PCTEST ENGINEERING LABORATORY, INC.
7185 Oakland Mills Road, Columbia, MD 21046 USA
Tel. 410.290.6652 / Fax 410.290.6654
http://www.pctestlab.com

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

Applicant Name:
Samsung Electronics Co., Ltd.
129, Samsung-ro,
Yeongtong-gu, Suwon-si
Gyeonggi-do, 16677, Korea

Date of Testing:
3/22 - 4/192016
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Test Report Serial No.:
0Y1603220564.A3L

FCC ID: **A3LSMG891A**

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

Application Type: Certification
Model(s): SM-G891A
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 D03 v01, KDB 648474 D03 v01r02, KDB 662911 D01 v02r01

Mode	UNII Band	Channel Bandwidth (MHz)	ANT1	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	38.371	15.84	42.364	16.27	N/A	
	2A	20	5260 - 5320	44.157	16.45	44.361	16.47		
	2C	20	5500 - 5720	41.879	16.22	44.566	16.49		
	3	20	5745 - 5825	42.462	16.28	41.879	16.22		
802.11n	1	20	5180 - 5240	39.174	15.93	40.458	16.07	79.632	19.01
	2A	20	5260 - 5320	44.259	16.46	40.551	16.08	84.346	19.26
	2C	20	5500 - 5720	42.954	16.33	43.451	16.38	84.946	19.29
	3	20	5745 - 5825	42.855	16.32	38.459	15.85	81.314	19.10
802.11ac	1	20	5180 - 5240	38.905	15.90	39.537	15.97	78.441	18.95
	2A	20	5260 - 5320	44.055	16.44	40.272	16.05	84.327	19.26
	2C	20	5500 - 5720	44.463	16.48	42.267	16.26	83.953	19.24
	3	20	5745 - 5825	44.566	16.49	39.355	15.95	83.025	19.19
802.11n	1	40	5190 - 5230	31.550	14.99	33.806	15.29	65.357	18.15
	2A	40	5270 - 5310	30.620	14.86	31.623	15.00	61.239	17.87
	2C	40	5510 - 5710	34.754	15.41	35.400	15.49	70.153	18.46
	3	40	5755 - 5795	32.659	15.14	29.174	14.65	61.833	17.91
802.11ac	1	40	5190 - 5230	31.915	15.04	32.810	15.16	64.725	18.11
	2A	40	5270 - 5310	31.333	14.96	31.046	14.92	62.378	17.95
	2C	40	5510 - 5710	34.356	15.36	35.400	15.49	68.059	18.33
	3	40	5755 - 5795	32.359	15.10	29.444	14.69	61.133	17.86
802.11ac	1	80	5210	16.406	12.15	15.453	11.89	31.858	15.03
	2A	80	5290	23.496	13.71	23.067	13.63	46.564	16.68
	2C	80	5530 - 5690	26.424	14.22	26.424	14.22	52.848	17.23
	3	80	5775	23.878	13.78	27.479	14.39	51.357	17.11

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 D03 v01. 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

ACCREDITED
TESTING CERT#2041.01

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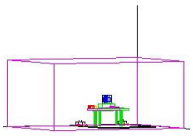
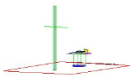


MEASUREMENT REPORT
FCC Part 15.407



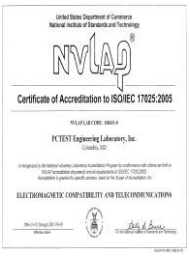
§ 2.1033 General Information

APPLICANT:	Samsung Electronics Co., Ltd.
APPLICANT ADDRESS:	129, Samsung-ro,
	Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, 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-G891A
FCC ID:	A3LSMG891A
FCC CLASSIFICATION:	Unlicensed National Information Infrastructure (UNII)
Test Device Serial No.:	18295, 18188 ☐ Production ☒ Pre-Production ☐ Engineering
DATE(S) OF TEST:	3/22 - 4/8/2016
TEST REPORT S/N:	0Y1603220564.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 39º 10'23" N latitude and 76º 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 C63.4-2014 on January 22, 2015.

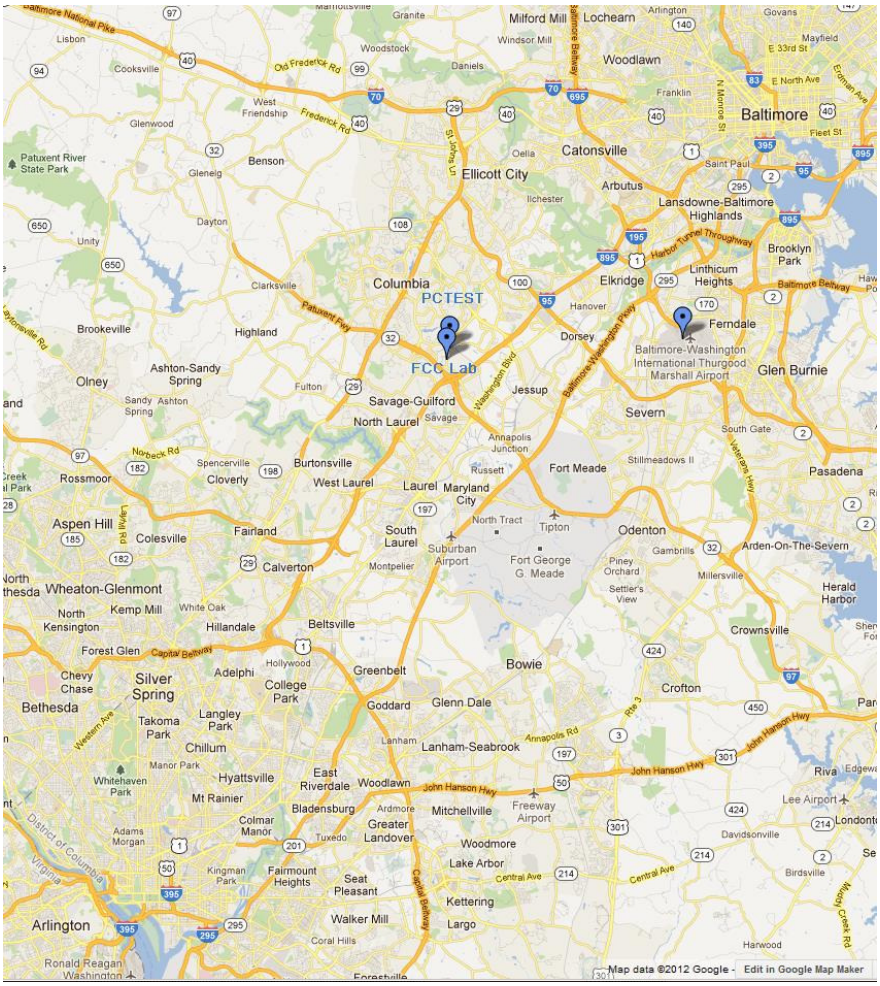

Figure 1-1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMG891A**. 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, 850/1700/1900 WCDMA, Multi-band LTE, 802.11b/g/n WLAN, 802.11a/n/ac UNII, Bluetooth (1x, EDR, LE), NFC, ANT+

Notes:

1. 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	98.5	98.5	N/A
	n (HT20)	98.5	98.5	96.9
	ac (HT20)	98.5	98.5	97.2
	n (HT40)	97.0	97.0	94.7
	ac (HT40)	97.0	97.0	94.8
	ac (HT80)	94.1	93.9	90.8

2. 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

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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)

3. In addition, this device supports simultaneous transmission operation, which allows for two SISO channels to operate independent of one another in the 2.4GHz and 5GHz bands simultaneously on each antenna. The following tables show the worst case simultaneous transmission configurations determined during testing. Both configurations were investigated. The worst case is reported.

Scenario A - Simultaneous Transmission Config-1: ANT1 transmitting in 2.4GHz mode and ANT2 in 5GHz mode.

Description	2.4 GHz Emission	5 GHz Emisison
Antenna	1	2
Channel	11	100
Operating Frequency(MHz)	2462	5500
Data Rate (Mbps)	1	6
Mode	802.11b	802.11a

Table 2-2. Simultaneous Transmission Config-1

Scenario B – Config-2: ANT1 transmitting in 5GHz mode and ANT2 in 2.4GHz mode

Description	5 GHz Tx	2.4 GHz Tx
Antenna	1	2
Channel	100	11
Operating Frequency(MHz)	5500	2462
Data Rate	6 Mbps	1 Mbps
Mode	802.11a	802.11b

Table 2-3. Config-2 (ANT1 5GHz & ANT2 2.4GHz)

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2.3 Test Configuration

The Samsung Portable Handset FCC ID: A3LSMG891A was tested per the guidance of KDB 789033 D02 v01. ANSI C63.10-2013 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 7.2, 7.3, 7.4, and 7.5 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 (WCP) 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 TESTS

3.1 Evaluation Procedure

The measurement procedures described in the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 789033 D02 v01 were used in the measurement of **Samsung Portable Handset FCC ID: A3LSMG891A.**

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 7.9. 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 Figure 5.7 of Clause 5 in ANSI C63.4-2014. 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 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, a 72.4cm high PVC support structure is placed on top of the turntable. A 3" (~7.6cm) sheet of high density polystyrene 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 measurements above 1GHz, a high density expanded polystyrene block is placed on top of the test table to bring the total table height to 1.5m.

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 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: A3LSMG891A** 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	120	5600	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	118	5590		
				:	:		
				142	5710	159	5795

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 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.13
Line Conducted Disturbance	3.09
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

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6.0 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)	4/28/2015	Annual	4/28/2016	RE1
-	WL25-1	Conducted Cable Set (25GHz)	4/8/2015	Annual	4/8/2016	WL25-1
Agilent	8447D	Broadband Amplifier	6/12/2015	Annual	6/12/2016	2443A01900
Agilent	N9020A	MXA Signal Analyzer	11/5/2015	Annual	11/5/2016	US46470561
Agilent	N9038A	MXE EMI Receiver	4/24/2015	Annual	4/24/2016	MY51210133
Anritsu	MA2411B	Pulse Power Sensor	10/14/2015	Biennial	10/14/2017	1027293
Anritsu	ML2495A	Power Meter	10/16/2015	Biennial	10/16/2017	1039008
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	7/30/2015	Biennial	7/30/2017	121034
Emco	3115	Horn Antenna (1-18GHz)	3/10/2016	Biennial	3/10/2018	9704-5182
Espec	ESX-2CA	Environmental Chamber	3/4/2016	Annual	3/4/2017	17620
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	4/20/2015	Annual	4/20/2016	251425001
K & L	11SH10-3075/U18000	High Pass Filter	7/18/2015	Annual	7/18/2016	11SH10-3075/U18000-2
K & L	11SH10-6000/T18000	High Pass Filter	7/18/2015	Annual	7/18/2016	11SH10-6000/T18000-1
Pasternack	NMLC-1	Line Conducted Emissions Cable (NM)	4/28/2015	Annual	4/28/2016	NMLC-1
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	7/17/2015	Annual	7/17/2016	100348
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	6/2/2015	Annual	6/2/2016	103200
Rohde & Schwarz	TS-PR18	1-18 GHz Pre-Amplifier	3/7/2016	Annual	3/7/2017	100071
Rohde & Schwarz	TS-PR26	18-26.5 GHz Pre-Amplifier	3/7/2016	Annual	3/7/2017	100040
Rohde & Schwarz	TS-PR40	26.5-40 GHz Pre-Amplifier	3/7/2016	Annual	3/7/2017	100037
Schwarzbeck	UHA 9105	Dipole Antenna (400 - 1GHz) Rx	3/30/2016	Biennial	3/30/2018	9105-2404
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	3/2/2016	Biennial	3/2/2018	N/A
Solar Electronics	8012-50-R-24-BNC	Line Impedance Stabilization Network	7/30/2015	Biennial	7/30/2017	310233
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	3/14/2016	Biennial	3/14/2018	A051107

Table 6-1. Annual Test Equipment Calibration Schedule

Note:

For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

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7.0 TEST RESULTS

7.1 Summary

Company Name: Samsung Electronics Co., Ltd.
FCC ID: A3LSMG891A
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 7.2
15.407(e)	6dB Bandwidth	>500kHz(5725-5850MHz)		PASS	Section 7.3
15.407 (a.1)	Maximum Conducted Output Power	< 250mW (23.98dBm) (5150-5250MHz) < 250mW (23.98dBm) (5250-5350MHz) < 250mW (23.98dBm) (5470-5725MHz) < 1W (30dBm) (5725-5850MHz)		PASS	Section 7.4
15.407 (a.1), (5)	Maximum Power Spectral Density	< 11 dBm/MHz (5150-5250MHz, 5250-5350MHz, 5470-5725MHz) < 30 dBm/500kHz (5725-5850MHz)		PASS	Section 7.5
15.407(g)	Frequency Stability	N/A		PASS	Section 7.6
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 (outside 5150-5350MHz, 5470-5725MHz, 5715-5860MHz) < -17 dBm/MHz EIRP (within 5715-5725MHz and 5850-5860MHz)	RADIATED	PASS	Section 7.7
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		PASS	Section 7.7, 7.8
15.407	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits	LINE CONDUCTED	PASS	Section 7.9

Table 7-1. 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 3.9.
5) For radiated band edge, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST "Chamber Automation," Version 1.1.2.

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7.2 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, 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.

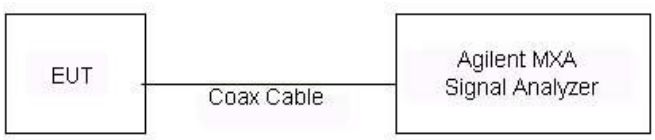

Figure 7-1. Test Instrument & Measurement Setup

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	31.28
	5200	40	a	6	24.79
	5240	48	a	6	29.65
	5180	36	n (20MHz)	6.5/7.2 (MCS0)	24.71
	5200	40	n (20MHz)	6.5/7.2 (MCS0)	23.61
	5240	48	n (20MHz)	6.5/7.2 (MCS0)	24.97
	5190	38	n (40MHz)	13.5/15 (MCS0)	59.99
	5230	46	n (40MHz)	13.5/15 (MCS0)	59.79
	5210	42	ac (80MHz)	29.3/32.5 (MCS0)	80.89
Band 2A	5260	52	a	6	24.11
	5280	56	a	6	25.88
	5320	64	a	6	24.34
	5260	52	n (20MHz)	6.5/7.2 (MCS0)	24.58
	5280	56	n (20MHz)	6.5/7.2 (MCS0)	23.95
	5320	64	n (20MHz)	6.5/7.2 (MCS0)	23.13
	5270	54	n (40MHz)	13.5/15 (MCS0)	49.21
	5310	62	n (40MHz)	13.5/15 (MCS0)	59.91
	5290	58	ac (80MHz)	29.3/32.5 (MCS0)	81.24
Band 2C	5500	100	a	6	24.15
	5600	120	a	6	23.22
	5720	144	a	6	21.93
	5500	100	n (20MHz)	6.5/7.2 (MCS0)	22.61
	5600	120	n (20MHz)	6.5/7.2 (MCS0)	23.39
	5720	144	n (20MHz)	6.5/7.2 (MCS0)	23.86
	5510	102	n (40MHz)	13.5/15 (MCS0)	48.62
	5590	118	n (40MHz)	13.5/15 (MCS0)	49.86
	5710	142	n (40MHz)	13.5/15 (MCS0)	49.83
	5530	106	ac (80MHz)	29.3/32.5 (MCS0)	81.11
	5610	122	ac (80MHz)	29.3/32.5 (MCS0)	80.62
	5690	138	ac (80MHz)	29.3/32.5 (MCS0)	81.17

Table 7-2. Conducted Bandwidth Measurements

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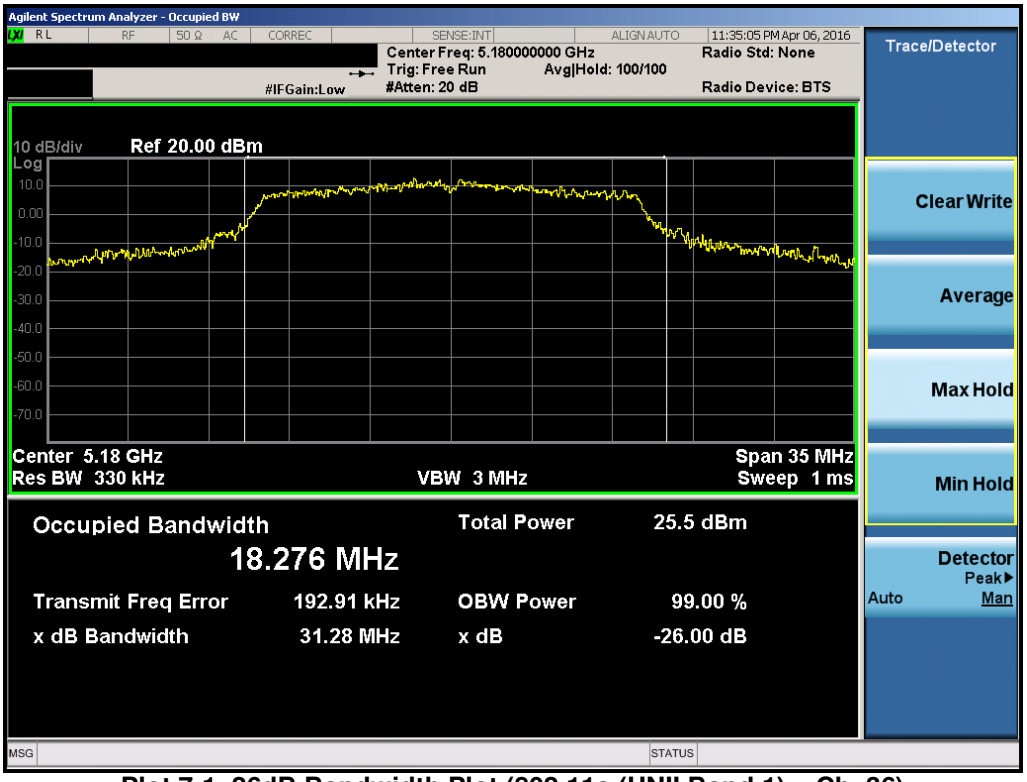

Plot 7-1. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 36)

Plot 7-2. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 40)

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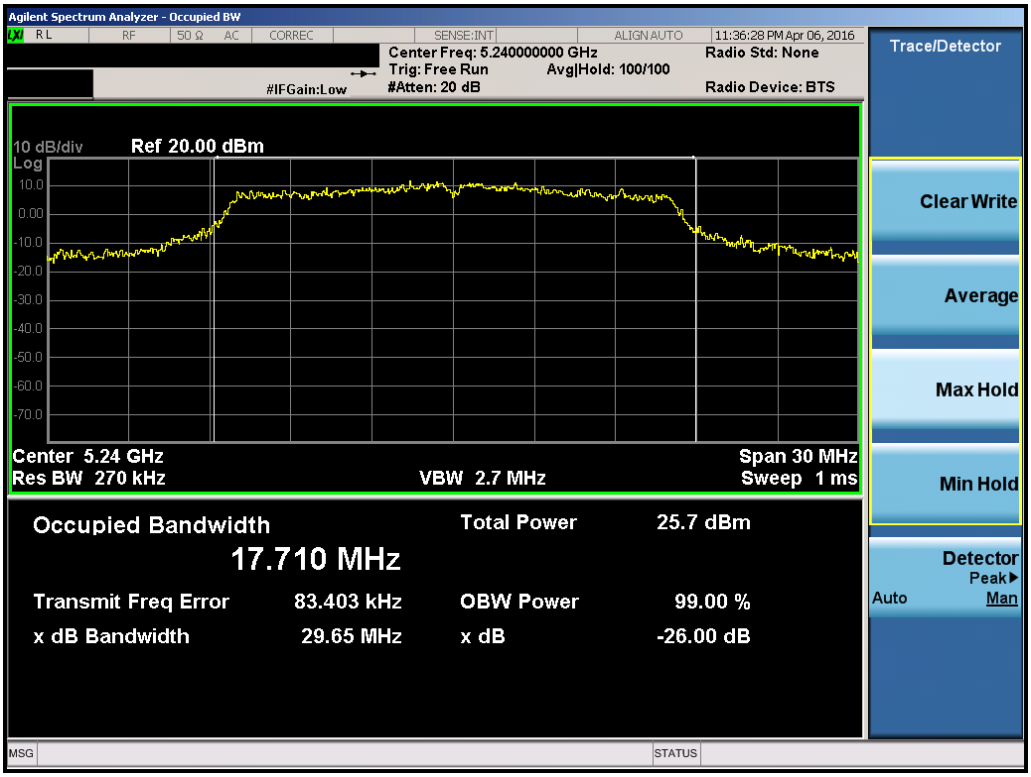
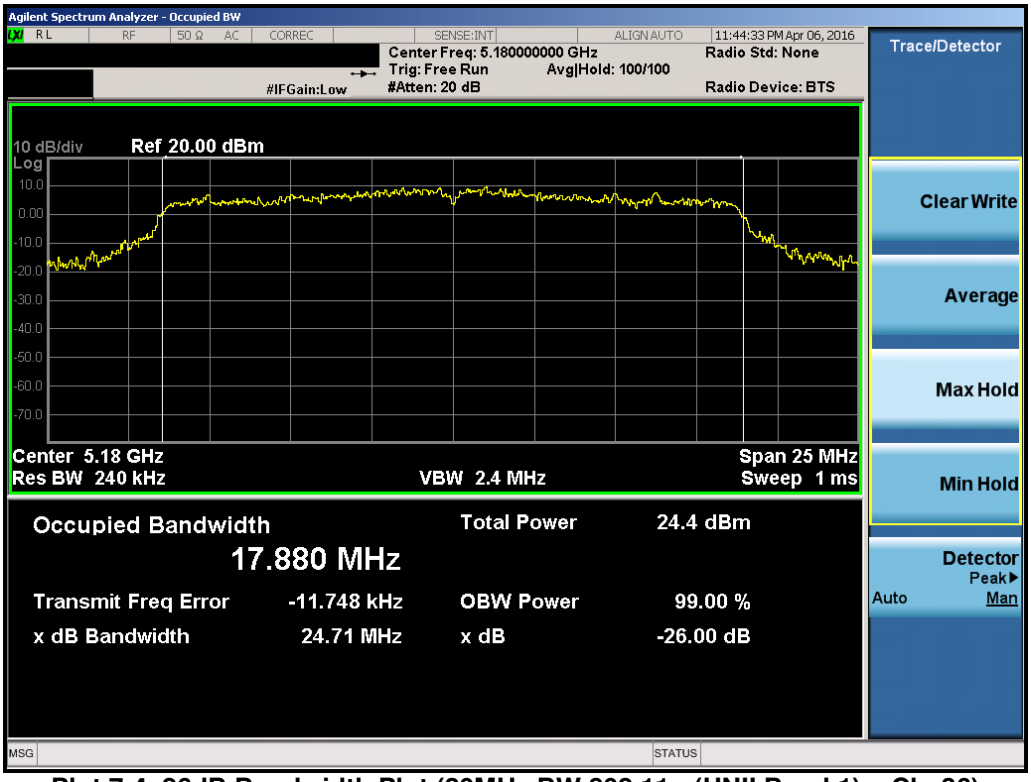


Plot 7-3. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 48)



Plot 7-4. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 36)

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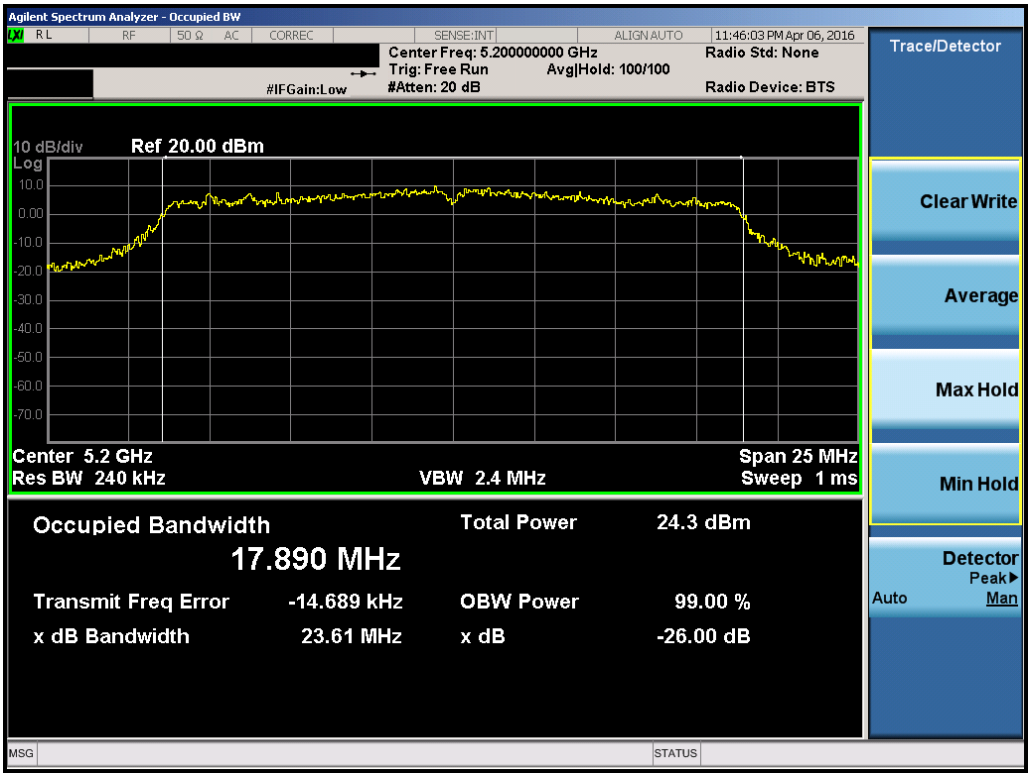

Plot 7-5. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 40)

Plot 7-6. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 48)

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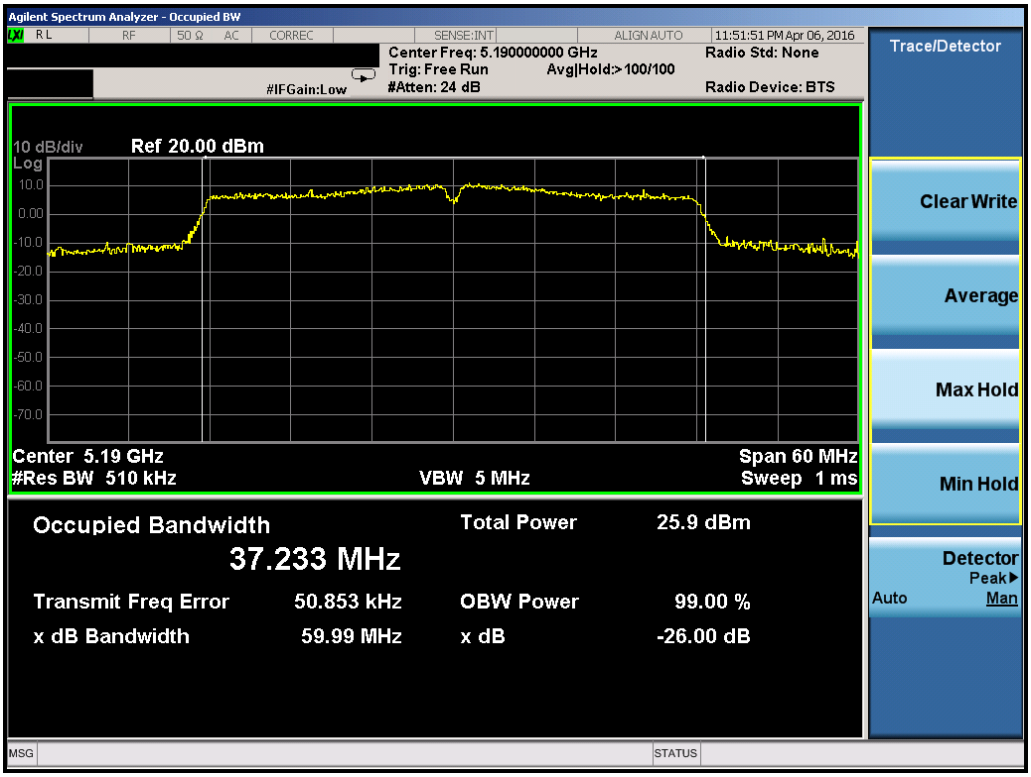
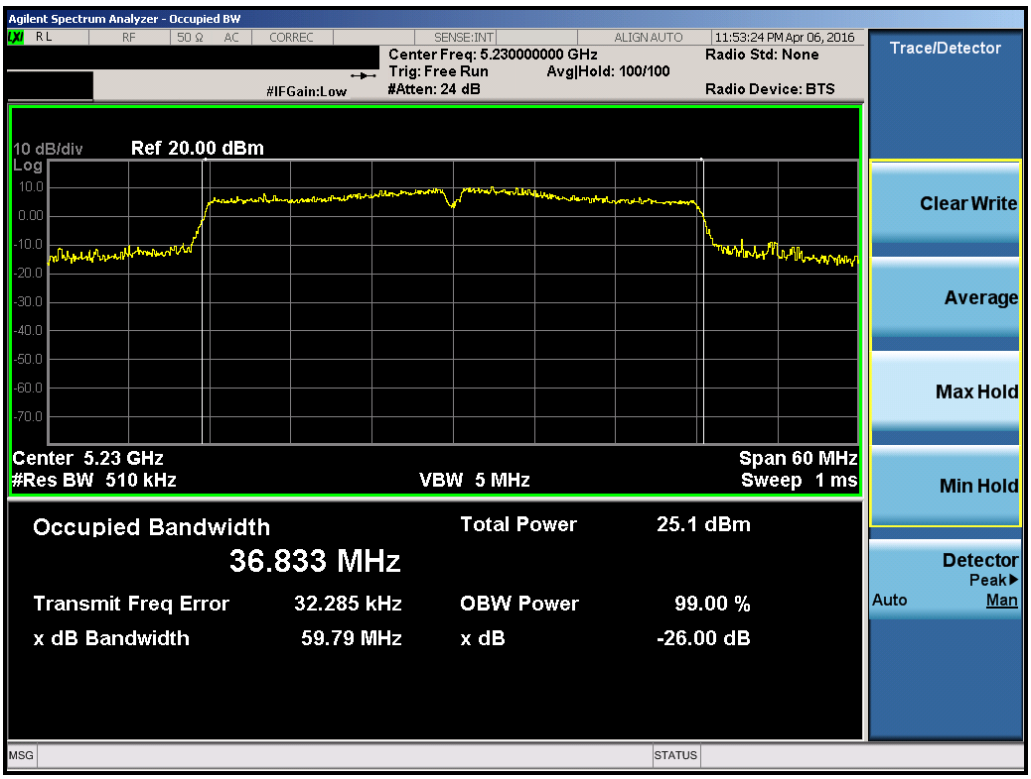


Plot 7-7. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 38)



Plot 7-8. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 46)

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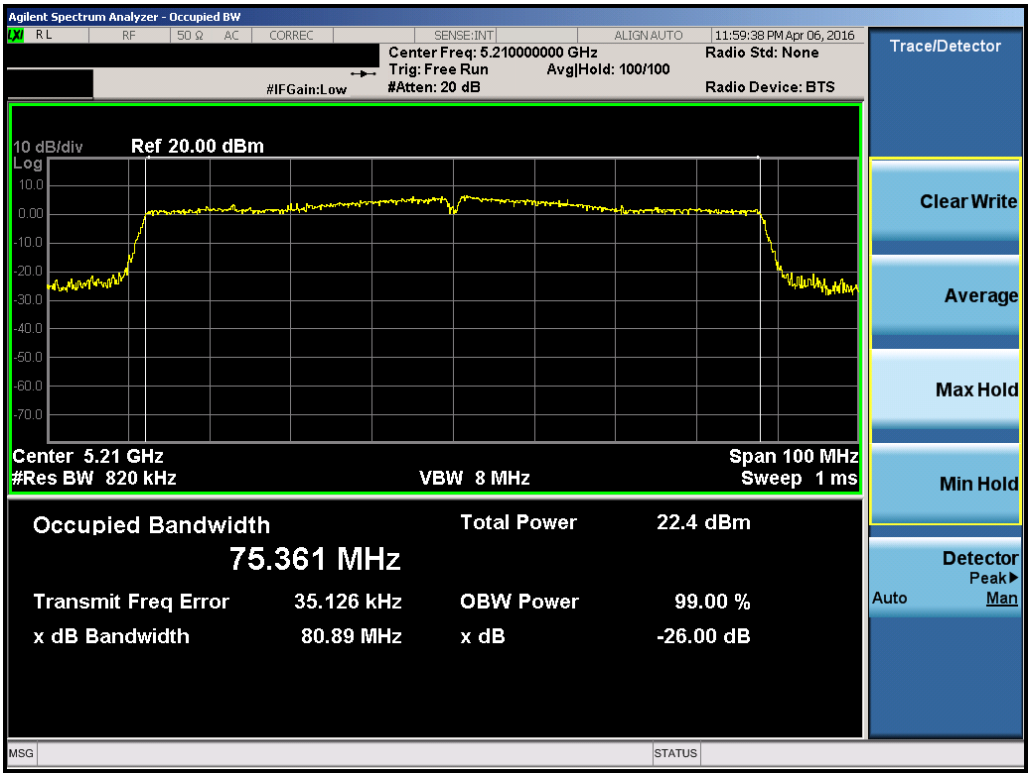
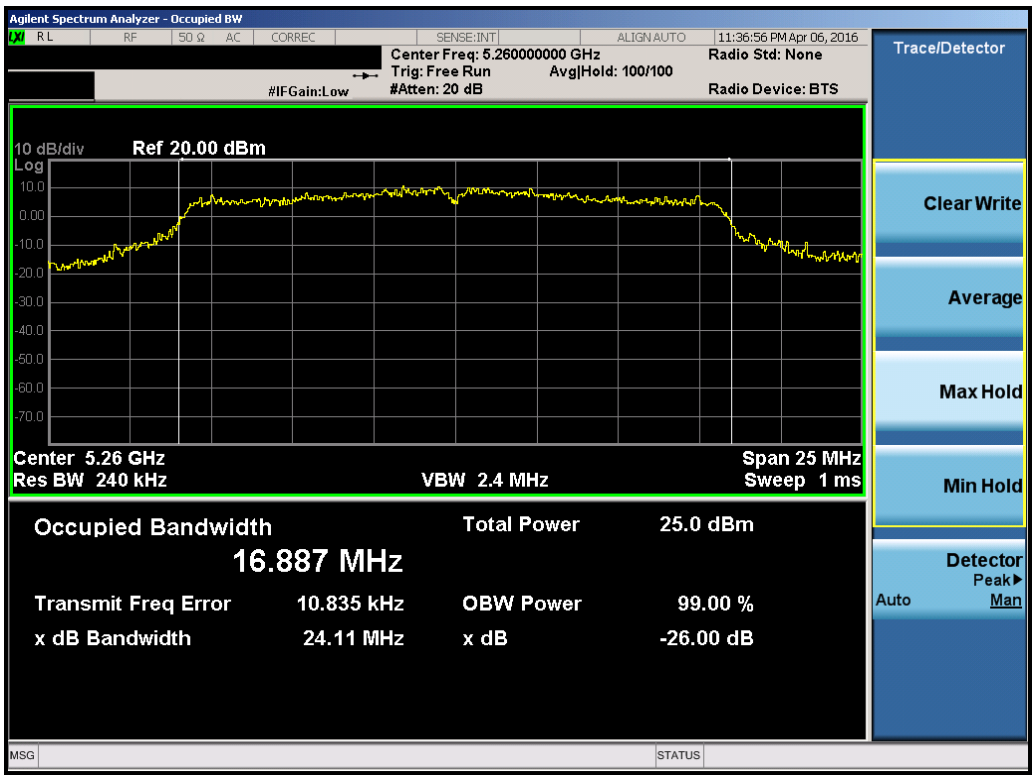


