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MEASUREMENT REPORT
FCC Part 15.247 WLAN 802.11b/g/n

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

Date of Testing:
1/8 - 1/22/2015
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Test Report Serial No.:
0Y1501080035.A3L

FCC ID:	**A3LSMG920KOR**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model(s):	SM-G920K, SM-G920S, SM-G920L
EUT Type:	Portable Handset
FCC Classification:	Digital Transmission System (DTS)
FCC Rule Part(s):	Part 15.247
Test Procedure(s):	KDB 558074 v03r02, KDB 662911 v02r01

Mode	Tx Frequency (MHz)	ANT1				ANT2				MIMO			
		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)
802.11b	2412 - 2462	46.881	16.71	97.949	19.91	52.845	17.23	107.152	20.30	N/A			
802.11g	2412 - 2462	23.605	13.73	95.060	19.78	26.182	14.18	100.231	20.01				
802.11n	2412 - 2462	17.539	12.44	64.714	18.11	15.922	12.02	58.210	17.65	32.364	15.10	119.165	20.76

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 v03r02. Test results reported herein relate only to the item(s) tested.

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

Randy Ortanez
President

ACCREDITED
TESTING CERT#2041.01

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MEASUREMENT REPORT
FCC Part 15.247

§ 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-G920K, SM-G920S, SM-G920L
FCC ID:	A3LSMG920KOR
FCC CLASSIFICATION:	Digital Transmission System (DTS)
Test Device Serial No.:	FCC 5, 08143 ☐ Production ☒ Pre-Production ☐ Engineering
DATE(S) OF TEST:	1/8 - 1/22/2015
TEST REPORT S/N:	0Y1501080035.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.

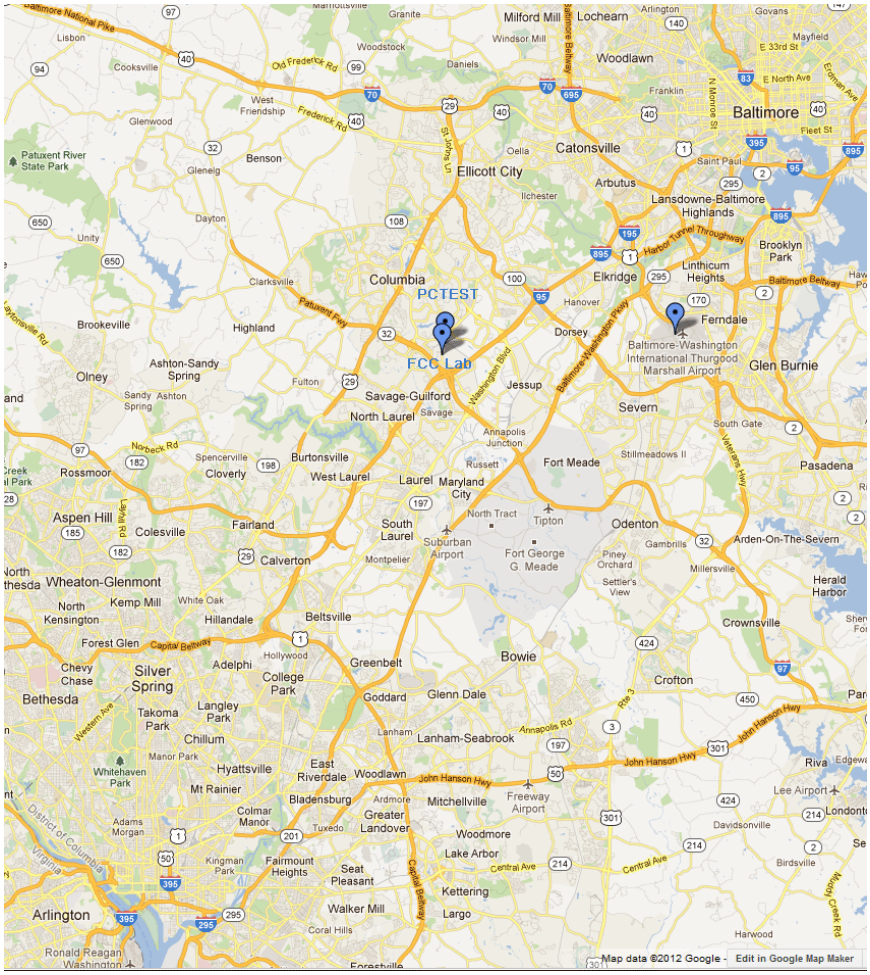

Figure 1-1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMG920KOR**. 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:

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

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 v03r02. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Maximum Achievable Duty Cycles				
802.11 Mode/Band		Duty Cycle [%]		
		ANT1	ANT2	MIMO
2.4GHz	b	99.50	99.50	N/A
	g	98.87	98.62	N/A
	n	98.53	98.38	98.31

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

WiFi Configurations		SISO		SDM	
		ANT1	ANT2	ANT1	ANT2
2.4GHz	11b	✓	✓	×	×
	11g	✓	✓	×	×
	11n	✓	✓	✓	✓

Table 2-1. Frequency / Channel Operations

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

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)

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2.3 Test Configuration

The Samsung Portable Handset FCC ID: A3LSMG920KOR was tested per the guidance of KDB 558074 v03r02. ANSI C63.10-2009 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. See Sections 3.2 for AC line conducted emissions test setups, 3.3 for radiated emissions test setups, and 6.2, 6.3, 6.4, 6.5, and 6.6 for antenna port conducted emissions test setups.

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

2.4 EMI Suppression Device(s)/Modifications

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

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3.0 DESCRIPTION OF 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 v03r02 were used in the measurement of the **Samsung Portable Handset FCC ID: A3LSMG920KOR.**

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

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3.3 Radiated Emissions

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

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

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

3.4 Environmental Conditions

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

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4.0 ANTENNA REQUIREMENTS

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

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

Conclusion:

The **Samsung Portable Handset FCC ID: A3LSMG920KOR** 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		

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

Table 5-1. Annual Test Equipment Calibration Schedule

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6.0 TEST RESULTS

6.1 Summary

Company Name: Samsung Electronics Co., Ltd.
FCC ID: A3LSMG920KOR
FCC Classification: Digital Transmission System (DTS)

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 ≥ 30dBc		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
15.207	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits	LINE CONDUCTED	PASS	Section 6.9

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 2.8.

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6.2 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 (>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 v03r02 – 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.

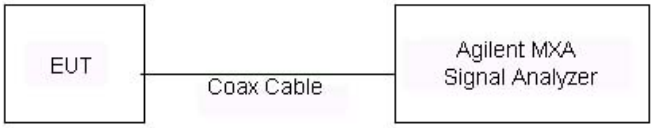

Figure 6-1. Test Instrument & Measurement Setup

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	8.068	0.500	Pass
2437	6	b	1	8.058	0.500	Pass
2462	11	b	1	7.605	0.500	Pass
2412	1	g	6	16.37	0.500	Pass
2437	6	g	6	16.40	0.500	Pass
2462	11	g	6	16.34	0.500	Pass
2412	1	n	6.5/7.2 (MCS0)	17.57	0.500	Pass
2437	6	n	6.5/7.2 (MCS0)	17.63	0.500	Pass
2462	11	n	6.5/7.2 (MCS0)	17.58	0.500	Pass

Table 6-2. Conducted Bandwidth Measurements

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

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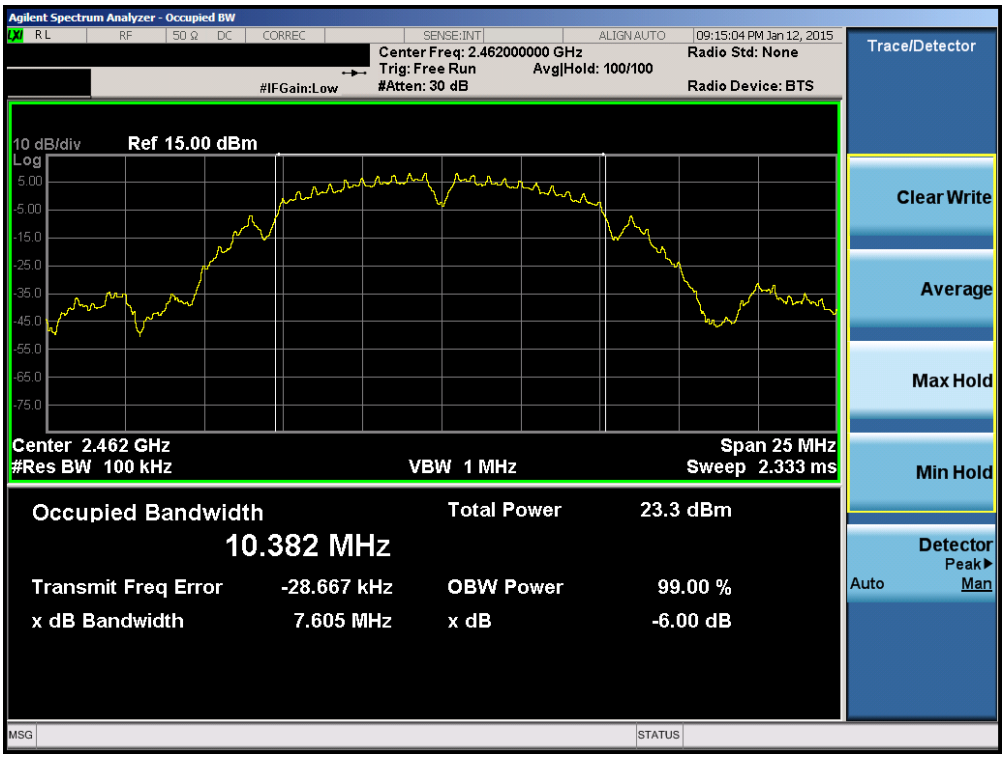
Plot 6-2. 6dB Bandwidth Plot (802.11b – Ch. 6)



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

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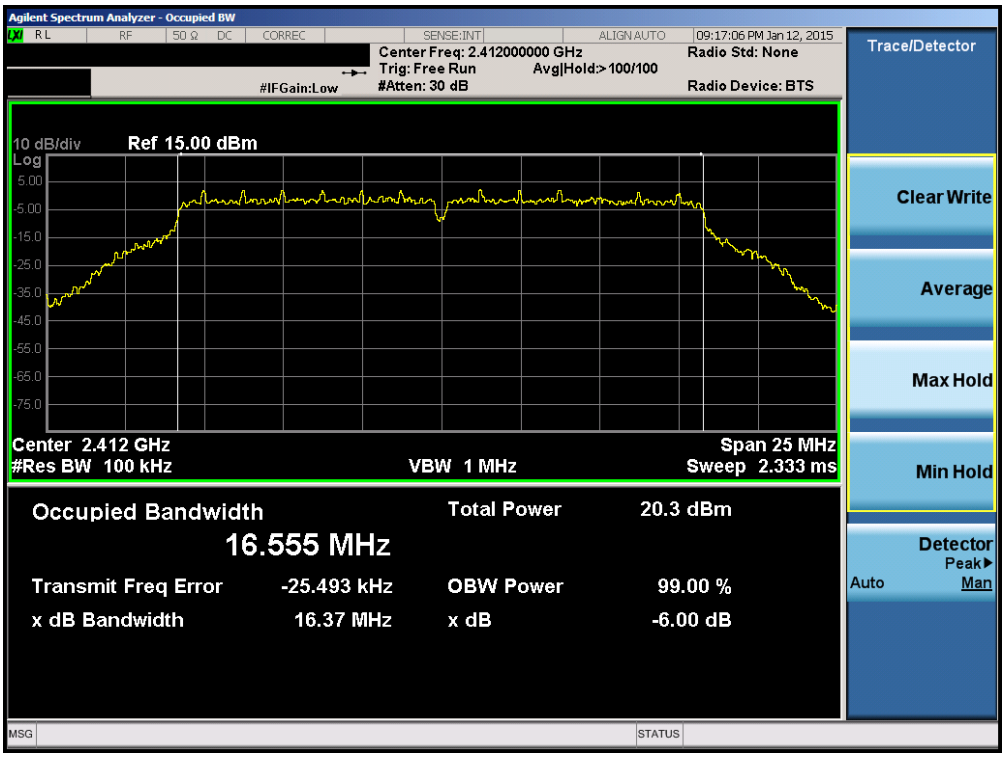
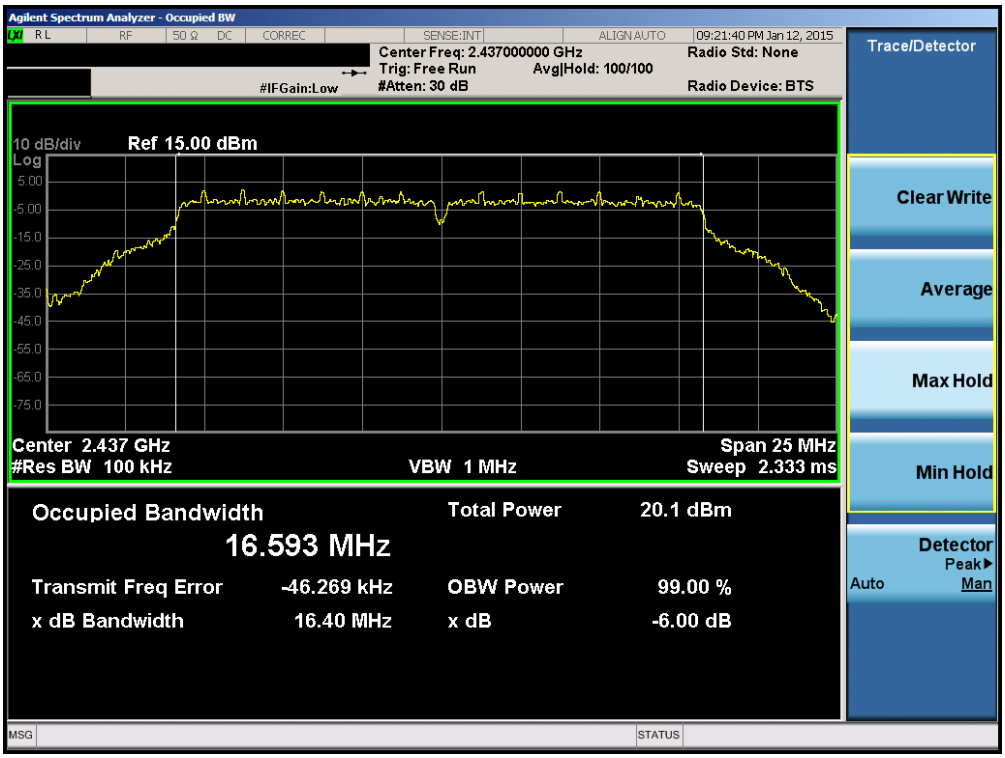


Plot 6-4. 6dB Bandwidth Plot (802.11g – Ch. 1)



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

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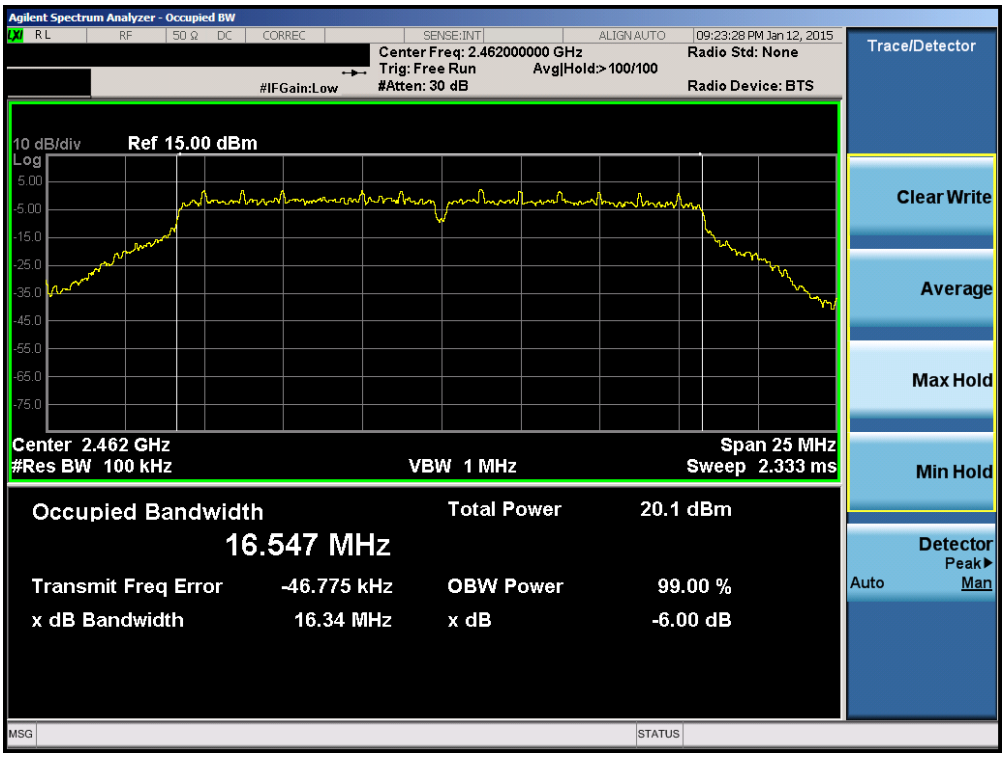
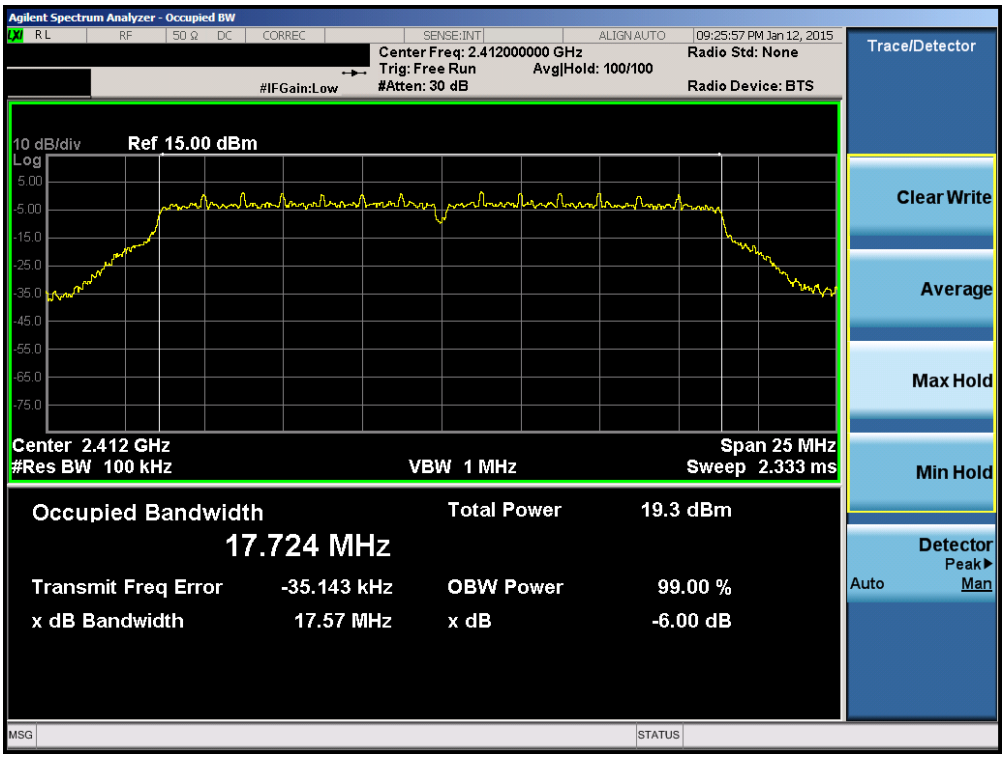


Plot 6-6. 6dB Bandwidth Plot (802.11g – Ch. 11)



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

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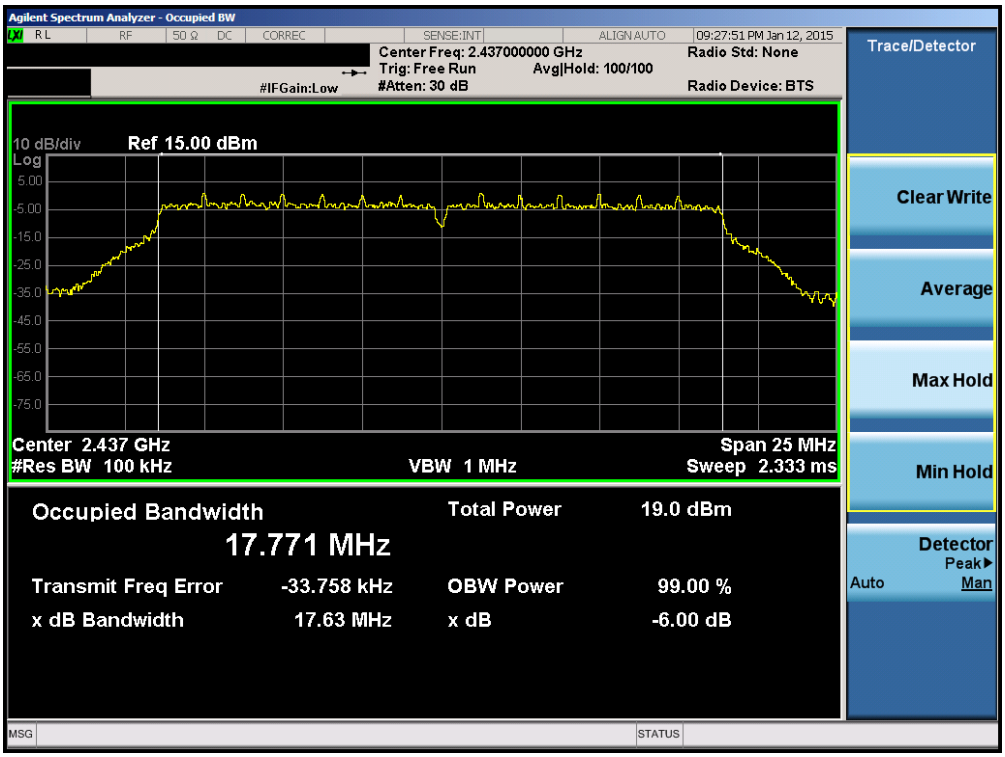
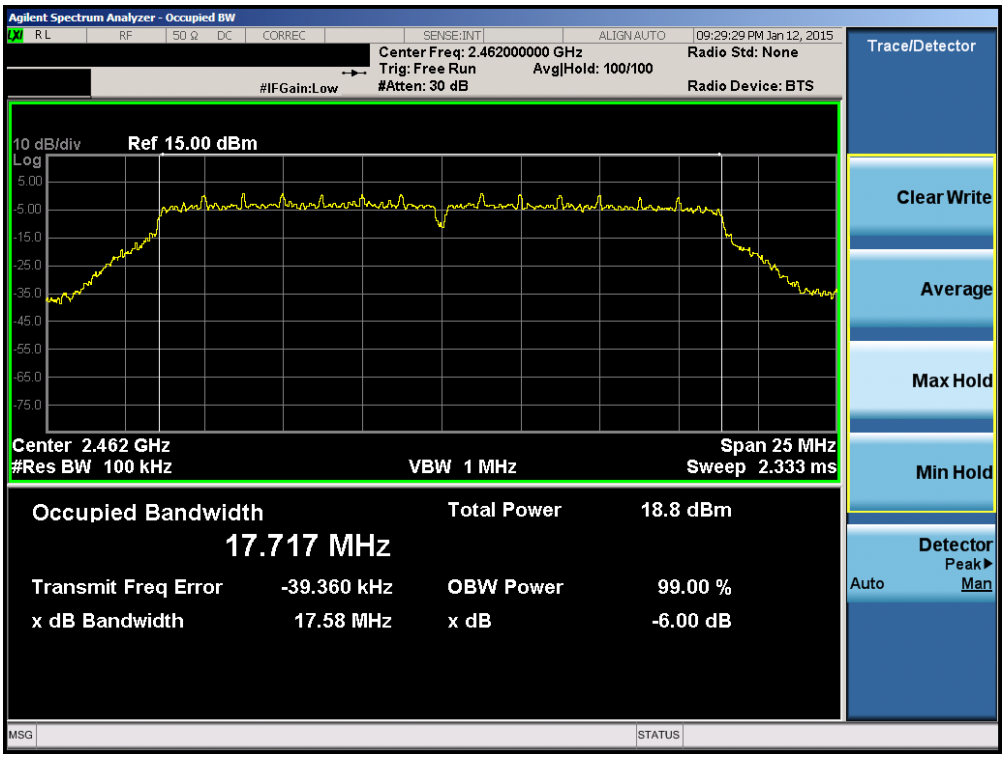


Plot 6-8. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 6)



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

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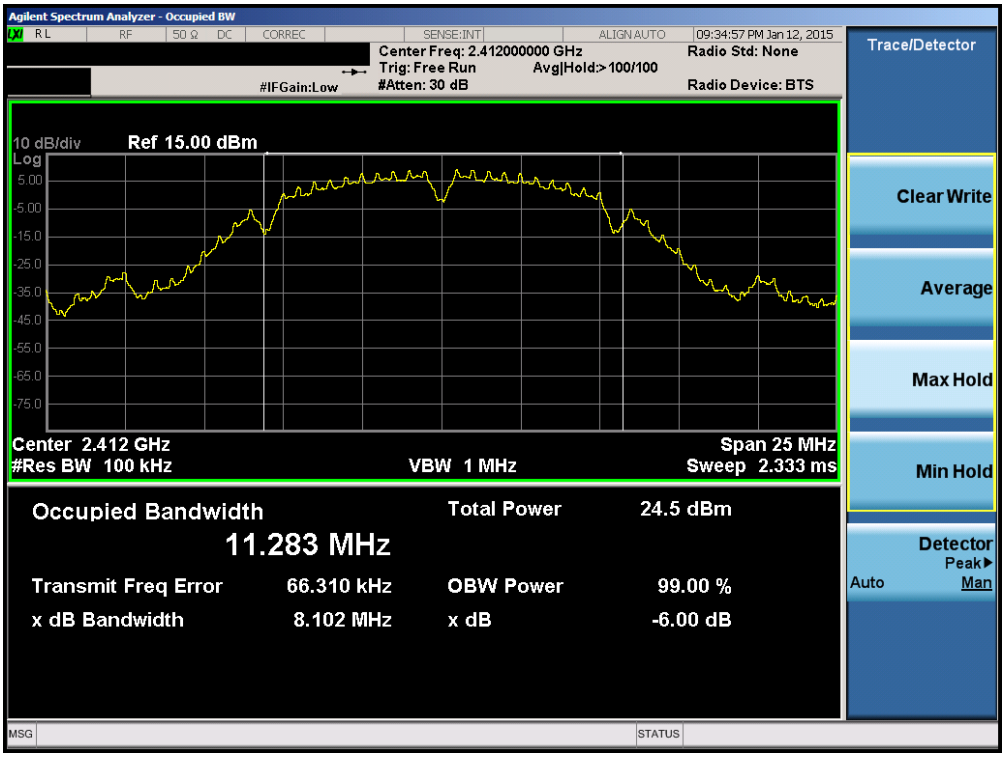
Antenna-2 6 dB Bandwidth Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
2412	1	b	1	8.102	0.500	Pass
2437	6	b	1	8.098	0.500	Pass
2462	11	b	1	8.560	0.500	Pass
2412	1	g	6	16.36	0.500	Pass
2437	6	g	6	16.39	0.500	Pass
2462	11	g	6	16.33	0.500	Pass
2412	1	n	6.5/7.2 (MCS0)	17.60	0.500	Pass
2437	6	n	6.5/7.2 (MCS0)	17.60	0.500	Pass
2462	11	n	6.5/7.2 (MCS0)	17.34	0.500	Pass

Table 6-3. Conducted Bandwidth Measurements



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

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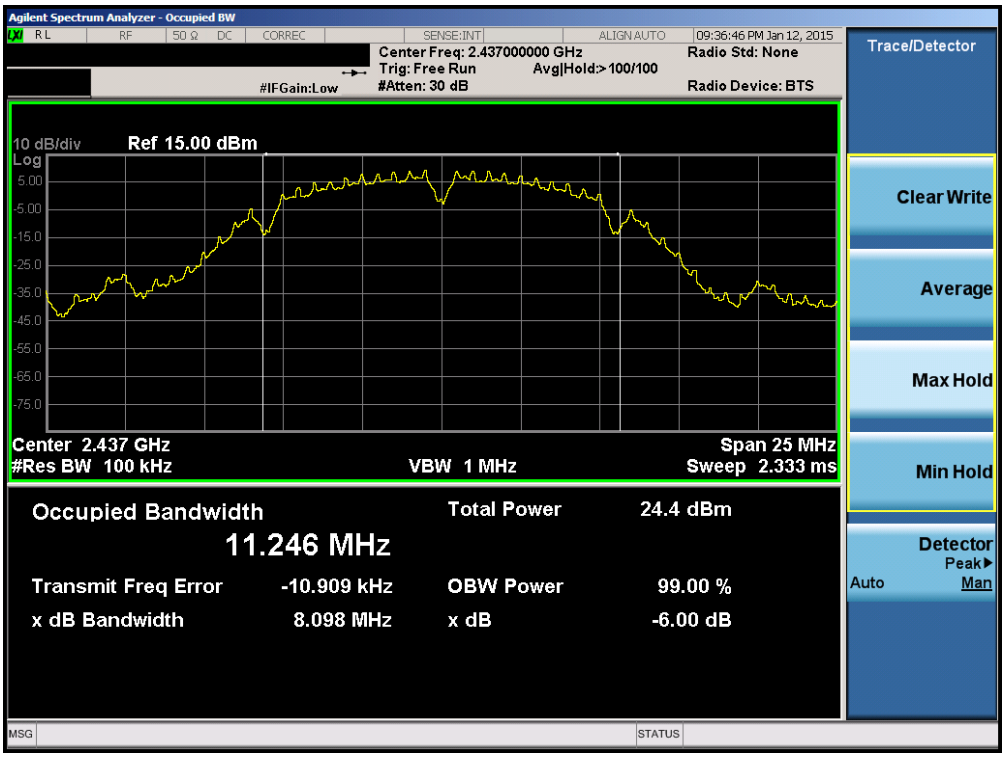
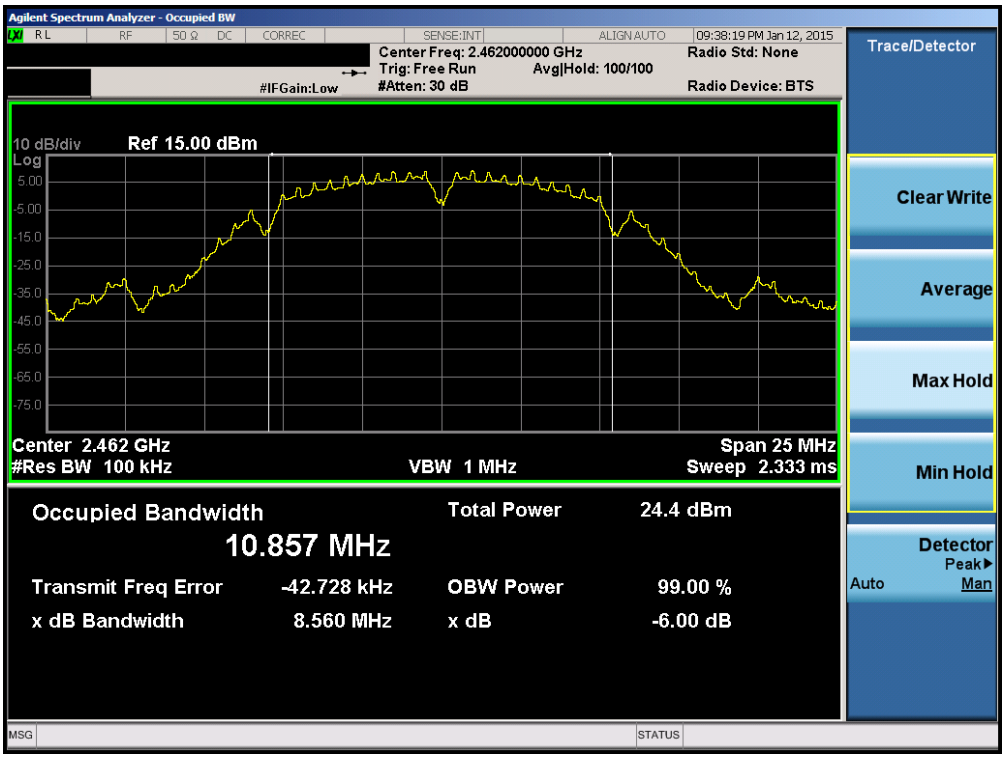


Plot 6-11. 6dB Bandwidth Plot (802.11b – Ch. 6)



