# FCC 47 CFR PART 15 SUBPART E

# CERTIFICATION TEST REPORT

**FOR**

**TABLET DEVICE**

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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** APPLE, INC.
1 INFINITE LOOP
CUPERTINO, CA 95014, U.S.A.

**EUT DESCRIPTION:** TABLET DEVICE

**MODEL:** A1538

**SERIAL NUMBER:** F4KP600FGJJT (CONDUCTED); F4KP606TGJJV (RADIATED); F4KNW077GG44 (DFS)

**DATE TESTED:** FEBRUARY 15 TO MAY 07, 2015

| APPLICABLE STANDARDS | |
|---|---|
| **STANDARD** | **TEST RESULTS** |
| CFR 47 Part 15 Subpart E | Pass |

UL Verification Services Inc. 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 UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. 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 UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. 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.

Approved & Released For
UL Verification Services Inc. By:

Memgistu Mekuria

MEMGISTU MEKURIA
SENIOR ENGINEER
UL VERIFICATION SERVICES INC.

Tested By:

ERIC YU
LAB ENGINEER
UL VERIFICATION SERVICES INC.


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# 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC 14-30, FCC KDB 662911 D01 v02r01, FCC KDB 905462 D02 v01r01/D03 v01r01/D06 v01, FCC KDB 789033 D02, FCC KDB 644545 D03 v01 ANSI C63.10-2009.

# 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

| 47173 Benicia Street | 47266 Benicia Street |
|---|---|
| ☐ Chamber A | ☒ Chamber D |
| ☐ Chamber B | ☐ Chamber E |
| ☐ Chamber C | ☐ Chamber F |
| | ☐ Chamber G |
| | ☐ Chamber H |

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers A through H are covered under Industry Canada company address code 2324B with site numbers 2324B - 1 through 2324B-8, respectively.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/2000650.htm.

# 4. CALIBRATION AND UNCERTAINTY

## 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

## 4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m


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### 4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| PARAMETER | UNCERTAINTY |
|---|---|
| Conducted Disturbance, 0.15 to 30 MHz | ± 3.52 dB |
| Radiated Disturbance, 30 to 1000 MHz | ± 4.94 dB |
| Radiated Disturbance, 1 to 6 GHz | ± 3.86 dB |
| Radiated Disturbance, 6 to 18 GHz | ± 4.23 dB |
| Radiated Disturbance, 18 to 26 GHz | ± 5.30 dB |
| Radiated Disturbance, 26 to 40 GHz | ± 5.23 dB |

Uncertainty figures are valid to a confidence level of 95%.

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is a tablet with multimedia functions (music, application support, and video), IEEE 802.11a/b/g/n/ac radio, and Bluetooth radio. The rechargeable battery is not user accessible.


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## 5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:
Note: The output power on covered modes is equal to or less than the one referenced.

**5.2GHz Band**

| Frequency Range (MHz) | Mode | Antenna | Output Power (dBm) | Output Power (mW) |
|---|---|---|---|---|
| 5180 - 5240 | 802.11a SISO | Covered by 802.11n HT20 SISO | | |
| 5180 - 5240 | 802.11a CDD 2TX | Covered by 802.11n HT20 CDD 2TX | | |
| 5180 - 5240 | 802.11n HT20 SISO | Antenna B | 16.50 | 44.67 |
| 5180 - 5240 | 802.11n HT20 SISO | Antenna A | 17.09 | 51.17 |
| 5180 - 5240 | 802.11n HT20 CDD 2TX | Antenna B + A | 18.99 | 79.25 |
| 5180 - 5240 | 802.11n HT20 STBC 2TX | Antenna B + A | 19.84 | 96.38 |
| 5180 - 5240 | 802.11n HT20 SDM 2TX | Coverd by 802.11n HT20 STBC 2TX | | |
| 5190 - 5230 | 802.11n HT40 SISO | Antenna B | 16.52 | 44.87 |
| 5190 - 5230 | 802.11n HT40 SISO | Antenna A | 17.05 | 50.70 |
| 5190 - 5230 | 802.11n HT40 CDD 2TX | Antenna B + A | 18.98 | 79.07 |
| 5190 - 5230 | 802.11n HT40 STBC 2TX | Antenna B + A | 19.73 | 93.97 |
| 5190 - 5230 | 802.11n HT40 SDM 2TX | Coverd by 802.11n HT40 STBC 2TX | | |
| 5210 | 802.11ac VHT80 SISO | Antenna B | 13.17 | 20.75 |
| 5210 | 802.11ac VHT80 SISO | Antenna A | 13.17 | 20.75 |
| 5210 | 802.11ac VHT80 CDD 2TX | Antenna B + A | 15.19 | 33.04 |
| 5210 | 802.11ac VHT80 STBC 2TX | Covered by 802.11ac VHT80 CDD 2TX | | |
| 5210 | 802.11ac VHT80 SDM 2TX | Covered by 802.11ac VHT80 CDD 2TX | | |

**5.3GHz Band**

| Frequency Range (MHz) | Mode | Antenna | Output Power (dBm) | Output Power (mW) |
|---|---|---|---|---|
| 5260 - 5320 | 802.11a SISO | Covered by 802.11n HT20 SISO | | |
| 5260 - 5320 | 802.11a CDD 2TX | Covered by 802.11n HT20 CDD 2TX | | |
| 5260 - 5320 | 802.11n HT20 SISO | Antenna B | 15.53 | 35.73 |
| 5260 - 5320 | 802.11n HT20 SISO | Antenna A | 16.09 | 40.64 |
| 5260 - 5320 | 802.11n HT20 CDD 2TX | Antenna B + A | 18.60 | 72.44 |
| 5260 - 5320 | 802.11n HT20 STBC 2TX | Antenna B + A | 18.87 | 77.09 |
| 5260 - 5320 | 802.11n HT20 SDM 2TX | Covered by 802.11n HT20 STBC 2TX | | |
| 5270 - 5310 | 802.11n HT40 SISO | Antenna B | 15.58 | 36.14 |
| 5270 - 5310 | 802.11n HT40 SISO | Antenna A | 16.04 | 40.18 |
| 5270 - 5310 | 802.11n HT40 CDD 2TX | Antenna B + A | 18.41 | 69.34 |
| 5270 - 5310 | 802.11n HT40 STBC 2TX | Antenna B + A | 18.79 | 75.68 |
| 5270 - 5310 | 802.11n HT40 SDM 2TX | Covered by 802.11n HT40 STBC 2TX | | |
| 5290 | 802.11ac VHT80 SISO | Antenna B | 14.17 | 26.12 |
| 5290 | 802.11ac VHT80 SISO | Antenna A | 14.11 | 25.76 |
| 5290 | 802.11ac VHT80 CDD 2TX | Antenna B + A | 16.22 | 41.88 |
| 5290 | 802.11ac VHT80 STBC 2TX | Covered by 802.11n HT80 CDD 2TX | | |
| 5290 | 802.11ac VHT80 SDM 2TX | Covered by 802.11n HT80 CDD 2TX | | |


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**5.6GHz Band**

| Frequency Range (MHz) | Mode | Antenna | Output Power (dBm) | Output Power (mW) |
|---|---|---|---|---|
| 5500 - 5700 | 802.11a SISO | Covered by 802.11n HT20 SISO | | |
| 5720 | 802.11a SISO | Covered by 802.11n HT20 SISO | | |
| 5500 - 5700 | 802.11a CDD 2TX | Covered by 802.11n HT20 CDD 2TX | | |
| 5720 | 802.11a CDD 2TX | Covered by 802.11n HT20 CDD 2TX | | |
| 5500 - 5700 | 802.11n HT20 SISO | Antenna B | 15.03 | 31.84 |
| 5720 | 802.11n HT20 SISO | Antenna B | 13.69 | 23.39 |
| 5500 - 5700 | 802.11n HT20 SISO | Antenna A | 14.99 | 31.55 |
| 5720 | 802.11n HT20 SISO | Antenna A | 13.81 | 24.04 |
| 5500 - 5700 | 802.11n HT20 CDD 2TX | Antenna B + A | 18.07 | 64.12 |
| 5720 | 802.11n HT20 CDD 2TX | Antenna B + A | 16.80 | 47.86 |
| 5500 - 5700 | 802.11n HT20 STBC 2TX | Covered by 802.11n HT20 CDD 2TX | | |
| 5500 - 5700 | 802.11n HT20 SDM 2TX | Covered by 802.11n HT20 CDD 2TX | | |
| 5720 | 802.11n HT20 STBC 2TX | Covered by 802.11n HT20 CDD 2TX | | |
| 5720 | 802.11n HT20 SDM 2TX | Covered by 802.11n HT20 CDD 2TX | | |
| 5510 - 5670 | 802.11n HT40 SISO | Antenna B | 15.04 | 31.92 |
| 5710 | 802.11n HT40 SISO | Antenna B | 14.08 | 25.59 |
| 5510 - 5670 | 802.11n HT40 SISO | Antenna A | 15.00 | 31.62 |
| 5710 | 802.11n HT40 SISO | Antenna A | 14.12 | 25.82 |
| 5510 - 5670 | 802.11n HT40 CDD 2TX | Antenna B + A | 18.07 | 64.12 |
| 5710 | 802.11n HT40 CDD 2TX | Antenna B + A | 16.67 | 46.45 |
| 5510 - 5670 | 802.11n HT40 STBC 2TX | Covered by 802.11n HT40 CDD 2TX | | |
| 5510 - 5670 | 802.11n HT40 SDM 2TX | Covered by 802.11n HT40 CDD 2TX | | |
| 5710 | 802.11n HT40 STBC 2TX | Covered by 802.11n HT40 CDD 2TX | | |
| 5710 | 802.11n HT40 SDM 2TX | Covered by 802.11n HT40 CDD 2TX | | |
| 5530-5610 | 802.11ac VHT80 SISO | Antenna B | 15.12 | 32.51 |
| 5690 | 802.11ac VHT80 SISO | Antenna B | 14.82 | 30.34 |
| 5530-5610 | 802.11ac VHT80 SISO | Antenna A | 15.19 | 33.04 |
| 5690 | 802.11ac VHT80 SISO | Antenna A | 15.09 | 32.28 |
| 5530-5610 | 802.11ac VHT80 CDD 2TX | Antenna B + A | 18.18 | 65.77 |
| 5690 | 802.11ac VHT80 CDD 2TX | Antenna B + A | 18.02 | 63.39 |
| 5530-5610 | 802.11ac VHT80 STBC 2TX | Covered by 802.11n HT80 CDD 2TX | | |
| 5530-5610 | 802.11ac VHT80 SDM 2TX | Covered by 802.11n HT80 CDD 2TX | | |
| 5690 | 802.11ac VHT80 STBC 2TX | Covered by 802.11n HT80 CDD 2TX | | |
| 5690 | 802.11ac VHT80 SDM 2TX | Covered by 802.11n HT80 CDD 2TX | | |


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**5.8GHz Band**

| Frequency Range (MHz) | Mode | Antenna | Output Power (dBm) | Output Power (mW) |
|---|---|---|---|---|
| 5745 - 5825 | 802.11a SISO | Covered by 802.11n HT20 SISO | | |
| 5745 - 5825 | 802.11a CDD 2TX | Covered by 802.11n HT20 CDD 2TX | | |
| 5745 - 5825 | 802.11n HT20 SISO | Antenna B | 16.50 | 44.67 |
| 5745 - 5825 | 802.11n HT20 SISO | Antenna A | 17.52 | 56.49 |
| 5745 - 5825 | 802.11n HT20 CDD 2TX | Antenna B + A | 19.99 | 99.77 |
| 5745 - 5825 | 802.11n HT20 STBC 2TX | Covered by 802.11n HT20 CDD 2TX | | |
| 5745 - 5825 | 802.11n HT20 SDM 2TX | Covered by 802.11n HT20 CDD 2TX | | |
| 5755 - 5795 | 802.11n HT40 SISO | Antenna B | 15.94 | 39.26 |
| 5755 - 5795 | 802.11n HT40 SISO | Antenna A | 15.93 | 39.17 |
| 5755 - 5795 | 802.11n HT40 CDD 2TX | Antenna B + A | 17.93 | 62.09 |
| 5755 - 5795 | 802.11n HT40 STBC 2TX | Covered by 802.11n HT40 CDD 2TX | | |
| 5755 - 5795 | 802.11n HT40 SDM 2TX | Covered by 802.11n HT40 CDD 2TX | | |
| 5775 | 802.11ac VHT80 SISO | Antenna B | 13.59 | 22.86 |
| 5775 | 802.11ac VHT80 SISO | Antenna A | 13.60 | 22.91 |
| 5775 | 802.11ac VHT80 CDD 2TX | Antenna B + A | 16.32 | 42.85 |
| 5775 | 802.11ac VHT80 STBC 2TX | Covered by 802.11ac VHT80 CDD 2TX | | |
| 5775 | 802.11ac VHT80 SDM 2TX | Covered by 802.11ac VHT80 CDD 2TX | | |


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## 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

| Frequency Band (GHz) | Antenna Gain | |
|---|---|---|
| | Antenna B | Antenna A |
| 5.2 | 4.1 | 2.1 |
| 5.3 | 4.2 | 3.1 |
| 5.5 | 4.8 | 3.2 |
| 5.8 | 4.9 | 3.4 |

## 5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was 12H33.


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## 5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

The following configurations were investigated and EUT powered by AC/DC adapter was the worst-case scenario. AC power line and below 1G radiated tests were conducted on configuration 1.

| Configuration | Descriptions |
|---|---|
| 1 | EUT powered by AC/DC adapter via USB cable |
| 2 | EUT powered by host PC via USB cable |

For SISO modes, there are two transmission antennas. The antenna used in any given time can be either antenna A or antenna B. For MIMO modes, both antenna A and antenna B used at the same time.

The fundamental of the EUT was investigated in three orthogonal orientations X/Y/Z. After the investigation it was determined that the below orientations was considered as the worst-case for each mode. Then all final radiated testing was performed with the EUT at the worst-case orientation.

| Frequency Band (GHz) | Mode | Antenna Port | Worst-case Orientation |
|---|---|---|---|
| 5.2 - 5.8 | 1TX SISO | Antenna A | Y-Landscape |
| | | Antenna B | Y-Landscape |
| | 2TX MIMO | Antenna A + Antenna B | Y-Landscape |

Worst-case data rates as provided by the client were:

802.11a mode: 6 Mbps
802.11n HT20 mode: MCS0
802.11n HT40 mode: MCS0
802.11ac VHT20 mode: MCS0
802.11ac VHT40 mode: MCS0
802.11ac VHT80 mode: MCS0

802.11ac VHT20 and VHT40 mode are different from 802.11nHT20 and HT40 only in control messages and have the same power settings.

There are two vendors of the WiFi/Bluetooth radio modules: variant 1 and variant 2. The Wi-Fi/Bluetooth radio modules have the same mechanical outline (e.g., the same package dimension and pin-out layout), use the same on-board antenna matching circuit, have an identical antenna structure, and are built and tested to conform to the same specifications and to operate within the same tolerances.
Baseline testing was performed on the two variants to determine the worst case on all conducted power and radiated emissions.

Radiated emissions for EUT with antenna was performed and passed; therefore, antenna port spurious was not performed.

For the co-located test, no other emissions were found after have been investigated from the conducted measurement with all different combination frequencies between BT & 5GHz bands.


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## 5.6. DESCRIPTION OF TEST SETUP

**SUPPORT EQUIPMENT**

| Support Equipment List | | | | |
|---|---|---|---|---|
| Description | Manufacturer | Model | Serial Number | FCC ID |
| Laptop AC/DC adapter | Lenovo | 92P1160 | 11S92P1160Z1ZBGH798B12 | NA |
| Laptop | Lenovo | 7659 | L3-AL664 08/03 | NA |
| Earphone | Apple | NA | NA | NA |
| EUT AC/DC adapter | Apple | MD836LL/A | NA | NA |

**I/O CABLES (CONDUCTED TEST)**

| I/O Cable List | | | | | | |
|---|---|---|---|---|---|---|
| Cable No | Port | # of identical ports | Connector Type | Cable Type | Cable Length (m) | Remarks |
| 1 | Antenna | 1 | SMA | Un-Shielded | 0.2 | To spectrum Analyzer |
| 2 | USB | 1 | USB | Shielded | 1 | N/A |

**I/O CABLES (RADIATED ABOVE 1 GHZ)**

| I/O Cable List | | | | | | |
|---|---|---|---|---|---|---|
| Cable No | Port | # of identical ports | Connector Type | Cable Type | Cable Length (m) | Remarks |
| None used | | | | | | |

**I/O CABLES (AC POWER CONDUCTED TEST and below 1 GHZ)**

| I/O Cable List | | | | | | |
|---|---|---|---|---|---|---|
| Cable No | Port | # of identical ports | Connector Type | Cable Type | Cable Length (m) | Remarks |
| 1 | AC | 1 | US115 | Un-Shielded | 0.8 | NA |
| 2 | DC | 1 | lightning | Un-Shielded | 1 | NA |
| 3 | Audio | 1 | Jack | Un-Shielded | 0.5 | NA |


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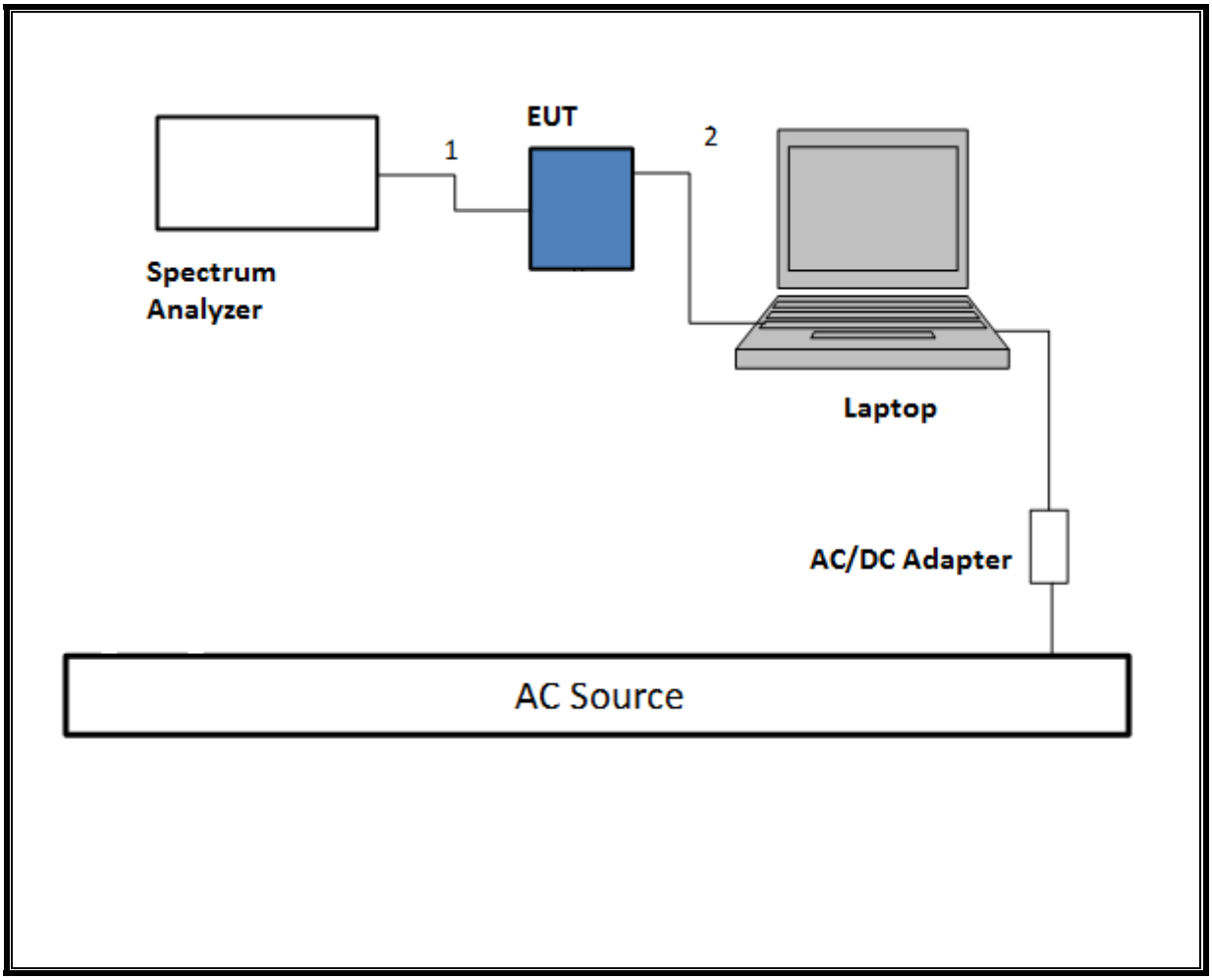
**TEST SETUP- CONDUCTED PORT**

The EUT was tested connected to a host Laptop via USB cable adapter and spectrum analyzer to antenna port. Test software exercised the EUT.

**SETUP DIAGRAM**





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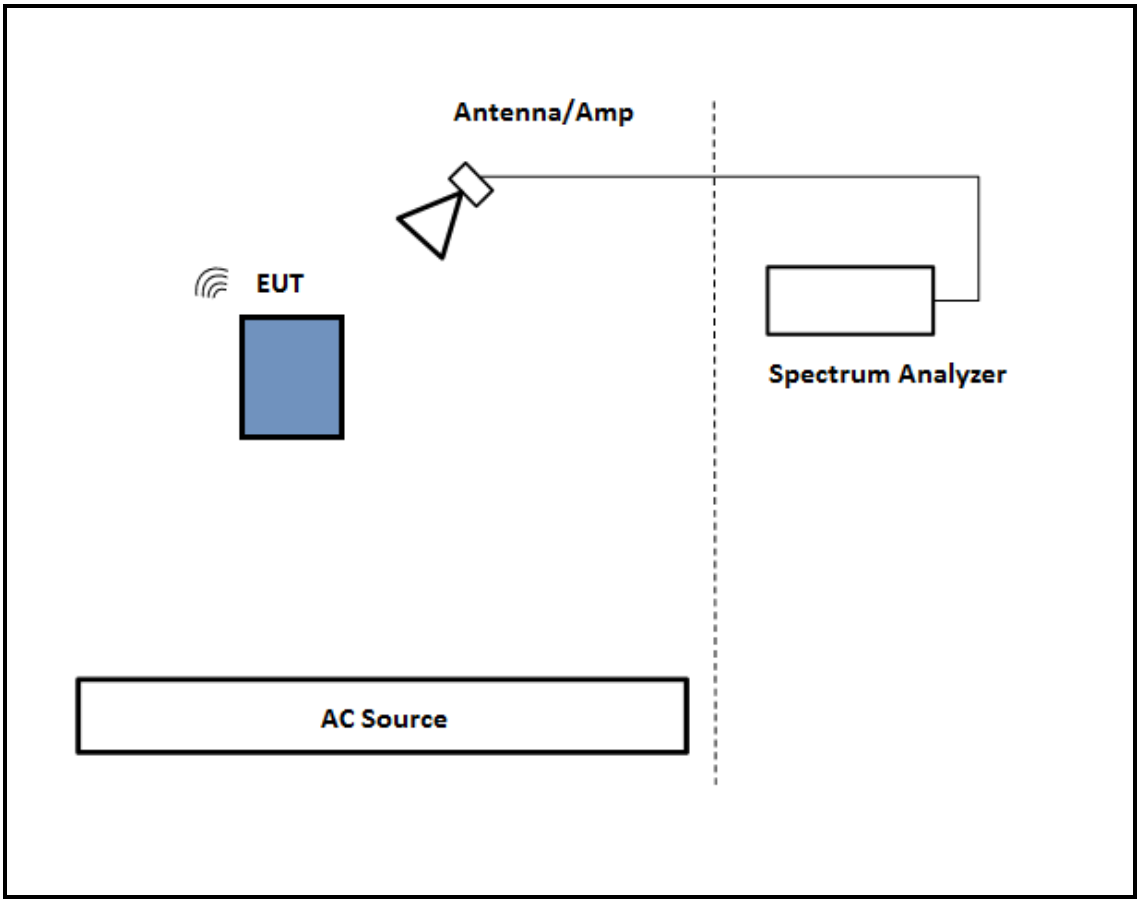
**TEST SETUP- RADIATED-ABOVE 1 GHZ**

The EUT was tested battery powered. Test software exercised the EUT.

