# FCC TEST REPORT

| | |
|---|---|
| **Product Name:** | Hybrid Full-Touch Handheld Computer |
| **Trade Mark:** | BLUEBIRD |
| **Model No.:** | HF550X |
| **Add. Model No.:** | N/A |
| **Report Number:** | 2208151076RFC-3 |
| **Test Standards:** | FCC 47 CFR Part 15 Subpart C |
| **FCC ID:** | SS4HF550X |
| **Test Result:** | PASS |
| **Date of Issue:** | October 26, 2022 |

Prepared for:

**Bluebird Inc.**
**3F, 115, Irwon-ro, Gangnam-gu, Seoul, Republic of Korea**

Prepared by:

**Shenzhen UnionTrust Quality and Technology Co., Ltd.**
**Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and technology park, Longhua district, Shenzhen, China**
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| | | | |
|---|---|---|---|
| Prepared by: | Kieron Luo | Reviewed by: | Henry Lu |
| | Project Engineer | | Team Leader |
| Approved by: | Kevin Liang | Date: | October 26, 2022 |
| | Assistant Manager | | |

# Version

| Version No. | Date | Description |
|---|---|---|
| V1.0 | October 26, 2022 | Original |

# CONTENTS

# 1. GENERAL INFORMATION

## 1.1 CLIENT INFORMATION

| | |
|---|---|
| **Applicant:** | Bluebird Inc. |
| **Address of Applicant:** | 3F, 115, Irwon-ro, Gangnam-gu, Seoul, Republic of Korea |
| **Manufacturer:** | Bluebird Inc. |
| **Address of Manufacturer:** | 3F, 115, Irwon-ro, Gangnam-gu, Seoul, Republic of Korea |

## 1.2 EUT INFORMATION

### 1.2.1 General Description of EUT

| | | | |
|---|---|---|---|
| **Product Name:** | Hybrid Full-Touch Handheld Computer | | |
| **Model No.:** | HF550X | | |
| **Add. Model No.:** | N/A | | |
| **Trade Mark:** | BLUEBIRD | | |
| **DUT Stage:** | Identical Prototype | | |
| **EUT Supports Function:** (Provided by the customer) | 2.4 GHz ISM Band: | IEEE 802.11b/g/n | |
| | | Bluetooth 5.1 | |
| | 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 |
| | NFC: | 13.553 MHz to 13.567 MHz | |
| **Software Version:** | R1.00 (Provided by the customer) | | |
| **Hardware Version:** | 0.5 (Provided by the customer) | | |
| **Sample Received Date:** | August 15, 2022 | | |
| **Sample Tested Date:** | August 19, 2022 to September 21, 2022 | | |
| **Remark:** The above EUT's information was provided by customer. Please refer to the specifications or user's manual for more detailed description. | | | |

### 1.2.2 Description of Accessories

| Adapter | |
|---|---|
| **Model No.:** | KSA29B0500200D5 |
| **Input:** | 100-240 V~50/60 Hz 0.5A |
| **Output:** | 5.0 V ⎓ 2.0A |
| **AC Cable:** | N/A |
| **DC Cable:** | N/A |

| Battery | |
|---|---|
| **Model No.:** | BAT-400001 |
| **Battery Type:** | Lithium-ion Rechargeable Battery |
| **Rated Voltage:** | 3.85 Vdc |
| **Limited Charge Voltage:** | 4.4 Vdc |
| **Rated Capacity:** | 4000 mAh |

| Cable | |
|---|---|
| **Description:** | USB Type-C Plug Cable |
| **Connector:** | USB Type-C / USB 3.0 Type A |
| **Cable Type:** | Shielded without ferrite |
| **Length:** | 1 Meter |

## 1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

| | | |
|---|---|---|
| **Frequency Band:** | 2400 MHz to 2483.5 MHz | |
| **Frequency Range:** | 2412 MHz to 2472 MHz | |
| **Support Standards:** | IEEE 802.11b, IEEE 802.11g, IEEE 802.11n-HT20, IEEE 802.11n-HT40 | |
| **Type of Modulation:** | IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK)<br>IEEE 802.11g: OFDM (64-QAM, 16-QAM, QPSK, BPSK)<br>IEEE 802.11n-HT20: OFDM (64-QAM, 16-QAM, QPSK, BPSK)<br>IEEE 802.11n-HT40: OFDM (64-QAM, 16-QAM, QPSK, BPSK) | |
| **Data Rate:** | IEEE 802.11b: Up to 11 Mbps<br>IEEE 802.11g: Up to 54 Mbps<br>IEEE 802.11n-HT20: Up to MCS 15<br>IEEE 802.11n-HT40: Up to MCS 15 | |
| **Number of Channels:** | IEEE 802.11b: 13<br>IEEE 802.11g: 13<br>IEEE 802.11n-HT20: 13<br>IEEE 802.11n-HT40: 9 | |
| **Channel Separation:** | 5 MHz | |
| **Antenna Type:**<br>(Provided by the customer) | Ant. 0 | PIFA Antenna |
| | Ant. 1 | PIFA Antenna |
| **Antenna Gain:**<br>(Provided by the customer) | Ant. 0 | 1.137 dBi |
| | Ant. 1 | 0.654 dBi |
| **Maximum Peak Power:** | SISO_ Ant. 0 | IEEE 802.11b: 21.42 dBm<br>IEEE 802.11g: 23.36 dBm<br>IEEE 802.11n-HT20: 20.14 dBm<br>IEEE 802.11n-HT40: 21.32 dBm |
| | SISO_ Ant. 1 | IEEE 802.11b: 21.17 dBm<br>IEEE 802.11g: 22.15 dBm<br>IEEE 802.11n-HT20: 19.17 dBm<br>IEEE 802.11n-HT40: 20.84 dBm |
| | MIMO_ Ant. 0+1 | IEEE 802.11n-HT20: 22.69 dBm<br>IEEE 802.11n-HT40: 24.07 dBm |
| **Normal Test Voltage:** | 3.85Vdc and/or 120 Vac | |

## 1.4 OTHER INFORMATION

| **Operation Frequency Each of Channel** | |
|---|---|
| **IEEE 802.11b,<br>IEEE 802.11g,<br>IEEE 802.11n-HT20** | **f = 2407 + 5k MHz, k = 1,…,13** |
| **IEEE 802.11n-HT40** | **f = 2407 + 5k MHz, k = 3,…,11** |
| 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 |
|---|---|---|---|---|
| Notebook | DELL | Inspiron 5409 | N/A | UnionTrust |

2) Support Cable

| Cable No. | Description | Connector | Length | Supplied by |
|---|---|---|---|---|
| 1 | Antenna Cable | SMA | 0.3 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, China 518109
Telephone: +86 (0) 755 2823 0888
Fax: +86 (0) 755 2823 0886

## 1.7 TEST FACILITY

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

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

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

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

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

## 1.8 DEVIATION FROM STANDARDS

None.

## 1.9 ABNORMALITIES FROM STANDARD CONDITIONS

None.

## 1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

## 1.11 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

| No. | Item | Measurement Uncertainty |
|---|---|---|
| 1 | Conducted emission 9KHz-150KHz | ±3.2 dB |
| 2 | Conducted emission 150KHz-30MHz | ±2.7 dB |
| 3 | Radiated emission 9KHz-30MHz | ±4.7 dB |
| 4 | Radiated emission 30MHz-1GHz | ±4.6 dB |
| 5 | Radiated emission 1GHz-18GHz | ±4.4 dB |
| 6 | Radiated emission 18GHz-26GHz | ±4.6 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 (b) | 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 | PASS |
| **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 |

# 3. EQUIPMENT LIST

| Radiated Emission Test Equipment List | | | | | | |
|---|---|---|---|---|---|---|
| **Used** | **Equipment** | **Manufacturer** | **Model No.** | **Serial Number** | **Cal. date** | **Cal. Due date** |
| ☒ | 3M Chamber & Accessory Equipment | ETS-LINDGREN | 3M | Euroshiedpn-CT001270-1317 | 22-Jan-2021 | 21-Jan-2024 |
| ☒ | Receiver | R&S | ESIB26 | 100114 | 5-Nov-2021 | 4-Nov-2022 |
| ☒ | Loop Antenna | ETS-LINDGREN | 6502 | 00202525 | 11-Nov-2021 | 10-Nov-2023 |
| ☒ | Broadband Antenna | ETS-LINDGREN | 3142E | 00201566 | 11-Nov-2021 | 10-Nov-2023 |
| ☒ | 6dB Attenuator | Talent | RA6A5-N-18 | 18103001 | 11-Nov-2021 | 10-Nov-2023 |
| ☒ | Preamplifier | HP | 8447F | 2805A02960 | 5-Nov-2021 | 4-Nov-2022 |
| ☒ | Horn Antenna (Pre-amplifier) | ETS-LINDGREN | 3117-PA | 00201874 | 17-Apr-2022 | 16-Apr-2024 |
| ☒ | Pre-amplifier | ETS-LINDGREN | 00118385 | 00201874 | 6-Nov-2021 | 5-Nov-2022 |
| ☐ | Horn Antenna | ETS-LINDGREN | 3116C | 00200180 | 17-Apr-2022 | 16-Apr-2024 |
| ☒ | Horn Antenna (Pre-amplifier) | ETS-LINDGREN | 3116C-PA | 00202652 | 14-Nov-2020 | 13-Nov-2022 |
| ☒ | Pre-amplifier | ETS-LINDGREN | 00118384 | 00202652 | 17-Nov-2020 | 16-Nov-2022 |
| ☒ | Band Reject Filter (2400MHz~2500MHz) | Micro-Tronics | BRM50702 | G248 | 6-Nov-2021 | 5-Nov-2022 |
| ☒ | Multi device Controller | ETS-LINDGREN | 7006-001 | 00160105 | N/A | N/A |
| ☒ | Test Software | Audix | e3 | Software Version: 9.160323 | | |

| Conducted Emission Test Equipment List | | | | | | |
|---|---|---|---|---|---|---|
| **Used** | **Equipment** | **Manufacturer** | **Model No.** | **Serial Number** | **Cal. date** | **Cal. Due date** |
| ☒ | Receiver | R&S | ESR7 | 101181 | 5-Nov-2021 | 4-Nov-2022 |
| ☒ | Pulse Limiter | R&S | ESH3-Z2 | 0357.8810.54 | 5-Nov-2021 | 4-Nov-2022 |
| ☒ | LISN | R&S | ESH2-Z5 | 860014/024 | 5-Nov-2021 | 4-Nov-2022 |
| ☐ | LISN | ETS-Lindgren | 3816/2SH | 00201088 | 5-Nov-2021 | 4-Nov-2022 |
| ☒ | Test Software | Audix | e3 | Software Version: 9 20151119i | | |

| RF Conducted Test Equipment List | | | | | | |
|---|---|---|---|---|---|---|
| **Used** | **Equipment** | **Manufacturer** | **Model No.** | **Serial Number** | **Cal. date** | **Cal. Due date** |
| ☒ | EXA Spectrum Analyzer | KEYSIGHT | N9010A | MY51440197 | 15-Apr-2022 | 14-Apr-2023 |
| ☒ | USB Wideband Power Sensor | KEYSIGHT | U2021XA | MY55430035 | 5-Nov-2021 | 4-Nov-2022 |
| ☒ | USB Wideband Power Sensor | KEYSIGHT | U2021XA | MY55430023 | 5-Nov-2021 | 4-Nov-2022 |

