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MEASUREMENT REPORT
FCC Part 15.247 WLAN 802.11a/b/g/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:
01/29-2/20/2014
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Test Report Serial No.:
0Y1402030267.A3L

FCC ID:	**A3LSMG900R4**
APPLICANT:	**Samsung Electronics, Co. Ltd.**

Application Type:	Certification
Model(s):	SM-G900R4
EUT Type:	Portable Handset
FCC Classification:	Digital Transmission System (DTS)
FCC Rule Part(s):	Part 15.247
Test Procedure(s):	KDB 558074 v03r01, KDB 648474 D03 v01r02

Mode	Tx Frequency (MHz)	Avg Conducted		Peak Conducted	
		Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)
802.11b	2412 - 2462	53.58	17.29	107.40	20.31
802.11g	2412 - 2462	26.61	14.25	106.41	20.27
802.11n	2412 - 2462	24.37	13.87	93.54	19.71
802.11a	5745 - 5825	22.08	13.44	98.18	19.92
802.11n (20MHz)	5745 - 5825	22.24	13.47	102.80	20.12
802.11n (40MHz)	5755 - 5795	17.53	12.44	84.14	19.25
802.11ac (80MHz)	5775	13.87	11.42	61.94	17.92

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 558074 v03r01. Test results reported herein relate only to the item(s) tested.

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

Randy Ortanez
President

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MEASUREMENT REPORT
FCC Part 15.247

§ 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 15.247
BASE MODEL:	SM-G900R4
FCC ID:	A3LSMG900R4
FCC CLASSIFICATION:	Digital Transmission System (DTS)
Test Device Serial No.:	20F7D, 20F7F ☐ Production ☒ Pre-Production ☐ Engineering
DATE(S) OF TEST:	01/29-2/20/2014
TEST REPORT S/N:	0Y1402030267.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.

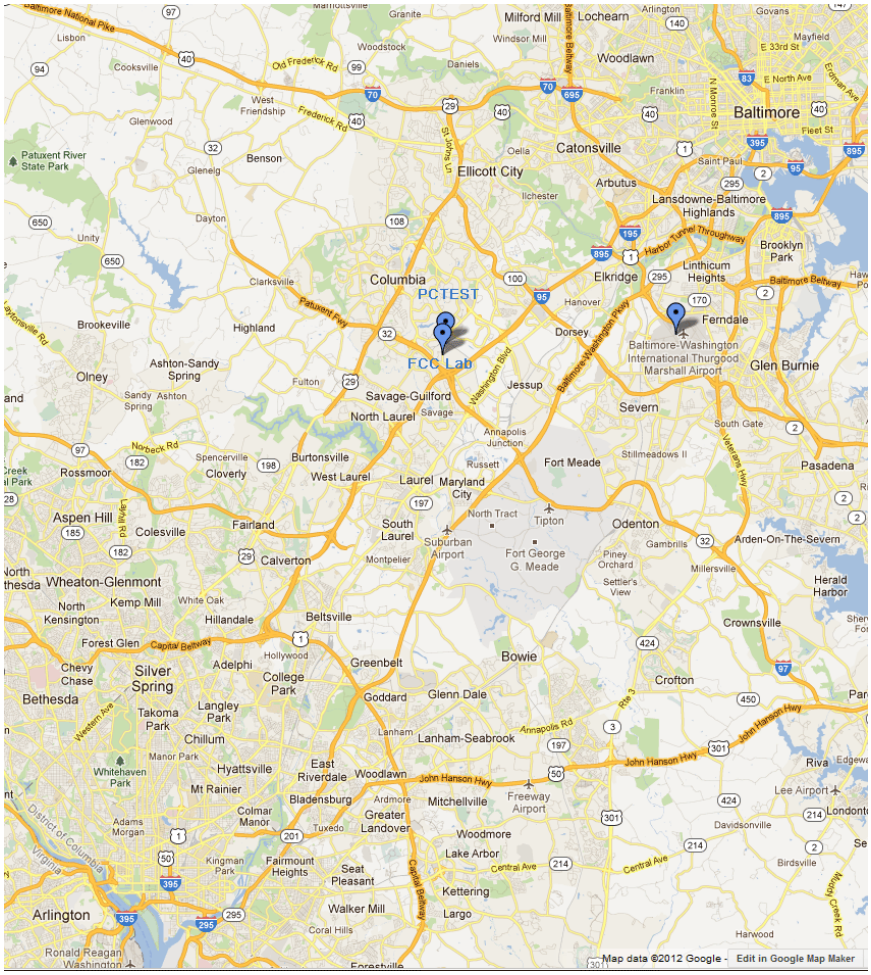

Figure 1-1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMG900R4**. The test data contained in this report pertains only to the emissions due to the EUT's WLAN (DTS) transmitter.

2.2 Device Capabilities

This device contains the following capabilities:

850/1900 CDMA/EvDO Rev0/A (BC0, BC1), Band 2, 4, 12, 17 (5/10MHz); 5 (1.4, 3, 5, 10MHz) LTE, 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, 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 6.0 b) of KDB 558074 v03r01. 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:

- 802.11b – 99.8%
- 802.11a/g/n 20MHz Bandwidth – 99.3%
- 802.11n 40MHz Bandwidth – 99.0%
- 802.11ac 80MHz Bandwidth – 98.3%

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: A3LSMG900R4 was tested per the guidance of KDB 558074 v03r01. 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. Additional emissions testing were performed per KDB 648474 D03 and the additional worst case emissions are reported herein and identified as WCC.

Per KDB 648474 D03, spurious emissions measurement data was also investigated with the wireless charging battery cover. The handset was placed on the representative charging pad under normal conditions and in a simulated call configuration. Only worst case emissions are 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.

2.5 Labeling Requirements

Per 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 558074 v03r01 were used in the measurement of the **Samsung Portable Handset FCC ID: A3LSMG900R4.**

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 6.11. 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 connections to an external antenna.

Conclusion:

The **Samsung Portable Handset FCC ID: A3LSMG900R4** unit complies with the requirement of §15.203.

Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437		

Ch.	BW (MHz)	Frequency (MHz)
149	20	5745
151	20 / 40	5755
153	20	5765
155	20 / 80	5775
157	20	5785

Ch.	BW (MHz)	Frequency (MHz)
159	20 / 40	5795
161	20	5805
163	20	5815
165	20	5825

Table 4-1. 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
-	RE2	Radiated Emissions Cable Set (VHF/UHF)	3/29/2013	Annual	3/29/2014	N/A
-	WL25-1	Conducted Cable Set (25GHz)	1/29/2014	Annual	1/29/2015	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	N9020A	MXA Signal Analyzer	10/29/2013	Annual	10/29/2014	US46470561
Agilent	N9030A	PXA Signal Analyzer (44GHz)	1/17/2014	Annual	1/17/2015	MY52350166
Anritsu	MA2411B	Pulse Sensor	11/13/2013	Annual	11/13/2014	1027293
Anritsu	ML2495A	Power Meter	10/31/2013	Annual	10/31/2014	1039008
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
Mini-Circuits	VHF-3100+	High Pass Filter	1/27/2014	Annual	1/27/2015	30841
Mini-Circuits	VHF-3100+	High Pass Filter	1/29/2014	Annual	1/29/2015	31144
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	1/24/2014	Annual	1/24/2015	100348
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
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:

For equipment listed above that has a calibration due date that falls within the test date range, care was taken to ensure that this equipment was utilized prior to the calibration due date.

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6.0 TEST RESULTS

6.1 Summary

Company Name: Samsung Electronics, Co. Ltd.
FCC ID: A3LSMG900R4
FCC Classification: Digital Transmission System (DTS)
Data Rate(s) Tested: 1Mbps, 2Mbps, 5.5Mbps, 11Mbps (b)
6Mbps, 9Mbps, 12Mbps, 18Mbps, 24Mbps, 36Mbps, 48Mbps, 54Mbps (a/g)
6.5/7.2Mbps, 13/14.4Mbps, 19.5/21.7Mbps, 26/28.9Mbps, 39/43.3Mbps, 52/57.8Mbps, 58.5/65Mbps, 65/72.2Mbps (n – 20MHz)
13.5/15Mbps, 27/30Mbps, 40.5/45Mbps, 54/60Mbps, 81/90Mbps, 108/120Mbps, 121.5/135Mbps, 135/150Mbps (n – 40MHz)
29.3/32.5Mbps, 58.5/65Mbps, 87.8/97.5Mbps, 117/130Mbps, 175.5/195Mbps, 234/260Mbps, 263.3/292.5Mbps, 292.5/325Mbps, 351/390Mbps, 390/433.3Mbps (ac – 80MHz BW)

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
TRANSMITTER MODE (TX)					
15.247(a)(2)	6dB Bandwidth	> 500kHz	CONDUCTED	PASS	Section 6.2
15.247(b)(3)	Transmitter Output Power	< 1 Watt		PASS	Sections 6.3
15.247(e)	Transmitter Power Spectral Density	< 8dBm / 3kHz Band		PASS	Section 6.4
15.247(d)	Band Edge / Out-of-Band Emissions	Conducted ≥ 20dBc		PASS	Sections 6.5, 6.6
15.205 15.209	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209	RADIATED	PASS	Sections 6.7, 6.8, 6.9, 6.10
15.207	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits	LINE CONDUCTED	PASS	Section 6.11

Table 6-1. Summary of Test Results

Notes:

1) All modes of operation and data rates were investigated. 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 "WLAN Automation", Version 2.3.

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6.2 6dB Bandwidth Measurement – 802.11a/b/g/n/ac

§15.247(a.2)

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 transmitter antenna terminal of the EUT while the EUT is operating at its maximum duty cycle (>98%), at maximum power, and at the appropriate frequencies. All data rates were investigated and the worst case configuration results are reported in this section.

The minimum permissible 6dB bandwidth is 500 kHz.

Test Procedure Used

KDB 558074 v03r01 – Section 8.2 Option 2

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 100kHz
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize

Test Setup

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

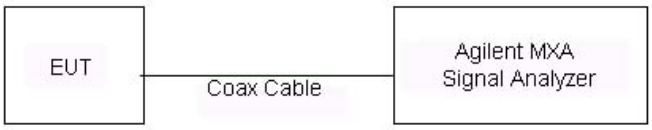

Figure 6-1. Test Instrument & Measurement Setup

Test Notes

None

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Antenna-1 6 dB Bandwidth Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
2412	1	b	1	9.025	0.500	Pass
2437	6	b	1	8.593	0.500	Pass
2462	11	b	1	8.594	0.500	Pass
2412	1	g	6	16.356	0.500	Pass
2437	6	g	6	16.374	0.500	Pass
2462	11	g	6	15.754	0.500	Pass
2412	1	n	6.5/7.2 (MCS0)	17.566	0.500	Pass
2437	6	n	6.5/7.2 (MCS0)	17.358	0.500	Pass
2462	11	n	6.5/7.2 (MCS0)	16.570	0.500	Pass
5745	149	a	6	16.346	0.500	Pass
5785	157	a	6	16.355	0.500	Pass
5825	165	a	6	16.478	0.500	Pass
5745	149	n (20MHz)	6.5/7.2 (MCS0)	17.353	0.500	Pass
5785	157	n (20MHz)	6.5/7.2 (MCS0)	17.581	0.500	Pass
5825	165	n (20MHz)	6.5/7.2 (MCS0)	17.601	0.500	Pass
5755	151	n (40MHz)	13.5/15 (MCS0)	36.322	0.500	Pass
5795	159	n (40MHz)	13.5/15 (MCS0)	36.320	0.500	Pass
5775	155	ac (80MHz)	29.3/32.5 (MCS0)	75.400	0.500	Pass

Table 6-2. Conducted Bandwidth Measurements

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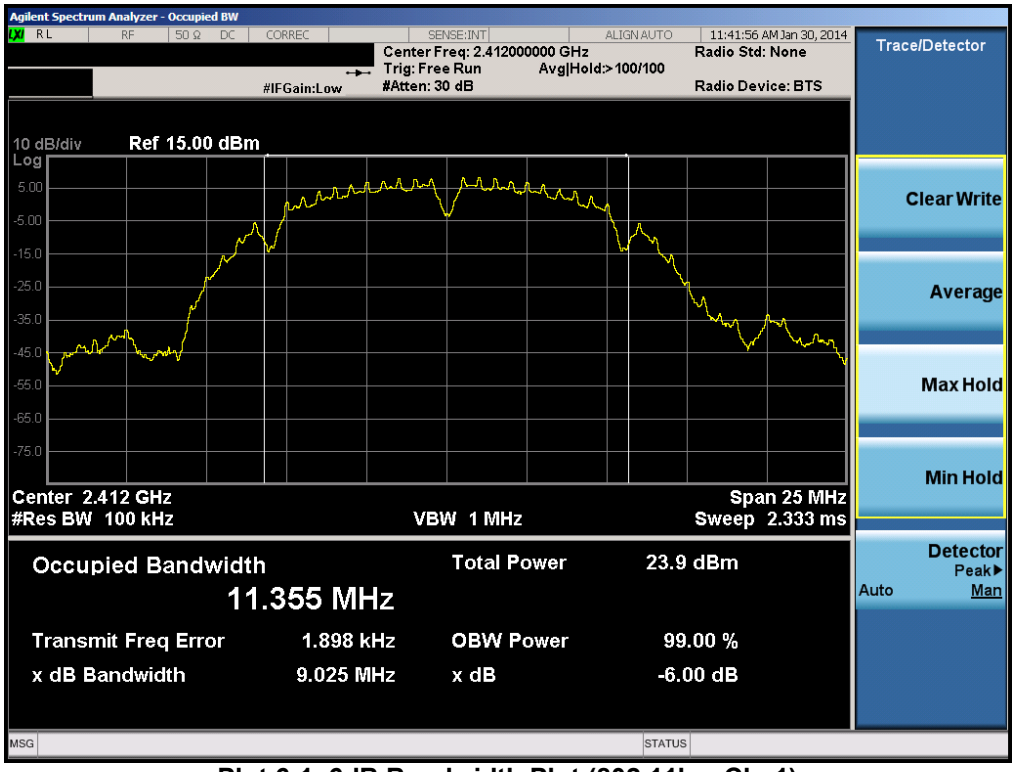
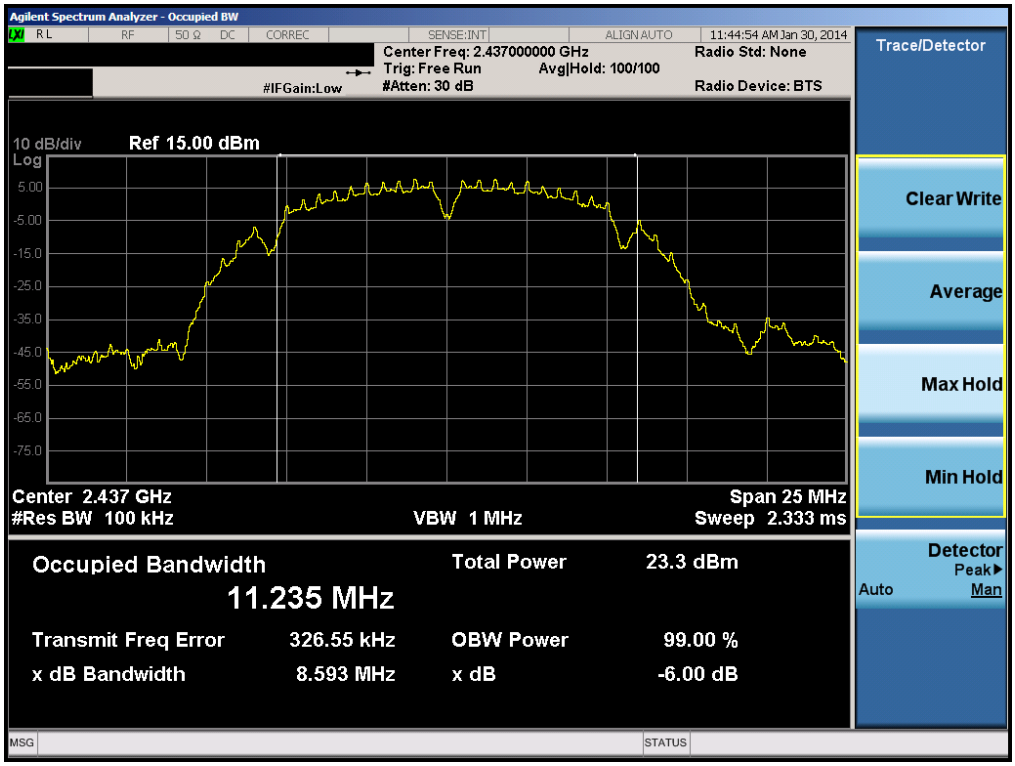


Plot 6-1. 6dB Bandwidth Plot (802.11b – Ch. 1)



Plot 6-2. 6dB Bandwidth Plot (802.11b – Ch. 6)

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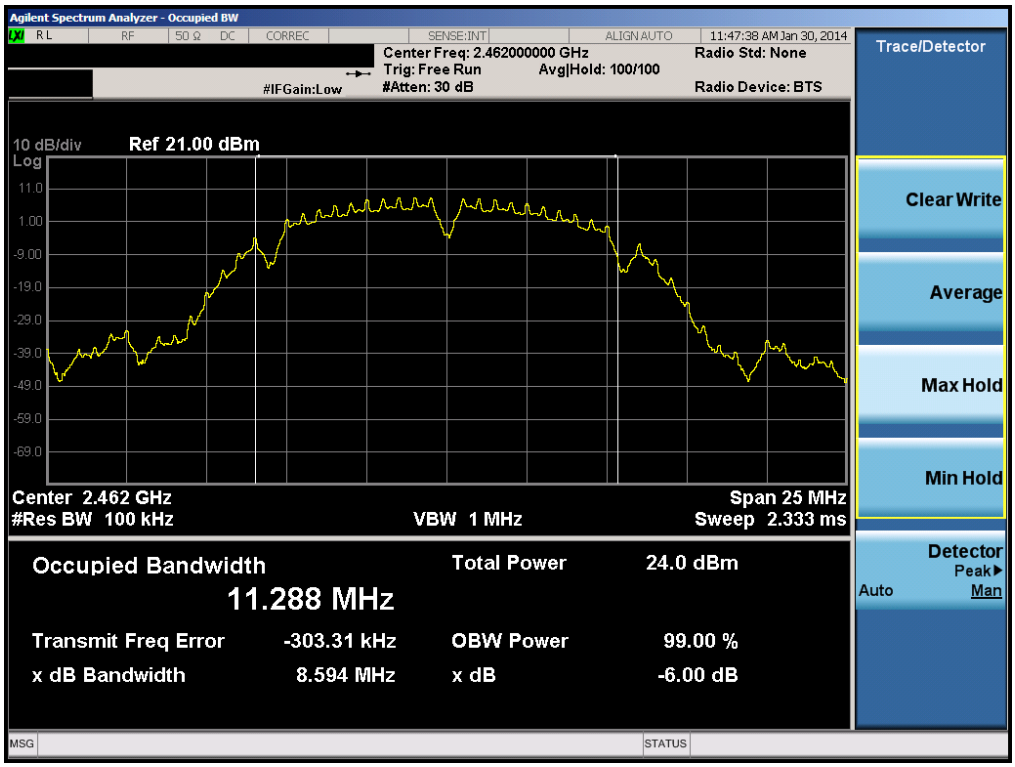
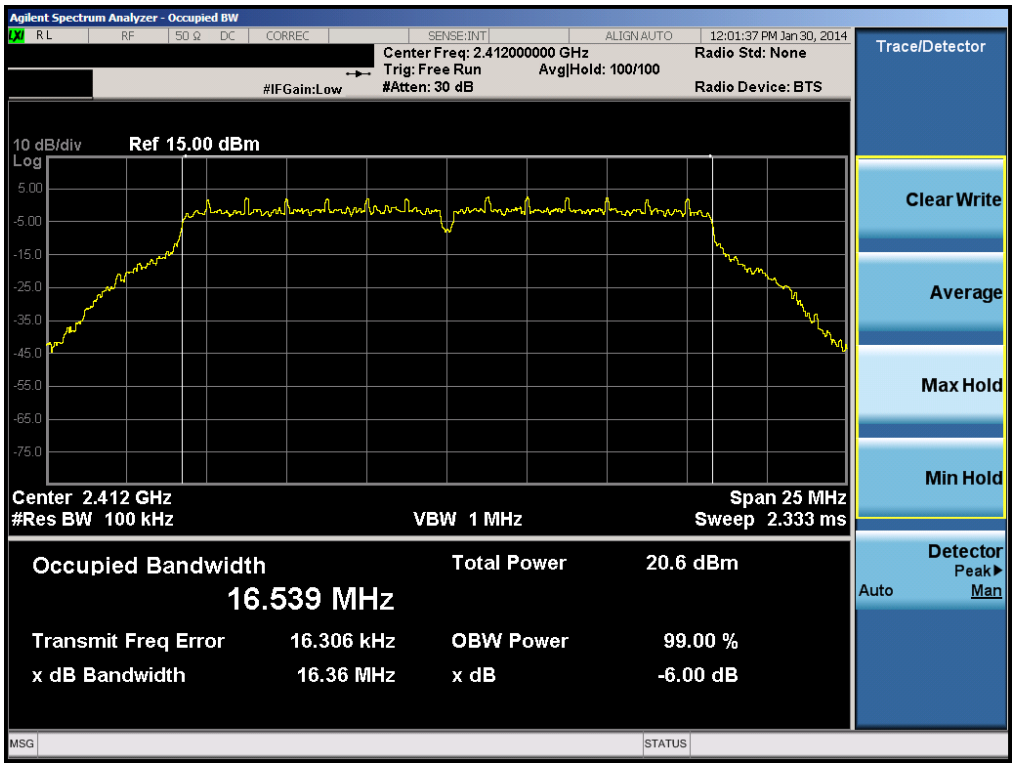


Plot 6-3. 6dB Bandwidth Plot (802.11b – Ch. 11)



Plot 6-4. 6dB Bandwidth Plot (802.11g – Ch. 1)

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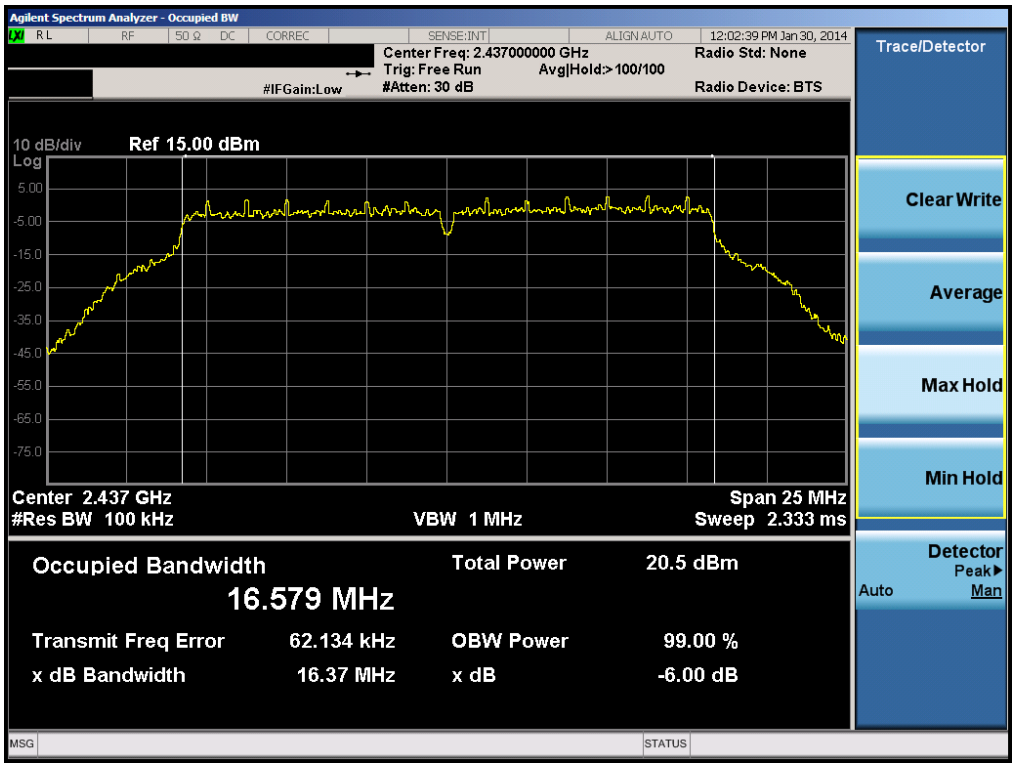
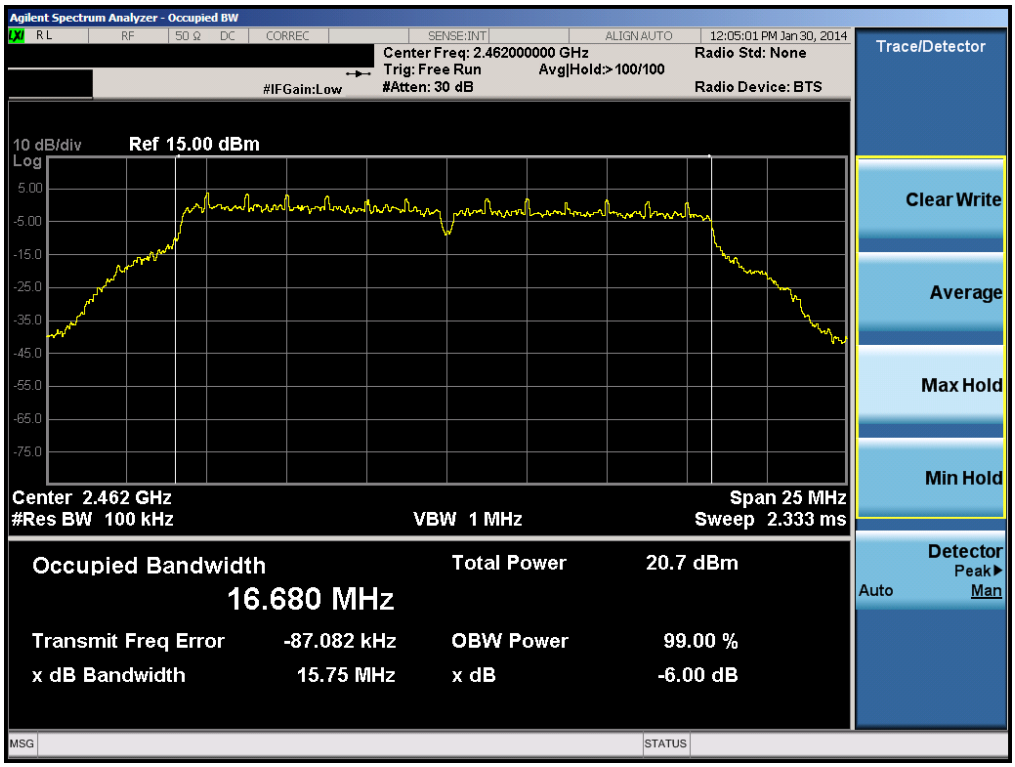


Plot 6-5. 6dB Bandwidth Plot (802.11g – Ch. 6)



Plot 6-6. 6dB Bandwidth Plot (802.11g – Ch. 11)

