



# **CERTIFICATION TEST REPORT**

**Report Number. :** 11696948-E4V6

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

**Model :** A1864, A1899

**FCC ID :** BCG-E3160A

**EUT Description :** SMARTPHONE

**Test Standard(s) :** FCC 47 CFR PART 15 SUBPART E

**Date Of Issue:**

August 23, 2017

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NVLAP LAB CODE 200065-0

Revision History

| Rev. | Issue Date | Revisions                            | Revised By         |
|------|------------|--------------------------------------|--------------------|
| V1   | 7/14/2017  | Initial Issue                        | Chin Pang          |
| V2   | 7/26/2017  | Address TCB's Questions              | Chin Pang          |
| V3   | 8/2/2017   | Address TCB's Questions              | Francisco Guarnero |
| V4   | 8/2/2017   | Additional TCB's Questions           | Francisco Guarnero |
| V5   | 8/07/2017  | TCB's Questions                      | Francisco Guarnero |
| V6   | 8/21/2017  | 2 <sup>nd</sup> TCB Review Questions | Francisco Guarnero |

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## 1. ATTESTATION OF TEST RESULTS

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

**EUT DESCRIPTION:** SMARTPHONE

**MODEL:** A1864, A1899

**SERIAL NUMBER:** C39TQ00HJ6KP, DFS (C39TJ049J300)

**DATE TESTED:** MARCH 08, 2017 – JUNE 21, 2017

| 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:

Prepared By:



CHIN PANG  
SENIOR ENGINEER  
UL VERIFICATION SERVICES INC.



JINGANG LI  
TEST ENGINEER  
UL VERIFICATION SERVICES INC.

## 2. TEST METHODOLOGY

FCC: 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 v02/D03 v01r02/D04 v01/D06 v02/ D07v02, FCC KDB 789033 D02 v01r04, FCC KDB 644545 D03 v01, ANSI C63.10-2013.

The tests documented in this report were performed in accordance with the DFS portion of FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC 06-96, FCC KDB 789033, KDB 905462 D02 and D03.

## 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 (IC:2324B-1) | <input checked="" type="checkbox"/> Chamber D (IC: 22541-1) |
| <input type="checkbox"/> Chamber B (IC:2324B-2) | <input checked="" type="checkbox"/> Chamber E (IC: 22541-2) |
| <input type="checkbox"/> Chamber C (IC:2324B-3) | <input checked="" type="checkbox"/> Chamber F (IC: 22541-3) |
|                                                 | <input type="checkbox"/> Chamber G (IC: 22541-4)            |
|                                                 | <input type="checkbox"/> Chamber H (IC: 22541-5)            |

The above test sites and facilities are covered under FCC Test Firm Registration # 208313.

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:

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

### 4.3. MEASUREMENT UNCERTAINTY

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

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

| Parameter                                           | Uncertainty |
|-----------------------------------------------------|-------------|
| Worst Case Conducted Disturbance, 9KHz to 0.15 MHz  | 3.84 dB     |
| Worst Case Conducted Disturbance, 0.15 to 30 MHz    | 3.65 dB     |
| Worst Case Radiated Disturbance, 9KHz to 30 MHz     | 3.15 dB     |
| Worst Case Radiated Disturbance, 30 to 1000 MHz     | 5.36 dB     |
| Worst Case Radiated Disturbance, 1000 to 18000 MHz  | 4.32 dB     |
| Worst Case Radiated Disturbance, 18000 to 26000 MHz | 4.45 dB     |
| Worst Case Radiated Disturbance, 26000 to 40000 MHz | 5.24 dB     |
| Occupied Channel Bandwidth                          | ±0.39 %     |
| Time                                                | ±0.02 %     |

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

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The Equipment Under Test is a mobile phone with GSM, GPRS, EGPRS, UMTS ,LTE, TD-SCDMA and CDMA technologies. It also supports IEEE 802.11a/b/g/n/ac, Bluetooth®, GPS and NFC. The device has a built-in inductive charging receiver which is not user user accessible. The rechargeable battery is not user accessible

### 5.2. DIFFERENCE IN MODEL NUMBER

Model A1864 and A1899 are exactly the same. Two models numbers are allocated for marketing and logistic purpose only. Model A1864 was used for all tedting.

### 5.3. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

NOTE: Covered modes are test reduction modes. The output powers on the “covered modes are equal to or less than the mode referenced and use the same modulation.

#### 5.2GHz Band

| Frequency Range<br>(MHz) | Mode                                                   | Output Power<br>(dBm)             | Output Power<br>(mW) |
|--------------------------|--------------------------------------------------------|-----------------------------------|----------------------|
| 5180 - 5240              | 802.11a                                                | Covered by 802.11n HT20 SISO      |                      |
|                          | 802.11n HT20 SISO                                      | 20.83                             | 121.06               |
|                          | 802.11n VHT20 1TX                                      | Covered by 802.11n HT20 SISO      |                      |
|                          | 802.11n HT20 CDD 2TX                                   | 20.89                             | 122.74               |
|                          | 802.11n HT20 STBC/SDM 2TX, 802.11ac VHT20 STBC/SDM 2TX | Covered by 802.11n HT20 2TX CDD   |                      |
| 5190 - 5230              | 802.11n HT40 SISO                                      | 18.39                             | 69.02                |
|                          | 802.11n VHT40 1TX                                      | Covered by 802.11n HT20 SISO      |                      |
|                          | 802.11n HT40 CDD 2TX                                   | 21.43                             | 139.00               |
|                          | 802.11n HT40 STBC/SDM 2TX, 802.11ac VHT40 STBC/SDM 2TX | Covered by 802.11n HT40 2TX CDD   |                      |
| 5210                     | 802.11ac VHT80 SISO                                    | 14.45                             | 27.86                |
|                          | 802.11ac VHT80 CDD 2TX                                 | 16.47                             | 44.36                |
|                          | 802.11ac VHT80 STBC/SDM 2TX                            | Covered by 802.11ac VHT80 2TX CDD |                      |

**5.3GHz Band**

| Frequency Range<br>(MHz) | Mode                                                      | Output Power<br>(dBm)            | Output Power<br>(mW) |
|--------------------------|-----------------------------------------------------------|----------------------------------|----------------------|
| 5260 - 5320              | 802.11a                                                   | Covered by 802.11n HT20 SISO     |                      |
|                          | 802.11n HT20 SISO                                         | 20.78                            | 119.67               |
|                          | 802.11n VHT20 1TX                                         | Covered by 802.11n HT20 SISO     |                      |
|                          | 802.11n HT20 CDD 2TX                                      | 20.83                            | 121.06               |
|                          | 802.11n HT20 STBC/SDM 2TX, 802.11ac<br>VHT20 STBC/SDM 2TX | Covered by 802.11n HT20 2TX CDD  |                      |
| 5270 - 5310              | 802.11n HT40 SISO                                         | 18.44                            | 69.82                |
|                          | 802.11n VHT40 1TX                                         | Covered by 802.11n HT40 SISO     |                      |
|                          | 802.11n HT40 CDD 2TX                                      | 21.35                            | 136.46               |
|                          | 802.11n HT40 STBC/SDM 2TX, 802.11ac<br>VHT40 STBC/SDM 2TX | Covered by 802.11n HT40 2TX CDD  |                      |
| 5290                     | 802.11ac VHT80 SISO                                       | 14.89                            | 30.83                |
|                          | 802.11ac VHT80 CDD 2TX                                    | 17.46                            | 55.72                |
|                          | 802.11ac VHT80 STBC/SDM 2TX                               | Covered by 802.11ac HT80 2TX CDD |                      |

**5.6GHz Band**

| Frequency Range (MHz) | Mode                                                              | Output Power (dBm)                | Output Power (mW) |
|-----------------------|-------------------------------------------------------------------|-----------------------------------|-------------------|
| 5500 - 5700           | 802.11a                                                           | Covered by 802.11n HT20 SISO      |                   |
| 5500 - 5700           | 802.11n HT20 SISO                                                 | 20.75                             | 118.85            |
|                       | 802.11n VHT20 1TX                                                 | Covered by 802.11n HT20 SISO      |                   |
| 5720                  | 802.11ac VHT20 SISO (based on UNII-2C band output power)          | 19.74                             | 94.19             |
| 5500 - 5700           | 802.11n HT20 CDD 2TX                                              | 20.85                             | 121.62            |
|                       | 802.11n HT20 STBC/SDM 2TX, 802.11ac VHT20 STBC/SDM 2TX            | Covered by 802.11n HT20 CDD 2TX   |                   |
| 5720                  | 802.11ac VHT20 CDD 2TX (based on UNII-2C band output power)       | 20.88                             | 122.46            |
|                       | 802.11ac VHT20 STBC SISO/2TX (based on UNII-2C band output power) | Covered by 802.11n HT20 2TX CDD   |                   |
| 5510 - 5670           | 802.11n HT40 SISO                                                 | 19.36                             | 86.30             |
|                       | 802.11n HT40 1TX                                                  | Covered by 802.11n HT40 SISO      |                   |
| 5710                  | 802.11ac VHT40 SISO (based on UNII-2C band output power)          | 19.34                             | 85.90             |
| 5510 - 5670           | 802.11n HT40 CDD 2TX                                              | 22.33                             | 171.00            |
|                       | 802.11n HT40 STBC/SDM 2TX, 802.11ac VHT40 STBC/SDM 2TX            | Covered by 802.11n HT40 CDD 2TX   |                   |
| 5710                  | 802.11ac VHT40 CDD 2TX (based on UNII-2C band output power)       | 22.37                             | 172.58            |
|                       | 802.11ac VHT40 STBC/SDM 2TX                                       | Covered by 802.11ac VHT40 CDD 2TX |                   |
| 5530-5610             | 802.11ac VHT80 SISO                                               | 18.95                             | 78.52             |
| 5690                  | 802.11ac VHT80 SISO (based on UNII-2C band output power)          | 18.78                             | 75.51             |
| 5530-5610             | 802.11ac VHT80 CDD 2TX                                            | 21.86                             | 153.46            |
|                       | 802.11ac VHT80 STBC/SDM 2TX                                       | Covered by 802.11ac VHT80 CDD 2TX |                   |
| 5690                  | 802.11ac VHT80 CDD 2TX (based on UNII-2C band output power)       | 21.52                             | 141.91            |
|                       | 802.11ac VHT80 STBC/SDM 2TX                                       | Covered by 802.11ac 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      |                   |
|                       | 802.11n HT20 SISO                                      | 20.90                             | 123.03            |
|                       | 802.11n VHT20 1TX                                      | Covered by 802.11n HT20 SISO      |                   |
|                       | 802.11n HT20 CDD 2TX                                   | 23.85                             | 242.66            |
|                       | 802.11n HT20 STBC/SDM 2TX, 802.11ac VHT20 STBC/SDM 2TX | Covered by 802.11n HT20 CDD 2TX   |                   |
| 5755 - 5795           | 802.11n HT40 SISO                                      | 19.42                             | 87.50             |
|                       | 802.11n VHT40 1TX                                      | Covered by 802.11n HT40 SISO      |                   |
|                       | 802.11n HT40 CDD 2TX                                   | 22.46                             | 176.20            |
|                       | 802.11n HT40 STBC/SDM 2TX, 802.11ac VHT40 STBC/SDM 2TX | Covered by 802.11n HT40 CDD 2TX   |                   |
| 5775                  | 802.11ac VHT80 SISO                                    | 18.92                             | 77.98             |
|                       | 802.11ac VHT80 CDD 2TX                                 | 20.38                             | 109.14            |
|                       | 802.11ac VHT80 STBC/SDM 2TX                            | Covered by 802.11ac VHT80 CDD 2TX |                   |

## 5.4. DESCRIPTION OF AVAILABLE ANTENNAS

| Frequency Band (GHz) | Antenna Gain (dBi) |       |
|----------------------|--------------------|-------|
|                      | UAT 2              | LAT 3 |
| 5.2                  | -4.61              | -0.98 |
| 5.3                  | -3.74              | -1.09 |
| 5.5                  | -0.75              | -0.96 |
| 5.8                  | 0.68               | -0.93 |

## 5.5. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was version 13.10.452.12

## 5.6. WORST-CASE CONFIGURATION AND MODE

For radiated harmonics spurious below 1GHz, 1-18GHz L/M/H channels, 18-40GHz, and power line conducted emissions were performed with the EUT set at the CDD mode among the CDD/STBC/SDM modes with power setting equal or higher than SISO modes as worst-case scenario.

Radiated band edge, harmonic, and spurious emissions from 1GHz to 18GHz were performed with the EUT set to transmit at highest power on Low/Middle/High channels.

Radiated emissions below 30MHz, below 1GHz, above 18GHz and power line conducted emissions were performed with the EUT transmits at the channel with the 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 UAT 2 or LAT 3. Both antenna ports have the same power; output power and PSD measurement for SISO modes on both antennas are reported. For MIMO modes, both UAT 2 and LAT 3 used at the same time.

The fundamental of the EUT was investigated in three orthogonal orientations X (Flatbed), Y (Landscape), Z (Portrait), on both UAT 2 and LAT 3 antennas. In addition, the EUT was also investigated with and without AC/DC charger, headphones & laptop. It was determined that (see table below) was worst-case orientation for both antennas without AC/DC charger, headphones, or laptop; therefore, all final radiated testing was performed with EUT only in (see table below) orientation for 1 - 18GHz, 18 - 26GHz, and 26 – 40GHz and for 30 – 1000MHz, the EUT was tested with AC/DC charger

All radiated harmonic 1-18GHz emissions on SISO mode, straddle channels are covered by 2TX MIMO mode with power setting equal or higher than SISO among the CDD/STBC/SDM modes.

| Frequency Band (GHz) | Mode     | Antenna Port  | Worst-case Orientation |
|----------------------|----------|---------------|------------------------|
| 5.2-5.8              | 1TX SISO | UAT 2         | Y-Landscape            |
|                      |          | LAT 3         | Y-Landscape            |
|                      | 2TX MIMO | UAT 2 + LAT 3 | 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 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.

For simultaneous transmission of multiple channels from the same antenna LAT 3 in the 2.4GHz BT/BLE and 5GHz bands, tests were conducted for various configurations having the highest power. No noticeable new emission was found.

## 5.7. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

| Support Equipment List |              |            |               |        |
|------------------------|--------------|------------|---------------|--------|
| Description            | Manufacturer | Model      | Serial Number | FCC ID |
| Laptop AC/DC adapter   | HP           | HSTNN-DA40 | 744481-003    | NA     |
| Laptop                 | HP           | 3160HMMW   | CND5340FPD    | 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                  |
| 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 (RADIATED BELOW 1 GHZ)

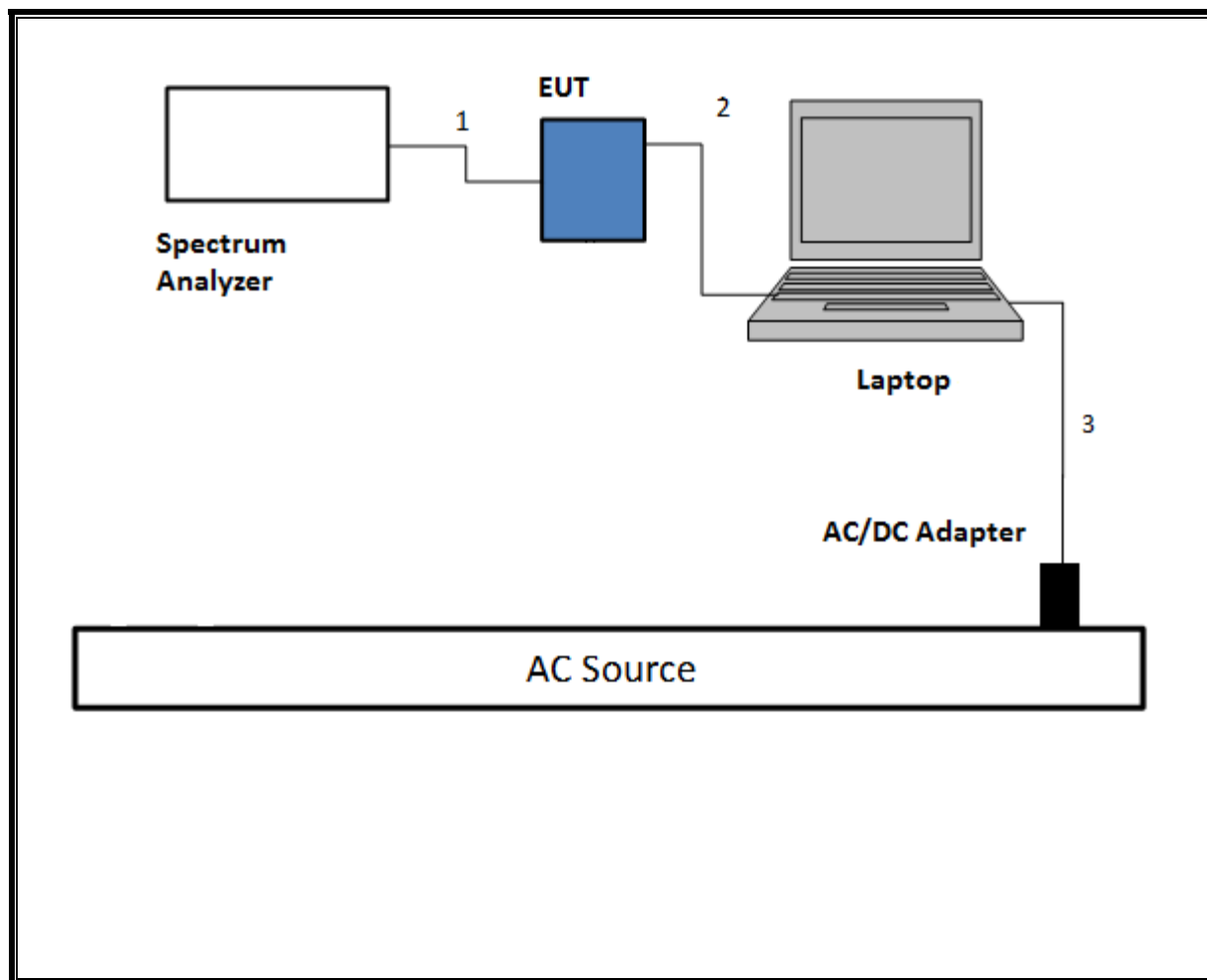
| I/O Cable List |      |                      |                |             |                  |         |
|----------------|------|----------------------|----------------|-------------|------------------|---------|
| Cable No       | Port | # of identical ports | Connector Type | Cable Type  | Cable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

### I/O CABLES (AC LINE CONDUCTED: LAPTOP CONFIGURATION)

| I/O Cable List |      |                |                |             |                  |         |
|----------------|------|----------------|----------------|-------------|------------------|---------|
| Cable No       | Port | # of identical | Connector Type | Cable Type  | Cable Length (m) | Remarks |
| 1              | AC   | 1              | AC             | Un-shielded | 3                | N/A     |
| 2              | USB  | 1              | USB            | Shielded    | 1                | N/A     |

**TEST SETUP - CONDUCTED TESTS**

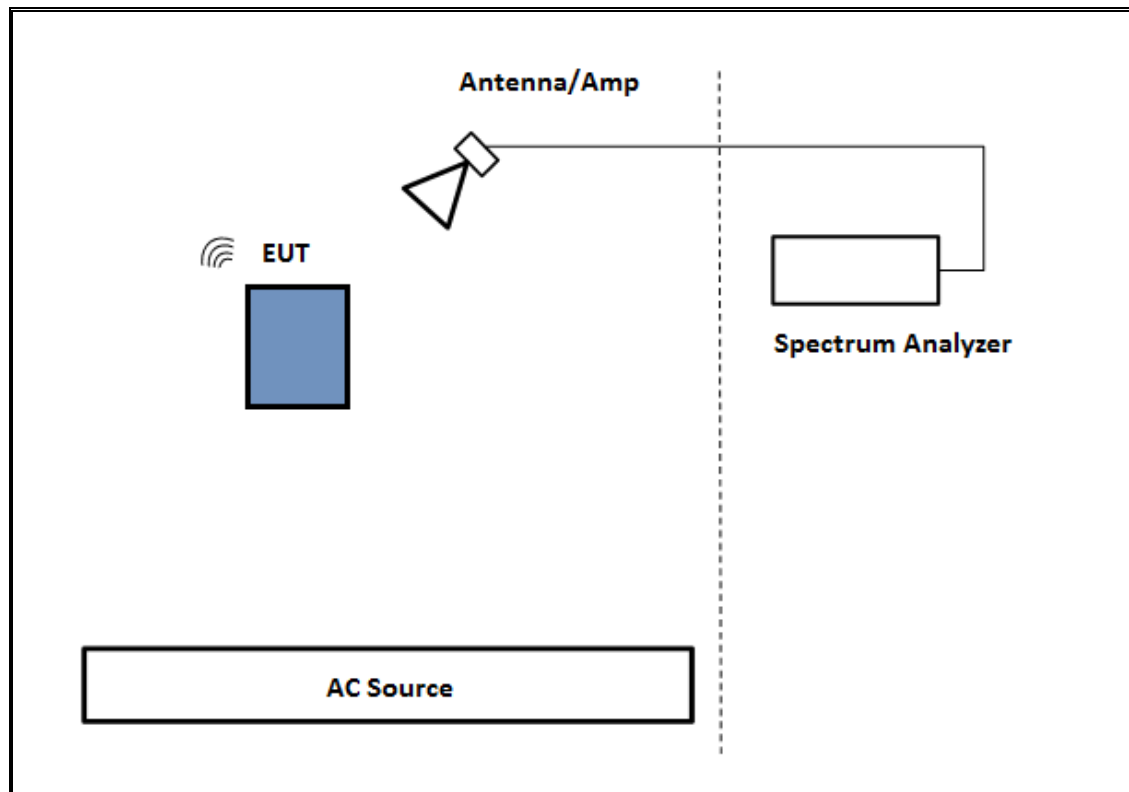
The EUT was tested connected to a host Laptop via USB cable adapter and spectrum analyzer to antenna port. Test software exercised the EUT.

