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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:
1/27 - 2/19/2014
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Test Report Serial No.:
0Y1402030280.A3L

FCC ID: **A3LSMG900F**

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

Application Type: Certification
Model(s): SM-G900F, SM-G900FQ
EUT Type: Portable Handset
FCC Classification: Unlicensed National Information Infrastructure (UNII)
FCC Rule Part(s): Part 15.407
Test Procedure(s): KDB 789033 v01r03, KDB 644545 v01r02, KDB 662911 v02r01

Mode	UNII Band	Channel Bandwidth (MHz)	Tx Frequency (MHz)	Conducted Power	
				Max. Power (mW)	Max. Power (dBm)
802.11a	1	20	5180 - 5240	13.932	11.44
	2A	20	5260 - 5320	14.093	11.49
	2C	20	5500 - 5700	14.093	11.49
802.11n	1	20	5180 - 5240	13.646	11.35
	2A	20	5260 - 5320	13.366	11.26
	2C	20	5500 - 5700	14.093	11.49
802.11n	1	40	5190 - 5230	8.710	9.40
	2A	40	5270 - 5310	8.770	9.43
	2C	40	5510 - 5670	8.892	9.49
802.11ac	1	80	5210	7.691	8.86
	2A	80	5290	8.395	9.24
	2C	80	5530	8.650	9.37

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 v01r03, KDB 644545 v01r02 and KDB 662911 v02r01. 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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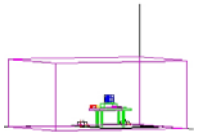

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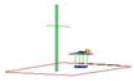
FCC Part 15.407

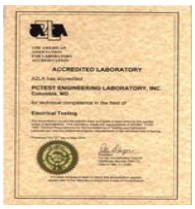


§ 2.1033 General Information

APPLICANT:	Samsung Electronics, Co. Ltd.
APPLICANT ADDRESS:	129, Samsung-ro, Maetan dong,
	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-G900F
FCC ID:	A3LSMG900F
FCC CLASSIFICATION:	Unlicensed National Information Infrastructure (UNII)
Test Device Serial No.:	14421, 14428, 15DEF ☐ Production ☒ Pre-Production ☐ Engineering
DATE(S) OF TEST:	1/27 - 2/19/2014
TEST REPORT S/N:	0Y1402030280.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.

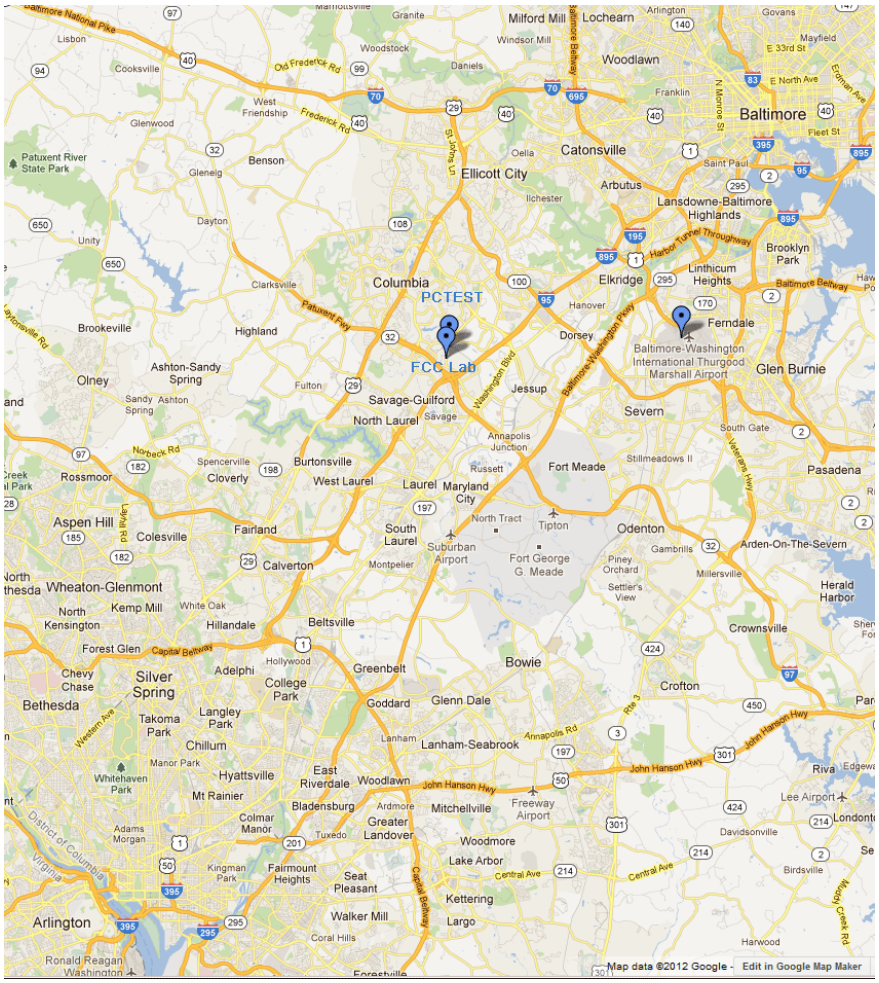

Figure 1-1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMG900F**. 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 GSM/GPRS/EDGE, 850/1900 WCDMA/HSPA, Band 2 LTE (1.4, 3, 5, 10, 15, 20MHz BW), Band 5 LTE (1.4, 3, 5, 10MHz BW), 802.11a/b/g/n/ac WLAN (DTS/NII), Bluetooth (1x,EDR, LE), NFC, ANT+

Note: 5GHz WLAN (DTS/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:

- 802.11a/n 20MHz Bandwidth – 99.0 %
- 802.11n 40MHz Bandwidth – 98.0 %
- 802.11ac 80MHz Bandwidth – 98.0 %

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

WiFi Configurations		SISO		SDM	
		ANT1	ANT2	ANT1	ANT2
2.4GHz	11b	✓	✓	×	×
	11g	✓	✓	×	×
	11n	✓	✓	✓	✓
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
.
CDD or Cyclic Delay Diversity MIMO function is also a capability of the EUT. However, since CDD only alters the system by transmitting a phase shifted (i.e. cyclical) copy of the original signal within the same allotted bandwidth and using the same Tx power, it was determined that CDD operation was the same, in regards to matters relating to the bandwidth and powers, as SDM MIMO mode, which is addressed in the report. Thus, no further measurements were performed for CDD MIMO operation.

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2.3 Test Configuration

The Samsung Portable Handset FCC ID: A3LSMG900F was tested per the guidance of KDB 789033 v01r03 and KDB 662911 v02r01. 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, 3.3, and 6.1 of this test report for a description of the AC line conducted emissions, radiated emissions, and antenna port conducted emissions test setups, respectively.

2.4 EMI Suppression Device(s)/Modifications

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

2.5 Labeling Requirements

Per 2.1074 & 15.19; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase. However, when the device is so small wherein placement of the label with specified statement is not practical, only the trade name and FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

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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 v01r03 and KDB 662911 v02r01 were used in the measurement of **Samsung Portable Handset FCC ID: A3LSMG900F.**

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 6.17. Automated test software was used to perform the AC line conducted emissions testing. Automated measurement software utilized is Rohde & Schwarz EMC32, Version 8.51.0.

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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. 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. For the EUT positioning, "H" is defined with the EUT lying flat on the test surface, "H2" is defined with the EUT standing up on its side, and "V" is defined with the EUT standing upright.

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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: A3LSMG900F** unit complies with the requirement of §15.203.

Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
36	5180	52	5260	100	5500
:	:	:	:	:	:
42	5210	56	5280	116	5580
:	:	:	:	:	:
48	5240	64	5320	140	5700

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

Band 1		Band 2A		Band 2C	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
38	5190	54	5270	102	5510
:	:	:	:	:	:
46	5230	62	5310	110	5550
				:	:
				134	5670

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

Band 1		Band 2A		Band 2C	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
42	5210	58	5290	106	5530

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)	3/29/2013	Annual	3/29/2014	N/A
-	WL25-1	Conducted Cable Set (25GHz)	1/29/2014	Annual	1/29/2015	N/A
-	RE2	Radiated Emissions Cable Set (VHF/UHF)	3/29/2013	Annual	3/29/2014	N/A
-	WL40-1	Conducted Cable Set (40GHz)	1/29/2014	Annual	1/29/2015	N/A
Agilent	8447D	Broadband Amplifier	5/31/2013	Annual	5/31/2014	2443A01900
Agilent	E4448A	PSA (3Hz-50GHz) Spectrum Analyzer	4/18/2013	Annual	4/18/2014	US42510244
Agilent	N9020A	MXA Signal Analyzer	10/29/2013	Annual	10/29/2014	US46470561
Anritsu	ML2495A	Power Meter	10/31/2013	Annual	10/31/2014	941001
Anritsu	MA2411B	Pulse Sensor	11/13/2013	Annual	11/13/2014	846215
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	6/26/2013	Annual	6/26/2014	121034
Espec	ESX-2CA	Environmental Chamber	4/16/2013	Annual	4/16/2014	17620
ETS Lindgren	3117	1-18 GHz DRG Horn (Medium)	7/24/2013	Biennial	7/24/2015	125518
ETS Lindgren	3160-09	18-26.5 GHz Standard Gain Horn	5/30/2012	Biennial	5/30/2014	135427
ETS Lindgren	3160-10	26.5-40 GHz Standard Gain Horn	6/6/2012	Biennial	6/6/2014	130993
Huber+Suhner	Sucoflex 102A	40GHz Radiated Cable	1/30/2014	Annual	1/30/2015	251425001
K & L	6000/T18000	High Pass Filter	2/7/2014	Annual	2/7/2015	1
Mini-Circuits	VHF-3100+	High Pass Filter	1/27/2014	Annual	1/27/2015	30841
Pasternack	NMLC-1	Line Conducted Emissions Cable (NM)	1/28/2014	Annual	1/28/2015	N/A
Rohde & Schwarz	TS-PR18	1-18 GHz Pre-Amplifier	5/31/2013	Annual	5/31/2014	100071
Rohde & Schwarz	TS-PR26	18-26.5 GHz Pre-Amplifier	5/31/2013	Annual	5/31/2014	100040
Rohde & Schwarz	TS-PR40	26.5-40 GHz Pre-Amplifier	6/6/2012	Biennial	6/6/2014	100037
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	1/24/2014	Annual	1/24/2015	100348
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

Note:

All test equipment listed above was used within the calibration period.

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6.0 TEST RESULTS

6.1 Summary

Company Name: Samsung Electronics, Co. Ltd.
FCC ID: A3LSMG900F
Method/System: Unlicensed National Information Infrastructure (UNII)
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)

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 (a.1)	Maximum Conducted Output Power	< 4 + 10log$_{10}$(BW) dBm (5150-5250MHz) [FCC] < 10 + 10log$_{10}$(BW) dBm (5150-5250MHz) [IC] < 11 + 10log$_{10}$(B) dBm (5250-5350MHz, 5470 – 5725MHz)		PASS	Section 6.3
15.407 (a.1), (5)	Peak Power Spectral Density	< 4 dBm/MHz (5150-5250) [FCC] < 10dBm/MHz (5150-5250) [IC] < 11dBm/MHz (5250-5350) < 11dBm/MHz (5470-5725)		PASS	Section 6.4
15.407(a.6)	Peak Excursion	< 13 dB/MHz maximum difference		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.1), (2),(3)	Undesirable Emissions	< -27 dBm/MHz EIRP (5150-5350MHz, 5470-5725MHz)	RADIATED	PASS	Section 6.7
15.205, 15.407(b.1), (5), (6)	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209 (RSS-210 table 3 limits)		PASS	Section 6.8, 6.9, 6.10, 6.11, 6.12, 6.13, 6.14, 6.15, 6.16
15.407	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits or < RSS-Gen table 2 limits	LINE CONDUCTED	PASS	Section 6.17

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 2.4.

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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 duty cycle (>98%), at its maximum power control level, as defined in KDB 789033 v01r03, 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 v01r03 – 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.

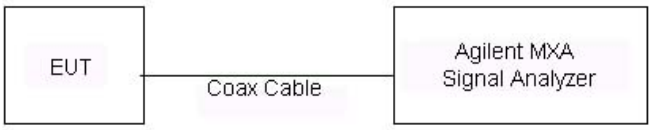

Figure 6-1. Test Instrument & Measurement Setup

Test Notes

Per KDB 644545 v01r01 and 15.215(c), a 20dB bandwidth measurement can be performed to demonstrate that the entire emission of one channel lies solely within a particular band. A 20dB bandwidth plot, representative of all channels, is included at the end of this section to show that the DFS requirements are not applicable in UNII Band 1 since the Band 1 channel does not cross over into Band 2A. Another 20dB bandwidth plot is also included to show that no emissions are present within the 5600 – 5650MHz TDWR band.

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Antenna-1 26dB Bandwidth Measurements

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured 26dB Bandwidth [MHz]
Band 1	5180	36	a	6	21.41
	5200	40	a	6	21.54
	5240	48	a	6	21.42
	5180	36	n (20MHz)	6.5/7.2 (MCS0)	21.62
	5200	40	n (20MHz)	6.5/7.2 (MCS0)	21.54
	5240	48	n (20MHz)	6.5/7.2 (MCS0)	21.58
	5190	38	n (40MHz)	13.5/15 (MCS0)	39.89
	5230	46	n (40MHz)	13.5/15 (MCS0)	39.76
	5210	42	ac (80MHz)	29.3/32.5 (MCS0)	81.47
Band 2A	5260	52	a	6	21.43
	5280	56	a	6	21.46
	5320	64	a	6	21.56
	5260	52	n (20MHz)	6.5/7.2 (MCS0)	21.65
	5280	56	n (20MHz)	6.5/7.2 (MCS0)	21.71
	5320	64	n (20MHz)	6.5/7.2 (MCS0)	21.53
	5270	54	n (40MHz)	13.5/15 (MCS0)	39.95
	5310	62	n (40MHz)	13.5/15 (MCS0)	40.03
	5290	58	ac (80MHz)	29.3/32.5 (MCS0)	81.48
Band 2C	5500	100	a	6	21.52
	5580	116	a	6	21.51
	5700	140	a	6	21.41
	5500	100	n (20MHz)	6.5/7.2 (MCS0)	21.68
	5580	116	n (20MHz)	6.5/7.2 (MCS0)	21.52
	5700	140	n (20MHz)	6.5/7.2 (MCS0)	21.70
	5510	102	n (40MHz)	13.5/15 (MCS0)	39.83
	5550	110	n (40MHz)	13.5/15 (MCS0)	39.99
	5670	134	n (40MHz)	13.5/15 (MCS0)	39.77
	5530	106	ac (80MHz)	29.3/32.5 (MCS0)	81.60

Table 6-2. Conducted Bandwidth Measurements

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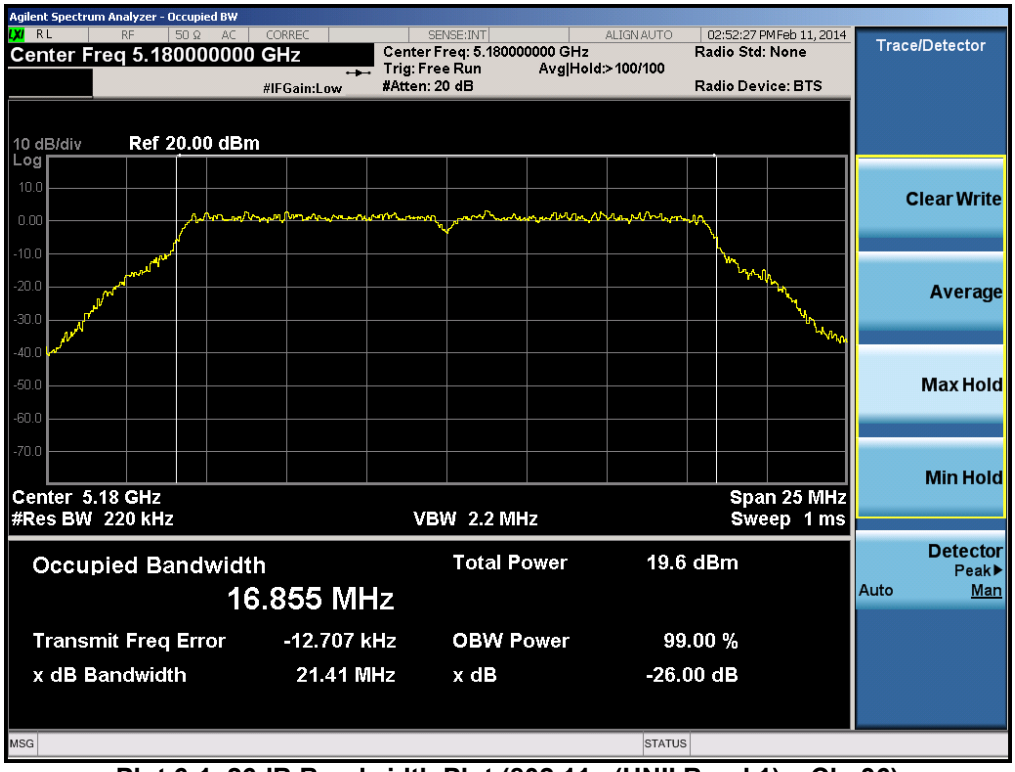
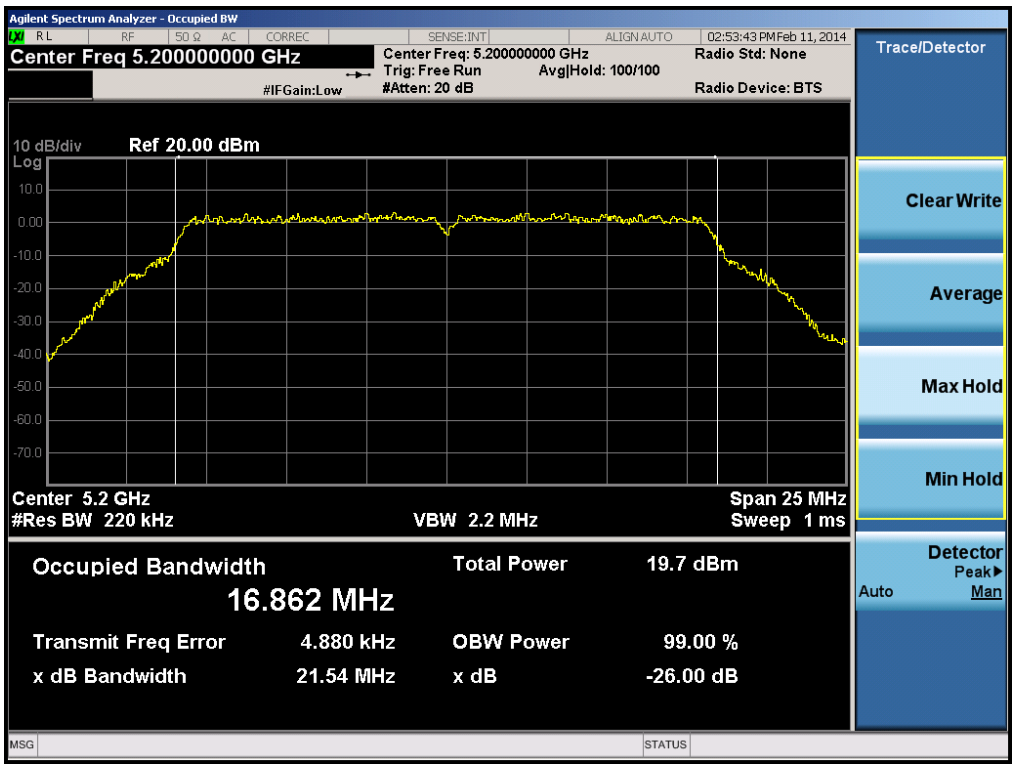


Plot 6-1. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 36)



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

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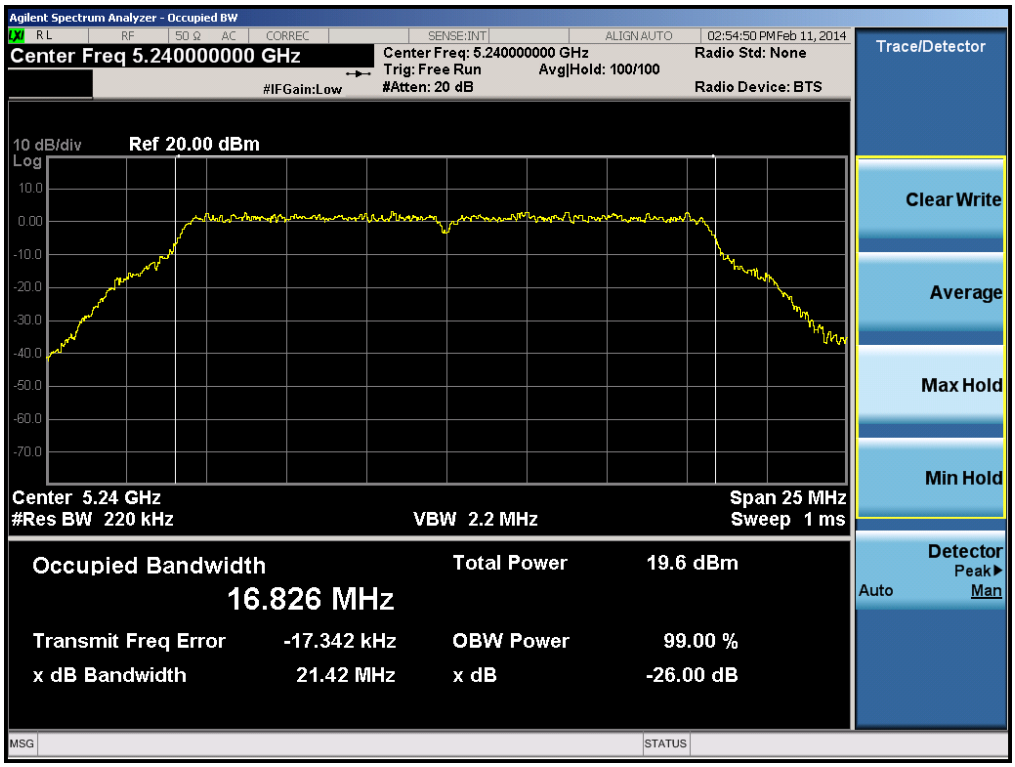
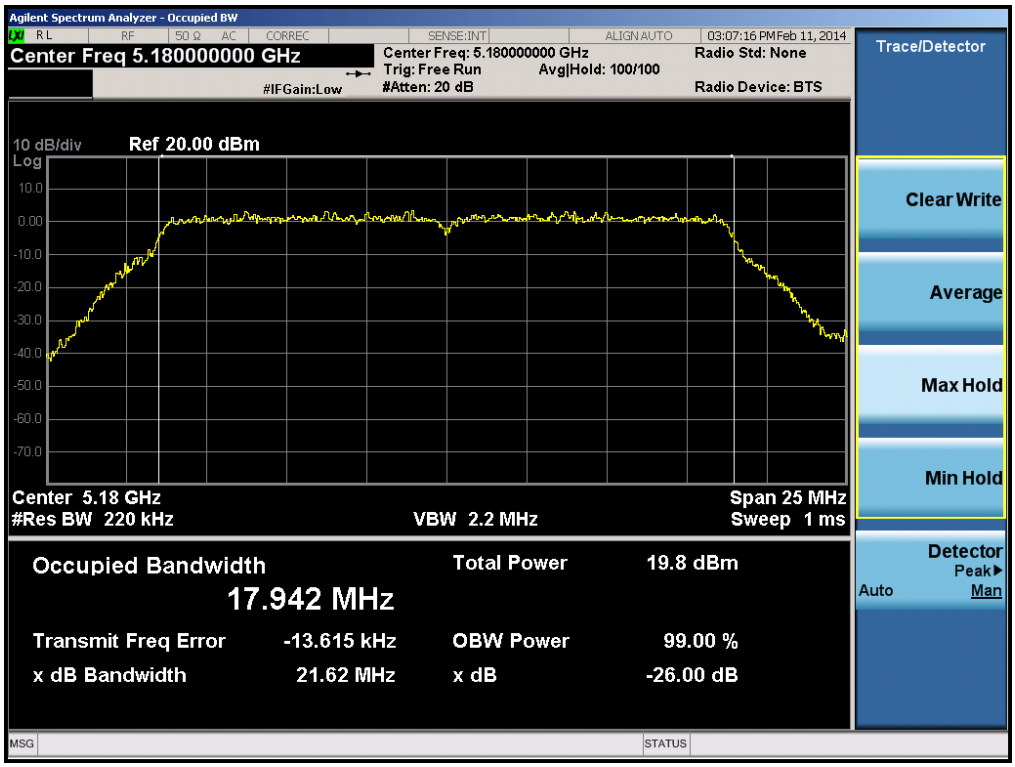


Plot 6-3. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 48)



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

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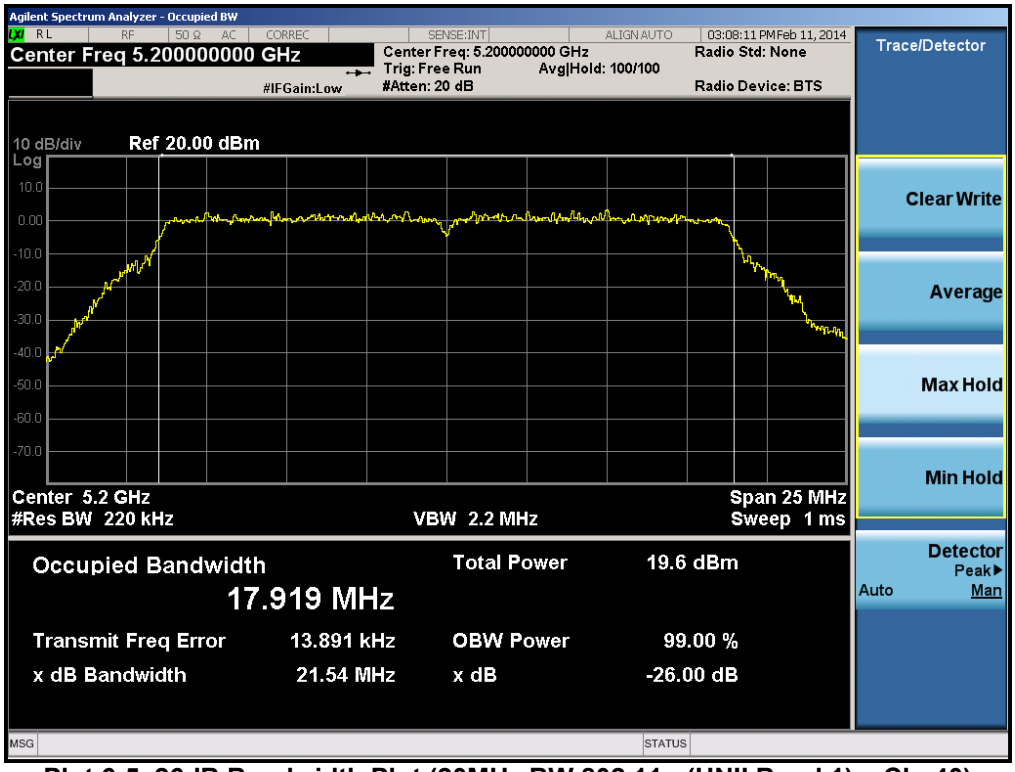
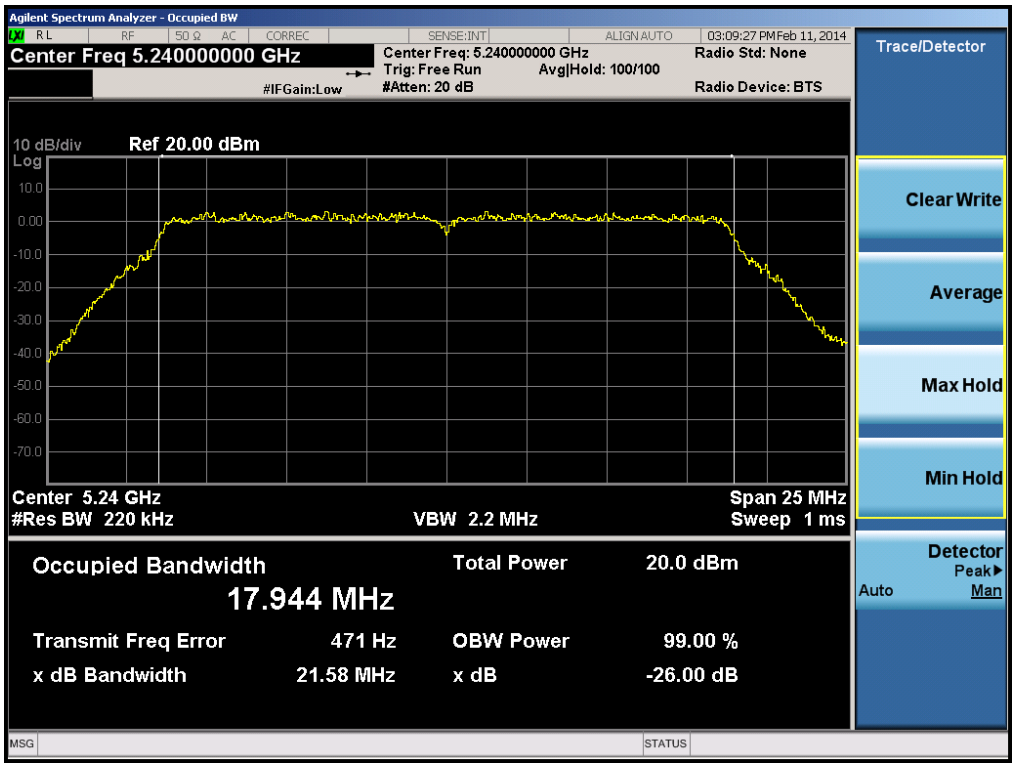


Plot 6-5. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 40)



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

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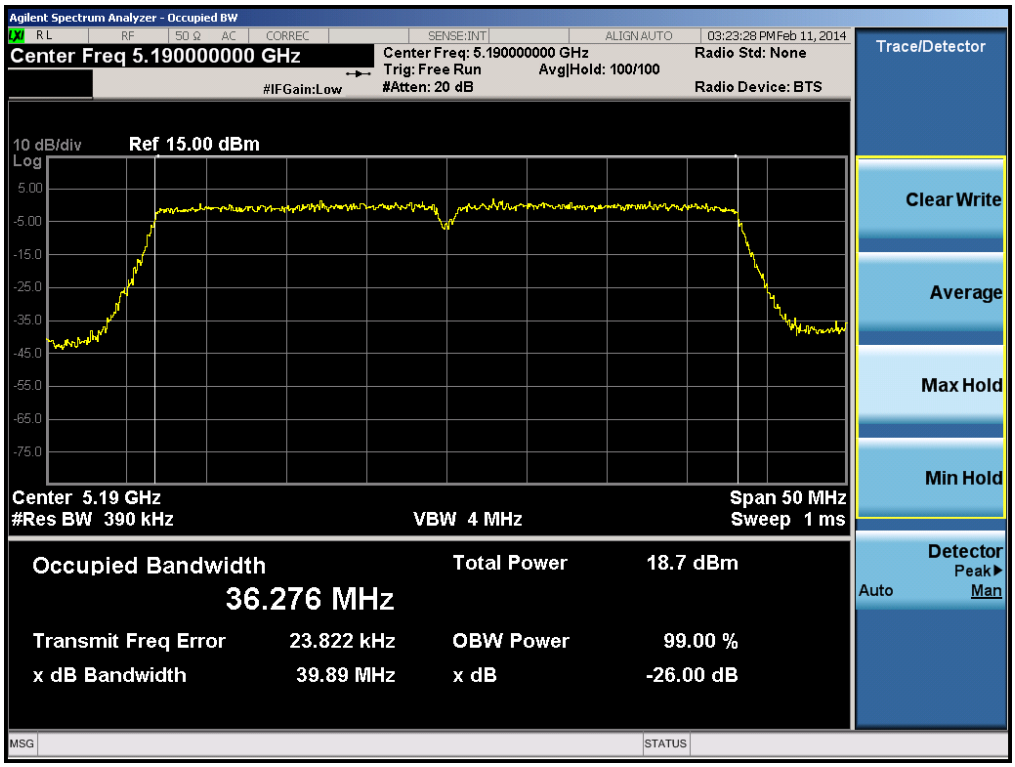
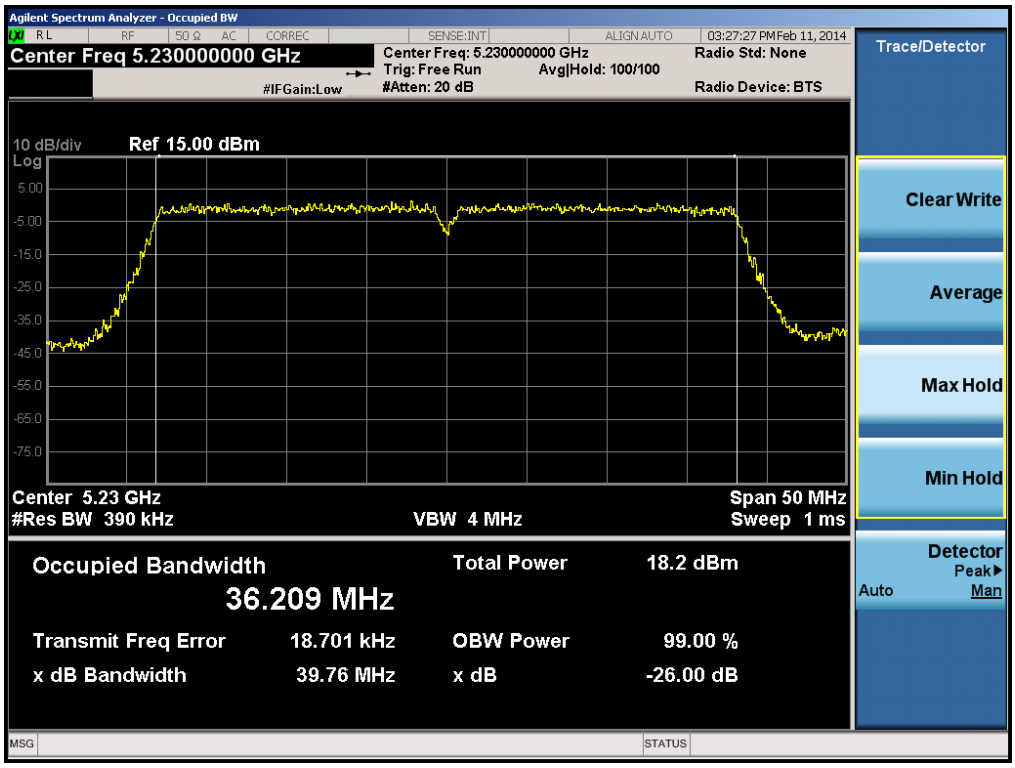


Plot 6-7. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 38)