# 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 | 3.85Vdc and/or 120 Vac | 20 to 75 |
| **Remark:** 1) NV: Normal Voltage; NT: Normal Temperature | | | |

### 4.1.2 Record of Normal Environment and Test Sample

| Test Item | Temp. (°C) | Relative Humidity (%) | Pressure (kPa) | Sample No. | Tested by |
|---|---|---|---|---|---|
| AC Power Line Conducted Emission | 24.3 | 42.7 | 98.95 | S20220815342-ZJA08/9 | David Zhang |
| Conducted Peak Output Power | 24.5 | 49 | 99.9 | S20220815342-ZJA09/9 | Hank Wu |
| 6dB Bandwidth | | | | | |
| Power Spectral Density | | | | | |
| Conducted Out of Band Emission | | | | | |
| Radiated Spurious Emissions | 25.2 | 50 | 100.6 | S20220815342-ZJA08/9 | Andy Lin |
| Band Edge Measurements (Radiated) | | | | | |

## 4.2 TEST CHANNELS

| Mode | Tx/Rx Frequency | Test RF Channel Lists | | | | |
|---|---|---|---|---|---|---|
| | | Lowest(L) | Middle(M) | Highest(H11) | Highest(H12) | Highest(H13) |
| IEEE 802.11b | 2412 MHz to 2472 MHz | Channel 1 | Channel 7 | Channel 11 | Channel 12 | Channel 13 |
| | | 2412 MHz | 2437 MHz | 2462 MHz | 2467 MHz | 2472 MHz |
| IEEE 802.11g | 2412 MHz to 2472 MHz | Channel 1 | Channel 7 | Channel 11 | Channel 12 | Channel 13 |
| | | 2412 MHz | 2437 MHz | 2462 MHz | 2467 MHz | 2472 MHz |
| IEEE 802.11n-HT20 | 2412 MHz to 2472 MHz | Channel 1 | Channel 7 | Channel 11 | Channel 12 | Channel 13 |
| | | 2412 MHz | 2437 MHz | 2462 MHz | 2467 MHz | 2472 MHz |
| **Mode** | **Tx/Rx Frequency** | **Test RF Channel Lists** | | | | |
| | | **Lowest(L)** | **Middle(M)** | **Highest(H9)** | **Highest(H10)** | **Highest(H11)** |
| IEEE 802.11n-HT40 | 2422 MHz to 2462 MHz | Channel 3 | Channel 7 | Channel 9 | Channel 10 | Channel 11 |
| | | 2422 MHz | 2437 MHz | 2452 MHz | 2457 MHz | 2462 MHz |

## 4.3 EUT TEST STATUS

| Mode | Tx/Rx Function | Description |
|---|---|---|
| IEEE 802.11b<br>IEEE 802.11g<br>IEEE 802.11n-HT20<br>IEEE 802.11n-HT40 | 1Tx/1Rx | 1. Keep the EUT in continuously transmitting or receiving with modulation test single. |
| IEEE 802.11n-HT20<br>IEEE 802.11n-HT40 | 2Tx/2Rx | 2. Keep the EUT in continuously transmitting or receiving with modulation test single. |

| Power Setting (Provided by the customer) | | | | | | |
|---|---|---|---|---|---|---|
| Mode | Channel 1-11 | | Channel 12 | | Channel 13 | |
| | Antenna 0 | Antenna 1 | Antenna 0 | Antenna 1 | Antenna 0 | Antenna 1 |
| IEEE 802.11b | 18 | 18 | 18 | 18 | 18 | 18 |
| IEEE 802.11g | 18 | 18 | 18 | 17 | 18 | 16 |
| IEEE 802.11n-HT20 | 14 | 14 | 14 | 14 | 14 | 14 |
| IEEE 802.11n-HT40 | 14 | 14 | 14 | 14 | 14 | 14 |

| Test Software (Provided by the customer) |
|---|
| Test software name: QRCT4 |

## 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 802.11b | 1 Mbps |
| IEEE 802.11g | 6 Mbps |
| IEEE 802.11n-HT20 | MCS0 |
| IEEE 802.11n-HT40 | MCS0 |

