# MEASUREMENT REPORT

## FCC PART 15C / WLAN 802.11b/g/n/ax

| | |
|---|---|
| **FCC ID:** | MCQ-EX50W |
| **Applicant:** | Digi International Inc. |
| **Application Type:** | Certification |
| **Product:** | 5G NR/LTE Router |
| **Model No.:** | Digi EX40, Digi EX50 |
| **Brand Name:** | DIGI |
| **FCC Classification:** | Digital Transmission System (DTS) |
| **FCC Rule Part(s):** | Part 15 Subpart C (Section 15.247) |
| **Test Procedure(s):** | ANSI C63.10-2013, KDB 662911 D01v02r01 |
| **Test Date:** | July 17 ~ August 27, 2021 |

**Reviewed By:** Kevin Guo

**Approved By:** Robin Wu

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.

# Revision History

| Report No. | Version | Description | Issue Date | Note |
|---|---|---|---|---|
| 2106RSU041-U1 | Rev. 01 | Initial Report | 11-16-2021 | Valid |
| | | | | |

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# 1. General Information

## 1.1. Applicant

Digi International Inc.

9350 Excelsior Blvd. Suite 700, Hopkins, Minnesota 55343, United States

## 1.2. Manufacturer

Digi International Inc.

9350 Excelsior Blvd. Suite 700, Hopkins, Minnesota 55343, United States

## 1.3. Testing Facility

| | | | | | |
|---|---|---|---|---|---|
| ☒ | **Test Site – MRT Suzhou Laboratory** | | | | |
| | **Laboratory Location (Suzhou - Wuzhong)** | | | | |
| | D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China | | | | |
| | **Laboratory Location (Suzhou - SIP)** | | | | |
| | 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)** | | | | |
| | 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)** | | | | |
| | No. 38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.) | | | | |
| | **Laboratory Accreditations** | | | | |
| | TAF: L3261-190725 | | | | |
| | FCC: 291082, TW3261 | | ISED: TW3261 | | |

### 1.4. Product Information

| | |
|---|---|
| Product Name | 5G NR/LTE Router |
| Model No. | Digi EX40, Digi EX50 |
| Brand Name | DIGI |
| Wi-Fi Specification | 802.11a/b/g/n/ac/ax |
| Antenna Specification | Refer to section 1.7 |
| EUT Identification No. | 20210622Sample#14 (Conducted)<br>20210622Sample#16 (Radiated & AC conducted emission)<br>20210713Sample#01 (Verified) |
| Power Supply | AC/DC Adapter or POE Adapter |
| Accessory | |
| Adapter | Model No.: DA-50F19<br>Input: 100-240V, 50/60Hz, 1.2A<br>Output: 19.0V, 2.63A, 49.97W |

Remark:

1. This report reused the test data from another authorized device (FCC ID: MCQ-WPQ618, Original Grant Date: 2021/11/15). And add some verified data according to KDB 484596 D01v01 and the difference (refer to as below table 1) between the FCC IDs.
2. Different models differ in the configuration of different authorized modules, Digi EX40 will be configured an LTE module, Digi EX50 will be configured a 5G NR module.
3. The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer.

Table 1

| Diff | Original | New | Remark |
|---|---|---|---|
| 1 | Without Enclosure,<br>Only the PCBA | With an Enclosure,<br>and add an authorized module | Just add an enclosure, PCBA and Antennas are the same. |

Conclusion:

According to the difference as above, only output power and radiated emission were verified in this report.

### 1.5. Radio Specification

| | |
|---|---|
| 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 |

Note: For other features of this EUT, test report will be issued separately.

### 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 | Antenna Gain (dBi) | CDD Directional Gain (dBi) | |
|---|---|---|---|---|---|
| | | | | For Power | For PSD |
| Omni Antenna | 2412 ~ 2462 | 2 | 8.00 | 8.00 | 11.01 |
| | 5150 ~ 5850 | 2 | 5.00 | 5.00 | 8.01 |

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

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,

  Array Gain = 0 dB for $N_{ANT} \leq 4$;

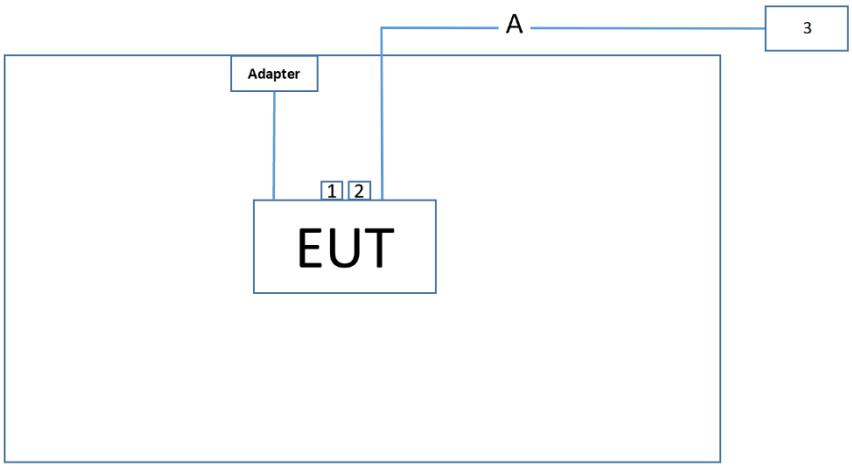
### 1.8. Test Mode

| | |
|---|---|
| Test Mode | Mode 1: Transmit by 802.11b (1Mbps) (CDD mode) |
| | Mode 2: Transmit by 802.11g (6Mbps) (CDD mode) |
| | Mode 3: Transmit by 802.11n-HT20 (MCS0) (CDD mode) |
| | Mode 4: Transmit by 802.11n-HT40 (MCS0) (CDD mode) |
| | Mode 5: Transmit by 802.11ax-HE20 (MCS0) (CDD mode) |
| | Mode 6: Transmit by 802.11ax-HE40 (MCS0) (CDD mode) |

### 1.9. 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




| Cable Type | | Cable Description |
|---|---|---|
| A | LAN Cable | Shielded, > 10m |

### 1.10. Test System Details

| Product | | Manufacturer | Model No. |
|---|---|---|---|
| 1~2 | Simulated load | N/A | 001 |
| 3 | Notebook | Lenovo | X230 |

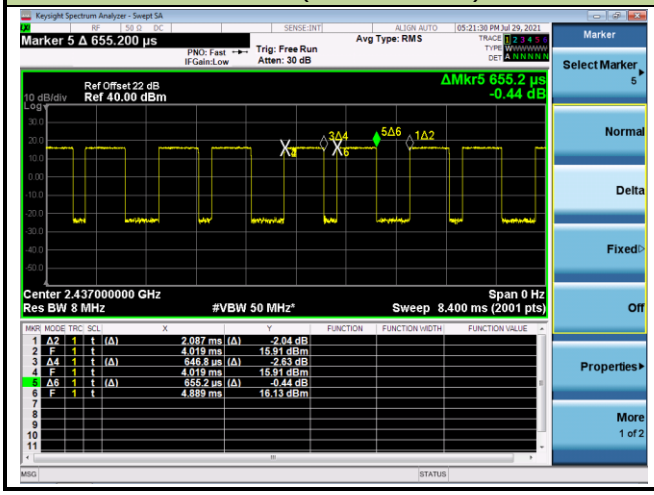
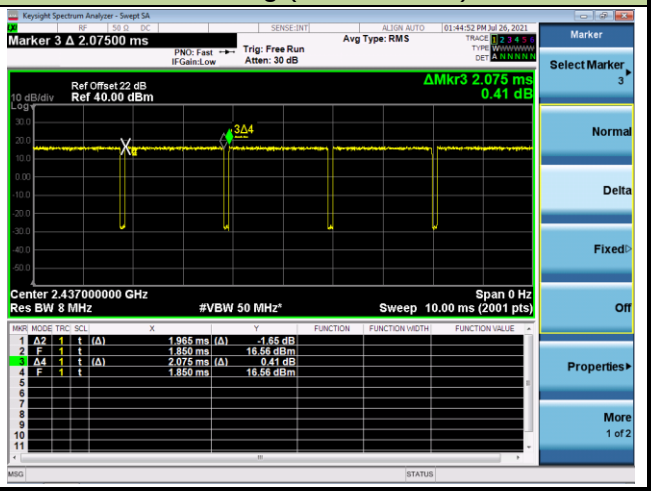
### 1.11. Test Software

