# FCC TEST REPORT

| | |
|---|---|
| **Product Name:** | 10.1 Android tablet |
| **Trade Mark:** | AVGO |
| **Model No.:** | NQFDZ |
| **Add. Model No.:** | WH106W |
| **Report Number:** | 190923003RFC-4 |
| **Test Standards:** | FCC 47 CFR Part 15 Subpart E |
| **FCC ID:** | 2AR7L-WH106W |
| **Test Result:** | PASS |
| **Date of Issue:** | October 17, 2019 |

Prepared for:

**YIBIN WEIHENG DIGITAL COMPANY LIMITED**
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Prepared by:

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Date: October 17, 2019

## Version

| Version No. | Date | Description |
|---|---|---|
| V1.0 | October 17, 2019 | Original |

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# 1. GENERAL INFORMATION

## 1.1 CLIENT INFORMATION

| | |
|---|---|
| **Applicant:** | YIBIN WEIHENG DIGITAL COMPANY LIMITED |
| **Address of Applicant:** | 23rd Building ,Yibin Lingang Economic and Technological Development Zone, YiBin, China |
| **Manufacturer:** | YIBIN WEIHENG DIGITAL COMPANY LIMITED |
| **Address of Manufacturer:** | 23rd Building ,Yibin Lingang Economic and Technological Development Zone, YiBin, China |

## 1.2 EUT INFORMATION

### 1.2.1 General Description of EUT

| | | | |
|---|---|---|---|
| **Product Name:** | 10.1 Android tablet | | |
| **Model No.:** | NQFDZ | | |
| **Add. Model No.:** | WH106W | | |
| **Trade Mark:** | AVGO | | |
| **DUT Stage:** | Identical Prototype | | |
| **EUT Supports Function:** | 2.4 GHz ISM Band: | IEEE 802.11b/g/n | |
| | | Bluetooth V4.0 | |
| | 5 GHz U-NII Bands: | 5 150 MHz to 5 250 MHz | IEEE 802.11a/n/ac |
| | | 5 250 MHz to 5 350 MHz | IEEE 802.11a/n/ac |
| | | 5 470 MHz to 5 725 MHz | IEEE 802.11a/n/ac |
| | | 5 725 MHz to 5 850 MHz | IEEE 802.11a/n/ac |
| **Software Version:** | Android 9.0 | | |
| **Hardware Version:** | R863-3326-LPDDR-V1.0 | | |
| **Sample Received Date:** | September 23, 2019 | | |
| **Sample Tested Date:** | October 5, 2019 to October 14, 2019 | | |
| **Note:** The additional model WH106W is identical with the test model NQFDZ except the model number for marketing purpose. | | | |

### 1.2.2 Description of Accessories

| **Adapter** | |
|---|---|
| **Model No.:** | BCT050200-078U |
| **Input:** | 100-240 V~50/60 Hz 0.3 A |
| **Output:** | 5.0 V ⎓ 2.0 A |
| **DC Cable:** | 0.8 Meter, Unshielded without ferrite |
| **Manufacturer:** | ShenZhen boreton science&technology Co., Ltd |

| **Battery** | |
|---|---|
| **Model No.:** | 3066170 |
| **Battery Type:** | Lithium-ion Polymer Rechargeable Battery |
| **Rated Voltage:** | 3.7 Vdc |
| **Rated Capacity:** | 4000 mAh |
| **Manufacturer:** | Shenzhen Dechuan New Energy Industry Co., Ltd. |

| Cable | |
|---|---|
| **Description:** | USB Micro-B Plug Cable |
| **Cable Type:** | Unshielded without ferrite |
| **Length:** | 0.8 Meter |

## 1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

| | | |
|---|---|---|
| **Frequency Bands:** | 5150 MHz to 5250 MHz (U-NII-1) | |
| | 5250 MHz to 5350 MHz (U-NII-2A) | |
| | 5470 MHz to 5725 MHz (U-NII-2C) | |
| | 5 725 MHz to 5 850 MHz (U-NII-3) | |
| **Frequency Ranges:** | 5180 MHz to 5240 MHz | |
| | 5260 MHz to 5320 MHz | |
| | 5500 MHz to 5700 MHz | |
| | 5 745 MHz to 5 825 MHz | |
| **Support Standards:** | IEEE 802.11a/n/ac | |
| **TPC Function:** | Not Support | |
| **DFS Operational mode:** | Slave without radar Interference detection function | |
| **Type of Modulation:** | IEEE 802.11a: OFDM(64QAM, 16QAM, QPSK, BPSK) | |
| | IEEE 802.11n: OFDM(64QAM, 16QAM, QPSK, BPSK) | |
| | IEEE 802.11ac: OFDM(64QAM, 16QAM, QPSK, BPSK) | |
| **Channel Spacing:** | IEEE 802.11a/n-HT20/ac-VHT20: 20 MHz | |
| | IEEE 802.11n-HT40/ac-VHT40: 40 MHz | |
| | IEEE 802.11ac-VHT80: 80 MHz | |
| **Data Rate:** | IEEE 802.11a: Up to 54 Mbps | |
| | IEEE 802.11n-HT20: Up to MCS7 | |
| | IEEE 802.11n-HT40: Up to MCS7 | |
| | IEEE 802.11ac-VHT20: Up to MCS8 | |
| | IEEE 802.11ac-VHT40: Up to MCS9 | |
| | IEEE 802.11ac-VHT80: Up to MCS9 | |
| **Number of Channels:** | 5150 MHz to 5250 MHz:<br>4 for IEEE 802.11a/n-HT20/ac-VHT20<br>2 for IEEE 802.11n-HT40)/ac-VHT40<br>1 for IEEE 802.11acVHT80 | |
| | 5250 MHz to 5350 MHz:<br>4 for IEEE 802.11a/n-HT20/ac-VHT20<br>2 for IEEE 802.11n-HT40)/ac-VHT40<br>1 for IEEE 802.11acVHT80 | |
| | 5470 MHz to 5725 MHz:<br>11 for IEEE 802.11a/n-HT20/ac-VHT20<br>5 for IEEE 802.11n-HT40/ac-VHT40<br>2 for IEEE 802.11ac-VHT80 | |
| | 5725 MHz to 5850 MHz:<br>5 for IEEE 802.11a/n-HT20/ac-VHT20<br>2 for IEEE 802.11n-HT40/ac-VHT40<br>1 for IEEE 802.11ac-VHT80 | |
| **Antenna Type:** | PIFA Antenna | |
| **Antenna Gain:** | 5150 MHz to 5250 MHz | 1.5 dBi |
| | 5250 MHz to 5350 MHz | 1.5 dBi |

| | | | | | |
|---|---|---|---|---|---|
| | 5470 MHz to 5725 MHz | 1.5 dBi | | | |
| | 5725 MHz to 5850 MHz | 1.5 dBi | | | |
| **Maximum conducted output power (dBm):** | | **U-NII-1** | **U-NII-2A** | **U-NII-2C** | **U-NII-3** |
| | IEEE 802.11a: | 17.60 | 17.72 | 16.80 | 16.51 |
| | IEEE 802.11n-HT20: | 17.19 | 17.39 | 16.45 | 16.06 |
| | IEEE 802.11n-HT40: | 17.18 | 17.00 | 16.29 | 15.99 |
| | IEEE 802.11ac-VHT20 | 17.23 | 17.36 | 16.41 | 16.05 |
| | IEEE 802.11ac-VHT40 | 17.12 | 17.08 | 16.30 | 15.96 |
| | IEEE 802.11ac-VHT80: | 16.95 | 17.21 | 15.88 | 16.08 |
| **Normal Test Voltage:** | 3.7 Vdc | | | | |

## 1.4 OTHER INFORMATION

| Operation Frequency Each of Channel | | | | |
|---|---|---|---|---|
| | U-NII-1 | U-NII-2A | U-NII-2C | U-NII-3 |
| IEEE 802.11a, IEEE 802.11n-HT20, IEEE 802.11ac-VHT20 | **f = 5000 + 5k, k = 32 + 4n** | | | **f = 5000 + 5k, k = 145 + 4n** |
| | **n = 1,…, 4** | **n = 5,…, 8** | **n = 17,…, 27** | **n = 1,…, 5** |
| IEEE 802.11n-HT40, IEEE 802.11ac-VHT40 | **f = 5000 + 5k, k = 30 + 8n** | | | **f = 5000 + 5k, k = 143 + 8n** |
| | **n = 1, 2** | **n = 1,…, 5** | **n = 9,…, 13** | **n = 1, 2** |
| IEEE 802.11ac-VHT80 | **f = 5000 + 5k, k = 26 + 16n** | | | **f = 5000 + 5k, k = 155** |
| | **n = 1** | **n = 1, 2** | **n = 5, 6** | |
| Note:<br>**f** is the operating frequency (MHz);<br>**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 |
|---|---|---|---|---|
| Earphone | N/A | QTER01JY | N/A | UnionTrust |
| Monitor | LG | U320S | 187A3028-00001D | Union Trust |
| Mouse | DELL | KB212-B | CN-0N291F-71581-624-006P-A01 | UnionTrust |
| Notebook | Lenovo | E450 | SL10G10780 | UnionTrust |
| USB flash disk | Kingston | DTSE9G2 | N/A | UnionTrust |
| micro SD card | Kingston | 8GB | N/A | UnionTrust |

2) Support Cable

| Cable No. | Description | Connector | Length | Supplied by |
|---|---|---|---|---|
| 1 | Antenna Cable | SMA | 0.30 Meter | UnionTrust |
| 2 | HDMI | Unshielded without ferrite | 1.0 Meter | UnionTrust |

## 1.6 TEST LOCATION

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

Address: 16/F, Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1, Longhua New District, Shenzhen, China 518109
Telephone: +86 (0) 755 2823 0888
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## 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/EN 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: 2005 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 | ±3.8 dB |
| 2 | Conducted emission 150KHz-30MHz | ±3.4 dB |
| 3 | Radiated emission 9KHz-30MHz | ±4.9 dB |
| 4 | Radiated emission 30MHz-1GHz | ±4.7 dB |
| 5 | Radiated emission 1GHz-18GHz | ±5.1 dB |
| 6 | Radiated emission 18GHz-26GHz | ±5.2 dB |
| 7 | Radiated emission 26GHz-40GHz | ±5.2 dB |

## 2. TEST SUMMARY

| FCC 47 CFR Part 15 Subpart E Test Cases | | | |
|---|---|---|---|
| **Test Item** | **Test Requirement** | **Test Method** | **Result** |
| **Antenna Requirement** | FCC 47 CFR Part 15 Subpart C Section 15.203<br>FCC 47 CFR Part 15 Subpart E Section 15.407(a)(1) (2) | N/A | PASS |
| **26 dB emission bandwidth** | FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(2)(5) | KDB 789033 D02 v02r01 Section C.1 | PASS |
| **6 dB bandwidth** | FCC 47 CFR Part 15 Subpart E Section 15.407 (e) | KDB 789033 D02 v02r01 Section C.2 | PASS |
| **Maximum conducted output power** | FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3) | KDB 789033 D02 v02r01 Section E.3.a (Method PM) | PASS |
| **Peak Power Spectral Density** | FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3) | KDB 789033 D02 v02r01 Section F | PASS |
| **Radiated Emissions and Band Edge Measurement** | FCC 47 CFR Part 15 Subpart E Section 15.407 (b)(1)(2)(3)(4)(6)<br>FCC 47 CFR Part 15 Subpart C Section 15.209/205 | KDB 789033 D02 v02r01 Section G.3, G.4, G.5, and G.6 | PASS |
| **Dynamic Frequency Selection** | FCC 47 CFR Part 15 Subpart E Section 15.407 (h) | KDB 905462 D03 Client Without DFS New Rules v01r02 | PASS |
| **AC Power Line Conducted Emission** | FCC 47 CFR Part 15 Subpart E Section 15.407 (b)(6)<br>FCC 47 CFR Part 15 Subpart C Section 15.207 | ANSI C63.10-2013, Section 6.2. | PASS |

