# FCC TEST REPORT

| | |
|---|---|
| **Product Name:** | Wireless Earbuds |
| **Trade Mark:** | N/A |
| **Model No.:** | AthlosLive-01 |
| **Report Number:** | 210809012RFC-1 |
| **Test Standards:** | FCC 47 CFR Part 15 Subpart C |
| **FCC ID:** | 2A2YB-ALA |
| **Test Result:** | PASS |
| **Date of Issue:** | September 6, 2021 |

Prepared for:

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Prepared by:

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Date: September 6, 2021

UnionTrust Laboratories UnionTrust *Control*

# Version

| Version No. | Date | Description |
|---|---|---|
| V1.0 | September 6, 2021 | Original |

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# 1. GENERAL INFORMATION

## 1.1 CLIENT INFORMATION

| | |
|---|---|
| **Applicant:** | UniRAM Technology, Inc. |
| **Address of Applicant:** | 19925 Stevens Creek Blvd. Suite 100, Cupertino, CA 95014, USA |
| **Manufacturer:** | UniRAM Technology, Inc. |
| **Address of Manufacturer:** | 19925 Stevens Creek Blvd. Suite 100, Cupertino, CA 95014, USA |
| **Factory:** | Yuzhuo Technology Limited |
| **Address of Factory:** | Room 1806, No 2095, Bixin Road, Longgang District, Shenzhen, China |

## 1.2 EUT INFORMATION

### 1.2.1 General Description of EUT

| | | |
|---|---|---|
| **Product Name:** | Wireless Earbuds | |
| **Model No.:** | AthlosLive-01 | |
| **Add. Model No.:** | AL-001, AL-002, AL-003, AL-101, AL-102, AL-103, ALG-001, ALJ-001, ALW-001 | |
| **Trade Mark:** | N/A | |
| **DUT Stage:** | Identical Prototype | |
| **EUT Supports Function:** | 2.4 GHz ISM Band: | Bluetooth V4.2 |
| **Sample Received Date:** | August 17, 2021 | |
| **Sample Tested Date:** | August 22, 2021 to August 26, 2021 | |
| **Note:** The additional model AL-001, AL-002, AL-003, AL-101, AL-102, AL-103, ALG-001, ALJ-001, ALW-001 is identical with the test model AthlosLive-01 except the model number for marketing purpose. | | |

### 1.2.2 Description of Accessories

| **Cable** | |
|---|---|
| **Description:** | USB-Type C Cable |
| **Cable Type:** | Unshielded without ferrite |
| **Length:** | 0.3 Meter |

## 1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

| | |
|---|---|
| **Frequency Band:** | 2400 MHz to 2483.5 MHz |
| **Frequency Range:** | 2402 MHz to 2480 MHz |
| **Bluetooth Version:** | Bluetooth LE |
| **Type of Modulation:** | GFSK |
| **Number of Channels:** | 40 |
| **Channel Separation:** | 2 MHz |
| **Antenna Type:** | PCB Antenna |
| **Antenna Gain:** | 1.75 dBi |
| **Maximum Peak Power:** | 0.88 dBm |
| **Normal Test Voltage:** | 3.7 Vdc |

## 1.4 OTHER INFORMATION

| Operation Frequency Each of Channel | |
|---|---|
| **f = 2402 + 2k MHz, k = 0,…,39** | |
| Note: | |
| **f** | is the operating frequency (MHz); |
| **k** | is the operating channel. |

## 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 | DELL | Latitude 3400 | 16238087894 | UnionTrust |
| Mouse | DELL | MS111 | CN-011D3V-738 | UnionTrust |

2) Support Cable

| Cable No. | Description | Connector | Length | Supplied by |
|---|---|---|---|---|
| 1 | Antenna Cable | SMA | 0.1 Meter | 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
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 150kHz-30MHz | ±2.7 dB |
| 2 | Radiated emission 9kHz-30MHz | ± 4.7 dB |
| 3 | Radiated emission 30MHz-1GHz | ± 4.6 dB |
| 4 | Radiated emission 1GHz-18GHz | ± 4.4 dB |
| 5 | Radiated emission 18GHz-26GHz | ± 4.6 dB |
| 6 | Conducted peak output power | ± 0.9 dB |
| 7 | Bandwidth | ± 1.8 % |
| 8 | Power spectral density | ± 0.6 dB |
| 9 | Conducted out of band emission | ± 2.7 dB |

## 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 15.203/15.247 (c) | N/A | PASS |
| **AC Power Line Conducted Emission** | FCC 47 CFR Part 15 Subpart C Section 15.207 | ANSI C63.10-2013 Clause 6.2 | NA(See Note 1) |
| **Conducted Peak Output Power** | FCC 47 CFR Part 15 Subpart C Section 15.247 (b)(3) | ANSI C63.10-2013 Clause 11.9.1.3 | PASS |
| **6dB Bandwidth** | FCC 47 CFR Part 15 Subpart C Section 15.247 (a)(2) | ANSI C63.10-2013 Clause 11.8.1 | PASS |
| **Power Spectral Density** | FCC 47 CFR Part 15 Subpart C Section 15.247 (e) | ANSI C63.10-2013 Clause 11.10.2 | PASS |
| **Conducted Out of Band Emission** | FCC 47 CFR Part 15 Subpart C Section 15.247(d) | ANSI C63.10-2013 Clause 11.11 | PASS |
| **Radiated Spurious Emissions** | FCC 47 CFR Part 15 Subpart C Section 15.205/15.209 | ANSI C63.10-2013 Clause 11.11 & Clause 11.12 | PASS |
| **Band Edge Measurements (Radiated)** | FCC 47 CFR Part 15 Subpart C Section 15.205/15.209 | ANSI C63.10-2013 Clause 11.13 | PASS |

**Note1:** N/A: In the whole report not application.

# 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. 18, 2020 | Nov. 17, 2021 |
| ☒ | Broadband Antenna | ETS-LINDGREN | 3142E | 00201566 | Nov. 14, 2020 | Nov. 13, 2021 |
| ☒ | 6dB Attenuator | Talent | RA6A5-N-18 | 18103001 | Nov. 14, 2020 | Nov.13, 2021 |
| ☒ | Preamplifier | HP | 8447F | 2805A02960 | Nov. 10, 2020 | Nov. 9, 2021 |
| ☒ | Double-Ridged Waveguide Horn Antenna | ETS-LINDGREN | 3117-PA | 00201541 | Apr. 30, 2021 | Apr. 29, 2022 |
| ☒ | Pre-amplifier | ETS-Lindgren | 00118385 | 00201874 | Nov. 10, 2020 | Nov. 9, 2021 |
| ☒ | Multi device Controller | ETS-LINDGREN | 7006-001 | 00160105 | N/A | N/A |
| ☒ | Band Reject Filter(2400MHz~2500 MHz) | micro-tronics | BRM50702 | G248 | Nov. 10, 2020 | Nov. 09, 2021 |
| ☒ | 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)** |
| ☒ | EXA Spectrum Analyzer | KEYSIGHT | N9010A | MY51440197 | Nov. 10, 2020 | Nov. 09, 2021 |
| ☒ | USB Wideband Power Sensor | KEYSIGHT | U2021XA | MY55430035 | Nov. 10, 2020 | Nov. 09, 2021 |

# 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 (%) |
| NT/NV | +15 to +35 | 3.7 | 20 to 75 |
| **Remark:**<br>1) NV: Normal Voltage; NT: Normal Temperature | | | |

### 4.1.2 Record of Normal Environment

| Test Item | Temperature (°C) | Relative Humidity (%) | Pressure (kPa) | Tested by |
|---|---|---|---|---|
| Conducted Peak Output Power | 25.2 | 50.1 | 100.1 | Eanrk Ouyang |
| 6dB Bandwidth | 25.2 | 50.1 | 100.1 | Eanrk Ouyang |
| Power Spectral Density | 25.2 | 50.1 | 100.1 | Eanrk Ouyang |
| Conducted Out of Band Emission | 25.2 | 50.1 | 100.1 | Eanrk Ouyang |
| Radiated Spurious Emissions | 25.2 | 52 | 100.02 | Andy Lin |
| Band Edge Measurements (Radiated) | 25.2 | 52 | 100.02 | Andy Lin |