Plot 7-9. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)



Plot 7-10. 26dB Bandwidth Plot (802.11a (UNII Band 2A) – Ch. 52)

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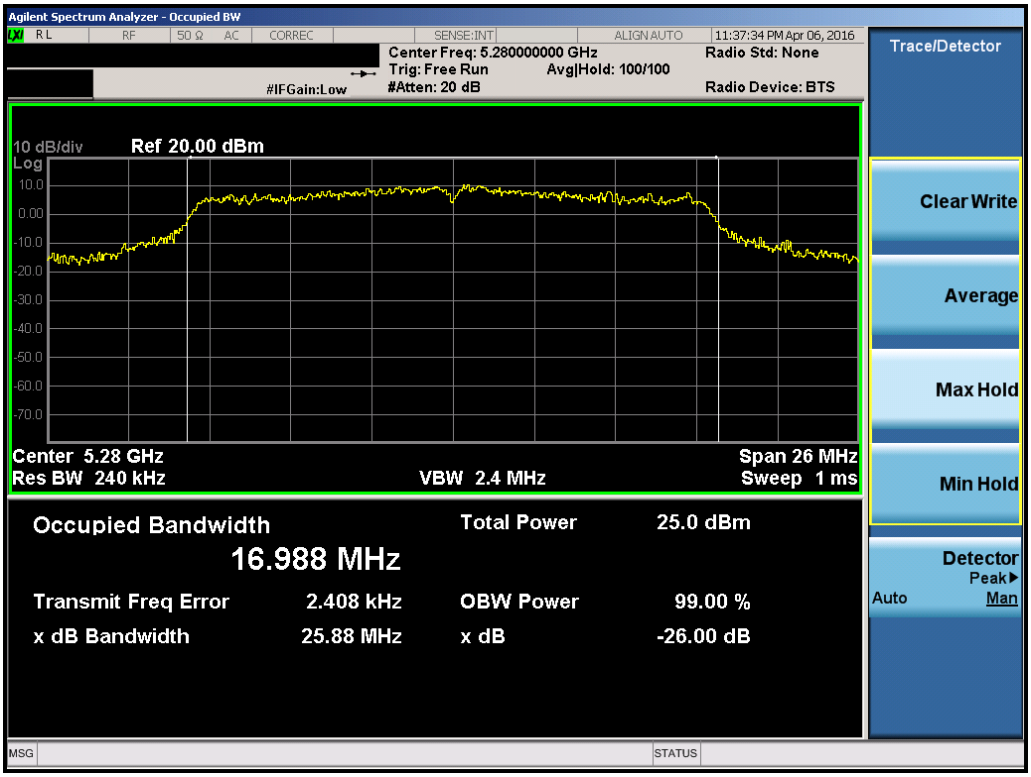
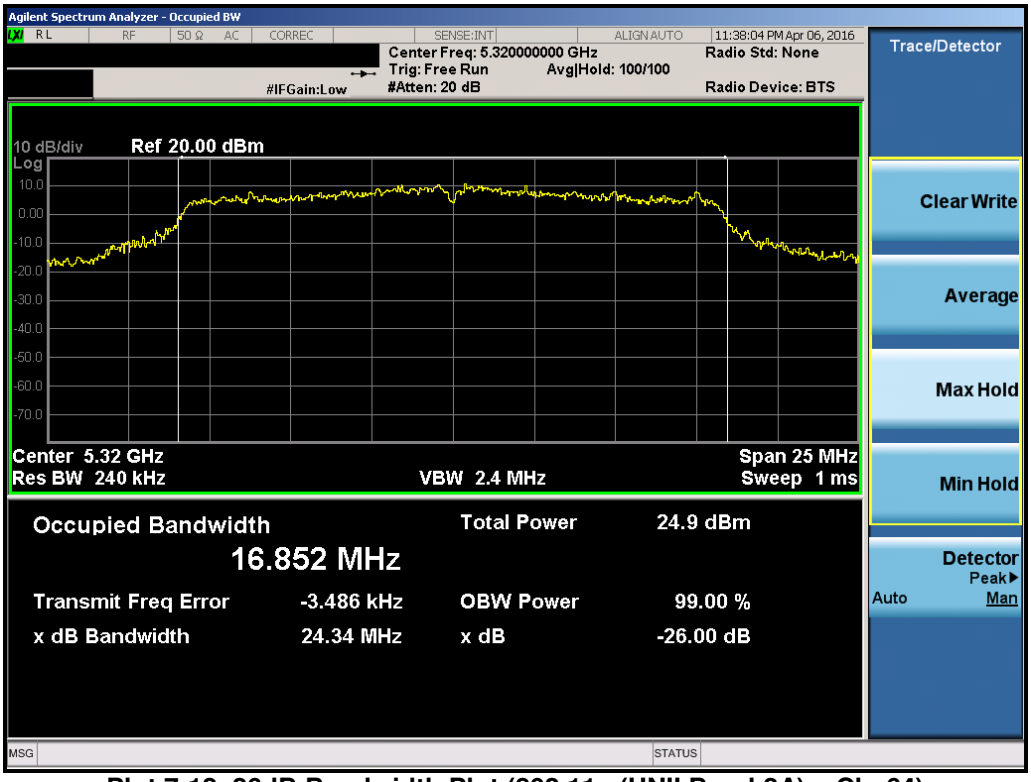


Plot 7-11. 26dB Bandwidth Plot (802.11a (UNII Band 2A) – Ch. 56)



Plot 7-12. 26dB Bandwidth Plot (802.11a (UNII Band 2A) – Ch. 64)

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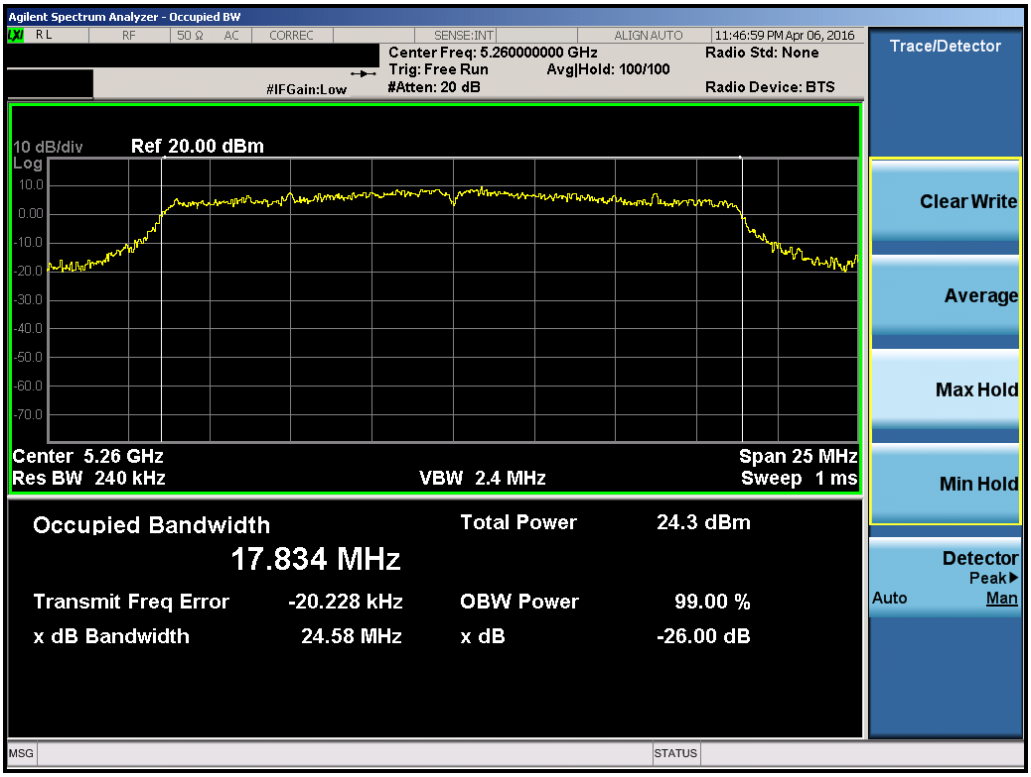

Plot 7-13. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 52)

Plot 7-14. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)

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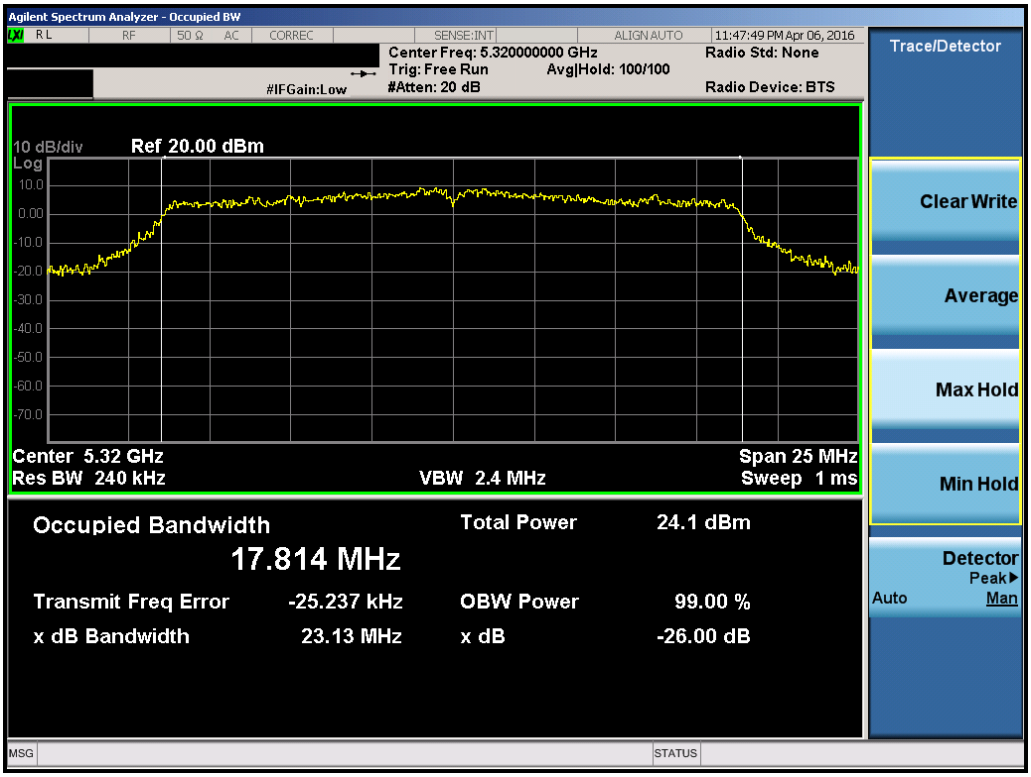
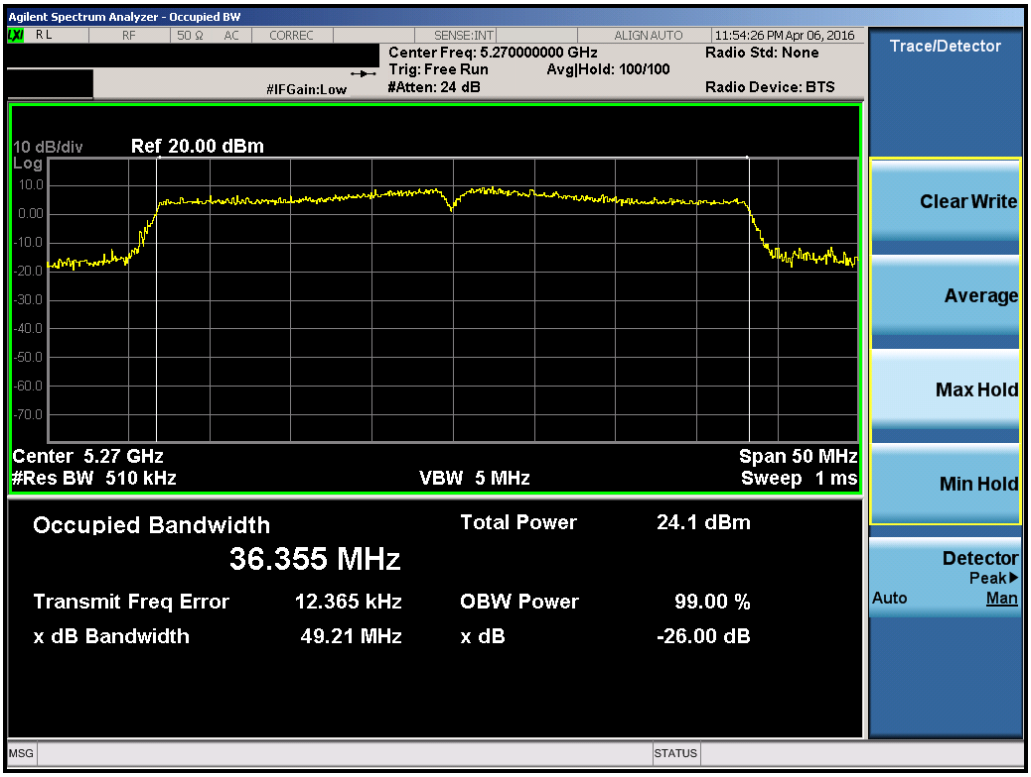


Plot 7-15. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 64)



Plot 7-16. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 54)

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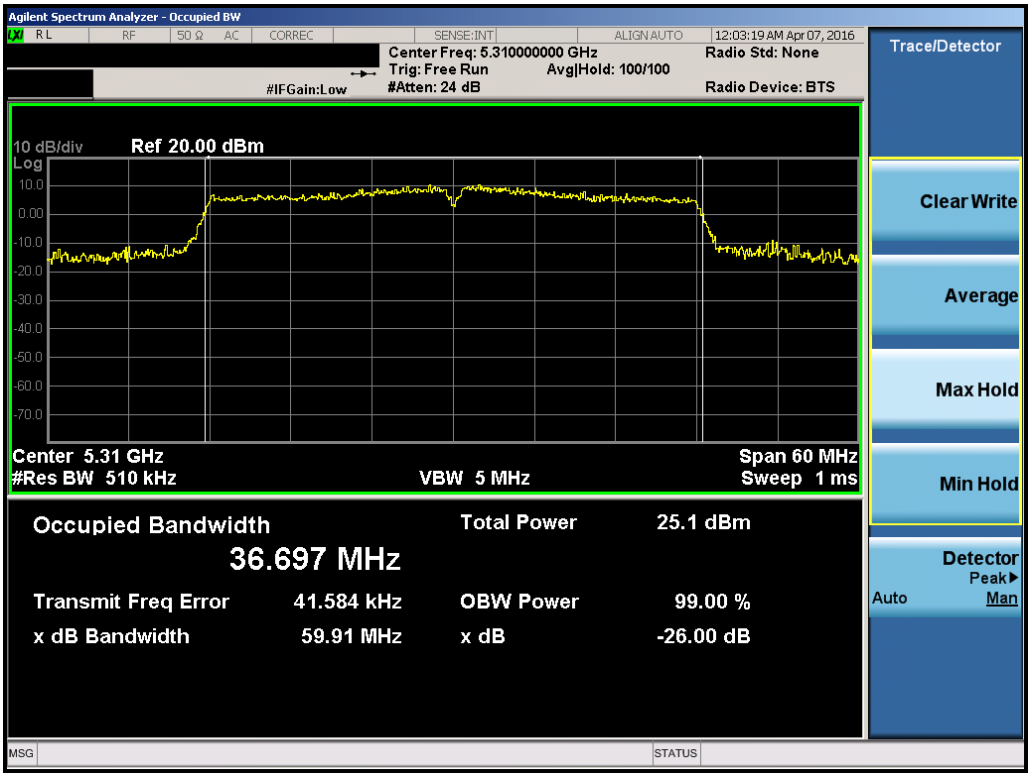

Plot 7-17. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 62)

Plot 7-18. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 2A) – Ch. 58)

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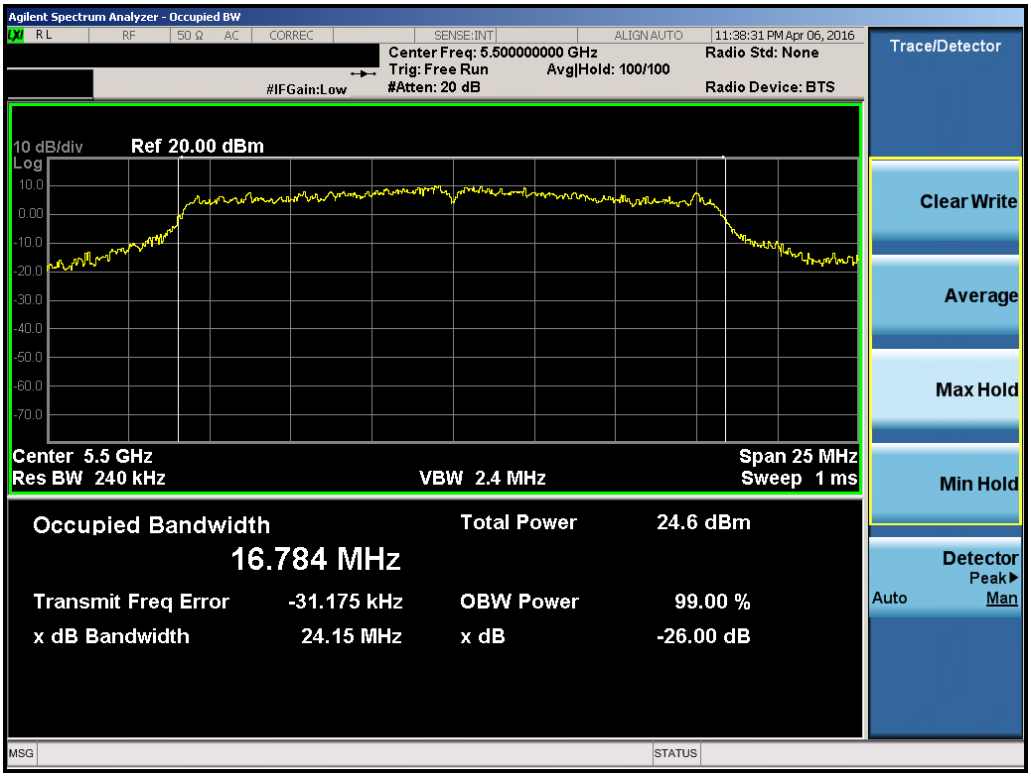
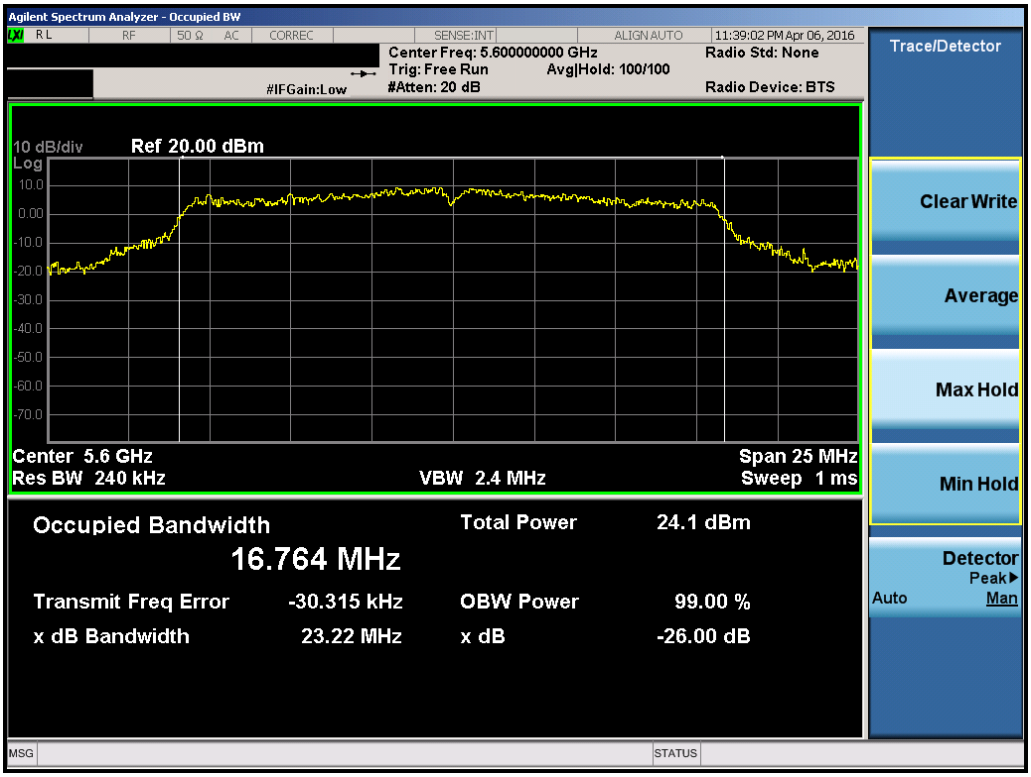


Plot 7-19. 26dB Bandwidth Plot (802.11a (UNII Band 2C) – Ch. 100)



Plot 7-20. 26dB Bandwidth Plot (802.11a (UNII Band 2C) – Ch. 120)

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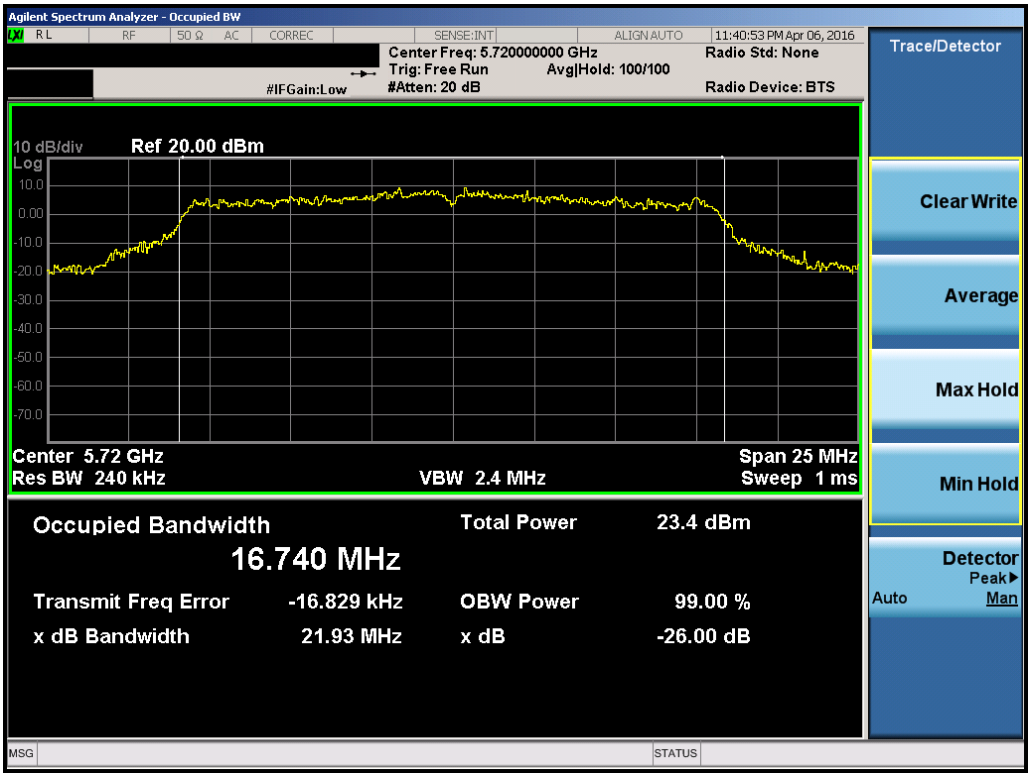
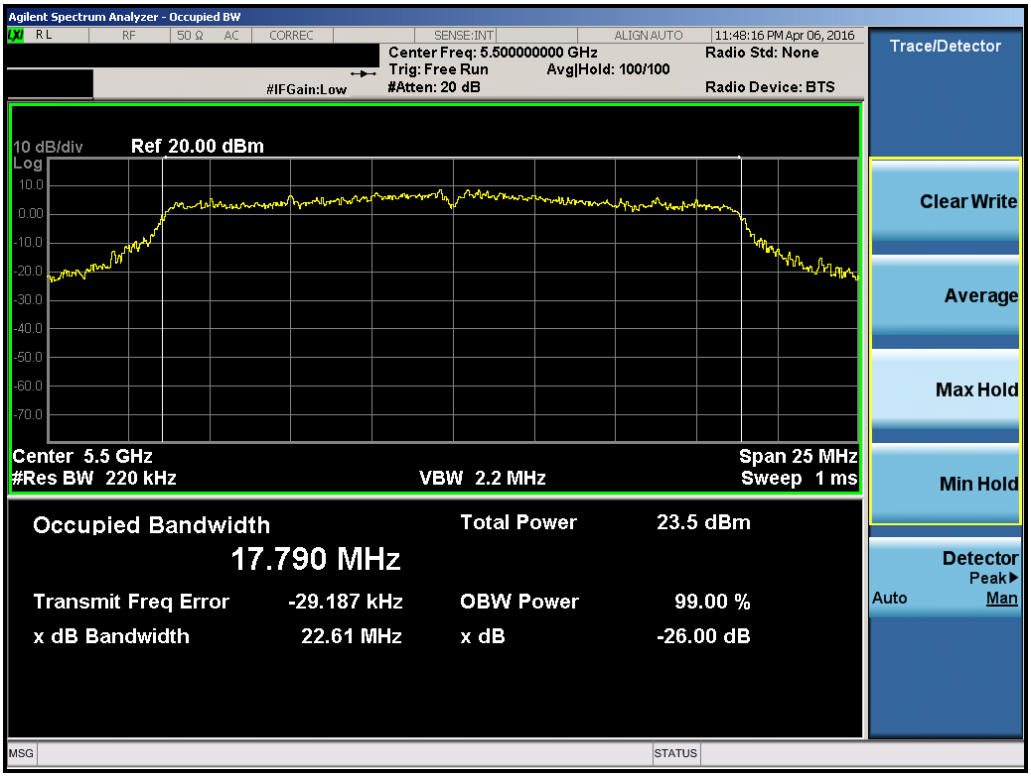


Plot 7-21. 26dB Bandwidth Plot (802.11a (UNII Band 2C) – Ch. 144)



Plot 7-22. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 100)

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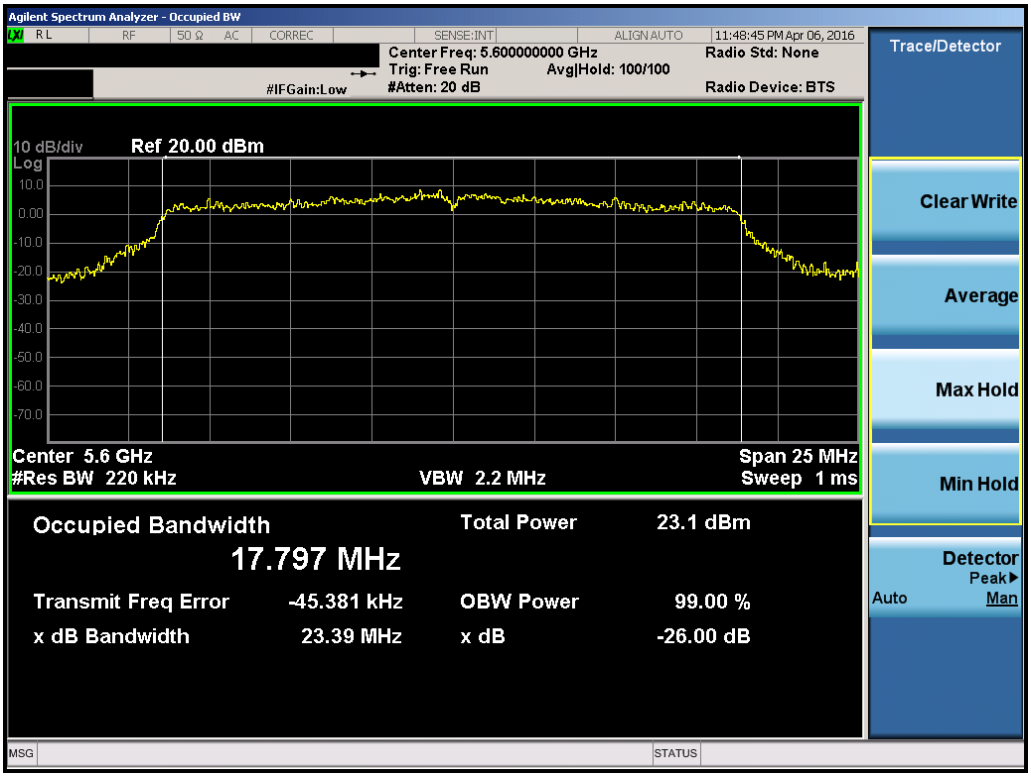

Plot 7-23. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 120)

Plot 7-24. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 144)

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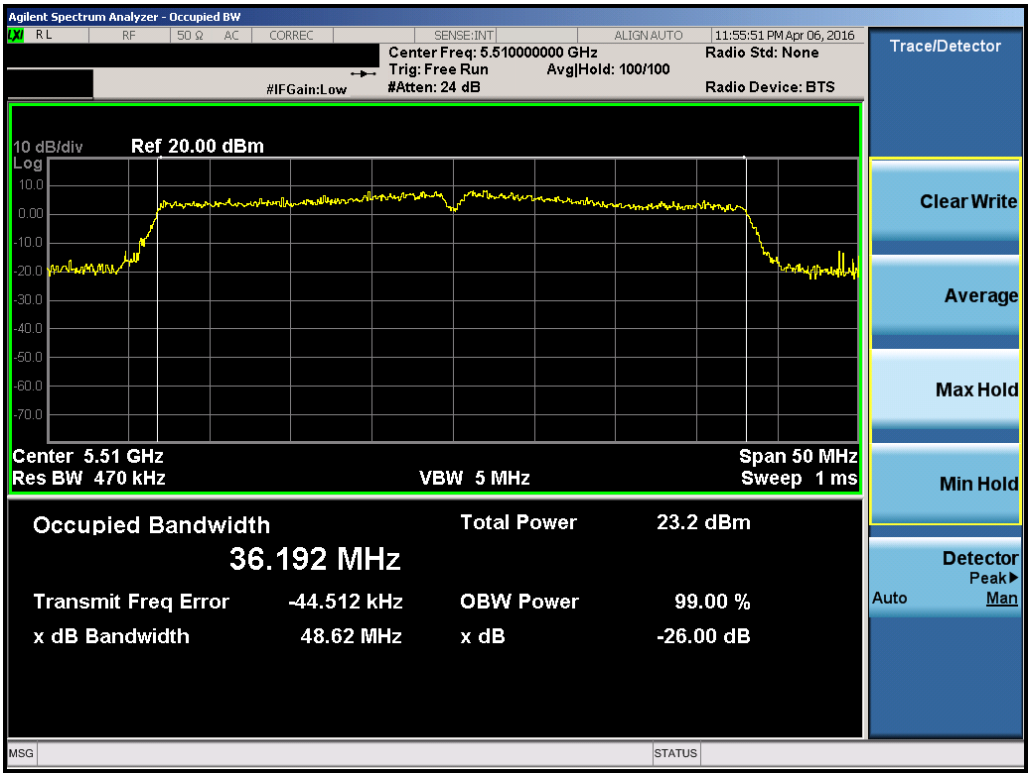
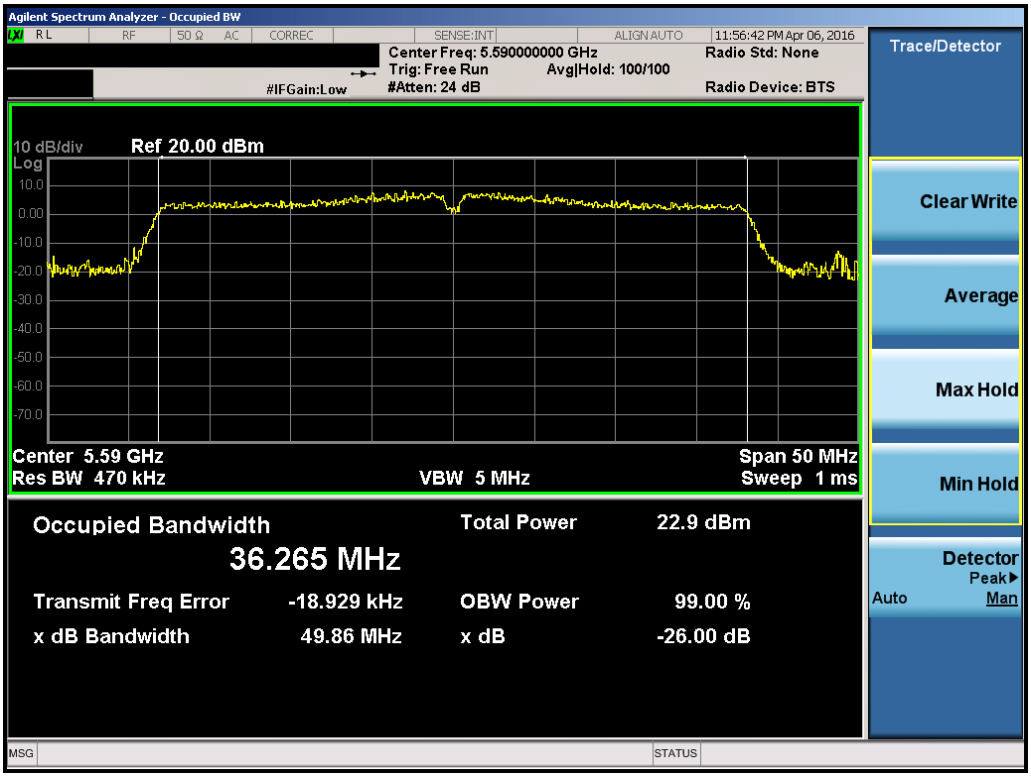


Plot 7-25. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 102)



Plot 7-26. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 118)