**SETUP DIAGRAM**

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

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

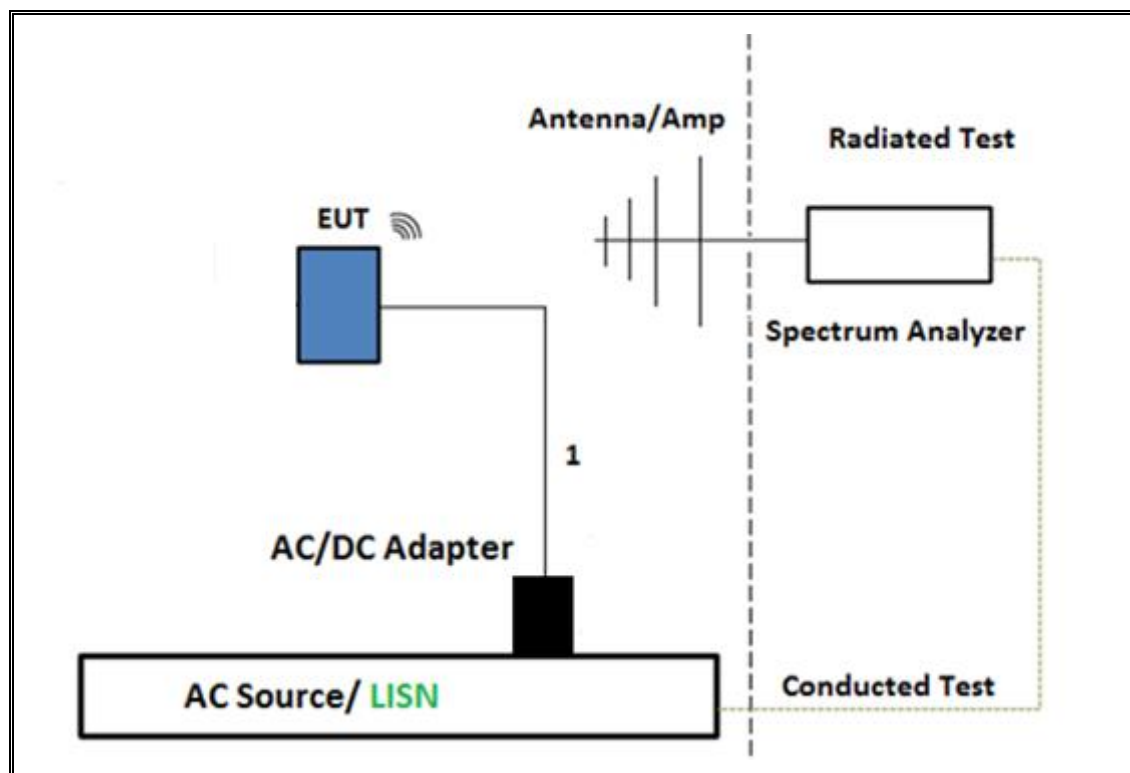
**SETUP DIAGRAM**



**TEST SETUP- BELOW 1GHz AND AC LINE CONDUCTED: AC/DC ADAPTER**

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

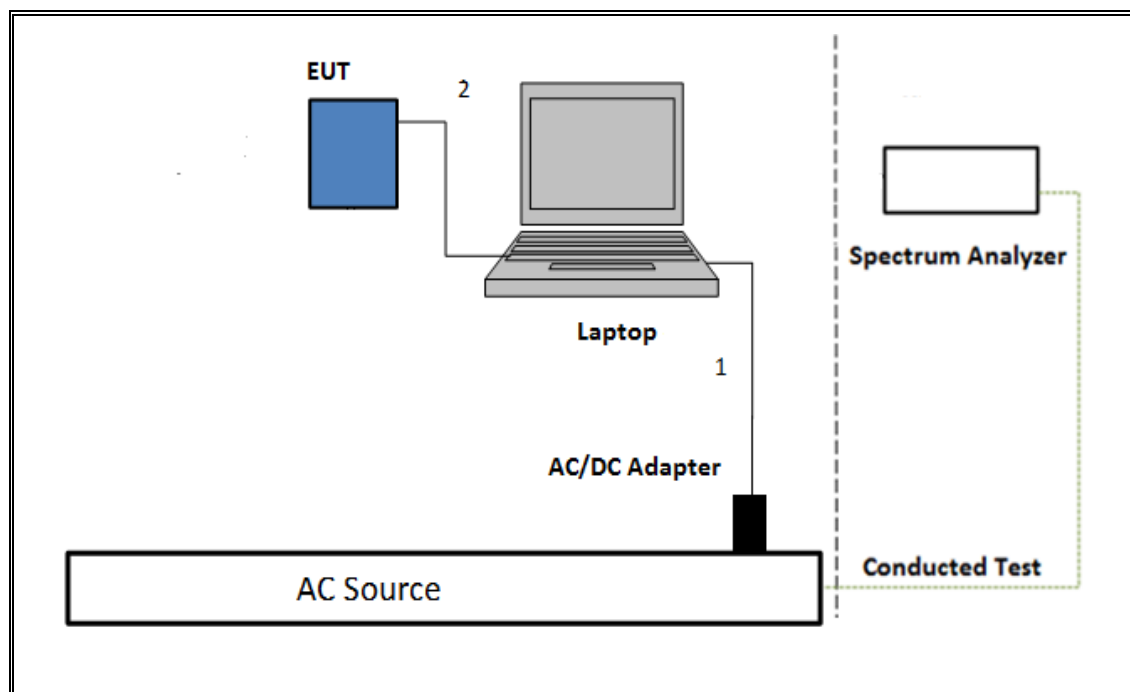
**SETUP DIAGRAM**



**TEST SETUP- AC LINE CONDUCTED: LAPTOP CONFIGURATION**

The EUT was tested with powered by host PC via USB cable. 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                   | T862                      | 4/20/2018  |
| Antenna, Broadband Hybrid, 30MHz to 2000MHz | Sunol Sciences                  | JB1                    | T243                      | 10/11/2017 |
| Amplifier, 10KHz to 1GHz, 32dB              | Sonoma                          | 310N                   | T286                      | 6/2/2018   |
| Amplifier, 1 to 18GHz                       | Miteq                           | AFS42-00101800-25-S-42 | T740                      | 11/29/17   |
| Spectrum Analyzer, PXA 3Hz to 44GHz         | Keysight                        | N9030A                 | T340                      | 12/14/2017 |
| Antenna, Horn 1-18GHz                       | ETS Lindgren                    | 3117                   | T863                      | 6/9/2018   |
| Amplifier, 1 to 18GHz                       | Miteq                           | AFS42-00101800-25-S-42 | T741                      | 11/29/2017 |
| Spectrum Analyzer, PXA 3Hz to 44GHz         | Keysight                        | N9030A                 | T1113                     | 12/20/2017 |
| Antenna, Horn 1-18GHz                       | ETS Lindgren                    | 3117                   | T119                      | 3/28/2018  |
| Amplifier, 1 to 18GHz                       | Miteq                           | AFS42-00101800-25-S-42 | T742                      | 11/29/2017 |
| Spectrum Analyzer, PSA, 3Hz to 44GHz        | Agilent (Keysight) Technologies | E4446A                 | T177                      | 03/20/2018 |
| Power Meter, P-series single channel        | Keysight                        | N1912A                 | T1245                     | 1/05/2018  |
| Power Sensor                                | Keysight                        | N1921A                 | T1224                     | 1/31/2018  |
| *Antenna Horn, 18 to 26GHz                  | ARA                             | MWH-1826               | T447                      | 6/16/2017  |
| Spectrum Analyzer, 40GHz                    | Agilent                         | 8564E                  | T106                      | 9/7/2017   |
| *Amplifier 26-40Ghz                         | Miteq                           | NSP 4000 SP2           | T88                       | 4/29/2017  |
| Antenna Horn 26-40GHz                       | ARA                             | MWH-2640               | T90                       | 8/19/2017  |
| Horn Antenna, 40GHz                         | ARA                             | MWH-2640/B             | 1029                      | 8/19/2017  |
| Spectrum Analyzer, PXA, 3Hz to 44GHz        | Agilent (Keysight) Technologies | N9030A                 | T339                      | 09/22/2017 |
| AC Line Conducted                           |                                 |                        |                           |            |
| EMI Test Receiver 9Khz-7GHz                 | Rohde & Schwarz                 | ESCI7                  | T1436                     | 01/06/2018 |
| *LISN for Conducted Emissions CISPR-16      | Fischer                         | 50/250-25-2-01         | T1310                     | 06/08/2017 |
| LISN for Conducted Emissions CISPR-16       | Fischer                         | 50/250-25-2-01         | T1310                     | 06/15/2018 |
| Power Cable, Line Conducted Emissions       | UL                              | PG1                    | T861                      | 9/1/2017   |
| UL AUTOMATION SOFTWARE                      |                                 |                        |                           |            |
| Radiated Software                           | UL                              | UL EMC                 | Ver 9.5, April 26, 2016   |            |
| Conducted Software                          | UL                              | UL EMC                 | Ver 5.4, October 13, 2016 |            |
| AC Line Conducted Software                  | UL                              | UL EMC                 | Ver 9.5, May 26, 2015     |            |

NOTE: \*testing is completed before equipment calibration expiration date.

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

### 7.1. ON TIME AND DUTY CYCLE

#### LIMITS

None; for reporting purposes only.

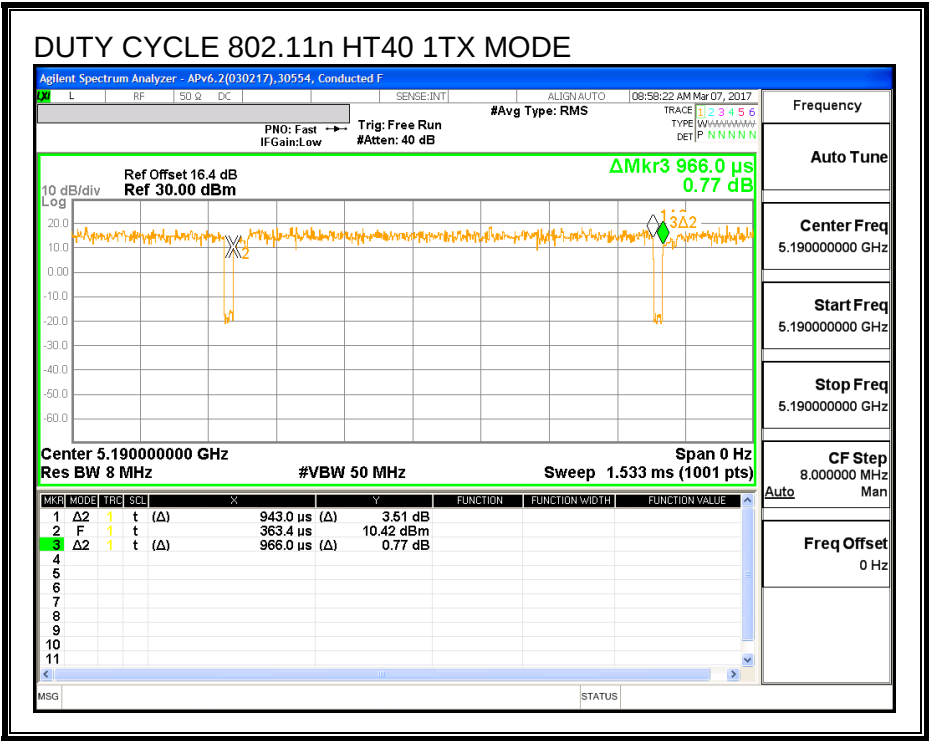
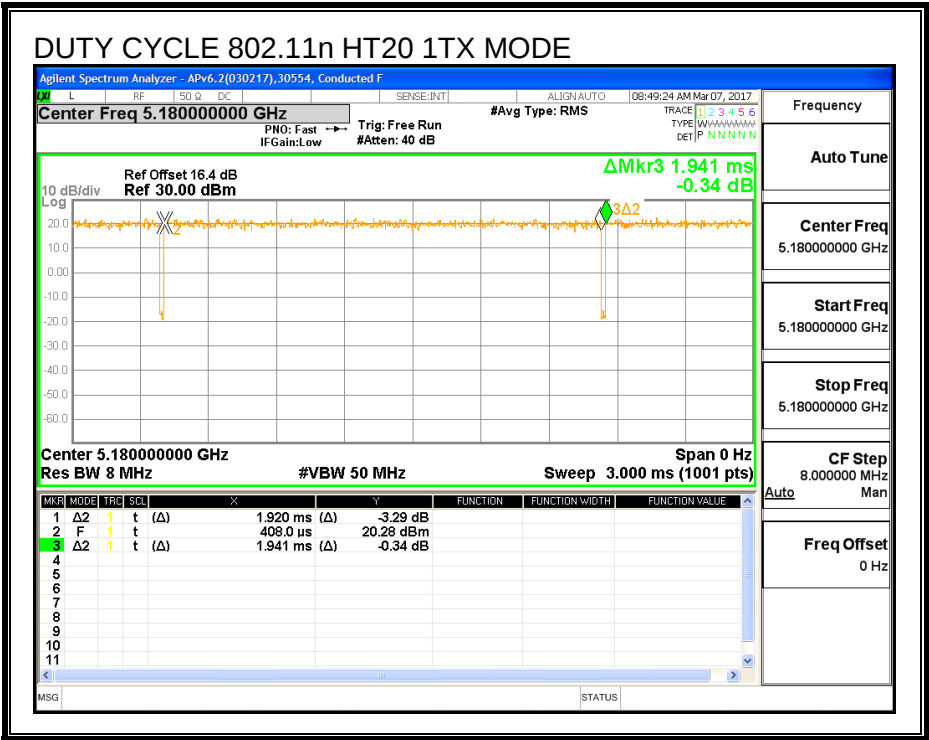
#### PROCEDURE

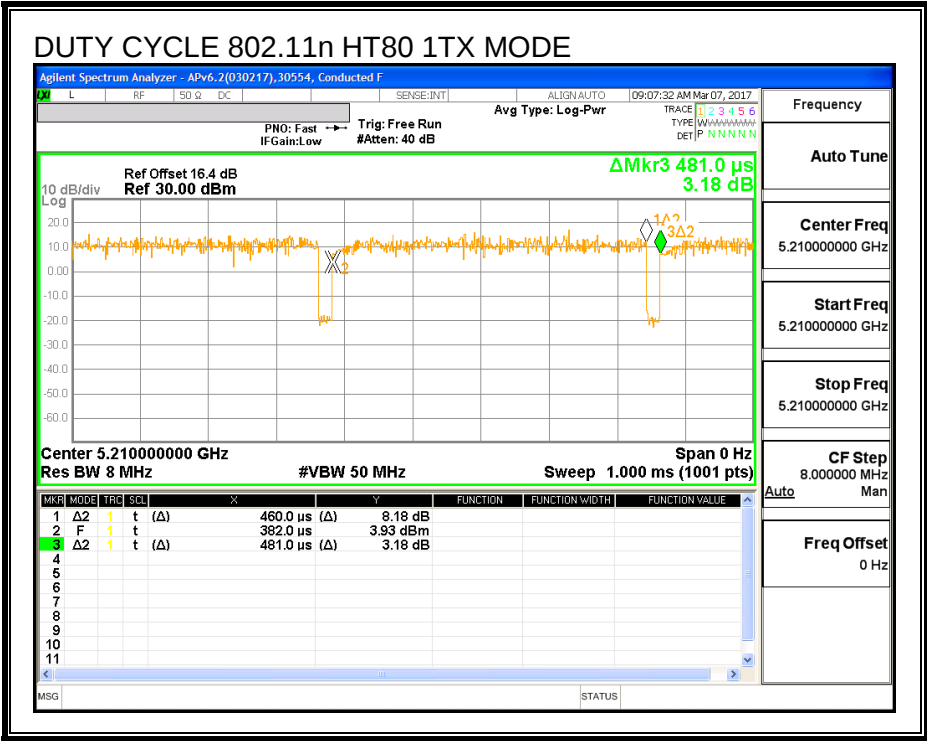
KDB 789033 Zero-Span Spectrum Analyzer Method.

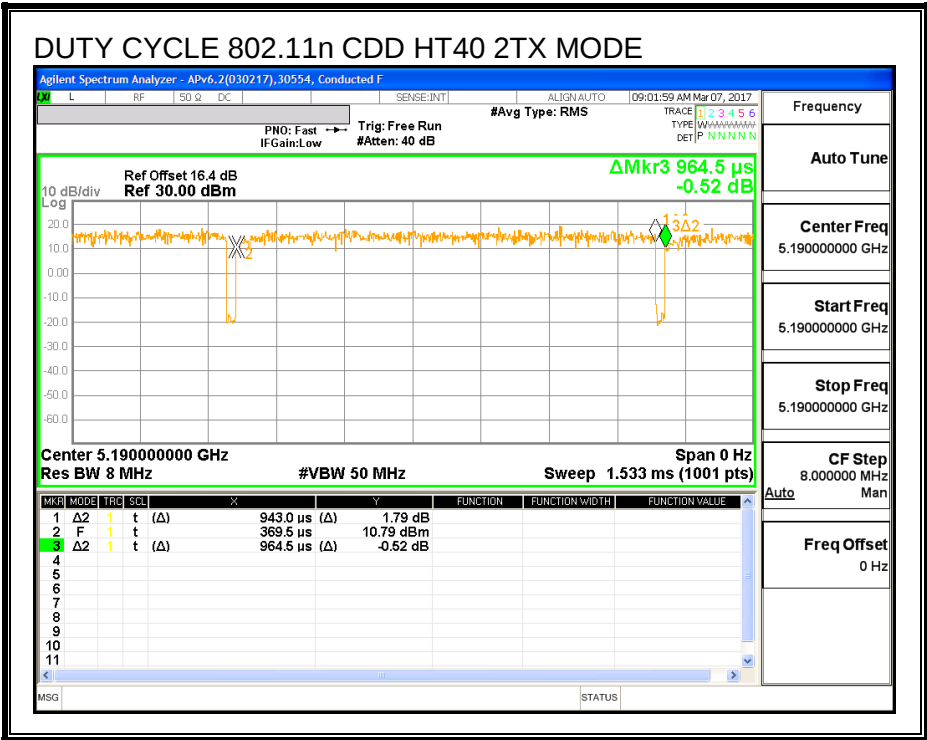
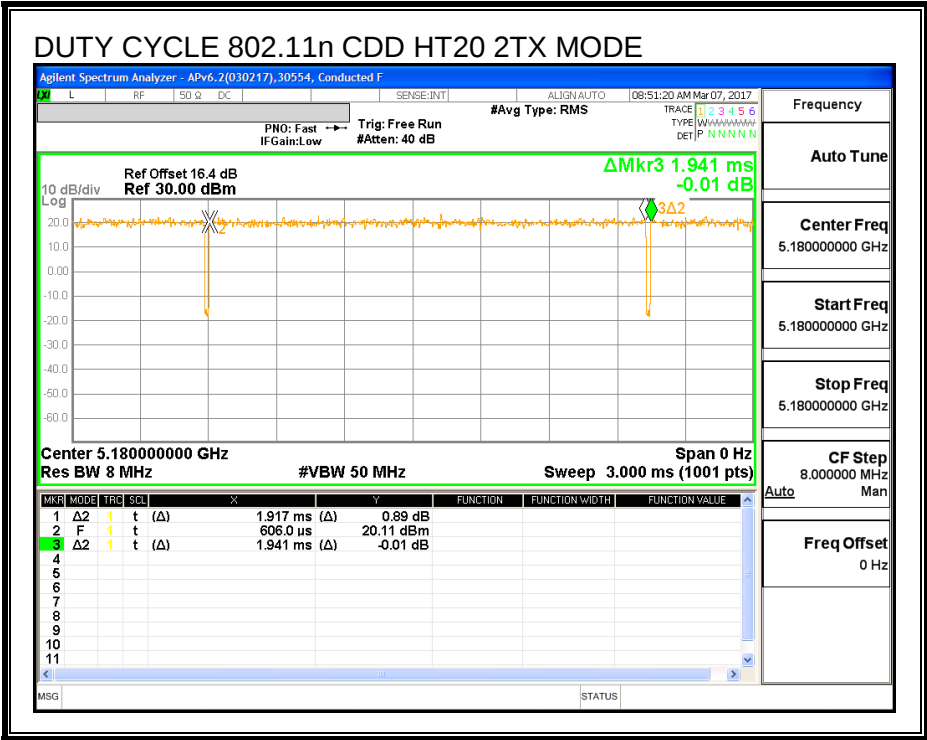
#### RESULTS

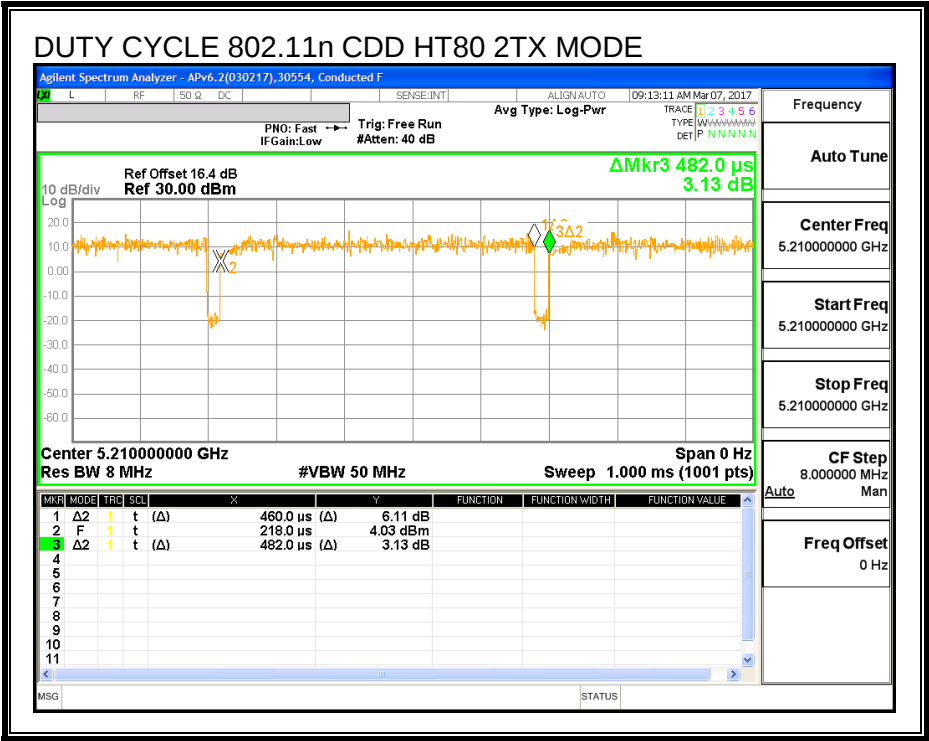
| Mode             | ON Time B<br>(msec) | Period<br>(msec) | Duty<br>Cycle x<br>(linear) | Duty Cycle<br>(%) | Duty Cycle<br>Correction<br>Factor (dB) | 1/B Minimum<br>VBW (kHz) |
|------------------|---------------------|------------------|-----------------------------|-------------------|-----------------------------------------|--------------------------|
| 11n HT20 1TX     | 1.920               | 1.941            | 0.989                       | 98.92%            | 0.00                                    | 0.010                    |
| 11n HT40 1TX     | 0.943               | 0.966            | 0.976                       | 97.62%            | 0.10                                    | 1.060                    |
| 11n HT80 1TX     | 0.460               | 0.481            | 0.954                       | 95.44%            | 0.20                                    | 2.174                    |
| 11n HT20 2TX CDD | 1.917               | 1.941            | 0.9876                      | 98.76%            | 0.00                                    | 1.058                    |
| 11n HT40 2TX CDD | 0.943               | 0.9645           | 0.952                       | 95.23%            | 0.10                                    | 2.179                    |
| 11n HT80 2TX CDD | 0.460               | 0.482            | 0.954                       | 95.44%            | 0.20                                    | 2.174                    |

DUTY CYCLE PLOTS









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## **7.2. MEASUREMENT METHODS**

6 dB Emission BW: KDB 789033 D02 v01r04, Section C.

26 dB Emission BW: KDB 789033 D02 v01r04, Section C.

99% Occupied BW: KDB 789033 D02 v01r04, Section D.

Conducted Output Power: KDB 789033 D02 v01r04, Section E.3.b (Method PM-G).

Power Spectral Density: KDB 789033 D02 v01r04, Section F (Method SA-2).

Unwanted emissions in restricted bands: KDB 789033 D02 v01r04, Sections G.3, G.4, G.5, and G.6.

Unwanted emissions in non-restricted bands: KDB 789033 D02 v01r04, Sections G.3, G.4, and G.5.

