# RADIO TEST REPORT

| | | |
|---|---|---|
| **Product** | : | IEEE 802.11ax/ac/a/b/g/n WiFi6E with BT5.2 Module |
| **Model Name** | : | ACB-QCA206x |
| **Series Model** | : | ACB-QCA2066-0WI1, ACB-QCA2066-0WX1, ACB-QCA2066-5WI1, ACB-QCA2066-5WX1, ACB-QCA2066-0WI4, ACB-QCA2066-0WX4, ACB-QCA2066-5WI4, ACB-QCA2066-5WX4 |
| **FCC ID** | : | 2AE3B-ACB-QCA206X |
| **Test Regulation** | : | FCC 47 CFR Part 15 Subpart C (Section 15.247) |
| **Received Date** | : | 2023/6/26 |
| **Test Date** | : | 2023/7/1 ~ 2023/8/11 |
| **Issued Date** | : | 2023/9/6 |
| **Applicant** | : | VOXMICRO LTD<br>20955 Pathfinder Rd., STE 100, Diamond Bar, California 91765, USA |
| **Issued By** | : | Underwriters Laboratories Taiwan Co., Ltd.<br>Building A, B and E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan |

Testing Laboratory
3398

# REVISION HISTORY

## Original Test Report No.: 4790836594-US-R0-V0

| Revision | Test report No. | Date | Page revised | Contents |
|---|---|---|---|---|
| Original | 4790836594-US-R0-V0 | 2023/9/6 | - | Initial issue |

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# 1. Attestation of Test Results

| | |
|---|---|
| **APPLICANT:** | VOXMICRO LTD<br>20955 Pathfinder Rd., STE 100, Diamond Bar, California 91765, USA |
| **MANUFACTURER:** | VOXMICRO LTD<br>8F.-3, No.5, Aly. 22, Ln. 513, Rueiguang Rd., Neihu Dist., Taipei City 114, Taiwan |
| **EUT DESCRIPTION:** | IEEE 802.11ax/ac/a/b/g/n WiFi6E with BT5.2 Module |
| **BRAND:** | AIRETOS |
| **MODEL:** | ACB-QCA206x |
| **SERIES MODEL:** | ACB-QCA2066-0WI1, ACB-QCA2066-0WX1, ACB-QCA2066-5WI1, ACB-QCA2066-5WX1, ACB-QCA2066-0WI4, ACB-QCA2066-0WX4, ACB-QCA2066-5WI4, ACB-QCA2066-5WX4 |
| **SAMPLE STAGE:** | Engineering Verification Test sample |
| **DATE of TESTED:** | 2023/7/1 ~ 2023/8/11 |

| **APPLICABLE STANDARDS** | |
|---|---|
| **STANDARD** | **Test Results** |
| FCC 47 CFR PART 15 Subpart C (Section 15.247) | PASS |

Underwriters Laboratories Taiwan Co., Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Underwriters Laboratories Taiwan Co., Ltd. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Prepared By:

Cindy Hsin Date : 2023/9/6
Project Handler

Approved and Authorized By:

Eric Lee Date : 2023/9/6
Senior Laboratory Engineer

## 2. Summary of Test Results

| Summary of Test Results | | |
|---|---|---|
| **FCC Clause** | **Test Items** | **Result** |
| 15.247(a)(2) | 6dB Bandwidth | PASS |
| 15.247(b) | Conducted Output Power | PASS |
| 15.247(e) | Power Spectral Density | PASS |
| 15.247(d) | Antenna Port Emission | PASS |
| 15.205 / 15.209 / 15.247(d) | Radiated Emissions and Band Edge Measurement | PASS |
| 15.207 | AC Power Conducted Emission | PASS |
| 15.203 | Antenna Requirement | PASS |

# 3. Test Methodology and Reference Procedures

The tests documented in this report were performed in accordance with 47 CFR FCC Part 2, KDB558074 D01 Meas Guidance v05r02, KDB414788 D01 Radiated Test Site v01r01, ANSI C63.10-2013 and KDB 662911 D01 Multiple Transmitter Output v02r01.

# 4. Facilities and Accreditation

| | |
|---|---|
| **Test Location** | Underwriters Laboratories Taiwan Co., Ltd. |
| **Address** | Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan |
| **Accreditation Certificate** | Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398. |

# 5. Measurement Uncertainty

For statement of conformity, Simple acceptance (Section 4.3.4 of ISO Guide 115) was applied as decision rule for measurement in this test report.

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor k=2.

Determining compliance based on the results of the compliance measurement, not considering measurement instrumentation uncertainty.

| Measurement | Frequency | Uncertainty |
|---|---|---|
| Conducted disturbance at mains terminals ports | 150kHz ~ 30MHz | ±3.1 dB |
| RF Conducted | 9 kHz - 40GHz | ±2.3 dB |
| Radiated disturbance below 30MHz | 9 kHz - 30 MHz | ±3.2 dB |
| Radiated disturbance below 1 GHz | 30MHz ~ 1GHz | ±6.1 dB |
| Radiated disturbance above 1 GHz | 1GHz ~ 40GHz | ±5.1 dB |

# 6. Equipment under Test

## 6.1. Description of EUT

| | |
|---|---|
| **Product** | IEEE 802.11ax/ac/a/b/g/n WiFi6E with BT5.2 Module |
| **Brand Name** | AIRETOS |
| **Model Name** | ACB-QCA206x |
| **Series Model** | ACB-QCA2066-0WI1, ACB-QCA2066-0WX1,<br>ACB-QCA2066-5WI1, ACB-QCA2066-5WX1,<br>ACB-QCA2066-0WI4, ACB-QCA2066-0WX4,<br>ACB-QCA2066-5WI4, ACB-QCA2066-5WX4 |
| **Operating Frequency** | 2412MHz ~ 2462MHz |
| **Modulation** | CCK, DQPSK, DBPSK for DSSS<br>1024QAM, 64QAM, 16QAM, QPSK, BPSK for OFDM |
| **Transfer Rate** | 802.11b: up to 11 Mbps<br>802.11g: up to 54 Mbps<br>802.11n: up to MCS15<br>802.11ac: up to MCS9<br>802.11ax: up to MCS11 |
| **Number of Channel** | 11 for 802.11b, 802.11g, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20)<br>7 for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40) |
| **Maximum Output Power** | 802.11b: 26.36 dBm<br>802.11g: 27.84 dBm<br>802.11ax (HE20): 27.86 dBm<br>802.11ax (HE40): 24.58 dBm |
| **Normal Voltage** | 3.3 Vdc from host system |
| **Sample ID** | 6199534 |

Note:

1. The models difference table as below:

| Model | Difference |
|---|---|
| ACB-QCA206x | Market assignment classification for application and grade finish |
| ACB-QCA2066-0WI1 | |
| ACB-QCA2066-0WX1 | |
| ACB-QCA2066-5WI1 | |
| ACB-QCA2066-5WX1 | |
| ACB-QCA2066-0WI4 | |
| ACB-QCA2066-0WX4 | |
| ACB-QCA2066-5WI4 | |
| ACB-QCA2066-5WX4 | |

2. The EUT incorporates a MIMO function. Physically, the EUT provides two completed transmitters and two receivers.

| Modulation Mode | Tx,Rx Function |
|---|---|
| 802.11b | 2TX,2RX |
| 802.11g | 2TX,2RX |
| 802.11n (HT20) | 2TX,2RX |
| 802.11n (HT40) | 2TX,2RX |
| 802.11ac (VHT20) | 2TX,2RX |
| 802.11ac (VHT40) | 2TX,2RX |
| 802.11ax (HE20) | 2TX,2RX |
| 802.11ax (HE40) | 2TX,2RX |

* The modulation and bandwidth are similar for 802.11n mode for HT20 / HT40 and 802.11ac mode for VHT20 / VHT40 and 802.11ax mode for HE20 / HE40, therefore investigated worst case to representative mode in test report.

3. The EUT contains following accessory devices:

| Product | Brand | Model | Description |
|---|---|---|---|
| Antenna | OXFORDTEC | WANT-4DBI-SMA | - |

4. The above EUT information is declared by manufacturer and for more detailed features description, please refer the manufacturer's or user's manual, the laboratory shall not be held responsible.

## 6.2. Channel List

11 channels are provided for 802.11b, 802.11g and 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20):

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---|---|---|---|
| 1 | 2412 | 7 | 2442 |
| 2 | 2417 | 8 | 2447 |
| 3 | 2422 | 9 | 2452 |
| 4 | 2427 | 10 | 2457 |
| 5 | 2432 | 11 | 2462 |
| 6 | 2437 | - | - |

7 channels are provided for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40):

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---|---|---|---|
| 3 | 2422 | 7 | 2442 |
| 4 | 2427 | 8 | 2447 |
| 5 | 2432 | 9 | 2452 |
| 6 | 2437 | - | - |

## 6.3. Test Condition

| Test Item | Test Site No. | Environmental Condition | Input Power | Test Date | Tested by |
|---|---|---|---|---|---|
| Antenna Port Conducted Measurement | SR4 | 21~28°C/ 51~69%RH | 3.3 Vdc from host system | 2023/07/18~ 2023/08/11 | Rex Chen |
| Radiated Spurious Emission | 966-2 | 21~28°C/ 51~69%RH | 3.3 Vdc from host system | 2023/07/01~ 2023/08/11 | Rex Chen |
| AC power Line Conducted Emission | SR1 | 21~28°C/ 51~69%RH | 3.3 Vdc from host system | 2023/08/07~ 2023/08/11 | Rex Chen |

FCC Test Firm Registration Number: 498077

### Sample Calculation:

Antenna Port Conducted Measurement:

- Where relevant, the follow sample calculation is provided:
  Result Value (dBm) = Reading Value (dBm) +Attenuator Factor (dB) + Cable Loss (dB).
  Example: Result Value (10dBm) = Reading Value (-2dBm) +Attenuator Factor (10dB) + Cable Loss(2dB).
  *Test plot only shown the “Result Value”.

Radiated Spurious Emission:

- Where relevant, the follow sample calculation is provided:
  Result Value (dBuV/m) = Reading Value (dBuV) + Correction Factor (dB/m).
  Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB) - Preamp Factor (dB).
  Example: Result Value (34.5dBuV/m) = Reading Value (40.1dBuV) + Antenna Factor (18.7dB/m) + Cable Loss (4.2dB) - Preamp Factor (28.5dB).

AC power Line Conducted Emission:

- Where relevant, the follow sample calculation is provided:
  Result Value (dBuV) = Reading Value (dBuV) + Correction Factor (dB).
  Correction Factor (dB) = Insertion loss(dB) + Cable loss(dB).
  Example: Result Value (53.7dBuV) = Reading Value (35.1dBuV) + Insertion loss(18.1dB) + Cable loss(0.5dB).

## 6.4. Description of Available Antennas

| Ant. No. | Transmitter Circuit | Brand Name | Model Name | Ant. Type | Maximum Gain (dBi) |
|---|---|---|---|---|---|
| 1 | Chain (0+1) | OXFORDTEC | WANT-4DBI-SMA | Omni | 3.5 |

Note: The above antenna information was provided from customer and for more detailed features description, please refer the manufacturer's specification or user's manual, the laboratory shall not be held responsible.

## 6.5. Test Mode Applicability and Tested Channel Detail

- The fundamental of the omni antenna was investigated in two orthogonal (lay and stand), it was determined that stand mode was worst-case. Therefore, all final radiated testing was performed with the dipole antenna in stand mode.
- The EUT has nine types for model: ACB-QCA206x, ACB-QCA2066-0WI1, ACB-QCA2066-0WX1, ACB-QCA2066-5WI1, ACB-QCA2066-5WX1, ACB-QCA2066-0WI4, ACB-QCA2066-0WX4, ACB-QCA2066-5WI4 and ACB-QCA2066-5WX4. The worst case was ACB-QCA206x by pretest. Therefore the test data of the ACB-QCA206x was recorded in this report only.
- For Antenna Port Conducted Measurement, this item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel), parallel and perpendicular are the worst orientations, therefore testing was performed on these two orientations only.
- For below 1 GHz radiated emission and AC power line conducted emission have performed all modes of operation were investigated and the worst-case emissions are reported.
- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

| Test Item | Mode | Modulation Technology | Modulation Type | Available Channel | Test Channel | Data Rate |
|---|---|---|---|---|---|---|
| Radiated Emissions (Above 1GHz) | 802.11b | DSSS | DBPSK | 1 to 11 | 1,6,10,11 | 1 Mbps |
| | 802.11g | OFDM | BPSK | 1 to 11 | 1,6,10,11 | 6 Mbps |
| | 802.11ax20 | OFDM | BPSK | 1 to 11 | 1,6,10,11 | HE0 |
| | 802.11ax40 | OFDM | BPSK | 3 to 9 | 3,6,9 | HE0 |
| Radiated Emissions (Below 1GHz) | 802.11ax20 | OFDM | BPSK | 1 to 11 | 6 | HE0 |
| AC Power Line Conducted Emission | 802.11ax20 | OFDM | BPSK | 1 to 11 | 6 | HE0 |
| Antenna Port Conducted Measurement | 802.11b | DSSS | DBPSK | 1 to 11 | 1,6,10,11 | 1 Mbps |
| | 802.11g | OFDM | BPSK | 1 to 11 | 1,6,10,11 | 6 Mbps |
| | 802.11ax20 | OFDM | BPSK | 1 to 11 | 1,6,10,11 | HE0 |
| | 802.11ax40 | OFDM | BPSK | 3 to 9 | 3,6,9 | HE0 |

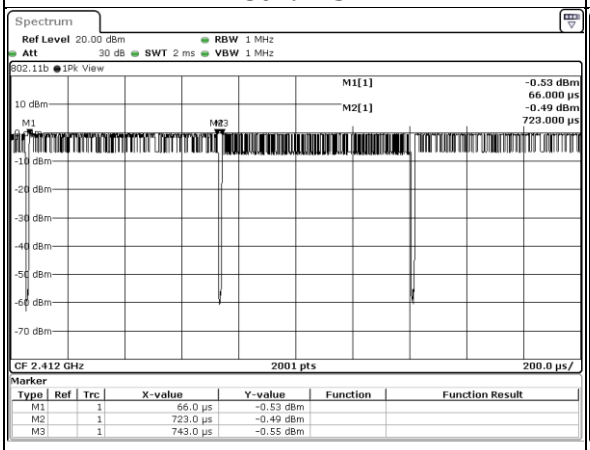
Simultaneously transmission condition:

| Condition | Technology | |
|---|---|---|
| 1 | BT-EDR | WLAN (2.4GHz) |
| 2 | WLAN (2.4GHz) | WLAN (5GHz) |
| 3 | WLAN (2.4GHz) | WLAN (6GHz) |
| Note: The emission of the simultaneous operation has been evaluated and no non-compliance was found. | | |

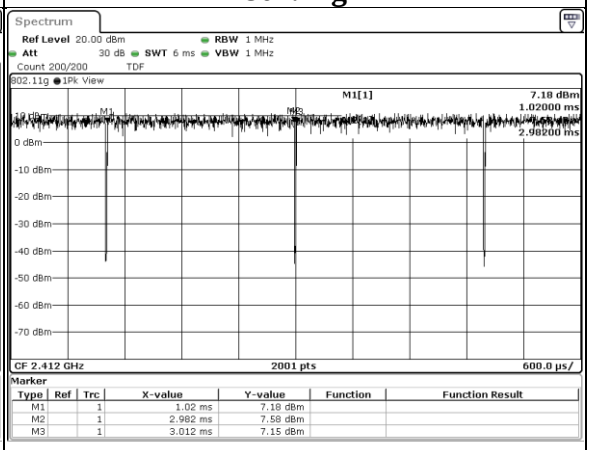
## 6.6. Duty cycle

| Mode | On Time (ms) | On+Off Time (ms) | Duty Cycle | Duty Factor (dB) | VBW Set (above 1GHz) |
|---|---|---|---|---|---|
| 802.11b | 0.657 | 0.677 | 0.9705 | 0.13 | 2kHz |
| 802.11g | 1.962 | 1.992 | 0.9849 | N/A | 10Hz |
| 802.11ax(HE20) | 5.406 | 5.448 | 0.9923 | N/A | 10Hz |
| 802.11ax(HE40) | 4.065 | 4.115 | 0.9878 | N/A | 10Hz |