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

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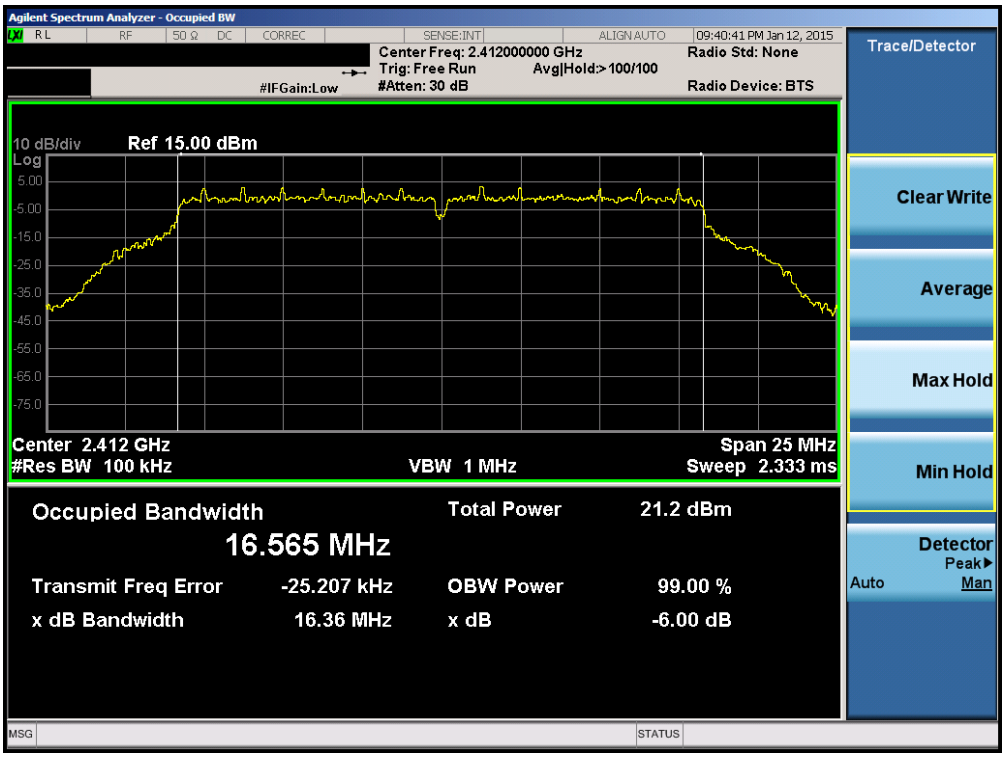

Plot 6-13. 6dB Bandwidth Plot (802.11g – Ch. 1)

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

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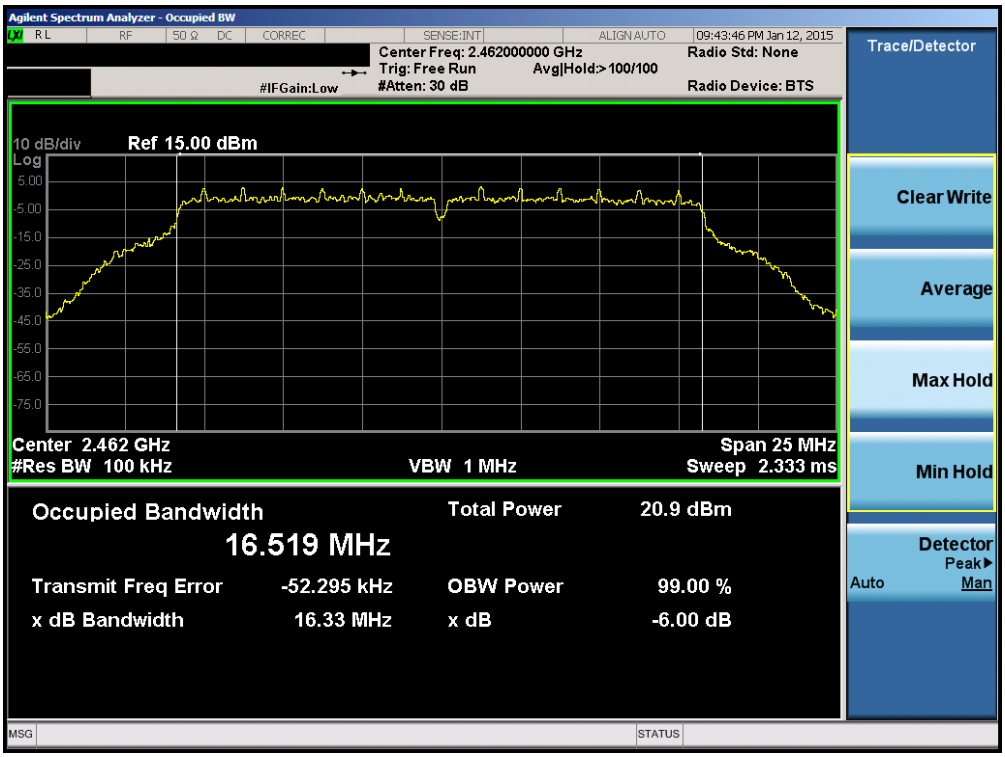
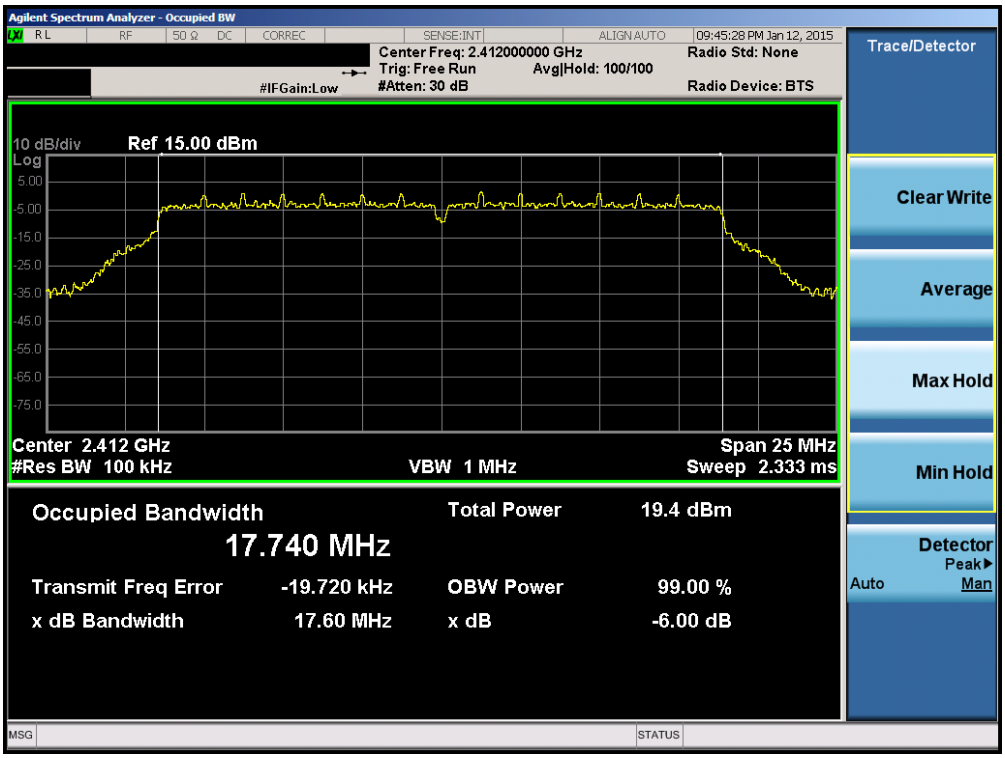


Plot 6-15. 6dB Bandwidth Plot (802.11g – Ch. 11)



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

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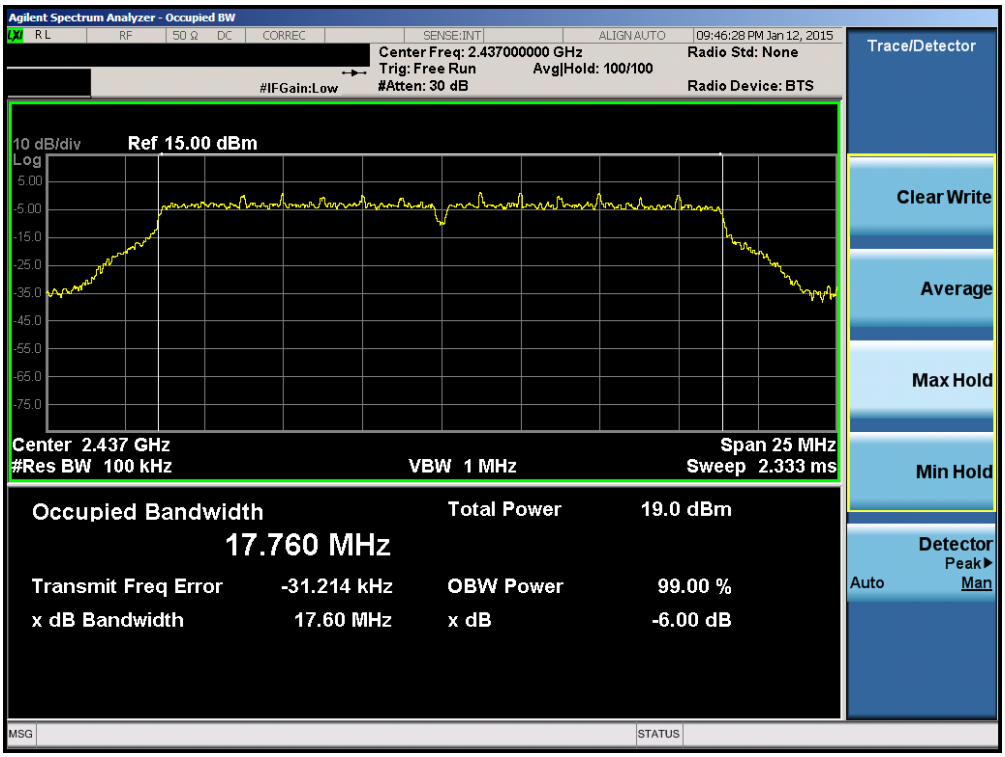
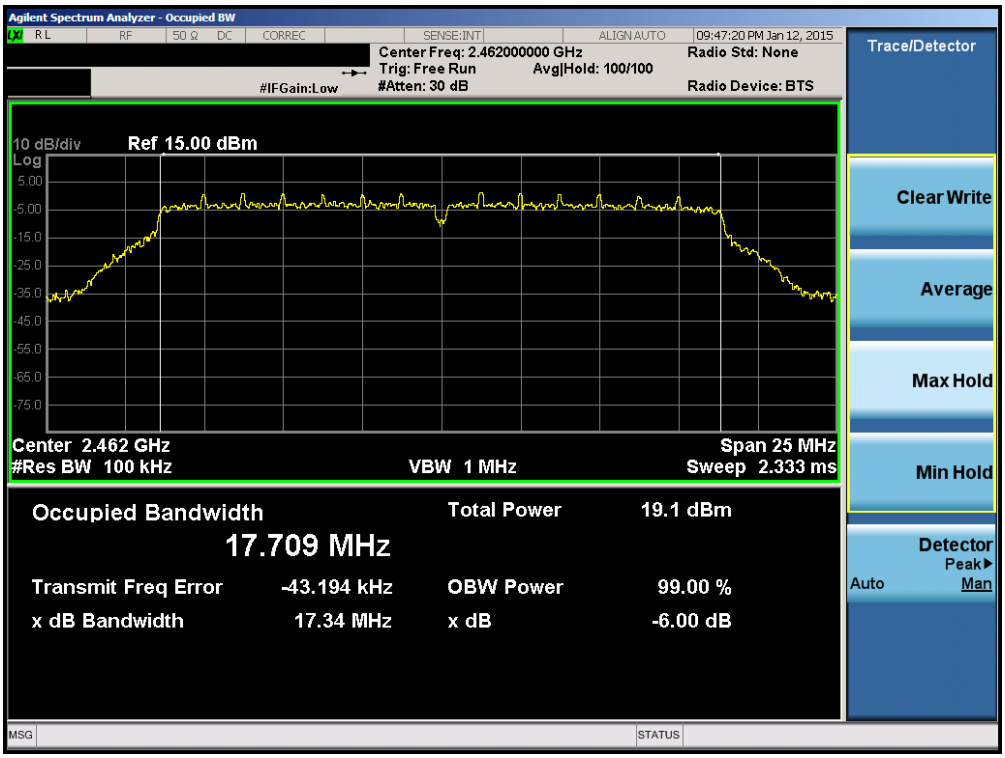


Plot 6-17. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 6)



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

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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 v03r02 – Section 9.1.2 PKPM1 Peak Power Method
KDB 558074 v03r02 – Section 9.2.3.2 Method AVGPM-G
KDB 662911 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.

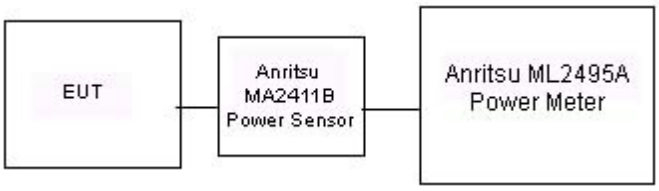

Figure 6-2. Test Instrument & Measurement Setup for Power Meter Measurements

Test Notes

None

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Freq [MHz]	Channel	Detector	2.4GHz Conducted Power [dBm]		
			IEEE Transmission Mode		
			802.11b	802.11g	802.11n
2412	1	AVG	16.22	13.44	12.02
		PEAK	19.22	19.30	17.55
2437	6	AVG	16.71	13.73	12.44
		PEAK	19.91	19.78	18.11
2462	11	AVG	16.60	13.51	12.15
		PEAK	19.78	19.55	17.50

Table 6-4. 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	17.21	14.18	12.02
		PEAK	20.24	19.95	17.65
2437	6	AVG	16.95	13.81	11.71
		PEAK	20.08	19.62	17.36
2462	11	AVG	17.23	14.04	11.90
		PEAK	20.30	20.01	17.41

Table 6-5. Antenna-2 Conducted Output Power Measurements

Freq [MHz]	Channel	Detector	2.4GHz Conducted Power [dBm]		
			IEEE Transmission Mode		
			ANT1	ANT2	MIMO
2412	1	AVG	12.02	12.02	15.03
		PEAK	17.55	17.65	20.61
2437	6	AVG	12.44	11.71	15.10
		PEAK	18.11	17.36	20.76
2462	11	AVG	12.15	11.90	15.04
		PEAK	17.50	17.41	20.47

Table 6-6. MIMO n-mode Conducted Output Power Measurements

Note:

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

Sample MIMO Calculation:

At 2412MHz the average conducted output power was measured to be 12.02 dBm for Antenna-1 and 12.02 dBm for Antenna-2.

Antenna 1 + Antenna 2 = MIMO

(12.02 dBm + 12.02 dBm) = (15.92 mW + 15.92 mW) = 31.84 mW = 15.03 dBm

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6.4 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 (>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 v03r02 – Section 10.2 Method PKPSD
KDB 662911 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.

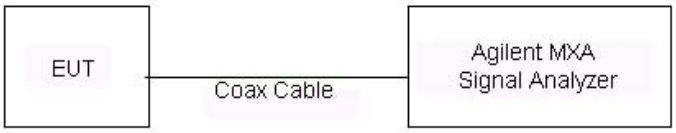

Figure 6-3. Test Instrument & Measurement Setup

Test Notes

None

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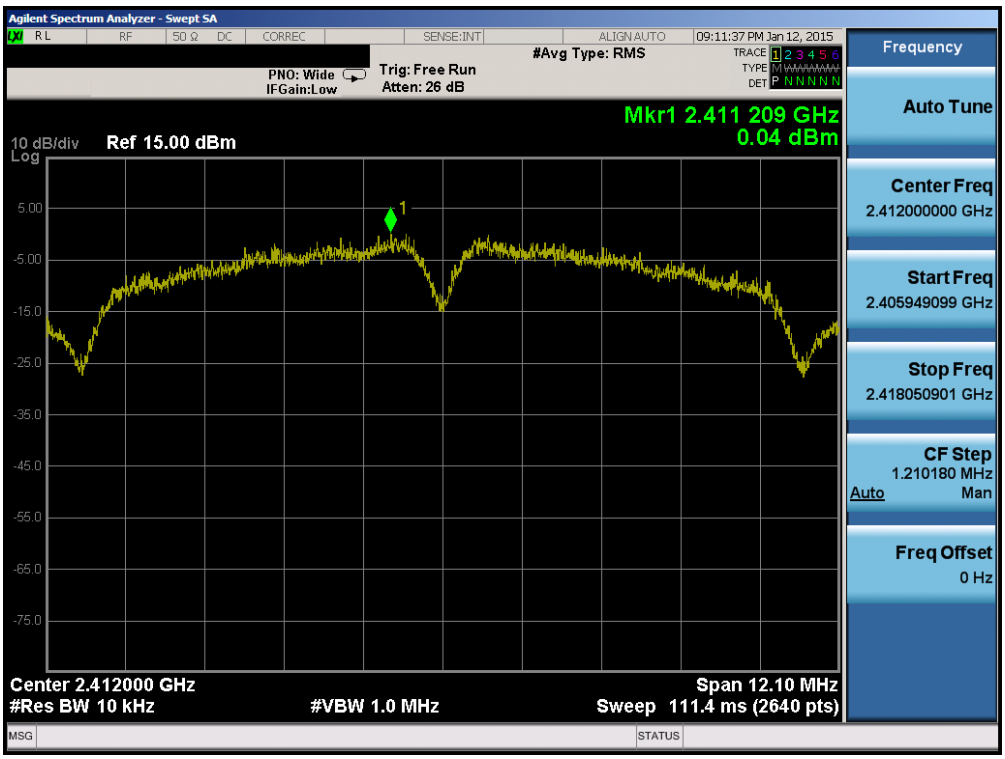
Antenna-1 Power Spectral Density Measurements

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	0.04	8.00	-7.96	Pass
2437	6	b	1	-0.45	8.00	-8.45	Pass
2462	11	b	1	-0.51	8.00	-8.51	Pass
2412	1	g	6	-6.27	8.00	-14.27	Pass
2437	6	g	6	-6.80	8.00	-14.80	Pass
2462	11	g	6	-6.23	8.00	-14.23	Pass
2412	1	n	6.5/7.2 (MCS0)	-7.82	8.00	-15.82	Pass
2437	6	n	6.5/7.2 (MCS0)	-7.26	8.00	-15.26	Pass
2462	11	n	6.5/7.2 (MCS0)	-8.19	8.00	-16.19	Pass

Table 6-7. Conducted Power Density Measurements



Plot 6-19. Power Spectral Density Plot (802.11b – Ch. 1)

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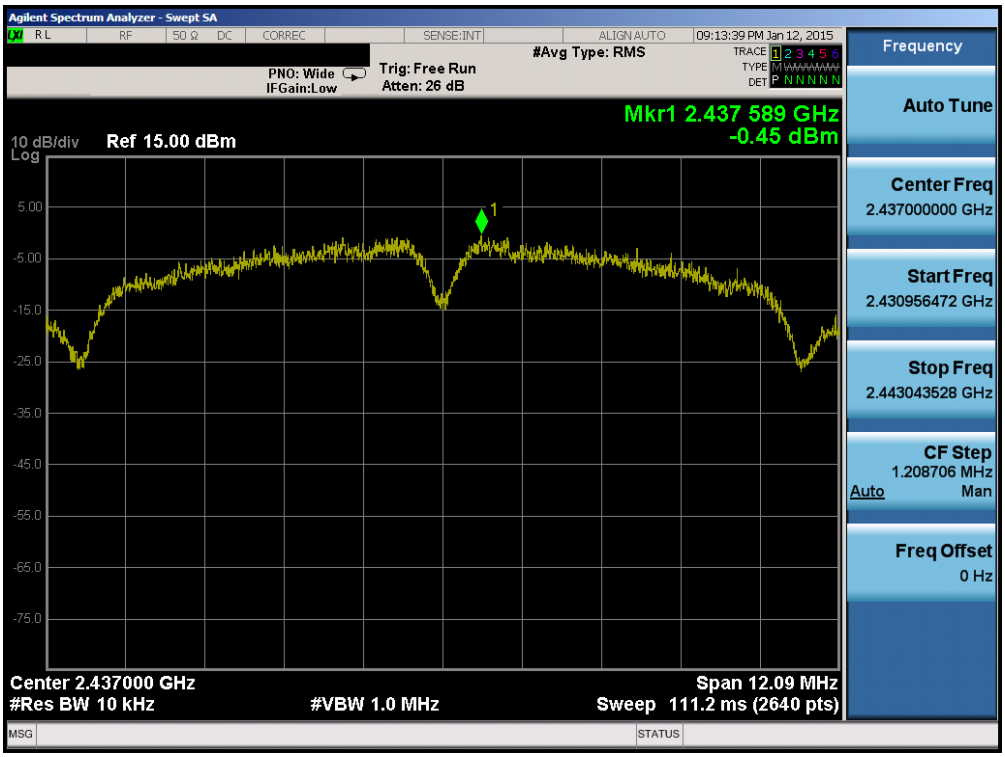

Plot 6-20. Power Spectral Density Plot (802.11b – Ch. 6)

Plot 6-21. Power Spectral Density Plot (802.11b – Ch. 11)

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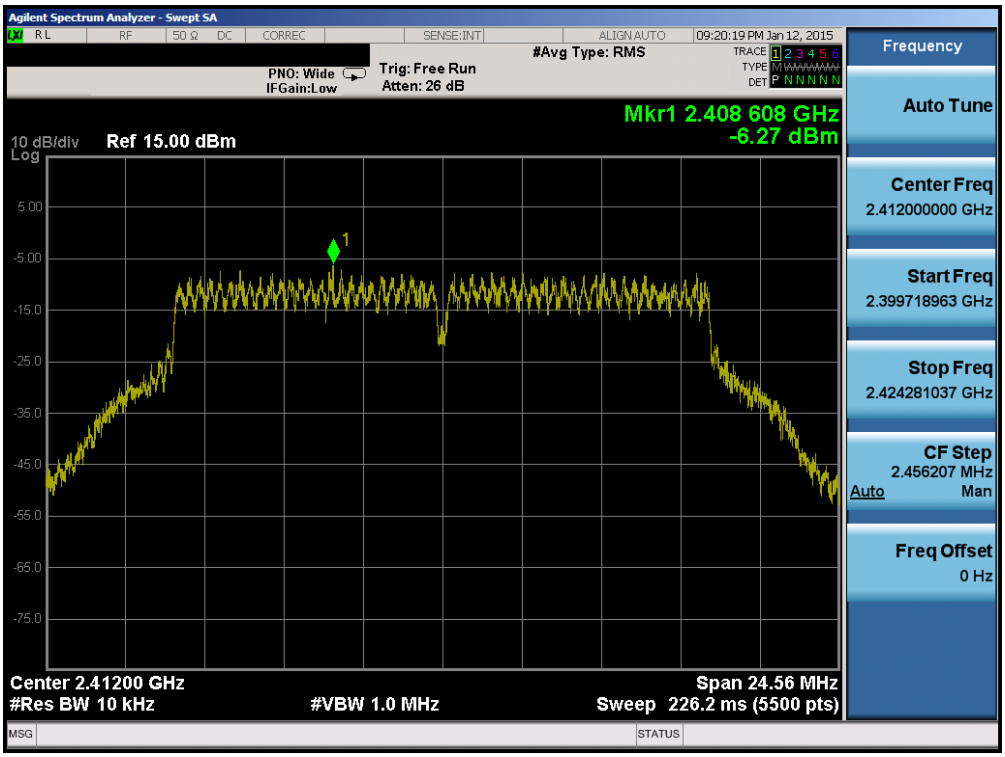
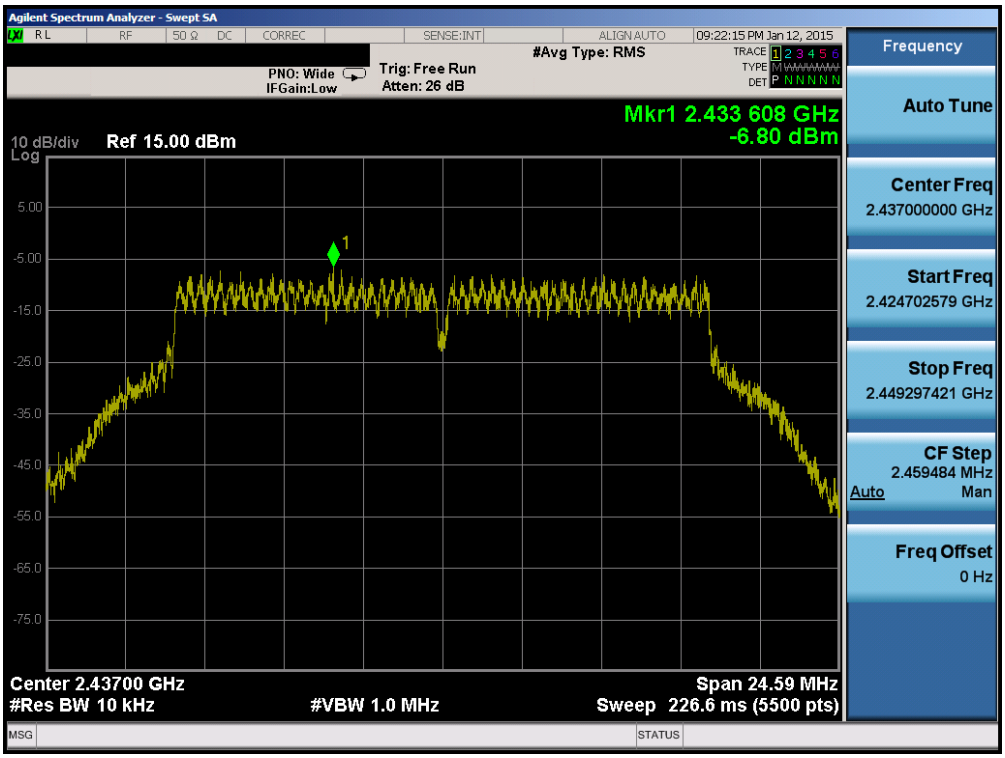


Plot 6-22. Power Spectral Density Plot (802.11g – Ch. 1)



Plot 6-23. Power Spectral Density Plot (802.11g – Ch. 6)

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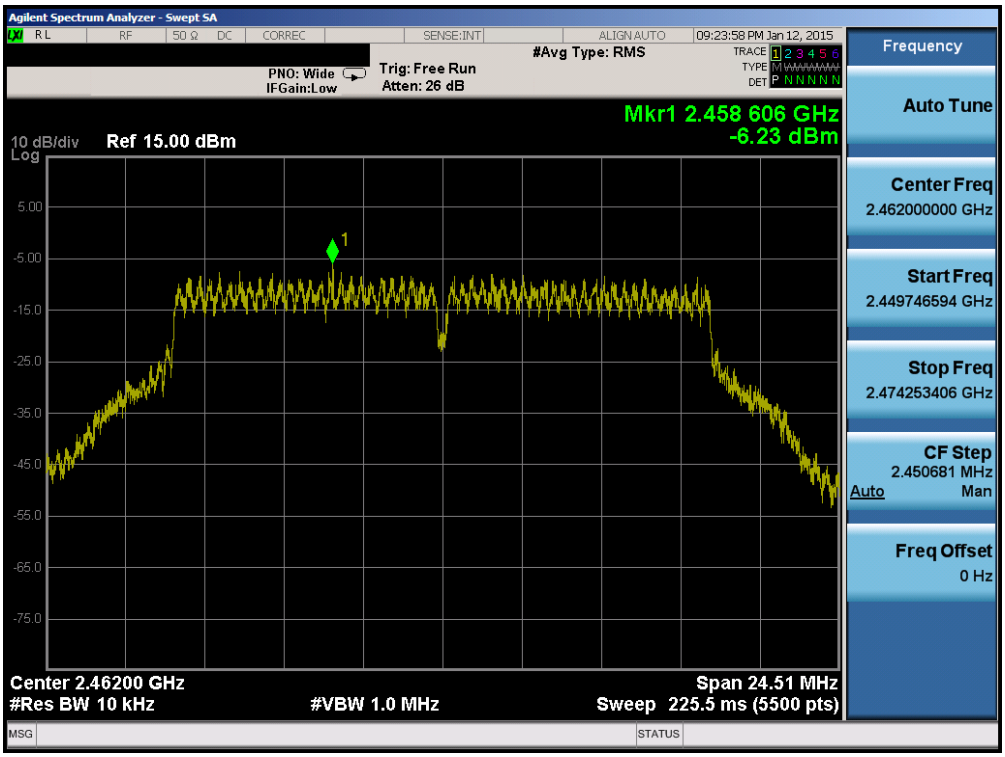
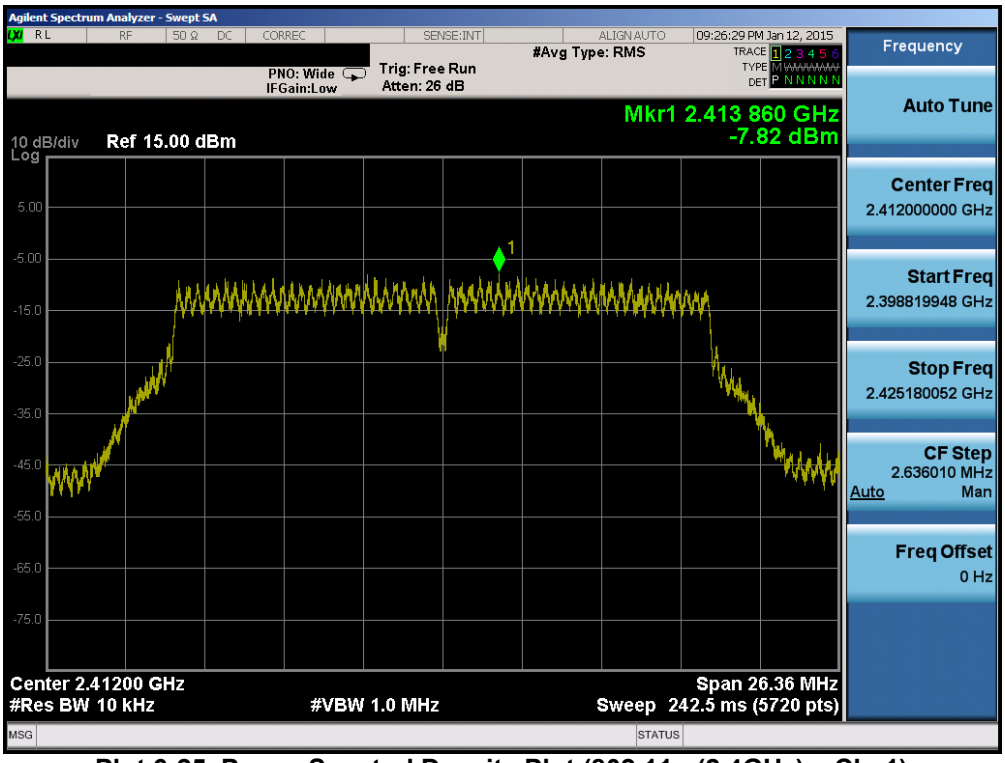


Plot 6-24. Power Spectral Density Plot (802.11g – Ch. 11)



Plot 6-25. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 1)