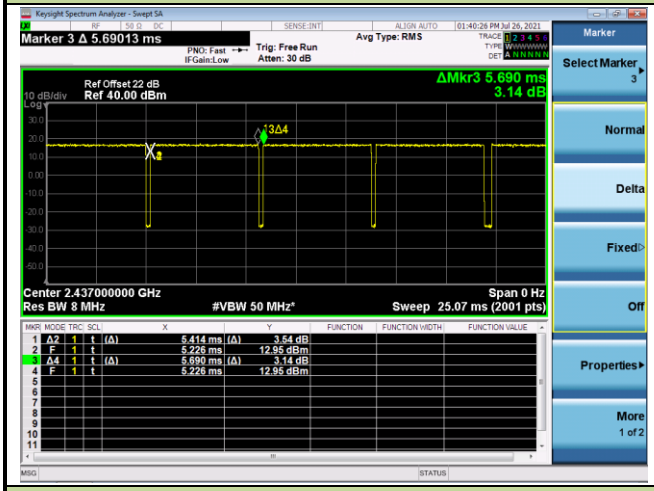
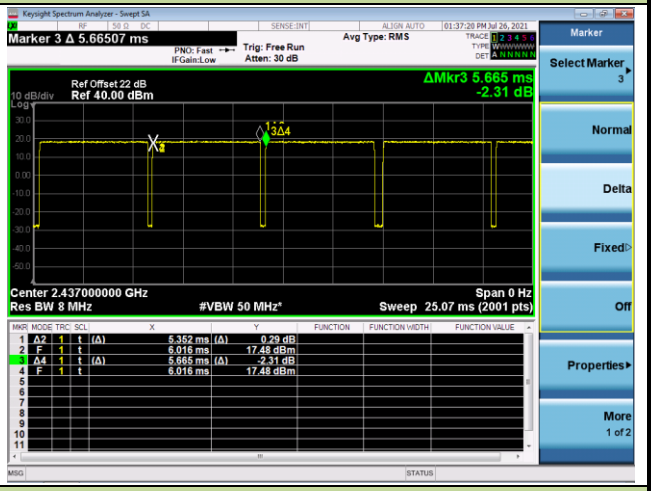
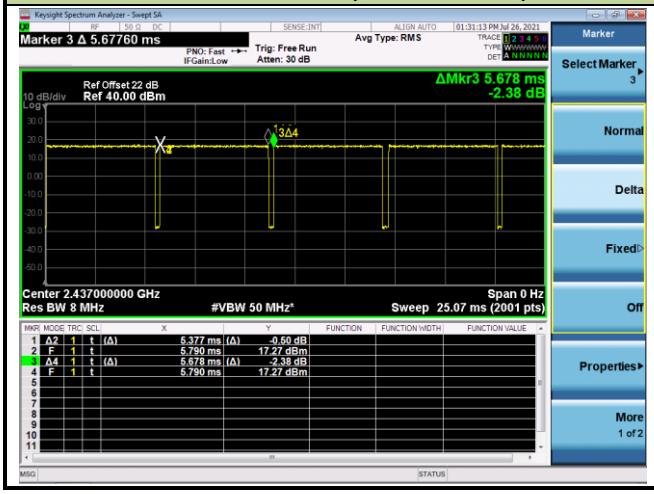
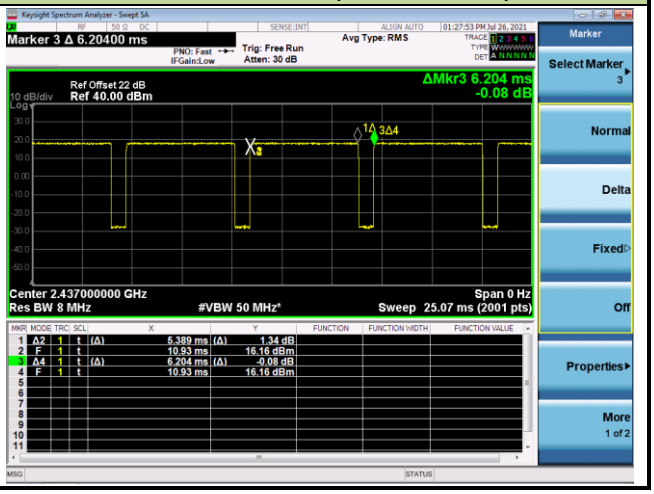
The test utility software used during testing was engineering order provided by manufacturer.
Note: Final power setting please refer to operational description.

### 1.12. Duty Cycle

The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHsz. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

| Test Mode | Duty Cycle |
|---|---|
| 802.11b | 62.39% |
| 802.11g | 94.70% |
| 802.11n-HT20 | 95.15% |
| 802.11n-HT40 | 94.47% |
| 802.11ax-HE20 | 94.70% |
| 802.11ax-HE40 | 86.86% |

| Duty Cycle (T = Transmission Duration) | |
|---|---|
| 802.11b (T = 1.302ms) | 802.11g (T = 1.965ms) |
|  |  |

| Duty Cycle (T = Transmission Duration) | |
|---|---|
| 802.11n-HT20 (T = 5.414ms) | 802.11n-HT40 (T = 5.352ms) |
|  |  |
| 802.11ax-HE20 (T = 5.377ms) | 802.11ax-HE40(T = 5.389ms) |
|  |  |

## 1.13. Test Environment Condition

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

# 2. 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 **unique I-PEX connector**
- There are no provisions for connection to an external antenna.

**Conclusion:**

The unit complies with the requirement of §15.203.

# 3. Test Equipment Calibration Date

Conducted Emission (NS-SR2)

| Instrument | Manufacturer | Type No. | Asset No. | Cali. Interval | Cali. Due Date |
|---|---|---|---|---|---|
| EMI Test Receiver | R&S | ESL3 | MRTSUE06576 | 1 year | 2022/06/27 |
| ENV216-LV-NETZNACHB | R&S | ENV216 | MRTSUE06577 | 1 year | 2022/07/04 |
| ENV216-LV-NETZNACHB | R&S | ENV216 | MRTSUE06578 | 1 year | 2022/07/04 |
| 8-WIRE ISN | R&S | ENY81 | MRTSUE06579 | 1 year | 2022/07/04 |
| 8-WIRE ISN for CAT6 | R&S | ENY81-CA6 | MRTSUE06580 | 1 year | 2022/06/15 |
| Temperature/Humidity Meter | deli | NO.8813 | MRTSUE06587 | 1 year | 2022/06/30 |
| Shielding Anechoic Chamber | BOOMWAVE | SR2 | MRTSUE06551 | 5-year | 2024/06/04 |

Radiated Emissions (NS-AC1)

| Instrument | Manufacturer | Type No. | Asset No. | Cali. Interval | Cal. Due Date |
|---|---|---|---|---|---|
| EXA Signal Analyzer | Keysight | N9010A | MRTSUE06195 | 1 year | 2022/03/17 |
| EXA Signal Analyzer | Keysight | N9020A-526 | MRTSUE10065 | 1 year | 2022/06/17 |
| EMI Test Receiver | ROHDE&SCHWARZ | ESR3 | MRTSUE06575 | 1 year | 2022/06/27 |
| Horn Antenna | Schwarzbeck | BBHA 9170 | MRTSUE06292 | 1 year | 2021/10/24 |
| Broad-Band Horn Antenna | Schwarzbeck | 9120D | MRTSUE06572 | 1 year | 2022/03/14 |
| Bilog Period Antenna | Schwarzbeck | VULB 9162 | MRTSUE06573 | 1 year | 2022/06/29 |
| Broadband Coaxial Preamplifier | Schwarzbeck | BBV 9718 | MRTSUE06574 | 1 year | 2022/07/12 |
| Temperature/Humidity Meter | DELI | NO.8813 | MRTSUE06588 | 1 year | 2022/06/30 |
| Anechoic Chamber | BOOMWAVE | AC1 | MRTSUE06496 | 1 year | 2022/07/24 |

Conducted Test Equipment (NS-TR2)

| Instrument | Manufacturer | Type No. | Asset No. | Cali. Interval | Cali. Due Date |
|---|---|---|---|---|---|
| Thermal Hygrometer | DELI | No.8813 | MRTSUE06783 | 1 year | 2022/05/09 |
| EXA Signal Analyzer | Keysight | N9010A | MRTSUE06195 | 1 year | 2022/03/17 |
| Attenuator | MVE | 3dB | MRTSUE06529 | 1 year | 2021/12/12 |
| Attenuator | MVE | 6dB | MRTSUE06534 | 1 year | 2021/12/12 |
| Attenuator | MVE | 10dB | MRTSUE06540 | 1 year | 2021/12/12 |
| Attenuator | MVE | 20dB | MRTSUE06547 | 1 year | 2021/12/12 |
| Temperature/Humidity Chamber | OK | OUKE INSTRUMENT | MRTSUE06899 | 1 year | 2021/11/27 |
| USB wideband power sensor | Keysight | U2021XA | MRTSUE06581 | 1 year | 2022/08/20 |

Conducted Test Equipment (WZ-TR3)

| Instrument | Manufacturer | Type No. | Asset No. | Cali. Interval | Cali. Due Date |
|---|---|---|---|---|---|
| EXA Signal Analyzer | Agilent | N9020A | MRTSUE06106 | 1 year | 2022/04/13 |
| EXA Signal Analyzer | Keysight | N9010B | MRTSUE06607 | 1 year | 2022/01/06 |
| Power Meter | Agilent | U2021XA | MRTSUE06030 | 1 year | 2021/10/22 |
| USB wideband power sensor | Keysight | U2021XA | MRTSUE06446 | 1 year | 2022/06/08 |
| USB wideband power sensor | Keysight | U2021XA | MRTSUE06447 | 1 year | 2022/06/08 |
| Attenuator | MVE | 3dB | MRTSUE06529 | 1 year | 2021/12/12 |
| Attenuator | MVE | 6dB | MRTSUE06534 | 1 year | 2021/12/12 |
| Attenuator | MVE | 10dB | MRTSUE06540 | 1 year | 2021/12/12 |
| Attenuator | MVE | 20dB | MRTSUE06547 | 1 year | 2021/12/12 |
| DC Power Supply | GWINSTEK | DPS-3303C | MRTSUE06064 | N/A | N/A |
| Temperature & Humidity Chamber | BAOYT | BYH-150CL | MRTSUE06051 | 1 year | 2021/10/21 |
| Thermal Hygrometer | testo | 608-H1 | MRTSUE06401 | 1 year | 2022/06/28 |

Radiated Emission (WZ-AC1)

| Instrument | Manufacturer | Type No. | Asset No. | Cali. Interval | Cali. Due Date |
|---|---|---|---|---|---|
| EMI Test Receiver | R&S | ESR7 | MRTSUE06001 | 1 year | 2022/01/04 |
| Loop Antenna | Schwarzbeck | FMZB 1519 | MRTSUE06025 | 1 year | 2021/11/08 |
| Bilog Period Antenna | Schwarzbeck | VULB 9168 | MRTSUE06172 | 1 year | 2022/08/08 |
| Horn Antenna | Schwarzbeck | BBHA 9120D | MRTSUE06023 | 1 year | 2021/09/27 |
| Horn Antenna | Schwarzbeck | BBHA9170 | MRTSUE06597 | 1 year | 2021/12/14 |
| Microwave System Amplifier | Agilent | 83017A | MRTSUE06076 | 1 year | 2021/11/14 |
| Preamplifier | Schwarzbeck | BBV 9721 | MRTSUE06121 | 1 year | 2022/06/09 |
| Thermal Hygrometer | testo | 608-H1 | MRTSUE06403 | 1 year | 2022/06/28 |
| Anechoic Chamber | TDK | Chamber-AC1 | MRTSUE06212 | 1 year | 2022/04/29 |

| Software | Version | Function |
|---|---|---|
| EMI Software | V3 | EMI Test Software |

# 4. 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: 3.74dB<br>150kHz~30MHz: 3.44dB |
| Radiated Disturbance |
| Measurement Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>Horizontal:<br>30MHz~300MHz: 5.04dB<br>300MHz~1GHz: 4.95dB<br>1GHz~40GHz: 6.40dB<br>Vertical:<br>30MHz~300MHz: 5.24dB<br>300MHz~1GHz: 6.03dB<br>1GHz~40GHz: 6.40dB |
| Spurious Emissions, Conducted |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>0.78dB |
| Output Power |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>1.13dB |
| Power Spectrum Density |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>1.15dB |
| Occupied Bandwidth |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>0.28% |

# 5. Test Result

## 5.1. Summary

| FCC Section(s) | Test Description | Test Limit | Test Condition | Test Result | Reference |
|---|---|---|---|---|---|
| 15.247(a)(2) | 6dB Bandwidth | ≥ 500kHz | Conducted | Pass | Section 5.2 |
| 15.247(b)(3) | Output Power | ≤ 30dBm | | Pass | Section 5.3 |
| 15.247(e) | Power Spectral Density | ≤ 8dBm/3kHz | | Pass | Section 5.4 |
| 15.247(d) | Band Edge / Out-of-Band Emissions | ≥ 30dBc (Average) | | Pass | Section 5.5 |
| 15.205<br>15.209 | General Field Strength (Restricted Bands and Radiated Emission) | Emissions in restricted bands must meet the radiated limits detailed in 15.209 | Radiated | Pass | Section 5.6 & 5.7 |
| 15.207 | AC Conducted Emissions 150kHz - 30MHz | < FCC 15.207 limits | Line Conducted | Pass | Section 5.8 |

**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) Output power test was verified over all data rates of each mode (data refers to operational description), and then choose the maximum power output (low data rate) for the final test of each channel.
3) 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.
4) EUT supports one configuration only in 802.11ax full RU mode, i.e. 242 tone in 11ax-HE20, 484 tone in 11ax-HE40.

