



TEST REPORT

Report Number: 101262612DEN-001B
Project Number: G101262612

Report Issue Date: 10/17/2013

Product Designation: Model: M1 (Revolv Hub)

Standards: FCC Part 15 Subpart C (15.247)
Operation within the bands 902-928 MHz, 2400-2483.5 MHz,
and 5725-5850 MHz

Tested by:
Intertek Testing Services NA, Inc.
1795 Dogwood St. Suite 200
Louisville, CO 80027

Client:
Revolv, Inc.
2060 Broadway, Suite 380
Boulder, CO 80302

Report prepared by

Randy Thompson
Senior EMC Project Engineer

Report reviewed by

Michael Spataro
Engineering Team Leader

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

TABLE OF CONTENTS

1 Introduction and Conclusion 3

2 Test Summary 4

3 Description of Product Under Test..... 6

4 System setup including cable interconnection details, support equipment and simplified block diagram 9

5 AC Voltage Variation/ Battery Requirement 13

6 Antenna Requirement..... 15

7 DTS Requirement..... 16

8 DTS Bandwidth (6dB Bandwidth)..... 17

9 RF Conducted Output Power 29

10 RF Conducted Spurious Emissions (-20dBc) – Including Band Edge 39

11 Transmitter Radiated Spurious Emissions – Restricted Band/ Band Edge 54

12 Power Spectral Density – PSD 110

13 Radiated Emissions (Digital Part of Receiver)..... 121

14 AC Mains Conducted Emissions - Transmitter 142

15 RF Exposure Requirement 149

16 Duty Cycle/ Duty Cycle Correction Factor 152

17 Measurement Uncertainty..... 153

18 Revision History 154

1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 3.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded **the product tested complies with the requirements of the standard(s) indicated**. The results obtained in this test report pertain only to the item(s) tested.

1.1 Test Report Scope

The scope of this report was to qualify the “Wi-Fi” radio configured within the Revolv Model M1 product. This radio operates in the following Tx Band: 2400 – 2483.5MHz.

Refer to the following Intertek Test Reports for the test results of the following radios configured within the Revolv Model M1 product:

- Unintentional Radiated and Conducted Emissions (DoC) 101262612DEN-001A
- **Radio #1 (WiFi): 101262612DEN-001B (This Report)**
- Radio #2 (Insteon): 101262612DEN-001C
- Radio #3 (ZWave): 101262612DEN-001D
- Radio #5 (CC1101 #0): 101262612DEN-001E
- Radio #6 (CC1101 #1): 101262612DEN-001F
- Radio #7 (433MHz): 101262612DEN-001G

1.2 Test Methodology

All measurements were performed according to the procedures in the following documents:

- ANSI C63.10:2009 – ANSI Standard for Testing Unlicensed Wireless Devices
- FCC Publication 558074, April 9, 2013 (Guidelines for Compliance Measurements on DTS Operating Under 15.247)

Radiated emissions tests were formed at an antenna-to-product distance of 3-meters.

1.3 Test Facility

Intertek Denver’s testing facilities are located at 1795 Dogwood St. Suite 200 Louisville, CO 80027. The testing facility is ISO17025:2005 accredited by A2LA, our lab code is 2506.02, our VCCI registration numbers are. R-1643, C-1752 and T-1558, our FCC designation no. US1121 and our IC lab no. 2042N.

Testing contained in this test report may not be covered under the laboratories scope of accreditation. A note will be placed in the specific test section for testing not covered under the laboratories scope.

2 Test Summary

TEST SECTION	TESTS	FCC REFERENCE	TEST DATE	RESULT
5	AC Voltage Variation	15.31(e)	08/21/2013	Complies
6	Antenna Requirement	15.203	N/A	Complies
7	DTS Requirement	15.247(a)	N/A	Complies
8	6dB Bandwidth	15.247(a)(2)	08/21/2013	Complies
9	RF Conducted Output Power	15.247(b)(3)(4)	08/21/2013	Complies
10	RF Conducted Spurious Emissions (-20dBc) Includes Band Edge	15.247(d)	08/22/2013	Complies
11	Transmitter Radiated Spurious Emissions (Restricted Bands – Band Edge)	15.247(d) 15.209/ 15.205	08/23/2013	Complies
12	Power Spectral Density (PSD)	15.247(e)	08/22/2013	Complies
13	Radiated Emissions – Digital Receiver	15.109	08/14/2013	Complies
14	Tx AC Line Conducted Emissions	15.207	08/24/2013	Complies
15	RF Exposure Requirement	15.247(i) 15.1.1307(b)(1)	10/15/2013	Complies
16	Duty Cycle/ Duty Cycle Correction Factor	15.35(c)	Note 2	N/A

Notes:

- 1) Product Receiver/Standby Mode of Operation: The product was tested and passed - refer to Intertek Report 101262612DEN-001A for details.
- 2) No duty cycle correction was utilized in this report.

General Radio Test Notes:

- ANSI C63.10, Section 6.3: Testing was performed in 3 different orthogonal axes to determine the worst-case emissions from the device. The worst-case axis and emissions are shown in this report.
- ANSI C63.10, Section 5.13/ FCC CFR Part 15.31(e): For battery-operated equipment, the equipment tests shall be performed using a new battery. For ac-operated equipment, measurements of the fundamental frequency were performed with the supply voltage varied between 85% and 115% of the nominal rated voltage to determine worst-case.
- ANSI C63.10, Section 4.2.3.2/ FCC 15.35: Measurement detector functions and bandwidths utilized in this testing were per the preceding guidelines.
- ANSI C63.10, Section 4.2.3.2.2/ FCC 15.35(b): When an average limit is specified, the peak emission must also be measured to ensure the emissions is less than 20dB above the average limit and/or below the peak limit specified. This report includes both average and peak test data.
- ANSI C63.10, Section 4.2.3.2.4/ FCC 15.35(c): When the field strength (or envelope power) is not constant or when it pulses, and an average detector/limit is specified to be used, a duty cycle correction factor may be utilized to determine the pulsed “average” of the field strength or power. Duty cycle correction was not utilized in this report.
- ANSI C63.10, Section 5.3/ FCC 15.31: All radiated field strength measurements taken at an antenna-to-product test distance of 3-meters.
- ANSI C63.10, Section 5.5, Table 2/ FCC 15.33(a): The frequency range of measurements were per the requirements of the preceding standards. The product was tested from 30MHz to 25GHz.
- ANSI C63.10, Section 6.3.1/ FCC 15.35(b): Measurement bandwidths utilized for fundamental peak emissions were equal to or greater than the 6dB bandwidth of the emission.
- ANSI C63.10, Section 6.3/ FCC 15.31(m): Measurements were taken for at the lowest, near the middle and highest channels of the product tested.

3 Description of Product Under Test

Model:	M1
Type of EUT:	Revolv "Hub" – RF-enabled home automation
Serial Number:	FCC1
FCC ID:	2AAIT-JARVIS1
Industry Canada ID:	N/A
Related Submittal(s) Grants:	W7Z-ZICM357P2 (Zigbee radio) PPD-AR6103 (WiFi radio module)
Company:	Revolv, Inc.
Customer:	Revolv, Inc.
Address:	Revolv, Inc. 2060 Broadway, Suite 380 Boulder, CO 80302
Phone:	(720) 961-5009
Fax:	----
e-mail:	mbergquist@revolv.com
Test Standards:	<input checked="" type="checkbox"/> 47 CFR, Part 15C:§15.247 DTS <input type="checkbox"/> RSS-210, Issue 8, 2010 <input type="checkbox"/> RSS-Gen, Issue 3, 2010 <input checked="" type="checkbox"/> 47 CFR, Part 15C:§15.207 <input type="checkbox"/> Other [REDACTED]
Type of radio:	<input type="checkbox"/> Stand -alone <input checked="" type="checkbox"/> Module <input type="checkbox"/> Hybrid
Date Sample Submitted:	08/11/2013
Test Work Started:	08/11/2013
Test Work Completed:	09/18/2013
Test Sample Conditions:	<input type="checkbox"/> Damaged <input type="checkbox"/> Poor (Usable) <input checked="" type="checkbox"/> Good

Product Description:	Wireless RF-Enabled Home Automation Hub
Transmitter Type:	<input type="checkbox"/> FHSS <input type="checkbox"/> Digital Modulation <input checked="" type="checkbox"/> WiFi <input type="checkbox"/> Blue Tooth
Operating Frequency Range(s):	2412MHz to 2462MHz
Number of Channels:	IEEE 802.11b, IEEE 802.11g, 802.11n HT20 (nHT40 not supported) 2400 – 2483.5 MHz (5GHz band not supported) 11-Channels
Modulation:	CCK, OFDM
Emission Designator:	17M8F1D (worst-case BW of 802.11b, g, nHT20 bands)
Antenna(s) Info:	Antenna: Type: 2.45GHz SMD Chip Gain: +2.0 dBi Connector Type: N/A Integral Antenna
Rated Power:	25.91 dBm (389.94 mW)
Antenna Installation:	<input type="checkbox"/> User <input type="checkbox"/> Professional <input checked="" type="checkbox"/> Factory
Transmitter power configuration:	<input type="checkbox"/> Internal battery <input checked="" type="checkbox"/> External power source
Special Test Arrangement:	Since the product can be mounted in several orientations, the EUT was rotated and tested in three orthogonal axes to determine the maximum emissions
Test Facility Accreditation:	A2LA (Certificate No. 2506.01)
Test Methodology:	Measurements performed according to the procedures in ANSI C63.10-2009 and FCC Guidance Publication 558074

3.1 Wi-Fi Channel Configurations

CHANNELS IN THE 2400 – 2483.5 MHZ BAND				
Channel Number	Frequency (MHz)	802.11b	802.11g	802.11n HT20
1	2412	tested	tested	tested
2	2417	x	x	x
3	2422	x	x	x
4	2427	x	x	x
5	2432	x	x	x
6	2437	tested	tested	tested
7	2442	x	x	x
8	2447	x	x	x
9	2452	x	x	x
10	2457	x	x	x
11	2462	tested	tested	tested

Note: x = available channels

3.2 Product Description - Detailed

Description of Equipment Under Test (provided by client)

The Revolv "Hub" product is designed to link a variety of RF-enabled home automation and home security products, which will collectively be referred to as "home automation products", to a WiFi Local Area Network, and through that WLAN out to the cloud and ultimately to the user's smart-phone, tablet, or computer where a software application will allow the user to access and control all of the linked home automation products.

Because there are numerous manufacturers of home automation products, there are also numerous radios, frequencies, and RF communication protocols employed. The Revolv Hub seeks compatibility with a broad spectrum of these products by employing multiple radios. Note the WiFi radio is a certified module. However, since the chip antenna has been modified and the antenna matching circuit is different than the original certification, full testing was performed. All antennas - except for the Zigbee radio - are chip-type and soldered directly to the main PCB.

The product is configured with the following discrete radios:

- Wi-Fi: 2.4GHz ISM Band (802.11 b/g/n HT20) – (Atheros AR6103 module)
- Insteon: 915MHz ISM Band (single channel)
- ZWave: 9908.42 MHz ISM Band (single channel)
- Zigbee: 2.4GHz ISM Band (Certified Module)
- CC1101 #0: 903 – 927 MHz ISM Band (multi-channel)
- CC1101 #1: 902.6 – 927.4 MHz ISM Band (multi-channel)
- CC1101 #3: 431 – 437 MHz (control signals multi-channel)

Note the radios do not transmit simultaneously and each radio has a dedicated antenna.

There are no signal or I/O ports or cables configured on the product.

The product is powered from an external AC Adapter.

For the purposes of this specific test report, the product supports the following data rates in the 2400 – 2483.5 MHz band:

- IEEE 802.11b: 1, 2, 5.5, 11 Mbps
- IEEE 802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps
- IEEE 802.11n HT20: 6.5, 13, 19.5, 26, 39, 52, 58.5, 65 Mbps

In 802.11n HT20 mode, the nominal bandwidth is 20MHz.

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
AC Adapter Input: 100-240VAC	0.3	50/60	1
AC Adapter Output: 5VDC	2.0	---	---

Descriptions of EUT Exercising
<input checked="" type="checkbox"/> Standby/Idle Mode
<input checked="" type="checkbox"/> Continuous transmission, un-modulated carrier (CW)
<input checked="" type="checkbox"/> Continuous transmission, modulated carrier (CW)
<input checked="" type="checkbox"/> Continuous Receive Mode

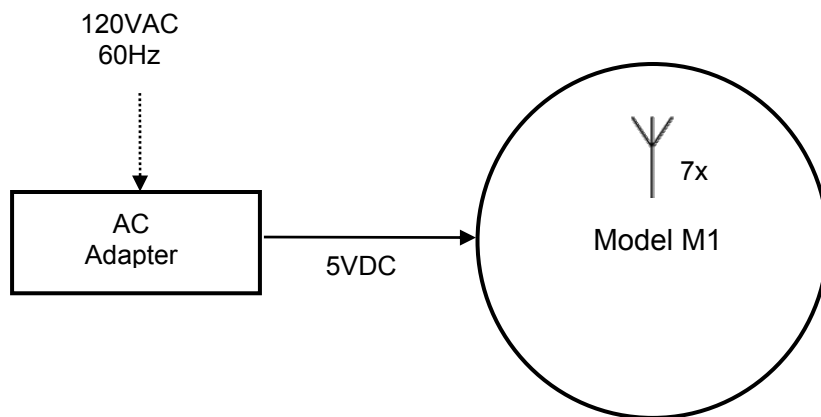
Note: The chosen mode of operation described above is dependent upon the specific test to be performed.

4 System setup including cable interconnection details, support equipment and simplified block diagram

4.1 Method:

Record the details of EUT cabling, document the support equipment, and show the interconnections in a block diagram.

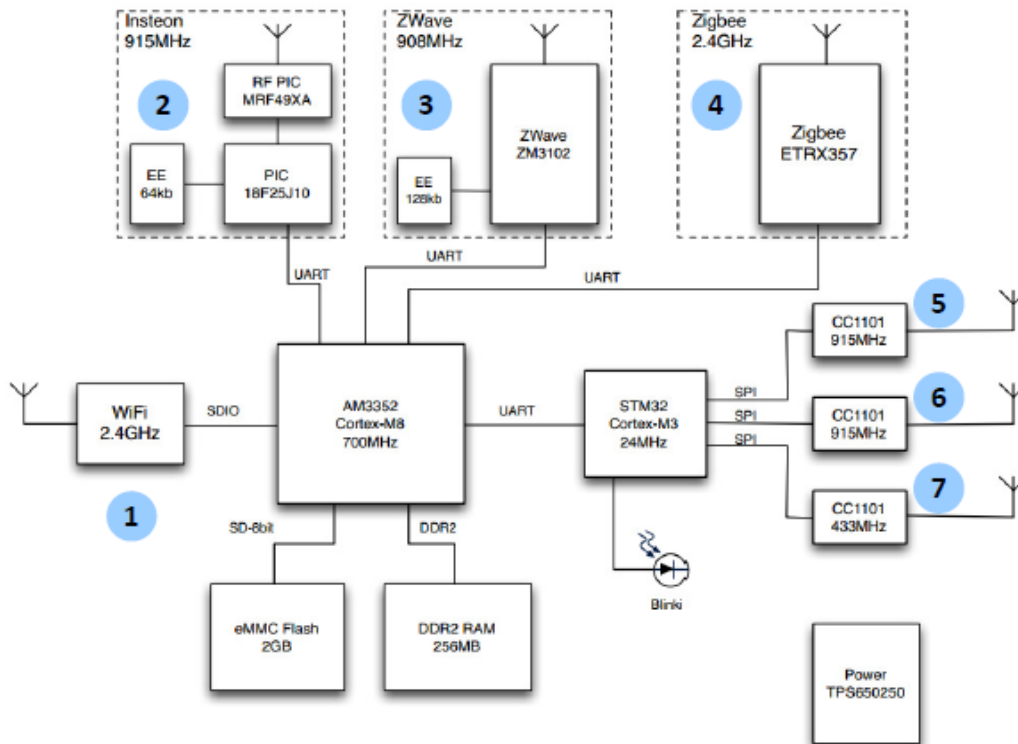
4.2 EUT Block Diagram:



Note: Dashed lines indicate auxiliary/support equipment outside the test area

4.3 EUT Block Diagram: Detailed

The Hub contains a number of discrete radios as shown in this product block diagram:



Purpose of this document is to describe the Hub and describe each radio to facilitate creation of FCC certification test plan and quotation for testing and TCB service to obtain FCC certification.

Intertek

Report Number: 101262612DEN-001B

Issued: 10/17/2013

4.4 Support Data:

ID	Description/ Function	Shield Type	Length	Connector	Connection	Ferrites
--	----	----	----	----	----	----

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Laptop	HP	---	---

Notes:

- 1) The laptop was utilized only to configure the product during testing (i.e. set channel, modulation, data rates, etc.).
- 2) The product has no signal or I/O cables.

4.5 Photograph: Product Tested – Test Axes

Model M1 (Revolv Hub)

Axis 1 – Product Horizontal (Flat on Table)



Axis 2 – Product Vertical (Wall Mount)



Axis 3 – Product Vertical & Rotated 90 degrees CW



5 AC Voltage Variation/ Battery Requirement

5.1 Method

Unless otherwise stated no deviations were made from FCC Part 15.31(e).

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

5.2 Test Requirement/Specification

For battery-operated equipment, the equipment tests shall be performed using a new battery. For ac-operated equipment, measurements of the fundamental frequency shall be performed with the supply voltage varied between 85% and 115% of the nominal rated voltage to determine worst-case.

- FCC 15.31(e)
- ANSI C63.10, Section 5.13

5.3 Test Equipment Used:

<u>Asset ID</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Serial</u>	<u>Cal Date</u>	<u>Cal Due</u>
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
E2	RF Conducted Port Cable	----	True Blue	001	09/12/2013	09/13/2014
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBU	VBU

5.4 Results:

There was no significant deviation in measurements as a function of ac supply voltage variation. Therefore, all output fundamental power measurements were performed at the nominal ac voltage of 115VAC.

5.5 Test Summary:

FREQ	LEVEL	DET	RF PORT CABLE	ANTENNA	PREAMP	ATTEN	FINAL
MHz	dBm	Qp Av Pk Rms	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBm]
Measurements Fundamental Output Power : 802.11b							
Nominal 115V							
2437.0000	23.98	Pk	0.86	0.00	0.00	0.00	24.84
115% Nominal 132V							
2437.0000	23.95	Pk	0.86	0.00	0.00	0.00	24.81
85% Nominal 98V							
2437.0000	23.96	Pk	0.86	0.00	0.00	0.00	24.82
Measurements Fundamental Output Power : 802.11g							
Nominal 115V							
2437.0000	24.10	Pk	0.86	0.00	0.00	0.00	24.96
115% Nominal 132V							
2437.0000	24.08	Pk	0.86	0.00	0.00	0.00	24.94
85% Nominal 98V							
2437.0000	23.98	Pk	0.86	0.00	0.00	0.00	24.84
Measurements Fundamental Output Power : 802.11n							
Nominal 115V							
2437.0000	23.02	Pk	0.86	0.00	0.00	0.00	23.88
115% Nominal 132V							
2437.0000	23.02	Pk	0.86	0.00	0.00	0.00	23.88
85% Nominal 98V							
2437.0000	22.97	Pk	0.86	0.00	0.00	0.00	23.83

6 Antenna Requirement

6.1 Method

Unless otherwise stated no deviations were made from FCC Part 15.203.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

6.2 Test Requirement/Specification

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.

6.3 Results:

The sample tested was found to comply.

The product incorporates an integral antenna embedded on the pc board. The user has no direct access to the antenna and the antenna is not replaceable.

7 DTS Requirement

7.1 Method

Unless otherwise stated no deviations were made from FCC Part 15.247(a).

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

7.2 Test Requirement/Specification

Operation under the provisions of this Section is limited to digitally-modulated intentional radiators.

- FCC 15.31(e)

7.3 Results:

The sample tested was found to comply.

The product incorporates the following WiFi digital modulation schemes and modes:

- DSSS & OFDM
- CCK, BPSK, QPSK

8 DTS Bandwidth (6dB Bandwidth)

8.1 Method

Unless otherwise stated no deviations were made from FCC Part 15.247.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

8.2 Test Requirements/Specification:

For the bands 2400 – 2483.5 GHz and 5725 – 5850 MHz, the minimum 6dB Bandwidth of the Fundamental signal shall be at least 500 kHz.

- FCC 15.247(a)(2)

8.3 Test Equipment Used:

<u>Asset ID</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Serial</u>	<u>Cal Date</u>	<u>Cal Due</u>
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
E2	RF Conducted Port Cable	-----	True Blue	001	09/12/2013	09/13/2014
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBU	VBU

8.4 Test Procedure:

The antenna port of the product was connected to the input of the spectrum analyzer. For each RF output channel investigated, the spectrum analyzer center frequency was set to the modulated channel carrier. A maximum peak output reading was taken and a display line was drawn 6 dB lower than measured peak level.

The 6dB bandwidth was determined from the two outermost amplitude points (lower and upper frequencies) where that where attenuated 6dB relative to the maximum peak level measured in the fundamental emission.

The following procedures described in FCC Publication 558074 (Guidelines for Compliance Measurements on DTS Operating Under 15.247), were used:

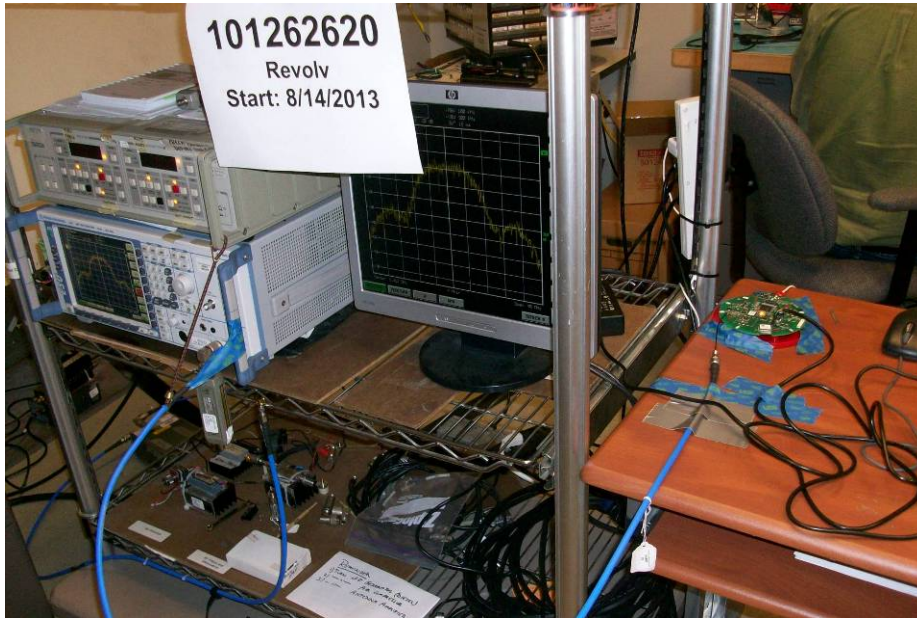
- FCC 558074 DTS Measurement Guidance, Section 8.1 (Option 1)

8.5 Test Results:

The sample tested was found to Comply.

8.6 Setup Photographs:

DTS Bandwidth - Test setup



8.7 Test Data Summary: 2400-2483.5 MHz Band

**DTS (6dB) Bandwidth 2400 – 2483.5 MHz
FCC Part 15.247(a)(2)**

CHANNEL	FREQUENCY, MHZ	STANDARD/ DATA RATE	6DB BANDWIDTH (MHZ)	6DB BANDWIDTH LIMIT (KHZ)	PLOT
1	2412	802.11b, 1Mbps	10.42	≥ 500kHz	x
		802.11g, 6Mbps	16.52	≥ 500kHz	x
		802.11n HT20, 6.5Mbps	17.79	≥ 500kHz	
6	2437	802.11b, 1Mbps	9.70	≥ 500kHz	x
		802.11g, 6Mbps	16.51	≥ 500kHz	x
		802.11n HT20, 6.5Mbps	17.63	≥ 500kHz	x
11	2462	802.11b, 1Mbps	9.62	≥ 500kHz	x
		802.11g, 6Mbps	16.51	≥ 500kHz	x
		802.11n HT20, 6.5Mbps	17.79	≥ 500kHz	x

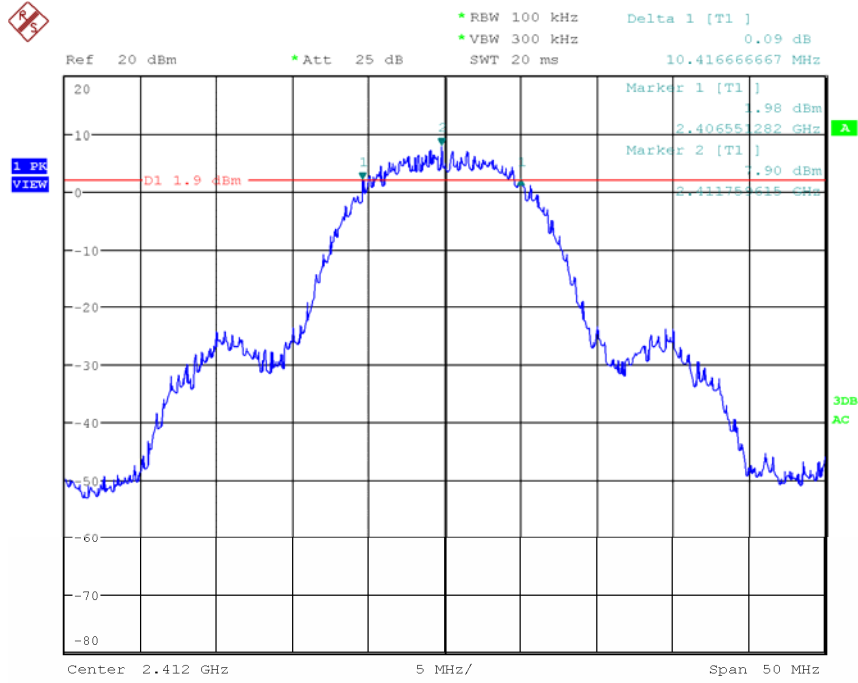
Note: The above represents the worst-case (least-bandwidth) modulation and data rate.

8.8 Test Data/Plots: DTS (6dB) Bandwidth

DTS (6dB) Bandwidth - FCC Part 15.247(a)(2)

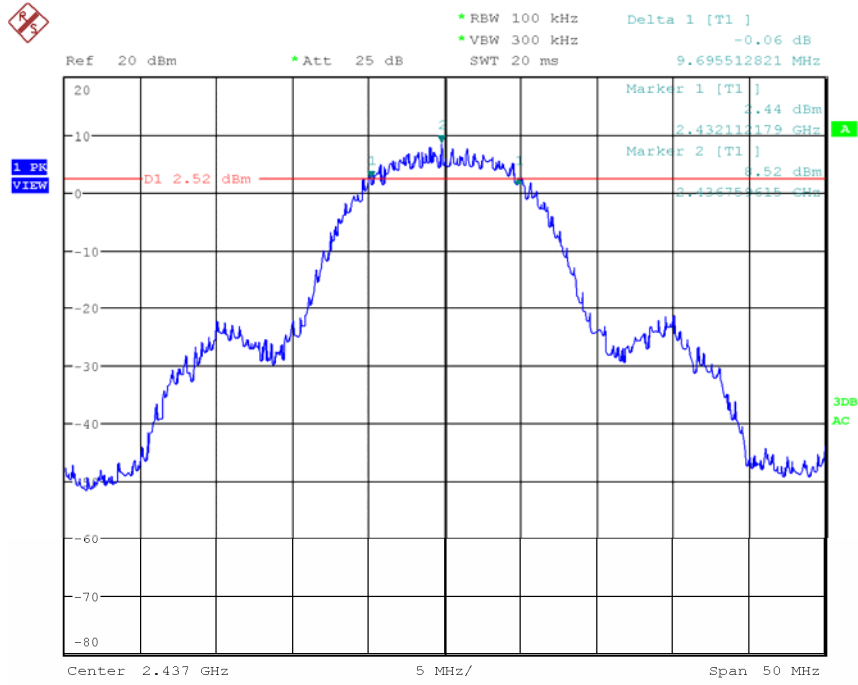
802.11b – CCK Modulation Mode

Low Channel 1: 2412MHz



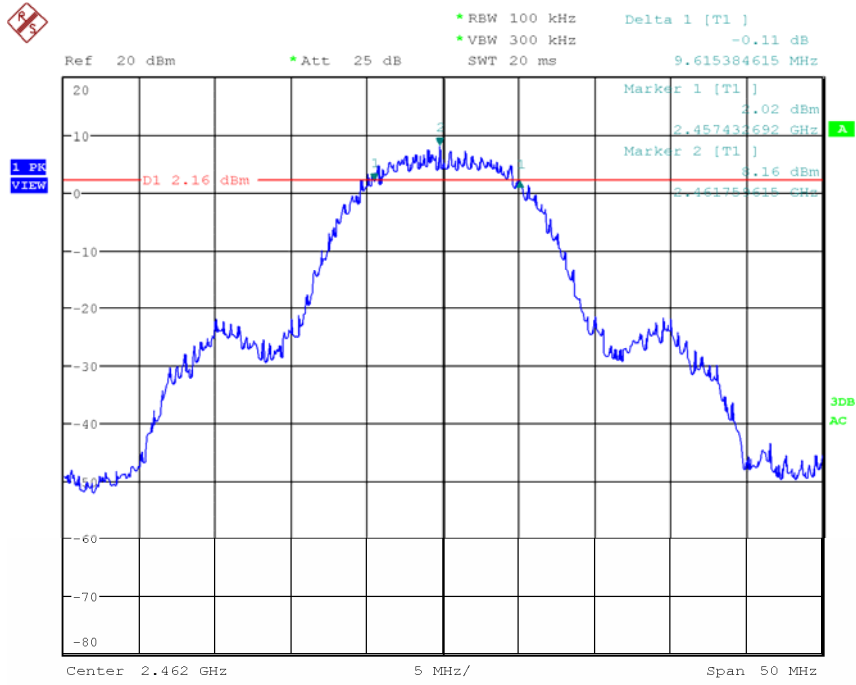
Date: 21.AUG.2013 09:38:19

802.11b – CCK Modulation Mode
Mid Channel 6: 2437MHz



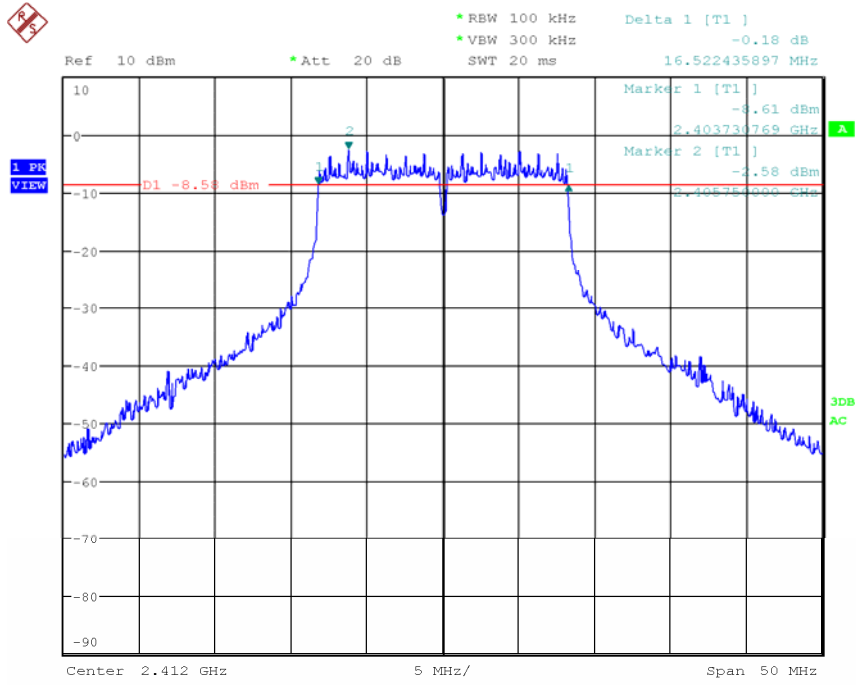
Date: 21.AUG.2013 09:42:03

802.11b – CCK Modulation Mode
High Channel 11: 2462MHz



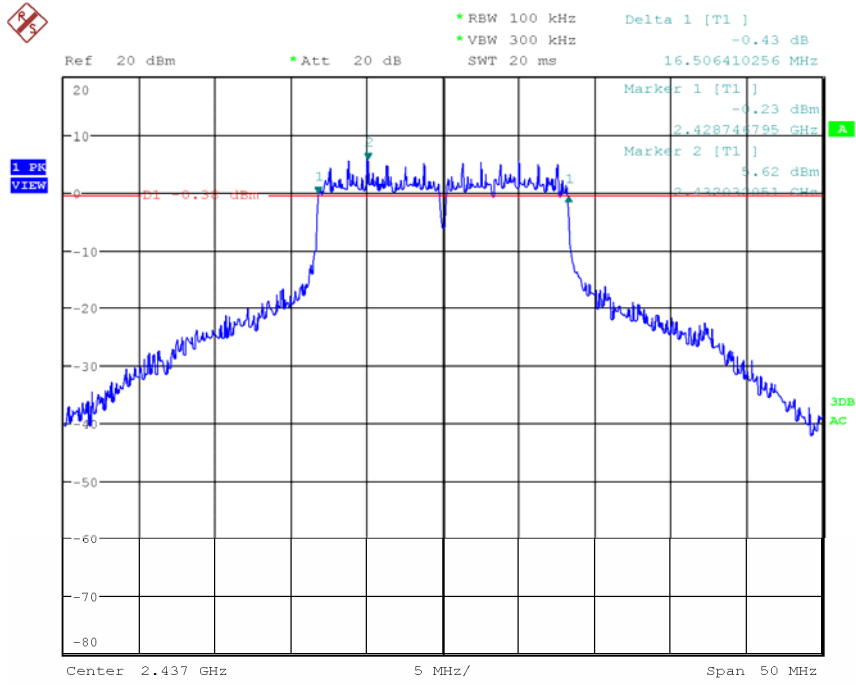
Date: 21.AUG.2013 09:45:06

802.11g – OFDM Modulation Mode
Low Channel 1: 2412MHz



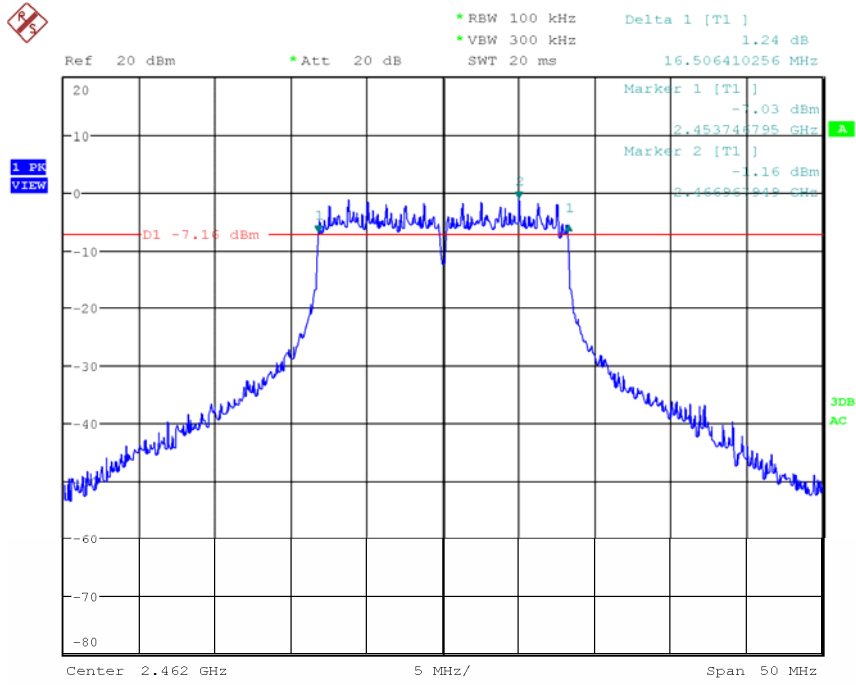
Date: 21.AUG.2013 09:50:29

802.11g – OFDM Modulation Mode
Mid Channel 6: 2437MHz



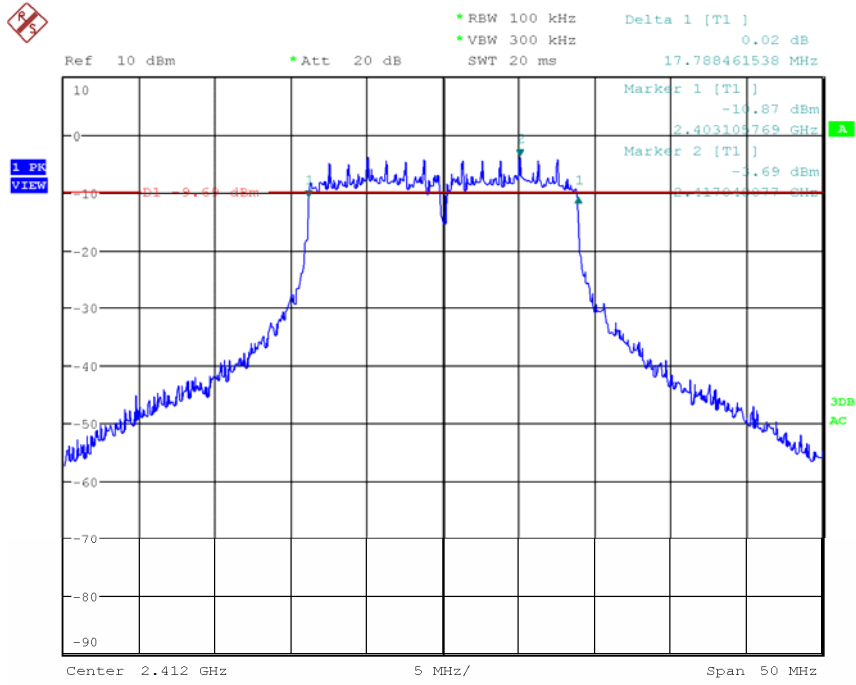
Date: 21.AUG.2013 09:59:11

802.11g – OFDM Modulation Mode
High Channel 11: 2462MHz



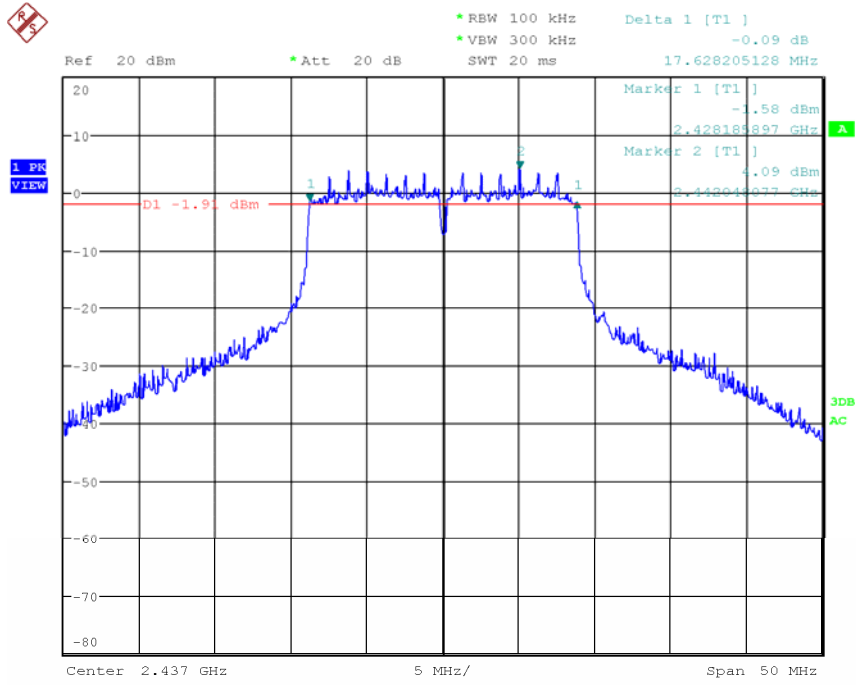
Date: 21.AUG.2013 10:01:48

802.11n HT20 OFDM Modulation Mode
Low Channel 1: 2412MHz



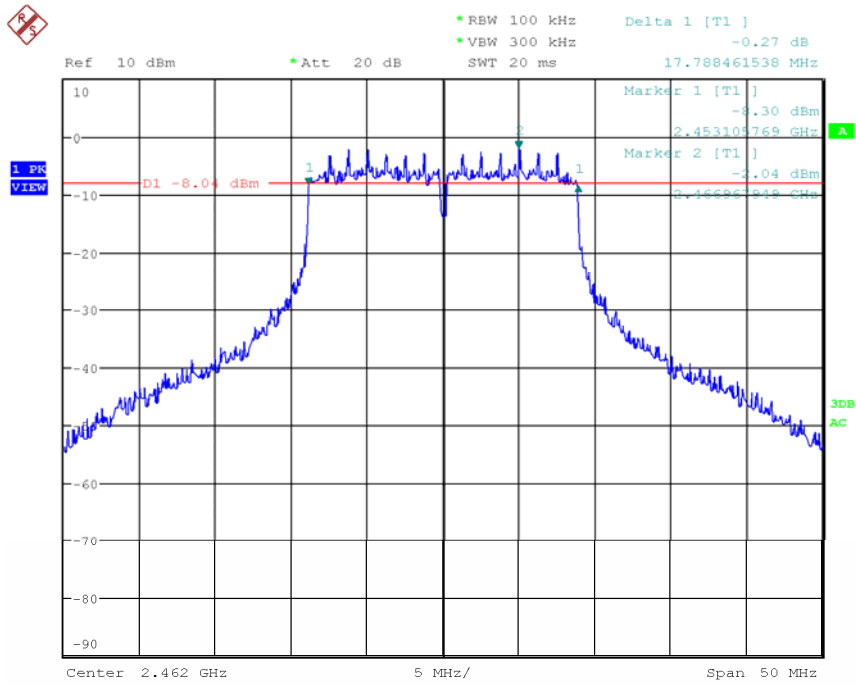
Date: 21.AUG.2013 10:06:30

802.11n HT20 OFDM Modulation Mode
Mid Channel 6: 2437MHz



Date: 21.AUG.2013 10:09:57

802.11n HT20 OFDM Modulation Mode
 High Channel 11: 2462MHz



Date: 21.AUG.2013 10:12:42

FCC Part 15.247(a)(2) 6dB Bandwidth Specification: Minimum 6dB BW > 500kHz

Worst-case 6dB Bandwidth Measurement (Minimum Bandwidth): 9.62MHz

- 802.11b – CCK Modulation Mode
- High Channel 11

9 RF Conducted Output Power

9.1 Method

Unless otherwise stated no deviations were made from FCC Part 15.247.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

9.2 Test Requirement/Specification

For the band 2400 – 2483.5 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 Watt (+30dBm) when using antennas with 6dBi or less gain.