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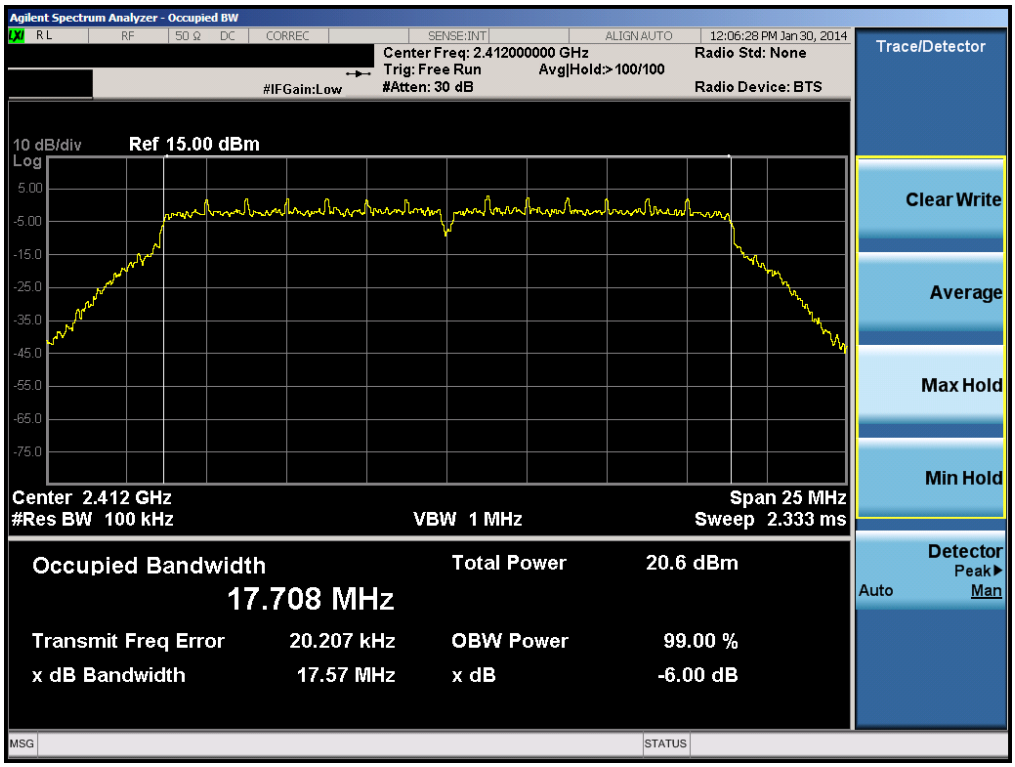
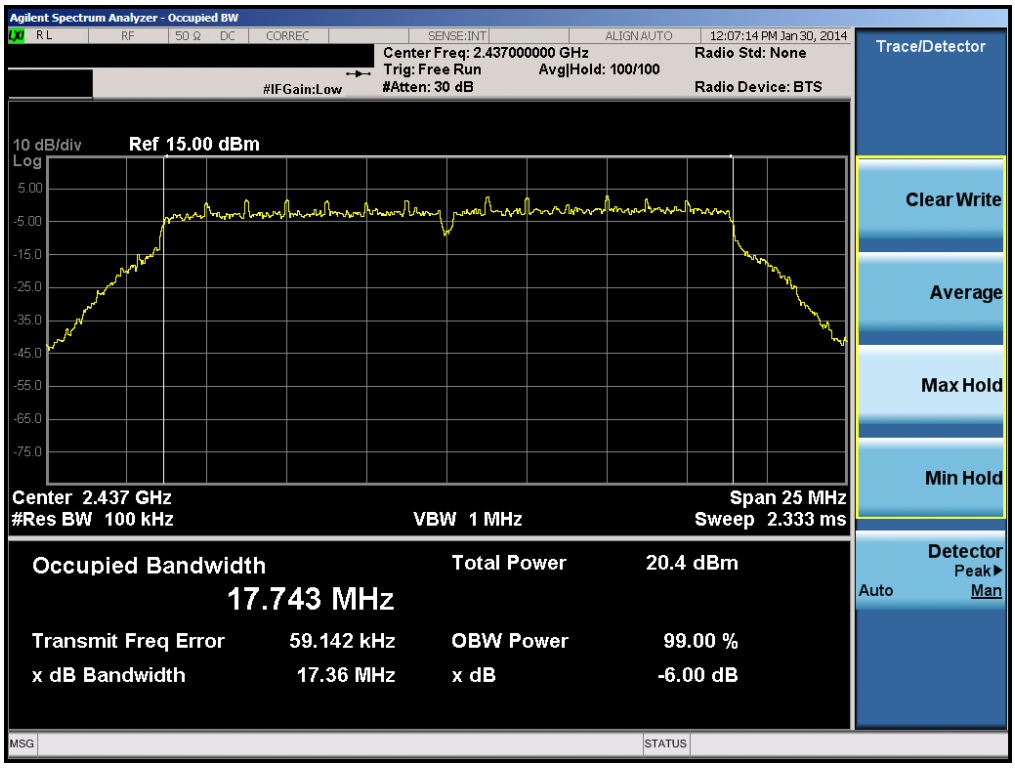


Plot 6-7. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 1)



Plot 6-8. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 6)

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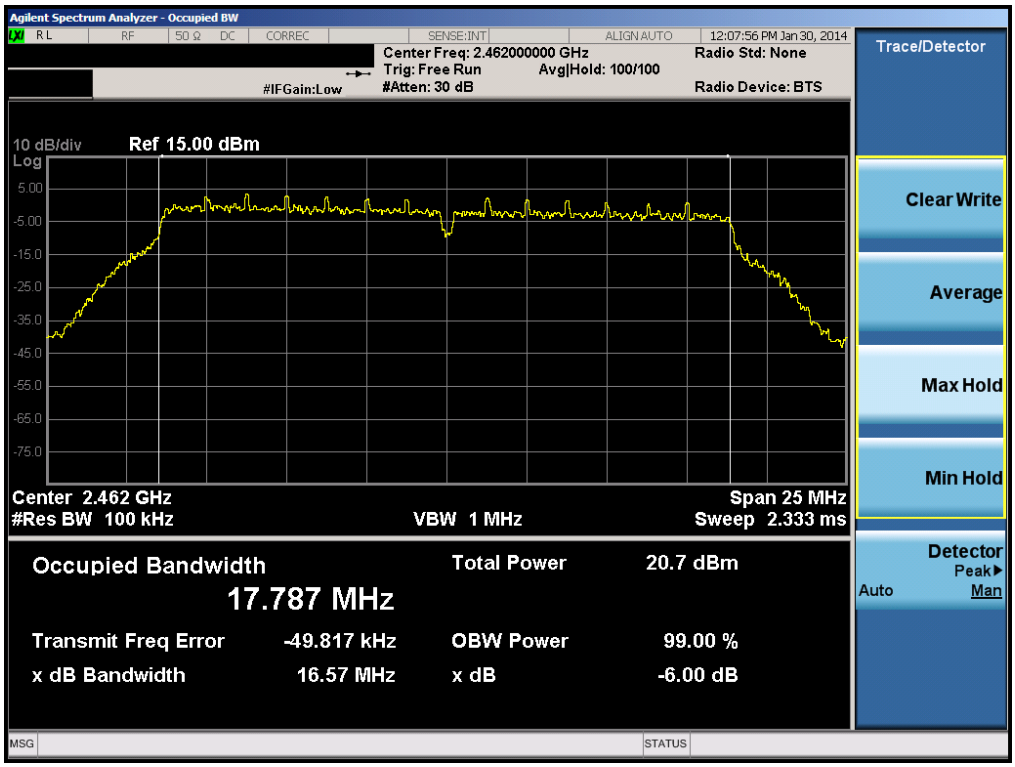
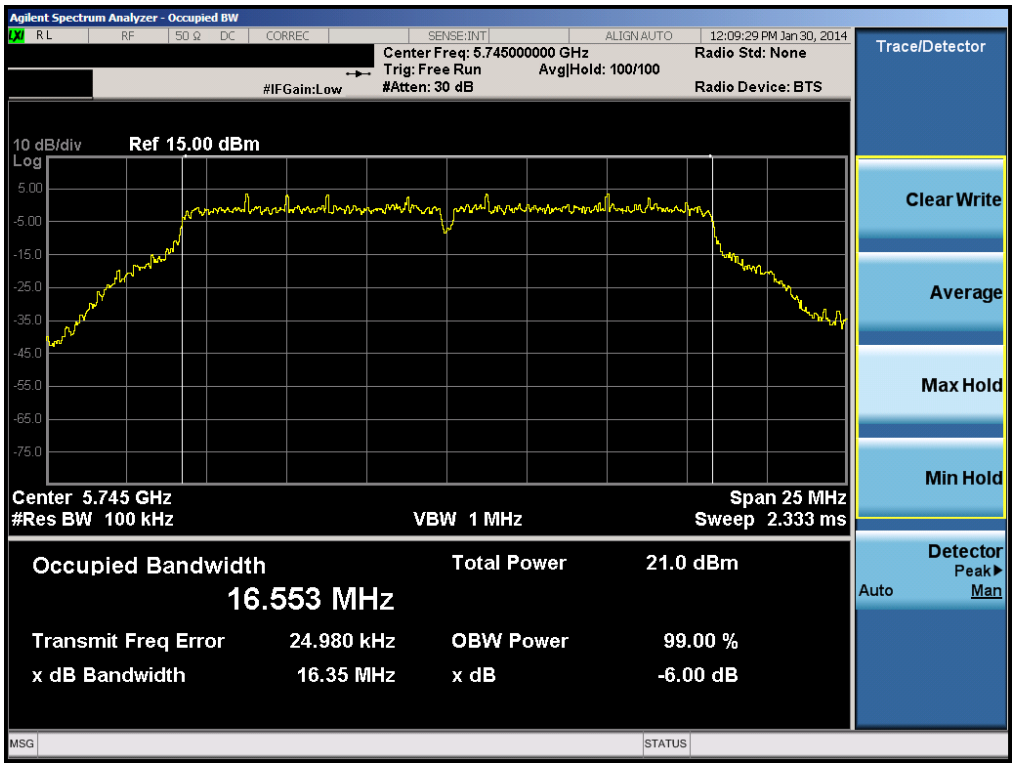


Plot 6-9. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 11)



Plot 6-10. 6dB Bandwidth Plot (802.11a – Ch. 149)

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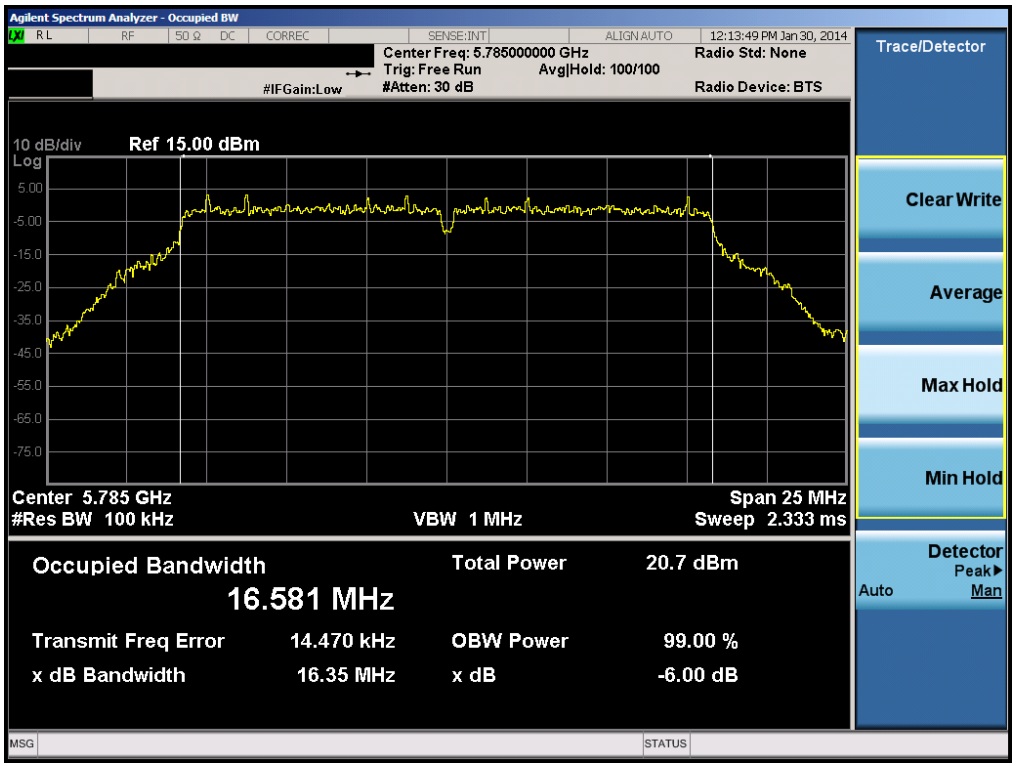
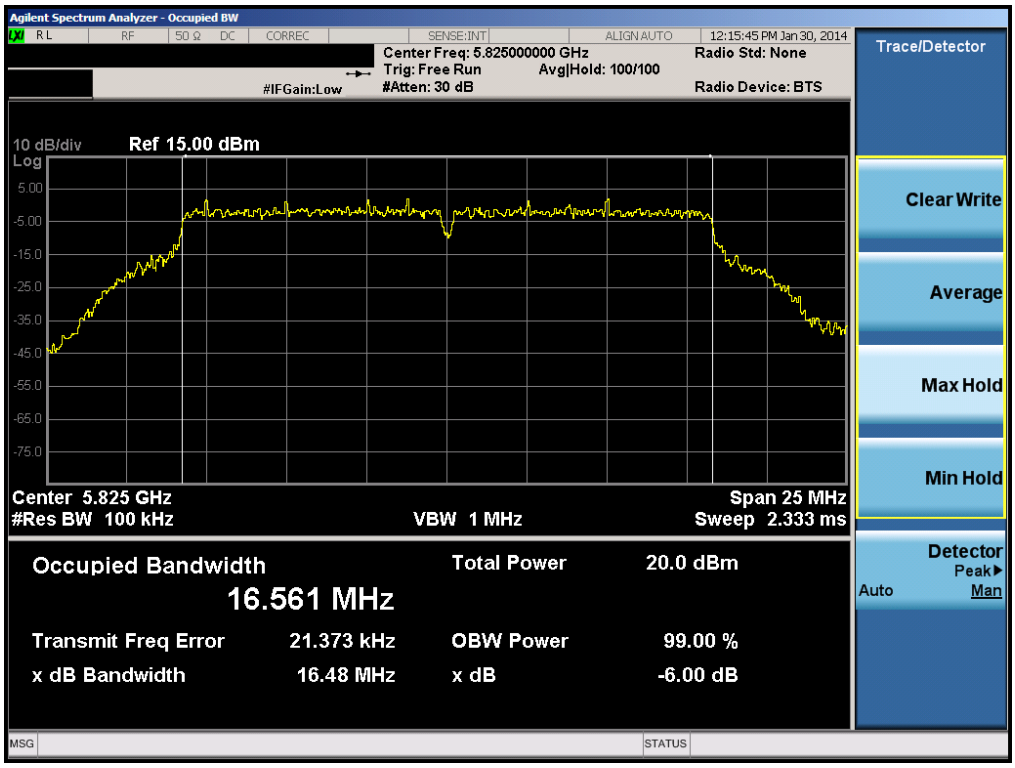


Plot 6-11. 6dB Bandwidth Plot (802.11a – Ch. 157)



Plot 6-12. 6dB Bandwidth Plot (802.11a – Ch. 165)

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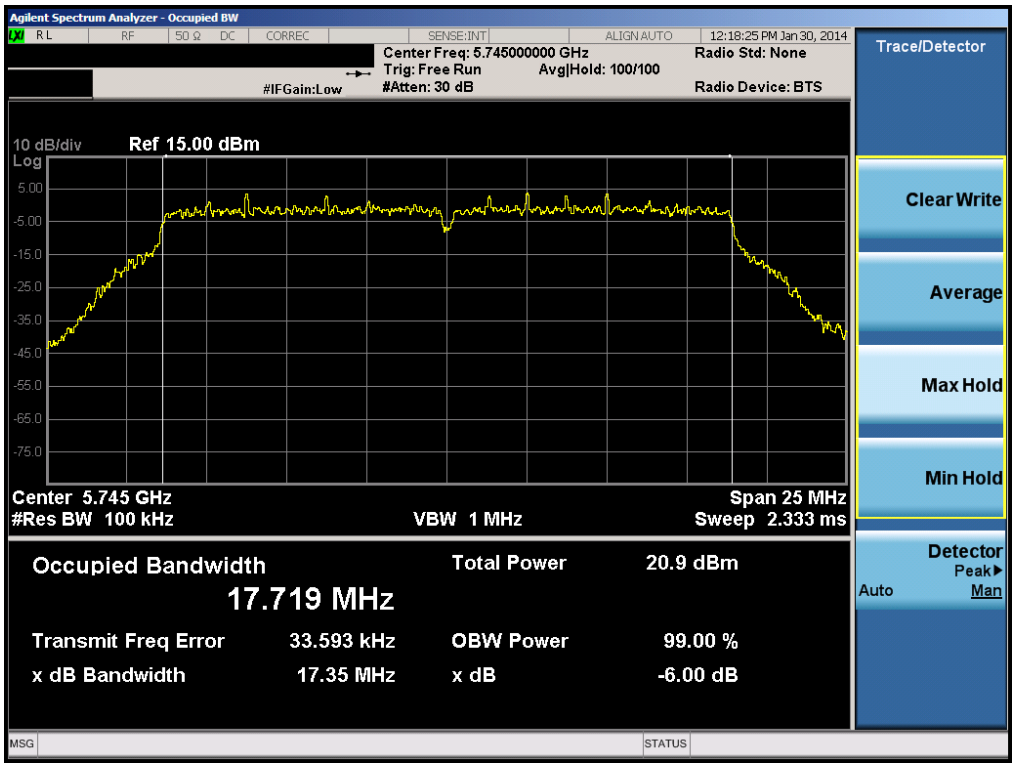
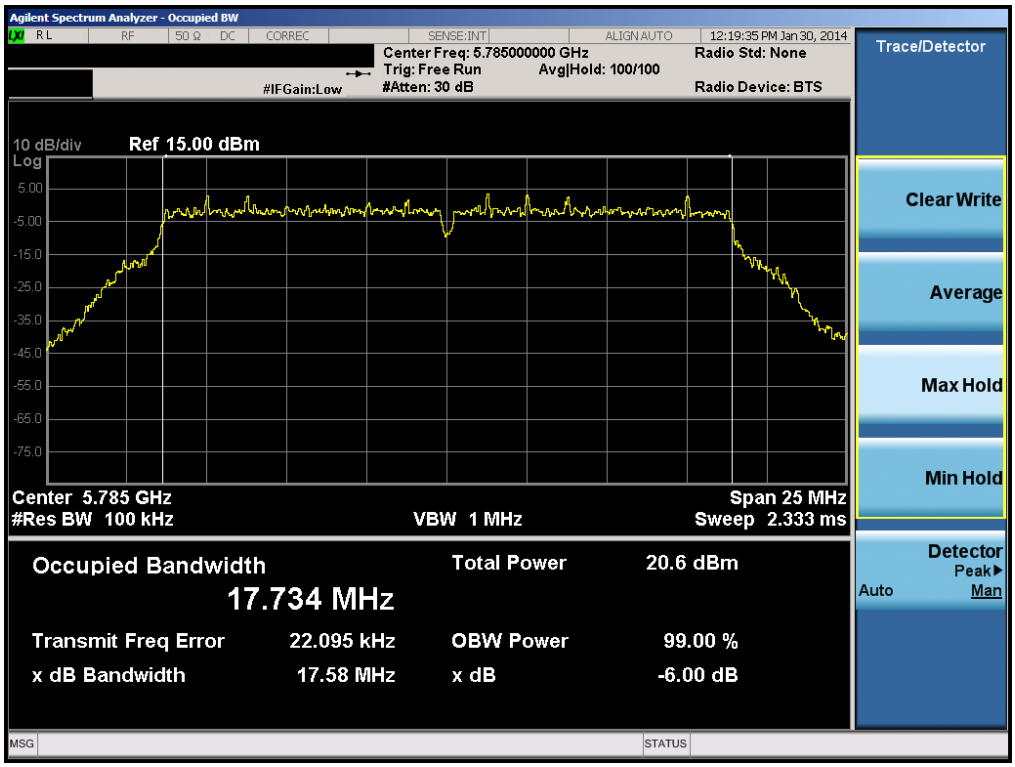


Plot 6-13. 6dB Bandwidth Plot (20MHz BW 802.11n (5.8GHz) – Ch. 149)



Plot 6-14. 6dB Bandwidth Plot (20MHz BW 802.11n (5.8GHz) – Ch. 157)

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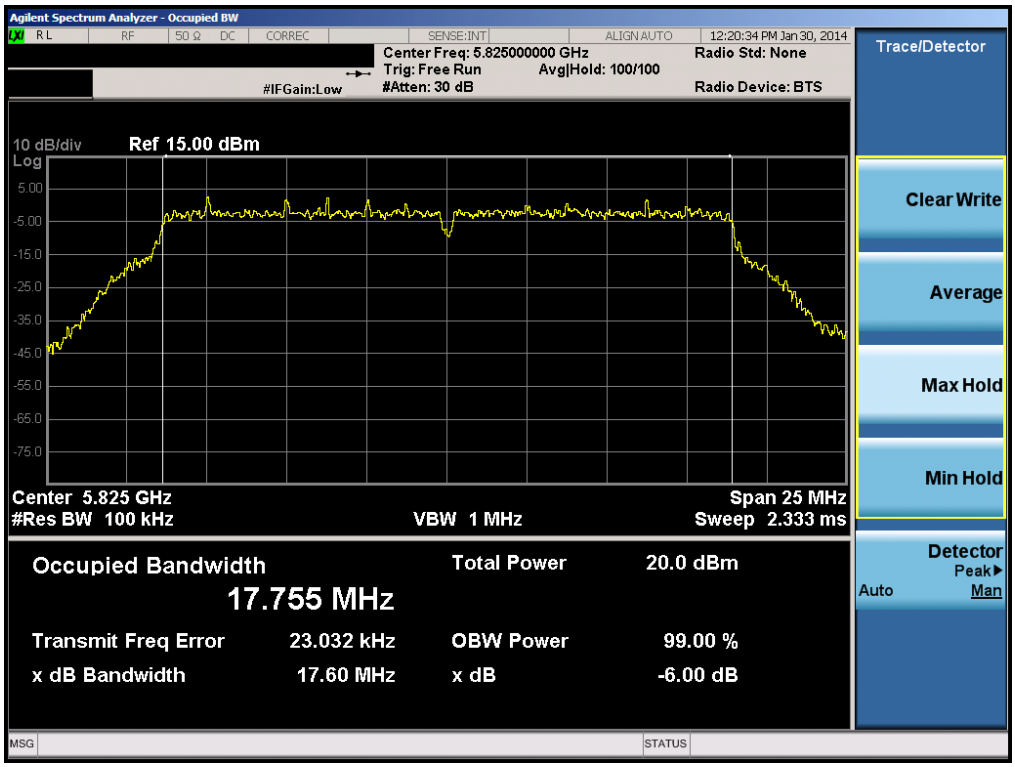
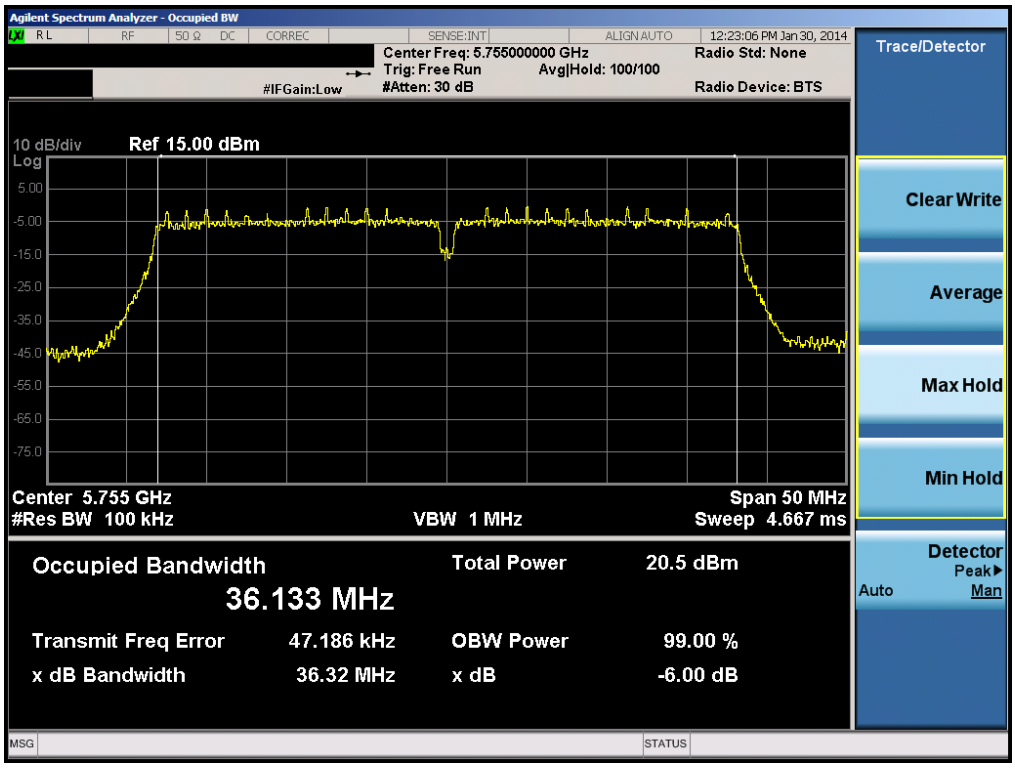


Plot 6-15. 6dB Bandwidth Plot (20MHz BW 802.11n (5.8GHz) – Ch. 165)



Plot 6-16. 6dB Bandwidth Plot (40MHz BW 802.11n (5.8GHz) – Ch. 151)

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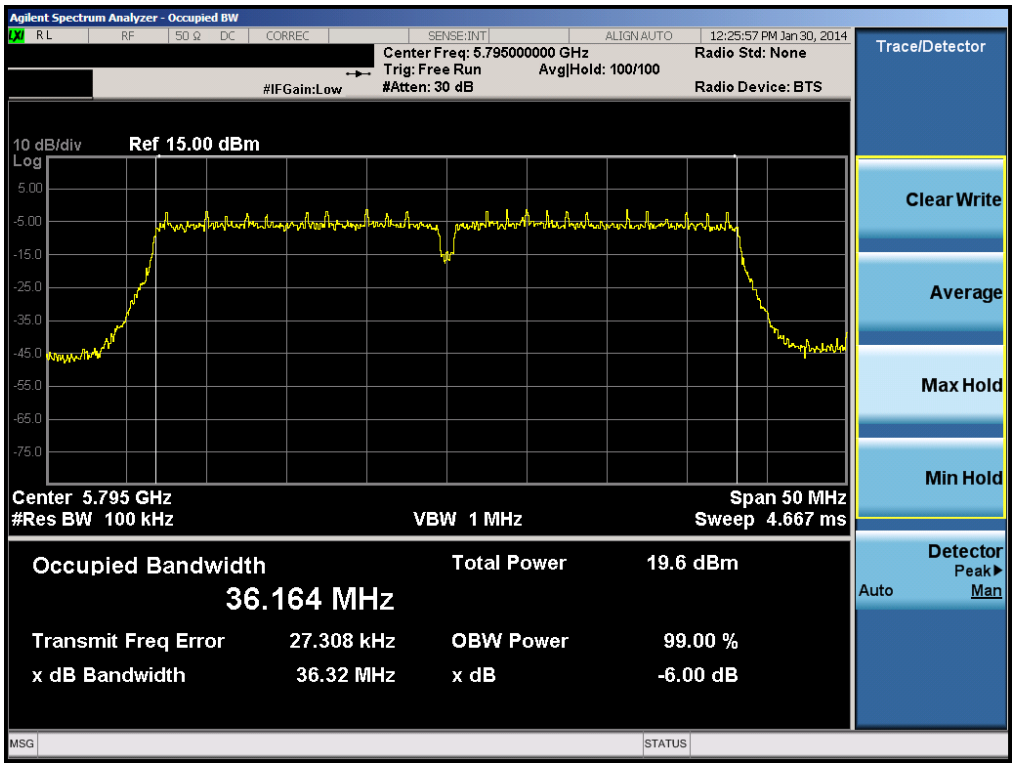
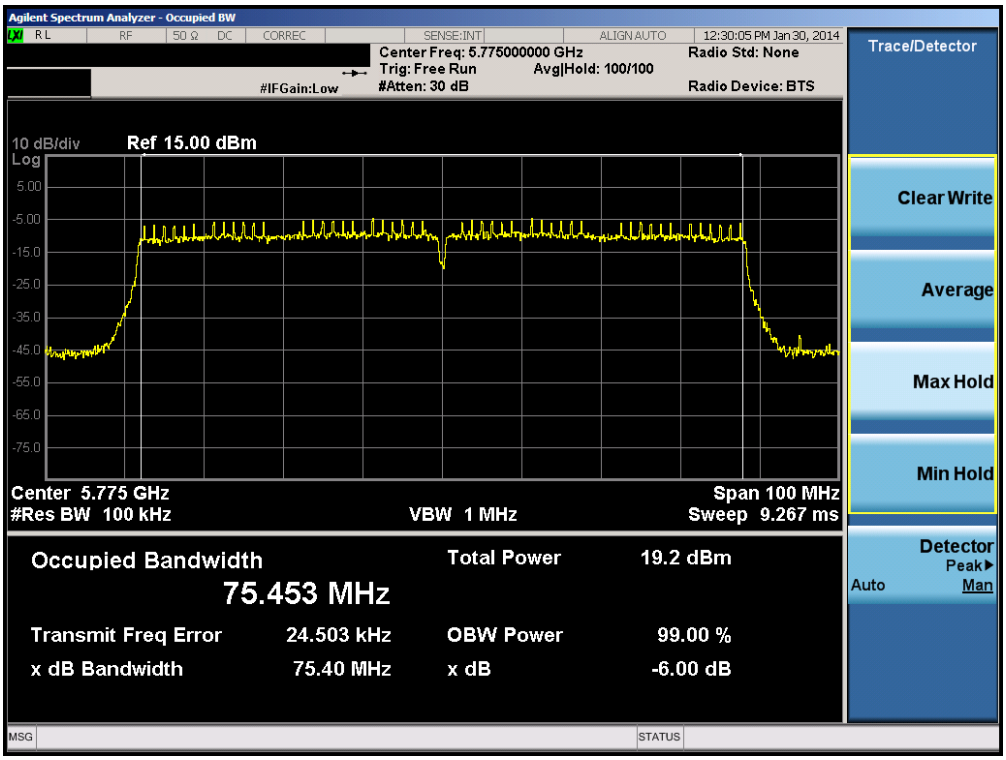


