



**FCC 47 CFR PART 15 SUBPART E  
CERTIFICATION TEST REPORT**

**FOR**

**CELLULAR PHONE WITH BLUETOOTH AND WLAN RADIOS**

**MODEL NUMBERS: A1633, A1688, A1691 AND A1700**

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# 1. ATTESTATION OF TEST RESULTS

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

**EUT DESCRIPTION:** CELLULAR PHONE WITH BLUETOOTH AND WLAN RADIOS

**MODELS:** A1633, A1688, A1691 AND A1700

**SERIAL NUMBER:** A1633:  
C7JPQ2Q1GNP9 (RADIATED); C7JPQ2PRGNP9 (CONDUCTED)  
A1688:  
C7JPR061GNPN (RADIATED); C7PG030GKWD (CONDUCTED)

**DATE TESTED:** APRIL 24– JULY 10, 2015

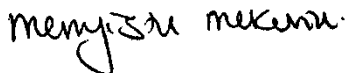
| APPLICABLE STANDARDS     |              |
|--------------------------|--------------|
| STANDARD                 | TEST RESULTS |
| CFR 47 Part 15 Subpart E | Pass         |

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:

Tested By:



MENGISTU MEKURIA  
SENIOR ENGINEER  
UL VERIFICATION SERVICES INC.

J. VANG  
EMC LAB ENGINEER  
UL VERIFICATION SERVICES INC.

## 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 and ANSI C63.10- 2013.

## 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                          |
|------------------------------------|---|
| <input type="checkbox"/> Chamber A | <input checked="" type="checkbox"/> Chamber D |
| <input type="checkbox"/> Chamber B | <input checked="" type="checkbox"/> Chamber E |
| <input type="checkbox"/> Chamber C | <input checked="" type="checkbox"/> Chamber F |
|                                    | <input checked="" type="checkbox"/> Chamber G |
|                                    | <input checked="" type="checkbox"/> 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:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

### 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 mobile phone with multimedia functions (music, application support, and video), cellular GSM/GPRS/EGPRS/WCDMA/HSPA+/DC-HSDPA/CDMA/EVDO/LTE radio, IEEE 802.11a/b/g/n/ac, NFC, Bluetooth and GPS radio. The rechargeable battery is not user accessible.

### 5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

#### 5.2GHz Band

| Frequency Range (MHz) | Mode                        | Output Power (dBm)              | Output Power (mW) |
|-----------------------|-----------------------------|---------------------------------|-------------------|
| 5180 - 5240           | 802.11a                     | Covered by 802.11n HT20 SISO    |                   |
|                       | 802.11n HT20 SISO           | 19.50                           | 89.13             |
|                       | 802.11n HT20 CDD 2TX        | 19.95                           | 98.86             |
|                       | 802.11n HT20 2TX STBC       | Covered by 802.11n HT20 CDD 2TX |                   |
| 5190 - 5230           | 802.11n HT40 SISO           | 16.92                           | 49.20             |
|                       | 802.11n HT40 CDD 2TX        | 19.92                           | 98.17             |
|                       | 802.11n HT40 2TX STBC       | Covered by 802.11n HT40 CDD 2TX |                   |
| 5210                  | 802.11ac VHT80 SISO         | 12.97                           | 19.82             |
|                       | 802.11ac VHT80 2TX CDD      | 14.95                           | 31.26             |
|                       | 802.11ac VHT80 2TX STBC/SDM | Covered by 802.11n HT80 CDD 2TX |                   |

#### 5.3GHz Band

| Frequency Range (MHz) | Mode                        | Output Power (dBm)              | Output Power (mW) |
|-----------------------|-----------------------------|---------------------------------|-------------------|
| 5260 - 5320           | 802.11a                     | Covered by 802.11n HT20 SISO    |                   |
|                       | 802.11n HT20 SISO           | 19.45                           | 88.10             |
|                       | 802.11n HT20 2TX CDD        | 19.95                           | 98.86             |
|                       | 802.11n HT20 2TX STBC       | Covered by 802.11n HT20 CDD 2TX |                   |
| 5270 - 5310           | 802.11n HT40 SISO           | 17.94                           | 62.23             |
|                       | 802.11n HT40 2TX CDD        | 20.90                           | 123.03            |
|                       | 802.11n HT40 2TX STBC       | Covered by 802.11n HT40 CDD 2TX |                   |
| 5290                  | 802.11ac VHT80 SISO         | 15.00                           | 31.62             |
|                       | 802.11ac VHT80 2TX CDD      | 16.96                           | 49.66             |
|                       | 802.11ac VHT80 2TX STBC/SDM | Covered by 802.11n HT80 CDD 2TX |                   |

**5.6GHz Band**

| Frequency Range (MHz) | Mode                      | Output Power (dBm)               | Output Power (mW) |
|-----------------------|---------------------------|----------------------------------|-------------------|
| 5500 - 5700           | 802.11a                   | Covered by 802.11n HT20 SISO     |                   |
| 5720                  | 802.11a                   | Covered by 802.11n HT20 SISO     |                   |
| 5500 - 5700           | 802.11n HT20 SISO         | 19.50                            | 89.13             |
| 5720                  | 802.11n HT20 SISO         | 19.48                            | 88.72             |
| 5500 - 5700           | 802.11n HT20 2TX CDD      | 19.93                            | 98.40             |
| 5720                  | 802.11n HT20 2TX CDD      | 19.96                            | 99.08             |
| 5500 - 5700           | 802.11n HT20 2TX STBC     | Covered by 802.11n HT20 CDD 2TX  |                   |
| 5720                  | 802.11n HT20 2TX STBC     | Covered by 802.11n HT20 CDD 2TX  |                   |
| 5510 - 5670           | 802.11n HT40 SISO         | 18.93                            | 78.16             |
| 5710                  | 802.11n HT40 SISO         | 18.84                            | 76.56             |
| 5510 - 5670           | 802.11n HT40 2TX CDD      | 21.70                            | 147.91            |
| 5710                  | 802.11n HT40 2TX CDD      | 21.48                            | 140.60            |
| 5510 - 5670           | 802.11n HT40 2TX STBC     | Covered by 802.11n HT40 CDD 2TX  |                   |
| 5710                  | 802.11n HT40 STBC/SDM 2TX | Covered by 802.11n HT40 CDD 2TX  |                   |
| 5530-5610             | 802.11ac VHT80 SISO       | 16.94                            | 49.43             |
| 5690                  | 802.11ac VHT80 SISO       | 18.43                            | 69.66             |
| 5530-5610             | 802.11ac VHT80 CDD 2TX    | 18.92                            | 77.98             |
| 5690                  | 802.11ac VHT80 CDD 2TX    | 21.28                            | 134.28            |
| 5530-5610             | 802.11ac VHT80 2TX STBC   | Covered by 802.11n VHT80 CDD 2TX |                   |
| 5690                  | 802.11ac VHT80 2TX STBC   | Covered by 802.11n VHT80 CDD 2TX |                   |

**5.8GHz Band**

| Frequency Range (MHz) | Mode                        | Output Power (dBm)               | Output Power (mW) |
|-----------------------|-----------------------------|----------------------------------|-------------------|
| 5745 - 5825           | 802.11a                     | Covered by 802.11n HT20 SISO     |                   |
| 5745 - 5825           | 802.11n HT20 SISO           | 19.46                            | 88.31             |
| 5745 - 5825           | 802.11a 2TX CDD             | Covered by 802.11n HT20 CDD 2TX  |                   |
| 5745 - 5825           | 802.11n HT20 CDD 2TX        | 22.18                            | 165.20            |
| 5745 - 5825           | 802.11n HT20 STBC/SDM 2TX   | Covered by 802.11n HT20 CDD 2TX  |                   |
| 5755 - 5795           | 802.11n HT40 SISO           | 17.97                            | 62.66             |
| 5755 - 5795           | 802.11n HT40 CDD 2TX        | 19.96                            | 99.08             |
| 5755 - 5795           | 802.11n HT40 STBC/SDM 2TX   | Covered by 802.11n HT40 CDD 2TX  |                   |
| 5775                  | 802.11ac VHT80 SISO         | 14.89                            | 30.83             |
| 5775                  | 802.11ac VHT80 CDD 2TX      | 17.94                            | 62.23             |
| 5775                  | 802.11ac VHT80 STBC/SDM 2TX | Covered by 802.11n VHT80 CDD 2TX |                   |

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

| Frequency Band<br>(GHz) | Antenna Gain |         |
|-------------------------|--------------|---------|
|                         | Chain 0      | Chain 1 |
| 5.2                     | -4.18        | -1.54   |
| 5.3                     | -2.96        | -1.54   |
| 5.5                     | -3.40        | -0.44   |
| 5.8                     | -4.33        | -1.00   |

### 5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was 7.15.213.1.



**5.6. 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.

For SISO modes, there are two transmission antennas. The antenna used in any given time can be either Chain 0 or Chain 1. Both antenna ports have different output powers. Therefore, output power and PSD measurement for SISO modes on both antenna ports are reported.

For MIMO modes, both Chain 0 and Chain 1 used at the same time.

The fundamental of the EUT was investigated in three orthogonal orientations X (Flatbed), Y (Landscape), Z (Portrait), it was determined that (see table below) was worst-case orientations. Therefore, all final radiated testing was performed with the EUT in (see table below) orientation.

| Frequency Band (GHz) | Mode     | Antenna Port      | Worst-case Orientation |
|----------------------|----------|-------------------|------------------------|
| 5.2-5.8              | 1TX SISO | Chain 0           | Z-Portrait             |
|                      |          | Chain 1           | Z-Portrait             |
|                      | 2TX MIMO | Chain 0 + Chain 1 | X-Flatbed              |

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 WiFi/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

Based on the manufacturer’s statement Model A1688, A1700 and A1691 are exactly same, except for marketing reasons.

For WLAN/BT mode, all four models use the same WLAN/BT chipset. Therefore, conducted tests on Model A1633 was considered representative of Model A1688. Radiated testing was performed on both models A1633 and A1688.

| Delta Items | A1633 | A1688 | A1691 | A1700 |
|-------------|-------|-------|-------|-------|
| Band 30     | Yes   | No    | No    | No    |

## 5.7. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

| Support Equipment List |              |               |                              |        |
|------------------------|--------------|---------------|------------------------------|--------|
| Description            | Manufacturer | Model         | Serial Number                | FCC ID |
| Laptop                 | Dell         | Latitude 3540 | 6LNG802                      | N/A    |
| Laptop AC/DC adapter   | Dell         | FA90PE1-00    | CN-0CM889-73245-95L-4954-A00 | N/A    |
| Earphone               | Apple        | NA            | NA                           | N/A    |
| EUT AC/DC adapter      | Apple        | A1385         | D293062F3WVDHLHCF            | N/A    |

### 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 | 2                    | SMA            | Un-Shielded | 0.2              | To spectrum Analyzer |
| 2              | USB     | 1                    | USB            | Shielded    | 1                | N/A                  |
| 3              | AC      | 1                    | AC             | Un-shielded | 3                | 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      |      |                      |                |            |                  |         |

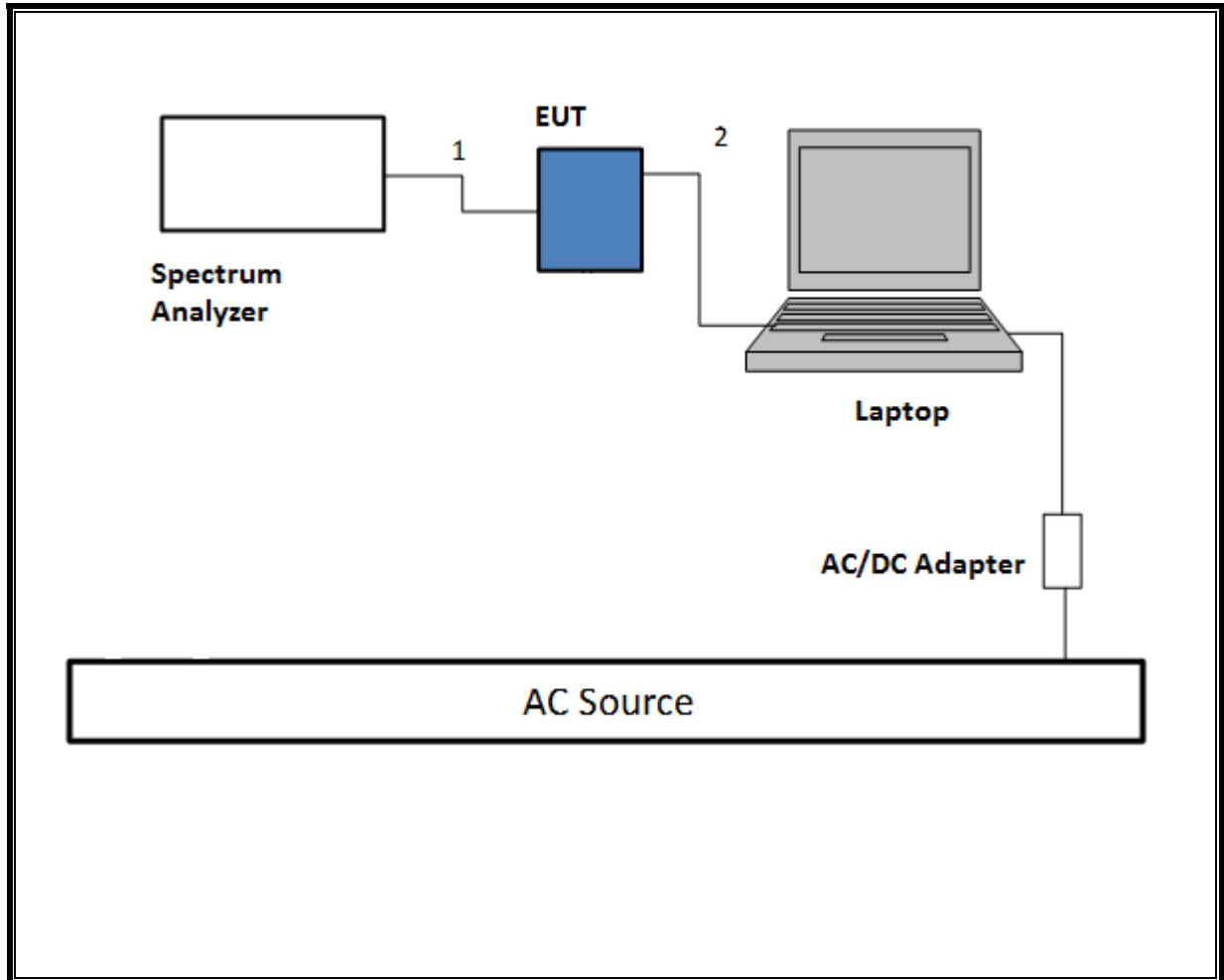
### I/O CABLES (AC POWER CONDUCTED TEST AND BELOW 1 GHZ)

| I/O Cable List |       |                      |                |             |                  |         |
|----------------|-------|----------------------|----------------|-------------|------------------|---------|
| Cable No       | Port  | # of identical ports | Connector Type | Cable Type  | Cable Length (m) | Remarks |
| 1              | AC    | 1                    | AC             | Un-shielded | 3                | N/A     |
| 2              | Audio | 1                    | Jack           | Un-shielded | 0.5              | NA      |

**TEST SETUP**

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

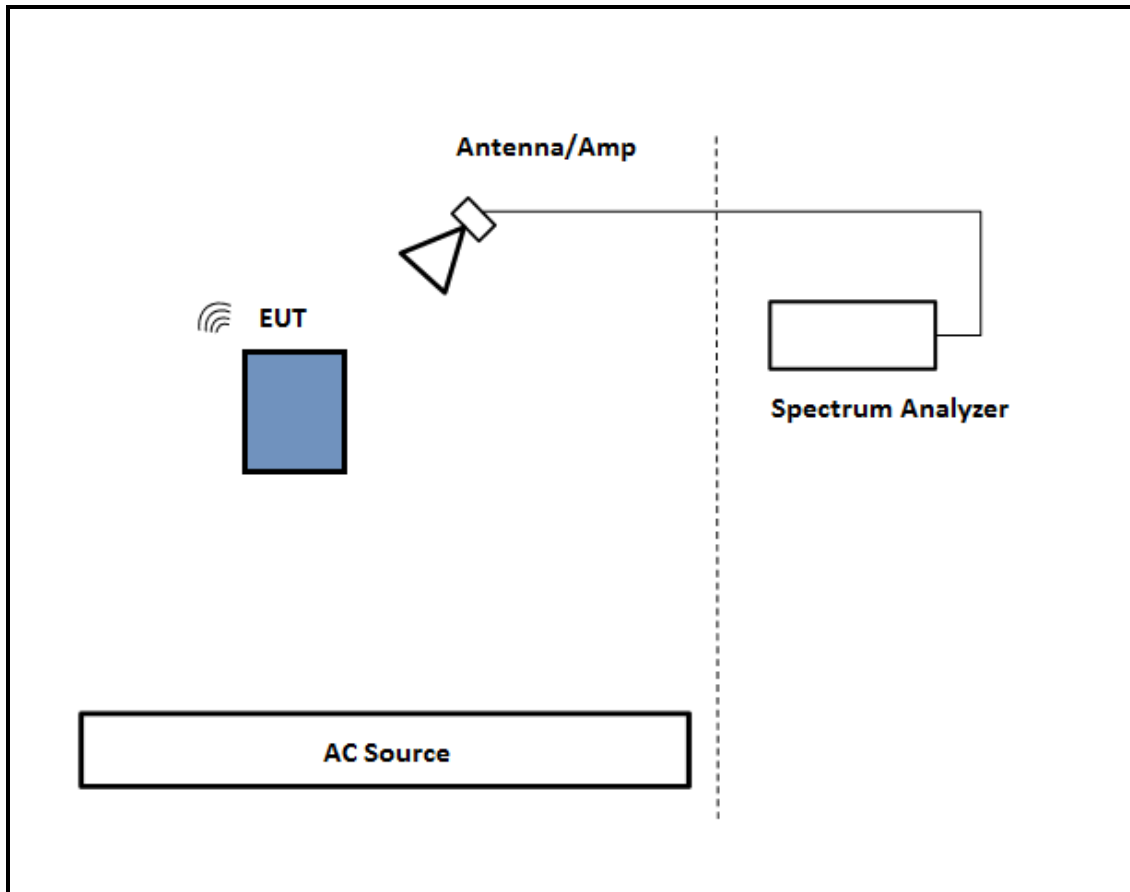
**SETUP DIAGRAM**



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

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

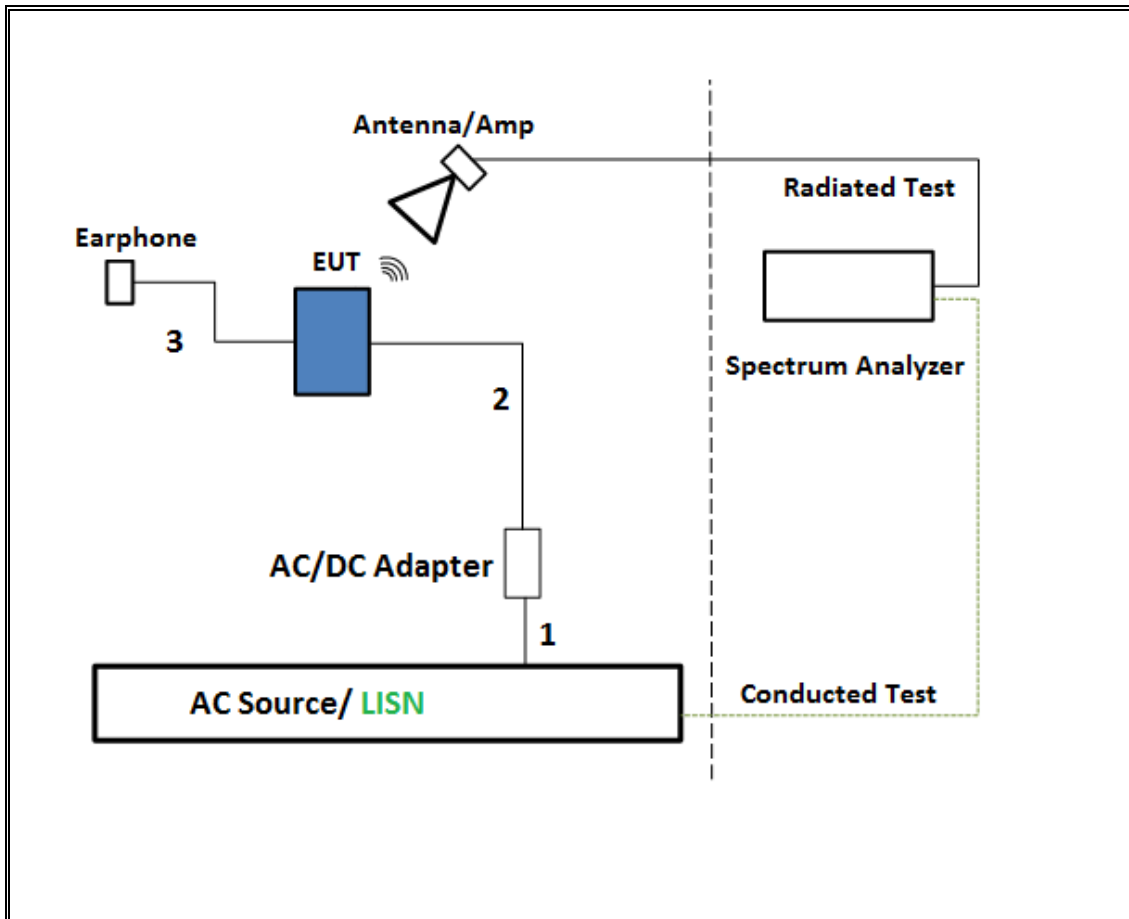
**SETUP DIAGRAM**



**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**



## 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                  | Asset                   | Cal Due    |
| Antenna, Horn 1-18GHz                              | ETS Lindgren    | 3117                   | 00143448                | 2/10/2016  |
| Antenna, Broadband Hybrid, 30MHz to 2000MHz        | Sunol Sciences  | JB3                    | A022813-1               | 1/14/2016  |
| Amplifier, 1 - 18GHz                               | Miteq           | AFS42-00101800-25-S-42 | 1782158                 | 1/26/2016  |
| Amplifier, 10KHz to 1GHz, 32dB                     | Sonoma          | 310N                   | 323561                  | 6/8/2016   |
| Spectrum Analyzer, PXA, 3Hz to 50GHz               | Agilent         | N9030A                 | MY52350427              | 9/13/2015  |
| Amplifier, 10KHz to 1GHz, 32dB                     | Sonoma          | 310N                   | 325117                  | 6/9/2016   |
| Spectrum Analyzer, PXA, 3Hz to 44GHz               | Agilent         | N9030A-544             | US51160264              | 12/23/2015 |
| Power Meter, P-series single channel               | Agilent         | N1911A                 | GB45100212              | 10/9/2015  |
| Power Sensor, P - series, 50MHz to 18GHz, Wideband | Agilent         | N1921A                 | MY53260010              | 7/12/2015  |
| Antenna, Horn 18 to 26.5GHz                        | ARA             | MWH-1826               | 1049                    | 12/17/2015 |
| Horn Antenna, 40GHz                                | ARA             | MWH-2640/B             | 1029                    | 7/15/2015  |
| Spectrum Analyzer, 40 GHz                          | Agilent         | 8564E                  | 3943A01643              | 8/6/2015   |
| Amplifier, 1 to 26.5GHz, 23.5dB Gain minimum       | Agilent         | 8449B                  | 3008A01114              | 10/4/2015  |
| Amplifier, 26 to 40GHz                             | Miteq           | NSP4000-SP2            | 1029                    | 9/3/2015   |
| AC Line Conducted                                  |                 |                        |                         |            |
| EMI Test Receiver 9KHz-7GHz                        | Rohde & Schwarz | ESC17                  | 100935                  | 9/16/2015  |
| LISN for Conducted Emissions CISPR-16              | FCC             | 50/250-25-2            | 114                     | 1/16/2016  |
| Power Cable, Line Conducted Emissions ANSI 63.4    | UL              | PG1                    | N/A                     | 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  |            |

Note: \* indicates automation software version used in the compliance certification testing

## 7. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

### 7.1. ON TIME AND DUTY CYCLE

#### LIMITS

None; for reporting purposes only.