**For Dynamic Frequency Selection**

| Test Case | Result |
|---|---|
| Channel Availability Check Time | N/A[1] |
| U-NII Detection Bandwidth | N/A[1] |
| Channel Closing Transmission Time | PASS |
| Channel Move Time | PASS |
| DFS Detection Threshold | N/A[1] |
| Non- Occupancy Period | N/A[1] |

**Note:**
1) The EUT is slave, NA 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 Chamber & Accessory Equipment | ETS-LINDGREN | 3M | N/A | Dec. 03, 2018 | Dec. 03, 2021 |
| ☒ | Receiver | R&S | ESIB26 | 100114 | Nov. 24, 2018 | Nov. 24, 2019 |
| ☒ | EXA Spectrum Analyzer | KEYSIGHT | N9010A | MY51440197 | Nov. 24, 2018 | Nov. 24, 2019 |
| ☒ | Loop Antenna | ETS-LINDGREN | 6502 | 00202525 | Dec. 03, 2018 | Dec. 03, 2019 |
| ☒ | Broadband Antenna | ETS-LINDGREN | 3142E | 00201566 | Dec. 08, 2018 | Dec. 08, 2019 |
| ☒ | 6dB Attenuator | Talent | RA6A5-N-18 | 18103001 | Dec. 08, 2018 | Dec. 08, 2019 |
| ☒ | Preamplifier | HP | 8447F | 2805A02960 | Nov. 24, 2018 | Nov. 24, 2019 |
| ☒ | Horn Antenna (Pre-amplifier) | ETS-LINDGREN | 3117-PA | 00201874 | May 22, 2018 | May 22, 2020 |
| ☒ | Horn Antenna (Pre-amplifier) | ETS-LINDGREN | 3116C-PA | 00202652 | Jan. 05, 2019 | Jan. 05, 2020 |
| ☒ | Multi device Controller | ETS-LINDGREN | 7006-001 | 00160105 | N/A | N/A |
| ☒ | Band Rejection Filter (5150MHz~5880MHz) | Micro-Tronics | BRM50716 | G1868 | Jun. 06, 2018 | Jun. 06, 2019 |
| ☒ | Test Software | Audix | e3 | Software Version: 9.160333 | | |

| 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. 24, 2018 | Nov. 24, 2019 |
| ☒ | Pulse Limiter | R&S | ESH3-Z2 | 0357.8810.54 | Nov. 24, 2018 | Nov. 24, 2019 |
| ☒ | LISN | R&S | ESH2-Z5 | 860014/024 | Nov. 24, 2018 | Nov. 24, 2019 |
| ☐ | LISN | ETS-Lindgren | 3816/2SH | 00201088 | Nov. 24, 2018 | Nov. 24, 2019 |
| ☒ | 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. 24, 2018 | Nov. 24, 2019 |
| ☒ | USB Wideband Power Sensor | KEYSIGHT | U2021XA | MY55430035 | Nov. 24, 2018 | Nov. 24, 2019 |
| ☐ | USB Wideband Power Sensor | KEYSIGHT | U2021XA | MY55430023 | Nov. 24, 2018 | Nov. 24, 2019 |
| ☒ | MXG X-Series RF Vector Signal Generator | KEYSIGHT | N5182B | MY51350267 | Nov. 24, 2018 | Nov. 24, 2019 |

# 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 | Relative Humidity (%) |
| NT/NV | +15 to +35 | 3.7Vdc | 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 |
|---|---|---|---|---|
| AC Power Line Conducted Emission | 24.2 | 58 | 100.03 | Bert Xiong |
| 26 dB emission bandwidth | 22.4 | 49 | 99.80 | Fire Huo |
| Maximum conducted output power | 22.4 | 49 | 99.80 | Fire Huo |
| Peak Power Spectral Density | 22.4 | 49 | 99.80 | Fire Huo |
| 6 dB bandwidth | 22.4 | 49 | 99.80 | Fire Huo |
| Dynamic Frequency Selection | 24.6 | 44 | 100.38 | Fire Huo |
| Radiated Emissions and Band Edge Measurement | 24.6 | 44 | 100.38 | Fire Huo |

## 4.2 TEST CHANNELS

| Mode | Tx/Rx Frequency | Test RF Channel Lists | | |
|---|---|---|---|---|
| | | Lowest(L) | Middle(M) | Highest(H) |
| IEEE 802.11a<br>IEEE 802.11n-HT20<br>IEEE 802.11ac-VHT20 | 5150 MHz to 5250 MHz | Channel 36 | Channel 44 | Channel 48 |
| | | 5180 MHz | 5220 MHz | 5240 MHz |
| | 5250 MHz to 5350 MHz | Channel 52 | Channel 60 | Channel 64 |
| | | 5260 MHz | 5300 MHz | 5320 MHz |
| | 5470 MHz to 5725 MHz | Channel 100 | Channel 116 | Channel 140 |
| | | 5500 MHz | 5580 MHz | 5700 MHz |
| | 5725 MHz to 5850 MHz | Channel 149 | Channel 157 | Channel 165 |
| | | 5745 MHz | 5785 MHz | 5825 MHz |
| IEEE 802.11n-HT40<br>IEEE 802.11ac-VHT40 | 5150 MHz to 5250 MHz | Channel 38 | -- | Channel 46 |
| | | 5190 MHz | -- | 5230 MHz |
| | 5250 MHz to 5350 MHz | Channel 54 | -- | Channel 62 |
| | | 5270 MHz | -- | 5310 MHz |
| | 5470 MHz to 5725 MHz | Channel 102 | Channel 110 | Channel 134 |
| | | 5510 MHz | 5550 MHz | 5670 MHz |
| | 5725 MHz to 5850 MHz | Channel 151 | -- | Channel 159 |
| | | 5755 MHz | -- | 5795 MHz |
| IEEE 802.11ac-VHT80 | 5150 MHz to 5250 MHz | -- | Channel 42 | -- |
| | | -- | 5210 MHz | -- |
| | 5250 MHz to 5350 MHz | -- | Channel 58 | -- |
| | | -- | 5290 MHz | -- |
| | 5470 MHz to 5725 MHz | Channel 106 | -- | Channel 122 |
| | | 5530 MHz | -- | 5610 MHz |
| | 5725 MHz to 5850 MHz | -- | Channel 155 | -- |
| | | -- | 5775 MHz | -- |

## 4.3 EUT TEST STATUS

| Mode | Tx/Rx Function | Description |
|---|---|---|
| IEEE 802.11a/n/ac | 1Tx | 1. Keep the EUT in transmitting mode with all kind of modulation and all kind of data rate. |

| Power Setting | | | | |
|---|---|---|---|---|
| | U-NII-1 | U-NII-2A | U-NII-2C | U-NII-3 |
| IEEE 802.11a | default | default | default | default |
| IEEE 802.11n-HT20 | default | default | default | default |
| IEEE 802.11n-HT40 | default | default | default | default |
| IEEE 802.11ac-VHT20 | default | default | default | default |
| IEEE 802.11ac-VHT40 | default | default | default | default |
| IEEE 802.11ac-VHT80 | default | default | default | default |
| Power Setting: not applicable, test used software default power level. | | | | |

| Test Software |
|---|
| Test software name: RF TestTool; |

## 4.4 PRE-SCAN

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and data rate. Following data rate was (were) selected for the final test as listed below

| Mode | Worst-case data rates |
|---|---|
| IEEE 802.11a | 6 Mbps |
| IEEE 802.11n-HT20 | MCS0 |
| IEEE 802.11n-HT40 | MCS0 |
| IEEE 802.11ac-VHT20 | MCS0 |
| IEEE 802.11ac-VHT40 | MCS0 |
| IEEE 802.11ac-VHT80 | MCS0 |

