



## CERTIFICATION TEST REPORT

**Report No. :** 15U21863-E1V4

**Applicant :** GOOGLE  
1600 AMPHITHEATRE PARKWAY  
MOUNTAIN VIEW, CA 94043, U.S.A

**Model :** GFRG250

**FCC ID :** A4RGFRG250

**EUT Description :** STORAGE NETWORK BOX II, 2TB HD, WIFI AP

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

**Date of Issue:**  
November 10<sup>th</sup>, 2016

**Prepared by:**  
UL Verification Services Inc.  
47173 Benicia Street  
Fremont, CA 94538, U.S.A.  
TEL: (510) 771-1000  
FAX: (510) 661-0888



NVLAP LAB CODE 200065-0

## REVISION HISTORY

| Rev. | Issue Date | Revisions                                                                                                                                                                                                                                                                   | Revised By        |
|------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| V1   | 09/29/2016 | Initial Issue                                                                                                                                                                                                                                                               | ---               |
| V2   | 10/07/2016 | Updated section 5                                                                                                                                                                                                                                                           | ---               |
| V3   | 11/02/2016 | <ul style="list-style-type: none"><li>Updated power in sections 4.5.6 – 4.5.8 and 5.1.6 – 5.1.8 for channels 149, 151 and 155 for BF 1 stream mode.</li><li>Updated power in sections 4.5.7, 4.5.8, 5.1.7 and 5.1.8 for channels 151 and 155 for BF 3 stream mode</li></ul> | Clifford Susa     |
| V4   | 11/10/2016 | Updated section 3.1.                                                                                                                                                                                                                                                        | Francisco de Anda |

## TABLE OF CONTENTS

|                                                             |           |
|-------------------------------------------------------------|-----------|
| <b>REVISION HISTORY .....</b>                               | <b>2</b>  |
| <b>TABLE OF CONTENTS .....</b>                              | <b>3</b>  |
| <b>1. ATTESTATION OF TEST RESULTS .....</b>                 | <b>5</b>  |
| <b>2. SUMMARY OF TESTING .....</b>                          | <b>6</b>  |
| 2.1. <i>FACILITIES AND ACCREDITATION .....</i>              | <i>6</i>  |
| 2.2. <i>TEST METHODOLOGY.....</i>                           | <i>6</i>  |
| 2.3. <i>CALIBRATION AND UNCERTAINTY .....</i>               | <i>7</i>  |
| 2.4. <i>MEASUREMENT METHOD.....</i>                         | <i>8</i>  |
| 2.5. <i>TEST AND MEASUREMENT EQUIPMENT.....</i>             | <i>9</i>  |
| <b>3. EQUIPMENT UNDER TEST .....</b>                        | <b>10</b> |
| 3.1. <i>MAXIMUM OUTPUT POWER.....</i>                       | <i>10</i> |
| 3.2. <i>DESCRIPTION OF AVAILABLE ANTENNAS .....</i>         | <i>11</i> |
| 3.3. <i>SOFTWARE AND FIRMWARE.....</i>                      | <i>11</i> |
| 3.4. <i>WORST-CASE CONFIGURATION AND MODE.....</i>          | <i>11</i> |
| 3.5. <i>DESCRIPTION OF TEST SETUP.....</i>                  | <i>12</i> |
| <b>4. ANTENNA PORT TEST RESULTS .....</b>                   | <b>17</b> |
| 4.1. <i>ON TIME AND DUTY CYCLE.....</i>                     | <i>17</i> |
| 4.1.1. <i>RESULTS .....</i>                                 | <i>17</i> |
| 4.2. <i>26 dB BANDWIDTH.....</i>                            | <i>22</i> |
| 4.2.1. <i>802.11a MODE IN THE 5.2 GHz BAND .....</i>        | <i>22</i> |
| 4.2.2. <i>802.11ac VHT20 MODE IN THE 5.2 GHz BAND .....</i> | <i>25</i> |
| 4.2.3. <i>802.11ac VHT40 MODE IN THE 5.2 GHz BAND .....</i> | <i>28</i> |
| 4.2.4. <i>802.11ac VHT80 MODE IN THE 5.2 GHz BAND .....</i> | <i>30</i> |
| 4.2.5. <i>802.11a MODE IN THE 5.8 GHz BAND .....</i>        | <i>31</i> |
| 4.2.6. <i>802.11ac VHT20 MODE IN THE 5.8 GHz BAND .....</i> | <i>34</i> |
| 4.2.7. <i>802.11ac VHT40 MODE IN THE 5.8 GHz BAND .....</i> | <i>37</i> |
| 4.2.8. <i>802.11ac VHT80 MODE IN THE 5.8 GHz BAND .....</i> | <i>39</i> |
| 4.3. <i>99% BANDWIDTH.....</i>                              | <i>40</i> |
| 4.3.1. <i>802.11a MODE IN THE 5.2 GHz BAND .....</i>        | <i>41</i> |
| 4.3.2. <i>802.11ac VHT20 MODE IN THE 5.2 GHz BAND .....</i> | <i>44</i> |
| 4.3.3. <i>802.11ac VHT40 MODE IN THE 5.2 GHz BAND .....</i> | <i>47</i> |
| 4.3.4. <i>802.11ac VHT80 MODE IN THE 5.2 GHz BAND .....</i> | <i>49</i> |
| 4.3.5. <i>802.11a MODE IN THE 5.8 GHz BAND .....</i>        | <i>50</i> |
| 4.3.6. <i>802.11ac VHT20 MODE IN THE 5.8 GHz BAND .....</i> | <i>53</i> |
| 4.3.7. <i>802.11ac VHT40 MODE IN THE 5.8 GHz BAND .....</i> | <i>56</i> |
| 4.3.8. <i>802.11ac VHT80 MODE IN THE 5.8 GHz BAND .....</i> | <i>58</i> |
| 4.4. <i>6 dB BANDWIDTH.....</i>                             | <i>59</i> |
| 4.4.1. <i>802.11a MODE IN THE 5.8 GHz BAND .....</i>        | <i>60</i> |

|           |                                                                                      |            |
|-----------|--------------------------------------------------------------------------------------|------------|
| 4.4.2.    | 802.11ac VHT20 MODE IN THE 5.8 GHz BAND .....                                        | 63         |
| 4.4.3.    | 802.11ac VHT40 MODE IN THE 5.8 GHz BAND .....                                        | 66         |
| 4.4.4.    | 802.11ac VHT80 MODE IN THE 5.8 GHz BAND .....                                        | 68         |
| 4.5.      | OUTPUT POWER AND PPSD.....                                                           | 69         |
| 4.5.1.    | 802.11a MODE IN THE 5.2 GHz BAND .....                                               | 71         |
| 4.5.2.    | 802.11ac VHT20 MODE IN THE 5.2 GHz BAND .....                                        | 75         |
| 4.5.3.    | 802.11ac VHT40 MODE IN THE 5.2 GHz BAND .....                                        | 91         |
| 4.5.4.    | 802.11ac VHT80 MODE IN THE 5.2 GHz BAND .....                                        | 103        |
| 4.5.5.    | 802.11a MODE IN THE 5.8 GHz BAND .....                                               | 111        |
| 4.5.6.    | 802.11ac VHT20 MODE IN THE 5.8 GHz BAND (low channel 1 stream BF) .....              | 118        |
| 4.5.7.    | 802.11ac VHT40 MODE IN THE 5.8 GHz BAND (low channel 3 stream and 1 stream BF) ..... | 146        |
| 4.5.8.    | 802.11ac VHT80 MODE IN THE 5.8 GHz BAND (3 and 1 stream BF) .....                    | 166        |
| <b>5.</b> | <b>RADIATED TEST RESULTS.....</b>                                                    | <b>178</b> |
| 5.1.      | TRANSMITTER ABOVE 1 GHz .....                                                        | 179        |
| 5.1.1.    | 802.11a MODE IN THE 5.2GHz BAND .....                                                | 179        |
| 5.1.2.    | 802.11ac VHT20 MODE IN THE 5.2GHz BAND .....                                         | 187        |
| 5.1.3.    | 802.11ac VHT40 MODE IN THE 5.2GHz BAND .....                                         | 219        |
| 5.1.4.    | 802.11ac VHT80 MODE IN THE 5.2GHz BAND .....                                         | 243        |
| 5.1.5.    | 802.11a MODE IN THE 5.8GHz BAND .....                                                | 259        |
| 5.1.6.    | 802.11ac VHT20 MODE IN THE 5.8GHz BAND (1 stream BF mode low channel) 269            |            |
| 5.1.7.    | 802.11ac VHT40 MODE IN THE 5.8GHz BAND (low channel 3 stream and 1 stream BF) .....  | 309        |
| 5.1.8.    | 802.11ac VHT80 MODE IN THE 5.8GHz BAND (3 and 1 stream BF) .....                     | 341        |
| 5.2.      | WORST-CASE BELOW 1 GHz .....                                                         | 365        |
| 5.3.      | WORST-CASE ABOVE 18 GHz .....                                                        | 369        |
| 5.3.1.    | SPURIOUS EMISSIONS 18 TO 26 GHz (WORST-CASE CONFIGURATION) ..                        | 369        |
| 5.3.2.    | SPURIOUS EMISSIONS 26 TO 40 GHz (WORST-CASE CONFIGURATION) ..                        | 371        |
| <b>6.</b> | <b>AC POWER LINE CONDUCTED EMISSIONS .....</b>                                       | <b>373</b> |
| <b>7.</b> | <b>SETUP PHOTOS .....</b>                                                            | <b>378</b> |

## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** GOOGLE  
1600 AMPHITEATRE PARKWAY  
MOUNTAIN VIEW, CA 94043, U.S.A

**EUT DESCRIPTION:** STORAGE NETWORK BOX II, 2TB HD, WIFI AP

**MODEL:** GFRG250

**SERIAL NUMBER:** BFAFSJ1538E0015, BFAFSJ1546E0047

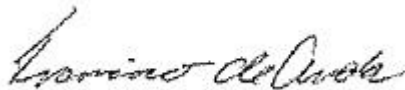
**DATE TESTED:** October 22<sup>nd</sup>, 2015 to November 1<sup>st</sup>, 2016

| 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:



FRANCISCO DE ANDA  
CONSUMER TECHNOLOGY DIVISION  
PROJECT MANAGER  
UL Verification Services Inc.

Prepared By:



CLIFFORD SUSA  
CONSUMER TECHNOLOGY DIVISION  
EMC ENGINEER  
UL Verification Services Inc.

## 2. SUMMARY OF TESTING

### 2.1. 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 checked="" type="checkbox"/> Chamber A(IC: 2324B-1) | <input type="checkbox"/> Chamber D(IC: 2324B-4)            |
| <input checked="" type="checkbox"/> Chamber B(IC: 2324B-2) | <input type="checkbox"/> Chamber E(IC: 2324B-5)            |
| <input type="checkbox"/> Chamber C(IC: 2324B-3)            | <input type="checkbox"/> Chamber F(IC: 2324B-6)            |
|                                                            | <input type="checkbox"/> Chamber G(IC: 2324B-7)            |
|                                                            | <input checked="" type="checkbox"/> Chamber H(IC: 2324B-8) |

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>.

### 2.2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC 14-30, FCC KDB 662911 D01 v02r01, FCC KDB 789033 D02 v01r02, FCC KDB 644545 D03 v01, ANSI C63.10-2013.

## 2.3. CALIBRATION AND UNCERTAINTY

### 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.

### SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

### MEASUREMENT UNCERTAINTY

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     |

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

## 2.4. MEASUREMENT METHOD

On Time and Duty Cycle: KDB 789033 D02 v01r02, Section B

6 dB Emission BW: KDB 789033 D02 v01 r02, Section C2.

26 dB Emission BW: KDB 789033 D02 v01 r02, Section C.

99% Occupied BW: KDB 789033 D02 v01 r02, Section D.

Conducted Output Power: KDB 789033 D02 v01 r02, Section E.2.d (Method SA-2).

Power Spectral Density: KDB 789033 D02 v01 r02, Section F.

Unwanted emissions in restricted bands: KDB 789033 D02 v01 r02, Sections G.3, G.4, G.5, and G.6.

Unwanted emissions in non-restricted bands: KDB 789033 D02 v01 r02, Sections G.3, G.4, and G.5.

AC Power Line Conducted Emissions: ANSI C63.10-2009, Section 6.2.

## 2.5. 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                     | ID Num                  | Cal Due  |
| Spectrum Analyzer, 44 GHz        | Keysight       | N9030A                    | PRE126763               | 12/09/16 |
| Spectrum Analyzer, 44 GHz        | Keysight       | N9030A                    | T917                    | 06/30/16 |
| Spectrum Analyzer, 44 GHz        | Keysight       | N9030A                    | T907                    | 01/06/17 |
| Spectrum Analyzer, 44 GHz        | Keysight       | N9030A                    | T906                    | 02/03/17 |
| Spectrum Analyzer, 40GHz         | Keysight       | 8564E                     | T106                    | 08/14/16 |
| Spectrum Analyzer, 26.5 GHz      | Keysight       | E4440A                    | T200                    | 09/02/16 |
| EMI Test Receiver, 9 kHz-7 GHz   | R & S          | ESCI 7                    | T284                    | 09/10/16 |
| EMI Test Receiver, 9 kHz-7 GHz   | R & S          | ESCR 7                    | T1436                   | 12/19/16 |
| Antenna, Horn, 1-18 GHz          | ETS Lindgren   | 3117                      | T863                    | 04/06/17 |
| Antenna, Horn, 1-18 GHz          | ETS Lindgren   | 3117                      | T346                    | 02/22/17 |
| Antenna, Horn, 1-18 GHz          | ETS Lindgren   | 3117                      | T345                    | 03/07/17 |
| Antenna, Horn, 1-18 GHz          | ETS Lindgren   | 3117                      | T120                    | 04/05/17 |
| Antenna, Horn, 18- 26 GHz        | ARA            | MWH-1826                  | T447                    | 05/26/16 |
| Antenna, Horn, 26-40 GHz         | ARA            | MWH-2640                  | T90                     | 07/28/16 |
| Antenna, Bilog, 30MHz-1 GHz      | Sunol Sciences | JB3                       | T477                    | 06/09/17 |
| RF Preamplifier, 10kHz - 1000MHz | Sonoma         | 310N                      | T300                    | 11/05/16 |
| RF Preamplifier, 1GHz - 8GHz     | Miteq          | AMF-4D-01000800-30-29P    | T782                    | 10/21/16 |
| RF Preamplifier, 1GHz - 8GHz     | Miteq          | AMF-4D-01000800-30-29P    | T1156                   | 03/09/17 |
| RF Preamplifier, 1GHz - 7GHz     | Amplicial      | AMP1G7-20-27              | T1562                   | 05/17/17 |
| RF Preamplifier, 1GHz - 7GHz     | Amplicial      | AMP1G7-20-27              | T1563                   | 09/15/17 |
| RF Preamplifier, 1GHz - 18GHz    | Miteq          | AFS42-00101800-25-S-42    | T493                    | 03/09/17 |
| RF Preamplifier, 1GHz - 18GHz    | Miteq          | AFS42-00101800-25-S-42    | T1172                   | 07/09/16 |
| RF Preamplifier, 1GHz - 18GHz    | Miteq          | AFS42-00101800-25-S-42    | T495                    | 09/15/17 |
| RF Preamplifier, 18GHz - 26.5GHz | Keysight       | 8449B                     | T404                    | 06/29/16 |
| RF Preamplifier, 26GHz - 40GHz   | Miteq          | NSP4000-SP2               | T88                     | 04/09/17 |
| Low Pass Filter 5GHz             | Micro-Tronics  | LPS17541                  | T891                    | 09/15/17 |
| Low Pass Filter 5GHz             | Micro-Tronics  | LPS17541                  | T481                    | 07/09/16 |
| Low Pass Filter 5GHz             | Micro-Tronics  | LPS17541                  | T483                    | 03/09/17 |
| High Pass Filter 6GHz            | Micro-Tronics  | HPS17542                  | T894                    | 09/15/17 |
| High Pass Filter 6GHz            | Micro-Tronics  | HPS17542                  | T484                    | 07/09/16 |
| High Pass Filter 6GHz            | Micro-Tronics  | HPS17542                  | T485                    | 03/09/17 |
| LISN                             | Fischer        | FCC-LISN-50/250-25-2-01-C | T1310                   | 09/16/16 |
| Radiated Software                | UL             | UL EMC                    | Ver 9.5, April 26, 2016 |          |
| Conducted Software               | UL             | UL EMC                    | Ver 4.7                 |          |

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

### 3. EQUIPMENT UNDER TEST

#### 3.1. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

##### 5.2 GHz BAND

| Frequency Range (MHz) | Mode           | Total Output Power (dBm) | Total Output Power (mW) |
|-----------------------|----------------|--------------------------|-------------------------|
| <b>4TX CDD</b>        |                |                          |                         |
| 5180 - 5240           | 802.11a        | 24.17                    | 261.22                  |
| 5180 - 5240           | 802.11n VHT20  | 27.26                    | 532.11                  |
| 5190 - 5230           | 802.11n VHT40  | 27.75                    | 595.66                  |
| 5210                  | 802.11ac VHT80 | 22.42                    | 174.58                  |
| <b>4TX BF</b>         |                |                          |                         |
| 5180 - 5240           | 802.11n VHT20  | 27.73                    | 592.93                  |
| 5190 - 5230           | 802.11n VHT40  | 28.98                    | 790.68                  |
| 5210                  | 802.11ac VHT80 | 21.21                    | 132.13                  |

##### 5.8 GHz BAND

| Frequency Range (MHz) | Mode           | Total Output Power (dBm) | Total Output Power (mW) |
|-----------------------|----------------|--------------------------|-------------------------|
| <b>4TX CDD</b>        |                |                          |                         |
| 5745 - 5825           | 802.11a        | 26.17                    | 414.00                  |
| 5745 - 5825           | 802.11n VHT20  | 26.01                    | 399.02                  |
| 5755 - 5795           | 802.11n VHT40  | 25.59                    | 362.24                  |
| 5775                  | 802.11ac VHT80 | 20.63                    | 115.61                  |
| <b>4TX BF</b>         |                |                          |                         |
| 5745 - 5825           | 802.11n VHT20  | 26.71                    | 468.81                  |
| 5755 - 5795           | 802.11n VHT40  | 28.35                    | 683.91                  |
| 5775                  | 802.11ac VHT80 | 27.47                    | 558.47                  |

##### List of test reduction

| Antenna Port & Radiated Testing |                      |                        |
|---------------------------------|----------------------|------------------------|
| Band                            | Mode                 | Covered by             |
| 5 GHz bands                     | 802.11n HT20 CDD 4TX | 802.11ac VHT20 CDD 4TX |
| 5 GHz bands                     | 802.11n HT40 CDD 4TX | 802.11ac VHT40 CDD 4TX |

### 3.2. DESCRIPTION OF AVAILABLE ANTENNAS

| Frequency<br>Band<br>(GHz) | Directional Antenna Gain   |                             |                             |                             |
|----------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|
|                            | 1                          | 2                           | 3                           | 4                           |
|                            | Spatial<br>Stream<br>(dBi) | Spatial<br>Streams<br>(dBi) | Spatial<br>Streams<br>(dBi) | Spatial<br>Streams<br>(dBi) |
| 5.2                        | 9.92                       | 6.95                        | 6.03                        | 3.98                        |
| 5.8                        | 9.95                       | 6.99                        | 6.07                        | 4.01                        |

### 3.3. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was version: V37.4.0.46.

The SW installed in the EUT during testing was version: Linux version 3.2.26

### 3.4. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario. The EUT was also evaluated according to ANSIC 63.10:2013, Clause 5.10.7 for external accessories. Reported is only the worst case configuration.

Based on the baseline scan, the worst-case data rates were:

802.11a 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.

### 3.5. DESCRIPTION OF TEST SETUP

#### SUPPORT EQUIPMENT

| Support Equipment List |              |             |                        |        |
|------------------------|--------------|-------------|------------------------|--------|
| Description            | Manufacturer | Model       | Serial Number          | FCC ID |
| EUT AC Adapter         | Liteon       | PB-1600-29  | 9T54 E132068           | N/A    |
| EUT AC Adapter         | Acbel        | OTD018      | 7Z00 E131875           | N/A    |
| Storage network box    | Google       | GFRG250     | BFAFSJ1538E0020        | N/A    |
| Laptop                 | Lenovo       | T440        | PC-00TFVU              | DoC    |
| Laptop AC Adapter      | Lenovo       | ADLX65NDC2A | 11S36200282ZZ20048SD3S | N/A    |
| USB-Serial adapter     | Trip-Lite    | USA-19HS    | 2448ATRCU791104077     | N/A    |

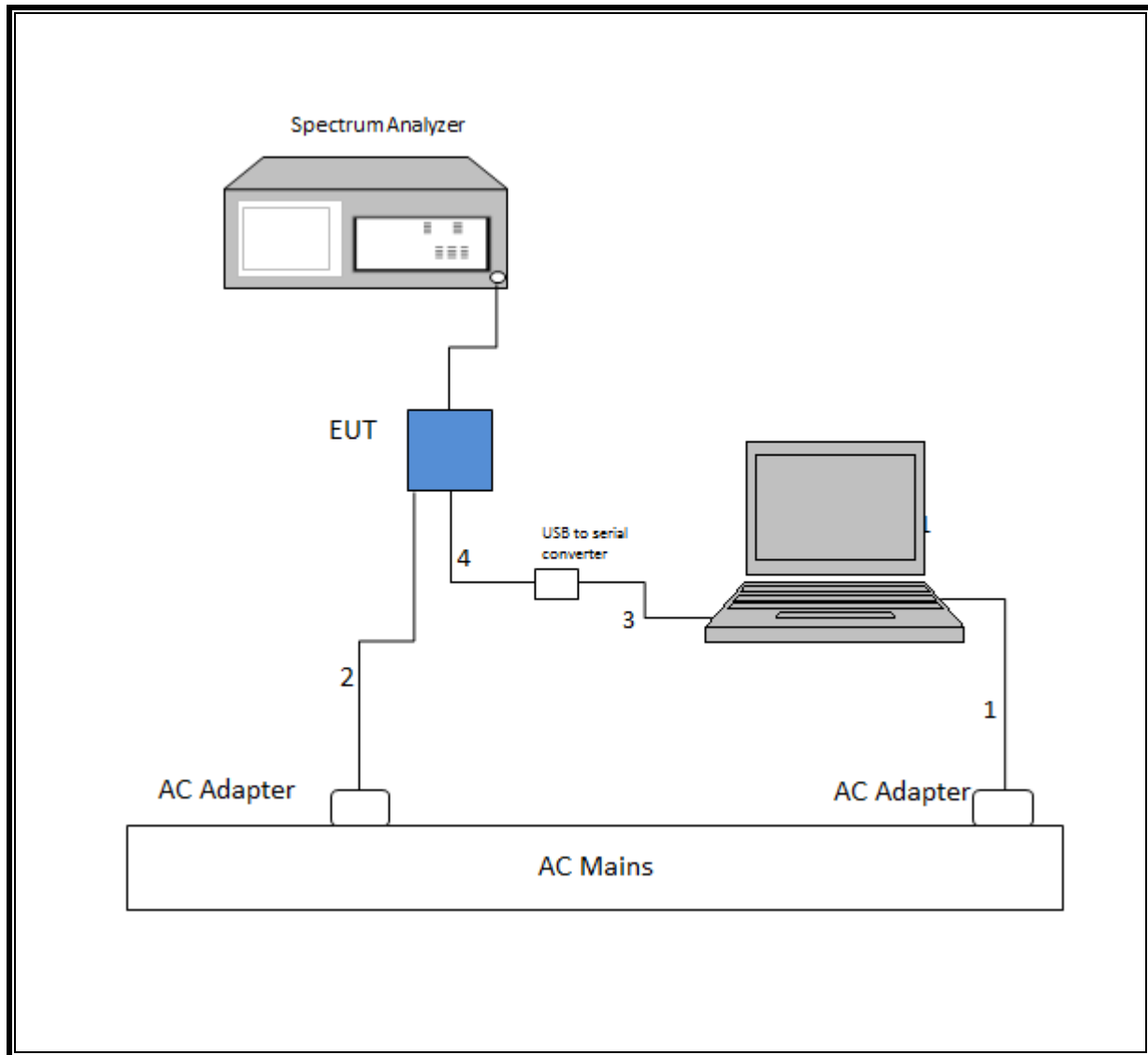
#### I/O CABLES

| I/O Cable List |        |                      |                |            |                  |         |
|----------------|--------|----------------------|----------------|------------|------------------|---------|
| Cable No       | Port   | # of identical ports | Connector Type | Cable Type | Cable Length (m) | Remarks |
| 1              | DC     | 1                    | Barrel         | unshielded | 2.7              | N/A     |
| 2              | DC     | 1                    | Barrel         | unshielded | 1.8              | N/A     |
| 3              | USB    | 1                    | USB            | unshielded | 2.8              | N/A     |
| 4              | Serial | 1                    | Serial         | unshielded | 0.35             | N/A     |

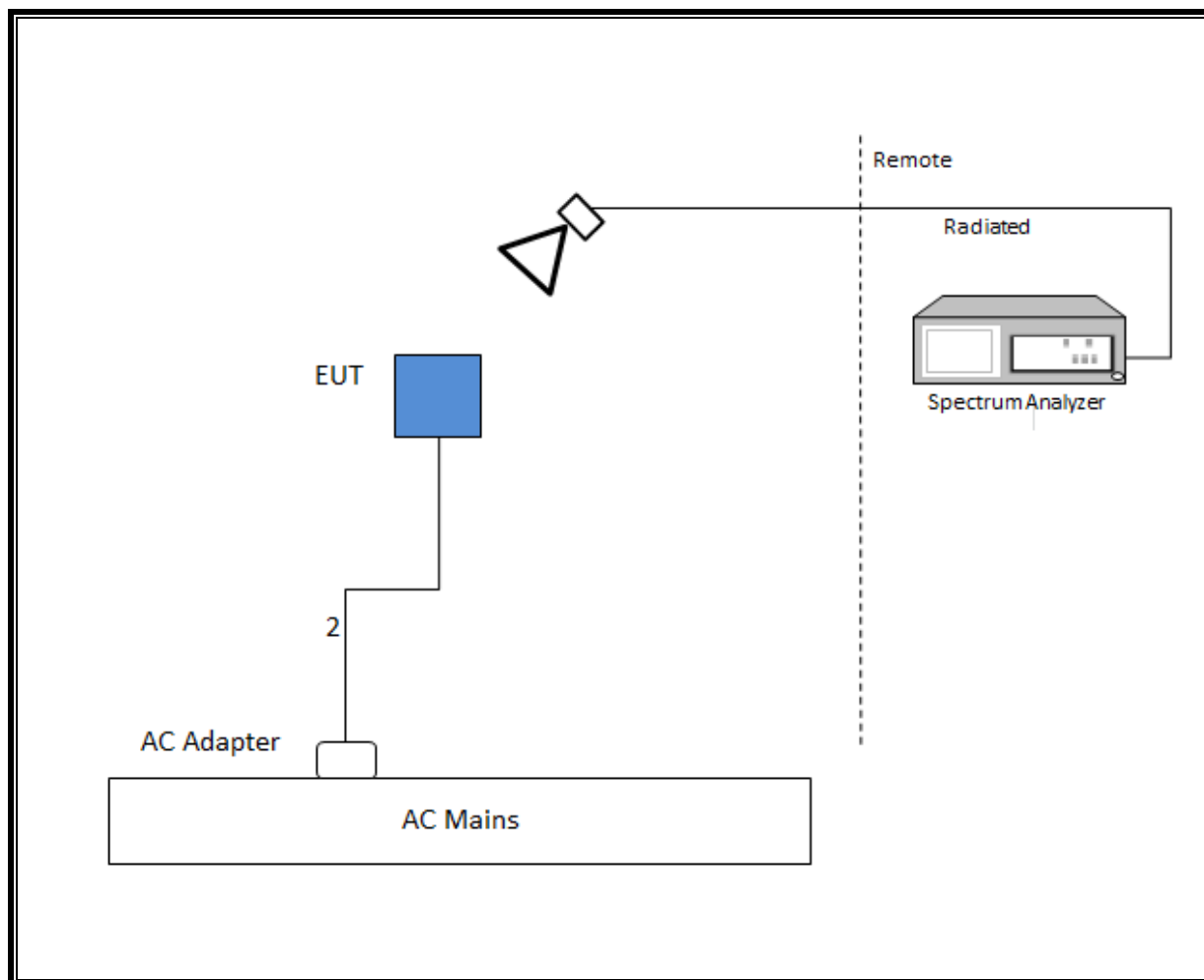
#### TEST SETUP

The EUT was connected to a host Laptop via USB – Serial cable adapter. Test software exercised the EUT.

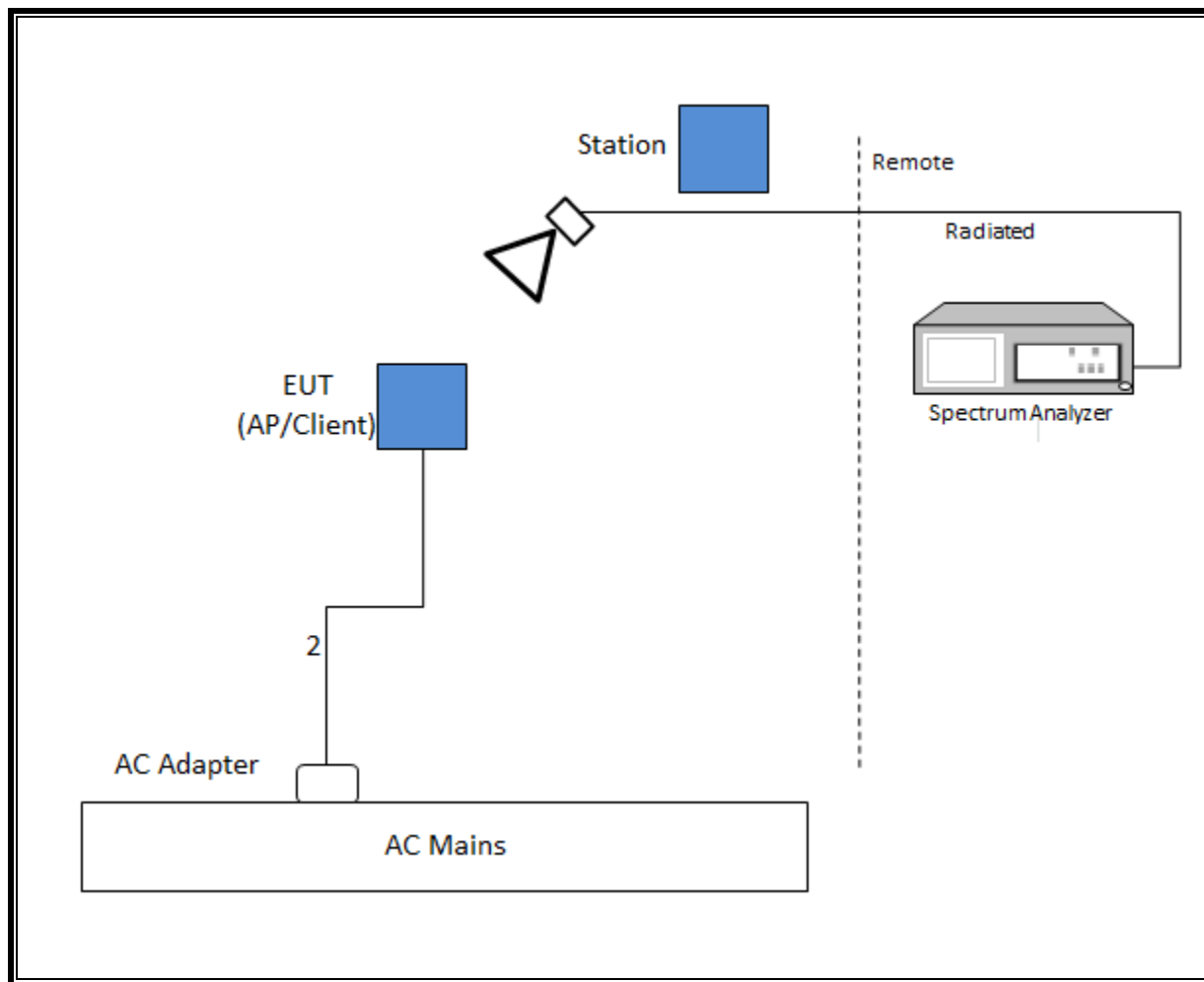
**SETUP DIAGRAM FOR CONDUCTED TESTS**



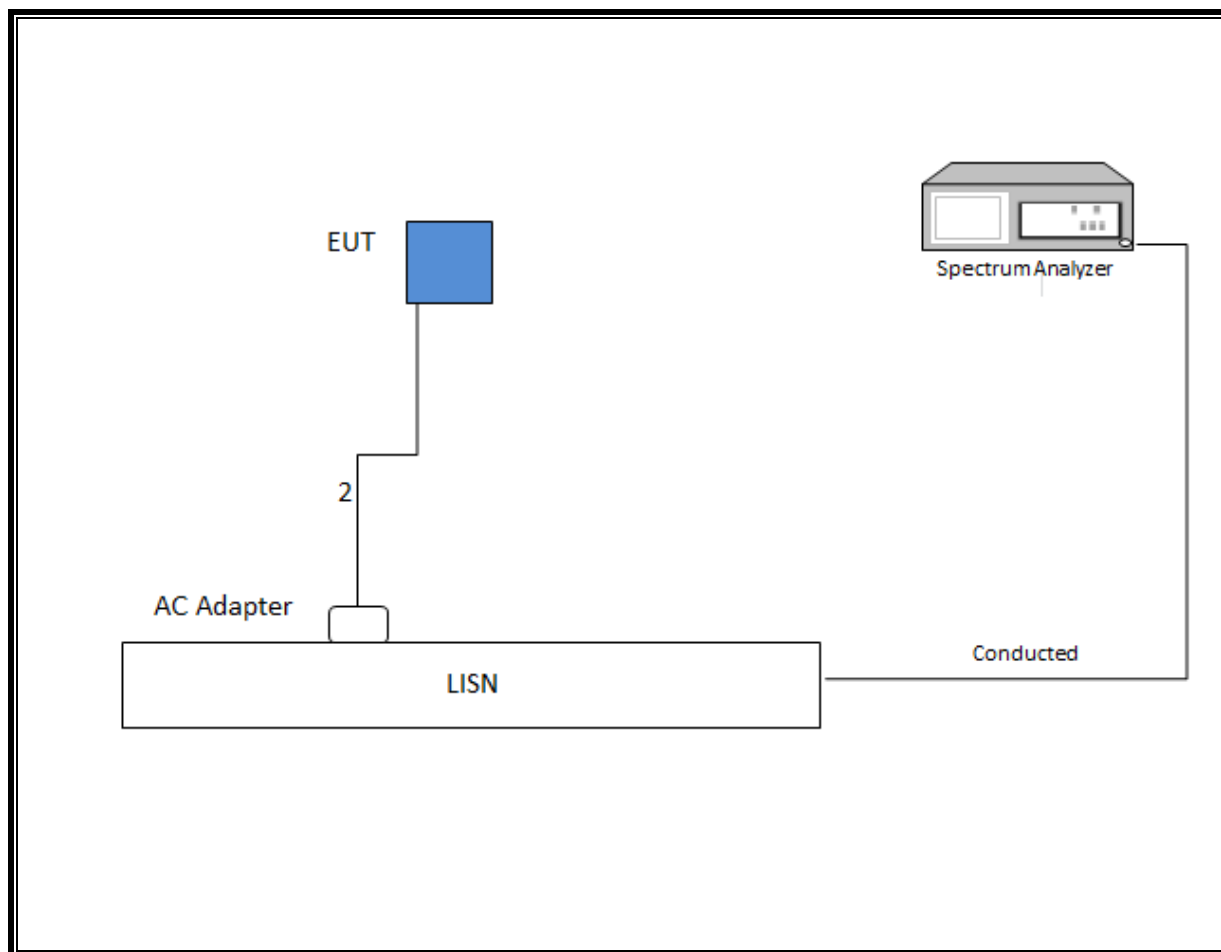
**SETUP DIAGRAM FOR RADIATED TESTS**



**SETUP DIAGRAM FOR RADIATED TESTS - Beamforming Mode**



**SETUP DIAGRAM FOR LINE CONDUCTED TEST**



## 4. ANTENNA PORT TEST RESULTS

### 4.1. ON TIME AND DUTY CYCLE

#### LIMITS

None; for reporting purposes only.

#### PROCEDURE

KDB 789033 Zero-Span Spectrum Analyzer Method.

