MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
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April 22, 2014

LifeShield LLC
2021 Cabot Blvd W
Langhorne, PA 19047

Dear Louis Stilp,

Enclosed is the EMC Wireless test report for compliance testing of the LifeShield LLC, S30 as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15, Subpart B for a Class B Digital Device, and FCC 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: (\LifeShield LLC\EMC39619-FCC247 Rev. 4)

Electromagnetic Compatibility Criteria
Test Report

for the

LifeShield LLC
S30

Tested under
the FCC Certification Rules
contained in
Title 47 of the CFR, Parts 15 Subpart B
for Class B Digital Devices
&
15.247 Subpart C for Intentional Radiators

MET Report: EMC39619-FCC247 Rev. 4

April 22, 2014

Prepared For:

LifeShield LLC
2021 Cabot Blvd W
Langhorne, PA 19047

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

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&
15.247 Subpart C for Intentional Radiators

Benjamin Taylor, 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 Parts 15B, 15.247 under normal use and maintenance.

Asad Bajwa
Director, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	February 20, 2014	Initial Issue.
1	February 25, 2014	Revised to reflect customer corrections.
2	March 6, 2014	Revised to reflect customer corrections.
3	March 10, 2014	Editorial correction.
4	April 22, 2014	Editorial correction.

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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 LifeShield LLC S30, 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 S30. LifeShield LLC should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the S30, 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 LifeShield LLC, purchase order number 4550052632 / PR63725. All tests were conducted using measurement procedure ANSI C63.4-2003.

FCC Reference 47 CFR Part 15.247:2005	Description	Compliance
47 CFR Part 15.107 (a)	Conducted Emission Limits for a Class B Digital Device	Compliant
47 CFR Part 15.109 (a)	Radiated Emission Limits for a Class B Digital Device	Compliant
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	Not Applicable. Wi-Fi radio is a pre-approved module, please see FCC ID QR4WF5370M08.
Title 47 of the CFR, Part 15 §15.247(b)	Peak Power Output	Not Applicable. Wi-Fi radio is a pre-approved module, please see FCC ID QR4WF5370M08.
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	Not Applicable. Wi-Fi radio is a pre-approved module, please see FCC ID QR4WF5370M08. Additionally, this unit contains an integral antenna, thus all testing is to be performed Radiated.
Title 47 of the CFR, Part 15 §15.247(d)	RF Conducted Band Edge	Not Applicable. Wi-Fi radio is a pre-approved module, please see FCC ID QR4WF5370M08.
Title 47 of the CFR, Part 15; §15.247(e)	Peak Power Spectral Density	Not Applicable. Wi-Fi radio is a pre-approved module, please see FCC ID QR4WF5370M08.
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 LifeShield LLC to perform testing on the S30, under LifeShield LLC's purchase order number 4550052632 / PR63725.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the LifeShield LLC, S30.

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

Model(s) Tested:	S30	
Model(s) Covered:	S30	
EUT Specifications:	Primary Power: 12 V , 1.5A	
	FCC ID: S9PS30	
	Type of Modulations:	DSSS and OFDM
	EUT Frequency Ranges:	2412-2462MHz
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:	Benjamin Taylor	
Report Date(s):	April 22, 2014	

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
CFR 47, Part 15, Subpart B	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
ANSI C63.4:2003	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 C63.10-2009	American National Standard for Testing Unlicensed Wireless Devices

Table 3. References

C. Test Site

All testing was performed at MET Laboratories, Inc., 914 W. Patapsco Ave., Baltimore, MD 21230. 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 3 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 LifeShield LLC, model S30, is part of a home security system. Connects to internet using 802.11 b/g/n radio or via hard wire Ethernet connection from other internet ready device. Device also has communication options of making calls over 3G cellular radio and POTS line. Receives 345 MHz sensor transmissions. S30 also use Z-wave technology for home automation and monitoring.

Photograph 1. LifeShield LLC S30

E. Support Equipment

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

Qty	Name / Description	Manufacturer	Model Number	Customer Supplied Calibration Data
3	S30, rev 3, SW ver 0.0.6	LifeShield	S30	Not Applicable
3	12 V Ac to DC power supply	DirecTV	EPS10R0-15	Not Applicable
1	Laptop with power supply	DELL	E5510	Not Applicable
1	PSTN Simulator with power supply	Virtual consloe	--	Not Applicable
1	Router with power supply	DLink	ULG54	Not Applicable

Table 4. Support Equipment

F. Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty	Length as tested (m)	Shielded? (Y/N)	Termination Box ID & Port Name
1	Data	RG59 Coax	1	15	Yes	CAT6
2	AC Input	2 conductor, 18 awg	1	2	No	120/60 HZ

Table 5. Ports and Cabling Information

G. Mode of Operation

The S30 is one component of a Home Security System. For the purposes of testing, it is being sent with 3 other components – 345 sensor, Telephone MODEM, and Wi-Fi router and together they comprise a very basic system, such as a user might have in their home. The S30 can be tested using Ethernet port to control the unit and response when respected command was issued.

Whenever the sensor is triggered, it communicates to the S30 system via a 345Mhz transmitter or Z-wave transmitter. The S30 will process and act on sensor messages based on type of messages. S30 has 4 level of redundancy to establish the communication to server. The primary path is over 2.4 GHZ 802.11 b/g/n radio or Ethernet connection to another internet capable device. This connection allows remote access to the system, and is the primary method for transmitting data to a monitoring center. If no internet connection available then S30 will use regular phone line if connected. If no phone line is connected then S30 will use 3 G cellular radio for communication of alarm messages. Unit will also send any event messages to use via SMS depending on use configuration of alerts. S30 communicates to keyfob, 345 repeaters, and mobile devices installed with respective application.

S30 is a battery powered device and can support up to 24 hours of operation on a single charge. The battery is not a user replaceable and end user has no access to battery compartment.

S30 is equipped with microphone and Speaker system which are connected to GSM and regular phone line.

H. Method of Monitoring EUT Operation

S30 is one component of system and selected operating mode in previous section simulates the real field application.

I. 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.

J. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to LifeShield LLC upon completion of testing.

III. Electromagnetic Compatibility Criteria for Unintentional Radiators

Electromagnetic Compatibility Criteria

§ 15.107 Conducted Emissions Limits

Test Requirement(s):

15.107 (a) Except for Class A digital devices, for equipment 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 30 MHz shall not exceed the limits in Table 6. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

15.107 (b) For a Class A digital device 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 30 MHz shall not exceed the limits in Table 6. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges.

Frequency range (MHz)	Class A Conducted Limits (dBµV)		*Class B Conducted Limits (dBµV)	
	Quasi-Peak	Average	Quasi-Peak	Average
* 0.15- 0.45	79	66	66 - 56	56 - 46
0.45 - 0.5	79	66	56	46
0.5 - 30	73	60	60	50
Note 1 — The lower limit shall apply at the transition frequencies. Note 2 — The limit decreases linearly with the logarithm if the frequency in the range 0.15 MHz to 0.5 MHz.				

Table 6. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(a) (b)

Test Procedures:

The EUT was placed on a non-metallic table, 80 cm above the ground plane and 40 cm from a vertical ground plane. The method of testing, test conditions, and test procedures of ANSI C63.4 were used. The EUT was powered through a 50Ω/50µH LISN. An EMI receiver, connected to the measurement port of the LISN, scanned the frequency range from 150 kHz to 30 MHz in order to find the peak conducted emissions. All peak emissions within 6 dB of the limit were re-measured using a quasi-peak and/or average detector as appropriate.

Test Results:

The EUT was compliant with the Class B requirement(s) of this section. Measured emissions were below applicable limits. Pre-scans were made with a peak detector.

Test Engineer(s):

Benjamin Taylor

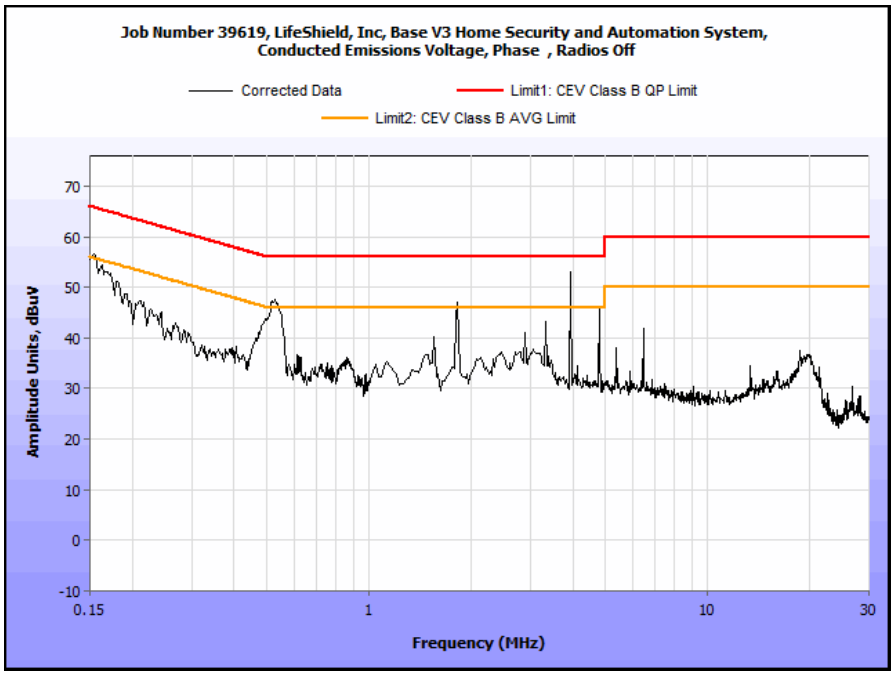
Test Date(s):

11/25/13

Conducted Emissions - Voltage, AC Power, Phase Line

Frequency (MHz)	Uncorrected Meter Reading (dBµV) QP	Cable Loss (dB)	Corrected Measurement (dBµV) QP	Limit (dBµV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBµV) Avg.	Cable Loss (dB)	Corrected Measurement (dBµV) AVG	Limit (dBµV) AVG	Margin (dB) AVG
0.174	47.22	0	47.22	64.77	-17.55	37.39	0	37.39	54.77	-17.38
0.216	44.95	0	44.95	62.97	-18.02	29.45	0	29.45	52.97	-23.52
0.4035	32.86	0	32.86	57.78	-24.92	24.72	0	24.72	47.78	-23.06
0.532	44.97	0	44.97	56	-11.03	39.2	0	39.2	46	-6.8
3.92	29.99	0	29.99	56	-26.01	27.8	0	27.8	46	-18.2
4.8	36.64	0	36.64	56	-19.36	20.54	0	20.54	46	-25.46

