MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
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August 14, 2015

Xytronix Research & Design, Inc.
1681 West 2960 South
Nibley, Utah 84321

Dear David Witbeck,

Enclosed is the EMC Wireless test report for compliance testing of the Xytronix Research & Design, Inc., Xytronix XW100 Wireless sensor as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15 Subpart C for Intentional Radiators.

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,
MET LABORATORIES, INC.

Jennifer Warnell
Documentation Department

Reference: (\Xytronix Research & Design, Inc.\EMCS86069-FCC247 Rev. 1)

Electromagnetic Compatibility Criteria
Test Report

for the

Xytronix Research & Design, Inc.
Xytronix XW100 Wireless sensor

Tested under
the FCC Certification Rules
contained in
15.247 Subpart C for Intentional Radiators

MET Report: EMCS86069-FCC247 Rev. 1

August 14, 2015

Prepared For:

Xytronix Research & Design, Inc.
1681 West 2960 South
Nibley, Utah 84321

Prepared By:
MET Laboratories, Inc.
914 W. Patapsco Ave.
Baltimore, MD 21230

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Poona Saber, Project Engineer
Electromagnetic Compatibility Lab

Jennifer Warnell
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules Part 15.247 under normal use and maintenance.

Asad Bajwa,
Director, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	August 10, 2015	Initial Issue.
1	August 14, 2015	Editorial corrections.

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List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci**b**els
dBµA	**D**eci**b**els above one **micro**amp
dBµV	**D**eci**b**els above one **micro**volt
dBµA/m	**D**eci**b**els above one **micro**amp **per m**eter
dBµV/m	**D**eci**b**els above one **micro**volt **per m**eter
DC	**D**irect **C**urrent
E	**E**lectric Field
DSL	**D**igital **S**ubscriber **L**ine
ESD	**E**lectro**s**tatic **D**ischarge
EUT	**E**quipment **U**nder **T**est
f	**F**requency
FCC	**F**ederal **C**ommunications **C**ommission
GRP	**G**round **R**eference **P**lane
H	Magnetic Field
HCP	**H**orizontal **C**oupling **P**lane
Hz	**H**ert**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**ert**z**
kPa	**k**ilo**pa**scal
kV	**k**ilo**v**olt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**microh**enry
µ	**microf**arad
µs	**micros**econds
NEBS	**N**etwork **E**quipment-**B**uilding **S**ystem
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
TWT	**T**raveling **W**ave **T**ube
V/m	**V**olts **per m**eter
VCP	**V**ertical **C**oupling **P**lane

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Xytronix Research & Design, Inc. Xytronix XW100 Wireless sensor, with the requirements of Part 15, §15.247. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the Xytronix XW100 Wireless sensor. Xytronix Research & Design, Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Xytronix XW100 Wireless sensor, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.247, in accordance with Xytronix Research & Design, Inc., purchase order number PO-0000021868. All tests were conducted using measurement procedure ANSI C63.4-2014.

FCC Reference 47 CFR Part 15.247:2005	Description	Compliance
Title 47 of the CFR, Part 15 §15.203	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15 §15.207(a)	Conducted Emission Limits	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(2)	6dB Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15 §15.247(b)	Peak Power Output	Compliant
Title 47 of the CFR, Part 15 §15.247(d); §15.209; §15.205	Radiated Spurious Emissions Requirements	Compliant
Title 47 of the CFR, Part 15 §15.247(d)	RF Conducted Spurious Emissions Requirements	Compliant
Title 47 of the CFR, Part 15 §15.247(d)	RF Conducted Band Edge	Compliant
Title 47 of the CFR, Part 15; §15.247(e)	Peak Power Spectral Density	Compliant
Title 47 of the CFR, Part 15 §15.247(i)	Maximum Permissible Exposure (MPE)	Compliant

Table 1. Executive Summary of EMC Part 15.247 ComplianceTesting

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Xytronix Research & Design, Inc. to perform testing on the Xytronix XW100 Wireless sensor, under Xytronix Research & Design, Inc.'s purchase order number PO-0000021868.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Xytronix Research & Design, Inc., Xytronix XW100 Wireless sensor.

The results obtained relate only to the item(s) tested.

Model(s) Tested:	Xytronix XW100 Wireless sensor	
Model(s) Covered:	Xytronix XW100 Wireless sensor	
EUT Specifications:	Primary Power: 120 VAC to 5Volt DC wall adapter, 60 Hz	
	FCC ID: 2AE4Z-XWD001	
	Type of Modulations:	DSS, OFDM
	Equipment Code:	DTS
	Peak RF Output Power:	14.99 dBm
	EUT Frequency Ranges:	2412-2462 MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35º C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Poona Saber	
Report Date(s):	August 14, 2015	

Table 2. EUT Summary Table

B. References

CFR 47, Part 15, Subpart C	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
ANSI C63.4:2014	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ISO/IEC 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
KDB 558074	DTS Meas Guidance v03r03

Table 3. References

C. Test Site

All testing was performed at MET Laboratories, Inc., 3162 Belick St., Santa Clara, CA 95054. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a 10 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

D. Description of Test Sample

The Xytronix Research & Design, Inc. Xytronix XW100 Wireless sensor, Equipment Under Test (EUT), is a small Wi-Fi wireless temperature monitoring and status alerting device. The XW-110 measures and reports temperature using a temperature probe. The XW-111 monitors and reports the status of switch closure sensors and alarms. They are used for applications where temperature or events must be monitored and Ethernet wiring is not accessible or practical to install.

The module is powered from either two internal AA batteries or a 5-volt wall transformer. A three position terminal strip provides connections for a temperature sensor or up to two switch closure sensors. No other cables, interfaces or PC utility programs are needed.

Two user accessible push button switches aid in provisioning the module. Press the "access point" switch to active the access point mode. With a PC or smart phone you then connect to and access the internal web server. Using the web server, configure the measurement interval, access port name and other setup parameters. Alternatively, press the WPS (Wi-Fi Protected Setup) switch on both the XW100 and your access point to add the XW100 to an existing network.

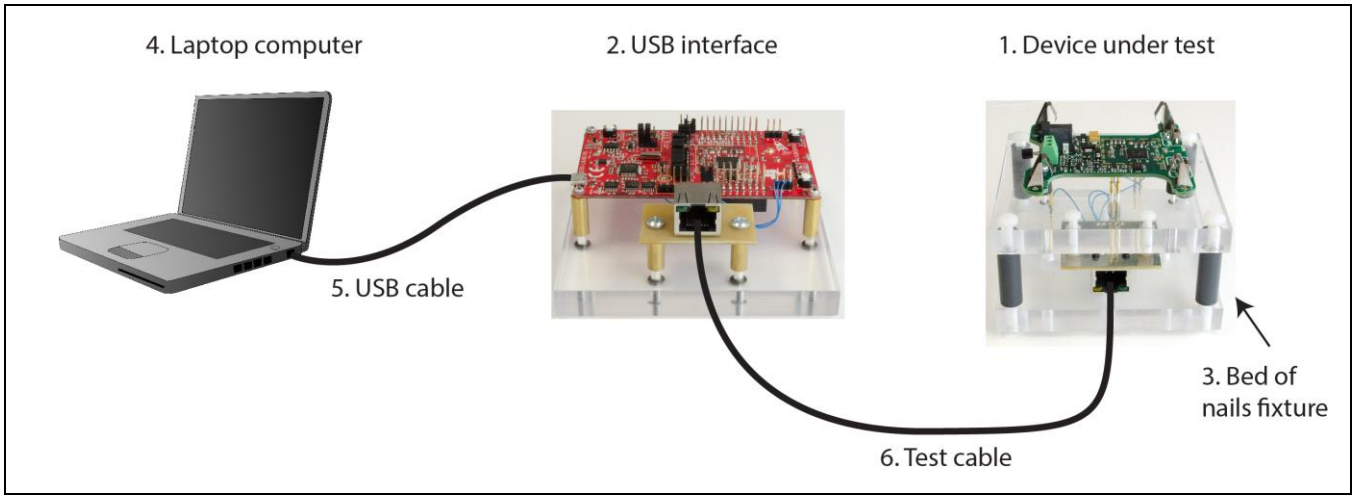


Figure 1. Block Diagram of Test Configuration, Continuous Emissions using the "Radio Tool"

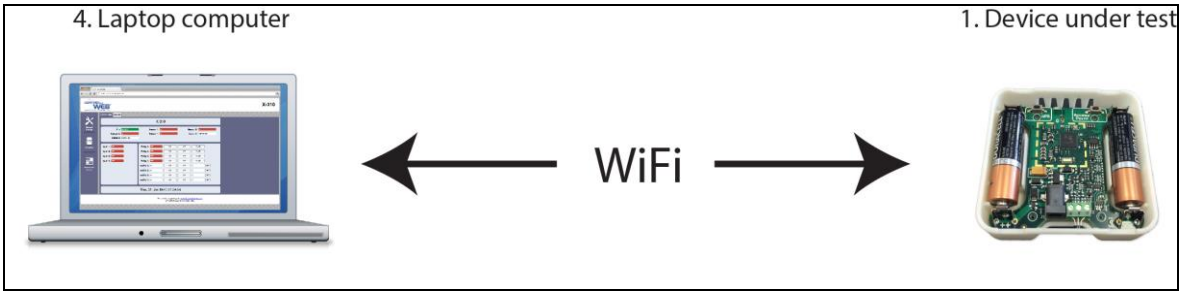


Figure 2. Block Diagram of Test Configuration, Intermittent Emissions (Normal Wi-Fi)

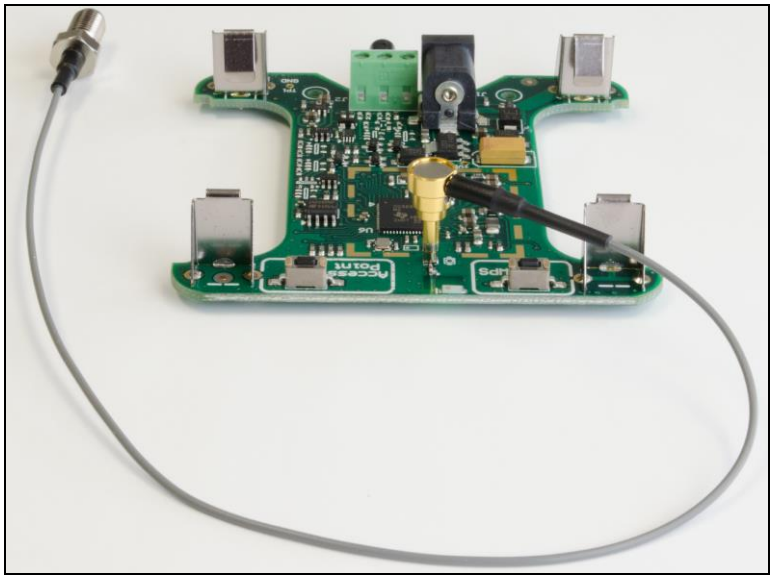


Figure 3. Block Diagram of Test Configuration, Conducted Emissions

E. Equipment Configuration

The EUT was set up as outlined in Figure 1, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Ref. ID	Name / Description	Model Number	Part Number	Serial Number	Revision
1	WiFi Sensor (temperature) with operational firmware	XW-110	XW-110	F4:B8:5E:01:12:9A	1.1
1	WiFi Sensor (temperature) with radio tool firmware	XW-110	XW-110	F4:B8:5E:01:12:05	1.1
1	WiFi Sensor (digital input) with operational firmware	XW-111	XW-111	F4:B8:5E:01:11:35	1.1
1	WiFi Sensor (digital input) with radio tool firmware	XW-111	XW-111	F4:B8:5E:01:12:01	1.1

Table 4. Equipment Configuration

F. Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

Ref. ID	Name / Description	Manufacturer	Model Number
1	device under test	Xytronix	XW-110
2	USB to UART interface	Xytronix	custom
3	bed of nails to UART interface	Xytronix	custom
4	laptop computer	--	--
5	USB cable	--	generic
6	8-conductor test cable	Xytronix	custom
7	AC/DC 5v output power supply	Powertron electronics corp	PA1015-1l

Table 5. Support Equipment

G. Ports and Cabling Information

Ref. ID	Port Name on EUT	Cable Description	Qty.	Length (m)	Shielded (Y/N)	Termination Point
Black DC Jack	DC input	2.5mm DC Jack	1	1.8M (72")	No	
Green Terminal Block	sensor input	3-position terminal block	1	1 cm	No	
SMT Jack	conducted emissions	SMA to SMT cable	1	30cm	Yes	

Table 6. Ports and Cabling Information

H. Mode of Operation

As a WiFi device, the XW100 normally communicates with a WiFi access point. The test device is setup for "stand alone mode" where it responds to beacons and HTML file requests. Transmissions are initiated and sequenced thru the access point.

For continuous operation during EMC testing the Radio Tool must be used to force carrier wave or packetized data transmissions. Using the "Continuous" transmission option from the Radio Tool will result in a continuous stream of back to back packet transmissions.

Packetized: Each packet is sent one at a time from the application MCU to the network processor. There is a large delay between packets in this mode. Generally used for RF evaluation

Continuous: This is a test mode where the network processor sends out packets back to back in an internal loop, without the intervention of host MCU. The delay between packets is typically very small and hence useful for FCC/ETSI certification purposes where high duty cycle is required. Only used for emission Certification.

CW: In this mode the device transmits an un-modulated RF tone. The frequencies can be selected in steps of 312.5 kHz. Note that the power output with tone 0 is very low. In case higher RF power is desired use tone numbers other than 0.

In order to use the Radio Tool to control the emissions, you must use a board having the label "Radio Tool Firmware" as opposed to "Production Firmware".

I. Method of Monitoring EUT Operation

Consistent with the Mode of Operation section above, there needs to be a means of continuously monitoring the operation of the EUT.

(#1) The XW100 has no LEDs or display. Proper operation can be monitored by successful data transmissions to a remote server or via successful access to the internal web server from a web browser when using the Production Firmware. Continuous monitoring can be made by refreshing the web browser display.

Alternatively, if using the Ratio Tool there will be feedback through the console of the program as well as indications as to the current operation.

(#2) If the XW100 is not performing its functions, the device will not be accessible from the web-browser or WiFi network selection list for the case of the Production Firmware.

The Radio Tool will display an error if it cannot communicate with the EUT. The Radio Tool is not capable of monitoring the emissions.

J. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

K. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Xytronix Research & Design, Inc. upon completion of testing.

III. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

Test Requirement: **§ 15.203:** An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall 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 manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

a.) Antenna must be permanently attached to the unit.

b.) Antenna must use a unique type of connector to attach to the EUT.

c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

Results: The EUT as tested is compliant the criteria of §15.203. The EUT meets the criteria (a) of above.

Test Engineer(s): Kaushani Dasgupta

Test Date(s): 06/17/15

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207(a) Conducted Emissions Limits

Test Requirement(s): **§ 15.207 (a):** For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 Σ line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency range (MHz)	§ 15.207(a), Conducted Limit (dBμV)	
	Quasi-Peak	Average
* 0.15- 0.45	66 - 56	56 - 46
0.45 - 0.5	56	46
0.5 - 30	60	50

Table 7. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was placed on a 0.8 m-high wooden table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 μH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.4-2003 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz"*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω/50 μH LISN as the input transducer to an EMC/field intensity meter. For the purpose of this testing, the transmitter was turned on. Scans were performed with the transmitter on.

Test Results: The EUT was compliant with this requirement.

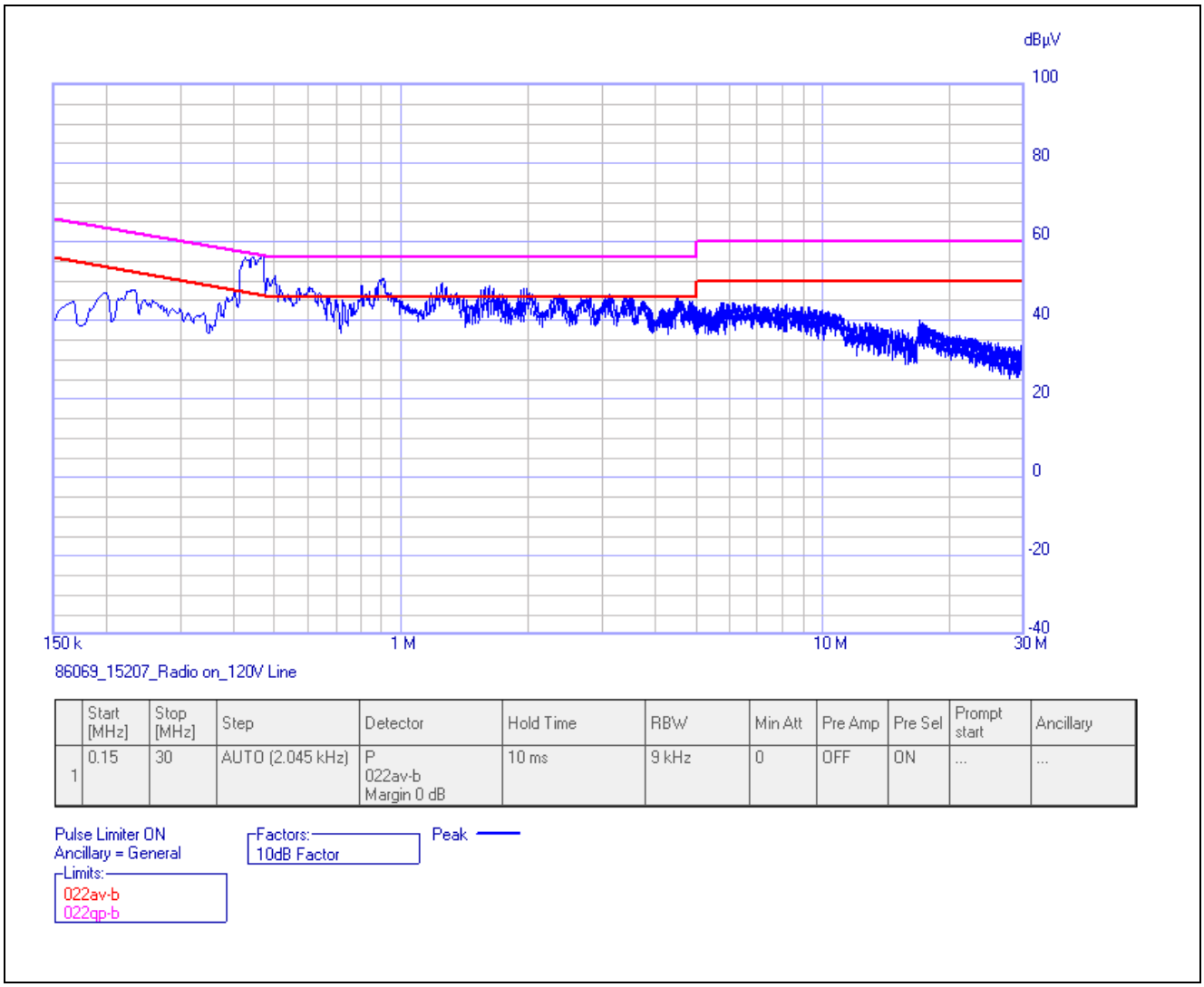
Test Engineer(s): Kaushani Dasgupta

Test Date(s): 06/15/15

15.207(a) Conducted Emissions Test Results

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line1	0.4690	53.61	56.547	-2.937	Pass	38.73	46.547	-7.817	Pass
Line1	0.8064	42.36	56	-13.64	Pass	29.3	46	-16.7	Pass
Line1	1.2440	44.15	56	-11.85	Pass	31.4	46	-14.6	Pass
Line1	1.6142	43.39	56	-12.61	Pass	31.14	46	-14.86	Pass
Line1	0.9066	45.25	56	-10.75	Pass	31.13	46	-14.87	Pass
Line1	1.2430	44.12	56	-11.88	Pass	31.38	46	-14.62	Pass