**SETUP DIAGRAM**





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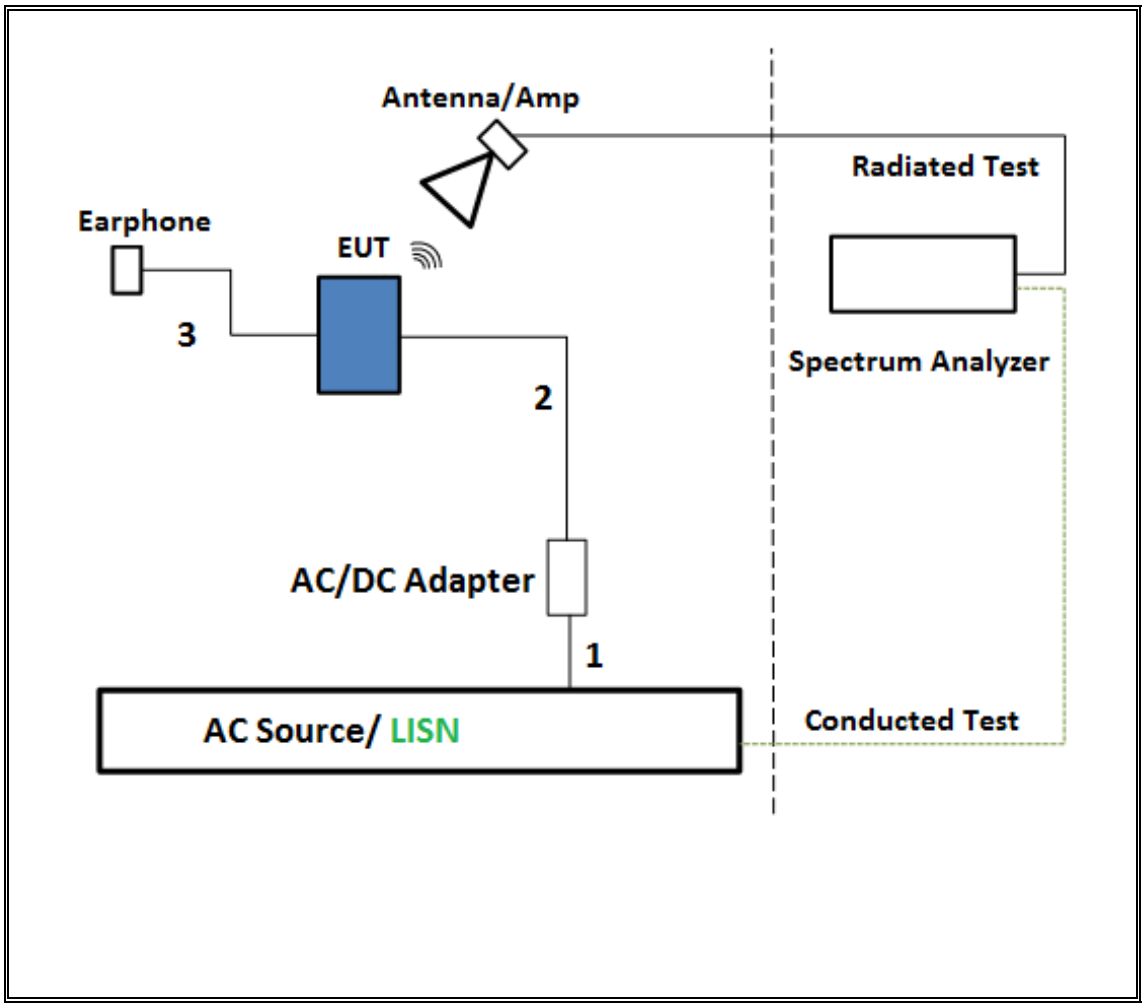
**TEST SETUP- BELOW 1GHZ & AC LINE CONDUCTED TESTS**

The EUT was tested with earphone connected and powered by AC adapter. Test software exercised the EUT.

**SETUP DIAGRAM**





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# 6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

| Test Equipment List | | | | |
|---|---|---|---|---|
| **Description** | **Manufacturer** | **Model** | **Cal Date** | **Cal Due** |
| Antenna, Horn 1-18GHz | ETS Lindgren | 3117 | 2/10/2015 | 2/10/2016 |
| Antenna, Broadband Hybrid, 30MHz to 2000MHz | Sunol Sciences | JB3 | 3/5/2015 | 3/3/2016 |
| Amplifier, 1 - 18GHz | Miteq | AFS42-00101800-25-S-42 | 1/26/2015 | 1/26/2016 |
| *Amplifier, 10KHz to 1GHz, 32dB | Sonoma | 310N | 4/23/2014 | 4/23/2015 |
| Spectrum Analyzer, PXA, 3Hz to 50GHz | Agilent | N9030A | 9/13/2014 | 9/13/2015 |
| *Power Meter, P-series single channel | Agilent | N1911A | 4/3/2014 | 4/3/2015 |
| Power Sensor, P - series, 50MHz to 18GHz, Wideband | Agilent | N1921A | 7/12/2014 | 7/12/2015 |
| Amplifier, 26 - 40GHz | Miteq | NSP4000-SP2 | 9/3/2014 | 9/3/2015 |
| Antenna, Horn 18 to 26.5GHz | ARA | MWH-1826 | 12/17/2014 | 12/17/2015 |
| Spectrum Analyzer, 40 GHz | Agilent | 8564E | 8/6/2014 | 8/6/2015 |
| *Amplifier, 1 to 26.5GHz, 23.5dB Gain minimum | Agilent | 8449B | 3/25/2014 | 3/25/2015 |
| Horn Antenna, 40GHz | ARA | MWH-2640/B | 7/15/2014 | 7/15/2015 |
| Amplifier, 26 to 40GHz | Miteq | NSP4000-SP2 | 9/3/2014 | 9/3/2015 |
| AC Line Conducted | | | | |
| EMI Test Receiver 9Khz-7GHz | Rohde & Schwarz | ECSI7 | 09/16/14 | 09/16/15 |
| LISN for Conducted Emissions CISPR-16 | FCC | 50/250-25-2 | 01/16/15 | 01/16/16 |
| Power Cable, Line Conducted Emissions ANSI 63.4 | U L | PG1 | 7/28/2014 | 7/28/2015 |
| **UL SOFTWARE** | | | | |
| Radiated Software | UL | UL EMC | Ver 9.5, July 22, 2014 | |
| Conducted Software | UL | UL EMC | Ver 2.2, March 31, 2015 | |
| AC Line Conducted Software | UL | UL EMC | Ver 9.5, April 3, 2015 | |

*equipment was used before expiration date.


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# 7. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

## 7.1. ON TIME AND DUTY CYCLE

**LIMITS**

None; for reporting purposes only.

**PROCEDURE**

KDB 789033 Zero-Span Spectrum Analyzer Method.

| Mode | ON Time B (msec) | Period (msec) | Duty Cycle x (linear) | Duty Cycle (%) | Duty Cycle Correction Factor (dB) | 1/B Minimum VBW (kHz) |
|---|---|---|---|---|---|---|
| 802.11n HT20 1TX | 1.916 | 1.940 | 0.988 | 98.76% | 0.00 | 0.010 |
| 802.11n HT20 CDD | 1.920 | 1.938 | 0.991 | 99.07% | 0.00 | 0.010 |
| 802.11n HT20 STBC | 1.924 | 1.948 | 0.988 | 98.77% | 0.00 | 0.010 |
| 802.11n HT40 1TX | 1.124 | 1.142 | 0.984 | 98.42% | 0.00 | 0.010 |
| 802.11n HT40 CDD | 1.124 | 1.142 | 0.984 | 98.42% | 0.00 | 0.010 |
| 802.11n HT40 STBC | 1.128 | 1.146 | 0.984 | 98.43% | 0.00 | 0.010 |
| 802.11ac VHT80 1TX | 0.544 | 0.565 | 0.963 | 96.28% | 0.16 | 1.838 |
| 802.11ac VHT80 CDD | 0.460 | 0.483 | 0.952 | 95.24% | 0.21 | 2.174 |
| 802.11ac VHT80 STBC | 0.468 | 0.490 | 0.955 | 95.51% | 0.20 | 2.137 |


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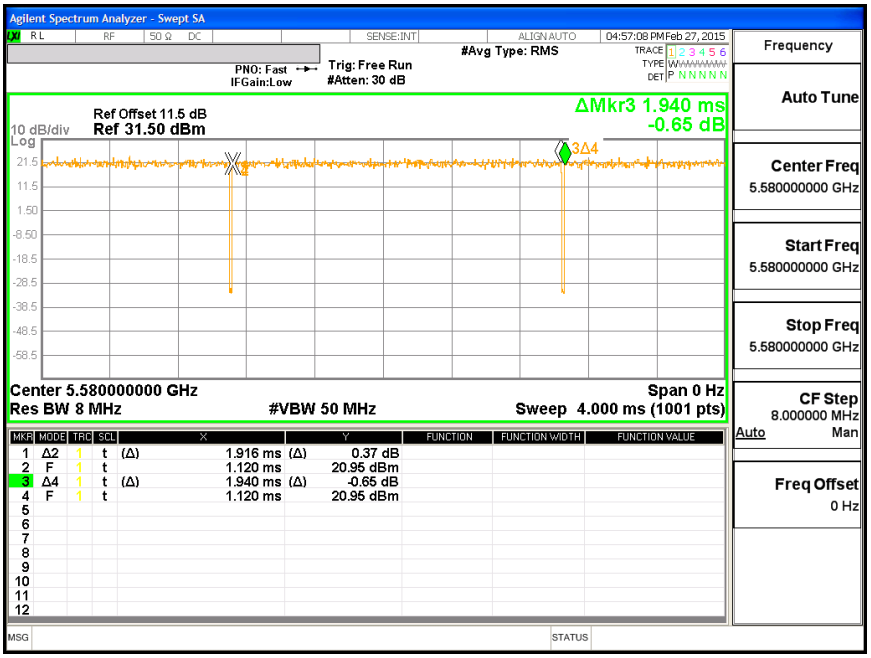
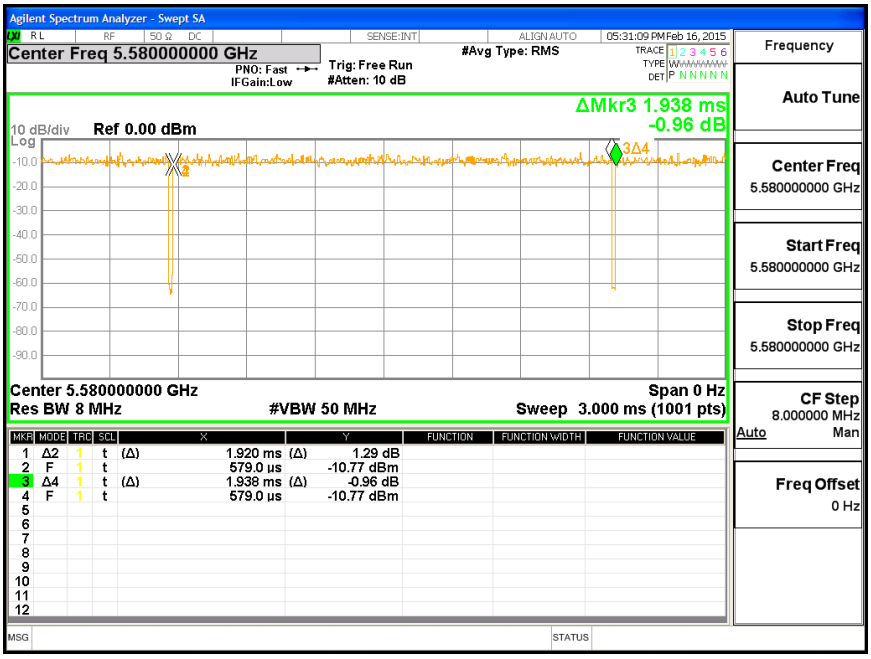
## 7.2. DUTY CYCLE PLOTS

DUTY CYCLE 802.11n HT20 1TX MODE




DUTY CYCLE 802.11n HT20 CDD MODE





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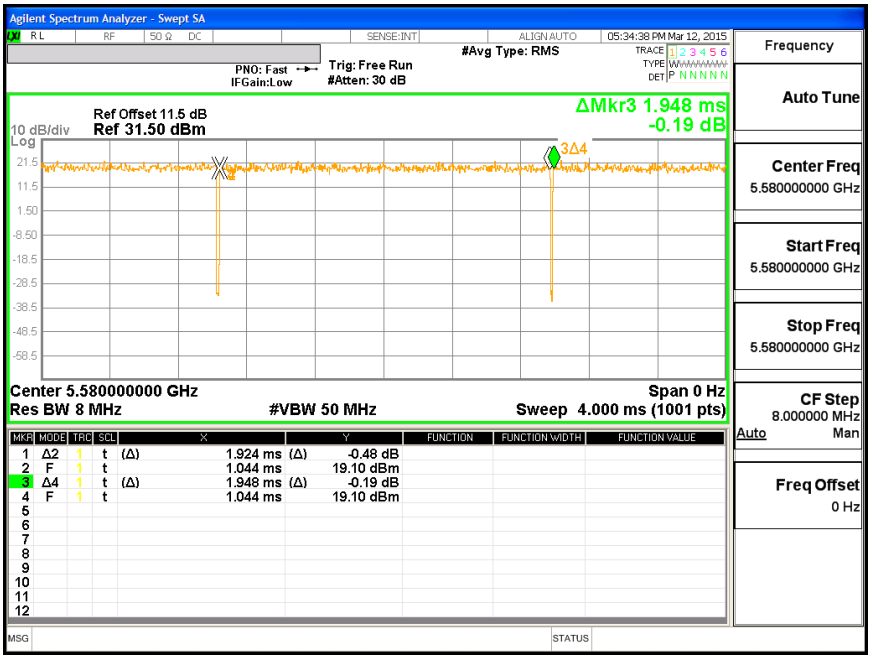
DUTY CYCLE 802.11n HT20 STBC MODE





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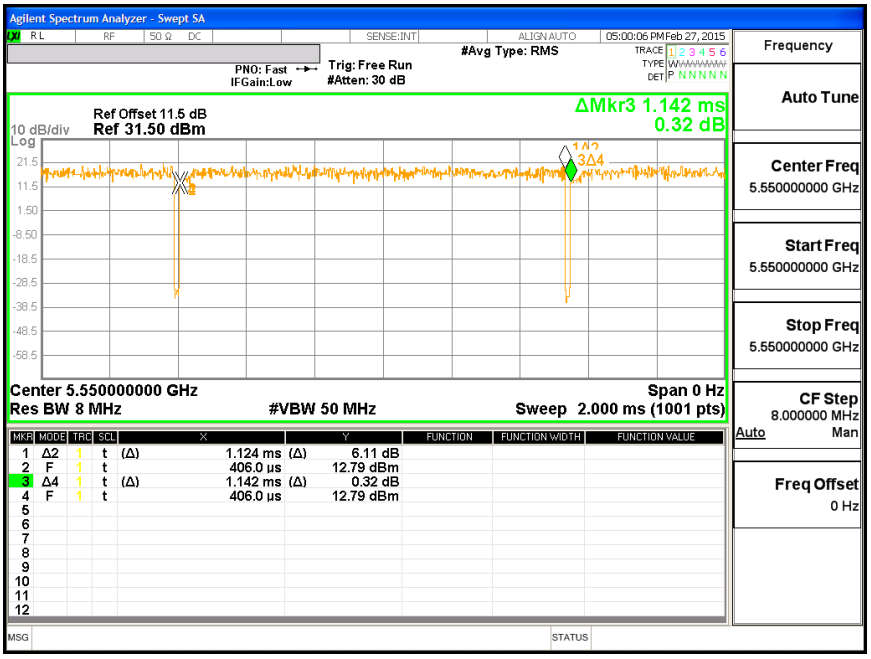
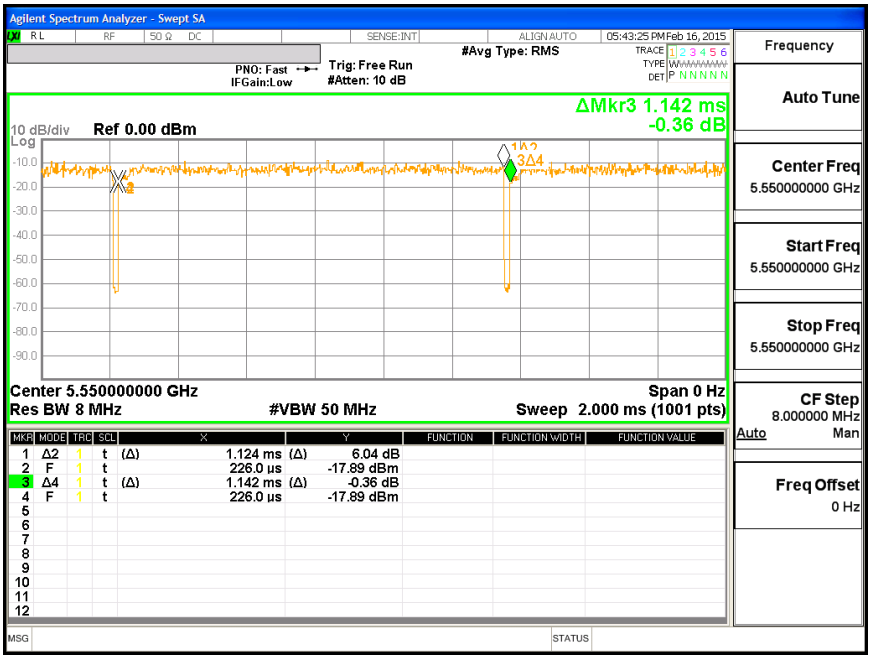
DUTY CYCLE 802.11n HT40 1TX MODE




DUTY CYCLE 802.11n HT40 CDD MODE





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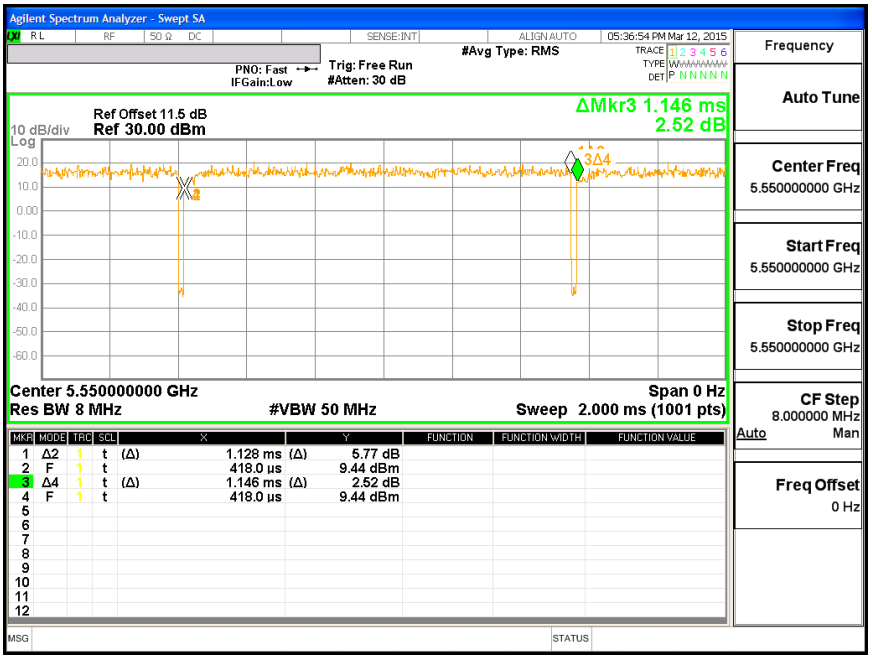
DUTY CYCLE 802.11n HT40 STBC MODE





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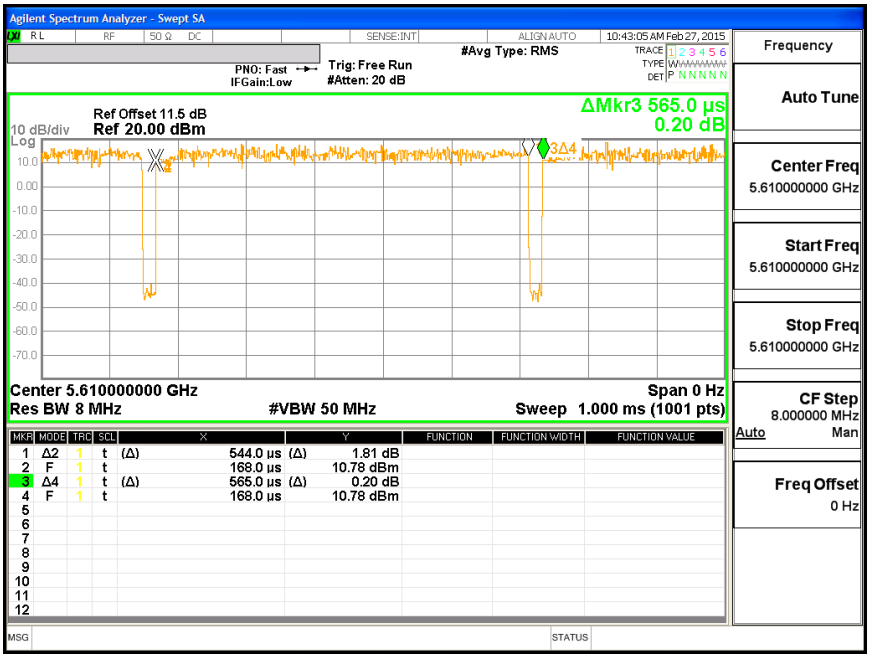
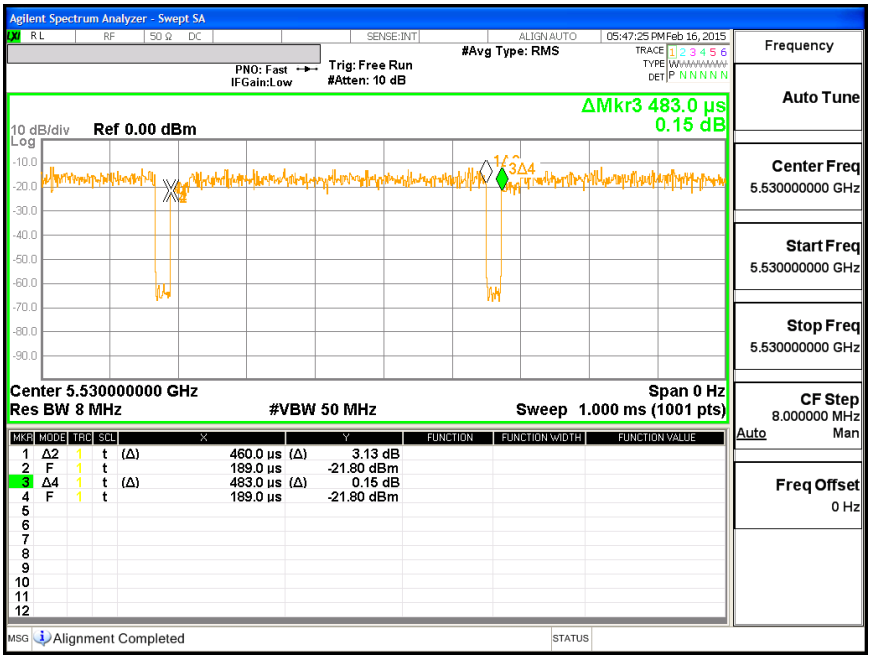
DUTY CYCLE 802.11ac VHT80 1TX MODE




DUTY CYCLE 802.11ac VHT80 CDD MODE





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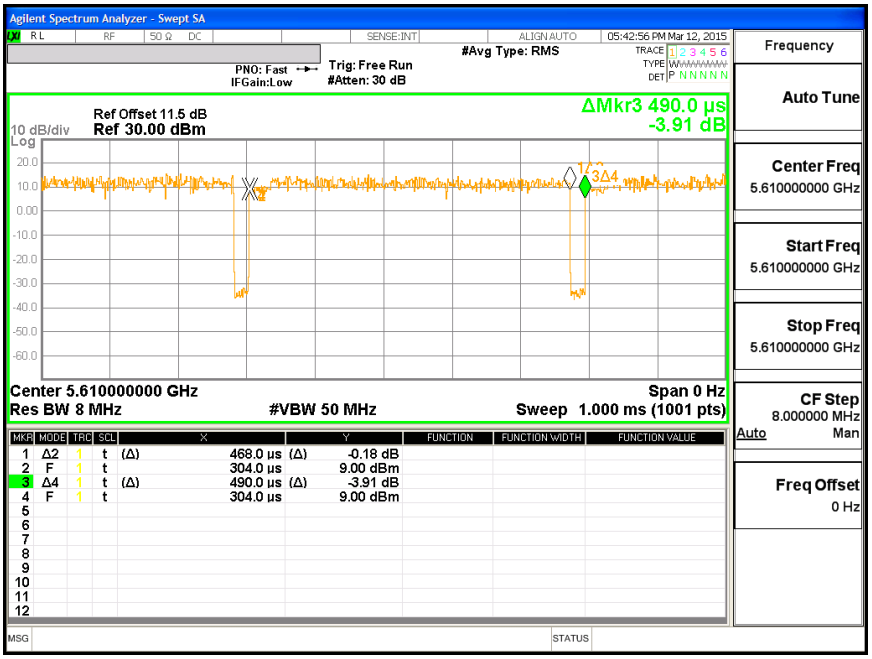
DUTY CYCLE 802.11ac VHT80 STBC MODE





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## 7.3. MEASUREMENT METHODS

26 dB Emission BW: KDB 789033 D02 v01, Section C.