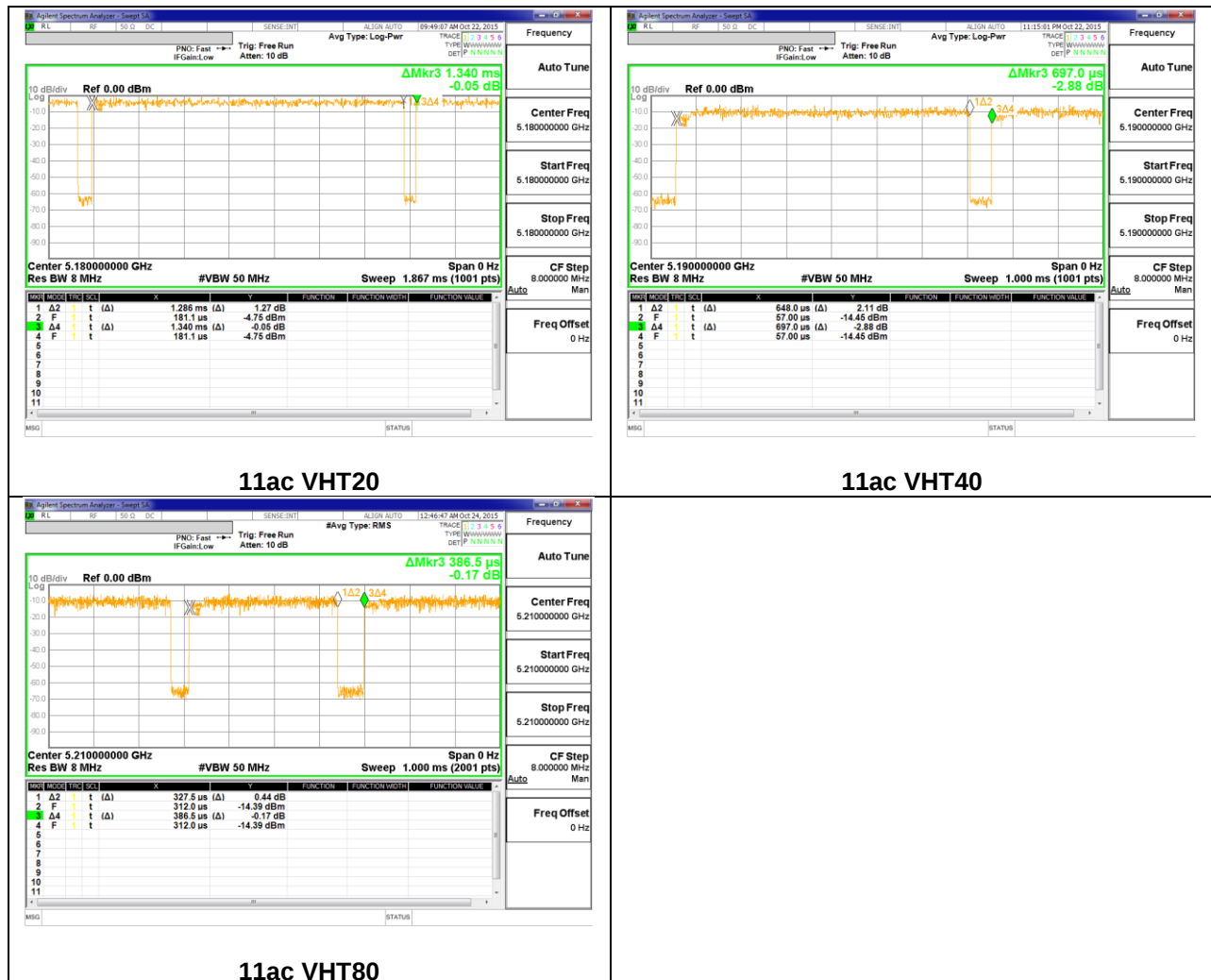
#### 4.1.1. RESULTS

| Mode                         | ON Time<br>B<br>(msec) | Period<br>(msec) | Duty Cycle<br>x<br>(linear) | Duty<br>Cycle<br>(%) | Duty Cycle<br>Correction Factor<br>(dB) | 1/T<br>Minimum VBW<br>(kHz) |
|------------------------------|------------------------|------------------|-----------------------------|----------------------|-----------------------------------------|-----------------------------|
| <b>4Tx 4 STREAM CDD MODE</b> |                        |                  |                             |                      |                                         |                             |
| 802.11ac VHT20               | 1.286                  | 1.340            | 0.960                       | 96.0%                | 0.18                                    | 0.778                       |
| 802.11ac VHT40               | 0.648                  | 0.697            | 0.930                       | 93.0%                | 0.32                                    | 1.543                       |
| 802.11ac VHT80               | 0.328                  | 0.387            | 0.847                       | 84.7%                | 0.72                                    | 3.053                       |
| <b>4Tx 1 STREAM CDD MODE</b> |                        |                  |                             |                      |                                         |                             |
| 802.11a                      | 0.563                  | 0.604            | 0.932                       | 93.2%                | 0.31                                    | 1.777                       |
| 802.11ac VHT20               | 4.907                  | 5.000            | 0.981                       | 98.1%                | 0.00                                    | 0.010                       |
| 802.11ac VHT40               | 2.423                  | 2.510            | 0.965                       | 96.5%                | 0.15                                    | 0.413                       |
| 802.11ac VHT80               | 1.134                  | 1.201            | 0.944                       | 94.4%                | 0.25                                    | 0.882                       |
| <b>4Tx 3 STREAM BF MODE</b>  |                        |                  |                             |                      |                                         |                             |
| 802.11ac VHT20               | 11.050                 | 12.380           | 0.893                       | 89.3%                | 0.49                                    | 0.090                       |
| 802.11ac VHT40               | 6.705                  | 8.090            | 0.829                       | 82.9%                | 0.82                                    | 0.149                       |
| 802.11ac VHT80               | 11.710                 | 13.600           | 0.861                       | 86.1%                | 0.65                                    | 0.085                       |
| <b>4Tx 1 STREAM BF MODE</b>  |                        |                  |                             |                      |                                         |                             |
| 802.11ac VHT20               | 10.480                 | 12.250           | 0.856                       | 85.6%                | 0.68                                    | 0.095                       |
| 802.11ac VHT40               | 5.000                  | 6.455            | 0.775                       | 77.5%                | 1.11                                    | 0.200                       |
| 802.11ac VHT80               | 4.246                  | 5.123            | 0.829                       | 82.9%                | 0.82                                    | 0.236                       |

Tested by: 37699 CS

Test Date: 10/22/15 – 6/1/16

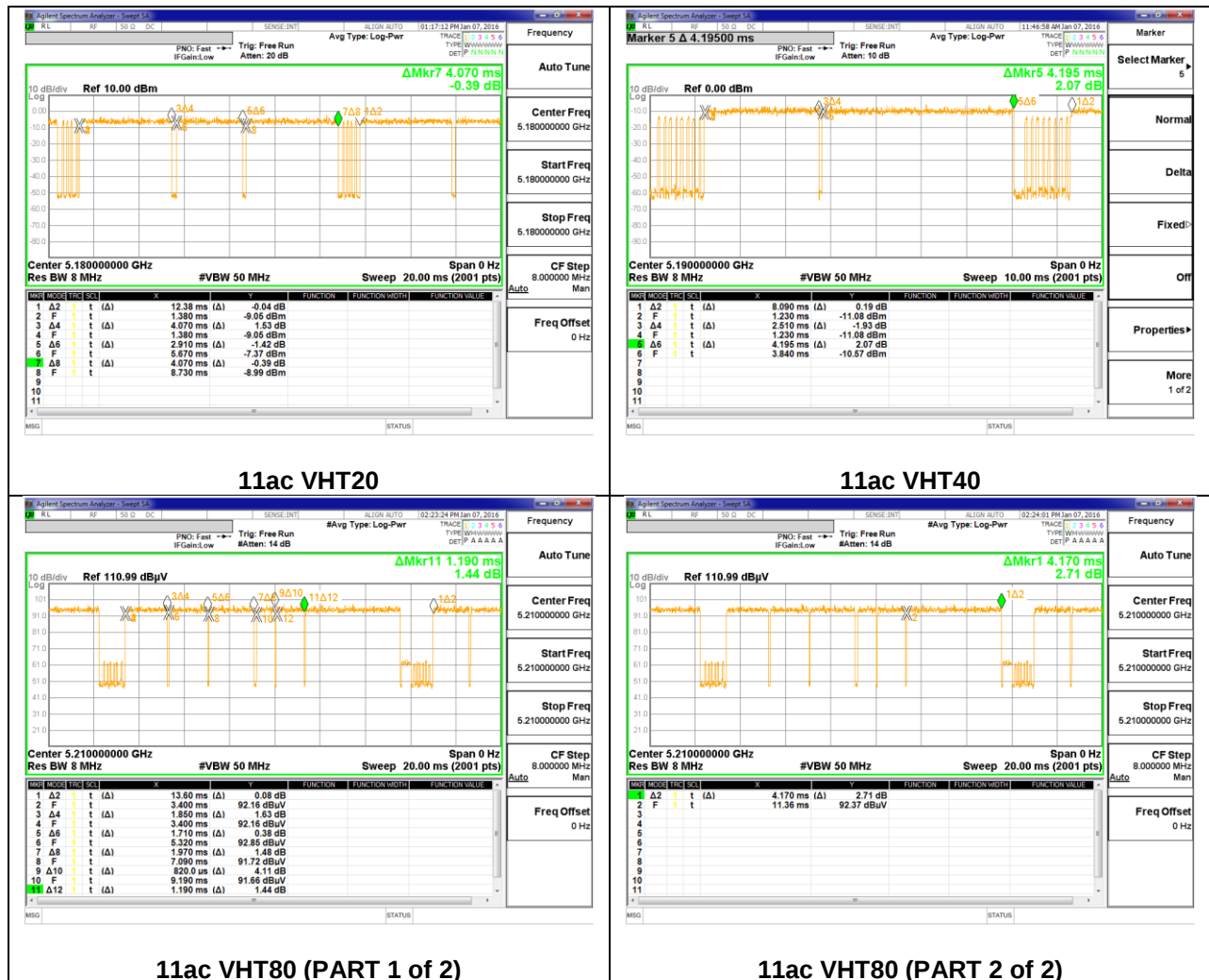
# 4Tx 4 STREAM CDD MODE DUTY CYCLE PLOTS



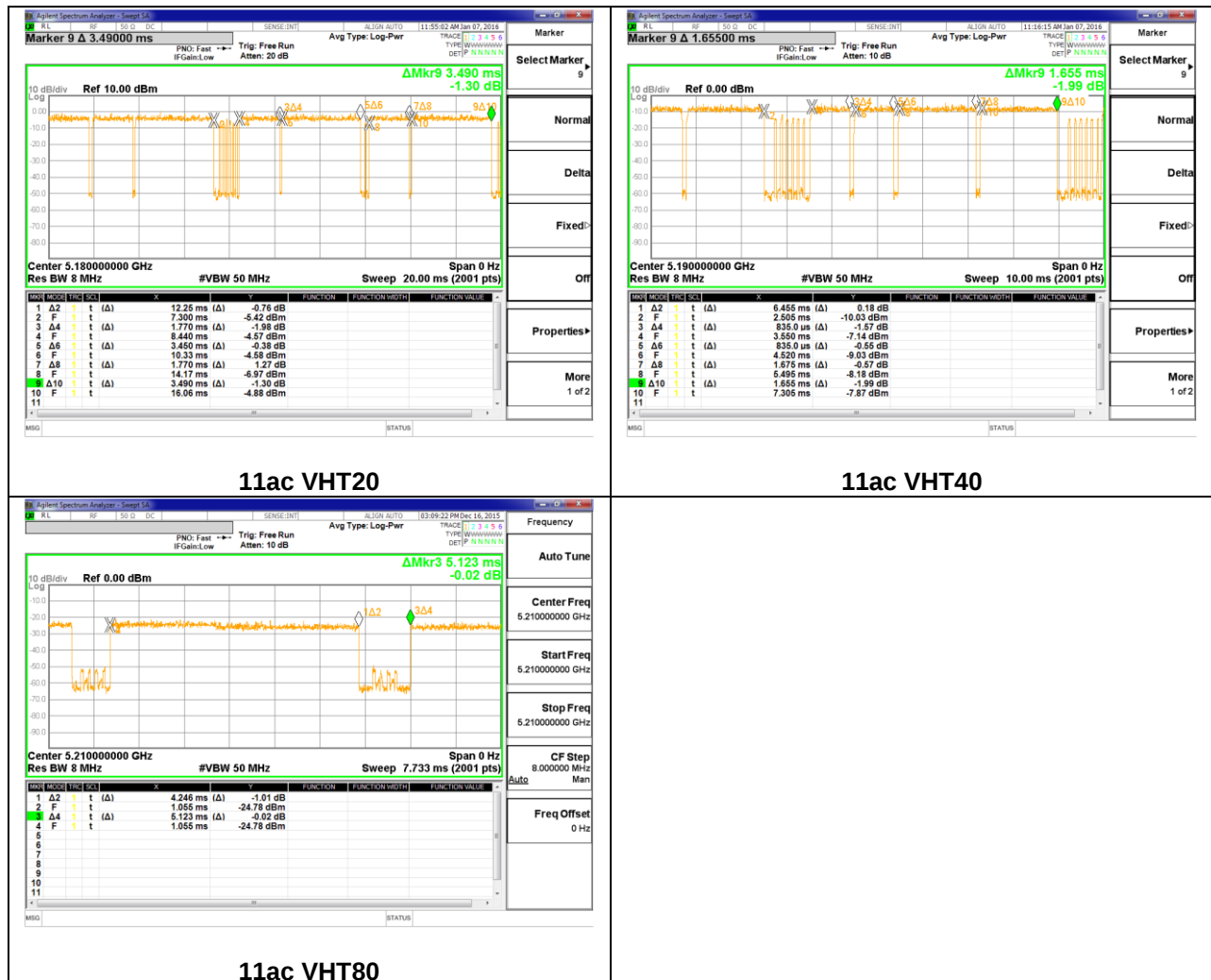
# 4Tx 1 STREAM CDD MODE DUTY CYCLE PLOTS



## 4Tx 3 STREAM BF MODE DUTY CYCLE PLOTS



# 4Tx 1 STREAM BF MODE DUTY CYCLE PLOTS



## 4.2. 26 dB BANDWIDTH

### LIMITS

None; for reporting purposes only.

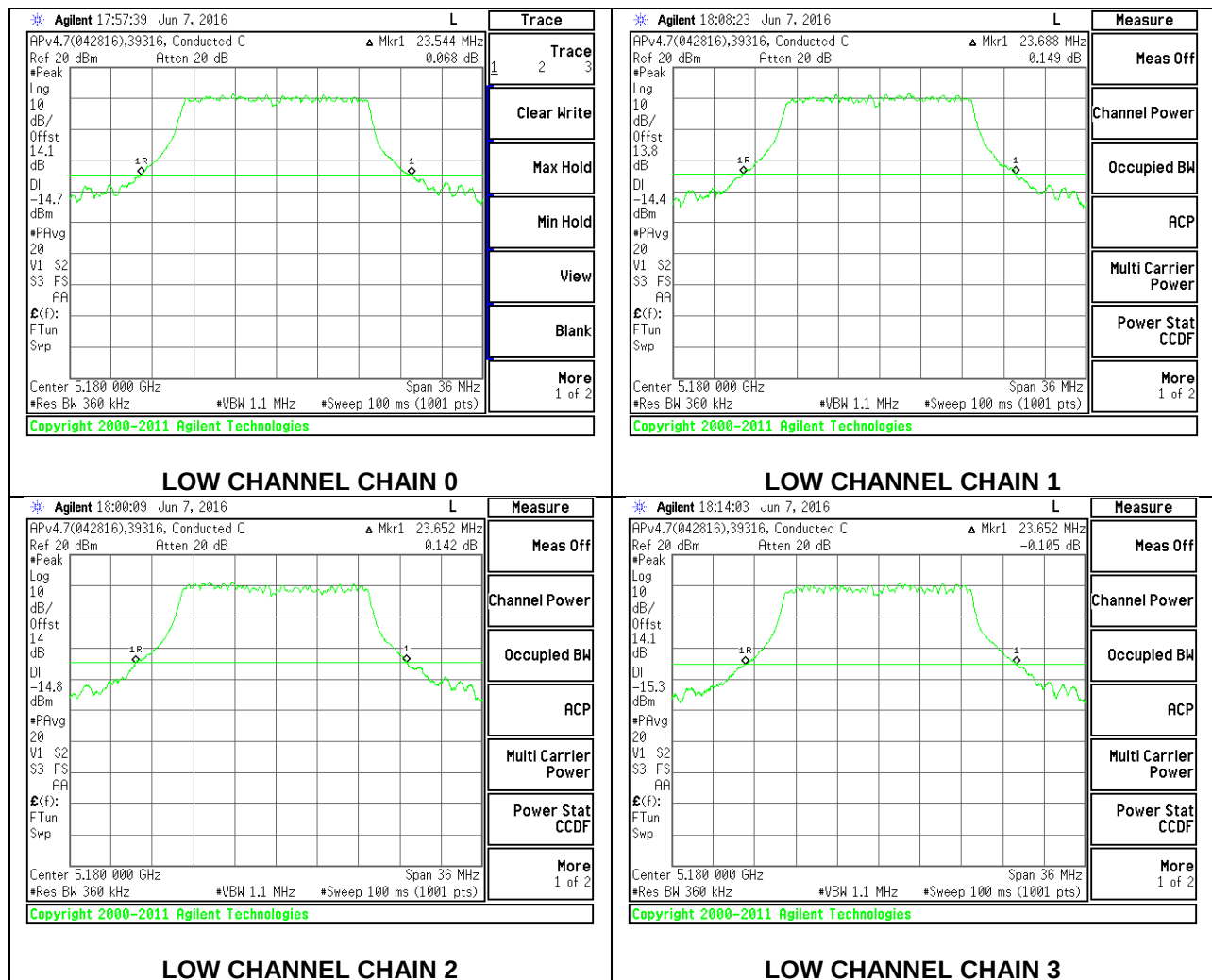
### RESULTS

#### 4.2.1. 802.11a MODE IN THE 5.2 GHz BAND

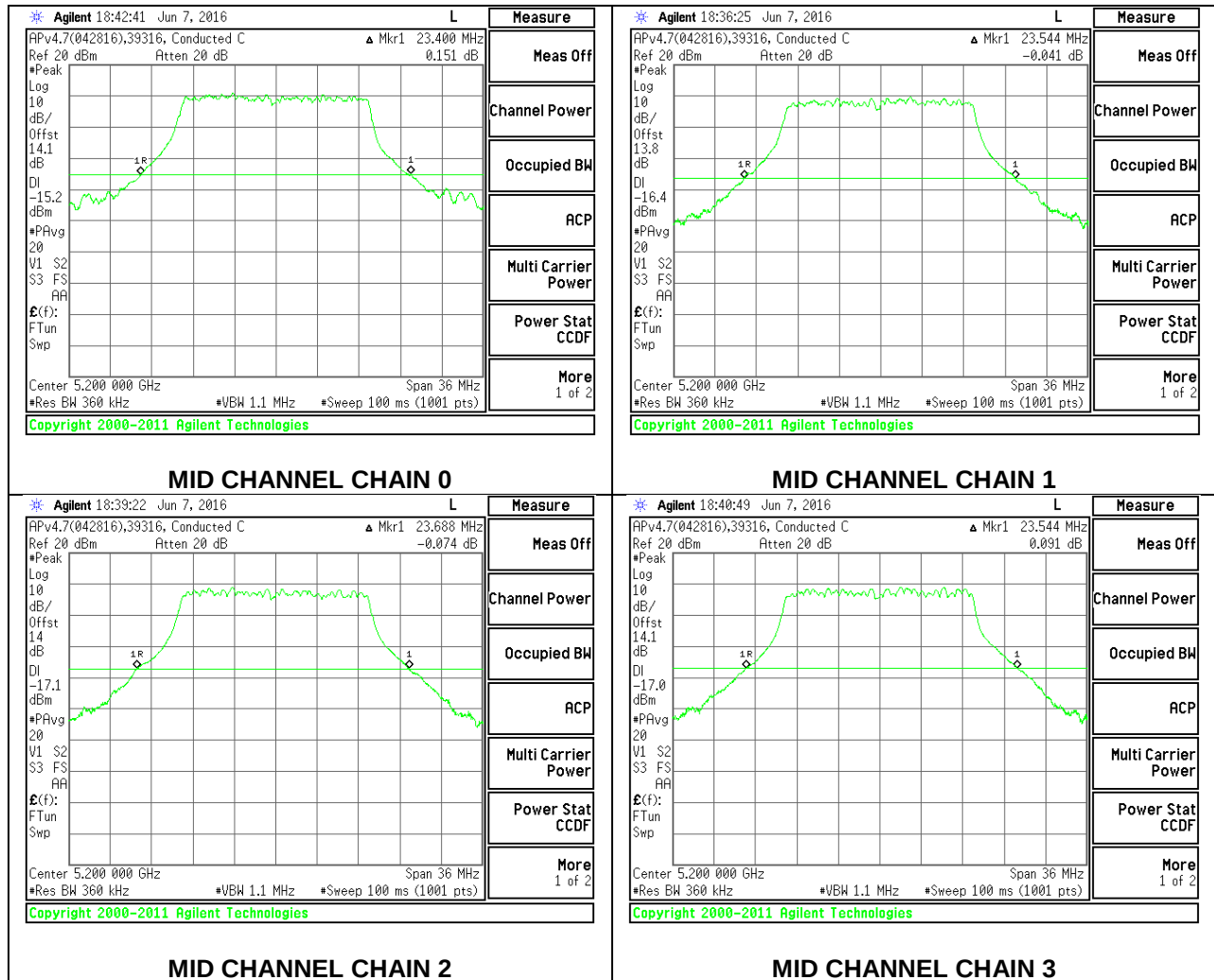
| Channel | Frequency | 26 dB Bandwidth<br>Chain 0<br>(MHz) | 26 dB Bandwidth<br>Chain 1<br>(MHz) | 26 dB Bandwidth<br>Chain 2<br>(MHz) | 26 dB Bandwidth<br>Chain 3<br>(MHz) |
|---------|-----------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Low     | 5180      | 23.544                              | 23.688                              | 23.652                              | 23.652                              |
| Mid     | 5200      | 23.400                              | 23.544                              | 23.688                              | 23.544                              |
| High    | 5240      | 23.940                              | 23.508                              | 23.544                              | 23.508                              |

### 4Tx CDD MODE

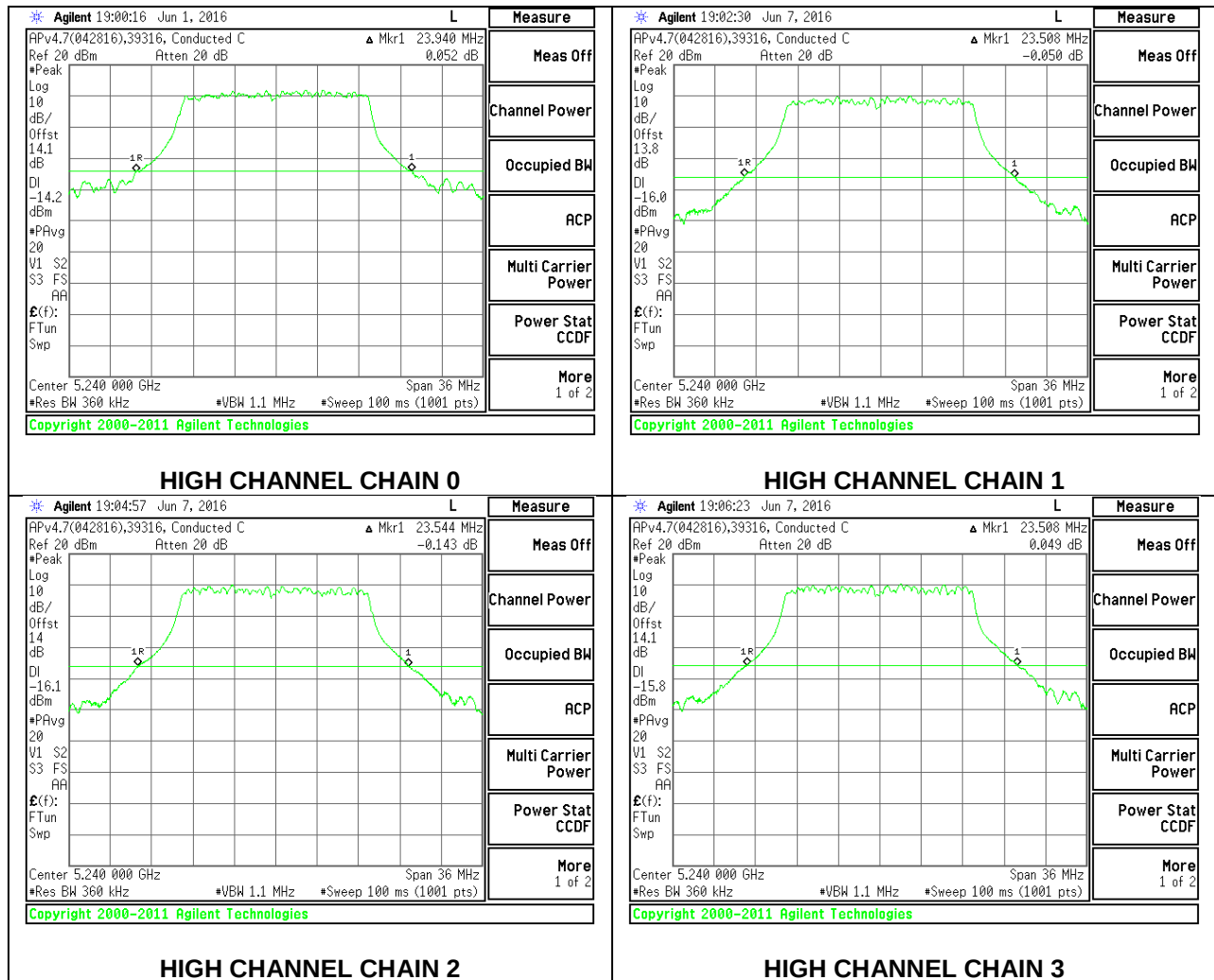
### LOW CHANNEL



## MID CHANNEL



## HIGH CHANNEL



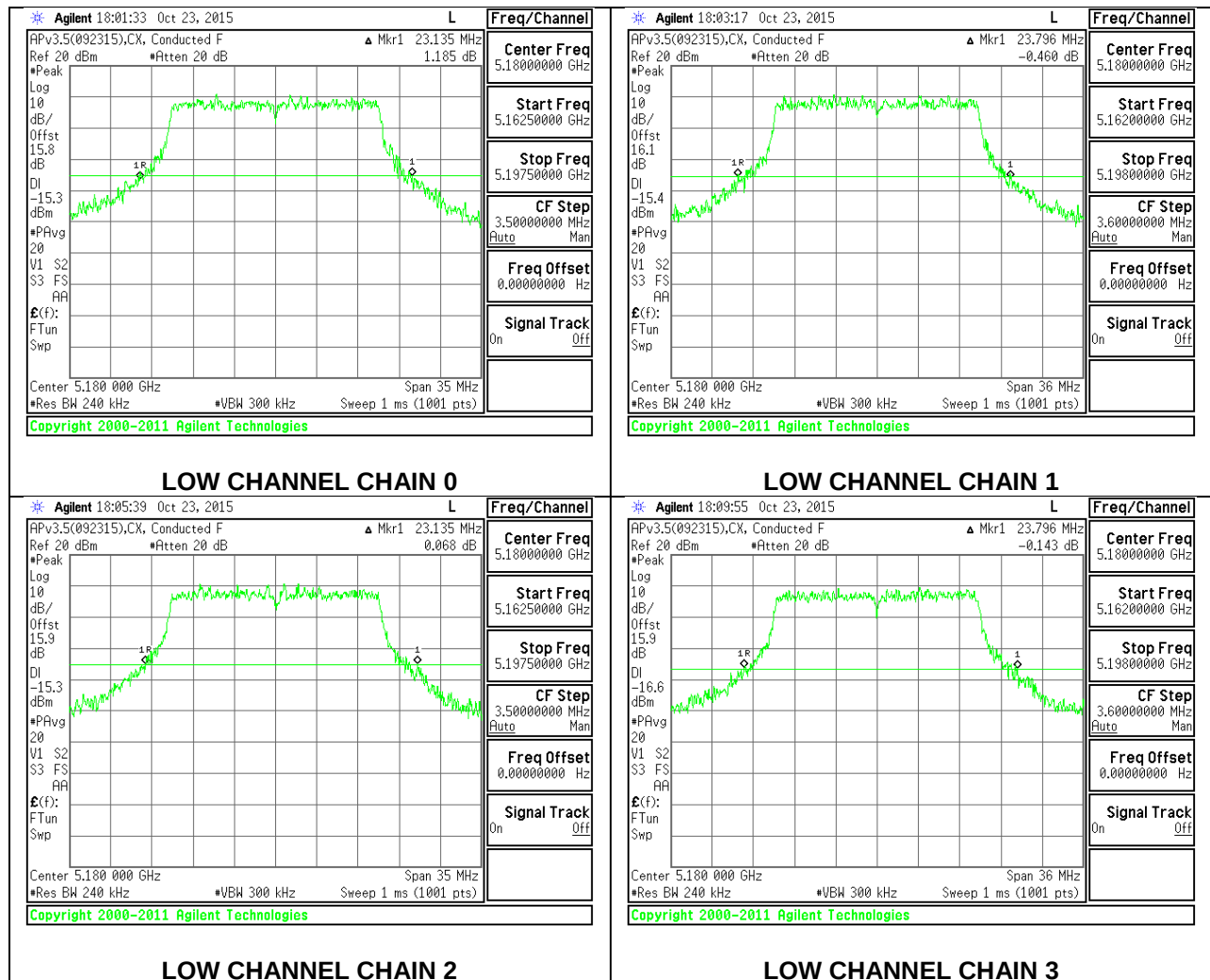
## 4.2.2. 802.11ac VHT20 MODE IN THE 5.2 GHz BAND

| Channel | Frequency<br>(MHz) | 26 dB Bandwidth<br>Chain 0<br>(MHz) | 26 dB Bandwidth<br>Chain 1<br>(MHz) | 26 dB Bandwidth<br>Chain 2<br>(MHz) | 26 dB Bandwidth<br>Chain 3<br>(MHz) |
|---------|--------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Low     | 5180               | 23.135                              | 23.796                              | 23.135                              | 23.796                              |
| Mid     | 5200               | 22.680                              | 23.940                              | 22.338                              | 22.925                              |
| High    | 5240               | 22.785                              | 23.760                              | 23.205                              | 23.400                              |

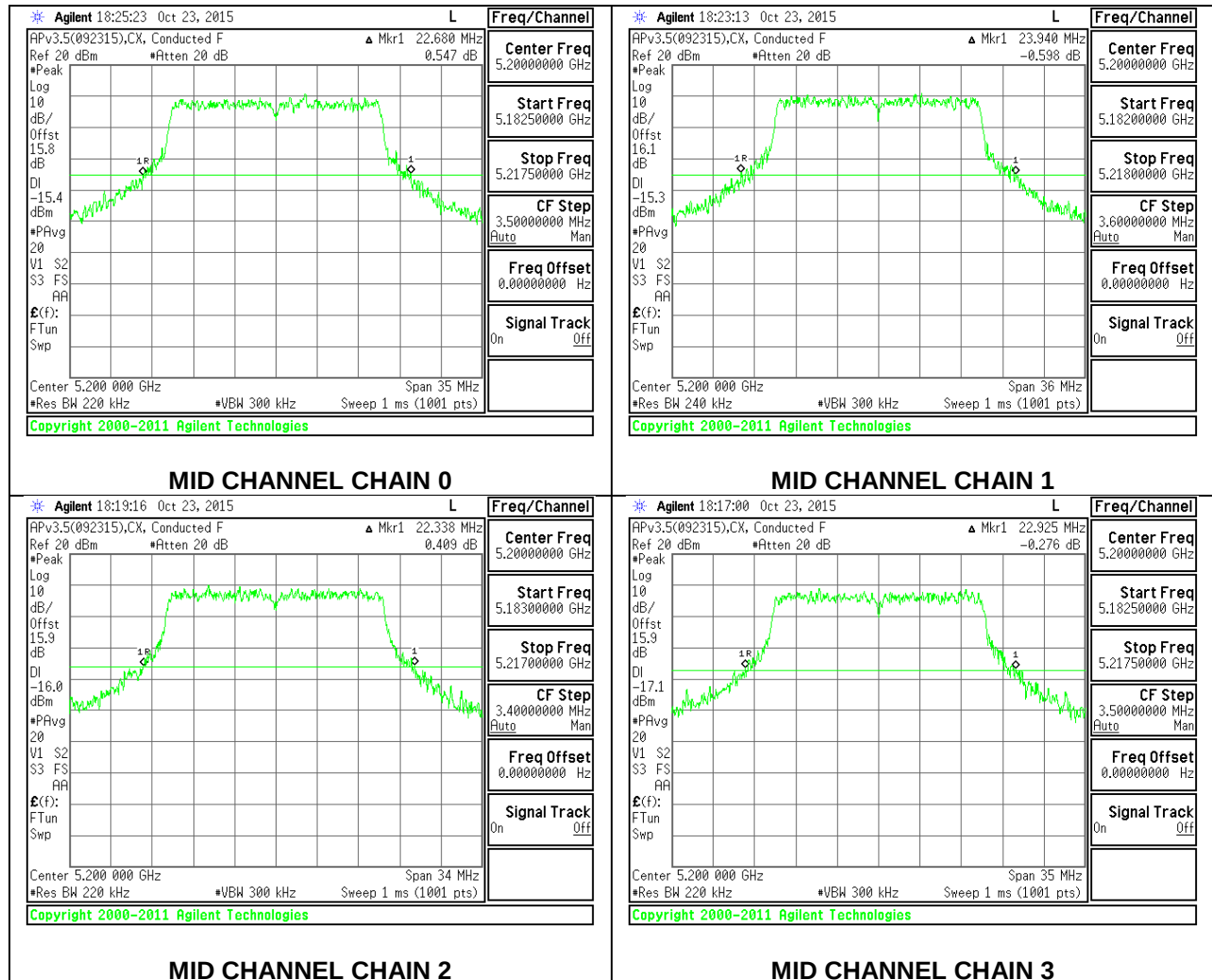
Test By: 39316 CX  
Test Date: 10/23/15

### 4Tx CDD MODE

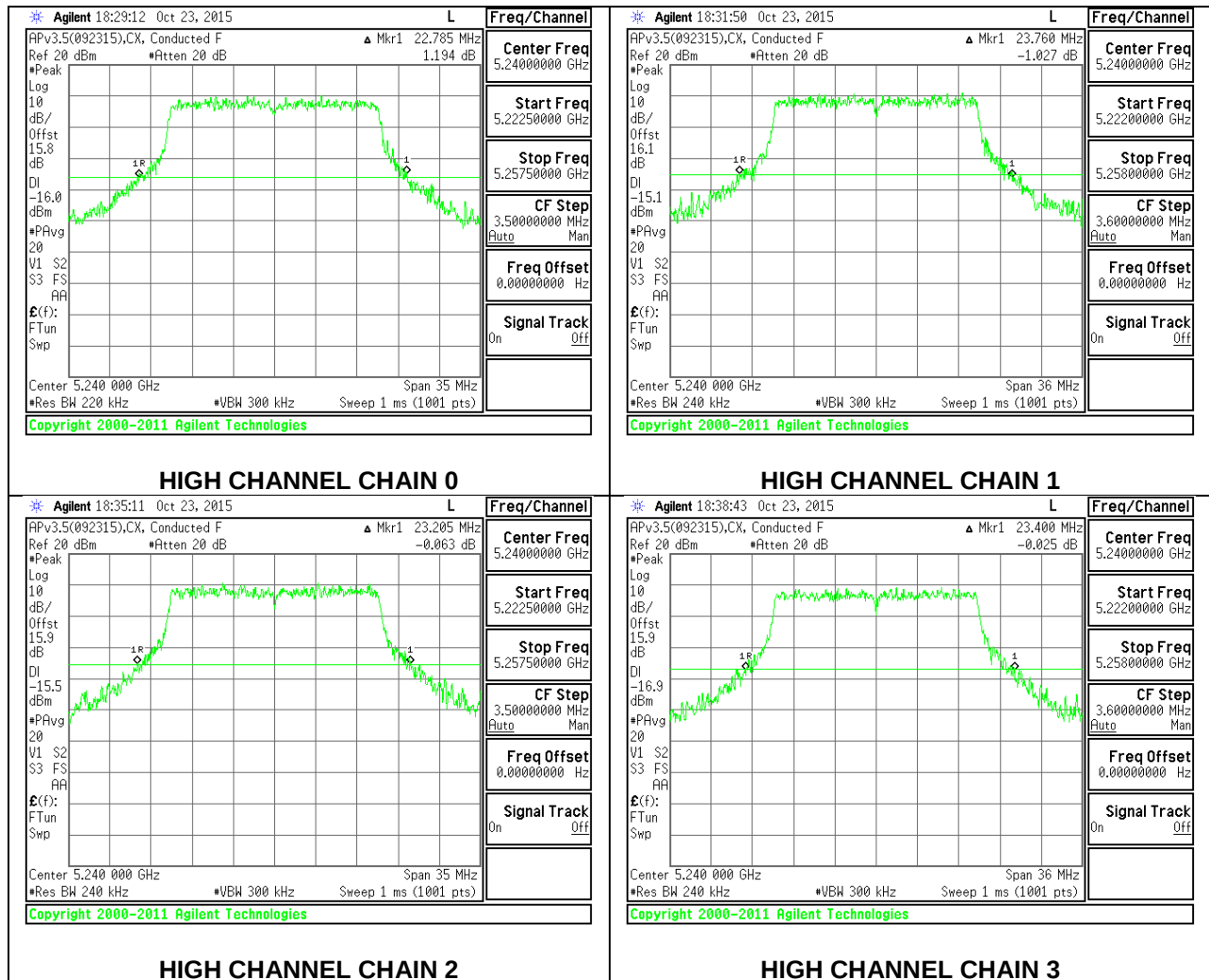
### LOW CHANNEL



## MID CHANNEL



## HIGH CHANNEL



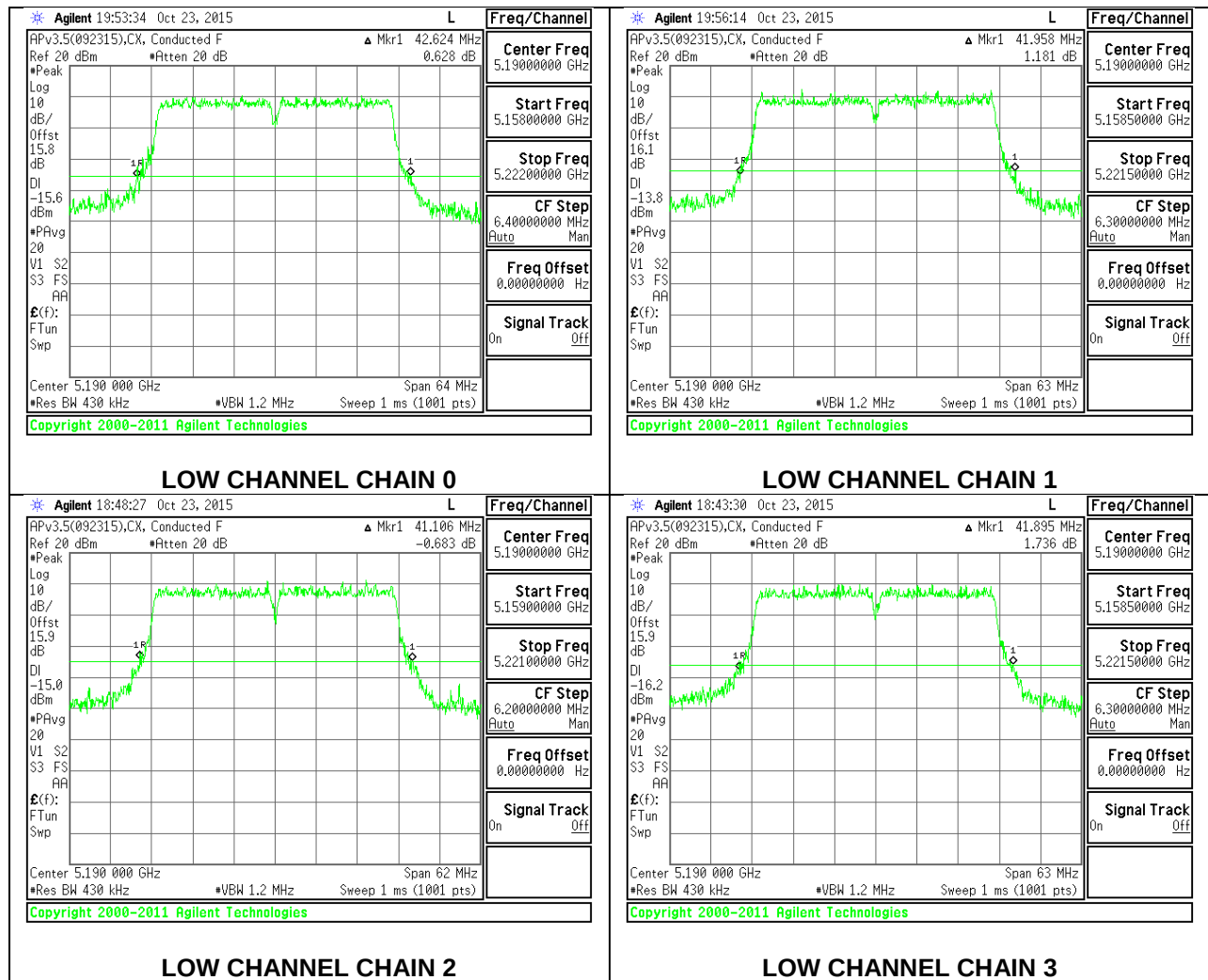
### 4.2.3. 802.11ac VHT40 MODE IN THE 5.2 GHz BAND

