PCTEST ENGINEERING LABORATORY, INC.
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MEASUREMENT REPORT
FCC Part 15.247 WLAN 802.11b/g/n/ac

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

Date of Testing:
11/23/2016-02/17/2017
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Test Report Serial No.:
0Y1611161808.A3L

FCC ID:	**A3LETWV530**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model:	ET-WV530
EUT Type:	Indoor Access Point
FCC Classification:	Digital Transmission System (DTS)
FCC Rule Part(s):	Part 15.247
Test Procedure(s):	KDB 558074 D01 v03r05, KDB 662911 D01 v02r01

Mode	Tx Frequency (MHz)	ANT1				ANT2				ANT3				ANT4				MIMO			
		Avg Conducted		Peak Conducted		Avg Conducted		Peak Conducted		Avg Conducted		Peak Conducted		Avg Conducted		Peak Conducted		Avg Conducted		Peak Conducted	
		Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)
802.11b	2412 - 2462	116.681	20.67	192.752	22.85	127.938	21.07	212.324	23.27	118.850	20.75	198.609	22.98	126.474	21.02	212.324	23.27	N/A			
802.11g	2412 - 2462	90.782	19.58	301.995	24.80	109.901	20.41	293.765	24.68	103.992	20.17	277.332	24.43	105.196	20.22	293.765	24.68	107.152	20.30	460.257	26.63
802.11n (20MHz)	2412 - 2462	90.573	19.57	299.226	24.76	102.565	20.11	288.403	24.60	96.605	19.85	267.917	24.28	99.770	19.99	284.446	24.54	103.992	20.17	439.542	26.43
802.11n/ac (40MHz)	2422 - 2457	19.815	12.97	33.113	15.20	19.907	12.99	33.420	15.24	19.770	12.96	33.343	15.23	19.907	12.99	35.810	15.54	62.373	17.95	113.240	20.54

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 D01 v03r05. 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

V 5.1
11/22/2016

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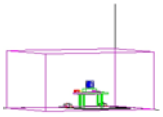
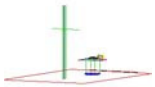


MEASUREMENT REPORT
FCC Part 15.247



§ 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 15.247
BASE MODEL:	ET-WV530
FCC ID:	A3LETWV530
FCC CLASSIFICATION:	Digital Transmission System (DTS)
Test Device Serial No.:	KPMX3S, LDX3S ☐ Production ☒ Pre-Production ☐ Engineering
DATE(S) OF TEST:	11/23/2016-02/17/2017
TEST REPORT S/N:	0Y1611161808.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.

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. (S*ee 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 C63.4-2014 on January 22, 2015.

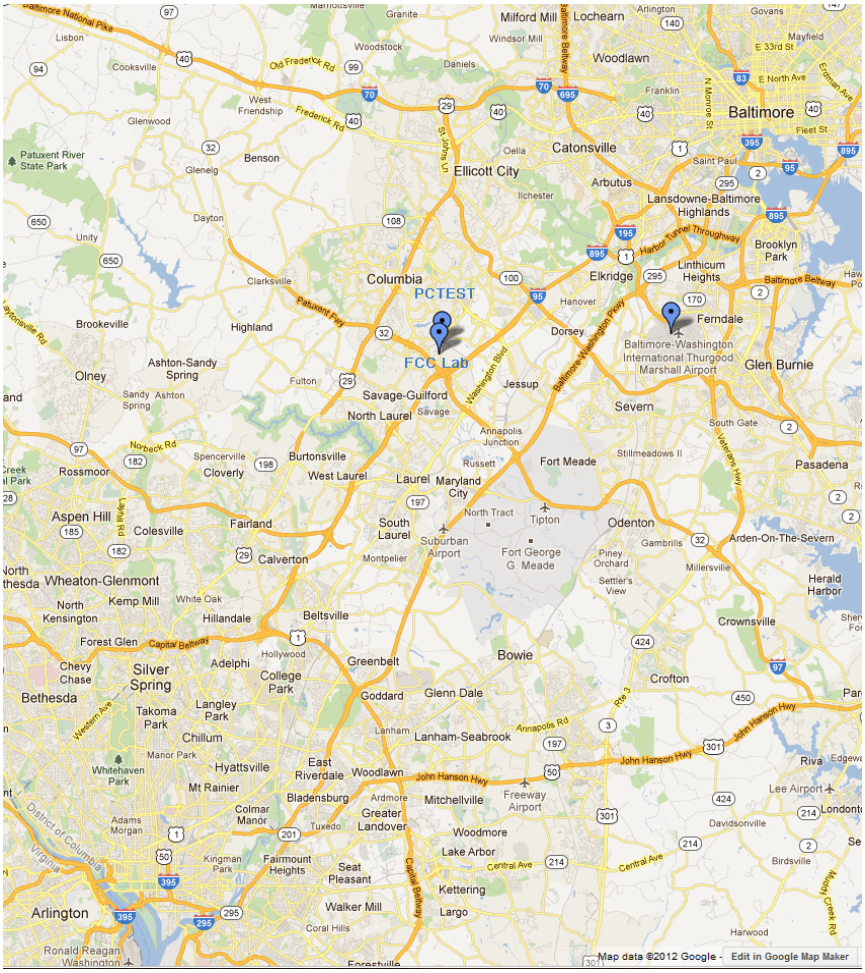


Figure 1-1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Indoor Access Point FCC ID: A3LETWV530**. 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:

802.11b/g/n WLAN, 802.11a/n/ac UNII, BT (LE), Zigbee, Zwave

Note: 2.4GHz operation is employed using 20MHz and 40MHz channel bandwidths with the frequencies shown in the table below.

Ch.	Ch. BW (MHz)	Frequency (MHz)	Ch.	Ch. BW (MHz)	Frequency (MHz)
1	20	2412	7	20/40	2442
2	20	2417	8	20/40	2447
3	20/40	2422	9	20/40	2452
4	20/40	2427	10	20/40	2457
5	20/40	2432	11	20	2462
6	20/40	2437			

Table 2-1. Frequency/ Channel Operations

Note: 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 D01 v03r05. 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	ANT3	ANT4	MIMO
2.4GHz	b	99.1	99.2	99.1	99.0	N/A
	g	98.2	98.0	98.2	98.1	99.3
	n	95.3	95.2	95.3	93.8	95.2
	ac	90.9	90.8	90.1	90.7	94.2

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

WiFi Configurations		SISO				SDM				CCD			
		ANT1	ANT2	ANT3	ANT4	ANT1	ANT2	ANT3	ANT4	ANT1	ANT2	ANT3	ANT4
2.4GHz	11b	✓	✓	✓	✓	×	×	×	×	×	×	×	×
	11g	✓	✓	✓	✓	×	×	×	×	✓	✓	✓	✓
	11n	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	11ac	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 2-2. Frequency / Channel Operations

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

Data Rates Supported: 1Mbps, 2Mbps, 5.5Mbps, 11Mbps (b)
6Mbps, 9Mbps, 12Mbps, 18Mbps, 24Mbps, 36Mbps, 48Mbps, 54Mbps (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)

13.5/15, 27/30, 40.5/45, 54/60, 81/90, 108/120, 121.5/135, 135/150, 162/180, 180/200 (n – 40MHz BW)

27/30, 54/60, 81/90, 108/120, 162/180, 216/240, 243,270, 270/300Mbps (MIMO n/ac – 40MHz) 324/360, 360/400Mbps (MIMO ac – 40MHz)

This device employs MIMO technology using four 2.4GHz outputs and four 5GHz outputs, which allows for multiple SISO channels to operate independent of one another in the 2.4GHz and 5GHz bands simultaneously. The following table shows the worst case configuration determined during testing. The data for this configuration is contained in the UNII report.

All 2.4 GHz Antennas transmitting in 2.4GHz mode and All 5 GHz Antennas transmitting in 5GHz mode

Description	2.4 GHz Emission	5 GHz Emisison
Antenna	ALL	ALL
Channel	6	36
Operating Frequency(MHz	2437	5180
Data Rate (Mbps)	1	6
Band	WLAN	UNII 1
Mode	802.11g	802.11a

Table 2-3. Config-1 (ALL 2.4GHz ANT & ALL 5GHz ANT)

2.3 Test Configuration

The EUT was tested per the guidance of KDB 558074 D01 v03r05. 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, 7.5, and 7.6 for antenna port conducted emissions test setups.

2.4 EMI Suppression Device(s)/Modifications

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

3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 558074 D01 v03r05 were used in the measurement of the EUT.

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. 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 7.10. The EMI Receiver mode of the Agilent MXE was used to perform AC line conducted emissions testing.

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. A 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. 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. 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, mode of operation, 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).

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 EUT are **permanently attached.**
- There are no provisions for connections to an external antenna.

Conclusion:

The EUT unit complies with the requirement of §15.203.

5.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013. 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

6.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2006.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	RE1	Radiated Emissions Cable Set (UHF/EHF)	7/11/2016	Annual	7/11/2017	RE1
-	WL25-1	Conducted Cable Set (25GHz)	4/11/2016	Annual	4/11/2017	WL25-1
Agilent	N9020A	MXA Signal Analyzer	10/28/2016	Annual	10/28/2017	US46470561
Agilent	N9030A	PXA Signal Analyzer (26.5GHz)	7/20/2016	Annual	7/20/2017	MY49432391
Agilent	N9038A	MXE EMI Receiver	4/21/2016	Annual	4/21/2017	MY51210133
Anritsu	MA2411B	Pulse Power Sensor	10/14/2015	Biennial	10/14/2017	846215
Anritsu	ML2495A	Power Meter	10/16/2015	Biennial	10/16/2017	941001
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	7/30/2015	Biennial	7/30/2017	121034
Com-Power	PAM-103	Pre-Amplifier (1-1000MHz)	7/6/2016	Annual	7/6/2017	441119
Com-Power	PAM-118A	PREAMPLIFIER 500MHZ TO 18GHZ	7/26/2016	Annual	7/26/2017	551079
Emco	3115	Horn Antenna (1-18GHz)	3/10/2016	Biennial	3/10/2018	9704-5182
EMCO	3160-09	Small Horn	8/23/2016	Biennial	8/23/2018	135427
ETS Lindgren	3117	1-18 GHz DRG Horn (Medium)	4/26/2016	Biennial	4/26/2018	125518
Huber+Suhner	Sucoflex 102A	40GHz Radiated Cable	4/26/2016	Annual	4/26/2017	251425001
K & L	11SH10-3075/U18000	High Pass Filter	7/11/2016	Annual	7/11/2017	11SH10-3075/U18000-2
PCTEST	-	EMC Switch System	7/11/2016	Annual	7/11/2017	NM1
PCTEST	-	EMC Switch System	7/6/2016	Annual	7/6/2017	NM2
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	5/16/2016	Annual	5/16/2017	100342
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	7/15/2016	Annual	7/15/2017	100348
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	7/27/2016	Annual	7/27/2017	103200
Rohde & Schwarz	TS-PR26	18-26.5 GHz Pre-Amplifier	3/7/2016	Annual	3/7/2017	100040
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

7.0 TEST RESULTS

7.1 Summary

Company Name: Samsung Electronics Co., Ltd.
FCC ID: A3LETWV530
FCC Classification: Digital Transmission System (DTS)

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(2)	6dB Bandwidth	> 500kHz	CONDUCTED	PASS	Section 7.2
15.247(b)(3)	Transmitter Output Power	< 1 Watt		PASS	Sections 7.3
15.247(e)	Transmitter Power Spectral Density	< 8dBm / 3kHz Band		PASS	Section 7.4
15.247(d)	Band Edge / Out-of-Band Emissions	Conducted ≥ 30dBc		PASS	Sections 7.5, 7.6
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 7.7, 7.9
15.207	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits	LINE CONDUCTED	PASS	Section 7.10

Table 7-1. 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 3.2.
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 1.1.3.

7.2 6dB Bandwidth Measurement

§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, 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 D01 v03r05 – 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.

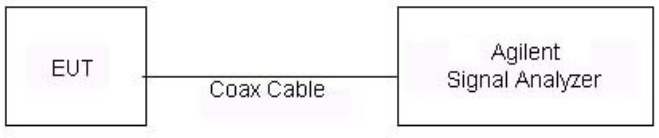


Figure 7-1. Test Instrument & Measurement Setup

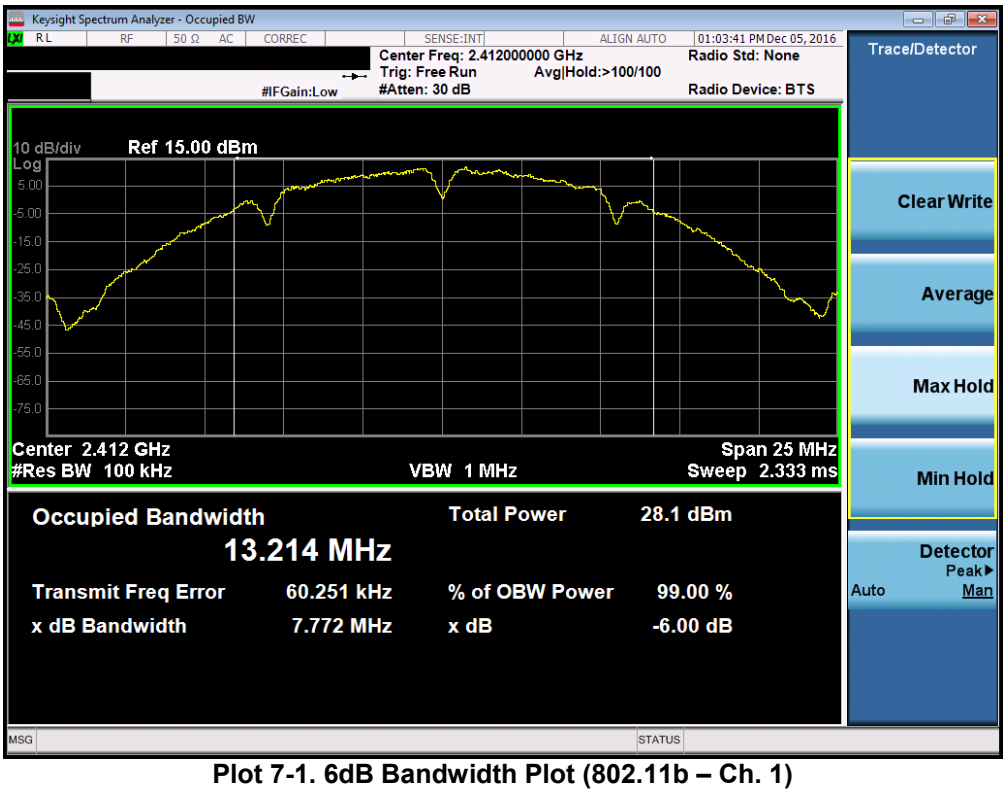
Test Notes

None

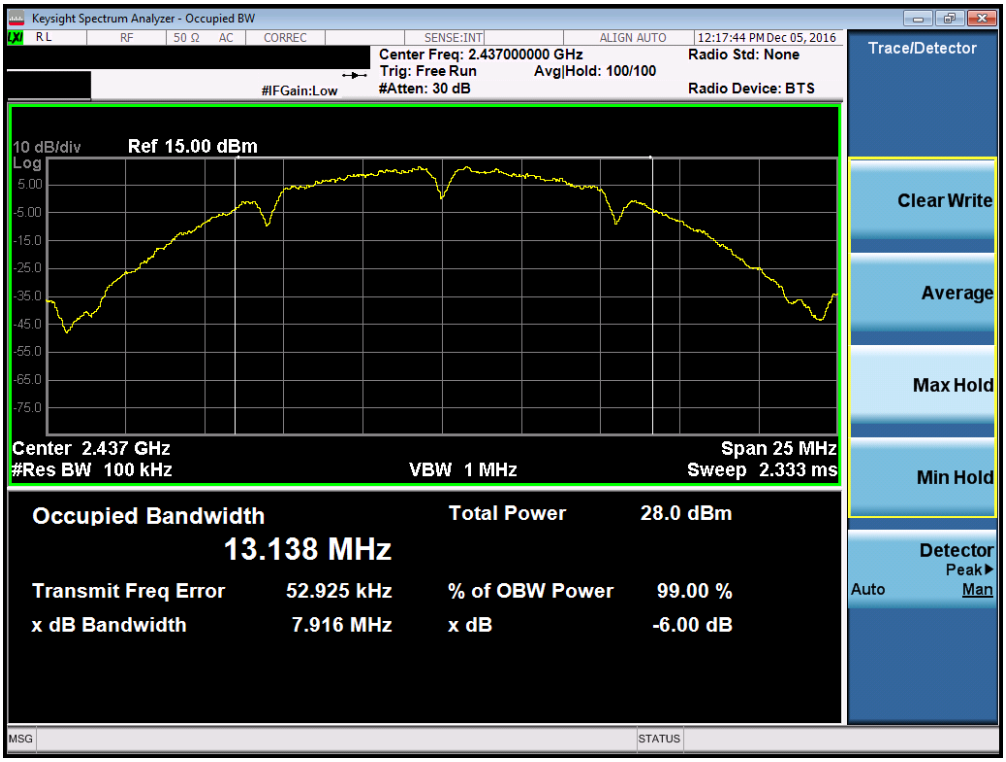
Antenna-1 6 dB Bandwidth Measurements (20MHz BW)

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
2412	1	b	1	7.772	0.500	Pass
2437	6	b	1	7.916	0.500	Pass
2462	11	b	1	8.159	0.500	Pass
2412	1	g	6	16.30	0.500	Pass
2437	6	g	6	16.32	0.500	Pass
2462	11	g	6	16.34	0.500	Pass
2412	1	n	6.5/7.2 (MCS0)	16.57	0.500	Pass
2437	6	n	6.5/7.2 (MCS0)	17.33	0.500	Pass
2462	11	n	6.5/7.2 (MCS0)	17.09	0.500	Pass

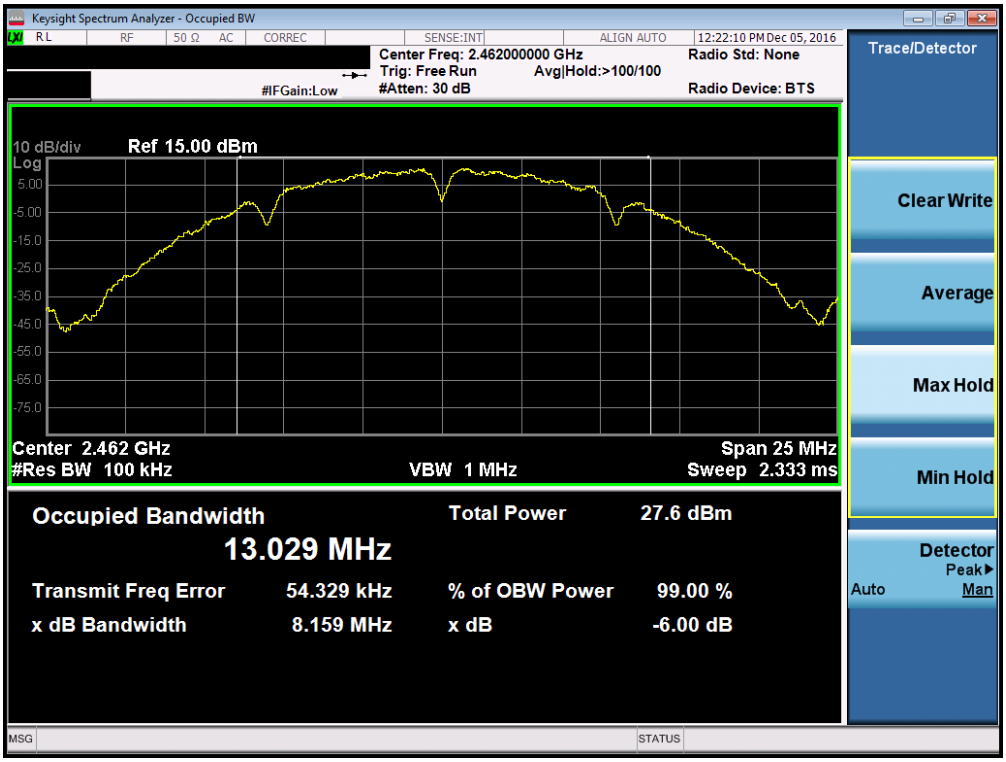
Table 7-2. Conducted Bandwidth Measurements



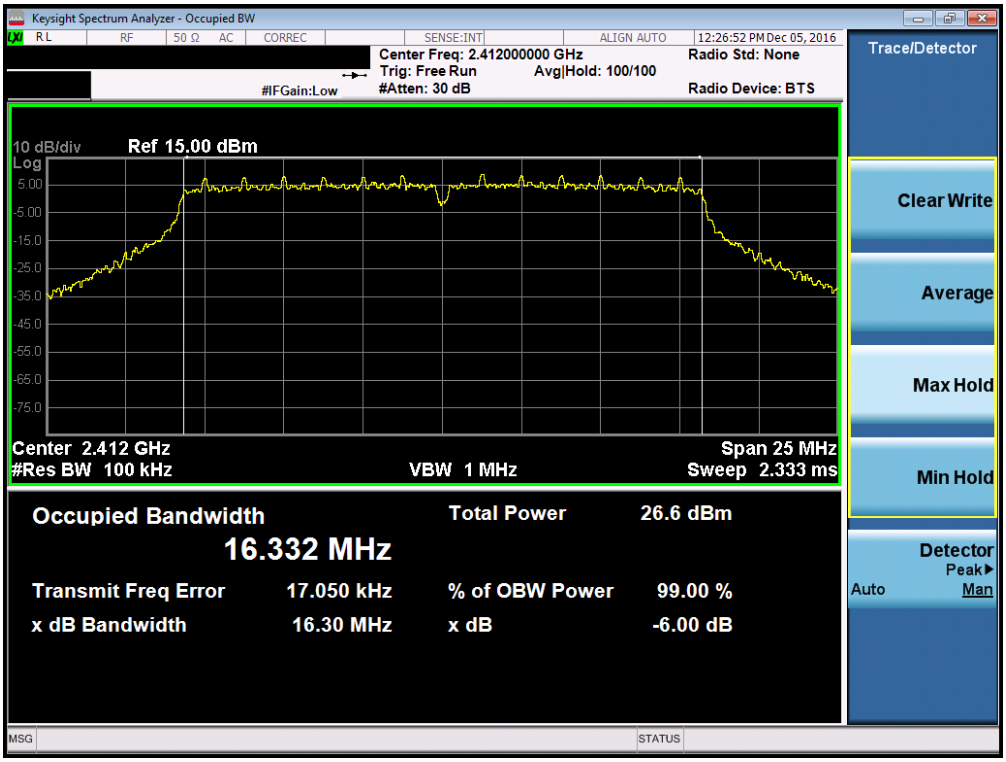
Plot 7-1. 6dB Bandwidth Plot (802.11b – Ch. 1)



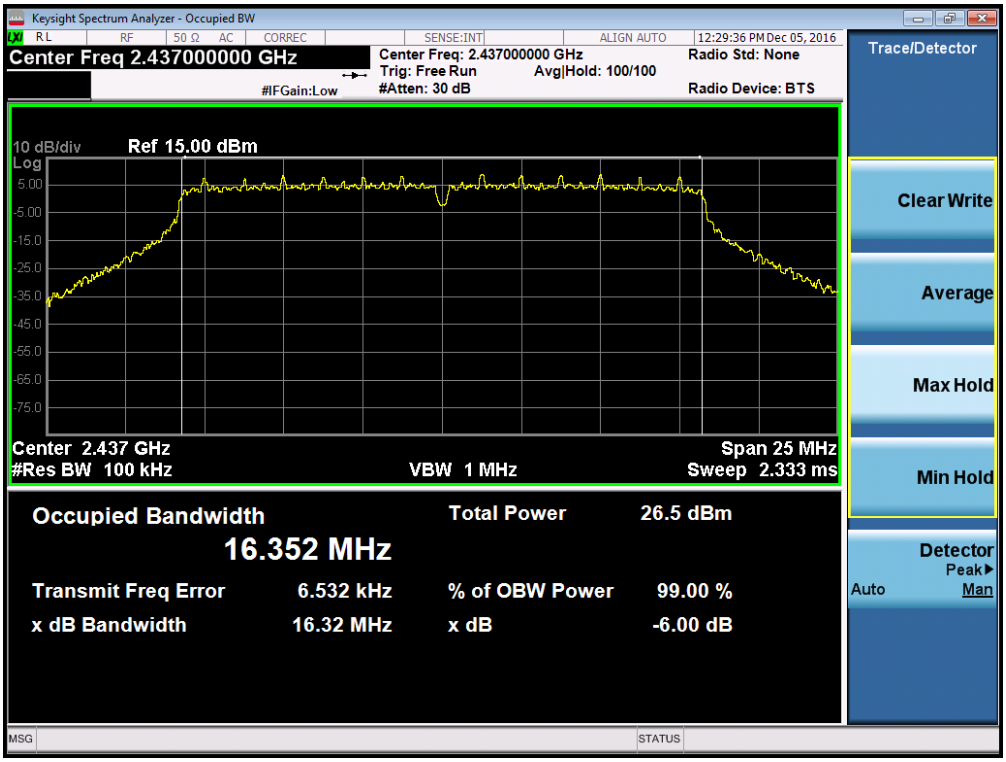
Plot 7-2. 6dB Bandwidth Plot (802.11b – Ch. 6)



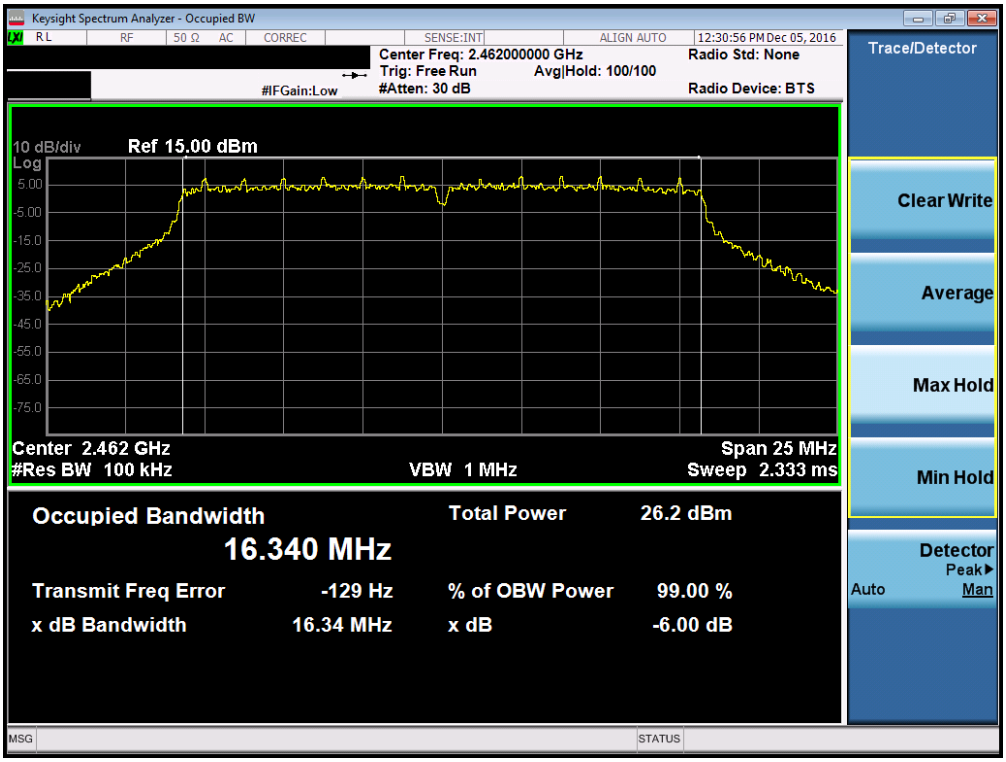
Plot 7-3. 6dB Bandwidth Plot (802.11b – Ch. 11)



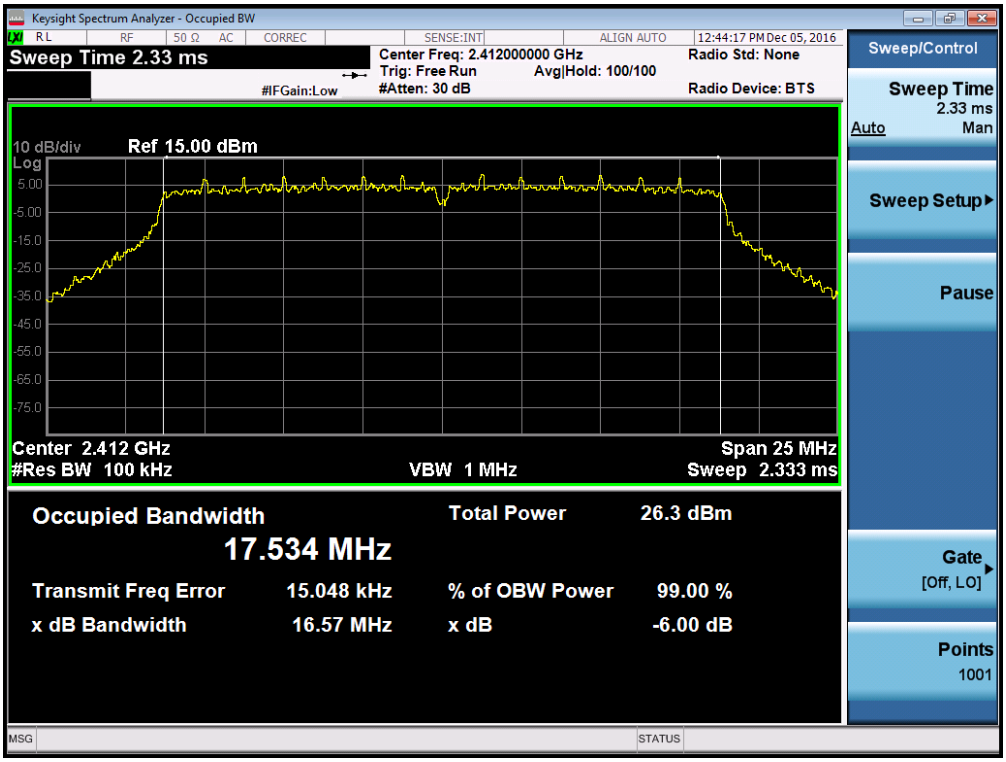
Plot 7-4. 6dB Bandwidth Plot (802.11g – Ch. 1)



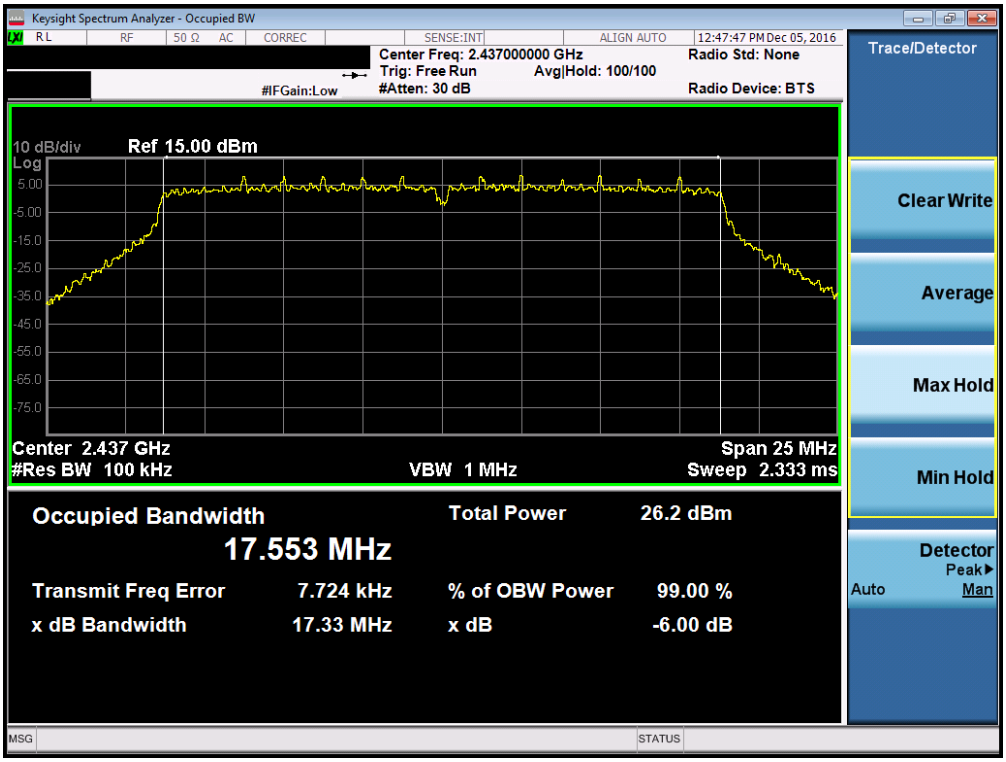
Plot 7-5. 6dB Bandwidth Plot (802.11g – Ch. 6)



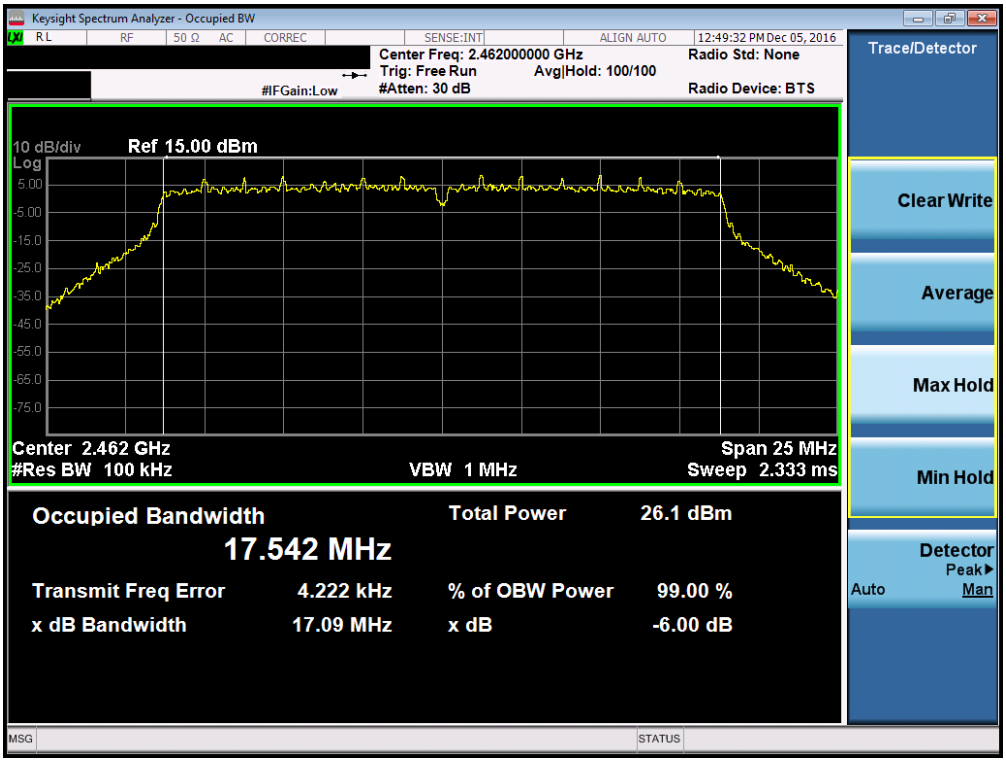
Plot 7-6. 6dB Bandwidth Plot (802.11g – Ch. 11)