Conducted line emissions: C63.10, Clause 6.2

## 8. ANTENNA PORT TEST RESULTS

### 8.1. 11n HT20 UAT 2 SISO MODE IN THE 5.2GHz BAND

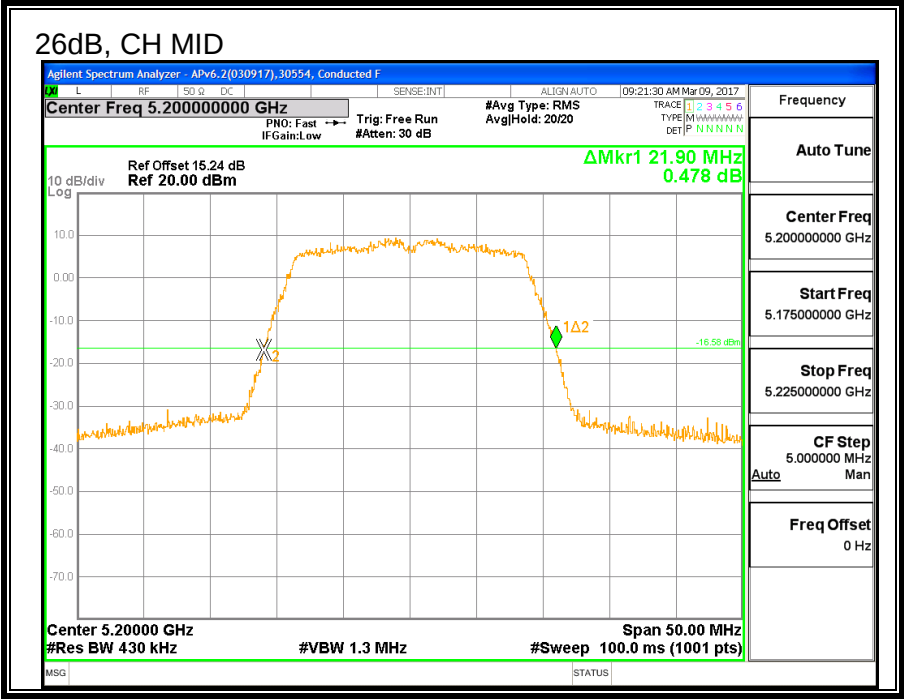
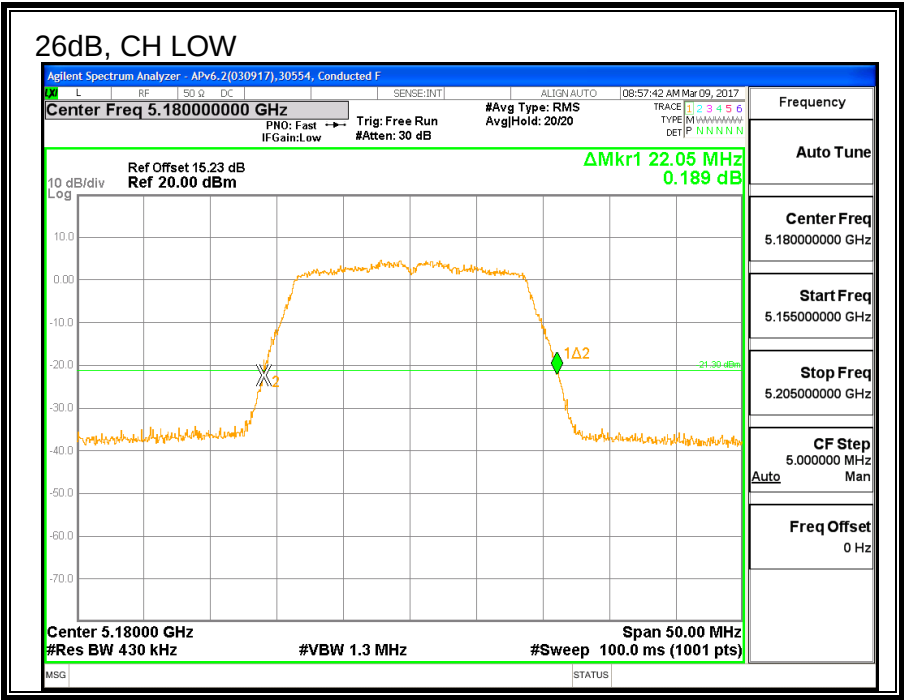
#### 8.1.1. 26 dB BANDWIDTH

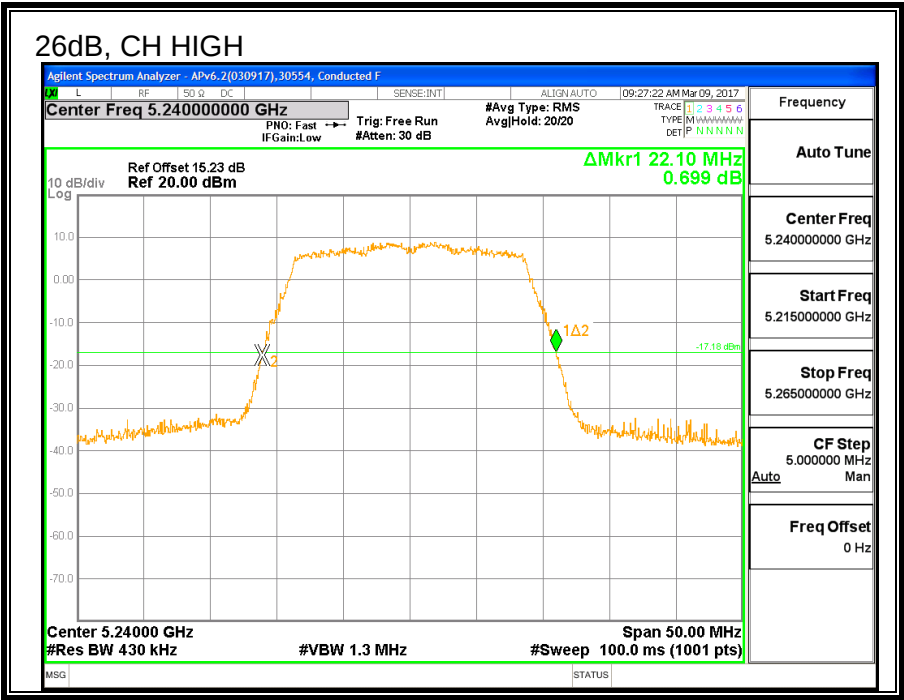
##### LIMITS

None; for reporting purposes only.

##### RESULTS

| Channel | Frequency | 26 dB BW UAT 2 (MHz) |
|---------|-----------|----------------------|
| Low     | 5180      | 22.05                |
| Mid     | 5200      | 21.90                |
| High    | 5240      | 22.10                |





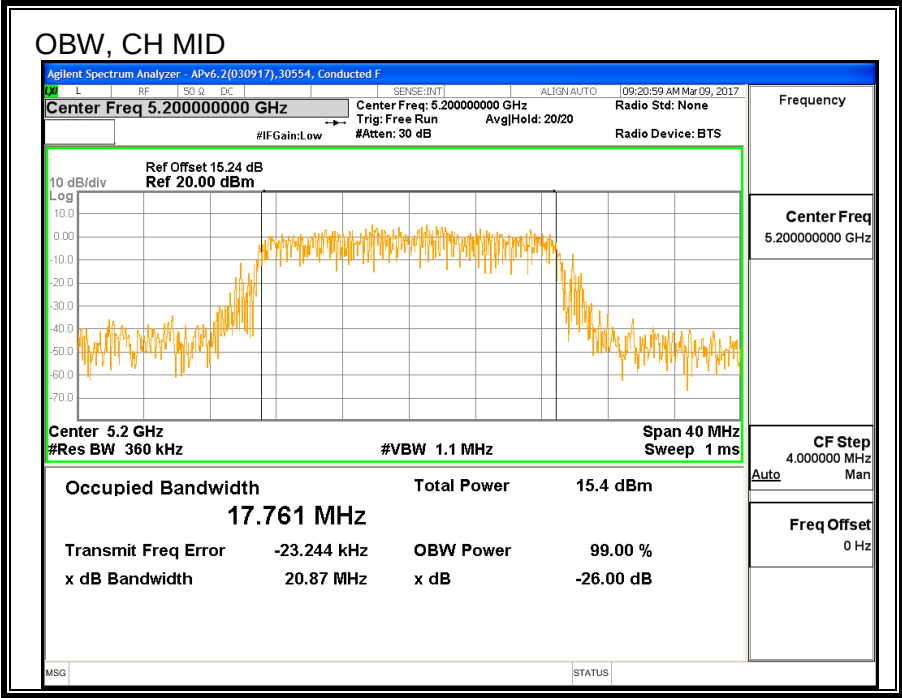
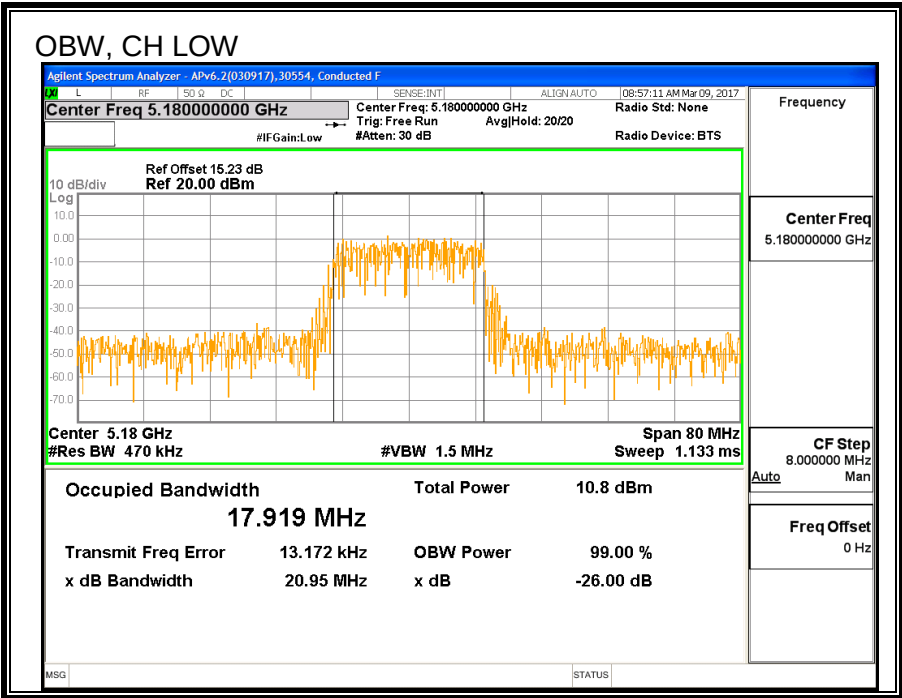
### 8.1.2. 99% BANDWIDTH

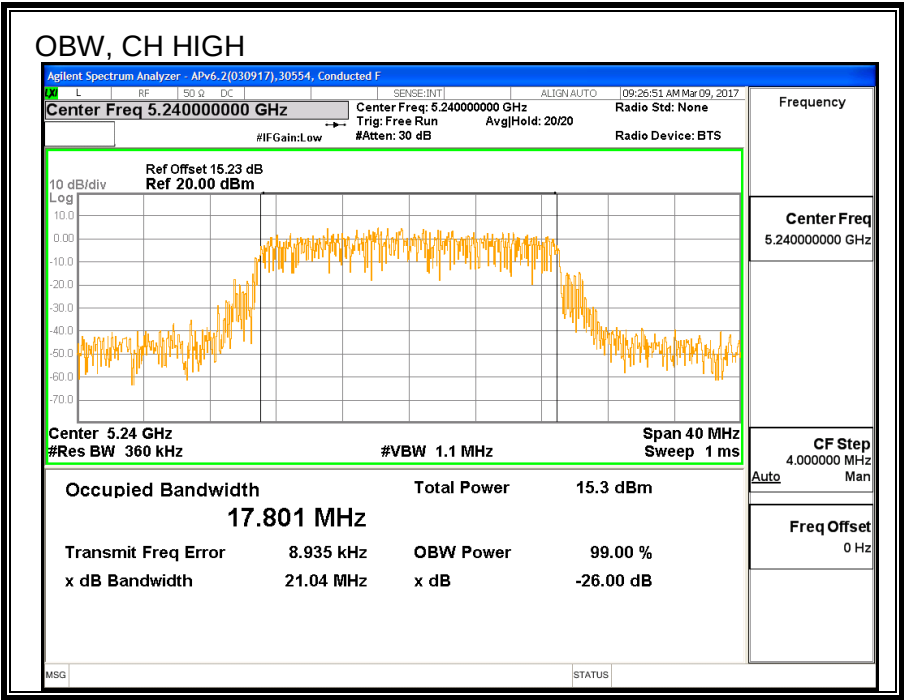
#### LIMITS

None; for reporting purposes only.

#### RESULTS

| Channel | Frequency | 99% BW UAT 2<br>(MHz) |
|---------|-----------|-----------------------|
| Low     | 5180      | 17.919                |
| Mid     | 5200      | 17.761                |
| High    | 5240      | 17.801                |





### 8.1.3. AVERAGE POWER

|            |       |              |          |
|------------|-------|--------------|----------|
| <b>ID:</b> | 30554 | <b>Date:</b> | 3/8/2017 |
|------------|-------|--------------|----------|

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.

#### RESULTS

| Channel | Frequency | Power UAT<br>2 (dBm) |
|---------|-----------|----------------------|
| Low     | 5180      | 17.42                |
| Mid     | 5200      | 19.43                |
| High    | 5240      | 20.83                |

## **8.1.4. OUTPUT POWER AND PPSD**

### **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.

### **TEST PROCEDURE**

Measurements perform using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

PSD Test Procedure: KDB 789033 D02 v01r04 Section F (Method SA-2)

### **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               | -4.61                                     | -4.61                                   | 24.00                   | 11.00                 |
| Mid     | 5200               | -4.61                                     | -4.61                                   | 24.00                   | 11.00                 |
| High    | 5240               | -4.61                                     | -4.61                                   | 24.00                   | 11.00                 |

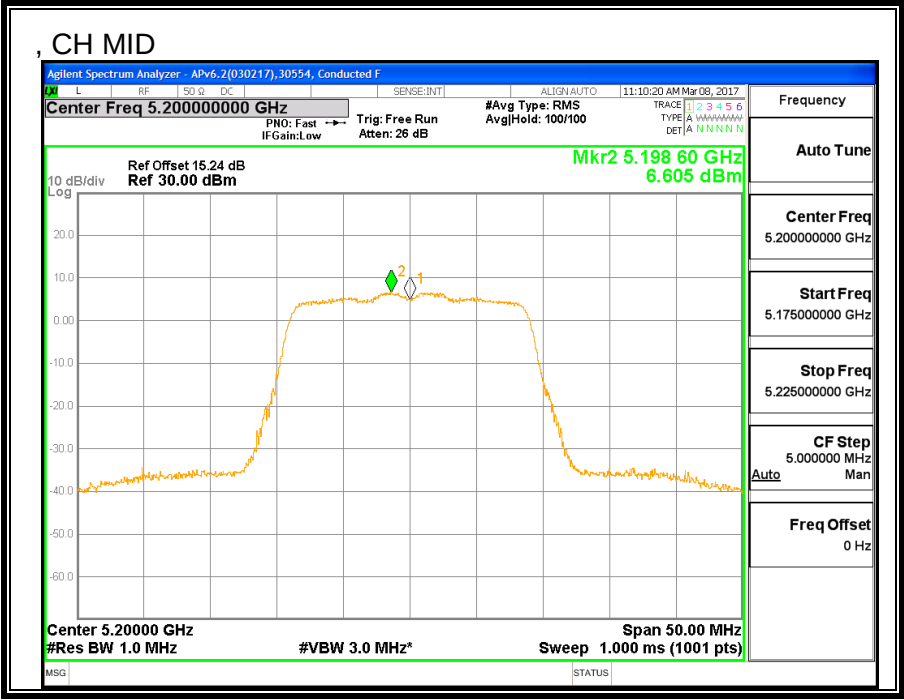
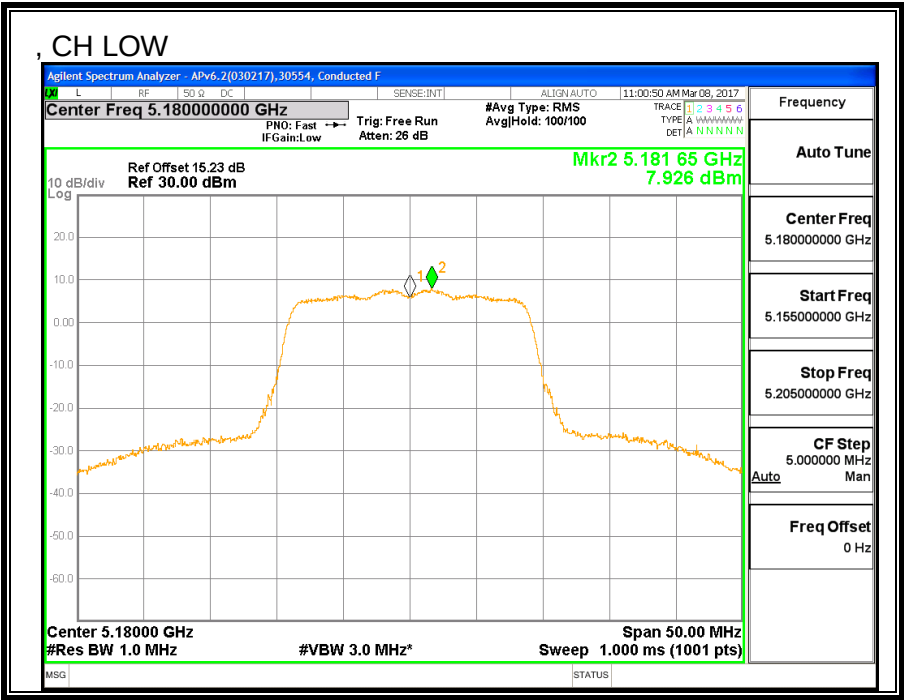
|                    |      |                                        |
|--------------------|------|----------------------------------------|
| Duty Cycle CF (dB) | 0.00 | Included in Calculations of Corr'd PSD |
|--------------------|------|----------------------------------------|

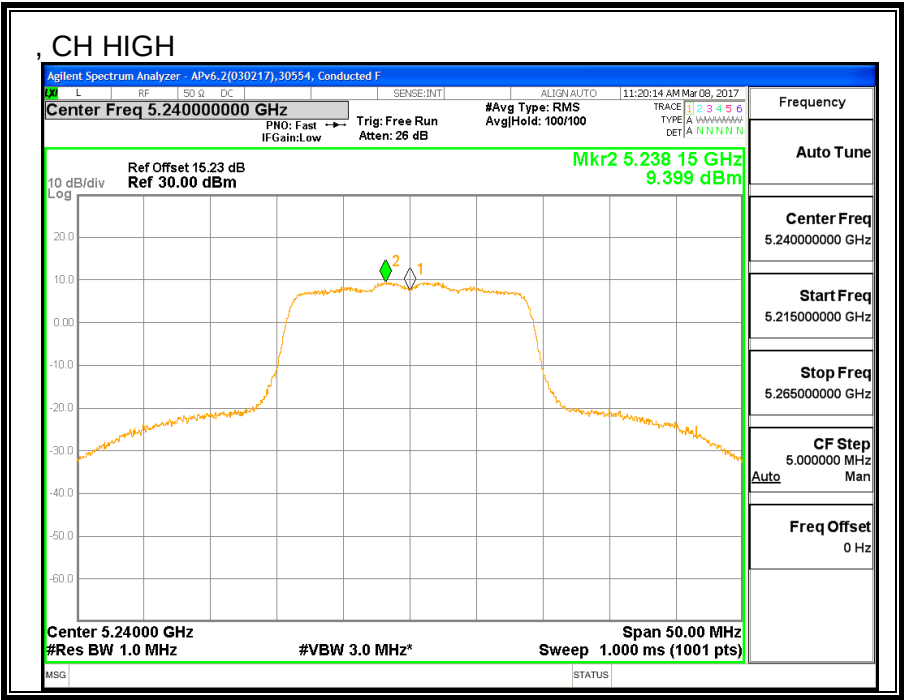
### Output Power Results

| Channel | Frequency<br>(MHz) | UAT 2<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               | 17.42                           | 17.42                             | 24.00                   | -6.58                   |
| Mid     | 5200               | 19.43                           | 19.43                             | 24.00                   | -4.57                   |
| High    | 5240               | 20.83                           | 20.83                             | 24.00                   | -3.17                   |

### PSD Results

| Channel | Frequency<br>(MHz) | UAT 2<br>Meas<br>PSD<br>(dBm/MHz) | Total<br>Corr'd<br>PSD<br>(dBm/MHz) | PSD<br>Limit<br>(dBm/MHz) | PSD<br>Margin<br>(dB) |
|---------|--------------------|-----------------------------------|-------------------------------------|---------------------------|-----------------------|
| Low     | 5180               | 7.93                              | 7.93                                | 11.00                     | -3.07                 |
| Mid     | 5200               | 6.61                              | 6.61                                | 11.00                     | -4.40                 |
| High    | 5240               | 9.40                              | 9.40                                | 11.00                     | -1.60                 |





## **8.2. 11n HT20 LAT 3 SISO MODE IN THE 5.2GHz BAND**

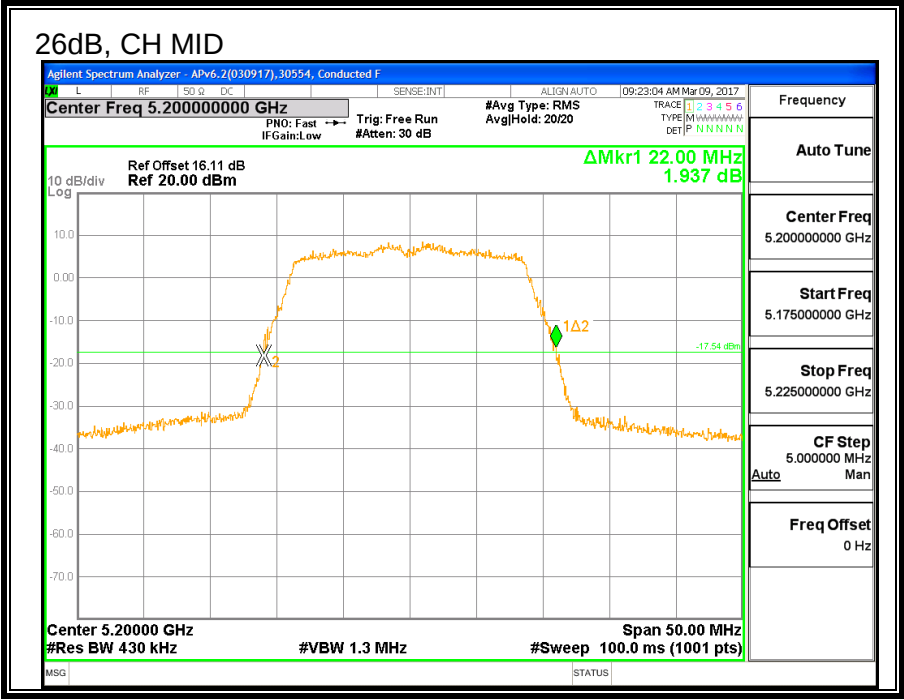
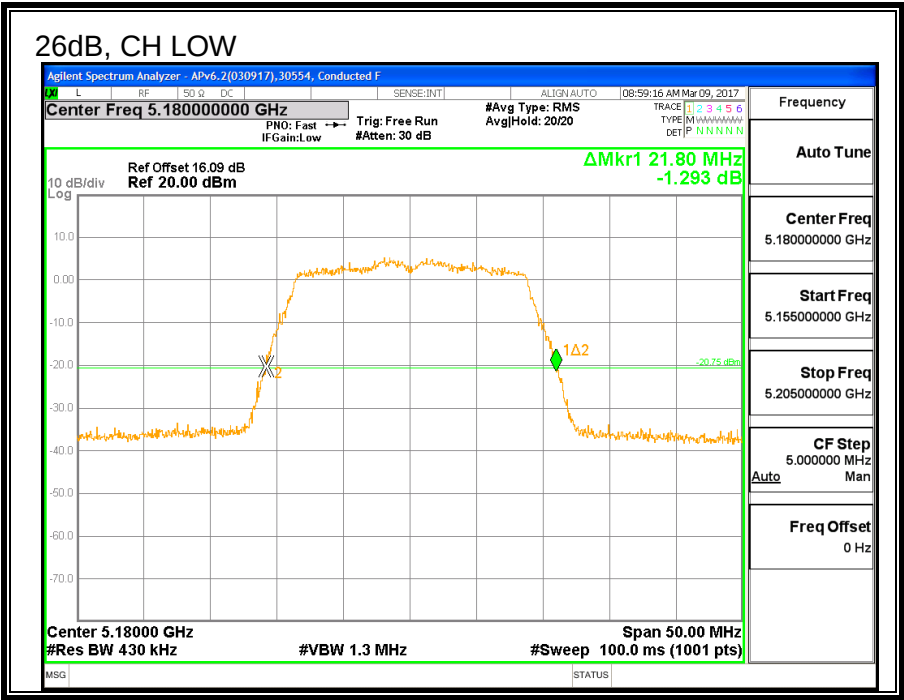
### **8.2.1. 26 dB BANDWIDTH**

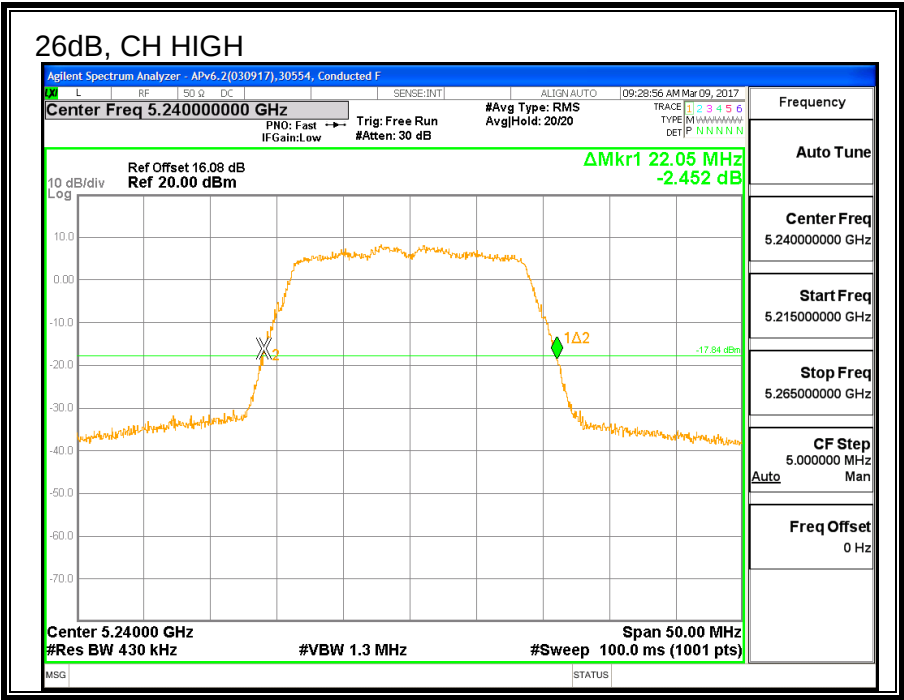
#### **LIMITS**

None; for reporting purposes only.