Table 8. Conducted Emissions, 15.207(a), Phase Line, Test Results

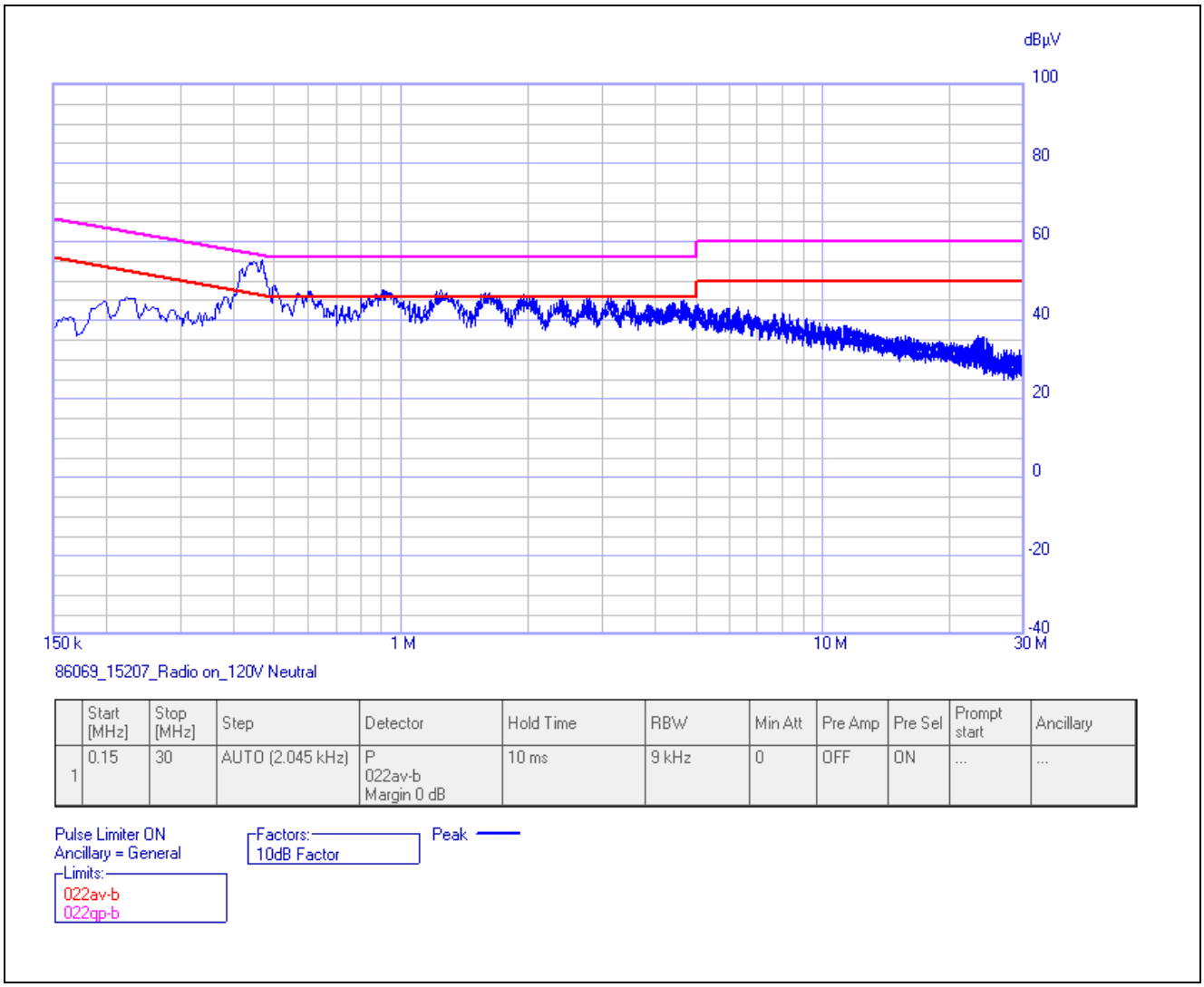


Plot 1. Conducted Emissions, 15.207(a), Phase Line

15.207(a) Conducted Emissions Test Results

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Neutral	0.4056	43.71	57.76	-14.05	Pass	34.14	47.76	-13.62	Pass
Neutral	0.4690	51.77	56.547	-4.777	Pass	41.39	46.547	-5.157	Fail
Neutral	0.6019	44.09	56	-11.91	Pass	35.28	46	-10.72	Fail
Neutral	0.9046	43.32	56	-12.68	Pass	33.36	46	-12.64	Pass
Neutral	1.2399	42.07	56	-13.93	Pass	34.28	46	-11.72	Pass
Neutral	1.5753	42.19	56	-13.81	Pass	33.47	46	-12.53	Pass

Table 9. Conducted Emissions, 15.207(a), Neutral Line, Test Results



Plot 2. Conducted Emissions, 15.207(a), Neutral Line

15.207(a) Conducted Emissions Test Setup Photo

Photograph 1. Conducted Emissions, 15.207(a), Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(2) 6 dB Bandwidth

Test Requirements: **§ 15.247(a)(2):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

Test Procedure: The transmitter was on and transmitting at the highest output power. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately 1% of the total emission bandwidth, VBW > RBW. The 6 dB Bandwidth was measured and recorded. The measurements were performed on the low, mid and high channels.

Test Results The EUT was compliant with § 15.247 (a)(2).

The 6 dB Bandwidth was determined from the plots on the following pages.

Test Engineer(s): Poona Saber

Test Date(s): 05/28/15

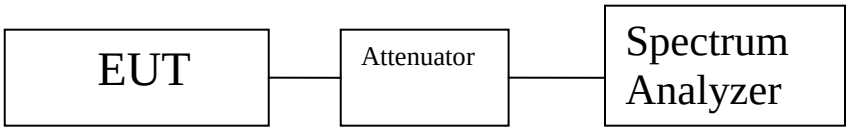
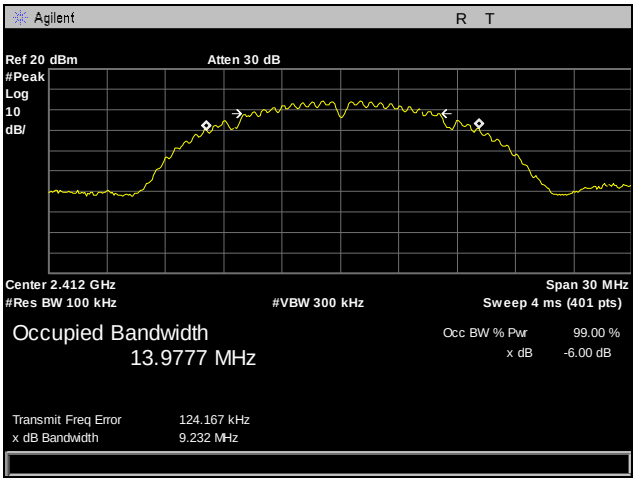


Figure 4. Block Diagram, Occupied Bandwidth Test Setup

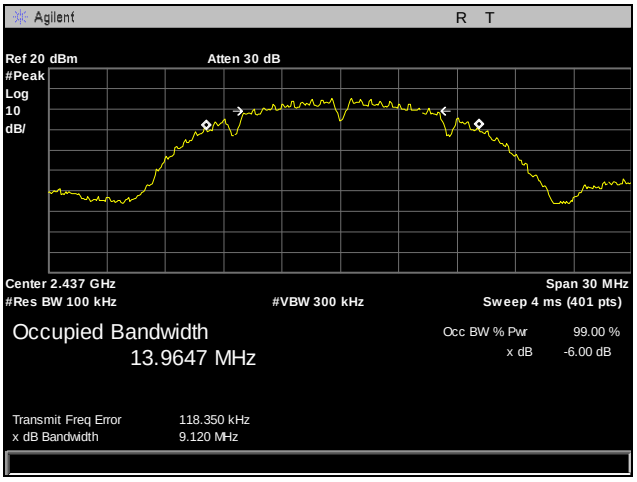
Occupied Bandwidth			
	Carrier Channel	**Frequency (MHz)**	**Measured 99% Bandwidth (MHz)**
802.11b	Low	2412	9.232
	Mid	2437	9.120
	High	2462	9.131
802.11g	Low	2412	15.195
	Mid	2437	15.189
	High	2462	15.189
802.11n	Low	2412	15.060
	Mid	2437	15.191
	High	2462	15.193

Table 10. 6 dB Occupied Bandwidth, Test Results

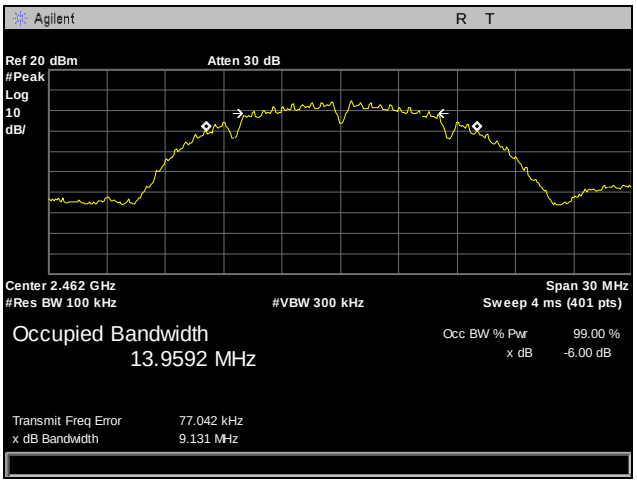
6 dB Occupied Bandwidth Test Results, 802.11b



Plot 3. 6 dB Occupied Bandwidth, Low Channel, 802.11b

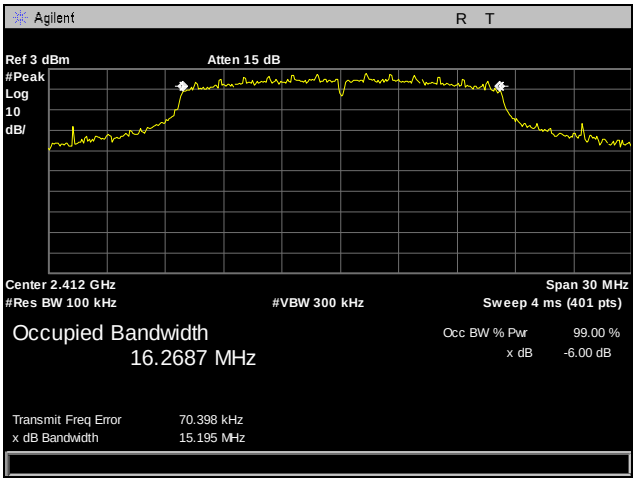


Plot 4. 6 dB Occupied Bandwidth, Mid Channel, 802.11b

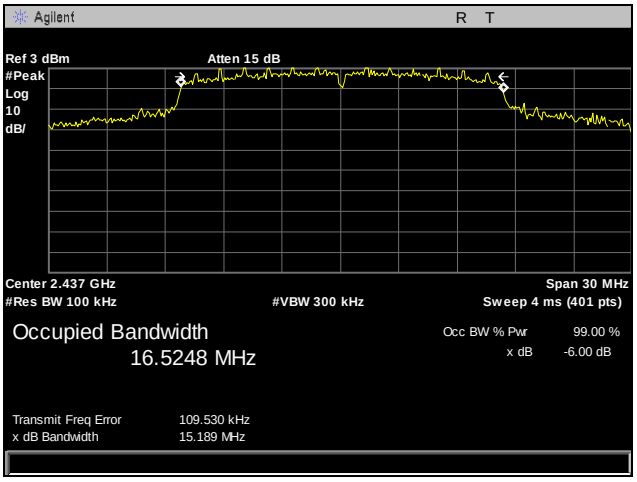


Plot 5. 6 dB Occupied Bandwidth, High Channel, 802.11b

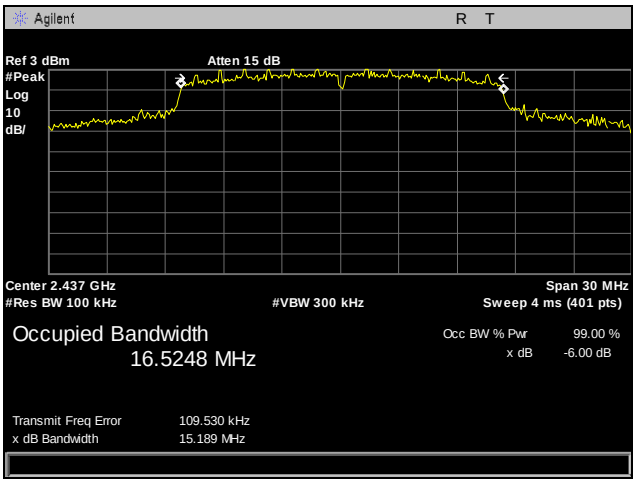
6 dB Occupied Bandwidth Test Results, 802.11g



Plot 6. 6 dB Occupied Bandwidth, Low Channel, 802.11g

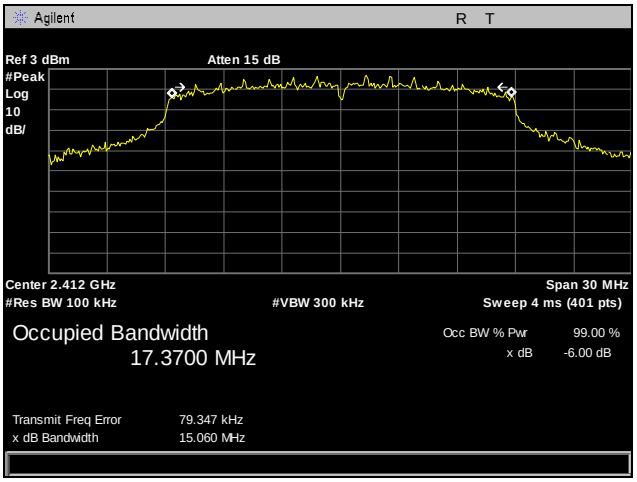


Plot 7. 6 dB Occupied Bandwidth, Mid Channel, 802.11g

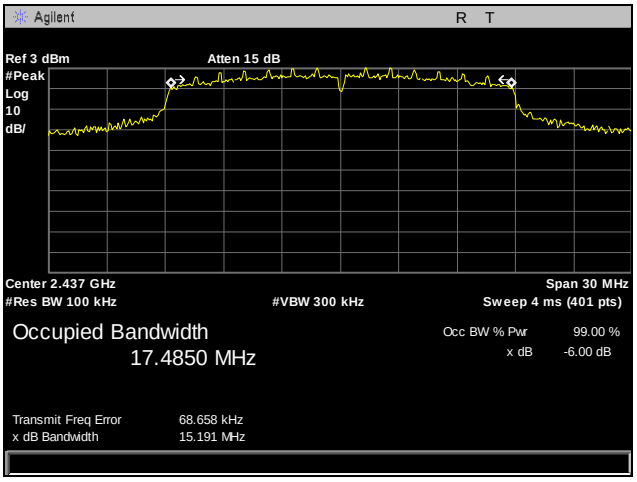


Plot 8. 6 dB Occupied Bandwidth, High Channel, 802.11g

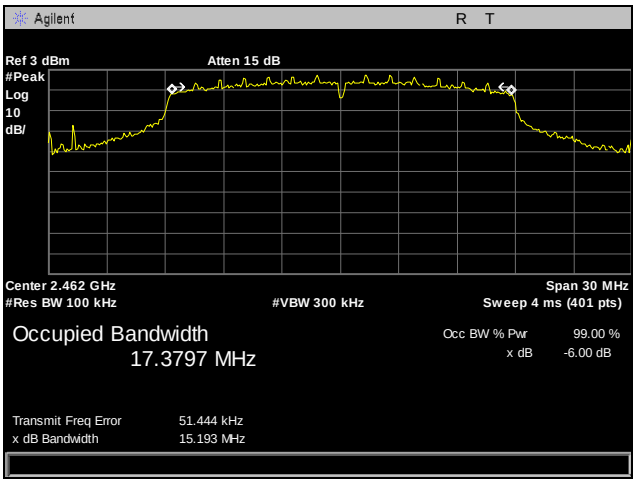
6 dB Occupied Bandwidth Test Results, 802.11n



Plot 9. 6 dB Occupied Bandwidth, Low Channel, 802.11n



Plot 10. 6 dB Occupied Bandwidth, Mid Channel, 802.11n



Plot 11. 6 dB Occupied Bandwidth, High Channel, 802.11n

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output

Test Requirements: **§15.247(b):** The maximum peak output power of the intentional radiator shall not exceed the following:

Digital Transmission Systems (MHz)	Output Limit (Watts)
902-928	1.000
2400–2483.5	1.000
5725– 5850	1.000

Table 11. Output Power Requirements from §15.247(b)

§15.247(c): if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in the Table 11, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400 – 2483.5 MHz band and using a point to point application may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

Fixed, point-to-point operation excludes the use of point-to-multipoint systems, Omni-directional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

Test Procedure: The transmitter was connected to a calibrated spectrum analyzer. The EUT was measured at the low, mid and high channels of each band at the maximum power level.

Test Results: The EUT was compliant with the Peak Power Output limits of **§15.247(b)**.

Test Engineer(s): Poona Saber

Test Date(s): 05/29/15

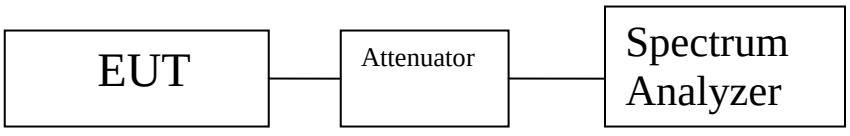


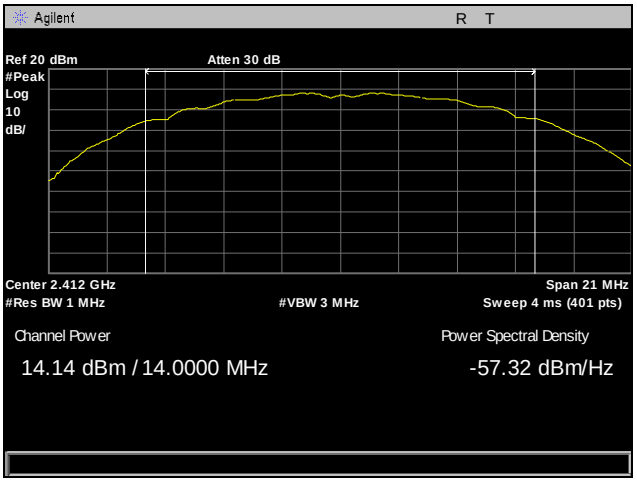
Figure 5. Peak Power Output Test Setup

Peak Power Output Test Results

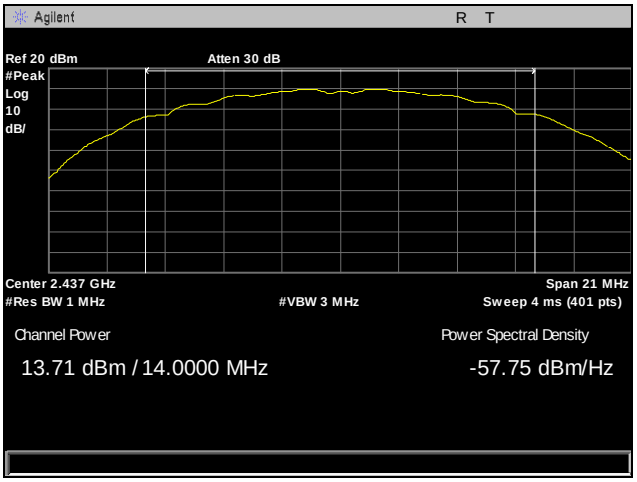
Peak Conducted Output Power			
	Carrier Channel	Frequency (MHz)	Measured Peak Output Power dBm
802.11b	Low	2412	14.14
	Mid	2437	13.71
	High	2462	14.99
802.11g	Low	2412	11.01
	Mid	2437	14.70
	High	2462	11.59
802.11n	Low	2412	10.57
	Mid	2437	13.78
	High	2462	11.24