## 4.2 TEST CHANNELS

| Type of Modulation | Tx/Rx Frequency | Test RF Channel Lists | | |
|---|---|---|---|---|
| | | Lowest(L) | Middle(M) | Highest(H) |
| GFSK | 2402 MHz to 2480 MHz | Channel 0 | Channel 19 | Channel 39 |
| | | 2402 MHz | 2440 MHz | 2480 MHz |

## 4.3 EUT TEST STATUS

| Type of Modulation | Tx Function | Description |
|---|---|---|
| GFSK | 1Tx | 1. Keep the EUT in continuously transmitting with modulation test single. |

| Power Setting |
|---|
| Power Setting: 10 |

| Test Software |
|---|
| Test software name: BT FCC TOOL V2.23 |

## 4.4 TEST SETUP

### 4.4.1 For Radiated Emissions test setup

**Figure 1. Below 30MHz**

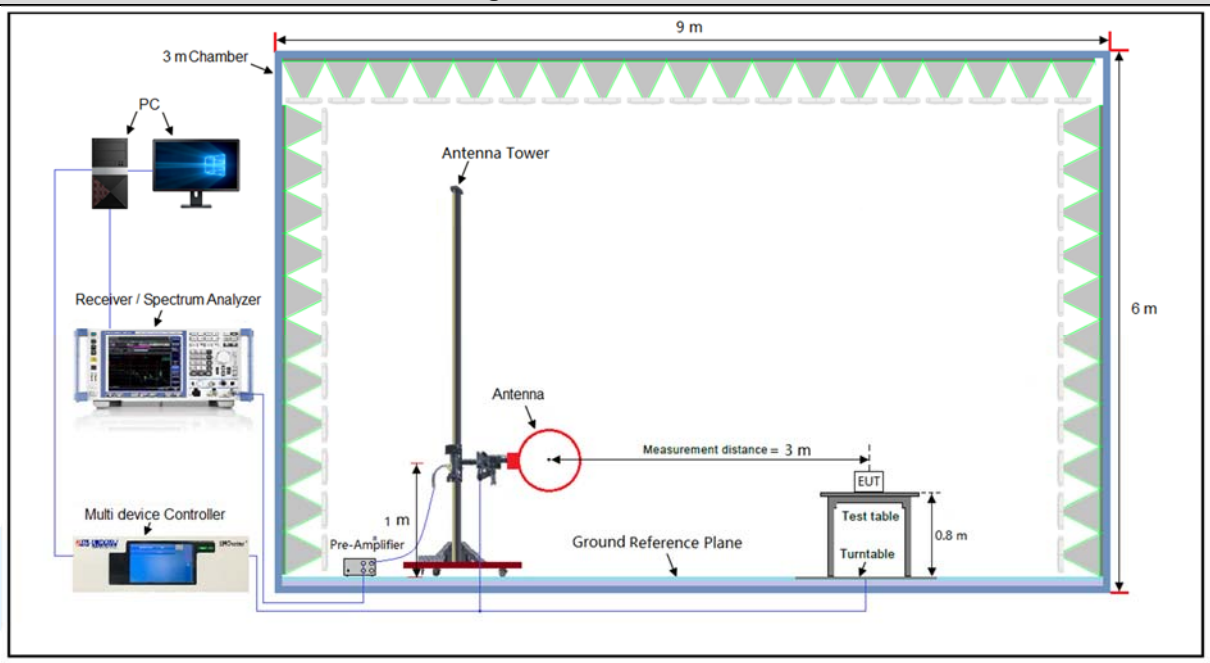



**Figure 2. 30MHz to 1GHz**

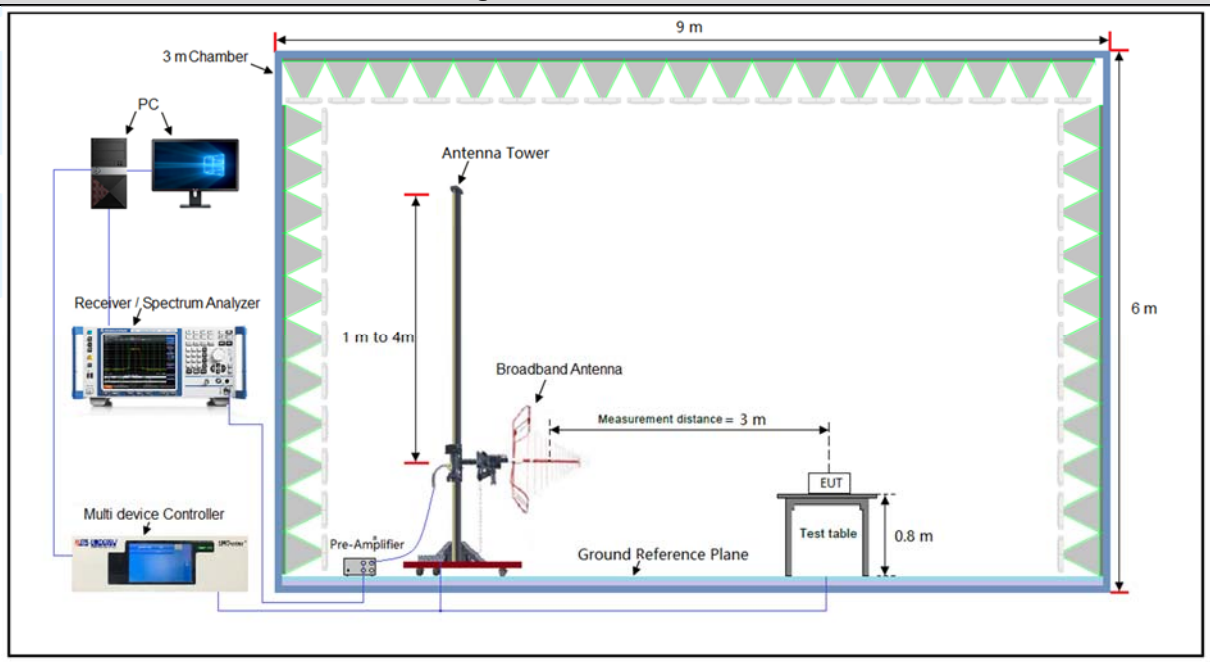
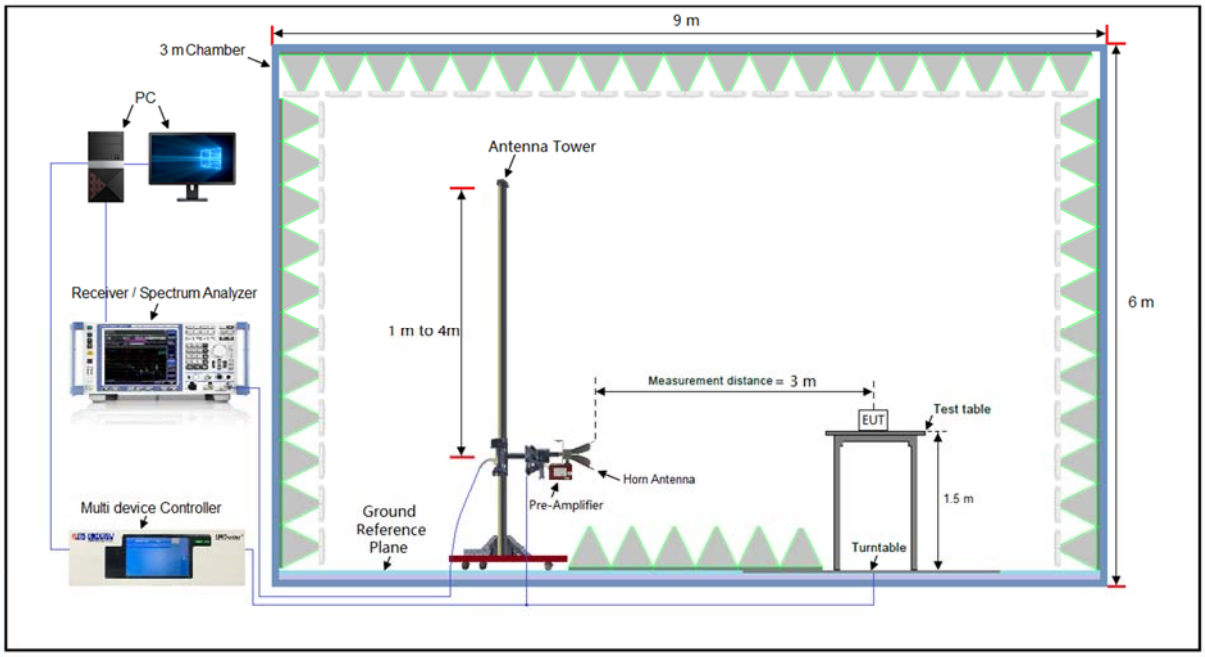
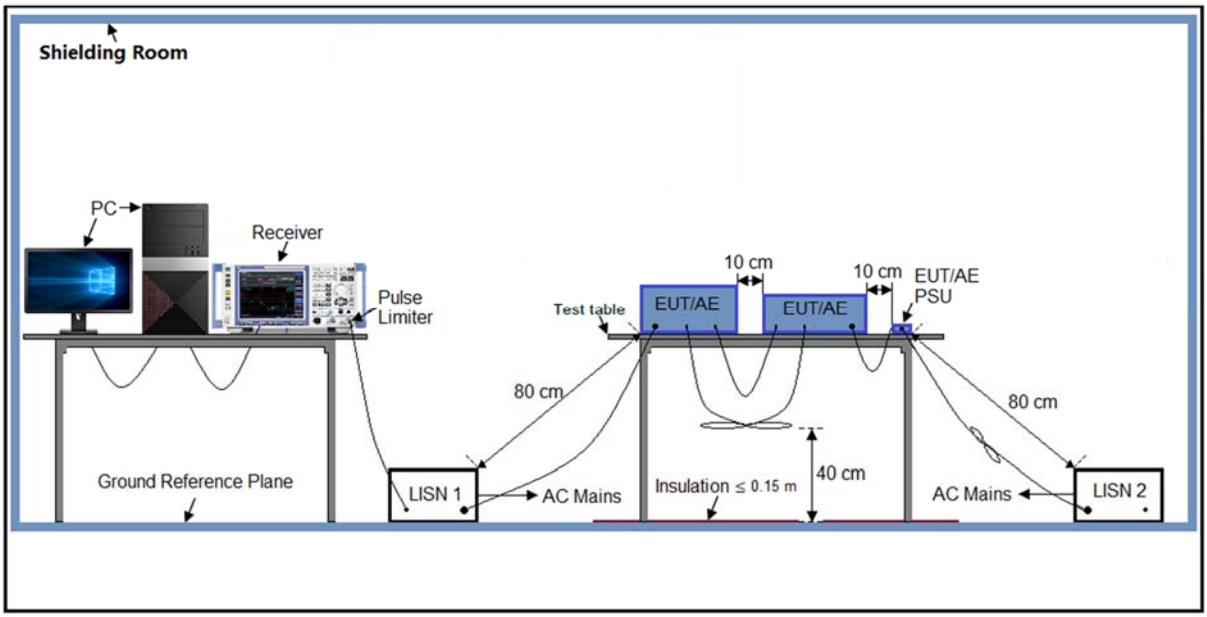