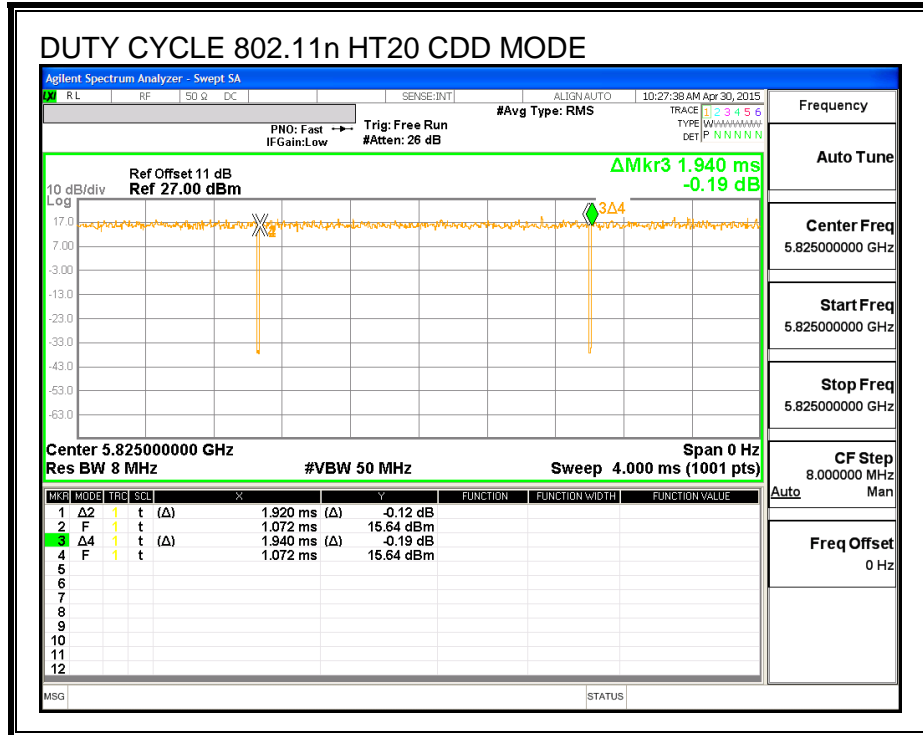
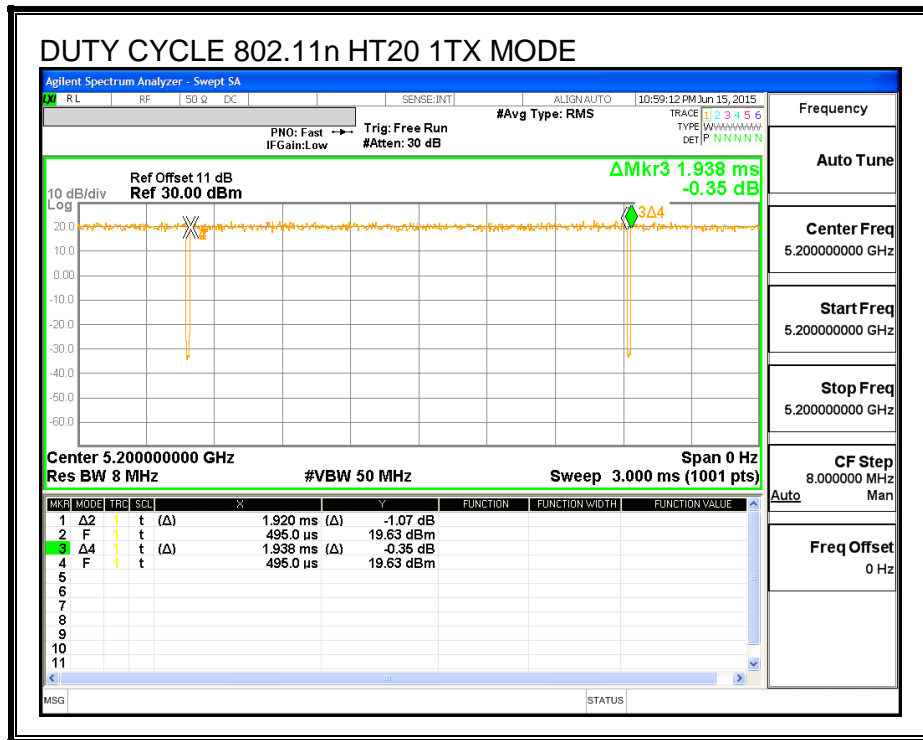
#### PROCEDURE

KDB 789033 Zero-Span Spectrum Analyzer Method.

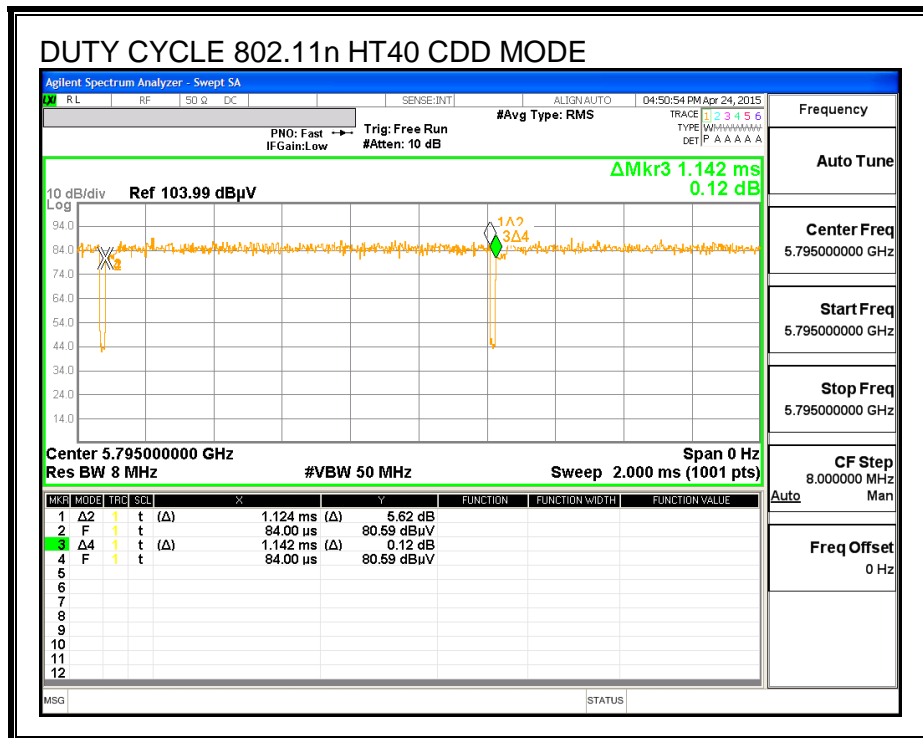
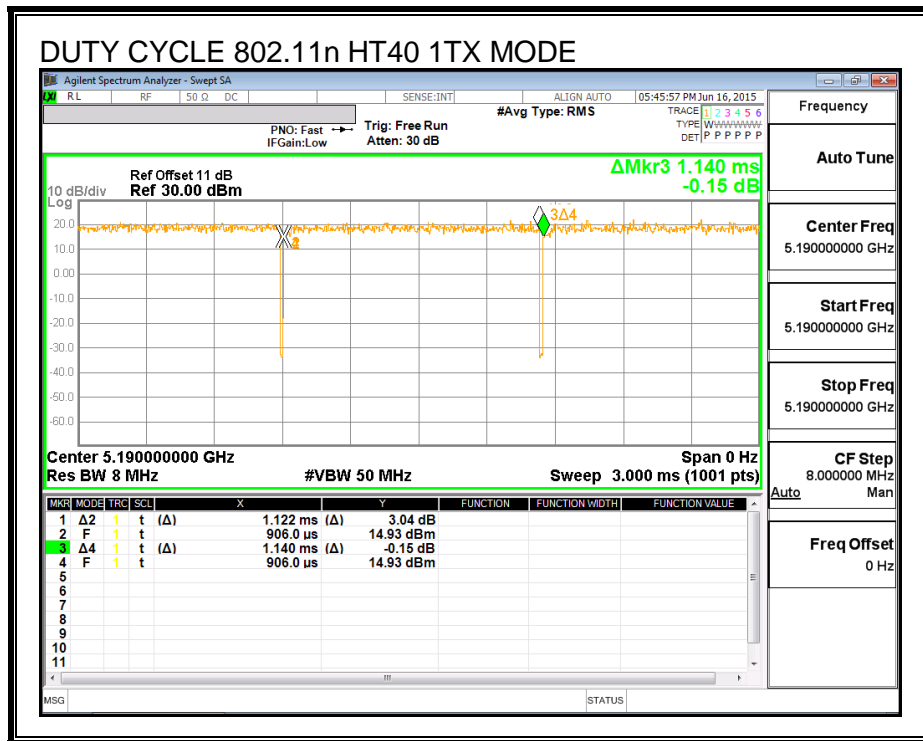
#### RESULTS

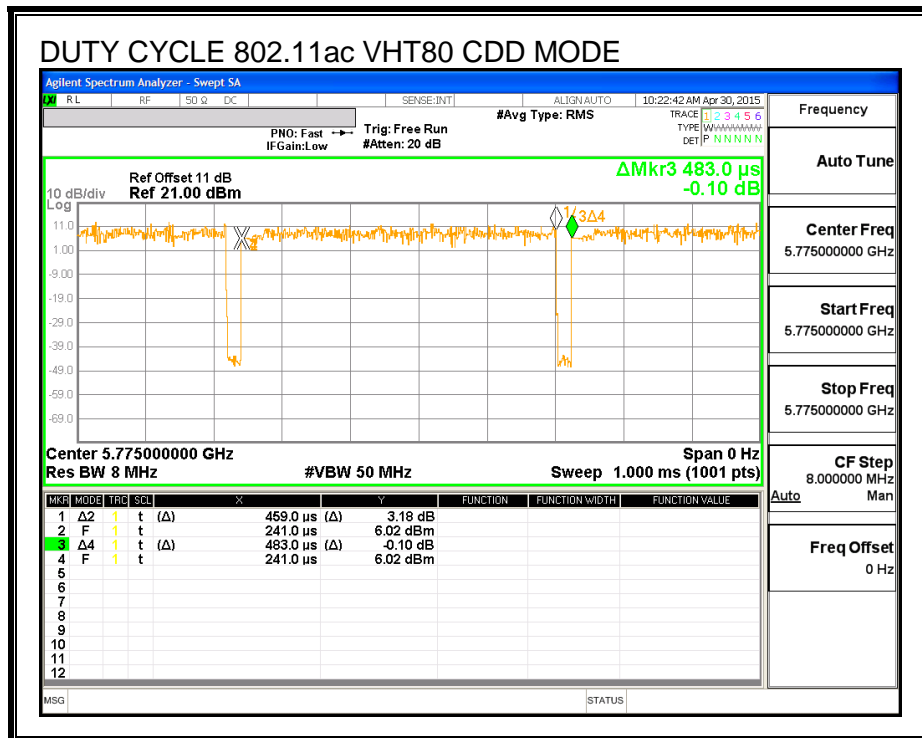
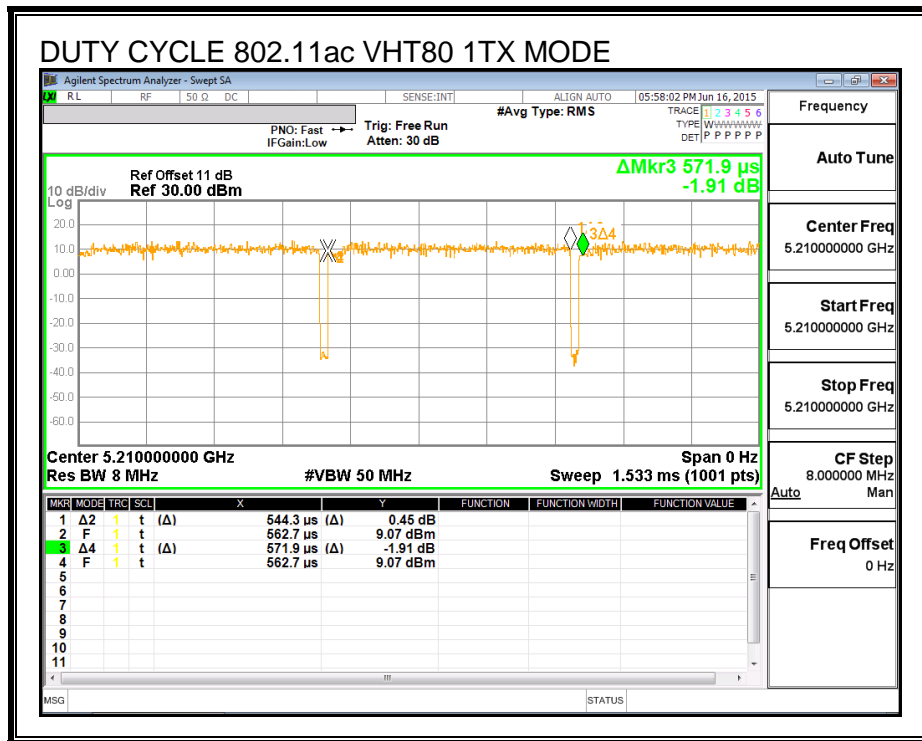
| Mode               | ON Time<br>B<br>(msec) | Period<br>(msec) | Duty Cycle<br>x<br>(linear) | Duty<br>Cycle<br>(%) | Duty Cycle<br>Correction Factor<br>(dB) | 1/B<br>Minimum VBW<br>(kHz) |
|--------------------|------------------------|------------------|-----------------------------|----------------------|---|-----------------------------|
| 802.11n HT20 1TX   | 1.920                  | 1.938            | 0.991                       | 99.07%               | 0.00                                    | 0.010                       |
| 802.11n HT20 CDD   | 1.920                  | 1.940            | 0.990                       | 98.97%               | 0.00                                    | 0.010                       |
| 802.11n HT40 1TX   | 1.122                  | 1.140            | 0.984                       | 98.42%               | 0.00                                    | 0.010                       |
| 802.11n HT40 CDD   | 1.124                  | 1.142            | 0.984                       | 98.42%               | 0.00                                    | 0.010                       |
| 802.11ac VHT80 1TX | 0.544                  | 0.572            | 0.952                       | 95.17%               | 0.21                                    | 1.837                       |
| 802.11ac VHT80 CDD | 0.459                  | 0.483            | 0.950                       | 95.03%               | 0.22                                    | 2.179                       |

**DUTY CYCLE PLOTS**









## **7.2. 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.

## 8. ANTENNA PORT TEST RESULTS (MODEL: A1633)

### 8.1. 802.11n HT20 CHAIN 0 MODE IN THE 5.2 GHz BAND

#### 8.1.1. 26 dB BANDWIDTH

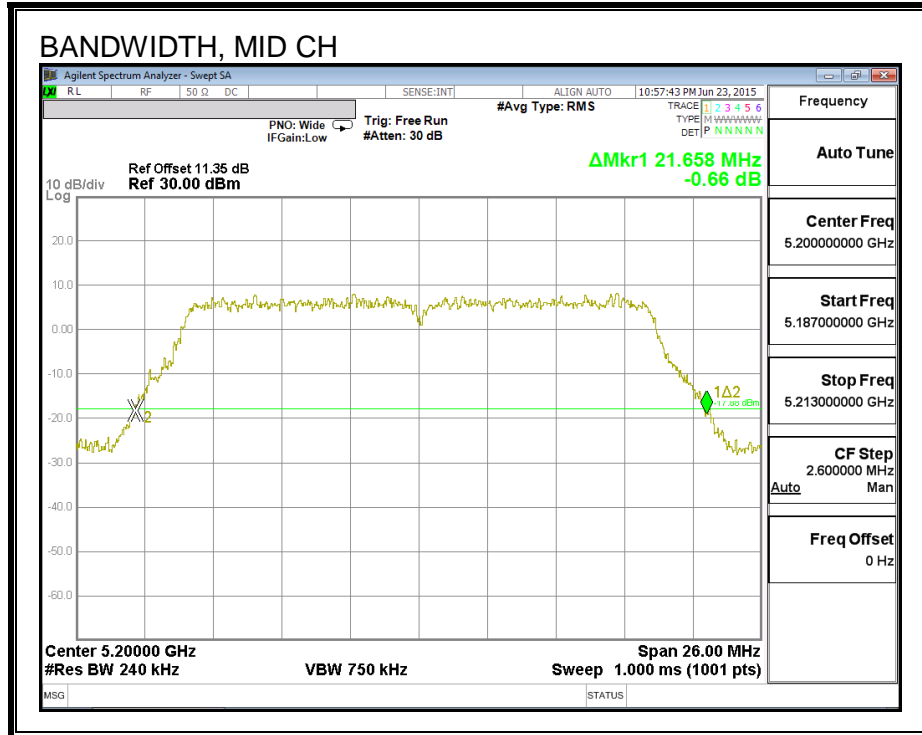
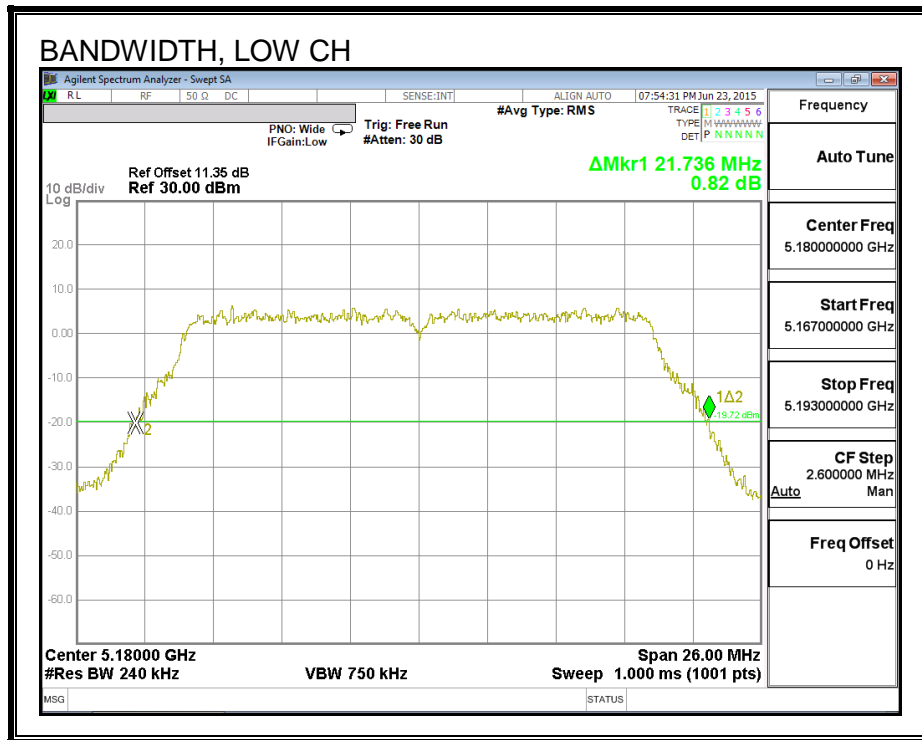
#### LIMITS

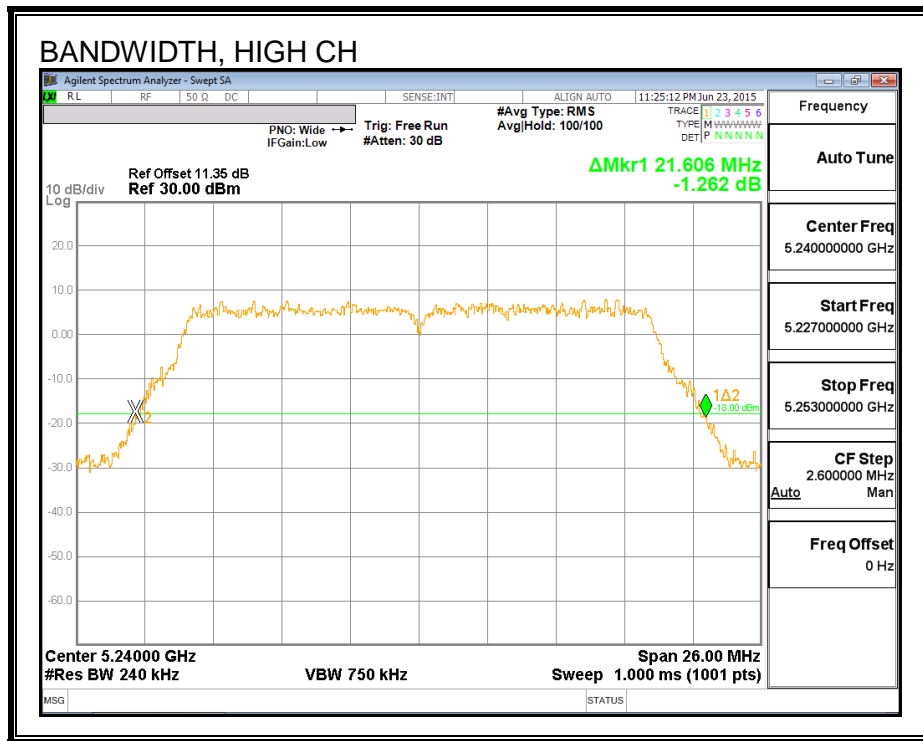
None; for reporting purposes only.

#### RESULTS

| Channel | Frequency (MHz) | 26 dB Bandwidth (MHz) |
|---------|-----------------|-----------------------|
| Low     | 5180            | 21.74                 |
| Mid     | 5200            | 21.66                 |
| High    | 5240            | 21.61                 |

**26 dB BANDWIDTH**





### 8.1.2. 99% BANDWIDTH

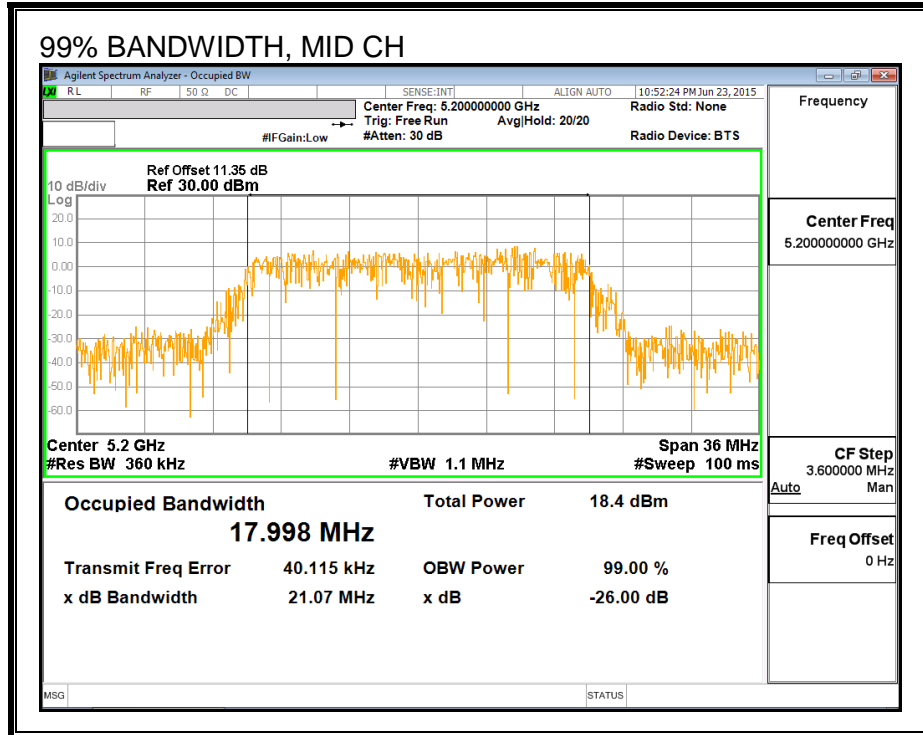
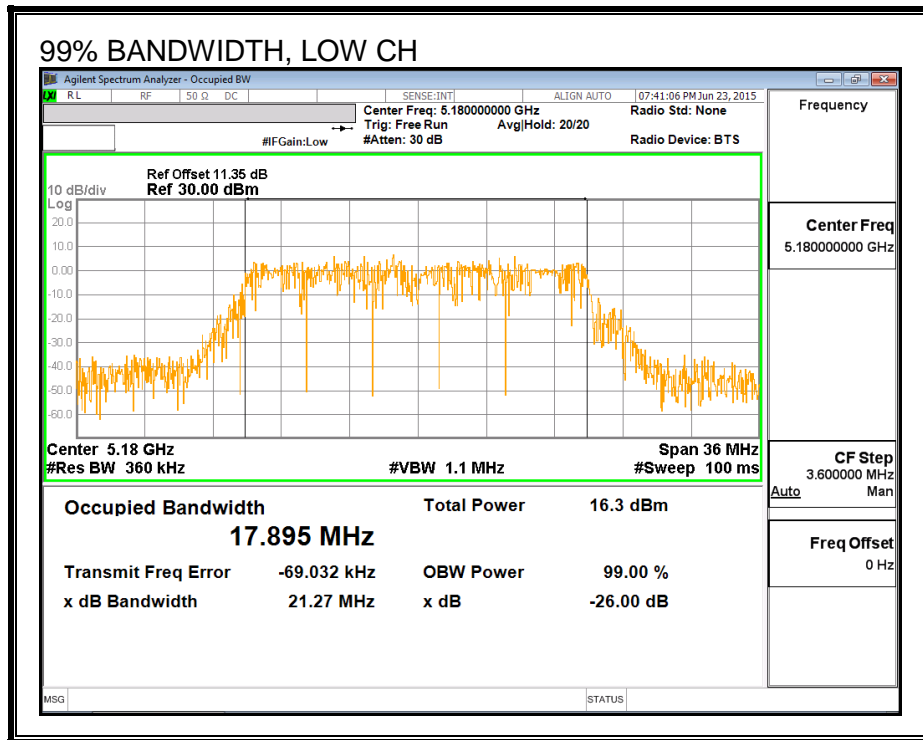
#### LIMITS

None; for reporting purposes only.

