# RF MEASUREMENT REPORT

| | |
|---|---|
| **FCC ID:** | Q9DASIN0306 |
| **Applicant:** | Hewlett Packard Enterprise |
| **Product:** | HPE Aruba User Experience Sensor |
| **Model No.:** | ASIN0306 |
| **Trademark:** | Hewlett Packard Enterprise, HPE aruba networking |
| **FCC Classification:** | Digital Transmission System (DTS) |
| **FCC Rule Part(s):** | Part 15 Subpart C (Section 15.247) |
| **Result:** | Complies |
| **Received Date:** | 2023-06-15 |
| **Test Date:** | 2023-06-19 ~ 2023-08-13 |

**Reviewed By:**

Jame Yuan

**Approved By:**

Robin Wu

ilac-MRA

ACCREDITED
TESTING LABORATORY
CERTIFICATE #3628.01

The test results relate only to the samples tested.
This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013. Test results reported herein relate only to the item(s) tested.
The test report shall not be reproduced except in full without the written approval of MRT Technology (Suzhou) Co., Ltd.

## Revision History

| Report No. | Version | Description | Issue Date | Note |
|---|---|---|---|---|
| 2306RSU027-U3 | V01 | Initial Report | 2023-09-22 | Invalid |
| 2306RSU027-U3 | V02 | Add 1-18GHz test plot of RSE | 2023-10-30 | Valid |
| | | | | |

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# 1. General Information

## 1.1. Applicant

Hewlett Packard Enterprise

6280 America Center Drive, San Jose CA 95002, United States

## 1.2. Manufacturer

Hewlett Packard Enterprise

6280 America Center Drive, San Jose CA 95002, United States

## 1.3. Testing Facility

| | | | | | |
|---|---|---|---|---|---|
| ☒ | **Test Site – MRT Suzhou Laboratory** | | | | |
| | **Laboratory Location (Suzhou - Wuzhong)**<br>D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China<br>**Laboratory Location (Suzhou - SIP)**<br>4b Building, Liando U Valley, No.200 Xingpu Rd., Shengpu Town, Suzhou Industrial Park, China | | | | |
| | **Laboratory Accreditations** | | | | |
| | A2LA: 3628.01 | | CNAS: L10551 | | |
| | FCC: CN1166 | | ISED: CN0001 | | |
| | VCCI: | ☐R-20025 | ☐G-20034 | ☐C-20020 | ☐T-20020 |
| | | ☐R-20141 | ☐G-20134 | ☐C-20103 | ☐T-20104 |
| ☐ | **Test Site – MRT Shenzhen Laboratory** | | | | |
| | **Laboratory Location (Shenzhen)**<br>1G, Building A, Junxiangda Building, Zhongshanyuan Road West, Nanshan District, Shenzhen, China | | | | |
| | **Laboratory Accreditations** | | | | |
| | A2LA: 3628.02 | | CNAS: L10551 | | |
| | FCC: CN1284 | | ISED: CN0105 | | |
| ☐ | **Test Site – MRT Taiwan Laboratory** | | | | |
| | **Laboratory Location (Taiwan)**<br>No. 38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.) | | | | |
| | **Laboratory Accreditations** | | | | |
| | TAF: 3261 | | | | |
| | FCC: 291082, TW3261 | | ISED: TW3261 | | |

### 1.4. Product Information

| | |
|---|---|
| Product Name | HPE Aruba User Experience Sensor |
| Model No. | ASIN0306 |
| Serial No. | CNQGLPM00G |
| Software Version | 6.5GA |
| Wi-Fi Specification | 802.11a/b/g/n/ac/ax |
| Bluetooth Specification | BLE only |
| ZigBee Specification | 802.15.4 |
| Power Type | AC/DC Adapter Input |
| Operating Temperature | 0 ~ 40 °C |
| Operating Environment | Indoor Use |
| Integrated Modular Information | |
| Specification | Model Number: EG21-G<br>FCC ID: XMR201906EG21G<br>GSM 850, PCS 1900<br>Supported UTRA Band: 2, 4, 5<br>Supported E-UTRA Band:<br>FDD Band: 2, 4, 5, 7, 12, 13, 25, 26 TDD Band: 38, 41<br>GNSS: GPS, BDS, GLONASS, Galileo |
| Accessories | |
| AC/DC Adapter | Model No.: WB-12G12R<br>Input: 100-240V, 50/60Hz, 0.3A Max<br>Output: 12.0V⎓1.0A 12.0W |
| Note: The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer. | |

### 1.5. Radio Specification under Test

| | | |
|---|---|---|
| Frequency Range | 802.11b/g/n-HT20/ax-HE20: 2412 ~ 2462MHz<br>802.11n-HT40/ax-HE40: 2422 ~ 2452MHz | |
| Channel Number | 802.11b/g/n-HT20/ax-HE20: 11<br>802.11n-HT40/ax-HE40: 7 | |
| Type of Modulation | 802.11b: DSSS<br>802.11g/n: OFDM<br>802.11ax: OFDMA | |
| Data Rate | 802.11b: 1/2/5.5/11Mbps<br>802.11g: 6/9/12/18/24/36/48/54Mbps<br>802.11n: up to 300Mbps<br>802.11ax: up to 573.6Mbps | |
| Channel Puncturing Function | ☐ Supported | ☒ Unsupported |
| Support RU | ☒ Full RU | ☐ Partial RU |

### 1.6. Working Frequencies

802.11b/g/n-HT20/ax-HE20

| Channel | Frequency | Channel | Frequency | Channel | Frequency |
|---|---|---|---|---|---|
| 01 | 2412 MHz | 02 | 2417 MHz | 03 | 2422 MHz |
| 04 | 2427 MHz | 05 | 2432 MHz | 06 | 2437 MHz |
| 07 | 2442 MHz | 08 | 2447 MHz | 09 | 2452 MHz |
| 10 | 2457 MHz | 11 | 2462 MHz | -- | -- |

802.11n-HT40/ax-HE40

| Channel | Frequency | Channel | Frequency | Channel | Frequency |
|---|---|---|---|---|---|
| 03 | 2422 MHz | 04 | 2427 MHz | 05 | 2432 MHz |
| 06 | 2437 MHz | 07 | 2442 MHz | 08 | 2447 MHz |
| 09 | 2452 MHz | -- | -- | -- | -- |

### 1.7. Antenna Details

| Antenna Type | Frequency Band (MHz) | $T_X$ Paths | Directional Gain (dBi) | | Beamforming Gain (dBi) |
|---|---|---|---|---|---|
| | | | Uncorrelated | Correlated | |
| Wi-Fi Antennas (Radio 0) | | | | | |
| PIFA Antenna | 2400 ~ 2483.5 | 2 | 2.1 | 5.0 | 5.0 |
| | 5150 ~ 5250 | 2 | 3.5 | 6.5 | 6.5 |
| | 5250 ~ 5350 | 2 | 3.5 | 6.5 | 6.5 |
| | 5470 ~ 5725 | 2 | 3.5 | 6.3 | 6.3 |
| | 5725 ~ 5850 | 2 | 3.5 | 6.0 | 6.0 |
| | 5850 ~ 5895 | 2 | 3.6 | 6.2 | 6.2 |
| Wi-Fi Antennas (Radio 1) | | | | | |
| PIFA Antenna | 2400 ~ 2483.5 | 2 | 2.0 | 4.8 | 4.8 |
| | 5925 ~ 6425 | 2 | 2.7 | 5.5 | 5.5 |
| | 6425 ~ 6525 | 2 | 3.1 | 6.0 | 6.0 |
| | 6525 ~ 6875 | 2 | 3.1 | 6.0 | 6.0 |
| | 6875 ~ 7125 | 2 | 3.2 | 6.1 | 6.1 |
| Bluetooth / ZigBee Antenna | | | | | |
| PIFA Antenna | 2400 ~ 2483.5 | 1 | 2.3 | -- | -- |

Note:

1, The EUT supports Cyclic Delay Diversity (CDD) mode, and CDD signals are correlated.

2, The EUT also supports Beam Forming mode, and the Beam Forming support 802.11n/ac/ax, not include 802.11a/b/g.

3, The antenna gain is from antenna report that was provided by the applicant.

# 2. Test Configuration

## 2.1. Test Mode

| |
|---|
| Mode 1: Transmit by 802.11b (1Mbps) (MIMO Mode) |
| Mode 2: Transmit by 802.11g (6Mbps) (MIMO Mode) |
| Mode 3: Transmit by 802.11n-HT20 (MCS0) _$N_{SS}$=1 (MIMO Mode) |
| Mode 4: Transmit by 802.11n-HT40 (MCS0) _$N_{SS}$=1 (MIMO Mode) |
| Mode 5: Transmit by 802.11ax-HE20 (MCS0) _$N_{SS}$=1 (MIMO Mode) |
| Mode 6: Transmit by 802.11ax-HE40 (MCS0) _$N_{SS}$=1 (MIMO Mode) |
| Note 1: All modes of operation and data rates were investigated, so all RF test requirements shall be executed at the worst data rate.<br>Note 2: For beamforming operation, manufacturer automatically backs power down based on a 10log($N_{ANT}$) factor based on CDD power. Therefore, only the CDD mode was evaluated in this report |

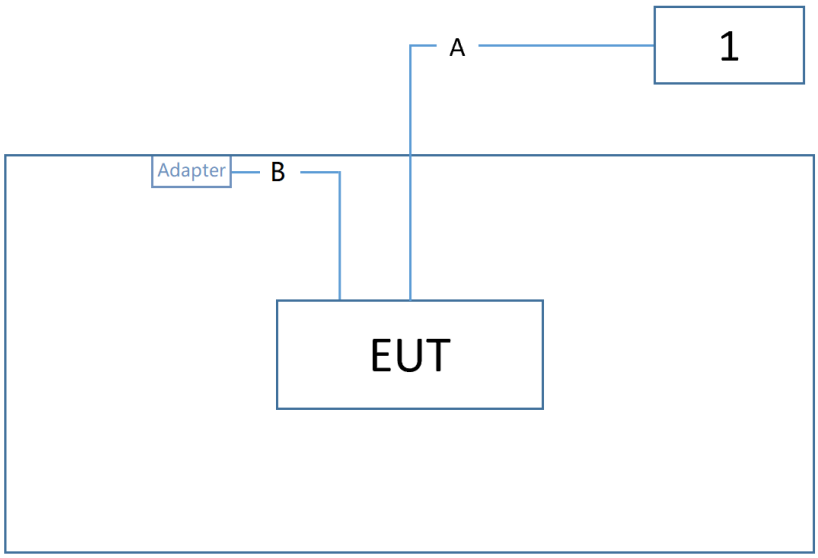
Radio Working Mode

| Work Groups | Wi-Fi Radio 0 | Wi-Fi Radio 1 | IOT |
|---|---|---|---|
| 1 | 2.4G | 6G | BLE or ZigBee |
| 2 | 5G | 2.4G | BLE or ZigBee |
| 3 | 5G | 6G | BLE or ZigBee |

### 2.2. Test System Connection Diagram

The device was tested per the guidance ANSI C63.10: 2013 was used to reference the appropriate EUT setup for radiated emissions testing and AC line conducted testing.

Connection Diagram – Radiated Emission testing & AC Conducted Emissions




| Cable Type | | Cable Description | |
|---|---|---|---|
| A | Ethernet Cable | Non shielded, > 10m | |
| B | Power Cable | Non shielded, 1.6m | |
| **Product** | | **Manufacturer** | **Model No.** |
| 1 | Notebook | Dell | Latitude 5491 |

### 2.3. Test Software

The test utility software used during testing was “accessMTool”, and the version was 3.2.1.5.

### 2.4. Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15.247
- KDB 558074 D01v05r02
- ANSI C63.10-2013

### 2.5. Test Environment Condition

| | |
|---|---|
| Ambient Temperature | 15 ~ 35°C |
| Relative Humidity | 20 ~ 75%RH |

## 3. Antenna Requirements

**Excerpt from §15.203 of the FCC Rules/Regulations:**

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 shall be considered sufficient to comply with the provisions of this section."

- The antenna of the device is **permanently attached.**
- There are no provisions for connection to an external antenna.

**Conclusion:**

The unit complies with the requirement of §15.203.

## 4. Measuring Instrument

| Instrument | Manufacturer | Model No. | Asset No. | Cali. Interval | Cali. Due Date | Test Site |
|---|---|---|---|---|---|---|
| EMI Test Receiver | R&S | ESR7 | MRTSUE06001 | 1 year | 2023-12-28 | WZ-AC1 |
| Horn Antenna | Schwarzbeck | BBHA 9120D | MRTSUE06023 | 1 year | 2023-08-22 | WZ-AC1 |
| Preamplifier | Agilent | 83017A | MRTSUE06076 | 1 year | 2024-05-07 | WZ-AC1 |
| TRILOG Antenna | Schwarzbeck | VULB 9168 | MRTSUE06172 | 1 year | 2024-06-09 | WZ-AC1 |
| Anechoic Chamber | TDK | WZ-AC1 | MRTSUE06212 | 1 year | 2024-04-20 | WZ-AC1 |
| Thermohygrometer | testo | 608-H1 | MRTSUE06403 | 1 year | 2024-05-31 | WZ-AC1 |
| Signal Analyzer | Keysight | N9010B | MRTSUE06607 | 1 year | 2023-12-28 | WZ-AC1 |
| Thermohygrometer | testo | 608-H1 | MRTSUE11039 | 1 year | 2023-11-01 | WZ-AC1 |
| Loop Antenna | Schwarzbeck | FMZB 1519 | MRTSUE06025 | 1 year | 2023-09-29 | WZ-AC1 |
| Horn Antenna | Schwarzbeck | BBHA 9170 | MRTSUE06597 | 1 year | 2023-11-05 | WZ-AC2 |
| Preamplifier | EMCI | EMC184045SE | MRTSUE06640 | 1 year | 2024-01-12 | WZ-AC2 |
| TRILOG Antenna | Schwarzbeck | VULB 9162 | MRTSUE06022 | 1 year | 2024-05-15 | WZ-AC2 |
| EMI Test Receiver | Agilent | N9038A | MRTSUE06125 | 1 year | 2024-05-23 | WZ-AC2 |
| Thermohygrometer | Mingle | ETH529 | MRTSUE06170 | 1 year | 2023-11-27 | WZ-AC2 |
| Horn Antenna | Schwarzbeck | BBHA 9120D | MRTSUE06171 | 1 year | 2023-10-13 | WZ-AC2 |
| Preamplifier | Schwarzbeck | BBV 9718 | MRTSUE06176 | 1 year | 2024-05-07 | WZ-AC2 |
| Anechoic Chamber | RIKEN | WZ-AC2 | MRTSUE06213 | 1 year | 2024-04-20 | WZ-AC2 |
| Thermohygrometer | testo | 608-H1 | MRTSUE11038 | 1 year | 2023-11-01 | WZ-AC2 |
| Two-Line V-Network | R&S | ENV216 | MRTSUE06002 | 1 year | 2024-05-23 | WZ-SR2 |
| Shielding Room | MIX-BEP | WZ-SR2 | MRTSUE06215 | 5 years | 2026-12-20 | WZ-SR2 |
| Thermohygrometer | testo | 608-H1 | MRTSUE06404 | 1 year | 2024-05-31 | WZ-SR2 |
| Four-Line V-Network | R&S | ENV432 | MRTSUE06615 | 1 year | 2023-10-08 | WZ-SR2 |
| EMI Test Receiver | R&S | ESR3 | MRTSUE06909 | 1 year | 2023-10-27 | WZ-SR2 |
| Thermohygrometer | testo | 608-H1 | MRTSUE06402 | 1 year | 2024-05-31 | WZ-SR5 |
| Shielding Room | HUAMING | WZ-SR5 | MRTSUE06442 | N/A | N/A | WZ-SR5 |
| Signal Analyzer | Keysight | N9010B | MRTSUE06457 | 1 year | 2024-05-23 | WZ-SR5 |
| USB Power Sensor | Keysight | U2021XA | MRTSUE06446 | 1 year | 2024-05-23 | WZ-SR5 |

| Software | Version | Function |
|---|---|---|
| EMI Software | V3.0.0 | EMI Test Software |
| Controller_MF 7802 | 2.03C | RE Antenna & Turntable |
| Controller_MF 7802 | 1.02 | RE Antenna & Turntable |
| BenchVue Power Meter | 2018.1 | Power |

# 5. Decision Rules and Measurement Uncertainty

## 5.1. Decision Rules

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4: 2012 Clause 8.2.

(Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

## 5.2. Measurement Uncertainty

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT 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.

| AC Conducted Emission Measurement |
|---|
| Measurement Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>9kHz~150kHz: 3.58dB<br>150kHz~30MHz: 3.20dB |
| Radiated Disturbance |
| Measurement Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>Coaxial: 9kHz~30MHz: 2.59dB<br>Coplanar: 9kHz~30MHz: 2.60dB<br>Horizontal: 30MHz~200MHz: 3.85dB<br>200MHz~1GHz: 4.36dB<br>1GHz~40GHz: 4.98dB<br>Vertical: 30MHz~200MHz: 4.06dB<br>200MHz~1GHz: 5.28dB<br>1GHz~40GHz: 4.91dB |
| Spurious Emissions, Conducted |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>2.3dB |
| Output Power |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>1.5dB |
| Power Spectrum Density |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>2.3dB |
| Occupied Bandwidth |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>3.2% |

# 6. Test Result

## 6.1. Summary

| FCC Section(s) | Test Description | Test Condition | Verdict |
|---|---|---|---|
| 15.247(a)(2) | 6dB Bandwidth | Conducted | Pass |
| 15.247(b)(3) | Output Power | | Pass |
| 15.247(e) | Power Spectral Density | | Pass |
| 15.247(d) | Band Edge / Out-of-Band Emissions | | Pass |
| 15.205<br>15.209 | General Field Strength<br>(Restricted Bands and Radiated Emission) | Radiated | Pass |
| 15.207 | AC Conducted Emissions<br>150kHz - 30MHz | Line Conducted | Pass |

**Notes:**

1. The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
2. For radiated emission tests, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst-case emissions.

## 6.2. 6dB Bandwidth Measurement

### 6.2.1. Test Limit

The minimum 6dB bandwidth shall be at least 500 kHz.

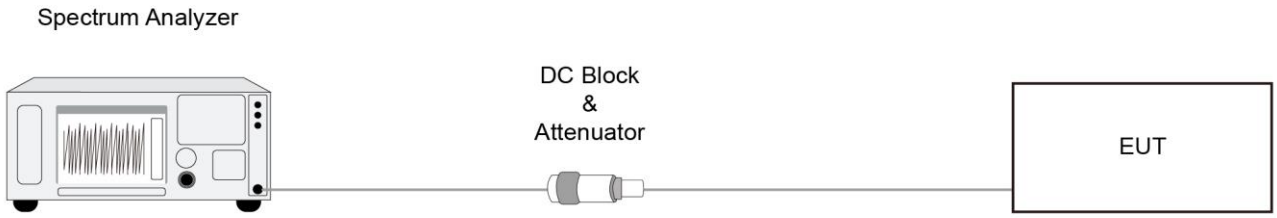
### 6.2.2. Test Procedure

ANSI C63.10 - 2013 - Section 11.8

### 6.2.3. Test Setting

1. The Spectrum's automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. Set RBW = 100 kHz
3. VBW ≥ 3 × RBW
4. Detector = Peak
5. Trace mode = Max hold
6. Sweep = Auto couple
7. Allow the trace to stabilize

### 6.2.4. Test Setup




### 6.2.5. Test Result

Refer to Appendix A.2.

## 6.3. Output Power Measurement

### 6.3.1. Test Limit

The maximum output power shall be less 1 Watt (30dBm).

The conducted output power limit specified in paragraph FCC Part 15.247(b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. 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 FCC Part 15.247(b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### 6.3.2. Test Procedure

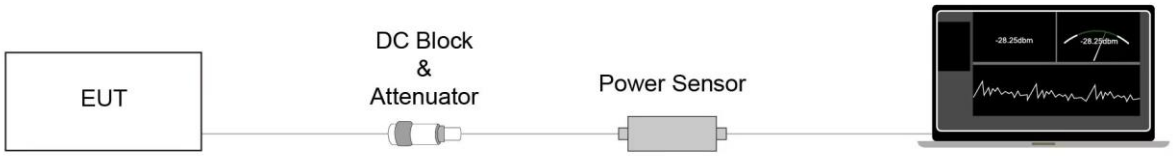
ANSI C63.10 - 2013 - Section 11.9.2.3.2

### 6.3.3. Test Setting

**Average Power Measurement**

Average power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter.

### 6.3.4. Test Setup




### 6.3.5. Test Result

Refer to Appendix A.3.

## 6.4. Power Spectral Density Measurement

### 6.4.1. Test Limit

The maximum permissible power spectral density is 8dBm in any 3 kHz band.

The same method of determining the conducted output power shall be used to determine the power spectral density.

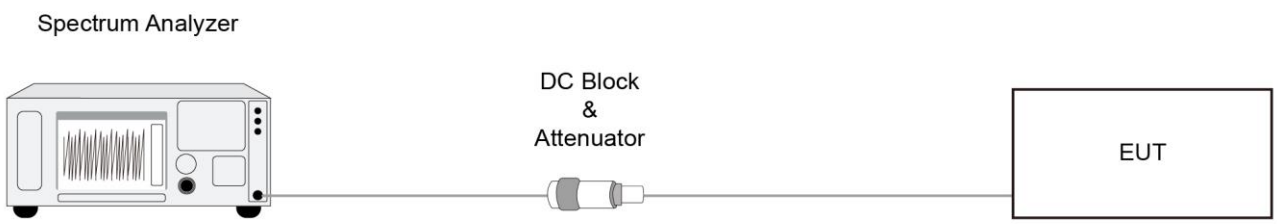
### 6.4.2. Test Procedure

ANSI C63.10 - 2013 - Section 11.10.3

### 6.4.3. Test Setting

1. Measure the duty cycle (x) of the transmitter output signal.
2. Set instrument center frequency to DTS channel center frequency.
3. Set span to at least 1.5 times the OBW.
4. RBW = 10 kHz.
5. VBW = 30 kHz.
6. Detector = RMS.
7. Ensure that the number of measurement points in the sweep ≥ 2 x span/RBW.
8. Sweep time = auto couple.
9. Don't use sweep triggering. Allow sweep to "free run".
10. Employ trace averaging (RMS) mode over a minimum of 100 traces.
11. Use the peak marker function to determine the maximum amplitude level.

### 6.4.4. Test Setup




### 6.4.5. Test Result

Refer to Appendix A.4.

## 6.5. Conducted Band Edge and Out-of-Band Emissions Measurement

### 6.5.1. Test Limit

The limit for out-of-band spurious emissions at the band edge is 30dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100 kHz bandwidth per the PSD procedure.

### 6.5.2. Test Procedure

ANSI C63.10-2013 - Section 11.11

### 6.5.3. Test Settitng

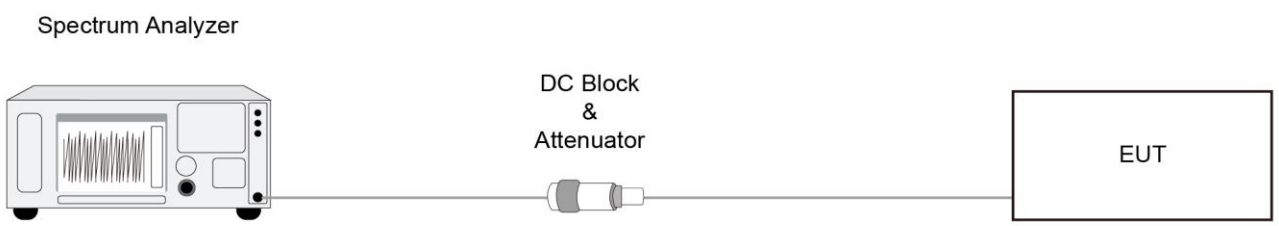
**Reference level measurement**

1. Set instrument center frequency to DTS channel center frequency
2. Set the span to ≥ 1.5 times the DTS bandwidth
3. Set the RBW = 100 kHz
4. Set the VBW ≥ 3 x RBW
5. Detector = peak
6. Sweep time = auto couple
7. Trace mode = max hold
8. Allow trace to fully stabilize

**Emission level measurement**

1. Set the center frequency and span to encompass frequency range to be measured
2. RBW = 100kHz
3. VBW = 300kHz
4. Detector = Peak
5. Trace mode = max hold
6. Sweep time = auto couple
7. The trace was allowed to stabilize

### 6.5.4. Test Setup



### 6.5.5. Test Result

Refer to Appendix A.5.

## 6.6. Radiated Spurious Emission Measurement

### 6.6.1. Test Limit

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Table per Section 15.209.

| FCC Part 15 Subpart C Paragraph 15.209 | | |
|---|---|---|
| Frequency [MHz] | Field Strength [μV/m] | Measured Distance [Meters] |
| 0.009 - 0.490 | 2400/F (kHz) | 300 |
| 0.490 - 1.705 | 24000/F (kHz) | 30 |
| 1.705 - 30 | 30 | 30 |
| 30 - 88 | 100 | 3 |
| 88 - 216 | 150 | 3 |
| 216 - 960 | 200 | 3 |
| Above 960 | 500 | 3 |

### 6.6.2. Test Procedure

ANSI C63.10 - 2013 - Section 11.11 & 11.12

ANSI C63.10 - 2013 - Section 6.3 (General Requirements)

ANSI C63.10 - 2013 - Section 6.4 (Standard test method below 30MHz)

ANSI C63.10 - 2013 - Section 6.5 (Standard test method above 30MHz to 1GHz)

ANSI C63.10 - 2013 - Section 6.6 (Standard test method above 1GHz)

### 6.6.3. Test Setting

**Table 1 - RBW as a function of frequency**

| Frequency | RBW |
|---|---|
| 9 ~ 150 kHz | 200 ~ 300 Hz |
| 0.15 ~ 30 MHz | 9 ~ 10 kHz |
| 30 ~ 1000 MHz | 100 ~ 120 kHz |
| > 1000MHz | 1MHz |

**Quasi-Peak Measurements below 1GHz**

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest

2. Span was set greater than 1MHz

3. RBW = as specified in Table 1

4. Detector = CISPR quasi-peak

5. Sweep time = auto couple

6. Trace was allowed to stabilize

**Peak Measurements above 1GHz**

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest

2. RBW = 1MHz

3. VBW = 3MHz

4. Detector = peak

5. Sweep time = auto couple

6. Trace mode = max hold

7. Trace was allowed to stabilize

**Average Measurements above 1GHz (Method VB)**

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest

2. RBW = 1MHz

3. VBW; If the EUT is configured to transmit with duty cycle ≥ 98%, set VBW = 10 Hz.

If the EUT duty cycle is < 98%, set VBW ≥ 1/T. T is the minimum transmission duration.

| | | | | | |
|---|---|---|---|---|---|
| 802.11b | 10Hz | 802.11g | 10Hz | 802.11n-HT20 | 10Hz |
| 802.11n-HT40 | 10Hz | 802.11ax-HE20 | 10Hz | 802.11ax-HE40 | 10Hz |