99% Occupied BW: KDB 789033 D02 v01, Section D.

Conducted Output Power: KDB 789033 D02 v01, Section E.3.a (Method PM).

Power Spectral Density: KDB 789033 D02 v01, Section F.

Unwanted emissions in restricted bands: KDB 789033 D02 v01, Sections G.3, G.4, G.5, and G.6.

Unwanted emissions in non-restricted bands: KDB 789033 D02 v01, Sections G.3, G.4, and G.5.


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# 8. ANTENNA PORT TEST RESULTS

## 8.1. 802.11n HT20 SISO MODE IN THE 5.2 GHz BAND ANTENNA B

### 8.1.1. 26 dB BANDWIDTH

**LIMITS**

None; for reporting purposes only.

**RESULTS**

| Channel | Frequency (MHz) | 26 dB Bandwidth (MHz) |
|---|---|---|
| Low | 5180 | 22.02 |
| Mid | 5200 | 22.02 |
| High | 5240 | 21.93 |


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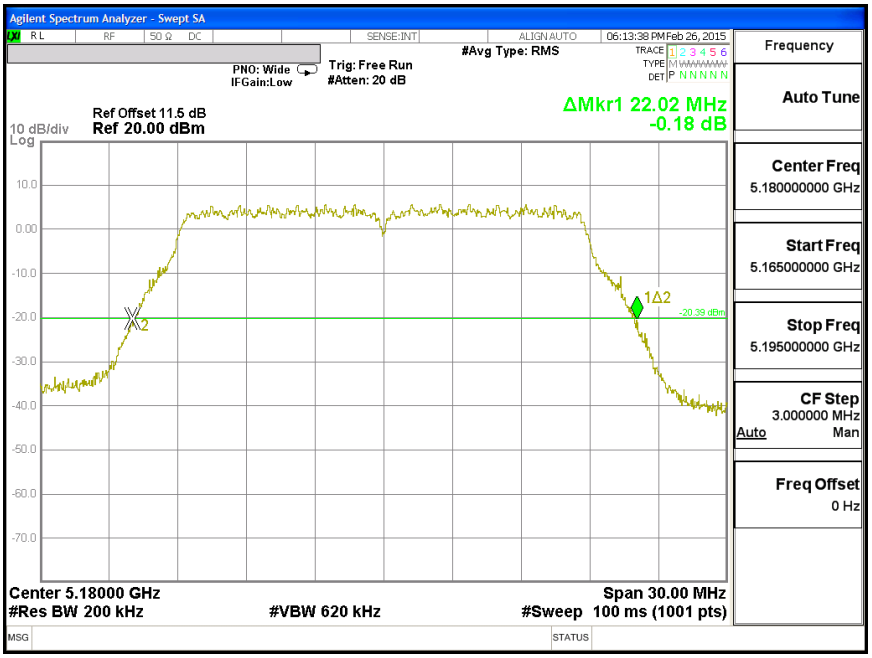
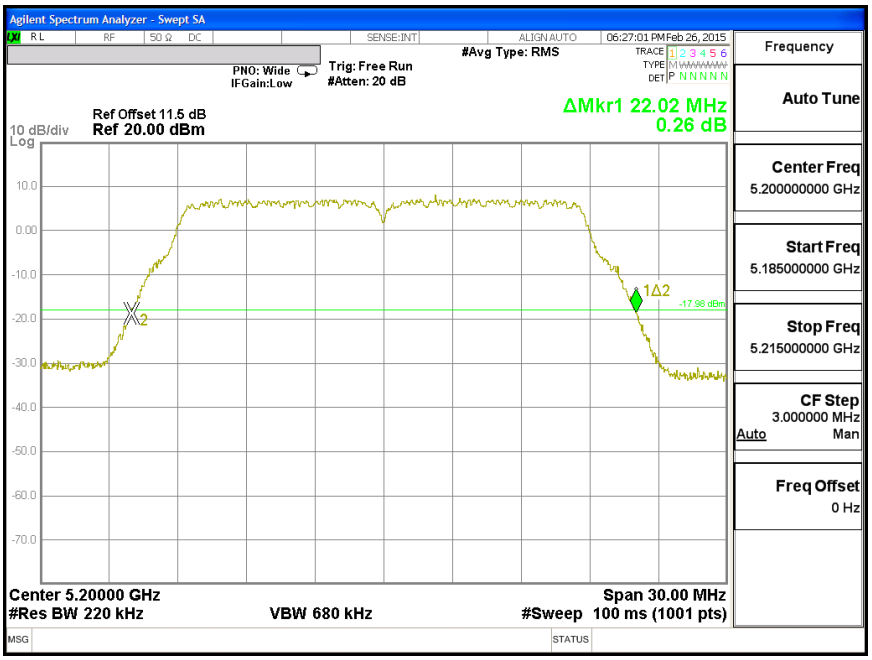
## 26 dB BANDWIDTH

BANDWIDTH LOW CH




BANDWIDTH MID CH





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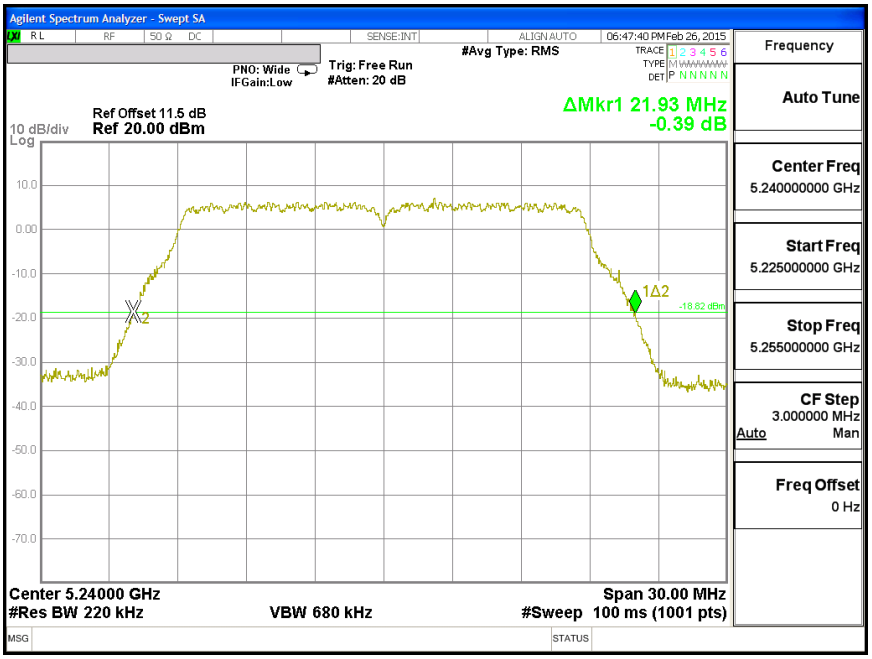
BANDWIDTH HIGH CH





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### 8.1.2. 99% BANDWIDTH

**LIMITS**

None; for reporting purposes only.

**RESULTS**

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---|---|---|
| Low | 5180 | 17.666 |
| Mid | 5200 | 17.746 |
| High | 5240 | 17.710 |


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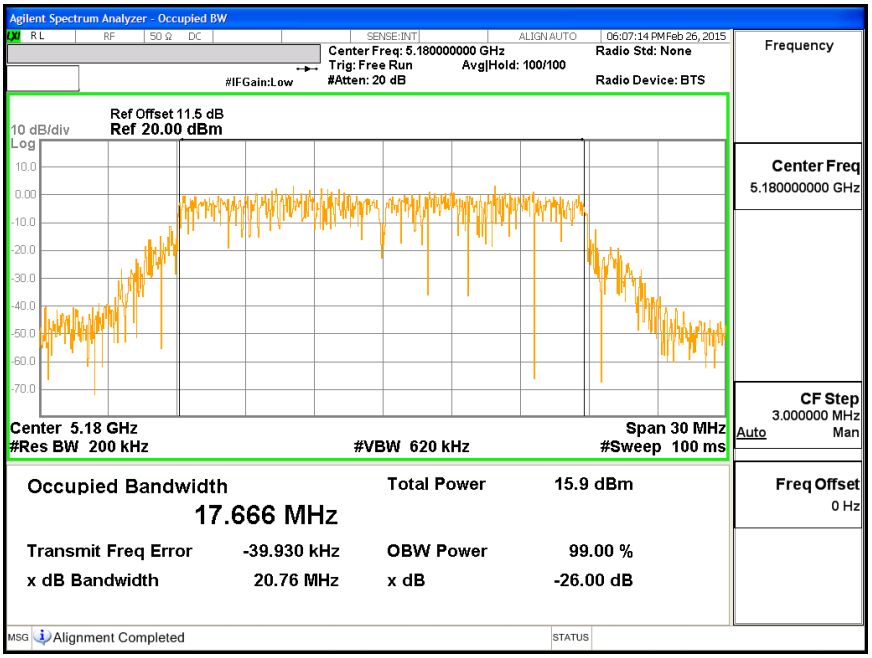
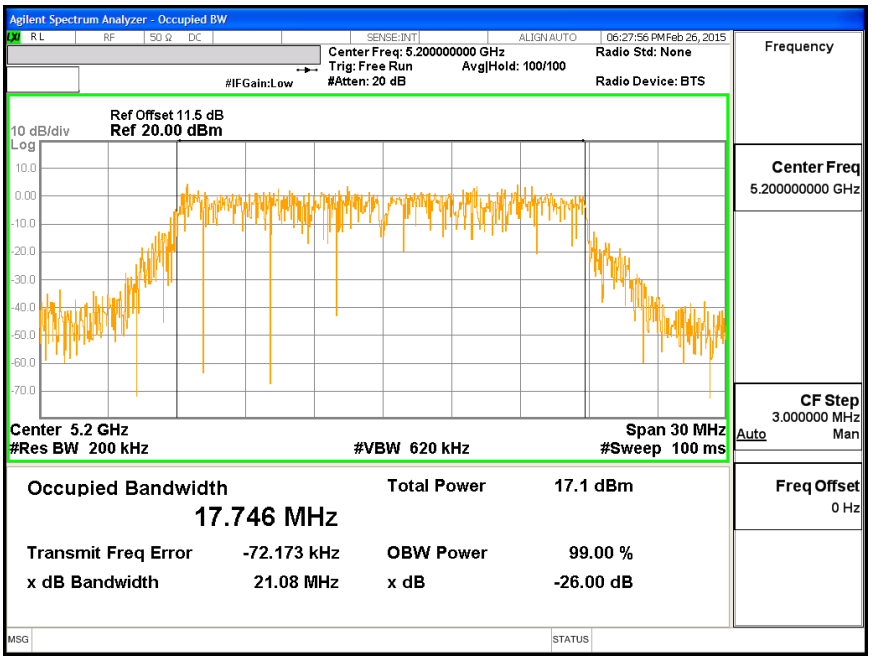
**99% BANDWIDTH**

BANDWIDTH LOW CH




BANDWIDTH MID CH





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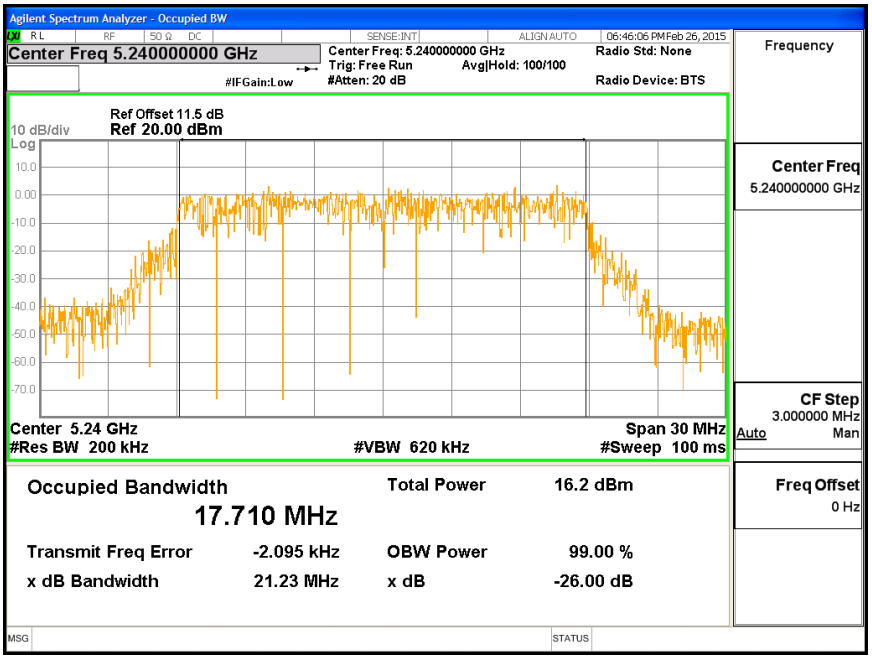
BANDWIDTH HIGH CH





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### 8.1.3. AVERAGE POWER

**LIMITS**

None; for reporting purposes only.

**RESULTS**

| Channel | Frequency (MHz) | Power (dBm) |
|---|---|---|
| Low | 5180 | 15.92 |
| Mid | 5200 | 16.49 |
| High | 5240 | 16.50 |


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### 8.1.4. OUTPUT POWER AND PSD

**LIMITS**

FCC §15.407 (a) (1)

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

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

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

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

**DIRECTIONAL ANTENNA GAIN**

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

**RESULTS**


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**Antenna Gain and Limits**

| Channel | Frequency (MHz) | Directional Gain for Power (dBi) | Directional Gain for PSD (dBi) | Power Limit (dBm) | PSD Limit (dBm) |
|---|---|---|---|---|---|
| Low | 5180 | 4.10 | 4.10 | 24.00 | 11.00 |
| Mid | 5200 | 4.10 | 4.10 | 24.00 | 11.00 |
| High | 5240 | 4.10 | 4.10 | 24.00 | 11.00 |

| | | |
|---|---|---|
| **Duty Cycle CF (dB)** | 0.00 | **Included in Calculations of Corr'd Power & PSD** |

**Output Power Results**

| Channel | Frequency (MHz) | Antenna B Meas Power (dBm) | Total Corr'd Power (dBm) | Power Limit (dBm) | Power Margin (dB) |
|---|---|---|---|---|---|
| Low | 5180 | 15.92 | 15.92 | 24.00 | -8.08 |
| Mid | 5200 | 16.49 | 16.49 | 24.00 | -7.51 |
| High | 5240 | 16.50 | 16.50 | 24.00 | -7.50 |

**PSD Results**

| Channel | Frequency (MHz) | Antenna B Meas PSD (dBm) | Total Corr'd PSD (dBm) | PSD Limit (dBm) | PSD Margin (dB) |
|---|---|---|---|---|---|
| Low | 5180 | 4.702 | 4.702 | 11.00 | -6.30 |
| Mid | 5200 | 5.351 | 5.351 | 11.00 | -5.65 |
| High | 5240 | 5.262 | 5.262 | 11.00 | -5.74 |


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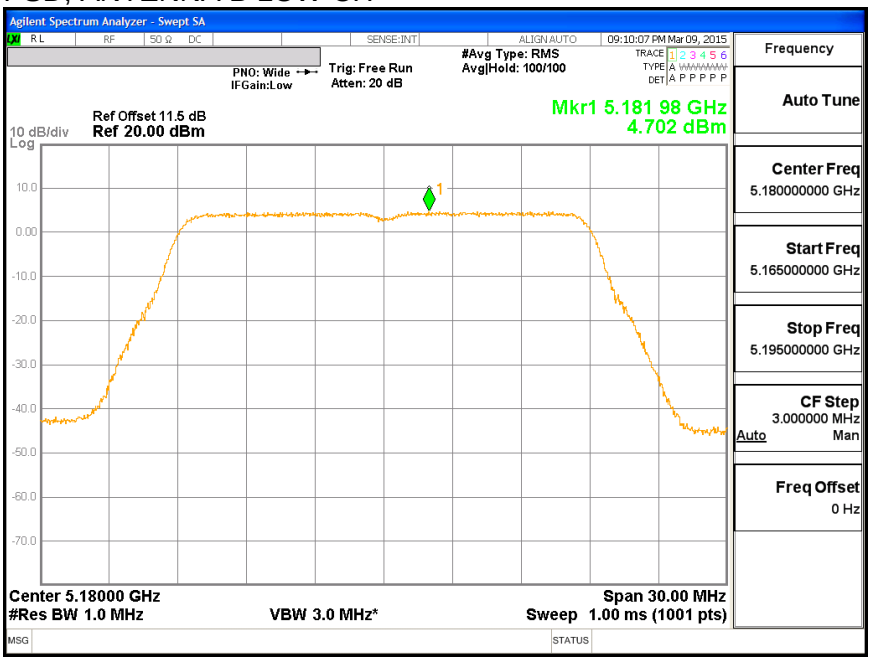
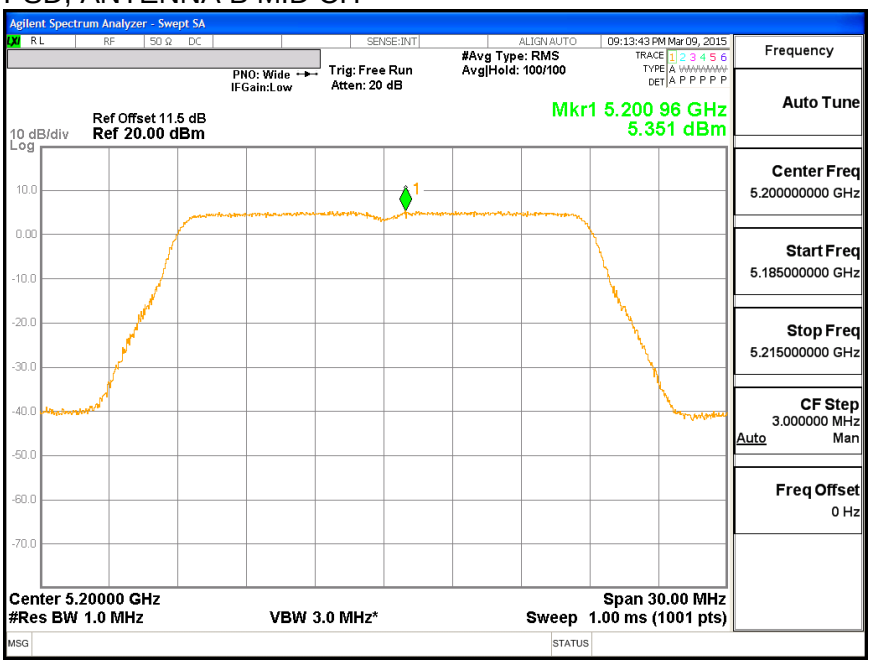
**PSD, ANTENNA B**

PSD, ANTENNA B LOW CH




PSD, ANTENNA B MID CH





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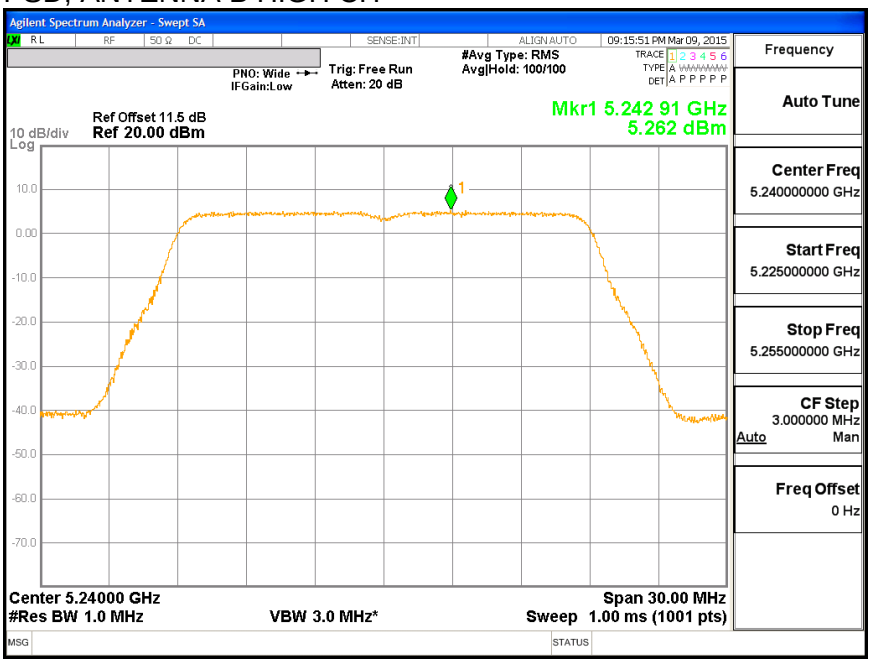
PSD, ANTENNA B HIGH CH





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## 8.2. 802.11n HT20 SISO MODE IN THE 5.2 GHz BAND ANTENNA A

### 8.2.1. 26 dB BANDWIDTH

**LIMITS**

None; for reporting purposes only.