## 4.5 TEST SETUP

### 4.5.1 For Radiated Emissions test setup

**Figure 1. Below 30MHz**

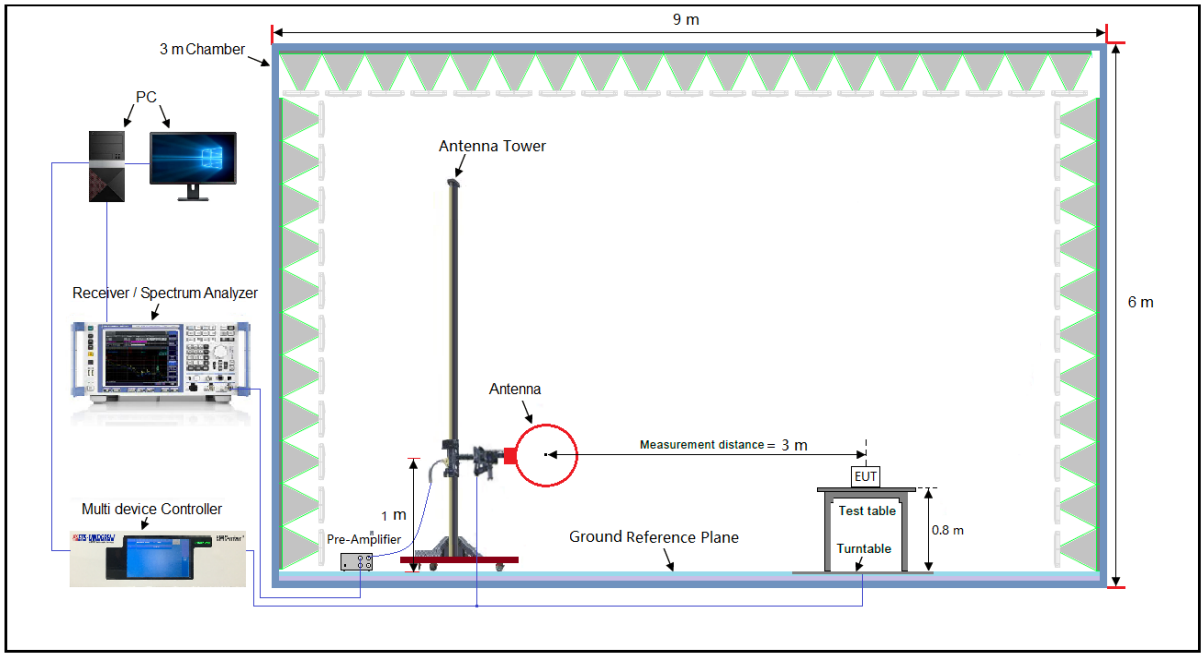



**Figure 2. 30MHz to 1GHz**

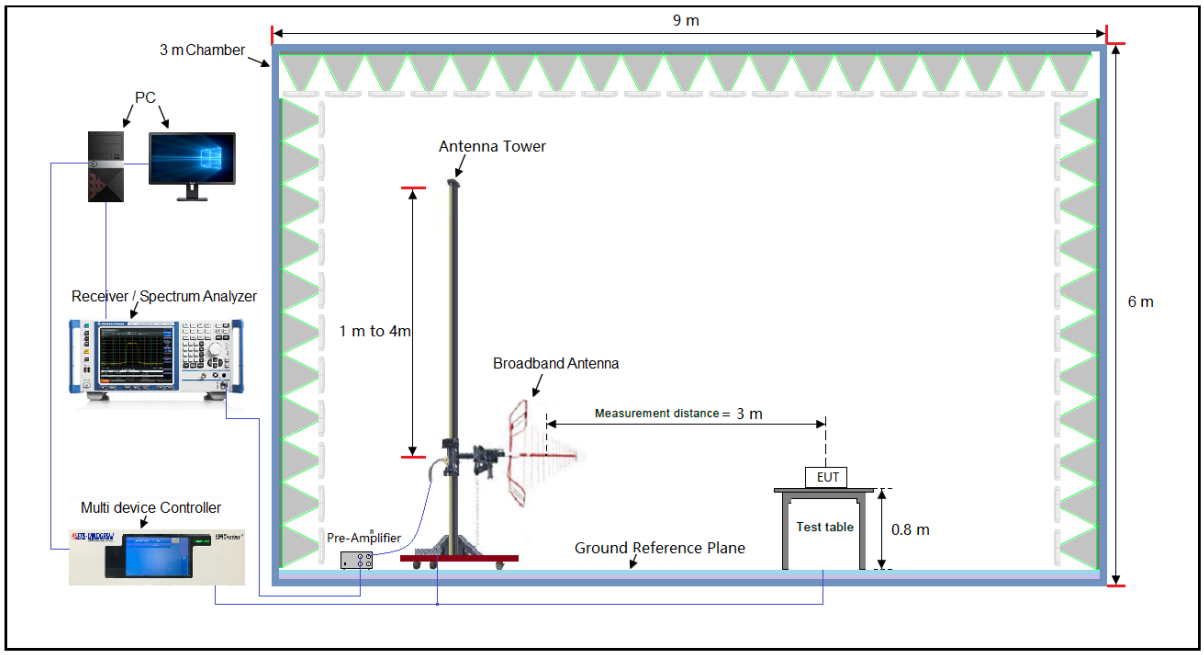
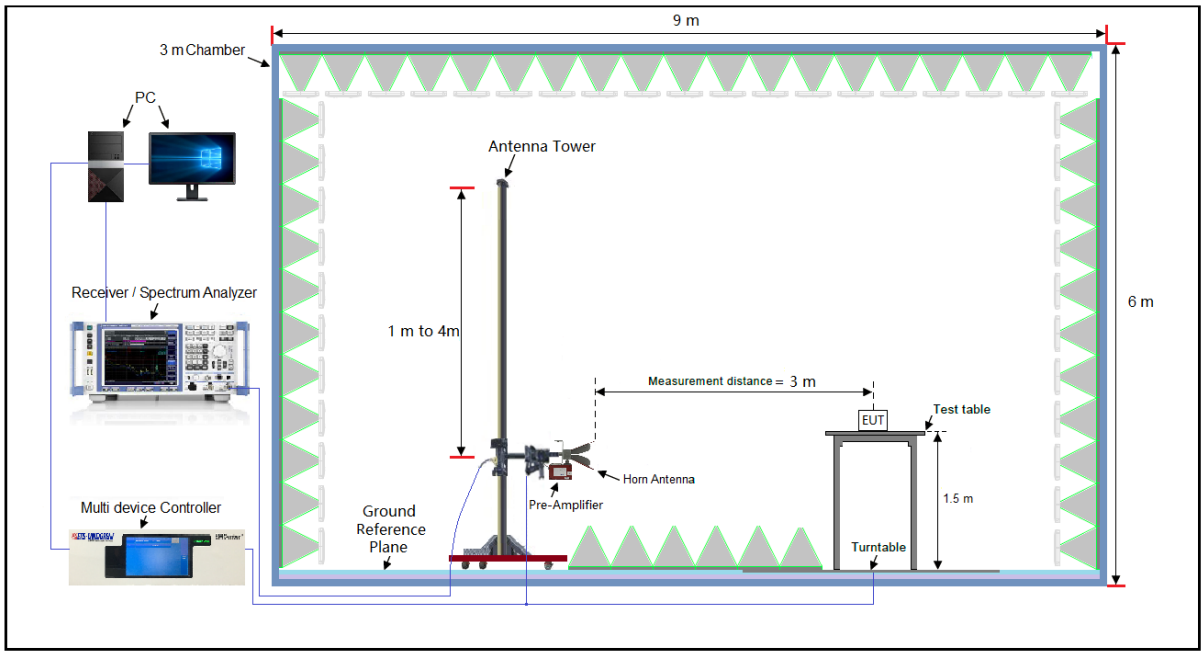
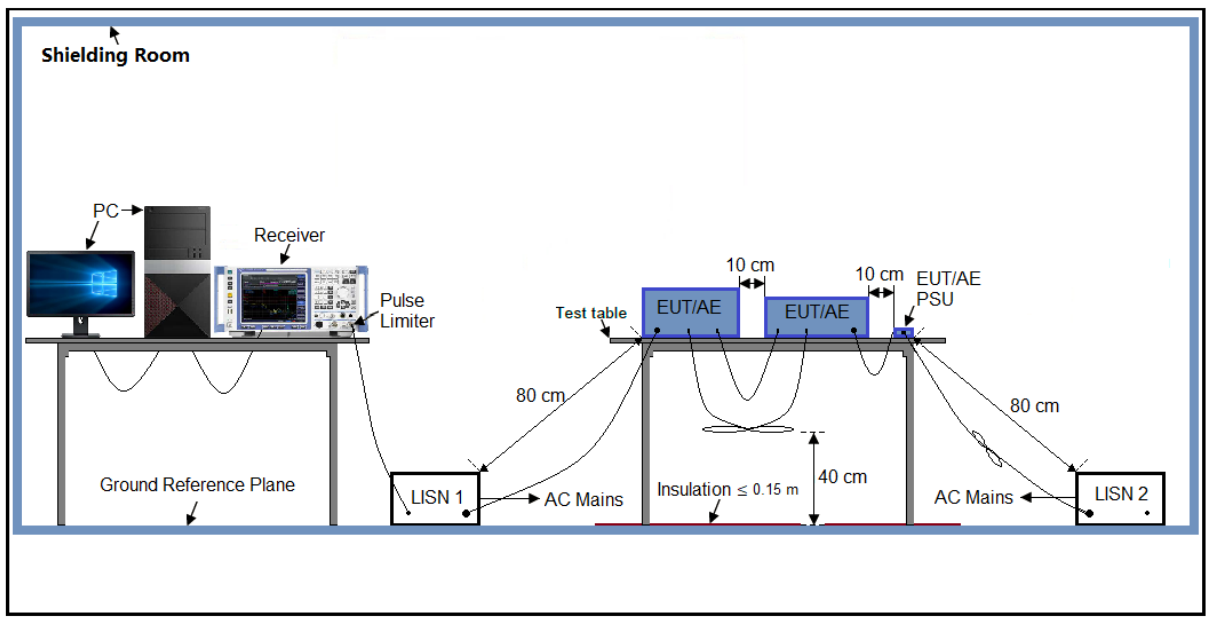


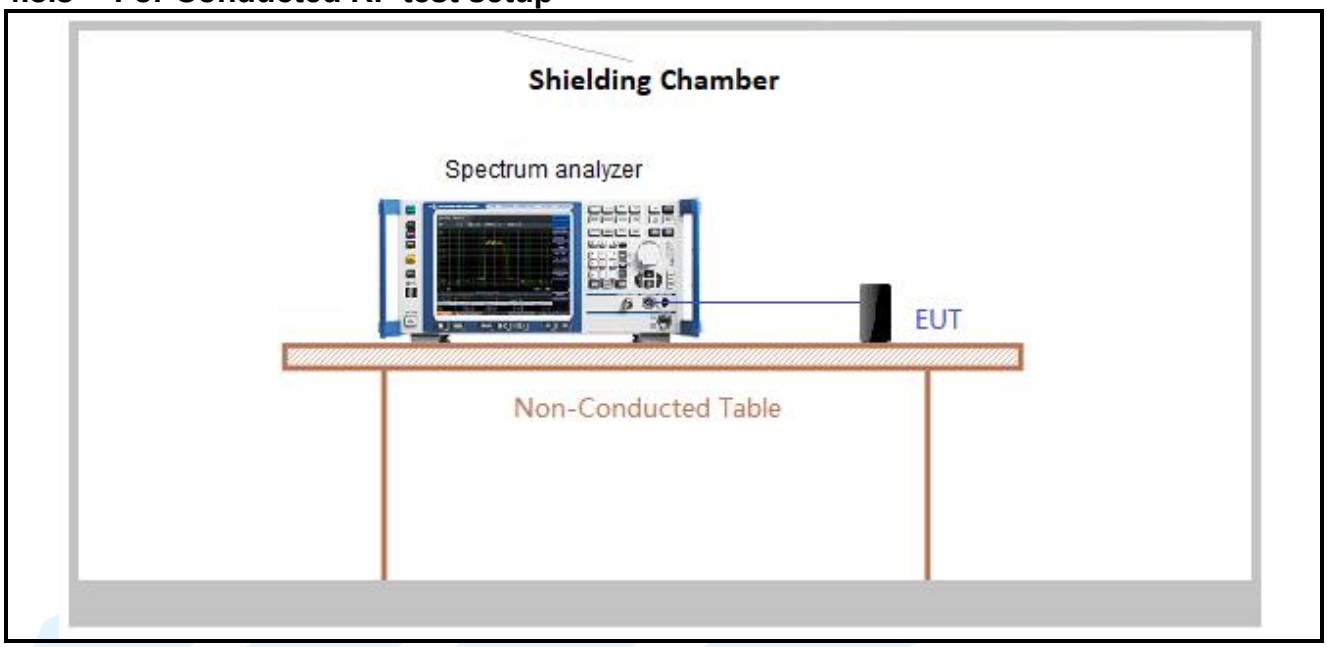
**Figure 3. Above 1GHz**




## 4.5.2 For Conducted Emissions test setup



### 4.5.3 For Conducted RF test setup




## 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 3.85V 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 orientation.

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 11.6.