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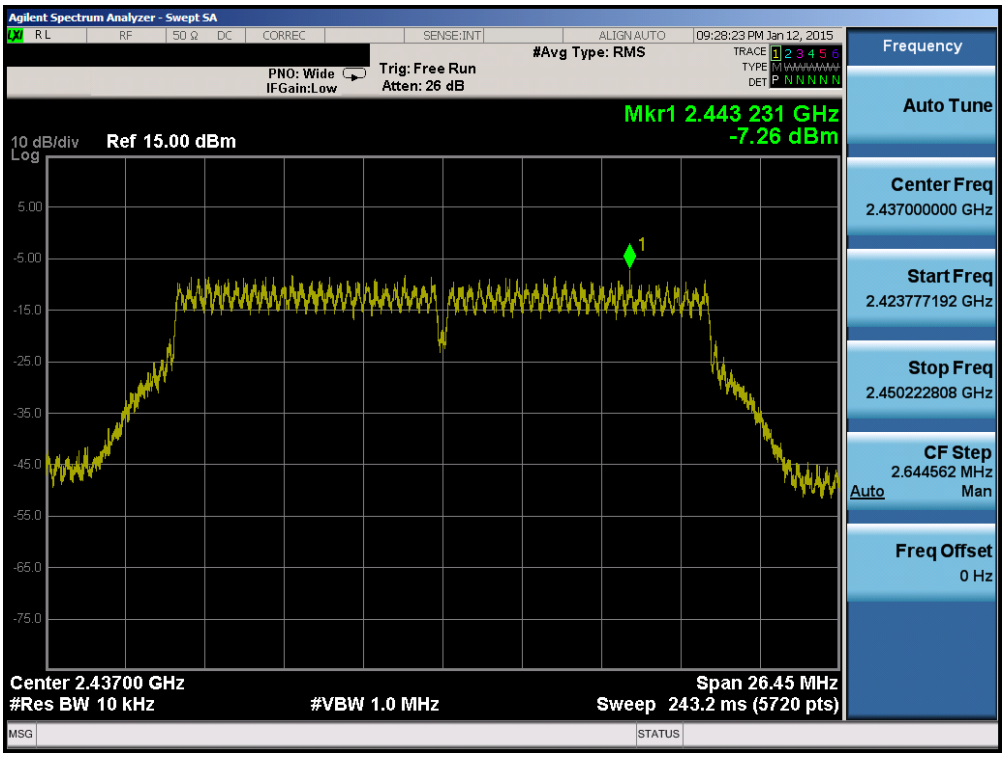
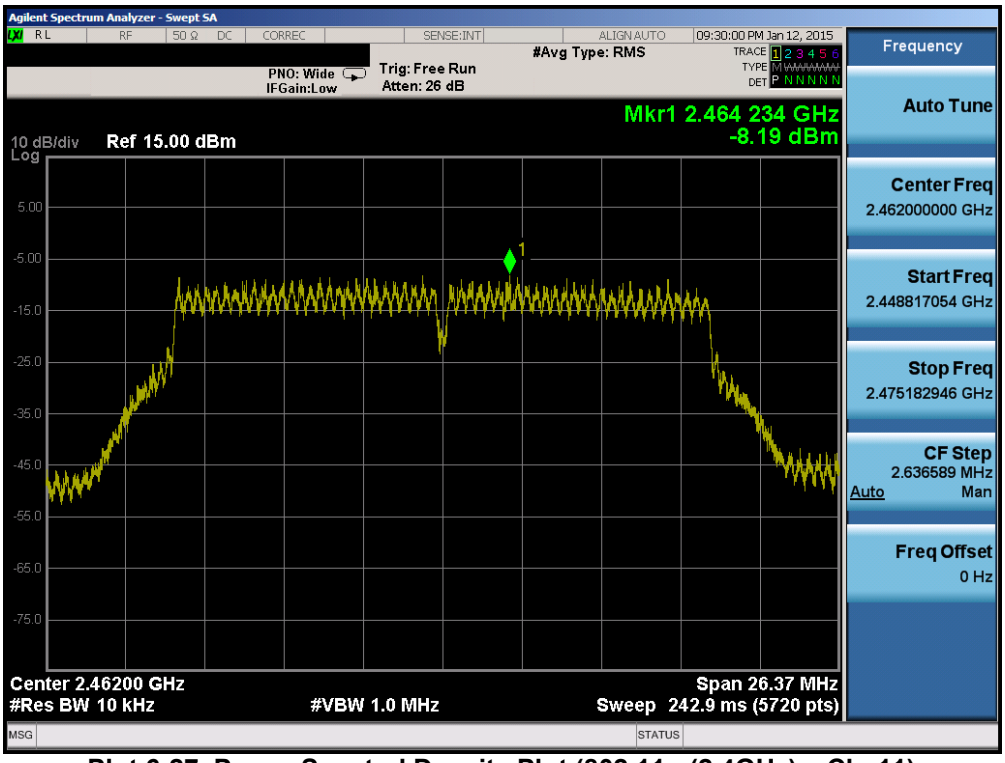


Plot 6-26. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 6)



Plot 6-27. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 11)

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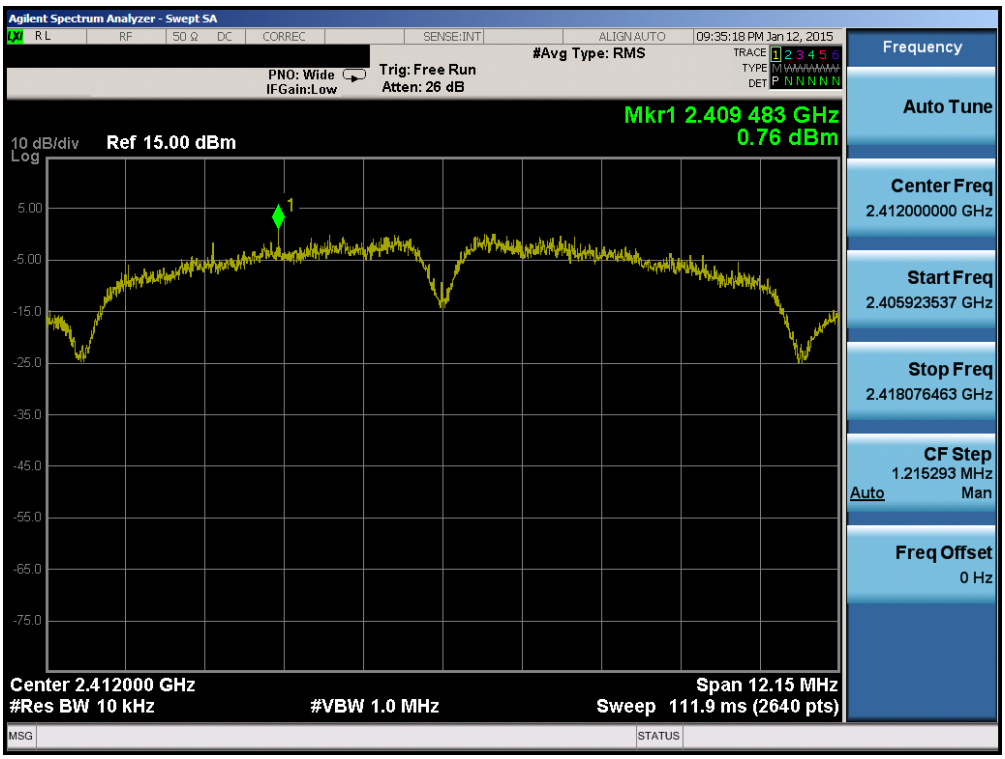
Antenna-2 Power Spectral Density Measurements

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	0.76	8.00	-7.24	Pass
2437	6	b	1	1.28	8.00	-6.72	Pass
2462	11	b	1	0.66	8.00	-7.34	Pass
2412	1	g	6	-5.83	8.00	-13.83	Pass
2437	6	g	6	-5.64	8.00	-13.64	Pass
2462	11	g	6	-5.58	8.00	-13.58	Pass
2412	1	n	6.5/7.2 (MCS0)	-7.43	8.00	-15.43	Pass
2437	6	n	6.5/7.2 (MCS0)	-7.96	8.00	-15.96	Pass
2462	11	n	6.5/7.2 (MCS0)	-7.53	8.00	-15.53	Pass

Table 6-8. Conducted Power Density Measurements



Plot 6-28. Power Spectral Density Plot (802.11b – Ch. 1)

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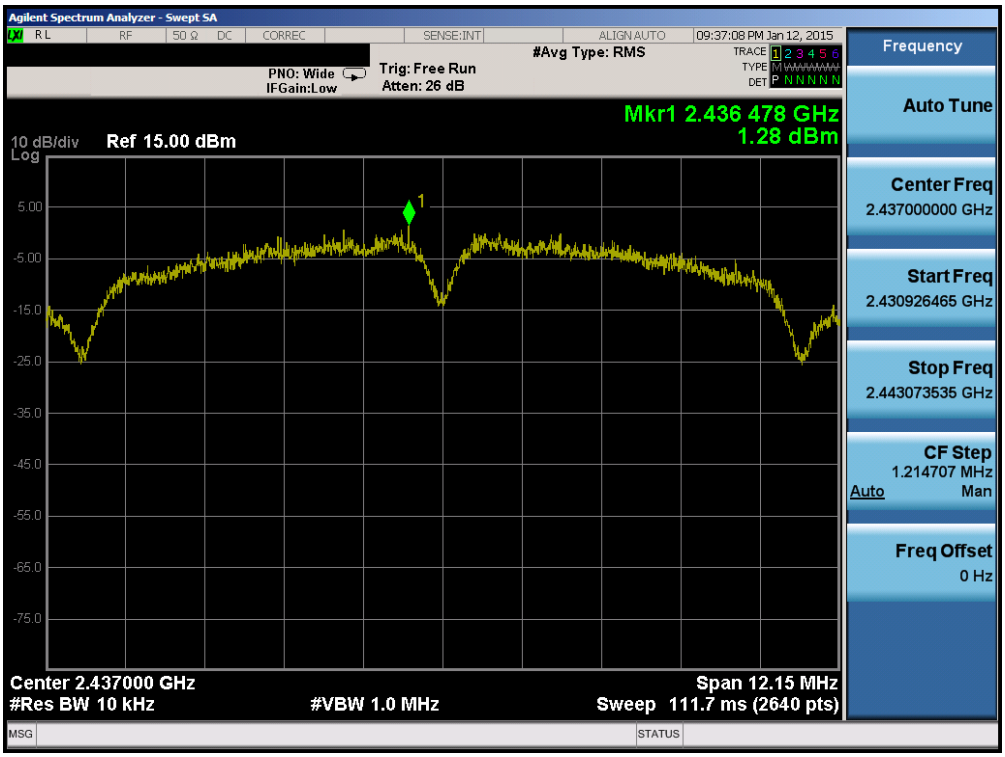
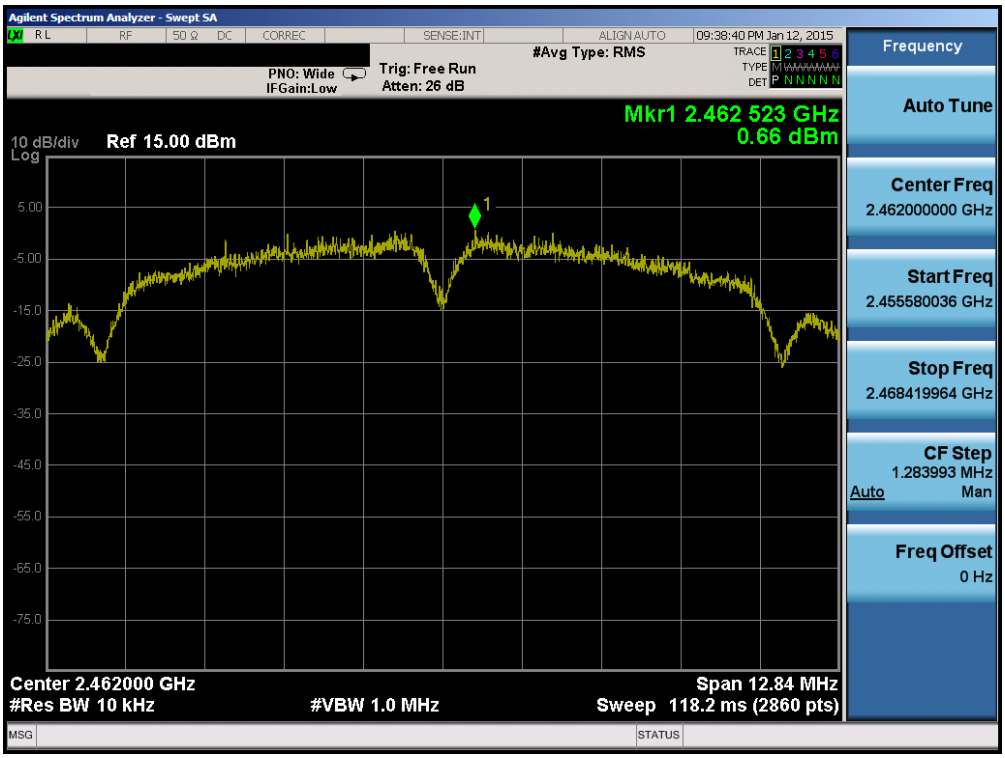


Plot 6-29. Power Spectral Density Plot (802.11b – Ch. 6)



Plot 6-30. Power Spectral Density Plot (802.11b – Ch. 11)

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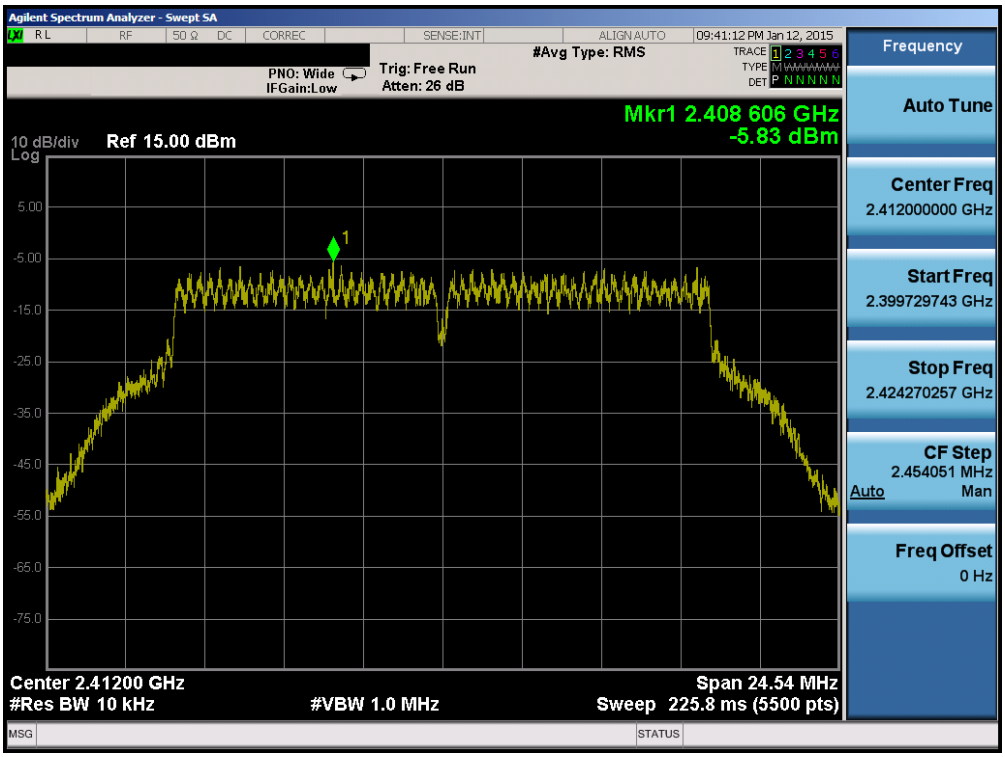
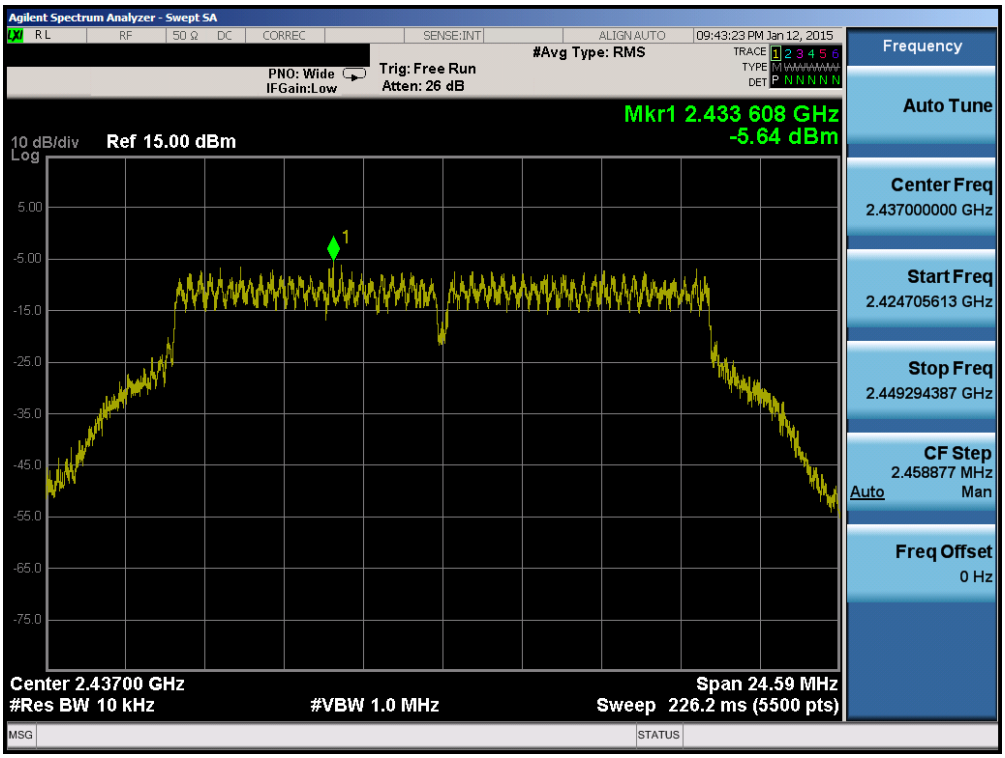


Plot 6-31. Power Spectral Density Plot (802.11g – Ch. 1)



Plot 6-32. Power Spectral Density Plot (802.11g – Ch. 6)

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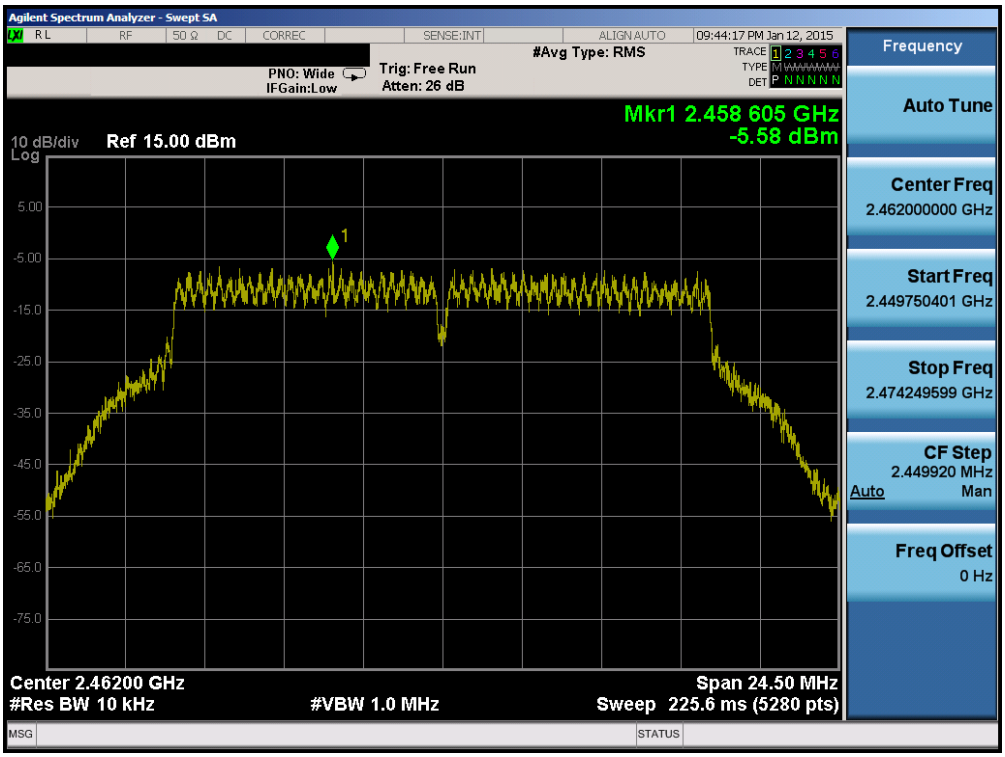
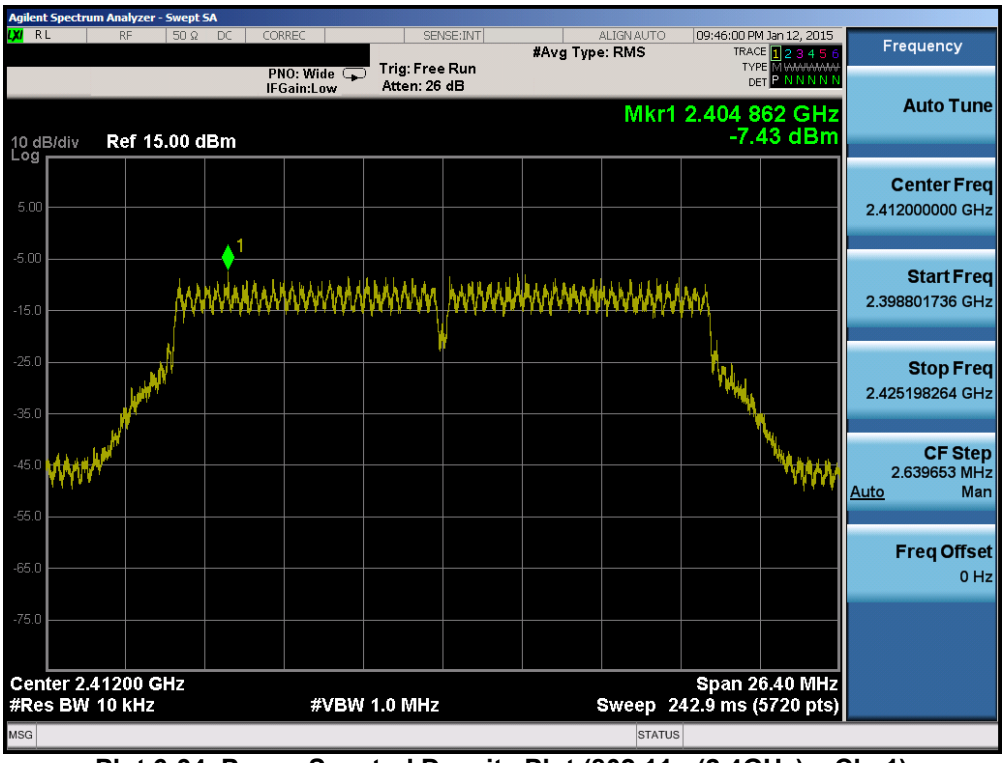


Plot 6-33. Power Spectral Density Plot (802.11g – Ch. 11)



Plot 6-34. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 1)

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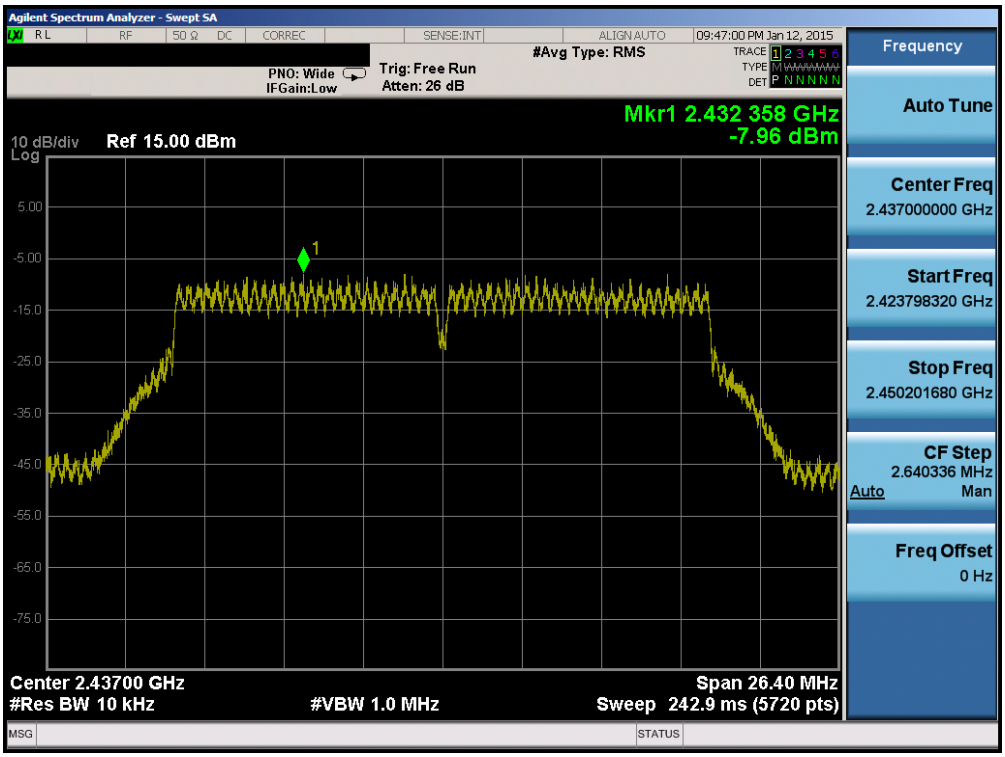
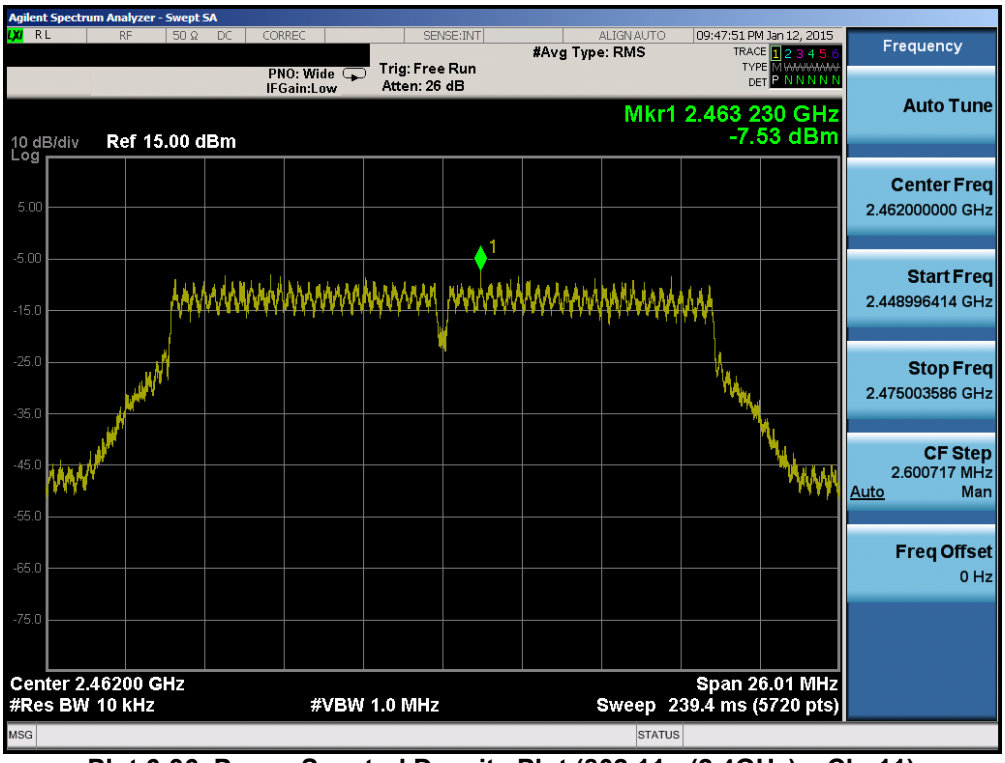


Plot 6-35. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 6)



Plot 6-36. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 11)

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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	n	6.5/7.2 (MCS0)	-7.82	-7.43	-4.61	8.00	-12.61	Pass
2437	6	n	6.5/7.2 (MCS0)	-7.26	-7.96	-4.59	8.00	-12.59	Pass
2462	11	n	6.5/7.2 (MCS0)	-8.19	-7.53	-4.84	8.00	-12.84	Pass

Table 6-9.MIMO Conducted Power Density Measurements

Note:

Per KDB 662911 Section E)2), the power spectral density at Antenna 1 and Antenna 2 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 -7.82 dBm for Antenna-1 and -7.43 dBm for Antenna-2.

Antenna 1 + Antenna 2 = MIMO

(-7.82 dBm + -7.43 dBm) = (0.17 mW + 0.18 mW) = 0.35 mW = -4.61 dBm

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6.5 Conducted Emissions at the Band Edge

§15.247(d)

Test Overview and Limit

All out of band emissions are 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 to determine the worst case configuration. For the following out of band conducted spurious emissions plots at the band edge, the EUT was set at a data rate of 1Mbps for "b" mode, 6 Mbps for "g" mode, and 6.5/7.2Mbps for "n" mode as these settings produced the worst-case emissions.

The limit for out-of-band spurious emissions at the band edge is 30dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100kHz bandwidth per the PSD procedure (Section 9.1).

Test Procedure Used

KDB 558074 v03r02 – Section 11.3

Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW = 100kHz
4. VBW = 1MHz
5. Detector = Peak
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = max hold
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Setup

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

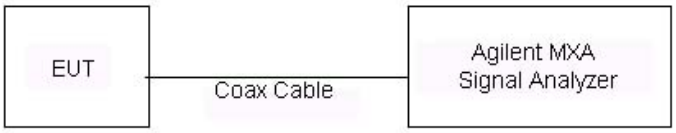

Figure 6-4. Test Instrument & Measurement Setup

Test Notes

None

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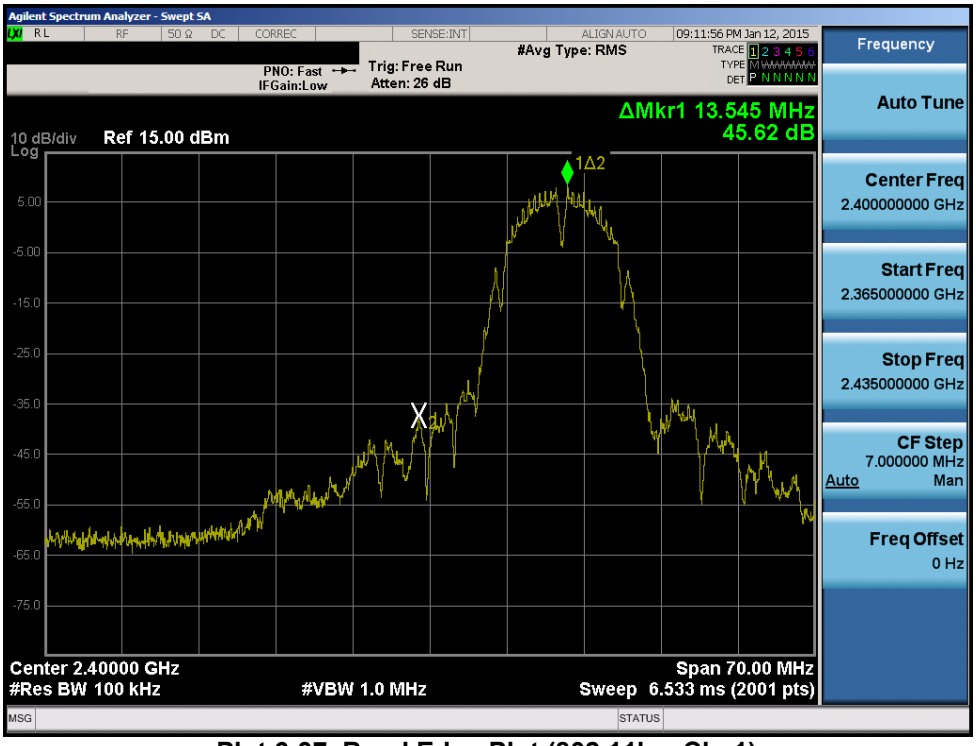
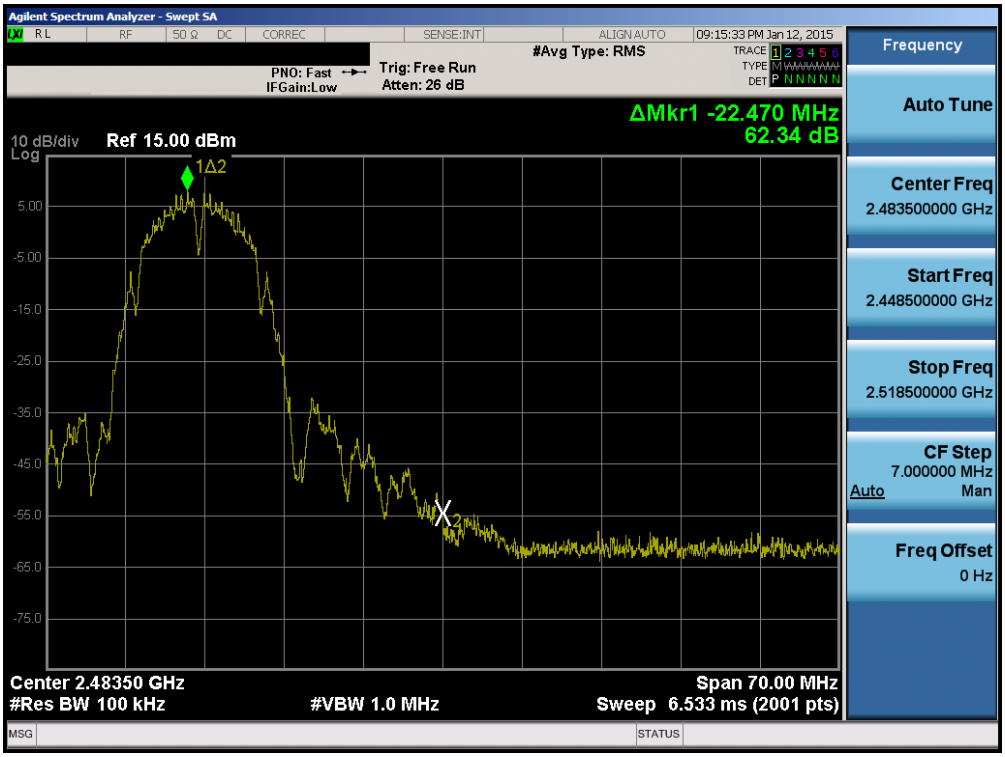
Antenna-1 Conducted Emissions at the Band Edge