Plot 6-17. 6dB Bandwidth Plot (40MHz BW 802.11n (5.8GHz) – Ch. 159)



Plot 6-18. 6dB Bandwidth Plot (80MHz BW 802.11ac (5.8GHz) – Ch. 155)

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Antenna-2 6 dB Bandwidth Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
2412	1	b	1	8.591	0.500	Pass
2437	6	b	1	8.616	0.500	Pass
2462	11	b	1	9.101	0.500	Pass
2412	1	g	6	16.35	0.500	Pass
2437	6	g	6	15.75	0.500	Pass
2462	11	g	6	16.41	0.500	Pass
2412	1	n	6.5/7.2 (MCS0)	17.18	0.500	Pass
2437	6	n	6.5/7.2 (MCS0)	16.37	0.500	Pass
2462	11	n	6.5/7.2 (MCS0)	17.63	0.500	Pass
5745	149	a	6	16.38	0.500	Pass
5785	157	a	6	16.34	0.500	Pass
5825	165	a	6	16.34	0.500	Pass
5745	149	n (20MHz)	6.5/7.2 (MCS0)	17.59	0.500	Pass
5785	157	n (20MHz)	6.5/7.2 (MCS0)	17.61	0.500	Pass
5825	165	n (20MHz)	6.5/7.2 (MCS0)	17.62	0.500	Pass
5755	151	n (40MHz)	13.5/15 (MCS0)	36.15	0.500	Pass
5795	159	n (40MHz)	13.5/15 (MCS0)	36.11	0.500	Pass
5775	155	ac (80MHz)	29.3/32.5 (MCS0)	75.84	0.500	Pass

Table 6-3. Conducted Bandwidth Measurements

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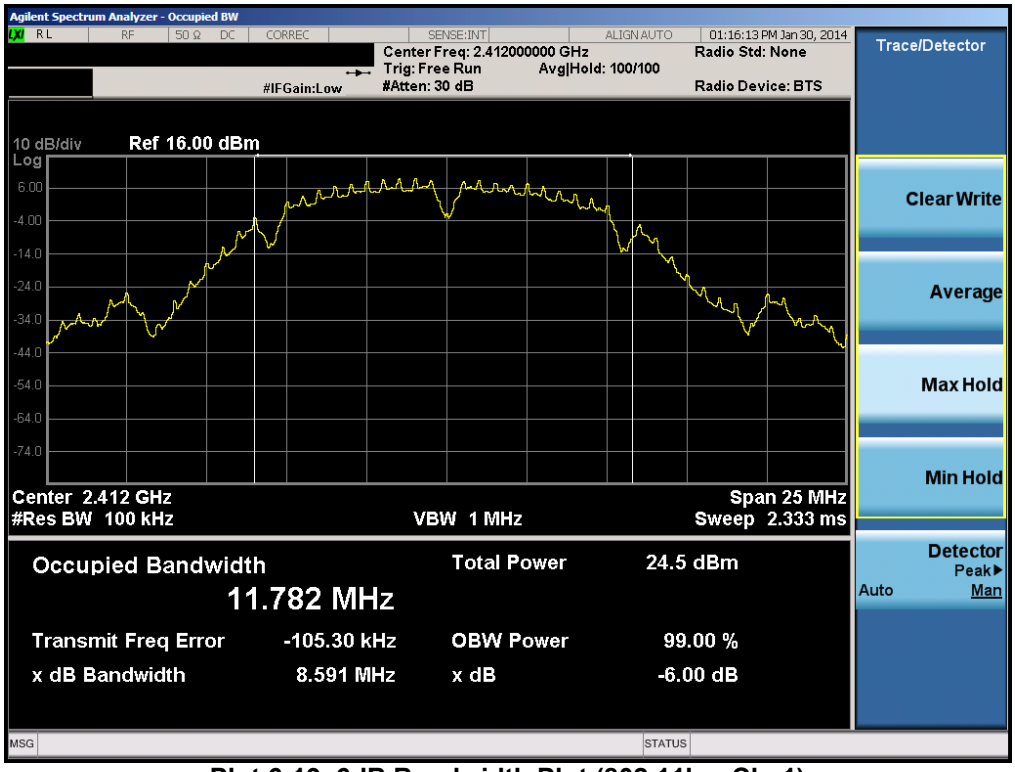
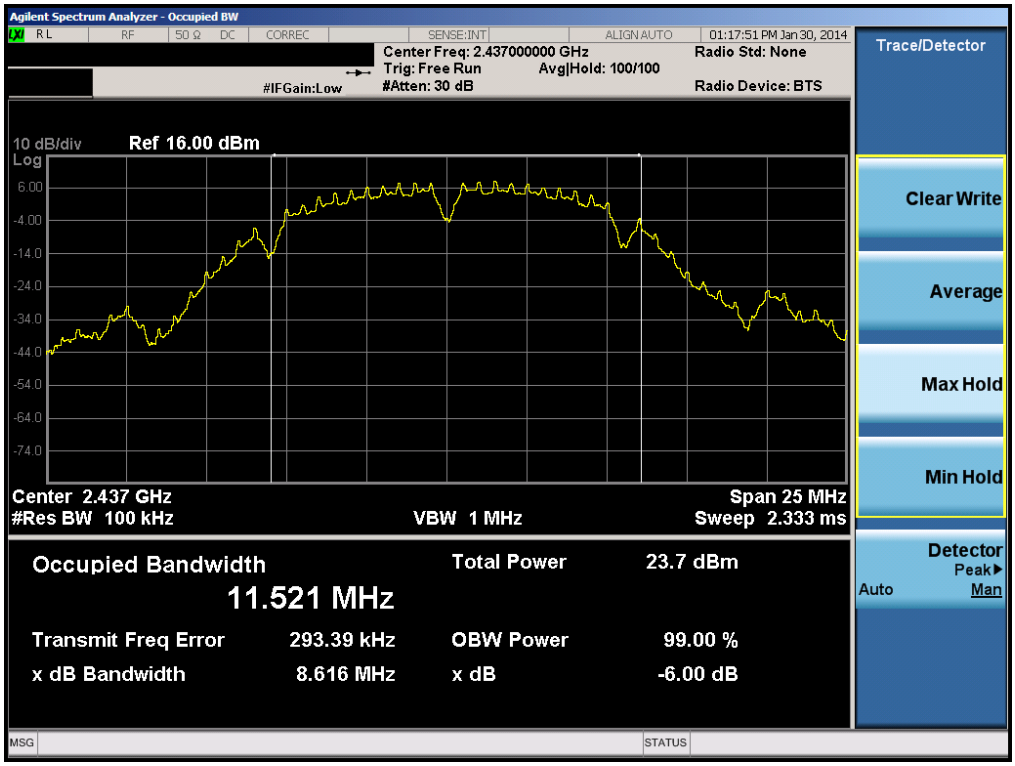


Plot 6-19. 6dB Bandwidth Plot (802.11b – Ch. 1)



Plot 6-20. 6dB Bandwidth Plot (802.11b – Ch. 6)

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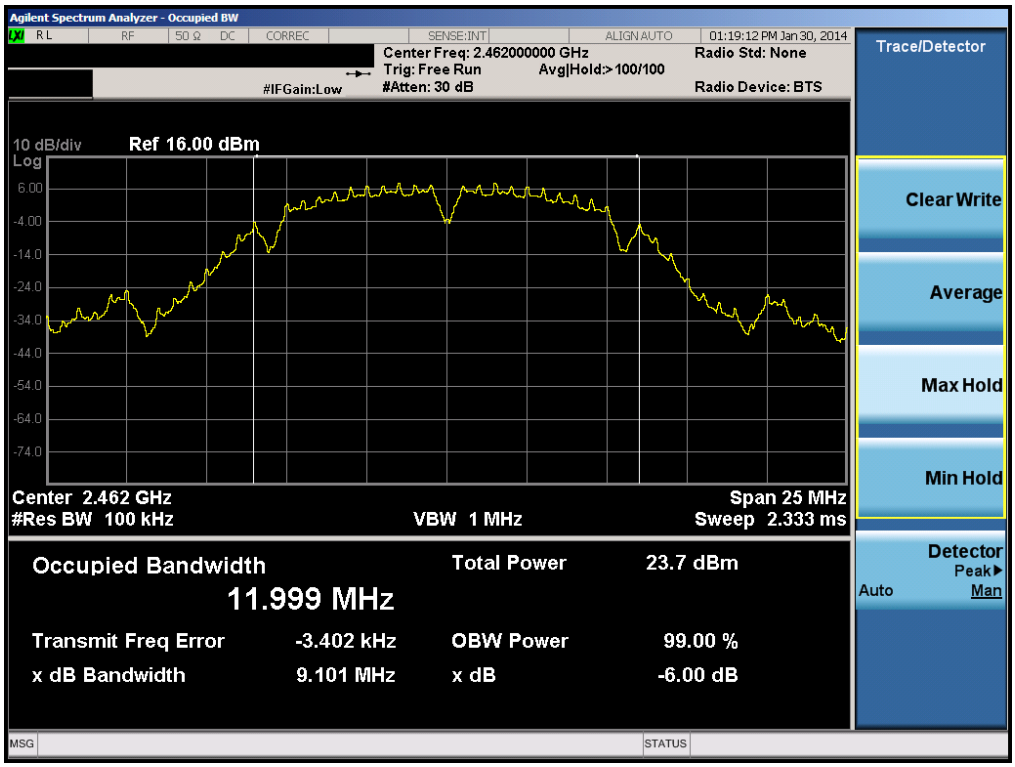
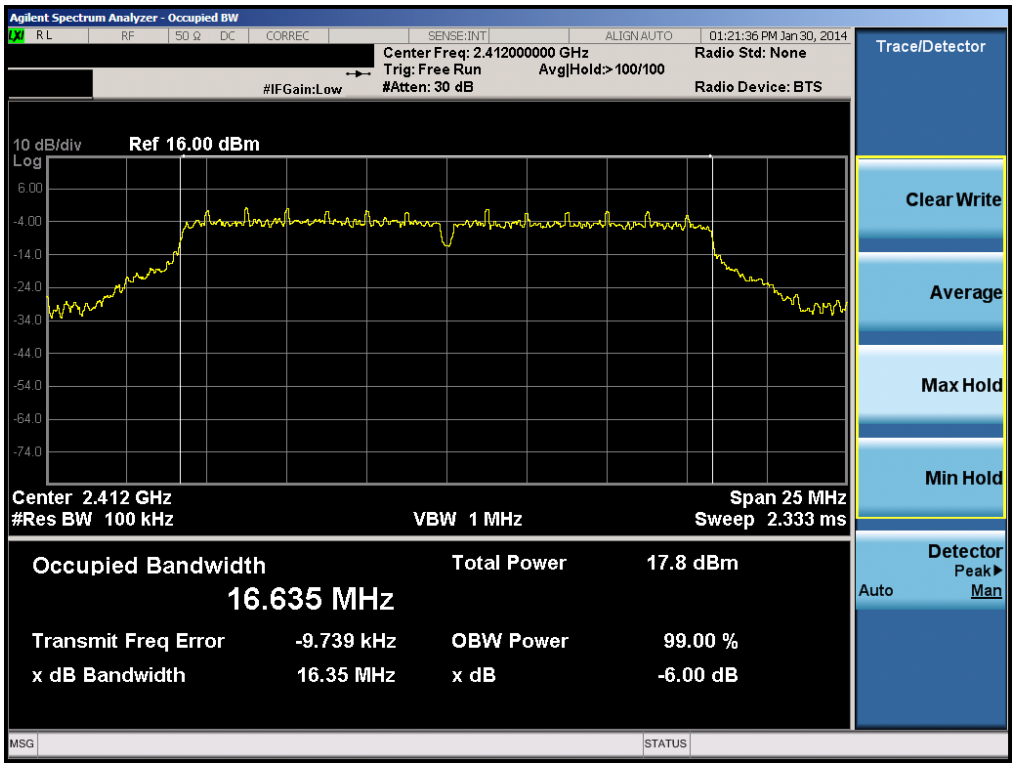


Plot 6-21. 6dB Bandwidth Plot (802.11b – Ch. 11)



Plot 6-22. 6dB Bandwidth Plot (802.11g – Ch. 1)

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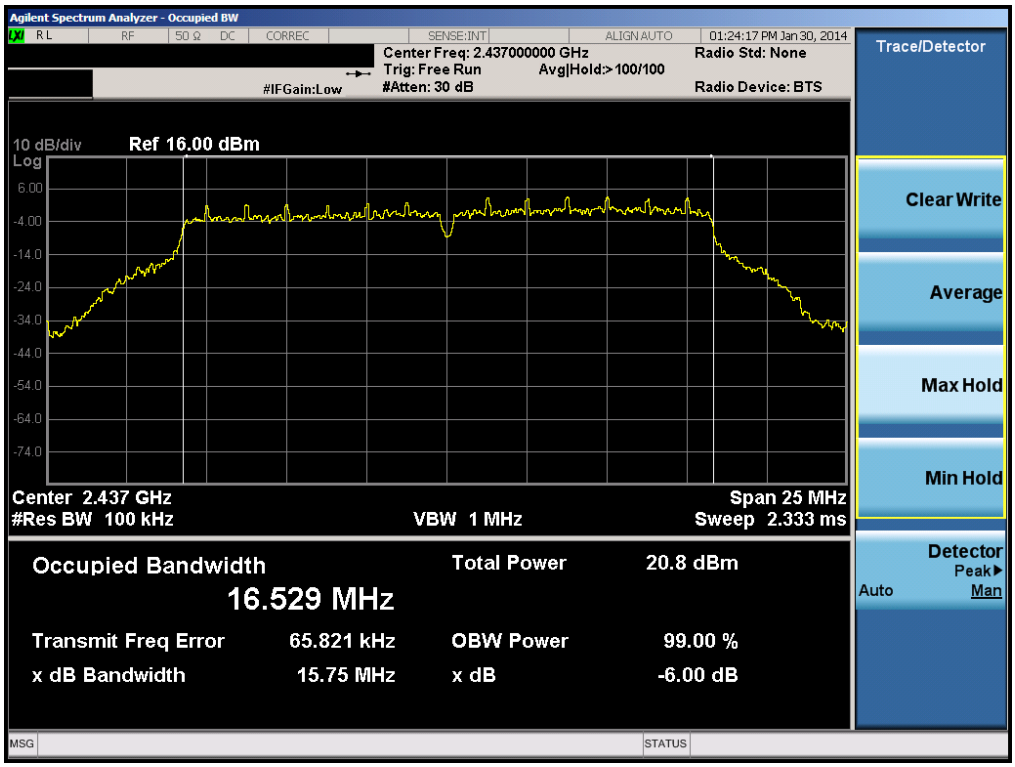
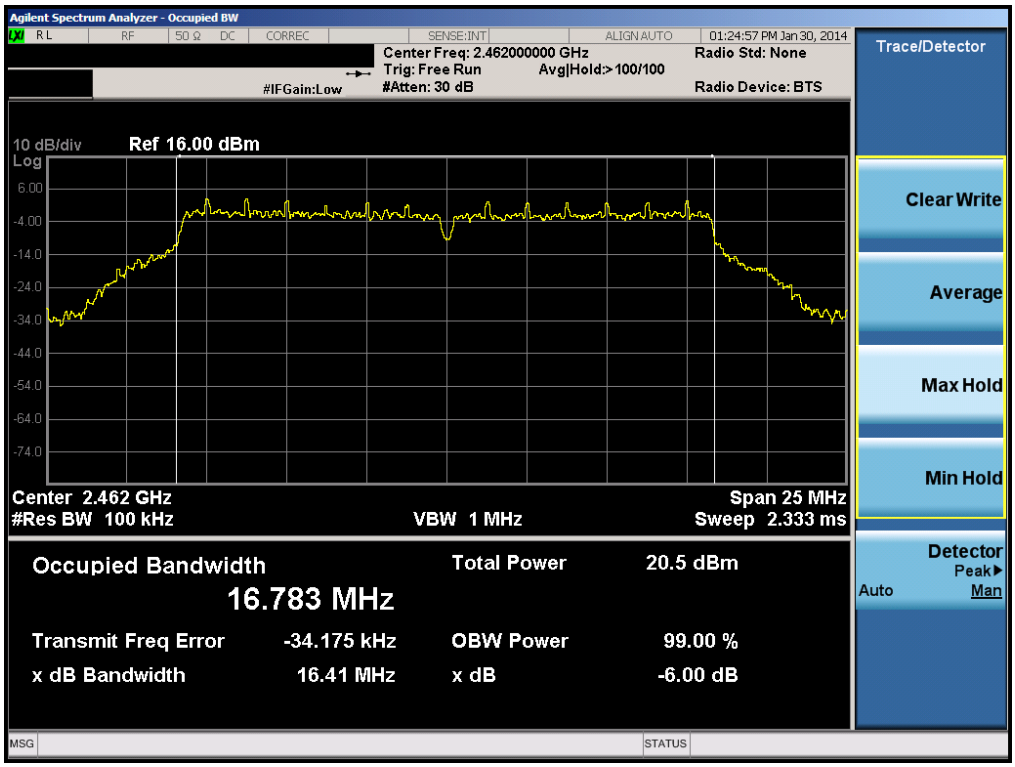


Plot 6-23. 6dB Bandwidth Plot (802.11g – Ch. 6)



Plot 6-24. 6dB Bandwidth Plot (802.11g – Ch. 11)

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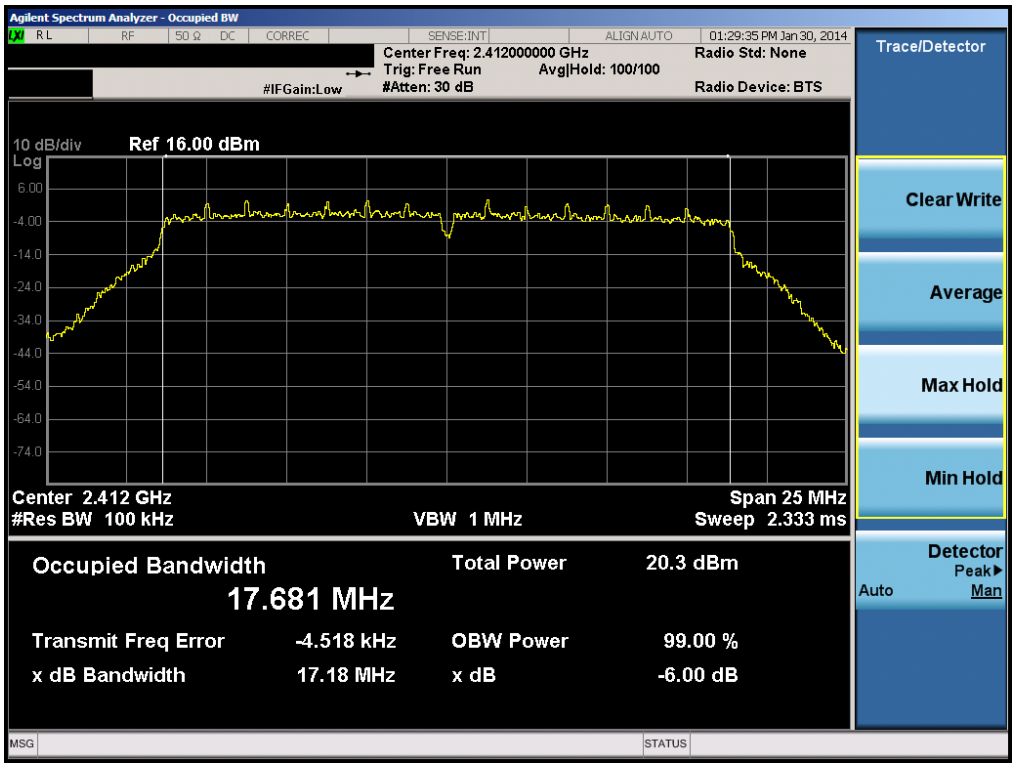
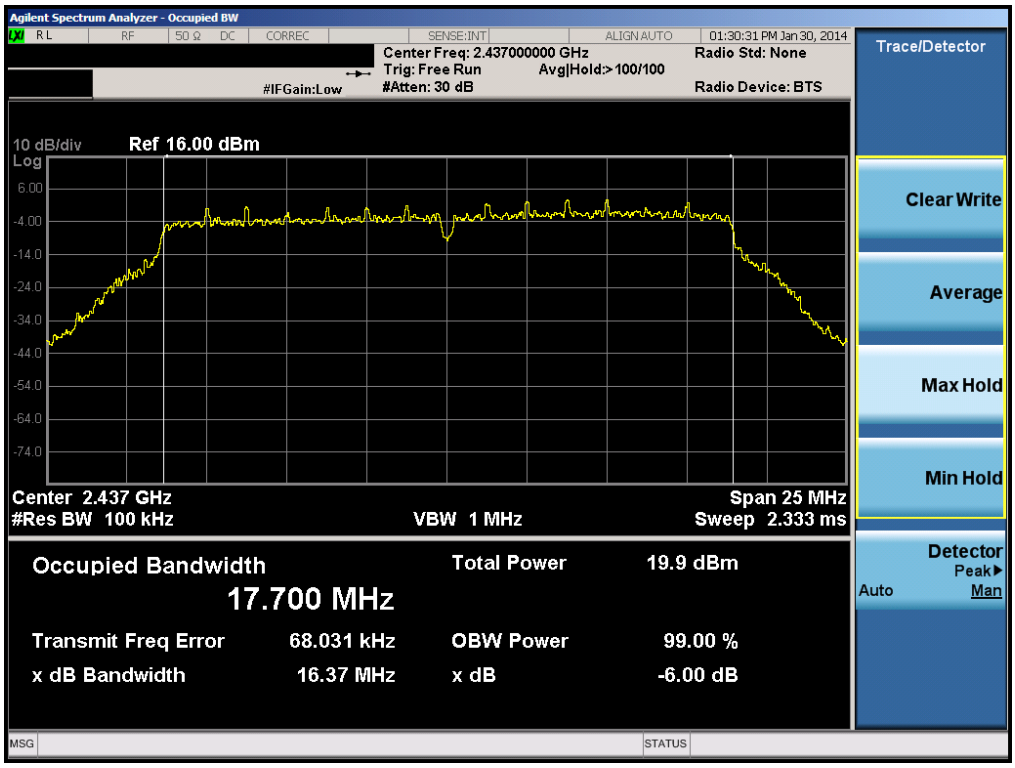


Plot 6-25. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 1)



Plot 6-26. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 6)

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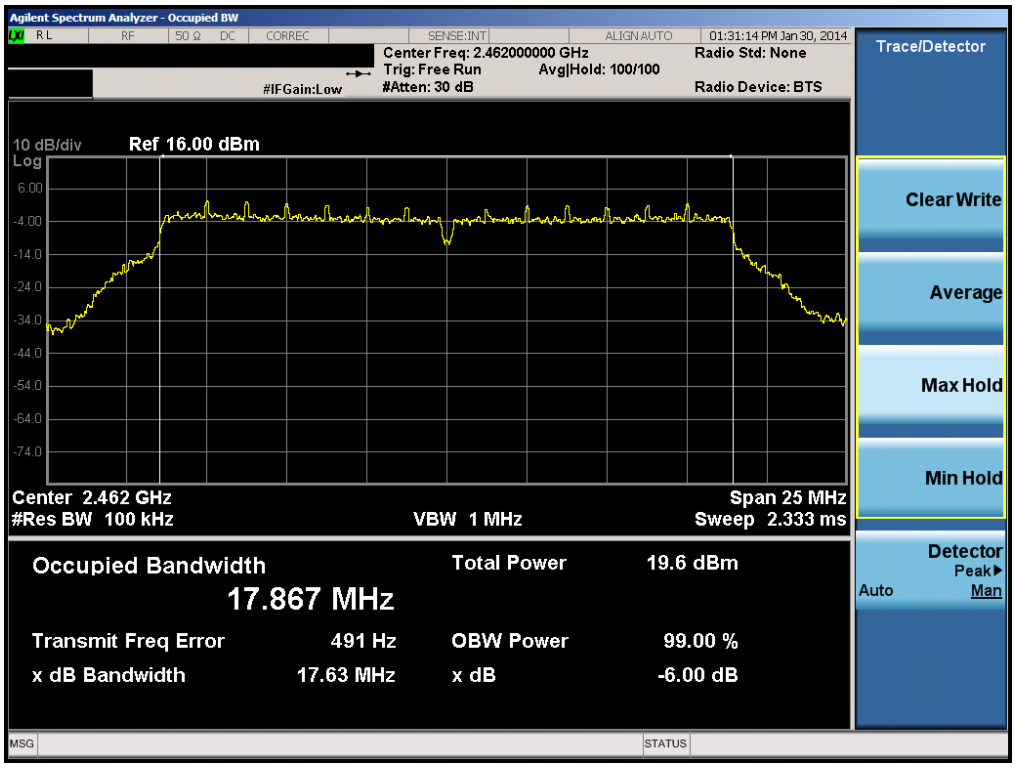
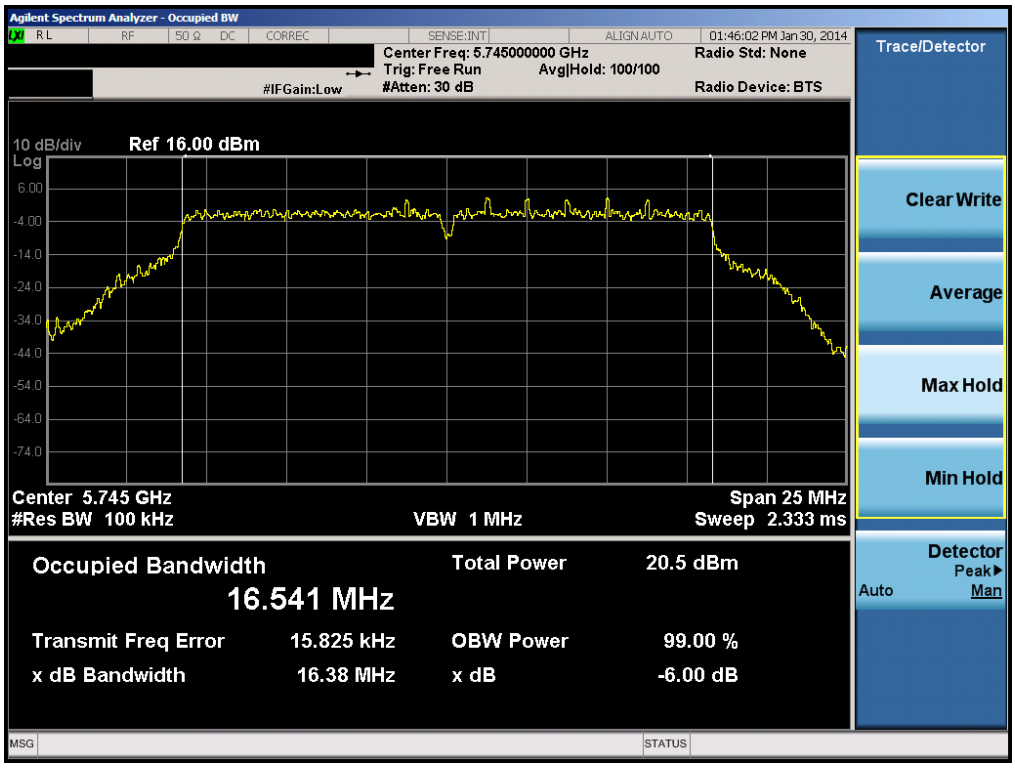


Plot 6-27. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 11)



Plot 6-28. 6dB Bandwidth Plot (802.11a – Ch. 149)