**RESULTS**

| Channel | Frequency (MHz) | 26 dB Bandwidth (MHz) |
|---|---|---|
| Low | 5180 | 22.05 |
| Mid | 5200 | 21.93 |
| High | 5240 | 21.90 |


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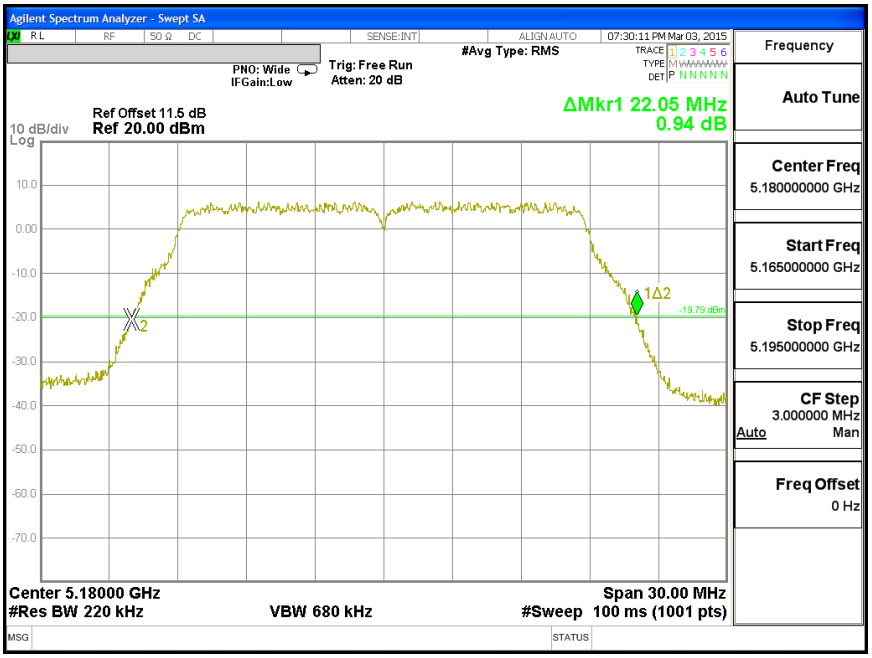
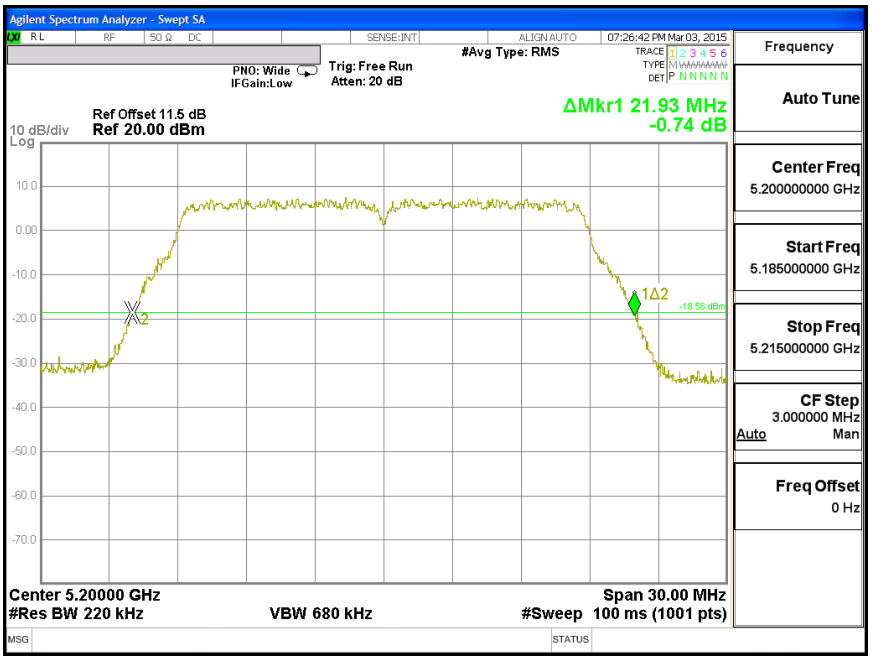
## 26 dB BANDWIDTH

BANDWIDTH LOW CH




BANDWIDTH MID CH





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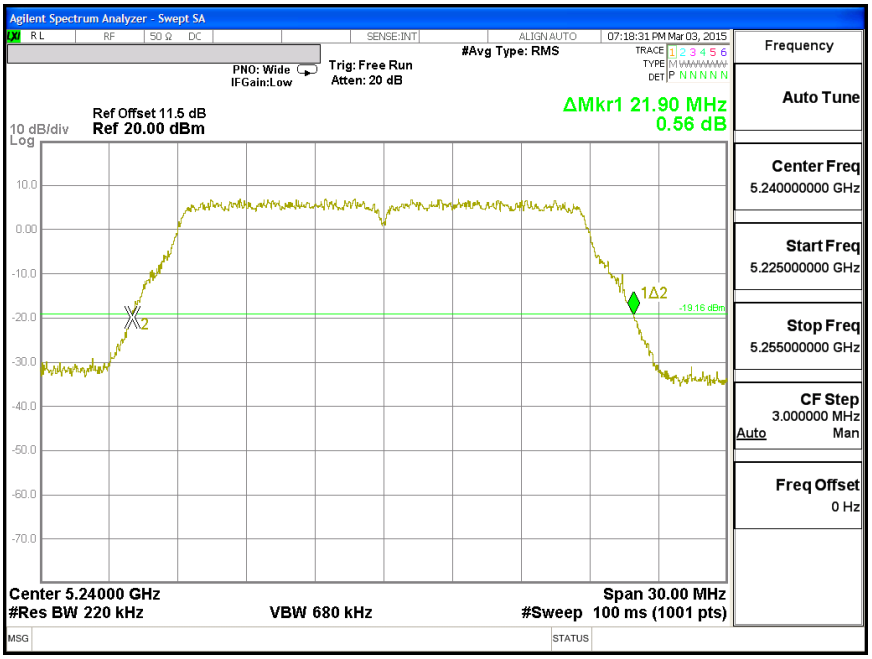
BANDWIDTH HIGH CH





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### 8.2.2. 99% BANDWIDTH

**LIMITS**

None; for reporting purposes only.

**RESULTS**

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---|---|---|
| Low | 5180 | 17.729 |
| Mid | 5200 | 17.736 |
| High | 5240 | 17.667 |


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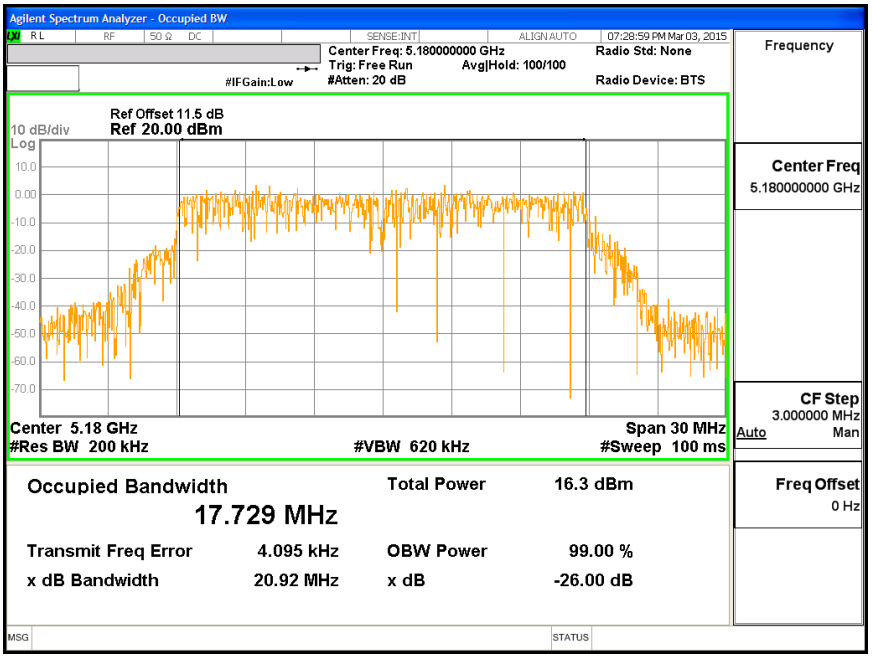
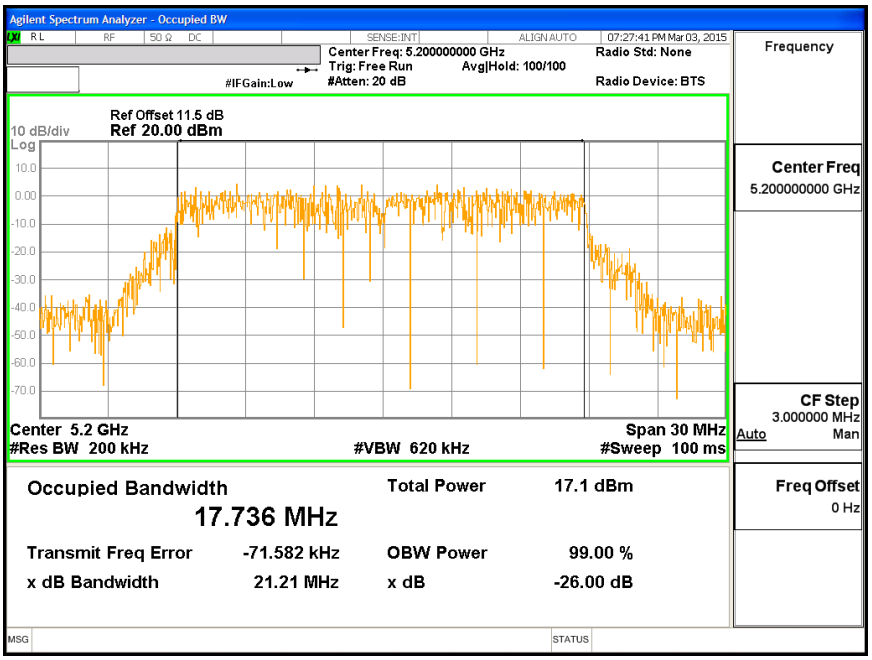
**99% BANDWIDTH**

BANDWIDTH LOW CH




BANDWIDTH MID CH





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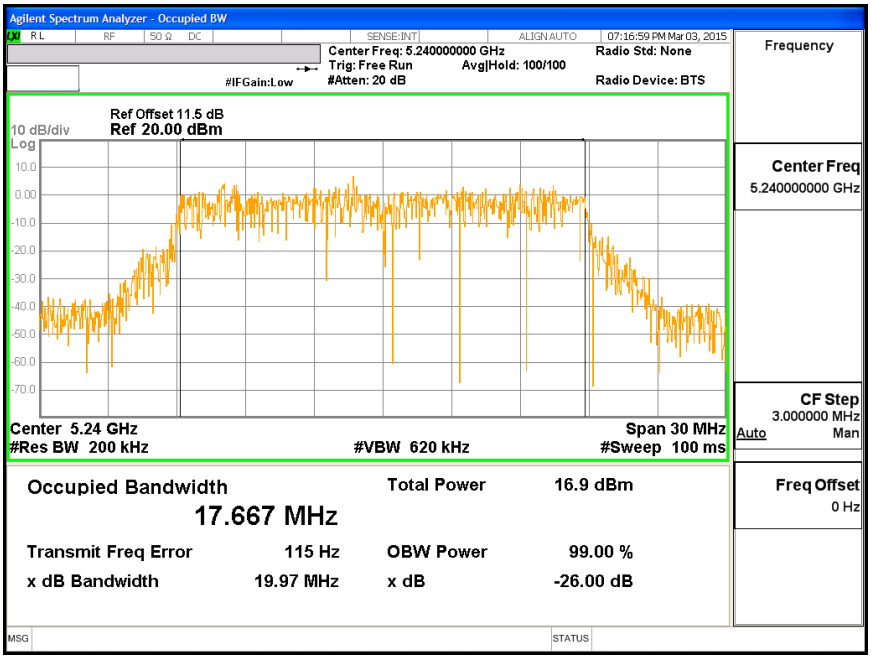
BANDWIDTH HIGH CH





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### 8.2.3. AVERAGE POWER

**LIMITS**

None; for reporting purposes only.

**RESULTS**

| Channel | Frequency (MHz) | Power (dBm) |
|---|---|---|
| Low | 5180 | 15.96 |
| Mid | 5200 | 16.99 |
| High | 5240 | 17.09 |


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### 8.2.4. OUTPUT POWER AND PSD

**LIMITS**

FCC §15.407 (a) (1)

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

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

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

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

**DIRECTIONAL ANTENNA GAIN**

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

**RESULTS**


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**Antenna Gain and Limits**

| Channel | Frequency (MHz) | Directional Gain for Power (dBi) | Directional Gain for PSD (dBi) | Power Limit (dBm) | PSD Limit (dBm) |
|---|---|---|---|---|---|
| Low | 5180 | 2.10 | 2.10 | 24.00 | 11.00 |
| Mid | 5200 | 2.10 | 2.10 | 24.00 | 11.00 |
| High | 5240 | 2.10 | 2.10 | 24.00 | 11.00 |

| | | |
|---|---|---|
| **Duty Cycle CF (dB)** | 0.00 | **Included in Calculations of Corr'd Power & PSD** |

**Output Power Results**

| Channel | Frequency (MHz) | Antenna A Meas Power (dBm) | Total Corr'd Power (dBm) | Power Limit (dBm) | Power Margin (dB) |
|---|---|---|---|---|---|
| Low | 5180 | 15.96 | 15.96 | 24.00 | -8.04 |
| Mid | 5200 | 16.99 | 16.99 | 24.00 | -7.01 |
| High | 5240 | 17.09 | 17.09 | 24.00 | -6.91 |

**PSD Results**

| Channel | Frequency (MHz) | Antenna A Meas PSD (dBm) | Total Corr'd PSD (dBm) | PSD Limit (dBm) | PSD Margin (dB) |
|---|---|---|---|---|---|
| Low | 5180 | 4.80 | 4.80 | 11.00 | -6.21 |
| Mid | 5200 | 5.83 | 5.83 | 11.00 | -5.17 |
| High | 5240 | 5.82 | 5.82 | 11.00 | -5.18 |


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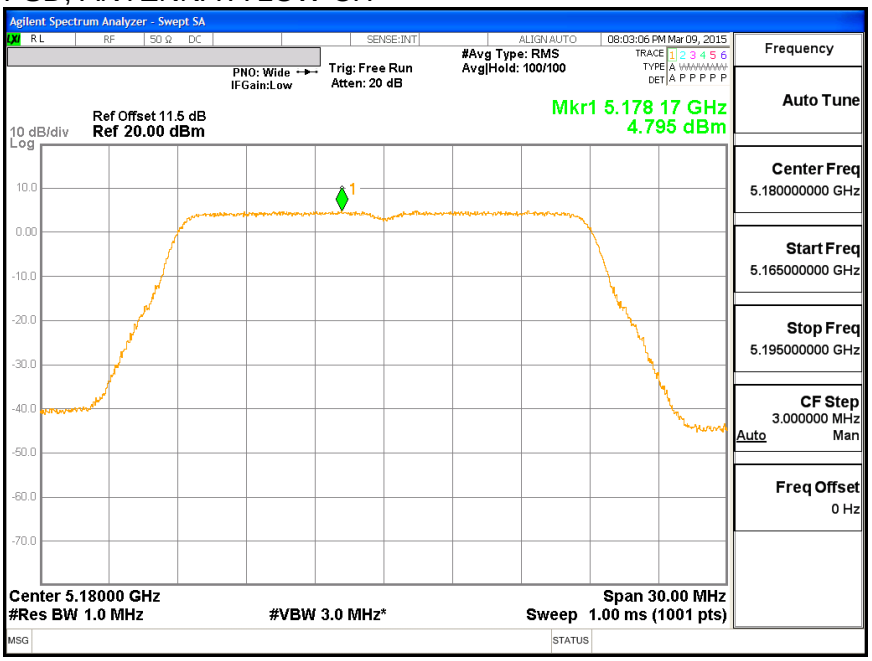
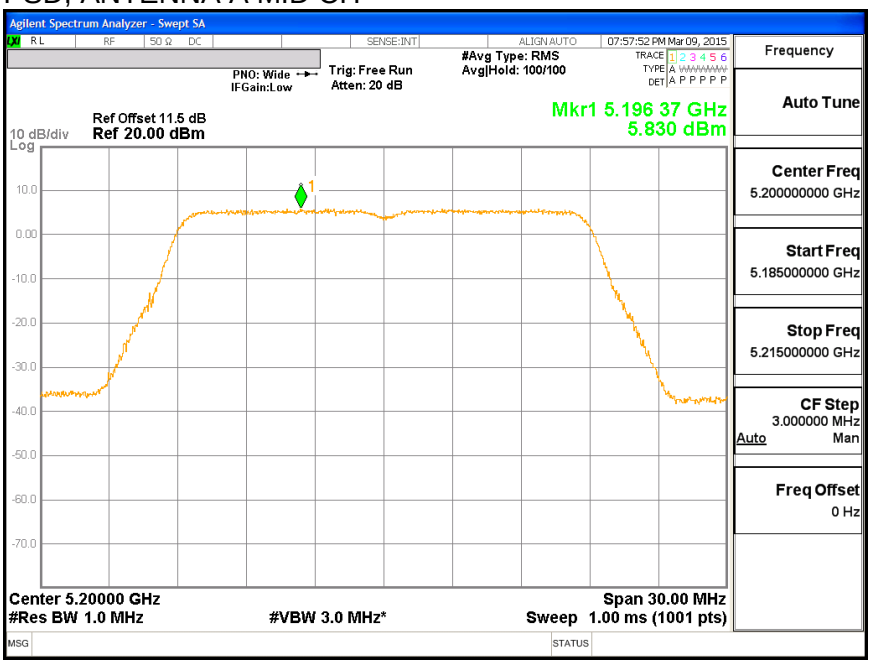
**PSD, ANTENNA A**

PSD, ANTENNA A LOW CH




PSD, ANTENNA A MID CH





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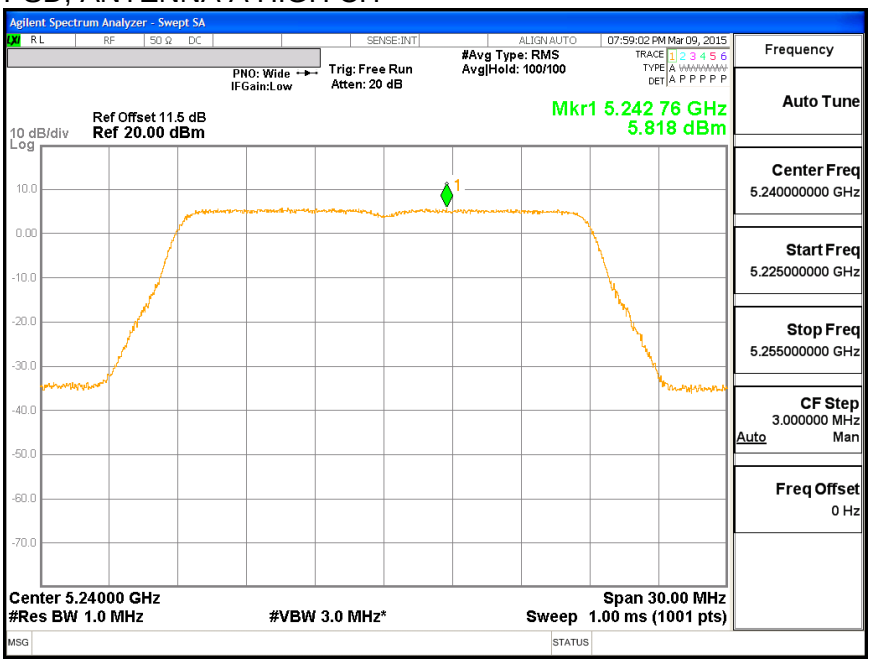
PSD, ANTENNA A HIGH CH





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## 8.3. 802.11n HT20 2Tx CDD MODE IN THE 5.2 GHz BAND

### 8.3.1. 26 dB BANDWIDTH

**LIMITS**

None; for reporting purposes only.

**RESULTS**

| Channel | Frequency (MHz) | 26 dB BW Antenna B (MHz) | 26 dB BW Antenna A (MHz) |
|---|---|---|---|
| Low | 5180 | 21.87 | 21.78 |
| Mid | 5200 | 21.87 | 21.69 |
| High | 5240 | 21.87 | 21.81 |


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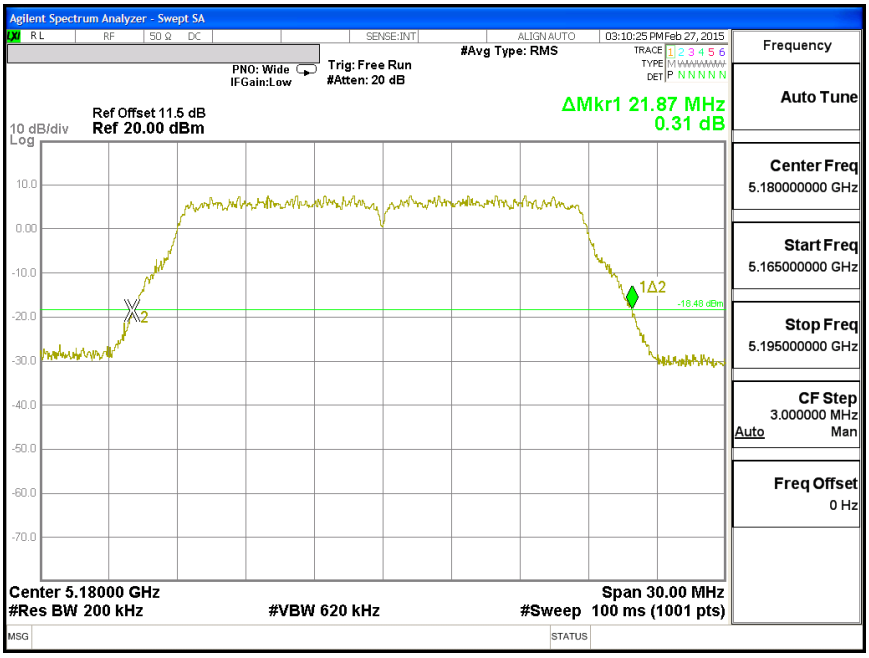
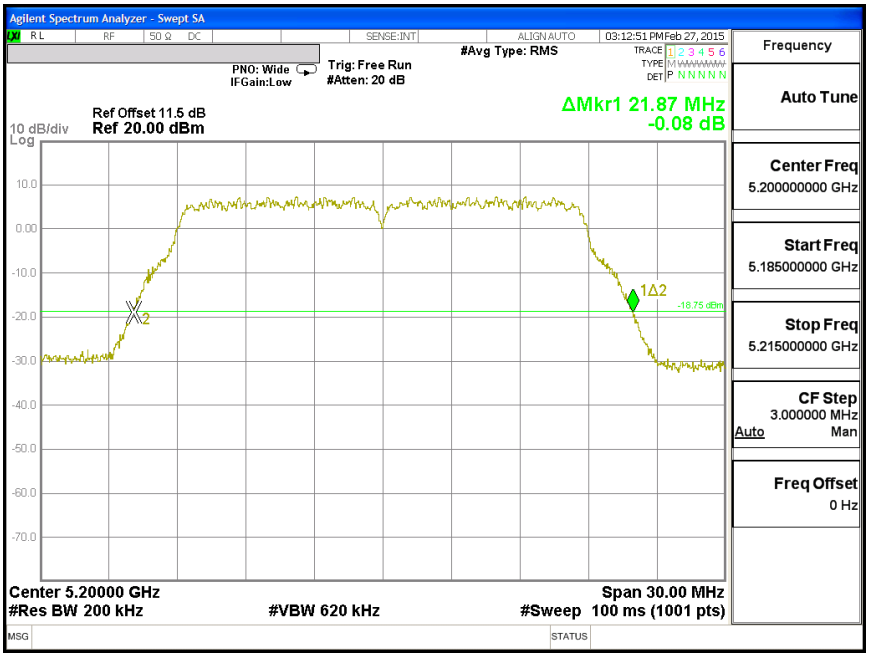
## 26 dB BANDWIDTH, ANTENNA B

BANDWIDTH ANTENNA B LOW CH




BANDWIDTH ANTENNA B MID CH





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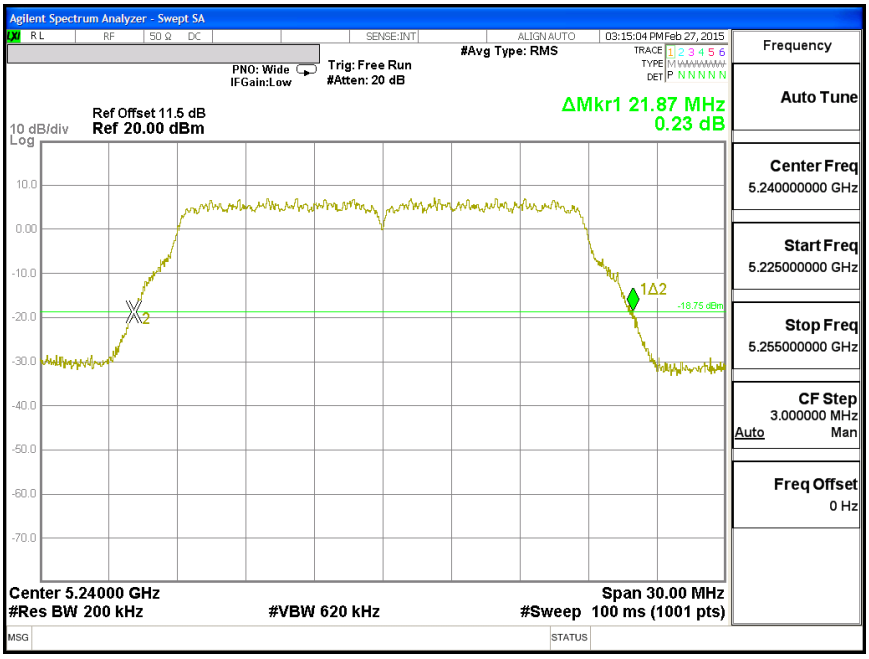
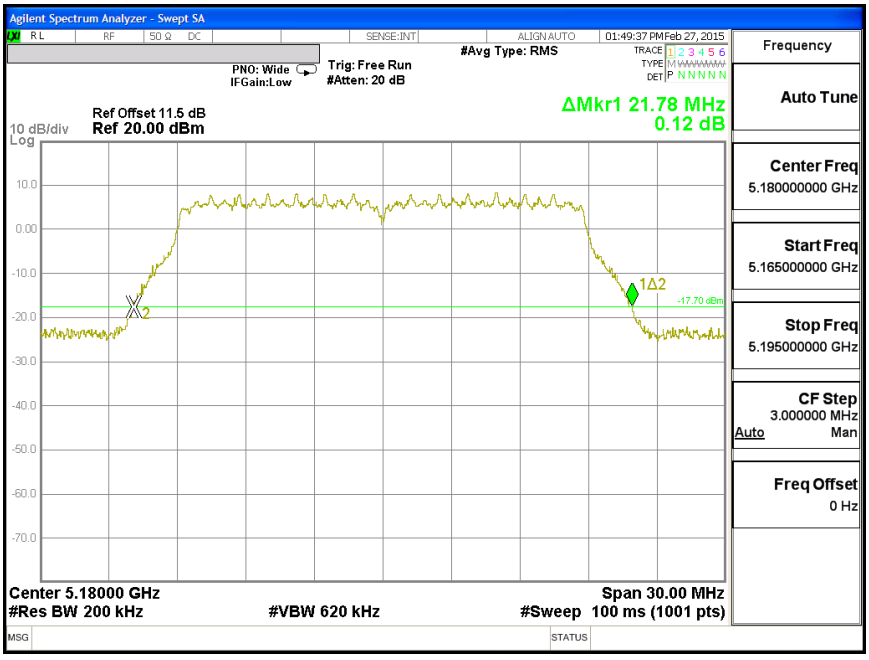
BANDWIDTH ANTENNA B HIGH CH