4. Detector = Peak

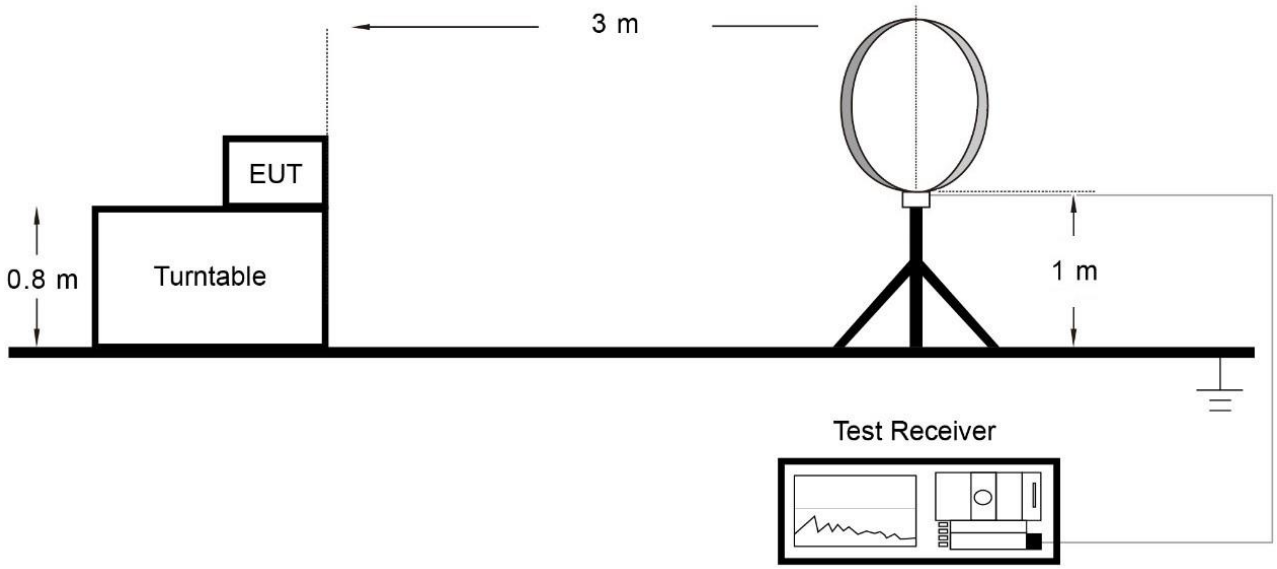
5. Sweep time = auto

6. Trace mode = max hold

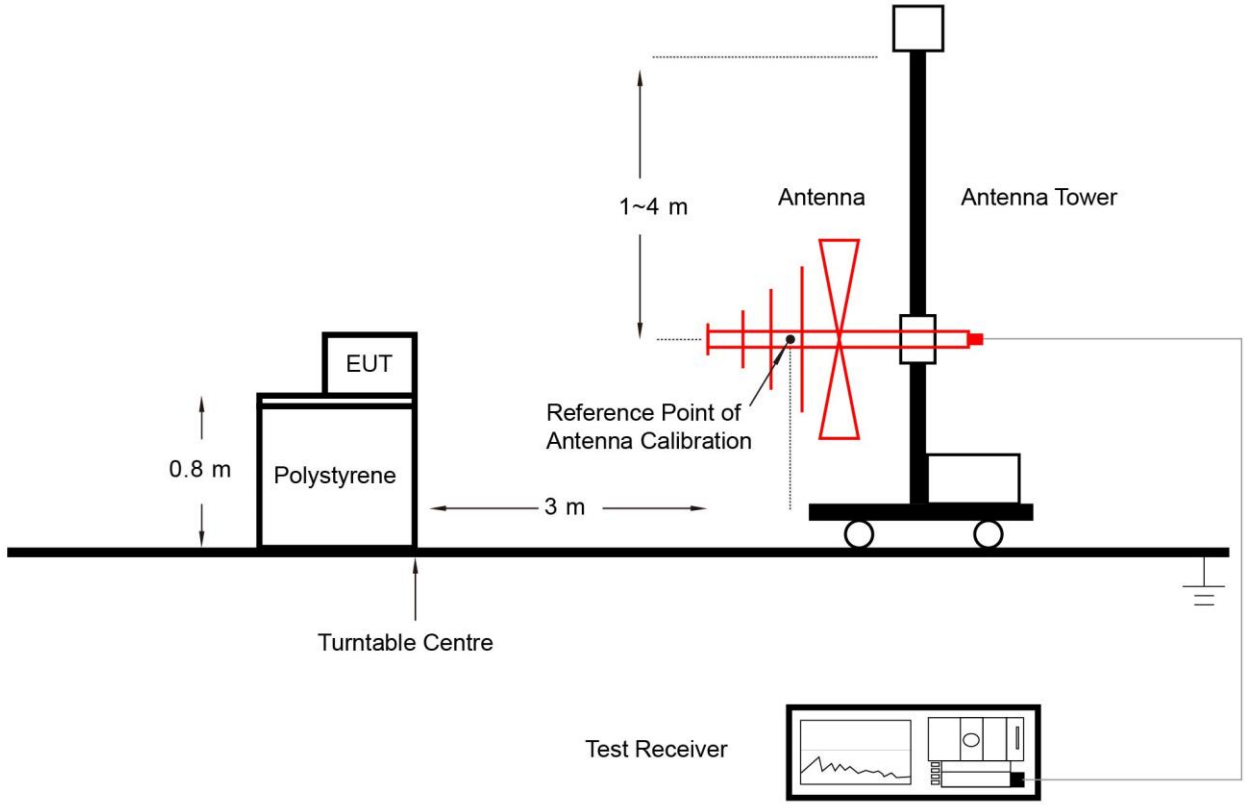
7. Trace was allowed to stabilize

### 6.6.4. Test Setup

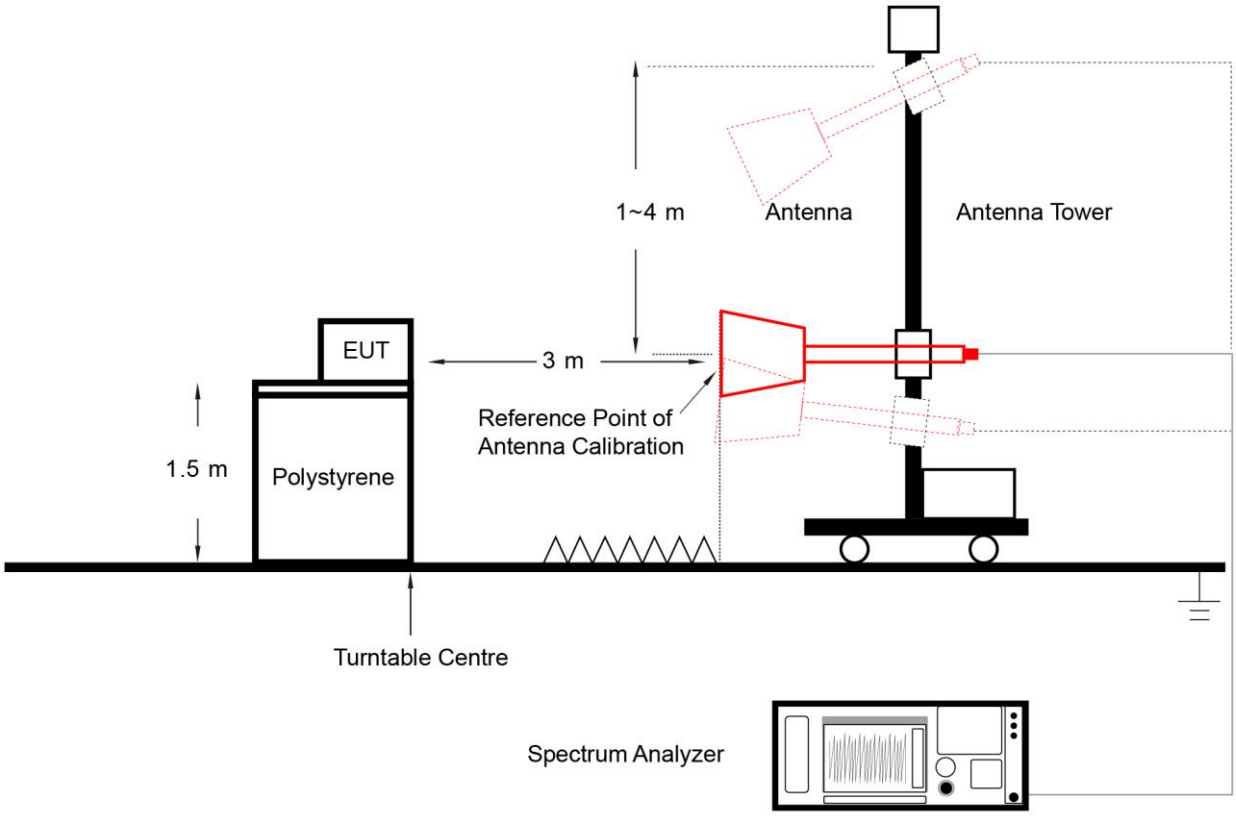
Below 30MHz Test Setup:




Below 1GHz Test Setup:



Above 1GHz Test Setup:




### 6.6.5. Test Result

Refer to Appendix A.6.

## 6.7. Radiated Restricted Band Edge Measurement

### 6.7.1. Test Limit

**For 15.205 requirement:**

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a) of FCC part 15, must also comply with the radiated emission limits specified in Section 15.209(a).

| Frequency (MHz) | Frequency (MHz) | Frequency (MHz) | Frequency (GHz) |
|---|---|---|---|
| 0.090 - 0.110 | 16.42 - 16.423 | 399.9 - 410 | 4.5 - 5.15 |
| [1] 0.495 - 0.505 | 16.69475 - 16.69525 | 608 - 614 | 5.35 - 5.46 |
| 2.1735 - 2.1905 | 16.80425 - 16.80475 | 960 - 1240 | 7.25 - 7.75 |
| 4.125 - 4.128 | 25.5 - 25.67 | 1300 - 1427 | 8.025 - 8.5 |
| 4.17725 - 4.17775 | 37.5 - 38.25 | 1435 - 1626.5 | 9.0 - 9.2 |
| 4.20725 - 4.20775 | 73 - 74.6 | 1645.5 - 1646.5 | 9.3 - 9.5 |
| 6.215 - 6.218 | 74.8 - 75.2 | 1660 - 1710 | 10.6 - 12.7 |
| 6.26775 - 6.26825 | 108 - 121.94 | 1718.8 - 1722.2 | 13.25 - 13.4 |
| 6.31175 - 6.31225 | 123 - 138 | 2200 - 2300 | 14.47 - 14.5 |
| 8.291 - 8.294 | 149.9 - 150.05 | 2310 - 2390 | 15.35 - 16.2 |
| 8.362 - 8.366 | 156.52475 - 156.52525 | 2483.5 - 2500 | 17.7 - 21.4 |
| 8.37625 - 8.38675 | 156.7 - 156.9 | 2690 - 2900 | 22.01 - 23.12 |
| 8.41425 - 8.41475 | 162.0125 - 167.17 | 3260 - 3267 | 23.6 - 24.0 |
| 12.29 - 12.293 | 167.72 - 173.2 | 3332 - 3339 | 31.2 - 31.8 |
| 12.51975 - 12.52025 | 240 - 285 | 3345.8 - 3358 | 36.43 - 36.5 |
| 12.57675 - 12.57725 | 322 - 335.4 | 3600 - 4400 | ([2]) |
| 13.36 - 13.41 | -- | -- | -- |

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47CFR must not exceed the limits shown in Table per Section 15.209.

| FCC Part 15 Subpart C Paragraph 15.209 | | |
|---|---|---|
| Frequency [MHz] | Field Strength [μV/m] | Measured Distance [Meters] |
| 0.009 - 0.490 | 2400/F (kHz) | 300 |
| 0.490 - 1.705 | 24000/F (kHz) | 30 |
| 1.705 - 30 | 30 | 30 |
| 30 - 88 | 100 | 3 |
| 88 - 216 | 150 | 3 |
| 216 - 960 | 200 | 3 |
| Above 960 | 500 | 3 |

### 6.7.2. Test Procedure

ANSI C63.10-2013 Section 6.3 & 6.6 & 11.13

### 6.7.3. Test Setting

**Peak Field Strength Measurements**

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

**Average Field Strength Measurements**

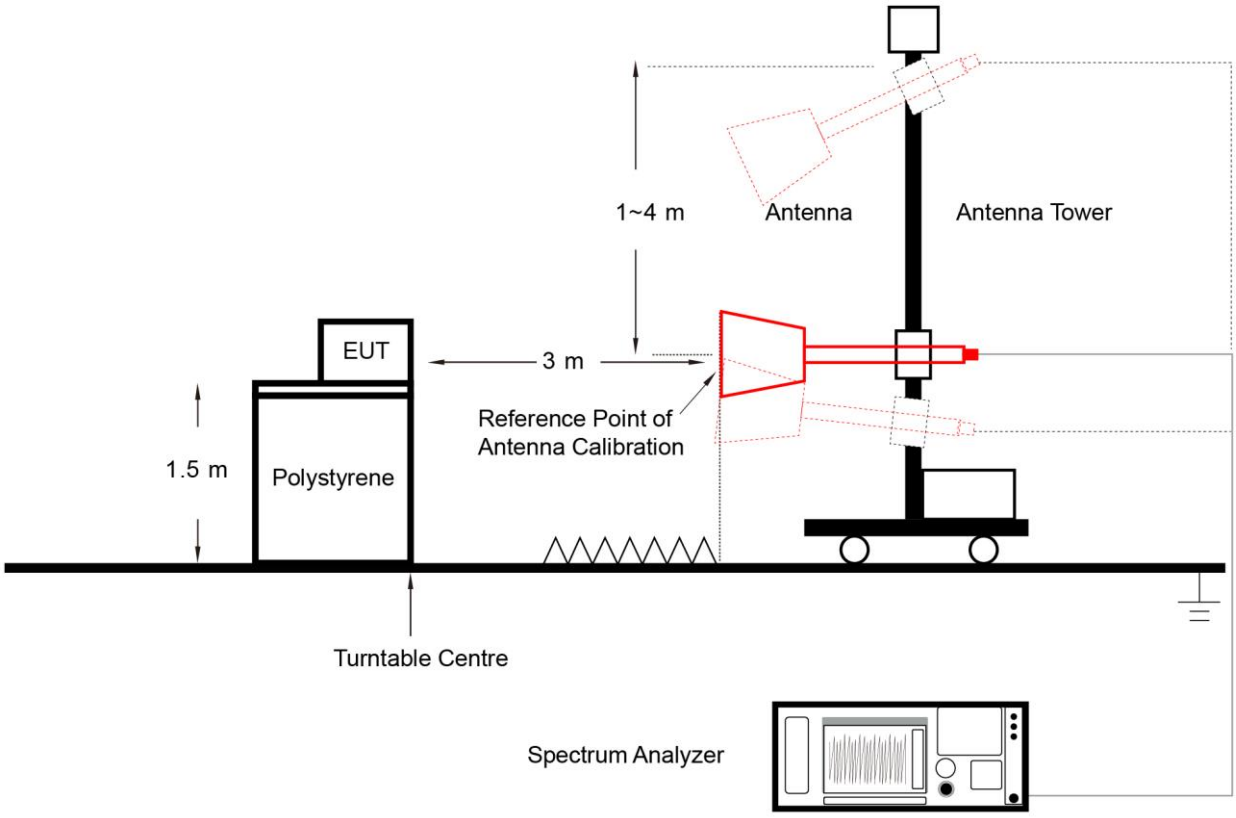
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW; If the EUT is configured to transmit with duty cycle ≥ 98%, set VBW = 10 Hz.