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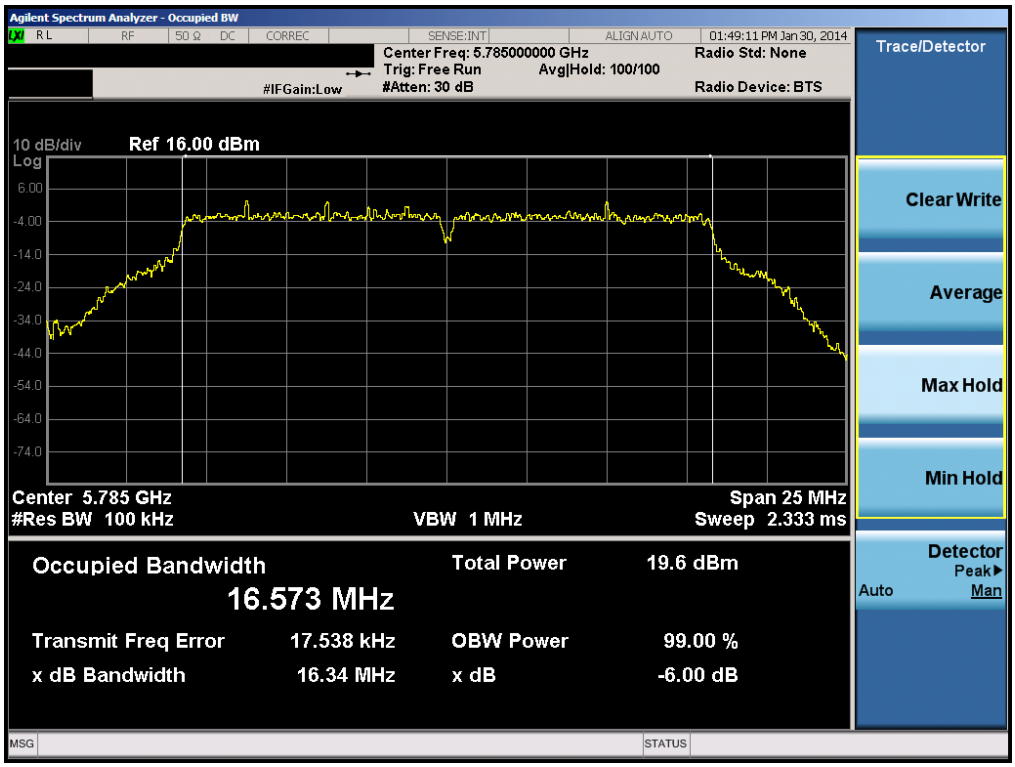
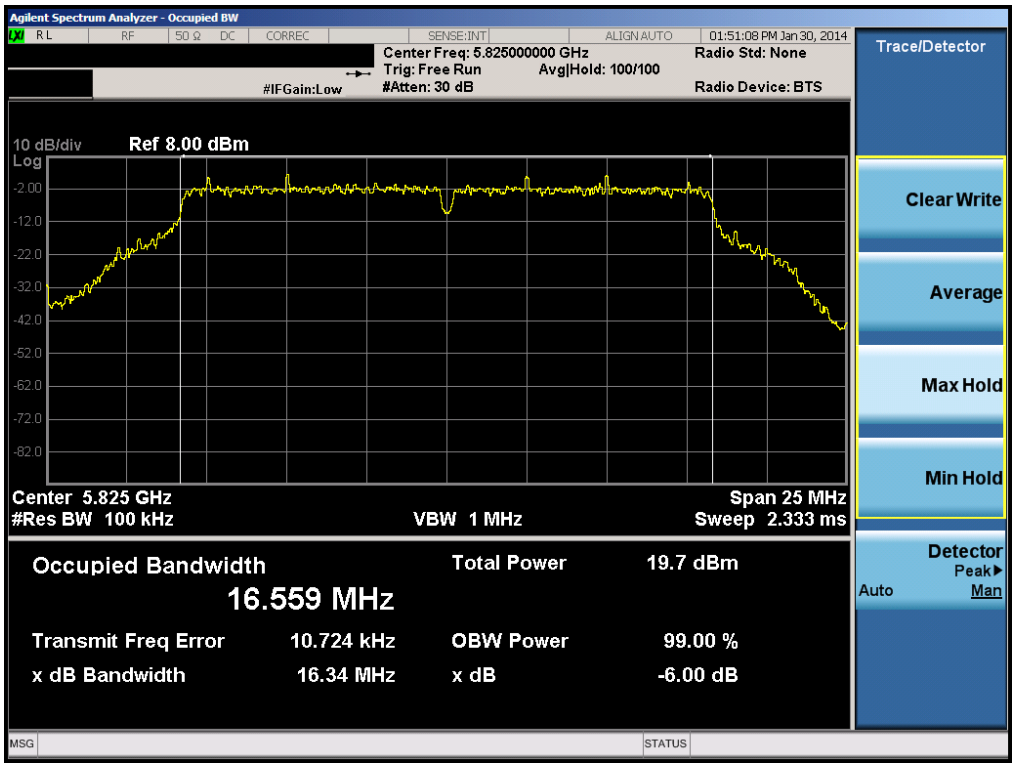


Plot 6-29. 6dB Bandwidth Plot (802.11a – Ch. 157)



Plot 6-30. 6dB Bandwidth Plot (802.11a – Ch. 165)

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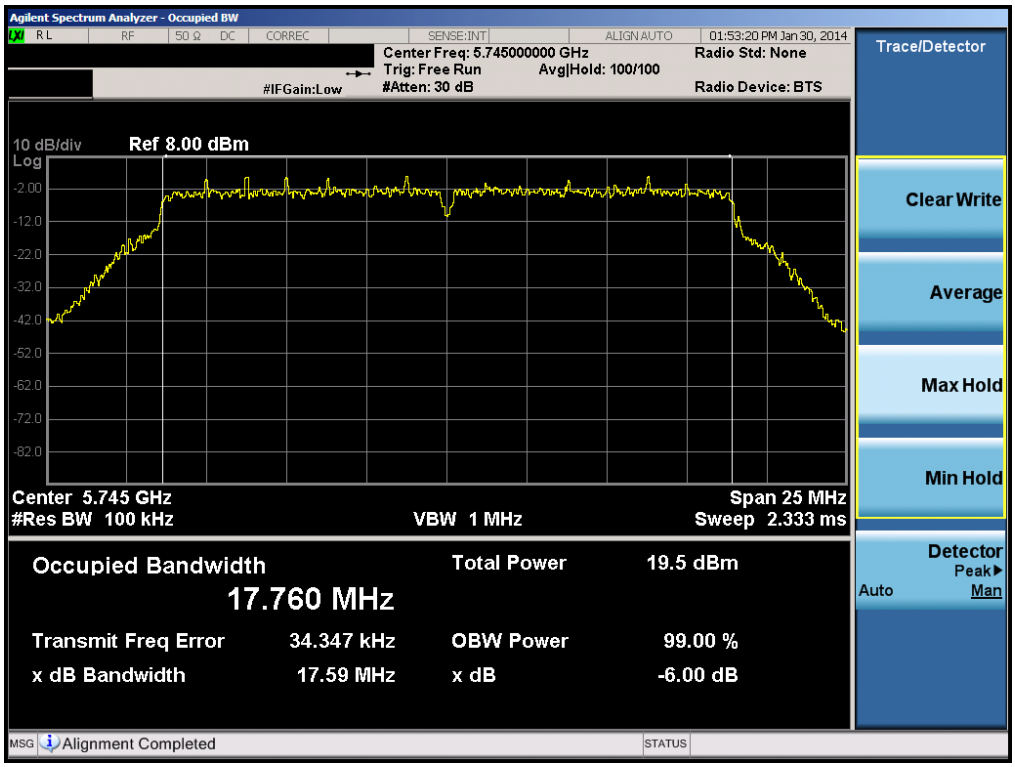
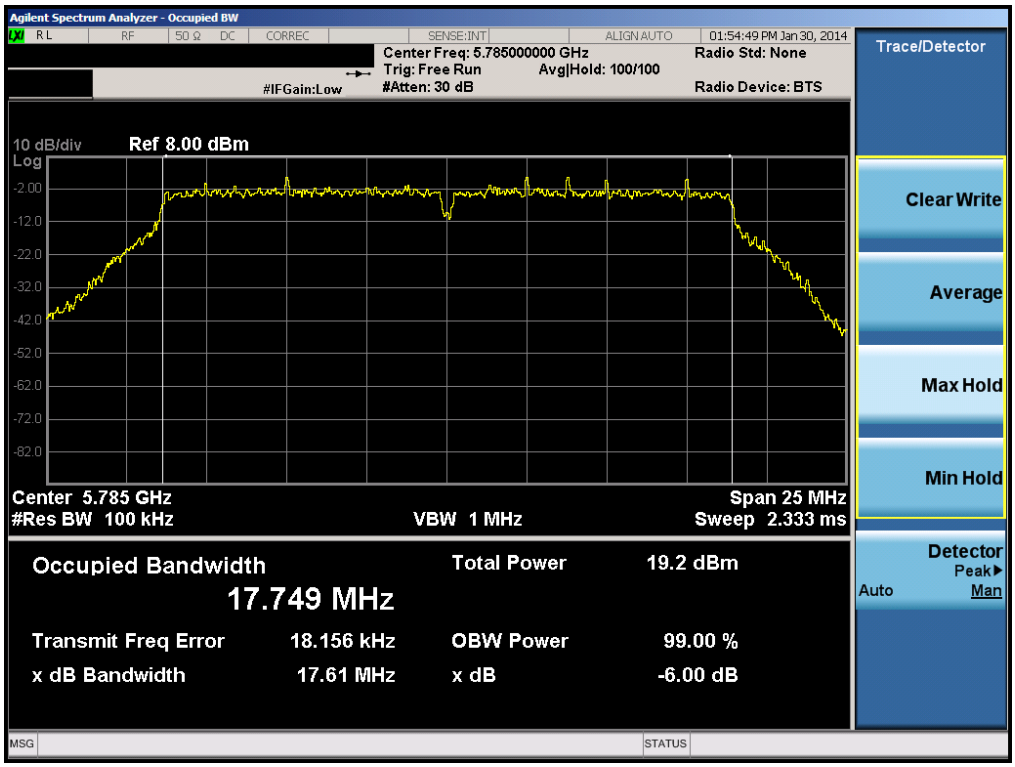


Plot 6-31. 6dB Bandwidth Plot (20MHz BW 802.11n (5.8GHz) – Ch. 149)



Plot 6-32. 6dB Bandwidth Plot (20MHz BW 802.11n (5.8GHz) – Ch. 157)

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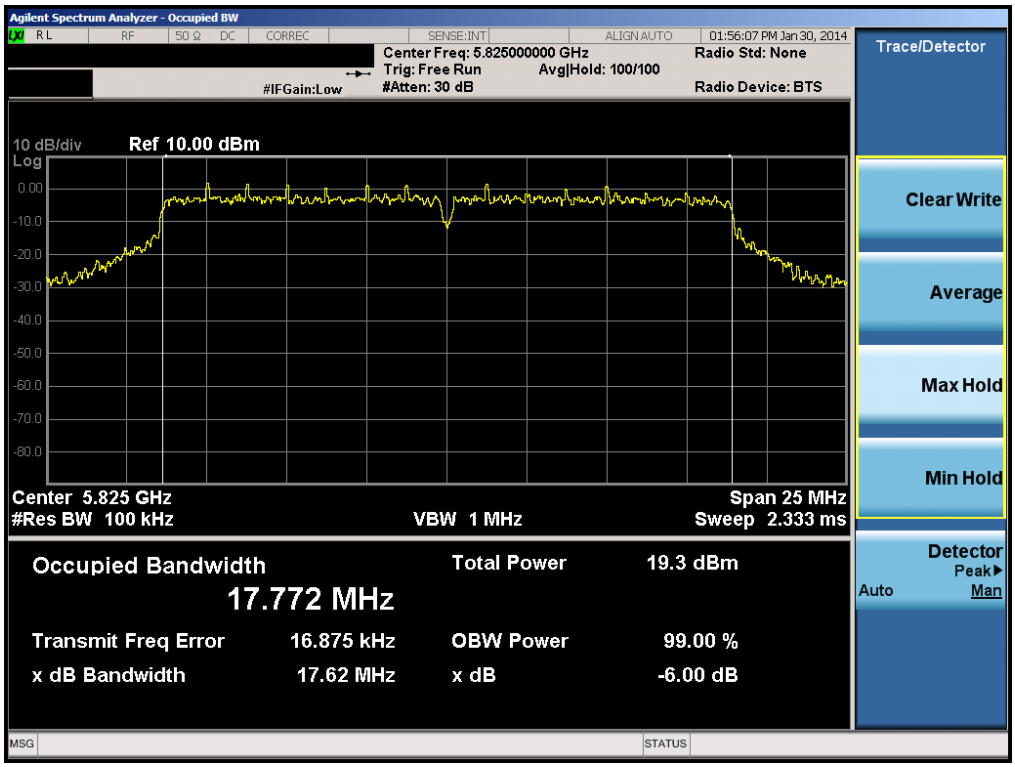
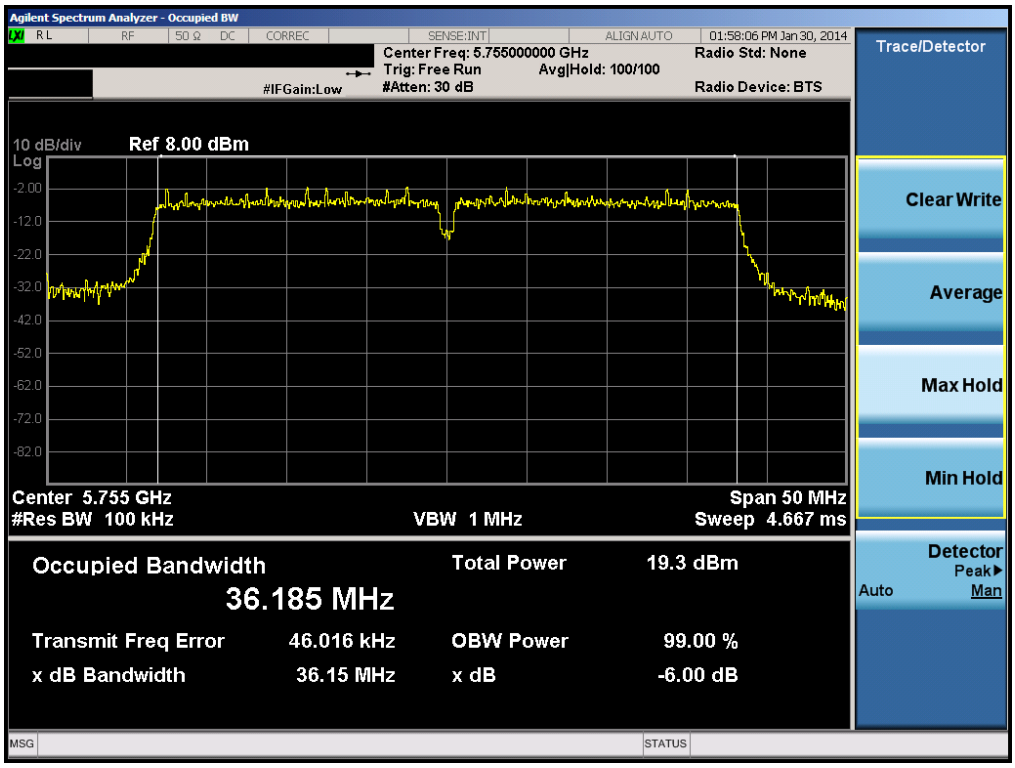


Plot 6-33. 6dB Bandwidth Plot (20MHz BW 802.11n (5.8GHz) – Ch. 165)



Plot 6-34. 6dB Bandwidth Plot (40MHz BW 802.11n (5.8GHz) – Ch. 151)

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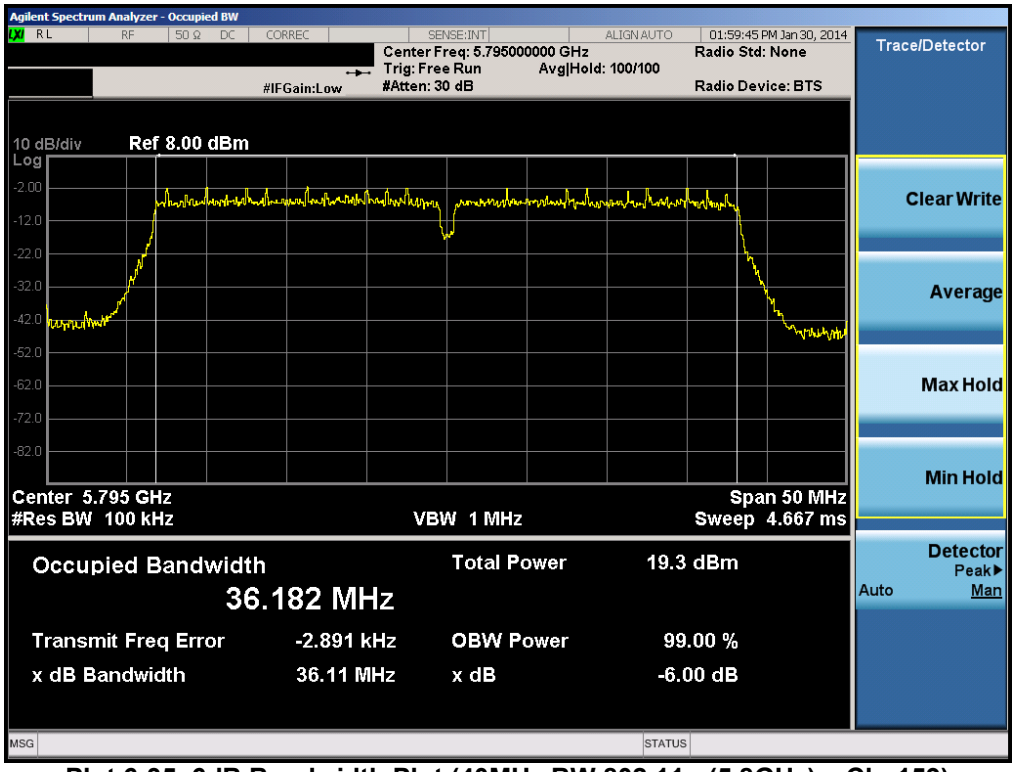
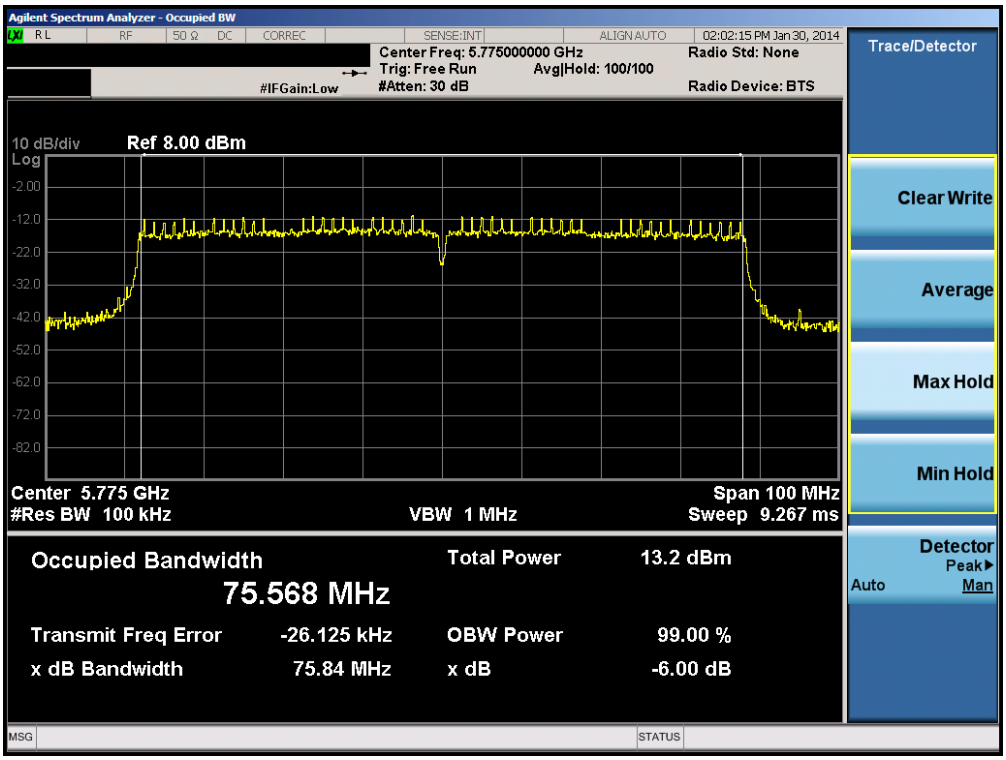


Plot 6-35. 6dB Bandwidth Plot (40MHz BW 802.11n (5.8GHz) – Ch. 159)



Plot 6-36. 6dB Bandwidth Plot (80MHz BW 802.11ac (5.8GHz) – Ch. 155)

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6.3 Output Power Measurement

§15.247(b.3)

Test Overview and Limits

A transmitter antenna terminal of EUT is connected to the input of an RF power sensor. Measurement is made using a broadband power meter capable of making peak and average measurements while the EUT is operating at its maximum duty cycle (>98%), at maximum power, and at the appropriate frequencies.

The maximum permissible conducted output power is 1 Watt.

Test Procedure Used

KDB 558074 v03r01 – Section 9.1.3 PKPM1 Peak Power Method (for signals with BW ≤ 50MHz)
KDB 558074 v03r01 – Section 9.1.2 Integrated Band Power Method (for signals with BW > 50MHz)
KDB 558074 v03r01 – Section 9.2.3.2 Method AVGPM-G (for signals of all BWs)

Test Settings

Method PKPM1 (Peak Power Measurement of Signals with DTS BW ≤ 50MHz)

Peak 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 pulse sensor employs a VBW = 50MHz so this method was only used for signals whose DTS bandwidth was less than or equal to 50MHz.

Integrated Band Power Method (Peak Power Measurement of Signals with DTS BW > 50MHz)

Since the RF power meter used only implemented a VBW of 50MHz, a signal analyzer was required to perform power measurements for signals' whose bandwidth were > 50MHz. The following settings shown in the next two sub-sections were used on a signal analyzer:

1. The signal analyzers' channel power measurement function was enabled with the integration bandwidth set to the measured DTS bandwidth
2. RBW = 1MHz
3. VBW ≥ 3 x RBW
4. Span ≥ 1.5 x DTS BW
5. Detector = peak
6. Sweep time = auto
7. Trace mode = max hold
8. Trace was allowed to fully stabilize

Method AVGPM-G (Average Power Measurements for Signals With Any Channel BW)

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.

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Test Setup

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

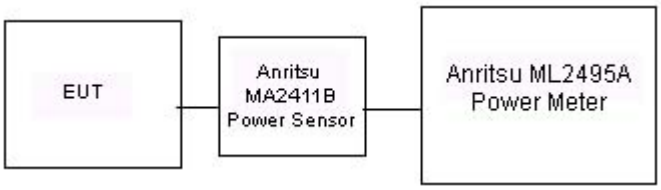

Figure 6-2. Test Instrument & Measurement Setup for Power Meter Measurements

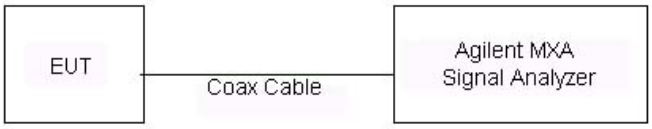

Figure 6-3. Test Instrument & Measurement Setup for Signal Analyzer Measurements

Test Notes

None

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Antenna-1 Output Power Measurement – 802.11b/g/n (2.4GHz)

Mode	Freq [MHz]	Channel	Detector	802.11b Conducted Power [dBm]			
				Data Rate [Mbps]			
				1	2	5.5	11
802.11b	2412	1	AVG	16.57	16.54	16.74	16.62
			PEAK	19.44	19.51	19.59	19.49
802.11b	2437	6	AVG	17.05	17.02	17.22	17.10
			PEAK	20.01	20.08	20.16	20.06
802.11b	2462	11	AVG	16.81	16.78	16.98	16.86
			PEAK	19.55	19.62	19.70	19.60

Table 6-4. 802.11b Conducted Output Power Measurements

Mode	Freq [MHz]	Channel	Detector	802.11g Conducted Power [dBm]							
				Data Rate [Mbps]							
				6	9	12	18	24	36	48	54
802.11g	2412	1	AVG	14.09	13.97	14.10	13.92	14.22	14.25	14.21	14.24
			PEAK	19.20	19.37	19.31	19.04	20.25	20.18	20.17	20.24
802.11g	2437	6	AVG	13.90	13.78	13.91	13.73	14.03	14.06	14.02	14.05
			PEAK	19.01	19.18	19.12	18.85	20.06	19.99	19.98	20.05
802.11g	2462	11	AVG	13.54	13.42	13.55	13.37	13.67	13.70	13.66	13.69
			PEAK	18.84	19.01	18.95	18.68	19.89	19.82	19.81	19.88

Table 6-5. 802.11g Conducted Output Power Measurements

Mode	Freq [MHz]	Channel	Detector	802.11n (2.4GHz) Conducted Power [dBm]							
				Data Rate [Mbps]							
				6.5	13	19.5	26	39	52	58.5	65
802.11n	2412	1	AVG	13.14	13.34	13.17	13.39	13.34	13.42	13.45	13.24
			PEAK	18.22	18.31	18.25	19.71	19.52	19.54	19.59	19.46
802.11n	2437	6	AVG	12.95	13.15	12.98	13.20	13.15	13.23	13.26	13.05
			PEAK	17.97	18.06	18.00	19.46	19.27	19.29	19.34	19.21
802.11n	2462	11	AVG	12.81	13.01	12.84	13.06	13.01	13.09	13.12	12.91
			PEAK	18.09	18.18	18.12	19.58	19.39	19.41	19.46	19.33

Table 6-6. 20MHz BW 802.11n (2.4GHz) Conducted Output Power Measurements

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Antenna-1 Output Power Measurement – 802.11a/n/ac (5GHz)

Mode	Freq [MHz]	Channel	Detector	802.11a Conducted Power [dBm]							
				Data Rate [Mbps]							
				6	9	12	18	24	36	48	54
802.11a	5745	149	AVG	13.31	13.12	13.33	13.25	12.81	12.63	12.79	12.56
			PEAK	18.86	19.30	18.79	18.69	19.03	18.94	18.79	19.09
802.11a	5765	153	AVG	13.21	13.02	13.23	13.15	12.71	12.53	12.69	12.46
			PEAK	18.49	18.93	18.42	18.32	18.66	18.57	18.42	18.72
802.11a	5785	157	AVG	13.15	12.96	13.17	13.09	12.65	12.47	12.63	12.40
			PEAK	18.46	18.90	18.39	18.29	18.63	18.54	18.39	18.69
802.11a	5805	161	AVG	13.20	13.01	13.22	13.14	12.70	12.52	12.68	12.45
			PEAK	18.52	18.96	18.45	18.35	18.69	18.60	18.45	18.75
802.11a	5825	165	AVG	12.98	12.79	13.00	12.92	12.48	12.30	12.46	12.23
			PEAK	18.27	18.71	18.20	18.10	18.44	18.35	18.20	18.50

Table 6-7. 802.11a Conducted Output Power Measurements

Mode	Freq [MHz]	Channel	Detector	20MHz BW 802.11n (5GHz) Conducted Power [dBm]							
				Data Rate [Mbps]							
				6.5	13	19.5	26	39	52	58.5	65
802.11n	5745	149	AVG	12.74	12.95	13.14	13.21	13.15	13.01	12.94	13.08
			PEAK	17.98	18.06	18.50	19.31	19.51	19.28	19.24	19.52
802.11n	5765	153	AVG	12.56	12.77	12.96	13.03	12.97	12.83	12.76	12.90
			PEAK	18.19	18.27	18.71	19.52	19.72	19.49	19.45	19.73
802.11n	5785	157	AVG	12.72	12.93	13.12	13.19	13.13	12.99	12.92	13.06
			PEAK	17.81	17.89	18.33	19.14	19.34	19.11	19.07	19.35
802.11n	5805	161	AVG	12.52	12.73	12.92	12.99	12.93	12.79	12.72	12.86
			PEAK	17.77	17.85	18.29	19.10	19.30	19.07	19.03	19.31
802.11n	5825	165	AVG	12.74	12.95	13.14	13.21	13.15	13.01	12.94	13.08
			PEAK	18.07	18.15	18.59	19.40	19.60	19.37	19.33	19.61