Plot 6-37. Band Edge Plot (802.11b – Ch. 1)



Plot 6-38. Band Edge Plot (802.11b – Ch. 11)

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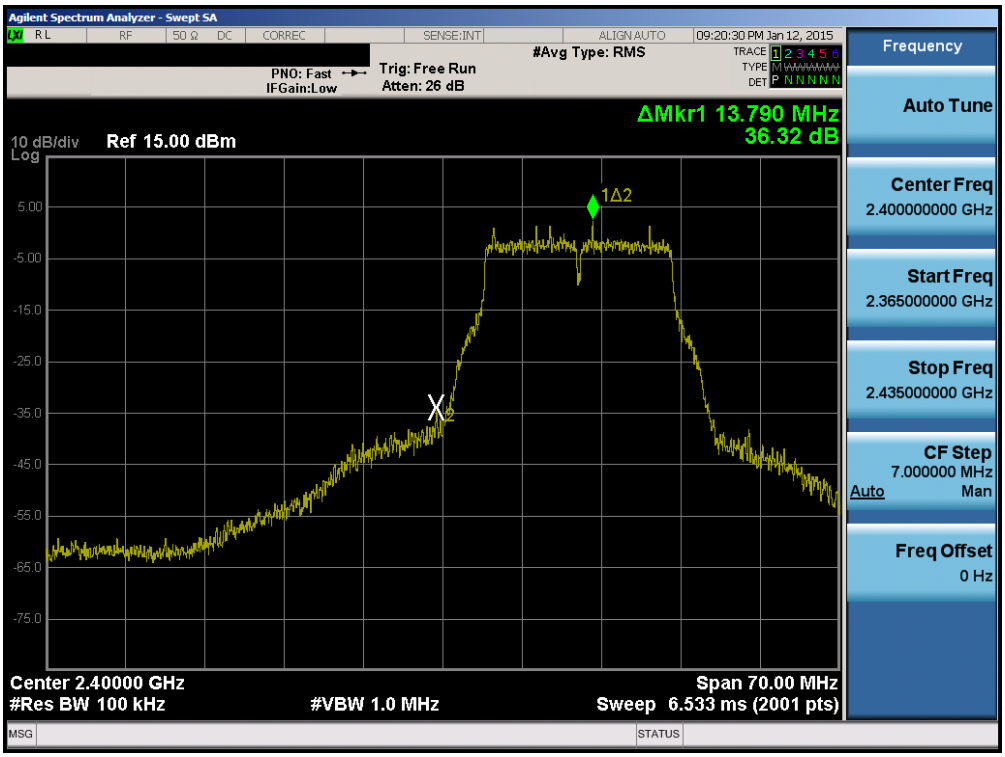
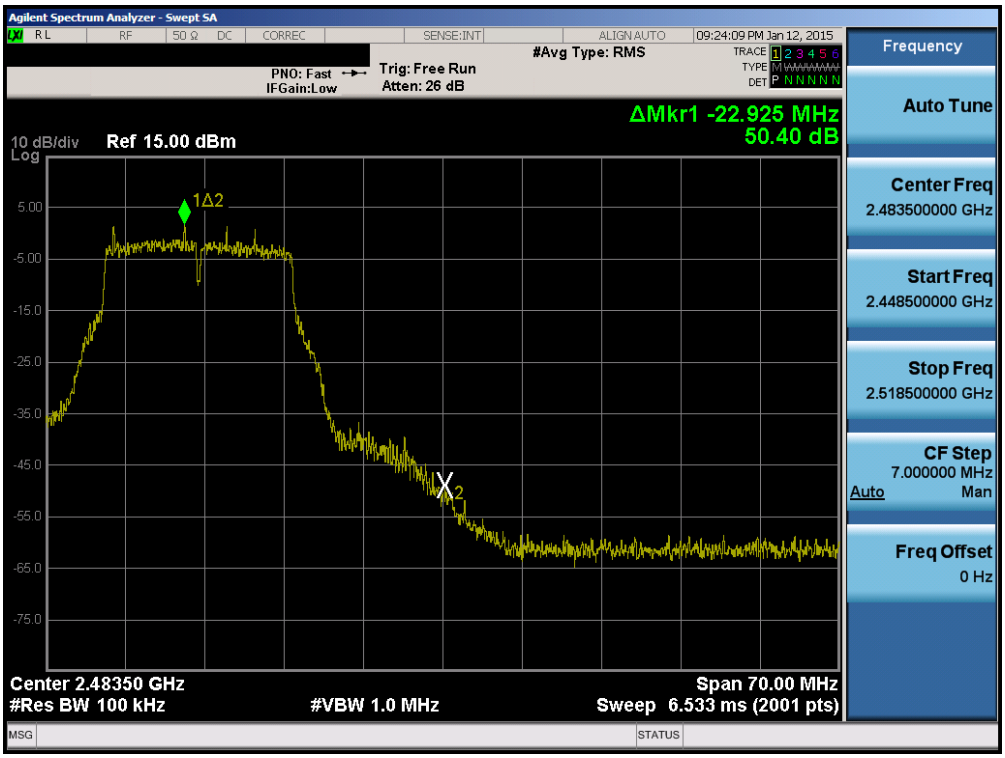


Plot 6-39. Band Edge Plot (802.11g– Ch. 1)



Plot 6-40. Band Edge Plot (802.11g – Ch. 11)

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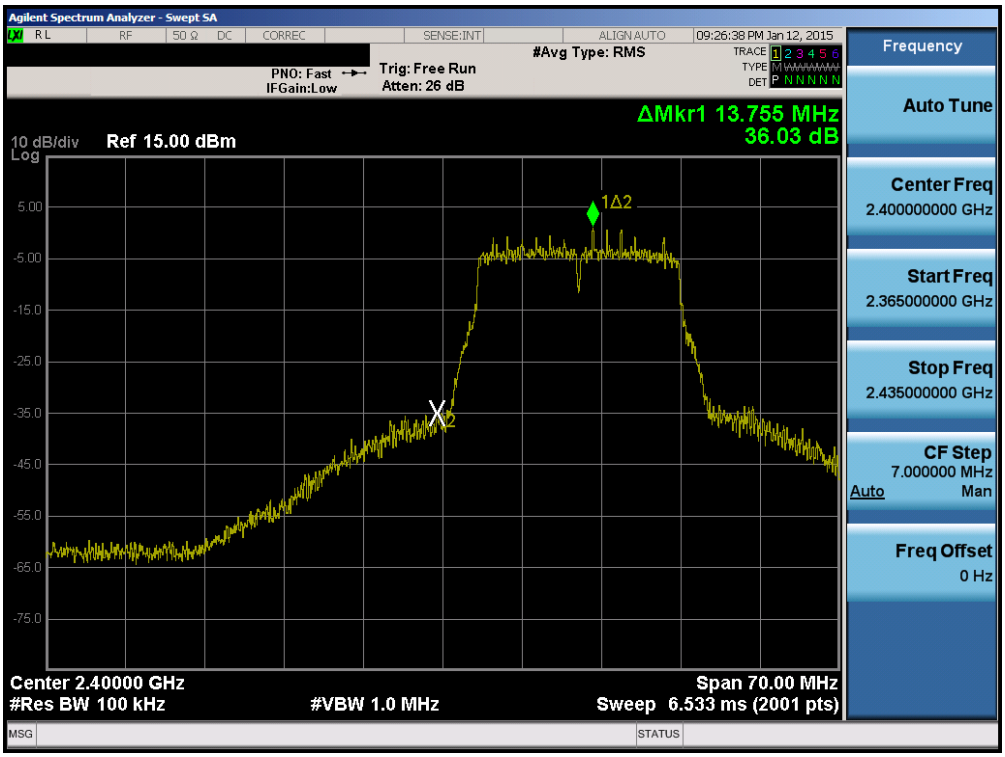
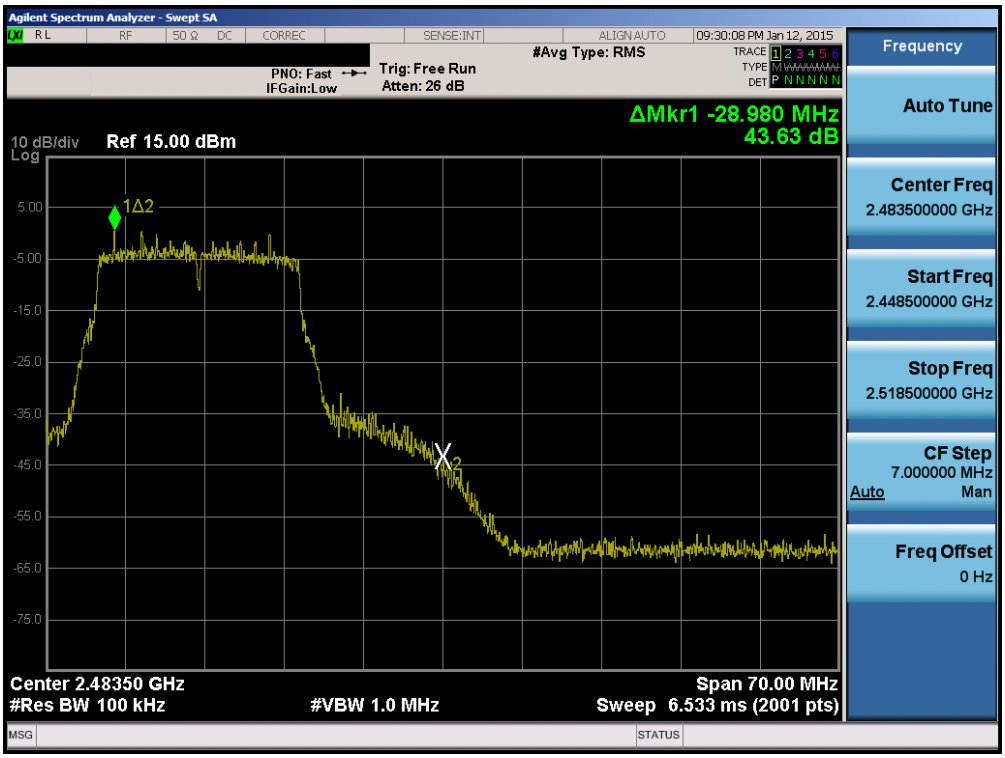


Plot 6-41. Band Edge Plot (802.11n (2.4GHz) – Ch. 1)



Plot 6-42. Band Edge Plot (802.11n (2.4GHz) – Ch. 11)

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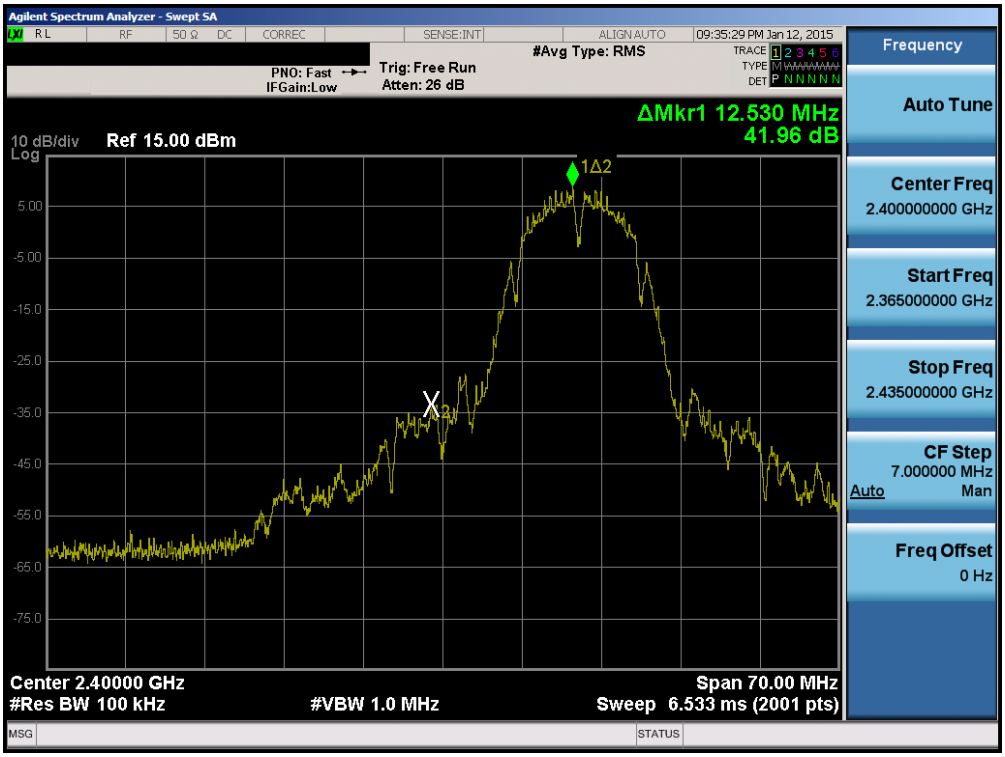
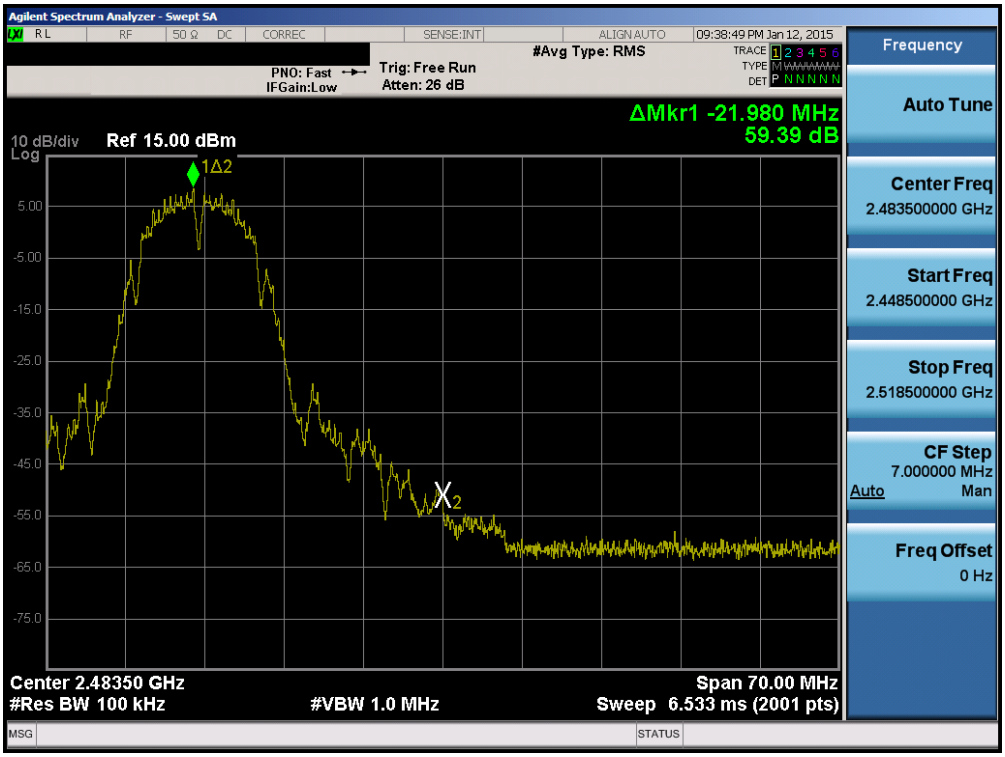
Antenna-2 Conducted Emissions at the Band Edge



Plot 6-43. Band Edge Plot (802.11b – Ch. 1)



Plot 6-44. Band Edge Plot (802.11b – Ch. 11)

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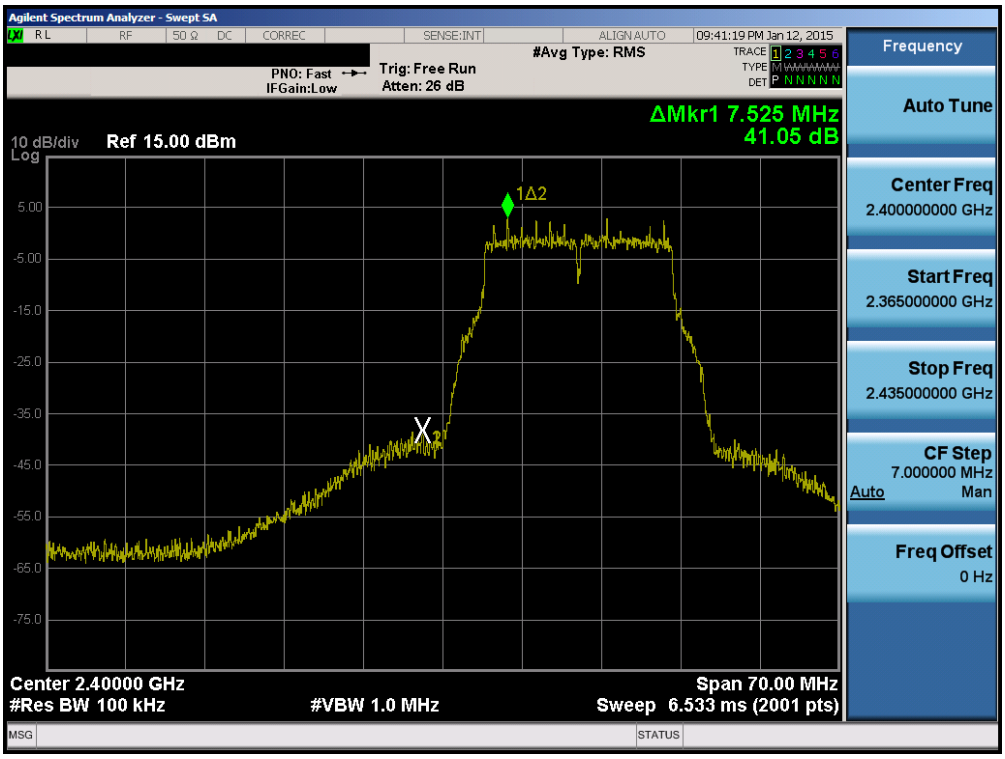
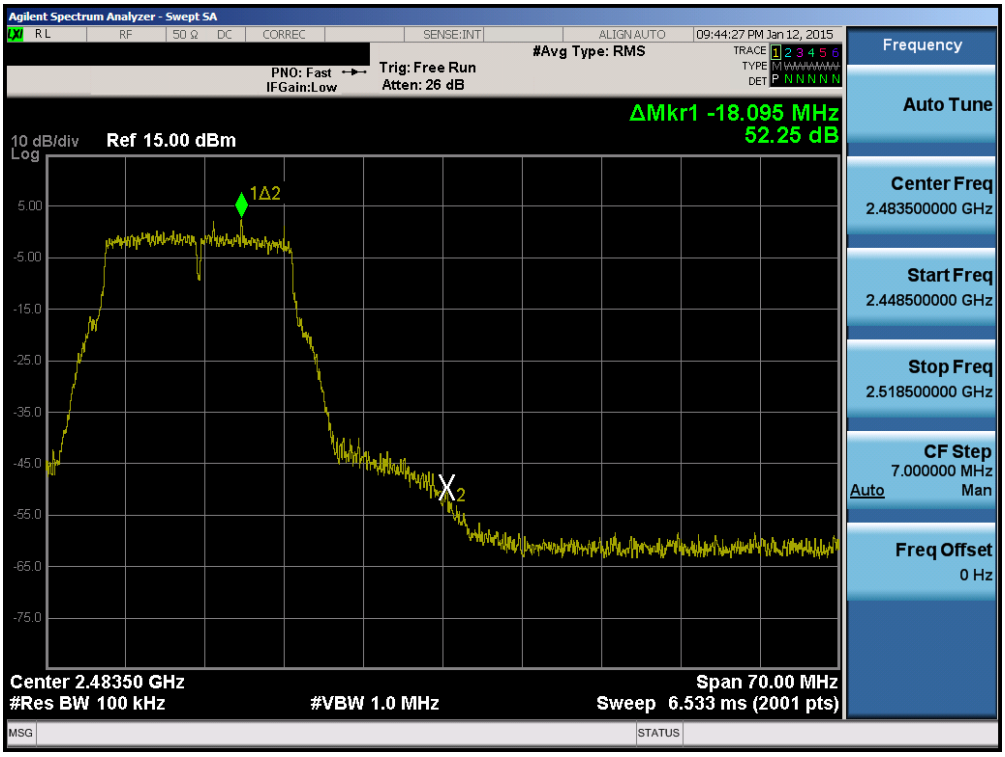


Plot 6-45. Band Edge Plot (802.11g– Ch. 1)



Plot 6-46. Band Edge Plot (802.11g – Ch. 11)

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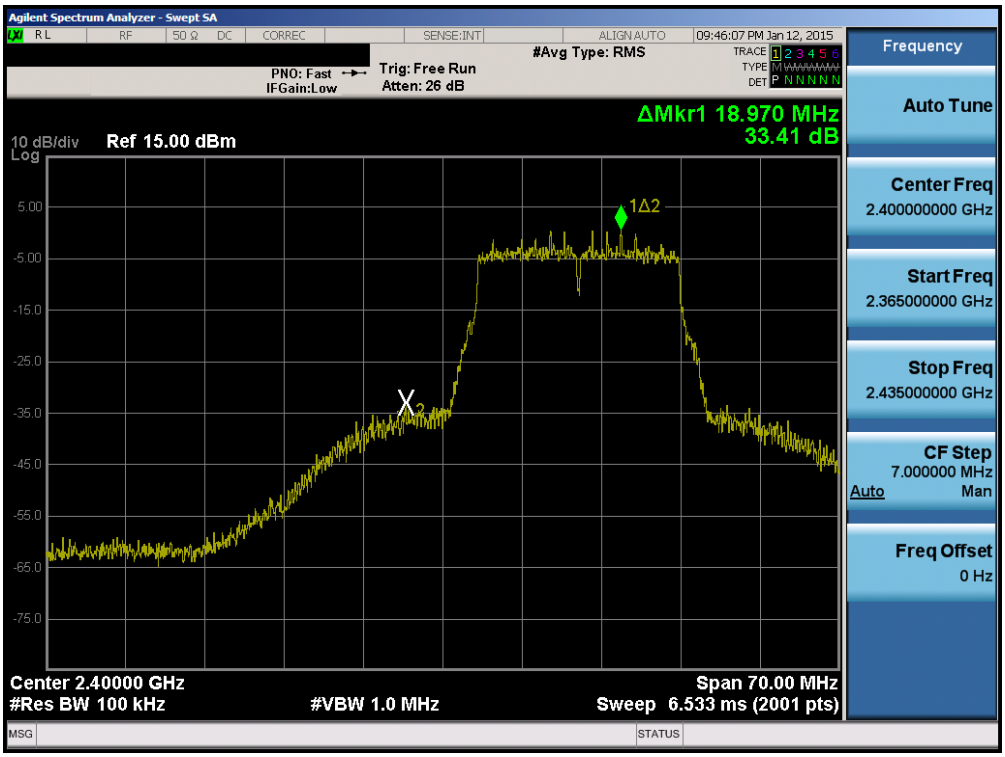
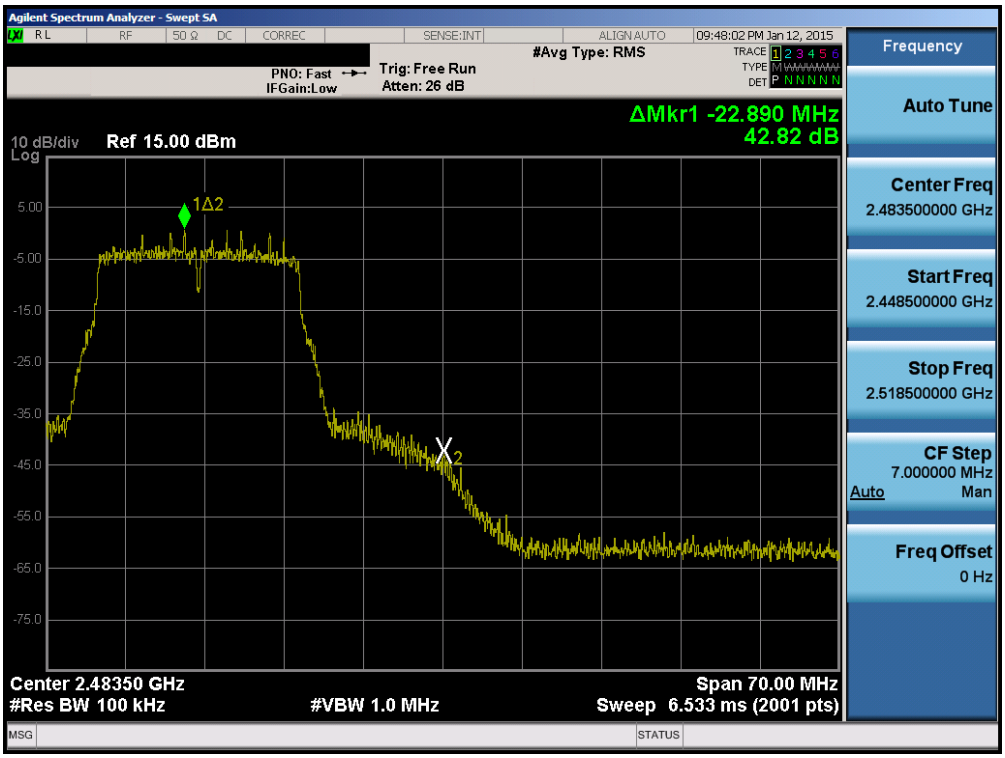


Plot 6-47. Band Edge Plot (802.11n (2.4GHz) – Ch. 1)



Plot 6-48. Band Edge Plot (802.11n (2.4GHz) – Ch. 11)

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6.6 Conducted Spurious Emissions

§15.247(d)

Test Overview and Limit

All out of band emissions are 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 to determine the worst case configuration. For the following out of band conducted spurious emissions plots, the EUT was investigated in all available data rates for "b", "g", and "n" modes. The worst case spurious emissions for the 2.4GHz band were found while transmitting in "b" mode at 1 Mbps and are shown in the plots below.

The limit for out-of-band spurious emissions at the band edge is 30dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100kHz bandwidth per the procedure in Section 11.1 of KDB 558074 v03r02.

Test Procedure Used

KDB 558074 v03r02 – Section 11.3
KDB 662911 v02r01 – Section E)3)b)

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 25GHz (separated into two plots per channel)
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = Peak
5. Trace mode = max hold
6. Sweep time = 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.

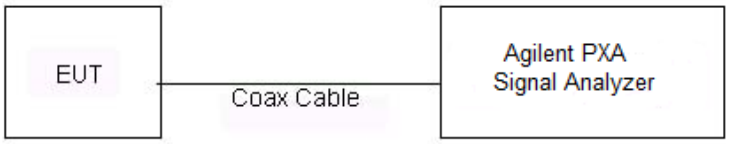

Figure 6-5. Test Instrument & Measurement Setup

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Test Notes

1. RBW was set to 1MHz rather than 100kHz in order to increase the measurement speed.

2. The display line shown in the following plots denotes the limit at 30dB below the fundamental emission level measured in a 100kHz bandwidth. However, since the traces in the following plots are measured with a 1MHz RBW, the display line may not necessarily appear to be 30dB below the level of the fundamental in a 1MHz bandwidth.

3. For plots showing conducted spurious emissions near the limit, the frequencies were investigated with a reduced RBW to ensure that no emissions were present.

4. The conducted spurious emissions were measured to relative limits. Therefore, in accordance with KDB 662911 v02r01 Section E)3)b), it was unnecessary to show compliance through the summation of test results of the individual outputs.

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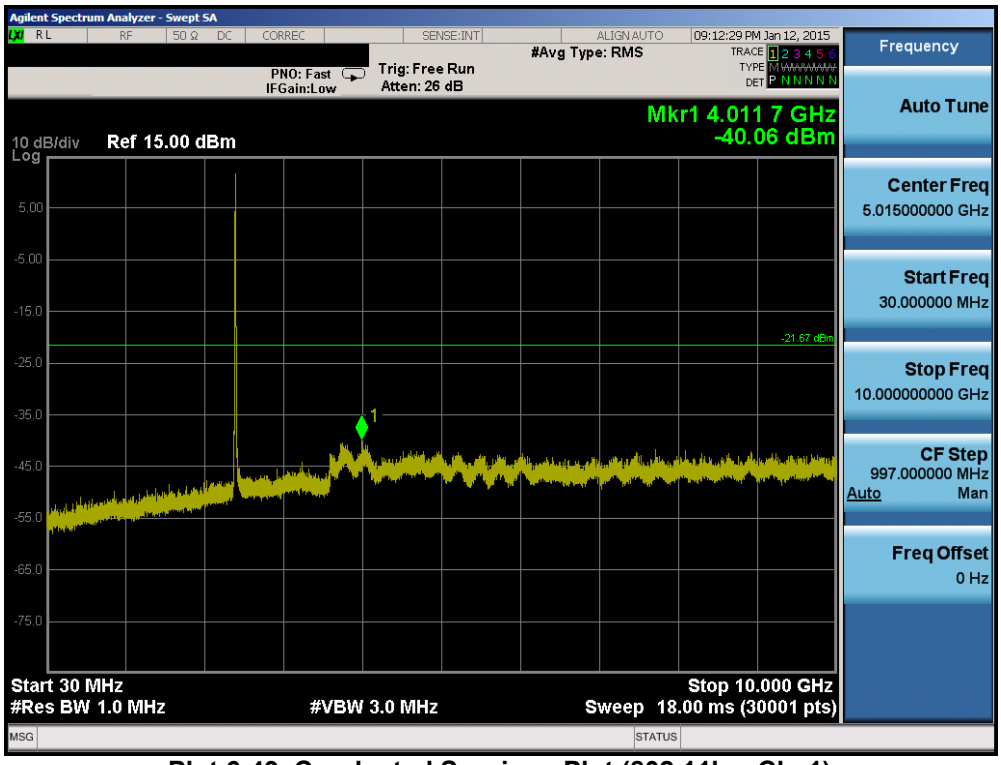
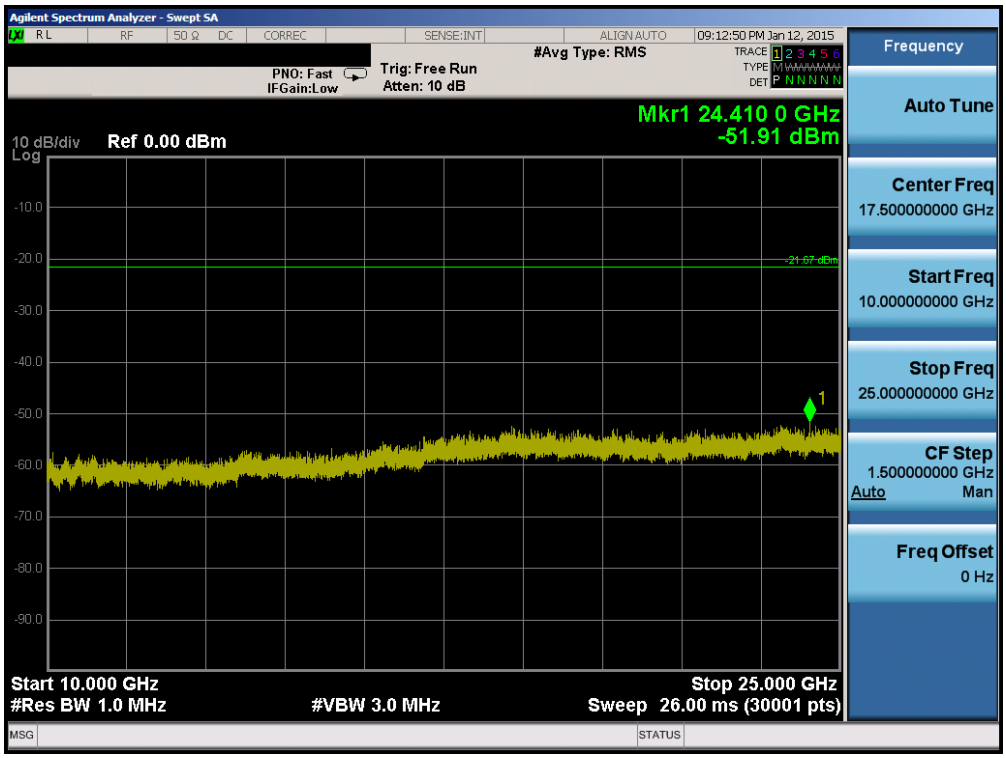
Antenna-1 Conducted Spurious Emissions



Plot 6-49. Conducted Spurious Plot (802.11b – Ch. 1)



Plot 6-50. Conducted Spurious Plot (802.11b – Ch. 1)