**26 dB BANDWIDTH, ANTENNA A**

BANDWIDTH ANTENNA A LOW CH





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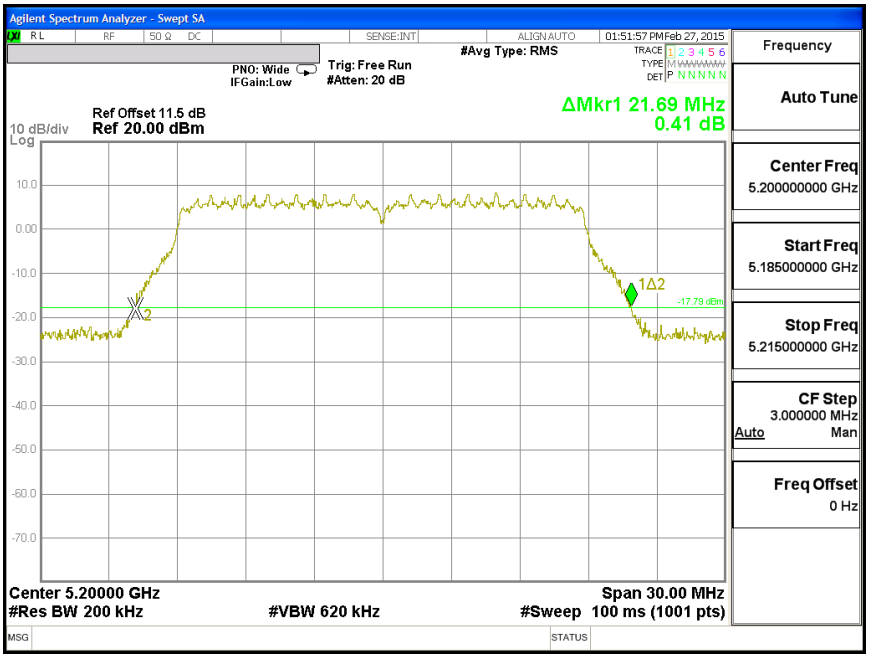
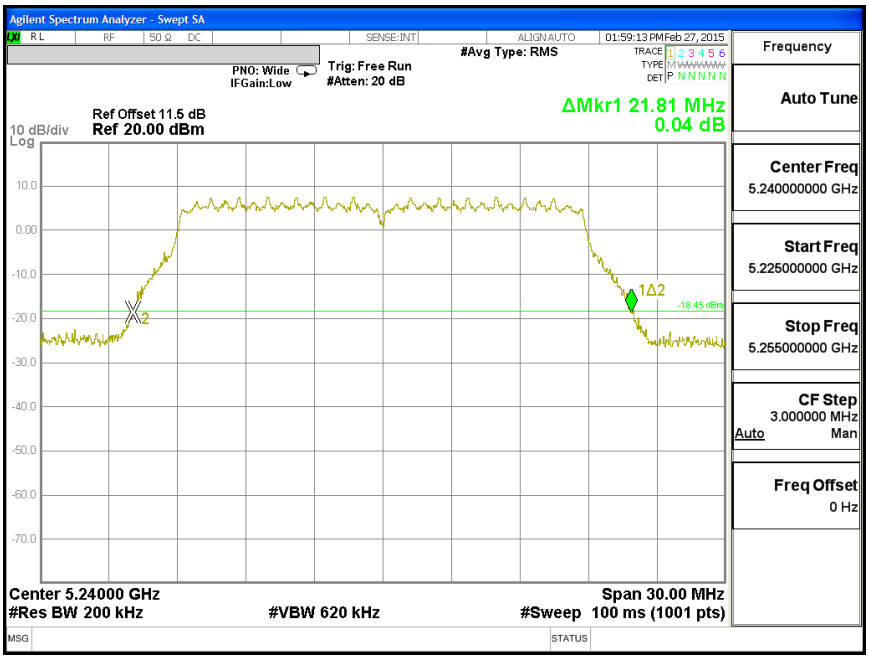
BANDWIDTH ANTENNA A MID CH




BANDWIDTH ANTENNA A HIGH CH





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### 8.3.2. 99% BANDWIDTH

**LIMITS**

None; for reporting purposes only.

**RESULTS**

| Channel | Frequency (MHz) | 99% BW Antenna B (MHz) | 99% BW Antenna A (MHz) |
|---|---|---|---|
| Low | 5180 | 17.7490 | 17.7700 |
| Mid | 5200 | 17.7800 | 17.7830 |
| High | 5240 | 17.6730 | 17.7580 |


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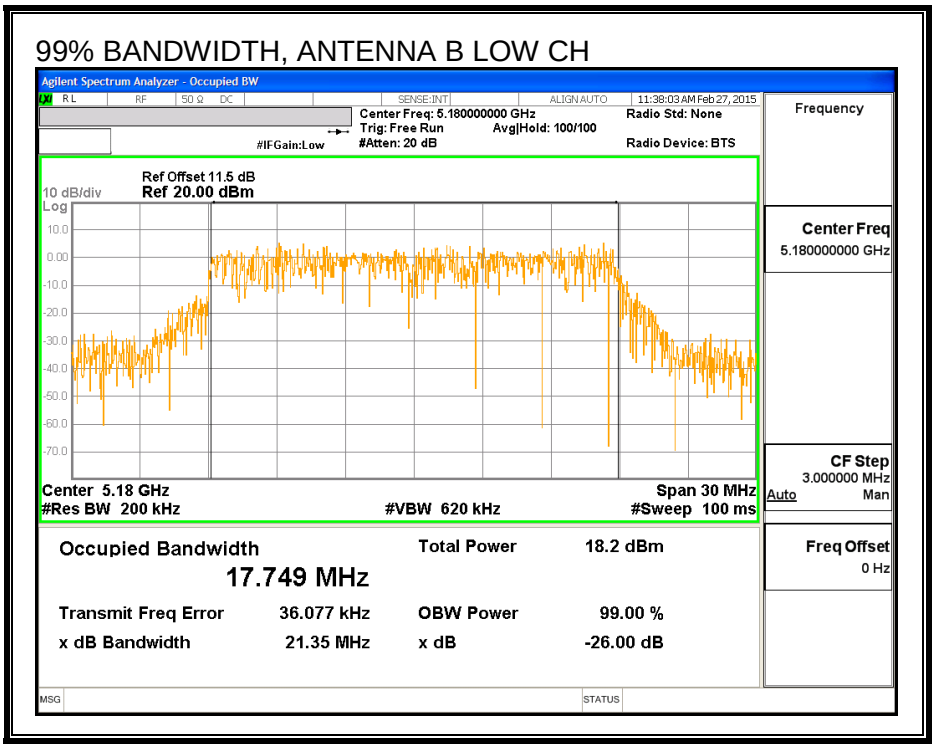
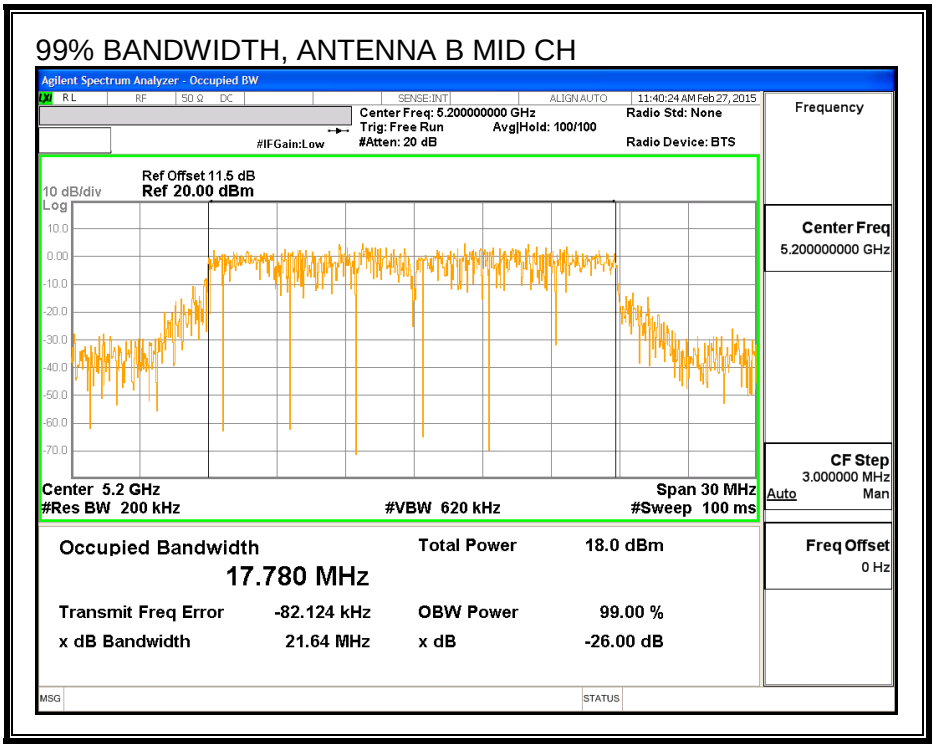
**99% BANDWIDTH, ANTENNA B**





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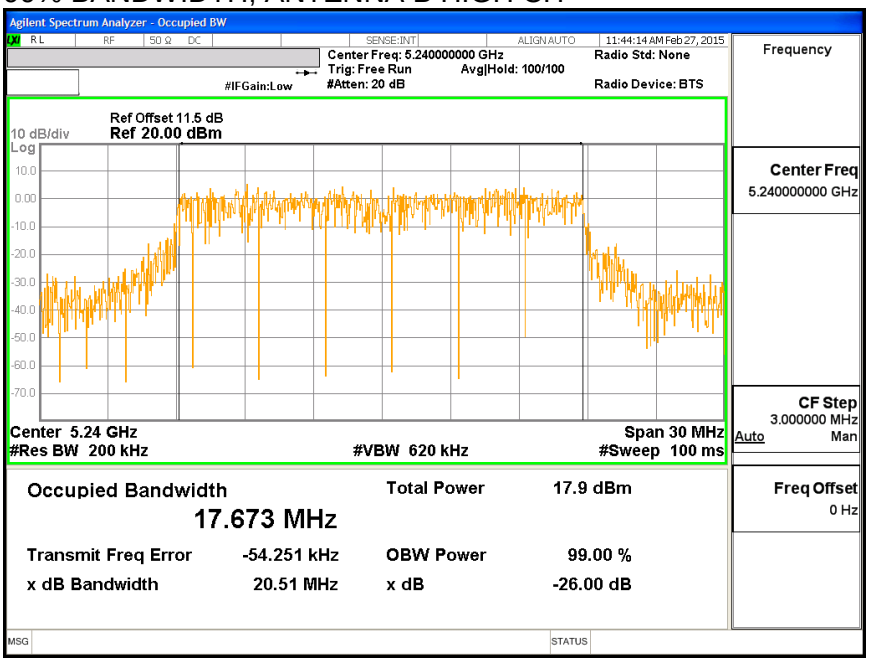
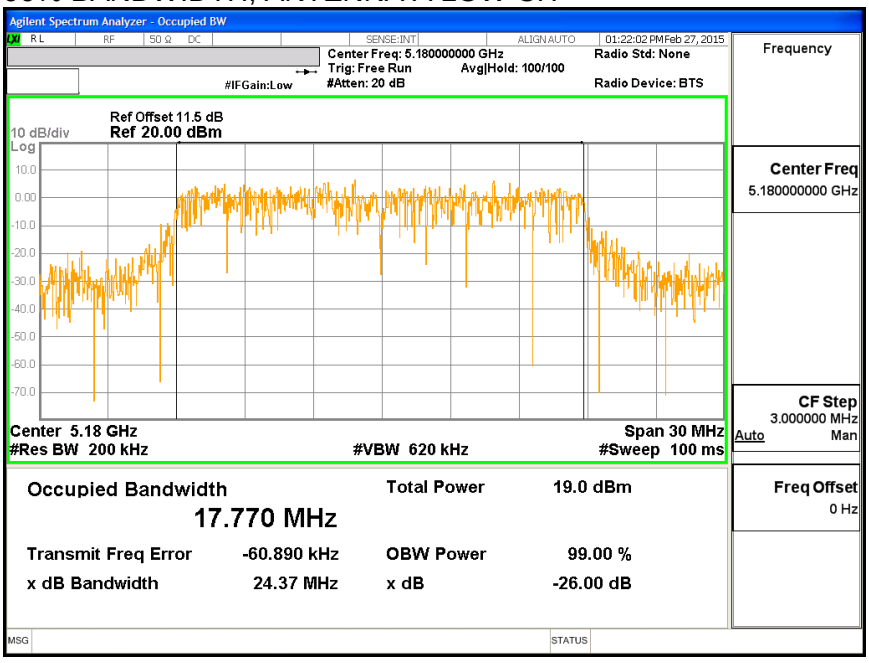
99% BANDWIDTH, ANTENNA B HIGH CH




**99% BANDWIDTH, ANTENNA A**

99% BANDWIDTH, ANTENNA A LOW CH





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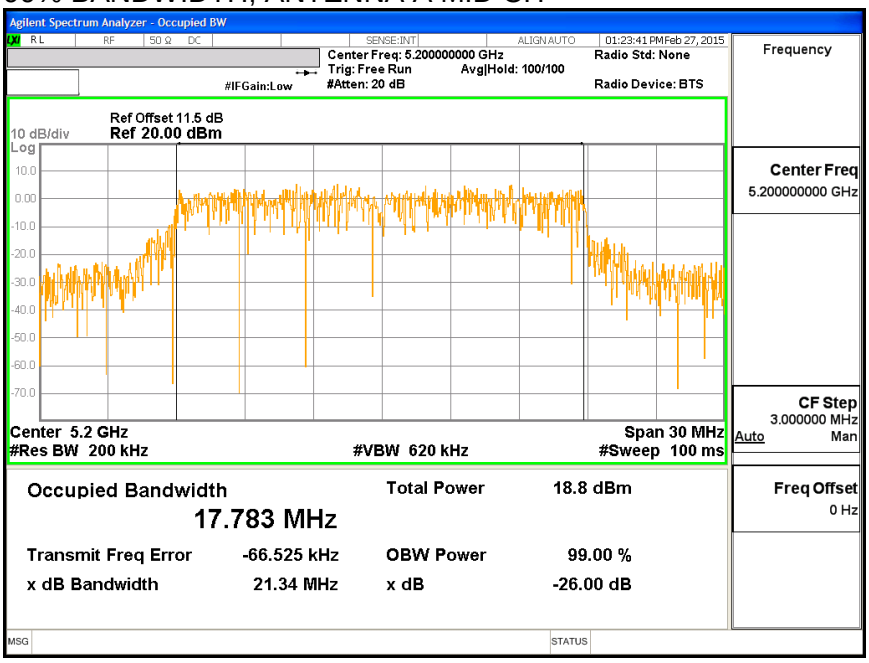
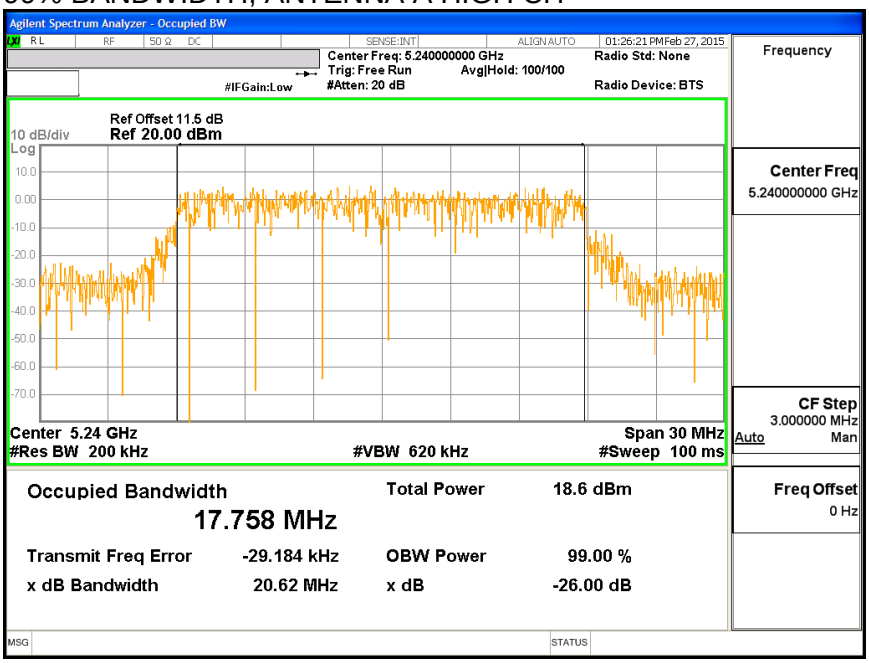
## 99% BANDWIDTH, ANTENNA A MID CH




## 99% BANDWIDTH, ANTENNA A HIGH CH





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### 8.3.3. AVERAGE POWER

**LIMITS**

None; for reporting purposes only.

**RESULTS**

**Average Power Results**

| Channel | Frequency (MHz) | Antenna B Power (dBm) | Antenna A Power (dBm) | Total Power (dBm) |
|---|---|---|---|---|
| Low | 5180 | 15.40 | 15.56 | 18.49 |
| Mid | 5200 | 15.95 | 16.00 | 18.99 |
| High | 5240 | 15.90 | 16.00 | 18.96 |


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### 8.3.4. OUTPUT POWER AND PSD

**LIMITS**

FCC §15.407 (a) (1)

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

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

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

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


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**DIRECTIONAL ANTENNA GAIN**

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

| Antenna B Antenna Gain (dBi) | Antenna A Antenna Gain (dBi) | Uncorrelated Chains Directional Gain (dBi) |
|---|---|---|
| 4.10 | 2.10 | 3.21 |

The TX chains are correlated and the antenna gain is unequal among the chains. The directional gain is:

| Antenna B Antenna Gain (dBi) | Antenna A Antenna Gain (dBi) | Correlated Chains Directional Gain (dBi) |
|---|---|---|
| 4.10 | 2.10 | 6.17 |


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**RESULTS**

**Antenna Gain and Limits**

| Channel | Frequency (MHz) | Directional Gain for Power (dBi) | Directional Gain for PSD (dBi) | Power Limit (dBm) | PSD Limit (dBm) |
|---|---|---|---|---|---|
| Low | 5180 | 3.21 | 6.17 | 24.00 | 10.83 |
| Mid | 5200 | 3.21 | 6.17 | 24.00 | 10.83 |
| High | 5240 | 3.21 | 6.17 | 24.00 | 10.83 |

| | | |
|---|---|---|
| **Duty Cycle CF (dB)** | 0.00 | **Included in Calculations of Corr'd Power & PSD** |

**Output Power Results**

| Channel | Frequency (MHz) | Antenna B Meas Power (dBm) | Antenna A Meas Power (dBm) | Total Corr'd Power (dBm) | Power Limit (dBm) | Power Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 5180 | 15.40 | 15.56 | 18.49 | 24.00 | -5.51 |
| Mid | 5200 | 15.95 | 16.00 | 18.99 | 24.00 | -5.01 |
| High | 5240 | 15.90 | 16.00 | 18.96 | 24.00 | -5.04 |

**PSD Results**

| Channel | Frequency (MHz) | Antenna B Meas PSD (dBm) | Antenna A Meas PSD (dBm) | Total Corr'd PSD (dBm) | PSD Limit (dBm) | PSD Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 5180 | 3.24 | 4.33 | 6.83 | 10.83 | -4.00 |
| Mid | 5200 | 3.44 | 4.82 | 7.19 | 10.83 | -3.64 |
| High | 5240 | 3.34 | 4.59 | 7.02 | 10.83 | -3.81 |


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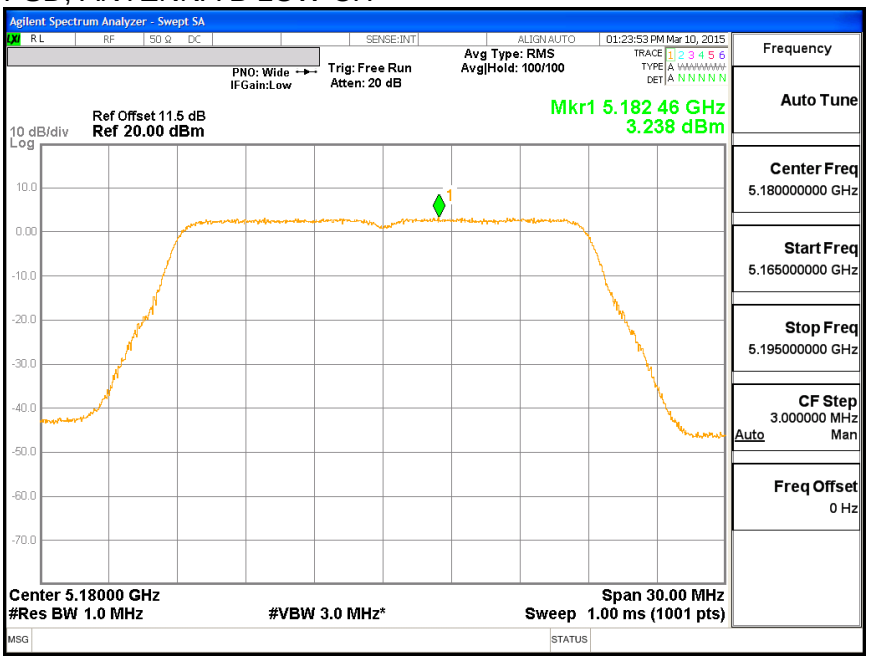
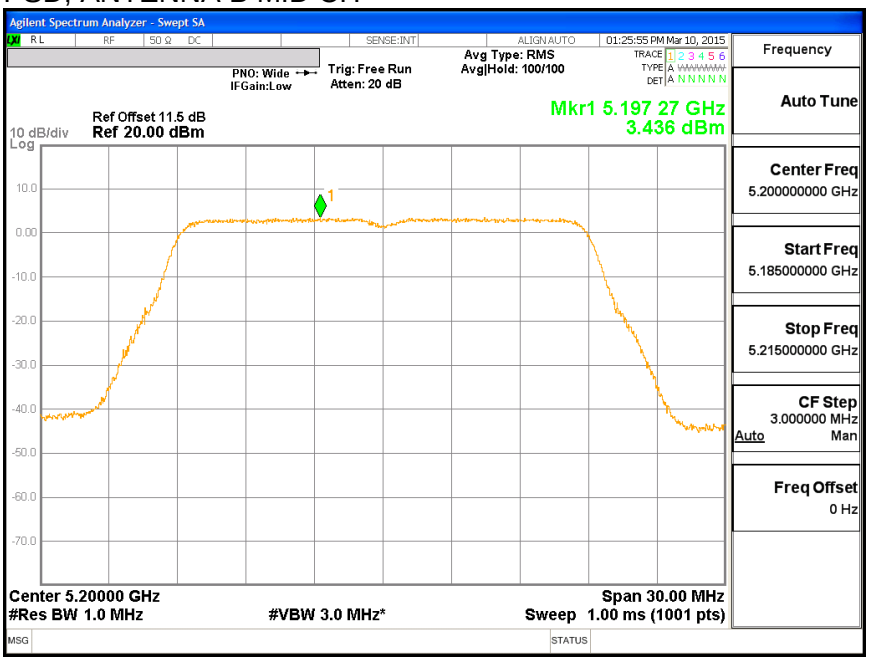
**PSD, ANTENNA B**