- FCC 15.247(b)(3)(4)

To determine compliance, the maximum peak conducted output power or the maximum (average) conducted output power is utilized.

The maximum peak conducted output power is defined as the maximum power level measured with a peak detector using a filter with width and shape of which is sufficient to accept the signal bandwidth. However, when a filter with adequate width is not available, an integrated method utilizing a peak detector is acceptable. The procedures for measuring the maximum peak conducted output power assume the use of the DTS (6dB) bandwidth.

The maximum (average) conducted output power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level.

The procedures for measuring the maximum conducted (average) output power assume the use of the occupied bandwidth (OBW) as the reference for power integration.

The measurement procedures described are based on the use of an antenna-port conducted test configuration. However, if antenna-port conducted tests cannot be performed on the product, radiated tests are acceptable for demonstrating compliance to the conducted emission requirements.

If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

9.3 Test Procedure

The antenna port of the EUT was connected to the input port of a spectrum analyzer using an appropriate rf port cable to measure the maximum conducted transmitter output power.

The following procedures described in FCC Publication 558074 (Guidelines for Compliance Measurements on DTS Operating Under 15.247), were used:

- 558074, Section 9.1.2 (Integrated band power method)
- ANSI C63.10: 2009 – General Guidance

9.4 Test Equipment Used:

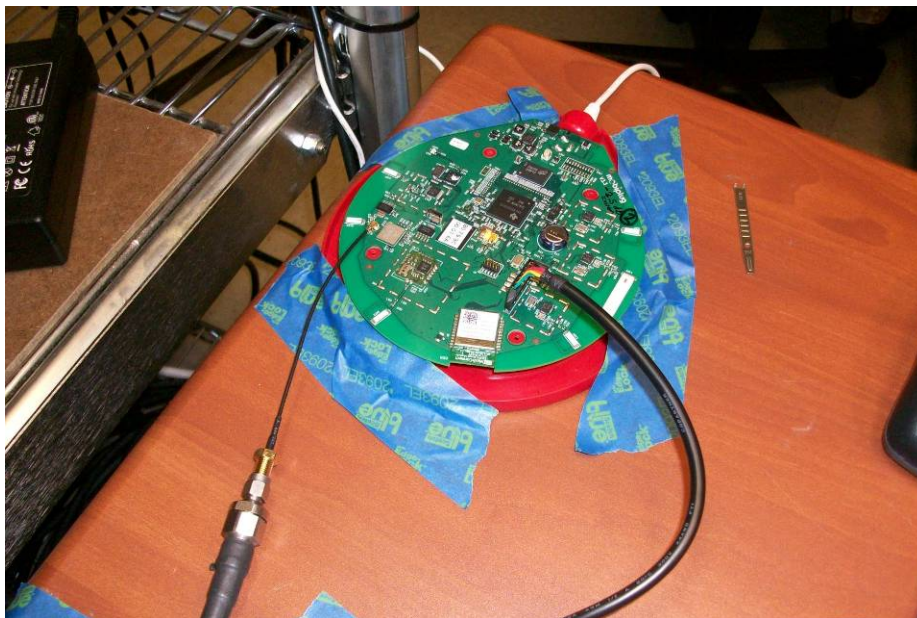
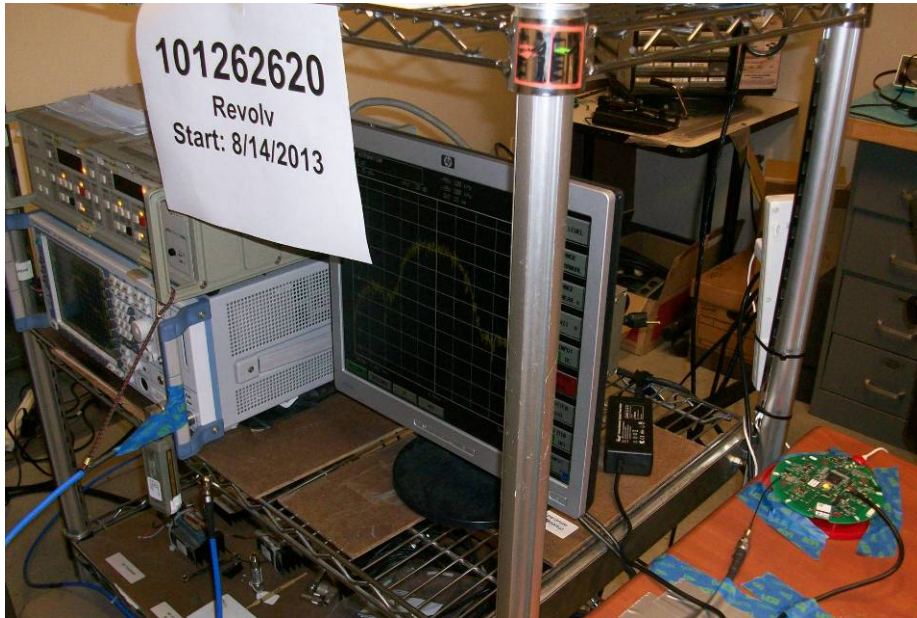
<u>Asset ID</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Serial</u>	<u>Cal Date</u>	<u>Cal Due</u>
DEN-073	EMI Receiver	RHODE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
E2 SW-6	RF Conducted Port Cable Software for Radiated and Conducted emissions.	----- Intertek	True Blue OATS vba	001 V. 3.0	09/12/2013 VBU	09/12/2014 VBU

9.5 Results:

The sample tested was found to Comply.

9.6 Setup Photographs:

RF Conducted Output Power - Test setup



9.7 Test Data Summary: RF Conducted Output Power

**RF Conducted Output Power 2400 – 2483.5 MHz
FCC Part 15.247(b)(3)**

CHANNEL	FREQUENCY (MHZ)	STANDARD/DATA RATE	CONDUCTED POWER (PK DBM)	CONDUCTED POWER LIMIT (DBM)	CONDUCTED POWER (PK MW)	CONDUCTED POWER LIMIT (MW)	PLOT
1	2412	802.11b, 11Mbps	24.16	30.0	260.62	1000	x
		802.11g, 24Mbps	18.59	30.0	72.28	1000	x
		802.11n HT20, 26Mbps	16.89	30.0	48.87	1000	
6	2437	802.11b, 11Mbps	24.80	30.0	302.00	1000	x
		802.11g, 24Mbps	25.91	30.0	389.94	1000	x
		802.11n HT40, 26Mbps	24.15	30.0	260.02	1000	
11	2462	802.11b, 11Mbps	24.13	30.0	258.82	1000	x
		802.11g, 24Mbps	19.92	30.0	98.17	1000	x
		802.11n HT20, 26Mbps	18.10	30.0	64.57	1000	x

The above data summary table represents the worst-case modulation/data rate combination.

Worst-case output power measurement: 802.11g, 25.91dBm = 389.94 mW

9.8 Test Data: RF Conducted Output Power

RF Conducted Port Power - FCC Part 15.247(b)(3)(4)

802.11b Band

Modulation Mode	Tx Channel	Frequency (MHz)	Data Rate	Peak Conducted (dBm)	Cable Loss (dB)	Final Conducted (dBm)	Spec Limit dBm	MIMO Limit (dBm)	Delta Limit	Test Result	EBW (MHz)	Plot
DSSS (CCK) Power Index = 17	1	2412	1	20.34	0.86	21.20	30	N/A	-8.80	Pass		
			2	20.62	0.86	21.48	30	N/A	-8.52	Pass		
			5.5	22.14	0.86	23.00	30	N/A	-7.00	Pass		
			11	23.30	0.86	24.16	30	N/A	-5.84	Pass		
802.11b												
Power Index = 17	6	2437	1	20.94	0.86	21.80	30	N/A	-8.20	Pass		
			2	21.21	0.86	22.07	30	N/A	-7.93	Pass		
			5.5	22.77	0.86	23.63	30	N/A	-6.37	Pass		
			11	23.94	0.86	24.80	30	N/A	-5.20	Pass	12.00	x
802.11b												
Power Index = 17	11	2462	1	19.59	0.87	20.46	30	N/A	-9.54	Pass		
			2	20.92	0.87	21.79	30	N/A	-8.21	Pass		
			5.5	22.46	0.87	23.33	30	N/A	-6.67	Pass		
			11	23.26	0.87	24.13	30	N/A	-5.87	Pass		
802.11b												

Intertek

Report Number: 101262612DEN-001B

Issued: 10/17/2013

RF Conducted Port Power - FCC Part 15.247(b)(3)(4)

802.11g Band

Modulation Mode	Tx Channel	Frequency (MHz)	Data Rate	Peak Cond (dBm)	Cable Loss (dB)	Final Cond (dBm)	Spec Limit dBm	MIMO Limit (dBm)	Delta Limit	Test Result	EBW (MHz)	Plot
OFDM	1	2412	6	17.39	0.86	18.25	30	N/A	-11.75	Pass		
Power Index = 7.5			9	17.00	0.86	17.86	30	N/A	-12.14	Pass		
Data Rate: 6-36			12	17.33	0.86	18.19	30	N/A	-11.81	Pass		
			18	16.85	0.86	17.71	30	N/A	-12.29	Pass		
Power Index = 10			24	17.73	0.86	18.59	30	N/A	-11.41	Pass		
Data Rate: 48-54			36	17.29	0.86	18.15	30	N/A	-11.85	Pass		
			48	16.86	0.86	17.72	30	N/A	-12.28	Pass		
802.11g			54	17.12	0.86	17.98	30	N/A	-12.02	Pass		
Power Index = 15	6	2437	6	24.15	0.86	25.01	30	N/A	-4.99	Pass		
Data Rate: 6-36			9	24.27	0.86	25.13	30	N/A	-4.87	Pass		
			12	24.40	0.86	25.26	30	N/A	-4.74	Pass		
			18	24.10	0.86	24.96	30	N/A	-5.04	Pass		
			24	25.05	0.86	25.91	30	N/A	-4.09	Pass	17.00	x
Power Index = 10			36	23.85	0.86	24.71	30	N/A	-5.29	Pass		
Data Rate:48-54			48	20.07	0.86	20.93	30	N/A	-9.07	Pass		
802.11g			54	20.25	0.86	21.11	30	N/A	-8.89	Pass		
Power Index = 7.5	11	2462	6	17.94	0.87	18.81	30	N/A	-11.19	Pass		
Data Rate: 6-36			9	18.14	0.87	19.01	30	N/A	-10.99	Pass		
			12	18.40	0.87	19.27	30	N/A	-10.73	Pass		
			18	17.98	0.87	18.85	30	N/A	-11.15	Pass		
			24	19.05	0.87	19.92	30	N/A	-10.08	Pass		
Power Index = 10			36	18.67	0.87	19.54	30	N/A	-10.46	Pass		
Data Rate: 48-54			48	18.71	0.87	19.58	30	N/A	-10.42	Pass		
802.11g			54	18.85	0.87	19.72	30	N/A	-10.28	Pass		

Intertek

Report Number: 101262612DEN-001B

Issued: 10/17/2013

RF Conducted Port Power - FCC Part 15.247(b)(3)(4)

802.11n HT20 Band

Modulation Mode	Tx Channel	Frequency (MHz)	Data Rate	Peak Cond (dBm)	Cable Loss (dB)	Final Cond (dBm)	Spec Limit dBm	MIMO Limit (dBm)	Delta Limit	Test Result	EBW (MHz)	Plot
OFDM Power Index = 6.5 Data Rate: 6.5-39 Power Index = 7 Data Rate: 52-65 802.11n HT20	1	2412	6.5	15.63	0.86	16.49	30	N/A	-13.51	Pass		
			13	15.48	0.86	16.34	30	N/A	-13.66	Pass		
			19.5	15.98	0.86	16.84	30	N/A	-13.16	Pass		
			26	16.03	0.86	16.89	30	N/A	-13.11	Pass		
			39	15.48	0.86	16.34	30	N/A	-13.66	Pass		
			52	15.90	0.86	16.76	30	N/A	-13.24	Pass		
			58.5	15.96	0.86	16.82	30	N/A	-13.18	Pass		
			65	15.89	0.86	16.75	30	N/A	-13.25	Pass		
Power Index = 14 Data Rate: 6.5-26 Power Index = 12 Data Rate: 39-52 Power Index = 7 Data Rate: 58.5-65 802.11n HT20	6	2437	6.5	23.17	0.86	24.03	30	N/A	-5.97	Pass		
			13	22.91	0.86	23.77	30	N/A	-6.23	Pass		
			19.5	23.07	0.86	23.93	30	N/A	-6.07	Pass		
			26	23.29	0.86	24.15	30	N/A	-5.85	Pass	19.00	x
			39	21.60	0.86	22.46	30	N/A	-7.54	Pass		
			52	21.73	0.86	22.59	30	N/A	-7.41	Pass		
			58.5	16.40	0.86	17.26	30	N/A	-12.74	Pass		
			65	16.26	0.86	17.12	30	N/A	-12.88	Pass		
Power Index = 14 Data Rate: 6.5-26 Power Index = 12 Data Rate: 39-52 Power Index = 7 Data Rate: 58.5-65 802.11n HT20	11	2462	6.5	17.06	0.87	17.93	30	N/A	-12.07	Pass		
			13	16.95	0.87	17.82	30	N/A	-12.18	Pass		
			19.5	17.04	0.87	17.91	30	N/A	-12.09	Pass		
			26	17.23	0.87	18.10	30	N/A	-11.90	Pass		
			39	17.04	0.87	17.91	30	N/A	-12.09	Pass		
			52	17.10	0.87	17.97	30	N/A	-12.03	Pass		
			58.5	16.13	0.87	17.00	30	N/A	-13.00	Pass		
			65	16.08	0.87	16.95	30	N/A	-13.05	Pass		

FCC Part 15.247(b)(3) Limit: 30dBm (1W)

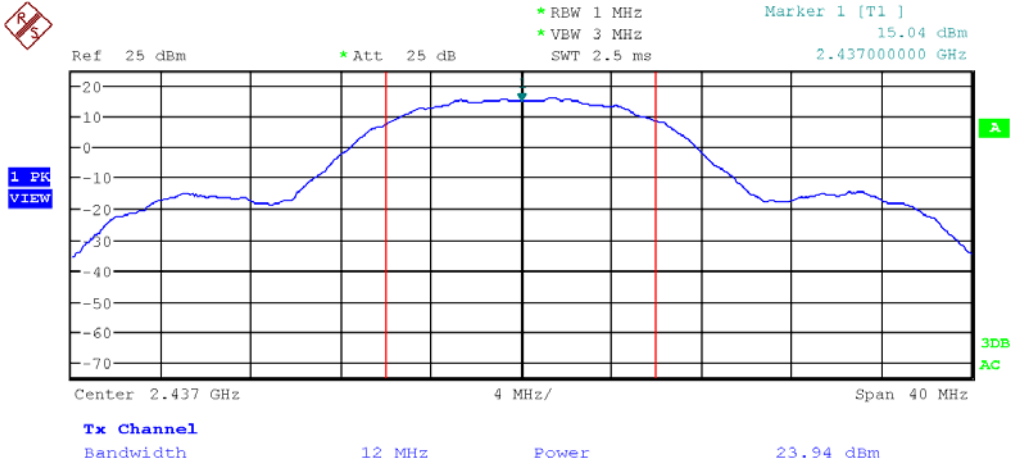
Worst-case RF Conducted Power measurement: 25.91 dBm = 0.38994 W (-0.61006 W under limit)

- 802.11g OFDM Modulation Mode
- Mid Channel 6

9.9 Plots: RF Conducted Output Power

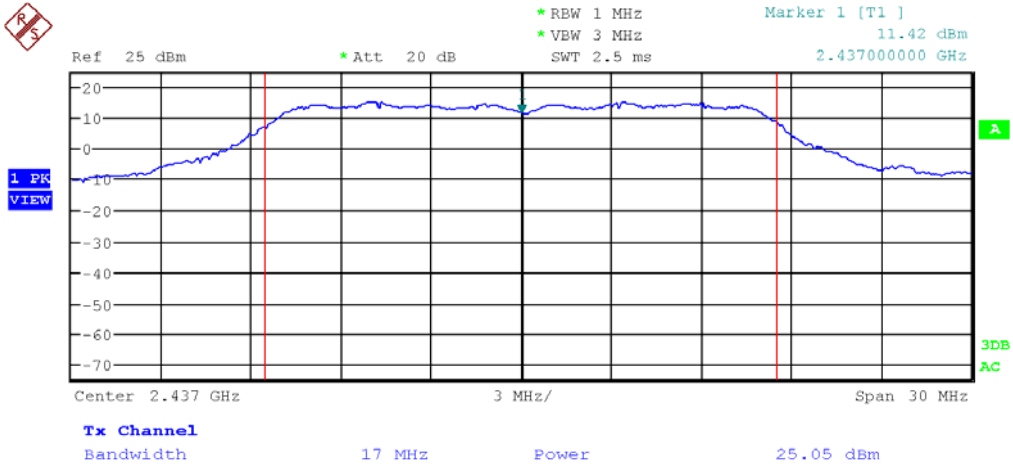
RF Conducted Output Power- FCC Part 15.247(b)(3)(4)

802.11b CCK Modulation Mode
Mid Channel 6 – Data Rate 11 Mbps



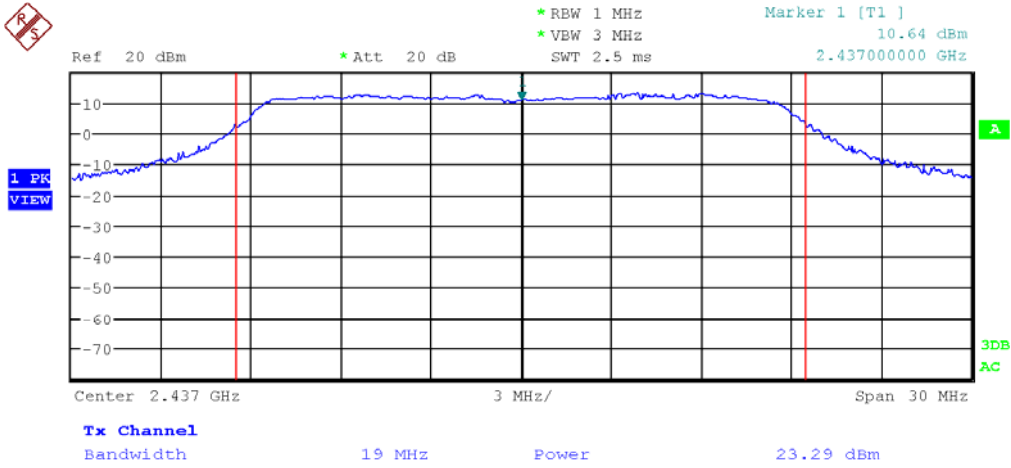
Date: 21.AUG.2013 13:15:49

802.11g OFDM Modulation Mode
Mid Channel 6 – Data Rate 24Mbps



Date: 21.AUG.2013 14:09:53

802.11n HT20 OFDM Modulation Mode
Mid Channel 6 – Data Rate 26 Mbps



Date: 21.AUG.2013 15:09:49

The above plots represent the worst-case for all channels, modulation modes and data rates tested.

10 RF Conducted Spurious Emissions (-20dBc) – Including Band Edge

10.1 Method

Unless otherwise stated no deviations were made from FCC Part 15.247.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

10.2 Test Requirement/Specification:

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.

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).

10.3 Test Equipment Used:

<u>Asset ID</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Serial</u>	<u>Cal Date</u>	<u>Cal Due</u>
DEN-073	EMI Receiver	RHODE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
E2	RF Conducted Port Cable	-----	True Blue	001	09/12/2013	09/12/2014
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBU	VBU

10.4 Test Procedure:

A spectrum analyzer/receiver was connected to the antenna port of the transmitter. The spectrum analyzer/receiver Resolution Bandwidth was set to 100 kHz. The out-of-band emissions were measured from 30 MHz to 26 GHz for the low, middle and high channels. Measurements included band edge measurements.

The following procedures described in FCC Publication 558074 (Guidelines for Compliance Measurements on DTS Operating Under 15.247), were used:

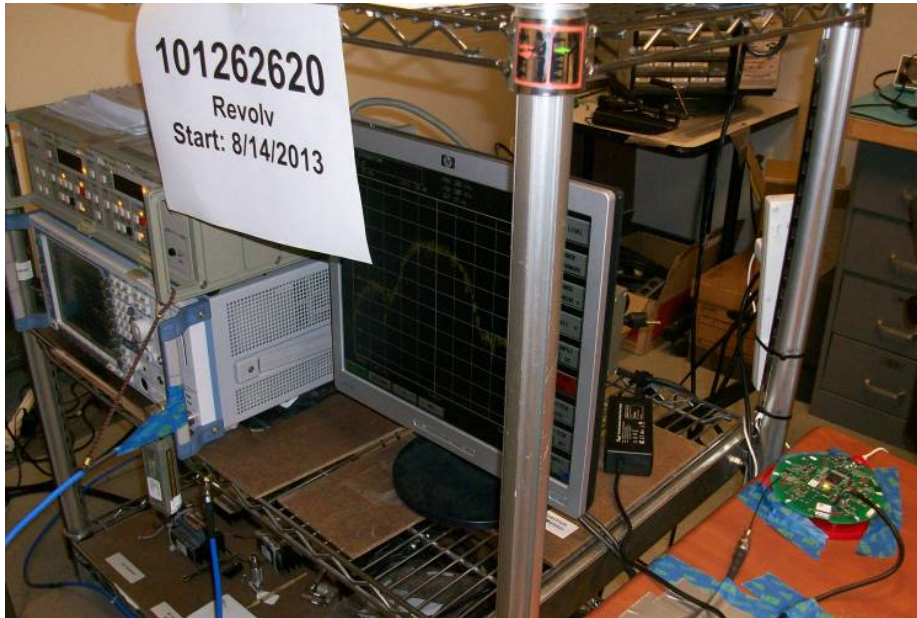
- 558074, Section 11.2 & 11.3
- ANSI C63.10: 2009 – General Guidance

10.5 Test Results:

The sample tested was found to Comply.

10.6 Setup Photographs:

Out-of-Band RF Conducted Emissions - Test setup



10.7 Test Data Summary: 2400-2483.5 MHz Band**Out-of-Band RF Conducted Emissions 2400 – 2483.5 MHz
FCC Part 15.247(d)**

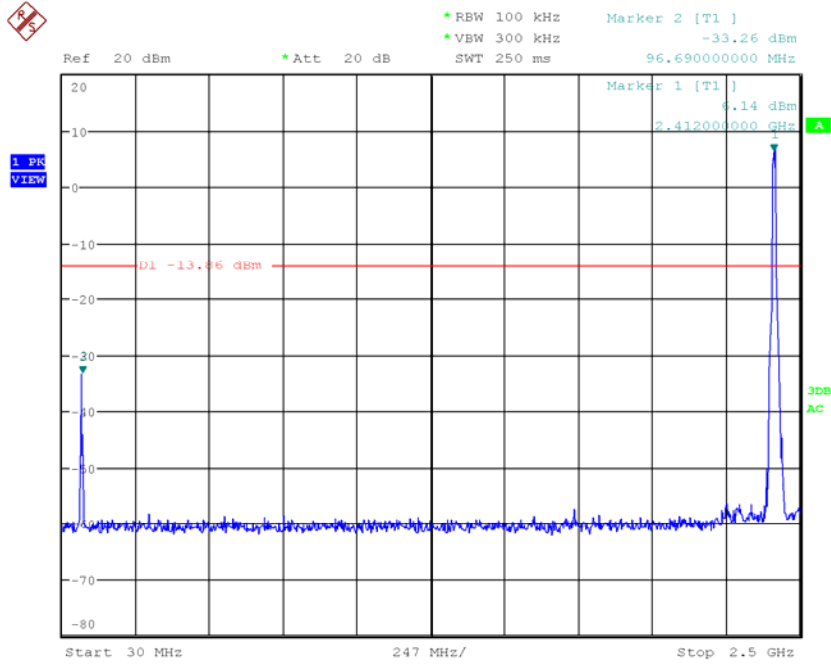
CHANNEL	FREQUENCY, MHZ	STANDARD/ DATA RATE	SCAN RANGE	PLOT
1	2412	802.11b, 11Mbps	30 MHz – 26 GHz	x
		802.11g, 24Mbps	30 MHz – 26 GHz	x
		802.11n HT20, 26Mbps	30 MHz – 26 GHz	x
6	2437	802.11b, 11Mbps	30 MHz – 26 GHz	x
		802.11g, 24Mbps	30 MHz – 26 GHz	x
		802.11n HT20, 26Mbps	30 MHz – 26 GHz	x
11	2462	802.11b, 11Mbps	30 MHz – 26 GHz	x
		802.11g, 24Mbps	30 MHz – 26 GHz	x
		802.11n HT20, 26Mbps	30 MHz – 26 GHz	x

Note: All out-of-band spurious emissions were at least 30dBc.

10.8 Test Data/Plots: 2400-2483.5 MHz
RF Conducted Spurious Emissions - FCC Part 15.247(d)

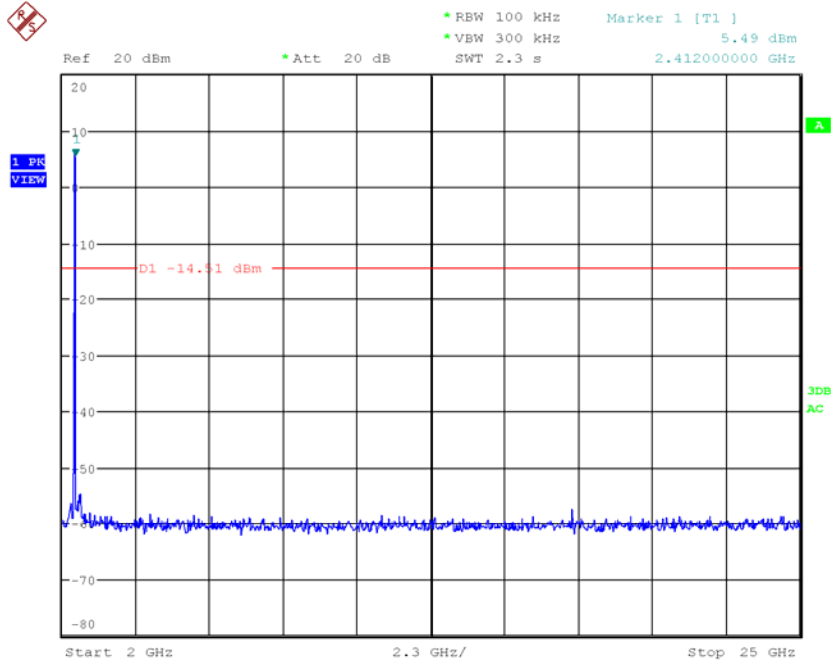
802.11b – CCK Modulation Mode
Low Channel 1: 2412MHz

30MHz to 2.5GHz



Date: 22.AUG.2013 09:28:51

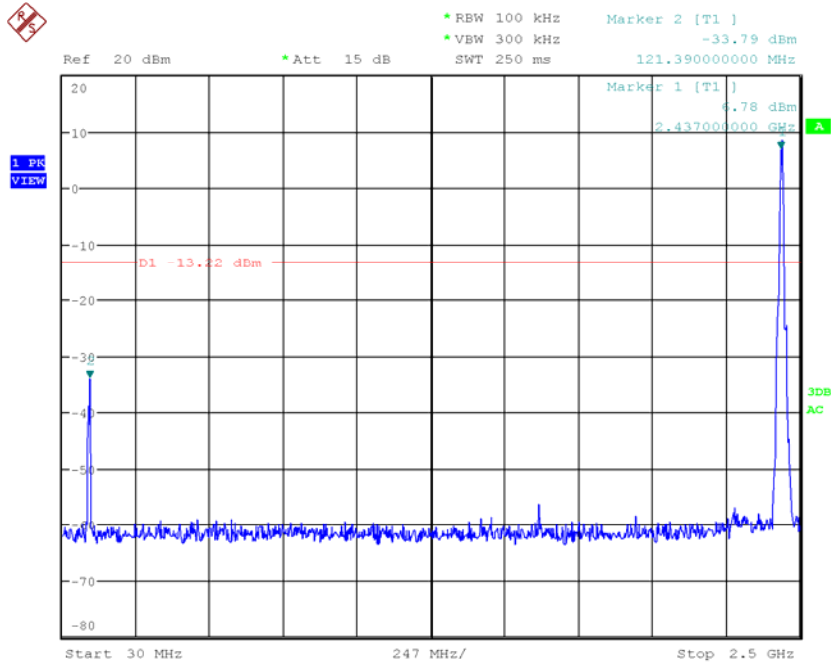
2GHz to 25GHz



Date: 22.AUG.2013 09:30:04

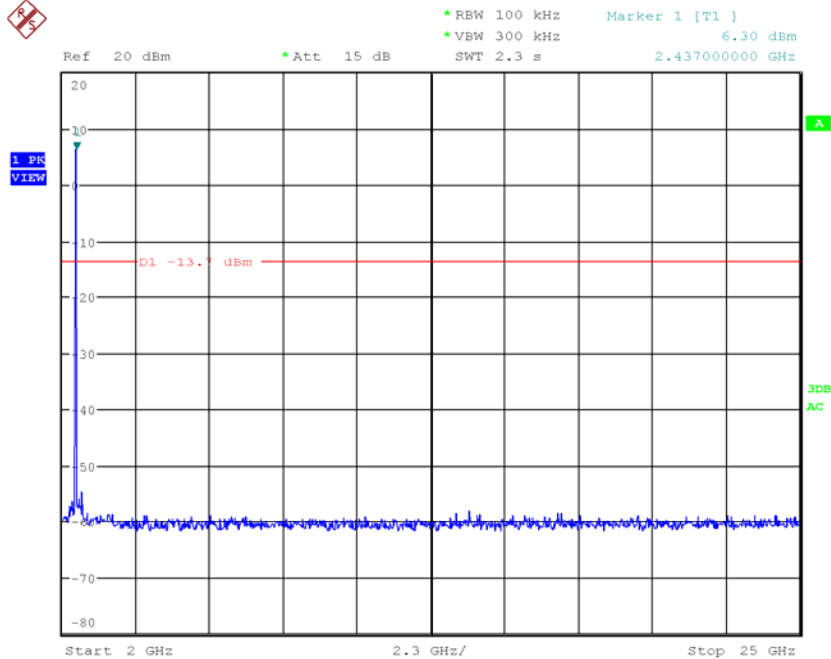
802.11b – CCK Modulation Mode
Mid Channel 6: 2437MHz

30MHz to 2.5GHz



Date: 21.AUG.2013 17:55:57

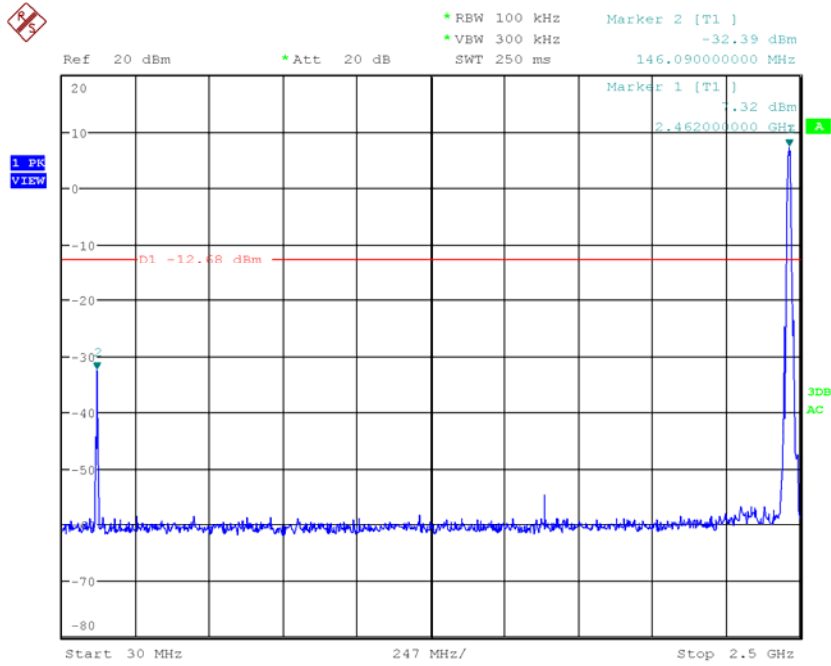
2GHz to 25GHz



Date: 21.AUG.2013 17:52:49

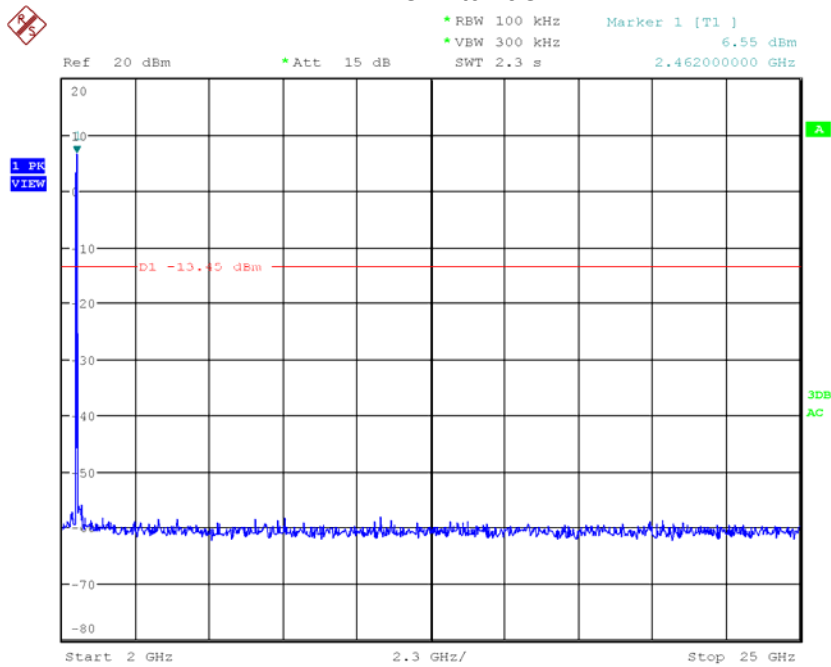
802.11b – CCK Modulation Mode
High Channel 11: 2462MHz

30MHz to 2.5GHz



Date: 21.AUG.2013 18:52:44

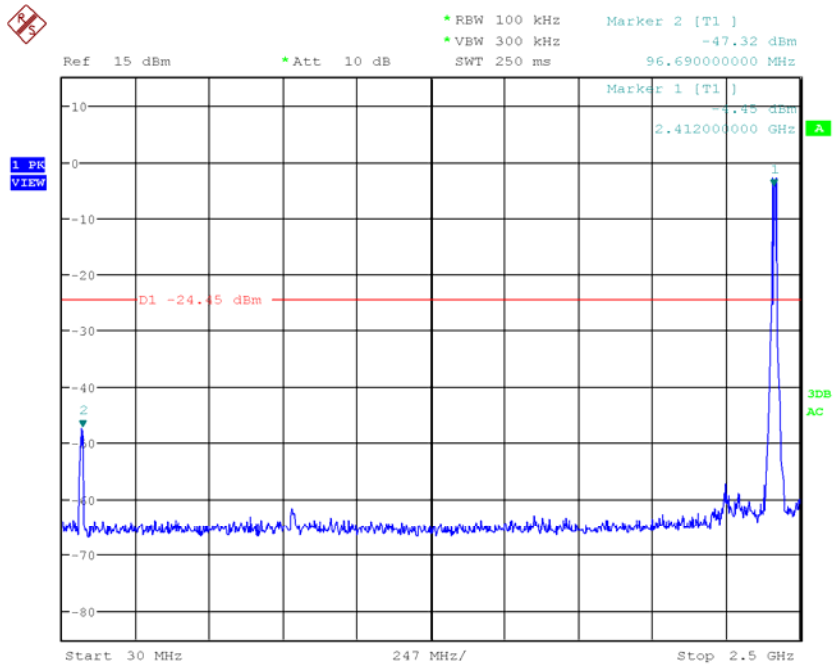
2GHz to 25GHz



Date: 21.AUG.2013 17:57:21

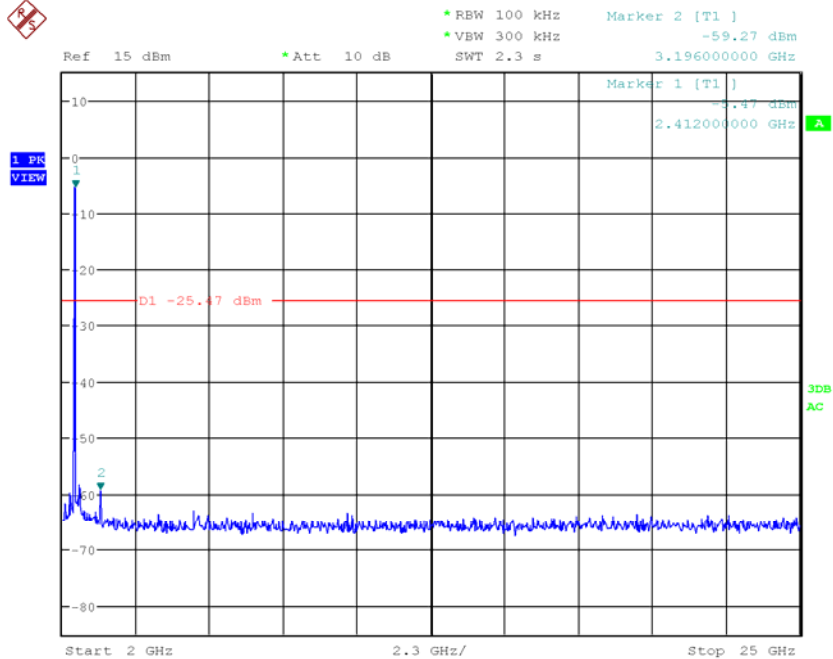
802.11g - OFDM Modulation Mode
Low Channel 1: 2412MHz

30MHz to 2.5GHz



Date: 21.AUG.2013 18:04:50

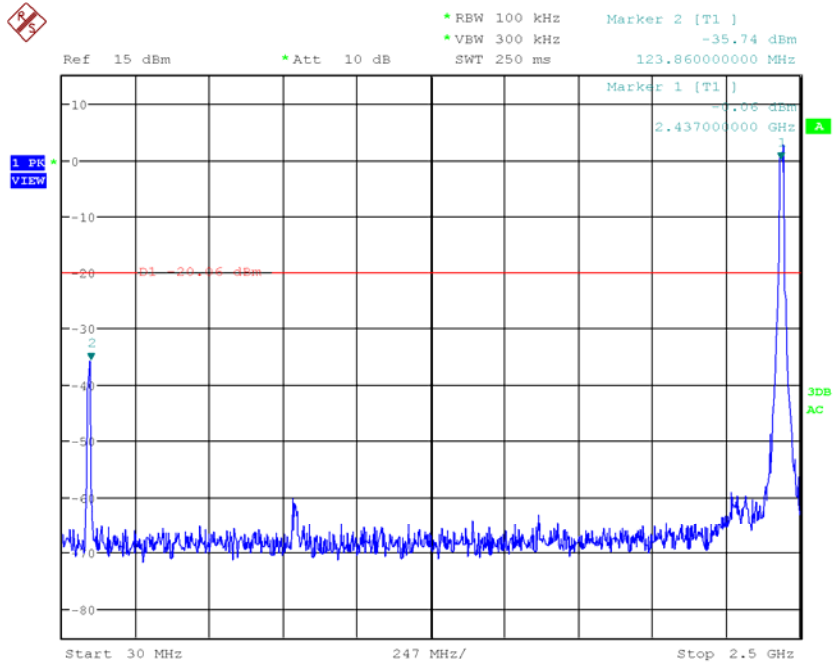
2GHz to 25GHz



Date: 21.AUG.2013 18:06:22

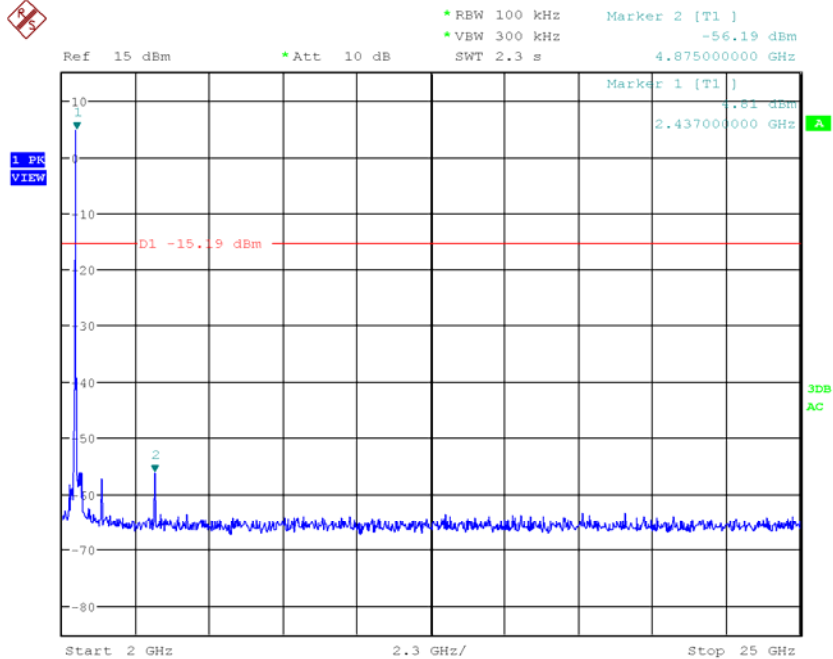
802.11g – OFDM Modulation Mode
Mid Channel 6: 2437MHz