Table 12. Peak Power Output, Test Results

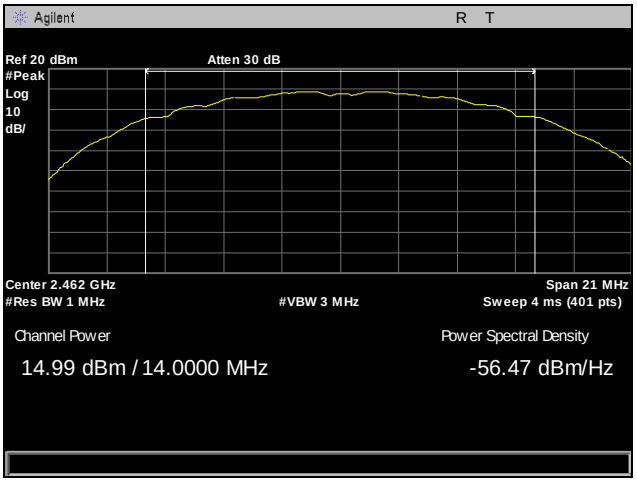
Peak Power Output Test Results, 802.11b



Plot 12. Peak Power Output, Low Channel, 802.11b

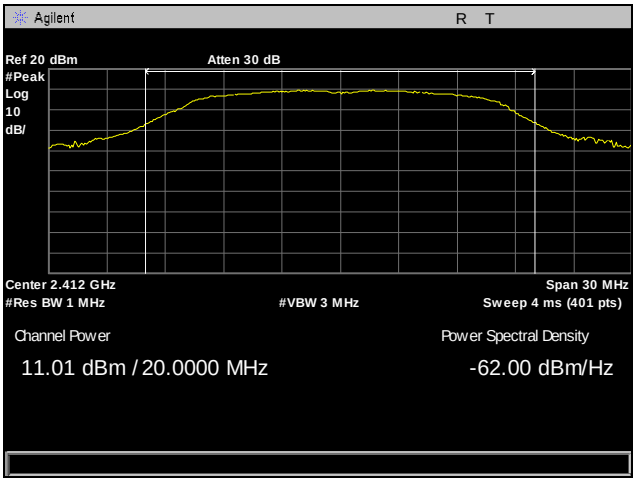


Plot 13. Peak Power Output, Mid Channel, 802.11b

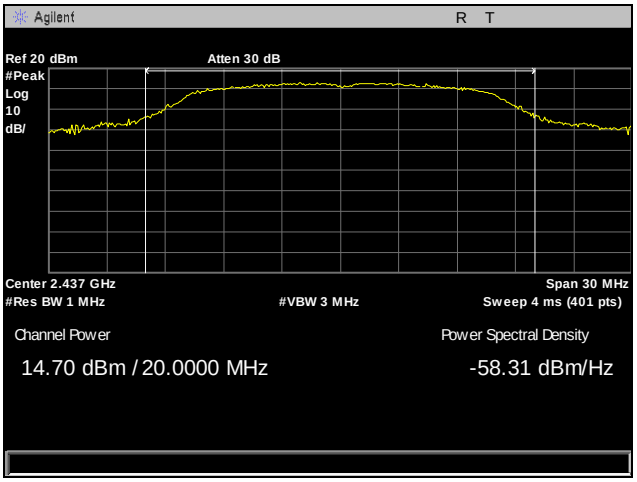


Plot 14. Peak Power Output, High Channel, 802.11b

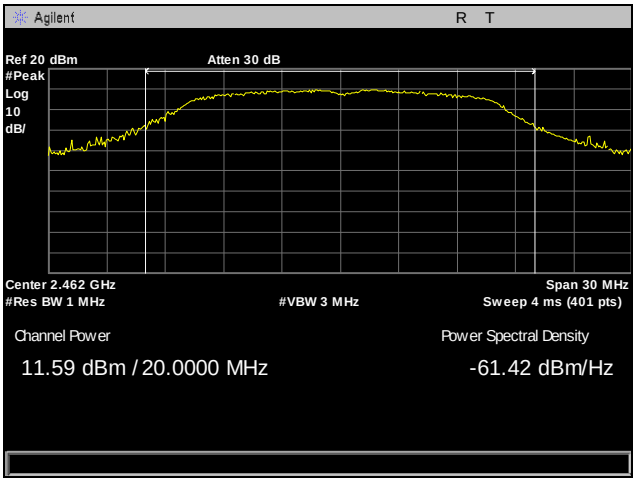
Peak Power Output Test Results, 802.11g



Plot 15. Peak Power Output, Low Channel, 802.11g

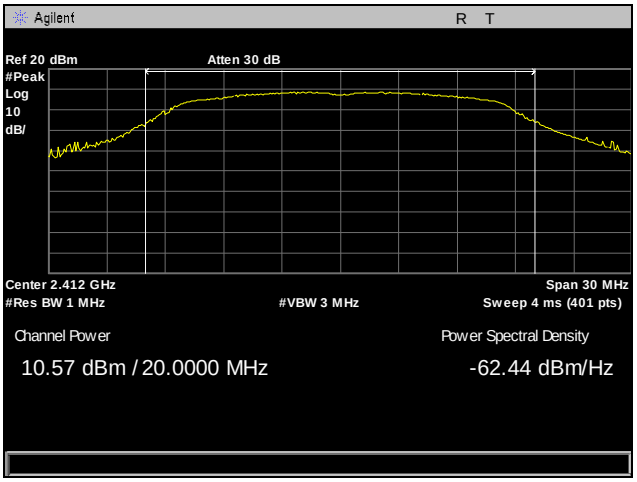


Plot 16. Peak Power Output, Mid Channel, 802.11g

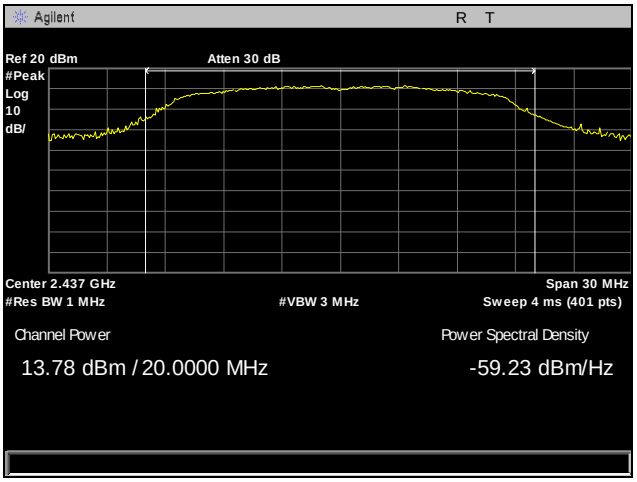


Plot 17. Peak Power Output, High Channel, 802.11g

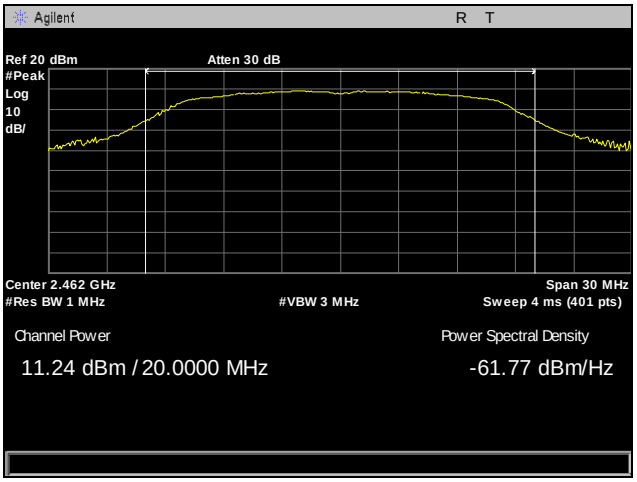
Peak Power Output Test Results, 802.11n



Plot 18. Peak Power Output, Low Channel, 802.11n



Plot 19. Peak Power Output, Mid Channel, 802.11n



Plot 20. Peak Power Output, High Channel, 802.11n

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Radiated Spurious Emissions Requirements and Band Edge

Test Requirements: **§15.247(d); §15.205:** Emissions outside the frequency band.

§15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

§15.205(a): Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090–0.110----------	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505----------	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905----------	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128----------	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775----------	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775----------	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218----------	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825----------	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225----------	123–138	2200–2300	14.47–14.5
8.291–8.294----------	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366----------	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675----------	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475----------	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293----------	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025----------	240–285	3345.8–3358 36.	43–36.5
12.57675–12.57725----------	322–335.4	3600–4400	([2])

Table 13. Restricted Bands of Operation

[1] Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.
[2] Above 38.6

Test Requirement(s): **§ 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 14.

Frequency (MHz)	§ 15.209(a),Radiated Emission Limits (dBµV) @ 3m
30 - 88	40.00
88 - 216	43.50
216 - 960	46.00
Above 960	54.00

Table 14. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

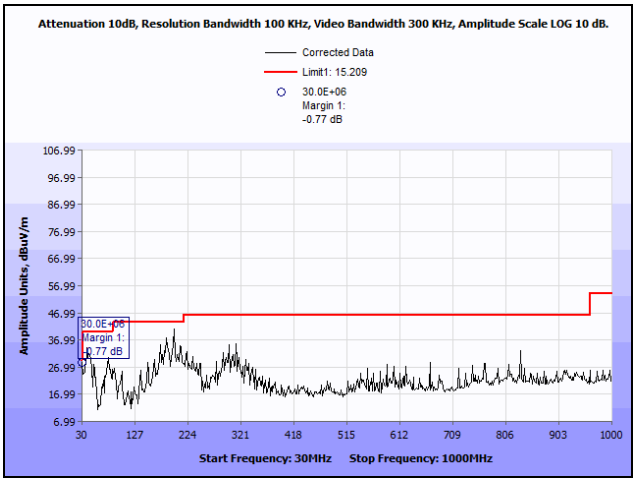
Test Procedures: The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line. Only noise floor was measured above 18 GHz.

Test Results: The EUT was compliant with the Radiated Spurious Emission limits of **§ 15.247(d)**.

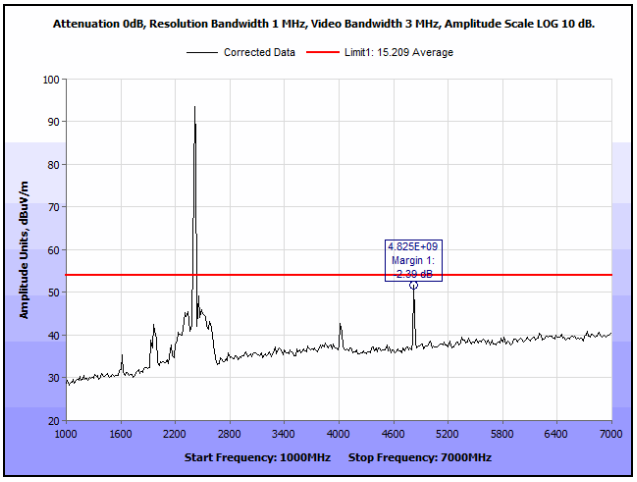
Test Engineer(s): Poona Saber

Test Date(s): 05/22/15

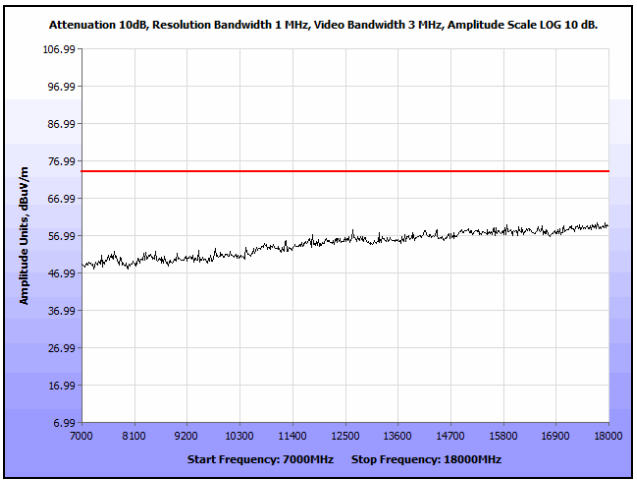
Radiated Spurious Emissions Test Results, 802.11b



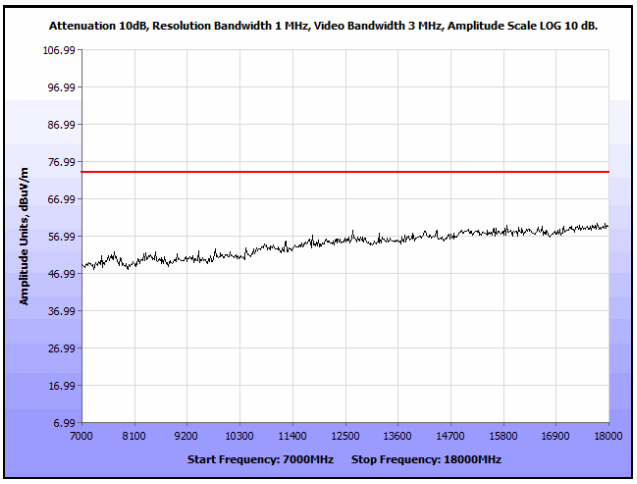
Plot 21. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz, 802.11b



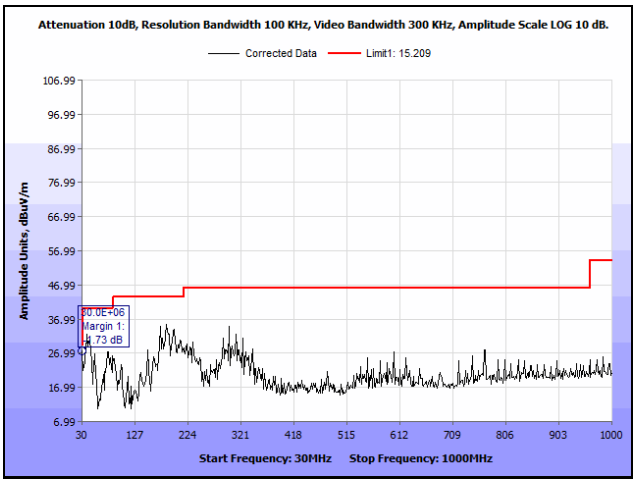
Plot 22. Radiated Spurious Emissions, Low Channel, 1 GHz – 7 GHz, Peak Measurement with Average Limit, 802.11b



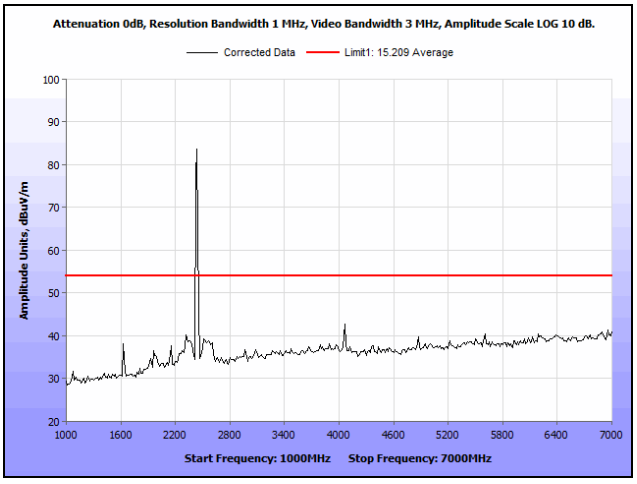
Plot 23. Radiated Spurious Emissions, Low Channel, 7 GHz – 18 GHz, Average, 802.11b



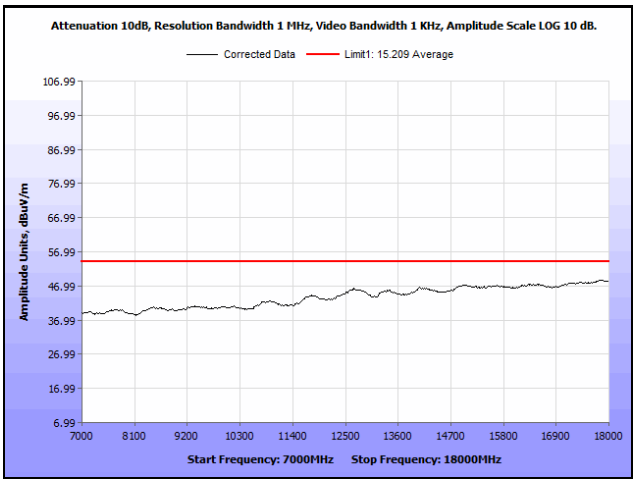
Plot 24. Radiated Spurious Emissions, Low Channel, 7 GHz – 18 GHz, Peak, 802.11b



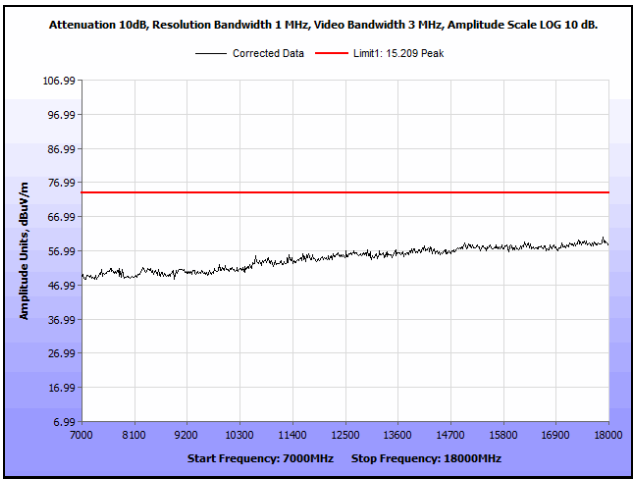
Plot 25. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, 802.11b



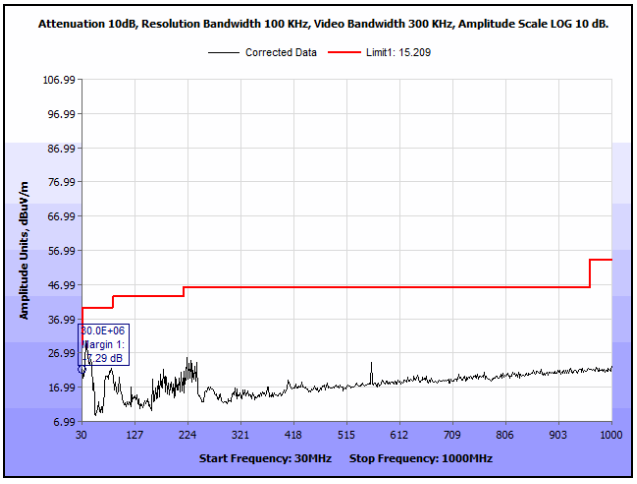
Plot 26. Radiated Spurious Emissions, Mid Channel, 1 GHz – 7 GHz, Peak Measurement with Average Limit, 802.11b



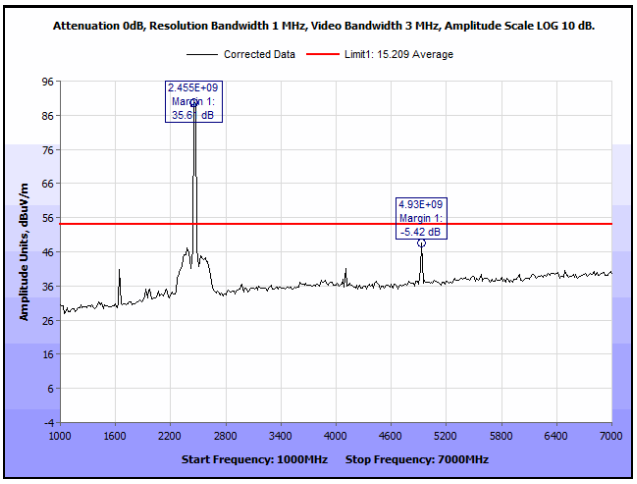
Plot 27. Radiated Spurious Emissions, Mid Channel, 7 GHz – 18 GHz, Average, 802.11b



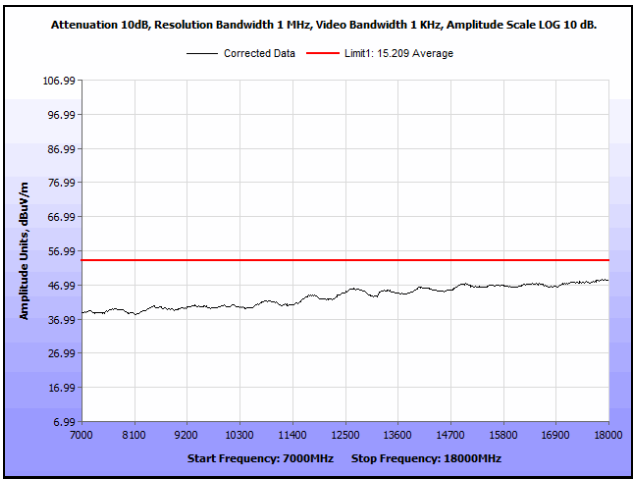
Plot 28. Radiated Spurious Emissions, Mid Channel, 7 GHz – 18 GHz, Peak, 802.11b



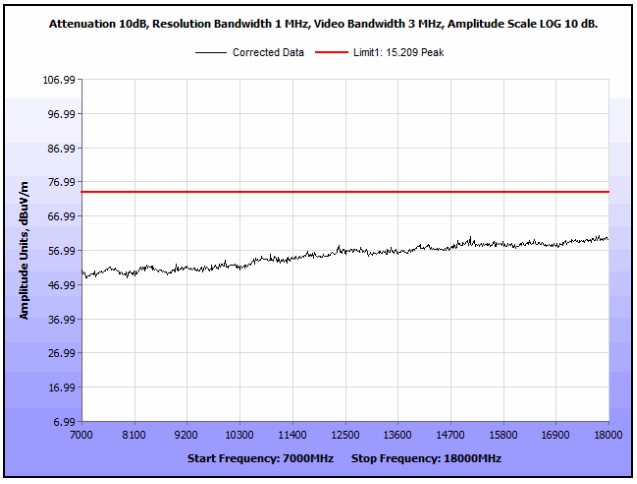
Plot 29. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz, 802.11b



Plot 30. Radiated Spurious Emissions, High Channel, 1 GHz – 7 GHz, Peak Measurement with Average Limit, 802.11b