PSD, ANTENNA B LOW CH




PSD, ANTENNA B MID CH





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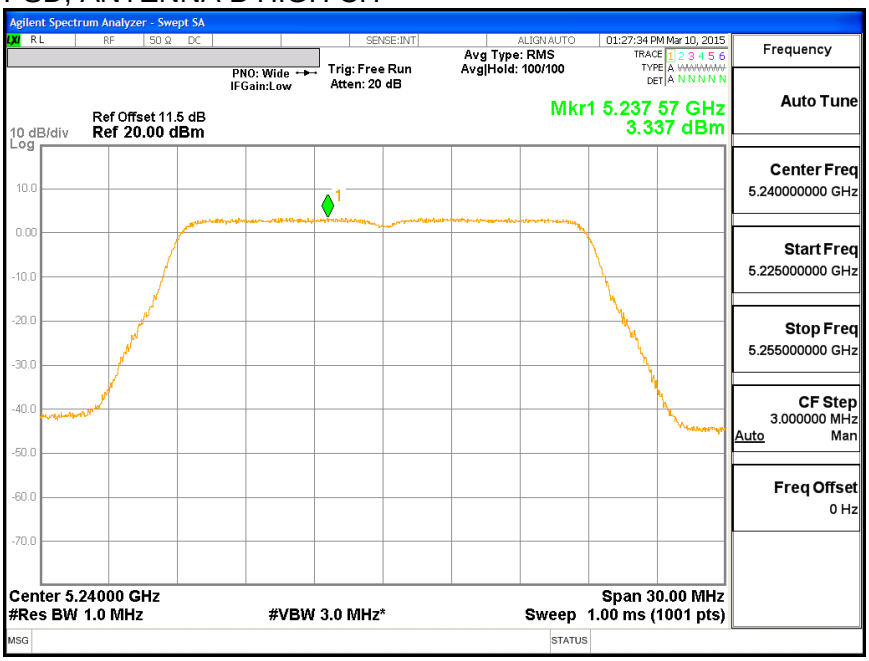
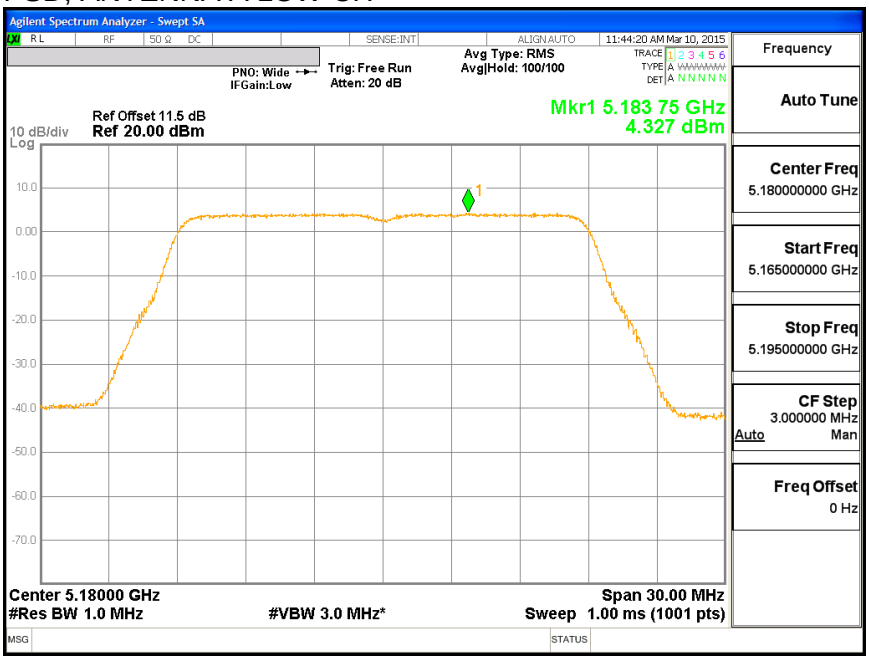
PSD, ANTENNA B HIGH CH




**PSD, ANTENNA A**

PSD, ANTENNA A LOW CH





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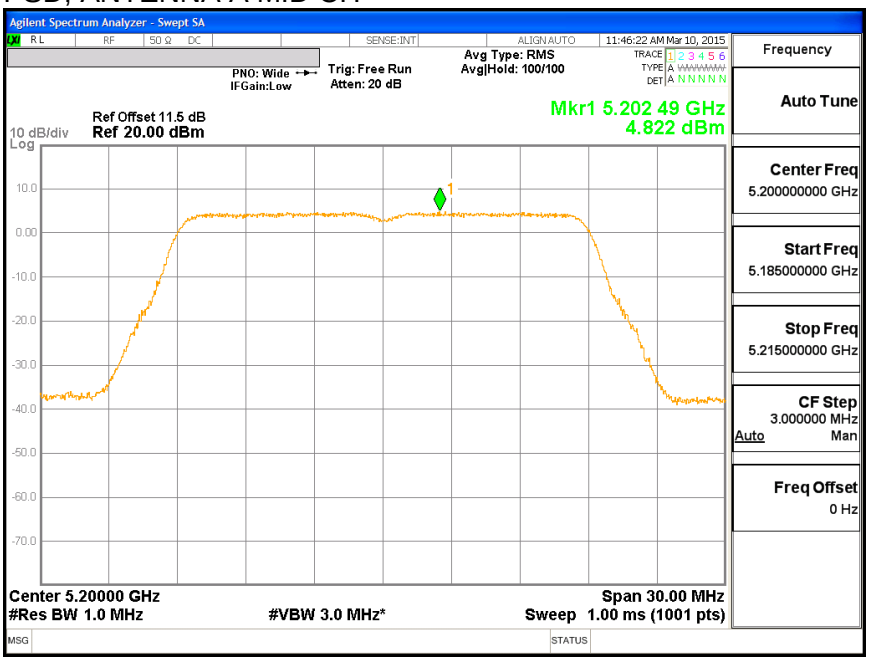
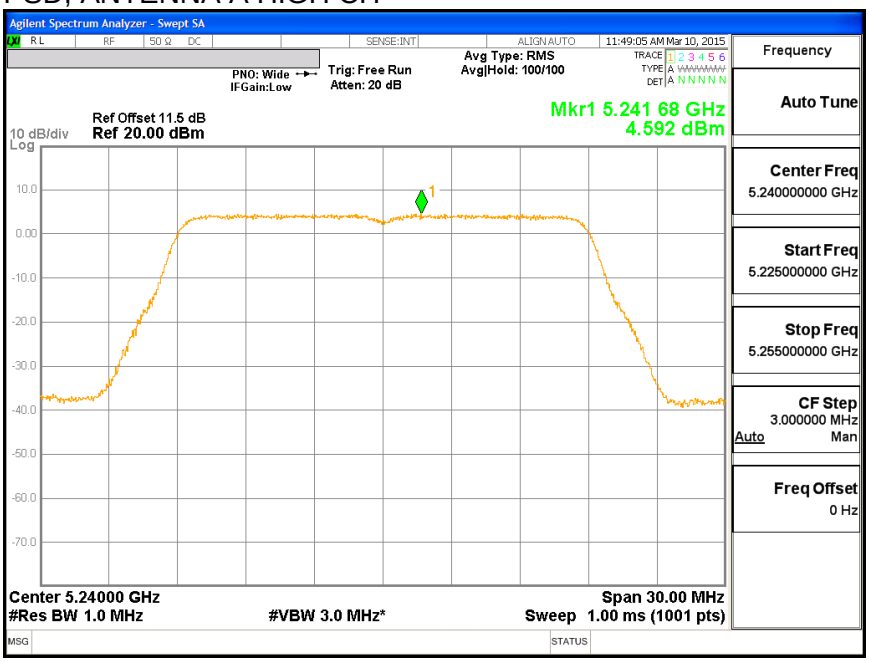
PSD, ANTENNA A MID CH




PSD, ANTENNA A HIGH CH





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## 8.4. 802.11n HT20 2Tx STBC MODE IN THE 5.2 GHz BAND

### 8.4.1. 26 dB BANDWIDTH

**LIMITS**

None; for reporting purposes only.

**RESULTS**

| Channel | Frequency (MHz) | 26 dB BW Antenna B (MHz) | 26 dB BW Antenna A (MHz) |
|---|---|---|---|
| Low | 5180 | 21.90 | 21.84 |
| Mid | 5200 | 22.05 | 22.02 |
| High | 5240 | 22.02 | 21.87 |


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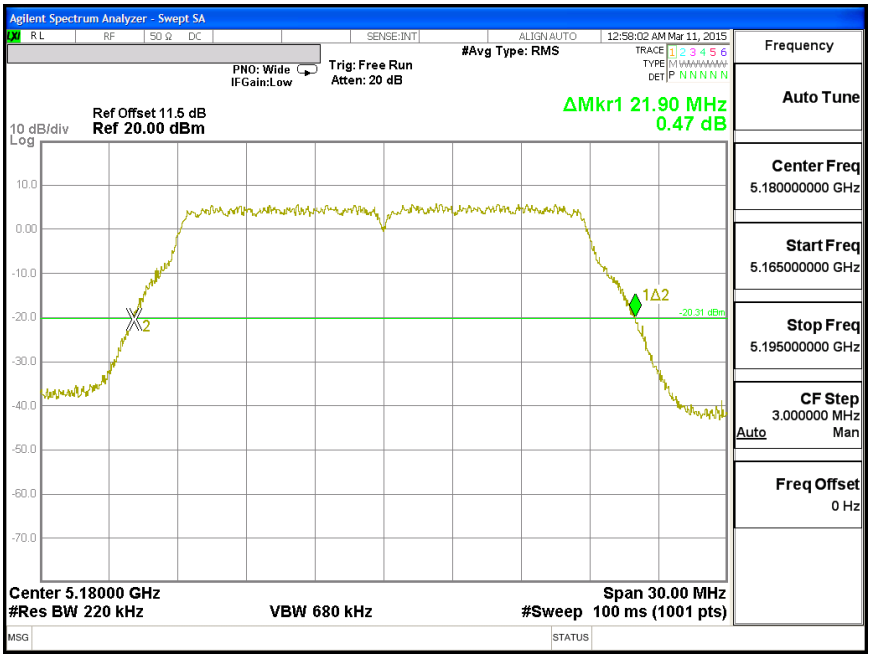
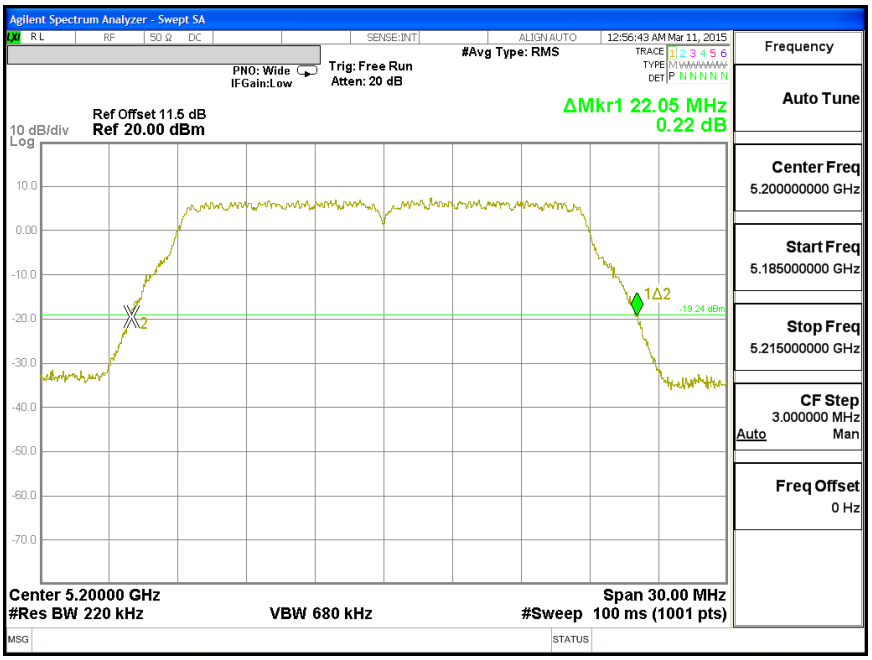
## 26 dB BANDWIDTH, ANTENNA B

BANDWIDTH ANTENNA B LOW CH




BANDWIDTH ANTENNA B MID CH





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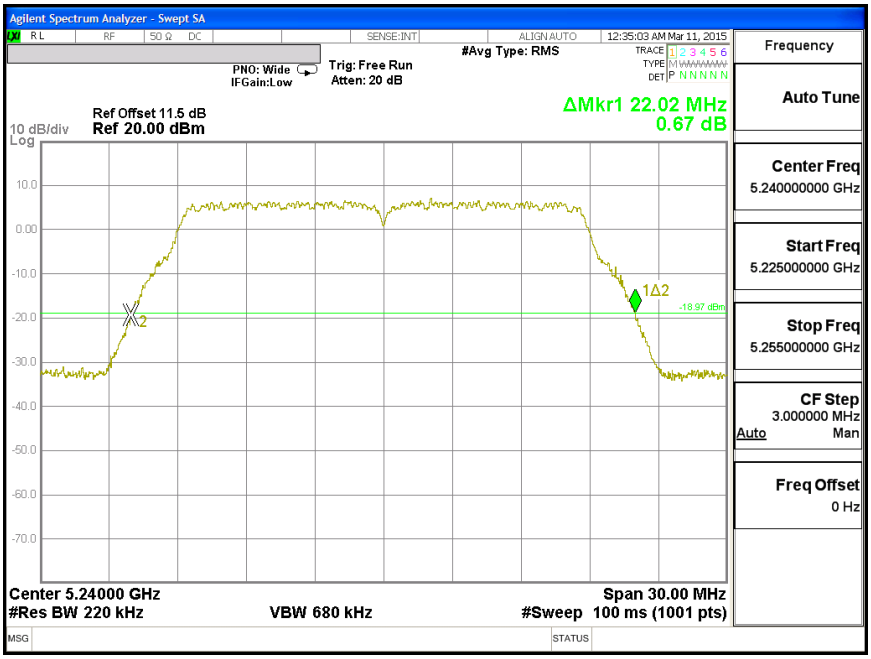
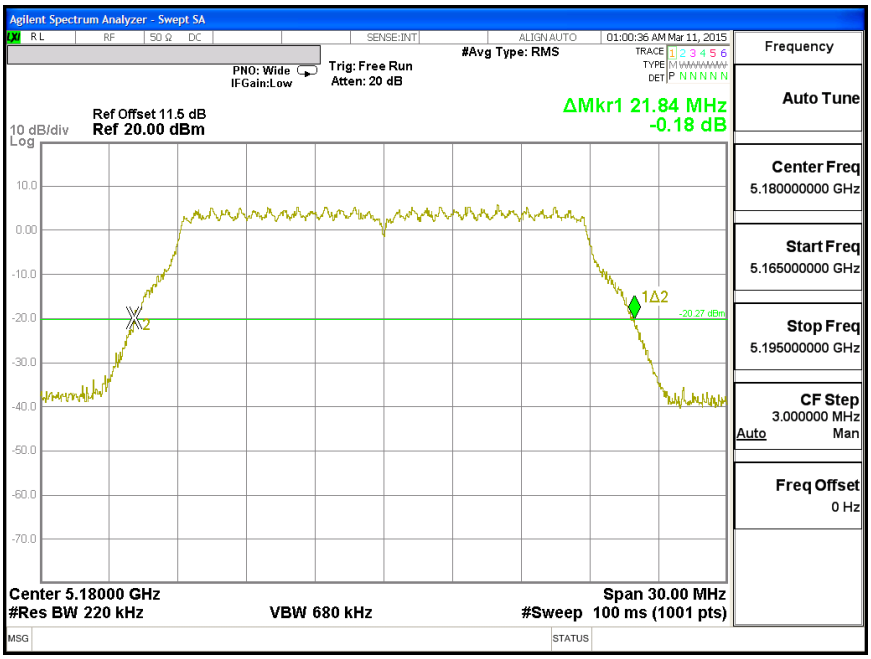
BANDWIDTH ANTENNA B HIGH CH




**26 dB BANDWIDTH, ANTENNA A**

BANDWIDTH ANTENNA A LOW CH





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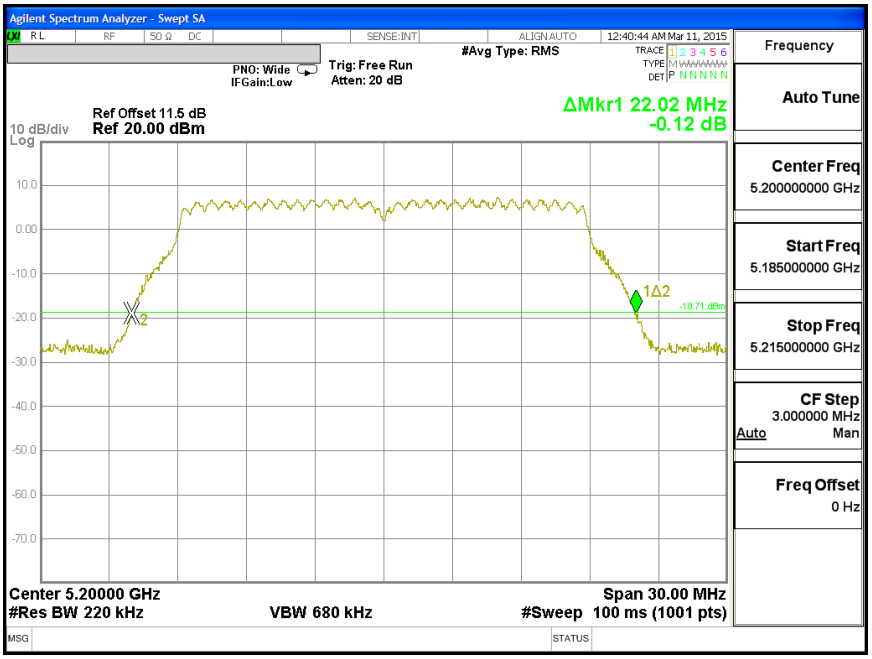
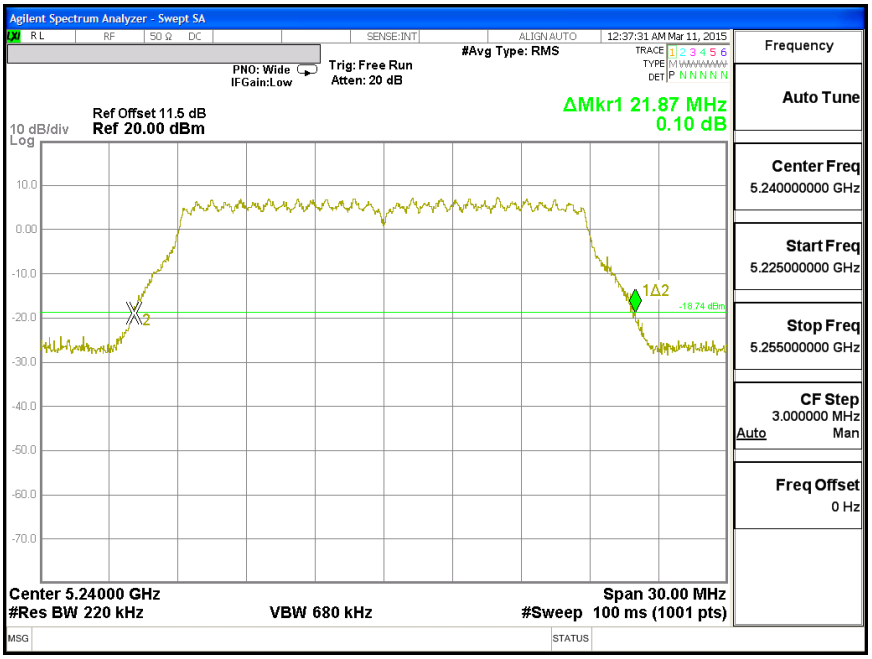
BANDWIDTH ANTENNA A MID CH




BANDWIDTH ANTENNA A HIGH CH





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### 8.4.2. 99% BANDWIDTH

**LIMITS**

None; for reporting purposes only.

**RESULTS**

| Channel | Frequency (MHz) | 99% BW Antenna B (MHz) | 99% BW Antenna A (MHz) |
|---|---|---|---|
| Low | 5180 | 17.712 | 17.655 |
| Mid | 5200 | 17.698 | 17.782 |
| High | 5240 | 17.669 | 17.704 |


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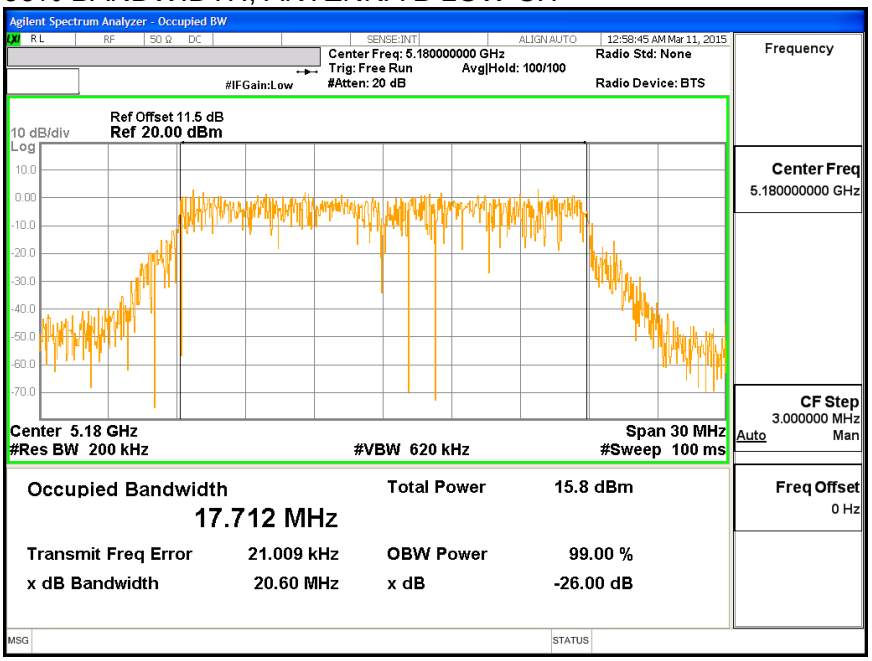
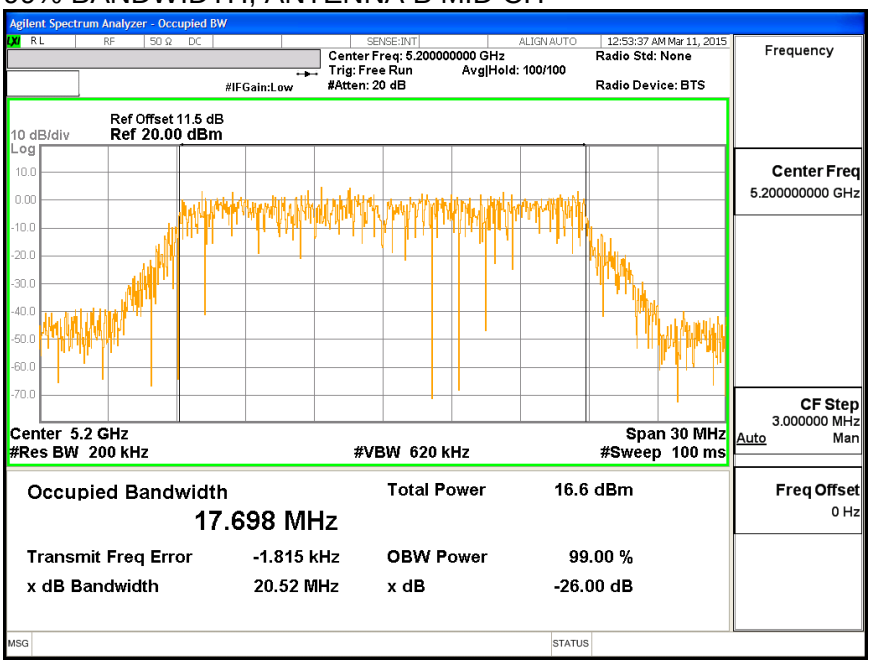
**99% BANDWIDTH, ANTENNA B**