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



Plot 7-8. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 6)

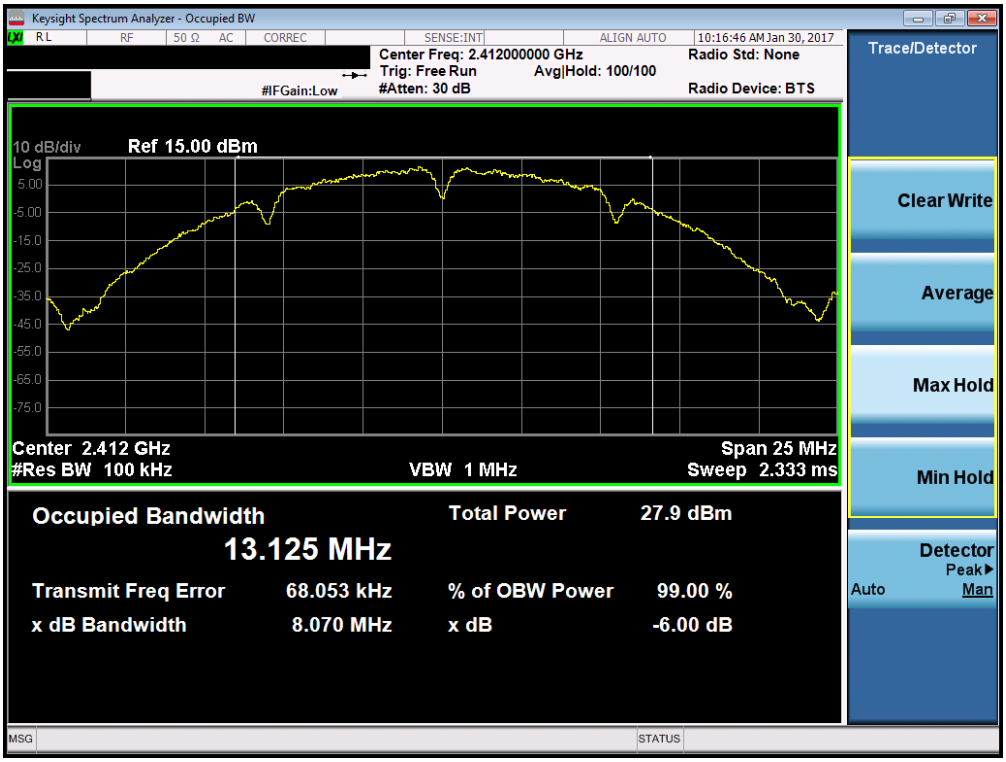


Plot 7-9. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 11)

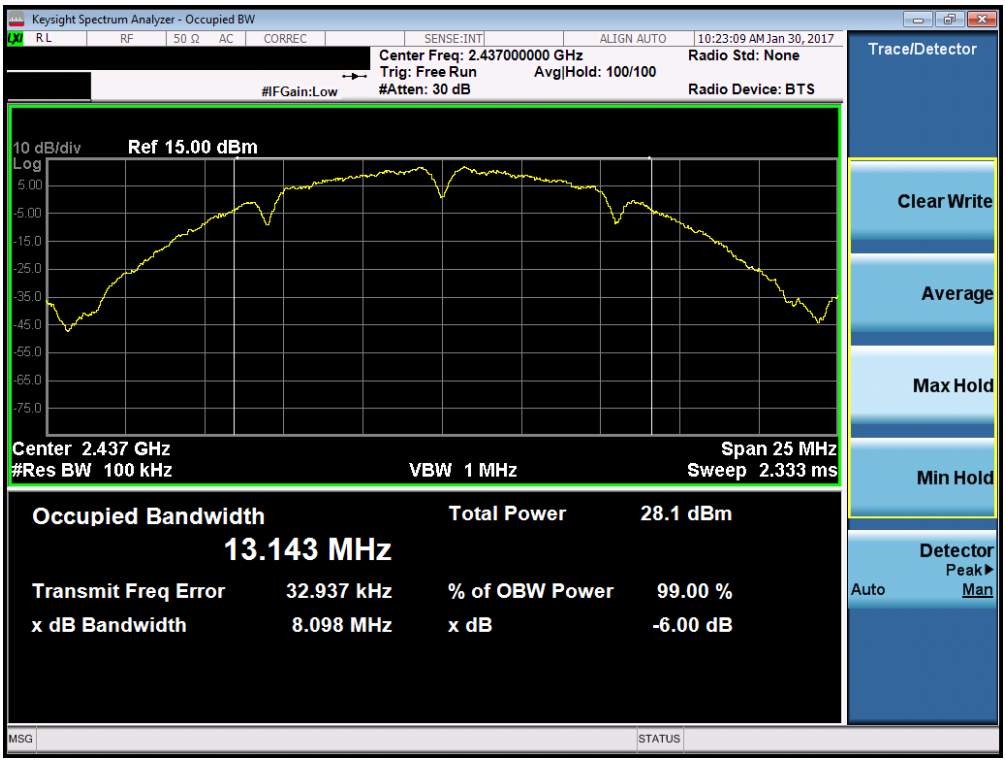
Antenna-2 6 dB Bandwidth Measurements (20MHz BW)

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
2412	1	b	1	8.070	0.500	Pass
2437	6	b	1	8.098	0.500	Pass
2462	11	b	1	7.787	0.500	Pass
2412	1	g	6	16.34	0.500	Pass
2437	6	g	6	16.33	0.500	Pass
2462	11	g	6	16.31	0.500	Pass
2412	1	n	6.5/7.2 (MCS0)	16.79	0.500	Pass
2437	6	n	6.5/7.2 (MCS0)	16.94	0.500	Pass
2462	11	n	6.5/7.2 (MCS0)	16.92	0.500	Pass

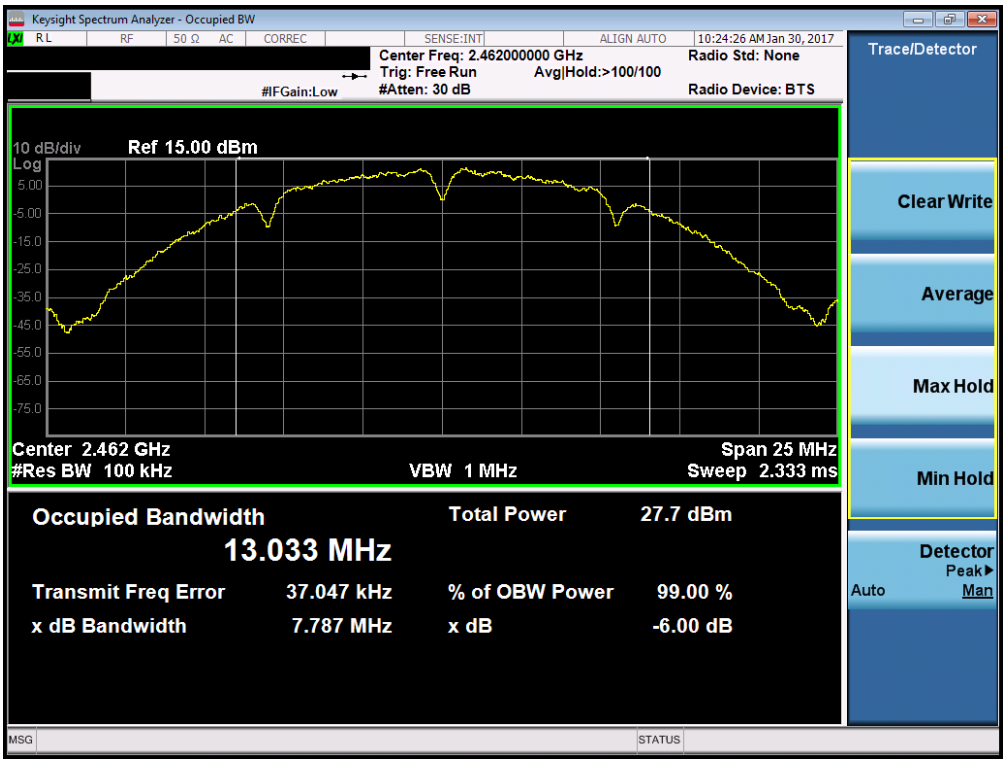
Table 7-3. Conducted Bandwidth



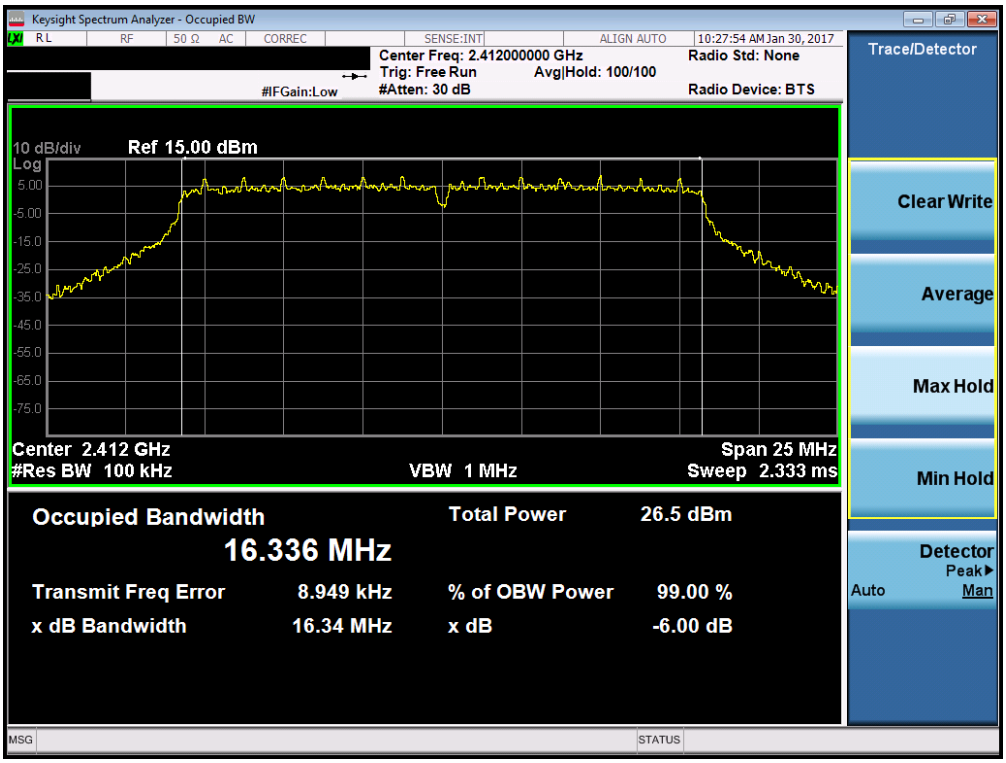
Plot 7-10. 6dB Bandwidth Plot (802.11b – Ch. 1)



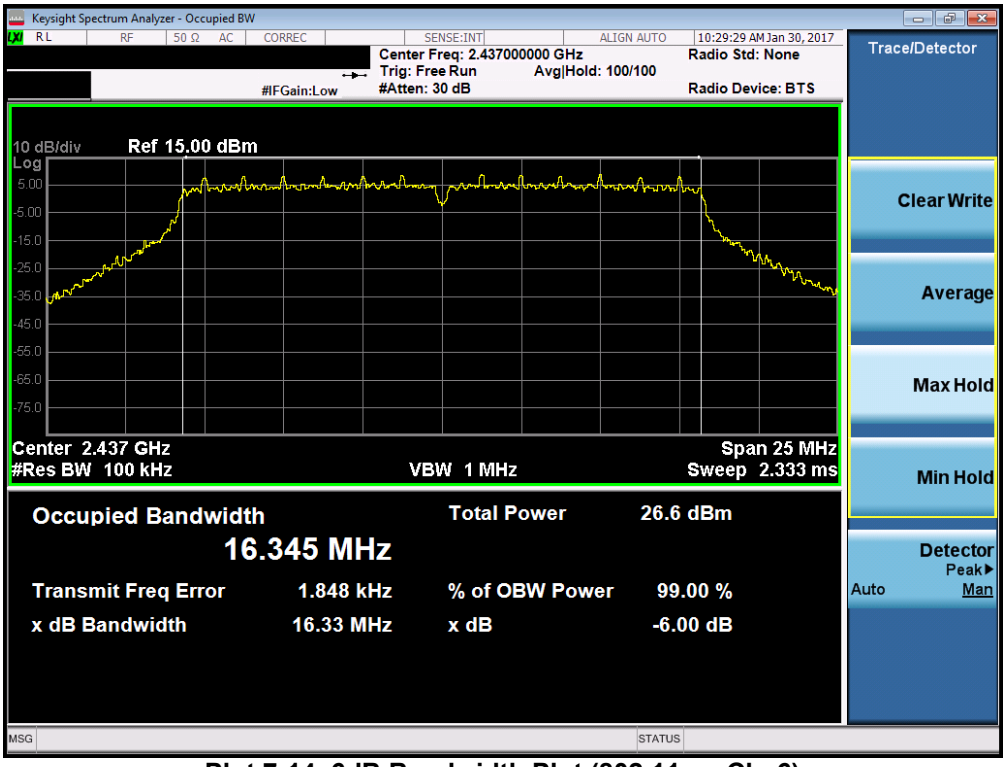
Plot 7-11. 6dB Bandwidth Plot (802.11b – Ch. 6)



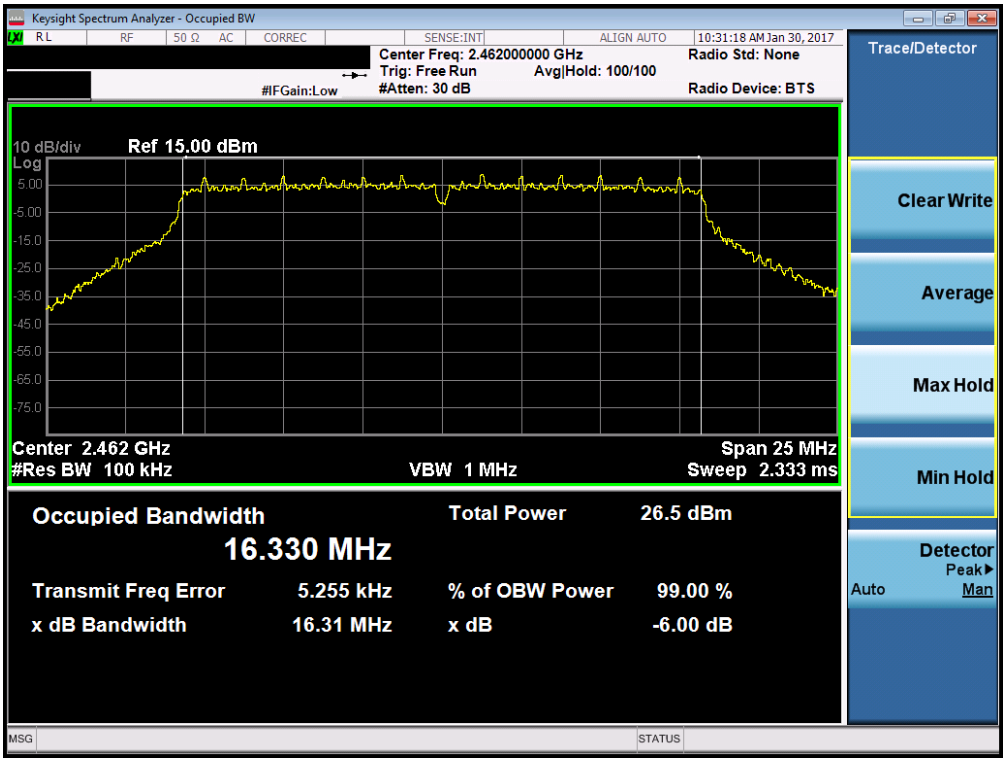
Plot 7-12. 6dB Bandwidth Plot (802.11b – Ch. 11)



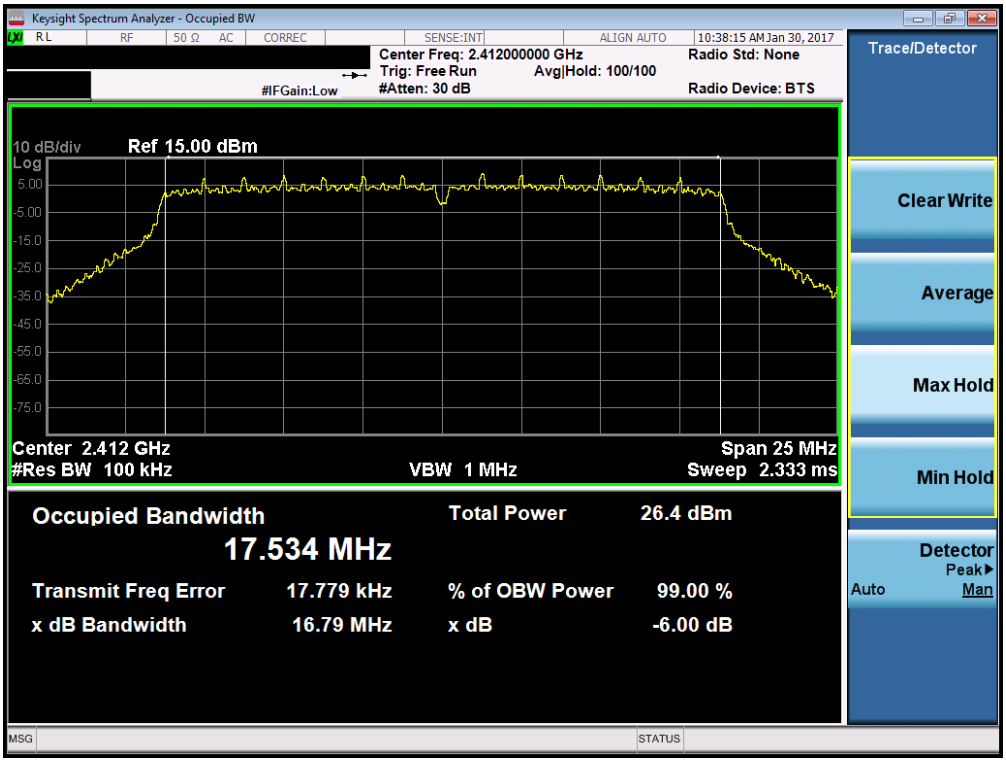
Plot 7-13. 6dB Bandwidth Plot (802.11g – Ch. 1)



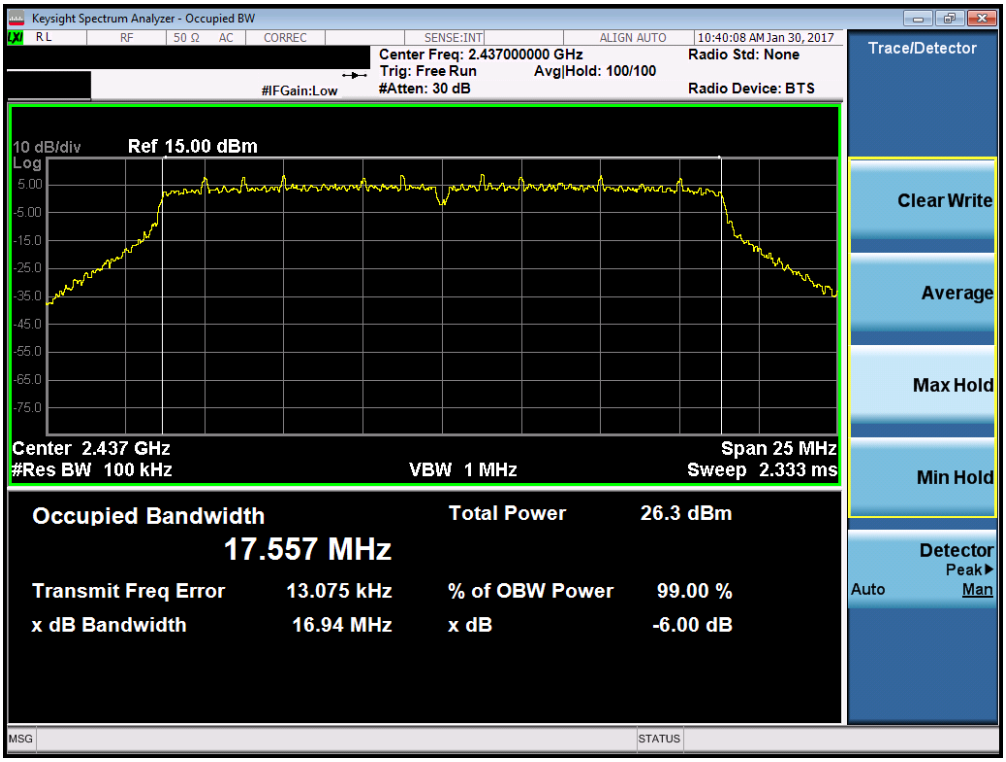
Plot 7-14. 6dB Bandwidth Plot (802.11g – Ch. 6)



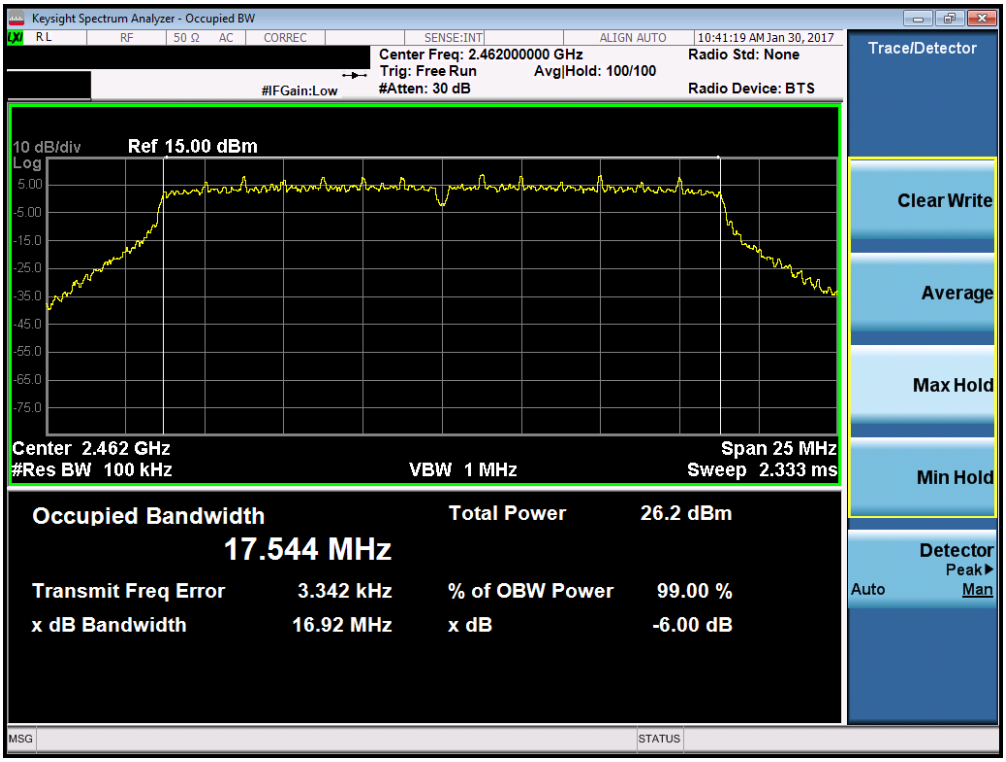
Plot 7-15. 6dB Bandwidth Plot (802.11g – Ch. 11)



Plot 7-16. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 1)



Plot 7-17. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 6)

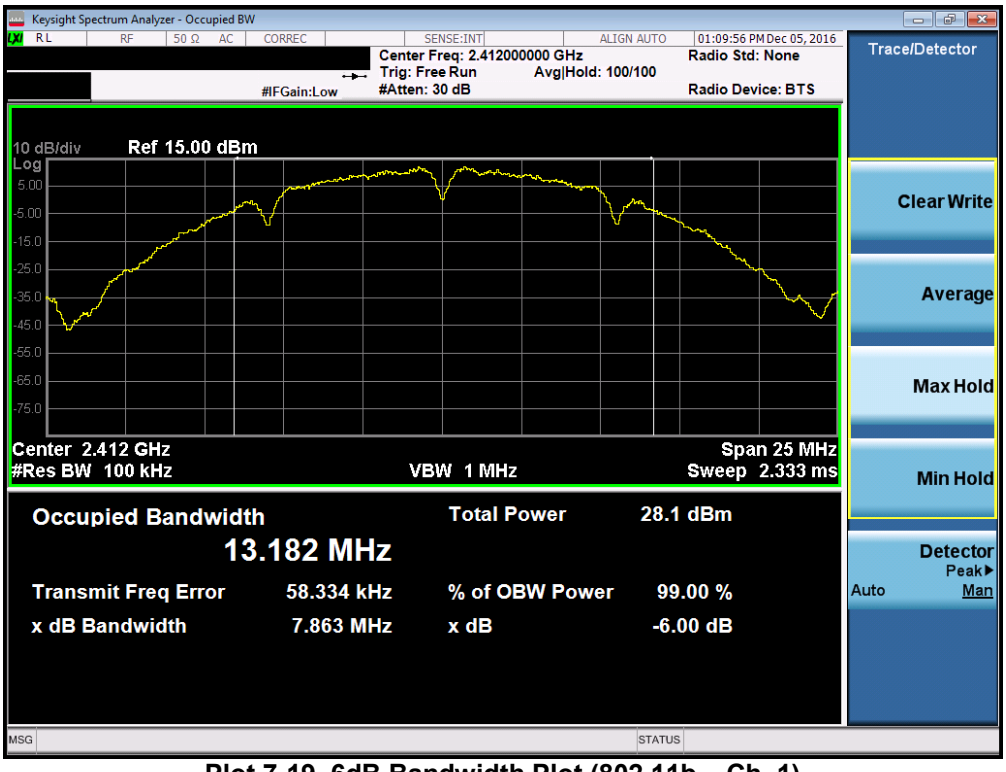


Plot 7-18. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 11)

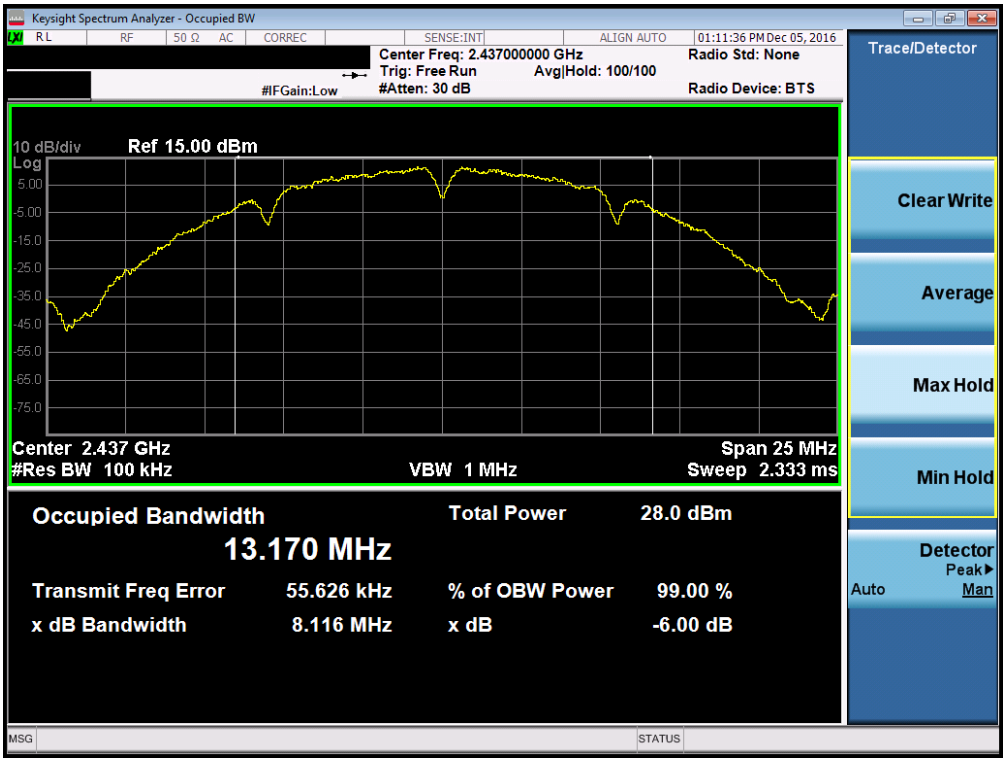
Antenna-3 6 dB Bandwidth Measurements (20MHz BW)

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
2412	1	b	1	7.863	0.500	Pass
2437	6	b	1	8.116	0.500	Pass
2462	11	b	1	7.977	0.500	Pass
2412	1	g	6	16.06	0.500	Pass
2437	6	g	6	16.33	0.500	Pass
2462	11	g	6	16.32	0.500	Pass
2412	1	n	6.5/7.2 (MCS0)	16.95	0.500	Pass
2437	6	n	6.5/7.2 (MCS0)	17.16	0.500	Pass
2462	11	n	6.5/7.2 (MCS0)	17.09	0.500	Pass

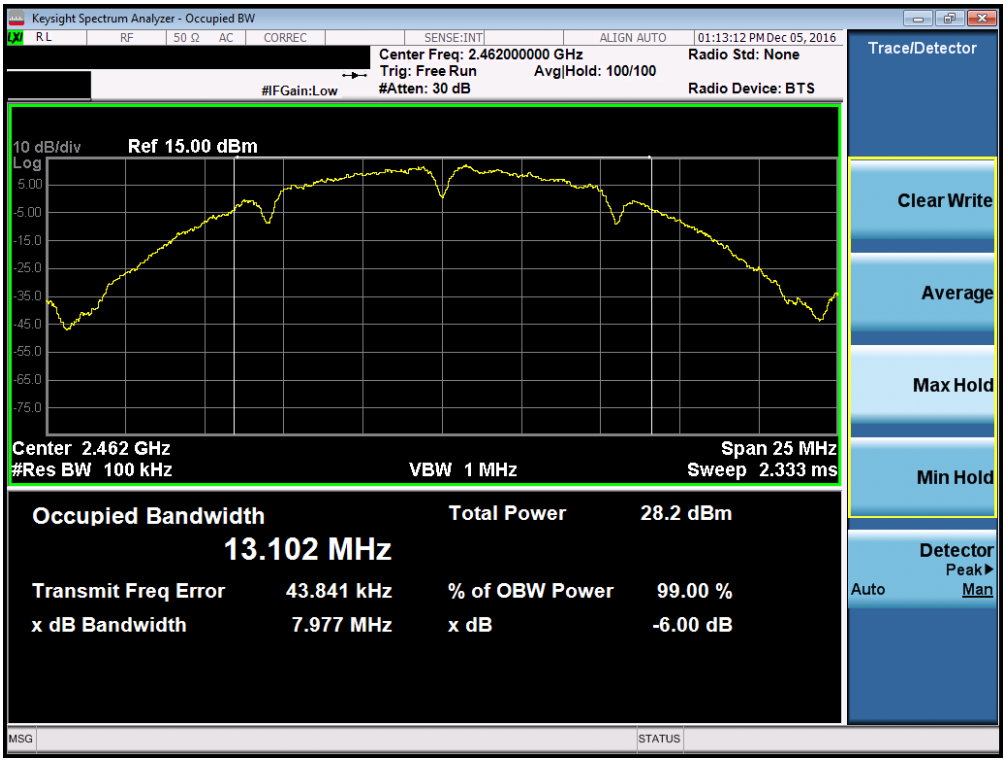
Table 7-4. Conducted Bandwidth Measurements



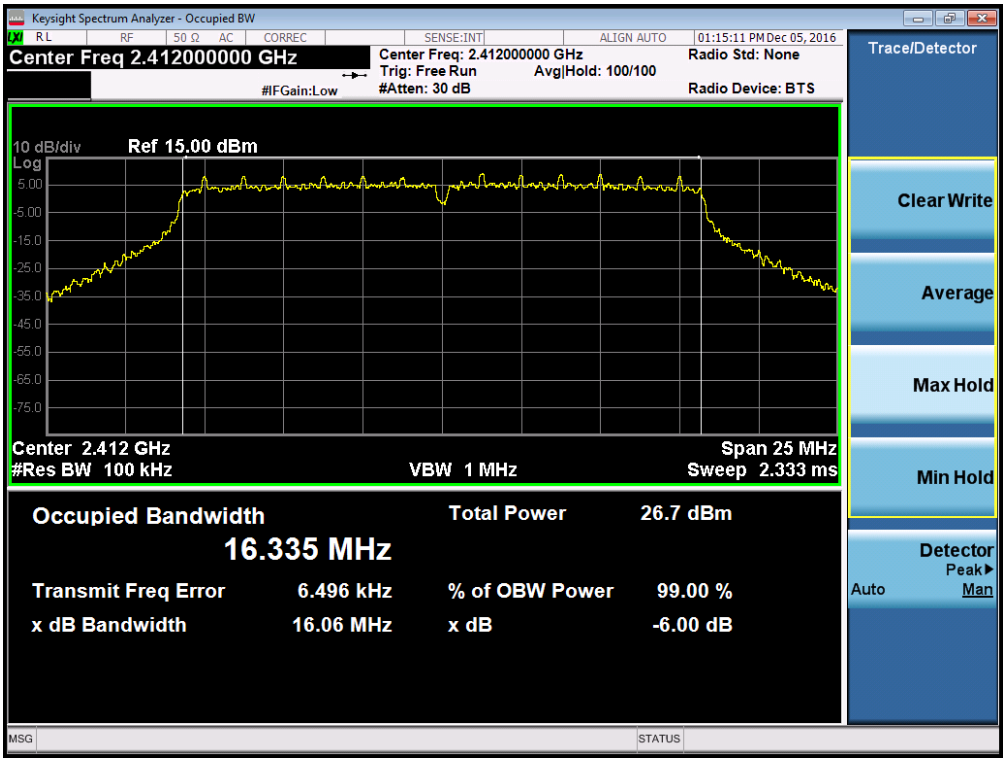
Plot 7-19. 6dB Bandwidth Plot (802.11b – Ch. 1)