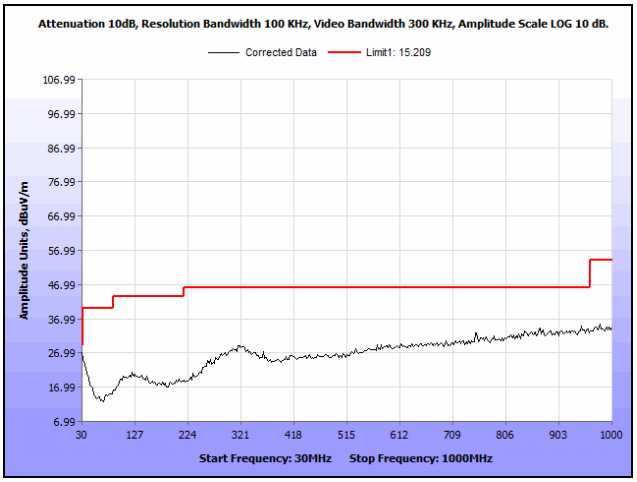


Plot 31. Radiated Spurious Emissions, High Channel, 7 GHz – 18 GHz, Average, 802.11b

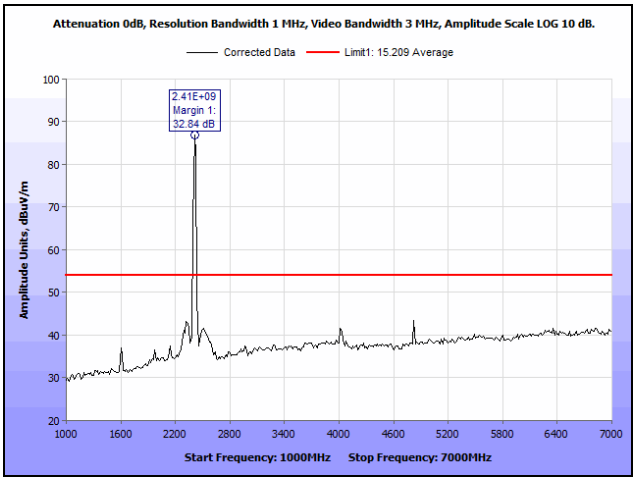


Plot 32. Radiated Spurious Emissions, High Channel, 7 GHz – 18 GHz, Peak, 802.11b

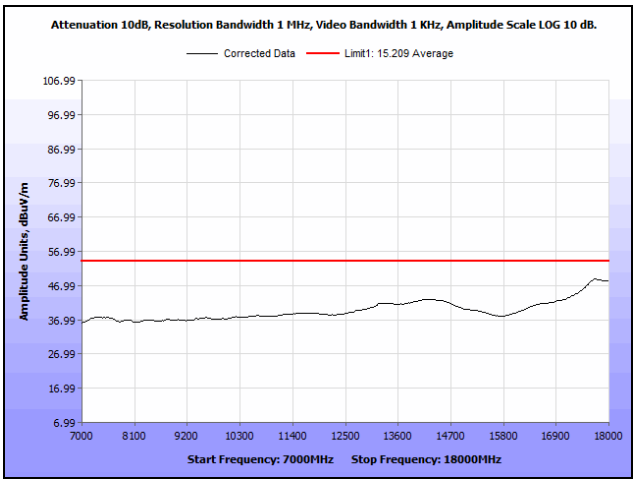
Radiated Spurious Emissions Test Results, 802.11g



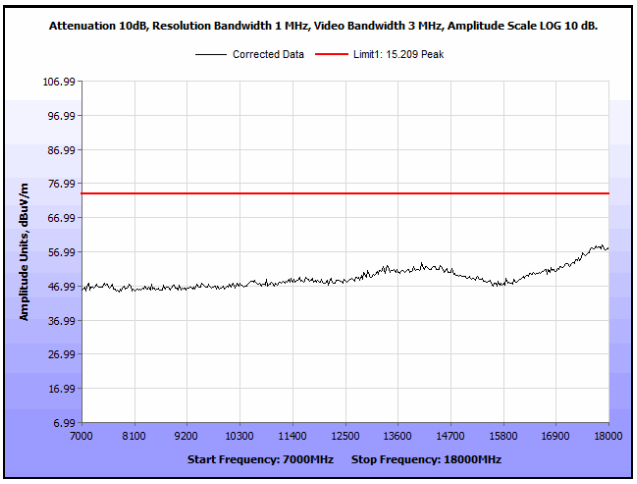
Plot 33. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz, 802.11g



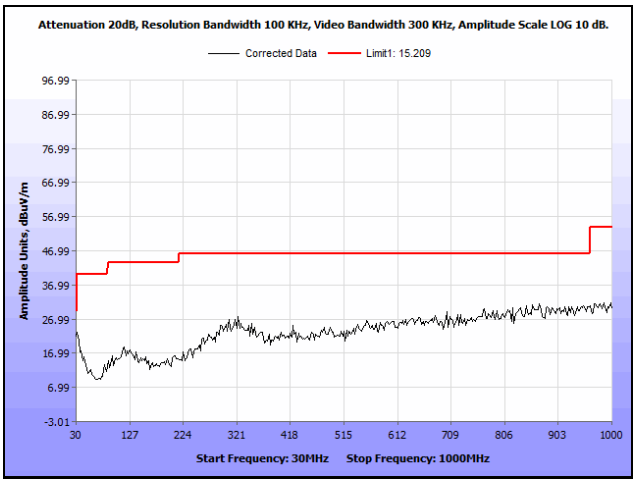
Plot 34. Radiated Spurious Emissions, Low Channel, 1 GHz – 7 GHz, Peak Measurement with Average Limit, 802.11g



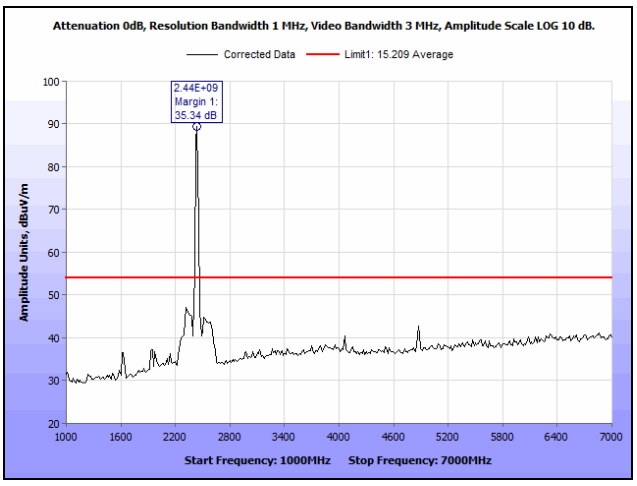
Plot 35. Radiated Spurious Emissions, Low Channel, 7 GHz – 18 GHz, Average, 802.11g



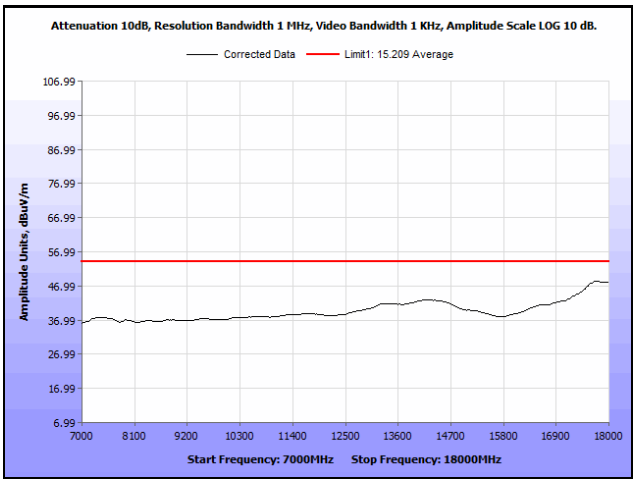
Plot 36. Radiated Spurious Emissions, Low Channel, 7 GHz – 18 GHz, Peak, 802.11g



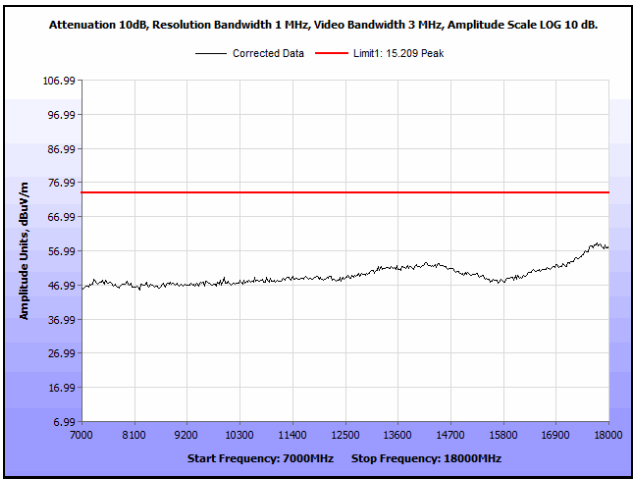
Plot 37. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, 802.11g



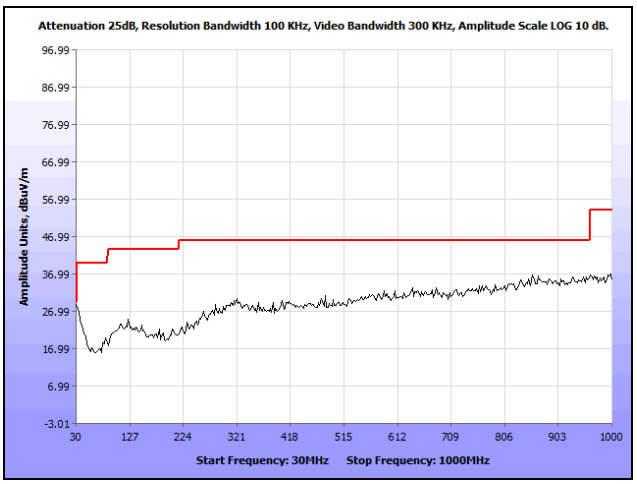
Plot 38. Radiated Spurious Emissions, Mid Channel, 1 GHz – 7 GHz, Peak Measurement with Average Limit, 802.11g



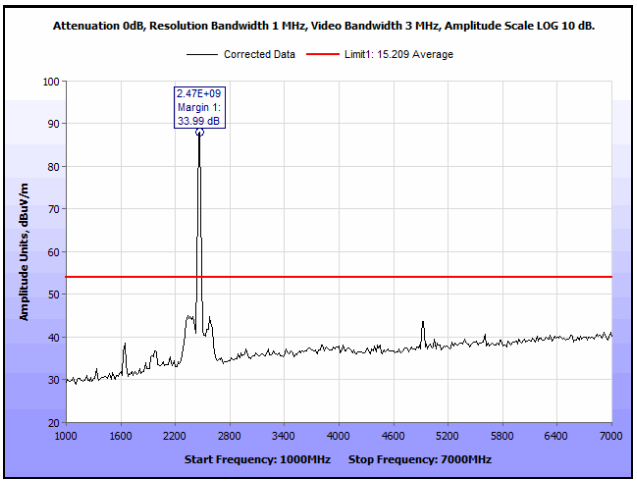
Plot 39. Radiated Spurious Emissions, Mid Channel, 7 GHz – 18 GHz, Average, 802.11g



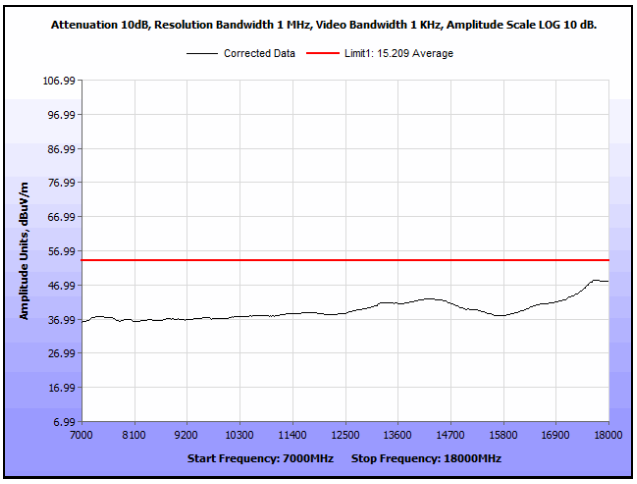
Plot 40. Radiated Spurious Emissions, Mid Channel, 7 GHz – 18 GHz, Peak, 802.11g



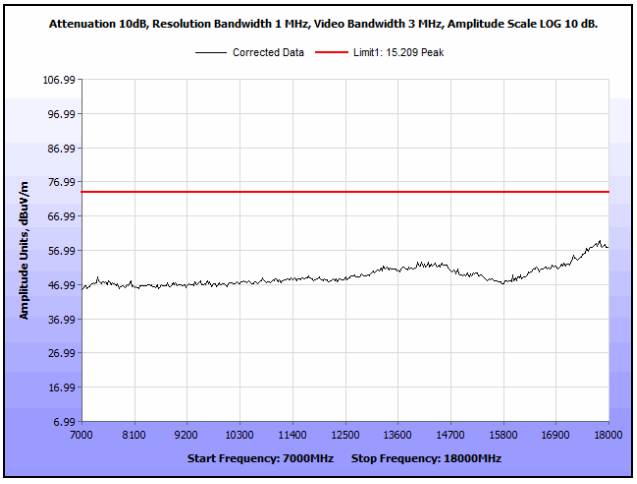
Plot 41. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz, 802.11g



Plot 42. Radiated Spurious Emissions, High Channel, 1 GHz – 7 GHz, Peak Measurement with Average Limit, 802.11g

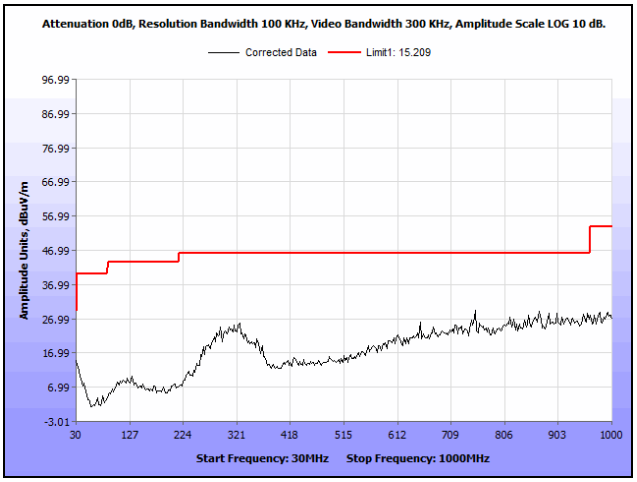


Plot 43. Radiated Spurious Emissions, High Channel, 7 GHz – 18 GHz, Average, 802.11g

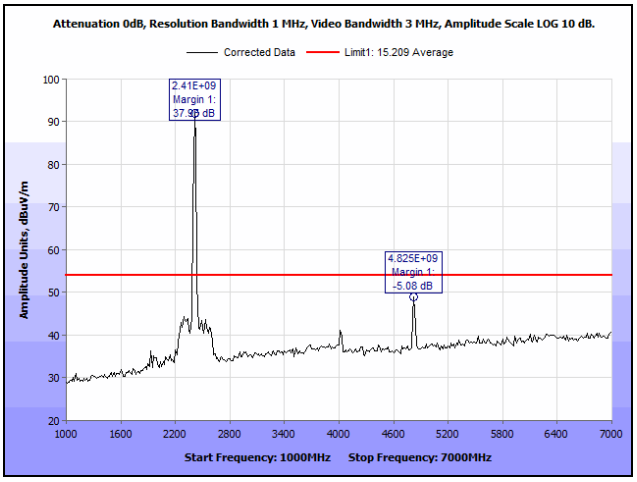


Plot 44. Radiated Spurious Emissions, High Channel, 7 GHz – 18 GHz, Peak, 802.11g

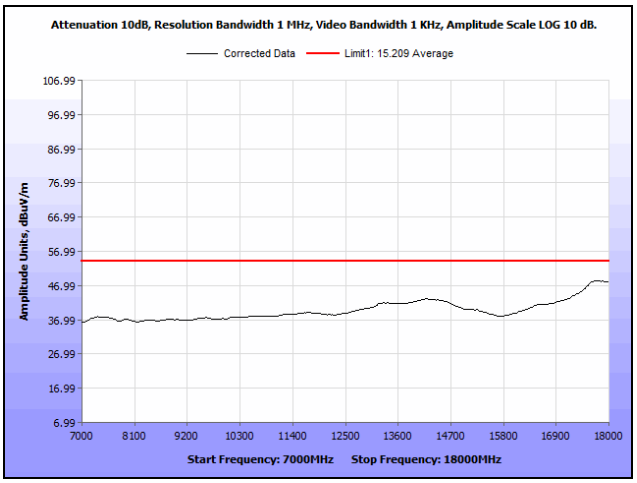
Radiated Spurious Emissions Test Results, 802.11n



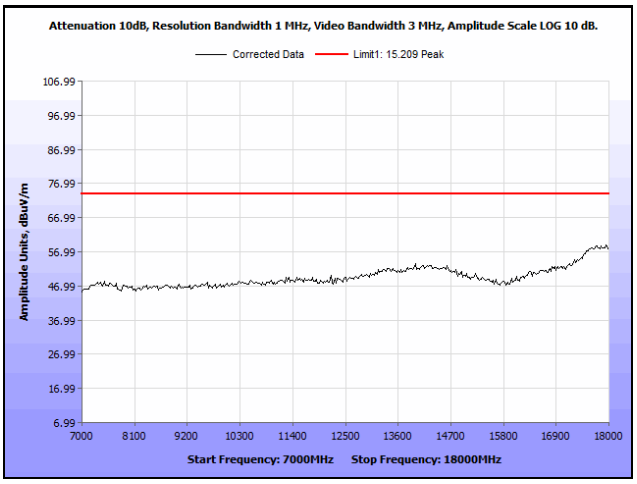
Plot 45. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz, 802.11n



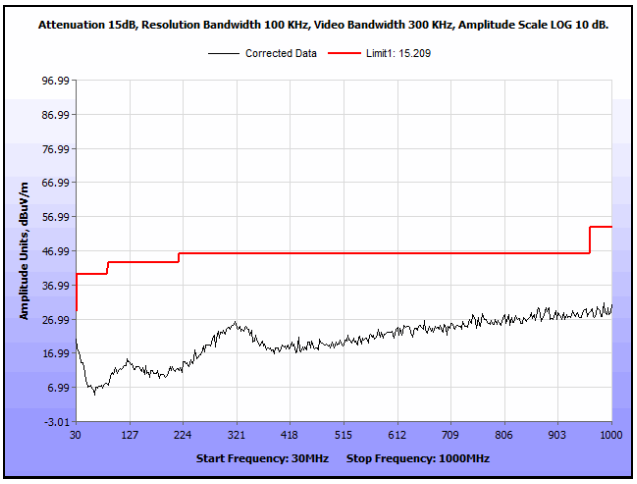
Plot 46. Radiated Spurious Emissions, Low Channel, 1 GHz – 7 GHz, Peak Measurement with Average Limit, 802.11n



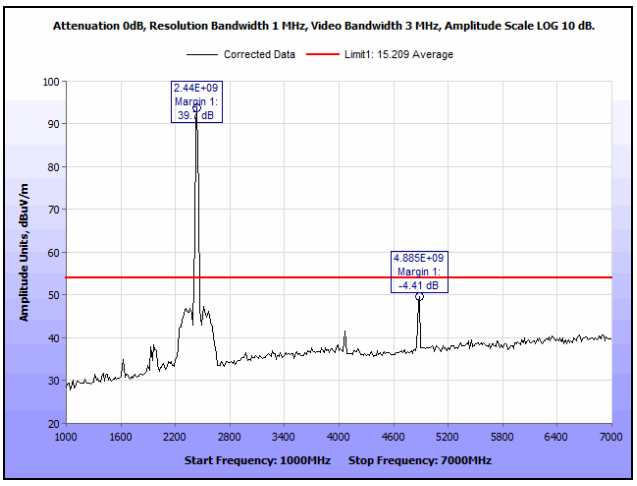
Plot 47. Radiated Spurious Emissions, Low Channel, 7 GHz – 18 GHz, Average, 802.11n



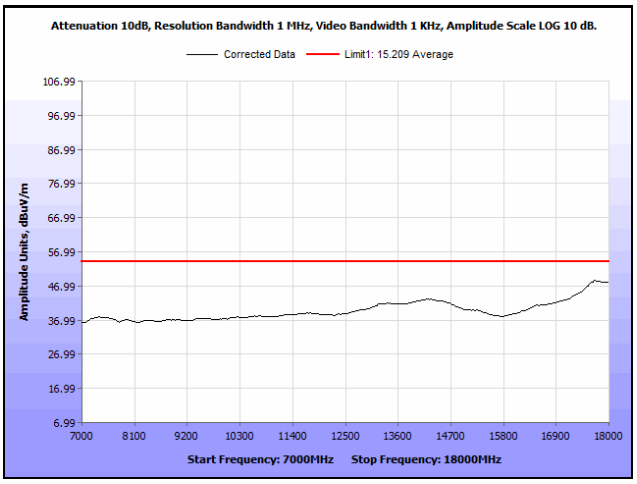
Plot 48. Radiated Spurious Emissions, Low Channel, 7 GHz – 18 GHz, Peak, 802.11n