## 5.2. 6dB Bandwidth Measurement

### 5.2.1.Test Limit

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

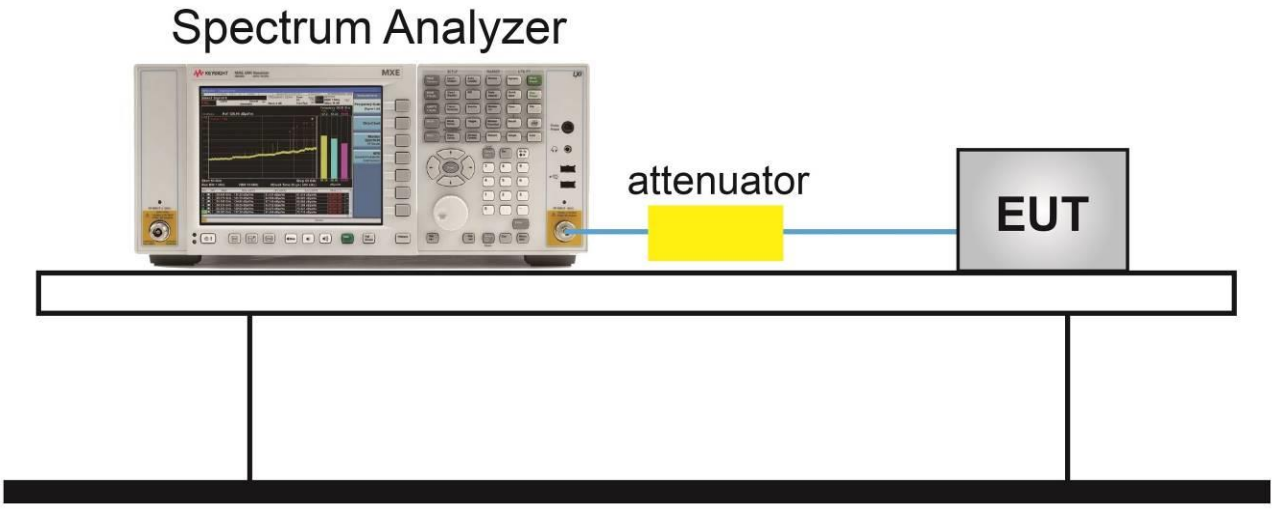
### 5.2.2.Test Procedure used

ANSI C63.10 - 2013 - Section 11.8

### 5.2.3.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

### 5.2.4.Test Setup



### 5.2.5.Test Result

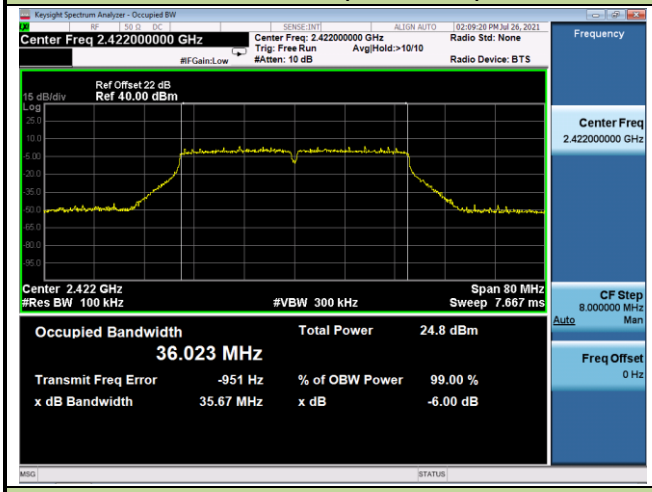
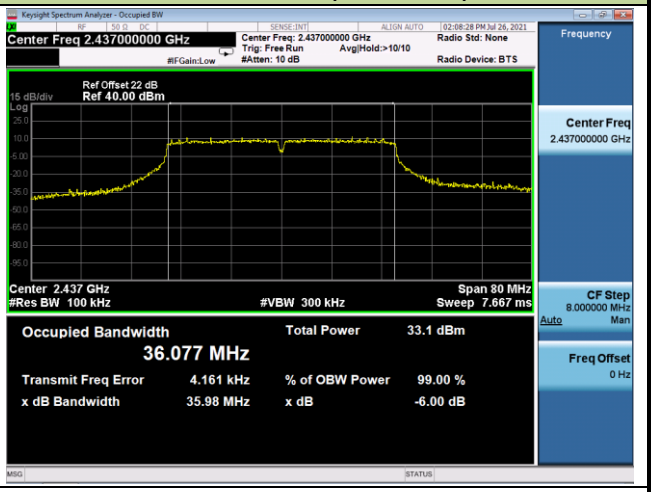
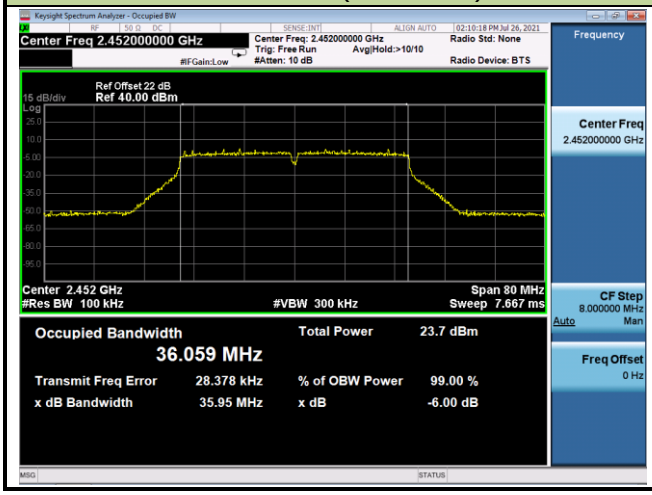
| Test Site | NS-TR2 | Test Engineer | Flag Yang |
|---|---|---|---|
| Test Date | 2021/07/26 | | |

| Test Mode | Data Rate / MCS | Channel No. | Frequency (MHz) | 6dB Bandwidth (MHz) | Limit (MHz) | Result |
|---|---|---|---|---|---|---|
| 802.11b | 1Mbps | 01 | 2412 | 8.09 | ≥ 0.5 | Pass |
| 802.11b | 1Mbps | 06 | 2437 | 7.59 | ≥ 0.5 | Pass |
| 802.11b | 1Mbps | 11 | 2462 | 7.12 | ≥ 0.5 | Pass |
| 802.11g | 6Mbps | 01 | 2412 | 15.66 | ≥ 0.5 | Pass |
| 802.11g | 6Mbps | 06 | 2437 | 16.30 | ≥ 0.5 | Pass |
| 802.11g | 6Mbps | 11 | 2462 | 15.66 | ≥ 0.5 | Pass |
| 802.11n-HT20 | MCS0 | 01 | 2412 | 16.78 | ≥ 0.5 | Pass |
| 802.11n-HT20 | MCS0 | 06 | 2437 | 16.94 | ≥ 0.5 | Pass |
| 802.11n-HT20 | MCS0 | 11 | 2462 | 16.51 | ≥ 0.5 | Pass |
| 802.11n-HT40 | MCS0 | 03 | 2422 | 35.67 | ≥ 0.5 | Pass |
| 802.11n-HT40 | MCS0 | 06 | 2437 | 35.98 | ≥ 0.5 | Pass |
| 802.11n-HT40 | MCS0 | 09 | 2452 | 35.95 | ≥ 0.5 | Pass |
| 802.11ax-HE20 | MCS0 | 01 | 2412 | 17.16 | ≥ 0.5 | Pass |
| 802.11ax-HE20 | MCS0 | 06 | 2437 | 18.35 | ≥ 0.5 | Pass |
| 802.11ax-HE20 | MCS0 | 11 | 2462 | 18.57 | ≥ 0.5 | Pass |
| 802.11ax-HE40 | MCS0 | 03 | 2422 | 37.68 | ≥ 0.5 | Pass |
| 802.11ax-HE40 | MCS0 | 06 | 2437 | 37.78 | ≥ 0.5 | Pass |
| 802.11ax-HE40 | MCS0 | 09 | 2452 | 37.82 | ≥ 0.5 | Pass |