Table 7. Conducted Emissions - Voltage, AC Power, Phase Line

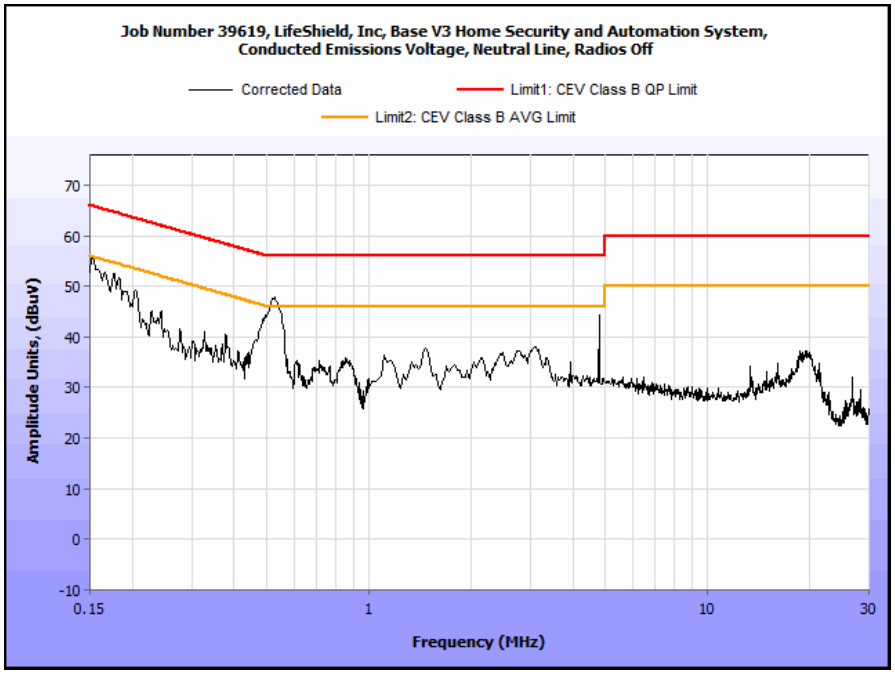


Plot 1. Conducted Emission, Phase Line Plot

Conducted Emissions - Voltage, AC Power, Neutral Line

Frequency (MHz)	Uncorrected Meter Reading (dBµV) QP	Cable Loss (dB)	Corrected Measurement (dBµV) QP	Limit (dBµV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBµV) Avg.	Cable Loss (dB)	Corrected Measurement (dBµV) AVG	Limit (dBµV) AVG	Margin (dB) AVG
0.211	47.2	0	47.2	63.17	-15.97	29.39	0	29.39	53.17	-23.78
0.176	50.33	0	50.33	64.67	-14.34	37.31	0	37.31	54.67	-17.36
0.327	34.56	0	34.56	59.53	-24.97	24.12	0	24.12	49.53	-25.41
0.5285	45.51	0	45.51	56	-10.49	40.14	0	40.14	46	-5.86
4.8	37.55	0	37.55	56	-18.45	20.28	0	20.28	46	-25.72
19.66	33.38	0	33.38	60	-26.62	28.79	0	28.79	50	-21.21

Table 8. Conducted Emissions - Voltage, AC Power, Neutral Line



Plot 2. Conducted Emission, Neutral Line Plot

Conducted Emission Limits Test Setup

Photograph 2. Conducted Emissions, Test Setup

Radiated Emission Limits

§ 15.109 Radiated Emissions Limits

Test Requirement(s): **15.109 (a)** Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the Class B limits expressed in Table 9.

15.109 (b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the Class A limits expressed in Table 9.

Frequency (MHz)	Field Strength (dBµV/m)	
	§15.109 (b), Class A Limit (dBµV) @ 10m	§15.109 (a),Class B Limit (dBµV) @ 3m
30 - 88	39.00	40.00
88 - 216	43.50	43.50
216 - 960	46.40	46.00
Above 960	49.50	54.00

Table 9. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (b)

Test Procedures: The EUT was placed on a 0.8m-high non-conductive table on the turntable inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4 were used. An antenna was located 3 m from the EUT on an adjustable mast. A pre-scan was performed in order to find prominent radiated emissions. For emissions measurements, the EUT was rotated and the antenna height was varied between 1 m and 4 m in order to maximize the emissions. Measurements in both horizontal and vertical polarities were made and the data was recorded.

Test Results: The EUT was found to comply with the Class B requirement(s) of this section. Measured emissions were below applicable limits. Pre-scans were made with a peak detector.

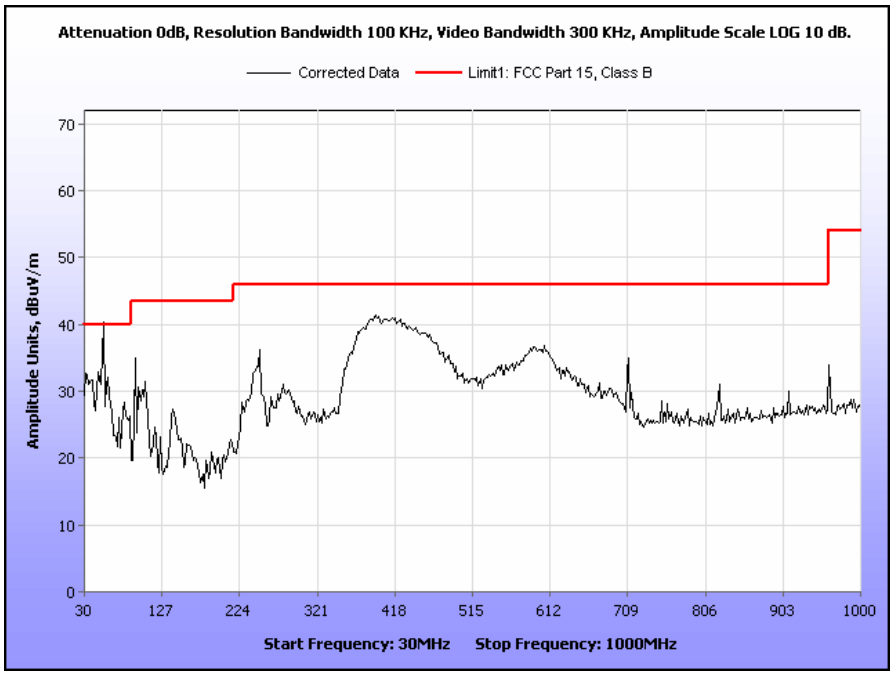
Test Engineer(s): Benjamin Taylor

Test Date(s): 12/02/13

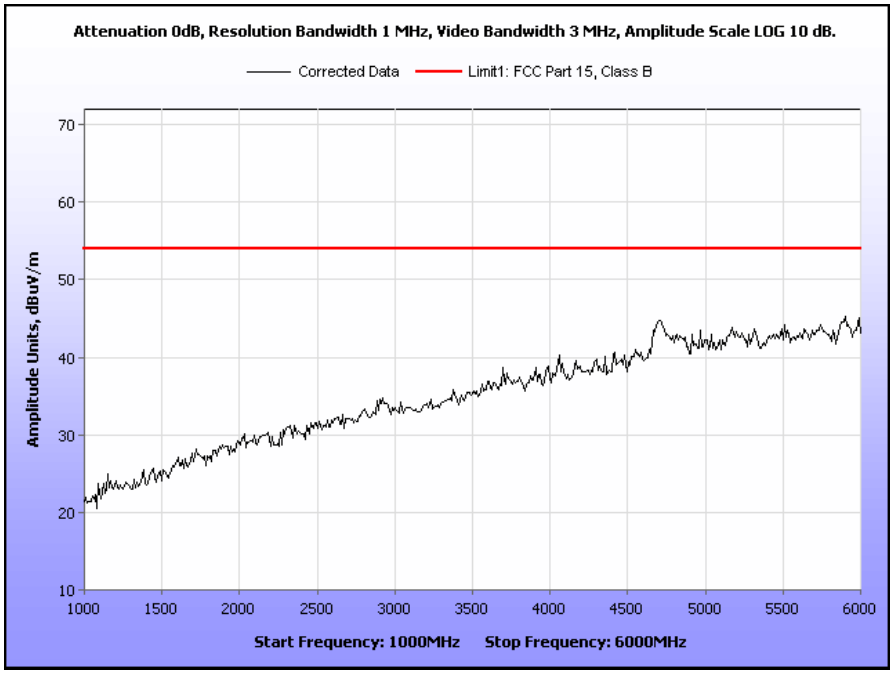
Radiated Emissions Limits Test Results

Frequency (MHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna HEIGHT (m)	Uncorrected Amplitude (dBµV)	Antenna Correction Factor (dB) (+)	Cable Loss (dB) (+)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
66.291959	303	H	2.07	8.24	7.86	0.61	10.46	6.25	39.00	-32.75
66.291959	315	V	2.03	27.40	7.86	0.61	10.46	25.41	39.00	-13.59
250	320	H	1.83	17.56	12.10	1.25	10.46	20.45	46.40	-25.95
250	307	V	1.80	20.96	12.10	1.25	10.46	23.85	46.40	-22.55

Table 10. Radiated Emissions, Test Results

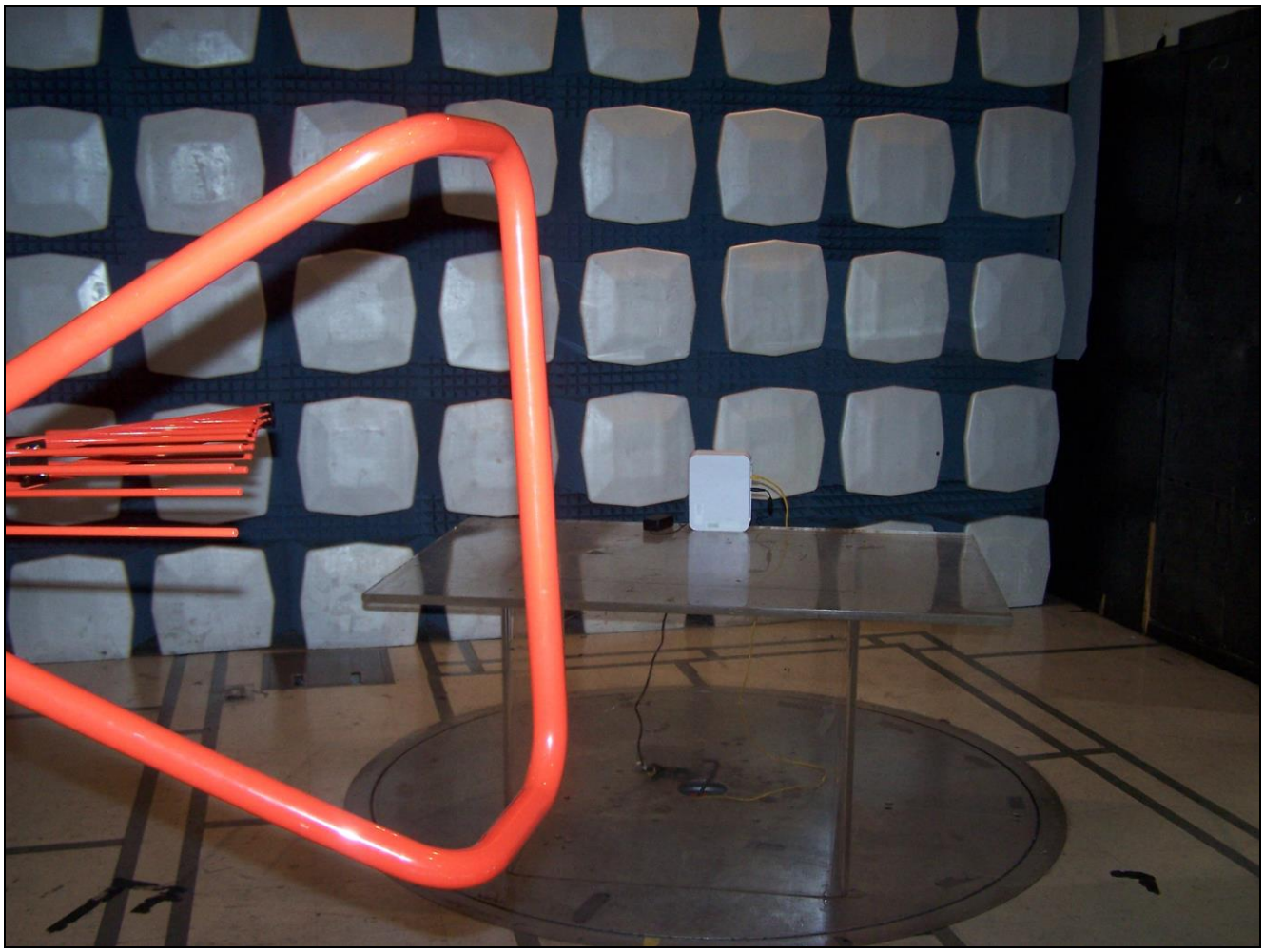


Plot 3. Radiated Emissions, Pre-Scan, 30 MHz – 1 GHz



Plot 4. Radiated Emissions, Pre-Scan, 1 GHz – 6 GHz

Radiated Emission Limits Test Setup



Photograph 3. Radiated Emissions, Test Setup

IV. 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 is compliant the criteria of §15.203. The EUT has an integral antenna.