## 4.5 TEST SETUP

### 4.5.1 For Radiated Emissions test setup

**Figure 1. Below 30MHz**

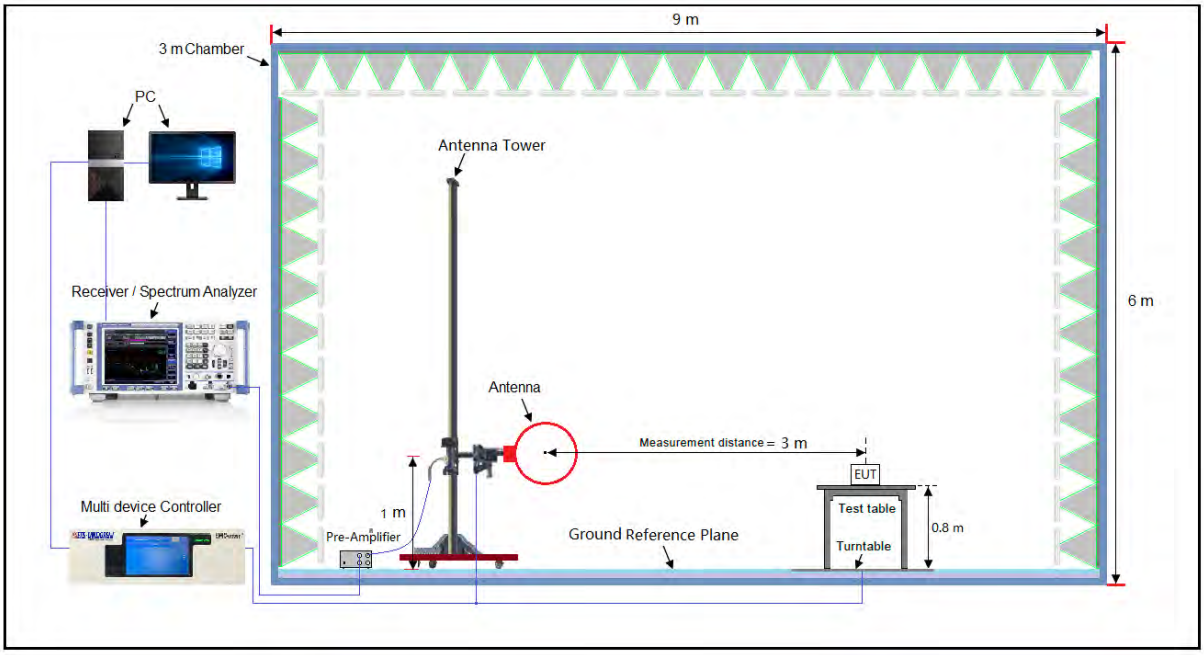



**Figure 2. 30MHz to 1GHz**

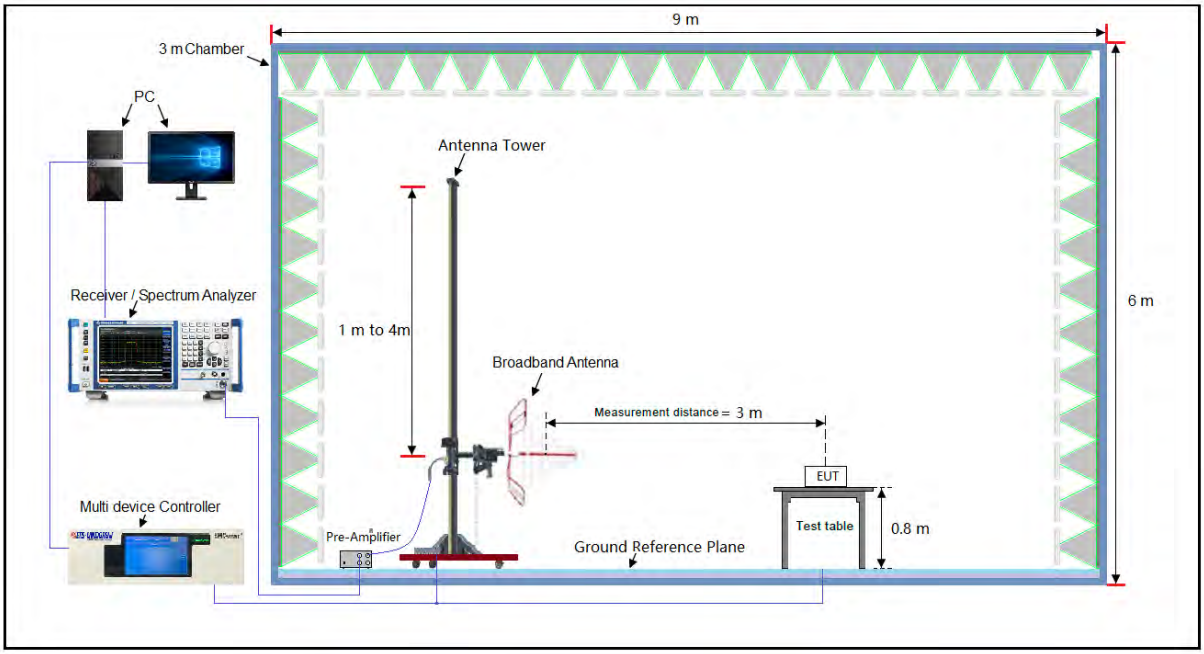
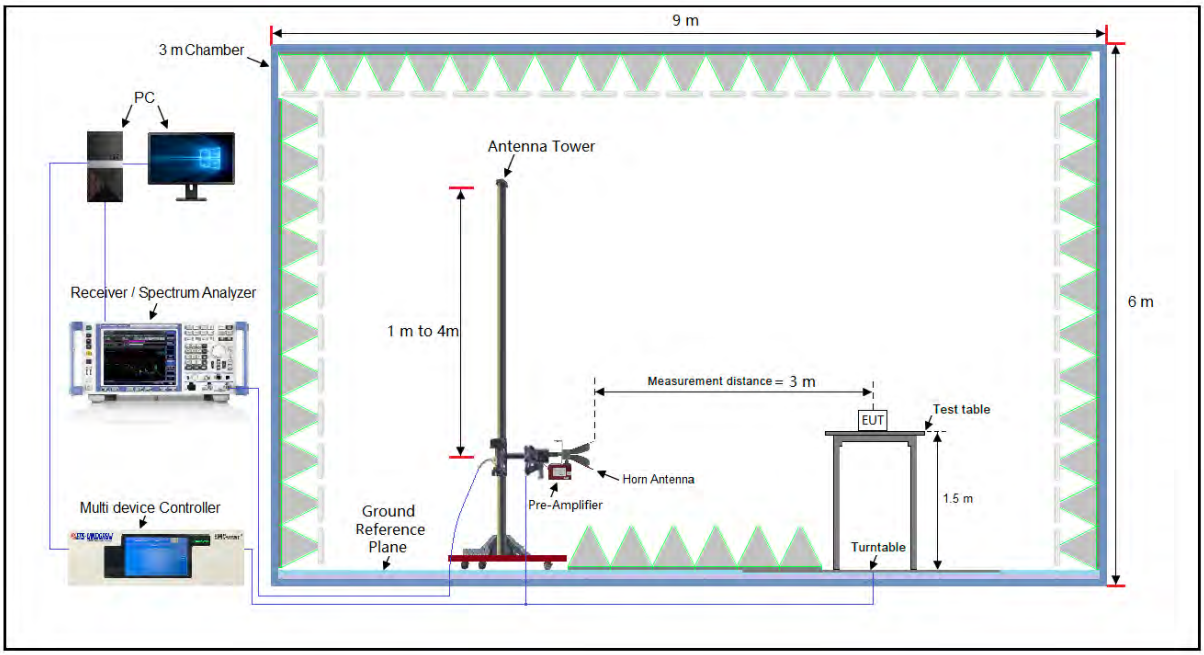
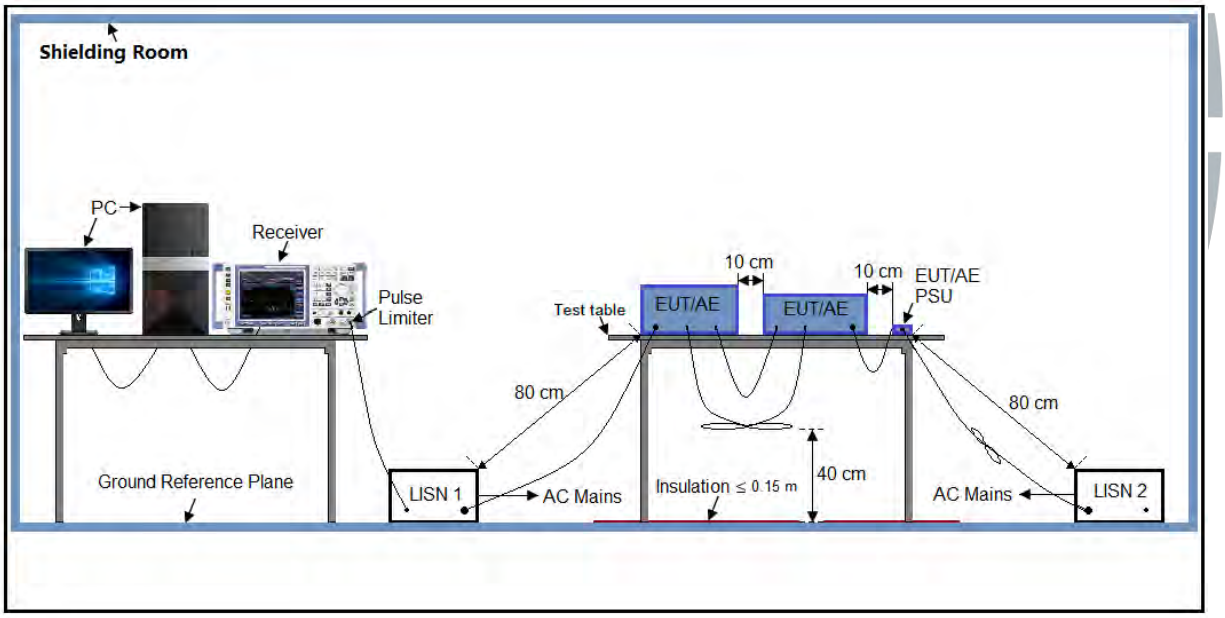


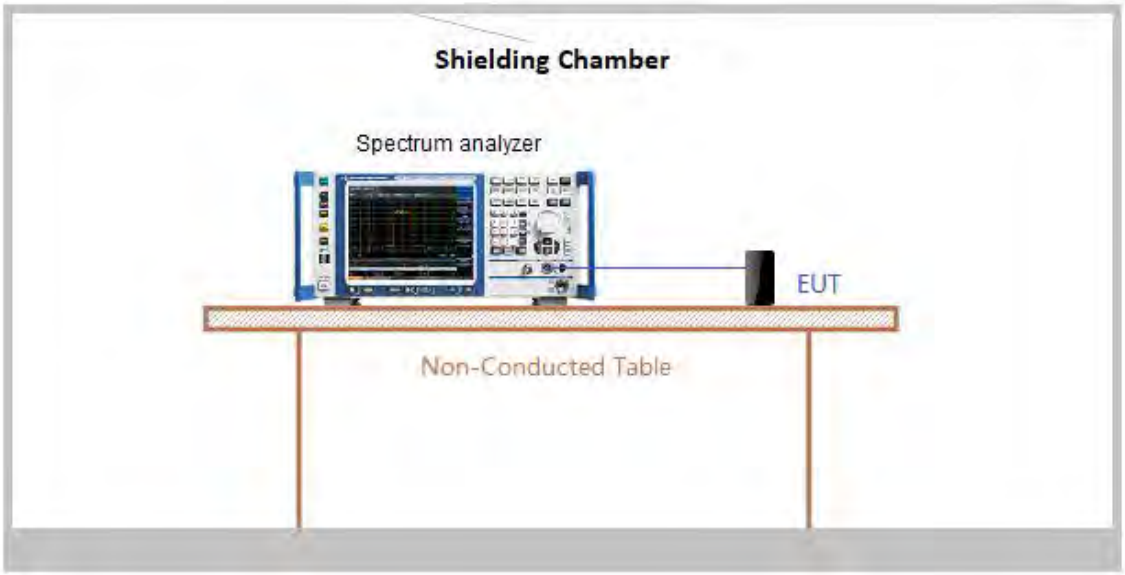
**Figure 3. Above 1GHz**




## 4.5.2 For Conducted Emissions test setup



### 4.5.3 For Conducted RF test setup




Normal 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. It was powered by a 3.7V battery. 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 | Y 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.