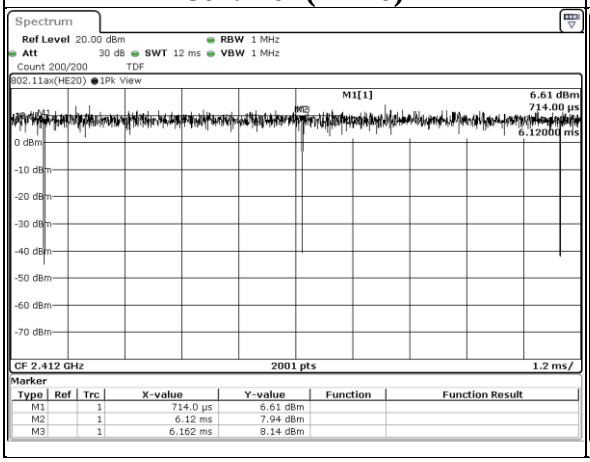
**802.11b**



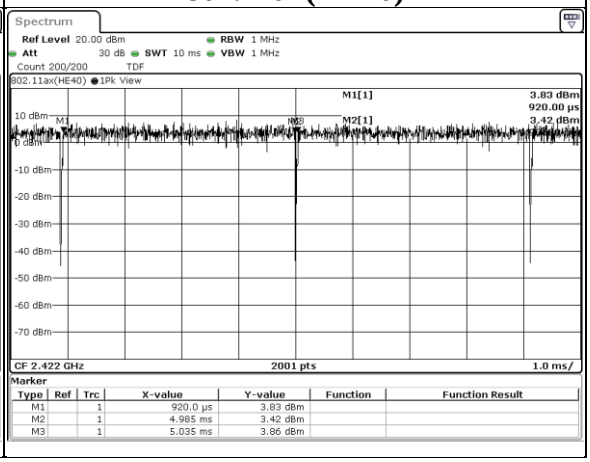

**802.11g**




**802.11ax(HE20)**




**802.11ax(HE40)**



# 7. Test Equipment

| Test Equipment List | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No.** | **Serial No.** | **Cal. Date** | **Expired date** |
| **Radiated Spurious Emission** | | | | | |
| Spectrum Analyzer | Keysight | N9010A | MY56070827 | 2023/4/7 | 2024/4/6 |
| EMI Test Receiver | Rohde & Schwarz | ESR7 | 101754 | 2022/12/13 | 2023/12/12 |
| Loop Antenna | ETS lindgren | 6502 | 00213440 | 2023/1/4 | 2024/1/3 |
| Trilog-Broadband Antenna with 5dB Attenuator | Schwarzbeck & EMCI | VULB 9168 & N-6-05 | 774 & AT-N0538 | 2023/2/13 | 2024/2/12 |
| Horn Antenna (1-18 GHz) | Schwarzbeck | BBHA 9120 D | 01690 | 2022/12/21 | 2023/12/20 |
| Horn Antenna (18-40 GHz) | Schwarzbeck | BBHA 9170 | 781 | 2022/12/30 | 2023/12/29 |
| Preamplifier (30-1000 MHz) | EMCI | EMC330E | 980405 | 2023/6/7 | 2024/6/6 |
| Preamplifier (1-18 GHz) | EMCI | EMC051835BE | 980406 | 2023/2/17 | 2024/2/16 |
| Preamplifier (18-40GHz) | EMCI | EMC184040SEE | 980426 | 2023/5/9 | 2024/5/8 |
| Cables | Hanyitek | K1K50-UP0264-K1K50-2500 | 170214-4 & 170425-2 | 2022/12/1 | 2023/11/30 |
| Cables | Hanyitek | K1K50-UP0264-K1K50-2500 | 170214-1 & 170214-2 | 2022/12/1 | 2023/11/30 |

| Test Equipment List | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No.** | **Serial No.** | **Cal. Date** | **Expired date** |
| **Antenna Port Conducted Measurement** | | | | | |
| Spectrum Analyzer | Keysight | N9010A | MY56070834 | 2022/10/24 | 2023/10/23 |
| Attenuator | EMCI | EMC-40ATK2W10 | 17002 | 2022/12/9 | 2023/12/8 |
| Pulse Power Sensor | Anritsu | MA2411B | 1531202 | 2023/1/4 | 2024/1/3 |
| Power Meter | Anritsu | ML2495A | 1645002 | 2023/1/4 | 2024/1/3 |
| **AC power Line Conducted Emission** | | | | | |
| EMI Test Receiver | Rohde & Schwarz | ESR7 | 101753 | 2022/11/10 | 2023/11/9 |
| Two-Line V-Network | Rohde & Schwarz | ENV216 | 102136 | 2023/5/24 | 2024/5/23 |
| Impuls-Begrenzer Pulse Limiter | Rohde & Schwarz | ESH3-Z2 | 102219-Qt | 2022/8/30 | 2023/8/29 |
| Cables | TITAN | CFD200 | T0732ACFD200 20A300-2 | 2023/5/23 | 2024/5/22 |

| UL Software | | |
|---|---|---|
| **Description** | **Name** | **Version** |
| Radiated measurement | e3 | 6.191211 (V6) |
| Conducted measurement | RF-Conducted-FCC 15247 | ver 1.0 |
| AC power Line Conducted Emission | EZ_EMC | UL-3A1.2 |

# 8. Description of Test Setup

## Support Equipment

| ID | Equipment | Brand Name | Model Name | S/N | Remark |
|---|---|---|---|---|---|
| A | Test Tool | NA | NA | NA | Supplied by client |
| B | Monitor | Dell | SE2417HG | NA | Provide by lab |
| C | Computer | Intel | Intel(R) Core(TW) i7-4790 CPU @ 3.60GHz | NA | Supplied by client |
| D | Keyboard | Dell | KB216t | NA | Provide by lab |
| E | Mouse | Dell | MS116p | NA | Provide by lab |

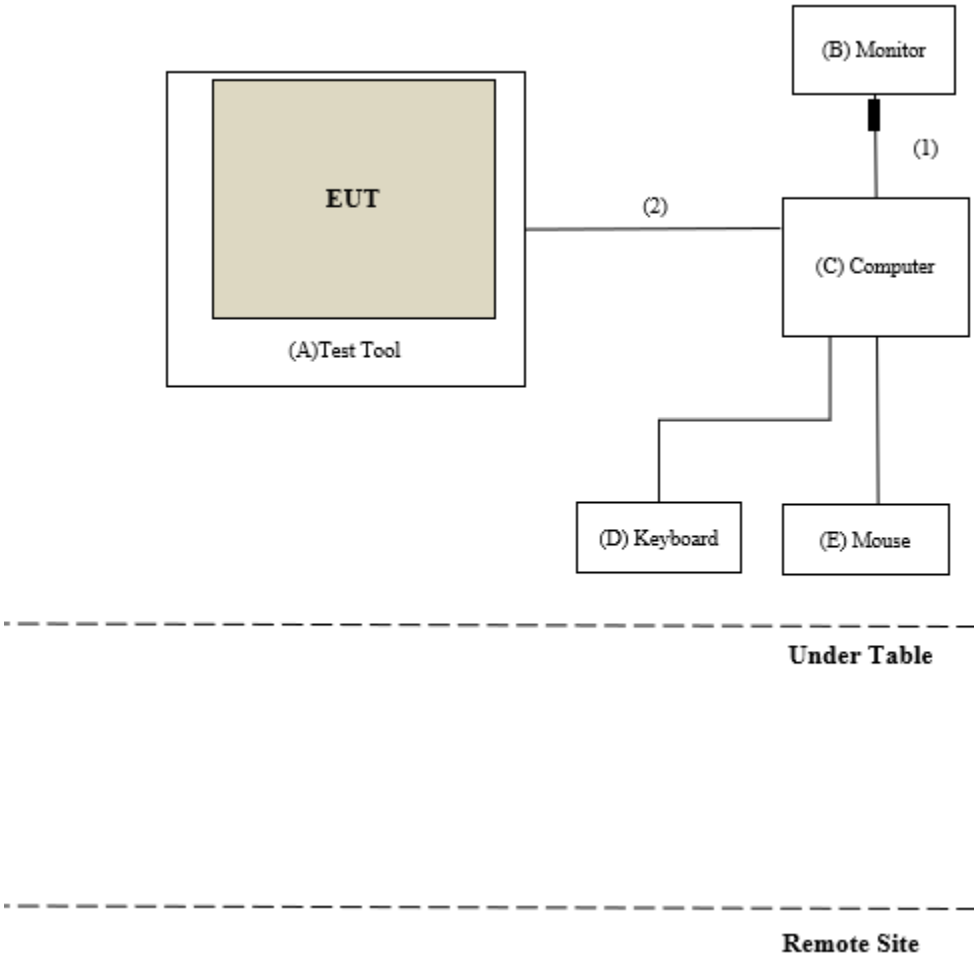
## I/O Cables

| ID | Equipment | Brand Name | Model Name | Length (m) | Remark |
|---|---|---|---|---|---|
| 1 | HDMI Cable | EATON | P568010 | 1.44 | Provide by lab with one core |
| 2 | Fiber Cable | NA | NA | 0.5 | Supplied by client |

## Test Setup

Controlled using a bespoke application (QSPR Version 5.0-00202) on a test Notebook. The application was used to enable a continuous transmission mode and to select the test channels, data rates, modulation schemes and power setting as required.

## Setup Diagram for Test



# 9. Test Results

## 9.1. 6dB Bandwidth

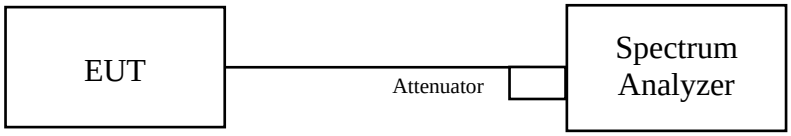
**Requirements**

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

**Test procedure**

a. Set resolution bandwidth (RBW) = 100kHz.
b. Set the video bandwidth (VBW) ≥ 3 x RBW, Detector = Peak.
c. Trace mode = max hold.
d. Sweep = auto couple.
e. Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.
f. The test spectrum plot only presents the worst-case value.

**Test Setup**

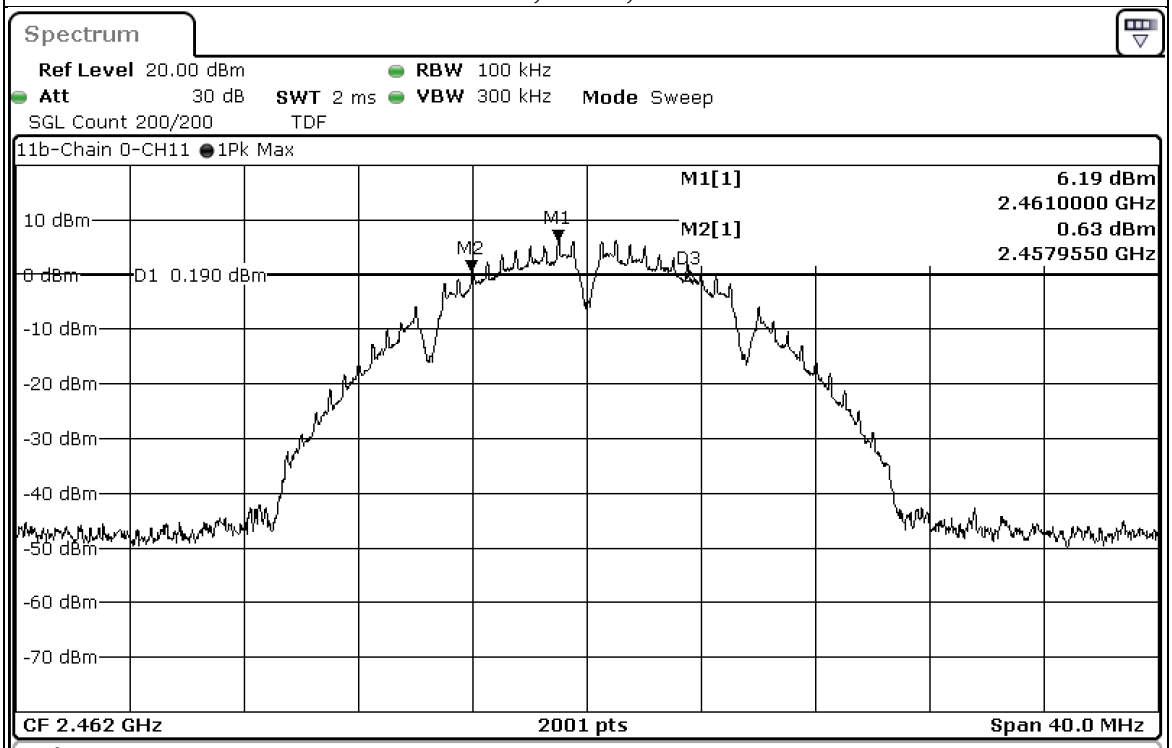



The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

## Test Data

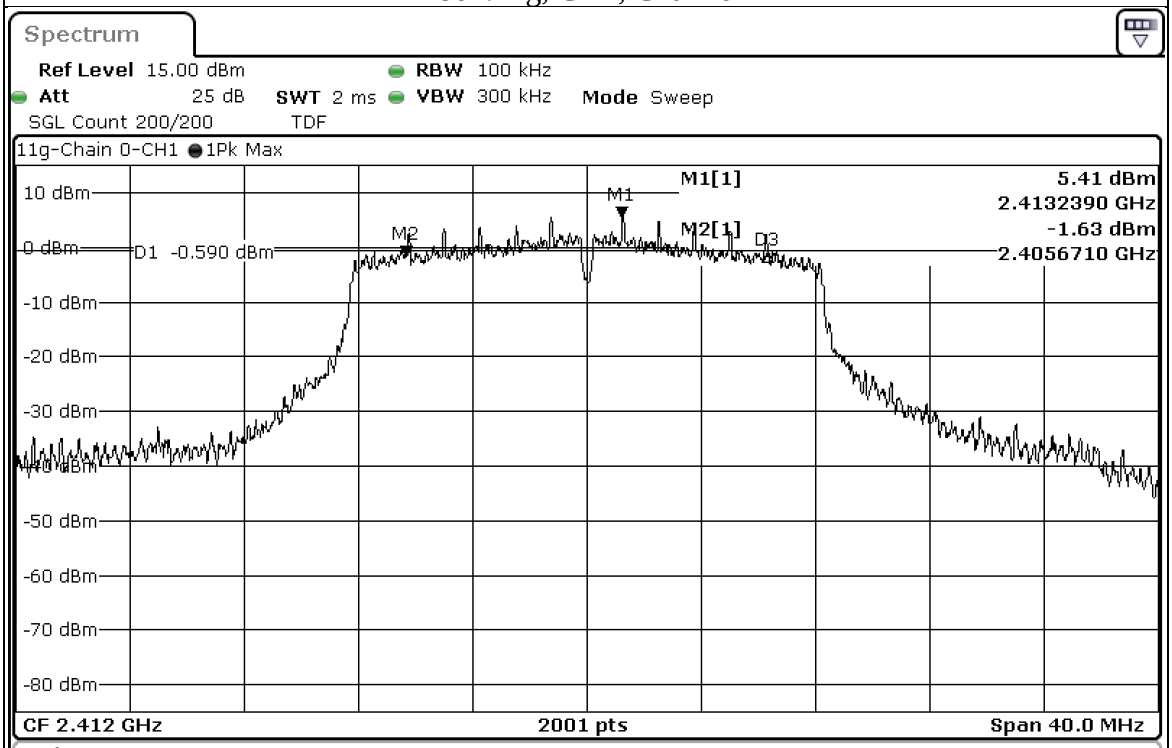
| Mode | CH | Freq (MHz) | 6dB BW (MHz) | | Limit (MHz) | Result |
|---|---|---|---|---|---|---|
| | | | Chain 0 | Chain 1 | | |
| 802.11b | 1 | 2412 | 8.085 | 8.035 | 0.5 | PASS |
| | 6 | 2437 | 8.082 | 8.079 | 0.5 | PASS |
| | 10 | 2457 | 8.506 | 8.039 | 0.5 | PASS |
| | 11 | 2462 | 7.613 | 8.039 | 0.5 | PASS |

802.11b, CH11, Chain 0



| Mode | CH | Freq (MHz) | 6dB BW (MHz) | | Limit (MHz) | Result |
|---|---|---|---|---|---|---|
| | | | Chain 0 | Chain 1 | | |
| 802.11g | 1 | 2412 | 12.664 | 14.032 | 0.5 | PASS |
| | 6 | 2437 | 15.066 | 14.452 | 0.5 | PASS |
| | 10 | 2457 | 16.009 | 15.331 | 0.5 | PASS |
| | 11 | 2462 | 15.276 | 15.084 | 0.5 | PASS |

802.11g, CH1, Chain 0

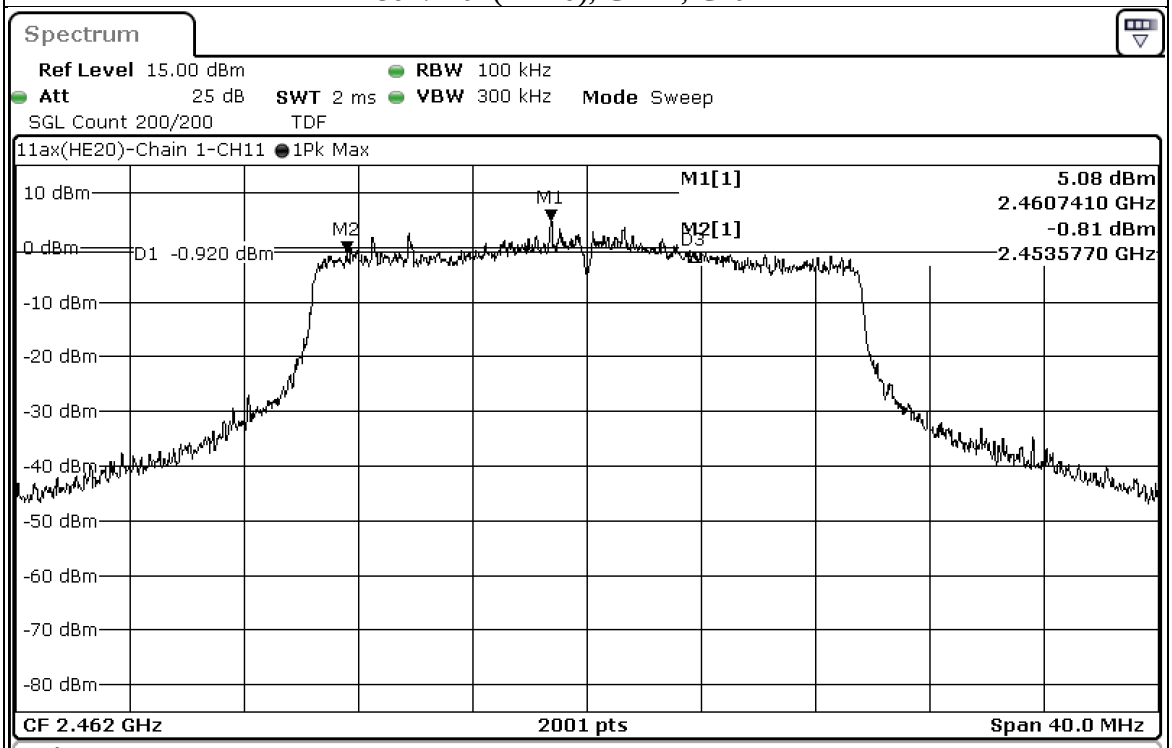



Marker

| Type | Ref | Trc | X-value | Y-value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | 2.413239 GHz | 5.41 dBm | | |
| M2 | | 1 | 2.405671 GHz | -1.63 dBm | | |
| D3 | M2 | 1 | 12.664 MHz | 0.64 dB | | |

| Mode | CH | Freq (MHz) | 6dB BW (MHz) | | Limit (MHz) | Result |
|---|---|---|---|---|---|---|
| | | | Chain 0 | Chain 1 | | |
| 802.11ax(HE20) | 1 | 2412 | 13.232 | 13.936 | 0.5 | PASS |
| | 6 | 2437 | 17.175 | 18.069 | 0.5 | PASS |
| | 10 | 2457 | 18.579 | 17.677 | 0.5 | PASS |
| | 11 | 2462 | 16.887 | 12.143 | 0.5 | PASS |