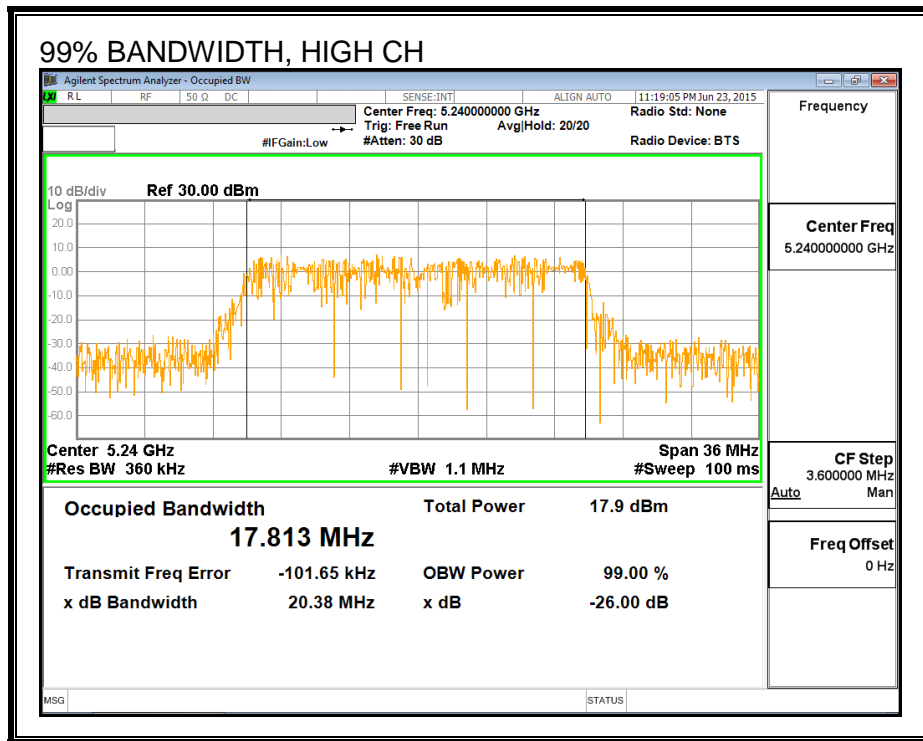
#### RESULTS

| Channel | Frequency<br>(MHz) | 99% BW<br>(MHz) |
|---------|--------------------|-----------------|
| Low     | 5180               | 17.895          |
| Mid     | 5200               | 17.998          |
| High    | 5240               | 17.813          |

**99% BANDWIDTH**







### 8.1.3. AVERAGE POWER (FCC)

#### LIMITS

None; for reporting purposes only.

#### RESULTS

| Channel | Frequency (MHz) | Power (dBm) |
|---------|-----------------|-------------|
| Low     | 5180            | 15.99       |
| Mid     | 5200            | 17.94       |
| High    | 5240            | 17.80       |

## 8.1.4. OUTPUT POWER AND PSD (FCC)

### 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**

**Antenna Gain and Limits**

| Channel | Frequency<br>(MHz) | Directional<br>Gain<br>for Power<br>(dBi) | Directional<br>Gain<br>for PSD<br>(dBi) | Power<br>Limit<br>(dBm) | PSD<br>Limit<br>(dBm) |
|---------|--------------------|---|---|-------------------------|-----------------------|
| Low     | 5180               | -4.18                                     | -4.18                                   | 24.00                   | 11.00                 |
| Mid     | 5200               | -4.18                                     | -4.18                                   | 24.00                   | 11.00                 |
| High    | 5240               | -4.18                                     | -4.18                                   | 24.00                   | 11.00                 |

|                           |      |   |
|---------------------------|------|---|
| <b>Duty Cycle CF (dB)</b> | 0.00 | <b>Included in Calculations of Corr'd Power &amp; PSD</b> |
|---------------------------|------|---|

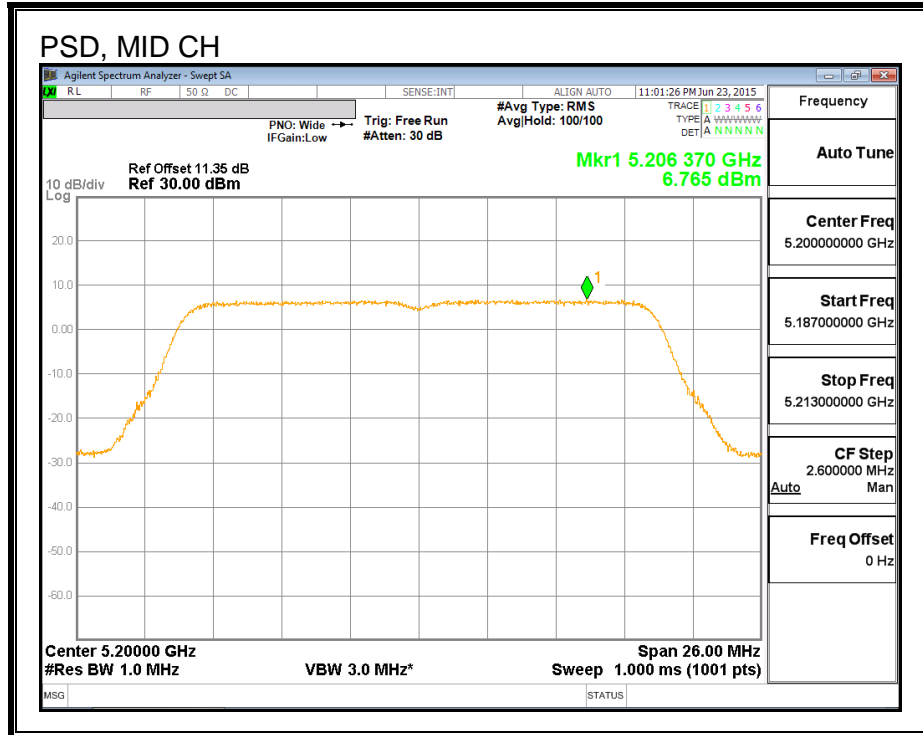
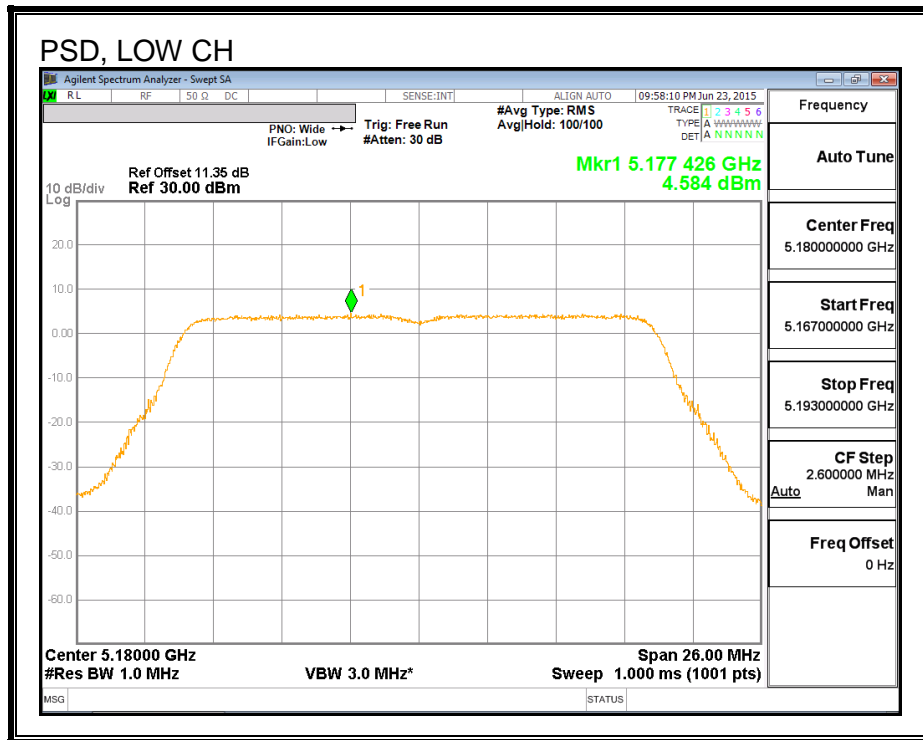
**Output Power Results**

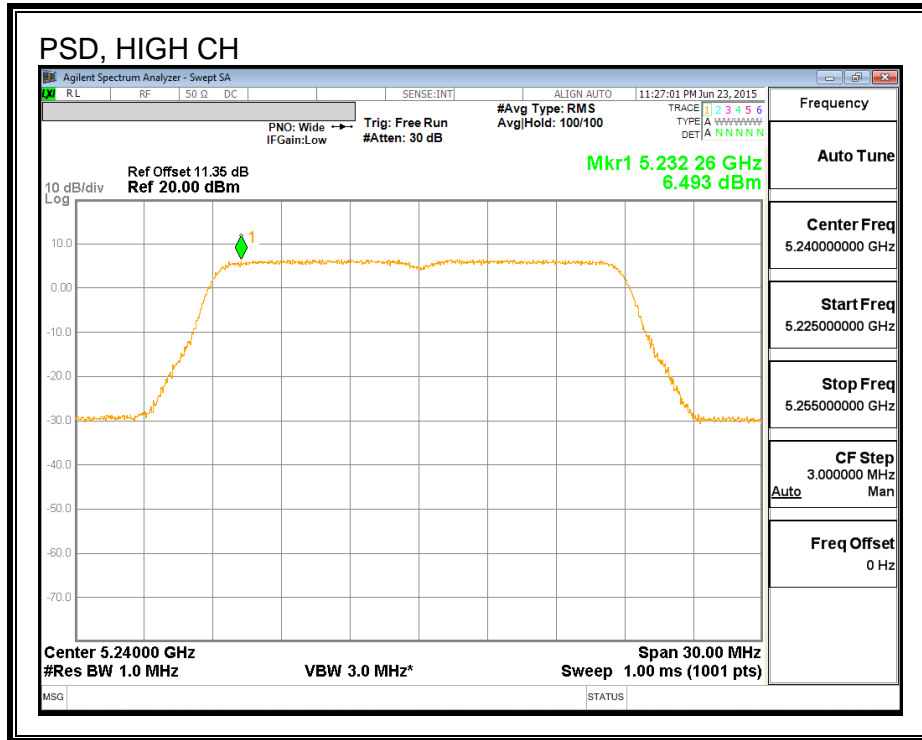
| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>Power<br>(dBm) | Total<br>Corr'd<br>Power<br>(dBm) | Power<br>Limit<br>(dBm) | Power<br>Margin<br>(dB) |
|---------|--------------------|-----------------------------------|-----------------------------------|-------------------------|-------------------------|
| Low     | 5180               | 15.99                             | 15.99                             | 24.00                   | -8.01                   |
| Mid     | 5200               | 17.94                             | 17.94                             | 24.00                   | -6.06                   |
| High    | 5240               | 17.80                             | 17.80                             | 24.00                   | -6.20                   |

**PSD Results**

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>PSD<br>(dBm) | Total<br>Corr'd<br>PSD<br>(dBm) | PSD<br>Limit<br>(dBm) | PSD<br>Margin<br>(dB) |
|---------|--------------------|---------------------------------|---------------------------------|-----------------------|-----------------------|
| Low     | 5180               | 4.58                            | 4.58                            | 11.00                 | -6.42                 |
| Mid     | 5200               | 6.77                            | 6.77                            | 11.00                 | -4.24                 |
| High    | 5240               | 6.49                            | 6.49                            | 11.00                 | -4.51                 |

**PSD**





**8.2. 802.11n HT20 CHAIN 1 MODE IN THE 5.2 GHz BAND**

**8.2.1. 26 dB BANDWIDTH**

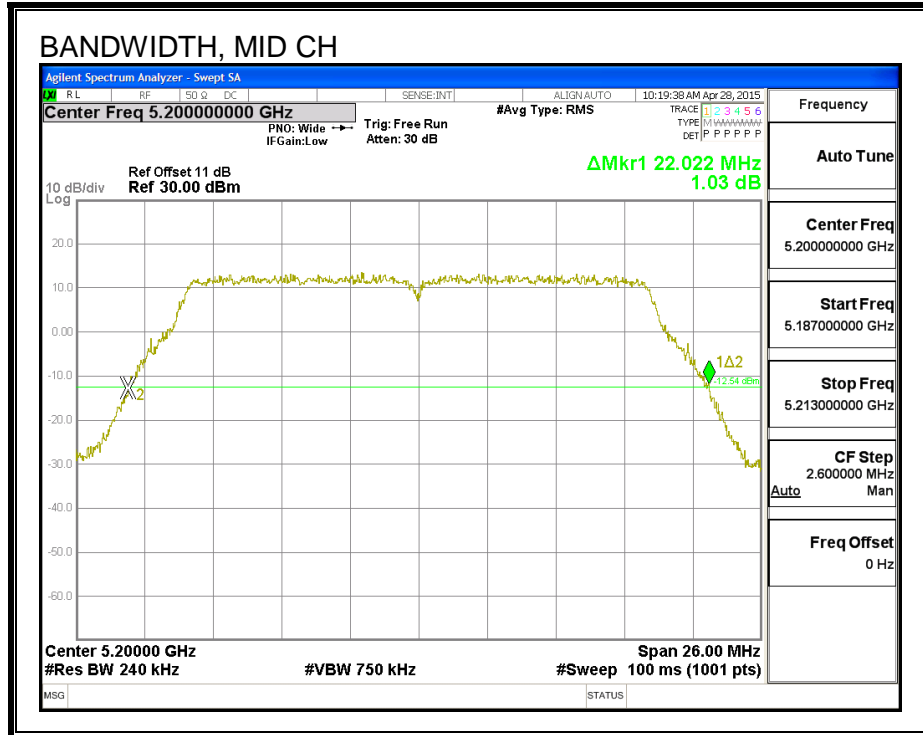
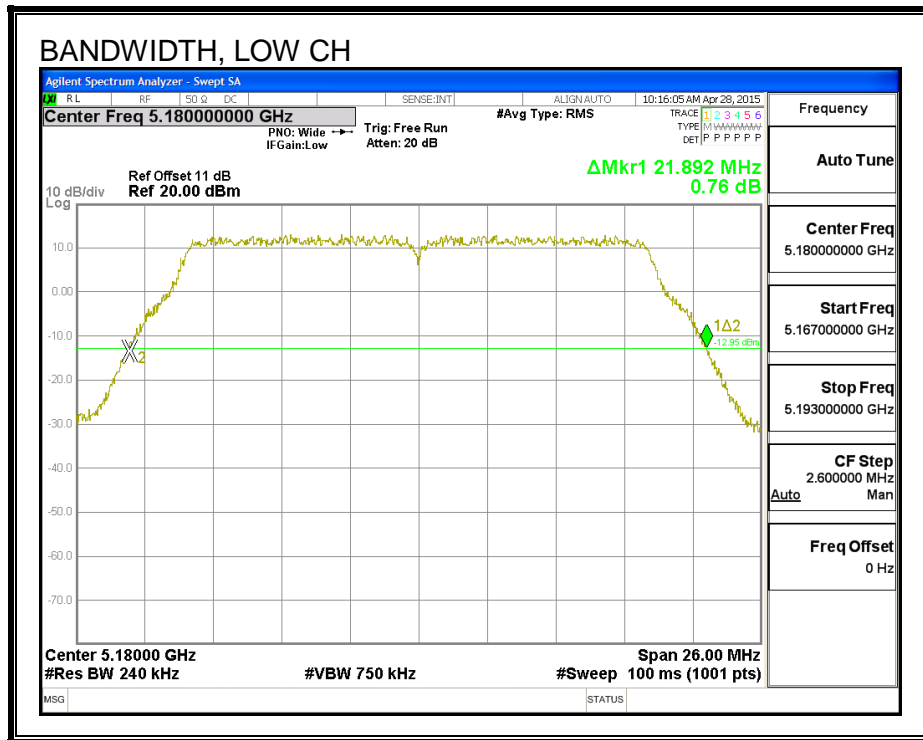
**LIMITS**

None; for reporting purposes only.

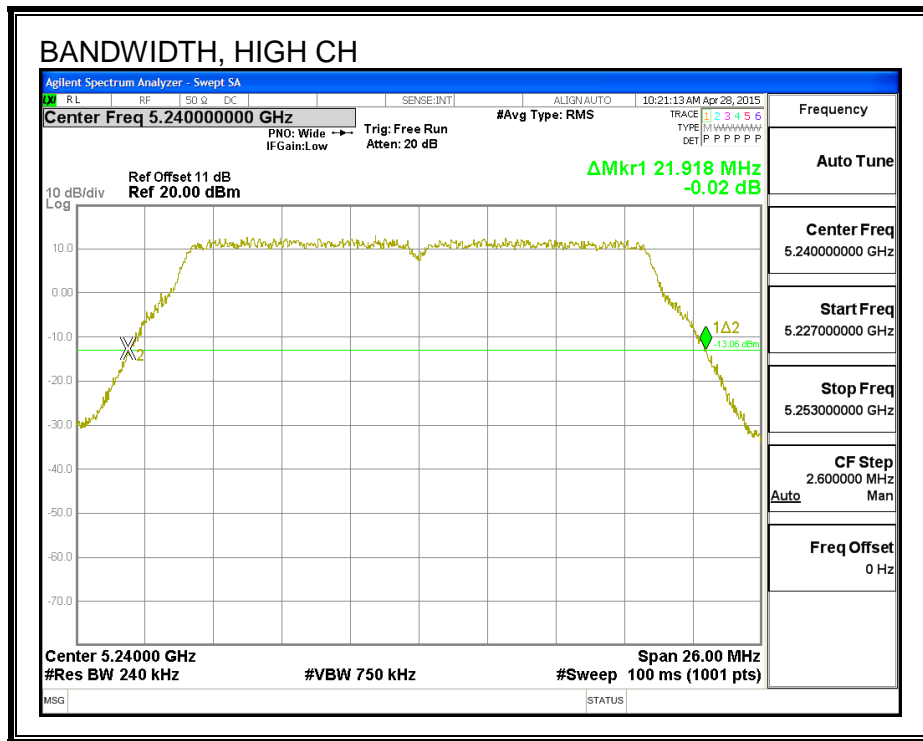
**RESULTS**

| Channel | Frequency (MHz) | 26 dB Bandwidth (MHz) |
|---------|-----------------|-----------------------|
| Low     | 5180            | 21.89                 |
| Mid     | 5200            | 22.02                 |
| High    | 5240            | 21.92                 |

**26 dB BANDWIDTH**







### 8.2.2. 99% BANDWIDTH

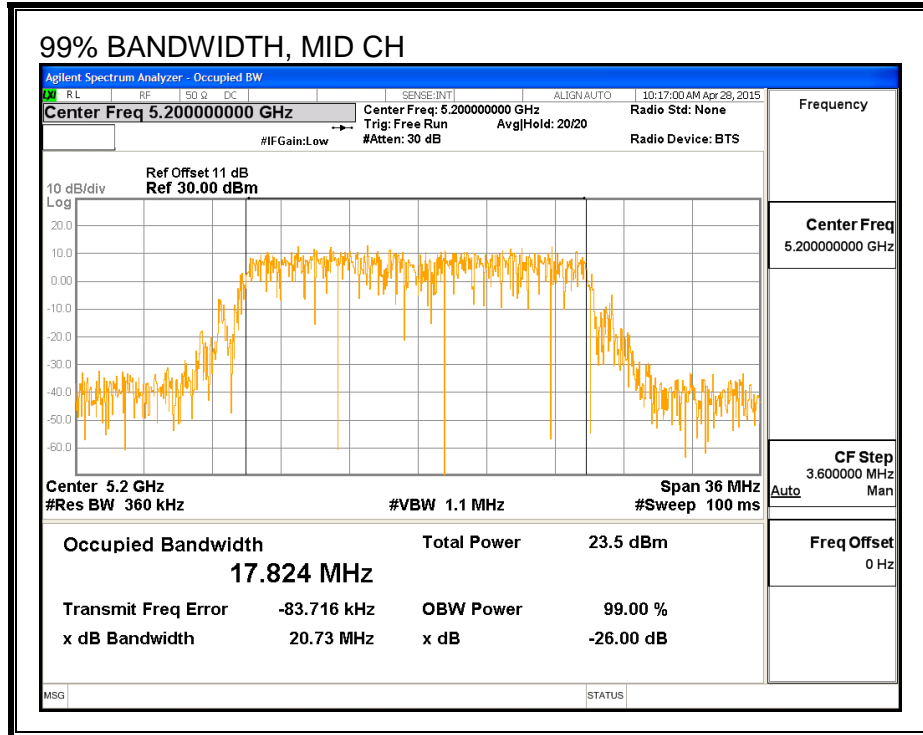
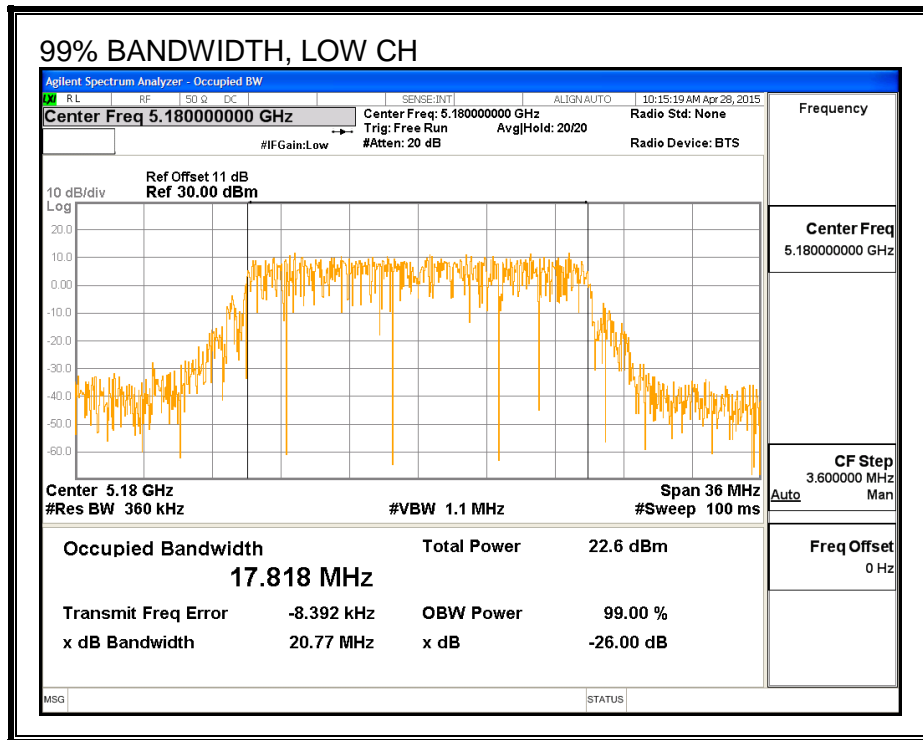
#### LIMITS

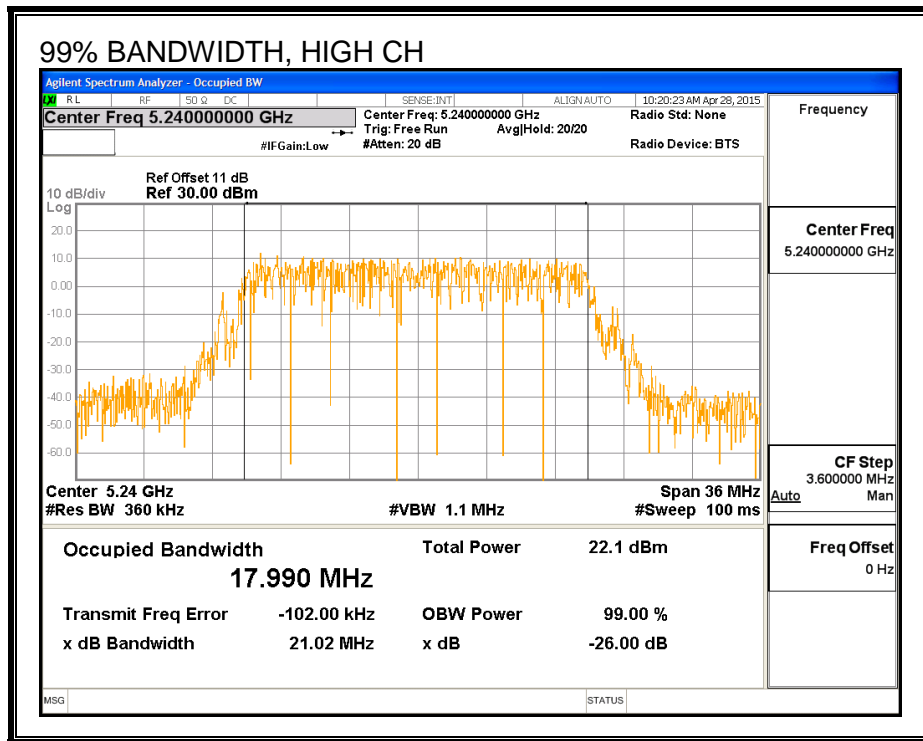
None; for reporting purposes only.