#### **RESULTS**

| <b>Channel</b> | <b>Frequency</b> | <b>26 dB BW LAT 3<br/>(MHz)</b> |
|----------------|------------------|---------------------------------|
| Low            | 5180             | 21.80                           |
| Mid            | 5200             | 22.00                           |
| High           | 5240             | 22.05                           |





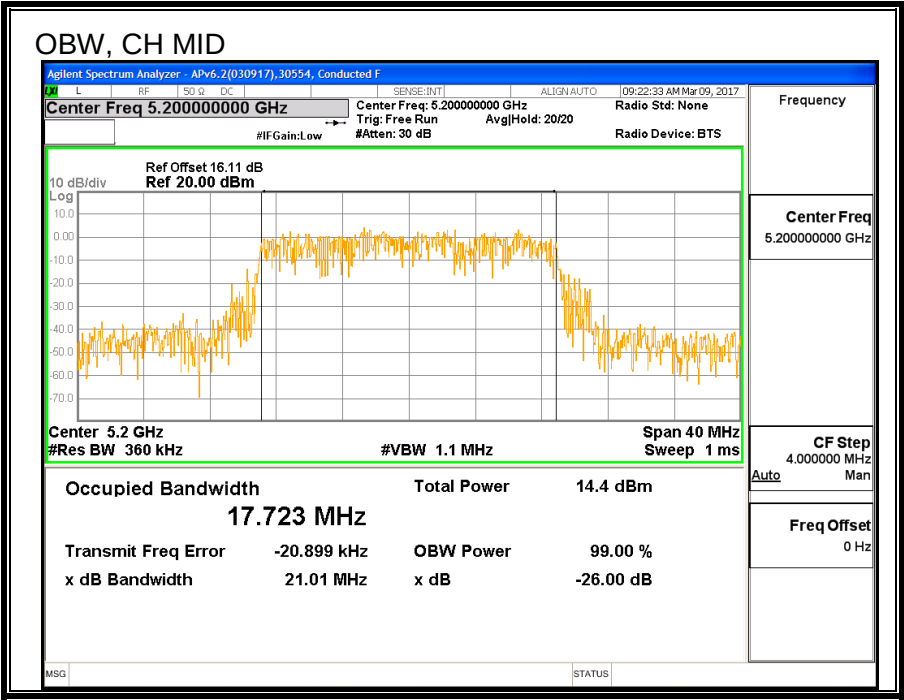
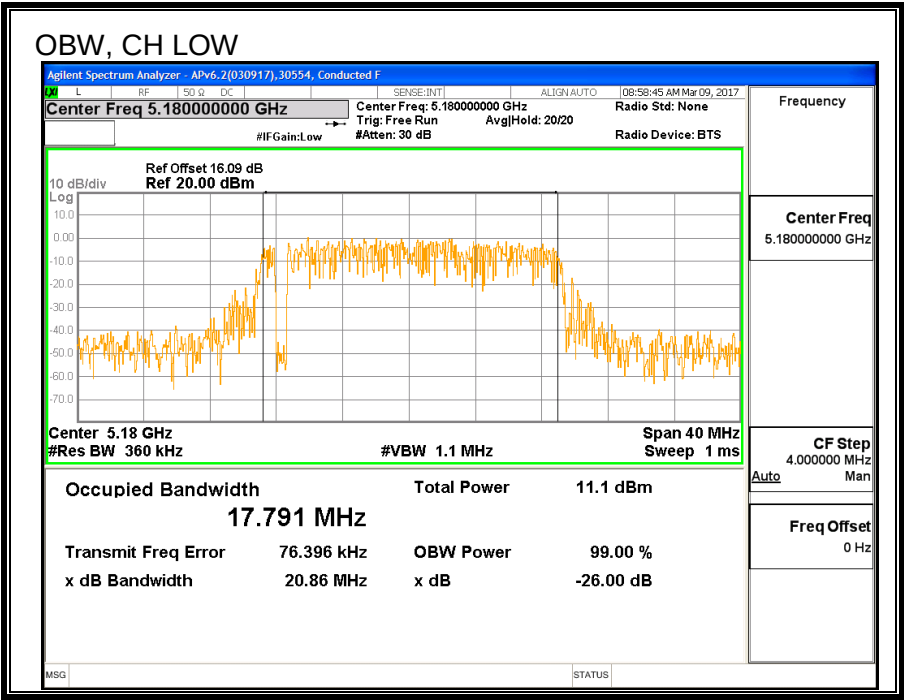
## 8.2.2. 99% BANDWIDTH

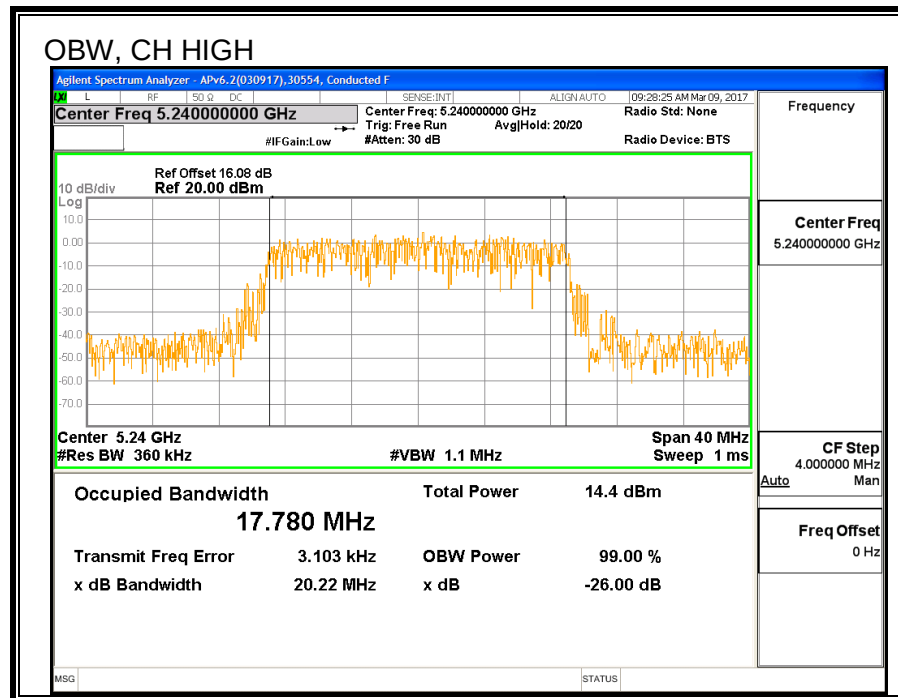
### LIMITS

None; for reporting purposes only.

### RESULTS

| Channel | Frequency | 99% BW LAT 3 (MHz) |
|---------|-----------|--------------------|
| Low     | 5180      | 17.791             |
| Mid     | 5200      | 17.723             |
| High    | 5240      | 17.780             |





### 8.2.3. AVERAGE POWER

|            |       |              |          |
|------------|-------|--------------|----------|
| <b>ID:</b> | 30554 | <b>Date:</b> | 3/8/2017 |
|------------|-------|--------------|----------|

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.

#### RESULTS

| Channel | Frequency | Power LAT<br>3 (dBm) |
|---------|-----------|----------------------|
| Low     | 5180      | 17.42                |
| Mid     | 5200      | 19.36                |
| High    | 5240      | 20.76                |

## **8.2.4. OUTPUT POWER AND PPSD**

### **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.

### **TEST PROCEDURE**

Measurements perform using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

PSD Test Procedure: KDB 789033 D02 v01r04 Section F (Method SA-2)

### **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               | -0.98                                     | -0.98                                   | 24.00                   | 11.00                 |
| Mid     | 5200               | -0.98                                     | -0.98                                   | 24.00                   | 11.00                 |
| High    | 5240               | -0.98                                     | -0.98                                   | 24.00                   | 11.00                 |

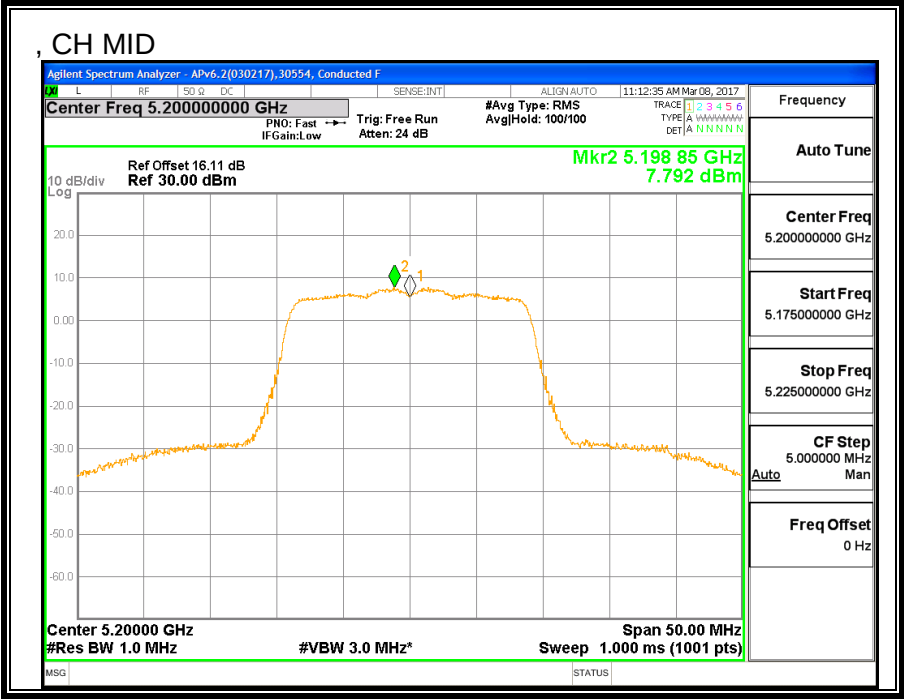
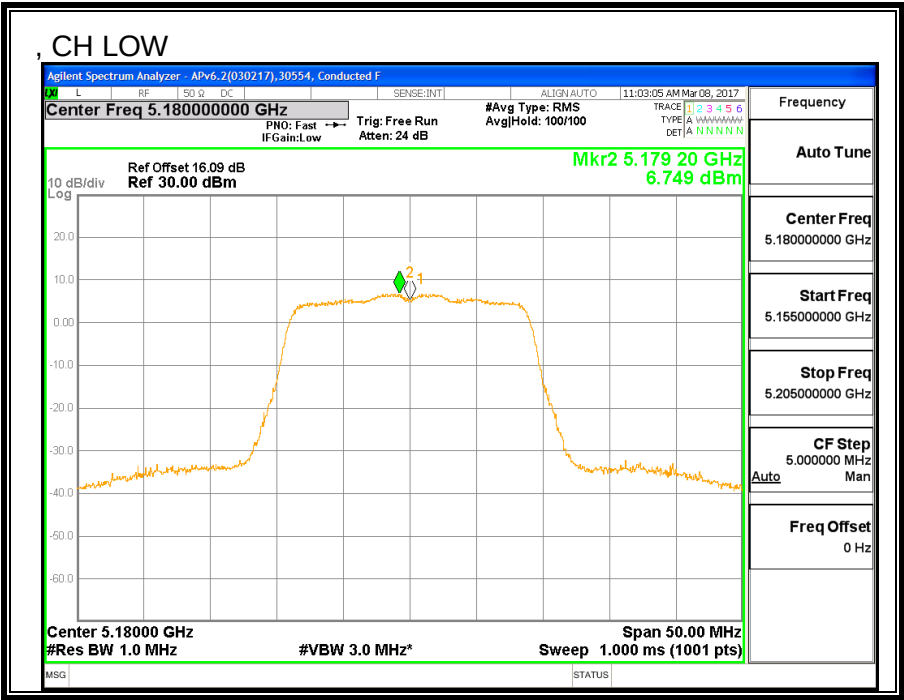
|                    |      |                                        |
|--------------------|------|----------------------------------------|
| Duty Cycle CF (dB) | 0.00 | Included in Calculations of Corr'd PSD |
|--------------------|------|----------------------------------------|

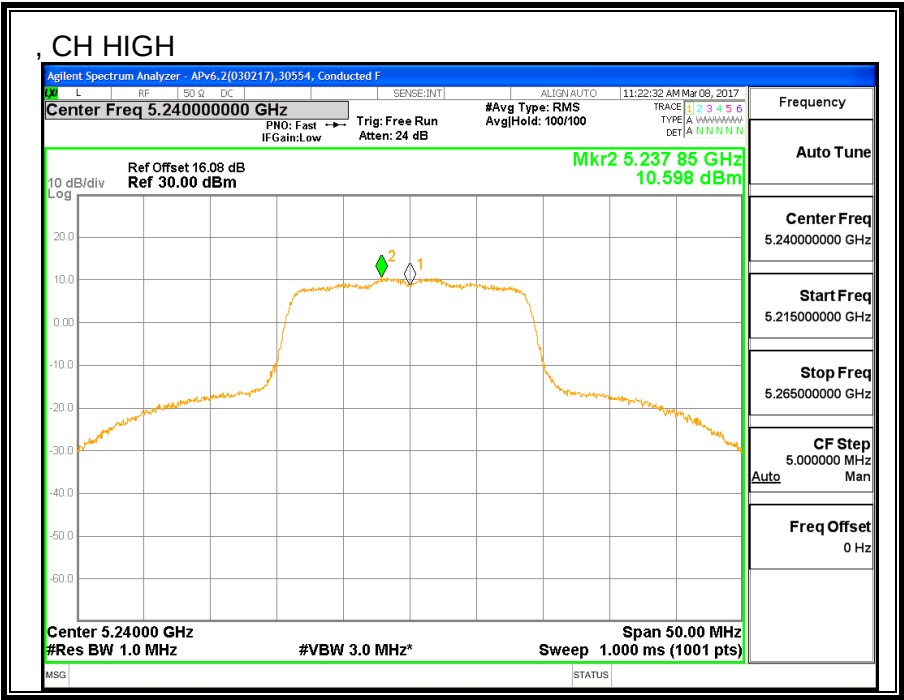
### Output Power Results

| Channel | Frequency<br>(MHz) | LAT 3<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               | 17.42                           | 17.42                             | 24.00                   | -6.58                   |
| Mid     | 5200               | 19.36                           | 19.36                             | 24.00                   | -4.64                   |
| High    | 5240               | 20.76                           | 20.76                             | 24.00                   | -3.24                   |

### PSD Results

| Channel | Frequency<br>(MHz) | LAT 3<br>Meas<br>PSD<br>(dBm/MHz) | Total<br>Corr'd<br>PSD<br>(dBm/MHz) | PSD<br>Limit<br>(dBm/MHz) | PSD<br>Margin<br>(dB) |
|---------|--------------------|-----------------------------------|-------------------------------------|---------------------------|-----------------------|
| Low     | 5180               | 6.75                              | 6.75                                | 11.00                     | -4.25                 |
| Mid     | 5200               | 7.79                              | 7.79                                | 11.00                     | -3.21                 |
| High    | 5240               | 10.60                             | 10.60                               | 11.00                     | -0.40                 |





### **8.3. 11n HT20 2TX CDD MIMO MODE IN THE 5.2GHz BAND**

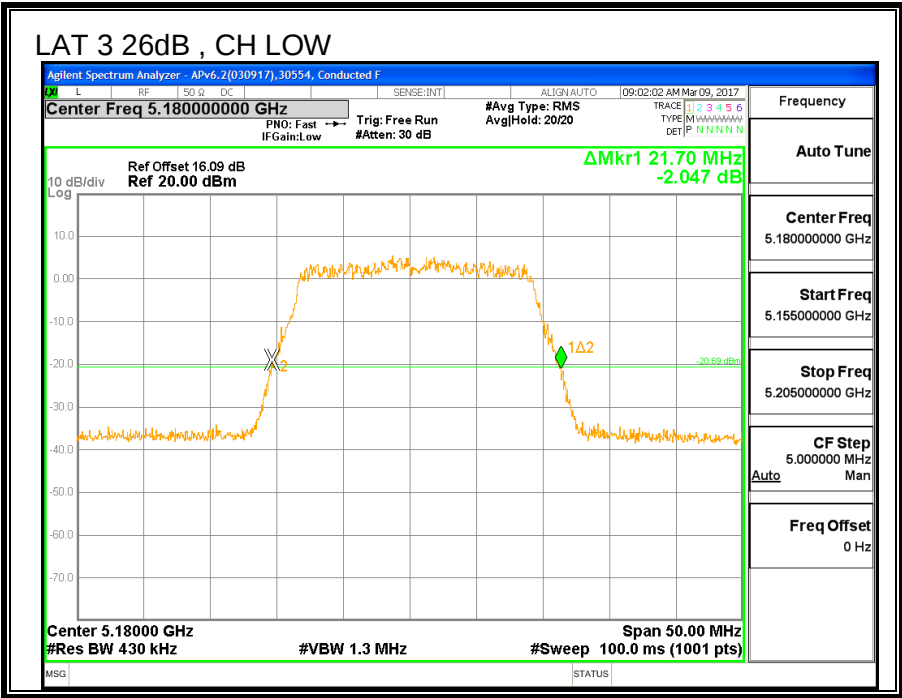
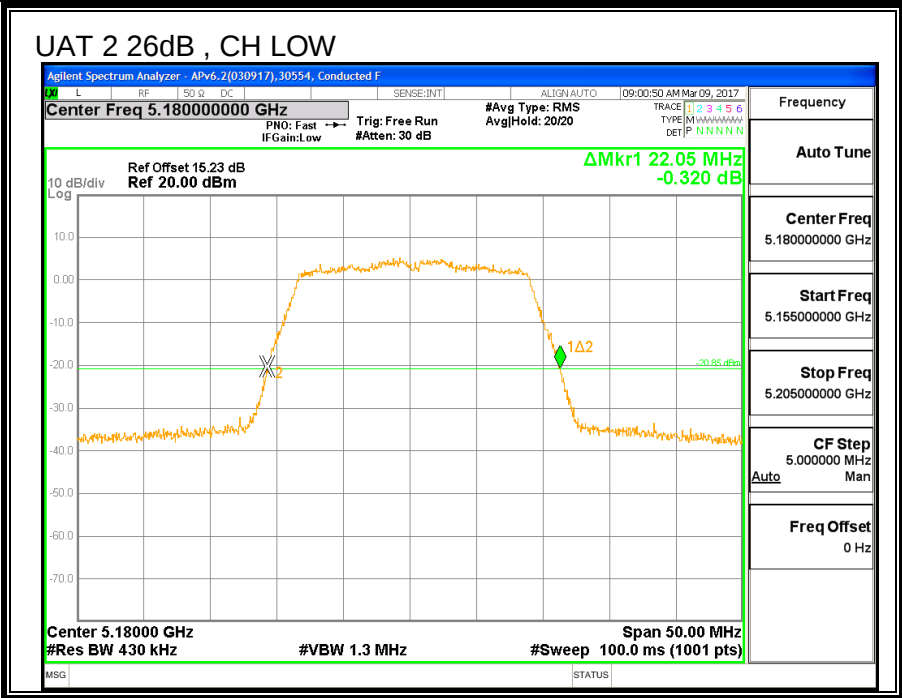
#### **8.3.1. 26 dB BANDWIDTH**