Table 6-8. 20MHz BW 802.11n (5GHz) Conducted Output Power Measurements

20MHz BW 802.11ac (5GHz) Conducted Power [dBm]				
Mode	Freq [MHz]	Channel	Detector	Data Rate
				6.5 Mbps
802.11ac	5745	149	AVG	12.69
			PEAK	17.77
802.11ac	5785	157	AVG	12.56
			PEAK	17.84
802.11ac	5825	165	AVG	12.54
			PEAK	17.65

Table 6-9. 20MHz BW 802.11ac (5GHz) Conducted Output Power Measurements

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Mode	Freq [MHz]	Channel	Detector	40MHz BW 802.11n (5GHz) Conducted Power [dBm]							
				Data Rate [Mbps]							
				13.5	27	40.5	54	81	108	121.5	135
802.11n	5755	151	AVG	11.43	11.23	11.42	11.48	11.52	11.46	11.32	11.47
			PEAK	16.79	16.87	18.16	18.22	17.76	17.89	17.96	18.04
802.11n	5795	159	AVG	11.29	11.09	11.28	11.34	11.38	11.32	11.18	11.33
			PEAK	16.67	16.75	18.04	18.10	17.64	17.77	17.84	17.92

Table 6-10. 40MHz BW 802.11n (5GHz) Conducted Output Power Measurements

40MHz BW 802.11ac (5GHz) Conducted Power [dBm]				
Mode	Freq [MHz]	Channel	Detector	Data Rate
				13.5 Mbps
802.11ac	5755	151	AVG	12.37
			PEAK	18.09
802.11ac	5795	159	AVG	12.34
			PEAK	17.75

Table 6-11. 40MHz BW 802.11ac (5GHz) Conducted Output Power Measurements

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	5775	155	AVG	11.25	11.14	10.94	11.09	11.32	10.92	11.10	11.17	10.89	10.52
			PEAK	16.27	16.32	16.24	17.21	17.50	17.73	17.87	17.92	16.92	16.96

Table 6-12. 80MHz BW 802.11ac (5GHz) Conducted Output Power Measurements

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Antenna-2 Output Power Measurement – 802.11b/g/n (2.4GHz)

Mode	Freq [MHz]	Channel	Detector	802.11b Conducted Power [dBm]			
				Data Rate [Mbps]			
				1	2	5.5	11
802.11b	2412	1	AVG	17.07	17.24	17.29	17.17
			PEAK	19.98	20.19	20.20	20.31
802.11b	2437	6	AVG	16.54	16.71	16.76	16.64
			PEAK	19.54	19.75	19.76	19.87
802.11b	2462	11	AVG	16.49	16.66	16.71	16.59
			PEAK	19.47	19.68	19.69	19.80

Table 6-13. 802.11b Conducted Output Power Measurements

Mode	Freq [MHz]	Channel	Detector	802.11g Conducted Power [dBm]							
				Data Rate [Mbps]							
				6	9	12	18	24	36	48	54
802.11g	2412	1	AVG	13.82	13.62	13.57	13.61	13.94	14.04	14.12	14.11
			PEAK	19.06	19.19	19.02	18.85	20.27	20.14	20.04	20.12
802.11g	2437	6	AVG	13.64	13.44	13.39	13.43	13.76	13.86	13.94	13.93
			PEAK	18.96	19.09	18.92	18.75	20.17	20.04	19.94	20.02
802.11g	2462	11	AVG	13.37	13.17	13.12	13.16	13.49	13.59	13.67	13.66
			PEAK	18.89	19.02	18.85	18.68	20.10	19.97	19.87	19.95

Table 6-14. 802.11g Conducted Output Power Measurements

Mode	Freq [MHz]	Channel	Detector	802.11n (2.4GHz) Conducted Power [dBm]							
				Data Rate [Mbps]							
				6.5	13	19.5	26	39	52	58.5	65
802.11n	2412	1	AVG	12.93	12.97	12.82	12.94	13.07	13.12	13.09	13.14
			PEAK	18.04	18.15	18.14	19.27	19.40	19.56	19.45	19.24
802.11n	2437	6	AVG	12.85	12.89	12.74	12.86	12.99	13.04	13.01	13.06
			PEAK	17.98	18.09	18.08	19.21	19.34	19.50	19.39	19.18
802.11n	2462	11	AVG	12.64	12.68	12.53	12.65	12.78	12.83	12.80	12.85
			PEAK	17.96	18.07	18.06	19.19	19.32	19.48	19.37	19.16

Table 6-15. 20MHz BW 802.11n (2.4GHz) Conducted Output Power Measurements

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Antenna-2 Output Power Measurement – 802.11a/n (5GHz)

Mode	Freq [MHz]	Channel	Detector	802.11a Conducted Power [dBm]							
				Data Rate [Mbps]							
				6	9	12	18	24	36	48	54
802.11a	5745	149	AVG	13.37	13.09	12.91	12.95	13.35	13.17	13.24	13.37
			PEAK	18.91	18.51	18.45	18.34	19.86	19.61	19.84	19.92
802.11a	5765	153	AVG	13.44	13.16	12.98	13.02	13.42	13.24	13.31	13.44
			PEAK	18.82	18.42	18.36	18.25	19.77	19.52	19.75	19.83
802.11a	5785	157	AVG	13.31	13.03	12.85	12.89	13.29	13.11	13.18	13.31
			PEAK	18.85	18.45	18.39	18.28	19.80	19.55	19.78	19.86
802.11a	5805	161	AVG	13.11	12.83	12.65	12.69	13.09	12.91	12.98	13.11
			PEAK	18.74	18.34	18.28	18.17	19.69	19.44	19.67	19.75
802.11a	5825	165	AVG	13.25	12.97	12.79	12.83	13.23	13.05	13.12	13.25
			PEAK	18.72	18.32	18.26	18.15	19.67	19.42	19.65	19.73

Table 6-16. 802.11a Conducted Output Power Measurements

Mode	Freq [MHz]	Channel	Detector	20MHz BW 802.11n (5GHz) Conducted Power [dBm]							
				Data Rate [Mbps]							
				6.5	13	19.5	26	39	52	58.5	65
802.11n	5745	149	AVG	13.08	13.12	13.27	13.29	13.25	13.21	13.30	13.24
			PEAK	18.35	18.52	18.65	19.79	19.64	19.54	19.68	19.79
802.11n	5765	153	AVG	13.11	13.15	13.30	13.32	13.28	13.24	13.33	13.27
			PEAK	18.42	18.59	18.72	19.86	19.71	19.61	19.75	19.86
802.11n	5785	157	AVG	13.21	13.25	13.40	13.42	13.38	13.34	13.43	13.37
			PEAK	18.59	18.76	18.89	20.03	19.88	19.78	19.92	20.03
802.11n	5805	161	AVG	13.25	13.29	13.44	13.46	13.42	13.38	13.47	13.41
			PEAK	18.68	18.85	18.98	20.12	19.97	19.87	20.01	20.12
802.11n	5825	165	AVG	13.16	13.20	13.35	13.37	13.33	13.29	13.38	13.32
			PEAK	18.58	18.75	18.88	20.02	19.87	19.77	19.91	20.02

Table 6-17. 20MHz BW 802.11n (5GHz) Conducted Output Power Measurements

20MHz BW 802.11ac (5GHz) Conducted Power [dBm]				
Mode	Freq [MHz]	Channel	Detector	Data Rate
				6.5 Mbps
802.11ac	5745	149	AVG	13.14
			PEAK	18.47
802.11ac	5785	157	AVG	13.38
			PEAK	18.55
802.11ac	5825	165	AVG	13.17
			PEAK	18.42

Table 6-18. 20MHz BW 802.11ac (5GHz) Conducted Output Power Measurements

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Mode	Freq [MHz]	Channel	Detector	40MHz BW 802.11n (5GHz) Conducted Power [dBm]							
				Data Rate [Mbps]							
				13.5	27	40.5	54	81	108	121.5	135
802.11n	5755	151	AVG	11.74	11.84	11.81	12.02	12.05	11.98	11.90	11.84
			PEAK	17.09	17.24	17.05	18.52	18.56	18.17	18.15	19.25
802.11n	5795	159	AVG	11.77	11.87	11.84	12.05	12.08	12.01	11.93	11.87
			PEAK	17.01	17.16	16.97	18.44	18.48	18.09	18.07	19.17

Table 6-19. 40MHz BW 802.11n (5GHz) Conducted Output Power Measurements

40MHz BW 802.11ac (5GHz) Conducted Power [dBm]				
Mode	Freq [MHz]	Channel	Detector	Data Rate
				13.5 Mbps
802.11ac	5755	151	AVG	11.75
			PEAK	17.39
802.11ac	5795	159	AVG	11.72
			PEAK	17.51

Table 6-20. 40MHz BW 802.11ac (5GHz) Conducted Output Power Measurements

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	5775	155	AVG	11.26	11.23	11.14	11.24	11.37	11.24	11.42	11.38	11.27	11.35
			PEAK	15.76	15.97	15.84	17.19	17.01	17.09	17.22	17.21	17.17	17.06

Table 6-21. 80MHz BW 802.11ac (5GHz) Conducted Output Power Measurements

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MIMO Output Power Measurement – 802.11n (2.4GHz, 5GHz)

Mode	Freq [MHz]	Channel	Detector	Data
				MCS8
802.11n	2412	1	AVG	10.59
			PEAK	15.85
802.11n	2437	6	AVG	10.12
			PEAK	15.52
802.11n	2462	11	AVG	10.08
			PEAK	15.37

Table 6-22. 20MHz BW 802.11n (2.4GHz) Conducted Output Power Measurements (Antenna1)

Mode	Freq [MHz]	Channel	Detector	Data
				MCS8
802.11n	2412	1	AVG	11.11
			PEAK	16.27
802.11n	2437	6	AVG	11.08
			PEAK	16.15
802.11n	2462	11	AVG	10.82
			PEAK	15.97

Table 6-23. 20MHz BW 802.11n (2.4GHz) Conducted Output Power Measurements (Antenna2)

Mode	Freq [MHz]	Channel	Detector	Data
				MCS8
802.11n	2412	1	AVG	13.87
			PEAK	19.08
802.11n	2437	6	AVG	13.64
			PEAK	18.86
802.11n	2462	11	AVG	13.48
			PEAK	18.69

Table 6-24. 20MHz BW 802.11n (2.4GHz) Conducted Output Power Measurements (Summed)

Mode	Freq [MHz]	Channel	Detector	Data
				MCS8
802.11n	5745	149	AVG	10.70
			PEAK	16.08
802.11n	5765	153	AVG	10.77
			PEAK	16.07
802.11n	5785	157	AVG	10.72
			PEAK	16.08
802.11n	5805	161	AVG	10.64
			PEAK	15.97
802.11n	5825	165	AVG	10.68
			PEAK	15.89

Table 6-25. 20MHz BW 802.11n (5GHz) Conducted Output Power Measurements (Antenna1)

Mode	Freq [MHz]	Channel	Detector	Data
				MCS8
802.11n	5745	149	AVG	10.14
			PEAK	15.16
802.11n	5765	153	AVG	10.13
			PEAK	15.15
802.11n	5785	157	AVG	10.11
			PEAK	15.11
802.11n	5805	161	AVG	10.19
			PEAK	15.27
802.11n	5825	165	AVG	10.11
			PEAK	15.14

Table 6-26. 20MHz BW 802.11n (5GHz) Conducted Output Power Measurements (Antenna2)

Mode	Freq [MHz]	Channel	Detector	Data
				MCS8
802.11n	5745	149	AVG	13.44
			PEAK	18.65
802.11n	5765	153	AVG	13.47
			PEAK	18.64
802.11n	5785	157	AVG	13.44
			PEAK	18.63
802.11n	5805	161	AVG	13.43
			PEAK	18.64
802.11n	5825	165	AVG	13.41
			PEAK	18.54

Table 6-27. 20MHz BW 802.11n (5GHz) Conducted Output Power Measurements (Summed)

Mode	Freq [MHz]	Channel	Detector	Data
				MCS8
802.11n	5755	151	AVG	9.55
			PEAK	15.17
802.11n	5795	159	AVG	9.41
			PEAK	14.99

Table 6-28. 40MHz BW 802.11n (5GHz) Conducted Output Power Measurements (Antenna1)

Mode	Freq [MHz]	Channel	Detector	Data
				MCS8
802.11n	5755	151	AVG	9.30
			PEAK	14.57
802.11n	5795	159	AVG	9.12
			PEAK	14.34

Table 6-29. 40MHz BW 802.11n (5GHz) Conducted Output Power Measurements (Antenna2)

Mode	Freq [MHz]	Channel	Detector	Data
				MCS8
802.11n	5755	151	AVG	12.44
			PEAK	17.89
802.11n	5795	159	AVG	12.28
			PEAK	17.69

Table 6-30. 40MHz BW 802.11n (5GHz) Conducted Output Power Measurements (Summed)

Mode	Freq [MHz]	Channel	Detector	Data
				29.3
802.11ac	5775	155	AVG	7.87
			PEAK	12.65

Table 6-31. 80MHz BW 802.11ac (5GHz) Conducted Output Power Measurements (Antenna1)

Mode	Freq [MHz]	Channel	Detector	Data
				29.3
802.11ac	5775	155	AVG	7.63
			PEAK	12.23

Table 6-32. 80MHz BW 802.11ac (5GHz) Conducted Output Power Measurements (Antenna2)

Mode	Freq [MHz]	Channel	Detector	Data
				29.3
802.11ac	5775	155	AVG	10.76
			PEAK	15.46

Table 6-33. 80MHz BW 802.11ac (5GHz) Conducted Output Power Measurements (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 2412MHz the average conducted output power was measured to be 10.59 dBm for Antenna-1 and 11.11 dBm for Antenna-2.

Antenna 1 + Antenna 2 = MIMO

(10.59 dBm + 11.11 dBm) = (11.46 mW + 12.91 mW) = 24.37 mW = 13.87 dBm

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6.4 Power Spectral Density (802.11a/b/g/n/ac)

§15.247(e)

Test Overview and Limit

The peak power density is measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle (>98%), at maximum power, and at the appropriate frequencies. All data rates were investigated and the worst case configuration results are reported in this section.

The maximum permissible power spectral density is 8 dBm in any 3 kHz band.

Test Procedure Used

KDB 558074 v03r01 – Section 10.2 Method PKPSD

Test Settings

1. Analyzer was set to the center frequency of the DTS channel under investigation
2. Span = 1.5 times the DTS channel bandwidth
3. RBW = 10kHz
4. VBW = 1MHz
5. Detector = peak
6. Sweep time = auto couple
7. Trace mode = max hold
8. Trace was allowed to stabilize

Test Setup

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

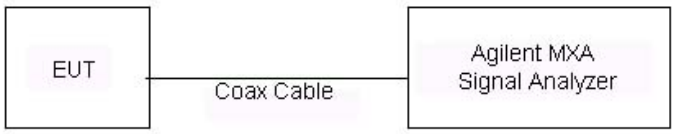

Figure 6-4. Test Instrument & Measurement Setup

Test Notes

None

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Antenna-1 Power Spectral Density Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]	Pass / Fail
2412	1	b	1	-1.45	8.00	-9.45	Pass
2437	6	b	1	-1.25	8.00	-9.25	Pass
2462	11	b	1	-0.62	8.00	-8.62	Pass
2412	1	g	6	-6.47	8.00	-14.47	Pass
2437	6	g	6	-6.63	8.00	-14.63	Pass
2462	11	g	6	-5.66	8.00	-13.66	Pass
2412	1	n	6.5/7.2 (MCS0)	-6.46	8.00	-14.46	Pass
2437	6	n	6.5/7.2 (MCS0)	-5.96	8.00	-13.96	Pass
2462	11	n	6.5/7.2 (MCS0)	-5.76	8.00	-13.76	Pass
5745	149	a	6	-5.35	8.00	-13.35	Pass
5785	157	a	6	-5.54	8.00	-13.54	Pass
5825	165	a	6	-6.18	8.00	-14.18	Pass
5745	149	n (20MHz)	6.5/7.2 (MCS0)	-6.04	8.00	-14.04	Pass
5785	157	n (20MHz)	6.5/7.2 (MCS0)	-6.29	8.00	-14.29	Pass
5825	165	n (20MHz)	6.5/7.2 (MCS0)	-7.05	8.00	-15.05	Pass
5755	151	n (40MHz)	13.5/15 (MCS0)	-8.61	8.00	-16.61	Pass
5795	159	n (40MHz)	13.5/15 (MCS0)	-9.40	8.00	-17.40	Pass
5775	155	ac (80MHz)	29.3/32.5 (MCS0)	-13.66	8.00	-21.66	Pass

Table 6-34. Conducted Power Density Measurements

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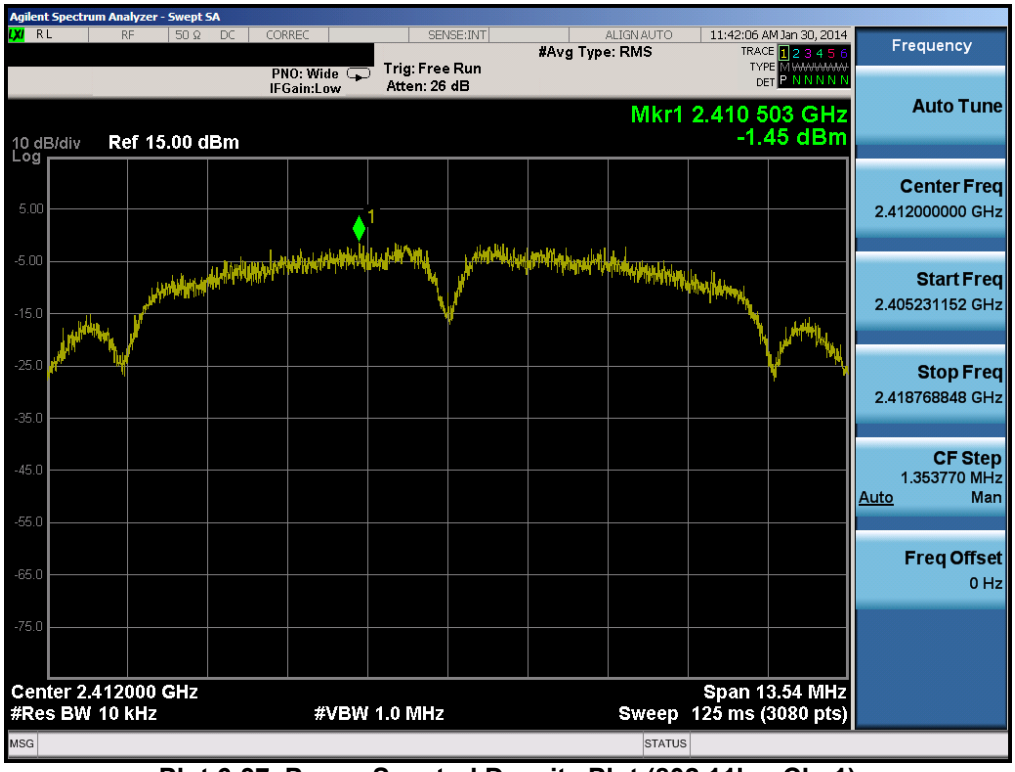
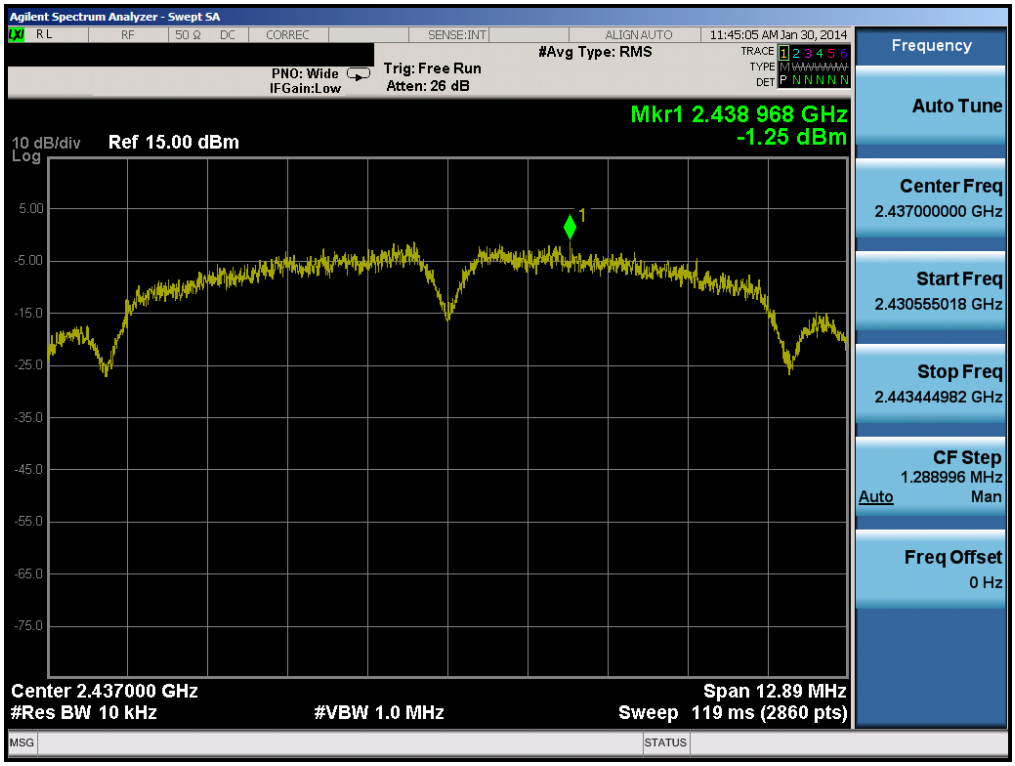


Plot 6-37. Power Spectral Density Plot (802.11b – Ch. 1)



Plot 6-38. Power Spectral Density Plot (802.11b – Ch. 6)

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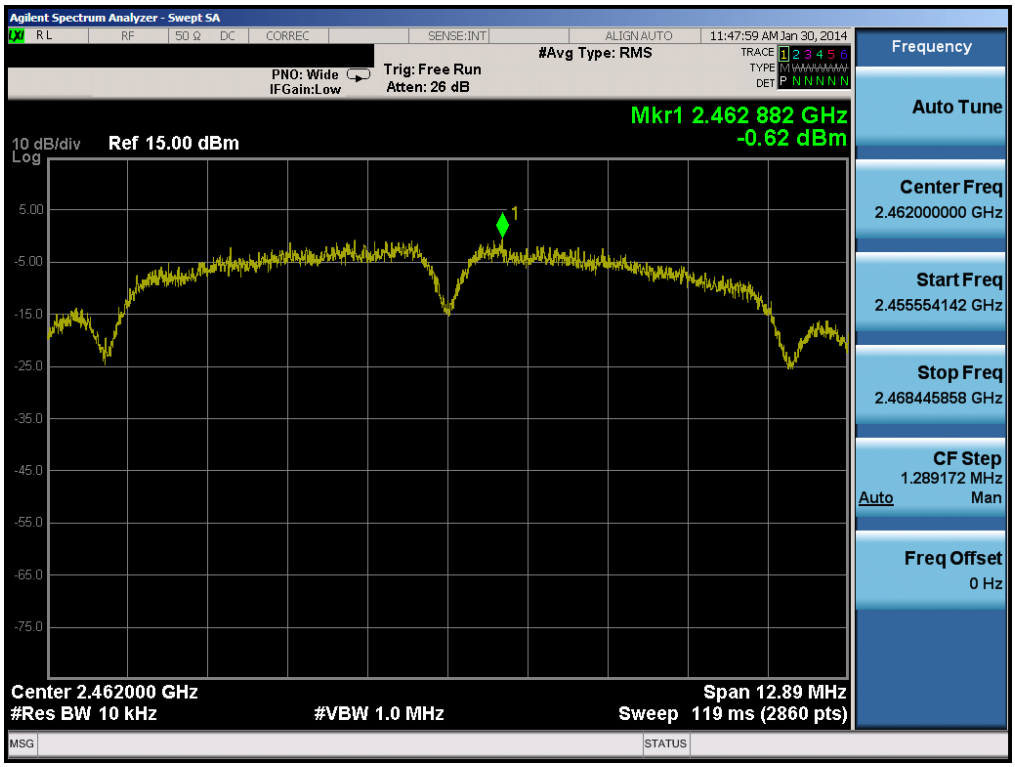
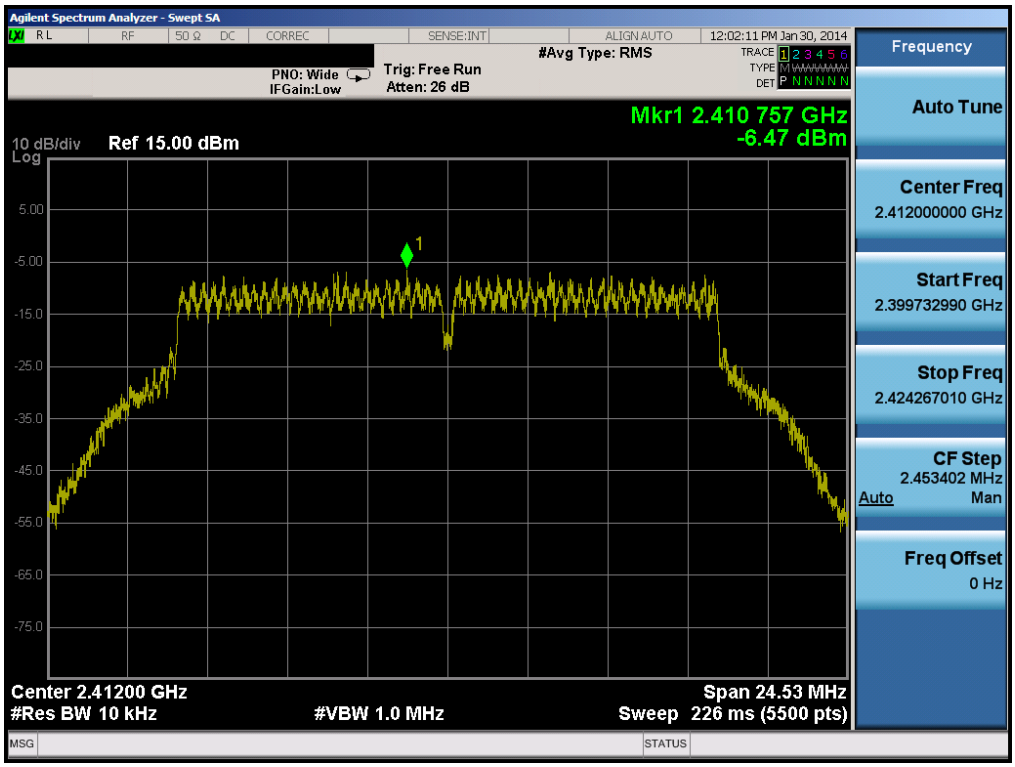


Plot 6-39. Power Spectral Density Plot (802.11b – Ch. 11)



Plot 6-40. Power Spectral Density Plot (802.11g – Ch. 1)