## 4.7 DUTY CYCLE

**Test Procedure:** ANSI C63.10-2013 Clause 12.2.

**Test Results**

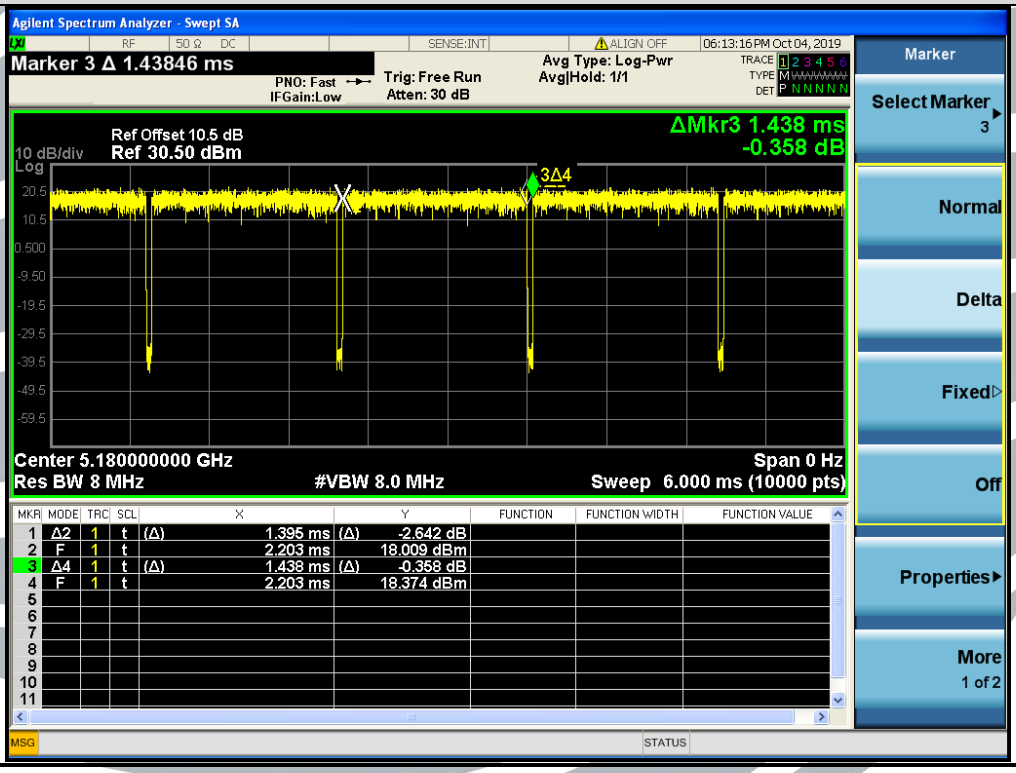
| Mode | Data rates (Mbps) | On Time (msec) | Period (msec) | Duty Cycle (linear) | Duty Cycle (%) | Duty Cycle Factor (dB) | 1/ T Minimum VBW (kHz) | Average Factor (dB) |
|---|---|---|---|---|---|---|---|---|
| IEEE 802.11a | 6 | 1.395 | 1.438 | 0.97 | 97.01 | 0.13 | 0.72 | -0.26 |
| IEEE 802.11n-HT20 | MCS0 | 1.308 | 1.351 | 0.97 | 96.82 | 0.14 | 0.76 | -0.28 |
| IEEE 802.11n-HT40 | MCS0 | 0.647 | 0.688 | 0.94 | 93.99 | 0.27 | 1.55 | -0.54 |
| IEEE 802.11ac-VHT20 | MCS0 | 1.314 | 1.358 | 0.97 | 96.76 | 0.14 | 0.76 | -0.29 |
| IEEE 802.11ac-VHT40 | MCS0 | 0.656 | 0.698 | 0.94 | 94.02 | 0.27 | 1.52 | -0.54 |
| IEEE 802.11ac-VHT80 | MCS0 | 0.324 | 0.366 | 0.89 | 88.57 | 0.53 | 3.09 | -1.05 |

**Remark:**

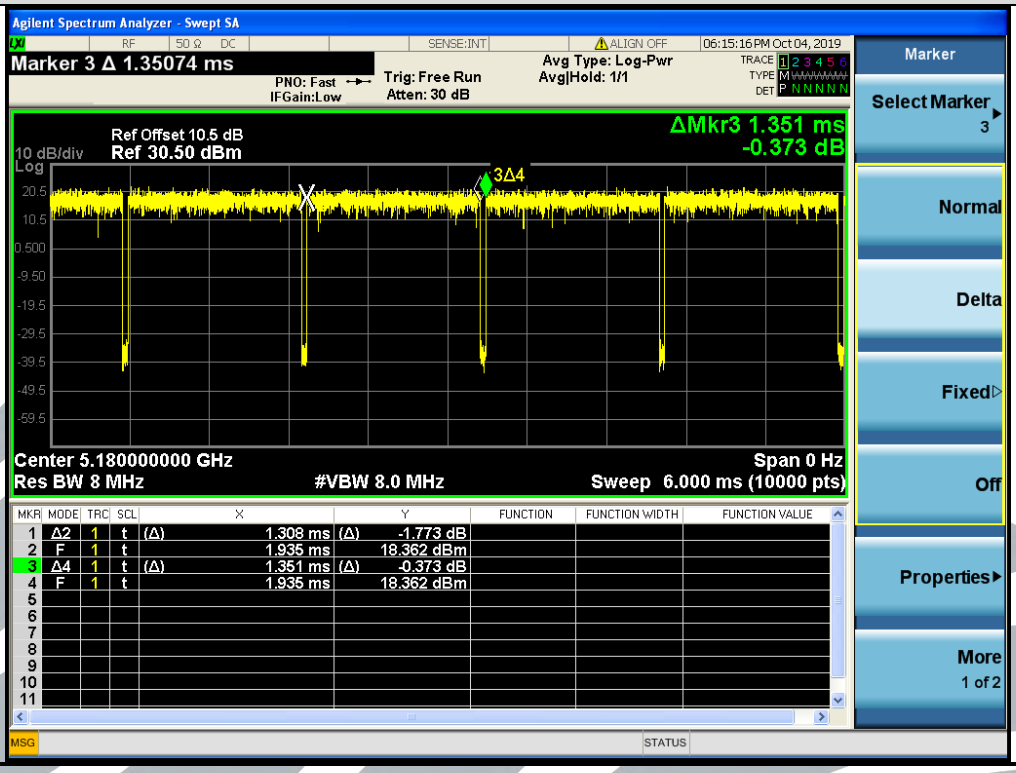
1) Duty cycle= On Time/ Period;
2) Duty Cycle factor = 10 * log(1/ Duty cycle);
3) Average factor = 20 $\log_{10}$ Duty Cycle.