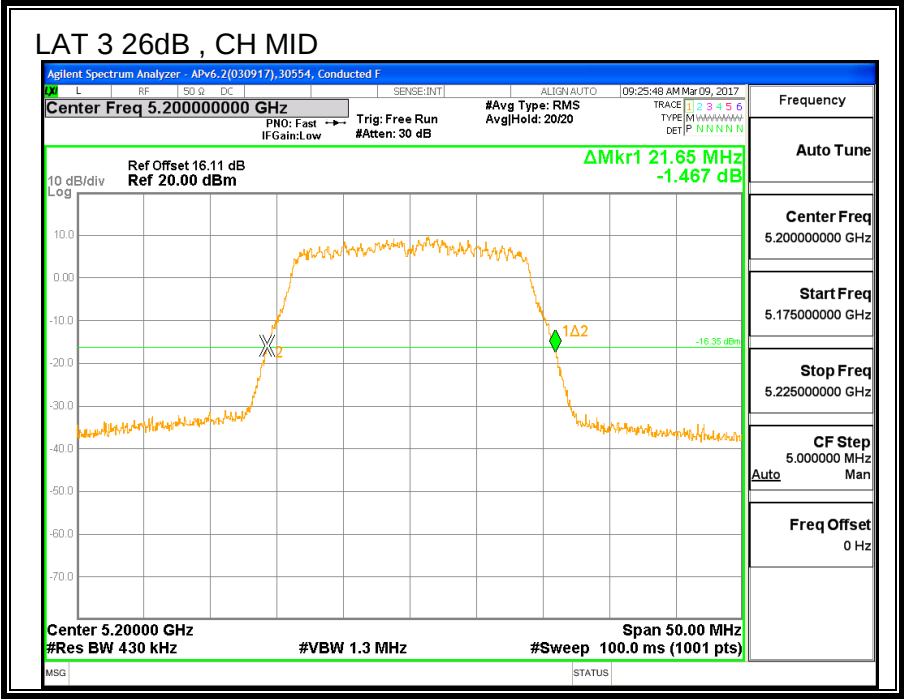
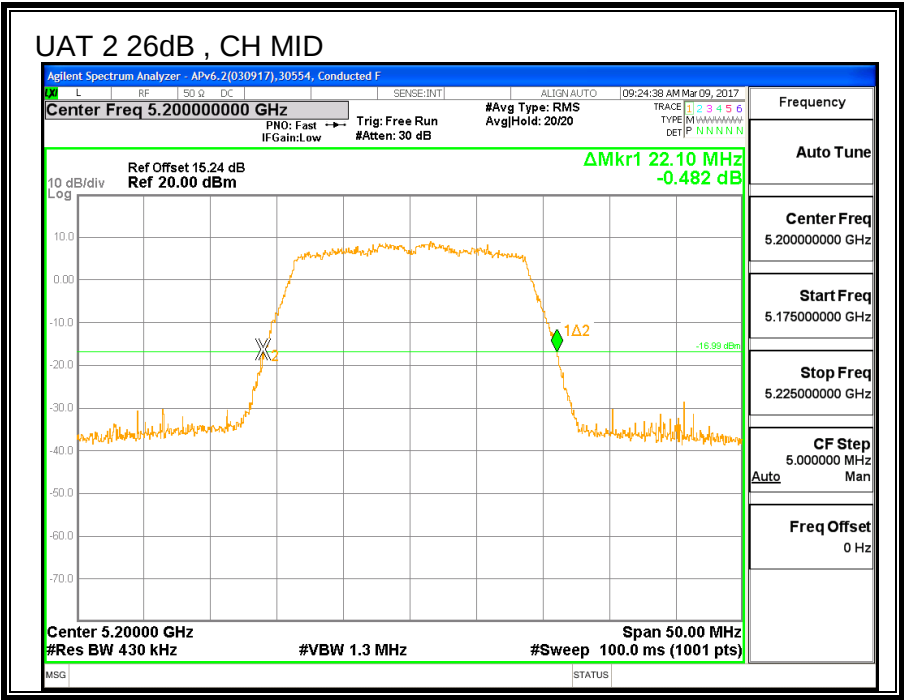
##### **LIMITS**

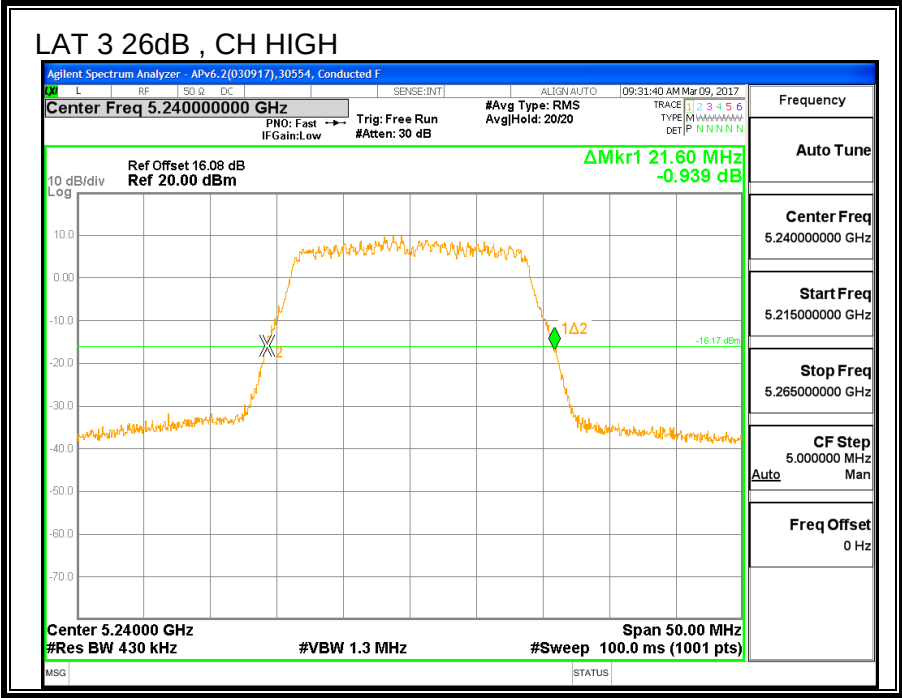
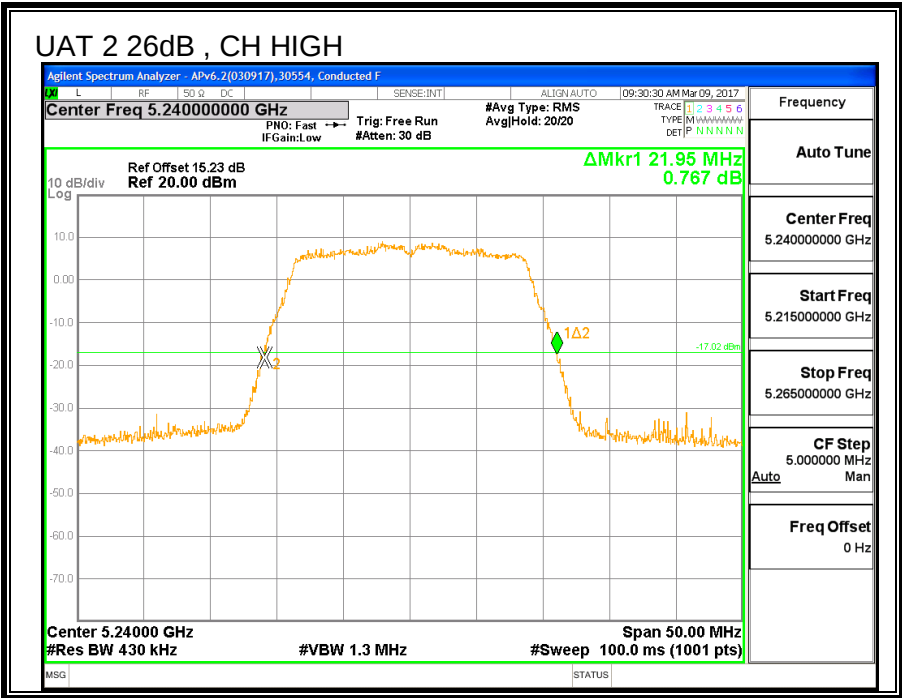
None; for reporting purposes only.

##### **RESULTS**

| Channel | Frequency | 26 dB BW<br>UAT 2 (MHz) | 26 dB BW<br>LAT 3 (MHz) |
|---------|-----------|-------------------------|-------------------------|
| Low     | 5180      | 22.05                   | 21.70                   |
| Mid     | 5200      | 22.10                   | 21.65                   |
| High    | 5240      | 21.95                   | 21.60                   |







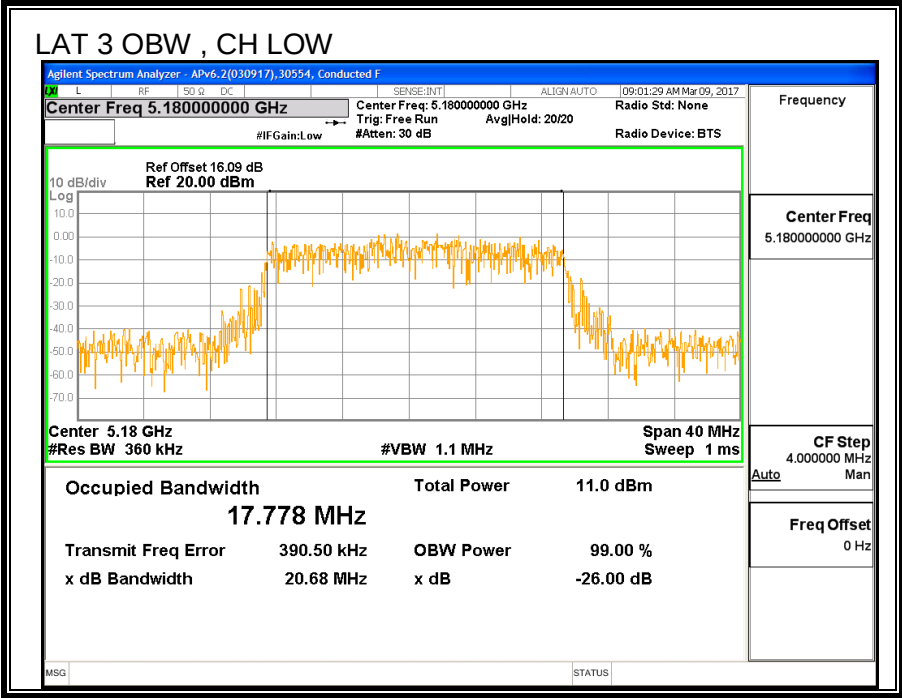
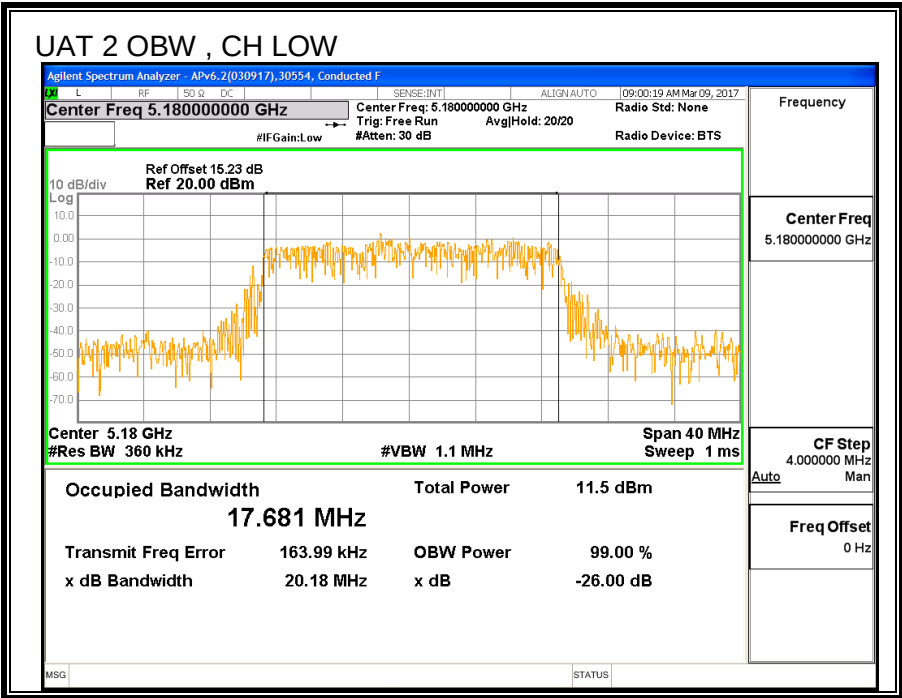
### 8.3.2. 99% BANDWIDTH

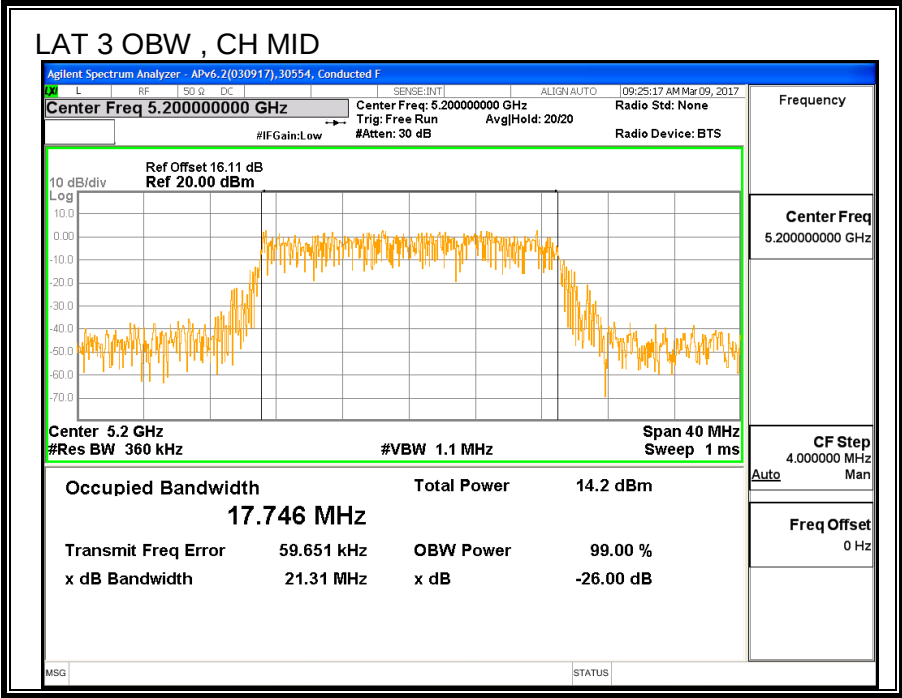
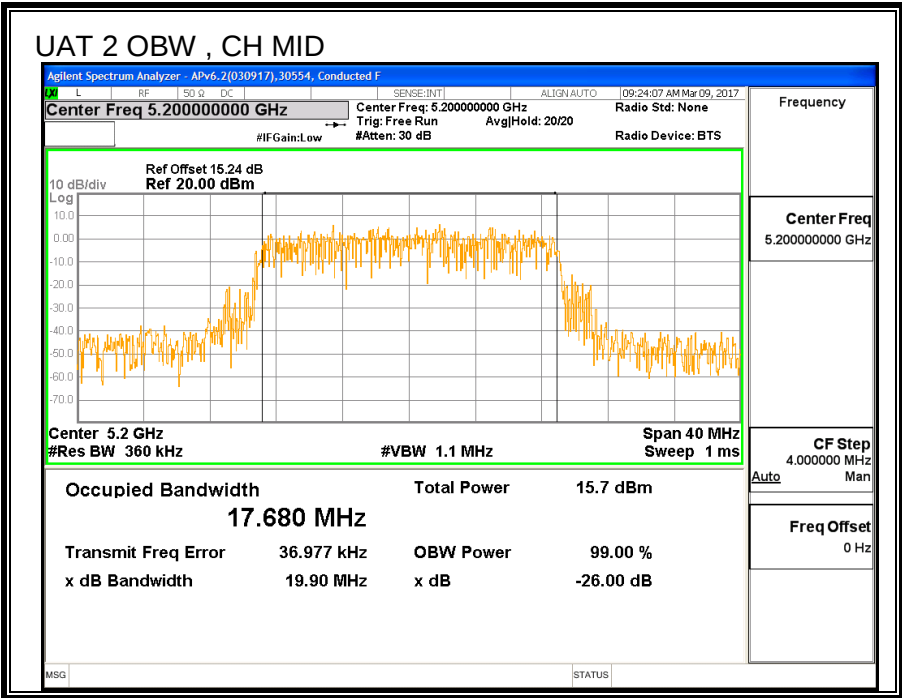
#### LIMITS

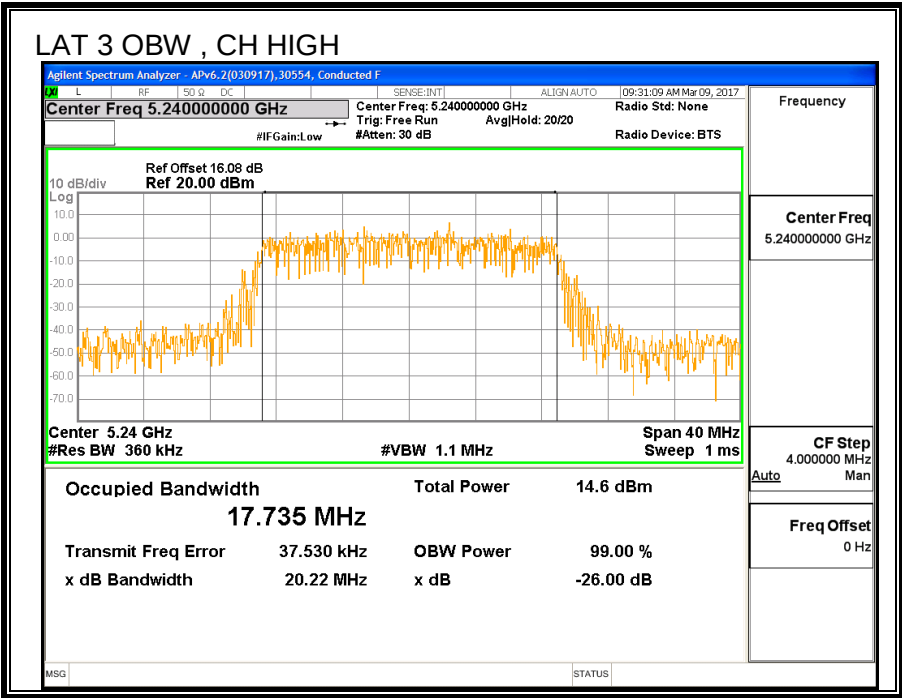
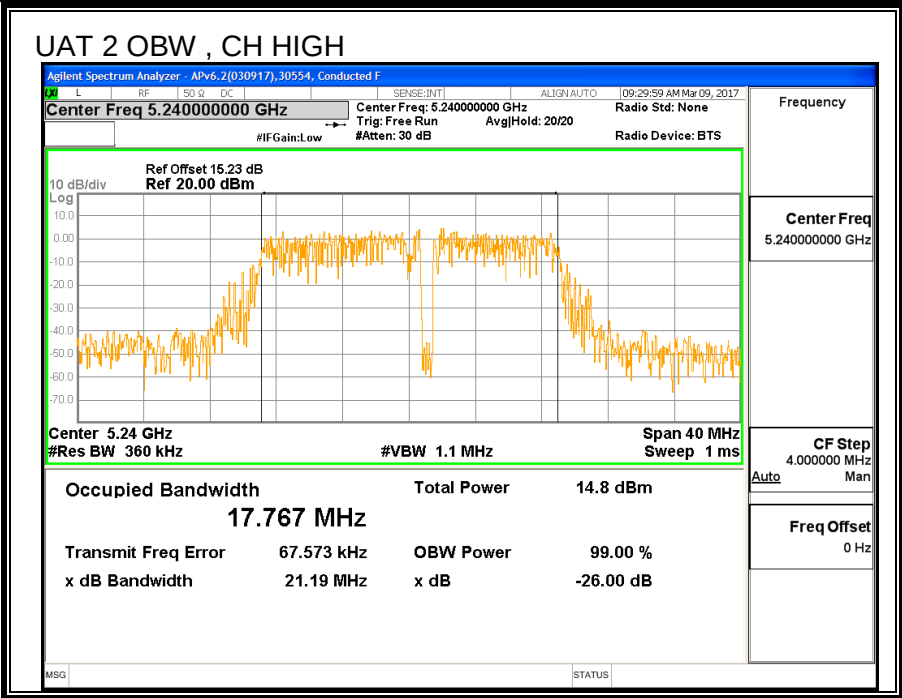
None; for reporting purposes only.

#### RESULTS

| Channel | Frequency | 99% BW<br>UAT 2 (MHz) | 99% BW<br>LAT 3 (MHz) |
|---------|-----------|-----------------------|-----------------------|
| Low     | 5180      | 17.681                | 17.778                |
| Mid     | 5200      | 17.680                | 17.746                |
| High    | 5240      | 17.767                | 17.735                |







### 8.3.3. AVERAGE POWER

|            |       |              |          |
|------------|-------|--------------|----------|
| <b>ID:</b> | 30554 | <b>Date:</b> | 3/8/2017 |
|------------|-------|--------------|----------|

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.

#### RESULTS

| Channel | Frequency | Power UAT 2 (dBm) | Power LAT 3 (dBm) | Total Power (dBm) |
|---------|-----------|-------------------|-------------------|-------------------|
| Low     | 5180      | 16.88             | 16.76             | 19.83             |
| Mid     | 5200      | 17.85             | 17.90             | 20.89             |
| High    | 5240      | 17.71             | 17.79             | 20.76             |

### 8.3.4. OUTPUT POWER AND PPSD

#### **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 colocated 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.

#### **TEST PROCEDURE**

Measurements perform using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

PSD Test Procedure: KDB 789033 D02 v01r04 Section F (Method SA-2)

**DIRECTIONAL ANTENNA GAIN**

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

| UAT 2<br>Antenna<br>Gain<br>(dBi) | LAT 3<br>Antenna<br>Gain<br>(dBi) | Uncorrelated Chains<br>Directional<br>Gain<br>(dBi) |
|-----------------------------------|-----------------------------------|-----------------------------------------------------|
| -4.61                             | -0.98                             | -2.43                                               |

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

| UAT 2<br>Antenna<br>Gain<br>(dBi) | LAT 3<br>Antenna<br>Gain<br>(dBi) | Correlated Chains<br>Directional<br>Gain<br>(dBi) |
|-----------------------------------|-----------------------------------|---------------------------------------------------|
| -4.61                             | -0.98                             | 0.40                                              |

## 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               | -2.43                                     | 0.40                                    | 24.00                   | 11.00                 |
| Mid     | 5200               | -2.43                                     | 0.40                                    | 24.00                   | 11.00                 |
| High    | 5240               | -2.43                                     | 0.40                                    | 24.00                   | 11.00                 |

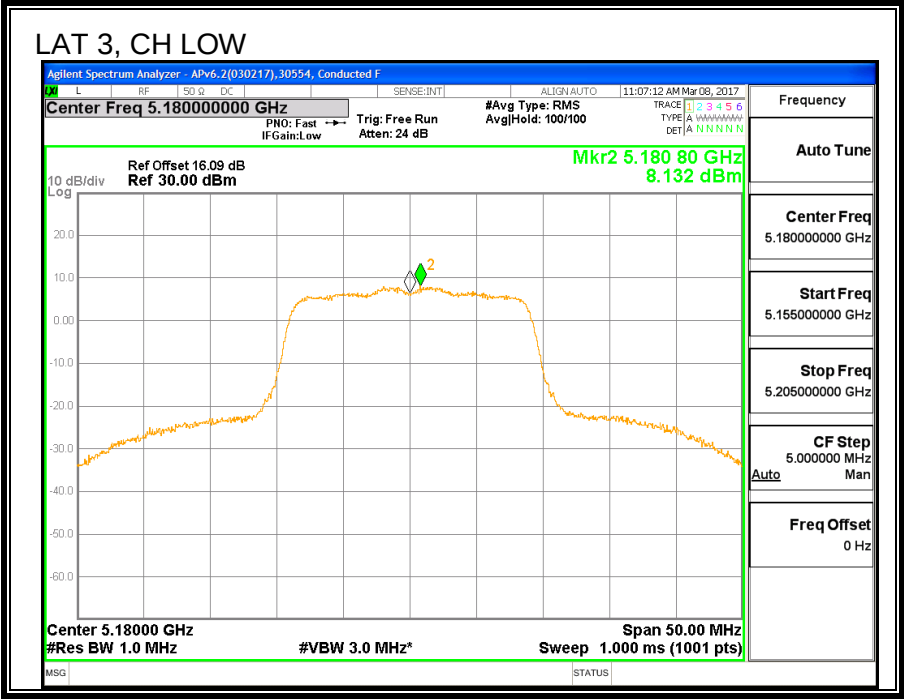
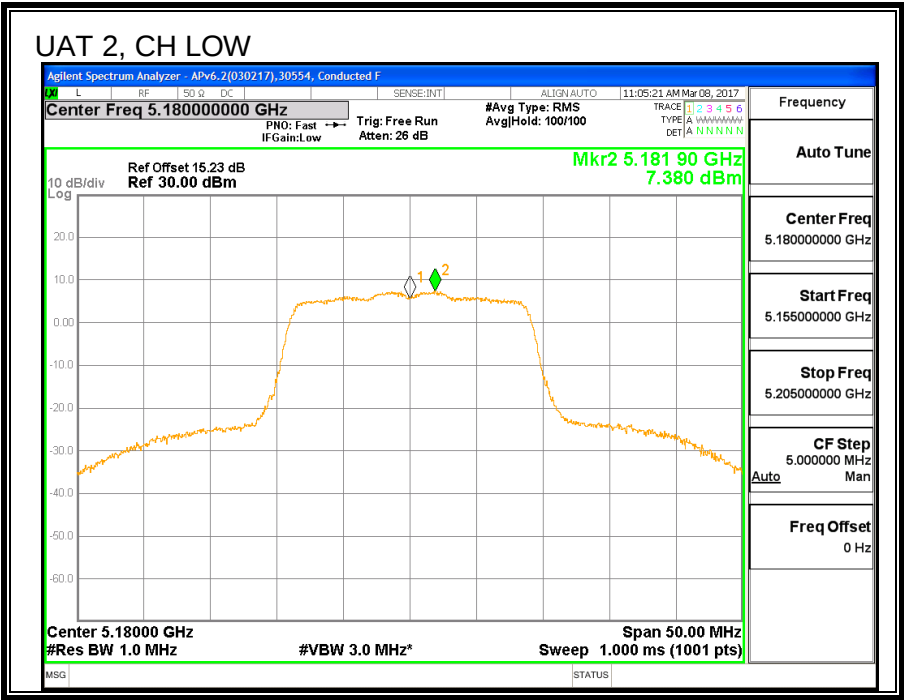
|                    |      |                                        |
|--------------------|------|----------------------------------------|
| Duty Cycle CF (dB) | 0.00 | Included in Calculations of Corr'd PSD |
|--------------------|------|----------------------------------------|