802.11ax(HE20), CH11, Chain 1

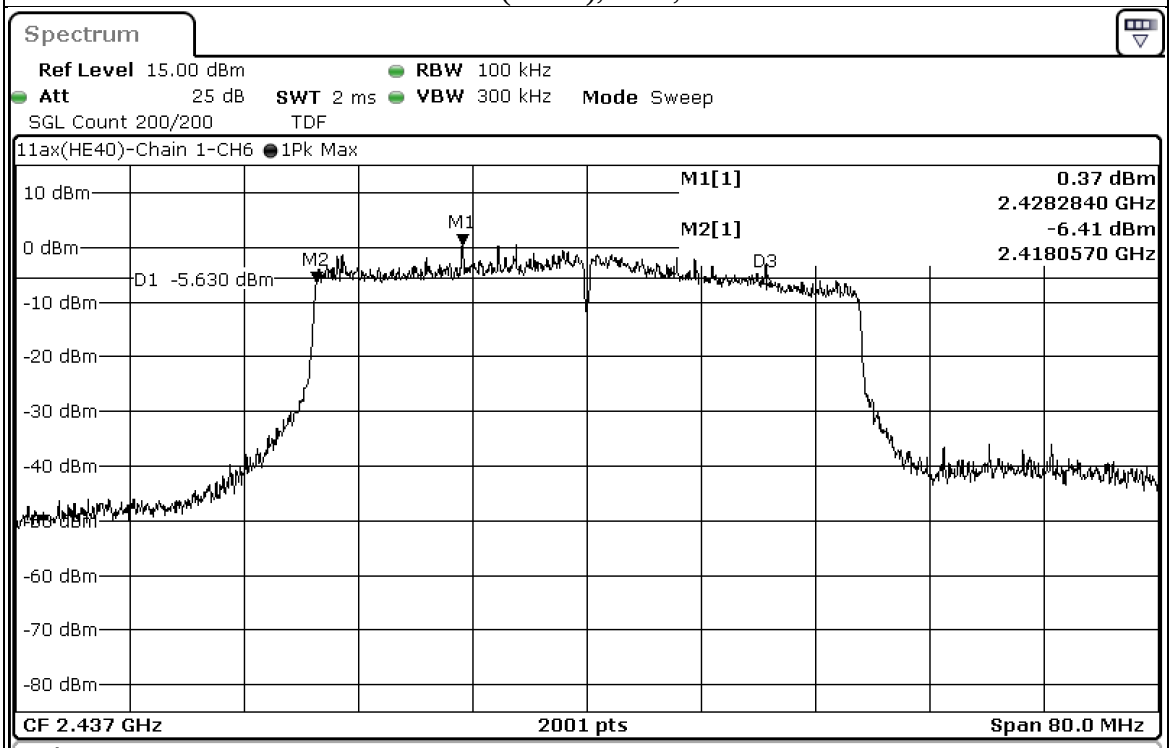



Marker

| Type | Ref | Trc | X-value | Y-value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | 2.460741 GHz | 5.08 dBm | | |
| M2 | | 1 | 2.453577 GHz | -0.81 dBm | | |
| D3 | M2 | 1 | 12.143 MHz | -0.12 dB | | |

| Mode | CH | Freq (MHz) | 6dB BW (MHz) | | Limit (MHz) | Result |
|---|---|---|---|---|---|---|
| | | | Chain 0 | Chain 1 | | |
| 802.11ax(HE40) | 3 | 2422 | 33.158 | 32.711 | 0.5 | PASS |
| | 6 | 2437 | 36.433 | 31.514 | 0.5 | PASS |
| | 9 | 2452 | 36.558 | 35.129 | 0.5 | PASS |

802.11ax(HE40), CH6, Chain 1



## 9.2. Conducted Output Power

### Requirements

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

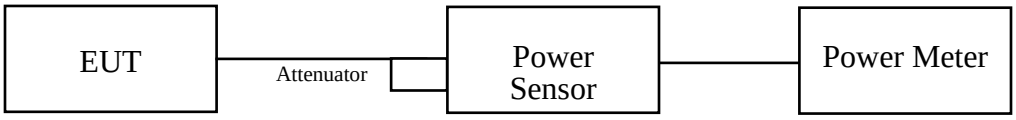
Note:

1. $P_{Out}$ = maximum conducted output power in dBm, $G_{TX}$ = the maximum transmitting antenna directional gain in dBi, B is the 26 dB emission bandwidth in megahertz
2. Directional Gain = 10 log[$(10^{G1/20} + 10^{G2/20} + ... + 10^{Gn/20})^2$ / Nant] dBi.
   Nant: Number of Transmit Antennas
   G1, G2,..., Gn: Gain of Individual Antennas
   Example: two antenna and gain 3.5 dBi / 3.5 dBi, so if it was used for TxBF power measurement
   Directional Gain = 10 log[$(10^{3.5/20} + 10^{3.5/20})^2$ / 2] dBi = 6.51 dBi
3. Per KDB 662911 Method of conducted output power measurement on IEEE 802.11 devices, CDD
   Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;
   Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any $N_{ANT}$;
   Array Gain = 5 log($N_{ANT}/N_{SS}$) dB or 3 dB, whichever is less for 20-MHz channel widths with $N_{ANT} \geq 5$.
   Example: Maximum antenna gain = 3.5 dBi and $N_{ANT} \leq 4$, so if it was used for CDD power measurement
   Directional Gain = 5 dBi + Array Gain = 3.5 dBi + 0 dB = 3.5 dBi
4. For power measurement of KDB 662911 is used with multiple transmitter output. Total conducted power is the sum of the conducted power levels measured at the various output ports.

### Test Procedure

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

### Test Setup




The loss between RF output port of the EUT and the input port of the Power Meter has been taken into consideration.

# Test Data

## Peak Power

### 802.11b

| Channel | Frequency (MHz) | Peak Power (dBm) | | Total Power (mW) | Total Power (dBm) | Limit (dBm) | Pass / Fail |
|---|---|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | | | |
| 1 | 2412 | 21.68 | 21.50 | 288.403 | 24.60 | 30 | PASS |
| 6 | 2437 | 23.47 | 23.22 | 432.514 | 26.36 | 30 | PASS |
| 10 | 2457 | 20.21 | 20.66 | 221.309 | 23.45 | 30 | PASS |
| 11 | 2462 | 17.72 | 18.31 | 127.057 | 21.04 | 30 | PASS |

### 802.11g

| Channel | Frequency (MHz) | Peak Power (dBm) | | Total Power (mW) | Total Power (dBm) | Limit (dBm) | Pass / Fail |
|---|---|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | | | |
| 1 | 2412 | 21.83 | 22.23 | 319.154 | 25.04 | 30 | PASS |
| 6 | 2437 | 24.54 | 25.11 | 608.135 | 27.84 | 30 | PASS |
| 10 | 2457 | 22.42 | 22.94 | 371.535 | 25.70 | 30 | PASS |
| 11 | 2462 | 21.35 | 22.09 | 298.538 | 24.75 | 30 | PASS |

### 802.11ax (HE20)

| Channel | Frequency (MHz) | Peak Power (dBm) | | Total Power (mW) | Total Power (dBm) | Limit (dBm) | Pass / Fail |
|---|---|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | | | |
| 1 | 2412 | 22.98 | 22.23 | 365.595 | 25.63 | 30 | PASS |
| 6 | 2437 | 24.47 | 25.19 | 610.942 | 27.86 | 30 | PASS |
| 10 | 2457 | 22.15 | 22.95 | 361.41 | 25.58 | 30 | PASS |
| 11 | 2462 | 21.05 | 21.18 | 258.821 | 24.13 | 30 | PASS |

### 802.11ax (HE40)

| Channel | Frequency (MHz) | Peak Power (dBm) | | Total Power (mW) | Total Power (dBm) | Limit (dBm) | Pass / Fail |
|---|---|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | | | |
| 3 | 2422 | 20.66 | 21.08 | 244.906 | 23.89 | 30 | PASS |
| 6 | 2437 | 21.86 | 21.26 | 287.078 | 24.58 | 30 | PASS |
| 9 | 2452 | 19.65 | 20.06 | 193.642 | 22.87 | 30 | PASS |

## Average Power (Reference Only)

### 802.11b

| Channel | Frequency (MHz) | Average Power (dBm) | | Total Power (mW) | Total Power (dBm) |
|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | |
| 1 | 2412 | 19.05 | 19.04 | 160.694 | 22.06 |
| 6 | 2437 | 21.38 | 20.75 | 256.448 | 24.09 |
| 10 | 2457 | 17.90 | 18.13 | 126.765 | 21.03 |
| 11 | 2462 | 15.35 | 15.87 | 72.946 | 18.63 |

### 802.11g

| Channel | Frequency (MHz) | Average Power (dBm) | | Total Power (mW) | Total Power (dBm) |
|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | |
| 1 | 2412 | 15.82 | 16.20 | 79.799 | 19.02 |
| 6 | 2437 | 19.99 | 20.01 | 199.986 | 23.01 |
| 10 | 2457 | 17.08 | 17.53 | 107.647 | 20.32 |
| 11 | 2462 | 15.60 | 16.30 | 78.886 | 18.97 |

### 802.11ax (HE20)

| Channel | Frequency (MHz) | Average Power (dBm) | | Total Power (mW) | Total Power (dBm) |
|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | |
| 1 | 2412 | 15.24 | 15.63 | 69.984 | 18.45 |
| 6 | 2437 | 19.56 | 19.62 | 181.97 | 22.60 |
| 10 | 2457 | 16.02 | 16.51 | 84.723 | 19.28 |
| 11 | 2462 | 14.51 | 15.19 | 61.235 | 17.87 |

### 802.11ax (HE40)

| Channel | Frequency (MHz) | Average Power (dBm) | | Total Power (mW) | Total Power (dBm) |
|---|---|---|---|---|---|
| | | Chain 0 | Chain 1 | | |
| 3 | 2422 | 14.48 | 14.65 | 57.28 | 17.58 |
| 6 | 2437 | 14.83 | 14.74 | 60.256 | 17.80 |
| 9 | 2452 | 13.47 | 13.88 | 46.666 | 16.69 |

## 9.3. Power Spectral Density

### Requirements

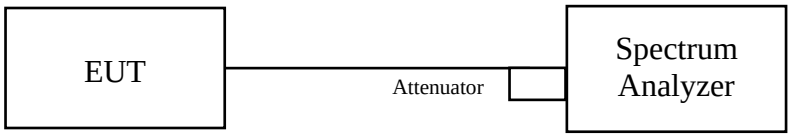
The Maximum of Power Spectral Density Measurement is 8dBm in any 3 kHz (If $G_{TX}$ > 6 dBi, then PSD = 8 – ($G_{TX}$ – 6)).

Note:
1. PSD = power spectral density that he same method as used to determine the conducted output power shall be used to determine the power spectral density. And power spectral density in dBm/MHz.
2. $G_{TX}$ = the maximum transmitting antenna directional gain in dBi.
3. Directional Gain = 10 log[($10^{G1/20} + 10^{G2/20} + ... + 10^{Gn/20}$)$^2$ / Nant] dBi.
   Nant: Number of Transmit Antennas
   G1, G2,..., Gn: Gain of Individual Antennas
   Example: two antenna and gain 3.5 dBi / 3.5 dBi, so if it was used for power density measurement
   Directional Gain = 10 log[($10^{3.5/20} + 10^{3.5/20}$)$^2$ / 2] dBi = 6.51 dBi
4. "PSD per chain" of the report shown is maximum value for each chain, at the "Total PSD" is summing entire spectra across corresponding frequency bins on the various outputs by computer, refer KDB 662911 Method a) for calculating total power density.
5. Method a) of power density measurement of KDB 662911 is used for calculating total power density with multiple transmitter output. Total power density is summing entire spectra across corresponding frequency bins on the various outputs by computer.

### Test procedure

a. Set analyzer center frequency to DTS channel center frequency.
b. Set the span to 1.5 times the DTS bandwidth.
c. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d. Set the VBW ≥ 3 × RBW.
e. Detector = peak.
f. Sweep time = auto couple.
g. Trace mode = max hold.
h. Allow trace to fully stabilize.
i. Use the peak marker function to determine the maximum amplitude level within the RBW.
j. The test spectrum plot only presents the worst-case value.

### Test Setup



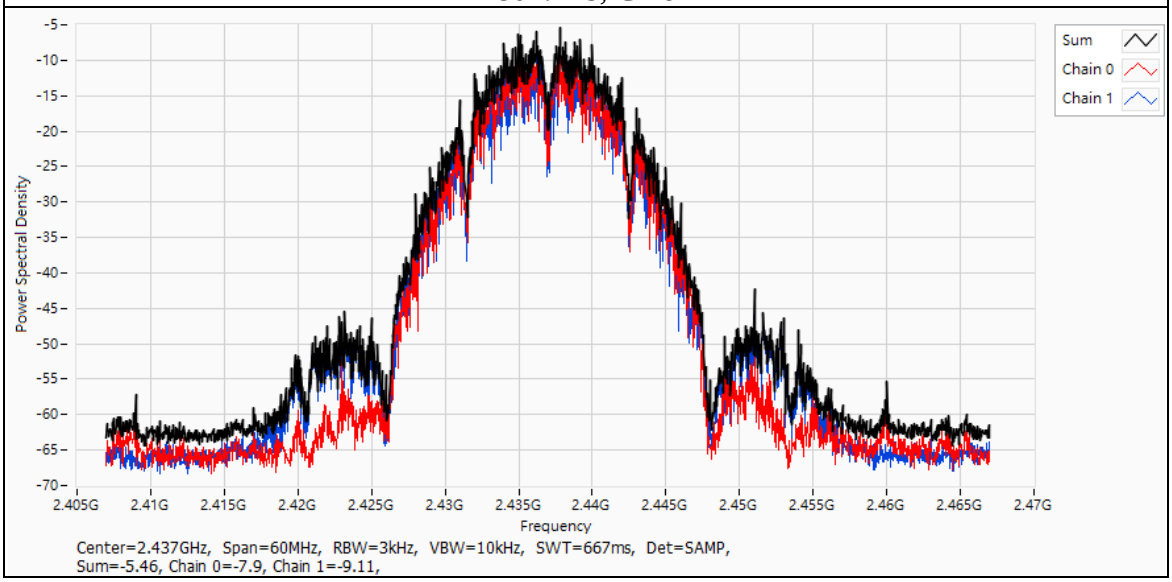

The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

## Test Data

| Mode | CH | Freq (MHz) | Total PSD (dBm/3kHz) | Limit (dBm/3kHz) | Directional Gain (dBi) | Result |
|---|---|---|---|---|---|---|
| 802.11b | 1 | 2412 | -7.88 | 7.49 | 6.51 | PASS |
| | 6 | 2437 | -5.46 | 7.49 | 6.51 | PASS |
| | 10 | 2457 | -7.83 | 7.49 | 6.51 | PASS |
| | 11 | 2462 | -9.27 | 7.49 | 6.51 | PASS |

| Mode | CH | Freq (MHz) | PSD per Chain (dBm/3kHz) | |
|---|---|---|---|---|
| | | | Chain 0 | Chain 1 |
| 802.11b | 1 | 2412 | -9.89 | -10.439 |
| | 6 | 2437 | -7.8 | -7.935 |
| | 10 | 2457 | -10.378 | -10.099 |
| | 11 | 2462 | -12.239 | -12.005 |

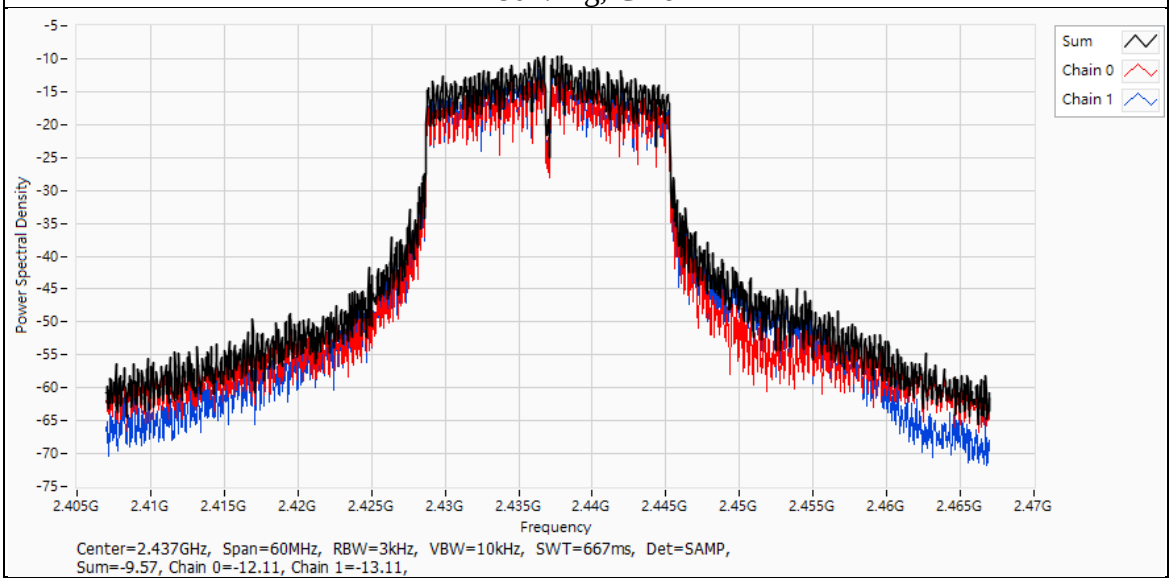
802.11b, CH6



| Mode | CH | Freq (MHz) | Total PSD (dBm/3kHz) | Limit (dBm/3kHz) | Directional Gain (dBi) | Result |
|---|---|---|---|---|---|---|
| 802.11g | 1 | 2412 | -13.12 | 7.49 | 6.51 | PASS |
| | 6 | 2437 | -9.57 | 7.49 | 6.51 | PASS |
| | 10 | 2457 | -11.04 | 7.49 | 6.51 | PASS |
| | 11 | 2462 | -13.42 | 7.49 | 6.51 | PASS |

| Mode | CH | Freq (MHz) | PSD per Chain (dBm/3kHz) | |
|---|---|---|---|---|
| | | | Chain 0 | Chain 1 |
| 802.11g | 1 | 2412 | -16.375 | -15.415 |
| | 6 | 2437 | -11.857 | -11.697 |
| | 10 | 2457 | -14.412 | -13.718 |
| | 11 | 2462 | -15.847 | -15.997 |