**The test plots as follows**

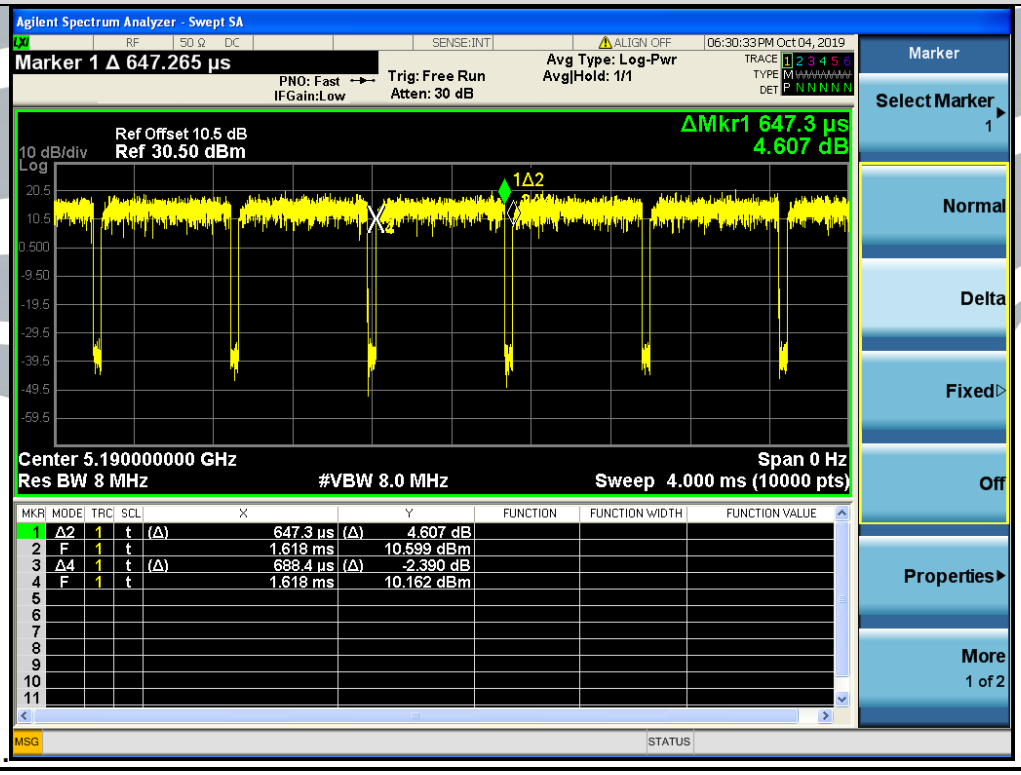
**IEEE 802.11a**



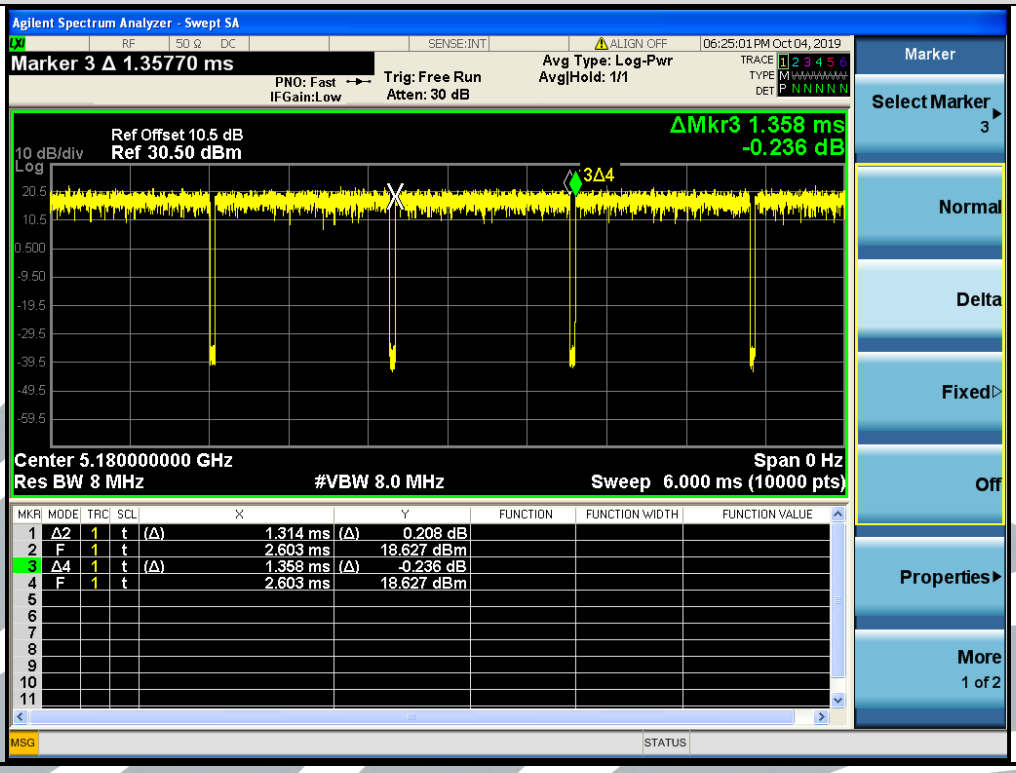
## IEEE 802.11n-HT20



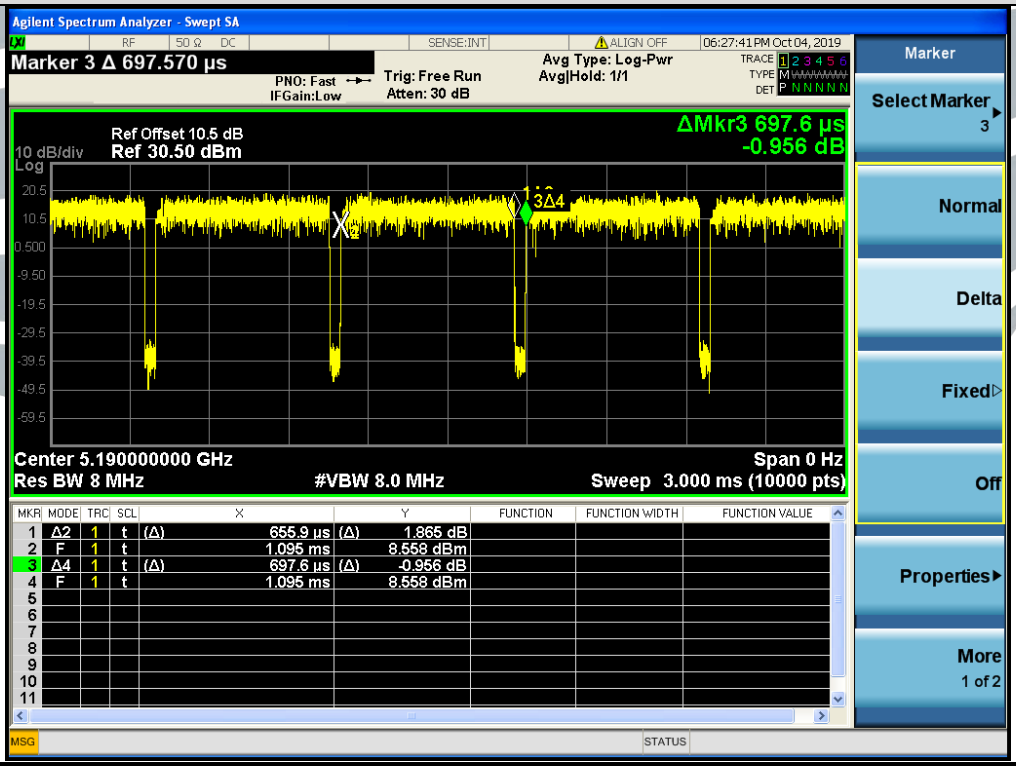

## IEEE 802.11n-HT40



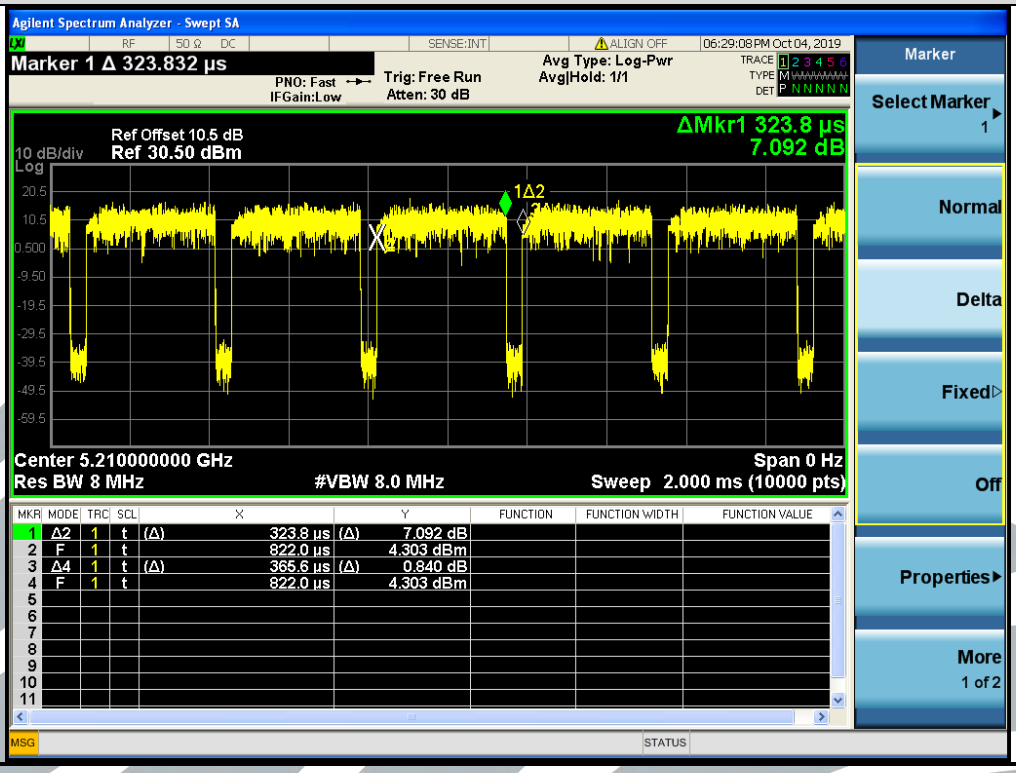
## IEEE 802.11ac-VHT20




## IEEE 802.11ac-VHT40



**IEEE 802.11ac-VHT80**



# 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 789033 D02 General UNII Test Procedures New Rules v02r01 | Guidelines for compliance testing of unlicensed national information infrastructure (U-NII) device part 15, subpart E |
| 5 | KDB 905462 D06 802.11 Channel Plans New Rules v02 | Operation in U-NII bands -802.11 channel PLAN(§15.407) |
| 6 | KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02 | Compliance measurement procedures for Unlicensed –National Information Infrastructure devices operates in the frequency bands 5250 MHz to 5350 MHz and 5470 MHz to 5725 MHz bands incorporating dynamic frequency selection |
| 7 | KDB 905462 D03 Client Without DFS New Rules v01r02 | U-NII client devices without radar detection capability |

## 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>**15.407(a)(1) (2) requirement:**<br>The conducted output power limit specified in paragraph (a) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (a) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power and the peak power spectral density shall be reduced by the 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. The gain of the antenna is 1.5dBi. |

## 5.3 26 DB BANDWIDTH

**Test Requirement:** FCC 47 CFR Part 15 Subpart E Section 15.407 (a) (2)(5)

**Test Method:** KDB 789033 D02 v02r01 Section C.1

**Limit:** None; for reporting purposes only.

**Test Procedure:**

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum analyzer.

Spectrum analyzer according to the following Settings:
a) Set RBW = approximately 1 % of the emission bandwidth.
b) Set the VBW > RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1 %.

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 Results:** Pass

| Mode | Channel | 26 dB Bandwidth (MHz) | 99% Bandwidth (MHz) |
|---|---|---|---|
| IEEE 802.11a | 36 (5180) | 27.56 | 17.239 |
| | 44 (5220) | 27.25 | 17.142 |
| | 48 (5240) | 25.85 | 17.175 |
| | 52 (5260) | 27.28 | 17.202 |
| | 60 (5300) | 23.67 | 17.082 |
| | 64 (5320) | 23.61 | 17.033 |
| | 100 (5500) | 22.22 | 16.983 |
| | 116 (5580) | 23.85 | 17.075 |
| | 140 (5700) | 24.45 | 16.970 |
| IEEE 802.11n-HT20 | 36 (5180) | 26.70 | 18.316 |
| | 44 (5220) | 28.17 | 18.144 |
| | 48 (5240) | 26.56 | 18.096 |
| | 52 (5260) | 22.94 | 18.073 |
| | 60 (5300) | 24.68 | 18.047 |
| | 64 (5320) | 26.58 | 18.056 |
| | 100 (5500) | 23.46 | 17.964 |
| | 116 (5580) | 22.65 | 18.018 |
| | 140 (5700) | 22.05 | 17.970 |
| IEEE 802.11n-HT40 | 38 (5190) | 57.38 | 36.418 |
| | 46 (5230) | 52.00 | 36.474 |
| | 54 (5270) | 48.02 | 36.342 |
| | 62 (5310) | 45.97 | 36.293 |
| | 102 (5510) | 47.17 | 36.352 |
| | 110 (5550) | 42.59 | 36.302 |
| | 134 (5670) | 40.95 | 36292 |

| Mode | Channel | 26 dB Bandwidth (MHz) | 99% Bandwidth (MHz) |
|---|---|---|---|
| IEEE 802.11ac-VHT20 | 36 (5180) | 25.80 | 18.077 |
| | 44 (5220) | 29.69 | 18.032 |
| | 48 (5240) | 25.60 | 18.085 |
| | 52 (5260) | 25.04 | 18.028 |
| | 60 (5300) | 22.80 | 17.979 |
| | 64 (5320) | 24.56 | 17.994 |
| | 100 (5500) | 23.80 | 18.028 |
| | 116 (5580) | 24.22 | 17.890 |
| | 140 (5700) | 24.27 | 17.952 |
| IEEE 802.11ac-VHT40 | 38 (5190) | 50.49 | 36.343 |
| | 46 (5230) | 47.41 | 36.466 |
| | 54 (5270) | 40.98 | 36.319 |
| | 62 (5310) | 46.13 | 36.363 |
| | 102 (5510) | 44.05 | 36.364 |
| | 110 (5550) | 43.31 | 36.352 |
| | 134 (5670) | 44.02 | 36.349 |
| IEEE 802.11ac-VHT80 | 42 (5210) | 109.5 | 75.885 |
| | 58 (5290) | 102.1 | 75.889 |
| | 106 (5530) | 89.27 | 75.710 |
| | 122 (5610) | 84.64 | 75.794 |