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

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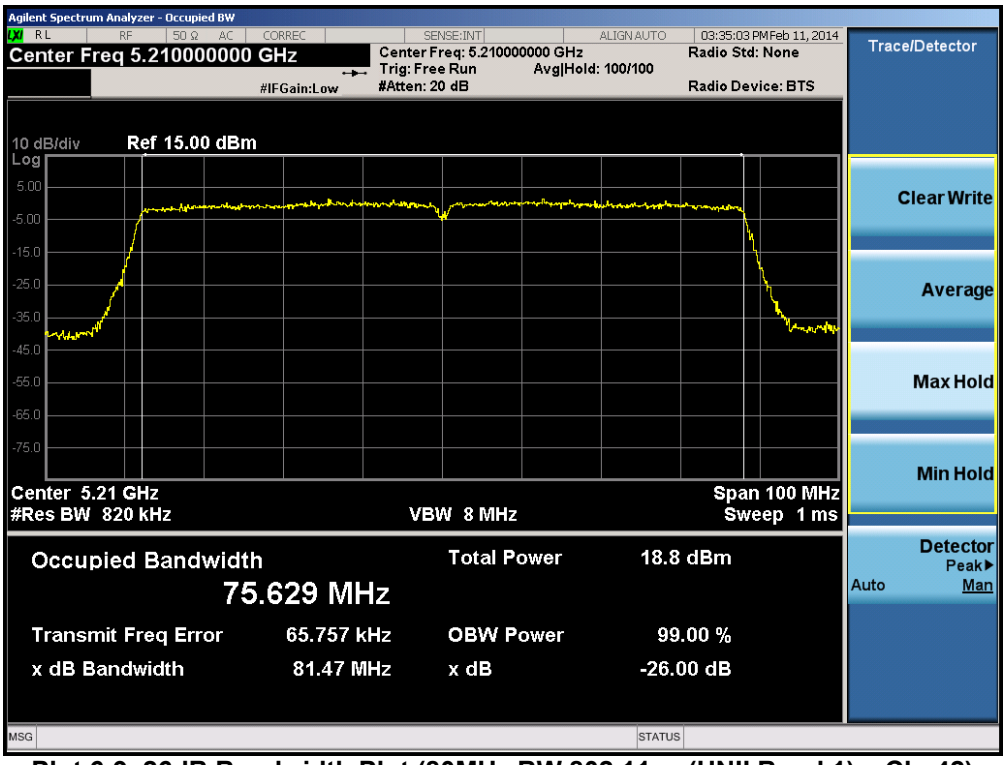
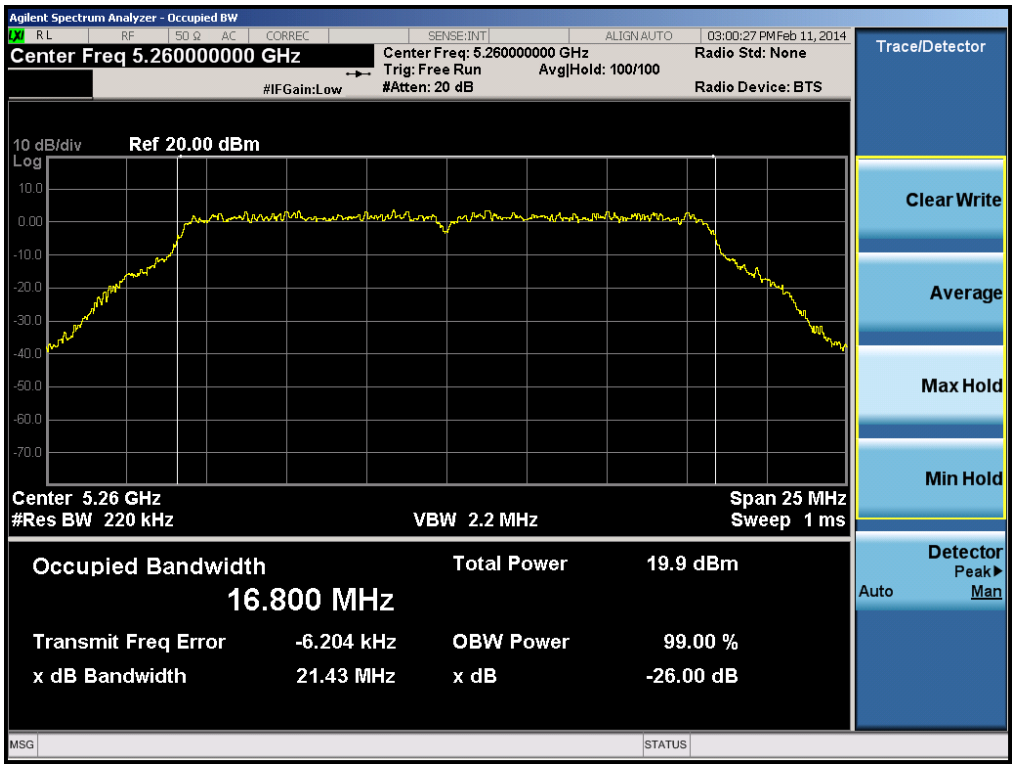


Plot 6-9. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)



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

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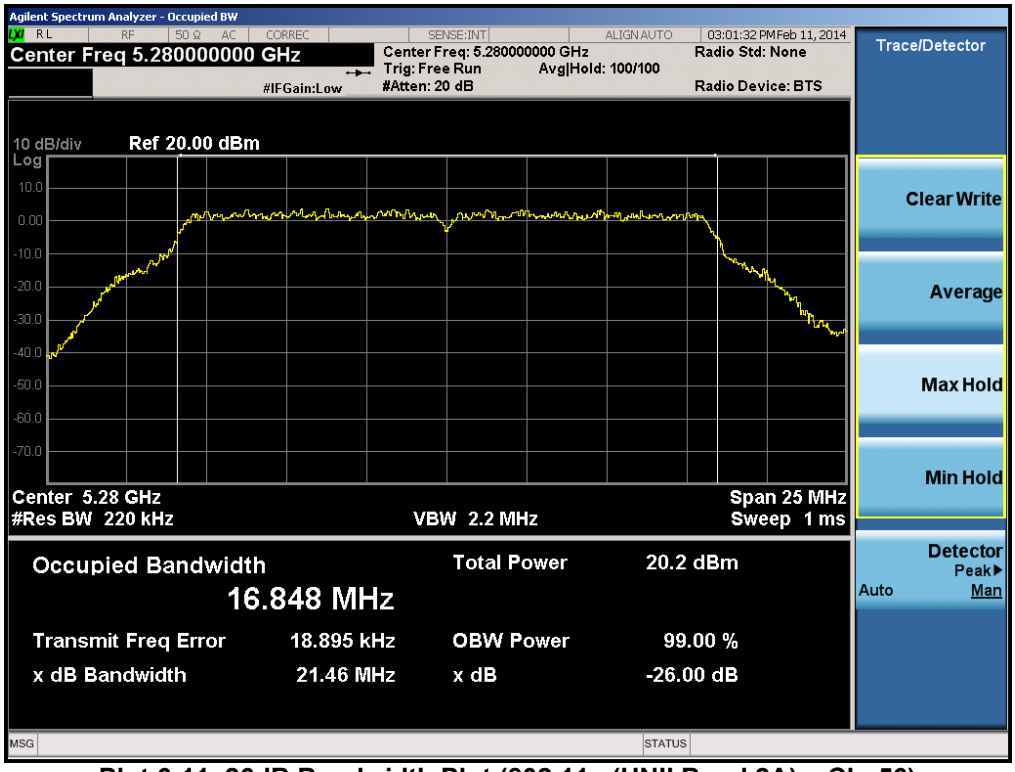
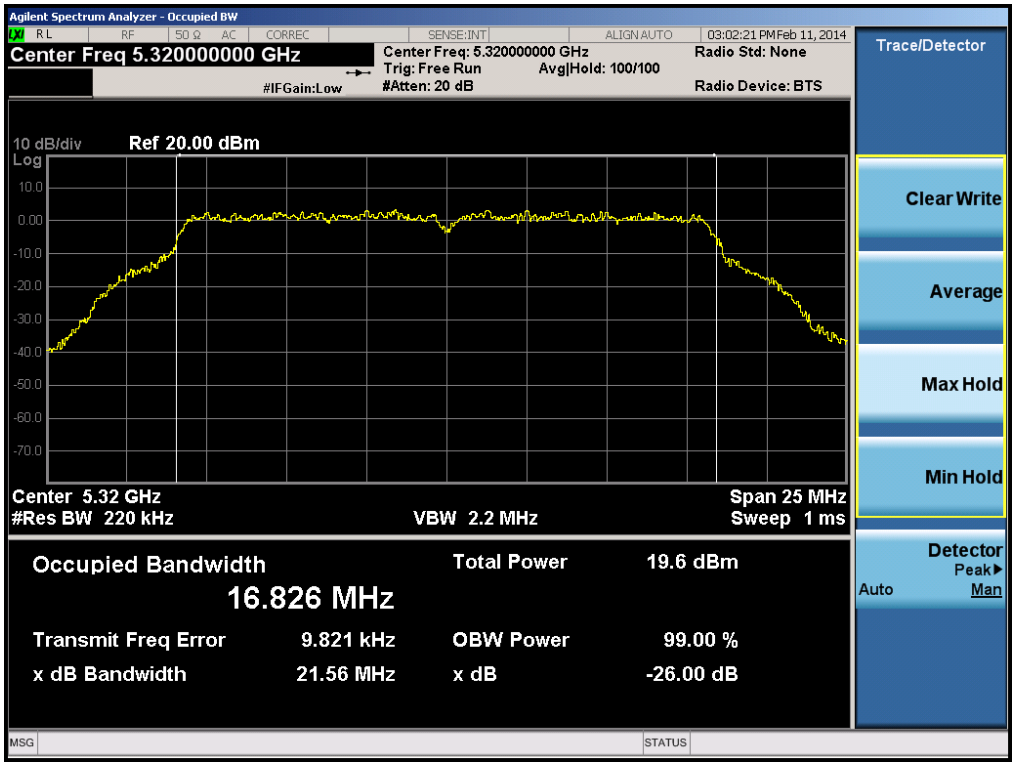


Plot 6-11. 26dB Bandwidth Plot (802.11a (UNII Band 2A) – Ch. 56)



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

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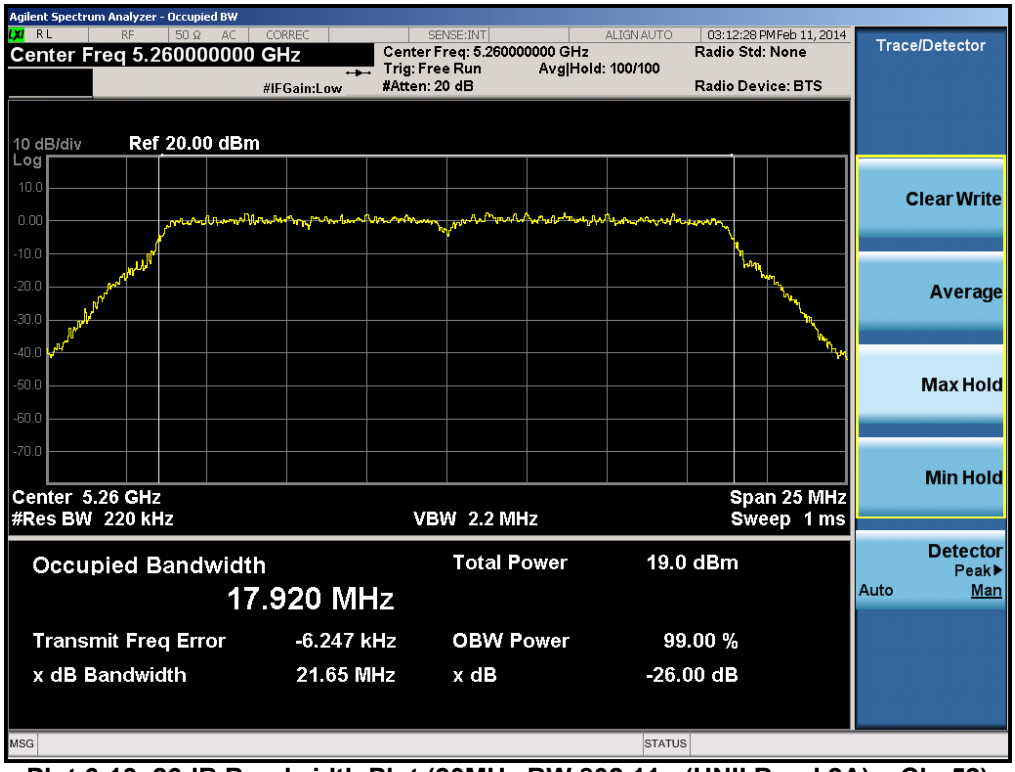
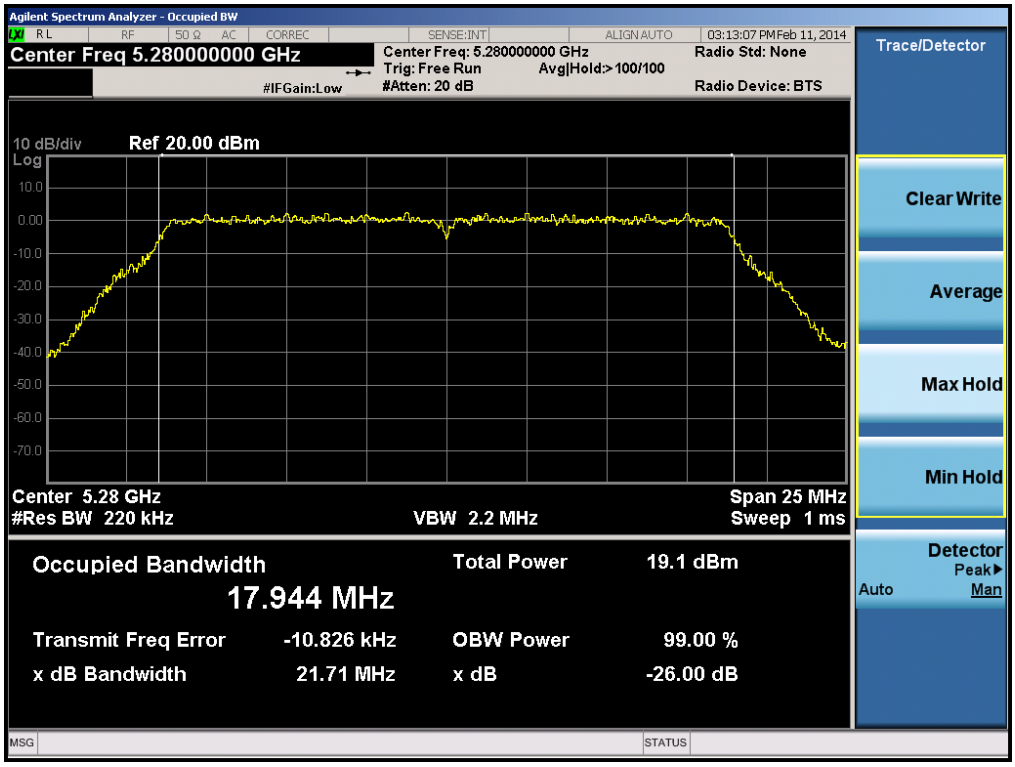


Plot 6-13. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 52)



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

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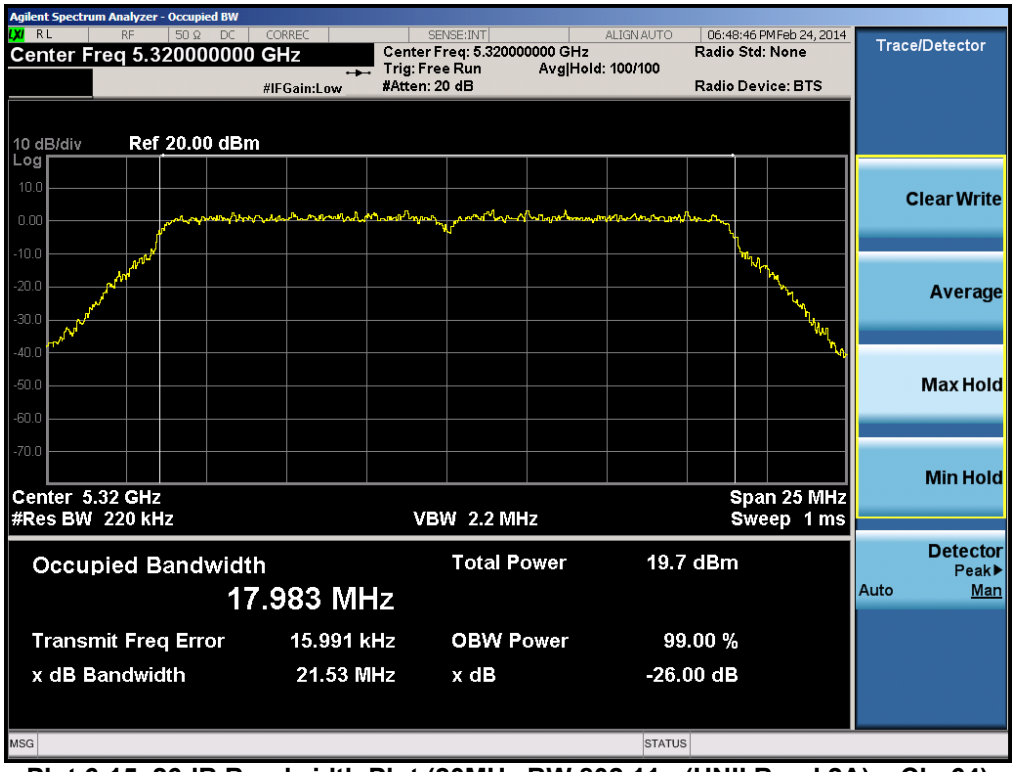
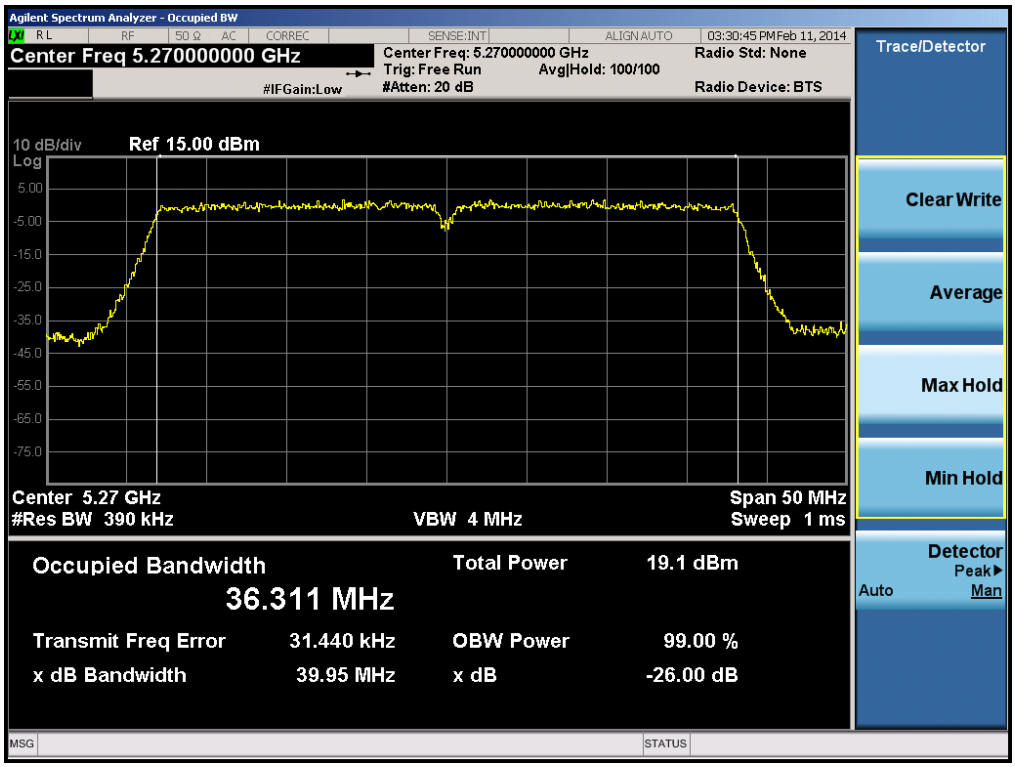


Plot 6-15. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 64)



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

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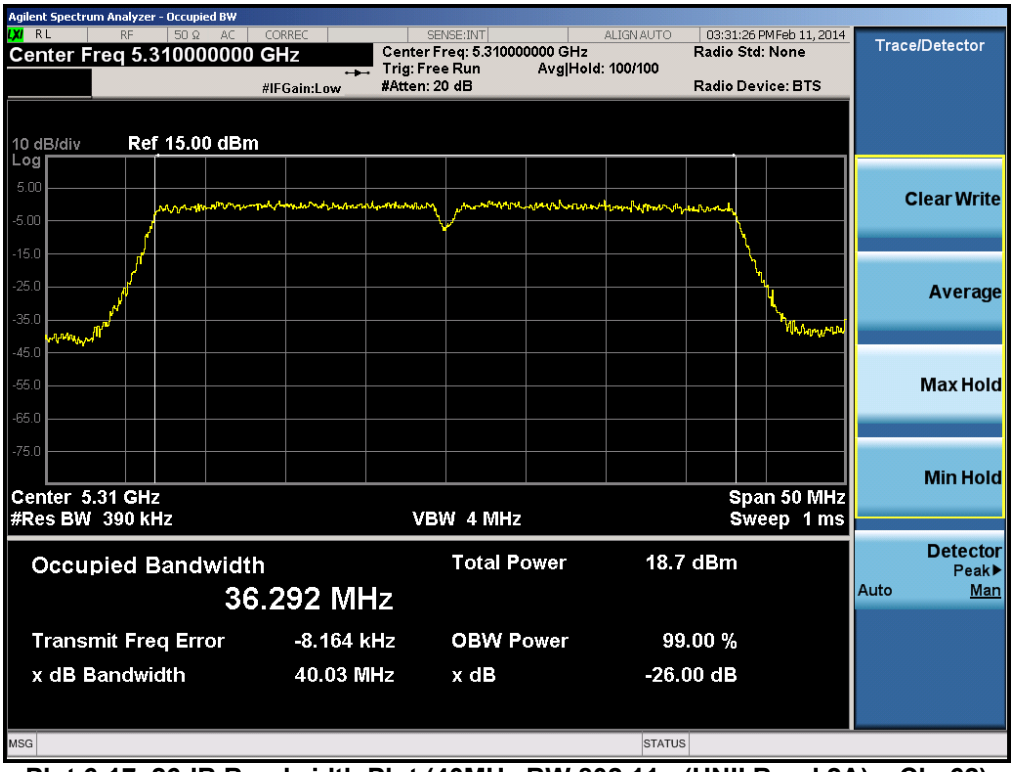
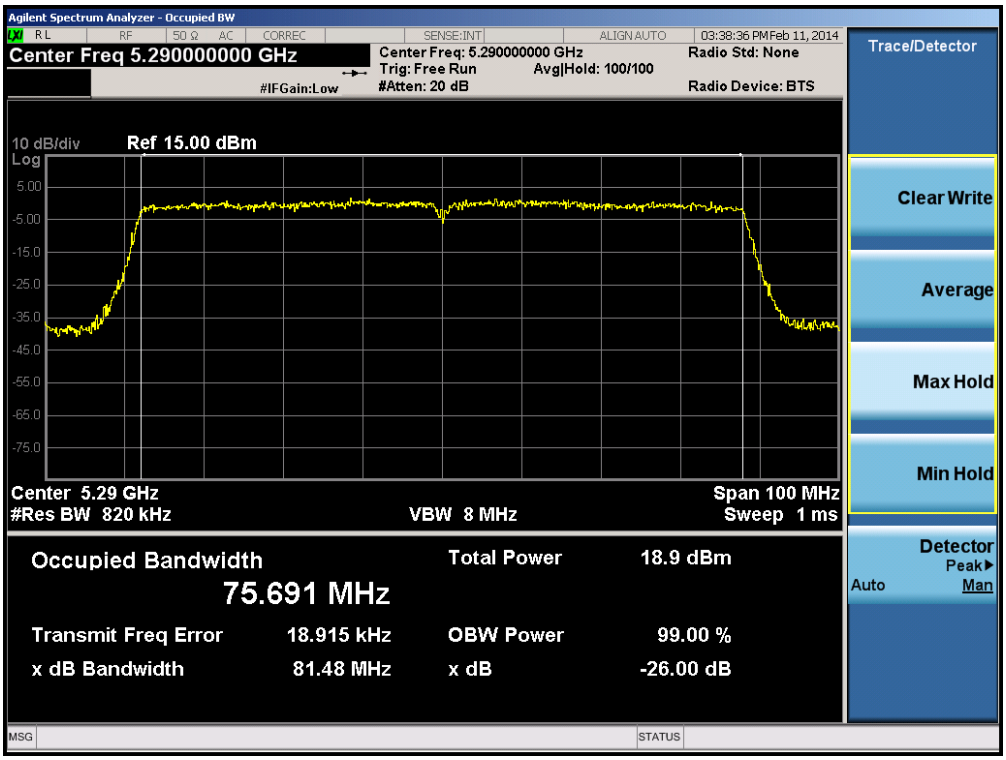


Plot 6-17. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 62)



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

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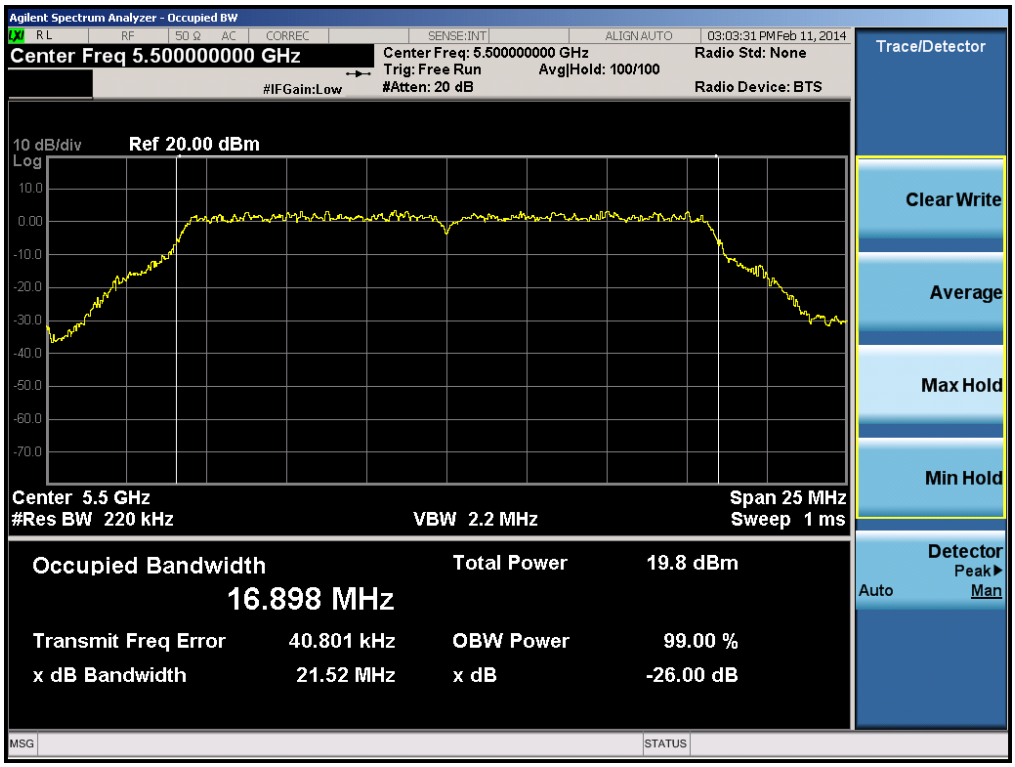
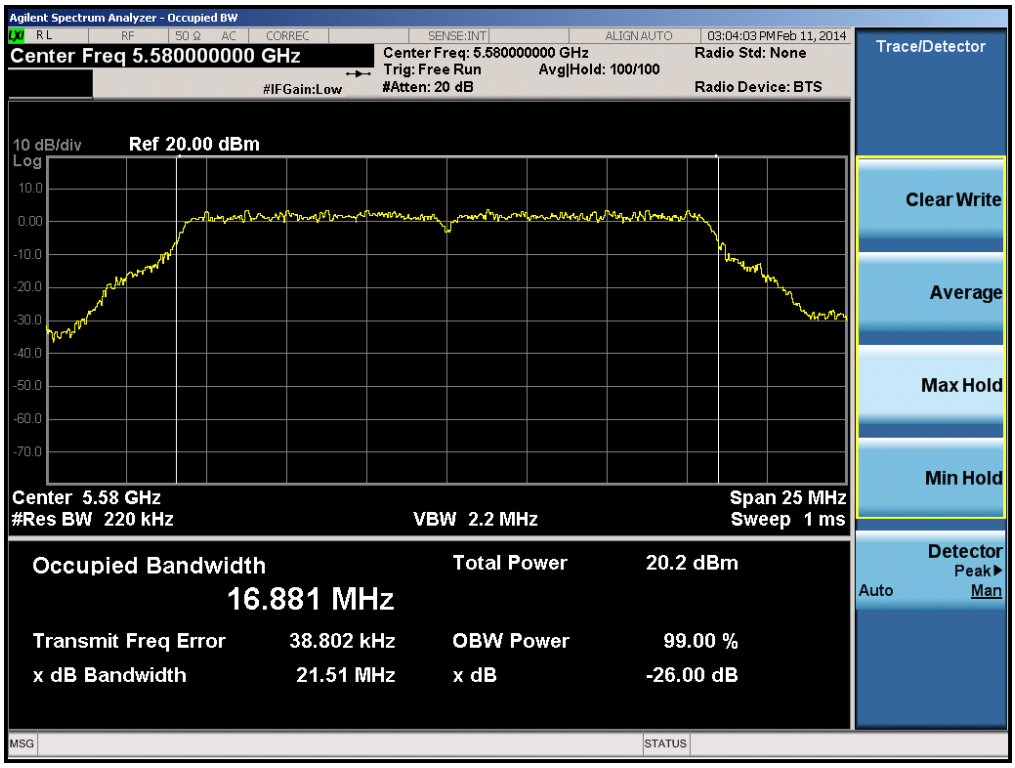


Plot 6-19. 26dB Bandwidth Plot (802.11a (UNII Band 2C) – Ch. 100)



Plot 6-20. 26dB Bandwidth Plot (802.11a (UNII Band 2C) – Ch. 116)

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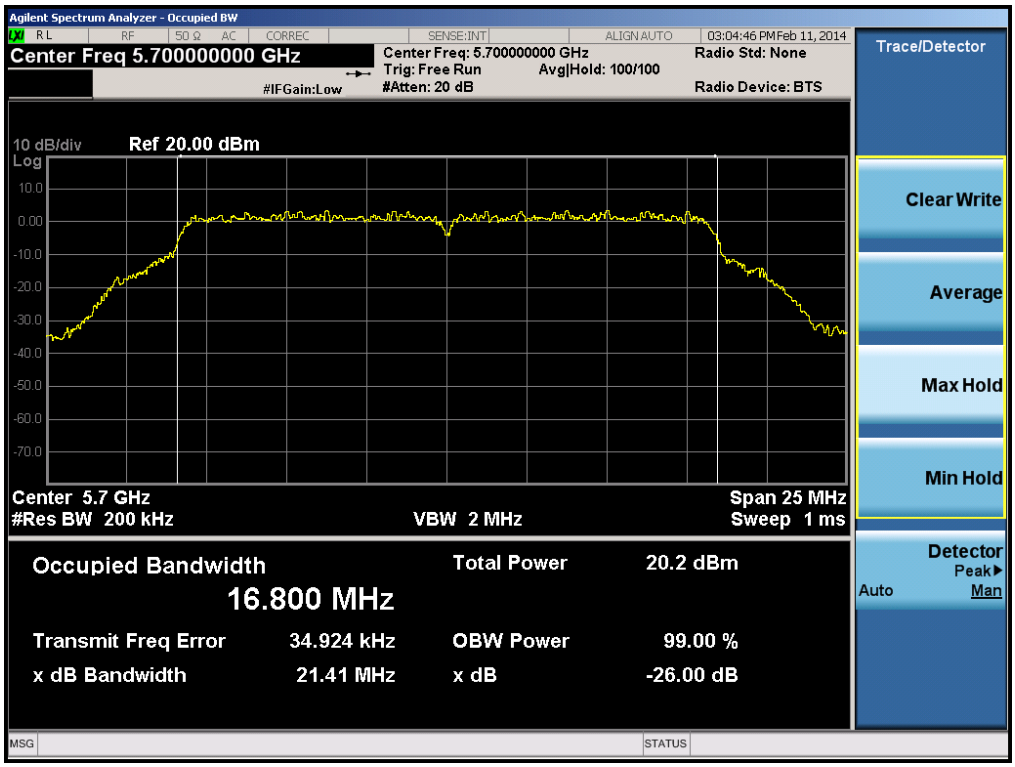
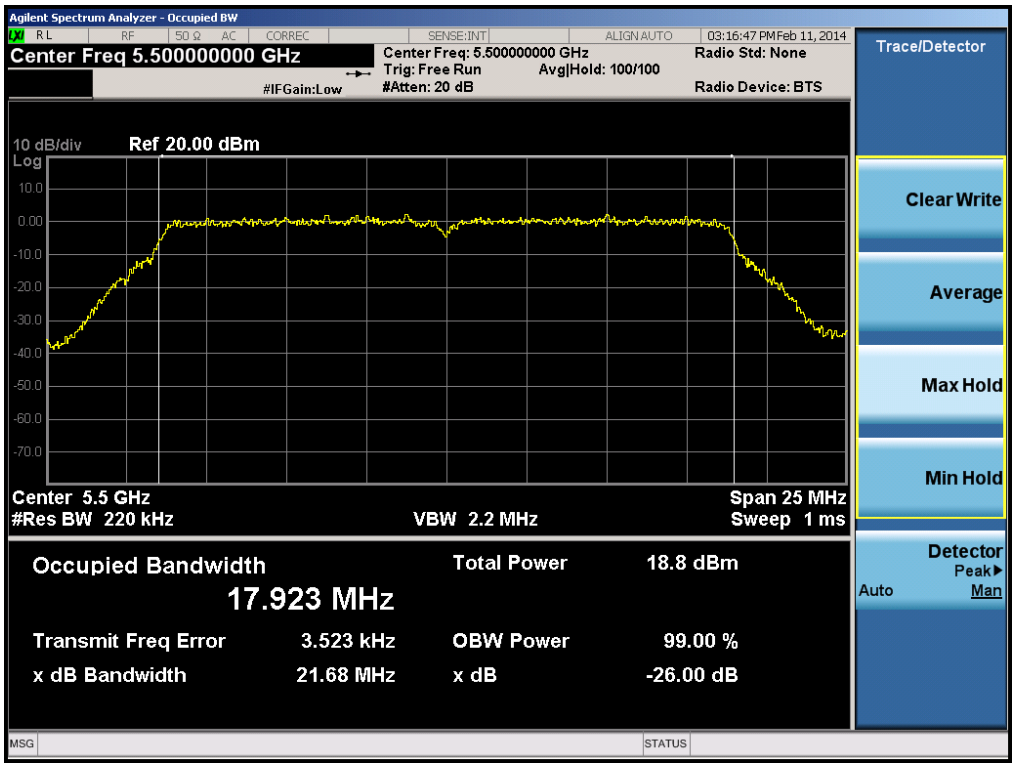


Plot 6-21. 26dB Bandwidth Plot (802.11a (UNII Band 2C) – Ch. 140)