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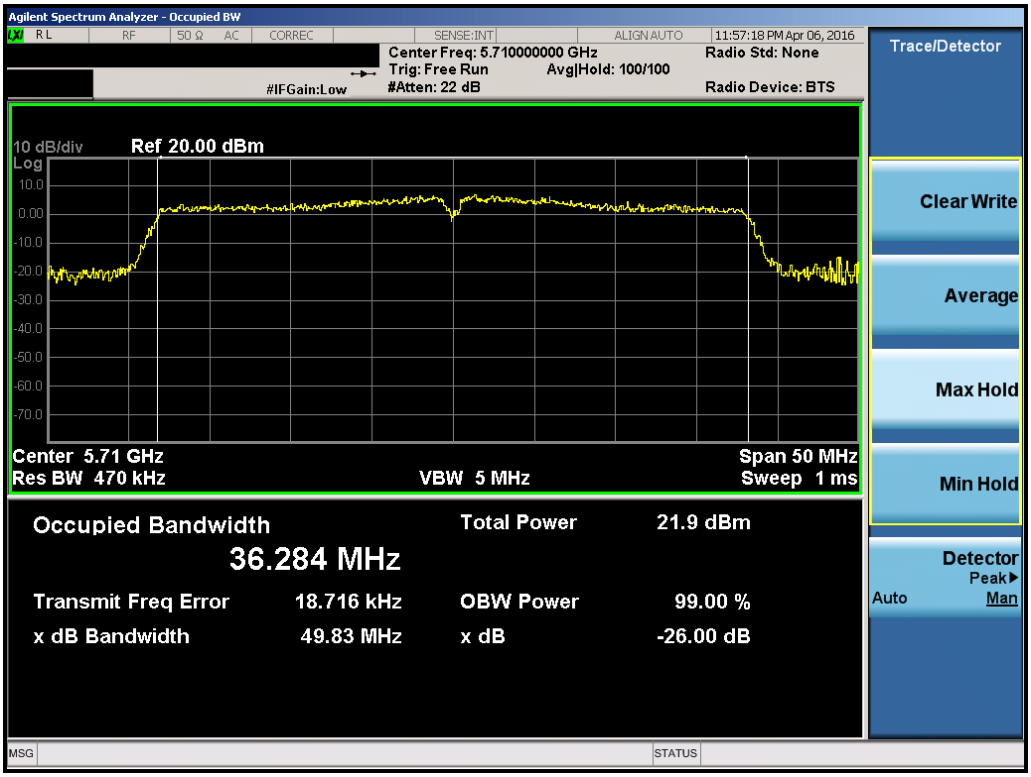
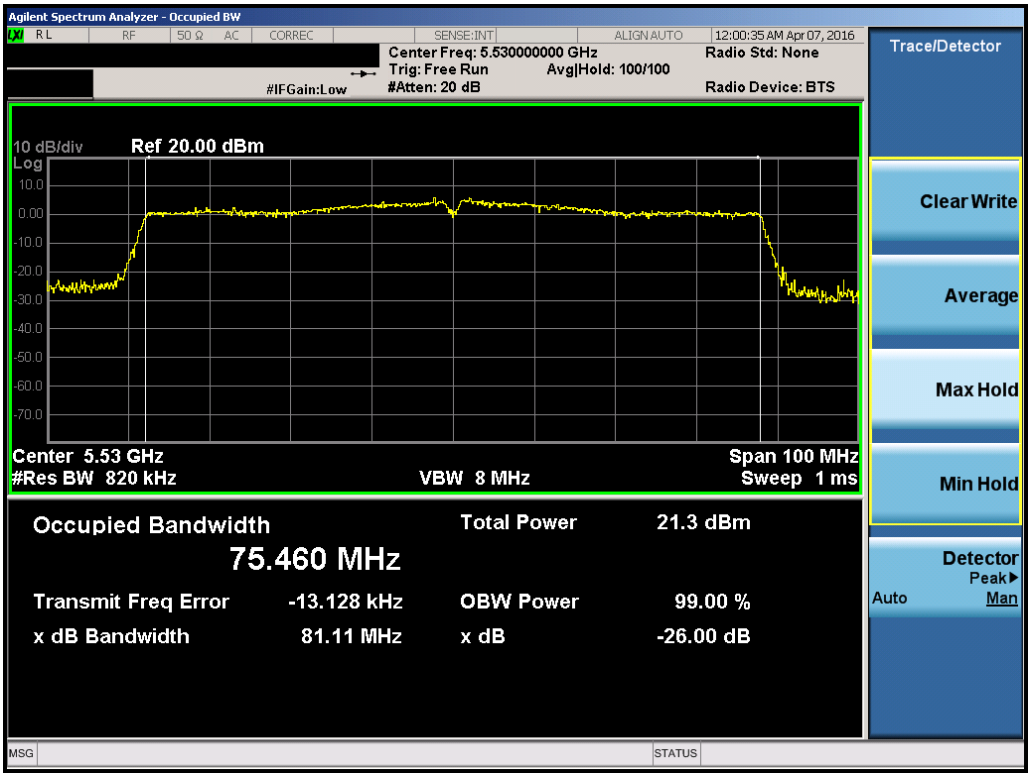


Plot 7-27. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 142)



Plot 7-28. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 2C) – Ch. 106)

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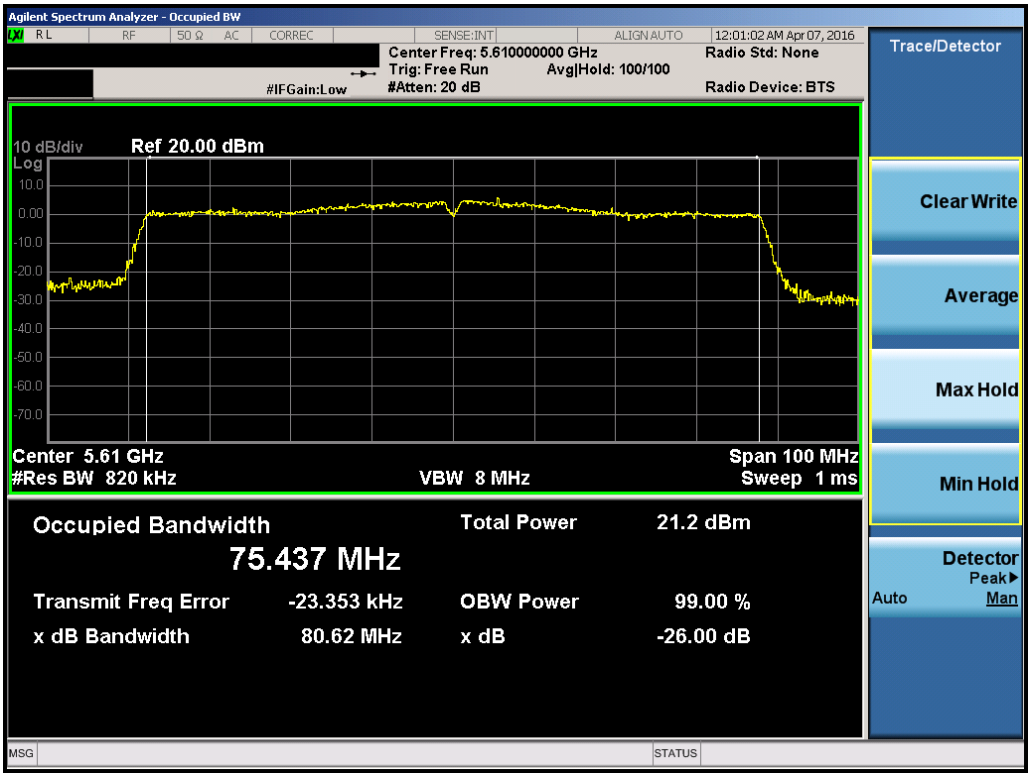
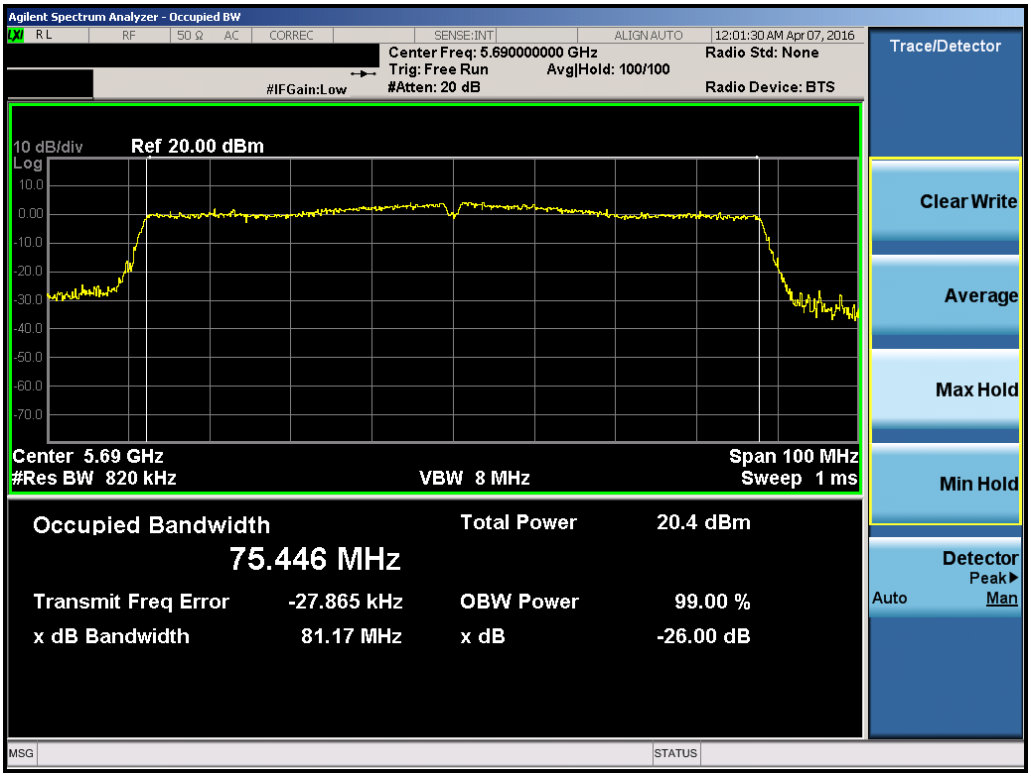


Plot 7-29. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 2C) – Ch. 122)



Plot 7-30. 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	21.34
	5200	40	a	6	20.79
	5240	48	a	6	21.19
	5180	36	n (20MHz)	6.5/7.2 (MCS0)	22.56
	5200	40	n (20MHz)	6.5/7.2 (MCS0)	22.32
	5240	48	n (20MHz)	6.5/7.2 (MCS0)	22.04
	5190	38	n (40MHz)	13.5/15 (MCS0)	44.46
	5230	46	n (40MHz)	13.5/15 (MCS0)	45.13
	5210	42	ac (80MHz)	29.3/32.5 (MCS0)	81.20
Band 2A	5260	52	a	6	22.18
	5280	56	a	6	21.02
	5320	64	a	6	21.79
	5260	52	n (20MHz)	6.5/7.2 (MCS0)	21.44
	5280	56	n (20MHz)	6.5/7.2 (MCS0)	21.48
	5320	64	n (20MHz)	6.5/7.2 (MCS0)	21.26
	5270	54	n (40MHz)	13.5/15 (MCS0)	39.62
	5310	62	n (40MHz)	13.5/15 (MCS0)	39.44
	5290	58	ac (80MHz)	29.3/32.5 (MCS0)	81.11
Band 2C	5500	100	a	6	21.46
	5600	120	a	6	23.58
	5720	144	a	6	23.01
	5500	100	n (20MHz)	6.5/7.2 (MCS0)	21.18
	5600	120	n (20MHz)	6.5/7.2 (MCS0)	21.42
	5720	144	n (20MHz)	6.5/7.2 (MCS0)	21.66
	5510	102	n (40MHz)	13.5/15 (MCS0)	40.11
	5590	118	n (40MHz)	13.5/15 (MCS0)	40.15
	5710	142	n (40MHz)	13.5/15 (MCS0)	43.99
	5530	106	ac (80MHz)	29.3/32.5 (MCS0)	81.13
	5610	122	ac (80MHz)	29.3/32.5 (MCS0)	81.21
	5690	138	ac (80MHz)	29.3/32.5 (MCS0)	80.33

Table 7-3. Conducted Bandwidth Measurements

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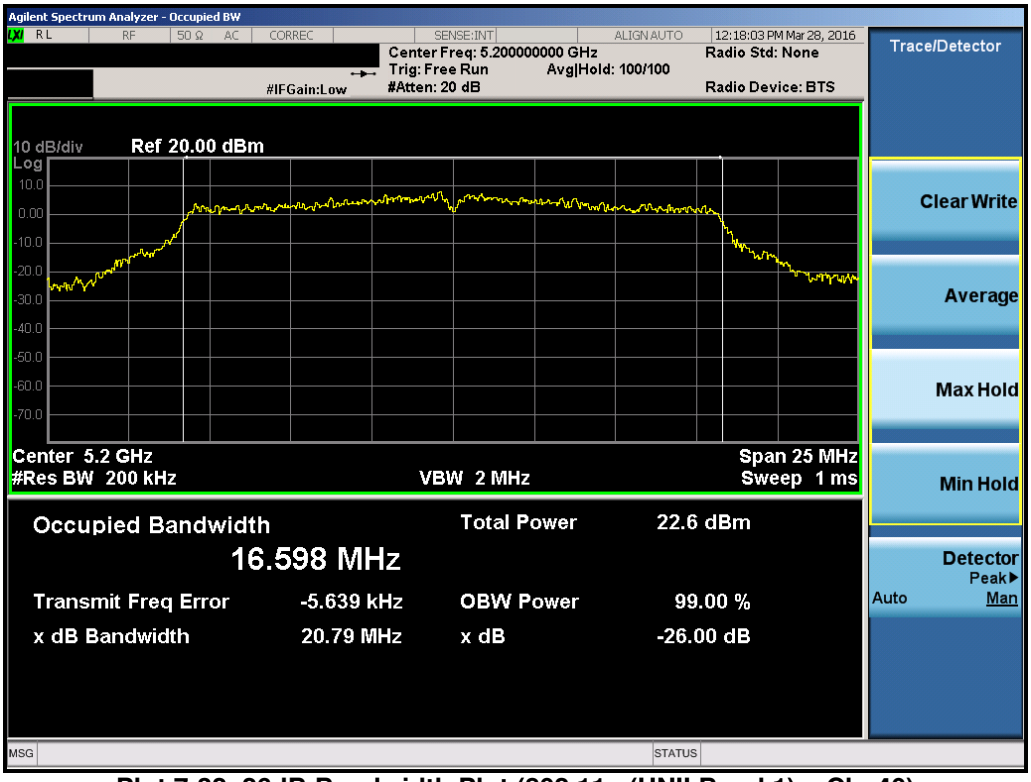
Plot 7-31. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 36)



Plot 7-32. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 40)

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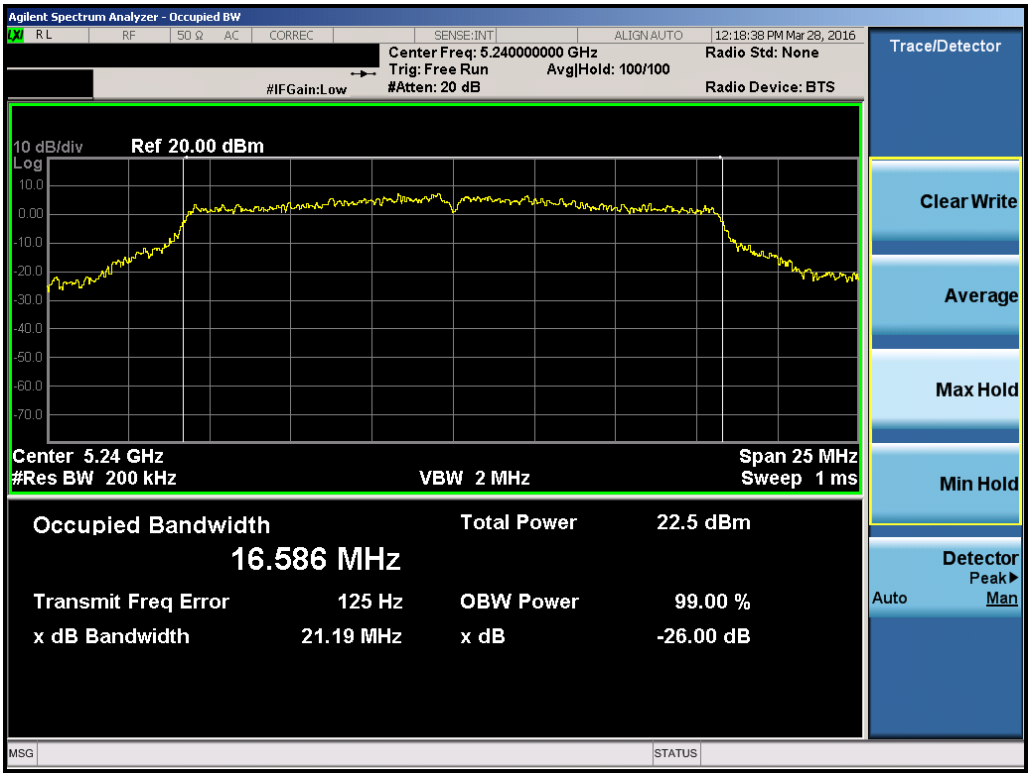

Plot 7-33. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 48)

Plot 7-34. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 36)

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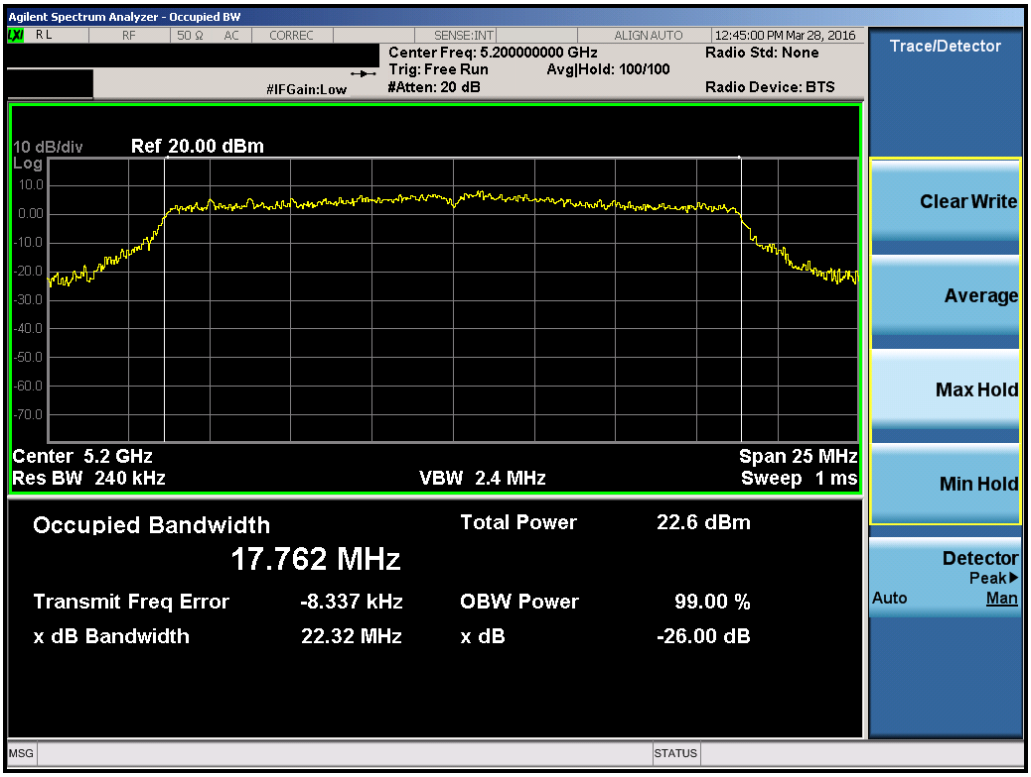
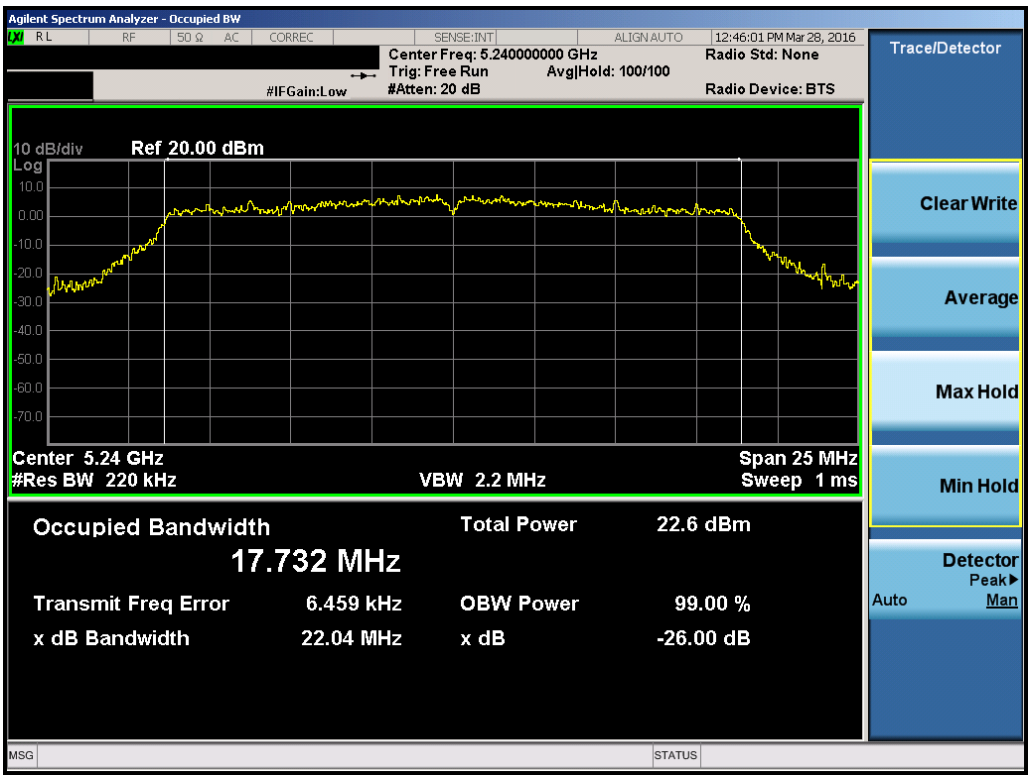


Plot 7-35. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 40)



Plot 7-36. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 48)

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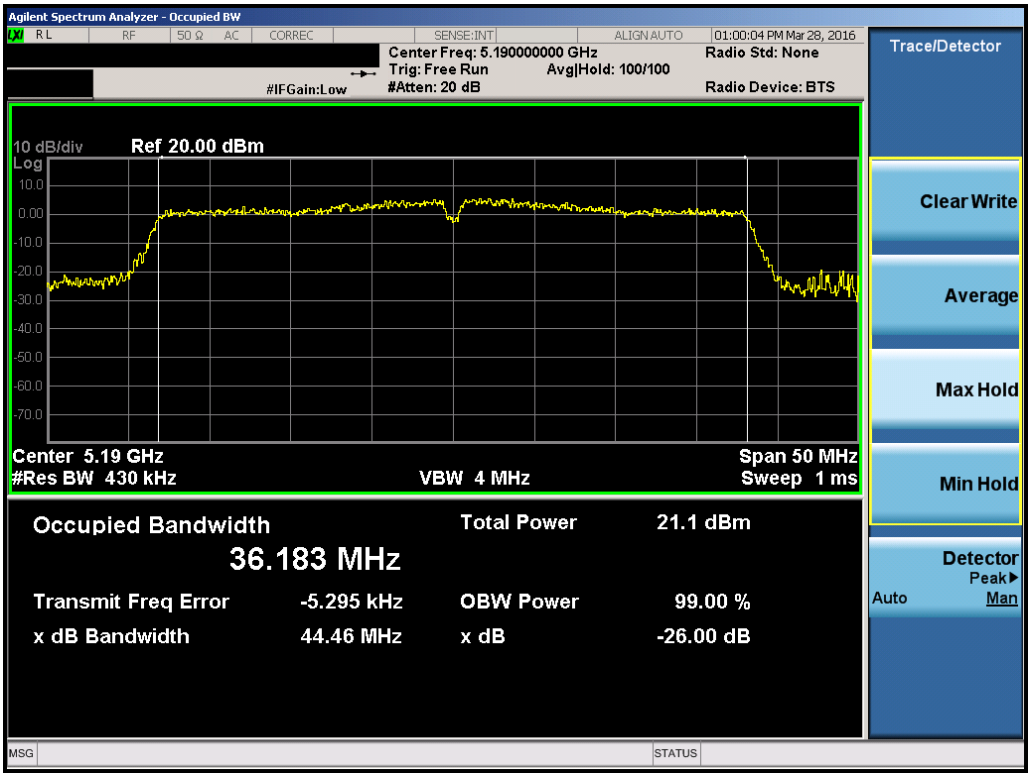

Plot 7-37. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 38)

Plot 7-38. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 46)

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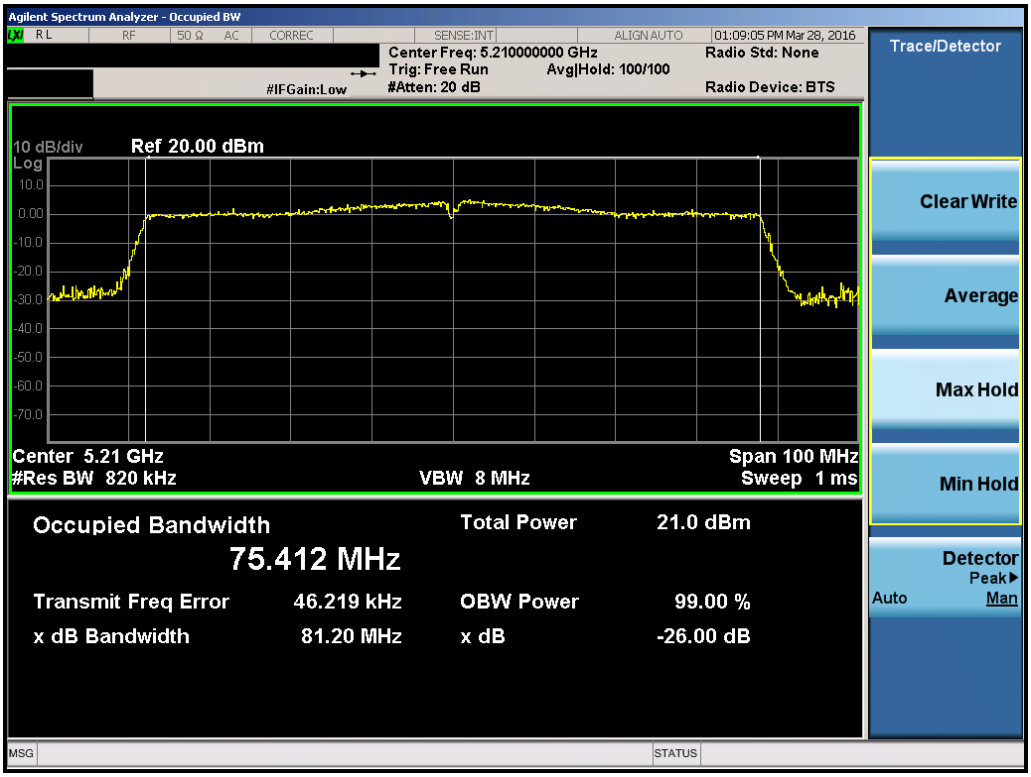
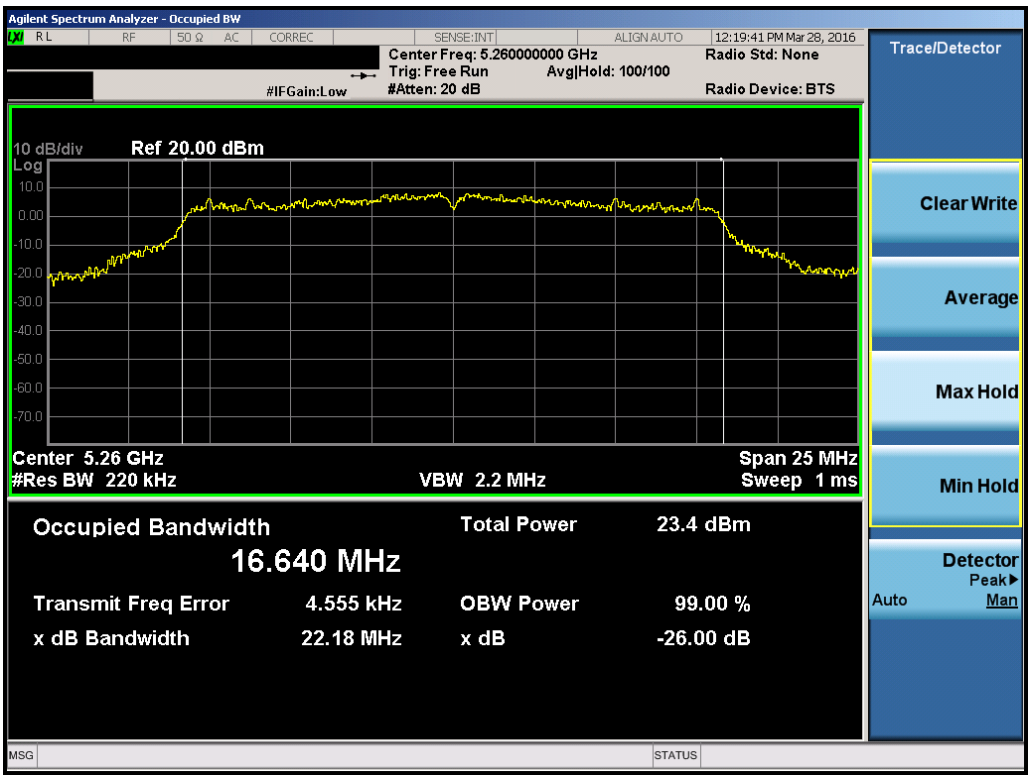


Plot 7-39. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)



Plot 7-40. 26dB Bandwidth Plot (802.11a (UNII Band 2A) – Ch. 52)

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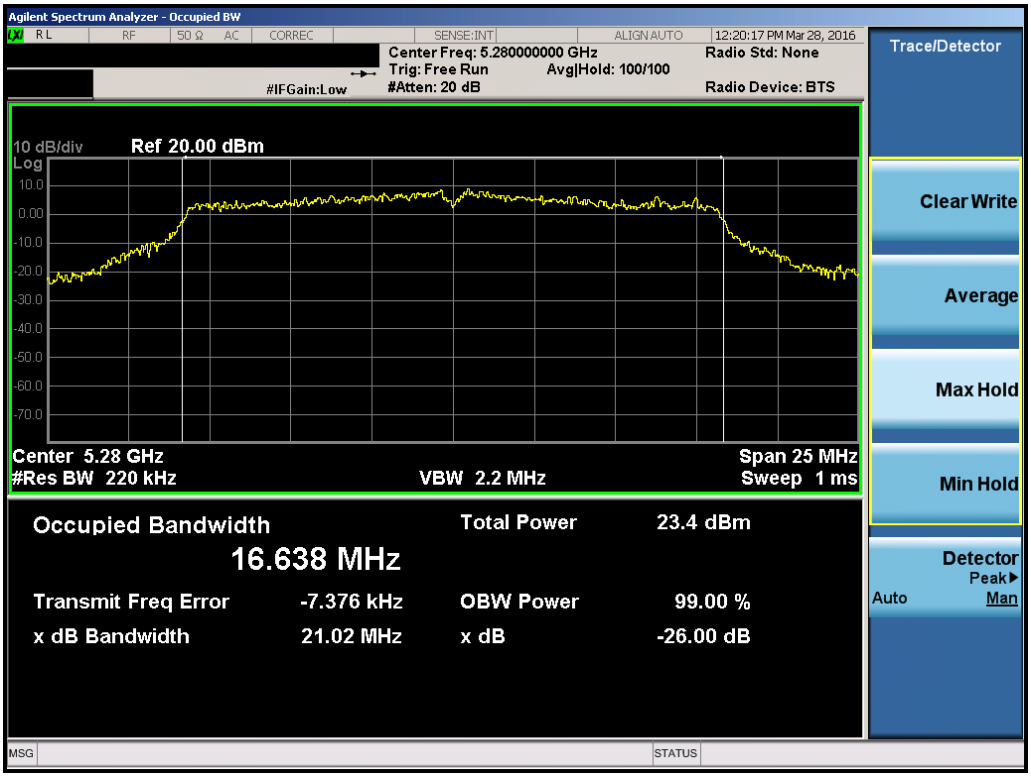

Plot 7-41. 26dB Bandwidth Plot (802.11a (UNII Band 2A) – Ch. 56)

Plot 7-42. 26dB Bandwidth Plot (802.11a (UNII Band 2A) – Ch. 64)

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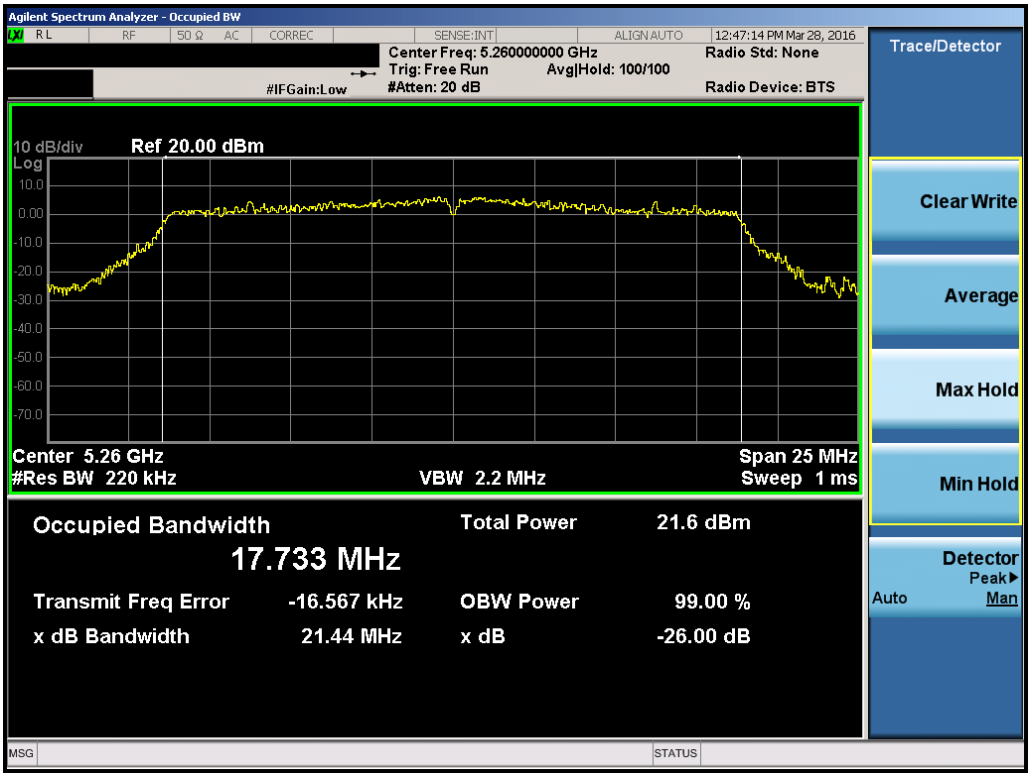
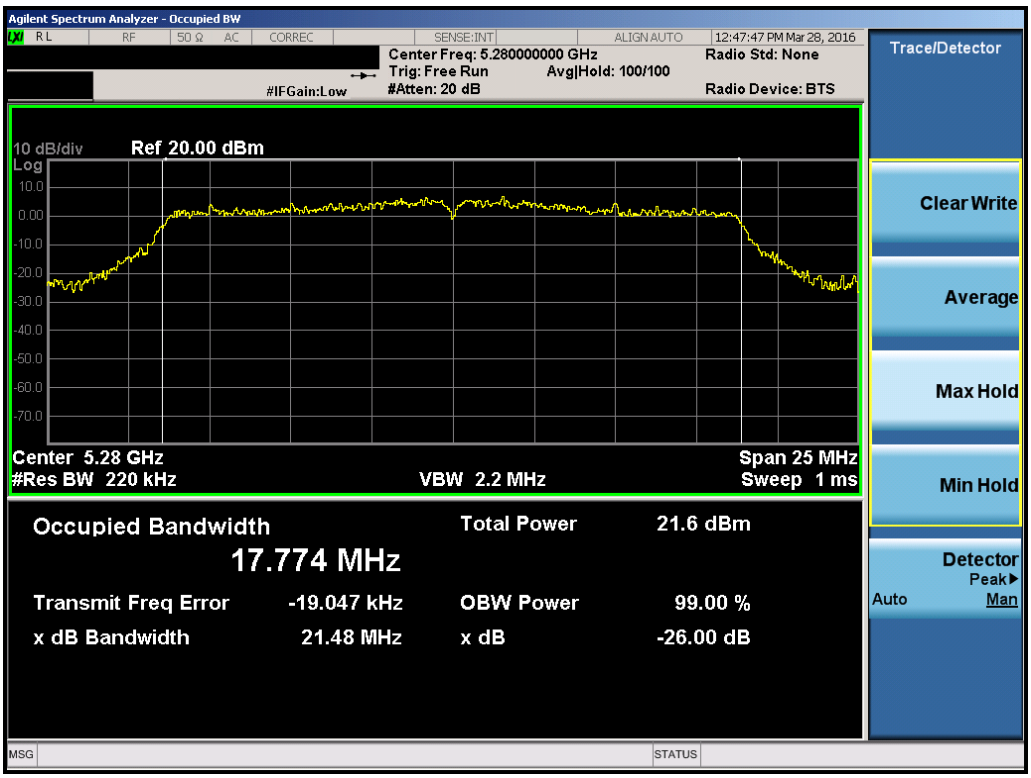