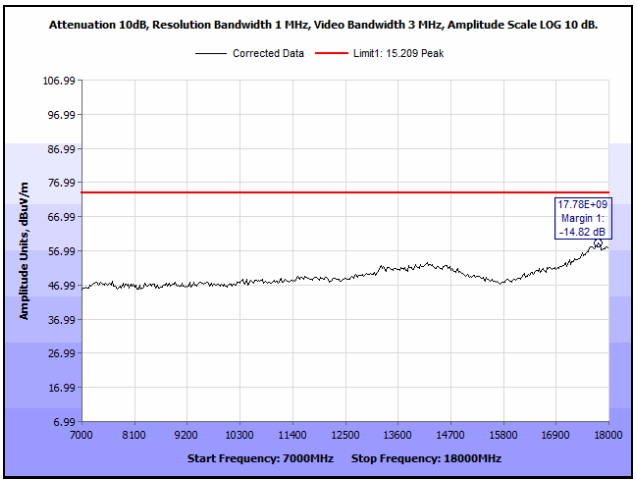
Plot 49. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, 802.11n



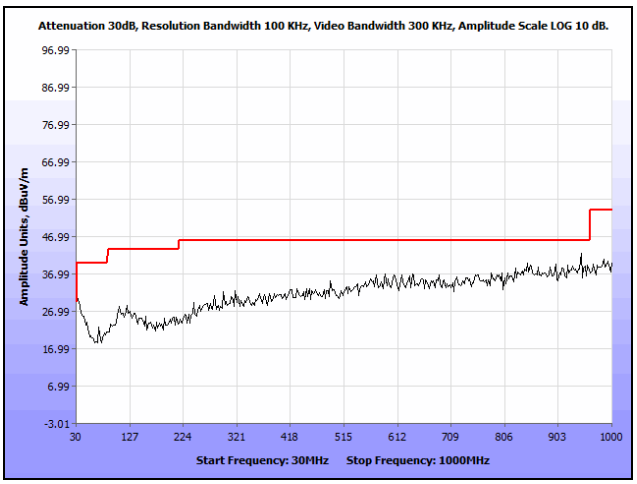
Plot 50. Radiated Spurious Emissions, Mid Channel, 1 GHz – 7 GHz, Peak Measurement with Average Limit, 802.11n



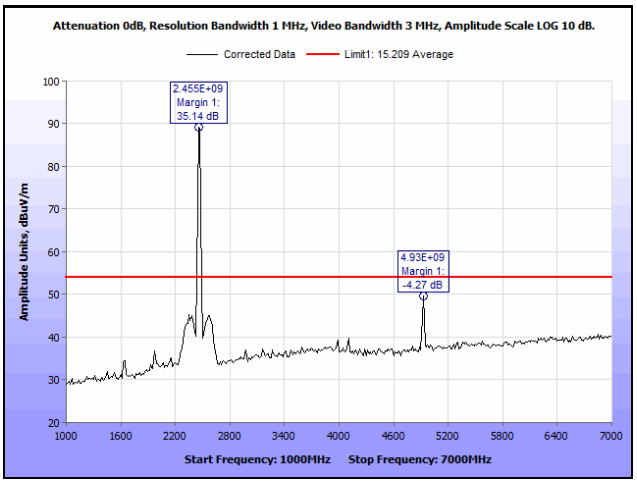
Plot 51. Radiated Spurious Emissions, Mid Channel, 7 GHz – 18 GHz, Average, 802.11n



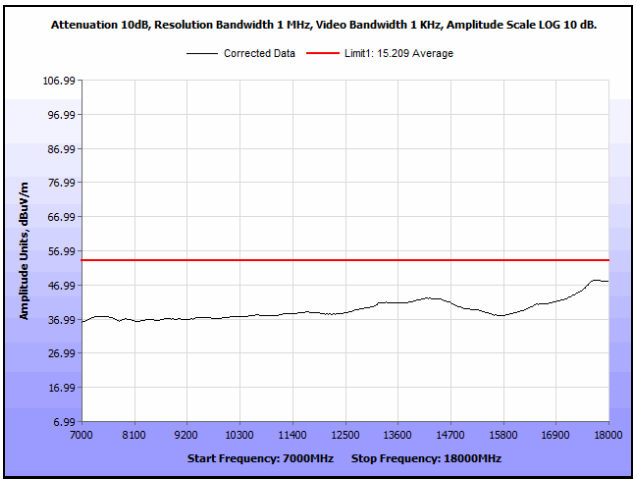
Plot 52. Radiated Spurious Emissions, Mid Channel, 7 GHz – 18 GHz, Peak, 802.11n



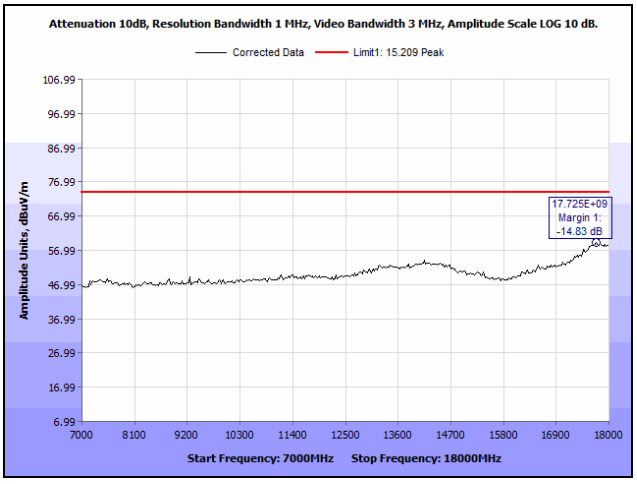
Plot 53. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz, 802.11n



Plot 54. Radiated Spurious Emissions, High Channel, 1 GHz – 7 GHz, Peak Measurement with Average Limit, 802.11n



Plot 55. Radiated Spurious Emissions, High Channel, 7 GHz – 18 GHz, Average, 802.11n

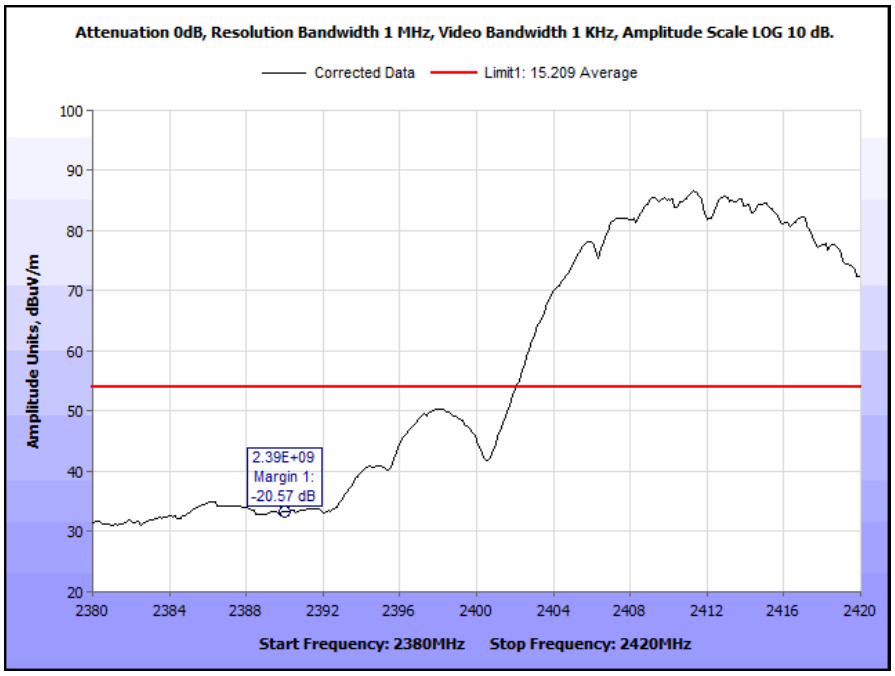


Plot 56. Radiated Spurious Emissions, High Channel, 7 GHz – 18 GHz, Peak, 802.11n

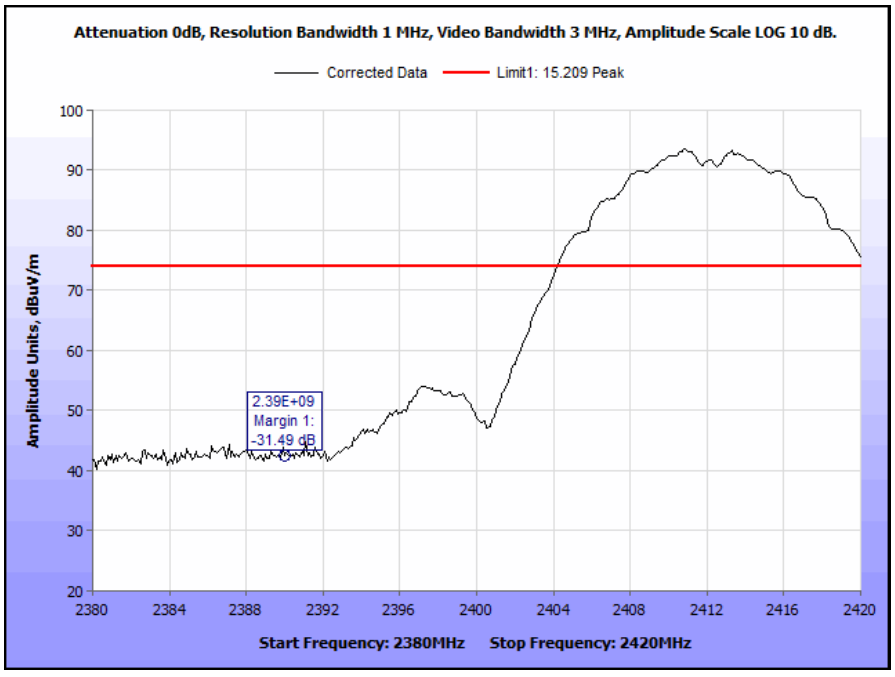
Radiated Band Edge Measurements

Test Procedures: The transmitter was turned on. Measurements were performed of the low and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line.

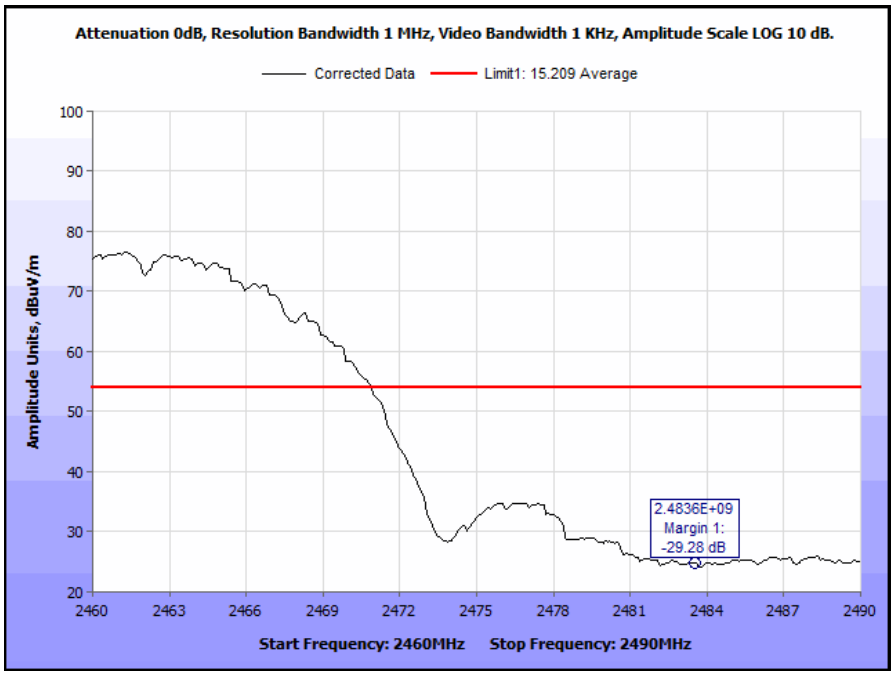
Radiated Band Edge Measurements, 802.11b



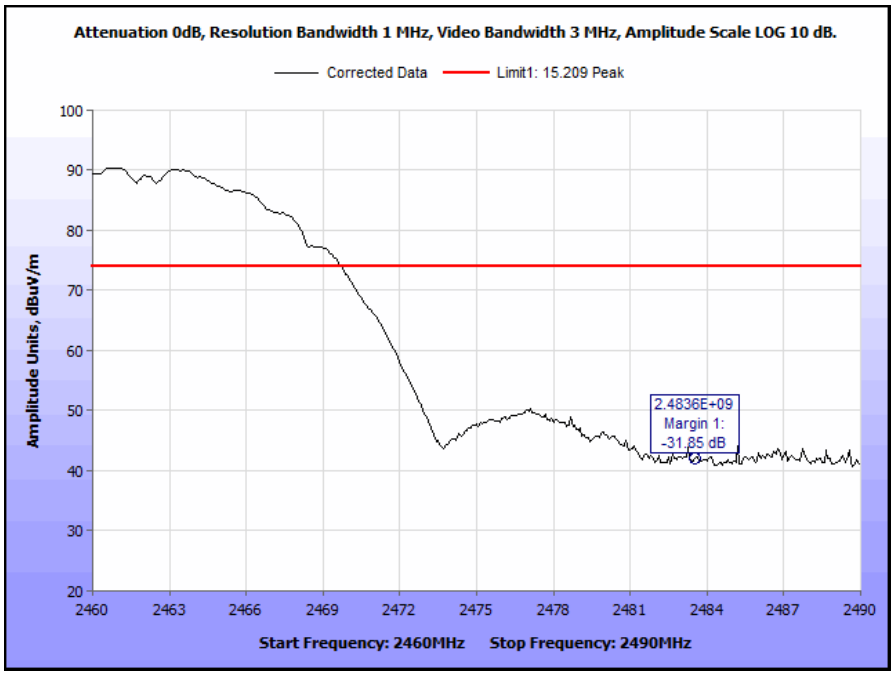
Plot 57. Radiated Restricted Band Edge, Low Channel, Average, 802.11b



Plot 58. Radiated Restricted Band Edge, Low Channel, Peak, 802.11b

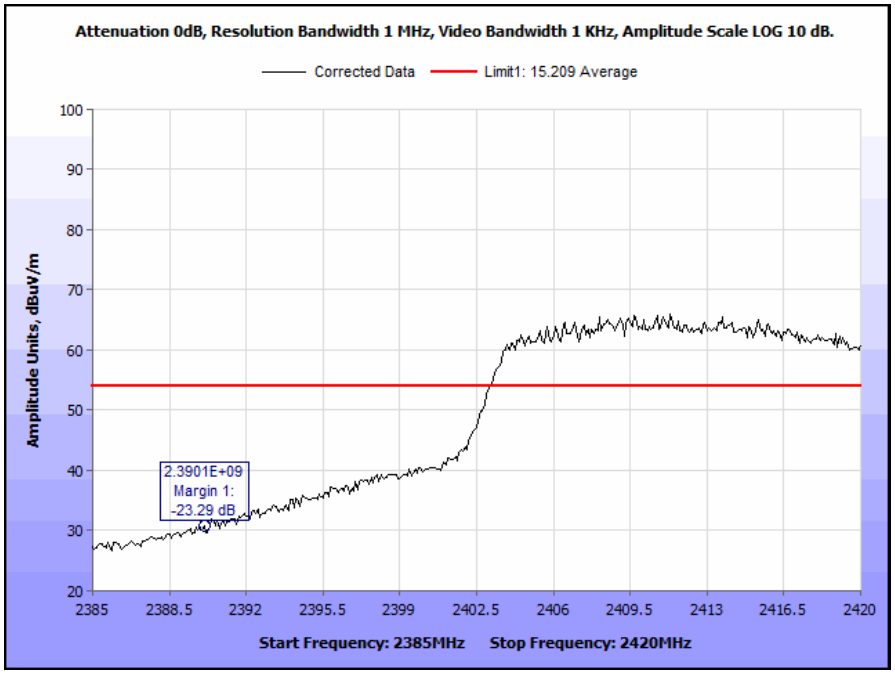


Plot 59. Radiated Restricted Band Edge, High Channel, Average, 802.11b

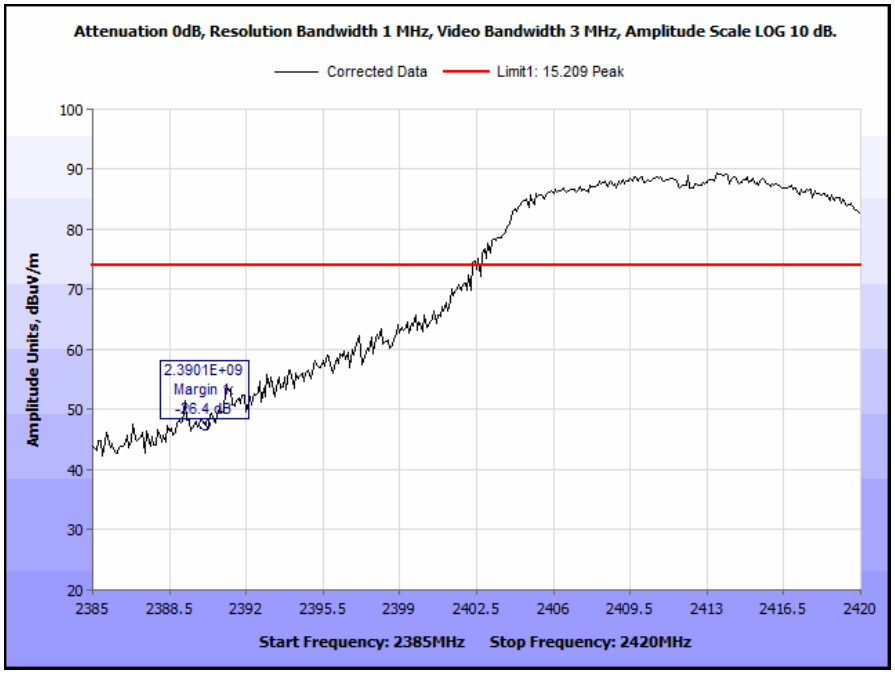


Plot 60. Radiated Restricted Band Edge, High Channel, Peak, 802.11b

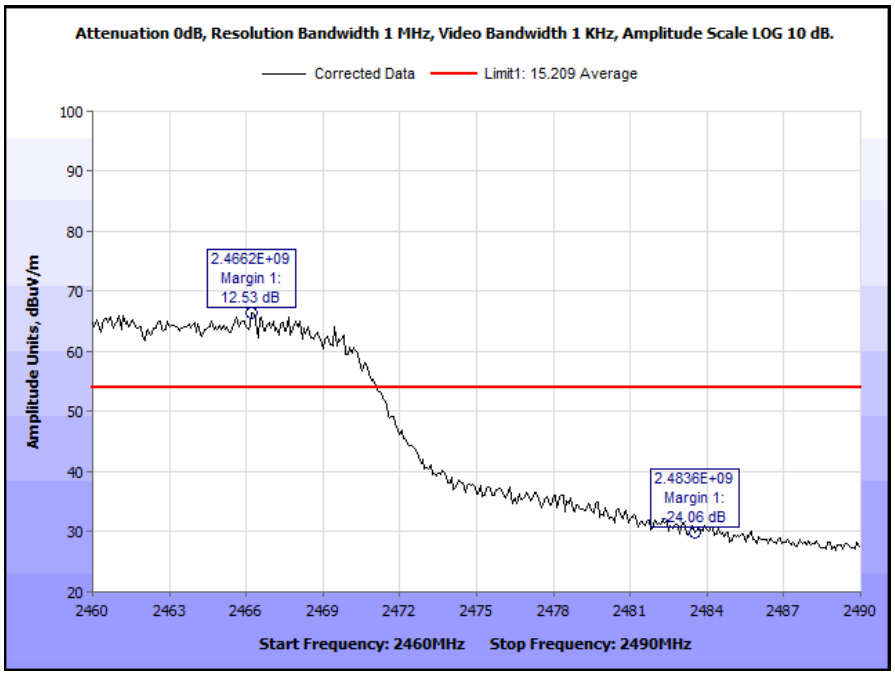
Radiated Band Edge Measurements, 802.11g