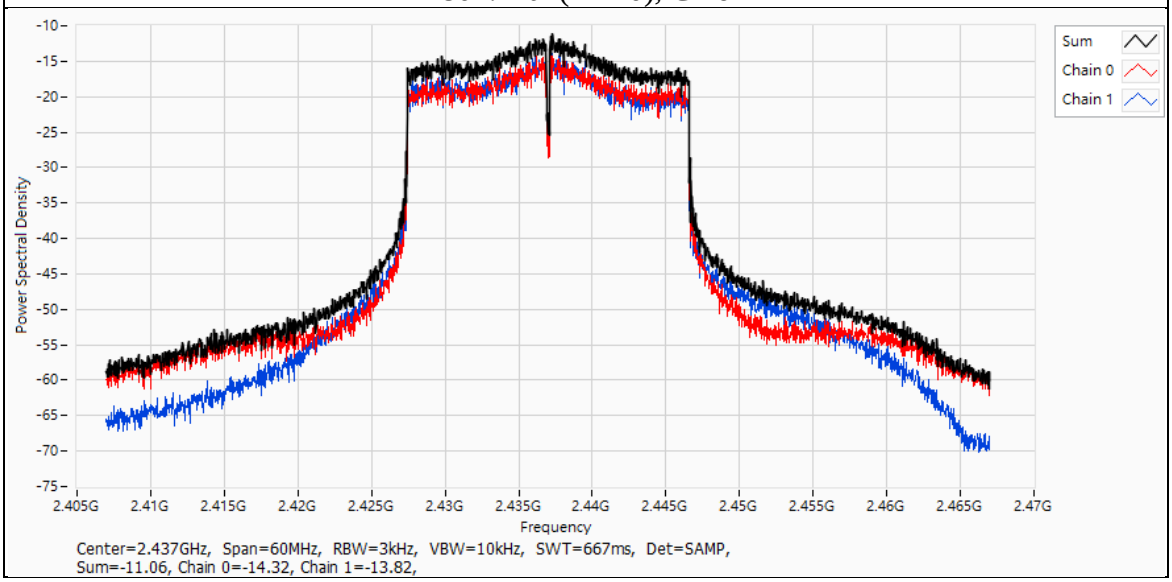
802.11g, CH6



| Mode | CH | Freq (MHz) | Total PSD (dBm/3kHz) | Limit (dBm/3kHz) | Directional Gain (dBi) | Result |
|---|---|---|---|---|---|---|
| 802.11ax(HE20) | 1 | 2412 | -15.94 | 7.49 | 6.51 | PASS |
| | 6 | 2437 | -11.06 | 7.49 | 6.51 | PASS |
| | 10 | 2457 | -14.87 | 7.49 | 6.51 | PASS |
| | 11 | 2462 | -15.9 | 7.49 | 6.51 | PASS |

| Mode | CH | Freq (MHz) | PSD per Chain (dBm/3kHz) | |
|---|---|---|---|---|
| | | | Chain 0 | Chain 1 |
| 802.11ax(HE20) | 1 | 2412 | -18.649 | -17.932 |
| | 6 | 2437 | -13.931 | -13.821 |
| | 10 | 2457 | -17.193 | -16.793 |
| | 11 | 2462 | -18.927 | -18.518 |

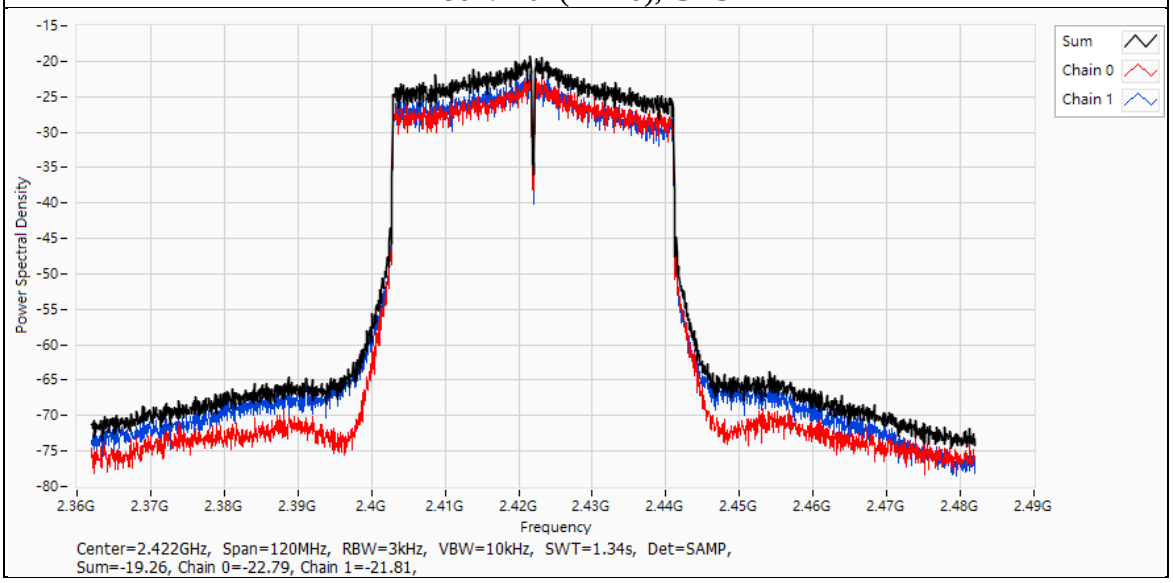
802.11ax(HE20), CH6



| Mode | CH | Freq (MHz) | Total PSD (dBm/3kHz) | Limit (dBm/3kHz) | Directional Gain (dBi) | Result |
|---|---|---|---|---|---|---|
| 802.11ax(HE40) | 3 | 2422 | -19.26 | 7.49 | 6.51 | PASS |
| | 6 | 2437 | -19.4 | 7.49 | 6.51 | PASS |
| | 9 | 2452 | -20.04 | 7.49 | 6.51 | PASS |

| Mode | CH | Freq (MHz) | PSD per Chain (dBm/3kHz) | |
|---|---|---|---|---|
| | | | Chain 0 | Chain 1 |
| 802.11ax(HE40) | 3 | 2422 | -22.244 | -21.812 |
| | 6 | 2437 | -21.788 | -22.288 |
| | 9 | 2452 | -23.002 | -22.371 |

802.11ax(HE40), CH3



## 9.4. Conducted Out of Band Emission

### Requirements

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b) (3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209 (a) is not required.

### Test procedure

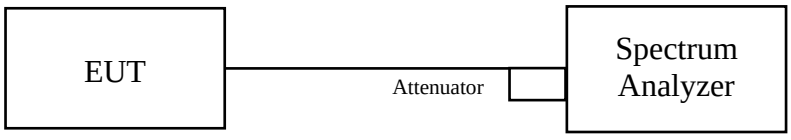
Measurement Procedure REF

1. Set the RBW = 100 kHz.
2. Set the VBW ≥ 300 kHz.
3. Set the span to 1.5 times the DTS bandwidth.
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