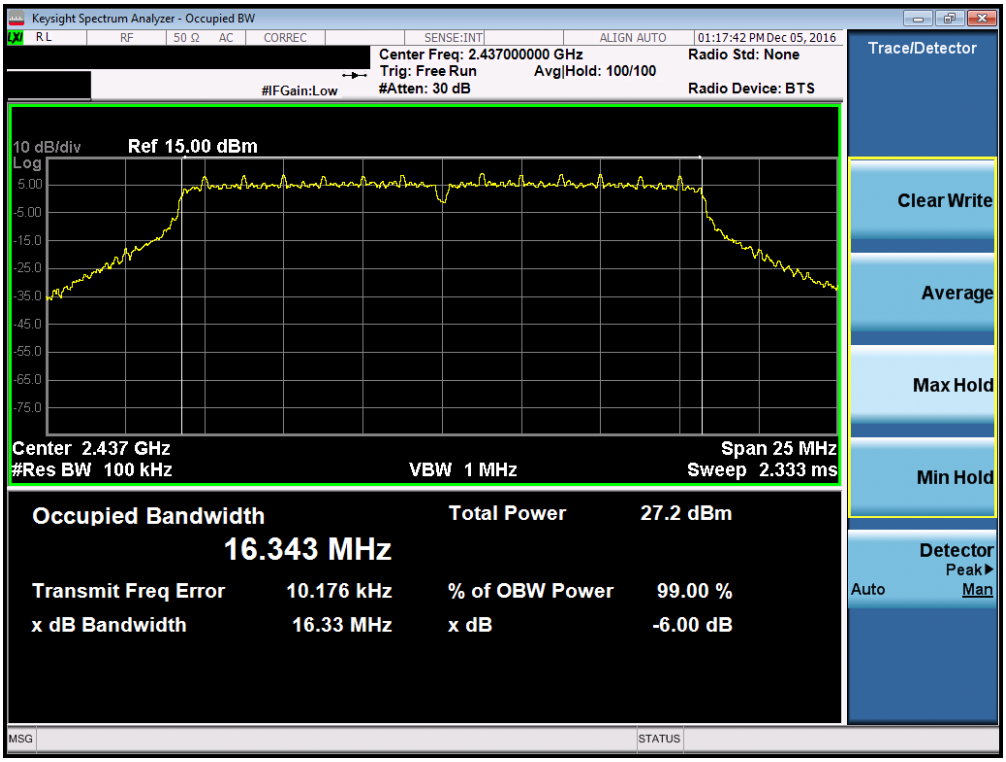
Plot 7-20. 6dB Bandwidth Plot (802.11b – Ch. 6)



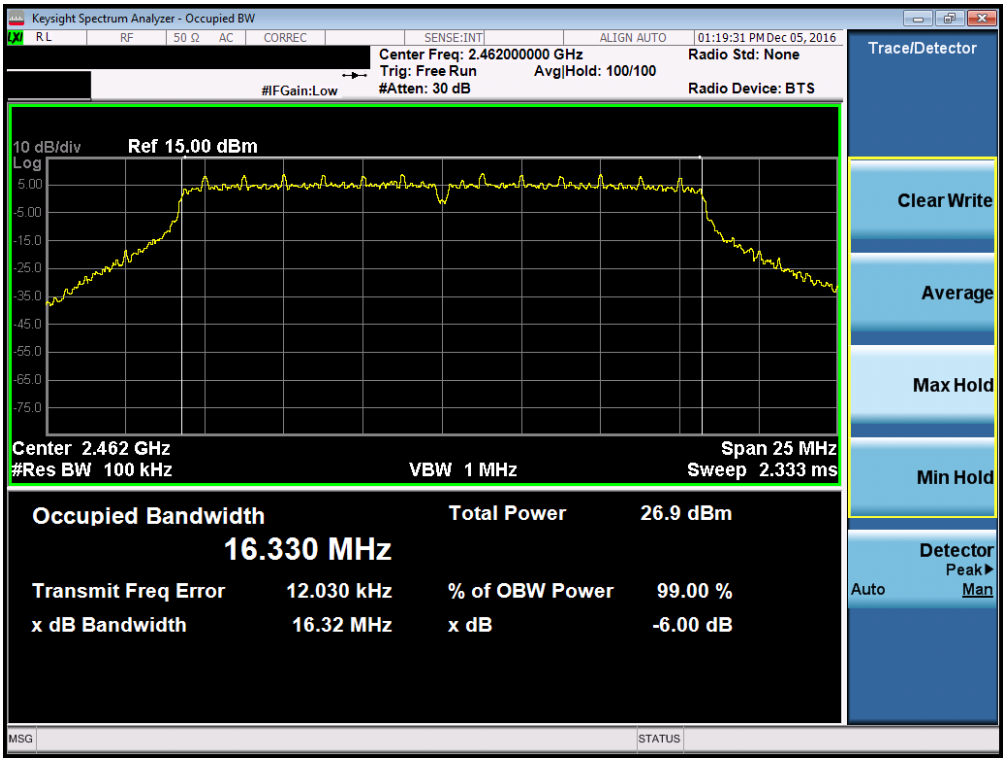
Plot 7-21. 6dB Bandwidth Plot (802.11b – Ch. 11)



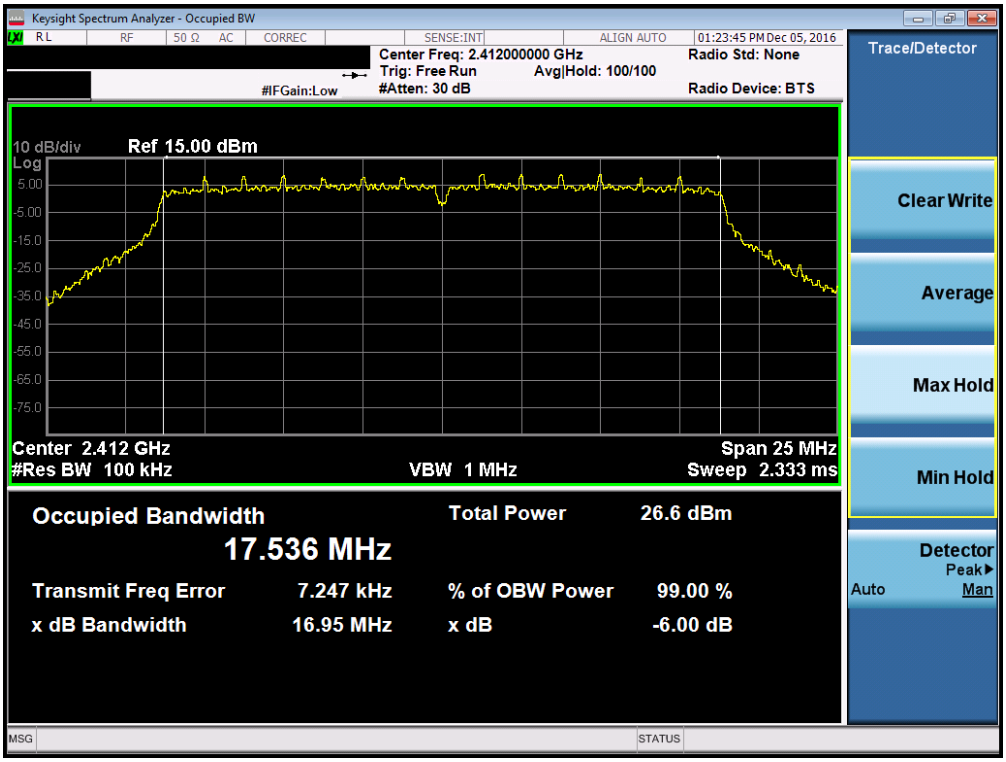
Plot 7-22. 6dB Bandwidth Plot (802.11g – Ch. 1)



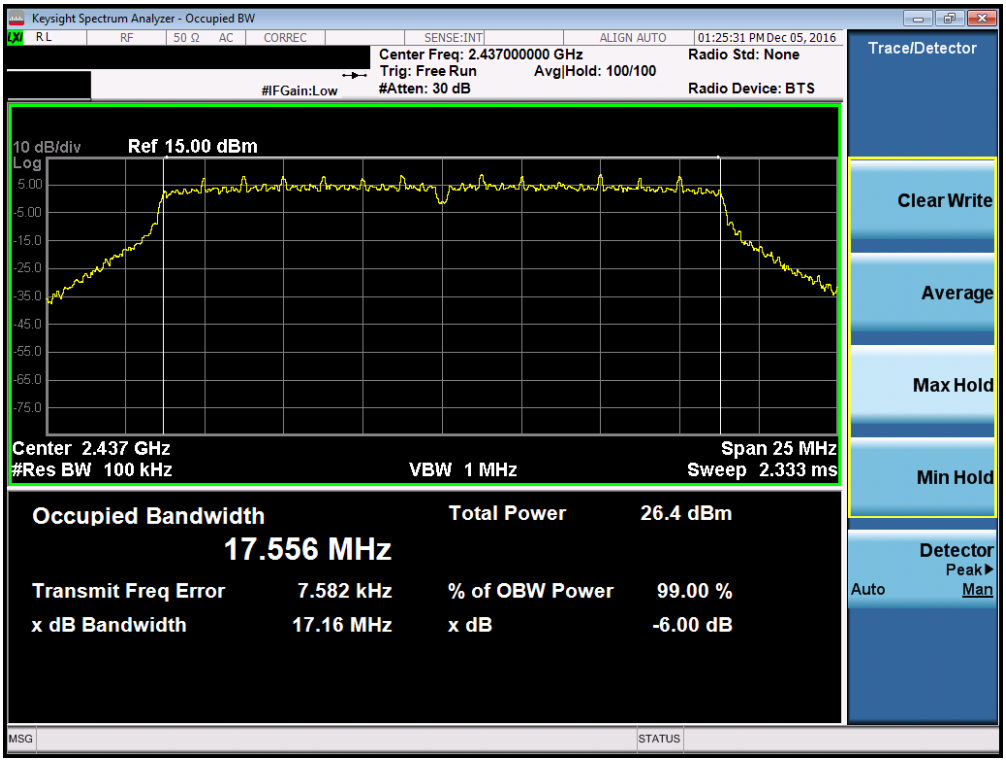
Plot 7-23. 6dB Bandwidth Plot (802.11g – Ch. 6)



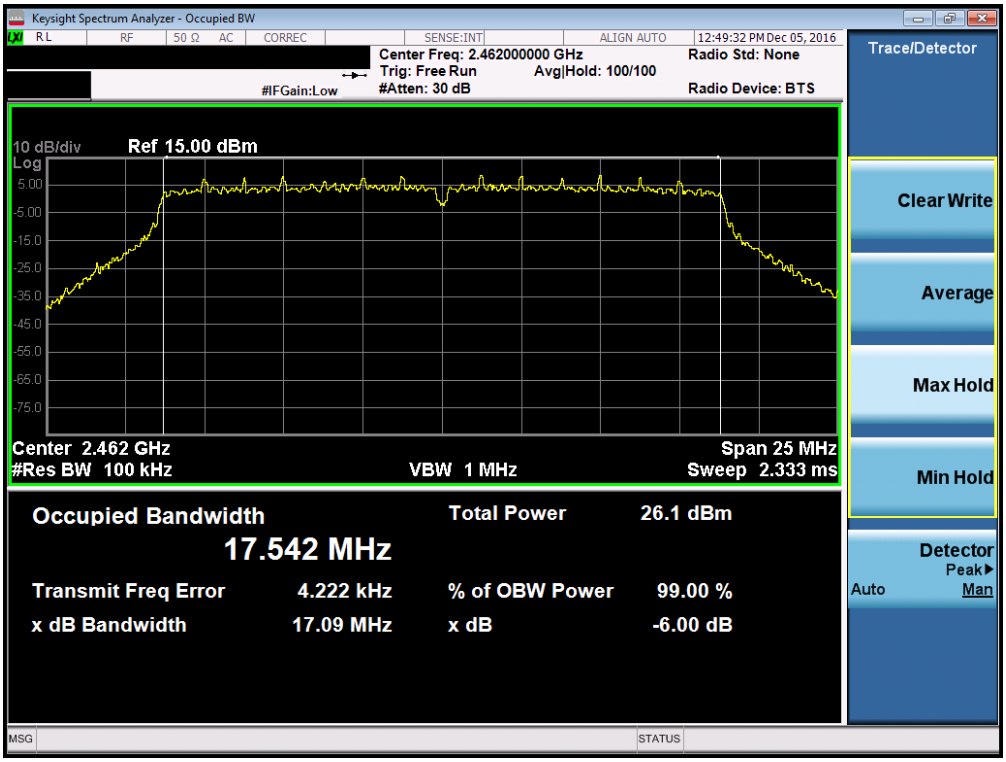
Plot 7-24. 6dB Bandwidth Plot (802.11g – Ch. 11)



Plot 7-25. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 1)



Plot 7-26. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 6)

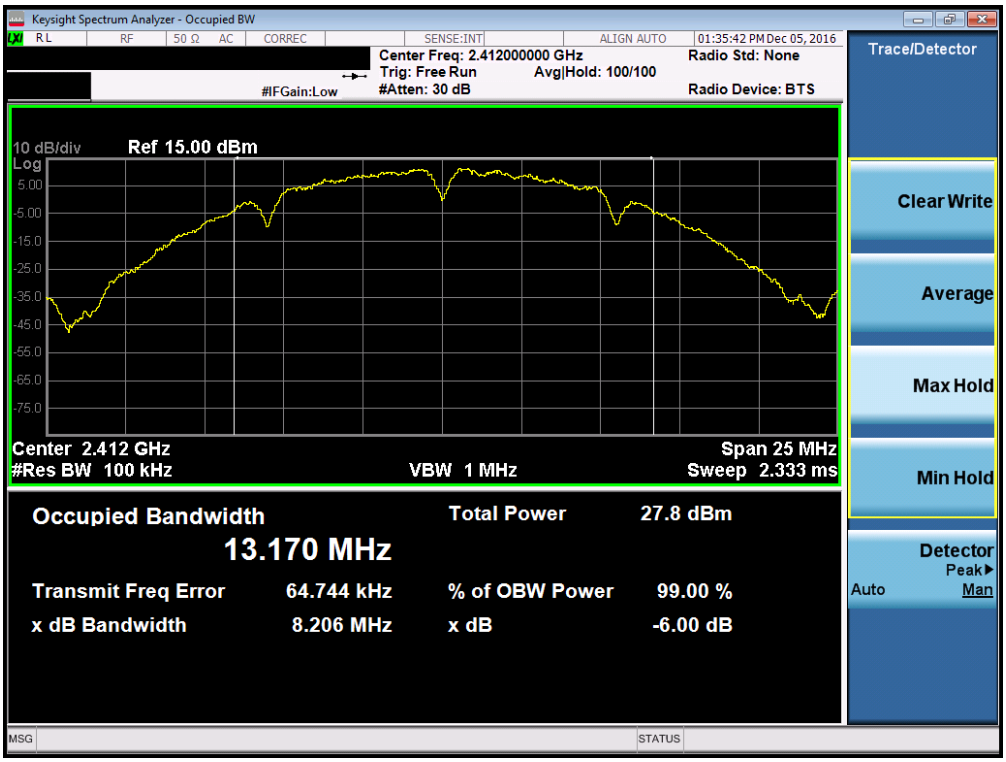


Plot 7-27. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 11)

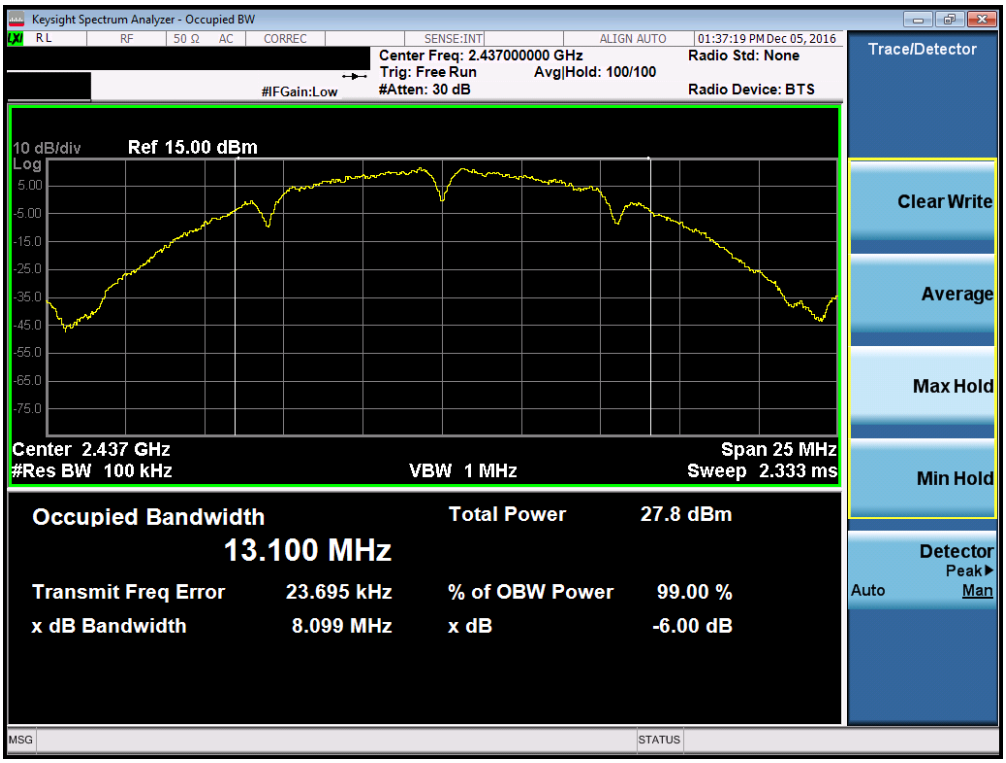
Antenna-4 6 dB Bandwidth Measurements (20MHz BW)

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
2412	1	b	1	8.206	0.500	Pass
2437	6	b	1	8.099	0.500	Pass
2462	11	b	1	8.223	0.500	Pass
2412	1	g	6	16.32	0.500	Pass
2437	6	g	6	16.31	0.500	Pass
2462	11	g	6	16.34	0.500	Pass
2412	1	n	6.5/7.2 (MCS0)	17.07	0.500	Pass
2437	6	n	6.5/7.2 (MCS0)	17.26	0.500	Pass
2462	11	n	6.5/7.2 (MCS0)	17.07	0.500	Pass

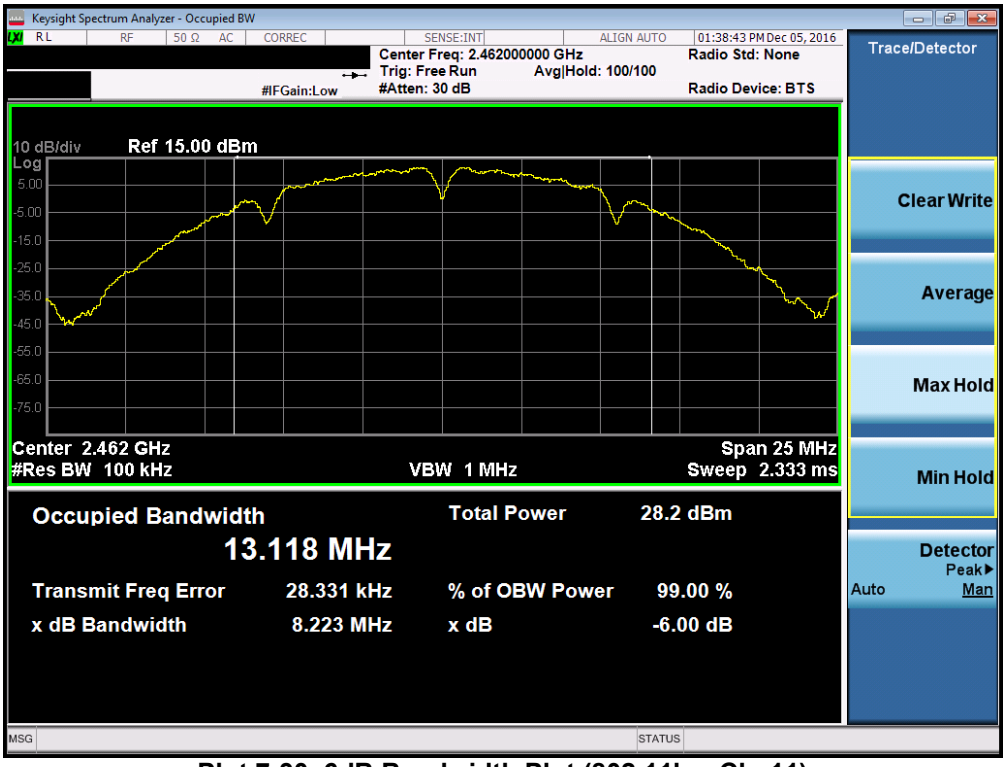
Table 7-5. Conducted Bandwidth Measurements



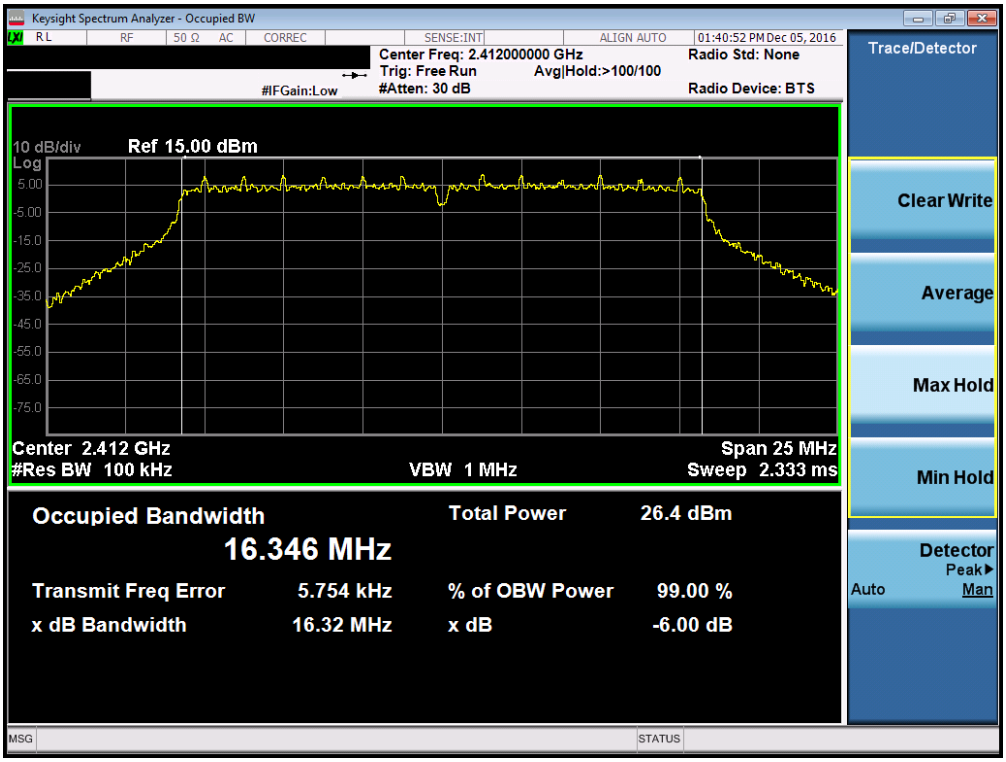
Plot 7-28. 6dB Bandwidth Plot (802.11b – Ch. 1)



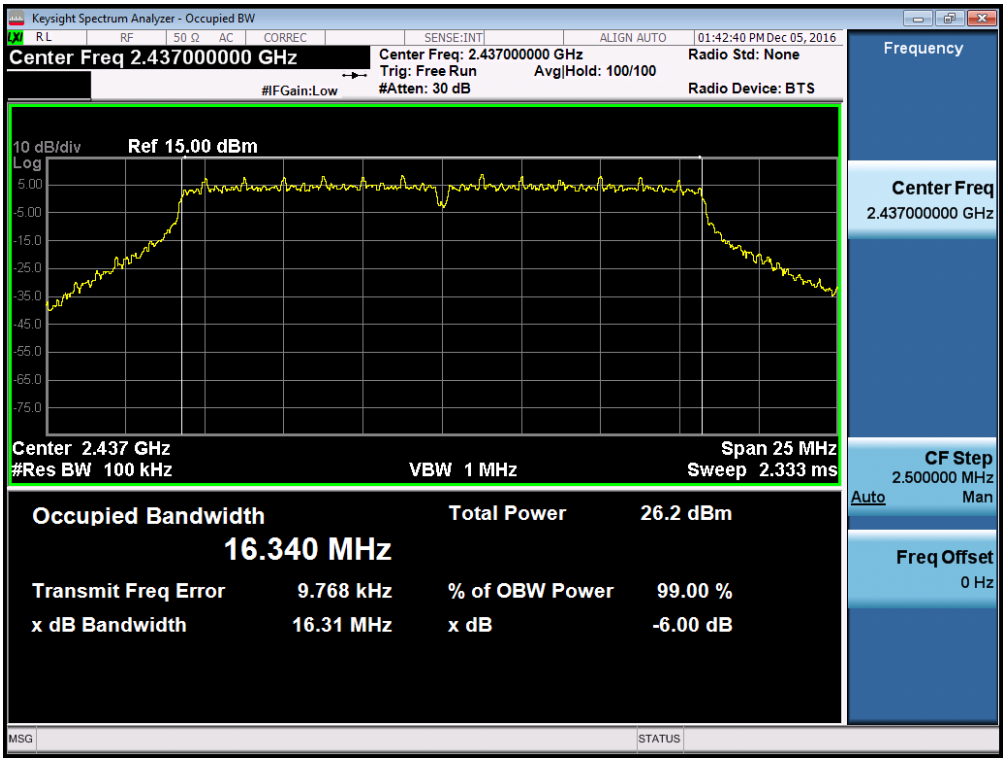
Plot 7-29. 6dB Bandwidth Plot (802.11b – Ch. 6)



Plot 7-30. 6dB Bandwidth Plot (802.11b – Ch. 11)



Plot 7-31. 6dB Bandwidth Plot (802.11g – Ch. 1)



Plot 7-32. 6dB Bandwidth Plot (802.11g – Ch. 6)

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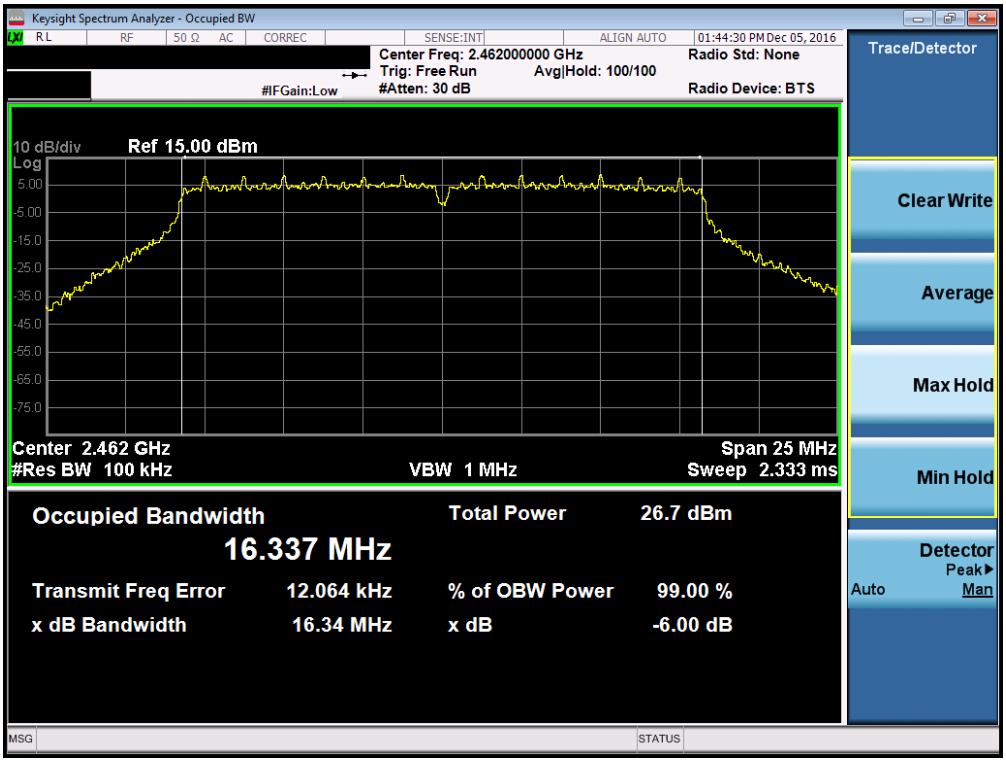
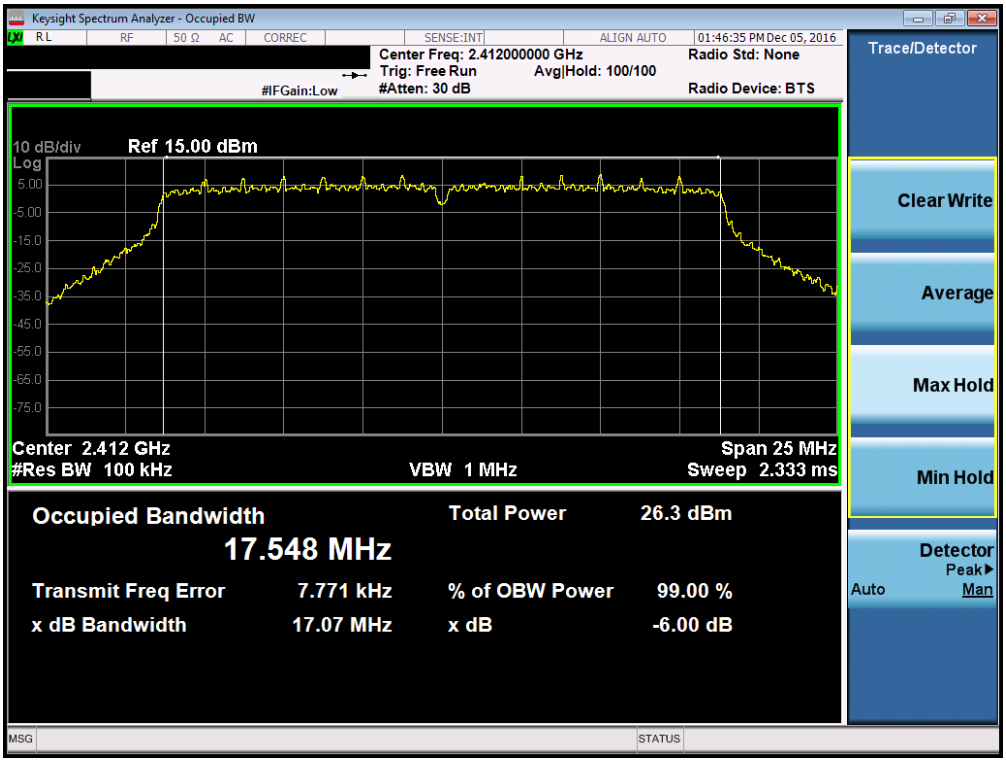
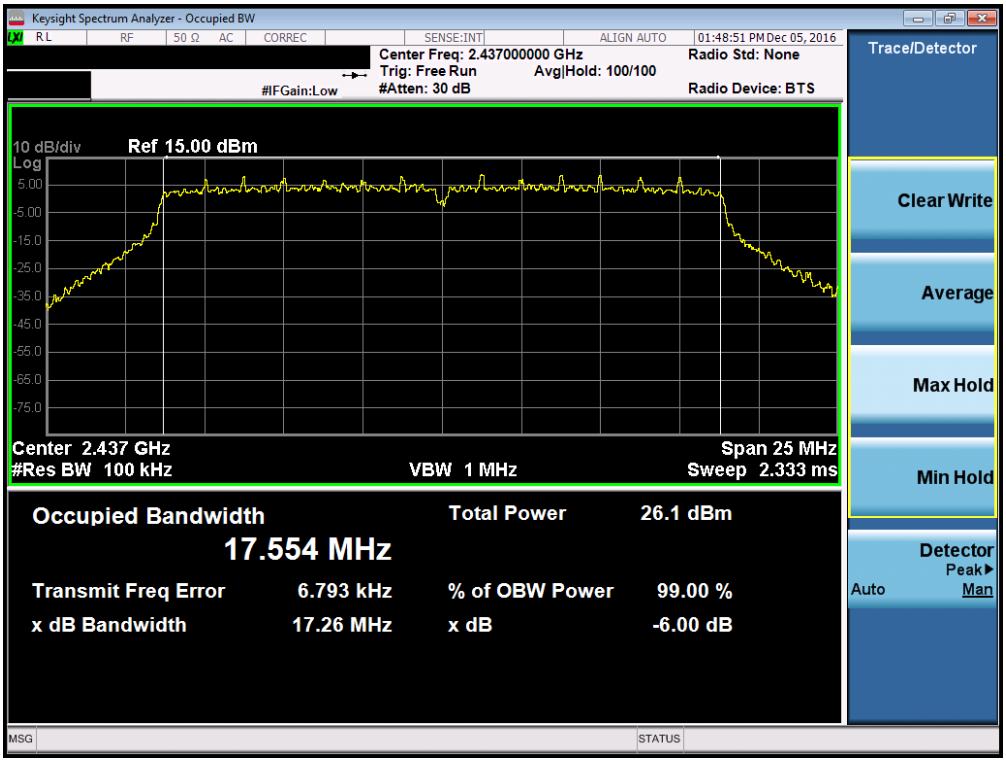