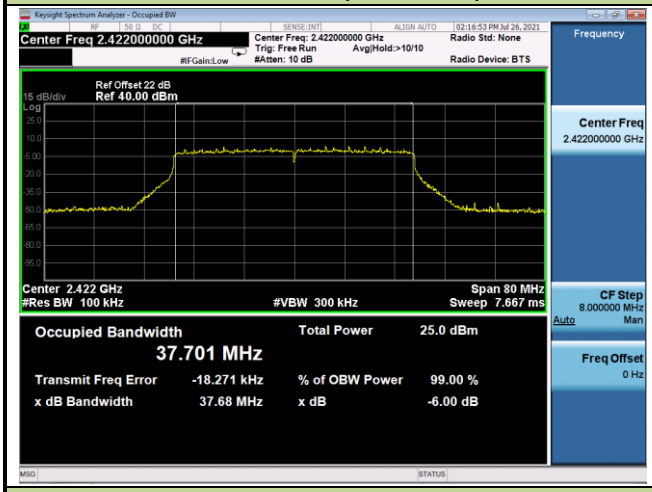
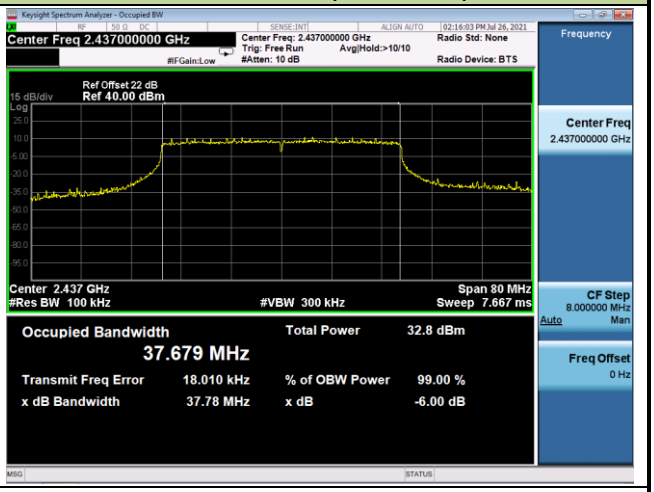
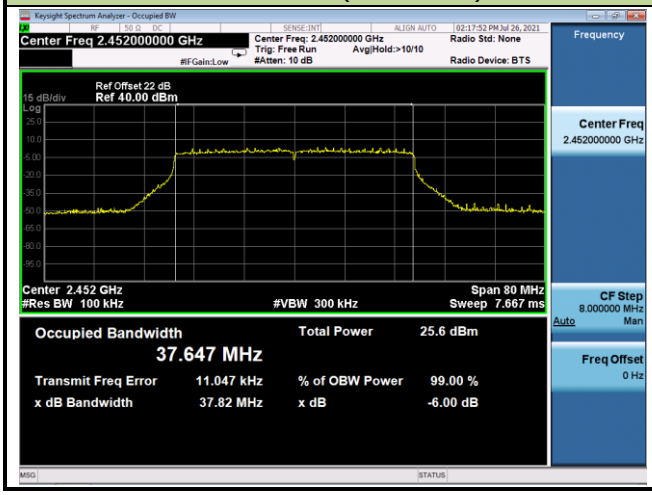
| 802.11b 6dB Bandwidth | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

| 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) | |
|  | |

## 5.3. Output Power Measurement

### 5.3.1.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.

### 5.3.2.Test Procedure Used

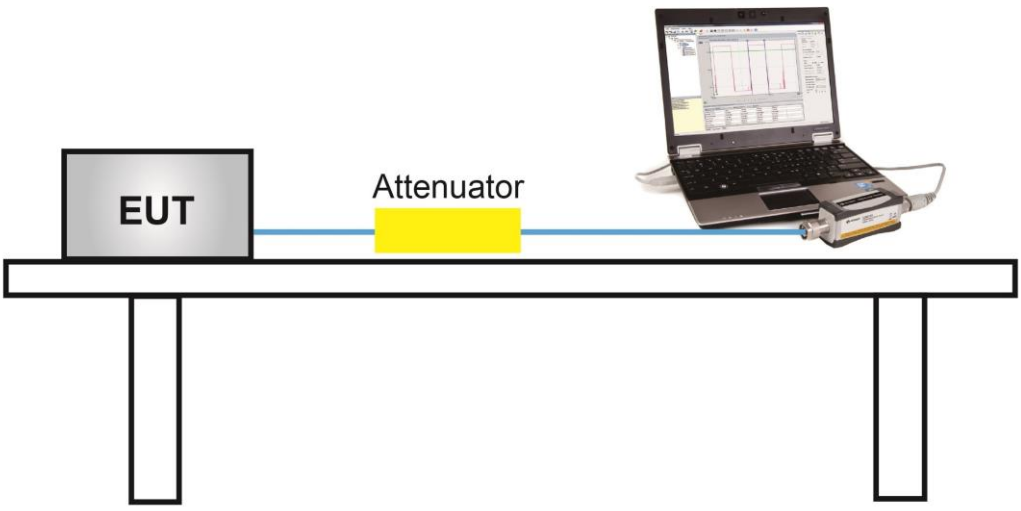
ANSI C63.10 - 2013 - Section 11.9.2.3.2

### 5.3.3.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.

### 5.3.4.Test Setup



### 5.3.5.Test Result

| Test Site | NS-TR2 | Test Engineer | Flag Yang |
|---|---|---|---|
| Test Date | 2021/08/06 | | |

| Test Mode | Data Rate/ MCS | Channel No. | Freq. (MHz) | Ant 0 Average Power (dBm) | Ant 1 Average Power (dBm) | Total Average Power (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|---|---|---|---|
| CDD Mode | | | | | | | | |
| 802.11b | 1Mbps | 01 | 2412 | 21.35 | 21.74 | 24.56 | ≤ 28.00 | Pass |
| 802.11b | 1Mbps | 06 | 2437 | 21.45 | 21.92 | 24.70 | ≤ 28.00 | Pass |
| 802.11b | 1Mbps | 11 | 2462 | 21.49 | 21.87 | 24.69 | ≤ 28.00 | Pass |
| 802.11g | 6Mbps | 01 | 2412 | 20.55 | 20.28 | 23.43 | ≤ 28.00 | Pass |
| 802.11g | 6Mbps | 02 | 2417 | 21.18 | 21.54 | 24.37 | ≤ 28.00 | Pass |
| 802.11g | 6Mbps | 06 | 2437 | 21.44 | 21.80 | 24.63 | ≤ 28.00 | Pass |
| 802.11g | 6Mbps | 10 | 2457 | 21.29 | 21.62 | 24.47 | ≤ 28.00 | Pass |
| 802.11g | 6Mbps | 11 | 2462 | 19.51 | 19.66 | 22.60 | ≤ 28.00 | Pass |
| 802.11n-HT20 | MCS0 | 01 | 2412 | 19.34 | 19.17 | 22.27 | ≤ 28.00 | Pass |
| 802.11n-HT20 | MCS0 | 02 | 2417 | 21.34 | 21.82 | 24.60 | ≤ 28.00 | Pass |
| 802.11n-HT20 | MCS0 | 06 | 2437 | 21.75 | 21.92 | 24.85 | ≤ 28.00 | Pass |
| 802.11n-HT20 | MCS0 | 10 | 2457 | 21.51 | 21.78 | 24.66 | ≤ 28.00 | Pass |
| 802.11n-HT20 | MCS0 | 11 | 2462 | 18.91 | 18.81 | 21.87 | ≤ 28.00 | Pass |
| 802.11n-HT40 | MCS0 | 03 | 2422 | 16.85 | 16.63 | 19.75 | ≤ 28.00 | Pass |
| 802.11n-HT40 | MCS0 | 06 | 2437 | 20.19 | 19.92 | 23.07 | ≤ 28.00 | Pass |
| 802.11n-HT40 | MCS0 | 08 | 2447 | 18.65 | 18.33 | 21.50 | ≤ 28.00 | Pass |
| 802.11n-HT40 | MCS0 | 09 | 2452 | 15.95 | 15.65 | 18.81 | ≤ 28.00 | Pass |
| 802.11ax-HE20 | MCS0 | 01 | 2412 | 19.07 | 19.02 | 22.06 | ≤ 28.00 | Pass |
| 802.11ax-HE20 | MCS0 | 02 | 2417 | 21.26 | 21.72 | 24.51 | ≤ 28.00 | Pass |
| 802.11ax-HE20 | MCS0 | 06 | 2437 | 21.42 | 21.72 | 24.58 | ≤ 28.00 | Pass |
| 802.11ax-HE20 | MCS0 | 10 | 2457 | 21.52 | 21.76 | 24.65 | ≤ 28.00 | Pass |
| 802.11ax-HE20 | MCS0 | 11 | 2462 | 18.14 | 18.21 | 21.19 | ≤ 28.00 | Pass |
| 802.11ax-HE40 | MCS0 | 03 | 2422 | 16.78 | 16.71 | 19.76 | ≤ 28.00 | Pass |
| 802.11ax-HE40 | MCS0 | 06 | 2437 | 19.22 | 18.88 | 22.06 | ≤ 28.00 | Pass |
| 802.11ax-HE40 | MCS0 | 09 | 2452 | 16.99 | 16.73 | 19.87 | ≤ 28.00 | Pass |

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

Note 2: Limit (dBm) = 30 - (8-6) = 28 dBm.

***Verified Data***

| Test Site | WZ-TR3 | Test Engineer | Bruce Wang |
|---|---|---|---|
| Test Date | 2021/08/27 | | |

| Test Mode | Data Rate/ MCS | Channel No. | Freq. (MHz) | Ant 0 Average Power (dBm) | Ant 1 Average Power (dBm) | Total Average Power (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|---|---|---|---|
| CDD Mode | | | | | | | | |
| 802.11b | 1Mbps | 01 | 2412 | 21.24 | 21.63 | 24.45 | ≤ 28.00 | Pass |
| 802.11b | 1Mbps | 06 | 2437 | 21.33 | 21.79 | 24.58 | ≤ 28.00 | Pass |
| 802.11b | 1Mbps | 11 | 2462 | 21.34 | 21.77 | 24.57 | ≤ 28.00 | Pass |
| 802.11g | 6Mbps | 01 | 2412 | 20.44 | 20.17 | 23.32 | ≤ 28.00 | Pass |
| 802.11g | 6Mbps | 02 | 2417 | 21.10 | 21.48 | 24.30 | ≤ 28.00 | Pass |
| 802.11g | 6Mbps | 06 | 2437 | 21.28 | 21.65 | 24.48 | ≤ 28.00 | Pass |
| 802.11g | 6Mbps | 10 | 2457 | 21.18 | 21.48 | 24.34 | ≤ 28.00 | Pass |
| 802.11g | 6Mbps | 11 | 2462 | 19.33 | 19.55 | 22.45 | ≤ 28.00 | Pass |
| 802.11n-HT20 | MCS0 | 01 | 2412 | 19.20 | 19.12 | 22.17 | ≤ 28.00 | Pass |
| 802.11n-HT20 | MCS0 | 02 | 2417 | 21.18 | 21.69 | 24.45 | ≤ 28.00 | Pass |
| 802.11n-HT20 | MCS0 | 06 | 2437 | 21.62 | 21.84 | 24.74 | ≤ 28.00 | Pass |
| 802.11n-HT20 | MCS0 | 10 | 2457 | 21.45 | 21.63 | 24.55 | ≤ 28.00 | Pass |
| 802.11n-HT20 | MCS0 | 11 | 2462 | 18.79 | 18.65 | 21.73 | ≤ 28.00 | Pass |
| 802.11n-HT40 | MCS0 | 03 | 2422 | 16.66 | 16.58 | 19.63 | ≤ 28.00 | Pass |
| 802.11n-HT40 | MCS0 | 06 | 2437 | 20.10 | 19.79 | 22.96 | ≤ 28.00 | Pass |
| 802.11n-HT40 | MCS0 | 08 | 2447 | 18.56 | 18.23 | 21.41 | ≤ 28.00 | Pass |
| 802.11n-HT40 | MCS0 | 09 | 2452 | 15.87 | 15.57 | 18.73 | ≤ 28.00 | Pass |
| 802.11ax-HE20 | MCS0 | 01 | 2412 | 19.01 | 18.89 | 21.96 | ≤ 28.00 | Pass |
| 802.11ax-HE20 | MCS0 | 02 | 2417 | 21.21 | 21.66 | 24.45 | ≤ 28.00 | Pass |
| 802.11ax-HE20 | MCS0 | 06 | 2437 | 21.33 | 21.66 | 24.51 | ≤ 28.00 | Pass |
| 802.11ax-HE20 | MCS0 | 10 | 2457 | 21.44 | 21.64 | 24.55 | ≤ 28.00 | Pass |
| 802.11ax-HE20 | MCS0 | 11 | 2462 | 18.10 | 18.16 | 21.14 | ≤ 28.00 | Pass |
| 802.11ax-HE40 | MCS0 | 03 | 2422 | 16.73 | 16.65 | 19.70 | ≤ 28.00 | Pass |
| 802.11ax-HE40 | MCS0 | 06 | 2437 | 19.13 | 18.76 | 21.96 | ≤ 28.00 | Pass |
| 802.11ax-HE40 | MCS0 | 09 | 2452 | 16.86 | 16.68 | 19.78 | ≤ 28.00 | Pass |