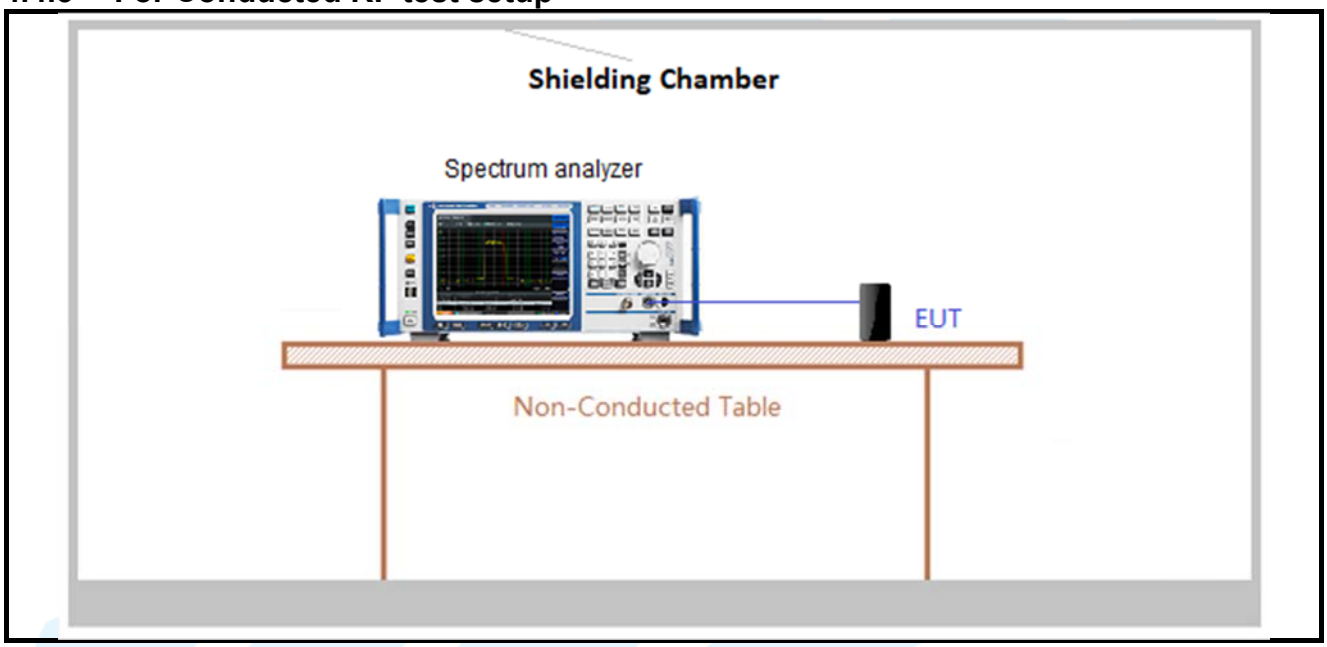
**Figure 3. Above 1GHz**




## 4.4.2 For Conducted Emissions test setup



### 4.4.3 For Conducted RF test setup




## 4.5 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.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. Therefore, all final radiated testing was performed with the EUT in (see table below) orientation.

| Frequency | Mode | Antenna Port | Worst-case axis positioning |
|---|---|---|---|
| Above 1GHz | 1TX | Chain 0 | Z axis |

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.

## 4.6 DUTY CYCLE

**Test Procedure:** ANSI C63.10-2013 Clause 11.6.

**Test Results**

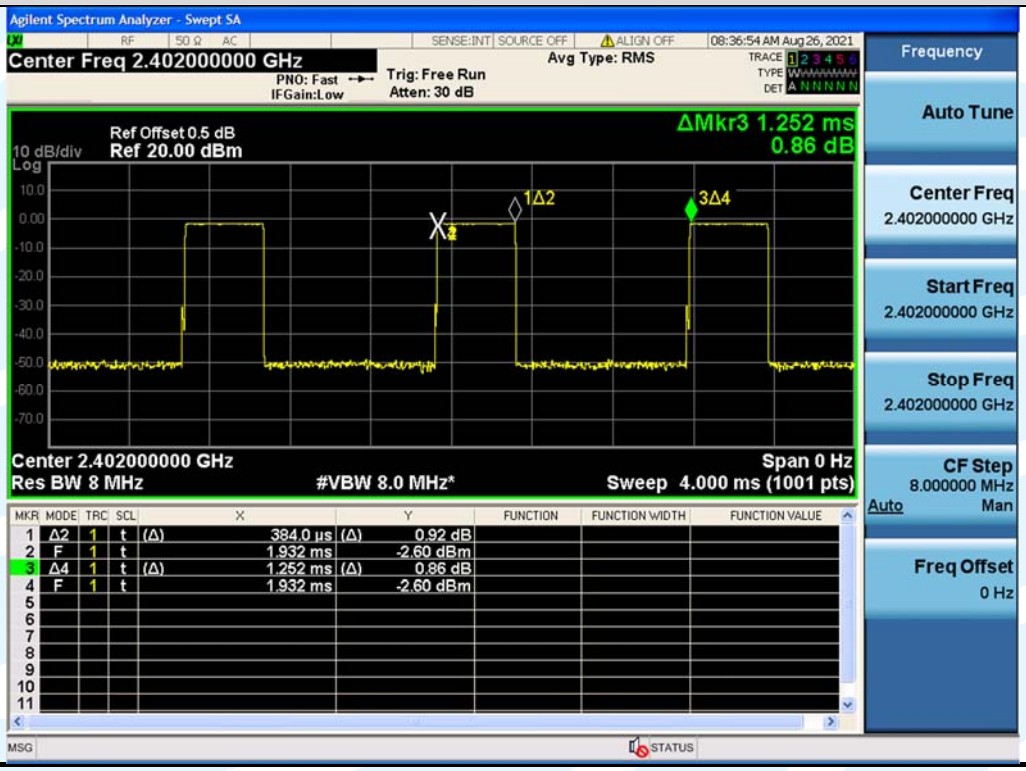
| Type of Modulation | On Time (msec) | Period (msec) | Duty Cycle (linear) | Duty Cycle (%) | Duty Cycle Factor (dB) | 1/ T Minimum VBW (kHz) | Average Factor (dB) |
|---|---|---|---|---|---|---|---|
| GFSK | 0.3840 | 1.2520 | 0.31 | 30.67 | 5.13 | 2.60 | -10.27 |

**Remark:**

1) Duty cycle= On Time/ Period;
2) Duty Cycle factor = 10 * log(1/ Duty cycle);
3) Average factor = 20 $\log_{10}$ Duty Cycle.