#### RESULTS

| Channel | Frequency<br>(MHz) | 99% BW<br>(MHz) |
|---------|--------------------|-----------------|
| Low     | 5180               | 17.818          |
| Mid     | 5200               | 17.824          |
| High    | 5240               | 17.990          |

**99% BANDWIDTH**





### 8.2.3. AVERAGE POWER

#### LIMITS

None; for reporting purposes only.

#### RESULTS

| Channel | Frequency (MHz) | Power (dBm) |
|---------|-----------------|-------------|
| Low     | 5180            | 15.99       |
| Mid     | 5200            | 19.50       |
| High    | 5240            | 19.48       |

## 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**

**Antenna Gain and Limits**

| Channel | Frequency<br>(MHz) | Directional<br>Gain<br>for Power<br>(dBi) | Directional<br>Gain<br>for PSD<br>(dBi) | Power<br>Limit<br>(dBm) | PSD<br>Limit<br>(dBm) |
|---------|--------------------|---|---|-------------------------|-----------------------|
| Low     | 5180               | -1.54                                     | -1.54                                   | 24.00                   | 11.00                 |
| Mid     | 5200               | -1.54                                     | -1.54                                   | 24.00                   | 11.00                 |
| High    | 5240               | -1.54                                     | -1.54                                   | 24.00                   | 11.00                 |

|                           |      |   |
|---------------------------|------|---|
| <b>Duty Cycle CF (dB)</b> | 0.00 | <b>Included in Calculations of Corr'd Power &amp; PSD</b> |
|---------------------------|------|---|

**Output Power Results**

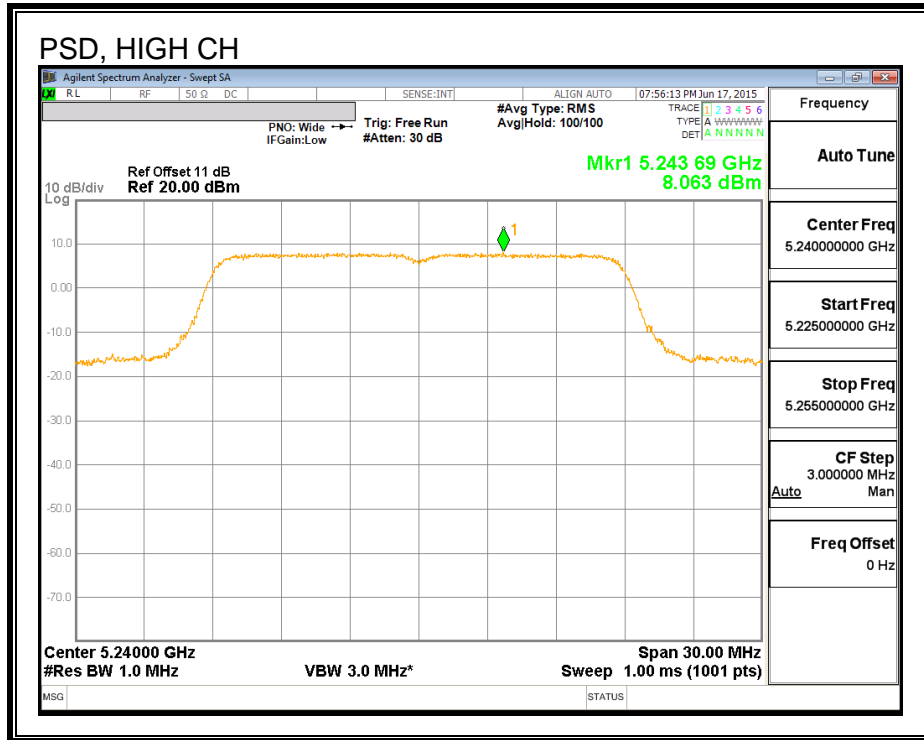
| Channel | Frequency<br>(MHz) | Chain 1<br>Meas<br>Power<br>(dBm) | Total<br>Corr'd<br>Power<br>(dBm) | Power<br>Limit<br>(dBm) | Power<br>Margin<br>(dB) |
|---------|--------------------|-----------------------------------|-----------------------------------|-------------------------|-------------------------|
| Low     | 5180               | 15.99                             | 15.99                             | 24.00                   | -8.01                   |
| Mid     | 5200               | 19.50                             | 19.50                             | 24.00                   | -4.50                   |
| High    | 5240               | 19.48                             | 19.48                             | 24.00                   | -4.52                   |

**PSD Results**

| Channel | Frequency<br>(MHz) | Chain 1<br>Meas<br>PSD<br>(dBm) | Total<br>Corr'd<br>PSD<br>(dBm) | PSD<br>Limit<br>(dBm) | PSD<br>Margin<br>(dB) |
|---------|--------------------|---------------------------------|---------------------------------|-----------------------|-----------------------|
| Low     | 5180               | 4.44                            | 4.44                            | 11.00                 | -6.56                 |
| Mid     | 5200               | 7.93                            | 7.93                            | 11.00                 | -3.07                 |
| High    | 5240               | 8.06                            | 8.06                            | 11.00                 | -2.94                 |







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

#### 8.3.1. 26 dB BANDWIDTH

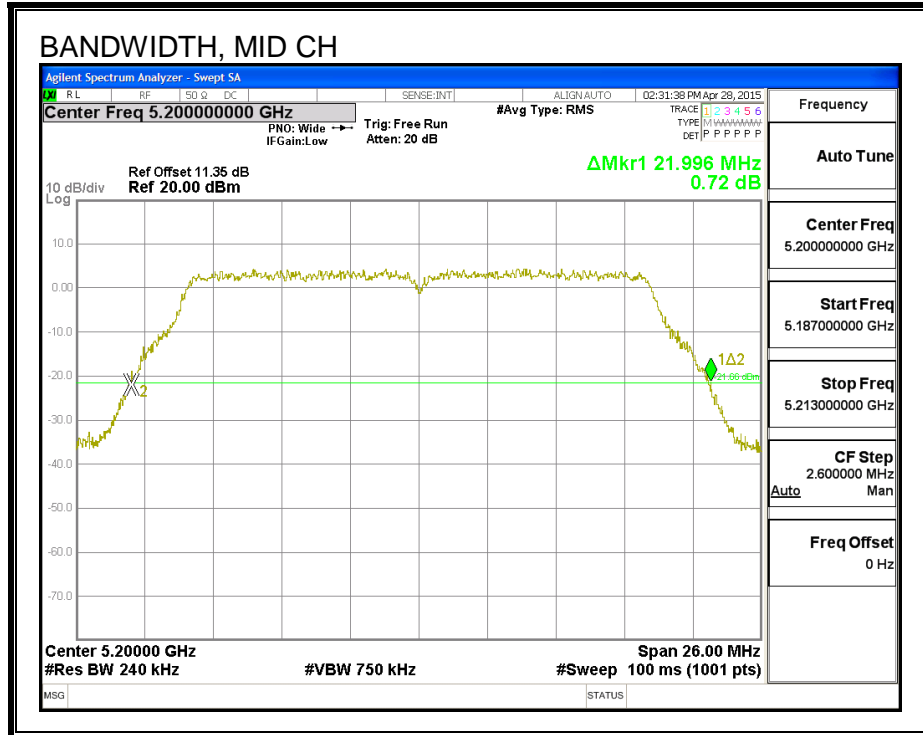
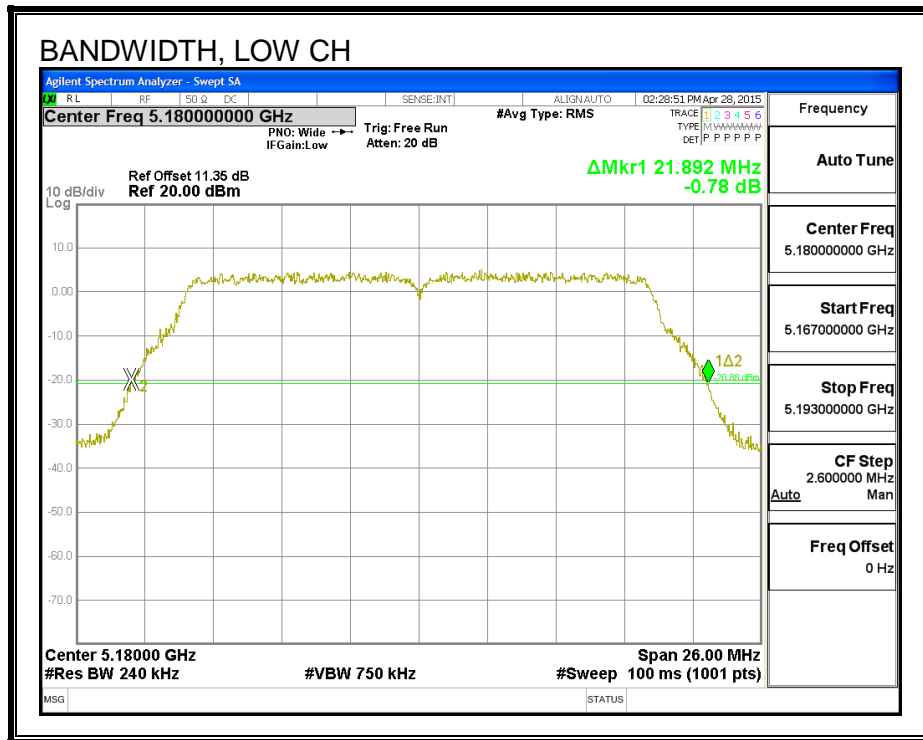
##### LIMITS

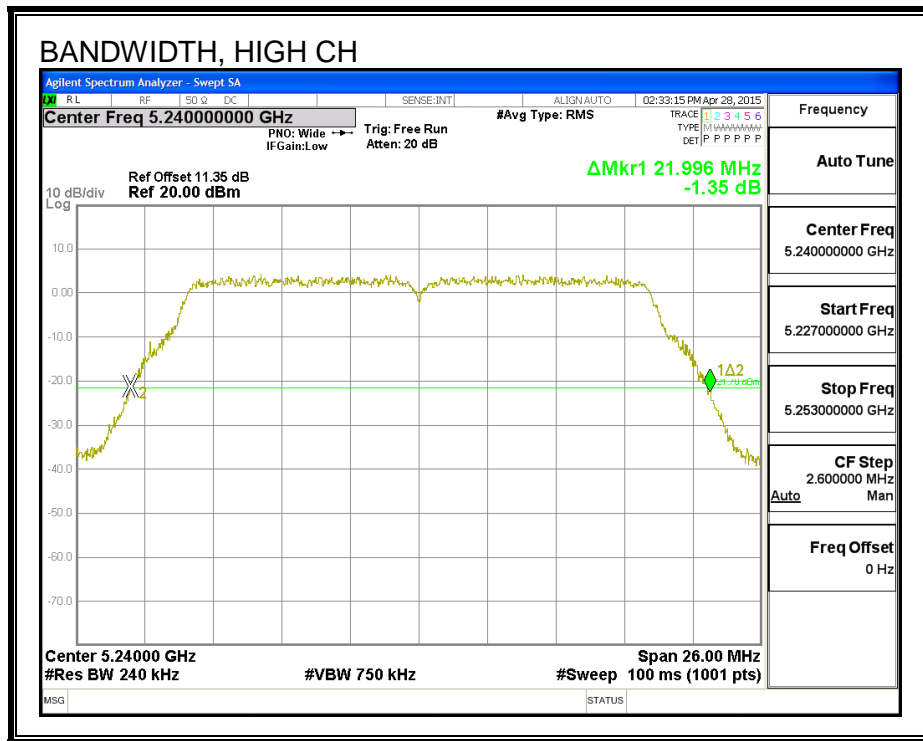
None; for reporting purposes only.

##### RESULTS

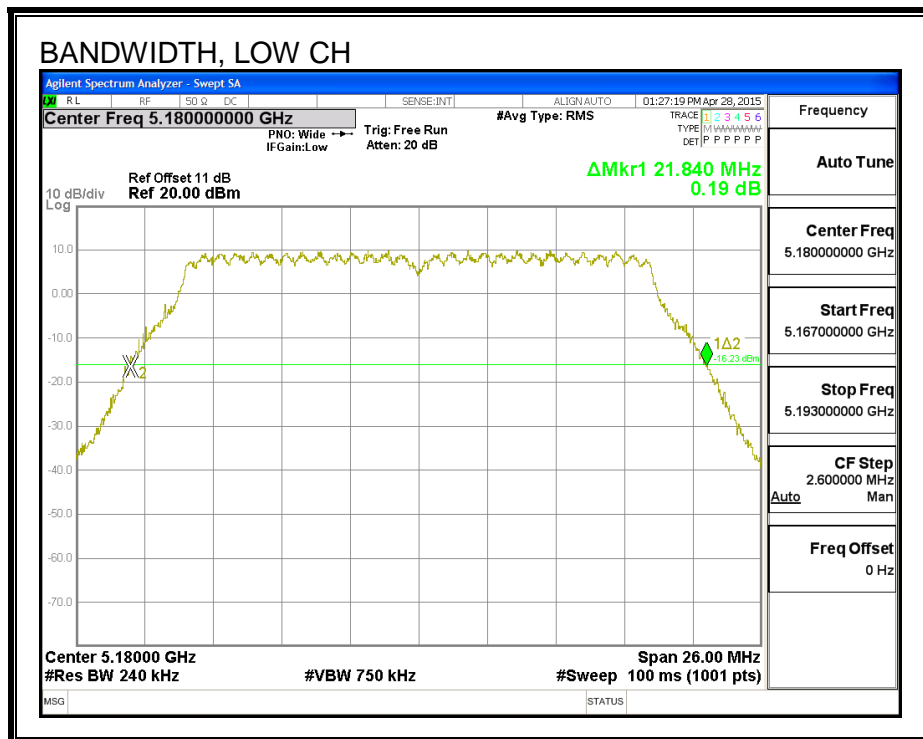
| Channel | Frequency<br>(MHz) | 26 dB BW<br>Chain 0<br>(MHz) | 26 dB BW<br>Chain 1<br>(MHz) |
|---------|--------------------|------------------------------|------------------------------|
| Low     | 5180               | 21.89                        | 21.84                        |
| Mid     | 5200               | 22.00                        | 21.92                        |
| High    | 5240               | 22.00                        | 21.84                        |

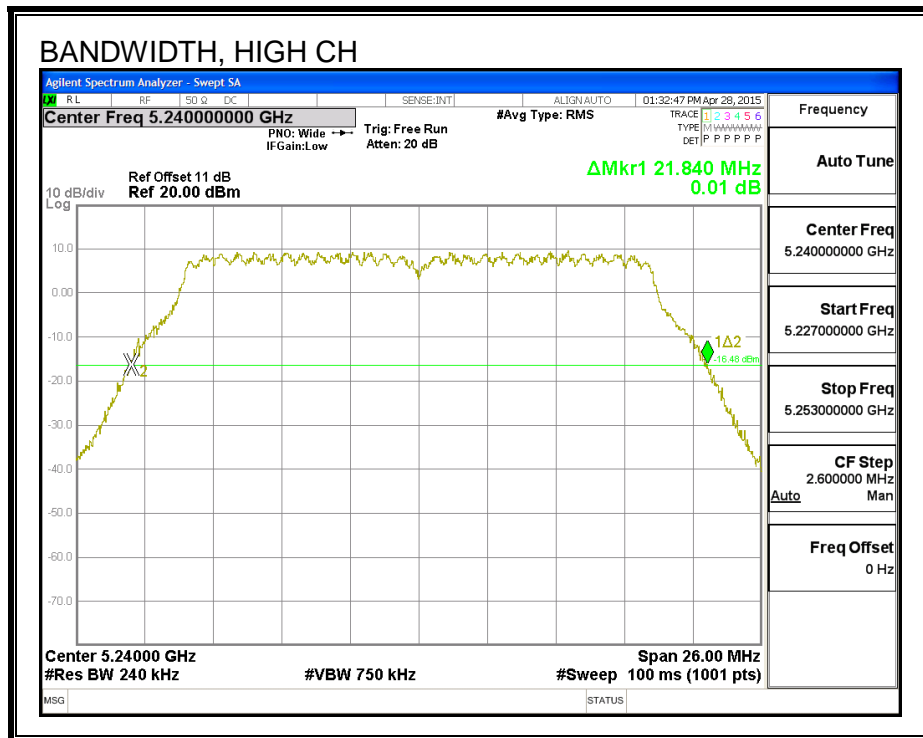
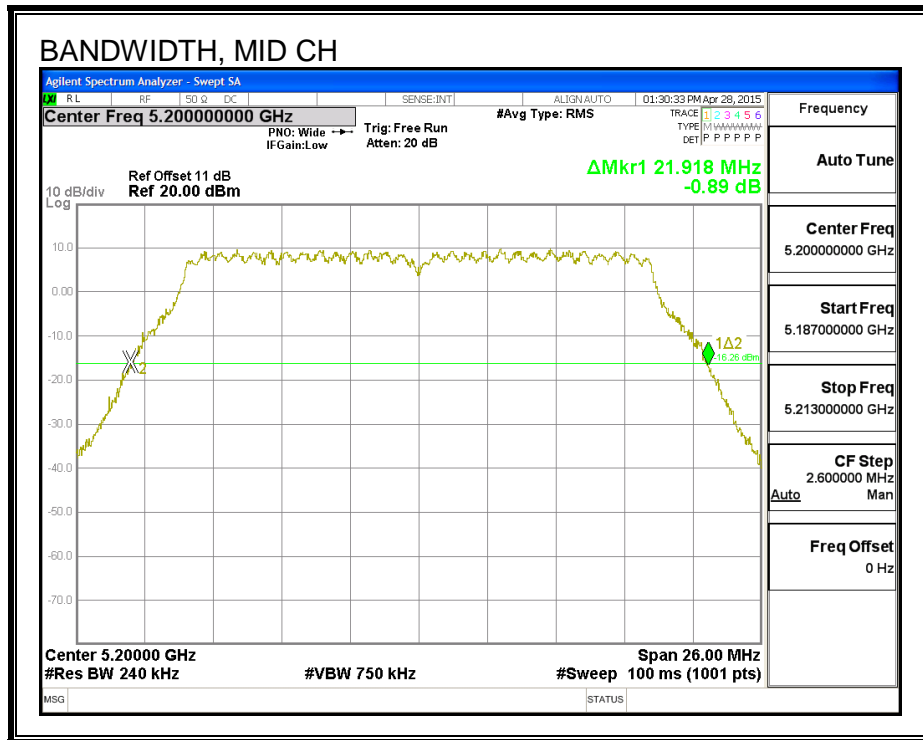
**26 DB BANDWIDTH, CHAIN 0**





**26 DB BANDWIDTH, CHAIN 1**





### 8.3.2. 99% BANDWIDTH

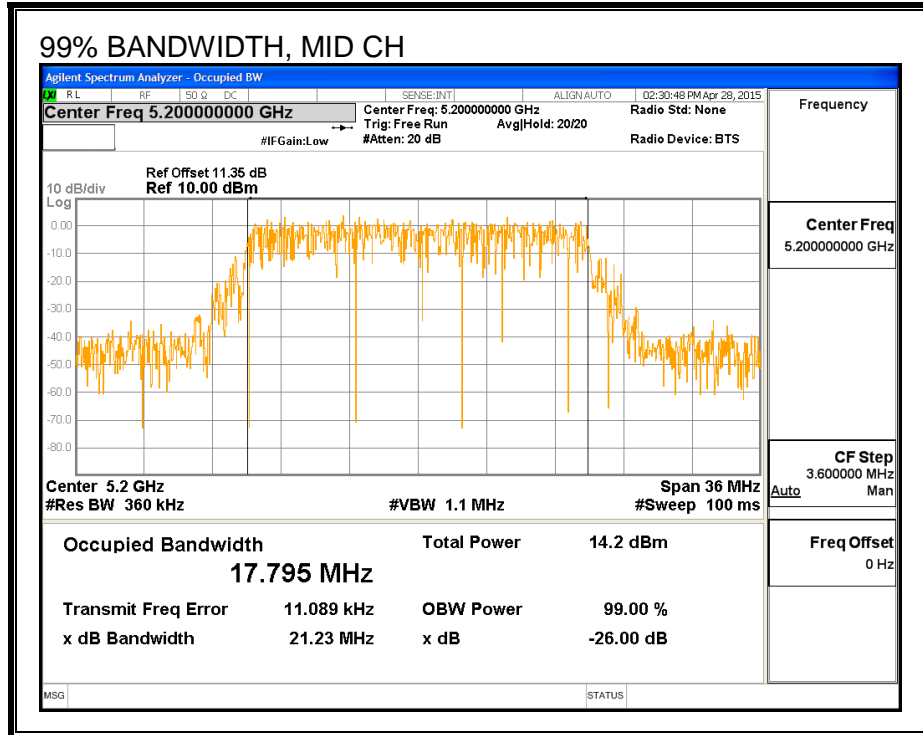
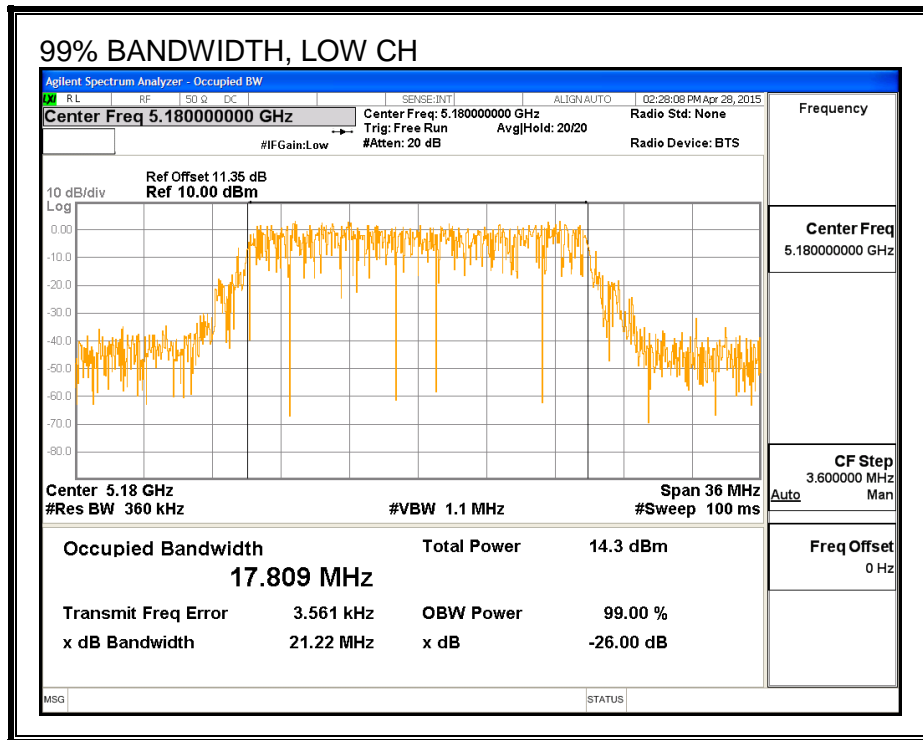
#### LIMITS