Test Engineer(s): Benjamin Taylor

Test Date(s): 12/11/13

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 11. 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.

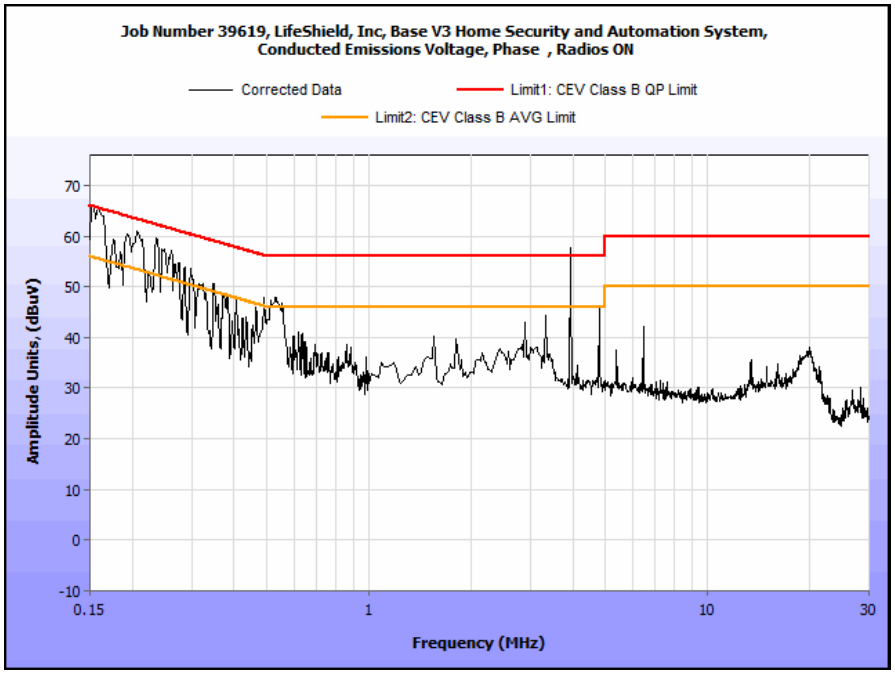
Test Engineer(s): Benjamin Taylor

Test Date(s): 11/25/13

15.207(a) Conducted Emissions Test Results

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.174	47.22	0	47.22	64.77	-17.55	37.39	0	37.39	54.77	-17.38
0.216	44.95	0	44.95	62.97	-18.02	29.45	0	29.45	52.97	-23.52
0.4035	32.86	0	32.86	57.78	-24.92	24.72	0	24.72	47.78	-23.06
0.532	44.97	0	44.97	56	-11.03	39.2	0	39.2	46	-6.8
3.92	29.99	0.1	30.09	56	-25.91	27.8	0.1	27.9	46	-18.1
4.8	36.64	0.17	36.81	56	-19.19	20.54	0.17	20.71	46	-25.29

Table 12. Conducted Emissions, 15.207(a), Phase Line, Test Results

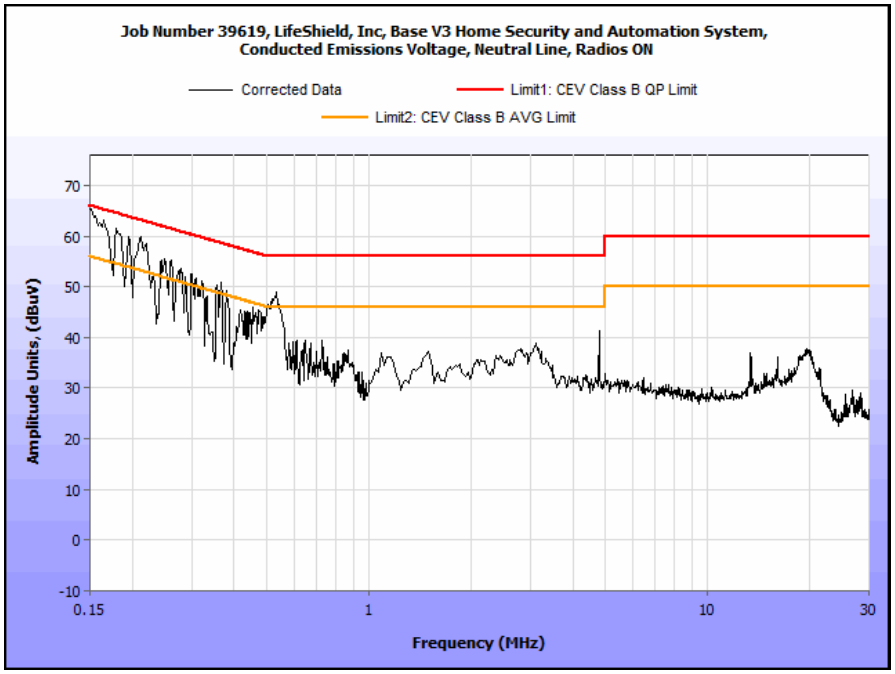


Plot 5. Conducted Emissions, 15.207(a), Phase Line

15.207(a) Conducted Emissions Test Results

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.211	47.2	0	47.2	63.17	-15.97	29.39	0	29.39	53.17	-23.78
0.176	50.33	0	50.33	64.67	-14.34	37.31	0	37.31	54.67	-17.36
0.327	34.56	0	34.56	59.53	-24.97	24.12	0	24.12	49.53	-25.41
0.5285	45.51	0	45.51	56	-10.49	40.14	0	40.14	46	-5.86
4.8	37.55	0.17	37.72	56	-18.28	20.28	0.17	20.45	46	-25.55
19.66	33.38	0	33.38	60	-26.62	28.79	0	28.79	50	-21.21

Table 13. Conducted Emissions, 15.207(a), Neutral Line, Test Results



Plot 6. Conducted Emissions, 15.207(a), Neutral Line

15.207(a) Conducted Emissions Test Setup Photo

Photograph 4. Conducted Emissions, 15.207(a), Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(2) 6 dB Occupied 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 Results The EUT was not applicable with § 15.247 (a)(2). Wi-Fi radio is a pre-approved module, please see FCC ID: QR4WF5370M08.

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 14. Output Power Requirements from §15.247(b)

§15.247(b)(4): The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Test Results: The EUT was not applicable with the Peak Power Output limits of **§15.247(b)**. The EUT was not applicable with § 15.247 (a)(2). Wi-Fi radio is a pre-approved module, please see FCC ID: QR4WF5370M08.

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 15. 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 16.

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

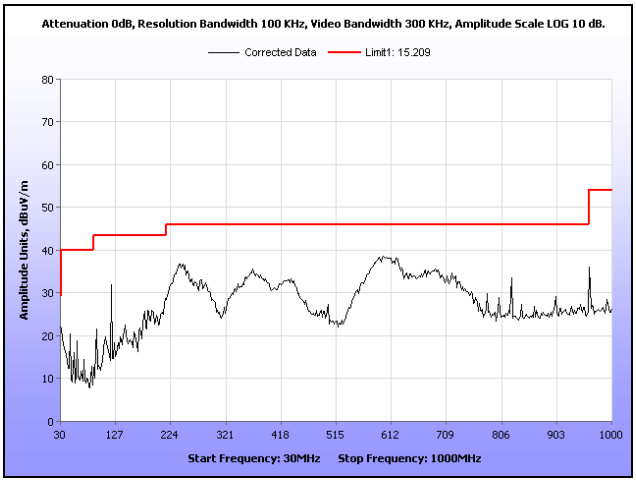
Test Procedures: The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line. Only noise floor was measured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

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

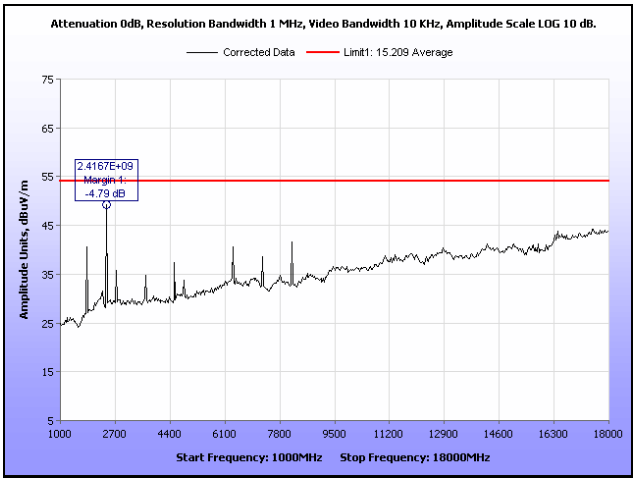
Test Engineer(s): Benjamin Taylor

Test Date(s): 02/05/14 – 02/07/14

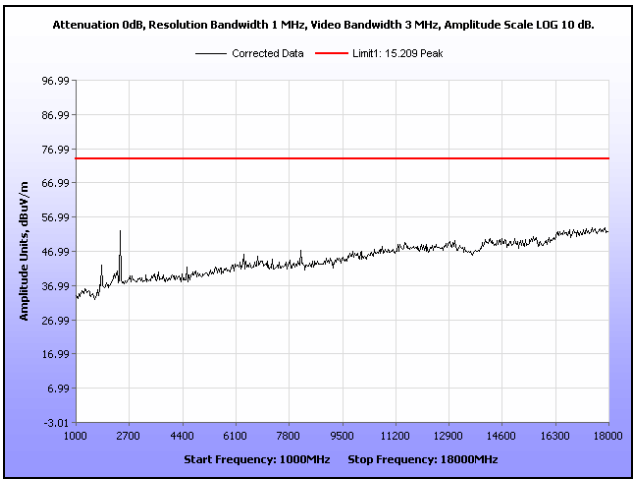
Radiated Spurious Emissions Test Results



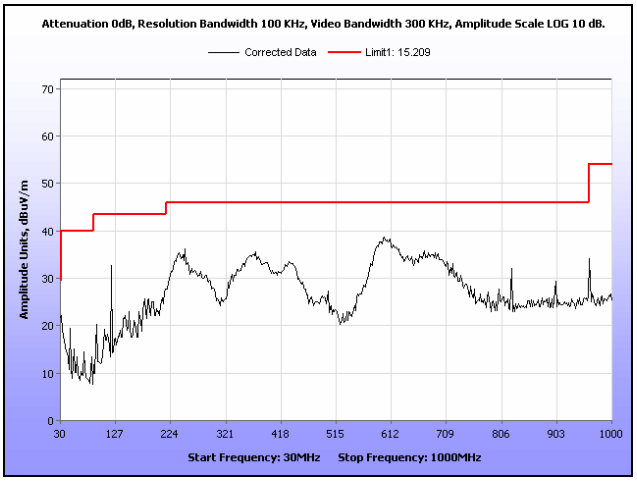
Plot 7. Radiated Spurious Emissions, 802.11b, 2412 MHz, 30 MHz – 1 GHz