**The test plot as follows**

**GFSK**



# 5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION

## 5.1 REFERENCE DOCUMENTS FOR TESTING

| No. | Identity | Document Title |
|---|---|---|
| 1 | FCC 47 CFR Part 2 | Frequency allocations and radio treaty matters; general rules and regulations |
| 2 | FCC 47 CFR Part 15 | Radio Frequency Devices |
| 3 | ANSI C63.10-2013 | American National Standard for Testing Unlicesed Wireless Devices |
| 4 | KDB 558074 D01 15.247 Meas Guidance v05r02 | Guidance for compliance measurements on Digital Transmission Systems, Frequency Hopping Spread Spectrum system, and Hybrid system devices operating under Section 15.247 of the FCC rules |

## 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>**15.247(b) (4) requirement:**<br>The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi. |
| **EUT Antenna:** |
| Antenna in the interior of the equipment and no consideration of replacement, and the antenna port comply with the 15.203 requirement.The gain of the antenna is 1.75 dBi. |

## 5.3 CONDUCTED PEAK OUTPUT POWER

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section15.247 (b)(3)

**Test Method:** ANSI C63.10-2013 Clause 11.9.1.3

**Limit:** For systems using digital modulation in the 2400-2483.5 MHz bands: 1 Watt.

**Test Procedure:**
1. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.
2. Measure out each test modes' peak or average output power, record the power level.

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

**Test Setup:** Refer to section 4.4.3 for details.

**Instruments Used:** Refer to section 3 for details

**Test Results:** Pass

| Type of Modulation | Channel | Frequency (MHz) | Maximum Conducted Peak Power (dBm) | Maximum Conducted Peak Power (mW) |
|---|---|---|---|---|
| GFSK | 0 | 2402 | -0.98 | 0.80 |
| | 19 | 2440 | -0.1 | 0.98 |
| | 39 | 2480 | **0.88** | **1.22** |

Note: The antenna gain of 1.75 dBi less than 6dBi maximum permission antenna gain value based on 1 watt peak output power limit.

## 5.46 DB BANDWIDTH

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.247 (a)(2)

**Test Method:** ANSI C63.10-2013 Clause 11.8.1

**Limit:** For direct sequence systems, the minimum 6dB bandwidth shall be at least 500kHz

**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) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 x RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

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

**Test Setup:** Refer to section 4.4.3 for details.

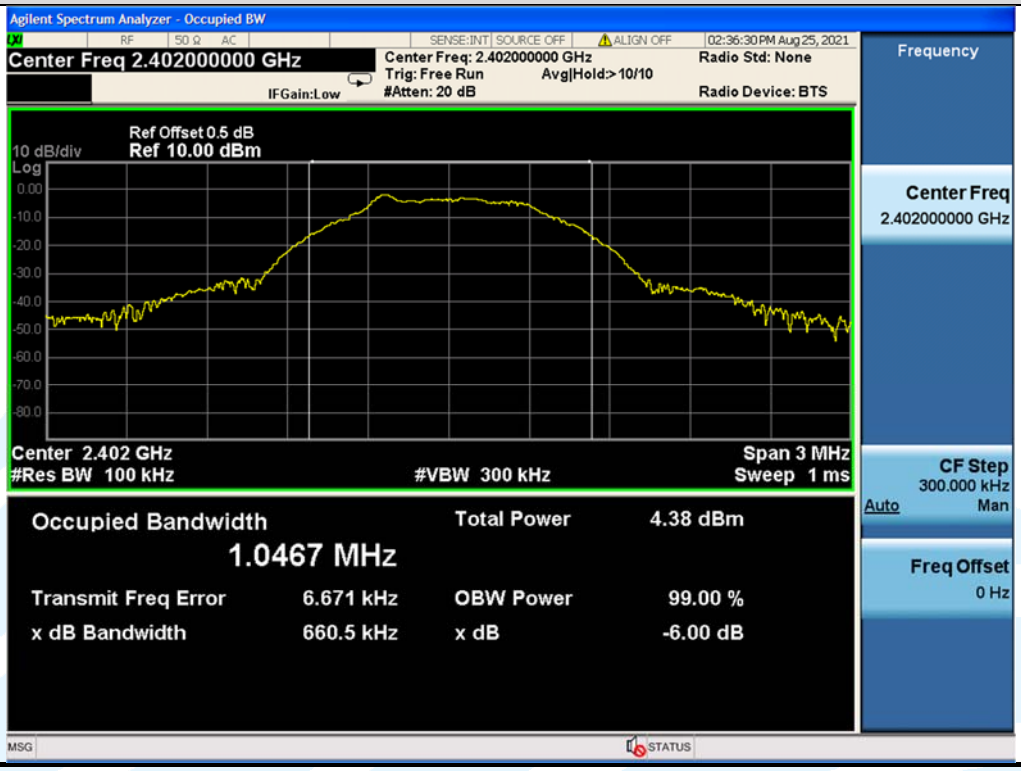
**Instruments Used:** Refer to section 3 for details

**Test Results:**

| Type of Modulation | Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | 99% Bandwidth (MHz) | 6 dB Bandwidth Limit | Pass / Fail |
|---|---|---|---|---|---|---|
| GFSK | 0 | 2402 | 0.6605 | 1.0467 | > 500 kHz | Pass |
| | 19 | 2440 | 0.6685 | 1.0488 | > 500 kHz | Pass |
| | 39 | 2480 | 0.6691 | 1.0499 | > 500 kHz | Pass |

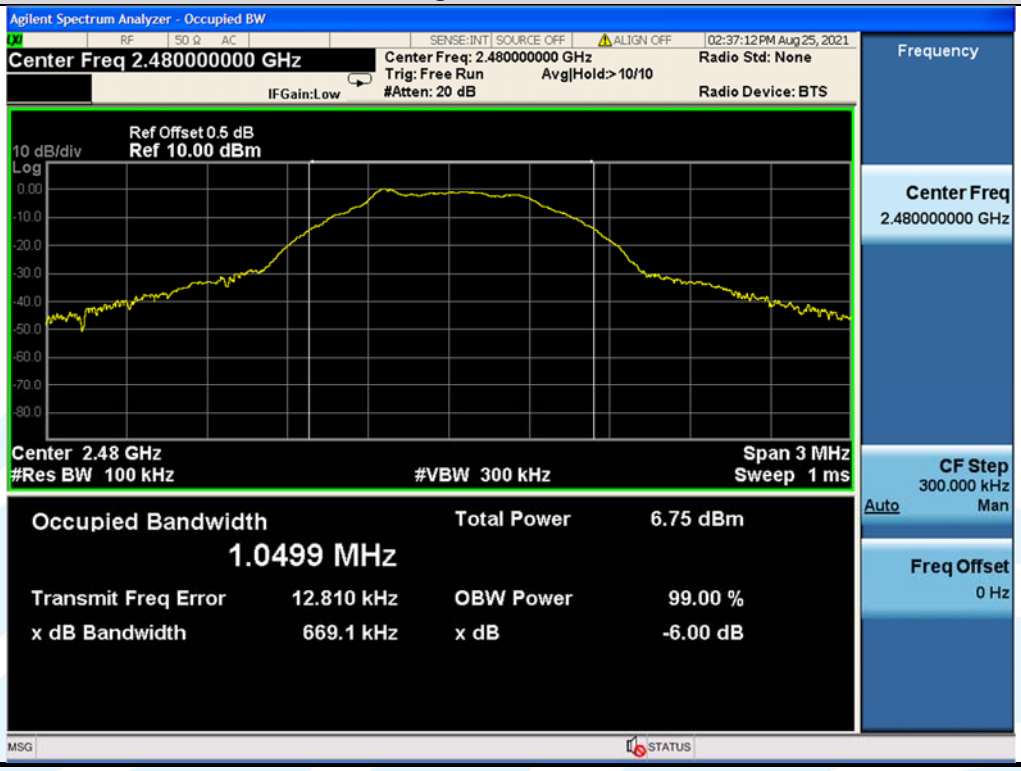
**The test plots as follows:**

**Lowest Channel**




**Middle Channel**

**Highest Channel**



## 5.5 POWER SPECTRAL DENSITY

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.247 (e)