Measurement Procedure OOBE

1. Set RBW = 100 kHz.
2. Set VBW ≥ 300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

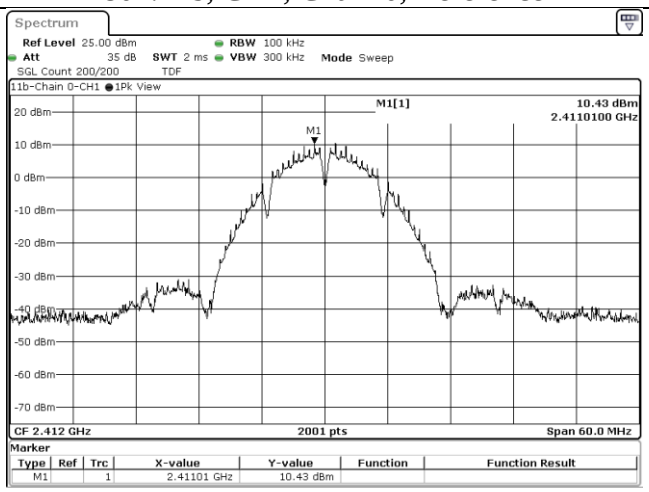
### Test Setup



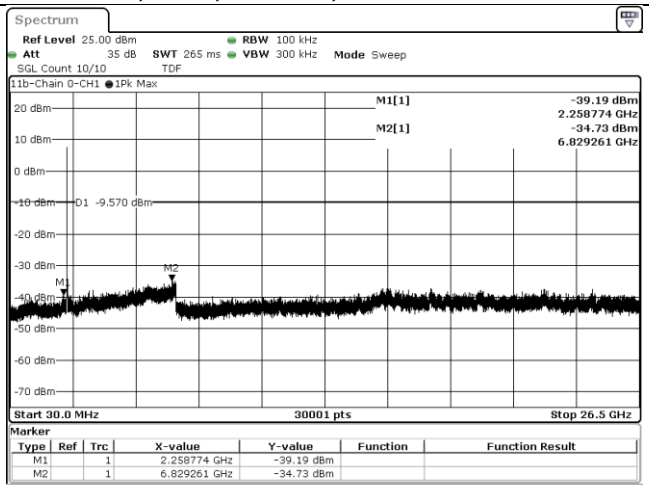

The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

## Test Data

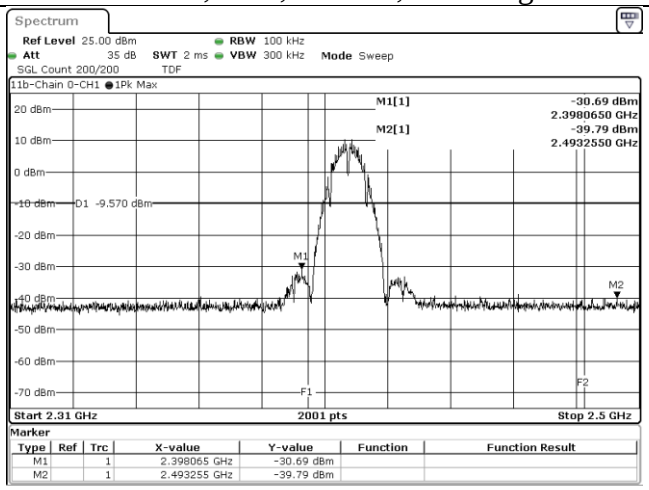
802.11b, CH1, Chain 0, Reference



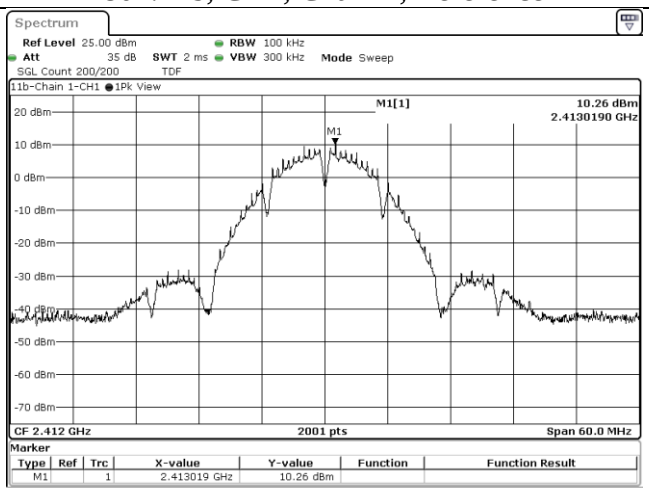

802.11b, CH1, Chain 0, Conducted Emission



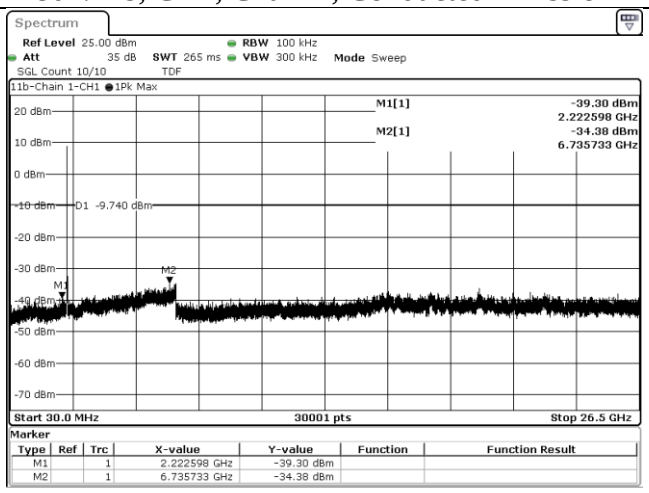

802.11b, CH1, Chain 0, Band edge



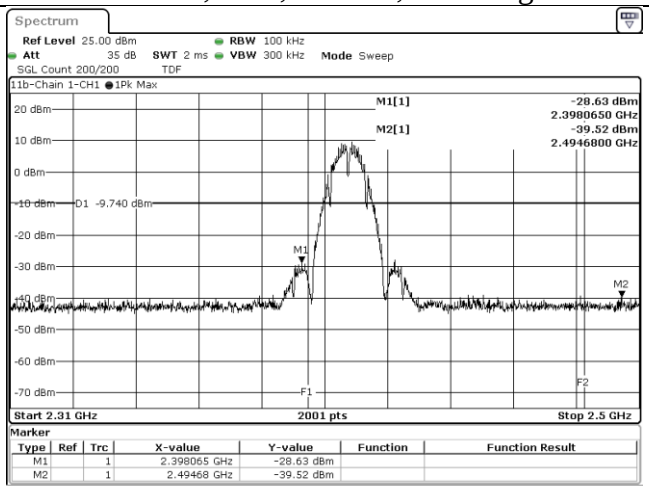
802.11b, CH1, Chain 1, Reference



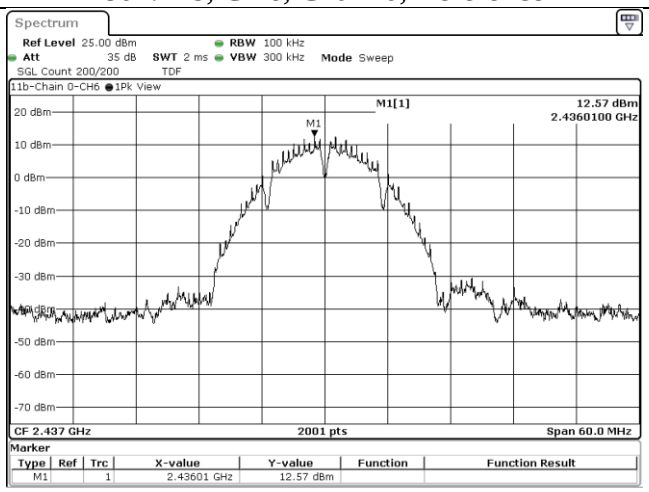

802.11b, CH1, Chain 1, Conducted Emission



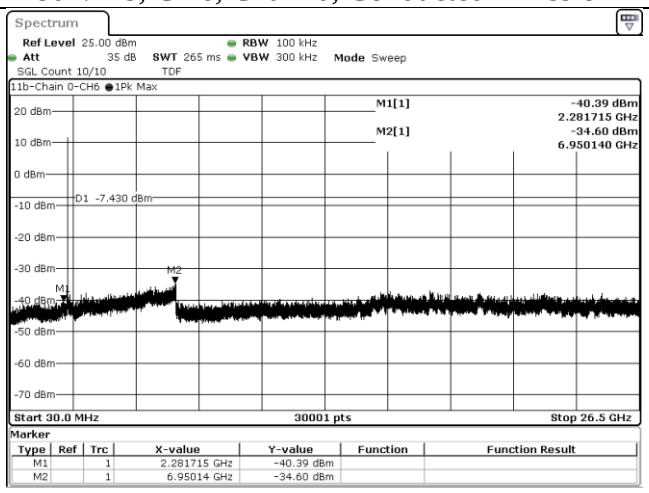

802.11b, CH1, Chain 1, Band edge



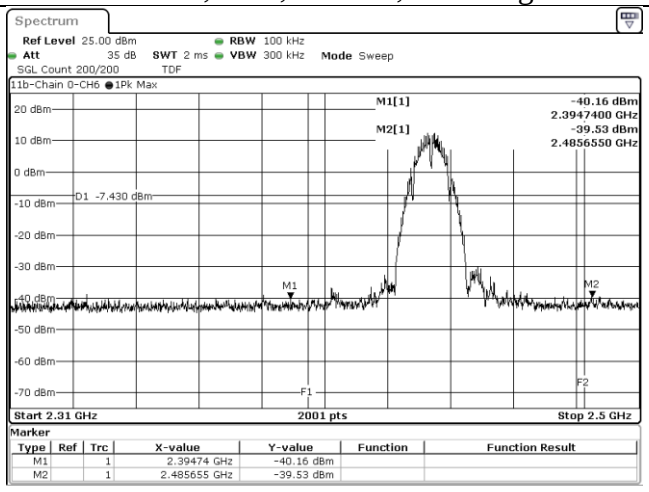
802.11b, CH6, Chain 0, Reference



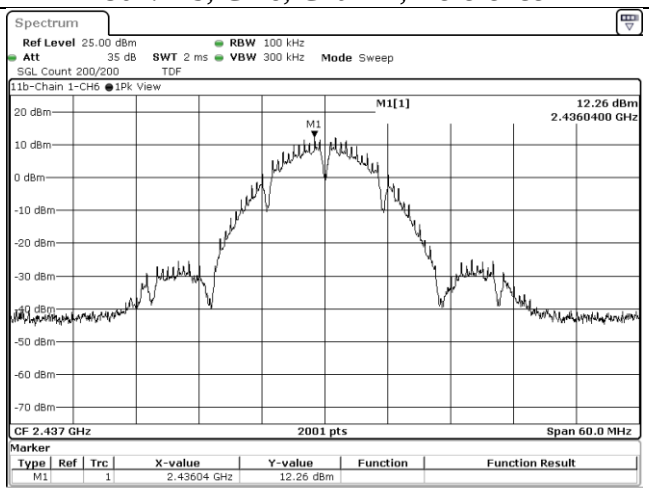

802.11b, CH6, Chain 0, Conducted Emission



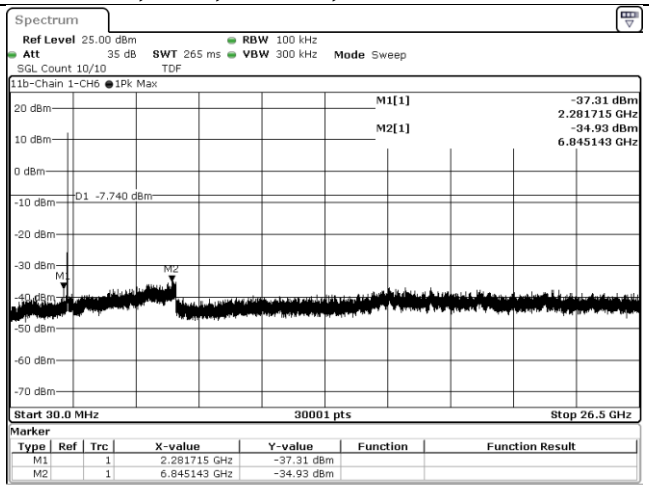

802.11b, CH6, Chain 0, Band edge



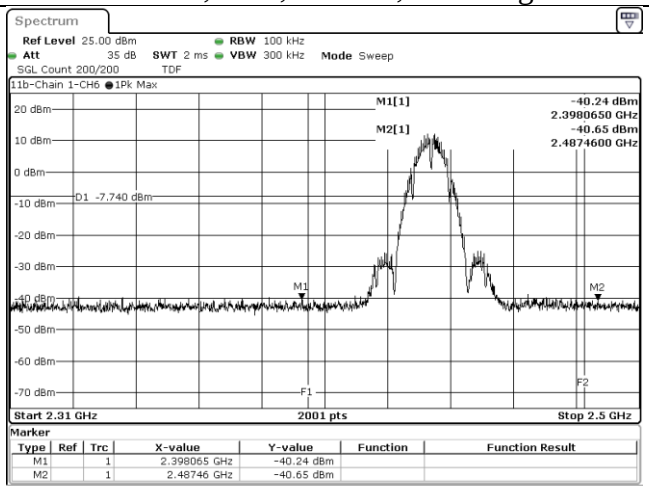
802.11b, CH6, Chain 1, Reference



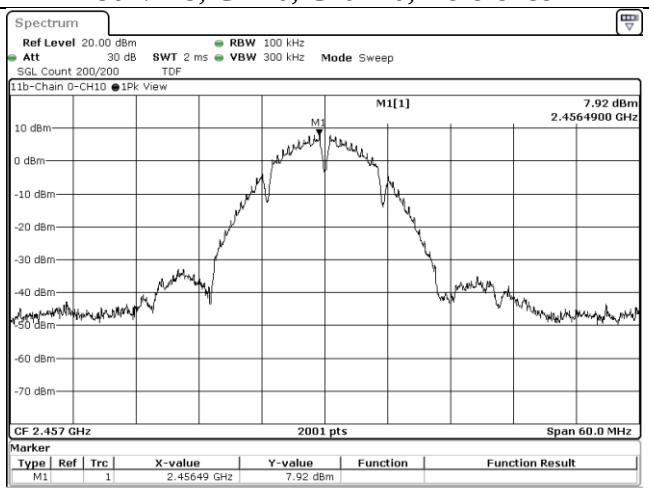

802.11b, CH6, Chain 1, Conducted Emission



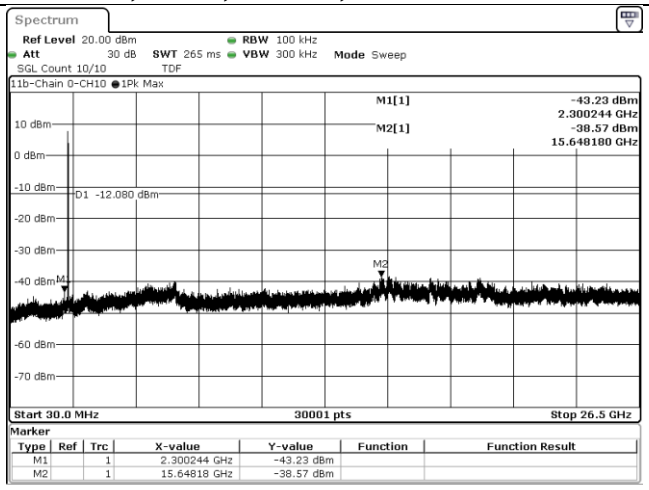

802.11b, CH6, Chain 1, Band edge



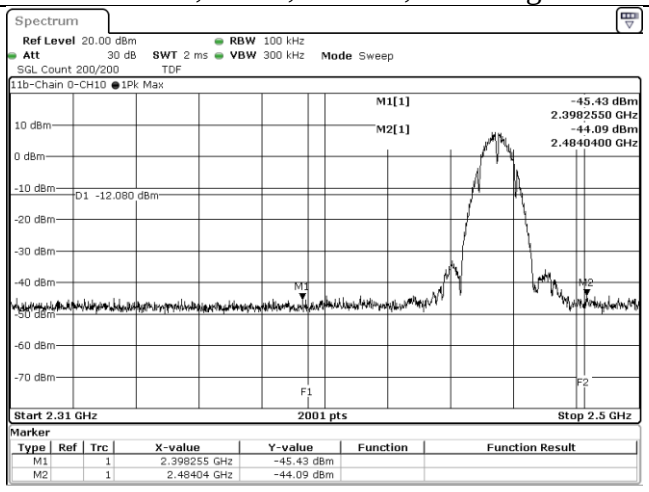
802.11b, CH10, Chain 0, Reference



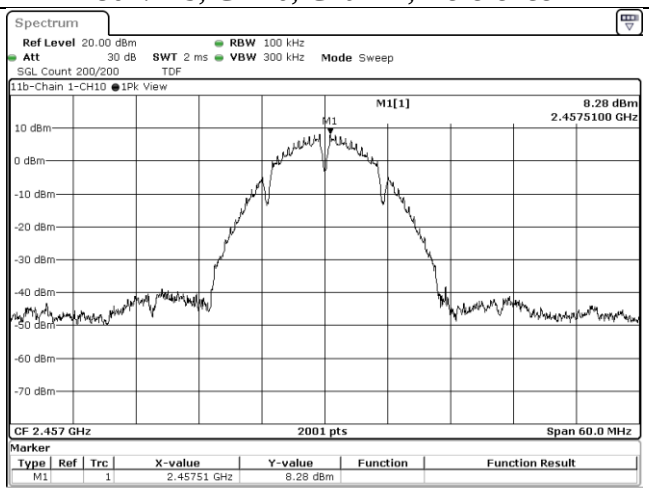

802.11b, CH10, Chain 0, Conducted Emission



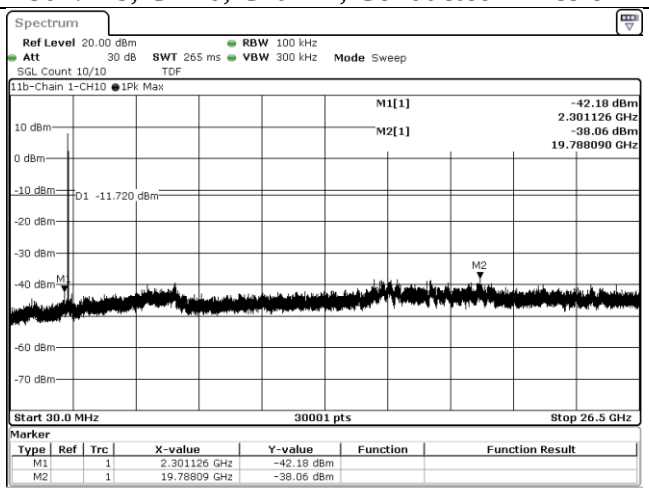

802.11b, CH10, Chain 0, Band edge



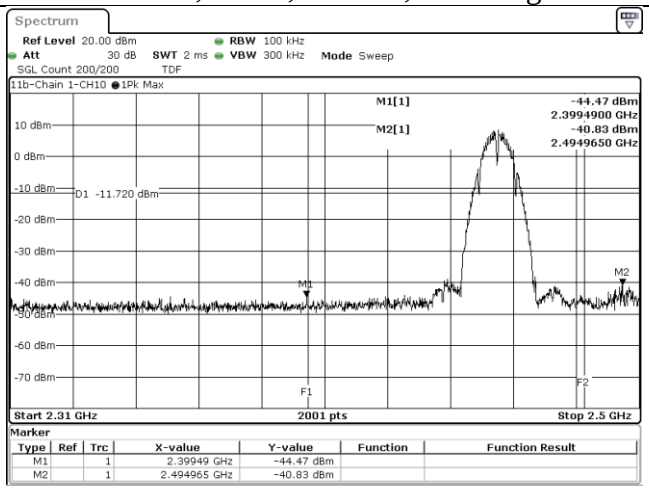
802.11b, CH10, Chain 1, Reference



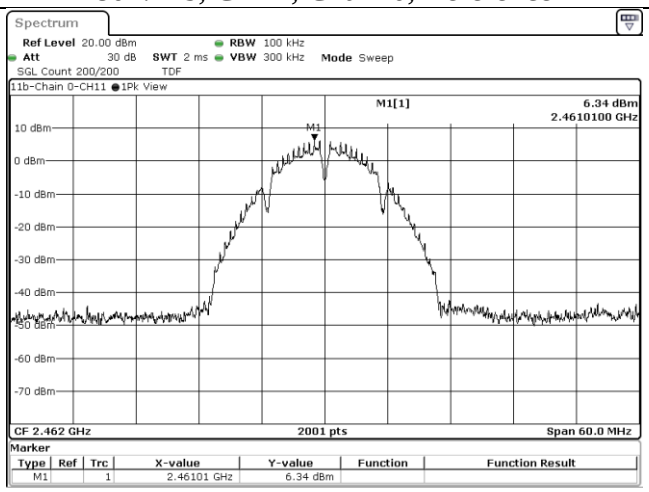

802.11b, CH10, Chain 1, Conducted Emission



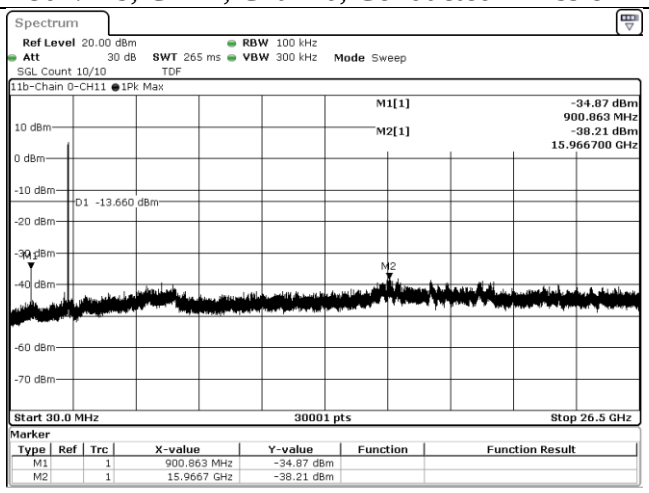

802.11b, CH10, Chain 1, Band edge



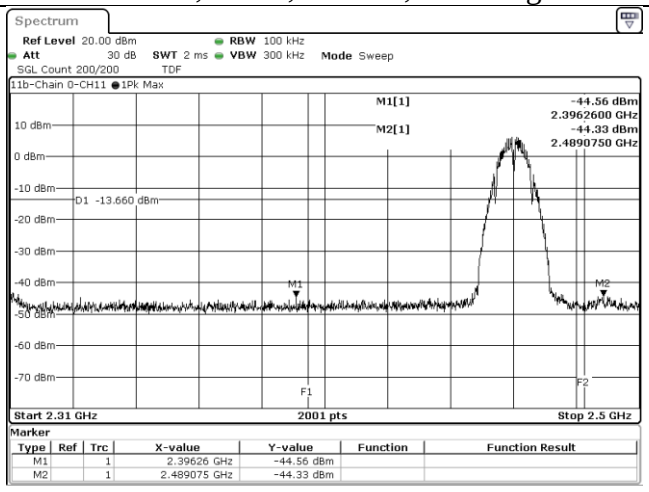
802.11b, CH11, Chain 0, Reference



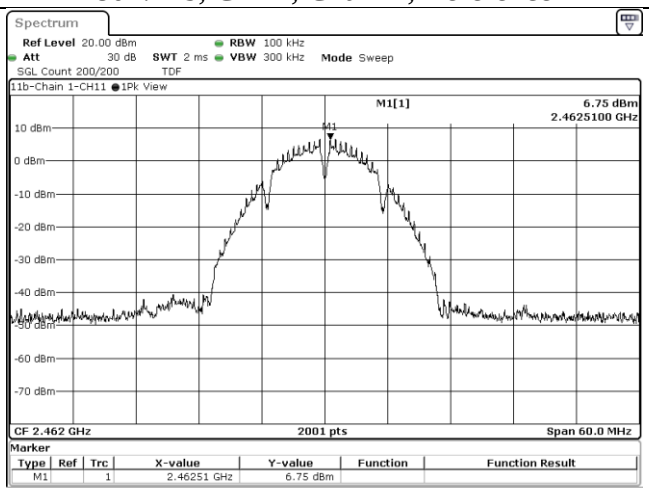

802.11b, CH11, Chain 0, Conducted Emission