Plot 7-43. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 52)



Plot 7-44. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)

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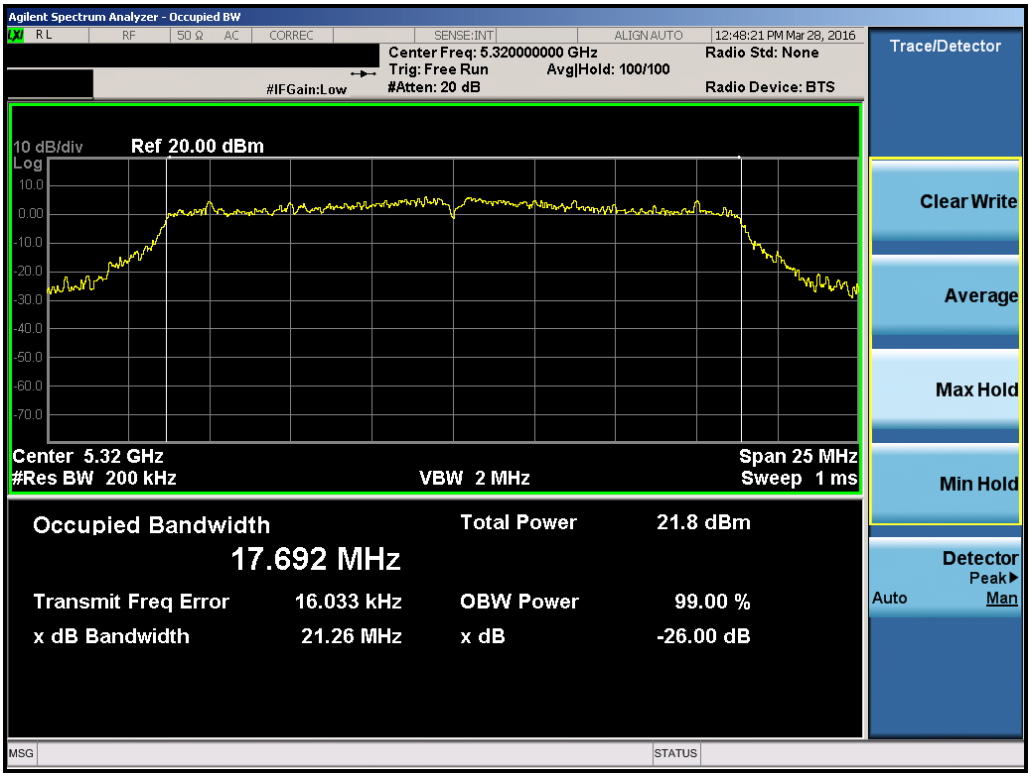
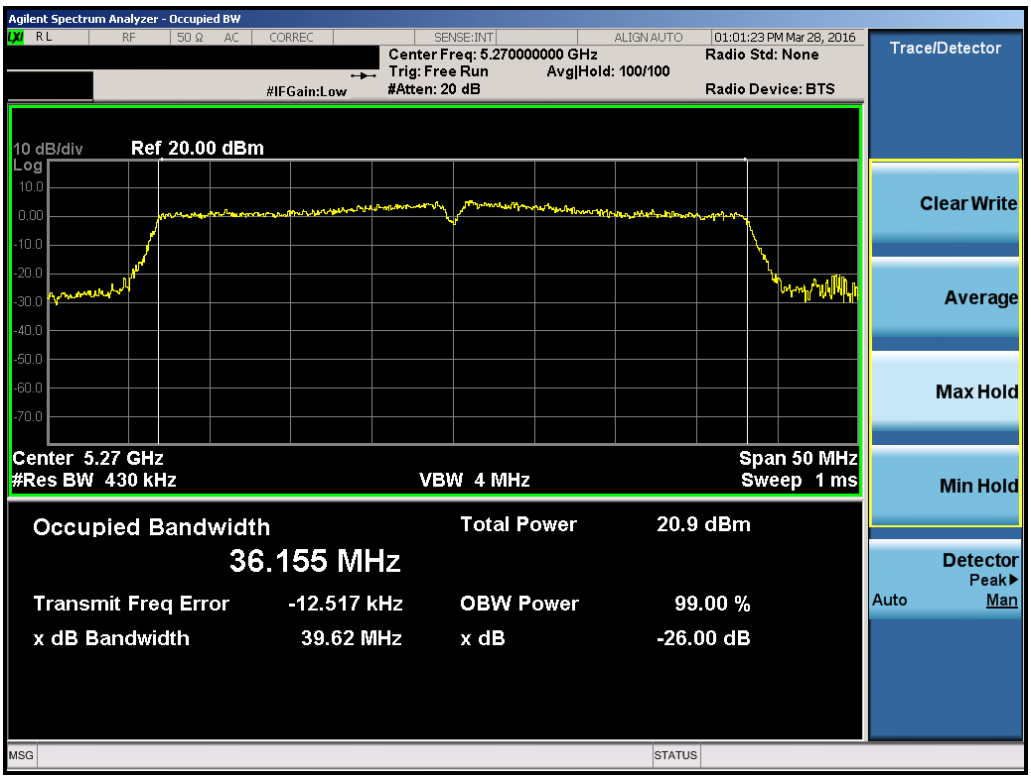


Plot 7-45. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 64)



Plot 7-46. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 54)

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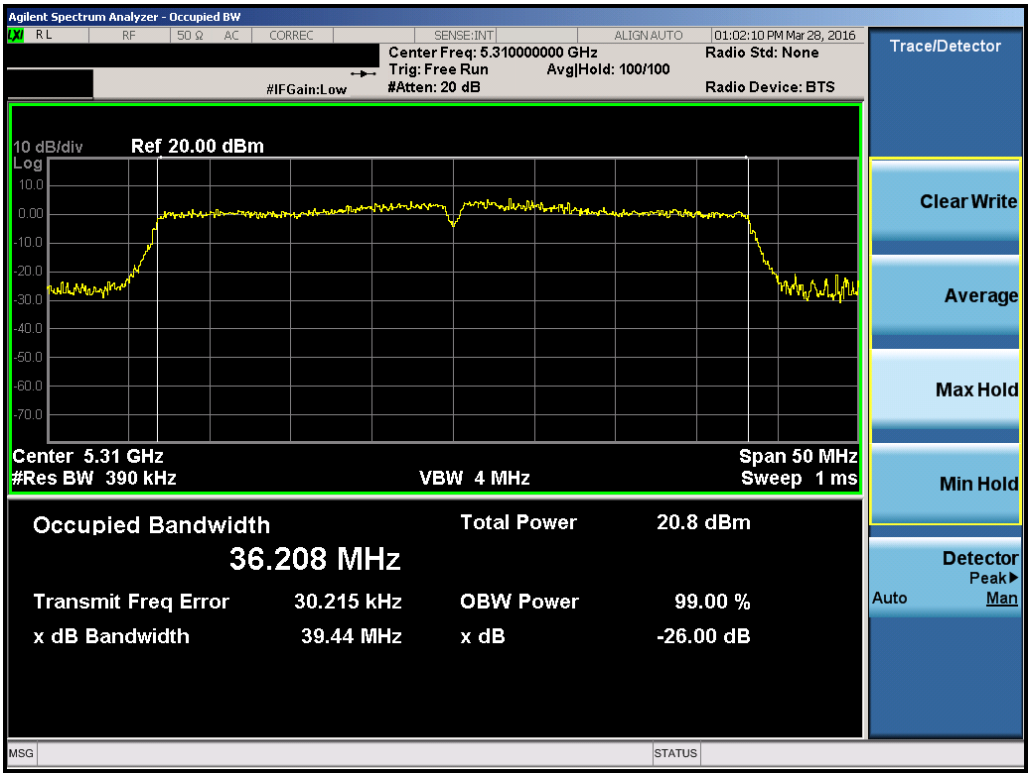

Plot 7-47. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 62)

Plot 7-48. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 2A) – Ch. 58)

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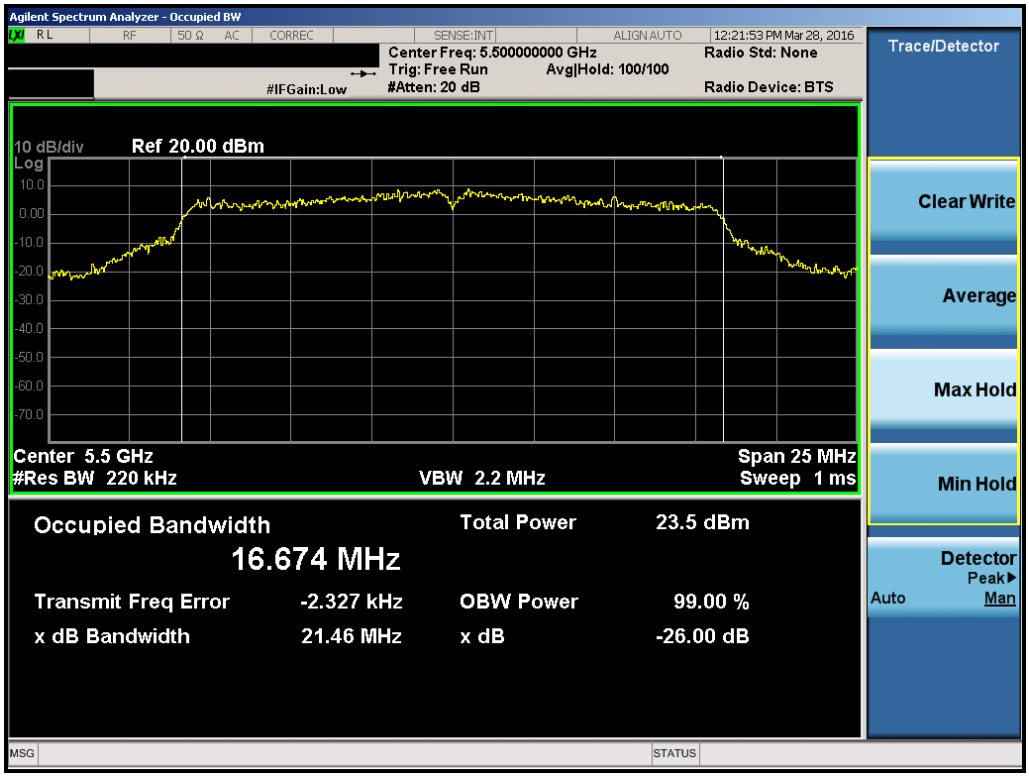
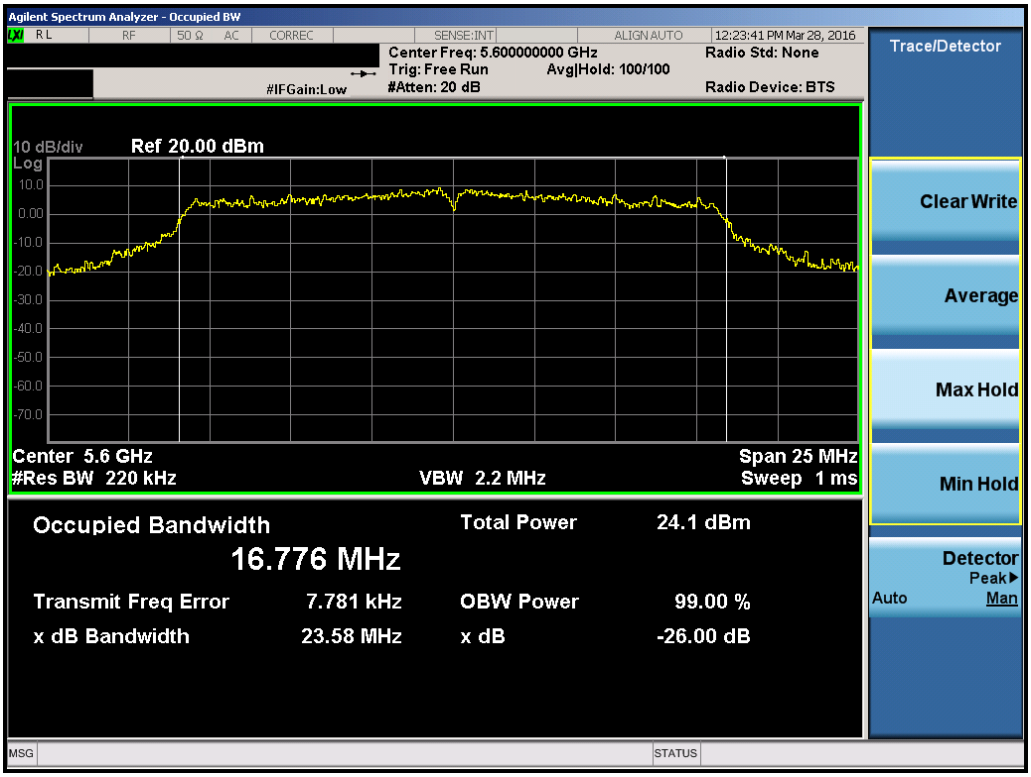


Plot 7-49. 26dB Bandwidth Plot (802.11a (UNII Band 2C) – Ch. 100)



Plot 7-50. 26dB Bandwidth Plot (802.11a (UNII Band 2C) – Ch. 120)

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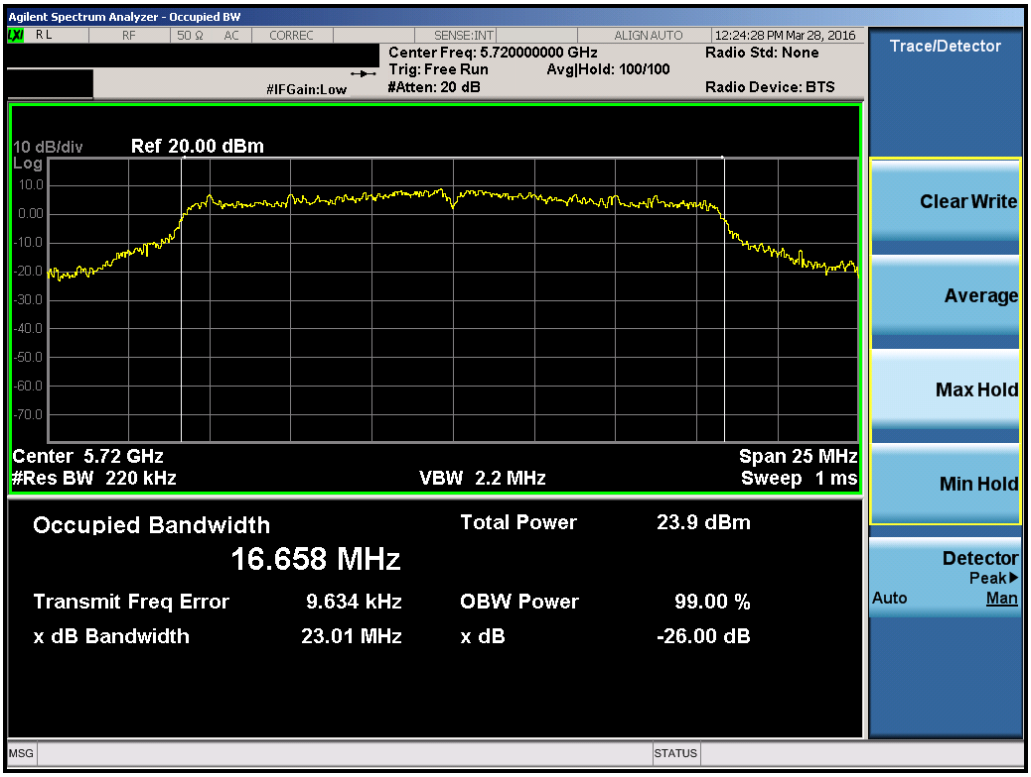
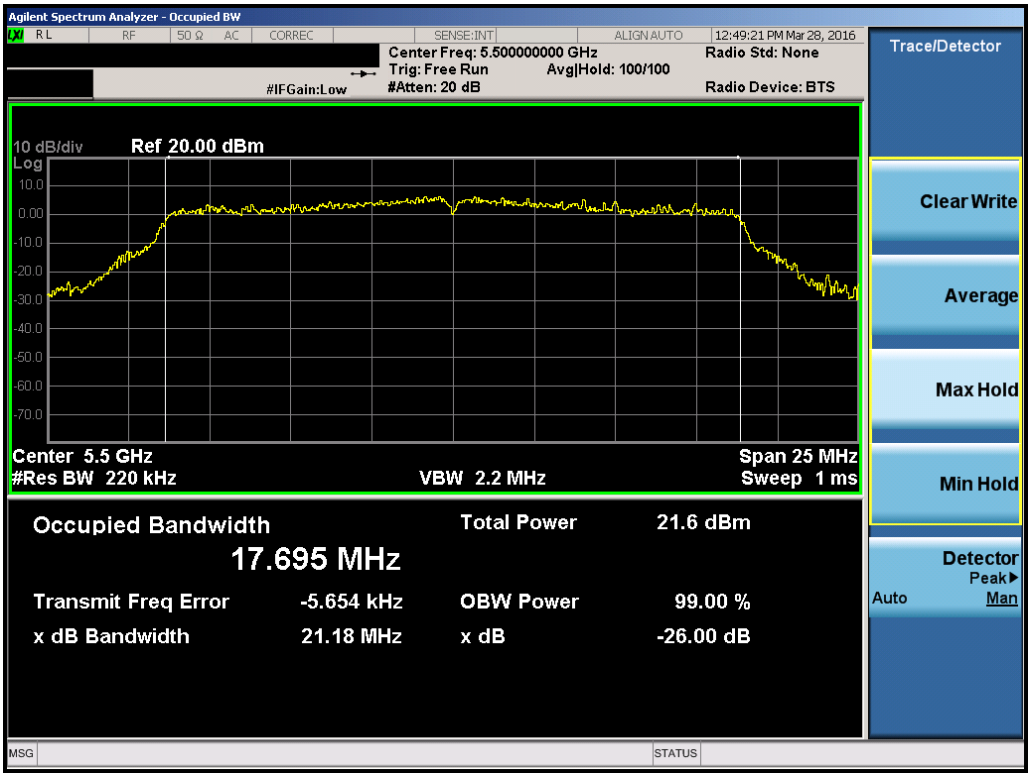


Plot 7-51. 26dB Bandwidth Plot (802.11a (UNII Band 2C) – Ch. 144)



Plot 7-52. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 100)

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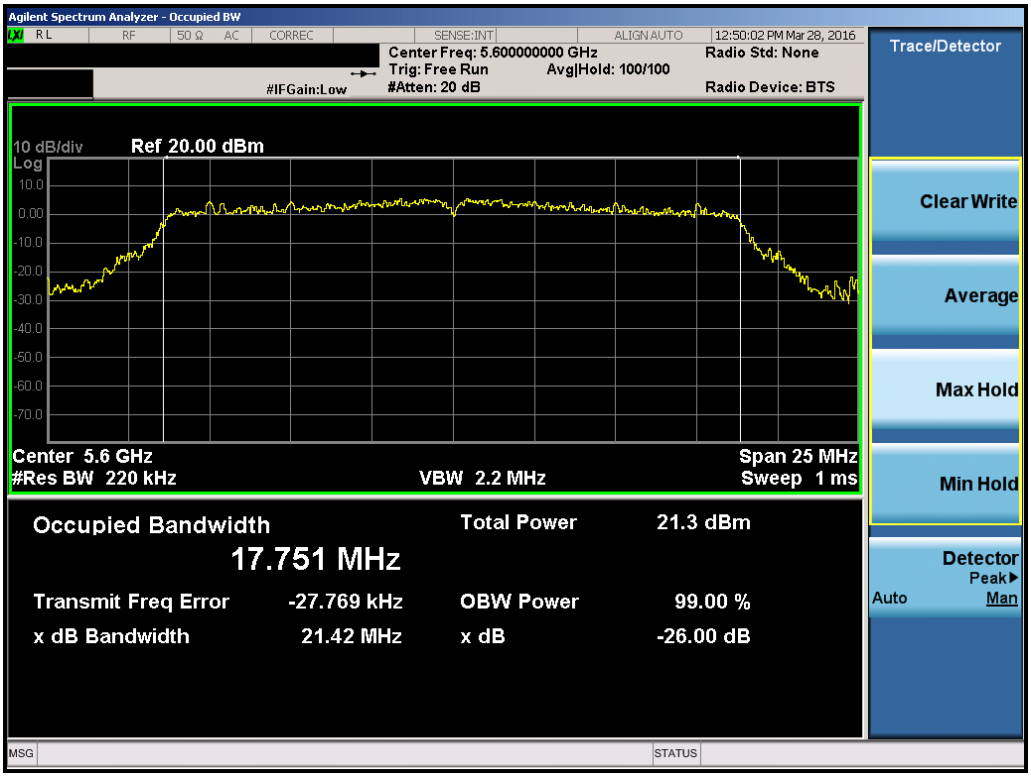

Plot 7-53. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 120)

Plot 7-54. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 144)

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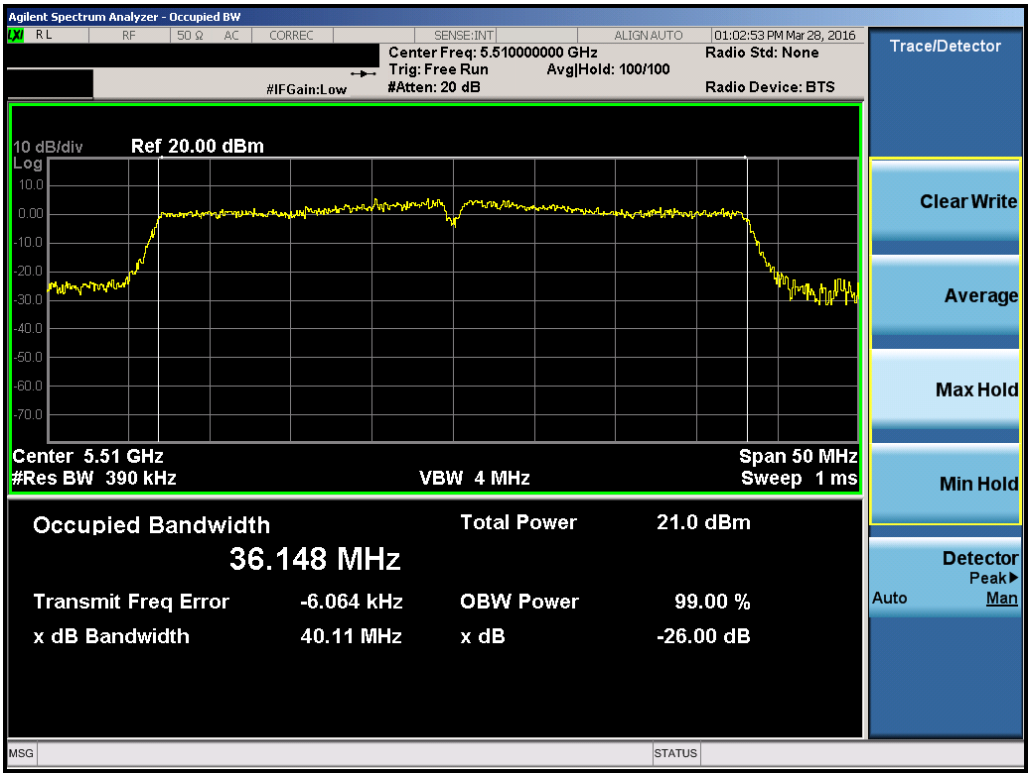
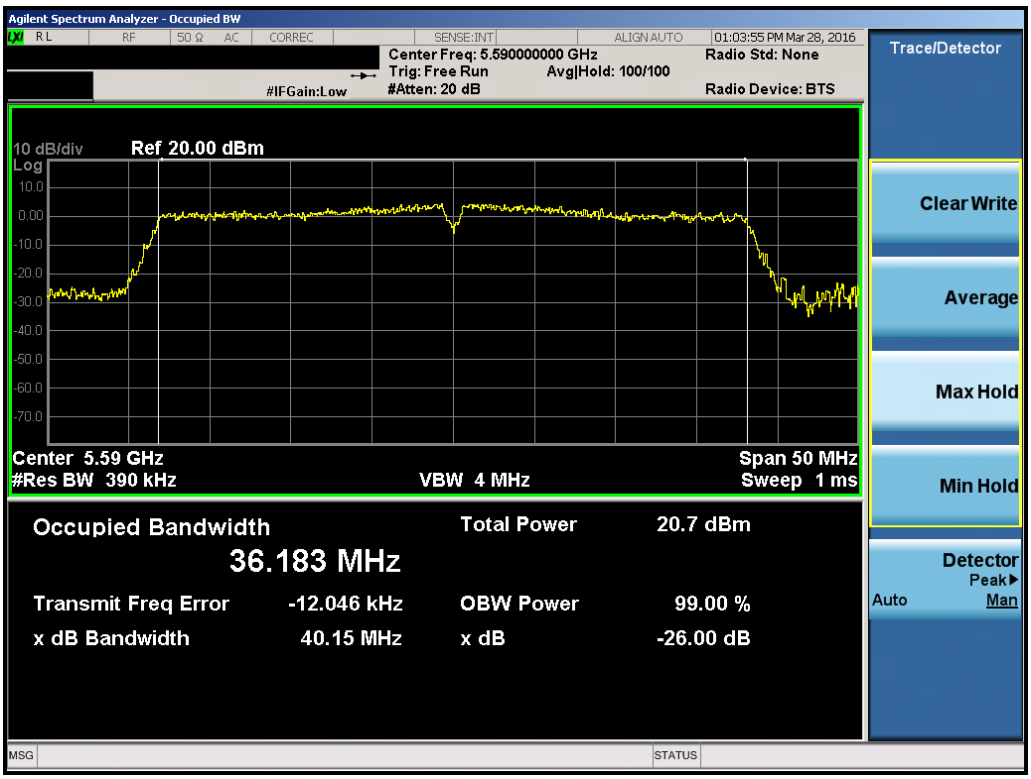


Plot 7-55. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 102)



Plot 7-56. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 118)

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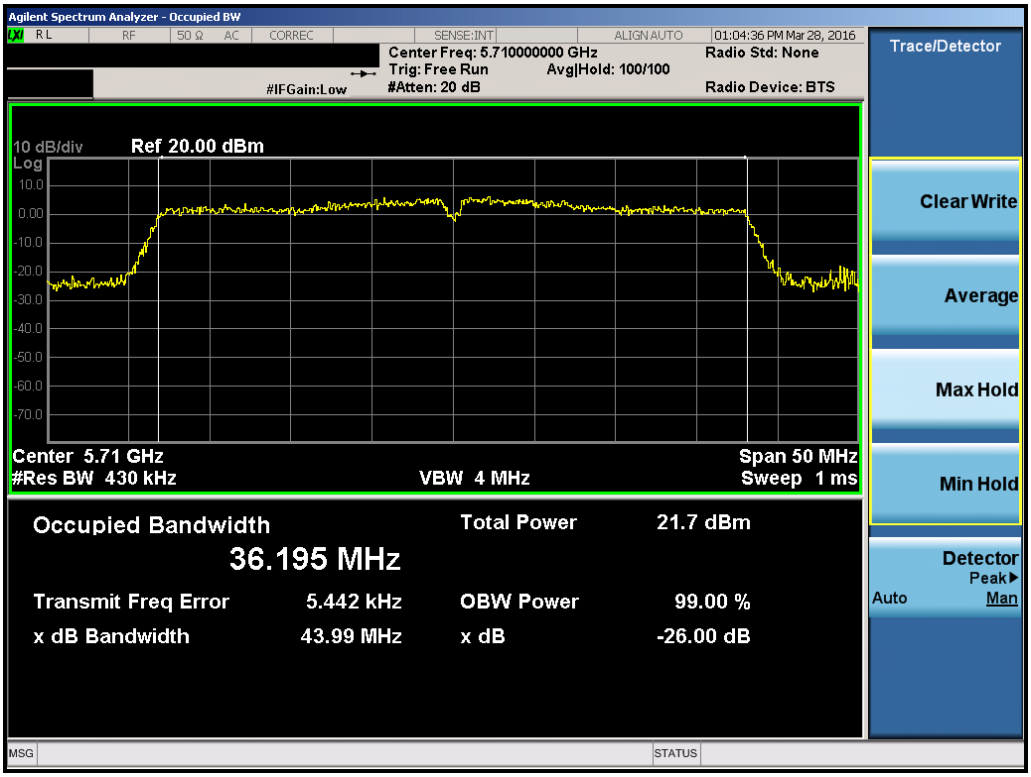
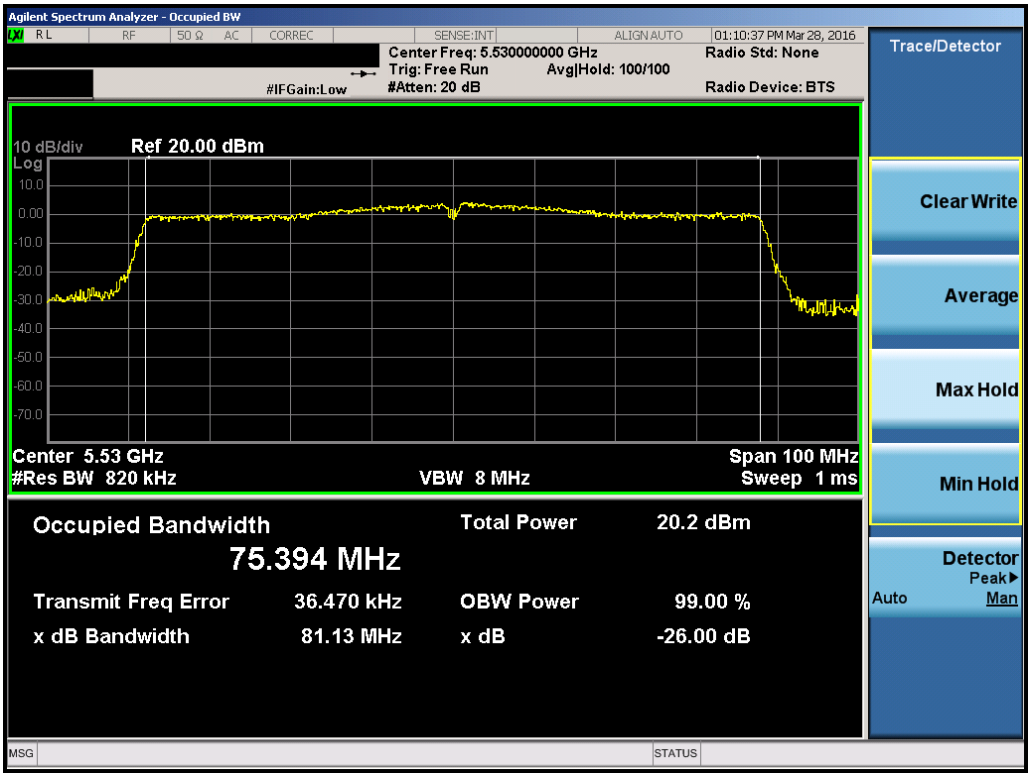


Plot 7-57. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 142)



Plot 7-58. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 2C) – Ch. 106)

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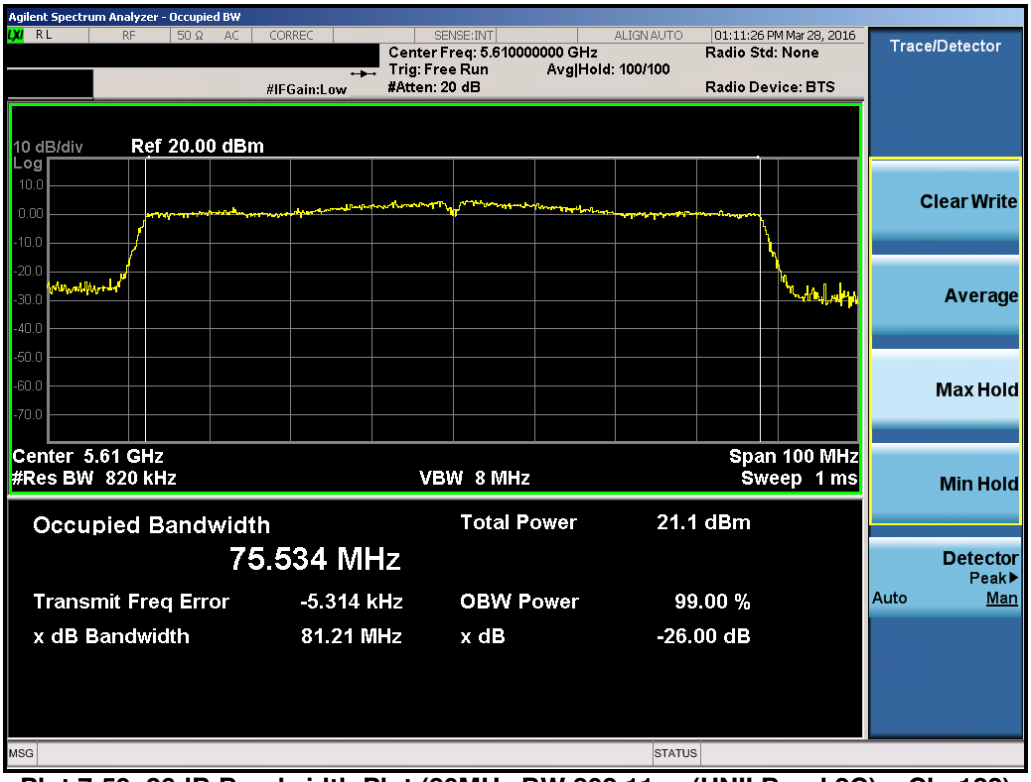
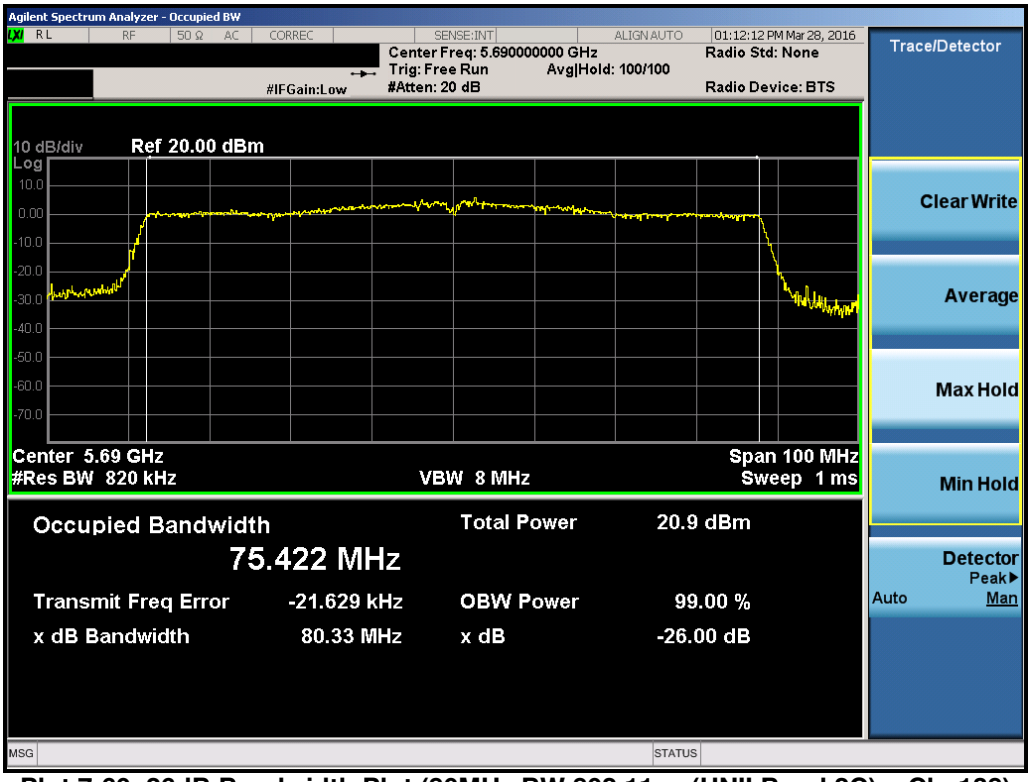


Plot 7-59. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 2C) – Ch. 122)



Plot 7-60. 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 2C) – Ch. 138)

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7.3 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 duty cycle, 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.