#### 4Tx CDD MODE

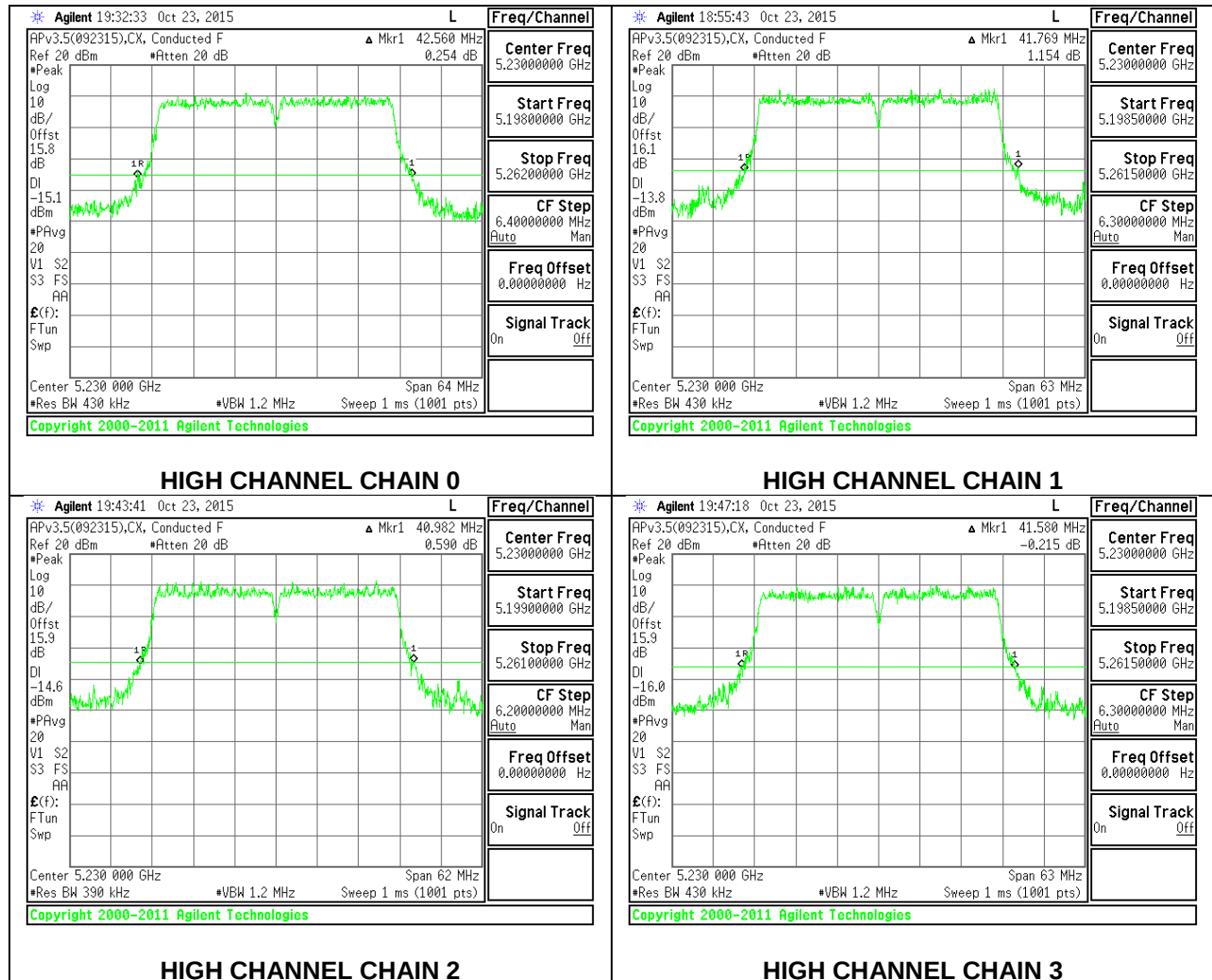
| Channel | Frequency | 26 dB Bandwidth<br>Chain 0<br>(MHz) | 26 dB Bandwidth<br>Chain 1<br>(MHz) | 26 dB Bandwidth<br>Chain 2<br>(MHz) | 26 dB Bandwidth<br>Chain 3<br>(MHz) |
|---------|-----------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Low     | 5190      | 42.624                              | 41.958                              | 41.106                              | 41.895                              |
| High    | 5230      | 42.560                              | 41.769                              | 40.982                              | 41.580                              |

Test By: 39316 CX  
Test Date: 10/23/15

#### LOW CHANNEL



## HIGH CHANNEL



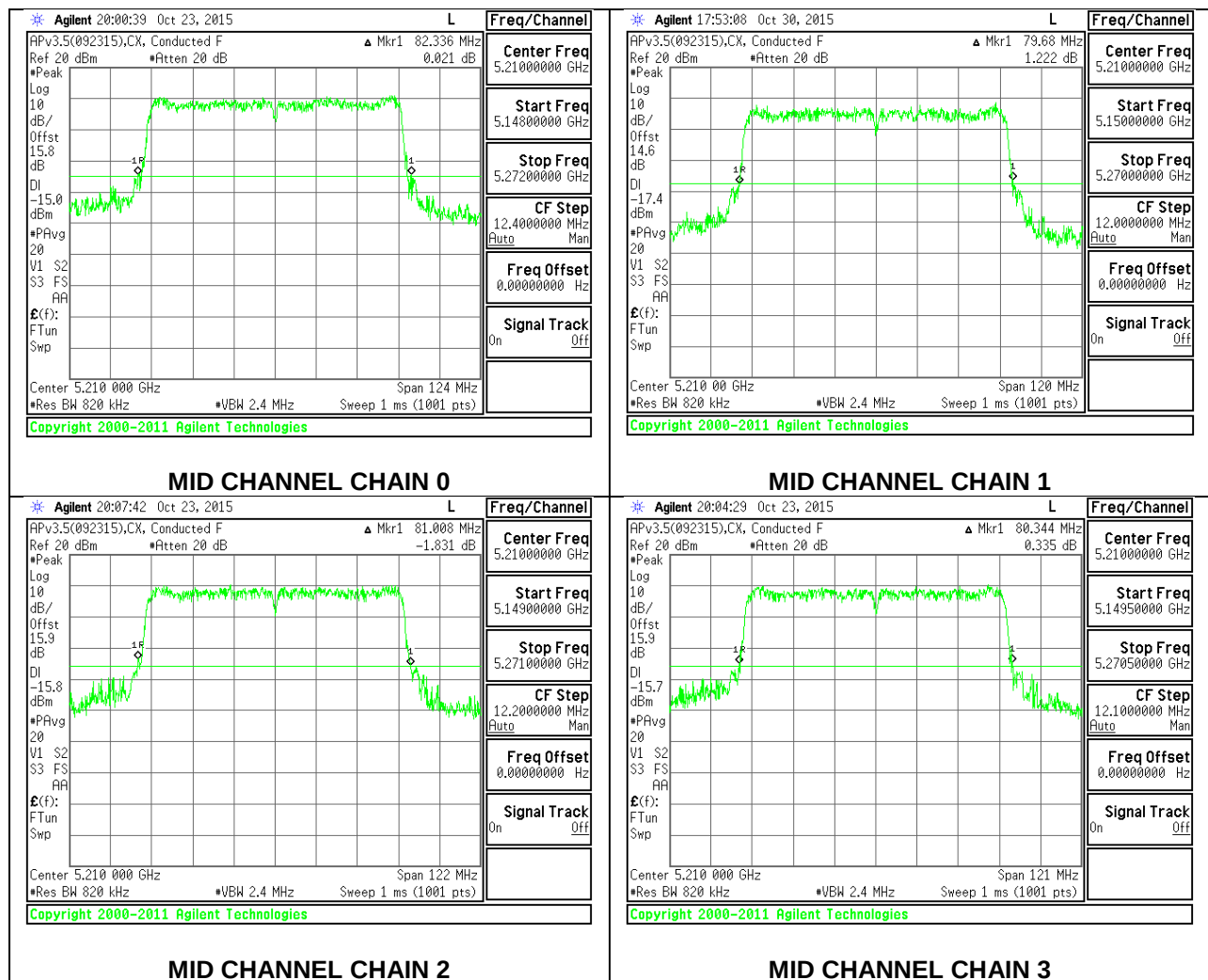
## 4.2.4. 802.11ac VHT80 MODE IN THE 5.2 GHz BAND

### 4Tx CDD MODE

| Channel | Frequency | 26 dB Bandwidth | 26 dB Bandwidth | 26 dB Bandwidth | 26 dB Bandwidth |
|---------|-----------|-----------------|-----------------|-----------------|-----------------|
|         | (MHz)     | Chain 0         | Chain 1         | Chain 2         | Chain 3         |
|         | (MHz)     | (MHz)           | (MHz)           | (MHz)           | (MHz)           |
| Mid     | 5210      | 82.336          | 79.680          | 81.008          | 80.344          |

Test By: 39316 CX  
Test Date: 10/23/15

### MID CHANNEL

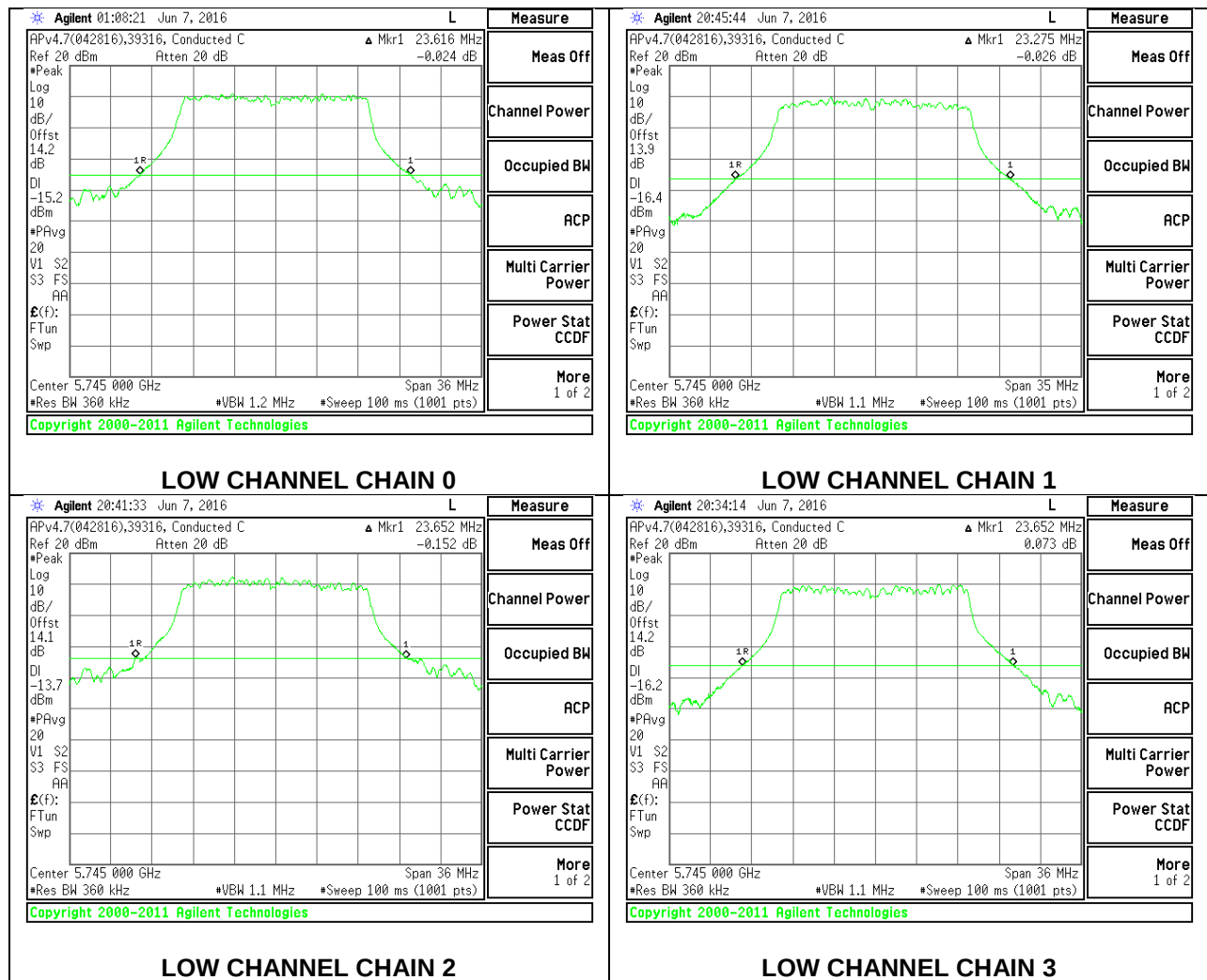


#### 4.2.5. 802.11a MODE IN THE 5.8 GHz BAND

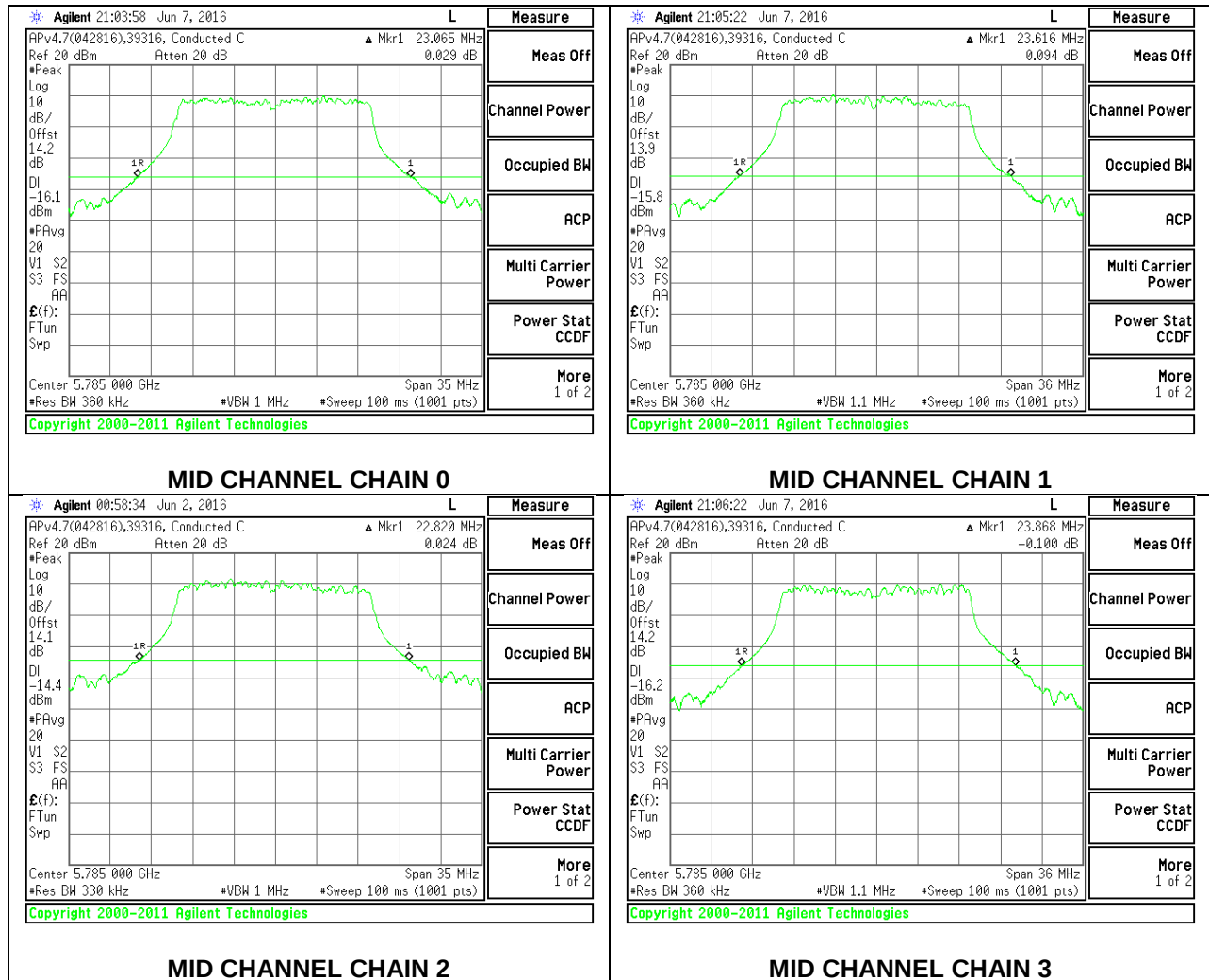
| Channel | Frequency | 26 dB Bandwidth<br>Chain 0<br>(MHz) | 26 dB Bandwidth<br>Chain 1<br>(MHz) | 26 dB Bandwidth<br>Chain 2<br>(MHz) | 26 dB Bandwidth<br>Chain 3<br>(MHz) |
|---------|-----------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Low     | 5745      | 23.616                              | 23.275                              | 23.652                              | 23.652                              |
| Mid     | 5785      | 23.065                              | 23.616                              | 22.820                              | 23.868                              |
| High    | 5825      | 23.508                              | 23.724                              | 23.292                              | 23.724                              |

#### 4Tx CDD MODE

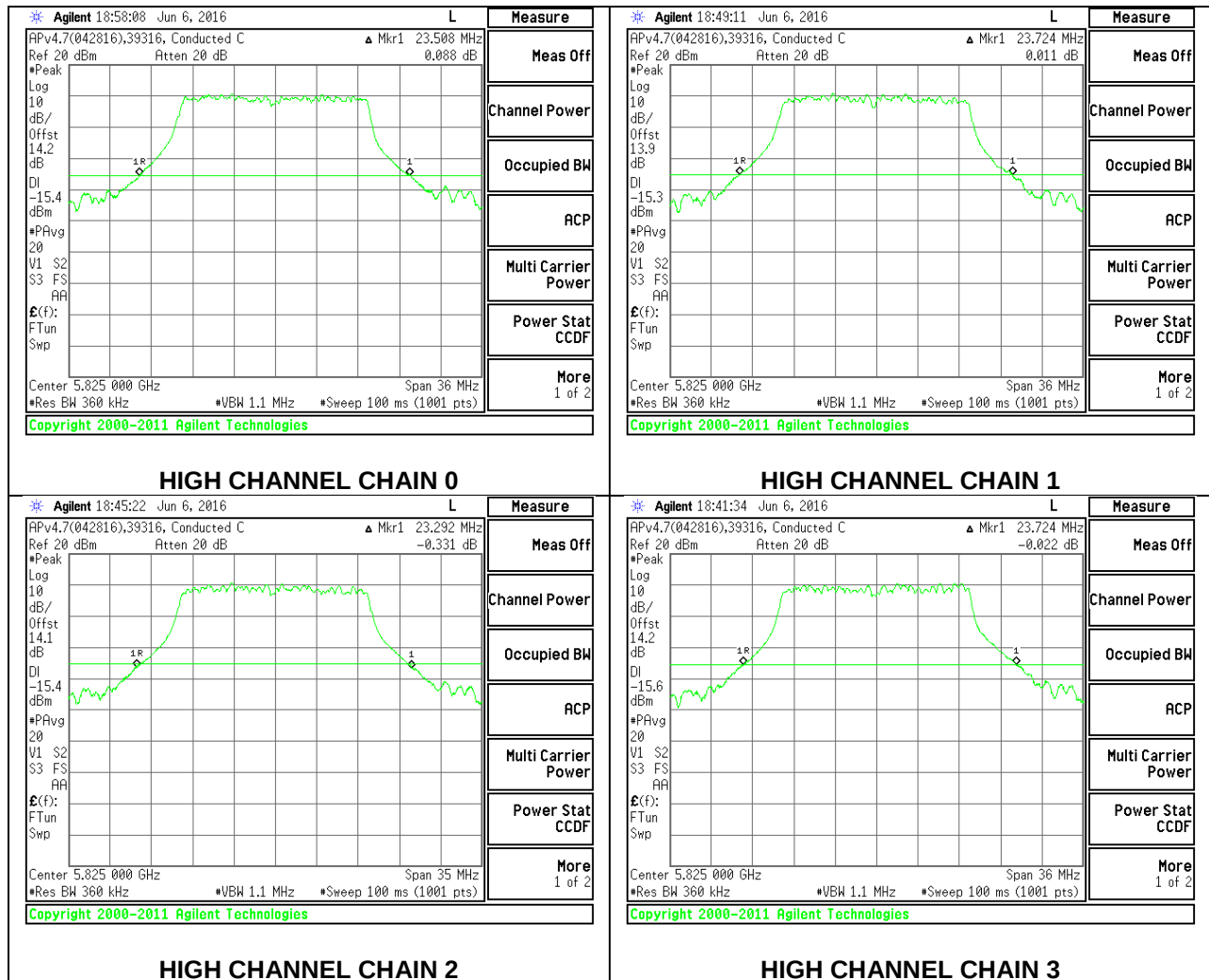
#### LOW CHANNEL



## MID CHANNEL



## HIGH CHANNEL



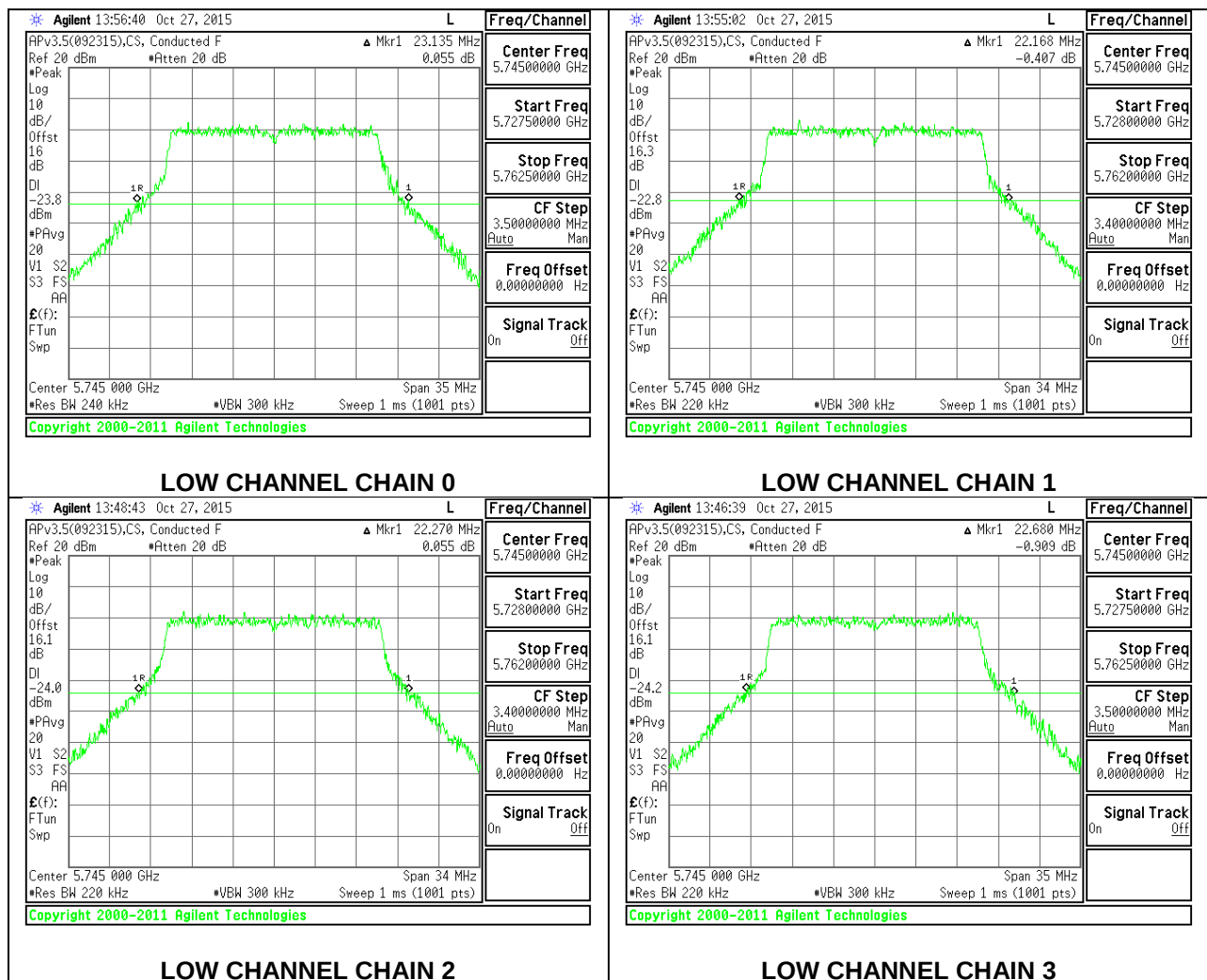
## 4.2.6. 802.11ac VHT20 MODE IN THE 5.8 GHz BAND

### 4 Tx CDD MODE

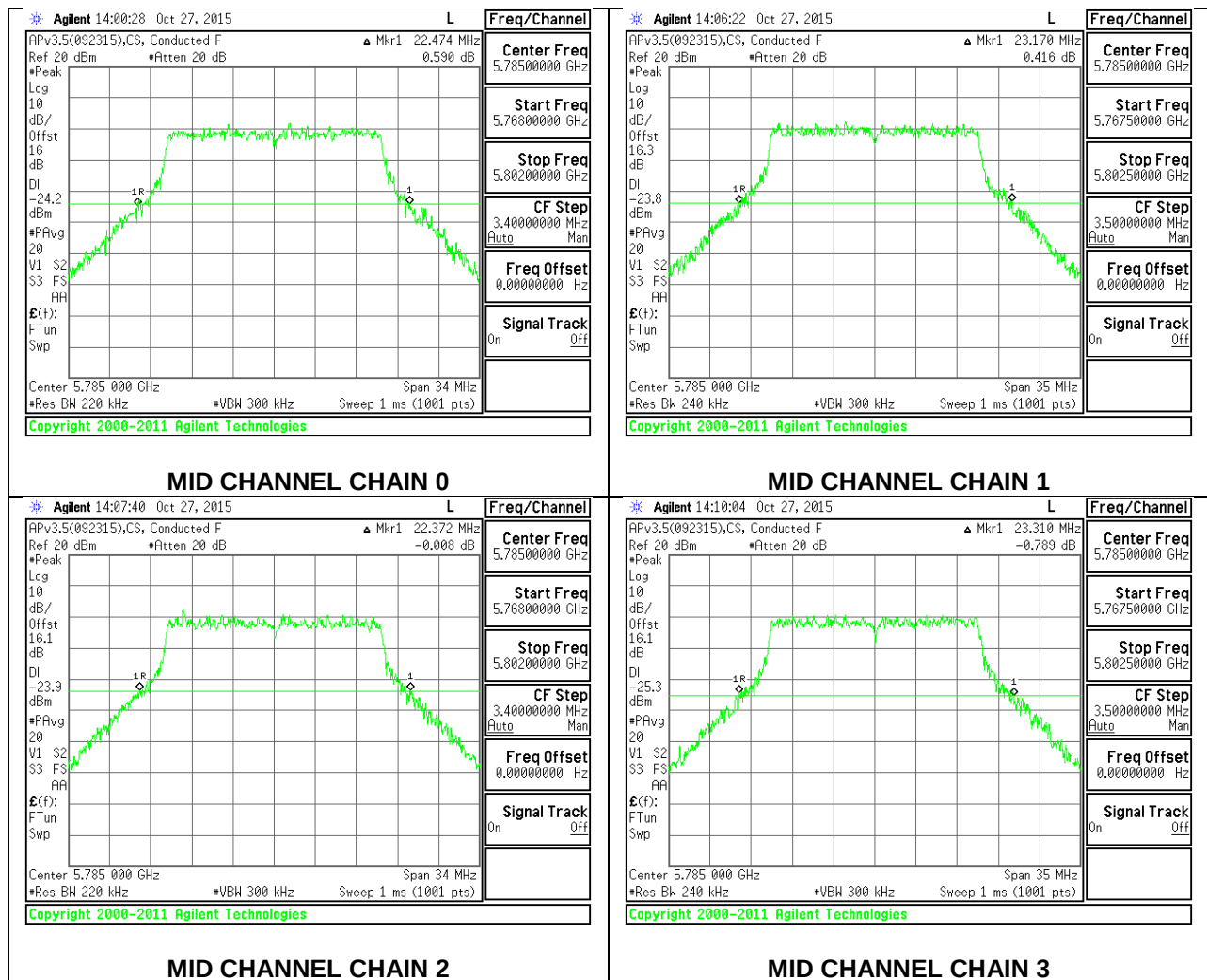
| Channel | Frequency<br>(MHz) | 26 dB Bandwidth<br>Chain 0<br>(MHz) | 26 dB Bandwidth<br>Chain 1<br>(MHz) | 26 dB Bandwidth<br>Chain 2<br>(MHz) | 26 dB Bandwidth<br>Chain 3<br>(MHz) |
|---------|--------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Low     | 5745               | 23.135                              | 22.168                              | 22.270                              | 22.680                              |
| Mid     | 5785               | 22.474                              | 23.170                              | 22.372                              | 23.310                              |
| High    | 5825               | 22.474                              | 22.680                              | 22.168                              | 23.508                              |

Test By: 37699 CS  
Test Date: 10/27/15

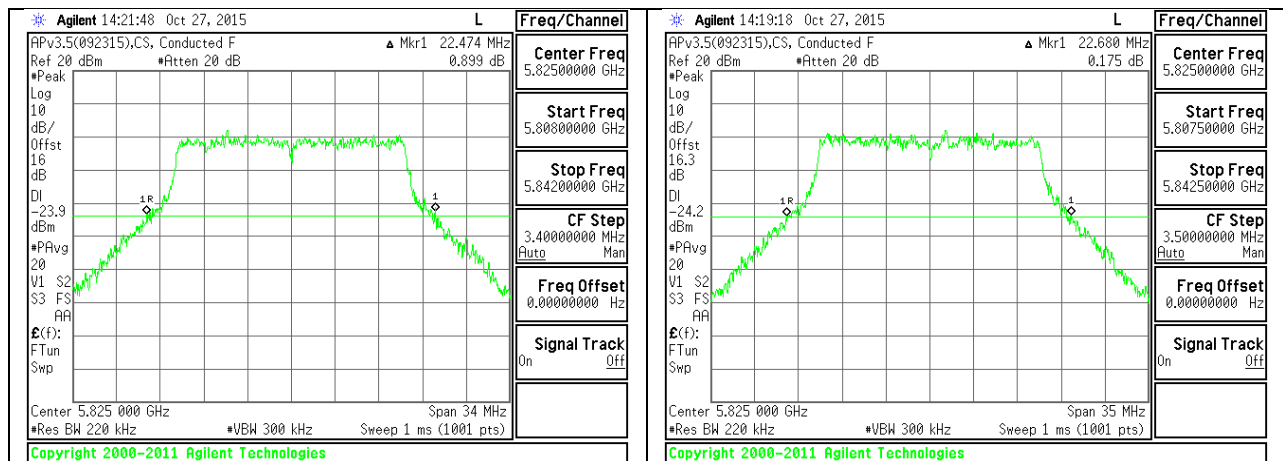
### LOW CHANNEL



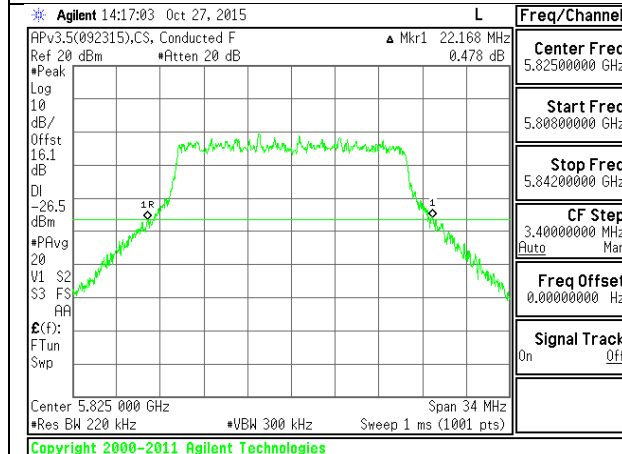
## MID CHANNEL



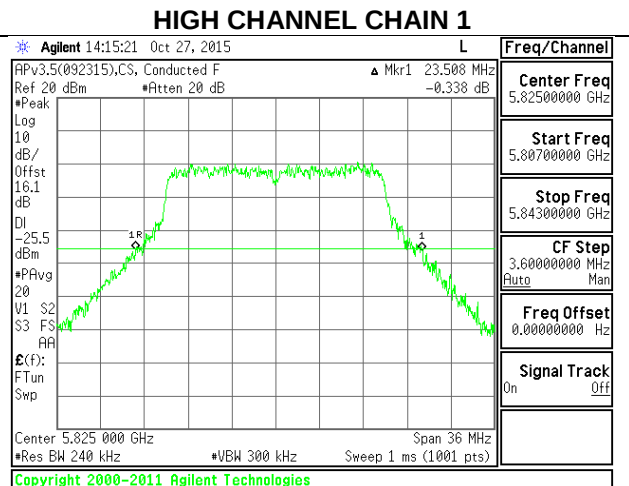
## HIGH CHANNEL



### HIGH CHANNEL CHAIN 0



### HIGH CHANNEL CHAIN 2



### HIGH CHANNEL CHAIN 3

## 4.2.7. 802.11ac VHT40 MODE IN THE 5.8 GHz BAND

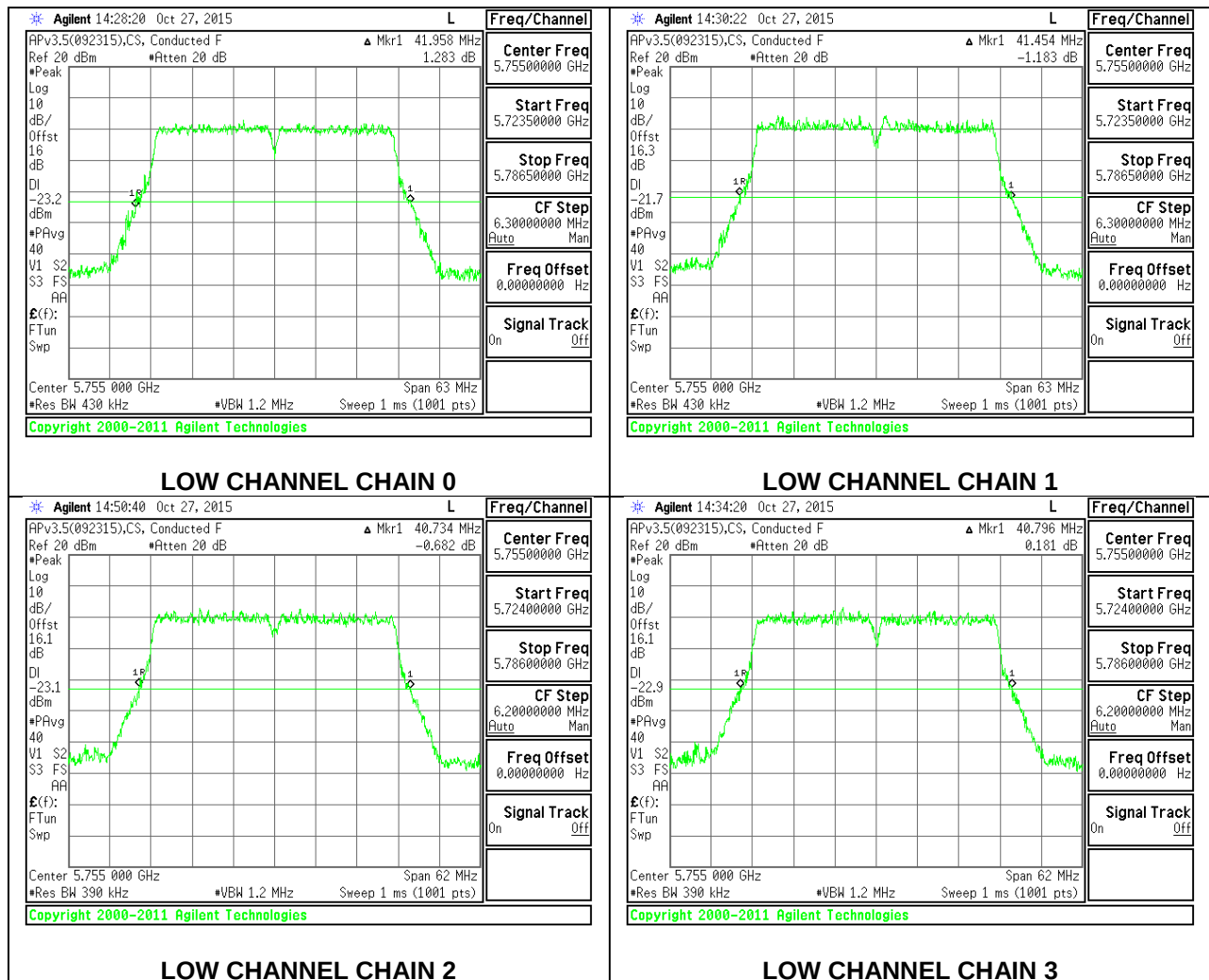
### 4 Tx CDD MODE

| Channel | Frequency<br>(MHz) | 26 dB Bandwidth<br>Chain 0<br>(MHz) | 26 dB Bandwidth<br>Chain 1<br>(MHz) | 26 dB Bandwidth<br>Chain 2<br>(MHz) | 26 dB Bandwidth<br>Chain 3<br>(MHz) |
|---------|--------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Low     | 5755               | 41.958                              | 41.454                              | 40.734                              | 40.796                              |
| High    | 5795               | 41.454                              | 41.391                              | 41.044                              | 40.920                              |