**Test Results**

| Mode | Data Rates | On Time (msec) | Period (msec) | Duty Cycle (linear) | Duty Cycle (%) | Duty Cycle Factor (dB) | 1/T Minimum VBW (kHz) |
|---|---|---|---|---|---|---|---|
| IEEE 802.11b | 1 Mbps | 12.41 | 12.54 | 0.99 | 98.96 | 0.00 | 0.01 |
| IEEE 802.11g | 6 Mbps | 2.04 | 2.10 | 0.97 | 97.14 | 0.13 | 0.49 |
| IEEE 802.11n-HT20 | MCS 0 | 1.91 | 1.96 | 0.97 | 97.45 | 0.11 | 0.52 |
| IEEE 802.11n-HT40 | MCS 0 | 0.940 | 1.00 | 0.94 | 94.00 | 0.27 | 1.06 |

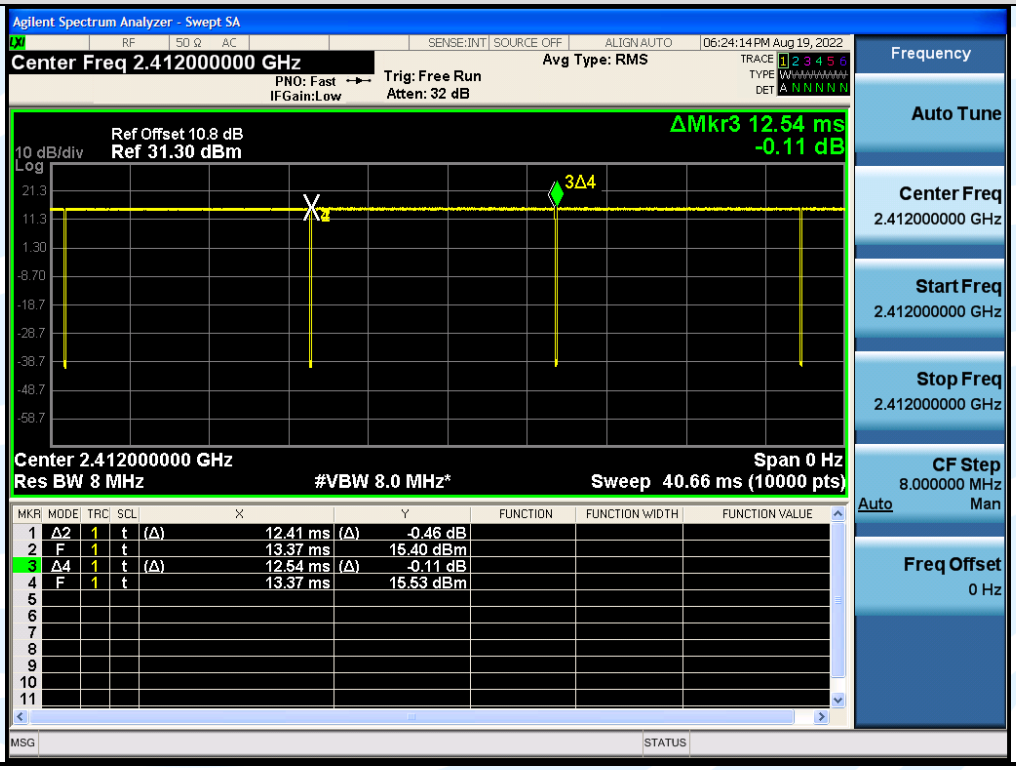
**Remark:**

1) Duty cycle= On Time/ Period;

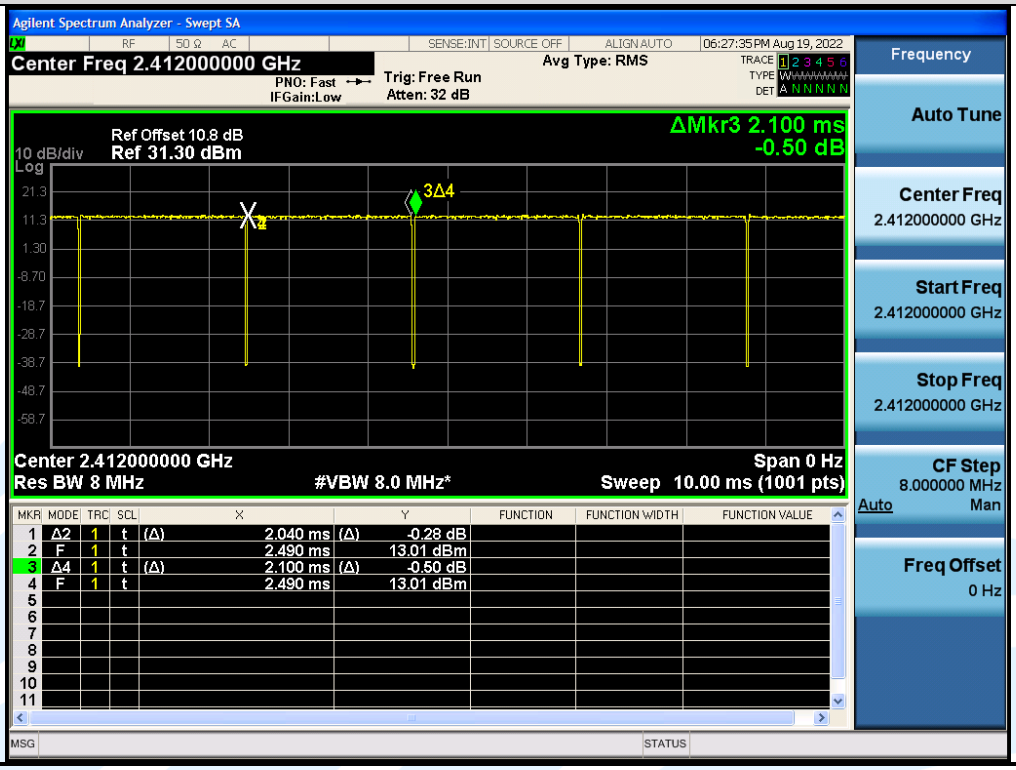
2) Duty Cycle factor = 10 * log(1/ Duty cycle)

**The test plots as follows**

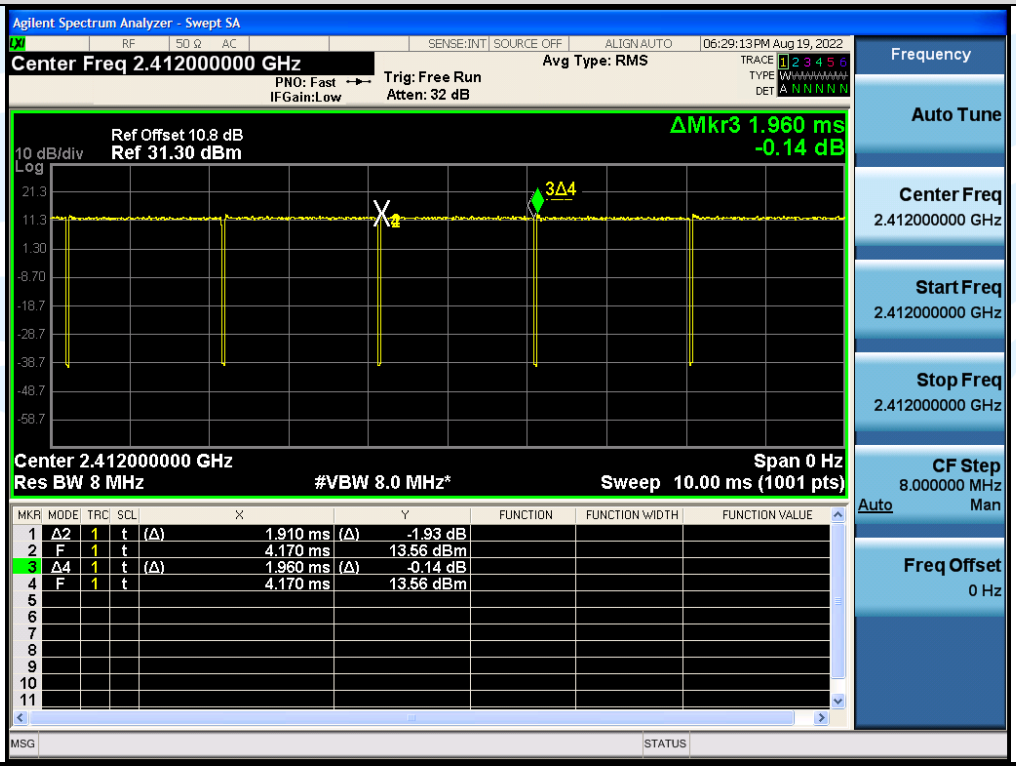
**IEEE 802.11b**



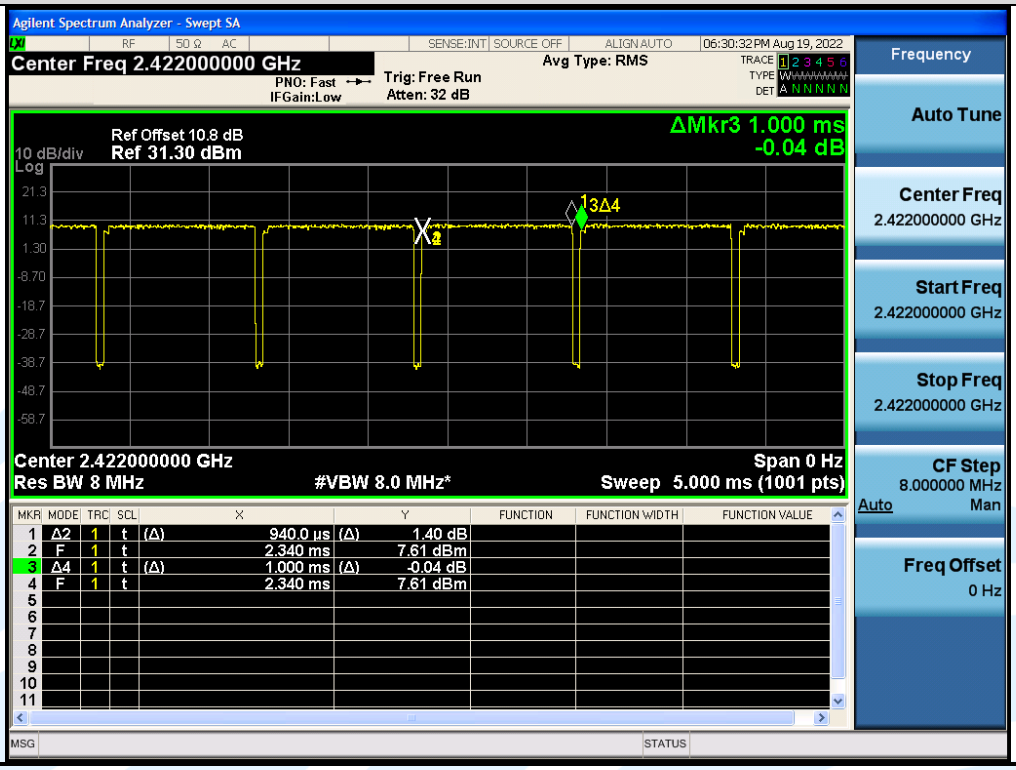
**IEEE 802.11g**




**IEEE 802.11n-HT20**



**IEEE 802.11n-HT40**



# 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 | KDB 662911 D01 Multiple Transmitter Output v02r01 | Emissions Testing of Transmitters with Multiple Outputs in the Same Band |