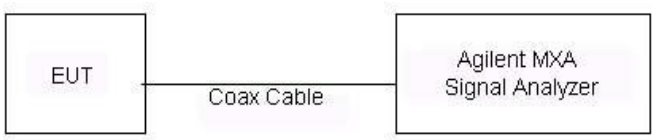

Figure 7-2. Test Instrument & Measurement Setup

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	16.30
	5785	157	a	6	16.04
	5825	165	a	6	16.32
	5745	149	n (20MHz)	6.5/7.2 (MCS0)	16.97
	5785	157	n (20MHz)	6.5/7.2 (MCS0)	17.18
	5825	165	n (20MHz)	6.5/7.2 (MCS0)	17.57
	5755	151	n (40MHz)	13.5/15 (MCS0)	35.93
	5795	159	n (40MHz)	13.5/15 (MCS0)	35.72
	5775	155	ac (80MHz)	29.3/32.5 (MCS0)	75.61

Table 7-4. Conducted Bandwidth Measurements

Plot 7-61. 6dB Bandwidth Plot (802.11a (UNII Band 3) – Ch. 149)

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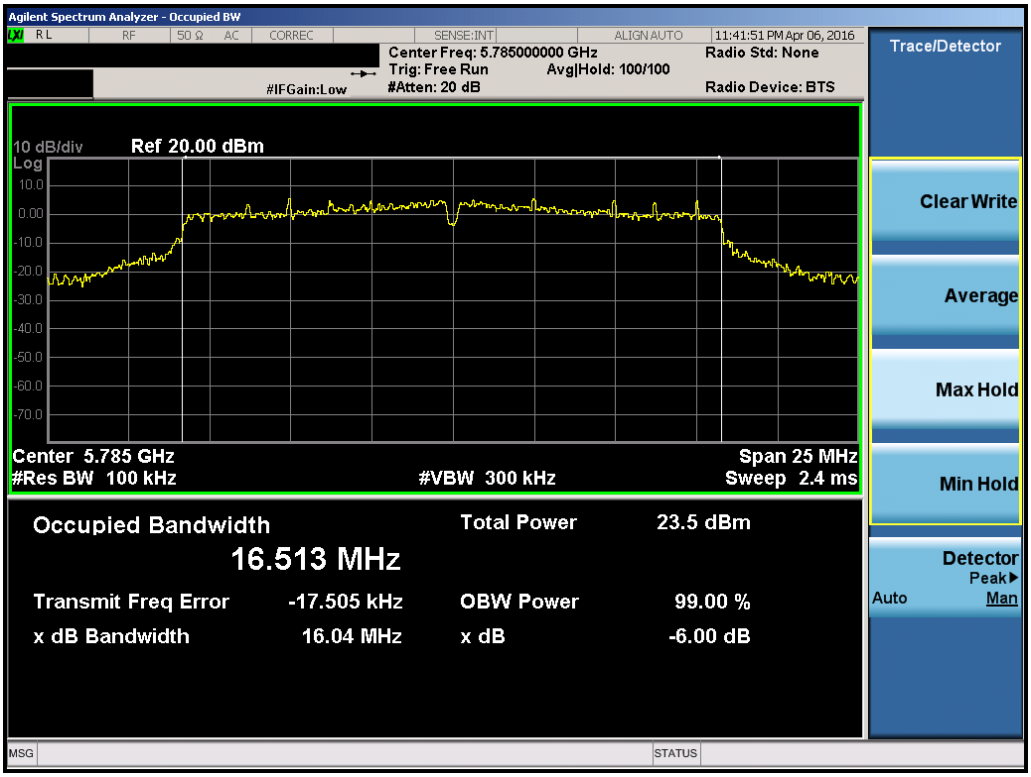
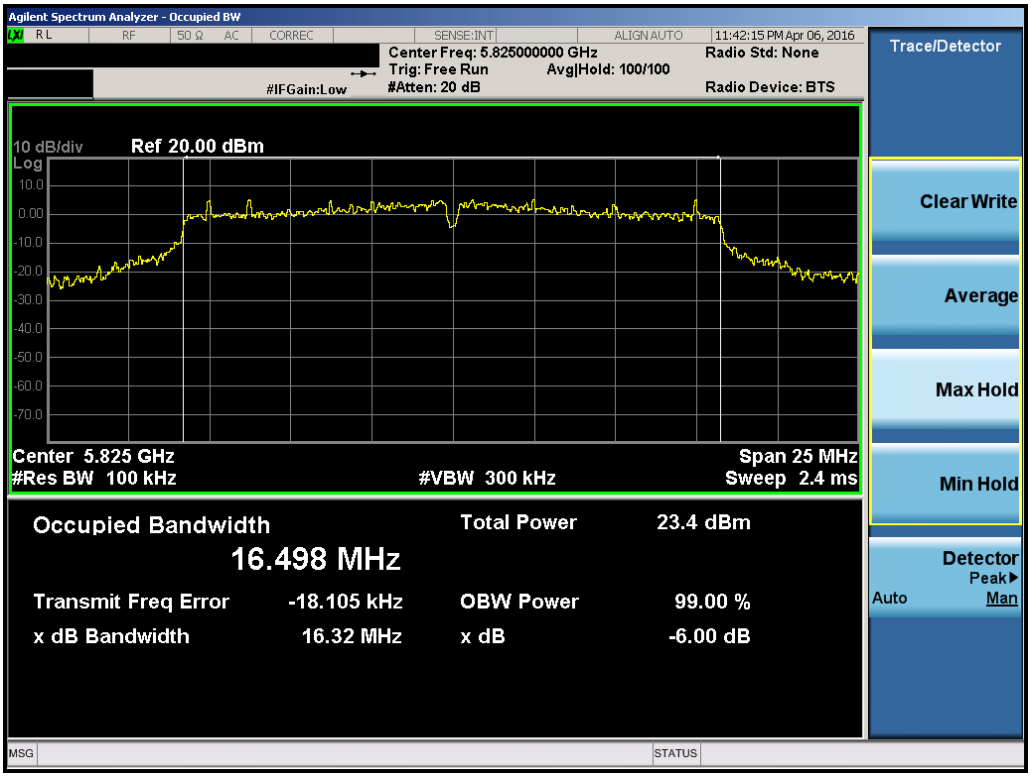


Plot 7-62. 6dB Bandwidth Plot (802.11a (UNII Band 3) – Ch. 157)



Plot 7-63. 6dB Bandwidth Plot (802.11a (UNII Band 3) – Ch. 165)

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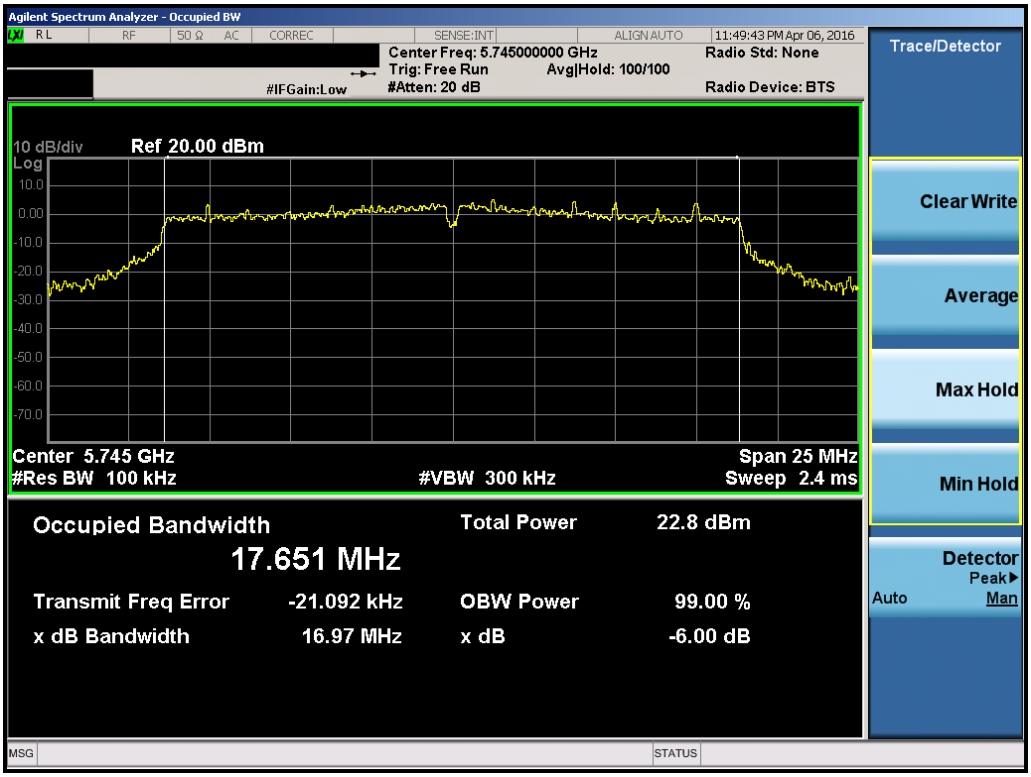
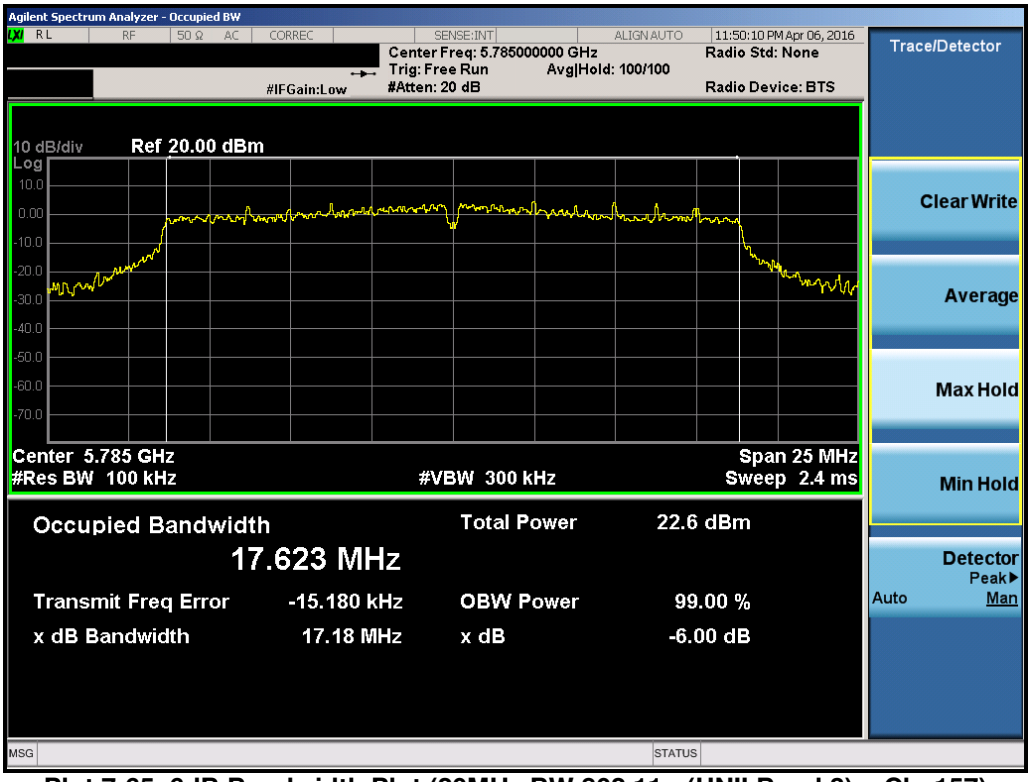


Plot 7-64. 6dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 149)



Plot 7-65. 6dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 157)

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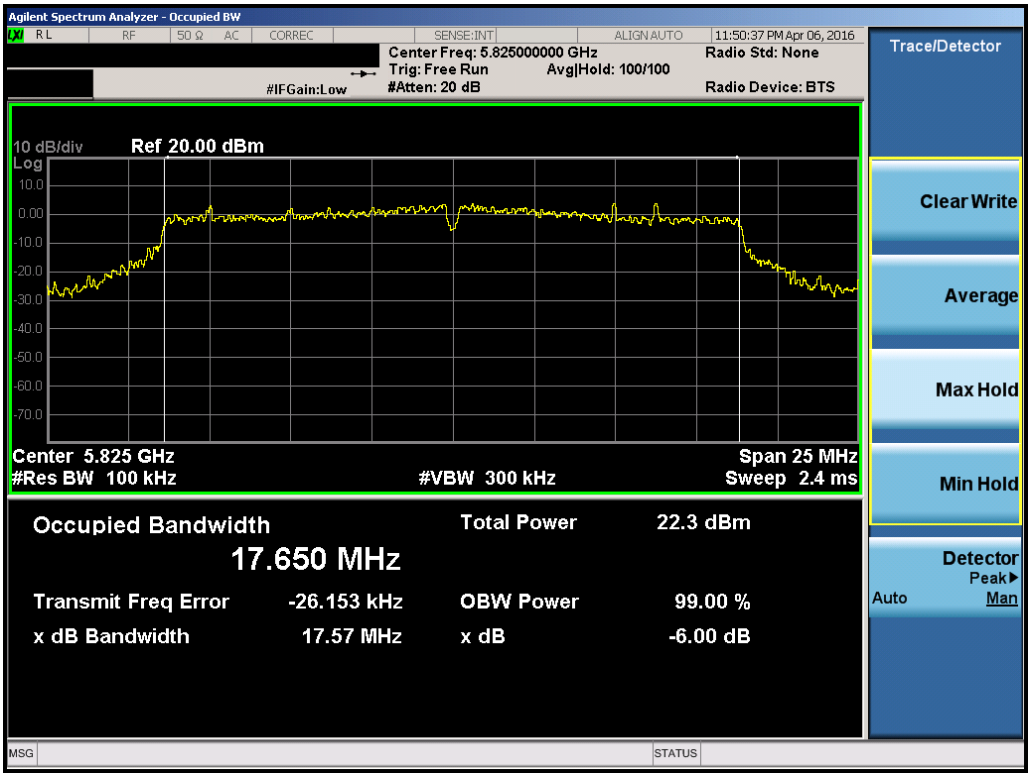

Plot 7-66. 6dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 165)

Plot 7-67. 6dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 3) – Ch. 151)

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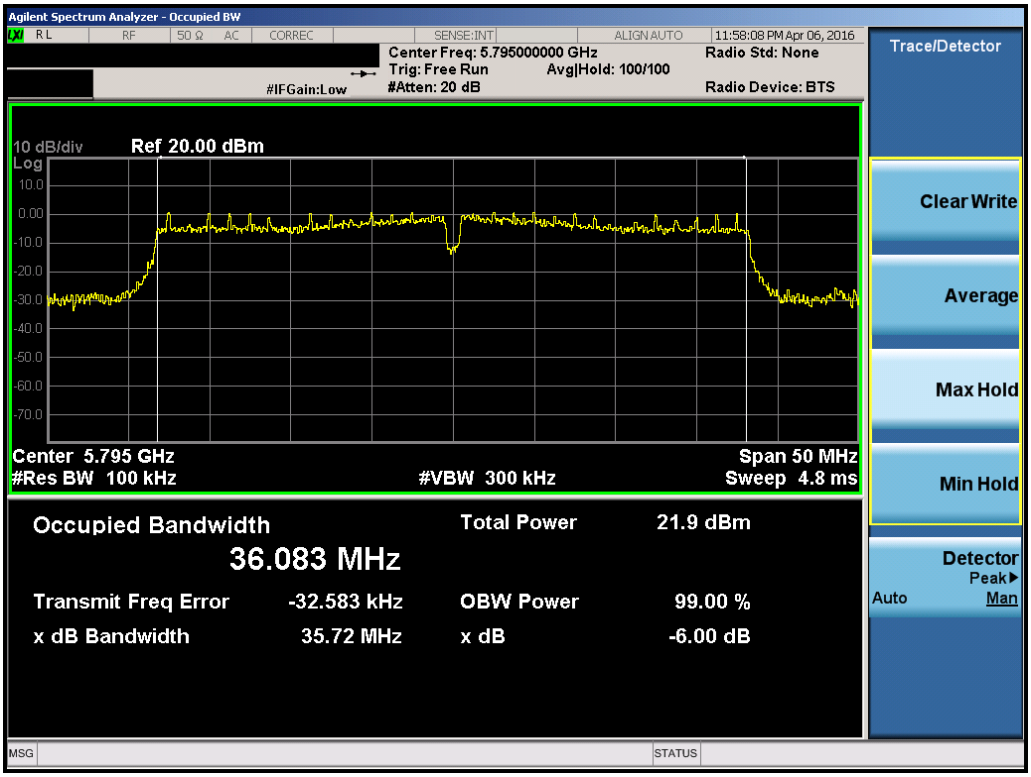

Plot 7-68. 6dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 3) – Ch. 159)

Plot 7-69. 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	16.06
	5785	157	a	6	15.41
	5825	165	a	6	16.31
	5745	149	n (20MHz)	6.5/7.2 (MCS0)	17.30
	5785	157	n (20MHz)	6.5/7.2 (MCS0)	17.15
	5825	165	n (20MHz)	6.5/7.2 (MCS0)	17.57
	5755	151	n (40MHz)	13.5/15 (MCS0)	35.63
	5795	159	n (40MHz)	13.5/15 (MCS0)	35.92
	5775	155	ac (80MHz)	29.3/32.5 (MCS0)	75.36

Table 7-5. Conducted Bandwidth Measurements

Plot 7-70. 6dB Bandwidth Plot (802.11a (UNII Band 3) – Ch. 149)

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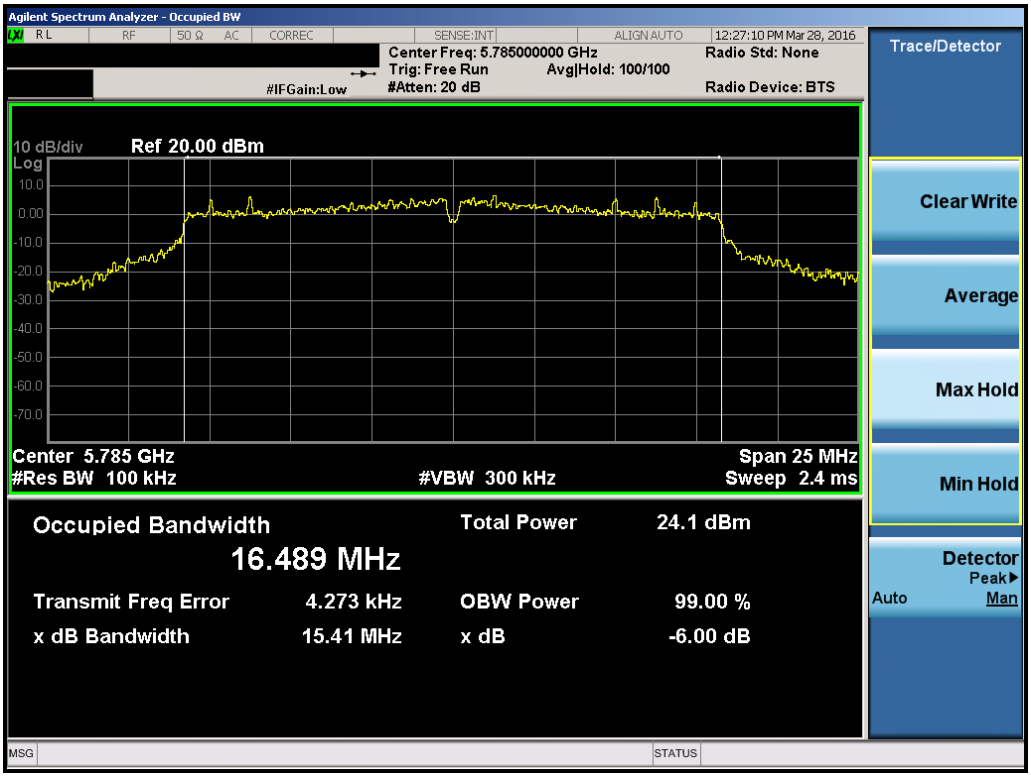

Plot 7-71. 6dB Bandwidth Plot (802.11a (UNII Band 3) – Ch. 157)

Plot 7-72. 6dB Bandwidth Plot (802.11a (UNII Band 3) – Ch. 165)

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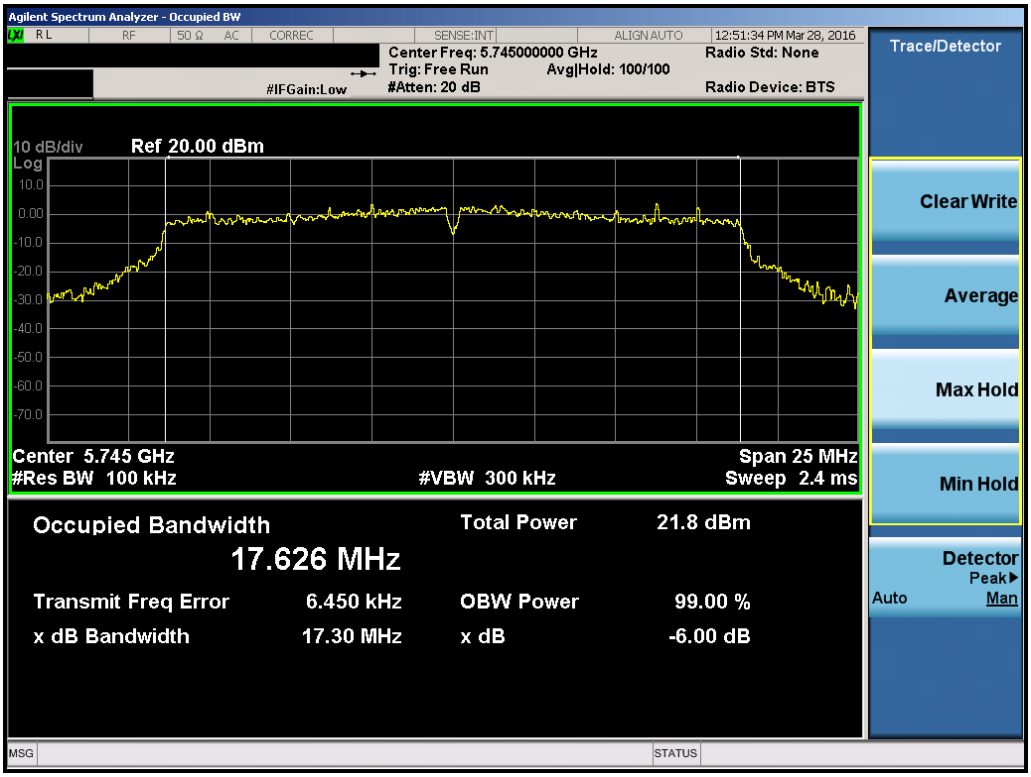
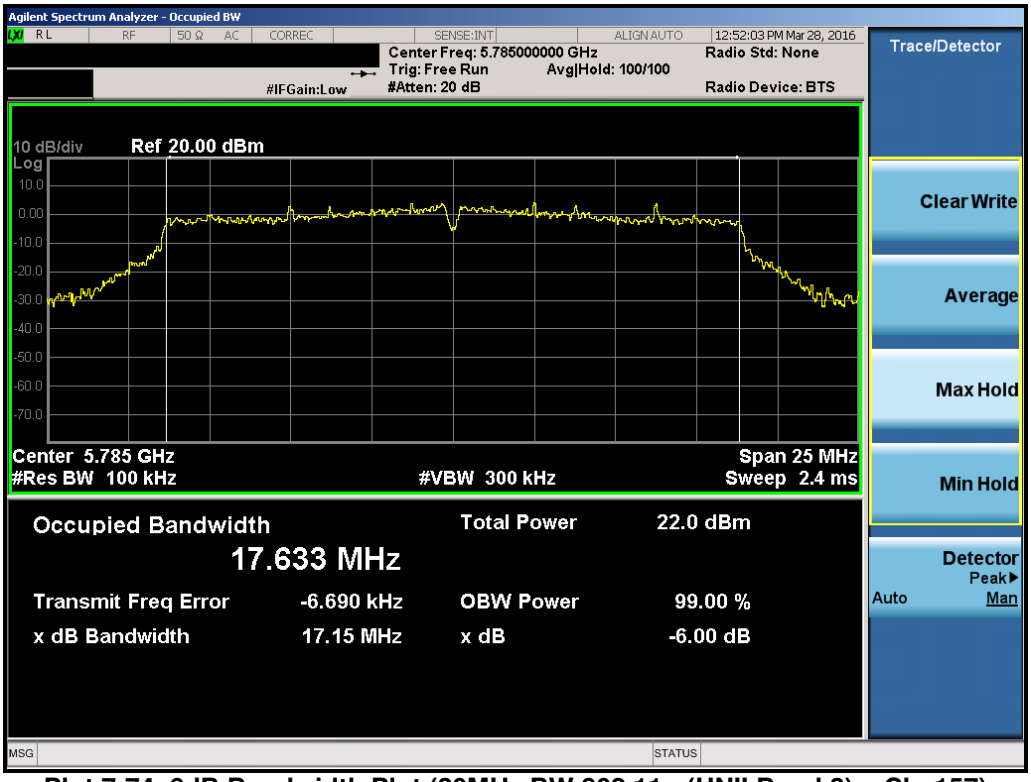


Plot 7-73. 6dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 149)



Plot 7-74. 6dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 157)

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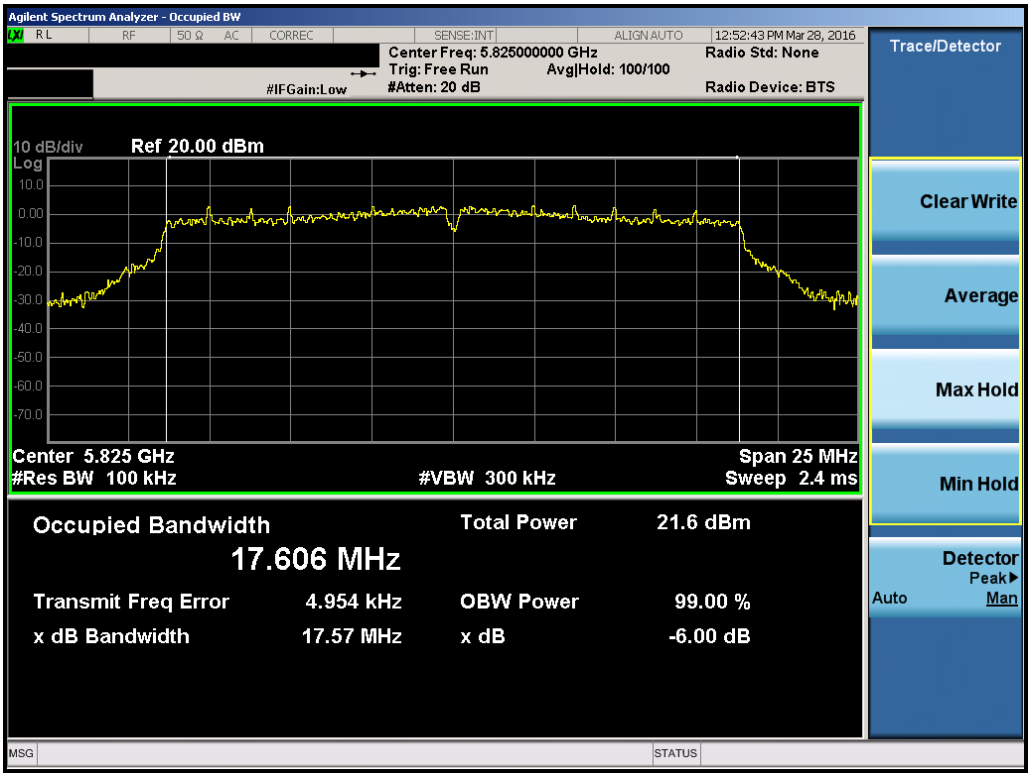

Plot 7-75. 6dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 165)

Plot 7-76. 6dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 3) – Ch. 151)

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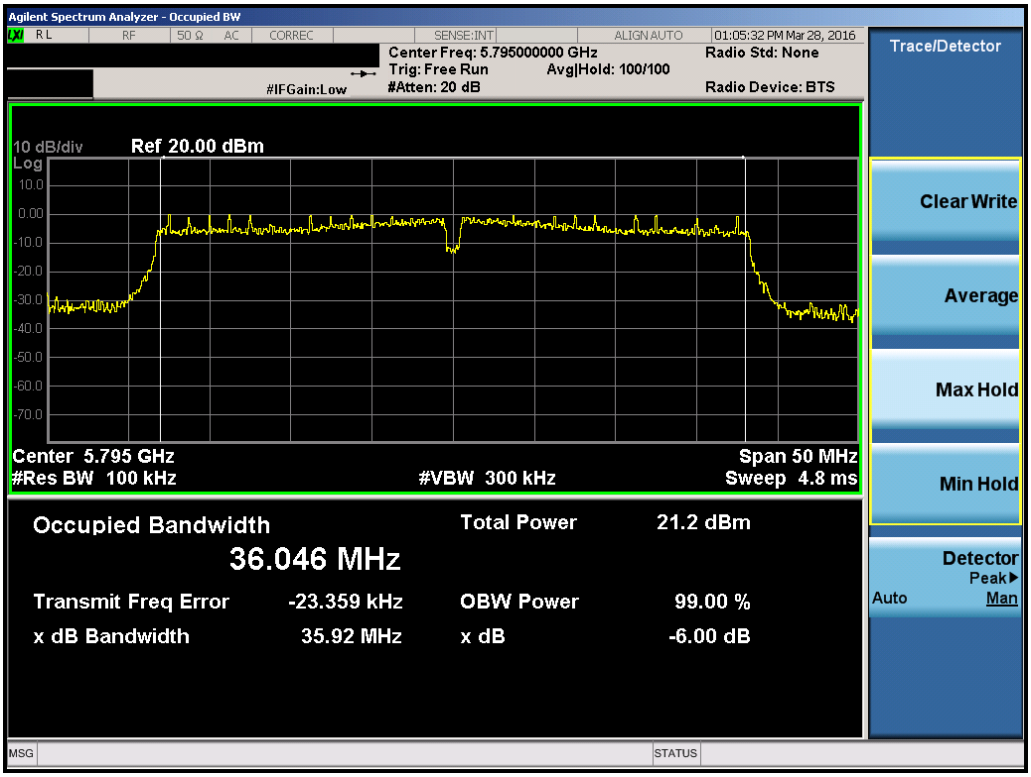

Plot 7-77. 6dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 3) – Ch. 159)

Plot 7-78. 6dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 3) – Ch. 155)

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7.4 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, 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$_{10}$(23.13) = 24.64dBm.

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$_{10}$(21.93) = 24.41dBm.

In the 5.725 – 5.850GHz 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.