If the EUT duty cycle is < 98%, set VBW ≥ 1/T. T is the minimum transmission duration.

| | | | | | |
|---|---|---|---|---|---|
| 802.11b | 10Hz | 802.11g | 10Hz | 802.11n-HT20 | 10Hz |
| 802.11n-HT40 | 10Hz | 802.11ax-HE20 | 10Hz | 802.11ax-HE40 | 10Hz |

4. Average Type = Voltage
5. Detector = Peak
6. Sweep time = auto
7. Trace mode = max hold
8. Allow max hold to run for at least 50 times (1/duty cycle) traces

### 6.7.4. Test Setup




### 6.7.5. Test Result

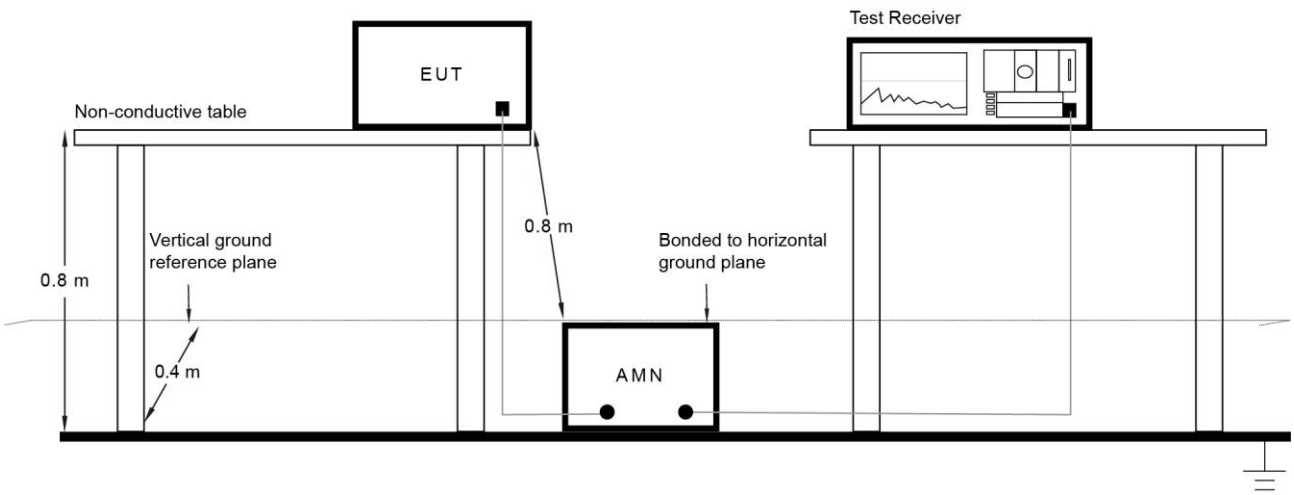
Refer to Appendix A.7.

## 6.8. AC Conducted Emissions Measurement

### 6.8.1. Test Limit

| FCC Part 15 Subpart C Paragraph 15.207 Limits | | |
|---|---|---|
| Frequency (MHz) | QP (dBμV) | AV (dBμV) |
| 0.15 - 0.50 | 66 - 56 | 56 - 46 |
| 0.50 - 5.0 | 56 | 46 |
| 5.0 - 30 | 60 | 50 |
| Note 1: The lower limit shall apply at the transition frequencies.<br>Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz. | | |

### 6.8.2. Test Setup




### 6.8.3. Test Result

Refer to Appendix A.8.

# Appendix A - Test Result

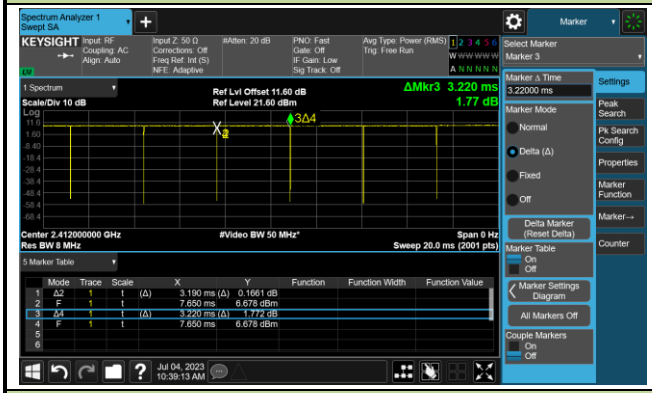
## A.1 Duty Cycle Test Result

| | | | |
|---|---|---|---|
| Test Site | WZ-SR5 | Test Engineer | Lynn Yang |
| Test Date | 2023-07-04 | Radio | 0 |

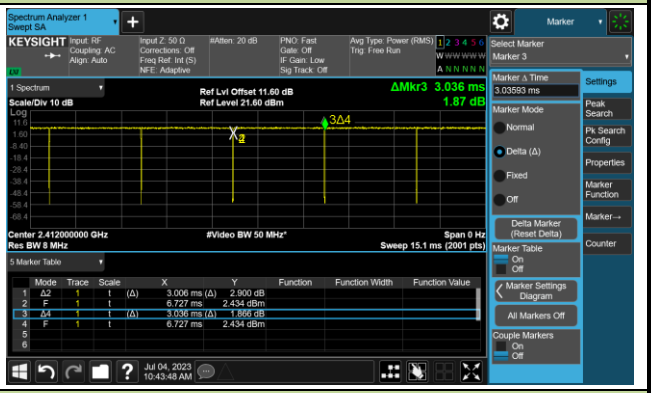
| Test Mode | Duty Cycle |
|---|---|
| 802.11b | 99.07% |
| 802.11g | 99.01% |
| 802.11n-HT20 | 99.01% |
| 802.11n-HT40 | 98.74% |
| 802.11ax-HE20 | 99.03% |
| 802.11ax-HE40 | 99.03% |

Duty Cycle (T = Transmission Duration)

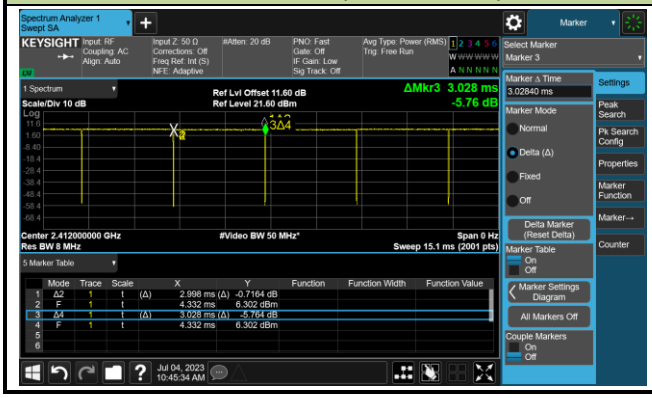
802.11b (T = 3.190ms)



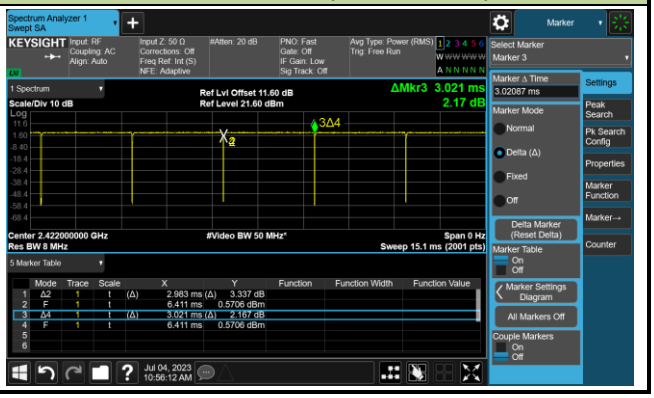

802.11g (T = 3.006ms)

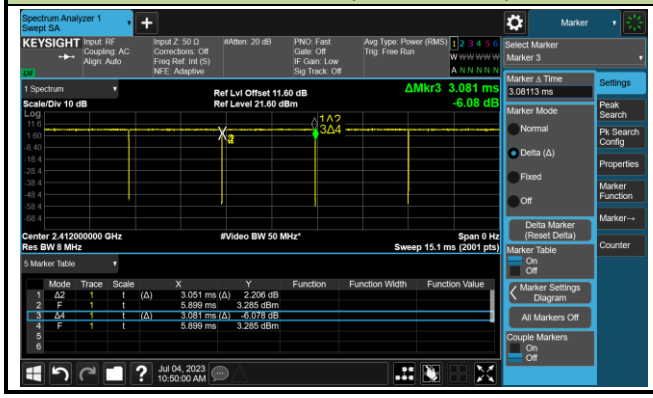
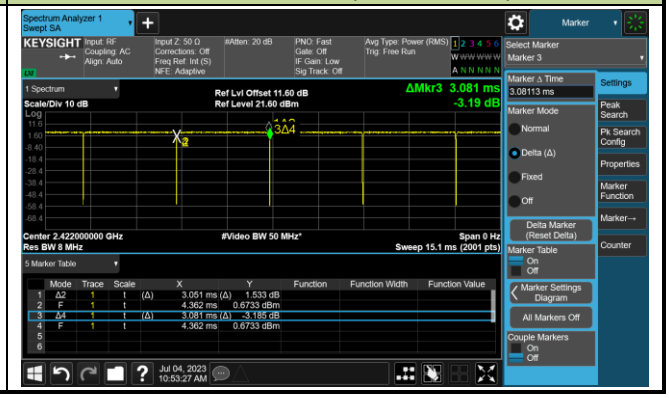



802.11n-HT20 (T = 2.998ms)




802.11n-HT40 (T = 2.983ms)



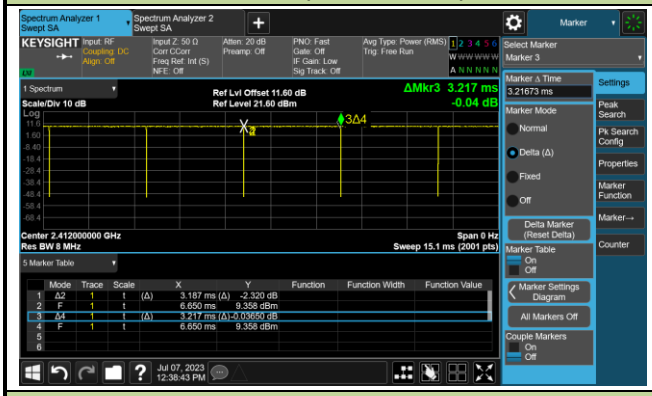
| Duty Cycle (T = Transmission Duration) | |
|---|---|
| 802.11ax-HE20 (T = 3.051ms) | 802.11ax-HE40 (T = 3.051ms) |
|  |  |

| | | | |
|---|---|---|---|
| Test Site | WZ-SR5 | Test Engineer | Lynn Yang |
| Test Date | 2023-07-07 | Radio | 1 |

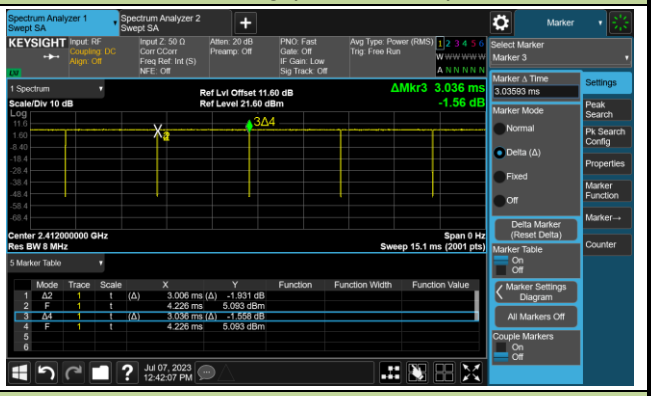
| Test Mode | Duty Cycle |
|---|---|
| 802.11b | 99.07% |
| 802.11g | 99.01% |
| 802.11n-HT20 | 98.75% |
| 802.11n-HT40 | 98.74% |
| 802.11ax-HE20 | 98.77% |
| 802.11ax-HE40 | 98.77% |

Duty Cycle (T = Transmission Duration)

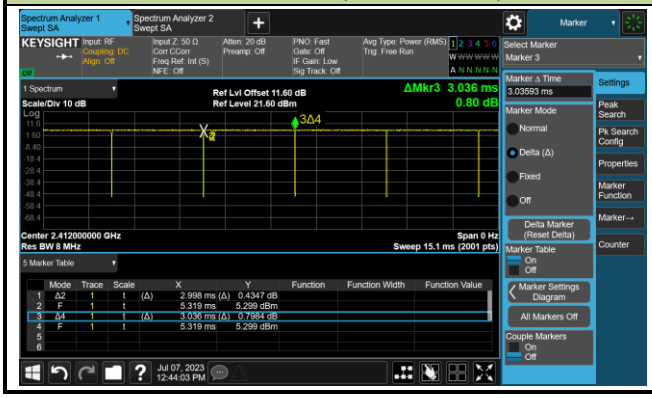
802.11b (T = 3.187ms)



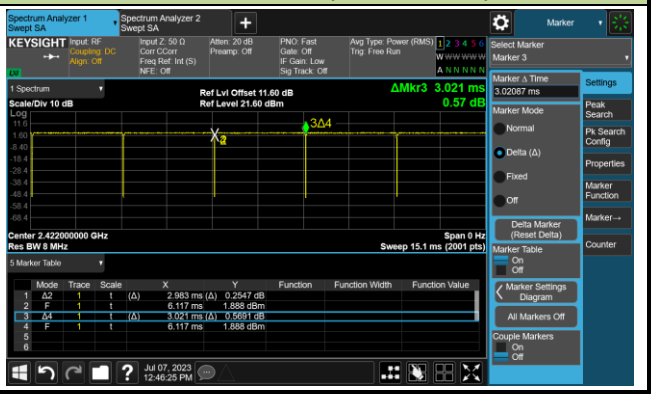

802.11g (T = 3.006ms)

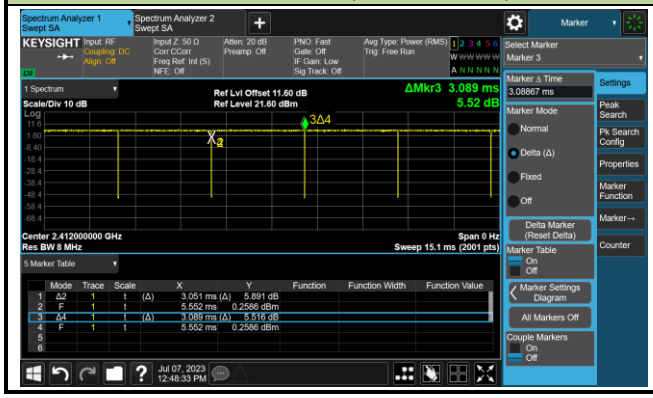
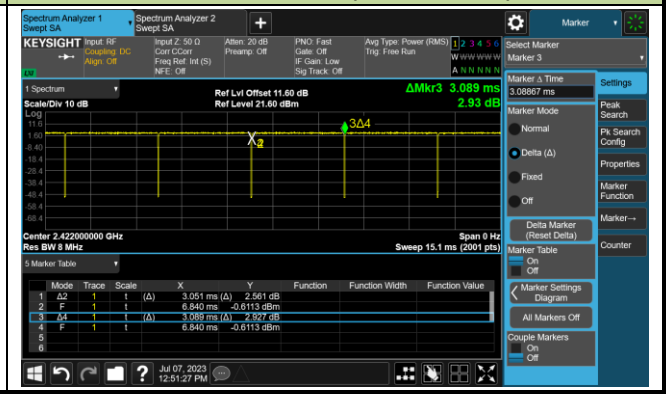



802.11n-HT20 (T = 2.998ms)




802.11n-HT40 (T = 2.983ms)