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

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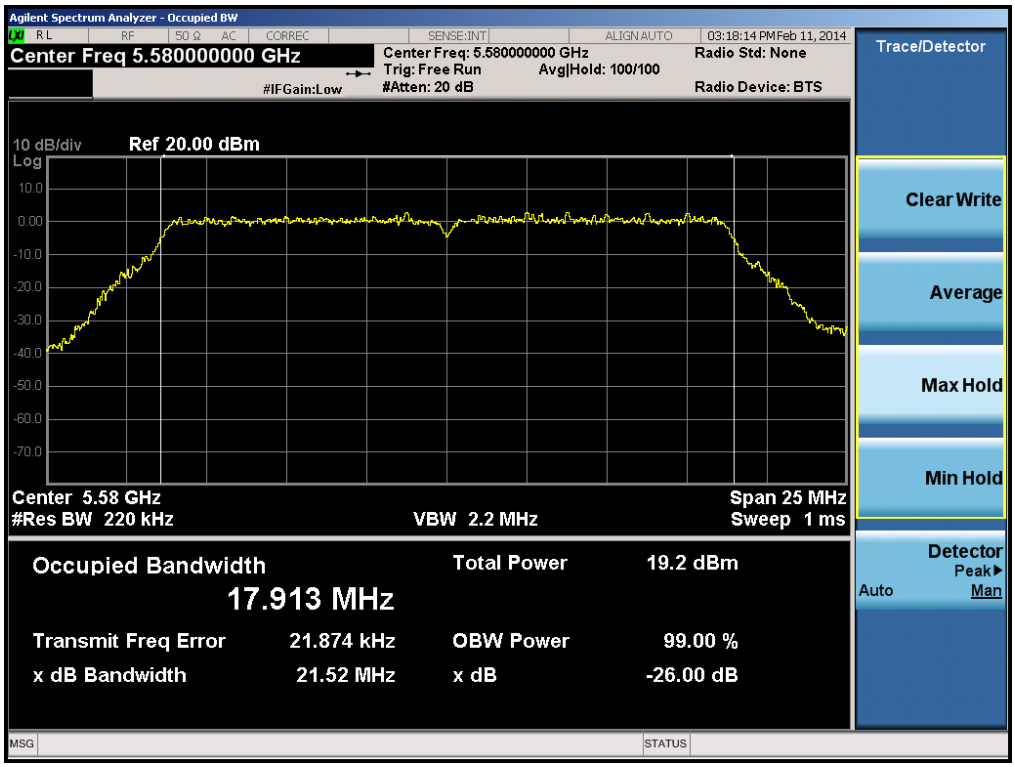
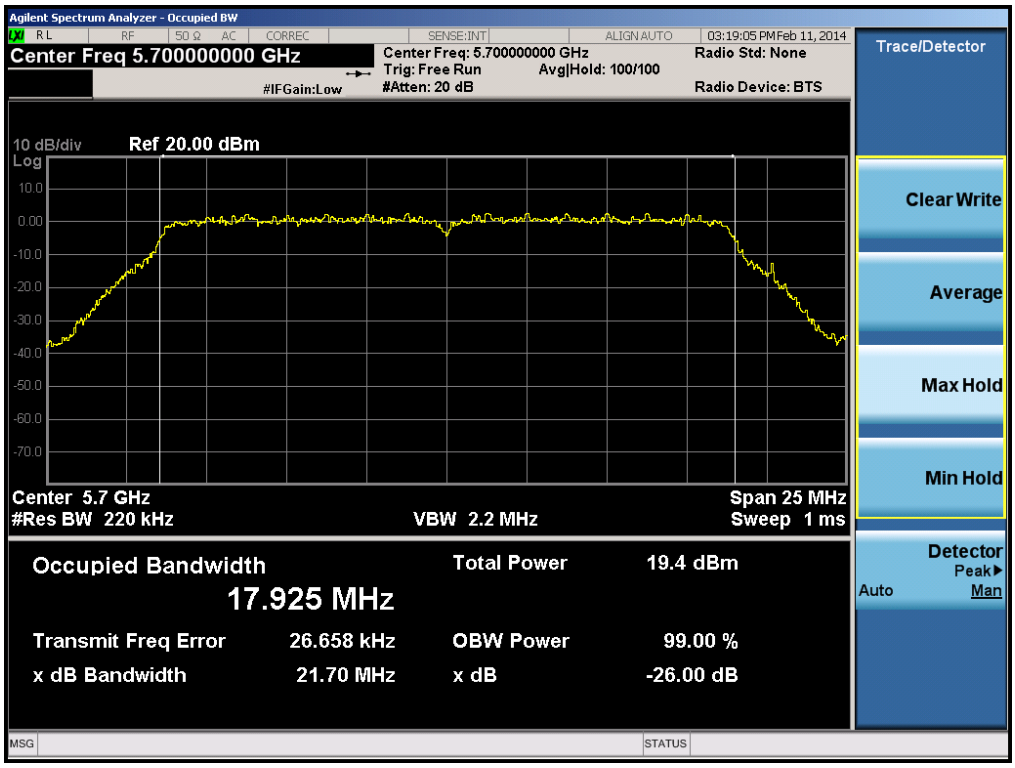


Plot 6-23. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 116)



Plot 6-24. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 140)

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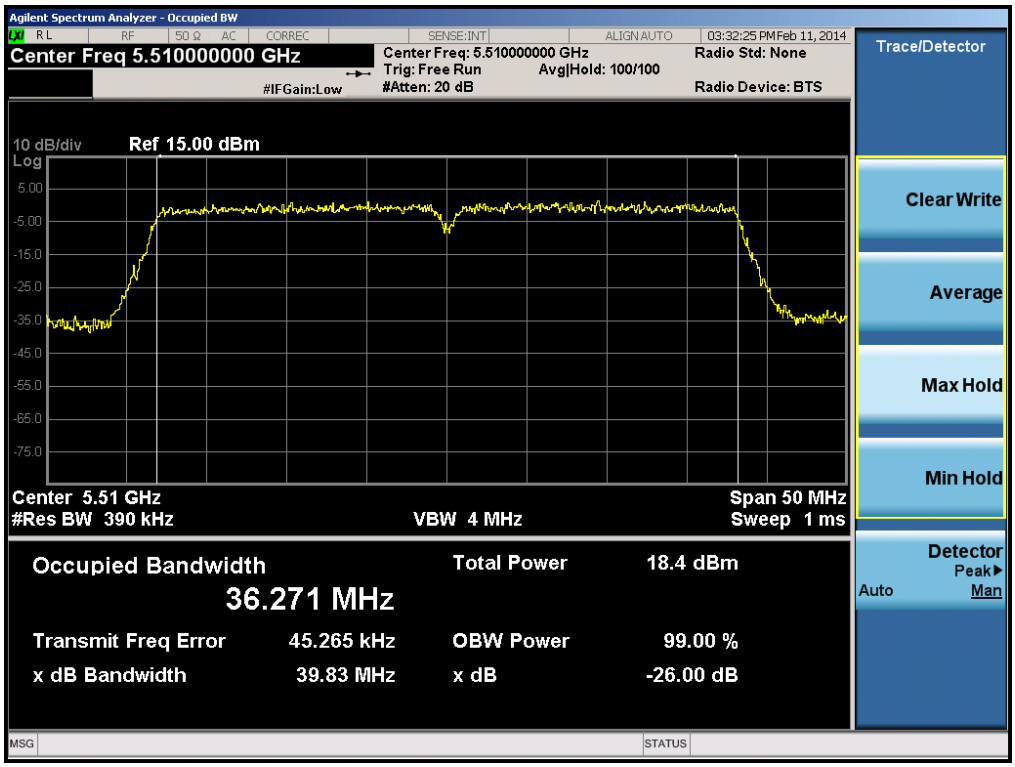
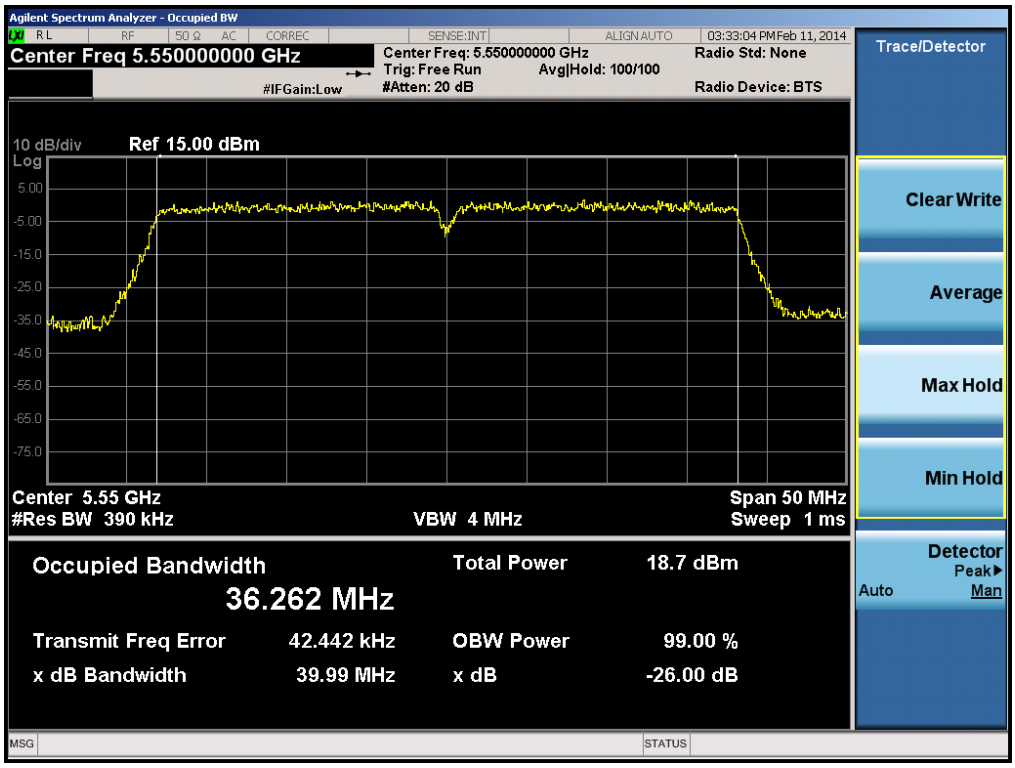


Plot 6-25. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 102)



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

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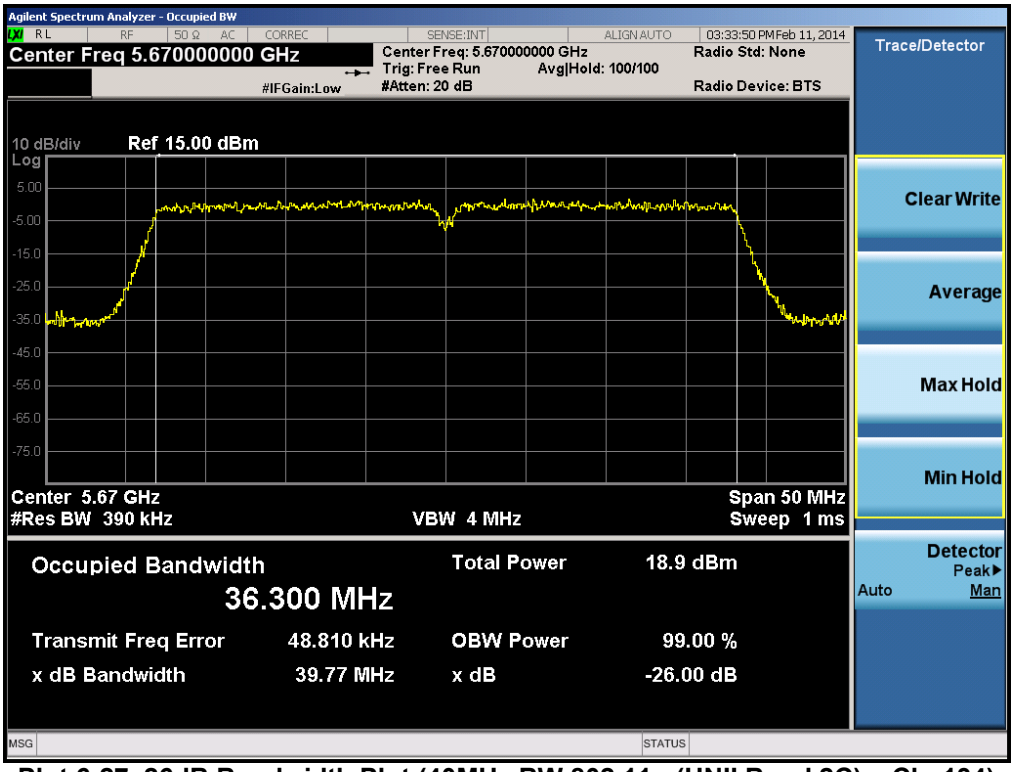
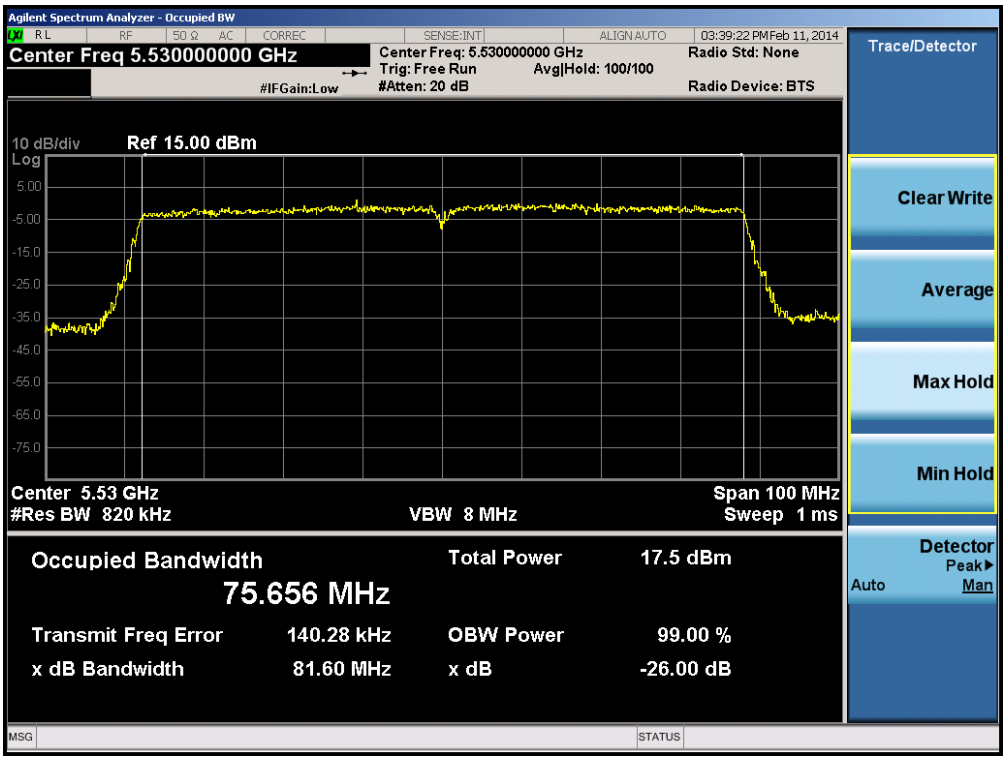


Plot 6-27. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 134)



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

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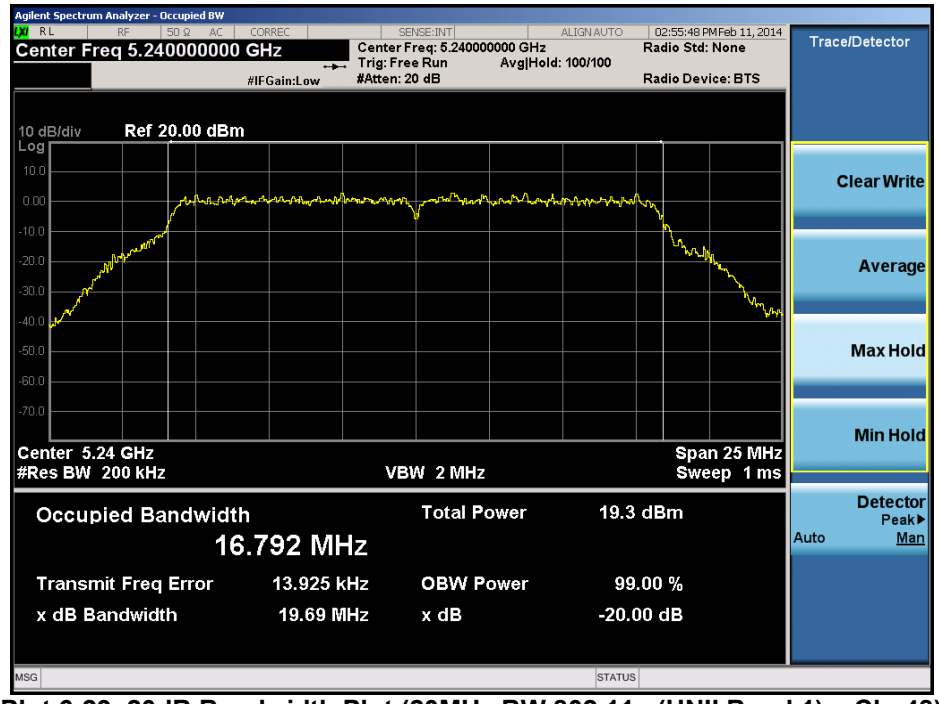
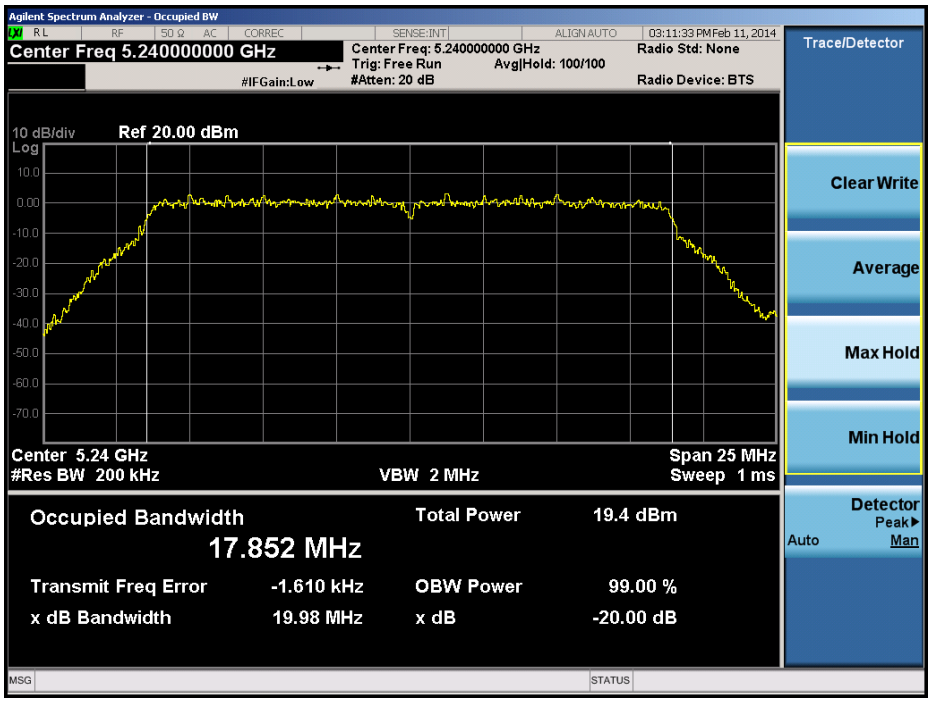


Plot 6-29. 20dB Bandwidth Plot (20MHz BW 802.11a (UNII Band 1) – Ch. 48)

Note: The 20dB bandwidth plot of the UNII Band 1 high channel was found to be within 20MHz and is, therefore, operating solely within the UNII Band 1 frequencies as per KDB 644545 v01r02.



Plot 6-30. 20dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 48)

Note: The 20dB bandwidth plot of the UNII Band 1 high channel was found to be within 20MHz and is, therefore, operating solely within the UNII Band 1 frequencies as per KDB 644545 v01r02.

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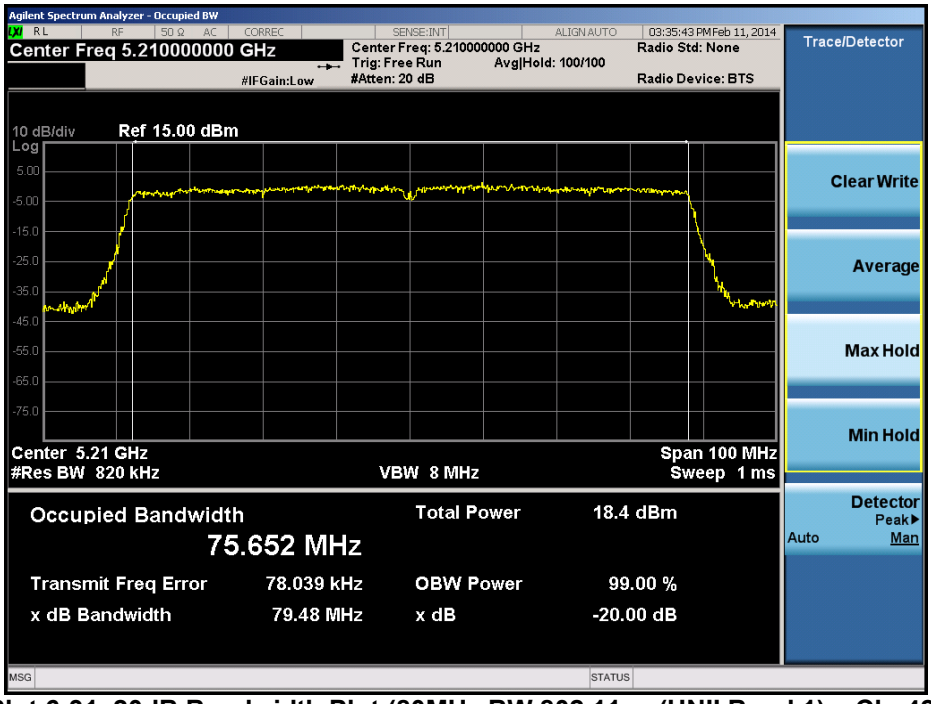
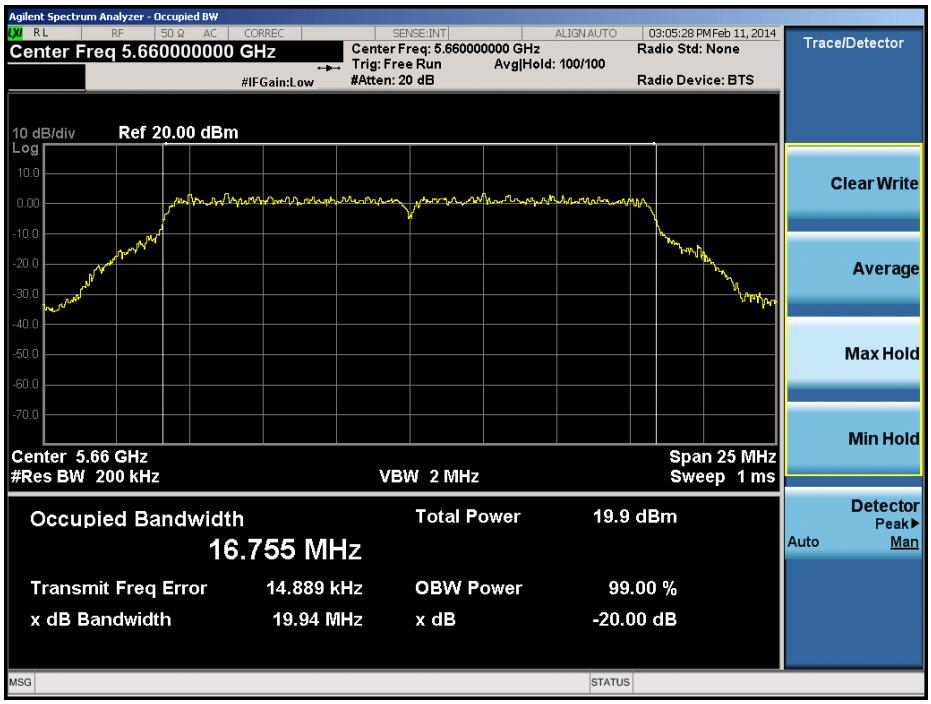


Plot 6-31. 20dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)

Note: The 20dB bandwidth plot of the UNII Band 1 high channel was found to be within 80MHz and is, therefore, operating solely within the UNII Band 1 frequencies as per KDB 644545 v01r02.



Plot 6-32. 20dB Bandwidth Plot (20MHz BW 802.11a (UNII Band 2C) – Ch. 132)

Note: The 20dB bandwidth plot of the UNII Band 2C channel 132 was found to be within 20MHz and is, therefore, operating solely within the UNII Band 2C frequencies and outside of the TDWR band.

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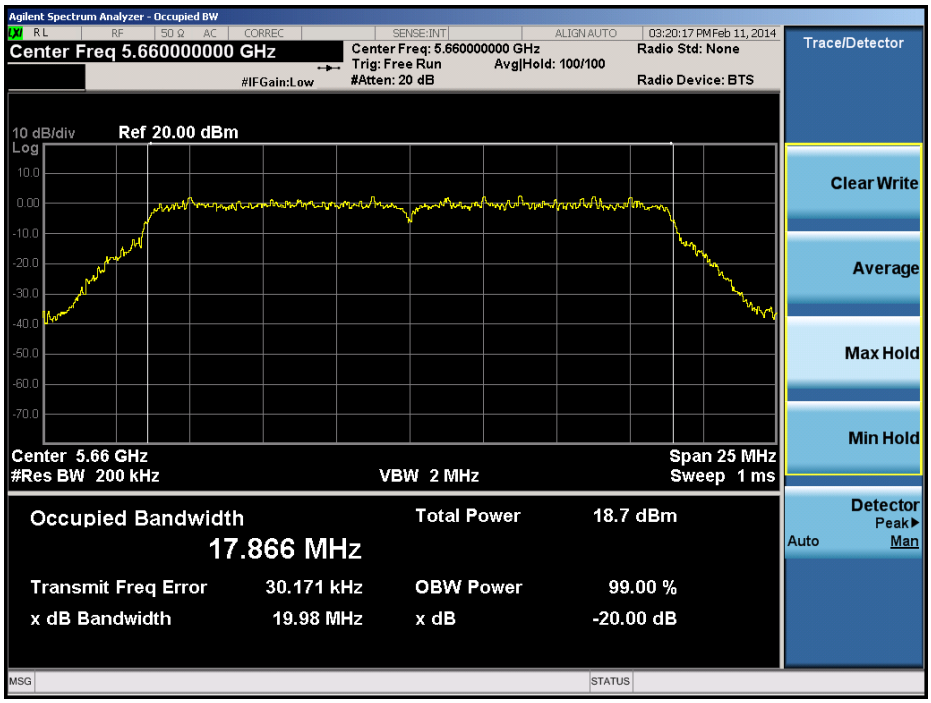
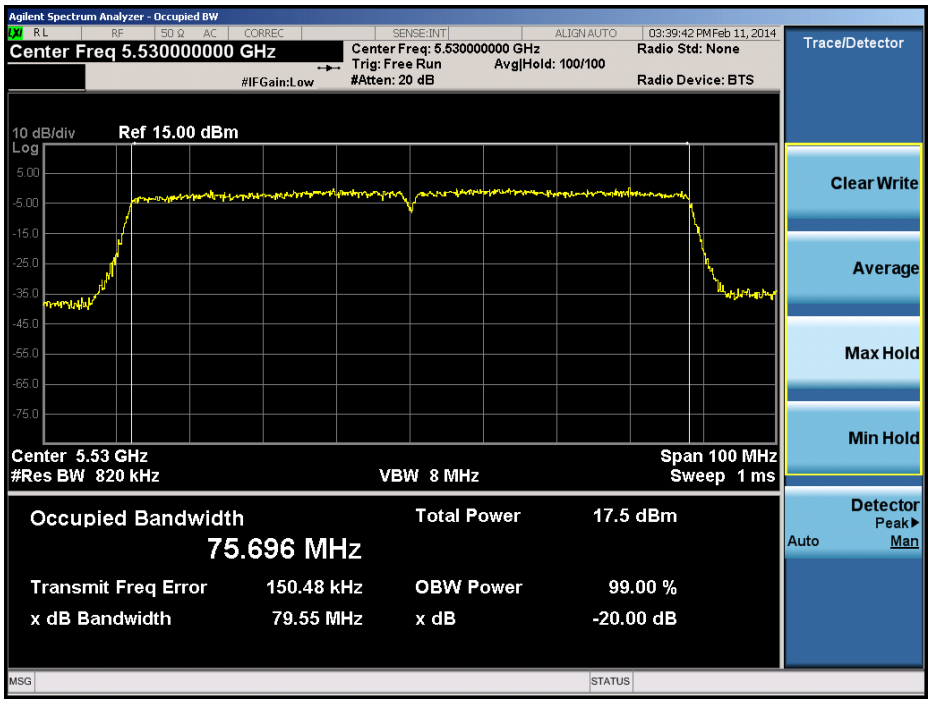


Plot 6-33. 20dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 132)

Note: The 20dB bandwidth plot of the UNII Band 2C channel 132 was found to be within 20MHz and is, therefore, operating solely within the UNII Band 2C frequencies and outside of the TDWR band.



Plot 6-34. 20dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 2C) – Ch. 106)

Note: The 20dB bandwidth plot of the UNII Band 2C channel 106 was found to be within 80MHz and is, therefore, operating solely within the UNII Band 2C frequencies and outside of the TDWR band.

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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	21.68
	5200	40	a	6	21.50
	5240	48	a	6	21.59
	5180	36	n (20MHz)	6.5/7.2 (MCS0)	21.82
	5200	40	n (20MHz)	6.5/7.2 (MCS0)	21.84
	5240	48	n (20MHz)	6.5/7.2 (MCS0)	21.89
	5190	38	n (40MHz)	13.5/15 (MCS0)	40.27
	5230	46	n (40MHz)	13.5/15 (MCS0)	39.94
	5210	42	ac (80MHz)	29.3/32.5 (MCS0)	82.24
Band 2A	5260	52	a	6	21.52
	5280	56	a	6	21.57
	5320	64	a	6	21.40
	5260	52	n (20MHz)	6.5/7.2 (MCS0)	21.71
	5280	56	n (20MHz)	6.5/7.2 (MCS0)	21.73
	5320	64	n (20MHz)	6.5/7.2 (MCS0)	21.67
	5270	54	n (40MHz)	13.5/15 (MCS0)	40.02
	5310	62	n (40MHz)	13.5/15 (MCS0)	39.88
	5290	58	ac (80MHz)	29.3/32.5 (MCS0)	81.90
Band 2C	5500	100	a	6	21.61
	5580	116	a	6	21.59
	5700	140	a	6	21.56
	5500	100	n (20MHz)	6.5/7.2 (MCS0)	21.73
	5580	116	n (20MHz)	6.5/7.2 (MCS0)	21.67
	5700	140	n (20MHz)	6.5/7.2 (MCS0)	21.70
	5510	102	n (40MHz)	13.5/15 (MCS0)	40.01
	5550	110	n (40MHz)	13.5/15 (MCS0)	40.15
	5670	134	n (40MHz)	13.5/15 (MCS0)	39.85
	5530	106	ac (80MHz)	29.3/32.5 (MCS0)	81.28

Table 6-3. Conducted Bandwidth Measurements

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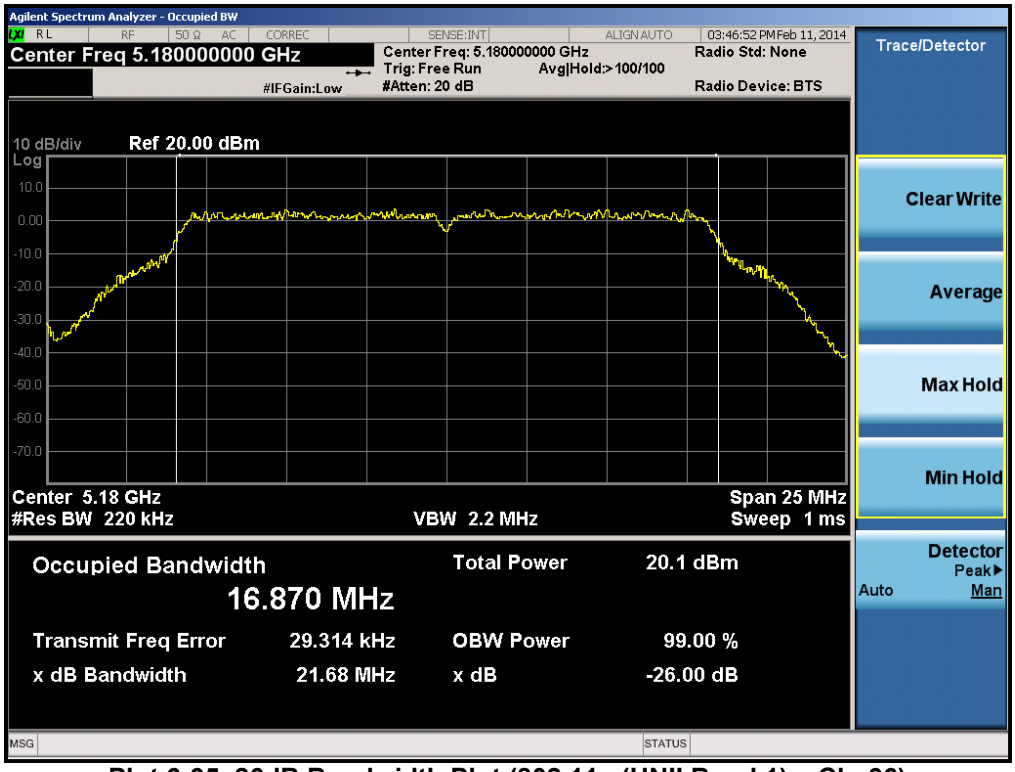
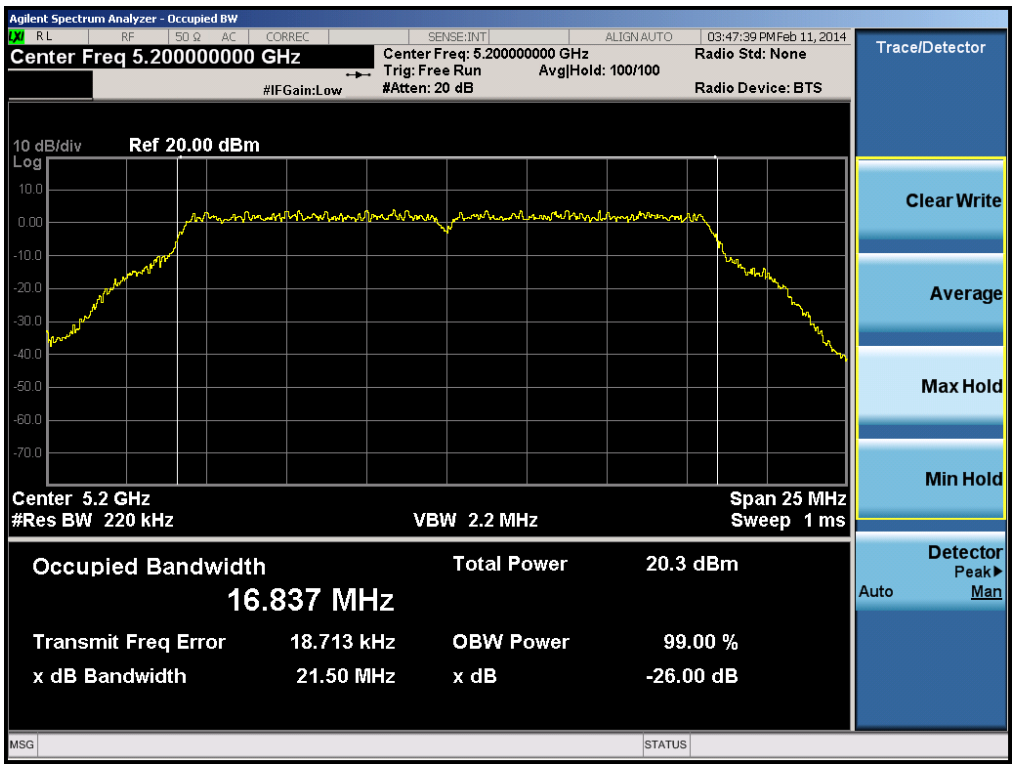


Plot 6-35. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 36)



Plot 6-36. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 40)