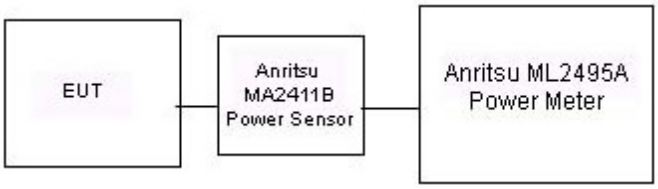

Figure 7-3. Test Instrument & Measurement Setup

Test Notes

None

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Antenna-1 Conducted Output Power Measurements

Freq [MHz]	Channel	5GHz (20MHz) Conducted Power [dBm]			Detector
		IEEE Transmission Mode			
		802.11a	802.11n	802.11ac	
5180	36	13.70	13.69	13.65	AVG
5200	40	15.84	15.88	15.89	AVG
5220	44	15.84	15.93	15.90	AVG
5240	48	15.72	15.91	15.83	AVG
5260	52	16.32	15.60	15.53	AVG
5280	56	16.45	15.54	15.55	AVG
5300	60	16.43	16.46	16.44	AVG
5320	64	13.52	14.12	14.16	AVG
5500	100	13.86	13.75	13.66	AVG
5520	104	15.75	15.58	15.52	AVG
5540	108	15.60	15.50	15.57	AVG
5560	112	15.69	15.51	15.53	AVG
5580	116	15.57	16.33	16.48	AVG
5600	120	16.21	16.25	16.32	AVG
5620	124	16.17	16.21	16.23	AVG
5640	128	16.19	16.18	16.17	AVG
5660	132	16.22	16.17	16.25	AVG
5680	136	16.10	16.20	16.12	AVG
5700	140	16.05	16.00	16.10	AVG
5720	144	16.04	16.06	16.02	AVG
5745	149	16.12	16.32	16.49	AVG
5765	153	16.28	16.21	16.33	AVG
5785	157	16.20	16.21	16.23	AVG
5805	161	16.22	16.14	16.15	AVG
5825	165	15.83	15.93	16.05	AVG

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

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Freq [MHz]	Channel	5GHz (40MHz) Conducted Power [dBm]		Detector
		IEEE Transmission Mode		
		802.11n	802.11ac	
5190	38	12.55	12.24	AVG
5230	46	14.99	15.04	AVG
5270	54	14.86	14.90	AVG
5310	62	14.71	14.96	AVG
5510	102	15.13	15.36	AVG
5550	110	14.90	15.10	AVG
5590	118	14.83	14.99	AVG
5630	126	14.62	14.64	AVG
5670	134	14.52	15.29	AVG
5710	142	15.41	15.14	AVG
5755	151	15.14	15.10	AVG
5795	159	14.99	14.86	AVG

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

5GHz (80MHz) Conducted Power [dBm]			Detector
Freq [MHz]	Channel	IEEE Transmission Mode	
		802.11ac	
5210	42	12.15	AVG
5290	58	13.71	AVG
5530	106	11.54	AVG
5610	122	14.22	AVG
5690	138	14.04	AVG
5775	155	13.78	AVG

Table 7-8. 80MHz BW (UNII) Maximum Conducted Output Power

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Antenna-2 Conducted Output Power Measurements

Freq [MHz]	Channel	5GHz (20MHz) Conducted Power [dBm]			Detector
		IEEE Transmission Mode			
		802.11a	802.11n	802.11ac	
5180	36	13.96	13.72	13.93	AVG
5200	40	15.60	15.99	15.94	AVG
5220	44	16.27	16.07	15.97	AVG
5240	48	15.51	16.07	15.90	AVG
5260	52	16.47	16.08	15.93	AVG
5280	56	16.42	16.04	15.99	AVG
5300	60	16.34	16.03	16.05	AVG
5320	64	13.60	13.69	13.77	AVG
5500	100	14.40	13.87	13.81	AVG
5520	104	15.94	15.82	15.84	AVG
5540	108	15.89	15.80	15.78	AVG
5560	112	15.84	15.79	15.66	AVG
5580	116	15.80	15.70	15.61	AVG
5600	120	15.82	15.67	15.62	AVG
5620	124	16.42	15.65	15.56	AVG
5640	128	15.76	16.38	16.26	AVG
5660	132	15.54	16.26	16.21	AVG
5680	136	16.36	16.23	16.18	AVG
5700	140	16.46	16.21	16.15	AVG
5720	144	16.49	16.15	16.11	AVG
5745	149	16.22	15.85	15.85	AVG
5765	153	15.79	15.81	15.95	AVG
5785	157	16.09	15.81	15.89	AVG
5805	161	15.83	15.75	15.72	AVG
5825	165	15.82	15.67	15.71	AVG

Table 7-9. 20MHz BW (UNII) Maximum Conducted Output Power

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Freq [MHz]	Channel	5GHz (40MHz) Conducted Power [dBm]		Detector
		IEEE Transmission Mode		
		802.11n	802.11ac	
5190	38	12.82	12.92	AVG
5230	46	15.29	15.16	AVG
5270	54	14.86	14.90	AVG
5310	62	15.00	14.92	AVG
5510	102	14.82	14.88	AVG
5550	110	14.77	14.77	AVG
5590	118	14.71	14.67	AVG
5630	126	14.54	14.50	AVG
5670	134	14.52	14.46	AVG
5710	142	15.49	15.49	AVG
5755	151	14.65	14.59	AVG
5795	159	14.52	14.69	AVG

Table 7-10. 40MHz BW (UNII) Maximum Conducted Output Power

5GHz (80MHz) Conducted Power [dBm]			Detector
Freq [MHz]	Channel	IEEE Transmission Mode	
		802.11ac	
5210	42	11.89	AVG
5290	58	13.63	AVG
5530	106	12.49	AVG
5610	122	14.22	AVG
5690	138	14.04	AVG
5775	155	14.39	AVG

Table 7-11. 80MHz BW (UNII) Maximum Conducted Output Power

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MIMO Maximum Conducted Output Power Measurements

Freq [MHz]	Channel	5GHz (20MHz) Conducted Power [dBm]			Detector
		ANT1	ANT2	MIMO	
5180	36	13.69	13.72	16.72	AVG
5200	40	15.88	15.99	18.95	AVG
5220	44	15.93	16.07	19.01	AVG
5240	48	15.91	16.07	19.00	AVG
5260	52	15.60	16.08	18.86	AVG
5280	56	15.54	16.04	18.81	AVG
5300	60	16.46	16.03	19.26	AVG
5320	64	14.12	13.69	16.92	AVG
5500	100	13.75	13.87	16.82	AVG
5560	112	15.51	15.79	18.66	AVG
5580	116	16.33	15.70	19.04	AVG
5640	128	16.18	16.38	19.29	AVG
5660	132	16.17	16.26	19.23	AVG
5700	140	16.00	16.21	19.12	AVG
5720	144	16.06	16.15	19.12	AVG
5745	149	16.32	15.85	19.10	AVG
5785	157	16.21	15.81	19.02	AVG
5825	165	15.93	15.67	18.81	AVG

Table 7-12. MIMO 20MHz BW 802.11n (UNII) Maximum Conducted Output Power

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Freq [MHz]	Channel	5GHz (20MHz) Conducted Power [dBm]			Detector
		ANT1	ANT2	MIMO	
5180	36	13.65	13.93	16.80	AVG
5200	40	15.89	15.94	18.93	AVG
5220	44	15.90	15.97	18.95	AVG
5240	48	15.83	15.90	18.88	AVG
5260	52	15.53	15.93	18.74	AVG
5280	56	15.55	15.99	18.79	AVG
5300	60	16.44	16.05	19.26	AVG
5320	64	14.16	13.77	16.98	AVG
5500	100	13.66	13.81	16.75	AVG
5560	112	15.53	15.66	18.61	AVG
5580	116	16.48	15.61	19.08	AVG
5640	128	16.17	16.26	19.23	AVG
5660	132	16.25	16.21	19.24	AVG
5700	140	16.10	16.15	19.14	AVG
5720	144	16.02	16.11	19.08	AVG
5745	149	16.49	15.85	19.19	AVG
5785	157	16.23	15.89	19.07	AVG
5825	165	16.05	15.71	18.89	AVG

Table 7-13. MIMO 20MHz BW 802.11ac (UNII) Maximum Conducted Output Power

Freq [MHz]	Channel	5GHz (40MHz) Conducted Power [dBm]			Detector
		ANT1	ANT2	MIMO	
5190	38	12.55	12.82	15.70	AVG
5230	46	14.99	15.29	18.15	AVG
5270	54	14.86	14.86	17.87	AVG
5310	62	14.71	15.00	17.87	AVG
5510	102	15.13	14.82	17.99	AVG
5550	110	14.90	14.77	17.85	AVG
5590	118	14.83	14.71	17.78	AVG
5630	126	14.62	14.54	17.59	AVG
5670	134	14.52	14.52	17.53	AVG
5710	142	15.41	15.49	18.46	AVG
5755	151	15.14	14.65	17.91	AVG
5795	159	14.99	14.52	17.77	AVG

Table 7-14. MIMO 40MHz BW 802.11n (UNII) Maximum Conducted Output Power

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Freq [MHz]	Channel	5GHz (40MHz) Conducted Power [dBm]			Detector
		ANT1	ANT2	MIMO	
5190	38	12.24	12.92	15.60	AVG
5230	46	15.04	15.16	18.11	AVG
5270	54	14.90	14.90	17.91	AVG
5310	62	14.96	14.92	17.95	AVG
5510	102	15.36	14.88	18.14	AVG
5550	110	15.10	14.77	17.95	AVG
5590	118	14.99	14.67	17.84	AVG
5630	126	14.64	14.50	17.58	AVG
5670	134	15.29	14.46	17.91	AVG
5710	142	15.14	15.49	18.33	AVG
5755	151	15.10	14.59	17.86	AVG
5795	159	14.86	14.69	17.79	AVG

Table 7-15. MIMO 40MHz BW 802.11ac (UNII) Maximum Conducted Output Power

Freq [MHz]	Channel	5GHz (80MHz) Conducted Power [dBm]			Detector
		ANT1	ANT2	MIMO	
5210	42	12.15	11.89	15.03	AVG
5290	58	13.71	13.63	16.68	AVG
5530	106	11.54	12.49	15.05	AVG
5610	122	14.22	14.22	17.23	AVG
5690	138	14.04	14.04	17.05	AVG
5775	155	13.78	14.39	17.11	AVG

Table 7-16. 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 13.69 dBm for Antenna-1 and 13.72 dBm for Antenna-2.

Antenna 1 + Antenna 2 = MIMO

(13.69 dBm + 13.72 dBm) = (23.39 mW + 23.55 mW) = 46.94 mW = 16.72 dBm

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7.5 Maximum 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, 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 for all modes
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.

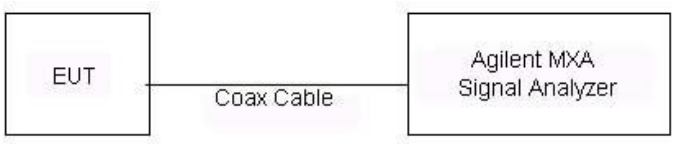

Figure 7-4. Test Instrument & Measurement Setup

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	9.79	11.0	-1.21	Pass
	5200	40	a	6	9.96	11.0	-1.04	Pass
	5240	48	a	6	10.43	11.0	-0.57	Pass
	5180	36	n (20MHz)	6.5/7.2 (MCS0)	6.93	11.0	-4.07	Pass
	5200	40	n (20MHz)	6.5/7.2 (MCS0)	6.88	11.0	-4.13	Pass
	5240	48	n (20MHz)	6.5/7.2 (MCS0)	6.76	11.0	-4.24	Pass
	5190	38	n (40MHz)	13.5/15 (MCS0)	6.34	11.0	-4.66	Pass
	5230	46	n (40MHz)	13.5/15 (MCS0)	6.49	11.0	-4.51	Pass
	5210	42	ac (80MHz)	29.3/32.5 (MCS0)	0.20	11.0	-10.80	Pass
Band 2A	5260	52	a	6	9.69	11.0	-1.31	Pass
	5280	56	a	6	9.60	11.0	-1.40	Pass
	5320	64	a	6	9.82	11.0	-1.18	Pass
	5260	52	n (20MHz)	6.5/7.2 (MCS0)	7.50	11.0	-3.50	Pass
	5280	56	n (20MHz)	6.5/7.2 (MCS0)	7.34	11.0	-3.66	Pass
	5320	64	n (20MHz)	6.5/7.2 (MCS0)	7.63	11.0	-3.37	Pass
	5270	54	n (40MHz)	13.5/15 (MCS0)	5.84	11.0	-5.16	Pass
	5310	62	n (40MHz)	13.5/15 (MCS0)	6.24	11.0	-4.76	Pass
	5290	58	ac (80MHz)	29.3/32.5 (MCS0)	0.04	11.0	-10.96	Pass
Band 2C	5500	100	a	6	9.28	11.0	-1.72	Pass
	5600	120	a	6	8.41	11.0	-2.59	Pass
	5720	144	a	6	8.19	11.0	-2.82	Pass
	5500	100	n (20MHz)	6.5/7.2 (MCS0)	7.71	11.0	-3.29	Pass
	5600	120	n (20MHz)	6.5/7.2 (MCS0)	7.29	11.0	-3.71	Pass
	5720	144	n (20MHz)	6.5/7.2 (MCS0)	7.21	11.0	-3.79	Pass
	5510	102	n (40MHz)	13.5/15 (MCS0)	4.51	11.0	-6.49	Pass
	5590	118	n (40MHz)	13.5/15 (MCS0)	4.43	11.0	-6.57	Pass
	5710	142	n (40MHz)	13.5/15 (MCS0)	3.52	11.0	-7.48	Pass
	5530	106	ac (80MHz)	29.3/32.5 (MCS0)	-0.73	11.0	-11.73	Pass
	5610	122	ac (80MHz)	29.3/32.5 (MCS0)	-1.44	11.0	-12.44	Pass
	5690	138	ac (80MHz)	29.3/32.5 (MCS0)	-5.02	11.0	-16.02	Pass

Table 7-17. Bands 1, 2A, 2C Conducted Power Spectral Density Measurements

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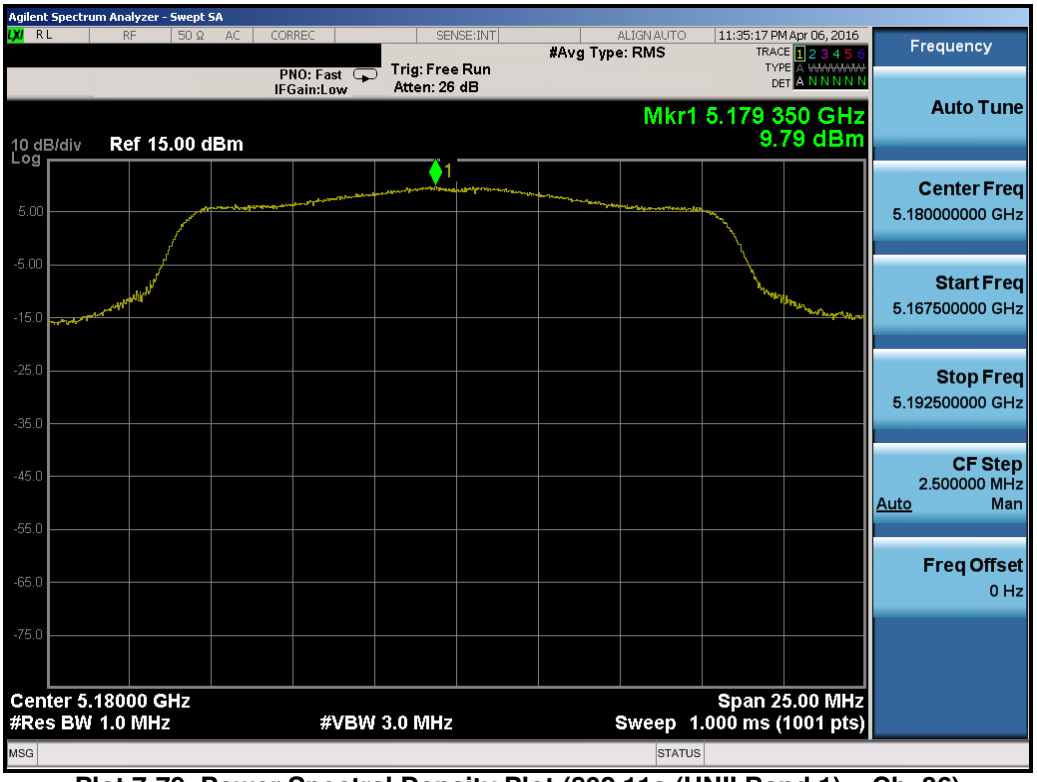
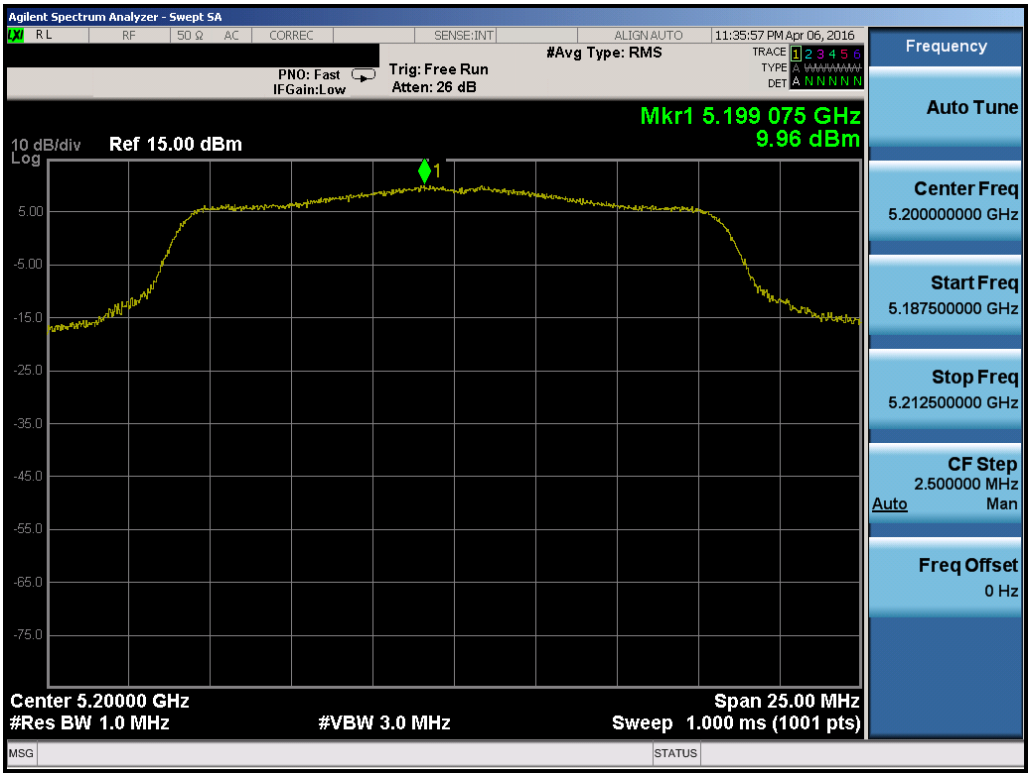


Plot 7-79. Power Spectral Density Plot (802.11a (UNII Band 1) – Ch. 36)



Plot 7-80. Power Spectral Density Plot (802.11a (UNII Band 1) – Ch. 40)

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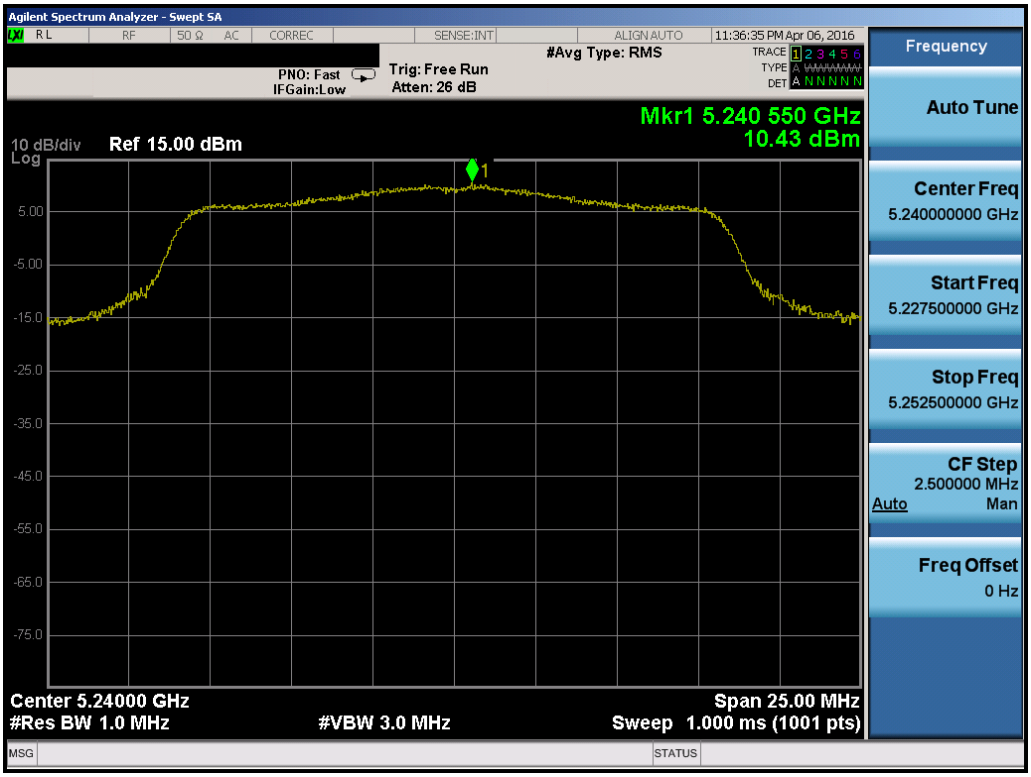
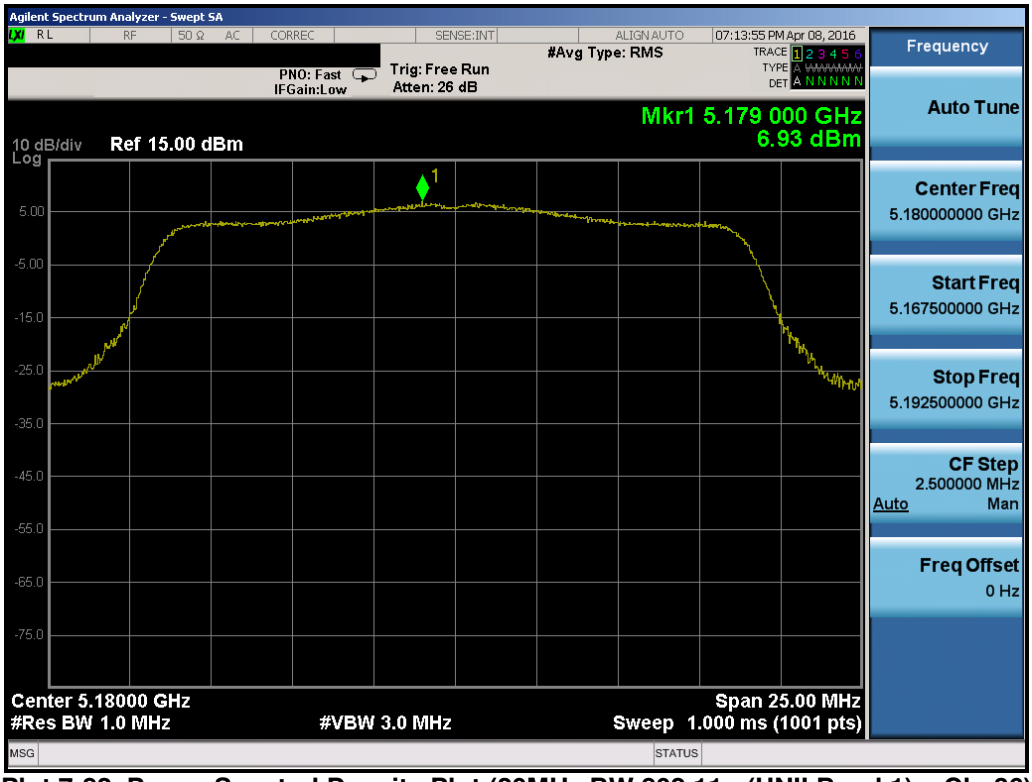


Plot 7-81. Power Spectral Density Plot (802.11a (UNII Band 1) – Ch. 48)



Plot 7-82. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 36)

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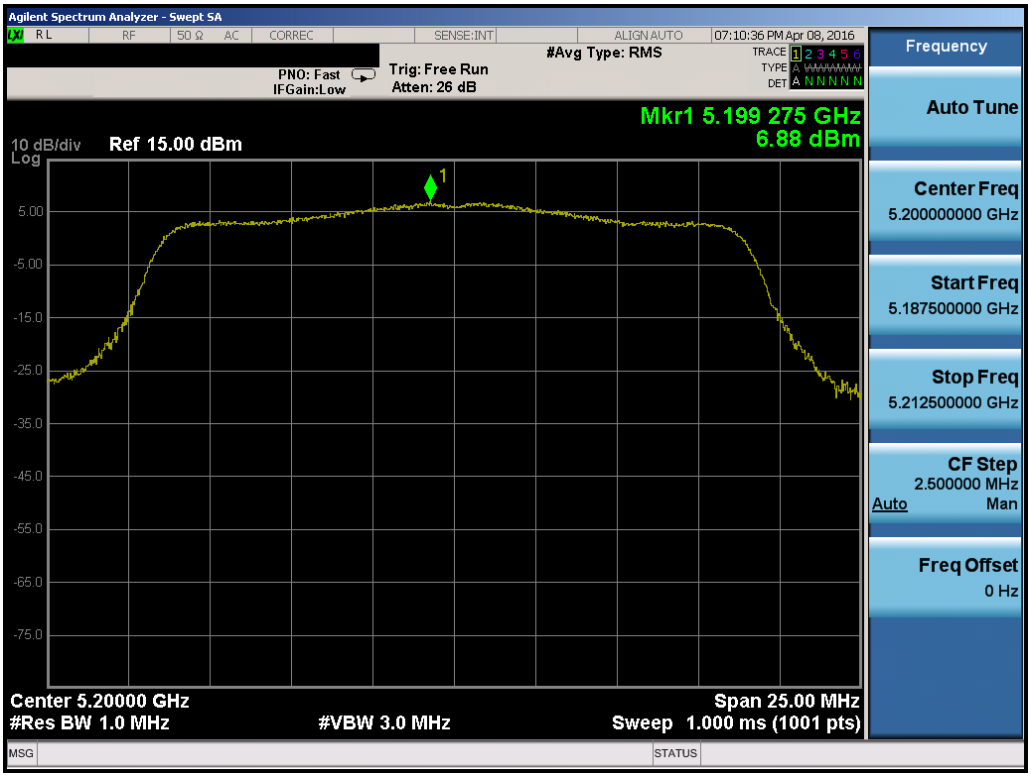
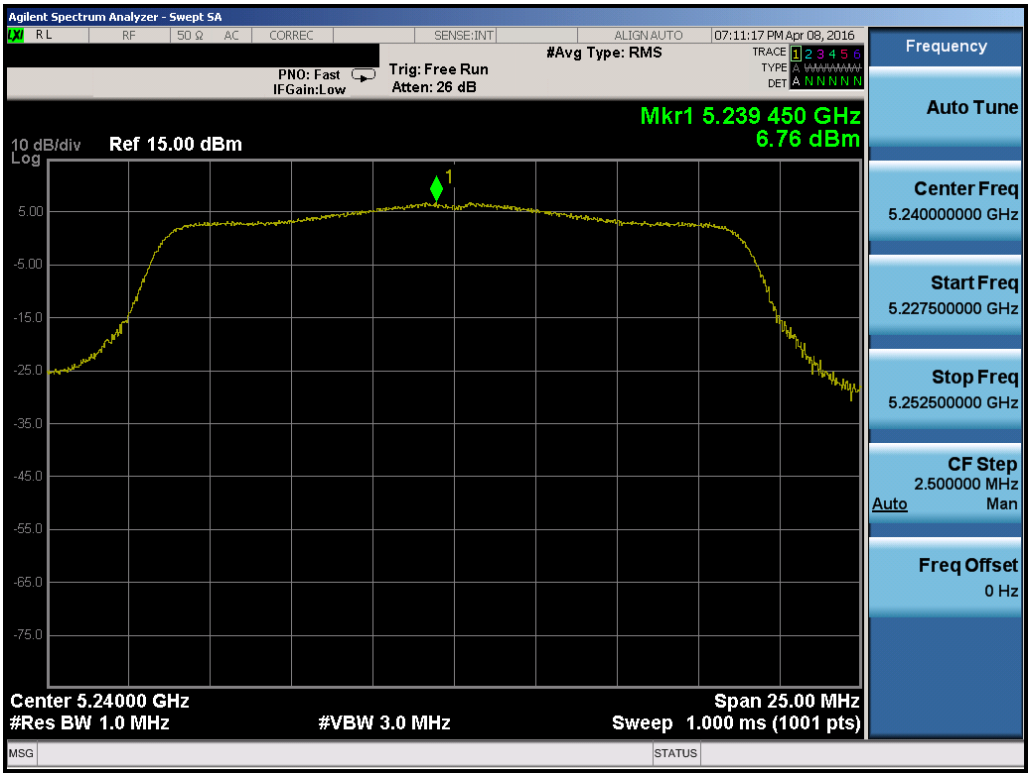


Plot 7-83. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 40)



Plot 7-84. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 48)

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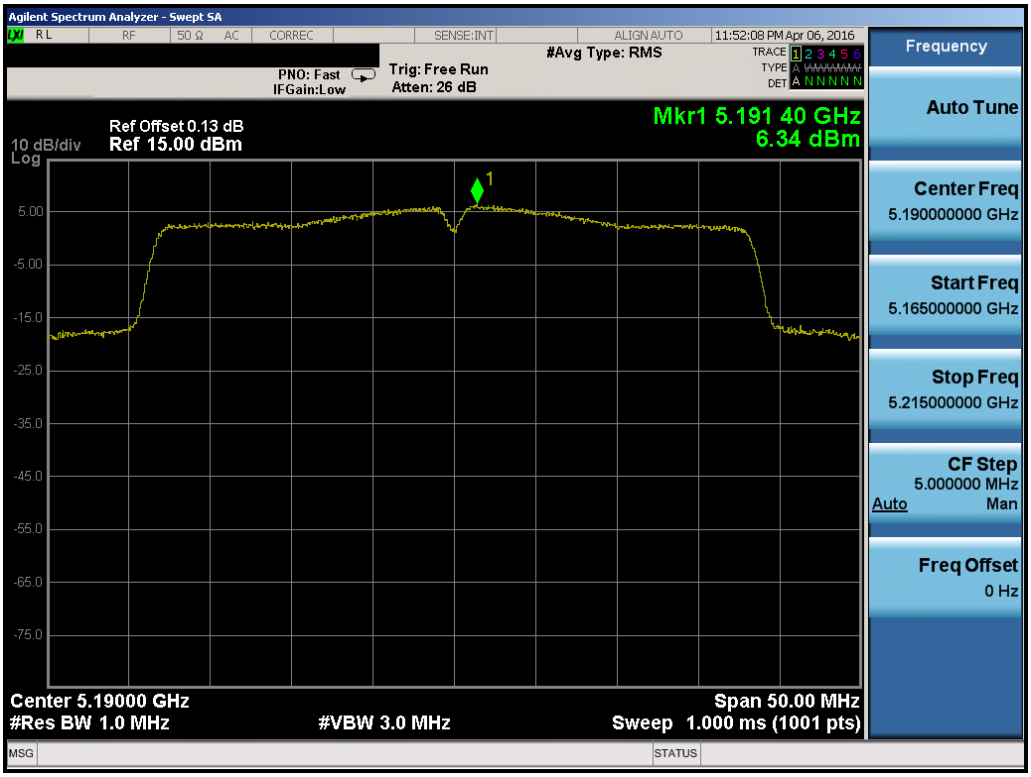
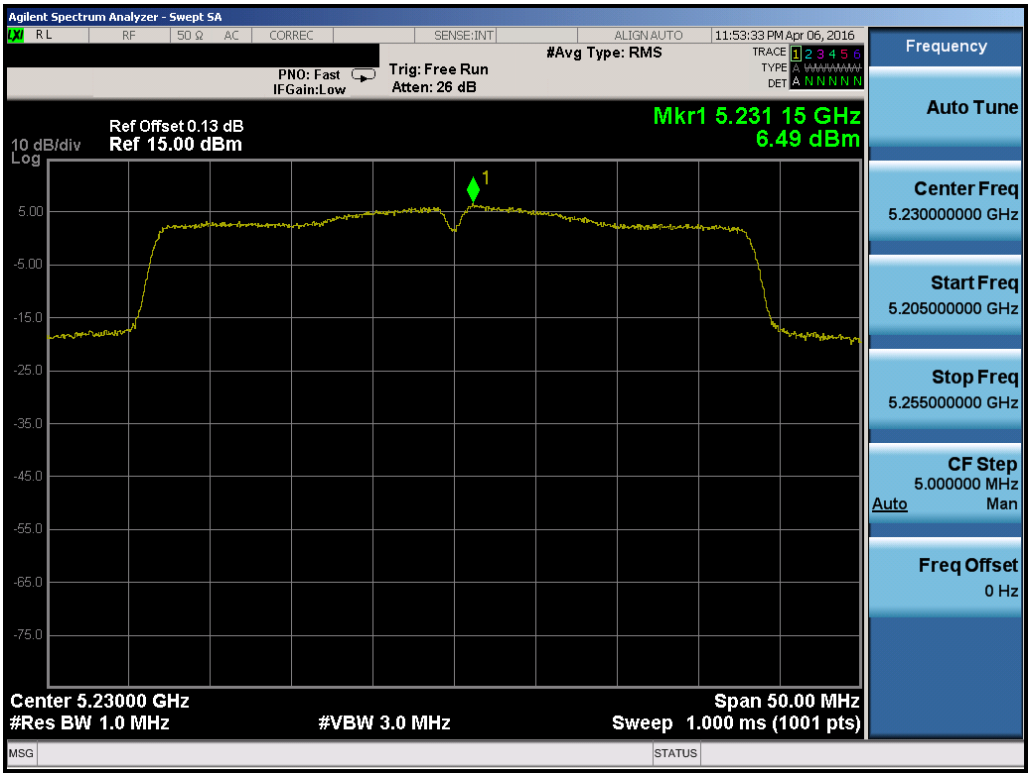


Plot 7-85. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 38)



Plot 7-86. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 46)

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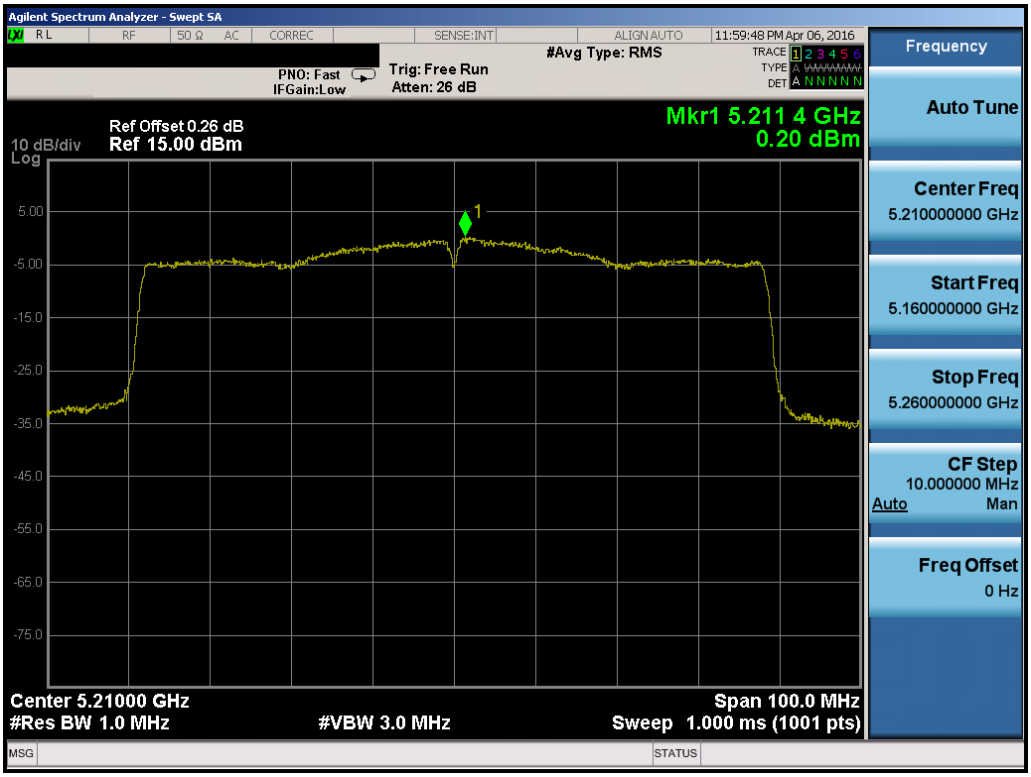
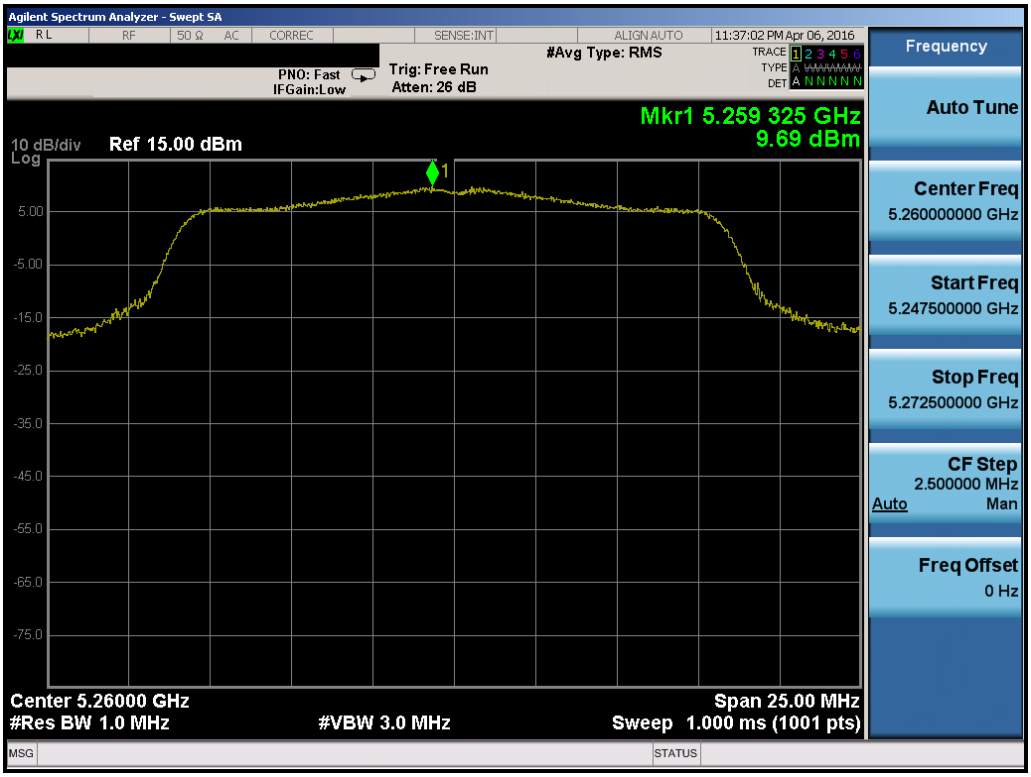