## 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:** |
| Both antenna in the interior of the equipment and no consideration of replacement. The transmit signals are correlated with each other and the antenna gain of both chains is completely consistent, the best case directional gain of the antenna is 0.9 dBi (See section 5.3). |

## 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 4.5.3 for details.

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

**Test Results:**

| Mode | Frequency | Max. Peak Power (dBm) | | | | Result |
|---|---|---|---|---|---|---|
| | (MHz) | Ant. 0 | Ant. 1 | Total | Limit dBm) | |
| IEEE 802.11b | 2412 | 20.67 | 20.34 | N/A | 30.00 | Pass |
| | 2437 | 20.81 | 20.16 | N/A | 30.00 | Pass |
| | 2462 | 20.53 | 20.24 | N/A | 30.00 | Pass |
| | 2467 | 21.18 | **21.17** | N/A | 30.00 | Pass |
| | 2472 | **21.42** | 21.03 | N/A | 30.00 | Pass |
| IEEE 802.11g | 2412 | 22.25 | 22.12 | N/A | 30.00 | Pass |
| | 2437 | 22.13 | 21.96 | N/A | 30.00 | Pass |
| | 2462 | 21.91 | 22.08 | N/A | 30.00 | Pass |
| | 2467 | 22.83 | 22.12 | N/A | 30.00 | Pass |
| | 2472 | **23.36** | **22.15** | N/A | 30.00 | Pass |
| IEEE 802.11n-HT20 | 2412 | 18.91 | 18.17 | 21.57 | 30.00 | Pass |
| | 2437 | 18.67 | 18.23 | 21.47 | 30.00 | Pass |
| | 2462 | 18.41 | 18.59 | 21.51 | 30.00 | Pass |
| | 2467 | 19.42 | 18.89 | 22.17 | 30.00 | Pass |
| | 2472 | **20.14** | **19.17** | **22.69** | 30.00 | Pass |
| IEEE 802.11n-HT40 | 2422 | 20.48 | 20.33 | 23.42 | 30.00 | Pass |
| | 2437 | 20.57 | 20.27 | 23.43 | 30.00 | Pass |
| | 2452 | 20.51 | 19.88 | 23.22 | 30.00 | Pass |
| | 2457 | **21.32** | 20.56 | 23.97 | 30.00 | Pass |
| | 2462 | 21.26 | **20.84** | **24.07** | 30.00 | Pass |

| Mode | Frequency (MHz) | Max. Avg. Power (dBm) | | | | |
|---|---|---|---|---|---|---|
| | | Meas Value Ant. 0 | Meas Value Ant. 1 | Corr'd Value Ant. 0 | Corr'd Value Ant. 1 | Total Ant.0+1 |
| IEEE 802.11b | 2412 | 18.31 | 17.92 | 18.31 | 17.92 | N/A |
| | 2437 | 18.48 | 17.65 | 18.48 | 17.65 | N/A |
| | 2462 | 18.25 | 17.88 | 18.25 | 17.88 | N/A |
| | 2467 | 18.88 | **18.67** | 18.88 | **18.67** | N/A |
| | 2472 | **18.95** | 18.48 | **18.95** | 18.48 | N/A |
| IEEE 802.11g | 2412 | 17.78 | **17.31** | 17.91 | **17.44** | N/A |
| | 2437 | 17.89 | 17.12 | 18.02 | 17.25 | N/A |
| | 2462 | 17.64 | 17.24 | 17.77 | 17.37 | N/A |
| | 2467 | 18.22 | 17.12 | 18.35 | 17.25 | N/A |
| | 2472 | **18.38** | 17.02 | **18.51** | 17.15 | N/A |
| IEEE 802.11n-HT20 | 2412 | 13.74 | 13.02 | 13.85 | 13.13 | 16.52 |
| | 2437 | 13.84 | 13.15 | 13.95 | 13.26 | 16.63 |
| | 2462 | 13.59 | 13.24 | 13.70 | 13.35 | 16.54 |
| | 2467 | 14.20 | **13.89** | 14.31 | **14.00** | **17.17** |
| | 2472 | **14.37** | 13.64 | **14.48** | 13.75 | 17.14 |
| IEEE 802.11n-HT40 | 2422 | 14.05 | 13.51 | 14.32 | 13.78 | 17.07 |
| | 2437 | 14.10 | 13.41 | 14.37 | 13.68 | 17.05 |
| | 2452 | 14.15 | 13.48 | 14.42 | 13.75 | 17.11 |
| | 2457 | **14.64** | **14.11** | **14.91** | **14.38** | **17.66** |
| | 2462 | 14.51 | 13.87 | 14.78 | 14.14 | 17.48 |

Remark:
1. Total (Ant 0+1) = $10*\log[(10^{Ant.\ 0/10})+(10^{Ant.\ 0/10})]$
2. Directional gain and the maximum conducted output power limit see table below:

| Frequency (MHz) | Antenna Gain (dBi) | | Uncorrelated Directional gain (dBi) | Correlated Directional gain (dBi) | Limit | |
|---|---|---|---|---|---|---|
| | Ant .0 | Ant .1 | Power | PSD | Power (dBm) | PSD (dBm/3kHz) |
| 2400 - 2483.5 | 1.137 | 0.654 | 0.90 | 3.91 | 30 | 8 |

For CDD transmissions, directional gain is calculated as follows. In all formulas,

$N_{ANT}$ = number of transmit antennas and
$N_{SS}$ = number of spatial streams. (Assume $N_{SS}$ = 1 unless you have specific information to the contrary.)

If all antennas have the same gain, $G_{ANT}$, Directional gain = $G_{ANT}$ + Array Gain, where Array Gain is as follows.

For power spectral density (PSD) measurements on all devices,

Array Gain = 10 log($N_{ANT}/N_{SS}$) dB.

For power measurements on IEEE 802.11 devices, 1,2

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;

Array Gain = 0 dB (i.e., no array gain) for channel widths $\geq$ 40 MHz for any $N_{ANT}$;

Array Gain = 5 log($N_{ANT}/N_{SS}$) dB or 3 dB, whichever is less, for 20-MHz channel widths with $N_{ANT} \geq 5$.

For Uncorrelated transmissions, directional gain is calculated as follows. In all formulas:

Directional gain = 10 $\log[(10^{G1/20} + 10^{G2/20} + \ldots + 10^{GN/20})^2 / NANT]$ dBi [Note the “20”s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