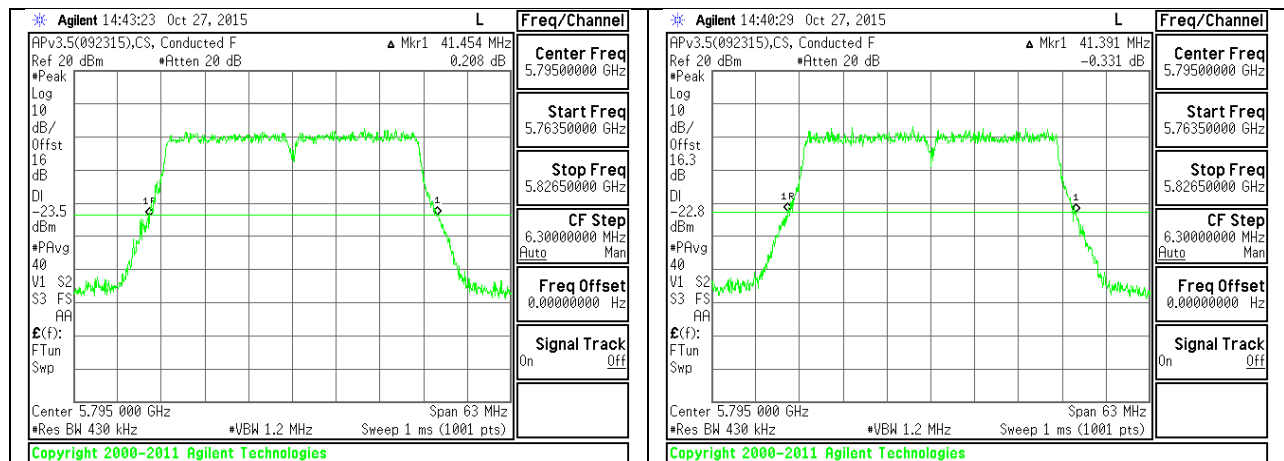
Test By: 37699 CS

Test Date: 10/27/15

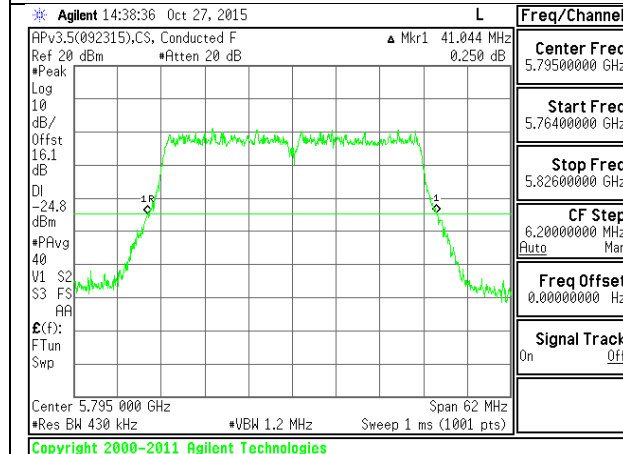
### LOW CHANNEL



## HIGH CHANNEL

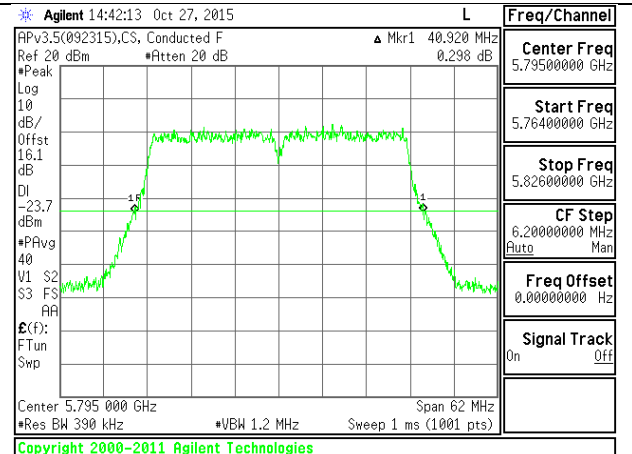


### HIGH CHANNEL CHAIN 0



### HIGH CHANNEL CHAIN 2

### HIGH CHANNEL CHAIN 1



### HIGH CHANNEL CHAIN 3

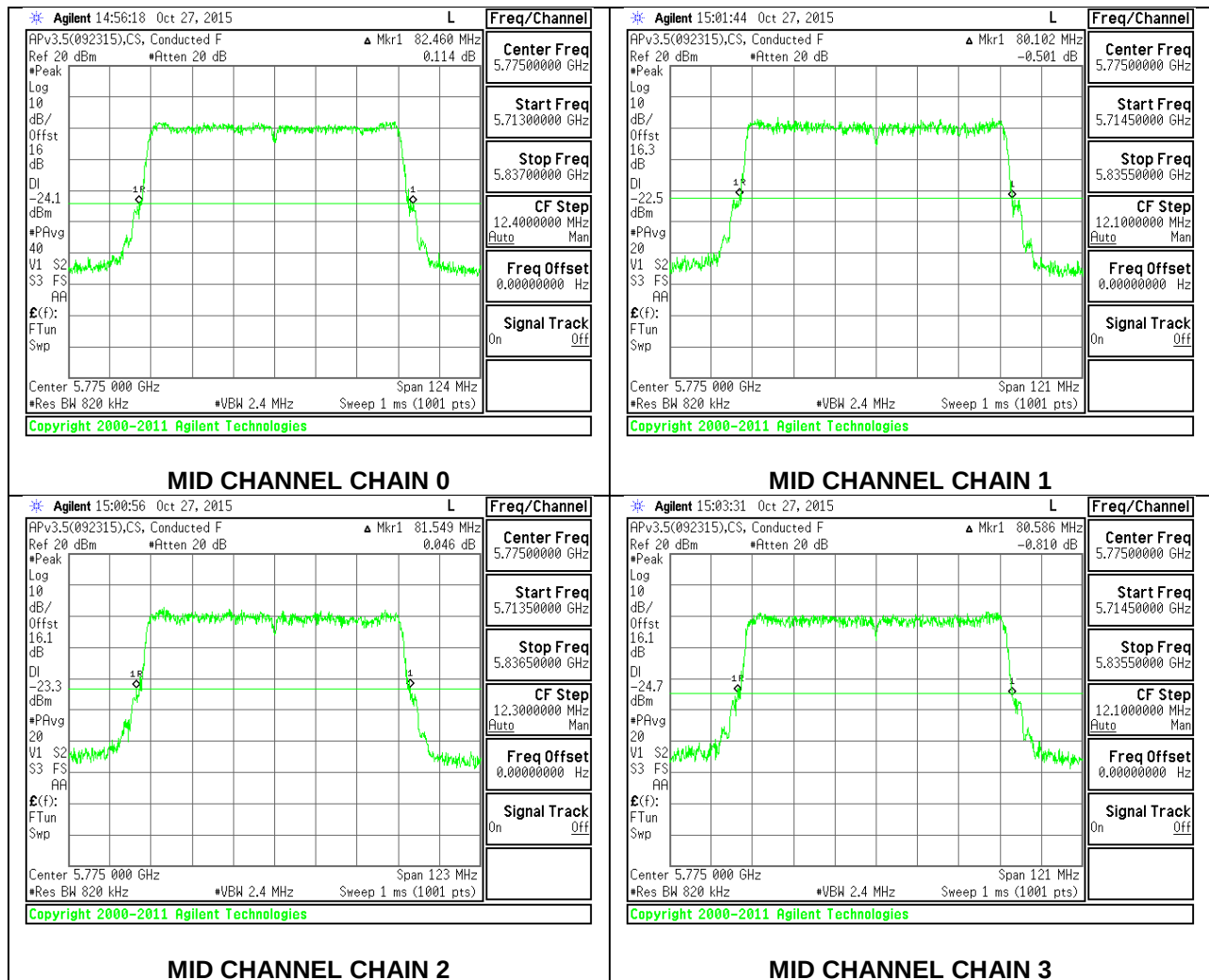
## 4.2.8. 802.11ac VHT80 MODE IN THE 5.8 GHz BAND

### 4 Tx CDD MODE

| Channel | Frequency<br>(MHz) | 26 dB Bandwidth<br>Chain 0<br>(MHz) | 26 dB Bandwidth<br>Chain 1<br>(MHz) | 26 dB Bandwidth<br>Chain 2<br>(MHz) | 26 dB Bandwidth<br>Chain 3<br>(MHz) |
|---------|--------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Mid     | 5775               | 82.460                              | 80.102                              | 81.549                              | 80.586                              |

Test By: 37699 CS  
Test Date: 10/27/15

### MID CHANNEL



### **4.3. 99% BANDWIDTH**

#### **LIMITS**

None; for reporting purposes only.

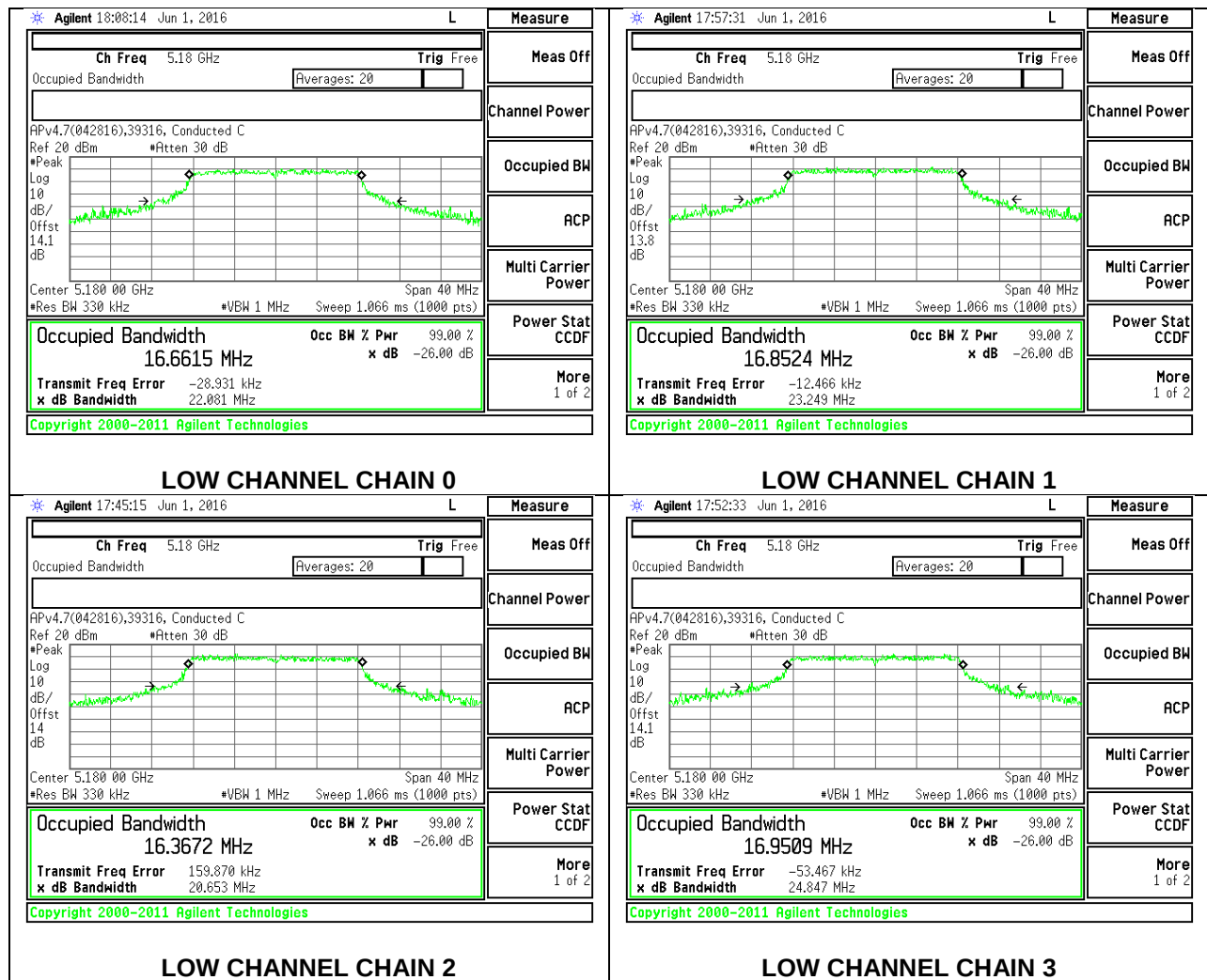
#### **RESULTS**

### 4.3.1. 802.11a MODE IN THE 5.2 GHz BAND

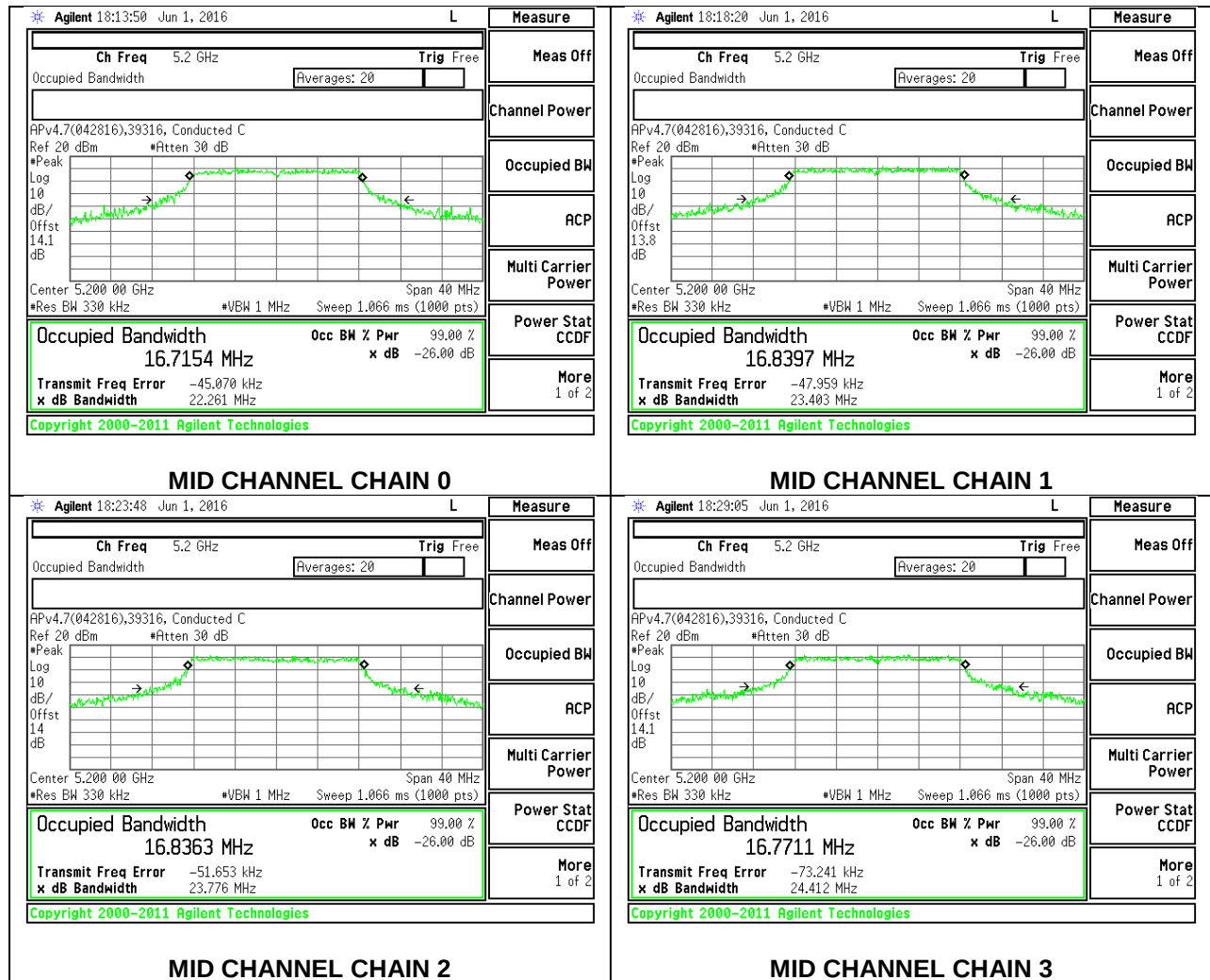
#### 4 Tx CDD MODE

| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>Chain 0<br>(MHz) | 99% Bandwidth<br>Chain 1<br>(MHz) | 99% Bandwidth<br>Chain 2<br>(MHz) | 99% Bandwidth<br>Chain 3<br>(MHz) |
|---------|--------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| Low     | 5180               | 16.662                            | 16.852                            | 16.367                            | 16.951                            |
| Mid     | 5200               | 16.715                            | 16.840                            | 16.836                            | 16.771                            |
| High    | 5240               | 16.771                            | 16.756                            | 16.883                            | 16.807                            |

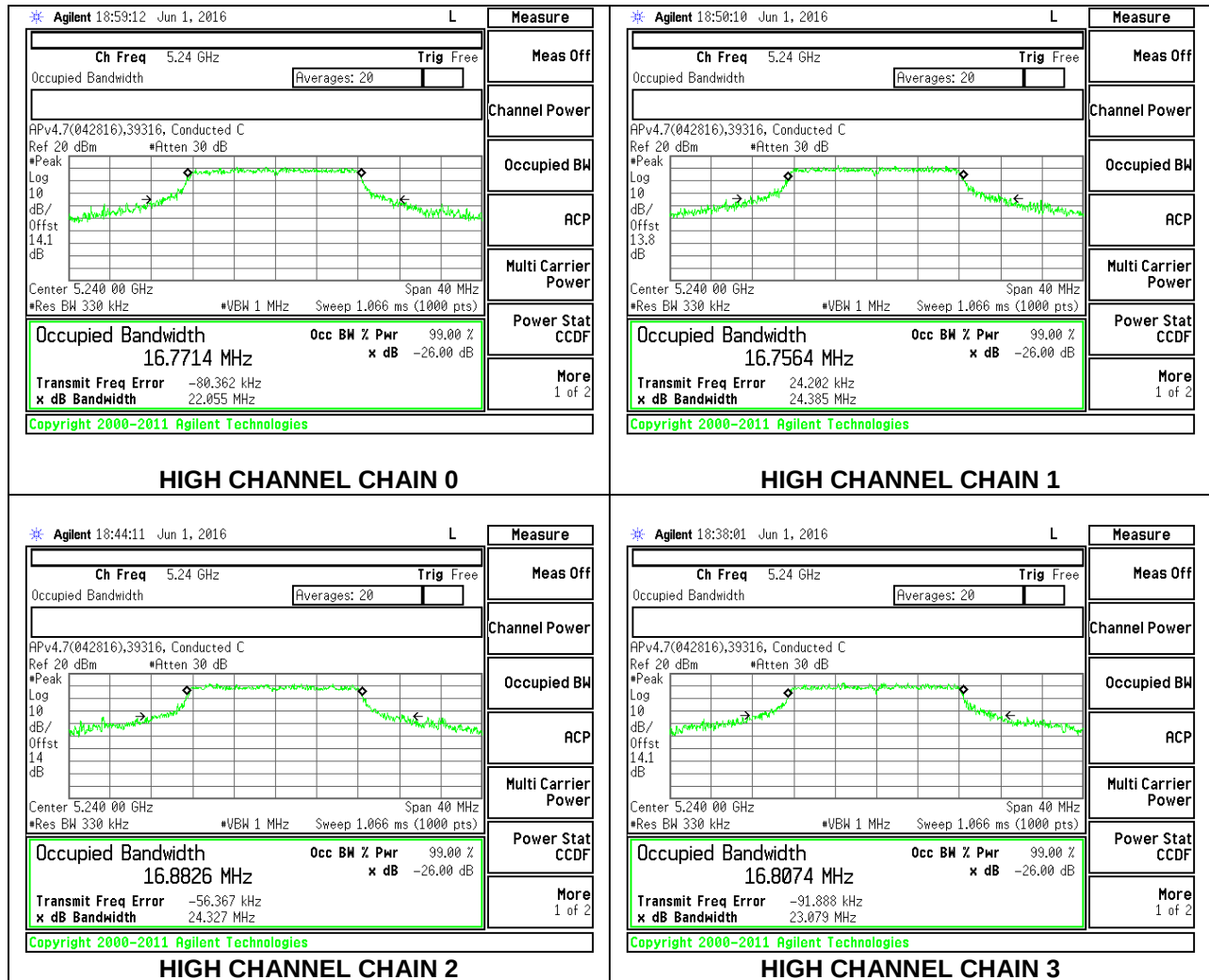
### LOW CHANNEL



## MID CHANNEL



## HIGH CHANNEL



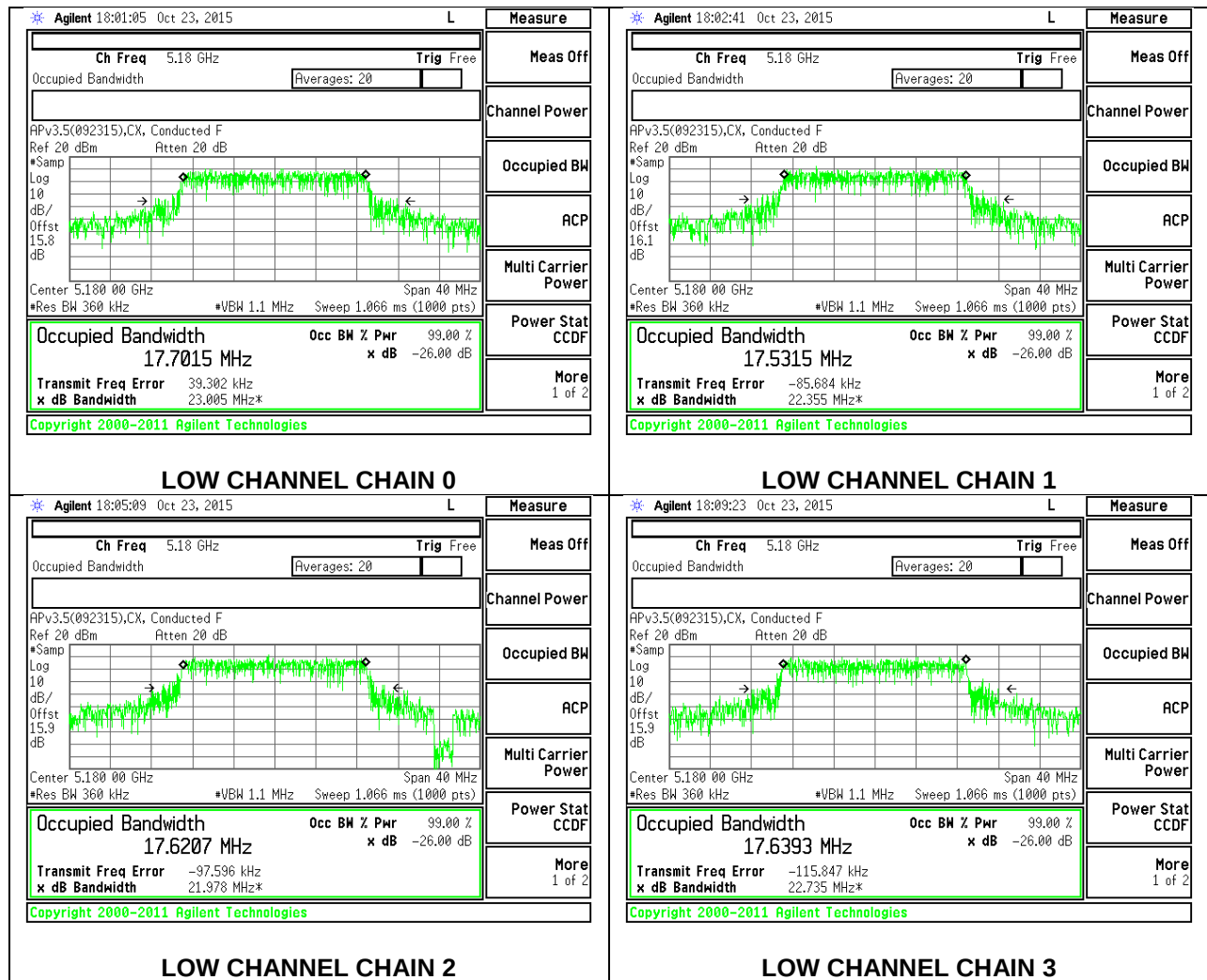
## 4.3.2. 802.11ac VHT20 MODE IN THE 5.2 GHz BAND

### 4 Tx CDD MODE

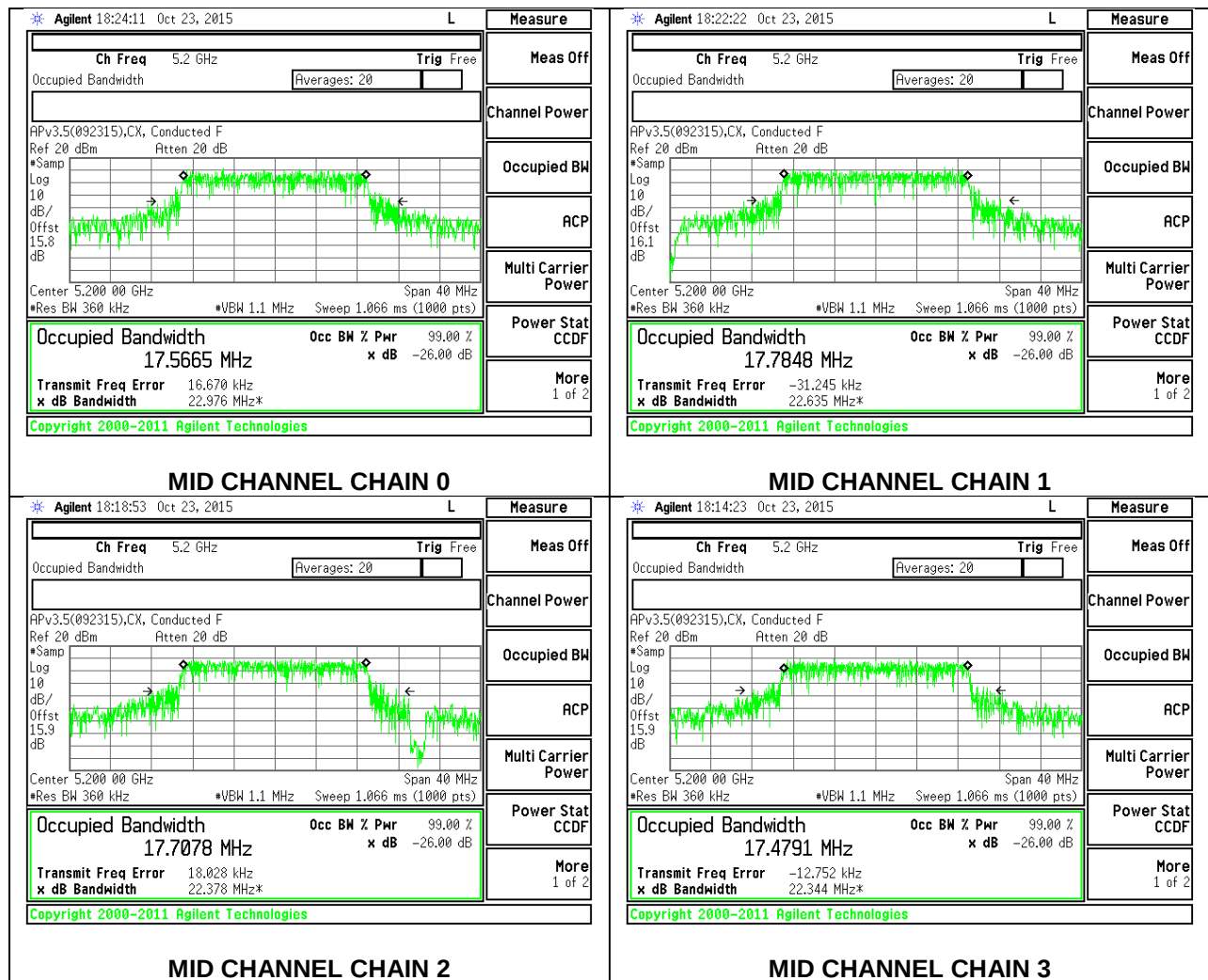
| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>Chain 0<br>(MHz) | 99% Bandwidth<br>Chain 1<br>(MHz) | 99% Bandwidth<br>Chain 2<br>(MHz) | 99% Bandwidth<br>Chain 3<br>(MHz) |
|---------|--------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| Low     | 5180               | 17.702                            | 17.532                            | 17.621                            | 17.639                            |
| Mid     | 5200               | 17.567                            | 17.785                            | 17.708                            | 17.479                            |
| High    | 5240               | 17.767                            | 17.708                            | 17.701                            | 17.829                            |

Test By: 39316 CX  
Test Date: 10/23/15

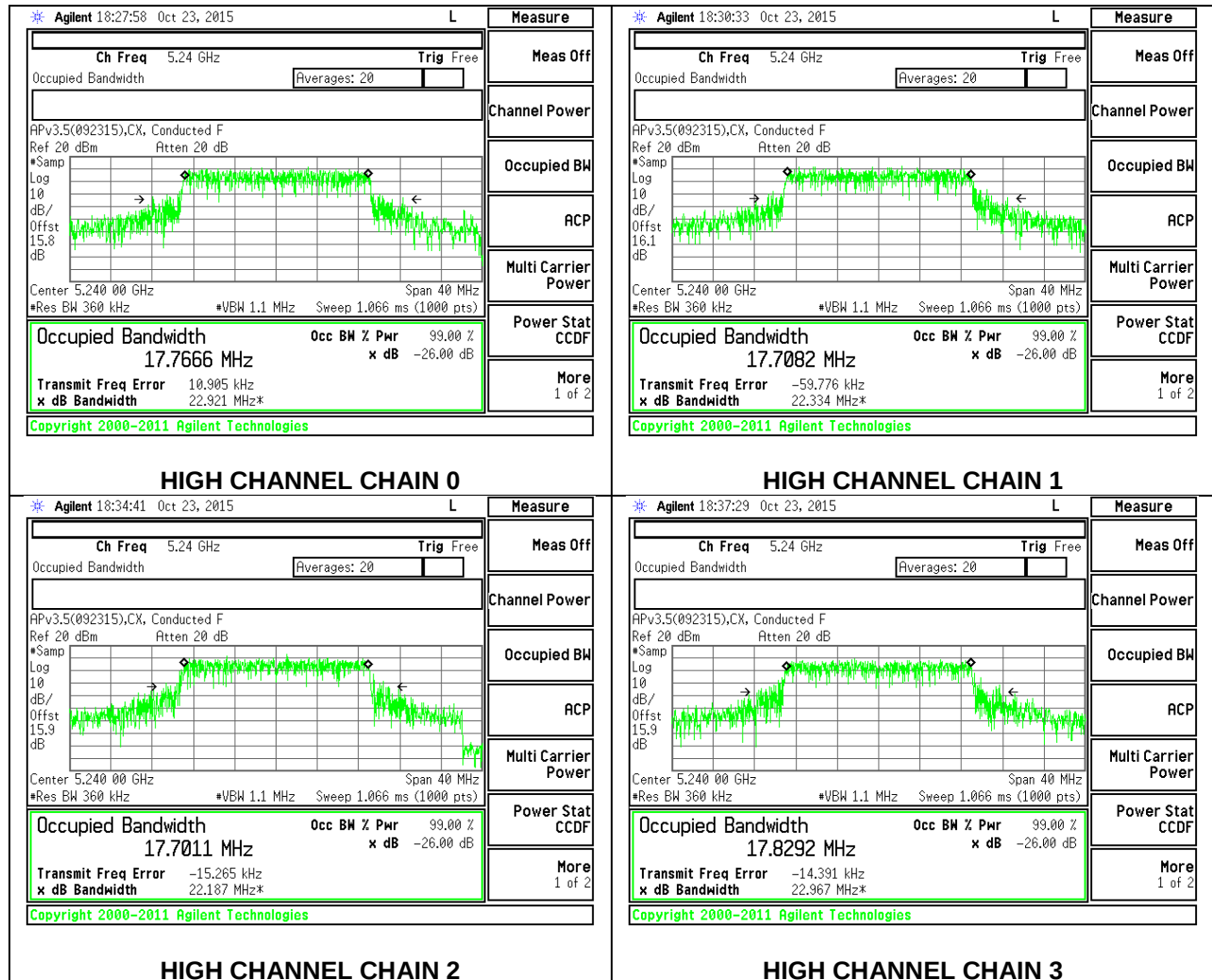
### LOW CHANNEL



## MID CHANNEL



## HIGH CHANNEL



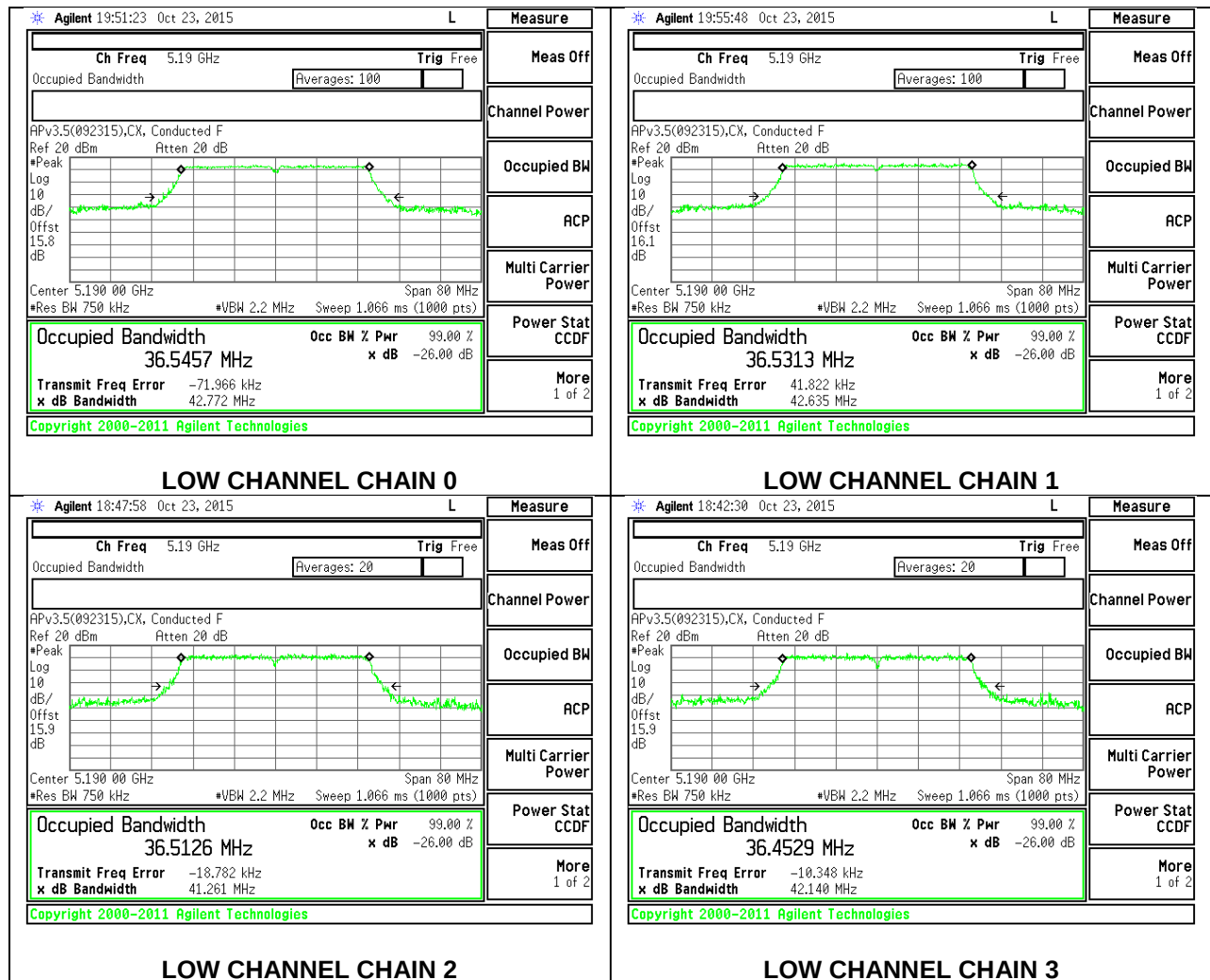
### 4.3.3. 802.11ac VHT40 MODE IN THE 5.2 GHz BAND