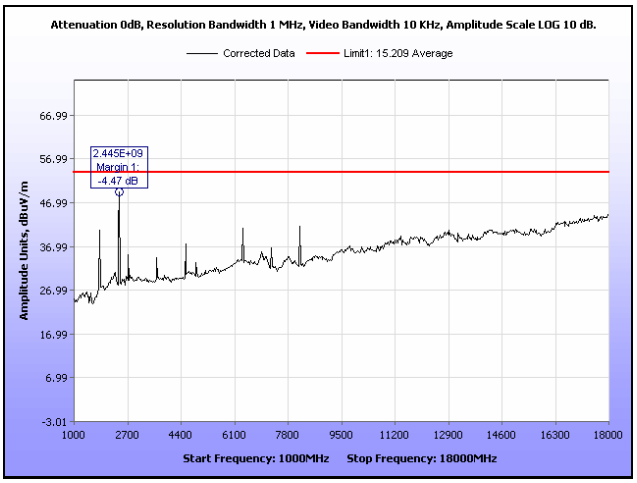
Plot 8. Radiated Spurious Emissions, 802.11b, 2412 MHz, 1 GHz – 18 GHz, Average



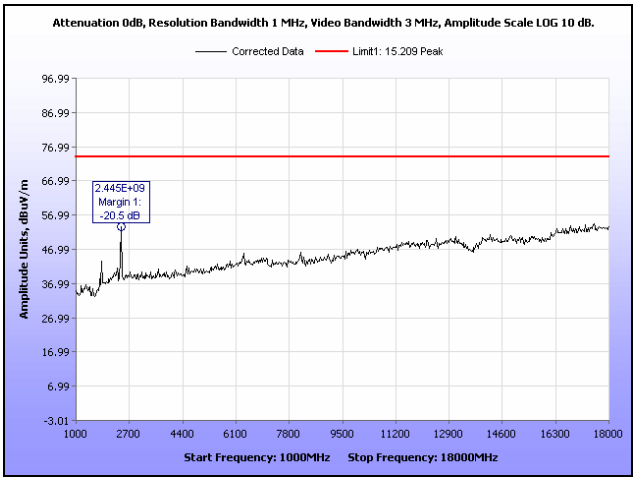
Plot 9. Radiated Spurious Emissions, 802.11b, 2412 MHz, 1 GHz – 18 GHz, Peak



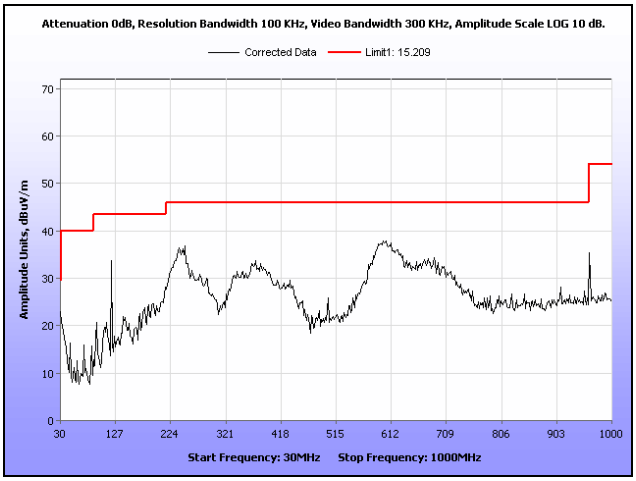
Plot 10. Radiated Spurious Emissions, 802.11b, 2437 MHz, 30 MHz – 1 GHz



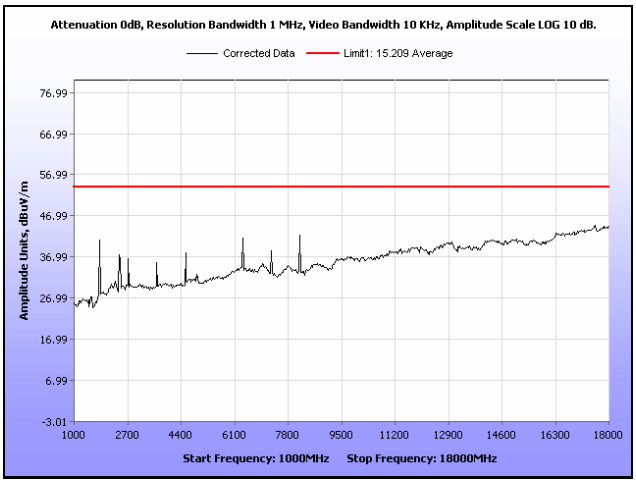
Plot 11. Radiated Spurious Emissions, 802.11b, 2437 MHz, 1 GHz – 18 GHz, Average



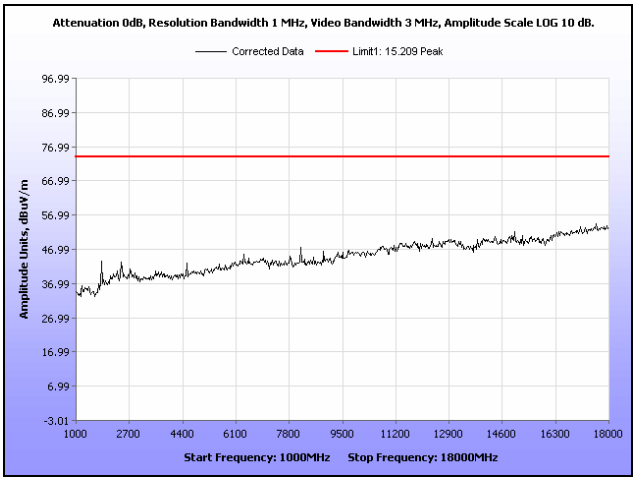
Plot 12. Radiated Spurious Emissions, 802.11b, 2437 MHz, 1 GHz – 18 GHz, Peak



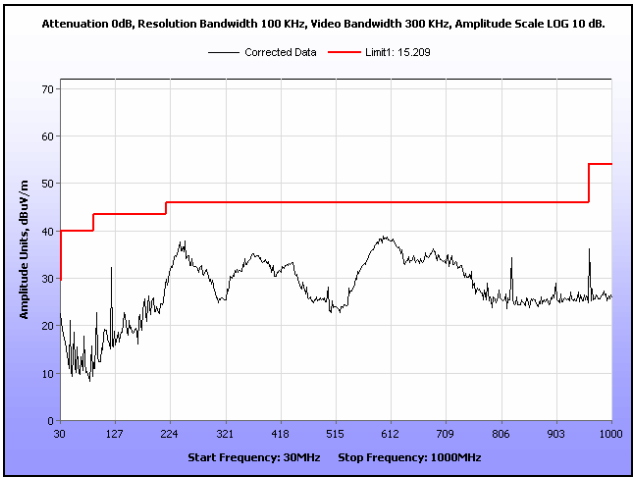
Plot 13. Radiated Spurious Emissions, 802.11b, 2462 MHz, 30 MHz – 1 GHz



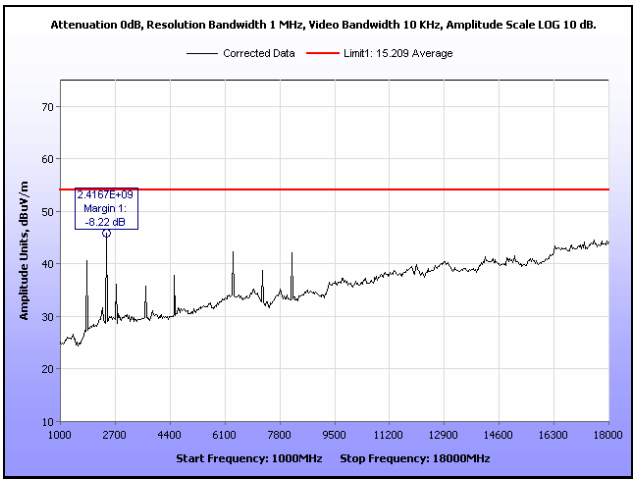
Plot 14. Radiated Spurious Emissions, 802.11b, 2462 MHz, 1 GHz – 18 GHz, Average



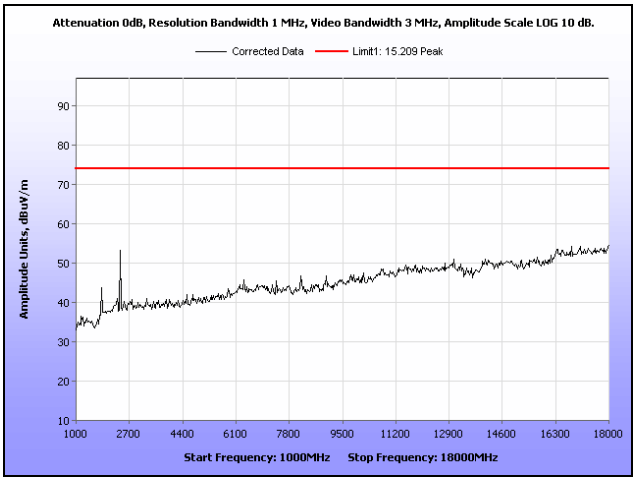
Plot 15. Radiated Spurious Emissions, 802.11b, 2462 MHz, 1 GHz – 18 GHz, Peak



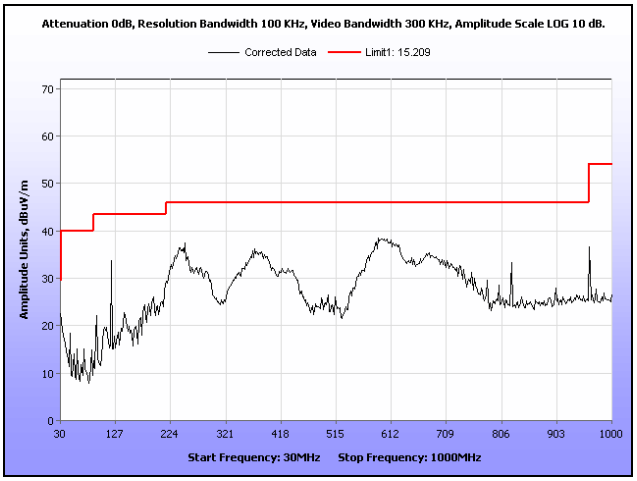
Plot 16. Radiated Spurious Emissions, 802.11g, 2412 MHz, 30 MHz – 1 GHz



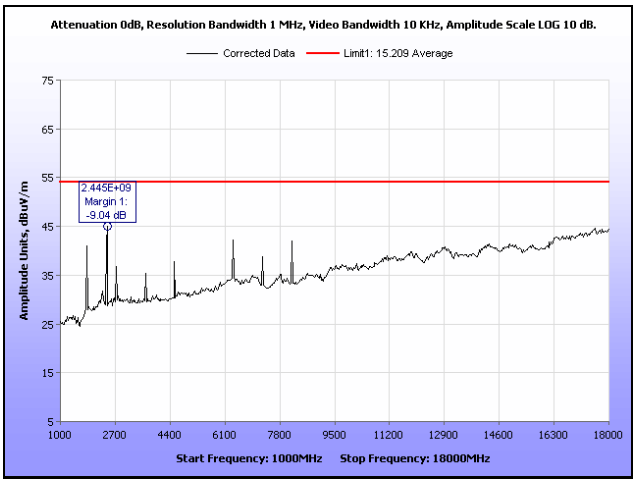
Plot 17. Radiated Spurious Emissions, 802.11g, 2412 MHz, 1 GHz – 18 GHz, Average