## 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.

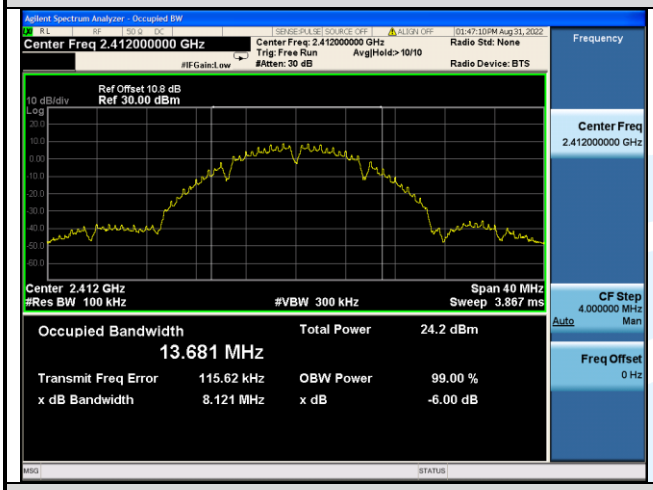
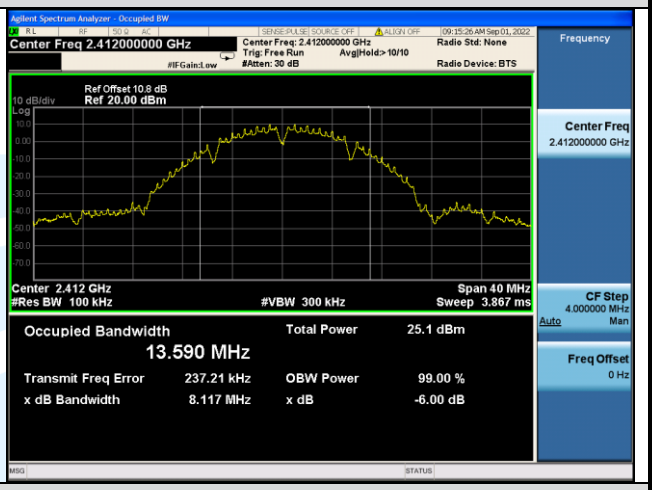
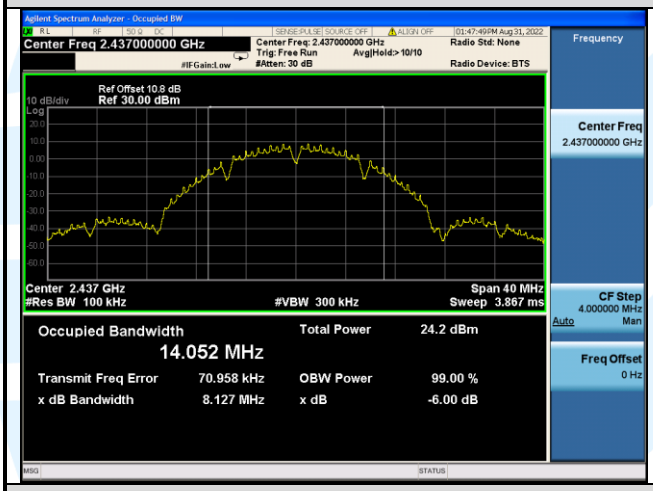
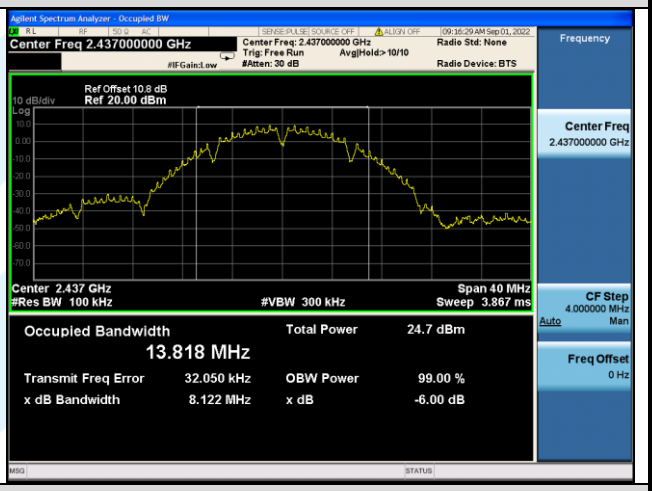
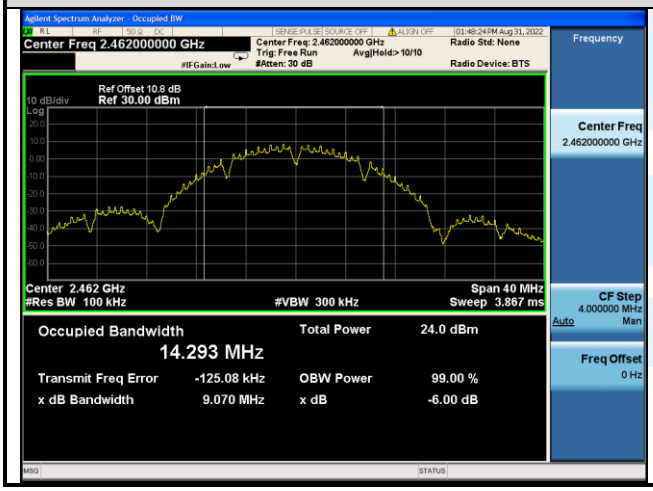
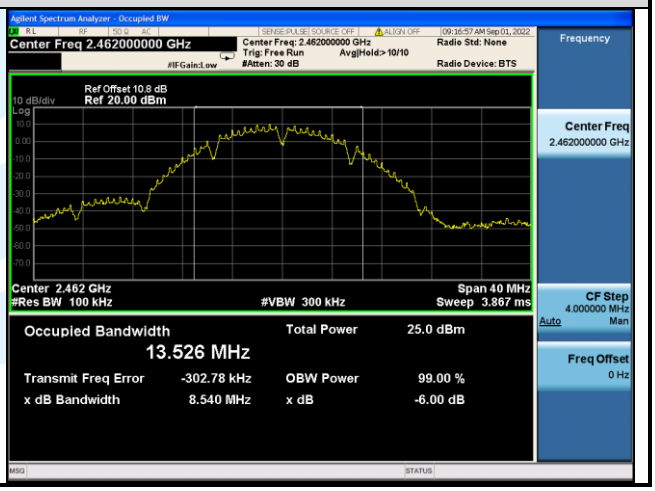
**Test Setup:** Refer to section 4.5.3 for details.

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

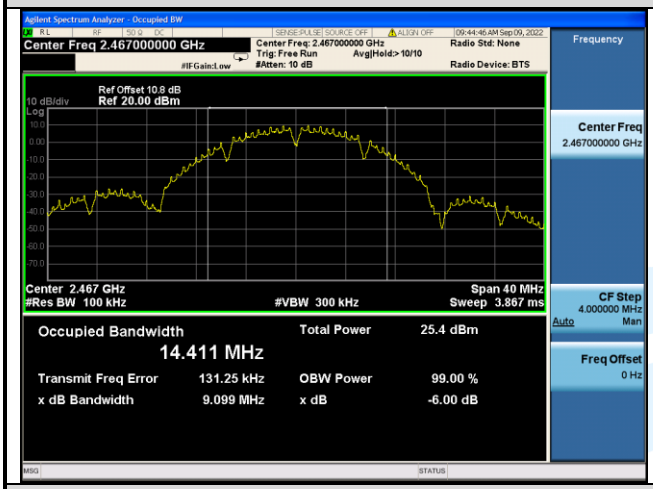
**Test Results:**

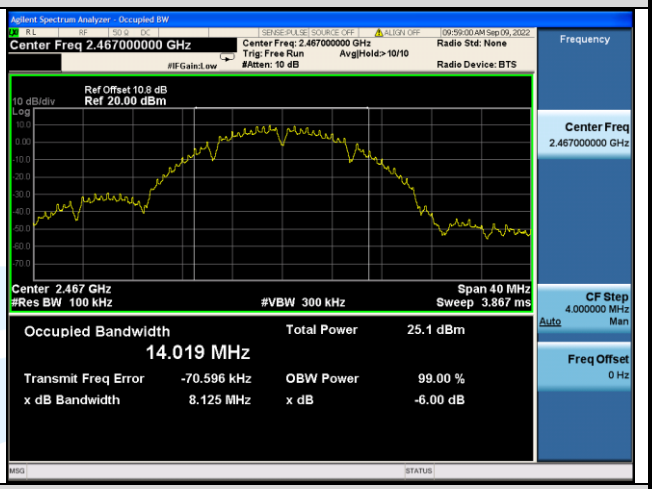
| Mode | Channel/ Frequency (MHz) | 6 dB Bandwidth (MHz) | | 6 dB Bandwidth Limit | Result |
|---|---|---|---|---|---|
| | | Ant. 0 | Ant. 1 | | |
| IEEE 802.11b | 1(2412) | 8.121 | 8.117 | > 500 kHz | Pass |
| | 6(2437) | 8.127 | 8.122 | > 500 kHz | Pass |
| | 11(2462) | 9.070 | 8.540 | > 500 kHz | Pass |
| | 12(2467) | 9.099 | 8.125 | > 500 kHz | Pass |
| | 13(2472) | 8.112 | 8.131 | > 500 kHz | Pass |
| IEEE 802.11g | 1(2412) | 15.17 | 15.17 | > 500 kHz | Pass |
| | 6(2437) | 15.38 | 15.68 | > 500 kHz | Pass |
| | 11(2462) | 15.95 | 15.76 | > 500 kHz | Pass |
| | 12(2467) | 15.84 | 16.34 | > 500 kHz | Pass |
| | 13(2472) | 15.15 | 15.49 | > 500 kHz | Pass |
| IEEE 802.11n-HT20 | 1(2412) | 15.17 | 15.17 | > 500 kHz | Pass |
| | 6(2437) | 16.02 | 16.57 | > 500 kHz | Pass |
| | 11(2462) | 16.40 | 16.38 | > 500 kHz | Pass |
| | 12(2467) | 16.32 | 16.98 | > 500 kHz | Pass |
| | 13(2472) | 15.15 | 16.05 | > 500 kHz | Pass |
| IEEE 802.11n-HT40 | 3(2422) | 35.21 | 35.18 | > 500 kHz | Pass |
| | 6(2437) | 35.80 | 36.38 | > 500 kHz | Pass |
| | 9(2452) | 35.15 | 35.14 | > 500 kHz | Pass |
| | 10(2457) | 35.40 | 35.14 | > 500 kHz | Pass |
| | 11(2462) | 35.78 | 35.24 | > 500 kHz | Pass |

**The test plots as follows:**

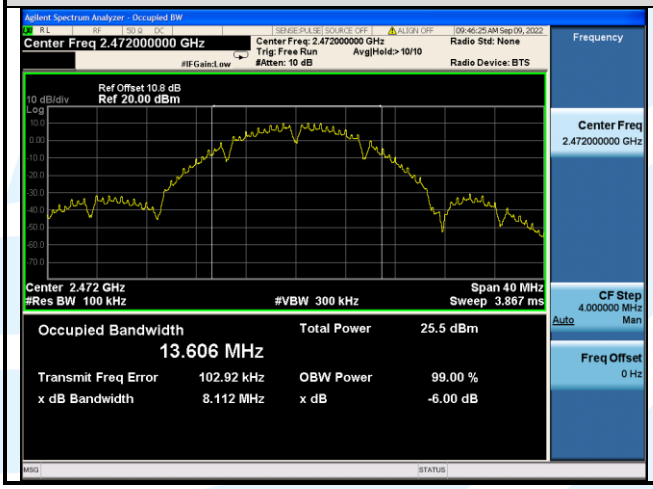
| IEEE 802.11b | |
|---|---|
| **Ant. 0** | **Ant. 1** |
| **Channel 1** | |
|  |  |
| **Channel 6** | |
|  |  |
| **Channel 11** | |
|  |  |