#### 4 Tx CDD MODE

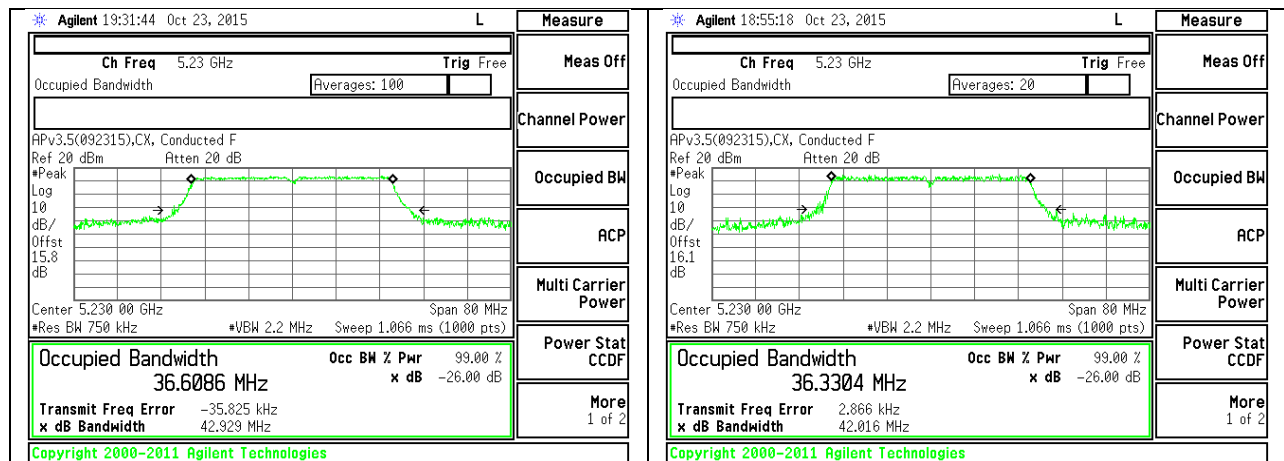
| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>Chain 0<br>(MHz) | 99% Bandwidth<br>Chain 1<br>(MHz) | 99% Bandwidth<br>Chain 2<br>(MHz) | 99% Bandwidth<br>Chain 3<br>(MHz) |
|---------|--------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| Low     | 5190               | 36.546                            | 36.531                            | 36.513                            | 36.453                            |
| High    | 5230               | 36.609                            | 36.330                            | 36.577                            | 36.423                            |

Test By: 39316 CX  
Test Date: 10/23/15

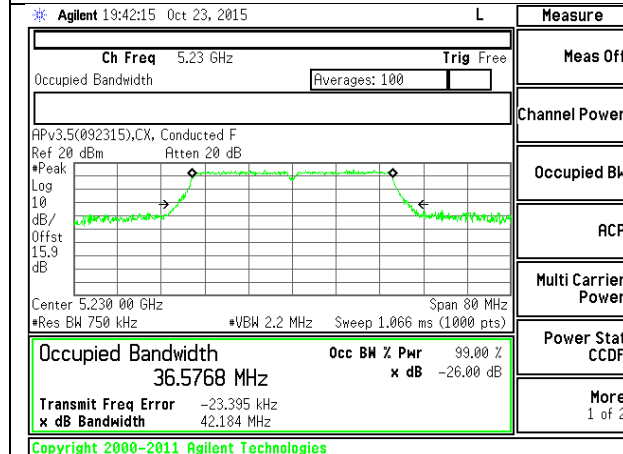
#### LOW CHANNEL



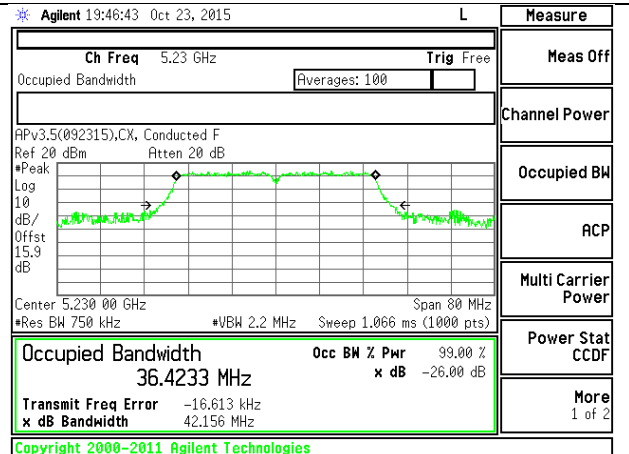
## HIGH CHANNEL



## HIGH CHANNEL CHAIN 0



## HIGH CHANNEL CHAIN 1



## HIGH CHANNEL CHAIN 2

## HIGH CHANNEL CHAIN 3

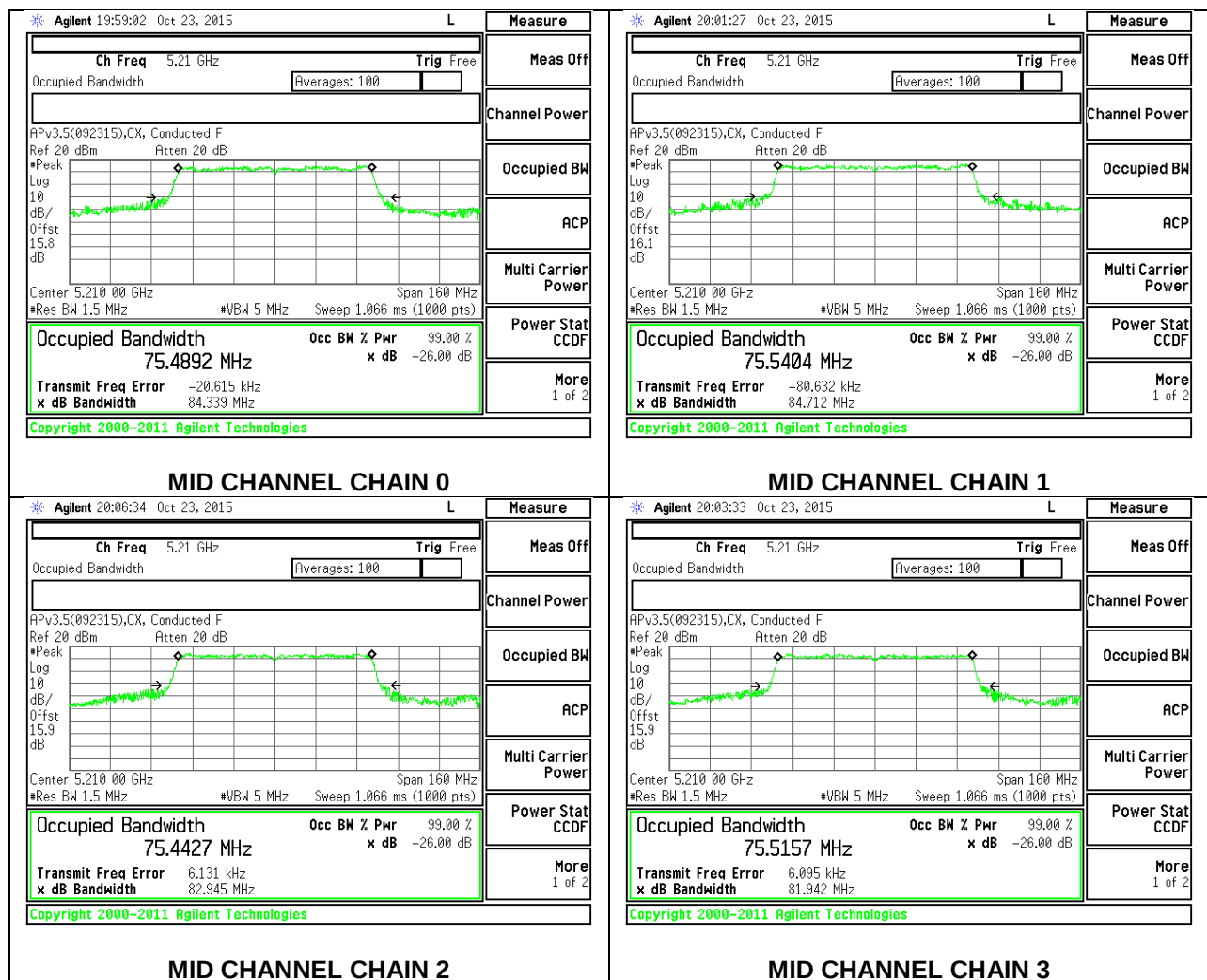
### 4.3.4. 802.11ac VHT80 MODE IN THE 5.2 GHz BAND

#### 4 Tx CDD MODE

| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>Chain 0<br>(MHz) | 99% Bandwidth<br>Chain 1<br>(MHz) | 99% Bandwidth<br>Chain 2<br>(MHz) | 99% Bandwidth<br>Chain 3<br>(MHz) |
|---------|--------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| Mid     | 5210               | 75.489                            | 75.540                            | 75.443                            | 75.516                            |

#### MID CHANNEL

Test By: 39316 CX  
Test Date: 10/23/15

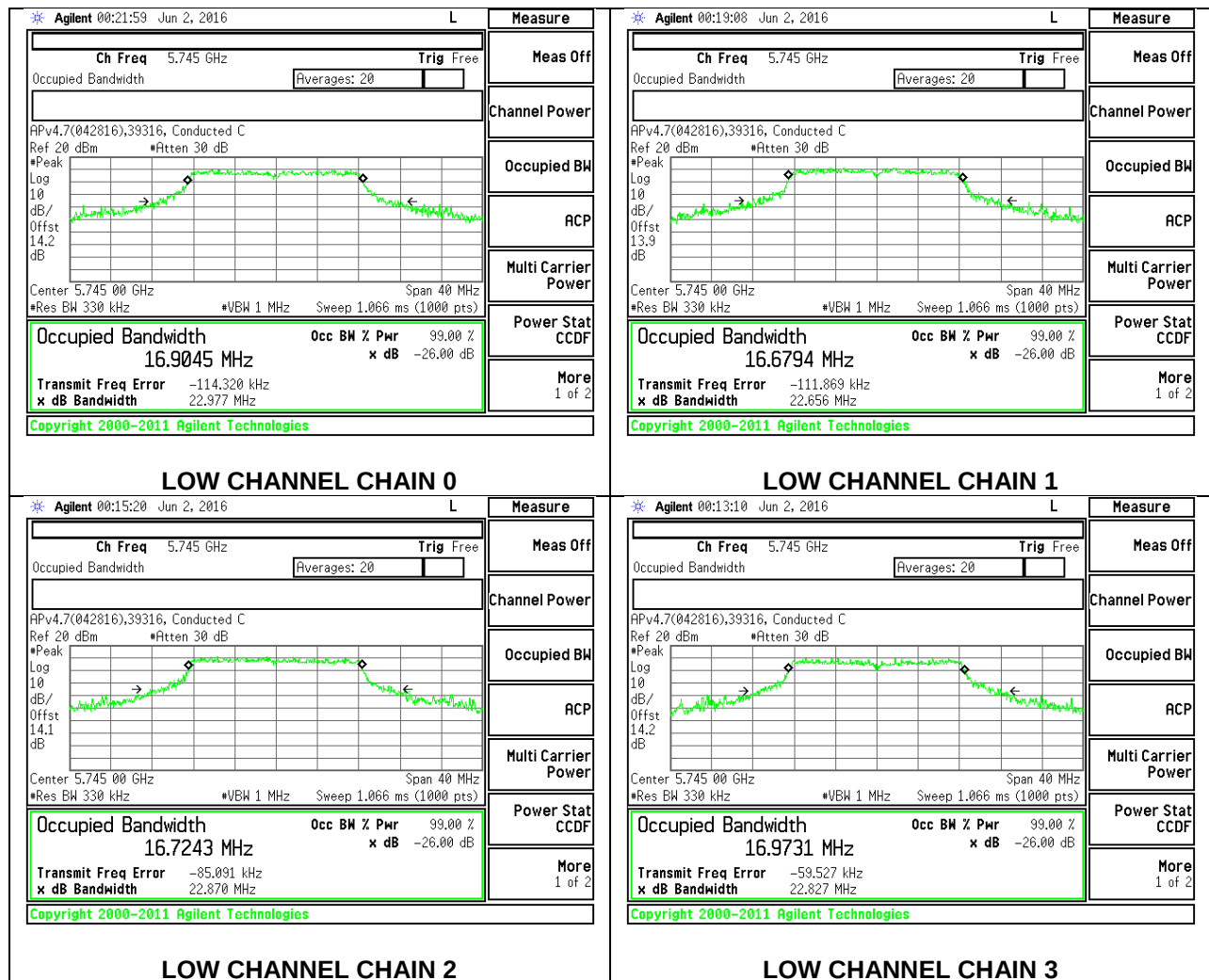


### 4.3.5. 802.11a MODE IN THE 5.8 GHz BAND

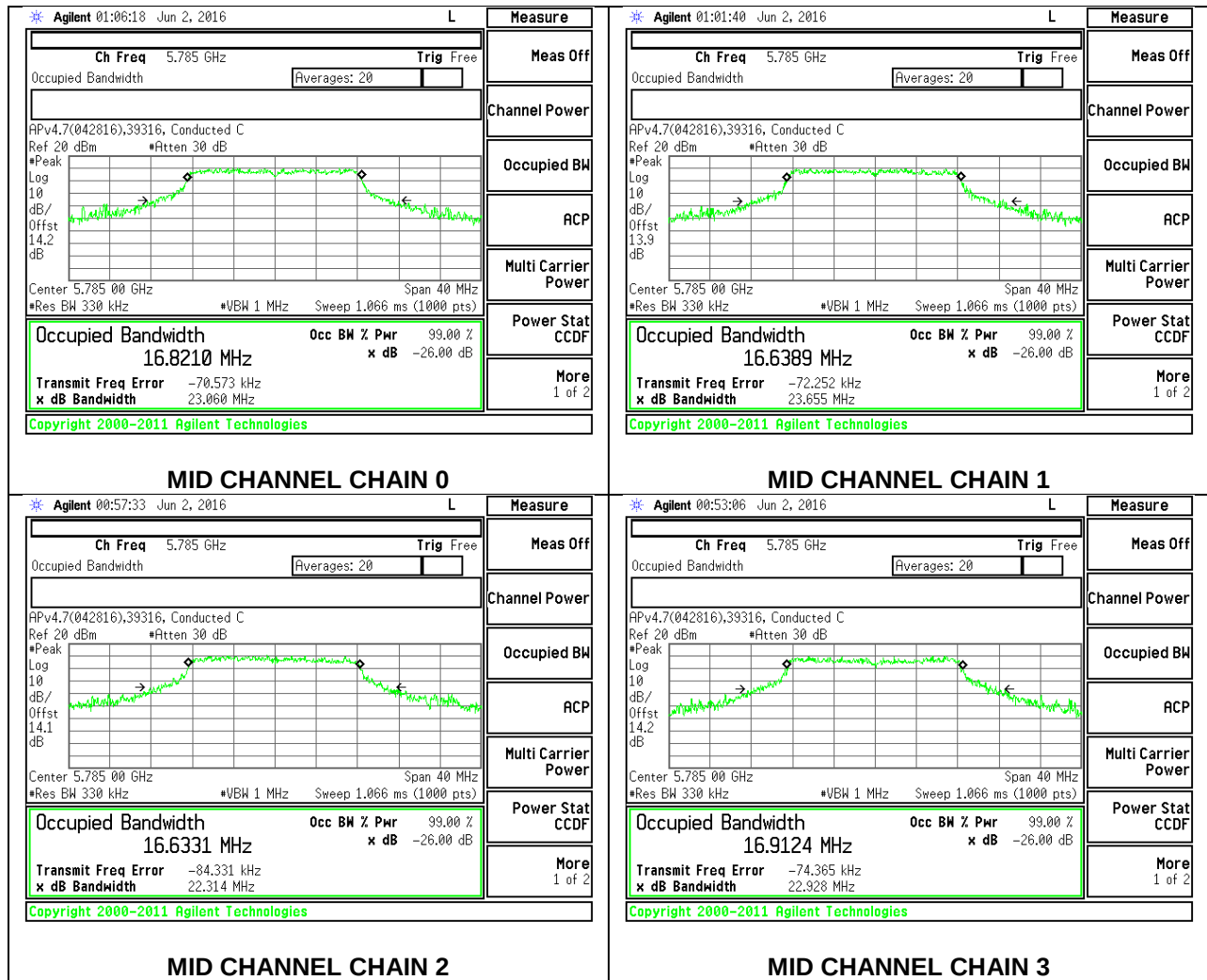
#### 4 Tx CDD MODE

| Channel | Frequency | 99% Bandwidth<br>Chain 0<br>(MHz) | 99% Bandwidth<br>Chain 1<br>(MHz) | 99% Bandwidth<br>Chain 2<br>(MHz) | 99% Bandwidth<br>Chain 3<br>(MHz) |
|---------|-----------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| Low     | 5745      | 16.905                            | 16.679                            | 16.724                            | 16.973                            |
| Mid     | 5785      | 16.821                            | 16.639                            | 16.633                            | 16.912                            |
| High    | 5825      | 16.768                            | 16.717                            | 16.828                            | 16.843                            |

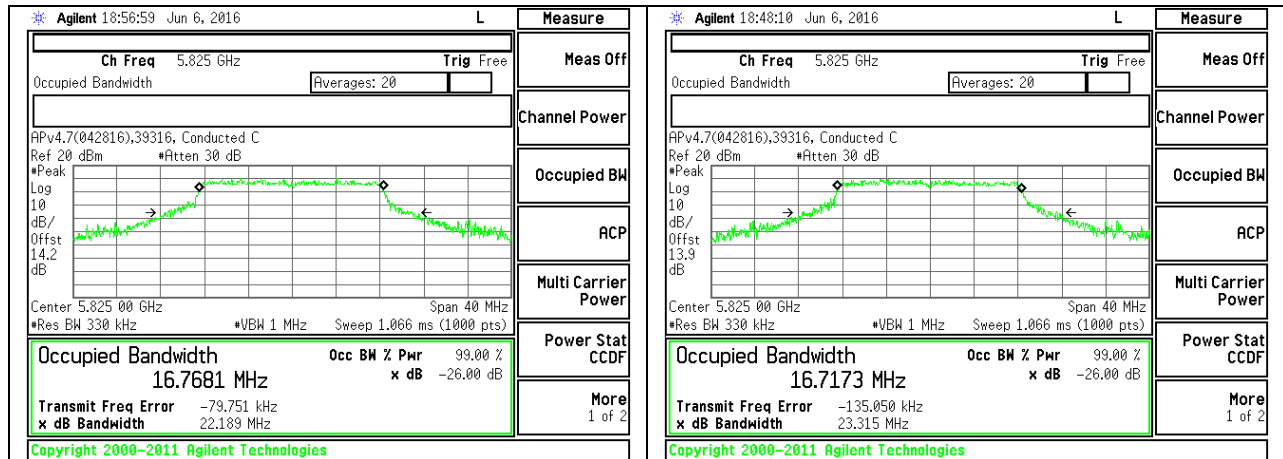
#### LOW CHANNEL



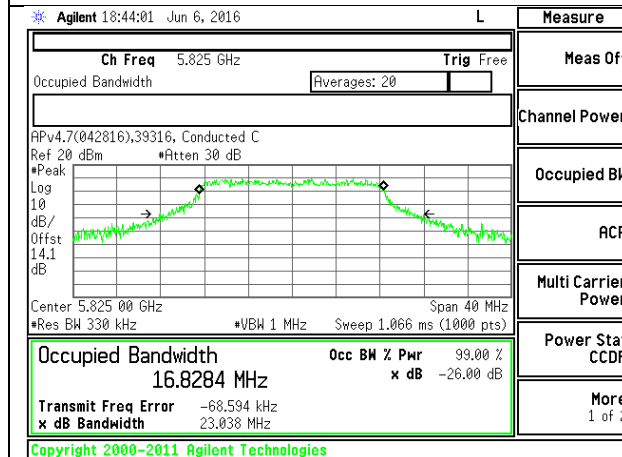
## MID CHANNEL



## HIGH CHANNEL

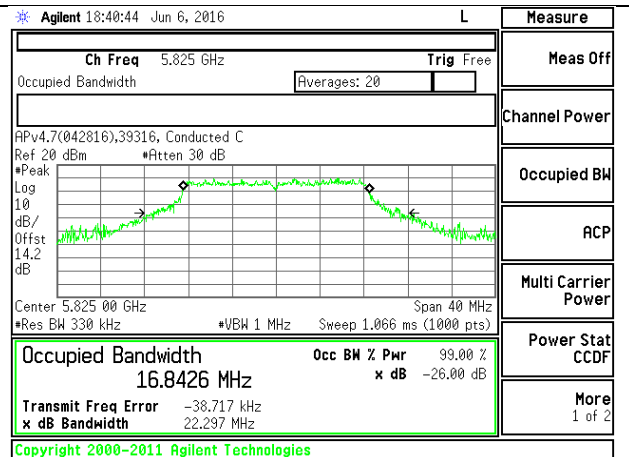


## HIGH CHANNEL CHAIN 0



## HIGH CHANNEL CHAIN 2

## HIGH CHANNEL CHAIN 1



## HIGH CHANNEL CHAIN 3

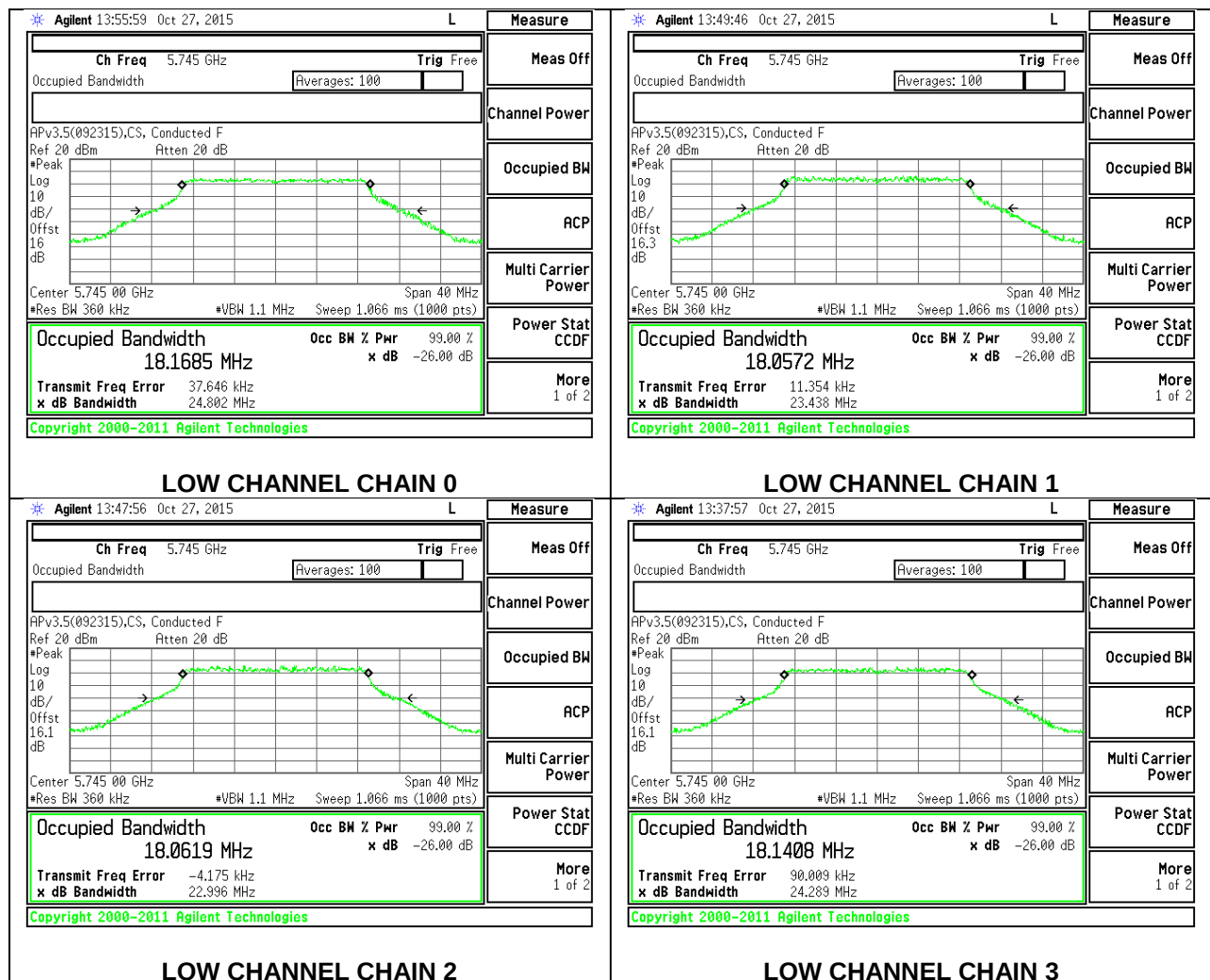
### 4.3.6. 802.11ac VHT20 MODE IN THE 5.8 GHz BAND

#### 4 Tx CDD MODE

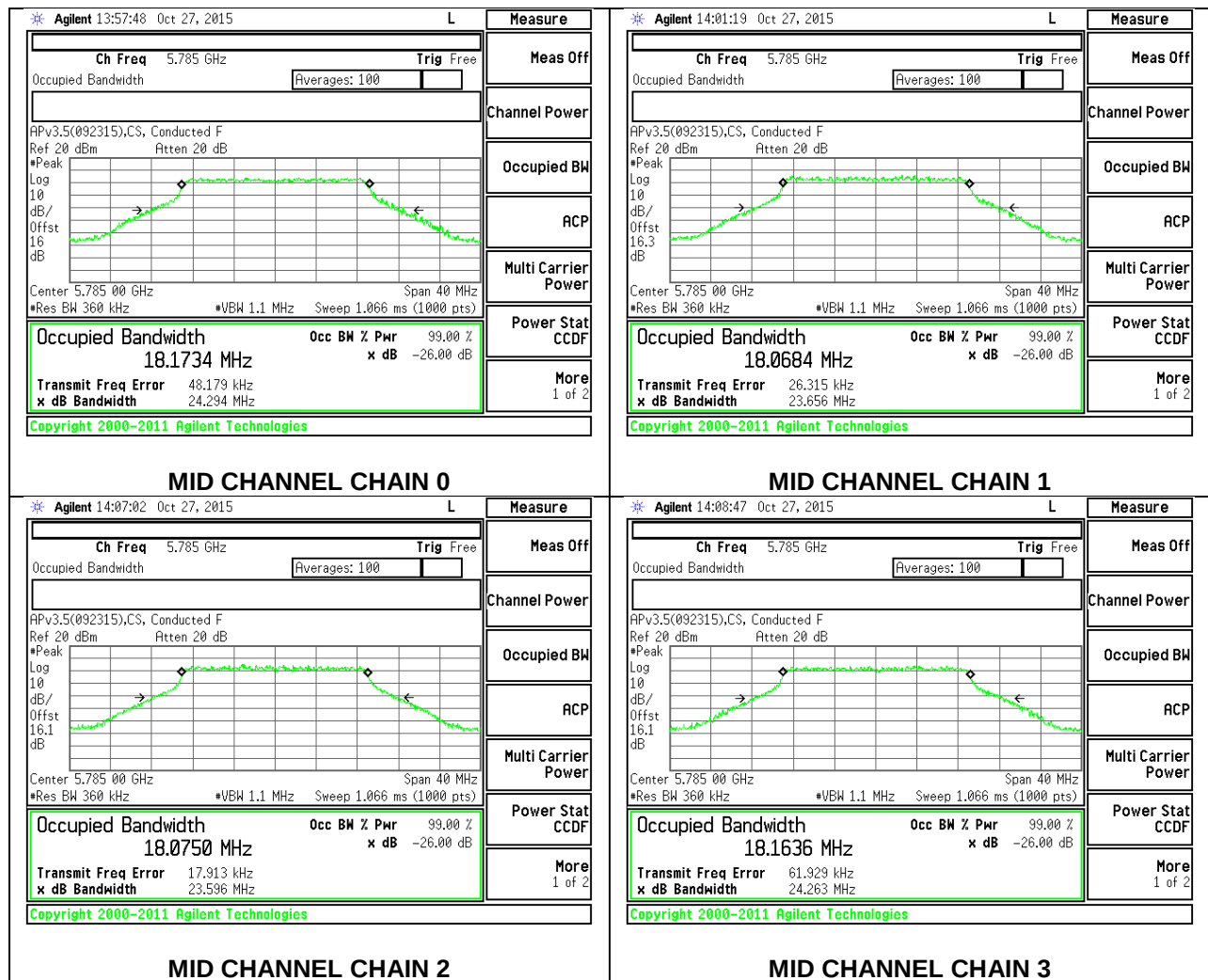
| Channel | Frequency (MHz) | 99% Bandwidth Chain 0 (MHz) | 99% Bandwidth Chain 1 (MHz) | 99% Bandwidth Chain 2 (MHz) | 99% Bandwidth Chain 3 (MHz) |
|---------|-----------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| Low     | 5745            | 18.169                      | 18.057                      | 18.062                      | 18.141                      |
| Mid     | 5785            | 18.173                      | 18.068                      | 18.075                      | 18.164                      |
| High    | 5825            | 18.090                      | 18.042                      | 17.997                      | 18.133                      |

Test By: 37699 CS  
Test Date: 10/27/15

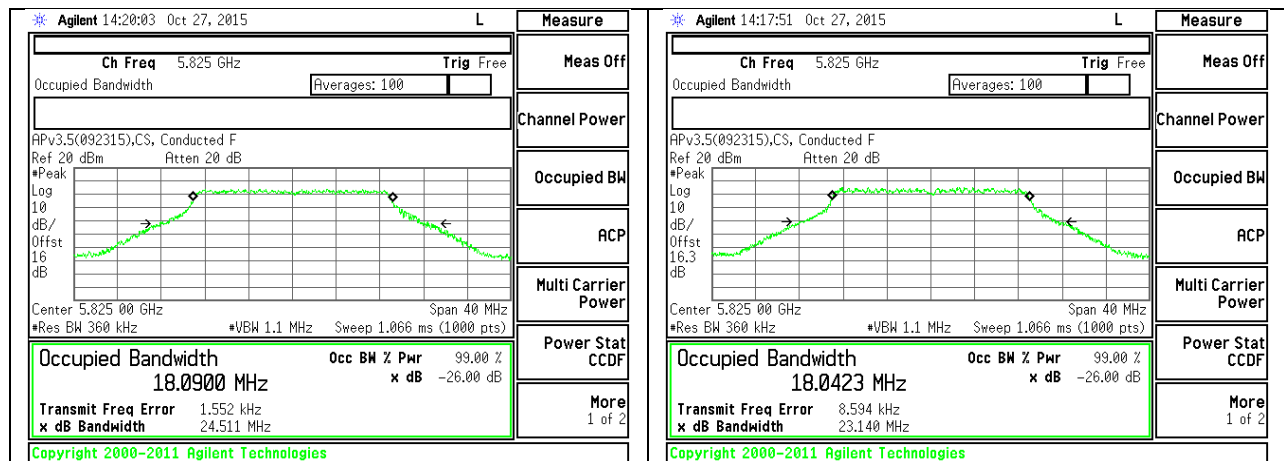
#### LOW CHANNEL



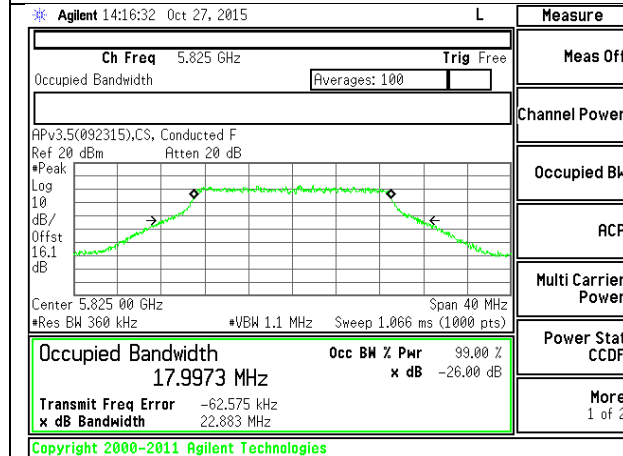
## MID CHANNEL



## HIGH CHANNEL

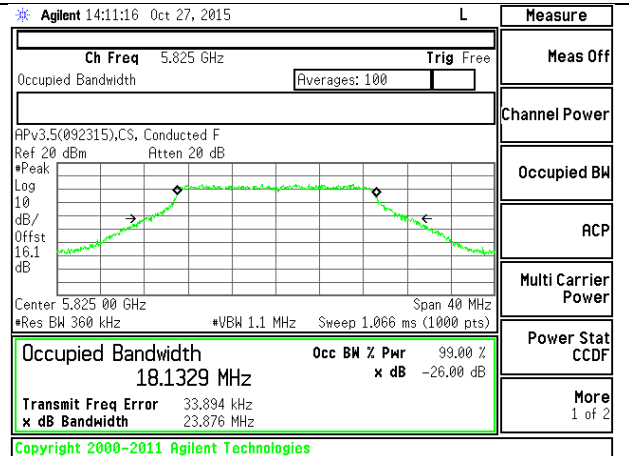


## HIGH CHANNEL CHAIN 0



## HIGH CHANNEL CHAIN 2

## HIGH CHANNEL CHAIN 1



## HIGH CHANNEL CHAIN 3

### 4.3.7. 802.11ac VHT40 MODE IN THE 5.8 GHz BAND

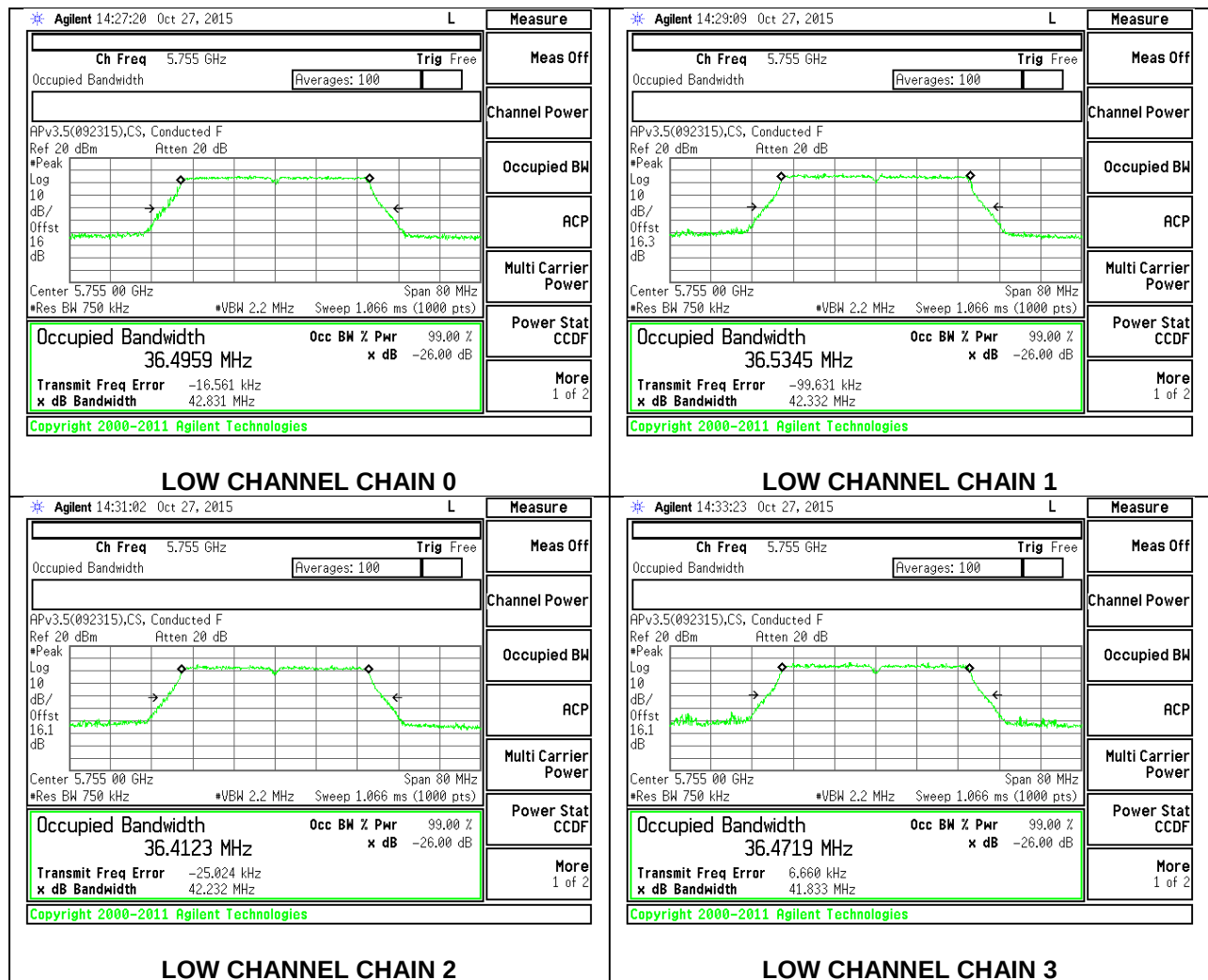
#### 4 Tx CDD MODE

| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>Chain 0<br>(MHz) | 99% Bandwidth<br>Chain 1<br>(MHz) | 99% Bandwidth<br>Chain 2<br>(MHz) | 99% Bandwidth<br>Chain 3<br>(MHz) |
|---------|--------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| Low     | 5755               | 36.496                            | 36.535                            | 36.412                            | 36.472                            |
| High    | 5795               | 36.603                            | 36.586                            | 36.443                            | 36.424                            |