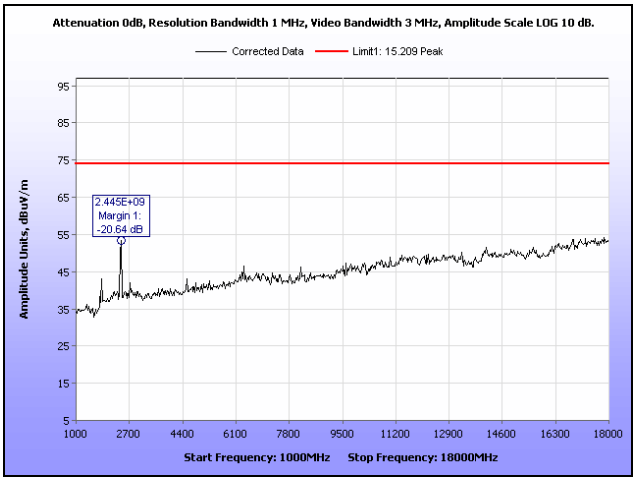
Plot 18. Radiated Spurious Emissions, 802.11g, 2412 MHz, 1 GHz – 18 GHz, Peak



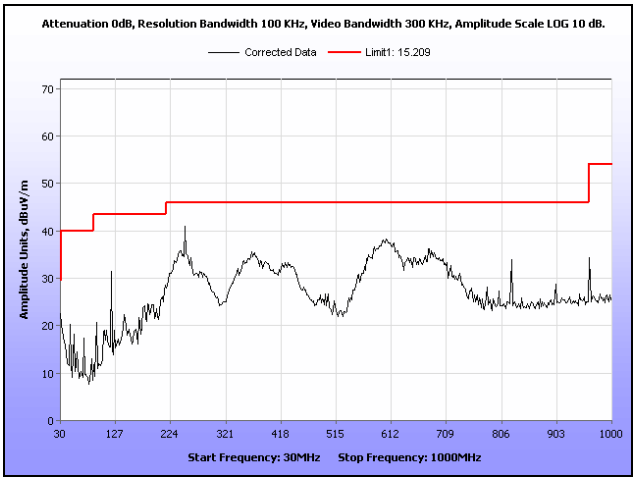
Plot 19. Radiated Spurious Emissions, 802.11g, 2437 MHz, 30 MHz – 1 GHz



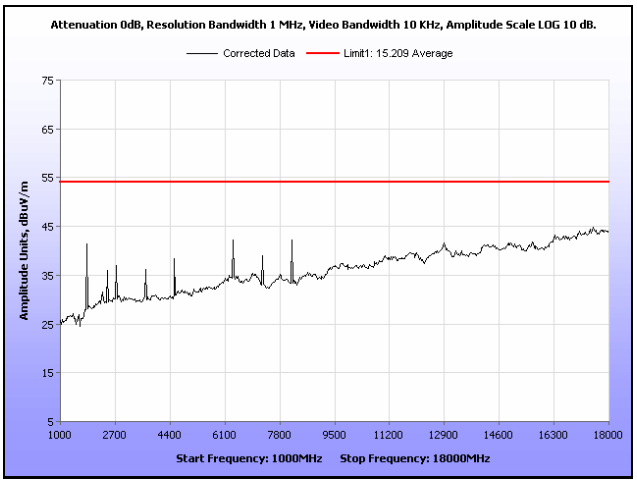
Plot 20. Radiated Spurious Emissions, 802.11g, 2437 MHz, 1 GHz – 18 GHz, Average



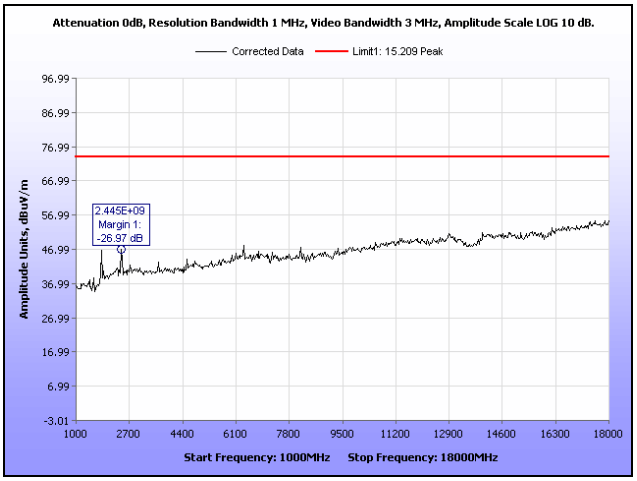
Plot 21. Radiated Spurious Emissions, 802.11g, 2437 MHz, 1 GHz – 18 GHz, Peak



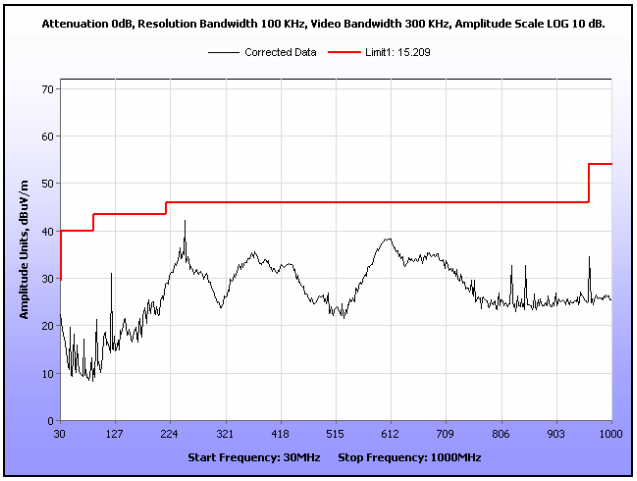
Plot 22. Radiated Spurious Emissions, 802.11g, 2462 MHz, 30 MHz – 1 GHz



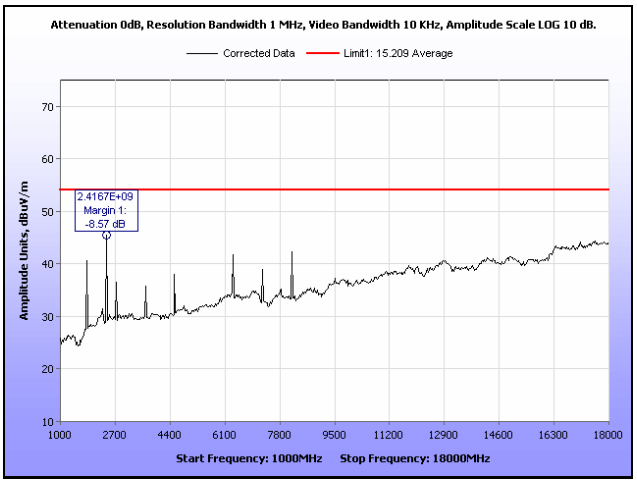
Plot 23. Radiated Spurious Emissions, 802.11g, 2462 MHz, 1 GHz – 18 GHz, Average



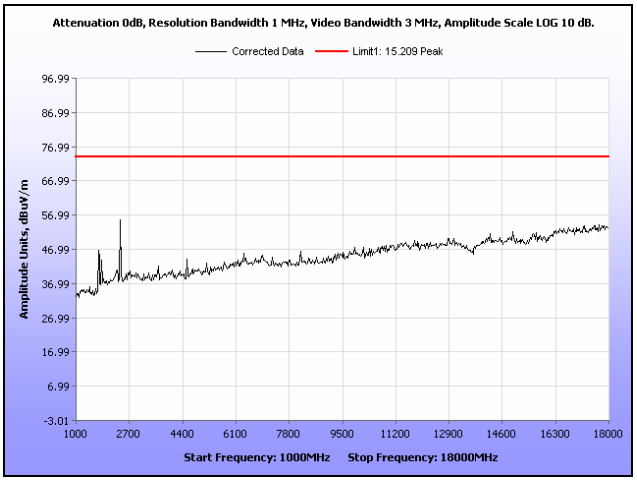
Plot 24. Radiated Spurious Emissions, 802.11g, 2462 MHz, 1 GHz – 18 GHz, Peak



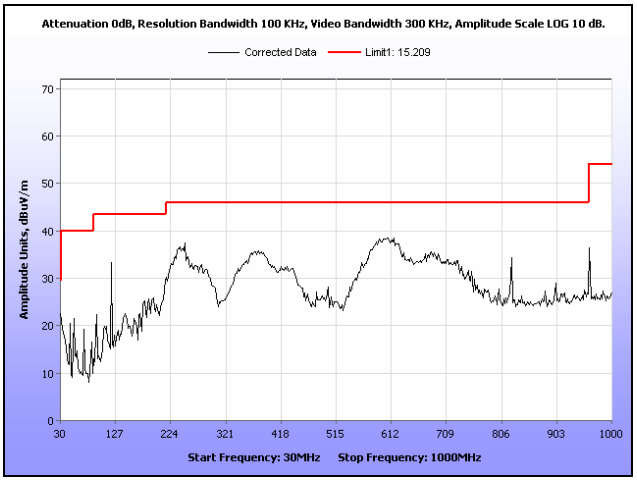
Plot 25. Radiated Spurious Emissions, 802.11n, 2412 MHz, 30 MHz – 1 GHz



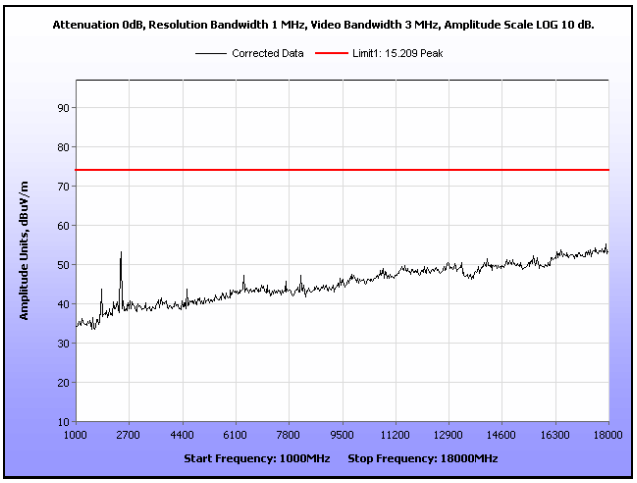
Plot 26. Radiated Spurious Emissions, 802.11n, 2412 MHz, 1 GHz – 18 GHz, Average



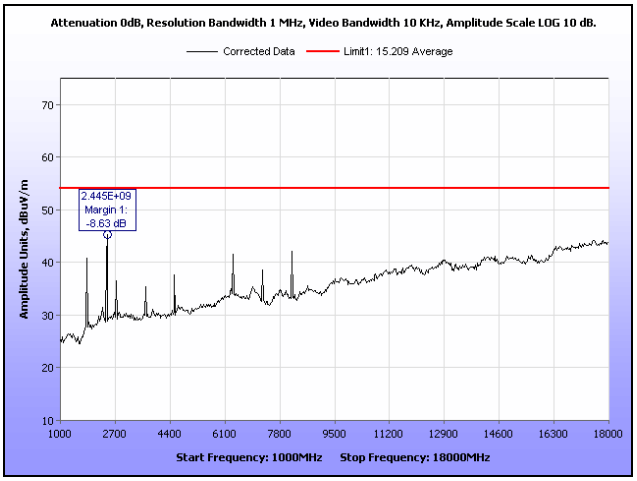
Plot 27. Radiated Spurious Emissions, 802.11n, 2412 MHz, 1 GHz – 18 GHz, Peak