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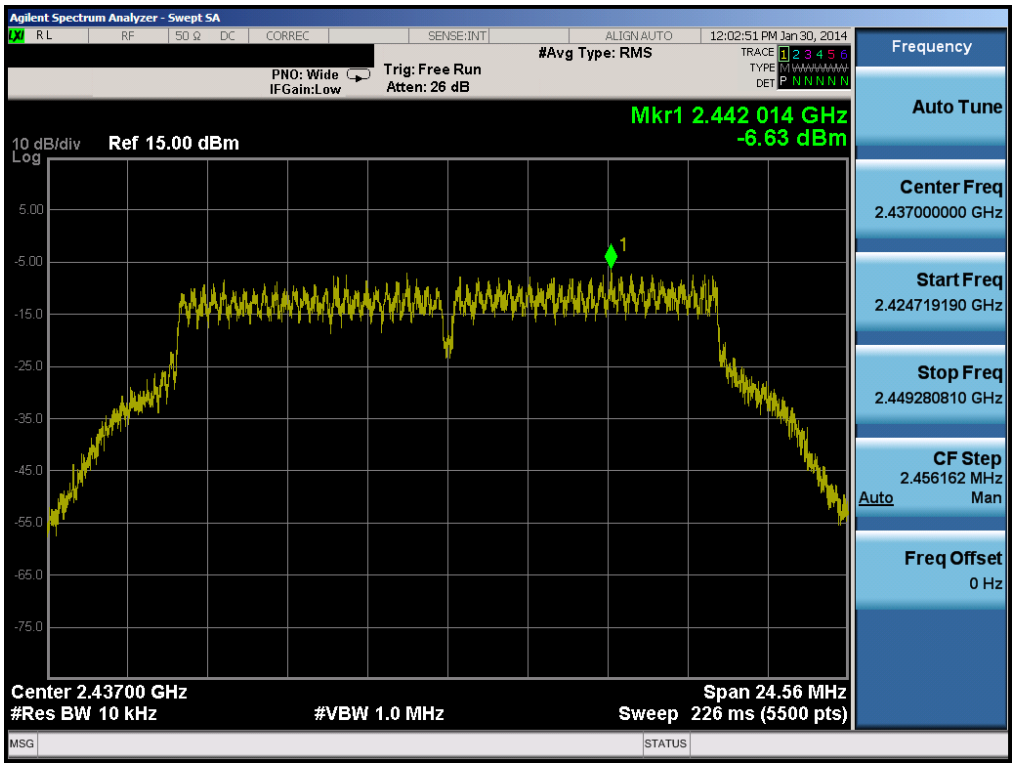
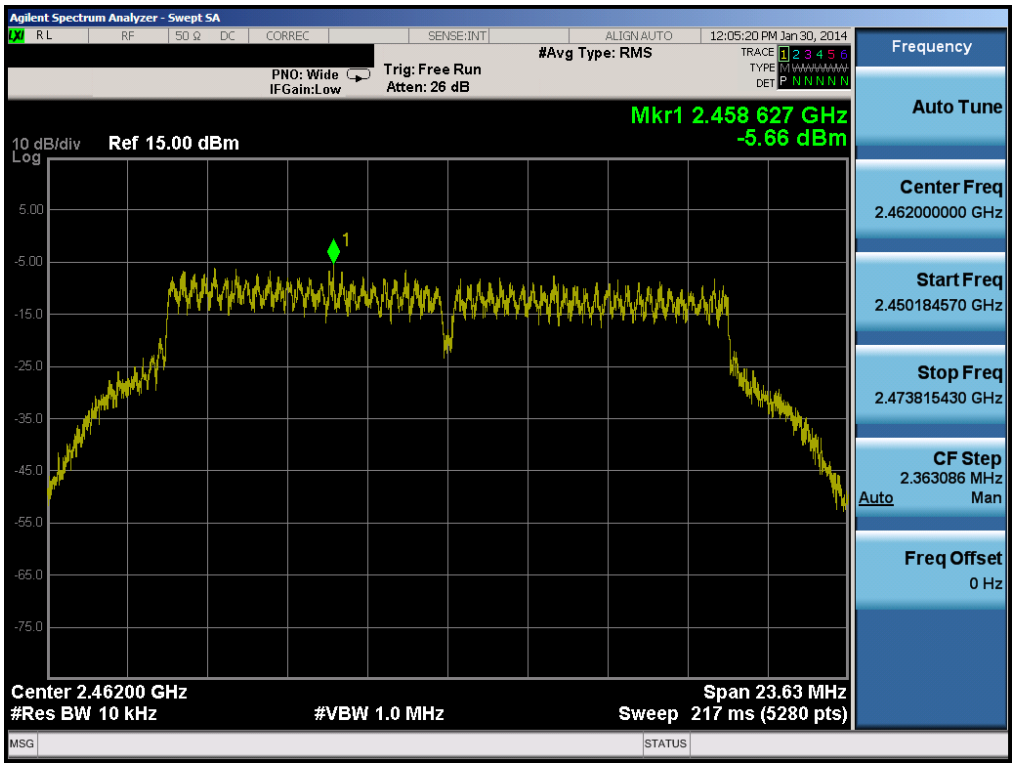


Plot 6-41. Power Spectral Density Plot (802.11g – Ch. 6)



Plot 6-42. Power Spectral Density Plot (802.11g – Ch. 11)

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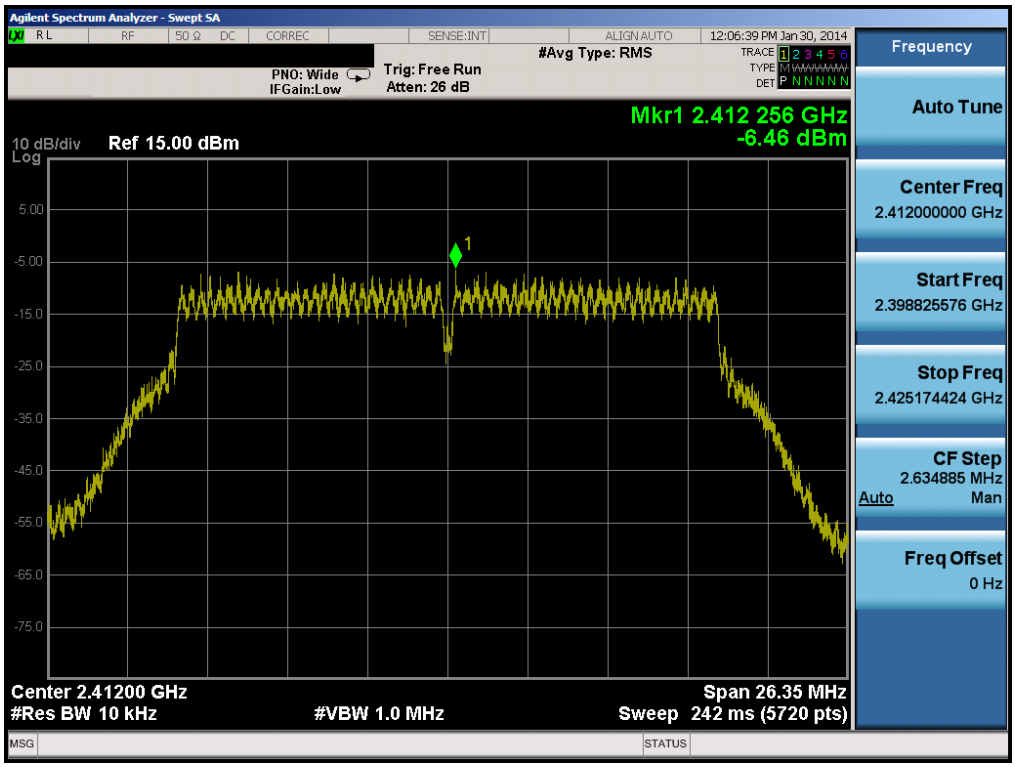
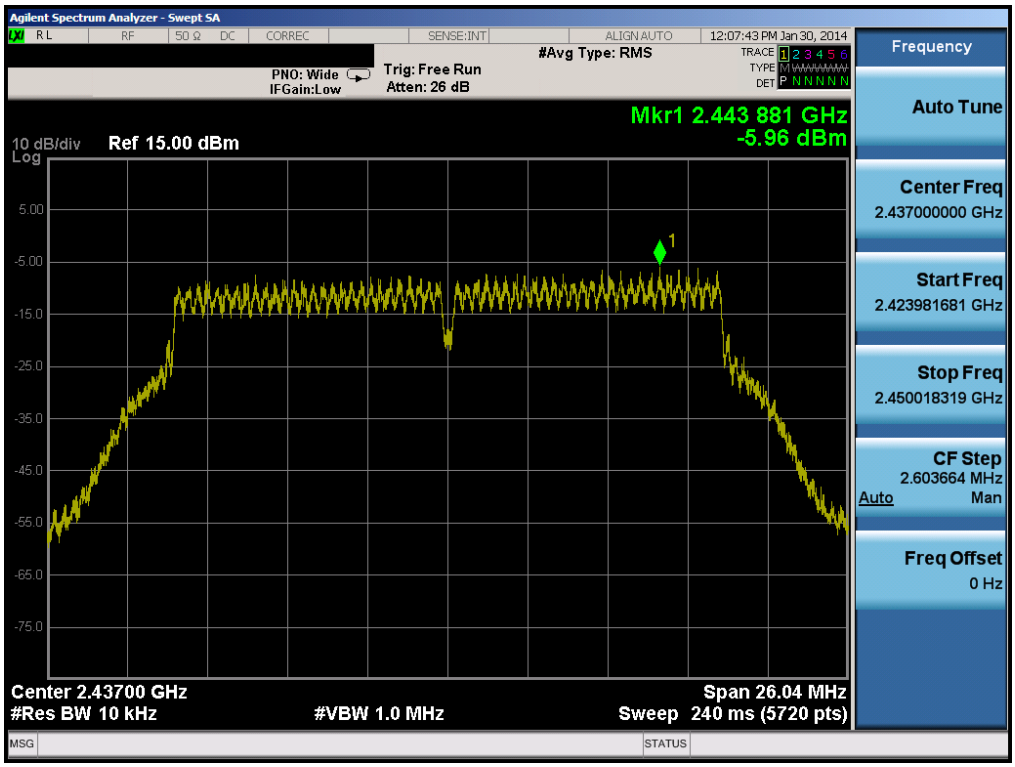


Plot 6-43. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 1)



Plot 6-44. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 6)

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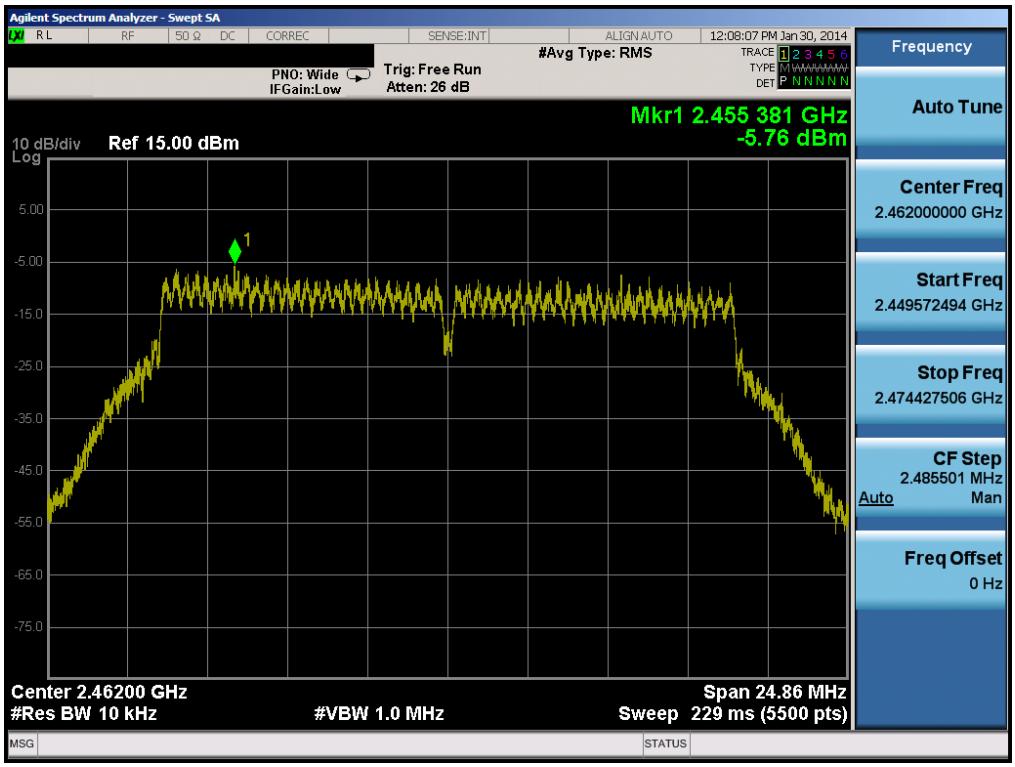
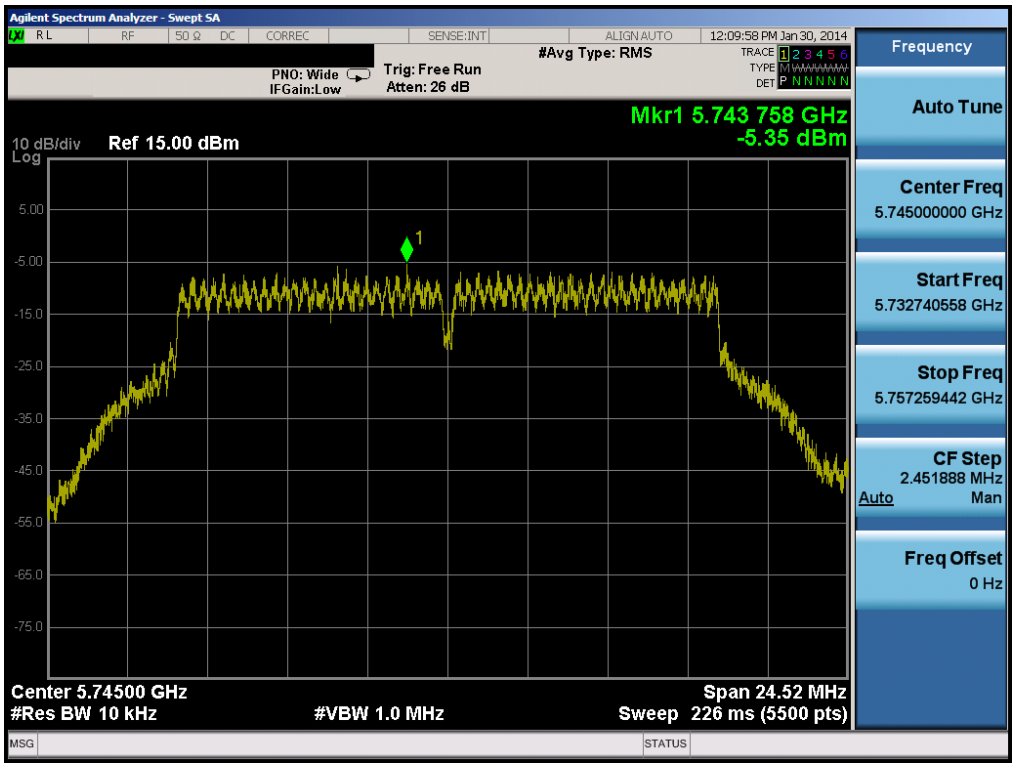


Plot 6-45. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 11)



Plot 6-46. Power Spectral Density Plot (802.11a – Ch. 149)

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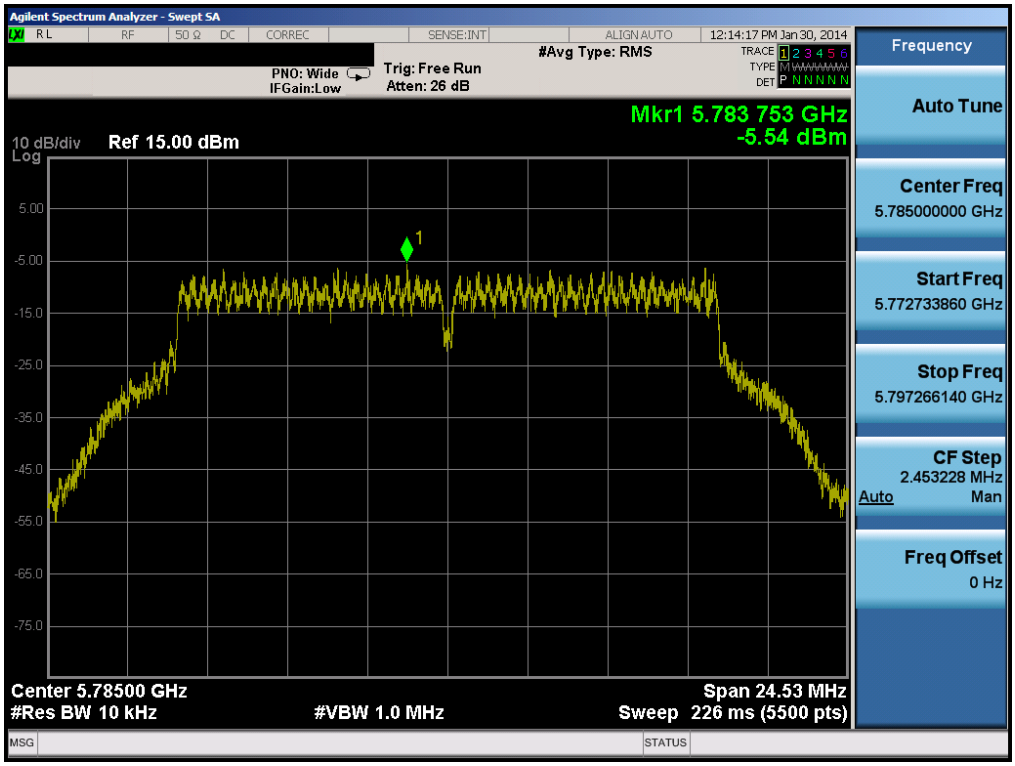
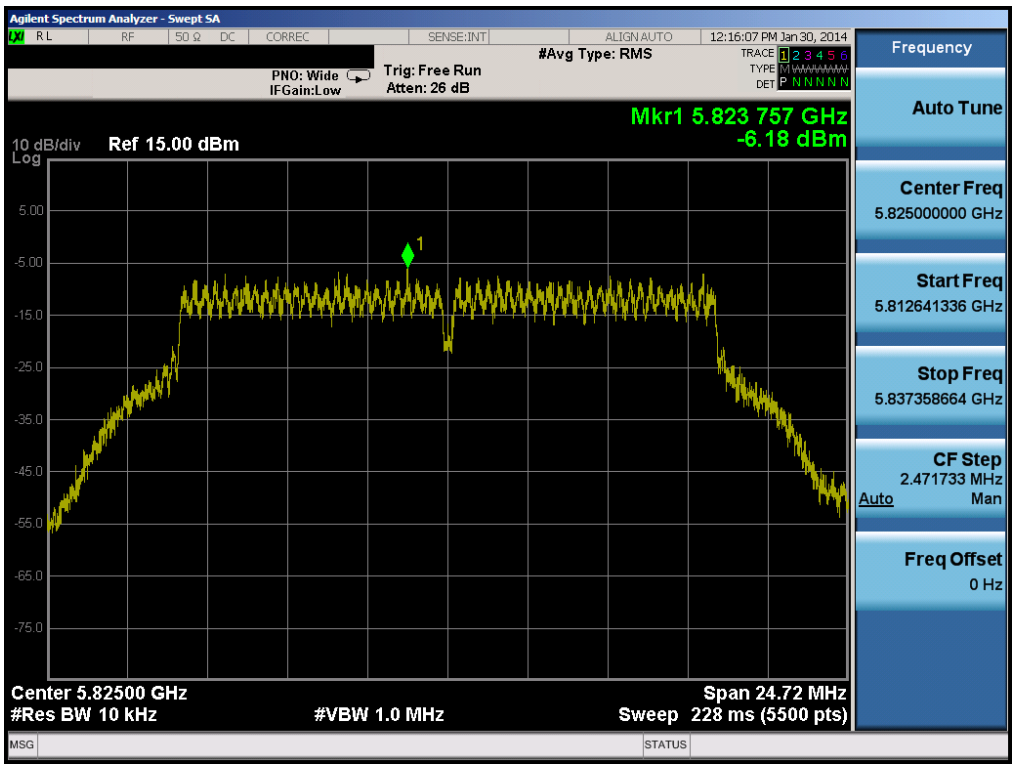


Plot 6-47. Power Spectral Density Plot (802.11a – Ch. 157)



Plot 6-48. Power Spectral Density Plot (802.11a – Ch. 165)

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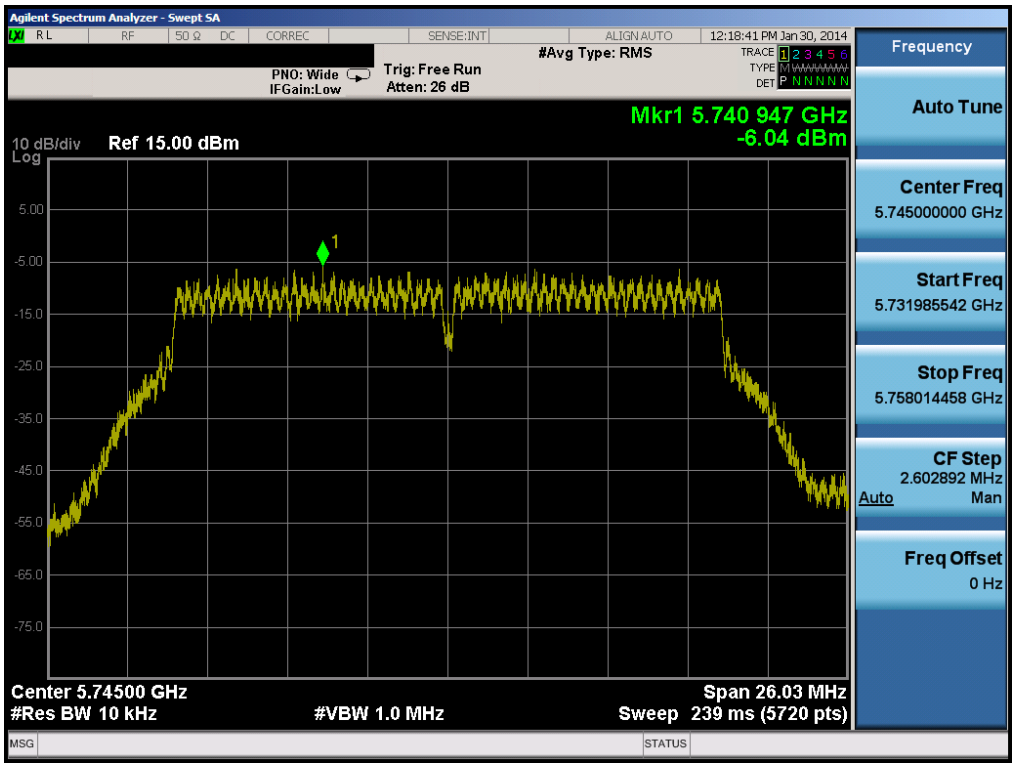
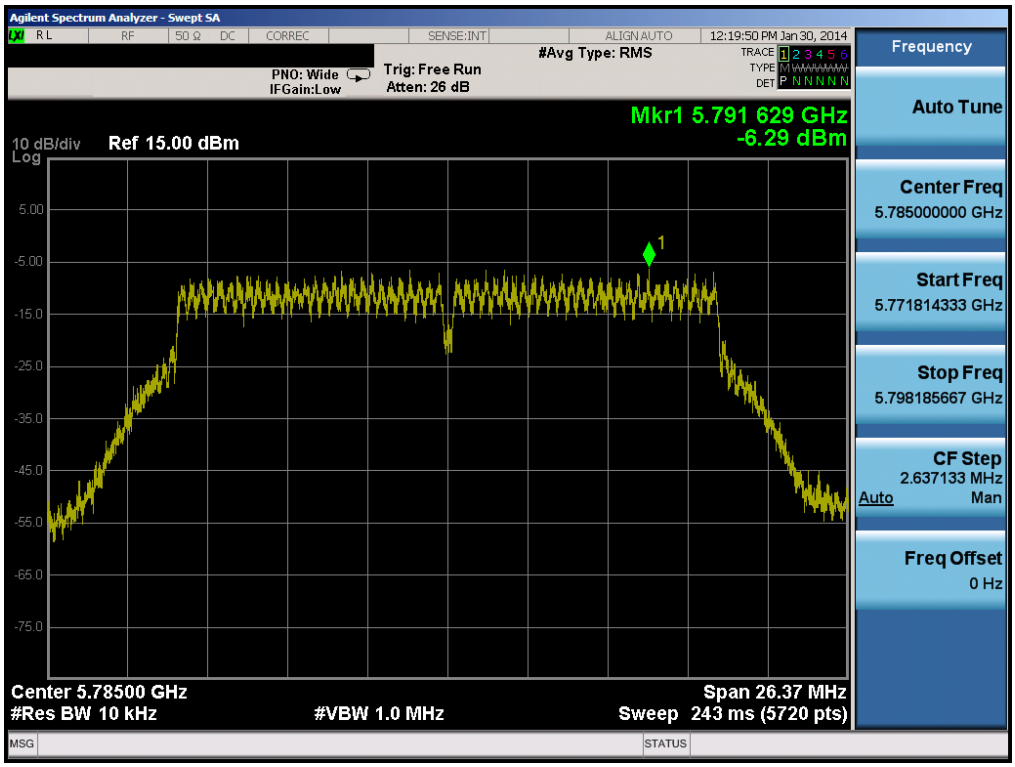


Plot 6-49. Power Spectral Density Plot (20MHz BW 802.11n (5.8GHz) – Ch. 149)



Plot 6-50. Power Spectral Density Plot (20MHz BW 802.11n (5.8GHz) – Ch. 157)

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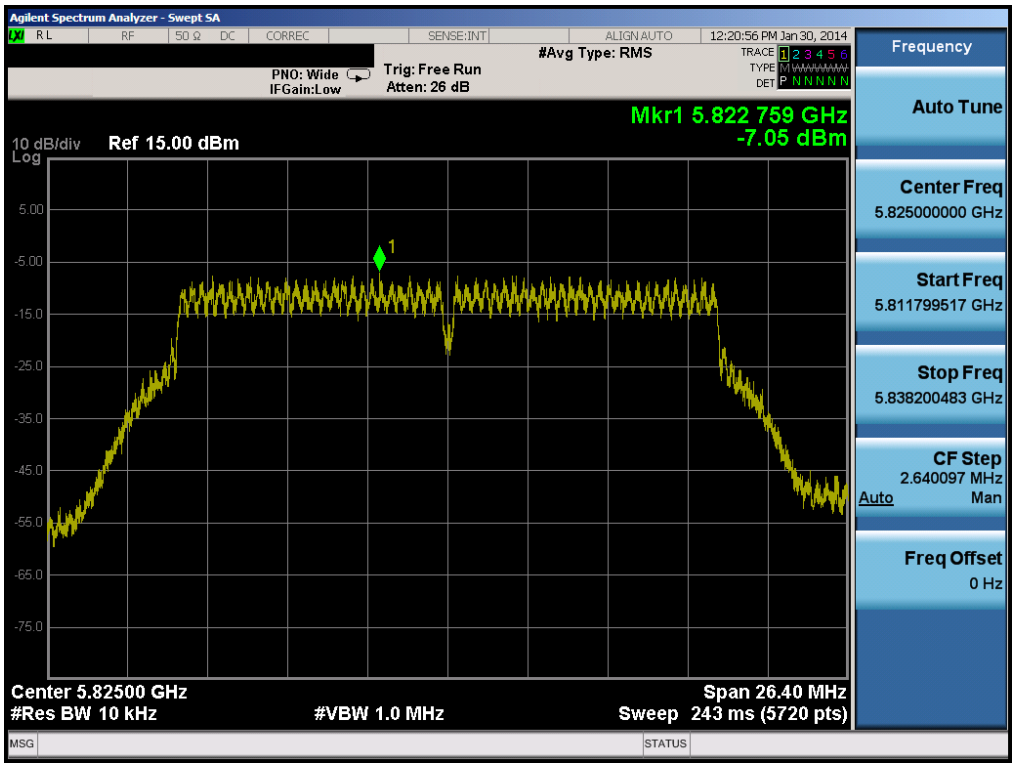
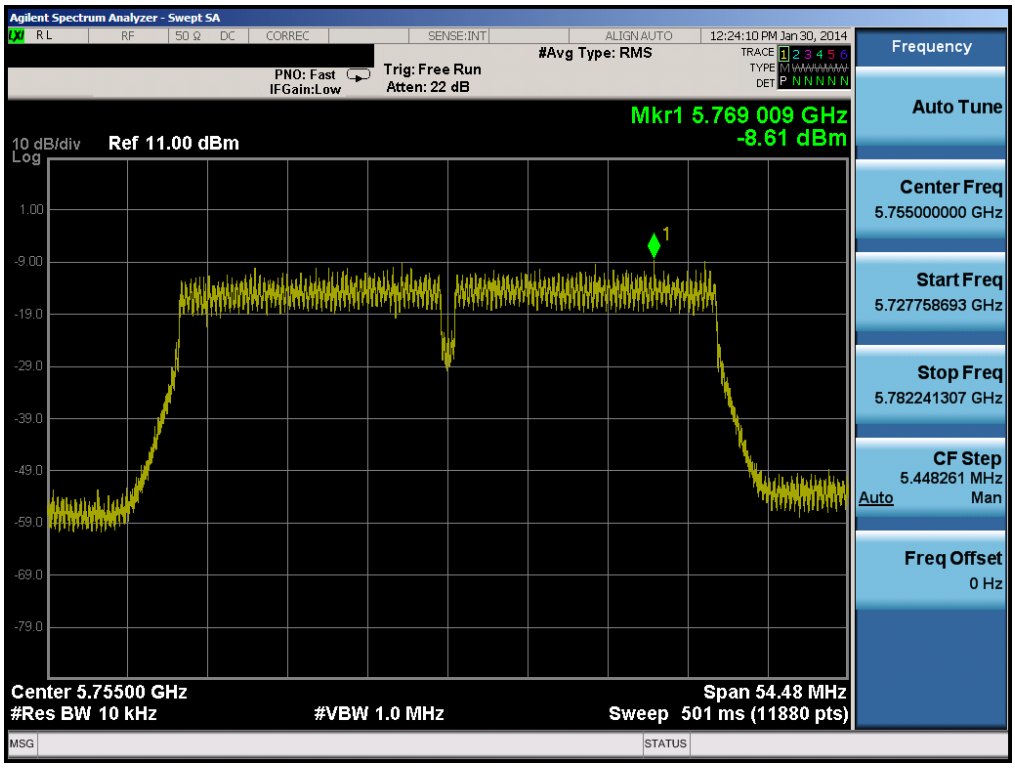