99% BANDWIDTH, ANTENNA B LOW CH




99% BANDWIDTH, ANTENNA B MID CH





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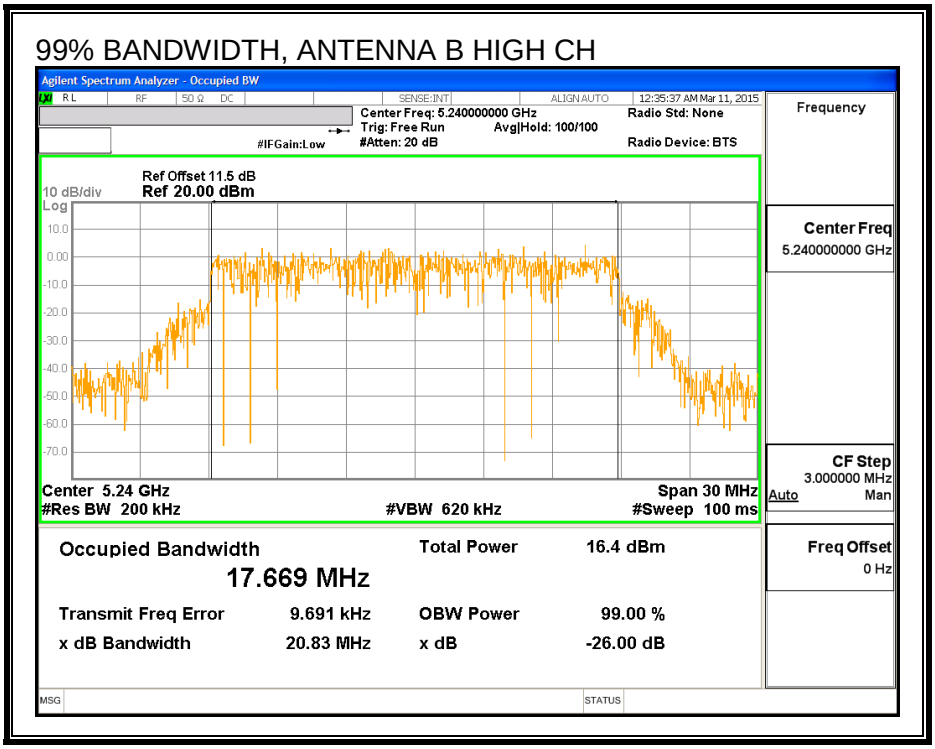
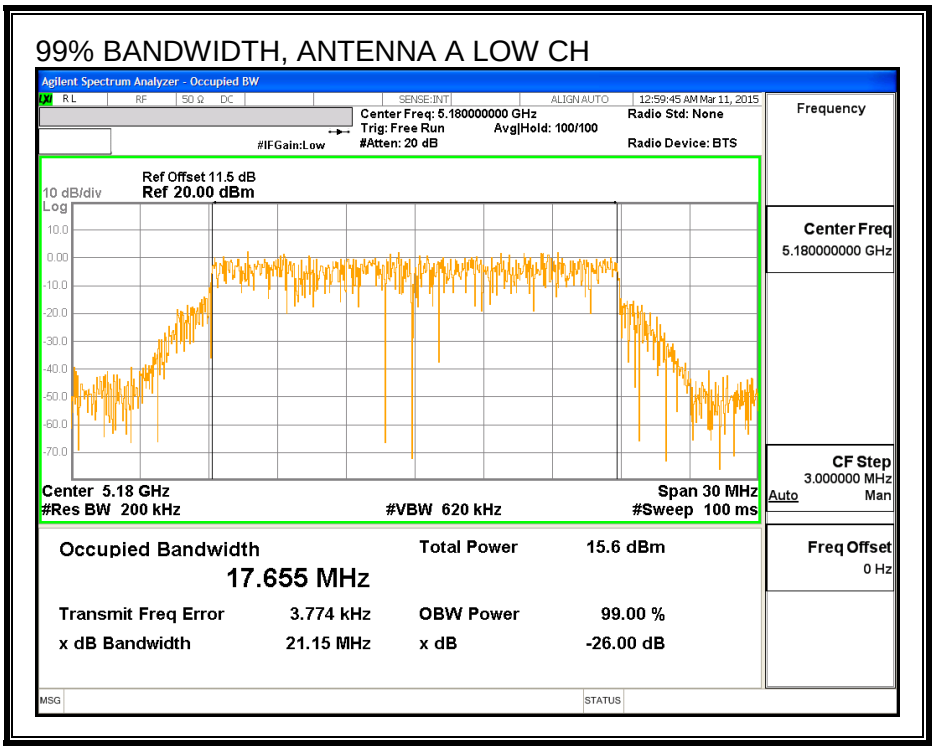



**99% BANDWIDTH, ANTENNA A**





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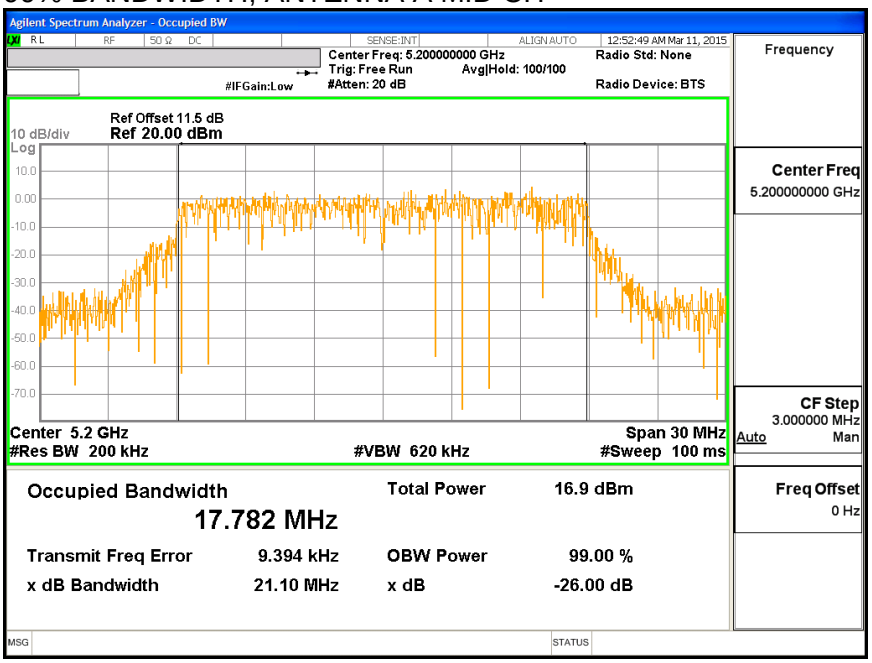
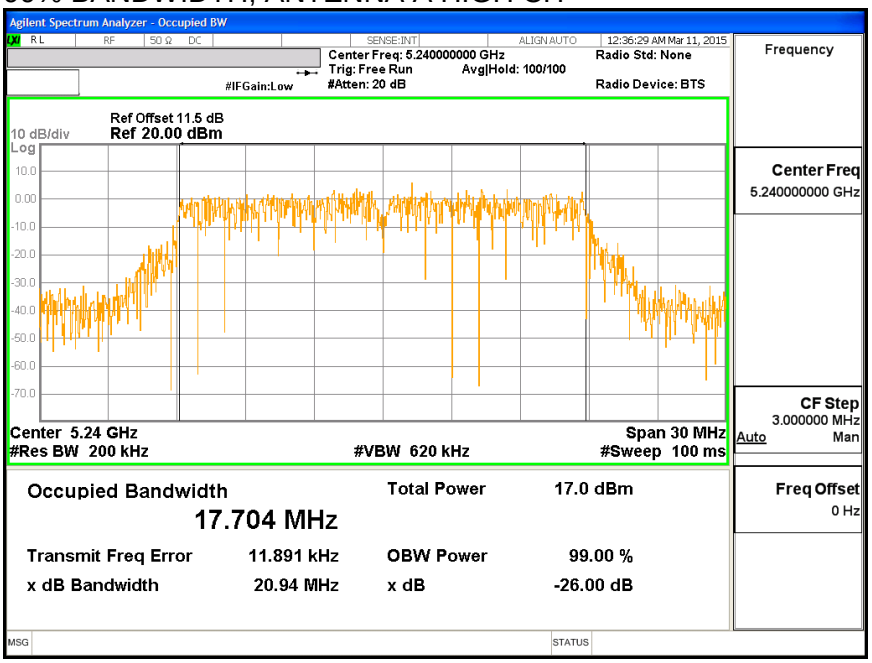
## 99% BANDWIDTH, ANTENNA A MID CH




## 99% BANDWIDTH, ANTENNA A HIGH CH





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### 8.4.3. AVERAGE POWER

**LIMITS**

None; for reporting purposes only.

**RESULTS**

**Average Power Results**

| Channel | Frequency (MHz) | Antenna B Power (dBm) | Antenna A Power (dBm) | Total Power (dBm) |
|---|---|---|---|---|
| Low | 5180 | 15.54 | 15.46 | 18.51 |
| Mid | 5200 | 16.43 | 17.05 | 19.76 |
| High | 5240 | 16.60 | 17.05 | 19.84 |


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### 8.4.4. OUTPUT POWER AND PSD

**LIMITS**

FCC §15.407 (a) (1)

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

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

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

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


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**DIRECTIONAL ANTENNA GAIN**

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

| Antenna B Antenna Gain (dBi) | Antenna A Antenna Gain (dBi) | Uncorrelated Chains Directional Gain (dBi) |
|---|---|---|
| 4.10 | 2.10 | 3.21 |


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**RESULTS**

**Antenna Gain and Limits**

| Channel | Frequency (MHz) | Directional Gain for Power (dBi) | Directional Gain for PSD (dBi) | Power Limit (dBm) | PSD Limit (dBm) |
|---|---|---|---|---|---|
| Low | 5180 | 3.21 | 3.21 | 24.00 | 11.00 |
| Mid | 5200 | 3.21 | 3.21 | 24.00 | 11.00 |
| High | 5240 | 3.21 | 3.21 | 24.00 | 11.00 |

| | | |
|---|---|---|
| **Duty Cycle CF (dB)** | 0.00 | **Included in Calculations of Corr'd Power & PSD** |

**Output Power Results**

| Channel | Frequency (MHz) | Antenna B Meas Power (dBm) | Antenna A Meas Power (dBm) | Total Corr'd Power (dBm) | Power Limit (dBm) | Power Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 5180 | 15.54 | 15.46 | 18.51 | 24.00 | -5.49 |
| Mid | 5200 | 16.43 | 17.05 | 19.76 | 24.00 | -4.24 |
| High | 5240 | 16.60 | 17.05 | 19.84 | 24.00 | -4.16 |

**PSD Results**

| Channel | Frequency (MHz) | Antenna B Meas PSD (dBm) | Antenna A Meas PSD (dBm) | Total Corr'd PSD (dBm) | PSD Limit (dBm) | PSD Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 5180 | 4.44 | 4.25 | 7.35 | 11.00 | -3.65 |
| Mid | 5200 | 5.13 | 5.86 | 8.52 | 11.00 | -2.48 |
| High | 5240 | 5.31 | 5.75 | 8.55 | 11.00 | -2.45 |


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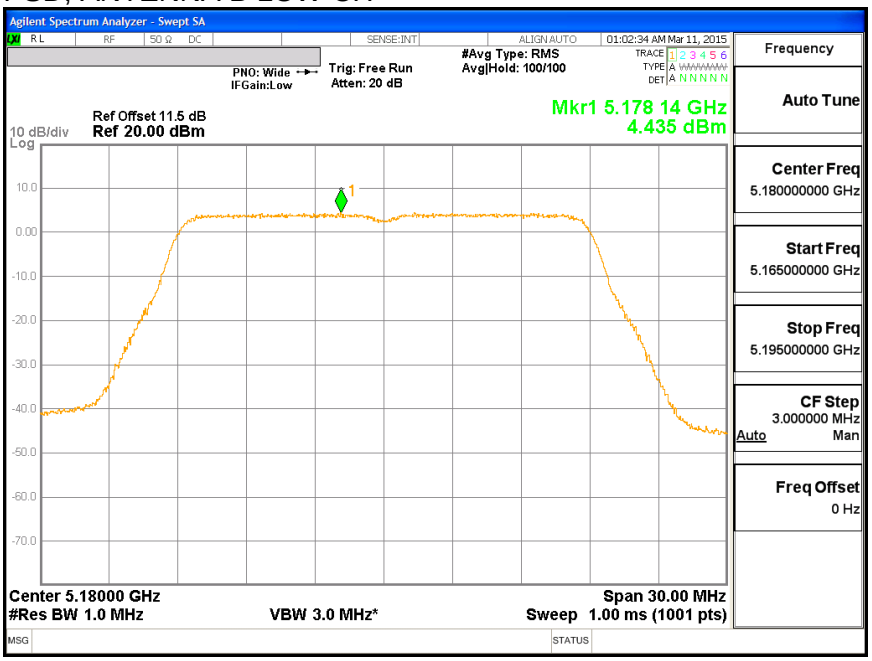
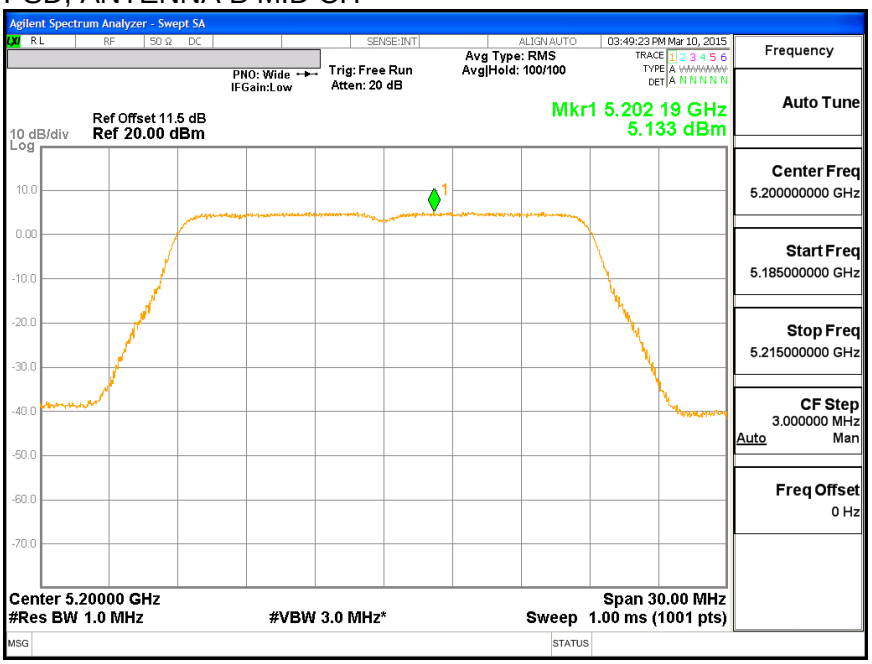
**PSD, ANTENNA B**

PSD, ANTENNA B LOW CH




PSD, ANTENNA B MID CH





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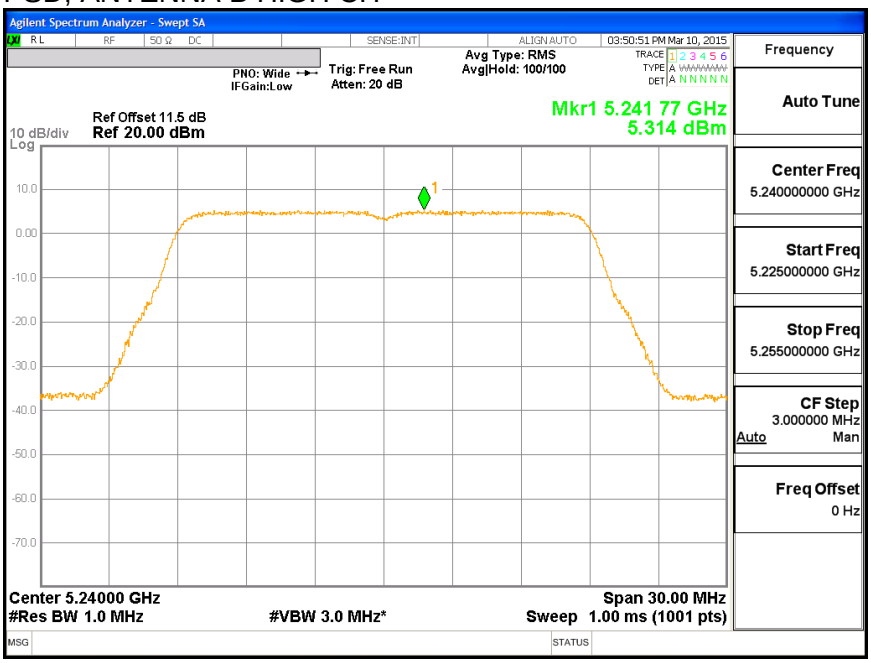
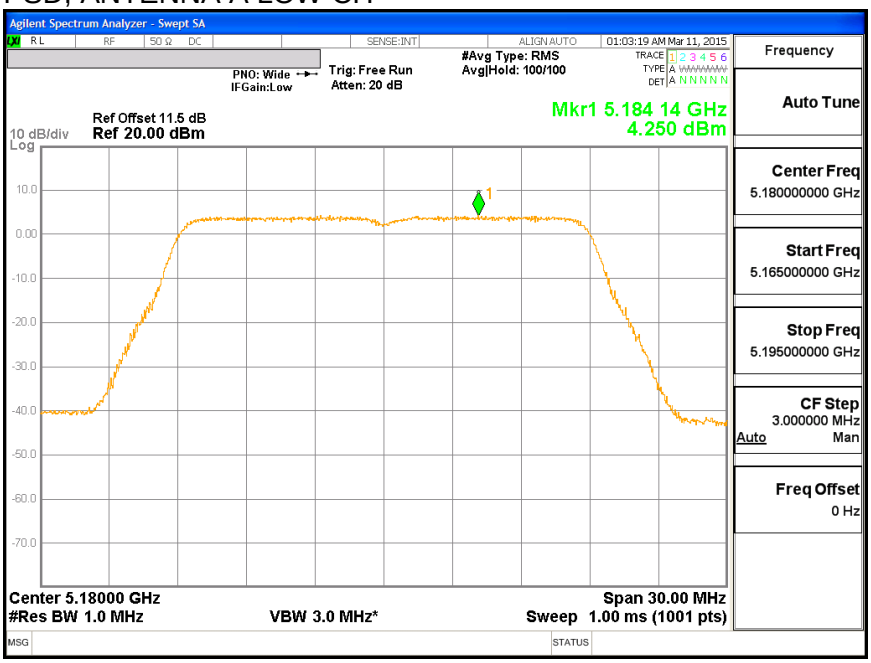
PSD, ANTENNA B HIGH CH




**PSD, ANTENNA A**

PSD, ANTENNA A LOW CH





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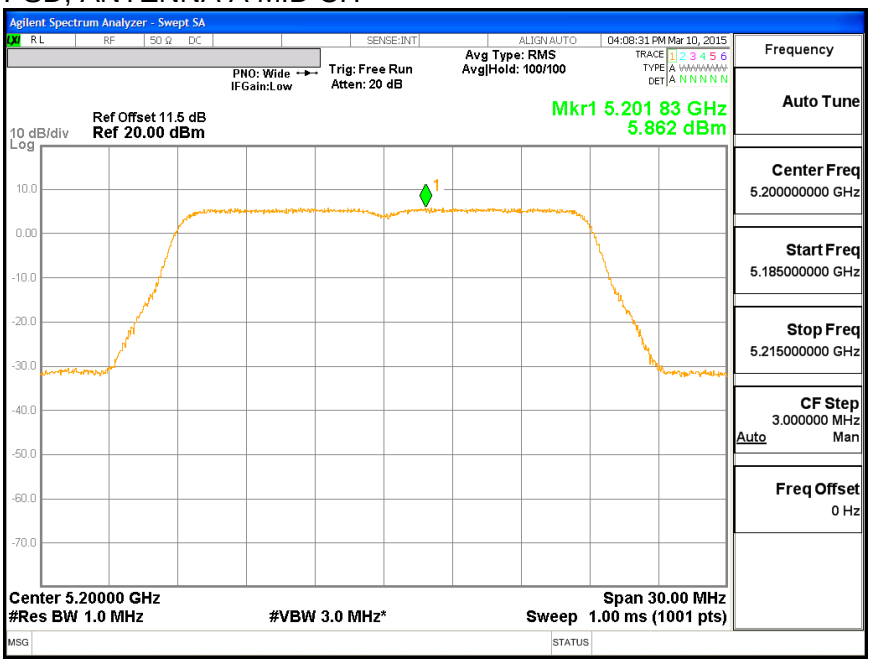
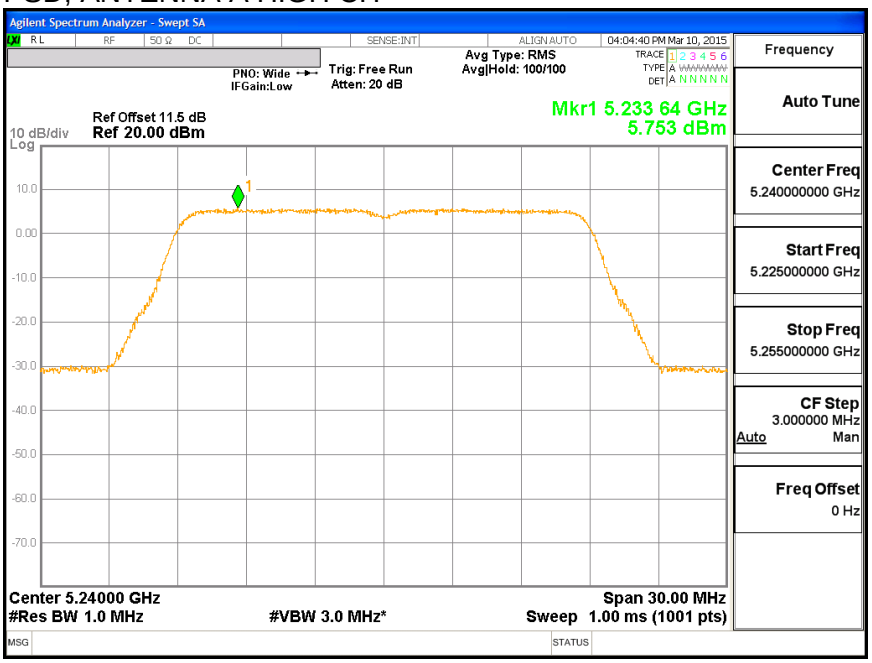
PSD, ANTENNA A MID CH




PSD, ANTENNA A HIGH CH





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# 8.5. 802.11n HT40 SISO MODE IN THE 5.2 GHz BAND ANTENNA B

## 8.5.1. 26 dB BANDWIDTH

**LIMITS**

None; for reporting purposes only.

**RESULTS**

| Channel | Frequency (MHz) | 26 dB Bandwidth (MHz) |
|---|---|---|
| Low | 5190 | 40.32 |
| High | 5230 | 40.08 |


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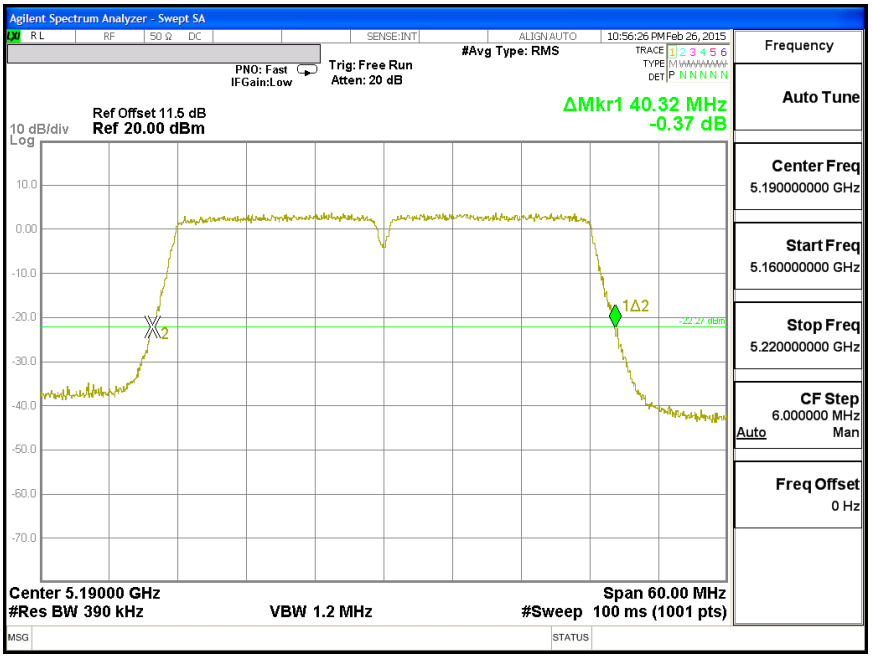
## 26 dB BANDWIDTH

BANDWIDTH LOW CH




BANDWIDTH HIGH CH

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### 8.5.2. 99% BANDWIDTH

**LIMITS**

None; for reporting purposes only.