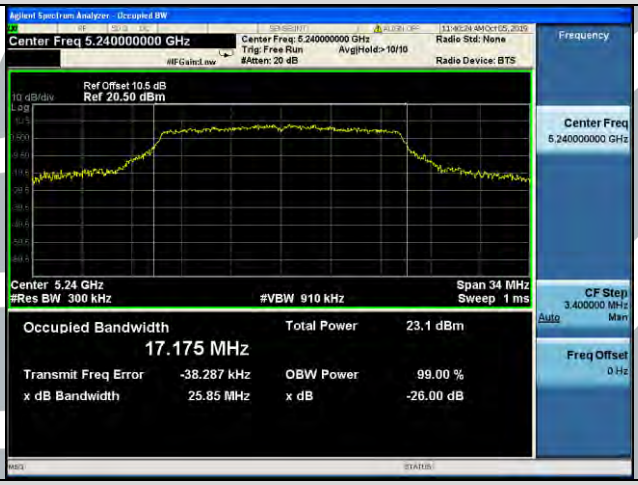
**The test plots as follows:**

## IEEE 802.11a

### Channel 36

### Channel 44

### Channel 48




### Channel 52

### Channel 60

### Channel 64

**Channel 100**

**Channel 116**

**Channel 140**

## IEEE 802.11n-HT20

**Channel 36**

**Channel 44**

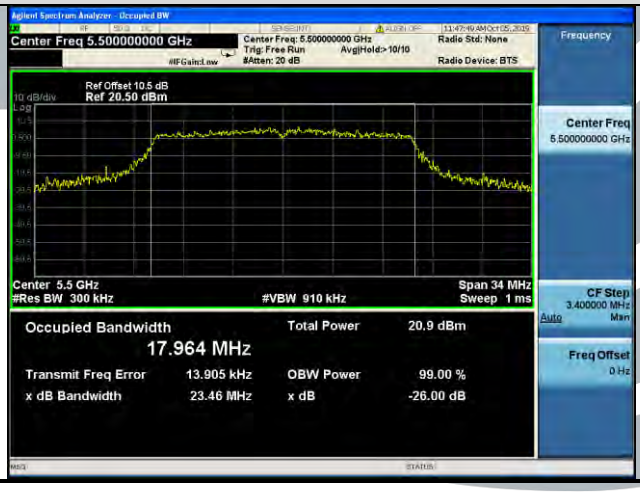
**Channel 48**

**Channel 52**

**Channel 60**

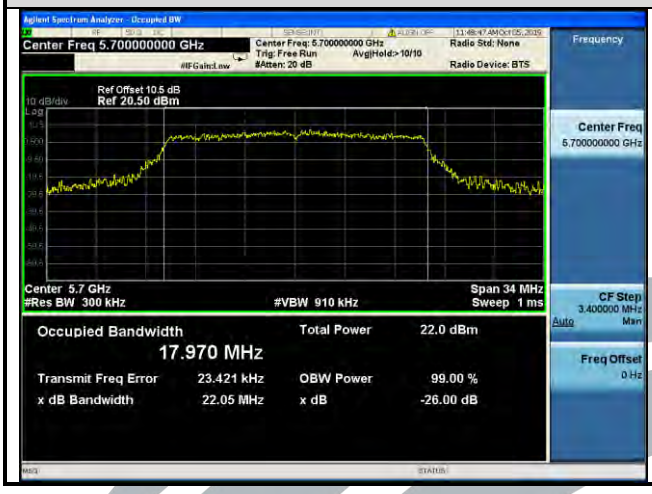
**Channel 64**

**Channel 100**



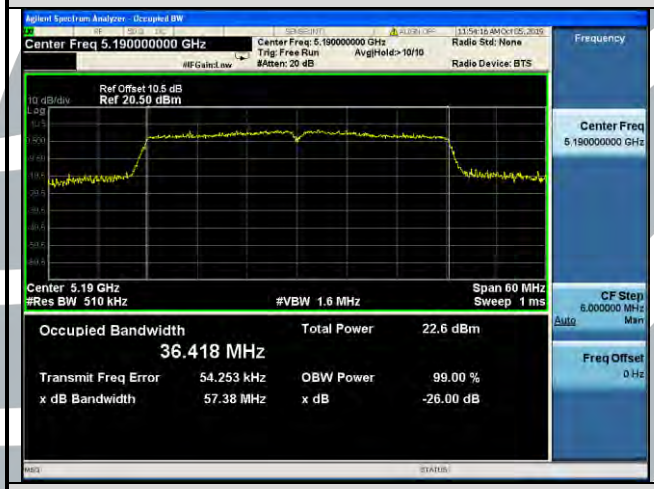

**Channel 116**

**Channel 140**



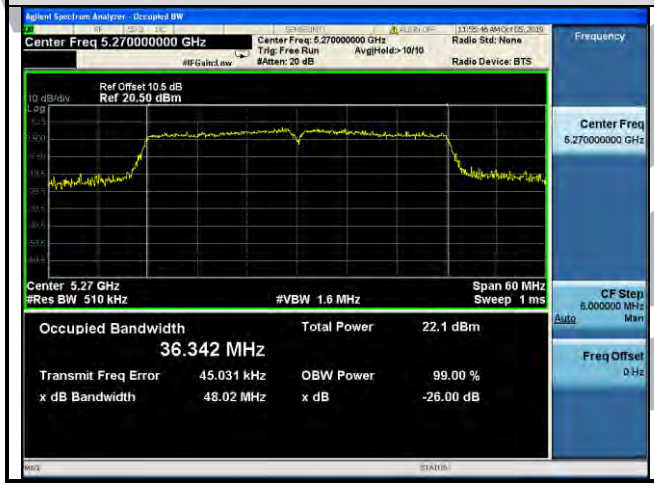

**IEEE 802.11n-HT40**

**Channel 38**



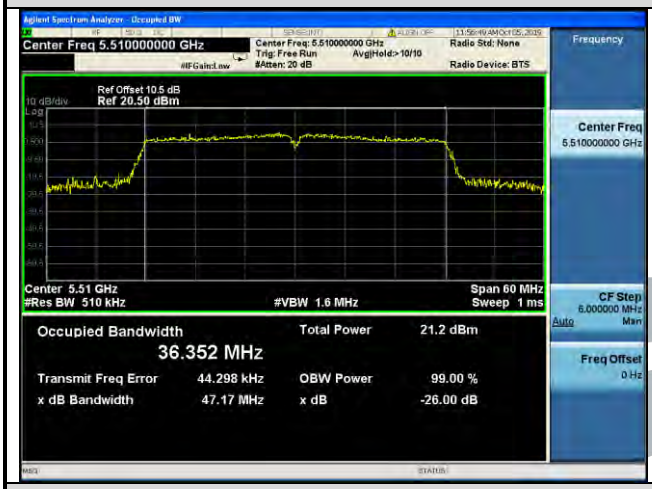

**Channel 46**

**Channel 54**



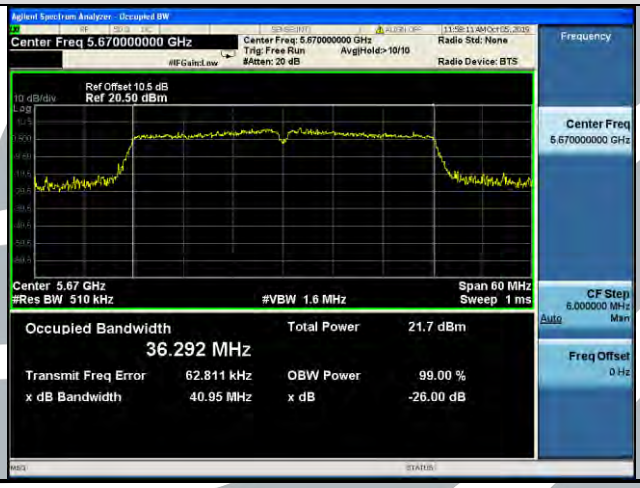

**Channel 62**

**Channel 102**




**Channel 110**

**Channel 134**



## IEEE 802.11ac-VHT20

### Channel 36

### Channel 44

### Channel 48

### Channel 52

### Channel 60

### Channel 64

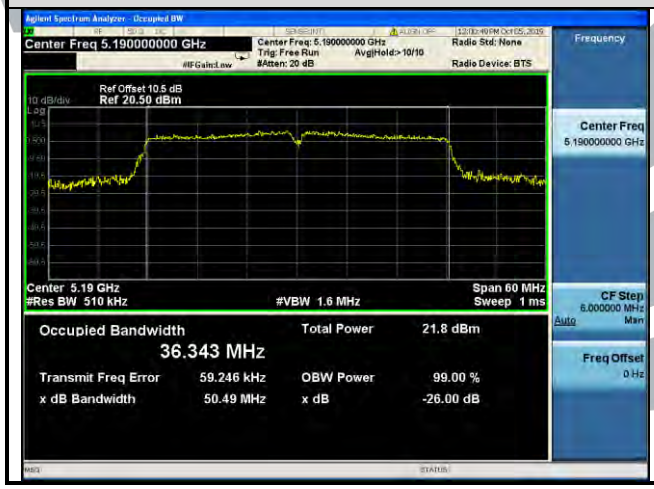
**Channel 100**

**Channel 116**

**Channel 140**

## IEEE 802.11ac-VHT40

**Channel 38**




**Channel 46**

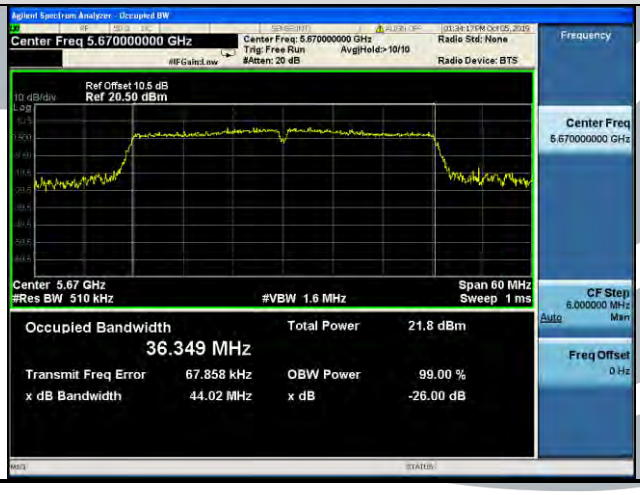
**Channel 54**

**Channel 62**

**Channel 102**

**Channel 110**

**Channel 134**

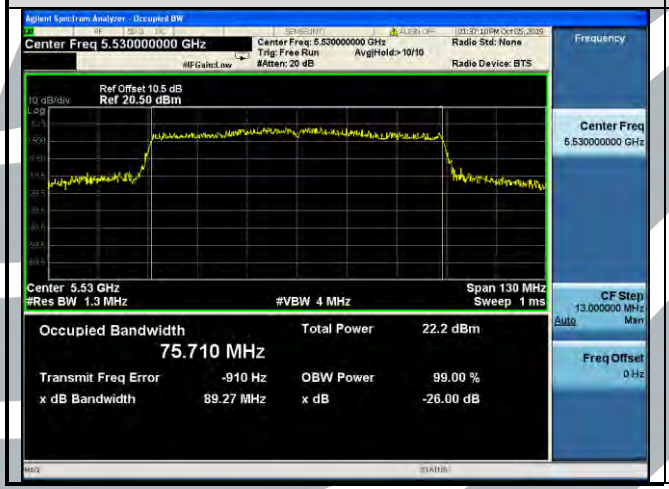


## IEEE 802.11ac-VHT80

### Channel 42

### Channel 58

### Channel 106




### Channel 122

## 5.46 DB BANDWIDTH

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.407 (e)

**Test Method:** KDB 789033 D02 v02r01Section C.2

**Limit:** Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

**Test Procedure:**

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer.

Spectrum analyzer according to the following Settings:
a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 * 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 4.5.3 for details.

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

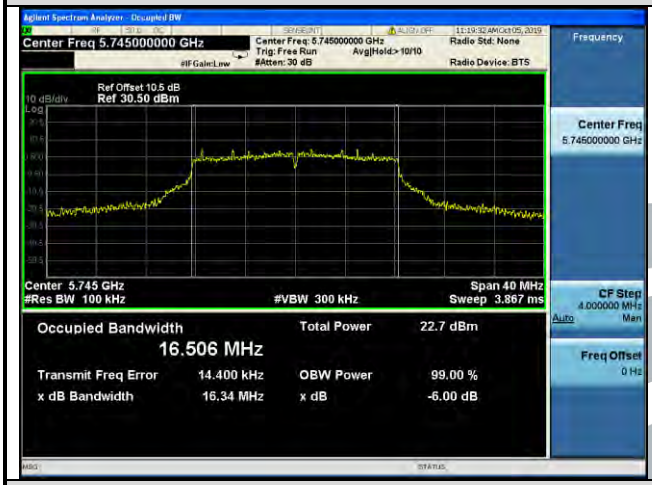
**Test Mode:** Transmitter mode

**Test Results:** Pass

**Test Data:**

| Mode | Channel/ Frequency (MHz) | 6 dB Bandwidth (MHz) | 99% Bandwidth (MHz) | 6 dB Bandwidth Limit | Pass / Fail |
|---|---|---|---|---|---|
| IEEE 802.11a | 149 (5745) | 16.34 | 17.038 | > 500 kHz | Pass |
| | 157 (5785) | 16.34 | 16.974 | > 500 kHz | Pass |
| | 165 (5825) | 16.31 | 16.998 | > 500 kHz | Pass |
| IEEE 802.11n-HT20 | 149 (5745) | 17.57 | 18.071 | > 500 kHz | Pass |
| | 157 (5785) | 17.30 | 17.985 | > 500 kHz | Pass |
| | 165 (5825) | 17.34 | 18.038 | > 500 kHz | Pass |
| IEEE 802.11n-HT40 | 151 (5755) | 35.52 | 36.211 | > 500 kHz | Pass |
| | 159 (5795) | 35.85 | 36.344 | > 500 kHz | Pass |
| IEEE 802.11ac-VHT20 | 149 (5745) | 17.20 | 18.095 | > 500 kHz | Pass |
| | 157 (5785) | 16.89 | 18.066 | > 500 kHz | Pass |
| | 165 (5825) | 16.81 | 18.072 | > 500 kHz | Pass |
| IEEE 802.11ac-VHT40 | 151 (5755) | 35.83 | 36.335 | > 500 kHz | Pass |
| | 159 (5795) | 35.74 | 36.274 | > 500 kHz | Pass |
| IEEE 802.11ac-VHT80 | 155 (5775) | 75.41 | 75.677 | > 500 kHz | Pass |