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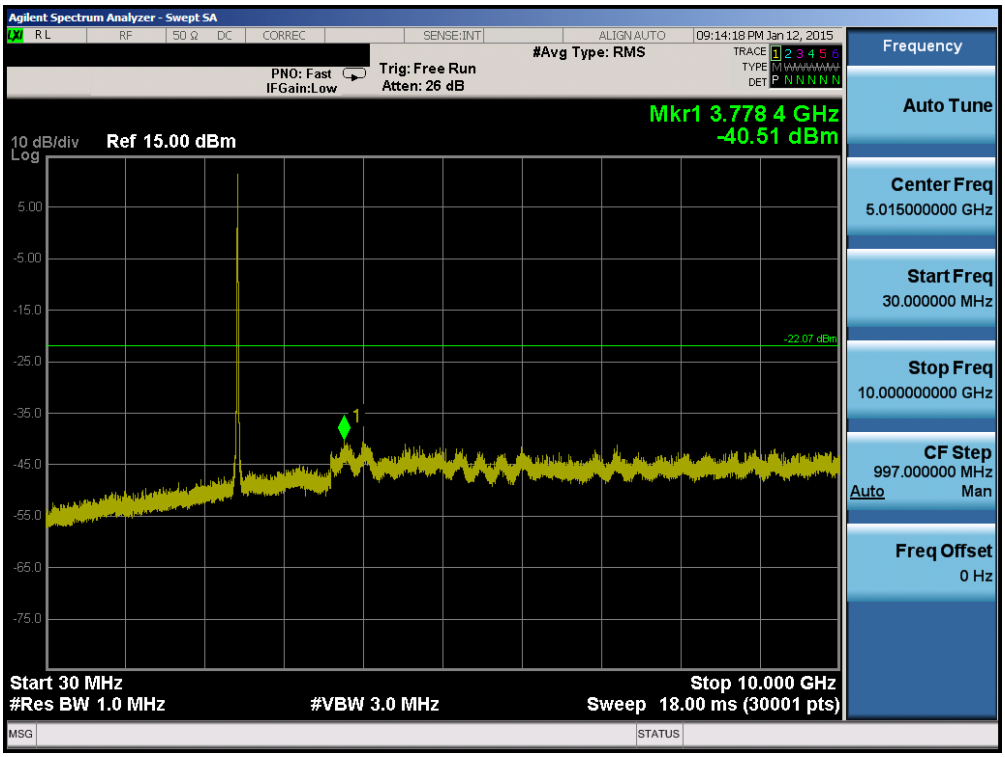
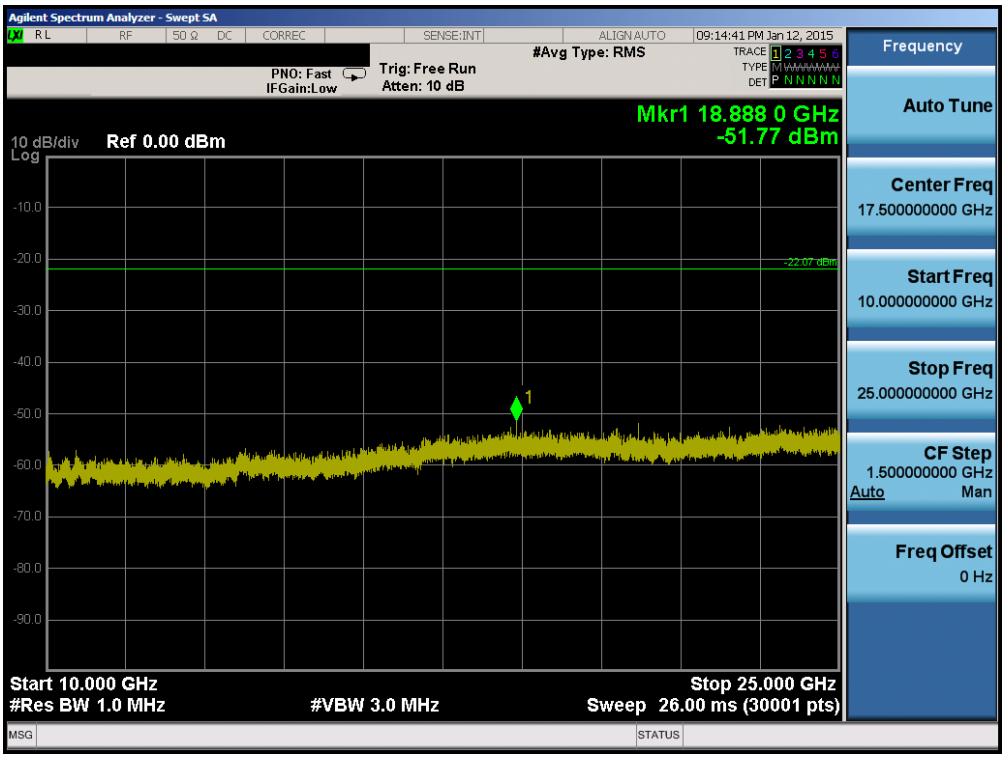


Plot 6-51. Conducted Spurious Plot (802.11b – Ch. 6)



Plot 6-52. Conducted Spurious Plot (802.11b – Ch. 6)

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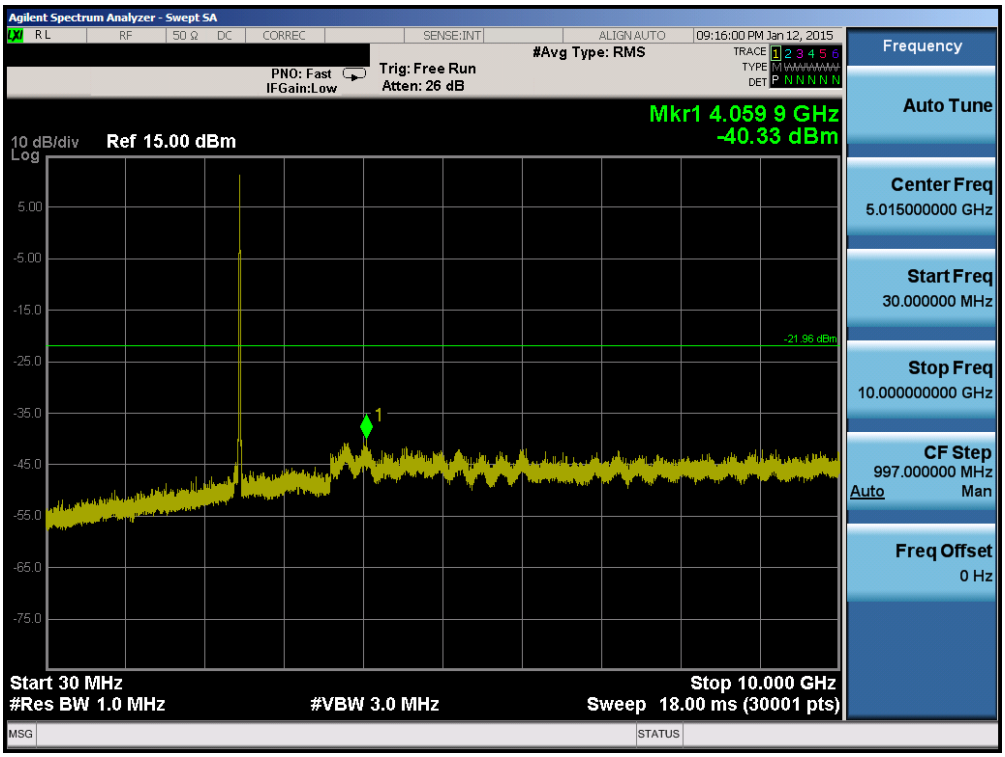
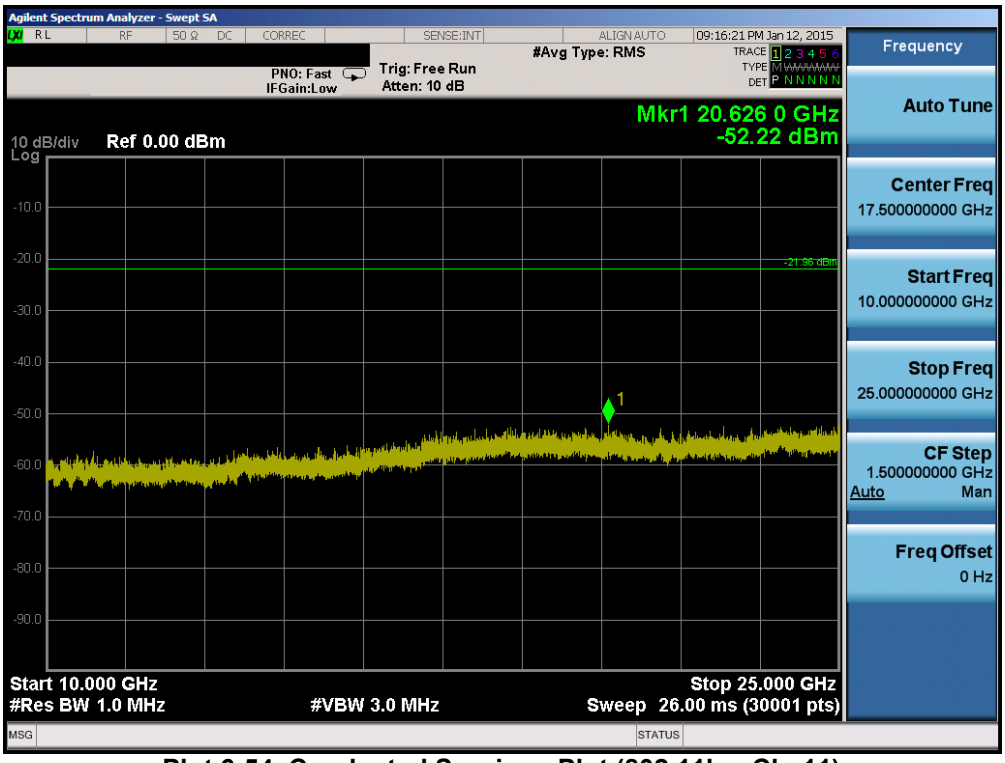


Plot 6-53. Conducted Spurious Plot (802.11b – Ch. 11)



Plot 6-54. Conducted Spurious Plot (802.11b – Ch. 11)

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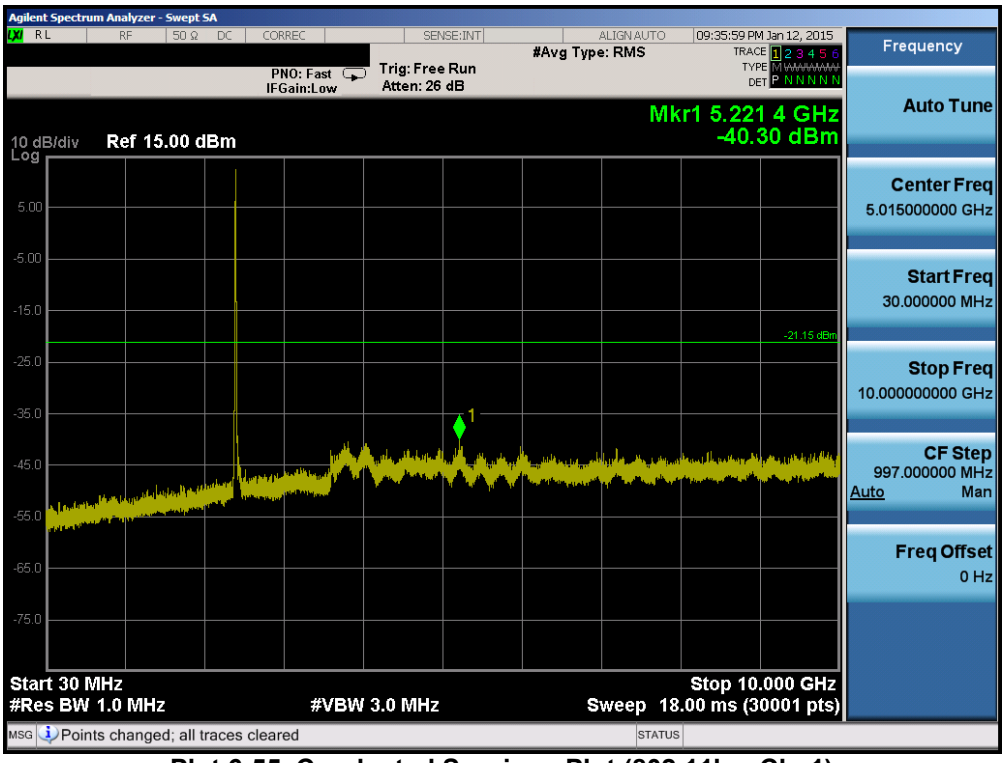
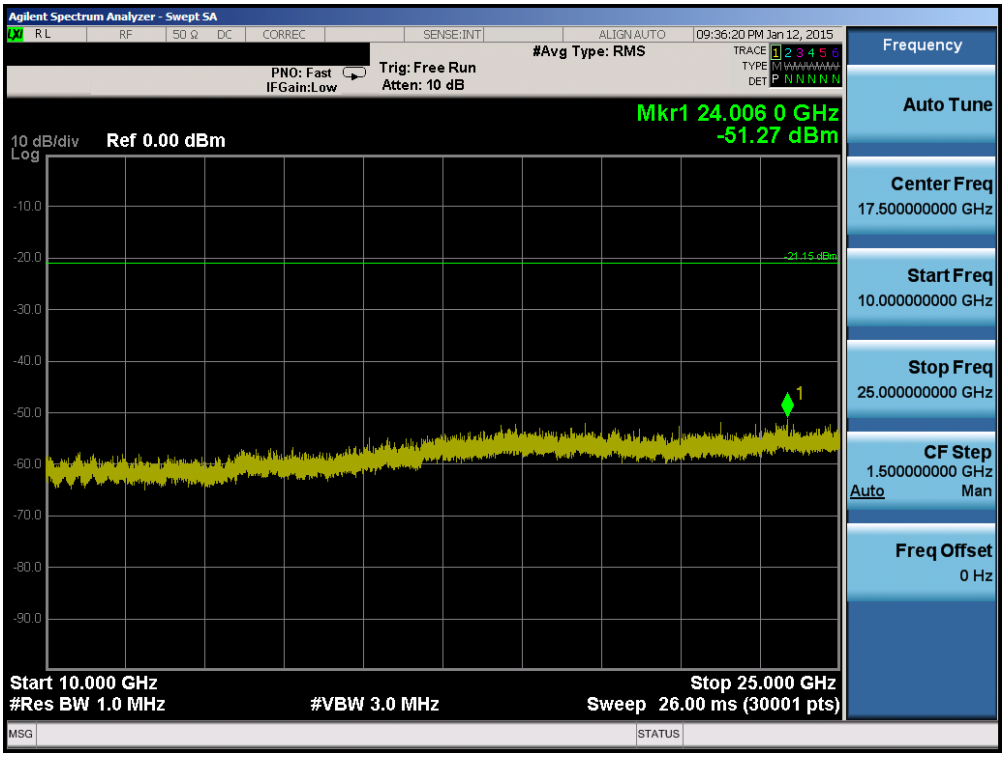
Antenna-2 Conducted Spurious Emissions



Plot 6-55. Conducted Spurious Plot (802.11b – Ch. 1)



Plot 6-56. Conducted Spurious Plot (802.11b – Ch. 1)

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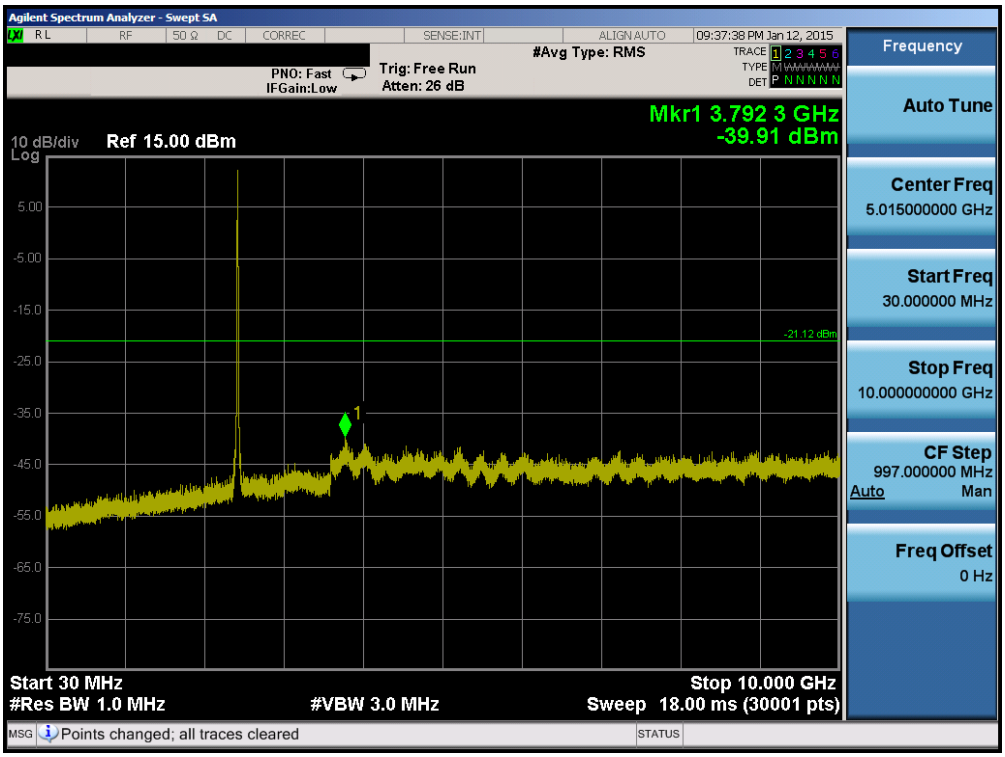
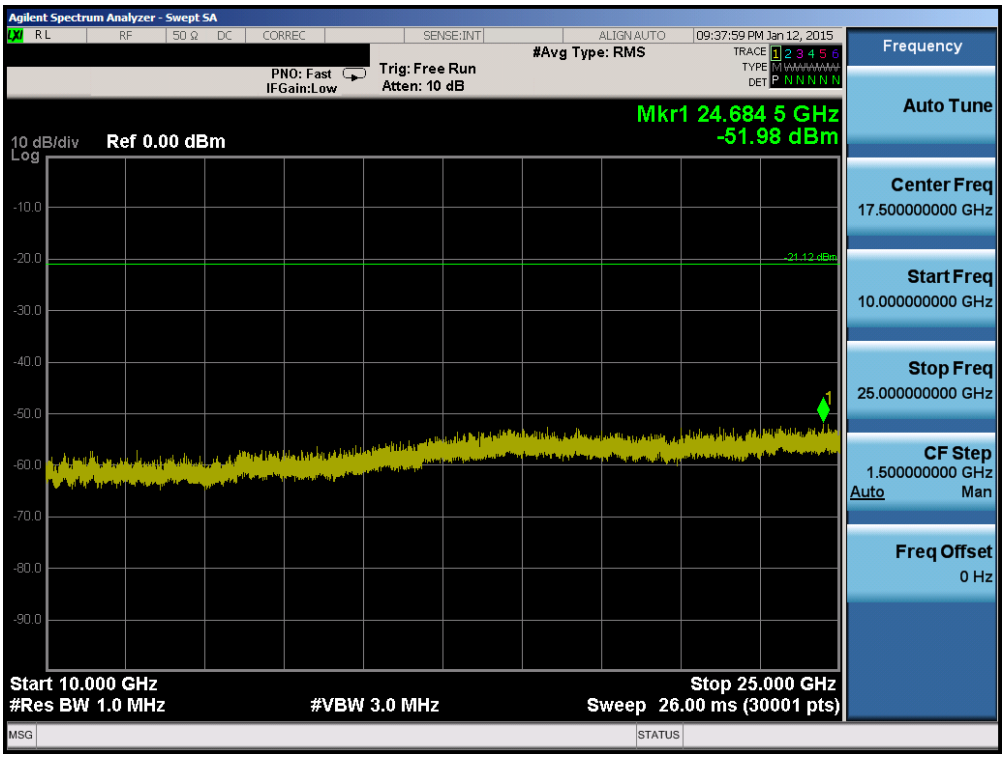


Plot 6-57. Conducted Spurious Plot (802.11b – Ch. 6)



Plot 6-58. Conducted Spurious Plot (802.11b – Ch. 6)

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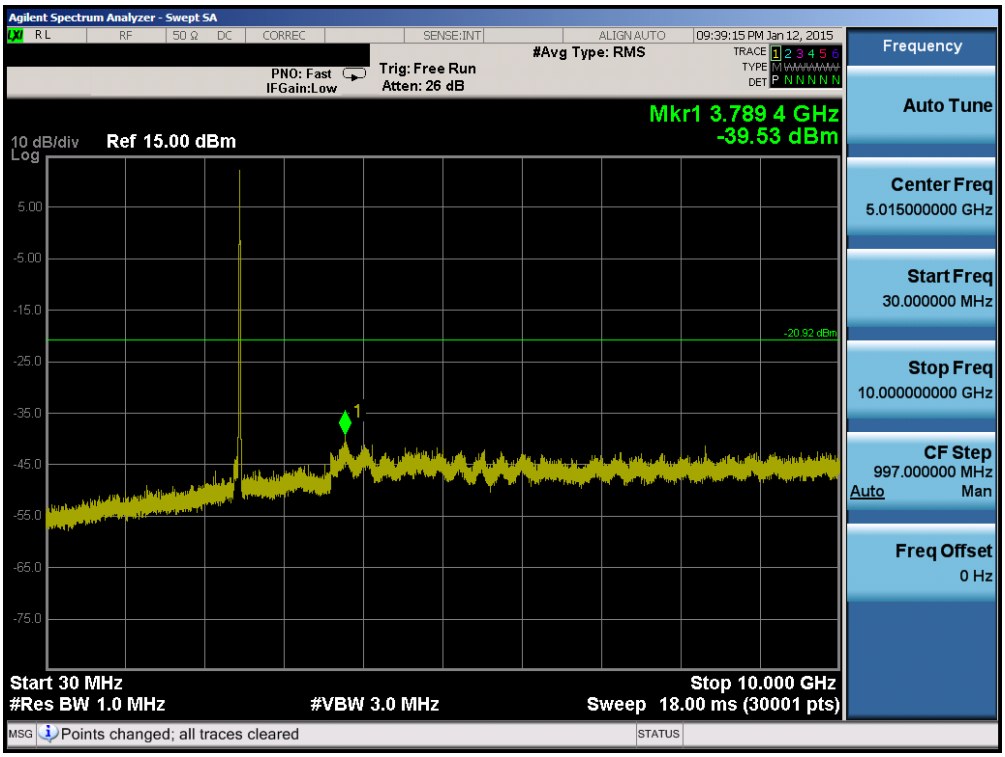
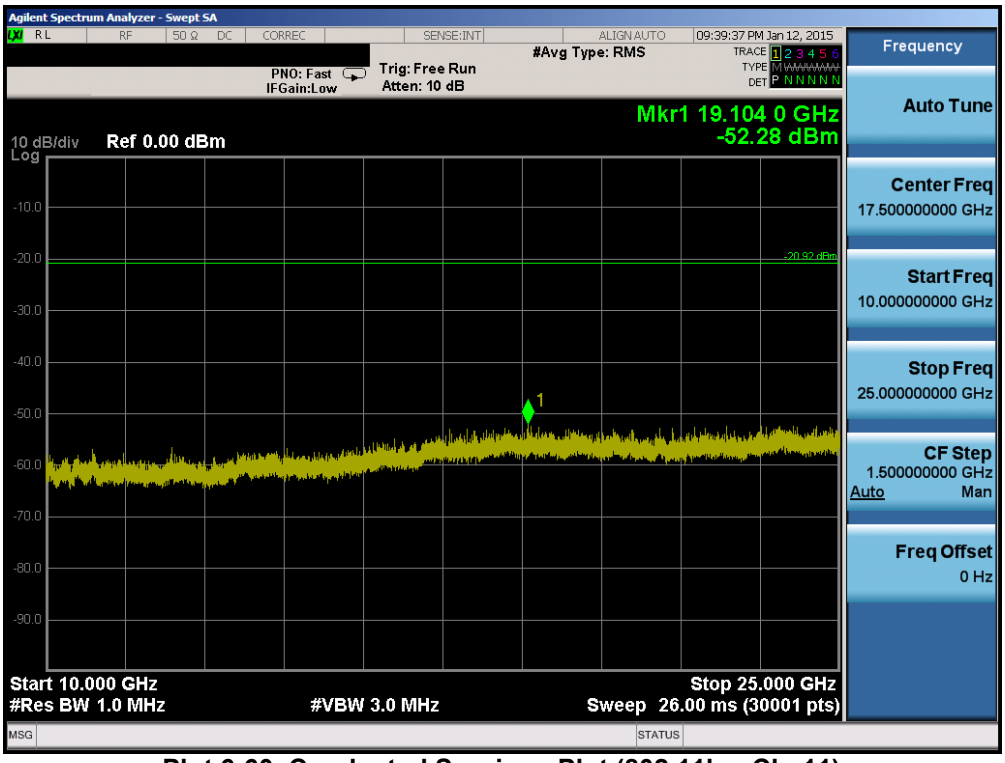


Plot 6-59. Conducted Spurious Plot (802.11b – Ch. 11)



Plot 6-60. Conducted Spurious Plot (802.11b – Ch. 11)

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6.7 Radiated Spurious Emission Measurements – Above 1 GHz

§15.247(d) §15.205 & §15.209

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at its maximum duty cycle (>98%), at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Table 6-10 per Section 15.209.

Frequency	Field Strength [μV/m]	Measured Distance [Meters]
Above 960.0 MHz	500	3

Table 6-10. Radiated Limits

Test Procedures Used

KDB 558074 v03r02 – Section 12.1, 12.2.7

Test Settings

Average Field Strength Measurements per Section 12.2.5.1 of KDB 558074 v03r02

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = power average (RMS)
5. Number of measurement points = 1001 (Number of points must be ≥ 2 x span/RBW)
6. Sweep time = auto
7. Trace (RMS) averaging was performed over at least 100 traces

Peak Field Strength Measurements per Section 12.2.4 of KDB 558074 v03r02

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

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Test Setup

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

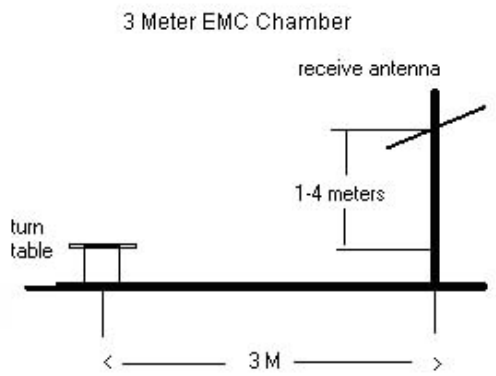

Figure 6-6. Test Instrument & Measurement Setup

Test Notes

1. The optional test procedures for antenna port conducted measurements of unwanted emissions per the guidance of KDB 558074 v03r02 were not used to evaluate this device for compliance to radiated limits. All radiated spurious emissions levels were measured in a radiated test setup.
2. All emissions lying in restricted bands specified in §15.205 are below the limit shown in Table 6-10.
3. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
4. The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1GHz. Above 1 GHz, average and peak measurements were taken using linearly polarized horn antennas. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.
5. Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.
6. Radiated spurious emissions were investigated while operating in MIMO mode, however, it was determined that single antenna operation produced the worst case emissions. Since the emissions produced from MIMO operation were found to be more than 20dB below the limit, the MIMO emissions are not reported.
7. Radiated spurious emissions pre-scan plots are also reported at the beginning of the next section. The plots apply the appropriate system corrections, however, they do not show the fully maximized spectrum. The plots are only included for the purposes of identifying spurious emissions requiring further investigation. Rohde & Schwarz EMC32, Version 9.15.00 automated test software was used to perform the Radiated Spurious Emissions Pre-Scan testing.

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Sample Calculations

Determining Spurious Emissions Levels

- Field Strength Level $_{[dB\mu V/m]}$ = Analyzer Level $_{[dBm]}$ + 107 + AFCL $_{[dB/m]}$
- AFCL $_{[dB/m]}$ = Antenna Factor $_{[dB/m]}$ + Cable Loss $_{[dB]}$
- Margin $_{[dB]}$ = Field Strength Level $_{[dB\mu V/m]}$ – Limit $_{[dB\mu V/m]}$

Radiated Band Edge Measurement Offset

- The amplitude offset shown in the radiated restricted band edge plots in Section 6.8 was calculated using the formula:
  Offset (dB) = (Antenna Factor + Cable Loss + 10 dB Attenuator) – Preamplifier Gain

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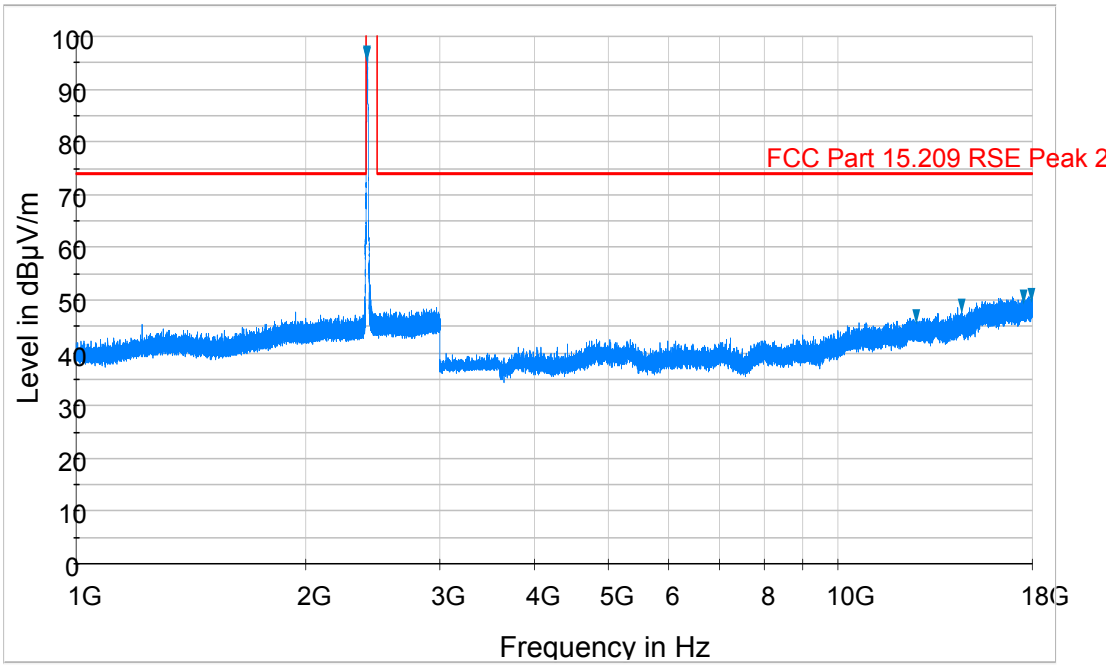
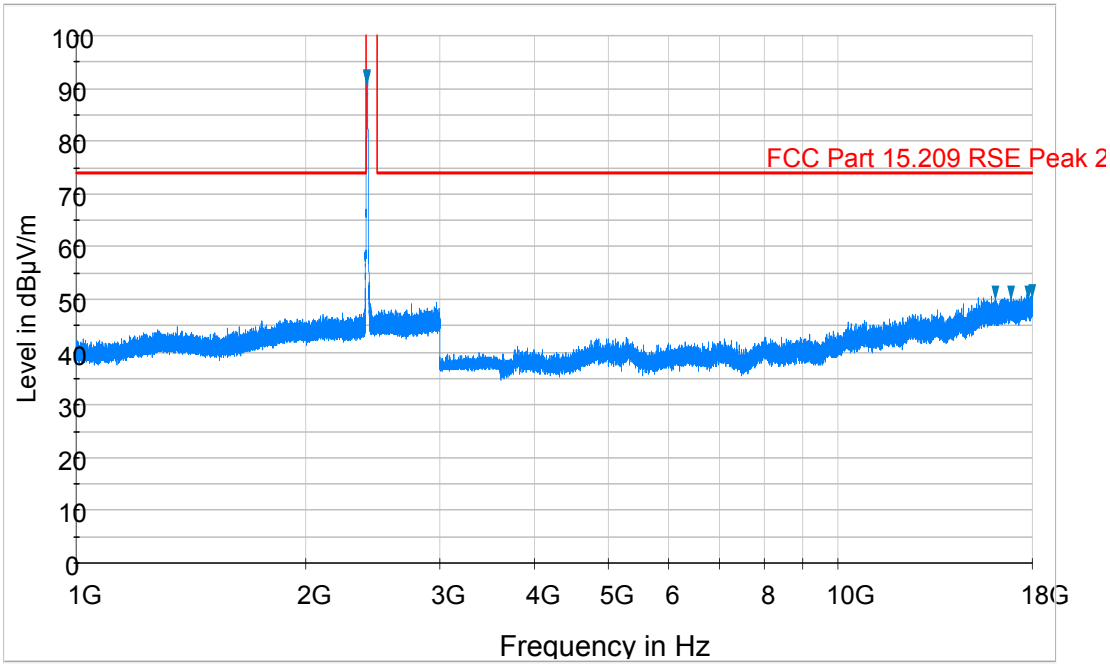
6.7.1 Antenna-1 Radiated Spurious Emission Measurements