30MHz to 2.5GHz



Date: 21.AUG.2013 18:11:02

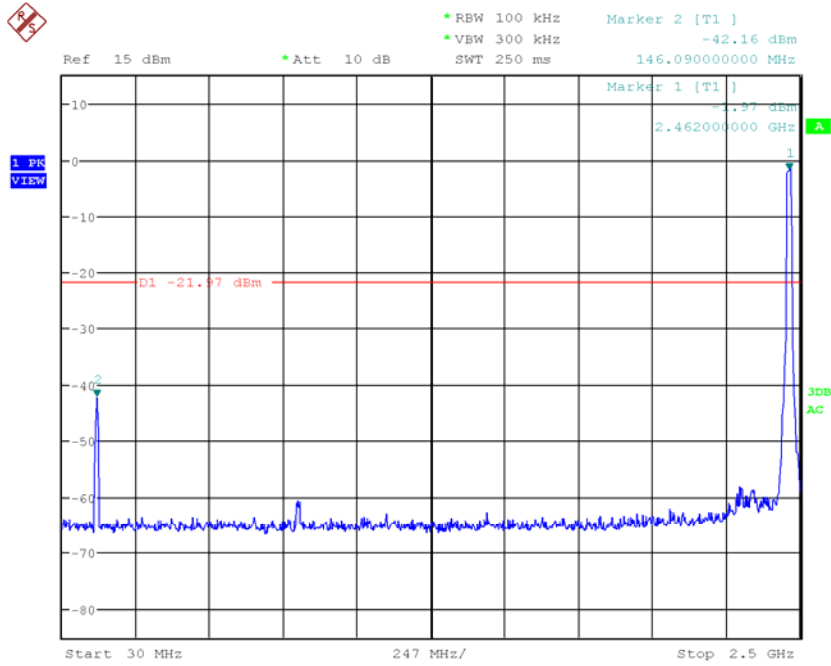
2GHz to 25GHz



Date: 21.AUG.2013 18:08:24

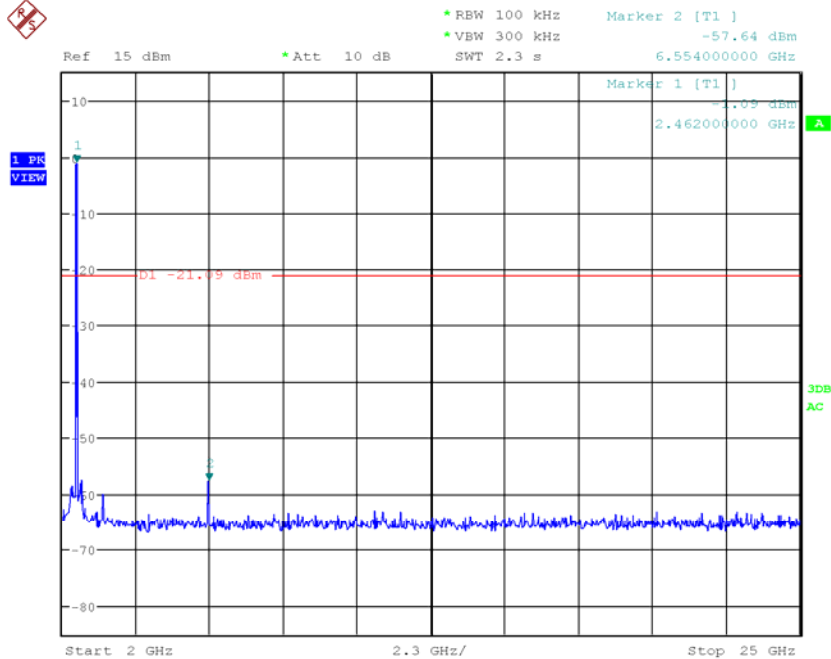
802.11g – OFDM Modulation Mode
High Channel 11: 2462MHz

30MHz to 2.5GHz



Date: 21.AUG.2013 18:13:05

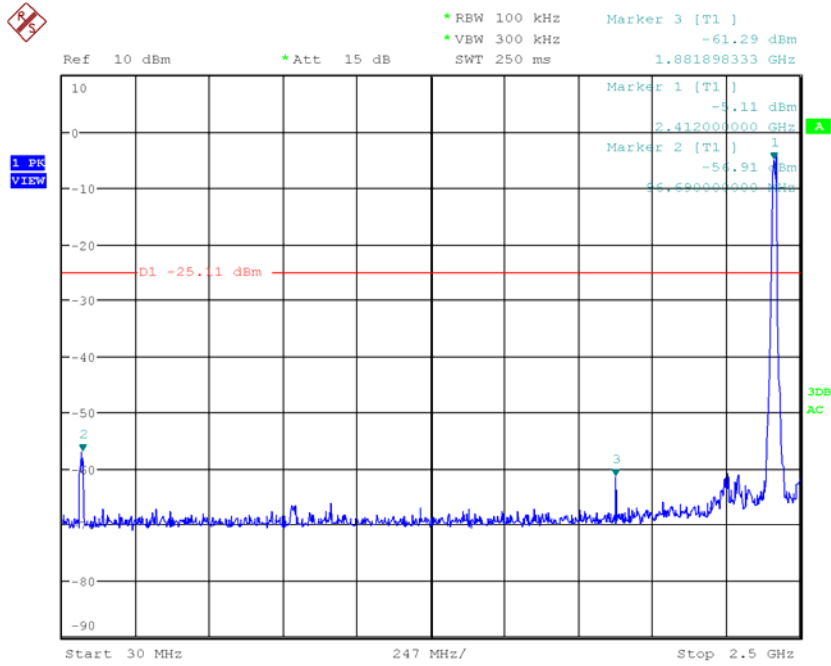
2GHz to 25GHz



Date: 21.AUG.2013 18:15:17

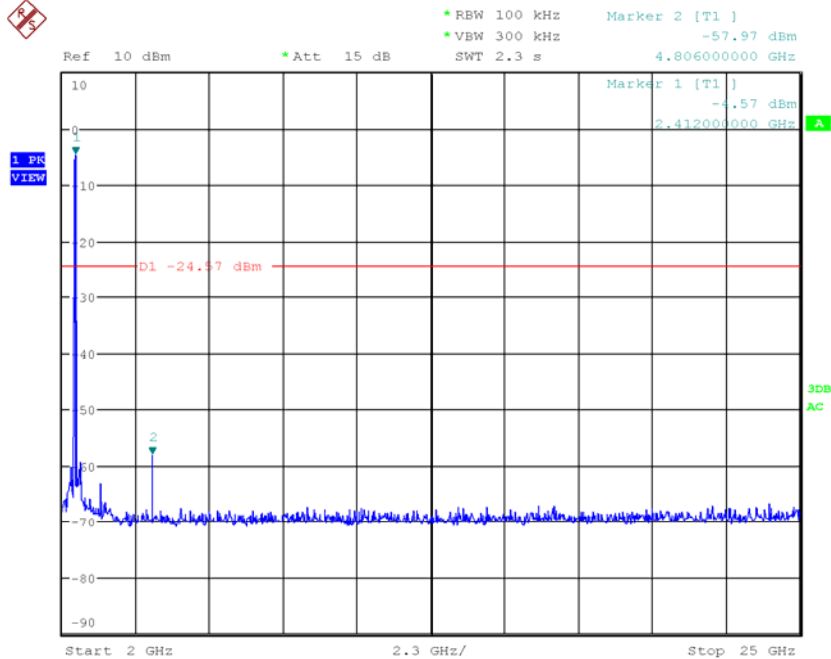
802.11n HT20 OFDM Modulation Mode
Low Channel 1: 2412MHz

30MHz to 2.5GHz



Date: 22.AUG.2013 08:49:33

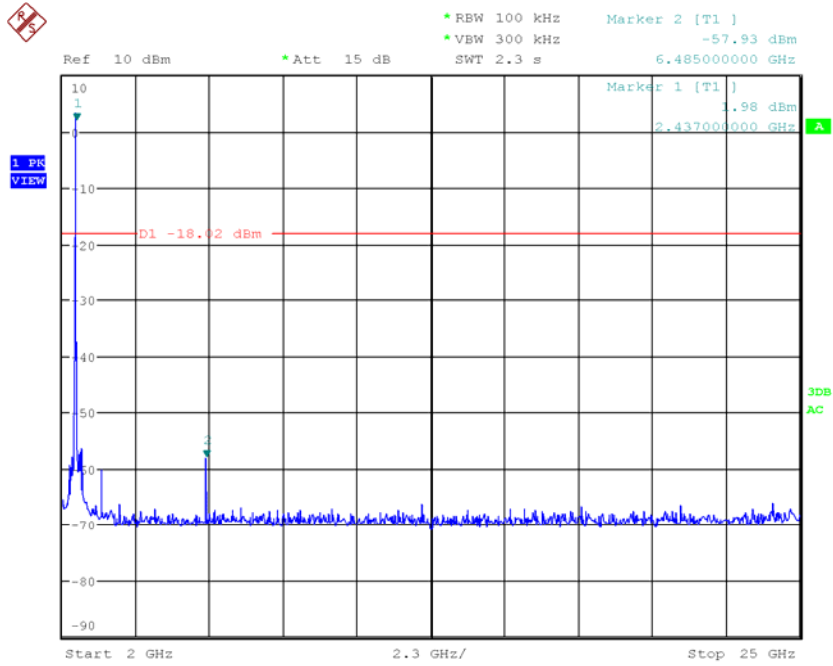
2GHz to 25GHz



Date: 22.AUG.2013 08:51:57

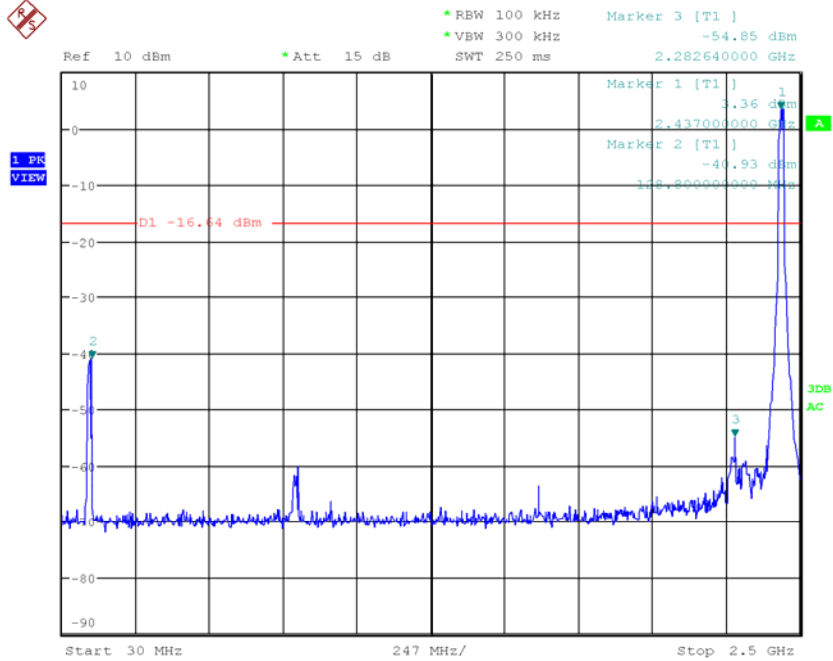
802.11n HT20 OFDM Modulation Mode
Mid Channel 6: 2437MHz

30MHz to 2.5GHz



Date: 22.AUG.2013 08:54:30

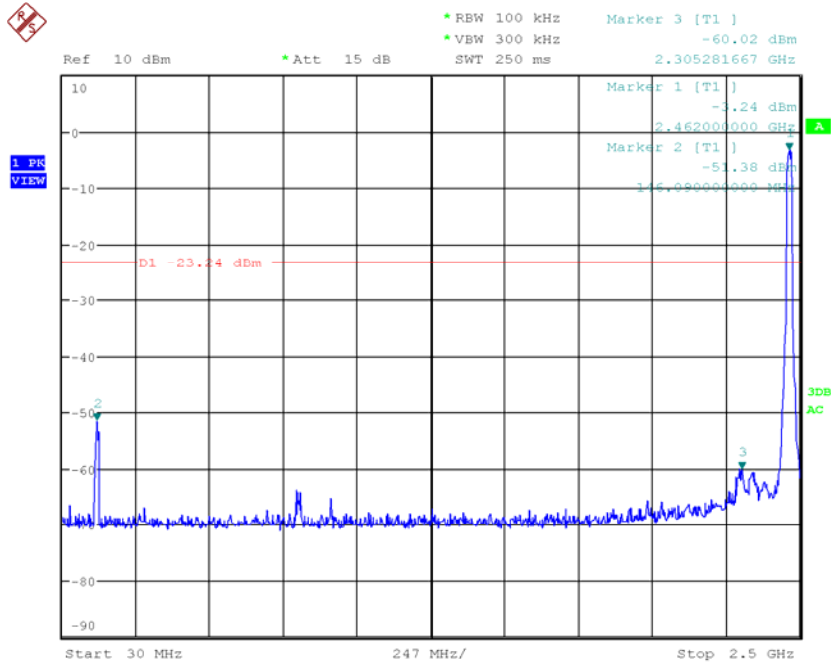
2GHz to 25GHz



Date: 22.AUG.2013 08:56:31

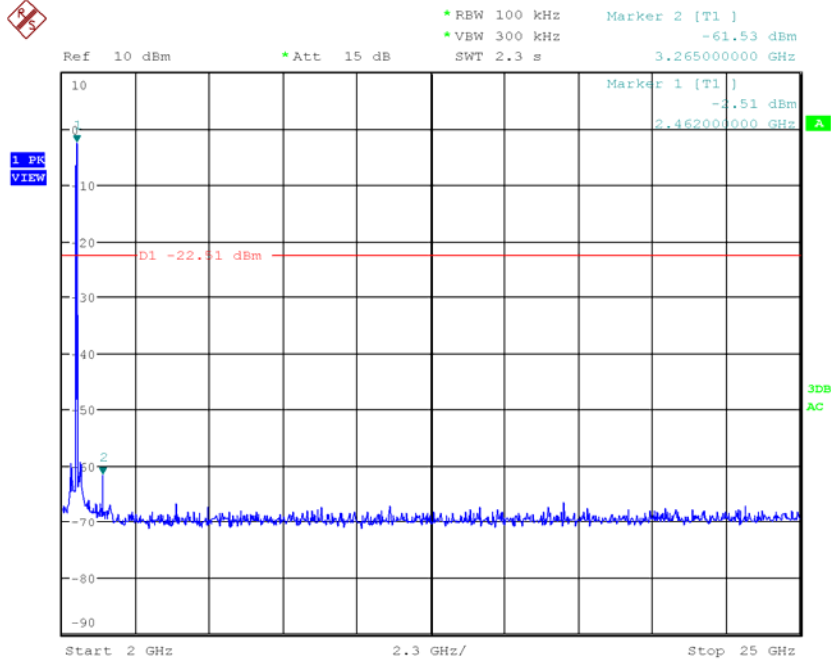
802.11n HT20 OFDM Modulation Mode
High Channel 11: 2462MHz

30MHz to 2.5GHz



Date: 22.AUG.2013 08:58:49

2GHz to 25GHz



Date: 22.AUG.2013 09:00:17

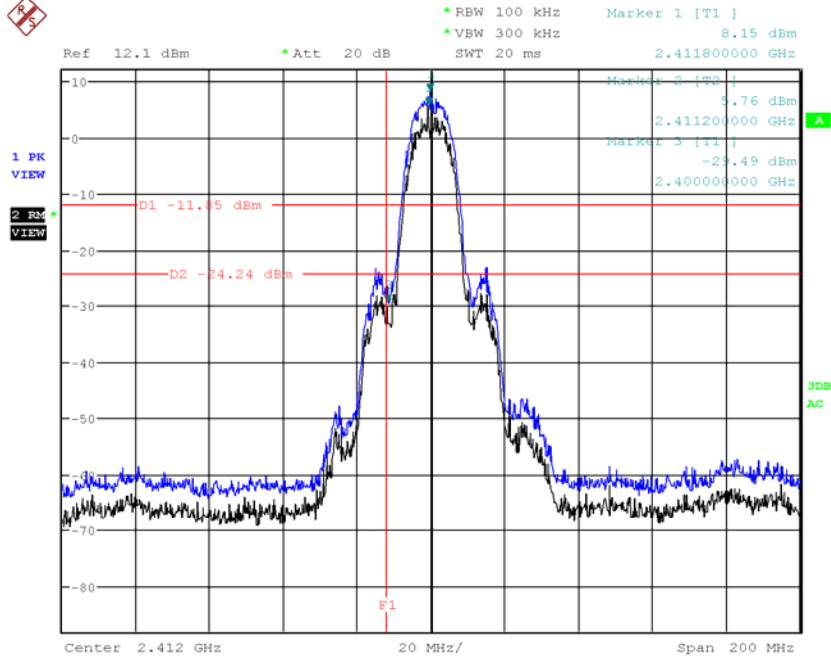
FCC Part 15.247(d) RF Conducted Spurious Emissions Specification: $\geq 20\text{dBc}$
Result: All RF Conducted Spurious Emissions $> 30\text{dBc}$

10.9 Test Data/Plots – Band Edge: 2400-2483.5 MHz

RF Conducted Band Edge Spurious Emissions - FCC Part 15.247(d)

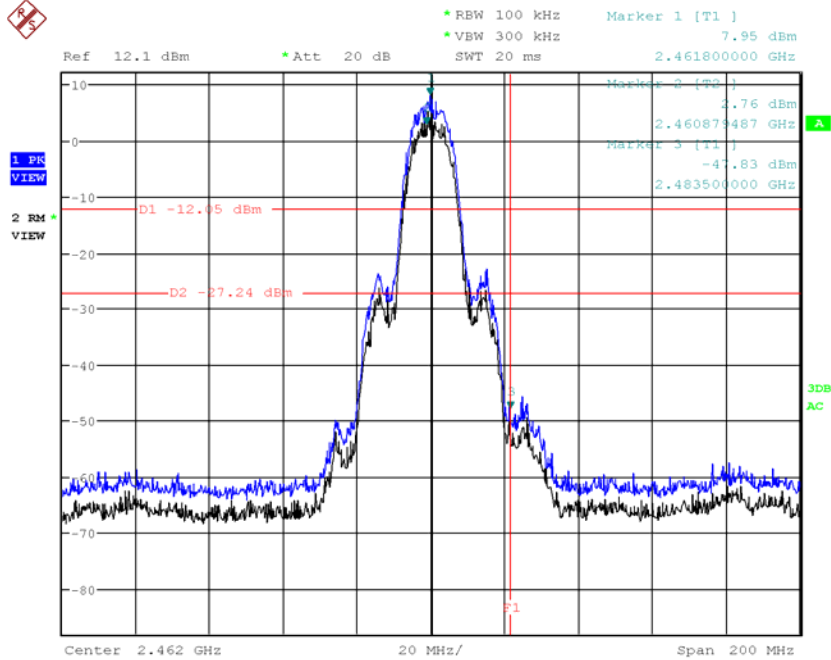
802.11b – CCK Modulation Mode

Low Channel 1: 2412MHz (Lower Band Edge)



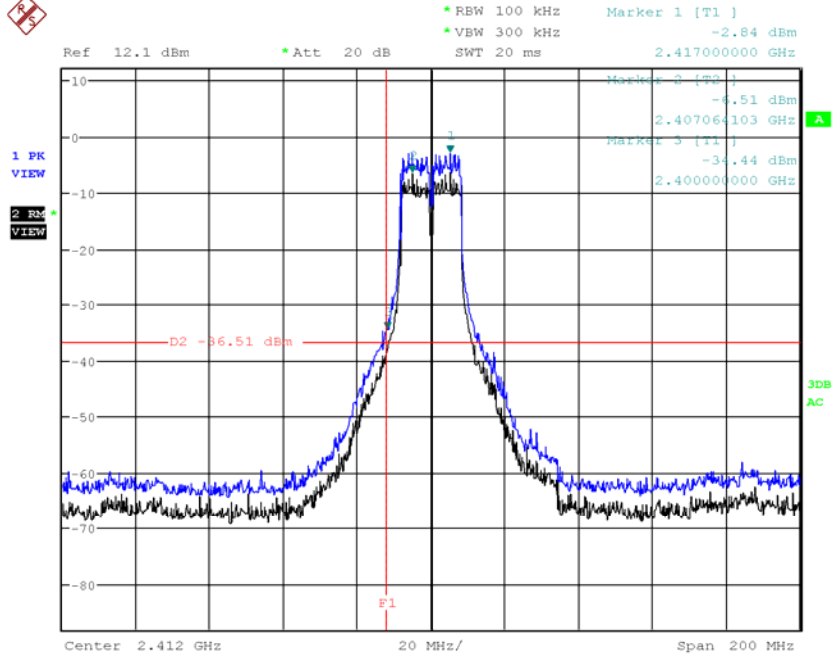
Date: 22.AUG.2013 10:58:21

High Channel 11: 2462MHz (Upper Band Edge)



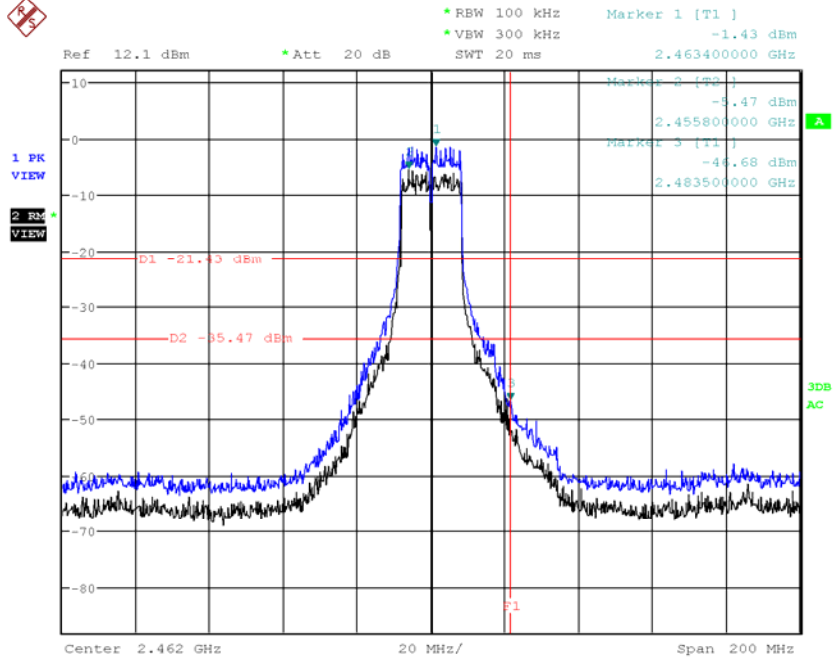
Date: 22.AUG.2013 10:29:24

802.11g – OFDM Modulation Mode Low Channel 1: 2412MHz (Lower Band Edge)



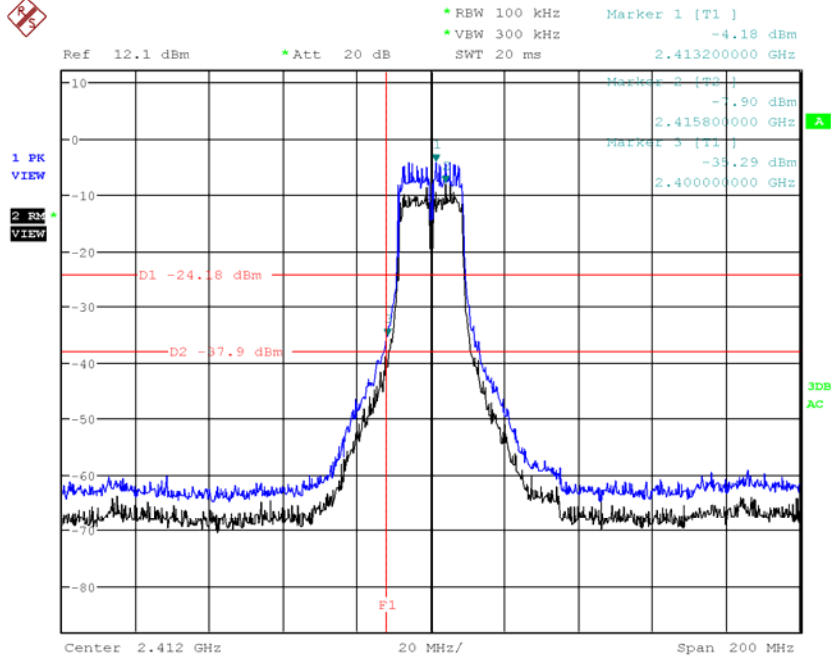
Date: 22.AUG.2013 11:02:10

High Channel 11: 2462MHz (Upper Band Edge)



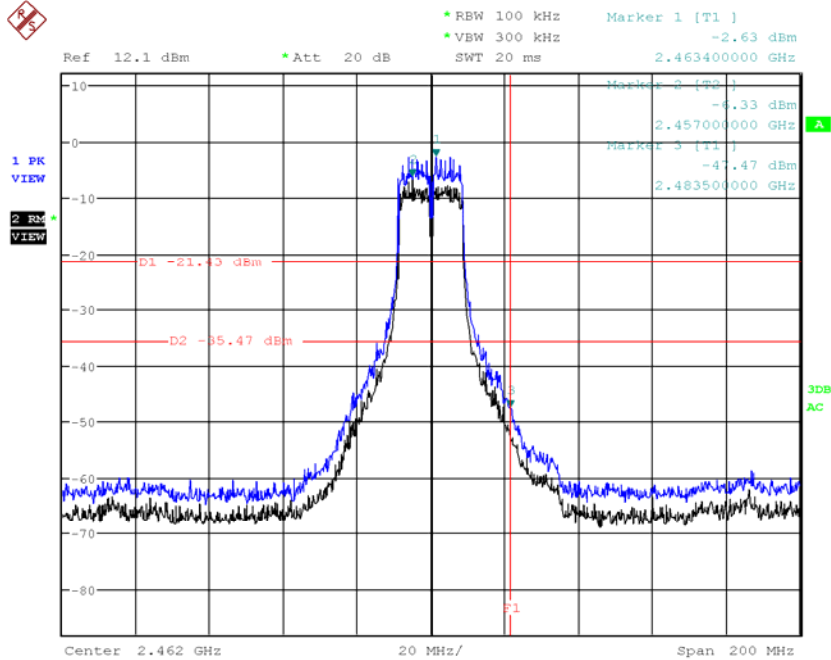
Date: 22.AUG.2013 10:32:34

802.11n HT20 OFDM Modulation Mode
Low Channel 1: 2412MHz (Lower Band Edge)



Date: 22.AUG.2013 11:04:45

High Channel 11: 2462MHz (Upper Band Edge)



Date: 22.AUG.2013 10:36:50

FCC Part 15.247(d) RF Conducted Spurious Band Edge Emissions Specification: $\geq 20dBc$
(Peak trace shown in blue – RMS trace shown in black for reference)

Intertek

Report Number: 101262612DEN-001B

Issued: 10/17/2013

11 Transmitter Radiated Spurious Emissions – Restricted Band/ Band Edge

11.1 Method

Unless otherwise stated no deviations were made from FCC Part 15.209/205.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

11.2 Test Requirement/ Specification:

Radiated emissions which fall in the restricted bands, as defined in FCC Part 15.205(a), must also comply with the radiated emission limits specified in Part 15.209(a) and Part 15.205(c). Measurements in the restricted bands include both peak detector and average detector measurements. Measurements in non-restricted bands include peak detector measurements.

Unwanted emissions below 1GHz must comply with the general field strength limits defined in FCC Part 15.209, when measured with a quasi-peak detector.

11.3 Test Equipment Used:

<u>Asset ID</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Serial</u>	<u>Cal Date</u>	<u>Cal Due</u>
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
18912	9 kHz- 1.3GHz Pre Amp	Hewlett-Packard	8447F	3113A05545	06/07/2013	06/07/2014
18906	RF Pre-Amp (1-4GHz)	Mini-Circuits Lab	ZHL-42	N052792-2	06/10/2013	06/10/2014
18900	RF Pre-Amplifier (4-8 GHz)	Avantek	AFT97-8434-10F	1007	06/10/2013	06/10/2014
18901	RF Pre-Amp (8-18GHz)	Avantek	AWT-18037	1002	06/10/2013	06/10/2014
19936	Bilog Antenna 30MHz – 6GHz	Sunol Sciences	JB6	A050707-1	11/15/2012	11/15/2013
18887	Horn Antenna 1-18GHz	EMCO	3115	9205-3886	03/19/2013	03/19/2014
18805	Harmonic Mixer	HP	11970K	2332A01280	01/30/2013	01/30/2014
18806	Harmonic Mixer	HP	11970A	3003A07640	01/30/2013	01/30/2014
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBU	VBU

11.4 Test Procedure:

The Resolution Bandwidth is 120 kHz or greater for frequencies 30 MHz -1000 MHz and 1 MHz for frequencies above 1000 MHz.

The EUT is placed on a plastic turntable that is 80 cm in height. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables are manipulated to produce worst-case emissions. The signal is maximized by rotating the turntable through a 360° rotation. The antenna height is varied from 1-4 meters. Both vertical and horizontal antenna configurations are utilized in the testing.

Radiated emissions 30MHz to 18GHz are taken at 3-meter antenna-to-product test distance.

Radiated emissions above 18GHz are taken using a harmonic mixer antenna/pre-amp setup at 1-meter antenna-to-product test distance.

Data is included for the worst-case configuration (the configuration which resulted in the highest emission levels).

The following procedures described in FCC Publication 558074 (Guidelines for Compliance Measurements on DTS Operating Under 15.247), were used:

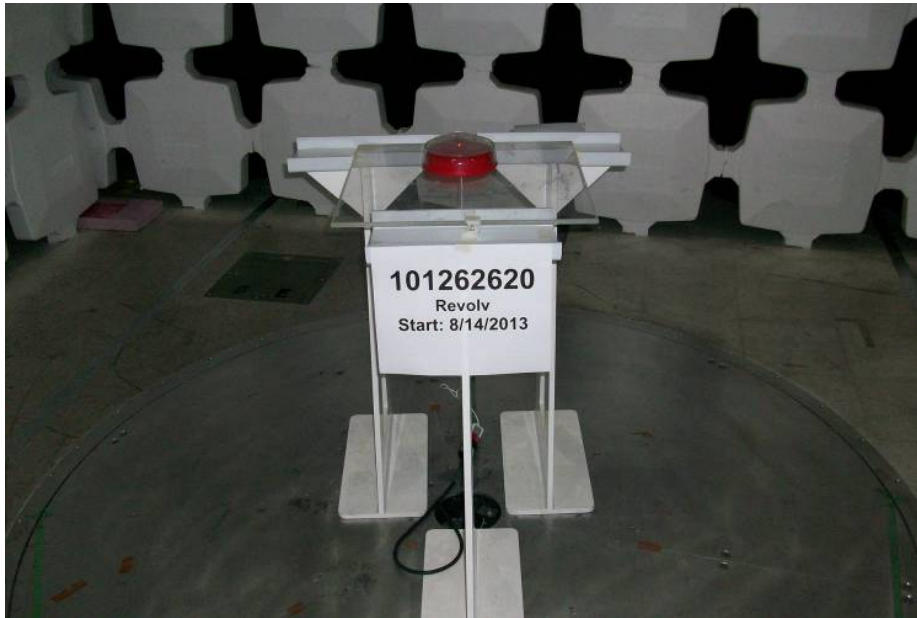
- 558074, Section 12.1 & 13.1
- ANSI C63.10: 2009 – General Guidance

11.5 Test Results:

The sample tested was found to Comply.

11.6 Setup Photographs: Product Axis 1

Transmitter Spurious Radiated Emissions - Test setup Front



Test Setup - Rear

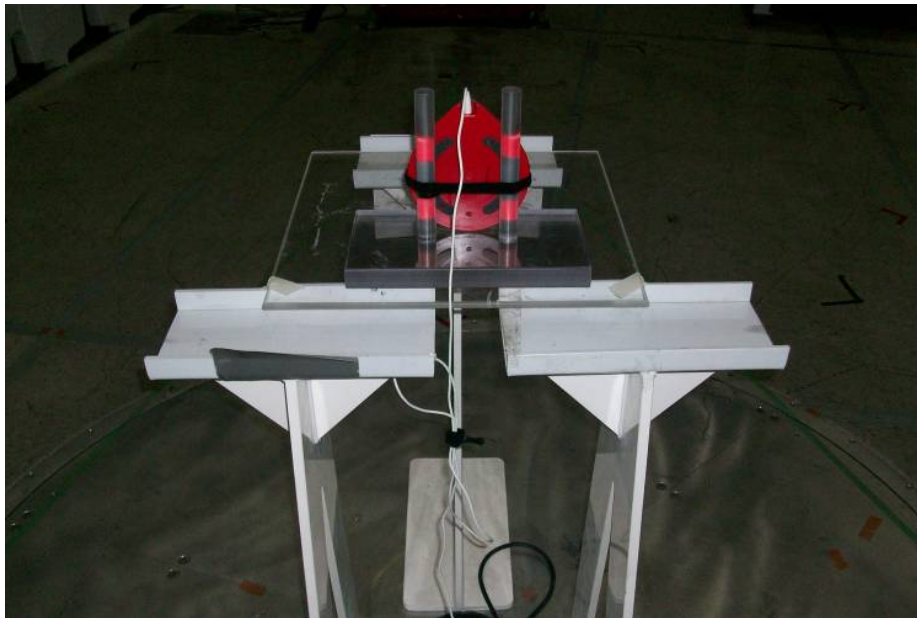


11.7 Setup Photographs: Product Axis 2

Transmitter Spurious Radiated Emissions - Test setup Front



Test Setup - Rear

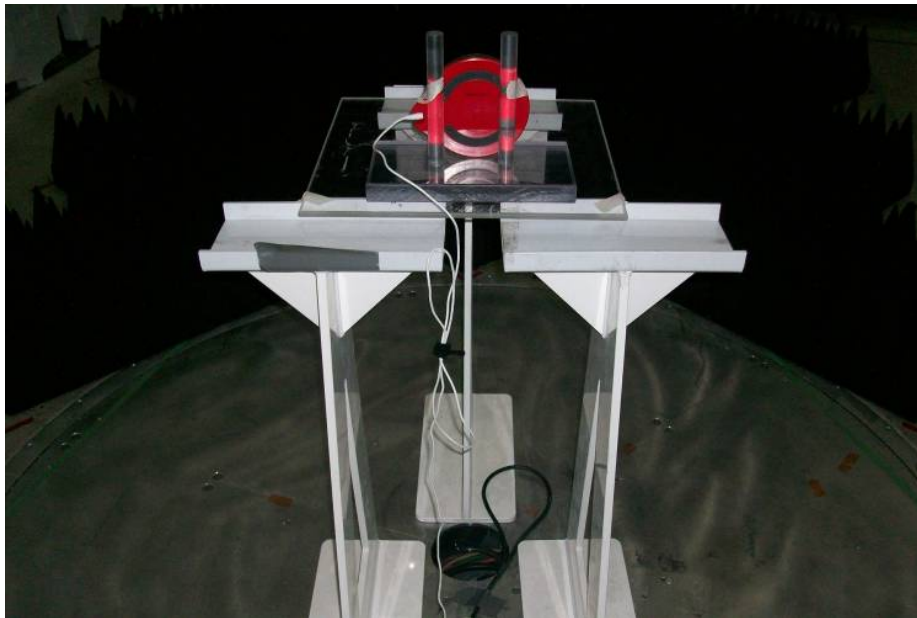


11.8 Setup Photographs: Product Axis 3

Transmitter Spurious Radiated Emissions - Test setup Front



Test Setup - Rear



11.9 Antenna Setups

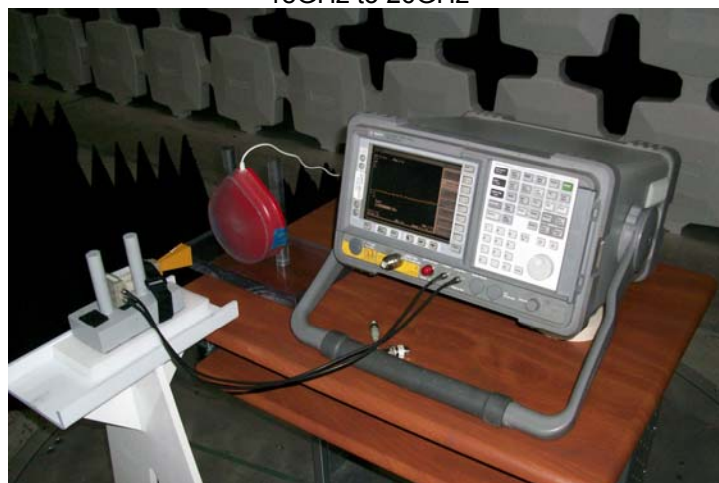
30MHz to 1GHz



1GHz to 18GHz



18GHz to 26GHz



Intertek

Report Number: 101262612DEN-001B

Issued: 10/17/2013

11.10 Test Data Summary: Tx Radiated Spurious Emissions

802.11g

Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Delta1	Delta2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.209 Average	N/A	(MHz)
Measurements: Mid Channel 30MHz to 1000MHz - Product Axis 1 (worst-case)													
192.0200	55.29	Qp	0.92	11.60	27.59	0.00	40.22	V	1.07	90.1	- 3.30	N/A	0.120

11.11 Test Data Summary: Tx Spurious Emissions – Band Edge/Restricted Band

802.11g

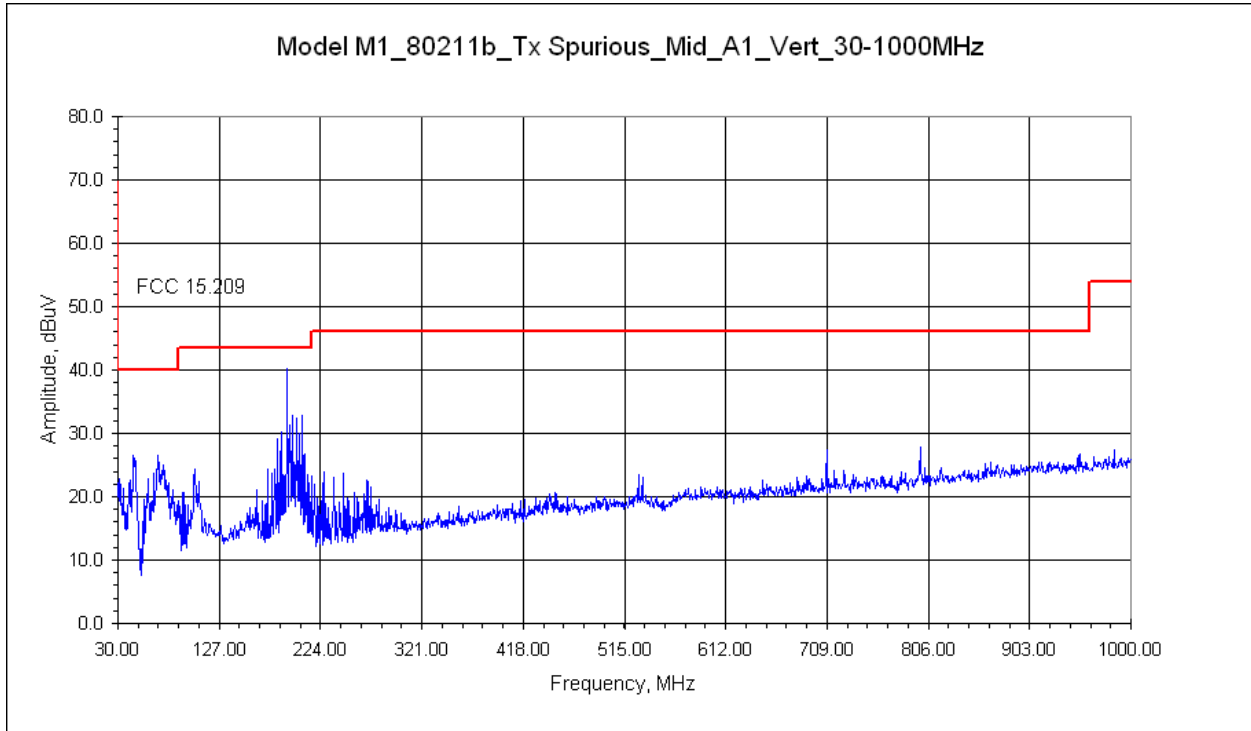
Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Delta1	Delta2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.209 Average	FCC 15.35(b) Peak	(MHz)
Measurements: Upper Band Edge – Axis 1 (worst-case)													
2483.5000	63.99	Pk	3.58	28.69	37.67	10.11	68.70	H	1.00	31.0	N/A	- 5.30	1.000
2483.5000	47.65	Av	3.58	28.69	37.67	10.11	52.36	H	1.00	31.0	- 1.64	NA	1.000

Note: The above represents the worst-case measurements of all 802.11b/g/n bands.