Plot 7-87. Power Spectral Density Plot (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)



Plot 7-88. Power Spectral Density Plot (802.11a (UNII Band 2A) – Ch. 52)

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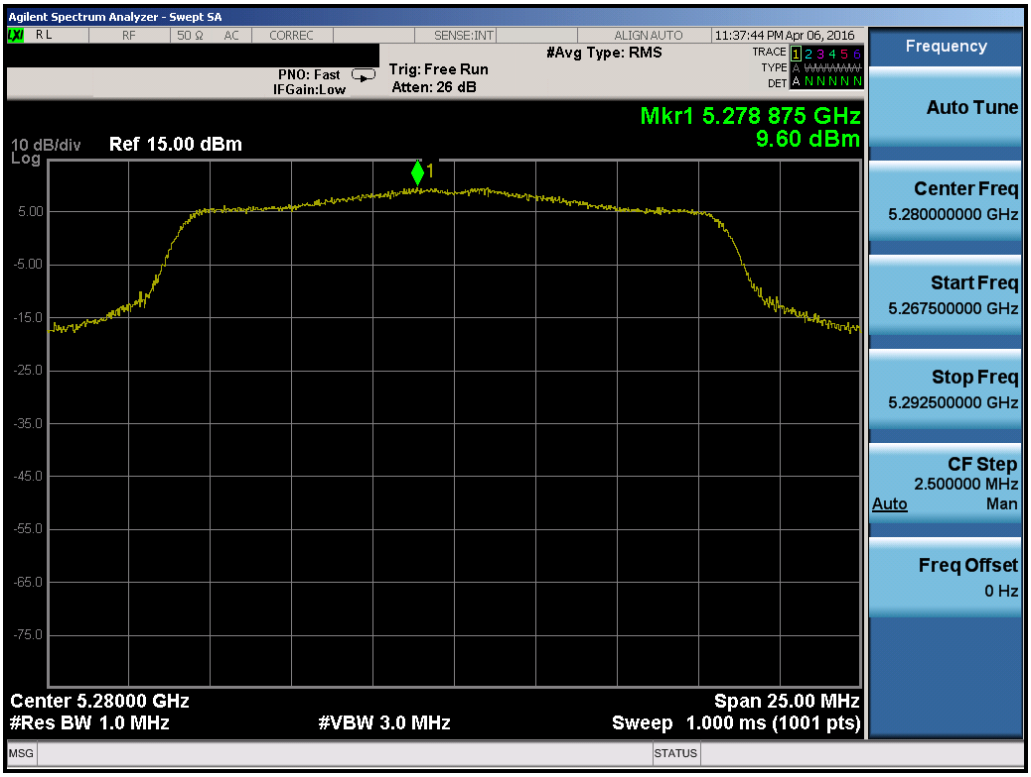
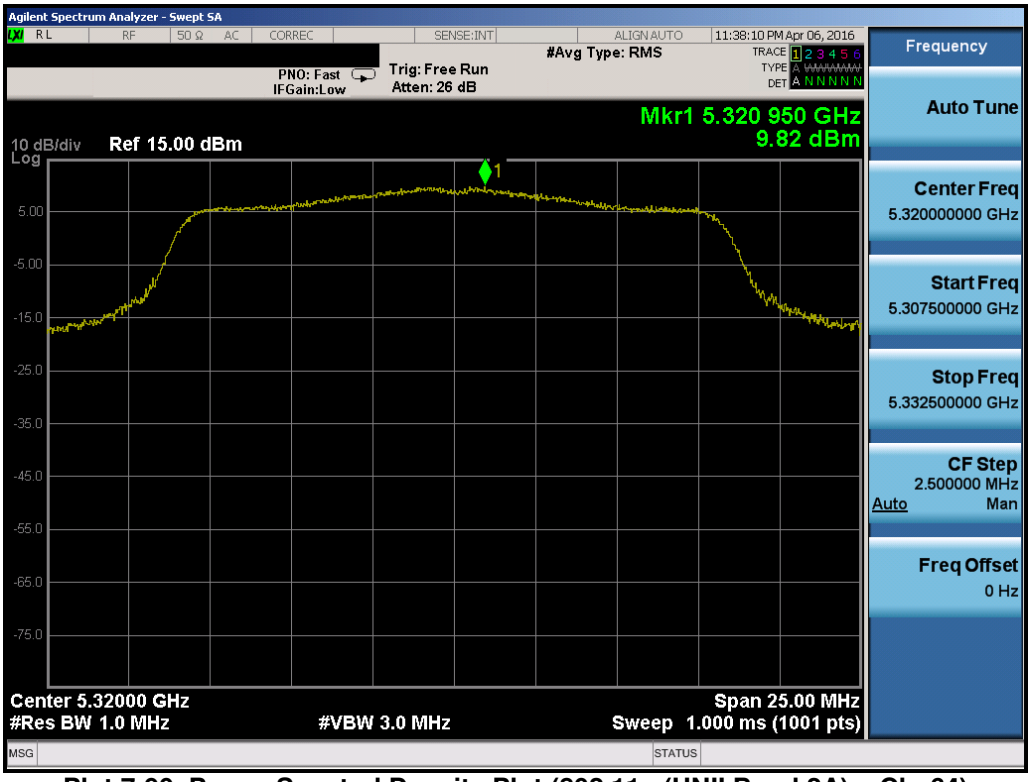


Plot 7-89. Power Spectral Density Plot (802.11a (UNII Band 2A) – Ch. 56)



Plot 7-90. Power Spectral Density Plot (802.11a (UNII Band 2A) – Ch. 64)

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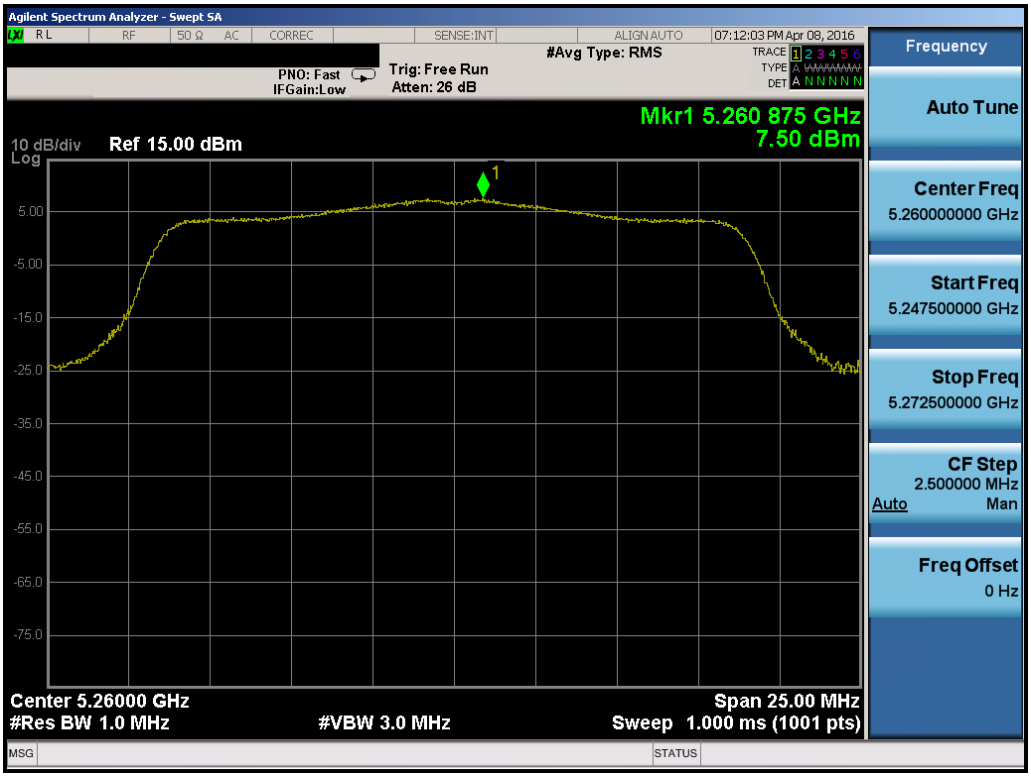
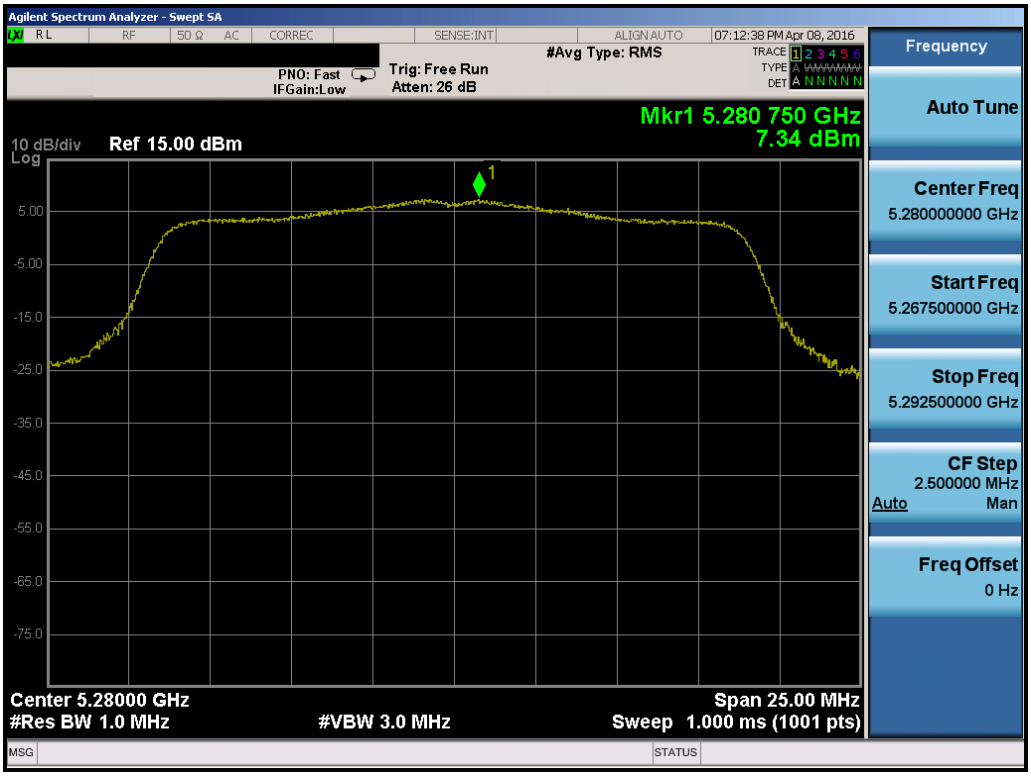


Plot 7-91. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 52)



Plot 7-92. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)

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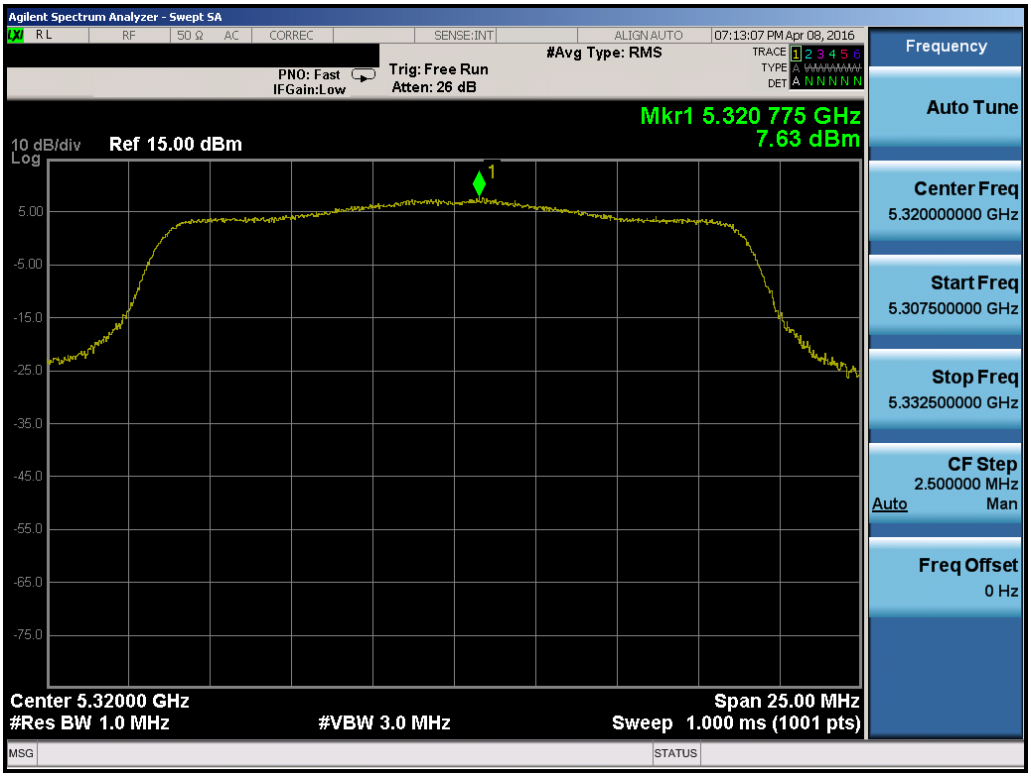
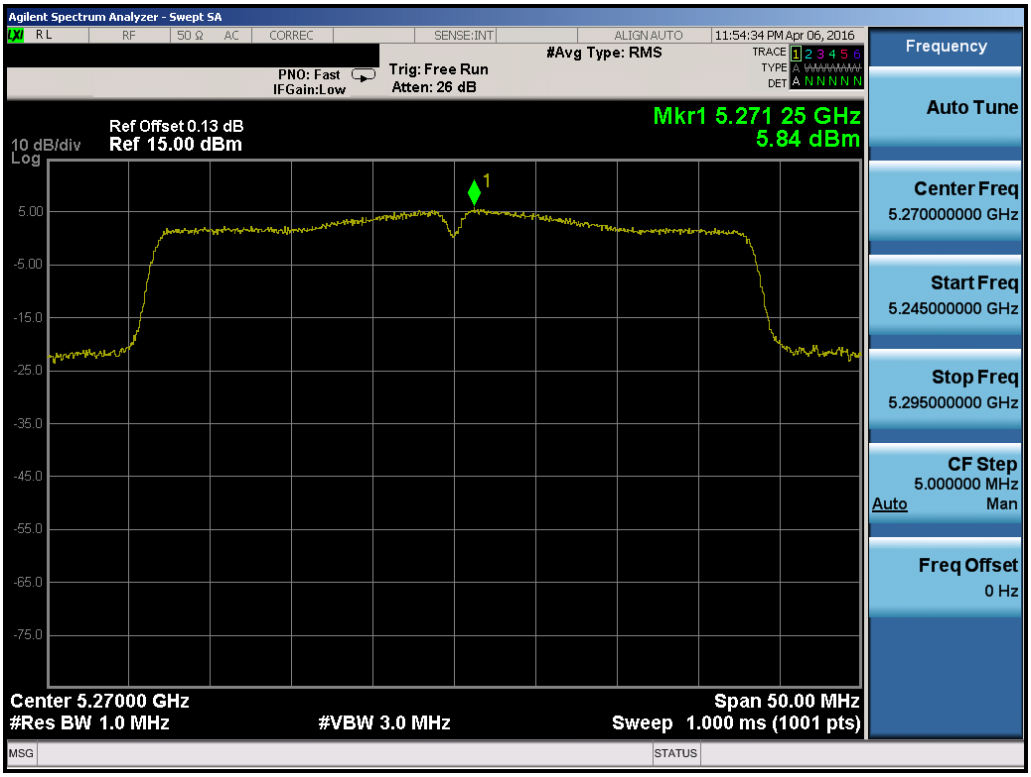


Plot 7-93. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 64)



Plot 7-94. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 54)

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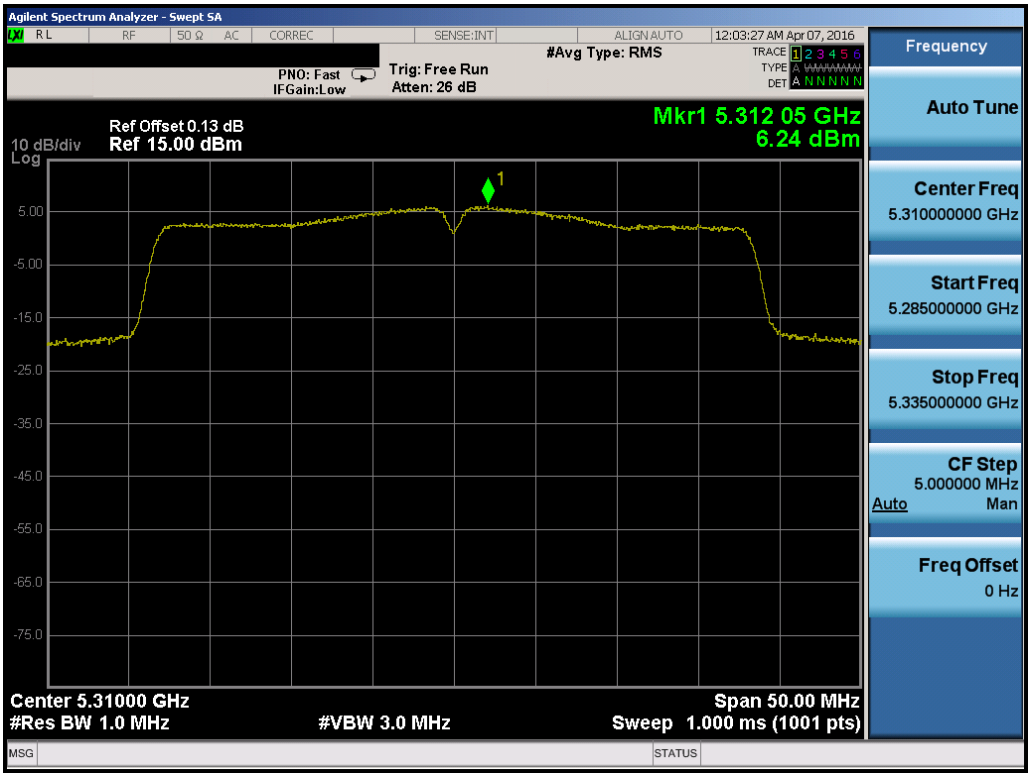
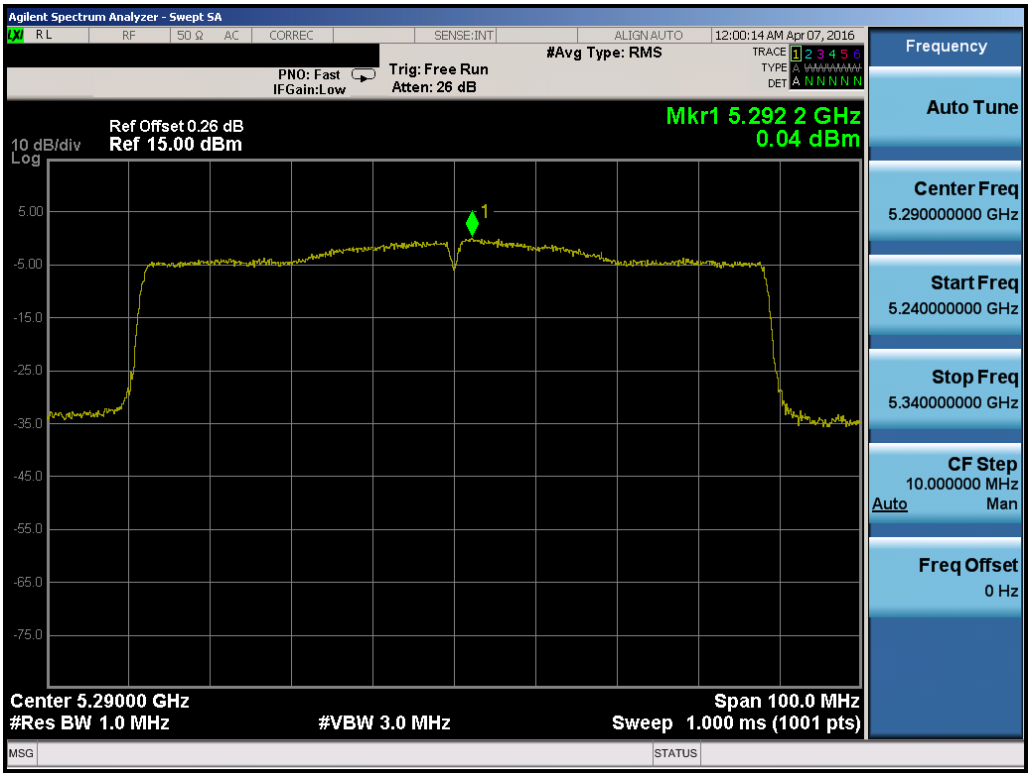


Plot 7-95. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 62)



Plot 7-96. Power Spectral Density Plot (80MHz BW 802.11ac (UNII Band 2A) – Ch. 58)

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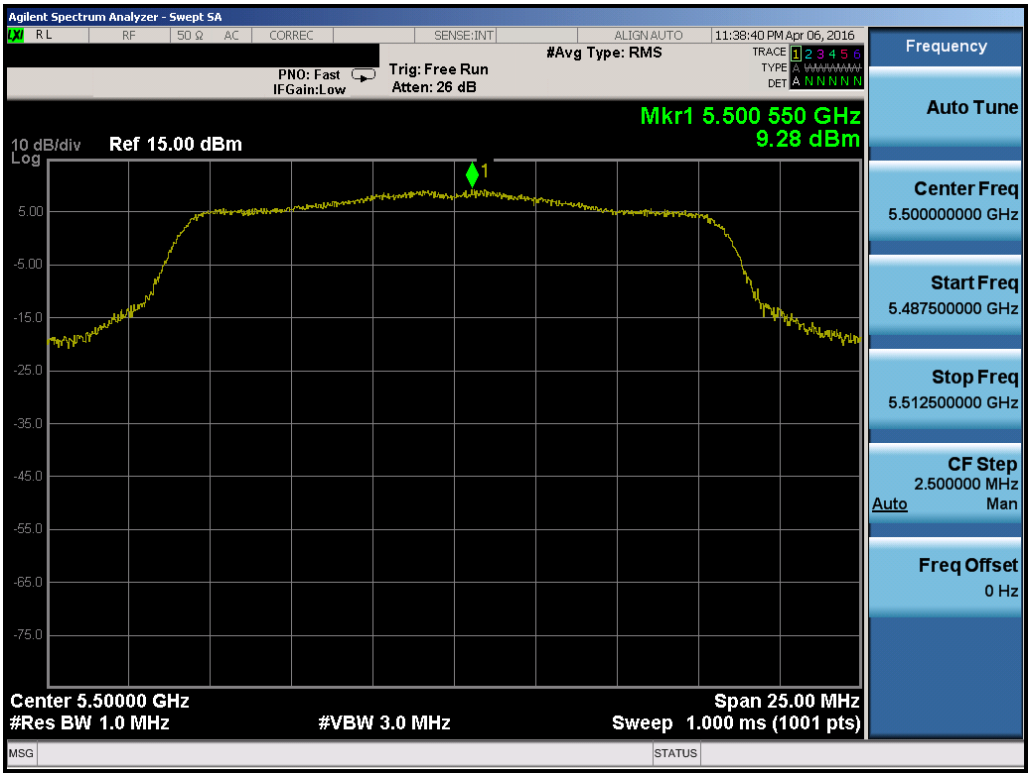
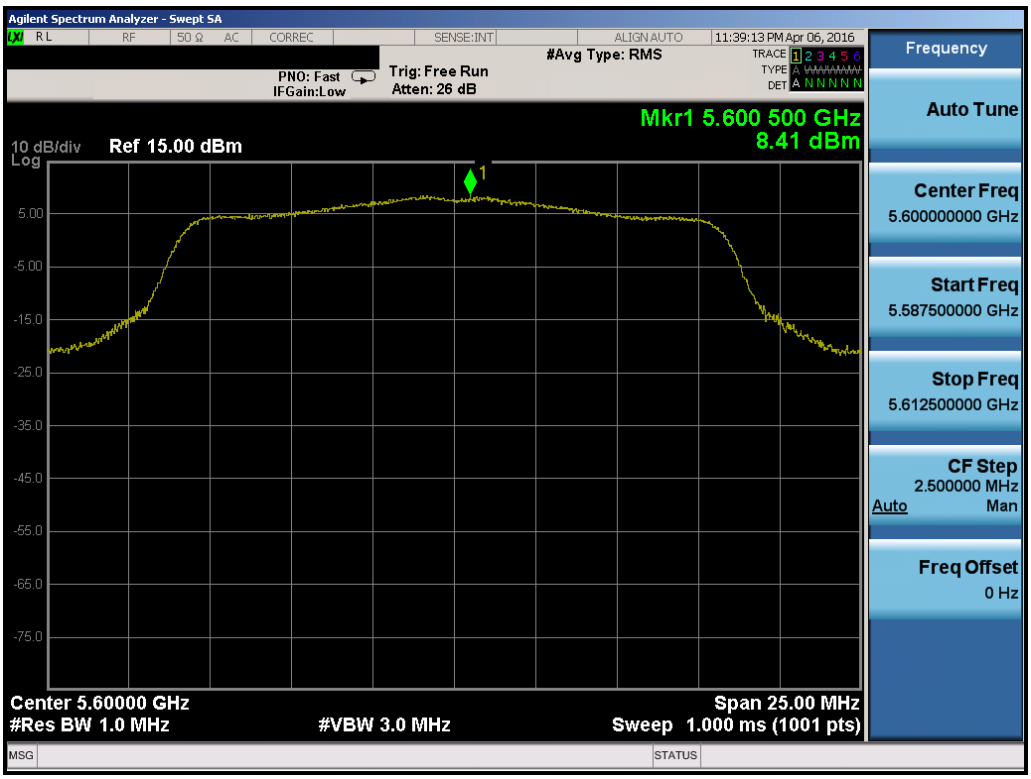


Plot 7-97. Power Spectral Density Plot (802.11a (UNII Band 2C) – Ch. 100)



Plot 7-98. Power Spectral Density Plot (802.11a (UNII Band 2C) – Ch. 120)

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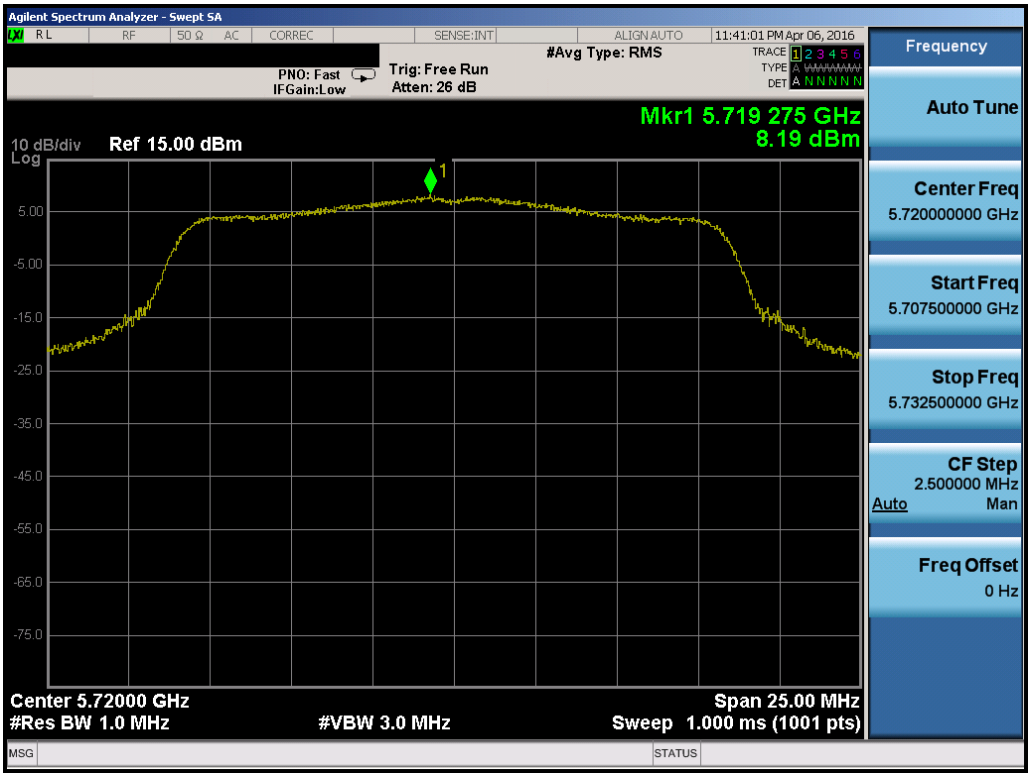
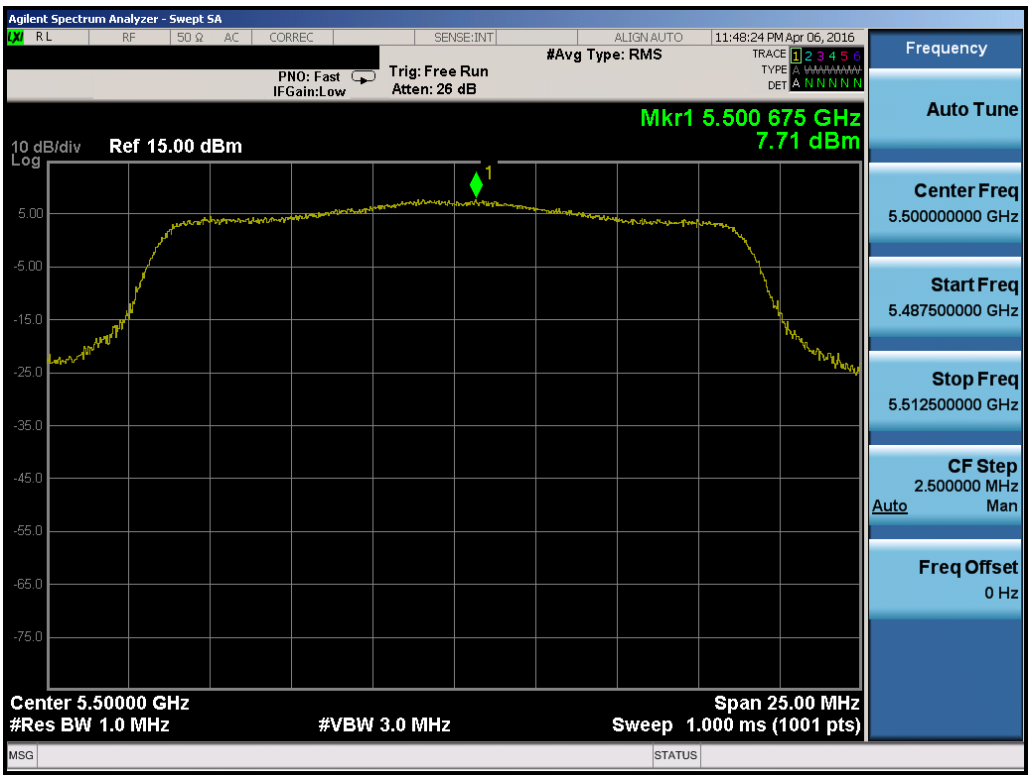


Plot 7-99. Power Spectral Density Plot (802.11a (UNII Band 2C) – Ch. 144)



Plot 7-100. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 100)

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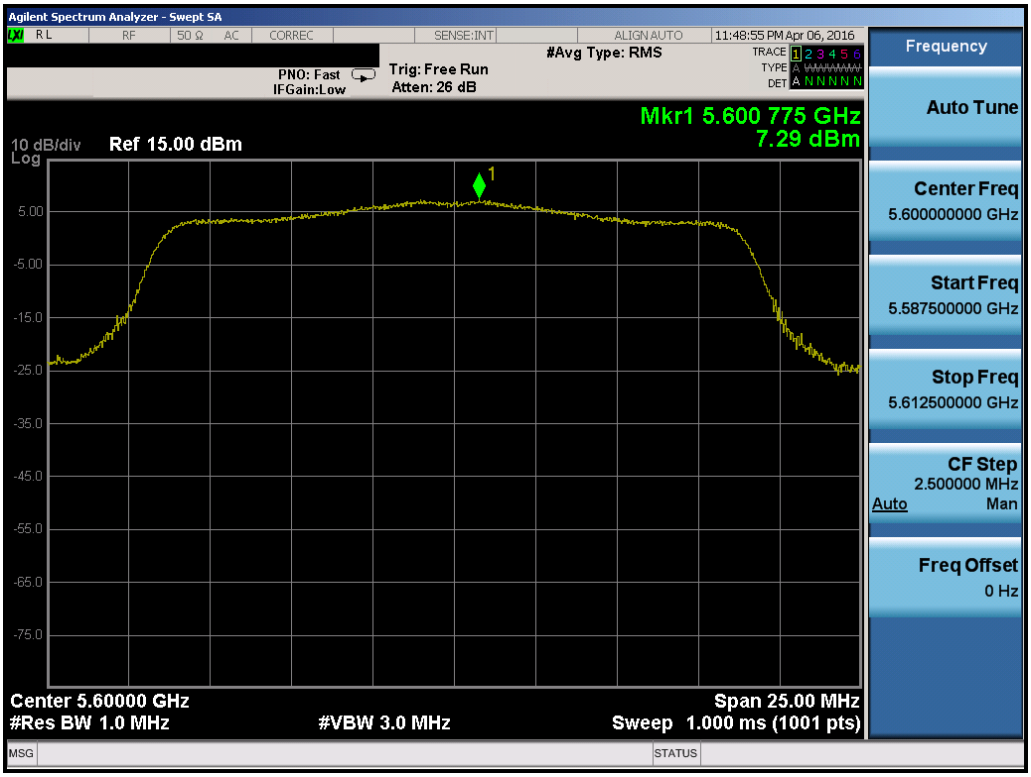
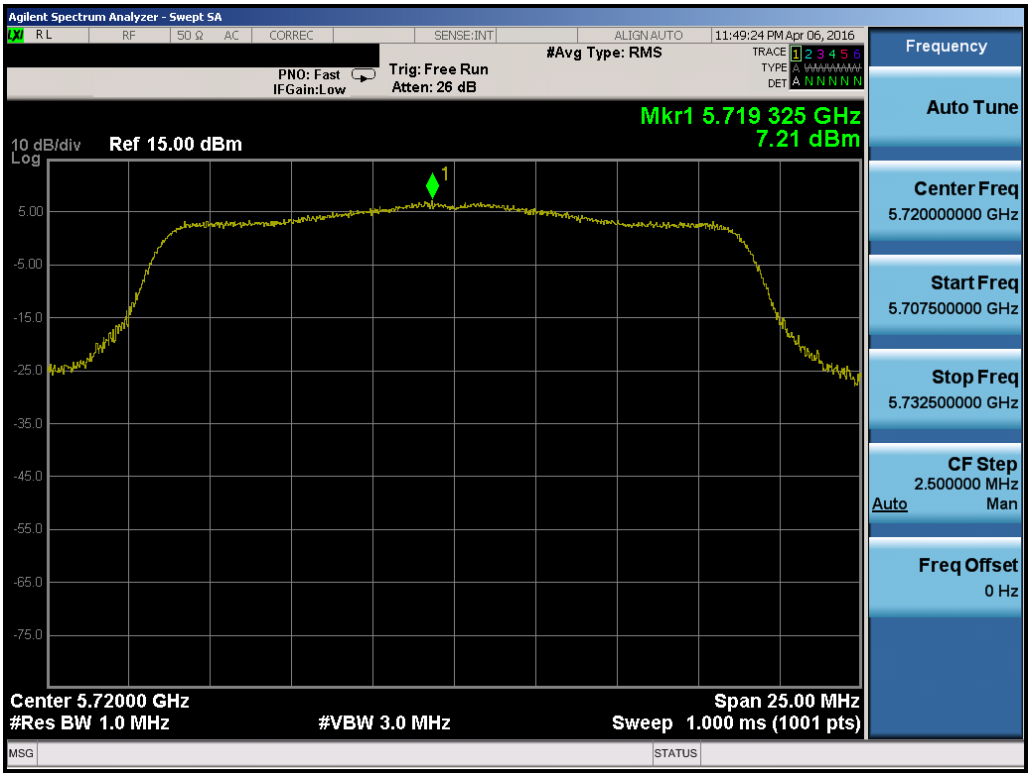