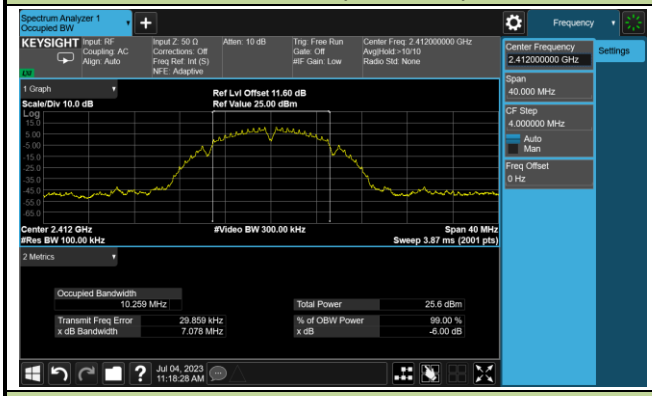
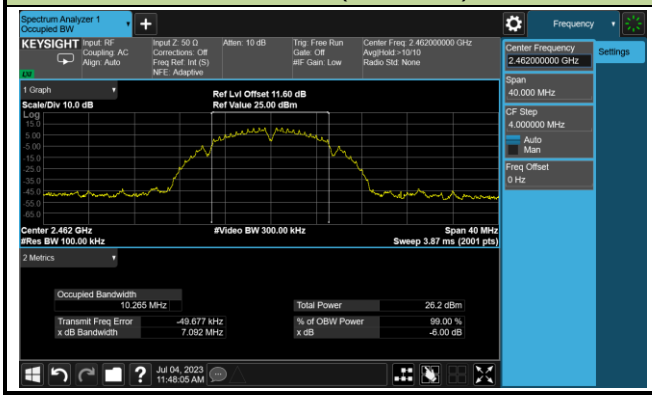


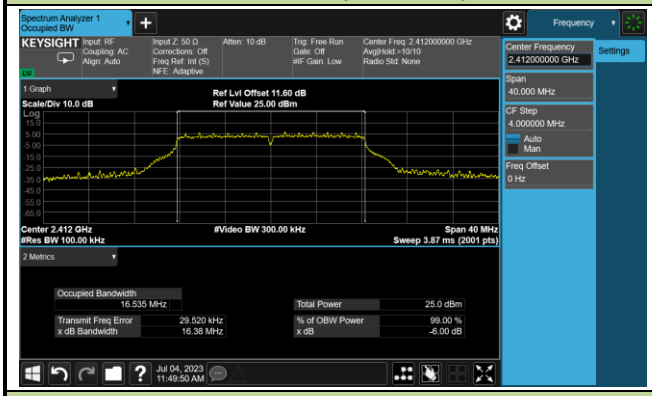
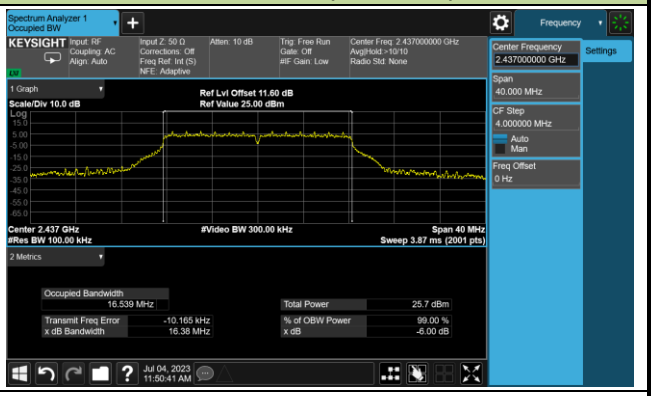
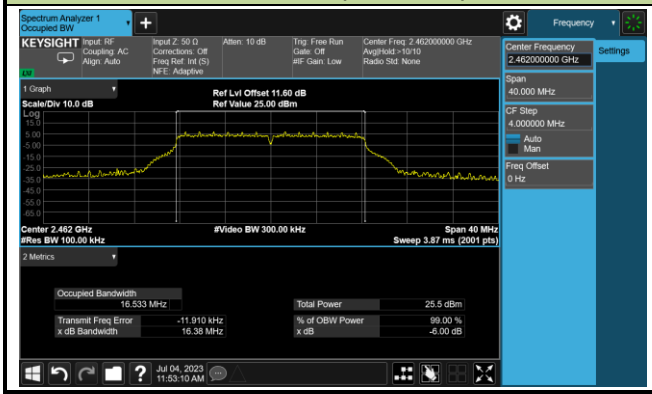
| Duty Cycle (T = Transmission Duration) | |
|---|---|
| 802.11ax-HE20 (T = 3.051ms) | 802.11ax-HE40 (T = 3.051ms) |
|  |  |

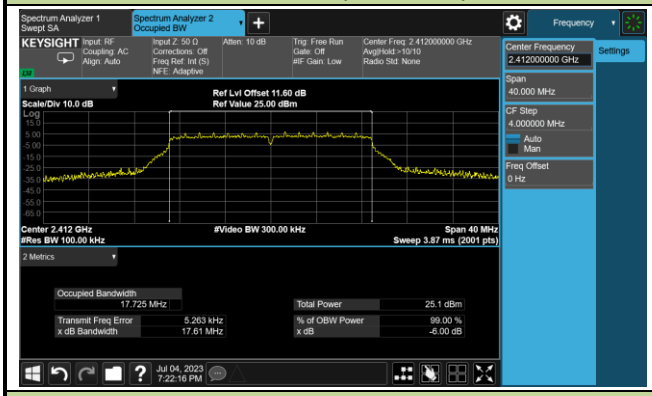
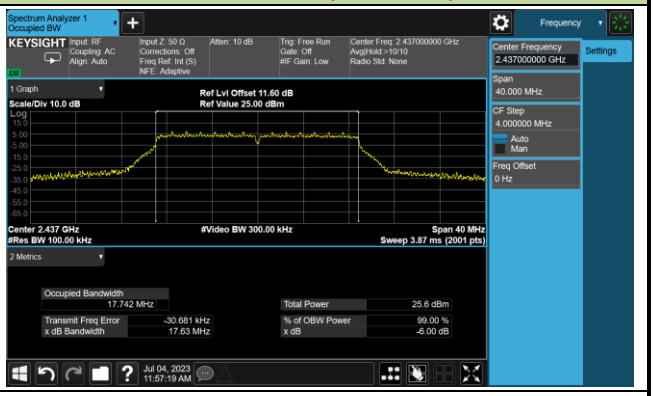
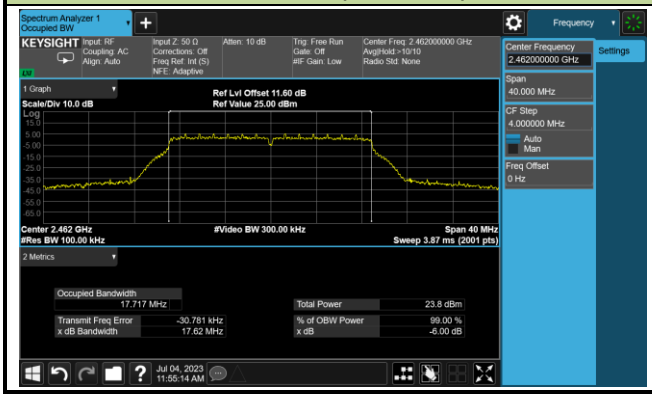
### A.2 6dB Bandwidth Test Result

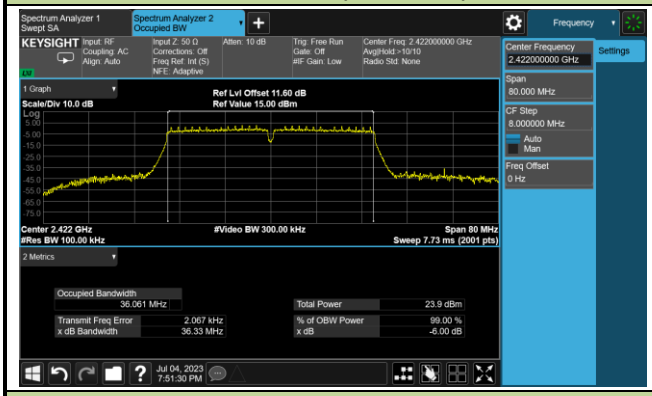
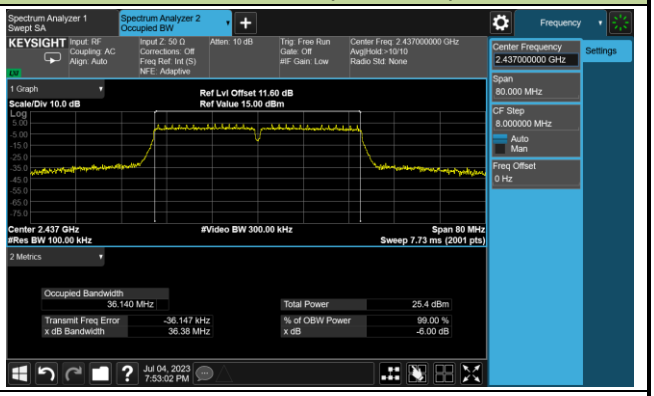
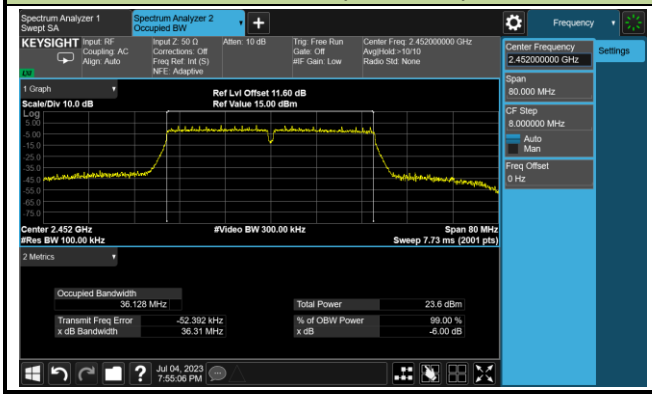
| | | | |
|---|---|---|---|
| Test Site | WZ-SR5 | Test Engineer | Lynn Yang |
| Test Date | 2023-07-04 | Radio | 0 |

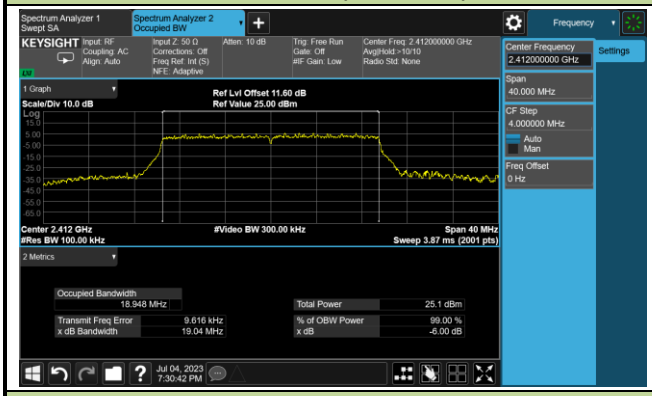
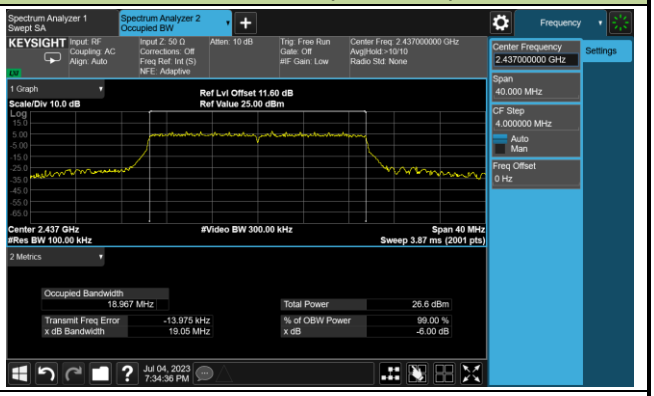
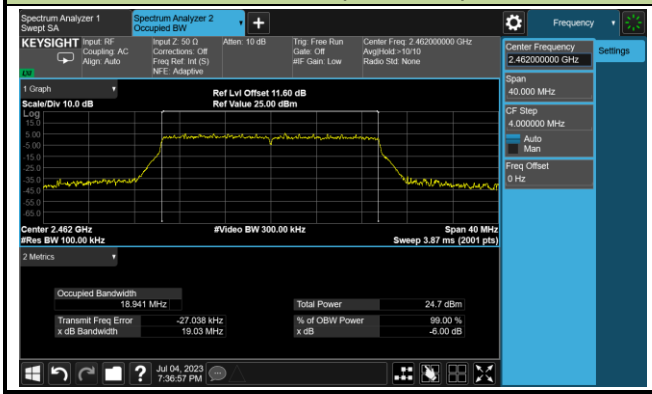
| Test Mode | Data Rate / MCS | Channel No. | Frequency (MHz) | 6dB Bandwidth (MHz) | Limit (MHz) |
|---|---|---|---|---|---|
| 11b | 1Mbps | 01 | 2412 | 7.078 | ≥ 0.5 |
| 11b | 1Mbps | 06 | 2437 | 7.081 | ≥ 0.5 |
| 11b | 1Mbps | 11 | 2462 | 7.092 | ≥ 0.5 |
| 11g | 6Mbps | 01 | 2412 | 16.38 | ≥ 0.5 |
| 11g | 6Mbps | 06 | 2437 | 16.38 | ≥ 0.5 |
| 11g | 6Mbps | 11 | 2462 | 16.38 | ≥ 0.5 |
| 11n-HT20 | MCS0 | 01 | 2412 | 17.61 | ≥ 0.5 |
| 11n-HT20 | MCS0 | 06 | 2437 | 17.63 | ≥ 0.5 |
| 11n-HT20 | MCS0 | 11 | 2462 | 17.62 | ≥ 0.5 |
| 11n-HT40 | MCS0 | 03 | 2422 | 36.33 | ≥ 0.5 |
| 11n-HT40 | MCS0 | 06 | 2437 | 36.38 | ≥ 0.5 |
| 11n-HT40 | MCS0 | 09 | 2452 | 36.31 | ≥ 0.5 |
| 11ax-HE20 | MCS0 | 01 | 2412 | 19.04 | ≥ 0.5 |
| 11ax-HE20 | MCS0 | 06 | 2437 | 19.05 | ≥ 0.5 |
| 11ax-HE20 | MCS0 | 11 | 2462 | 19.03 | ≥ 0.5 |
| 11ax-HE40 | MCS0 | 03 | 2422 | 37.32 | ≥ 0.5 |
| 11ax-HE40 | MCS0 | 06 | 2437 | 37.70 | ≥ 0.5 |
| 11ax-HE40 | MCS0 | 09 | 2452 | 37.40 | ≥ 0.5 |