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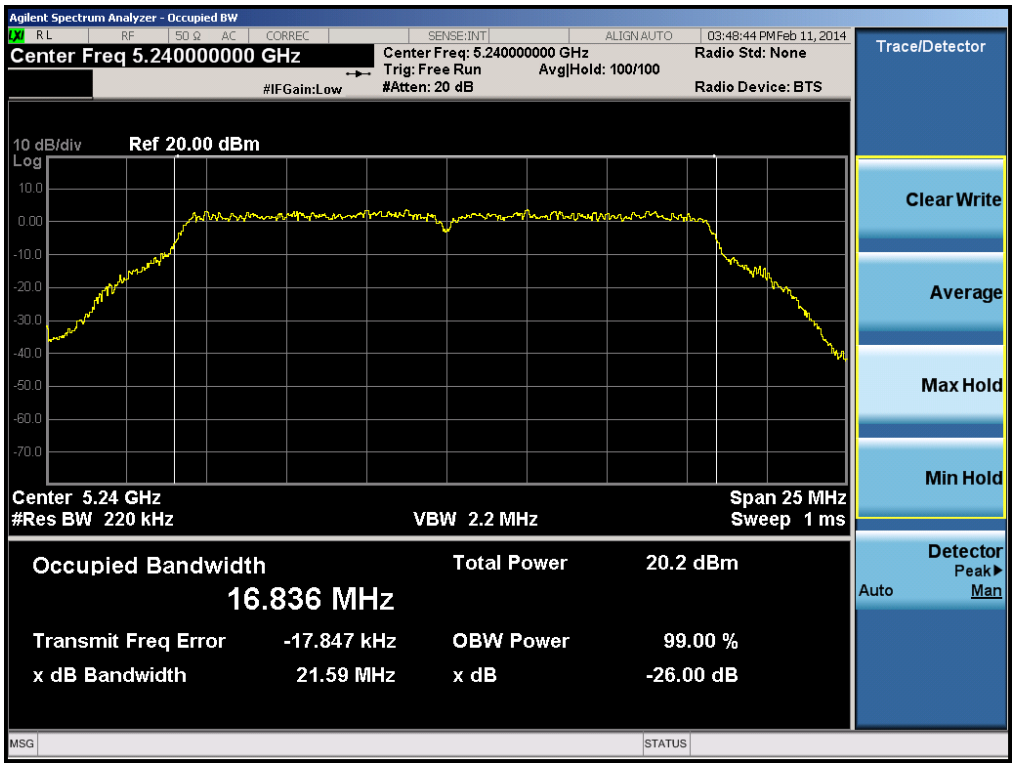
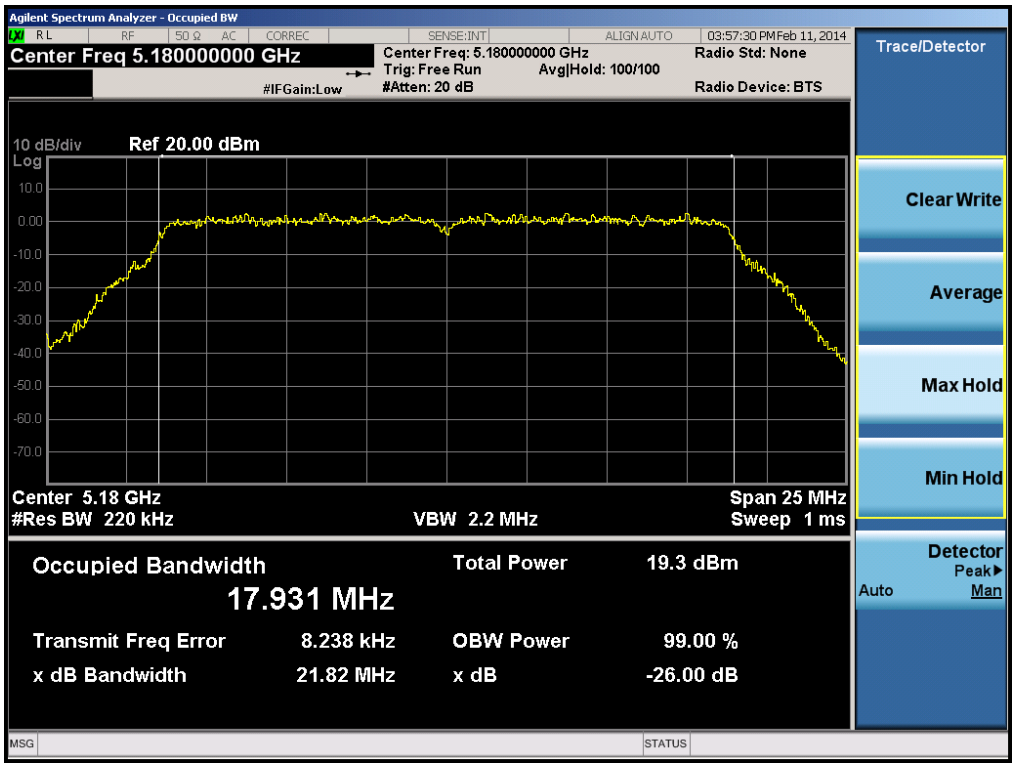


Plot 6-37. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 48)



Plot 6-38. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 36)

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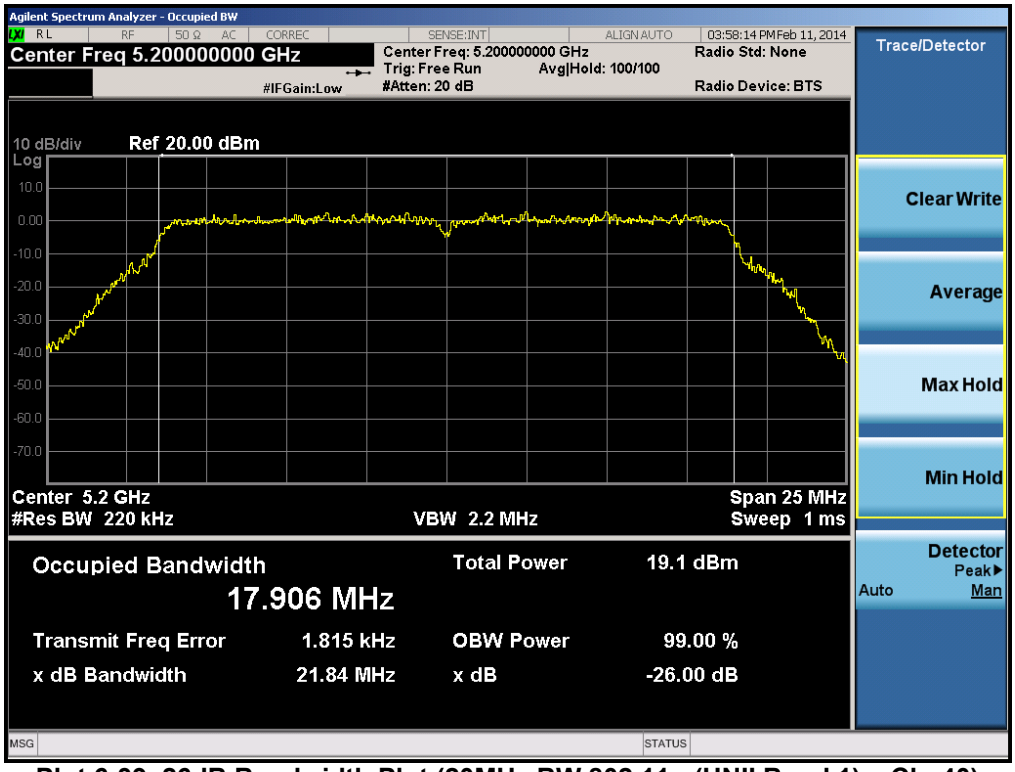
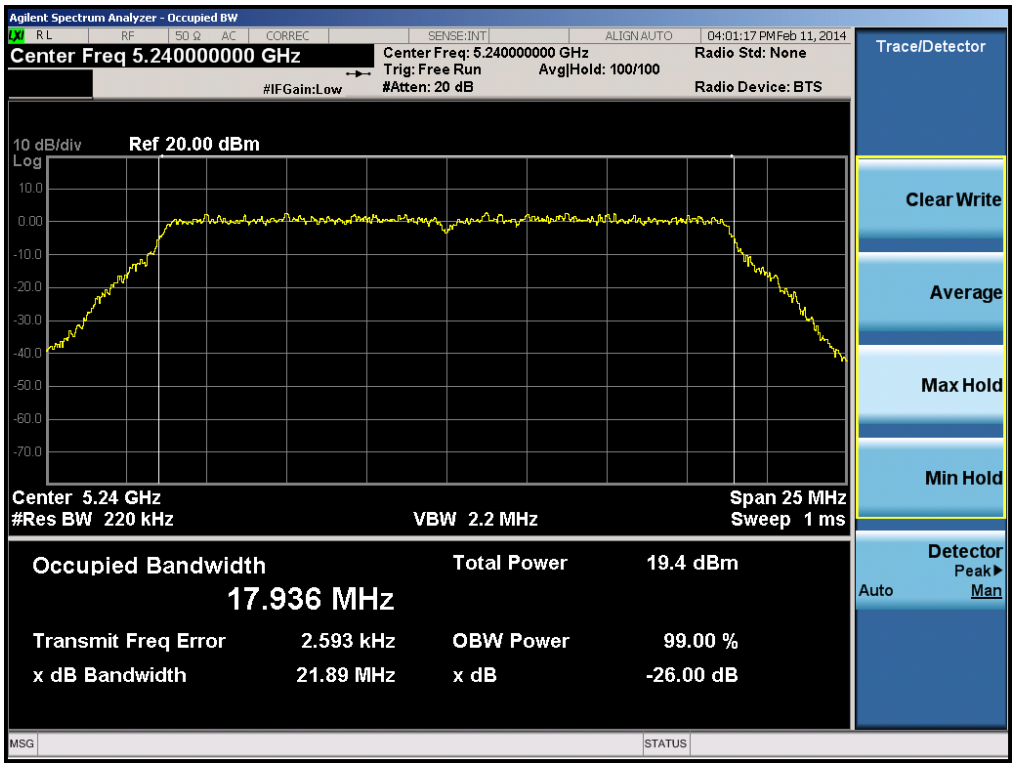


Plot 6-39. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 40)



Plot 6-40. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 48)

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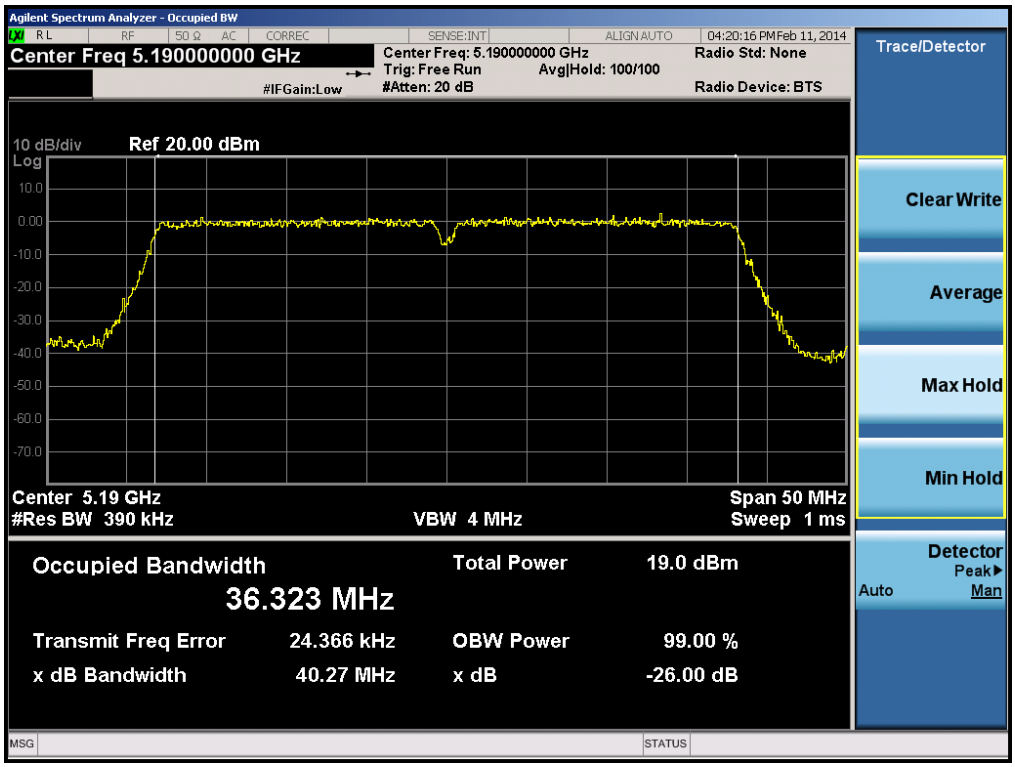
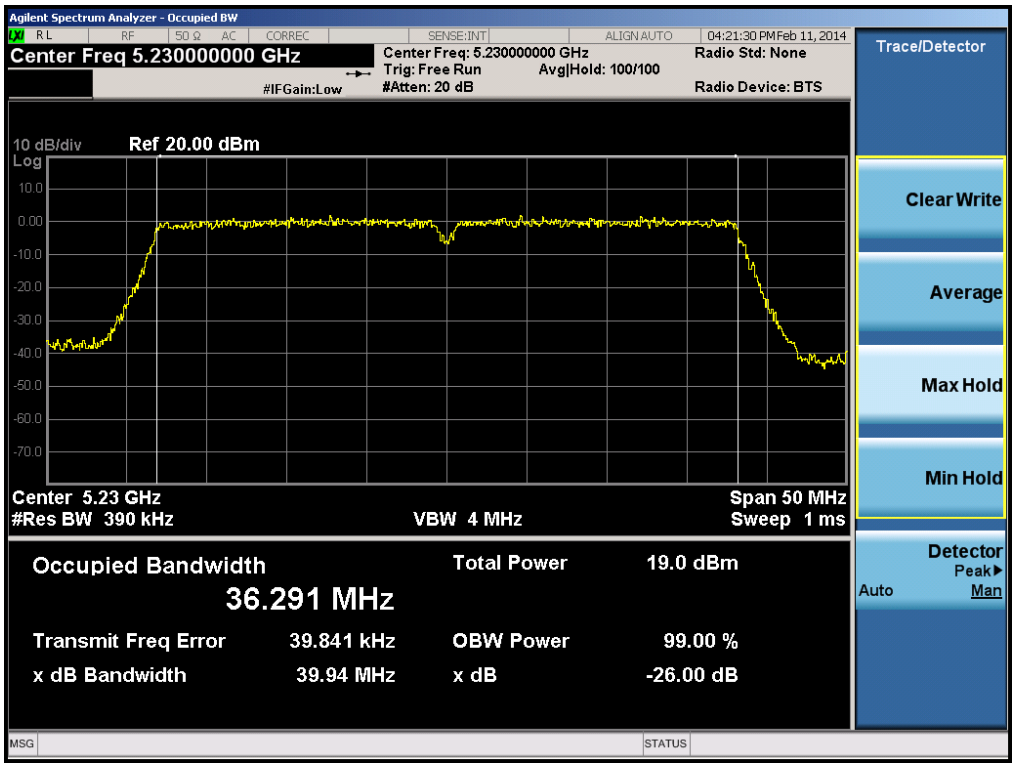


Plot 6-41. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 38)



Plot 6-42. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 46)

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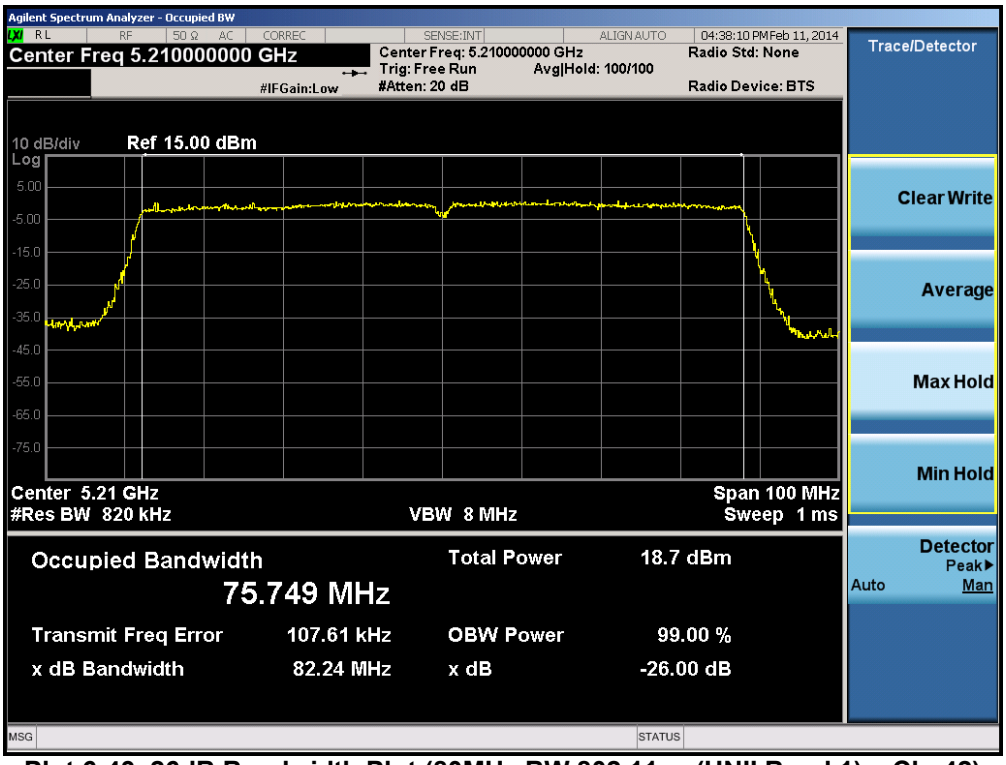
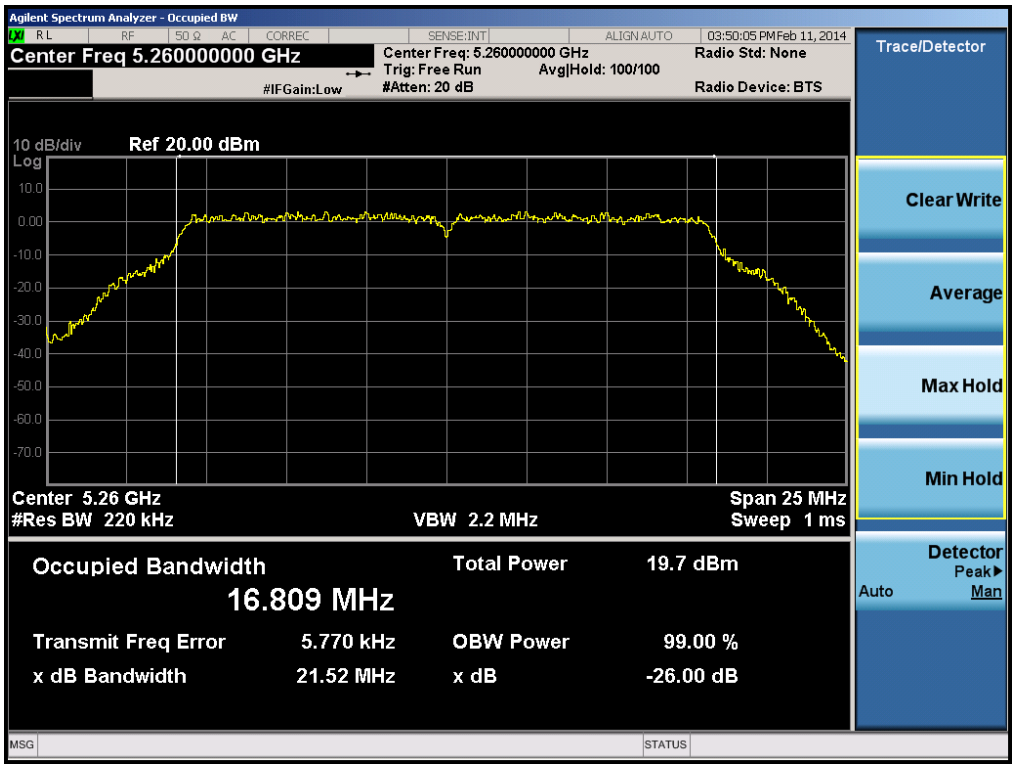


Plot 6-43. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)



Plot 6-44. 26dB Bandwidth Plot (802.11a (UNII Band 2A) – Ch. 52)

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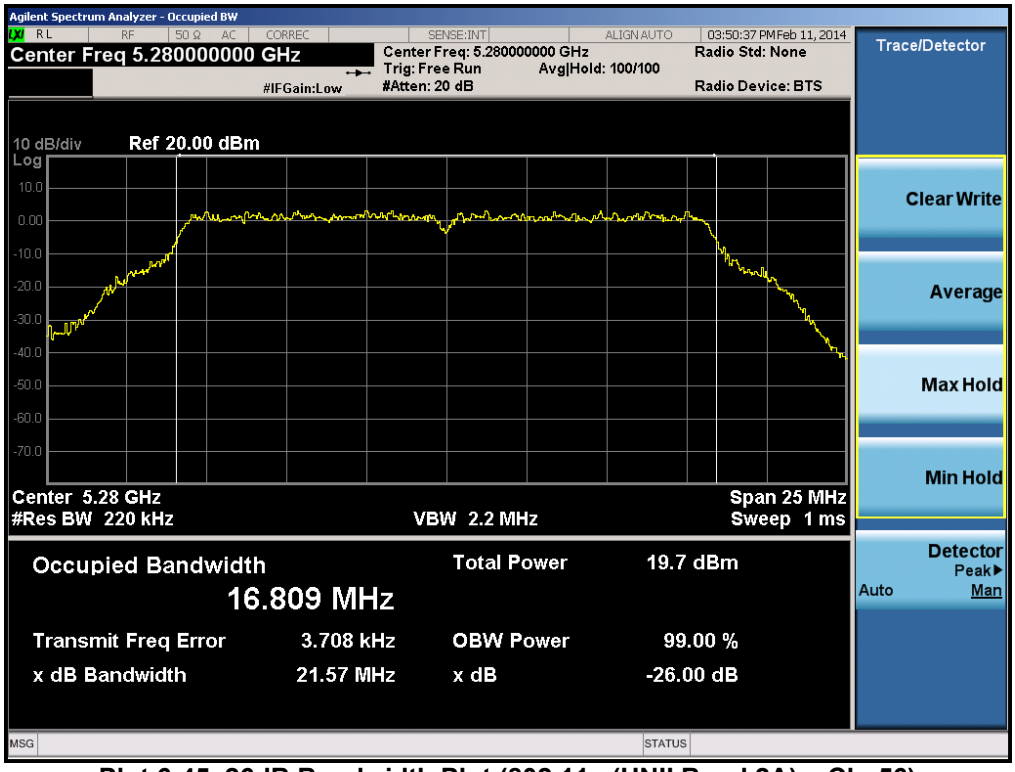
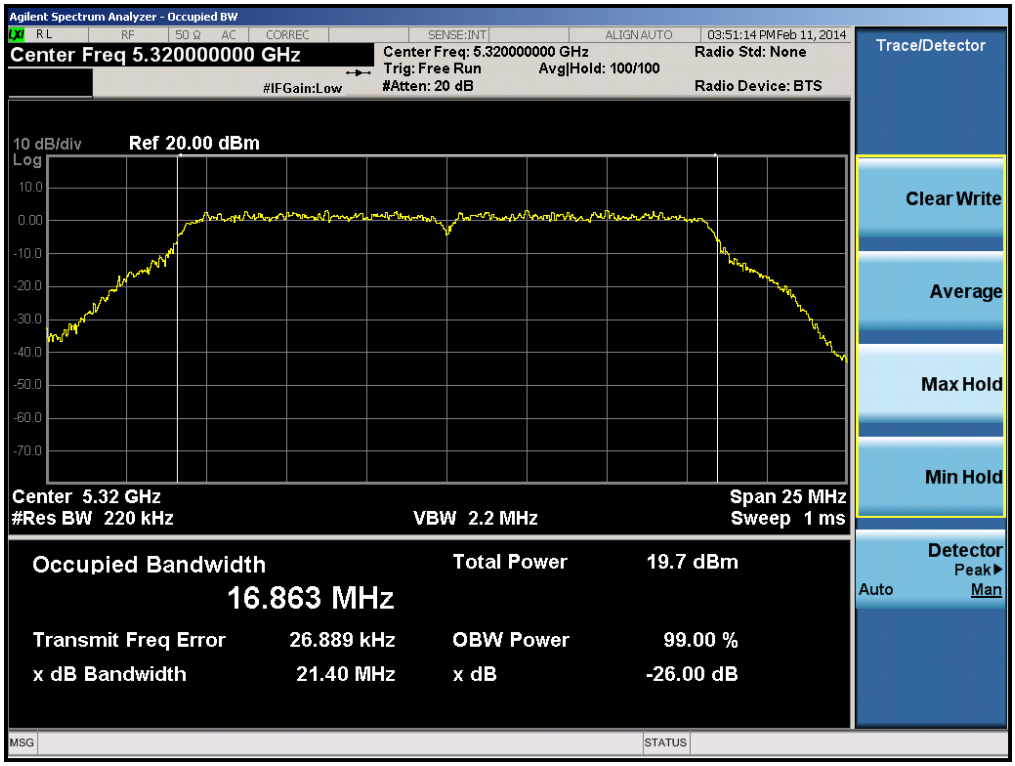


Plot 6-45. 26dB Bandwidth Plot (802.11a (UNII Band 2A) – Ch. 56)



Plot 6-46. 26dB Bandwidth Plot (802.11a (UNII Band 2A) – Ch. 64)

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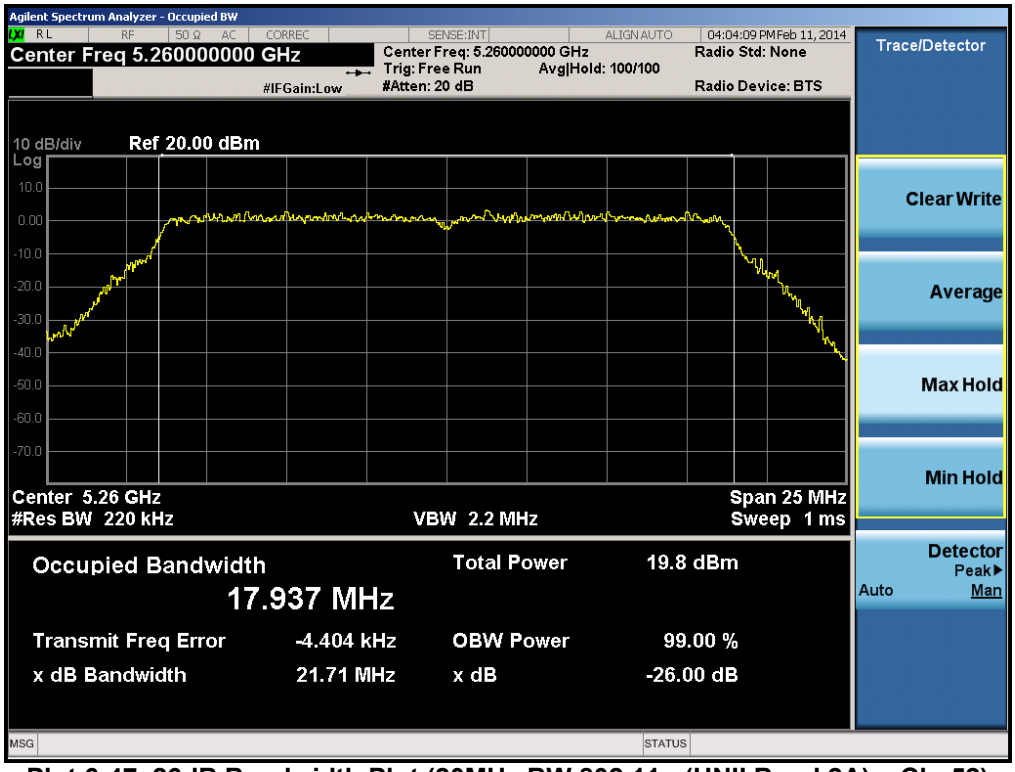
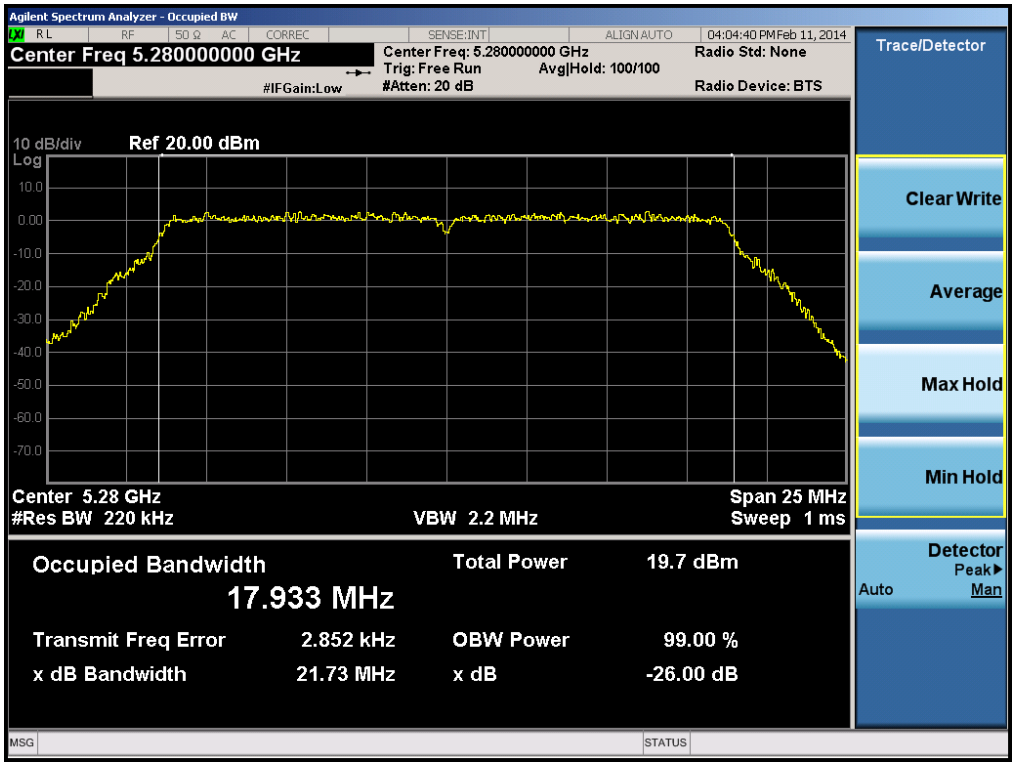


Plot 6-47. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 52)



Plot 6-48. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)

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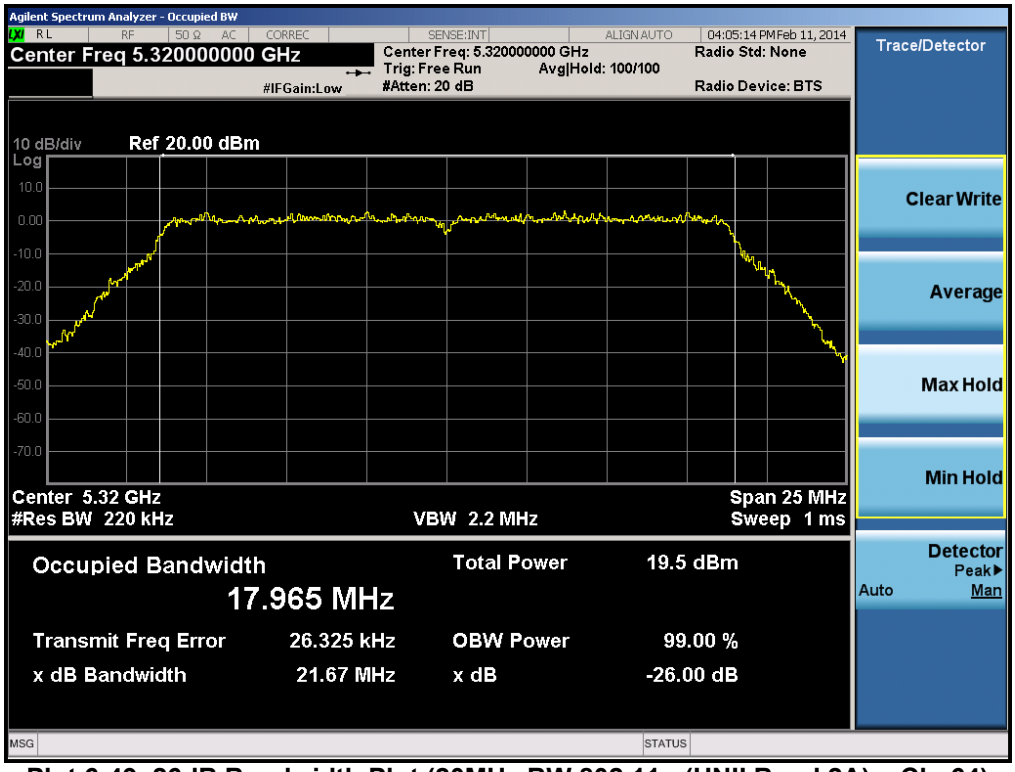
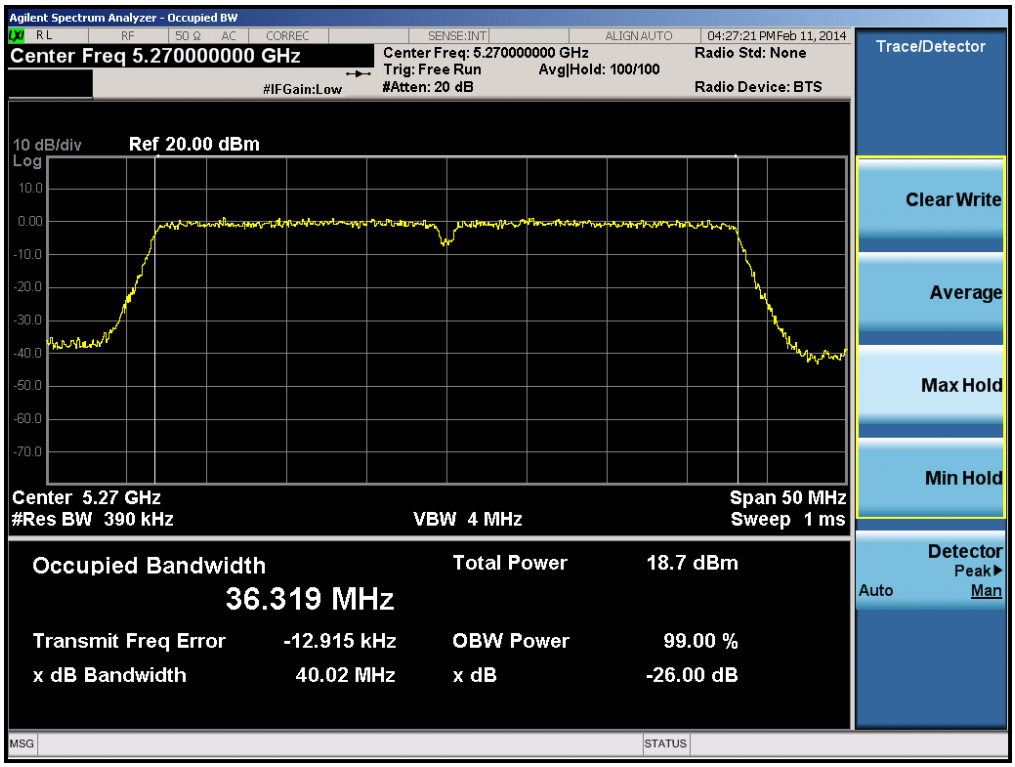