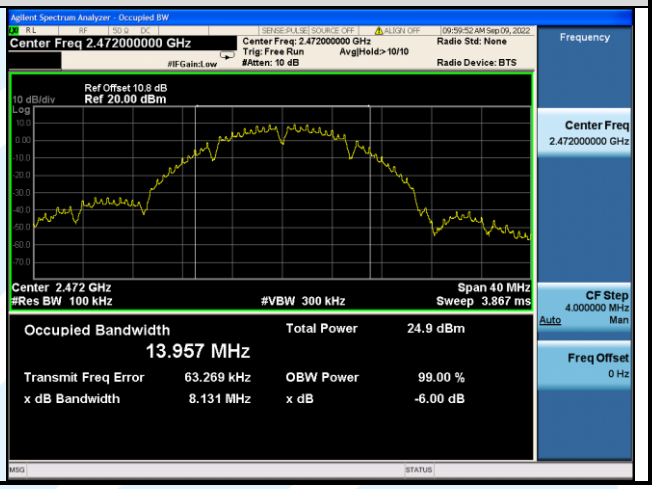
**Channel 12**

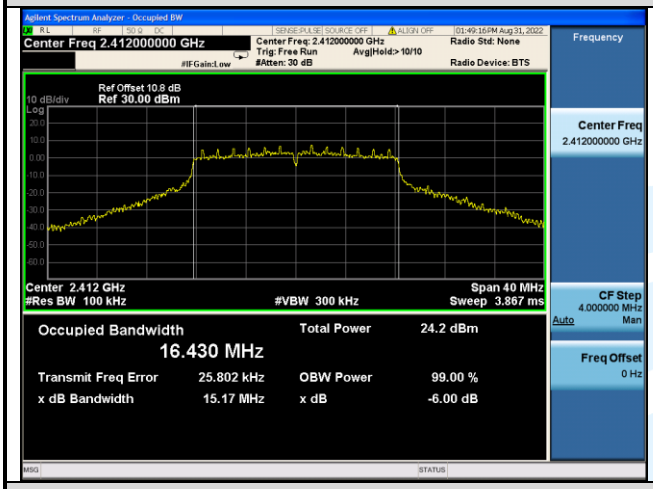
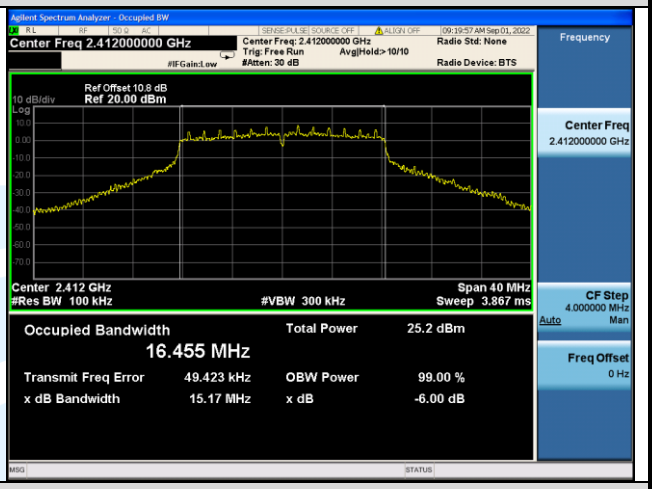
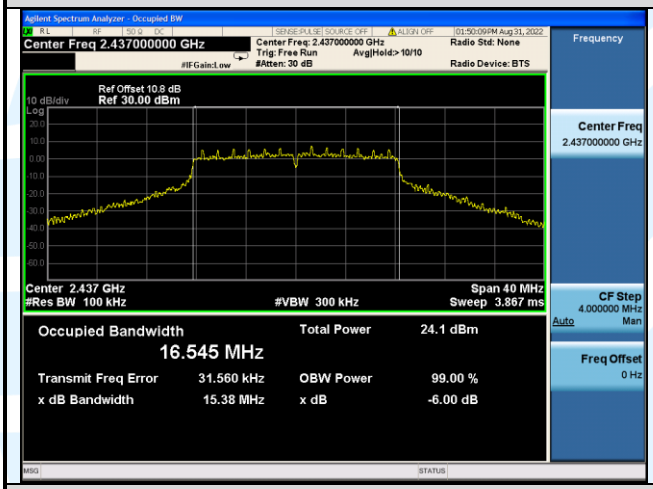
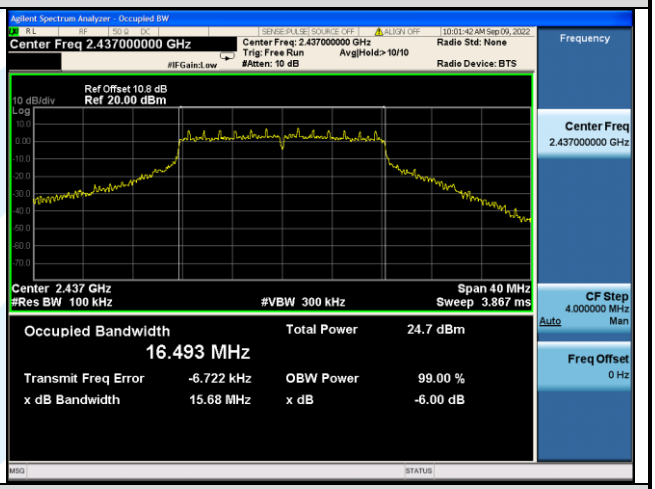
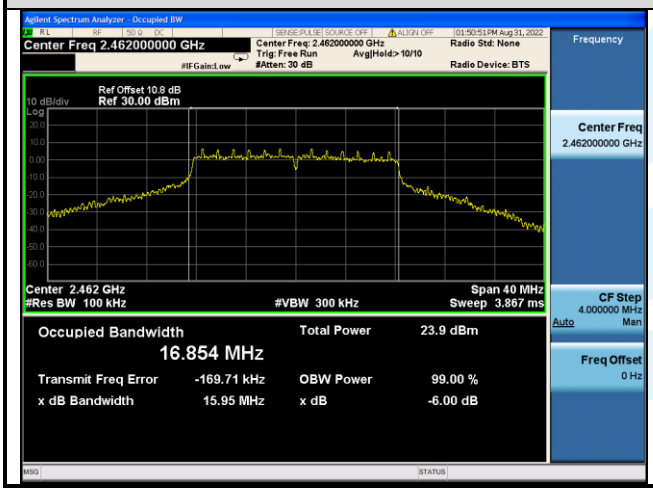
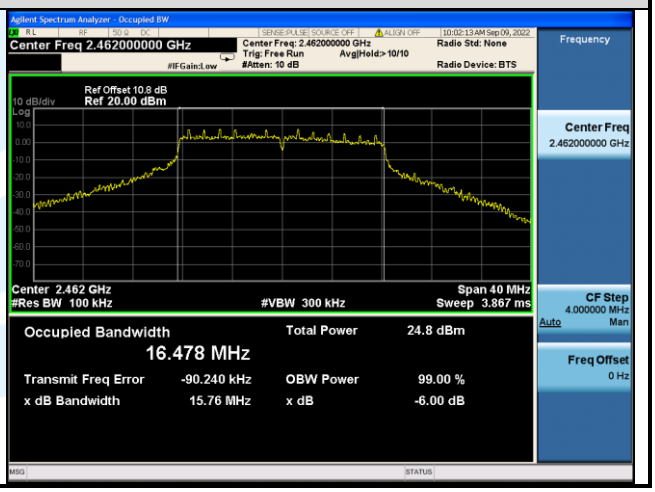


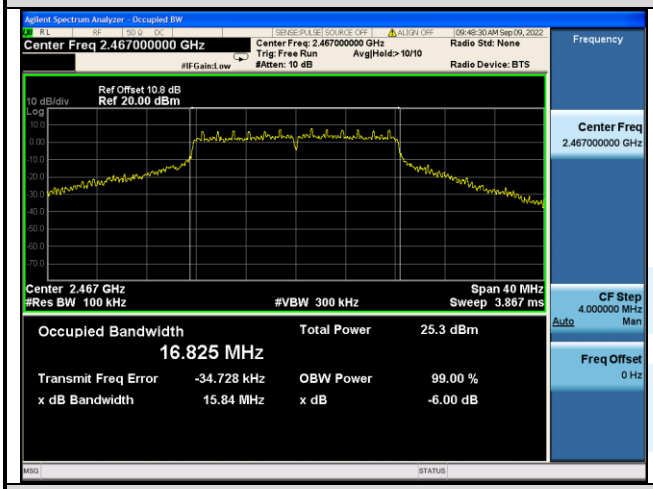

**Channel 13**

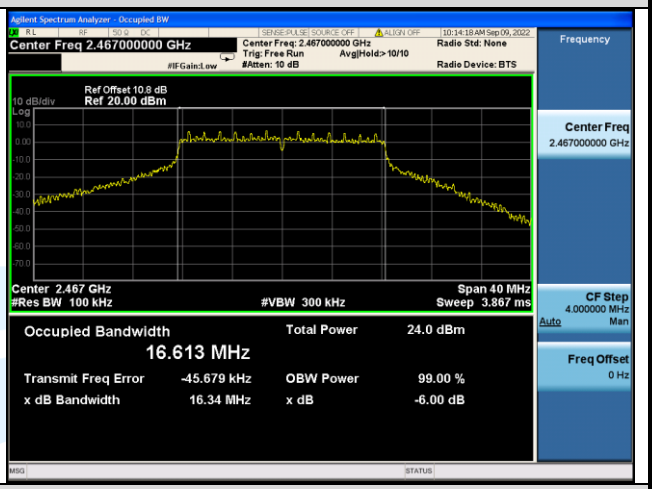


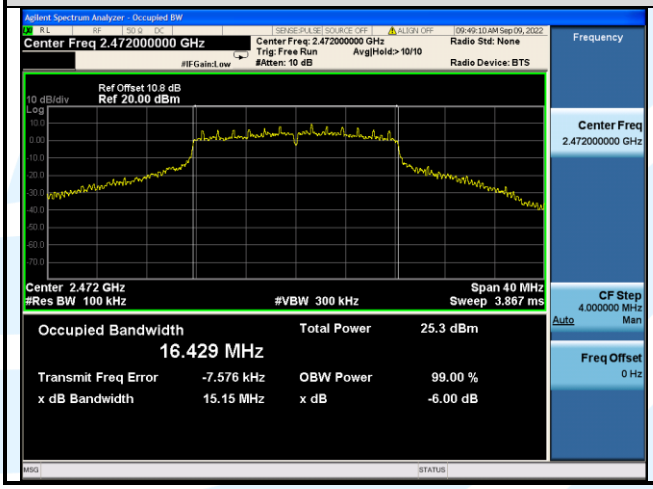
| IEEE 802.11g | |
|---|---|
| Ant. 0 | Ant. 1 |
| **Channel 1** | |
|  |  |
| **Channel 6** | |
|  |  |
| **Channel 11** | |
|  |  |