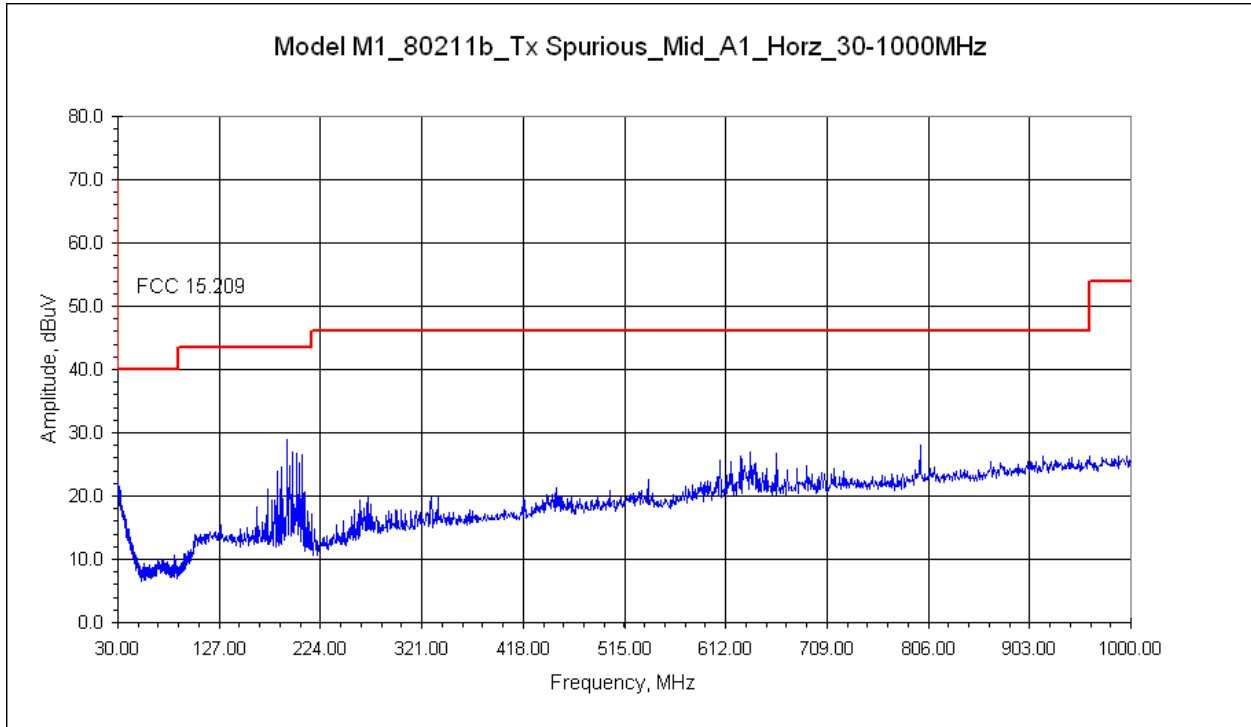
11.12 Plots: 802.11b Band

Vertical – Axis 1

30MHz to 1000MHz



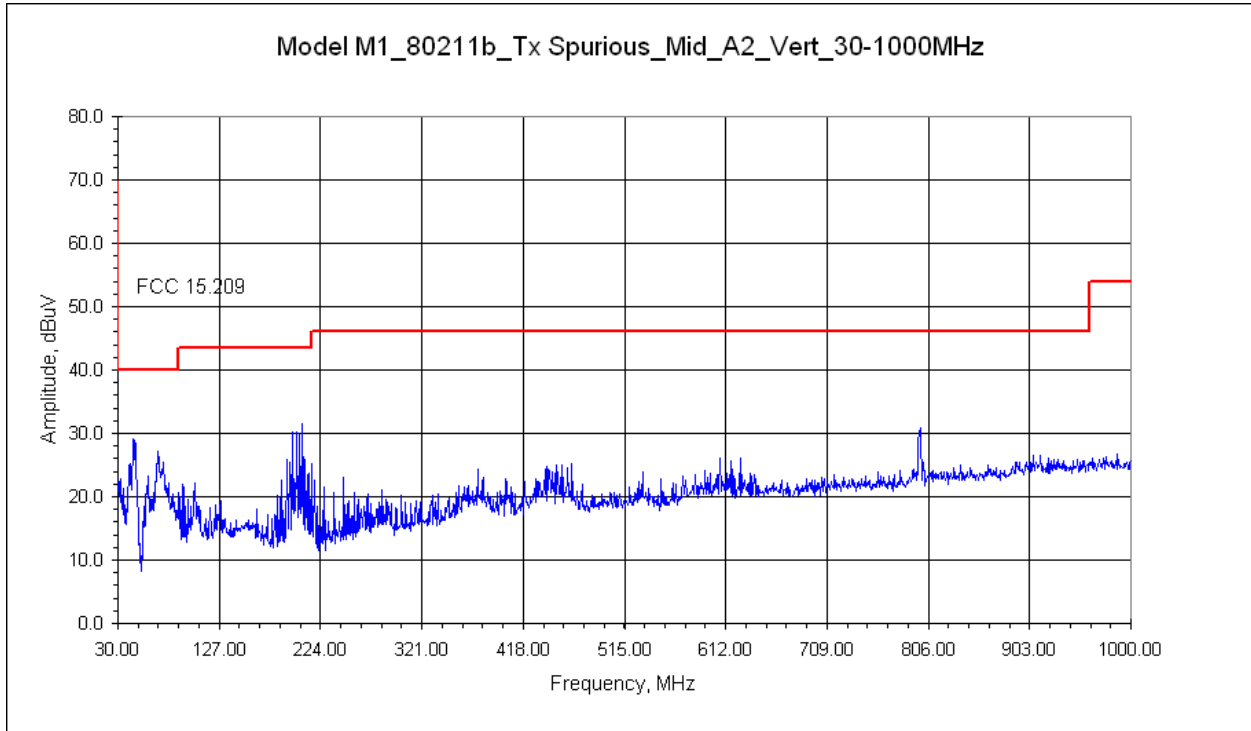
Horizontal – Axis 1



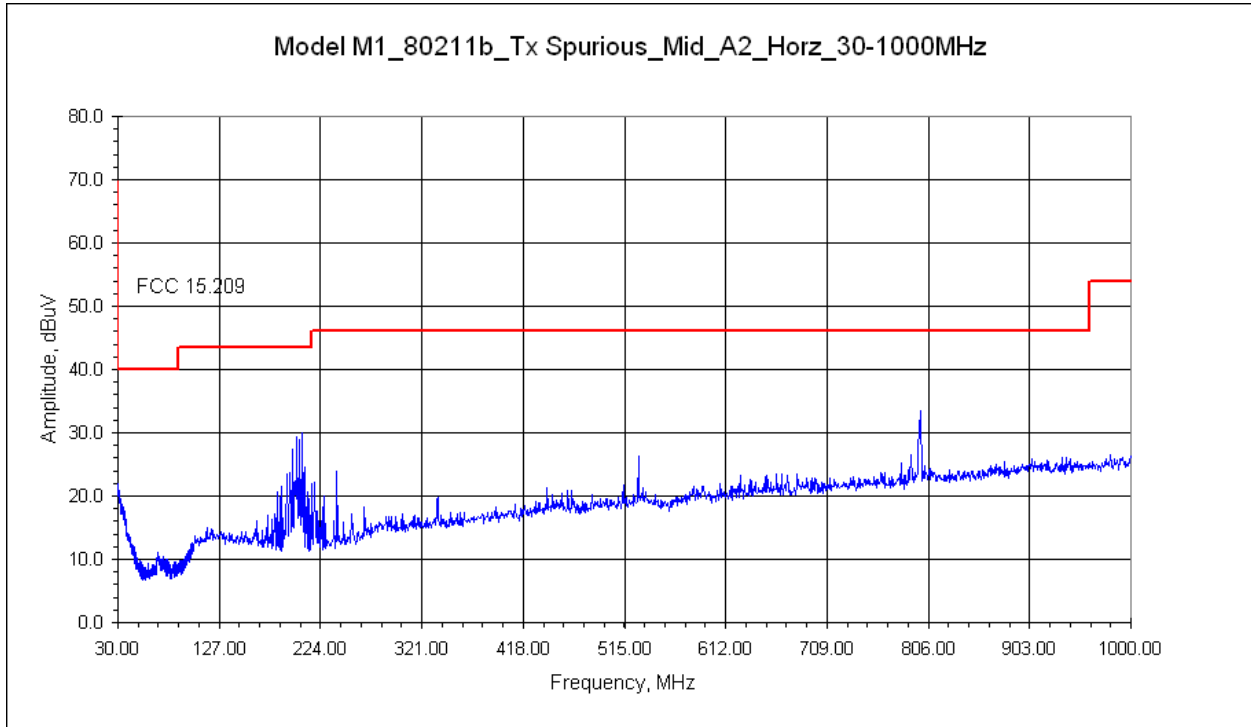
11.13 Plots: 802.11b Band

Vertical – Axis 2

30MHz to 1000MHz



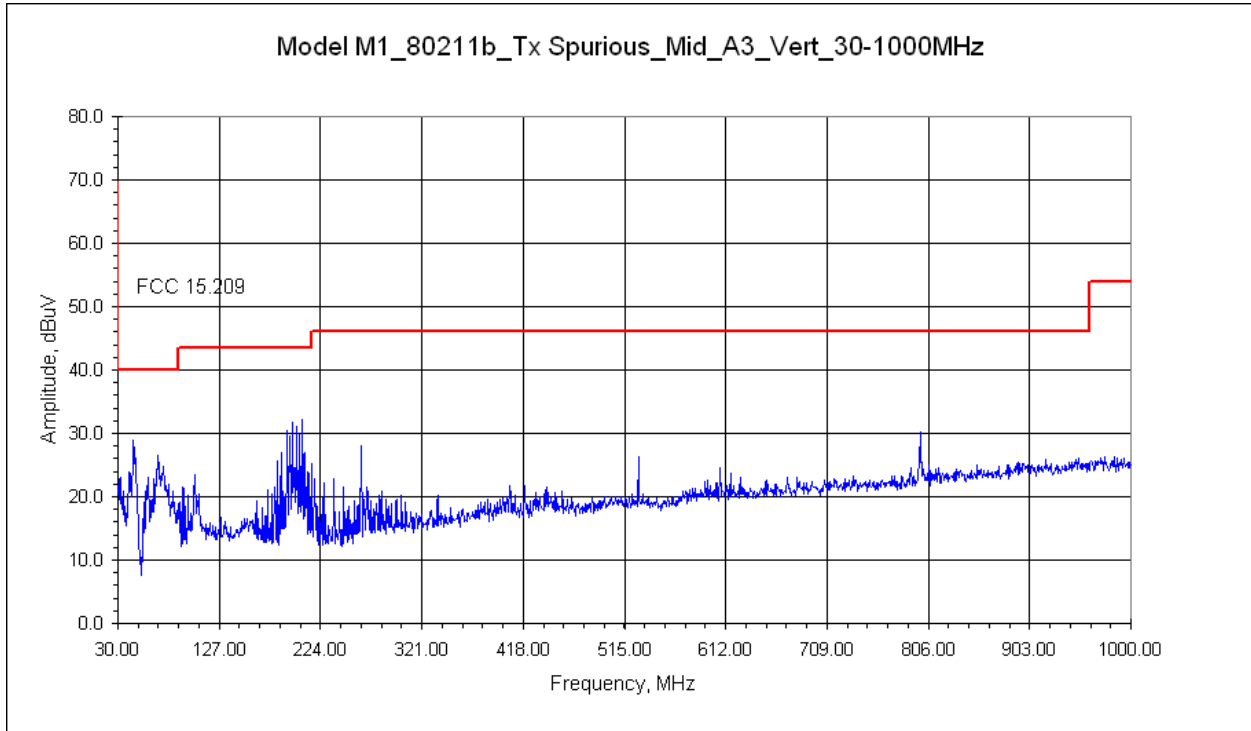
Horizontal – Axis 2



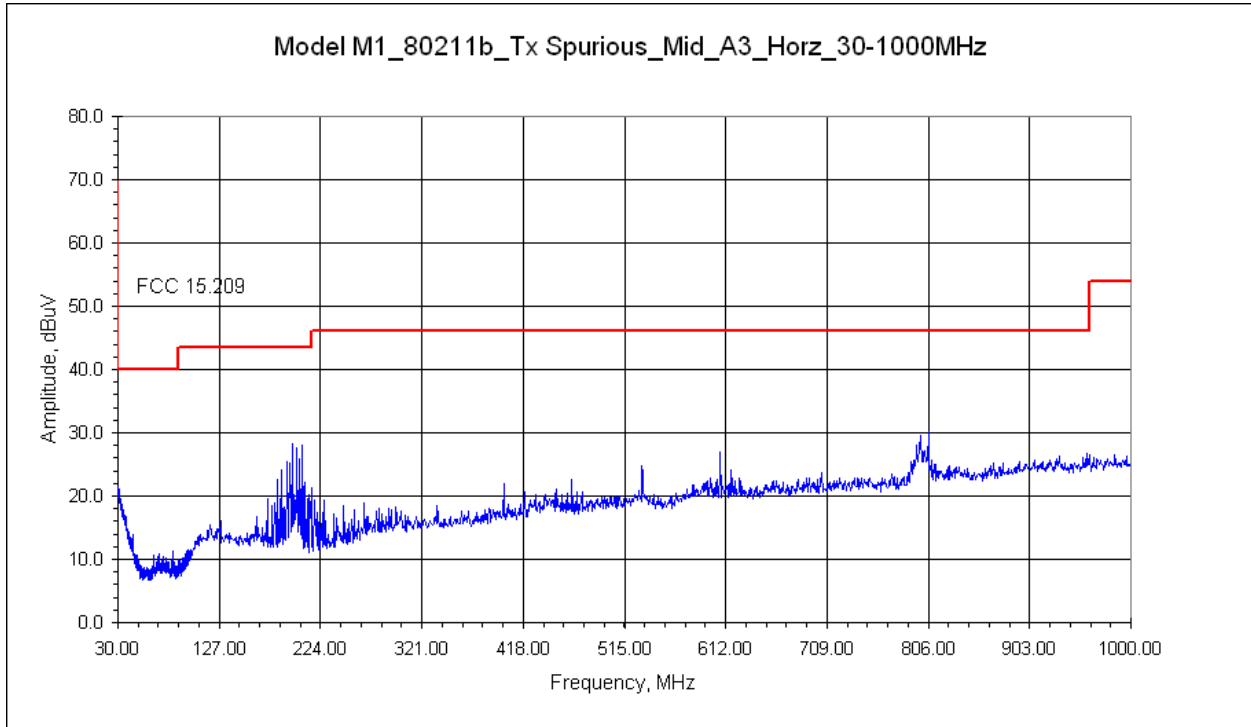
11.14 Plots: 802.11b Band

Vertical – Axis 3

30MHz to 1000MHz



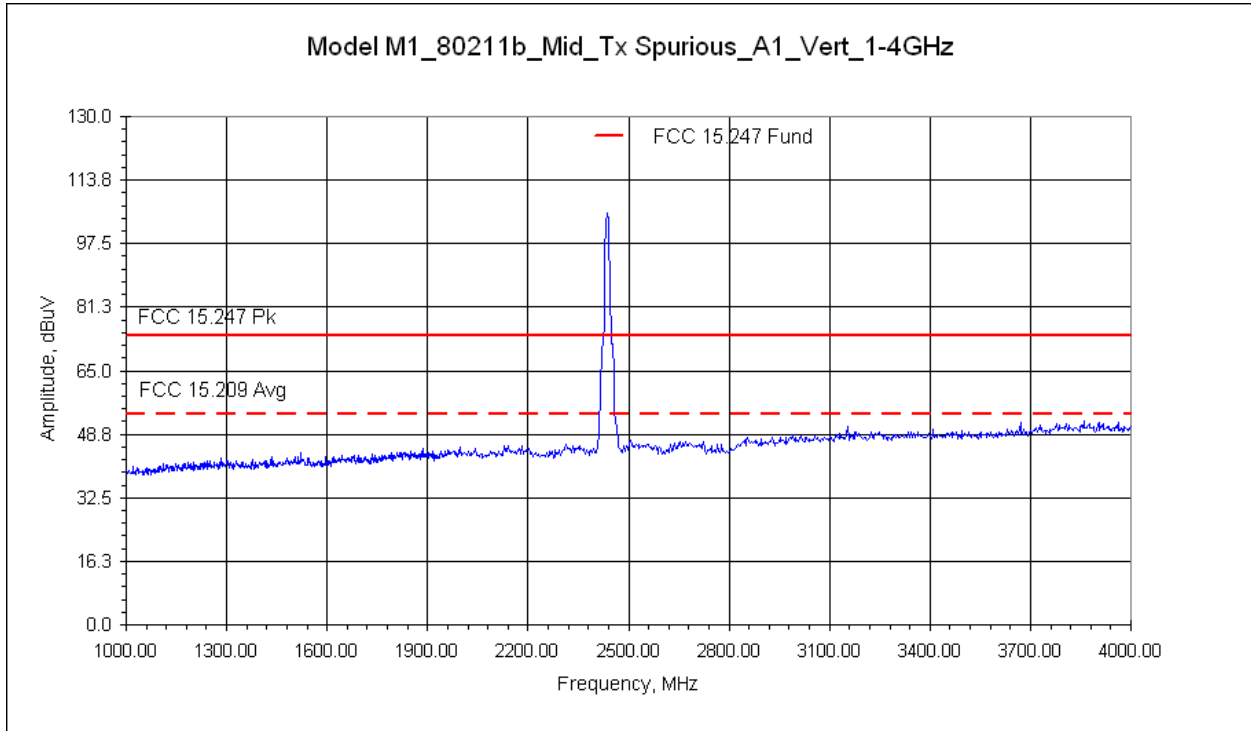
Horizontal – Axis 3



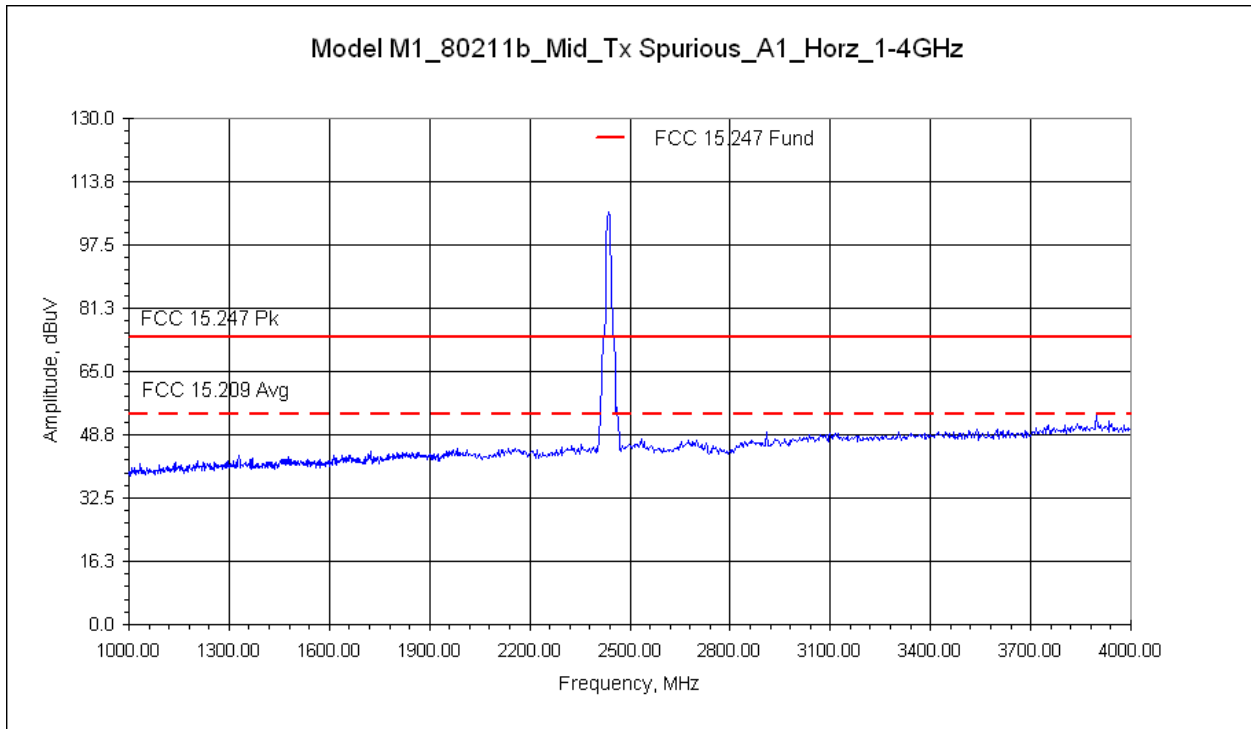
11.15 Plots: 802.11b Band

Vertical – Axis 1

1GHz to 4GHz



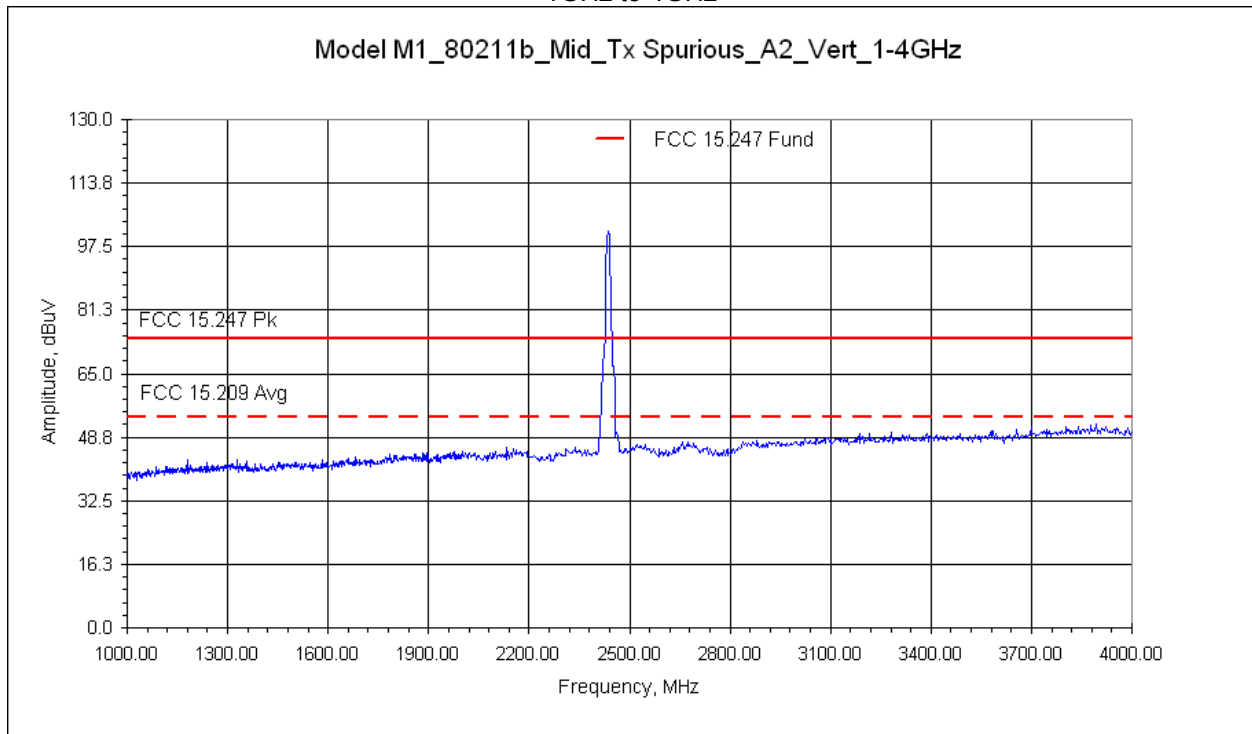
Horizontal – Axis 1



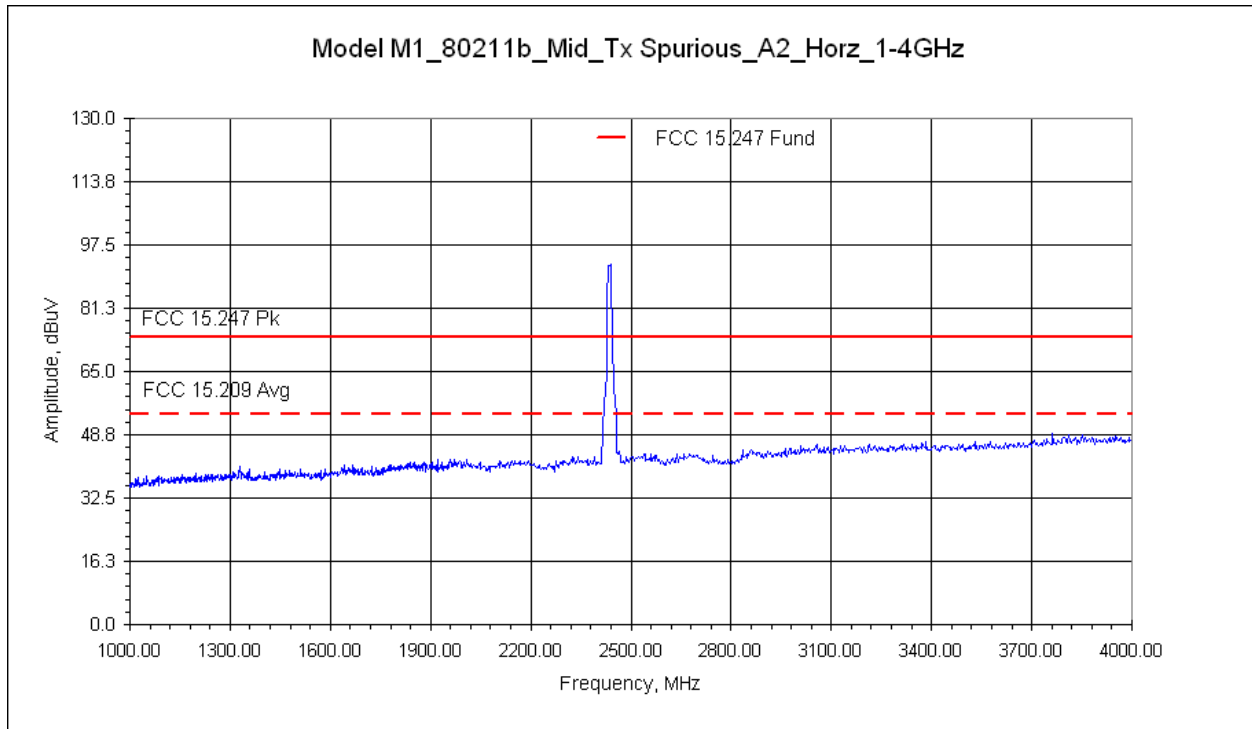
11.16 Plots: 802.11b Band

Vertical – Axis 2

1GHz to 4GHz



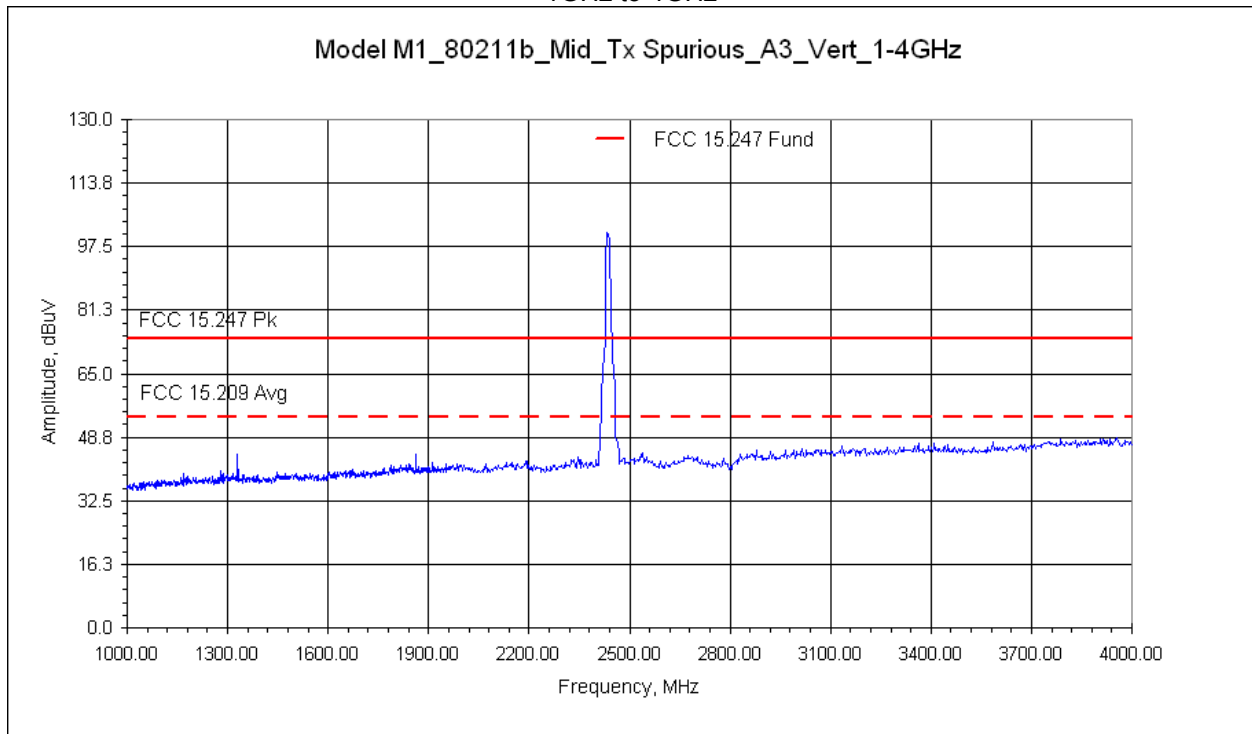
Horizontal – Axis 2



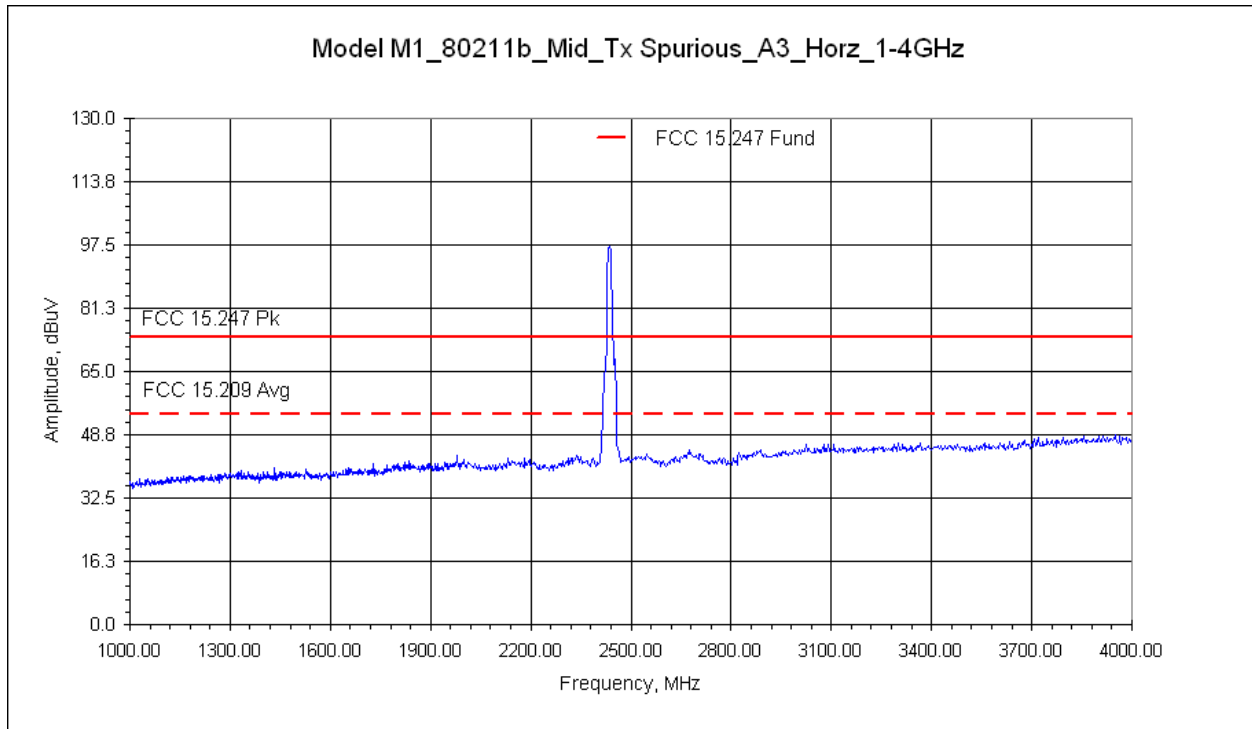
11.17 Plots: 802.11b Band

Vertical – Axis 3

1GHz to 4GHz



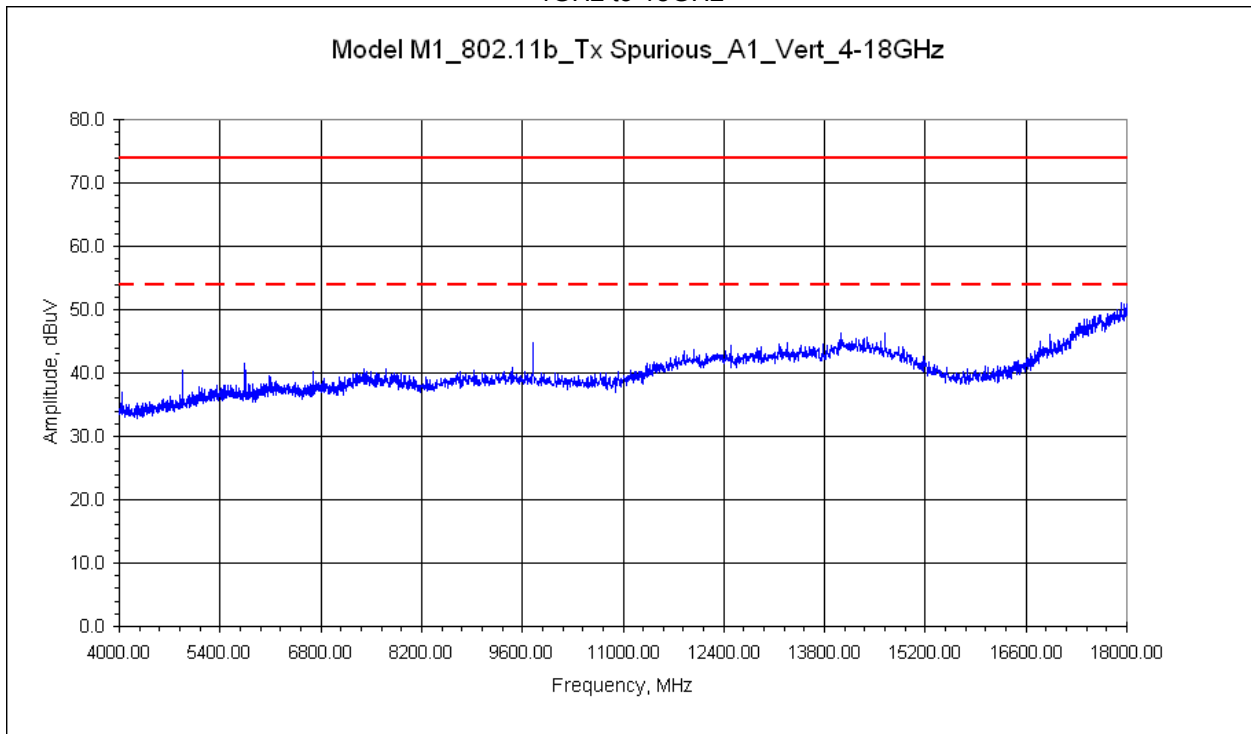
Horizontal – Axis 3



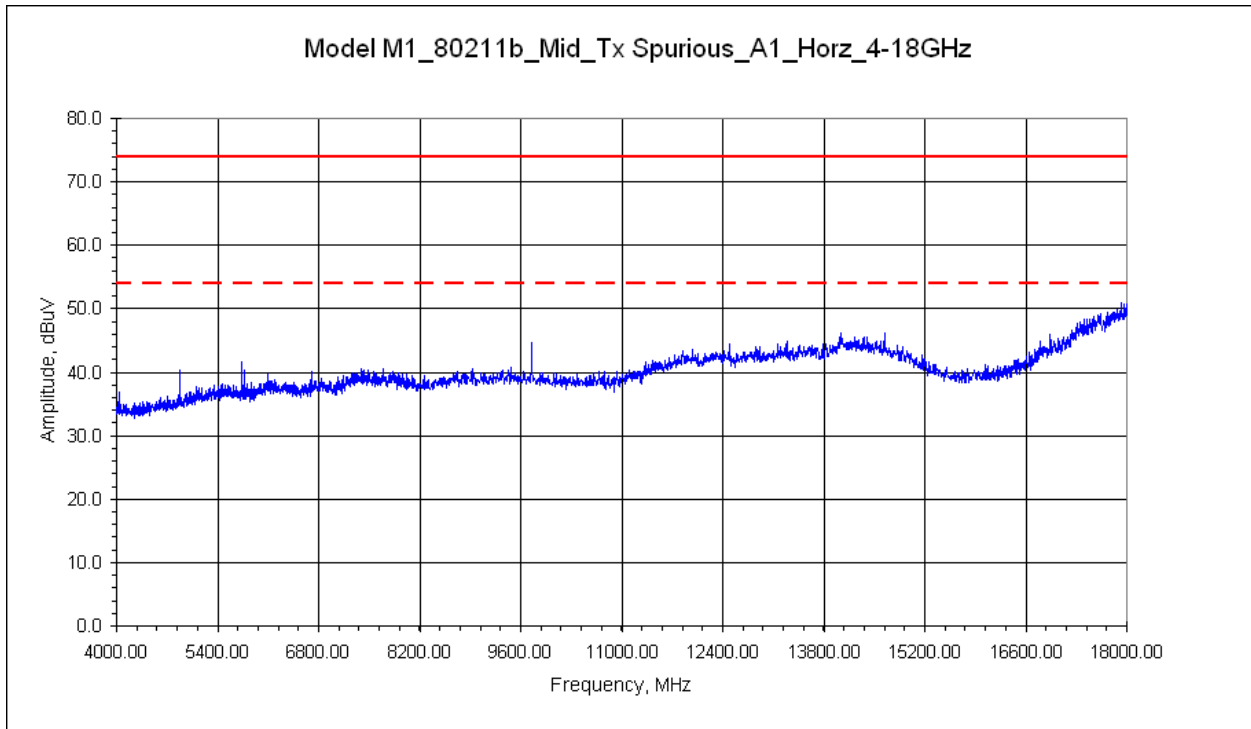
11.18 Plots: 802.11b Band

Vertical – Axis 1

4GHz to 18GHz



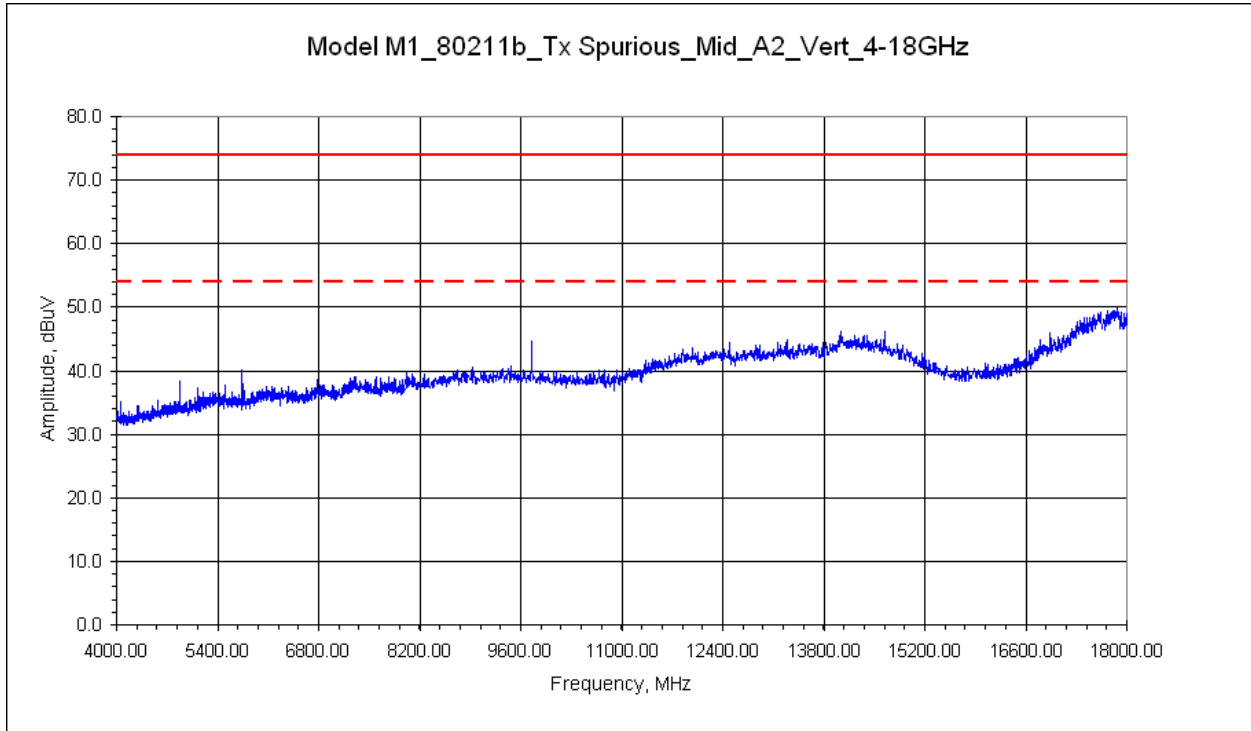
Horizontal – Axis 1