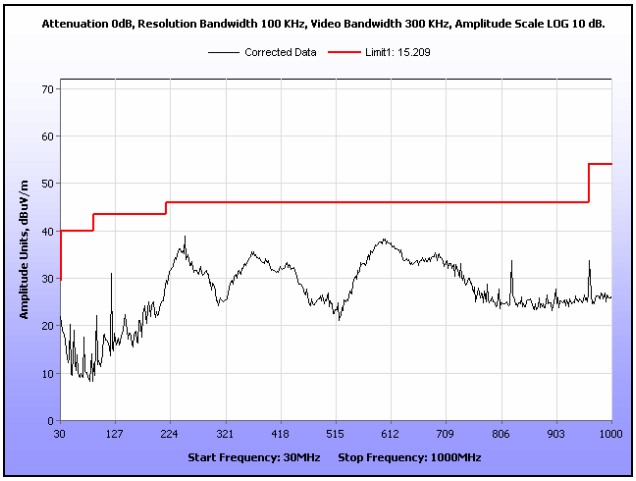
Plot 28. Radiated Spurious Emissions, 802.11n, 2437 MHz, 30 MHz – 1 GHz



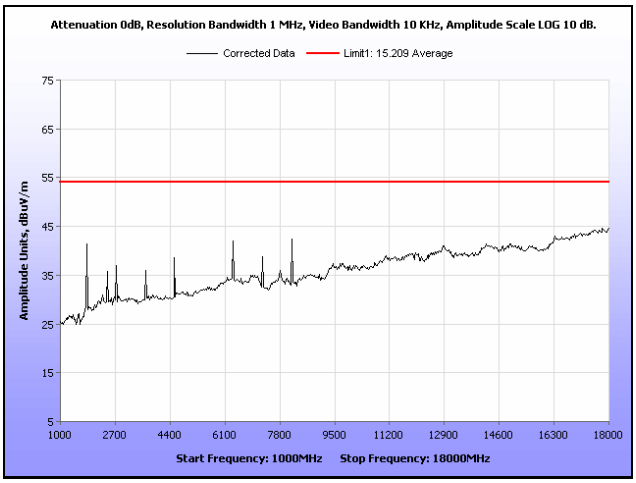
Plot 29. Radiated Spurious Emissions, 802.11n, 2437 MHz, 1 GHz – 18 GHz, Average



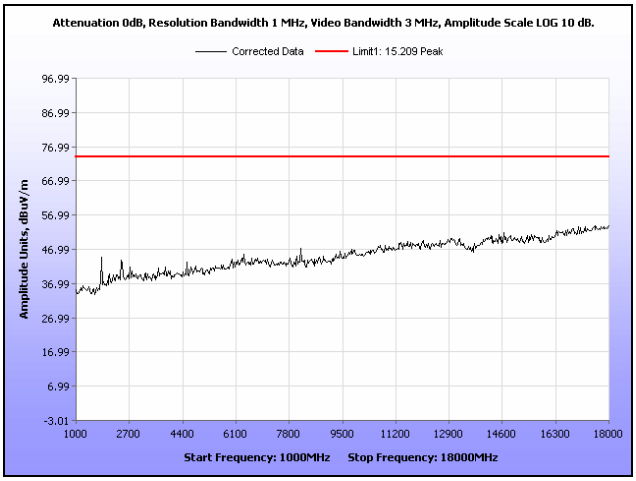
Plot 30. Radiated Spurious Emissions, 802.11n, 2437 MHz, 1 GHz – 18 GHz, Peak



Plot 31. Radiated Spurious Emissions, 802.11n, 2462 MHz, 30 MHz – 1 GHz



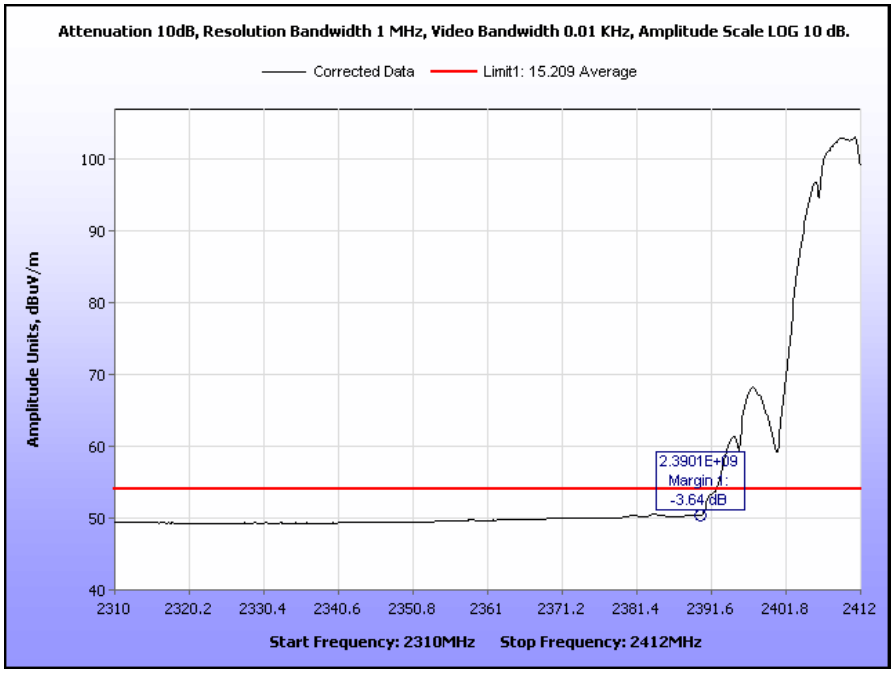
Plot 32. Radiated Spurious Emissions, 802.11n, 2462 MHz, 1 GHz – 18 GHz, Average



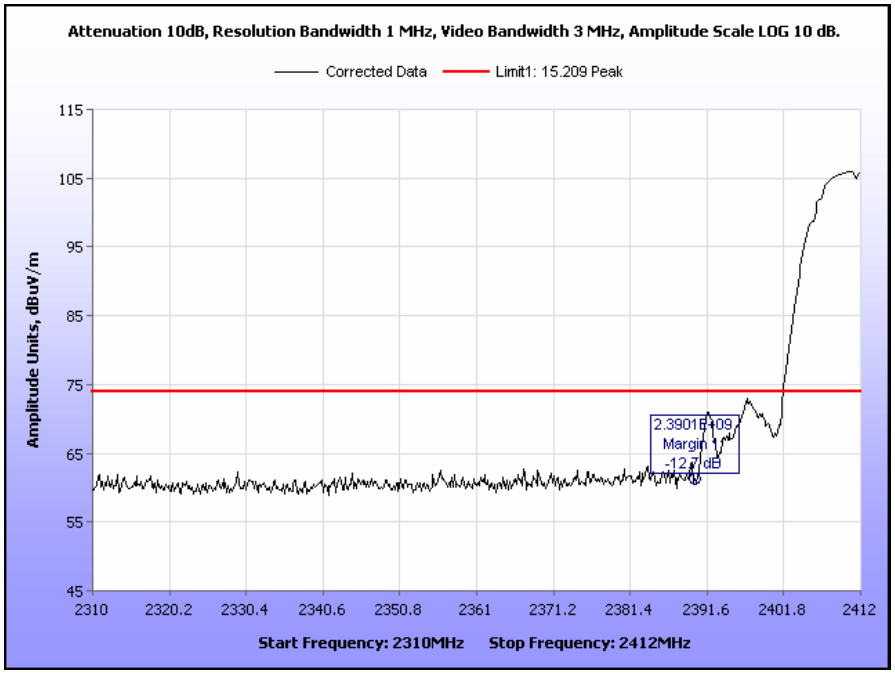
Plot 33. Radiated Spurious Emissions, 802.11n, 2462 MHz, 1 GHz – 18 GHz, Peak

Radiated Band Edge Measurements

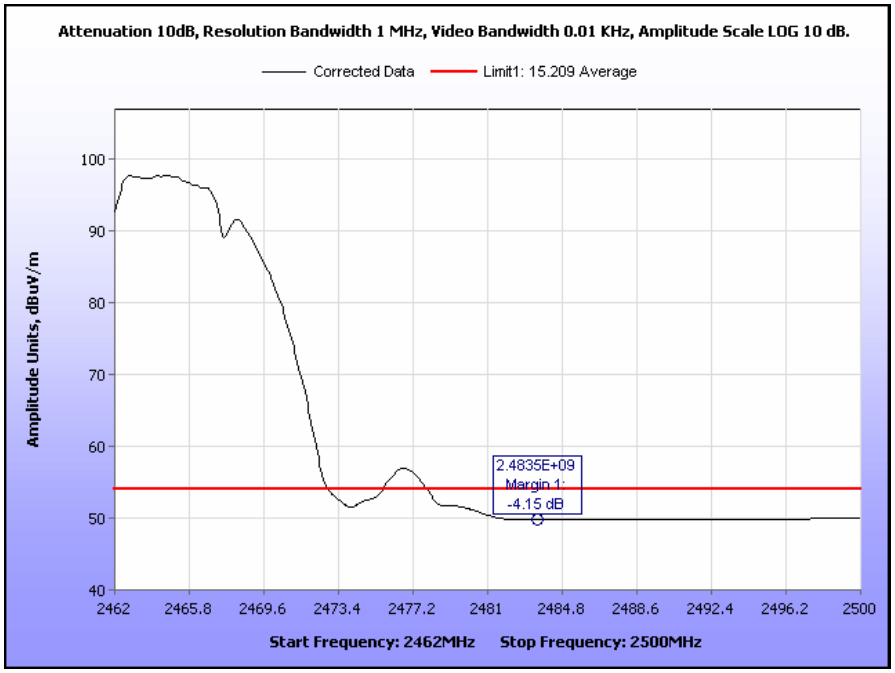
Test Procedures: The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line.