**RESULTS**

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---|---|---|
| Low | 5190 | 36.2780 |
| High | 5230 | 36.4100 |


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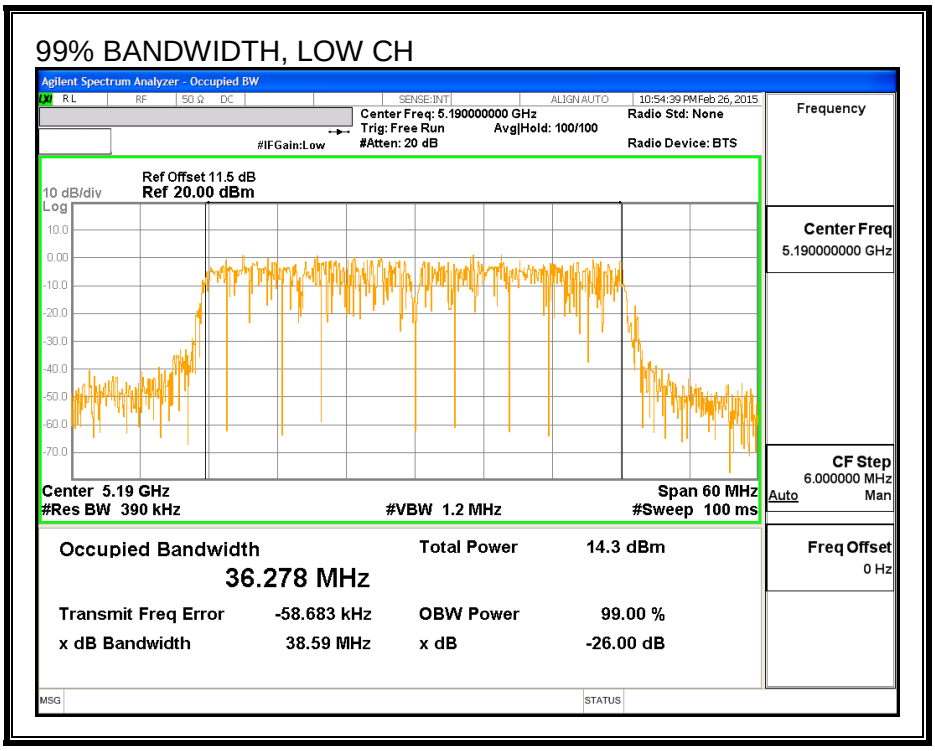
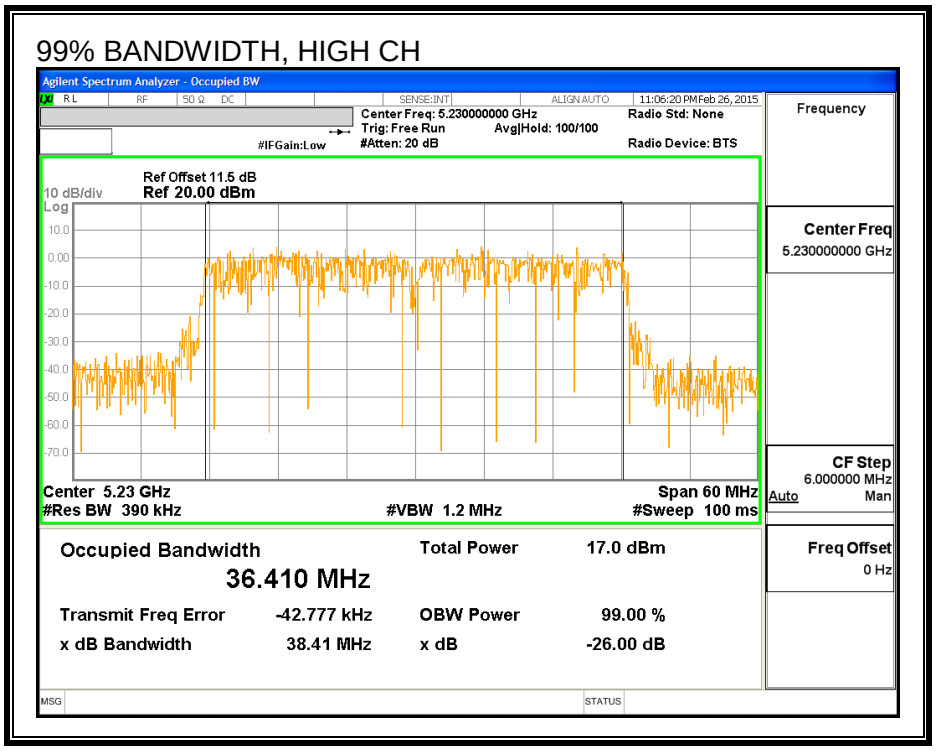
**99% BANDWIDTH**





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### 8.5.3. AVERAGE POWER

**LIMITS**

None; for reporting purposes only.

**RESULTS**

| Channel | Frequency (MHz) | Power (dBm) |
|---|---|---|
| Low | 5190 | 13.50 |
| High | 5230 | 16.52 |


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### 8.5.4. OUTPUT POWER AND PSD

**LIMITS**

FCC §15.407 (a) (1)

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

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

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

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

**DIRECTIONAL ANTENNA GAIN**

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

**RESULTS**


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**Antenna Gain and Limits**

| Channel | Frequency (MHz) | Directional Gain for Power (dBi) | Directional Gain for PSD (dBi) | Power Limit (dBm) | PSD Limit (dBm) |
|---|---|---|---|---|---|
| Low | 5190 | 4.10 | 4.10 | 24.00 | 11.00 |
| High | 5230 | 4.10 | 4.10 | 24.00 | 11.00 |

| | | |
|---|---|---|
| **Duty Cycle CF (dB)** | 0.00 | **Included in Calculations of Corr'd Power & PSD** |

**Output Power Results**

| Channel | Frequency (MHz) | Antenna B Meas Power (dBm) | Total Corr'd Power (dBm) | Power Limit (dBm) | Power Margin (dB) |
|---|---|---|---|---|---|
| Low | 5190 | 13.50 | 13.50 | 24.00 | -10.50 |
| High | 5230 | 16.52 | 16.52 | 24.00 | -7.48 |

**PSD Results**

| Channel | Frequency (MHz) | Antenna B Meas PSD (dBm) | Total Corr'd PSD (dBm) | PSD Limit (dBm) | PSD Margin (dB) |
|---|---|---|---|---|---|
| Low | 5190 | -0.34 | -0.34 | 11.00 | -11.34 |
| High | 5230 | 2.30 | 2.30 | 11.00 | -8.70 |


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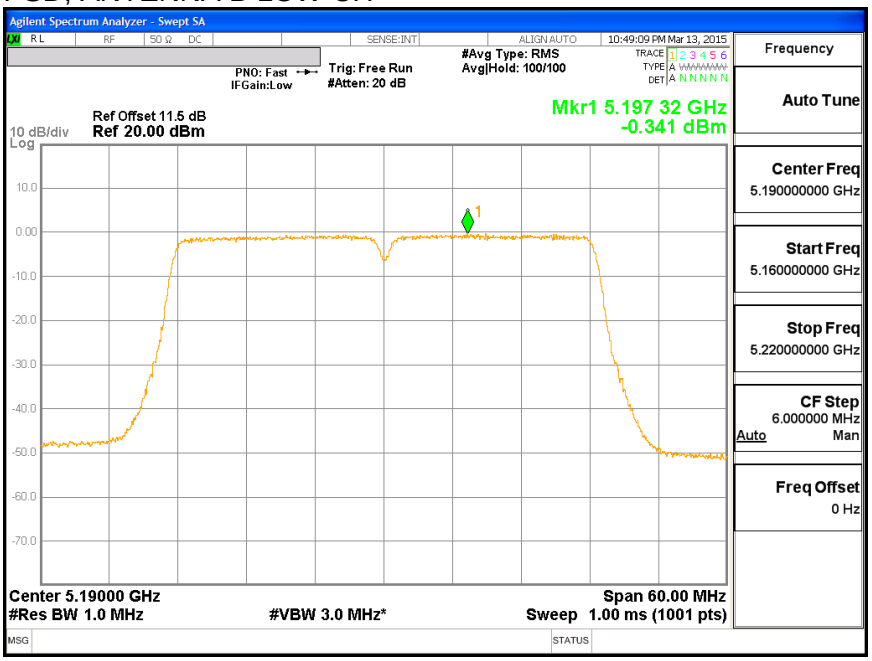
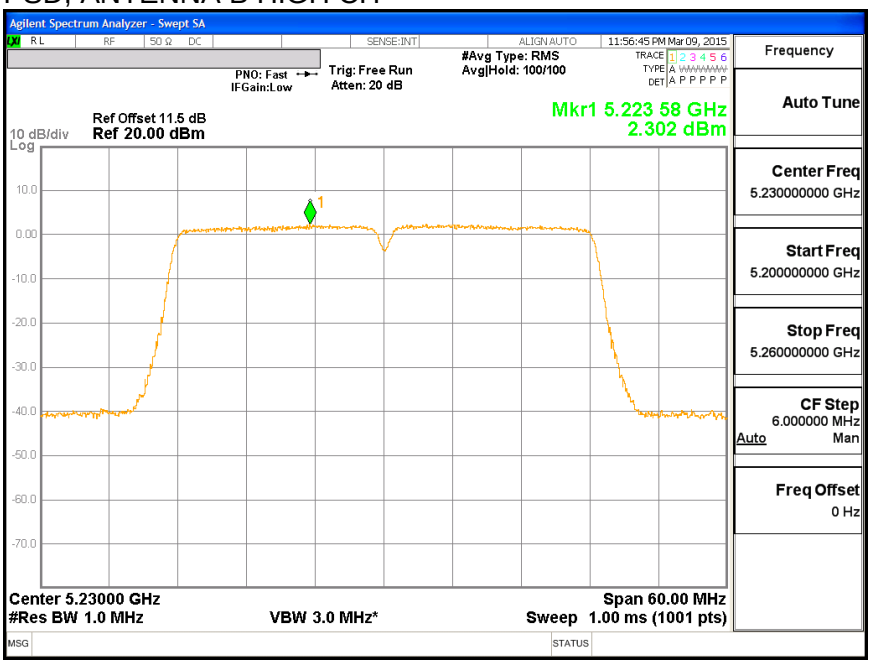
**PSD, ANTENNA B**

PSD, ANTENNA B LOW CH




PSD, ANTENNA B HIGH CH





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## 8.6. 802.11n HT40 SISO MODE IN THE 5.2 GHz BAND ANTENNA A

### 8.6.1. 26 dB BANDWIDTH

**LIMITS**

None; for reporting purposes only.

**RESULTS**

| Channel | Frequency (MHz) | 26 dB Bandwidth (MHz) |
|---|---|---|
| Low | 5190 | 40.20 |
| High | 5230 | 40.50 |


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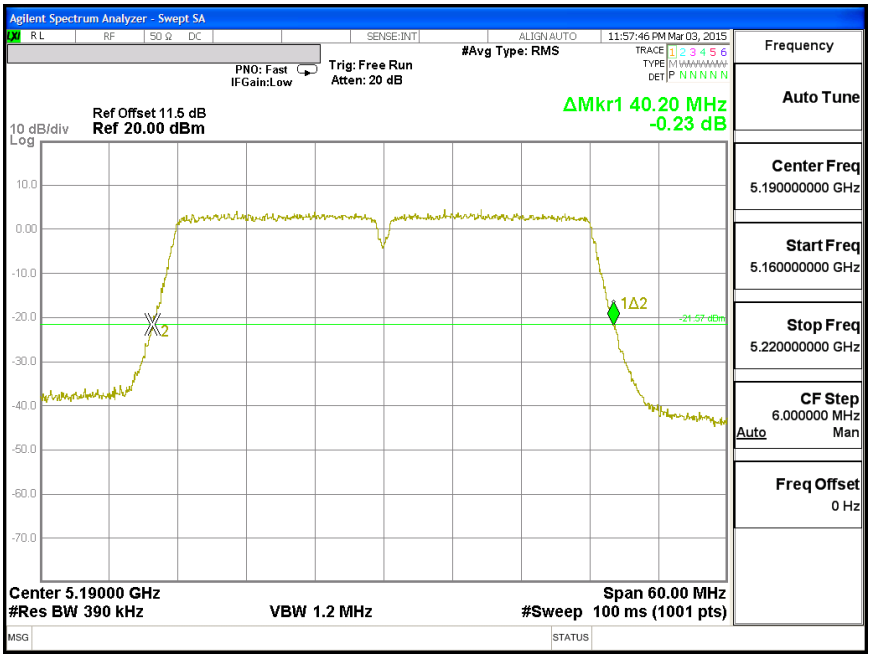
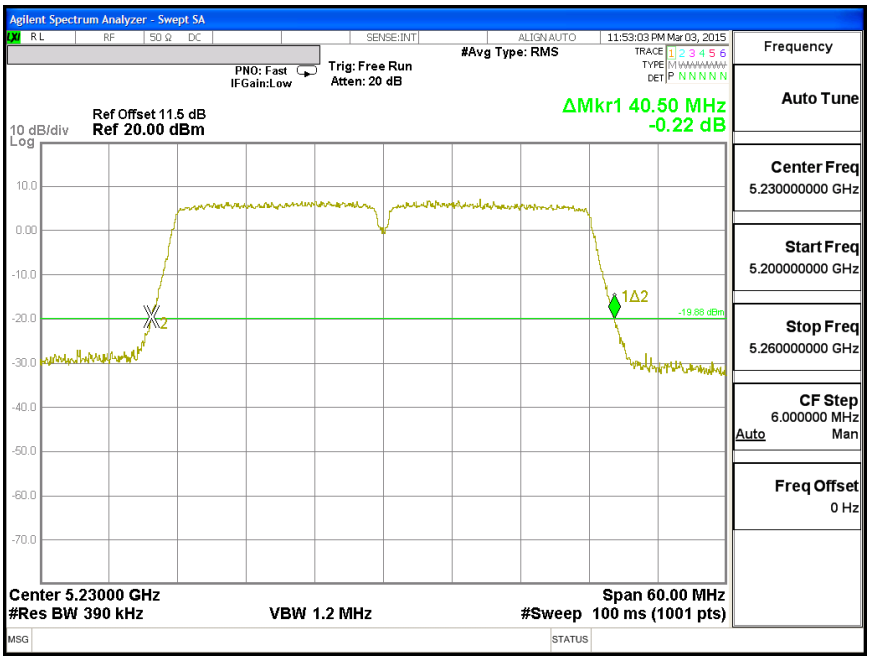
## 26 dB BANDWIDTH

BANDWIDTH LOW CH




BANDWIDTH HIGH CH





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### 8.6.2. 99% BANDWIDTH

**LIMITS**

None; for reporting purposes only.

**RESULTS**

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---|---|---|
| Low | 5190 | 36.402 |
| High | 5230 | 36.184 |


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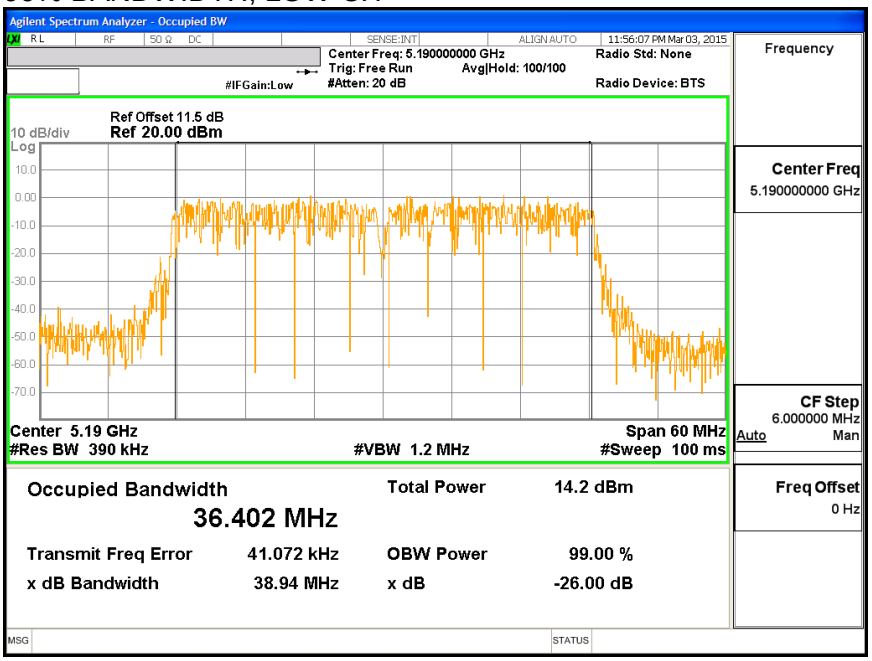
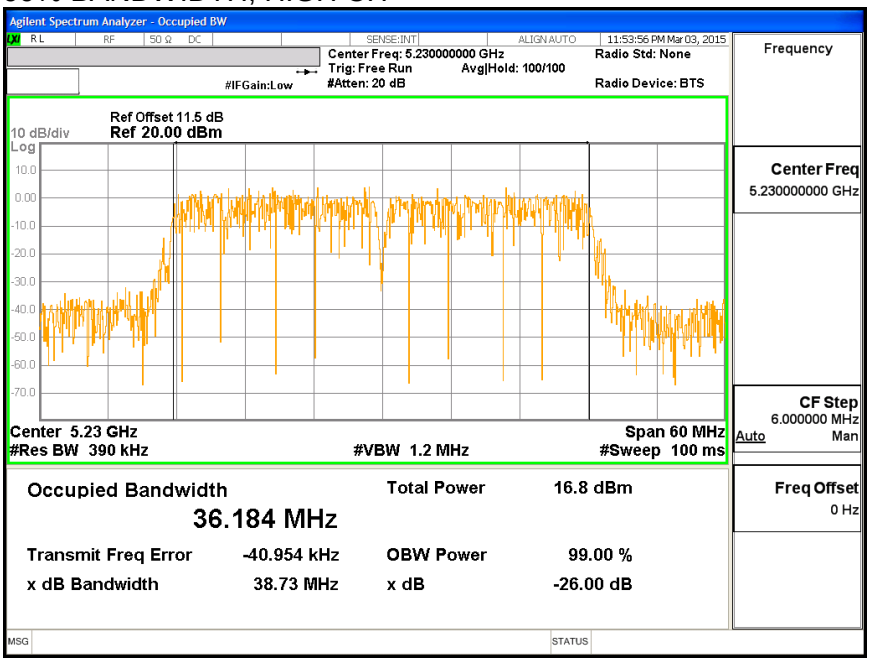
**99% BANDWIDTH**

99% BANDWIDTH, LOW CH




99% BANDWIDTH, HIGH CH





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### 8.6.3. AVERAGE POWER

**LIMITS**

None; for reporting purposes only.

**RESULTS**

| Channel | Frequency (MHz) | Power (dBm) |
|---|---|---|
| Low | 5190 | 13.45 |
| High | 5230 | 17.05 |


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### 8.6.4. OUTPUT POWER AND PSD

**LIMITS**

FCC §15.407 (a) (1)

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

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

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

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

**DIRECTIONAL ANTENNA GAIN**

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

**RESULTS**


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**Antenna Gain and Limits**

| Channel | Frequency (MHz) | Directional Gain for Power (dBi) | Directional Gain for PSD (dBi) | Power Limit (dBm) | PSD Limit (dBm) |
|---|---|---|---|---|---|
| Low | 5190 | 2.10 | 2.10 | 24.00 | 11.00 |
| High | 5230 | 2.10 | 2.10 | 24.00 | 11.00 |

| | | |
|---|---|---|
| **Duty Cycle CF (dB)** | 0.00 | **Included in Calculations of Corr'd Power & PSD** |

**Output Power Results**

| Channel | Frequency (MHz) | Antenna A Meas Power (dBm) | Total Corr'd Power (dBm) | Power Limit (dBm) | Power Margin (dB) |
|---|---|---|---|---|---|
| Low | 5190 | 13.45 | 13.45 | 24.00 | -10.55 |
| High | 5230 | 17.05 | 17.05 | 24.00 | -6.95 |

**PSD Results**

| Channel | Frequency (MHz) | Antenna A Meas PSD (dBm) | Total Corr'd PSD (dBm) | PSD Limit (dBm) | PSD Margin (dB) |
|---|---|---|---|---|---|
| Low | 5190 | -1.02 | -1.02 | 11.00 | -12.02 |
| High | 5230 | 2.94 | 2.94 | 11.00 | -8.06 |


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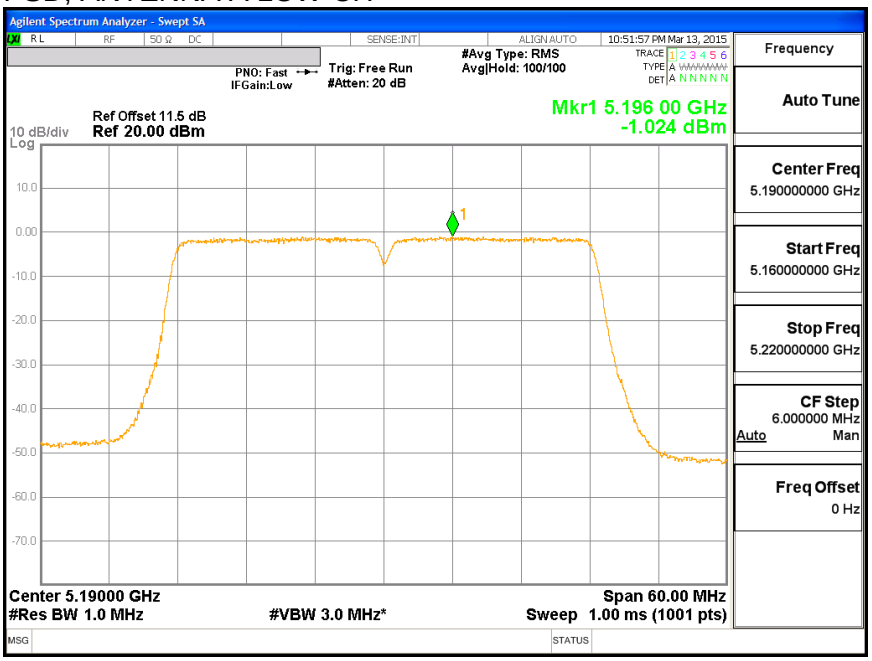
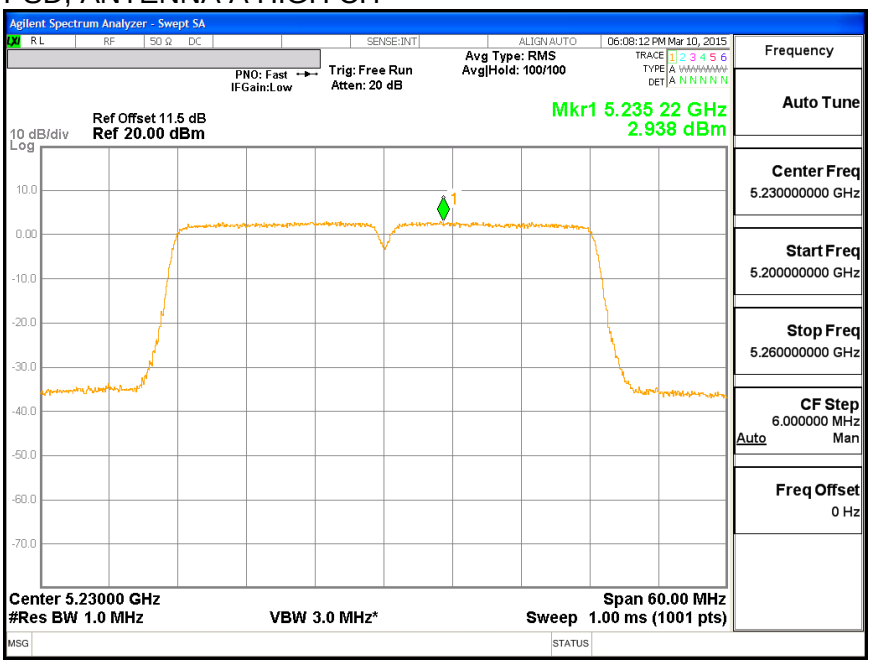
**PSD, ANTENNA A**

PSD, ANTENNA A LOW CH




PSD, ANTENNA A HIGH CH





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