§15.247(d) §15.205 & §15.209



Plot 6-61. Radiated Spurious Plot above 1GHz (802.11b – Ch. 1, Ant. Pol. H)



Plot 6-62. Radiated Spurious Plot above 1GHz (802.11b – Ch. 1, Ant. Pol. V)

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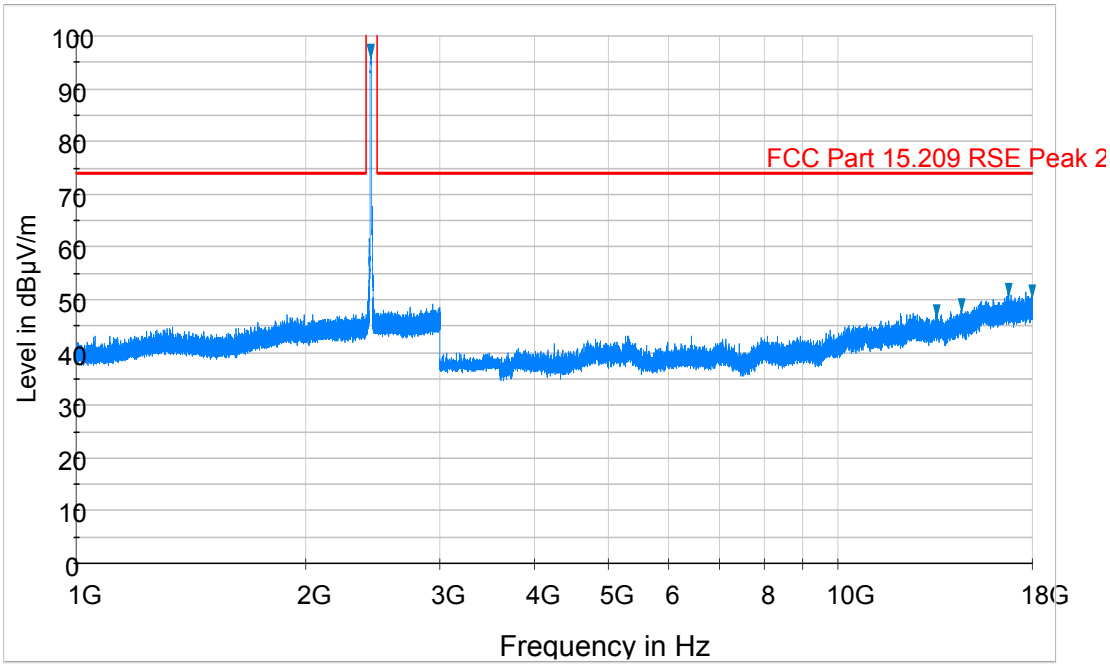
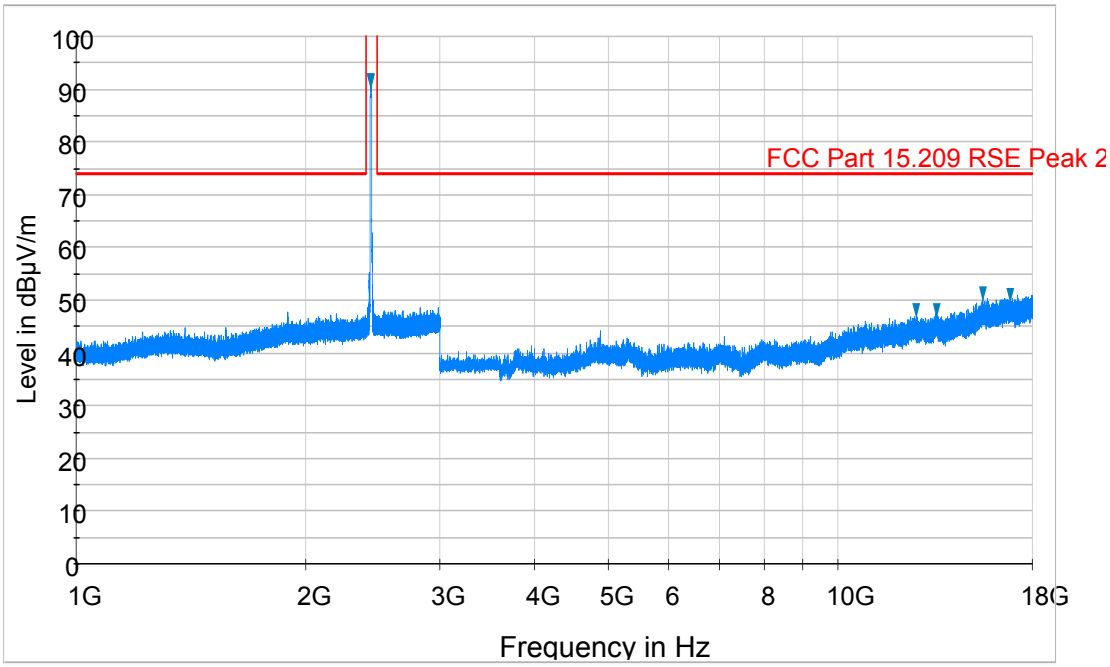


Plot 6-63. Radiated Spurious Plot above 1GHz (802.11b – Ch. 6, Ant. Pol. H)



Plot 6-64. Radiated Spurious Plot above 1GHz (802.11b – Ch. 6, Ant. Pol. V)

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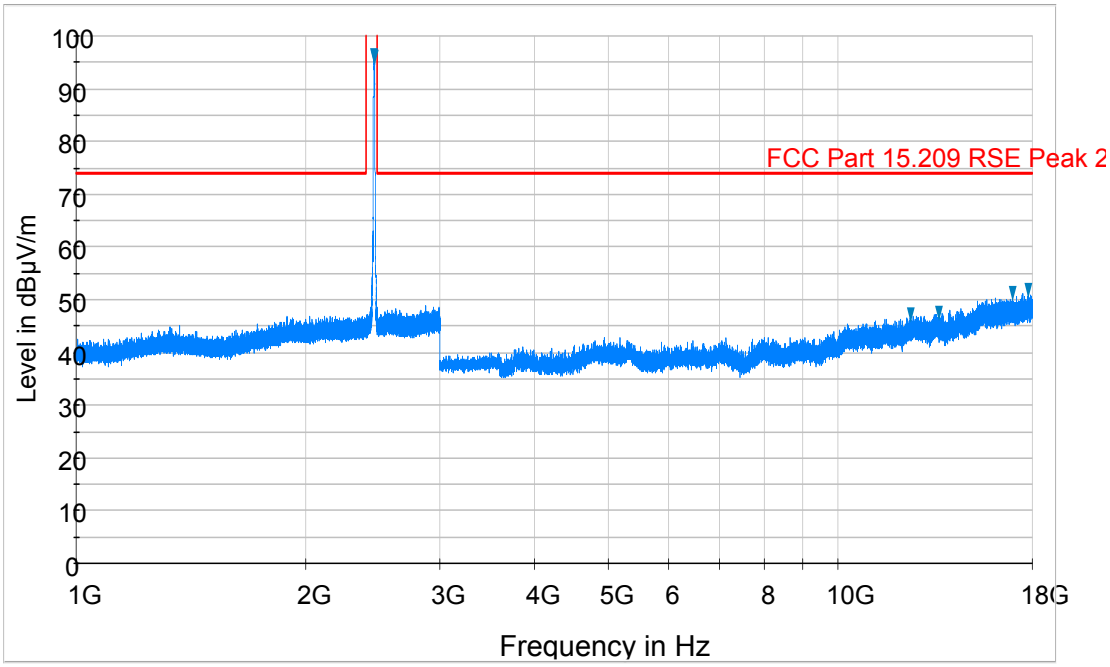
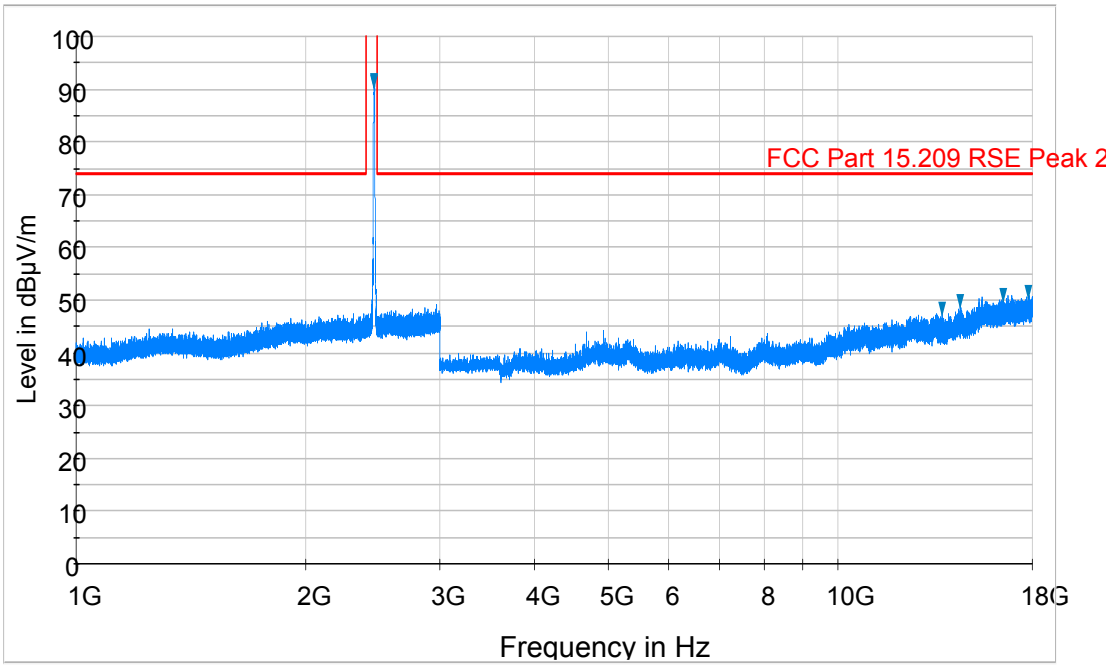


Plot 6-65. Radiated Spurious Plot above 1GHz (802.11b – Ch. 11, Ant. Pol. H)



Plot 6-66. Radiated Spurious Plot above 1GHz (802.11b – Ch. 11, Ant. Pol. V)

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Antenna-1 Radiated Spurious Emission Measurements

§15.247(d) §15.205 & §15.209

Worst Case Mode: 802.11b
Worst Case Transfer Rate: 1 Mbps
Distance of Measurements: 3 Meters
Operating Frequency: 2412MHz
Channel: 01

Frequency [MHz]	Analyzer Level [dBm]	Detector	Ant. Pol. [H/V]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4824.00	-108.47	Avg	H	40.56	39.09	53.98	-14.89
4824.00	-100.65	Peak	H	40.56	46.91	73.98	-27.07
12060.00	-113.94	Avg	H	46.44	39.50	53.98	-14.48
12060.00	-103.58	Peak	H	46.44	49.86	73.98	-24.12

Table 6-11. Radiated Measurements

Worst Case Mode: 802.11b
Worst Case Transfer Rate: 1 Mbps
Distance of Measurements: 3 Meters
Operating Frequency: 2437MHz
Channel: 06

Frequency [MHz]	Analyzer Level [dBm]	Detector	Ant. Pol. [H/V]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4874.00	-108.22	Avg	H	40.57	39.35	53.98	-14.63
4874.00	-100.54	Peak	H	40.57	47.03	73.98	-26.95
7311.00	-106.96	Avg	H	42.89	42.93	53.98	-11.05
7311.00	-98.93	Peak	H	42.89	50.96	73.98	-23.02
12185.00	-115.41	Avg	H	46.56	38.15	53.98	-15.83
12185.00	-104.22	Peak	H	46.56	49.34	73.98	-24.64

Table 6-12. Radiated Measurements

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Worst Case Mode: 802.11b
Worst Case Transfer Rate: 1 Mbps
Distance of Measurements: 3 Meters
Operating Frequency: 2462MHz
Channel: 11

Frequency [MHz]	Analyzer Level [dBm]	Detector	Ant. Pol. [H/V]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4924.00	-111.28	Avg	H	40.56	36.28	53.98	-17.70
4924.00	-102.24	Peak	H	40.56	45.32	73.98	-28.66
7386.00	-110.54	Avg	H	42.98	39.44	53.98	-14.54
7386.00	-101.59	Peak	H	42.98	48.39	73.98	-25.59
12310.00	-115.79	Avg	H	46.72	37.93	53.98	-16.05
12310.00	-104.28	Peak	H	46.72	49.44	73.98	-24.54

Table 6-13. Radiated Measurements

Worst Case Mode: 802.11b
Worst Case Transfer Rate: 1 Mbps
Distance of Measurements: 3 Meters
Operating Frequency: 2437MHz
Channel: 06

Frequency [MHz]	Analyzer Level [dBm]	Detector	Ant. Pol. [H/V]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4874.00	-107.76	Avg	H	40.57	39.81	53.98	-14.17
4874.00	-100.60	Peak	H	40.57	46.97	73.98	-27.01
7311.00	-107.63	Avg	H	42.89	42.26	53.98	-11.72
7311.00	-98.63	Peak	H	42.89	51.26	73.98	-22.72
12185.00	-114.75	Avg	H	46.56	38.81	53.98	-15.17
12185.00	-104.74	Peak	H	46.56	48.82	73.98	-25.16

Table 6-14. Radiated Measurements (with WCP)

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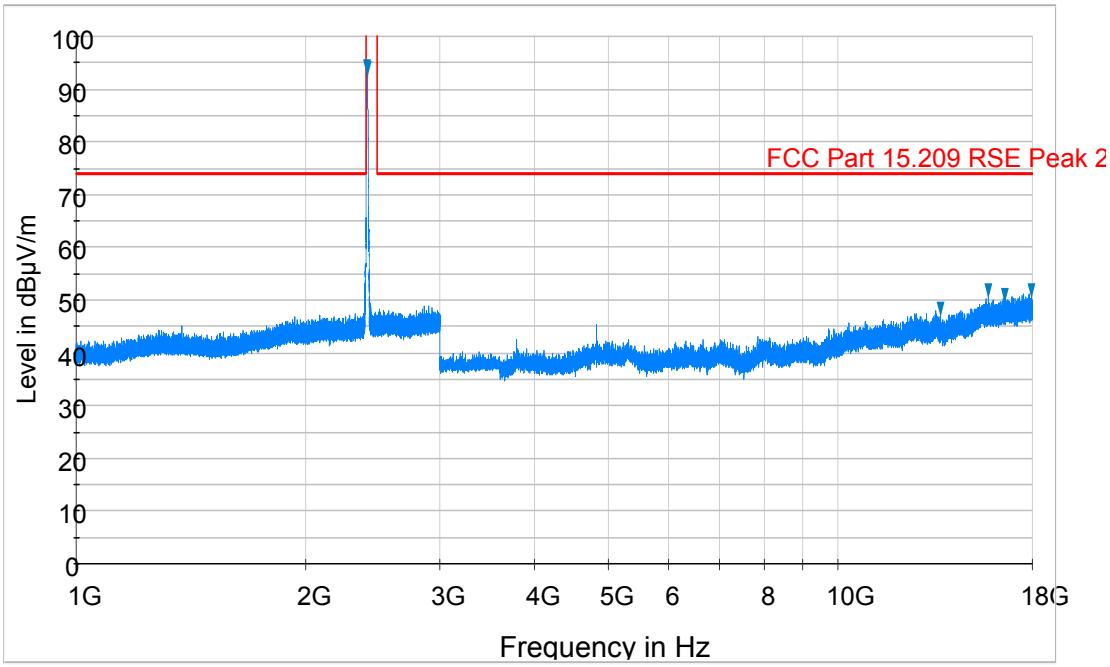
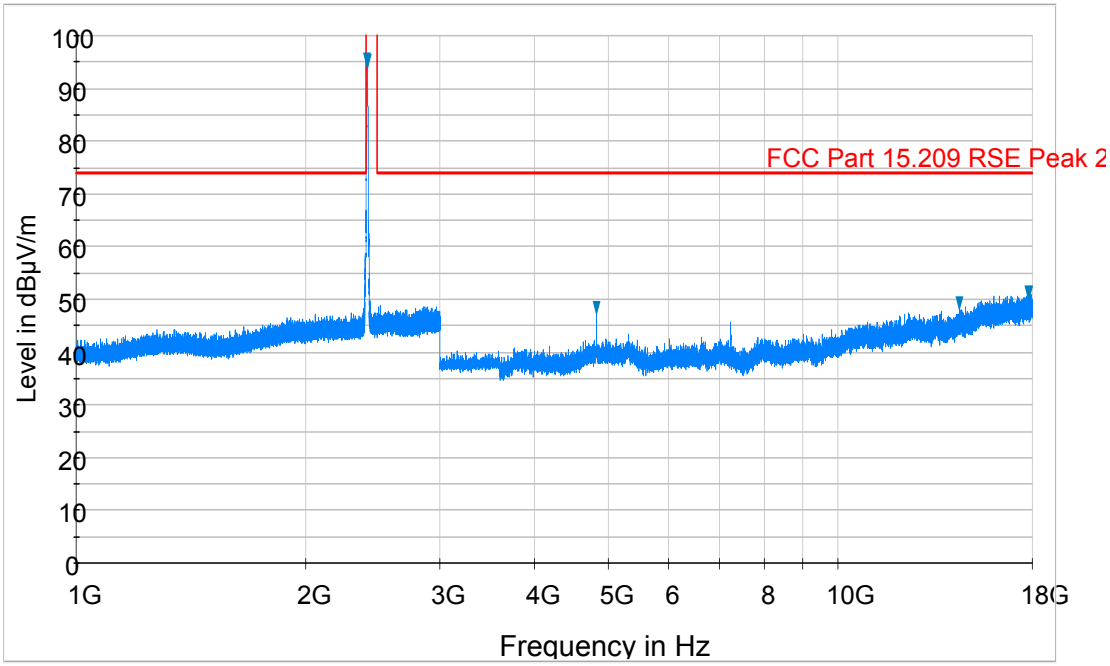
6.7.2 Antenna-2 Radiated Spurious Emission Measurements

§15.247(d) §15.205 & §15.209

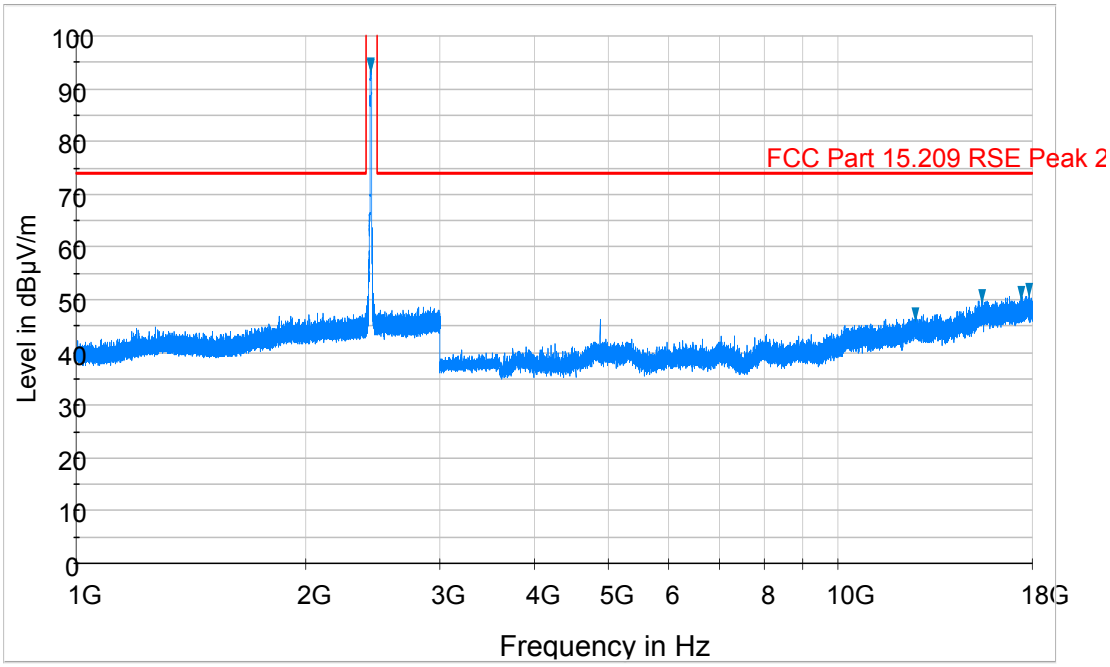


Plot 6-67. Radiated Spurious Plot above 1GHz (802.11b – Ch. 1, Ant. Pol. H)

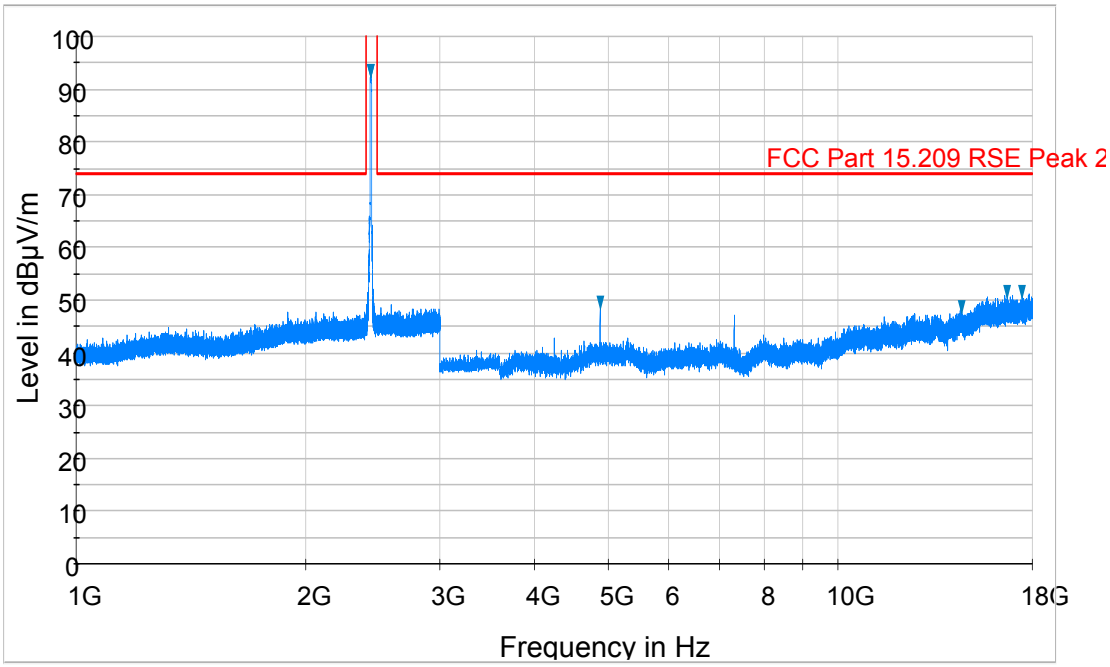


Plot 6-68. Radiated Spurious Plot above 1GHz (802.11b – Ch. 1, Ant. Pol. V)

© 2015 PCTEST Engineering Laboratory, Inc.



Plot 6-69. Radiated Spurious Plot above 1GHz (802.11b – Ch. 6, Ant. Pol. H)



Plot 6-70. Radiated Spurious Plot above 1GHz (802.11b – Ch. 6, Ant. Pol. V)

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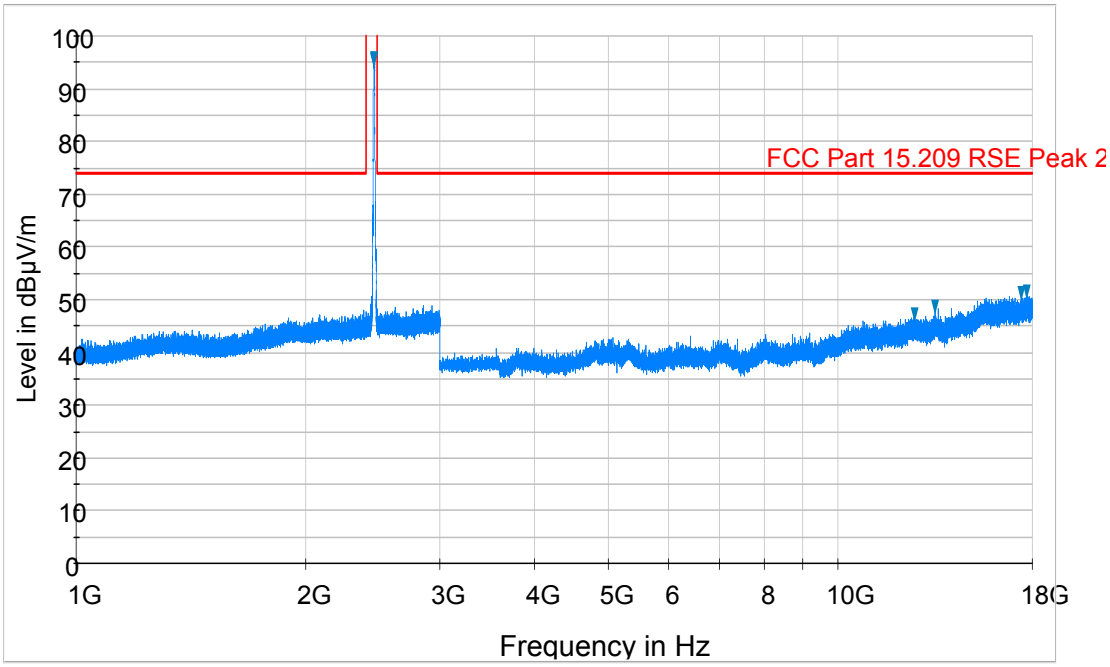
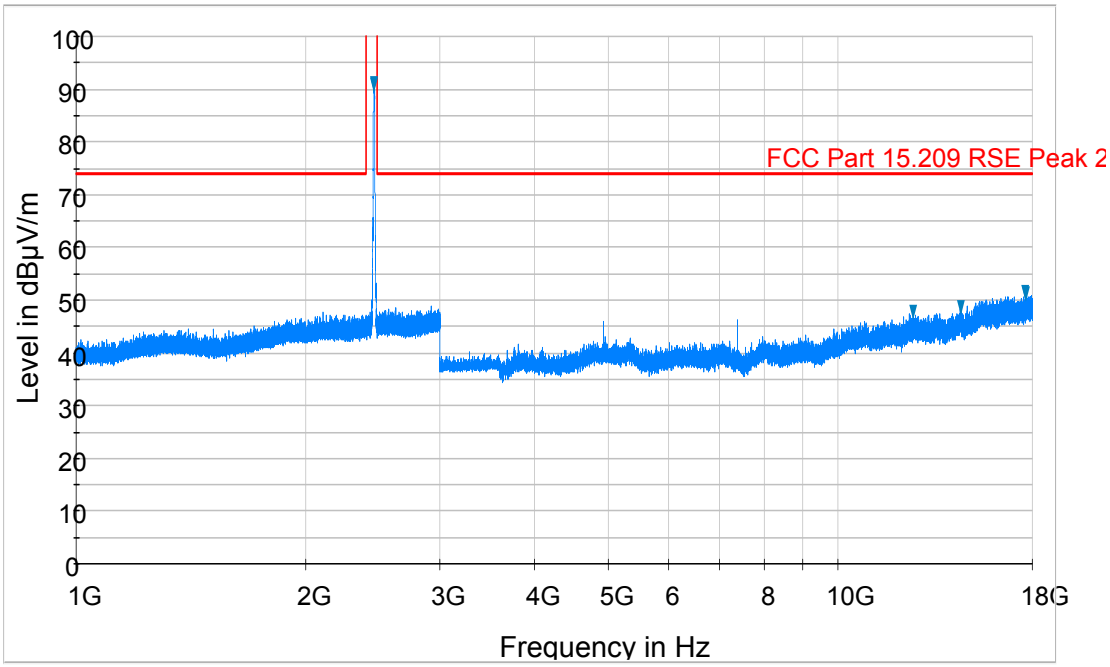


Plot 6-71. Radiated Spurious Plot above 1GHz (802.11b – Ch. 11, Ant. Pol. H)



Plot 6-72. Radiated Spurious Plot above 1GHz (802.11b – Ch. 11, Ant. Pol. V)

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Antenna-2 Radiated Spurious Emission Measurements

§15.247(d) §15.205 & §15.209

Worst Case Mode: 802.11b
Worst Case Transfer Rate: 1 Mbps
Distance of Measurements: 3 Meters
Operating Frequency: 2412MHz
Channel: 01

Frequency [MHz]	Analyzer Level [dBm]	Detector	Ant. Pol. [H/V]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4824.00	-102.11	Avg	H	40.56	45.45	53.98	-8.53
4824.00	-96.89	Peak	H	40.56	50.67	73.98	-23.31
12060.00	-113.32	Avg	H	46.44	40.12	53.98	-13.86
12060.00	-102.81	Peak	H	46.44	50.63	73.98	-23.35

Table 6-15. Radiated Measurements

Worst Case Mode: 802.11b
Worst Case Transfer Rate: 1 Mbps
Distance of Measurements: 3 Meters
Operating Frequency: 2437MHz
Channel: 06

Frequency [MHz]	Analyzer Level [dBm]	Detector	Ant. Pol. [H/V]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4874.00	-99.60	Avg	H	40.57	47.97	53.98	-6.01
4874.00	-94.74	Peak	H	40.57	52.83	73.98	-21.15
7311.00	-106.04	Avg	H	42.89	43.85	53.98	-10.13
7311.00	-99.04	Peak	H	42.89	50.85	73.98	-23.13
12185.00	-115.54	Avg	H	46.56	38.02	53.98	-15.96
12185.00	-103.83	Peak	H	46.56	49.73	73.98	-24.25

Table 6-16. Radiated Measurements

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Worst Case Mode: 802.11b
Worst Case Transfer Rate: 1 Mbps
Distance of Measurements: 3 Meters
Operating Frequency: 2462MHz
Channel: 11

Frequency [MHz]	Analyzer Level [dBm]	Detector	Ant. Pol. [H/V]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4924.00	-103.41	Avg	H	40.56	44.15	53.98	-9.83
4924.00	-98.65	Peak	H	40.56	48.91	73.98	-25.07
7386.00	-108.14	Avg	H	42.98	41.84	53.98	-12.14
7386.00	-98.59	Peak	H	42.98	51.39	73.98	-22.59
12310.00	-115.52	Avg	H	46.72	38.20	53.98	-15.78
12310.00	-104.01	Peak	H	46.72	49.71	73.98	-24.27

Table 6-17. Radiated Measurements

Worst Case Mode: 802.11b
Worst Case Transfer Rate: 1 Mbps
Distance of Measurements: 3 Meters
Operating Frequency: 2437MHz
Channel: 06

Frequency [MHz]	Analyzer Level [dBm]	Detector	Ant. Pol. [H/V]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4874.00	-106.49	Avg	H	40.57	41.08	53.98	-12.90
4874.00	-100.13	Peak	H	40.57	47.44	73.98	-26.54
7311.00	-111.13	Avg	H	42.89	38.76	53.98	-15.22
7311.00	-106.13	Peak	H	42.89	43.76	73.98	-30.22
12185.00	-115.64	Avg	H	46.56	37.92	53.98	-16.06
12185.00	-103.94	Peak	H	46.56	49.62	73.98	-24.36