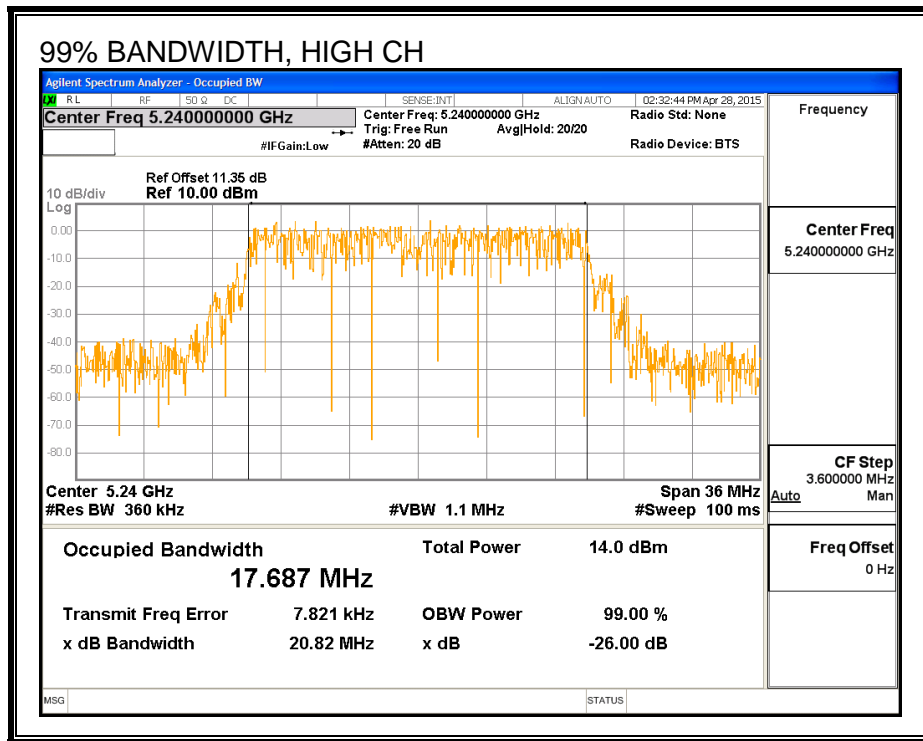
None; for reporting purposes only.

#### RESULTS

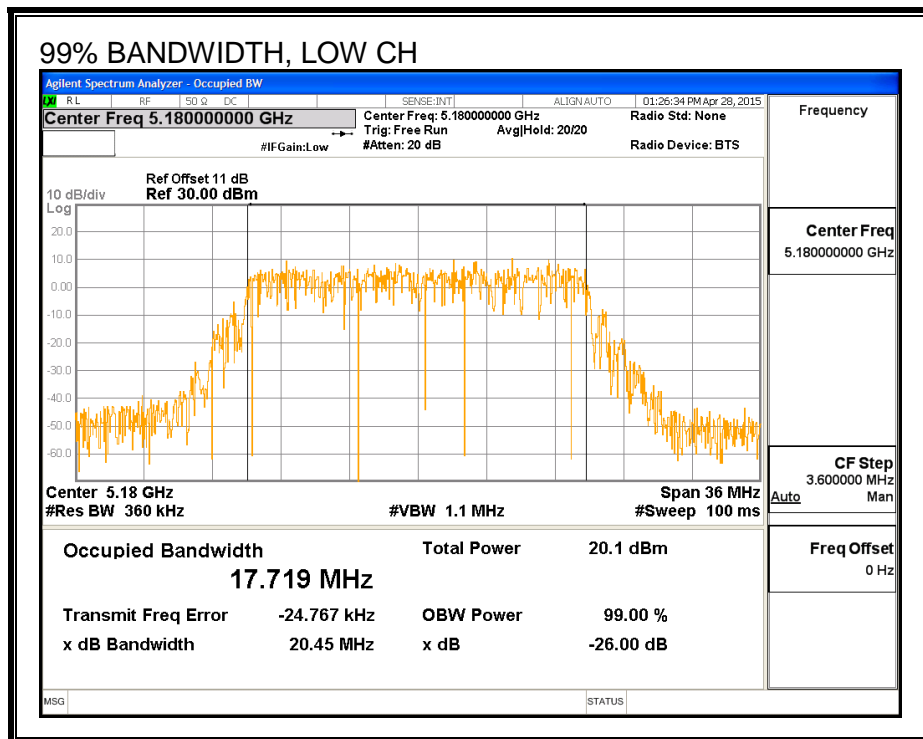
| Channel | Frequency<br>(MHz) | 99% BW<br>Chain 0<br>(MHz) | 99% BW<br>Chain 1<br>(MHz) |
|---------|--------------------|----------------------------|----------------------------|
| Low     | 5180               | 17.809                     | 17.719                     |
| Mid     | 5200               | 17.795                     | 17.830                     |
| High    | 5240               | 17.687                     | 17.963                     |

**99% BANDWIDTH, CHAIN 0**

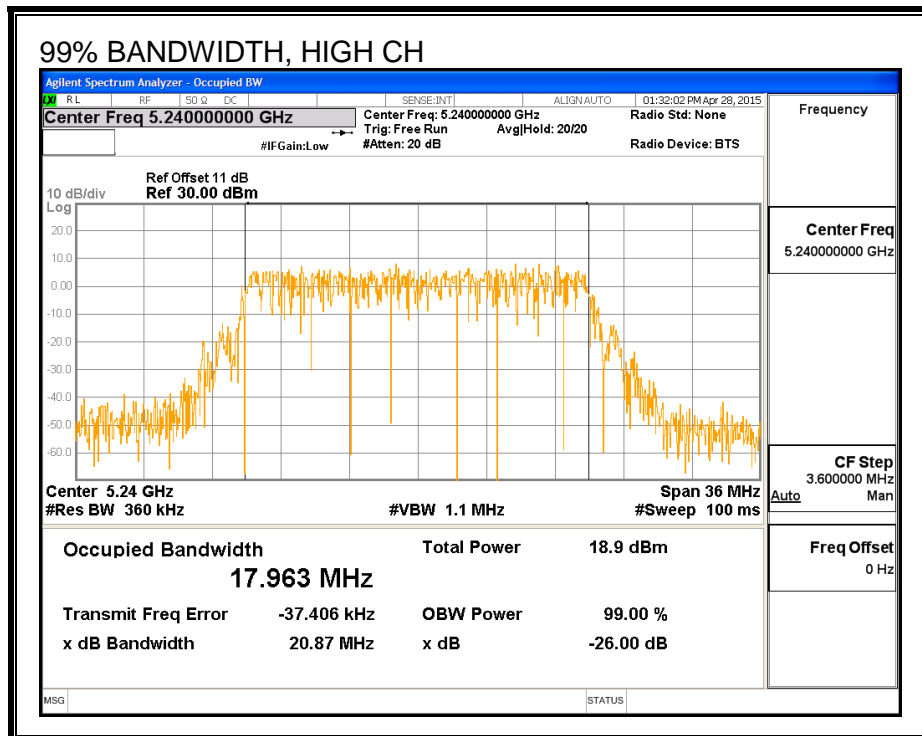
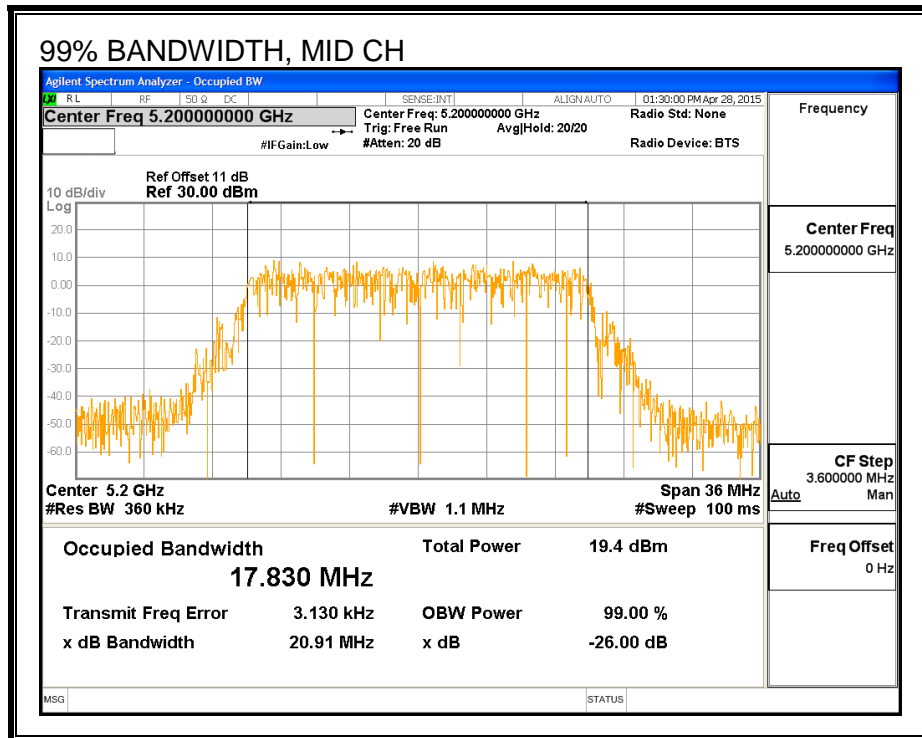




**99% BANDWIDTH, CHAIN 1**







### 8.3.3. AVERAGE POWER

#### LIMITS

None; for reporting purposes only.

#### RESULTS

| Channel | Frequency<br>(MHz) | Chain 0<br>Power<br>(dBm) | Chain 1<br>Power<br>(dBm) | Total<br>Power<br>(dBm) |
|---------|--------------------|---------------------------|---------------------------|-------------------------|
| Low     | 5180               | 16.00                     | 15.98                     | 19.00                   |
| Mid     | 5200               | 16.96                     | 16.91                     | 19.95                   |
| High    | 5240               | 16.95                     | 16.90                     | 19.94                   |

### 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.

**DIRECTIONAL ANTENNA GAIN**

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

| <b>Chain 0<br/>Antenna<br/>Gain<br/>(dBi)</b> | <b>Chain 1<br/>Antenna<br/>Gain<br/>(dBi)</b> | <b>Uncorrelated Chains<br/>Directional<br/>Gain<br/>(dBi)</b> |
|---|---|---|
| -4.18   | -1.54   | -2.66   |

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

| <b>Chain 0<br/>Antenna<br/>Gain<br/>(dBi)</b> | <b>Chain 1<br/>Antenna<br/>Gain<br/>(dBi)</b> | <b>Correlated Chains<br/>Directional<br/>Gain<br/>(dBi)</b> |
|---|---|---|
| -4.18   | -1.54   | 0.25  |

**RESULTS**

**Antenna Gain and Limits**

| Channel | Frequency<br>(MHz) | Directional<br>Gain<br>for Power<br>(dBi) | Directional<br>Gain<br>for PSD<br>(dBi) | Power<br>Limit<br>(dBm) | PSD<br>Limit<br>(dBm) |
|---------|--------------------|---|---|-------------------------|-----------------------|
| Low     | 5180               | -2.66                                     | 0.25                                    | 24.00                   | 11.00                 |
| Mid     | 5200               | -2.66                                     | 0.25                                    | 24.00                   | 11.00                 |
| High    | 5240               | -2.66                                     | 0.25                                    | 24.00                   | 11.00                 |

|                           |      |   |
|---------------------------|------|---|
| <b>Duty Cycle CF (dB)</b> | 0.00 | <b>Included in Calculations of Corr'd Power &amp; PSD</b> |
|---------------------------|------|---|

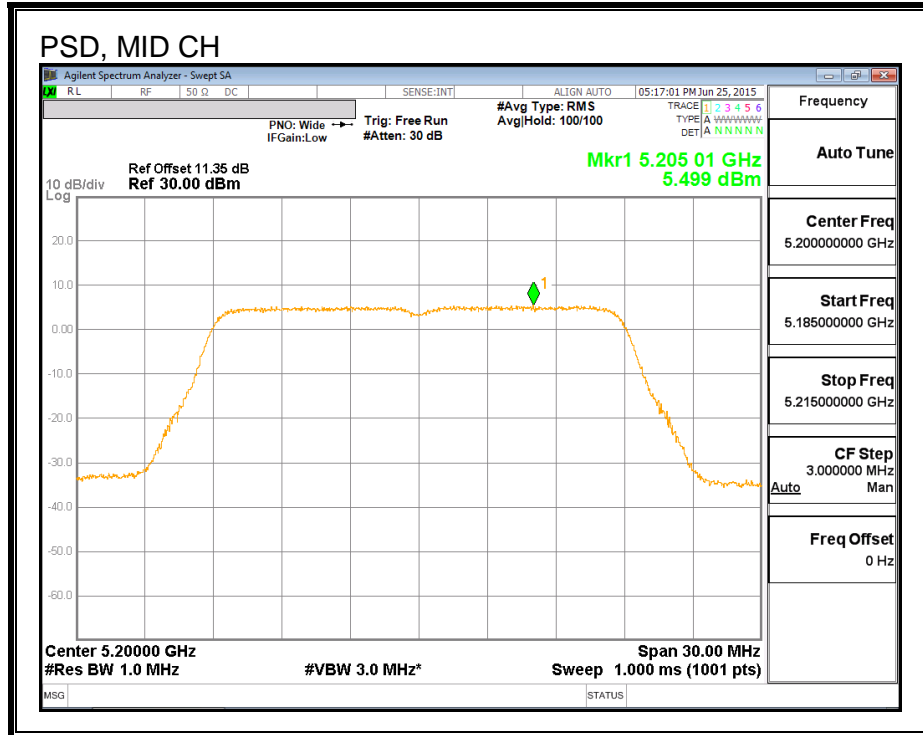
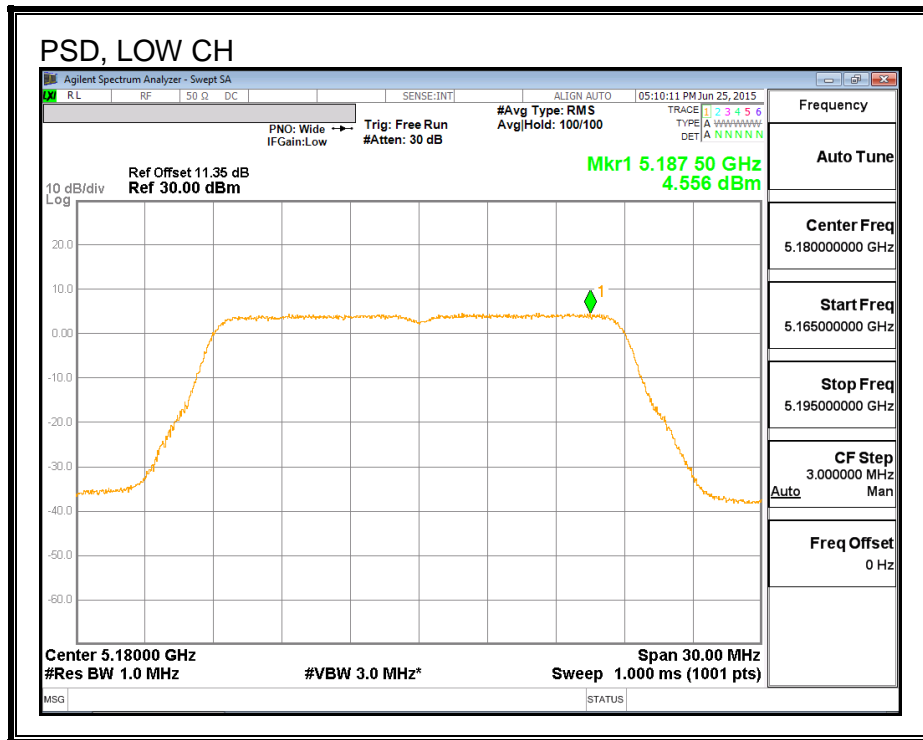
**Output Power Results**

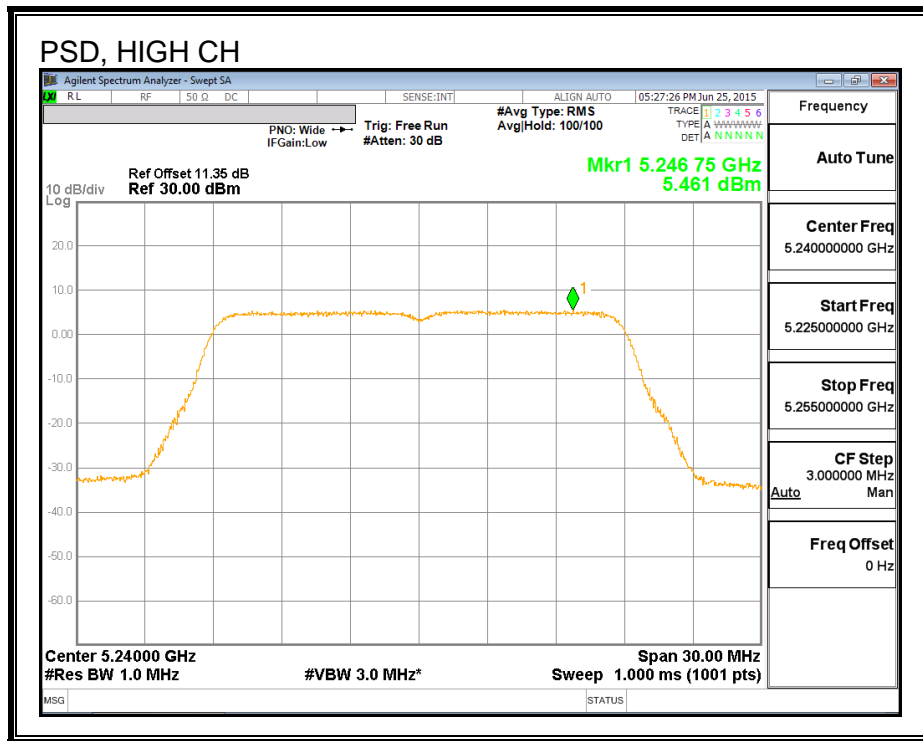
| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>Power<br>(dBm) | Chain 1<br>Meas<br>Power<br>(dBm) | Total<br>Corr'd<br>Power<br>(dBm) | Power<br>Limit<br>(dBm) | Power<br>Margin<br>(dB) |
|---------|--------------------|-----------------------------------|-----------------------------------|-----------------------------------|-------------------------|-------------------------|
| Low     | 5180               | 16.00                             | 15.98                             | 19.00                             | 24.00                   | -5.00                   |
| Mid     | 5200               | 16.96                             | 16.91                             | 19.95                             | 24.00                   | -4.05                   |
| High    | 5240               | 16.95                             | 16.90                             | 19.94                             | 24.00                   | -4.06                   |

**PSD Results**

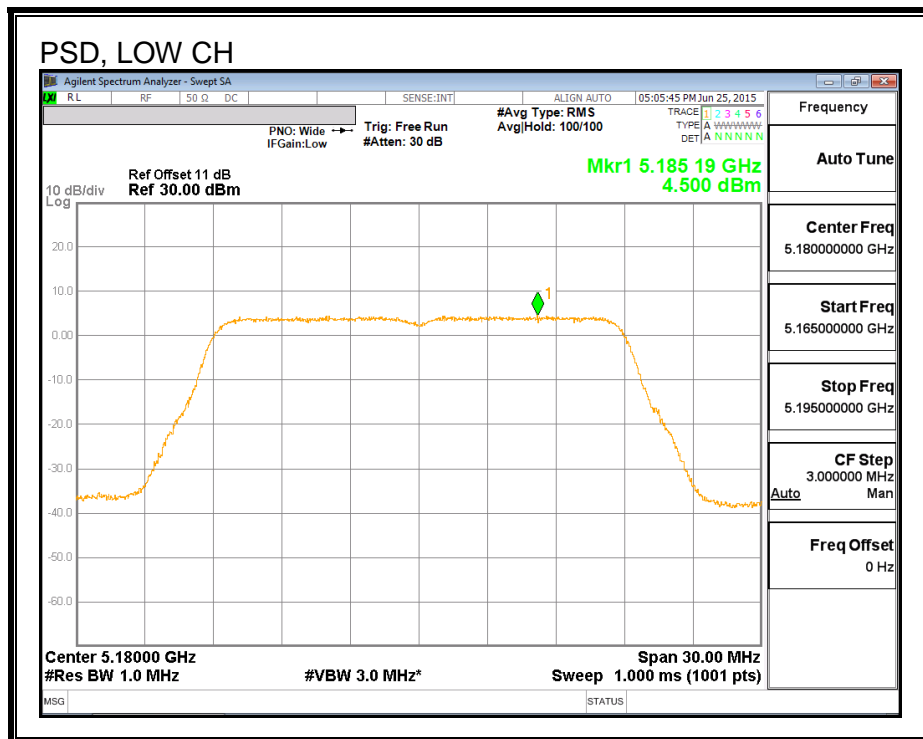
| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>PSD<br>(dBm) | Chain 1<br>Meas<br>PSD<br>(dBm) | Total<br>Corr'd<br>PSD<br>(dBm) | PSD<br>Limit<br>(dBm) | PSD<br>Margin<br>(dB) |
|---------|--------------------|---------------------------------|---------------------------------|---------------------------------|-----------------------|-----------------------|
| Low     | 5180               | 4.56                            | 4.50                            | 7.54                            | 11.00                 | -3.46                 |
| Mid     | 5200               | 5.50                            | 5.49                            | 8.51                            | 11.00                 | -2.49                 |
| High    | 5240               | 5.46                            | 5.36                            | 8.42                            | 11.00                 | -2.58                 |

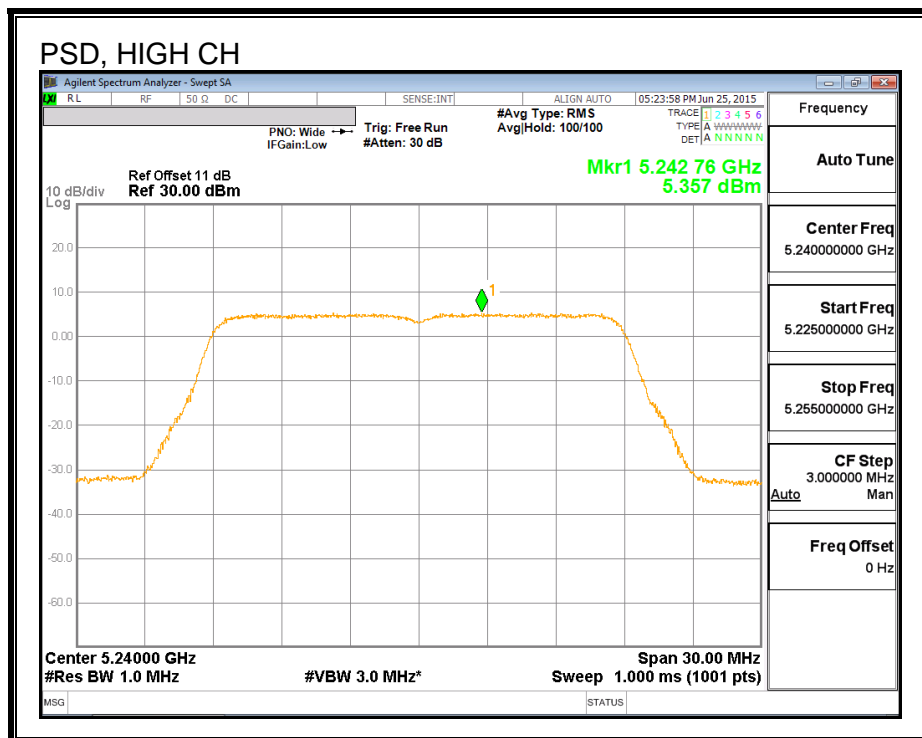
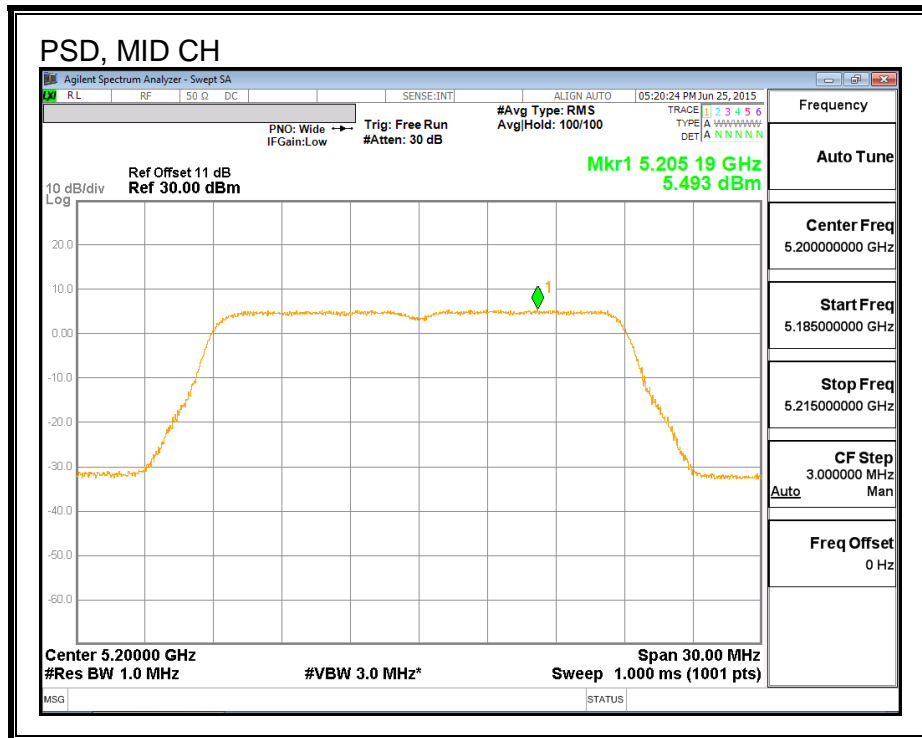
**PSD, CHAIN 0**





**PSD, CHAIN 1**







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

**Note:** Covered by 802.11n HT20 2Tx CDD MODE

## 8.5. 802.11n HT40 CHAIN 0 MODE IN THE 5.2 GHz BAND

### 8.5.1. 26 dB BANDWIDTH

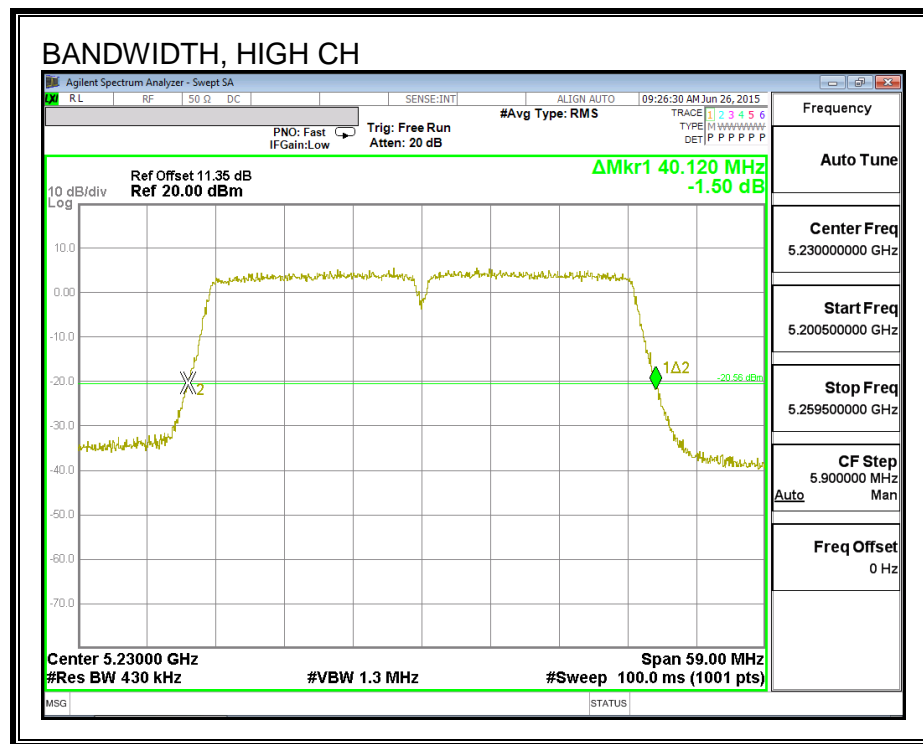
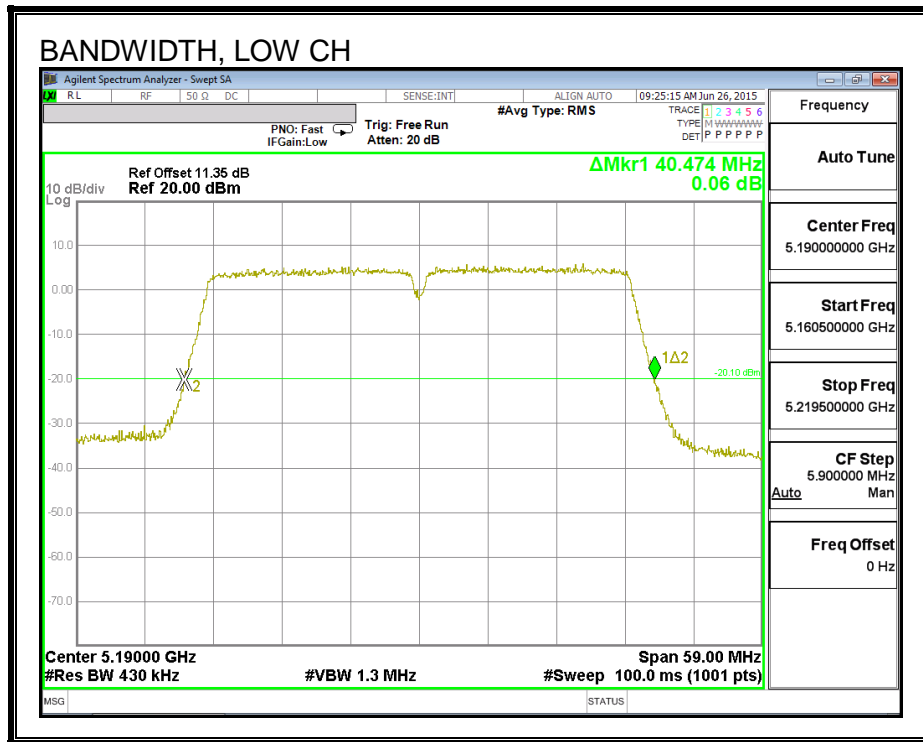
#### LIMITS

None; for reporting purposes only.

#### RESULTS

| Channel | Frequency (MHz) | 26 dB Bandwidth (MHz) |
|---------|-----------------|-----------------------|
| Low     | 5190            | 40.47                 |
| High    | 5230            | 40.12                 |

**26 dB BANDWIDTH**



### 8.5.2. 99% BANDWIDTH

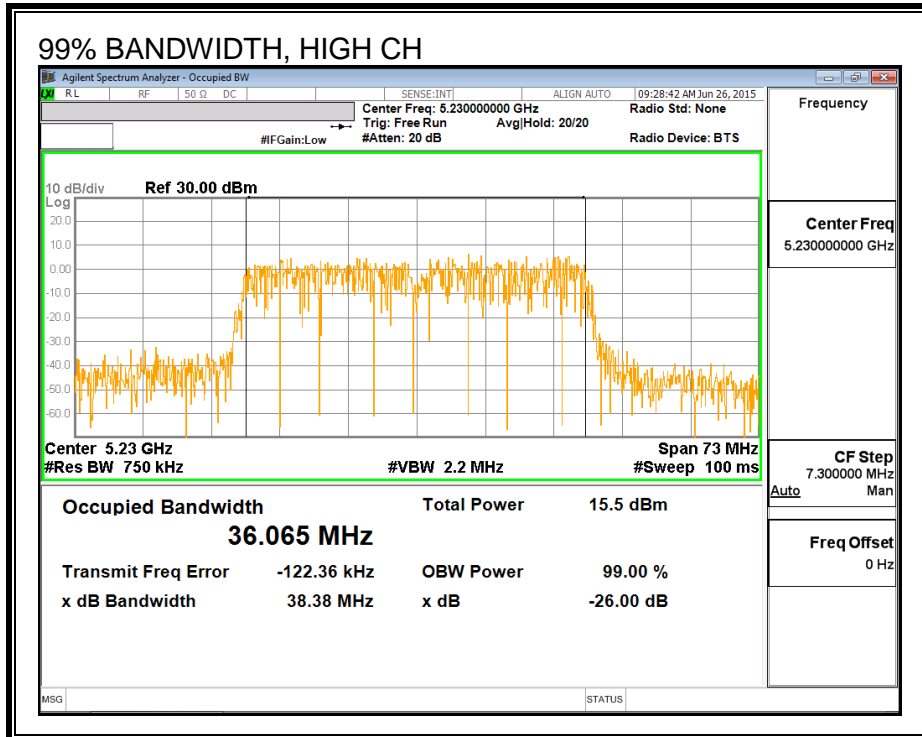
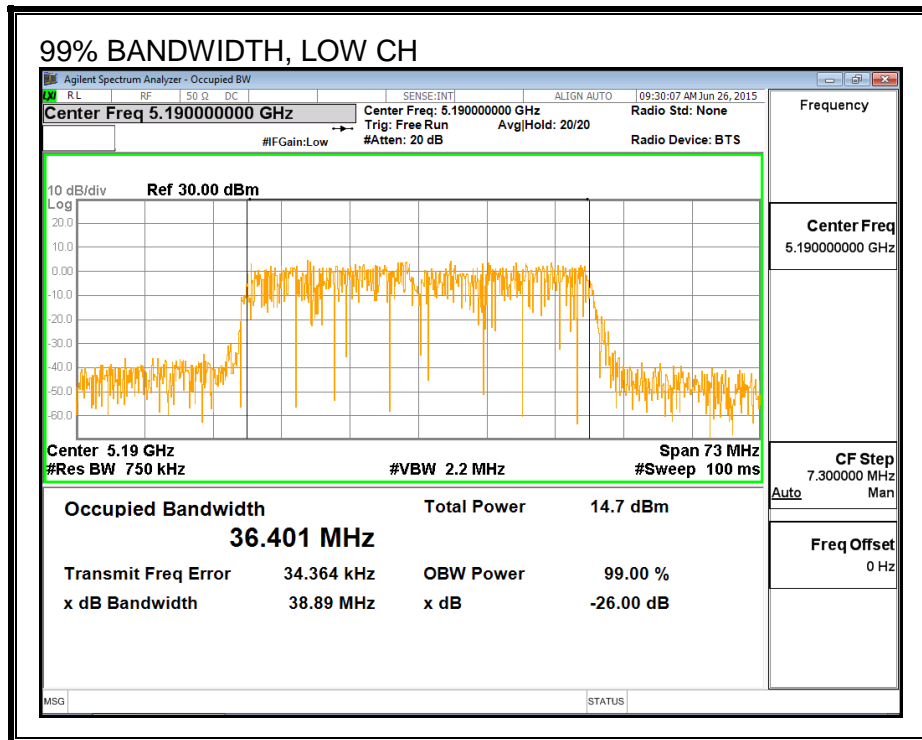
#### LIMITS

None; for reporting purposes only.

#### RESULTS

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|---------------------|
| Low     | 5190            | 36.401              |
| High    | 5230            | 36.065              |

**99% BANDWIDTH**



### 8.5.3. AVERAGE POWER

#### LIMITS

None; for reporting purposes only.

#### RESULTS

| Channel | Frequency (MHz) | Power (dBm) |
|---------|-----------------|-------------|
| Low     | 5190            | 14.37       |
| High    | 5230            | 16.92       |

## 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**

**Antenna Gain and Limits**

| Channel | Frequency<br>(MHz) | Directional<br>Gain<br>for Power<br>(dBi) | Directional<br>Gain<br>for PSD<br>(dBi) | Power<br>Limit<br>(dBm) | PSD<br>Limit<br>(dBm) |
|---------|--------------------|---|---|-------------------------|-----------------------|
| Low     | 5190               | -4.18                                     | -4.18                                   | 24.00                   | 11.00                 |
| High    | 5230               | -4.18                                     | -4.18                                   | 24.00                   | 11.00                 |

|                           |      |   |
|---------------------------|------|---|
| <b>Duty Cycle CF (dB)</b> | 0.00 | <b>Included in Calculations of Corr'd Power &amp; PSD</b> |
|---------------------------|------|---|

**Output Power Results**

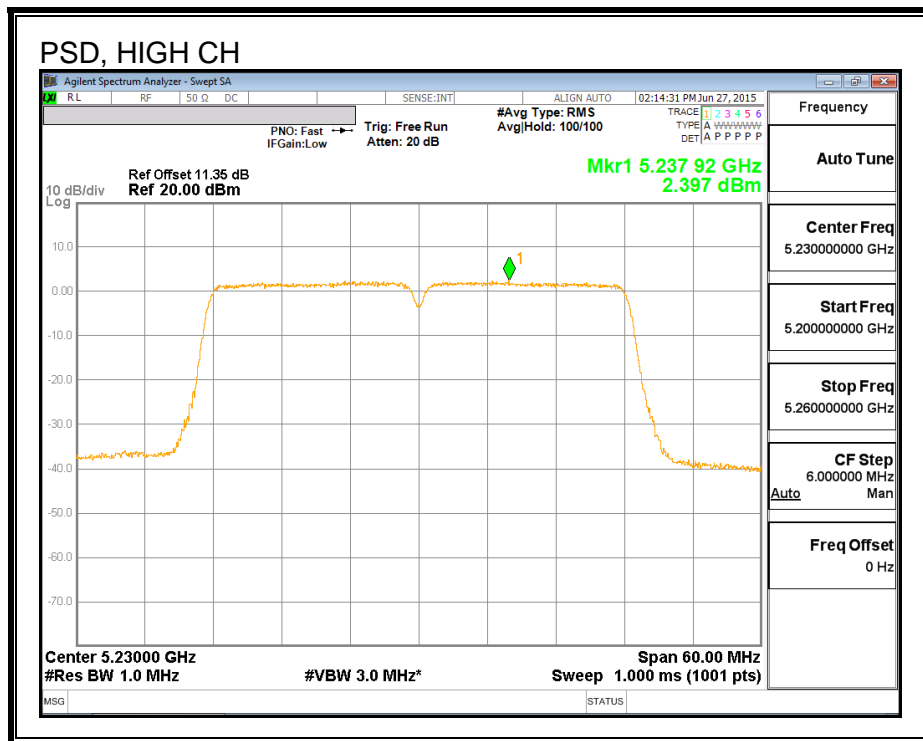
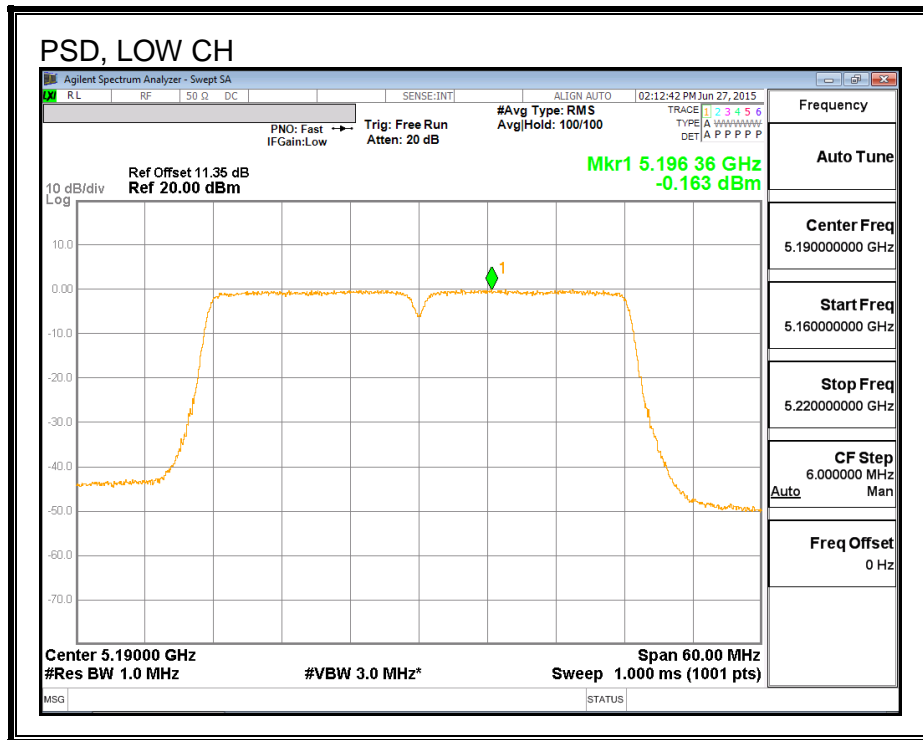
| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>Power<br>(dBm) | Total<br>Corr'd<br>Power<br>(dBm) | Power<br>Limit<br>(dBm) | Power<br>Margin<br>(dB) |
|---------|--------------------|-----------------------------------|-----------------------------------|-------------------------|-------------------------|
| Low     | 5190               | 14.37                             | 14.37                             | 24.00                   | -9.63                   |
| High    | 5230               | 16.92                             | 16.92                             | 24.00                   | -7.08                   |

**PSD Results**

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>PSD<br>(dBm) | Total<br>Corr'd<br>PSD<br>(dBm) | PSD<br>Limit<br>(dBm) | PSD<br>Margin<br>(dB) |
|---------|--------------------|---------------------------------|---------------------------------|-----------------------|-----------------------|
| Low     | 5190               | -0.16                           | -0.16                           | 11.00                 | -11.16                |
| High    | 5230               | 2.40                            | 2.40                            | 11.00                 | -8.60                 |



**PSD**



## 8.6. 802.11n HT40 CHAIN 1 MODE IN THE 5.2 GHz BAND

### 8.6.1. 26 dB BANDWIDTH

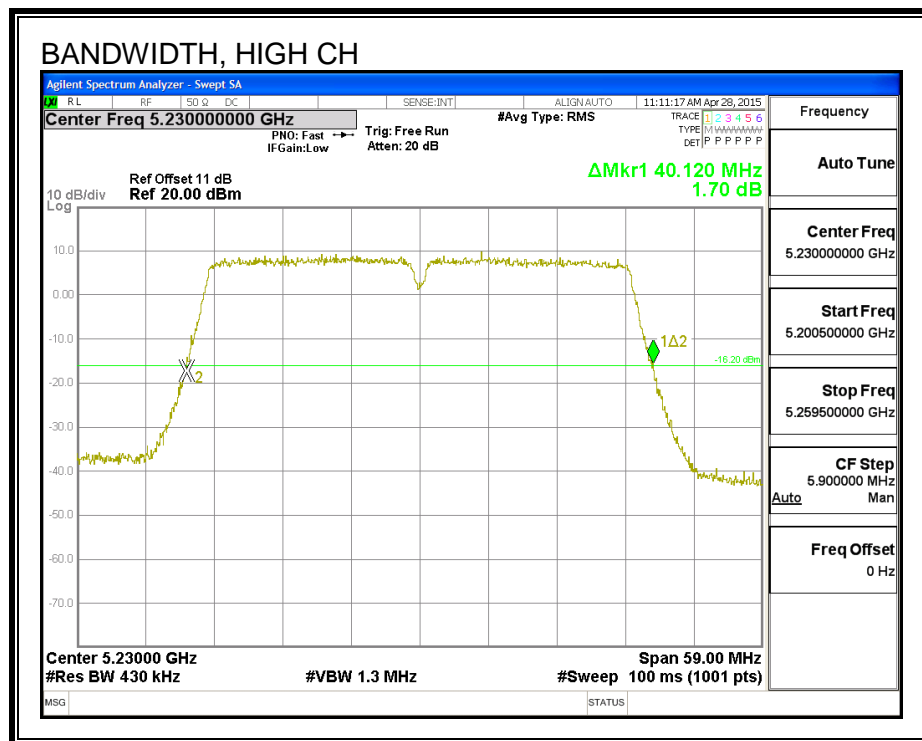
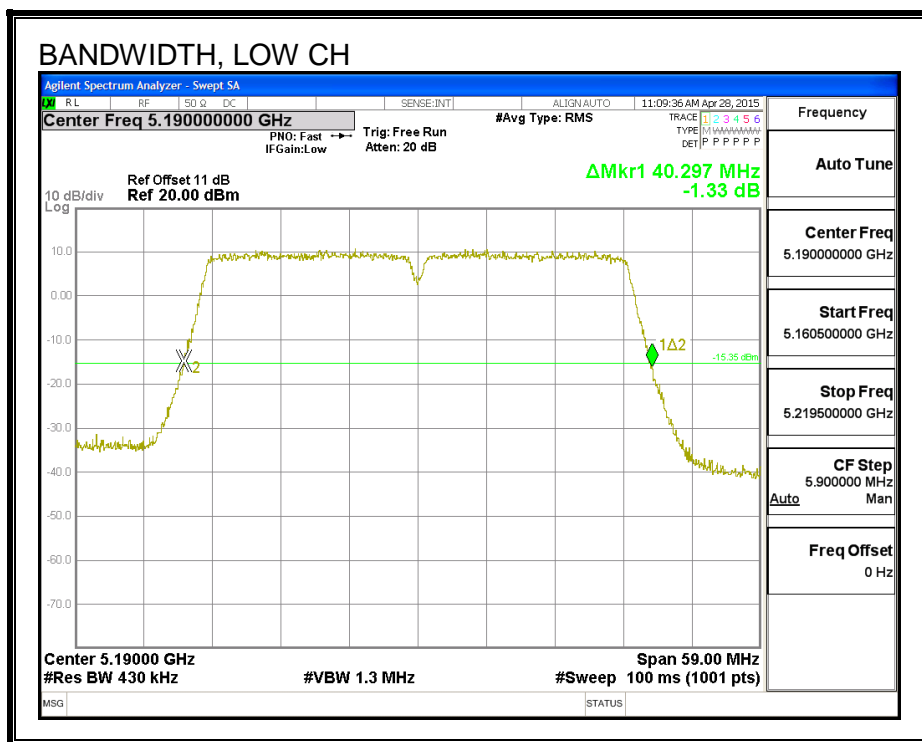
#### LIMITS

None; for reporting purposes only.