Plot 7-101. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 120)



Plot 7-102. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 144)

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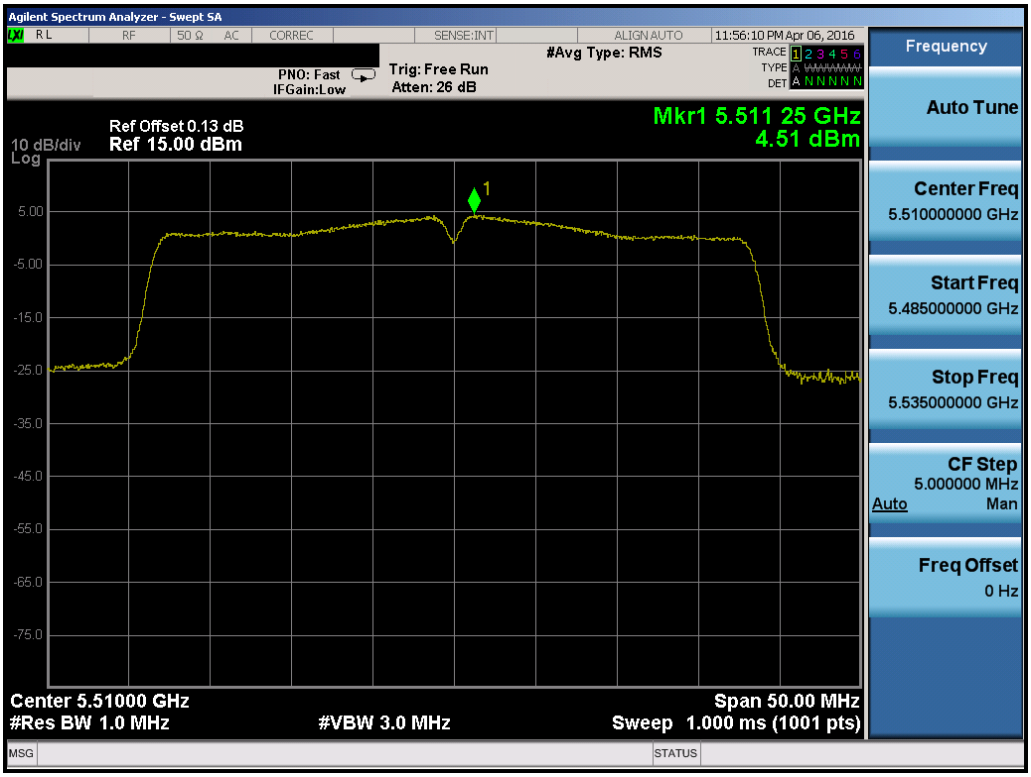
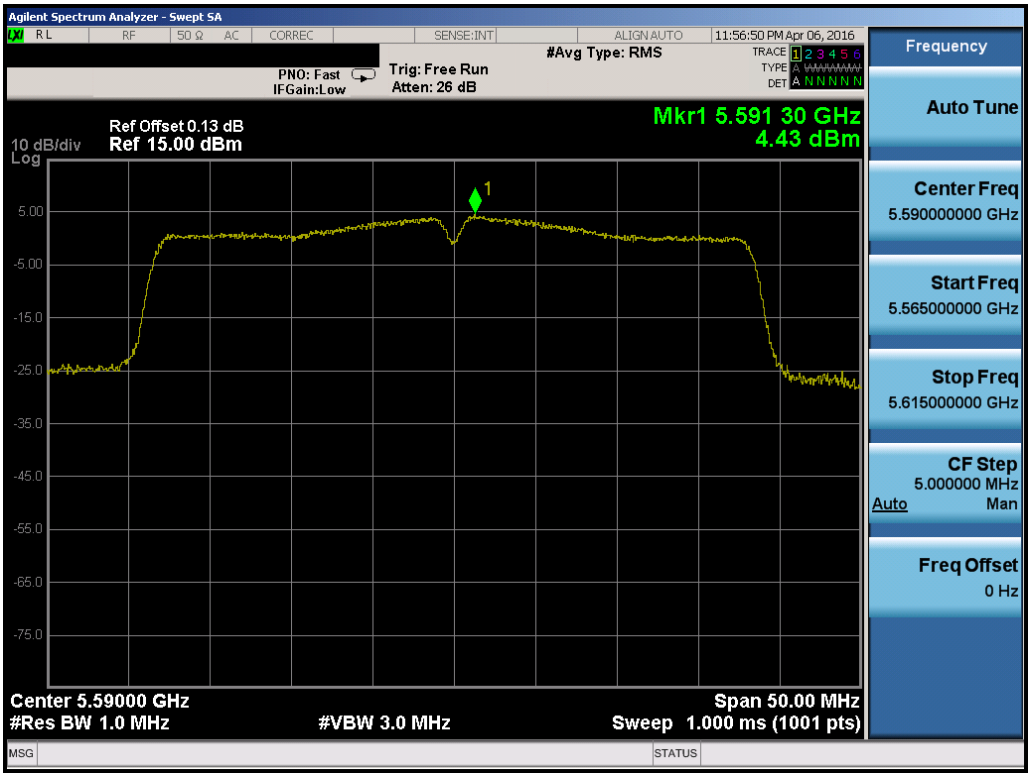


Plot 7-103. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 102)



Plot 7-104. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 118)

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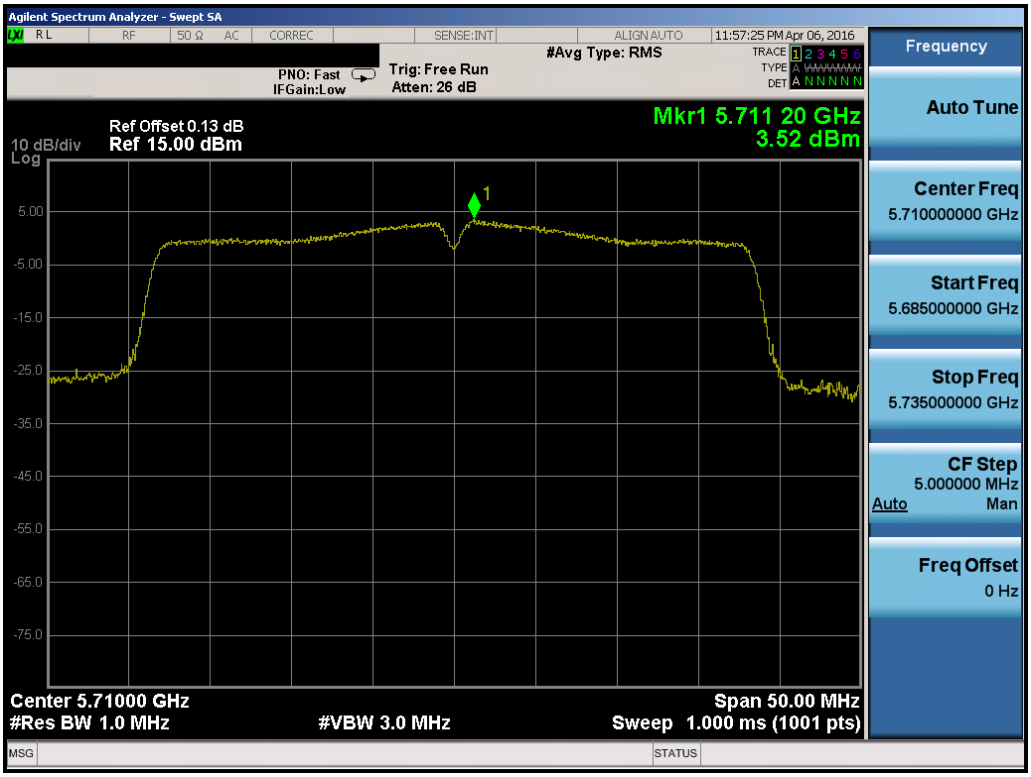
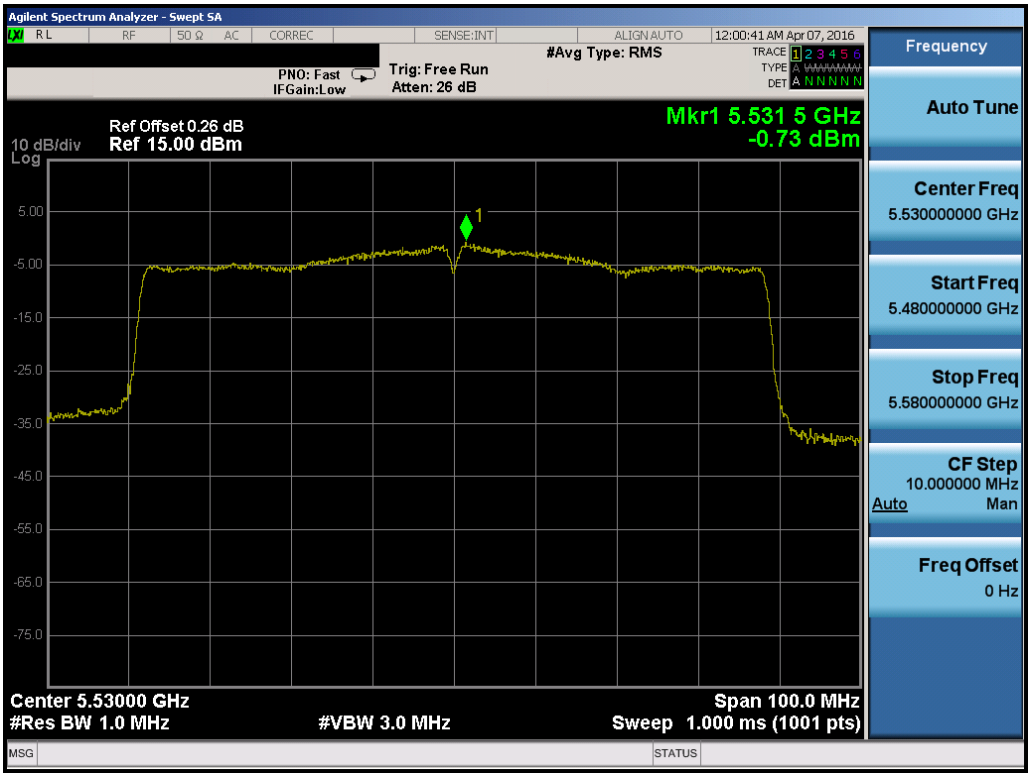


Plot 7-105. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 142)



Plot 7-106. Power Spectral Density Plot (80MHz BW 802.11ac (UNII Band 2C) – Ch. 106)

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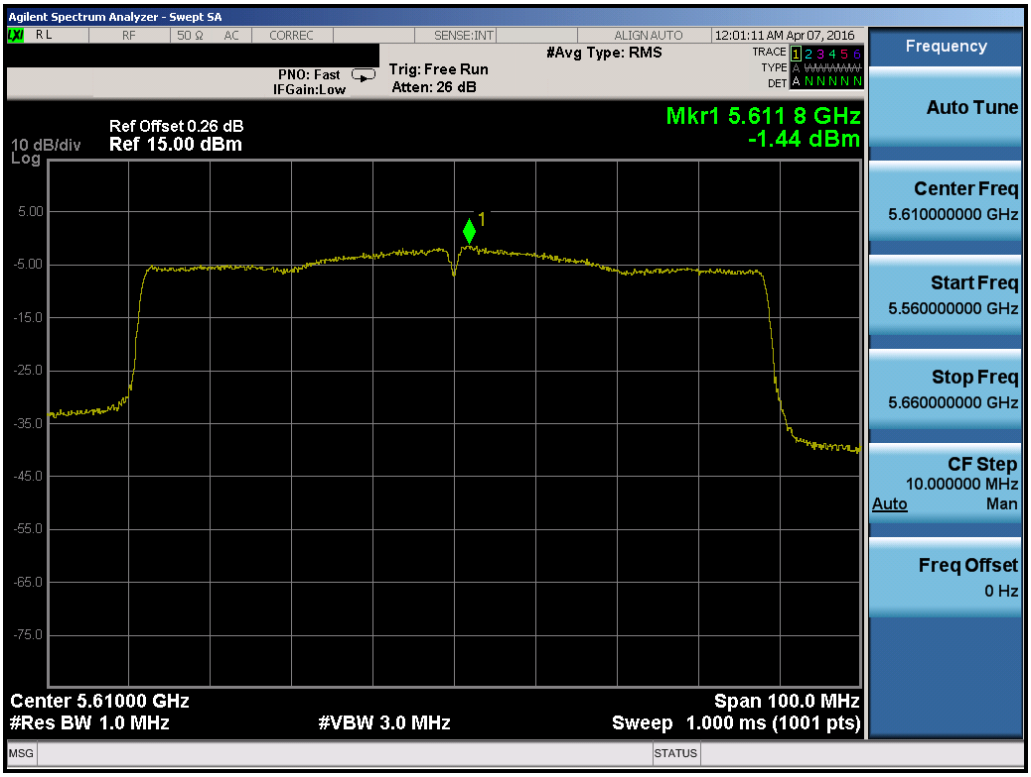
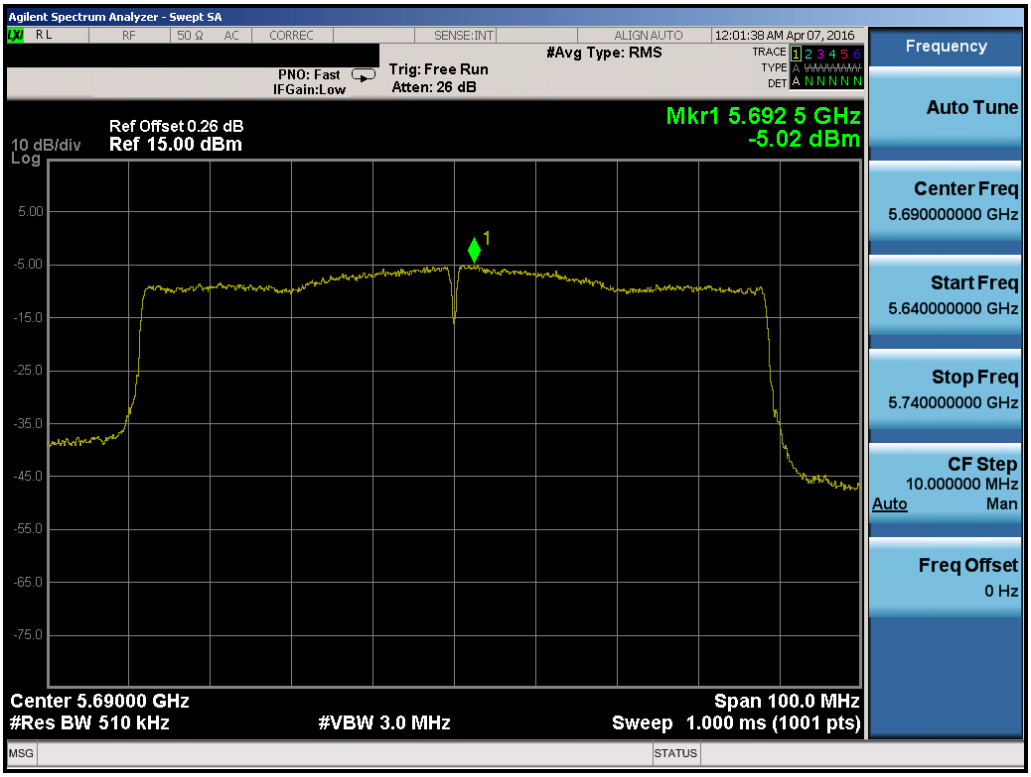


Plot 7-107. Power Spectral Density Plot (80MHz BW 802.11ac (UNII Band 2C) – Ch. 122)



Plot 7-108. Power Spectral Density Plot (80MHz BW 802.11ac (UNII Band 2C) – Ch. 138)

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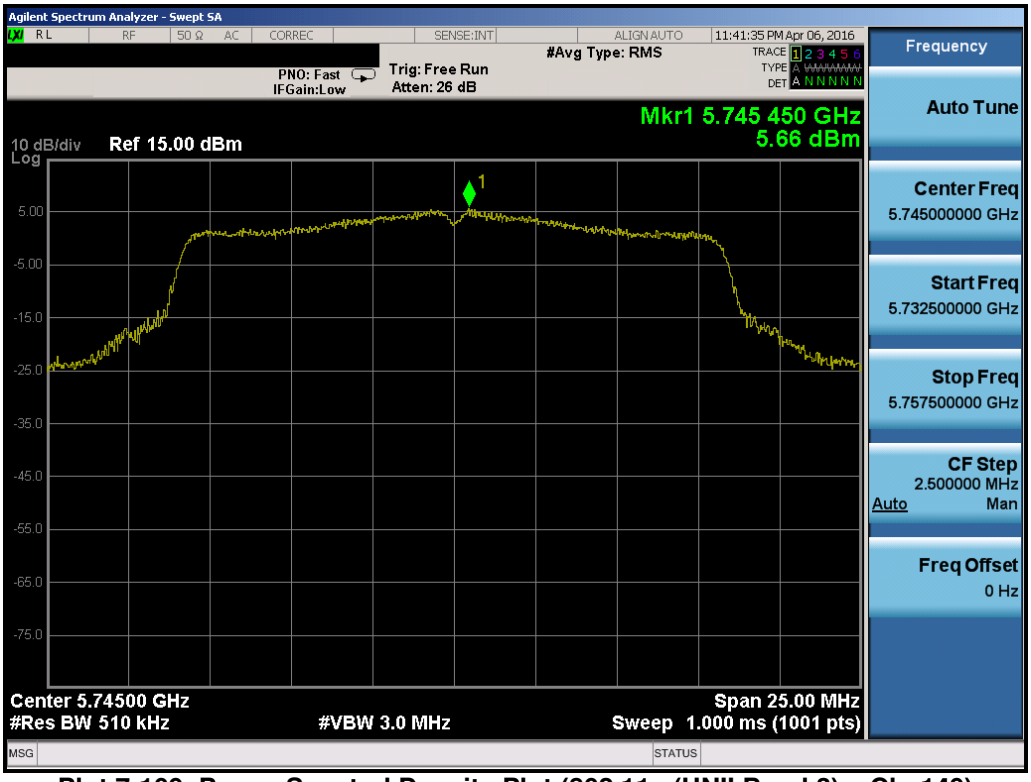
	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Power Density [dBm]	Max Permissible Power Density [dBm/500kHz]	Margin [dB]	Pass / Fail
Band 3	5745	149	a	6	5.66	30.0	-24.34	Pass
	5785	157	a	6	5.56	30.0	-24.44	Pass
	5825	165	a	6	5.41	30.0	-24.59	Pass
	5745	149	n (20MHz)	6.5/7.2 (MCS0)	4.90	30.0	-25.10	Pass
	5785	157	n (20MHz)	6.5/7.2 (MCS0)	4.25	30.0	-25.75	Pass
	5825	165	n (20MHz)	6.5/7.2 (MCS0)	3.89	30.0	-26.11	Pass
	5755	151	n (40MHz)	13.5/15 (MCS0)	0.41	30.0	-29.59	Pass
	5795	159	n (40MHz)	13.5/15 (MCS0)	0.13	30.0	-29.87	Pass
	5775	155	ac (80MHz)	29.3/32.5 (MCS0)	-2.08	30.0	-32.08	Pass

Table 7-18. Band 3 Conducted Power Spectral Density Measurements



Plot 7-109. Power Spectral Density Plot (802.11a (UNII Band 3) – Ch. 149)

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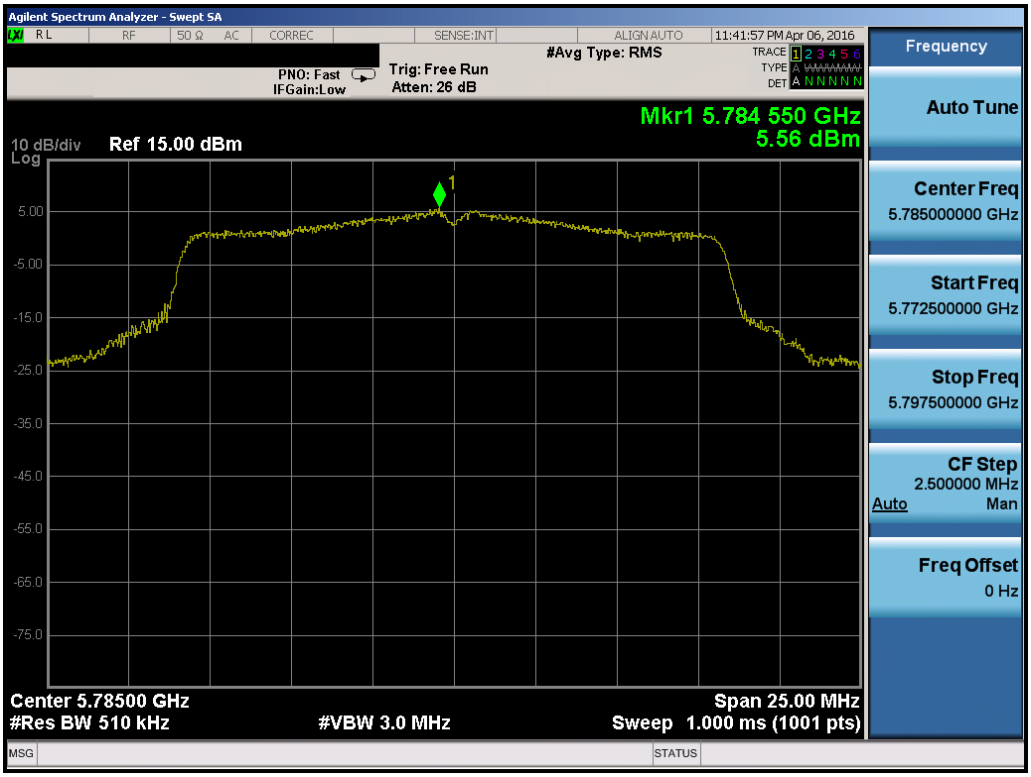
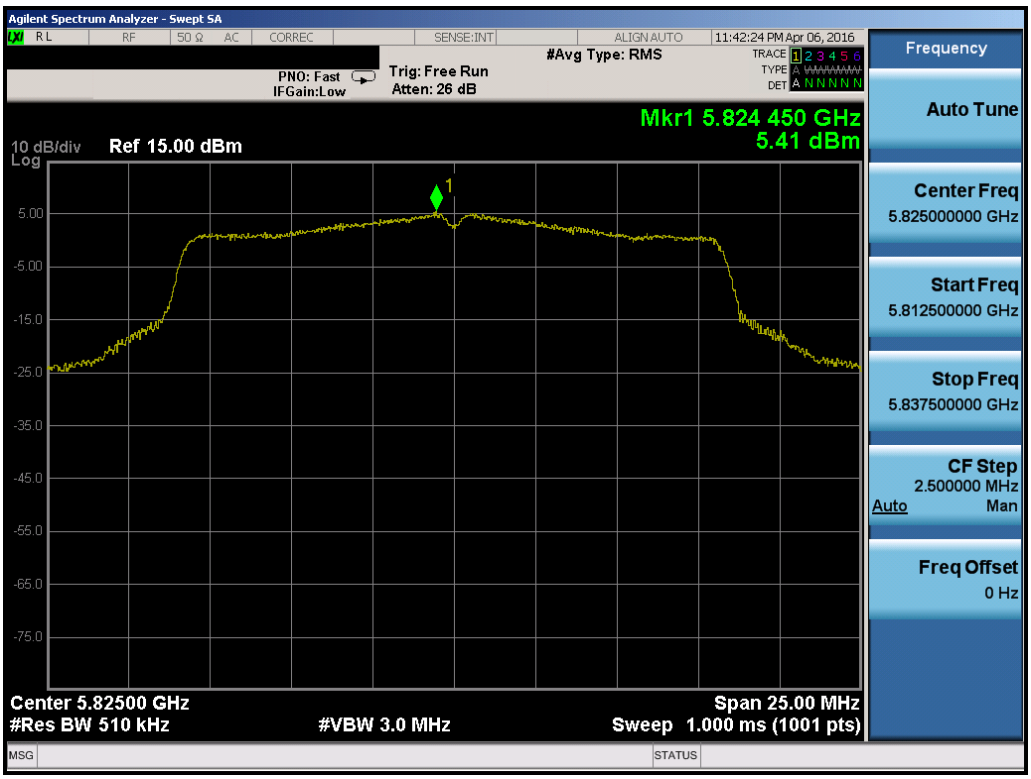


Plot 7-110. Power Spectral Density Plot (802.11a (UNII Band 3) – Ch. 157)



Plot 7-111. Power Spectral Density Plot (802.11a (UNII Band 3) – Ch. 165)

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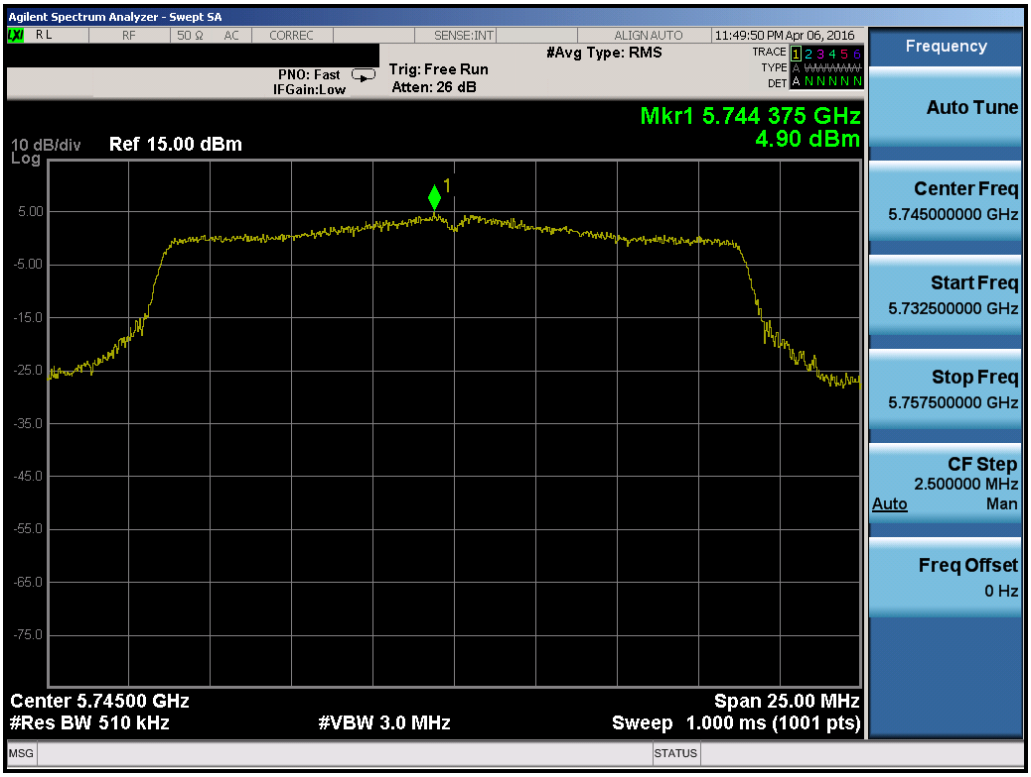
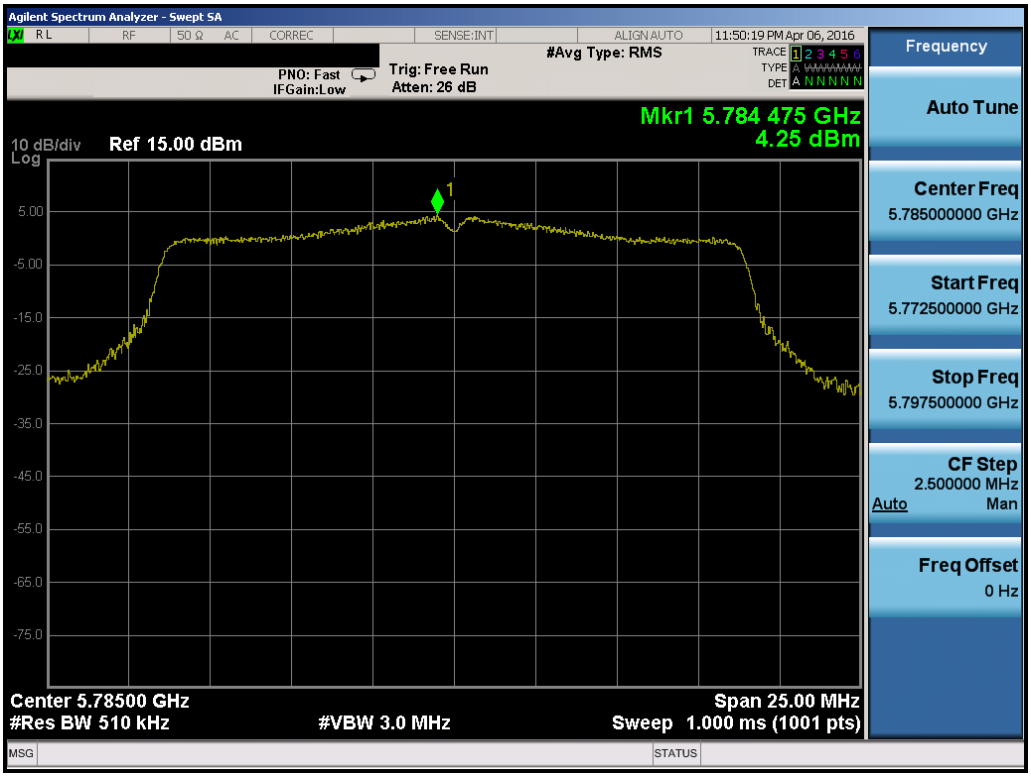


Plot 7-112. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 149)



Plot 7-113. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 157)

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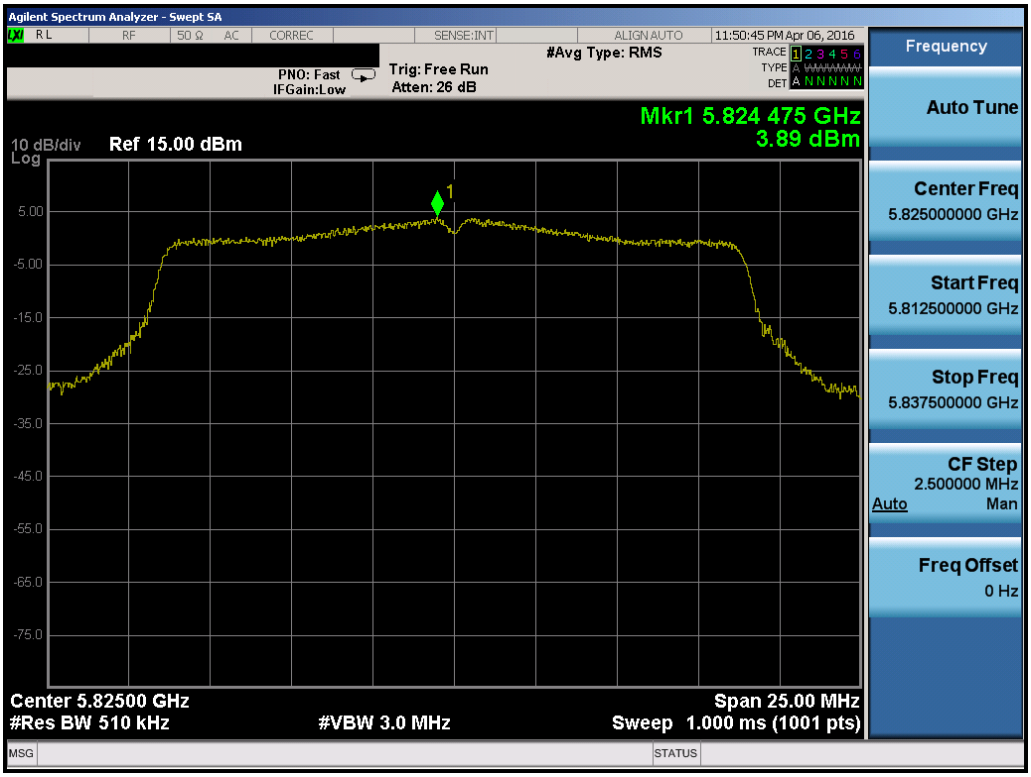
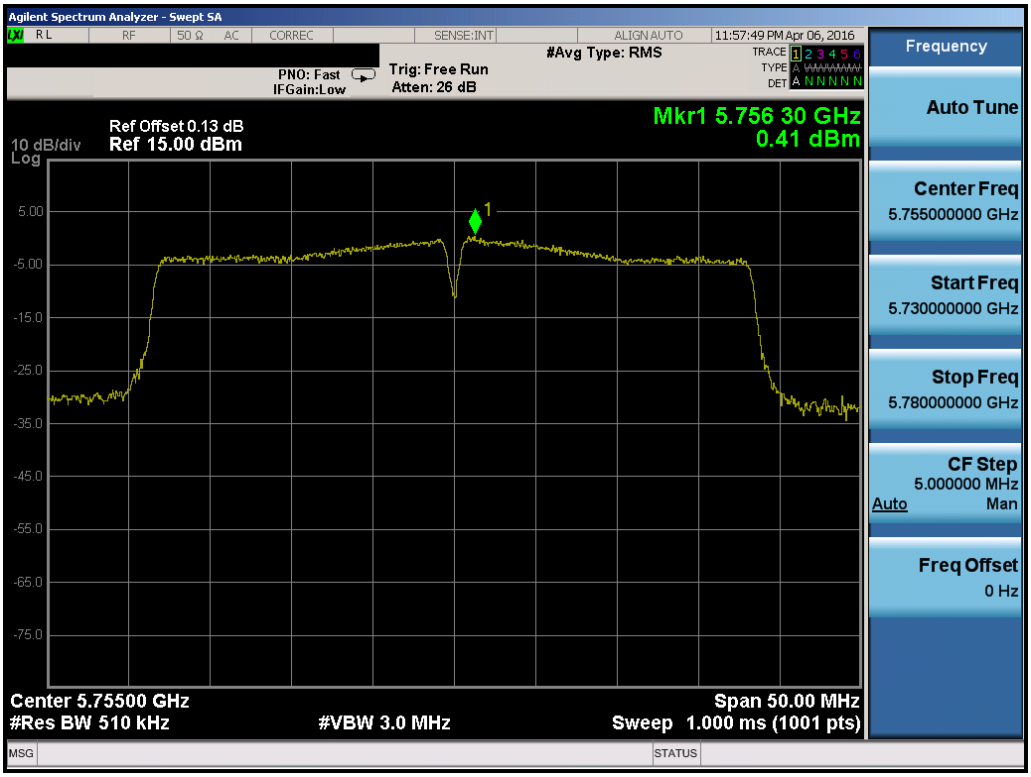


Plot 7-114. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 165)



Plot 7-115. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 3) – Ch. 151)

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