**Test Method:** ANSI C63.10-2013 Clause 11.10.2

**Limit:** For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.

**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) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ 3 x RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

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

**Test Setup:** Refer to section 4.4.3 for details.

**Instruments Used:** Refer to section 3 for details

**Test Results:** Pass

| Type of Modulation | Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) | Result (Pass / Fail) |
|---|---|---|---|---|---|
| GFSK | 0 | 2402 | -13.730 | 8 | Pass |
| | 19 | 2440 | -12.636 | 8 | Pass |
| | 39 | 2480 | -11.488 | 8 | Pass |

**The test plots as follows:**

**Lowest Channel**

**Middle Channel**

**Highest Channel**

## 5.6 CONDUCTED OUT OF BAND EMISSION

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.247(d)

**Test Method:** ANSI C63.10-2013 Clause 11.11

**Limit:** In any 100kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.

**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:

**Step 1:Measurement Procedure REF**

a) Set instrument center frequency to DTS channel center frequency.
b) Set the span to ≥ 1.5 times the DTS bandwidth.
c) Set the RBW = 100 kHz.
d) Set the VBW ≥ 3 x RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum PSD level.
j) Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

**Step 2:Measurement Procedure OOBE**

a) Set RBW = 100 kHz.
b) Set VBW ≥ 300 kHz.
c) Detector = peak.
d) Sweep = auto couple.
e) Trace Mode = max hold.
f) Allow trace to fully stabilize.
g) Use the peak marker function to determine the maximum amplitude level.

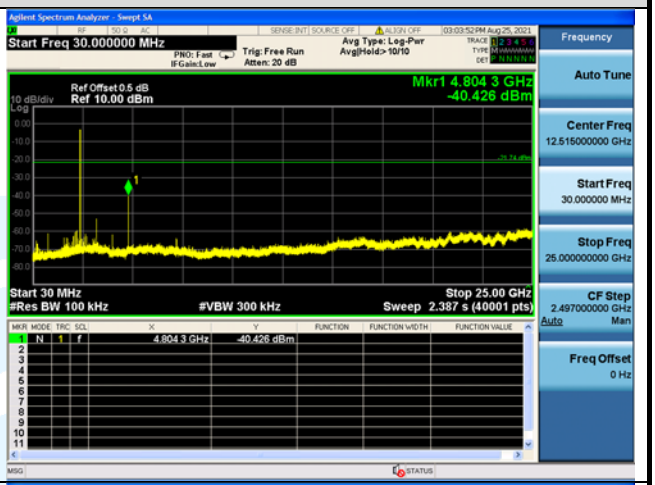
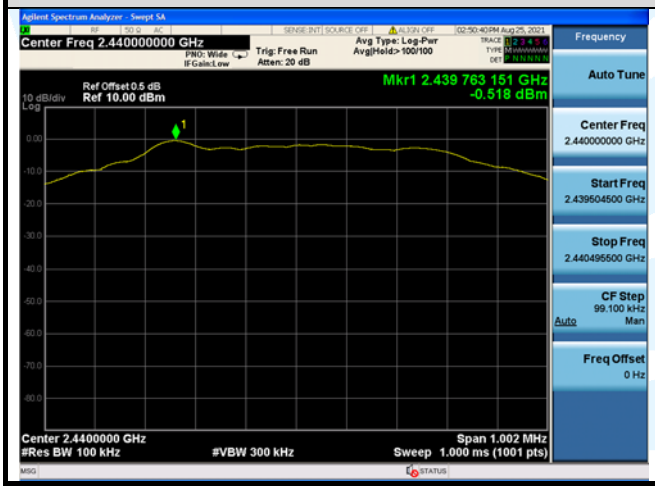
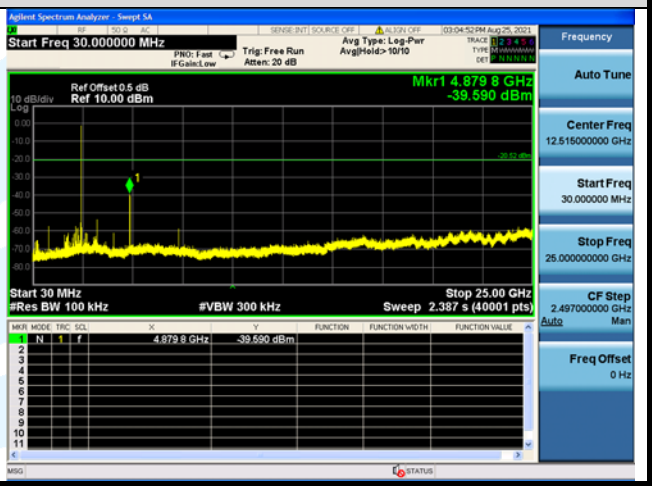
Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

**Test Setup:** Refer to section 4.4.3 for details.

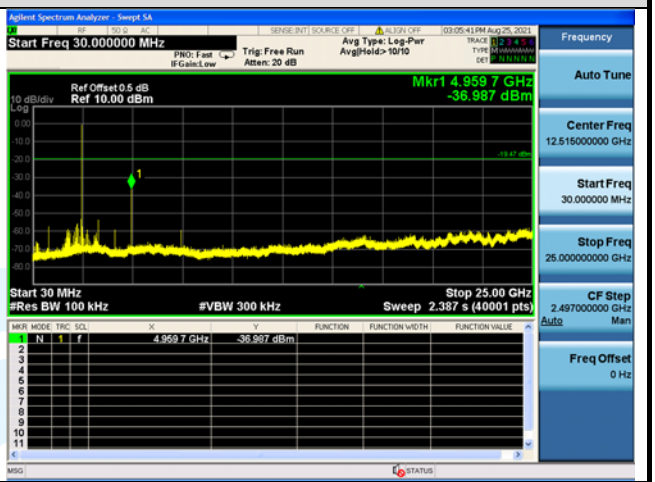
**Instruments Used:** Refer to section 3 for details

**Test Results:** Pass

**The test plots as follows:**

| In-Band Reference Level | Out of Band Emission |
|---|---|
| **Lowest Channel** | |
| |  |
| **Middle Channel** | |
|  |  |

**Highest Channel**



## 5.7 RADIATED SPURIOUS EMISSIONS

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.205/15.209

**Test Method:** ANSI C63.10-2013 Clause 11.11 & Clause 11.12

**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:**

**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 (dBuV/m) = 20 log Emission level (uV/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 4.4.1 for details.

**Test Procedures:**

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

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.

2. Above 1GHz test procedure as below:

1) Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 meter to 1.5 meter( Above 18GHz the distance is 1 meter and table is 1.5 meter).
2) Test the EUT in the lowest channel ,middle channel, the Highest channel

3) The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the Z axis positioning which it is worse case.
4) Repeat above procedures until all frequencies measured was complete.