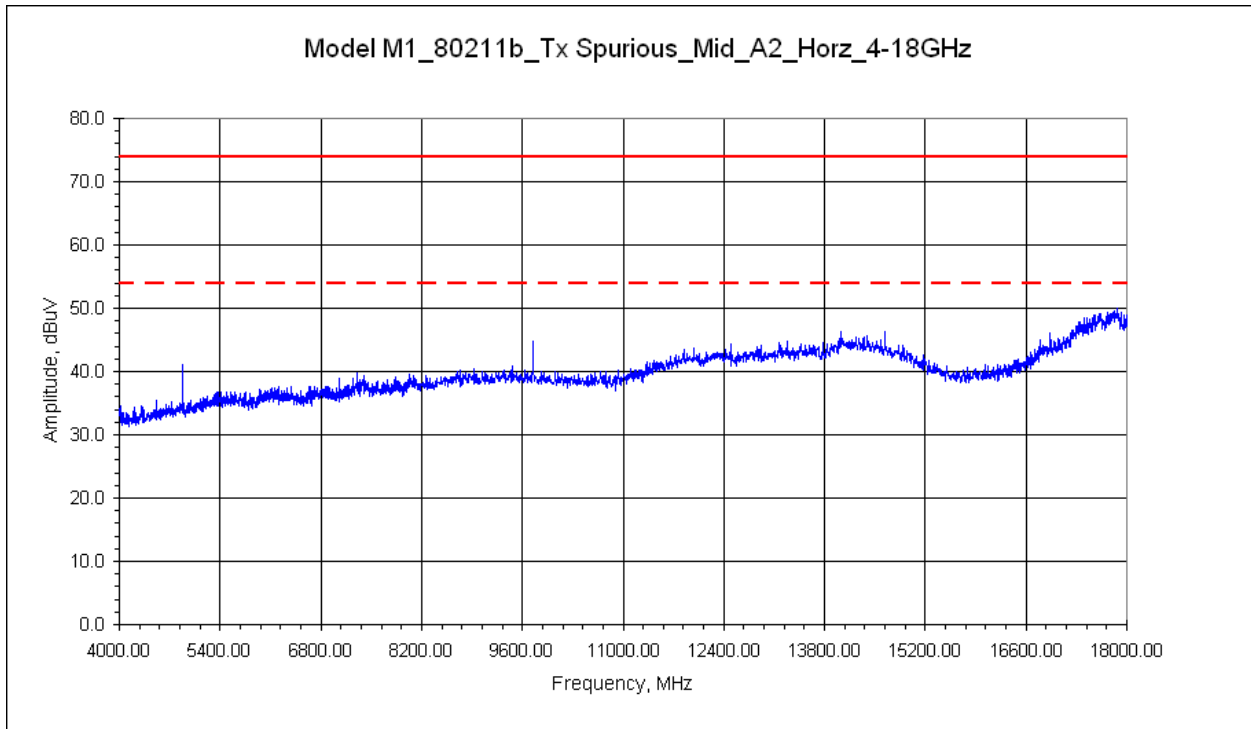
11.19 Plots: 802.11b Band

Vertical – Axis 2

4GHz to 18GHz



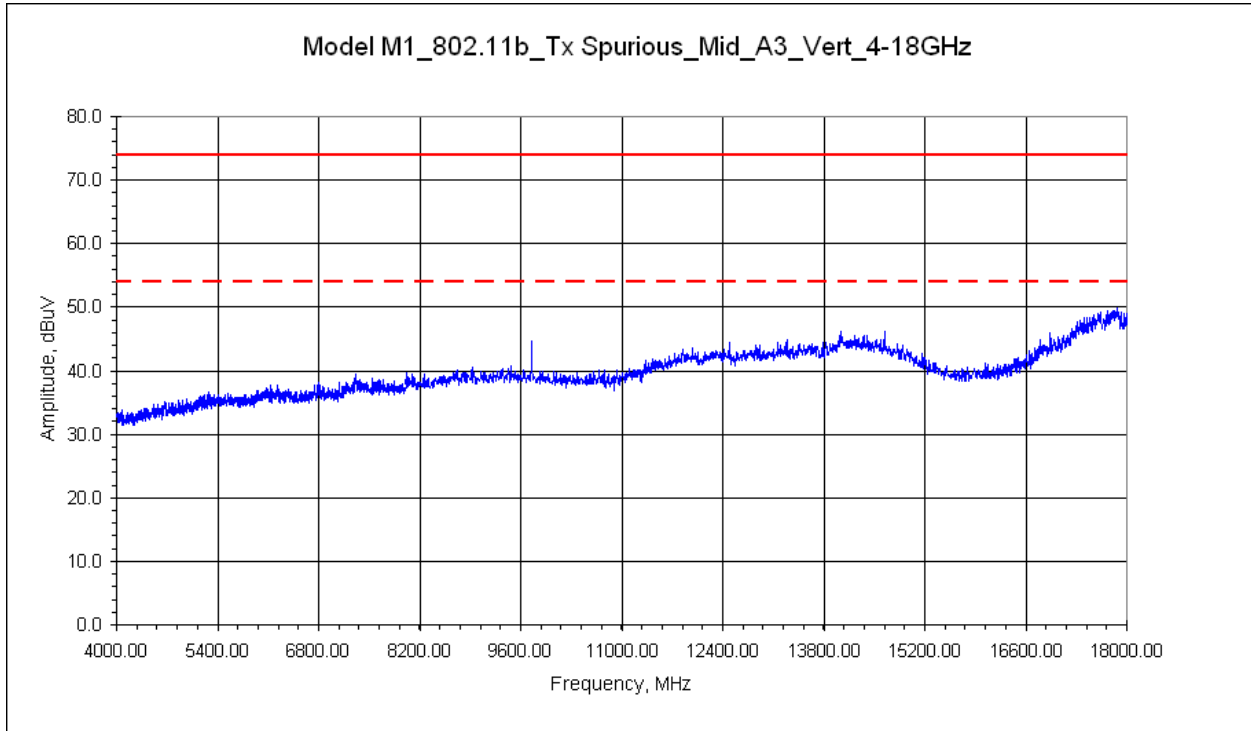
Horizontal – Axis 2



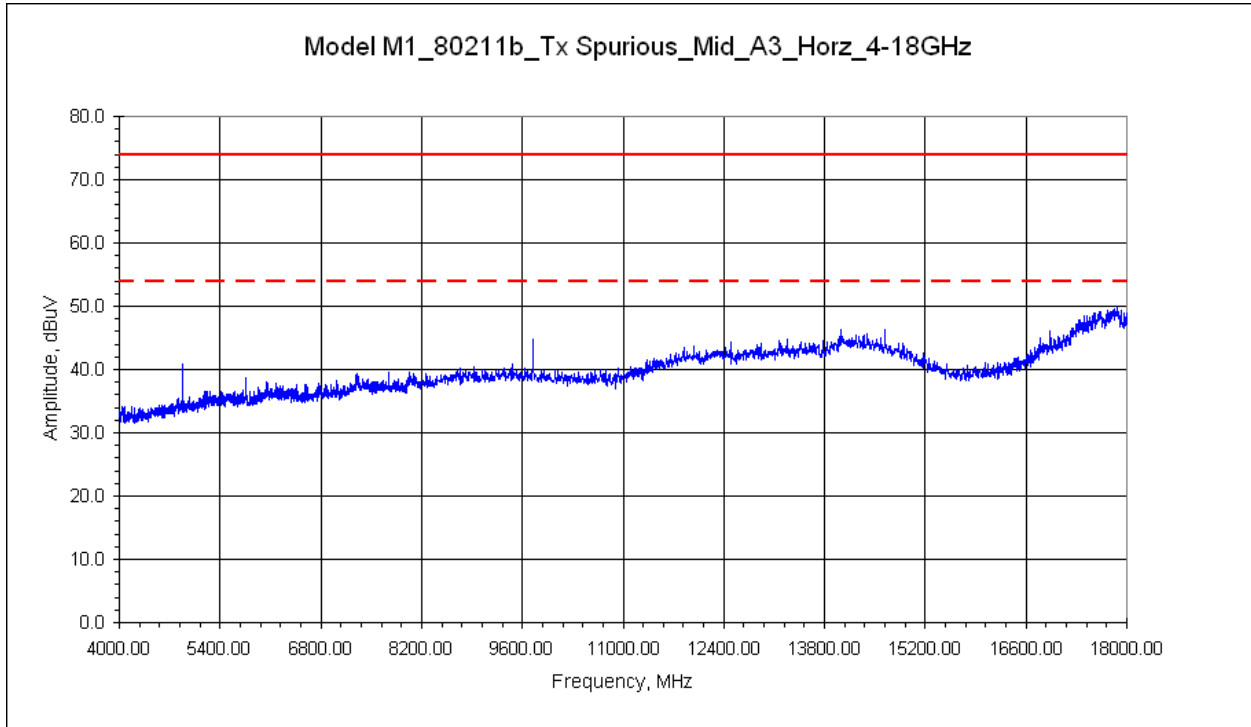
11.20 Plots: 802.11b Band

Vertical – Axis 3

4GHz to 18GHz



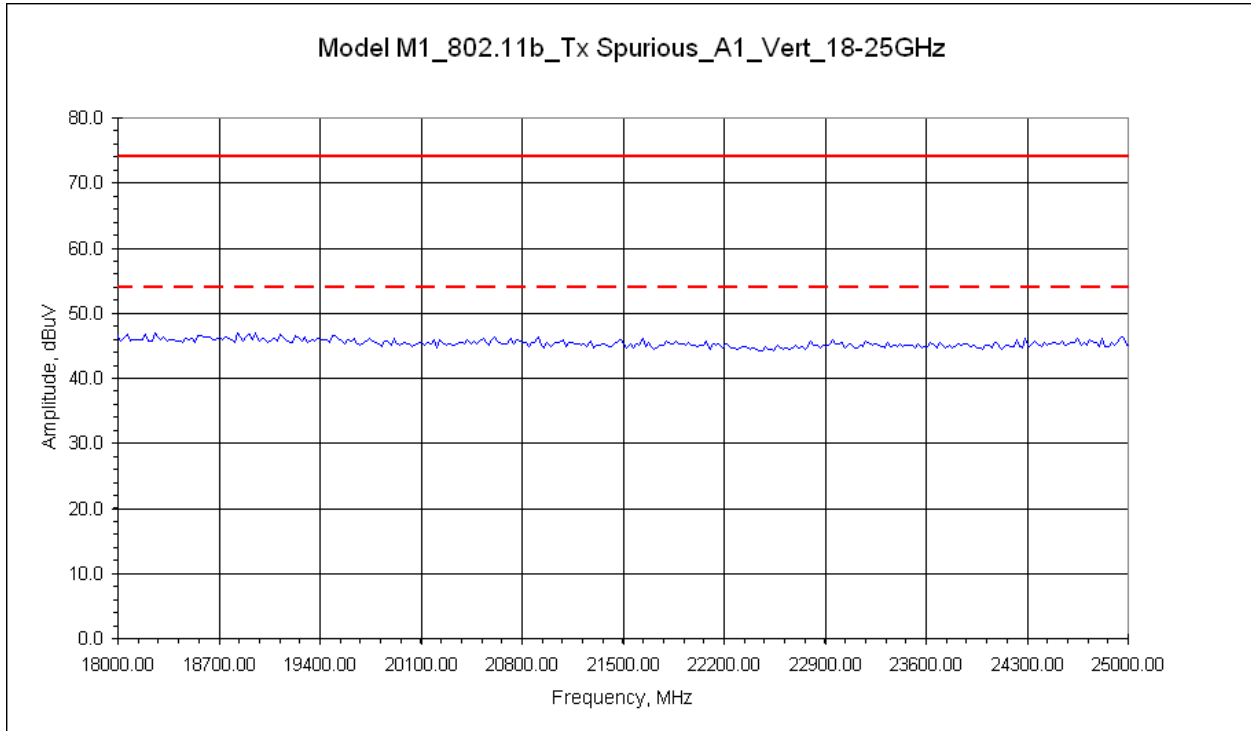
Horizontal – Axis 3



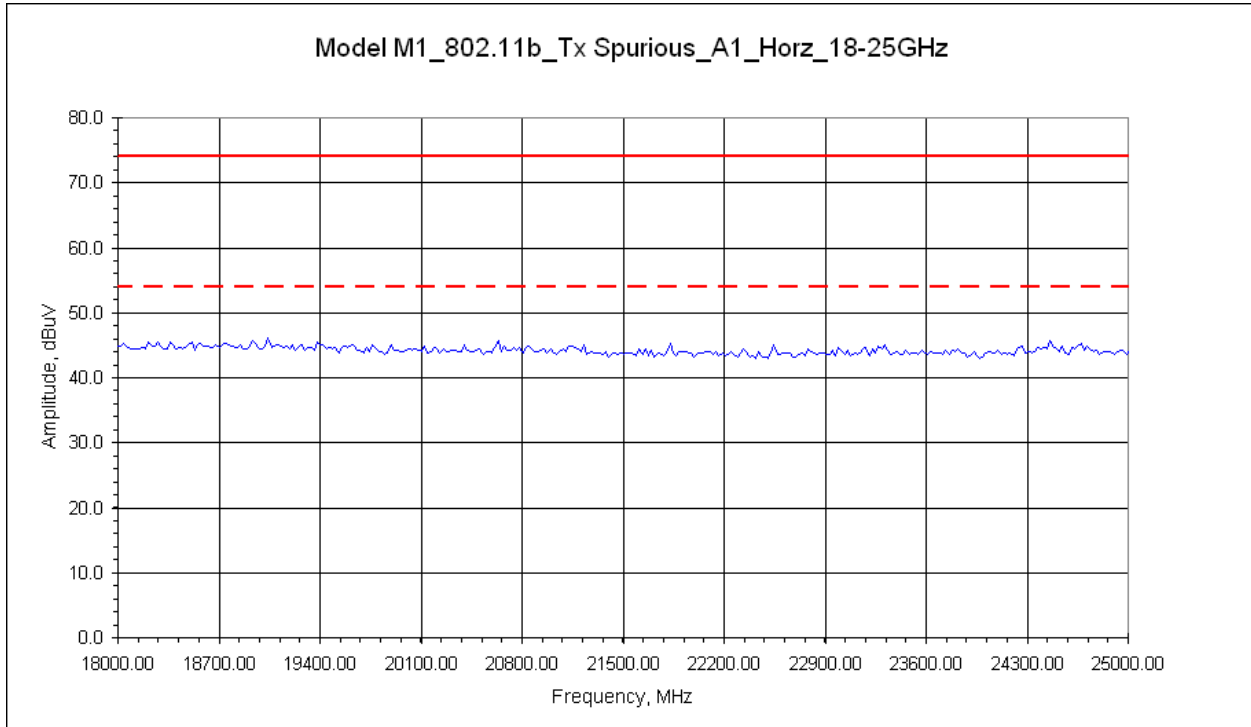
11.21 Plots: 802.11b Band

Vertical – Axis 1

18GHz to 25GHz



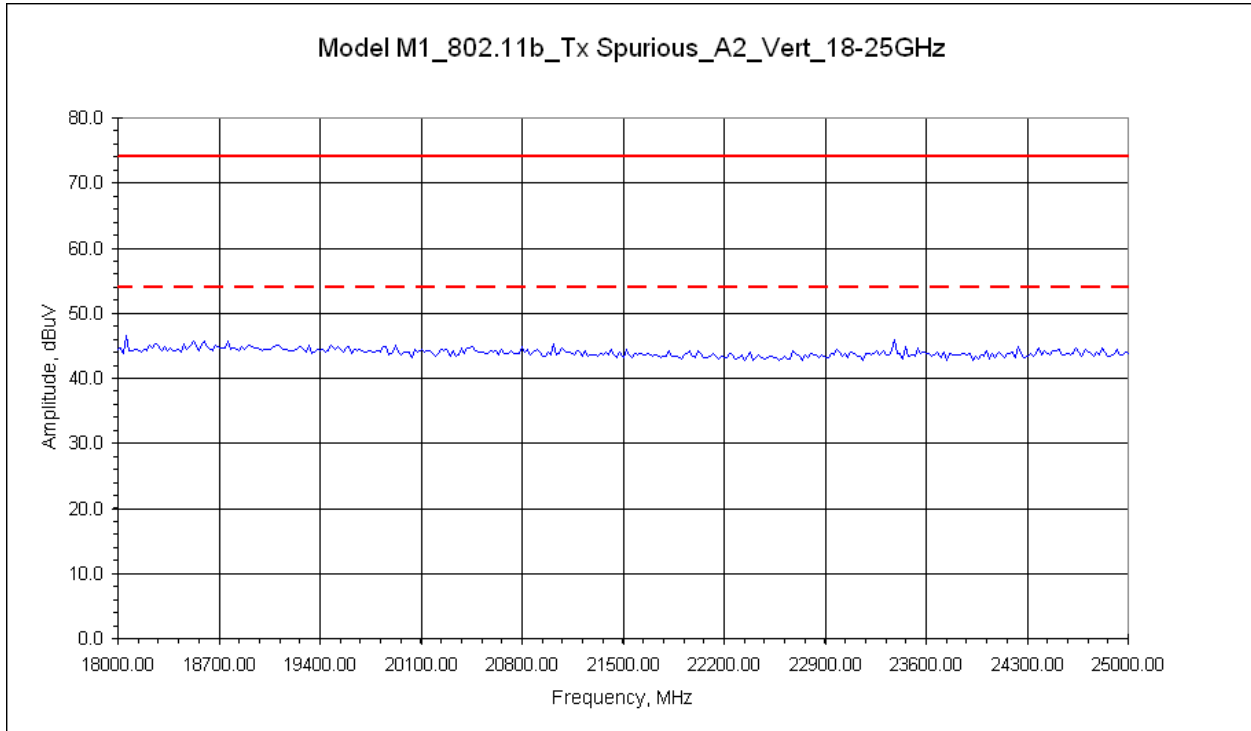
Horizontal – Axis 1



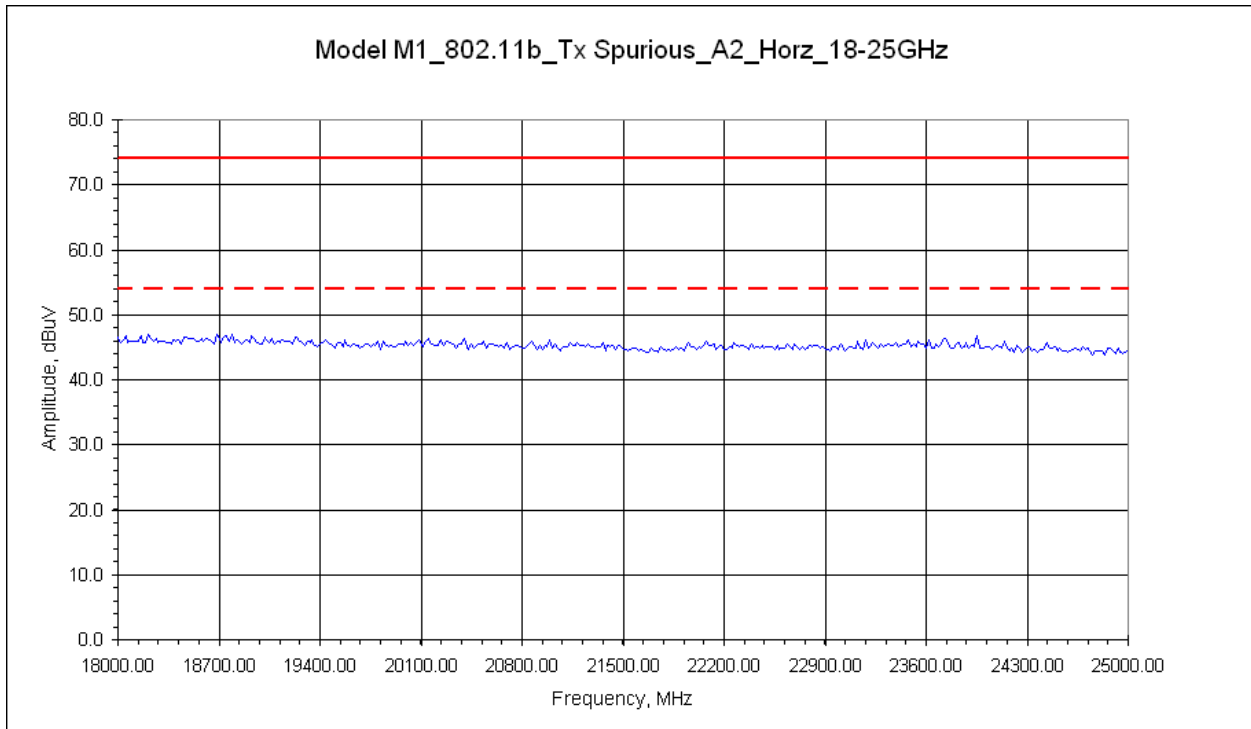
11.22 Plots: 802.11b Band

Vertical – Axis 2

18GHz to 25GHz



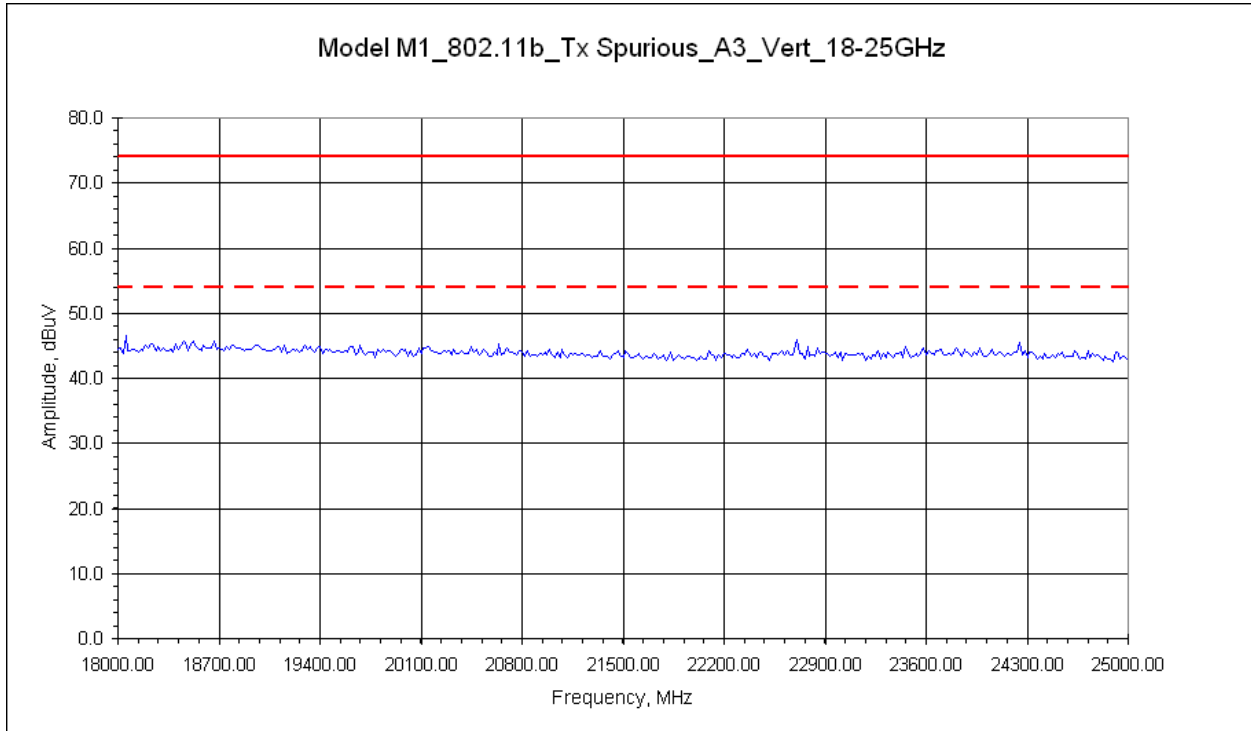
Horizontal – Axis 2



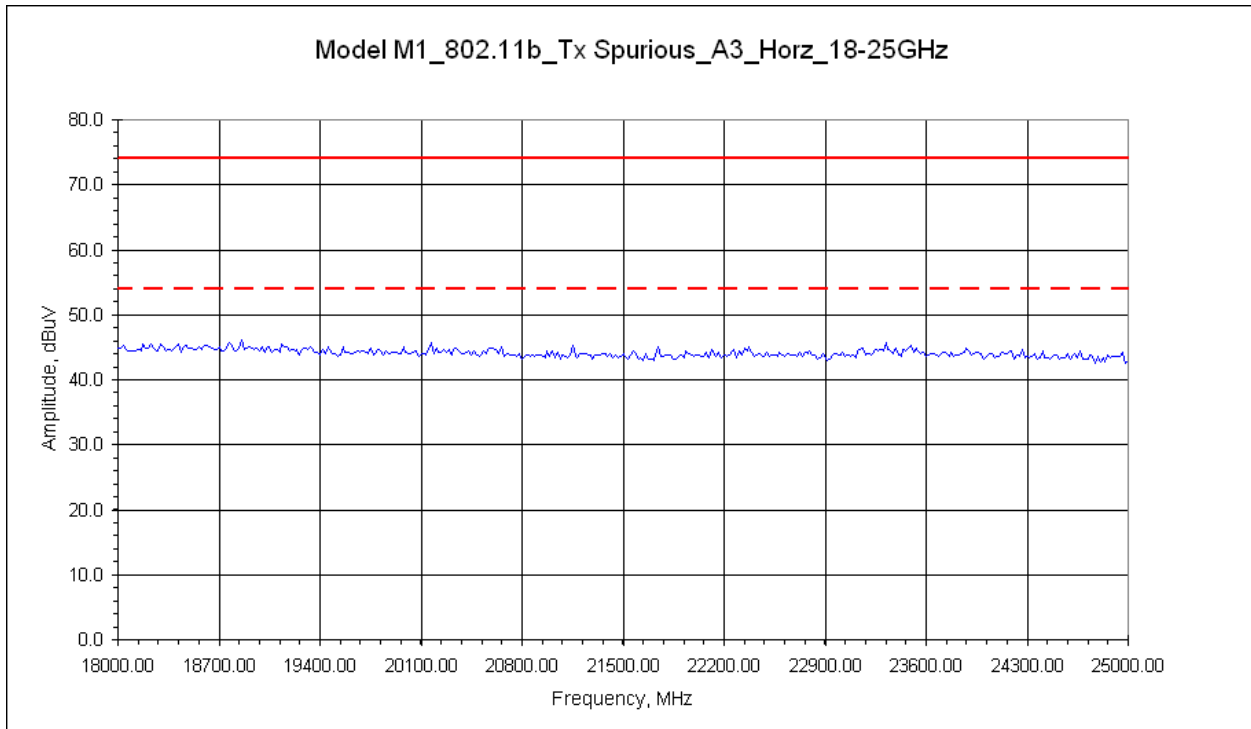
11.23 Plots: 802.11b Band

Vertical – Axis 3

18GHz to 25GHz



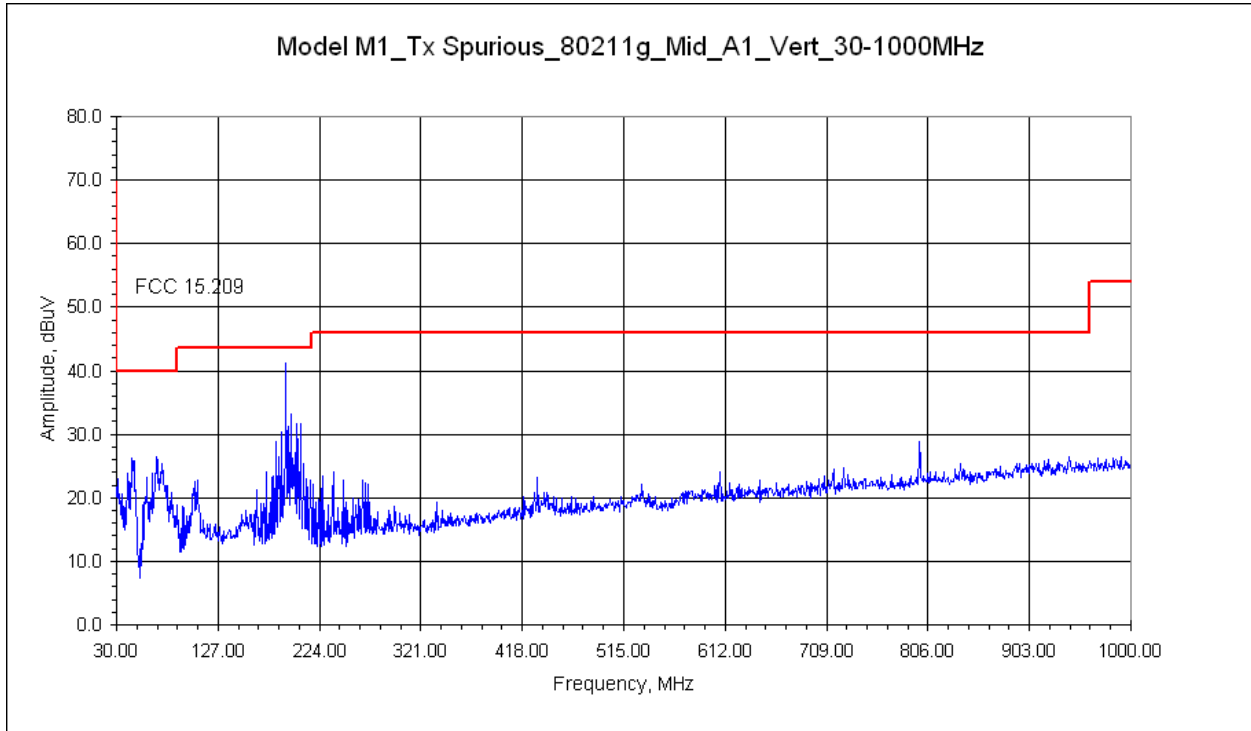
Horizontal – Axis 3



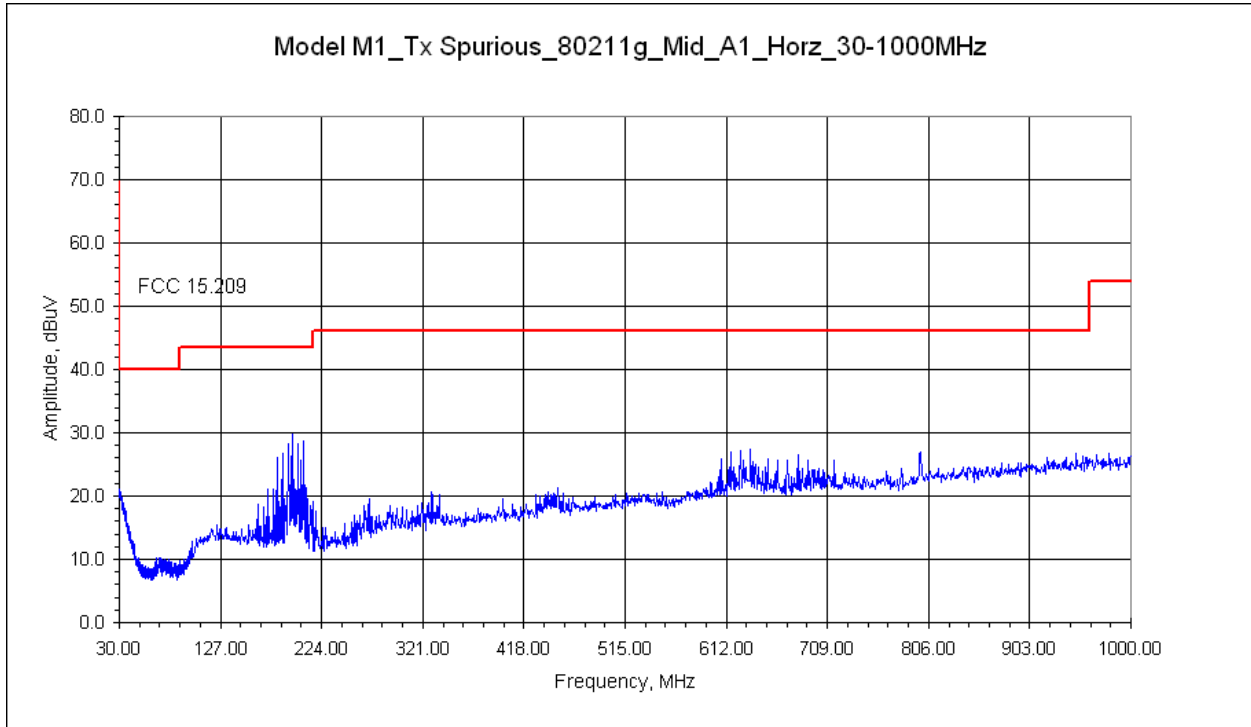
11.24 Plots: 802.11g Band

Vertical – Axis 1

30MHz to 1000MHz



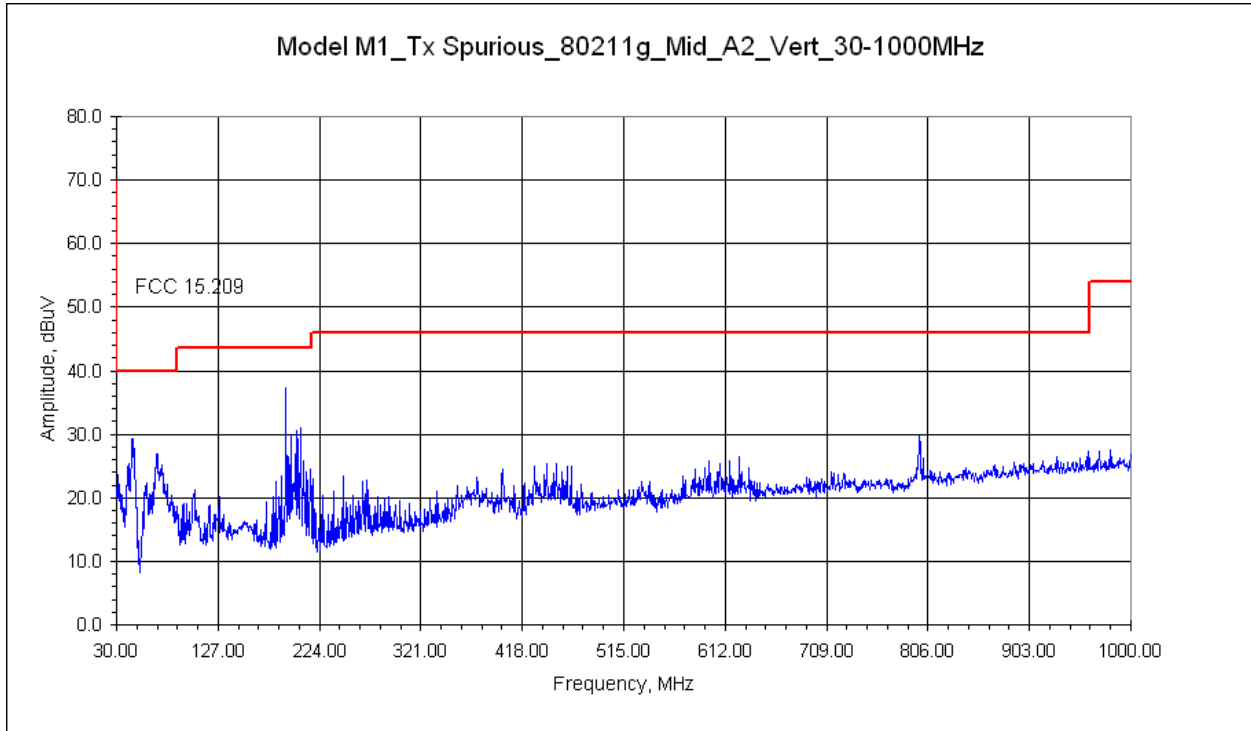
Horizontal – Axis 1



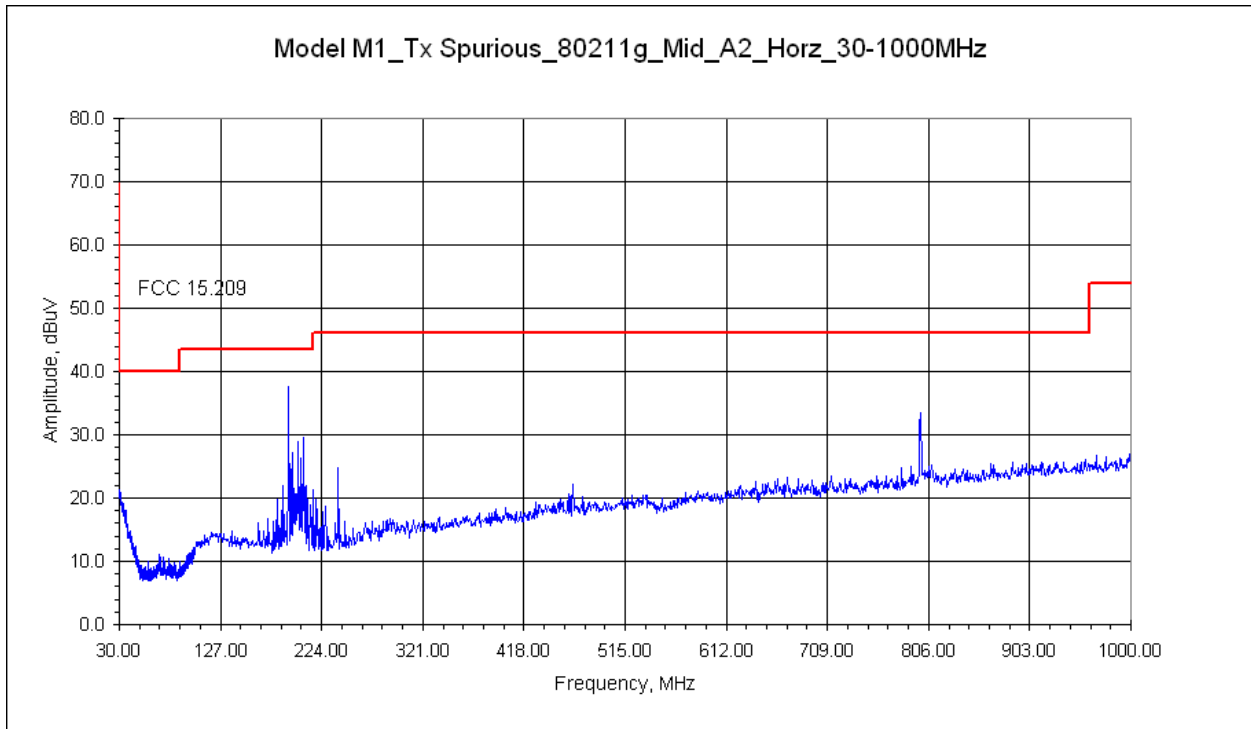
11.25 Plots: 802.11g Band

Vertical – Axis 2

30MHz to 1000MHz



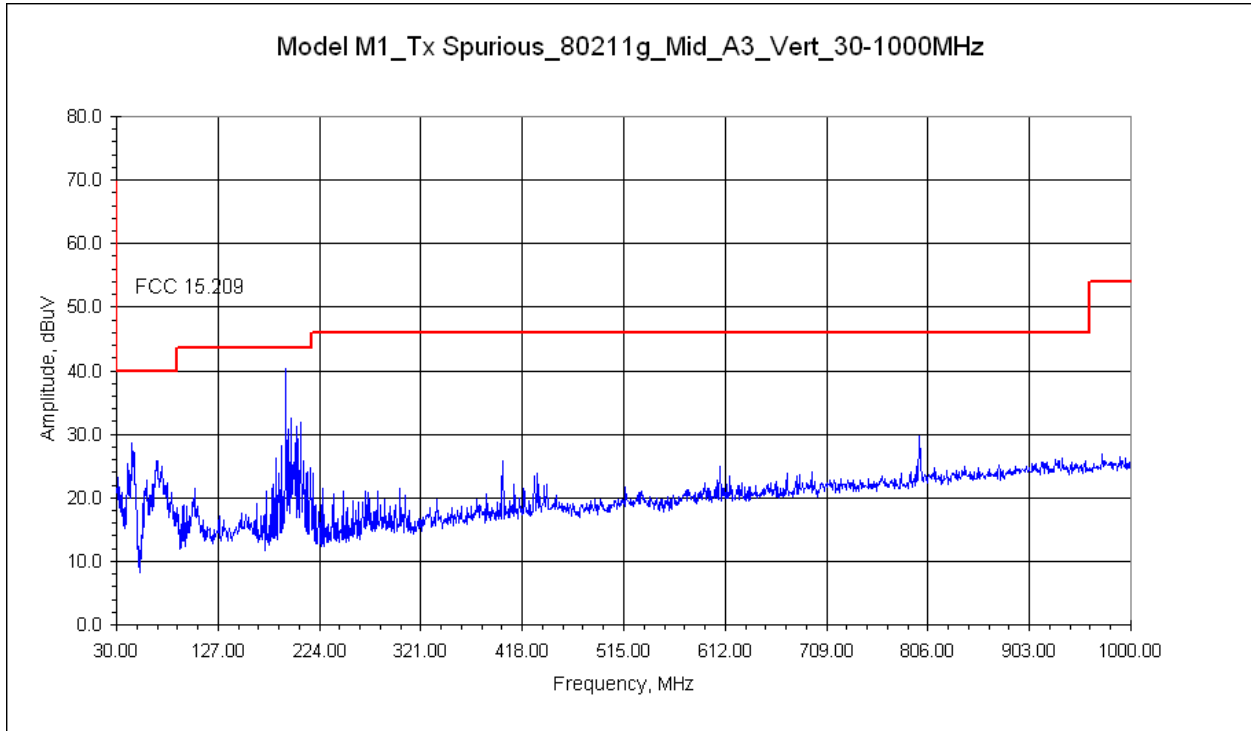
Horizontal – Axis 2