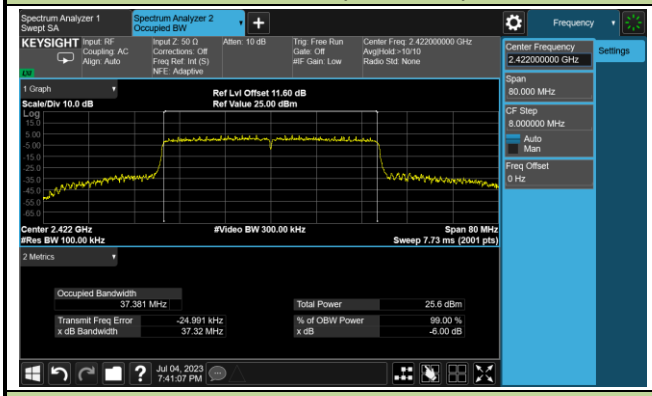
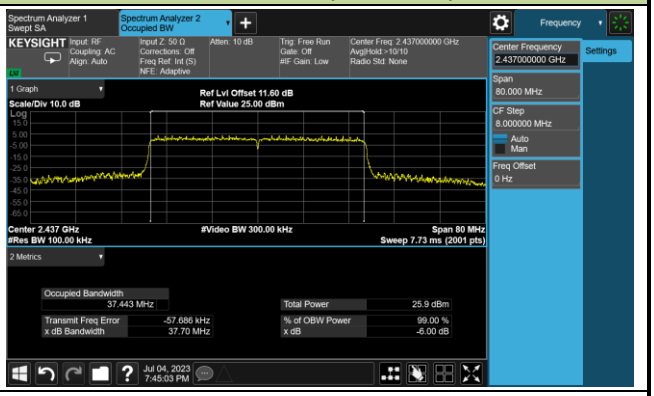
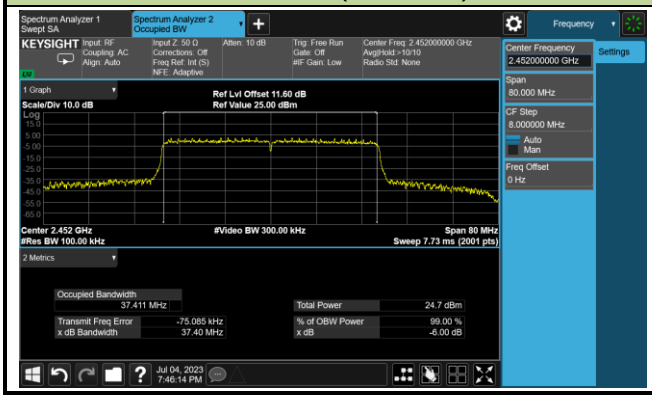
| 802.11b 6dB Bandwidth | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  | |
| Channel 11 (2462MHz) | |
|  | |

| 802.11g 6dB Bandwidth | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

| 802.11n-HT20 6dB Bandwidth | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

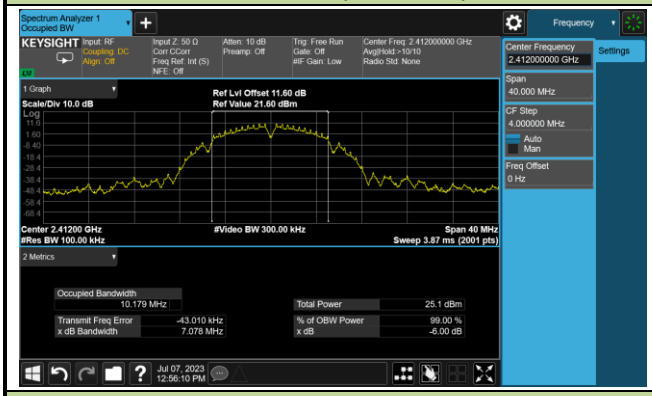
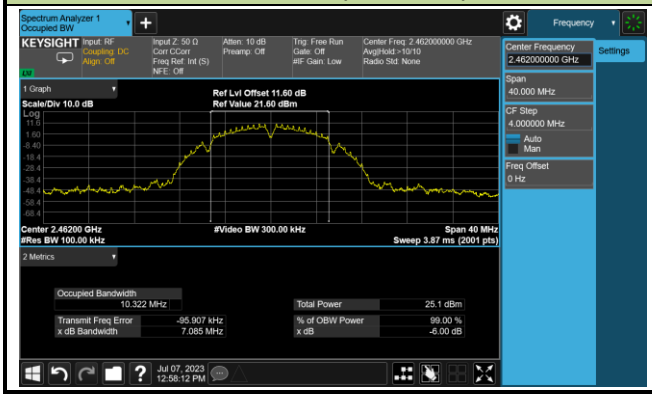
| 802.11n-HT40 6dB Bandwidth | |
|---|---|
| Channel 03 (2422MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 09 (2452MHz) | |
|  | |

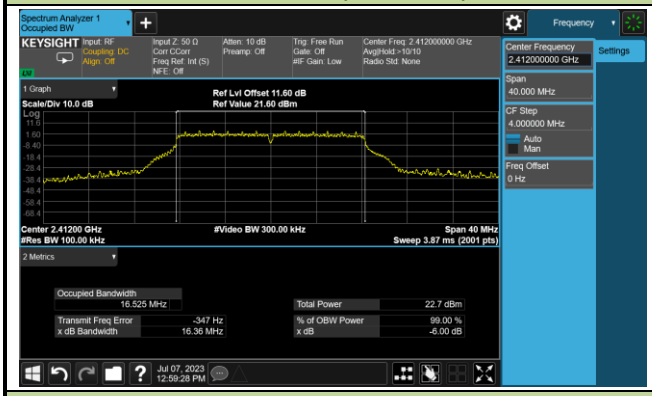
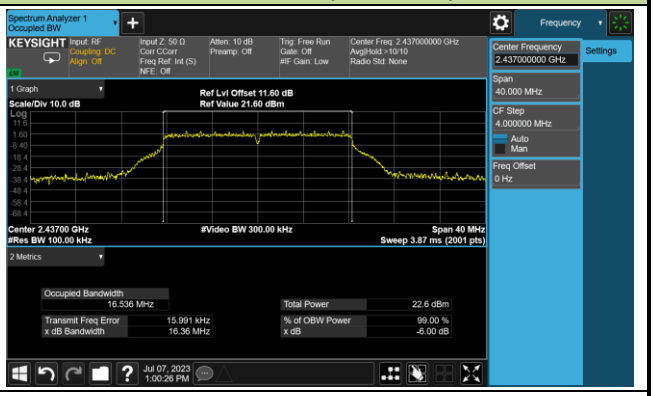
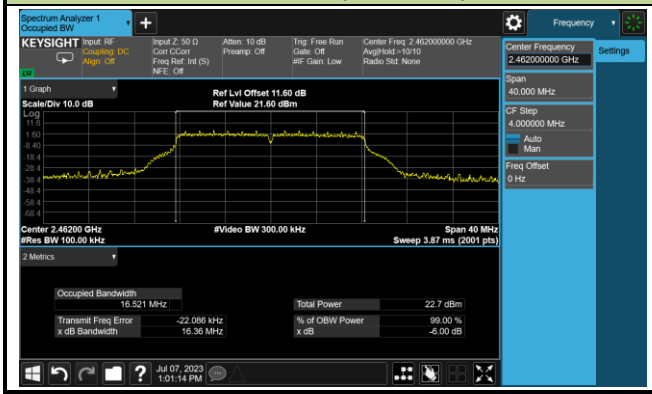
| 802.11ax-HE20 6dB Bandwidth | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

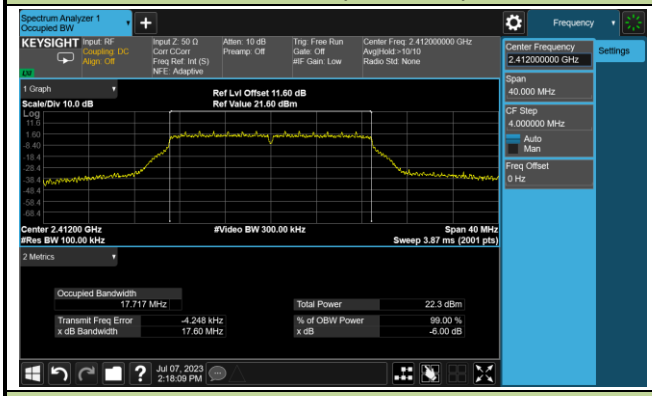
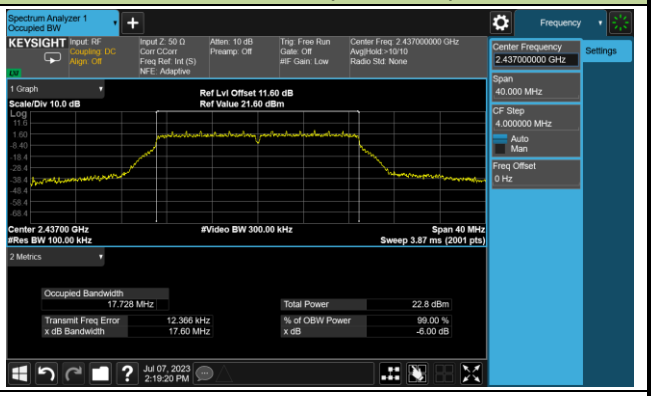
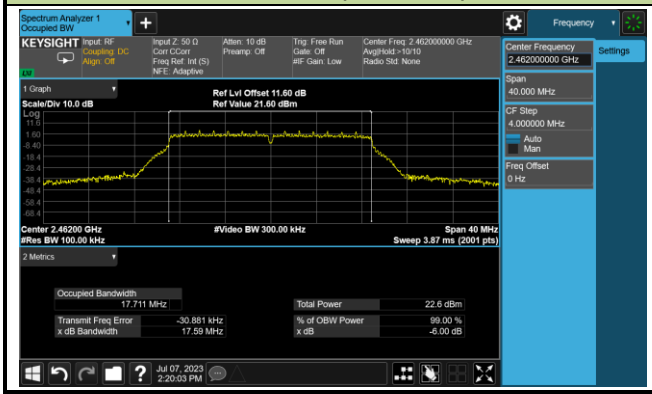
| 802.11ax-HE40 6dB Bandwidth | |
|---|---|
| Channel 03 (2422MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 09 (2452MHz) | |
|  | |

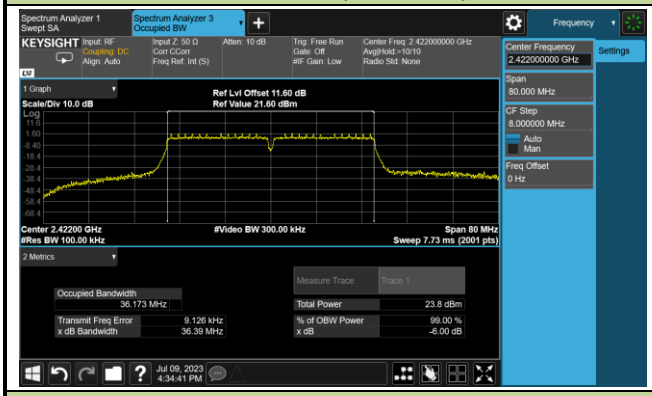
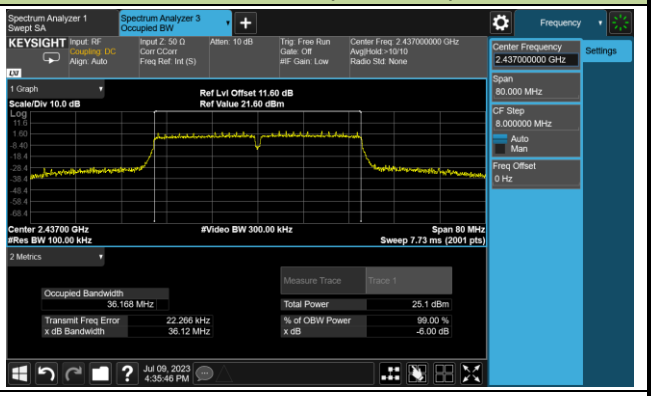
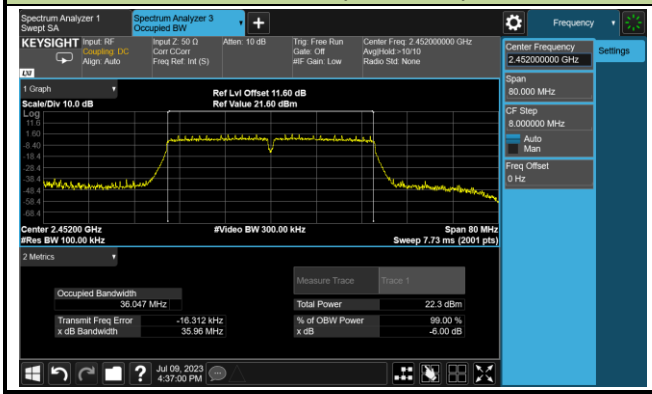
| | | | |
|---|---|---|---|
| Test Site | WZ-SR5 | Test Engineer | Lynn Yang |
| Test Date | 2023-07-07 | Radio | 1 |