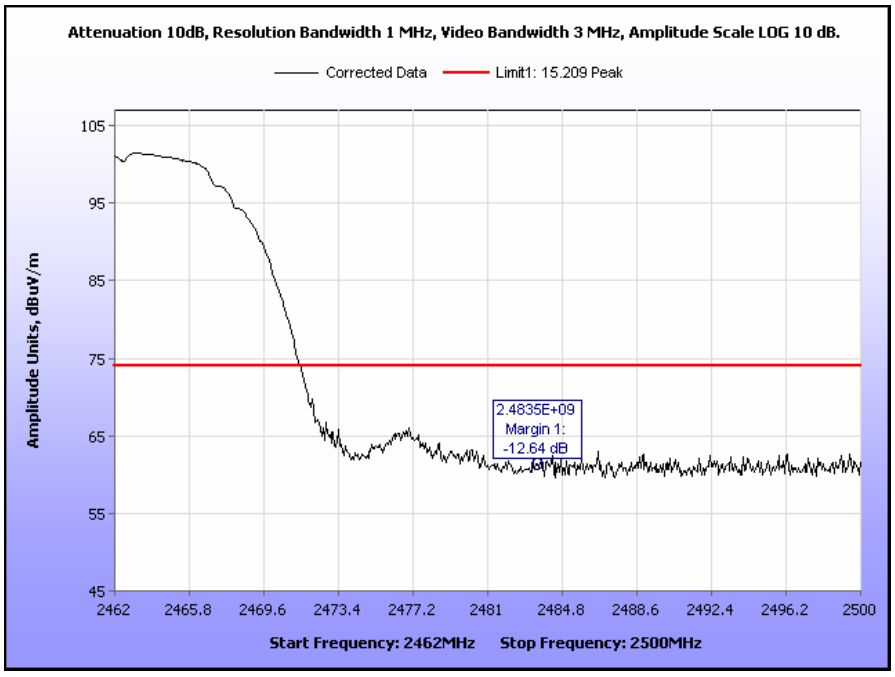
Plot 34. Radiated Restricted Band Edge, 802.11b, 2412 MHz, Average



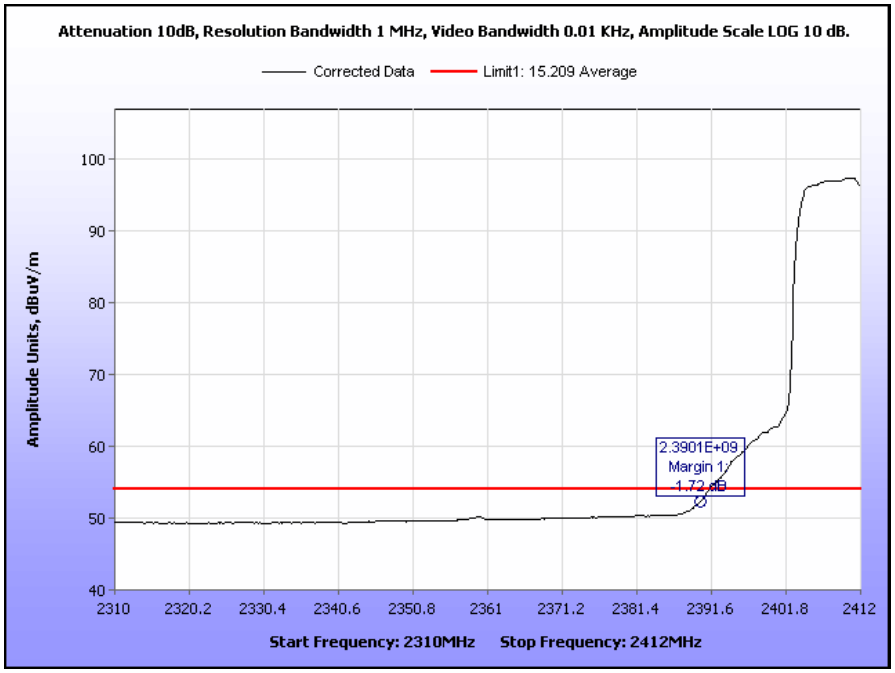
Plot 35. Radiated Restricted Band Edge, 802.11b, 2412 MHz, Peak



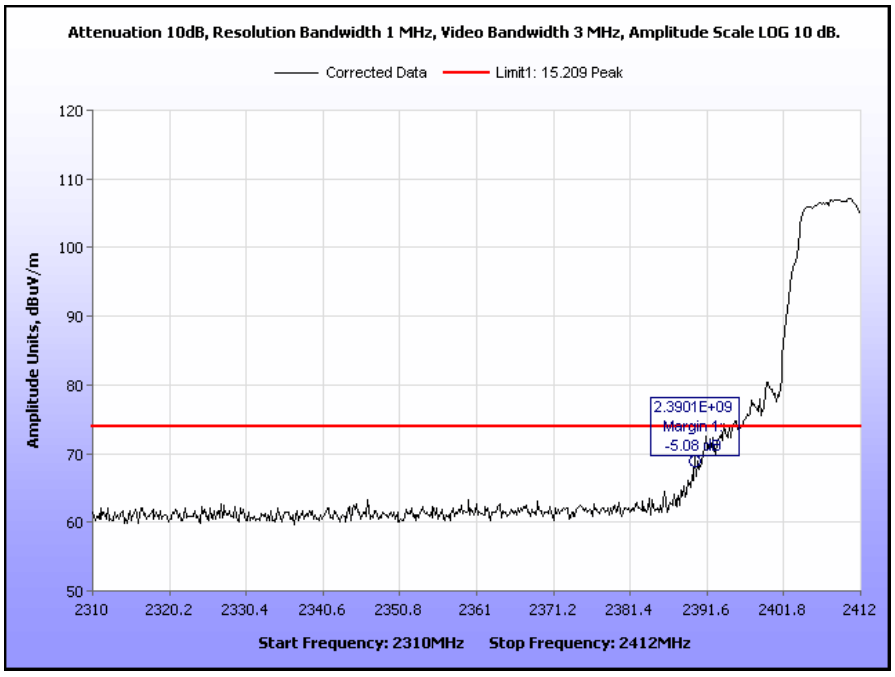
Plot 36. Radiated Restricted Band Edge, 802.11b, 2462 MHz, Average



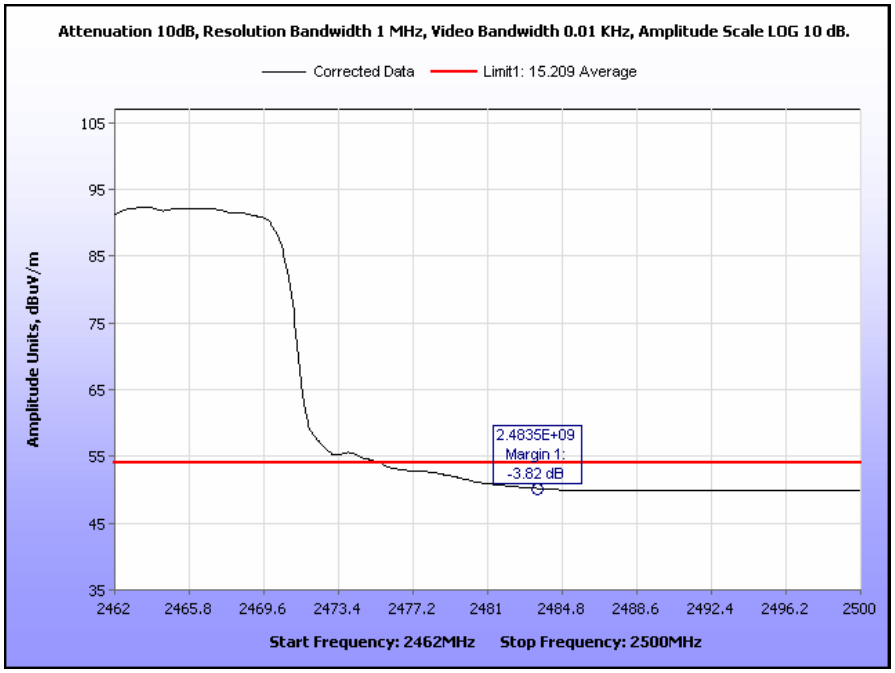
Plot 37. Radiated Restricted Band Edge, 802.11b, 2462 MHz, Peak



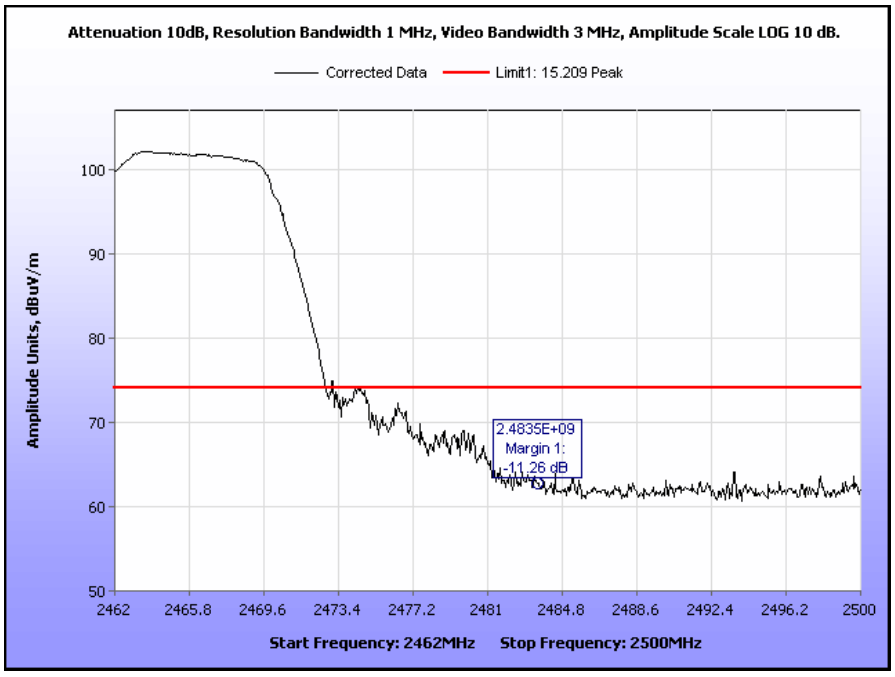
Plot 38. Radiated Restricted Band Edge, 802.11g, 2412 MHz, Average



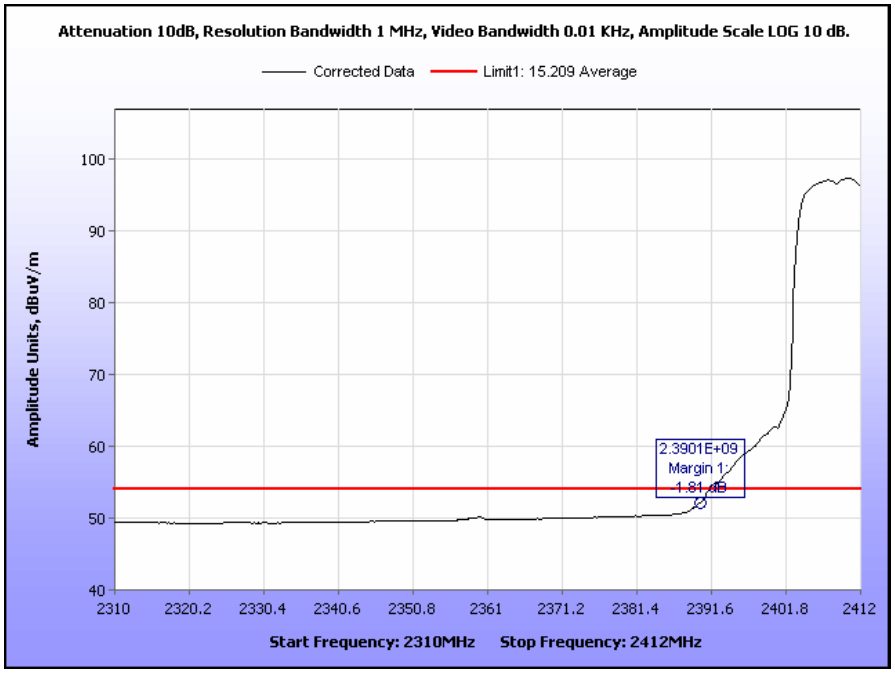
Plot 39. Radiated Restricted Band Edge, 802.11g, 2412 MHz, Peak