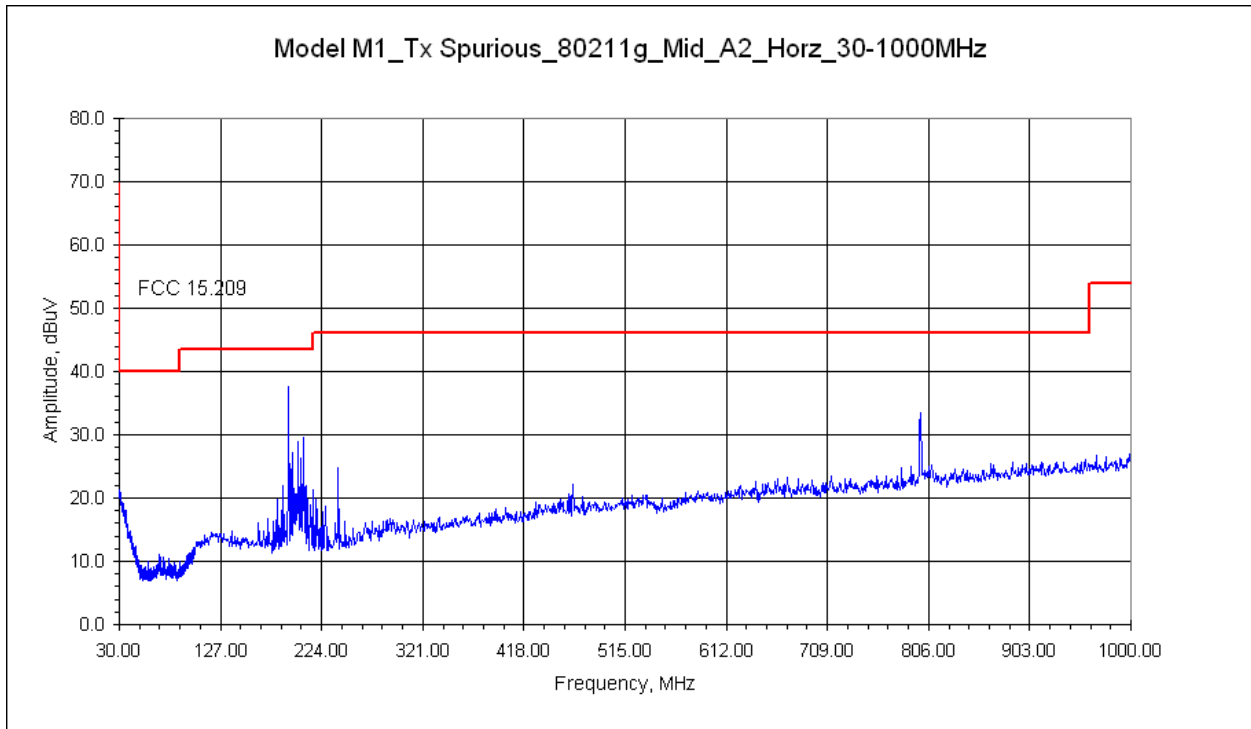
11.26 Plots: 802.11g Band

Vertical – Axis 3

30MHz to 1000MHz



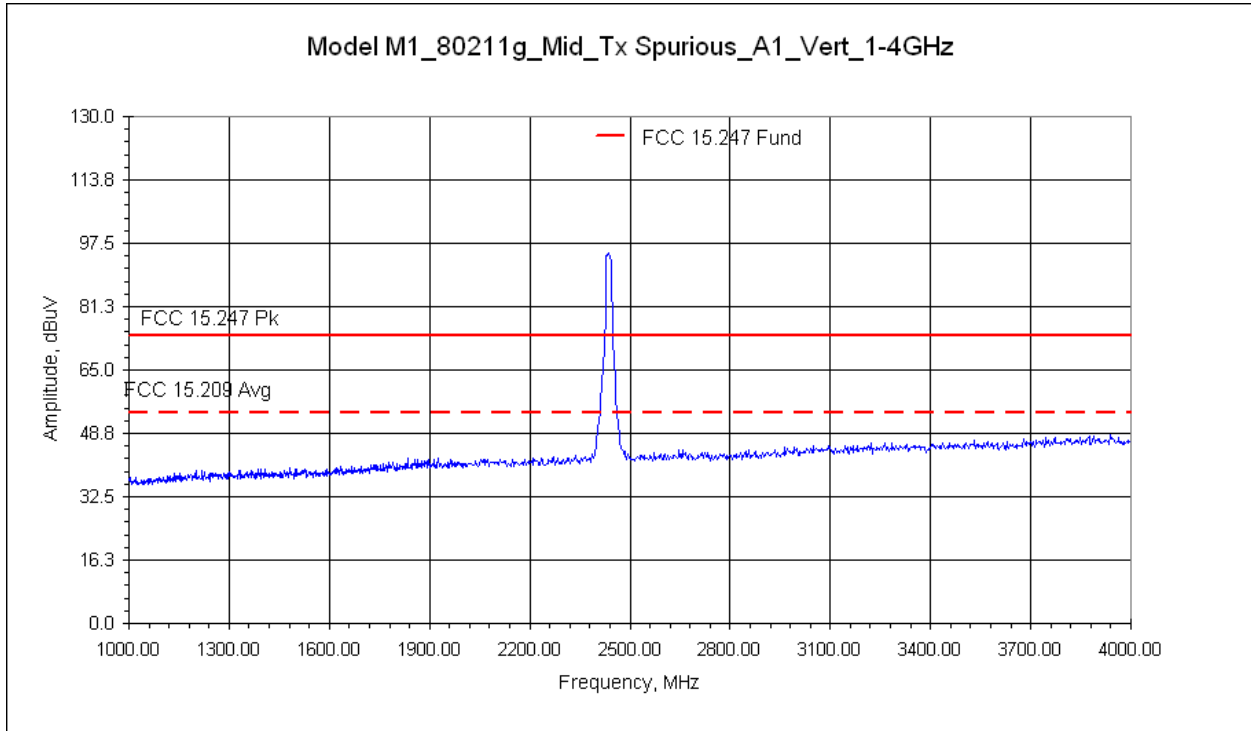
Horizontal – Axis 3



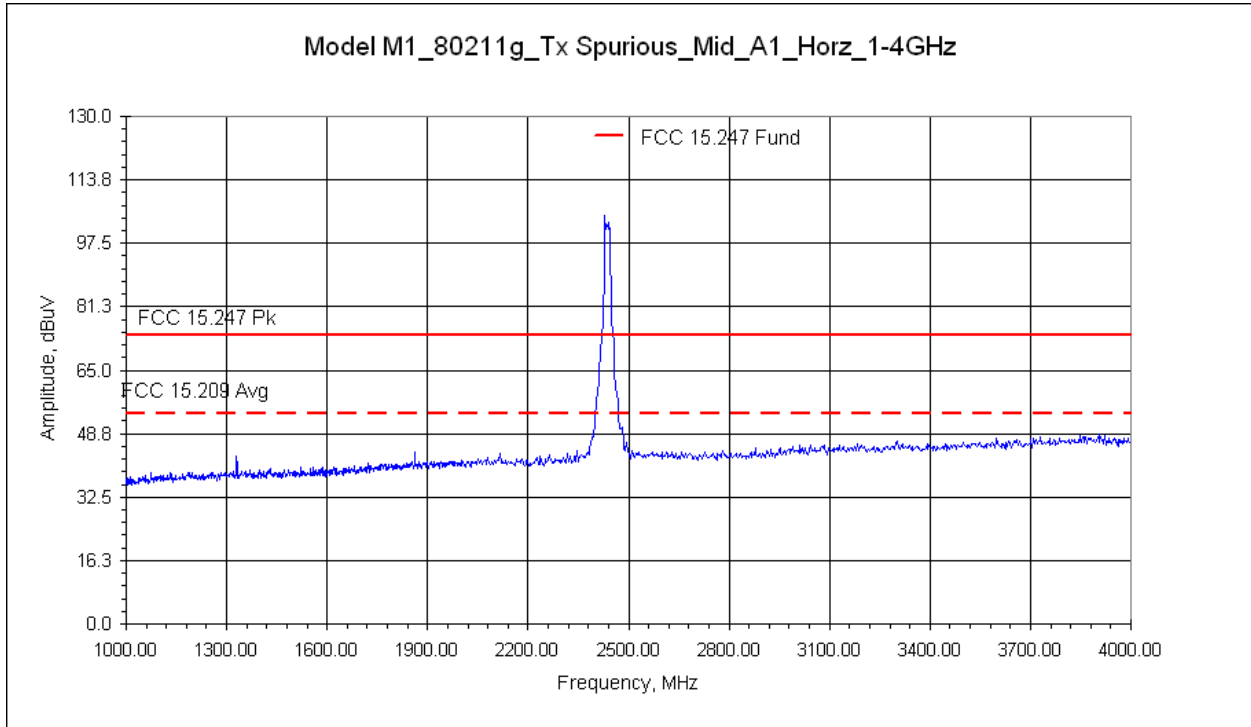
11.27 Plots: 802.11g Band

Vertical – Axis 1

1GHz to 4GHz



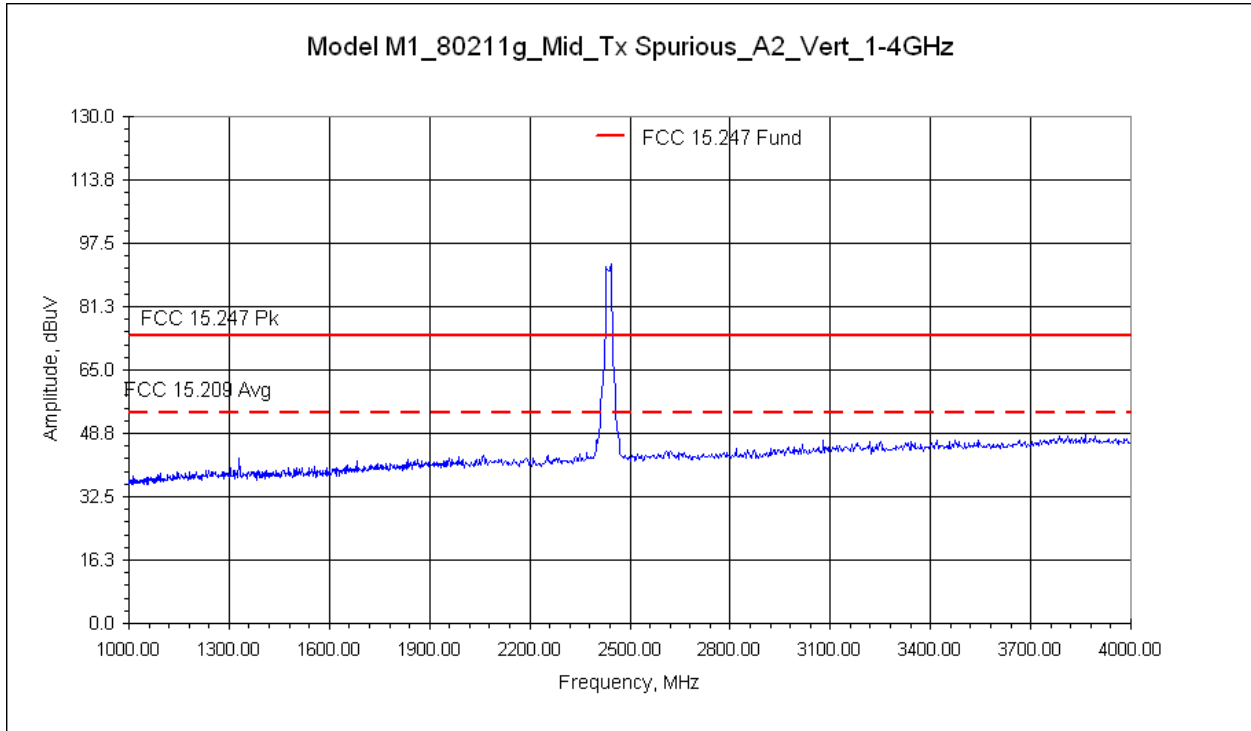
Horizontal – Axis 1



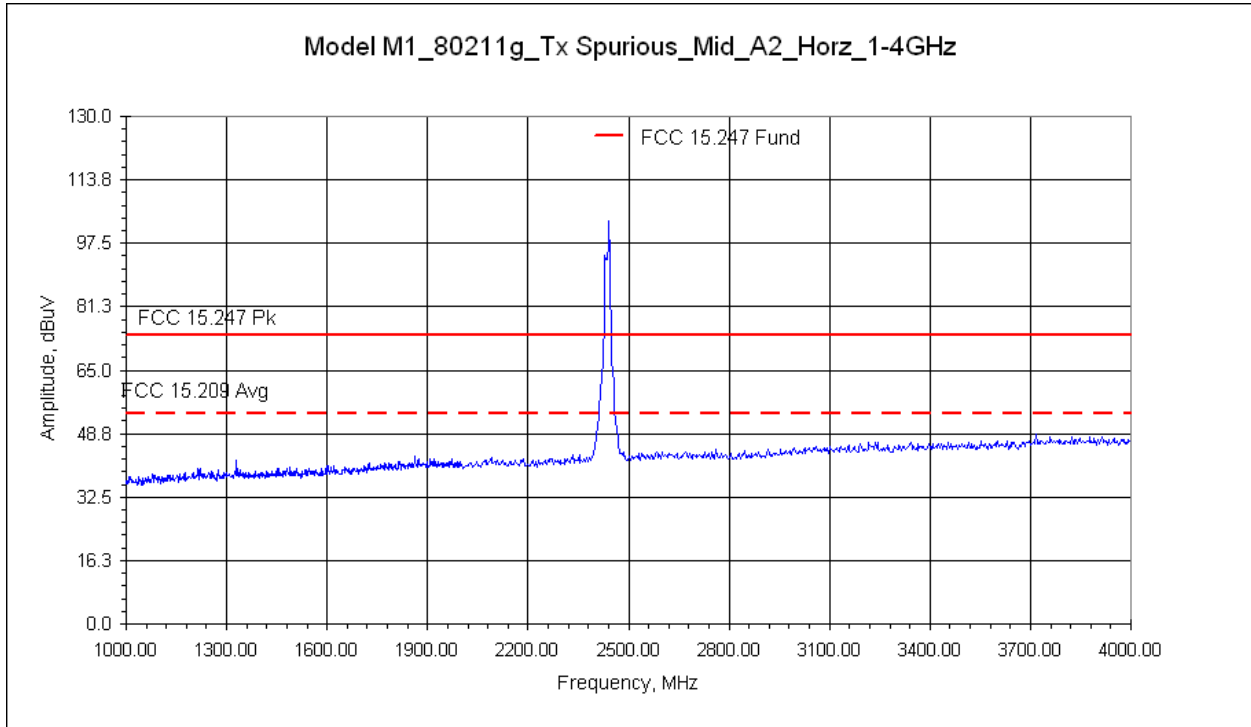
11.28 Plots: 802.11g Band

Vertical – Axis 2

1GHz to 4GHz



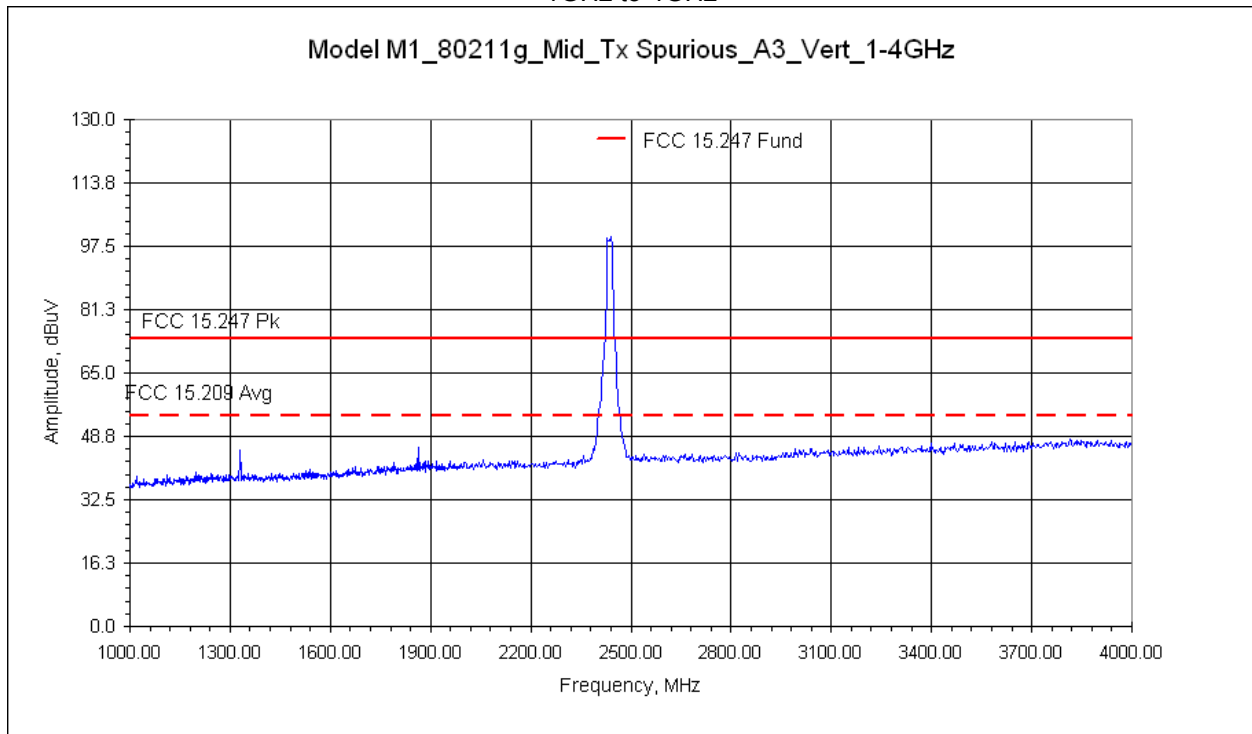
Horizontal – Axis 2



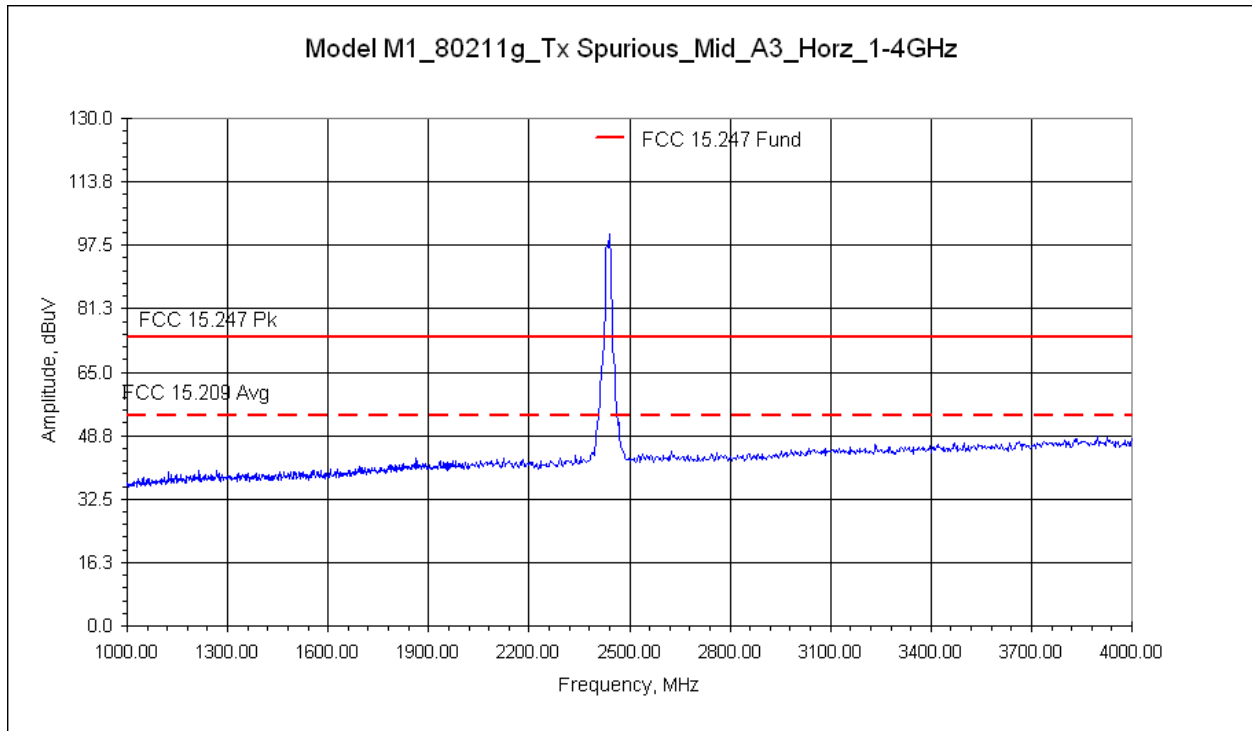
11.29 Plots: 802.11g Band

Vertical – Axis 3

1GHz to 4GHz



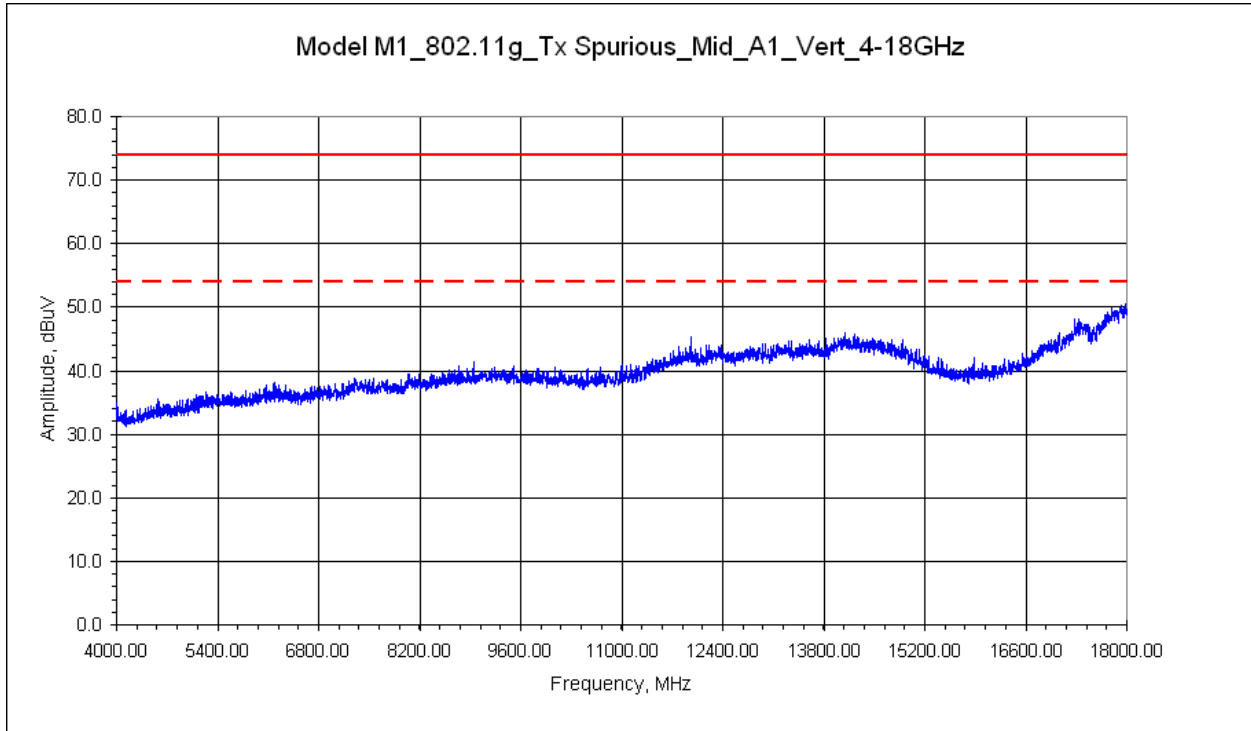
Horizontal – Axis 3



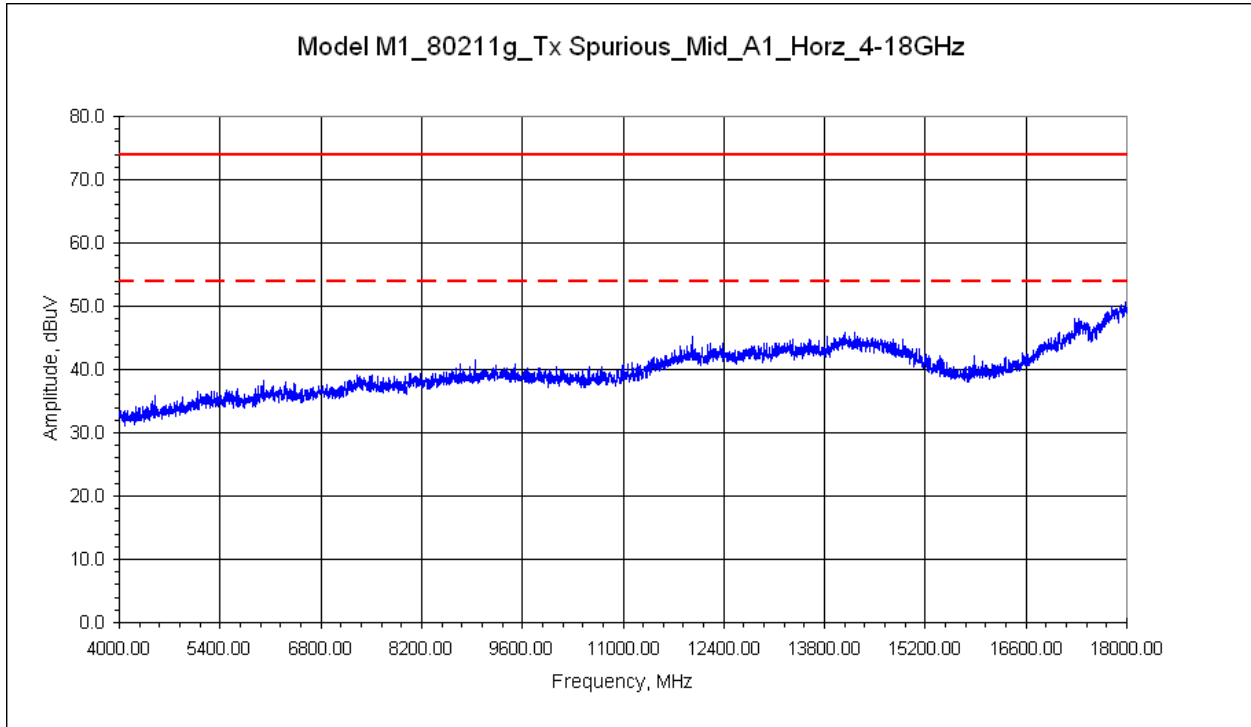
11.30 Plots: 802.11g Band

Vertical – Axis 1

4GHz to 18GHz



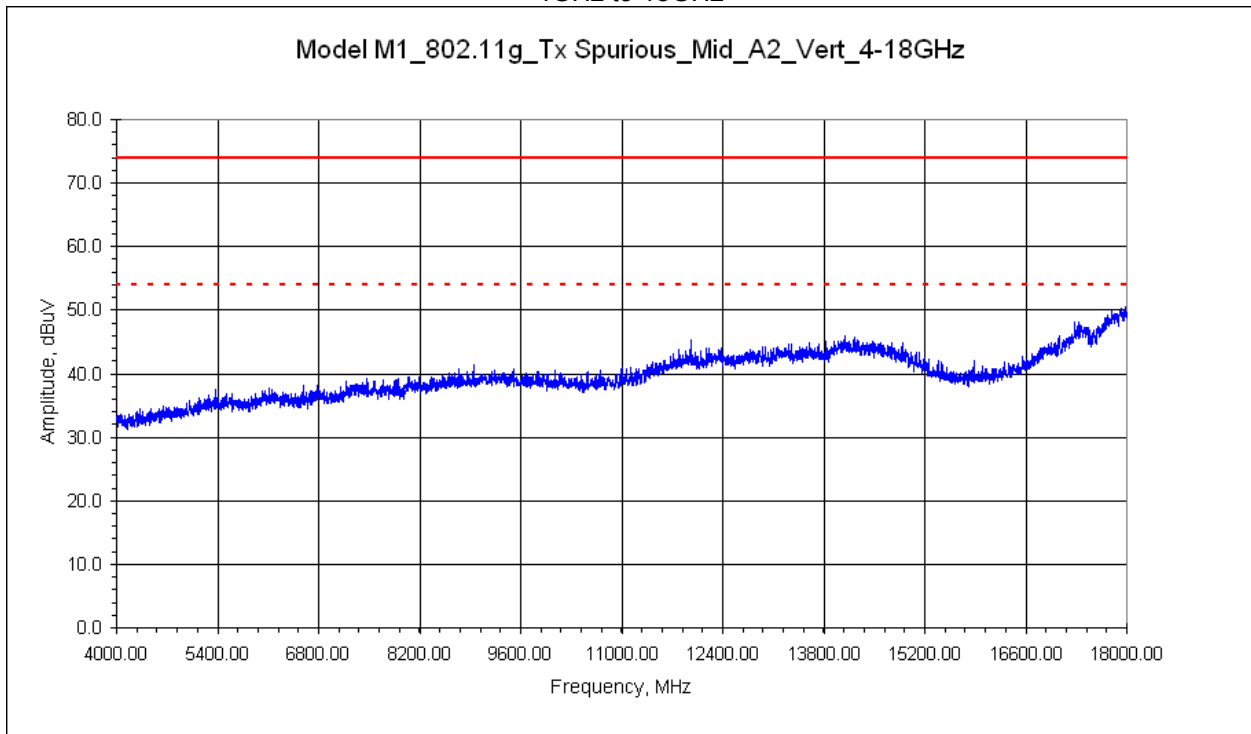
Horizontal – Axis 1



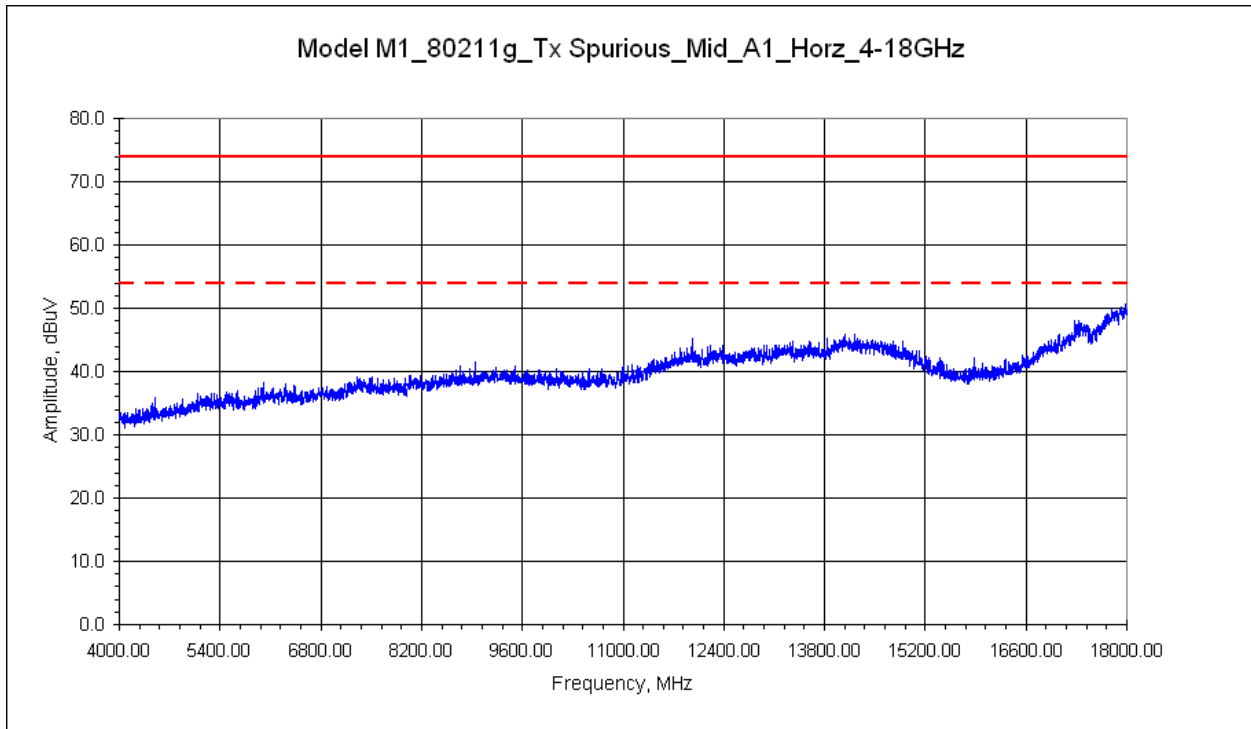
11.31 Plots: 802.11g Band

Vertical – Axis 2

4GHz to 18GHz



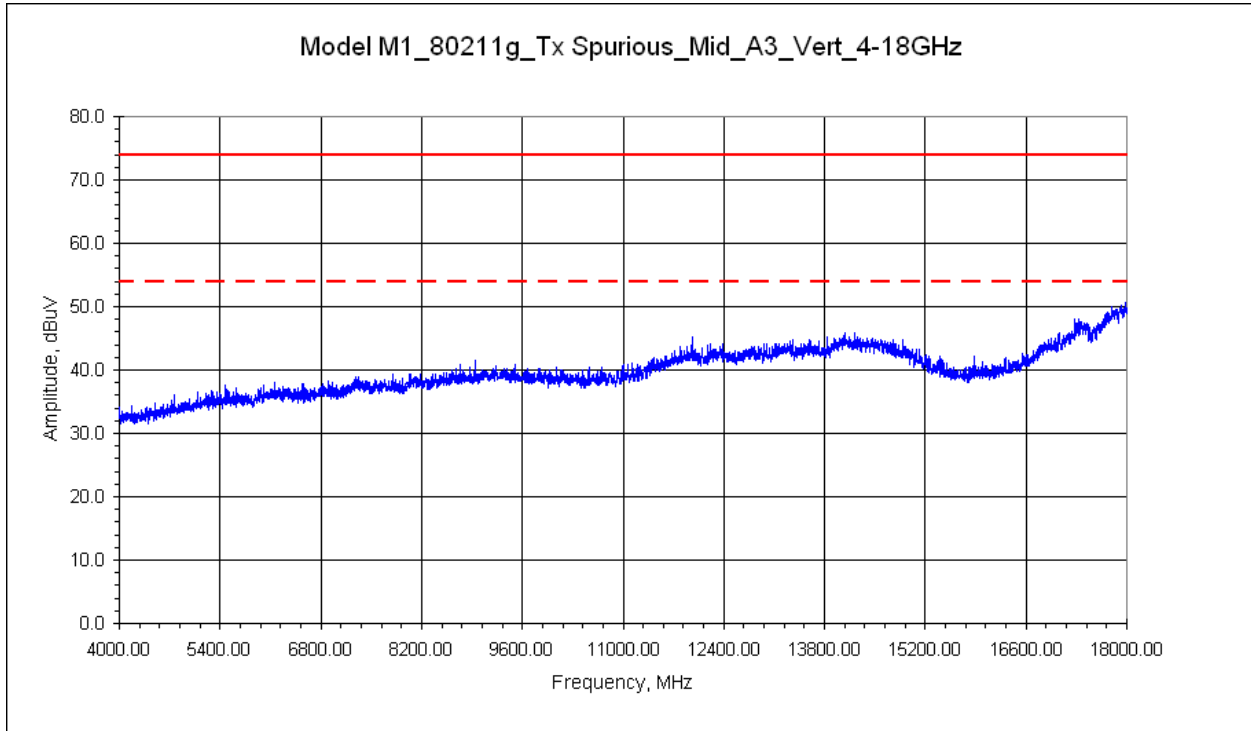
Horizontal – Axis 2



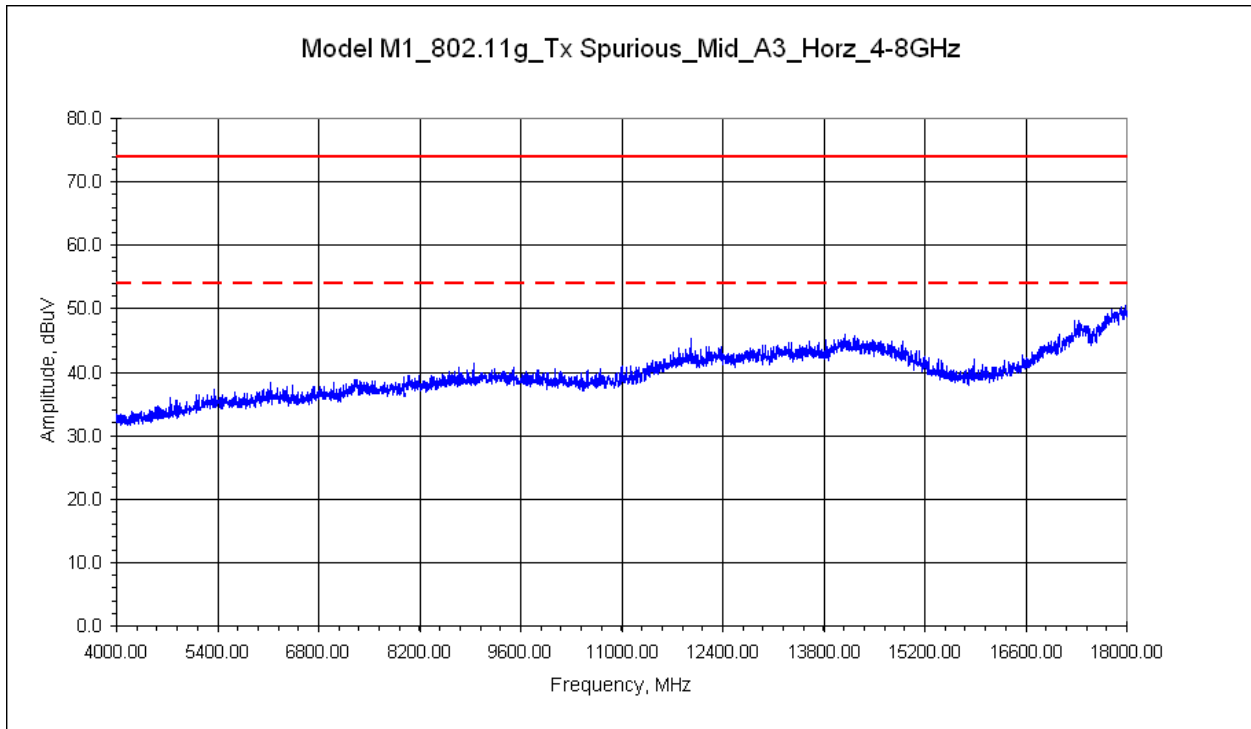
11.32 Plots: 802.11g Band

Vertical – Axis 3

4GHz to 18GHz



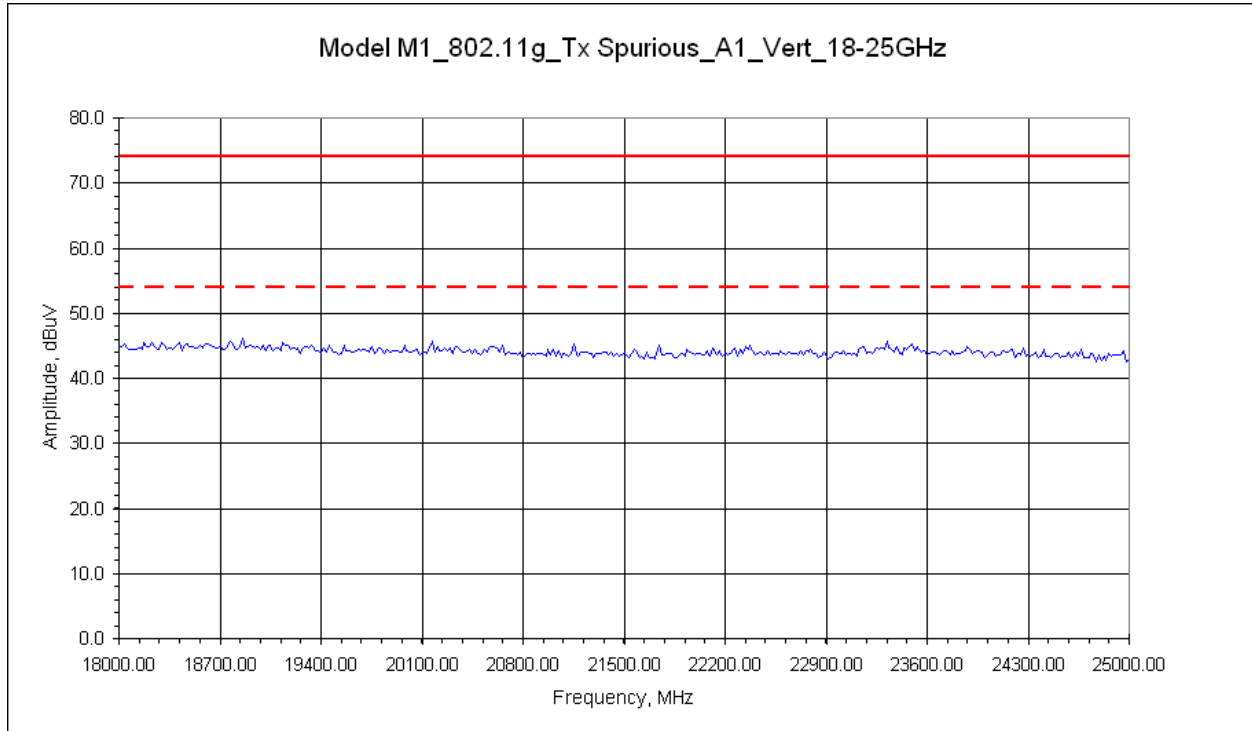
Horizontal – Axis 3



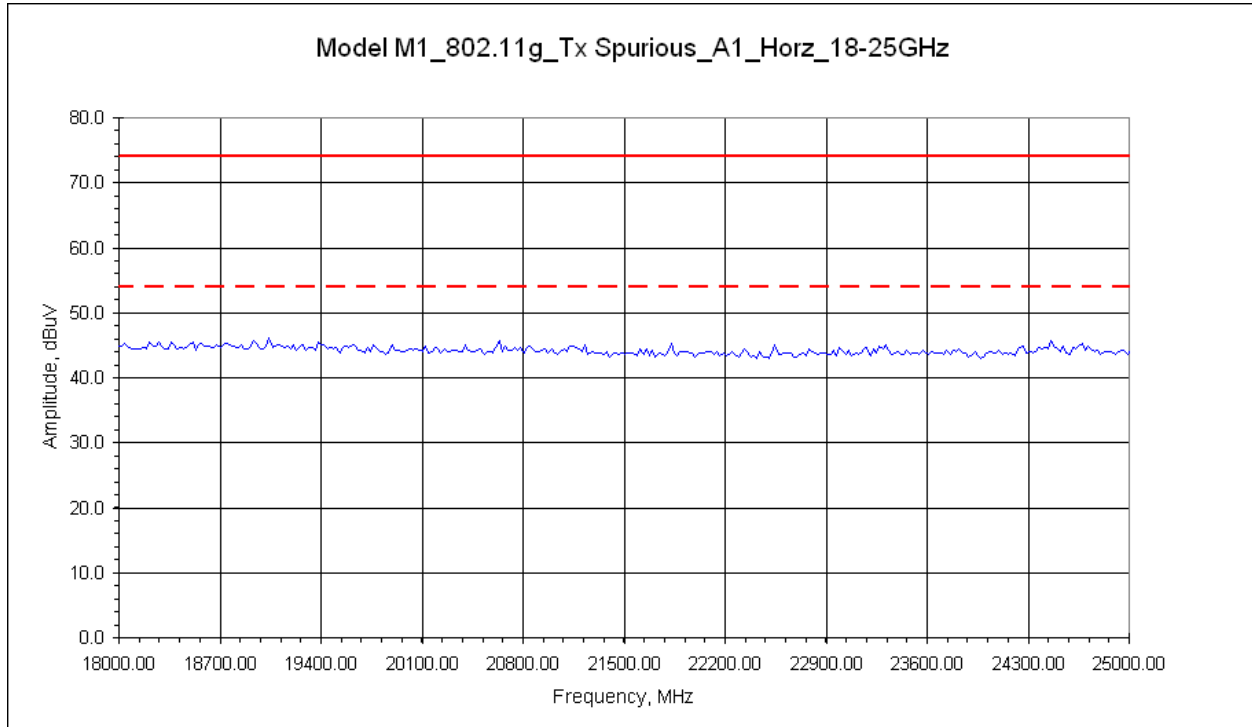