**The test plots as follows:**

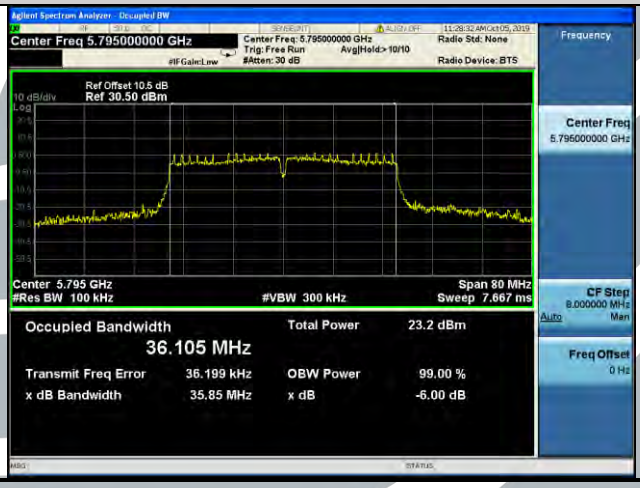
| IEEE 802.11a | IEEE 802.11n-HT20 |
|---|---|
| **Channel 149** | |
|  | |
| **Channel 157** | |
| | |
| **Channel 165** | |
| | |

## IEEE 802.11ac-VHT20

### Channel 149

### Channel 157

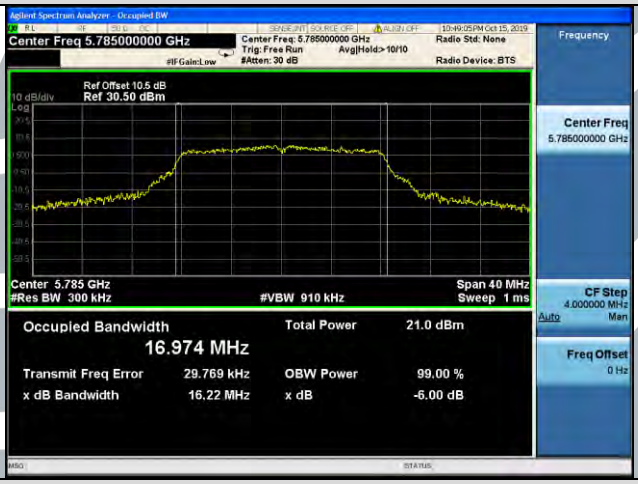
### Channel 165

| IEEE 802.11n-HT40 | IEEE 802.11ac-VHT40 |
|---|---|
| **Channel 151** | |
| | |
| **Channel 159** | |
|  | |



| IEEE 802.11ac-VHT80 |
|---|
| **Channel 155** |
| |

**For 99%:**

| IEEE 802.11a | IEEE 802.11n-HT20 |
|---|---|
| **Channel 149** | |
| | |
| **Channel 157** | |
|  | |
| **Channel 165** | |
| | |

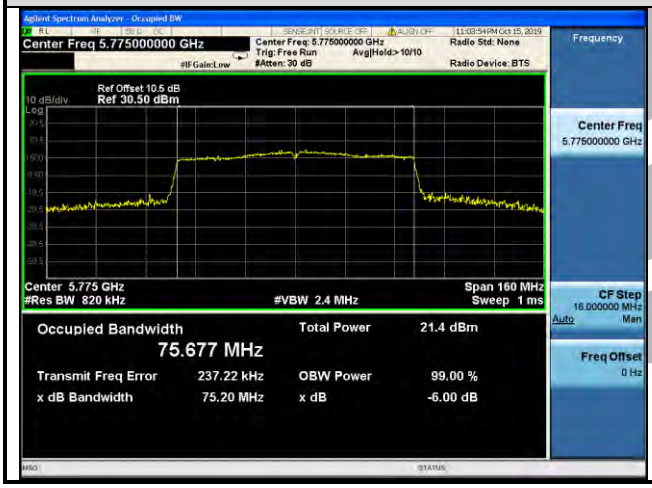
**IEEE 802.11ac-VHT20**

**Channel 149**

**Channel 157**

**Channel 165**

| IEEE 802.11n-HT40 | IEEE 802.11ac-VHT40 |
|---|---|
| **Channel 151** | |
| | |
| **Channel 159** | |
| | |

| IEEE 802.11ac-VHT80 |
|---|
| **Channel 155** |
|  |

## 5.5 MAXIMUM CONDUCTED OUTPUT POWER

**Test Requirement:** FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3)

**Test Method:** KDB 789033 D02 v02r01 Section E.3.a(Method PM)

**Limits:**

1. For the band 5.15-5.25 GHz.
   (i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

   (ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

   (iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

   (iv) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

2. For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3. For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

**Test Procedure:**

1. Connected the EUT's antenna port to measure device by 10dB attenuator.
2. Method PM is used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of Tx on burst.

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:**

**Antenna gain and the maximum output power limit.**

| Frequency Band | Antenna Gain (dBi)) | Peak Power Limits (dBm) |
|---|---|---|
| U-NII-1 | 1.50 | 24.00 |
| U-NII-2A | 1.50 | 24.00 |
| U-NII-2C | 1.50 | 24.00 |
| U-NII-3 | 1.50 | 30.00 |

**For U-NII-1 Band:**

| Mode | Channel/ Frequency (MHz) | Maximum conducted output power (dBm) | | Limit (dBm) | Pass / Fail |
|---|---|---|---|---|---|
| | | Meas Power | Corr'd Power | | |
| IEEE 802.11a | 36 (5180) | 17.00 | 17.13 | 24 | Pass |
| | 44 (5220) | 17.44 | 17.57 | 24 | Pass |
| | 48 (5240) | 17.47 | 17.60 | 24 | Pass |
| IEEE 802.11n-HT20 | 36 (5180) | 16.69 | 16.83 | 24 | Pass |
| | 44 (5220) | 16.99 | 17.13 | 24 | Pass |
| | 48 (5240) | 17.05 | 17.19 | 24 | Pass |
| IEEE 802.11n-HT40 | 38 (5190) | 16.53 | 16.80 | 24 | Pass |
| | 46 (5230) | 16.91 | 17.18 | 24 | Pass |
| IEEE 802.11ac-VHT20 | 36 (5180) | 16.61 | 16.75 | 24 | Pass |
| | 44 (5220) | 17.01 | 17.15 | 24 | Pass |
| | 48 (5240) | 17.09 | 17.23 | 24 | Pass |
| IEEE 802.11ac-VHT40 | 38 (5190) | 16.48 | 16.75 | 24 | Pass |
| | 46 (5230) | 16.85 | 17.12 | 24 | Pass |
| IEEE 802.11ac-VHT80 | 42 (5210) | 16.42 | 16.95 | 24 | Pass |

**Remark:**

1. Corr'd Power = Meas Power + Duty Cycle Factor

**For U-NII-2A Band:**

| Mode | Channel/ Frequency (MHz) | Maximum conducted output power (dBm) | | Limit (dBm) | Pass / Fail |
|---|---|---|---|---|---|
| | | Meas Power | Corr'd Power | | |
| IEEE 802.11a | 52 (5260) | 17.51 | 17.64 | 24 | Pass |
| | 60 (5300) | 17.59 | 17.72 | 24 | Pass |
| | 64 (5320) | 17.51 | 17.64 | 24 | Pass |
| IEEE 802.11n-HT20 | 52 (5260) | 17.25 | 17.39 | 24 | Pass |
| | 60 (5300) | 17.15 | 17.29 | 24 | Pass |
| | 64 (5320) | 17.23 | 17.37 | 24 | Pass |
| IEEE 802.11n-HT40 | 54 (5270) | 16.62 | 16.89 | 24 | Pass |
| | 62 (5310) | 16.73 | 17.00 | 24 | Pass |
| IEEE 802.11ac-VHT20 | 52 (5260) | 17.08 | 17.22 | 24 | Pass |
| | 60 (5300) | 17.14 | 17.28 | 24 | Pass |
| | 64 (5320) | 17.22 | 17.36 | 24 | Pass |
| IEEE 802.11ac-VHT40 | 54 (5270) | 16.73 | 17.00 | 24 | Pass |
| | 62 (5310) | 16.81 | 17.08 | 24 | Pass |
| IEEE 802.11ac-VHT80 | 58 (5290) | 16.68 | 17.21 | 24 | Pass |

**Remark:**

1. Corr'd Power = Meas Power + Duty Cycle Factor

**Note:**

For IEEE 802.11 a/n/ac, the minimum 26 dB emission bandwidth is 22.80 MHz

11 dBm + $10\log_{10}(22.80)$ = 24.58 dBm > 24 dBm (250mW)

So the 24 dB limit applicable

**For U-NII-2C Band:**

| Mode | Channel/ Frequency (MHz) | Maximum conducted output power (dBm) | | Limit (dBm) | Pass / Fail |
|---|---|---|---|---|---|
| | | Meas Power | Corr'd Power | | |
| IEEE 802.11a | 100 (5500) | 16.17 | 16.30 | 24 | Pass |
| | 116 (5580) | 16.27 | 16.40 | 24 | Pass |
| | 140 (5700) | 16.67 | 16.80 | 24 | Pass |
| IEEE 802.11n-HT20 | 100 (5500) | 15.79 | 15.93 | 24 | Pass |
| | 116 (5580) | 15.85 | 15.99 | 24 | Pass |
| | 140 (5700) | 16.31 | 16.45 | 24 | Pass |
| IEEE 802.11n-HT40 | 102 (5510) | 15.39 | 15.66 | 24 | Pass |
| | 110 (5550) | 15.45 | 15.72 | 24 | Pass |
| | 134 (5670) | 16.02 | 16.29 | 24 | Pass |
| IEEE 802.11ac-VHT20 | 100 (5500) | 15.78 | 15.92 | 24 | Pass |
| | 116 (5580) | 15.83 | 15.97 | 24 | Pass |
| | 140 (5700) | 16.27 | 16.41 | 24 | Pass |
| IEEE 802.11ac-VHT40 | 102 (5510) | 15.51 | 15.78 | 24 | Pass |
| | 110 (5550) | 15.61 | 15.88 | 24 | Pass |
| | 134 (5670) | 16.03 | 16.30 | 24 | Pass |
| IEEE 802.11ac-VHT80 | 106 (5530) | 15.35 | 15.88 | 24 | Pass |

**Remark:**

1. Corr'd Power = Meas Power + Duty Cycle Factor

**Note:**
For IEEE 802.11 a/n/ac, the minimum 26 dB emission bandwidth is 22.05 MHz
11 dBm + $10\log_{10}(22.05)$ = 24.43 dBm > 24 dBm (250mW)
So the 24 dB limit applicable