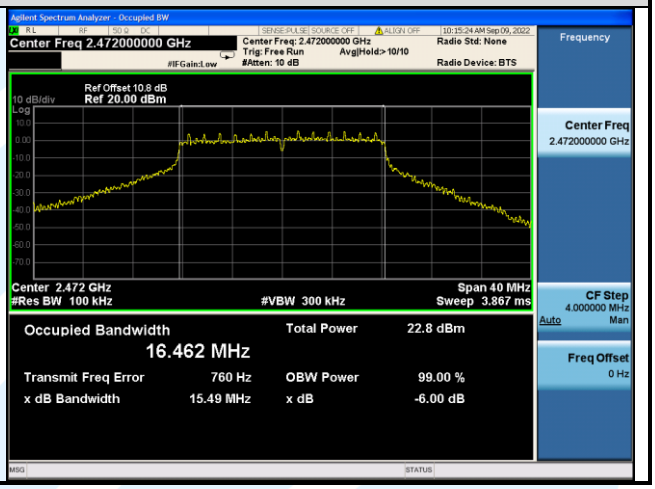
**Channel 12**

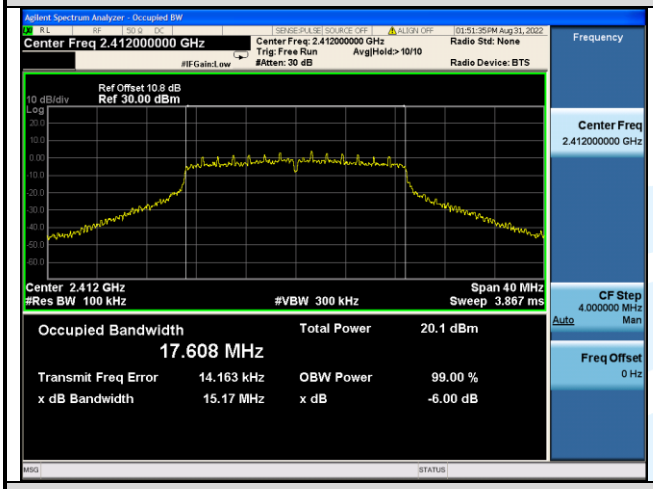
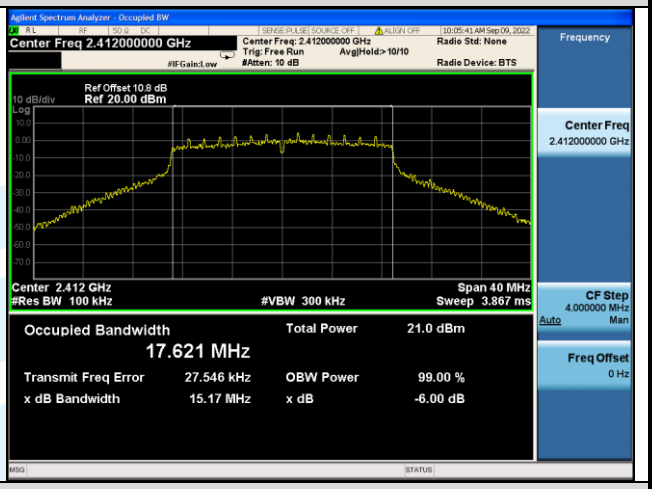
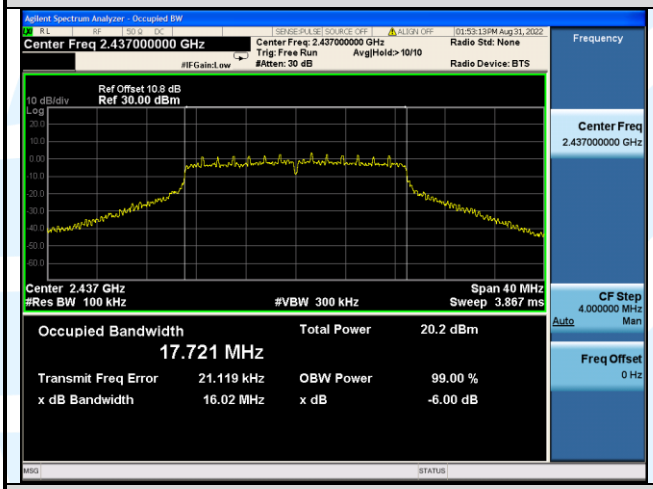
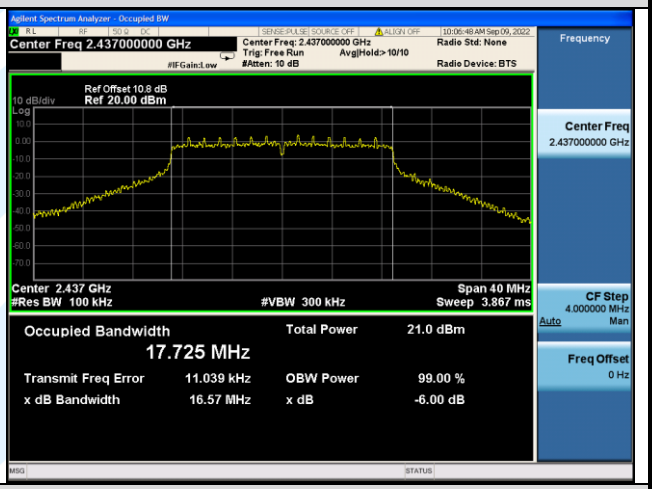
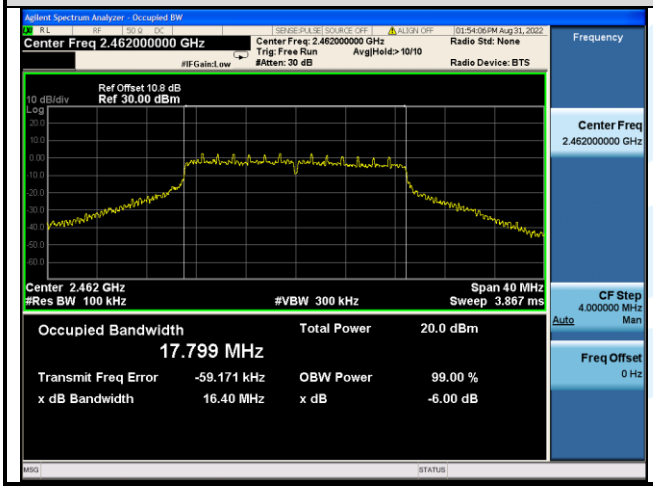
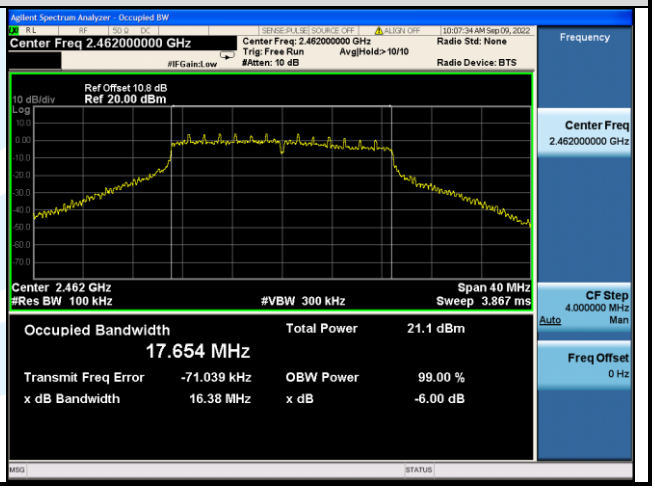


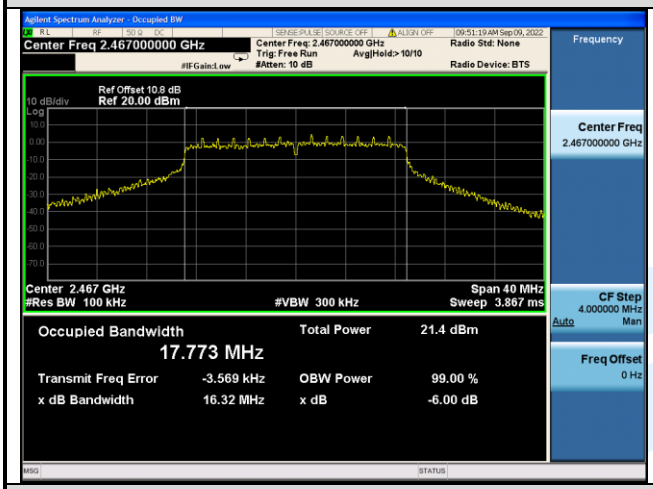

**Channel 13**

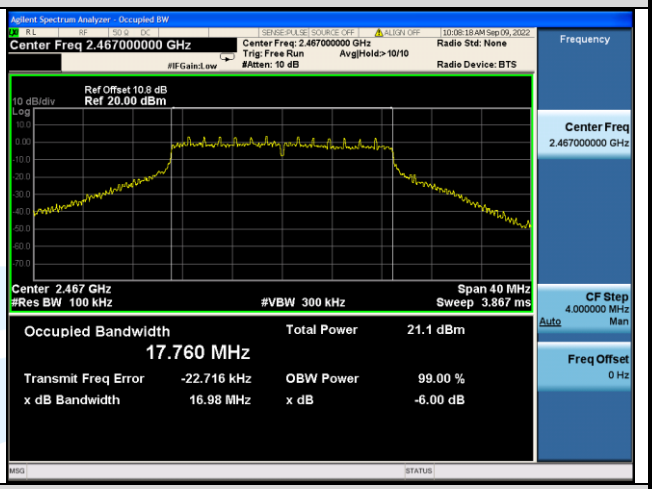


| IEEE 802.11n-HT20 | |
|---|---|
| Ant. 0 | Ant. 1 |
| **Channel 1** | |
|  |  |
| **Channel 6** | |
|  |  |
| **Channel 11** | |
|  |  |

**Channel 12**




**Channel 13**