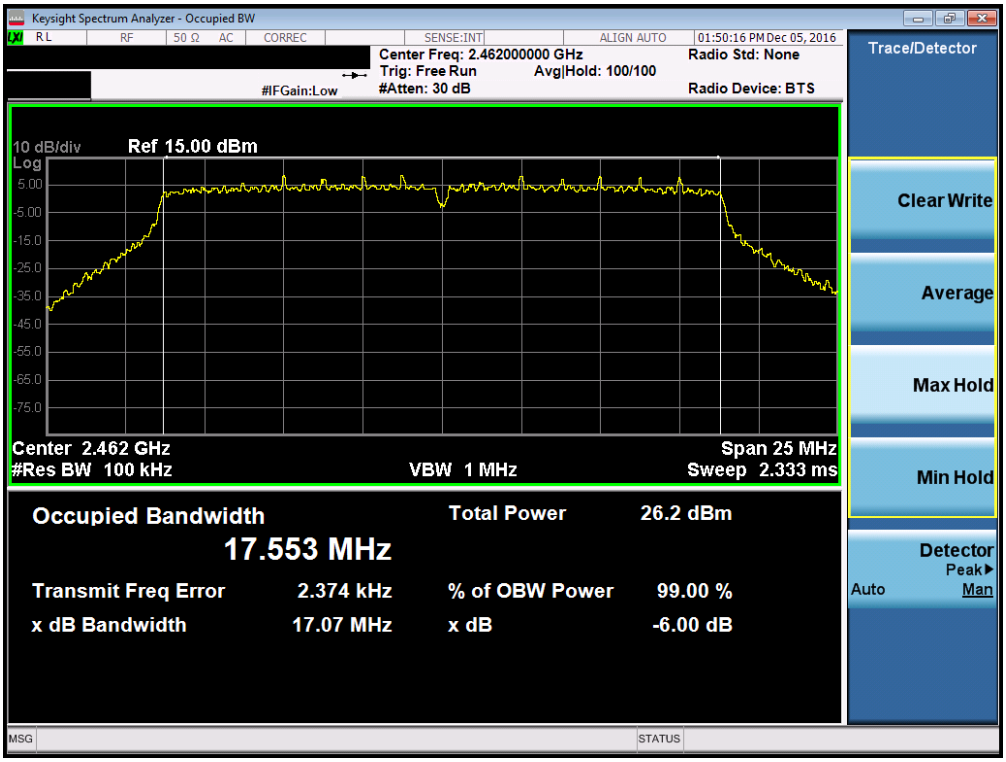
Plot 7-33. 6dB Bandwidth Plot (802.11g – Ch. 11)



Plot 7-34. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 1)



Plot 7-35. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 6)

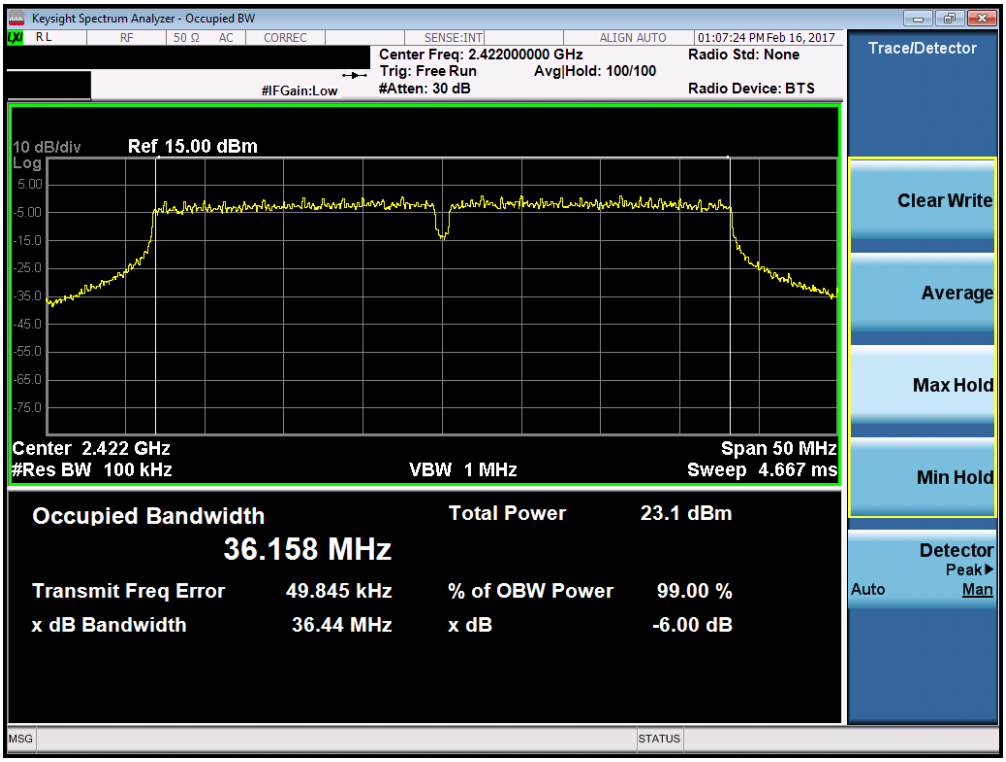


Plot 7-36. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 11)

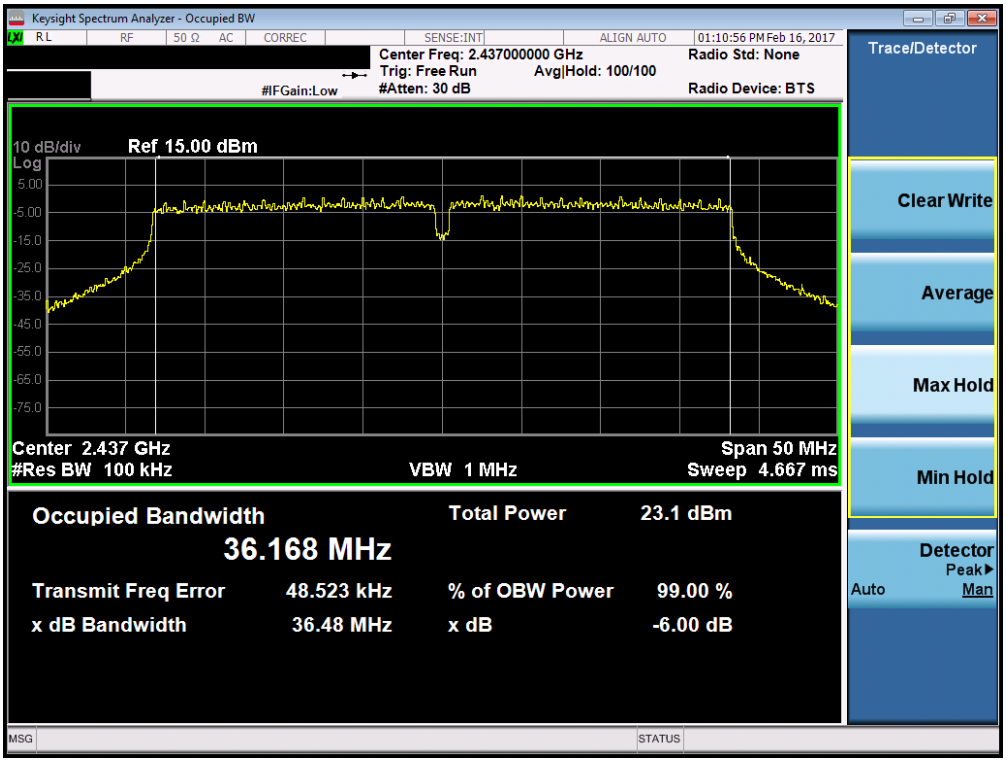
Antenna-1 40MHz 6 dB Bandwidth Measurements (40MHz BW)

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Bandwidth [MHz]
2422	3	n/ac	162/180 (MCS8)	36.44
2437	6	n/ac	162/180 (MCS8)	36.48
2457	10	n/ac	162/180 (MCS8)	36.48

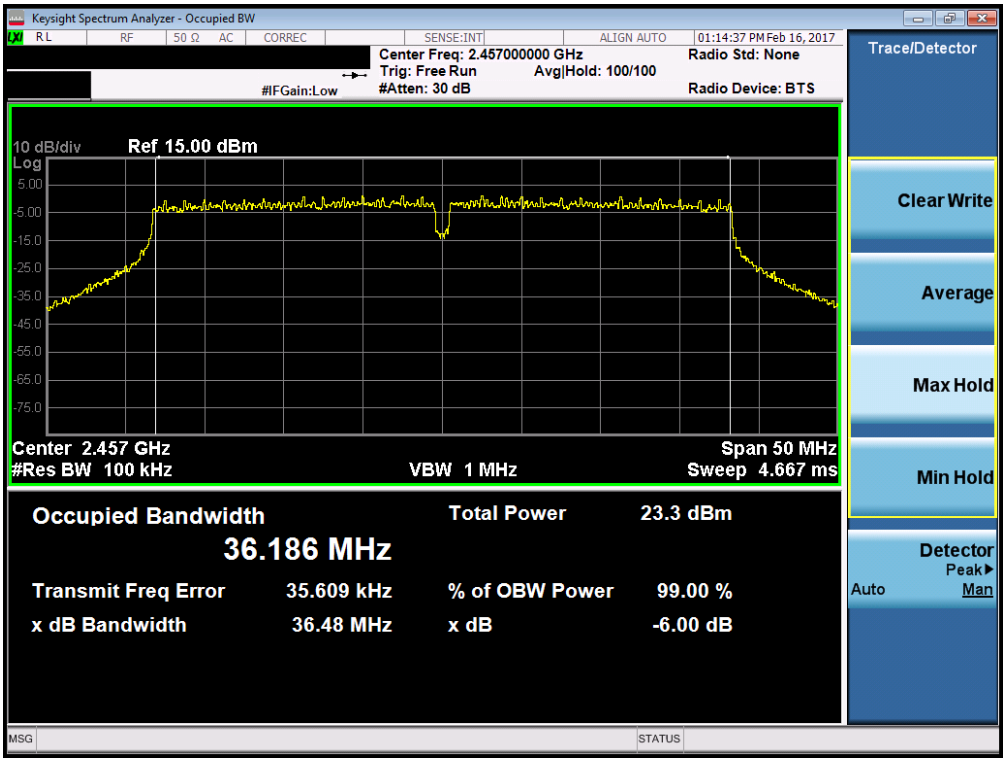
Table 7-6. Conducted Bandwidth Measurements



Plot 7-37. 6dB Bandwidth Plot (40MHz 802.11ac – Ch. 3)



Plot 7-38. 6dB Bandwidth Plot (40MHz 802.11ac – Ch. 6)

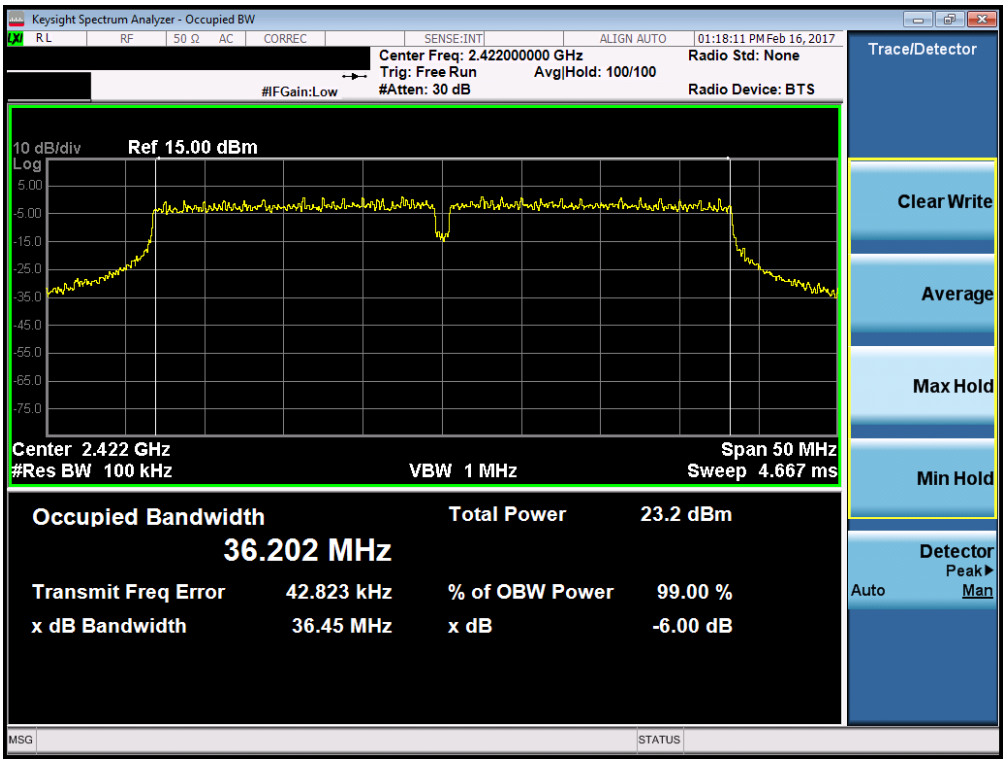


Plot 7-39. 6dB Bandwidth Plot (40MHz 802.11ac – Ch. 10)

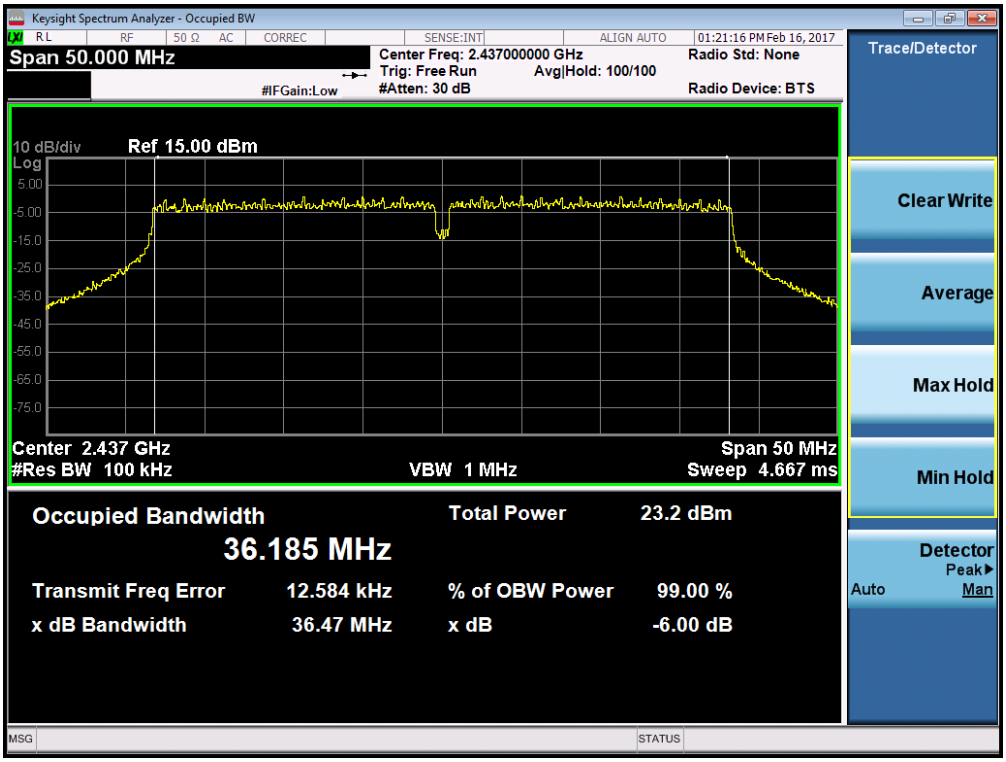
Antenna-2 40MHz 6 dB Bandwidth Measurements (40MHz BW)

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Bandwidth [MHz]
2422	3	n/ac	162/180 (MCS8)	36.45
2437	6	n/ac	162/180 (MCS8)	36.47
2457	10	n/ac	162/180 (MCS8)	36.51

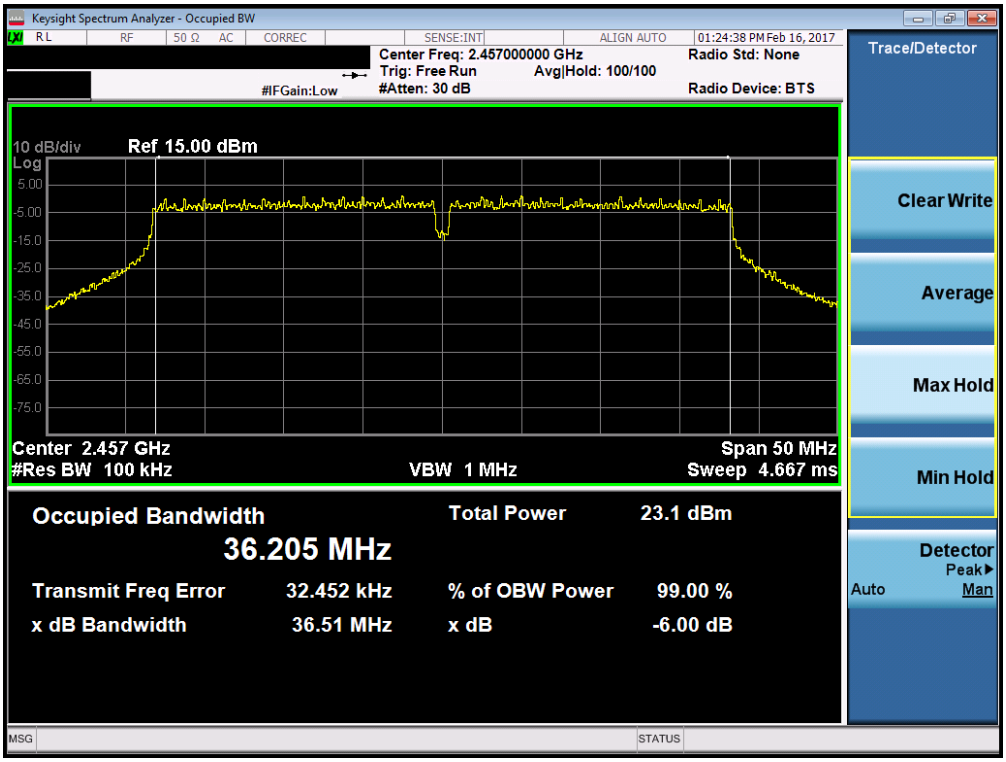
Table 7-7. Conducted Bandwidth



Plot 7-40. 6dB Bandwidth Plot (40MHz 802.11ac – Ch. 3)



Plot 7-41. 6dB Bandwidth Plot (40MHz 802.11ac – Ch. 6)

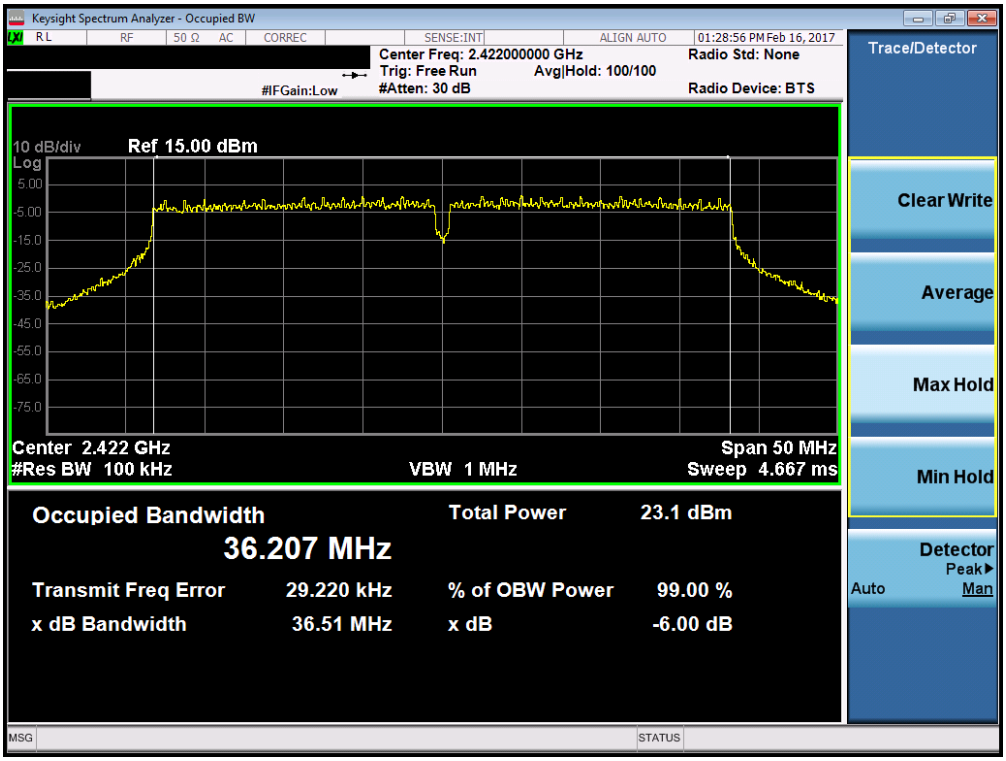


Plot 7-42. 6dB Bandwidth Plot (40MHz 802.11ac – Ch. 10)

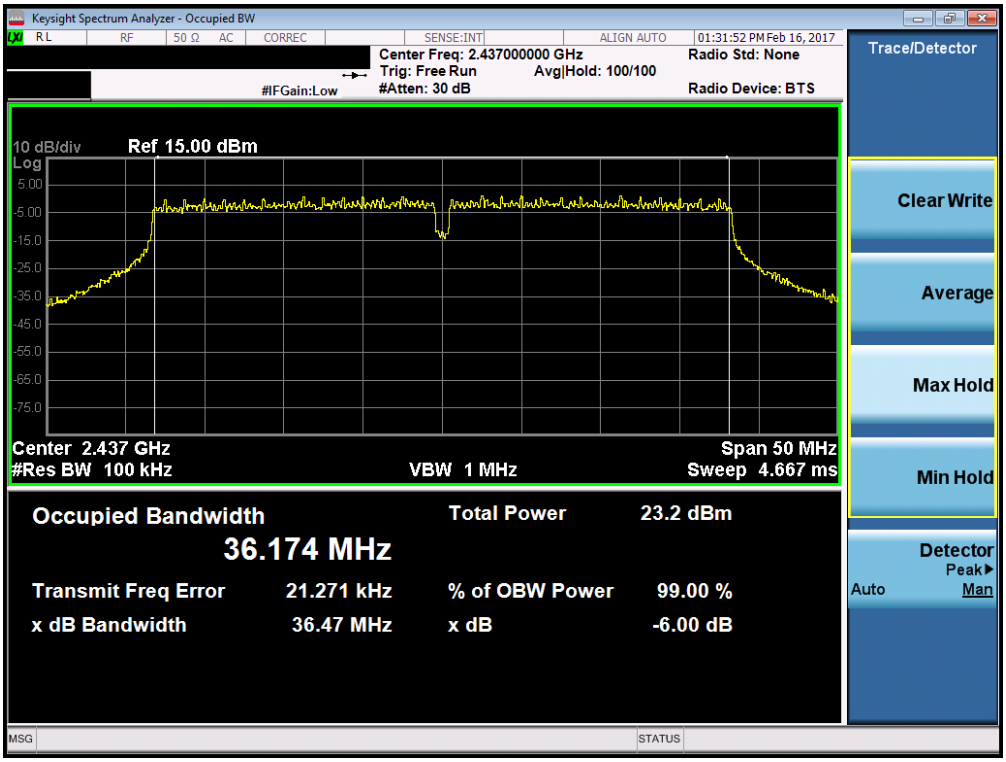
Antenna-3 40MHz 6 dB Bandwidth Measurements (40MHz BW)

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Bandwidth [MHz]
2422	3	n/ac	162/180 (MCS8)	36.51
2437	6	n/ac	162/180 (MCS8)	36.47
2457	10	n/ac	162/180 (MCS8)	36.49

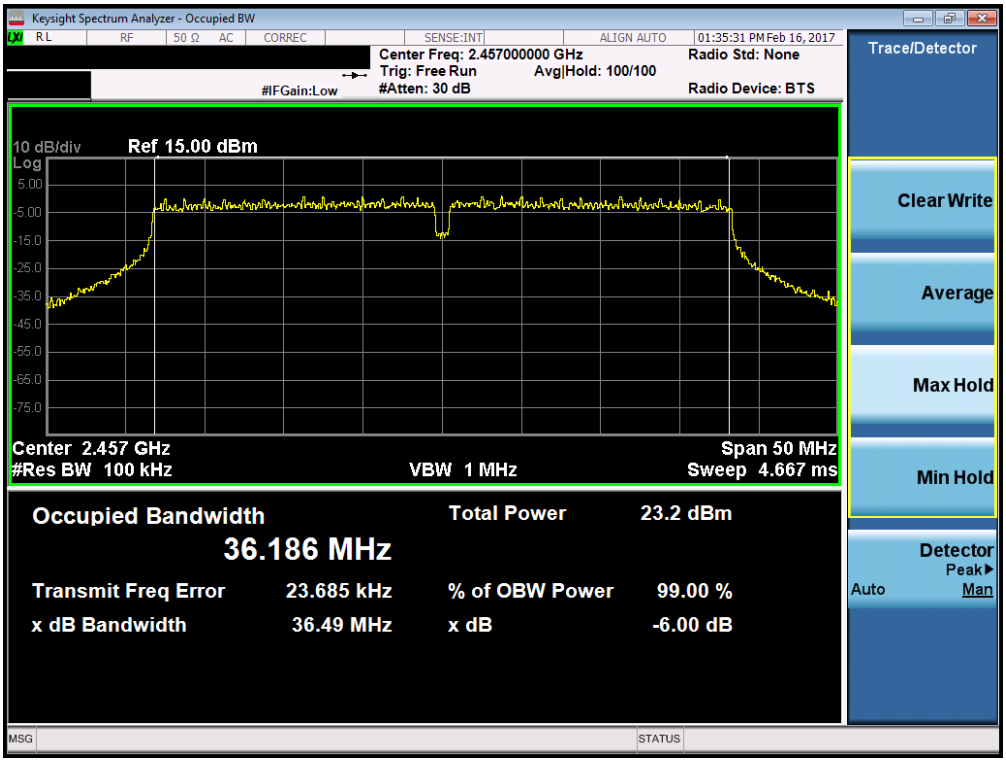
Table 7-8. Conducted Bandwidth Measurements



Plot 7-43. 6dB Bandwidth Plot (40MHz 802.11ac – Ch. 3)



Plot 7-44. 6dB Bandwidth Plot (40MHz 802.11ac – Ch. 6)

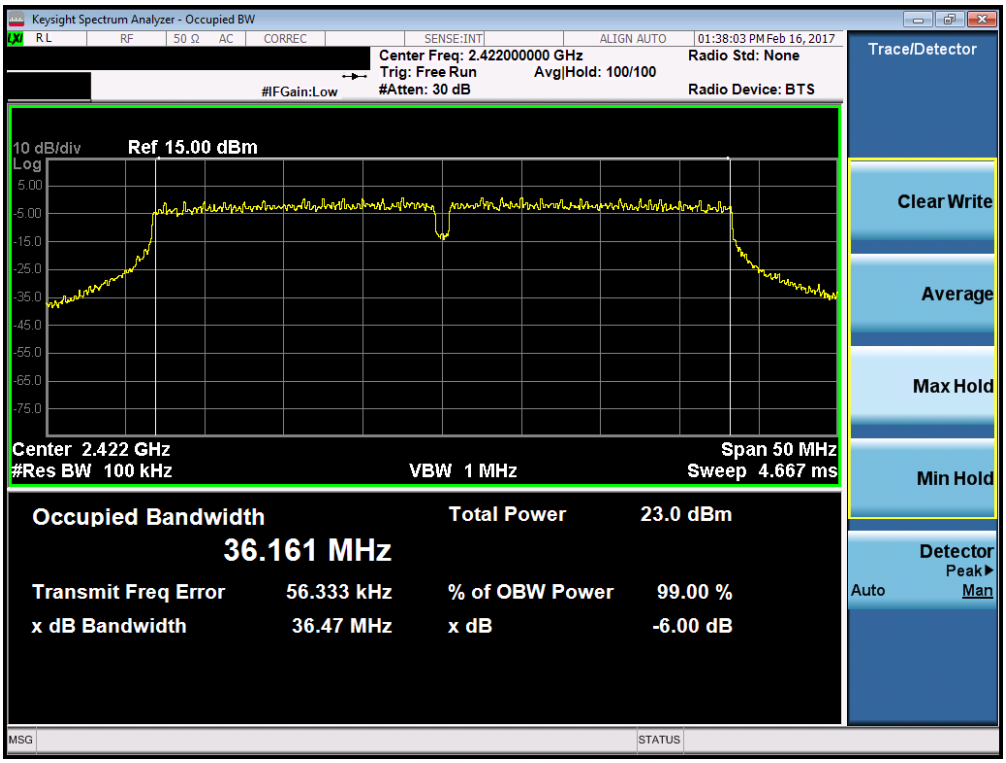


Plot 7-45. 6dB Bandwidth Plot (40MHz 802.11ac – Ch. 10)

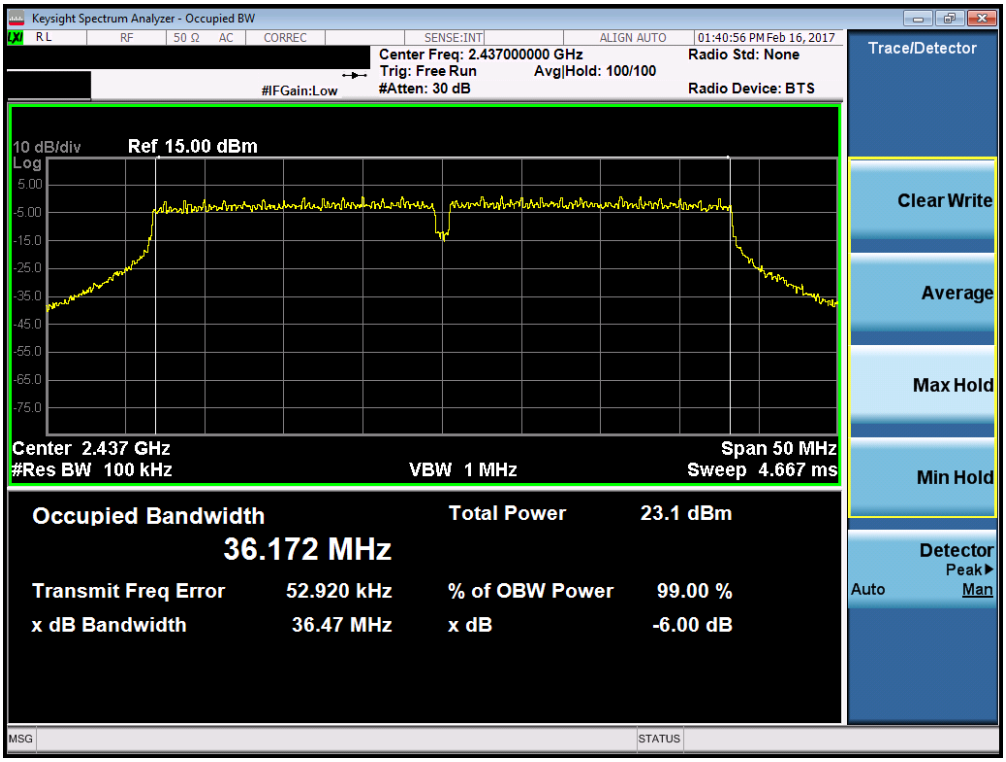
Antenna-4 40MHz 6 dB Bandwidth Measurements (40MHz BW)

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Bandwidth [MHz]
2422	3	n/ac	162/180 (MCS8)	36.47
2437	6	n/ac	162/180 (MCS8)	36.47
2457	10	n/ac	162/180 (MCS8)	36.49

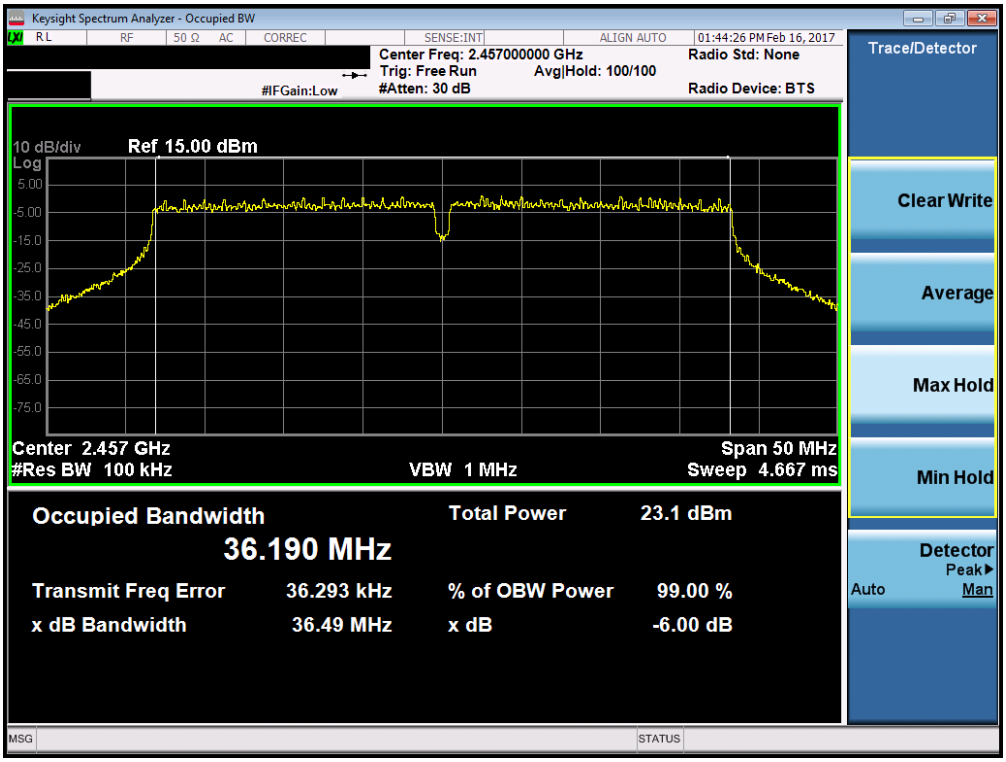
Table 7-9. Conducted Bandwidth Measurements



Plot 7-46. 6dB Bandwidth Plot (40MHz 802.11ac – Ch. 3)



Plot 7-47. 6dB Bandwidth Plot (40MHz 802.11ac – Ch. 6)



Plot 7-48. 6dB Bandwidth Plot (40MHz 802.11ac – Ch. 10)

7.3 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, at maximum power, and at the appropriate frequencies.