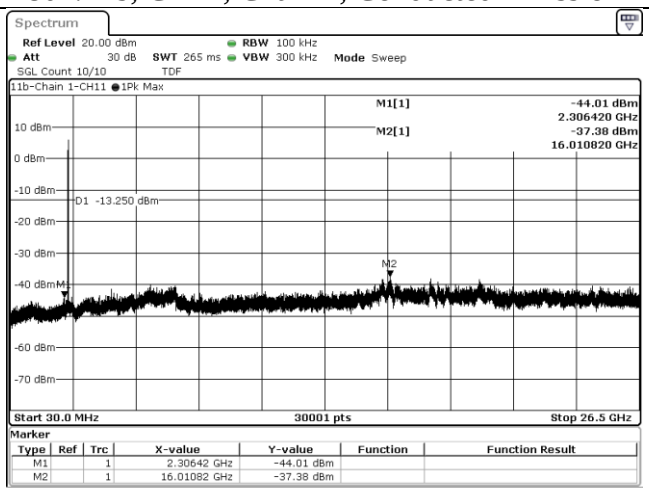

802.11b, CH11, Chain 0, Band edge



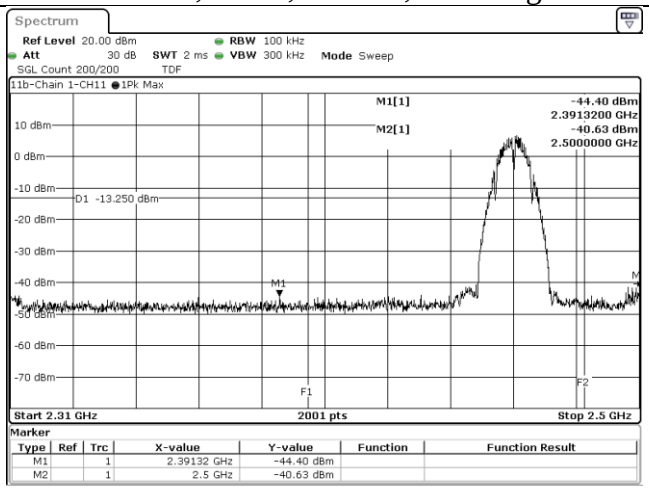
802.11b, CH11, Chain 1, Reference



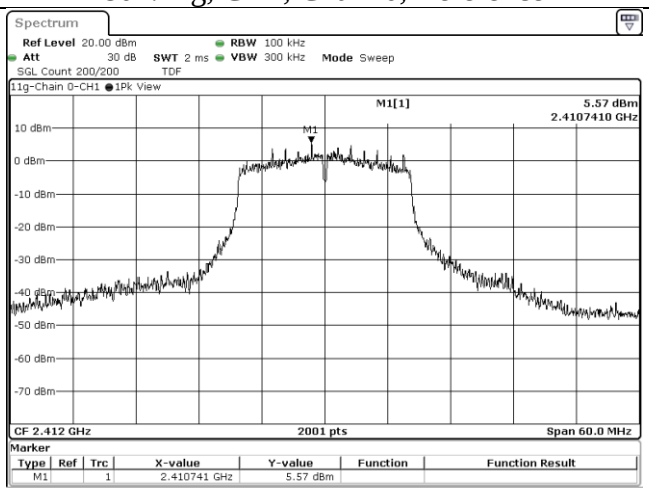

802.11b, CH11, Chain 1, Conducted Emission



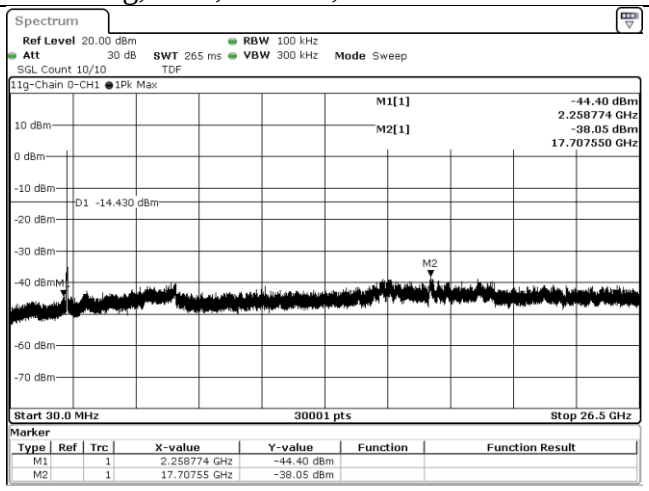

802.11b, CH11, Chain 1, Band edge



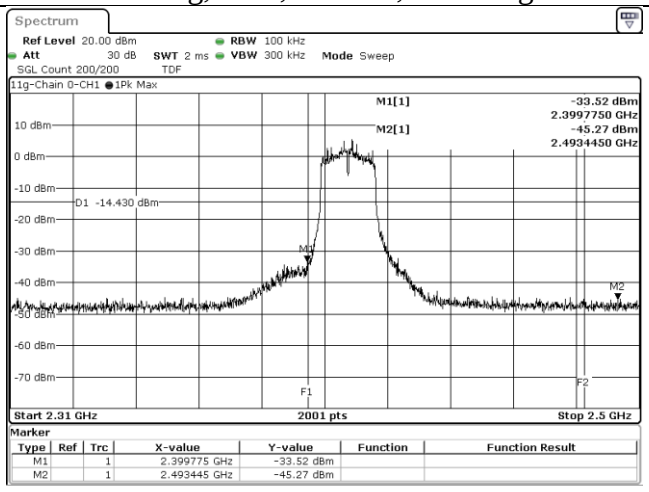
802.11g, CH1, Chain 0, Reference




802.11g, CH1, Chain 0, Conducted Emission




802.11g, CH1, Chain 0, Band edge



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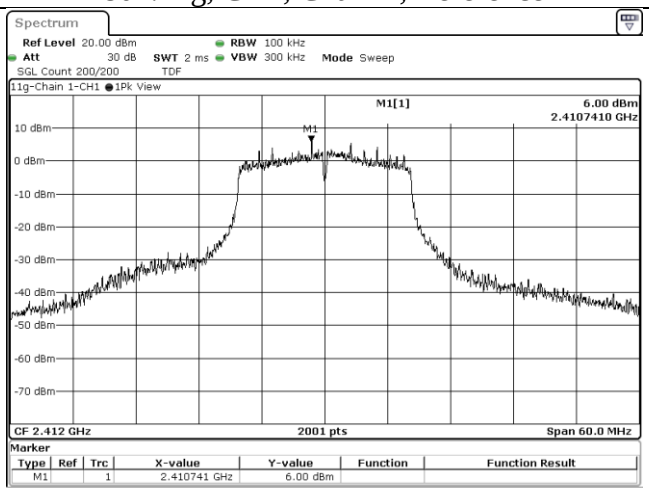
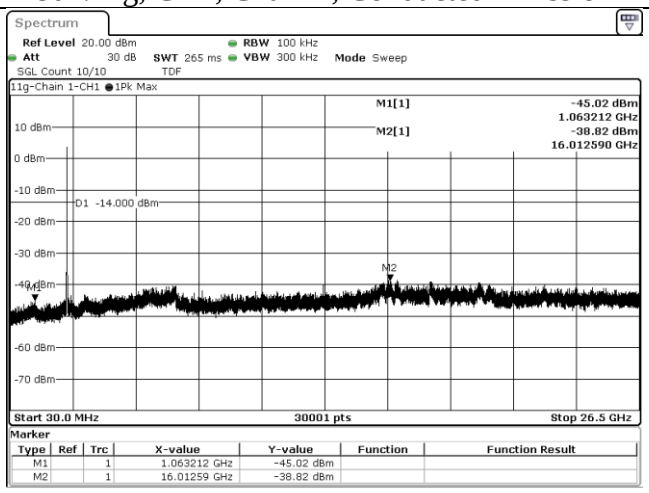
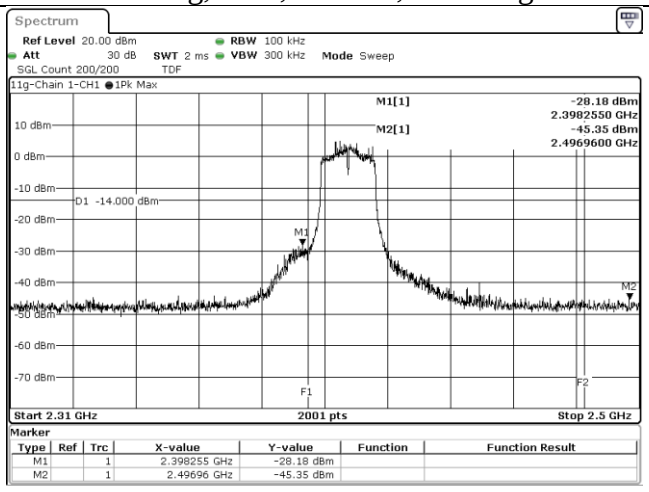


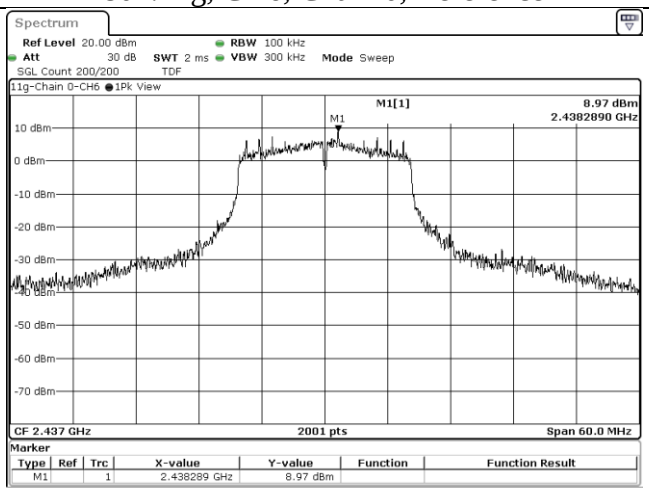

802.11g, CH1, Chain 1, Conducted Emission



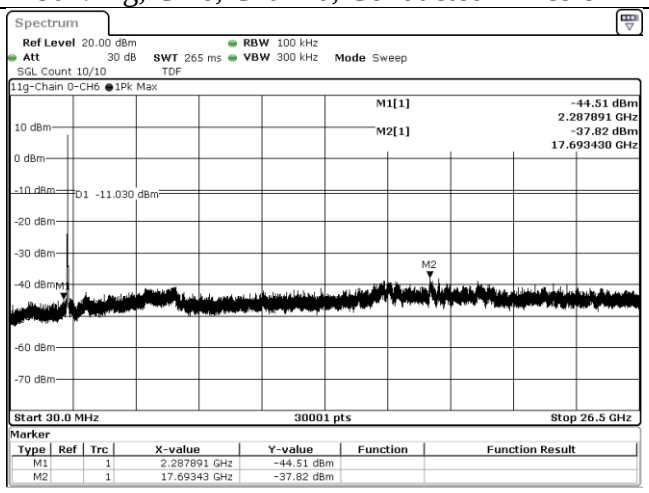

802.11g, CH1, Chain 1, Band edge



802.11g, CH6, Chain 0, Reference




802.11g, CH6, Chain 0, Conducted Emission

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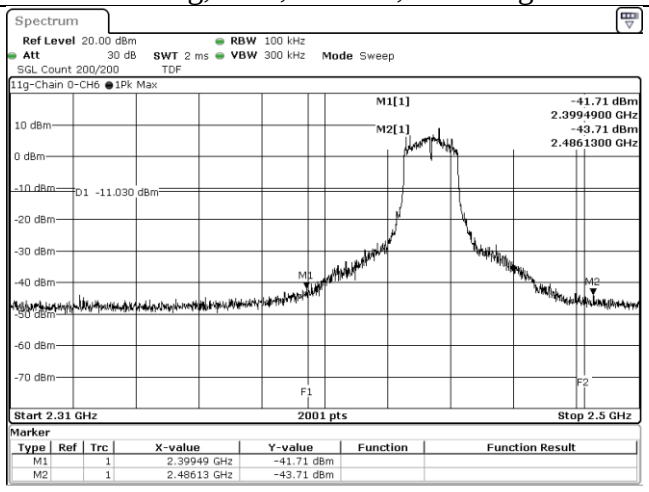

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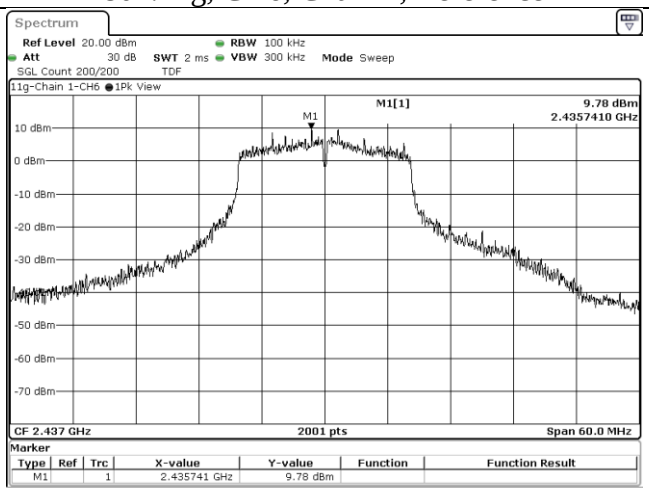


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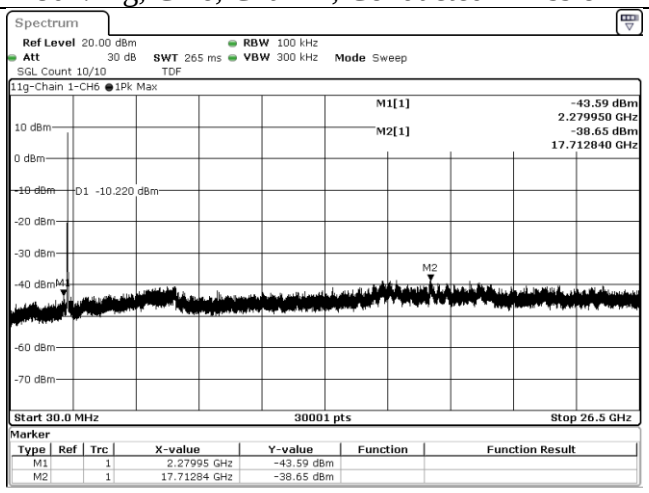
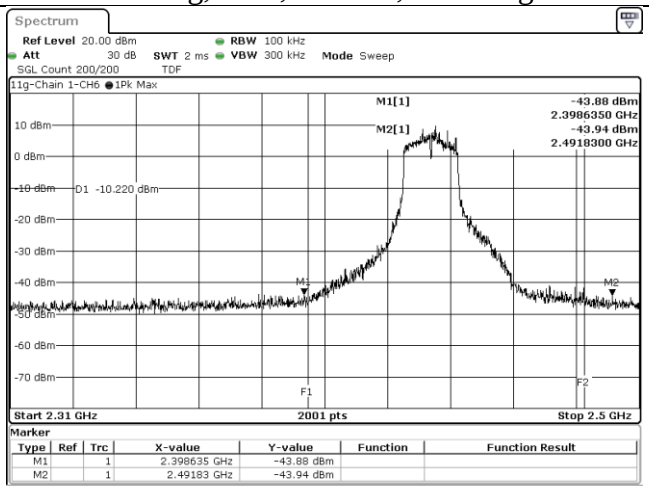
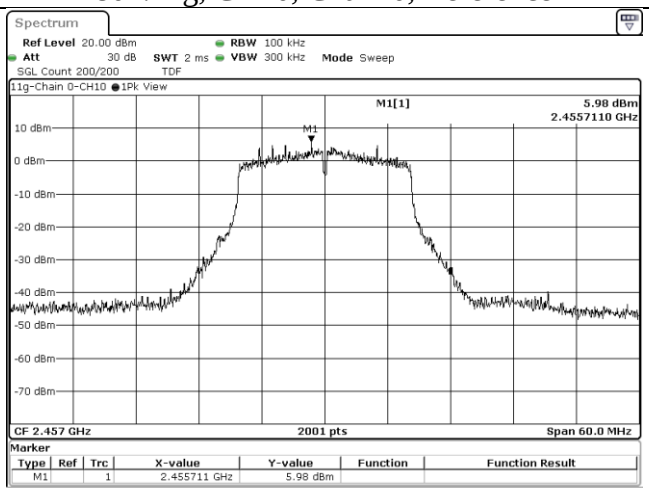


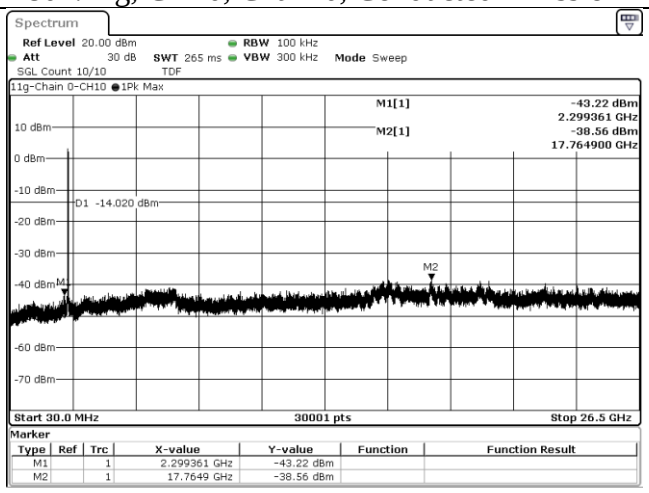

802.11g, CH6, Chain 1, Band edge



802.11g, CH10, Chain 0, Reference




802.11g, CH10, Chain 0, Conducted Emission

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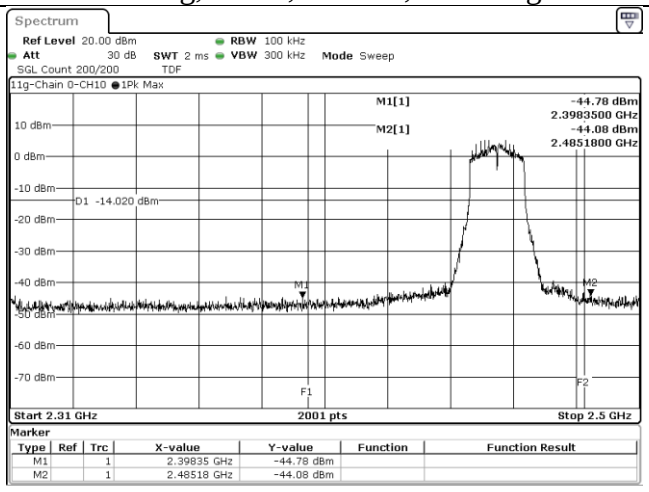

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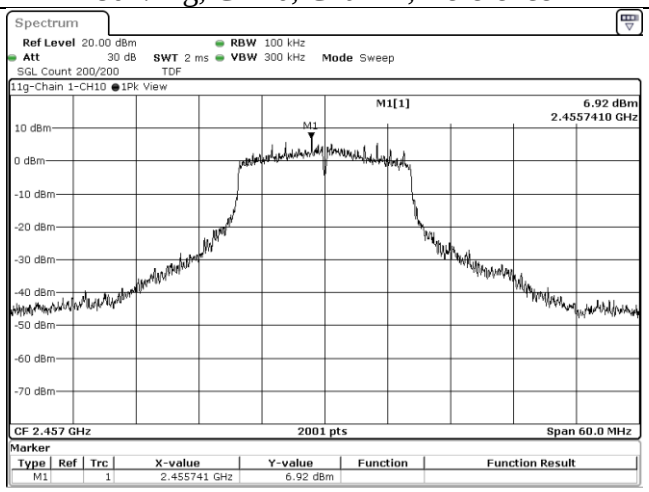


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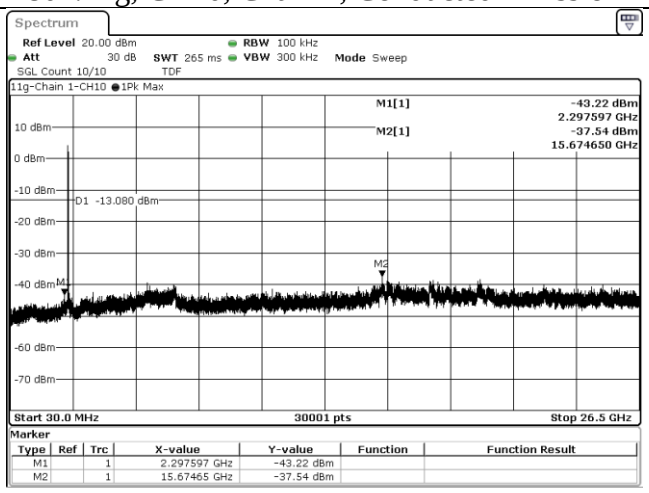


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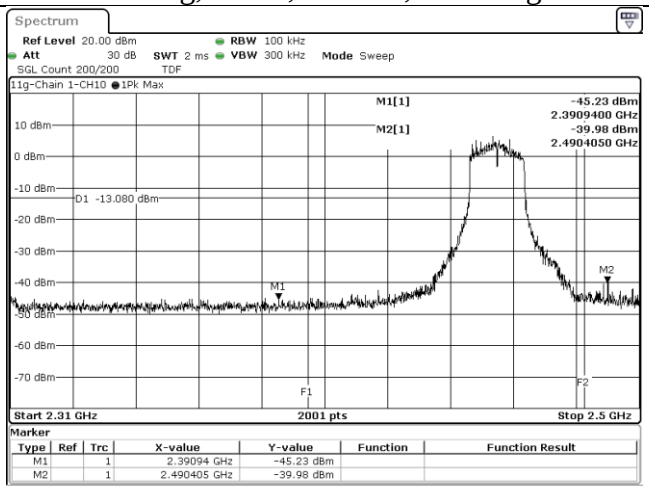

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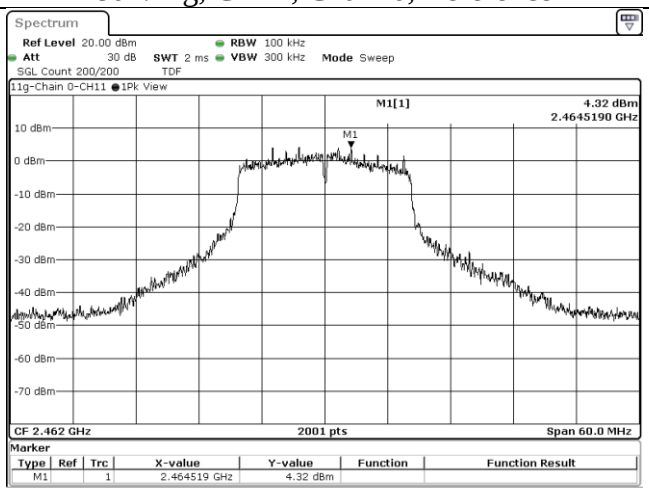