Plot 6-51. Power Spectral Density Plot (20MHz BW 802.11n (5.8GHz) – Ch. 165)



Plot 6-52. 6dB Bandwidth Plot (40MHz BW 802.11n (5.8GHz) – Ch. 151)

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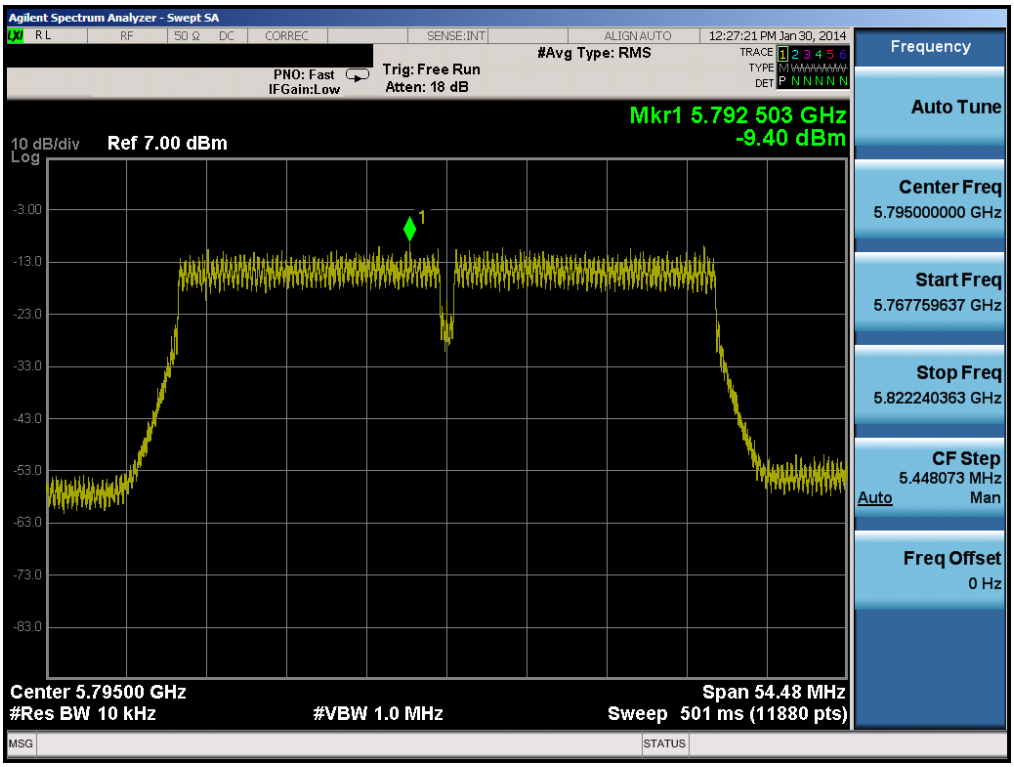
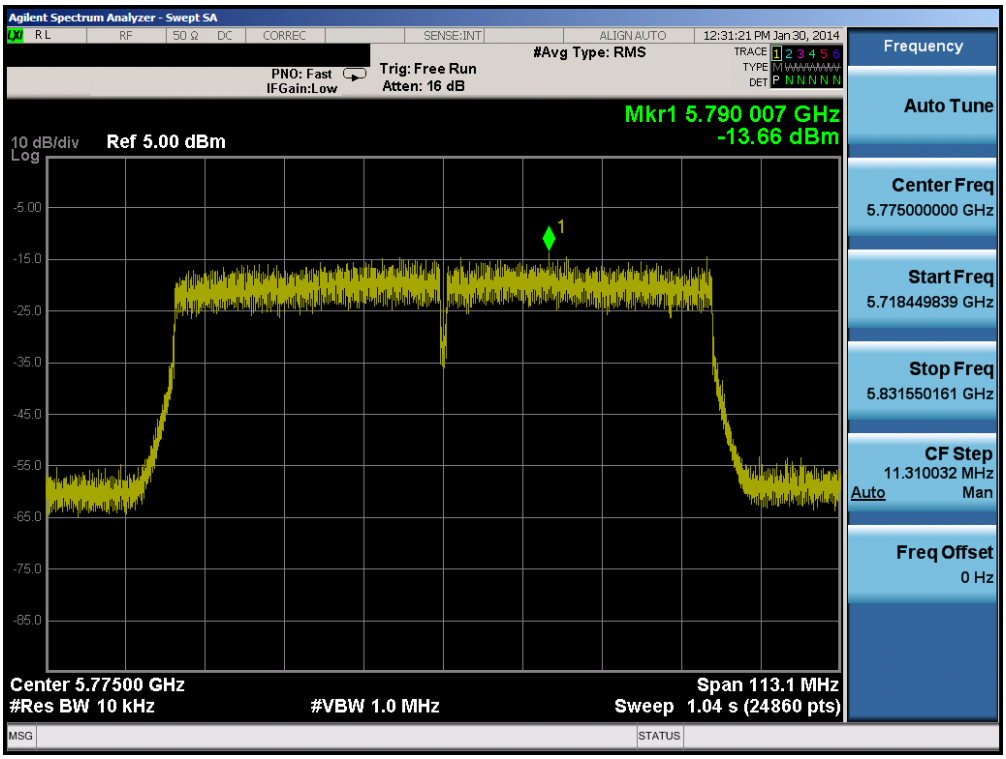


Plot 6-53. 6dB Bandwidth Plot (40MHz BW 802.11n (5.8GHz) – Ch. 159)



Plot 6-54. Power Spectral Density Plot (80MHz BW 802.11ac (5.8GHz) – Ch. 155)

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Antenna-2 Power Spectral Density Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]	Pass / Fail
2412	1	b	1	-0.35	8.00	-8.35	Pass
2437	6	b	1	-1.01	8.00	-9.01	Pass
2462	11	b	1	-1.07	8.00	-9.07	Pass
2412	1	g	6	-5.80	8.00	-13.80	Pass
2437	6	g	6	-6.22	8.00	-14.22	Pass
2462	11	g	6	-6.41	8.00	-14.41	Pass
2412	1	n	6.5/7.2 (MCS0)	-5.98	8.00	-13.98	Pass
2437	6	n	6.5/7.2 (MCS0)	-5.18	8.00	-13.18	Pass
2462	11	n	6.5/7.2 (MCS0)	-6.87	8.00	-14.87	Pass
5745	149	a	6	-5.91	8.00	-13.91	Pass
5785	157	a	6	-5.79	8.00	-13.79	Pass
5825	165	a	6	-6.97	8.00	-14.97	Pass
5745	149	n (20MHz)	6.5/7.2 (MCS0)	-6.47	8.00	-14.47	Pass
5785	157	n (20MHz)	6.5/7.2 (MCS0)	-6.81	8.00	-14.81	Pass
5825	165	n (20MHz)	6.5/7.2 (MCS0)	-6.98	8.00	-14.98	Pass
5755	151	n (40MHz)	13.5/15 (MCS0)	-9.12	8.00	-17.12	Pass
5795	159	n (40MHz)	13.5/15 (MCS0)	-9.27	8.00	-17.27	Pass
5775	155	ac (80MHz)	29.3/32.5 (MCS0)	-20.83	8.00	-28.83	Pass

Table 6-35. Conducted Power Density Measurements

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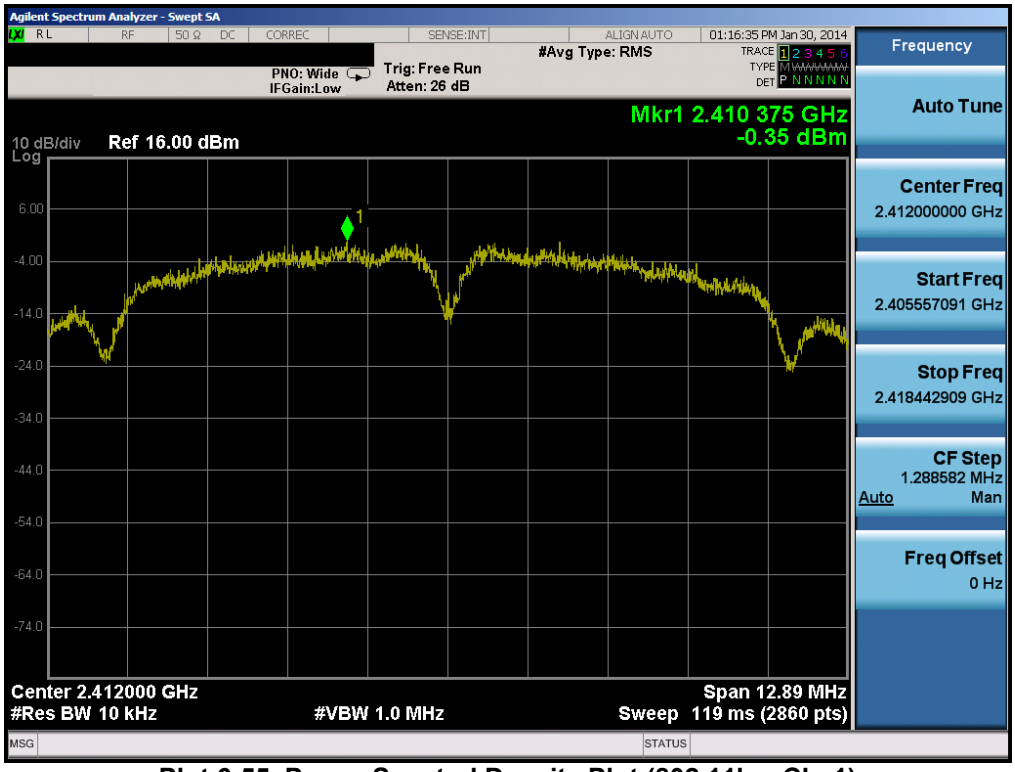
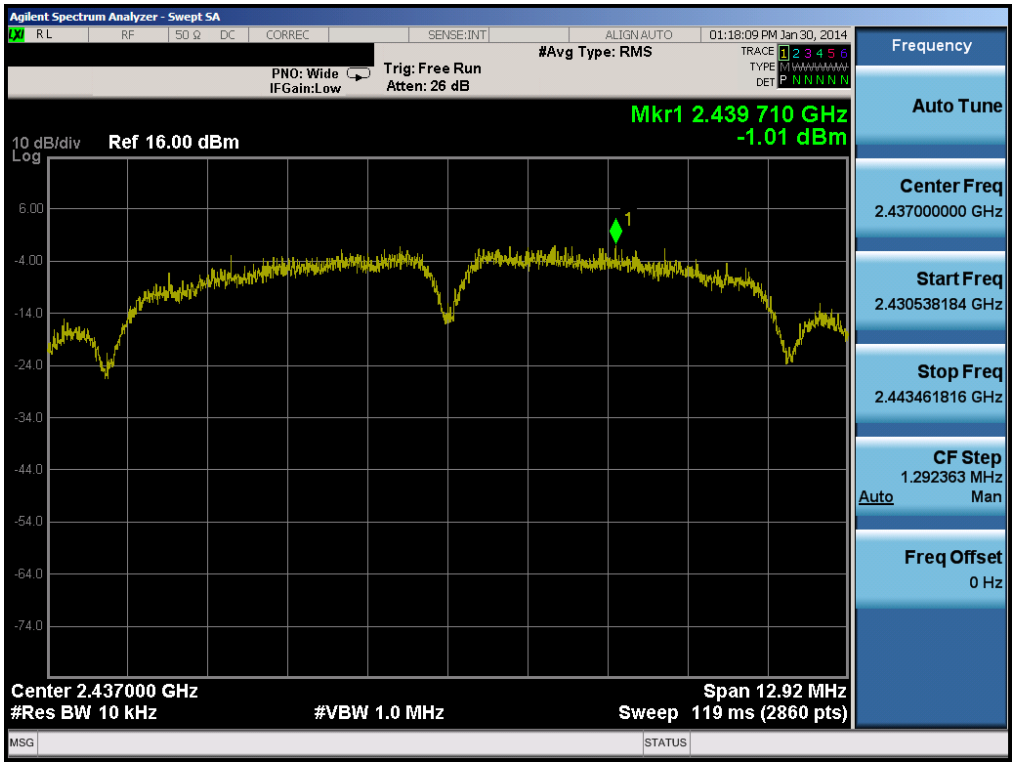


Plot 6-55. Power Spectral Density Plot (802.11b – Ch. 1)



Plot 6-56. Power Spectral Density Plot (802.11b – Ch. 6)

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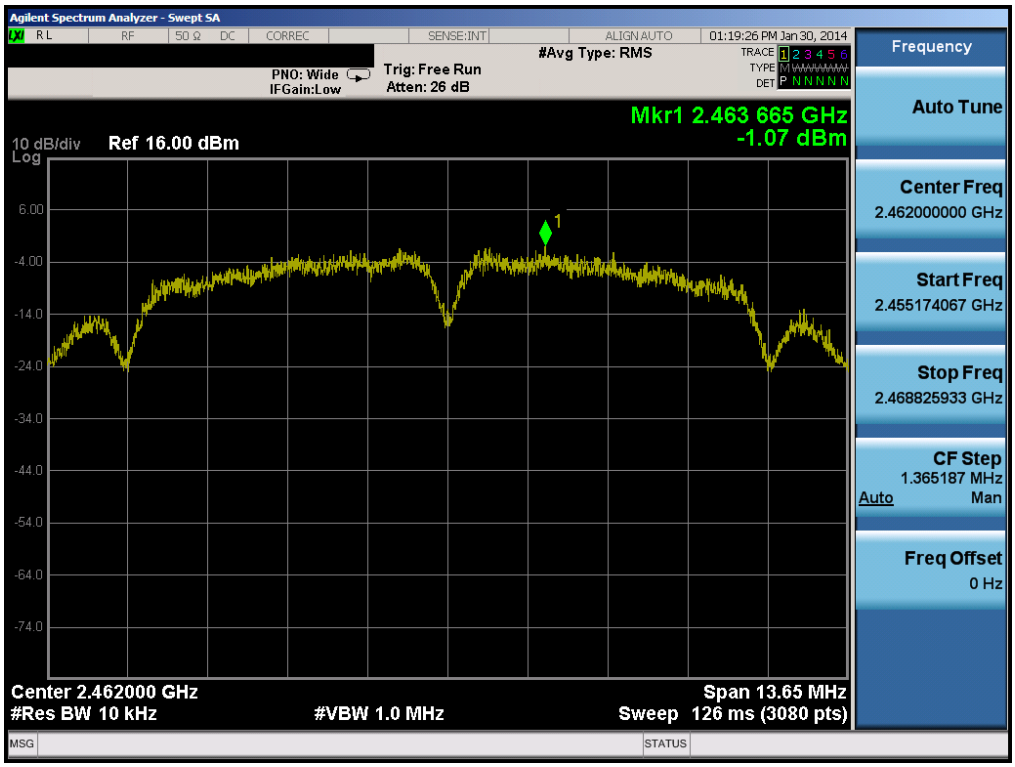
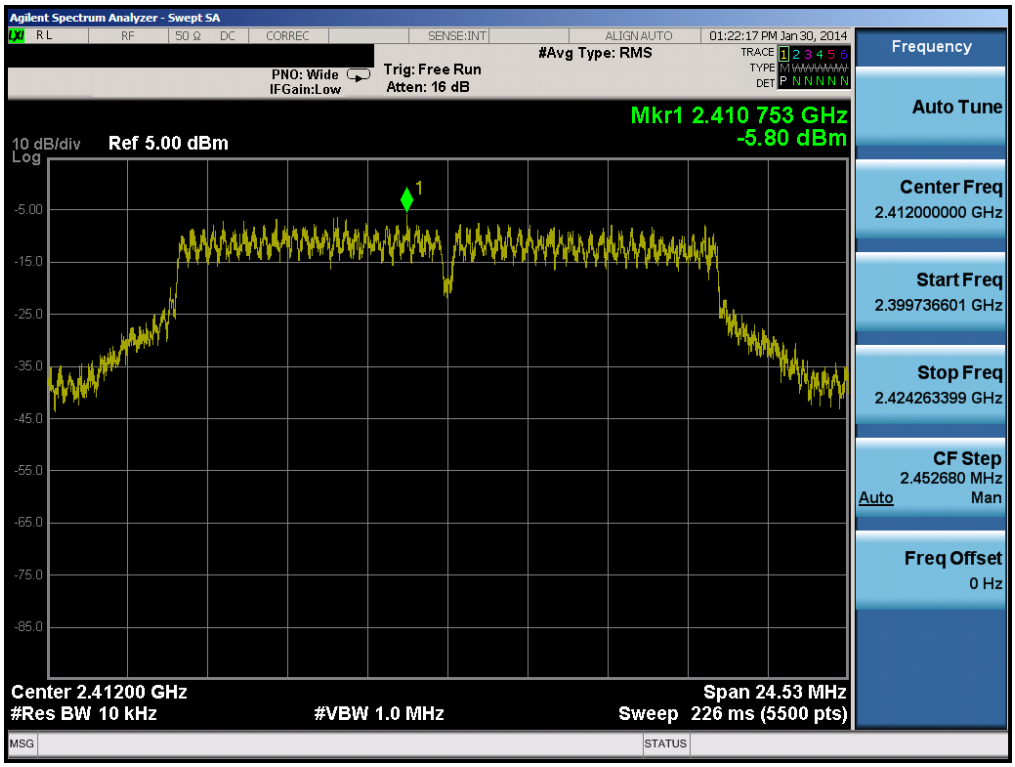


Plot 6-57. Power Spectral Density Plot (802.11b – Ch. 11)



Plot 6-58. Power Spectral Density Plot (802.11g – Ch. 1)

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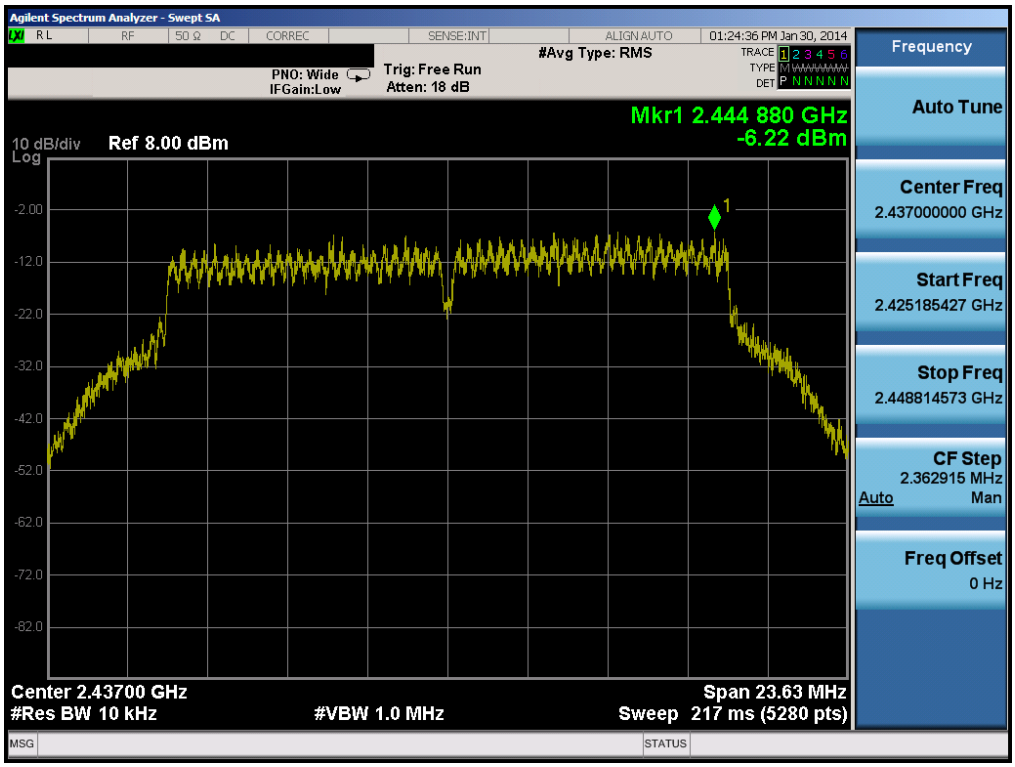
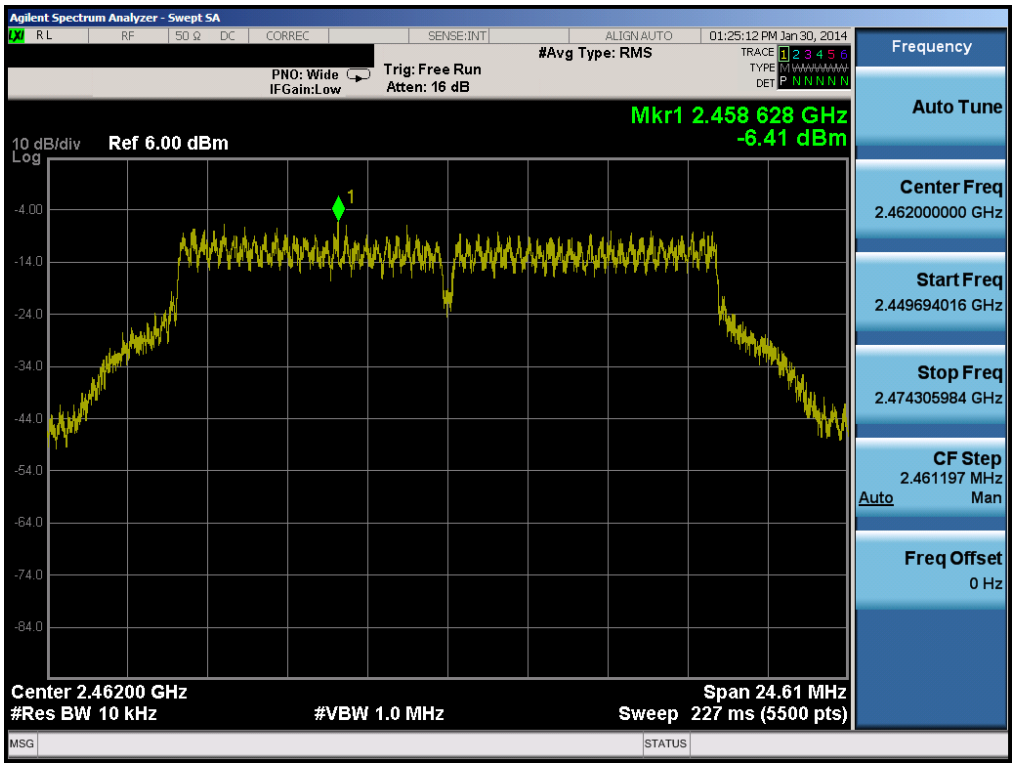


Plot 6-59. Power Spectral Density Plot (802.11g – Ch. 6)



Plot 6-60. Power Spectral Density Plot (802.11g – Ch. 11)

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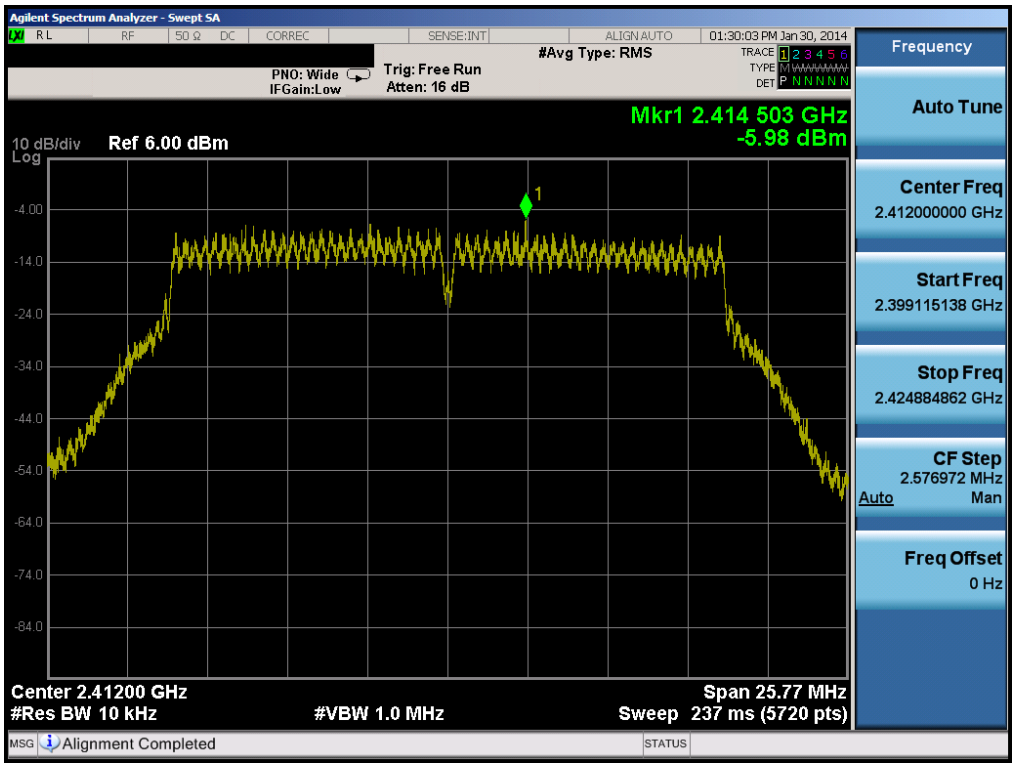
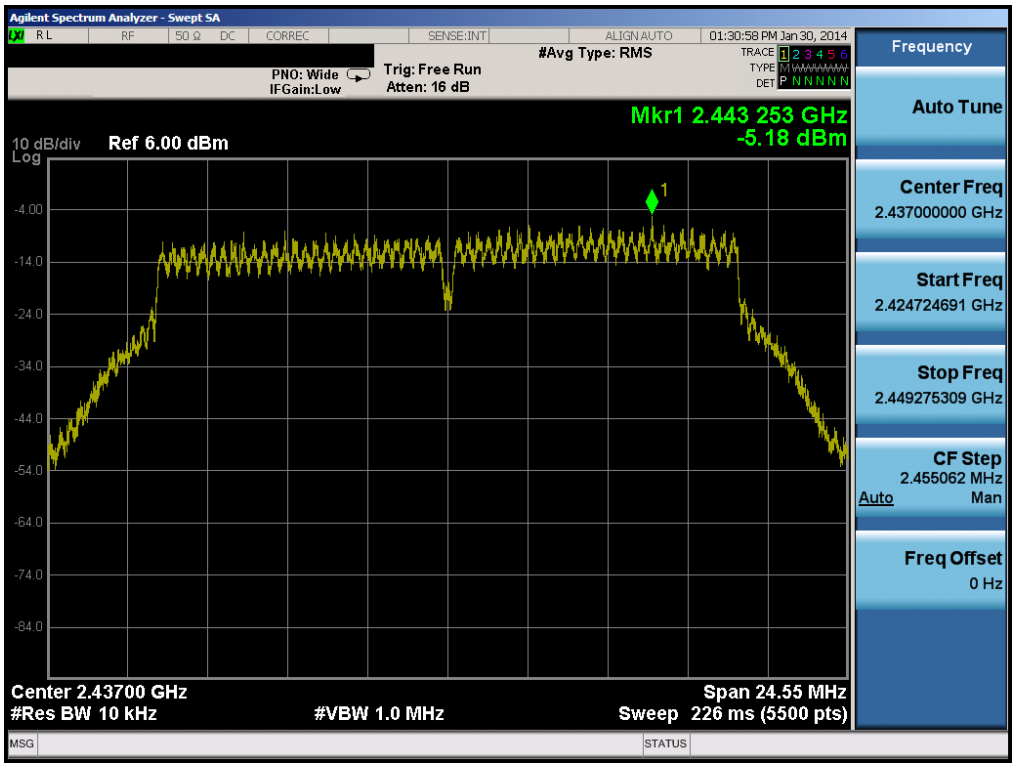


Plot 6-61. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 1)



Plot 6-62. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 6)