Table 6-18. Radiated Measurements

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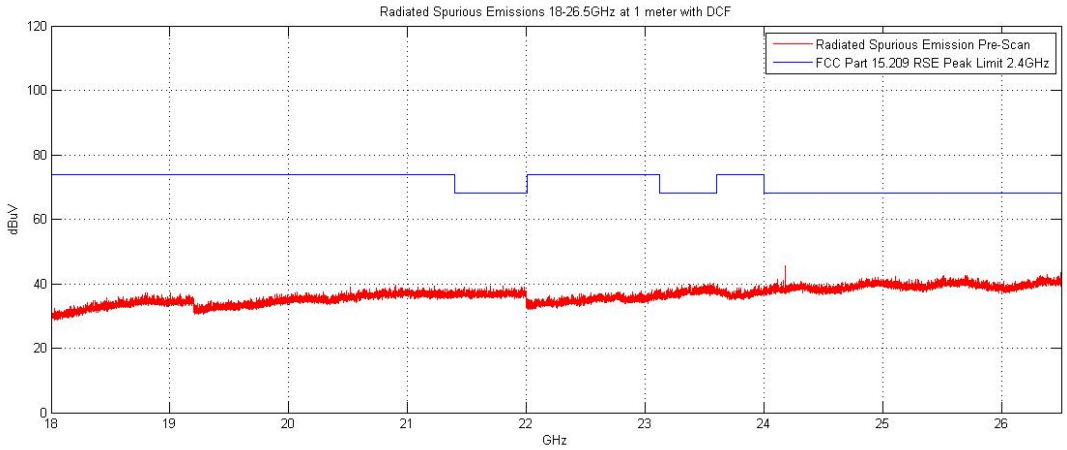
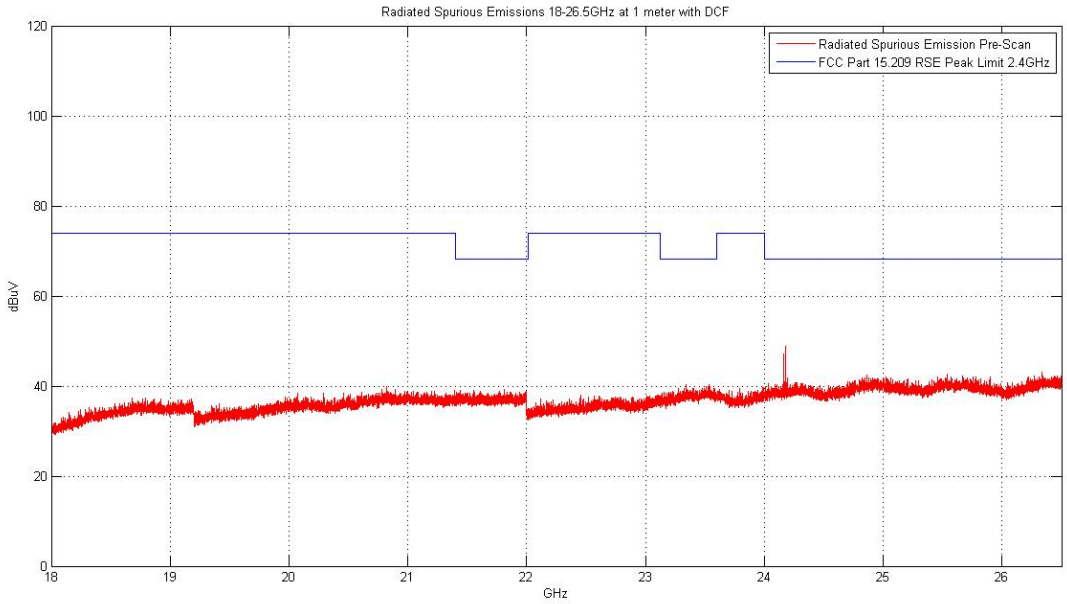
Antenna-1 Radiated Spurious Emissions Measurements (Above 18GHz)
§15.209



Plot 6-73. Radiated Spurious Plot above 18GHz (Pol. H)



Plot 6-74. Radiated Spurious Plot above 18GHz (Pol. V)

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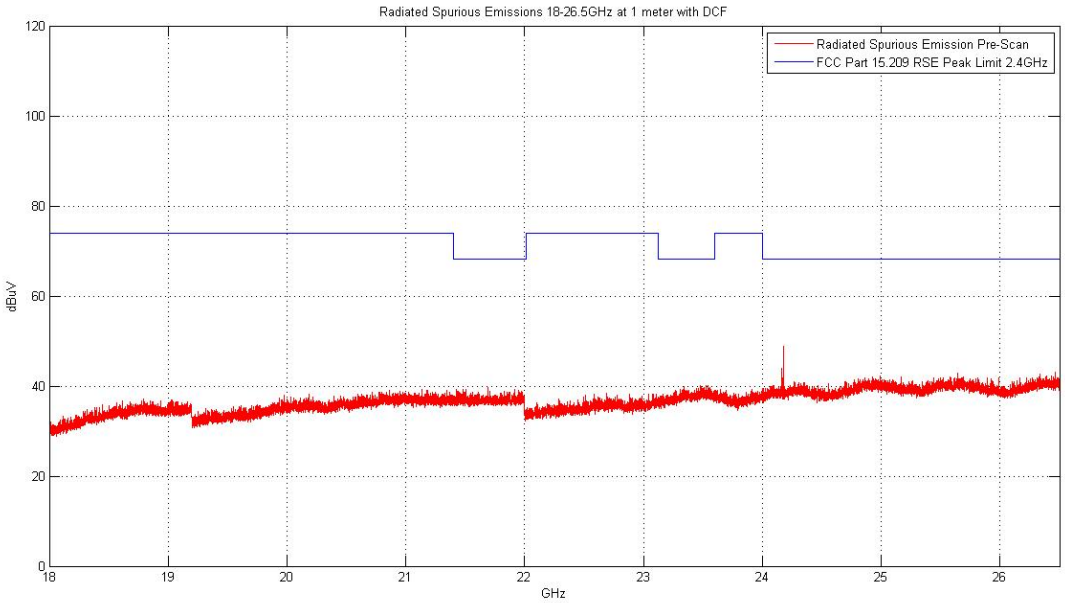
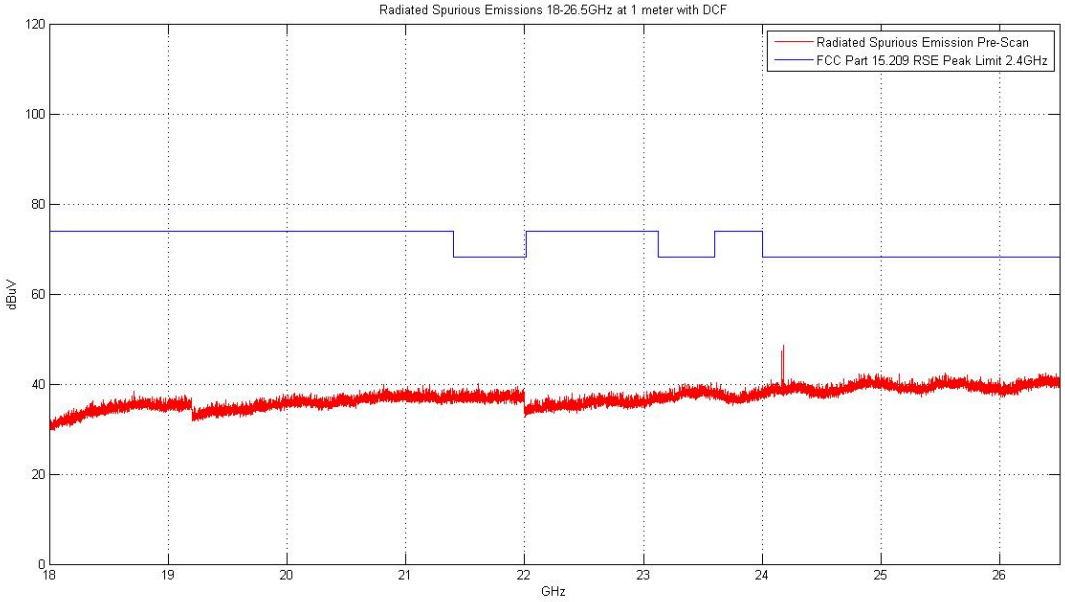
Antenna-2 Radiated Spurious Emissions Measurements (Above 18GHz)
§15.209



Plot 6-75. Radiated Spurious Plot above 18GHz (Pol. H)



Plot 6-76. Radiated Spurious Plot above 18GHz (Pol. V)

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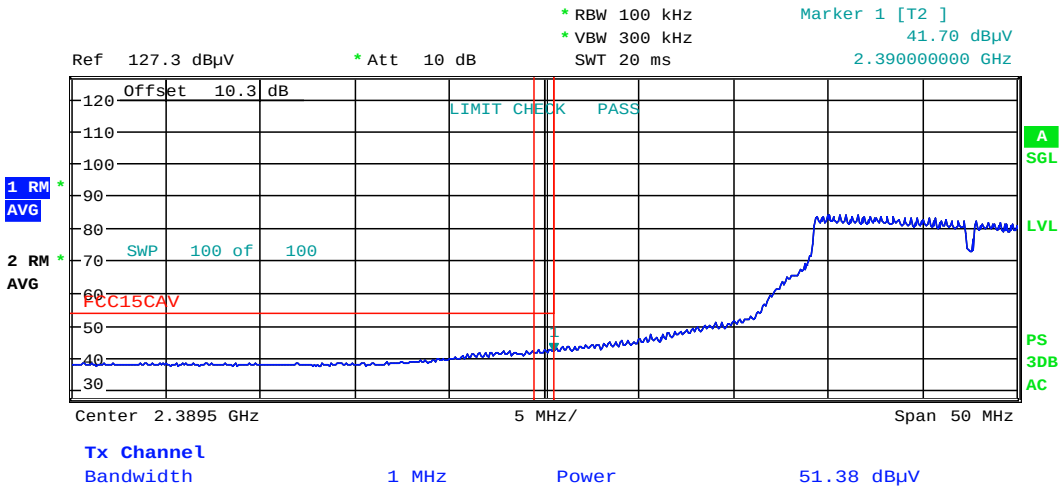
6.7.3 Antenna-1 Radiated Restricted Band Edge Measurements

§15.205 §15.209

The radiated restricted band edge measurements are measured with an EMI test receiver connected to the receive antenna while the EUT is transmitting.

Worst Case Mode:	802.11g
Worst Case Transfer Rate:	6 Mbps
Distance of Measurements:	3 Meters
Operating Frequency:	2412MHz
Channel:	1



Date: 8.JAN.2015 20:24:28

Plot 6-77. Radiated Restricted Lower Band Edge Measurement (Average)

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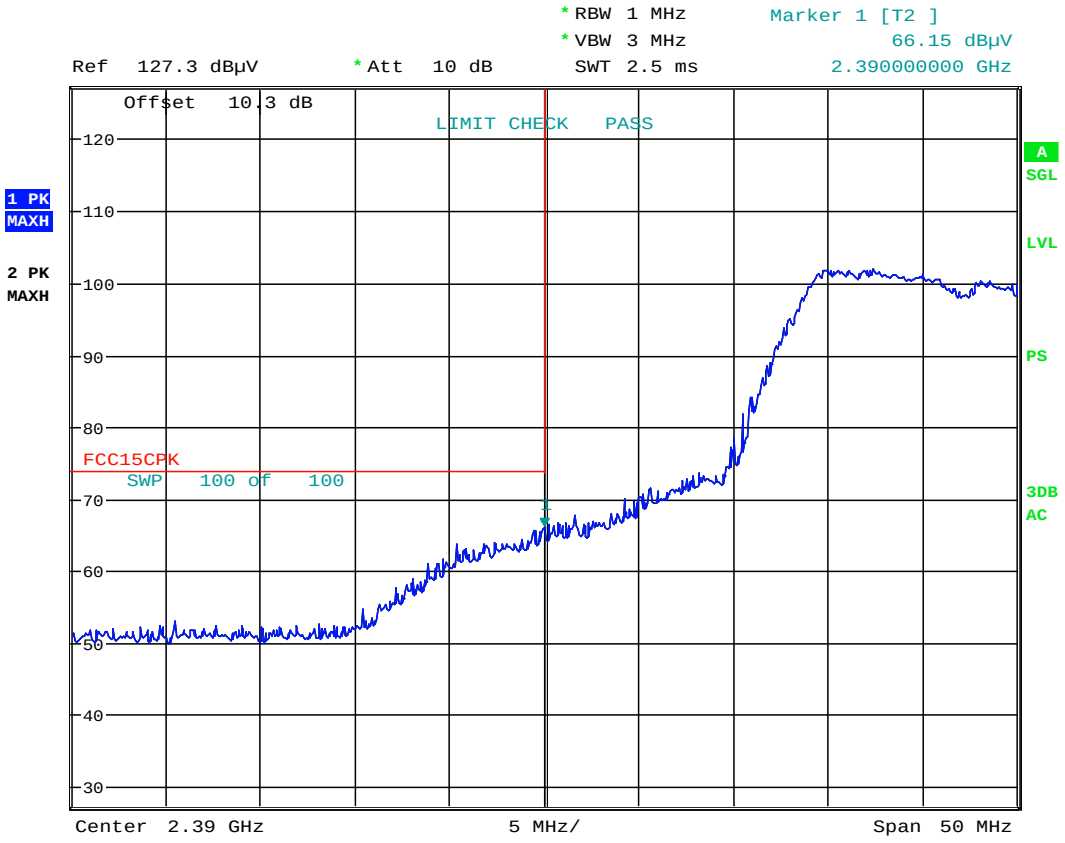
Antenna-1 Radiated Restricted Band Edge Measurements

§15.205 §15.209



Date: 8.JAN.2015 20:25:33

Plot 6-78. Radiated Restricted Lower Band Edge Measurement (Peak)

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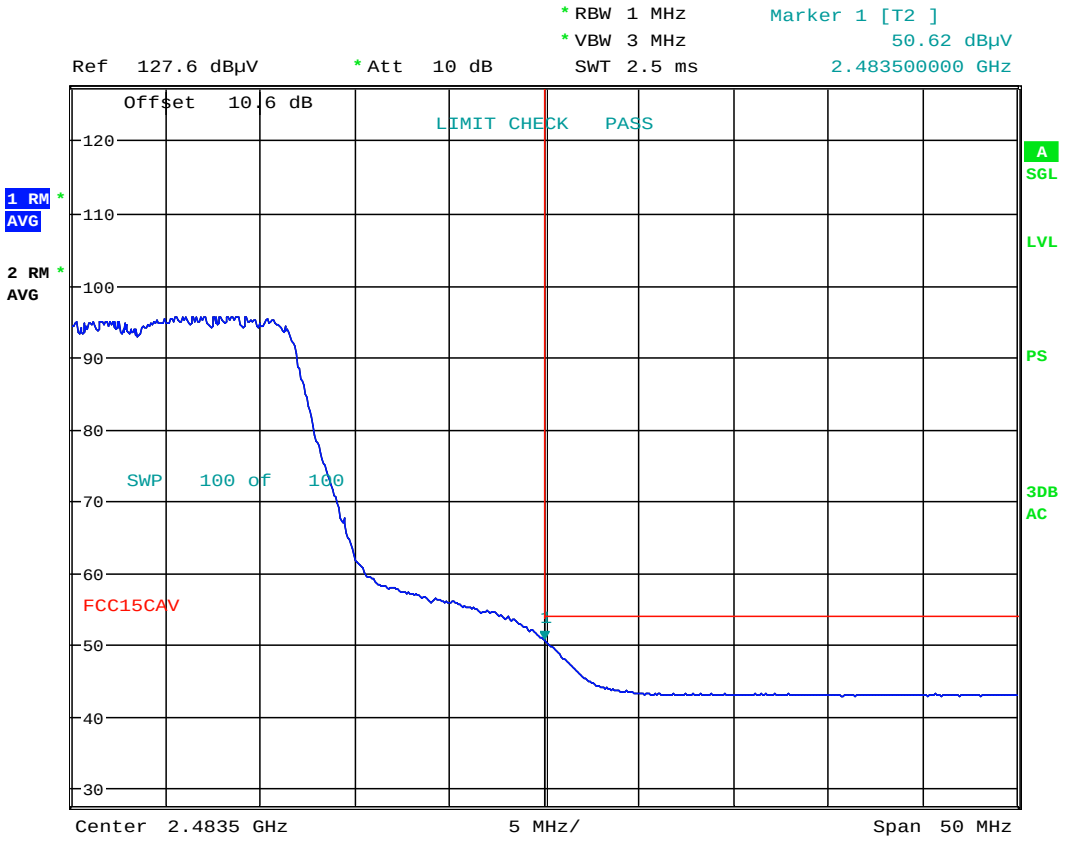
Antenna-1 Radiated Restricted Band Edge Measurements

§15.205 §15.209

Worst Case Mode:	802.11g
Worst Case Transfer Rate:	6 Mbps
Distance of Measurements:	3 Meters
Operating Frequency:	2462MHz
Channel:	11



Date: 8.JAN.2015 19:58:00

Plot 6-79. Radiated Restricted Upper Band Edge Measurement (Average)

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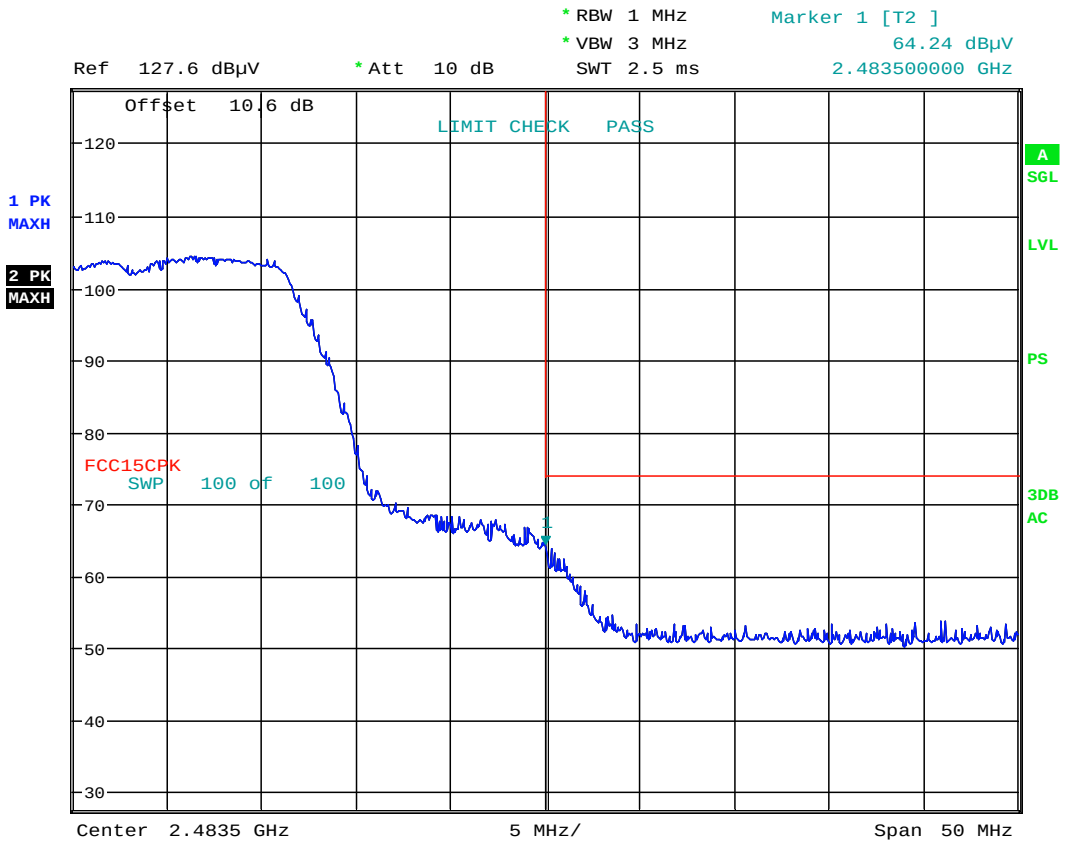
Antenna-1 Radiated Restricted Band Edge Measurements

§15.205 §15.209



Date: 8.JAN.2015 19:58:53

Plot 6-80. Radiated Restricted Upper Band Edge Measurement (Peak)

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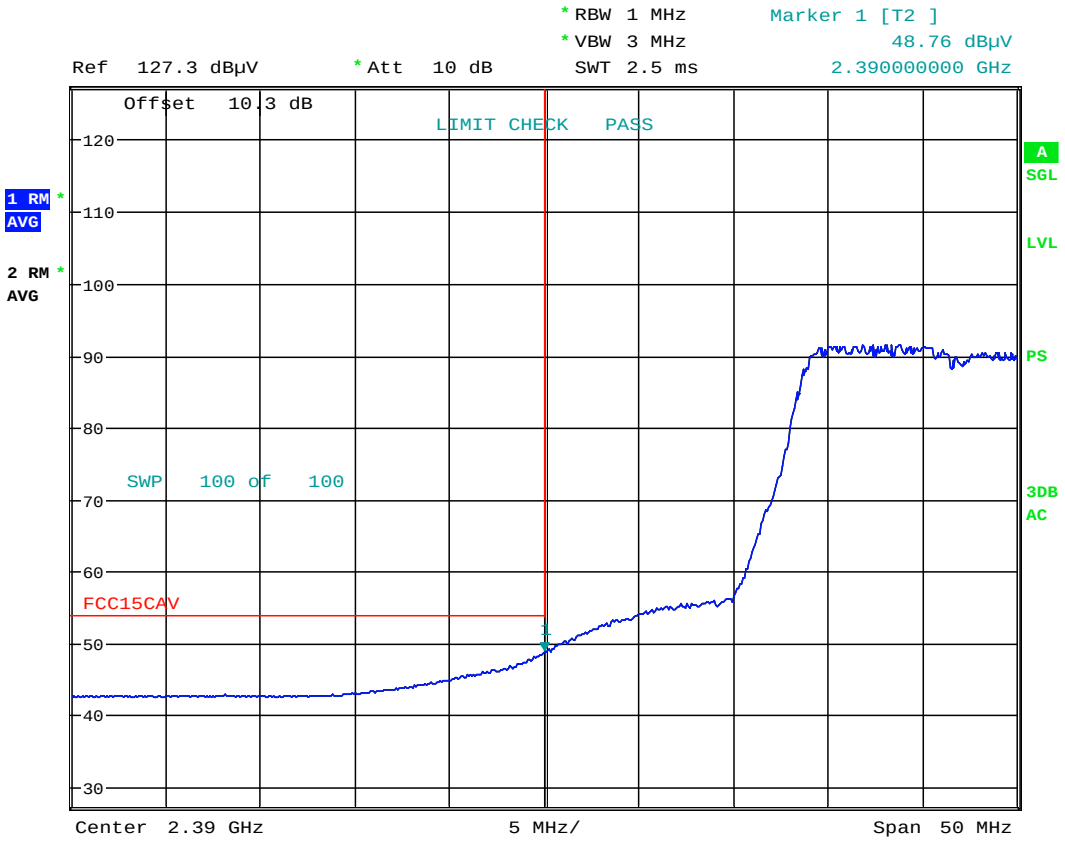
6.7.4 Antenna-2 Radiated Restricted Band Edge Measurements

§15.205 §15.209

The radiated restricted band edge measurements are measured with an EMI test receiver connected to the receive antenna while the EUT is transmitting.

Worst Case Mode:	802.11g
Worst Case Transfer Rate:	6 Mbps
Distance of Measurements:	3 Meters
Operating Frequency:	2412MHz
Channel:	1



Date: 8.JAN.2015 20:40:13

Plot 6-81. Radiated Restricted Lower Band Edge Measurement (Average)

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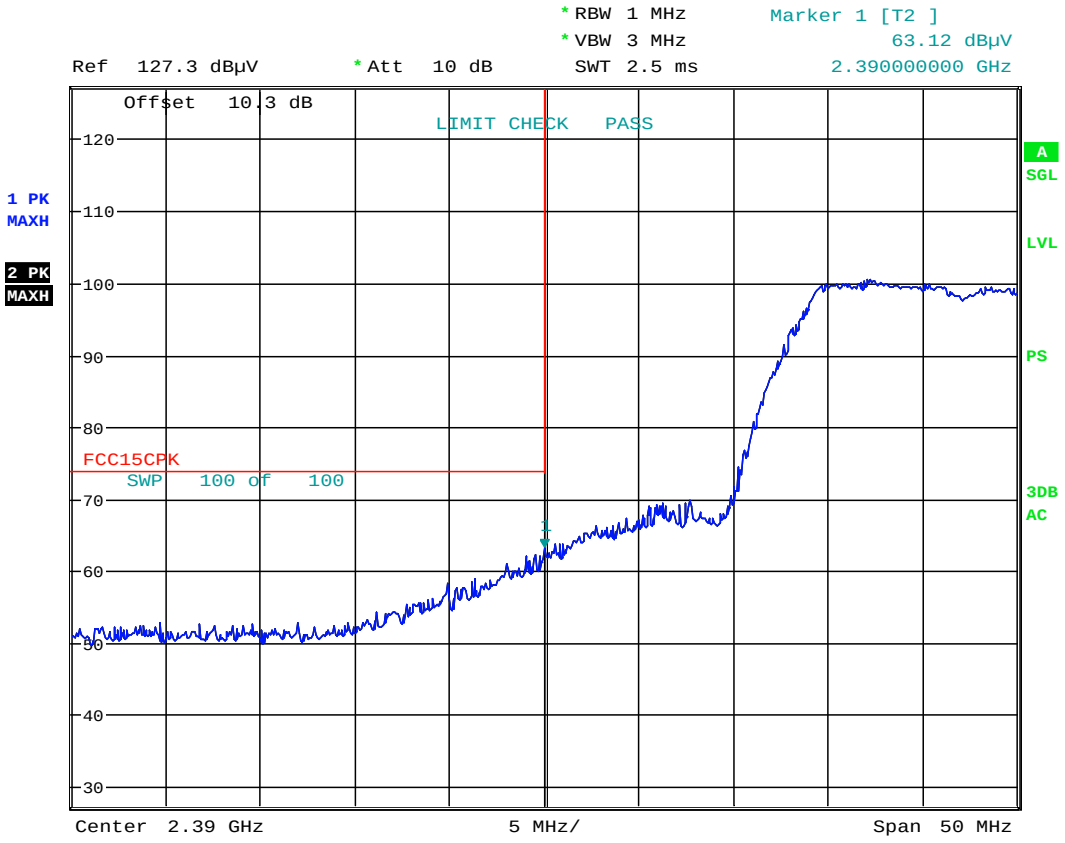
Antenna-2 Radiated Restricted Band Edge Measurements

§15.205 §15.209



Date: 8.JAN.2015 20:40:49

Plot 6-82. Radiated Restricted Lower Band Edge Measurement (Peak)

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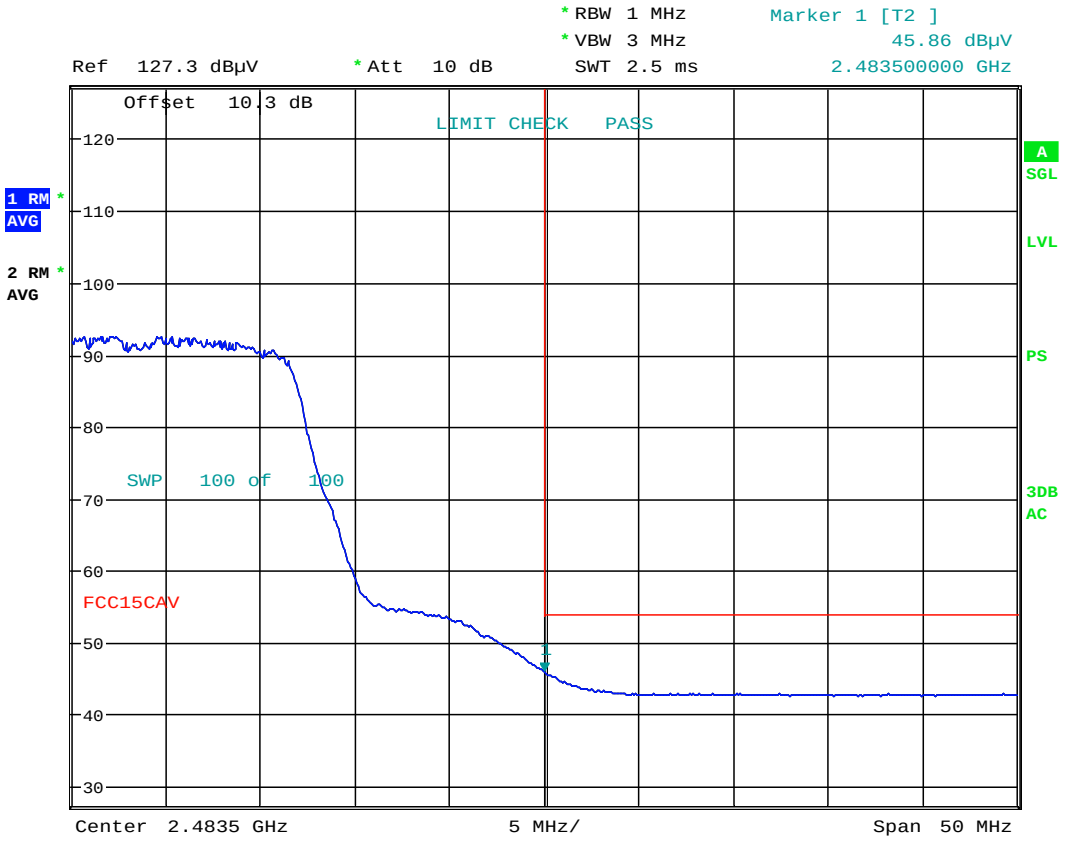
Antenna-2 Radiated Restricted Band Edge Measurements

§15.205 §15.209

Worst Case Mode:	802.11g
Worst Case Transfer Rate:	6 Mbps
Distance of Measurements:	3 Meters
Operating Frequency:	2462MHz
Channel:	11



Date: 8.JAN.2015 20:52:47

Plot 6-83. Radiated Restricted Upper Band Edge Measurement (Average)

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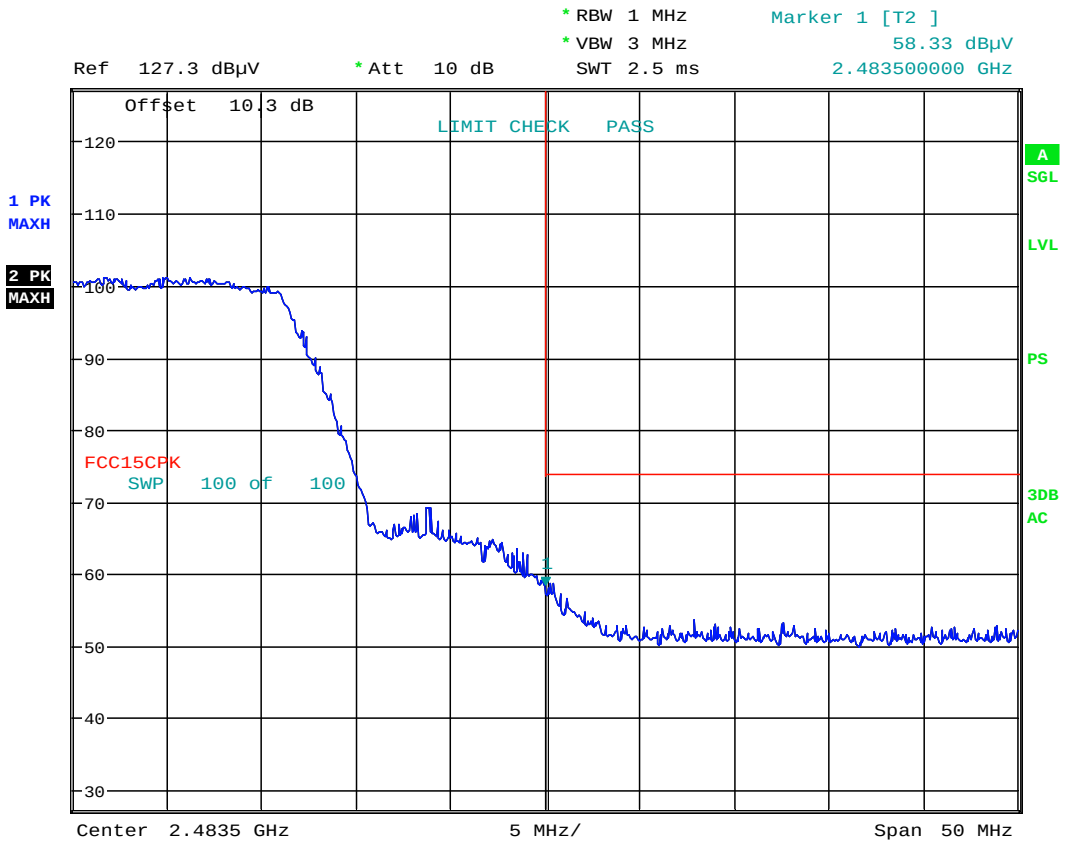
Antenna-2 Radiated Restricted Band Edge Measurements

§15.205 §15.209



Date: 8.JAN.2015 20:53:24

Plot 6-84. Radiated Restricted Upper Band Edge Measurement (Peak)

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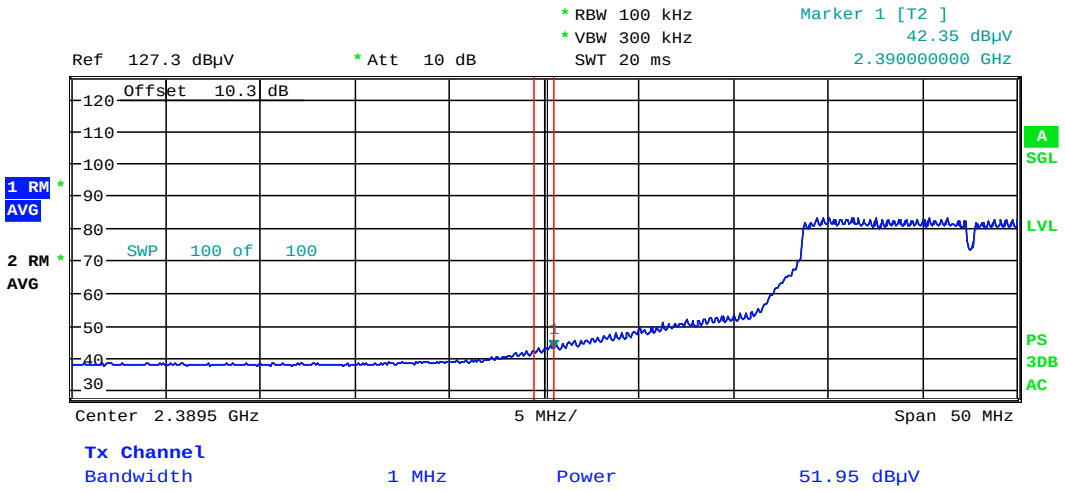
6.7.5 MIMO Radiated Restricted Band Edge Measurements

§15.205 §15.209

The radiated restricted band edge measurements are measured with an EMI test receiver connected to the receive antenna while the EUT is transmitting.