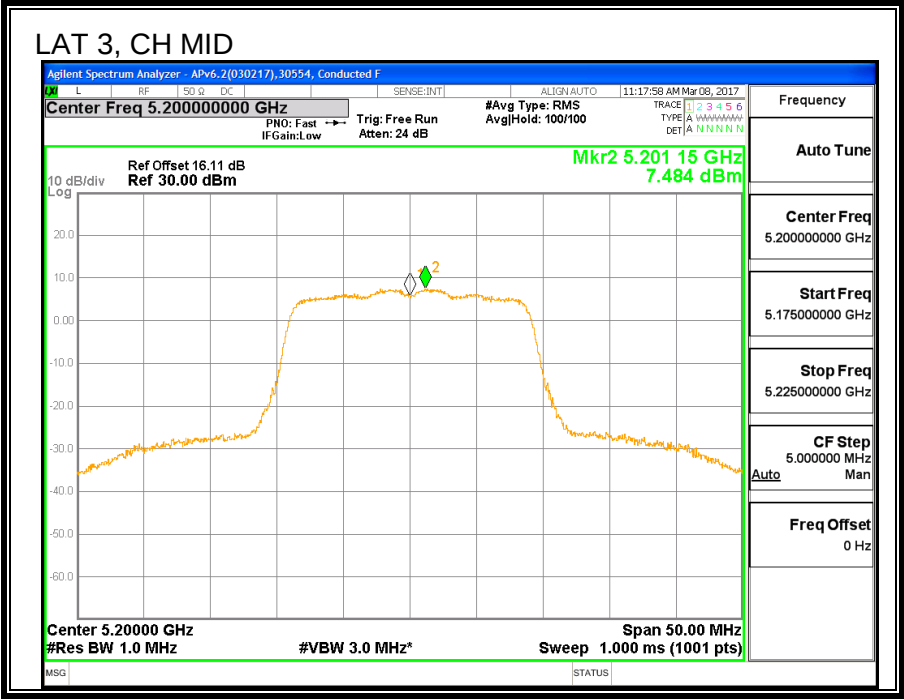
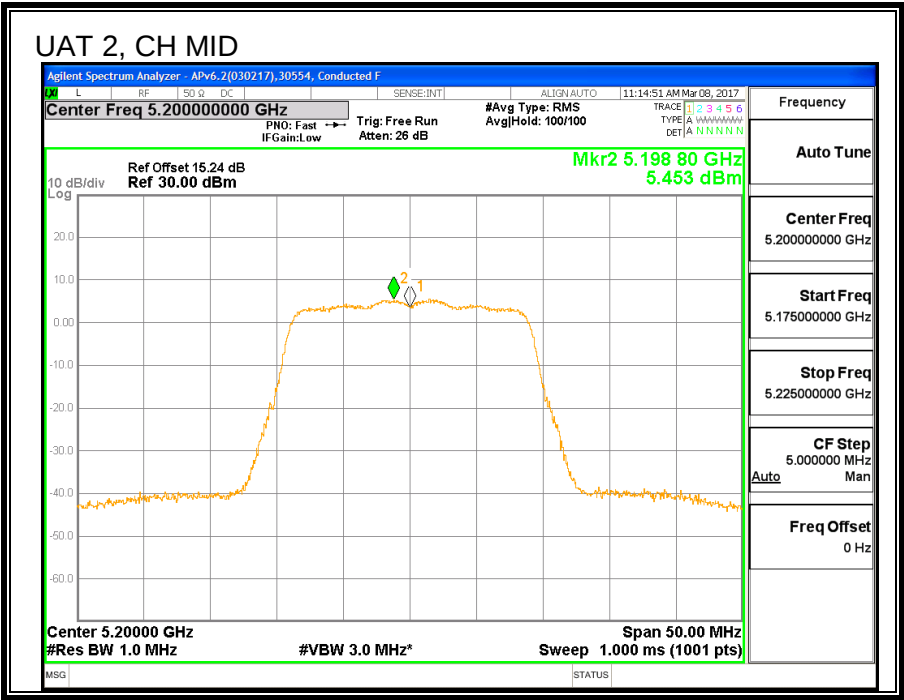
### Output Power Results

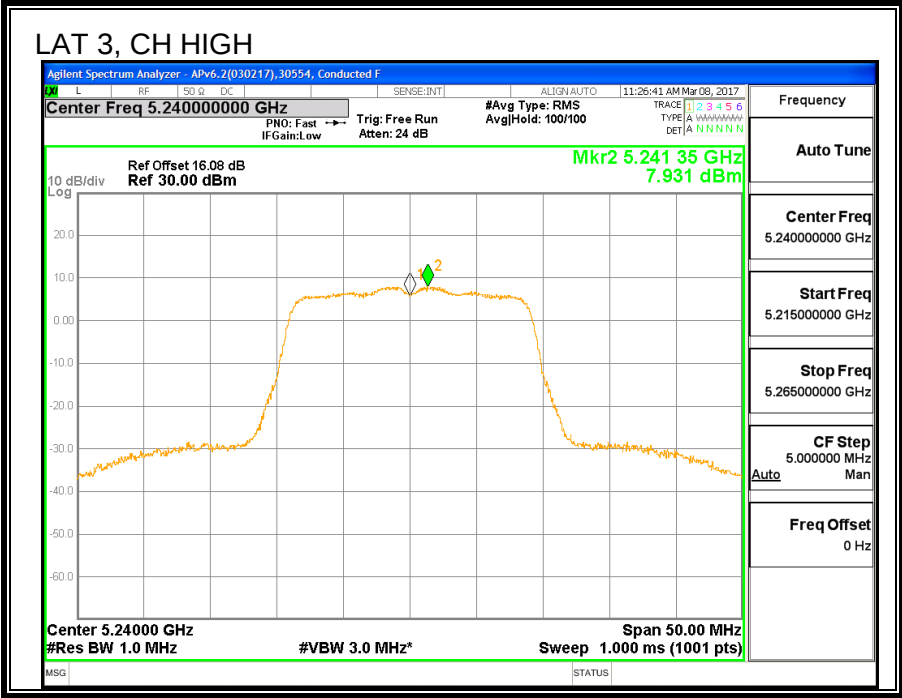
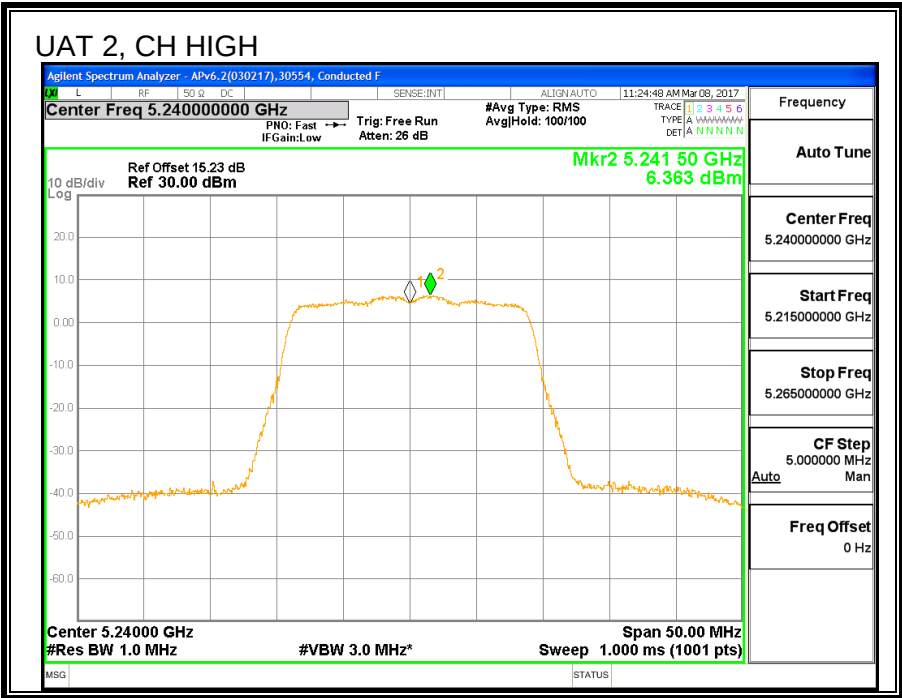
| Channel | Frequency<br>(MHz) | UAT 2<br>Meas<br>Power<br>(dBm) | LAT 3<br>Meas<br>Power<br>(dBm) | Total<br>Corr'd<br>Power<br>(dBm) | Power<br>Limit<br>(dBm) | Power<br>Margin<br>(dB) |
|---------|--------------------|---------------------------------|---------------------------------|-----------------------------------|-------------------------|-------------------------|
| Low     | 5180               | 16.88                           | 16.76                           | 19.83                             | 24.00                   | -4.17                   |
| Mid     | 5200               | 17.85                           | 17.90                           | 20.89                             | 24.00                   | -3.11                   |
| High    | 5240               | 17.71                           | 17.79                           | 20.76                             | 24.00                   | -3.24                   |

### PSD Results

| Channel | Frequency<br>(MHz) | UAT 2<br>Meas<br>PSD<br>(dBm/MHz) | LAT 3<br>Meas<br>PSD<br>(dBm/MHz) | Total<br>Corr'd<br>PSD<br>(dBm/MHz) | PSD<br>Limit<br>(dBm) | PSD<br>Margin<br>(dB) |
|---------|--------------------|-----------------------------------|-----------------------------------|-------------------------------------|-----------------------|-----------------------|
| Low     | 5180               | 7.38                              | 8.13                              | 10.78                               | 11.00                 | -0.22                 |
| Mid     | 5200               | 5.45                              | 7.48                              | 9.60                                | 11.00                 | -1.40                 |
| High    | 5240               | 6.36                              | 7.93                              | 10.23                               | 11.00                 | -0.77                 |







## **8.4. 11n HT40 UAT 2 SISO MODE IN THE 5.2GHz BAND**

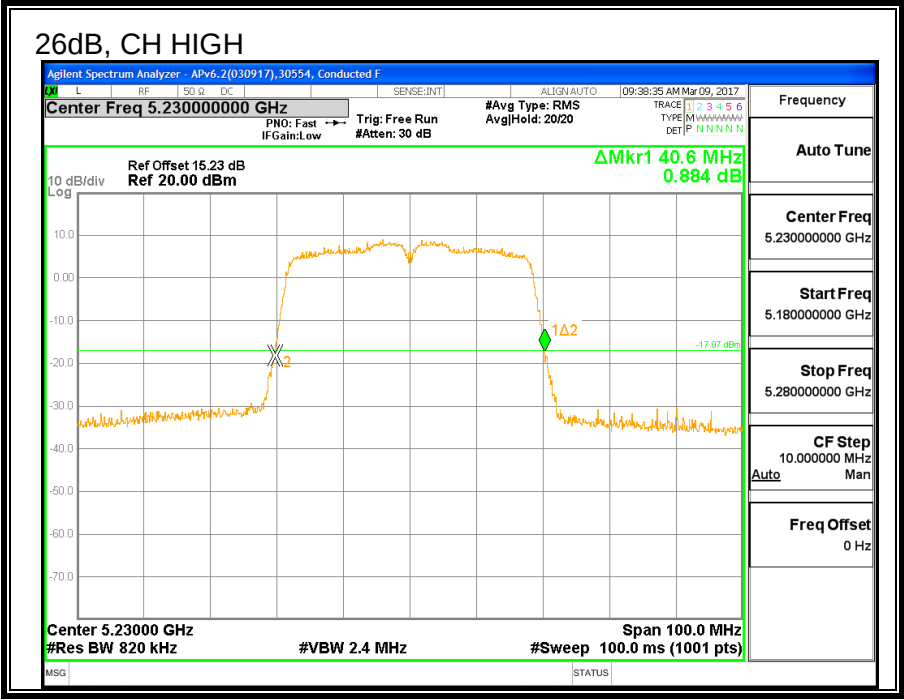
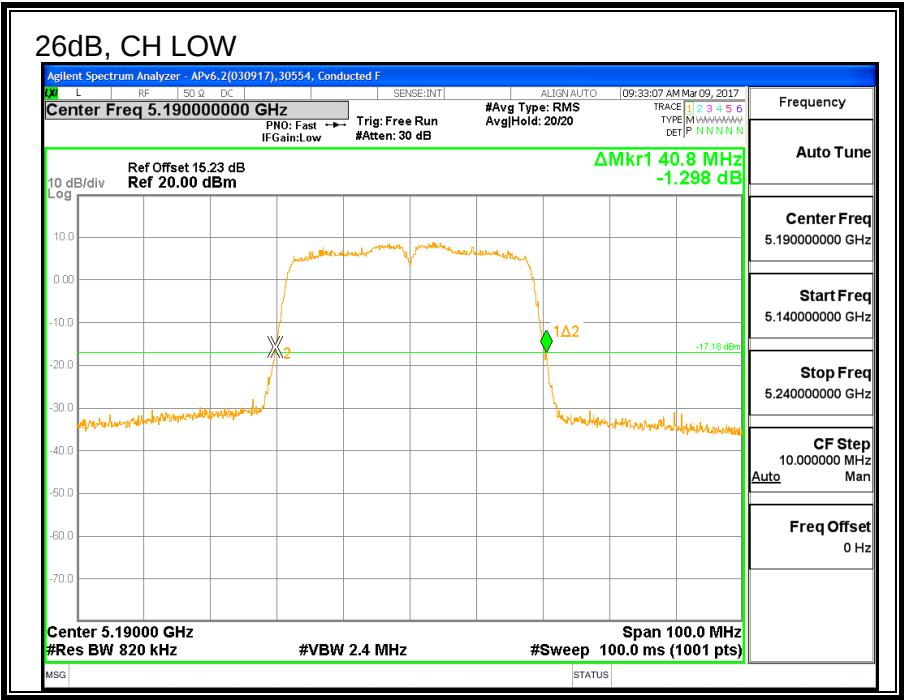
### **8.4.1. 26 dB BANDWIDTH**

#### **LIMITS**

None; for reporting purposes only.

#### **RESULTS**

| <b>Channel</b> | <b>Frequency</b> | <b>26 dB BW<br/>UAT 2 (MHz)</b> |
|----------------|------------------|---------------------------------|
| Low            | 5190             | 40.8                            |
| High           | 5230             | 40.6                            |



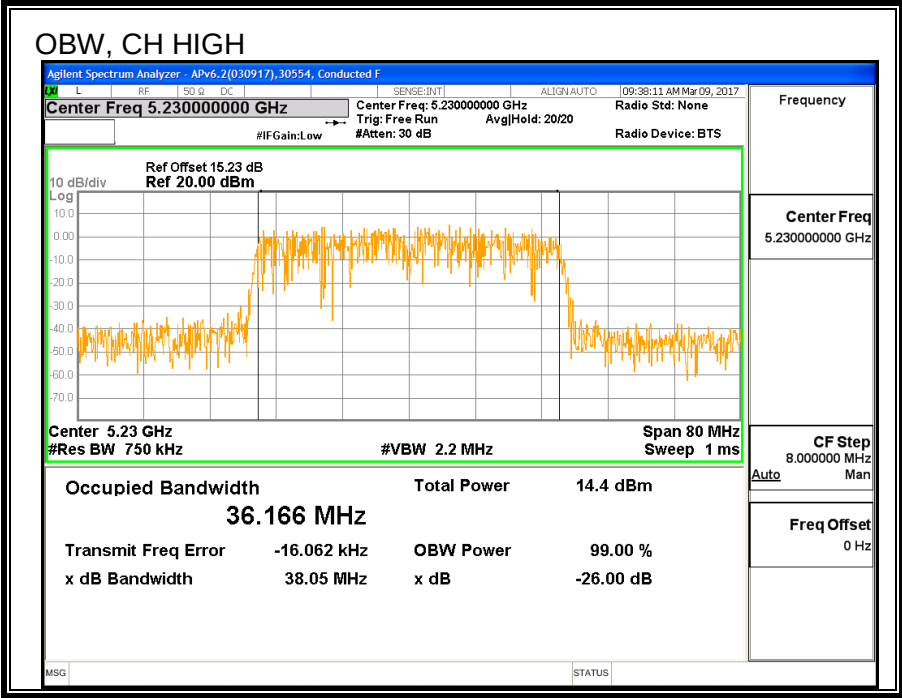
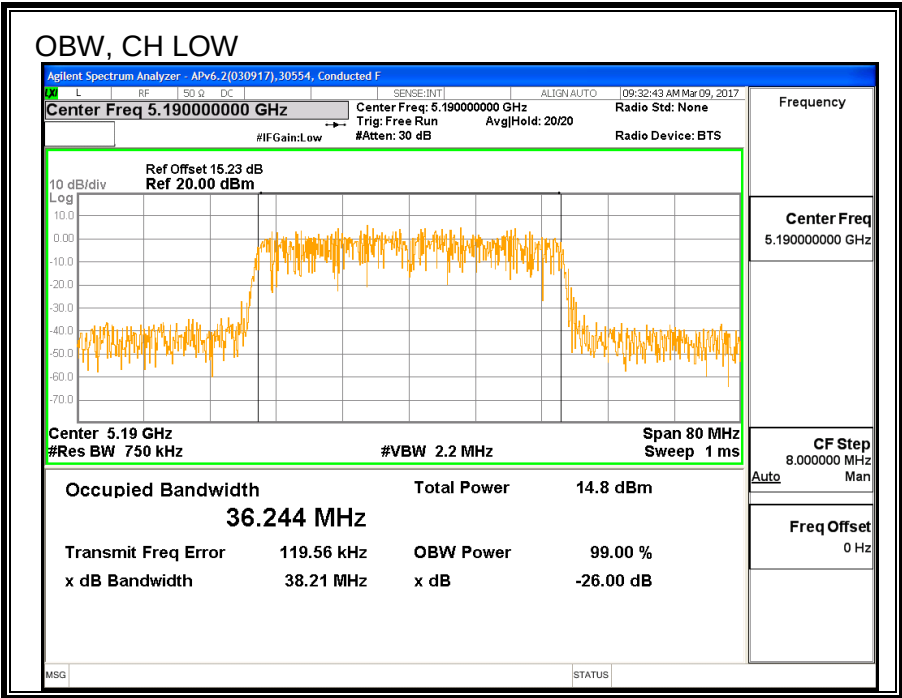
### 8.4.2. 99% BANDWIDTH

#### LIMITS

None; for reporting purposes only.

#### RESULTS

| Channel | Frequency | 99% BW UAT 2 (MHz) |
|---------|-----------|--------------------|
| Low     | 5190      | 36.244             |
| High    | 5230      | 36.166             |



### 8.4.3. AVERAGE POWER

|            |       |              |          |
|------------|-------|--------------|----------|
| <b>ID:</b> | 30554 | <b>Date:</b> | 3/8/2017 |
|------------|-------|--------------|----------|

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.

#### RESULTS

| Channel | Frequency | Power UAT<br>2 (dBm) |
|---------|-----------|----------------------|
| Low     | 5190      | 15.44                |
| High    | 5230      | 18.39                |

#### **8.4.4. OUTPUT POWER AND PPSD**

##### **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.

##### **TEST PROCEDURE**

Measurements perform using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

PSD Test Procedure: KDB 789033 D02 v01r04 Section F (Method SA-2)

##### **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               | -4.61                                     | -4.61                                   | 24.00                   | 11.00                 |
| High    | 5230               | -4.61                                     | -4.61                                   | 24.00                   | 11.00                 |

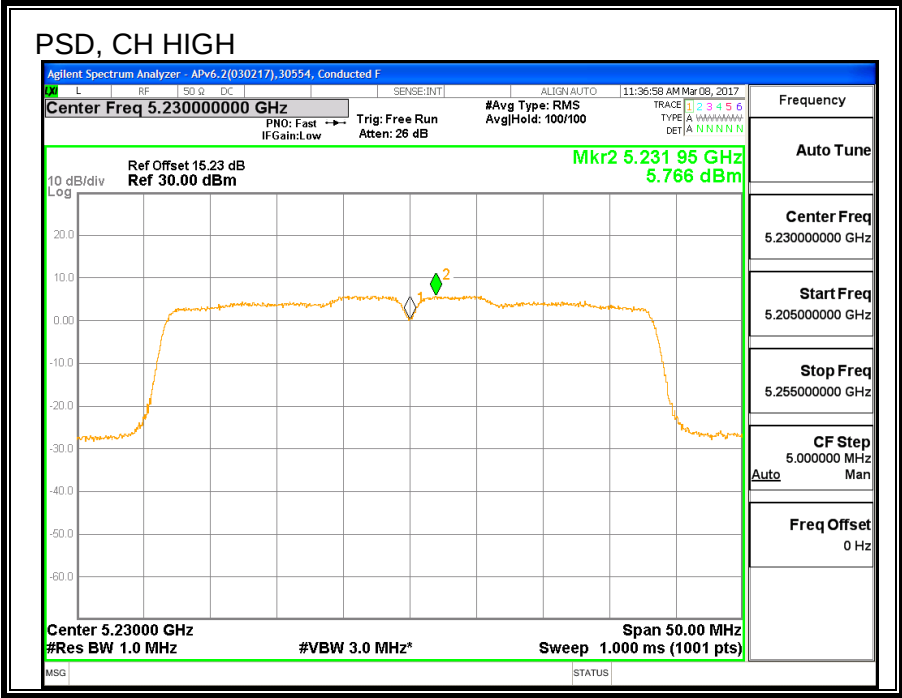
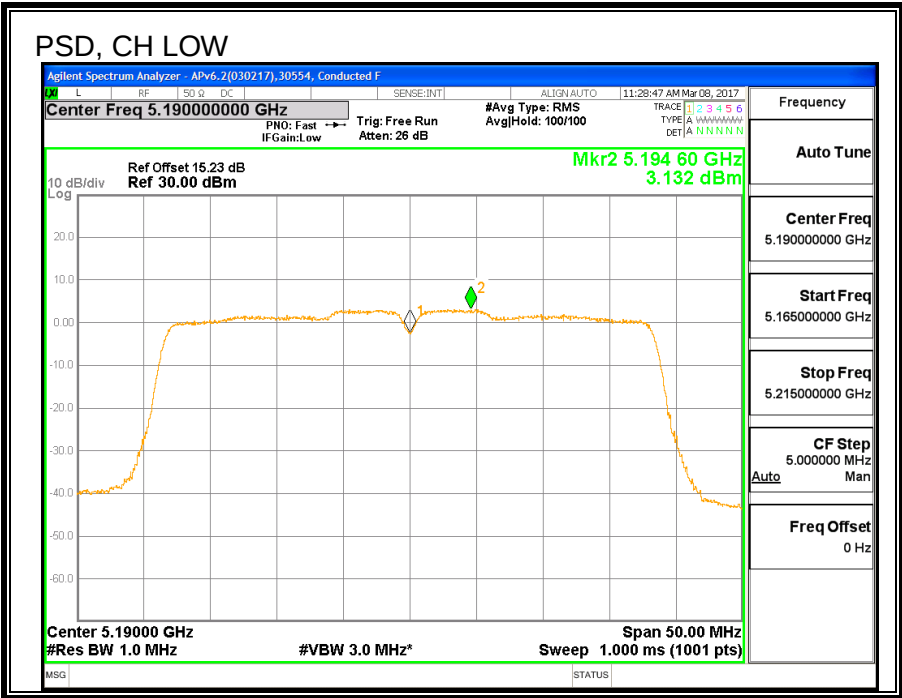
|                    |      |                                      |
|--------------------|------|--------------------------------------|
| Duty Cycle CF (dB) | 0.10 | Included in Calculations of Corr'PSD |
|--------------------|------|--------------------------------------|