#### RESULTS

| Channel | Frequency (MHz) | 26 dB Bandwidth (MHz) |
|---------|-----------------|-----------------------|
| Low     | 5190            | 40.30                 |
| High    | 5230            | 40.12                 |

**26 dB BANDWIDTH**



### 8.6.2. 99% BANDWIDTH

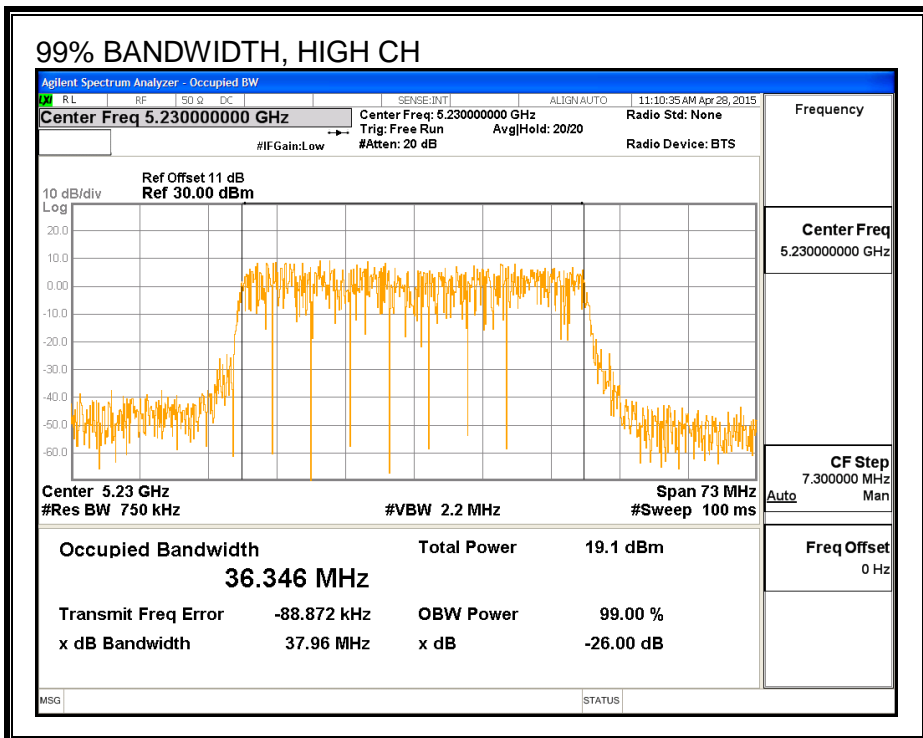
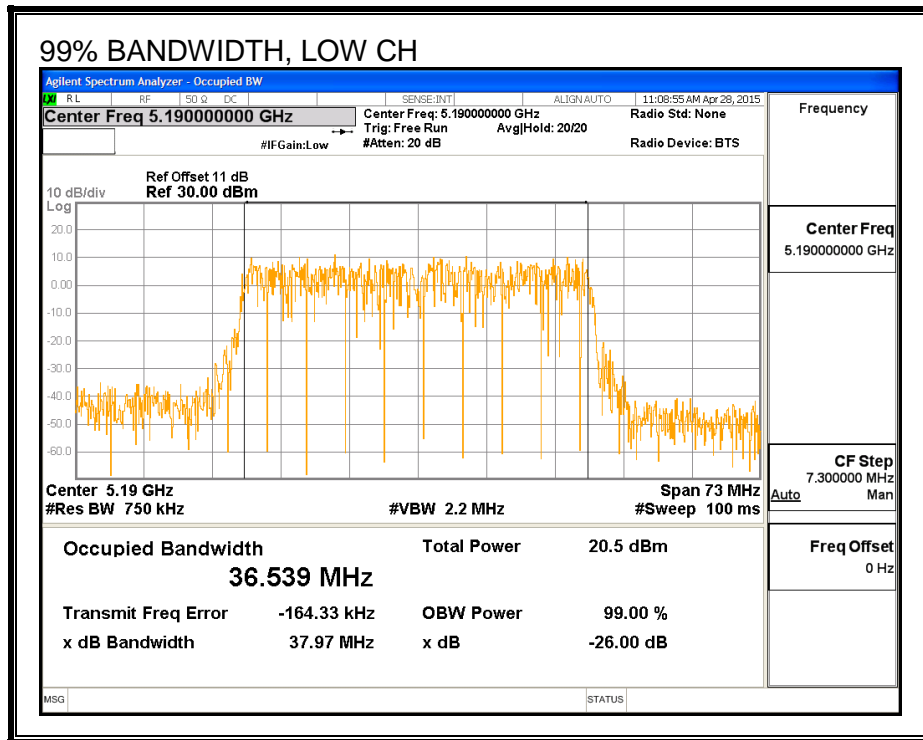
#### LIMITS

None; for reporting purposes only.

#### RESULTS

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|---------------------|
| Low     | 5190            | 36.539              |
| High    | 5230            | 36.346              |

**99% BANDWIDTH**



### 8.6.3. AVERAGE POWER

#### LIMITS

None; for reporting purposes only.

#### RESULTS

| Channel | Frequency (MHz) | Power (dBm) |
|---------|-----------------|-------------|
| Low     | 5190            | 14.45       |
| High    | 5230            | 16.75       |

## 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**

**Antenna Gain and Limits**

| Channel | Frequency<br>(MHz) | Directional<br>Gain<br>for Power<br>(dBi) | Directional<br>Gain<br>for PSD<br>(dBi) | Power<br>Limit<br>(dBm) | PSD<br>Limit<br>(dBm) |
|---------|--------------------|---|---|-------------------------|-----------------------|
| Low     | 5190               | -1.54                                     | -1.54                                   | 24.00                   | 11.00                 |
| High    | 5230               | -1.54                                     | -1.54                                   | 24.00                   | 11.00                 |

|                           |      |   |
|---------------------------|------|---|
| <b>Duty Cycle CF (dB)</b> | 0.00 | <b>Included in Calculations of Corr'd Power &amp; PSD</b> |
|---------------------------|------|---|

**Output Power Results**

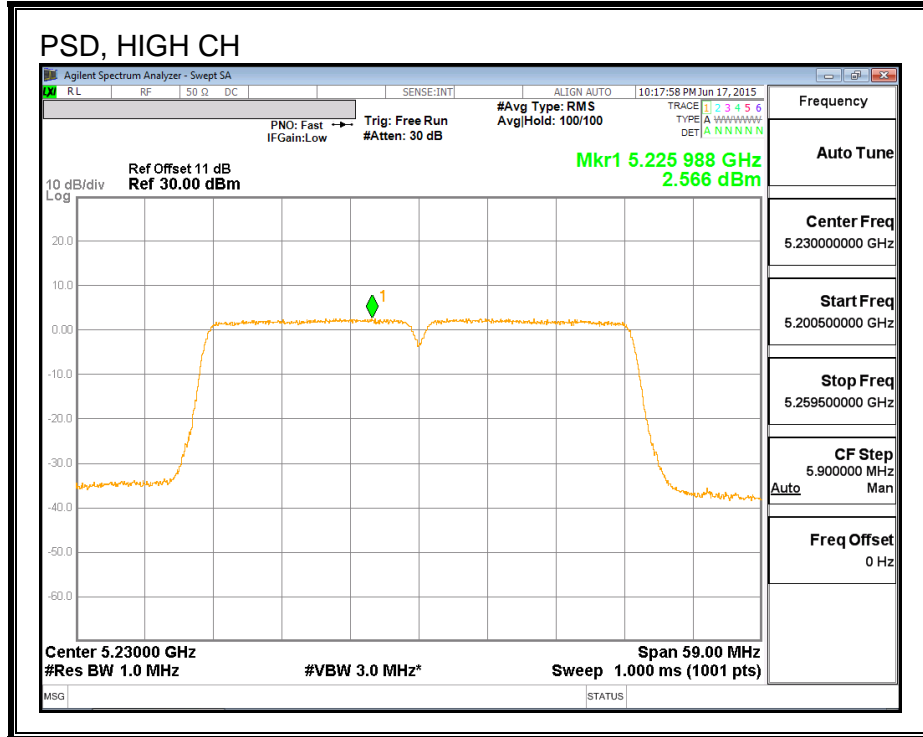
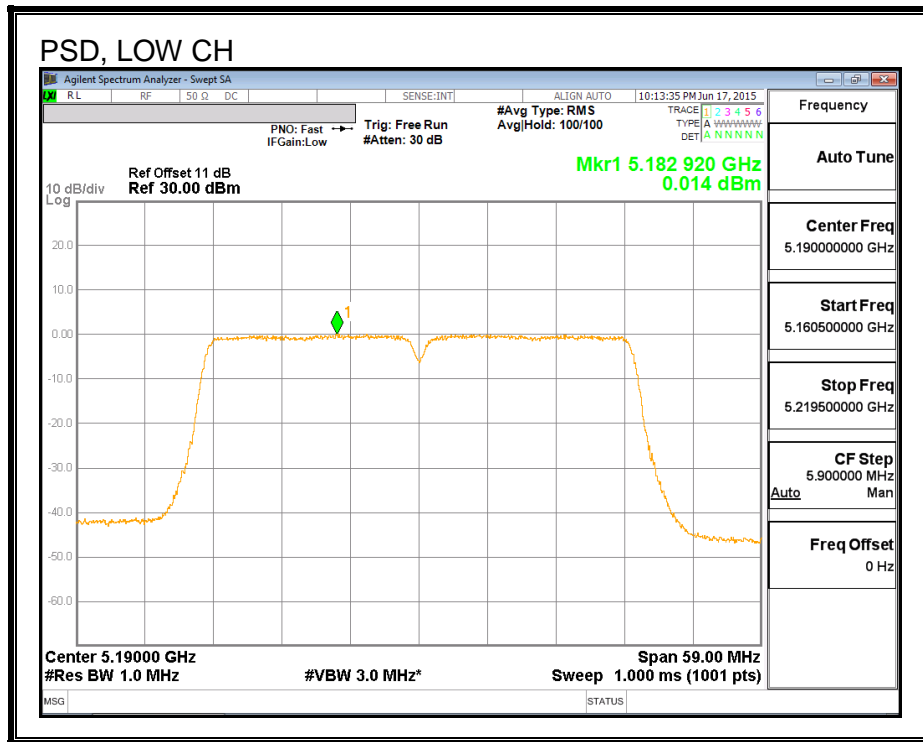
| Channel | Frequency<br>(MHz) | Chain 1<br>Meas<br>Power<br>(dBm) | Total<br>Corr'd<br>Power<br>(dBm) | Power<br>Limit<br>(dBm) | Power<br>Margin<br>(dB) |
|---------|--------------------|-----------------------------------|-----------------------------------|-------------------------|-------------------------|
| Low     | 5190               | 14.45                             | 14.45                             | 24.00                   | -9.55                   |
| High    | 5230               | 16.75                             | 16.75                             | 24.00                   | -7.25                   |

**PSD Results**

| Channel | Frequency<br>(MHz) | Chain 1<br>Meas<br>PSD<br>(dBm) | Total<br>Corr'd<br>PSD<br>(dBm) | PSD<br>Limit<br>(dBm) | PSD<br>Margin<br>(dB) |
|---------|--------------------|---------------------------------|---------------------------------|-----------------------|-----------------------|
| Low     | 5190               | 0.01                            | 0.01                            | 11.00                 | -10.99                |
| High    | 5230               | 2.57                            | 2.57                            | 11.00                 | -8.43                 |



**PSD**



## 8.7. 802.11n HT40 2Tx CDD MODE IN THE 5.2 GHz BAND

### 8.7.1. 26 dB BANDWIDTH

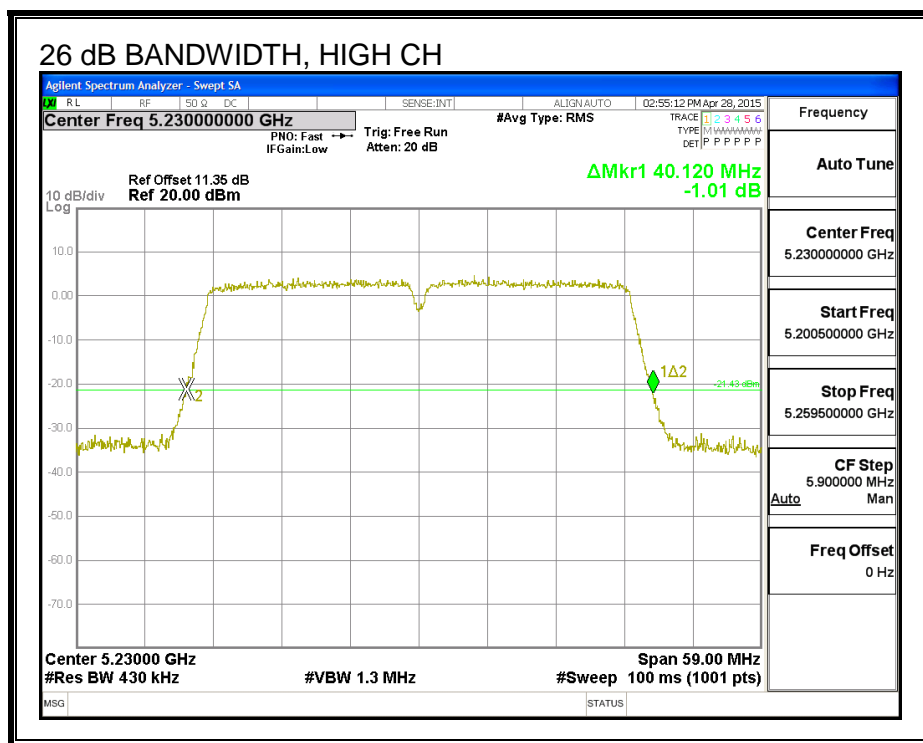
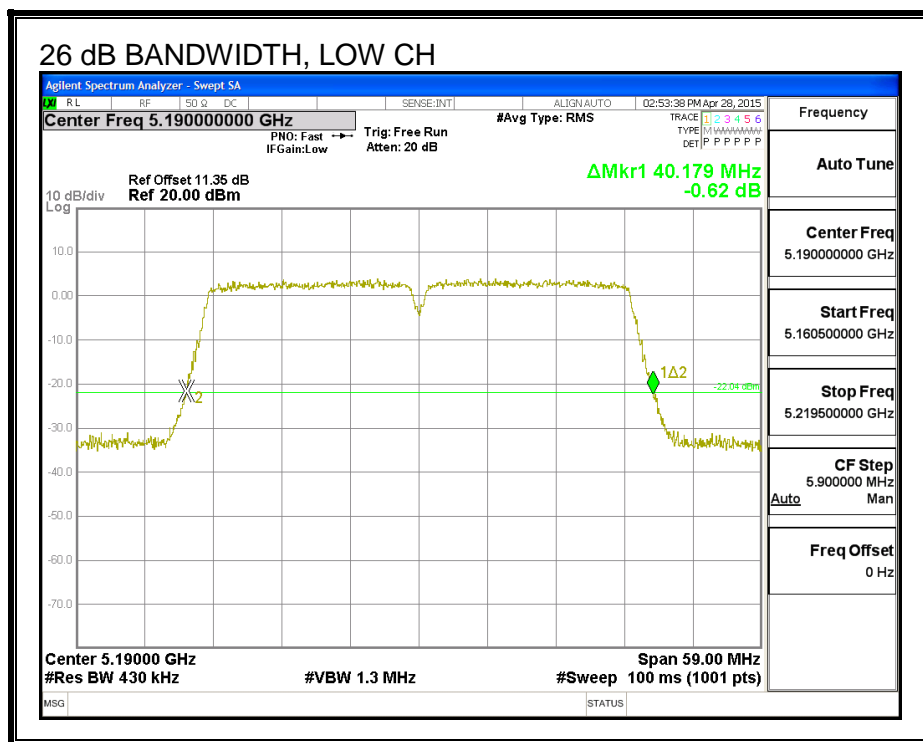
#### LIMITS

None; for reporting purposes only.

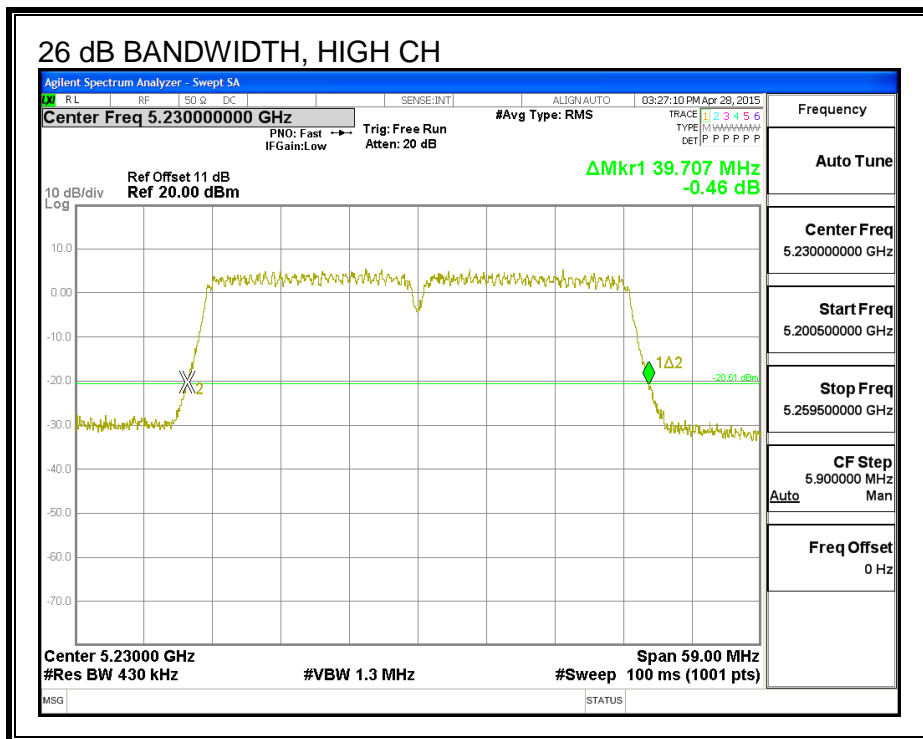
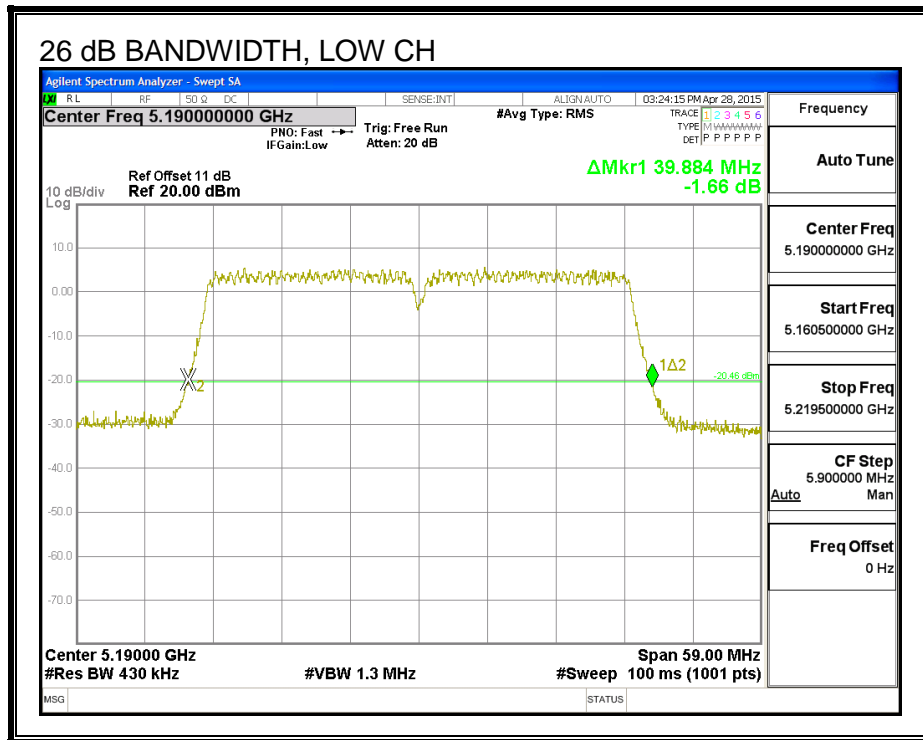
#### RESULTS

| Channel | Frequency<br>(MHz) | 26 dB BW<br>Chain 0<br>(MHz) | 26 dB BW<br>Chain 1<br>(MHz) |
|---------|--------------------|------------------------------|------------------------------|
| Low     | 5190               | 40.18                        | 39.88                        |
| High    | 5230               | 40.12                        | 39.71                        |

**26 DB BANDWIDTH, CHAIN 0**



**26 DB BANDWIDTH, CHAIN 1**



### 8.7.2. 99% BANDWIDTH

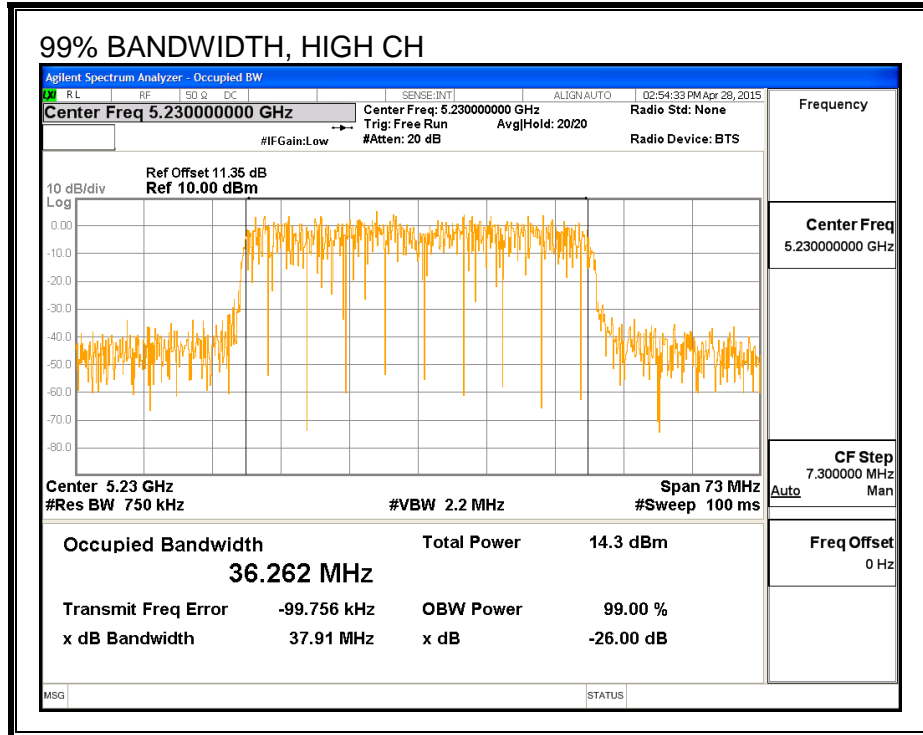
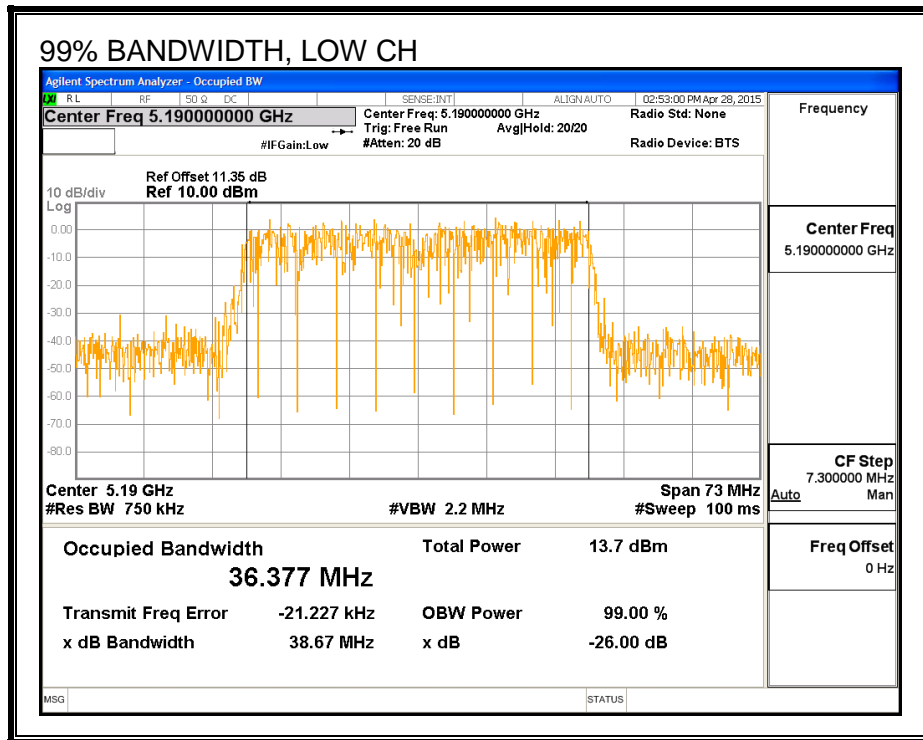
#### LIMITS

None; for reporting purposes only.