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS8
Distance of Measurements:	3 Meters
Operating Frequency:	2412MHz
Channel:	1



Date: 8.JAN.2015 21:22:11

Plot 6-85. Radiated Restricted Lower Band Edge Measurement (Average)

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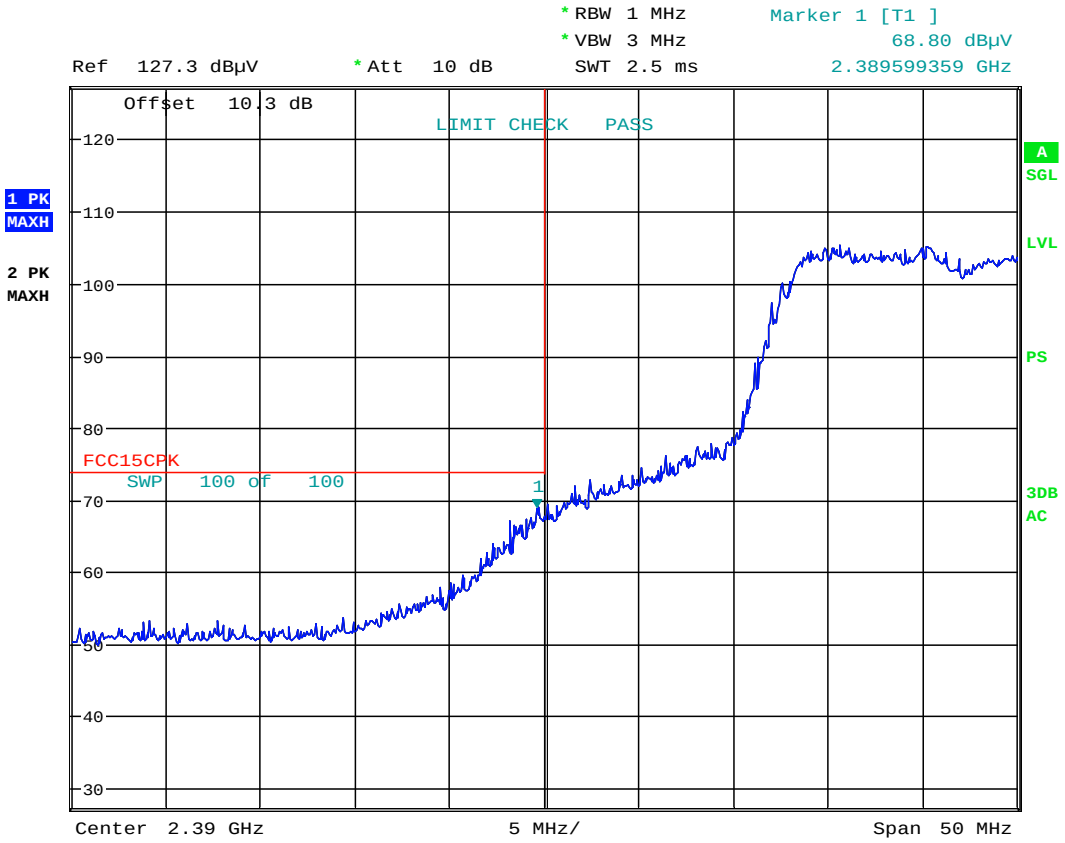
MIMO Radiated Restricted Band Edge Measurements

§15.205 §15.209



Date: 8.JAN.2015 21:12:59

Plot 6-86. Radiated Restricted Lower Band Edge Measurement (Peak)

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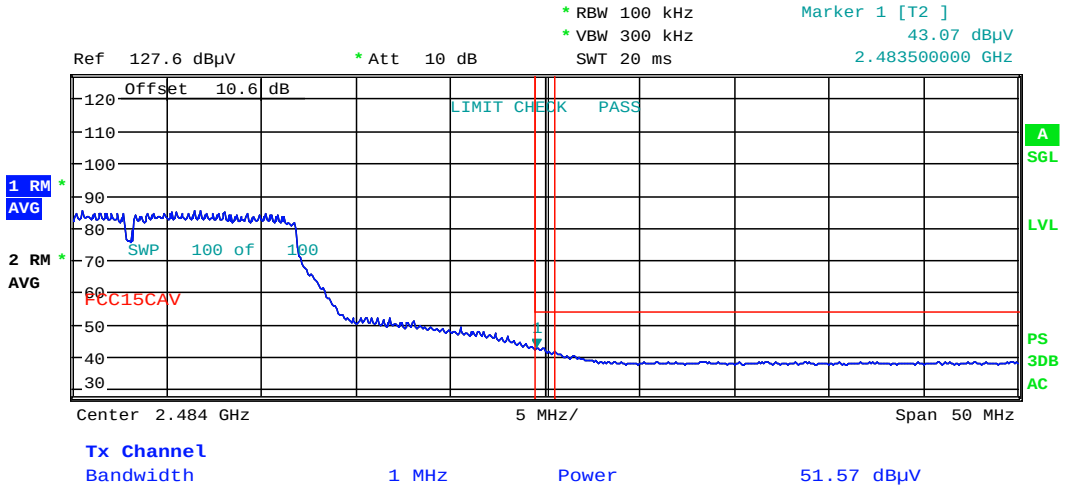
MIMO Radiated Restricted Band Edge Measurements

§15.205 §15.209

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS8
Distance of Measurements:	3 Meters
Operating Frequency:	2462MHz
Channel:	11



Date: 8.JAN.2015 21:03:08

Plot 6-87. Radiated Restricted Upper Band Edge Measurement (Average)

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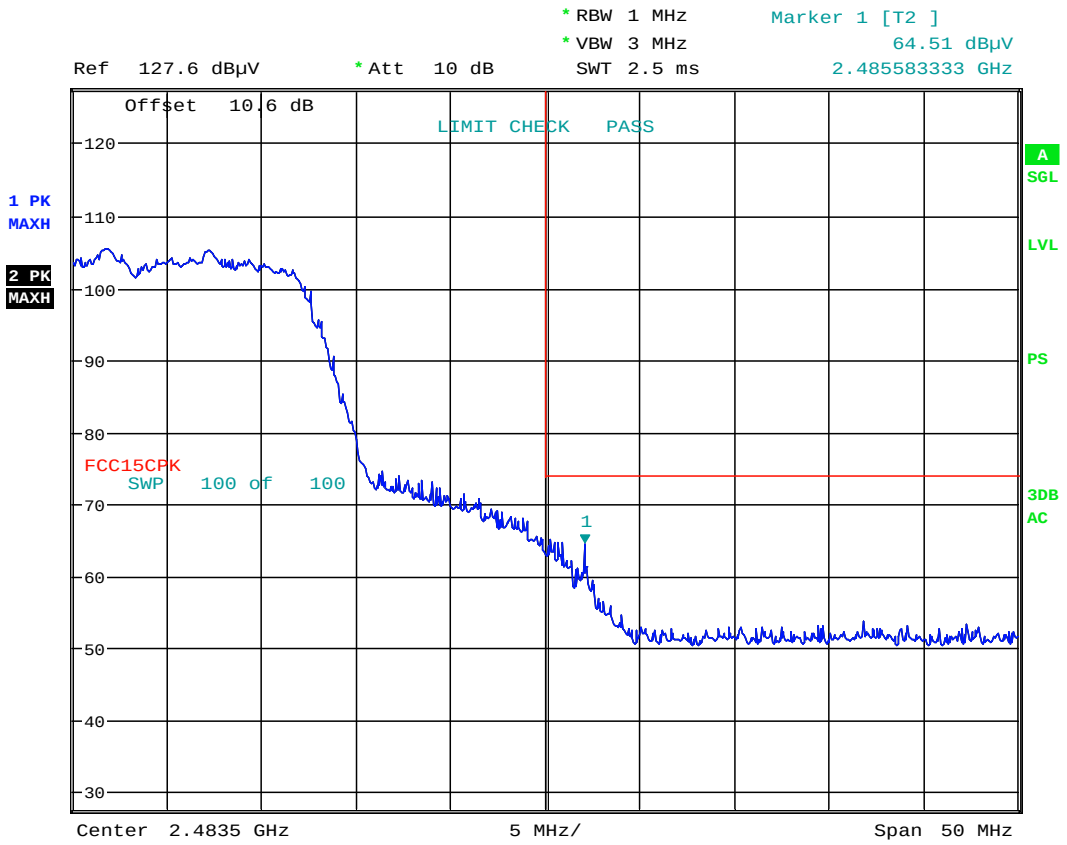
MIMO Radiated Restricted Band Edge Measurements

§15.205 §15.209



Date: 8.JAN.2015 21:04:02

Plot 6-88. Radiated Restricted Upper Band Edge Measurement (Peak)

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6.8 Radiated Spurious Emissions Measurements – Below 1GHz

§15.209

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at its maximum duty cycle (>98%), at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Table 6-19 per Section 15.209.

Frequency	Field Strength [μV/m]	Measured Distance [Meters]
0.009 – 0.490 MHz	2400/F (kHz)	300
0.490 – 1.705 MHz	24000/F (kHz)	30
1.705 – 30.00 MHz	30	30
30.00 – 88.00 MHz	100	3
88.00 – 216.0 MHz	150	3
216.0 – 960.0 MHz	200	3
Above 960.0 MHz	500	3

Table 6-19. Radiated Limits

Test Procedures Used

ANSI C63.4-2009

Test Settings

Quasi-Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 120kHz (for emissions from 30MHz – 1GHz)
3. Detector = quasi-peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

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Test Setup

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

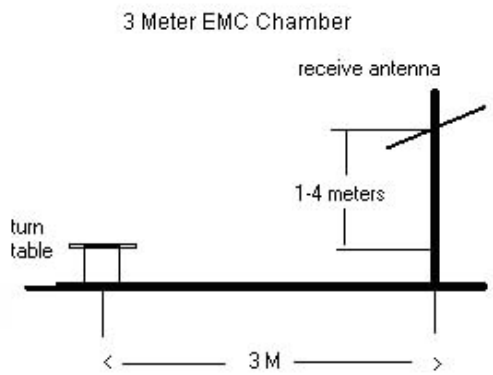

Figure 6-7. Test Instrument & Measurement Setup

Test Notes

1. All emissions lying in restricted bands specified in §15.205 are below the limit shown in Table 6-10.
2. The broadband receive antenna is manipulated through vertical and horizontal polarizations during the tests. The EUT is manipulated through three orthogonal planes.
3. The spectrum is investigated using a peak detector and final measurements are recorded using CISPR quasi peak detector. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.
4. Emissions were measured at a 3 meter test distance.
5. Emissions are investigated while operating on the center channel of the mode, band, and modulation that produced the worst case results during the transmitter spurious emissions testing.
6. No spurious emissions were detected within 20dB of the limit below 30MHz.
7. The results recorded using the broadband antenna is known to correlate with the results obtained by using a tuned dipole with an acceptable degree of accuracy. The VSWR for the measurement antenna was found to be less than 2:1.

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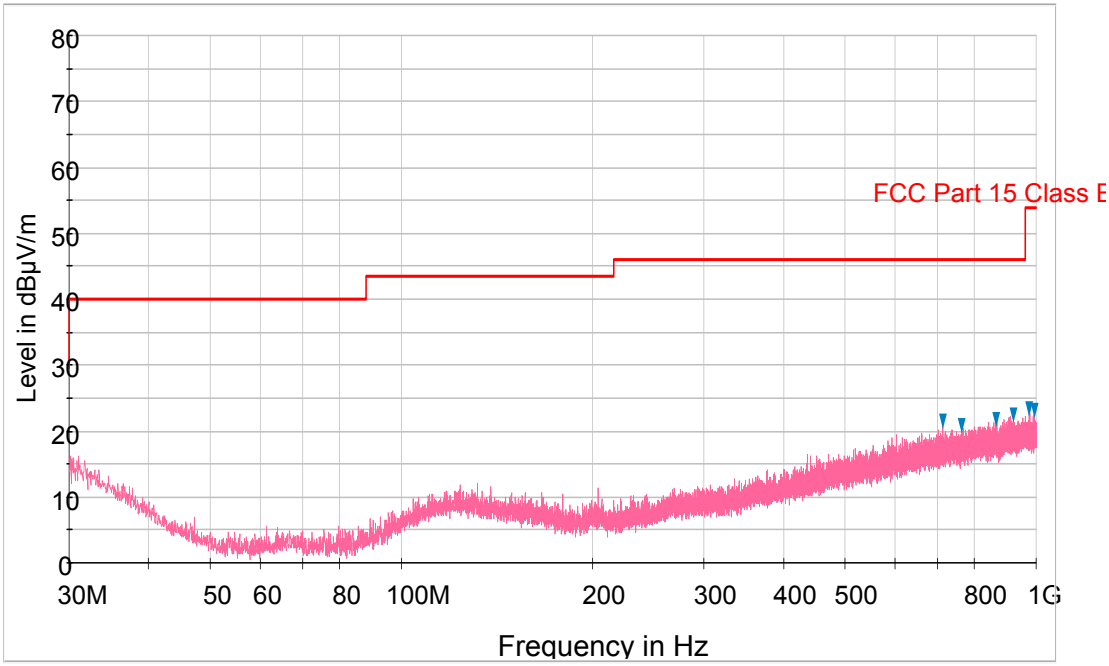
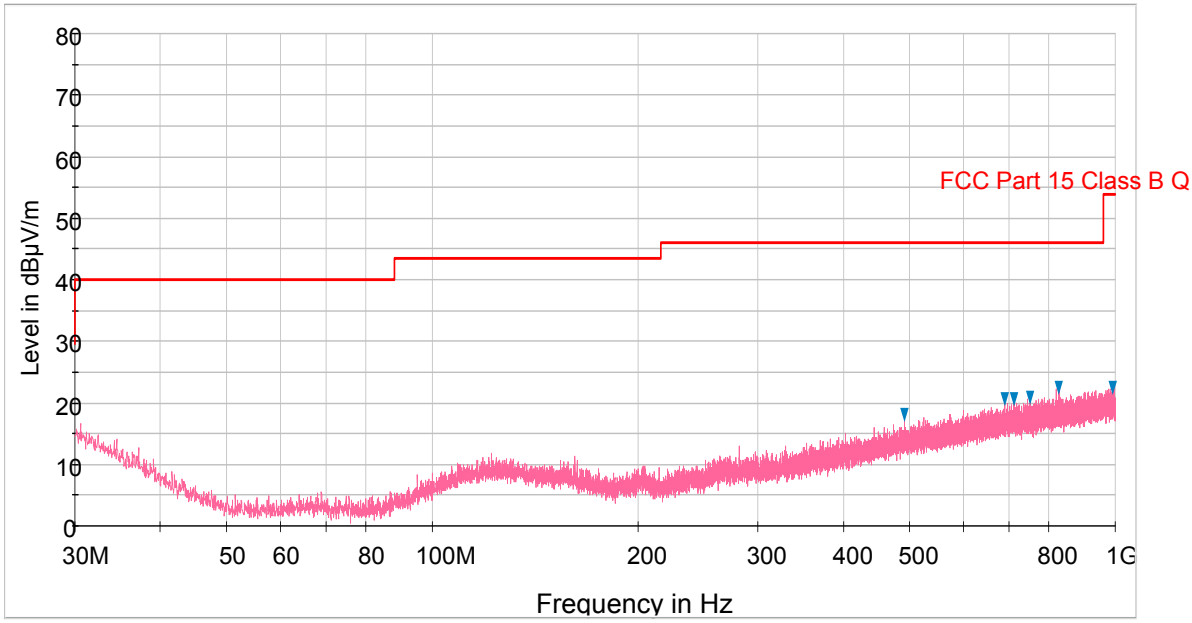
Antenna-1 Radiated Spurious Emissions Measurements (Below 1GHz)

§15.209



Plot 6-89. Radiated Spurious Plot below 1GHz (Pol. H)



Plot 6-90. Radiated Spurious Plot below 1GHz (Pol. V)

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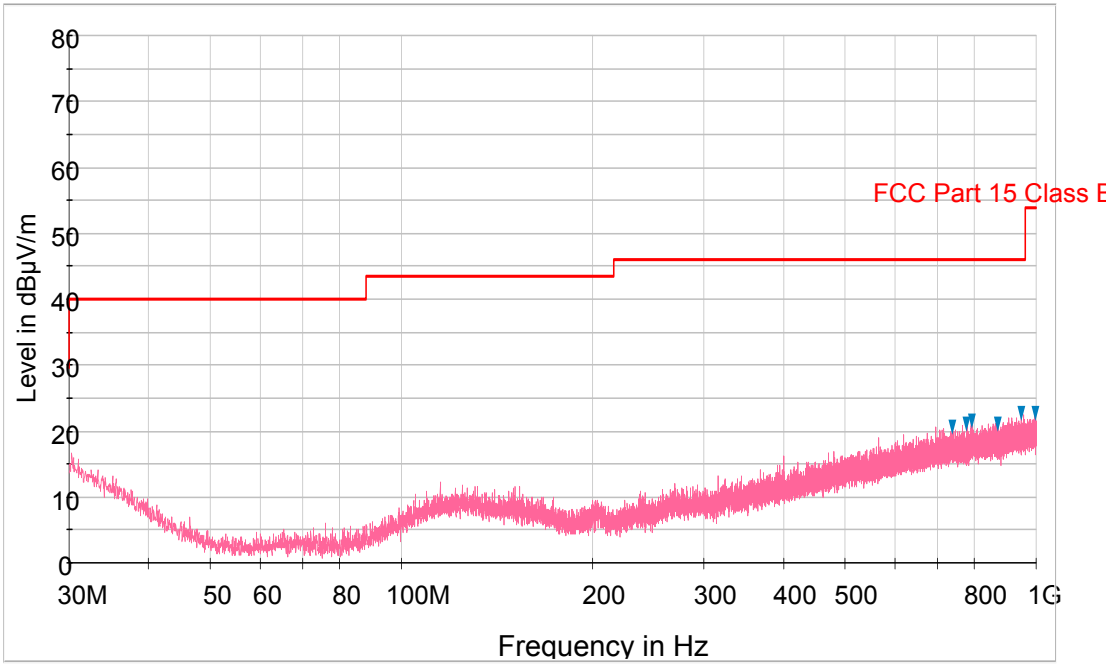
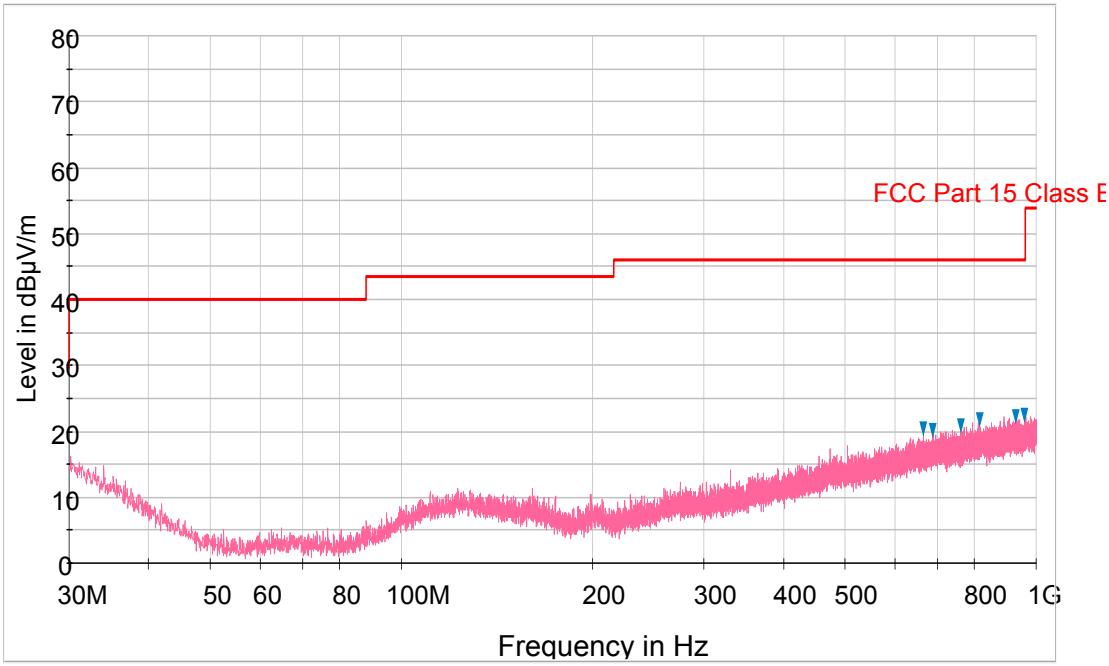
Antenna-2 Radiated Spurious Emissions Measurements (Below 1GHz)

§15.209



Plot 6-91. Radiated Spurious Plot below 1GHz (Pol. H)



Plot 6-92. Radiated Spurious Plot below 1GHz (Pol. V)

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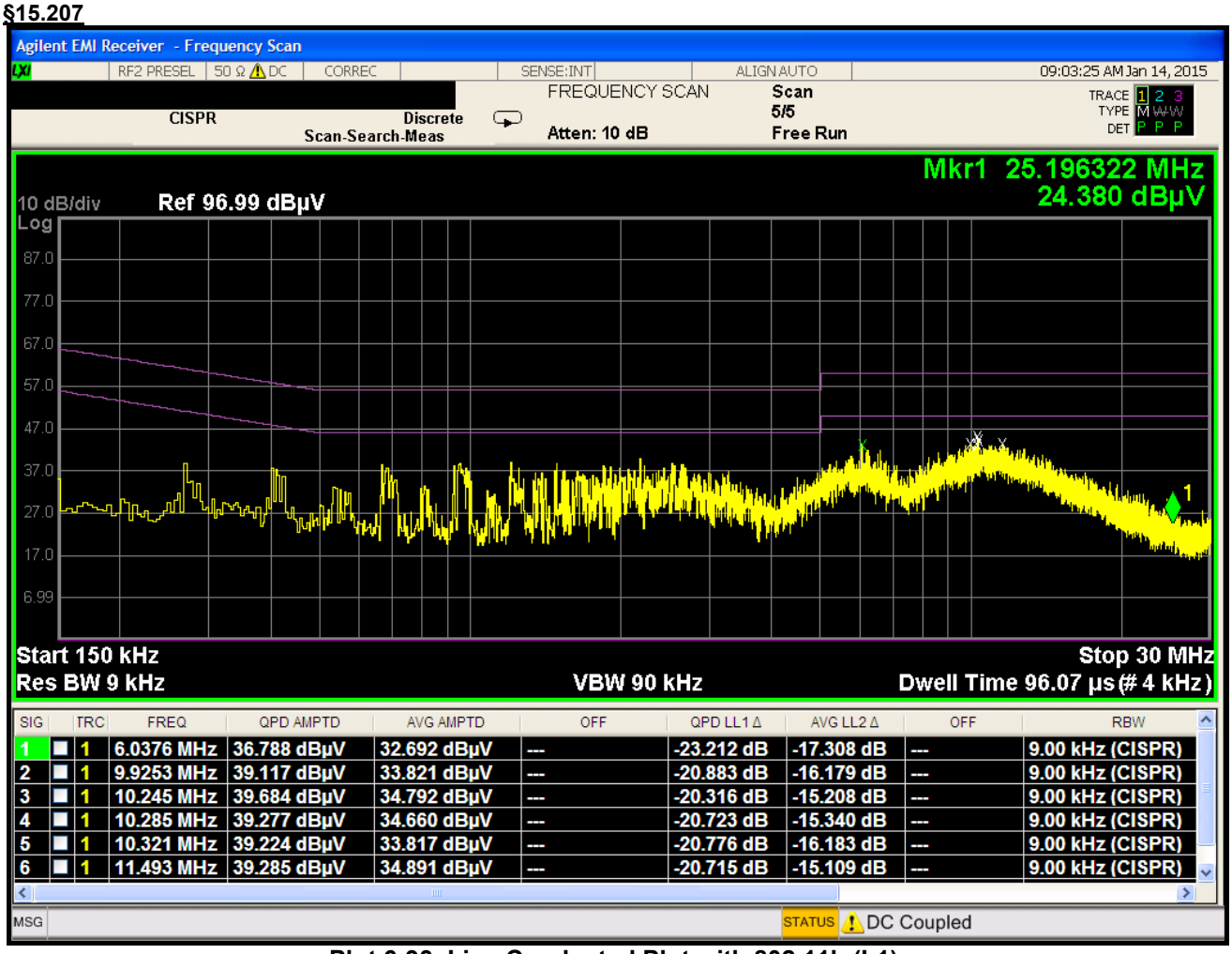
6.9 Line-Conducted Test Data

§15.207



SIG		TRC	FREQ	QPD AMPTD	AVG AMPTD	OFF	QPD LL1 Δ	AVG LL2 Δ	OFF	RBW
1	■	1	6.0376 MHz	36.788 dBµV	32.692 dBµV	---	-23.212 dB	-17.308 dB	---	9.00 kHz (CISPR)
2	■	1	9.9253 MHz	39.117 dBµV	33.821 dBµV	---	-20.883 dB	-16.179 dB	---	9.00 kHz (CISPR)
3	■	1	10.245 MHz	39.684 dBµV	34.792 dBµV	---	-20.316 dB	-15.208 dB	---	9.00 kHz (CISPR)
4	■	1	10.285 MHz	39.277 dBµV	34.660 dBµV	---	-20.723 dB	-15.340 dB	---	9.00 kHz (CISPR)
5	■	1	10.321 MHz	39.224 dBµV	33.817 dBµV	---	-20.776 dB	-16.183 dB	---	9.00 kHz (CISPR)
6	■	1	11.493 MHz	39.285 dBµV	34.891 dBµV	---	-20.715 dB	-15.109 dB	---	9.00 kHz (CISPR)

Plot 6-93. Line Conducted Plot with 802.11b (L1)

Notes:

1. All modes of operation, data rates, and test channels were investigated and the worst-case emissions are reported in 802.11b mode using 1Mbps on Channel 6. The emissions found were not affected by the choice of channel used during testing.
2. The limit for Class B device(s) from 150kHz to 30MHz are specified in Section 15.207 of the Title 47 CFR.
3. Factor (dB) = Cable loss (dB) + LISN insertion factor (dB)
4. QP/AV Level (dBµV) = QP/AV Analyzer/Receiver Level (dBµV) + Factor (dB)
5. Margin (dB) = QP/AV Limit (dBµV) – QP/AV Level (dBµV)
6. Traces shown in plot are made using a peak detector.
7. Deviations to the Specifications: None.

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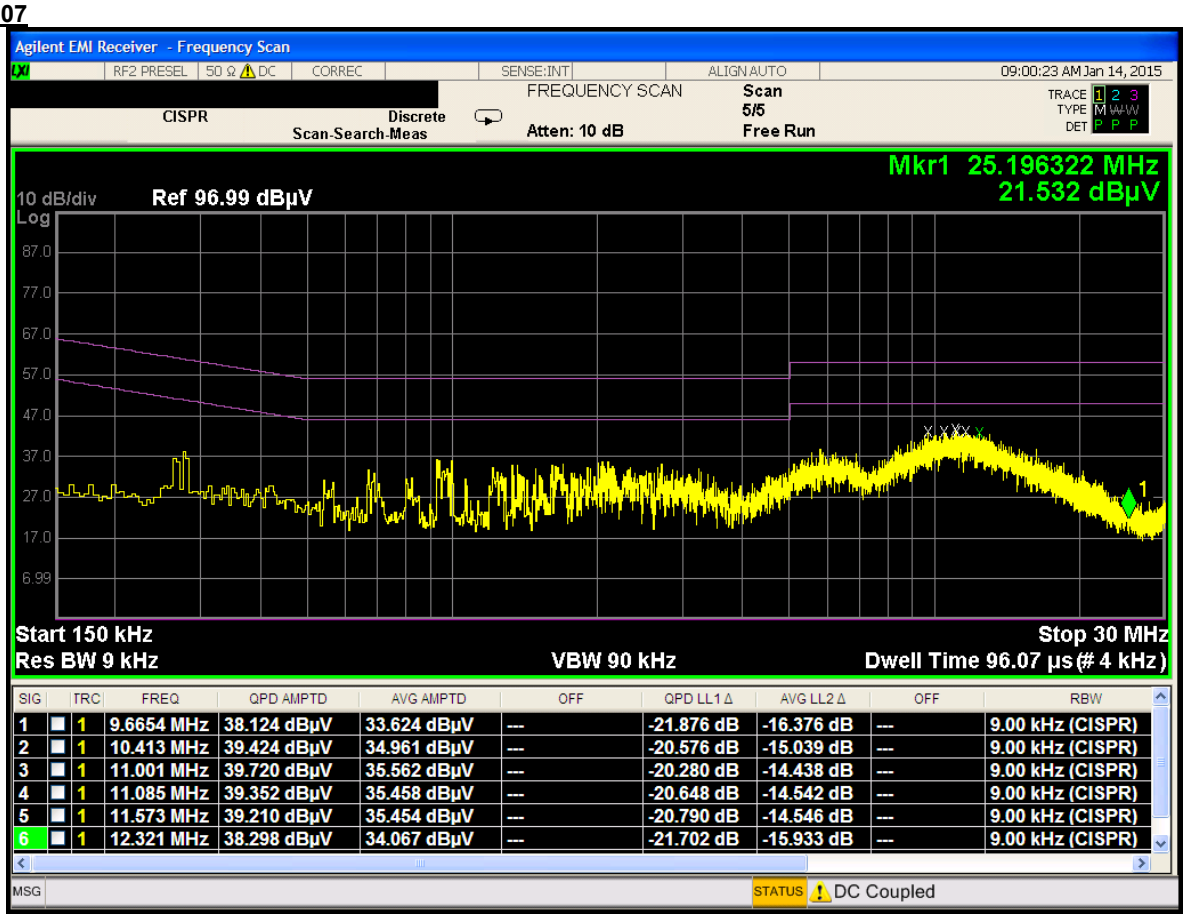
Line-Conducted Test Data

§15.207



SIG		TRC	FREQ	QPD AMPTD	AVG AMPTD	OFF	QPD LL1 Δ	AVG LL2 Δ	OFF	RBW
1	■	1	9.6654 MHz	38.124 dBµV	33.624 dBµV	---	-21.876 dB	-16.376 dB	---	9.00 kHz (CISPR)
2	■	1	10.413 MHz	39.424 dBµV	34.961 dBµV	---	-20.576 dB	-15.039 dB	---	9.00 kHz (CISPR)
3	■	1	11.001 MHz	39.720 dBµV	35.562 dBµV	---	-20.280 dB	-14.438 dB	---	9.00 kHz (CISPR)
4	■	1	11.085 MHz	39.352 dBµV	35.458 dBµV	---	-20.648 dB	-14.542 dB	---	9.00 kHz (CISPR)
5	■	1	11.573 MHz	39.210 dBµV	35.454 dBµV	---	-20.790 dB	-14.546 dB	---	9.00 kHz (CISPR)
6	■	1	12.321 MHz	38.298 dBµV	34.067 dBµV	---	-21.702 dB	-15.933 dB	---	9.00 kHz (CISPR)

Plot 6-94. Line Conducted Plot with 802.11b (N)

Notes:

1. All modes of operation, data rates, and test channels were investigated and the worst-case emissions are reported in 802.11b mode using 1Mbps on Channel 6. The emissions found were not affected by the choice of channel used during testing.
2. The limit for Class B device(s) from 150kHz to 30MHz are specified in Section 15.207 of the Title 47 CFR.
3. Factor (dB) = Cable loss (dB) + LISN insertion factor (dB)
4. QP/AV Level (dBµV) = QP/AV Analyzer/Receiver Level (dBµV) + Factor (dB)
5. Margin (dB) = QP/AV Limit (dBµV) – QP/AV Level (dBµV)
6. Traces shown in plot are made using a peak detector.
7. Deviations to the Specifications: None.

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7.0 CONCLUSION

The data collected relate only the item(s) tested and show that the **Samsung Portable Handset FCC ID: A3LSMG920KOR** is in compliance with Part 15C of the FCC Rules.

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