Plot 6-49. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 64)



Plot 6-50. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 54)

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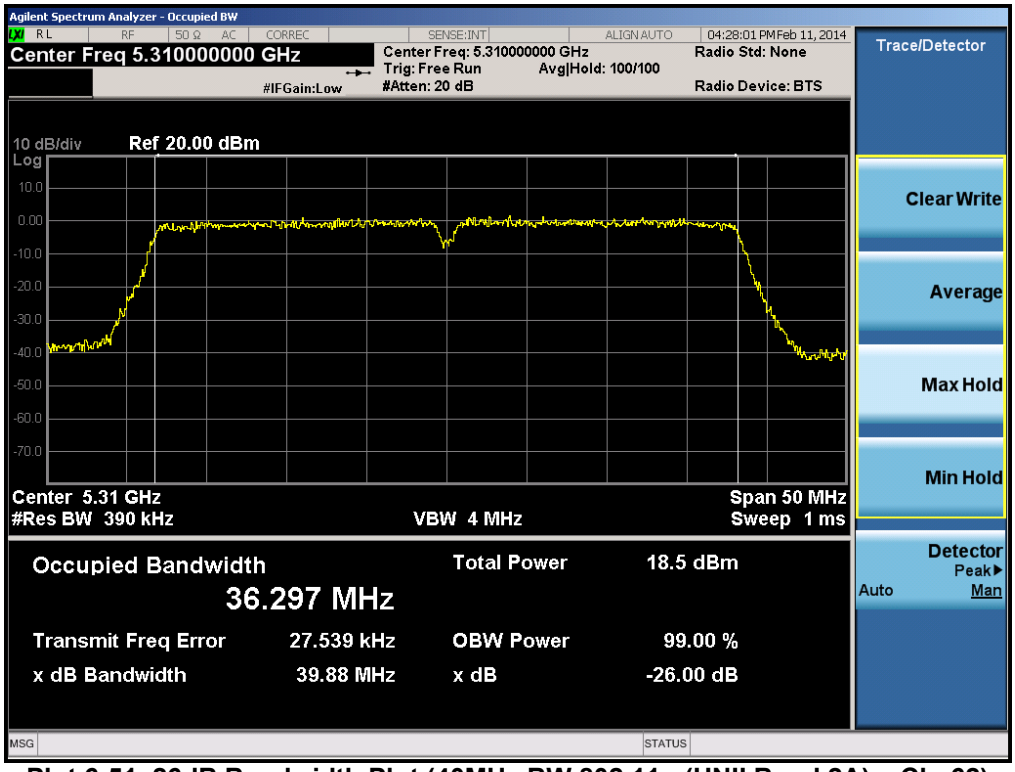
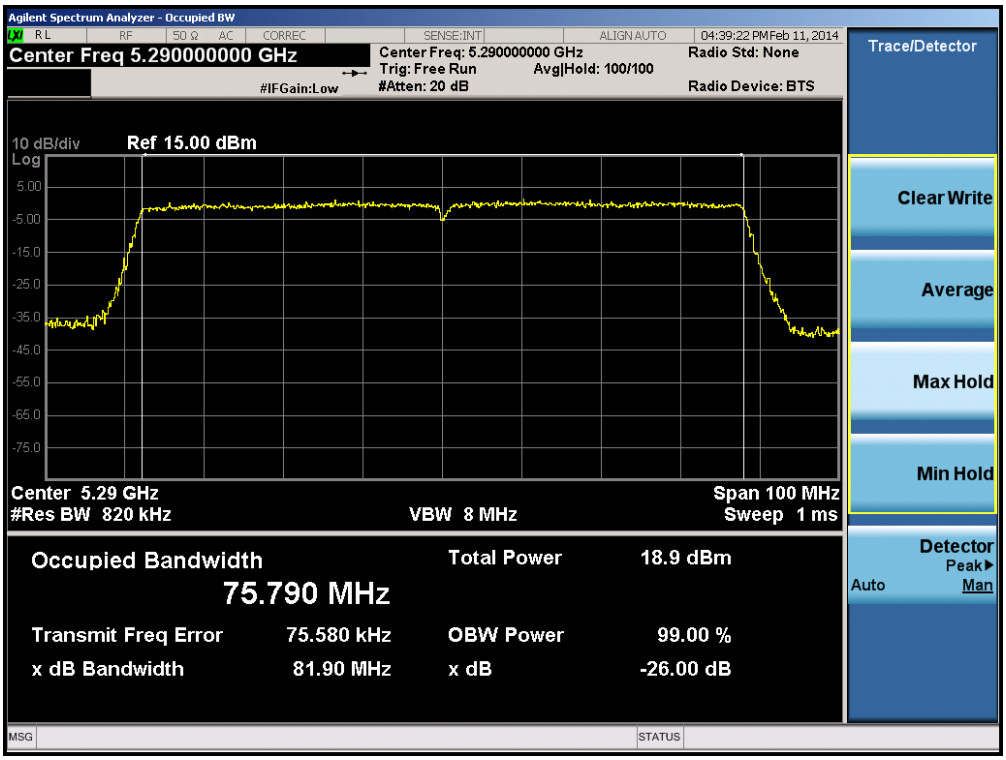


Plot 6-51. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 62)



Plot 6-52. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 2A) – Ch. 58)

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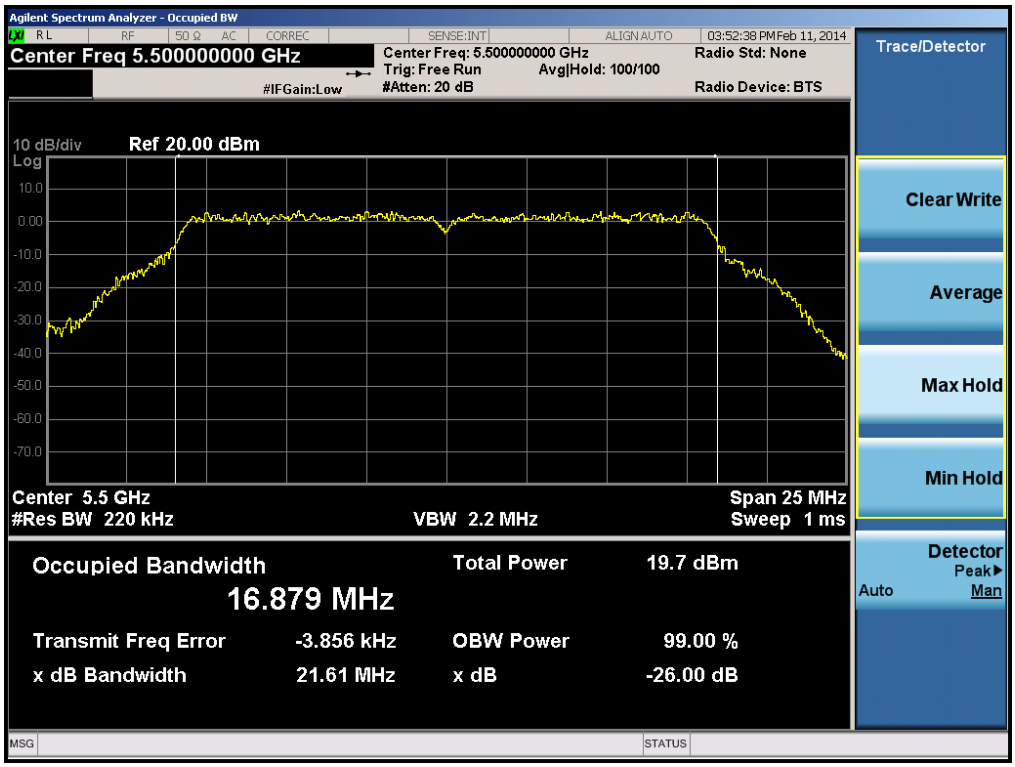
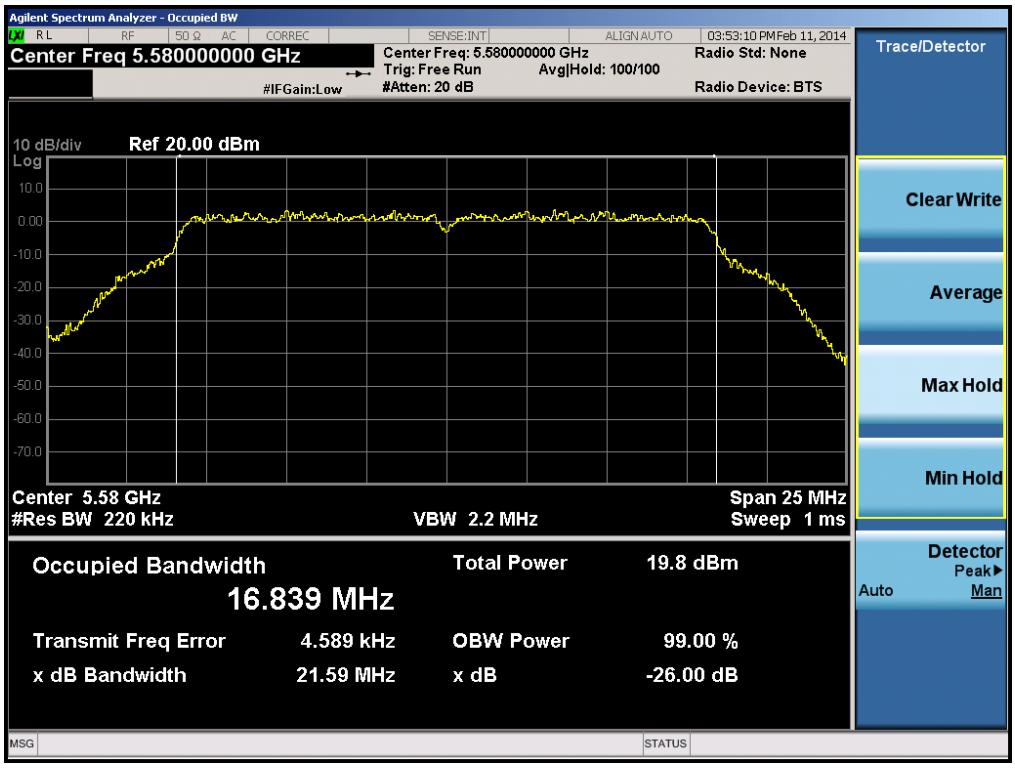


Plot 6-53. 26dB Bandwidth Plot (802.11a (UNII Band 2C) – Ch. 100)



Plot 6-54. 26dB Bandwidth Plot (802.11a (UNII Band 2C) – Ch. 116)

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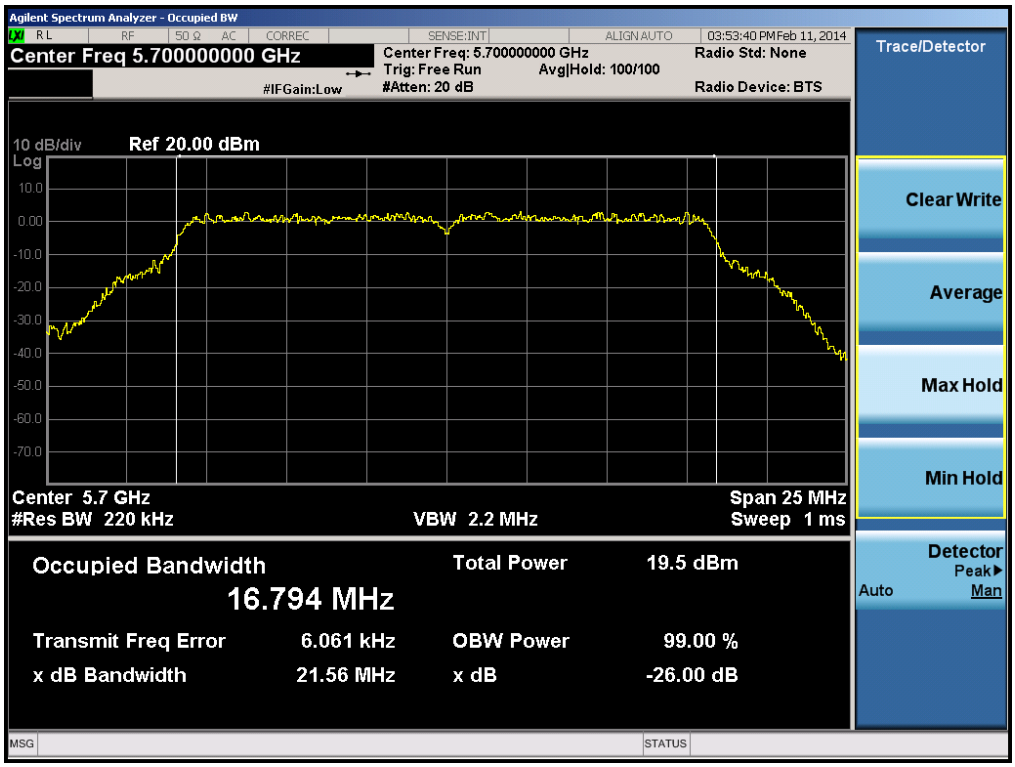
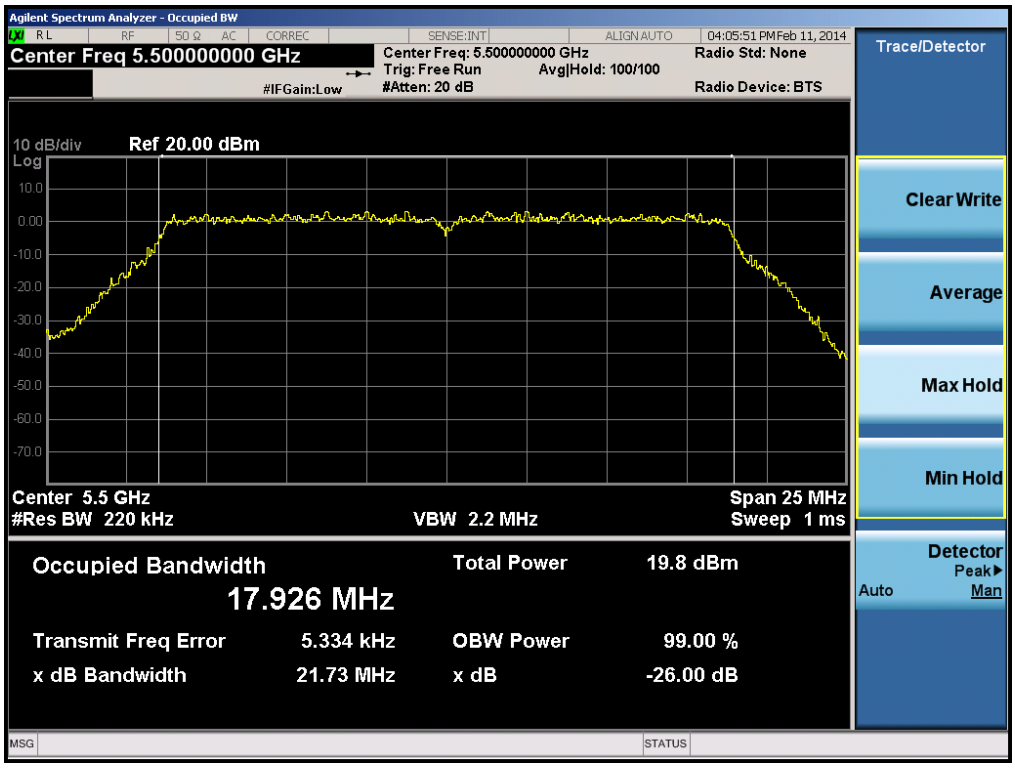


Plot 6-55. 26dB Bandwidth Plot (802.11a (UNII Band 2C) – Ch. 140)



Plot 6-56. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 100)

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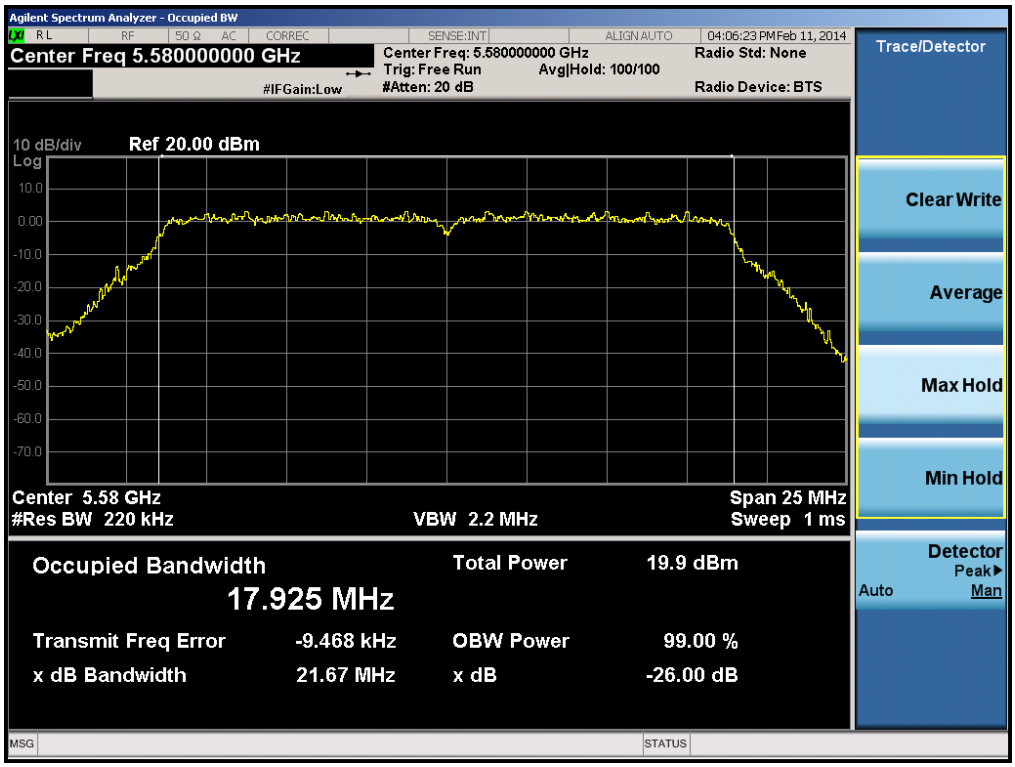
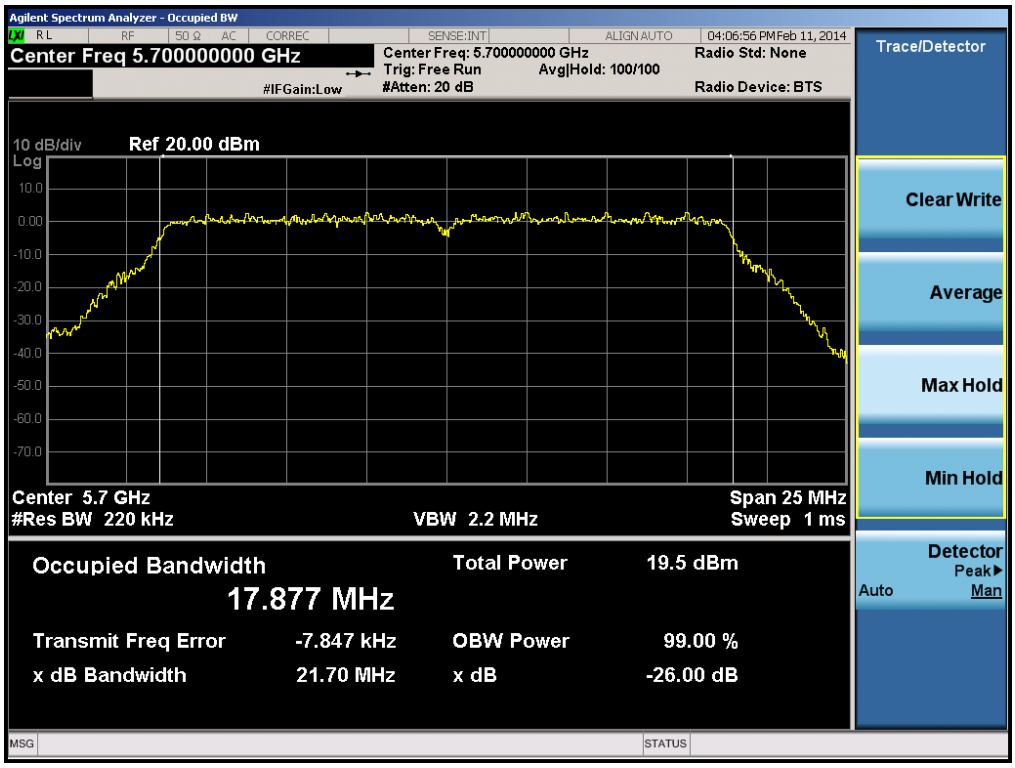


Plot 6-57. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 116)



Plot 6-58. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 140)

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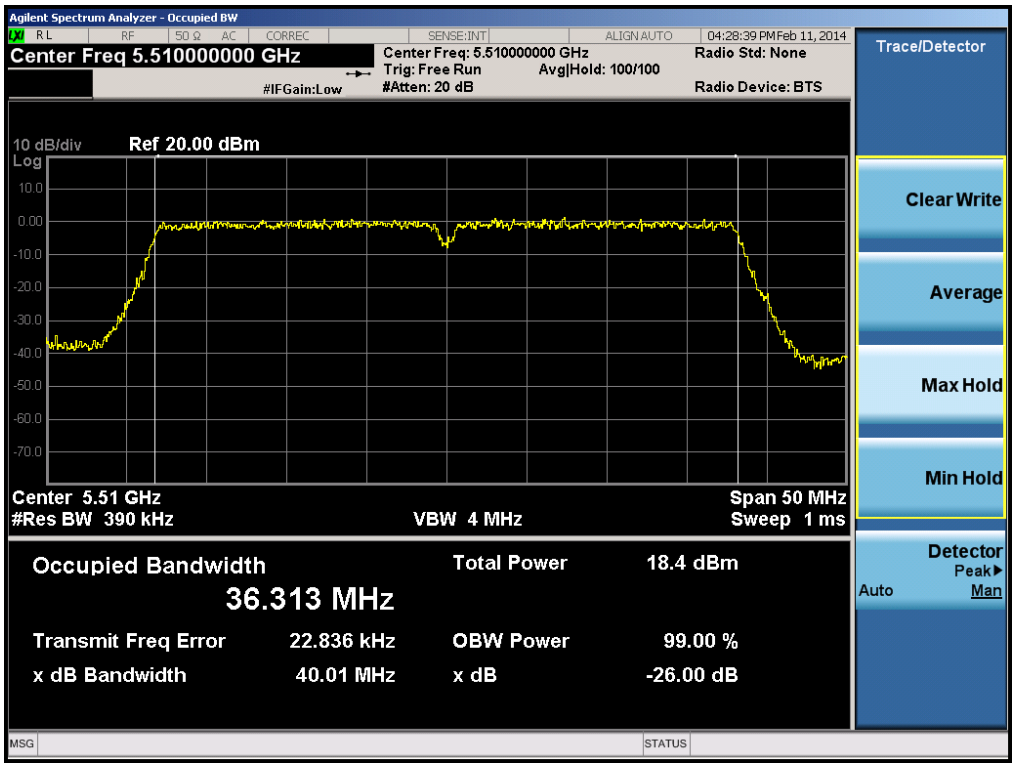
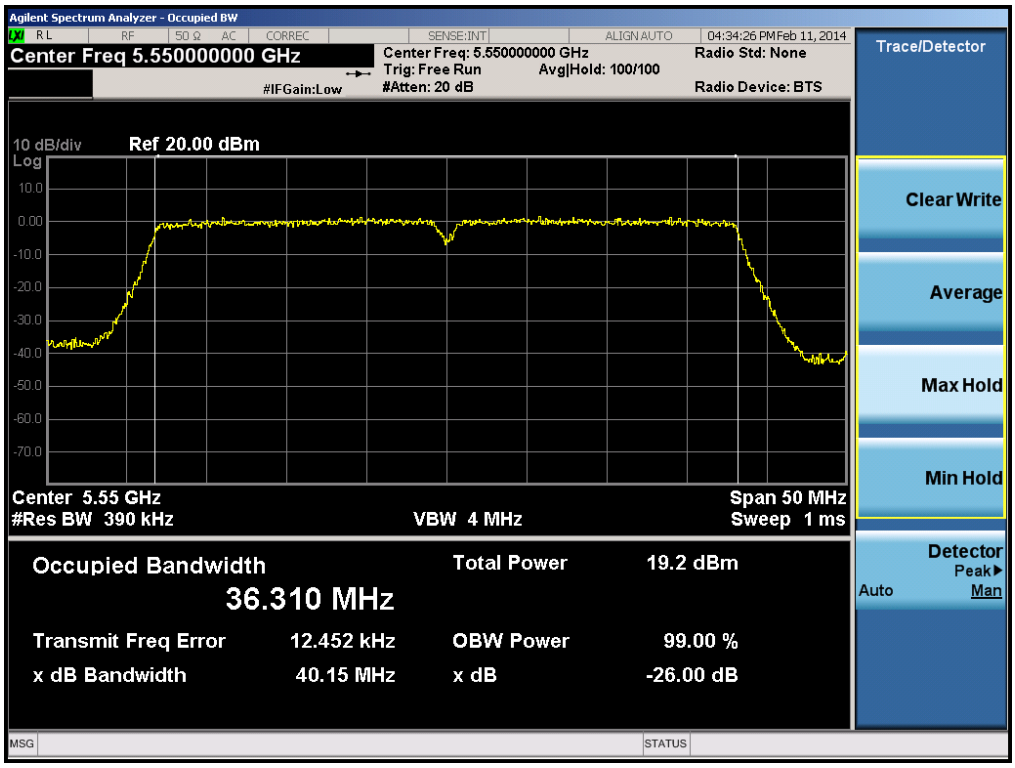


Plot 6-59. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 102)



Plot 6-60. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 110)

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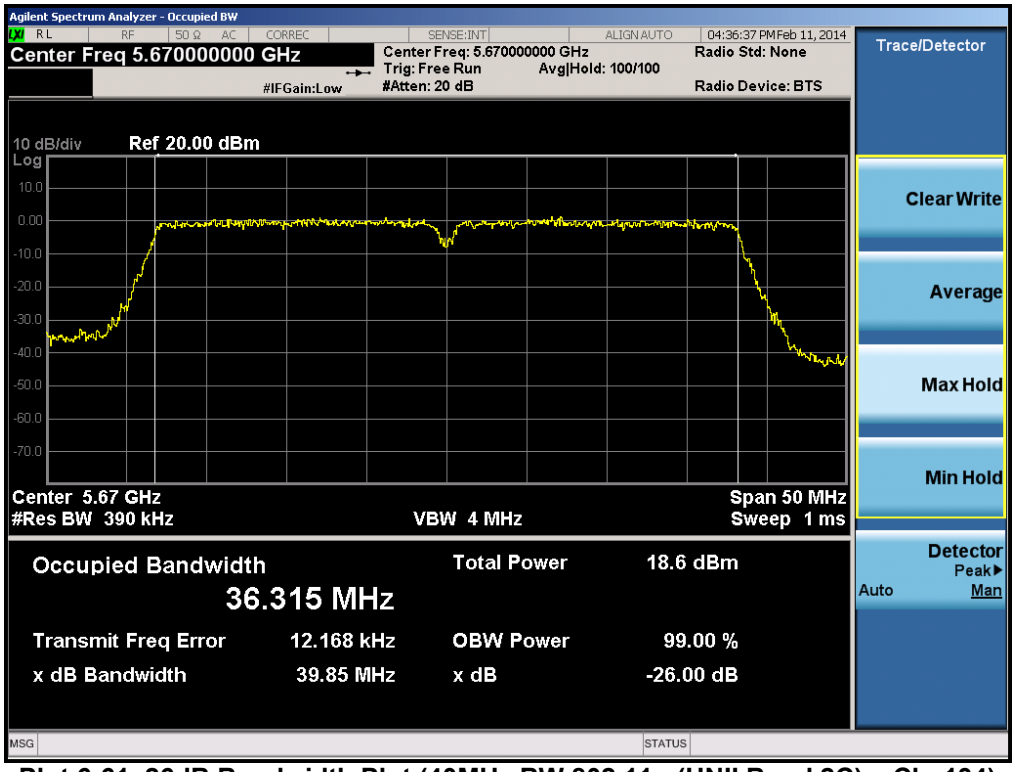
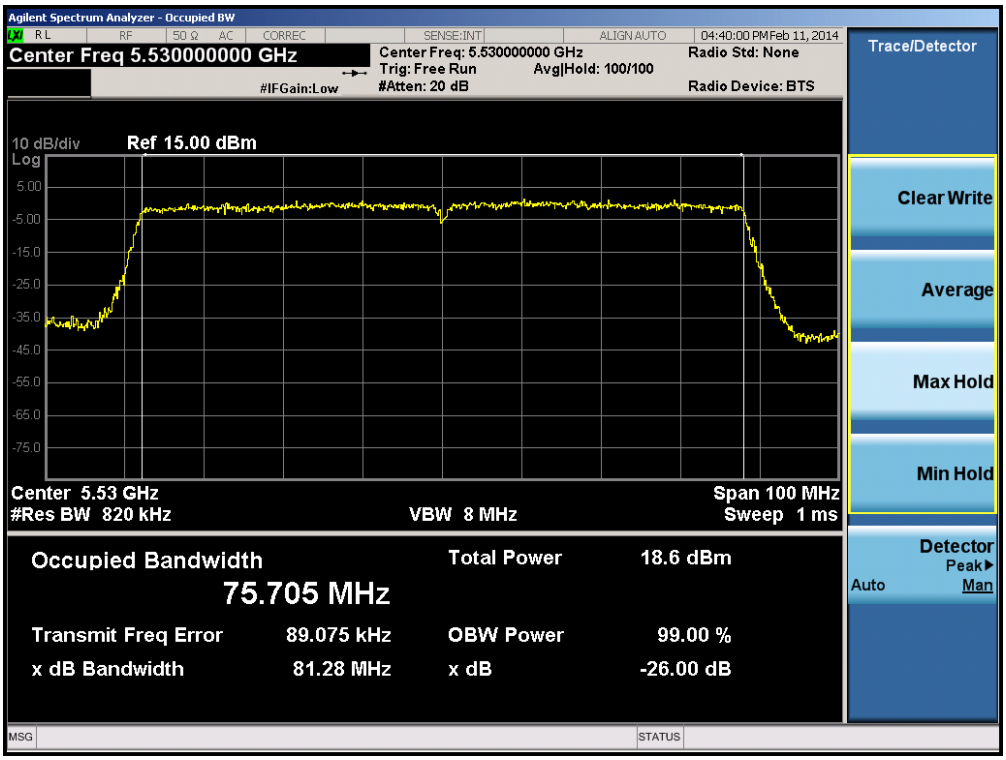


Plot 6-61. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 134)



Plot 6-62. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 2C) – Ch. 106

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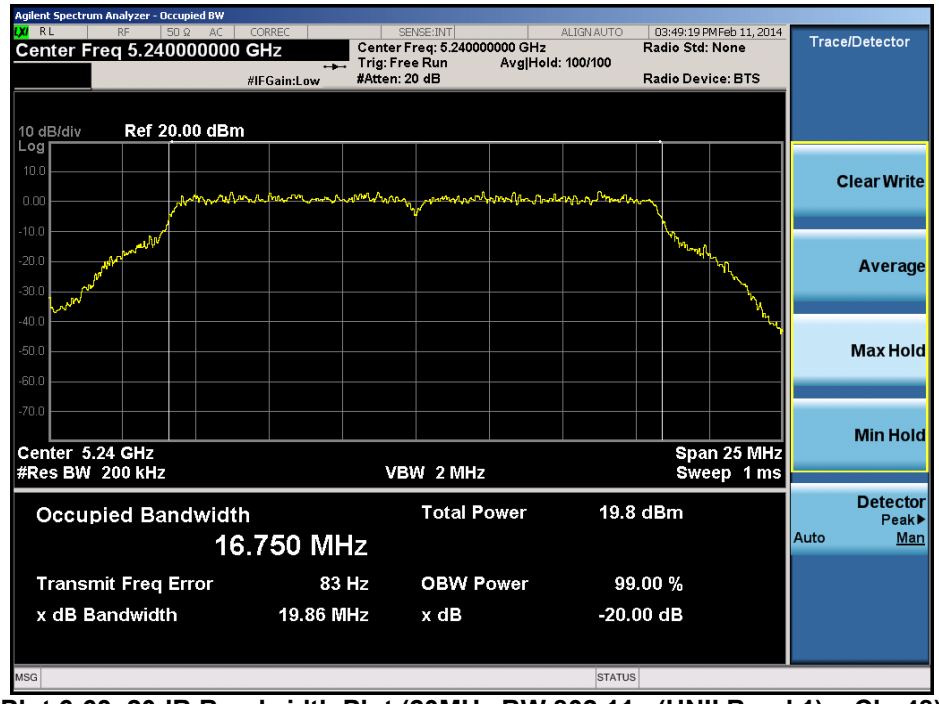
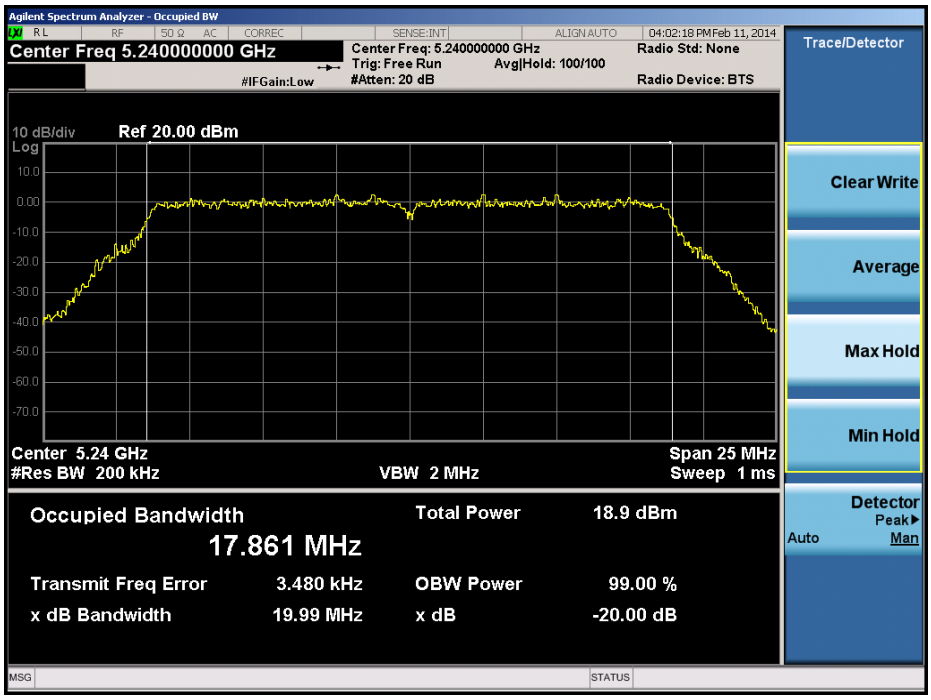


Plot 6-63. 20dB Bandwidth Plot (20MHz BW 802.11a (UNII Band 1) – Ch. 48)

Note: The 20dB bandwidth plot of the UNII Band 1 high channel was found to be within 20MHz and is, therefore, operating solely within the UNII Band 1 frequencies as per KDB 644545 v01r02.



Plot 6-64. 20dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 48)

Note: The 20dB bandwidth plot of the UNII Band 1 high channel was found to be within 20MHz and is, therefore, operating solely within the UNII Band 1 frequencies as per KDB 644545 v01r02.