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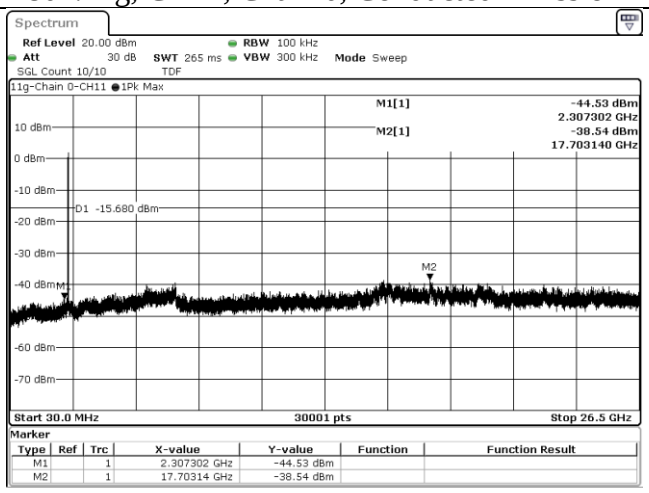


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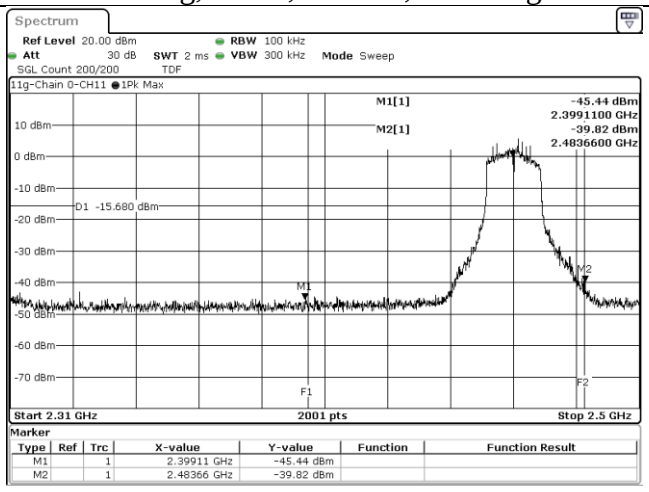

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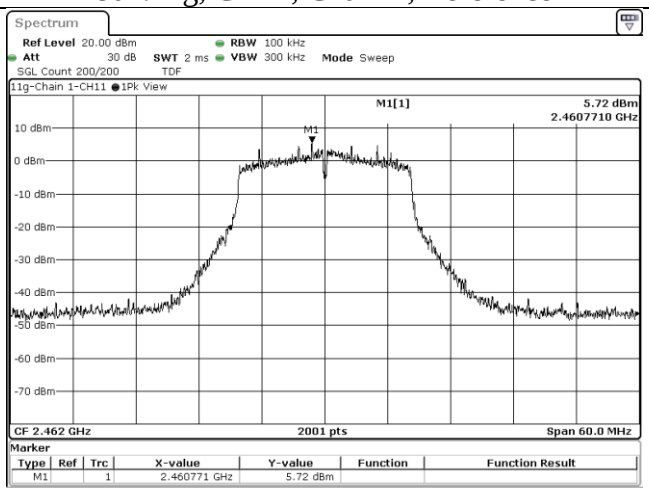
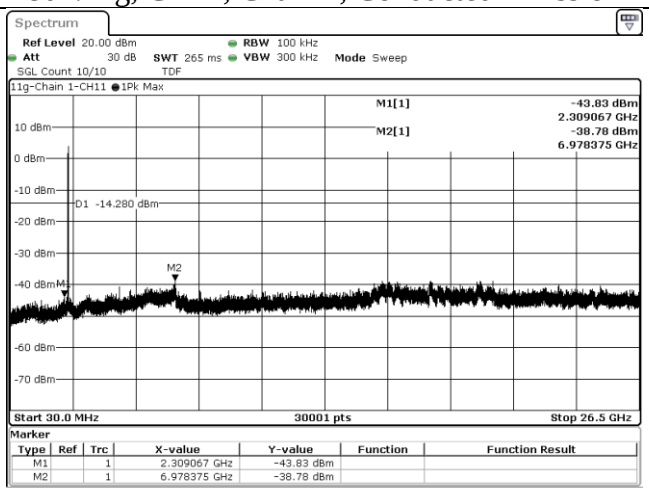



802.11g, CH11, Chain 1, Conducted Emission

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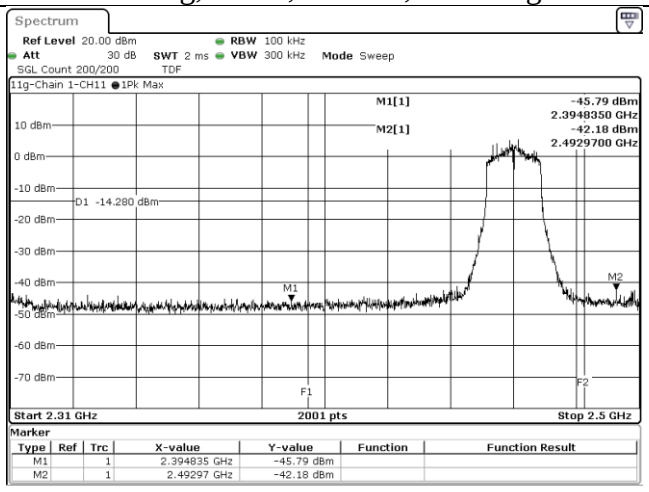
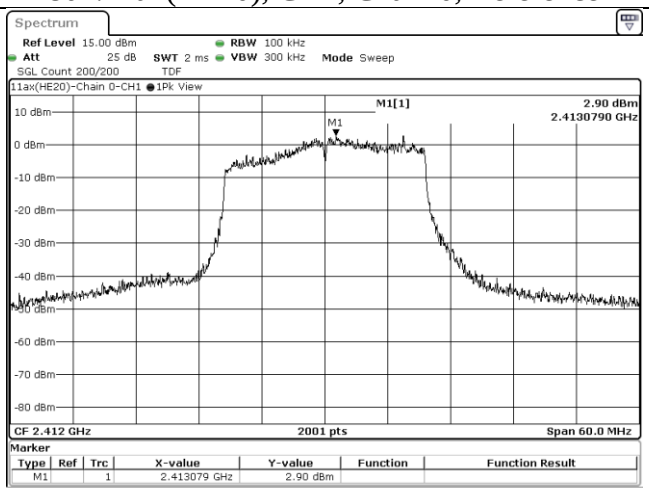


802.11ax(HE20), CH1, Chain 0, Reference

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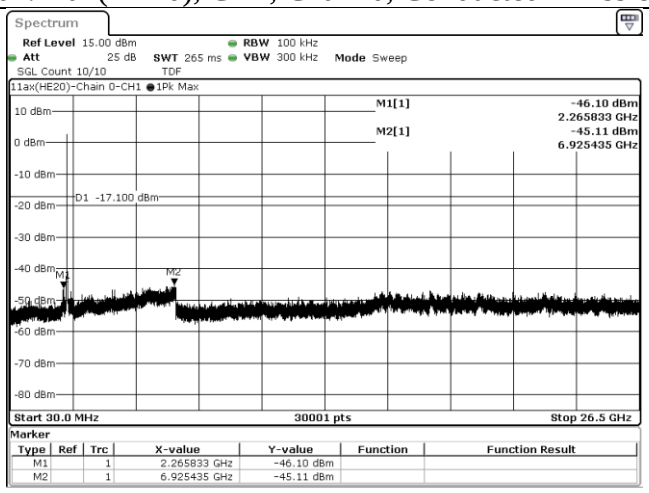
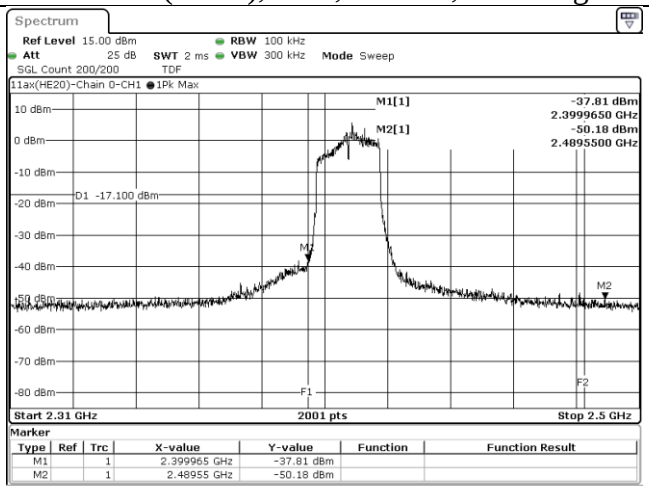



802.11ax(HE20), CH1, Chain 0, Band edge



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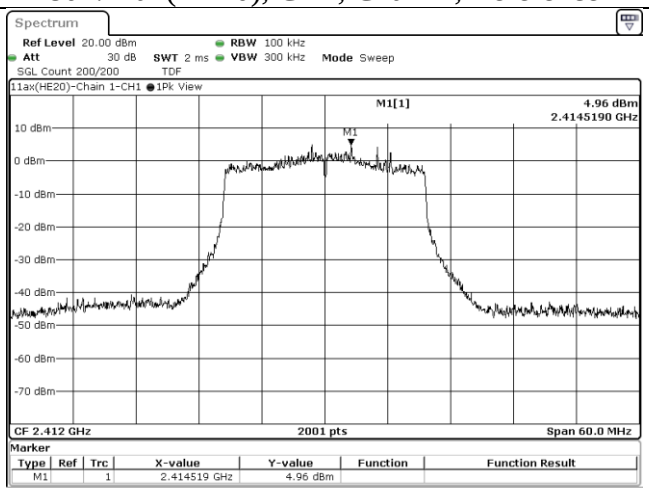


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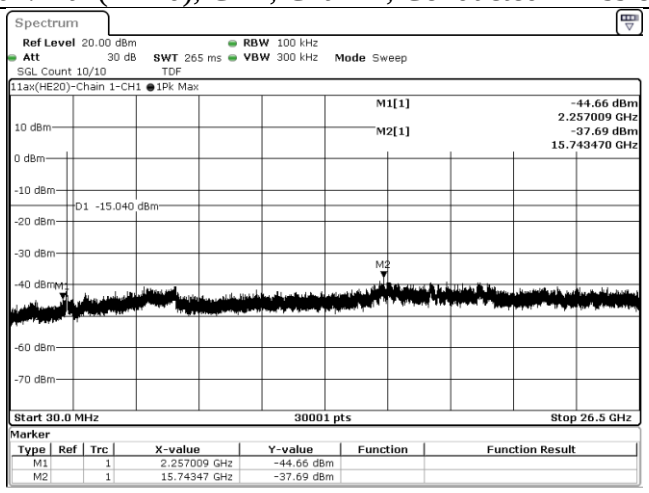
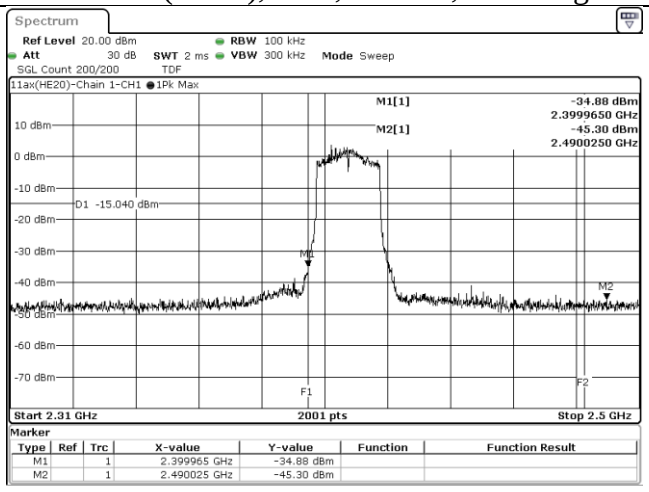
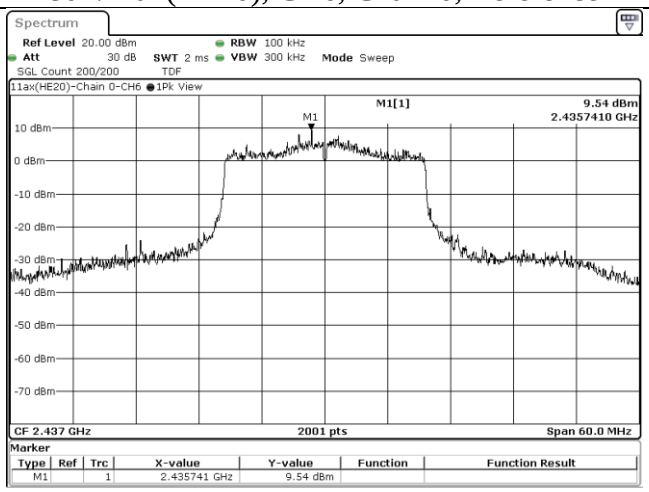



802.11ax(HE20), CH1, Chain 1, Band edge



802.11ax(HE20), CH6, Chain 0, Reference

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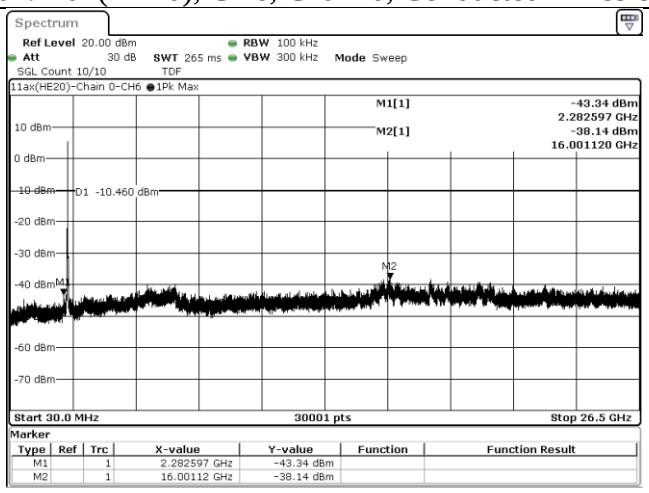


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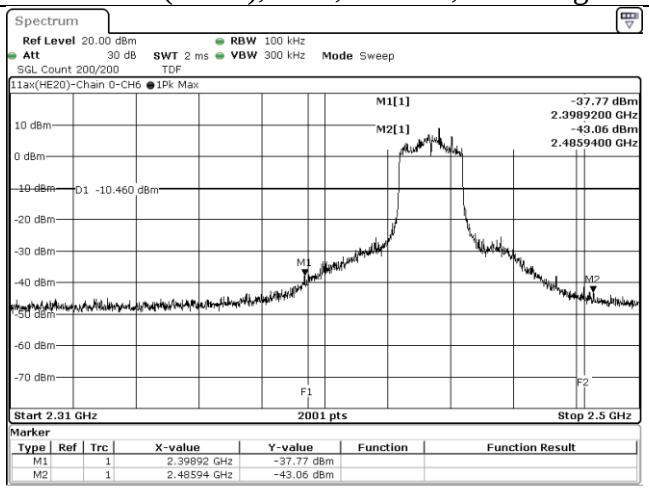

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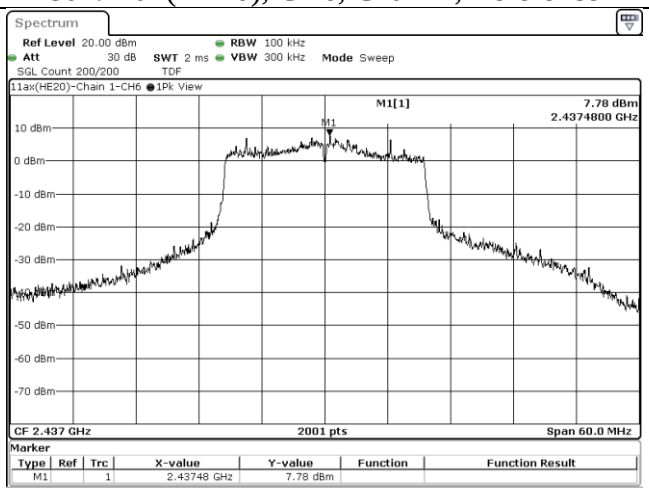


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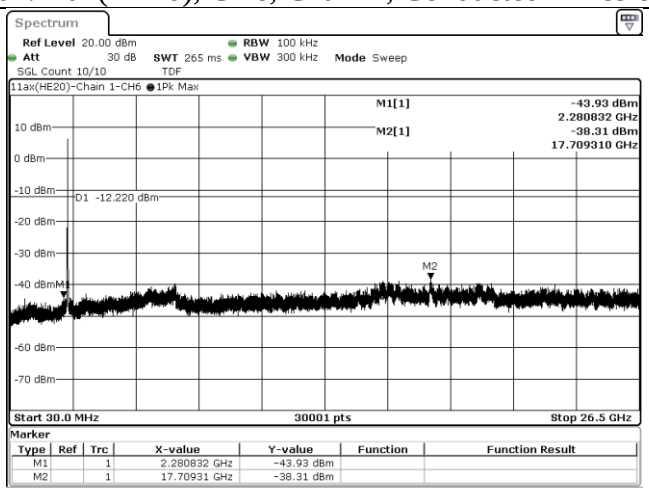
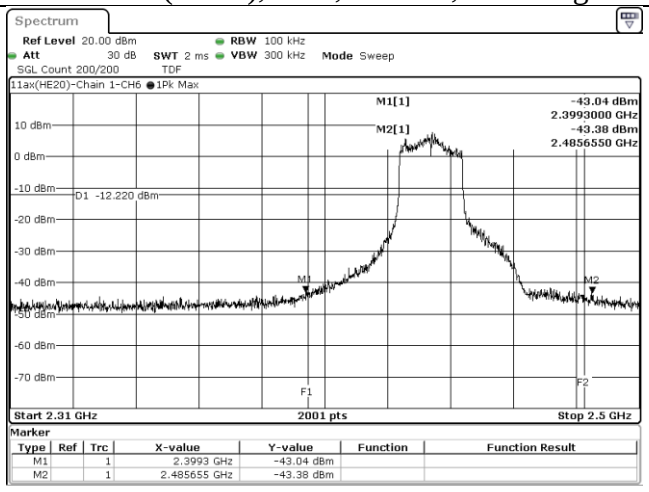