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

Note 2: Limit (dBm) = 30 - (8-6) = 28 dBm.

## 5.4. Power Spectral Density Measurement

### 5.4.1.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.

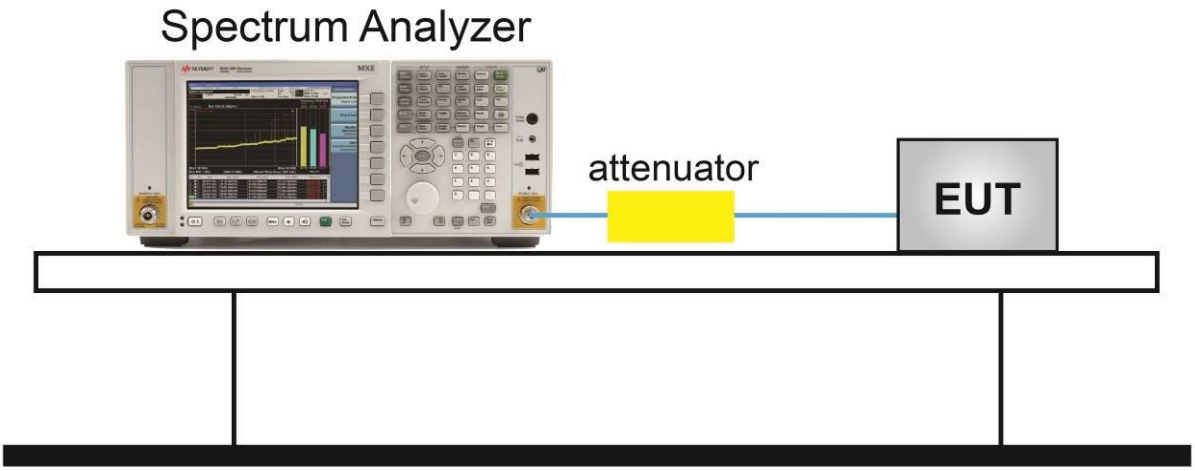
### 5.4.2.Test Procedure Used

ANSI C63.10 - 2013 - Section 11.10.5

### 5.4.3.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.
12. Add 10 log (1/x), where x is the duty cycle measured in step (a, to the measured PSD to compute the average PSD during the actual transmission time. If measured value exceeds requirement specified by regulatory agency, then reduce RBW (but no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span to meet the minimum measurement point requirement as the RBW is reduced).

### 5.4.4.Test Setup



### 5.4.5.Test Result

| Test Site | NS-TR2 | Test Engineer | Flag Yang |
|---|---|---|---|
| Test Date | 2021/07/26~2021/08/05 | | |

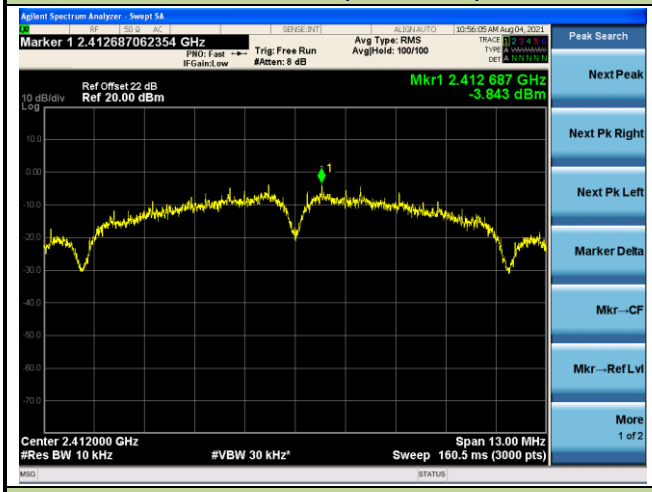
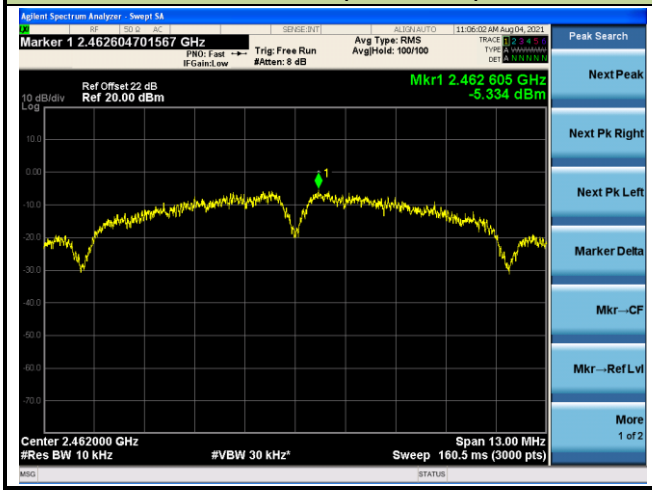
| Test Mode | Data Rate/ MCS | Channel No. | Freq. (MHz) | Ant 0 PSD (dBm/ 10kHz) | Ant 1 PSD (dBm/ 10kHz) | Duty Cycle (%) | Total PSD (dBm/ 10kHz) | Limit (dBm/ 3kHz) | Result |
|---|---|---|---|---|---|---|---|---|---|
| 802.11b | 1Mbps | 01 | 2412 | -3.84 | -3.55 | 62.39 | 1.36 | ≤ 2.99 | Pass |
| 802.11b | 1Mbps | 06 | 2437 | -5.08 | -5.41 | 62.39 | -0.19 | ≤ 2.99 | Pass |
| 802.11b | 1Mbps | 11 | 2462 | -5.33 | -5.31 | 62.39 | -0.26 | ≤ 2.99 | Pass |
| 802.11g | 6Mbps | 01 | 2412 | -8.43 | -8.71 | 94.70 | -5.32 | ≤ 2.99 | Pass |
| 802.11g | 6Mbps | 06 | 2437 | -7.71 | -7.05 | 94.70 | -4.12 | ≤ 2.99 | Pass |
| 802.11g | 6Mbps | 11 | 2462 | -9.61 | -8.93 | 94.70 | -6.01 | ≤ 2.99 | Pass |
| 802.11n-HT20 | MCS0 | 01 | 2412 | -10.16 | -10.52 | 95.15 | -7.11 | ≤ 2.99 | Pass |
| 802.11n-HT20 | MCS0 | 06 | 2437 | -8.30 | -8.01 | 95.15 | -4.92 | ≤ 2.99 | Pass |
| 802.11n-HT20 | MCS0 | 11 | 2462 | -11.06 | -11.28 | 95.15 | -7.94 | ≤ 2.99 | Pass |
| 802.11n-HT40 | MCS0 | 03 | 2422 | -16.01 | -16.00 | 94.47 | -12.75 | ≤ 2.99 | Pass |
| 802.11n-HT40 | MCS0 | 06 | 2437 | -11.96 | -12.44 | 94.47 | -8.94 | ≤ 2.99 | Pass |
| 802.11n-HT40 | MCS0 | 09 | 2452 | -16.76 | -17.16 | 94.47 | -13.70 | ≤ 2.99 | Pass |
| 802.11ax-HE20 | MCS0 | 01 | 2412 | -11.71 | -12.00 | 94.70 | -8.61 | ≤ 2.99 | Pass |
| 802.11ax-HE20 | MCS0 | 06 | 2437 | -9.19 | -9.47 | 94.70 | -6.08 | ≤ 2.99 | Pass |
| 802.11ax-HE20 | MCS0 | 11 | 2462 | -12.74 | -12.96 | 94.70 | -9.60 | ≤ 2.99 | Pass |
| 802.11ax-HE40 | MCS0 | 03 | 2422 | -16.91 | -16.84 | 86.86 | -13.25 | ≤ 2.99 | Pass |
| 802.11ax-HE40 | MCS0 | 06 | 2437 | -13.61 | -14.05 | 86.86 | -10.20 | ≤ 2.99 | Pass |
| 802.11ax-HE40 | MCS0 | 09 | 2452 | -16.58 | -16.87 | 86.86 | -13.10 | ≤ 2.99 | Pass |