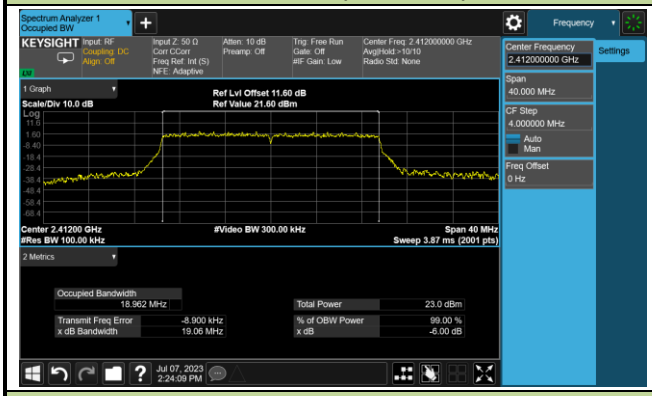
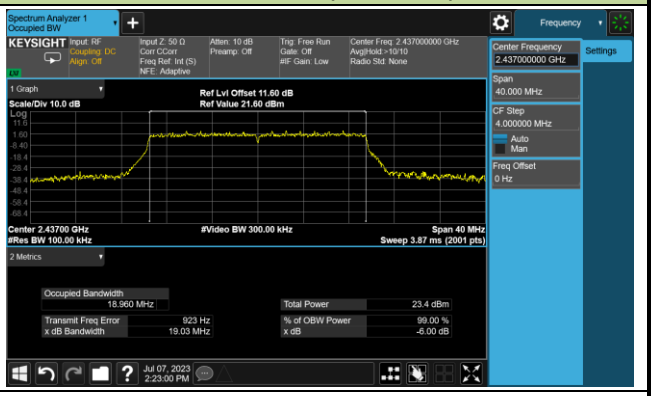
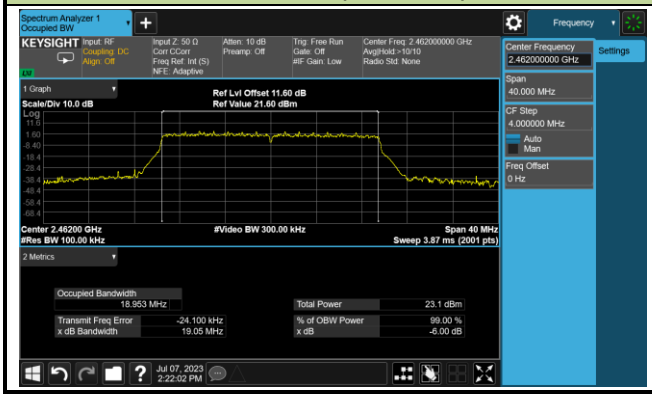
| Test Mode | Data Rate / MCS | Channel No. | Frequency (MHz) | 6dB Bandwidth (MHz) | Limit (MHz) |
|---|---|---|---|---|---|
| 11b | 1Mbps | 01 | 2412 | 7.078 | ≥ 0.5 |
| 11b | 1Mbps | 06 | 2437 | 7.062 | ≥ 0.5 |
| 11b | 1Mbps | 11 | 2462 | 7.085 | ≥ 0.5 |
| 11g | 6Mbps | 01 | 2412 | 16.36 | ≥ 0.5 |
| 11g | 6Mbps | 06 | 2437 | 16.36 | ≥ 0.5 |
| 11g | 6Mbps | 11 | 2462 | 16.36 | ≥ 0.5 |
| 11n-HT20 | MCS0 | 01 | 2412 | 17.60 | ≥ 0.5 |
| 11n-HT20 | MCS0 | 06 | 2437 | 17.60 | ≥ 0.5 |
| 11n-HT20 | MCS0 | 11 | 2462 | 17.59 | ≥ 0.5 |
| 11n-HT40 | MCS0 | 03 | 2422 | 36.39 | ≥ 0.5 |
| 11n-HT40 | MCS0 | 06 | 2437 | 36.12 | ≥ 0.5 |
| 11n-HT40 | MCS0 | 09 | 2452 | 35.96 | ≥ 0.5 |
| 11ax-HE20 | MCS0 | 01 | 2412 | 19.06 | ≥ 0.5 |
| 11ax-HE20 | MCS0 | 06 | 2437 | 19.03 | ≥ 0.5 |
| 11ax-HE20 | MCS0 | 11 | 2462 | 19.05 | ≥ 0.5 |
| 11ax-HE40 | MCS0 | 03 | 2422 | 37.64 | ≥ 0.5 |
| 11ax-HE40 | MCS0 | 06 | 2437 | 37.58 | ≥ 0.5 |
| 11ax-HE40 | MCS0 | 09 | 2452 | 37.17 | ≥ 0.5 |

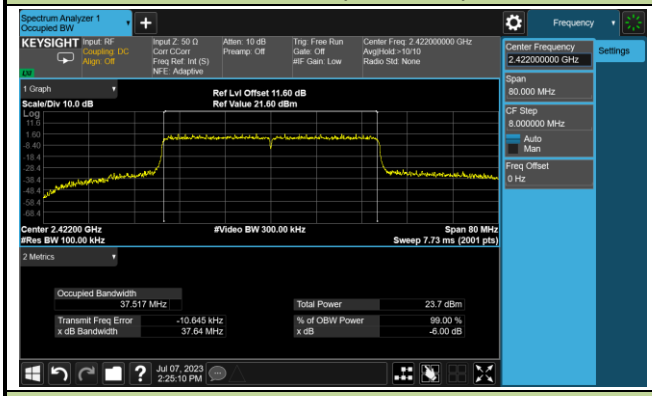
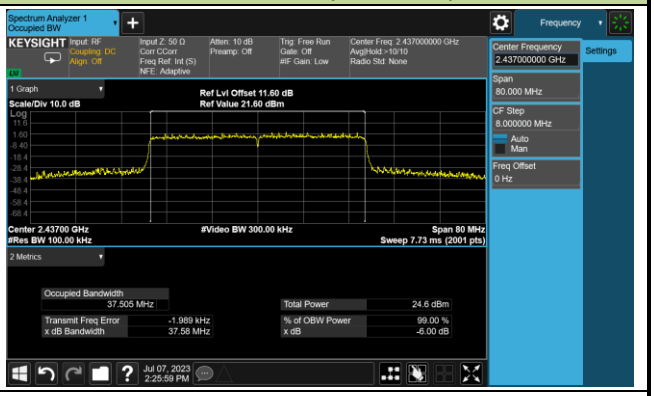
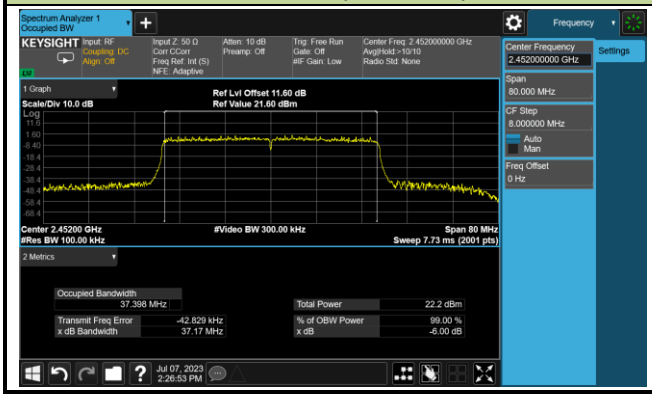
| 802.11b 6dB Bandwidth | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  | |
| Channel 11 (2462MHz) | |
|  | |

| 802.11g 6dB Bandwidth | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

| 802.11n-HT20 6dB Bandwidth | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

| 802.11n-HT40 6dB Bandwidth | |
|---|---|
| Channel 03 (2422MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 09 (2452MHz) | |
|  | |

| 802.11ax-HE20 6dB Bandwidth | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

| 802.11ax-HE40 6dB Bandwidth | |
|---|---|
| Channel 03 (2422MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 09 (2452MHz) | |
|  | |

### A.3 Output Power Test Result

| | | | |
|---|---|---|---|
| Test Site | WZ-SR5 | Test Engineer | Lynn Yang |
| Test Date | 2023-07-04 | Radio | 0 |

| Test Mode | Data Rate/ MCS | Channel No. | Freq. (MHz) | Average Power (dBm) | | Total Power (dBm) | Limit (dBm) |
|---|---|---|---|---|---|---|---|
| | | | | Ant 0 | Ant 1 | | |
| 11b | 1Mbps | 01 | 2412 | 17.71 | 18.34 | 21.05 | ≤ 30.00 |
| 11b | 1Mbps | 06 | 2437 | 17.80 | 18.42 | 21.13 | ≤ 30.00 |
| 11b | 1Mbps | 11 | 2462 | 18.31 | 18.27 | 21.30 | ≤ 30.00 |
| 11g | 6Mbps | 01 | 2412 | 17.02 | 17.52 | 20.29 | ≤ 30.00 |
| 11g | 6Mbps | 06 | 2437 | 18.08 | 18.31 | 21.21 | ≤ 30.00 |
| 11g | 6Mbps | 11 | 2462 | 17.51 | 17.28 | 20.41 | ≤ 30.00 |
| 11n-HT20 | MCS0 | 01 | 2412 | 17.85 | 17.93 | 20.90 | ≤ 30.00 |
| 11n-HT20 | MCS0 | 06 | 2437 | 18.02 | 18.34 | 21.19 | ≤ 30.00 |
| 11n-HT20 | MCS0 | 11 | 2462 | 15.90 | 15.81 | 18.87 | ≤ 30.00 |
| 11n-HT40 | MCS0 | 03 | 2422 | 15.96 | 16.23 | 19.11 | ≤ 30.00 |
| 11n-HT40 | MCS0 | 06 | 2437 | 17.70 | 18.32 | 21.03 | ≤ 30.00 |
| 11n-HT40 | MCS0 | 09 | 2452 | 16.51 | 16.26 | 19.40 | ≤ 30.00 |
| 11ax-HE20 | MCS0 | 01 | 2412 | 17.21 | 17.23 | 20.23 | ≤ 30.00 |
| 11ax-HE20 | MCS0 | 06 | 2437 | 18.05 | 18.32 | 21.20 | ≤ 30.00 |
| 11ax-HE20 | MCS0 | 11 | 2462 | 16.70 | 16.16 | 19.45 | ≤ 30.00 |
| 11ax-HE40 | MCS0 | 03 | 2422 | 15.68 | 16.14 | 18.93 | ≤ 30.00 |
| 11ax-HE40 | MCS0 | 06 | 2437 | 17.73 | 18.31 | 21.04 | ≤ 30.00 |
| 11ax-HE40 | MCS0 | 09 | 2452 | 16.46 | 16.17 | 19.33 | ≤ 30.00 |

Note: Total AV Power (dBm) = $10*\log \{10^{(\text{Ant 0 Average Power /10})} + 10^{(\text{Ant 1 Average Power /10})}\}$.

| Test Site | WZ-SR5 | Test Engineer | Lynn Yang |
|---|---|---|---|
| Test Date | 2023-07-04 | Radio | 1 |

| Test Mode | Data Rate/ MCS | Channel No. | Freq. (MHz) | Average Power (dBm) | | Total Power (dBm) | Limit (dBm) |
|---|---|---|---|---|---|---|---|
| | | | | Ant 0 | Ant 1 | | |
| 11b | 1Mbps | 01 | 2412 | 18.25 | 17.07 | 20.71 | ≤ 30.00 |
| 11b | 1Mbps | 06 | 2437 | 18.40 | 18.26 | 21.34 | ≤ 30.00 |
| 11b | 1Mbps | 11 | 2462 | 18.41 | 17.87 | 21.16 | ≤ 30.00 |
| 11g | 6Mbps | 01 | 2412 | 15.80 | 16.51 | 19.18 | ≤ 30.00 |
| 11g | 6Mbps | 06 | 2437 | 16.62 | 18.39 | 20.60 | ≤ 30.00 |
| 11g | 6Mbps | 11 | 2462 | 16.00 | 17.58 | 19.87 | ≤ 30.00 |
| 11n-HT20 | MCS0 | 01 | 2412 | 15.44 | 15.96 | 18.72 | ≤ 30.00 |
| 11n-HT20 | MCS0 | 06 | 2437 | 16.42 | 18.27 | 20.45 | ≤ 30.00 |
| 11n-HT20 | MCS0 | 11 | 2462 | 15.95 | 17.17 | 19.61 | ≤ 30.00 |
| 11n-HT40 | MCS0 | 03 | 2422 | 16.31 | 16.59 | 19.46 | ≤ 30.00 |
| 11n-HT40 | MCS0 | 06 | 2437 | 18.15 | 18.42 | 21.30 | ≤ 30.00 |
| 11n-HT40 | MCS0 | 09 | 2452 | 14.92 | 15.85 | 18.42 | ≤ 30.00 |
| 11ax-HE20 | MCS0 | 01 | 2412 | 15.05 | 16.25 | 18.70 | ≤ 30.00 |
| 11ax-HE20 | MCS0 | 06 | 2437 | 16.62 | 18.30 | 20.55 | ≤ 30.00 |
| 11ax-HE20 | MCS0 | 11 | 2462 | 15.45 | 16.63 | 19.09 | ≤ 30.00 |
| 11ax-HE40 | MCS0 | 03 | 2422 | 15.97 | 16.51 | 19.26 | ≤ 30.00 |
| 11ax-HE40 | MCS0 | 06 | 2437 | 17.72 | 18.34 | 21.05 | ≤ 30.00 |
| 11ax-HE40 | MCS0 | 09 | 2452 | 14.62 | 15.53 | 18.11 | ≤ 30.00 |

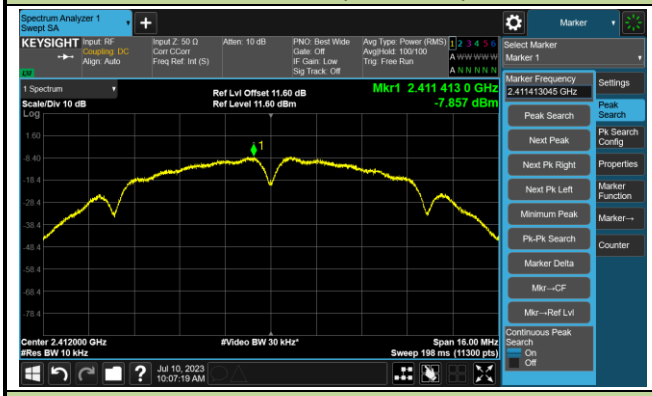
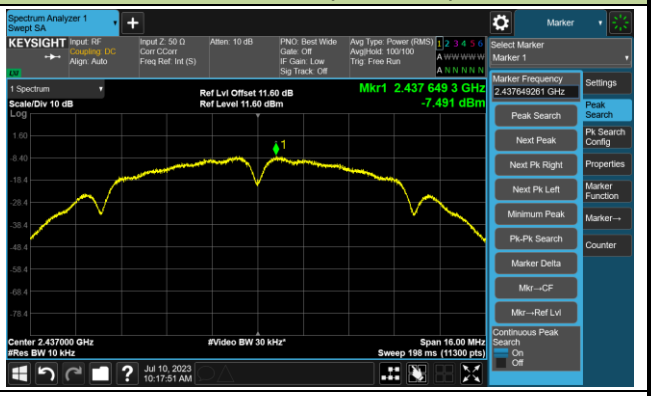
Note: Total AV Power (dBm) = $10*\log \{10^{(\text{Ant 0 Average Power /10})} + 10^{(\text{Ant 1 Average Power /10})}\}$.