11.33 Plots: 802.11g Band

Vertical – Axis 1

18GHz to 25GHz



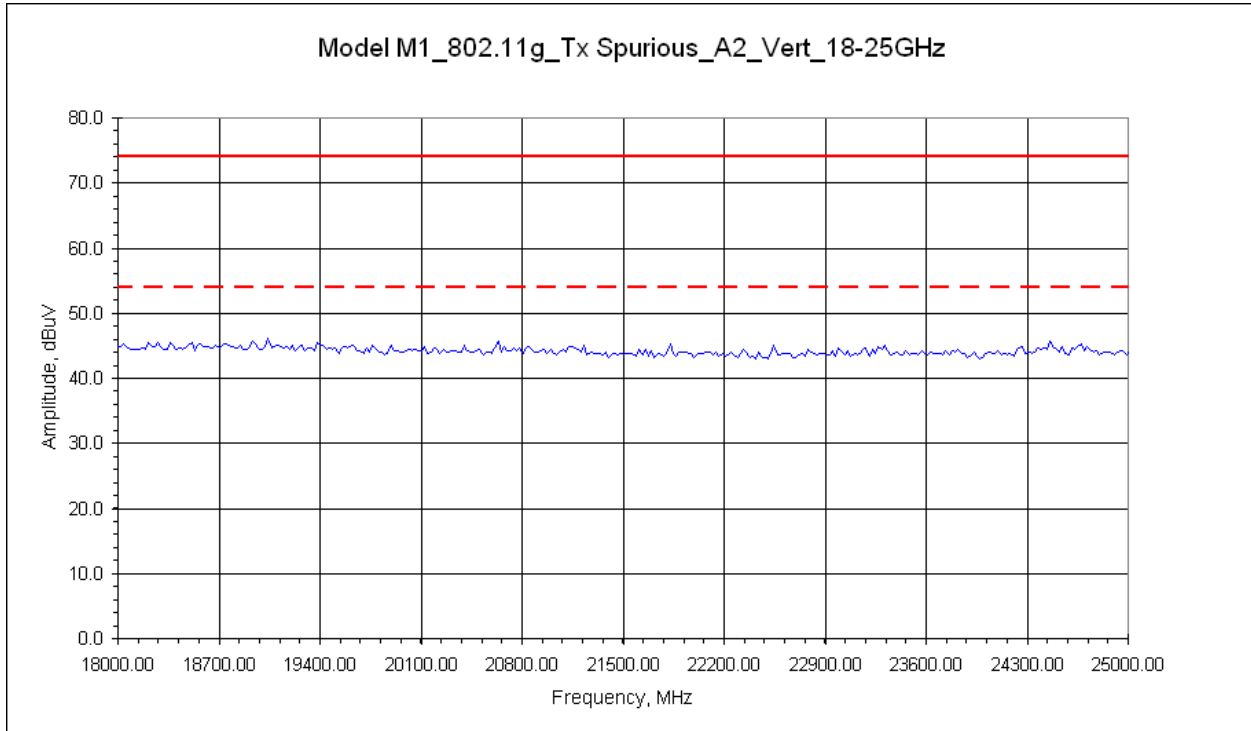
Horizontal – Axis 1



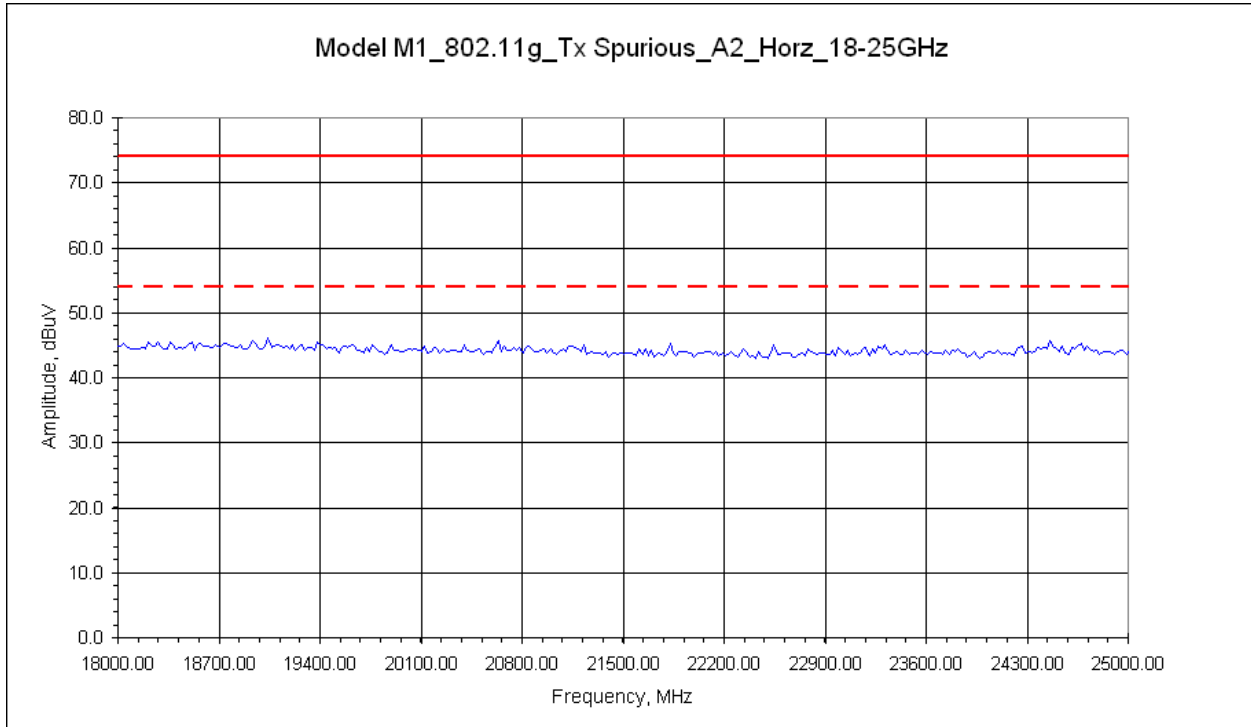
11.34 Plots: 802.11g Band

Vertical – Axis 2

18GHz to 25GHz



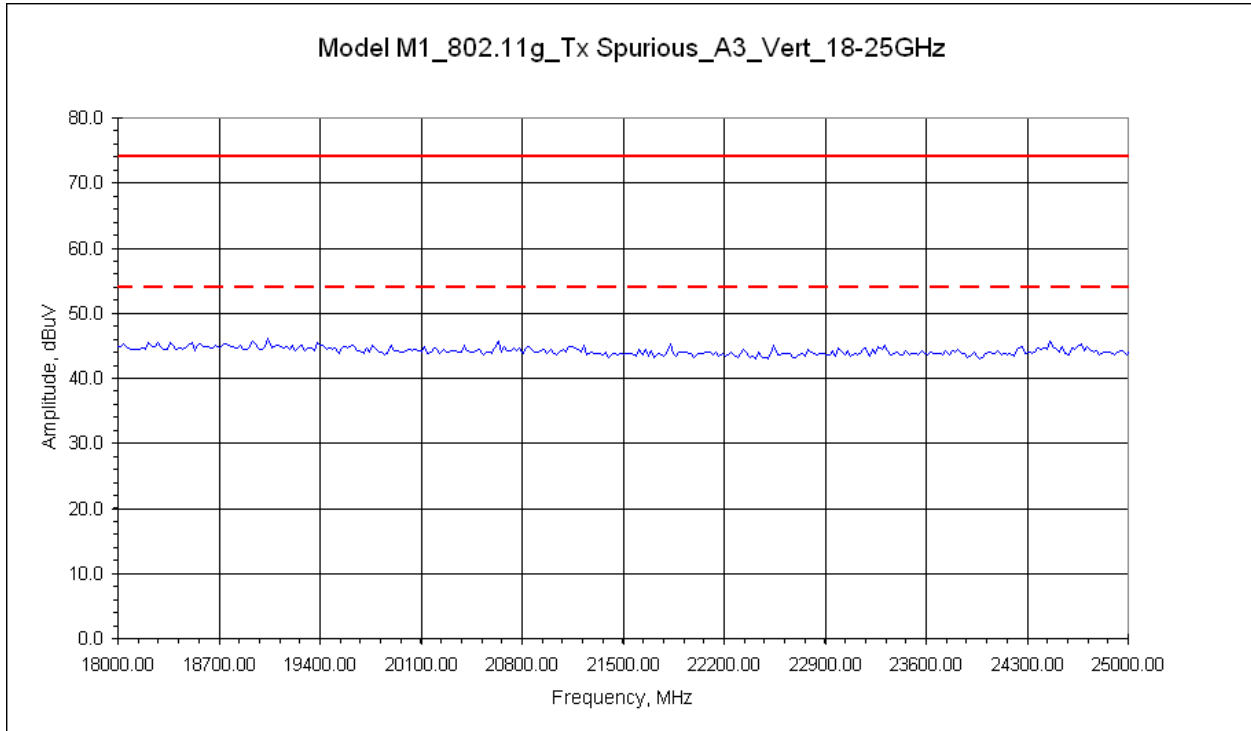
Horizontal – Axis 2



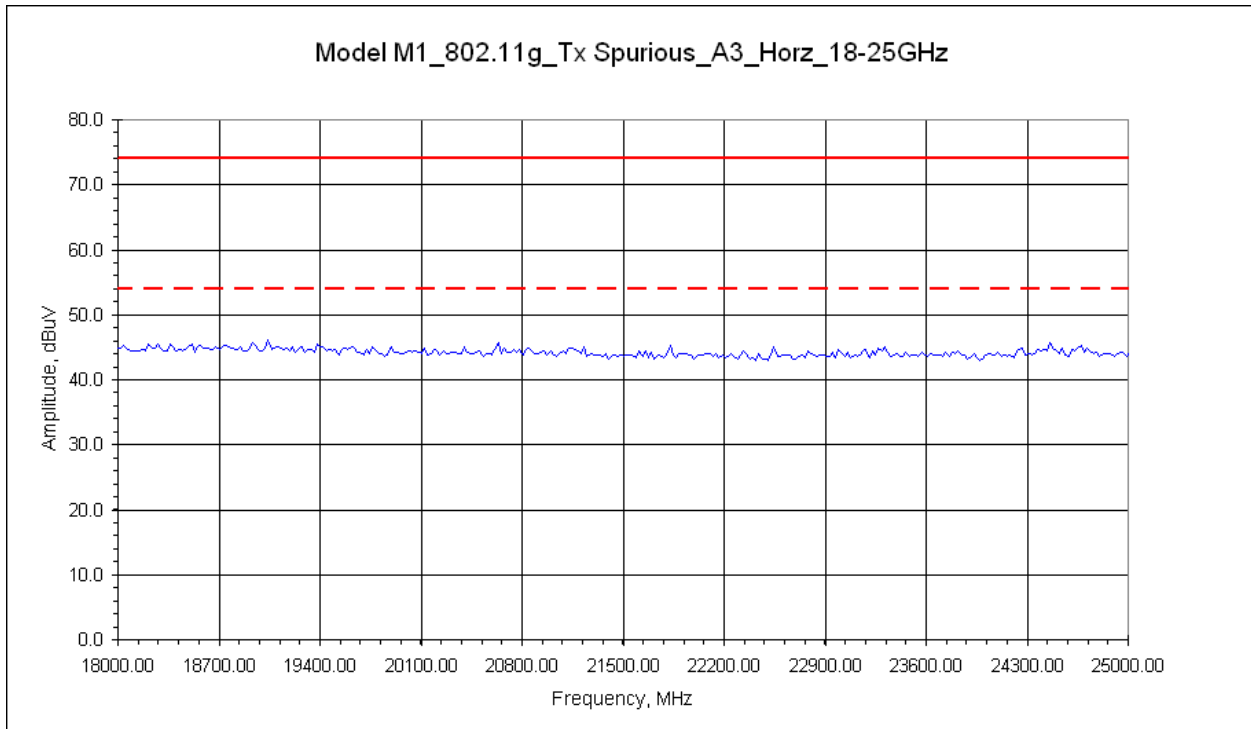
11.35 Plots: 802.11g Band

Vertical – Axis 3

18GHz to 25GHz



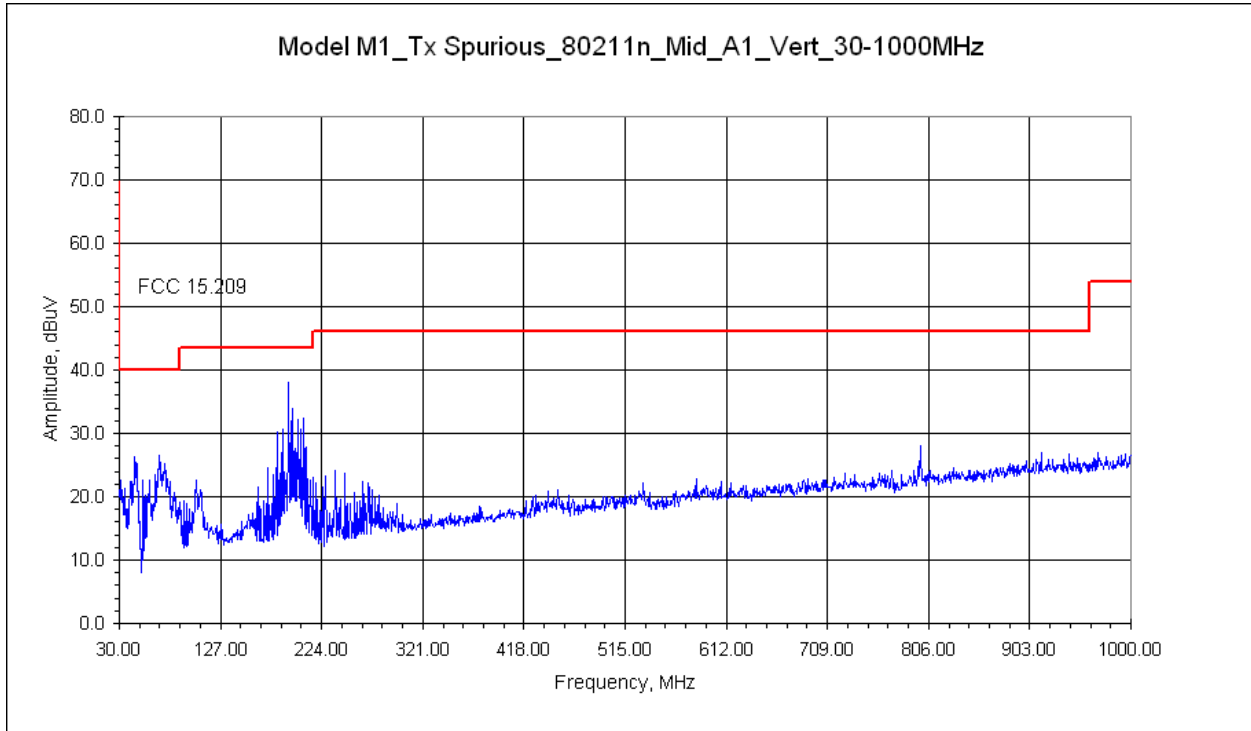
Horizontal – Axis 3



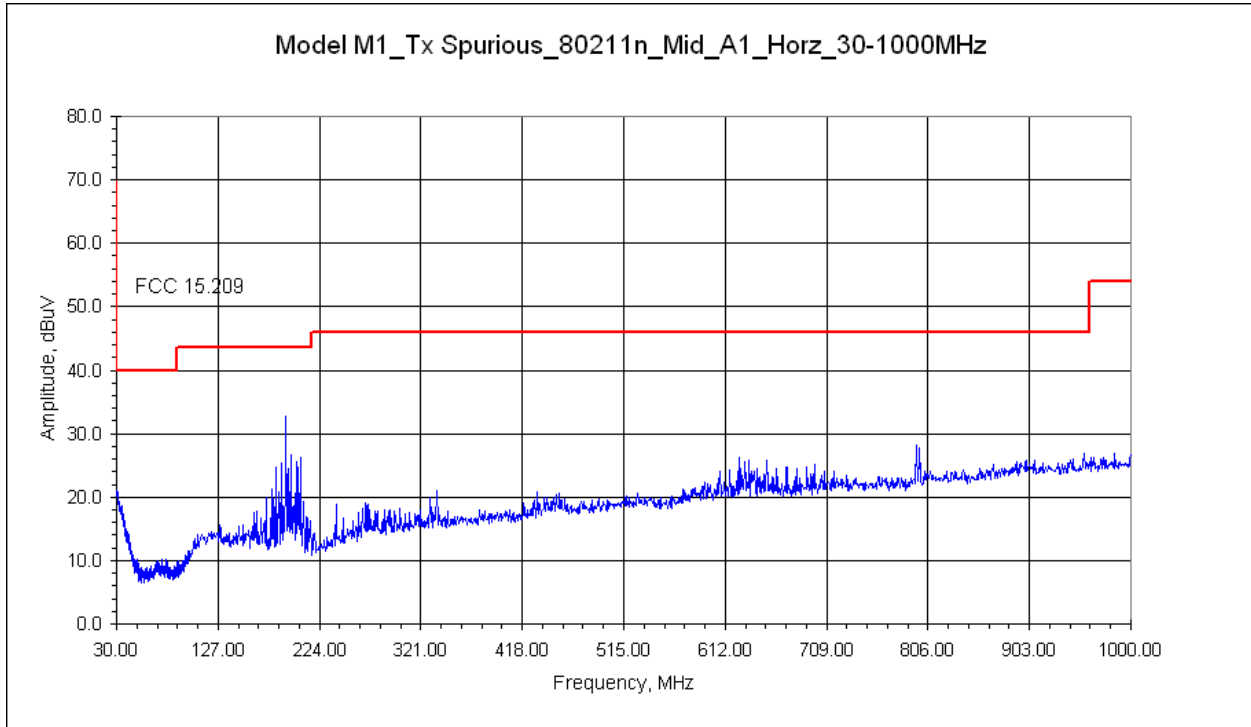
11.36 Plots: 802.11n HT20 Band

Vertical – Axis 1

30MHz to 1000MHz



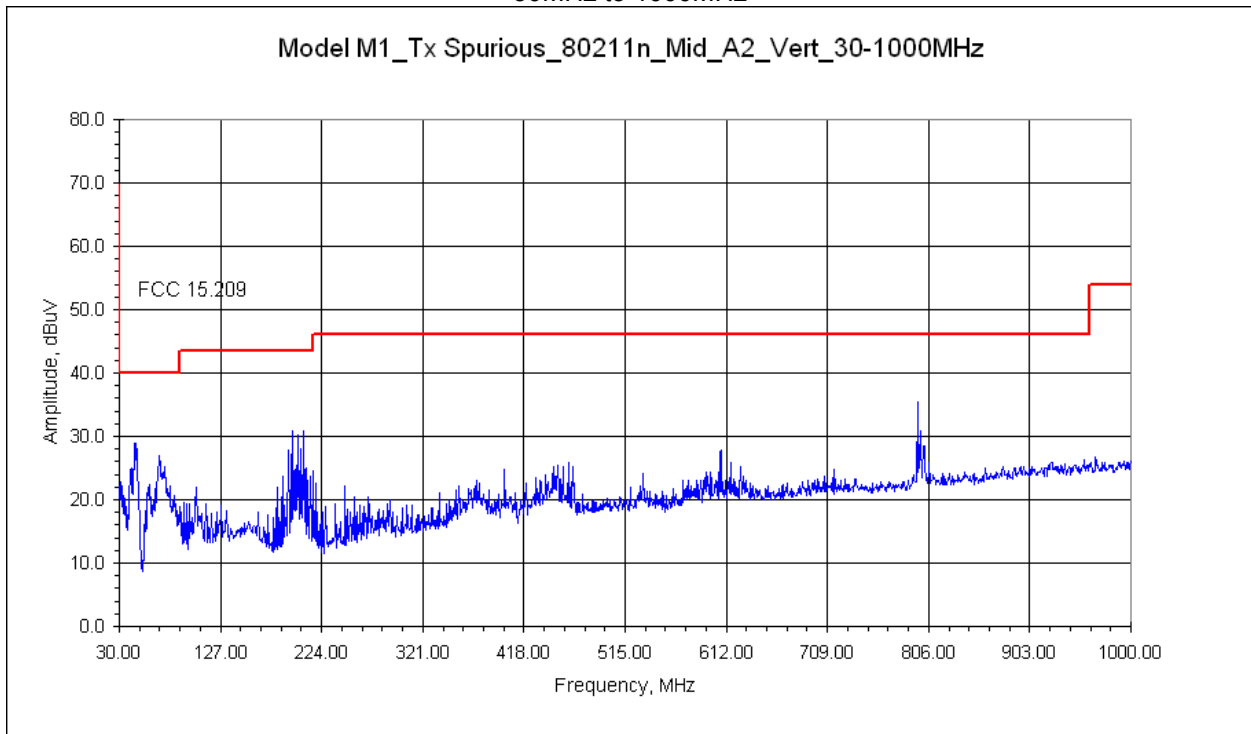
Horizontal – Axis 1



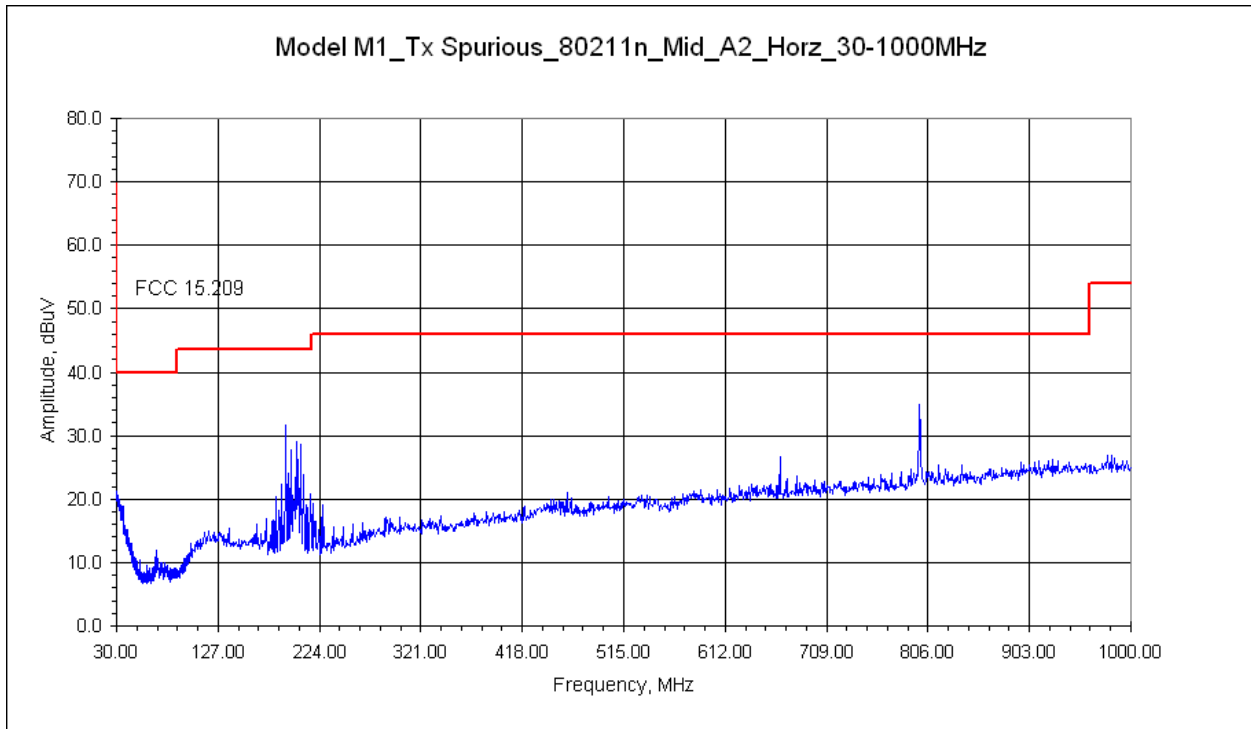
11.37 Plots: 802.11n HT20 Band

Vertical – Axis 2

30MHz to 1000MHz



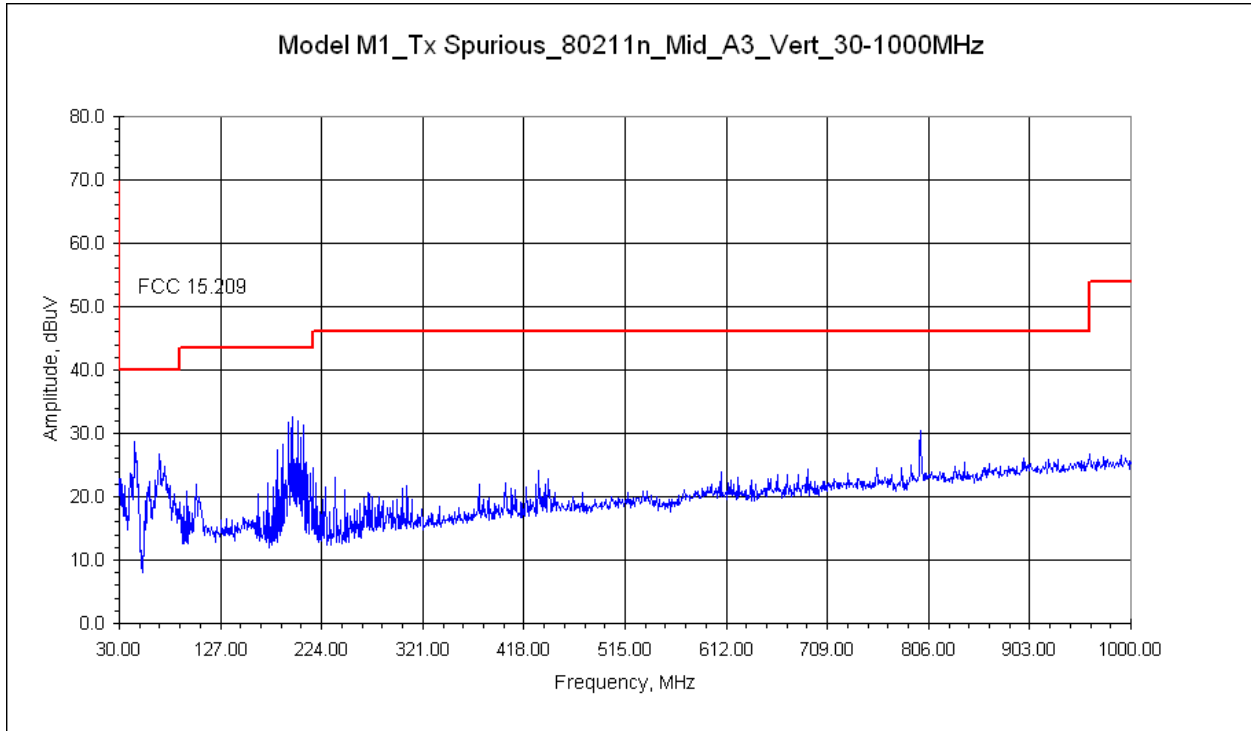
Horizontal – Axis 2



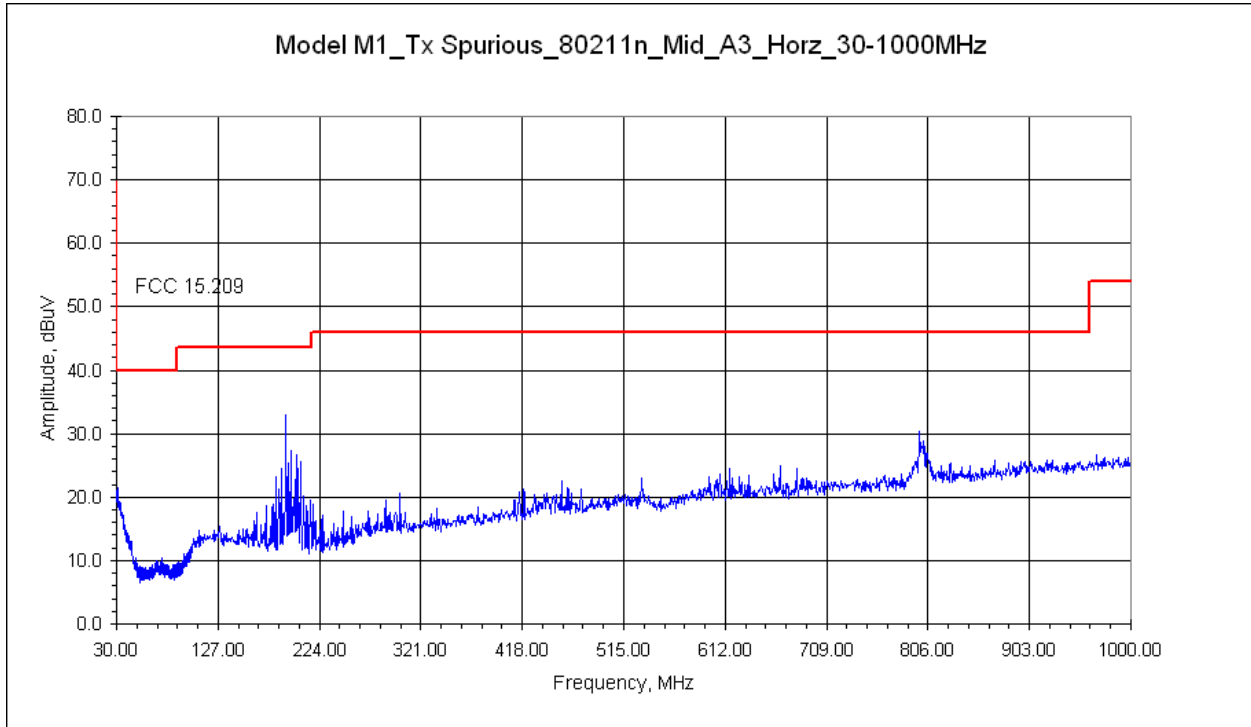
11.38 Plots: 802.11n HT20 Band

Vertical – Axis 3

30MHz to 1000MHz



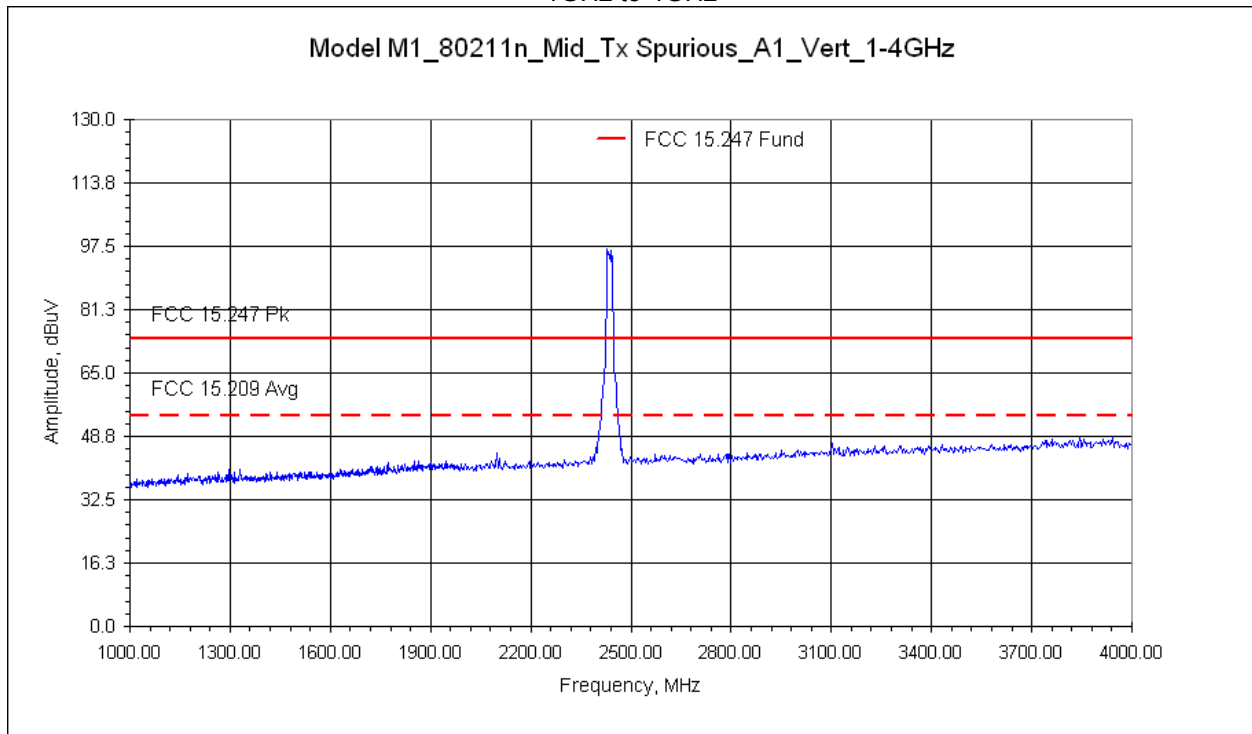
Horizontal – Axis 3



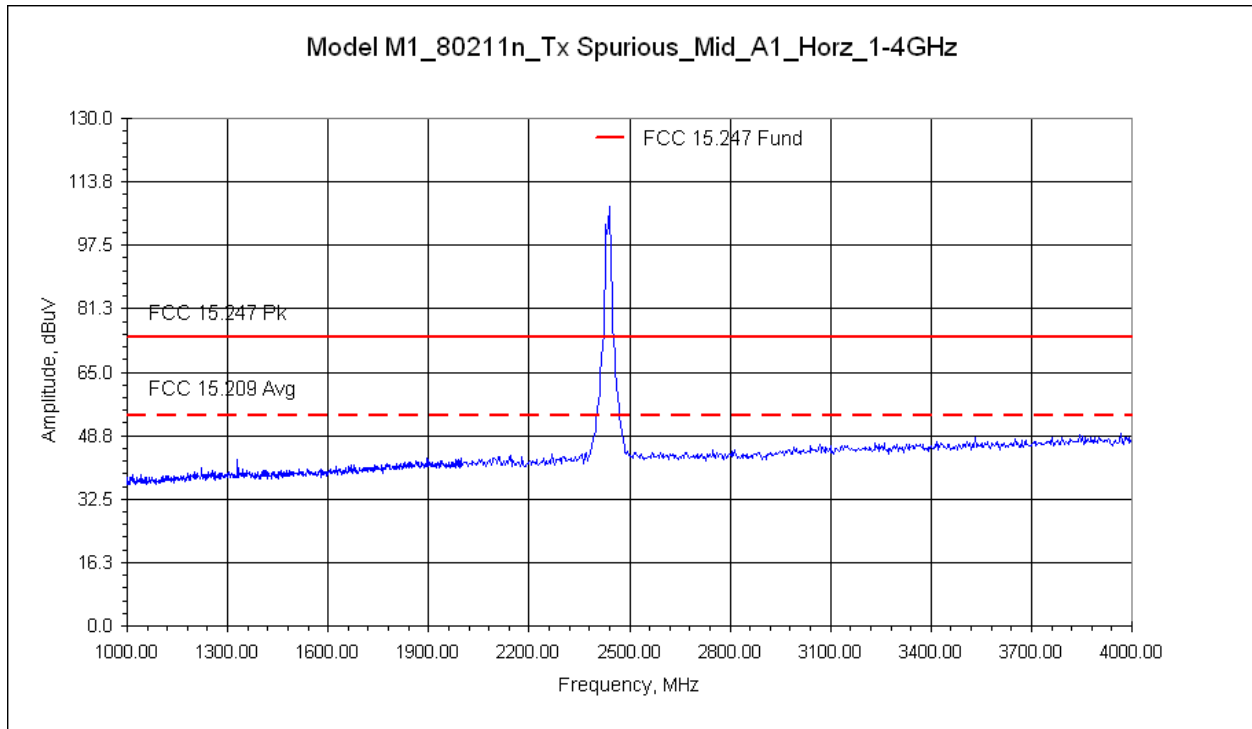
11.39 Plots: 802.11n HT20 Band

Vertical – Axis 1

1GHz to 4GHz



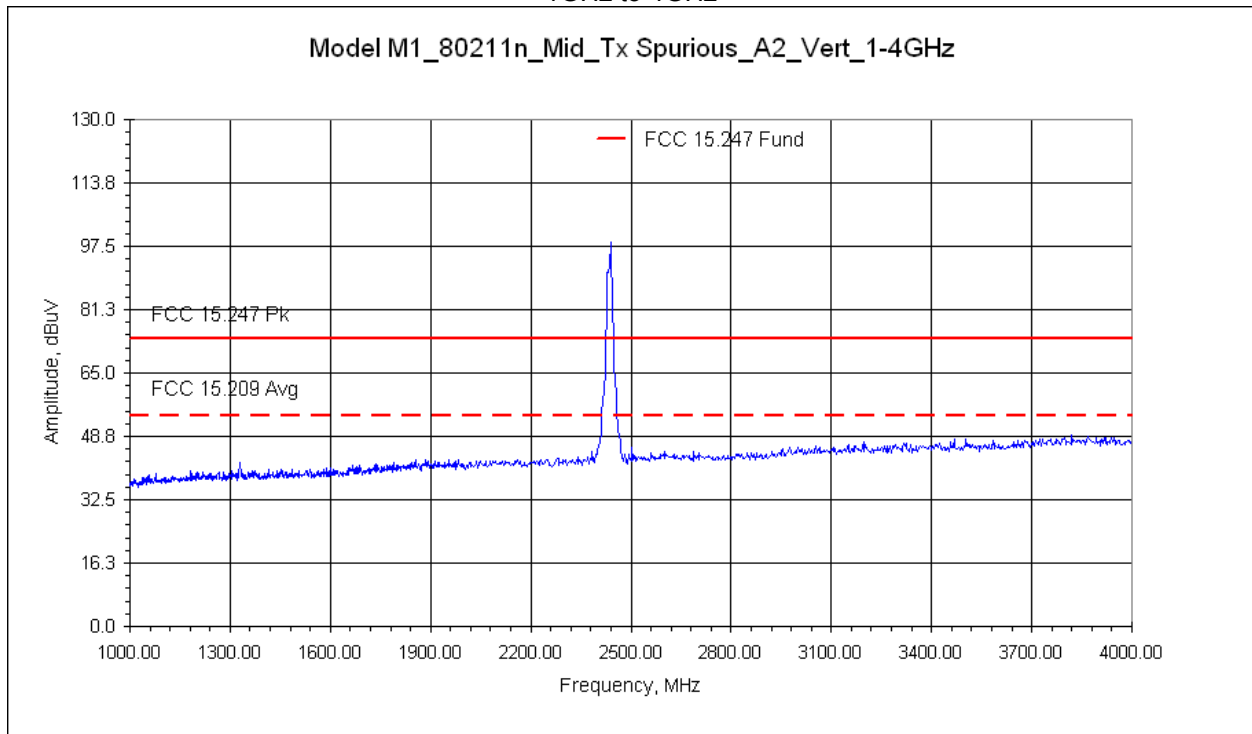
Horizontal – Axis 1