The maximum permissible conducted output power is 1 Watt.

Test Procedure Used

KDB 558074 D01 v03r05 – Section 9.1.2 PKPM1 Peak Power Method
KDB 558074 D01 v03r05 – Section 9.2.3.2 Method AVGPM-G
KDB 662911 D01 v02r01 – Section E)1) Measure-and-Sum Technique

Test Settings

Method PKPM1 (Peak Power Measurement)

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.

Method AVGPM-G (Average Power Measurement)

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 diagrams below.

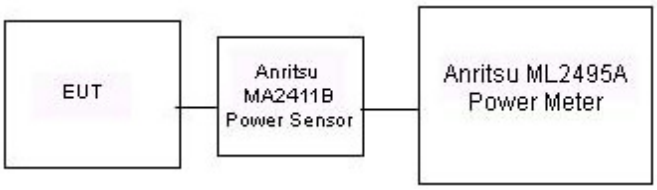


Figure 7-2. Test Instrument & Measurement Setup for Power Meter Measurements

Test Notes

Since the output of each of the four antennas transmit simultaneously and the signals are correlated, a directional gain is determined based on the guidance from KDB 662911 for systems with equal transmit powers and unequal antenna gains. The directional gain is applied to the summed simultaneous output power and is equal to $10\log[(10^{G1/20} + 10^{G2/20} + 10^{G3/20} + 10^{G4/20})^2 / N_{ANT}]$ dB, where the gains are specified in units of dBi.

Freq [MHz]	Channel	Detector	2.4GHz Conducted Power [dBm]		
			IEEE Transmission Mode		
			802.11b	802.11g	802.11n
2412	1	AVG	20.50	18.40	18.40
		PEAK	22.65	24.65	24.76
2437	6	AVG	20.67	19.58	19.57
		PEAK	22.85	24.80	24.62
2462	11	AVG	20.61	18.24	18.12
		PEAK	22.83	24.73	24.73

Table 7-10. Antenna-1 Conducted Output Power Measurements

Freq [MHz]	Channel	Detector	2.4GHz Conducted Power [dBm]		
			IEEE Transmission Mode		
			802.11b	802.11g	802.11n
2412	1	AVG	21.05	18.44	18.13
		PEAK	23.27	24.68	24.60
2437	6	AVG	21.00	20.41	20.11
		PEAK	23.26	24.67	24.48
2462	11	AVG	21.07	18.40	18.10
		PEAK	23.24	24.67	24.55

Table 7-11. Antenna-2 Conducted Output Power Measurements

Freq [MHz]	Channel	Detector	2.4GHz Conducted Power [dBm]		
			IEEE Transmission Mode		
			802.11b	802.11g	802.11n
2412	1	AVG	20.75	18.22	18.11
		PEAK	22.97	24.43	24.27
2437	6	AVG	20.75	20.17	19.85
		PEAK	22.98	24.43	24.28
2462	11	AVG	20.55	18.21	18.10
		PEAK	22.87	24.30	24.15

Table 7-12. Antenna-3 Conducted Output Power Measurements

Freq [MHz]	Channel	Detector	2.4GHz Conducted Power [dBm]		
			IEEE Transmission Mode		
			802.11b	802.11g	802.11n
2412	1	AVG	20.96	18.22	17.99
		PEAK	23.19	24.61	24.47
2437	6	AVG	20.93	20.22	19.99
		PEAK	23.14	24.55	24.39
2462	11	AVG	21.02	18.34	18.11
		PEAK	23.27	24.68	24.54

Table 7-4. Antenna-2 Conducted Output Power Measurements

Freq [MHz]	Channel	Detector	2.4GHz Conducted Power [dBm]			
			IEEE Transmission Mode			
			ANT1	ANT2	ANT3	ANT4
2422	3	AVG	10.11	9.91	9.99	9.90
		PEAK	12.22	12.35	12.64	12.41
2427	4	AVG	9.98	9.10	9.88	9.78
		PEAK	12.24	12.34	12.44	12.46
2432	5	AVG	12.30	11.81	11.97	11.99
		PEAK	14.41	14.46	14.68	14.34
2437	6	AVG	12.97	12.99	12.96	12.99
		PEAK	15.20	15.24	15.23	15.54
2442	7	AVG	11.23	10.98	11.27	11.20
		PEAK	13.24	13.24	13.54	13.64
2447	8	AVG	9.99	10.01	10.11	10.21
		PEAK	12.35	12.31	12.50	12.54
2452	9	AVG	9.11	9.34	9.21	9.20
		PEAK	12.50	12.40	12.35	12.24
2457	10	AVG	8.57	8.61	8.51	8.62
		PEAK	11.50	11.47	11.55	11.44

Table 7-4. 802.11n/ac (40MHz BW) Conducted Output Power Measurements

Freq [MHz]	Channel	Detector	Directional Gain [dBi]	2.4GHz Conducted Power [dBm]					Max Permissible Conducted Power [dBm]	Adjusted Limit [dBm]	Margin [dB]
				IEEE Transmission Mode							
				ANT1	ANT2	ANT3	ANT4	MIMO			
2412	1	AVG	7.83	14.44	14.11	14.11	13.77	20.13	30.00	28.17	-8.04
		PEAK	7.83	20.71	20.22	20.21	20.31	26.39	30.00	28.17	-1.78
2437	6	AVG	7.68	13.98	13.99	14.22	14.40	20.17	30.00	28.32	-8.15
		PEAK	7.68	20.66	20.31	20.27	20.38	26.43	30.00	28.32	-1.89
2462	11	AVG	7.32	12.11	12.09	12.09	12.12	18.12	30.00	28.68	-10.56
		PEAK	7.32	19.09	19.01	19.21	19.10	25.12	30.00	28.68	-3.56

Table 7-13. MIMO 802.11n (20MHz BW) Conducted Output Power Measurements

Freq [MHz]	Channel	Detector	Directional Gain [dBi]	2.4GHz Conducted Power [dBm]					Max Permissible Conducted Power	Adjusted Limit [dBm]	Margin [dB]
				IEEE Transmission Mode							
				ANT1	ANT2	ANT3	ANT4	MIMO			
2422	3	AVG	7.83	8.32	8.32	8.31	8.38	14.35	30.00	28.17	-13.82
		PEAK	7.83	11.44	11.21	11.54	11.50	17.44	30.00	28.17	-10.73
2427	4	AVG	7.83	8.33	8.33	8.24	8.26	14.31	30.00	28.17	-13.86
		PEAK	7.83	11.44	11.54	11.61	11.58	17.56	30.00	28.17	-10.61
2432	5	AVG	7.83	11.98	11.92	11.97	11.84	17.95	30.00	28.17	-10.22
		PEAK	7.83	14.35	14.35	14.24	14.60	20.41	30.00	28.17	-7.76
2437	6	AVG	7.68	11.92	11.62	11.99	11.81	17.86	30.00	28.32	-10.46
		PEAK	7.68	14.50	14.65	14.30	14.60	20.54	30.00	28.32	-7.78
2442	7	AVG	7.32	9.98	10.24	10.26	10.22	16.20	30.00	28.68	-12.48
		PEAK	7.32	12.24	12.51	12.41	12.18	18.36	30.00	28.68	-10.32
2447	8	AVG	7.32	8.88	9.20	9.24	9.22	15.16	30.00	28.68	-13.52
		PEAK	7.32	11.24	11.50	11.45	11.57	17.46	30.00	28.68	-11.22
2452	9	AVG	7.68	7.81	8.20	8.24	8.22	14.14	30.00	28.32	-14.18
		PEAK	7.68	10.24	10.54	10.45	10.64	16.49	30.00	28.32	-11.83
2457	10	AVG	7.68	7.88	8.26	8.26	8.22	14.18	30.00	28.32	-14.14
		PEAK	7.68	10.35	10.54	10.49	10.64	16.53	30.00	28.32	-11.79

Table 7-14. MIMO 802.11n/ac (40MHz BW) Conducted Output Power Measurements

Note:

Per KDB 662911 D01 v02r01 Section E)1), the conducted powers at the first four antennas 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 2412MHz the average conducted output power was measured to be 14.44 dBm for Antenna-1, 14.11 dBm for Antenna-2, 14.11 dBm for Antenna-3 and 13.77 dBm for Antenna-4.

Antenna 1 + Antenna 2 + Antenna 3 + Antenna 4 = MIMO

(14.44 dBm + 14.11 dBm + 14.11 dBm + 13.77 dBm) = (27.80 mW + 25.76 mW + 25.76 mW + 23.82 mW) = 103.14 mW = 20.13 dBm

7.4 Power Spectral Density

§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, 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 D01 v03r05 – Section 10.2 Method PKPSD
KDB 662911 D01 v02r01 – Section E)2) Measure-and-Sum Technique

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.

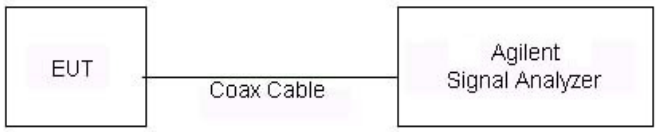


Figure 7-3. Test Instrument & Measurement Setup

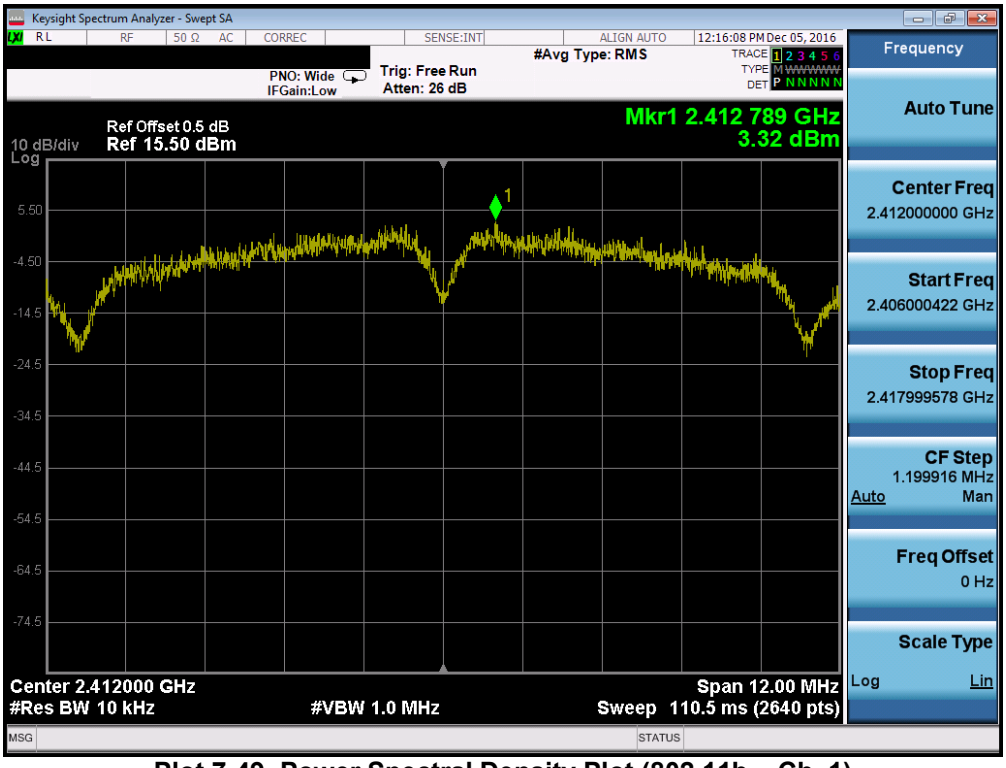
Test Notes

Since the output of each of the four antennas transmit simultaneously and the signals are correlated, a directional gain is determined based on the guidance from KDB 662911 for systems with equal transmit powers and unequal antenna gains. The directional gain is applied to the summed simultaneous output power and is equal to $10\log[(10^{G1/20} + 10^{G2/20} + 10^{G3/20} + 10^{G4/20})^2 / N_{ANT}]$ dB, where the gains are specified in units of dBi.

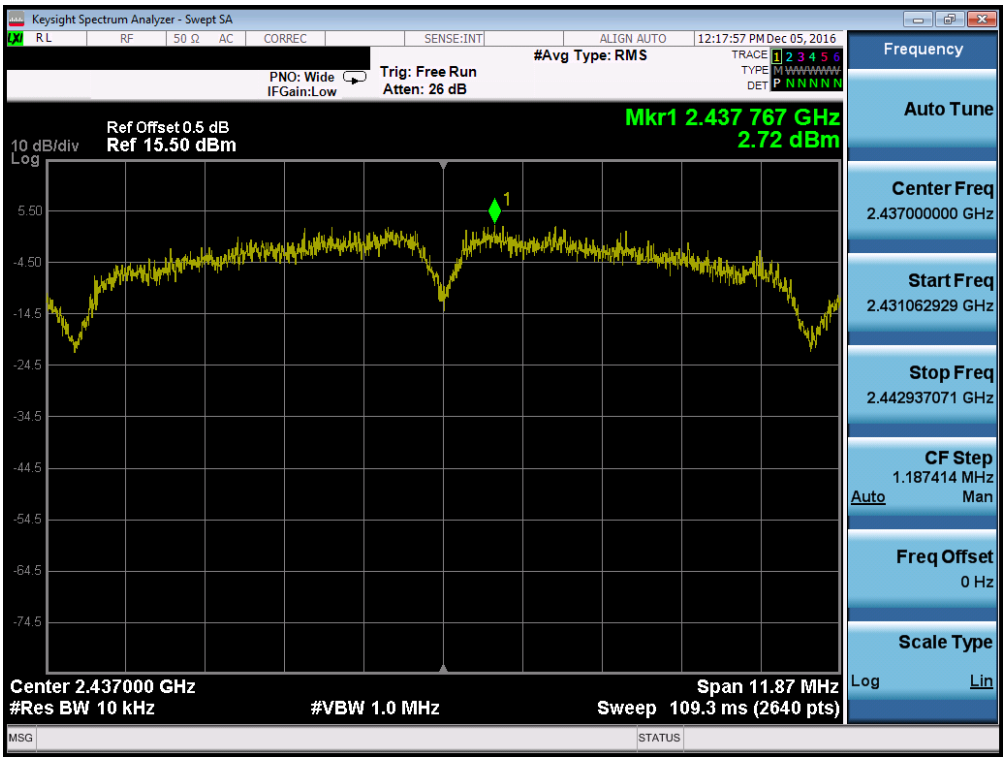
Antenna-1 Power Spectral Density Measurements (20MHz BW)

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	3.32	8.00	-4.68	Pass
2437	6	b	1	2.72	8.00	-5.28	Pass
2462	11	b	1	2.88	8.00	-5.12	Pass
2412	1	g	6	0.54	8.00	-7.46	Pass
2437	6	g	6	-0.92	8.00	-8.92	Pass
2462	11	g	6	-0.23	8.00	-8.23	Pass
2412	1	n	6.5/7.2 (MCS0)	-0.51	8.00	-8.51	Pass
2437	6	n	6.5/7.2 (MCS0)	-0.84	8.00	-8.84	Pass
2462	11	n	6.5/7.2 (MCS0)	-0.80	8.00	-8.80	Pass

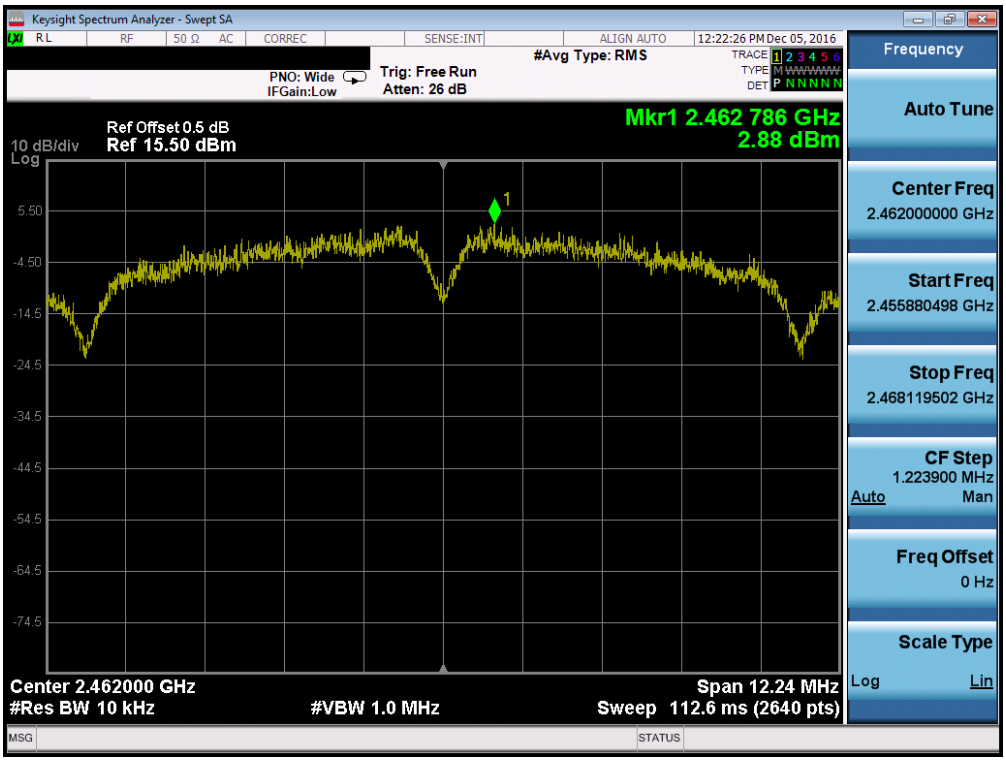
Table 7-15. Conducted Power Density Measurements



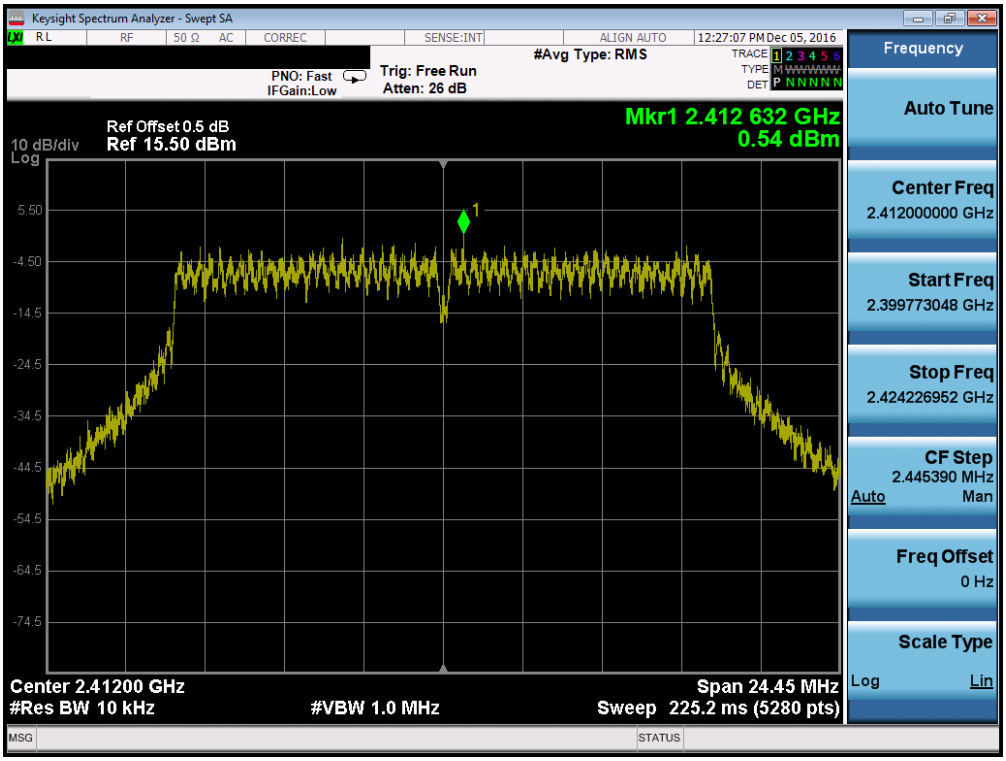
Plot 7-49. Power Spectral Density Plot (802.11b – Ch. 1)



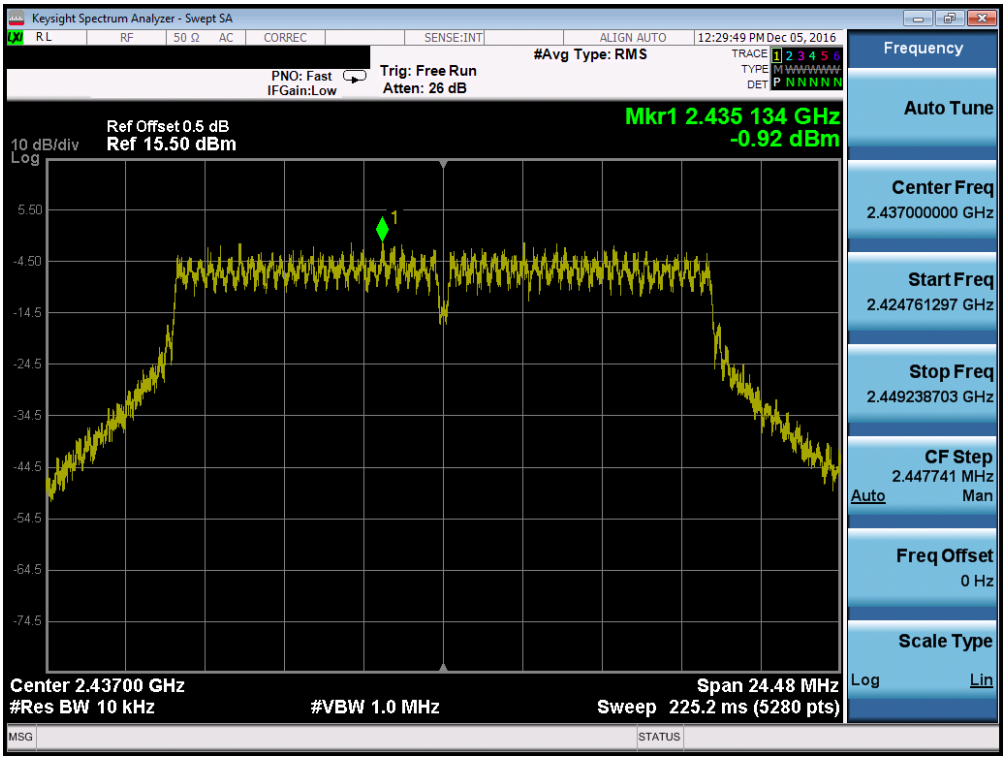
Plot 7-50. Power Spectral Density Plot (802.11b – Ch. 6)



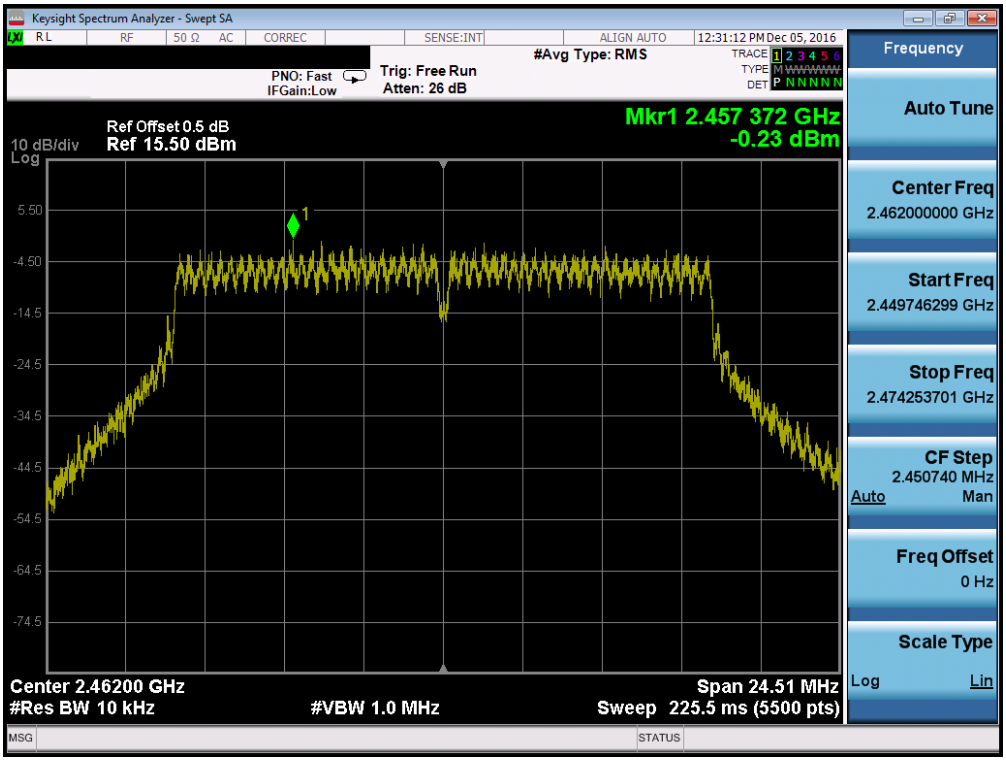
Plot 7-51. Power Spectral Density Plot (802.11b – Ch. 11)



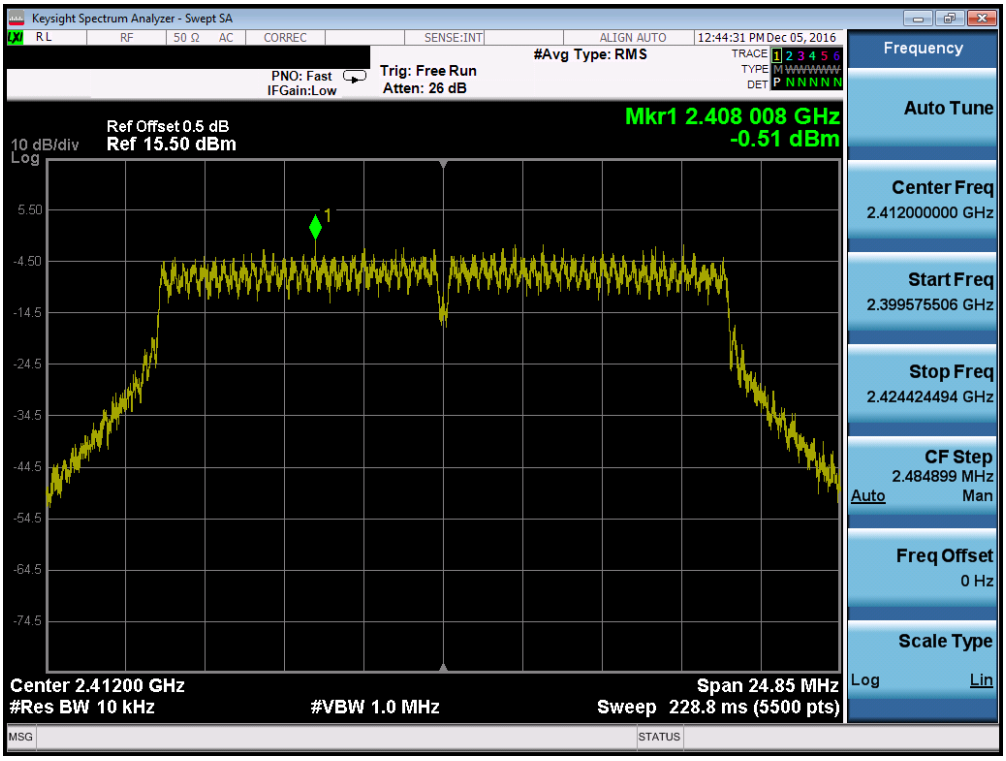
Plot 7-52. Power Spectral Density Plot (802.11g – Ch. 1)



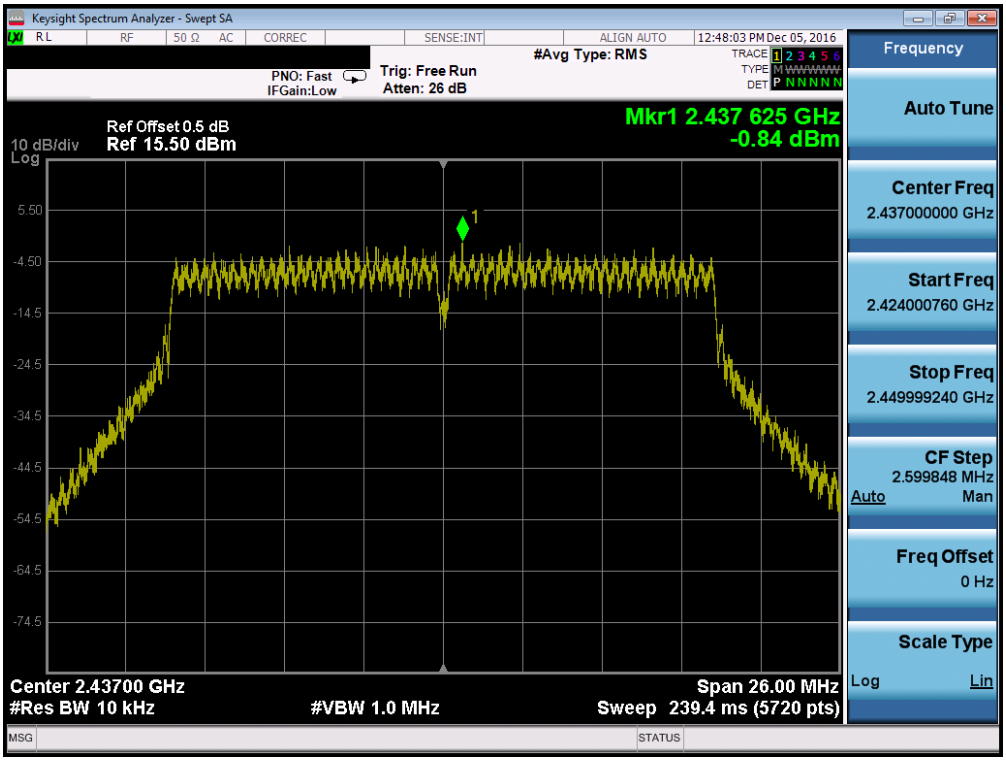
Plot 7-53. Power Spectral Density Plot (802.11g – Ch. 6)



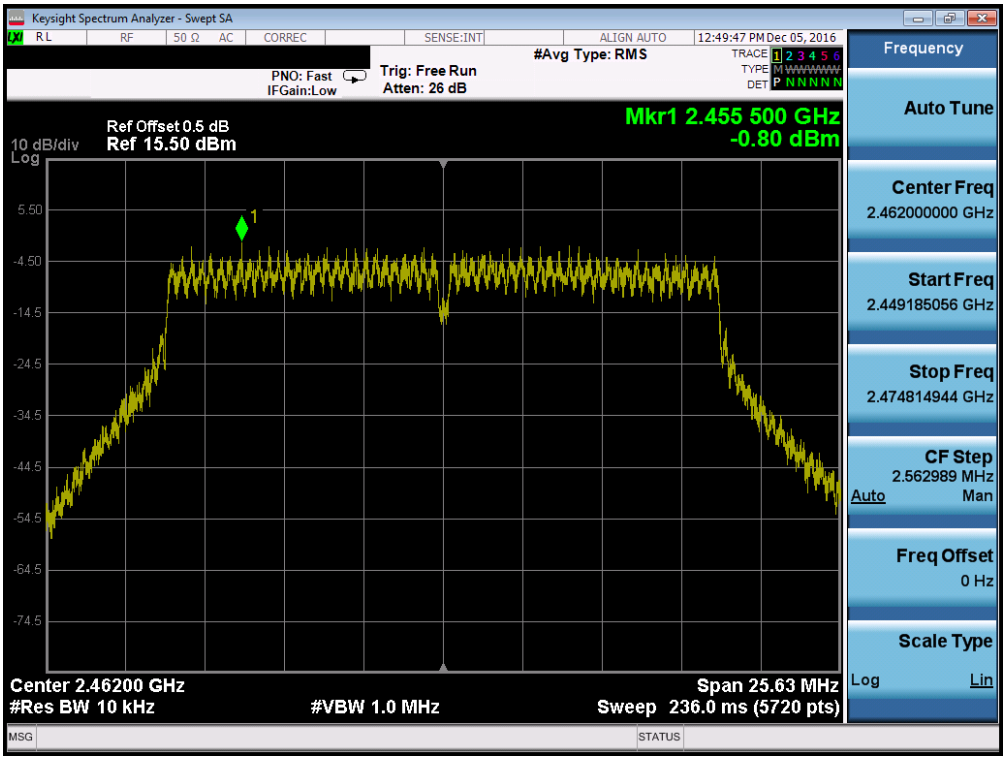
Plot 7-54. Power Spectral Density Plot (802.11g – Ch. 11)



Plot 7-55. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 1)



Plot 7-56. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 6)

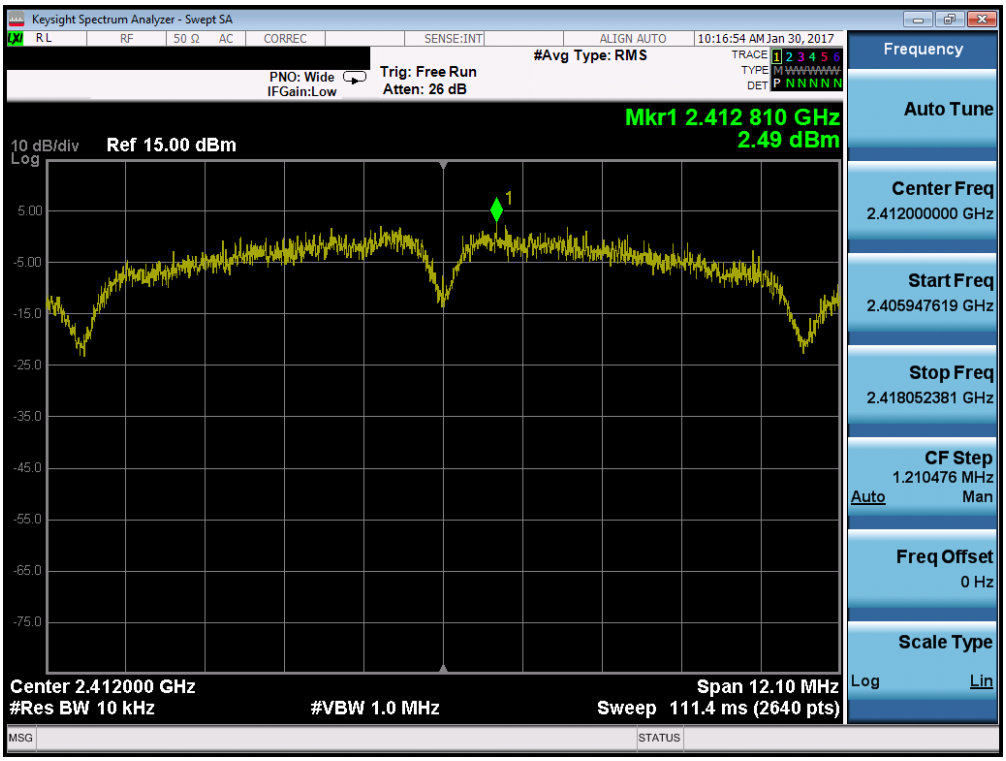


Plot 7-57. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 11)