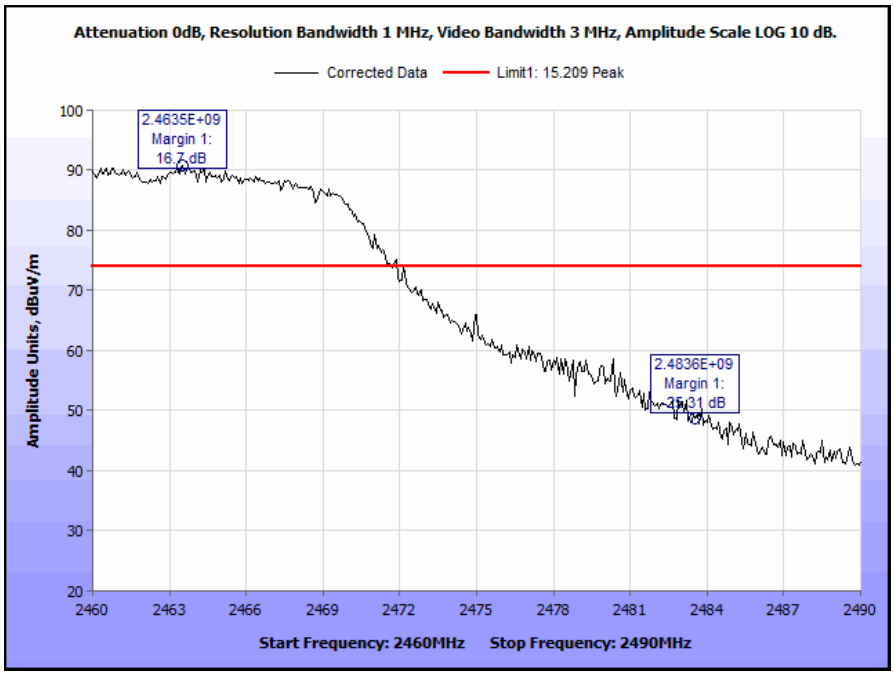
Plot 61. Radiated Restricted Band Edge, Low Channel, Average, 802.11g



Plot 62. Radiated Restricted Band Edge, Low Channel, Peak, 802.11g

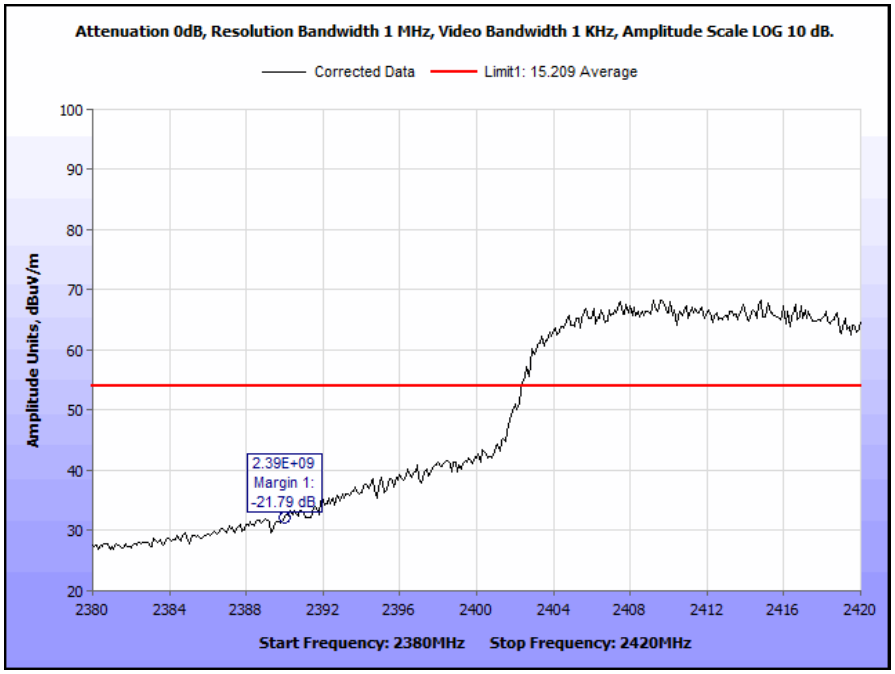


Plot 63. Radiated Restricted Band Edge, High Channel, Average, 802.11g

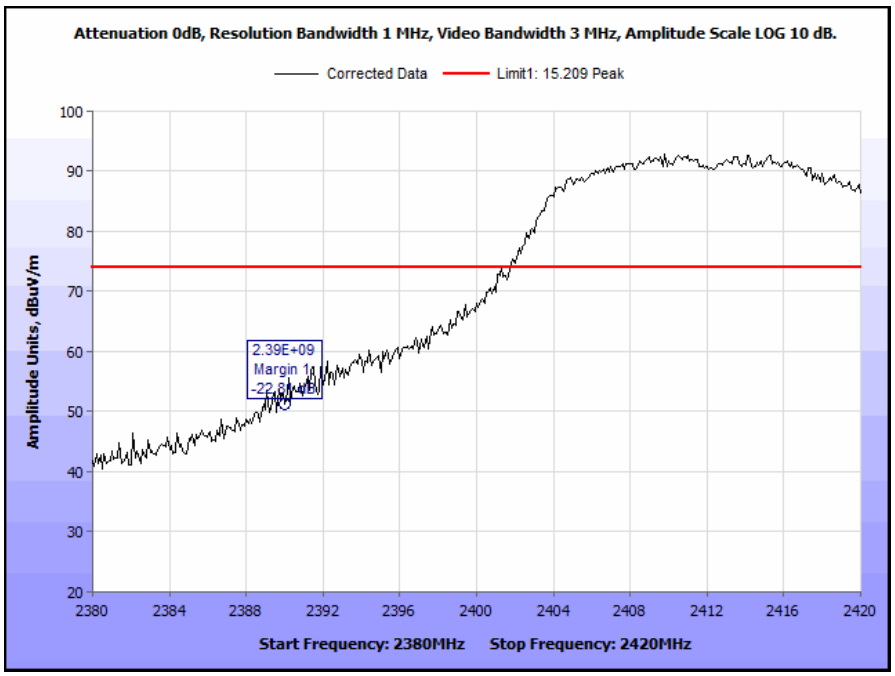


Plot 64. Radiated Restricted Band Edge, High Channel, Peak, 802.11g

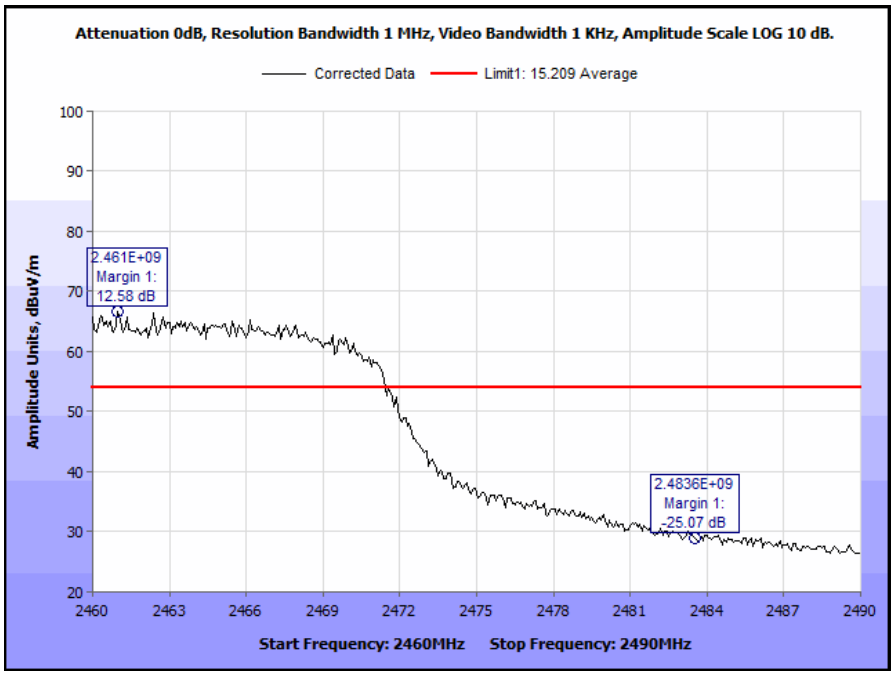
Radiated Band Edge Measurements, 802.11n



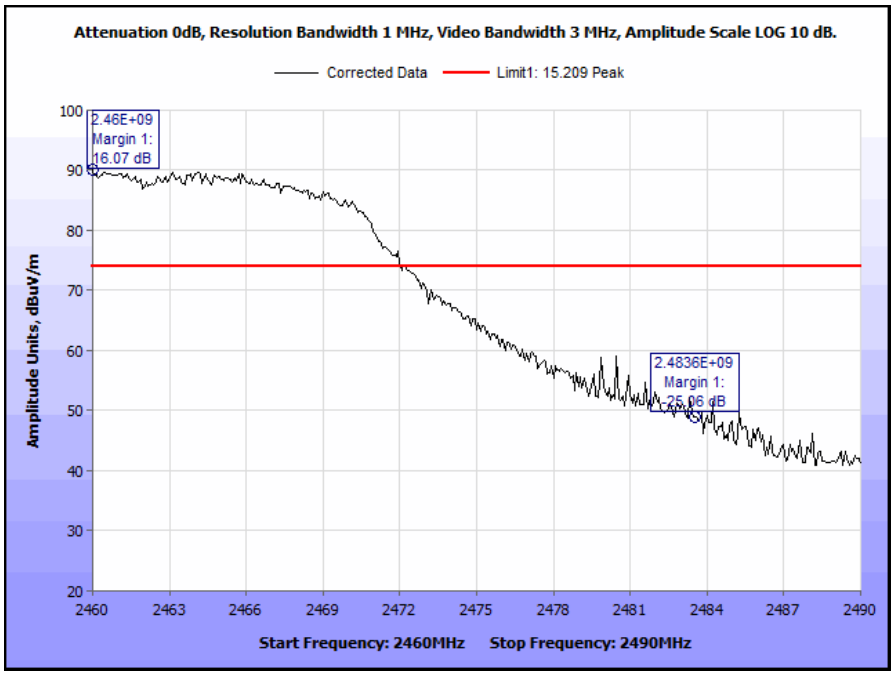
Plot 65. Radiated Restricted Band Edge, Low Channel, Average, 802.11n



Plot 66. Radiated Restricted Band Edge, Low Channel, Peak, 802.11n

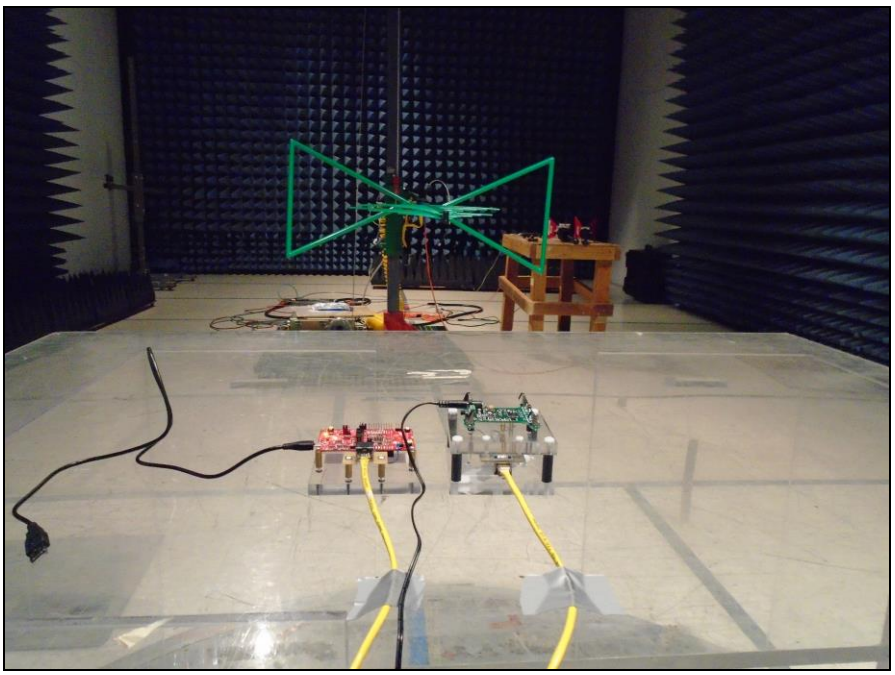


Plot 67. Radiated Restricted Band Edge, High Channel, Average, 802.11n

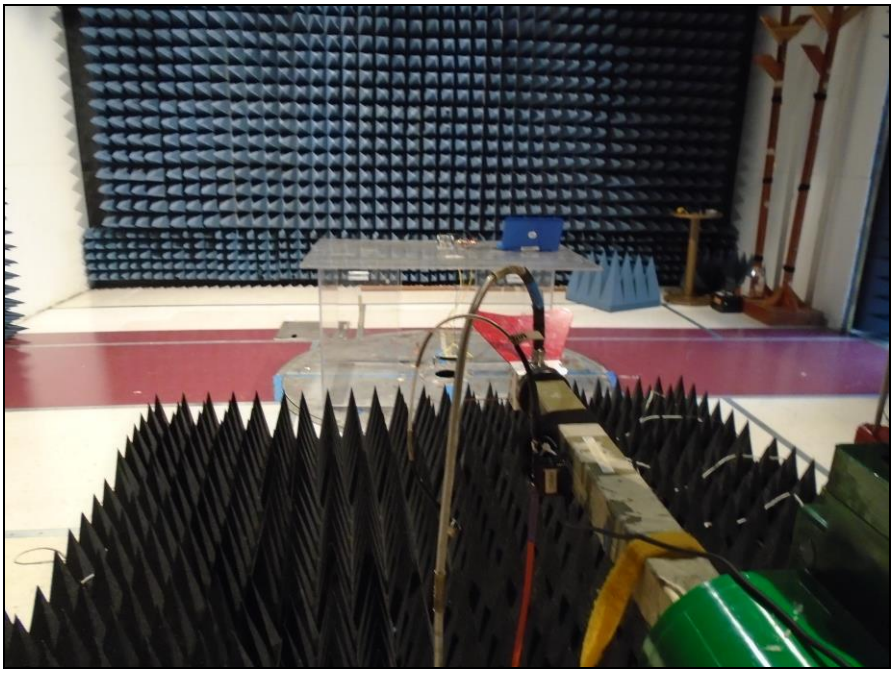


Plot 68. Radiated Restricted Band Edge, High Channel, Peak, 802.11n

Radiated Spurious Emissions Test Setup



Photograph 2. Radiated Spurious Emissions, Test Setup, 30 MHz – 1 GHz



Photograph 3. Radiated Spurious Emissions, Test Setup, 1 GHz – 18 GHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) RF Conducted Spurious Emissions Requirements and Band Edge

Test Requirement: **15.247(d)** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Test Procedure: For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

Since the EUT had an integral antenna, conducted measurements could not be performed. Measurements needed to be taken radiated. An antenna was located 3 m away from the EUT and plots were taken. The EUT was rotated through all three orthogonal axes. The plots were corrected for both antenna correction factor and cable lost.

See following pages for detailed test results with RF Conducted Spurious Emissions.

Test Results: The EUT was compliant with the Conducted Spurious Emission limits of **§15.247(d)**.

Test Engineer(s): Poona Saber

Test Date(s): 06/10/15

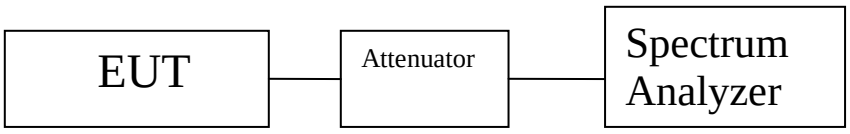
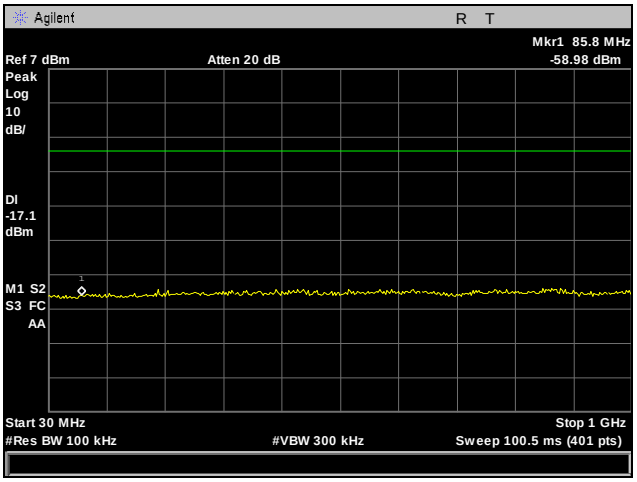
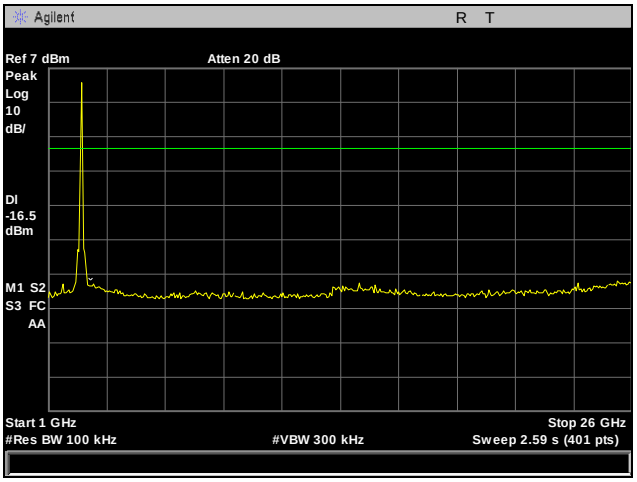


Figure 6. Block Diagram, Conducted Spurious Emissions Test Setup

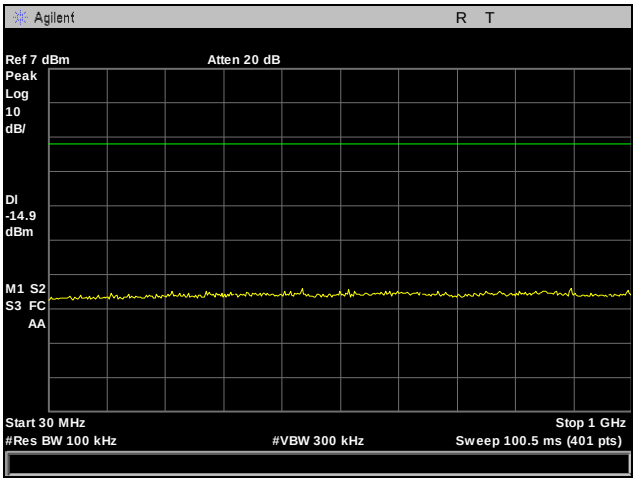
Conducted Spurious Emissions Test Results, 802.11b



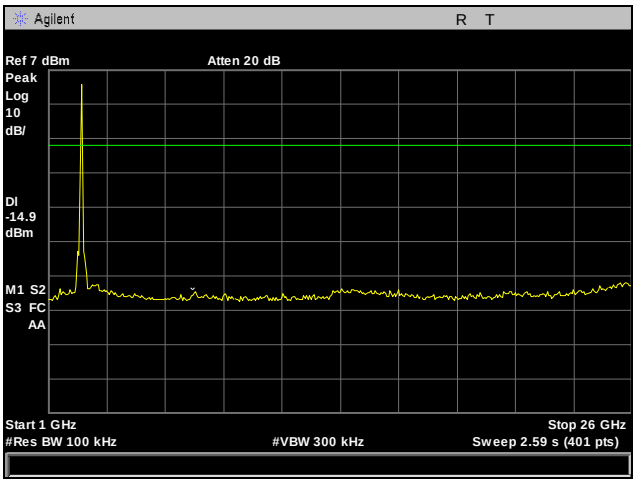
Plot 69. Conducted Spurious Emissions, Low Channel, 30 MHz – 1 GHz, 802.11b



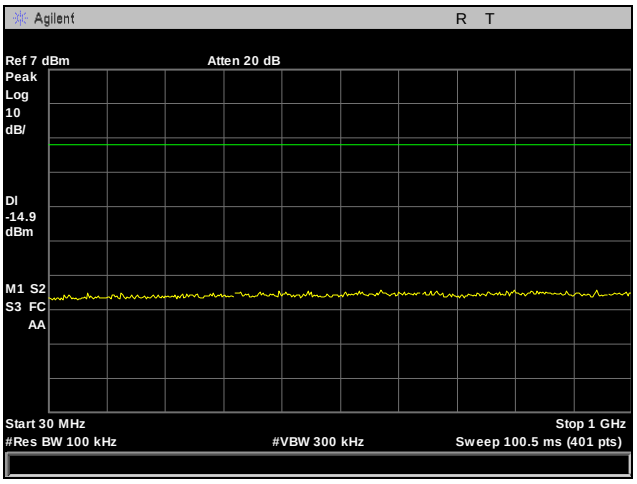
Plot 70. Conducted Spurious Emissions, Low Channel, 1 GHz – 26 GHz, 802.11b