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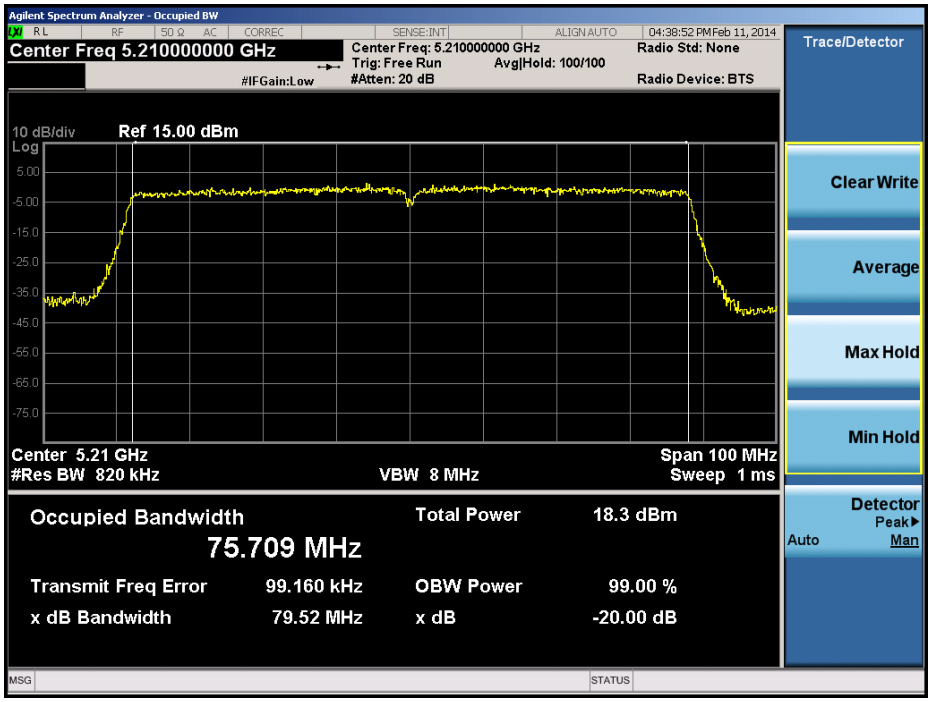
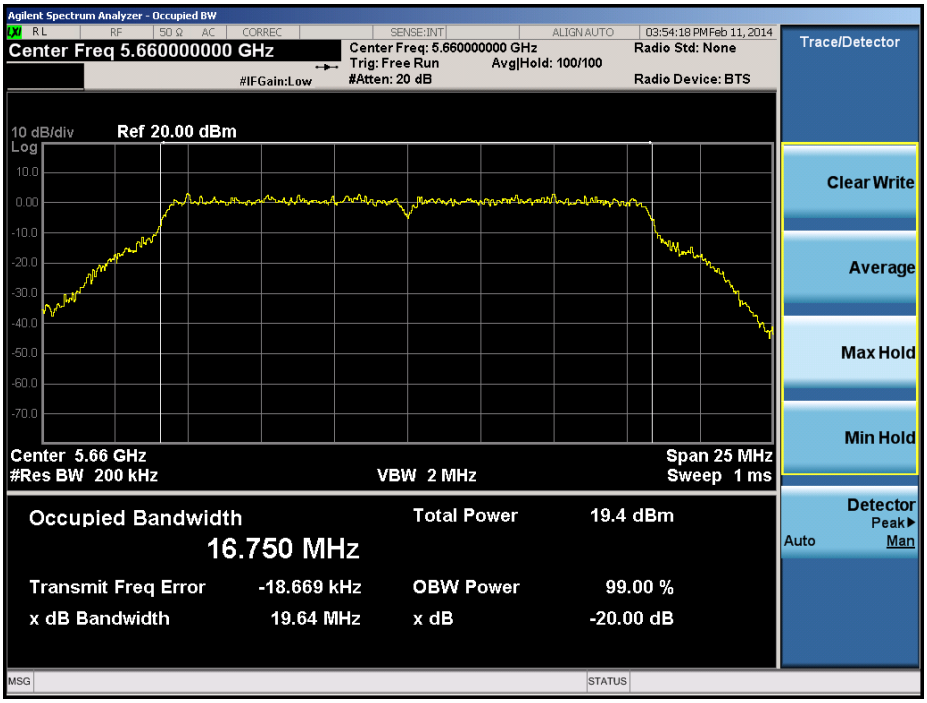


Plot 6-65. 20dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)

Note: The 20dB bandwidth plot of the UNII Band 1 high channel was found to be within 80MHz and is, therefore, operating solely within the UNII Band 1 frequencies as per KDB 644545 v01r02.



Plot 6-66. 20dB Bandwidth Plot (20MHz BW 802.11a (UNII Band 2C) – Ch. 132)

Note: The 20dB bandwidth plot of the UNII Band 2C channel 132 was found to be within 20MHz and is, therefore, operating solely within the UNII Band 2C frequencies and outside of the TDWR band.

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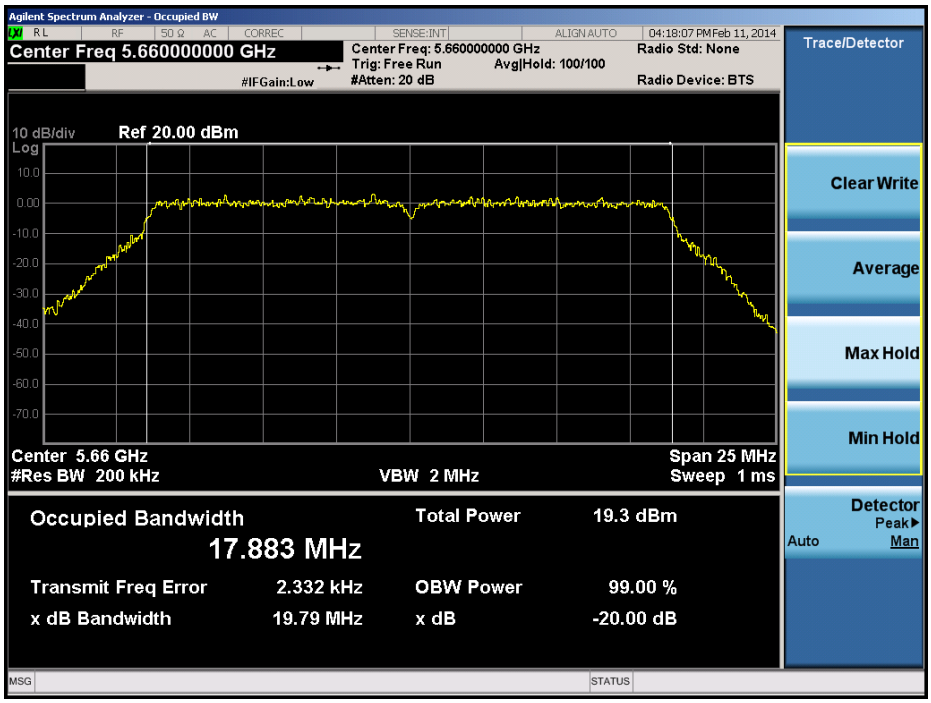
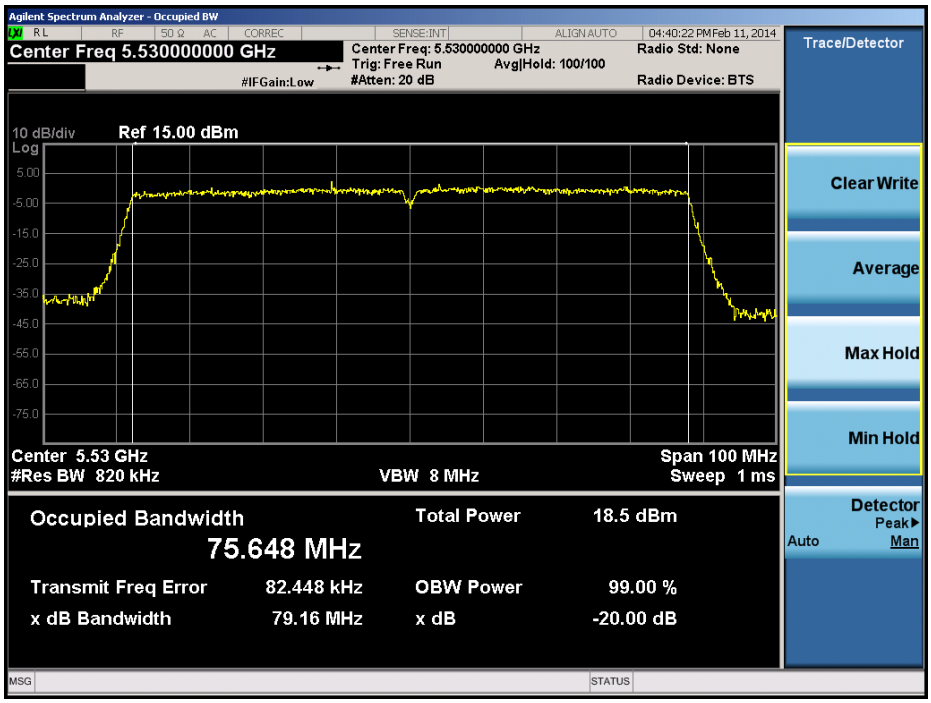


Plot 6-67. 20dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 132)

Note: The 20dB bandwidth plot of the UNII Band 2C channel 132 was found to be within 20MHz and is, therefore, operating solely within the UNII Band 2C frequencies and outside of the TDWR band.



Plot 6-68. 20dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 2C) – Ch. 106)

Note: The 20dB bandwidth plot of the UNII Band 2C channel 106 was found to be within 80MHz and is, therefore, operating solely within the UNII Band 2C frequencies and outside of the TDWR band.

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6.3 UNII Output Power Measurement – 802.11a/n/ac

§15.407 (a.1)

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 duty cycle (>98%), at its maximum power control level, as defined in KDB 789033 v01r03, and at the appropriate frequencies.

In the 5.15 – 5.25GHz band, the maximum permissible conducted output power is the lesser of 50mW (16.99dBm) and 4 dBm + 10log$_{10}$(26dB BW) = 4 dBm + 10log$_{10}$(21.41) = 17.31dBm.

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$_{10}$(21.43) = 17.31dBm.

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$_{10}$(21.41) = 17.31dBm.

Test Procedure Used

KDB 789033 v01r03 – Section E)3)b) Method PM-G
KDB 662911 v02r01

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.

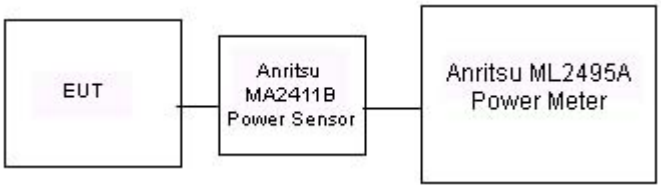

Figure 6-2. Test Instrument & Measurement Setup

Test Notes

Per KDB 662911 v02r01, the MIMO Output Power Measurements were calculated by summing the power measurements from Antenna-1 and 2 in linear power units.

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Antenna-1 Conducted Output Power Measurements

Mode	Freq [MHz]	Channel	Detector	802.11a Conducted Power [dBm] Data Rate [Mbps] 6	9	12	18	24	36	48	54
802.11a	5180	36	AVG	11.14	11.14	11.30	11.30	11.35	11.27	11.37	11.23
802.11a	5200	40	AVG	11.17	11.15	11.37	11.26	11.41	11.30	11.43	11.35
802.11a	5220	44	AVG	11.20	11.20	11.36	11.39	11.44	11.33	11.41	11.30
802.11a	5240	48	AVG	11.14	11.20	11.31	11.30	11.33	11.31	11.28	11.15
802.11a	5260	52	AVG	11.36	11.37	11.45	11.40	11.49	11.46	11.41	11.33
802.11a	5280	56	AVG	11.34	11.38	11.41	11.39	11.39	11.49	11.41	11.35
802.11a	5300	60	AVG	11.26	11.22	11.28	11.32	11.33	11.44	11.30	11.16
802.11a	5320	64	AVG	11.24	11.31	11.25	11.32	11.44	11.37	11.29	11.17
802.11a	5500	100	AVG	10.64	10.70	10.70	10.51	10.88	10.79	10.87	10.64
802.11a	5520	104	AVG	10.62	10.74	10.70	10.50	10.85	10.80	10.83	10.61
802.11a	5540	108	AVG	10.96	11.03	10.99	10.83	11.13	11.20	11.21	10.97
802.11a	5560	112	AVG	11.01	11.07	11.10	10.89	11.32	11.13	11.24	11.06
802.11a	5580	116	AVG	11.10	11.23	11.16	11.02	11.30	11.31	11.42	11.05
802.11a	5660	132	AVG	11.34	11.44	11.39	11.10	11.49	11.43	11.46	11.33
802.11a	5680	136	AVG	11.42	11.46	11.41	11.21	11.43	11.47	11.42	11.36
802.11a	5700	140	AVG	11.24	11.24	11.21	11.13	11.49	11.44	11.47	11.17

Table 6-4. 802.11a (UNII) Maximum Conducted Output Power

Mode	Freq [MHz]	Channel	Detector	20MHz BW 802.11n (5GHz) Conducted Power [dBm] Data Rate [Mbps] 6.5/7.2	13/14.4	19.5/21.7	26/28.9	39/43.4	52/57.8	58.5/65	65/72.2
802.11n	5180	36	AVG	10.86	10.83	10.83	10.94	10.99	11.06	11.07	11.09
802.11n	5200	40	AVG	10.83	10.77	10.75	10.89	10.99	11.05	11.04	11.06
802.11n	5220	44	AVG	11.12	11.11	11.14	11.20	11.28	11.30	11.35	11.32
802.11n	5240	48	AVG	11.01	10.96	10.97	11.07	11.20	11.27	11.18	11.21
802.11n	5260	52	AVG	11.05	11.05	11.24	10.71	10.78	10.90	10.78	10.80
802.11n	5280	56	AVG	10.51	10.56	10.69	10.27	10.32	10.37	10.25	10.22
802.11n	5300	60	AVG	10.46	10.51	10.58	10.17	10.19	10.37	10.25	10.28
802.11n	5320	64	AVG	10.35	10.42	10.47	9.96	10.13	10.14	10.07	10.14
802.11n	5500	100	AVG	10.80	10.66	10.60	11.00	10.90	11.00	11.08	11.00
802.11n	5520	104	AVG	10.83	10.70	10.56	10.99	10.92	10.96	11.03	10.98
802.11n	5540	108	AVG	11.01	10.88	10.85	11.24	11.11	11.30	11.32	11.26
802.11n	5560	112	AVG	11.16	11.06	10.98	11.31	11.22	11.44	11.49	11.43
802.11n	5580	116	AVG	11.19	11.03	11.02	11.41	11.33	11.37	11.49	11.35
802.11n	5660	132	AVG	11.10	10.93	10.92	11.22	11.26	11.32	11.34	11.25
802.11n	5680	136	AVG	11.01	10.89	10.75	11.17	11.06	11.21	11.24	11.24
802.11n	5700	140	AVG	10.83	10.70	10.65	10.94	10.89	11.01	11.19	10.98

Table 6-5. 20MHz BW 802.11n (UNII) Maximum Conducted Output Power

Mode	Freq [MHz]	Channel	Detector	40MHz BW 802.11n (5GHz) Conducted Power [dBm] Data Rate [Mbps] 13.5/15	27/30	40.5/45	54/60	81/90	108/120	121.5/135	135/150
802.11n	5190	38	AVG	9.38	9.28	9.22	9.18	9.22	9.27	9.35	9.40
802.11n	5230	46	AVG	9.19	9.07	9.12	8.99	8.99	9.04	9.13	9.23
802.11n	5270	54	AVG	9.25	9.03	9.09	9.31	9.24	9.27	9.33	9.25
802.11n	5310	62	AVG	8.89	8.62	8.68	8.98	8.83	8.91	8.89	8.82
802.11n	5510	102	AVG	8.34	8.37	8.37	8.43	8.45	8.51	8.64	8.58
802.11n	5550	110	AVG	8.51	8.57	8.55	8.61	8.54	8.69	8.80	8.72
802.11n	5670	134	AVG	8.75	8.77	8.80	8.79	8.82	8.99	9.06	9.02

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

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20MHz BW 802.11ac (5GHz) Conducted Power [dBm]				
Mode	Freq [MHz]	Channel	Detector	Data Rate
				6.5 Mbps
802.11ac	5180	36	AVG	10.58
802.11ac	5200	40	AVG	10.54
802.11ac	5240	48	AVG	10.49
802.11ac	5260	52	AVG	10.71
802.11ac	5280	56	AVG	10.65
802.11ac	5320	64	AVG	10.55
802.11ac	5500	100	AVG	10.85
802.11ac	5580	116	AVG	11.23
802.11ac	5700	140	AVG	10.91

Table 6-7. 20MHz BW 802.11ac (UNII) Maximum Conducted Output Power

40MHz BW 802.11ac (5GHz) Conducted Power [dBm]				
Mode	Freq [MHz]	Channel	Detector	Data Rate
				13.5 Mbps
802.11ac	5190	38	AVG	9.08
802.11ac	5230	46	AVG	9.06
802.11ac	5270	54	AVG	9.19
802.11ac	5310	62	AVG	9.06
802.11ac	5510	102	AVG	8.38
802.11ac	5550	110	AVG	8.55
802.11ac	5670	134	AVG	8.65

Table 6-7. 40MHz BW 802.11ac (UNII) Maximum Conducted Output Power

Mode	Freq	Channel	Detector	80MHz BW 802.11ac (5GHz) Conducted Power [dBm]									
				Data Rate [Mbps]									
	[MHz]			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
802.11ac	5210	42	AVG	8.62	8.81	8.81	8.86	8.70	8.80	8.76	8.81	8.70	8.75
802.11ac	5290	58	AVG	8.95	8.90	9.13	9.19	9.14	9.15	9.10	9.18	9.08	9.11
802.11ac	5530	106	AVG	8.49	8.44	8.42	8.73	8.68	8.55	8.73	8.71	8.72	8.69

Table 6-8. 80MHz BW 802.11ac (UNII) Maximum Conducted Output Power

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Antenna-2 Conducted Output Power Measurements

Mode	Freq [MHz]	Channel	Detector	802.11a Conducted Power [dBm] Data Rate [Mbps] 6	9	12	18	24	36	48	54
802.11a	5180	36	AVG	11.03	11.05	10.85	11.07	10.59	10.55	10.48	10.75
802.11a	5200	40	AVG	11.01	11.03	10.75	11.03	10.51	10.60	10.54	10.58
802.11a	5220	44	AVG	11.08	11.12	10.99	11.23	10.68	10.63	10.46	10.54
802.11a	5240	48	AVG	10.91	10.93	10.81	11.16	10.51	10.49	10.47	10.54
802.11a	5260	52	AVG	11.16	11.28	11.06	11.15	10.52	10.49	10.59	10.55
802.11a	5280	56	AVG	11.12	11.26	11.18	11.21	10.62	10.59	10.50	10.63
802.11a	5300	60	AVG	11.14	11.16	11.08	11.15	10.61	10.54	10.29	10.43
802.11a	5320	64	AVG	11.04	11.22	11.13	11.09	10.46	10.50	10.49	10.61
802.11a	5500	100	AVG	11.18	11.30	11.24	11.26	10.68	10.74	10.54	10.63
802.11a	5520	104	AVG	11.23	11.24	11.32	11.39	10.76	10.72	10.77	10.87
802.11a	5540	108	AVG	11.26	11.20	11.18	11.24	10.71	10.65	10.57	10.80
802.11a	5560	112	AVG	11.18	11.23	11.28	11.25	10.67	10.70	10.63	10.64
802.11a	5580	116	AVG	11.09	11.10	11.12	11.18	10.67	10.62	10.52	10.61
802.11a	5660	132	AVG	11.06	11.09	11.14	11.17	10.48	10.45	10.41	10.51
802.11a	5680	136	AVG	11.07	11.11	11.06	11.10	10.56	10.49	10.43	10.50
802.11a	5700	140	AVG	11.05	11.08	11.06	11.13	10.47	10.46	10.39	10.56

Table 6-9. 802.11a (UNII) Maximum Conducted Output Power

Mode	Freq [MHz]	Channel	Detector	20MHz BW 802.11n (5GHz) Conducted Power [dBm] Data Rate [Mbps] 6.5/7.2	13/14.4	19.5/21.7	26/28.9	39/43.4	52/57.8	58.5/65	65/72.2
802.11n	5180	36	AVG	10.96	10.88	10.89	11.12	11.10	11.05	11.05	11.01
802.11n	5200	40	AVG	11.07	10.93	10.97	11.15	11.31	11.15	11.11	11.18
802.11n	5220	44	AVG	10.83	10.77	10.76	11.05	11.03	10.99	11.02	10.90
802.11n	5240	48	AVG	10.94	10.89	10.99	11.26	11.29	11.18	11.27	11.28
802.11n	5260	52	AVG	11.14	11.13	11.18	10.52	10.47	10.52	10.53	10.54
802.11n	5280	56	AVG	11.21	11.26	11.25	10.56	10.63	10.53	10.64	10.61
802.11n	5300	60	AVG	10.98	11.01	11.04	10.42	10.41	10.34	10.35	10.31
802.11n	5320	64	AVG	11.02	11.00	11.10	10.41	10.53	10.48	10.47	10.49
802.11n	5500	100	AVG	11.19	11.19	11.22	10.64	10.62	10.54	10.67	10.59
802.11n	5520	104	AVG	11.13	11.24	11.18	10.63	10.61	10.52	10.65	10.59
802.11n	5540	108	AVG	11.12	11.01	11.04	10.57	10.51	10.43	10.64	10.49
802.11n	5560	112	AVG	11.01	11.09	11.10	10.52	10.57	10.40	10.46	10.46
802.11n	5580	116	AVG	11.07	10.92	10.85	10.36	10.30	10.34	10.42	10.28
802.11n	5660	132	AVG	11.19	11.07	11.21	10.61	10.63	10.61	10.56	10.57
802.11n	5680	136	AVG	10.82	10.75	10.81	10.34	10.36	10.24	10.28	10.10
802.11n	5700	140	AVG	10.87	10.89	10.88	10.34	10.28	10.27	10.29	10.23

Table 6-10. 20MHz BW 802.11n (UNII) Maximum Conducted Output Power

Mode	Freq [MHz]	Channel	Detector	40MHz BW 802.11n (5GHz) Conducted Power [dBm] Data Rate [Mbps] 13.5/15	27/30	40.5/45	54/60	81/90	108/120	121.5/135	135/150
802.11n	5190	38	AVG	8.91	9.02	9.01	8.44	8.40	8.28	8.30	8.29
802.11n	5230	46	AVG	8.95	8.98	9.06	8.38	8.47	8.36	8.48	8.34
802.11n	5270	54	AVG	9.03	9.05	9.05	9.32	9.35	9.29	9.34	9.36
802.11n	5310	62	AVG	9.06	9.21	9.31	9.33	9.42	9.37	9.43	9.37
802.11n	5510	102	AVG	9.13	9.17	9.21	9.44	9.45	9.42	9.48	9.44
802.11n	5550	110	AVG	9.19	9.32	9.27	9.48	9.49	9.46	9.43	9.45
802.11n	5670	134	AVG	9.04	9.07	9.01	9.20	9.16	9.23	9.28	9.31

Table 6-11. 40MHz BW 802.11n (UNII) Maximum Conducted Output Power

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20MHz BW 802.11ac (5GHz) Conducted Power [dBm]				
Mode	Freq [MHz]	Channel	Detector	Data Rate
				6.5 Mbps
802.11ac	5180	36	AVG	10.91
802.11ac	5200	40	AVG	10.97
802.11ac	5240	48	AVG	10.84
802.11ac	5260	52	AVG	11.26
802.11ac	5280	56	AVG	11.02
802.11ac	5320	64	AVG	11.23
802.11ac	5500	100	AVG	11.12
802.11ac	5580	116	AVG	11.21
802.11ac	5700	140	AVG	11.09

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

40MHz BW 802.11ac (5GHz) Conducted Power [dBm]				
Mode	Freq [MHz]	Channel	Detector	Data Rate
				13.5 Mbps
802.11ac	5190	38	AVG	8.91
802.11ac	5230	46	AVG	8.94
802.11ac	5270	54	AVG	8.97
802.11ac	5310	62	AVG	9.02
802.11ac	5510	102	AVG	9.09
802.11ac	5550	110	AVG	9.24
802.11ac	5670	134	AVG	9.19

Table 6-13. 40MHz BW 802.11ac (UNII) Maximum Conducted Output Power

Mode	Freq [MHz]	Channel	Detector	80MHz BW 802.11ac (5GHz) Conducted Power [dBm]									
				Data Rate [Mbps]									
				29.3	58.5	87.8	117	175.5	234	263.3	292.5	351	390
802.11ac	5210	42	AVG	8.61	8.62	8.66	8.02	7.93	8.03	8.03	8.05	8.00	8.25
802.11ac	5290	58	AVG	8.76	8.64	8.67	8.03	8.24	8.07	8.09	8.04	8.09	8.14
802.11ac	5530	106	AVG	8.87	8.91	8.76	8.39	8.18	8.20	8.21	8.18	8.19	8.28

Table 6-14. 80MHz BW 802.11ac (UNII) Maximum Conducted Output Power

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MIMO Maximum Conducted Output Power Measurements

Mode	Freq [MHz]	Channel	Detector	Data Rate [Mbps] MCS8
802.11n	5180	36	AVG	7.32
802.11n	5200	40	AVG	7.34
802.11n	5220	44	AVG	7.26
802.11n	5240	48	AVG	7.34
802.11n	5260	52	AVG	7.22
802.11n	5280	56	AVG	7.08
802.11n	5300	60	AVG	7.03
802.11n	5320	64	AVG	6.95
802.11n	5500	100	AVG	6.78
802.11n	5520	104	AVG	6.74
802.11n	5540	108	AVG	6.80
802.11n	5560	112	AVG	6.86
802.11n	5580	116	AVG	6.88
802.11n	5660	132	AVG	6.68
802.11n	5680	136	AVG	6.55
802.11n	5700	140	AVG	6.47

Table 6-15. MIMO 20MHz BW 802.11n (UNII) Maximum Conducted Output Power (Antenna1)

Mode	Freq [MHz]	Channel	Detector	Data Rate MCS8
802.11n	5180	36	AVG	8.25
802.11n	5200	40	AVG	8.34
802.11n	5220	44	AVG	8.47
802.11n	5240	48	AVG	8.33
802.11n	5260	52	AVG	8.23
802.11n	5280	56	AVG	8.43
802.11n	5300	60	AVG	8.39
802.11n	5320	64	AVG	8.13
802.11n	5500	100	AVG	8.48
802.11n	5520	104	AVG	8.56
802.11n	5540	108	AVG	8.48
802.11n	5560	112	AVG	8.42
802.11n	5580	116	AVG	8.16
802.11n	5660	132	AVG	8.20
802.11n	5680	136	AVG	8.15
802.11n	5700	140	AVG	8.23

Table 6-16. MIMO 20MHz BW 802.11n (UNII) Maximum Conducted Output Power (Antenna2)

Mode	Freq [MHz]	Channel	Detector	Data Rate MCS8
802.11n	5180	36	AVG	10.82
802.11n	5200	40	AVG	10.88
802.11n	5220	44	AVG	10.92
802.11n	5240	48	AVG	10.87
802.11n	5260	52	AVG	10.76
802.11n	5280	56	AVG	10.82
802.11n	5300	60	AVG	10.77
802.11n	5320	64	AVG	10.59
802.11n	5500	100	AVG	10.72
802.11n	5520	104	AVG	10.75
802.11n	5540	108	AVG	10.73
802.11n	5560	112	AVG	10.72
802.11n	5580	116	AVG	10.58
802.11n	5660	132	AVG	10.52
802.11n	5680	136	AVG	10.43
802.11n	5700	140	AVG	10.45

Table 6-17. MIMO 20MHz BW 802.11n (UNII) Maximum Conducted Output Power (Summed)

Mode	Freq [MHz]	Channel	Detector	Data Rate [Mbps] MCS8
802.11n	5190	38	AVG	5.20
802.11n	5230	46	AVG	5.21
802.11n	5270	54	AVG	5.01
802.11n	5310	62	AVG	4.83
802.11n	5510	102	AVG	4.71
802.11n	5550	110	AVG	4.73
802.11n	5670	134	AVG	4.28

Table 6-18. MIMO 40MHz BW 802.11n (UNII) Maximum Conducted Output Power (Antenna1)

Mode	Freq [MHz]	Channel	Detector	Data Rate MCS8
802.11n	5190	38	AVG	5.95
802.11n	5230	46	AVG	5.91
802.11n	5270	54	AVG	5.51
802.11n	5310	62	AVG	5.81
802.11n	5510	102	AVG	5.93
802.11n	5550	110	AVG	5.94
802.11n	5670	134	AVG	5.91

Table 6-19. MIMO 40MHz BW 802.11n (UNII) Maximum Conducted Output Power (Antenna2)

Mode	Freq [MHz]	Channel	Detector	Data Rate MCS8
802.11n	5190	38	AVG	8.60
802.11n	5230	46	AVG	8.58
802.11n	5270	54	AVG	8.28
802.11n	5310	62	AVG	8.36
802.11n	5510	102	AVG	8.37
802.11n	5550	110	AVG	8.39
802.11n	5670	134	AVG	8.18

Table 6-20. MIMO 40MHz BW 802.11n (UNII) Maximum Conducted Output Power (Summed)

Mode	Freq [MHz]	Channel	Detector	Data Rate [Mbps] 58.5/65
802.11ac	5210	42	AVG	5.04
802.11ac	5290	58	AVG	5.69
802.11ac	5530	106	AVG	5.56

Table 6-21. MIMO 80MHz BW 802.11ac (UNII) Maximum Conducted Output Power (Antenna1)

Mode	Freq [MHz]	Channel	Detector	Data Rate 58.5/65
802.11ac	5210	42	AVG	6.03
802.11ac	5290	58	AVG	6.71
802.11ac	5530	106	AVG	7.03

Table 6-22. MIMO 80MHz BW 802.11ac (UNII) Maximum Conducted Output Power (Antenna2)

Mode	Freq [MHz]	Channel	Detector	Data Rate 58.5/65
802.11ac	5210	42	AVG	8.57
802.11ac	5290	58	AVG	9.24
802.11ac	5530	106	AVG	9.37

Table 6-23. MIMO 80MHz BW 802.11ac (UNII) Maximum Conducted Output Power (Summed)

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Note:

As shown in the section above, the conducted powers at Antenna 1 and Antenna 2 were first measured separately during MIMO transmission. 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 7.32 dBm for Antenna-1 and 8.25 dBm for Antenna-2.

Antenna 1 + Antenna 2 = MIMO

(7.32 dBm + 8.25 dBm) = (5.40 mW + 6.68 mW) = 12.08 mW = 10.82 dBm

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6.4 Peak Power Spectral Density – 802.11a/n/ac

§15.407(a.1)(2.5)

Test Overview and Limit

The spectrum analyzer was connected to the antenna terminal while the EUT was operating at its maximum duty cycle (>98%), at its maximum power control level, as defined in KDB 789033 v01r03, and at the appropriate frequencies. Method SA-1, as defined in KDB 789033 v01r03, was used to measure the power spectral density.

In the 5.15 – 5.25GHz band, the maximum permissible power spectral density is 4dBm/MHz.

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

Test Procedure Used

KDB 789033 v01r03 – Section F
KDB 662911 v02r01

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 ≥ 2 x (span/RBW)
6. Sweep time = auto
7. Detector = power averaging (RMS)
8. Trigger was set to free run since the EUT was operating at a duty cycle ≥ 98%
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.

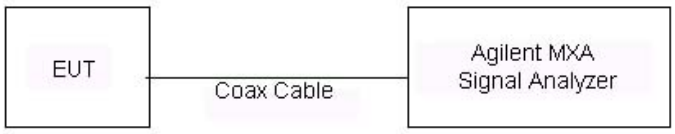

Figure 6-3. Test Instrument & Measurement Setup

Test Notes

Per KDB 662911 v02r01, Section E)2)b), MIMO peak power spectral density values were calculated by summing the maximum power spectral density values from Antenna-1 and Antenna-2 in linear power units (mW), then converted back to dBm.