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

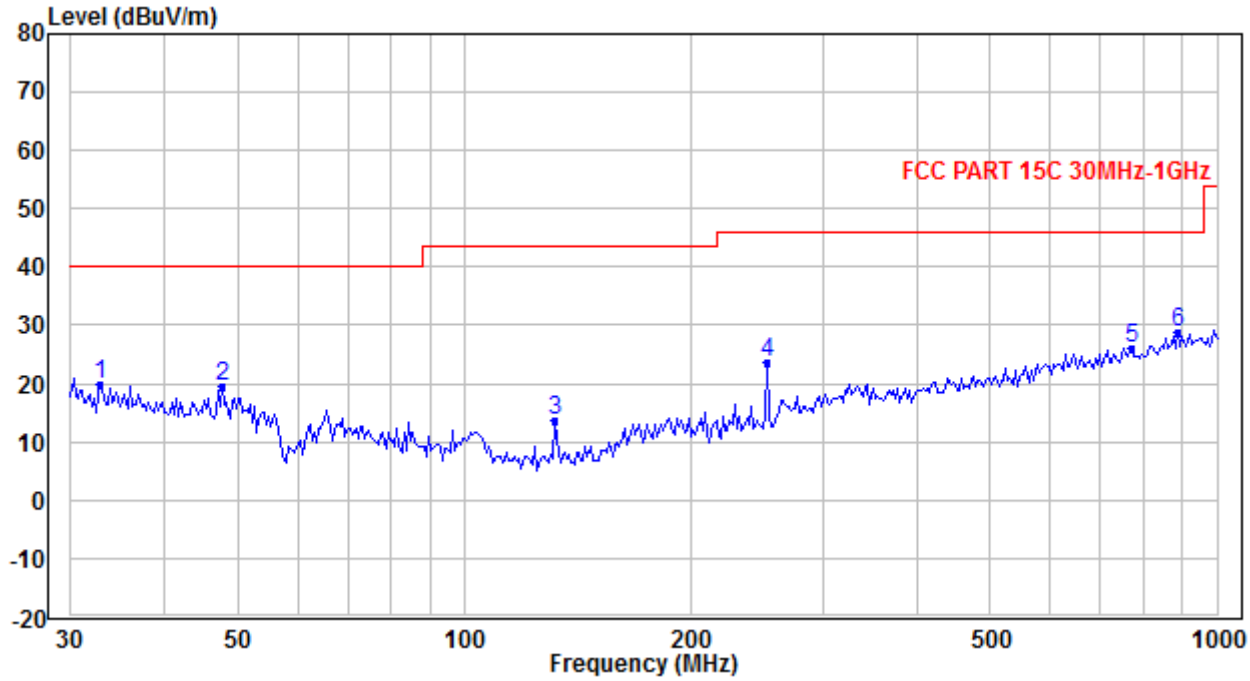
**Test Result:** Pass

**The measurement data as follows:**

| **Radiated Emission Test Data (9 kHz ~ 30 MHz):** |
|---|
| The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report. |

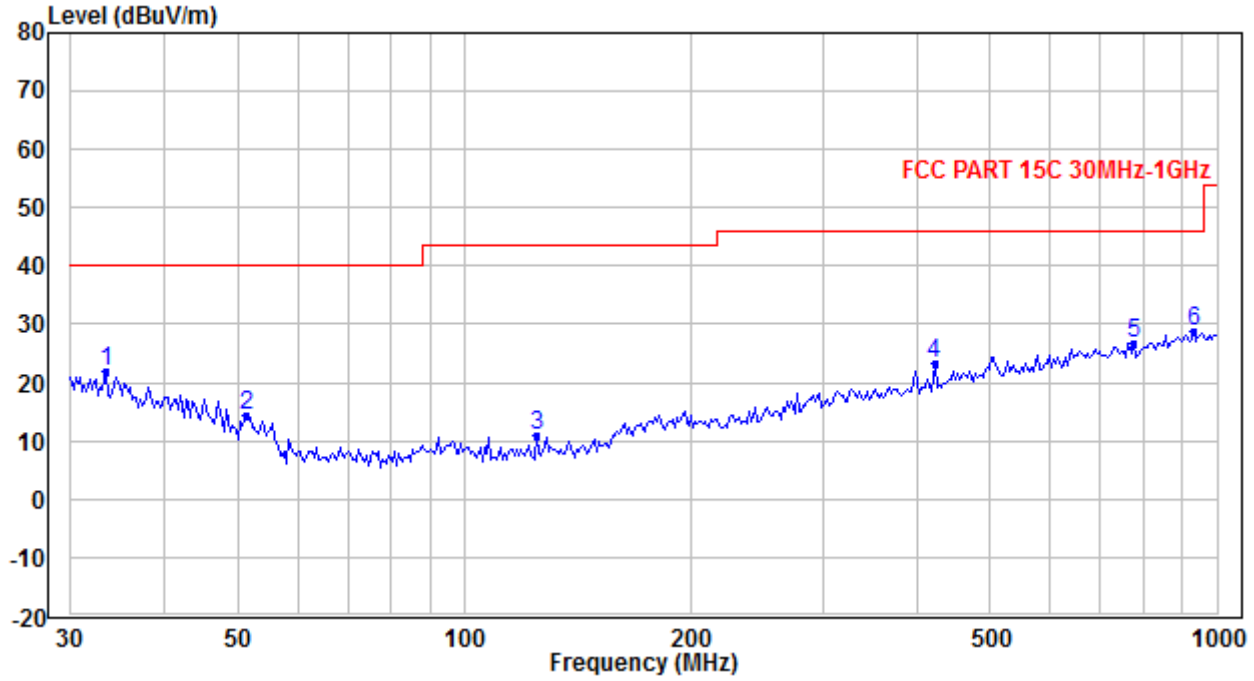
**Radiated Emission Test Data (30 MHz ~ 1 GHz):**
**Worst-Case Configuration**

**Horizontal**




| No. | Frequency (MHz) | Reading (dBμV) | Correction factor (dB/m ) | Result (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 32.870 | 24.66 | -4.75 | 19.91 | 40.00 | -20.09 | QP |
| 2 | 47.703 | 32.81 | -13.14 | 19.67 | 40.00 | -20.33 | QP |
| 3 | 132.149 | 29.50 | -15.85 | 13.65 | 43.50 | -29.85 | QP |
| 4 | 252.252 | 32.38 | -8.81 | 23.57 | 46.00 | -22.43 | QP |
| 5 | 771.047 | 24.12 | 2.01 | 26.13 | 46.00 | -19.87 | QP |
| 6 | 887.398 | 24.60 | 4.07 | 28.67 | 46.00 | -17.33 | QP |

**Vertical**




| No. | Frequency (MHz) | Reading (dBμV) | Correction factor (dB/m ) | Result (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 33.335 | 26.64 | -4.73 | 21.91 | 40.00 | -18.09 | QP |
| 2 | 51.176 | 29.79 | -15.43 | 14.36 | 40.00 | -25.64 | QP |
| 3 | 124.925 | 26.74 | -15.83 | 10.91 | 43.50 | -32.59 | QP |
| 4 | 421.329 | 27.51 | -4.38 | 23.13 | 46.00 | -22.87 | QP |
| 5 | 776.485 | 25.03 | 1.82 | 26.85 | 46.00 | -19.15 | QP |
| 6 | 932.141 | 24.41 | 4.26 | 28.67 | 46.00 | -17.33 | QP |

**Radiated Emission Test Data (1GHz ~ 25GHz):**

**Lowest Channel:**

| No. | Frequency (MHz) | Reading (dBμV/m) | Correction factor (dB) | Result (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Detector | Antenna Polaxis |
|---|---|---|---|---|---|---|---|---|
| 1 | 4804.00 | 41.62 | -3.32 | 38.30 | 74.00 | -35.70 | Peak | Horizontal |
| 2 | 4804.00 | 29.24 | -3.32 | 25.92 | 54.00 | -28.08 | Average | Horizontal |
| 3 | 7206.00 | 41.25 | 0.84 | 42.09 | 74.00 | -31.91 | Peak | Horizontal |
| 4 | 7206.00 | 28.19 | 0.84 | 29.03 | 54.00 | -24.97 | Average | Horizontal |
| 5 | 4804.00 | 40.97 | -3.22 | 37.75 | 74.00 | -36.25 | Peak | Vertical |
| 6 | 4804.00 | 29.10 | -3.22 | 25.88 | 54.00 | -28.12 | Average | Vertical |
| 7 | 7206.00 | 40.24 | 0.94 | 41.18 | 74.00 | -32.82 | Peak | Vertical |
| 8 | 7206.00 | 27.24 | 0.94 | 28.18 | 54.00 | -25.82 | Average | Vertical |