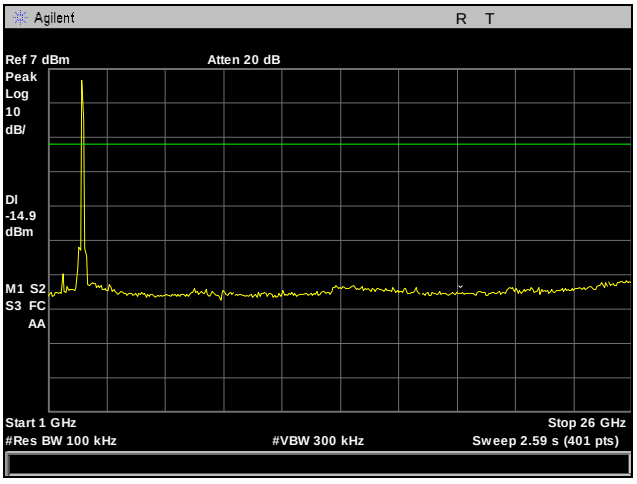
Plot 71. Conducted Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, 802.11b



Plot 72. Conducted Spurious Emissions, Mid Channel, 1 GHz – 26 GHz, 802.11b

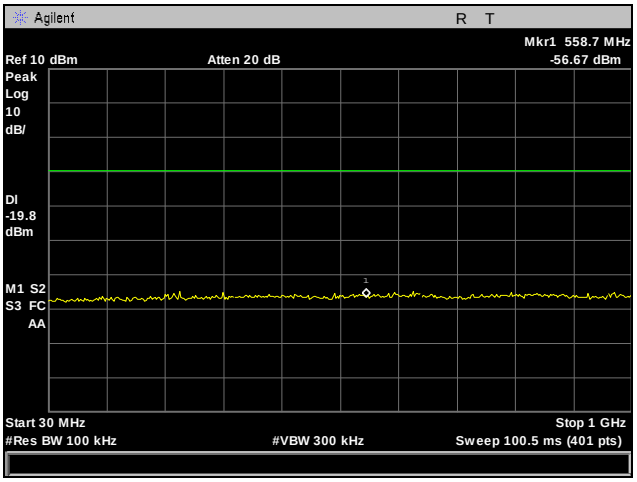


Plot 73. Conducted Spurious Emissions, High Channel, 30 MHz – 1 GHz, 802.11b

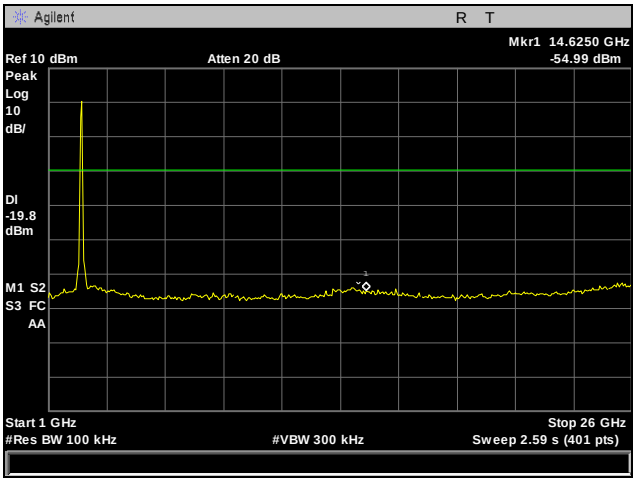


Plot 74. Conducted Spurious Emissions, High Channel, 1 GHz – 26 GHz, 802.11b

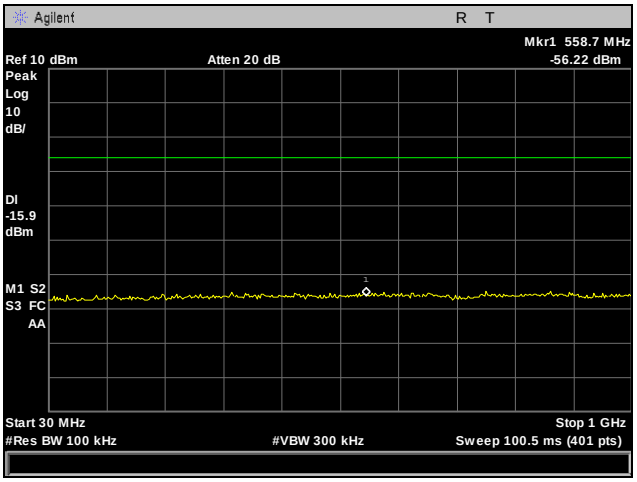
Conducted Spurious Emissions Test Results, 802.11g



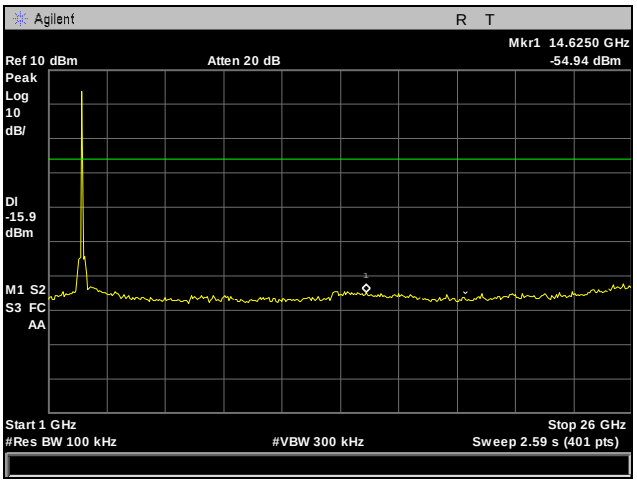
Plot 75. Conducted Spurious Emissions, Low Channel, 30 MHz – 1 GHz, 802.11g



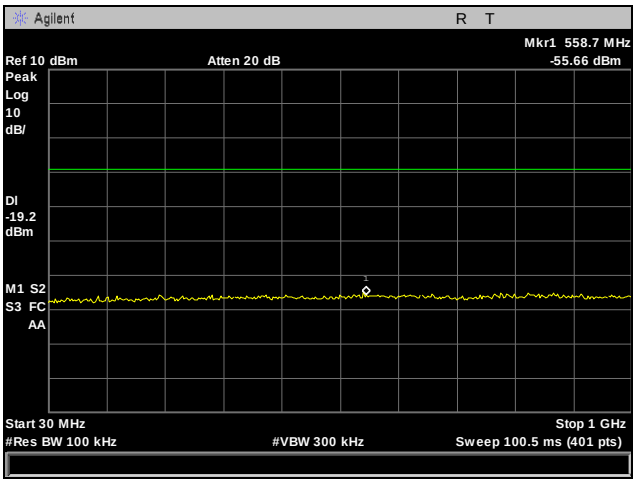
Plot 76. Conducted Spurious Emissions, Low Channel, 1 GHz – 26 GHz, 802.11g



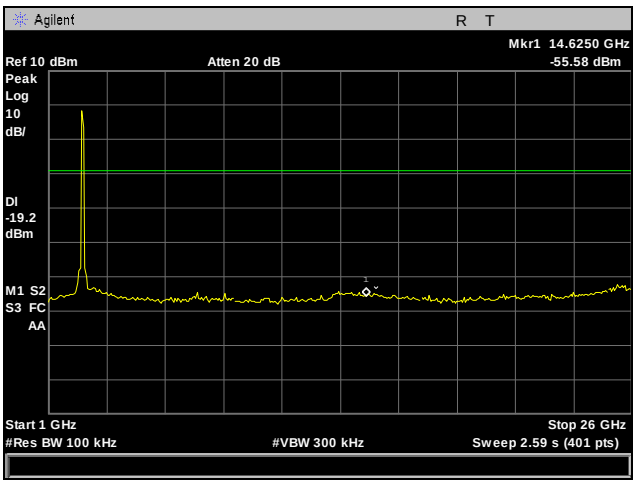
Plot 77. Conducted Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, 802.11g



Plot 78. Conducted Spurious Emissions, Mid Channel, 1 GHz – 26 GHz, 802.11g

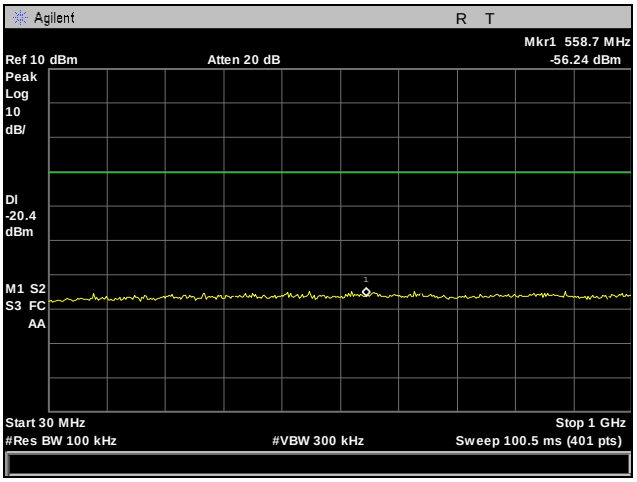


Plot 79. Conducted Spurious Emissions, High Channel, 30 MHz – 1 GHz, 802.11g

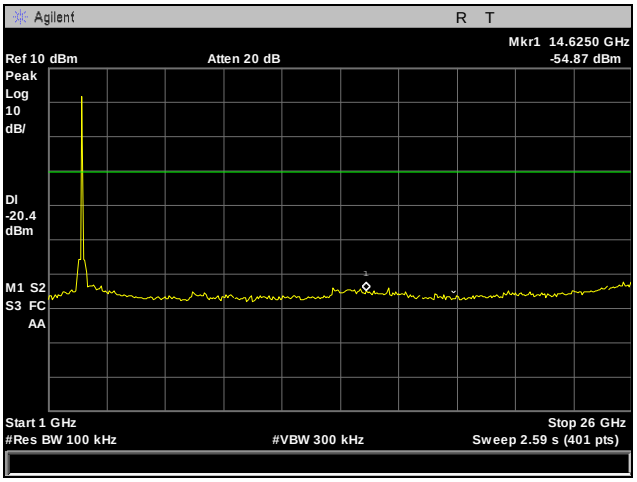


Plot 80. Conducted Spurious Emissions, High Channel, 1 GHz – 26 GHz, 802.11g

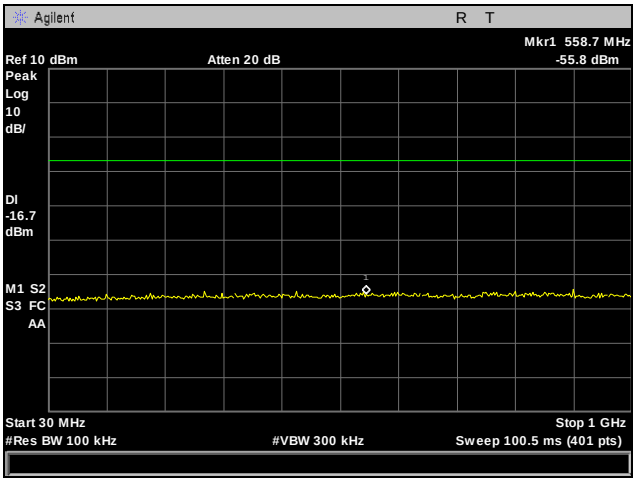
Conducted Spurious Emissions Test Results, 802.11n



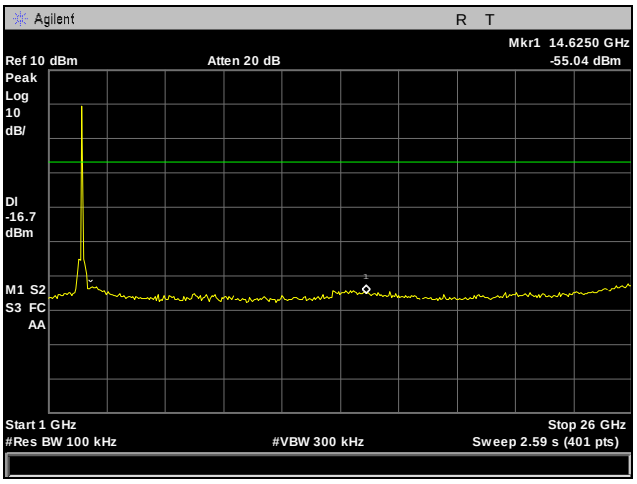
Plot 81. Conducted Spurious Emissions, Low Channel, 30 MHz – 1 GHz, 802.11n



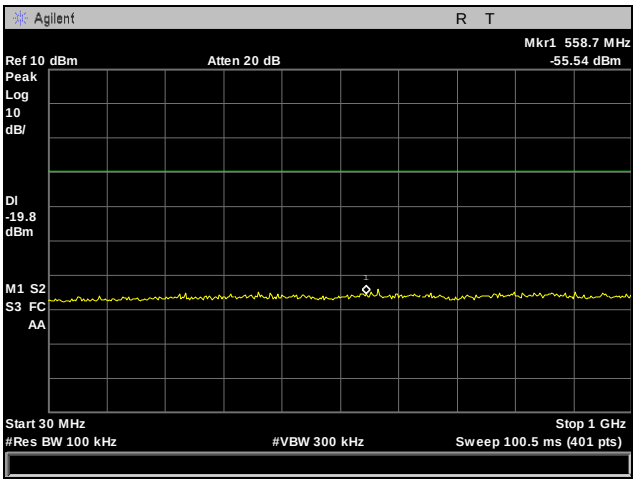
Plot 82. Conducted Spurious Emissions, Low Channel, 1 GHz – 26 GHz, 802.11n



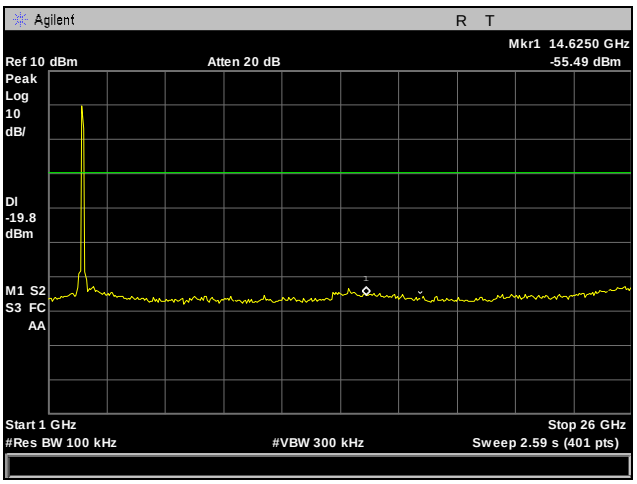
Plot 83. Conducted Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, 802.11n