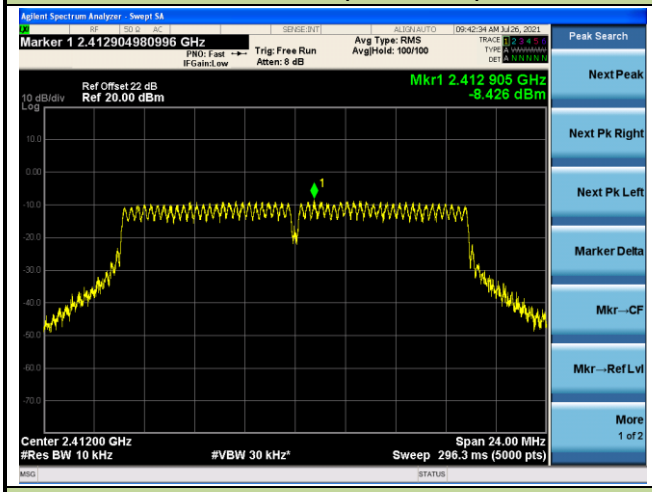
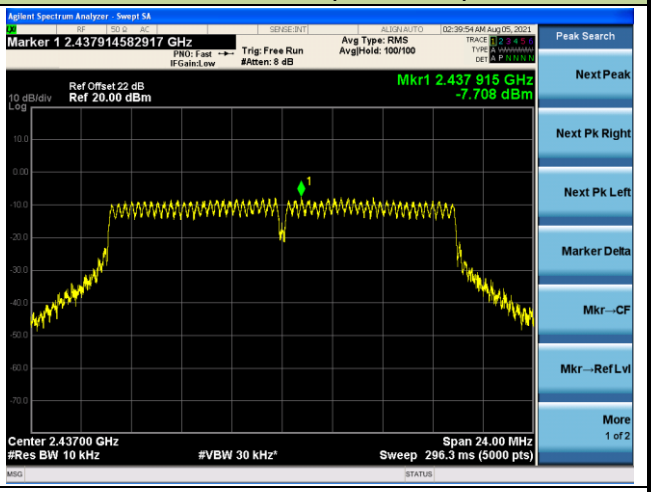
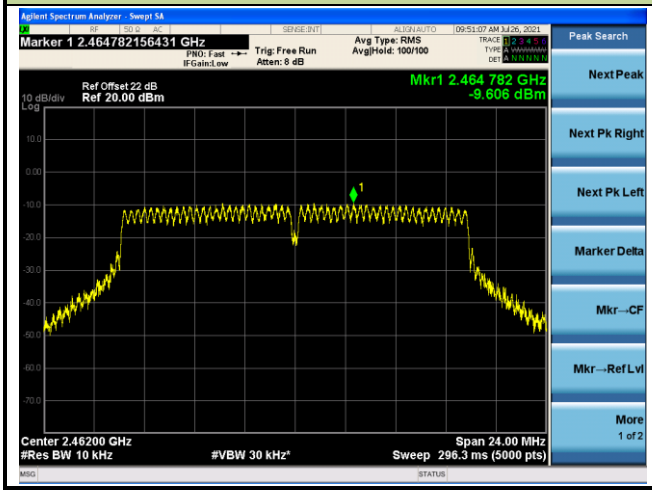
Note 1:

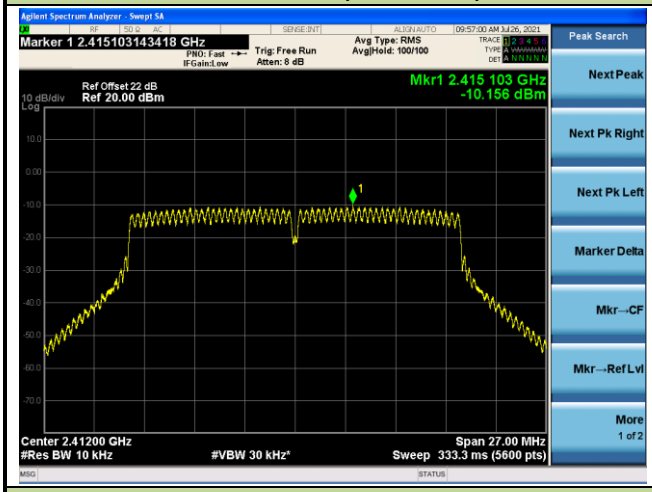
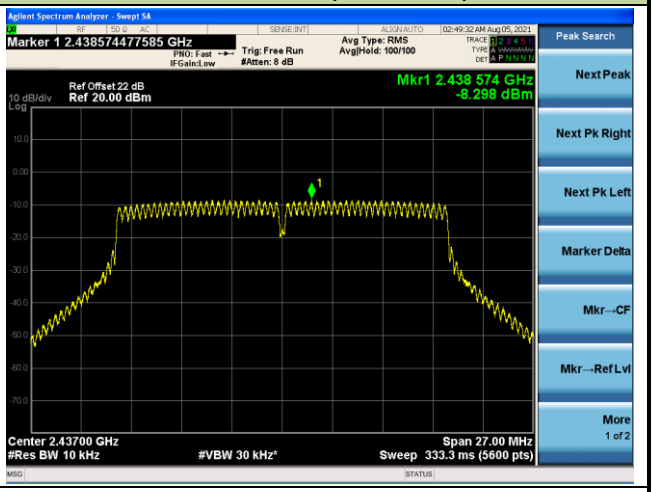
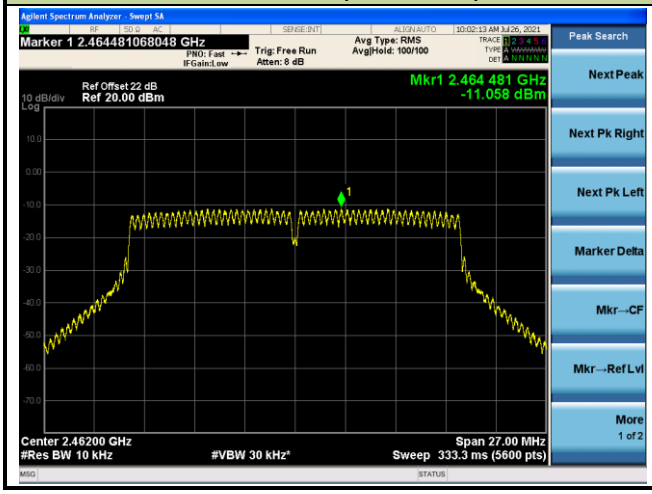
When EUT duty cycle > 98%, Total AVGPSD = 10*log $\{10^{(\text{Ant 0 AVGPSD}/10)} + 10^{(\text{Ant 1 AVGPSD}/10)}\}$

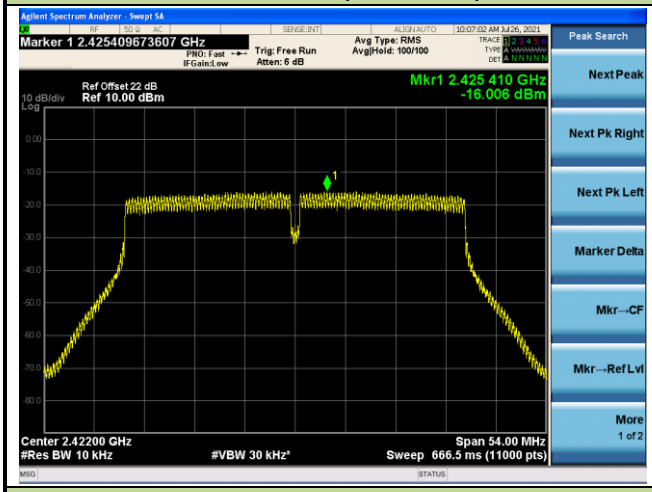
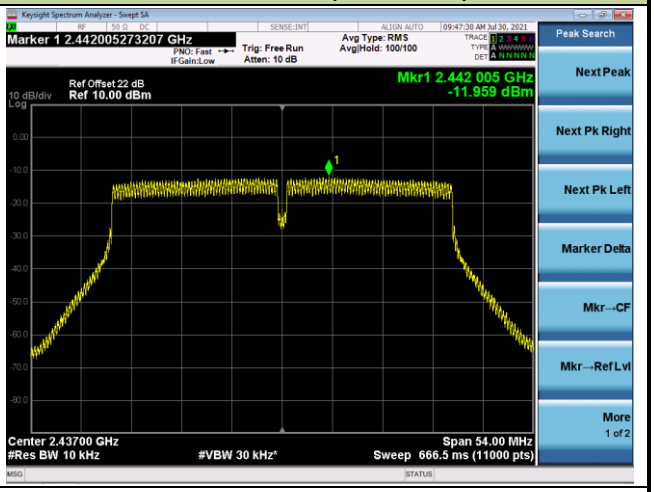
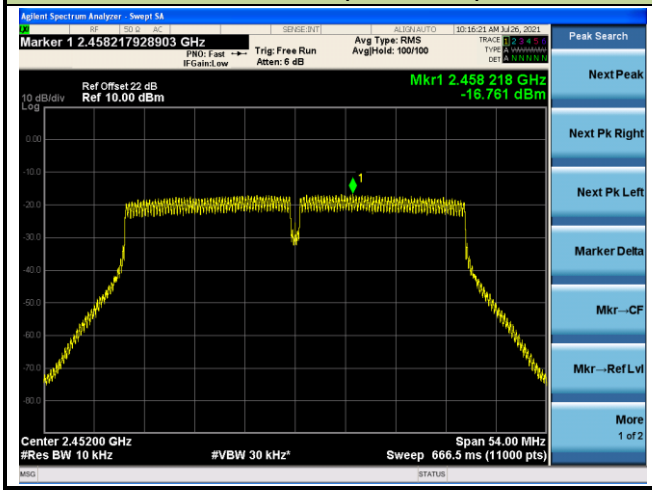
When EUT duty cycle ≤ 98%, Total AVGPSD = 10*log $\{10^{(\text{Ant 0 AVGPSD}/10)} + 10^{(\text{Ant 1 AVGPSD}/10)}\}$ + 10*log (1/Duty Cycle).