### Output Power Results

| Channel | Frequency<br>(MHz) | UAT 2<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               | 15.44                           | 15.44                             | 24.00                   | -8.56                   |
| High    | 5230               | 18.39                           | 18.39                             | 24.00                   | -5.61                   |

### PSD Results

| Channel | Frequency<br>(MHz) | UAT 2<br>Meas<br>PSD<br>(dBm/MHz) | Total<br>Corr'd<br>PSD<br>(dBm/MHz) | PSD<br>Limit<br>(dBm/MHz) | PSD<br>Margin<br>(dB) |
|---------|--------------------|-----------------------------------|-------------------------------------|---------------------------|-----------------------|
| Low     | 5190               | 3.13                              | 3.23                                | 11.00                     | -7.77                 |
| High    | 5230               | 5.77                              | 5.87                                | 11.00                     | -5.13                 |



## **8.5. 11n HT40 LAT 3 SISO MODE IN THE 5.2GHz BAND**

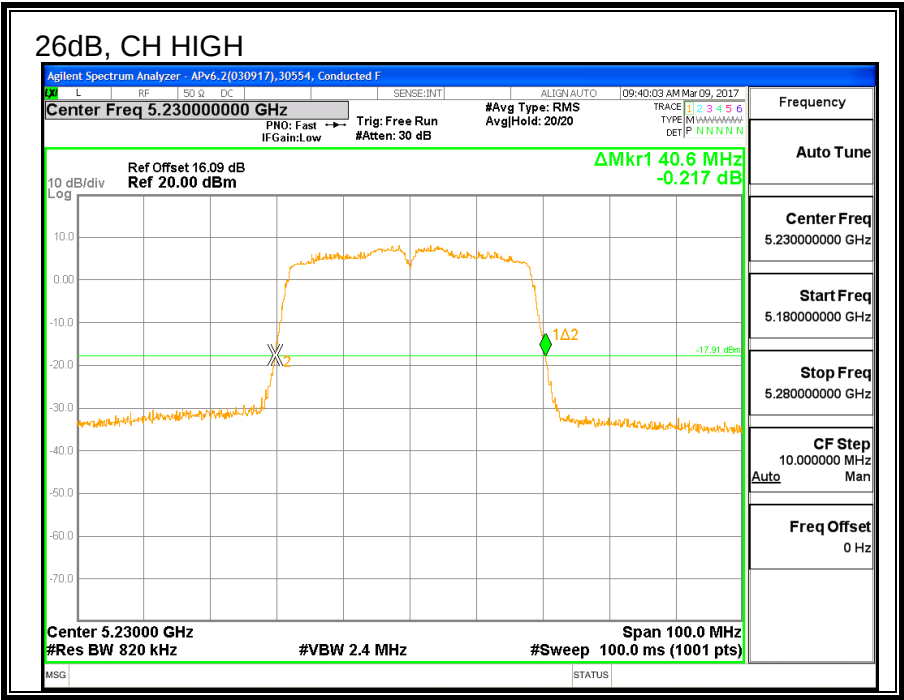
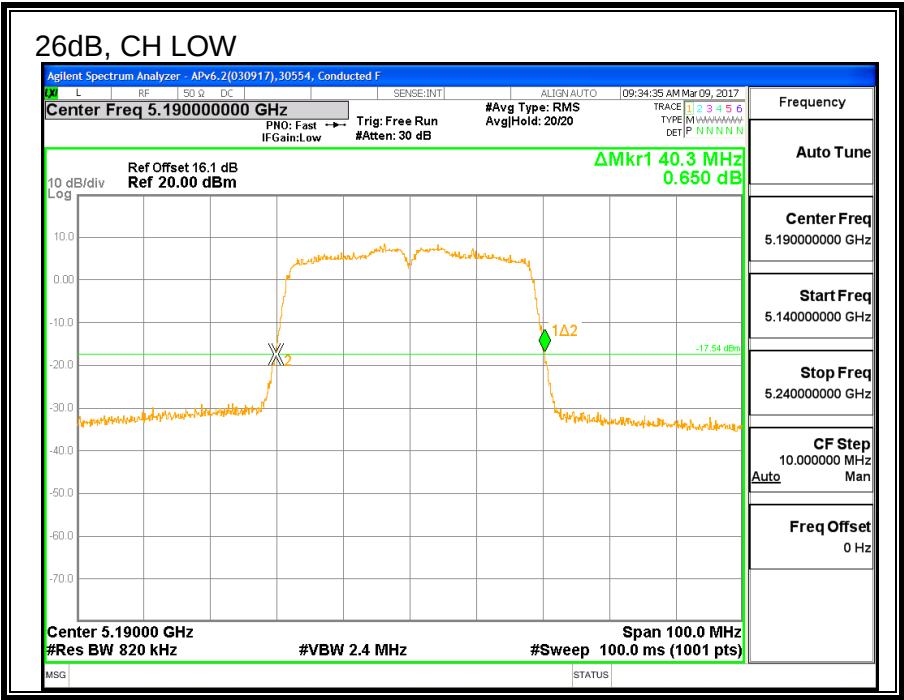
### **8.5.1. 26 dB BANDWIDTH**

#### **LIMITS**

None; for reporting purposes only.

#### **RESULTS**

| <b>Channel</b> | <b>Frequency</b> | <b>26 dB BW<br/>LAT 3 (MHz)</b> |
|----------------|------------------|---------------------------------|
| Low            | 5190             | 40.3                            |
| High           | 5230             | 40.6                            |



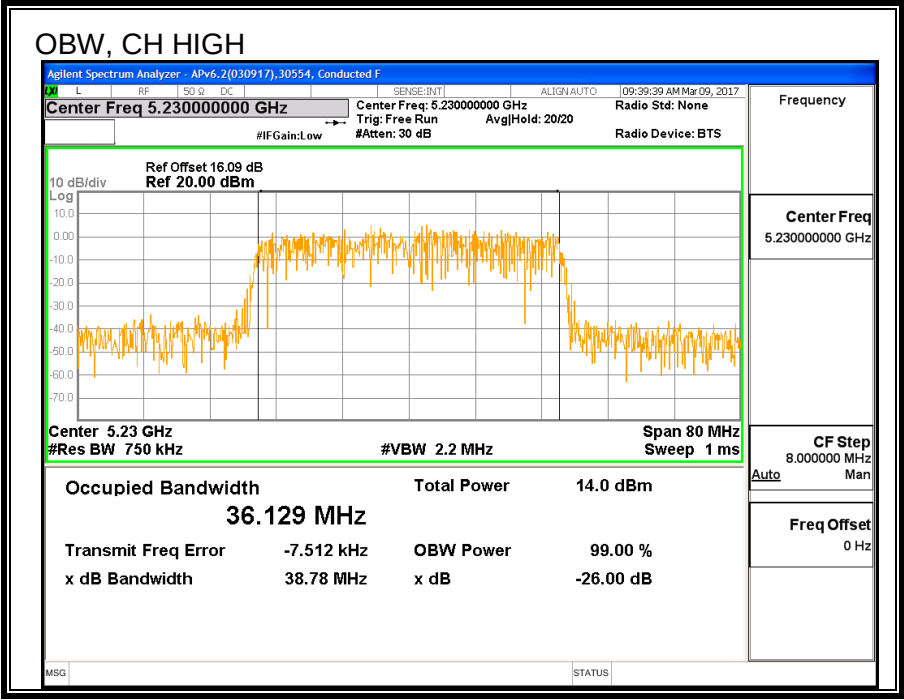
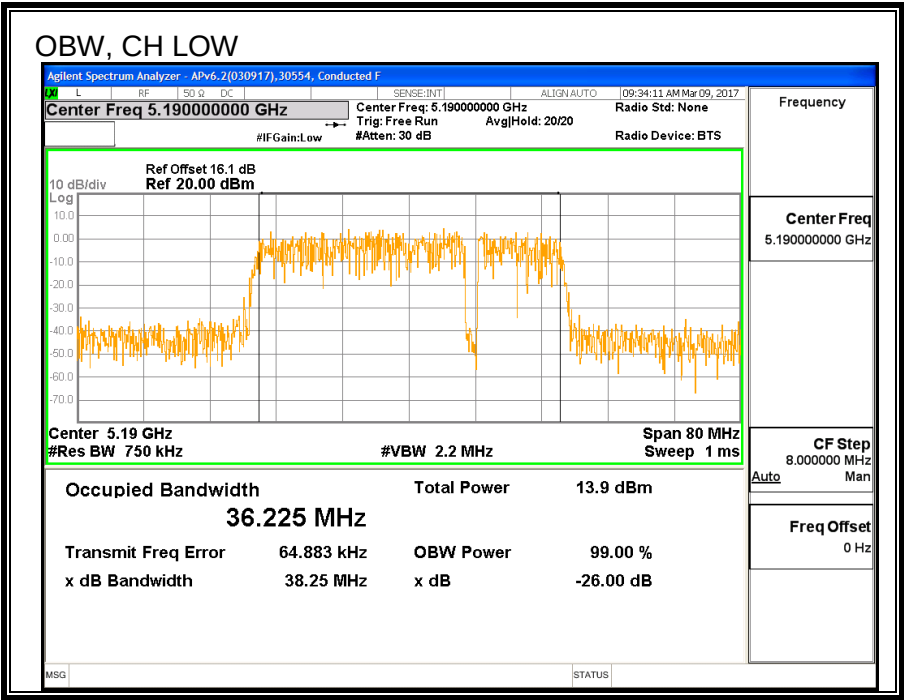
**8.5.2. 99% BANDWIDTH)**

**LIMITS**

None; for reporting purposes only.

**RESULTS**

| Channel | Frequency | 99% BW LAT 3 (MHz) |
|---------|-----------|--------------------|
| Low     | 5190      | 36.225             |
| High    | 5230      | 36.129             |



### 8.5.3. AVERAGE POWER

|            |       |              |          |
|------------|-------|--------------|----------|
| <b>ID:</b> | 30554 | <b>Date:</b> | 3/8/2017 |
|------------|-------|--------------|----------|

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.

#### RESULTS

| Channel | Frequency | Power LAT<br>3 (dBm) |
|---------|-----------|----------------------|
| Low     | 5190      | 15.42                |
| High    | 5230      | 18.39                |

## **8.5.4. OUTPUT POWER AND PPSD**

### **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 colocated 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.

### **TEST PROCEDURE**

Measurements perform using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

PSD Test Procedure: KDB 789033 D02 v01r04 Section F (Method SA-2)

### **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               | -0.98                                     | -0.98                                   | 24.00                   | 11.00                 |
| High    | 5230               | -0.98                                     | -0.98                                   | 24.00                   | 11.00                 |

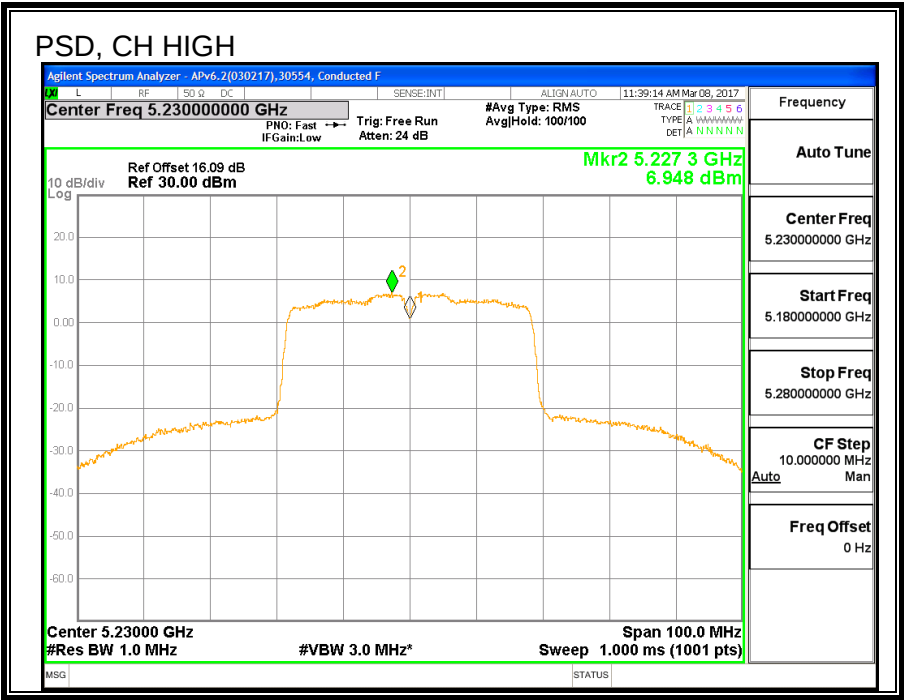
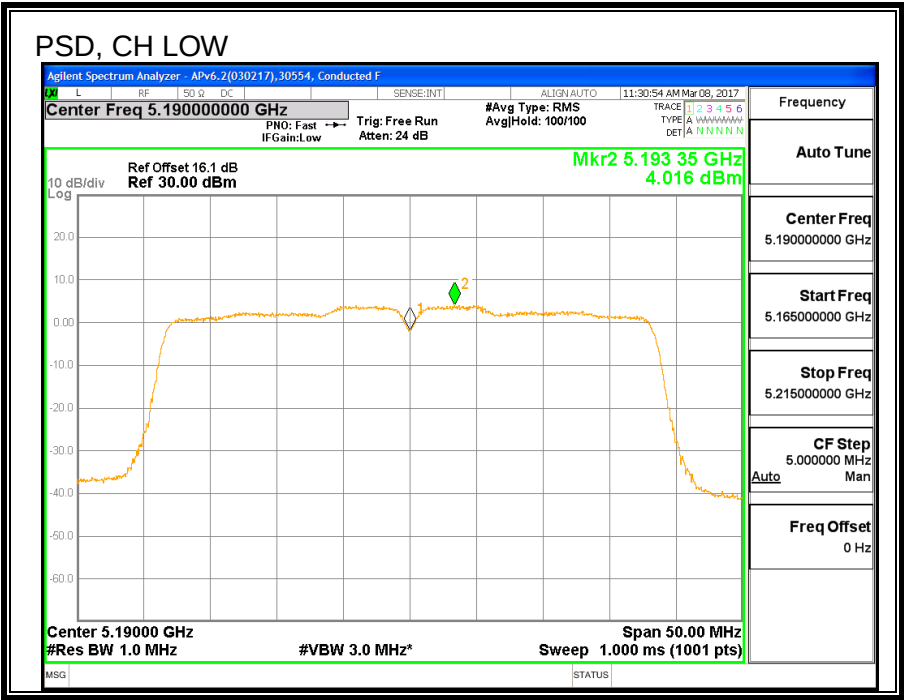
|                    |      |                                      |
|--------------------|------|--------------------------------------|
| Duty Cycle CF (dB) | 0.10 | Included in Calculations of Corr'PSD |
|--------------------|------|--------------------------------------|

### Output Power Results

| Channel | Frequency<br>(MHz) | LAT 3<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               | 15.42                           | 15.42                             | 24.00                   | -8.58                   |
| High    | 5230               | 18.39                           | 18.39                             | 24.00                   | -5.61                   |

### PSD Results

| Channel | Frequency<br>(MHz) | LAT 3<br>Meas<br>PSD<br>(dBm/MHz) | Total<br>Corr'd<br>PSD<br>(dBm/MHz) | PSD<br>Limit<br>(dBm/MHz) | PSD<br>Margin<br>(dB) |
|---------|--------------------|-----------------------------------|-------------------------------------|---------------------------|-----------------------|
| Low     | 5190               | 4.02                              | 4.12                                | 11.00                     | -6.88                 |
| High    | 5230               | 6.95                              | 7.05                                | 11.00                     | -3.95                 |



## **8.6. 11n HT40 2TX CDD MIMO MODE IN THE 5.2GHz BAND**

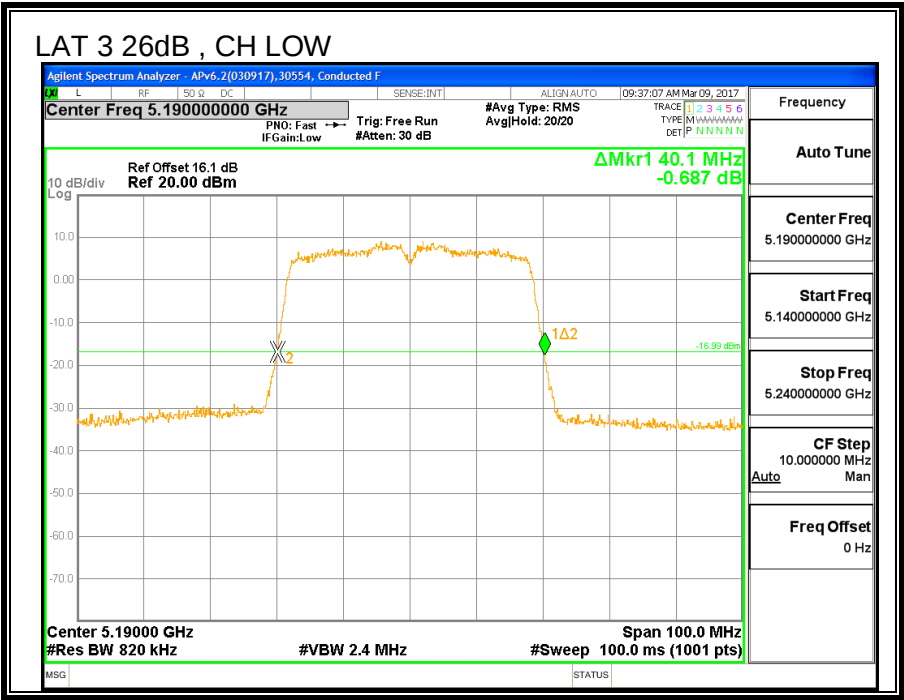
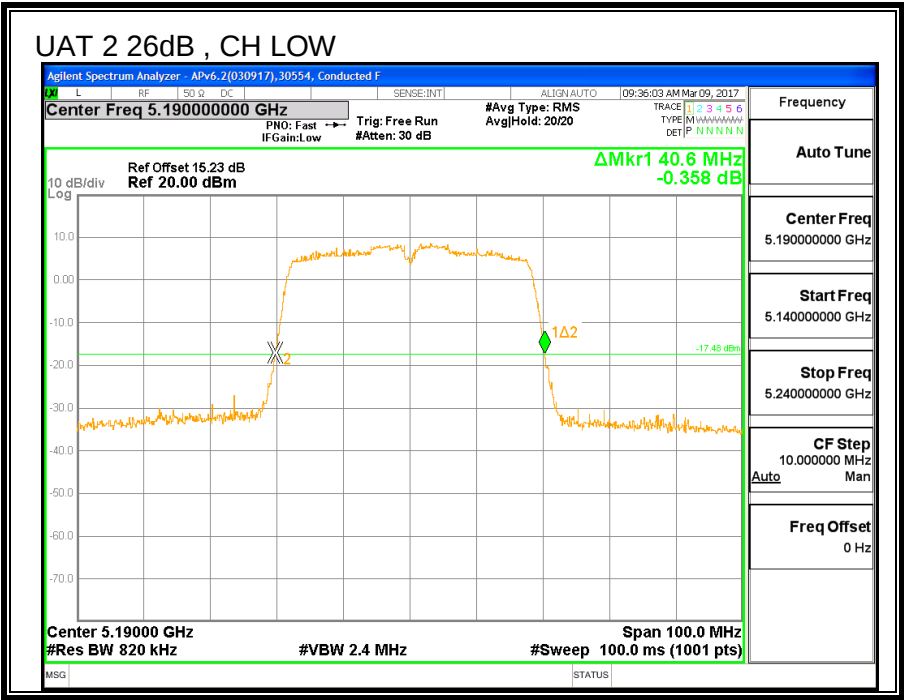
### **8.6.1. 26 dB BANDWIDTH**

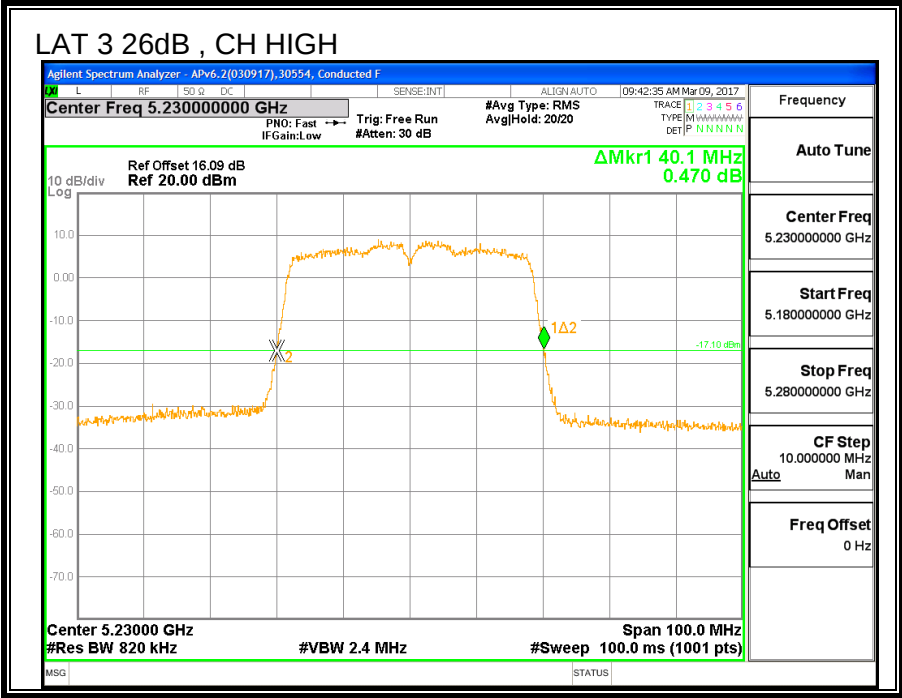
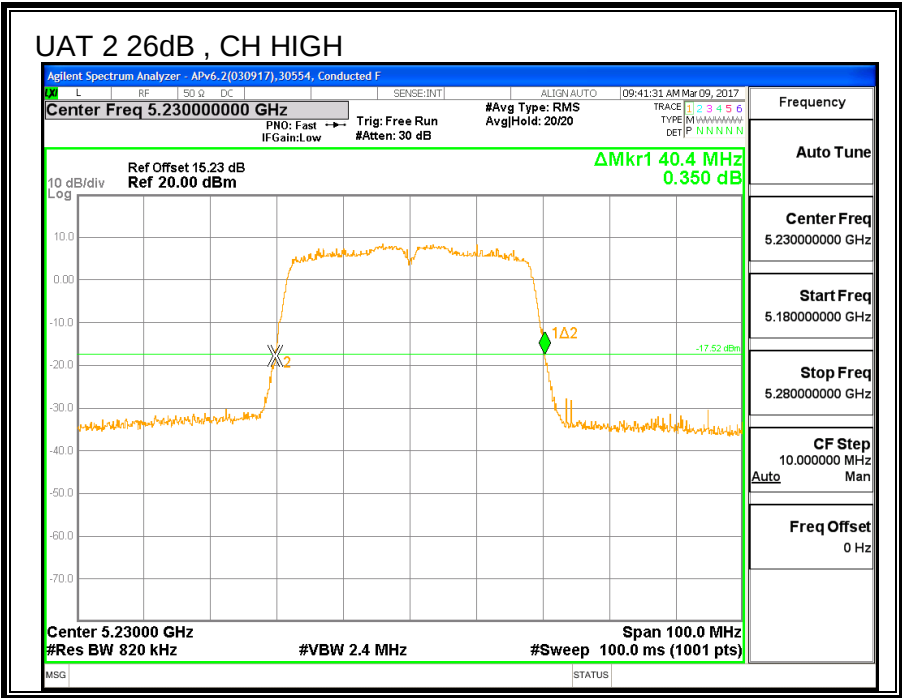
#### **LIMITS**

None; for reporting purposes only.