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Antenna-1 Peak Power Spectral Density – 802.11a/n/ac

	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	1.93	4.0	-2.07	Pass
	5200	40	a	6	1.96	4.0	-2.04	Pass
	5240	48	a	6	1.84	4.0	-2.16	Pass
	5180	36	n (20MHz)	6.5/7.2 (MCS0)	1.71	4.0	-2.29	Pass
	5200	40	n (20MHz)	6.5/7.2 (MCS0)	1.73	4.0	-2.27	Pass
	5240	48	n (20MHz)	6.5/7.2 (MCS0)	1.93	4.0	-2.07	Pass
	5190	38	n (40MHz)	13.5/15 (MCS0)	-2.58	4.0	-6.58	Pass
	5230	46	n (40MHz)	13.5/15 (MCS0)	-2.78	4.0	-6.78	Pass
	5210	42	ac (80MHz)	29.3/32.5 (MCS0)	-6.02	4.0	-10.02	Pass
Band 2A	5260	52	a	6	2.43	11.0	-8.57	Pass
	5280	56	a	6	2.37	11.0	-8.63	Pass
	5320	64	a	6	2.21	11.0	-8.79	Pass
	5260	52	n (20MHz)	6.5/7.2 (MCS0)	1.21	11.0	-9.79	Pass
	5280	56	n (20MHz)	6.5/7.2 (MCS0)	1.10	11.0	-9.91	Pass
	5320	64	n (20MHz)	6.5/7.2 (MCS0)	1.81	11.0	-9.19	Pass
	5270	54	n (40MHz)	13.5/15 (MCS0)	-2.07	11.0	-13.07	Pass
	5310	62	n (40MHz)	13.5/15 (MCS0)	-2.41	11.0	-13.41	Pass
	5290	58	ac (80MHz)	29.3/32.5 (MCS0)	-5.73	11.0	-16.73	Pass
Band 2C	5500	100	a	6	2.19	11.0	-8.81	Pass
	5580	116	a	6	2.54	11.0	-8.46	Pass
	5700	140	a	6	2.44	11.0	-8.56	Pass
	5500	100	n (20MHz)	6.5/7.2 (MCS0)	0.78	11.0	-10.22	Pass
	5580	116	n (20MHz)	6.5/7.2 (MCS0)	1.36	11.0	-9.64	Pass
	5700	140	n (20MHz)	6.5/7.2 (MCS0)	1.12	11.0	-9.88	Pass
	5510	102	n (40MHz)	13.5/15 (MCS0)	-2.46	11.0	-13.46	Pass
	5550	110	n (40MHz)	13.5/15 (MCS0)	-1.97	11.0	-12.97	Pass
	5670	134	n (40MHz)	13.5/15 (MCS0)	-2.11	11.0	-13.11	Pass
	5530	106	ac (80MHz)	29.3/32.5 (MCS0)	-6.98	11.0	-17.98	Pass

Table 6-24. Conducted Power Spectral Density Measurements

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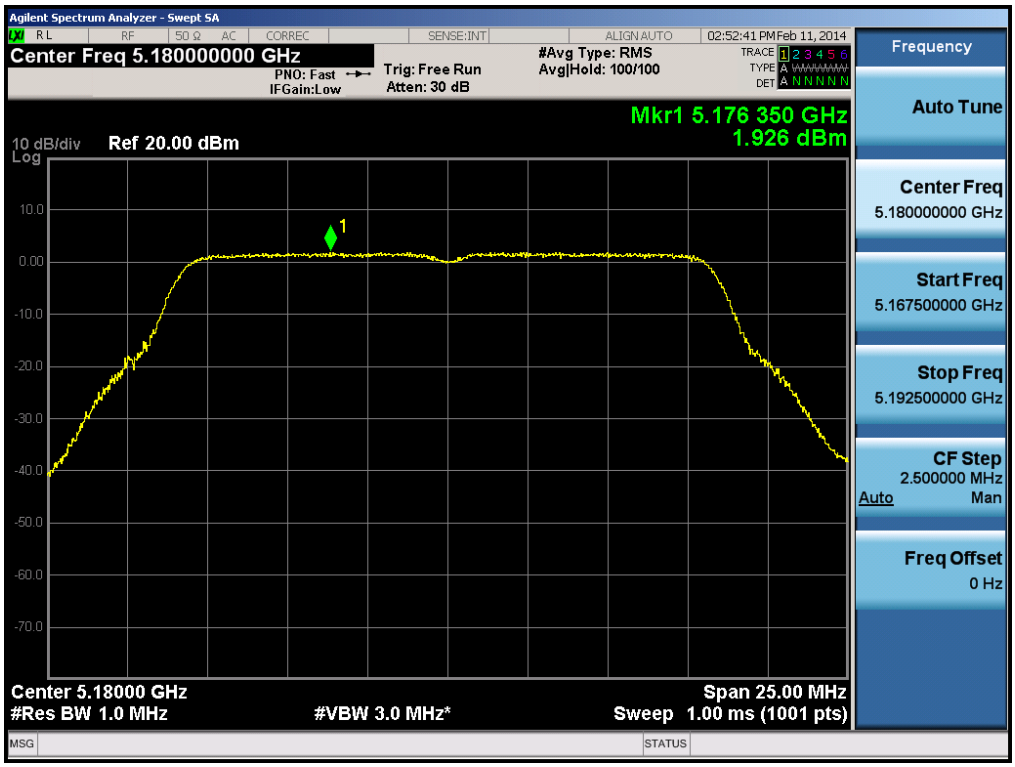
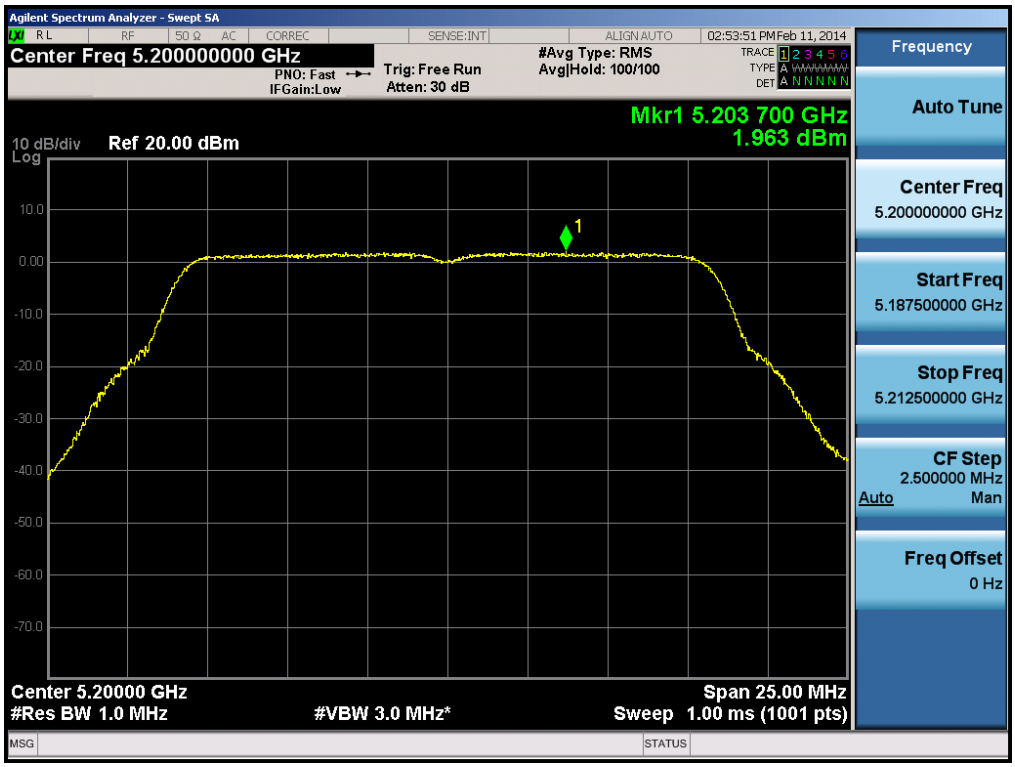


Plot 6-69. Peak Power Spectral Density Plot (802.11a (UNII Band 1) – Ch. 36)



Plot 6-70. Peak Power Spectral Density Plot (802.11a (UNII Band 1) – Ch. 40)

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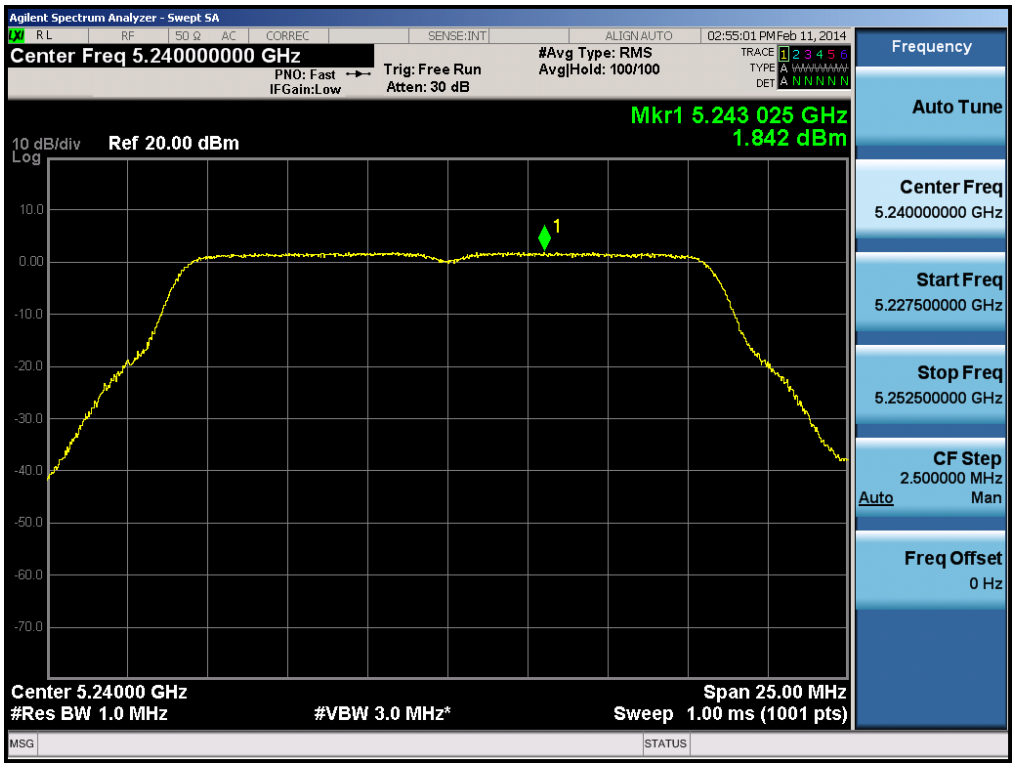
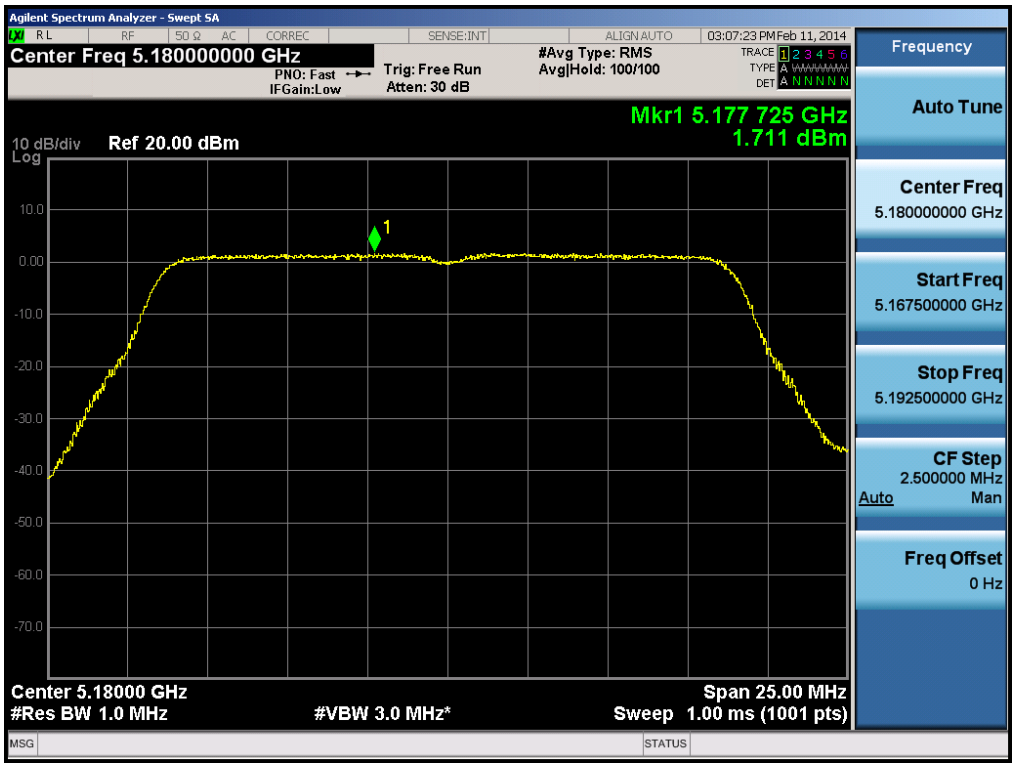


Plot 6-71. Peak Power Spectral Density Plot (802.11a (UNII Band 1) – Ch. 48)



Plot 6-72. Peak Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 36)

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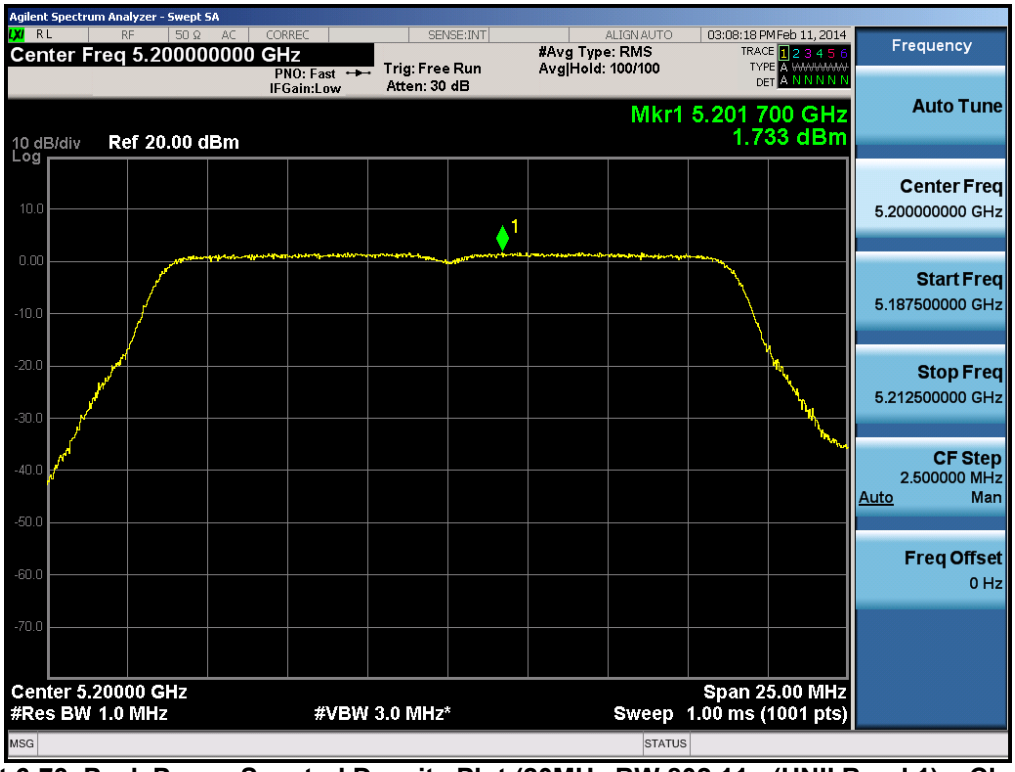
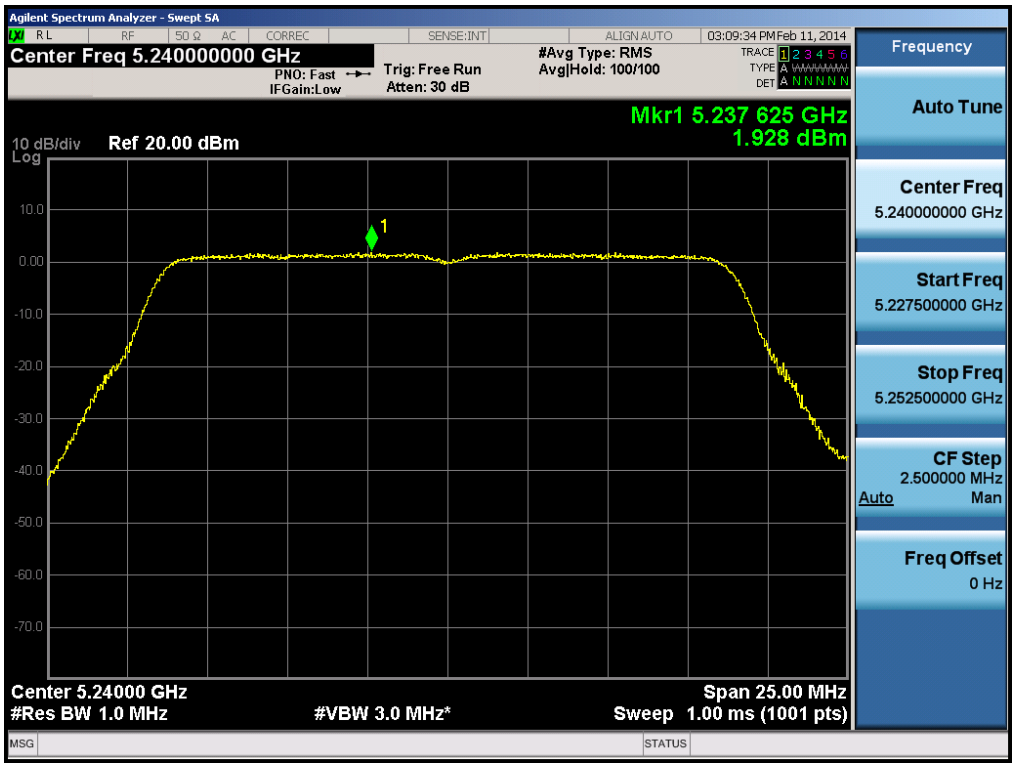


Plot 6-73. Peak Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 40)



Plot 6-74. Peak Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 48)

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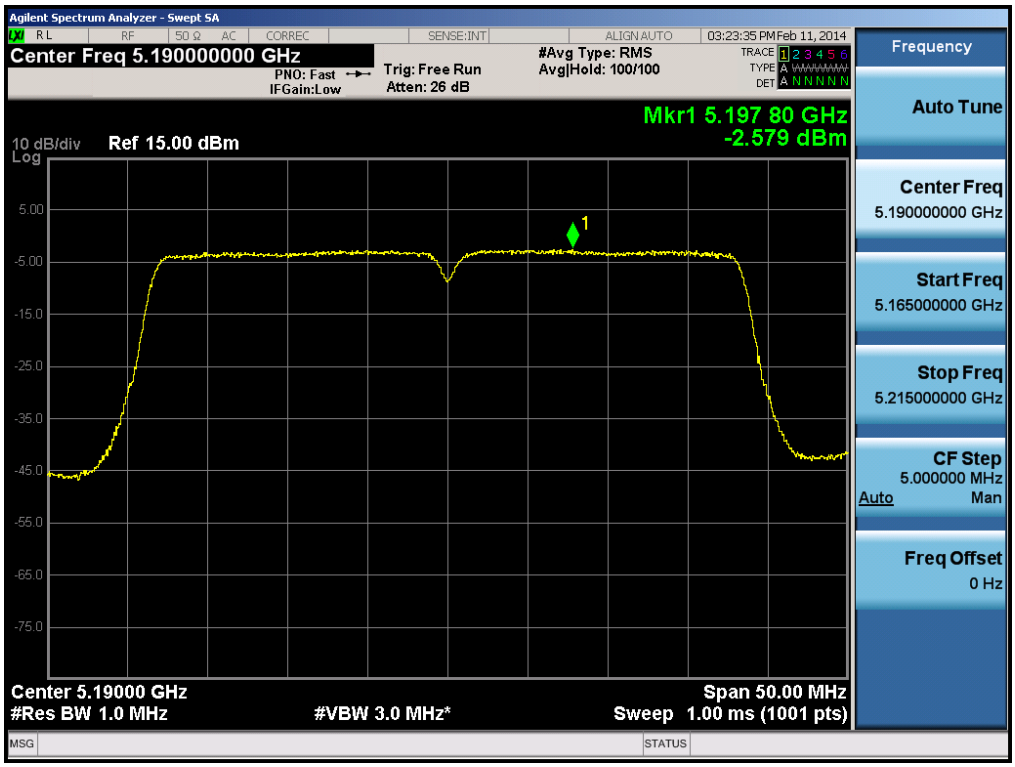
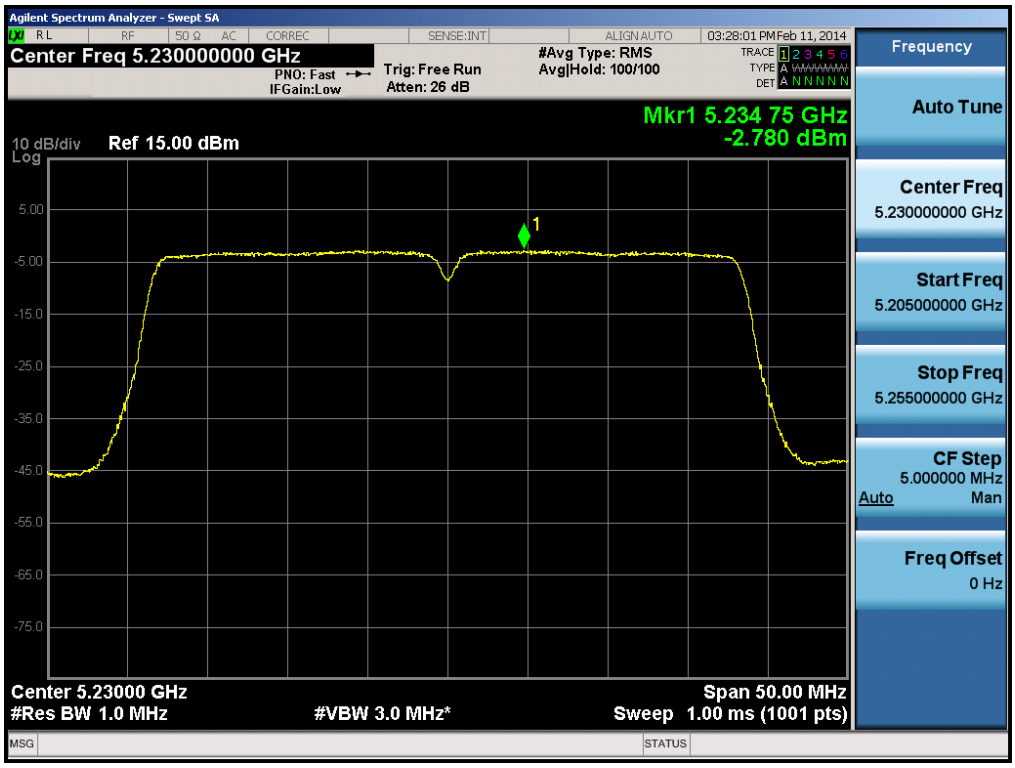


Plot 6-75. Peak Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 38)



Plot 6-76. Peak Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 46)

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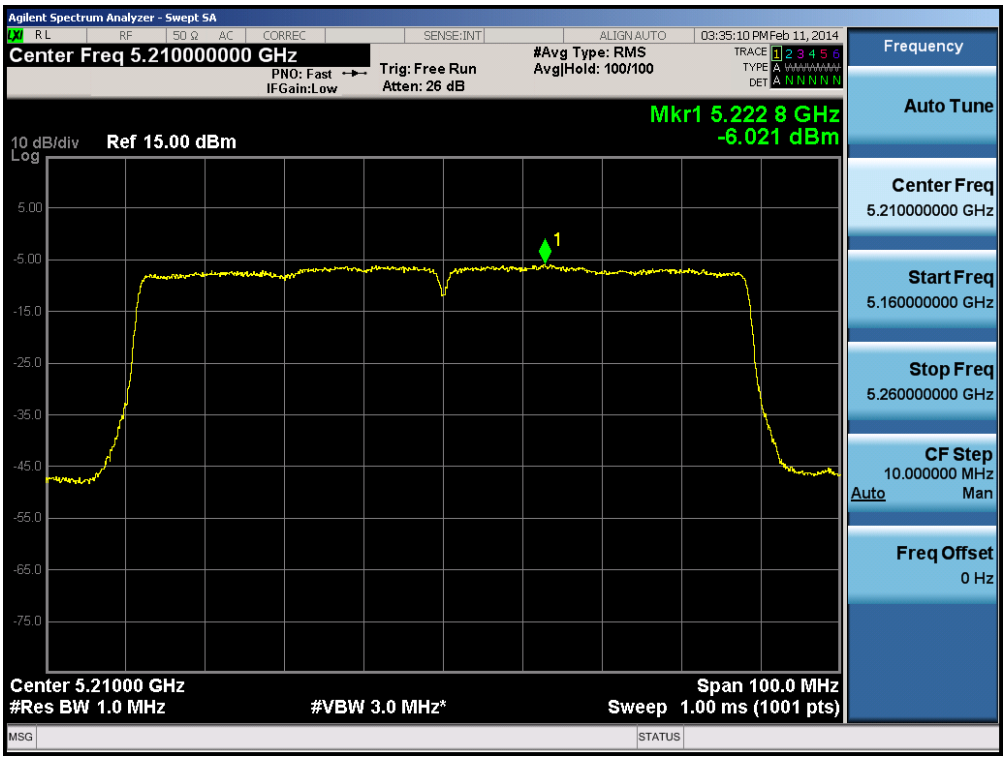
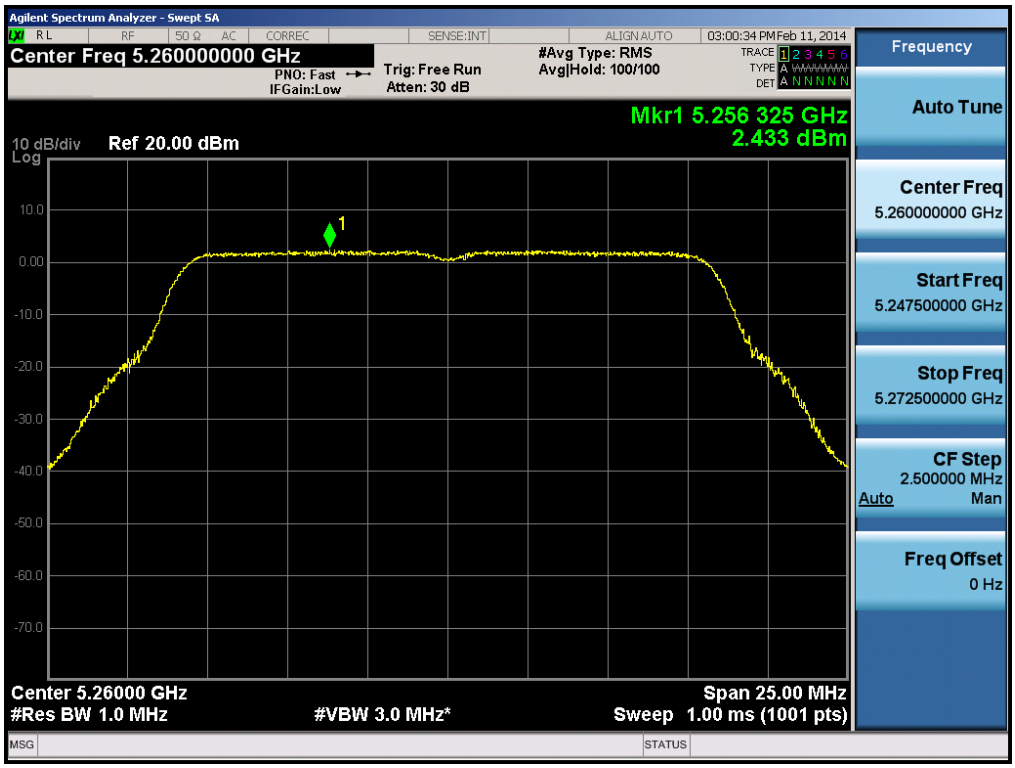


Plot 6-77. Peak Power Spectral Density Plot (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)



Plot 6-78. Peak Power Spectral Density Plot (802.11a (UNII Band 2A) – Ch. 52)

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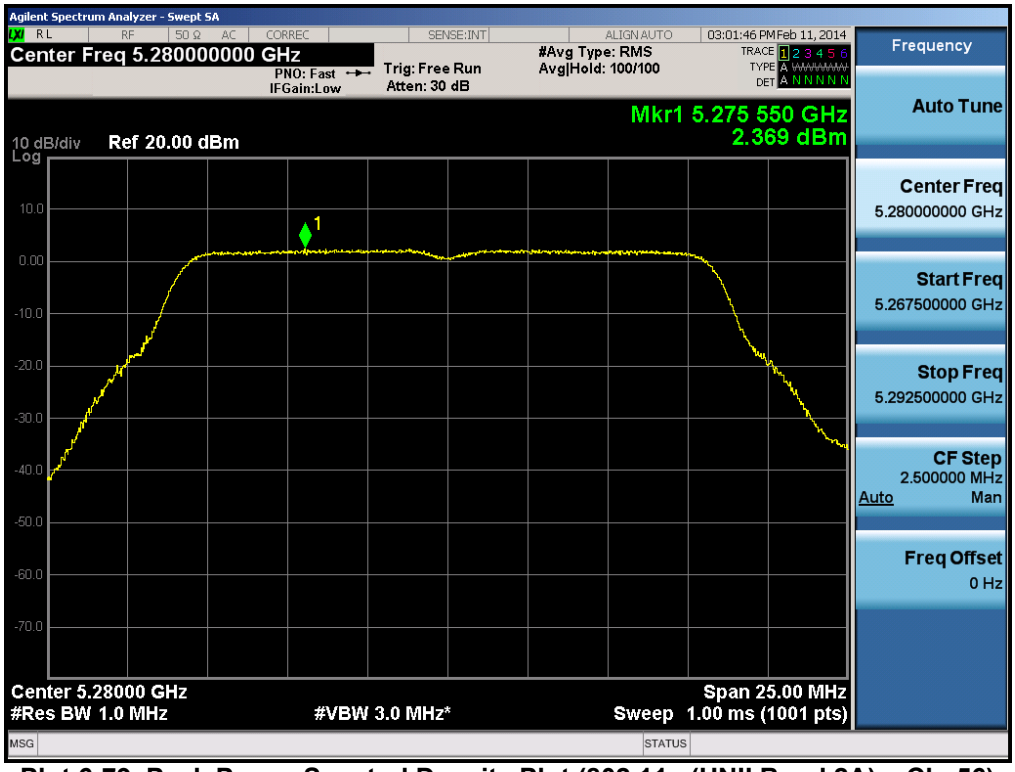
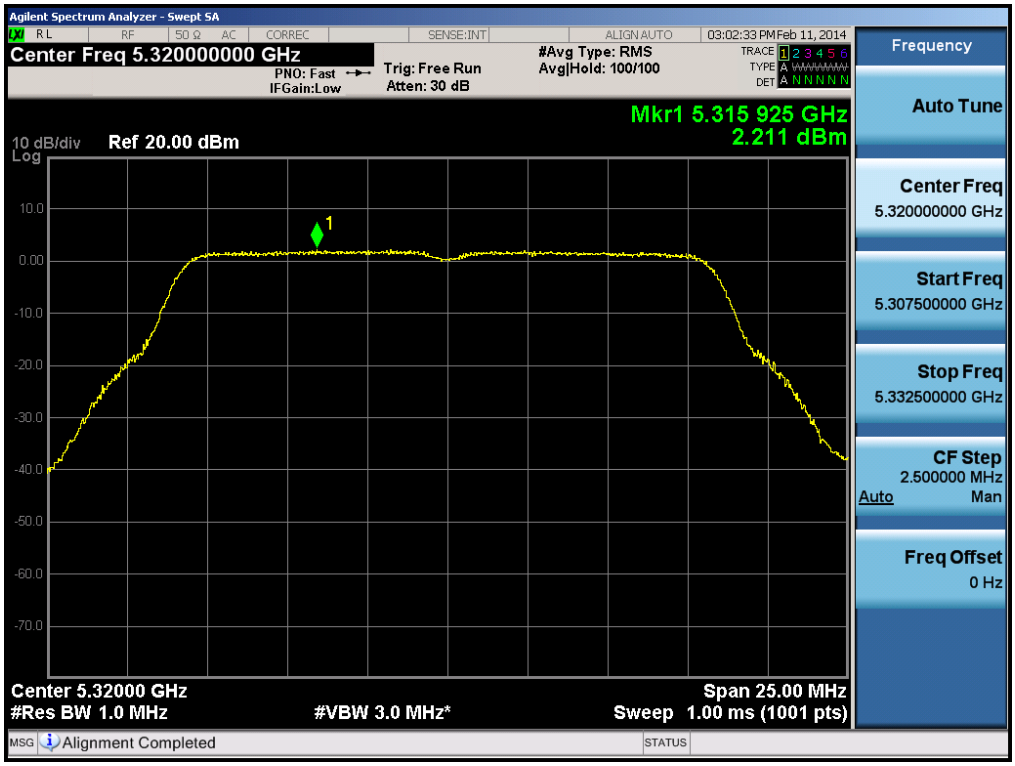


Plot 6-79. Peak Power Spectral Density Plot (802.11a (UNII Band 2A) – Ch. 56)



Plot 6-80. Peak Power Spectral Density Plot (802.11a (UNII Band 2A) – Ch. 64)

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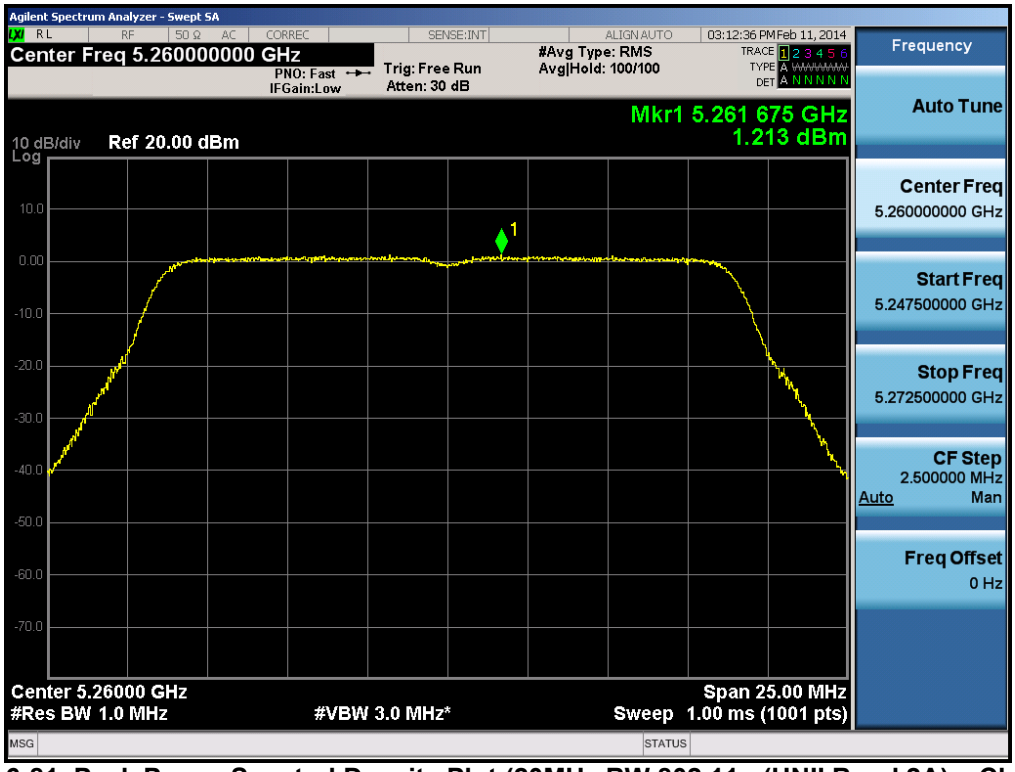
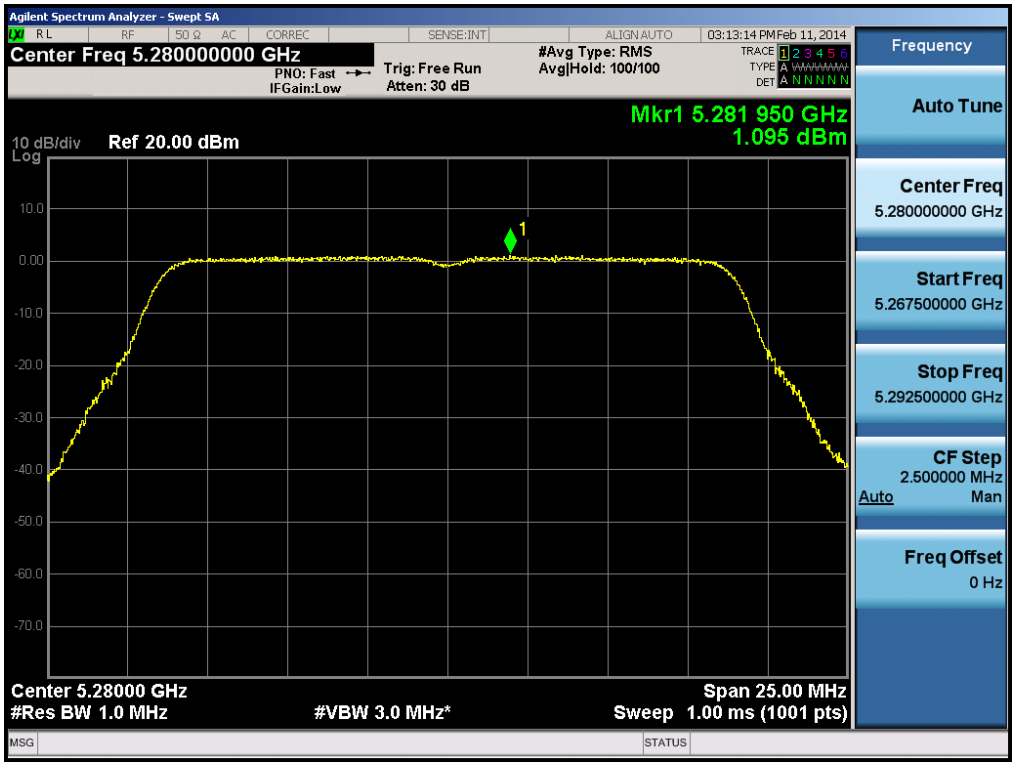


Plot 6-81. Peak Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 52)



Plot 6-82. Peak Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)