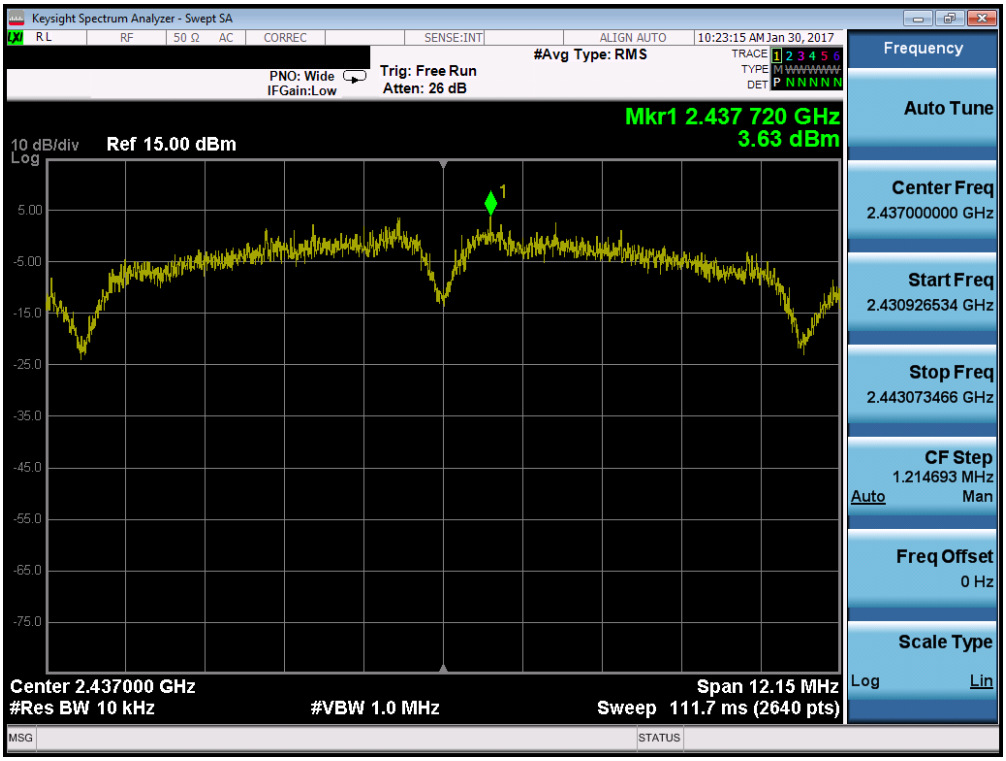
Antenna-2 Power Spectral Density Measurements (20MHz BW)

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	2.49	8.00	-5.51	Pass
2437	6	b	1	3.63	8.00	-4.37	Pass
2462	11	b	1	3.65	8.00	-4.35	Pass
2412	1	g	6	-0.79	8.00	-8.79	Pass
2437	6	g	6	-0.18	8.00	-8.18	Pass
2462	11	g	6	-0.57	8.00	-8.57	Pass
2412	1	n	6.5/7.2 (MCS0)	-1.78	8.00	-9.78	Pass
2437	6	n	6.5/7.2 (MCS0)	-2.10	8.00	-10.10	Pass
2462	11	n	6.5/7.2 (MCS0)	-2.83	8.00	-10.83	Pass

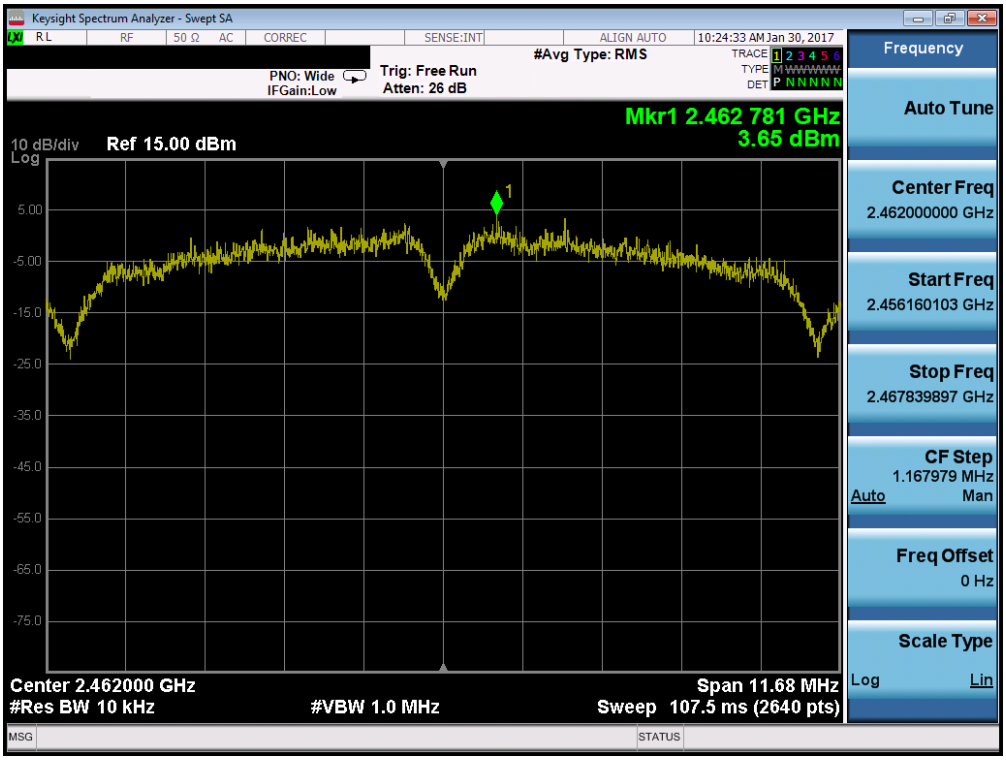
Table 7-16. Conducted Power Density Measurements



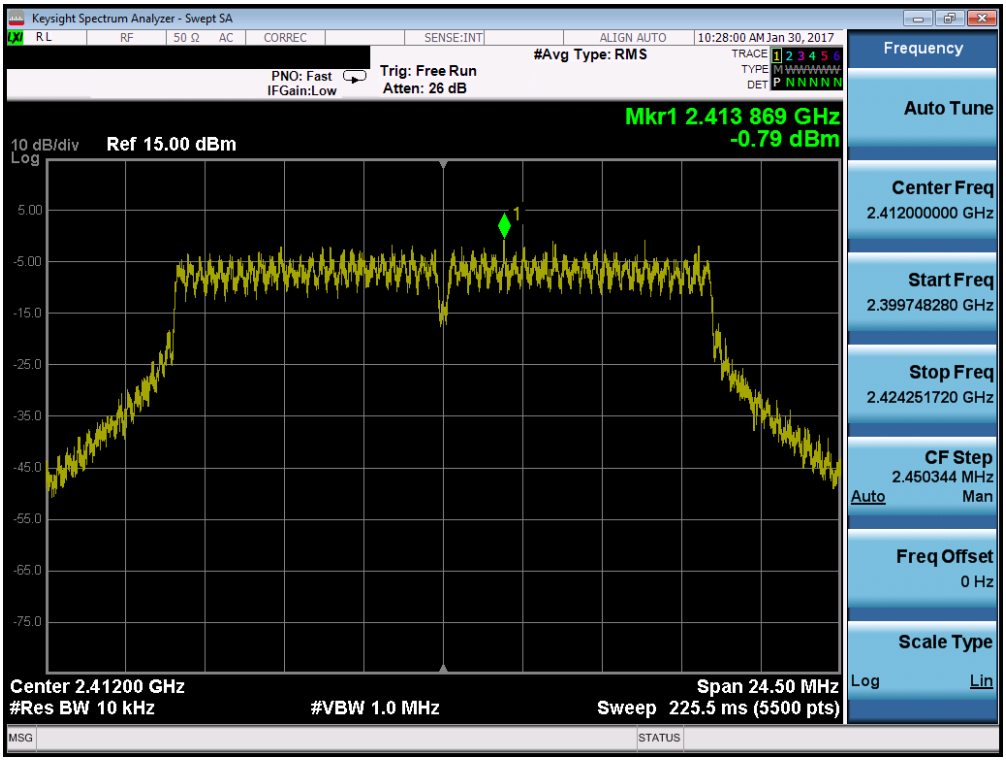
Plot 7-58. Power Spectral Density Plot (802.11b – Ch. 1)



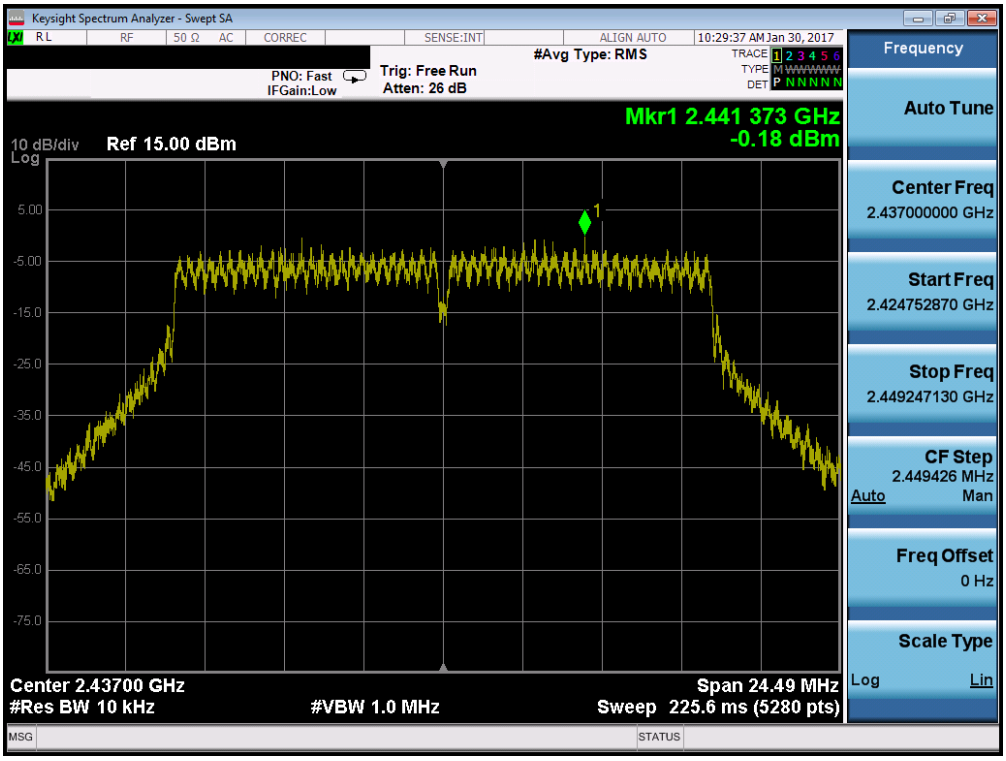
Plot 7-59. Power Spectral Density Plot (802.11b – Ch. 6)



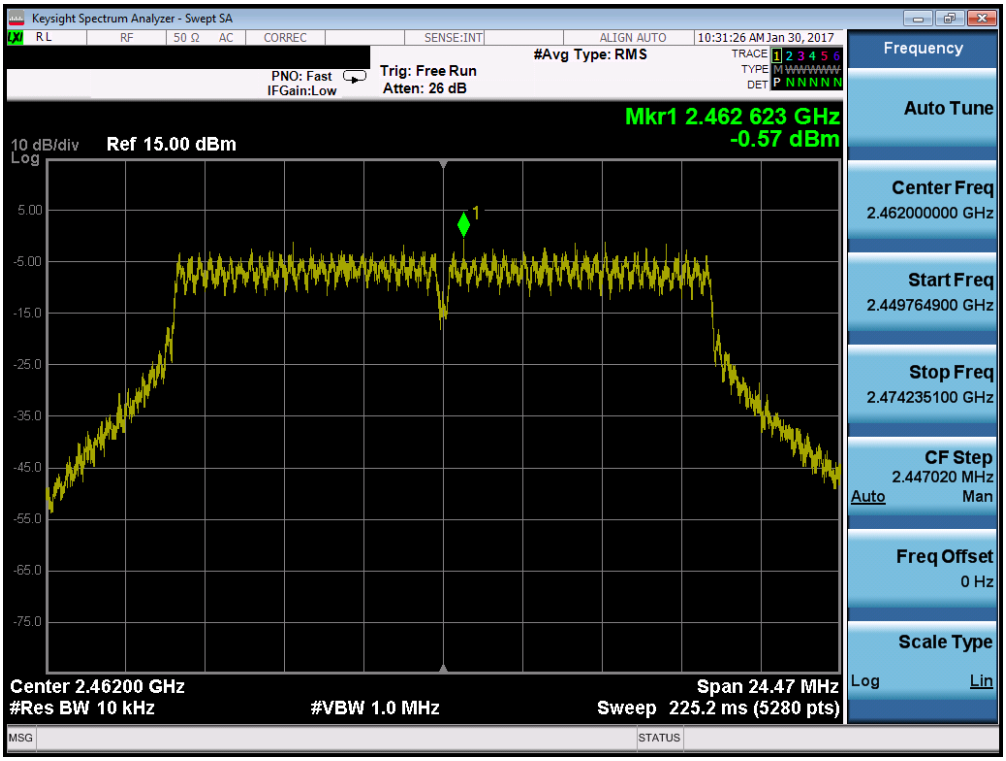
Plot 7-60. Power Spectral Density Plot (802.11b – Ch. 11)



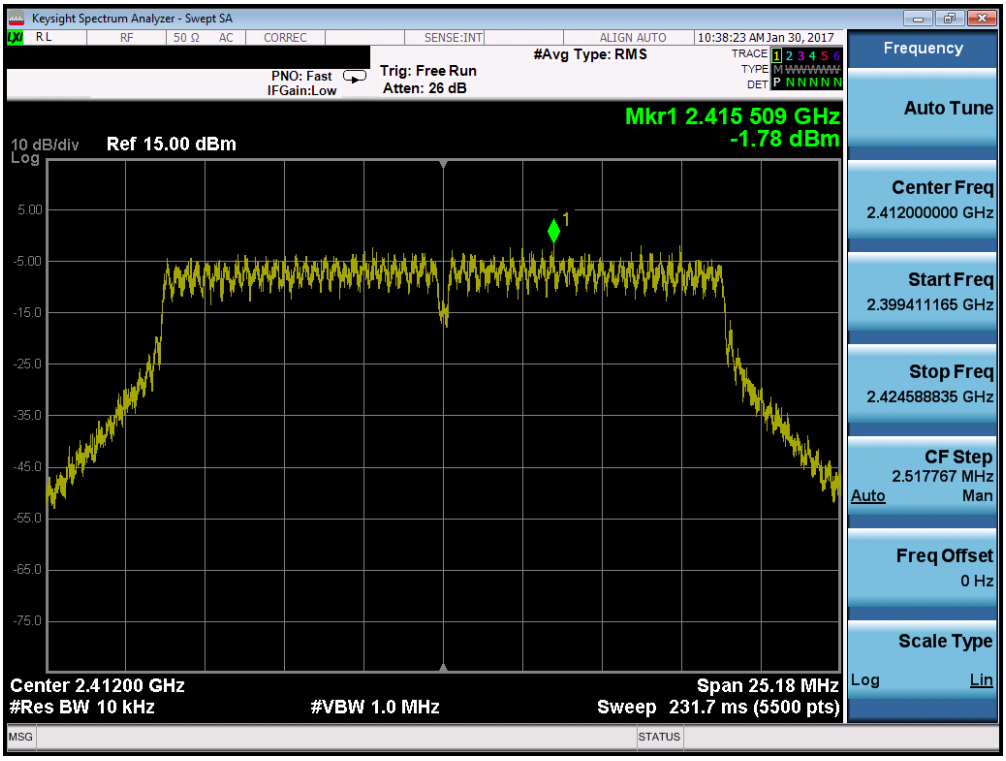
Plot 7-61. Power Spectral Density Plot (802.11g – Ch. 1)



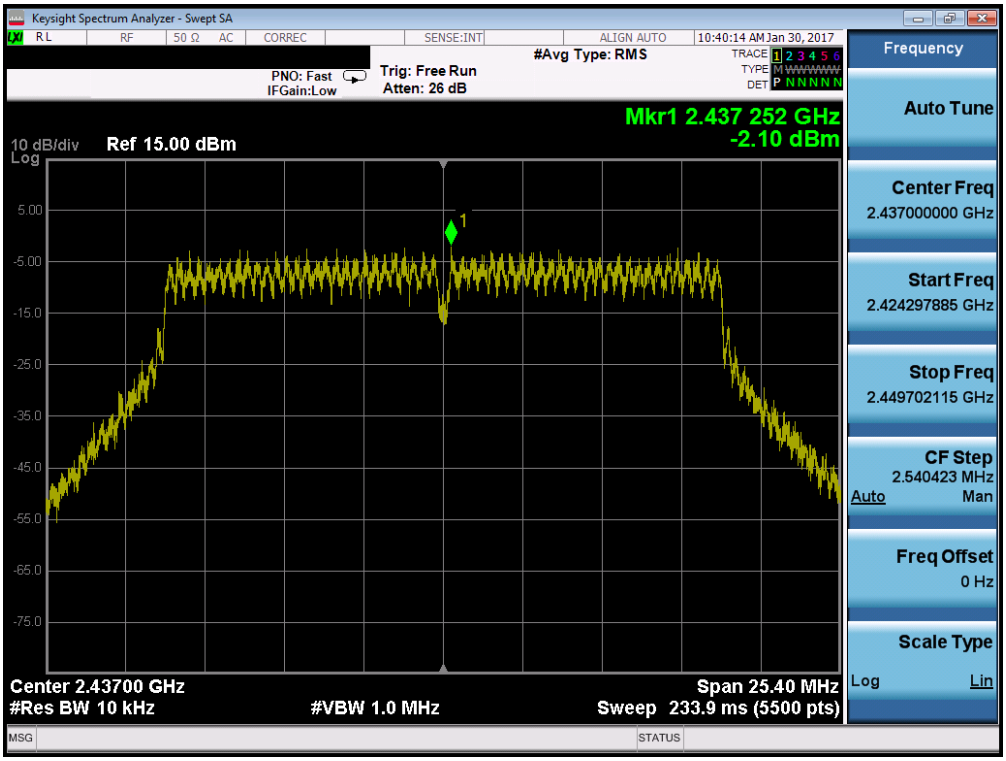
Plot 7-62. Power Spectral Density Plot (802.11g – Ch. 6)



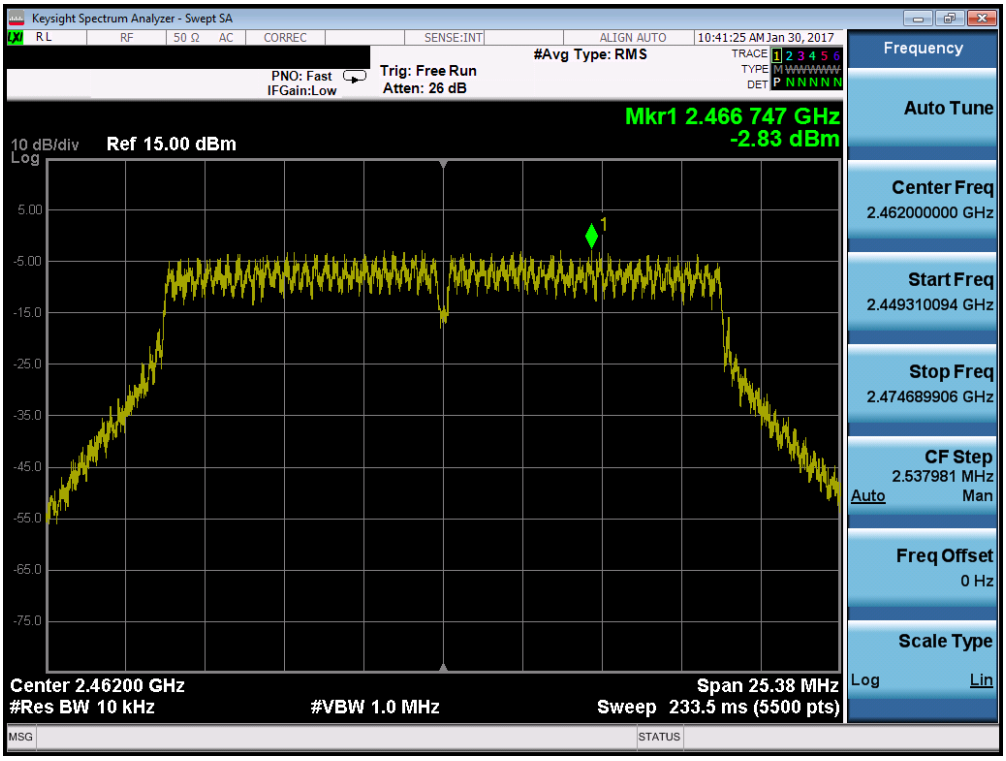
Plot 7-63. Power Spectral Density Plot (802.11g – Ch. 11)



Plot 7-64. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 1)



Plot 7-65. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 6)

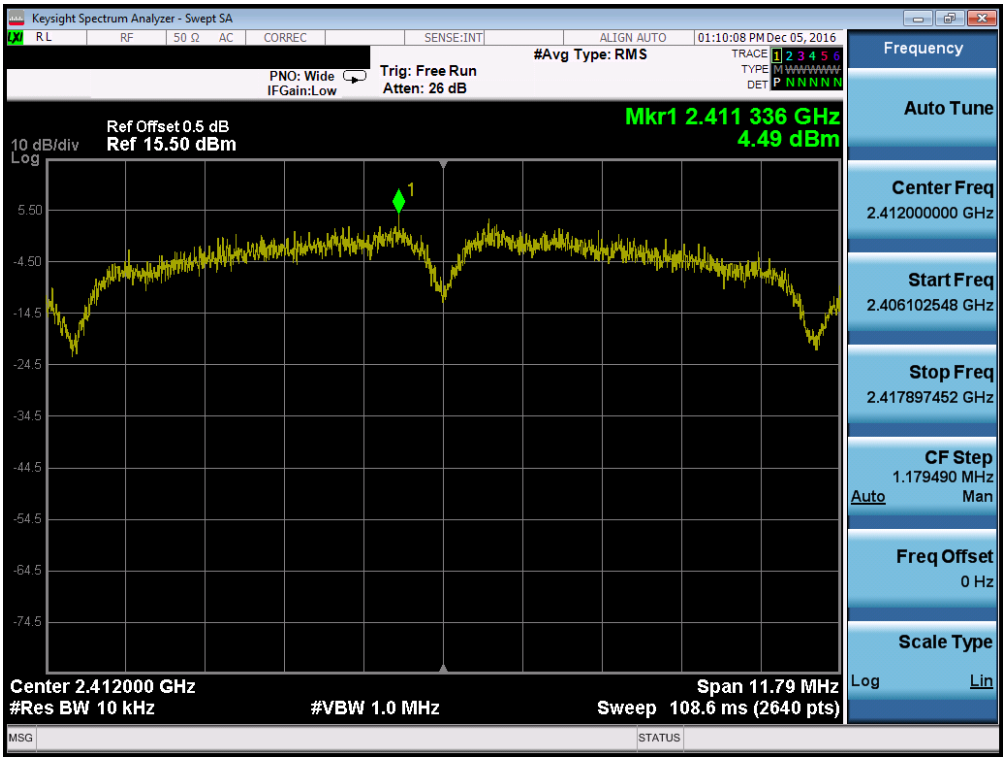


Plot 7-66. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 11)

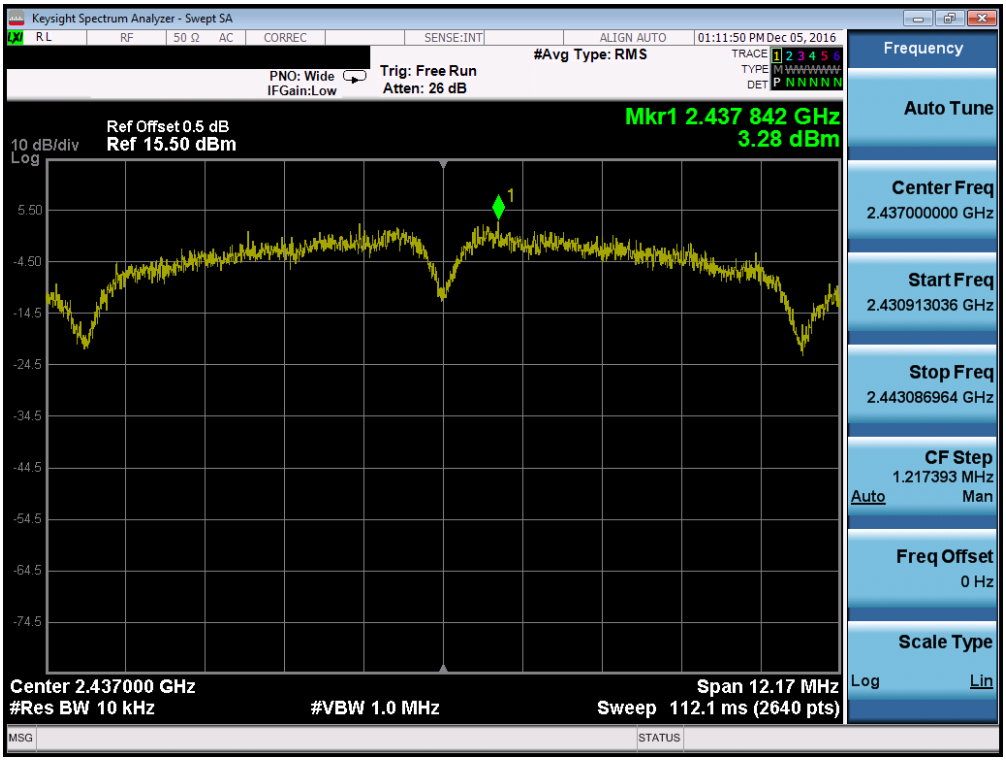
Antenna-3 Power Spectral Density Measurements (20MHz BW)

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	4.49	8.00	-3.51	Pass
2437	6	b	1	3.28	8.00	-4.72	Pass
2462	11	b	1	3.35	8.00	-4.65	Pass
2412	1	g	6	-0.61	8.00	-8.61	Pass
2437	6	g	6	-0.30	8.00	-8.30	Pass
2462	11	g	6	-0.09	8.00	-8.09	Pass
2412	1	n	6.5/7.2 (MCS0)	-0.11	8.00	-8.11	Pass
2437	6	n	6.5/7.2 (MCS0)	-0.86	8.00	-8.86	Pass
2462	11	n	6.5/7.2 (MCS0)	-0.80	8.00	-8.80	Pass

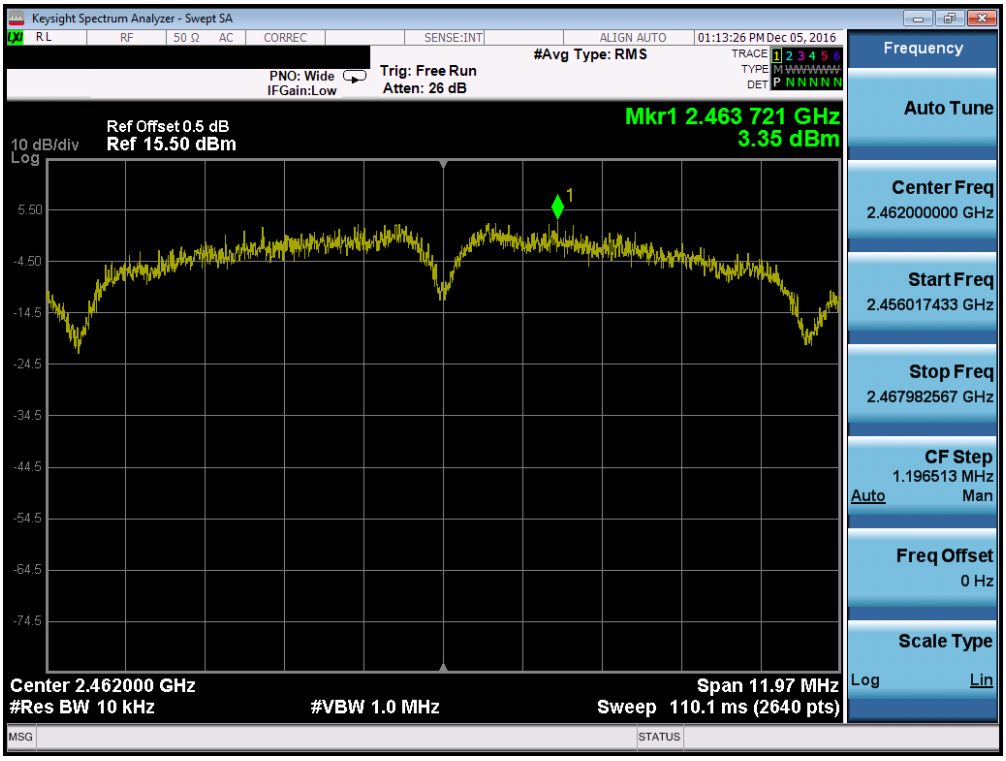
Table 7-17. Conducted Power Density Measurements



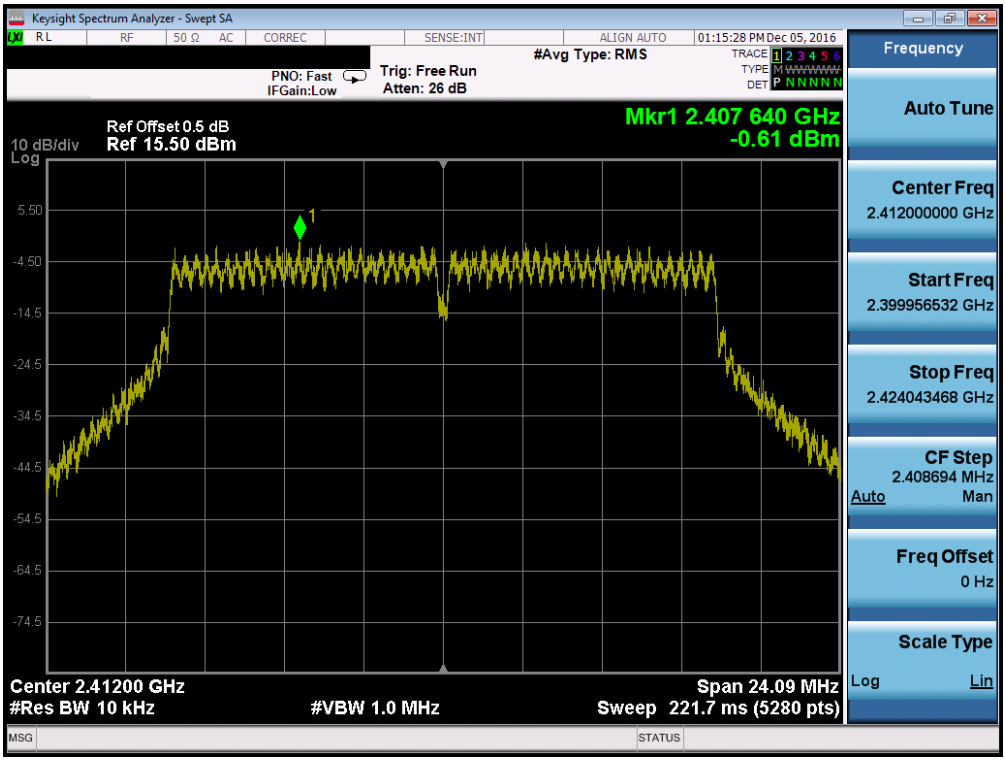
Plot 7-67. Power Spectral Density Plot (802.11b – Ch. 1)



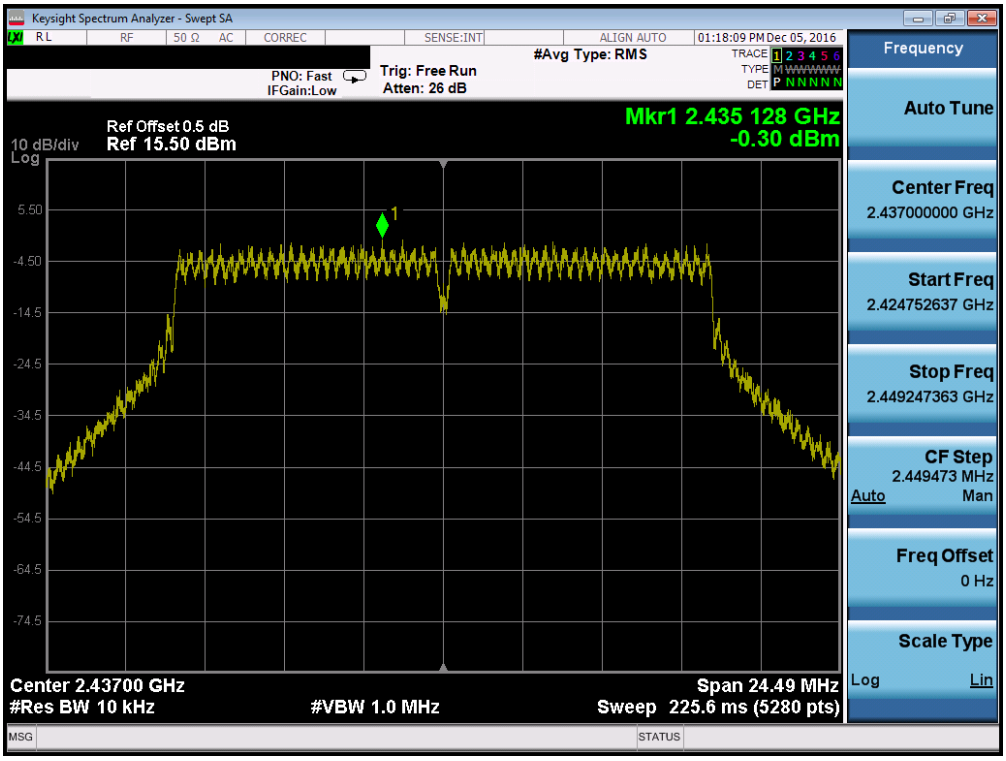
Plot 7-68. Power Spectral Density Plot (802.11b – Ch. 6)