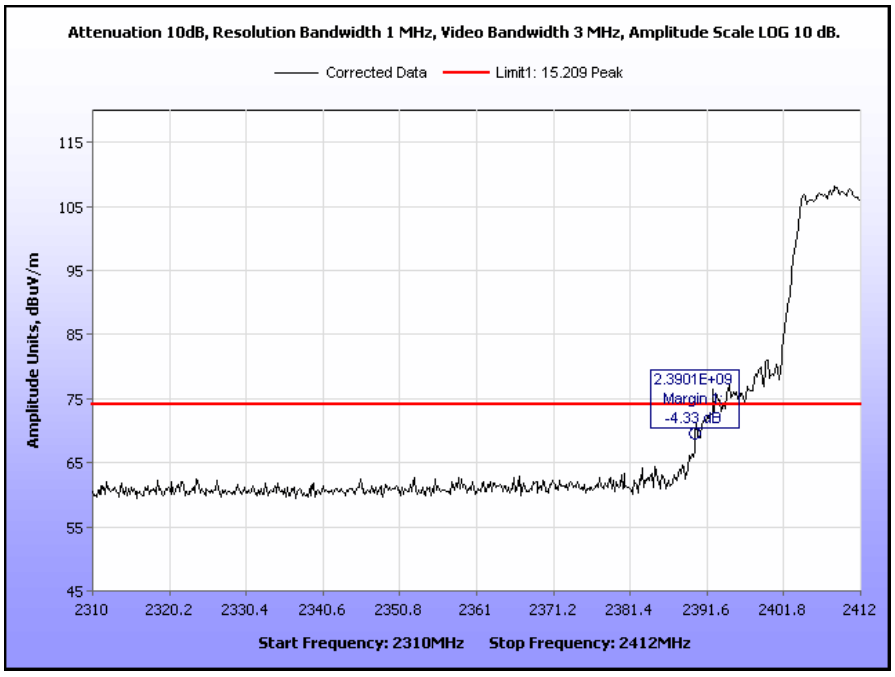
Plot 40. Radiated Restricted Band Edge, 802.11g, 2462 MHz, Average



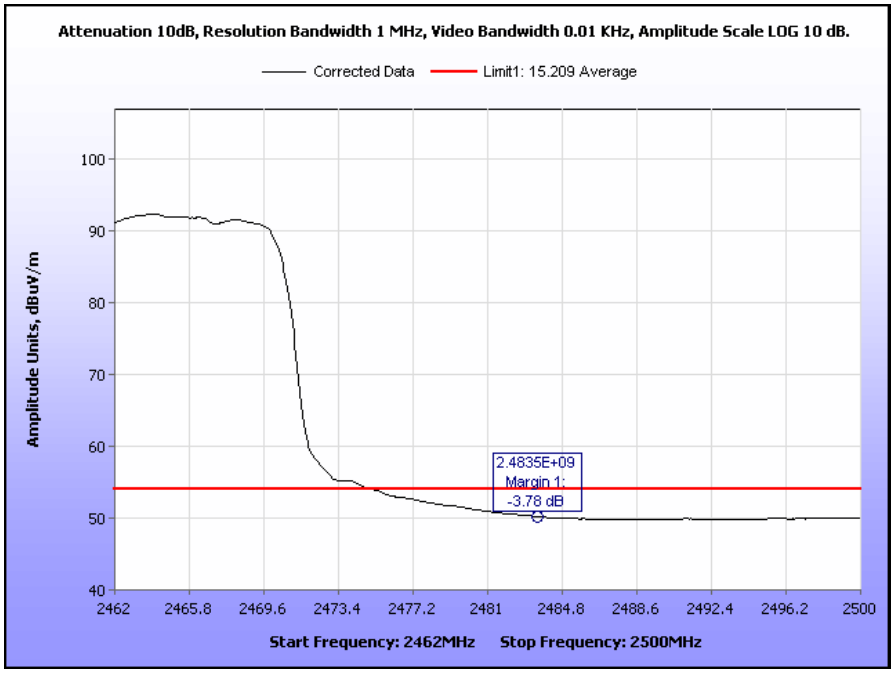
Plot 41. Radiated Restricted Band Edge, 802.11g, 2462 MHz, Peak



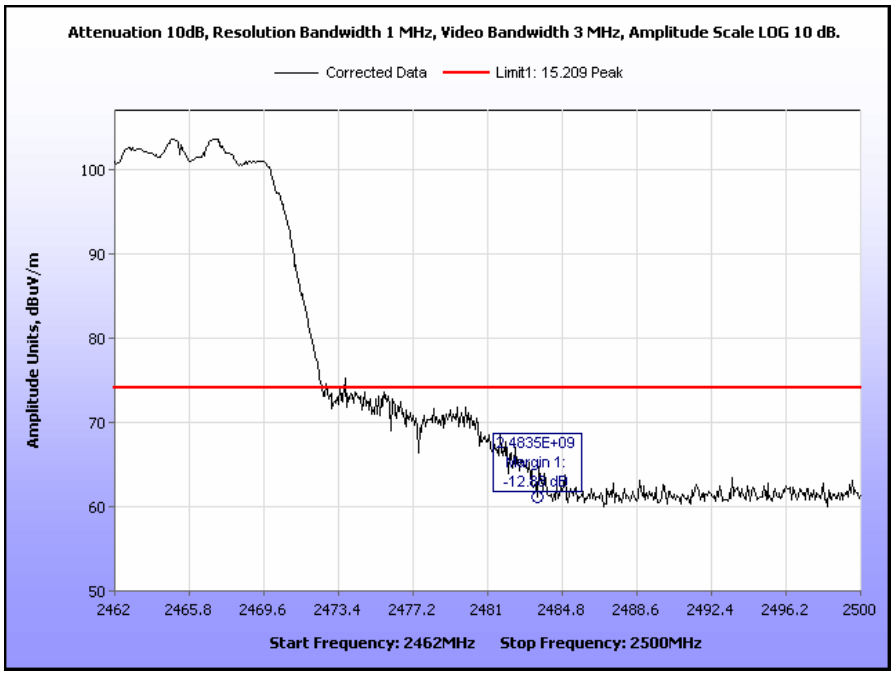
Plot 42. Radiated Restricted Band Edge, 802.11n, 2412 MHz, Average



Plot 43. Radiated Restricted Band Edge, 802.11n, 2412 MHz, Peak

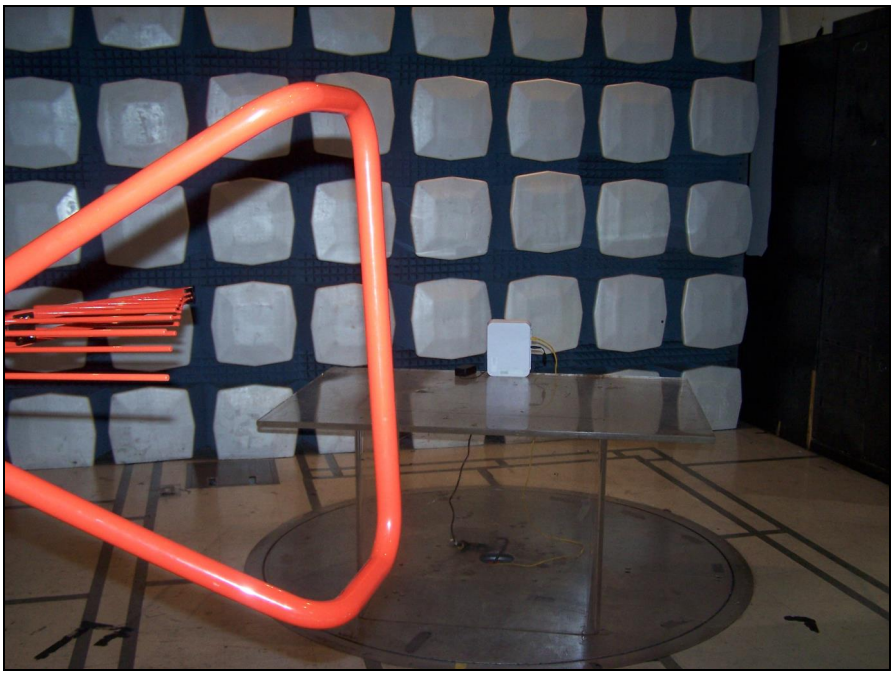


Plot 44. Radiated Restricted Band Edge, 802.11n, 2462 MHz, Average

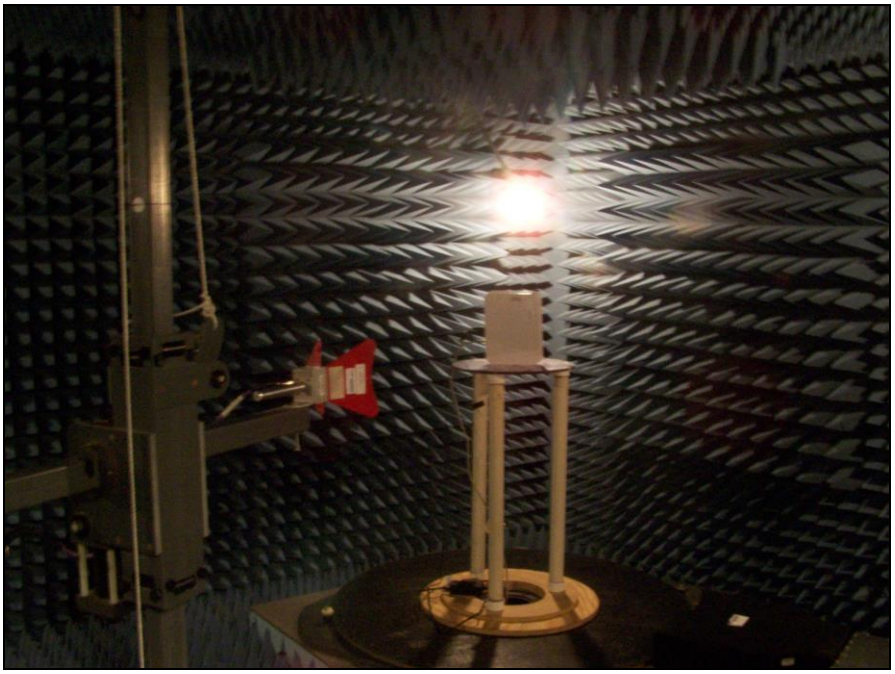


Plot 45. Radiated Restricted Band Edge, 802.11n, 2462 MHz, Peak

Radiated Spurious Emissions Test Setup



Photograph 5. Radiated Spurious Emissions, Test Setup, 30 MHz – 1 GHz



Photograph 6. Radiated Spurious Emissions, Test Setup, Above 1 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 Results: The EUT was not applicable with the Conducted Spurious Emission limits of **§15.247(d)**. The EUT was not applicable with § 15.247 (a)(2). Wi-Fi radio is a pre-approved module, please see FCC ID: QR4WF5370M08. Additionally, this unit contains an integral antenna, thus all testing was performed radiated.

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 Results: The EUT was not applicable with the peak power spectral density limits of **§ 15.247 (e)**. The EUT was not applicable with § 15.247 (a)(2). Wi-Fi radio is a pre-approved module, please see FCC ID: QR4WF5370M08.

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
1T4300	SEMI-ANECHOIC CHAMBER # 1 (NSA)	EMC TEST SYSTEMS	NONE	07/24/2012	07/24/2015
1T4409	EMI RECEIVER	ROHDE & SCHWARZ	ESIB7	07/16/2012	07/16/2014
1T4751	ANTENNA - BILOG	SUNOL SCIENCES	JB6	01/08/2013	07/08/2014
1T2511	ANTENNA; HORN	EMCO	3115	03/28/2013	09/28/2014
1T4612	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	07/30/2013	07/30/2014
1T4442	PRE-AMPLIFIER, MICROWAVE	MITEQ	AFS42-01001800-30-10P	SEE NOTE	
1T4149	HIGH-FREQUENCY ANECHOIC CHAMBER	RAY-PROOF	81	NOT REQUIRED	

Table 17. 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