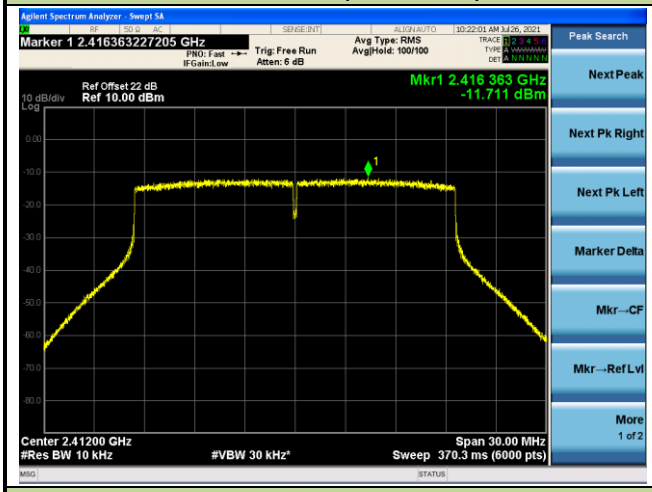
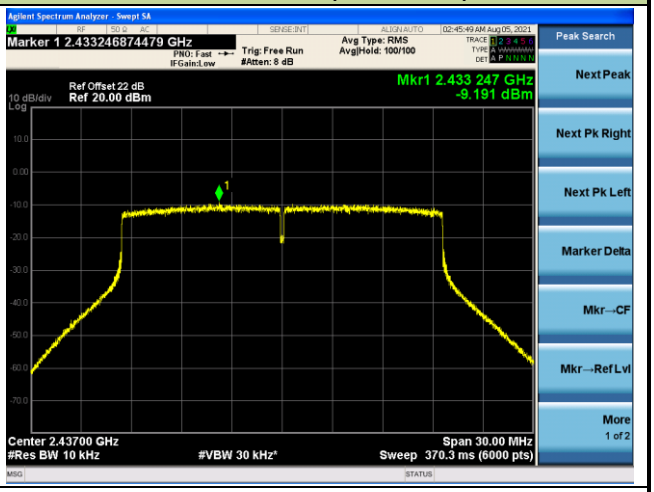
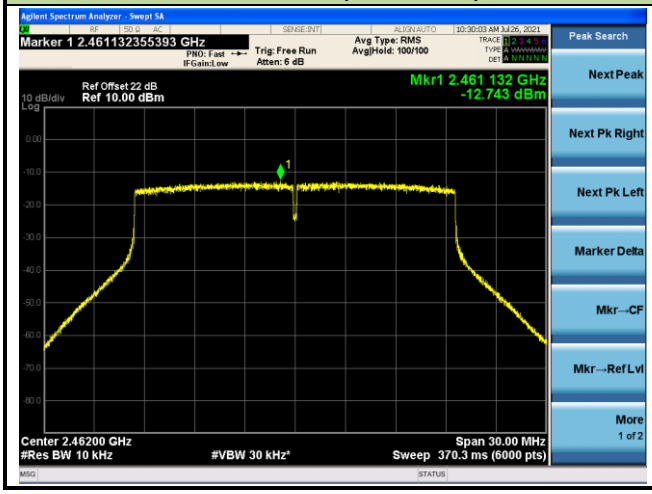
Note 2: Limit (dBm/3kHz) = 8 - (11.01 - 6) = 2.99 dBm/3kHz.

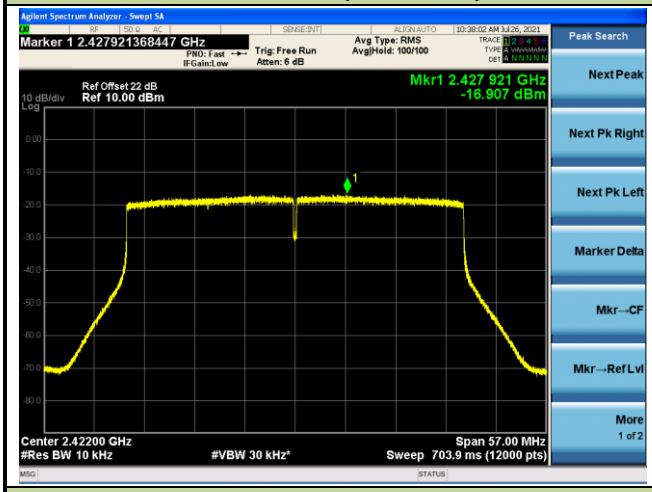
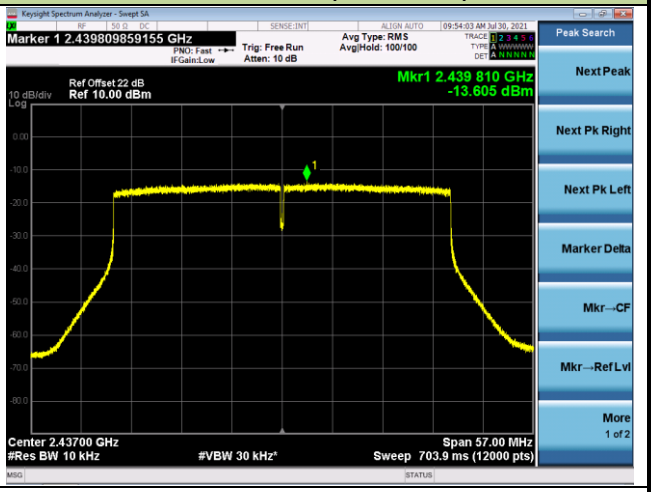
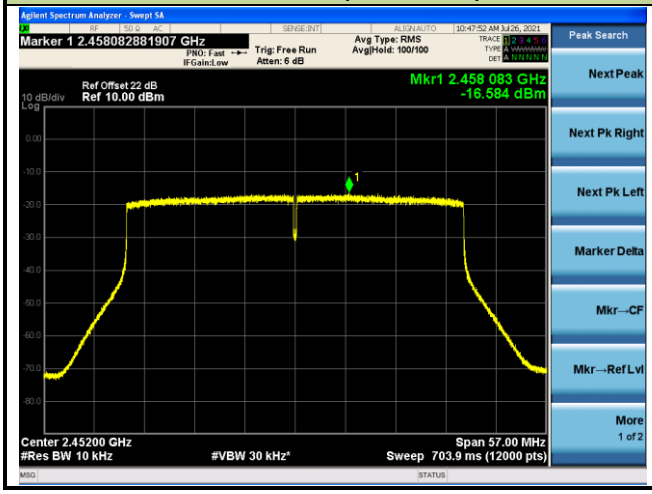
| 802.11b - AVGPSD - Ant 0 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

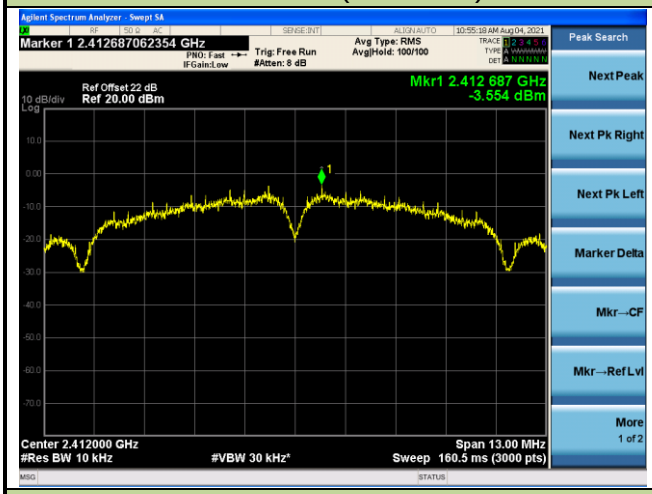
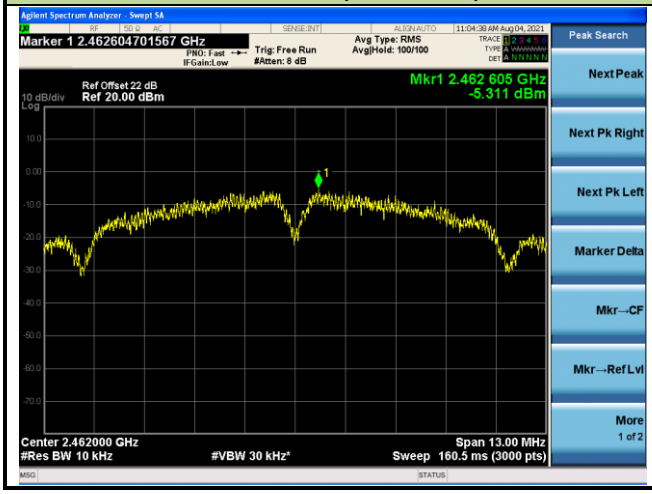
| 802.11g - AVGPSD - Ant 0 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

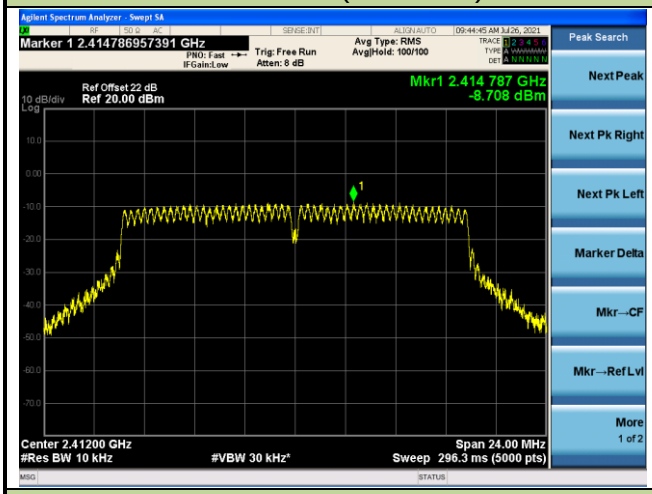
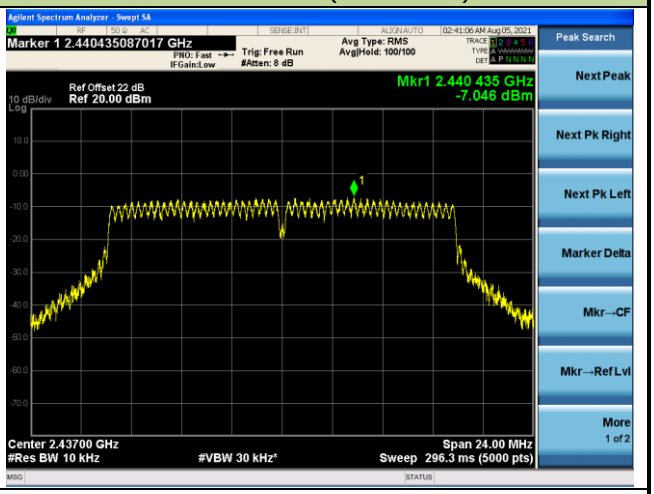
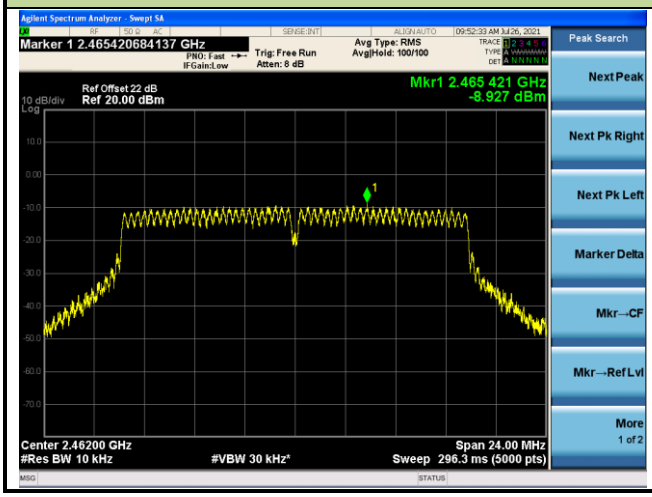
| 802.11n-HT20 - AVGPSD - Ant 0 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