Plot 84. Conducted Spurious Emissions, Mid Channel, 1 GHz – 26 GHz, 802.11n

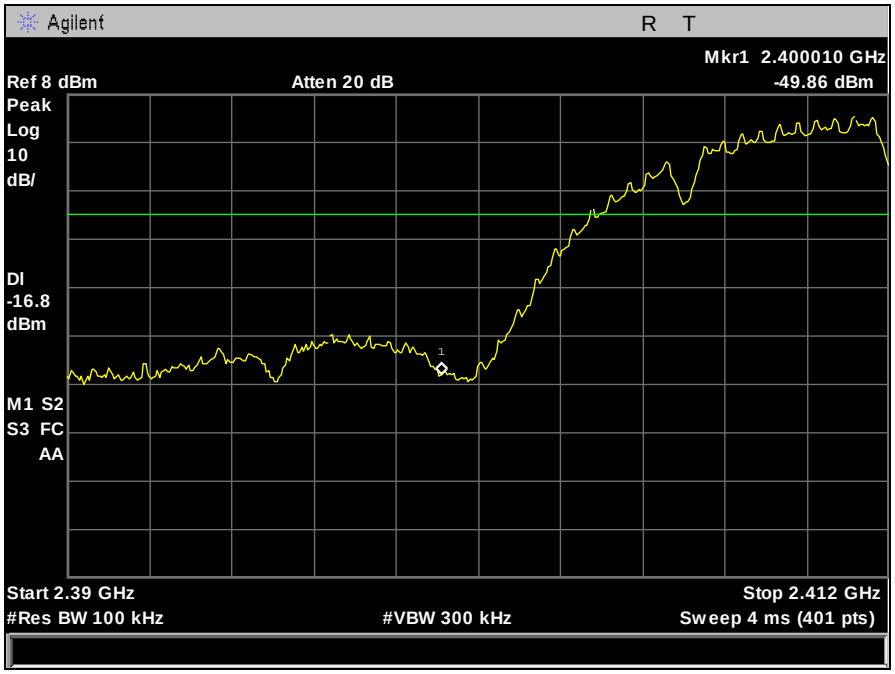


Plot 85. Conducted Spurious Emissions, High Channel, 30 MHz – 1 GHz, 802.11n

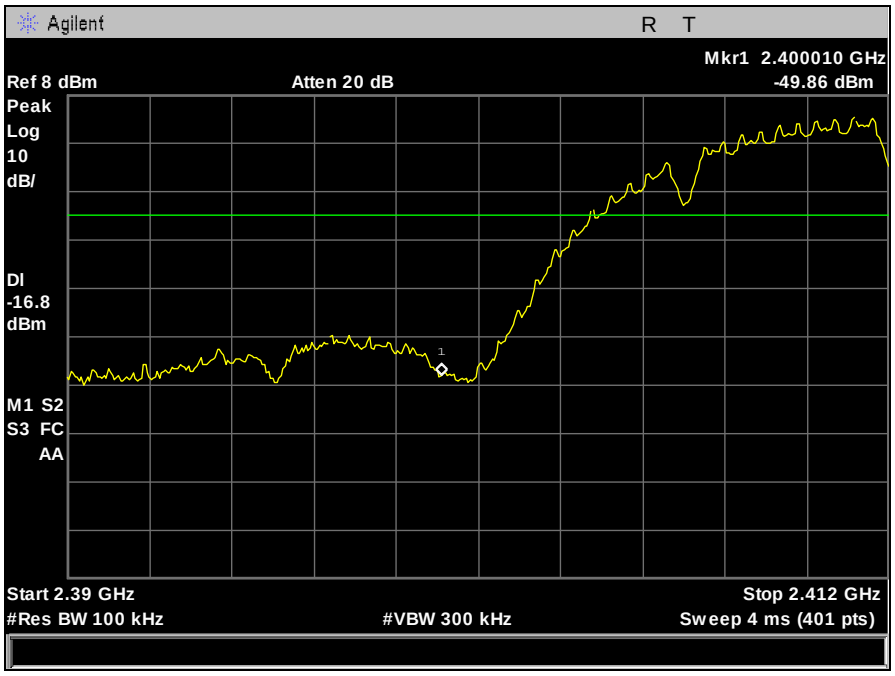


Plot 86. Conducted Spurious Emissions, High Channel, 1 GHz – 26 GHz, 802.11n

Conducted Band Edge, 802.11b

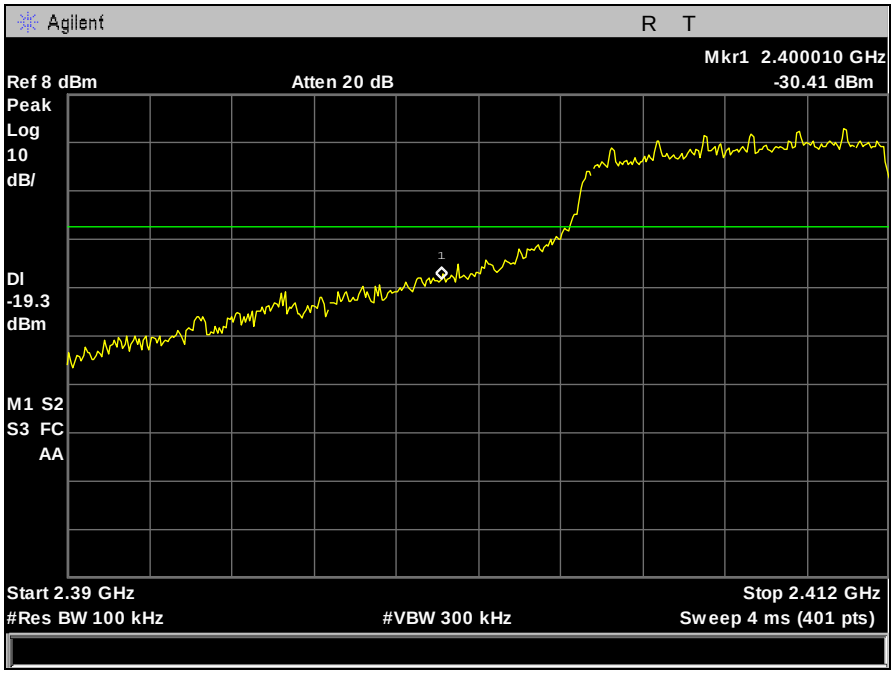


Plot 87. Conducted Band Edge, Low Channel, 802.11b

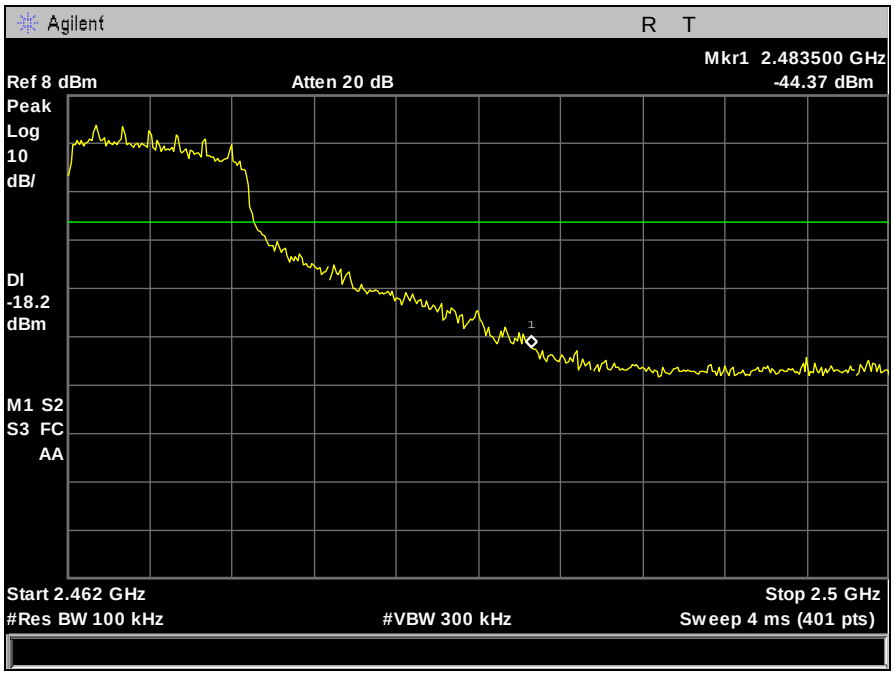


Plot 88. Conducted Band Edge, High Channel, 802.11b

Conducted Band Edge, 802.11g

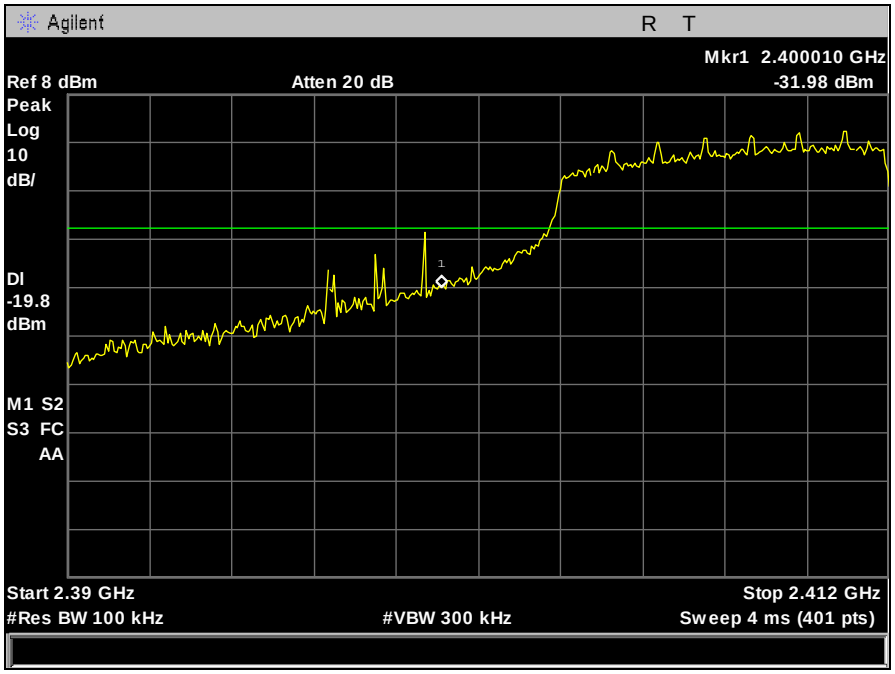


Plot 89. Conducted Band Edge, Low Channel, 802.11g

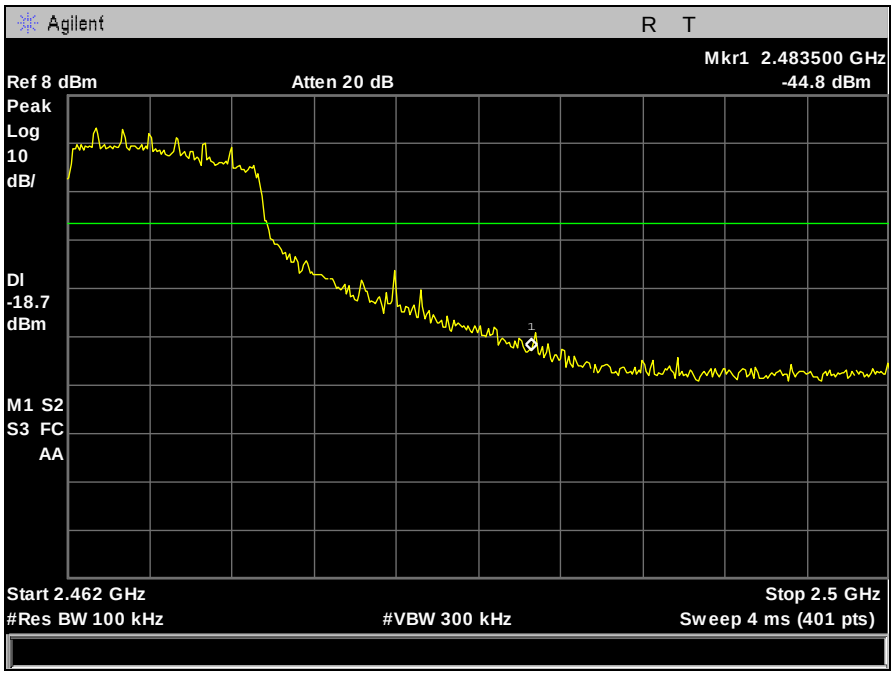


Plot 90. Conducted Band Edge, High Channel, 802.11g

Conducted Band Edge, 802.11n



Plot 91. Conducted Band Edge, Low Channel, 802.11n



Plot 92. Conducted Band Edge, High Channel, 802.11n

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(e) Peak Power Spectral Density

Test Requirements: **§15.247(e):** For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

Test Procedure: The transmitter was connected directly to a Spectrum Analyzer through an attenuator. The power level was set to the maximum level. The spectrum analyzer was set to an auto sweep time and a peak detector was used. Measurements were carried out at the low, mid and high channels.

Test Results: The EUT was compliant with the peak power spectral density limits of **§ 15.247 (e)**.

The peak power spectral density was determined from plots on the following page(s).

Test Engineer: Poona Saber

Test Date: 06/12/15

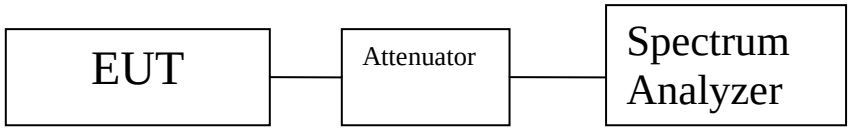


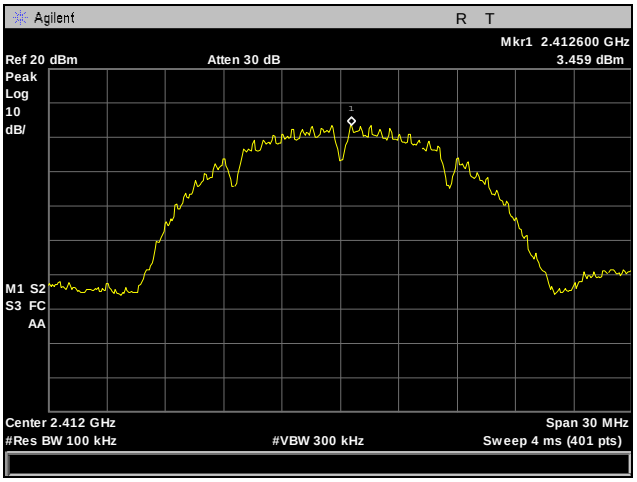
Figure 7. Block Diagram, Peak Power Spectral Density Test Setup

Peak Power Spectral Density Test Results

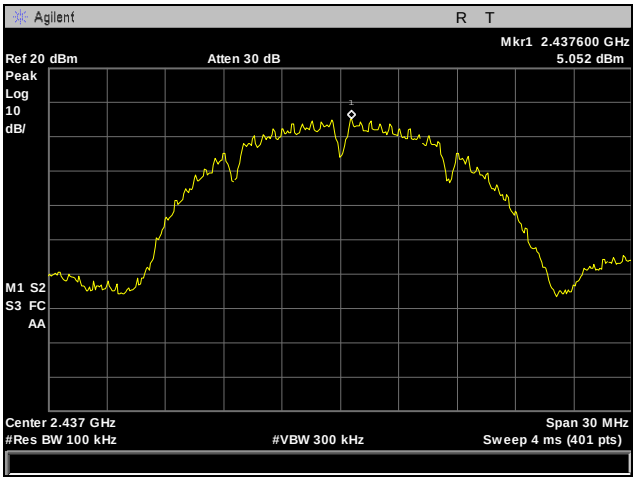
Peak Power Spectral Density					
	Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
802.11b	Low	2412	3.459	8	4.541
	Mid	2437	5.052	8	2.948
	High	2462	5.086	8	2.914
802.11g	Low	2412	0.162	8	7.838
	Mid	2437	4.082	8	3.918
	High	2462	0.787	8	7.213
802.11n	Low	2412	-0.413	8	8.413
	Mid	2437	3.267	8	4.733
	High	2462	0.232	8	7.768

Table 15. Peak Power Spectral Density, Test Results

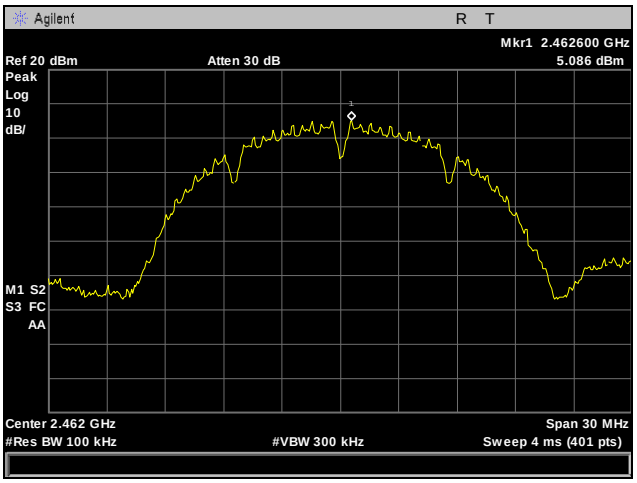
Peak Power Spectral Density, 802.11b



Plot 93. Peak Power Spectral Density, Low Channel, 802.11b

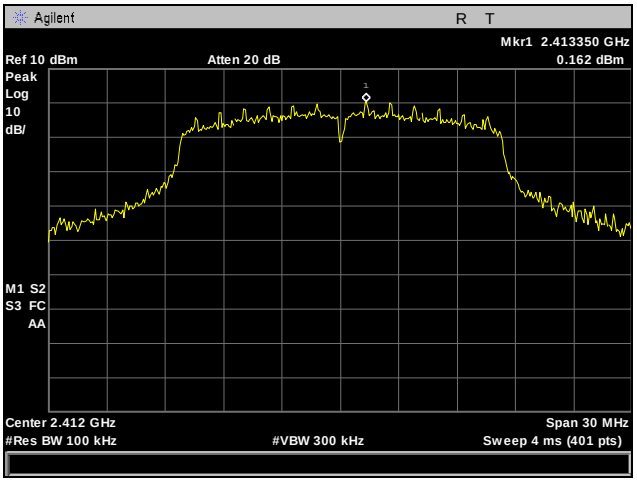


Plot 94. Peak Power Spectral Density, Mid Channel, 802.11b

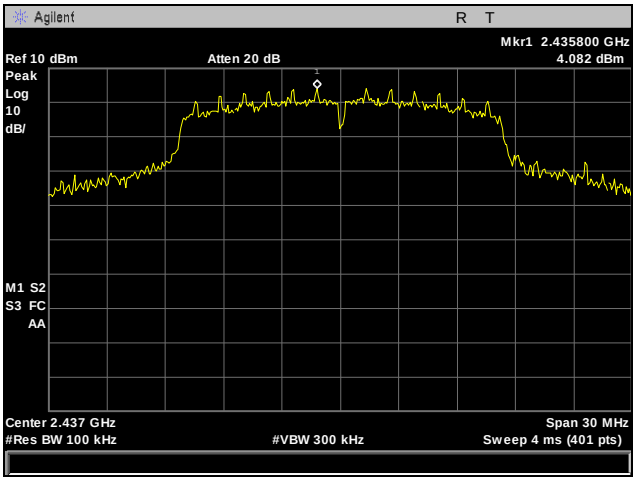


Plot 95. Peak Power Spectral Density, High Channel, 802.11b

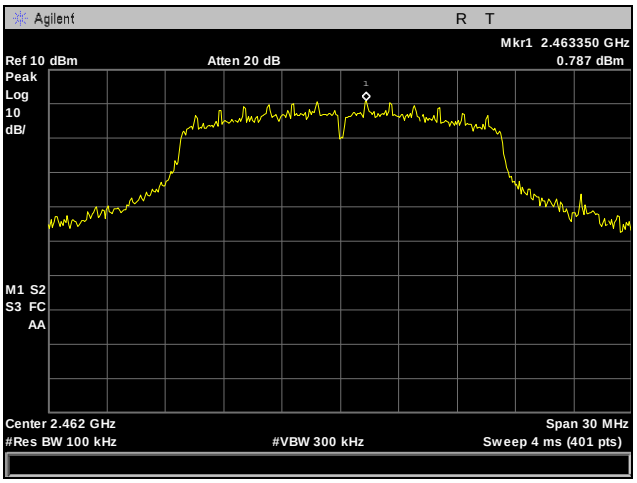
Peak Power Spectral Density, 802.11g



Plot 96. Peak Power Spectral Density, Low Channel, 802.11g

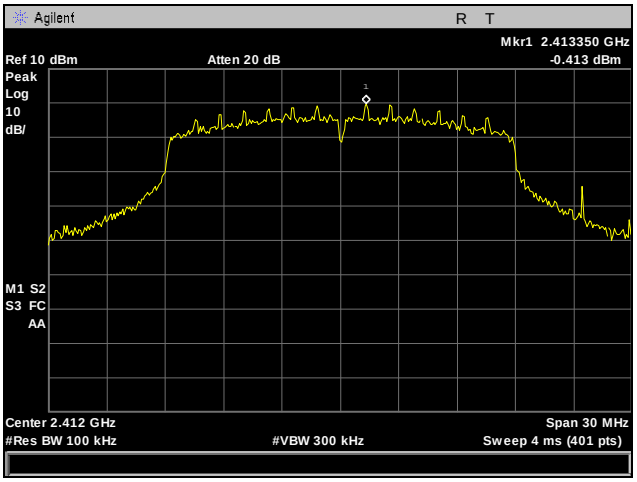


Plot 97. Peak Power Spectral Density, Mid Channel, 802.11g

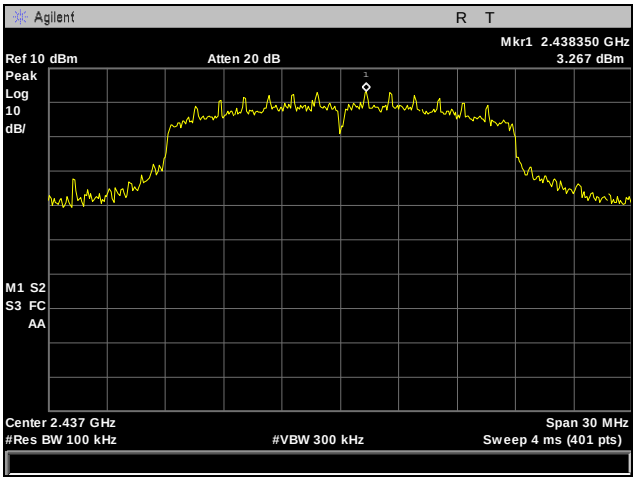


Plot 98. Peak Power Spectral Density, High Channel, 802.11g

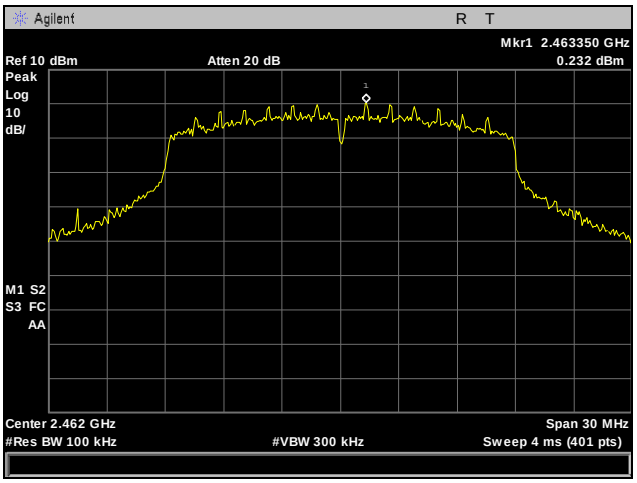
Peak Power Spectral Density, 802.11n



Plot 99. Peak Power Spectral Density, Low Channel, 802.11n



Plot 100. Peak Power Spectral Density, Mid Channel, 802.11n



Plot 101. Peak Power Spectral Density, High Channel, 802.11n

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(i) Maximum Permissible Exposure

RF Exposure Requirements: **§1.1307(b)(1) and §1.1307(b)(2):** Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

RF Radiation Exposure Limit: **§1.1310:** As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter.

MPE Limit Calculation: EUT's operating frequencies @ 2400-2483.5 MHz; highest conducted power = *14.99dBm* (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

EUT maximum antenna gain = *1.9 dBi.*

Equation from page 18 of OET 65, Edition 97-01

$$S = PG / 4\pi R^2 \quad \text{or} \quad R = \sqrt{PG / 4\pi S}$$

where, S = Power Density (1 mW/cm^2)
P = Power Input to antenna (31.5 mW)
G = Antenna Gain (1.54 numeric)

S= (31.5*1.54) / 4*3.14*400 = 0.0095

Therefore the uncontrolled exposure limit is met at 20cm.

IV. Test Equipment

Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2005.

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2460	1-26GHZ SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	2/27/2014	8/27/2015
1S2482	5 METER CHAMBER (NSA)	PANASHIELD	5 METER SEMI-ANECHOIC CHAMBER	3/12/2015	3/12/2016
1S2600	BILOG ANTENNA	TESEQ	CBL6112D	8/29/2013	8/29/2015
1S2603	DOUBLE RIDGED WAVEGUIDE HORN	ETS-LINDGREN	3117	5/11/2015	5/11/2016
1S2421	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB7	9/10/2014	9/10/2015
1S2583	PSA SPECTRUM ANALYZER	AGILENT	E4448A	11/19/2014	11/19/2015
1S2121	PRE-AMPLIFIER	HP	1S2121	SEE NOTE	
N/A	ATTENUATOR	N/A	N/A	SEE NOTE	
N/A	FILTERS	N/A	N/A	SEE NOTE	
1S2678	LISN, DUAL-LINE V-NETWORK	TESEQ	NNB 51	2/3/2015	2/3/2016

Table 16. Test Equipment List

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

V. Certification & User's Manual Information

Certification & User's Manual Information

A. Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

§ 2.801 Radio-frequency device defined.

As used in this part, a radio-frequency device is any device which in its operation is capable of Emitting radio-frequency energy by radiation, conduction, or other means. Radio- frequency devices include, but are not limited to:

(a) The various types of radio communication transmitting devices described throughout this chapter.

(b) The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.

(c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.

(d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

§ 2.803 Marketing of radio frequency devices prior to equipment authorization.

(a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:

(1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or

(2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.

(d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.

(e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:

(i) Compliance testing;

(ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or

(v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.

(e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.

(f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

Certification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — Equipment Authorization Procedures:

§ 2.901 Basis and Purpose

(a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is to be operated.[1] *In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer*, be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.

(b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, and the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant.

§ 2.907 Certification.

(a) Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.

(b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

[1] In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart B (of Part 15), which deals with unintentional radiators.

Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

(a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.

(1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.

(i) If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.

(ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.

(2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.

Certification & User's Manual Information

1. Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

§ 15.19 Labeling requirements.

(a) In addition to the requirements in Part 2 of this chapter, a device subject to certification or verification shall be labeled as follows:

(1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

(2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.

(3) All other devices shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.

(5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

§ 15.21 Information to user.

The user's manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Verification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart B — Unintentional Radiators:

§ 15.105 Information to the user.

(a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

– Reorient or relocate the receiving antenna.

– Increase the separation between the equipment and receiver.

– Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

– Consult the dealer or an experienced radio/TV technician for help.

End of Report