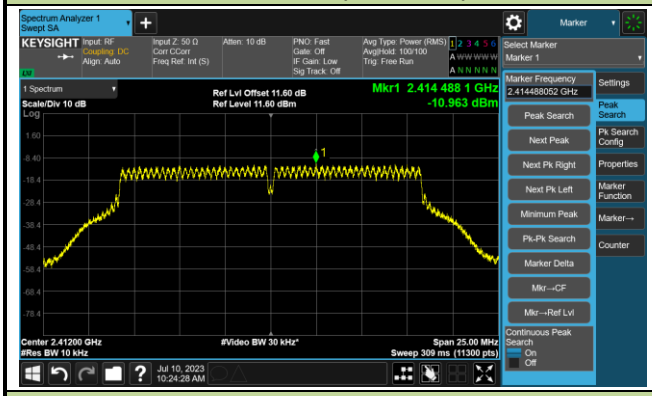
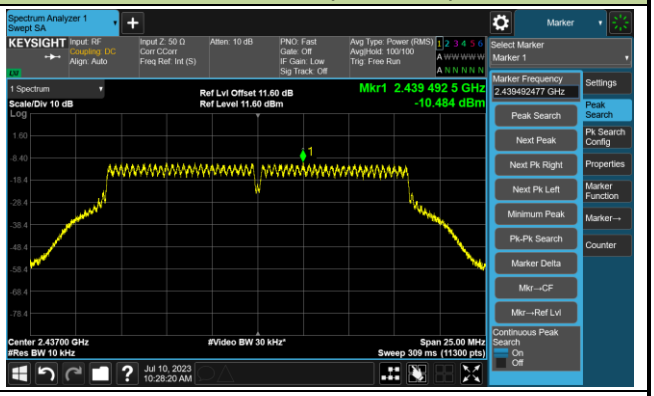
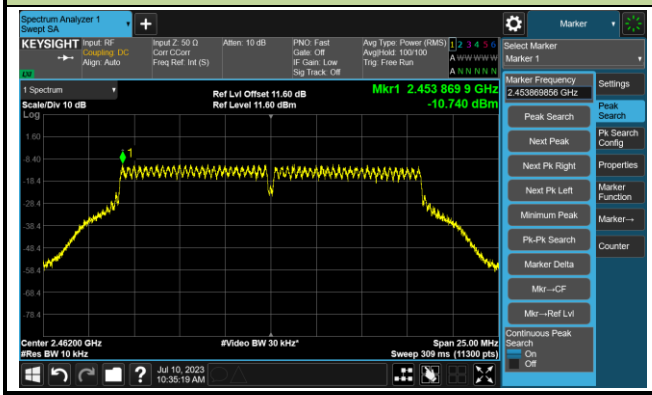
### A.4 Power Spectral Density Test Result

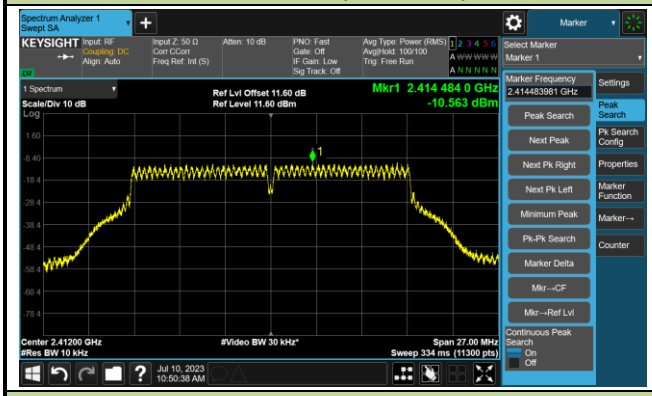
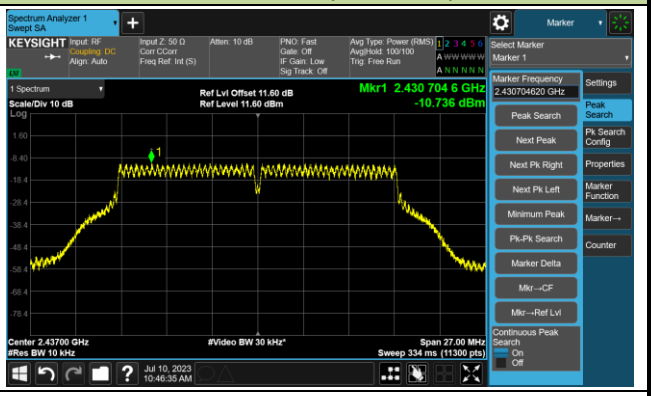
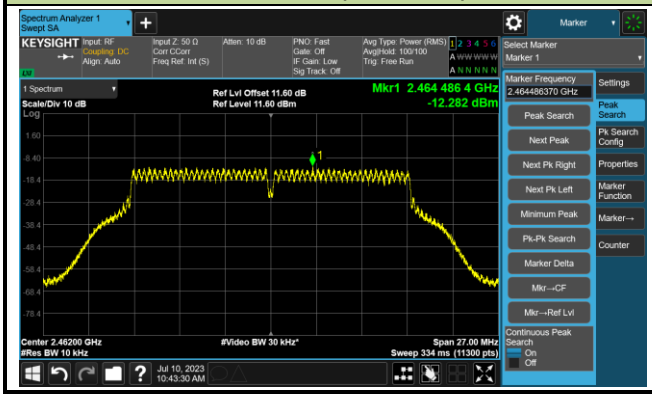
| | | | |
|---|---|---|---|
| Test Site | WZ-SR5 | Test Engineer | Lynn Yang |
| Test Date | 2023-07-10 ~ 2023-07-11 | Radio | 0 |

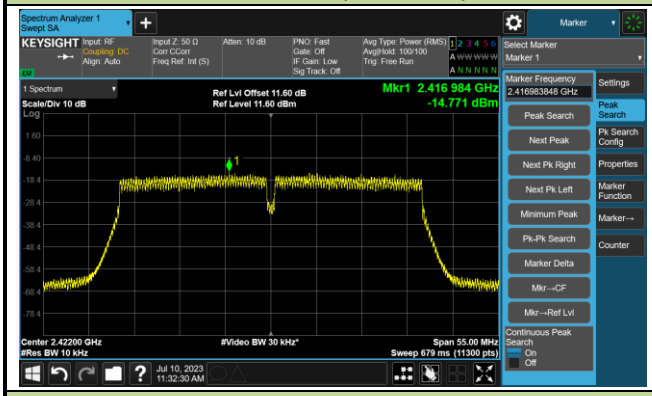
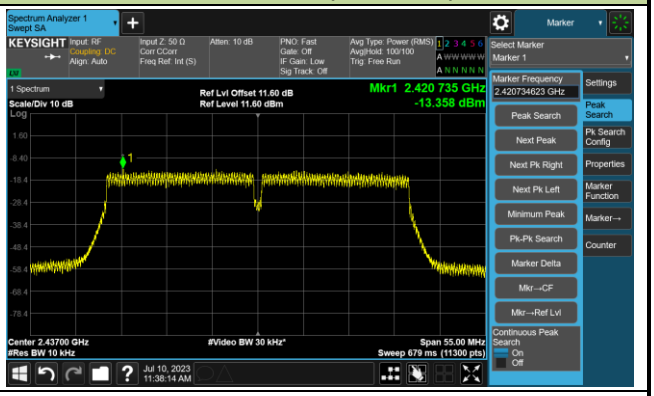
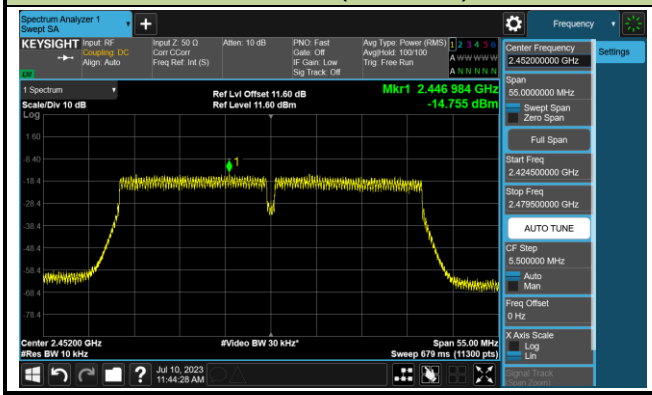
| Test Mode | Data Rate/ MCS | Channel No. | Freq. (MHz) | AVPSD (dBm/10kHz) | | Total PSD (dBm/10kHz) | Limit (dBm/3kHz) | Result |
|---|---|---|---|---|---|---|---|---|
| | | | | Ant 0 | Ant 1 | | | |
| 11b | 1Mbps | 01 | 2412 | -7.857 | -7.046 | -4.42 | ≤ 8.00 | Pass |
| 11b | 1Mbps | 06 | 2437 | -7.491 | -7.293 | -4.38 | ≤ 8.00 | Pass |
| 11b | 1Mbps | 11 | 2462 | -7.070 | -7.110 | -4.08 | ≤ 8.00 | Pass |
| 11g | 6Mbps | 01 | 2412 | -10.963 | -10.147 | -7.53 | ≤ 8.00 | Pass |
| 11g | 6Mbps | 06 | 2437 | -10.484 | -10.681 | -7.57 | ≤ 8.00 | Pass |
| 11g | 6Mbps | 11 | 2462 | -10.740 | -11.098 | -7.91 | ≤ 8.00 | Pass |
| 11n-HT20 | MCS0 | 01 | 2412 | -10.563 | -10.543 | -7.54 | ≤ 8.00 | Pass |
| 11n-HT20 | MCS0 | 06 | 2437 | -10.736 | -9.947 | -7.31 | ≤ 8.00 | Pass |
| 11n-HT20 | MCS0 | 11 | 2462 | -12.282 | -12.805 | -9.53 | ≤ 8.00 | Pass |
| 11n-HT40 | MCS0 | 03 | 2422 | -14.771 | -15.153 | -11.95 | ≤ 8.00 | Pass |
| 11n-HT40 | MCS0 | 06 | 2437 | -13.358 | -13.162 | -10.25 | ≤ 8.00 | Pass |
| 11n-HT40 | MCS0 | 09 | 2452 | -14.755 | -15.090 | -11.91 | ≤ 8.00 | Pass |
| 11ax-HE20 | MCS0 | 01 | 2412 | -12.877 | -12.239 | -9.54 | ≤ 8.00 | Pass |
| 11ax-HE20 | MCS0 | 06 | 2437 | -11.695 | -11.888 | -8.78 | ≤ 8.00 | Pass |
| 11ax-HE20 | MCS0 | 11 | 2462 | -12.782 | -13.668 | -10.19 | ≤ 8.00 | Pass |
| 11ax-HE40 | MCS0 | 03 | 2422 | -16.641 | -16.410 | -13.51 | ≤ 8.00 | Pass |
| 11ax-HE40 | MCS0 | 06 | 2437 | -15.300 | -14.584 | -11.92 | ≤ 8.00 | Pass |
| 11ax-HE40 | MCS0 | 09 | 2452 | -15.987 | -15.996 | -12.98 | ≤ 8.00 | Pass |

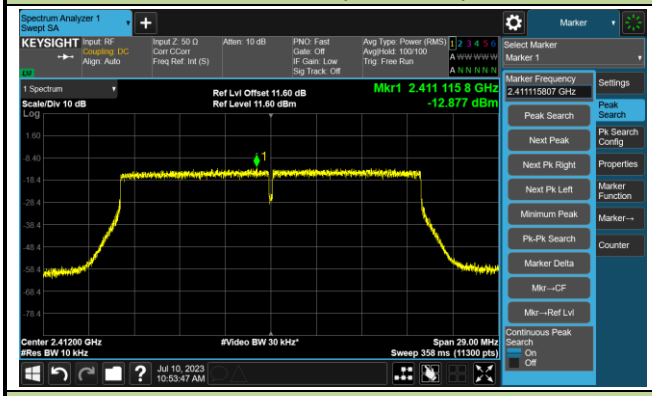
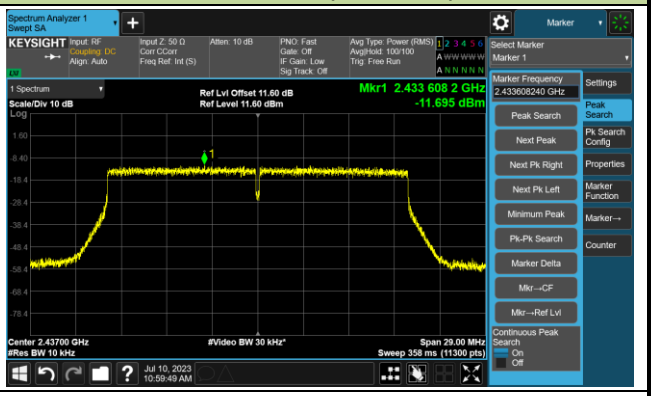
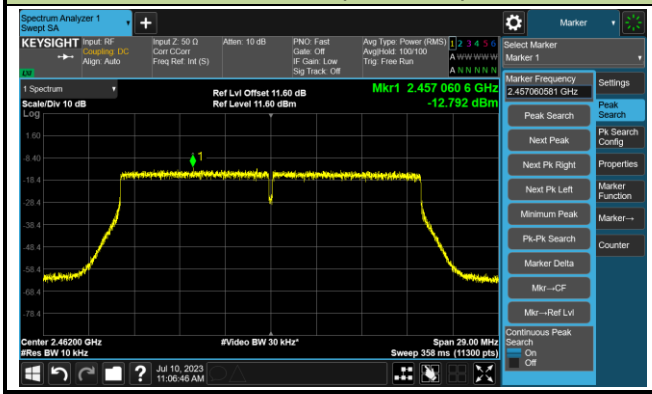
Note: Total PSD (dBm/10kHz) = $10*\log \{10^{(\text{Ant 0 AVPSD}/10)} + 10^{(\text{Ant 1 AVPSD}/10)}\}$.

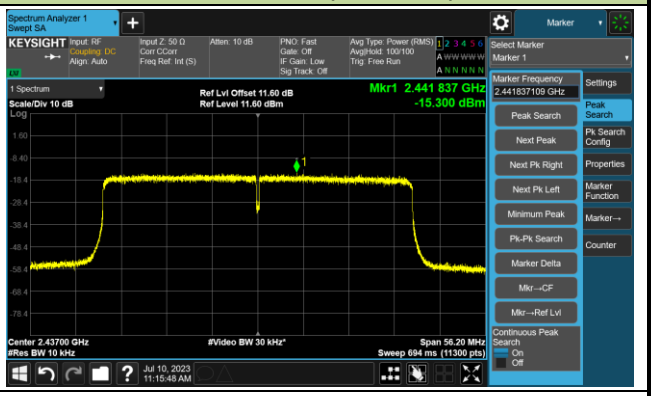
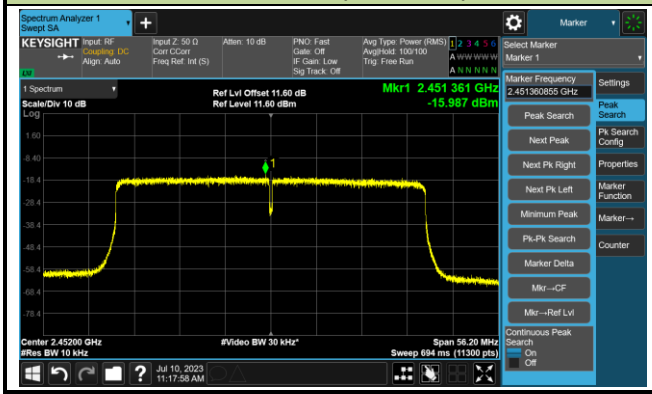
| 802.11b - AVPSD – Ant 0 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
| | |

| 802.11g - AVPSD – Ant 0 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

| 802.11n-HT20 - AVPSD – Ant 0 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

| 802.11n-HT40 - AVPSD – Ant 0 | |
|---|---|
| Channel 03 (2422MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 09 (2452MHz) | |
|  | |

| 802.11ax-HE20 - AVPSD – Ant 0 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

| 802.11ax-HE40 - AVPSD – Ant 0 | |
|---|---|
| Channel 03 (2422MHz) | Channel 06 (2437MHz) |
| |  |
| Channel 09 (2452MHz) | |
|  | |