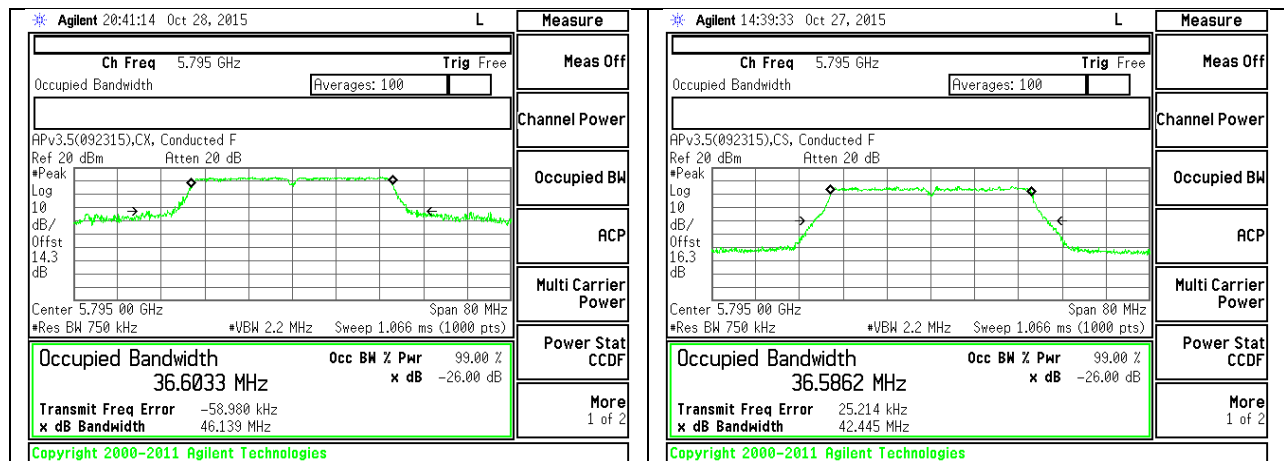
Test By: 37699 CS

Test Date: 10/27/15 – 10/28/15

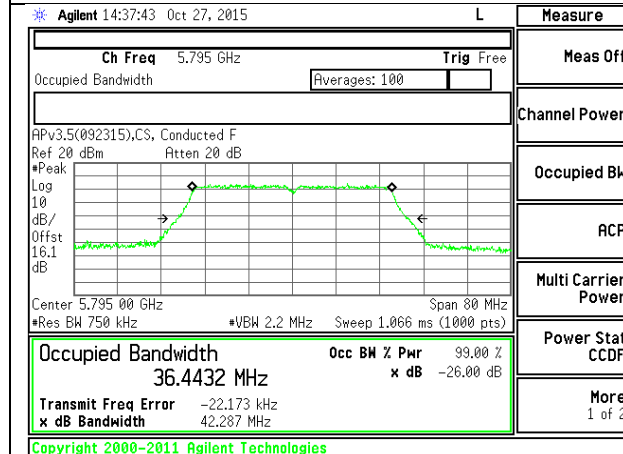
#### LOW CHANNEL



## HIGH CHANNEL

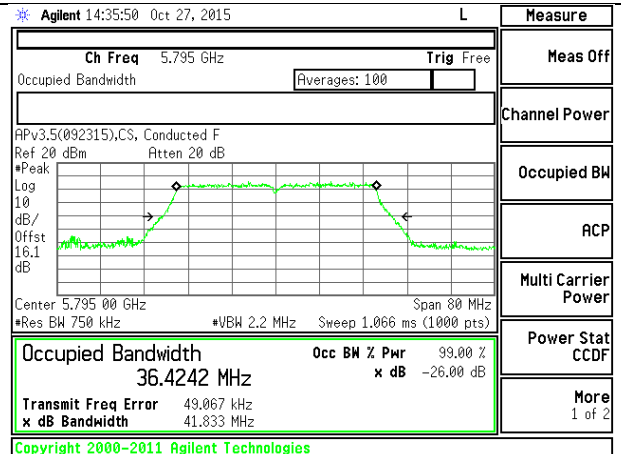


## HIGH CHANNEL CHAIN 0



## HIGH CHANNEL CHAIN 2

## HIGH CHANNEL CHAIN 1



## HIGH CHANNEL CHAIN 3

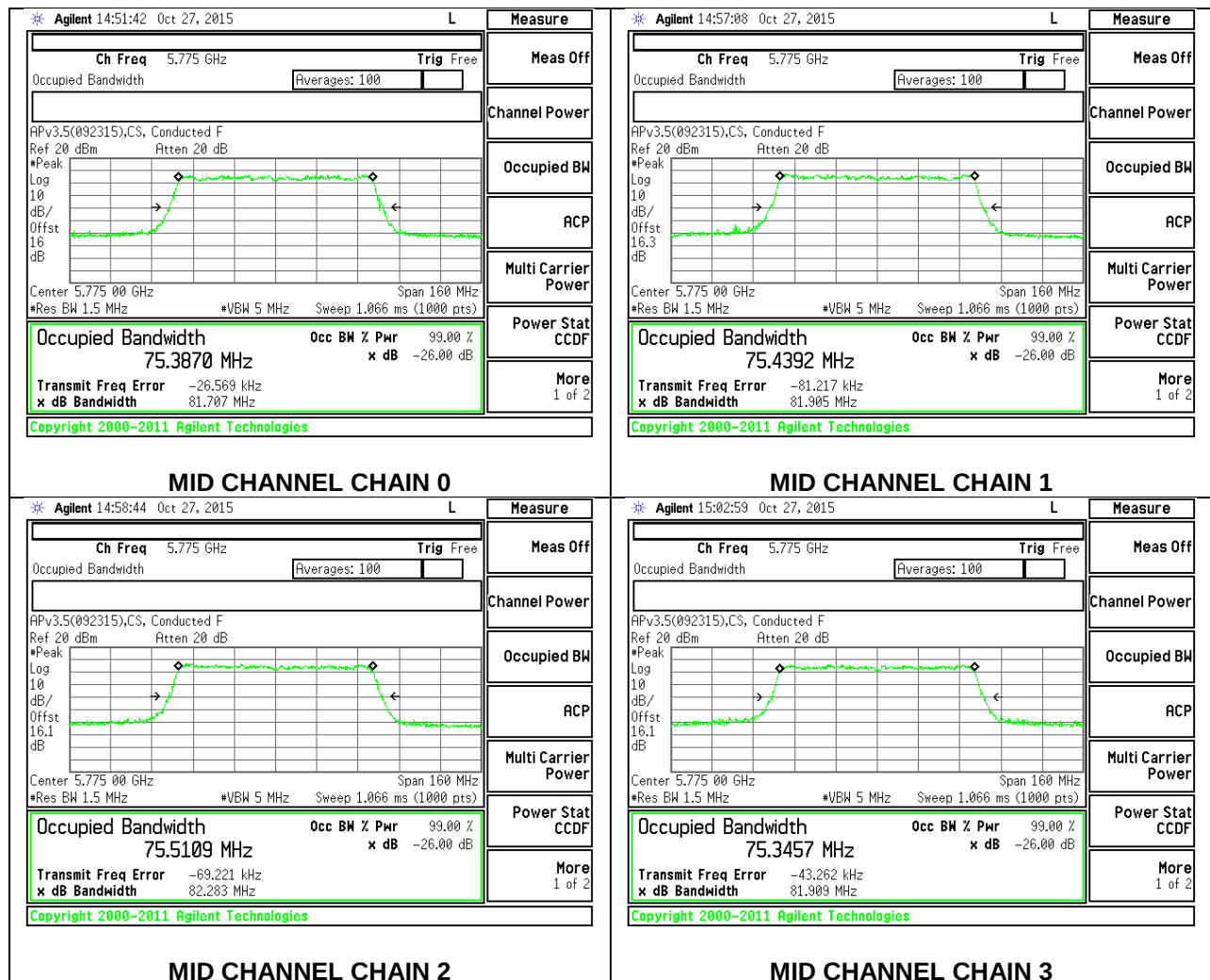
### 4.3.8. 802.11ac VHT80 MODE IN THE 5.8 GHz BAND

#### 4 Tx CDD MODE

| Channel | Frequency (MHz) | 99% Bandwidth Chain 0 (MHz) | 99% Bandwidth Chain 1 (MHz) | 99% Bandwidth Chain 2 (MHz) | 99% Bandwidth Chain 3 (MHz) |
|---------|-----------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| Mid     | 5775            | 75.387                      | 75.439                      | 75.511                      | 75.346                      |

Test By: 37699 CS  
Test Date: 10/27/15

#### MID CHANNEL



#### **4.4. 6 dB BANDWIDTH**

##### **LIMITS**

FCC §15.407  
RSS-247 6.2.4

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

##### **TEST PROCEDURE**

Reference to 789033 D02 General UNII Test Procedures New Rules v01: The transmitter output is connected to a spectrum analyzer with the RBW set to 100KHz, the VBW  $\geq 3 \times$  RBW, peak detector and max hold.

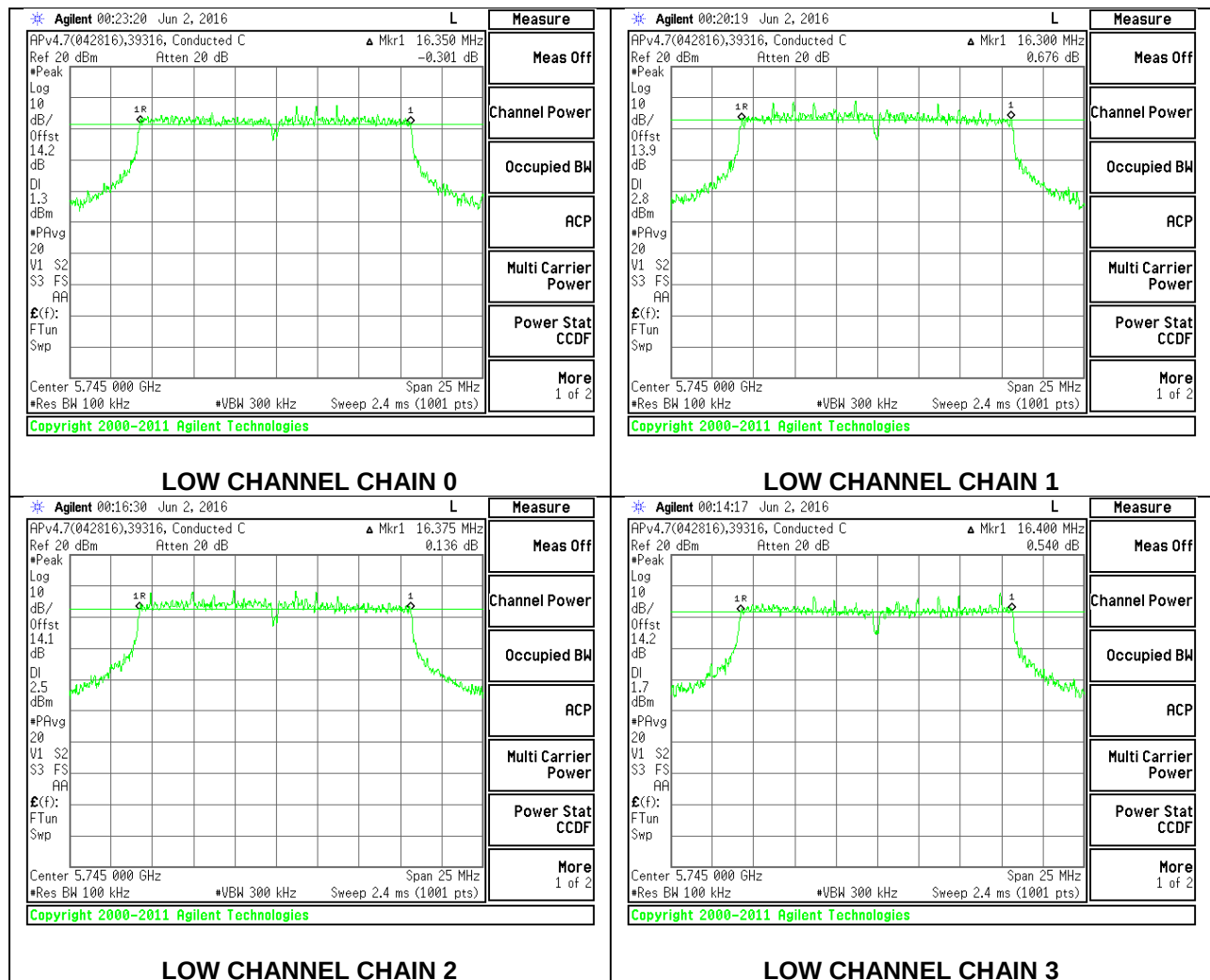
##### **RESULTS**

### 4.4.1. 802.11a MODE IN THE 5.8 GHz BAND

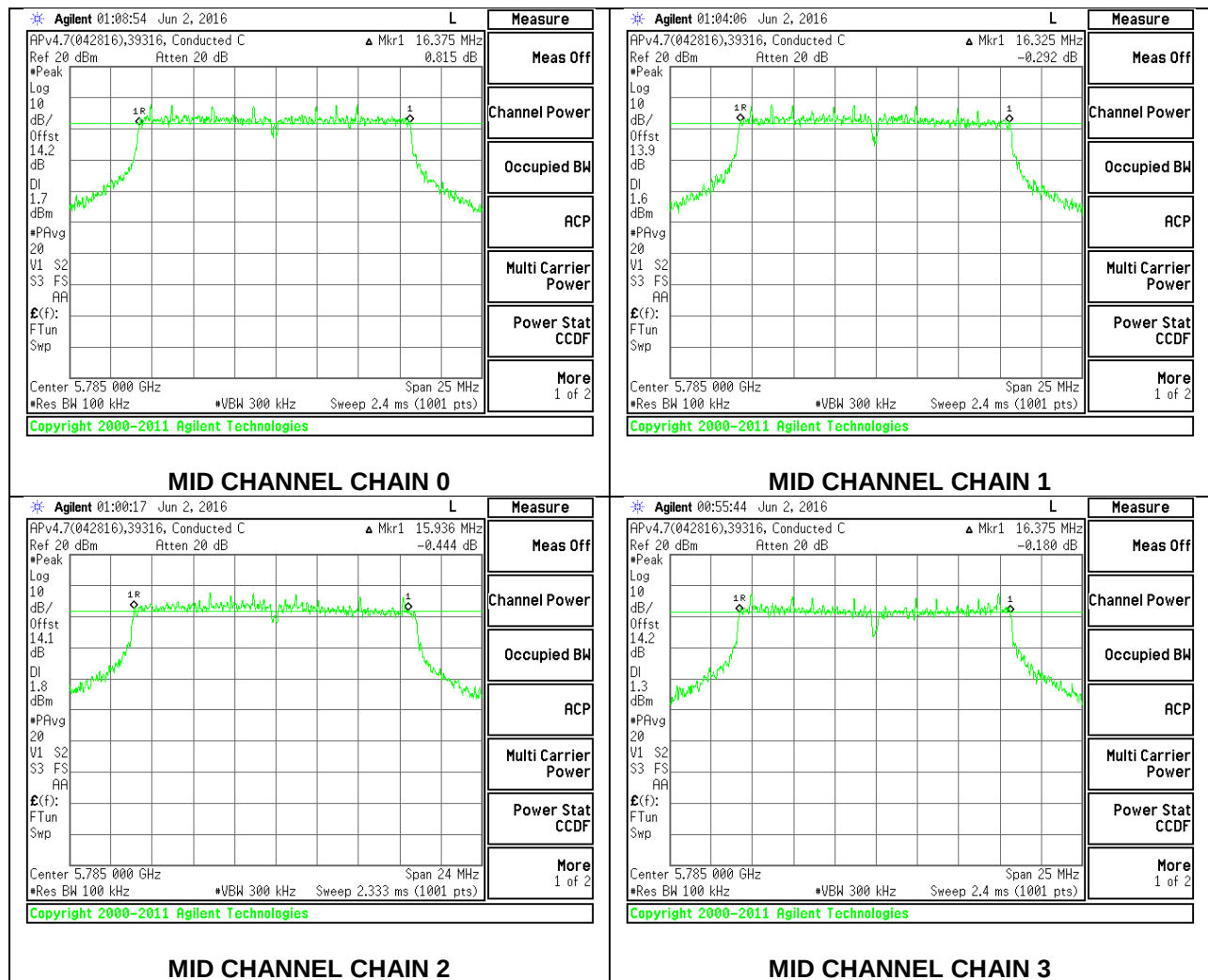
#### 4 Tx CDD MODE

| Channel | Frequency<br>(MHz) | 6 dB Bandwidth<br>Chain 0<br>(MHz) | 6 dB Bandwidth<br>Chain 1<br>(MHz) | 6 dB Bandwidth<br>Chain 2<br>(MHz) | 6 dB Bandwidth<br>Chain 3<br>(MHz) | Minimum<br>Limit<br>(MHz) |
|---------|--------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|---------------------------|
| Low     | 5745               | 16.350                             | 16.300                             | 16.375                             | 16.400                             | 0.5                       |
| Mid     | 5785               | 16.375                             | 16.325                             | 15.936                             | 16.375                             | 0.5                       |
| High    | 5825               | 16.400                             | 16.375                             | 16.400                             | 16.375                             | 0.5                       |

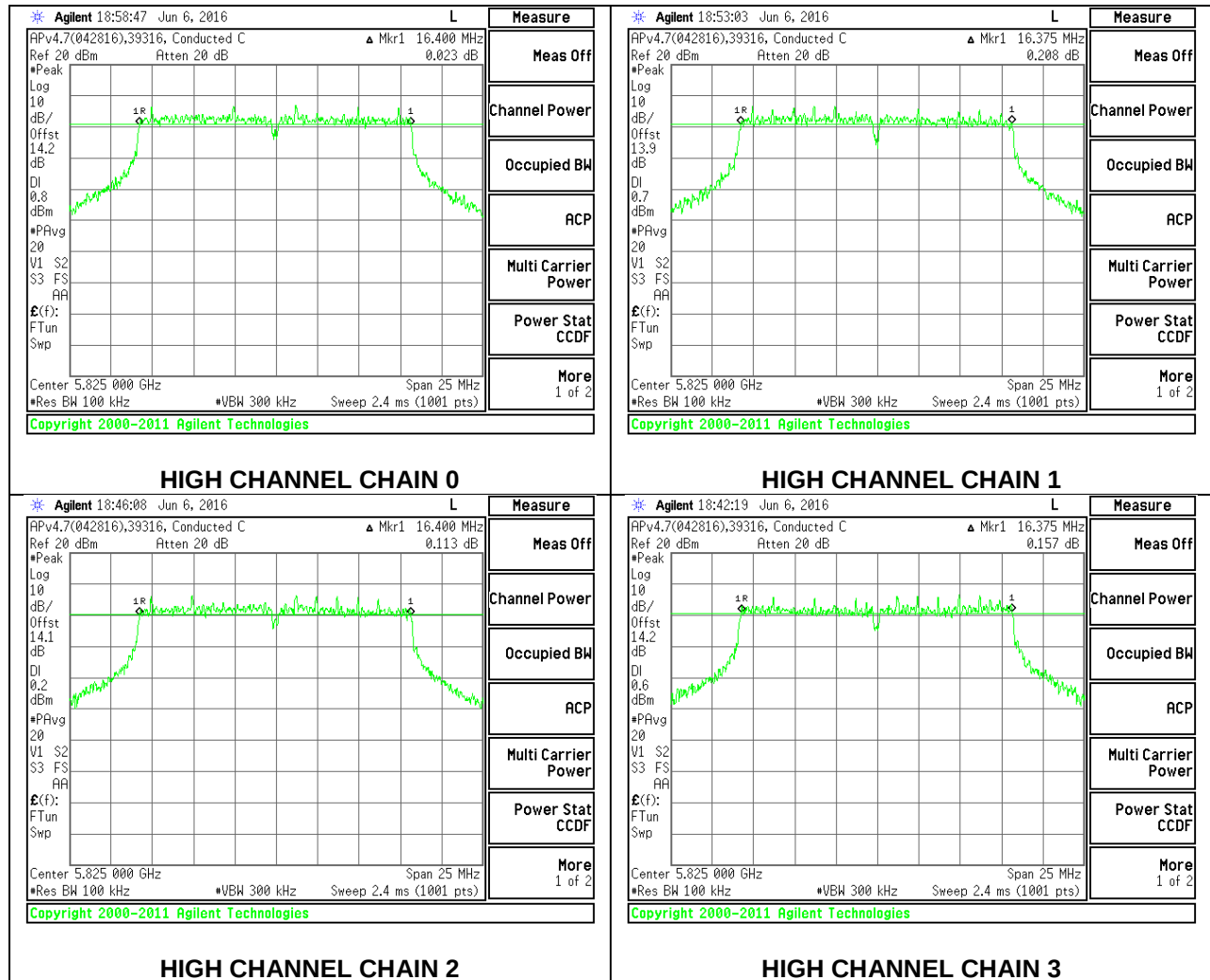
#### LOW CHANNEL



## MID CHANNEL



## HIGH CHANNEL



## 4.4.2. 802.11ac VHT20 MODE IN THE 5.8 GHz BAND

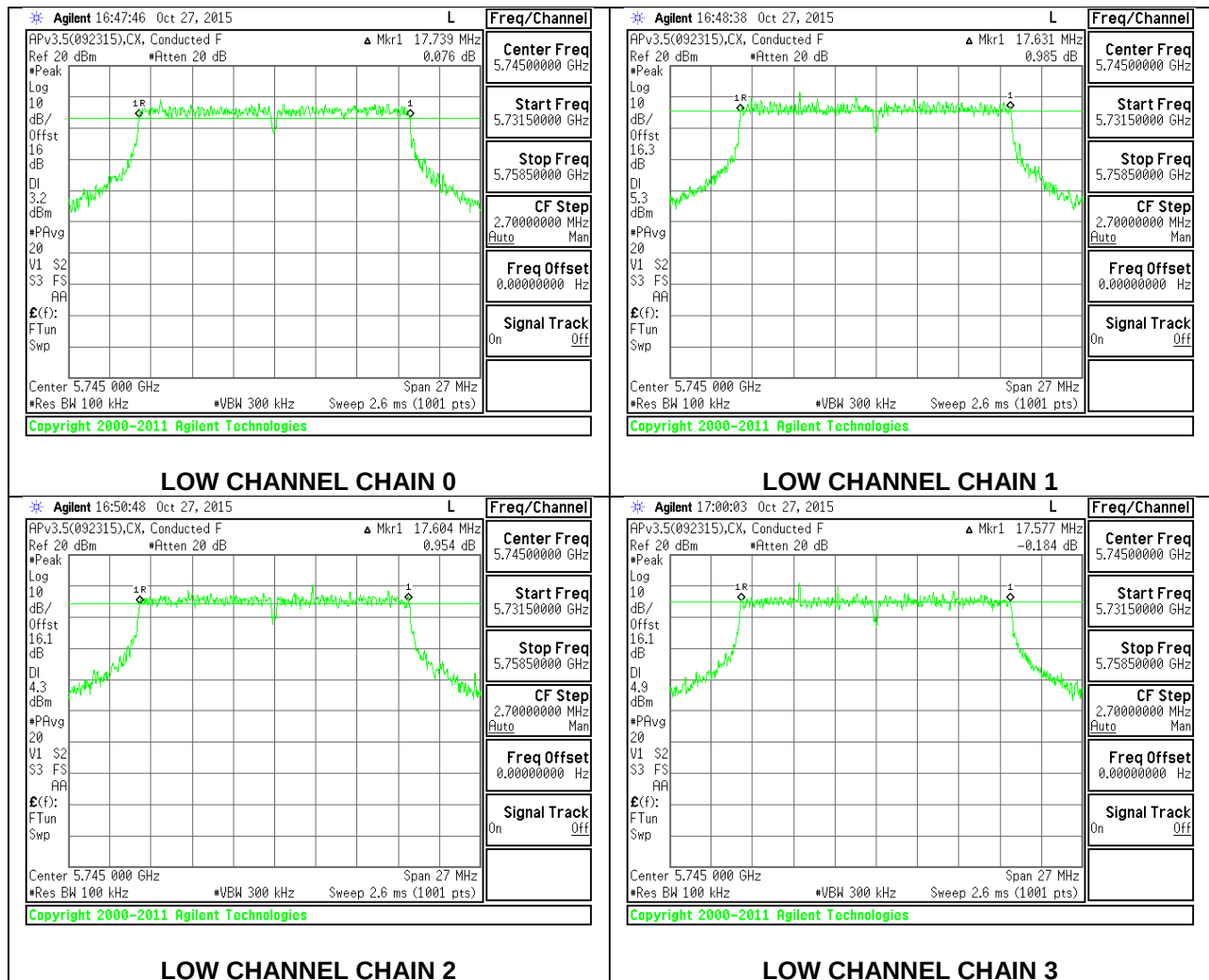
### 4 Tx CDD MODE

| Channel | Frequency<br>(MHz) | 6 dB Bandwidth<br>Chain 0<br>(MHz) | 6 dB Bandwidth<br>Chain 1<br>(MHz) | 6 dB Bandwidth<br>Chain 2<br>(MHz) | 6 dB Bandwidth<br>Chain 3<br>(MHz) | Minimum<br>Limit<br>(MHz) |
|---------|--------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|---------------------------|
| Low     | 5745               | 17.739                             | 17.631                             | 17.604                             | 17.577                             | 0.5                       |
| Mid     | 5785               | 17.550                             | 17.712                             | 17.658                             | 17.604                             | 0.5                       |
| High    | 5825               | 17.604                             | 17.739                             | 17.631                             | 17.685                             | 0.5                       |

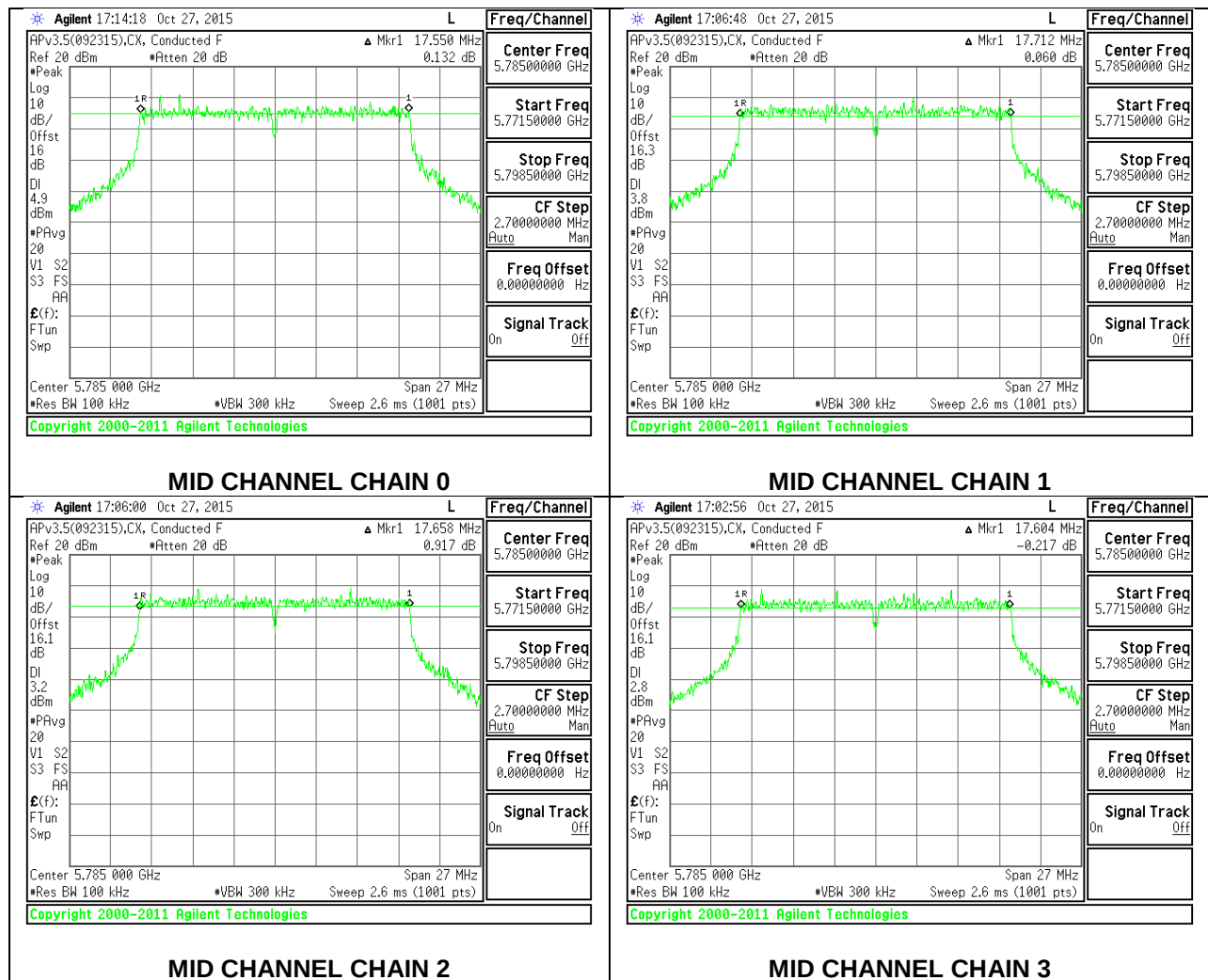
Test By: 39316 CX

Test Date: 10/27/15

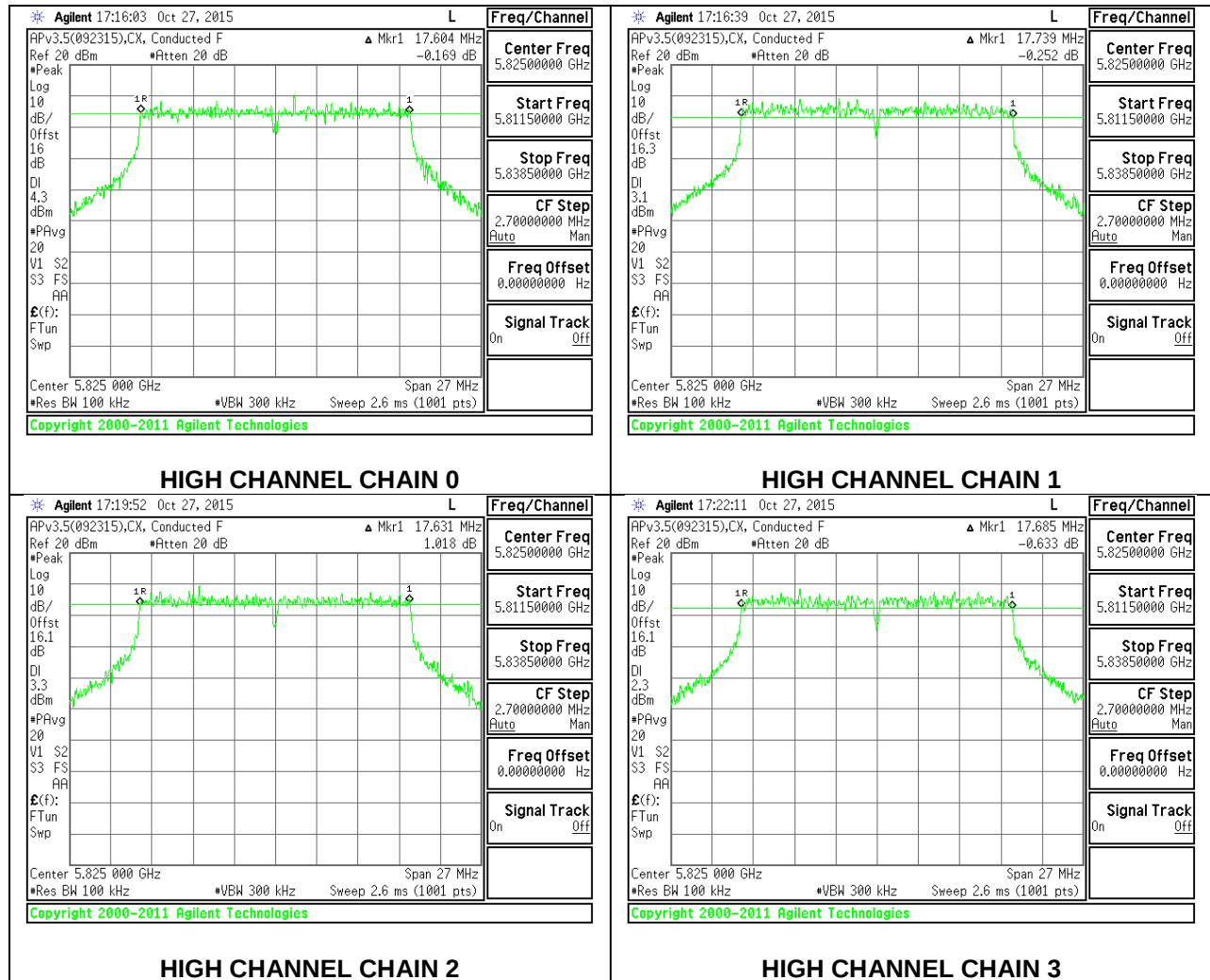
### LOW CHANNEL



## MID CHANNEL



## HIGH CHANNEL



### 4.4.3. 802.11ac VHT40 MODE IN THE 5.8 GHz BAND

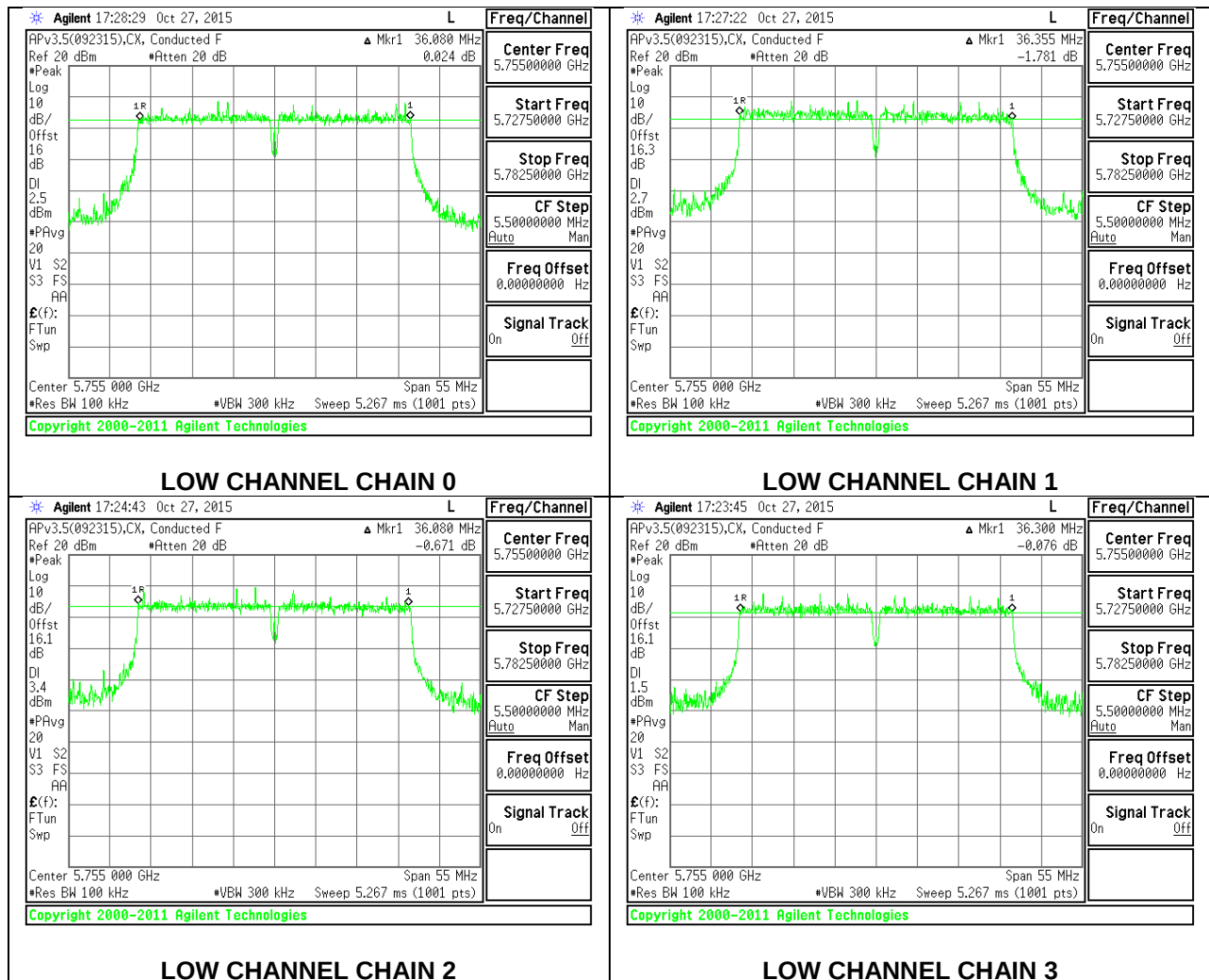
#### 4 Tx CDD MODE

| Channel | Frequency | 6 dB Bandwidth<br>Chain 0<br>(MHz) | 6 dB Bandwidth<br>Chain 1<br>(MHz) | 6 dB Bandwidth<br>Chain 2<br>(MHz) | 6 dB Bandwidth<br>Chain 3<br>(MHz) | Minimum<br>Limit<br>(MHz) |
|---------|-----------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|---------------------------|
| Low     | 5755      | 36.080                             | 36.355                             | 36.080                             | 36.300                             | 0.5                       |
| High    | 5795      | 35.964                             | 36.410                             | 36.300                             | 36.025                             | 0.5                       |

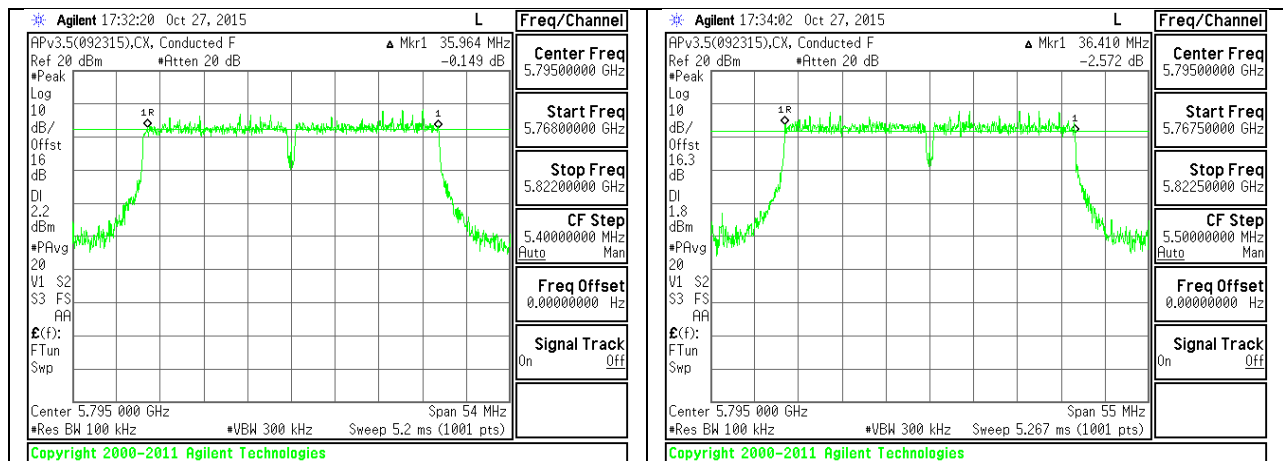
Test By: 39316 CX

Test Date: 10/27/15

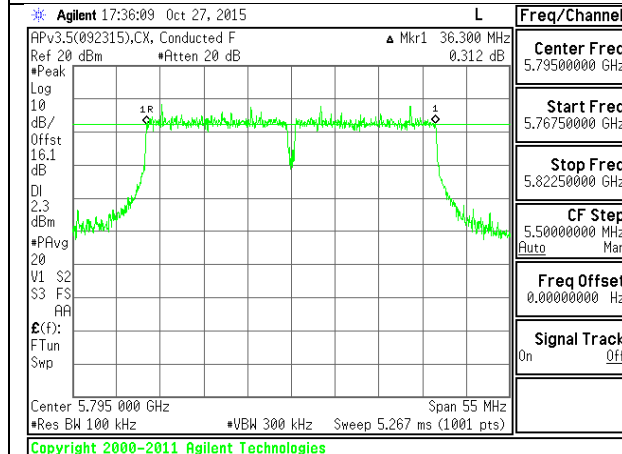
#### LOW CHANNEL



## HIGH CHANNEL

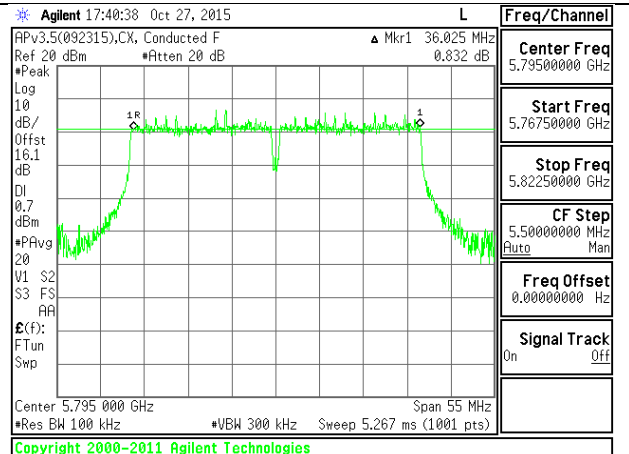


### HIGH CHANNEL CHAIN 0



### HIGH CHANNEL CHAIN 2

### HIGH CHANNEL CHAIN 1



### HIGH CHANNEL CHAIN 3

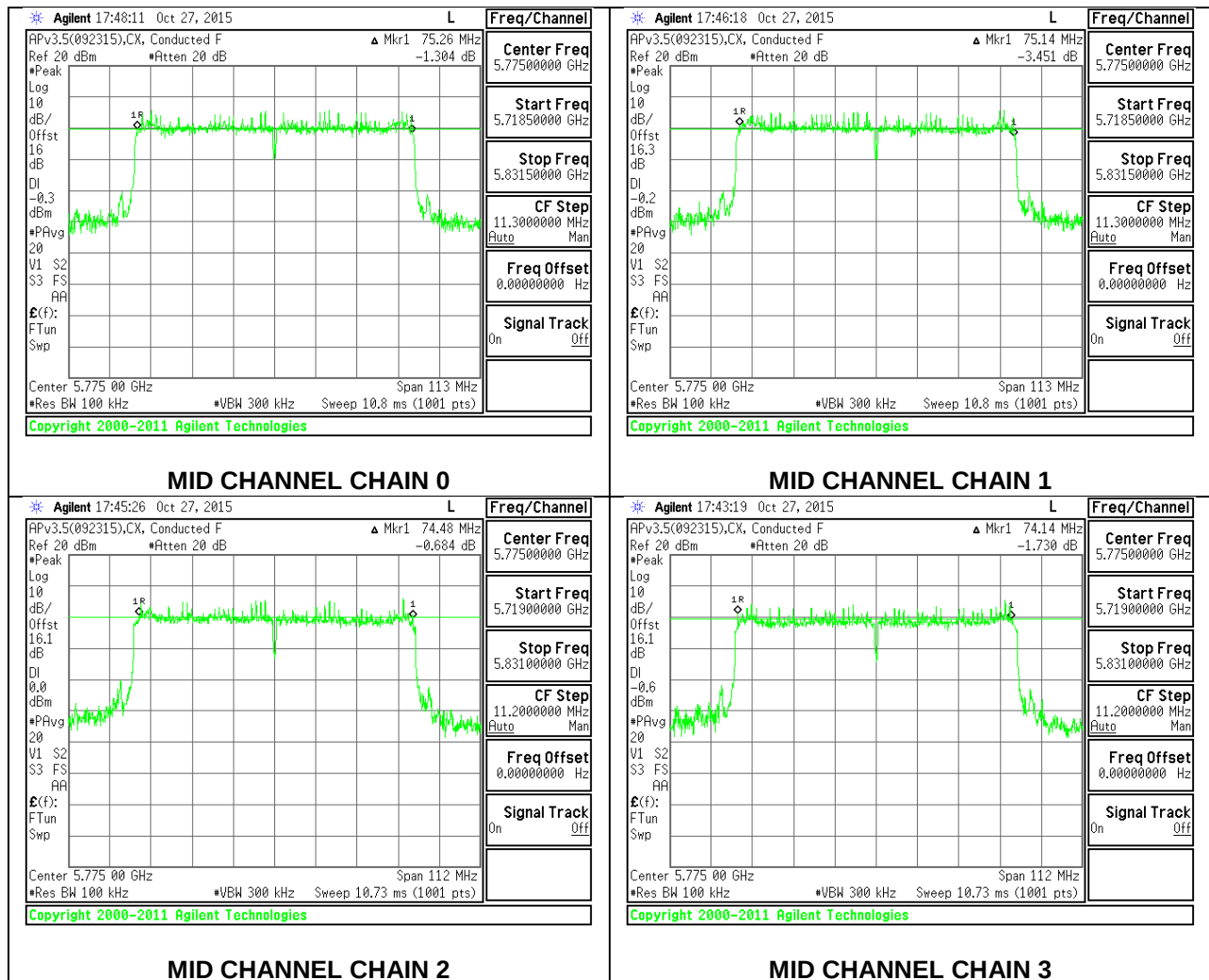
#### 4.4.4. 802.11ac VHT80 MODE IN THE 5.8 GHz BAND

##### 4 Tx CDD MODE

| Channel | Frequency<br>(MHz) | 6 dB Bandwidth<br>Chain 0<br>(MHz) | 6 dB Bandwidth<br>Chain 1<br>(MHz) | 6 dB Bandwidth<br>Chain 2<br>(MHz) | 6 dB Bandwidth<br>Chain 3<br>(MHz) | Minimum<br>Limit<br>(MHz) |
|---------|--------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|---------------------------|
| Mid     | 5775               | 75.260                             | 75.140                             | 74.480                             | 74.140                             | 0.5                       |

Test By: 39316 CX  
Test Date: 10/27/15

##### MID CHANNEL



## 4.5. OUTPUT POWER AND PPSD

### LIMITS

#### FCC §15.407 (a)

(1)(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.

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or  $11 \text{ dBm} + 10 \log B$ , where B is the 26 dB emission bandwidth in megahertz. 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.

(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band.

**DIRECTIONAL ANTENNA GAIN**

| Frequency<br>Band<br>(GHz) | Directional Antenna Gain   |                             |                             |                             |
|----------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|
|                            | 1                          | 2                           | 3                           | 4                           |
|                            | Spatial<br>Stream<br>(dBi) | Spatial<br>Streams<br>(dBi) | Spatial<br>Streams<br>(dBi) | Spatial<br>Streams<br>(dBi) |
| 5.2                        | 9.92                       | 6.95                        | 6.03                        | 3.98                        |
| 5.8                        | 9.95                       | 6.99                        | 6.07                        | 4.01                        |

## RESULTS

### 4.5.1. 802.11a MODE IN THE 5.2 GHz BAND

#### 4Tx 1 STREAM CDD MODE

##### 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               | 3.98                                      | 9.92                                    | 30.00                   | 13.08                 |
| Mid     | 5200               | 3.98                                      | 9.92                                    | 30.00                   | 13.08                 |
| High    | 5240               | 3.98                                      | 9.92                                    | 30.00                   | 13.08                 |

|                    |      |                                                |
|--------------------|------|------------------------------------------------|
| Duty Cycle CF (dB) | 0.31 | Included in Calculations of Corr'd Power & PSD |
|--------------------|------|------------------------------------------------|

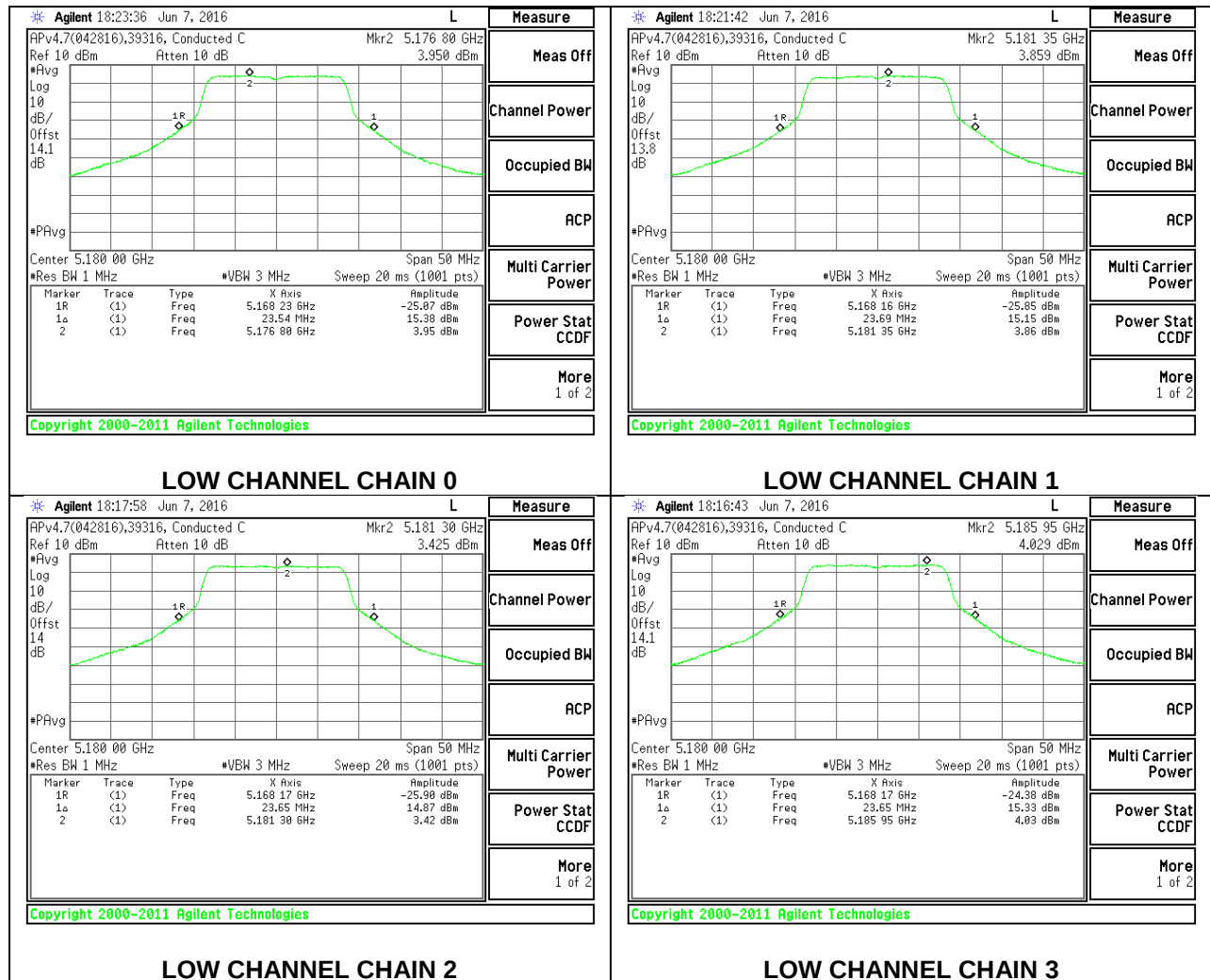
##### Output Power Results

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>Power<br>(dBm) | Chain 1<br>Meas<br>Power<br>(dBm) | Chain 2<br>Meas<br>Power<br>(dBm) | Chain 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               | 15.38                             | 15.15                             | 14.87                             | 15.33                             | 21.52                             | 30.00                   | -8.48                   |
| Mid     | 5200               | 18.18                             | 17.38                             | 17.51                             | 18.22                             | 24.17                             | 30.00                   | -5.83                   |
| High    | 5240               | 17.35                             | 17.04                             | 17.13                             | 17.43                             | 23.57                             | 30.00                   | -6.43                   |

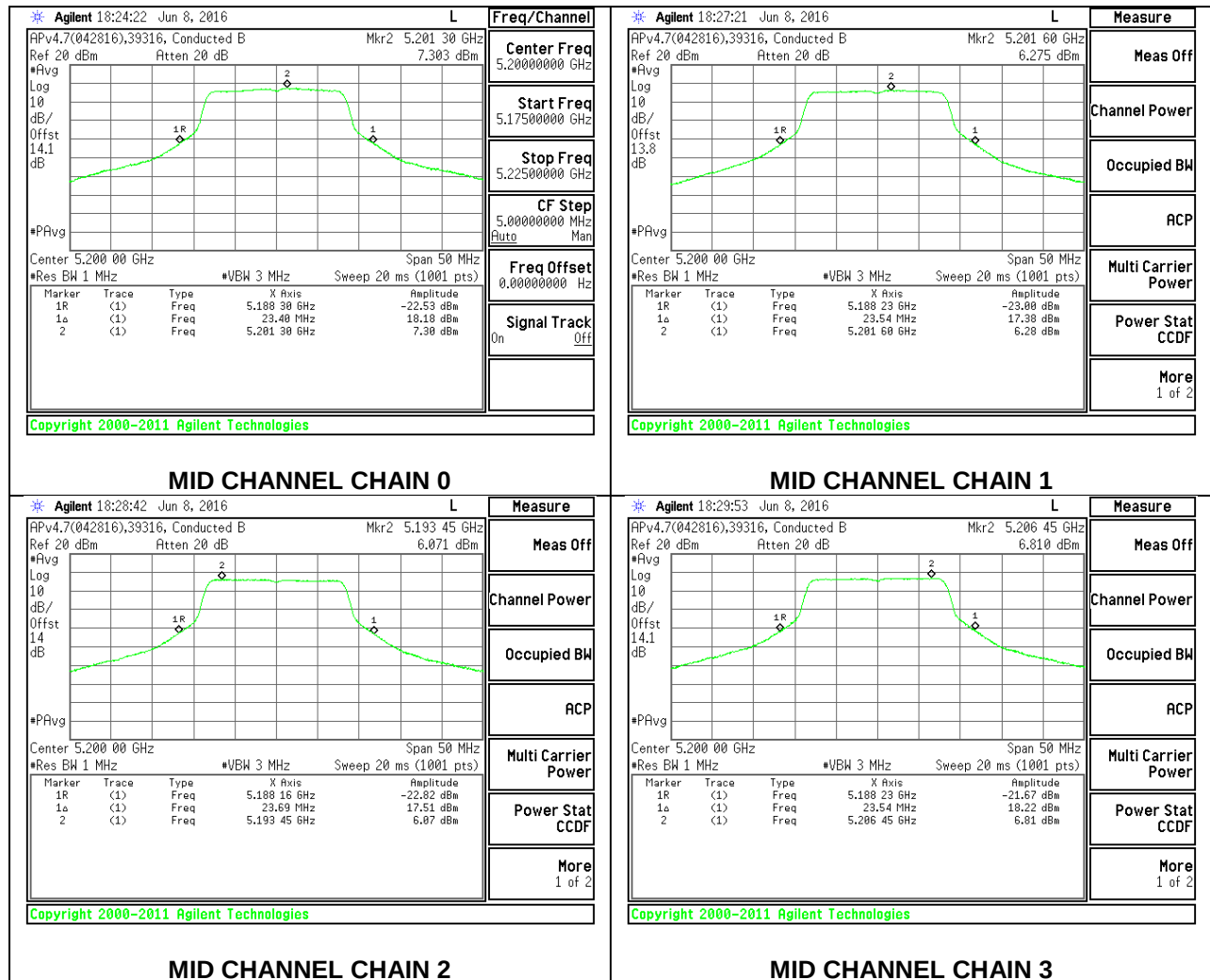
##### PSD Results

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>PSD<br>(dBm) | Chain 1<br>Meas<br>PSD<br>(dBm) | Chain 2<br>Meas<br>PSD<br>(dBm) | Chain 3<br>Meas<br>PSD<br>(dBm) | Total<br>Corr'd<br>PSD<br>(dBm) | PSD<br>Limit<br>(dBm) | PSD<br>Margin<br>(dB) |
|---------|--------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|-----------------------|-----------------------|
| Low     | 5180               | 3.95                            | 3.86                            | 3.43                            | 4.03                            | 10.15                           | 13.08                 | -2.93                 |
| Mid     | 5200               | 7.30                            | 6.28                            | 6.07                            | 6.81                            | 12.97                           | 13.08                 | -0.11                 |
| High    | 5240               | 6.15                            | 5.65                            | 5.70                            | 5.92                            | 12.19                           | 13.08                 | -0.89                 |

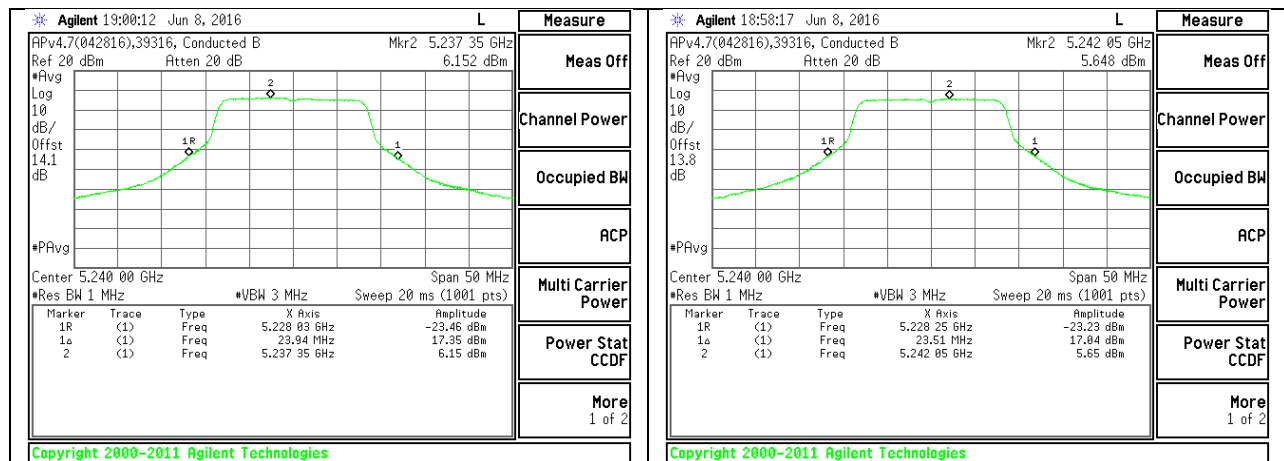
## LOW CHANNEL



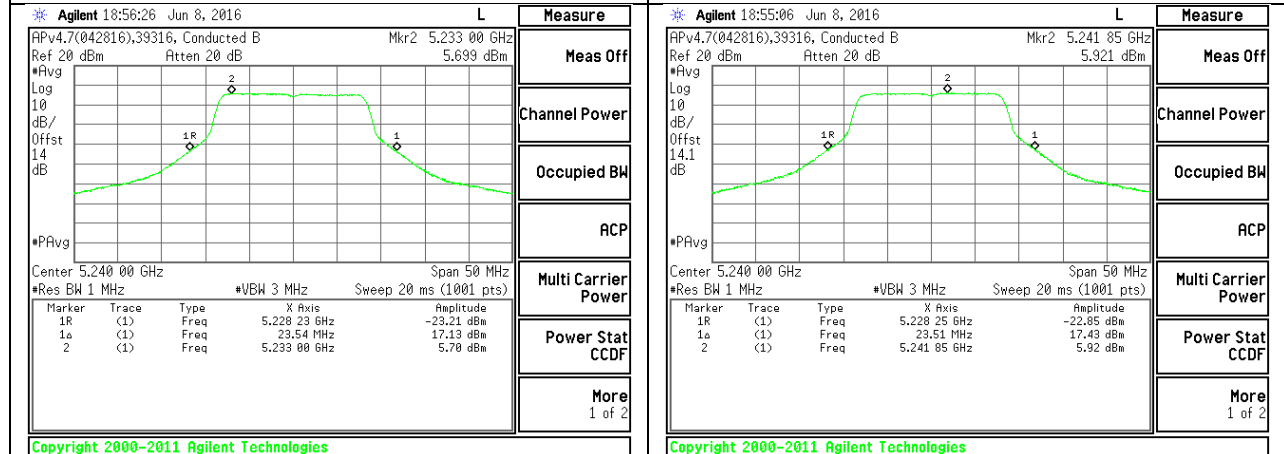
## MID CHANNEL



## HIGH CHANNEL



## HIGH CHANNEL CHAIN 0



## HIGH CHANNEL CHAIN 2

## HIGH CHANNEL CHAIN 3

## 4.5.2. 802.11ac VHT20 MODE IN THE 5.2 GHz BAND

### 4Tx 4 STREAM CDD MODE

#### 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               | 3.98                                      | 3.98                                    | 30.00                   | 17.00                 |
| Mid     | 5200               | 3.98                                      | 3.98                                    | 30.00                   | 17.00                 |
| High    | 5240               | 3.98                                      | 3.98                                    | 30.00                   | 17.00                 |

|                    |      |                                                |
|--------------------|------|------------------------------------------------|
| Duty Cycle CF (dB) | 0.18 | Included in Calculations of Corr'd Power & PSD |
|--------------------|------|------------------------------------------------|

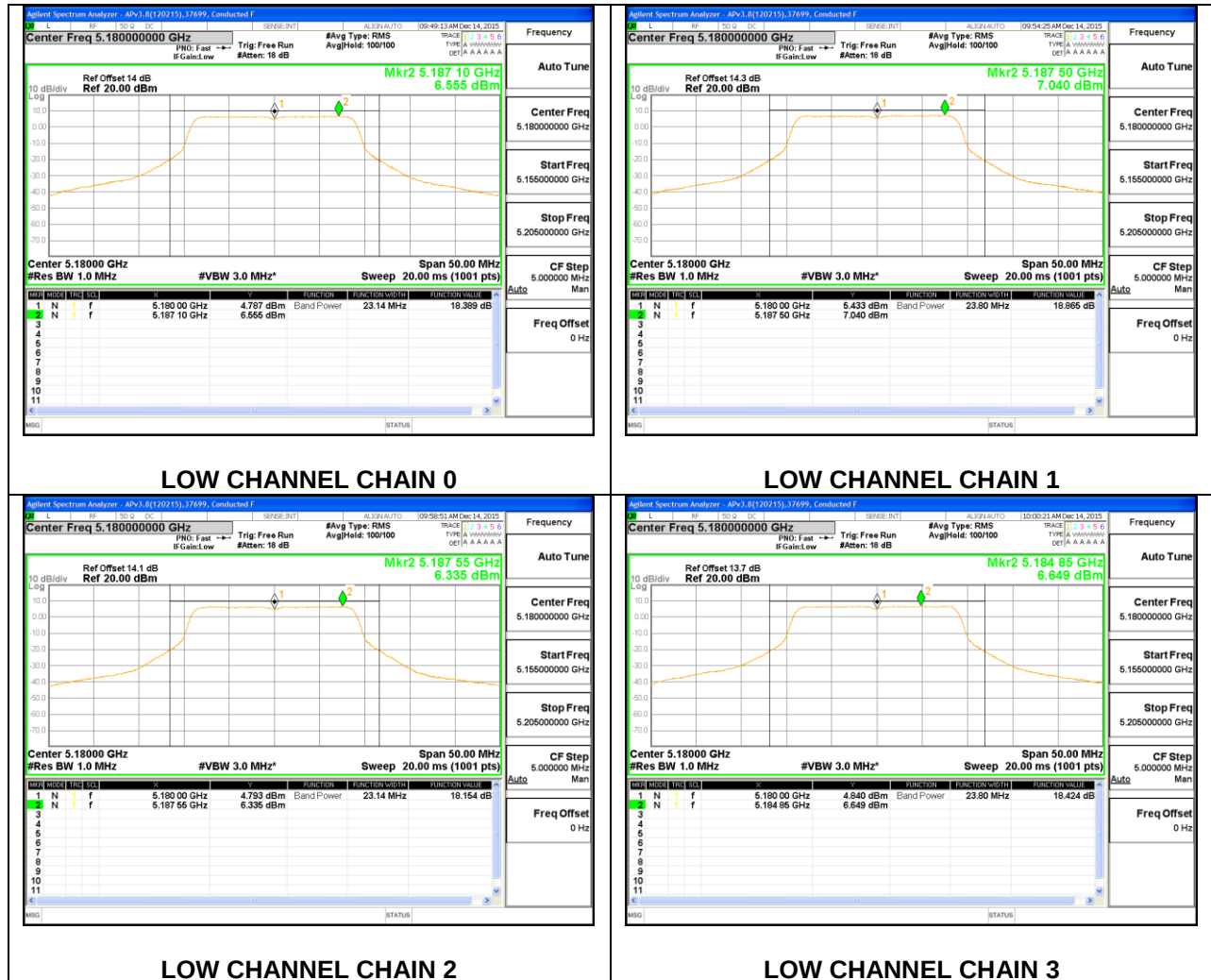
#### Output Power Results

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>Power<br>(dBm) | Chain 1<br>Meas<br>Power<br>(dBm) | Chain 2<br>Meas<br>Power<br>(dBm) | Chain 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               | 18.39                             | 18.87                             | 18.15                             | 18.42                             | 24.67                             | 30.00                   | -5.33                   |
| Mid     | 5200               | 20.99                             | 20.93                             | 20.56                             | 21.00                             | 27.07                             | 30.00                   | -2.93                   |
| High    | 5240               | 21.09                             | 21.20                             | 20.92                             | 21.01                             | 27.26                             | 30.00                   | -2.74                   |

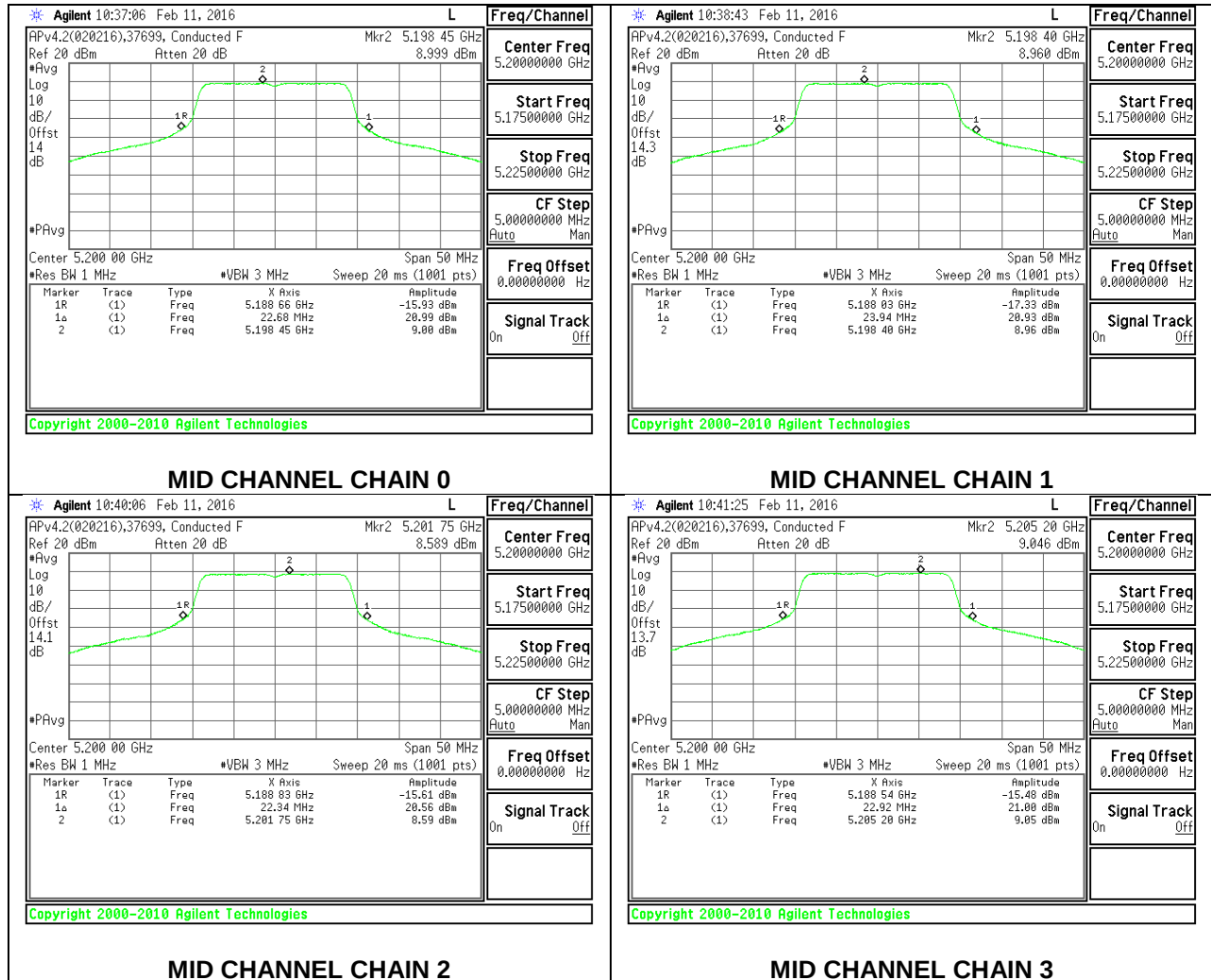
#### PSD Results

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>PSD<br>(dBm) | Chain 1<br>Meas<br>PSD<br>(dBm) | Chain 2<br>Meas<br>PSD<br>(dBm) | Chain 3<br>Meas<br>PSD<br>(dBm) | Total<br>Corr'd<br>PSD<br>(dBm) | PSD<br>Limit<br>(dBm) | PSD<br>Margin<br>(dB) |
|---------|--------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|-----------------------|-----------------------|
| Low     | 5180               | 6.56                            | 7.04                            | 6.34                            | 6.65                            | 12.85                           | 17.00                 | -4.15                 |
| Mid     | 5200               | 9.00                            | 8.96                            | 8.59                            | 9.05                            | 15.10                           | 17.00                 | -1.90                 |
| High    | 5240               | 9.18                            | 9.25                            | 8.98                            | 9.06                            | 15.32                           | 17.00                 | -1.68                 |

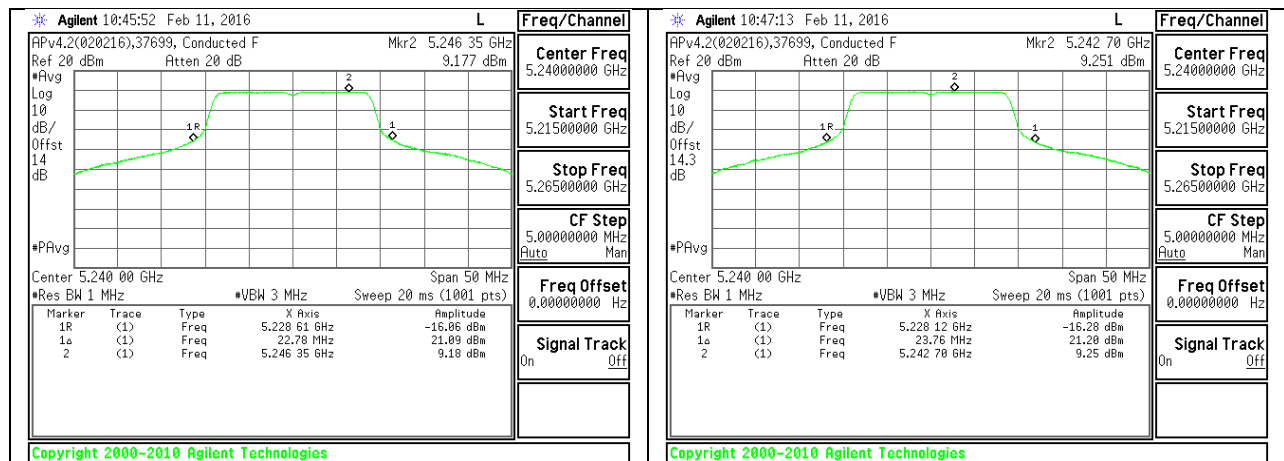
## LOW CHANNEL



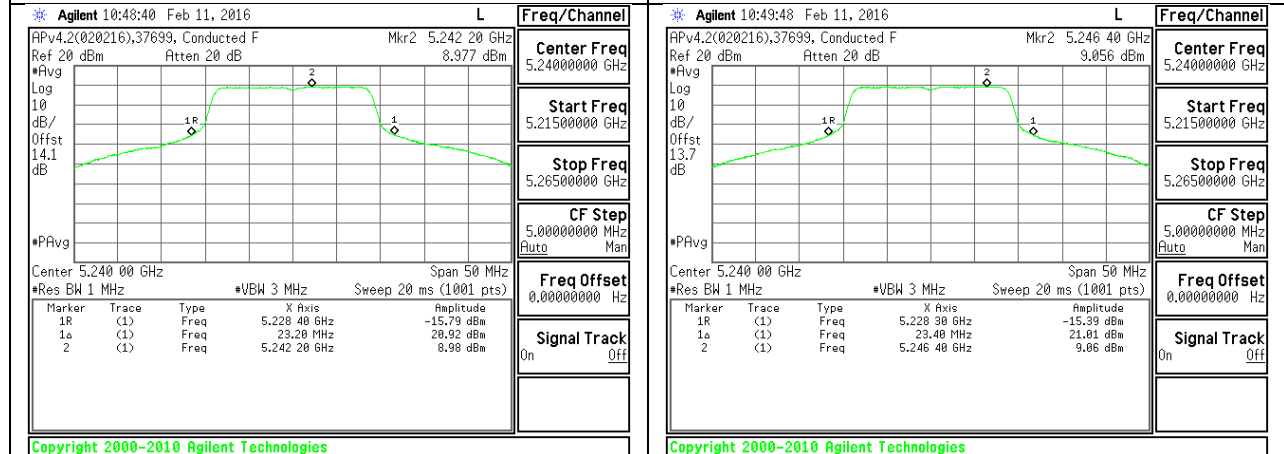
## MID CHANNEL



## HIGH CHANNEL



## HIGH CHANNEL CHAIN 0



## HIGH CHANNEL CHAIN 2

## HIGH CHANNEL CHAIN 3

#### 4Tx 1 STREAM CDD MODE

##### 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               | 3.98                                      | 9.92                                    | 30.00                   | 13.08                 |
| Mid     | 5200               | 3.98                                      | 9.92                                    | 30.00                   | 13.08                 |
| High    | 5240               | 3.98                                      | 9.92                                    | 30.00                   | 13.08                 |

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

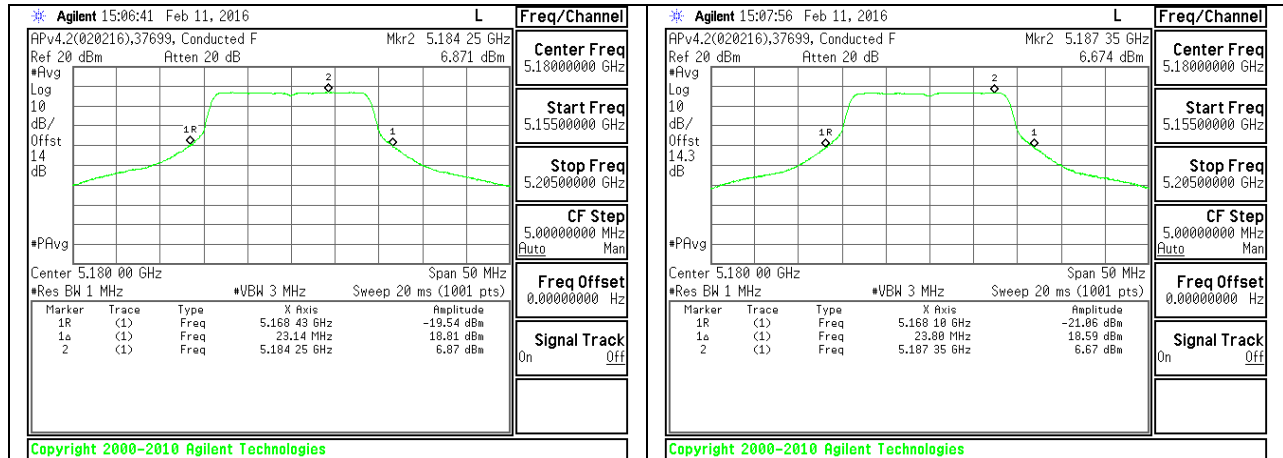
##### Output Power Results

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>Power<br>(dBm) | Chain 1<br>Meas<br>Power<br>(dBm) | Chain 2<br>Meas<br>Power<br>(dBm) | Chain 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               | 18.81                             | 18.59                             | 18.73                             | 18.54                             | 24.69                             | 30.00                   | -5.31                   |
| Mid     | 5200               | 18.93                             | 18.80                             | 18.85                             | 18.23                             | 24.73                             | 30.00                   | -5.27                   |
| High    | 5240               | 19.20                             | 18.79                             | 18.80                             | 18.60                             | 24.87                             | 30.00                   | -5.13                   |

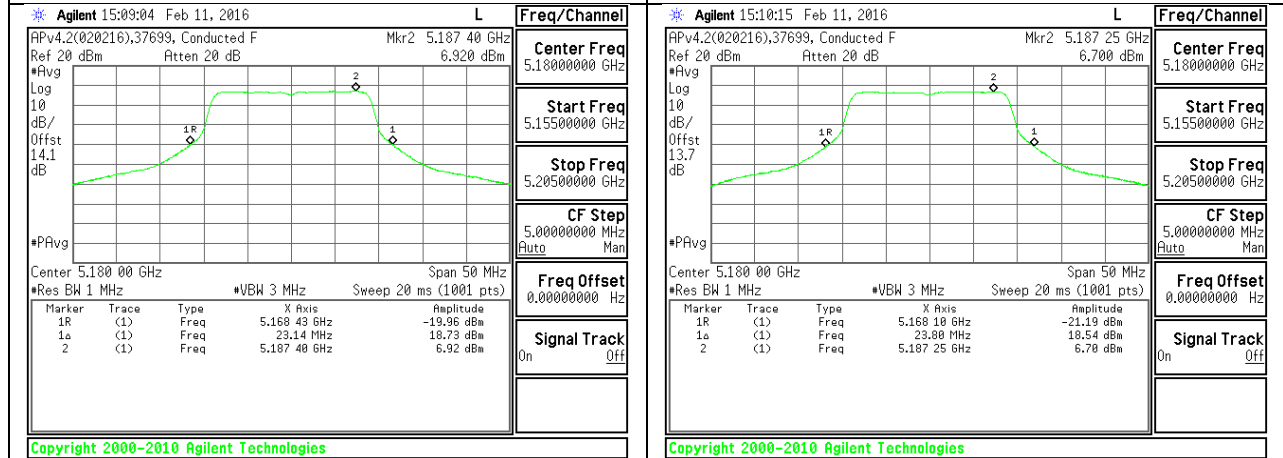
##### PSD Results

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>PSD<br>(dBm) | Chain 1<br>Meas<br>PSD<br>(dBm) | Chain 2<br>Meas<br>PSD<br>(dBm) | Chain 3<br>Meas<br>PSD<br>(dBm) | Total<br>Corr'd<br>PSD<br>(dBm) | PSD<br>Limit<br>(dBm) | PSD<br>Margin<br>(dB) |
|---------|--------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|-----------------------|-----------------------|
| Low     | 5180               | 6.87                            | 6.67                            | 6.92                            | 6.70                            | 12.81                           | 13.08                 | -0.27                 |
| Mid     | 5200               | 6.95                            | 6.87                            | 6.92                            | 6.29                            | 12.78                           | 13.08                 | -0.30                 |
| High    | 5240               | 7.32                            | 6.89                            | 6.98                            | 6.73                            | 13.01                           | 13.08                 | -0.07                 |

## LOW CHANNEL



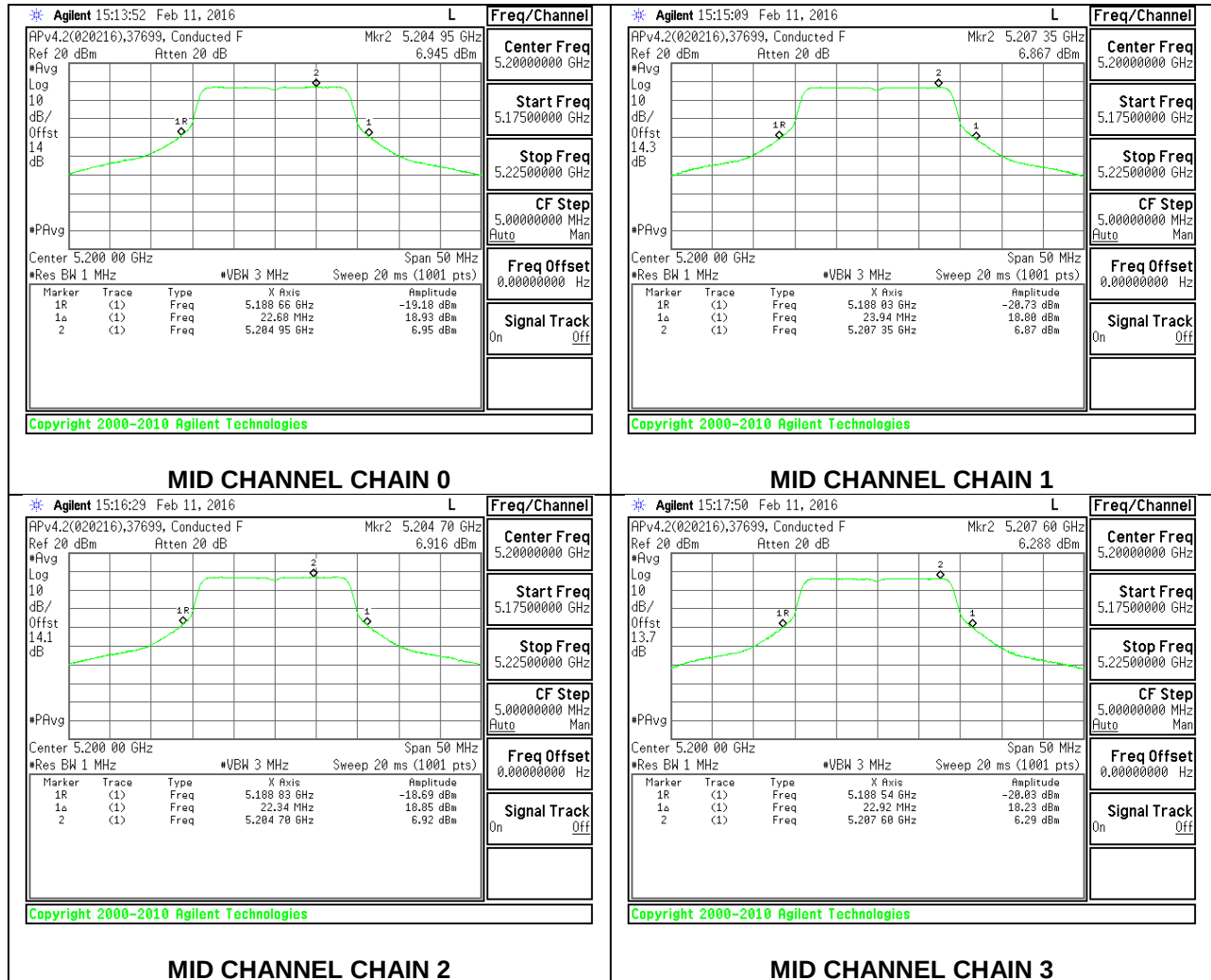
### LOW CHANNEL CHAIN 0



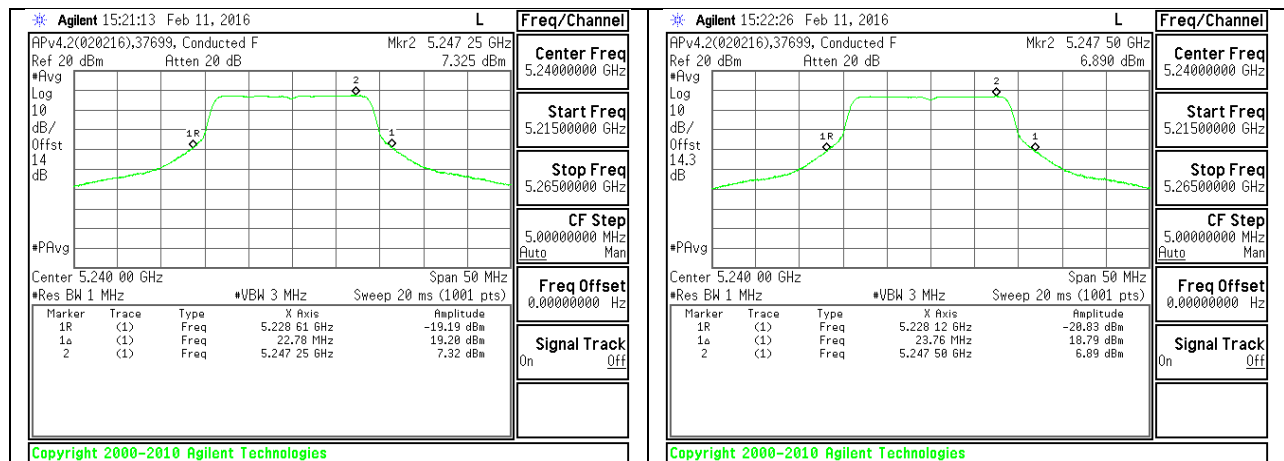
### LOW CHANNEL CHAIN 2

### LOW CHANNEL CHAIN 3

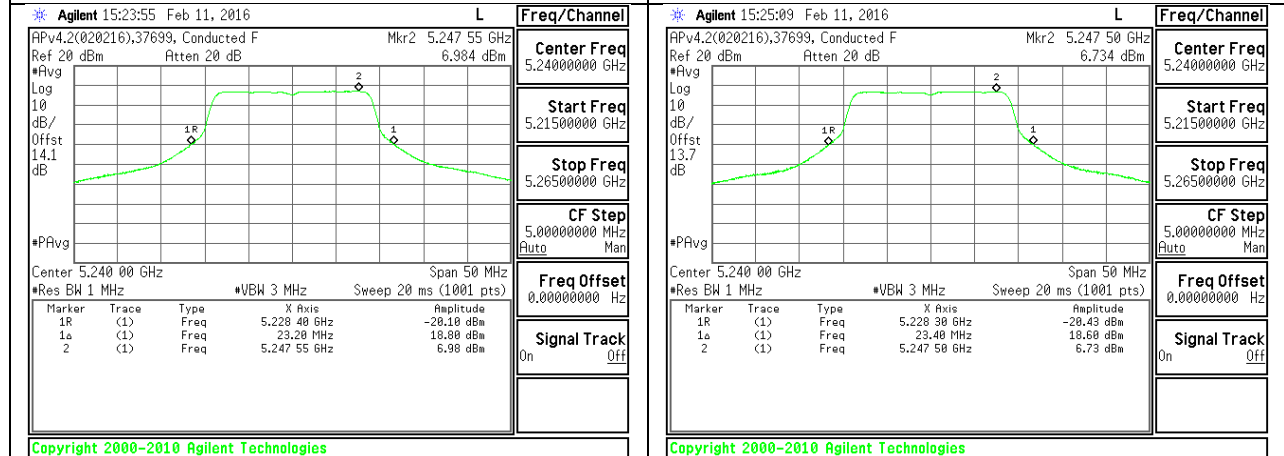
## MID CHANNEL



## HIGH CHANNEL



## HIGH CHANNEL CHAIN 0



## HIGH CHANNEL CHAIN 2

## HIGH CHANNEL CHAIN 3

#### 4Tx 3 STREAM BF MODE

##### 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               | 6.03                                      | 6.03                                    | 29.97                   | 16.97                 |
| Mid     | 5200               | 6.03                                      | 6.03                                    | 29.97                   | 16.97                 |
| High    | 5240               | 6.03                                      | 6.03                                    | 29.97                   | 16.97                 |

|                    |      |                                                |
|--------------------|------|------------------------------------------------|
| Duty Cycle CF (dB) | 0.49 | Included in Calculations of Corr'd Power & PSD |
|--------------------|------|------------------------------------------------|

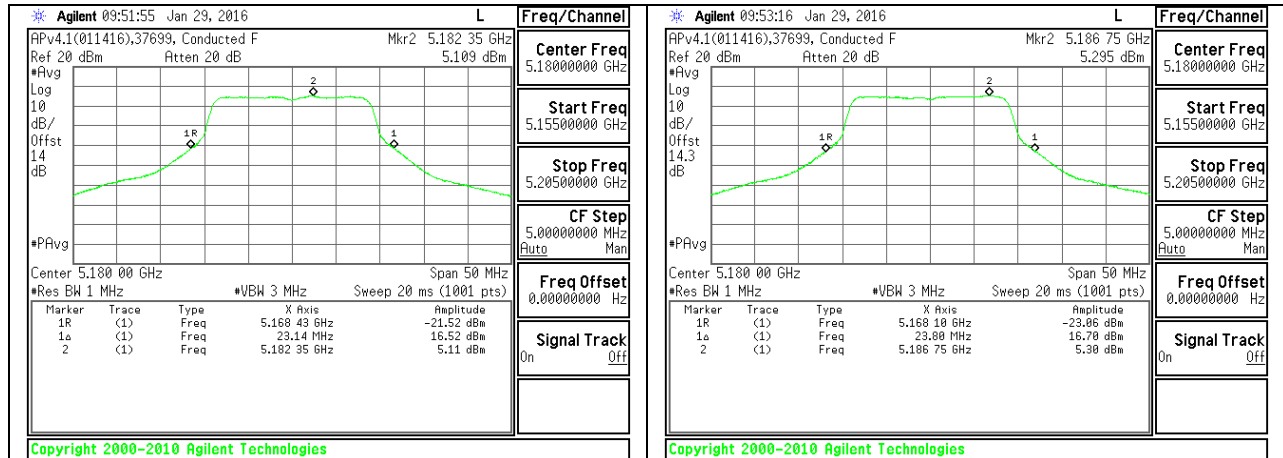
##### Output Power Results

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>Power<br>(dBm) | Chain 1<br>Meas<br>Power<br>(dBm) | Chain 2<br>Meas<br>Power<br>(dBm) | Chain 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               | 16.52                             | 16.70                             | 16.48                             | 15.64                             | 22.86                             | 29.97                   | -7.11                   |
| Mid     | 5200               | 17.90                             | 17.82                             | 17.38                             | 16.75                             | 24.00                             | 29.97                   | -5.97                   |
| High    | 5240               | 21.49                             | 21.54                             | 20.96                             | 20.86                             | 27.73                             | 29.97                   | -2.24                   |

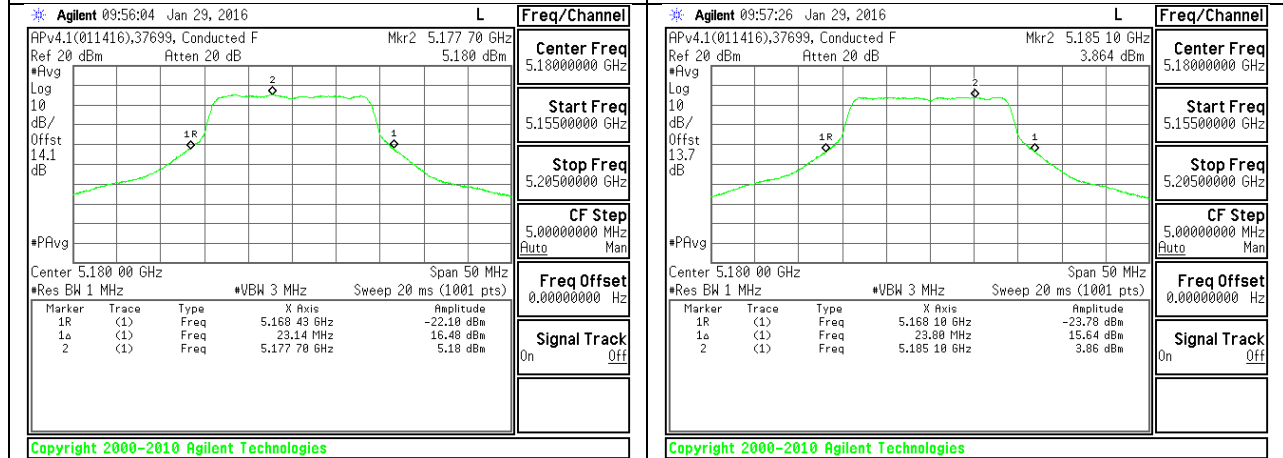
##### PSD Results

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>PSD<br>(dBm) | Chain 1<br>Meas<br>PSD<br>(dBm) | Chain 2<br>Meas<br>PSD<br>(dBm) | Chain 3<br>Meas<br>PSD<br>(dBm) | Total<br>Corr'd<br>PSD<br>(dBm) | PSD<br>Limit<br>(dBm) | PSD<br>Margin<br>(dB) |
|---------|--------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|-----------------------|-----------------------|
| Low     | 5180               | 5.11                            | 5.30                            | 5.18                            | 3.86                            | 11.41                           | 16.97                 | -5.56                 |
| Mid     | 5200               | 6.39                            | 6.25                            | 6.84                            | 4.95                            | 12.67                           | 16.97                 | -4.30                 |
| High    | 5240               | 9.90                            | 10.52                           | 9.70                            | 9.26                            | 16.38                           | 16.97                 | -0.59                 |

## LOW CHANNEL



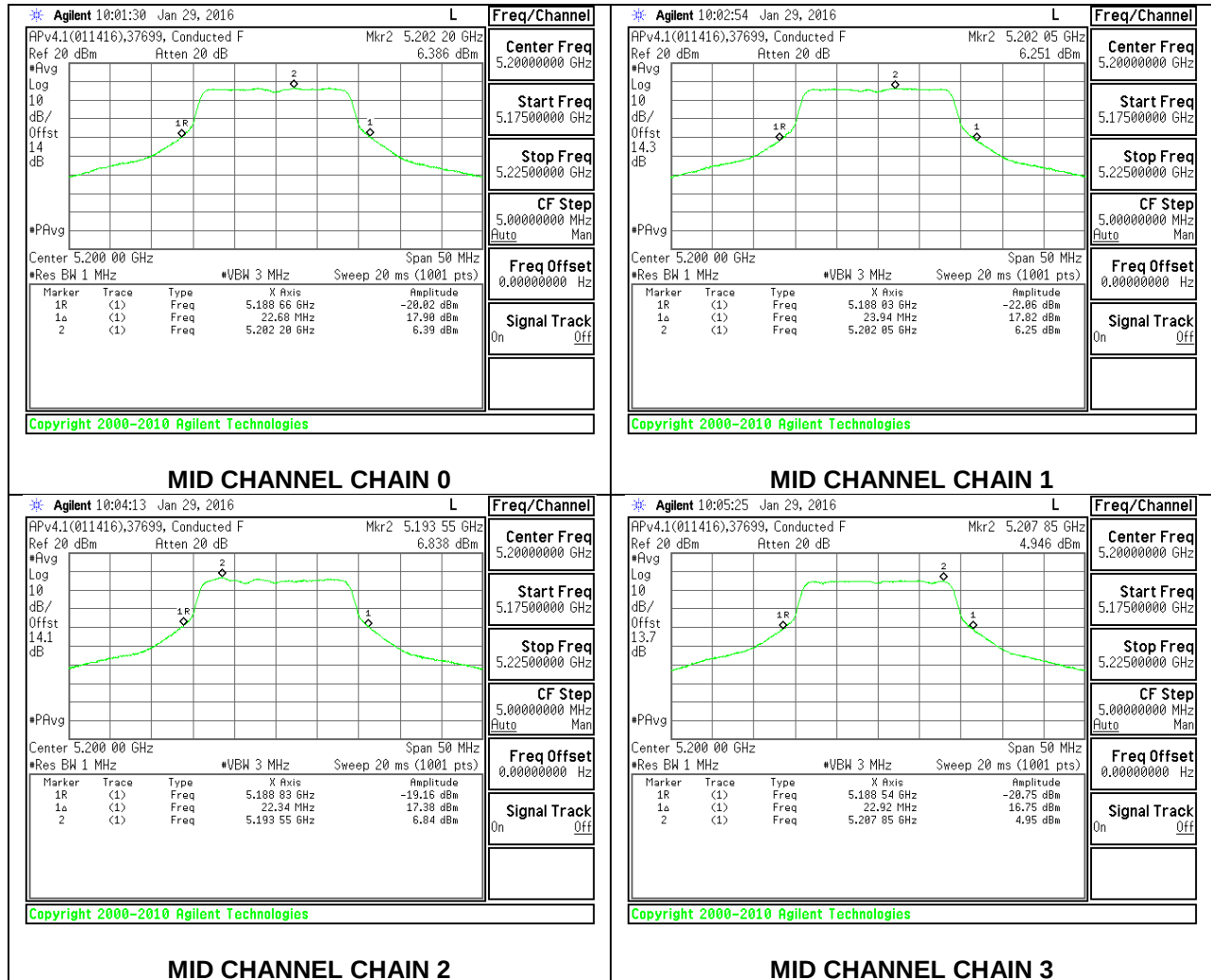
### LOW CHANNEL CHAIN 0



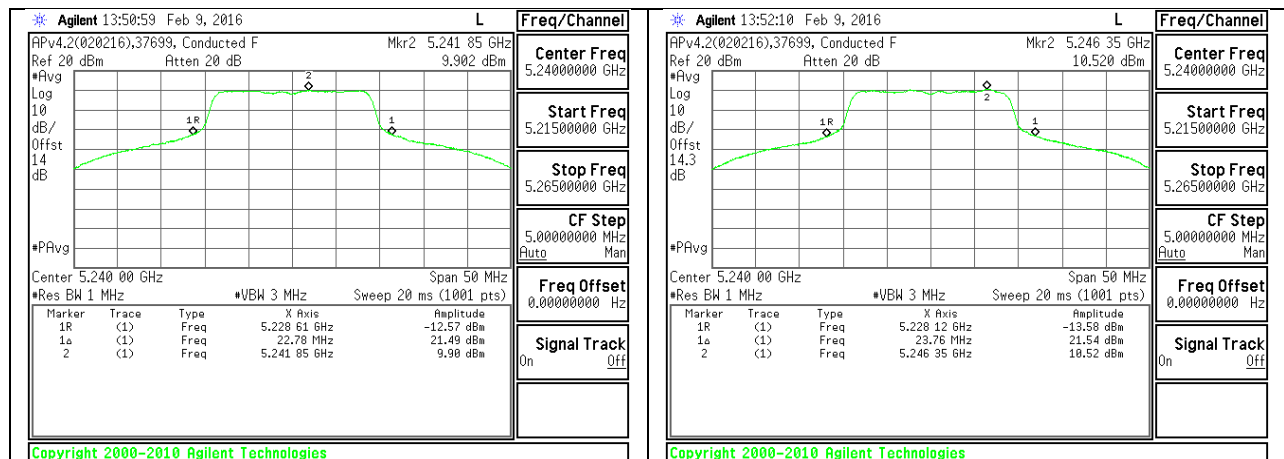
### LOW CHANNEL CHAIN 2

### LOW CHANNEL CHAIN 3

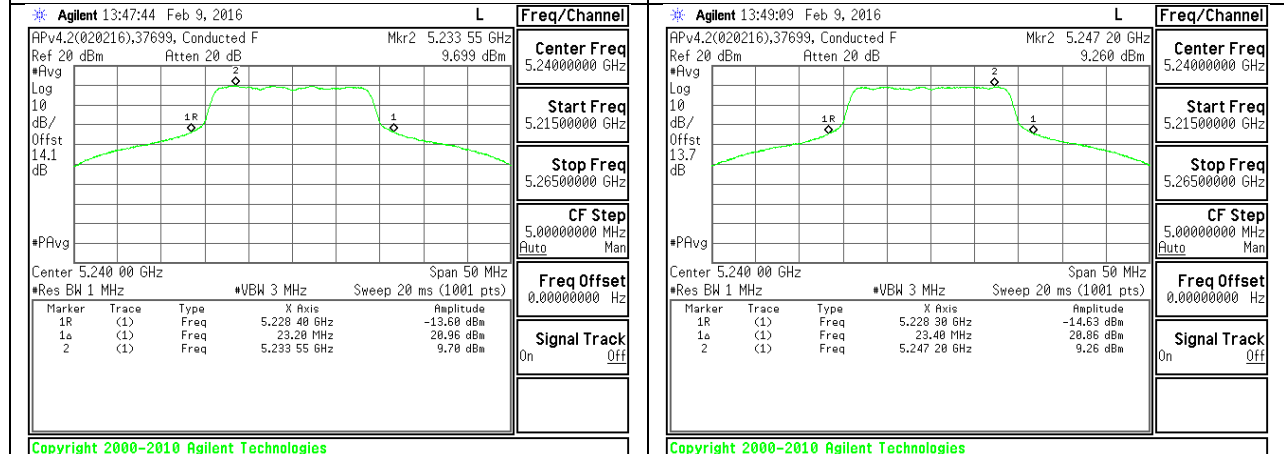
## MID CHANNEL



## HIGH CHANNEL



## HIGH CHANNEL CHAIN 0



## HIGH CHANNEL CHAIN 2

## HIGH CHANNEL CHAIN 3

#### 4Tx 1 STREAM BF MODE

##### 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               | 9.92                                      | 9.92                                    | 26.08                   | 13.08                 |
| Mid     | 5200               | 9.92                                      | 9.92                                    | 26.08                   | 13.08                 |
| High    | 5240               | 9.92                                      | 9.92                                    | 26.08                   | 13.08                 |

|                    |      |                                                |
|--------------------|------|------------------------------------------------|
| Duty Cycle CF (dB) | 0.68 | Included in Calculations of Corr'd Power & PSD |
|--------------------|------|------------------------------------------------|

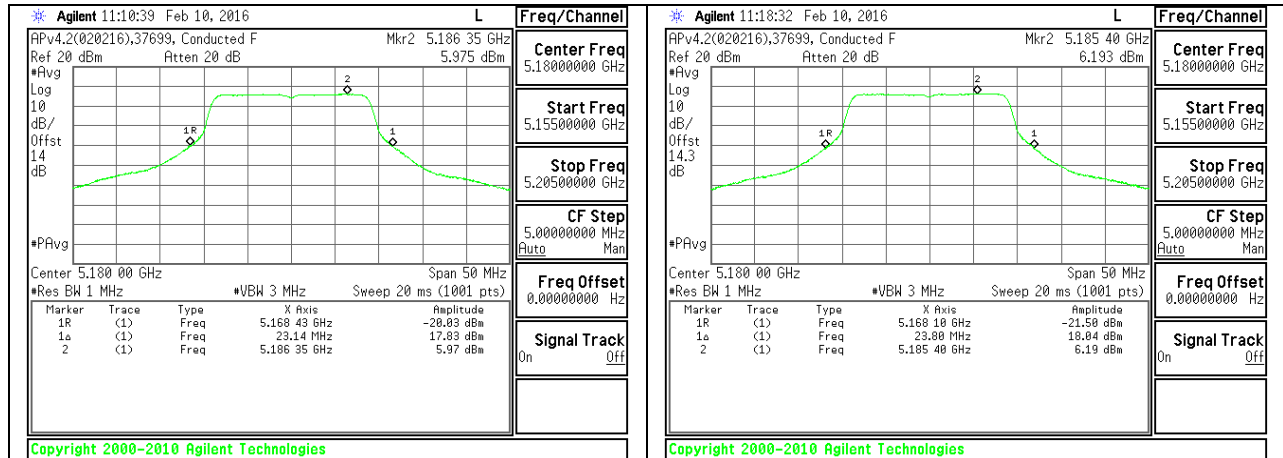
##### Output Power Results

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>Power<br>(dBm) | Chain 1<br>Meas<br>Power<br>(dBm) | Chain 2<br>Meas<br>Power<br>(dBm) | Chain 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               | 17.83                             | 18.04                             | 15.14                             | 16.55                             | 23.74                             | 26.08                   | -2.34                   |
| Mid     | 5200               | 18.64                             | 19.37                             | 17.03                             | 17.24                             | 24.88                             | 26.08                   | -1.20                   |
| High    | 5240               | 17.77                             | 17.95                             | 15.70                             | 16.63                             | 23.81                             | 26.08                   | -2.27                   |

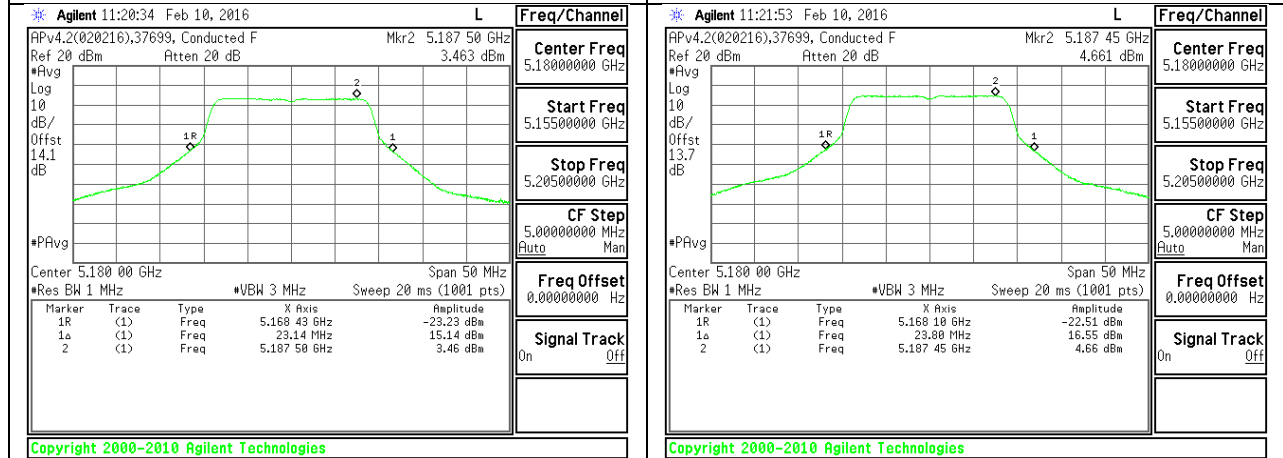
##### PSD Results

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>PSD<br>(dBm) | Chain 1<br>Meas<br>PSD<br>(dBm) | Chain 2<br>Meas<br>PSD<br>(dBm) | Chain 3<br>Meas<br>PSD<br>(dBm) | Total<br>Corr'd<br>PSD<br>(dBm) | PSD<br>Limit<br>(dBm) | PSD<br>Margin<br>(dB) |
|---------|--------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|-----------------------|-----------------------|
| Low     | 5180               | 5.98                            | 6.19                            | 3.46                            | 4.66                            | 11.91                           | 13.08                 | -1.17                 |
| Mid     | 5200               | 6.78                            | 7.41                            | 5.43                            | 5.45                            | 13.05                           | 13.08                 | -0.03                 |
| High    | 5240               | 6.05                            | 6.26                            | 4.92                            | 5.00                            | 12.30                           | 13.08                 | -0.78                 |

## LOW CHANNEL



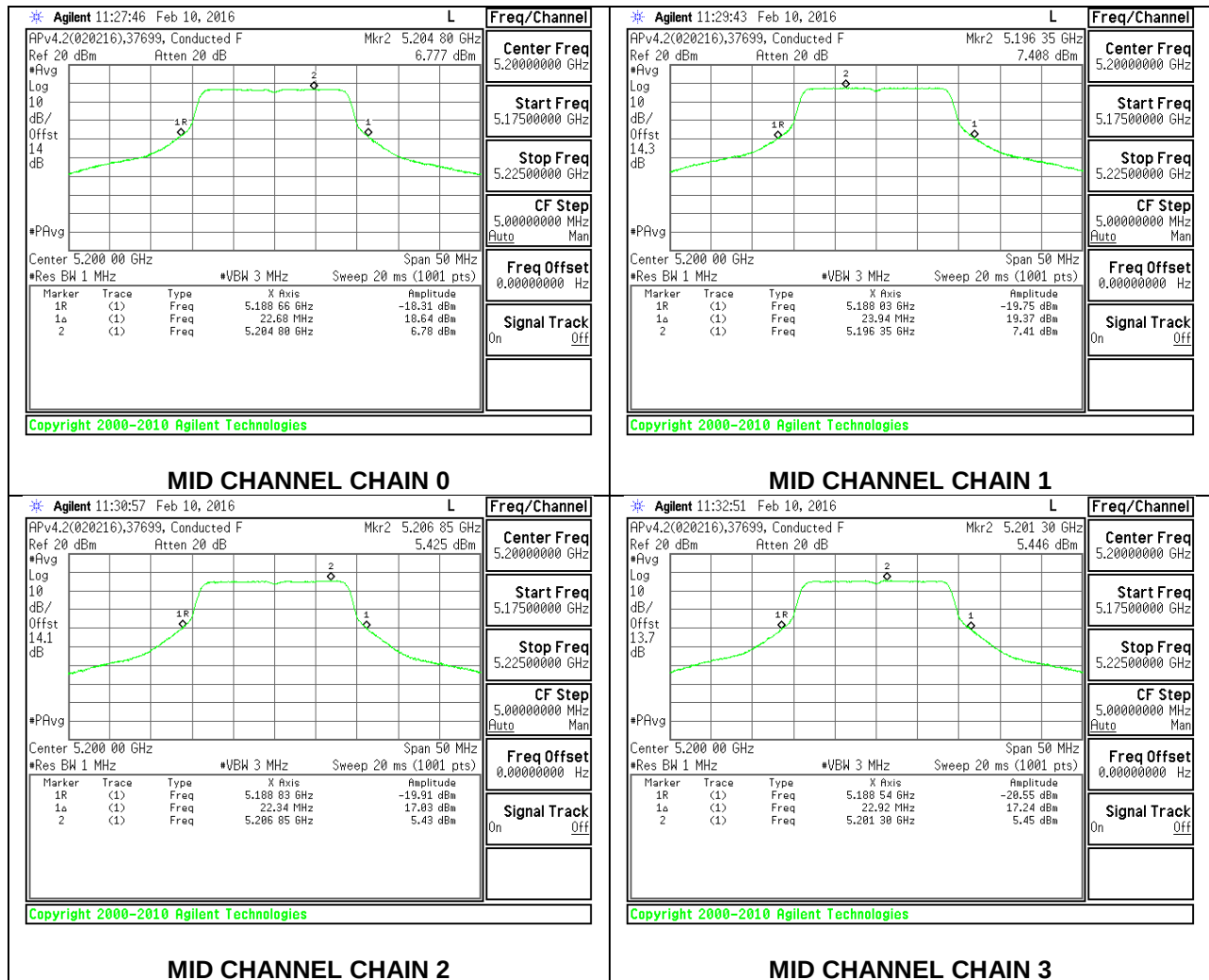
### LOW CHANNEL CHAIN 0



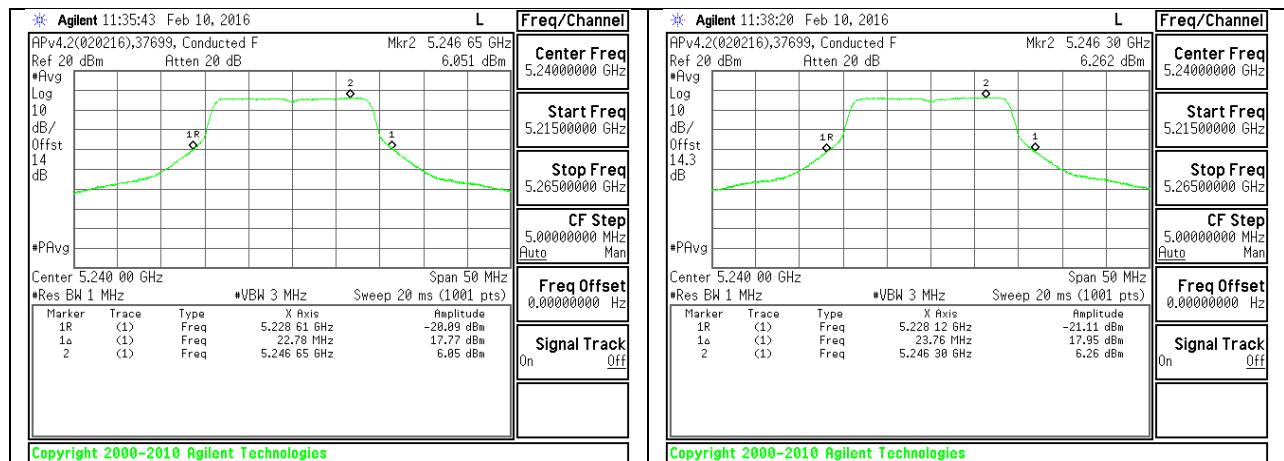
### LOW CHANNEL CHAIN 2

### LOW CHANNEL CHAIN 3

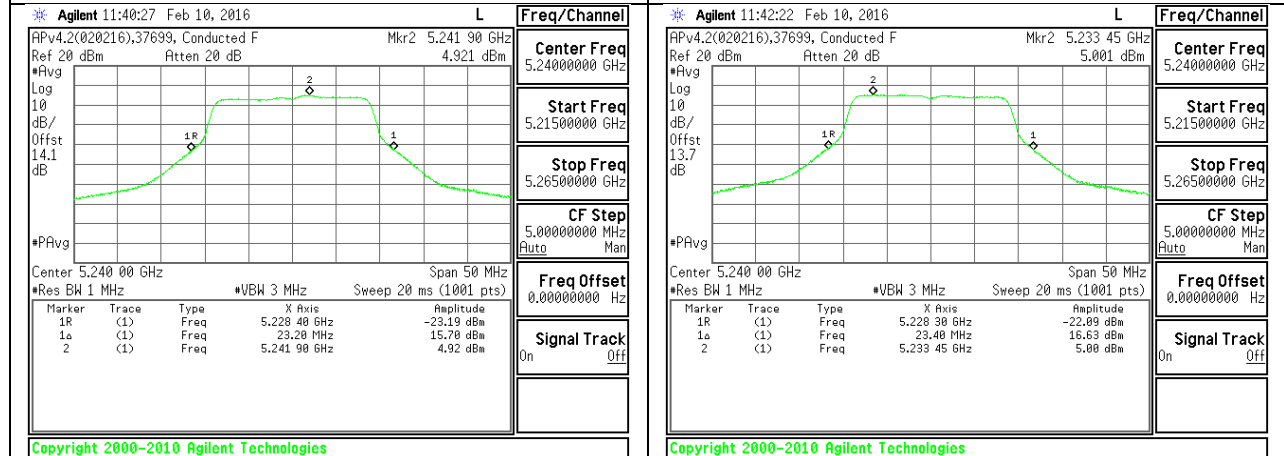
## MID CHANNEL



## HIGH CHANNEL



## HIGH CHANNEL CHAIN 0



## HIGH CHANNEL CHAIN 2

## HIGH CHANNEL CHAIN 3