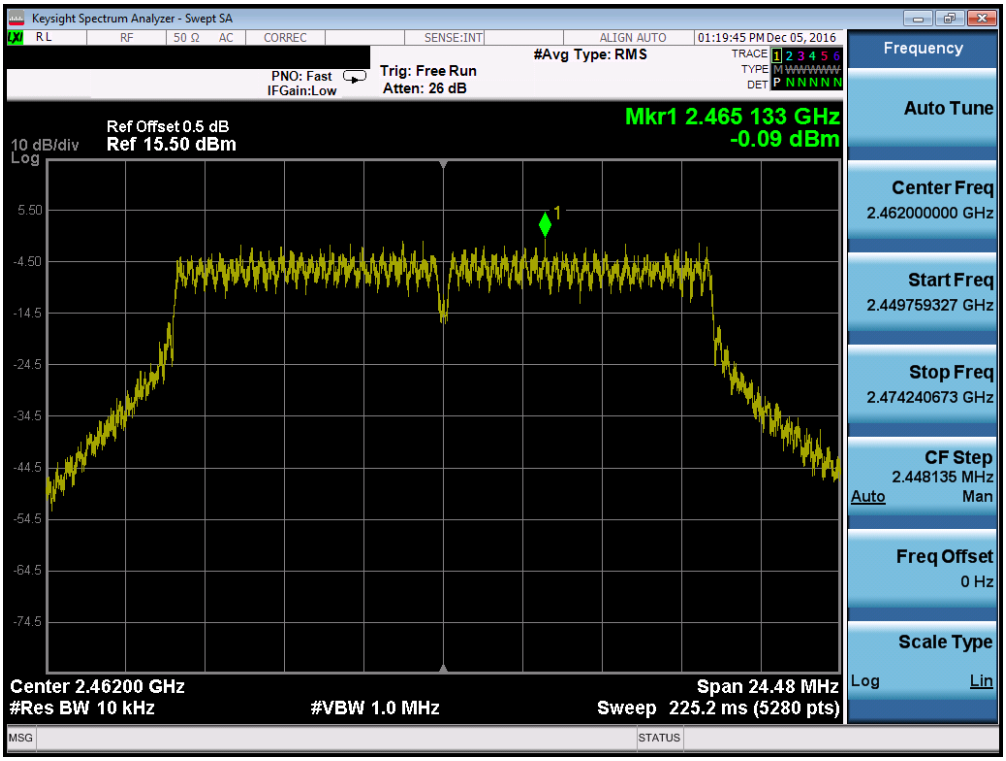
Plot 7-69. Power Spectral Density Plot (802.11b – Ch. 11)



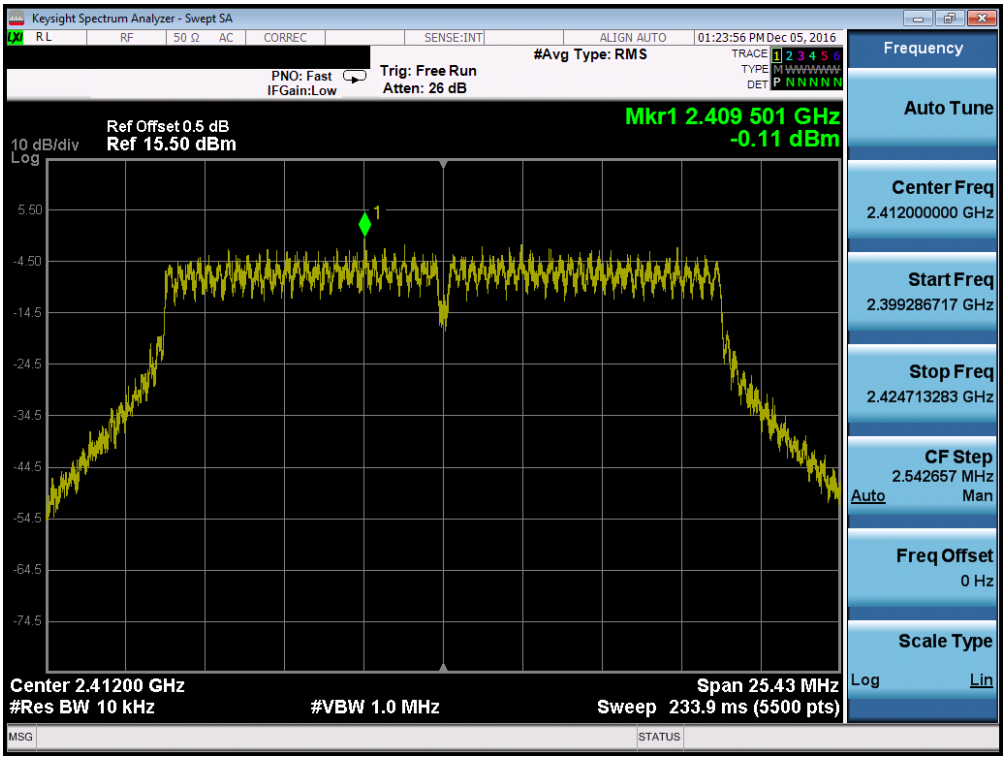
Plot 7-70. Power Spectral Density Plot (802.11g – Ch. 1)



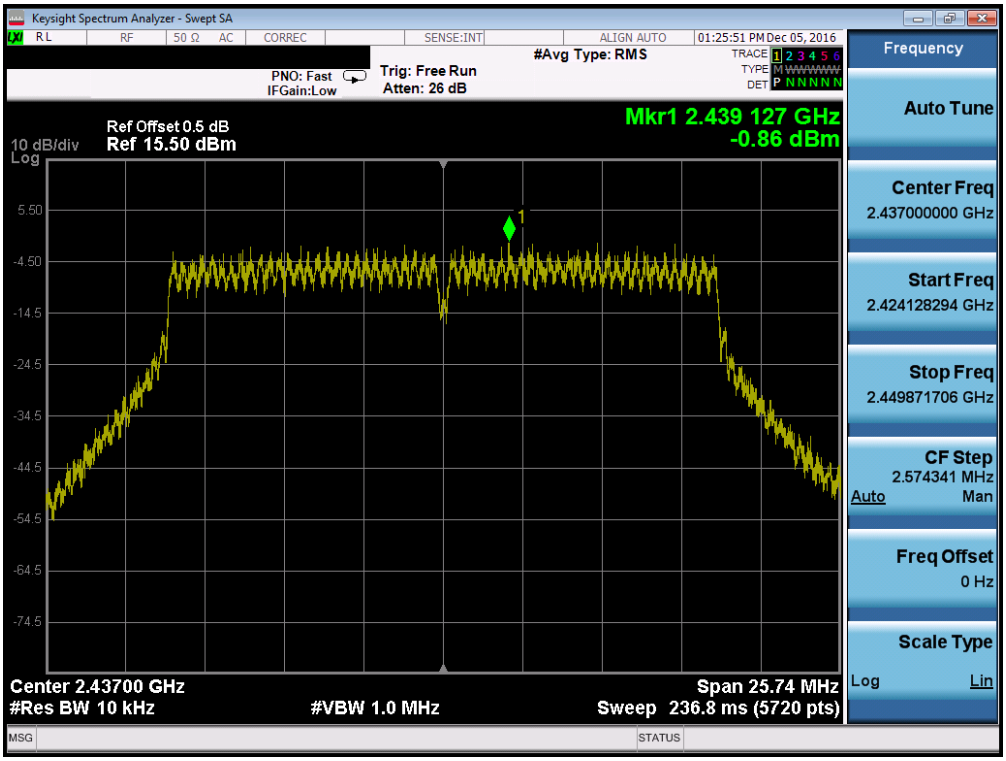
Plot 7-71. Power Spectral Density Plot (802.11g – Ch. 6)



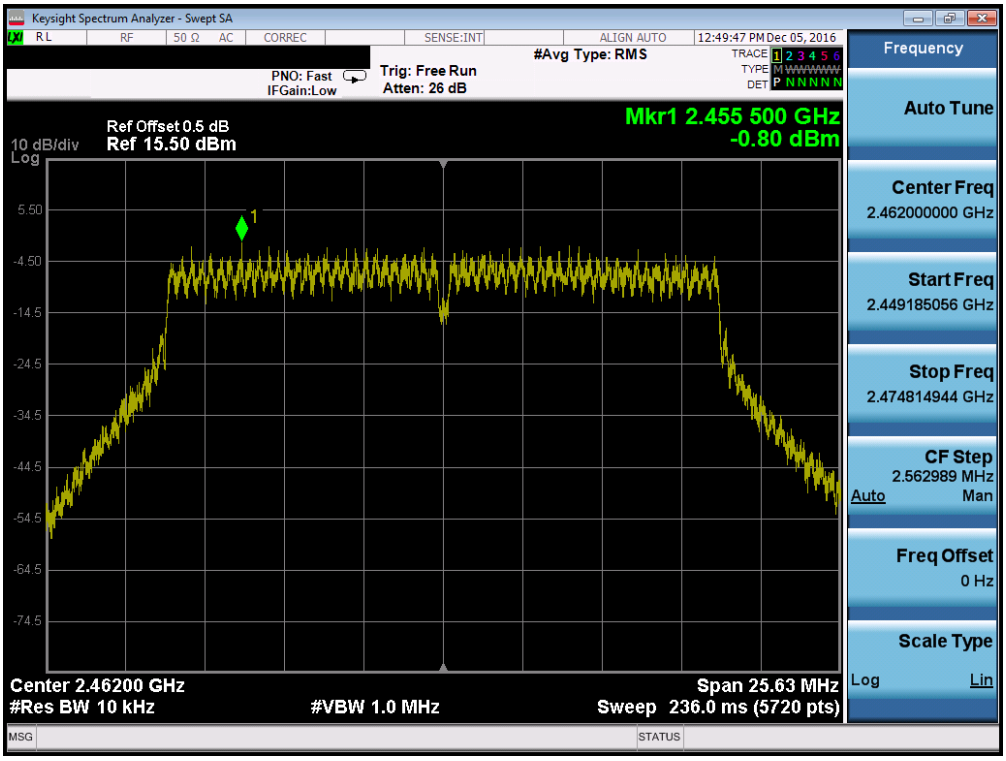
Plot 7-72. Power Spectral Density Plot (802.11g – Ch. 11)



Plot 7-73. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 1)



Plot 7-74. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 6)

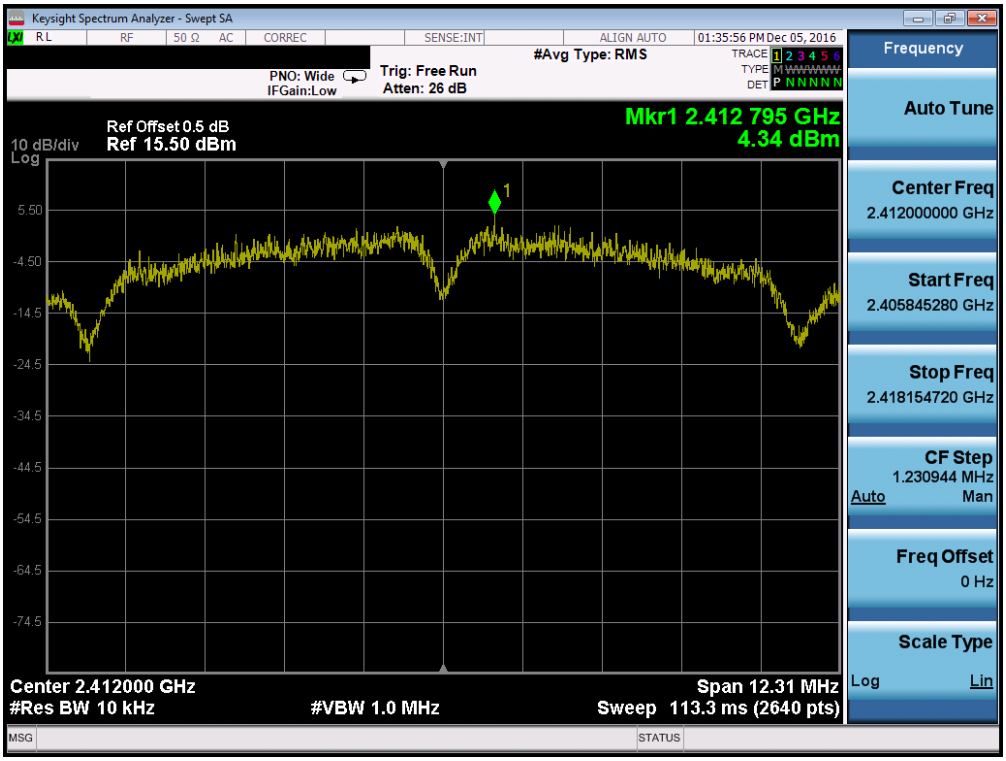


Plot 7-75. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 11)

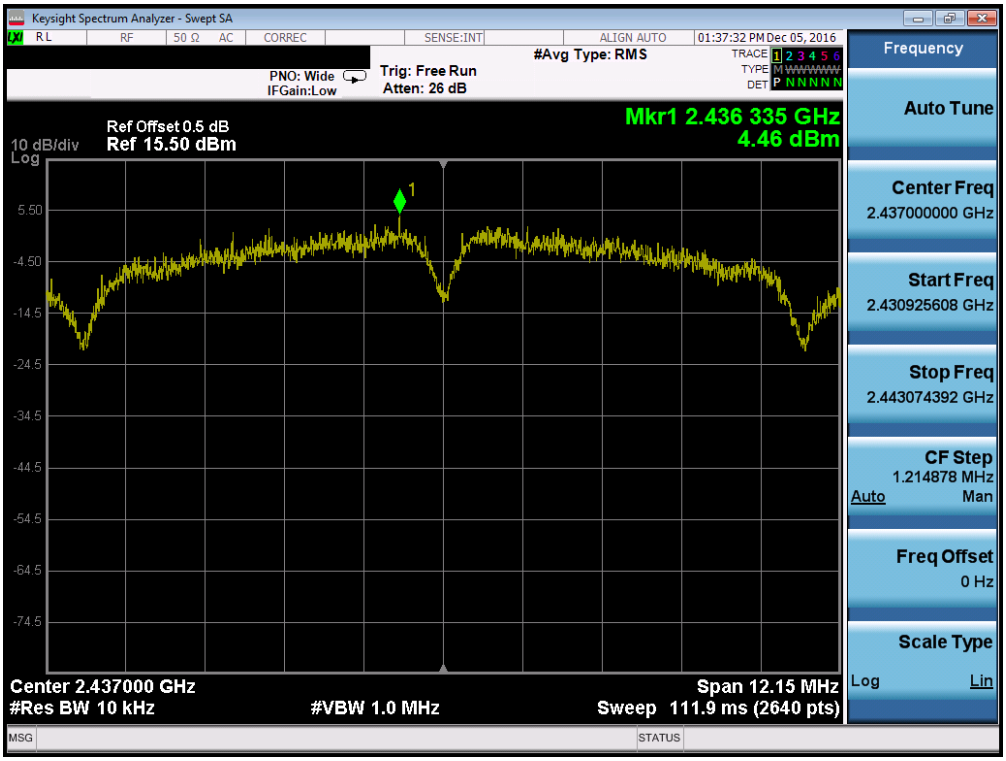
Antenna-4 Power Spectral Density Measurements (20MHz BW)

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	4.34	8.00	-3.66	Pass
2437	6	b	1	4.46	8.00	-3.54	Pass
2462	11	b	1	4.09	8.00	-3.91	Pass
2412	1	g	6	-0.14	8.00	-8.14	Pass
2437	6	g	6	-0.53	8.00	-8.53	Pass
2462	11	g	6	-0.78	8.00	-8.78	Pass
2412	1	n	6.5/7.2 (MCS0)	-0.64	8.00	-8.64	Pass
2437	6	n	6.5/7.2 (MCS0)	-1.89	8.00	-9.89	Pass
2462	11	n	6.5/7.2 (MCS0)	-0.56	8.00	-8.56	Pass

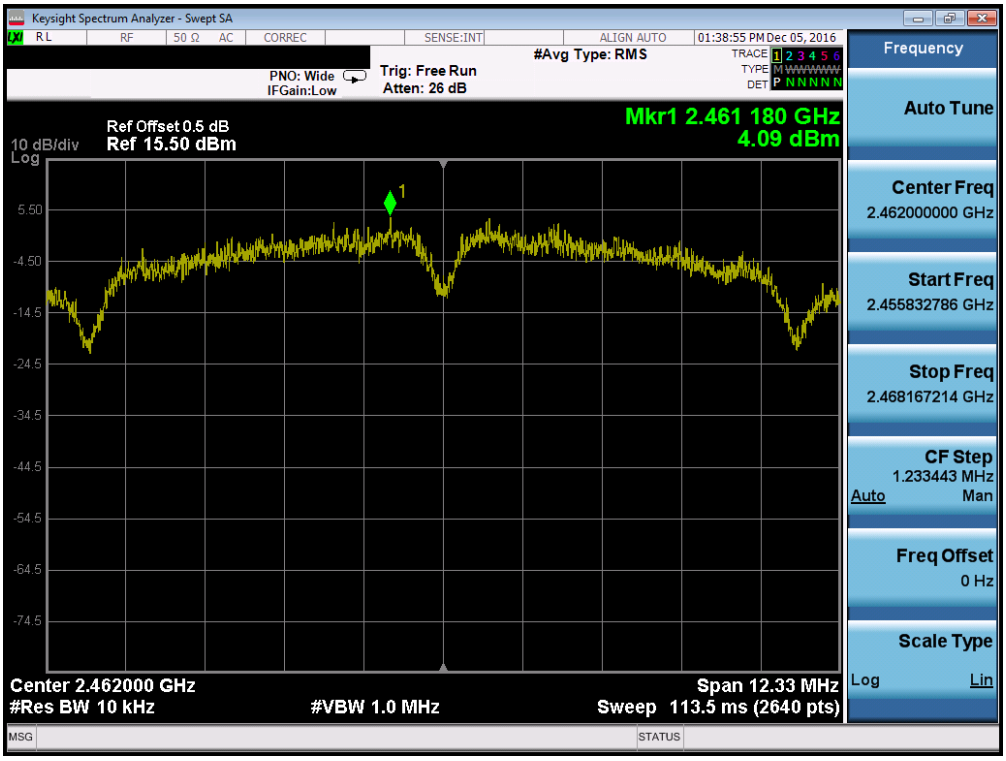
Table 7-18. Conducted Power Density Measurements



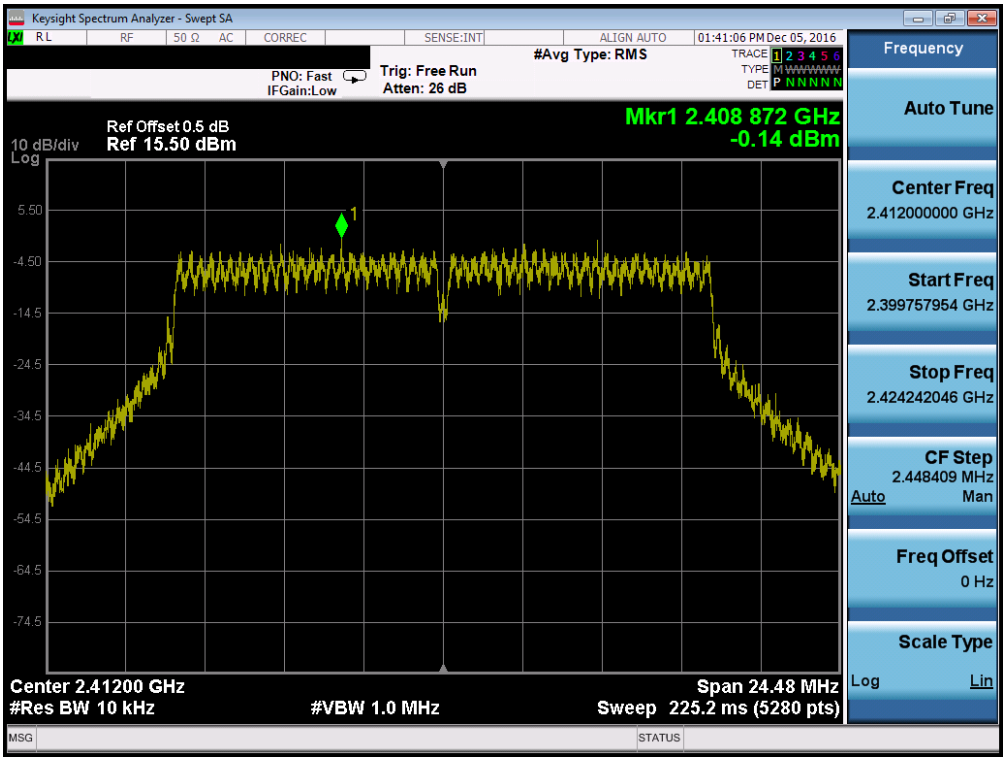
Plot 7-76. Power Spectral Density Plot (802.11b – Ch. 1)



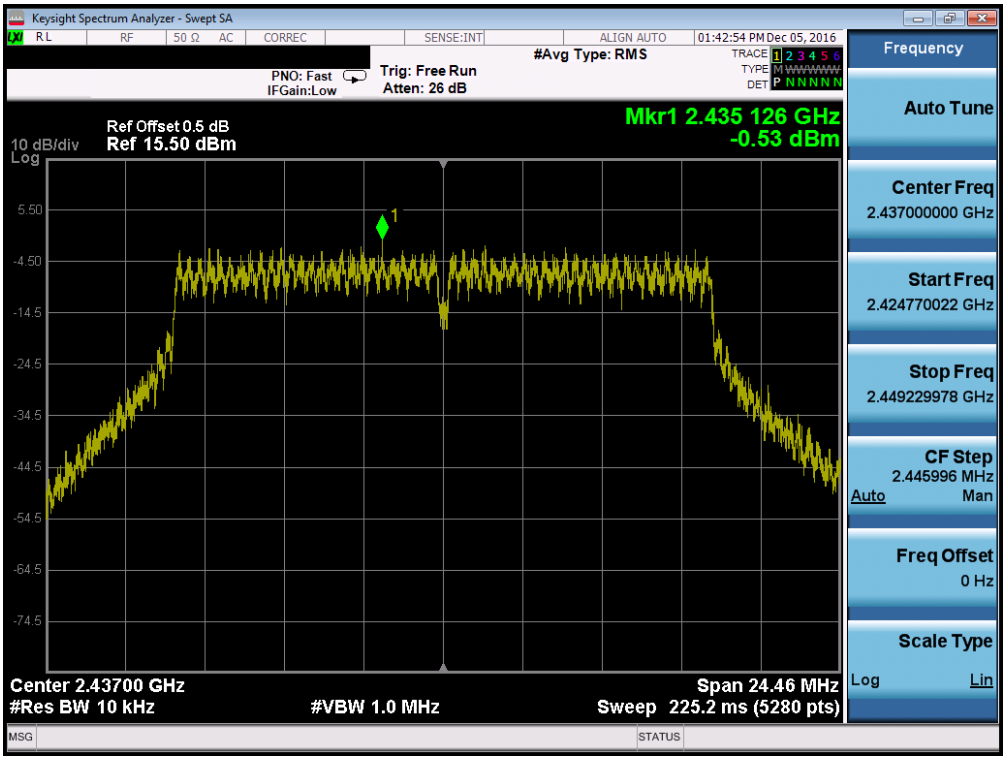
Plot 7-77. Power Spectral Density Plot (802.11b – Ch. 6)



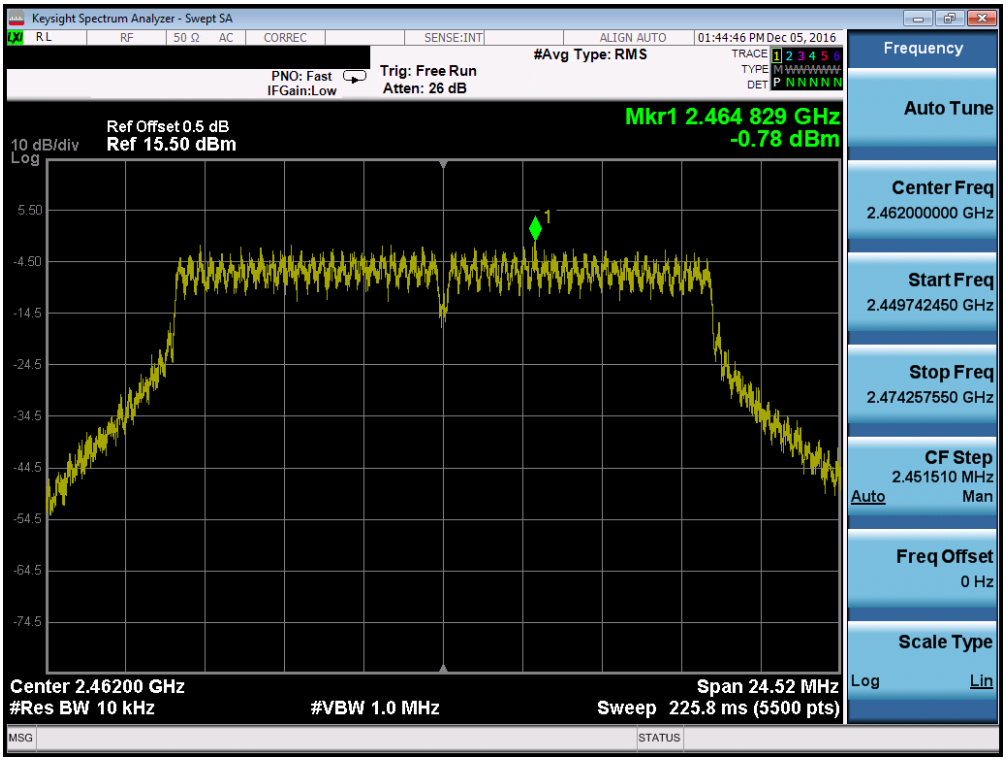
Plot 7-78. Power Spectral Density Plot (802.11b – Ch. 11)



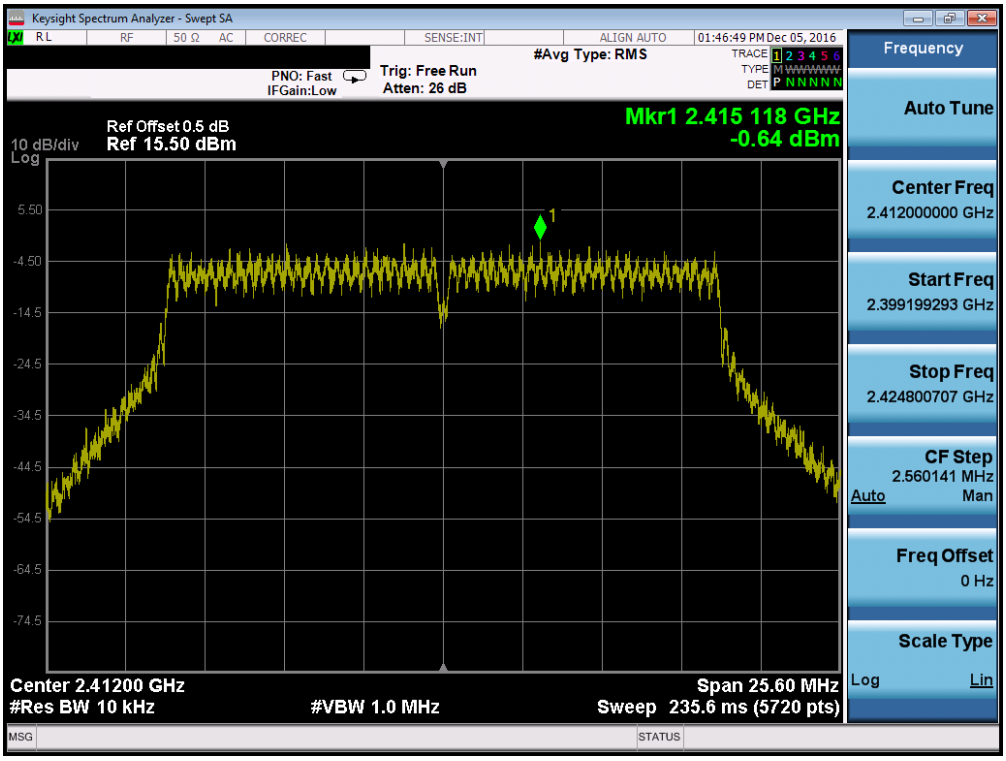
Plot 7-79. Power Spectral Density Plot (802.11g – Ch. 1)



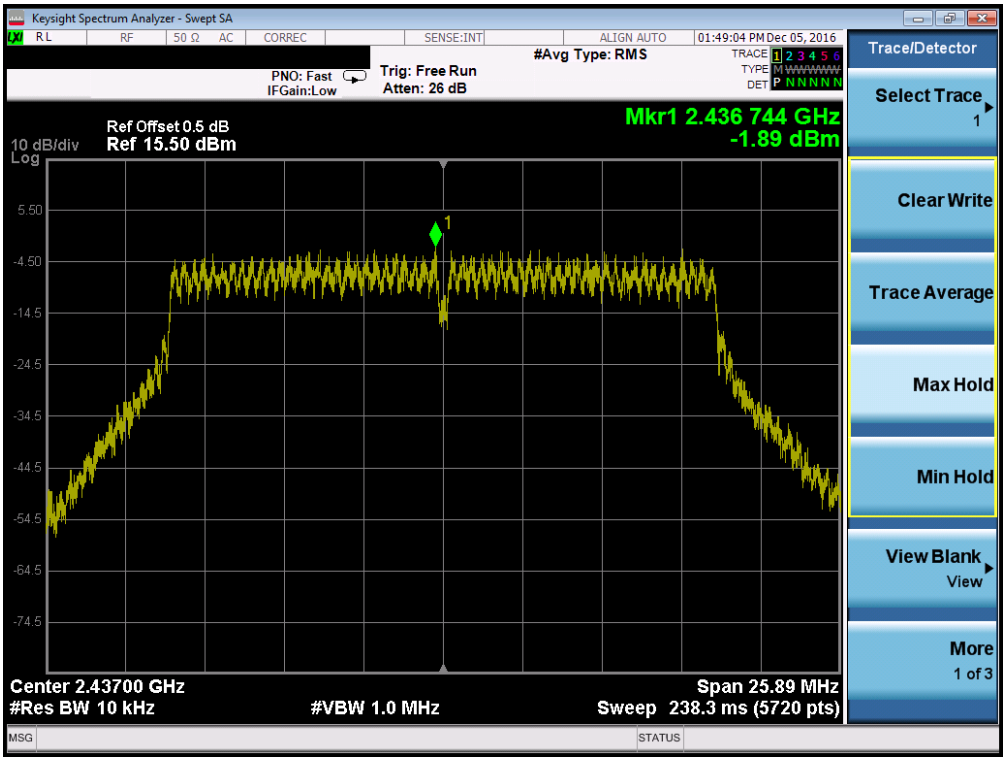
Plot 7-80. Power Spectral Density Plot (802.11g – Ch. 6)



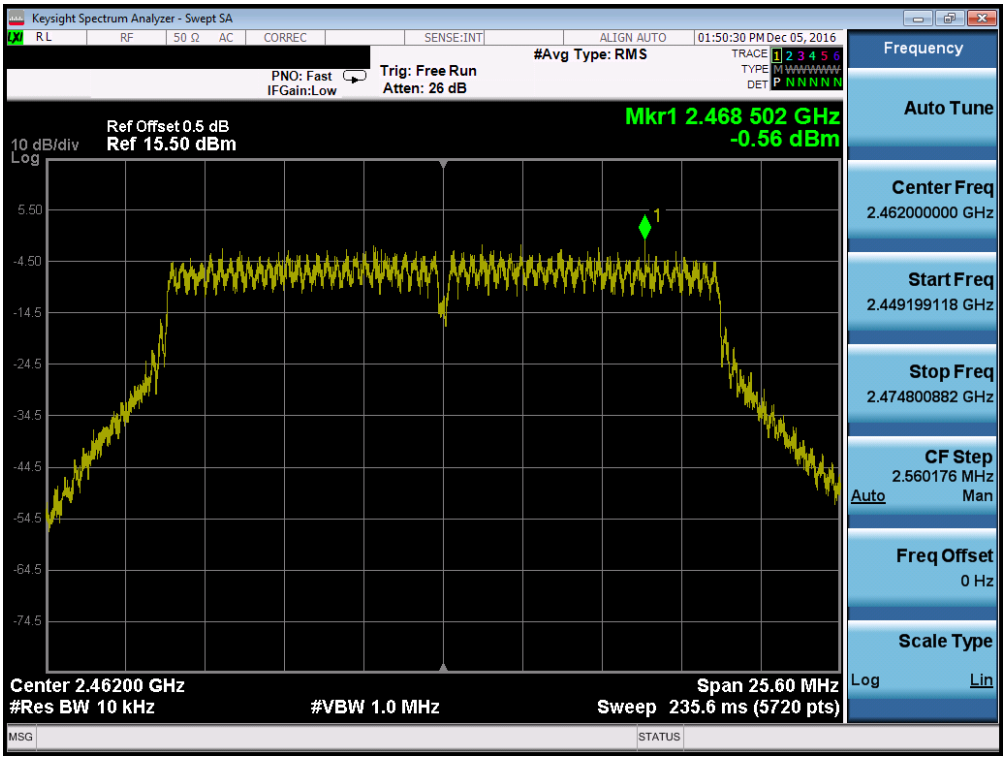
Plot 7-81. Power Spectral Density Plot (802.11g – Ch. 11)



Plot 7-82. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 1)



Plot 7-83. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 6)