**For U-NII-3 Band:**

| Mode | Channel/ Frequency (MHz) | Maximum conducted output power (dBm) | | Limit (dBm) | Pass / Fail |
|---|---|---|---|---|---|
| | | Meas Power | Corr'd Power | | |
| IEEE 802.11a | 149 (5745) | 16.29 | 16.42 | 30 | Pass |
| | 157 (5785) | 16.38 | 16.51 | 30 | Pass |
| | 165 (5825) | 16.21 | 16.34 | 30 | Pass |
| IEEE 802.11n-HT20 | 149 (5745) | 15.86 | 16.00 | 30 | Pass |
| | 157 (5785) | 15.92 | 16.06 | 30 | Pass |
| | 165 (5825) | 15.69 | 15.83 | 30 | Pass |
| IEEE 802.11n-HT40 | 151 (5755) | 15.72 | 15.99 | 30 | Pass |
| | 159 (5795) | 15.61 | 15.88 | 30 | Pass |
| IEEE 802.11ac-VHT20 | 149 (5745) | 15.83 | 15.97 | 30 | Pass |
| | 157 (5785) | 15.91 | 16.05 | 30 | Pass |
| | 165 (5825) | 15.69 | 15.83 | 30 | Pass |
| IEEE 802.11ac-VHT40 | 151 (5755) | 15.69 | 15.96 | 30 | Pass |
| | 159 (5795) | 15.63 | 15.90 | 30 | Pass |
| IEEE 802.11ac-VHT80 | 155 (5775) | 15.55 | 16.08 | 30 | Pass |

**Remark:**
1. Corr'd Power = Meas Power + Duty Cycle Factor

## 5.6 PEAK POWER SPECTRAL DENSITY

**Test Requirement:** FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3)

**Test Method:** KDB 789033 D02 v02r01 Section F

**Limits:**

1. For the band 5.15-5.25 GHz.
   (i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

   (ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

   (iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

   (iv) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

2. For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
3. For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

**Test Procedure:**
The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer.

Spectrum analyzer according to the following Settings:
**1. For U-NII-1, U-NII-2A, U-NII-2C band:**
Using method SA-2
a) Set span to encompass the entire emission bandwidth (EBW) of the signal.
b) Set RBW = 1 MHz, Set VBW ≥ 3 RBW, Detector = RMS
c) Sweep time = auto, trigger set to “free run”.
d) Trace average at least 100 traces in power averaging mode.
e) Record the max value and add 10 log (1/duty cycle)
**2. For U-NII-3 band:**
a) Set span to encompass the entire emission bandwidth (EBW) of the signal.
b) Set RBW = 500 kHz, Set VBW ≥ 3 RBW, Detector = RMS
c) Use the peak marker function to determine the maximum power level in any 500 kHz band segment within the fundamental EBW.
d) Sweep time = auto, trigger set to “free run”.
e) Trace average at least 100 traces in power averaging mode.
f) Record the max value and add 10 log (1/duty cycle)

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:**

**Antenna gain and the maximum output power limit.**

| Frequency Band | Antenna Gain (dBi)) | PSD Limits (dBm/MHz or dBm/500kHz) |
|---|---|---|
| U-NII-1 | 1.50 | 11.00 |
| U-NII-2A | 1.50 | 11.00 |
| U-NII-2C | 1.50 | 11.00 |
| U-NII-3 | 1.50 | 30.00 |

**For U-NII-1 Band:**

| Mode | Channel/ Frequency (MHz) | Power spectral density (dBm/MHz) | | Limit (dBm/MHz) | Pass / Fail |
|---|---|---|---|---|---|
| | | Meas PSD | Corr'd PSD | | |
| IEEE 802.11a | 36 (5180) | 6.013 | 6.14 | 11 | Pass |
| | 44 (5220) | 6.443 | 6.57 | 11 | Pass |
| | 48 (5240) | 6.372 | 6.50 | 11 | Pass |
| IEEE 802.11n-HT20 | 36 (5180) | 5.556 | 5.70 | 11 | Pass |
| | 44 (5220) | 5.600 | 5.74 | 11 | Pass |
| | 48 (5240) | 5.966 | 6.11 | 11 | Pass |
| IEEE 802.11n-HT40 | 38 (5190) | 2.453 | 2.72 | 11 | Pass |
| | 46 (5230) | 2.652 | 2.92 | 11 | Pass |
| IEEE 802.11ac-VHT20 | 36 (5180) | 5.595 | 5.74 | 11 | Pass |
| | 44 (5220) | 5.781 | 5.92 | 11 | Pass |
| | 48 (5240) | 5.900 | 6.04 | 11 | Pass |
| IEEE 802.11ac-VHT40 | 38 (5190) | 2.343 | 2.61 | 11 | Pass |
| | 46 (5230) | 2.701 | 2.97 | 11 | Pass |
| IEEE 802.11ac-VHT80 | 42 (5210) | -0.355 | 0.17 | 11 | Pass |

**Remark:**

1. Corr'd PSD = Meas PSD + Duty Cycle Factor

**For U-NII-2A Band:**

| Mode | Channel/ Frequency (MHz) | Power spectral density (dBm/MHz) | | Limit (dBm/MHz) | Pass / Fail |
|---|---|---|---|---|---|
| | | Meas PSD | Meas PSD | | |
| IEEE 802.11a | 52 (5260) | 6.498 | 6.63 | 11 | Pass |
| | 60 (5300) | 6.330 | 6.46 | 11 | Pass |
| | 64 (5320) | 6.202 | 6.33 | 11 | Pass |
| IEEE 802.11n-HT20 | 52 (5260) | 5.798 | 5.94 | 11 | Pass |
| | 60 (5300) | 5.588 | 5.73 | 11 | Pass |
| | 64 (5320) | 5.621 | 5.76 | 11 | Pass |
| IEEE 802.11n-HT40 | 54 (5270) | 2.459 | 2.73 | 11 | Pass |
| | 62 (5310) | 2.425 | 2.69 | 11 | Pass |
| IEEE 802.11ac-VHT20 | 52 (5260) | 5.938 | 6.08 | 11 | Pass |
| | 60 (5300) | 5.823 | 5.97 | 11 | Pass |
| | 64 (5320) | 6.087 | 6.23 | 11 | Pass |
| IEEE 802.11ac-VHT40 | 54 (5270) | 2.335 | 2.60 | 11 | Pass |
| | 62 (5310) | 2.584 | 2.85 | 11 | Pass |
| IEEE 802.11ac-VHT80 | 58 (5290) | -0.378 | 0.15 | 11 | Pass |

**Remark:**

1. Corr'd PSD = Meas PSD + Duty Cycle Factor

**For U-NII-2C Band:**

| Mode | Channel/ Frequency (MHz) | Power spectral density (dBm/MHz) | | Limit (dBm/MHz) | Pass / Fail |
|---|---|---|---|---|---|
| | | Meas PSD | Meas PSD | | |
| IEEE 802.11a | 100 (5500) | 5.053 | 5.18 | 11 | Pass |
| | 116 (5580) | 5.156 | 5.29 | 11 | Pass |
| | 140 (5700) | 5.894 | 6.03 | 11 | Pass |
| IEEE 802.11n-HT20 | 100 (5500) | 4.291 | 4.43 | 11 | Pass |
| | 116 (5580) | 4.574 | 4.71 | 11 | Pass |
| | 140 (5700) | 5.452 | 5.59 | 11 | Pass |
| IEEE 802.11n-HT40 | 102 (5510) | 1.360 | 1.63 | 11 | Pass |
| | 110 (5550) | 1.341 | 1.61 | 11 | Pass |
| | 134 (5670) | 2.054 | 2.32 | 11 | Pass |
| IEEE 802.11ac-VHT20 | 100 (5500) | 4.293 | 4.44 | 11 | Pass |
| | 116 (5580) | 4.782 | 4.93 | 11 | Pass |
| | 140 (5700) | 5.407 | 5.55 | 11 | Pass |
| IEEE 802.11ac-VHT40 | 102 (5510) | 1.574 | 1.84 | 11 | Pass |
| | 110 (5550) | 1.351 | 1.62 | 11 | Pass |
| | 134 (5670) | 1.986 | 2.25 | 11 | Pass |
| IEEE 802.11ac-VHT80 | 106 (5530) | -1.222 | -0.69 | 11 | Pass |

**Remark:**

1. Corr'd PSD = Meas PSD + Duty Cycle Factor

**For U-NII-3 Band:**

| Mode | Channel/ Frequency (MHz) | Power spectral density (dBm/500KHz) | | Limit (dBm/500KHz) | Pass / Fail |
|---|---|---|---|---|---|
| | | Meas PSD | Meas PSD | | |
| IEEE 802.11a | 149 (5745) | 3.136 | 3.27 | 30 | Pass |
| | 157 (5785) | 2.953 | 3.08 | 30 | Pass |
| | 165 (5825) | 2.706 | 2.84 | 30 | Pass |
| IEEE 802.11n-HT20 | 149 (5745) | 2.338 | 2.48 | 30 | Pass |
| | 157 (5785) | 2.444 | 2.58 | 30 | Pass |
| | 165 (5825) | 2.029 | 2.17 | 30 | Pass |
| IEEE 802.11n-HT40 | 151 (5755) | -0.832 | -0.56 | 30 | Pass |
| | 159 (5795) | -0.573 | -0.30 | 30 | Pass |
| IEEE 802.11ac-VHT20 | 149 (5745) | 2.253 | 2.40 | 30 | Pass |
| | 157 (5785) | 2.512 | 2.66 | 30 | Pass |
| | 165 (5825) | 2.358 | 2.50 | 30 | Pass |
| IEEE 802.11ac-VHT40 | 151 (5755) | -1.073 | -0.81 | 30 | Pass |
| | 159 (5795) | -0.941 | -0.67 | 30 | Pass |
| IEEE 802.11ac-VHT80 | 155 (5775) | -3.514 | -2.99 | 30 | Pass |

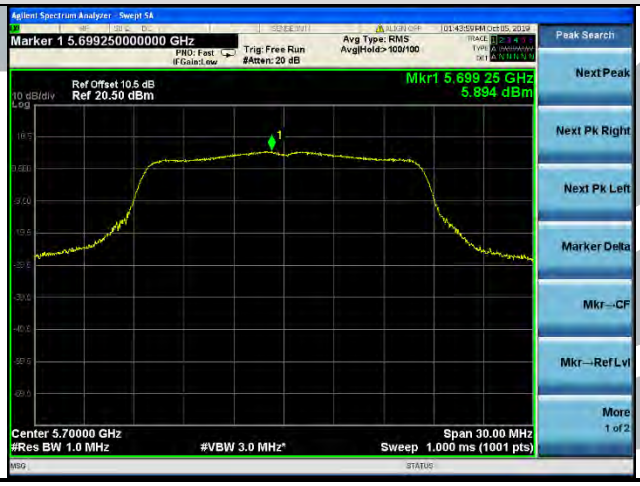
**Remark:**

1. Corr'd PSD = Meas PSD + Duty Cycle Factor

**The test plots as follows:**

| IEEE 802.11a | IEEE 802.11n-HT20 |
|---|---|
| **Channel 36** | |
| | |
| **Channel 44** | |
| | |
| **Channel 48** | |
| | |

| IEEE 802.11a | IEEE 802.11n-HT20 |
|---|---|
| **Channel 52** | |
| | |
| **Channel 60** | |
| | |
| **Channel 64** | |
| | |

| IEEE 802.11a | IEEE 802.11n-HT20 |
|---|---|
| **Channel 100** | |
| | |
| **Channel 116** | |
| | |
| **Channel 140** | |
|  | |

| IEEE 802.11a | IEEE 802.11n-HT20 |
|---|---|
| **Channel 149** | |
| | |
| **Channel 157** | |
| | |
| **Channel 165** | |
| | |