**Middle Channel:**

| No. | Frequency (MHz) | Reading (dBμV/m) | Correction factor (dB) | Result (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Detector | Antenna Polaxis |
|---|---|---|---|---|---|---|---|---|
| 1 | 4880.00 | 41.54 | -3.24 | 38.30 | 74.00 | -35.70 | Peak | Horizontal |
| 2 | 4880.00 | 28.69 | -3.24 | 25.45 | 54.00 | -28.55 | Average | Horizontal |
| 3 | 7320.00 | 40.24 | 0.98 | 41.22 | 74.00 | -32.78 | Peak | Horizontal |
| 4 | 7320.00 | 27.68 | 0.98 | 28.66 | 54.00 | -25.34 | Average | Horizontal |
| 5 | 4880.00 | 41.59 | -3.06 | 38.53 | 74.00 | -35.47 | Peak | Vertical |
| 6 | 4880.00 | 29.16 | -3.06 | 26.10 | 54.00 | -27.90 | Average | Vertical |
| 7 | 7320.00 | 40.06 | 1.08 | 41.14 | 74.00 | -32.86 | Peak | Vertical |
| 8 | 7320.00 | 26.66 | 1.08 | 27.74 | 54.00 | -26.26 | Average | Vertical |

**Highest Channel:**

| No. | Frequency (MHz) | Reading (dBμV/m) | Correction factor (dB) | Result (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Detector | Antenna Polaxis |
|---|---|---|---|---|---|---|---|---|
| 1 | 4960.00 | 38.27 | -3.17 | 35.10 | 74.00 | -38.90 | Peak | Horizontal |
| 2 | 4960.00 | 26.15 | -3.17 | 22.98 | 54.00 | -31.02 | Average | Horizontal |
| 3 | 7440.00 | 38.01 | 1.13 | 39.14 | 74.00 | -34.86 | Peak | Horizontal |
| 4 | 7440.00 | 27.20 | 1.13 | 28.33 | 54.00 | -25.67 | Average | Horizontal |
| 5 | 4960.00 | 38.18 | -2.91 | 35.27 | 74.00 | -38.73 | Peak | Vertical |
| 6 | 4960.00 | 25.85 | -2.91 | 22.94 | 54.00 | -31.06 | Average | Vertical |
| 7 | 7440.00 | 39.62 | 1.23 | 40.85 | 74.00 | -33.15 | Peak | Vertical |
| 8 | 7440.00 | 27.27 | 1.23 | 28.50 | 54.00 | -25.50 | Average | Vertical |

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

## 5.8 BAND EDGE MEASUREMENTS (RADIATED)

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.205/15.209

**Test Method:** ANSI C63.10-2013 Clause 11.13

**Limits:**

Radiated emissions which fall in the restricted bands, as defined in section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a).

| Frequency | Limit (dBμV/m @3m) | Remark |
|---|---|---|
| 30 MHz-88 MHz | 40.0 | Quasi-peak Value |
| 88 MHz-216 MHz | 43.5 | Quasi-peak Value |
| 216 MHz-960 MHz | 46.0 | Quasi-peak Value |
| 960 MHz-1 GHz | 54.0 | Quasi-peak Value |
| Above 1 GHz | 54.0 | Average Value |
| | 74.0 | Peak Value |

**Test Setup:** Refer to section 4.4.1 for details.

**Test Procedures:**

Radiated band edge measurements at 2390 MHz and 2483.5 MHz were made with the unit transmitting in the low end of the channel range and the high end closest to the restricted bands respectively. The emissions were made on the 966 Semi-Chamber. Use (resolution bandwidth (RBW) = 1 MHz, video bandwidth (VBW) = 3 MHz for peak levels and RBW = 1 MHz and VBW = 10 Hz or 1/T for average levels).

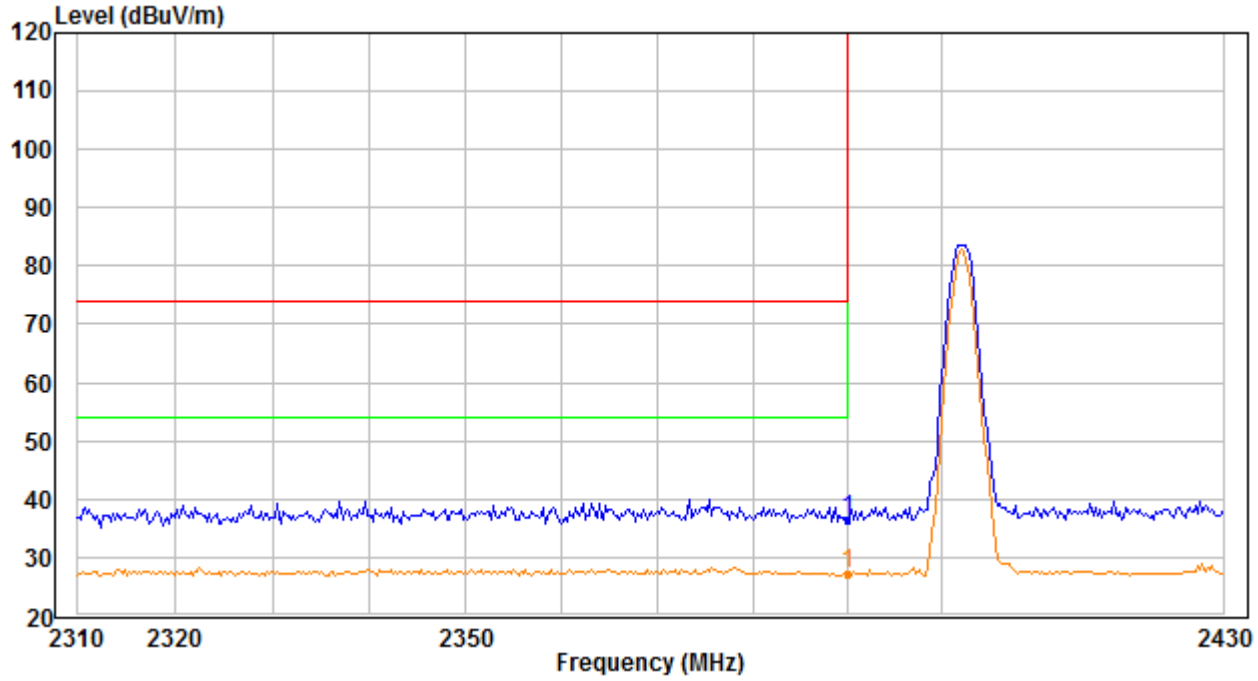
1. Use radiated spurious emission test procedure described in clause 5.10. The transmitter output (antenna port) was connected to the test receiver.
2. Set the PK and AV limit line.
3. Record the fundamental emission and emissions out of the band-edge.
4. Determine band-edge compliance as required.

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

**Test Result:** Pass

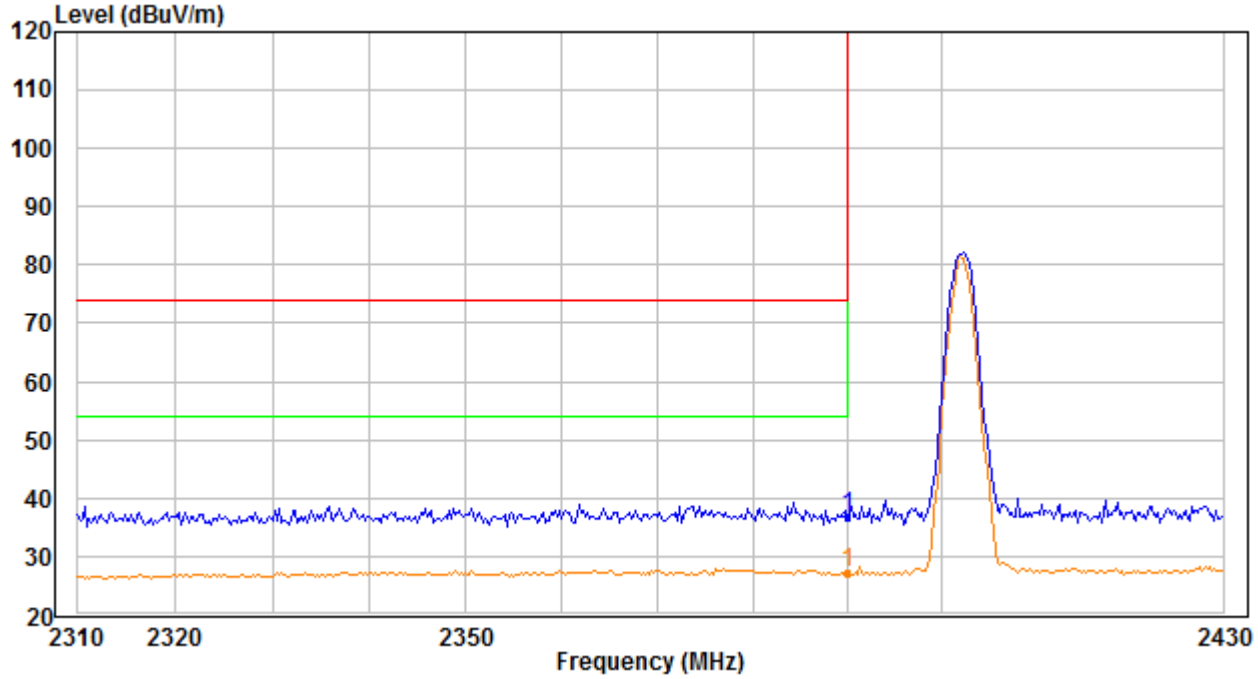
**The measurement data as follows:**

| Test Channel: | Lowest Channel | Ant. Polar. : | Horizontal |
|---|---|---|---|