802.11ax(HE20), CH6, Chain 1, Band edge



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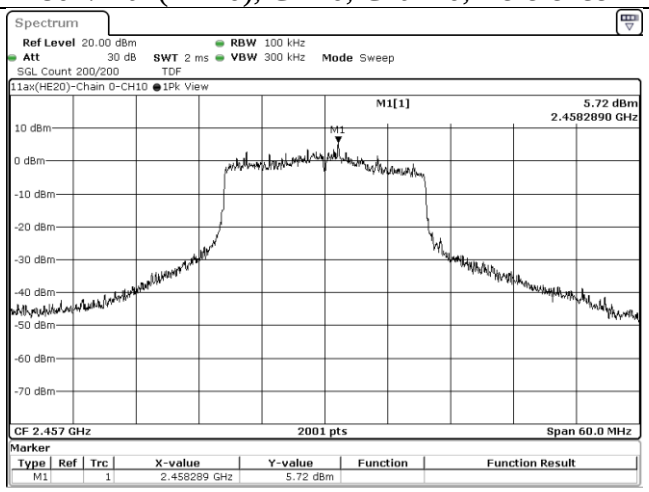


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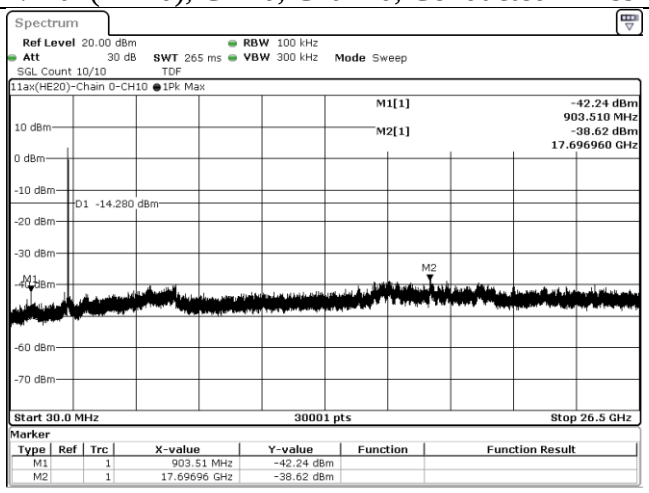
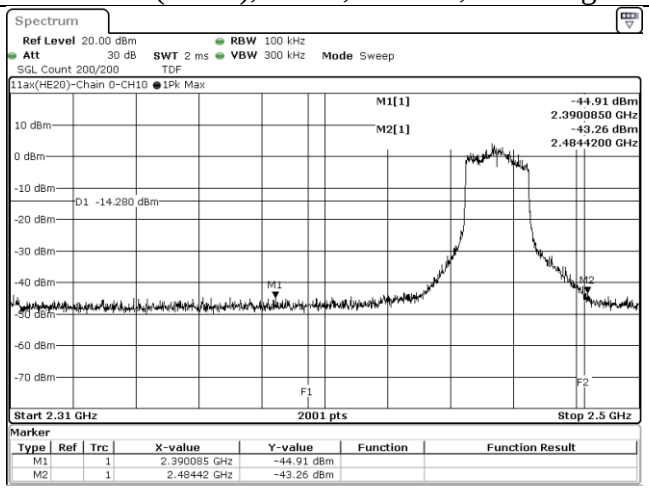



802.11ax(HE20), CH10, Chain 0, Band edge



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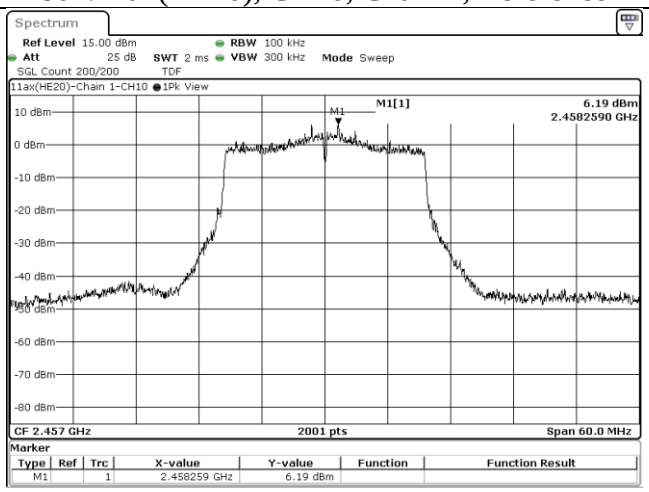


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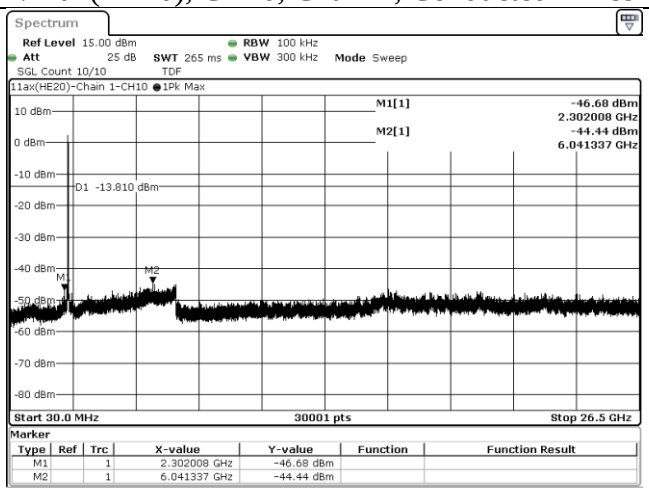
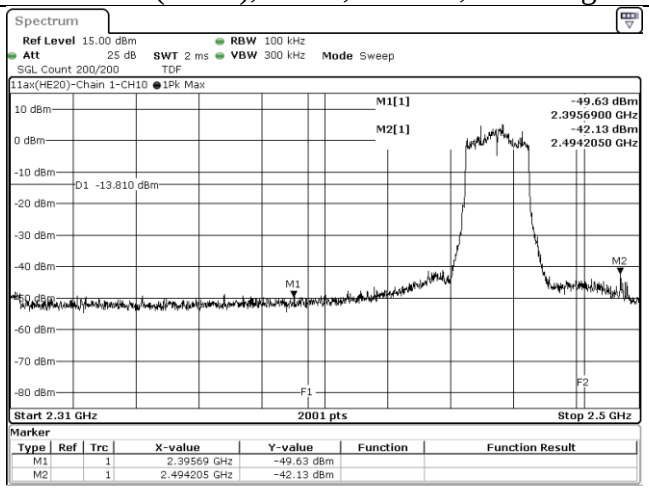



802.11ax(HE20), CH10, Chain 1, Band edge



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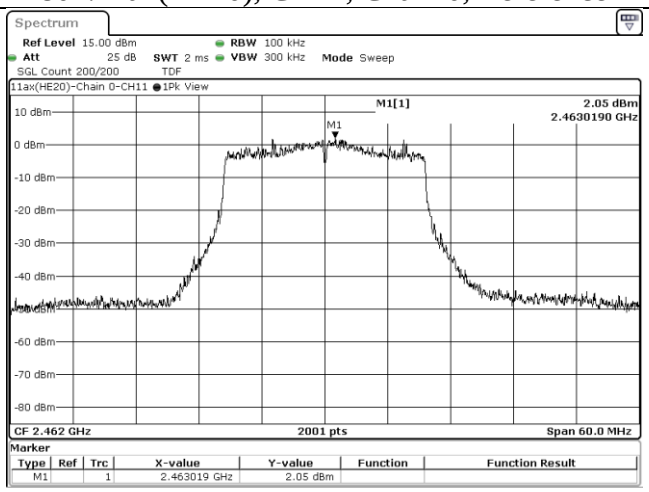


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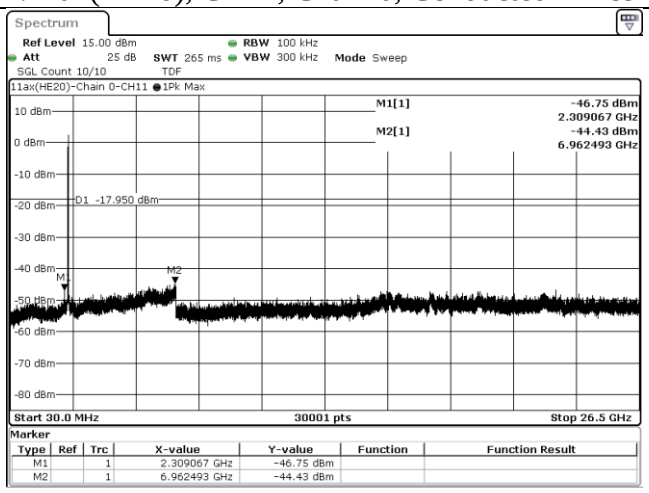
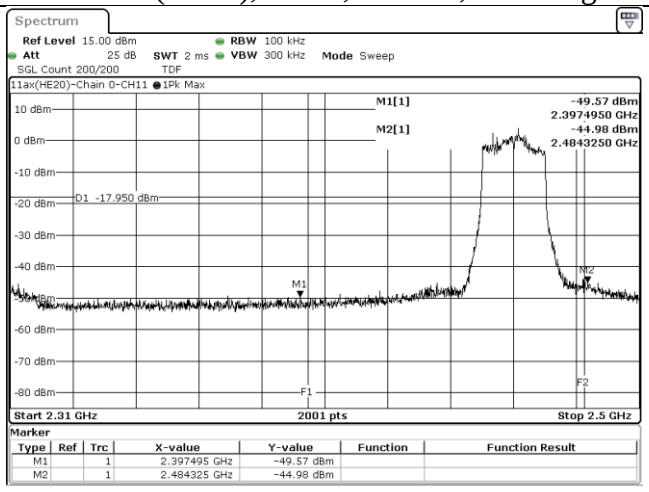



802.11ax(HE20), CH11, Chain 0, Band edge



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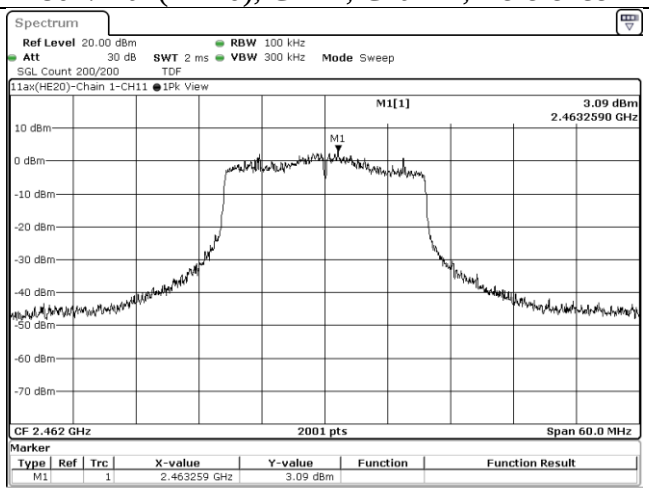
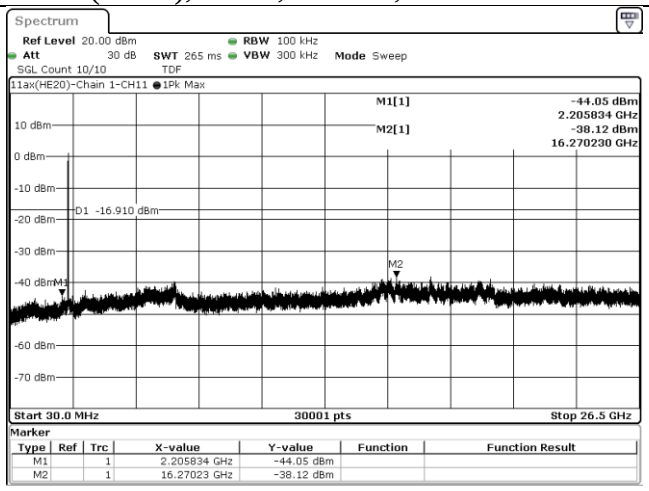
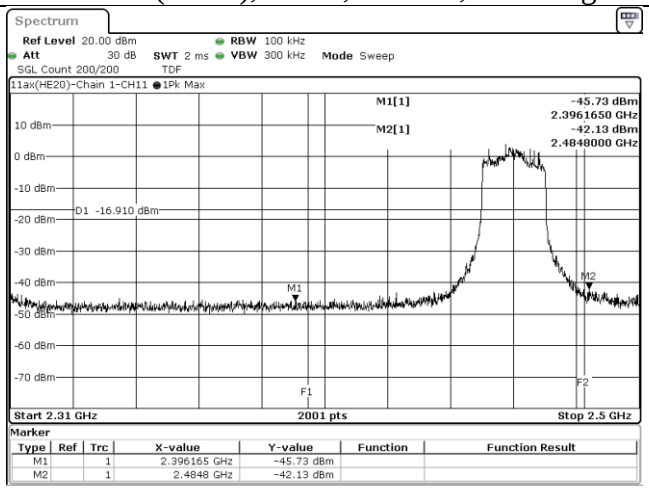



802.11ax(HE20), CH11, Chain 1, Conducted Emission




802.11ax(HE20), CH11, Chain 1, Band edge



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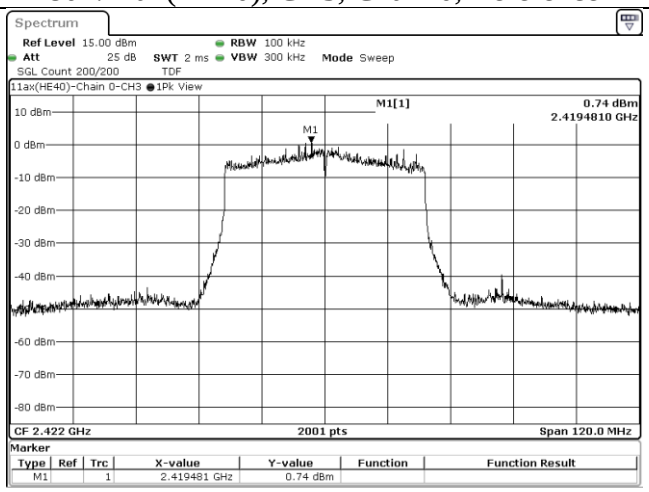


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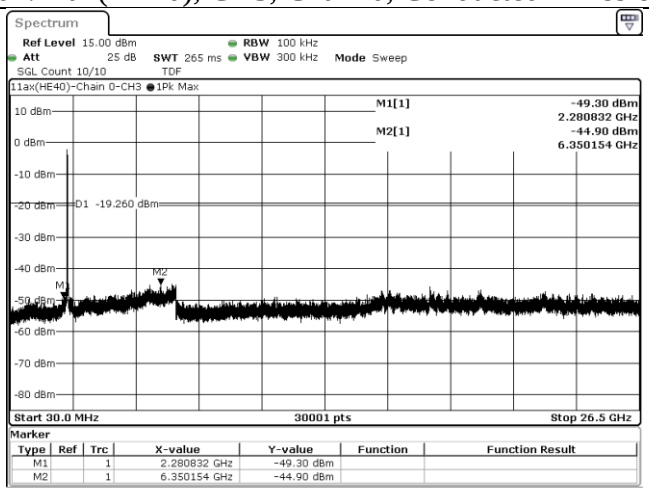
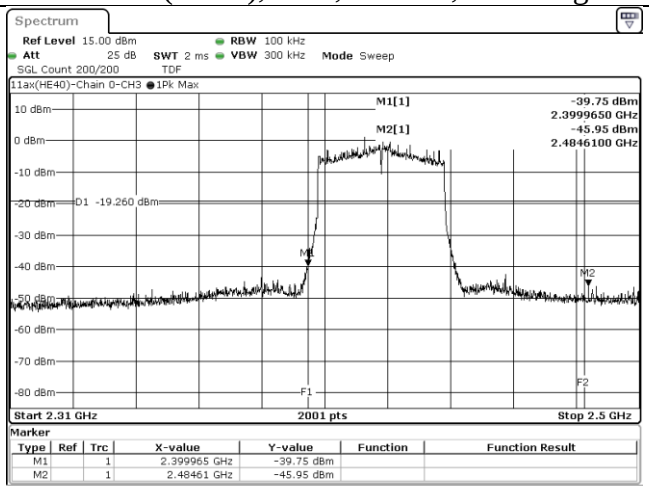
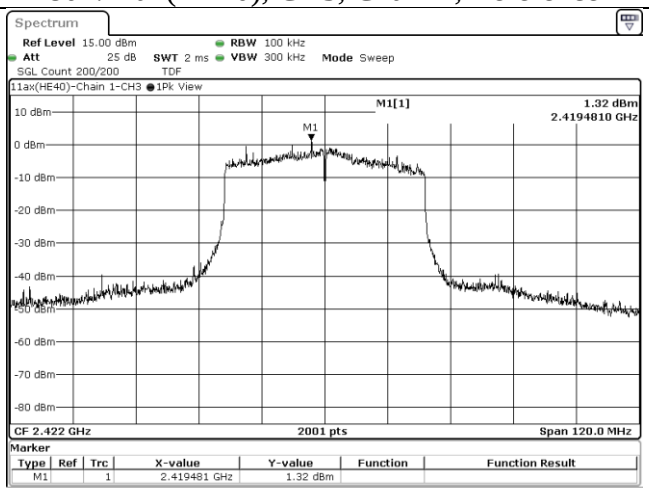


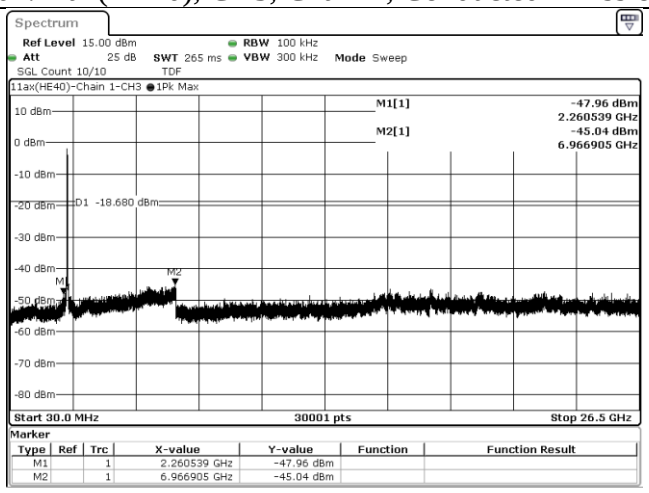

802.11ax(HE40), CH3, Chain 0, Band edge



802.11ax(HE40), CH3, Chain 1, Reference




802.11ax(HE40), CH3, Chain 1, Conducted Emission




802.11ax(HE40), CH3, Chain 1, Band edge