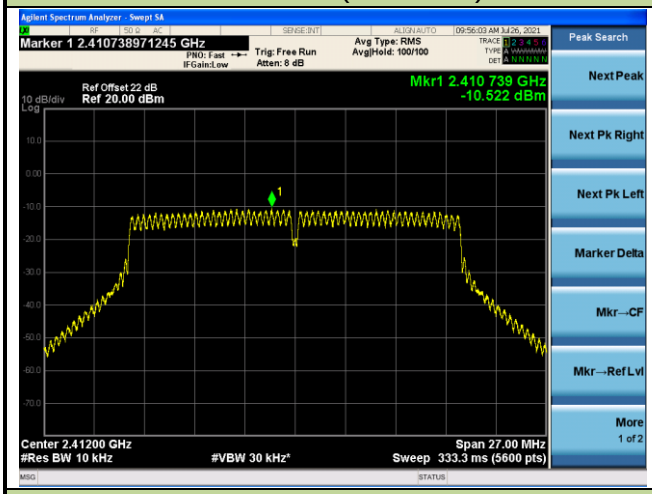
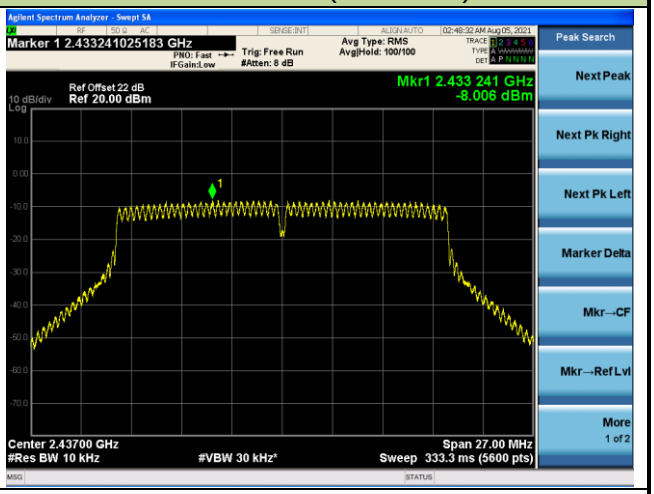
| 802.11n-HT40 - AVGPSD - Ant 0 | |
|---|---|
| Channel 03 (2422MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 09 (2452MHz) | |
|  | |

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

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

| 802.11b AVGPSD - Ant 1 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

| 802.11g - AVGPSD - Ant 1 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

| 802.11n-HT20 - AVGPSD - Ant 1 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
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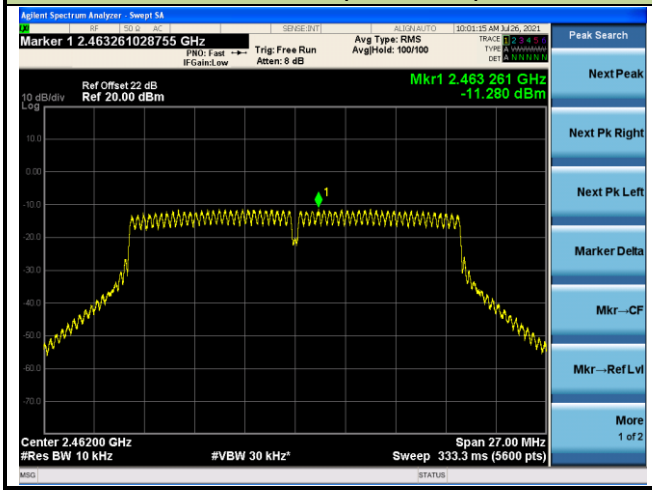
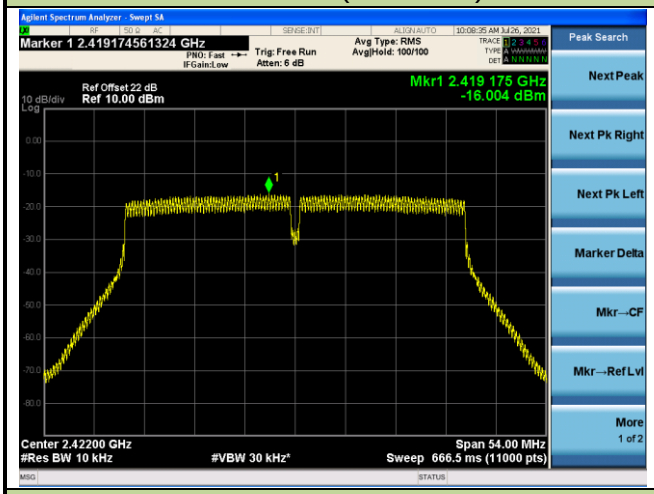
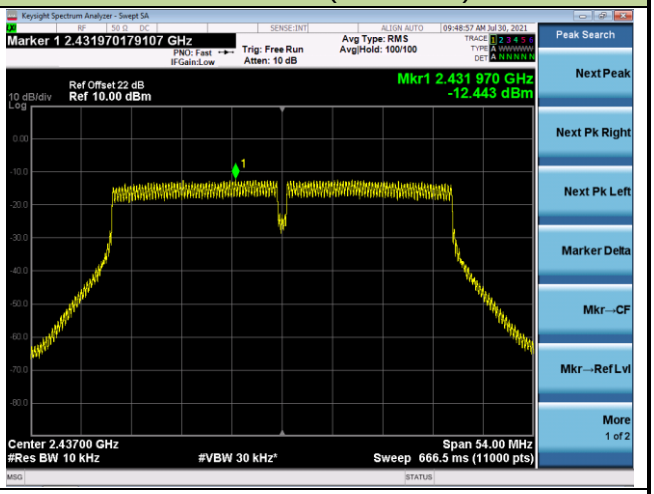
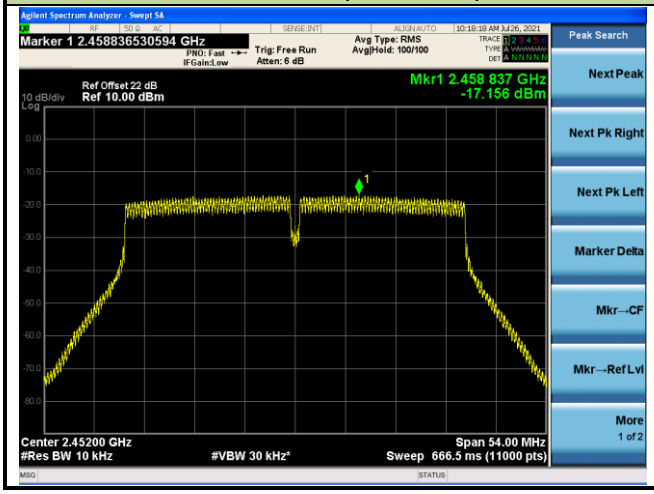
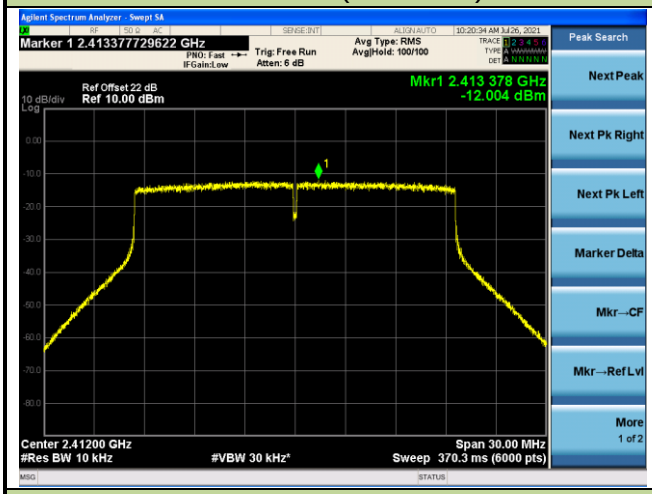
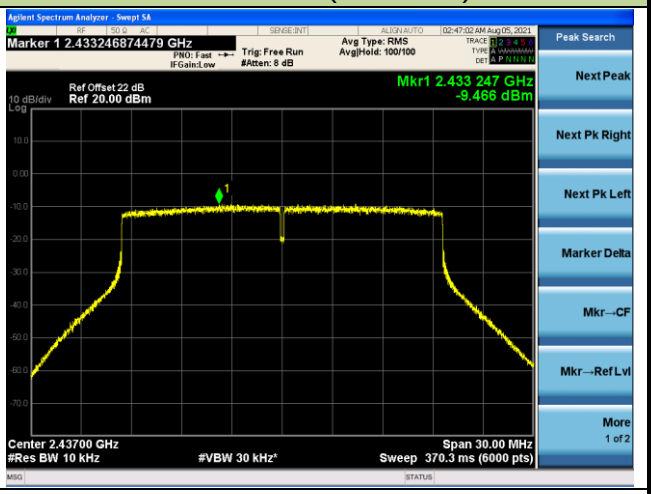
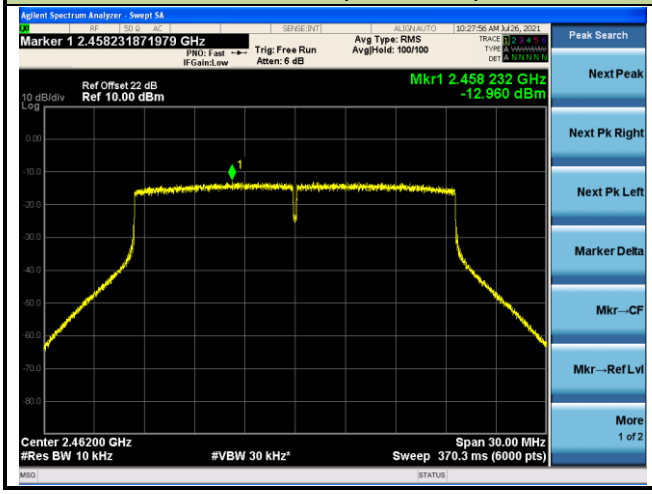
|  | |

| 802.11n-HT40 - AVGPSD - Ant 1 | |
|---|---|
| Channel 03 (2422MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 09 (2452MHz) | |
|  | |

| 802.11ax-HE20 - AVGPSD - Ant 1 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |