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# MEASUREMENT REPORT
## FCC Part 15.407 UNII 802.11a/n/ac

**Applicant Name:**
Samsung Electronics Co., Ltd.
129, Samsung-ro, Maetan dong,
Yeongtong-gu, Suwon-si
Gyeonggi-do 443-742, Korea

**Date of Testing:**
1/20 – 2/12/2015, 3/2 – 3/3/2015
**Test Site/Location:**
PCTEST Lab, Columbia, MD, USA
**Test Report Serial No.:**
0Y1502030355.A3L

**FCC ID:** **A3LSMG925R4**

**APPLICANT:** **Samsung Electronics Co., Ltd.**

**Application Type:** Certification
**Model(s):** SM-G925R4
**EUT Type:** Portable Handset
**FCC Classification:** Unlicensed National Information Infrastructure (UNII)
**FCC Rule Part(s):** Part 15.407
**Test Procedure(s):** KDB 789033 D02 v01, KDB 644545 v01r02, KDB 662911 D01 v02r01, KDB 648474 D03 v01r02

| Mode | UNII Band | Channel Bandwidth (MHz) | Tx Frequency (MHz) | ANT1 | | ANT2 | | MIMO | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Max. Power (mW) | Max. Power (dBm) | Max. Power (mW) | Max. Power (dBm) | Max. Power (mW) | Max. Power (dBm) |
| 802.11a | 1 | 20 | 5180 - 5240 | 25.177 | 14.01 | 26.977 | 14.31 | N/A | |
| | 2A | 20 | 5260 - 5320 | 26.607 | 14.25 | 25.177 | 14.01 | | |
| | 2C | 20 | 5500 - 5720 | 27.925 | 14.46 | 27.861 | 14.45 | | |
| | 3 | 20 | 5745 - 5825 | 27.861 | 14.45 | 27.733 | 14.43 | | |
| 802.11n | 1 | 20 | 5180 - 5240 | 20.749 | 13.17 | 20.845 | 13.19 | 41.308 | 16.16 |
| | 2A | 20 | 5260 - 5320 | 20.749 | 13.17 | 19.634 | 12.93 | 40.383 | 16.06 |
| | 2C | 20 | 5500 - 5720 | 21.928 | 13.41 | 21.878 | 13.40 | 41.879 | 16.22 |
| | 3 | 20 | 5745 - 5825 | 21.281 | 13.28 | 21.627 | 13.35 | 43.109 | 16.35 |
| 802.11ac | 1 | 20 | 5180 - 5240 | 21.086 | 13.24 | 21.086 | 13.24 | 42.027 | 16.24 |
| | 2A | 20 | 5260 - 5320 | 20.606 | 13.14 | 19.543 | 12.91 | 40.150 | 16.04 |
| | 2C | 20 | 5500 - 5720 | 19.953 | 13.00 | 21.577 | 13.34 | 40.521 | 16.08 |
| | 3 | 20 | 5745 - 5825 | 21.577 | 13.34 | 21.928 | 13.41 | 43.505 | 16.39 |
| 802.11n | 1 | 40 | 5190 - 5230 | 16.444 | 12.16 | 15.417 | 11.88 | 31.823 | 15.03 |
| | 2A | 40 | 5270 - 5310 | 14.757 | 11.69 | 17.298 | 12.38 | 32.055 | 15.06 |
| | 2C | 40 | 5510 - 5710 | 15.959 | 12.03 | 15.812 | 11.99 | 31.769 | 15.02 |
| | 3 | 40 | 5755 - 5795 | 15.311 | 11.85 | 15.171 | 11.81 | 29.996 | 14.77 |
| 802.11ac | 1 | 40 | 5190 - 5230 | 16.482 | 12.17 | 15.560 | 11.92 | 31.970 | 15.05 |
| | 2A | 40 | 5270 - 5310 | 14.894 | 11.73 | 17.458 | 12.42 | 32.352 | 15.10 |
| | 2C | 40 | 5510 - 5710 | 15.996 | 12.04 | 15.631 | 11.94 | 31.405 | 14.97 |
| | 3 | 40 | 5755 - 5795 | 15.311 | 11.85 | 15.066 | 11.78 | 30.377 | 14.83 |
| 802.11ac | 1 | 80 | 5210 | 11.885 | 10.75 | 12.531 | 10.98 | 24.416 | 13.88 |
| | 2A | 80 | 5290 | 12.735 | 11.05 | 12.246 | 10.88 | 24.981 | 13.98 |
| | 2C | 80 | 5530 - 5690 | 12.246 | 10.88 | 12.882 | 11.10 | 25.129 | 14.00 |
| | 3 | 80 | 5775 | 13.646 | 11.35 | 12.764 | 11.06 | 26.410 | 14.22 |

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in KDB 789033 D02 v01 and KDB 644545 v01r02. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Randy Ortanez
President


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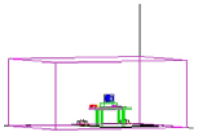

# MEASUREMENT REPORT
## FCC Part 15.407

## § 2.1033 General Information

| | |
|---|---|
| **APPLICANT:** | Samsung Electronics Co., Ltd. |
| **APPLICANT ADDRESS:** | 129, Samsung-ro, Maetan dong,<br>Yeongtong-gu, Suwon-si, Gyeonggi-do 443-742, Korea |
| **TEST SITE:** | PCTEST ENGINEERING LABORATORY, INC. |
| **TEST SITE ADDRESS:** | 7185 Oakland Mills Road, Columbia, MD 21046 USA |
| **FCC RULE PART(S):** | Part 15.407 |
| **BASE MODEL:** | SM-G925R4 |
| **FCC ID:** | A3LSMG925R4 |
| **FCC CLASSIFICATION:** | Unlicensed National Information Infrastructure (UNII) |
| **Test Device Serial No.:** | 234C3, 234F2, 234C9 ☐ Production ☒ Pre-Production ☐ Engineering |
| **DATE(S) OF TEST:** | 1/20 – 2/12/2015, 3/2 – 3/3/2015 |
| **TEST REPORT S/N:** | 0Y1502030355.A3L |

## Test Facility / Accreditations

**Measurements were performed at PCTEST Engineering Lab located in Columbia, MD 21046, U.S.A.**

- PCTEST facility is an FCC registered (PCTEST Reg. No. 159966) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules and Industry Canada (2451B-1).
- PCTEST Lab is accredited to ISO 17025 by U.S. National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP Lab code: 100431-0) in EMC, FCC and Telecommunications.
- PCTEST Lab is accredited to ISO 17025-2005 by the American Association for Laboratory Accreditation (A2LA) in Specific Absorption Rate (SAR) testing, Hearing Aid Compatibility (HAC) testing, CTIA Test Plans, and wireless testing for FCC and Industry Canada Rules.

- PCTEST Lab is a recognized U.S. Conformity Assessment Body (CAB) in EMC and R&TTE (n.b. 0982) under the U.S.-EU Mutual Recognition Agreement (MRA).
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC Guide 65 by the American National Standards Institute (ANSI) in all scopes of FCC Rules and Industry Canada Standards (RSS).
- PCTEST facility is an IC registered (2451B-1) test laboratory with the site description on file at Industry Canada.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) for AMPS, CDMA, and EvDO wireless devices and for Over-the-Air (OTA) Antenna Performance testing for AMPS, CDMA, GSM, GPRS, EGPRS, UMTS (W-CDMA), CDMA 1xEVDO, and CDMA 1xRTT.


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# 1.0 INTRODUCTION

## 1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

## 1.2 PCTEST Test Location

The map below shows the location of the PCTEST LABORATORY, its proximity to the FCC Laboratory, the Columbia vicinity, the Baltimore-Washington Internt'l (BWI) airport, the city of Baltimore and the Washington, DC area. (*See Figure 1-1*).

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility located at 7185 Oakland Mills Road, Columbia, MD 21046. The site coordinates are 39° 10'23" N latitude and 76° 49'50" W longitude. The facility is 0.4 miles North of the FCC laboratory, and the ambient signal and ambient signal strength are approximately equal to those of the FCC laboratory. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4-2009 on February 15, 2012.

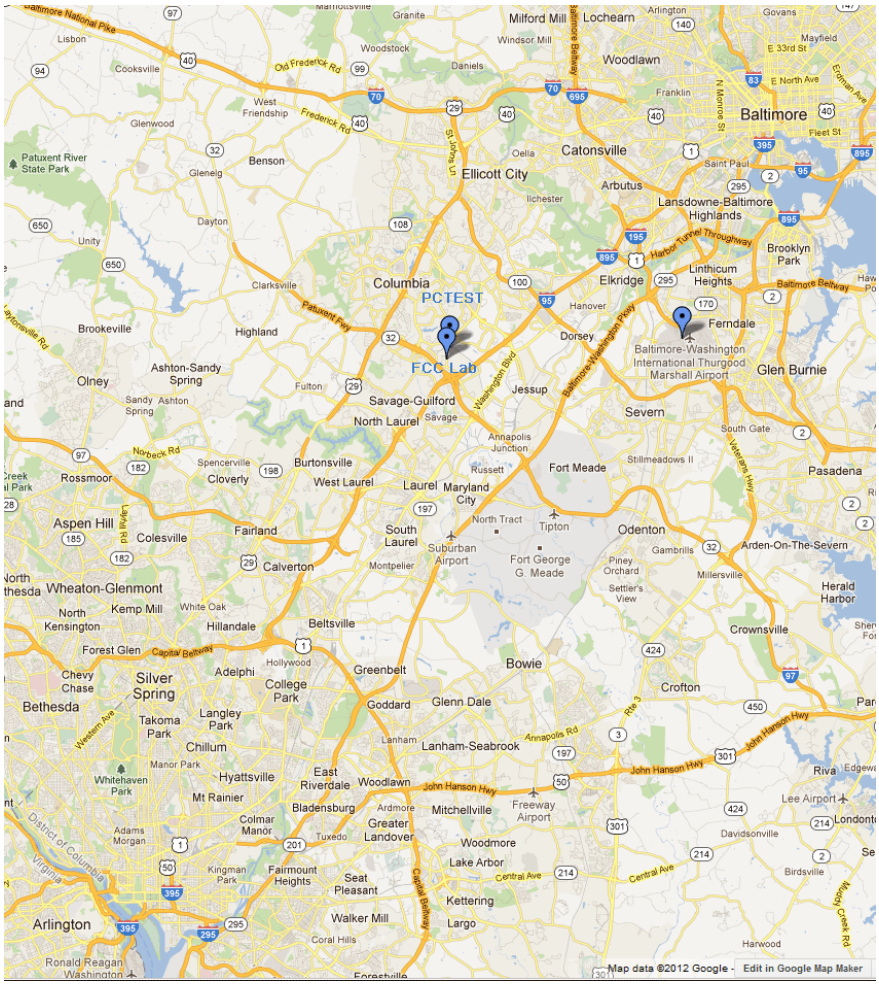


**Figure 1-1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area**


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# 2.0 PRODUCT INFORMATION

## 2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMG925R4**. The test data contained in this report pertains only to the emissions due to the EUT's UNII transmitter.

## 2.2 Device Capabilities

This device contains the following capabilities:

850/1900 CDMA/EvDO (BC0, BC1), 850/1900 GSM/GPRS/EDGE, 850/1900 WCDMA/HSPA, Multi-band LTE, 802.11b/g/n WLAN, 802.11a/n/ac UNII, Bluetooth (1x, EDR, LE), NFC, ANT+

**Note:**

5GHz (NII) operation is possible in 20MHz, and 40MHz, and 80MHz channel bandwidths. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = peak per the guidance of Section B)2)b) of KDB 789033. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

| Maximum Achievable Duty Cycles | | | | |
|---|---|---|---|---|
| 802.11 Mode/Band | | Duty Cycle [%] | | |
| | | ANT1 | ANT2 | MIMO |
| 5GHz | a | 98.75 | 98.81 | N/A |
| | n (HT20) | 98.97 | 98.83 | 98.31 |
| | ac (HT20) | 98.94 | 98.70 | 98.03 |
| | n (HT40) | 98.74 | 98.65 | 97.58 |
| | ac (HT40) | 98.67 | 98.44 | 97.58 |
| | ac (HT80) | 98.18 | 98.11 | 92.69 |

The device employs MIMO technology. Below are the possible configurations.

| WiFi Configurations | | SISO | | SDM | |
|---|---|---|---|---|---|
| | | ANT1 | ANT2 | ANT1 | ANT2 |
| 5GHz | 11a | ✓ | ✓ | × | × |
| | 11n (20MHz) | ✓ | ✓ | ✓ | ✓ |
| | 11n (40MHz) | ✓ | ✓ | ✓ | ✓ |
| | 11ac (80MHz) | ✓ | ✓ | ✓ | ✓ |

**Table 2-1. Frequency / Channel Operations**

✓= Support ; × = NOT Support
**SISO** = Single Input Single Output
**SDM** = Spatial Diversity Multiplexing – MIMO function

Data Rate(s) Tested: 6, 9, 12, 18, 24, 36, 48, 54Mbps (802.11a)
6.5/7.2, 13/14.4, 19.5/21.7, 26/28.9, 39/43.3, 52/57.8, 58.5/65, 65/72.2 (n – 20MHz)
13.5/15, 27/30, 40.5/45, 54/60, 81/90, 108/120, 121.5/135, 135/150 (n – 40MHz BW)
29.3/32.5, 58.5/65, 87.8/97.5, 117/130, 175.5/195, 234/260, 263.3/292.5, 292.5/325, 351/390, 390/433.3 (ac – 80MHz BW)


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## 2.3 Test Configuration

The Samsung Portable Handset FCC ID: A3LSMG925R4 was tested per the guidance of KDB 789033 D02 v01. ANSI C63.10-2009 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. See Sections 3.2 for AC line conducted emissions test setups, 3.3 for radiated emissions test setups, and 6.2, 6.3, 6.4 and 6.5 for antenna port conducted emissions test setups.

This device supports wireless charging capability and, thus, is subject to the test requirements of KDB 648474 D03 v01r02. Additional radiated spurious emission measurements were performed with the EUT lying flat on a certified wireless charging pad while operating under normal conditions in a simulated call or data transmission configuration. The worst case radiated emissions data is shown in this report.

## 2.4 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.


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# 3.0 DESCRIPTION OF TEST

## 3.1 Evaluation Procedure

The measurement procedures described in the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2009) and the guidance provided in KDB 789033 D02 v01 were used in the measurement of **Samsung Portable Handset FCC ID: A3LSMG925R4.**

**Deviation from measurement procedure……..…….....None**

## 3.2 AC Line Conducted Emissions

The line-conducted facility is located inside a 10'x16'x9' shielded enclosure. The shielded enclosure is manufactured by ETS Lindgren RF Enclosures. The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 65-5. A 1m x 1.5m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50μH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. The external power line filter is an ETS Lindgren Model LPRX-4X30 (100dB Attenuation, 14kHz-18GHz) and the two EMI/RFI filters are ETS Lindgren Model LRW-2030-S1 (100dB Minimum Insertion Loss, 14kHz – 10GHz). These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply line(s) will be connected to the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference groundplane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The spectrum was scanned from 150kHz to 30MHz with a spectrum analyzer. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 10kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was also maximized by varying: power lines, the mode of operation or resolution, clock or data exchange speed, scrolling H pattern to the EUT and/or support equipment whichever determined the worst-case emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions is used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

Line conducted emissions test results are shown in Section 6.9. The EMI Receiver mode of the Agilent MXE was used to perform AC line conducted emissions testing.


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## 3.3 Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Clause 5, Figure 5.7 of ANSI C63.4-2009. For measurements above 1GHz absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1GHz, the absorbers are removed. An ETS Lindgren Model 2188 raised turntable is used for radiated measurement. It is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. A 78cm high PVC support structure is placed on top of the turntable. A ¾" (~1.9cm) sheet of high density polyethylene is used as the table top and is placed on top of the PVC supports to bring the total height of the table to 80cm.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up was placed on top of the 0.8 meter high, 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, if applicable, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions.

## 3.4 Environmental Conditions

The temperature is controlled within range of 15°C to 35°C. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).


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# 4.0 ANTENNA REQUIREMENTS

**Excerpt from §15.203 of the FCC Rules/Regulations:**
"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

- The antennas of the Portable Handset are **permanently attached.**
- There are no provisions for connection to an external antenna.

**Conclusion:**

The **Samsung Portable Handset FCC ID: A3LSMG925R4** unit complies with the requirement of §15.203.

| Band 1 | | Band 2A | | Band 2C | | Band 3 | |
|---|---|---|---|---|---|---|---|
| Ch. | Frequency (MHz) | Ch. | Frequency (MHz) | Ch. | Frequency (MHz) | Ch. | Frequency (MHz) |
| 36 | 5180 | 52 | 5260 | 100 | 5500 | 149 | 5745 |
| : | : | : | : | : | : | : | : |
| 42 | 5210 | 56 | 5280 | 116 | 5580 | 157 | 5785 |
| : | : | : | : | : | : | : | : |
| 48 | 5240 | 64 | 5320 | 144 | 5720 | 165 | 5825 |

**Table 4-1. 802.11a / 802.11n / 802.11ac (20MHz) Frequency / Channel Operations**

| Band 1 | | Band 2A | | Band 2C | | Band 3 | |
|---|---|---|---|---|---|---|---|
| Ch. | Frequency (MHz) | Ch. | Frequency (MHz) | Ch. | Frequency (MHz) | Ch. | Frequency (MHz) |
| 38 | 5190 | 54 | 5270 | 102 | 5510 | 151 | 5755 |
| : | : | : | : | : | : | : | : |
| 46 | 5230 | 62 | 5310 | 110 | 5550 | 159 | 5795 |
| | | | | : | : | | |
| | | | | 142 | 5710 | | |

**Table 4-2. 802.11n / 802.11ac (40MHz BW) Frequency / Channel Operations**

| Band 1 | | Band 2A | | Band 2C | | Band 3 | |
|---|---|---|---|---|---|---|---|
| Ch. | Frequency (MHz) | Ch. | Frequency (MHz) | Ch. | Frequency (MHz) | Ch. | Frequency (MHz) |
| 42 | 5210 | 58 | 5290 | 106 | 5530 | 155 | 5775 |
| | | | | : | : | | |
| | | | | 138 | 5690 | | |

**Table 4-3. 802.11ac (80MHz BW) Frequency / Channel Operations**


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# 5.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST).

| Manufacturer | Model | Description | Cal Date | Cal Interval | Cal Due | Serial Number |
|---|---|---|---|---|---|---|
| - | RE1 | Radiated Emissions Cable Set (UHF/EHF) | 5/29/2014 | Annual | 5/29/2015 | N/A |
| - | WL40-1 | Conducted Cable Set (40GHz) | 10/14/2014 | Annual | 10/14/2015 | N/A |
| Agilent | 8447D | Broadband Amplifier | 5/30/2014 | Annual | 5/30/2015 | 2443A01900 |
| Agilent | E4448A | PSA (3Hz-50GHz) Spectrum Analyzer | 4/16/2014 | Annual | 4/16/2015 | US42510244 |
| Agilent | N9020A | MXA Signal Analyzer | 10/27/2014 | Annual | 10/27/2015 | US46470561 |
| Agilent | N9038A | MXE EMI Receiver | 3/3/2014 | Annual | 3/3/2015 | MY51210133 |
| Agilent | N9030A | PXA Signal Analyzer (26.5GHz) | 5/8/2014 | Annual | 5/8/2015 | MY49432391 |
| Agilent | N9030A | PXA Signal Analyzer (44GHz) | 3/17/2014 | Annual | 3/17/2015 | MY52350166 |
| Anritsu | ML2495A | Power Meter | 10/31/2013 | Biennial | 10/31/2015 | 941001 |
| Anritsu | MA2411B | Pulse Sensor | 4/8/2014 | Biennial | 4/8/2016 | 846215 |
| Emco | 3115 | Horn Antenna (1-18GHz) | 1/30/2014 | Biennial | 1/30/2016 | 9704-5182 |
| Emco | 6502 | Active Loop Antenna (10k - 30 MHz) | 6/24/2014 | Biennial | 6/24/2016 | 267 |
| ETS Lindgren | 3117 | 1-18 GHz DRG Horn (Medium) | 4/8/2014 | Biennial | 4/8/2016 | 125518 |
| ETS Lindgren | 3160-09 | 18-26.5 GHz Standard Gain Horn | 6/17/2014 | Biennial | 6/17/2016 | 135427 |
| ETS Lindgren | 3160-10 | 26.5-40 GHz Standard Gain Horn | 6/17/2014 | Biennial | 6/17/2016 | 130993 |
| Huber+Suhner | Sucoflex 102A | 40GHz Radiated Cable | 10/15/2014 | Annual | 10/15/2015 | 251425001 |
| K & L | 11SH10-6000/T18000 | High Pass Filter | 2/7/2014 | Annual | 2/7/2015 | 1 |
| K & L | 11SH10-3075/U18000 | High Pass Filter | 5/2/2014 | Annual | 5/2/2015 | 2 |
| Rohde & Schwarz | TS-PR18 | 1-18 GHz Pre-Amplifier | 3/5/2014 | Annual | 3/5/2015 | 100071 |
| Rohde & Schwarz | TS-PR26 | 18-26.5 GHz Pre-Amplifier | 3/12/2014 | Annual | 3/12/2015 | 100040 |
| Rohde & Schwarz | ESU26 | EMI Test Receiver (26.5GHz) | 3/27/2014 | Annual | 3/27/2015 | 100342 |
| Rohde & Schwarz | TS-PR40 | 26.5-40 GHz Pre-Amplifier | 5/15/2014 | Annual | 5/15/2015 | 100037 |
| Rohde & Schwarz | ESU40 | EMI Test Receiver (40GHz) | 5/21/2014 | Annual | 5/21/2015 | 100348 |
| Seekonk | NC-100 | Torque Wrench 5/16", 8" lbs | 3/18/2014 | Biennial | 3/18/2016 | N/A |
| Solar Electronics | 8012-50-R-24-BNC | Line Impedance Stabilization Network | 6/20/2013 | Biennial | 6/20/2015 | 310233 |
| Sunol | JB5 | Bi-Log Antenna (30M - 5GHz) | 1/28/2014 | Biennial | 1/28/2016 | A051107 |

**Table 5-1. Annual Test Equipment Calibration Schedule**


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# 6.0 TEST RESULTS

## 6.1 Summary

Company Name: Samsung Electronics Co., Ltd.
FCC ID: A3LSMG925R4
Method/System: Unlicensed National Information Infrastructure (UNII)

| FCC Part Section(s) | Test Description | Test Limit | Test Condition | Test Result | Reference |
|---|---|---|---|---|---|
| **TRANSMITTER MODE (TX)** | | | | | |
| N/A | 26dB Bandwidth | N/A | CONDUCTED | PASS | Section 6.2 |
| 15.407(e) | 6dB Bandwidth | ≥ 500 kHz | | PASS | Section 6.3 |
| 15.407 (a) | Maximum Conducted Output Power | < 250mW (23.98dBm) (5150-5250MHz)<br>< 250mW (23.98dBm) (5250-5350MHz)<br>< 250mW (23.98dBm) (5470-5725MHz)<br>< 1W (5725-5825MHz) | | PASS | Section 6.4 |
| 15.407 (a) | Peak Power Spectral Density | < 11 dBm/MHz (5150 – 5350MHz, 5470 – 5725MHz)<br>< 30 dBm/500kHz (5725 - 5850MHz) | | PASS | Section 6.5 |
| 15.407(g) | Frequency Stability | N/A | | PASS | Section 6.6 |
| 15.407(h) | Dynamic Frequency Selection | See DFS Test Report | | PASS | See DFS Test Report |
| 15.407(b) | Undesirable Emissions | < -27 dBm/MHz EIRP (5150-5350MHz, 5470-5725MHz)<br><-17 dBm/MHz EIRP (5725-5825MHz, within 10MHz of the band edge; <-27 dBm/MHz EIRP otherwise) | RADIATED | PASS | Section 6.7 |
| 15.205, 15.407(b) | General Field Strength Limits (Restricted Bands and Radiated Emission Limits) | Emissions in restricted bands must meet the radiated limits detailed in 15.209 | | PASS | Section 6.7, 6.8 |
| 15.407 | AC Conducted Emissions 150kHz – 30MHz | < FCC 15.207 limits or | LINE CONDUCTED | PASS | Section 6.9 |

**Table 6-1. Summary of Test Results**

**Notes:**

1) All channels, modes, and modulations/data rates were investigated among all UNII bands. The test results shown in the following sections represent the worst case emissions.
2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.
4) For conducted spurious emissions, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST "UNII Automation", Version 3.4.


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## 6.2 26dB Bandwidth Measurement – 802.11a/n/ac

**Test Overview and Limit**

The bandwidth at 26dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating at its maximum power control level, as defined in KDB 789033 D02 v01, and at the appropriate frequencies. The spectrum analyzer's bandwidth measurement function is configured to measure the 26dB bandwidth.

***The 26dB bandwidth is used to determine the conducted power limits.***

**Test Procedure Used**

KDB 789033 D02 v01 – Section C

**Test Settings**

1. The signal analyzers' automatic bandwidth measurement capability was used to perform the 26dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 26. The automatic bandwidth measurement function also has the capability of simultaneously measuring the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = approximately 1% of the emission bandwidth
3. VBW $\geq$ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold

**Test Setup**

The EUT and measurement equipment were set up as shown in the diagram below.

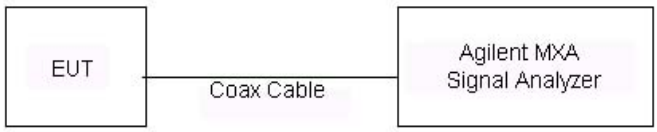


**Figure 6-1. Test Instrument & Measurement Setup**

**Test Notes**

None.


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## Antenna-1 26 dB Bandwidth Measurements

| | Frequency [MHz] | Channel No. | 802.11 Mode | Data Rate [Mbps] | Measured 26dB Bandwidth [MHz] |
|---|---|---|---|---|---|
| Band 1 | 5180 | 36 | a | 6 | 21.50 |
| | 5200 | 40 | a | 6 | 21.48 |
| | 5240 | 48 | a | 6 | 21.52 |
| | 5180 | 36 | n (20MHz) | 6.5/7.2 (MCS0) | 21.61 |
| | 5200 | 40 | n (20MHz) | 6.5/7.2 (MCS0) | 21.66 |
| | 5240 | 48 | n (20MHz) | 6.5/7.2 (MCS0) | 21.40 |
| | 5190 | 38 | n (40MHz) | 13.5/15 (MCS0) | 39.75 |
| | 5230 | 46 | n (40MHz) | 13.5/15 (MCS0) | 39.94 |
| | 5210 | 42 | ac (80MHz) | 29.3/32.5 (MCS0) | 82.03 |
| Band 2A | 5260 | 52 | a | 6 | 21.29 |
| | 5280 | 56 | a | 6 | 21.58 |
| | 5320 | 64 | a | 6 | 21.59 |
| | 5260 | 52 | n (20MHz) | 6.5/7.2 (MCS0) | 21.72 |
| | 5280 | 56 | n (20MHz) | 6.5/7.2 (MCS0) | 21.72 |
| | 5320 | 64 | n (20MHz) | 6.5/7.2 (MCS0) | 21.56 |
| | 5270 | 54 | n (40MHz) | 13.5/15 (MCS0) | 39.64 |
| | 5310 | 62 | n (40MHz) | 13.5/15 (MCS0) | 39.98 |
| | 5290 | 58 | ac (80MHz) | 29.3/32.5 (MCS0) | 81.47 |
| Band 2C | 5500 | 100 | a | 6 | 21.36 |
| | 5580 | 116 | a | 6 | 21.51 |
| | 5720 | 144 | a | 6 | 21.35 |
| | 5500 | 100 | n (20MHz) | 6.5/7.2 (MCS0) | 21.64 |
| | 5580 | 116 | n (20MHz) | 6.5/7.2 (MCS0) | 21.44 |
| | 5720 | 144 | n (20MHz) | 6.5/7.2 (MCS0) | 21.81 |
| | 5510 | 102 | n (40MHz) | 13.5/15 (MCS0) | 39.89 |
| | 5550 | 110 | n (40MHz) | 13.5/15 (MCS0) | 40.16 |
| | 5710 | 142 | n (40MHz) | 13.5/15 (MCS0) | 39.95 |
| | 5530 | 106 | ac (80MHz) | 29.3/32.5 (MCS0) | 81.89 |
| | 5690 | 138 | ac (80MHz) | 29.3/32.5 (MCS0) | 80.96 |

**Table 6-2. Conducted Bandwidth Measurements**


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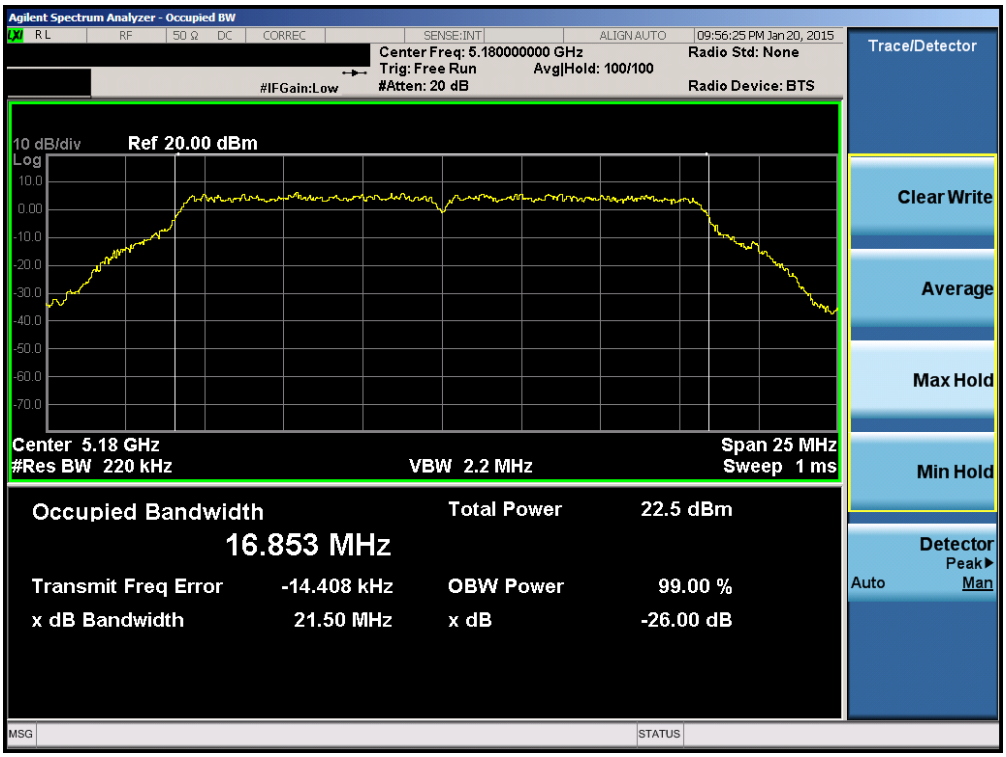
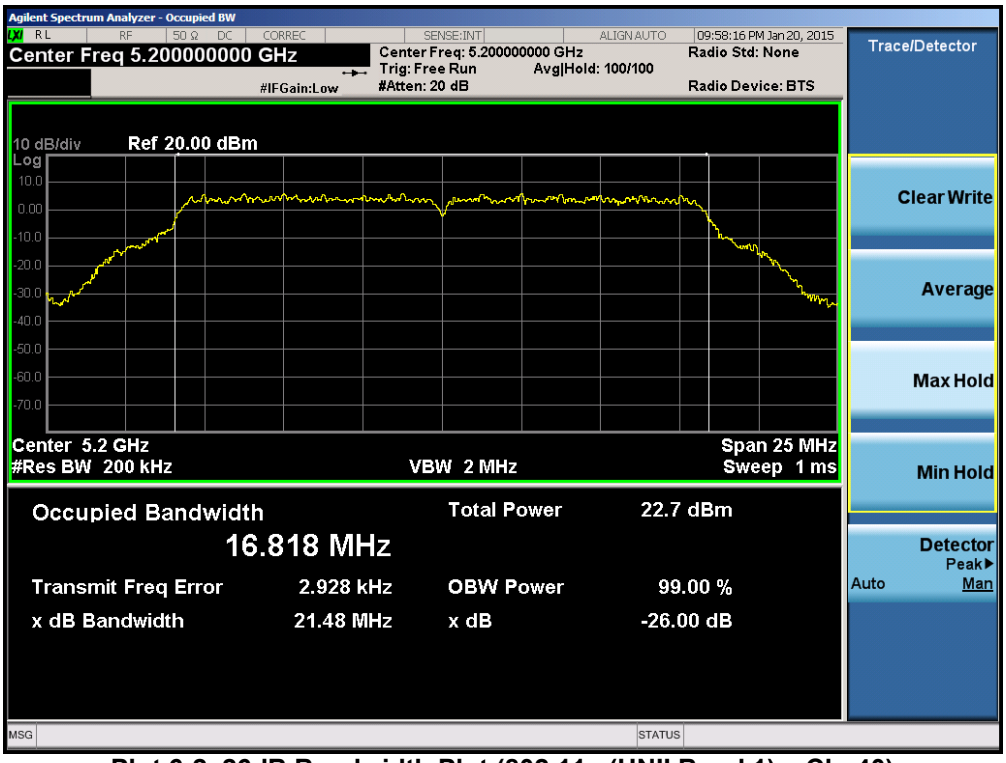



**Plot 6-1. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 36)**




**Plot 6-2. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 40)**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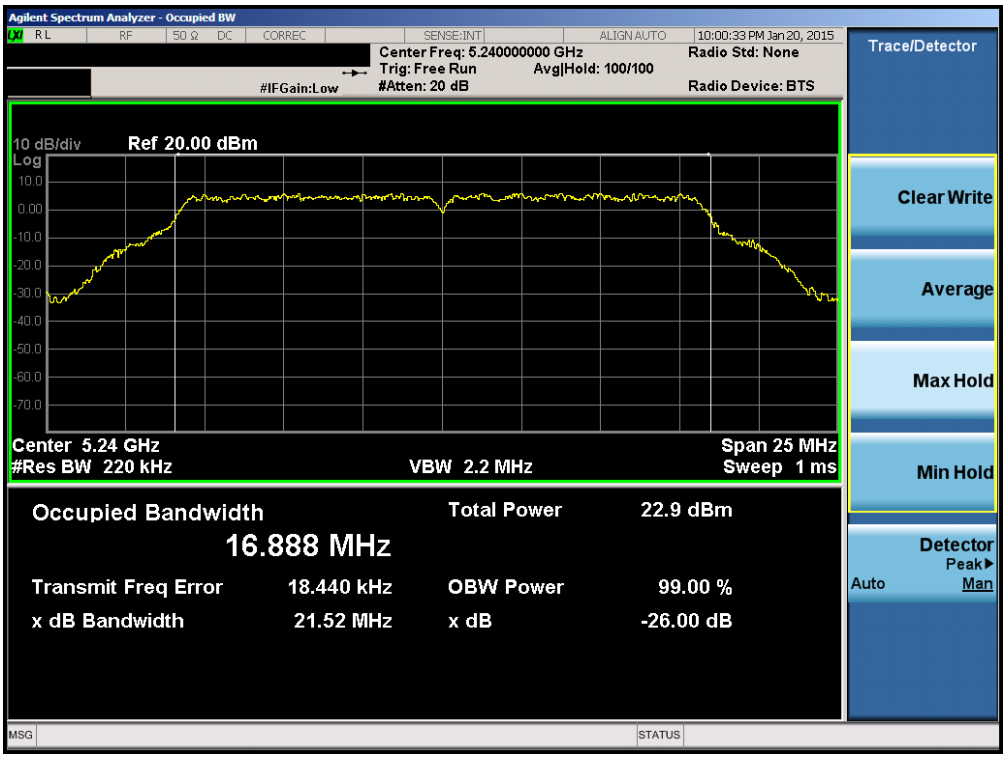
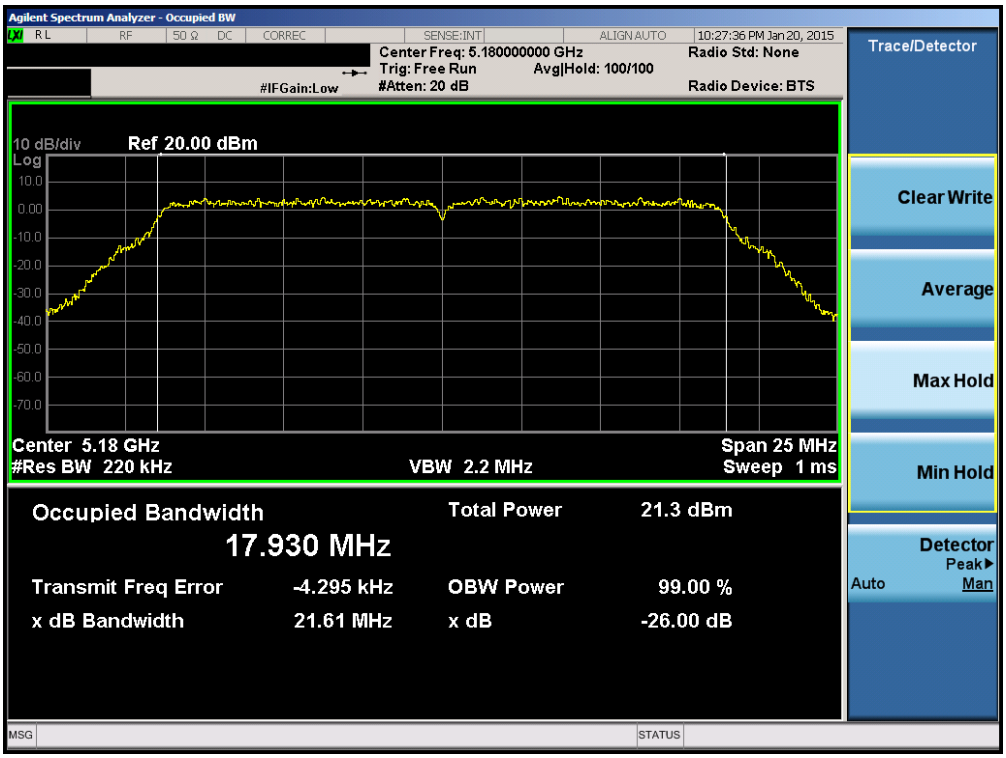



**Plot 6-3. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 48)**




**Plot 6-4. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 36)**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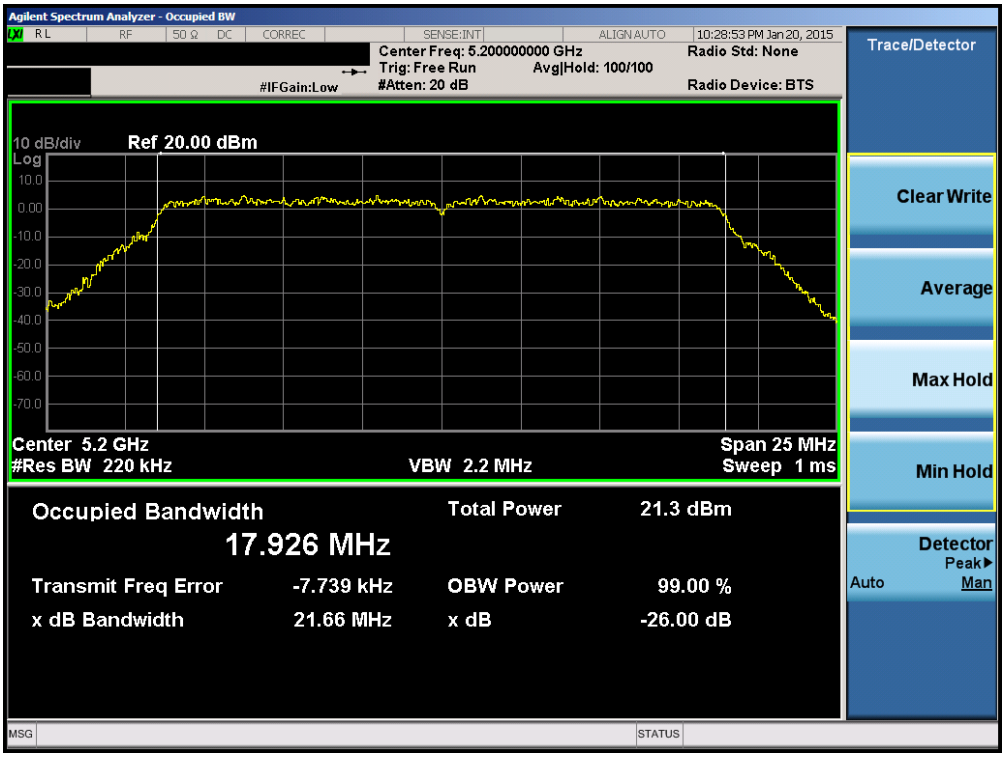
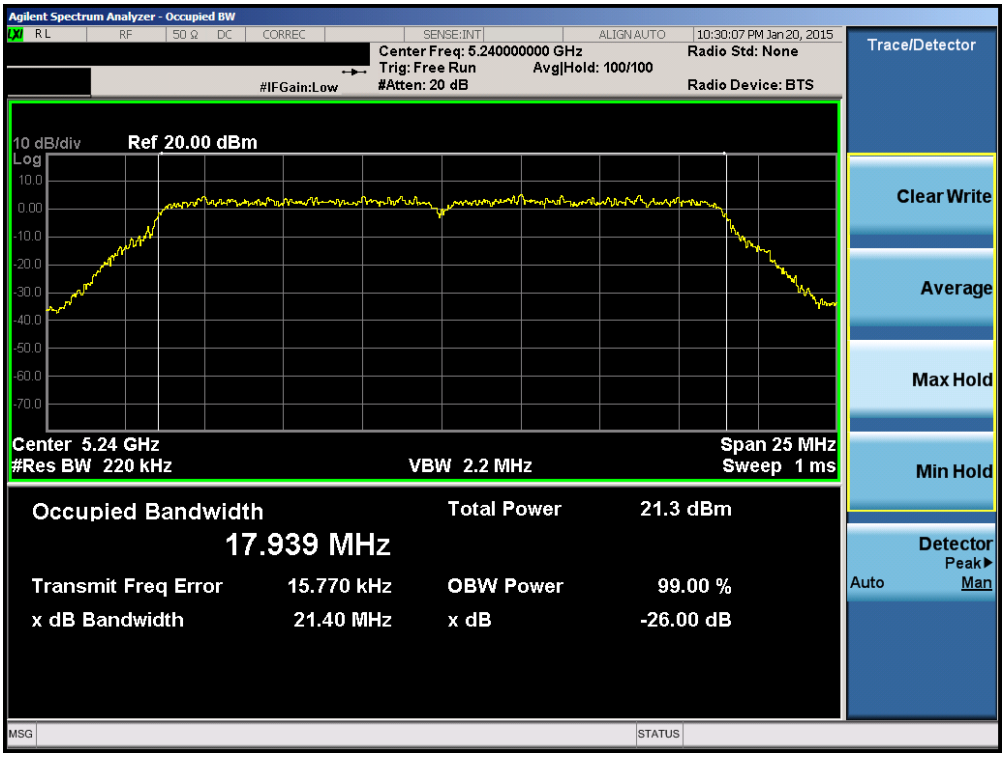



**Plot 6-5. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 40)**




**Plot 6-6. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 48)**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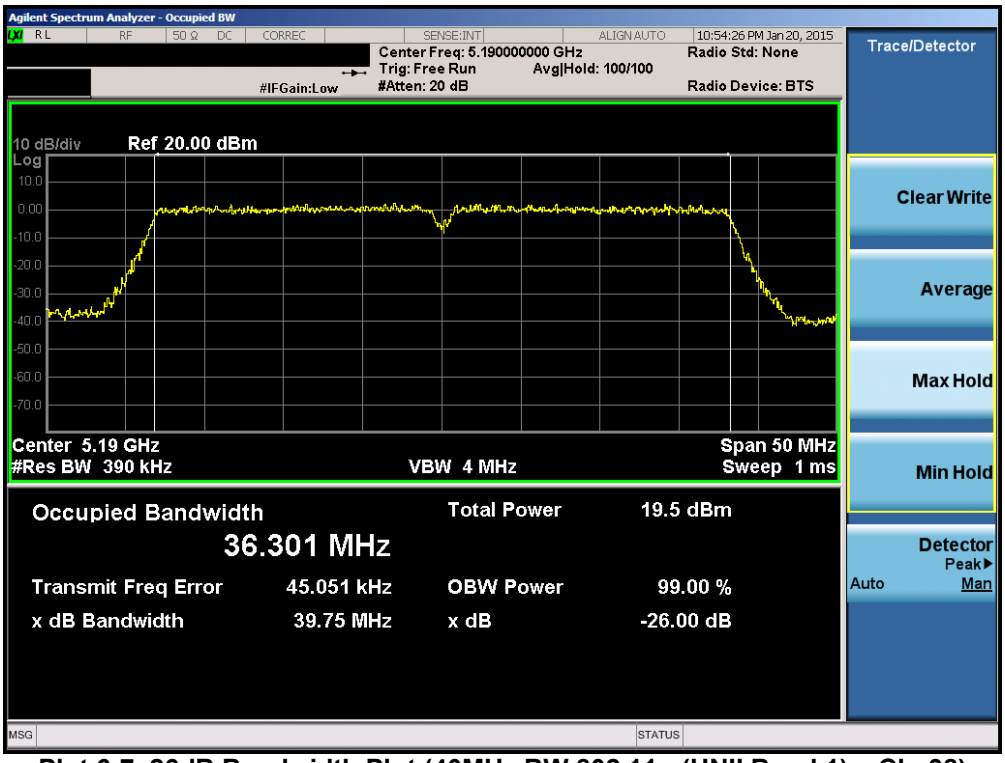
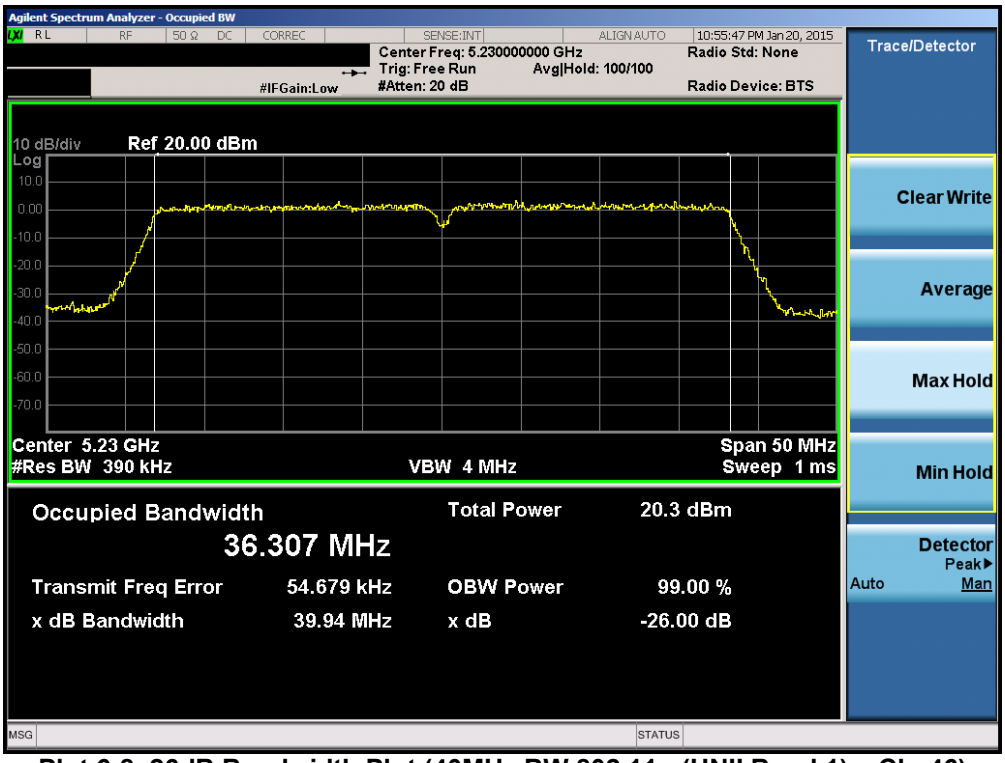



**Plot 6-7. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 38)**




**Plot 6-8. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 46)**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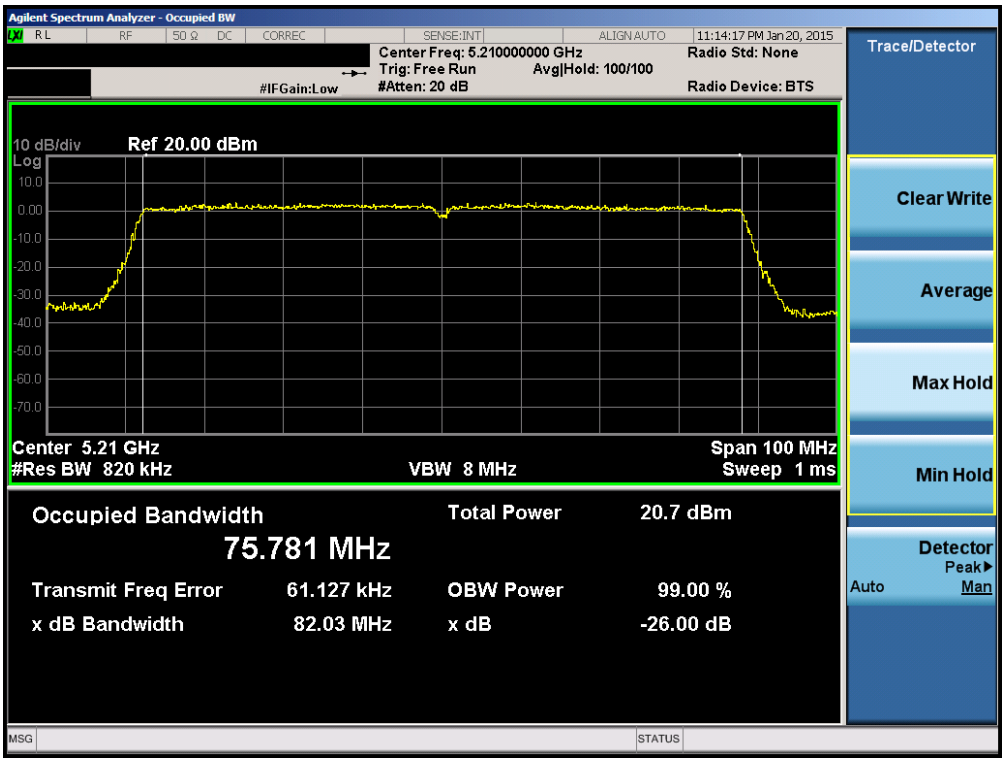
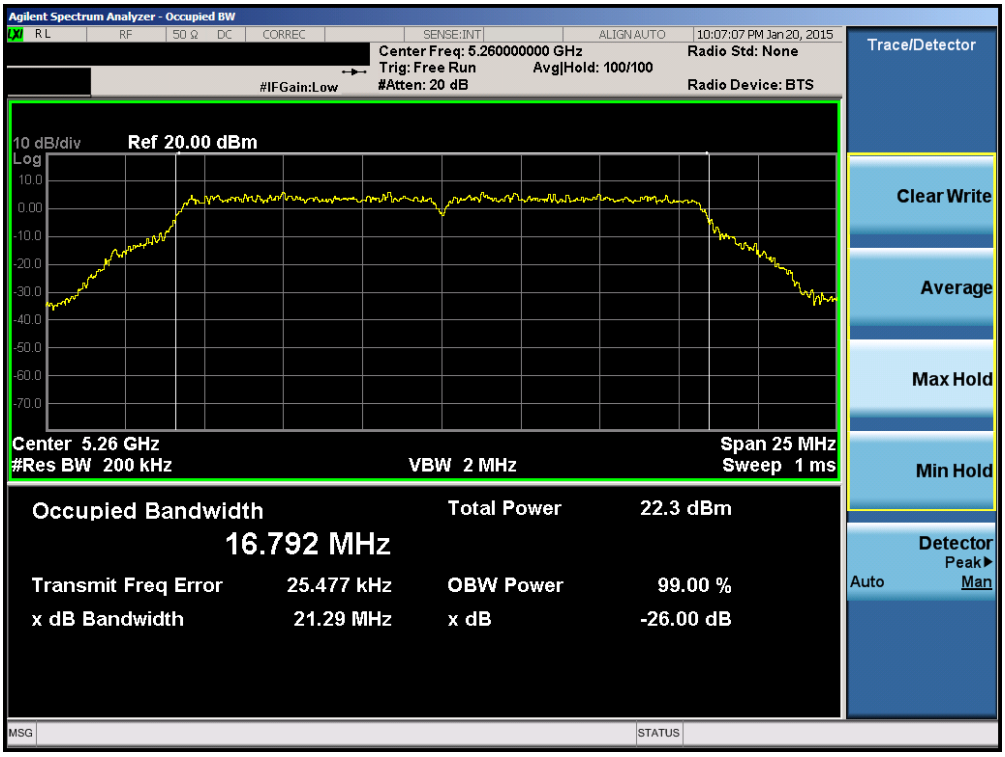



**Plot 6-9. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)**




**Plot 6-10. 26dB Bandwidth Plot (802.11a (UNII Band 2A) – Ch. 52)**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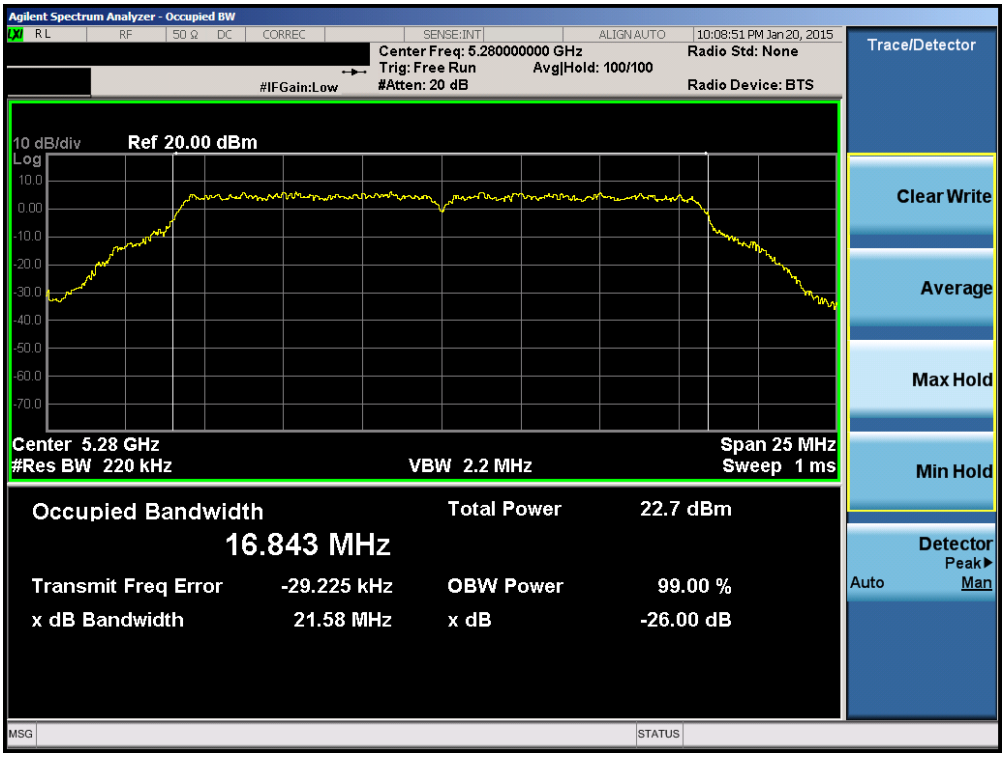
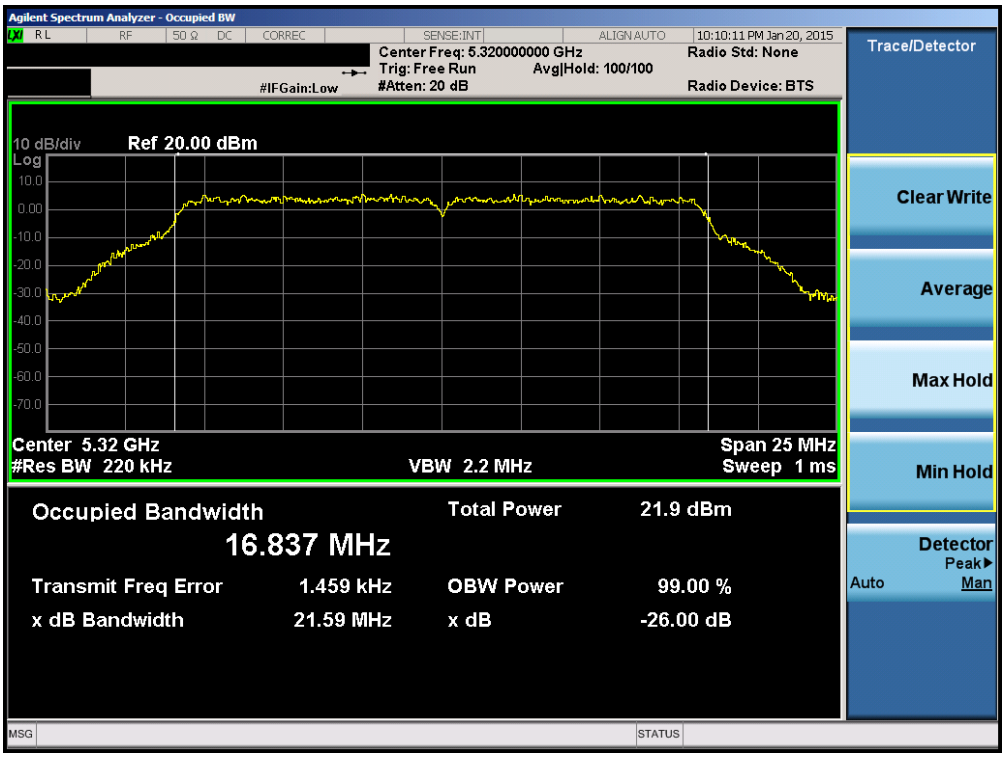



**Plot 6-11. 26dB Bandwidth Plot (802.11a (UNII Band 2A) – Ch. 56)**




**Plot 6-12. 26dB Bandwidth Plot (802.11a (UNII Band 2A) – Ch. 64)**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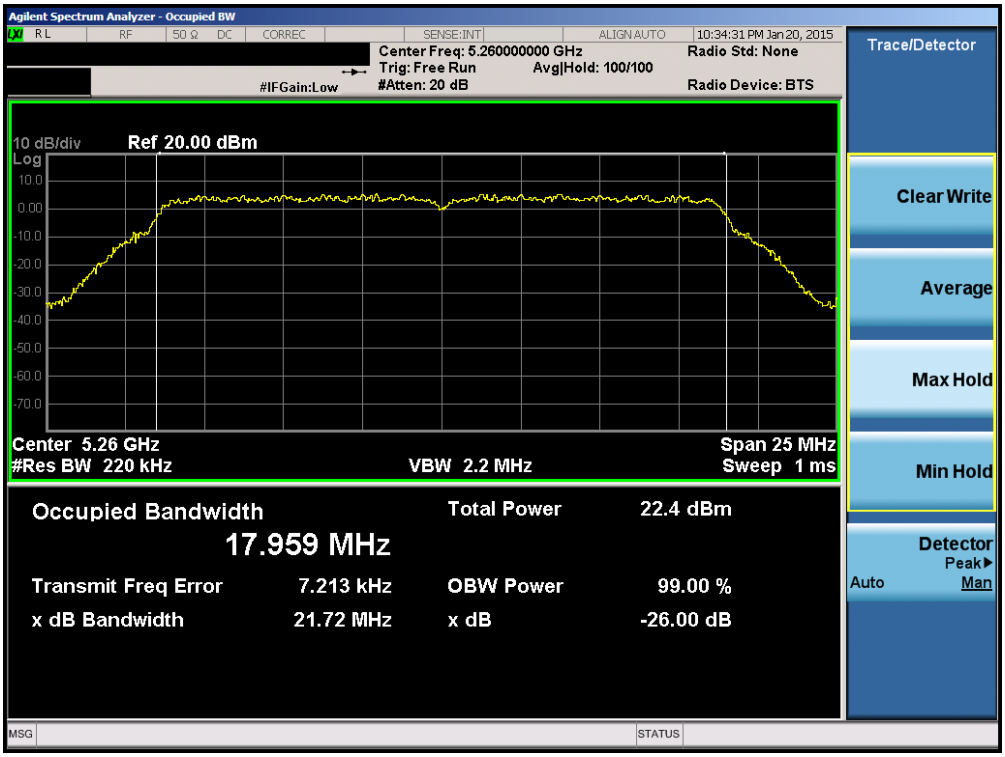
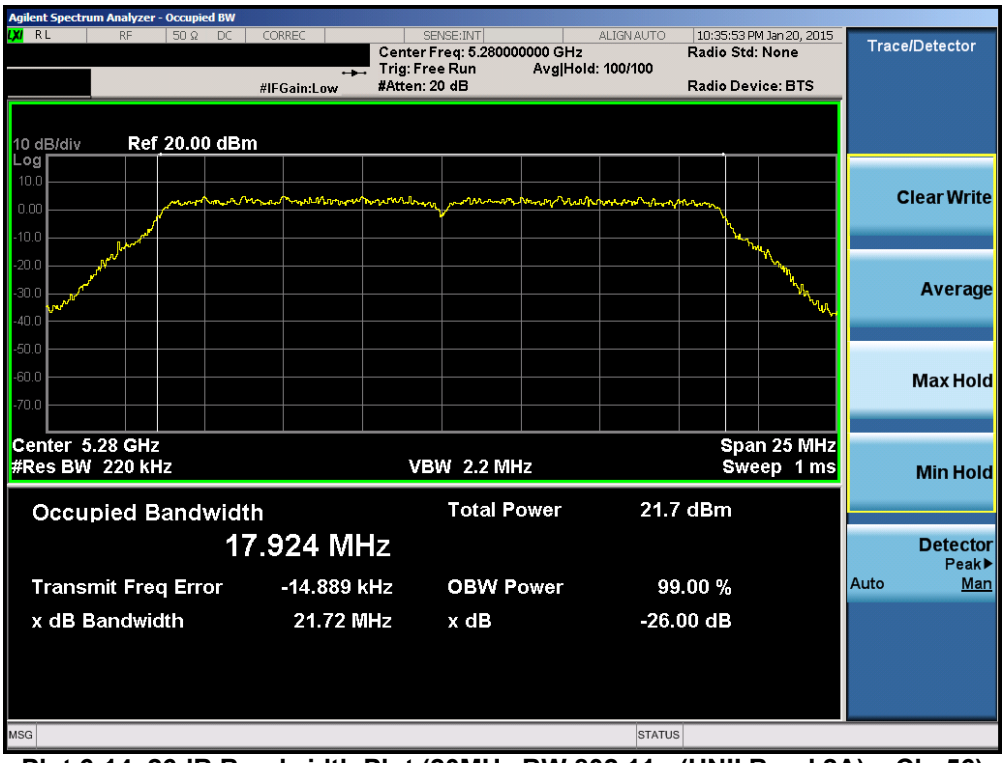



**Plot 6-13. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 52)**




**Plot 6-14. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)**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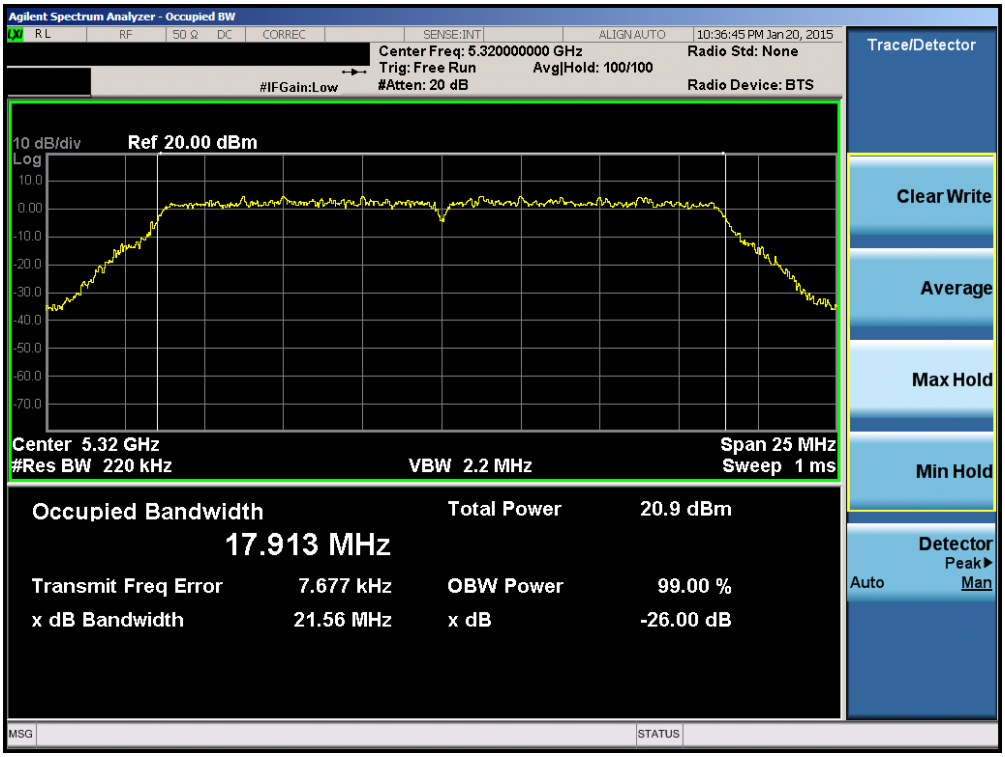
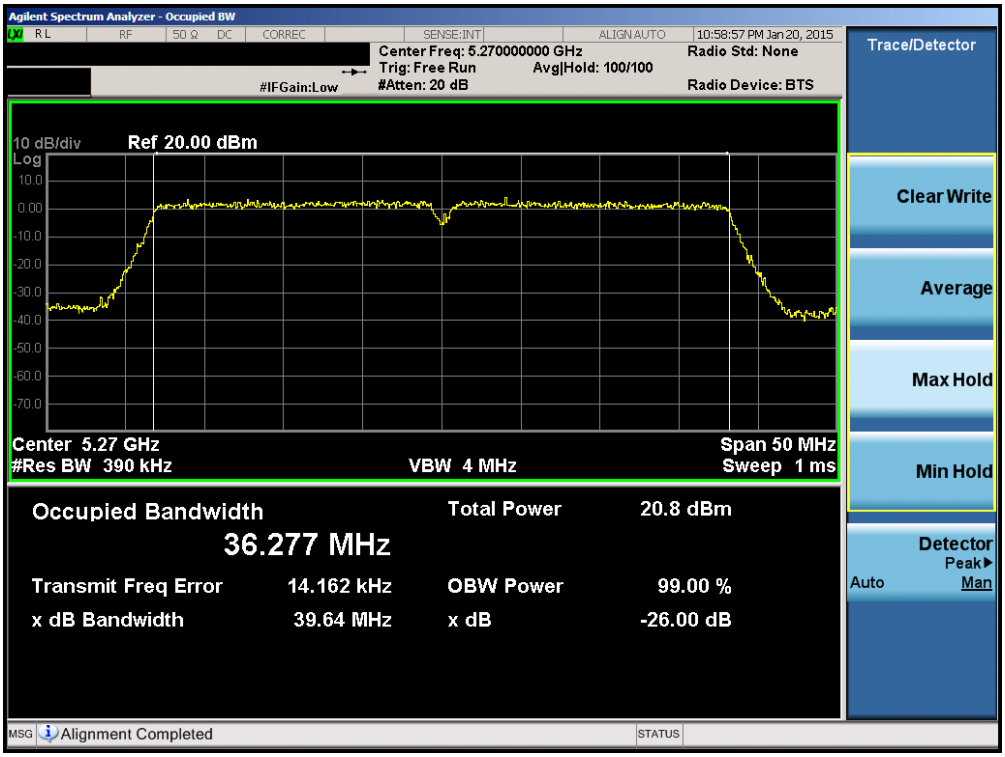



**Plot 6-15. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 64)**




**Plot 6-16. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 54)**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**Plot 6-17. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 62)**

**Plot 6-18. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 2A) – Ch. 58)**


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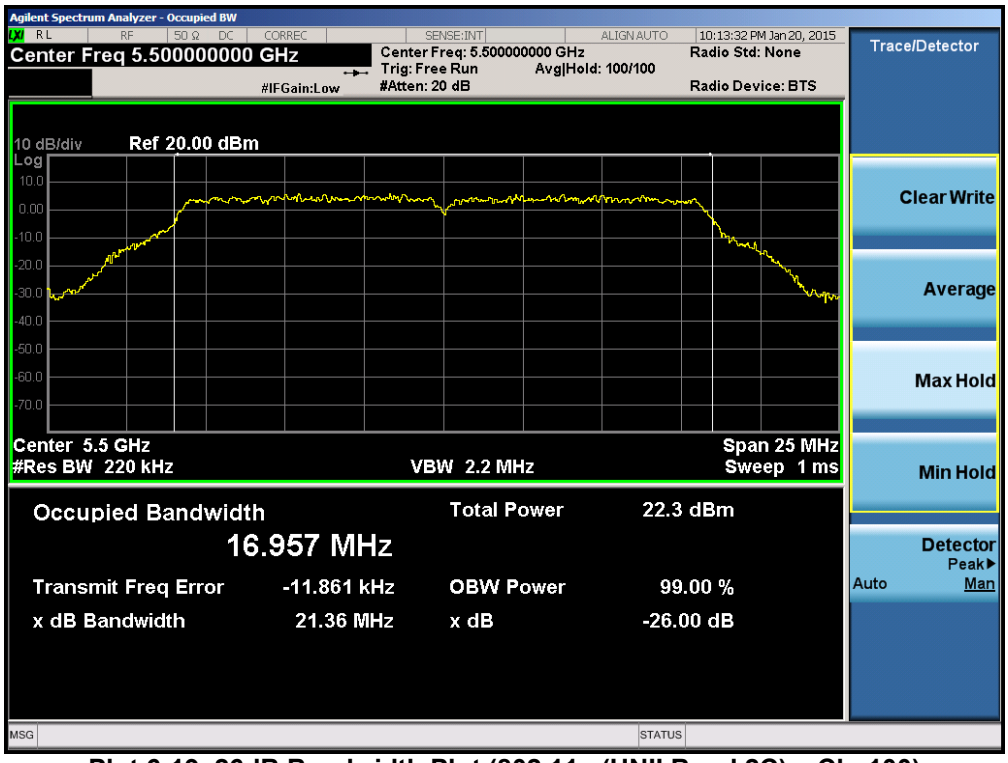
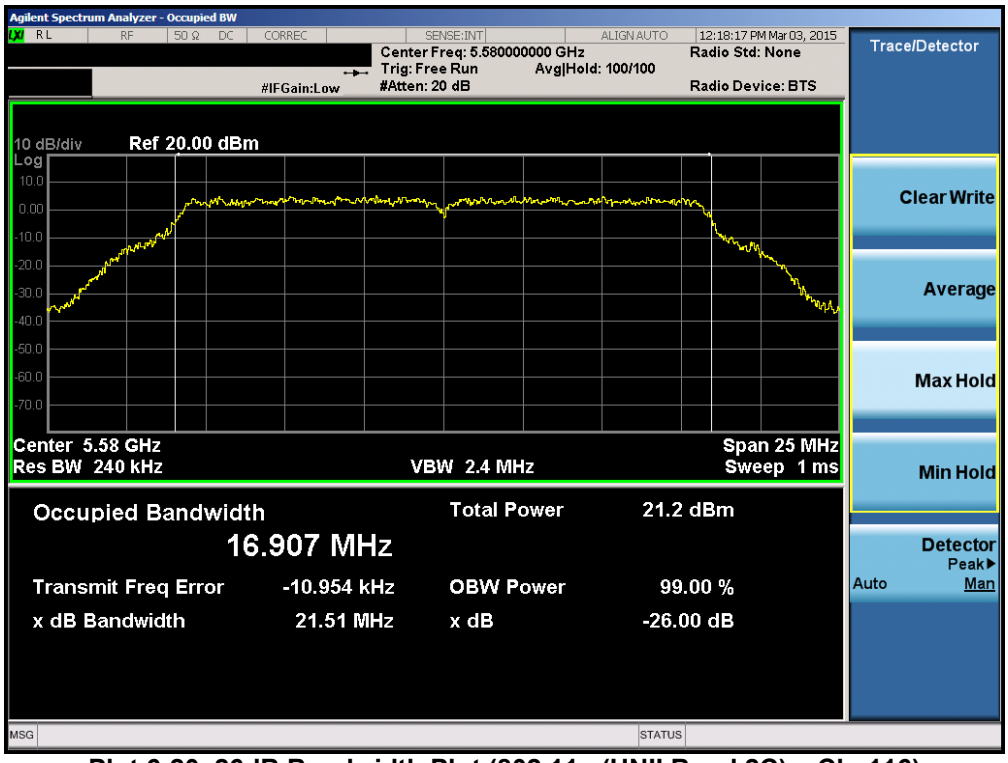



**Plot 6-19. 26dB Bandwidth Plot (802.11a (UNII Band 2C) – Ch. 100)**




**Plot 6-20. 26dB Bandwidth Plot (802.11a (UNII Band 2C) – Ch. 116)**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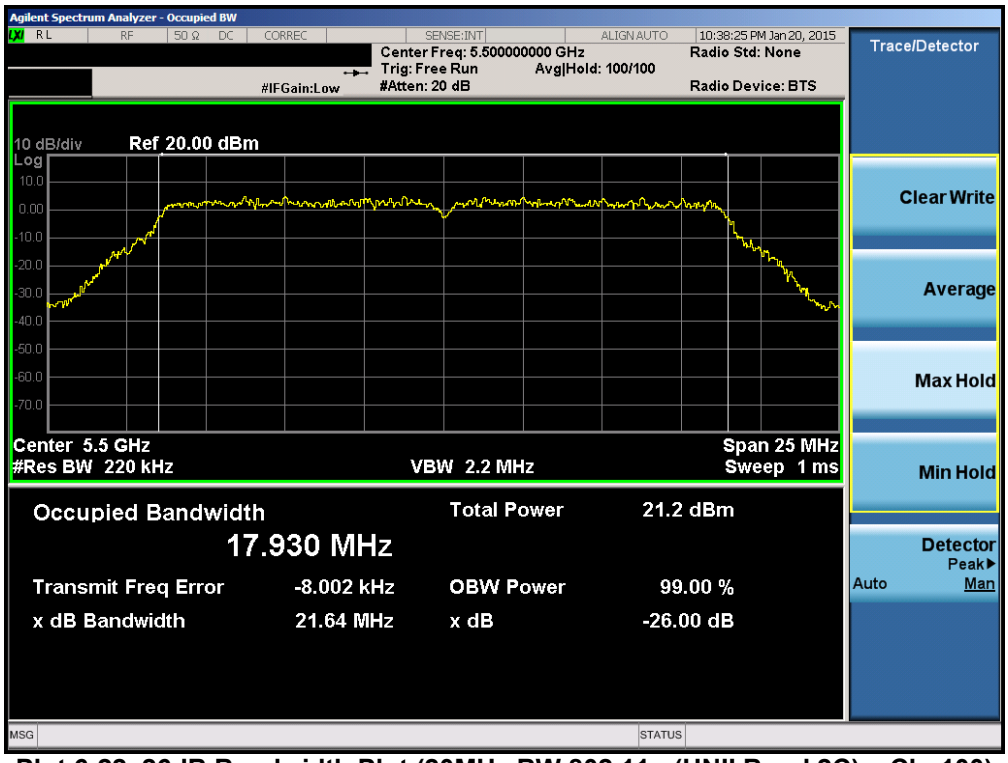
**Plot 6-21. 26dB Bandwidth Plot (20MHz BW 802.11a (UNII Band 2C) – Ch. 144)**




**Plot 6-22. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 100)**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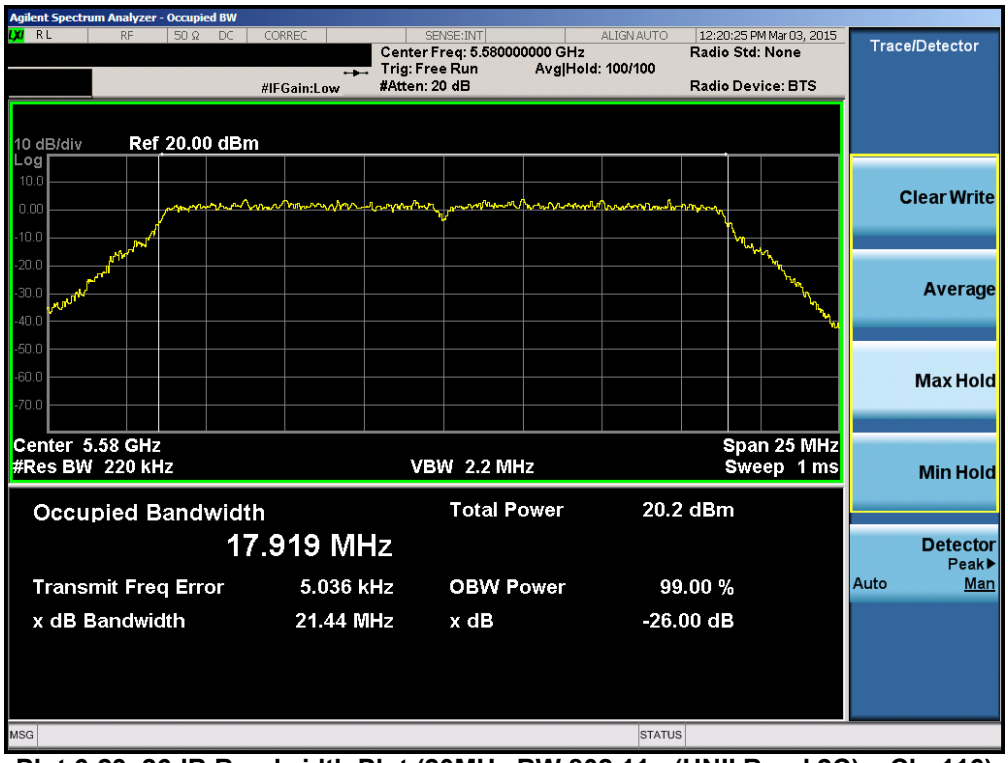
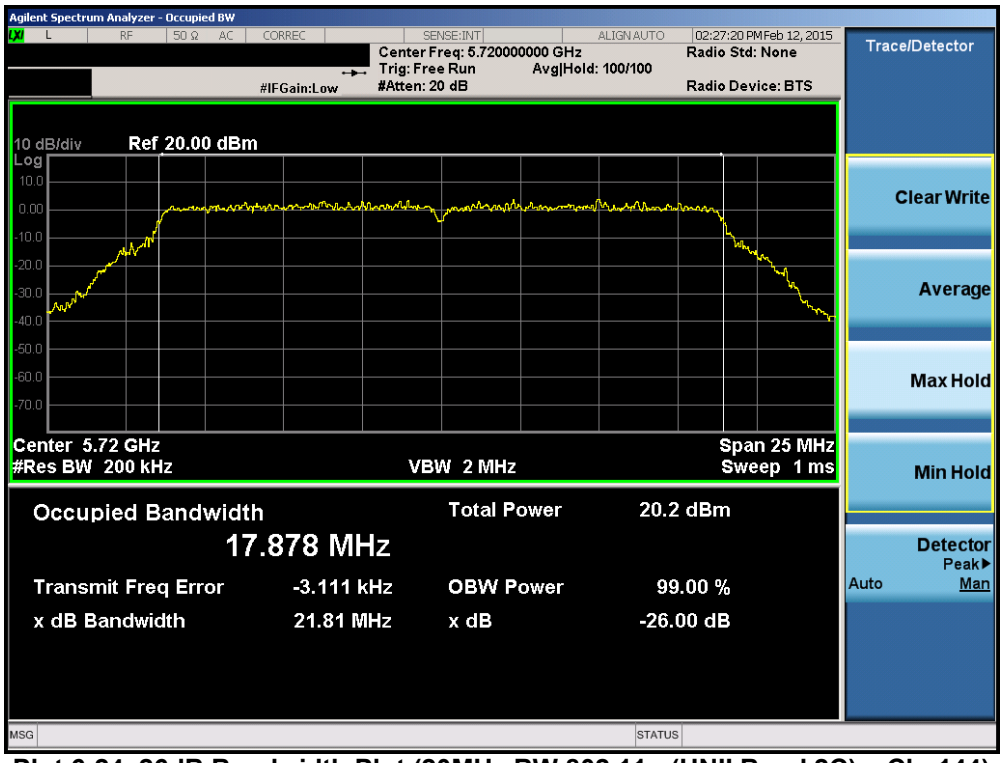



**Plot 6-23. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 116)**




**Plot 6-24. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 144)**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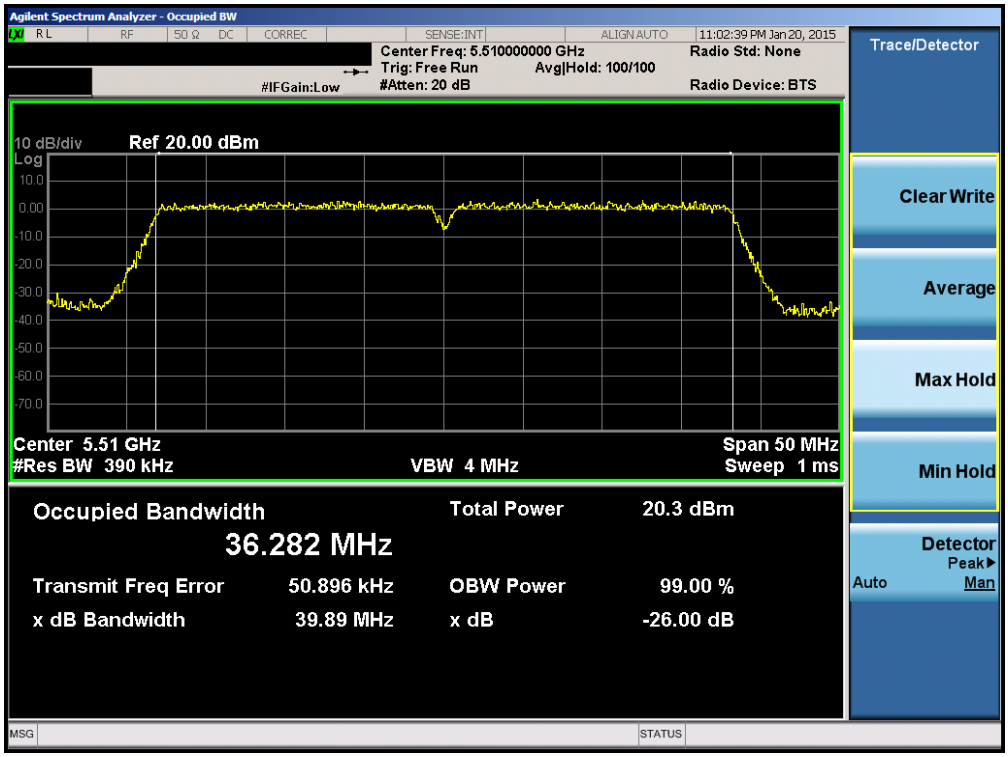
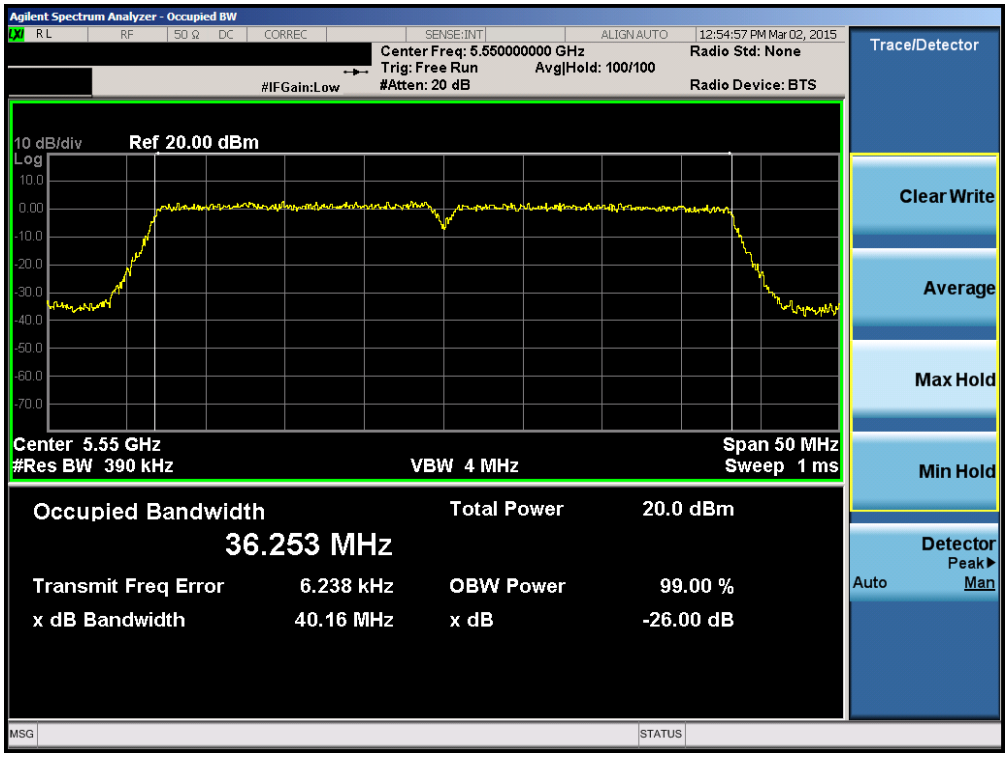



**Plot 6-25. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 102)**




**Plot 6-26. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 110)**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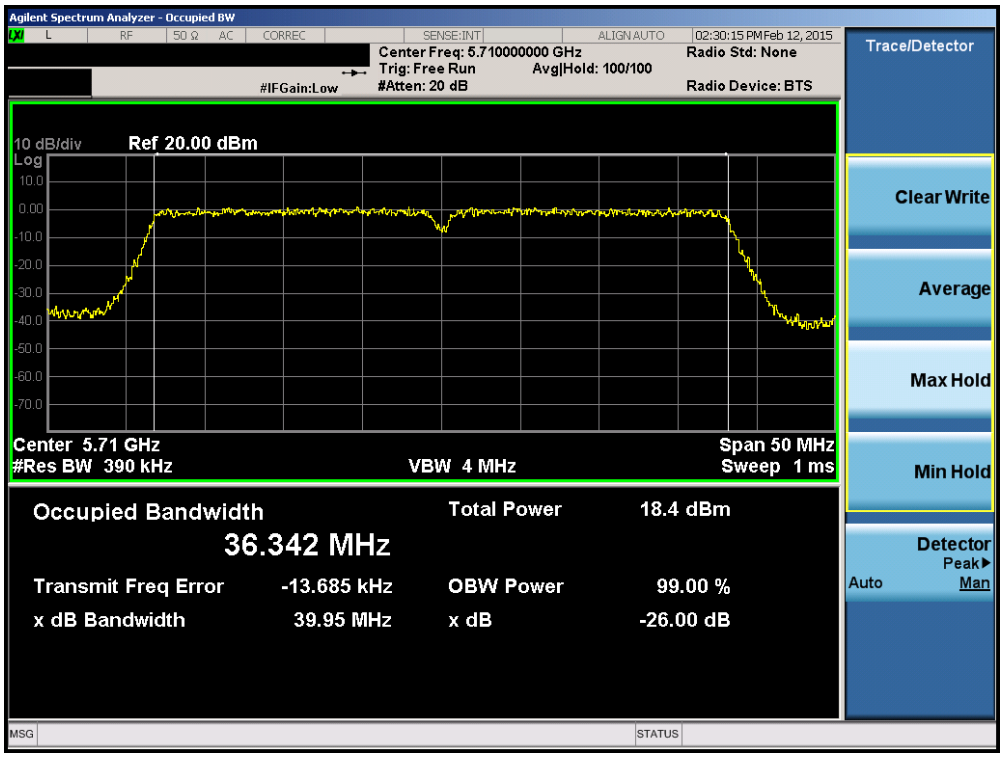
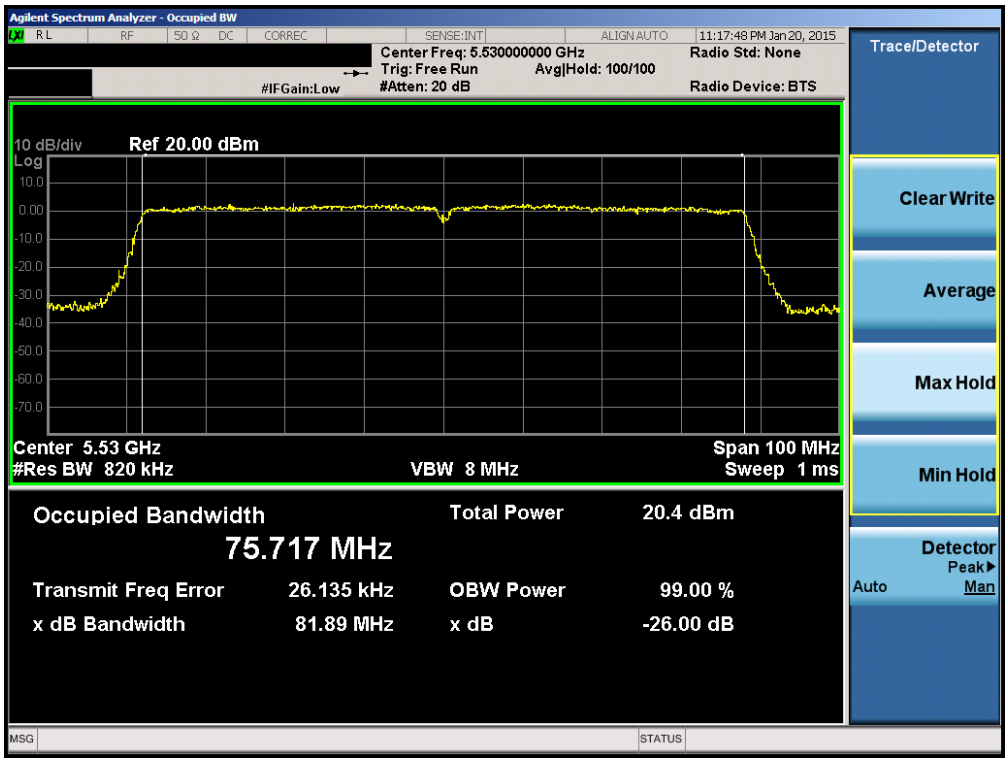



**Plot 6-27. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 142)**




**Plot 6-28. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 2C) – Ch. 106)**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**Plot 6-29. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 2C) – Ch. 138**


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## Antenna-2 26dB Bandwidth Measurements

| | Frequency [MHz] | Channel No. | 802.11 Mode | Data Rate [Mbps] | Measured 26dB Bandwidth [MHz] |
|---|---|---|---|---|---|
| Band 1 | 5180 | 36 | a | 6 | 21.58 |
| | 5200 | 40 | a | 6 | 21.35 |
| | 5240 | 48 | a | 6 | 21.32 |
| | 5180 | 36 | n (20MHz) | 6.5/7.2 (MCS0) | 21.79 |
| | 5200 | 40 | n (20MHz) | 6.5/7.2 (MCS0) | 21.90 |
| | 5240 | 48 | n (20MHz) | 6.5/7.2 (MCS0) | 21.43 |
| | 5190 | 38 | n (40MHz) | 13.5/15 (MCS0) | 40.04 |
| | 5230 | 46 | n (40MHz) | 13.5/15 (MCS0) | 40.03 |
| | 5210 | 42 | ac (80MHz) | 29.3/32.5 (MCS0) | 81.37 |
| Band 2A | 5260 | 52 | a | 6 | 21.35 |
| | 5280 | 56 | a | 6 | 21.74 |
| | 5320 | 64 | a | 6 | 21.64 |
| | 5260 | 52 | n (20MHz) | 6.5/7.2 (MCS0) | 21.64 |
| | 5280 | 56 | n (20MHz) | 6.5/7.2 (MCS0) | 21.87 |
| | 5320 | 64 | n (20MHz) | 6.5/7.2 (MCS0) | 21.90 |
| | 5270 | 54 | n (40MHz) | 13.5/15 (MCS0) | 39.87 |
| | 5310 | 62 | n (40MHz) | 13.5/15 (MCS0) | 40.13 |
| | 5290 | 58 | ac (80MHz) | 29.3/32.5 (MCS0) | 81.74 |
| Band 2C | 5500 | 100 | a | 6 | 21.58 |
| | 5580 | 116 | a | 6 | 21.57 |
| | 5720 | 144 | a | 6 | 21.36 |
| | 5500 | 100 | n (20MHz) | 6.5/7.2 (MCS0) | 21.86 |
| | 5580 | 116 | n (20MHz) | 6.5/7.2 (MCS0) | 21.62 |
| | 5720 | 144 | n (20MHz) | 6.5/7.2 (MCS0) | 21.59 |
| | 5510 | 102 | n (40MHz) | 13.5/15 (MCS0) | 40.28 |
| | 5550 | 110 | n (40MHz) | 13.5/15 (MCS0) | 39.96 |
| | 5710 | 142 | n (40MHz) | 13.5/15 (MCS0) | 39.87 |
| | 5530 | 106 | ac (80MHz) | 29.3/32.5 (MCS0) | 81.35 |
| | 5690 | 138 | ac (80MHz) | 29.3/32.5 (MCS0) | 80.89 |

**Table 6-3. Conducted Bandwidth Measurements**


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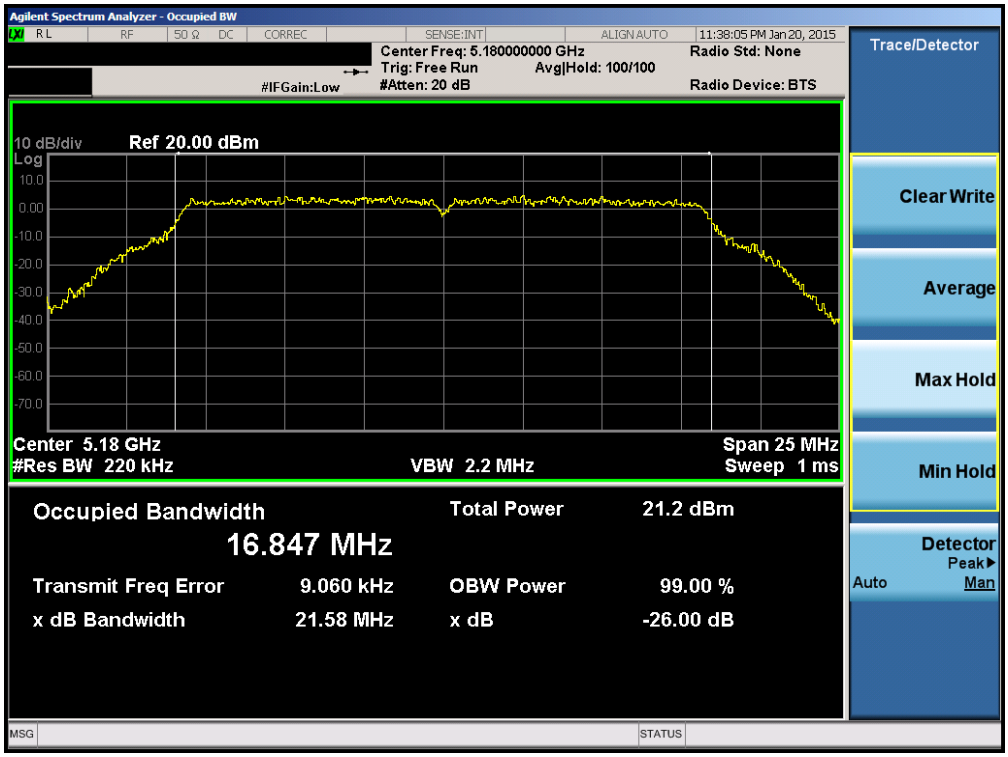
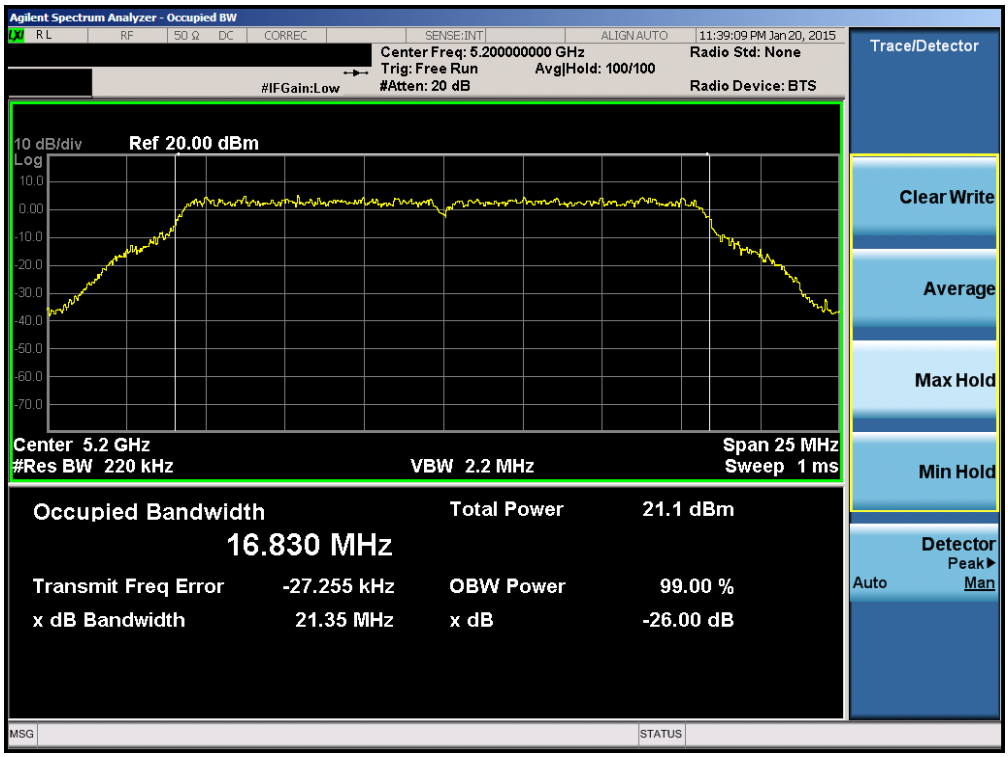



**Plot 6-30. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 36)**




**Plot 6-31. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 40)**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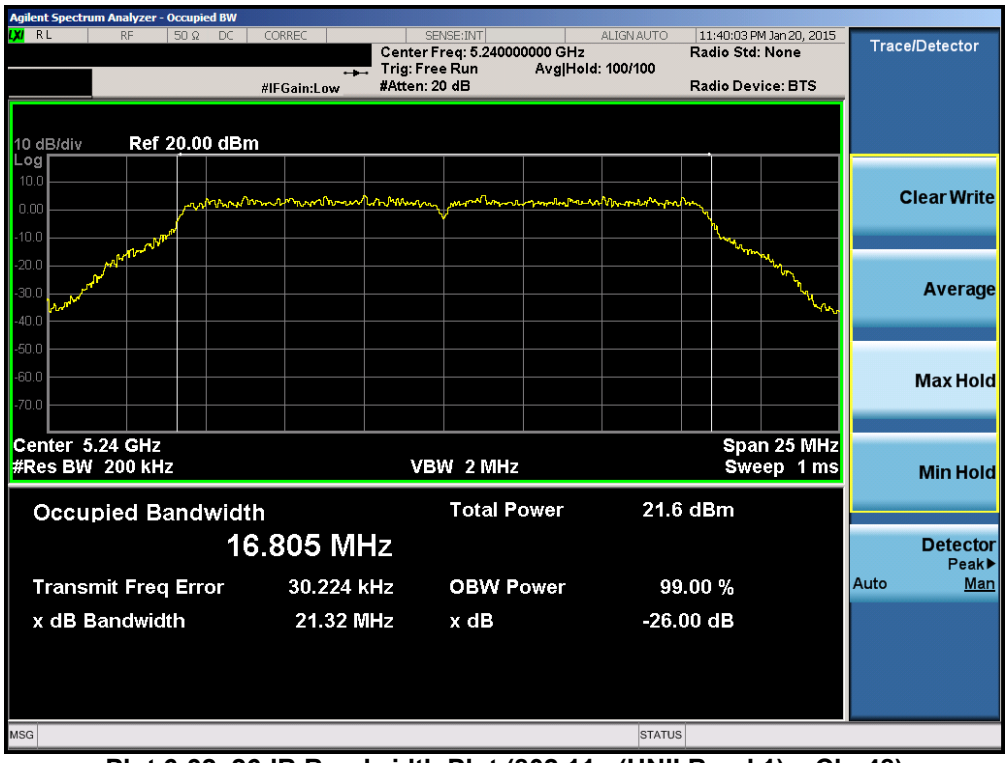


**Plot 6-32. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 48)**

**Plot 6-33. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 36)**


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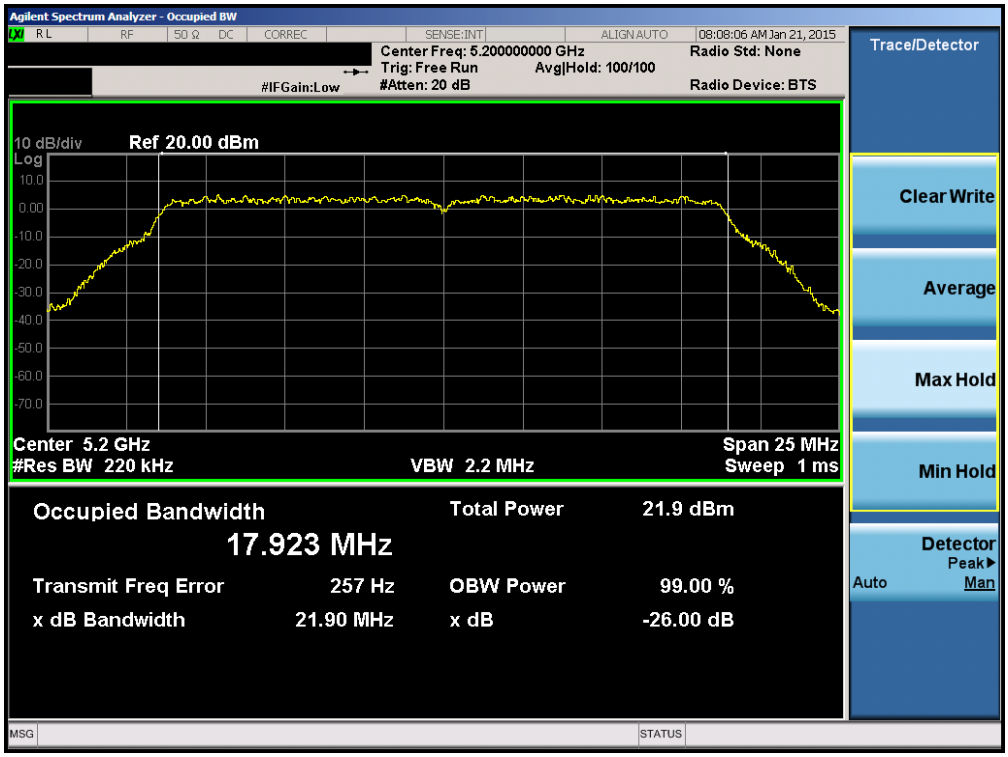
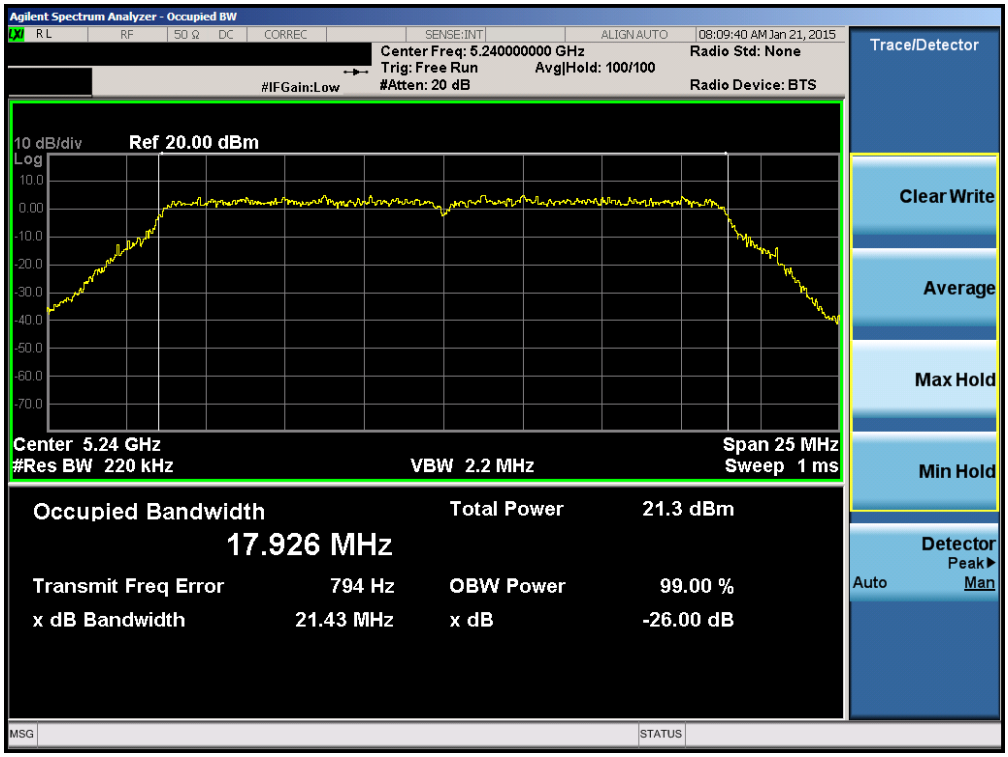



**Plot 6-34. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 40)**




**Plot 6-35. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 48)**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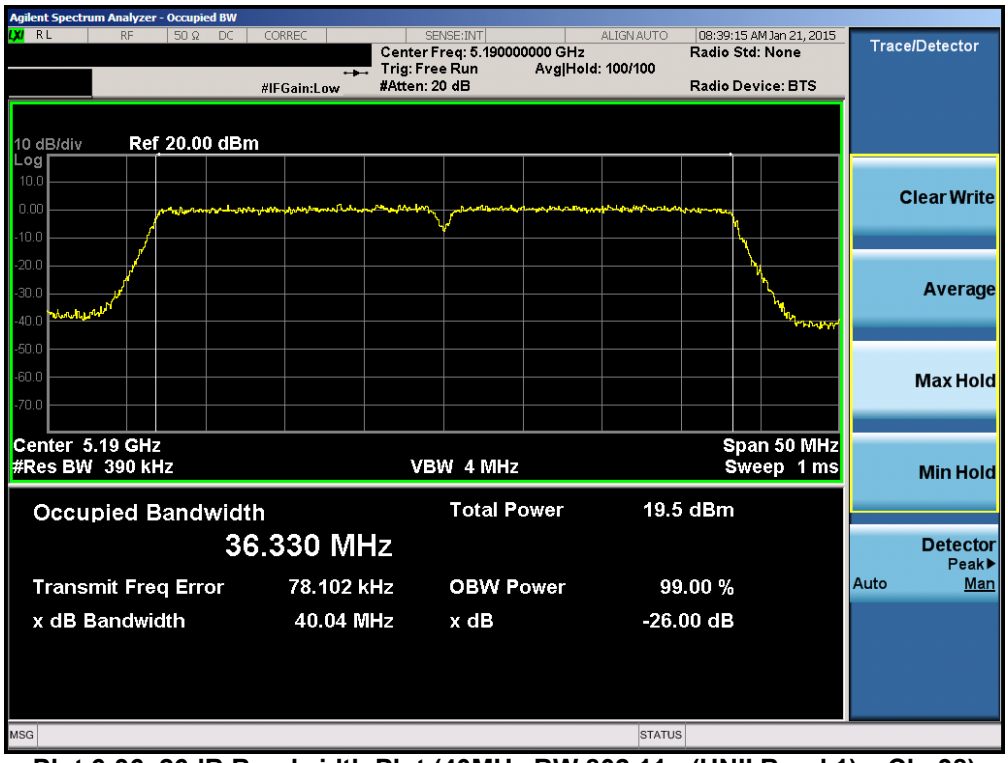
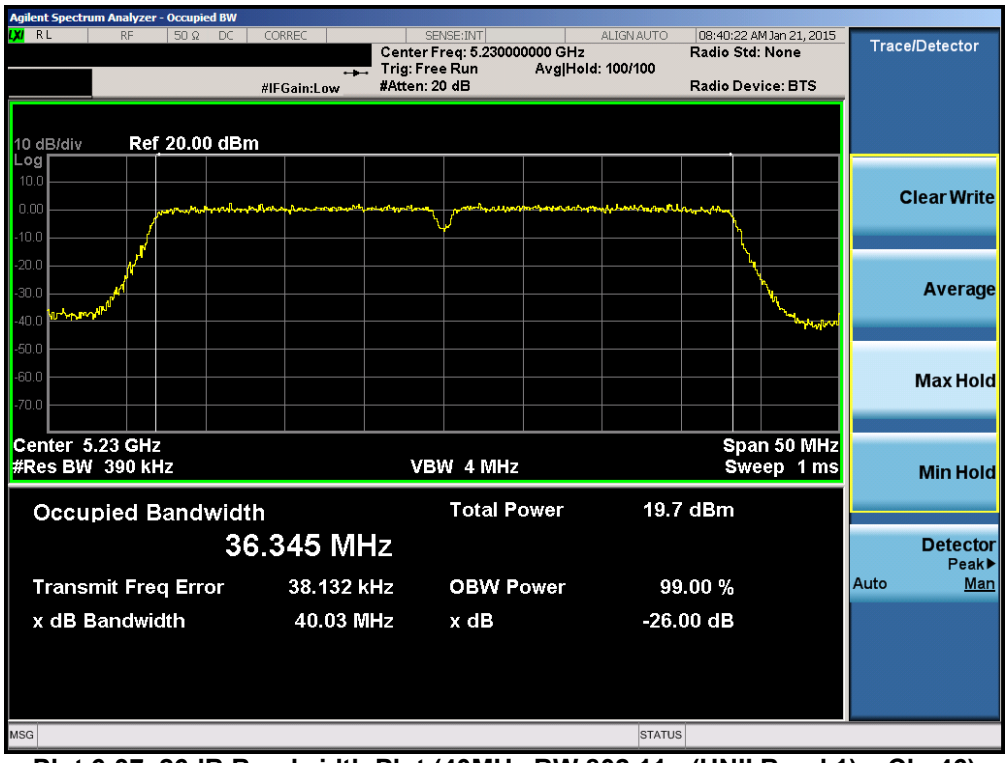



**Plot 6-36. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 38)**




**Plot 6-37. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 46)**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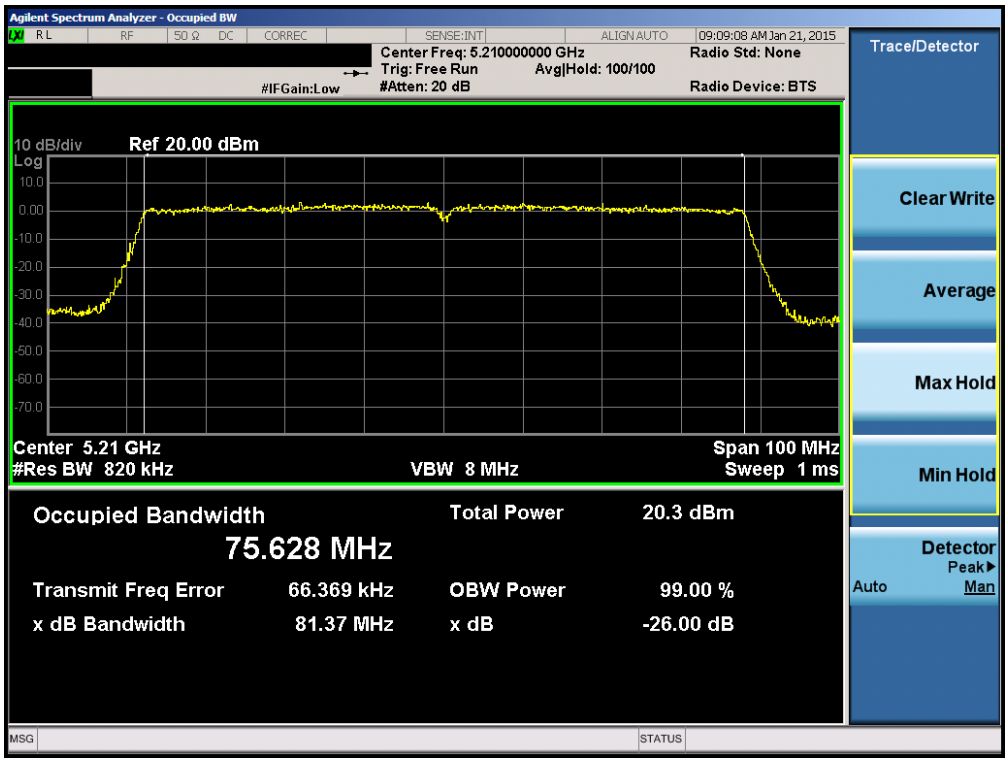
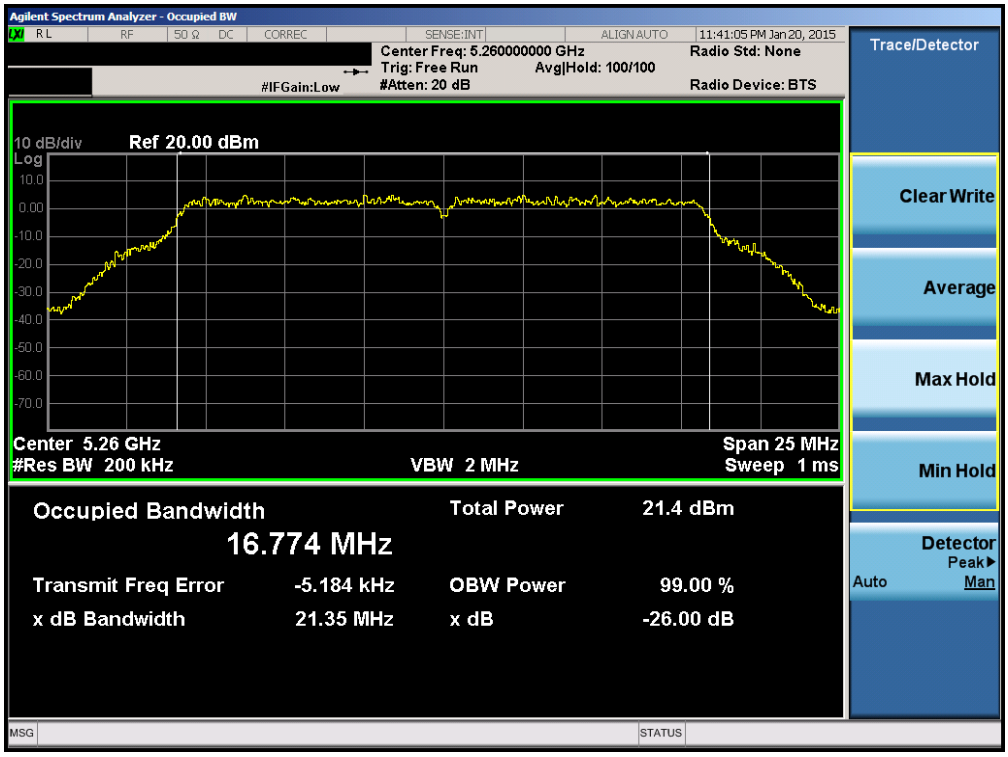



**Plot 6-38. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)**




**Plot 6-39. 26dB Bandwidth Plot (802.11a (UNII Band 2A) – Ch. 52)**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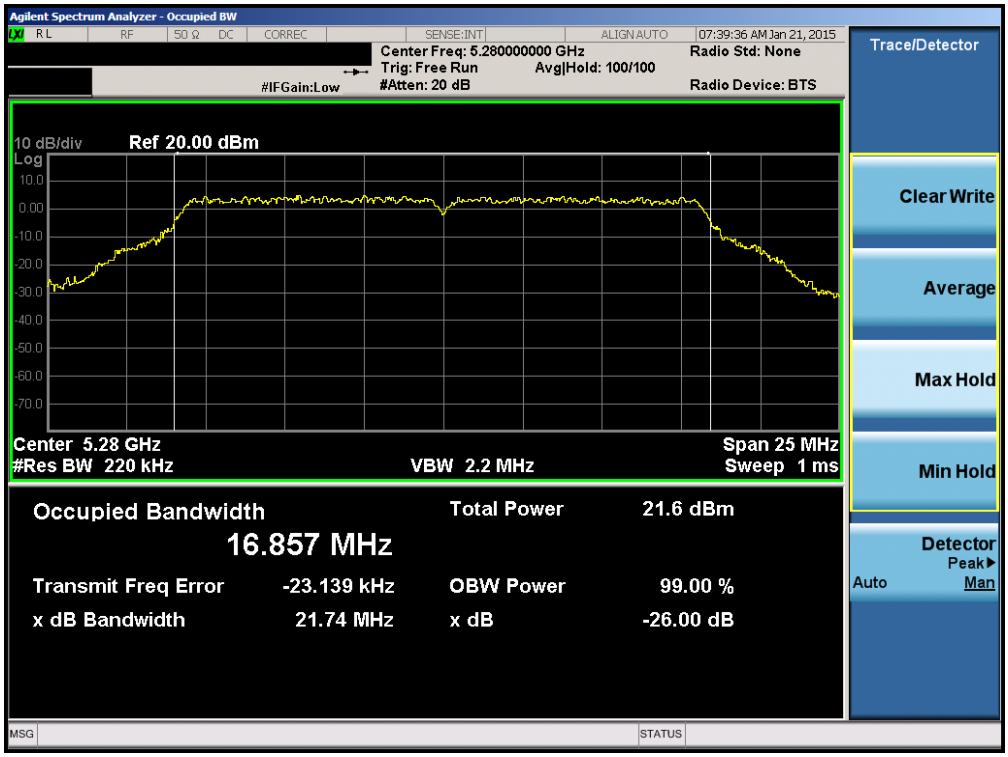
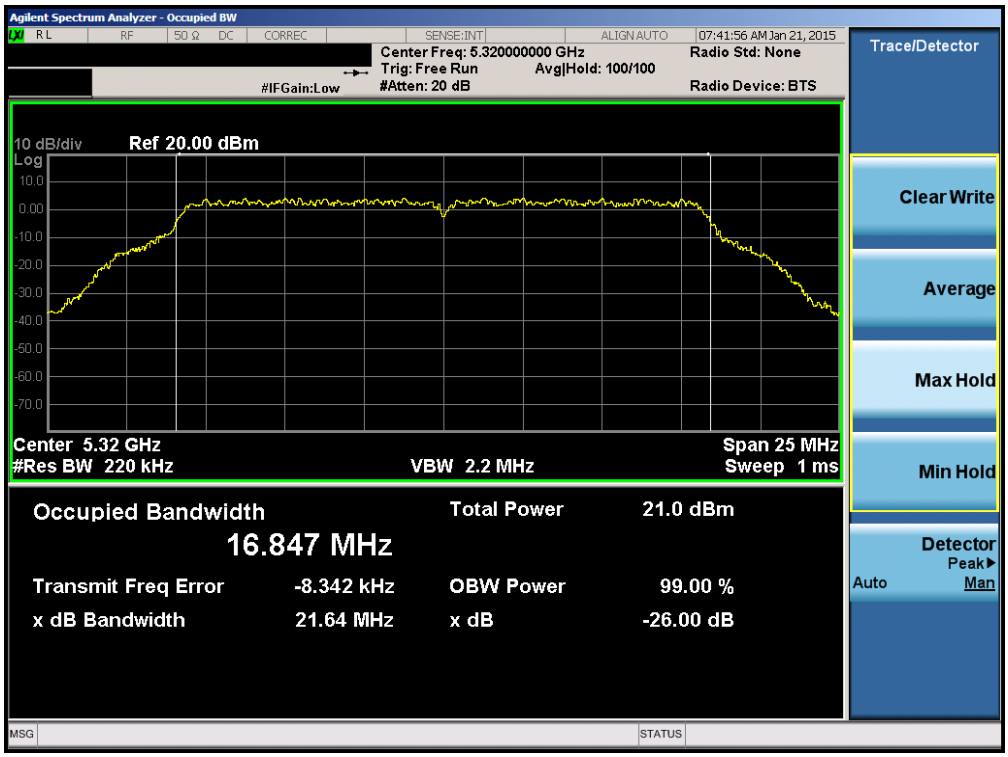



**Plot 6-40. 26dB Bandwidth Plot (802.11a (UNII Band 2A) – Ch. 56)**




**Plot 6-41. 26dB Bandwidth Plot (802.11a (UNII Band 2A) – Ch. 64)**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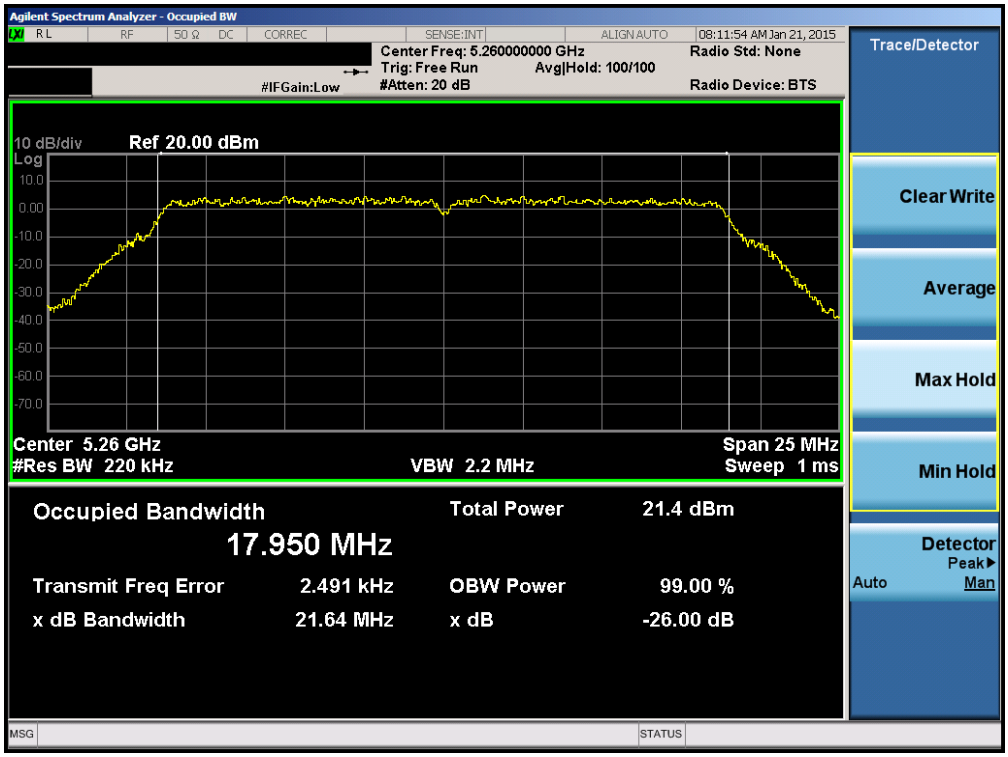
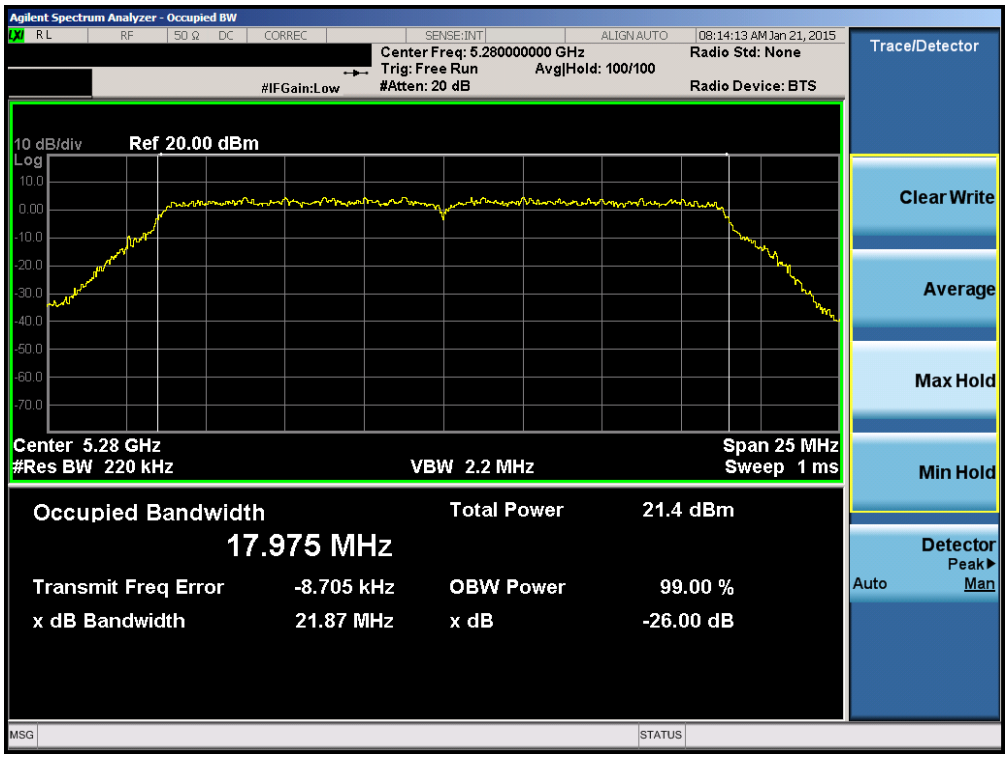



**Plot 6-42. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 52)**




**Plot 6-43. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)**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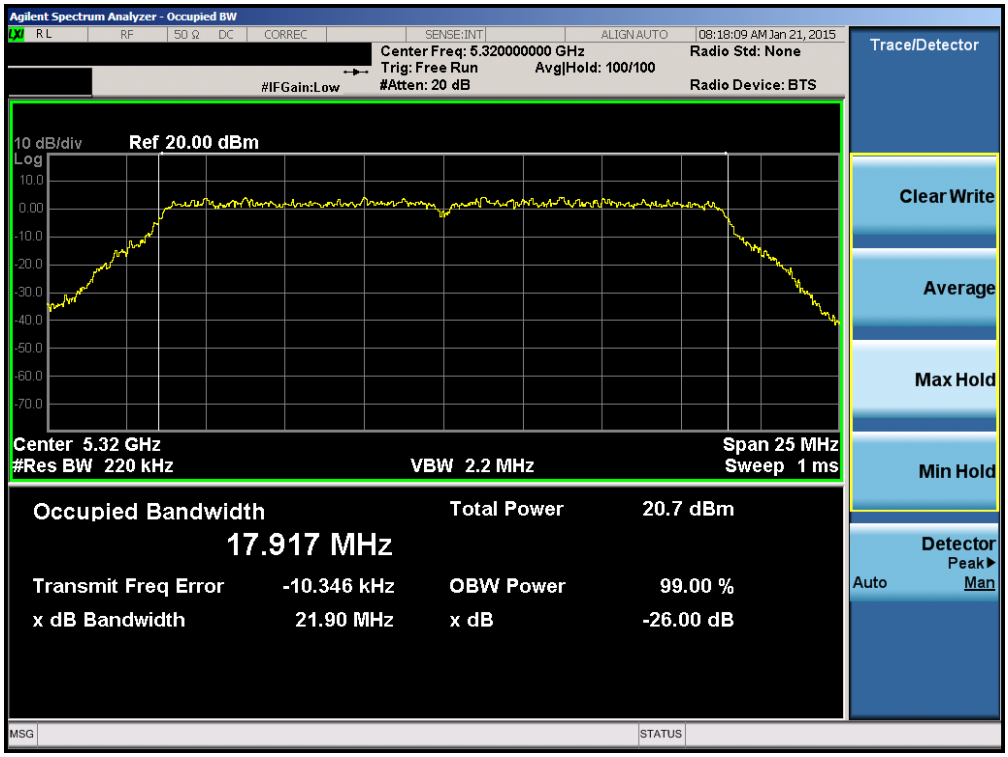
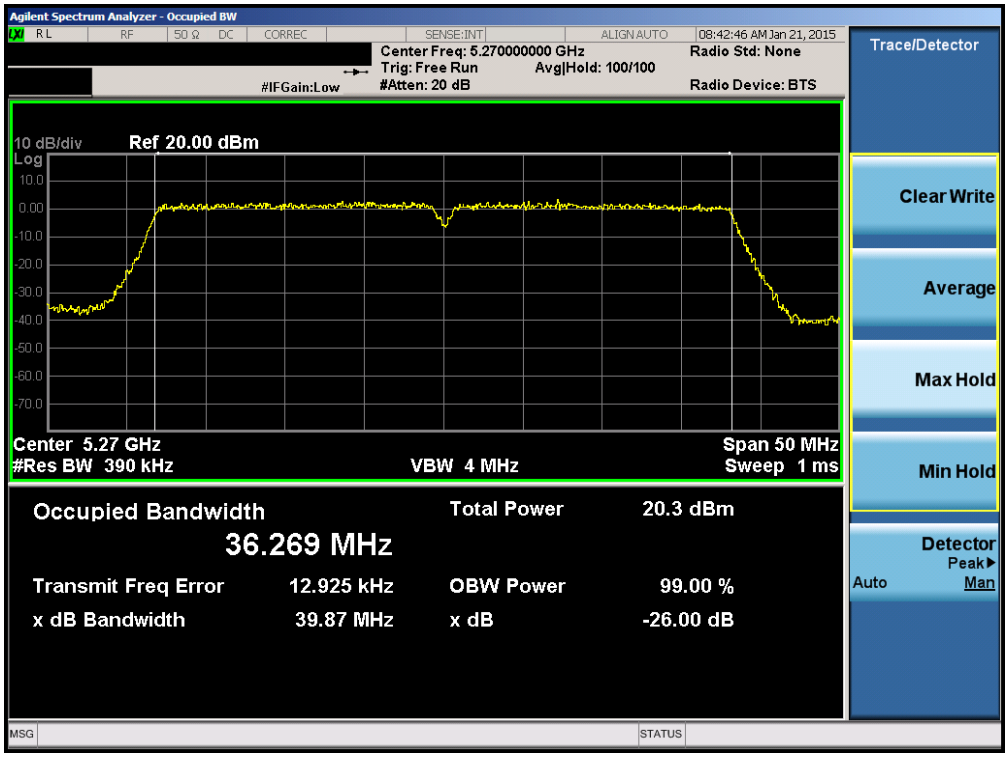



**Plot 6-44. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 64)**




**Plot 6-45. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 54)**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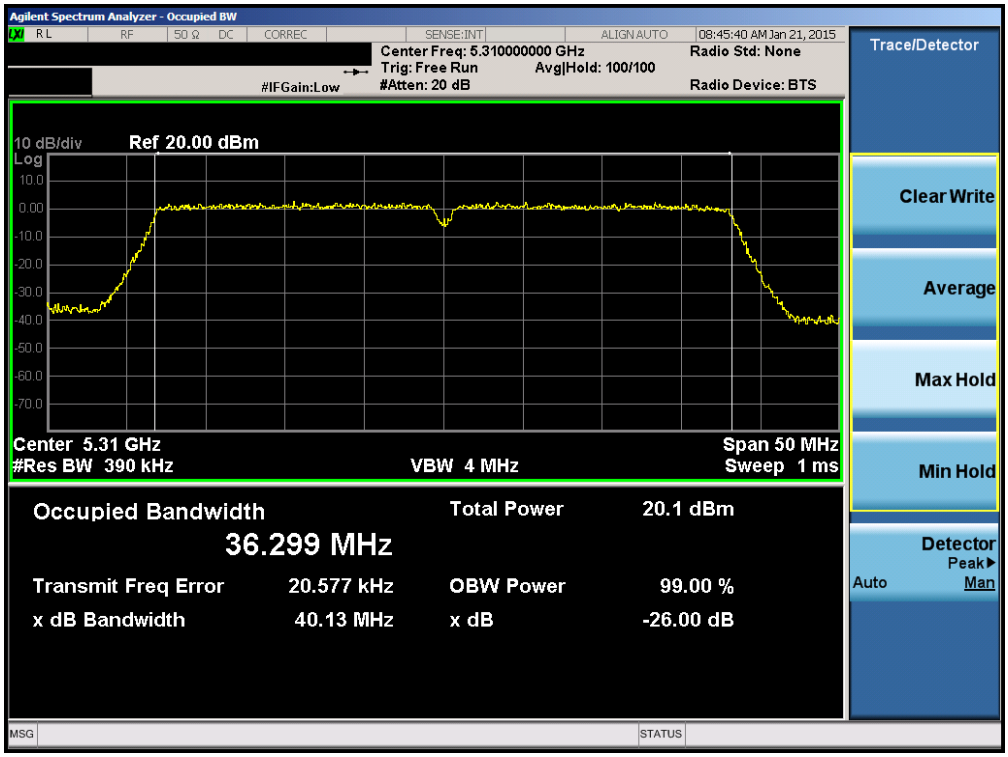
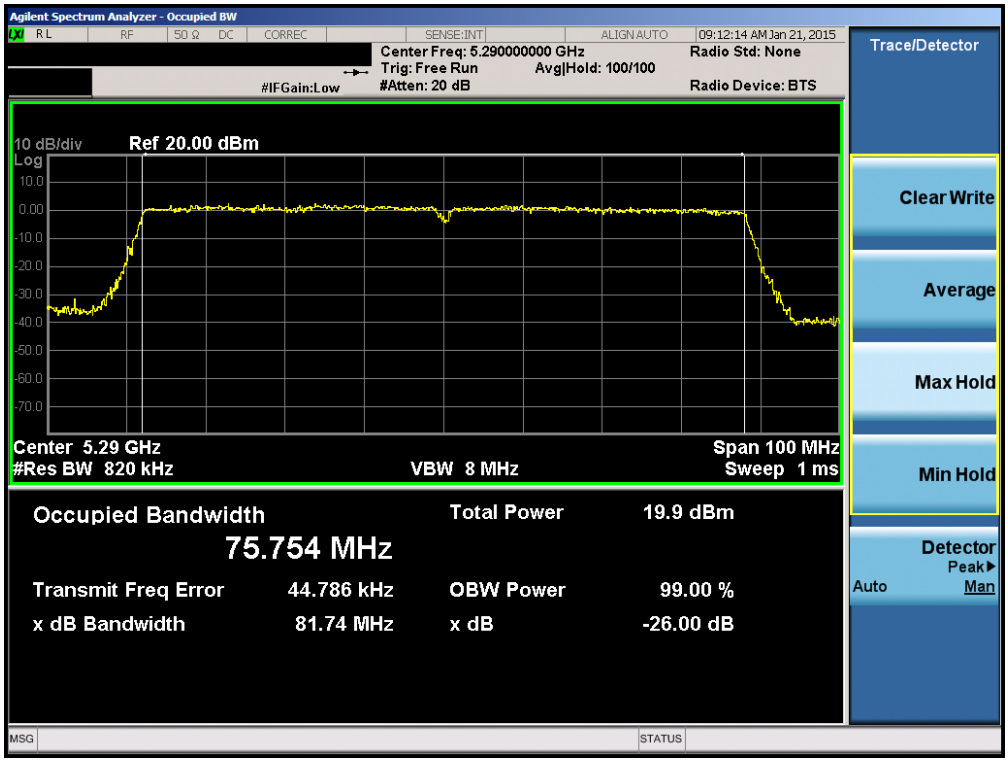



**Plot 6-46. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 62)**




**Plot 6-47. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 2A) – Ch. 58)**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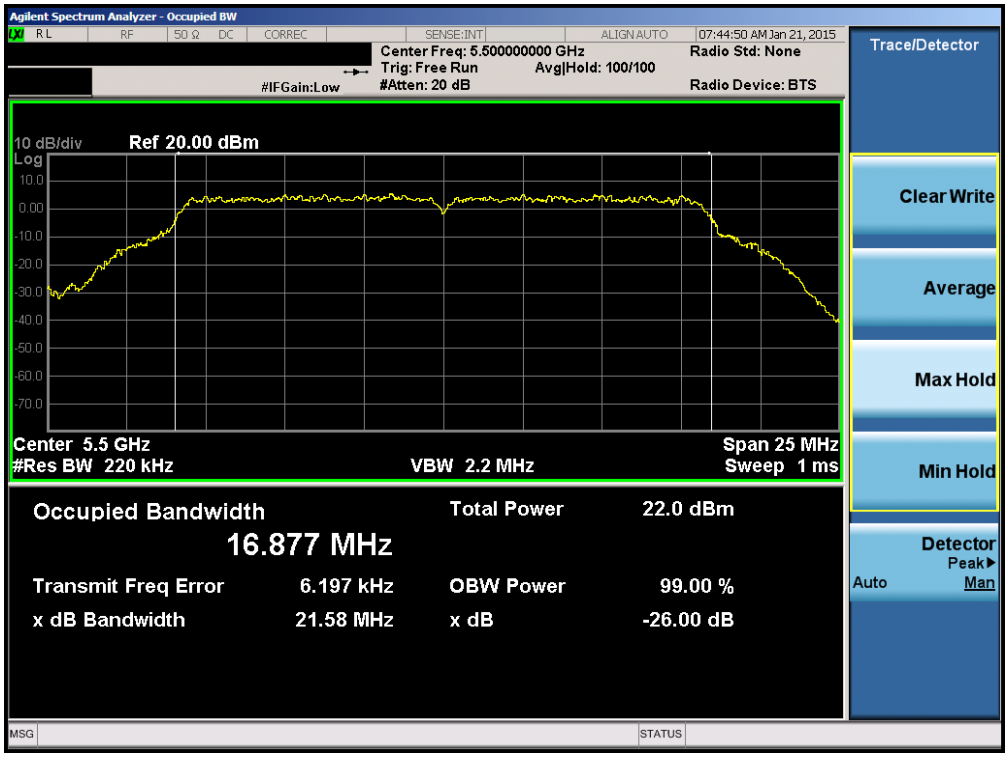
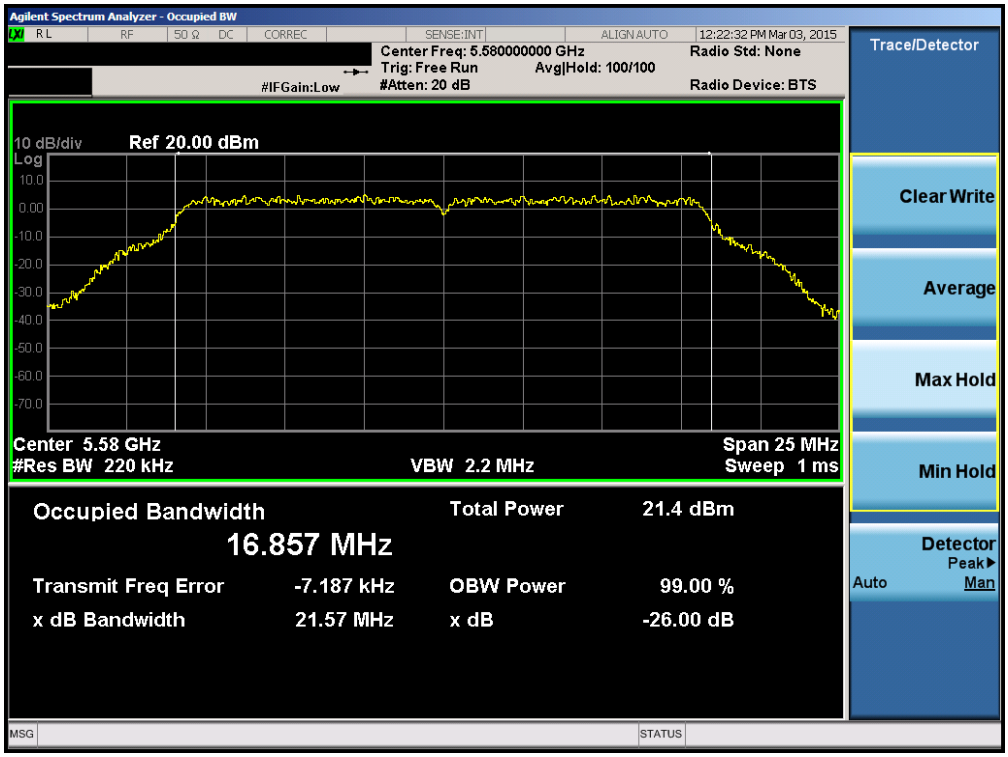



**Plot 6-48. 26dB Bandwidth Plot (802.11a (UNII Band 2C) – Ch. 100)**




**Plot 6-49. 26dB Bandwidth Plot (802.11a (UNII Band 2C) – Ch. 116)**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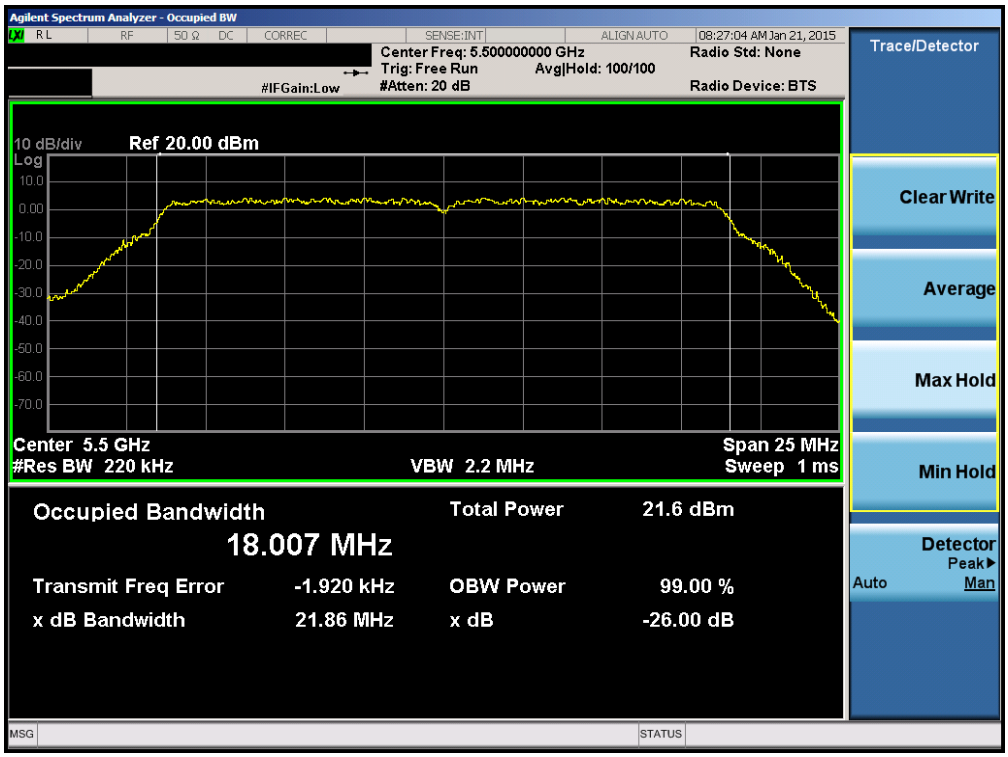
**Plot 6-50. 26dB Bandwidth Plot (20MHz BW 802.11a (UNII Band 2C) – Ch. 144)**




**Plot 6-51. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 100)**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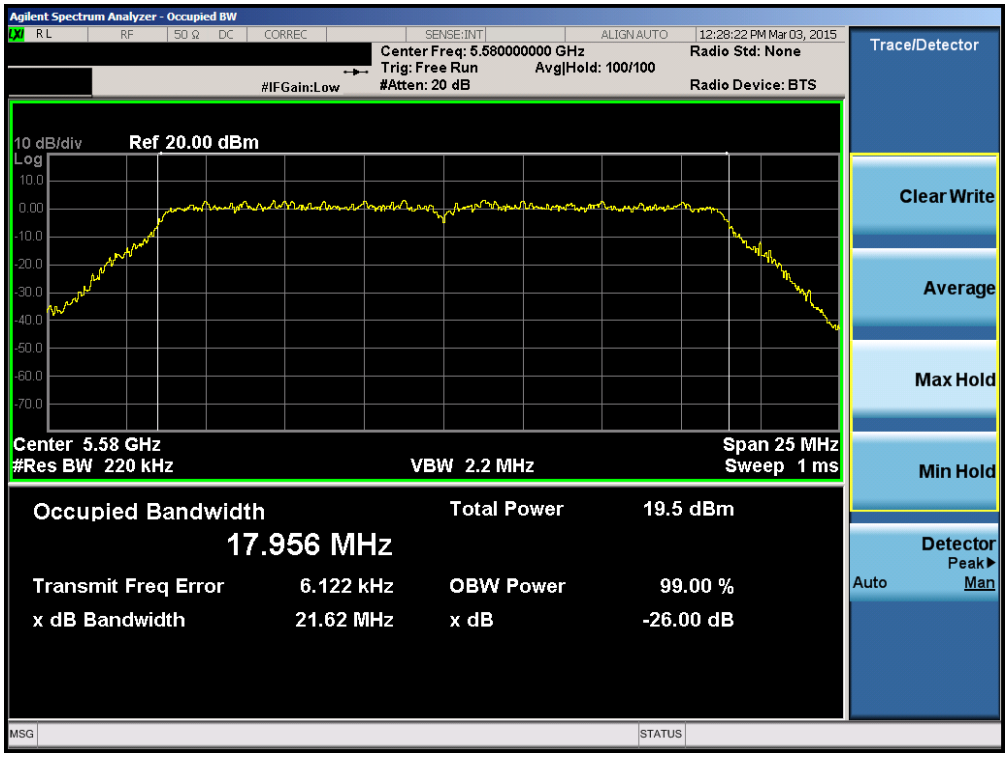


**Plot 6-52. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 116)**

**Plot 6-53. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 144)**


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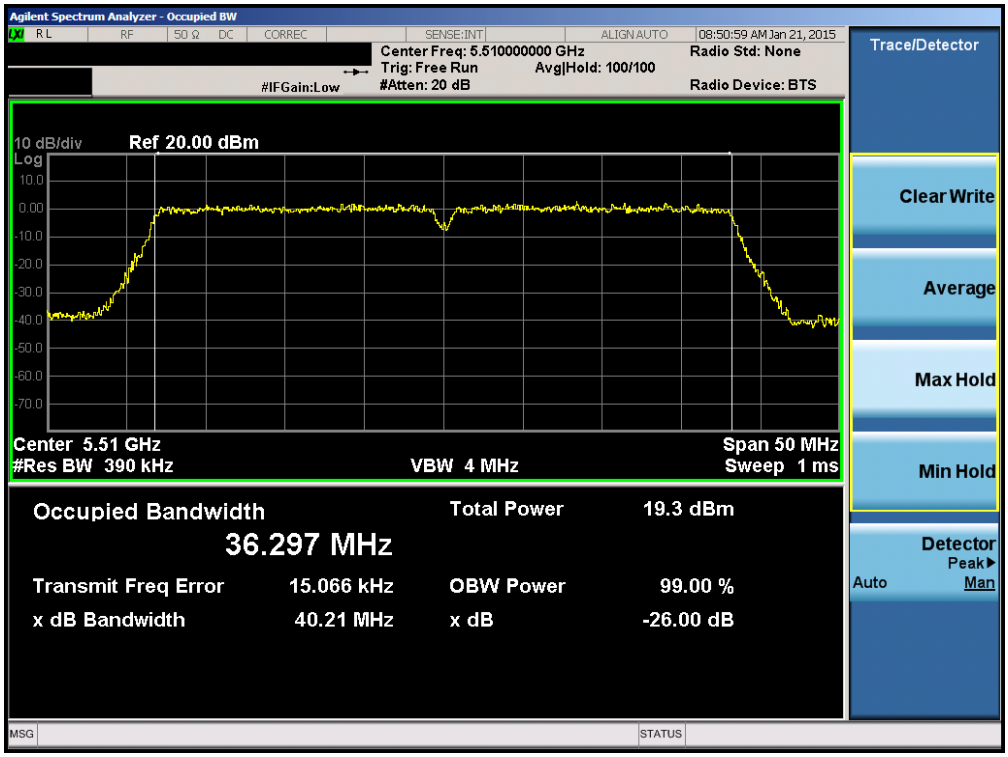
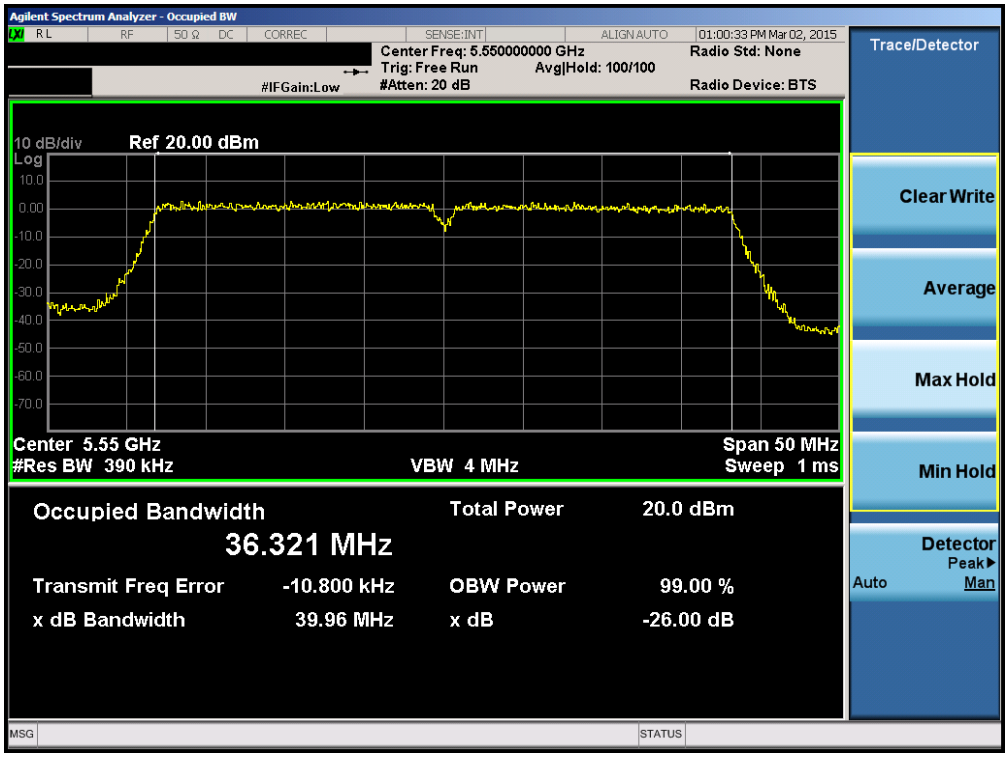



**Plot 6-54. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 102)**




**Plot 6-55. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 110)**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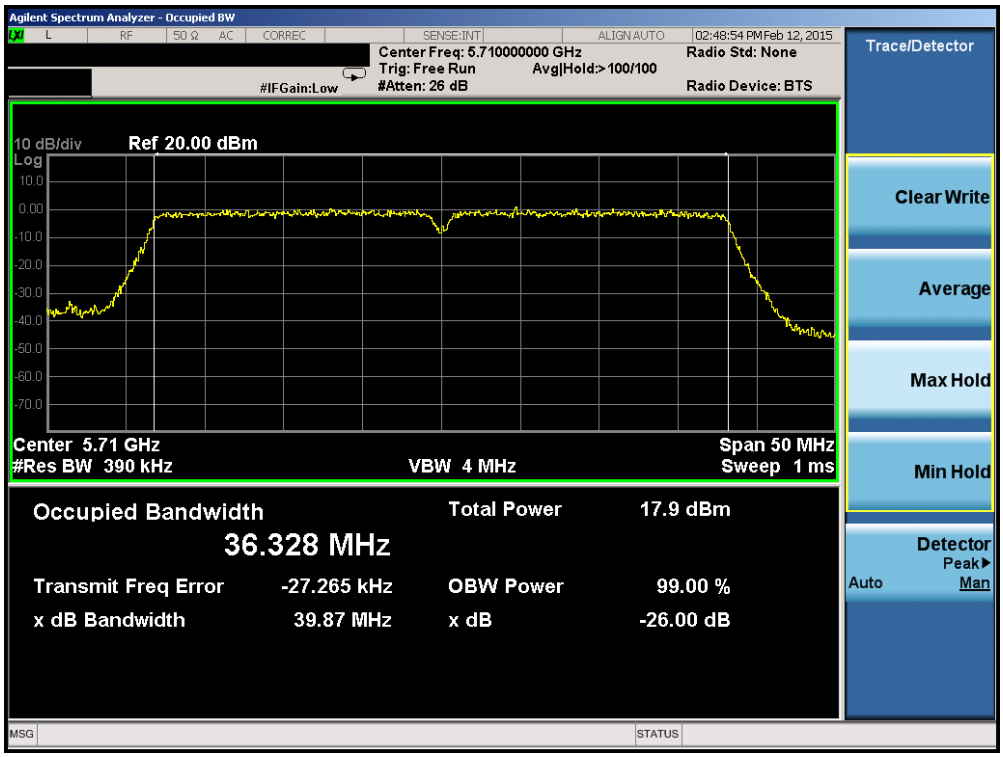
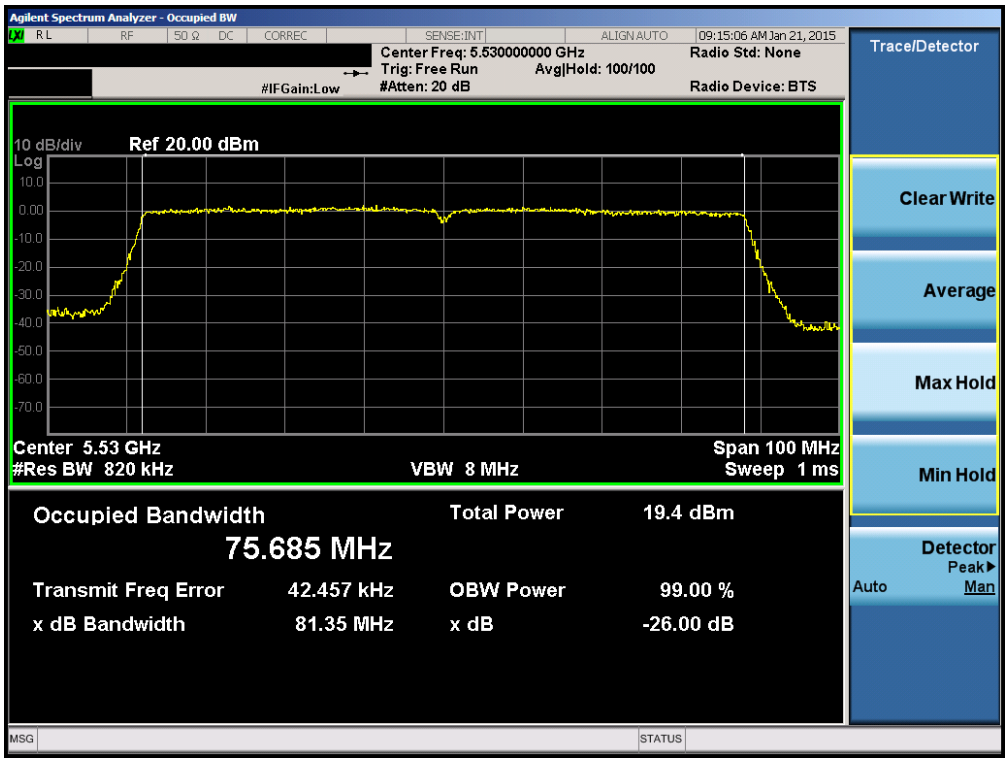



**Plot 6-56. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 142)**




**Plot 6-57. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 2C) – Ch. 106)**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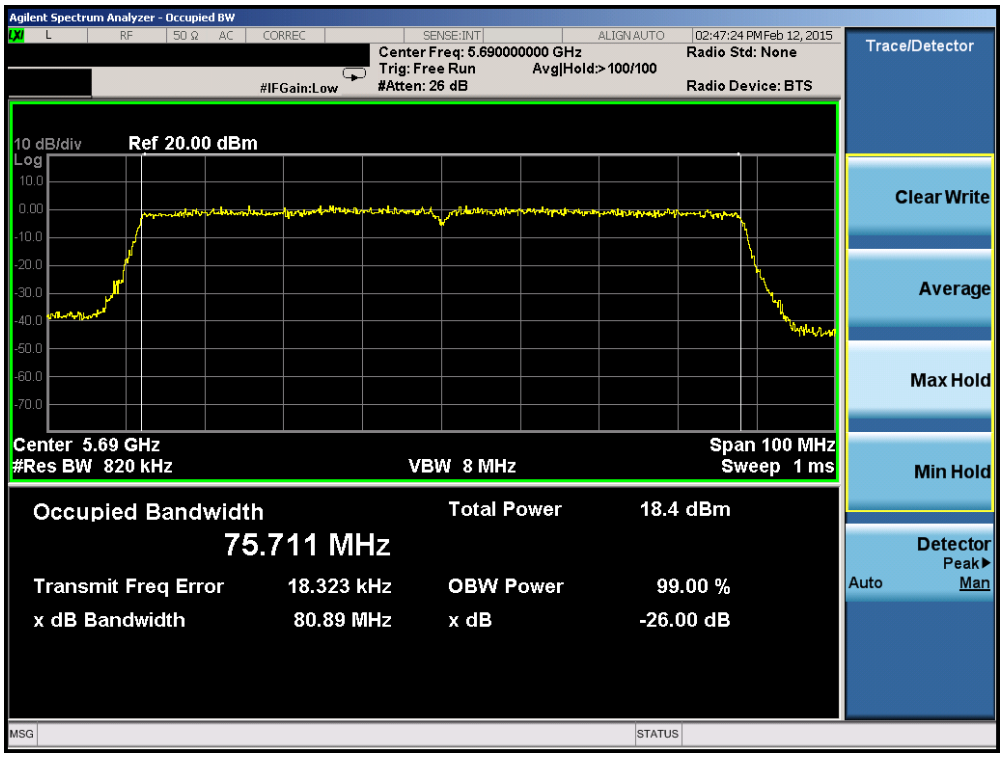


**Plot 6-58. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 2C) – Ch. 138)**


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## 6.3 6dB Bandwidth Measurement – 802.11a/n/ac

**§15.407(e)**

**Test Overview and Limit**

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating at its maximum power control level, as defined in KDB 789033 D02 v01, and at the appropriate frequencies. The spectrum analyzer's bandwidth measurement function is configured to measure the 6dB bandwidth.

***In the 5.725 – 5.850GHz band, the 6dB bandwidth must be ≥ 500 kHz.***

**Test Procedure Used**

KDB 789033 D02 v01 – Section C

**Test Settings**

1. The signal analyzers' automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The automatic bandwidth measurement function also has the capability of simultaneously measuring the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 100 kHz
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple

**Test Setup**

The EUT and measurement equipment were set up as shown in the diagram below.

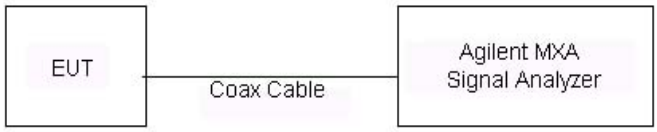


**Figure 6-2. Test Instrument & Measurement Setup**

**Test Notes**

None.


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## Antenna-1 6 dB Bandwidth Measurements

| | Frequency [MHz] | Channel No. | 802.11 Mode | Data Rate [Mbps] | Measured 6dB Bandwidth [MHz] |
|---|---|---|---|---|---|
| Band 3 | 5745 | 149 | a | 6 | 16.38 |
| | 5785 | 157 | a | 6 | 16.39 |
| | 5825 | 165 | a | 6 | 16.37 |
| | 5745 | 149 | n (20MHz) | 6.5/7.2 (MCS0) | 17.60 |
| | 5785 | 157 | n (20MHz) | 6.5/7.2 (MCS0) | 17.60 |
| | 5825 | 165 | n (20MHz) | 6.5/7.2 (MCS0) | 17.61 |
| | 5755 | 151 | n (40MHz) | 13.5/15 (MCS0) | 36.34 |
| | 5795 | 159 | n (40MHz) | 13.5/15 (MCS0) | 36.35 |
| | 5775 | 155 | ac (80MHz) | 29.3/32.5 (MCS0) | 75.28 |

**Table 6-4. Conducted Bandwidth Measurements**

**Plot 6-59. 6dB Bandwidth Plot (802.11a (UNII Band 3) – Ch. 149)**


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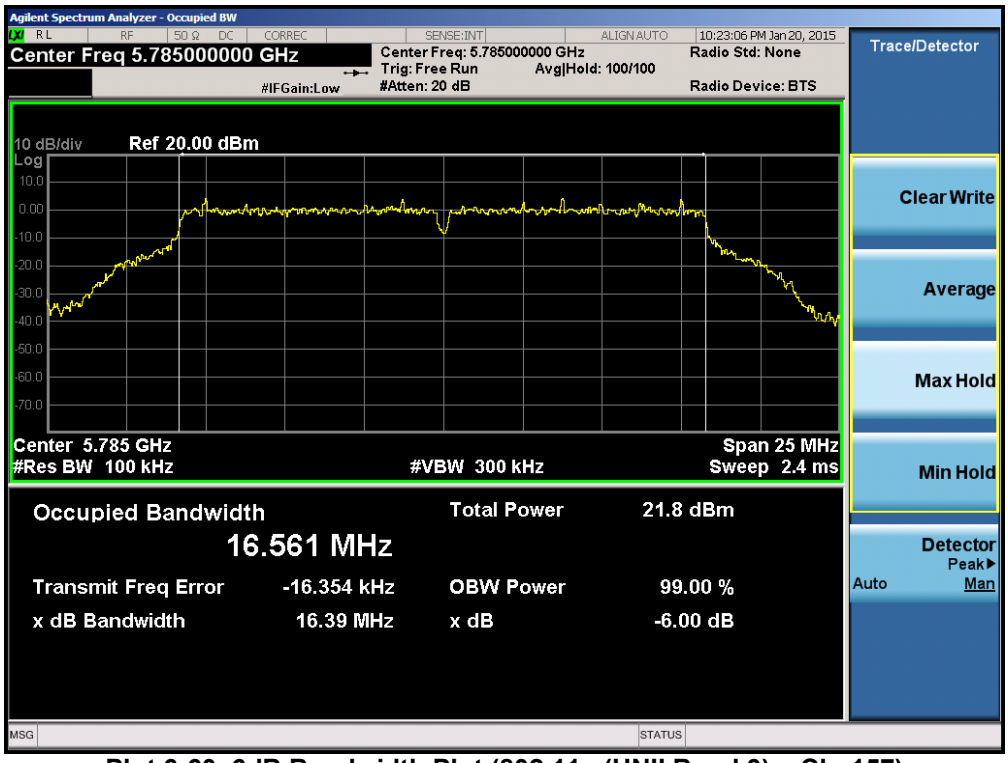
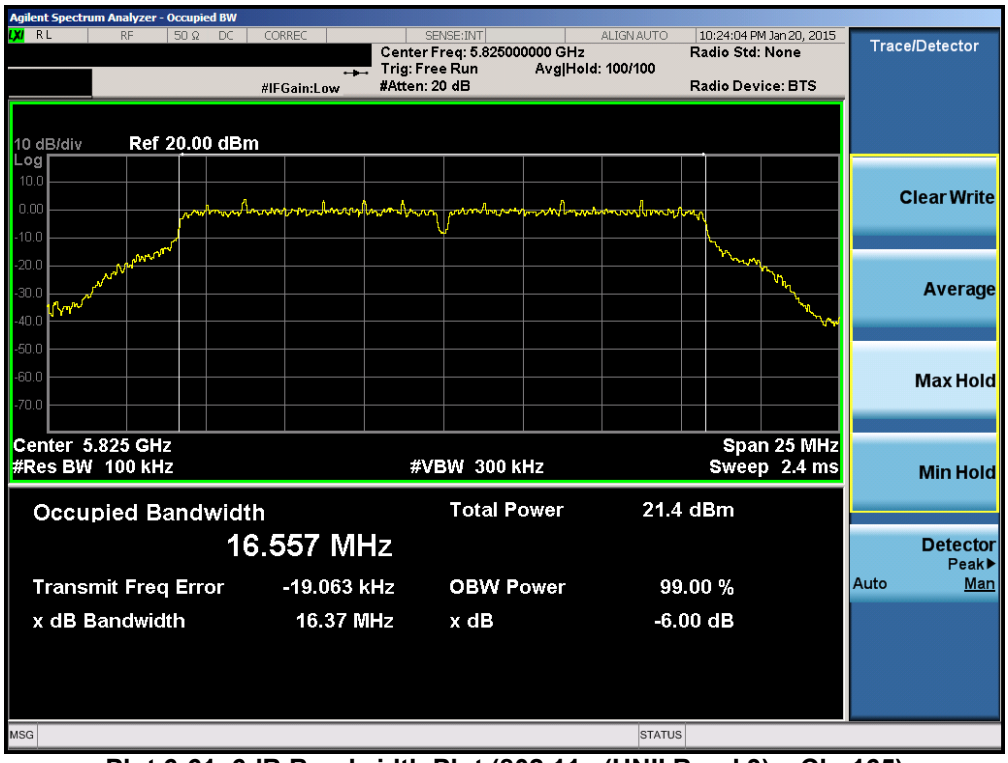



**Plot 6-60. 6dB Bandwidth Plot (802.11a (UNII Band 3) – Ch. 157)**




**Plot 6-61. 6dB Bandwidth Plot (802.11a (UNII Band 3) – Ch. 165)**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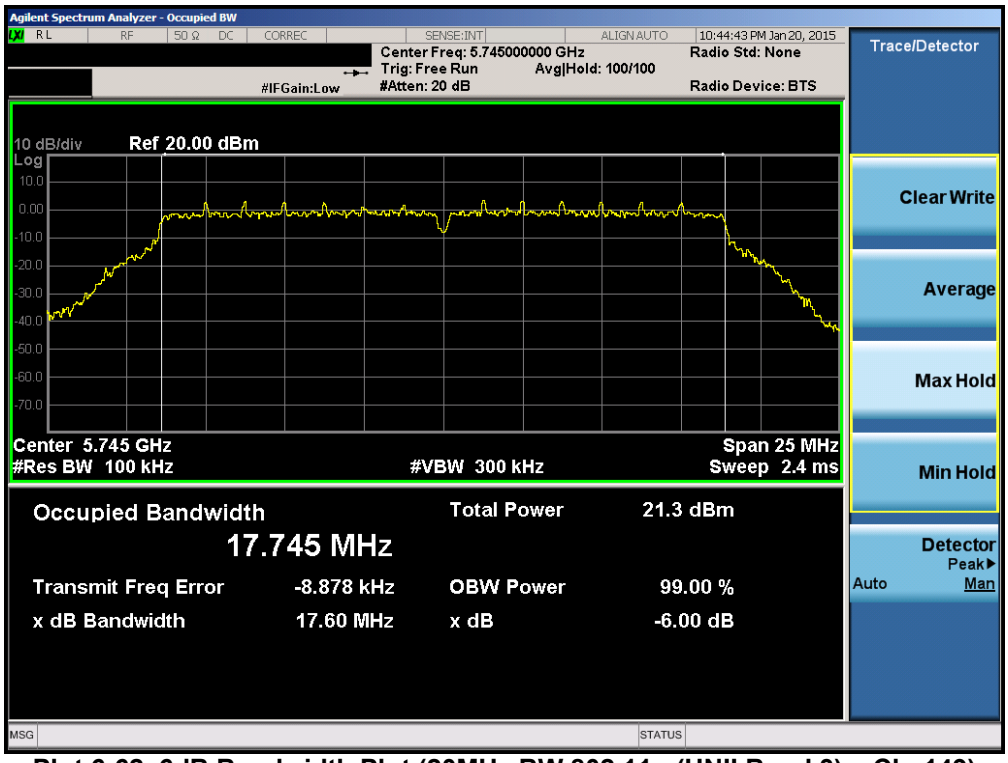
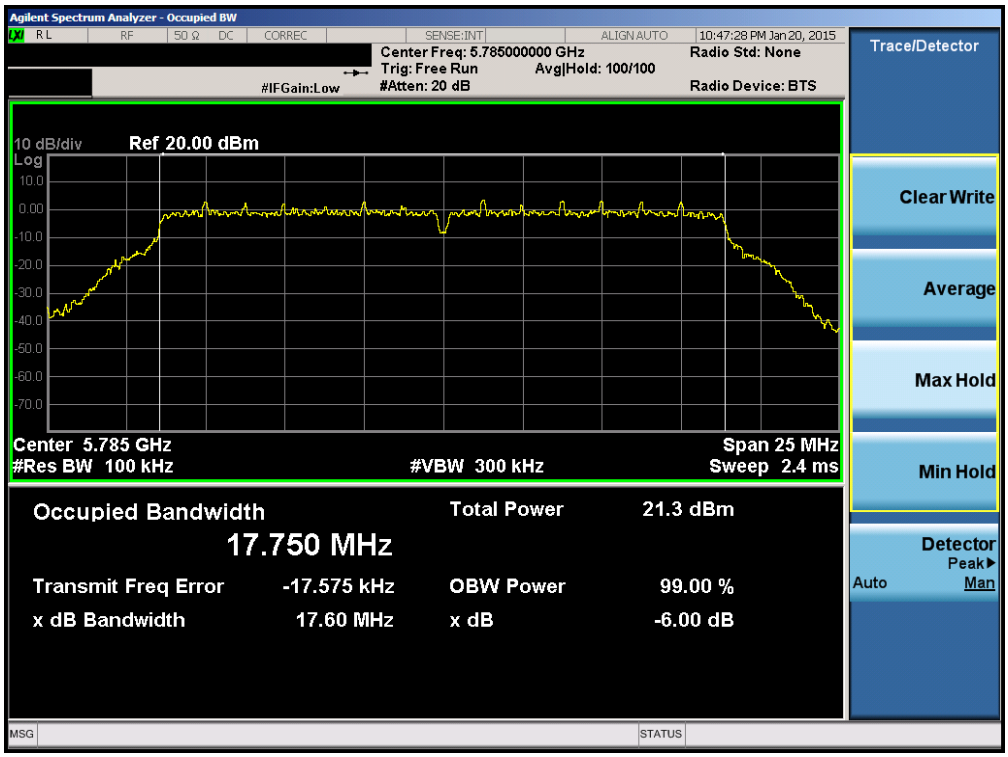



**Plot 6-62. 6dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 149)**




**Plot 6-63. 6dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 157)**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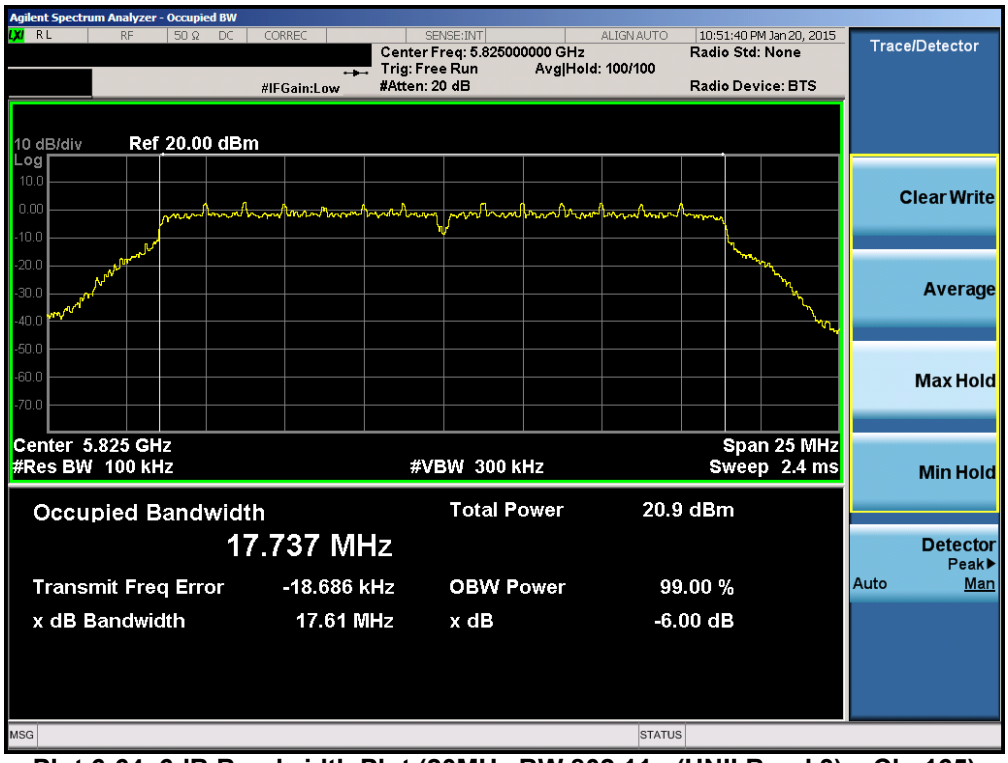
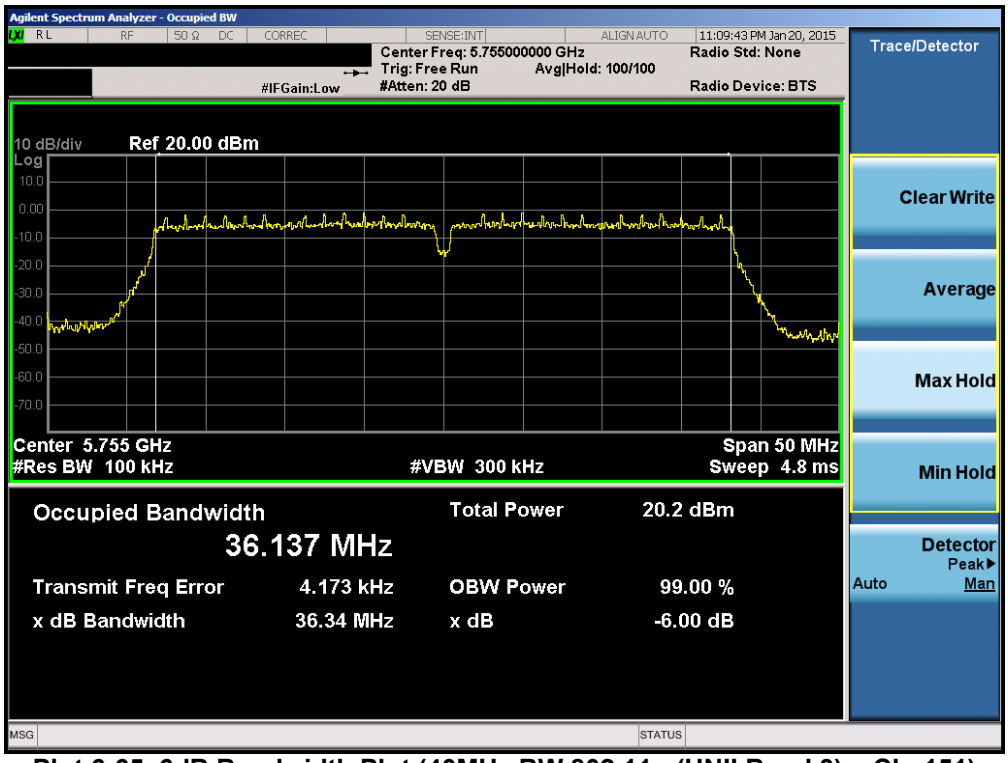



**Plot 6-64. 6dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 165)**




**Plot 6-65. 6dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 3) – Ch. 151)**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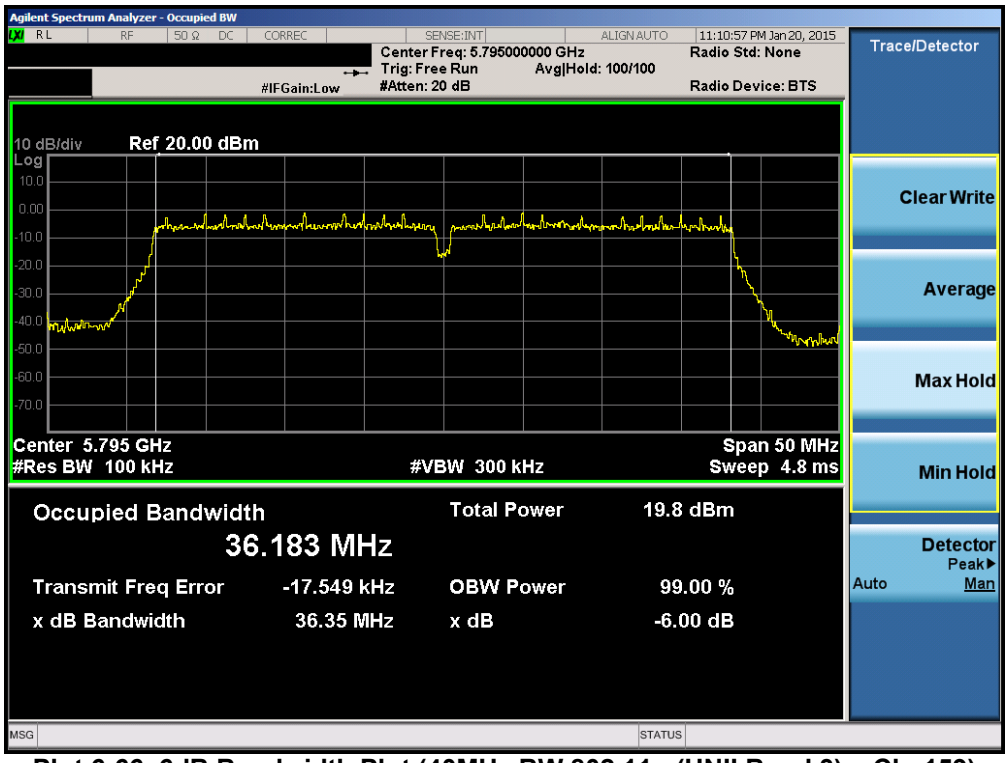
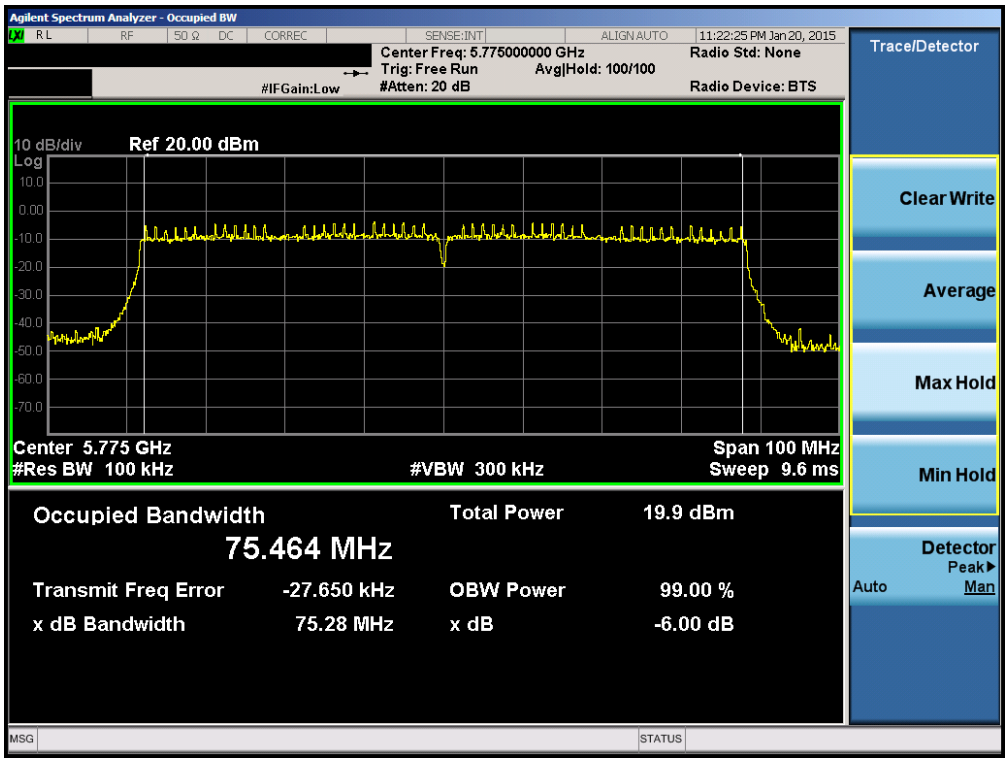



**Plot 6-66. 6dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 3) – Ch. 159)**




**Plot 6-67. 6dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 3) – Ch. 155)**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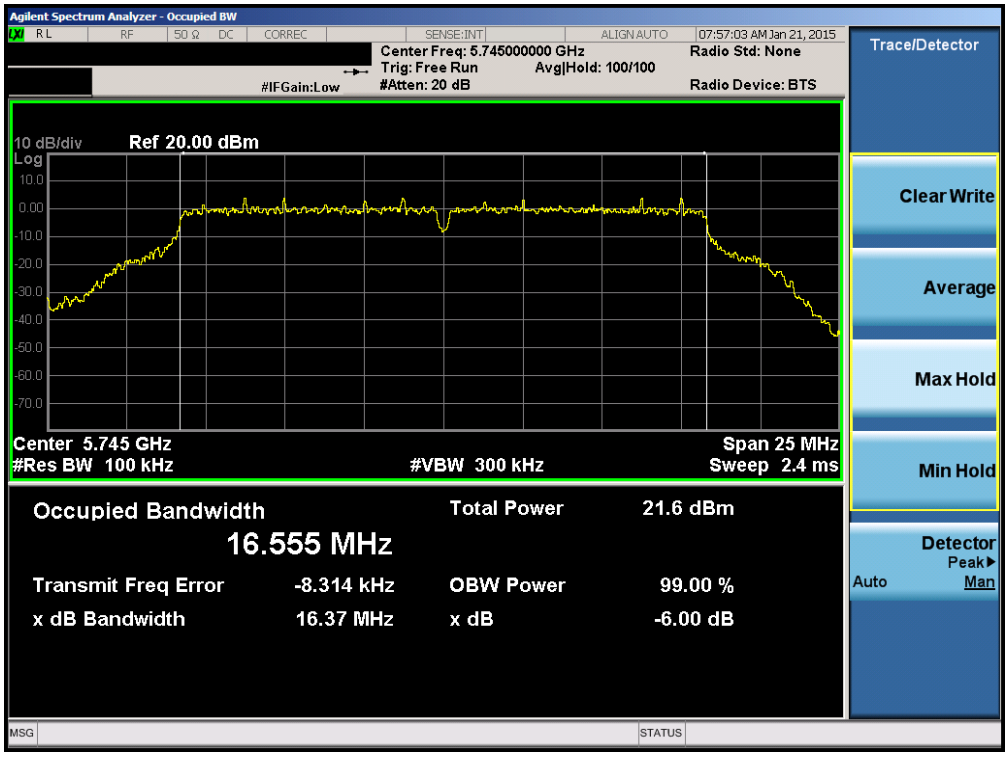
## Antenna-2 6dB Bandwidth Measurements

| | Frequency [MHz] | Channel No. | 802.11 Mode | Data Rate [Mbps] | Measured 6dB Bandwidth [MHz] |
|---|---|---|---|---|---|
| Band 3 | 5745 | 149 | a | 6 | 16.37 |
| | 5785 | 157 | a | 6 | 16.39 |
| | 5825 | 165 | a | 6 | 16.38 |
| | 5745 | 149 | n (20MHz) | 6.5/7.2 (MCS0) | 17.60 |
| | 5785 | 157 | n (20MHz) | 6.5/7.2 (MCS0) | 17.62 |
| | 5825 | 165 | n (20MHz) | 6.5/7.2 (MCS0) | 17.59 |
| | 5755 | 151 | n (40MHz) | 13.5/15 (MCS0) | 36.38 |
| | 5795 | 159 | n (40MHz) | 13.5/15 (MCS0) | 36.37 |
| | 5775 | 155 | ac (80MHz) | 29.3/32.5 (MCS0) | 75.50 |

**Table 6-5. Conducted Bandwidth Measurements**




**Plot 6-68. 6dB Bandwidth Plot (802.11a (UNII Band 3) – Ch. 149)**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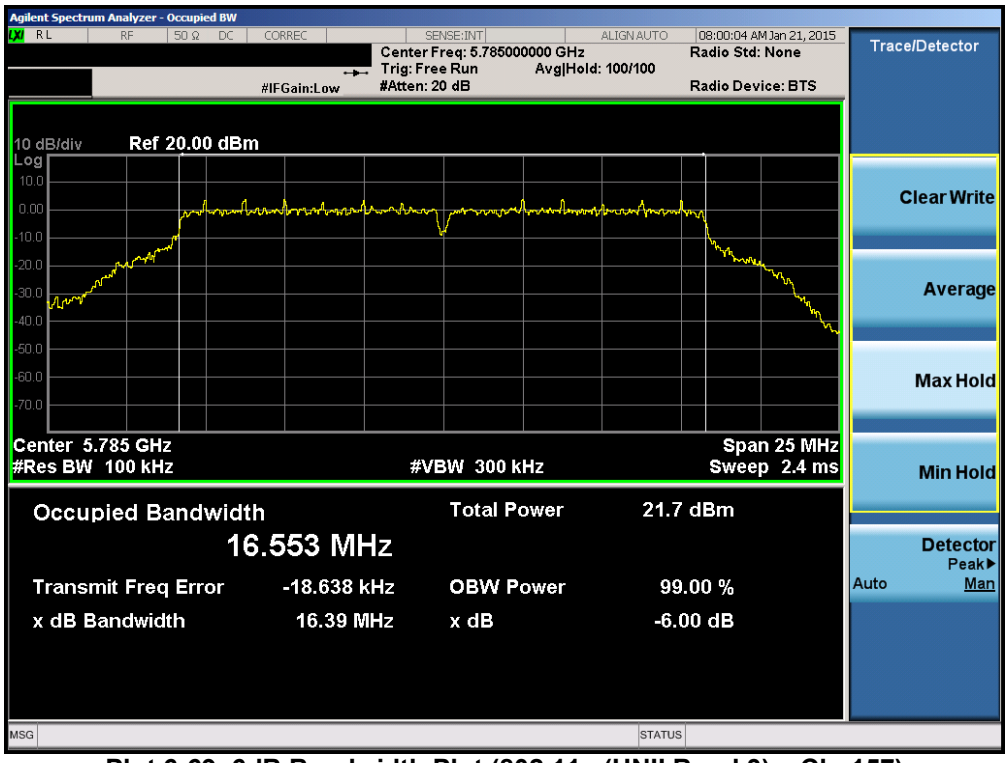
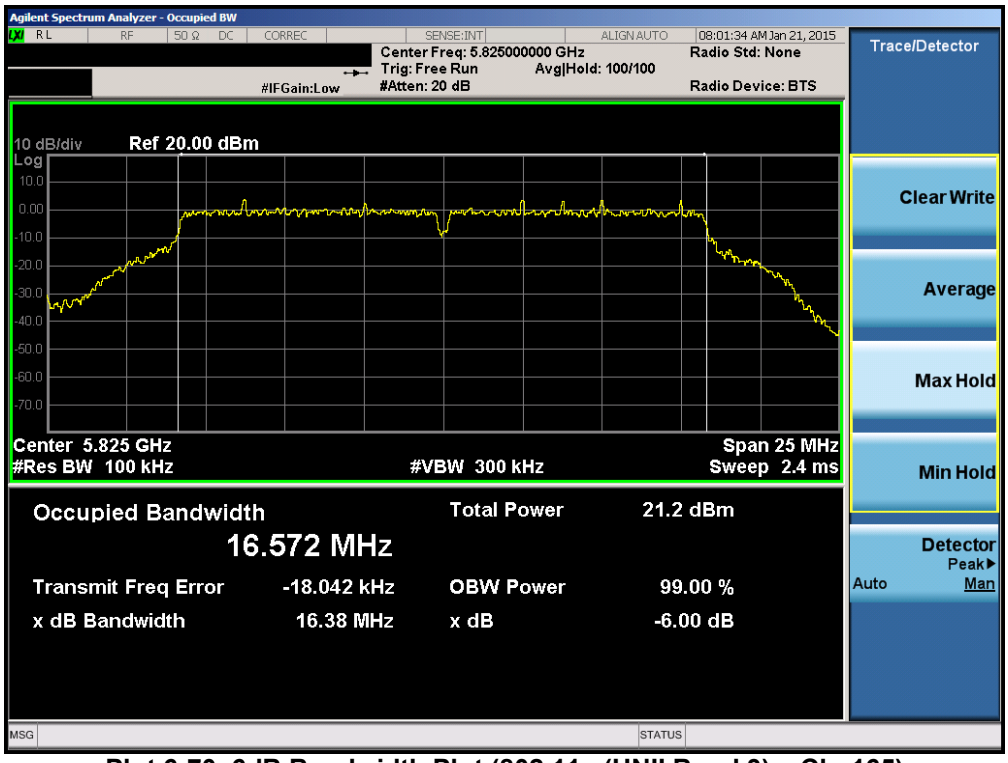



**Plot 6-69. 6dB Bandwidth Plot (802.11a (UNII Band 3) – Ch. 157)**




**Plot 6-70. 6dB Bandwidth Plot (802.11a (UNII Band 3) – Ch. 165)**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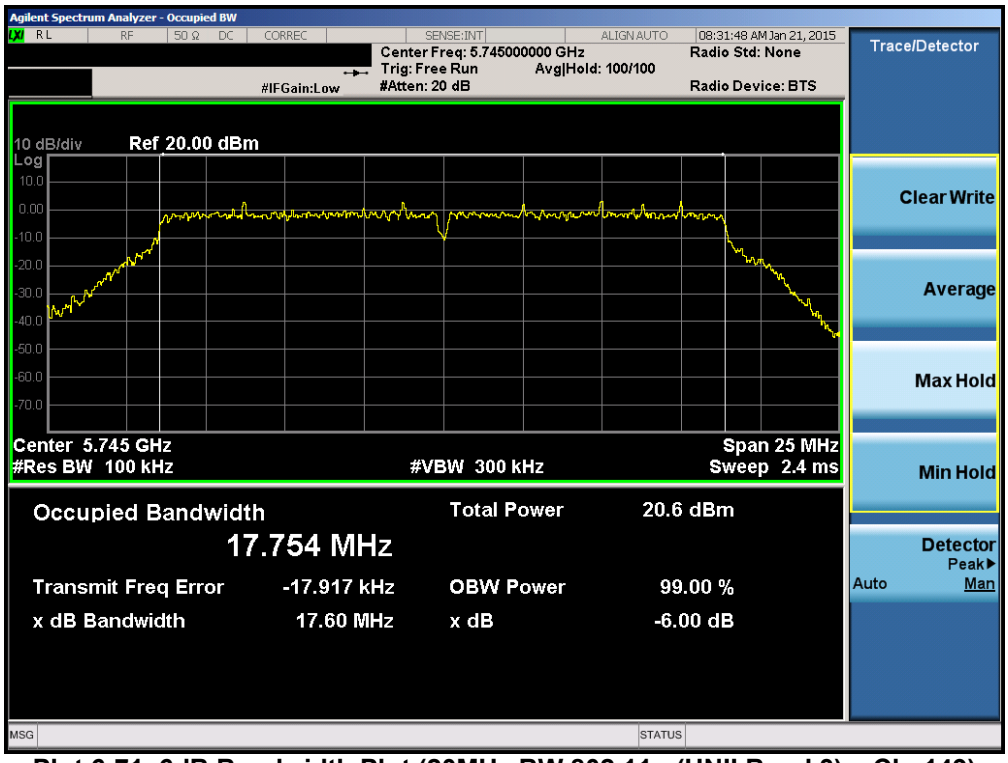
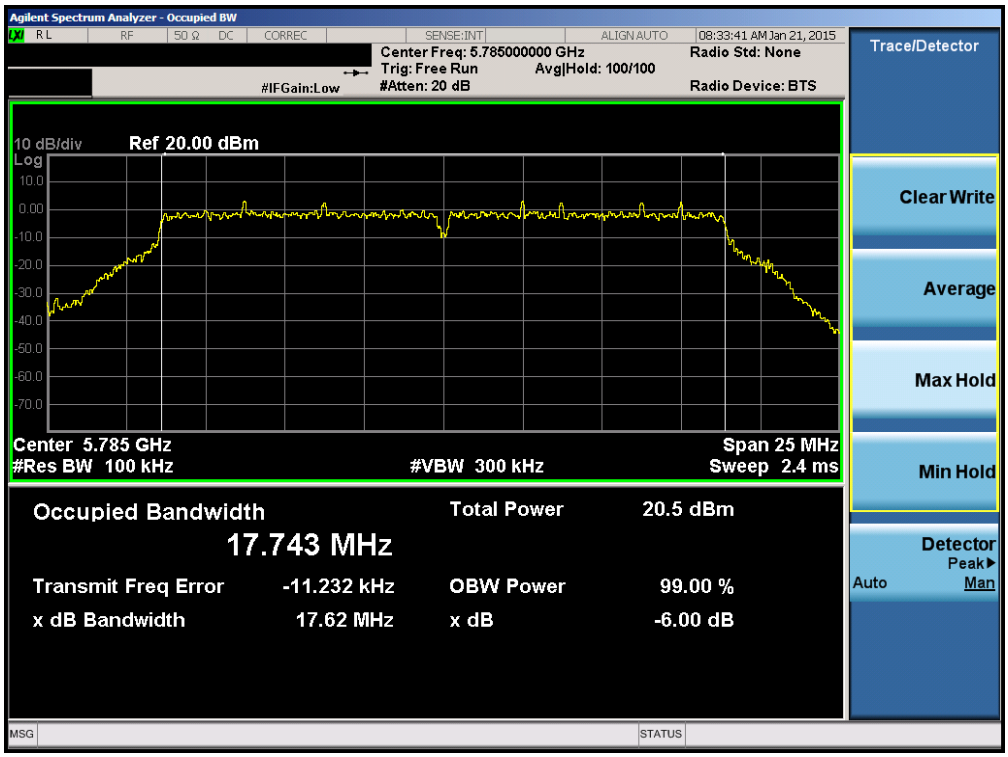



**Plot 6-71. 6dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 149)**




**Plot 6-72. 6dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 157)**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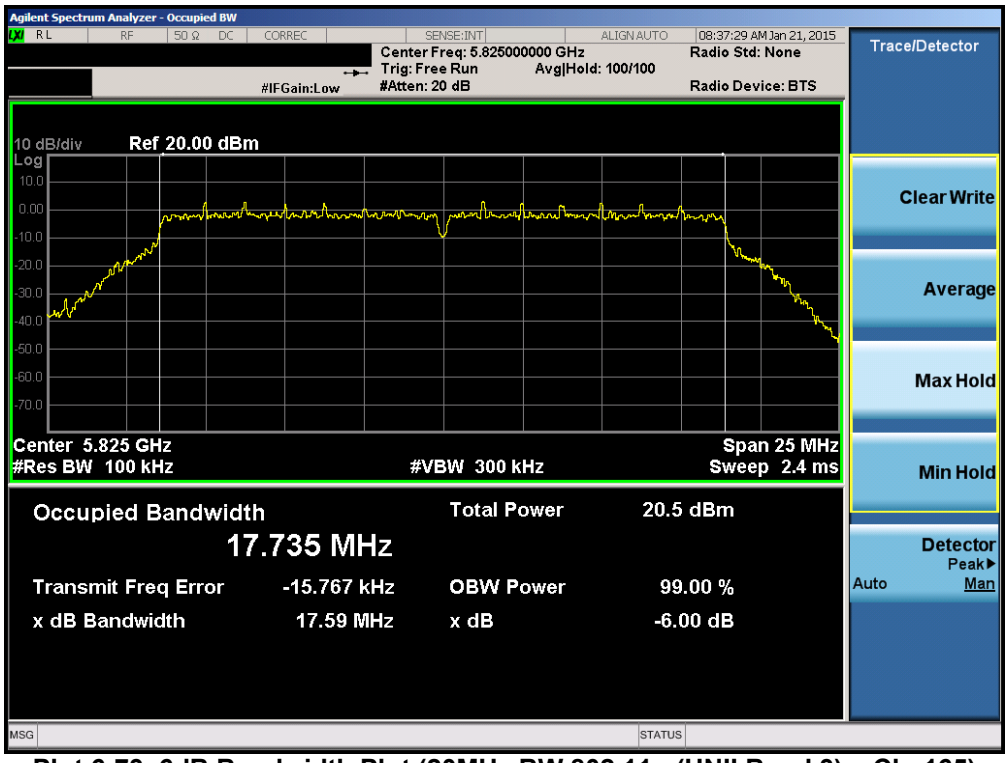
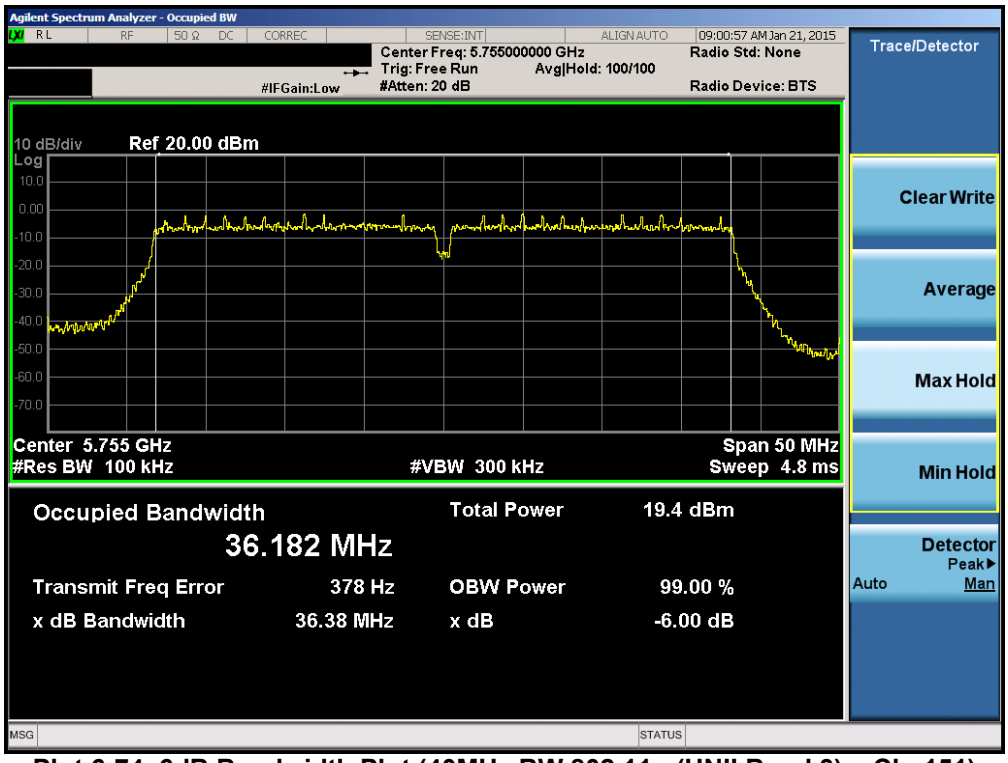



**Plot 6-73. 6dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 165)**




**Plot 6-74. 6dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 3) – Ch. 151)**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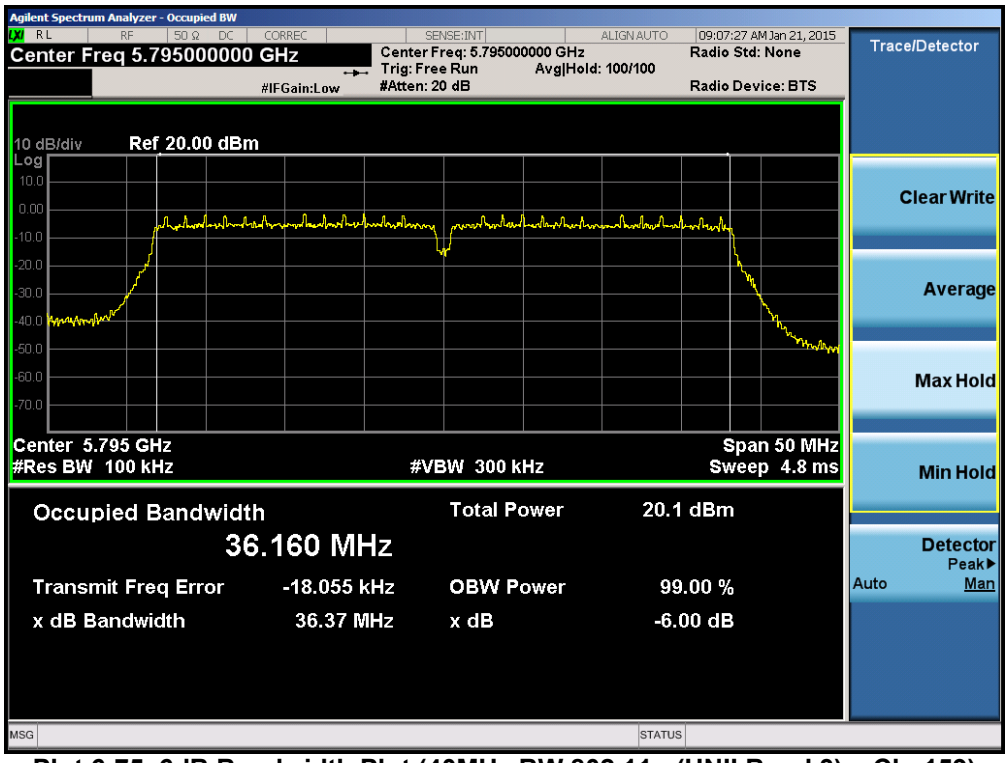
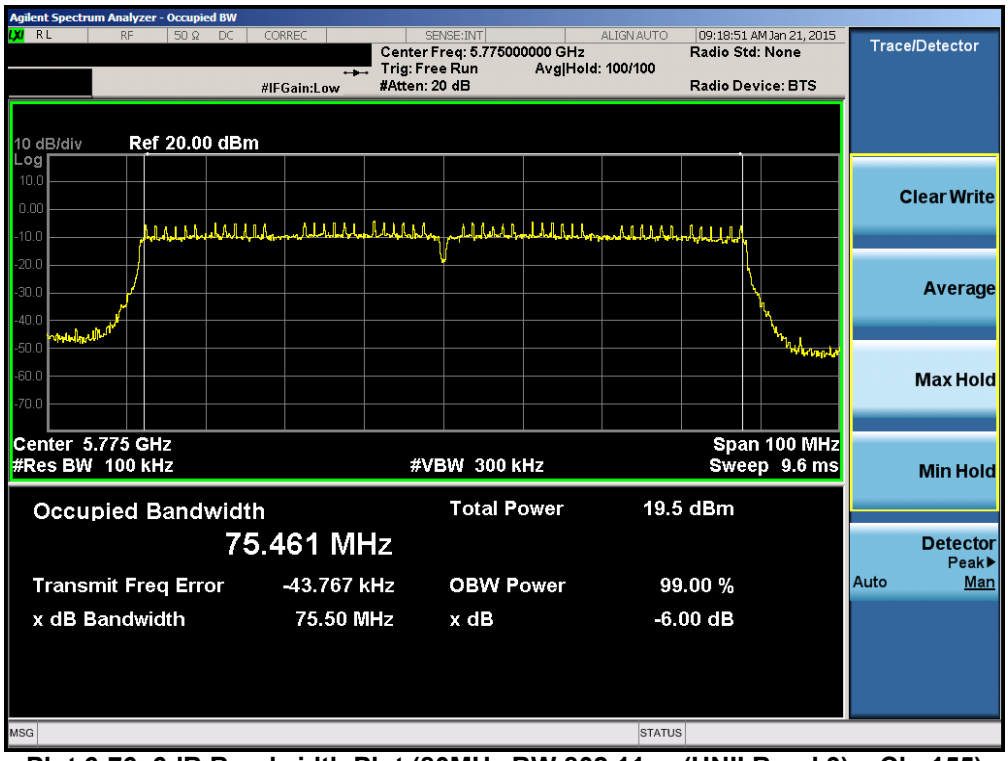



**Plot 6-75. 6dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 3) – Ch. 159)**




**Plot 6-76. 6dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 3) – Ch. 155)**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## 6.4 UNII Output Power Measurement – 802.11a/n/ac

**§15.407 (a)**

**Test Overview and Limits**

A transmitter antenna terminal of the EUT is connected to the input of an RF pulse power sensor. Measurement is made using a broadband average power meter while the EUT is operating at its maximum power control level, as defined in KDB 789033 D02 v01, and at the appropriate frequencies.

***In the 5.15 – 5.25GHz band, the maximum permissible conducted output power is 250mW (23.98dBm).***

***In the 5.25 – 5.35GHz band, the maximum permissible conducted output power is the lesser of 250mW (23.98dBm) and 11 dBm + 10log$_{10}$(26dB BW) = 11 dBm + 10log$_{10}$(21.29) = 24.28dBm.***

***In the 5.47 – 5.725GHz band, the maximum permissible conducted output power is the lesser of 250mW (23.98dBm) and 11 dBm + 10log$_{10}$(26dB BW) = 11 dBm + 10log$_{10}$(21.36) = 24.30dBm.***

***In the 5.725 – 5.825GHz band, the maximum permissible conducted output power is 1W (30dBm).***

**Test Procedure Used**

KDB 789033 D02 v01 – Section E)3)b) Method PM-G
KDB 662911 v02r01 – Section E)1) Measure-and-Sum Technique

**Test Settings**

Average power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter. The trace was averaged over 100 traces to obtain the final measured average power.

**Test Setup**

The EUT and measurement equipment were set up as shown in the diagram below.

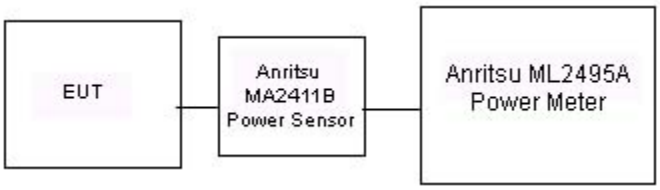


**Figure 6-3. Test Instrument & Measurement Setup**

**Test Notes**

None


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## Antenna-1 Conducted Output Power Measurements

| Freq [MHz] | Channel | Detector | 5GHz (20MHz) Conducted Power [dBm] | | |
|---|---|---|---|---|---|
| | | | IEEE Transmission Mode | | |
| | | | 802.11a | 802.11n | 802.11ac |
| 5180 | 36 | AVG | 14.01 | 13.11 | 13.13 |
| 5200 | 40 | AVG | 13.96 | 13.06 | 13.21 |
| 5220 | 44 | AVG | 13.95 | 13.14 | 13.13 |
| 5240 | 48 | AVG | 13.94 | 13.17 | 13.24 |
| 5260 | 52 | AVG | 14.15 | 13.06 | 13.14 |
| 5280 | 56 | AVG | 14.25 | 13.17 | 13.12 |
| 5300 | 60 | AVG | 14.08 | 13.15 | 13.13 |
| 5320 | 64 | AVG | 14.21 | 13.07 | 13.08 |
| 5500 | 100 | AVG | 13.81 | 12.83 | 12.76 |
| 5540 | 108 | AVG | 13.52 | 12.56 | 12.61 |
| 5580 | 116 | AVG | 13.94 | 12.97 | 12.99 |
| 5660 | 132 | AVG | 14.09 | 13.02 | 13.00 |
| 5720 | 144 | AVG | 14.46 | 13.41 | 12.8 |
| 5745 | 149 | AVG | 14.45 | 13.28 | 13.34 |
| 5785 | 157 | AVG | 14.36 | 13.27 | 13.15 |
| 5825 | 165 | AVG | 14.24 | 13.15 | 13.10 |

**Table 6-6. 20MHz BW (UNII) Maximum Conducted Output Power**

| Freq [MHz] | Channel | Detector | 5GHz (40MHz) Conducted Power [dBm] | |
|---|---|---|---|---|
| | | | IEEE Transmission Mode | |
| | | | 802.11n | 802.11ac |
| 5190 | 38 | AVG | 12.15 | 12.17 |
| 5230 | 46 | AVG | 12.16 | 12.05 |
| 5270 | 54 | AVG | 11.67 | 11.73 |
| 5310 | 62 | AVG | 11.69 | 11.53 |
| 5510 | 102 | AVG | 11.55 | 11.52 |
| 5550 | 110 | AVG | 11.73 | 11.70 |
| 5710 | 142 | AVG | 12.03 | 11.98 |
| 5755 | 151 | AVG | 11.85 | 11.85 |
| 5795 | 159 | AVG | 11.71 | 11.74 |

**Table 6-7. 40MHz BW (UNII) Maximum Conducted Output Power**

| 5GHz (80MHz) Conducted Power [dBm] | | | |
|---|---|---|---|
| Freq [MHz] | Channel | Detector | IEEE Transmission Mode |
| | | | 802.11ac |
| 5210 | 42 | AVG | **10.75** |
| 5290 | 58 | AVG | **11.05** |
| 5530 | 106 | AVG | **10.88** |
| 5690 | 138 | AVG | 10.73 |
| 5775 | 155 | AVG | **11.35** |

**Table 6-8. 80MHz BW (UNII) Maximum Conducted Output Power**


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## Antenna-2 Conducted Output Power Measurements

| Freq [MHz] | Channel | Detector | 5GHz (20MHz) Conducted Power [dBm] | | |
|---|---|---|---|---|---|
| | | | IEEE Transmission Mode | | |
| | | | 802.11a | 802.11n | 802.11ac |
| 5180 | 36 | AVG | 14.31 | 13.09 | 13.15 |
| 5200 | 40 | AVG | 14.27 | 13.19 | 13.24 |
| 5220 | 44 | AVG | 14.31 | 13.14 | 13.11 |
| 5240 | 48 | AVG | 14.25 | 13.13 | 13.14 |
| 5260 | 52 | AVG | 14.01 | 12.84 | 12.91 |
| 5280 | 56 | AVG | 13.97 | 12.93 | 12.83 |
| 5300 | 60 | AVG | 13.98 | 12.86 | 12.79 |
| 5320 | 64 | AVG | 13.92 | 12.74 | 12.67 |
| 5500 | 100 | AVG | 14.45 | 13.40 | 13.34 |
| 5540 | 108 | AVG | 13.75 | 13.10 | 13.15 |
| 5580 | 116 | AVG | 14.17 | 13.18 | 13.14 |
| 5660 | 132 | AVG | 14.01 | 12.90 | 12.88 |
| 5720 | 144 | AVG | 14.16 | 12.99 | 12.96 |
| 5745 | 149 | AVG | 14.43 | 13.35 | 13.41 |
| 5785 | 157 | AVG | 14.33 | 13.31 | 13.31 |
| 5825 | 165 | AVG | 14.38 | 13.34 | 13.38 |

**Table 6-9. 20MHz BW (UNII) Maximum Conducted Output Power**

| Freq [MHz] | Channel | Detector | 5GHz (40MHz) Conducted Power [dBm] | |
|---|---|---|---|---|
| | | | IEEE Transmission Mode | |
| | | | 802.11n | 802.11ac |
| 5190 | 38 | AVG | 11.88 | 11.90 |
| 5230 | 46 | AVG | 11.86 | 11.92 |
| 5270 | 54 | AVG | 12.37 | 12.42 |
| 5310 | 62 | AVG | 12.38 | 12.20 |
| 5510 | 102 | AVG | 11.77 | 11.89 |
| 5550 | 110 | AVG | 11.82 | 11.74 |
| 5710 | 142 | AVG | 11.99 | 11.94 |
| 5755 | 151 | AVG | 11.66 | 11.78 |
| 5795 | 159 | AVG | 11.81 | 11.75 |

**Table 6-10. 40MHz BW (UNII) Maximum Conducted Output Power**

| 5GHz (80MHz) Conducted Power [dBm] | | | |
|---|---|---|---|
| Freq [MHz] | Channel | Detector | IEEE Transmission Mode |
| | | | 802.11ac |
| 5210 | 42 | AVG | **10.98** |
| 5290 | 58 | AVG | **10.88** |
| 5530 | 106 | AVG | **11.10** |
| 5690 | 138 | AVG | 10.66 |
| 5775 | 155 | AVG | **11.06** |

**Table 6-11. 80MHz BW (UNII) Maximum Conducted Output Power**


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# MIMO Maximum Conducted Output Power Measurements

| Freq [MHz] | Channel | Detector | 5GHz (20MHz) Conducted Power [dBm] | | |
|---|---|---|---|---|---|
| | | | ANT1 | ANT2 | MIMO |
| 5180 | 36 | AVG | 13.11 | 13.09 | 16.11 |
| 5200 | 40 | AVG | 13.06 | 13.19 | 16.14 |
| 5220 | 44 | AVG | 13.14 | 13.14 | 16.15 |
| 5240 | 48 | AVG | 13.17 | 13.13 | 16.16 |
| 5260 | 52 | AVG | 13.06 | 12.84 | 15.96 |
| 5280 | 56 | AVG | 13.17 | 12.93 | 16.06 |
| 5300 | 60 | AVG | 13.15 | 12.86 | 16.02 |
| 5320 | 64 | AVG | 13.07 | 12.74 | 15.92 |
| 5500 | 100 | AVG | 12.83 | 13.40 | 16.13 |
| 5580 | 116 | AVG | 12.97 | 13.18 | 16.09 |
| 5660 | 132 | AVG | 13.02 | 12.90 | 15.97 |
| 5720 | 144 | AVG | 13.41 | 12.99 | 16.22 |
| 5745 | 149 | AVG | 13.28 | 13.35 | 16.33 |
| 5765 | 153 | AVG | 13.28 | 13.39 | 16.35 |
| 5785 | 157 | AVG | 13.27 | 13.31 | 16.30 |
| 5805 | 161 | AVG | 13.20 | 13.29 | 16.26 |
| 5825 | 165 | AVG | 13.15 | 13.34 | 16.26 |

**Table 6-12. MIMO 20MHz BW 802.11n (UNII) Maximum Conducted Output Power**

| Freq [MHz] | Channel | Detector | 5GHz (20MHz) Conducted Power [dBm] | | |
|---|---|---|---|---|---|
| | | | ANT1 | ANT2 | MIMO |
| 5180 | 36 | AVG | 13.13 | 13.15 | 16.15 |
| 5200 | 40 | AVG | 13.21 | 13.24 | 16.24 |
| 5220 | 44 | AVG | 13.13 | 13.11 | 16.13 |
| 5240 | 48 | AVG | 13.24 | 13.14 | 16.20 |
| 5260 | 52 | AVG | 13.14 | 12.91 | 16.04 |
| 5280 | 56 | AVG | 13.12 | 12.83 | 15.99 |
| 5300 | 60 | AVG | 13.13 | 12.79 | 15.97 |
| 5320 | 64 | AVG | 13.08 | 12.67 | 15.89 |
| 5500 | 100 | AVG | 12.76 | 13.34 | 16.07 |
| 5580 | 116 | AVG | 12.99 | 13.14 | 16.08 |
| 5660 | 132 | AVG | 13.00 | 12.88 | 15.95 |
| 5720 | 144 | AVG | 12.8 | 12.96 | 15.89 |
| 5745 | 149 | AVG | 13.34 | 13.41 | 16.39 |
| 5765 | 153 | AVG | 13.25 | 13.35 | 16.31 |
| 5785 | 157 | AVG | 13.15 | 13.31 | 16.24 |
| 5805 | 161 | AVG | 13.19 | 13.35 | 16.28 |
| 5825 | 165 | AVG | 13.10 | 13.38 | 16.25 |

**Table 6-13. MIMO 20MHz BW 802.11ac (UNII) Maximum Conducted Output Power**


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| Freq [MHz] | Channel | Detector | 5GHz (40MHz) Conducted Power [dBm] | | |
|---|---|---|---|---|---|
| | | | ANT1 | ANT2 | MIMO |
| 5190 | 38 | AVG | 12.15 | 11.88 | 15.03 |
| 5230 | 46 | AVG | 12.16 | 11.86 | 15.02 |
| 5270 | 54 | AVG | 11.67 | 12.37 | 15.04 |
| 5310 | 62 | AVG | 11.69 | 12.38 | 15.06 |
| 5510 | 102 | AVG | 11.55 | 11.77 | 14.67 |
| 5550 | 110 | AVG | 11.73 | 11.82 | 14.79 |
| 5710 | 142 | AVG | 12.03 | 11.99 | 15.02 |
| 5755 | 151 | AVG | 11.85 | 11.66 | 14.77 |
| 5795 | 159 | AVG | 11.71 | 11.81 | 14.77 |

**Table 6-14. MIMO 40MHz BW 802.11n (UNII) Maximum Conducted Output Power**

| Freq [MHz] | Channel | Detector | 5GHz (40MHz) Conducted Power [dBm] | | |
|---|---|---|---|---|---|
| | | | ANT1 | ANT2 | MIMO |
| 5190 | 38 | AVG | 12.17 | 11.90 | 15.05 |
| 5230 | 46 | AVG | 12.05 | 11.92 | 15.00 |
| 5270 | 54 | AVG | 11.73 | 12.42 | 15.10 |
| 5310 | 62 | AVG | 11.53 | 12.20 | 14.89 |
| 5510 | 102 | AVG | 11.52 | 11.89 | 14.72 |
| 5550 | 110 | AVG | 11.70 | 11.74 | 14.73 |
| 5710 | 142 | AVG | 11.98 | 11.94 | 14.97 |
| 5755 | 151 | AVG | 11.85 | 11.78 | 14.83 |
| 5795 | 159 | AVG | 11.74 | 11.75 | 14.76 |

**Table 6-15. MIMO 40MHz BW 802.11ac (UNII) Maximum Conducted Output Power**

| Freq [MHz] | Channel | Detector | 5GHz (80MHz) Conducted Power [dBm] | | |
|---|---|---|---|---|---|
| | | | ANT1 | ANT2 | MIMO |
| 5210 | 42 | AVG | **10.75** | **10.98** | **13.88** |
| 5290 | 58 | AVG | **11.05** | **10.88** | **13.98** |
| 5530 | 106 | AVG | **10.88** | **11.10** | **14.00** |
| 5690 | 138 | AVG | 10.73 | 10.66 | 13.71 |
| 5775 | 155 | AVG | **11.35** | **11.06** | **14.22** |

**Table 6-16. MIMO 80MHz BW 802.11ac (UNII) Maximum Conducted Output Power**

**Note:**
Per KDB 662911 v02r01 Section E)1), the conducted powers at Antenna 1 and Antenna 2 were first measured separately during MIMO transmission as shown in the section above. The measured values were then summed in linear power units then converted back to dBm.

**Sample MIMO Calculation:**
At 5180MHz the average conducted output power was measured to be 13.11 dBm for Antenna-1 and 13.09 dBm for Antenna-2.

Antenna 1 + Antenna 2 = MIMO

(13.11 dBm + 13.09 dBm) = (20.46 mW + 20.37 mW) = 40.83 mW = 16.11 dBm


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## 6.5 Maximum Power Spectral Density – 802.11a/n/ac

**§15.407(a)**

**Test Overview and Limit**

The spectrum analyzer was connected to the antenna terminal while the EUT was operating at its maximum power control level, as defined in KDB 789033 D02 v01, and at the appropriate frequencies. Method SA-1, as defined in KDB 789033 D02 v01, was used to measure the power spectral density.

***In the 5.15 – 5.25GHz, 5.25 – 5.35GHz, 5.47 – 5.725GHz bands, the maximum permissible power spectral density is 11dBm/MHz.***

***In the 5.725 – 5.850GHz band, the maximum permissible power spectral density is 30dBm/500kHz.***

**Test Procedure Used**

KDB 789033 D02 v01 – Section F
KDB 662911 v02r01 – Section E)2) Measure-and-Sum Technique

**Test Settings**

1. Analyzer was set to the center frequency of the UNII channel under investigation
2. Span was set to encompass the entire emission bandwidth of the signal
3. RBW = 1MHz
4. VBW = 3MHz
5. Number of sweep points $\geq$ 2 x (span/RBW)
6. Sweep time = auto
7. Detector = power averaging (RMS)
8. Trigger was set to free run
9. Trace was averaged over 100 sweeps
10. The peak search function of the spectrum analyzer was used to find the peak of the spectrum.

**Test Setup**

The EUT and measurement equipment were set up as shown in the diagram below.

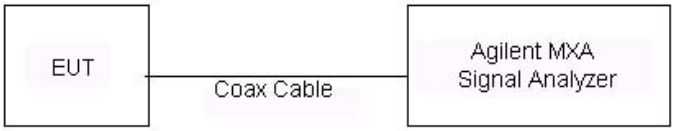


**Figure 6-4. Test Instrument & Measurement Setup**

**Test Notes**

None


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## Antenna-1 Power Spectral Density Measurements

| | Frequency [MHz] | Channel No. | 802.11 Mode | Data Rate [Mbps] | Measured Power Density [dBm] | Max Permissible Power Density [dBm/MHz] | Margin [dB] | Pass / Fail |
|---|---|---|---|---|---|---|---|---|
| Band 1 | 5180 | 36 | a | 6 | 5.30 | 11.0 | -5.70 | Pass |
| | 5200 | 40 | a | 6 | 4.78 | 11.0 | -6.22 | Pass |
| | 5240 | 48 | a | 6 | 5.04 | 11.0 | -5.96 | Pass |
| | 5180 | 36 | n (20MHz) | 6.5/7.2 (MCS0) | 3.39 | 11.0 | -7.61 | Pass |
| | 5200 | 40 | n (20MHz) | 6.5/7.2 (MCS0) | 3.52 | 11.0 | -7.49 | Pass |
| | 5240 | 48 | n (20MHz) | 6.5/7.2 (MCS0) | 3.73 | 11.0 | -7.27 | Pass |
| | 5190 | 38 | n (40MHz) | 13.5/15 (MCS0) | -1.30 | 11.0 | -12.30 | Pass |
| | 5230 | 46 | n (40MHz) | 13.5/15 (MCS0) | -0.46 | 11.0 | -11.46 | Pass |
| | 5210 | 42 | ac (80MHz) | 29.3/32.5 (MCS0) | -4.30 | 11.0 | -15.30 | Pass |
| Band 2A | 5260 | 52 | a | 6 | 5.29 | 11.0 | -5.72 | Pass |
| | 5280 | 56 | a | 6 | 4.84 | 11.0 | -6.16 | Pass |
| | 5320 | 64 | a | 6 | 4.22 | 11.0 | -6.78 | Pass |
| | 5260 | 52 | n (20MHz) | 6.5/7.2 (MCS0) | 3.75 | 11.0 | -7.25 | Pass |
| | 5280 | 56 | n (20MHz) | 6.5/7.2 (MCS0) | 3.72 | 11.0 | -7.28 | Pass |
| | 5320 | 64 | n (20MHz) | 6.5/7.2 (MCS0) | 2.96 | 11.0 | -8.05 | Pass |
| | 5270 | 54 | n (40MHz) | 13.5/15 (MCS0) | -0.21 | 11.0 | -11.21 | Pass |
| | 5310 | 62 | n (40MHz) | 13.5/15 (MCS0) | -0.88 | 11.0 | -11.88 | Pass |
| | 5290 | 58 | ac (80MHz) | 29.3/32.5 (MCS0) | -3.87 | 11.0 | -14.87 | Pass |
| Band 2C | 5500 | 100 | a | 6 | 4.41 | 11.0 | -6.59 | Pass |
| | 5580 | 116 | a | 6 | 3.92 | 11.0 | -7.09 | Pass |
| | 5720 | 144 | a | 6 | 4.23 | 11.0 | -6.77 | Pass |
| | 5500 | 100 | n (20MHz) | 6.5/7.2 (MCS0) | 3.23 | 11.0 | -7.77 | Pass |
| | 5580 | 116 | n (20MHz) | 6.5/7.2 (MCS0) | 2.80 | 11.0 | -8.20 | Pass |
| | 5720 | 144 | n (20MHz) | 6.5/7.2 (MCS0) | 2.57 | 11.0 | -8.43 | Pass |
| | 5510 | 102 | n (40MHz) | 13.5/15 (MCS0) | -0.68 | 11.0 | -11.68 | Pass |
| | 5550 | 110 | n (40MHz) | 13.5/15 (MCS0) | -0.39 | 11.0 | -11.39 | Pass |
| | 5710 | 142 | n (40MHz) | 13.5/15 (MCS0) | -2.27 | 11.0 | -13.27 | Pass |
| | 5530 | 106 | ac (80MHz) | 29.3/32.5 (MCS0) | -4.47 | 11.0 | -15.47 | Pass |
| | 5690 | 138 | ac (80MHz) | 29.3/32.5 (MCS0) | -6.65 | 11.0 | -17.65 | Pass |

**Table 6-17. Bands 1, 2A, 2C Conducted Power Spectral Density Measurements**


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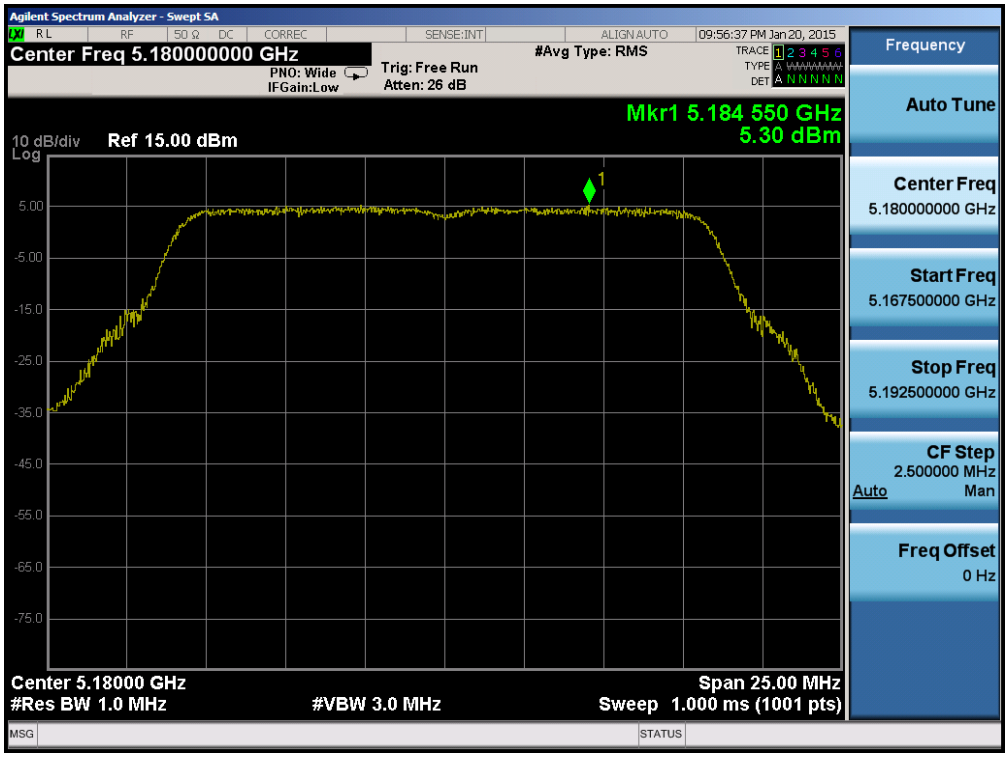
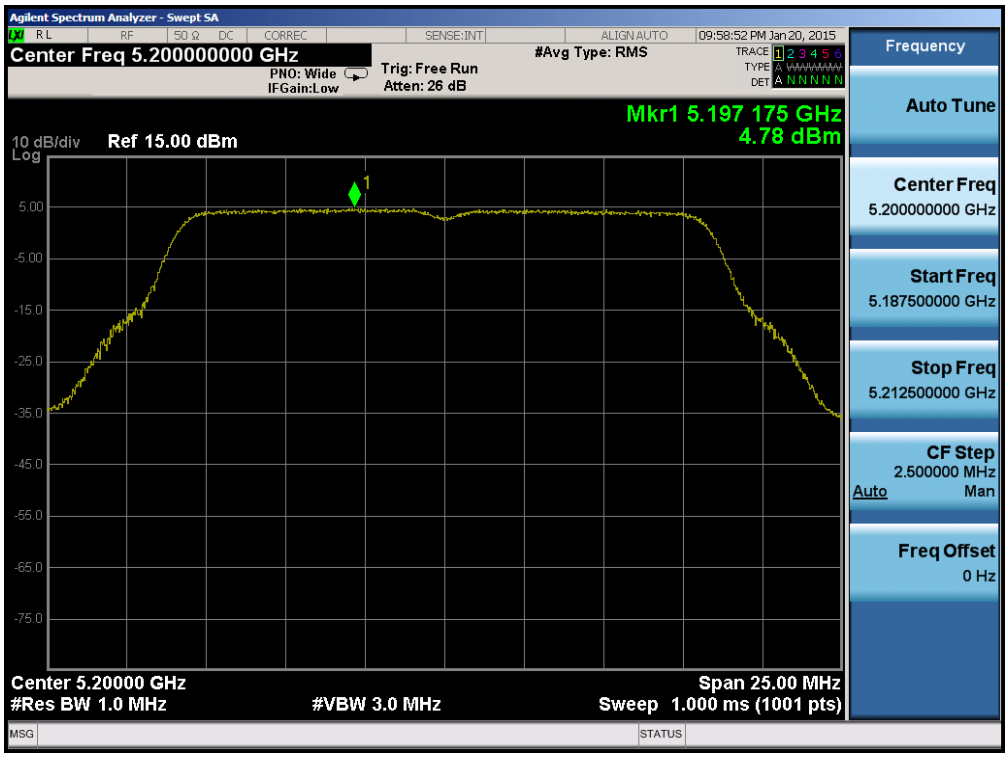



**Plot 6-77. Power Spectral Density Plot (802.11a (UNII Band 1) – Ch. 36)**




**Plot 6-78. Power Spectral Density Plot (802.11a (UNII Band 1) – Ch. 40)**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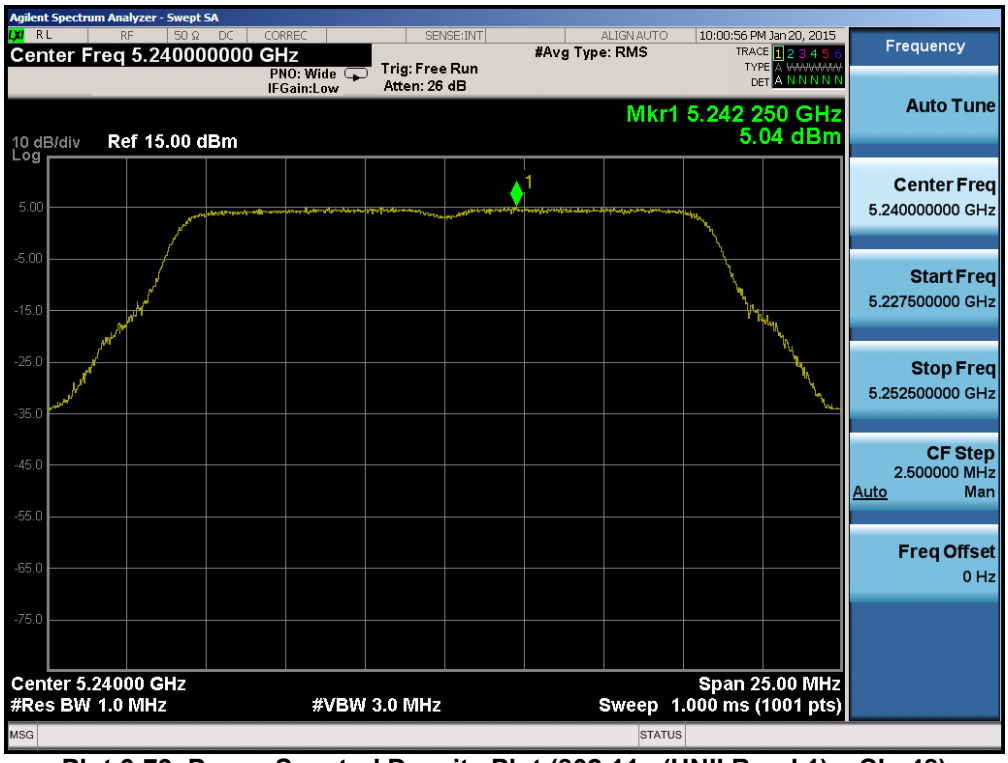
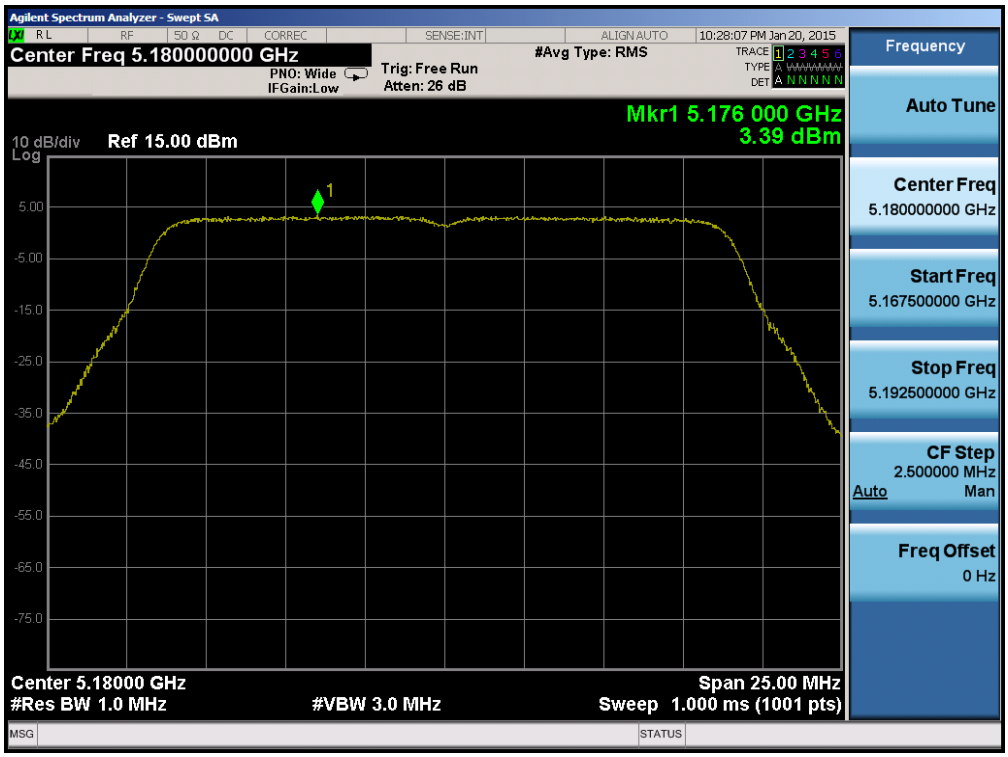



**Plot 6-79. Power Spectral Density Plot (802.11a (UNII Band 1) – Ch. 48)**




**Plot 6-80. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 36)**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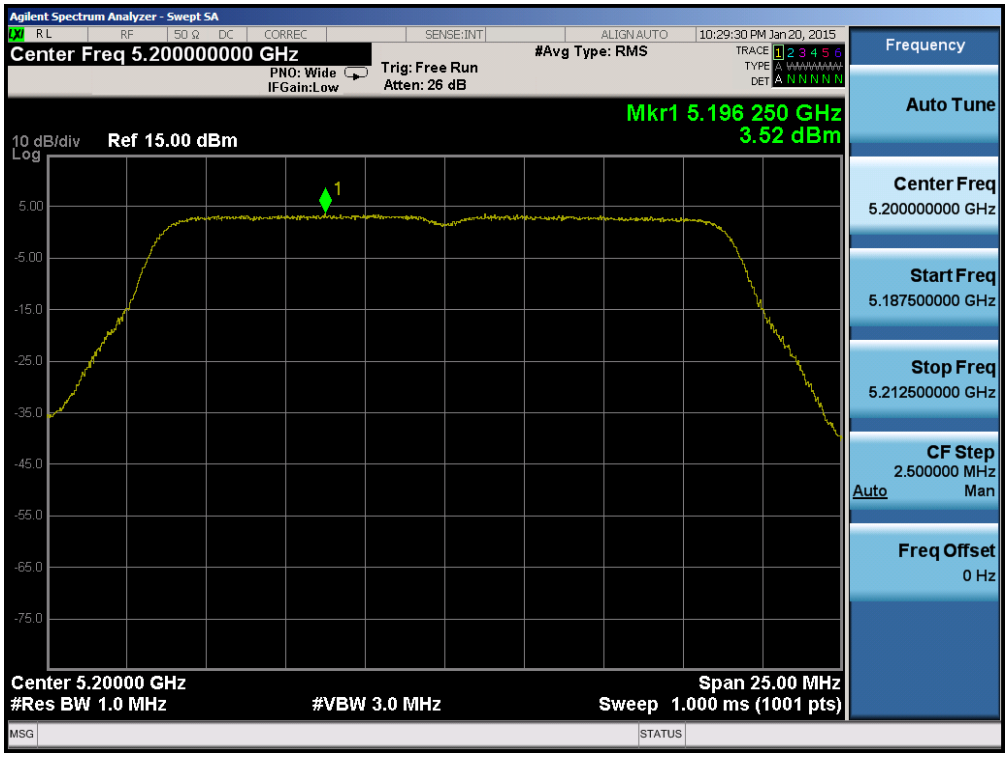
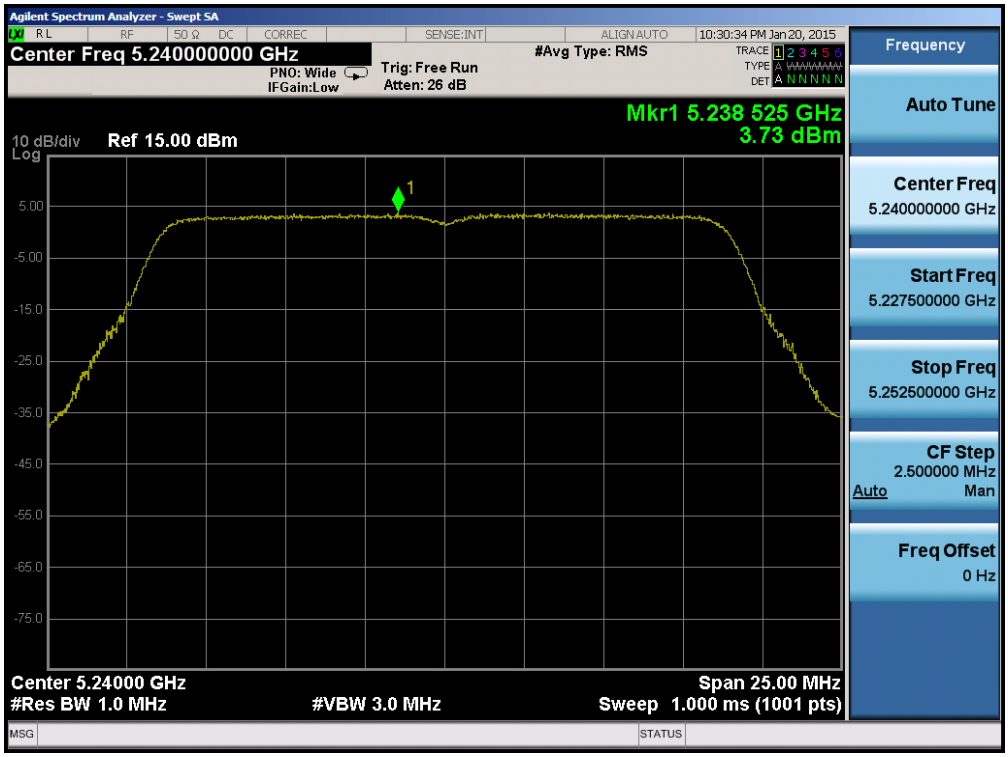



**Plot 6-81. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 40)**




**Plot 6-82. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 48)**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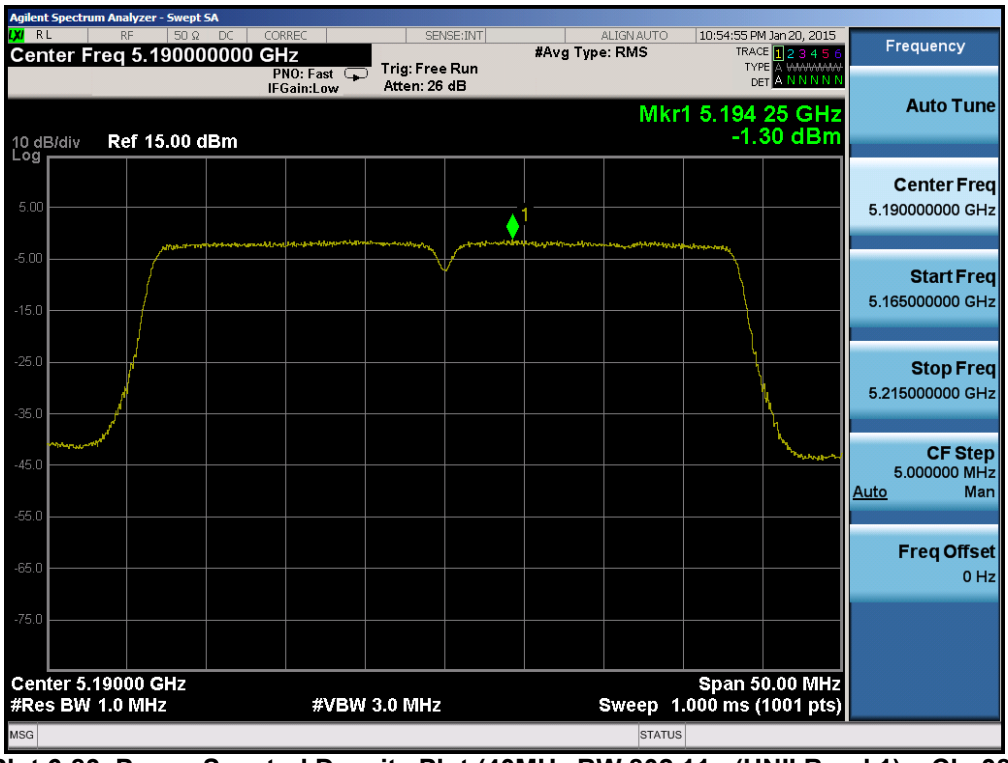
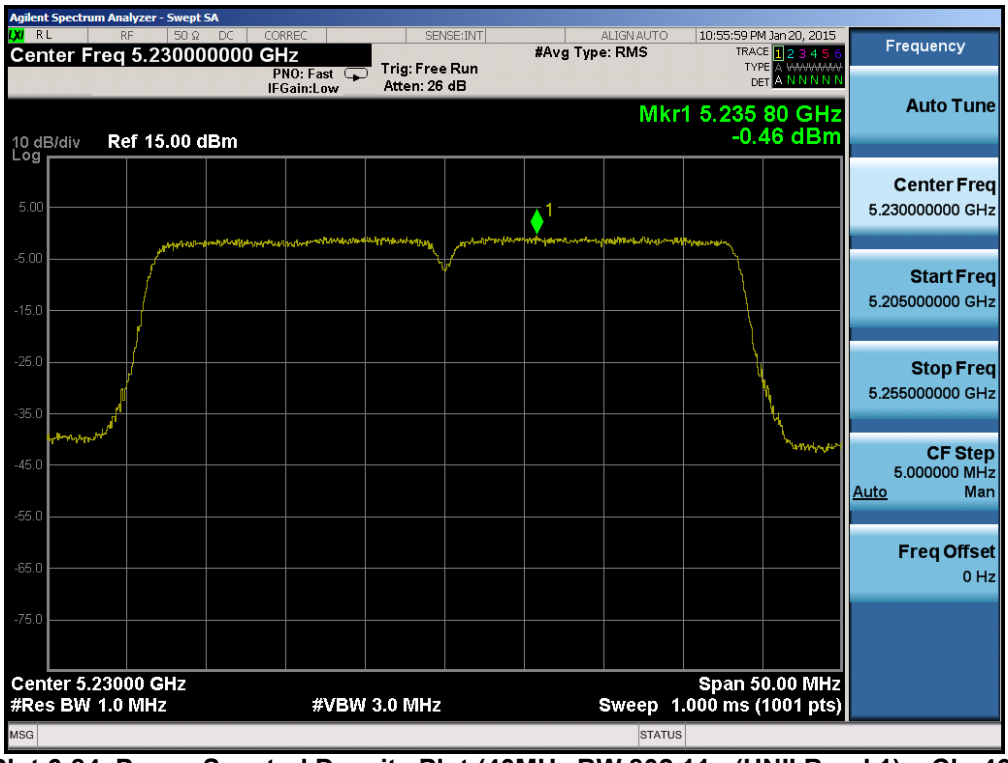



**Plot 6-83. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 38)**




**Plot 6-84. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 46)**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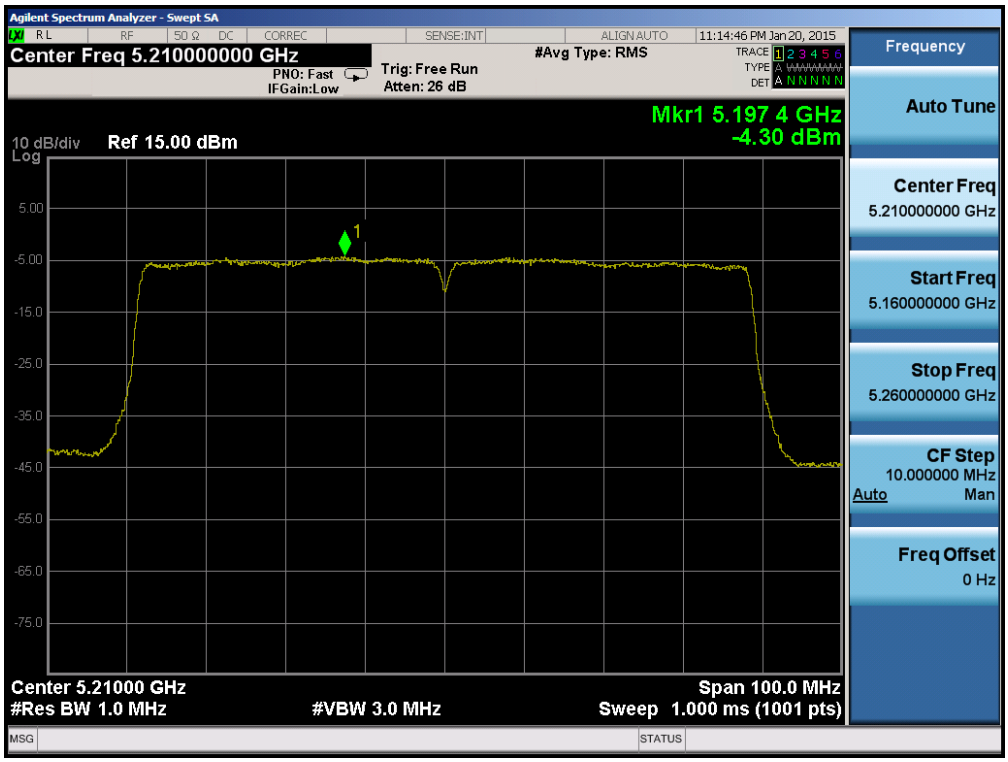
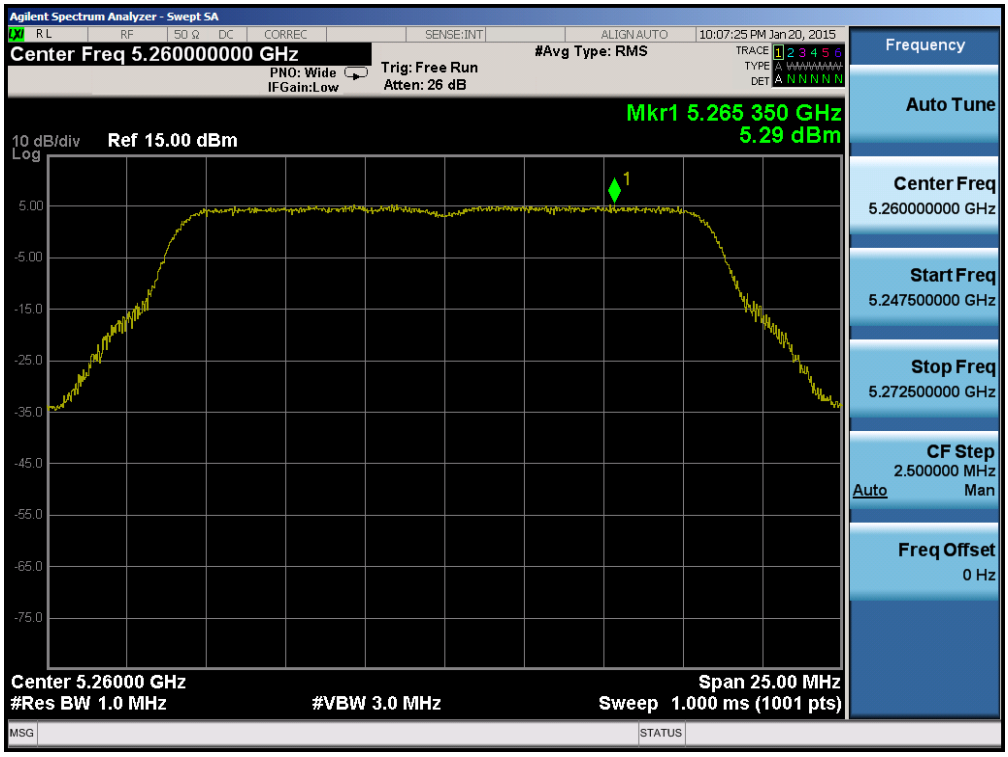



**Plot 6-85. Power Spectral Density Plot (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)**




**Plot 6-86. Power Spectral Density Plot (802.11a (UNII Band 2A) – Ch. 52)**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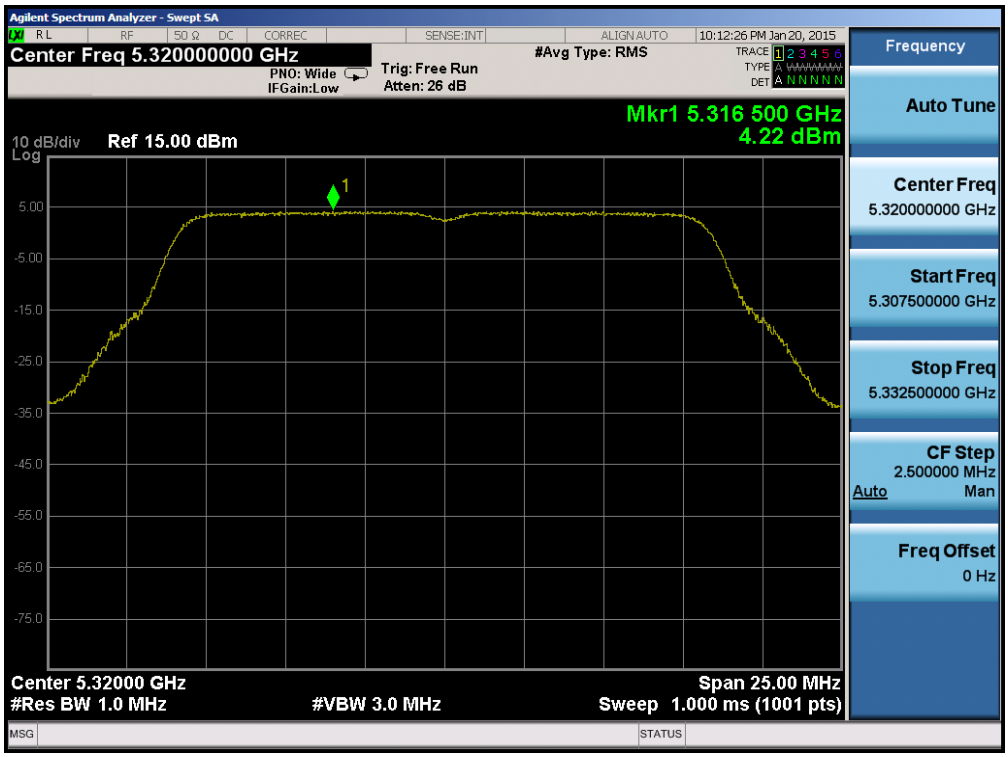
**Plot 6-87. Power Spectral Density Plot (802.11a (UNII Band 2A) – Ch. 56)**




**Plot 6-88. Power Spectral Density Plot (802.11a (UNII Band 2A) – Ch. 64)**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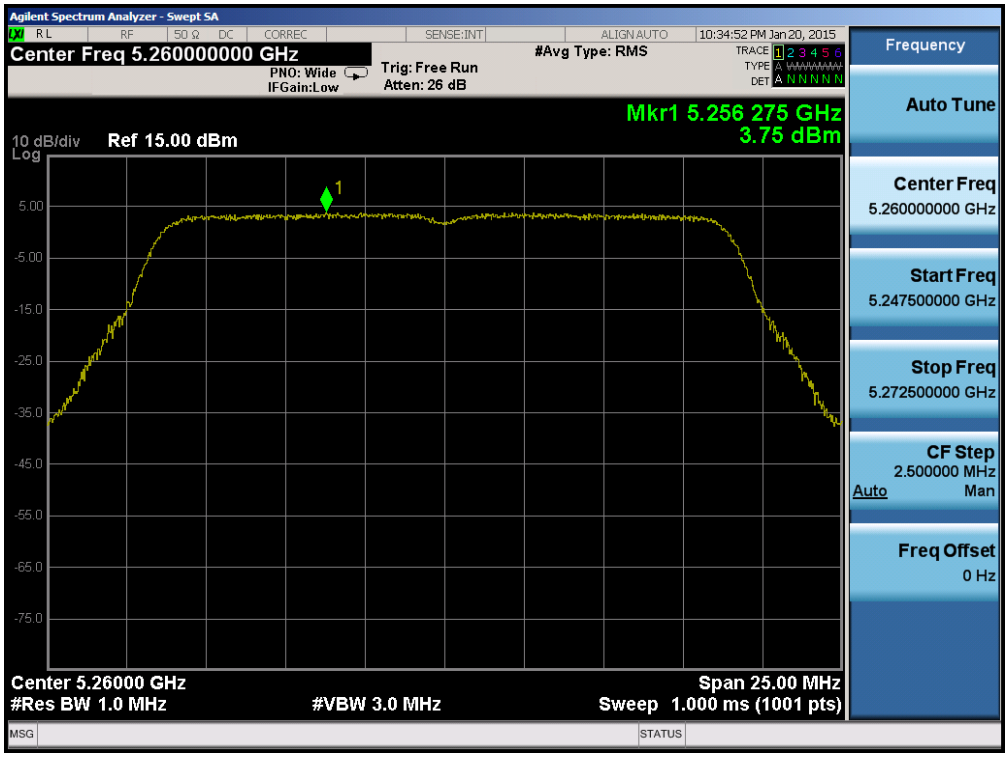
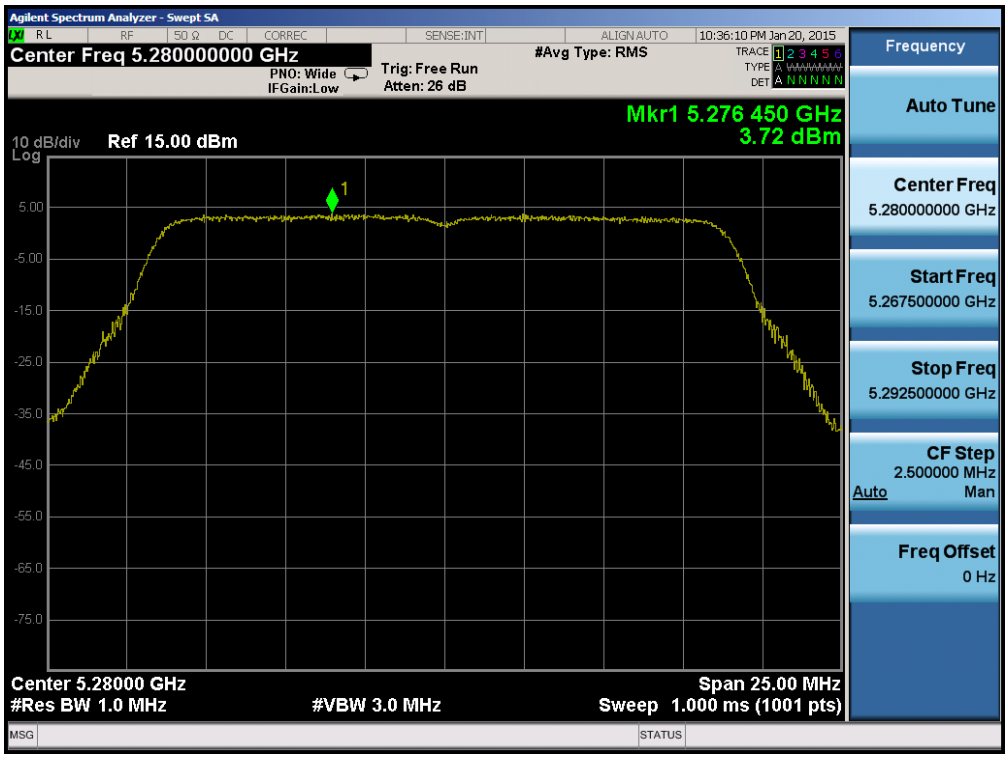



**Plot 6-89. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 52)**




**Plot 6-90. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)**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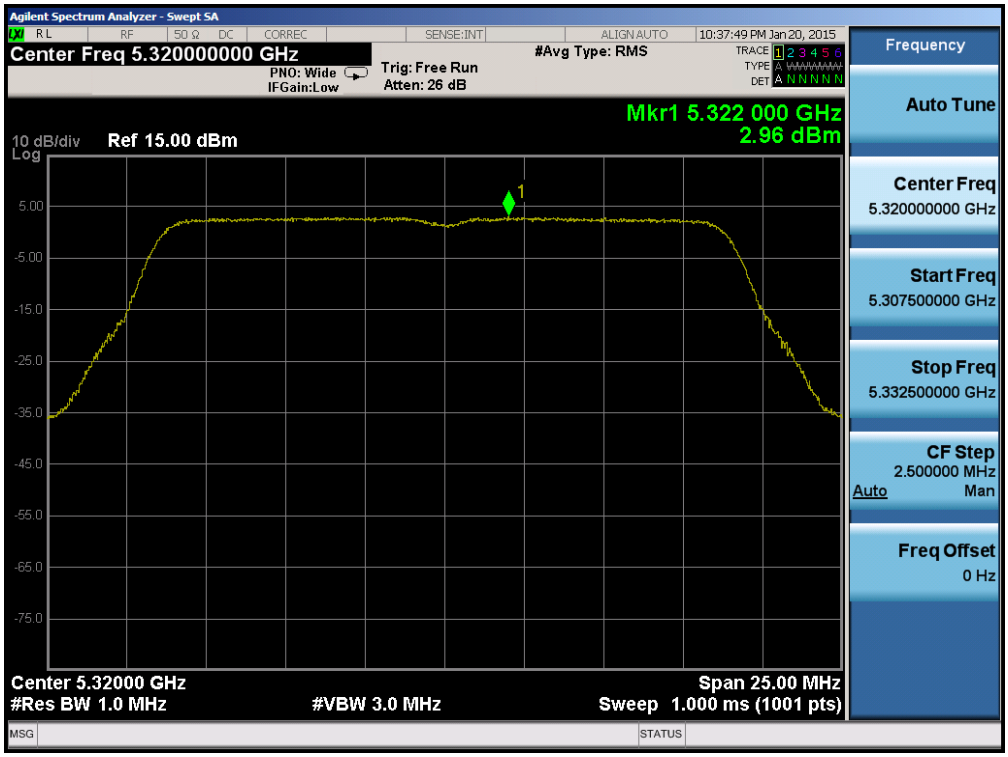
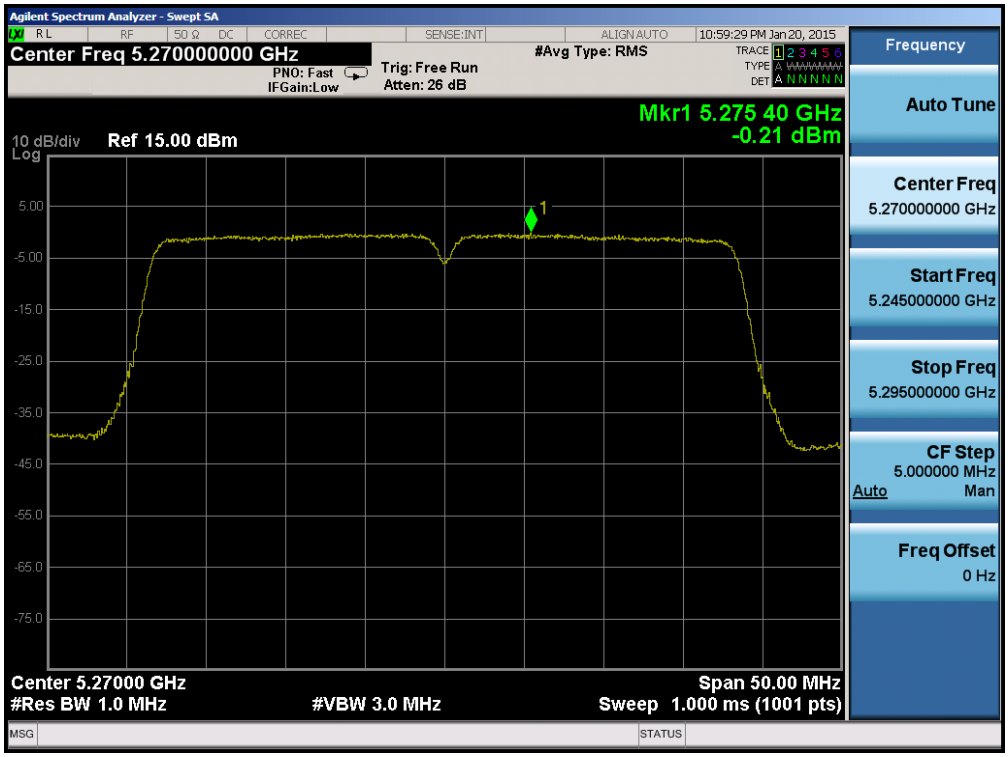



**Plot 6-91. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 64)**




**Plot 6-92. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 54)**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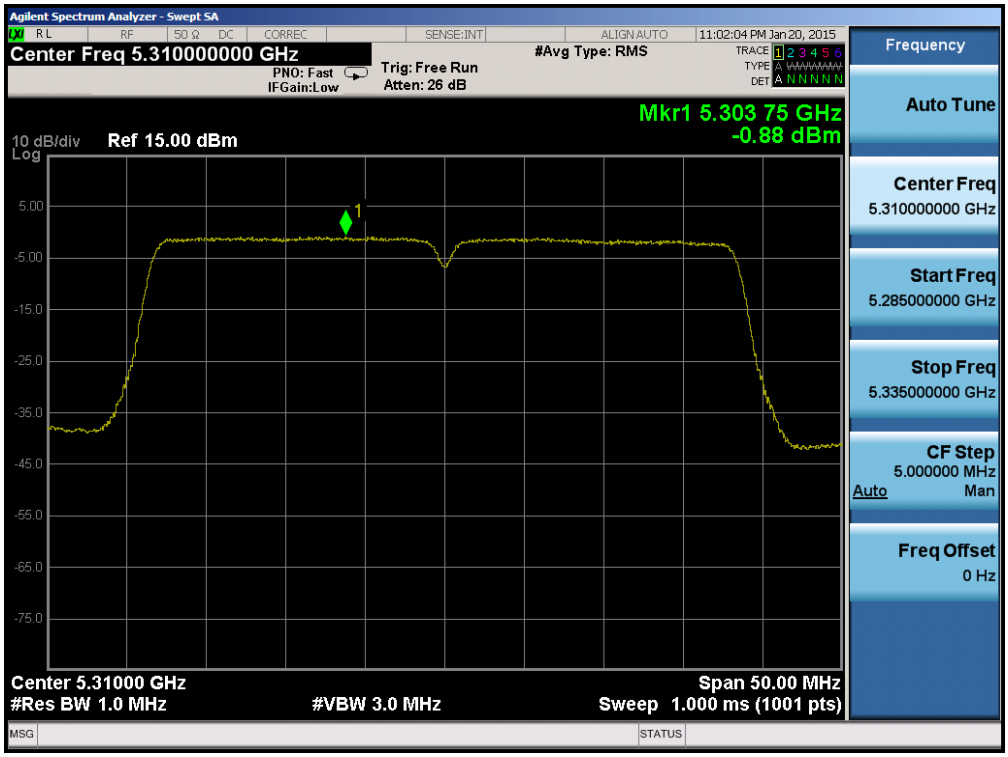
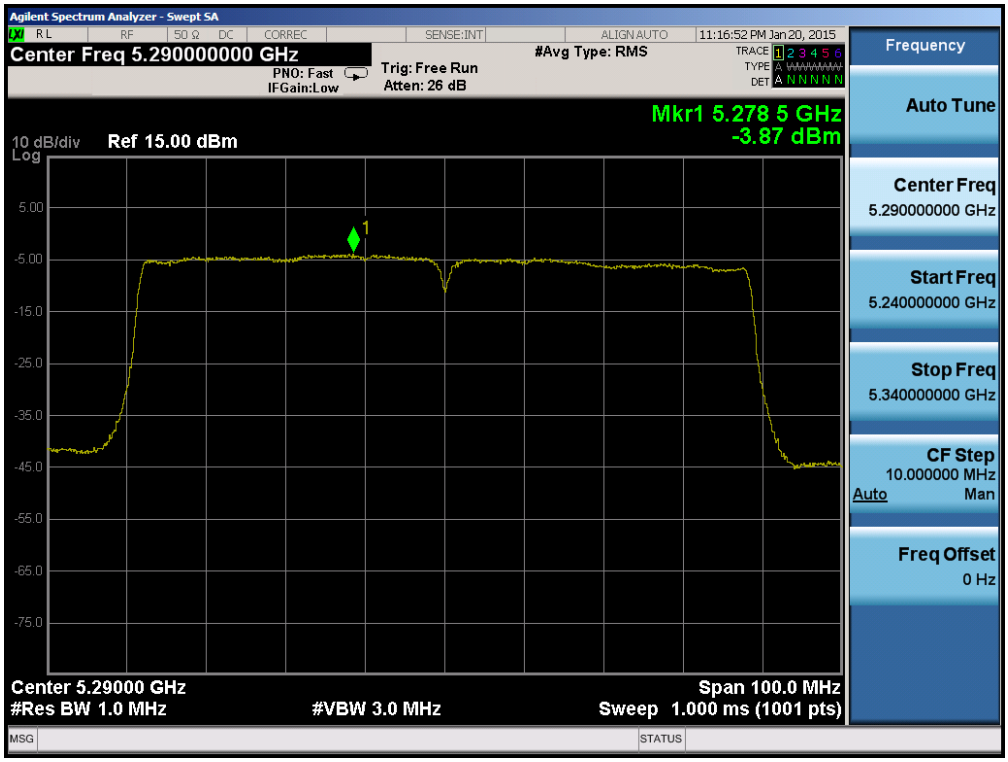



**Plot 6-93. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 62)**




**Plot 6-94. Power Spectral Density Plot (80MHz BW 802.11ac (UNII Band 2A) – Ch. 58)**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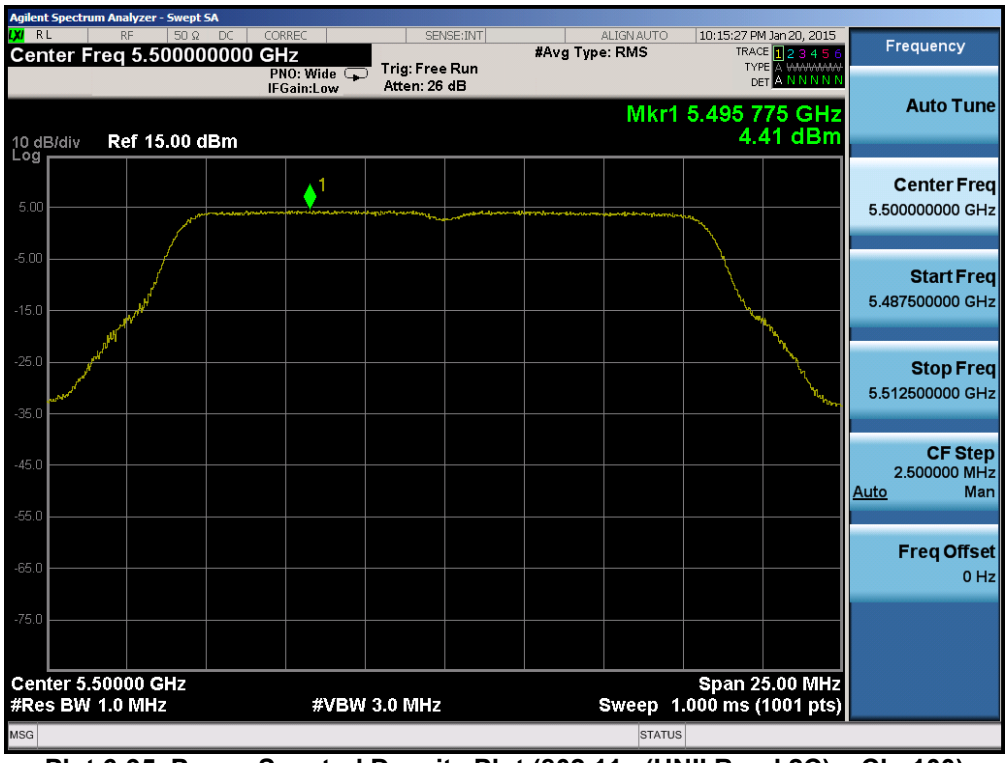
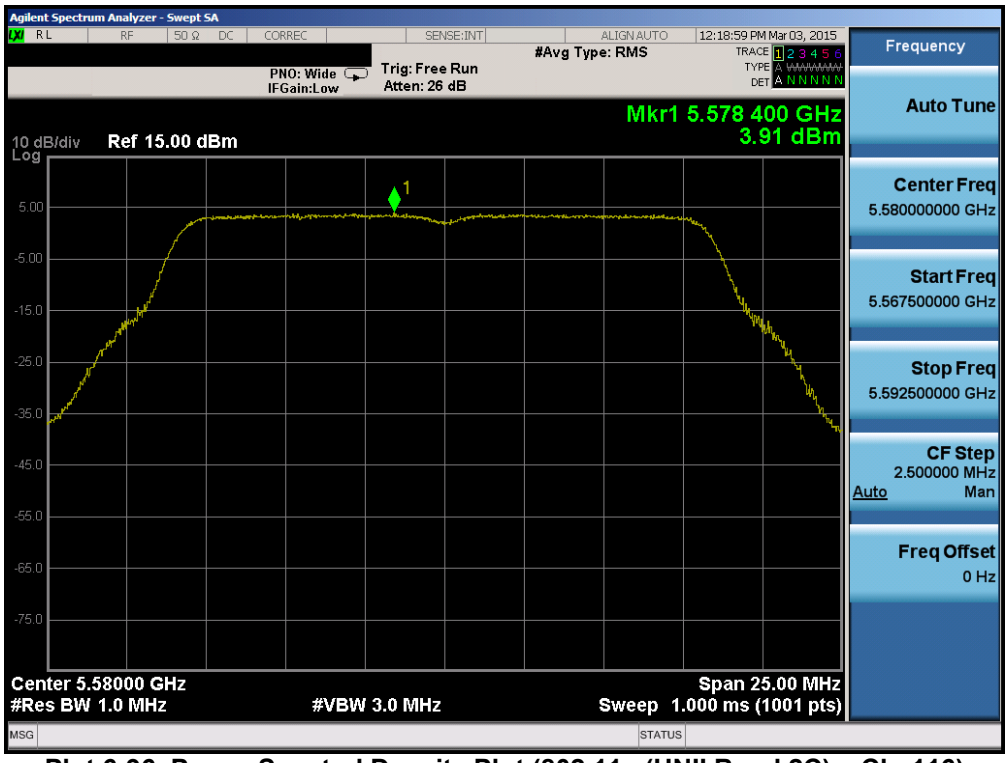



**Plot 6-95. Power Spectral Density Plot (802.11a (UNII Band 2C) – Ch. 100)**




**Plot 6-96. Power Spectral Density Plot (802.11a (UNII Band 2C) – Ch. 116)**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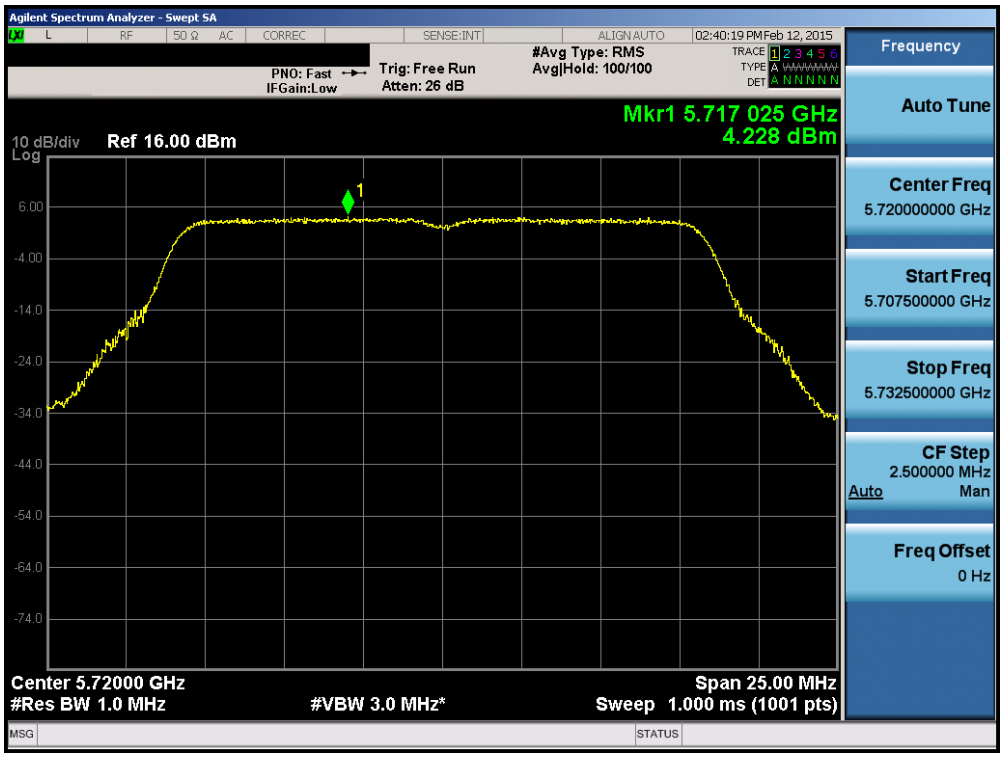
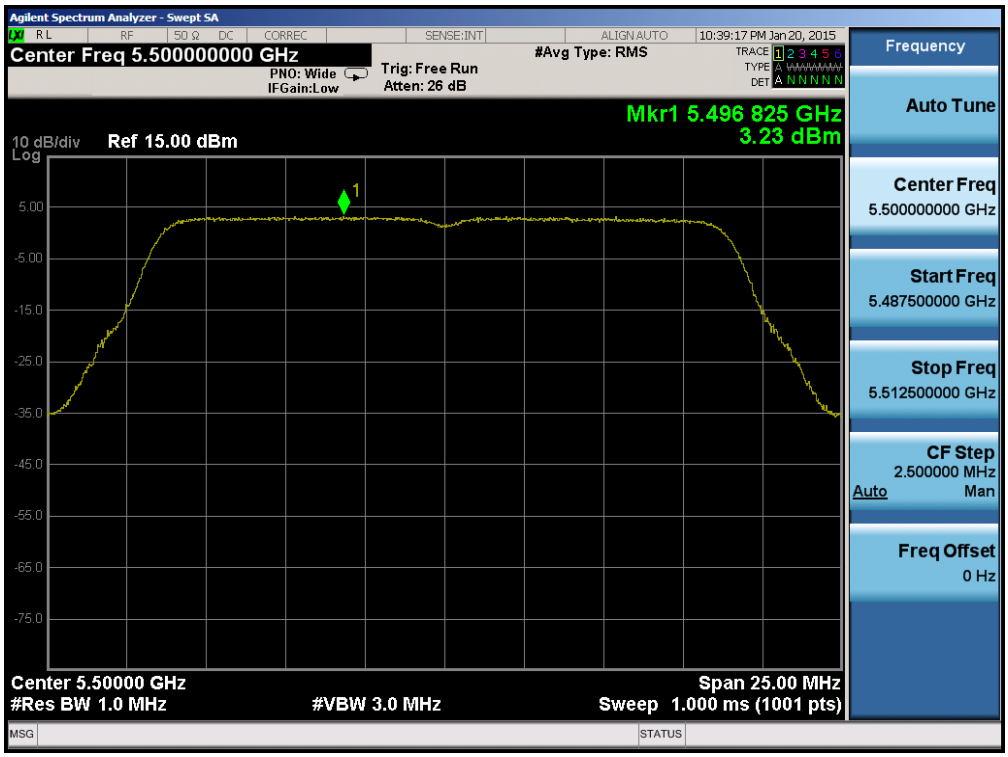



**Plot 6-97. Power Spectral Density Plot (20MHz BW 802.11a (UNII Band 2C) – Ch. 144)**




**Plot 6-98. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 100)**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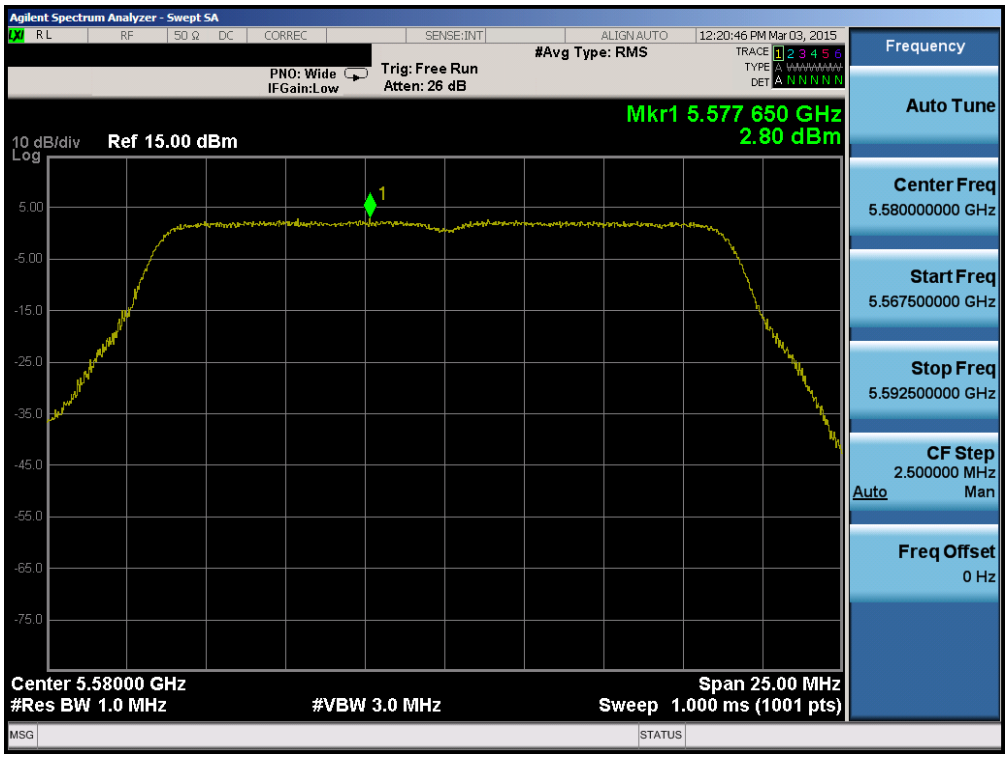


**Plot 6-99. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 116)**

**Plot 6-100. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 144)**


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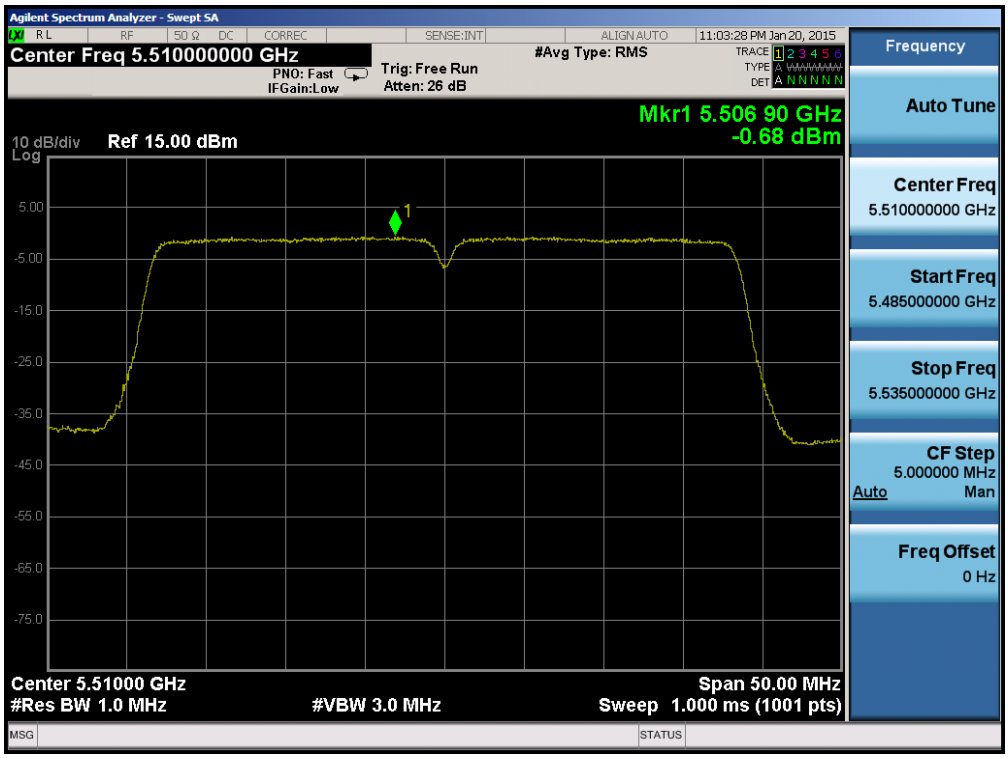
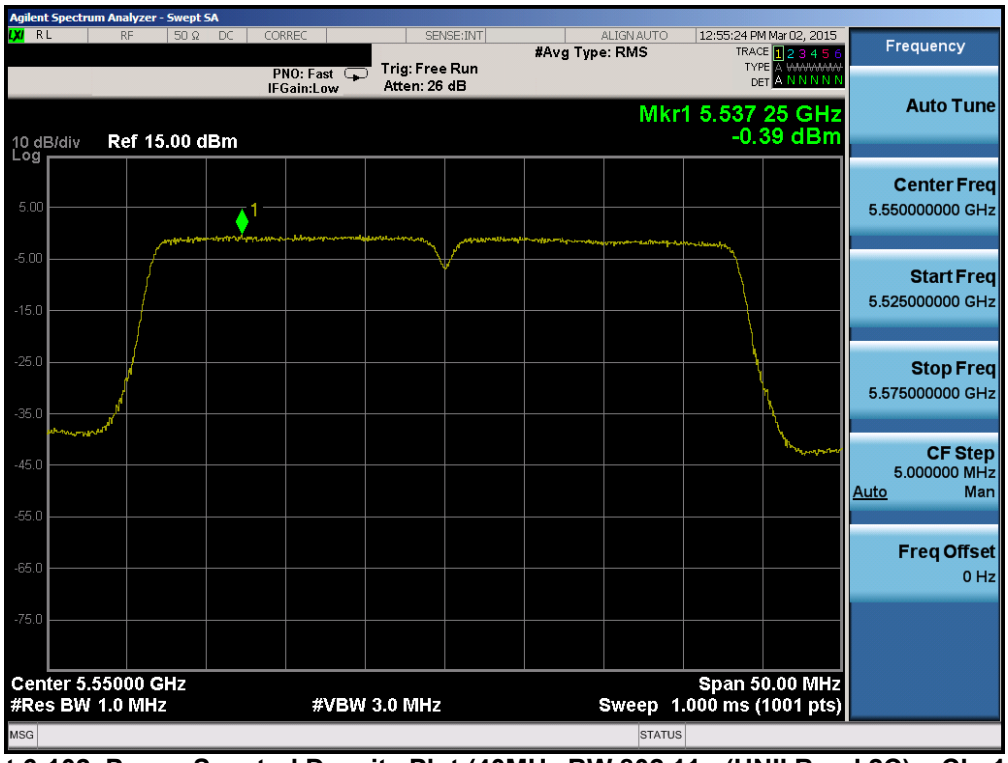



**Plot 6-101. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 102)**




**Plot 6-102. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 110)**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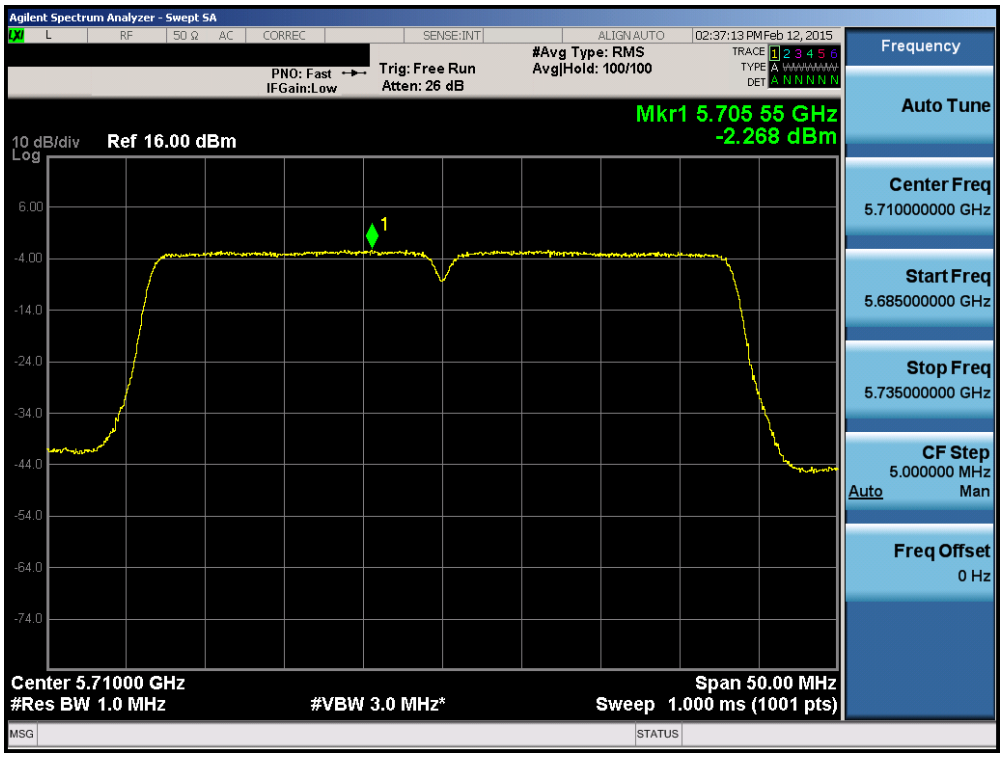
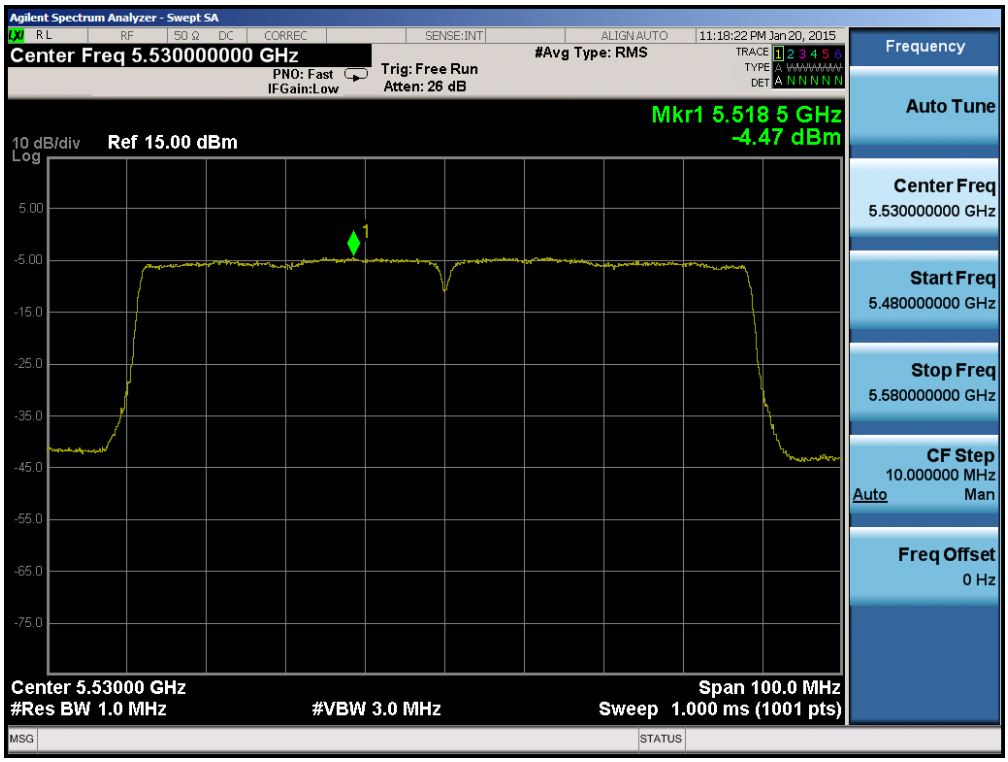



**Plot 6-103. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 142)**




**Plot 6-104. Power Spectral Density Plot (80MHz BW 802.11ac (UNII Band 2C) – Ch. 106)**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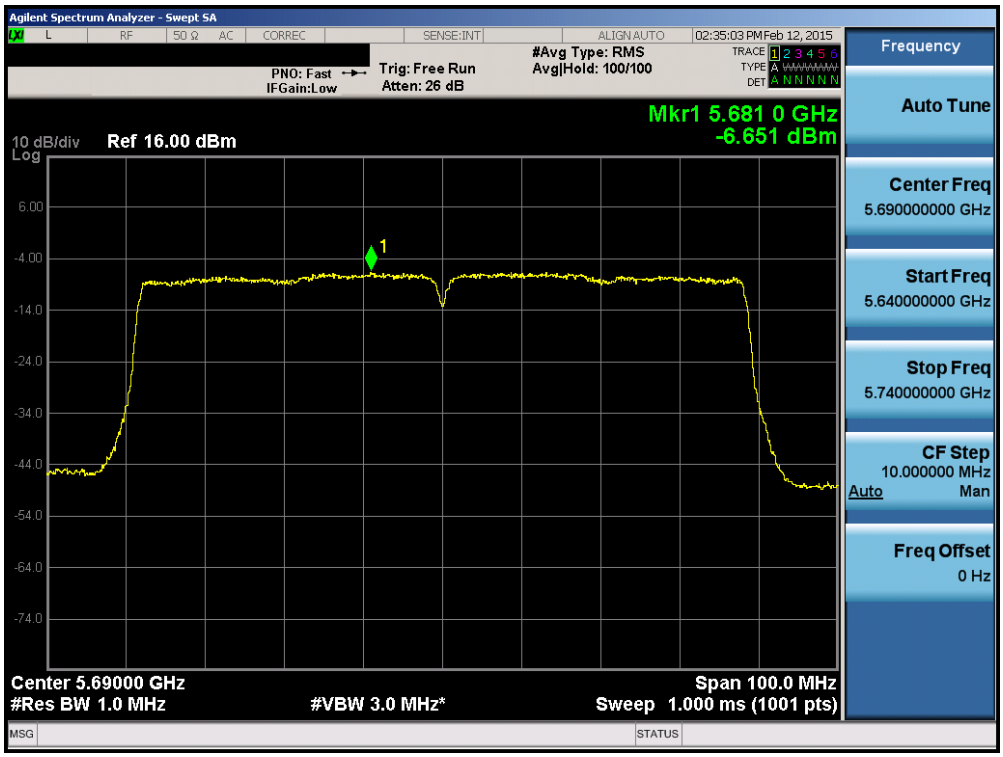


**Plot 6-105. Power Spectral Density Plot (80MHz BW 802.11ac (UNII Band 2C) – Ch. 138)**


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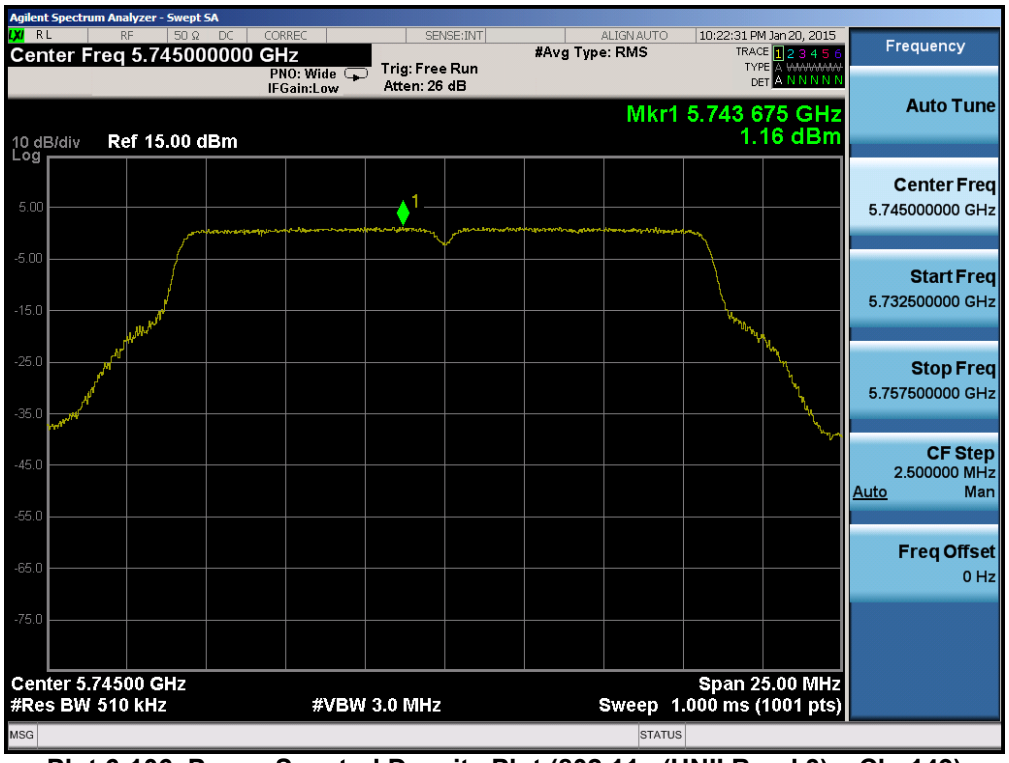
| | Frequency [MHz] | Channel No. | 802.11 Mode | Data Rate [Mbps] | Measured Power Density [dBm] | Max Permissible Power Density [dBm/500kHz] | Margin [dB] | Pass / Fail |
|---|---|---|---|---|---|---|---|---|
| Band 3 | 5745 | 149 | a | 6 | 1.16 | 30.0 | -28.84 | Pass |
| | 5785 | 157 | a | 6 | 1.42 | 30.0 | -28.58 | Pass |
| | 5825 | 165 | a | 6 | 0.65 | 30.0 | -29.35 | Pass |
| | 5745 | 149 | n (20MHz) | 6.5/7.2 (MCS0) | -0.15 | 30.0 | -30.15 | Pass |
| | 5785 | 157 | n (20MHz) | 6.5/7.2 (MCS0) | -0.28 | 30.0 | -30.28 | Pass |
| | 5825 | 165 | n (20MHz) | 6.5/7.2 (MCS0) | -0.83 | 30.0 | -30.83 | Pass |
| | 5755 | 151 | n (40MHz) | 13.5/15 (MCS0) | -3.95 | 30.0 | -33.95 | Pass |
| | 5795 | 159 | n (40MHz) | 13.5/15 (MCS0) | -4.27 | 30.0 | -34.27 | Pass |
| | 5775 | 155 | ac (80MHz) | 29.3/32.5 (MCS0) | -7.50 | 30.0 | -37.50 | Pass |

**Table 6-18. Band 3 Conducted Power Spectral Density Measurements**




**Plot 6-106. Power Spectral Density Plot (802.11a (UNII Band 3) – Ch. 149)**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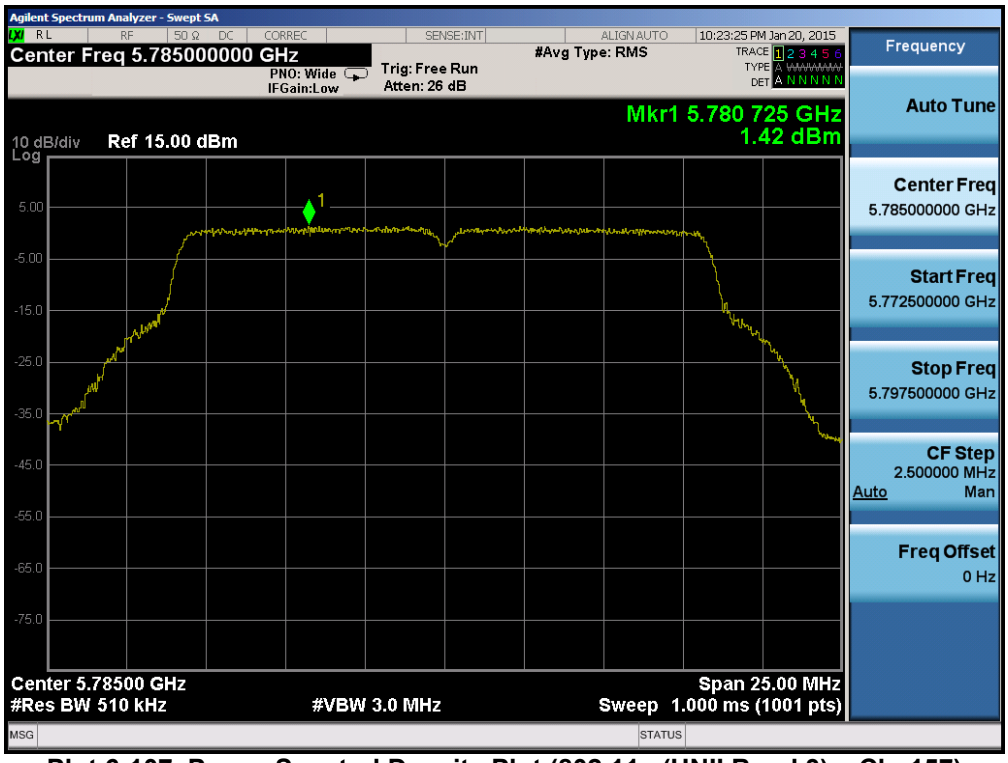
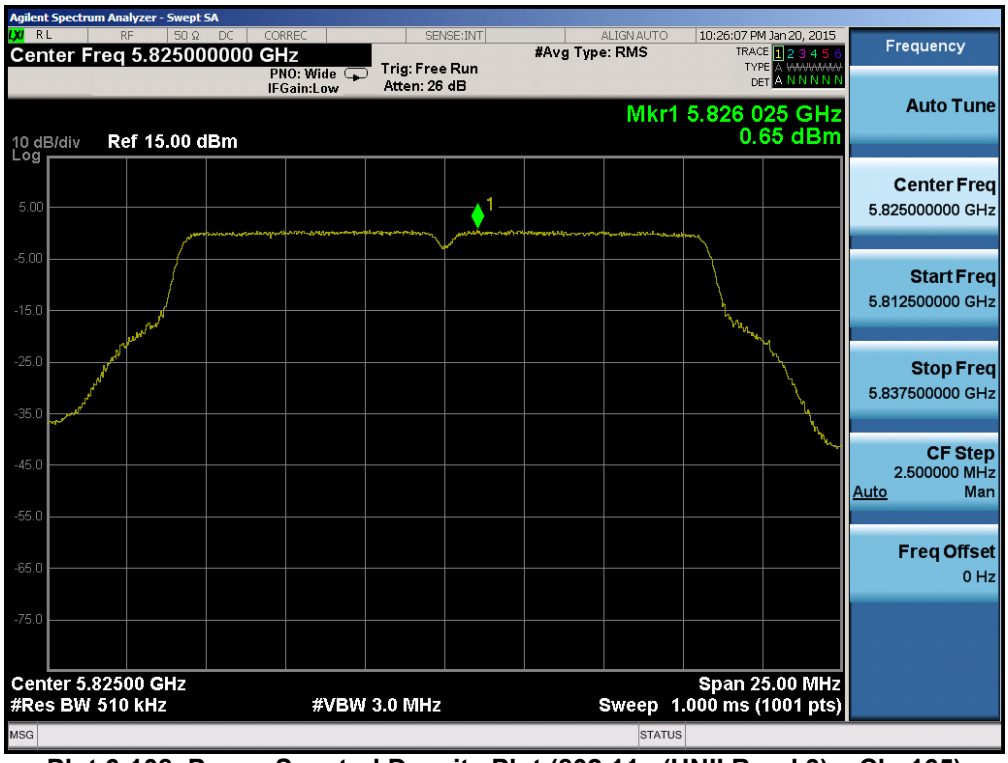



**Plot 6-107. Power Spectral Density Plot (802.11a (UNII Band 3) – Ch. 157)**




**Plot 6-108. Power Spectral Density Plot (802.11a (UNII Band 3) – Ch. 165)**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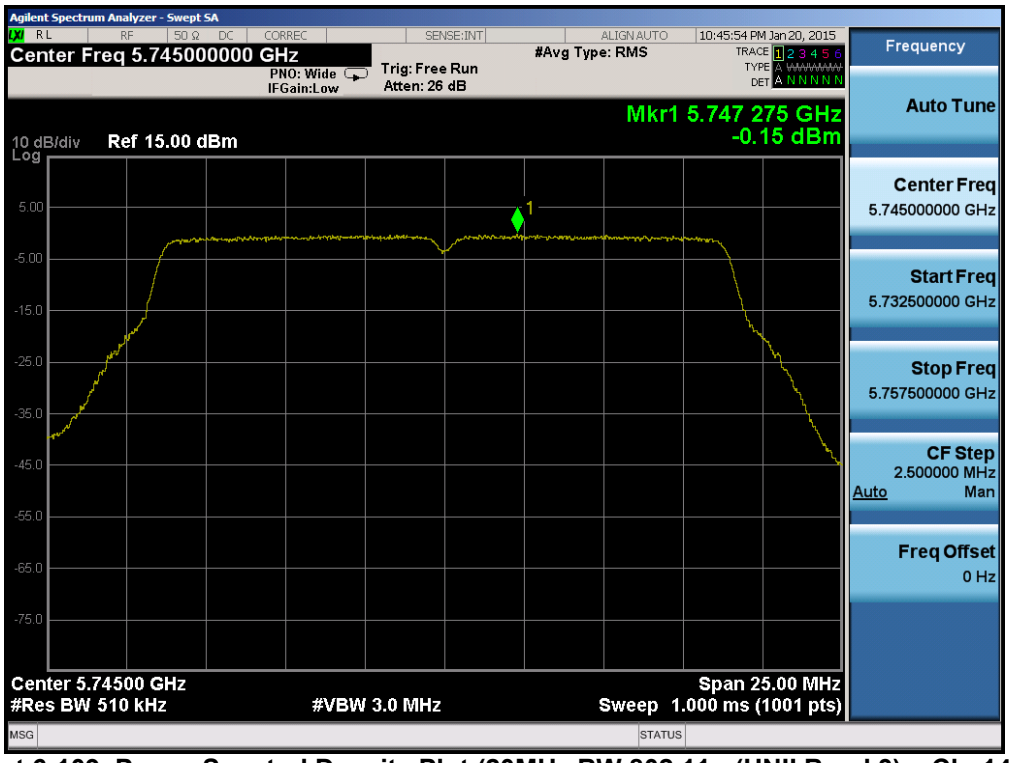
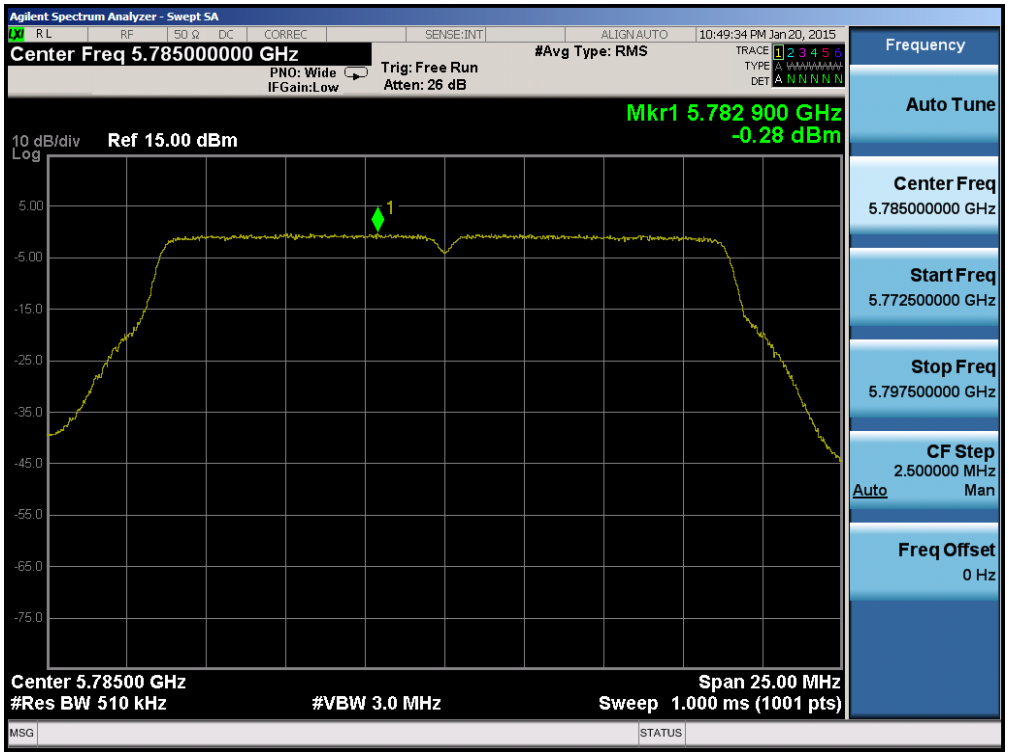



**Plot 6-109. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 149)**




**Plot 6-110. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 157)**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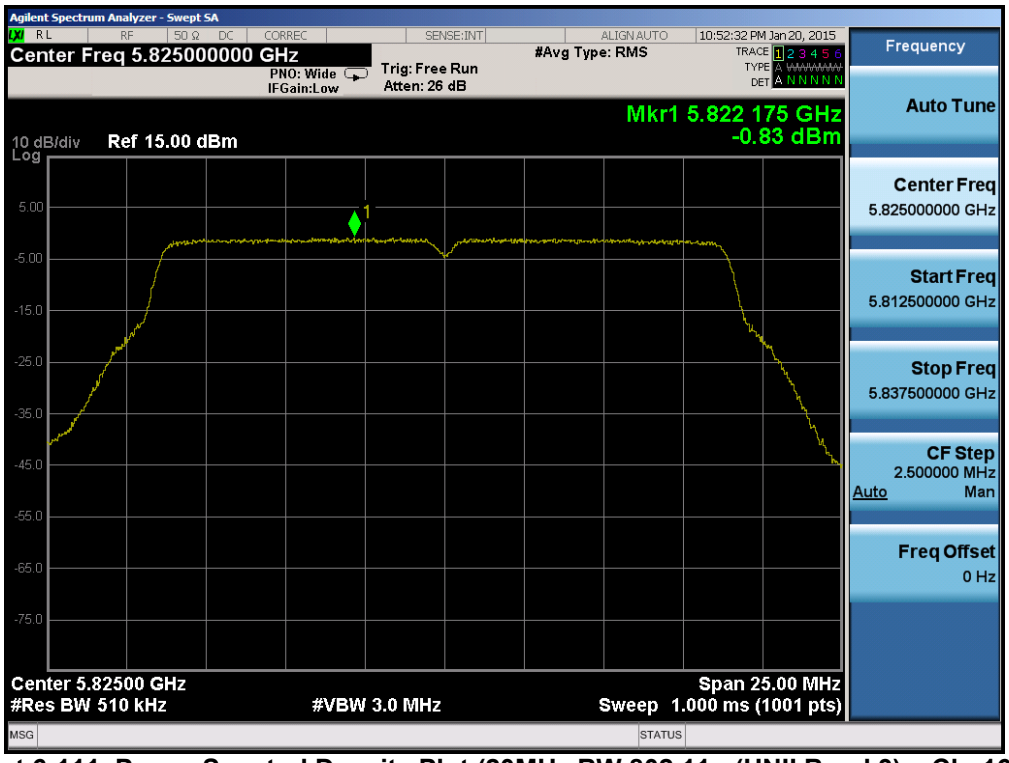
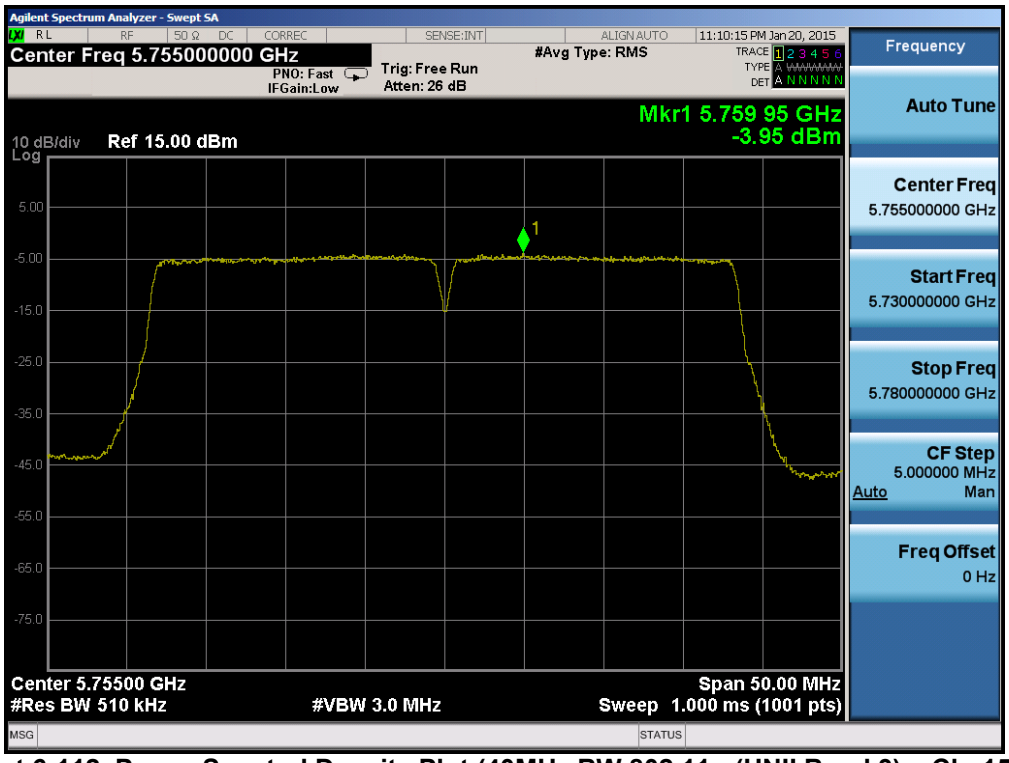



**Plot 6-111. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 165)**




**Plot 6-112. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 3) – Ch. 151)**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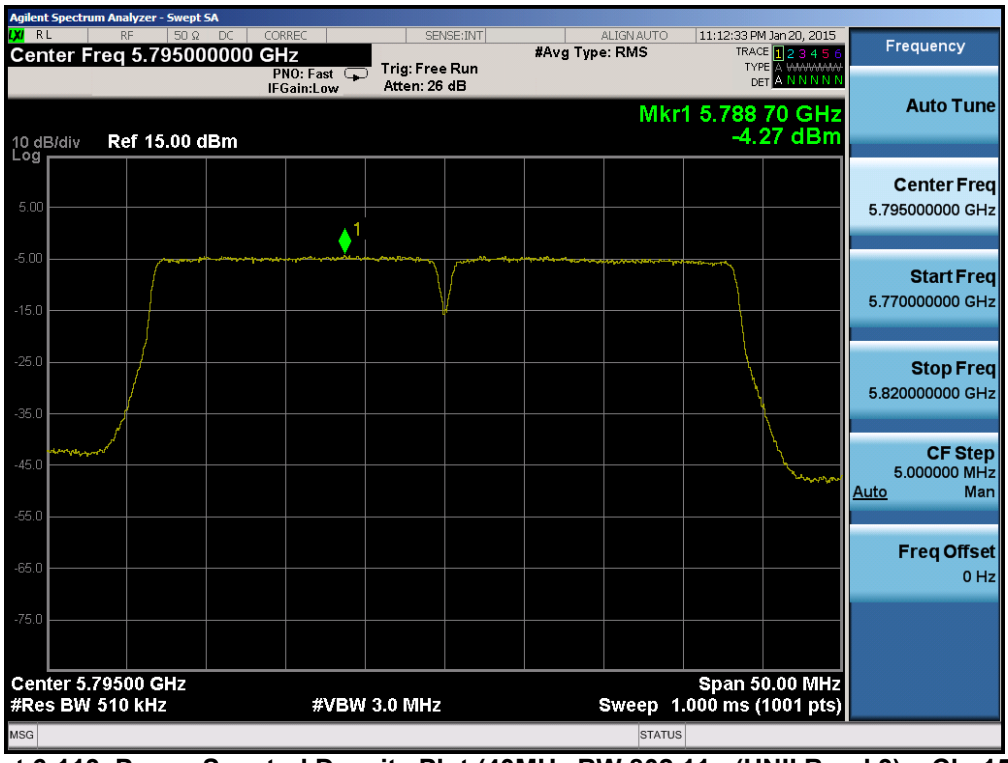
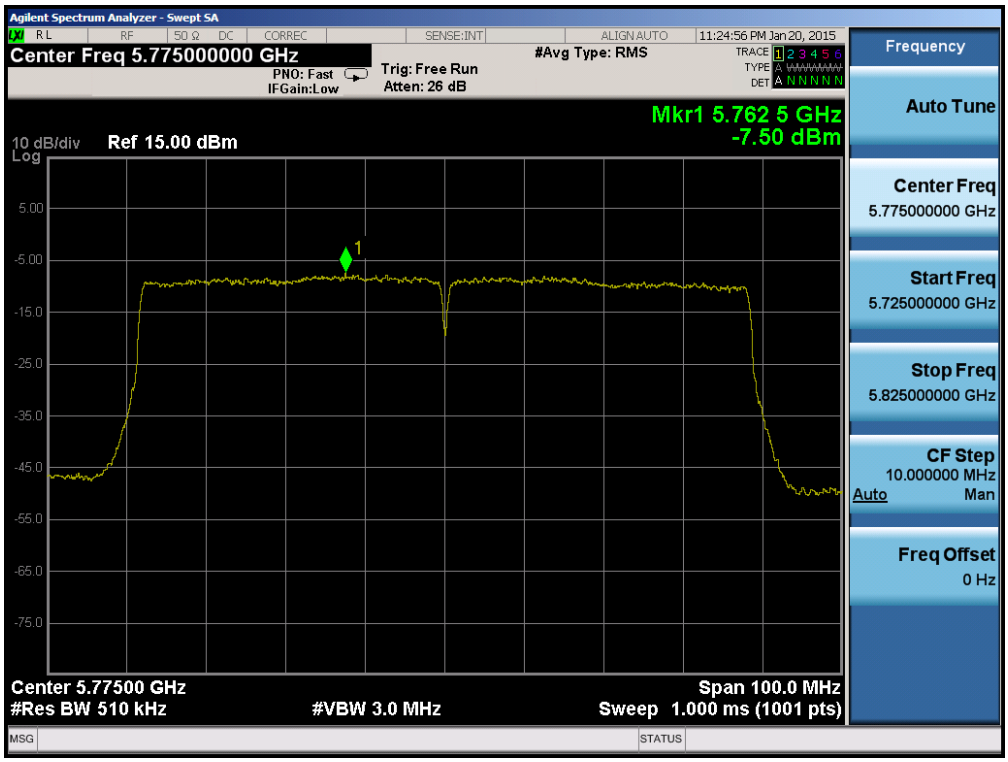



**Plot 6-113. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 3) – Ch. 159)**




**Plot 6-114. Power Spectral Density Plot (80MHz BW 802.11ac (UNII Band 3) – Ch. 155)**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