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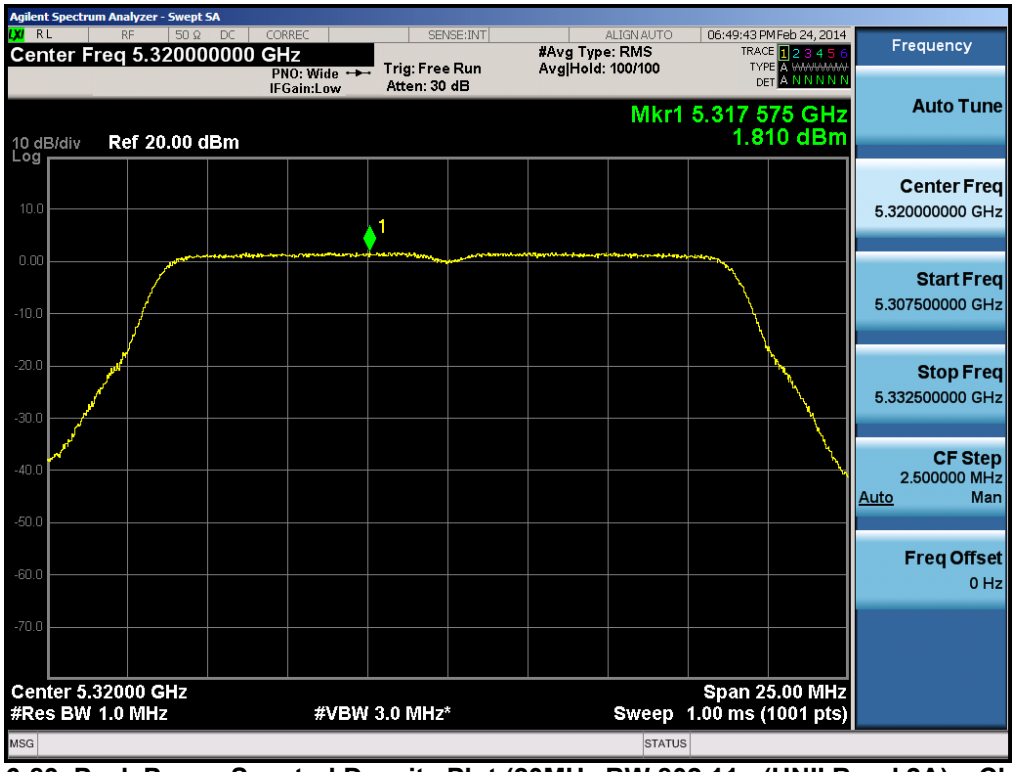
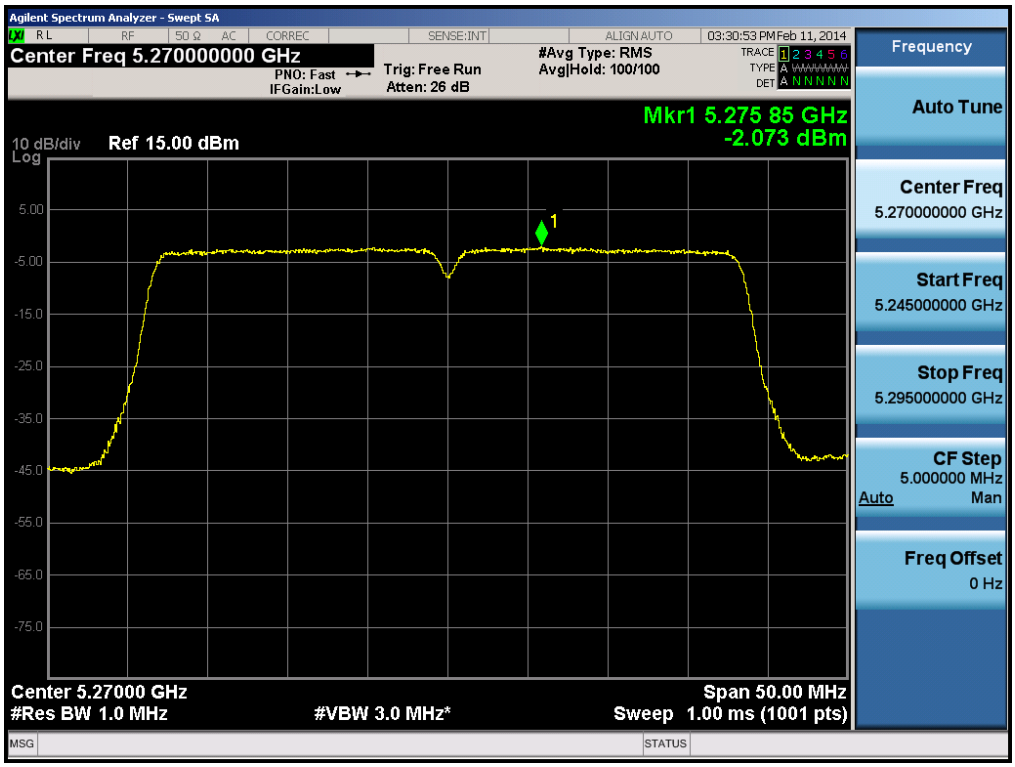


Plot 6-83. Peak Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 64)



Plot 6-84. Peak Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 54)

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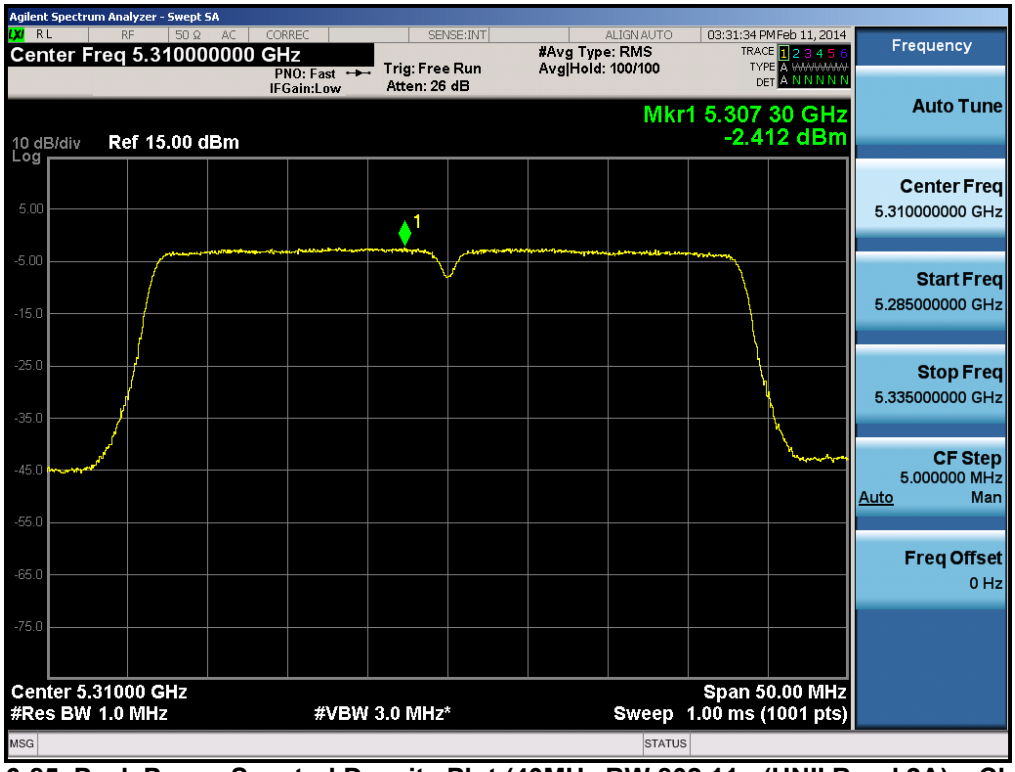
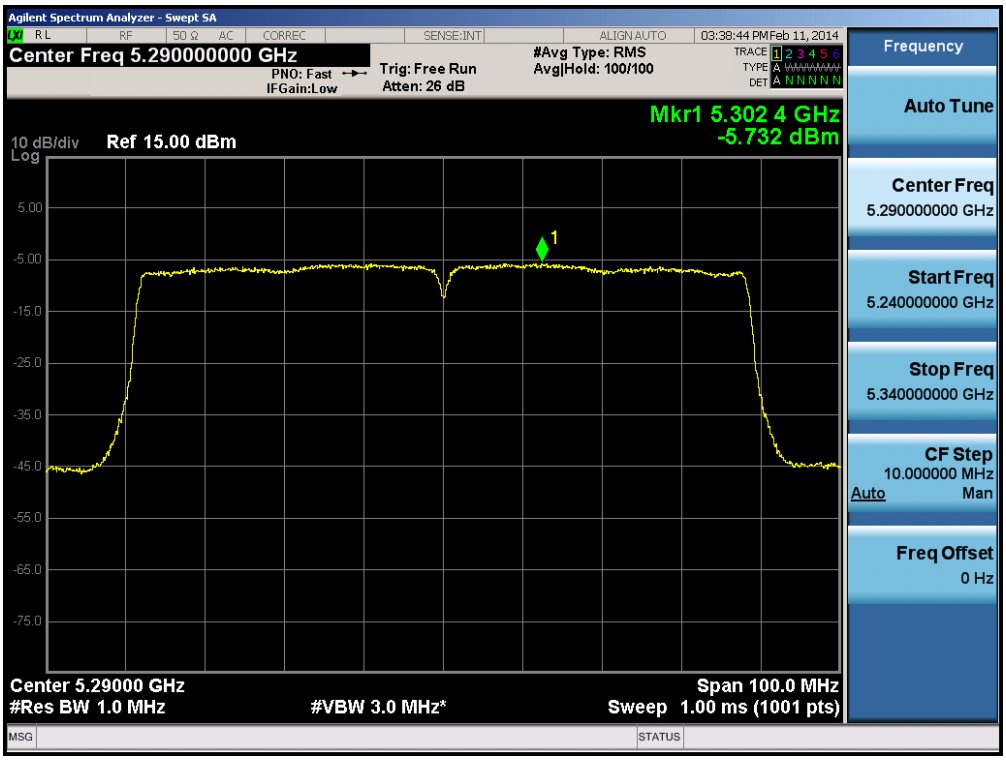


Plot 6-85. Peak Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 62)



Plot 6-86. Peak Power Spectral Density Plot (80MHz BW 802.11ac (UNII Band 2A) – Ch. 58)

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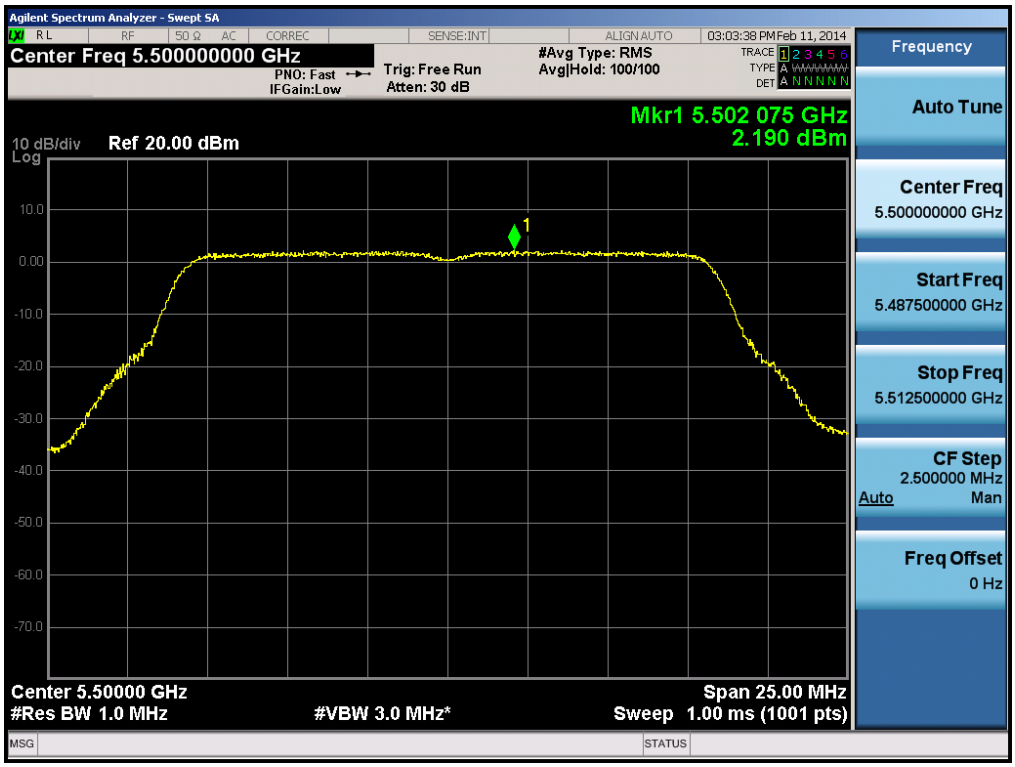
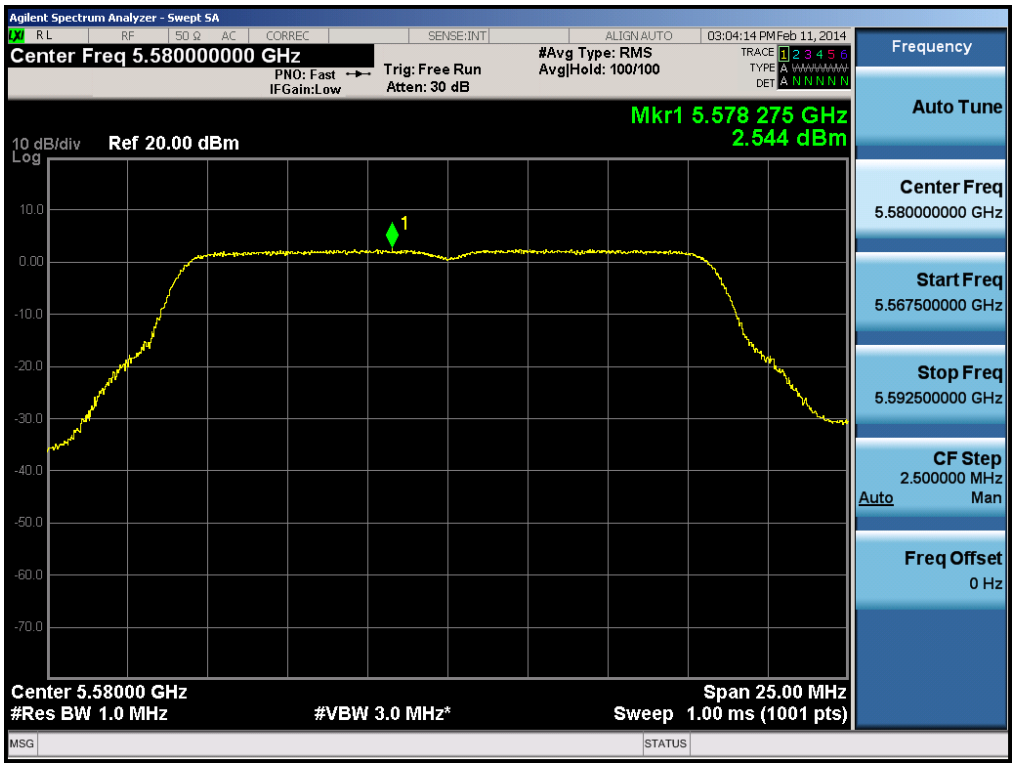


Plot 6-87. Peak Power Spectral Density Plot (802.11a (UNII Band 2C) – Ch. 100)



Plot 6-88. Peak Power Spectral Density Plot (802.11a (UNII Band 2C) – Ch. 116)

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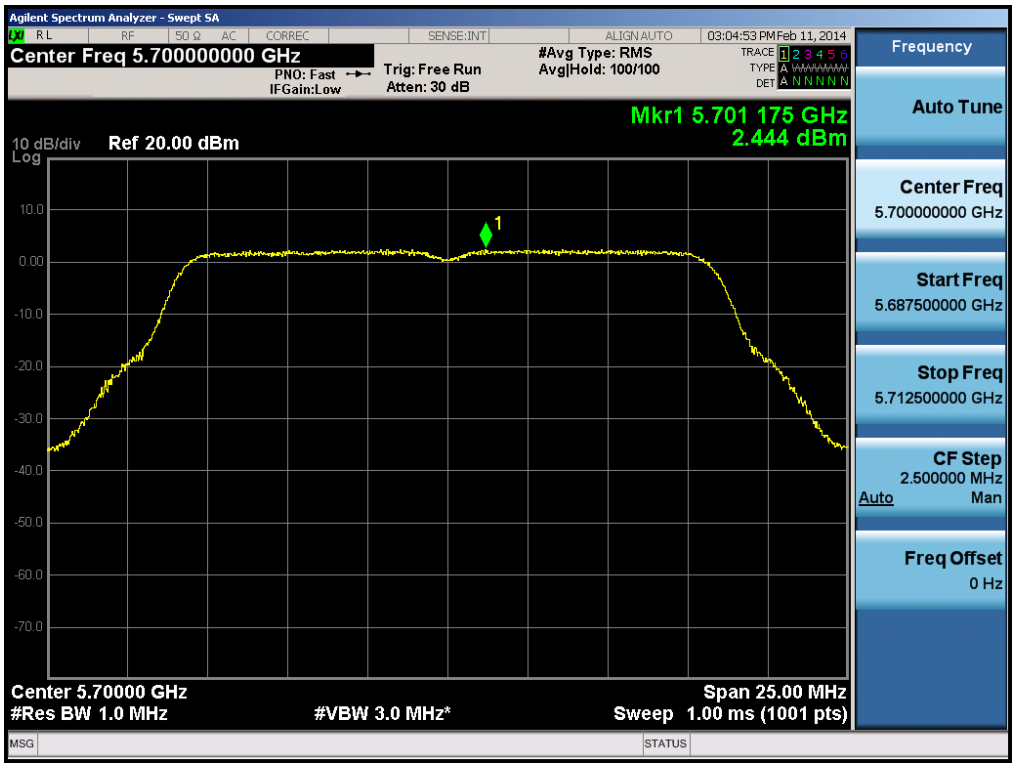
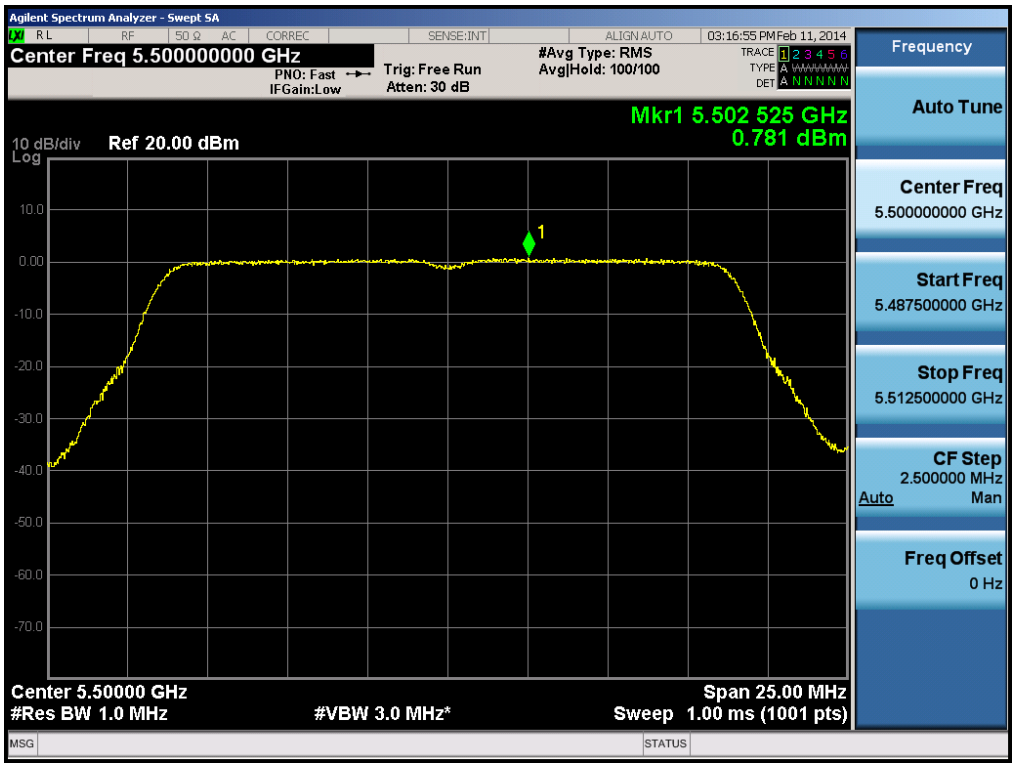


Plot 6-89. Peak Power Spectral Density Plot (802.11a (UNII Band 2C) – Ch. 140)



Plot 6-90. Peak Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 100)

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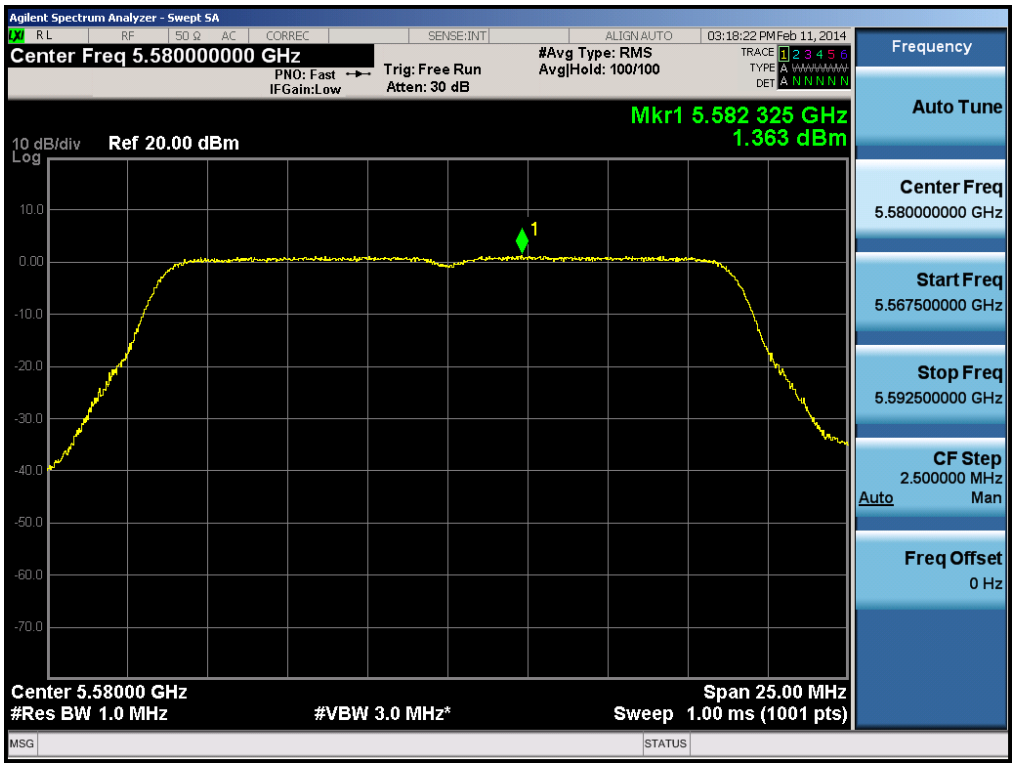
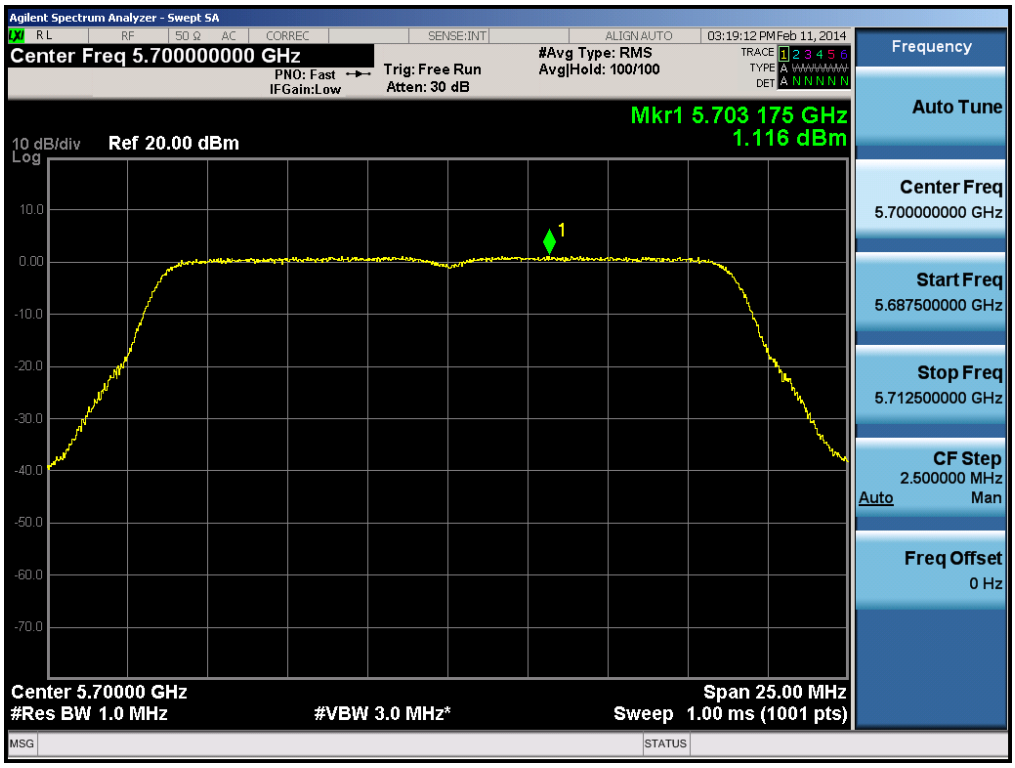


Plot 6-91. Peak Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 116)



Plot 6-92. Peak Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 140)

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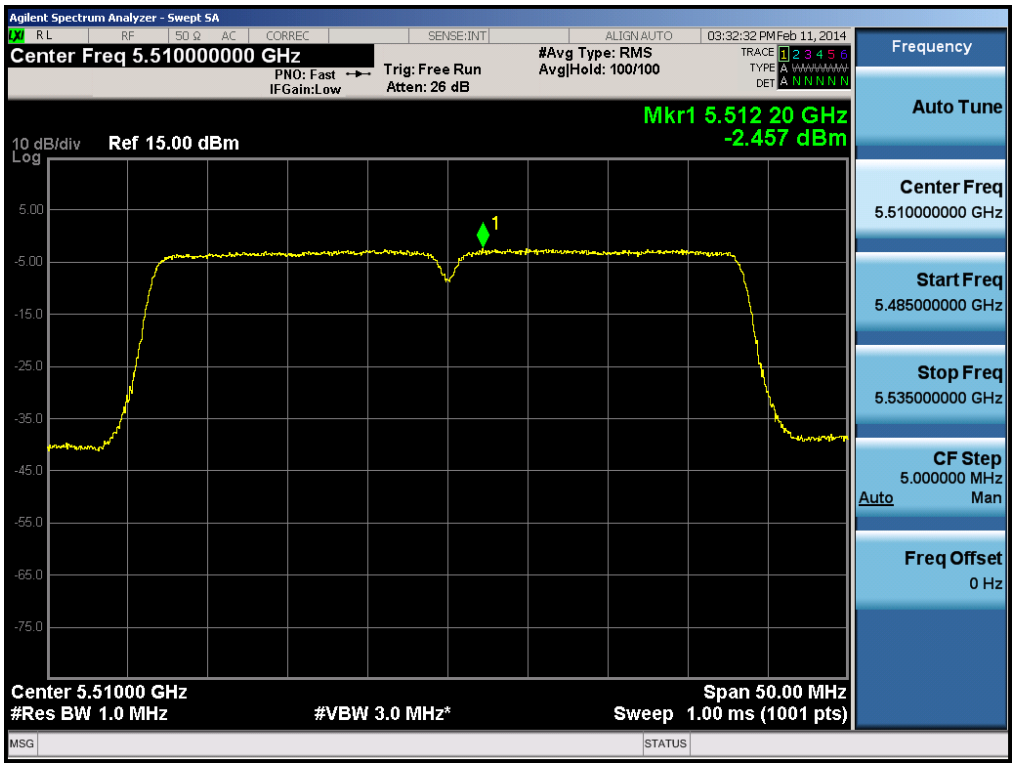
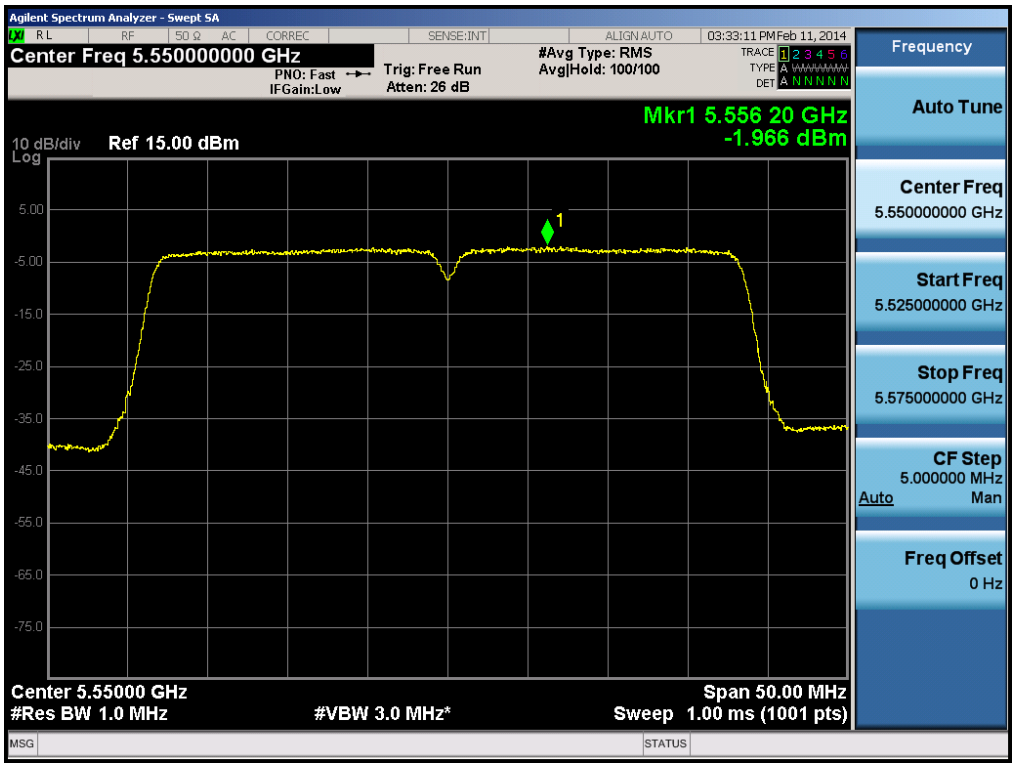


Plot 6-93. Peak Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 102)



Plot 6-94. Peak Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 110)

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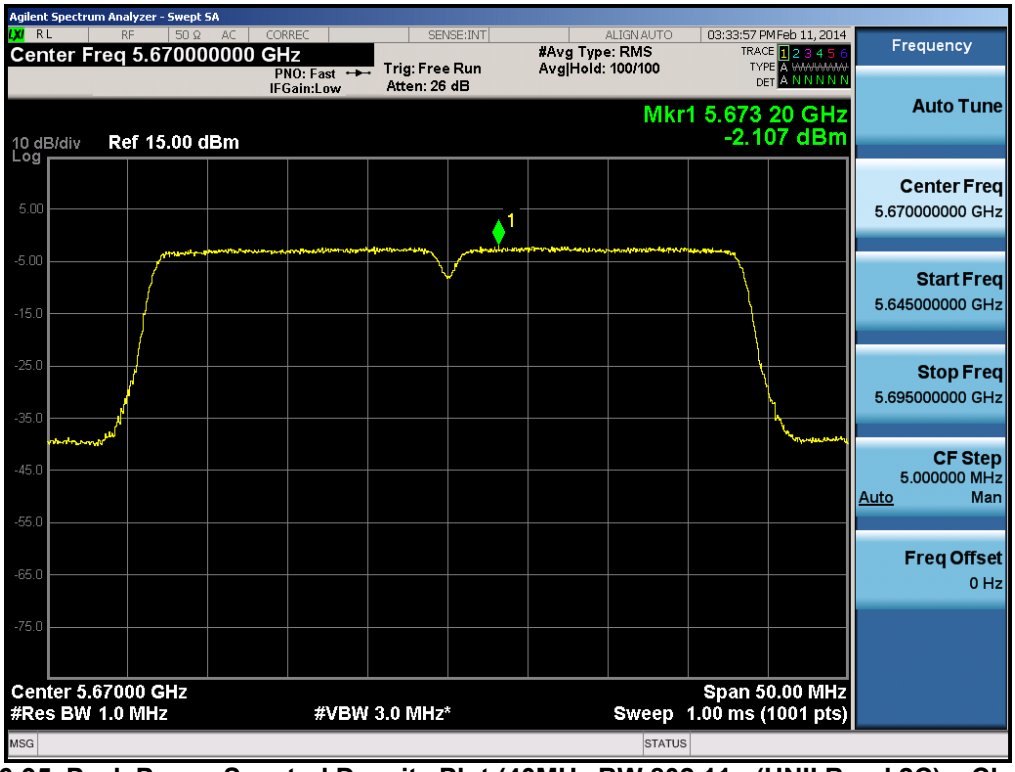
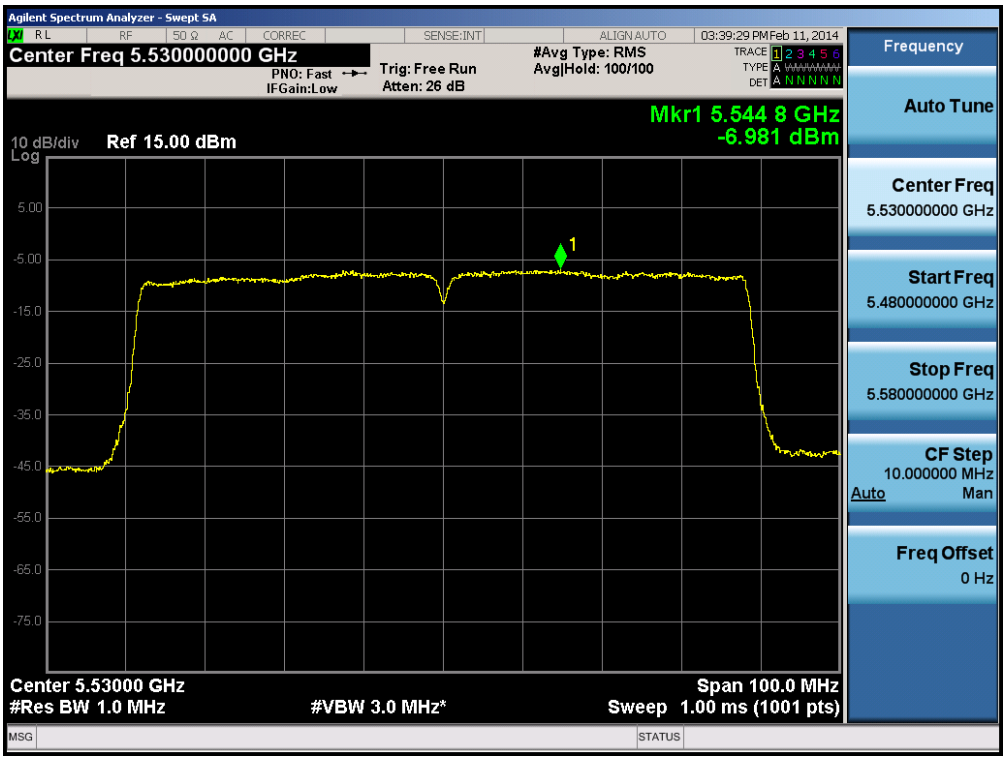


Plot 6-95. Peak Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 134)



Plot 6-96. Peak Power Spectral Density Plot (80MHz BW 802.11ac (UNII Band 2C) – Ch. 106)

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