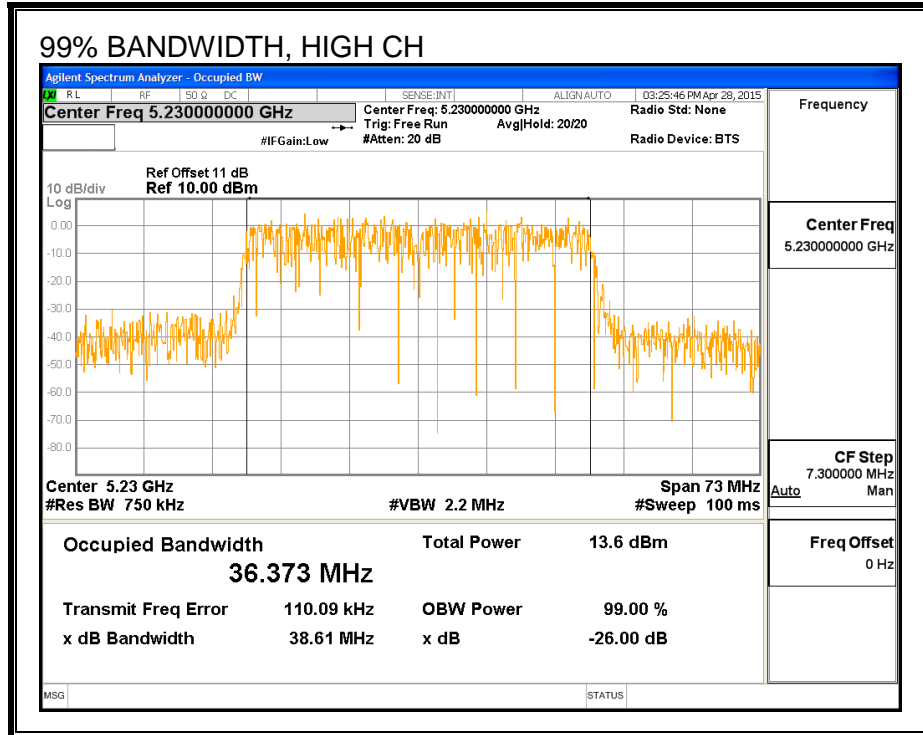
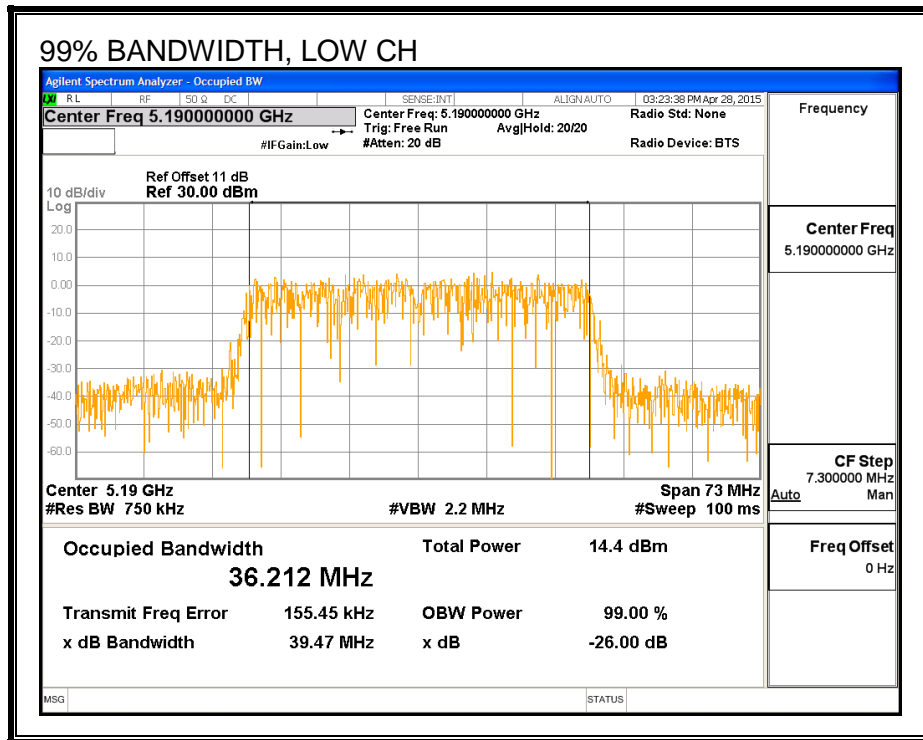
#### RESULTS

| Channel | Frequency<br>(MHz) | 99% BW<br>Chain 0<br>(MHz) | 99% BW<br>Chain 1<br>(MHz) |
|---------|--------------------|----------------------------|----------------------------|
| Low     | 5190               | 36.377                     | 36.212                     |
| High    | 5230               | 36.262                     | 36.373                     |

**99% BANDWIDTH, CHAIN 0**



**99% BANDWIDTH, CHAIN 1**



### 8.7.3. AVERAGE POWER

#### LIMITS

None; for reporting purposes only.

#### RESULTS

##### Average Power Results

| Channel | Frequency<br>(MHz) | Chain 0<br>Power<br>(dBm) | Chain 1<br>Power<br>(dBm) | Total<br>Power<br>(dBm) |
|---------|--------------------|---------------------------|---------------------------|-------------------------|
| Low     | 5190               | 13.75                     | 13.89                     | 16.83                   |
| High    | 5230               | 16.86                     | 16.96                     | 19.92                   |



## 8.7.4. 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**

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

| <b>Chain 0<br/>Antenna<br/>Gain<br/>(dBi)</b> | <b>Chain 1<br/>Antenna<br/>Gain<br/>(dBi)</b> | <b>Uncorrelated Chains<br/>Directional<br/>Gain<br/>(dBi)</b> |
|---|---|---|
| -4.18   | -1.54   | -2.66   |

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

| <b>Chain 0<br/>Antenna<br/>Gain<br/>(dBi)</b> | <b>Chain 1<br/>Antenna<br/>Gain<br/>(dBi)</b> | <b>Correlated Chains<br/>Directional<br/>Gain<br/>(dBi)</b> |
|---|---|---|
| -4.18   | -1.54   | 0.25  |

**RESULTS**

**Antenna Gain and Limits**

| Channel | Frequency<br>(MHz) | Directional<br>Gain<br>for Power<br>(dBi) | Directional<br>Gain<br>for PSD<br>(dBi) | Power<br>Limit<br>(dBm) | PSD<br>Limit<br>(dBm) |
|---------|--------------------|---|---|-------------------------|-----------------------|
| Low     | 5190               | -2.66                                     | 0.25                                    | 24.00                   | 11.00                 |
| High    | 5230               | -2.66                                     | 0.25                                    | 24.00                   | 11.00                 |

|                           |      |   |
|---------------------------|------|---|
| <b>Duty Cycle CF (dB)</b> | 0.00 | <b>Included in Calculations of Corr'd Power &amp; PSD</b> |
|---------------------------|------|---|

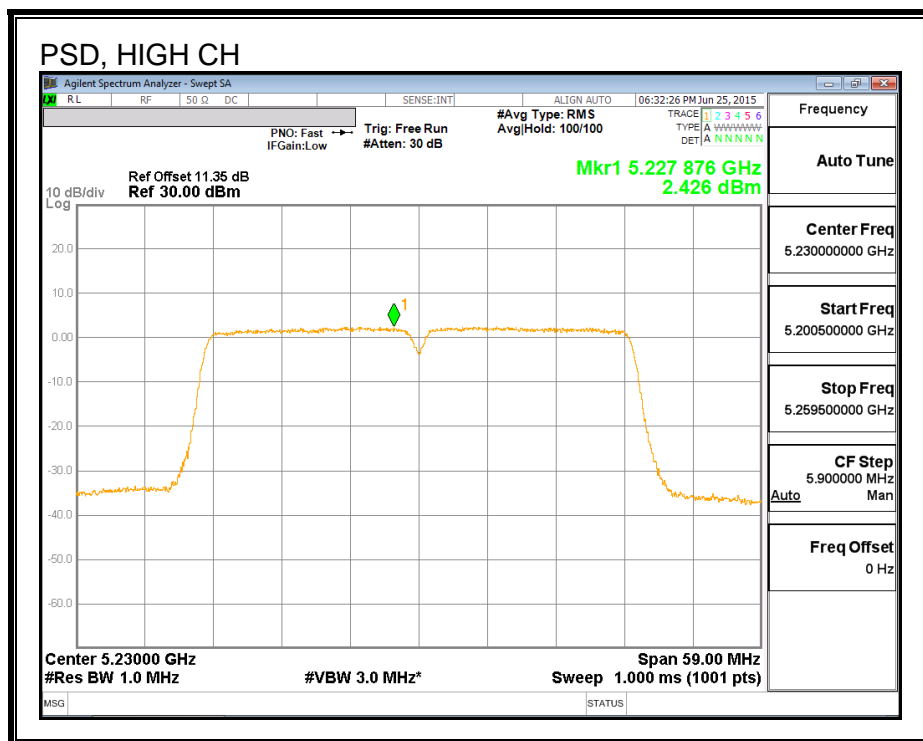
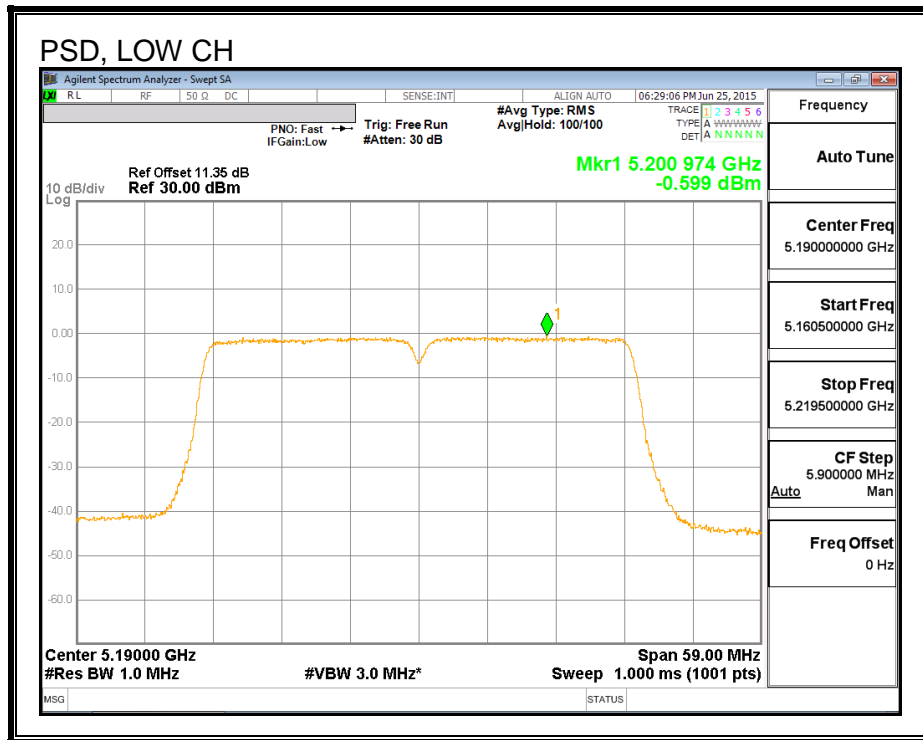
**Output Power Results**

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>Power<br>(dBm) | Chain 1<br>Meas<br>Power<br>(dBm) | Total<br>Corr'd<br>Power<br>(dBm) | Power<br>Limit<br>(dBm) | Power<br>Margin<br>(dB) |
|---------|--------------------|-----------------------------------|-----------------------------------|-----------------------------------|-------------------------|-------------------------|
| Low     | 5190               | 13.75                             | 13.89                             | 16.83                             | 24.00                   | -7.17                   |
| High    | 5230               | 16.86                             | 16.96                             | 19.92                             | 24.00                   | -4.08                   |

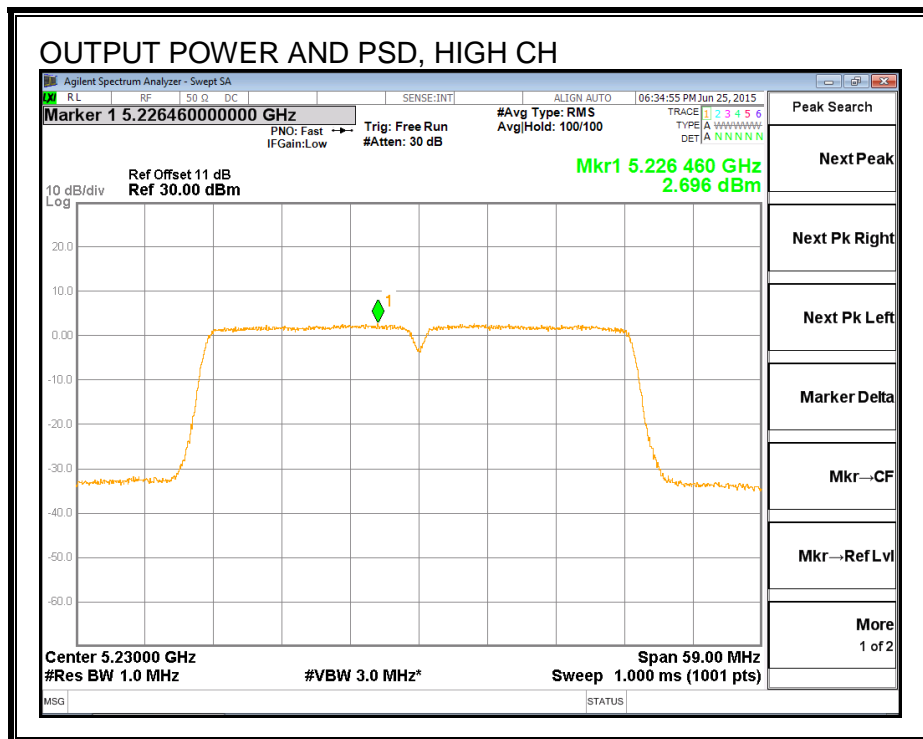
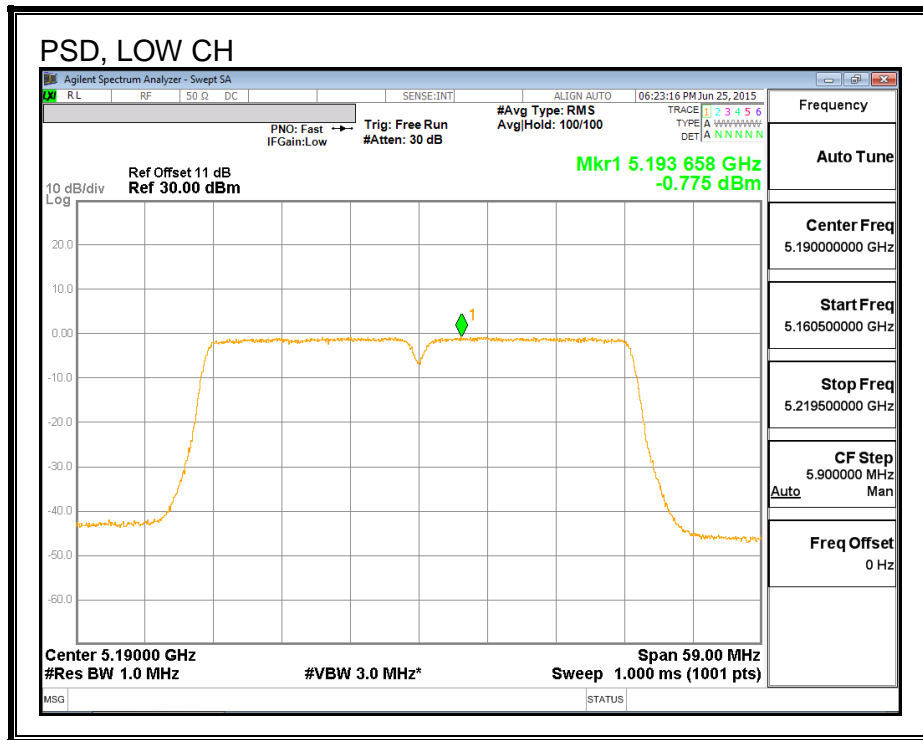
**PSD Results**

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>PSD<br>(dBm) | Chain 1<br>Meas<br>PSD<br>(dBm) | Total<br>Corr'd<br>PSD<br>(dBm) | PSD<br>Limit<br>(dBm) | PSD<br>Margin<br>(dB) |
|---------|--------------------|---------------------------------|---------------------------------|---------------------------------|-----------------------|-----------------------|
| Low     | 5190               | -0.60                           | -0.78                           | 2.32                            | 11.00                 | -8.68                 |
| High    | 5230               | 2.43                            | 2.70                            | 5.57                            | 11.00                 | -5.43                 |

**PSD, CHAIN 0**



**PSD, CHAIN 1**



**8.8. 802.11n HT40 2Tx STBC MODE IN THE 5.2 GHz BAND**

**Note:** Covered by 802.11n HT40 2Tx CDD MODE

## 8.9. 802.11ac HT80 CHAIN 0 MODE IN THE 5.2 GHz BAND

### 8.9.1. 26 dB BANDWIDTH

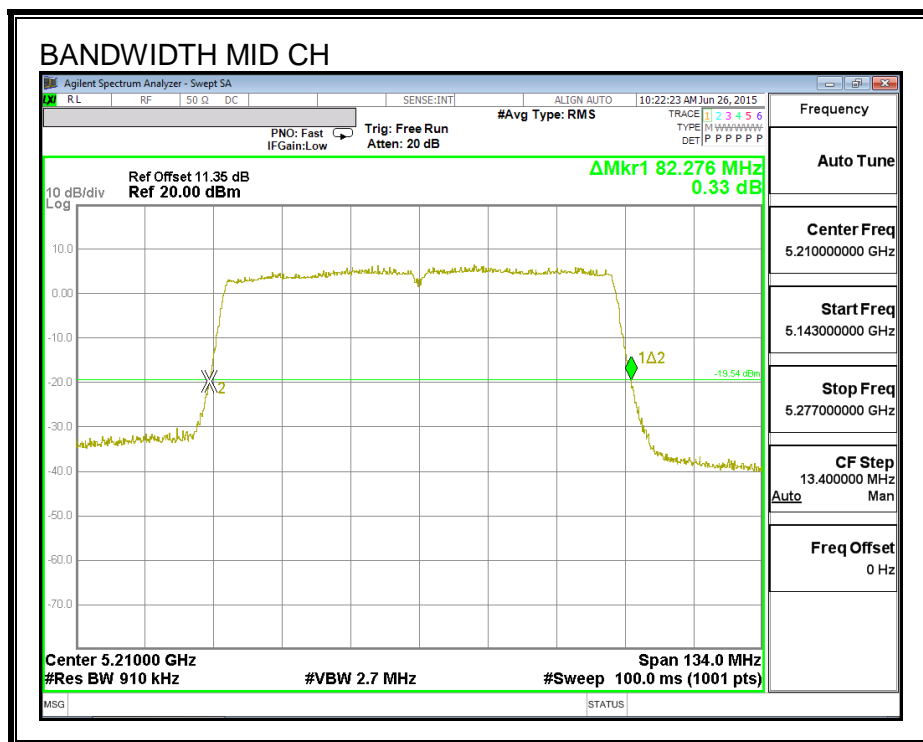
#### LIMITS

None; for reporting purposes only.

#### RESULTS

| Channel | Frequency (MHz) | 26 dB Bandwidth (MHz) |
|---------|-----------------|-----------------------|
| Mid     | 5210            | 82.28                 |

#### 26 dB BANDWIDTH



### 8.9.2. 99% BANDWIDTH

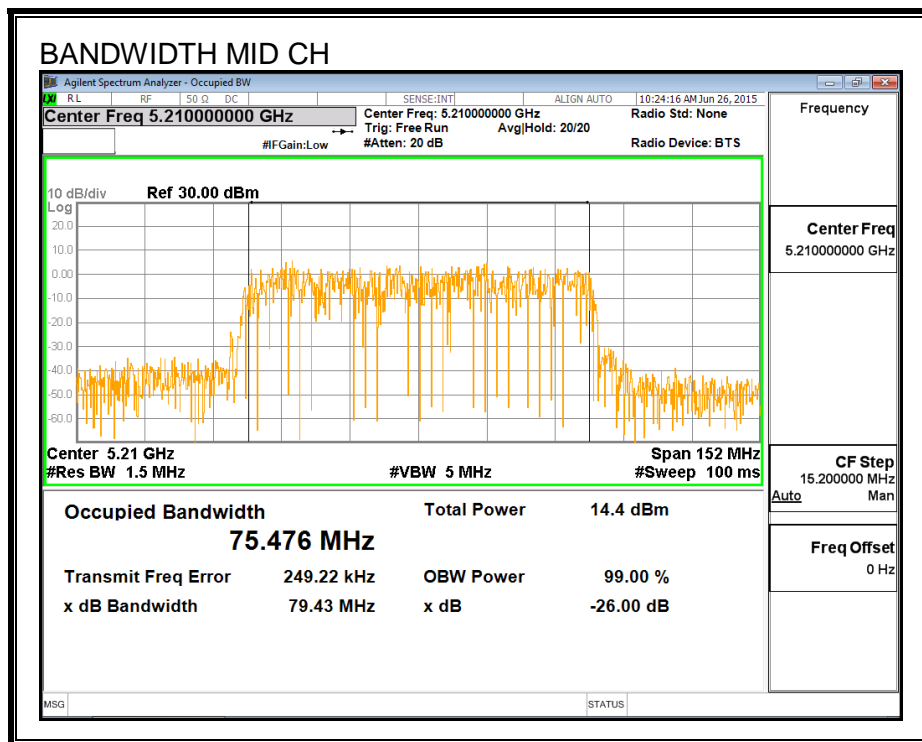
#### LIMITS

None; for reporting purposes only.

#### RESULTS

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|---------------------|
| Mid     | 5210            | 75.476              |

#### 99% BANDWIDTH





### 8.9.3. AVERAGE POWER

#### LIMITS

None; for reporting purposes only.

#### RESULTS

| Channel | Frequency<br>(MHz) | Power<br>(dBm) |
|---------|--------------------|----------------|
| Mid     | 5210               | 12.92          |

## 8.9.4. 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**

**Antenna Gain and Limits**

| Channel | Frequency<br>(MHz) | Directional<br>Gain<br>for Power<br>(dBi) | Directional<br>Gain<br>for PSD<br>(dBi) | Power<br>Limit<br>(dBm) | PSD<br>Limit<br>(dBm) |
|---------|--------------------|---|---|-------------------------|-----------------------|
| Mid     | 5210               | -4.18                                     | -4.18                                   | 24.00                   | 11.00                 |

|                           |      |   |
|---------------------------|------|---|
| <b>Duty Cycle CF (dB)</b> | 0.21 | <b>Included in Calculations of Corr'd Power &amp; PSD</b> |
|---------------------------|------|---|

**Output Power Results**

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>Power<br>(dBm) | Total<br>Corr'd<br>Power<br>(dBm) | Power<br>Limit<br>(dBm) | Power<br>Margin<br>(dB) |
|---------|--------------------|-----------------------------------|-----------------------------------|-------------------------|-------------------------|
| Mid     | 5210               | 12.92                             | 13.13                             | 24.00                   | -10.87                  |

**PSD Results**

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>PSD<br>(dBm) | Total<br>Corr'd<br>PSD<br>(dBm) | PSD<br>Limit<br>(dBm) | PSD<br>Margin<br>(dB) |
|---------|--------------------|---------------------------------|---------------------------------|-----------------------|-----------------------|
| Mid     | 5210               | -4.98                           | -4.77                           | 11.00                 | -15.77                |

**PSD**

