

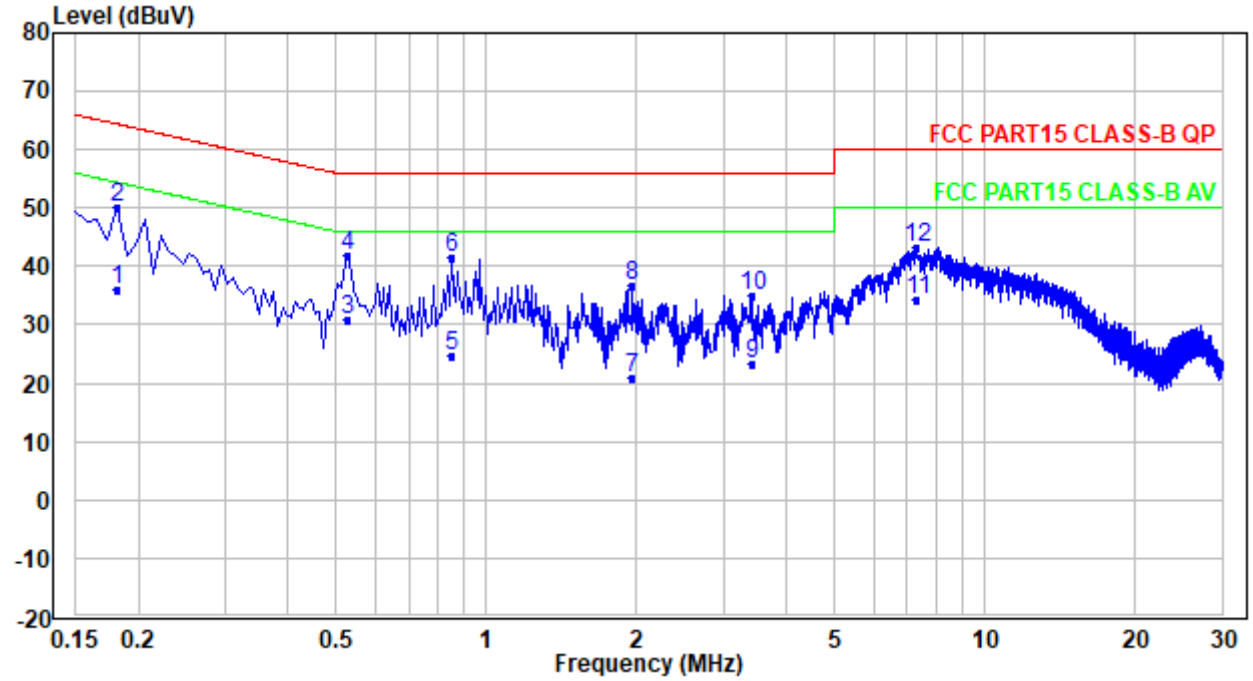
**Quasi Peak and Average:**
**Adapter 3**
**Test Mode4**

**Live Line**




| No. | Frequency (MHz) | Reading (dBµV) | Correction factor (dB) | Result (dBµV) | Limit (dBµV) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 0.158 | 29.53 | 10.03 | 39.56 | 55.57 | -16.01 | Average |
| 2 | 0.158 | 41.53 | 10.03 | 51.56 | 65.57 | -14.01 | QP |
| 3 | 0.526 | 27.38 | 10.04 | 37.42 | 46.00 | -8.58 | Average |
| 4 | 0.526 | 37.38 | 10.04 | 47.42 | 56.00 | -8.58 | QP |
| 5 | 0.870 | 21.01 | 10.06 | 31.07 | 46.00 | -14.93 | Average |
| 6 | 0.870 | 33.01 | 10.06 | 43.07 | 56.00 | -12.93 | QP |
| 7 | 1.190 | 18.66 | 10.08 | 28.74 | 46.00 | -17.26 | Average |
| 8 | 1.190 | 30.66 | 10.08 | 40.74 | 56.00 | -15.26 | QP |
| 9 | 3.301 | 16.77 | 10.21 | 26.98 | 46.00 | -19.02 | Average |
| 10 | 3.301 | 28.77 | 10.21 | 38.98 | 56.00 | -17.02 | QP |
| 11 | 7.509 | 24.78 | 10.45 | 35.23 | 50.00 | -14.77 | Average |
| 12 | 7.509 | 35.78 | 10.45 | 46.23 | 60.00 | -13.77 | QP |

**Neutral Line**




| No. | Frequency (MHz) | Reading (dBμV) | Correction factor (dB) | Result (dBμV) | Limit (dBμV) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 0.182 | 26.17 | 10.00 | 36.17 | 54.39 | -18.22 | Average |
| 2 | 0.182 | 40.17 | 10.00 | 50.17 | 64.39 | -14.22 | QP |
| 3 | 0.526 | 20.82 | 10.03 | 30.85 | 46.00 | -15.15 | Average |
| 4 | 0.526 | 31.82 | 10.03 | 41.85 | 56.00 | -14.15 | QP |
| 5 | 0.854 | 14.63 | 10.05 | 24.68 | 46.00 | -21.32 | Average |
| 6 | 0.854 | 31.63 | 10.05 | 41.68 | 56.00 | -14.32 | QP |
| 7 | 1.966 | 10.71 | 10.10 | 20.81 | 46.00 | -25.19 | Average |
| 8 | 1.966 | 26.71 | 10.10 | 36.81 | 56.00 | -19.19 | QP |
| 9 | 3.413 | 12.91 | 10.22 | 23.13 | 46.00 | -22.87 | Average |
| 10 | 3.413 | 24.91 | 10.22 | 35.13 | 56.00 | -20.87 | QP |
| 11 | 7.317 | 23.75 | 10.41 | 34.16 | 50.00 | -15.84 | Average |
| 12 | 7.317 | 32.75 | 10.41 | 43.16 | 60.00 | -16.84 | 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 possible modes of operation were investigated, and testing at two nominal voltages of 240V/50Hz and 120V/60Hz, only the worst case emissions reported.

# 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.

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********** End of Report **********



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