#### **RESULTS**

| <b>Channel</b> | <b>Frequency</b> | <b>26 dB BW<br/>UAT 2<br/>(MHz)</b> | <b>26 dB BW<br/>LAT 3<br/>(MHz)</b> |
|----------------|------------------|-------------------------------------|-------------------------------------|
| Low            | 5190             | 40.6                                | 40.1                                |
| High           | 5230             | 40.4                                | 40.1                                |





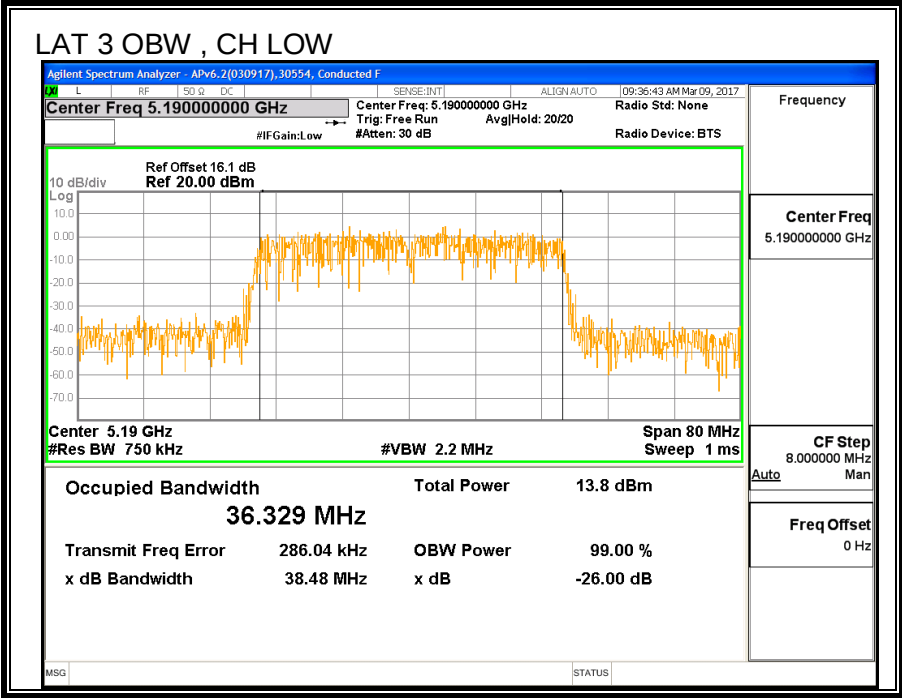
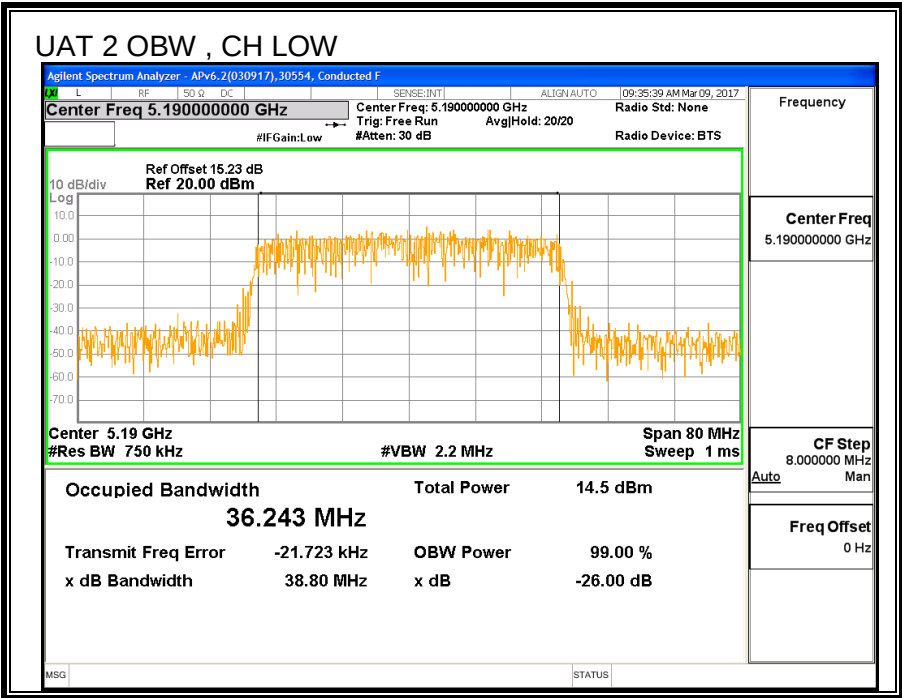
## 8.6.2. 99% BANDWIDTH

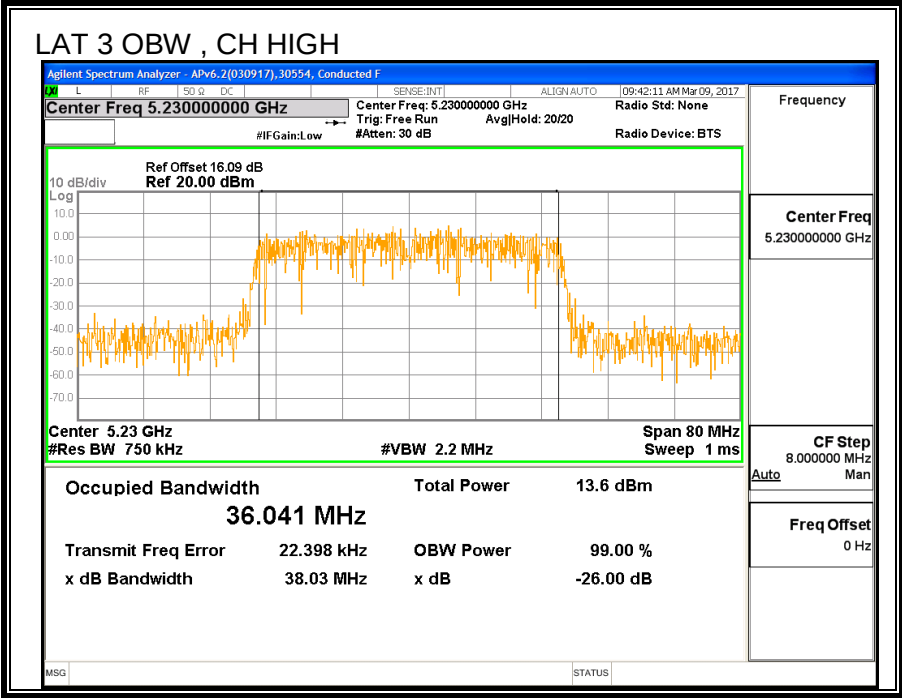
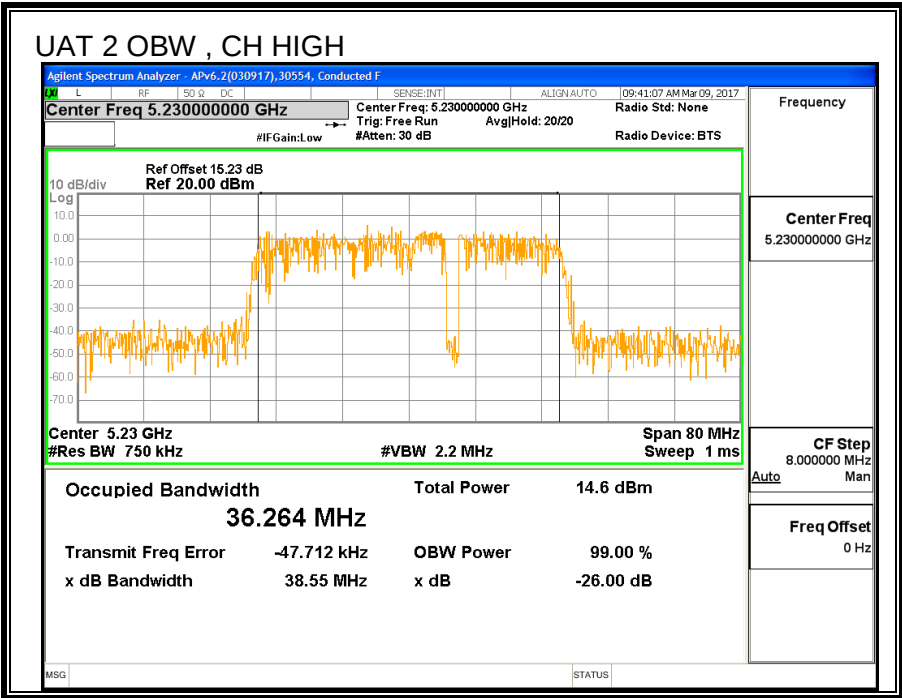
### LIMITS

None; for reporting purposes only.

### RESULTS

| Channel | Frequency | 99% BW<br>UAT 2<br>(MHz) | 99% BW<br>LAT 3<br>(MHz) |
|---------|-----------|--------------------------|--------------------------|
| Low     | 5190      | 36.243                   | 36.329                   |
| High    | 5230      | 36.264                   | 36.041                   |





### 8.6.3. AVERAGE POWER

|            |       |              |          |
|------------|-------|--------------|----------|
| <b>ID:</b> | 30554 | <b>Date:</b> | 3/8/2017 |
|------------|-------|--------------|----------|

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.

#### RESULTS

##### Average Power Results

| Channel | Frequency<br>(MHz) | UAT 2<br>Power<br>(dBm) | LAT 3<br>Power<br>(dBm) | Total<br>Power<br>(dBm) |
|---------|--------------------|-------------------------|-------------------------|-------------------------|
| Low     | 5190               | 13.78                   | 13.85                   | 16.83                   |
| High    | 5230               | 18.44                   | 18.39                   | 21.43                   |

## 8.6.4. OUTPUT POWER AND PPSD

### 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.

### TEST PROCEDURE

Measurements perform using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

PSD Test Procedure: KDB 789033 D02 v01r04 Section F (Method SA-2)

# **DIRECTIONAL ANTENNA GAIN**

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

| UAT 2<br>Antenna<br>Gain<br>(dBi) | LAT 3<br>Antenna<br>Gain<br>(dBi) | Uncorrelated Chains<br>Directional<br>Gain<br>(dBi) |
|-----------------------------------|-----------------------------------|-----------------------------------------------------|
| -4.61                             | -0.98                             | -2.43                                               |

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

| UAT 2<br>Antenna<br>Gain<br>(dBi) | LAT 3<br>Antenna<br>Gain<br>(dBi) | Correlated Chains<br>Directional<br>Gain<br>(dBi) |
|-----------------------------------|-----------------------------------|---------------------------------------------------|
| -4.61                             | -0.98                             | 0.40                                              |

## 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               | -2.43                                     | 0.40                                    | 24.00                   | 11.00                 |
| High    | 5230               | -2.43                                     | 0.40                                    | 24.00                   | 11.00                 |

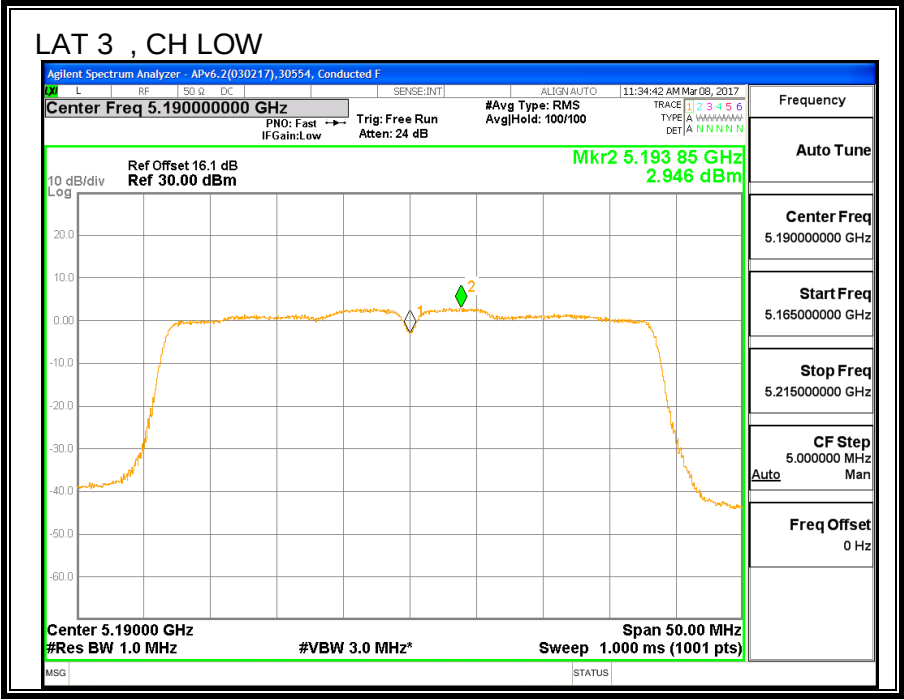
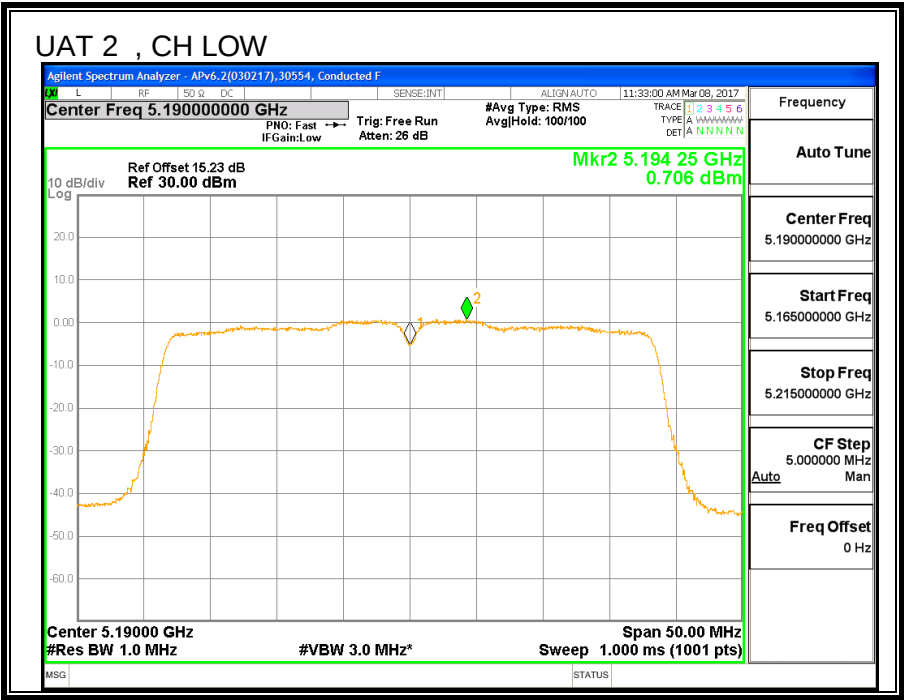
|                    |      |                                        |
|--------------------|------|----------------------------------------|
| Duty Cycle CF (dB) | 0.10 | Included in Calculations of Corr'd PSD |
|--------------------|------|----------------------------------------|

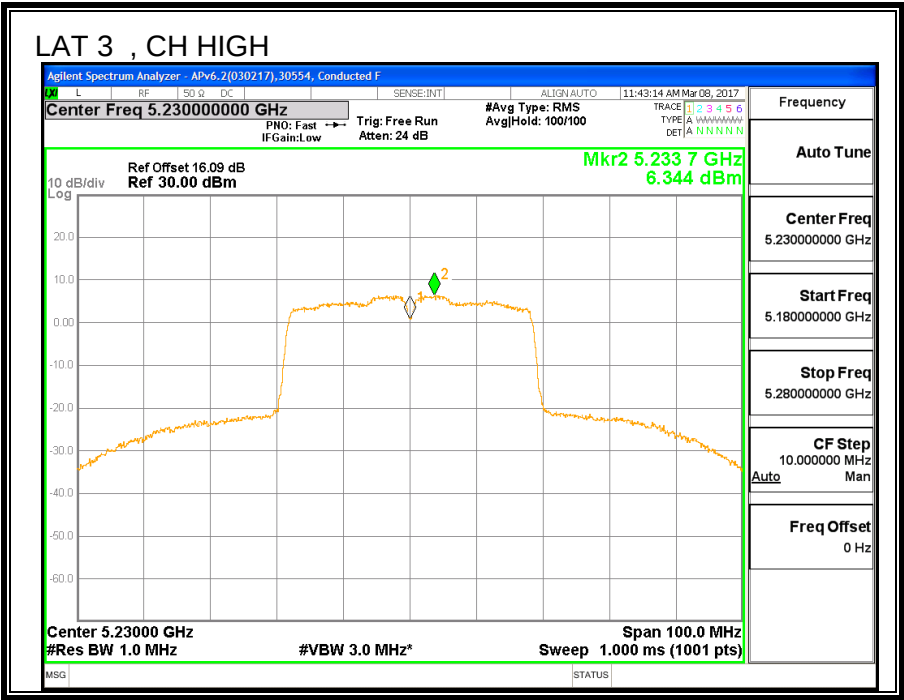
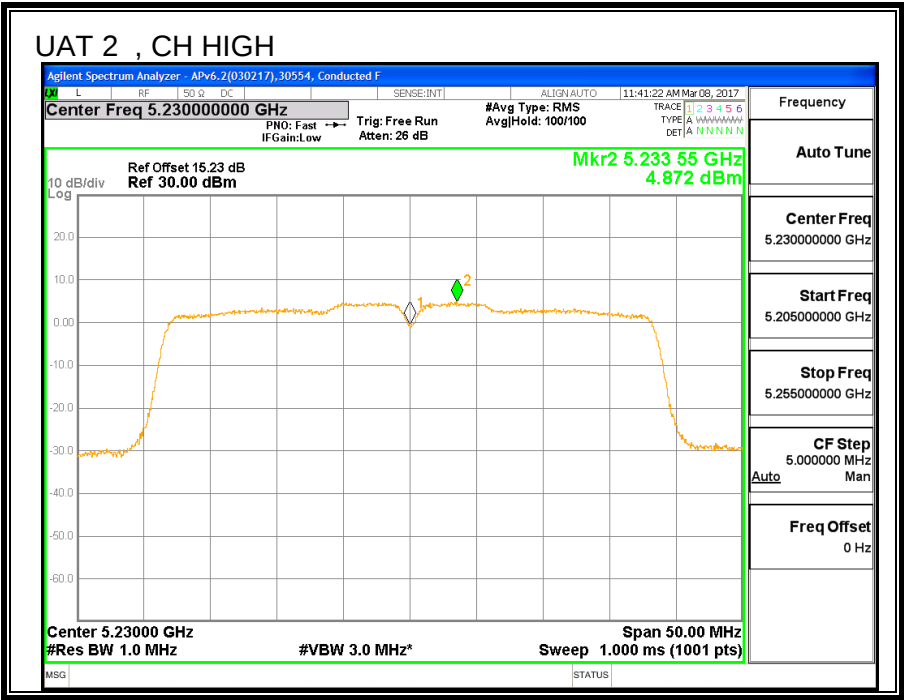
### Output Power Results

| Channel | Frequency<br>(MHz) | UAT 2<br>Meas<br>Power<br>(dBm) | LAT 3<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               | 13.78                           | 13.85                           | 16.83                             | 24.00                   | -7.17                   |
| High    | 5230               | 18.44                           | 18.39                           | 21.43                             | 24.00                   | -2.57                   |

### PSD Results

| Channel | Frequency<br>(MHz) | UAT 2<br>Meas<br>PSD<br>(dBm/MHz) | LAT 3<br>Meas<br>PSD<br>(dBm/MHz) | Total<br>Corr'd<br>PSD<br>(dBm/MHz) | PSD<br>Limit<br>(dBm/MHz) | PSD<br>Margin<br>(dB) |
|---------|--------------------|-----------------------------------|-----------------------------------|-------------------------------------|---------------------------|-----------------------|
| Low     | 5190               | 0.71                              | 2.95                              | 5.08                                | 11.00                     | -5.92                 |
| High    | 5230               | 4.87                              | 6.34                              | 8.78                                | 11.00                     | -2.22                 |





## **8.7. 11ac HT80 UAT 2 SISO MODE IN THE 5.2GHz BAND**

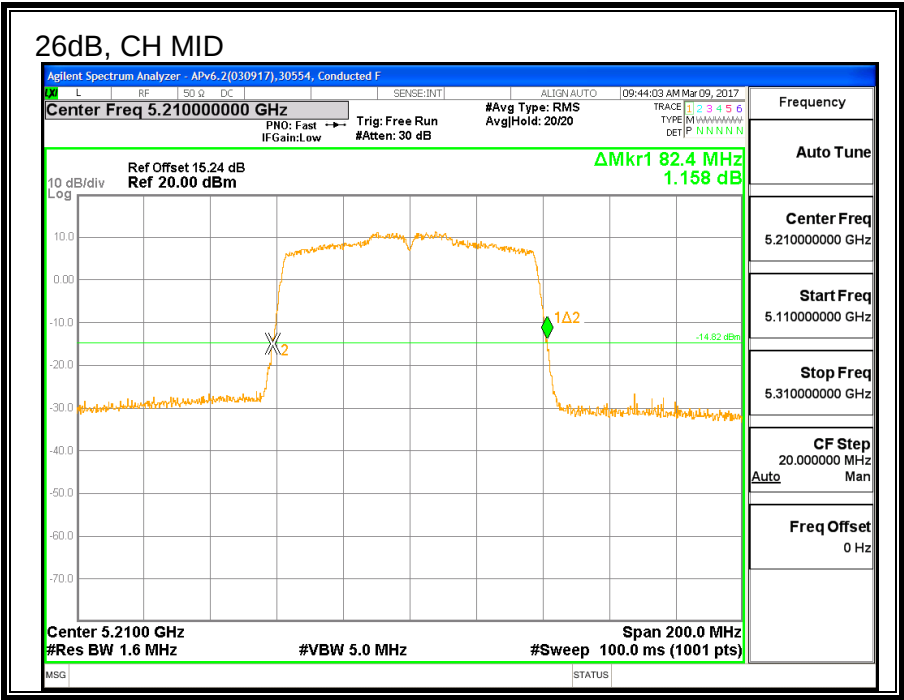
### **8.7.1. 26 dB BANDWIDTH**

#### **LIMITS**

None; for reporting purposes only.

#### **RESULTS**

| <b>Channel</b> | <b>Frequency</b> | <b>26 dB BW<br/>UAT 2<br/>(MHz)</b> |
|----------------|------------------|-------------------------------------|
| Mid            | 5210             | 82.4                                |



### 8.7.2. 99% BANDWIDTH

#### LIMITS

None; for reporting purposes only.

#### RESULTS

| Channel | Frequency | 99% BW<br>UAT 2<br>(MHz) |
|---------|-----------|--------------------------|
| Mid     | 5210      | 75.424                   |