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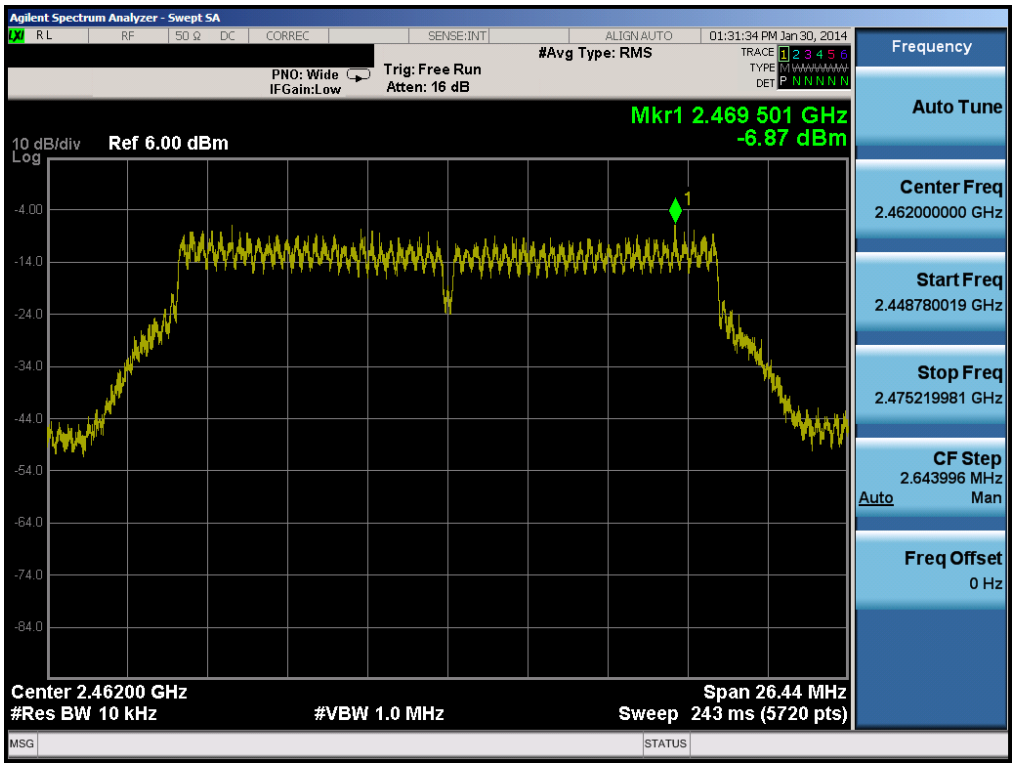
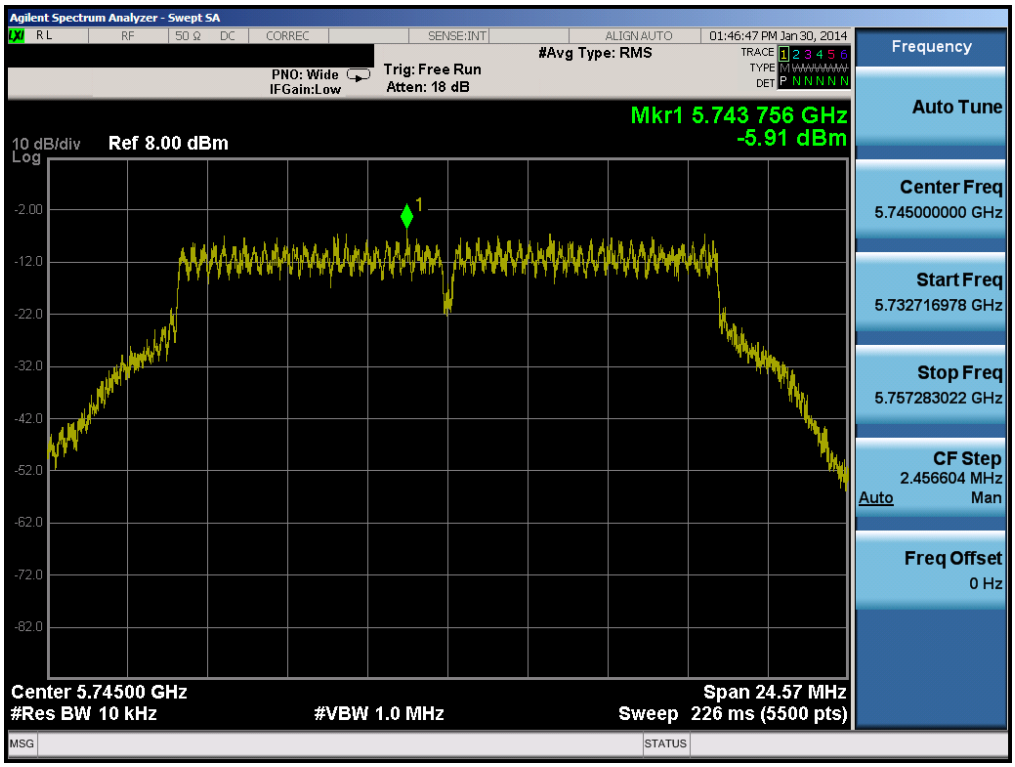


Plot 6-63. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 11)



Plot 6-64. Power Spectral Density Plot (802.11a – Ch. 149)

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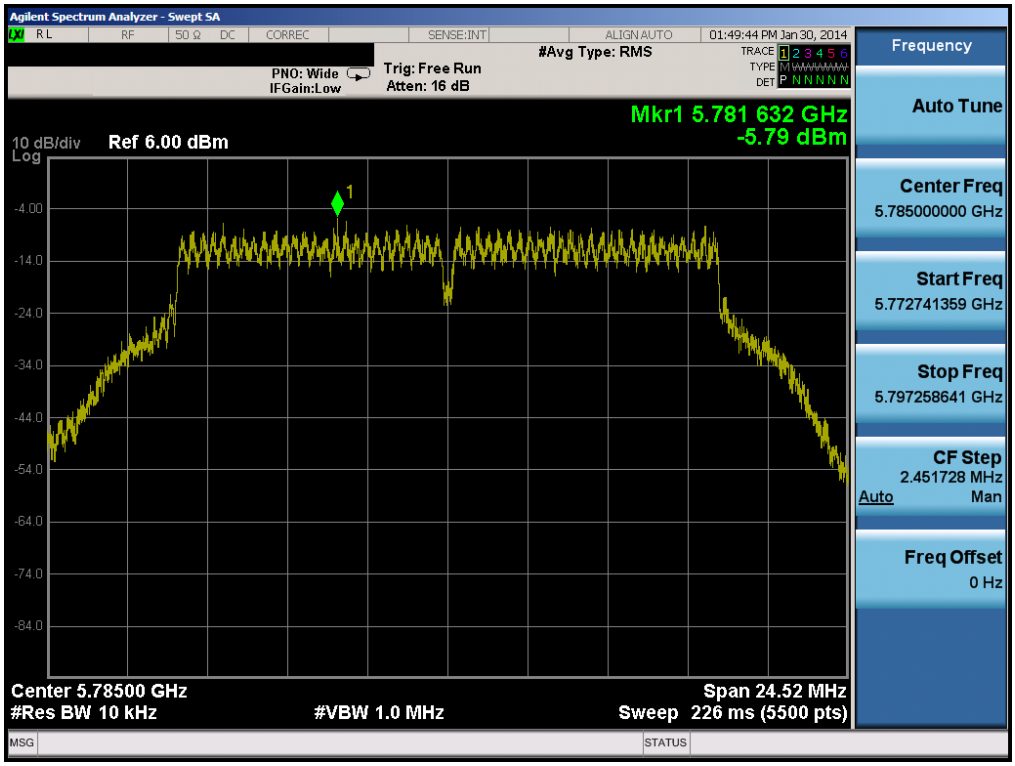
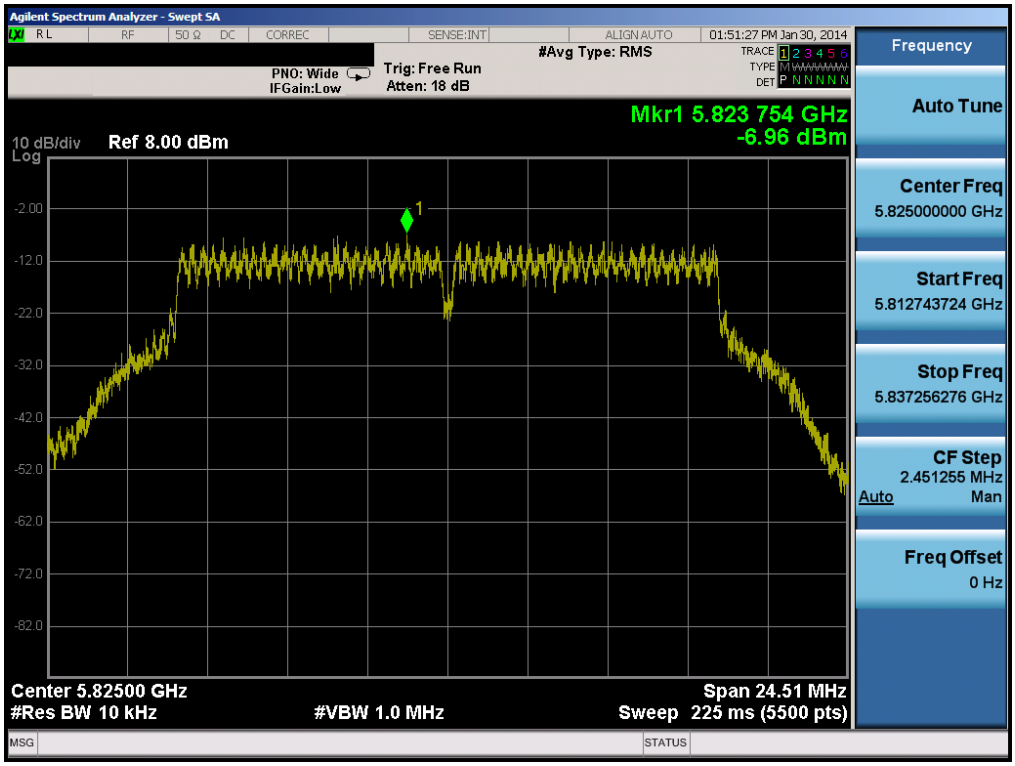


Plot 6-65. Power Spectral Density Plot (802.11a – Ch. 157)



Plot 6-66. Power Spectral Density Plot (802.11a – Ch. 165)

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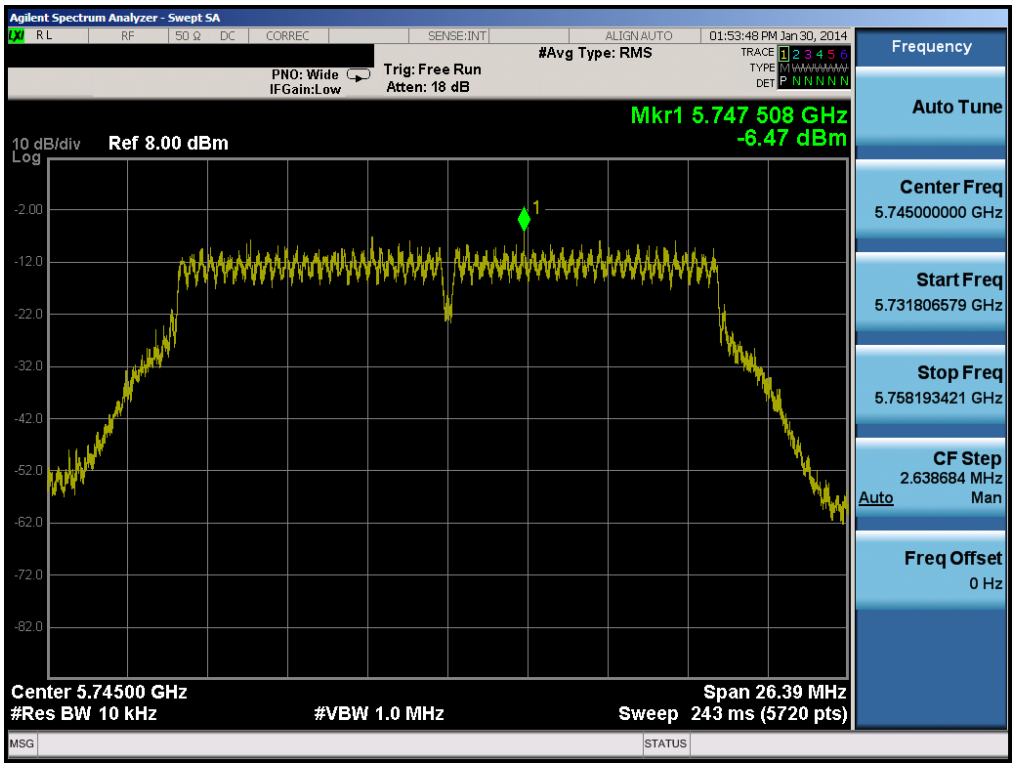
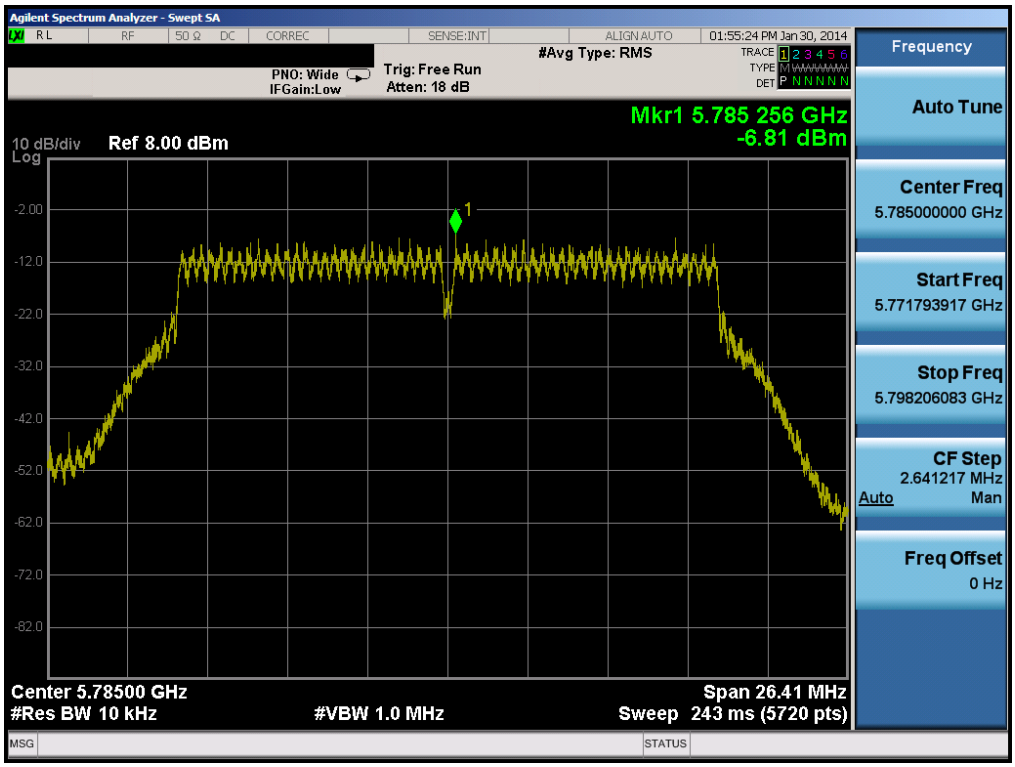


Plot 6-67. Power Spectral Density Plot (20MHz BW 802.11n (5.8GHz) – Ch. 149)



Plot 6-68. Power Spectral Density Plot (20MHz BW 802.11n (5.8GHz) – Ch. 157)

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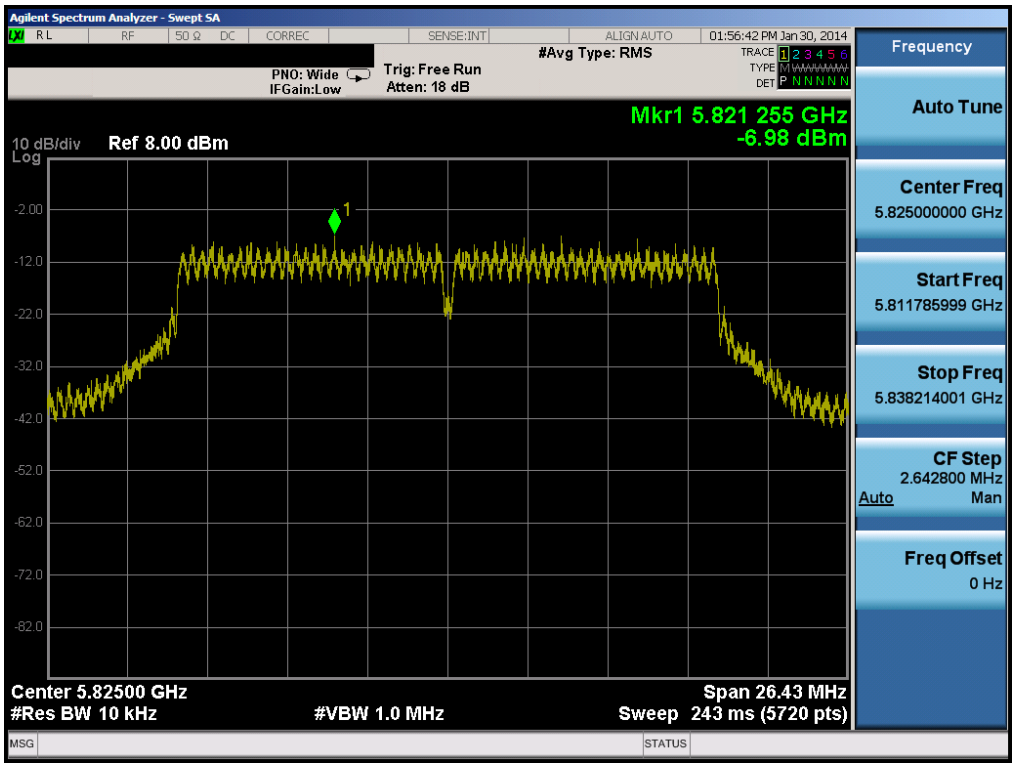
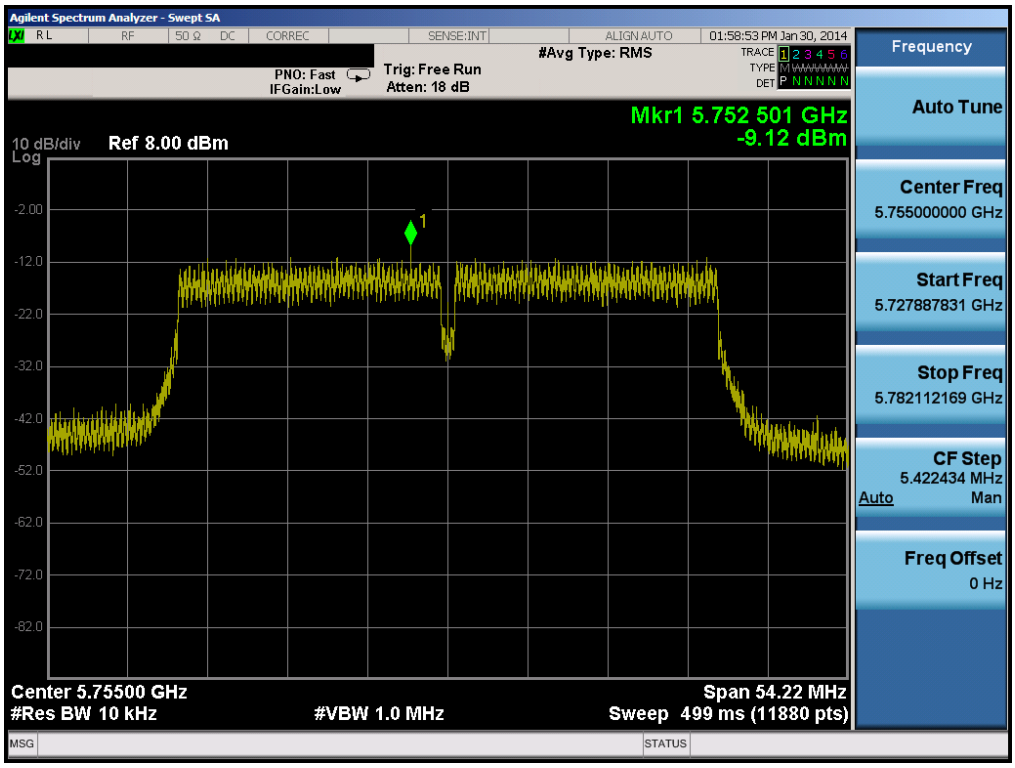


Plot 6-69. Power Spectral Density Plot (20MHz BW 802.11n (5.8GHz) – Ch. 165)



Plot 6-70. 6dB Bandwidth Plot (40MHz BW 802.11n (5.8GHz) – Ch. 151)

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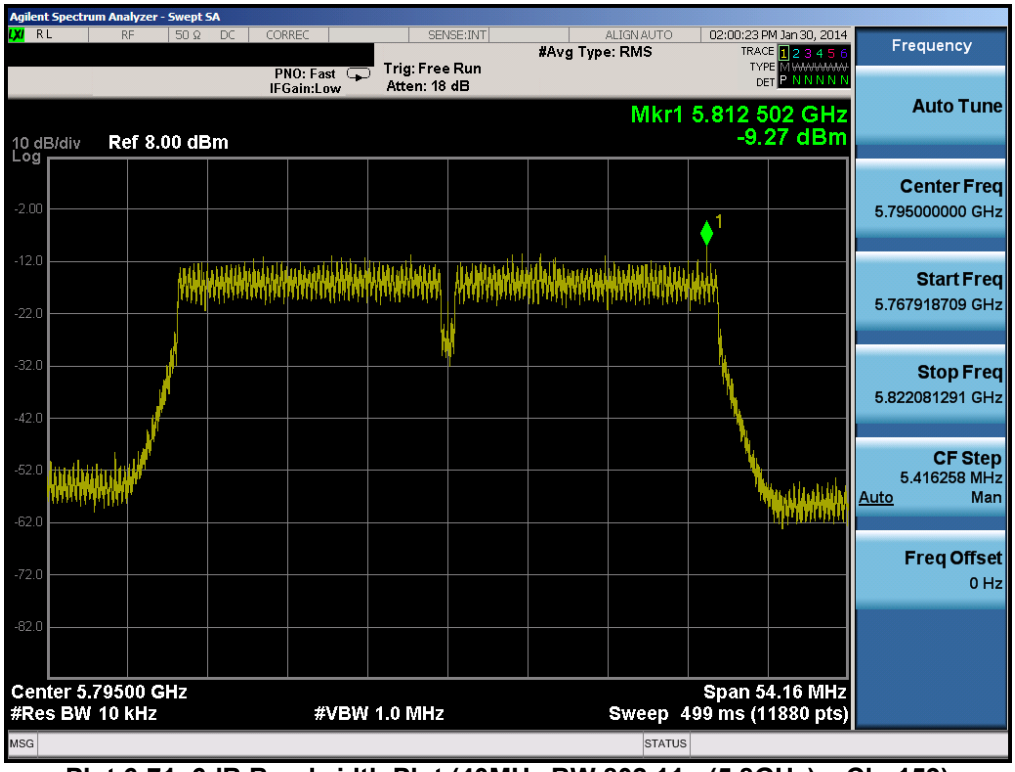
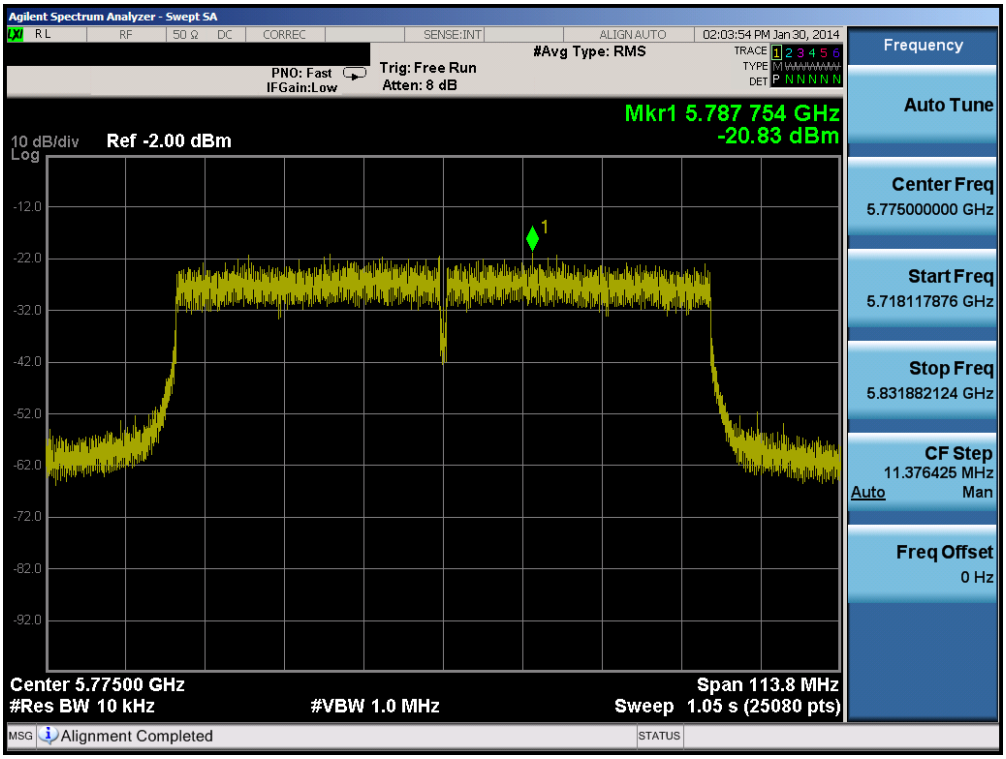


Plot 6-71. 6dB Bandwidth Plot (40MHz BW 802.11n (5.8GHz) – Ch. 159)



Plot 6-72. Power Spectral Density Plot (80MHz BW 802.11ac (5.8GHz) – Ch. 155)

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MIMO Power Spectral Density Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	ANT 1 Power Spectral Density [dBm]	ANT 2 Power Spectral Density [dBm]	Summed MIMO Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]	Pass / Fail
2412	1	b	1	-1.45	-0.35	2.14	8.00	-5.86	Pass
2437	6	b	1	-1.25	-1.01	1.88	8.00	-6.12	Pass
2462	11	b	1	-0.62	-1.07	2.17	8.00	-5.83	Pass
2412	1	g	6	-6.47	-5.80	-3.11	8.00	-11.11	Pass
2437	6	g	6	-6.63	-6.22	-3.41	8.00	-11.41	Pass
2462	11	g	6	-5.66	-6.41	-3.01	8.00	-11.01	Pass
2412	1	n	6.5/7.2 (MCS0)	-6.46	-5.98	-3.20	8.00	-11.20	Pass
2437	6	n	6.5/7.2 (MCS0)	-5.96	-5.18	-2.54	8.00	-10.54	Pass
2462	11	n	6.5/7.2 (MCS0)	-5.76	-6.87	-3.27	8.00	-11.27	Pass
5745	149	a	6	-5.35	-5.91	-2.61	8.00	-10.61	Pass
5785	157	a	6	-5.54	-5.79	-2.65	8.00	-10.65	Pass
5825	165	a	6	-6.18	-6.97	-3.55	8.00	-11.55	Pass
5745	149	n (20MHz)	6.5/7.2 (MCS0)	-6.04	-6.47	-3.24	8.00	-11.24	Pass
5785	157	n (20MHz)	6.5/7.2 (MCS0)	-6.29	-6.81	-3.53	8.00	-11.53	Pass
5825	165	n (20MHz)	6.5/7.2 (MCS0)	-7.05	-6.98	-4.00	8.00	-12.00	Pass
5755	151	n (40MHz)	13.5/15 (MCS0)	-8.61	-9.12	-5.84	8.00	-13.84	Pass
5795	159	n (40MHz)	13.5/15 (MCS0)	-9.40	-9.27	-6.33	8.00	-14.33	Pass
5775	155	ac (80MHz)	29.3/32.5 (MCS0)	-13.66	-20.83	-12.90	8.00	-20.90	Pass

Table 6-36.MIMO Conducted Power Density Measurements

Note:

As shown in the section above, the power spectral density at Antenna 1 and Antenna 2 were first measured separately. The measured values were then summed in linear power units then converted back to dBm.

Sample MIMO Calculation:

At 2412MHz the average conducted power spectral density was measured to be -1.45 dBm for Antenna-1 and -0.35 dBm for Antenna-2.

Antenna 1 + Antenna 2 = MIMO

(-1.45 dBm + -0.35 dBm) = (0.716 mW + 0.923 mW) = 1.639 mW = 2.14 dBm

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