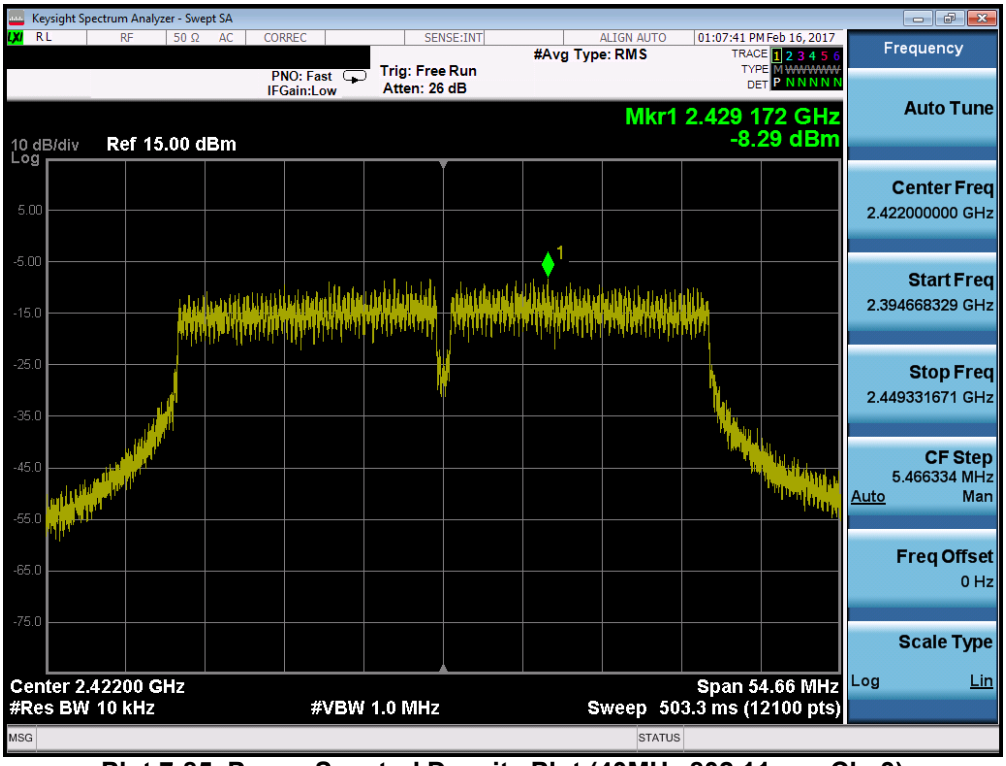


Plot 7-84. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 11)

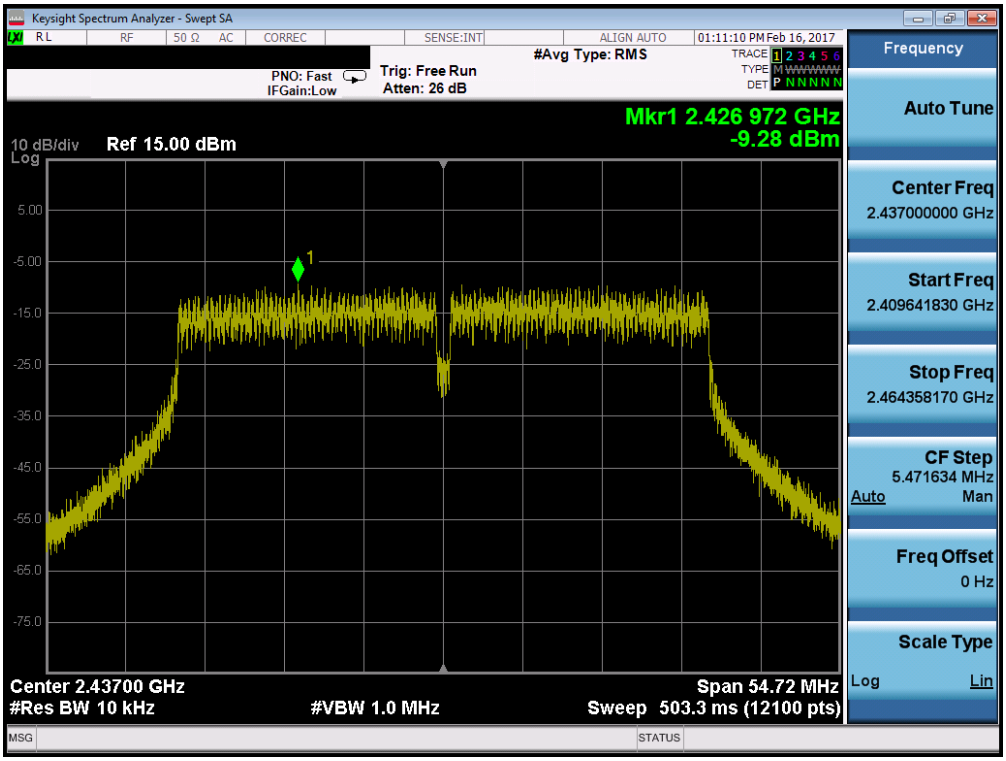
Antenna-1 Power Spectral Density Measurements (40MHz BW)

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
2422	3	n/ac	162/180 (MCS8)	-8.29	8.00	-16.29	Pass
2437	6	n/ac	162/180 (MCS8)	-9.28	8.00	-17.28	Pass
2457	10	n/ac	162/180 (MCS8)	-8.34	8.00	-16.34	Pass

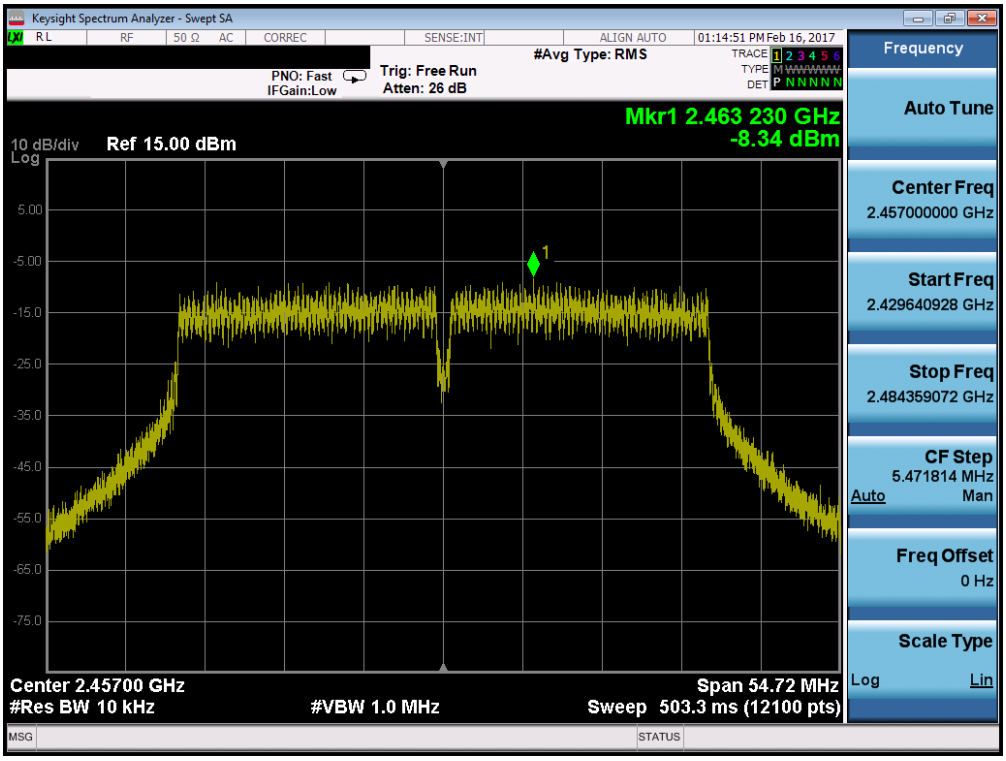
Table 7-19. Conducted Power Density Measurements



Plot 7-85. Power Spectral Density Plot (40MHz 802.11ac – Ch. 3)



Plot 7-86. Power Spectral Density Plot (40MHz 802.11ac – Ch. 6)

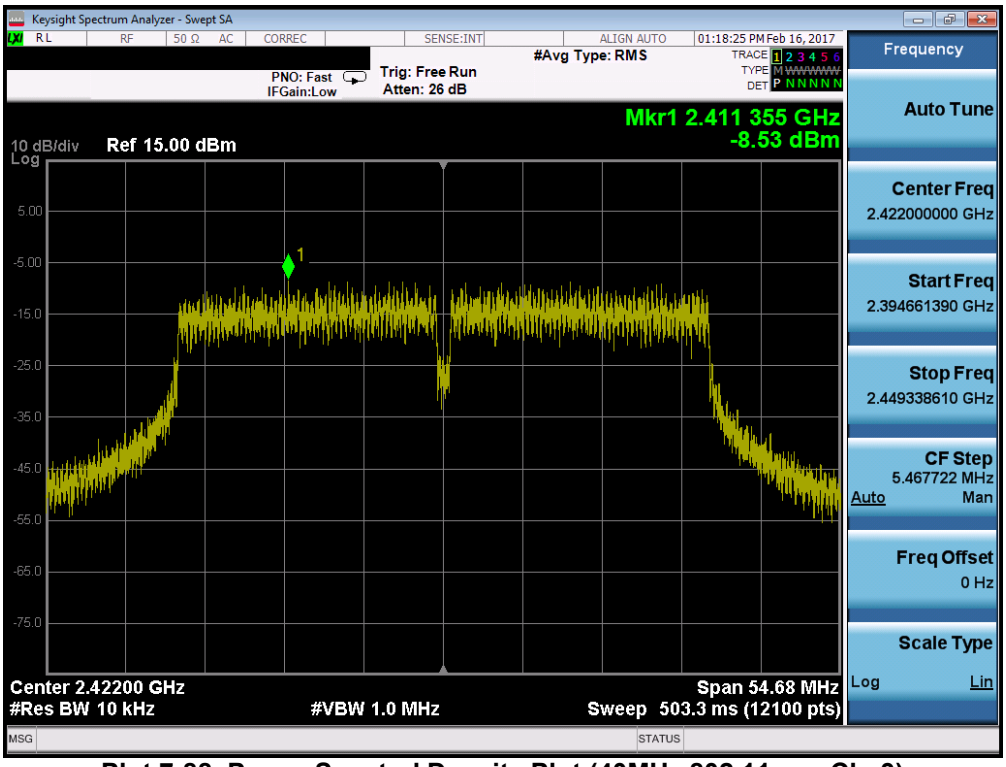


Plot 7-87. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 10)

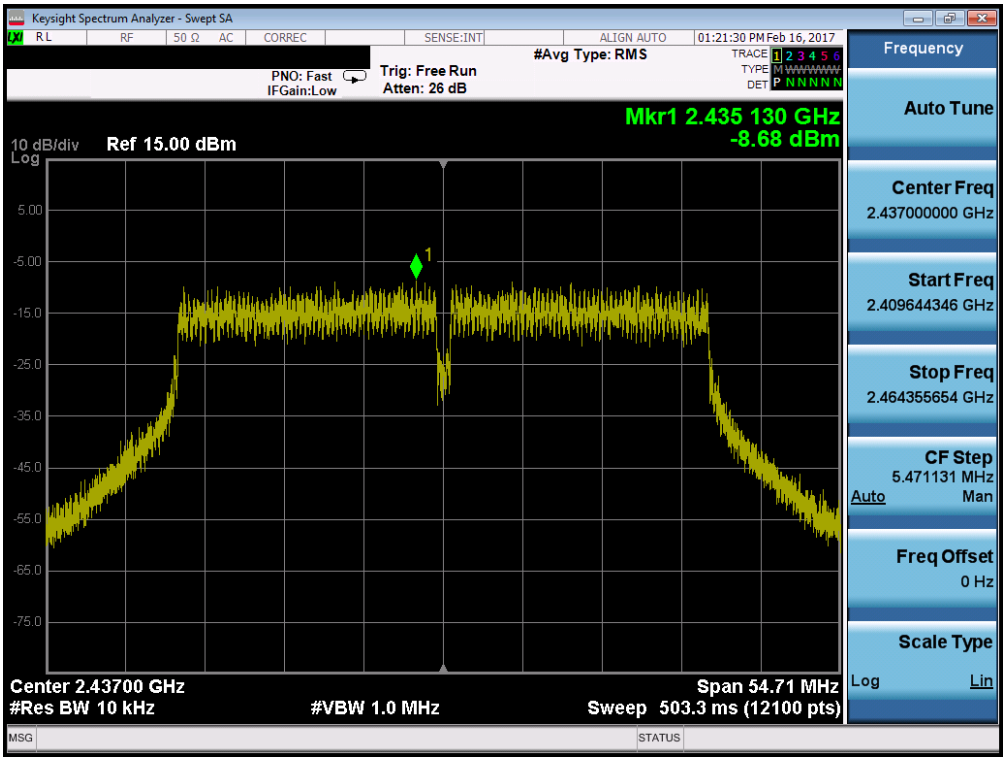
Antenna-2 Power Spectral Density Measurements (40MHz BW)

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
2422	3	n/ac	162/180 (MCS8)	-8.53	8.00	-16.53	Pass
2437	6	n/ac	162/180 (MCS8)	-8.68	8.00	-16.68	Pass
2457	10	n/ac	162/180 (MCS8)	-8.34	8.00	-16.34	Pass

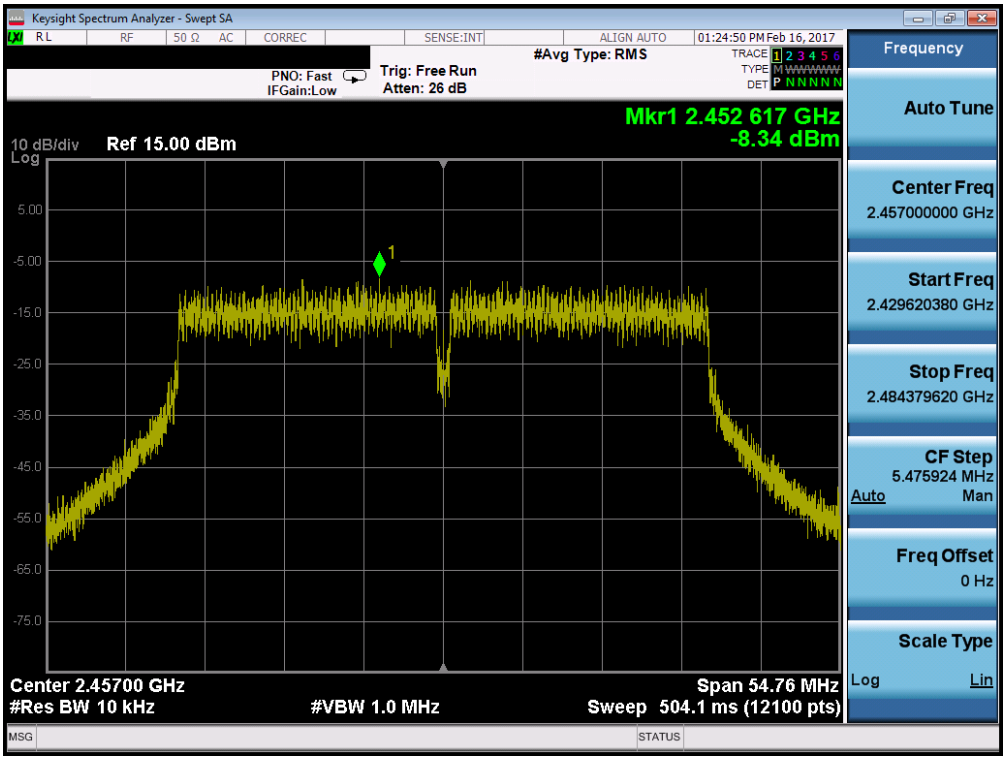
Table 7-20. Conducted Power Density Measurements



Plot 7-88. Power Spectral Density Plot (40MHz 802.11ac – Ch. 3)



Plot 7-89. Power Spectral Density Plot (40MHz 802.11ac – Ch. 6)

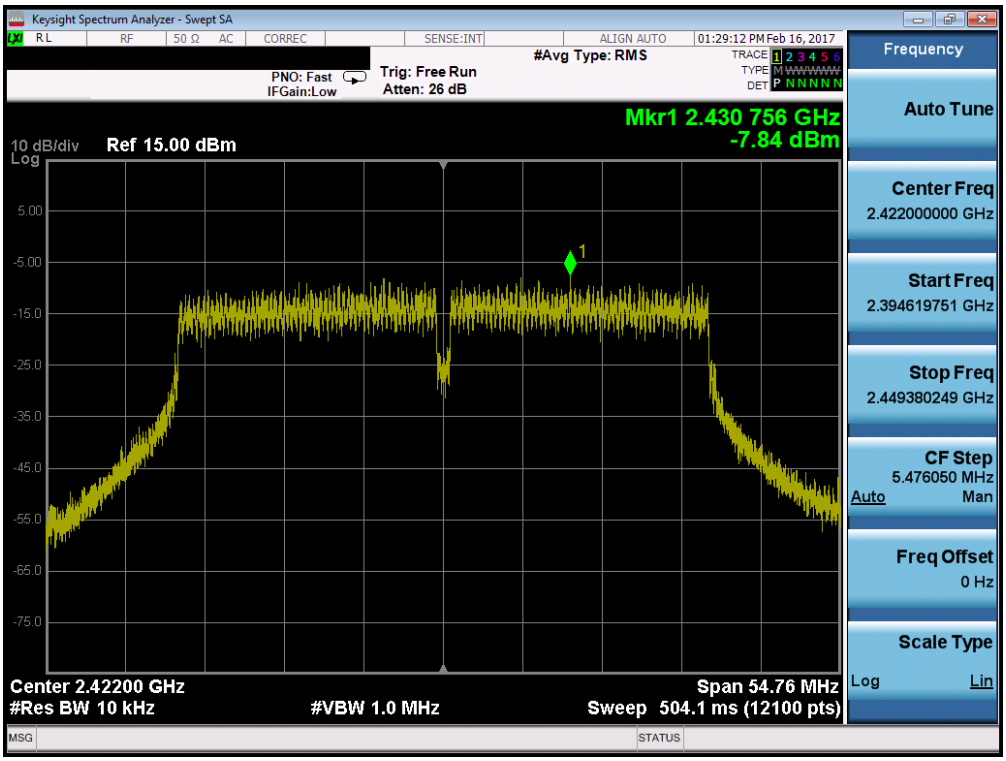


Plot 7-90. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 10)

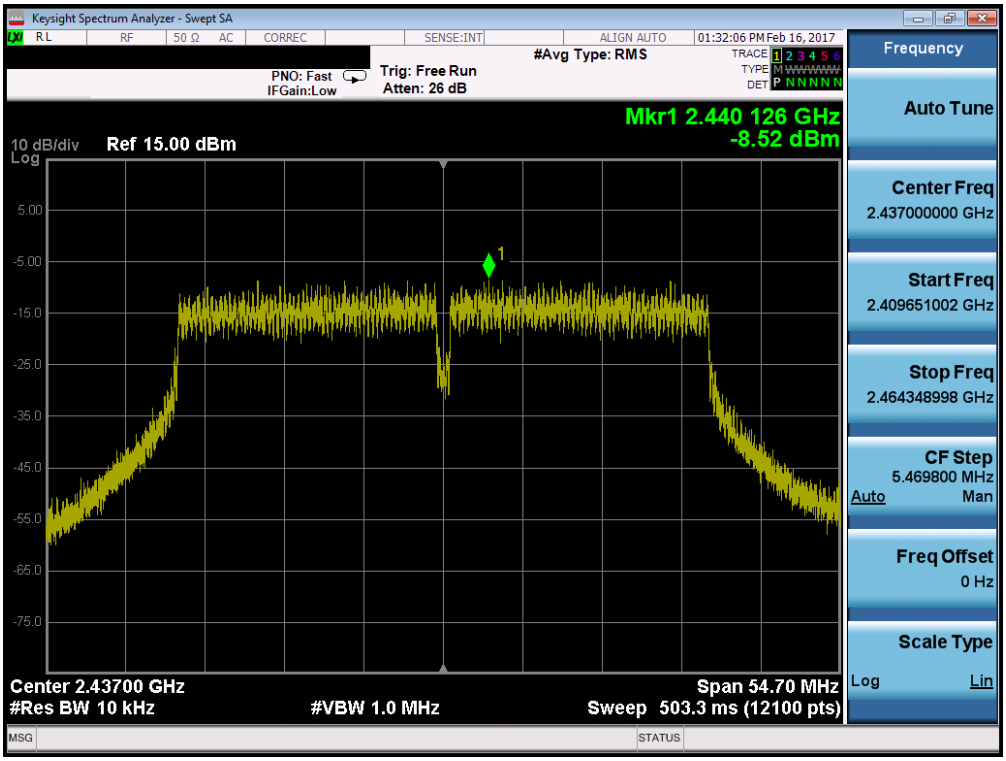
Antenna-3 Power Spectral Density Measurements (40MHz BW)

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
2422	3	n/ac	162/180 (MCS8)	-7.84	8.00	-15.84	Pass
2437	6	n/ac	162/180 (MCS8)	-8.52	8.00	-16.52	Pass
2457	10	n/ac	162/180 (MCS8)	-8.14	8.00	-16.14	Pass

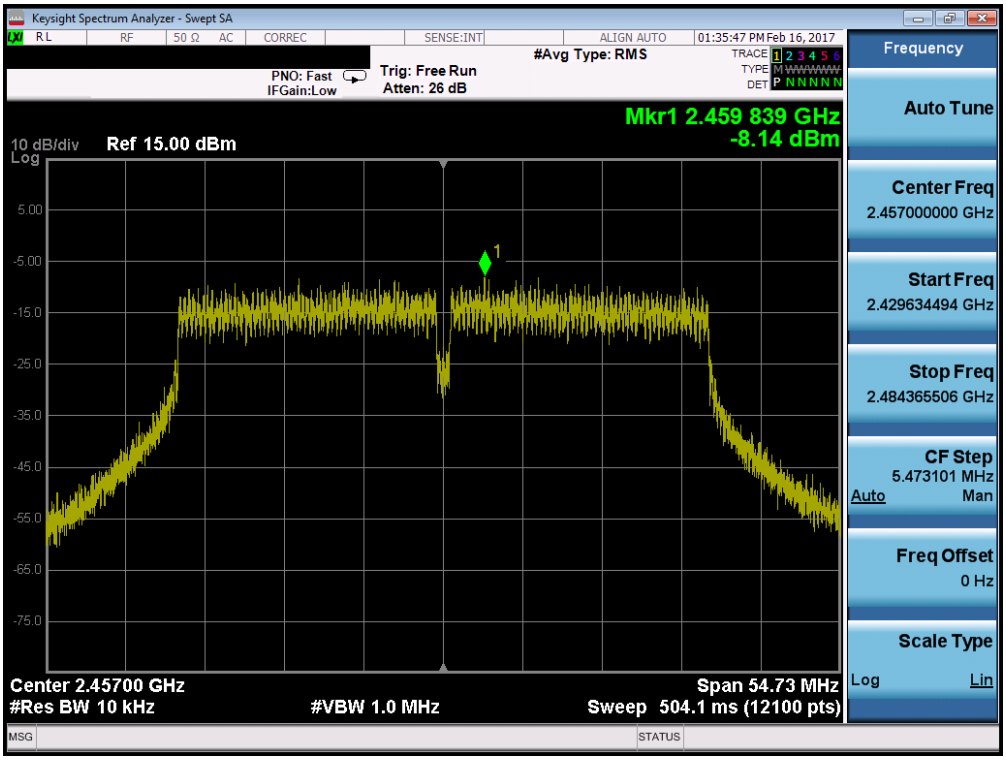
Table 7-21. Conducted Power Density Measurements



Plot 7-91. Power Spectral Density Plot (40MHz 802.11ac – Ch. 3)



Plot 7-92. Power Spectral Density Plot (40MHz 802.11ac – Ch. 6)

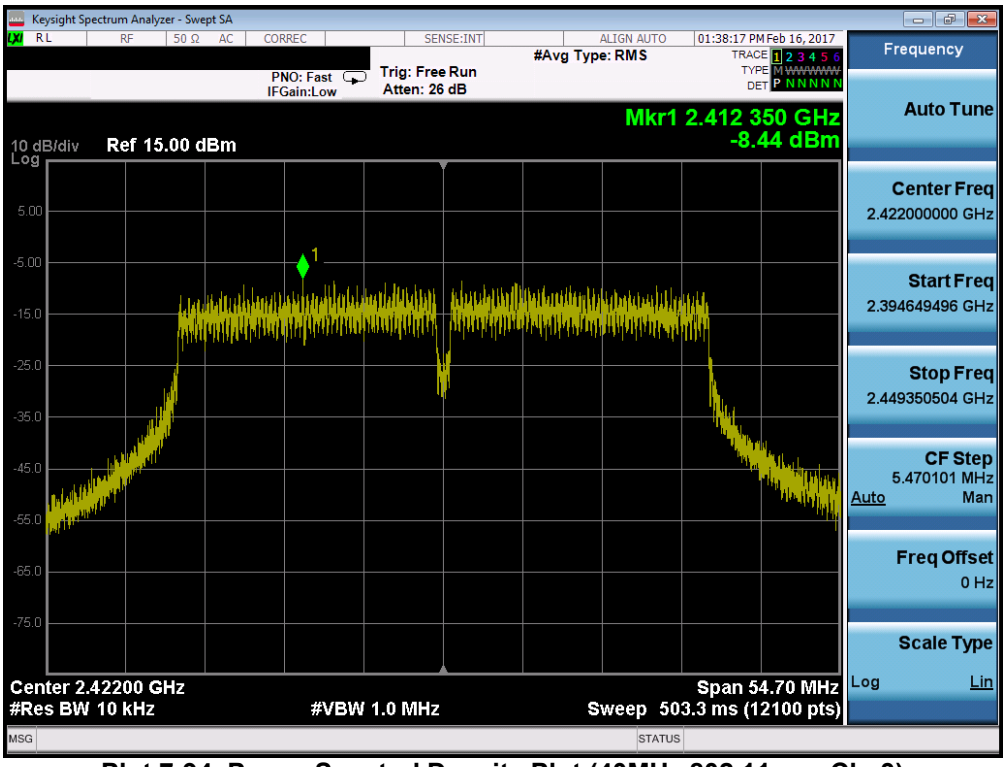


Plot 7-93. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 10)

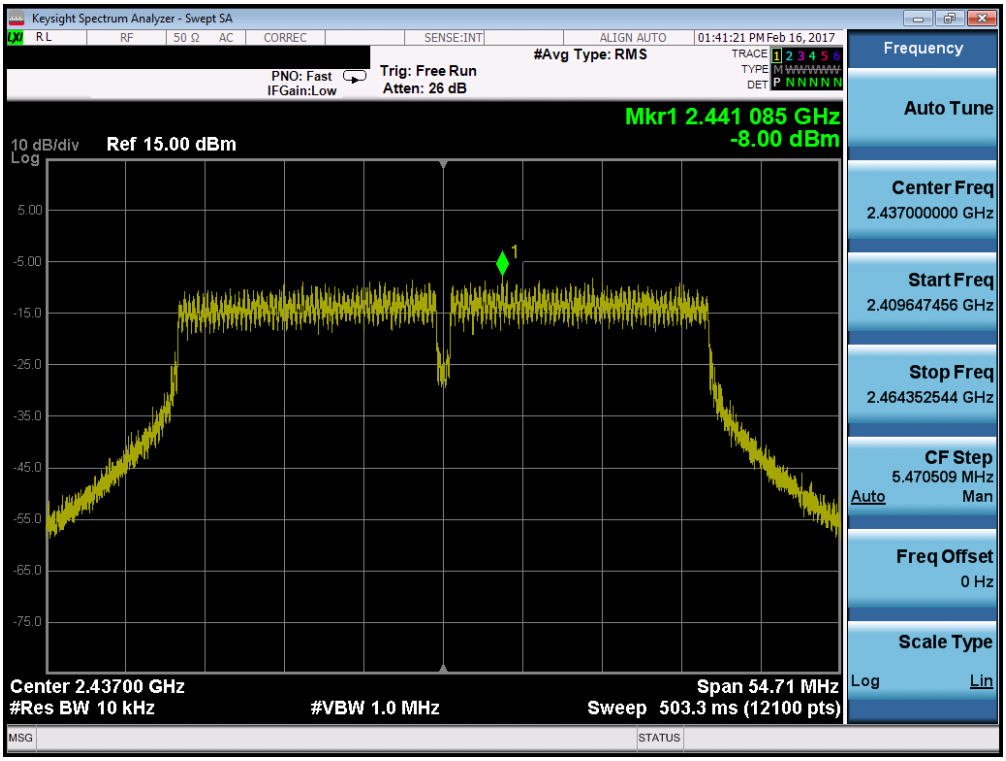
Antenna-4 Power Spectral Density Measurements (40MHz BW)

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
2422	3	n/ac	162/180 (MCS8)	-8.44	8.00	-16.44	Pass
2437	6	n/ac	162/180 (MCS8)	-8.00	8.00	-16.00	Pass
2457	10	n/ac	162/180 (MCS8)	-8.05	8.00	-16.05	Pass

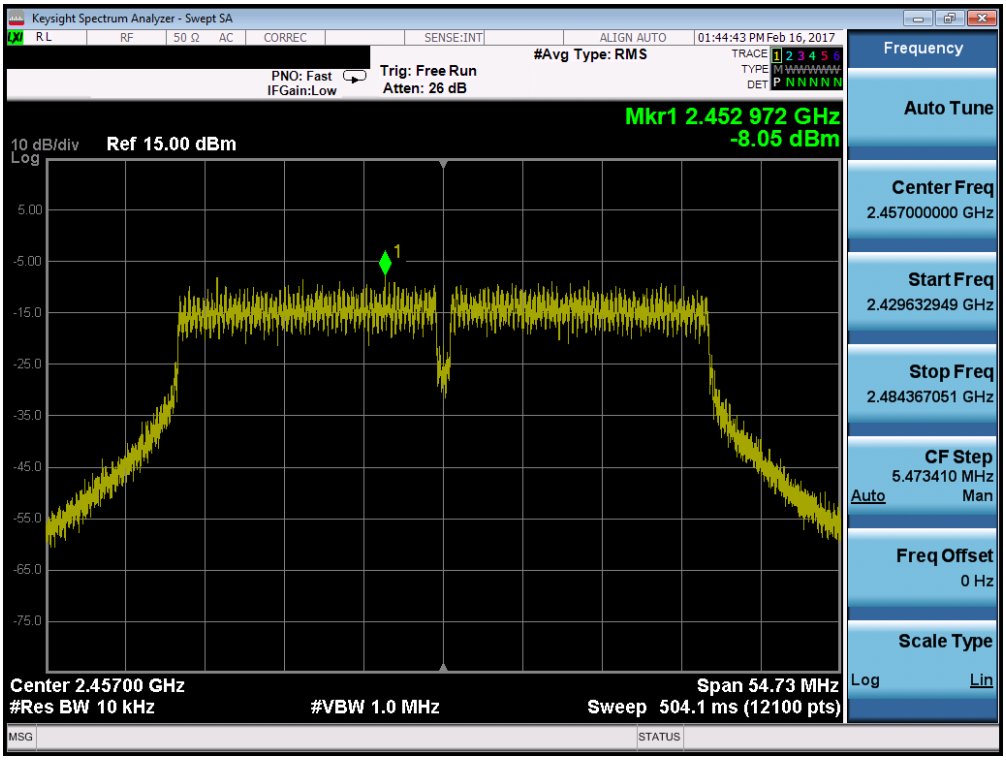
Table 7-22. Conducted Power Density Measurements



Plot 7-94. Power Spectral Density Plot (40MHz 802.11ac – Ch. 3)



Plot 7-95. Power Spectral Density Plot (40MHz 802.11ac – Ch. 6)



Plot 7-96. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 10)

MIMO Power Spectral Density Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Directional Gain [dBi]	ANT 1 Power Spectral Density [dBm]	ANT 2 Power Spectral Density [dBm]	ANT 3 Power Spectral Density [dBm]	ANT 4 Power Spectral Density [dBm]	Summed MIMO Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Adjusted Limit	Margin [dB]	Pass / Fail
2412	1	n	6.5/7.2 (MCS0)	7.83	-0.51	-1.78	-0.11	-0.64	5.30	8.00	6.17	-0.87	Pass
2437	6	n	6.5/7.2 (MCS0)	7.68	-0.84	-2.10	-0.86	-1.89	4.64	8.00	6.32	-1.68	Pass
2462	11	n	6.5/7.2 (MCS0)	7.32	-0.80	-2.83	-0.80	-0.56	4.86	8.00	6.68	-1.82	Pass

Table 7-23. 802.11n (20MHz BW) MIMO Conducted Power Density Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Directional Gain [dBi]	ANT 1 Power Spectral Density [dBm]	ANT 2 Power Spectral Density [dBm]	ANT 3 Power Spectral Density [dBm]	ANT 4 Power Spectral Density [dBm]	Summed MIMO Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Adjusted Limit	Margin [dB]	Pass / Fail
2422	3	n/ac	6.5/7.2 (MCS0)	7.83	-8.29	-8.53	-7.84	-8.44	-2.25	8.00	6.17	-8.42	Pass
2437	6	n/ac	6.5/7.2 (MCS0)	7.68	-9.28	-8.68	-8.52	-8.00	-2.58	8.00	6.32	-8.90	Pass
2457	10	n/ac	6.5/7.2 (MCS0)	7.68	-8.34	-8.34	-8.14	-8.05	-2.20	8.00	6.32	-8.52	Pass

Table 7-24.802.11n/ac (40MHz BW) MIMO Conducted Power Density Measurements

Note:

Per KDB 662911 D01 v02r01 Section E)2), the power spectral density at the four antennas were first measured separately 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 2412MHz the average conducted power spectral density was measured to be -0.51 dBm for Antenna-1, -1.78 dBm for Antenna-2, -0.11 dBm for Antenna-3 and -0.64 dBm for Antenna-4.

Antenna 1 + Antenna 2 + Antenna 3 + Antenna 4 = MIMO

(-0.51 dBm + -1.78 dBm + -0.11 dBm + -0.64 dBm) = (0.89 mW + 0.66 mW + 0.97 mW + 0.86 mW) = 3.38 mW = 5.30 dBm