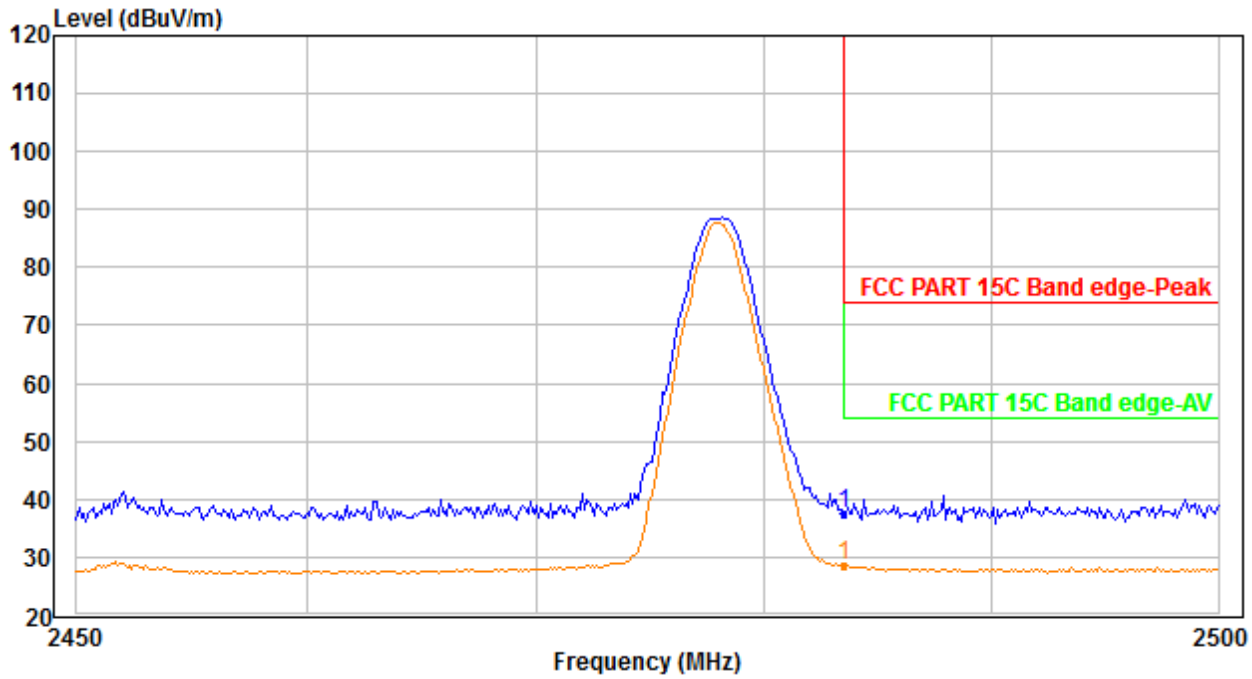

| Frequency (MHz) | Peak level (dBμV/m) | Peak Limit (dBμV/m) | AV level (dBμV/m) | AV Limit (dBμV/m) | Conclusion |
|---|---|---|---|---|---|
| 2390.0000 | 36.50 | 74.00 | 27.08 | 54.00 | Pass |

| Test Channel: | Lowest Channel | Ant. Polar. : | Vertical |
|---|---|---|---|



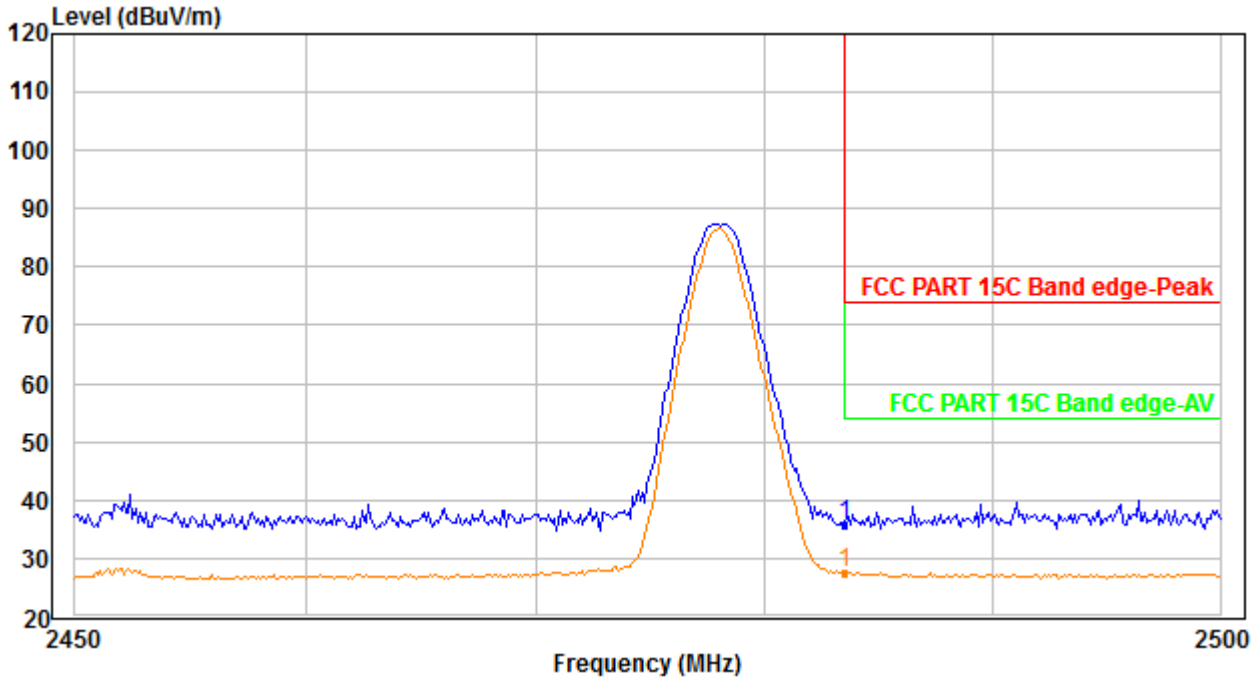

| Frequency (MHz) | Peak level (dBμV/m) | Peak Limit (dBμV/m) | AV level (dBμV/m) | AV Limit (dBμV/m) | Conclusion |
|---|---|---|---|---|---|
| 2390.0000 | 36.98 | 74.00 | 27.13 | 54.00 | Pass |

| Test Channel: | Highest Channel | Ant. Polar. : | Horizontal |
|---|---|---|---|




| Frequency (MHz) | Peak level (dBμV/m) | Peak Limit (dBμV/m) | AV level (dBμV/m) | AV Limit (dBμV/m) | Conclusion |
|---|---|---|---|---|---|
| 2483.5000 | 37.55 | 74.00 | 28.53 | 54.00 | Pass |

| Test Channel: | Highest Channel | Ant. Polar. : | Vertical |
|---|---|---|---|




| Frequency (MHz) | Peak level (dBμV/m) | Peak Limit (dBμV/m) | AV level (dBμV/m) | AV Limit (dBμV/m) | Conclusion |
|---|---|---|---|---|---|
| 2483.5000 | 35.79 | 74.00 | 27.52 | 54.00 | Pass |

## 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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