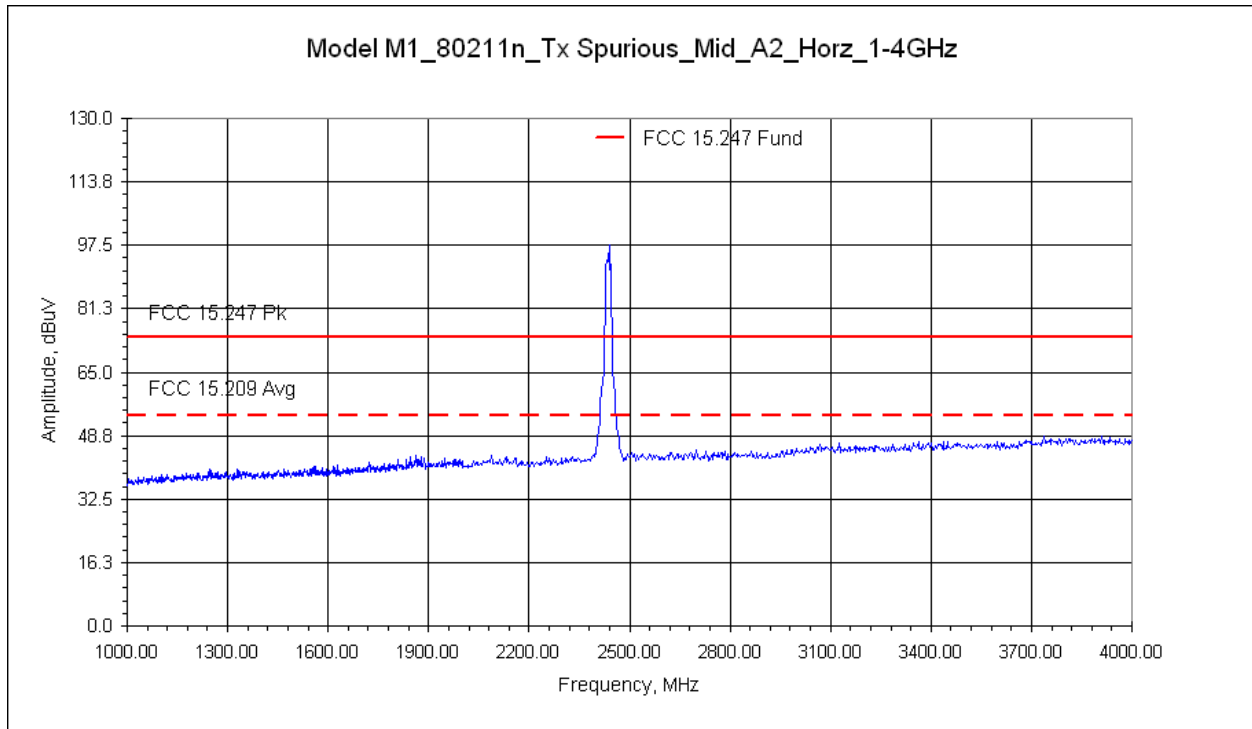
11.40 Plots: 802.11n HT20 Band

Vertical – Axis 2

1GHz to 4GHz



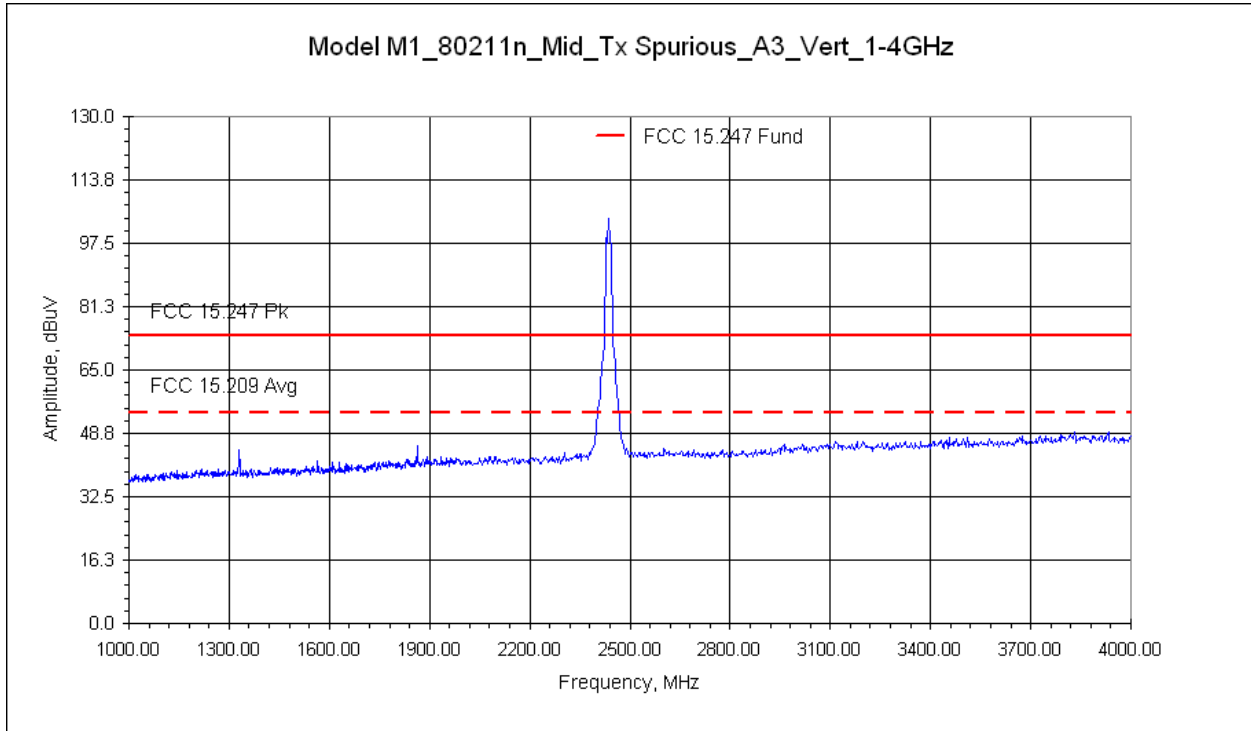
Horizontal – Axis 2



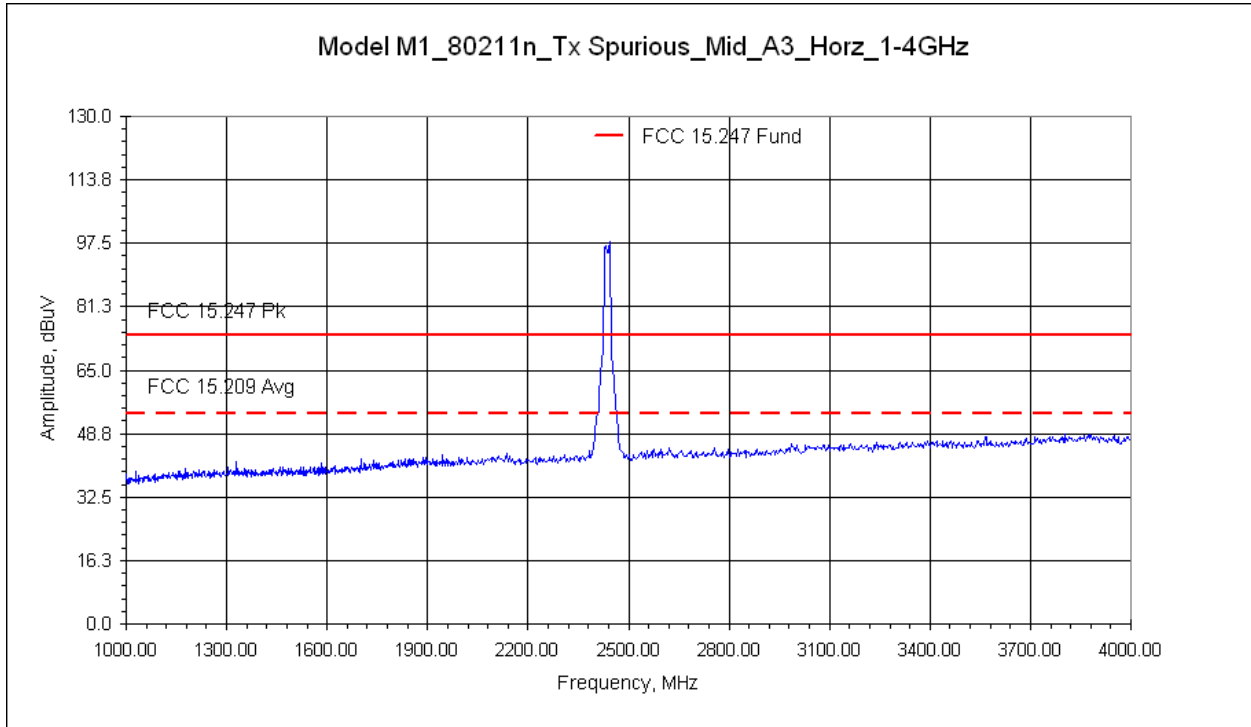
11.41 Plots: 802.11n HT20 Band

Vertical – Axis 3

1GHz to 4GHz



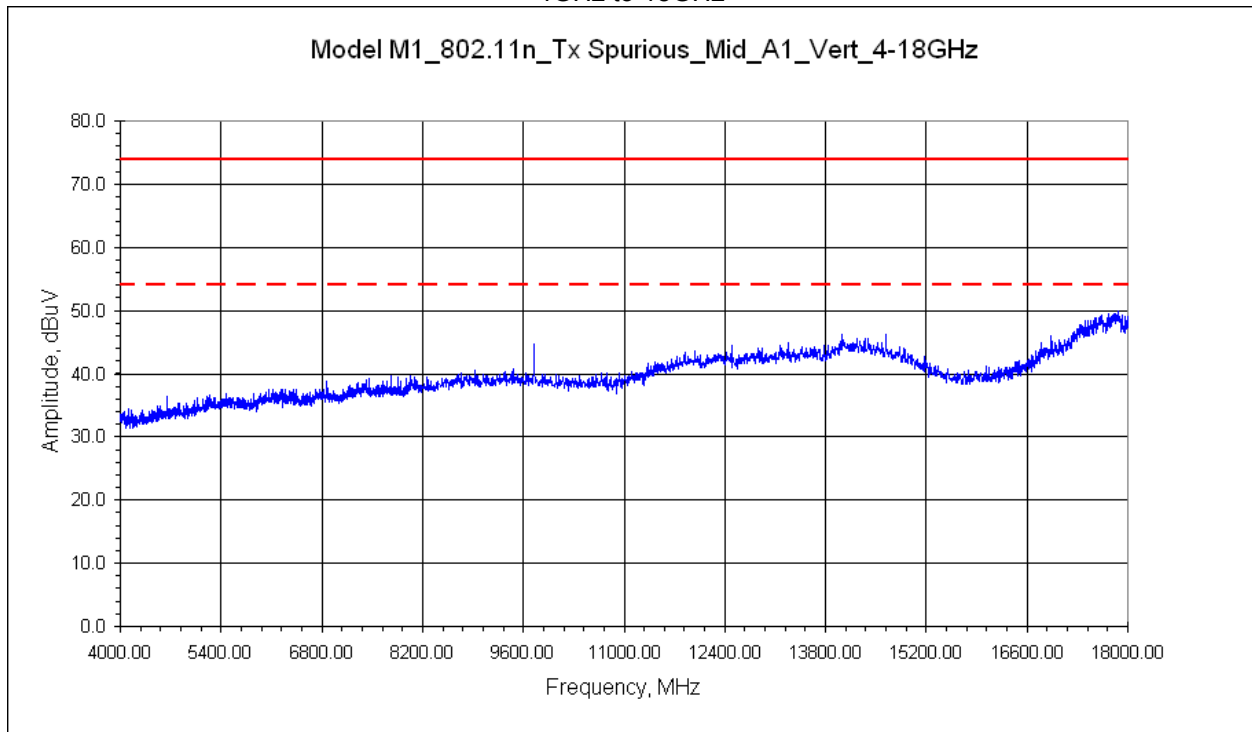
Horizontal – Axis 3



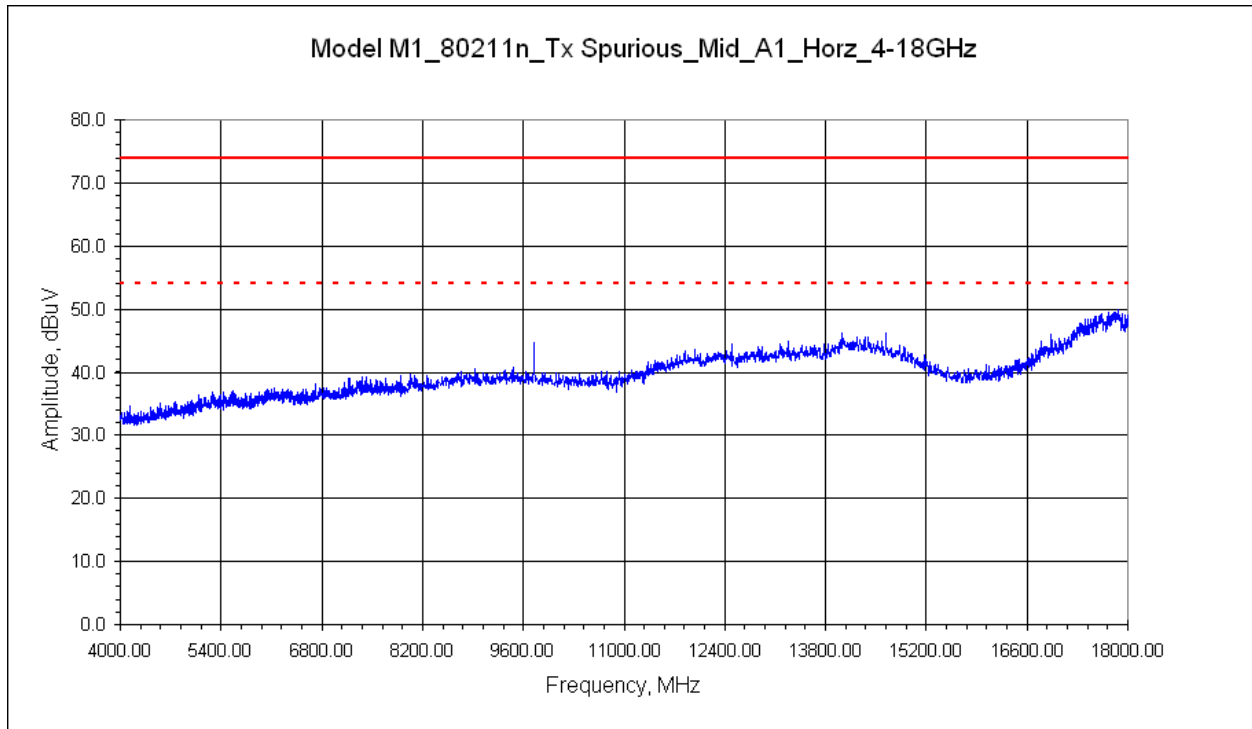
11.42 Plots: 802.11n HT20 Band

Vertical – Axis 1

4GHz to 18GHz



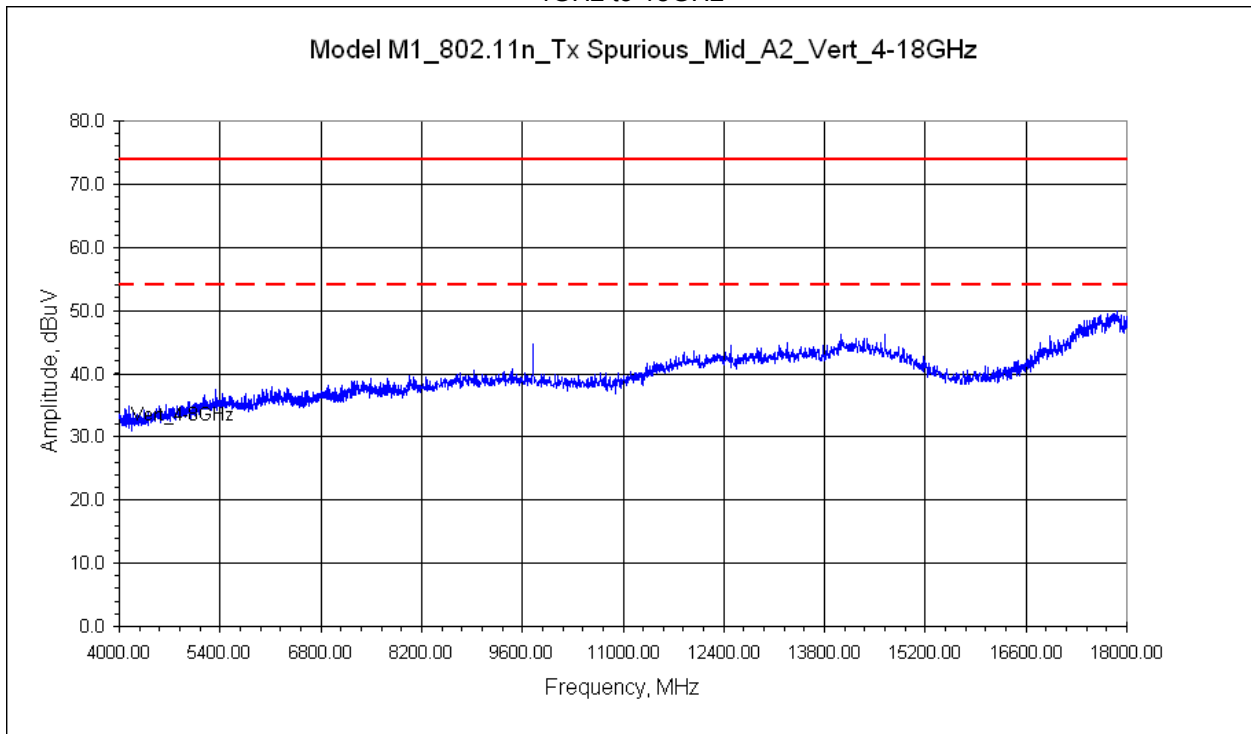
Horizontal – Axis 1



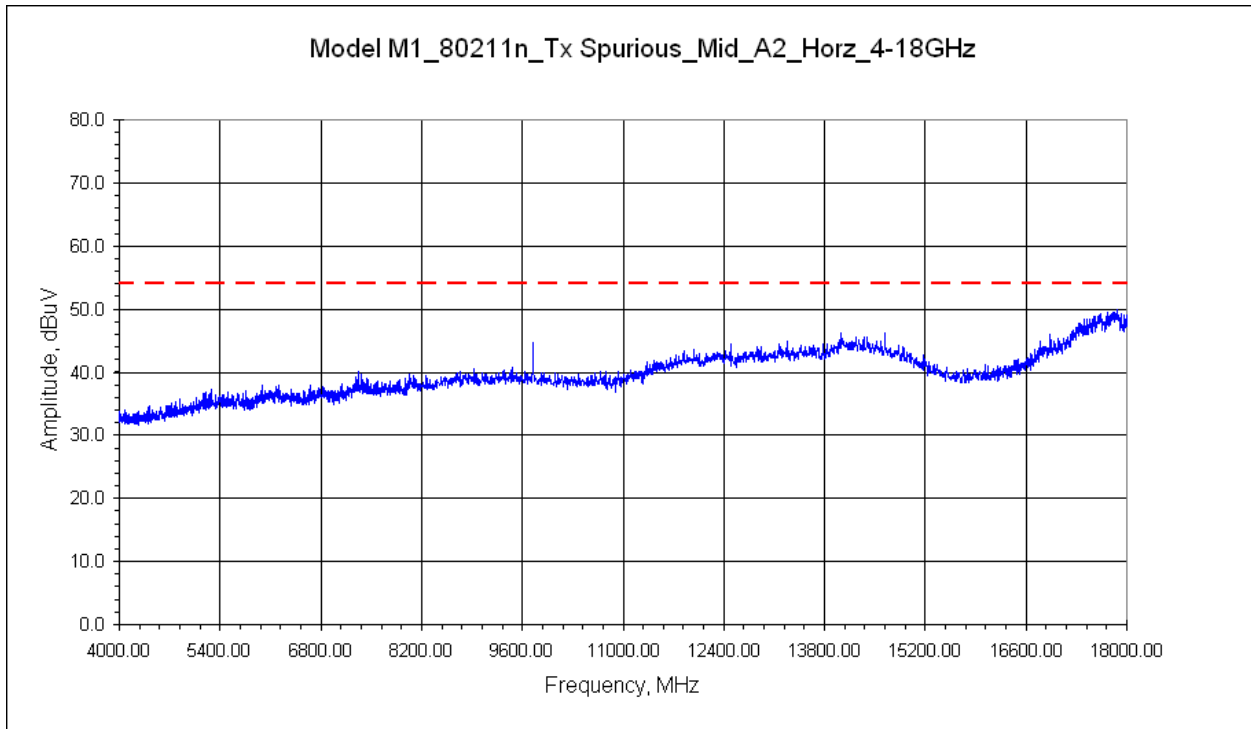
11.43 Plots: 802.11n HT20 Band

Vertical – Axis 2

4GHz to 18GHz



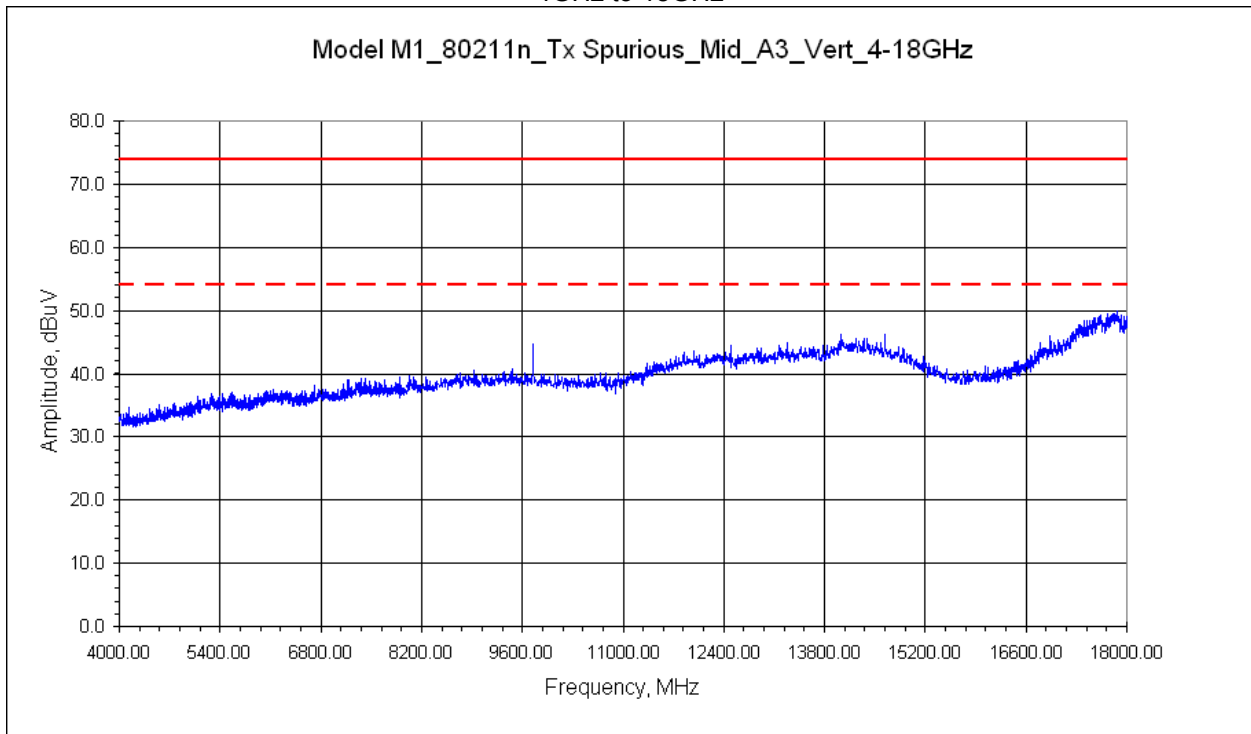
Horizontal – Axis 2



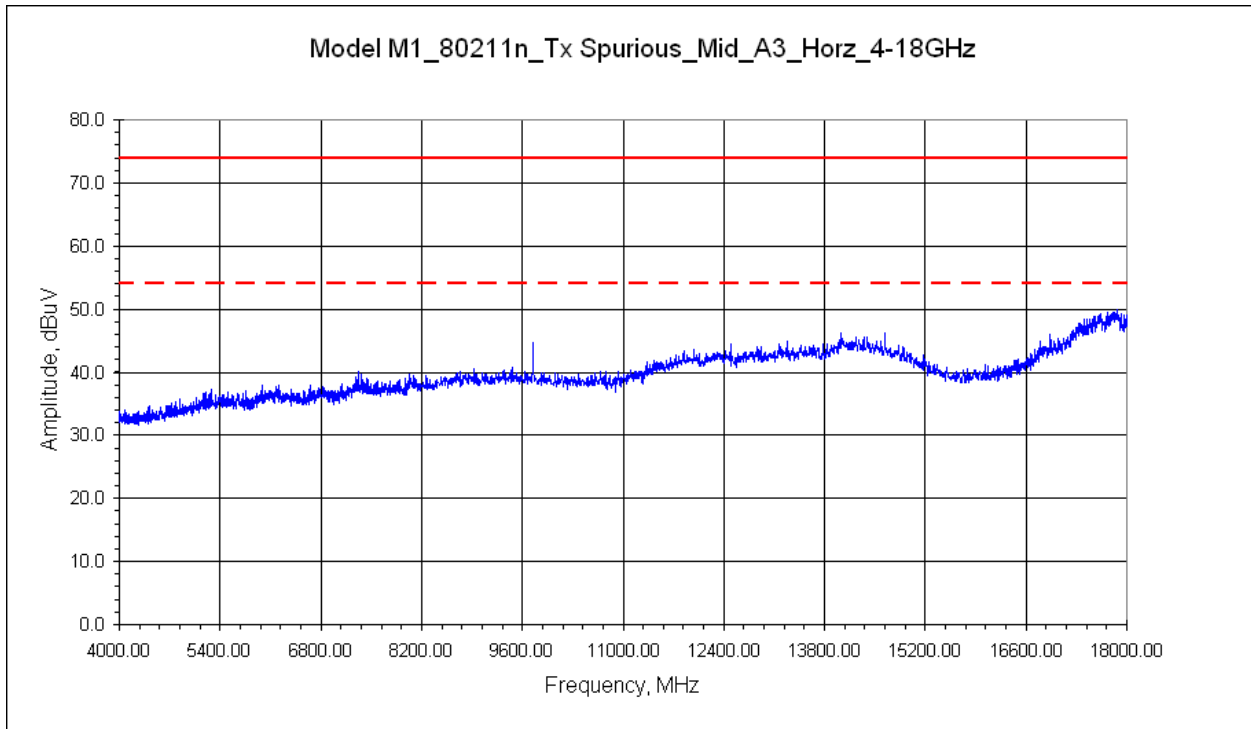
11.44 Plots: 802.11n HT20Band

Vertical – Axis 3

4GHz to 18GHz



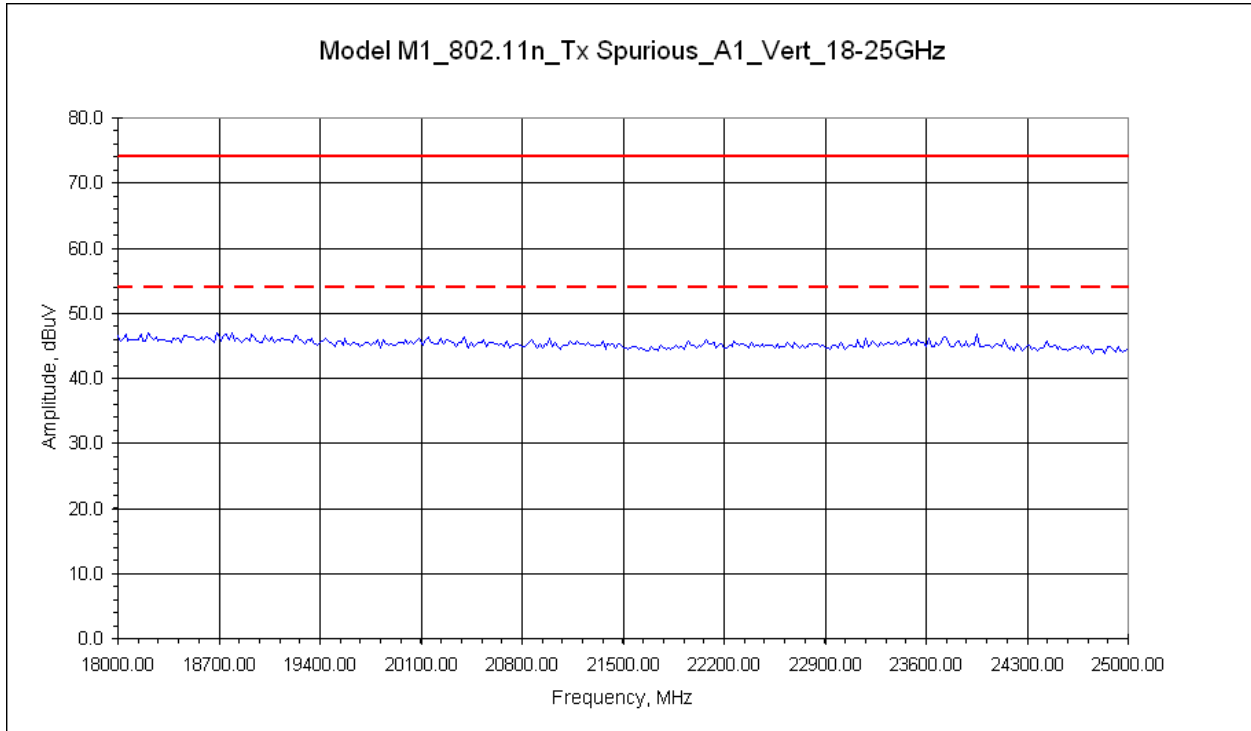
Horizontal – Axis 3



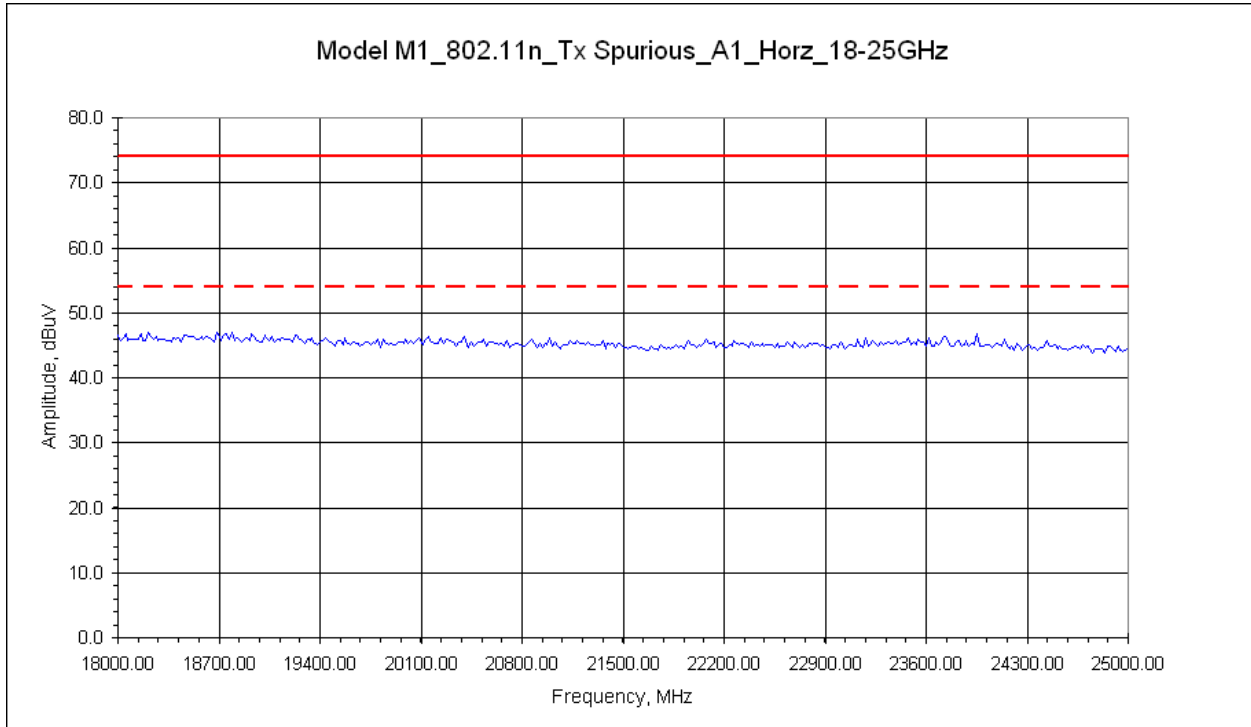
11.45 Plots: 802.11n HT20 Band

Vertical – Axis 1

18GHz to 25GHz



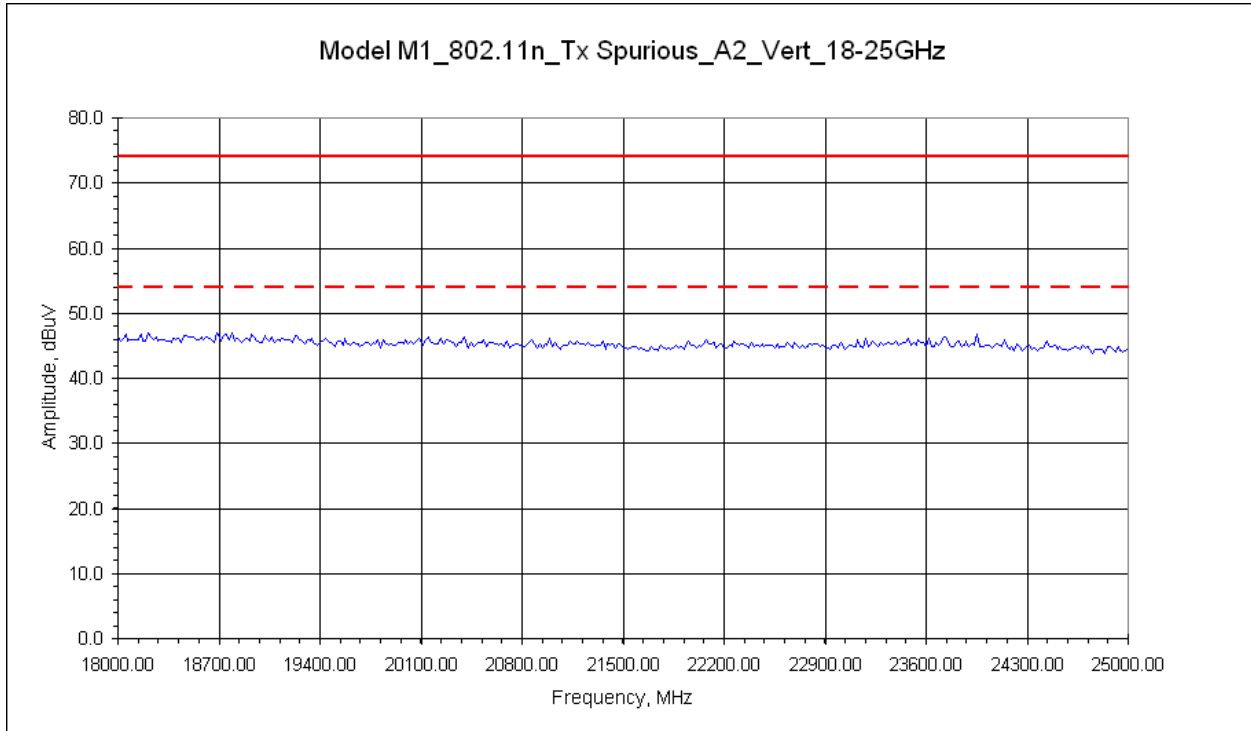
Horizontal – Axis 1



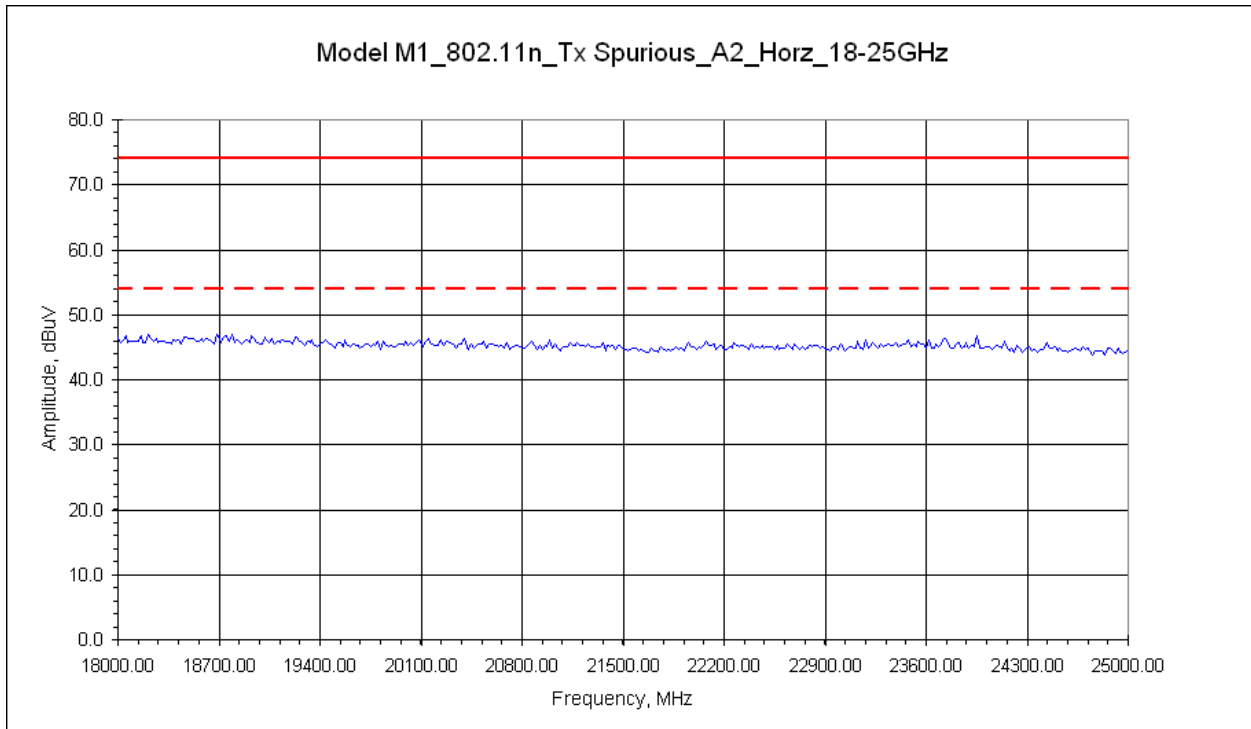
11.46 Plots: 802.11n HT20 Band

Vertical – Axis 2

18GHz to 25GHz



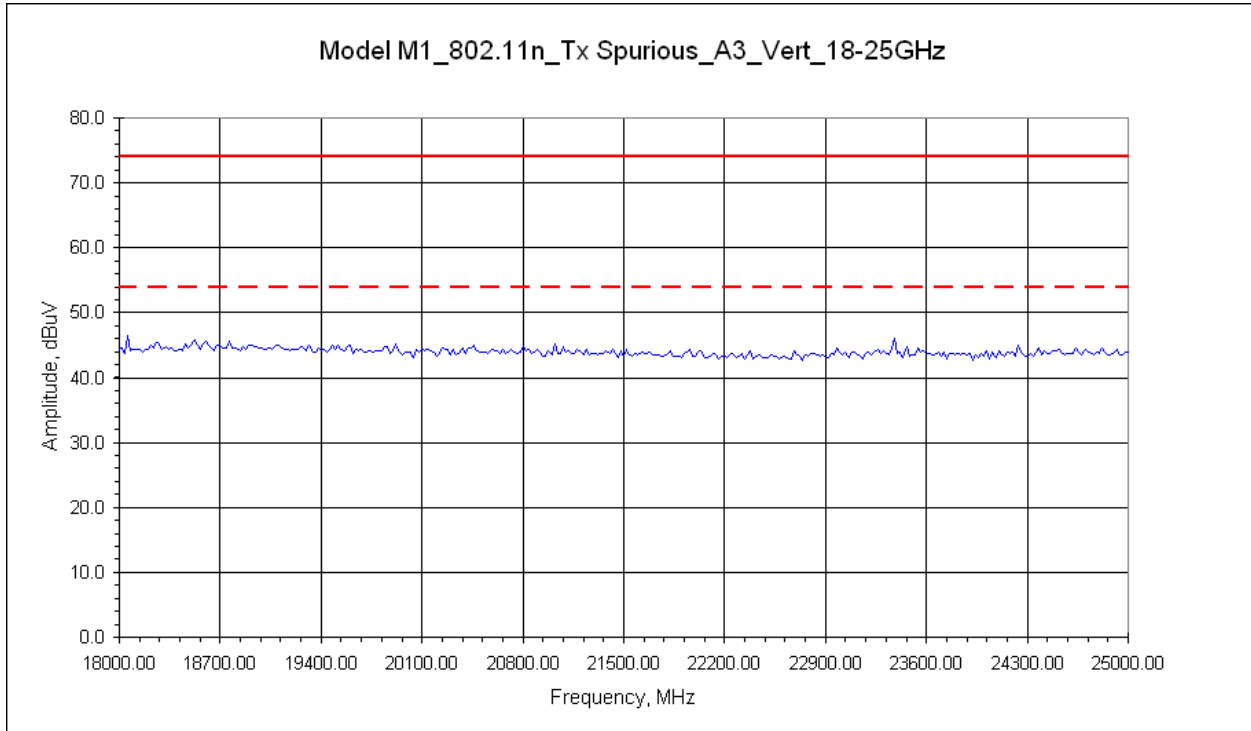
Horizontal – Axis 2



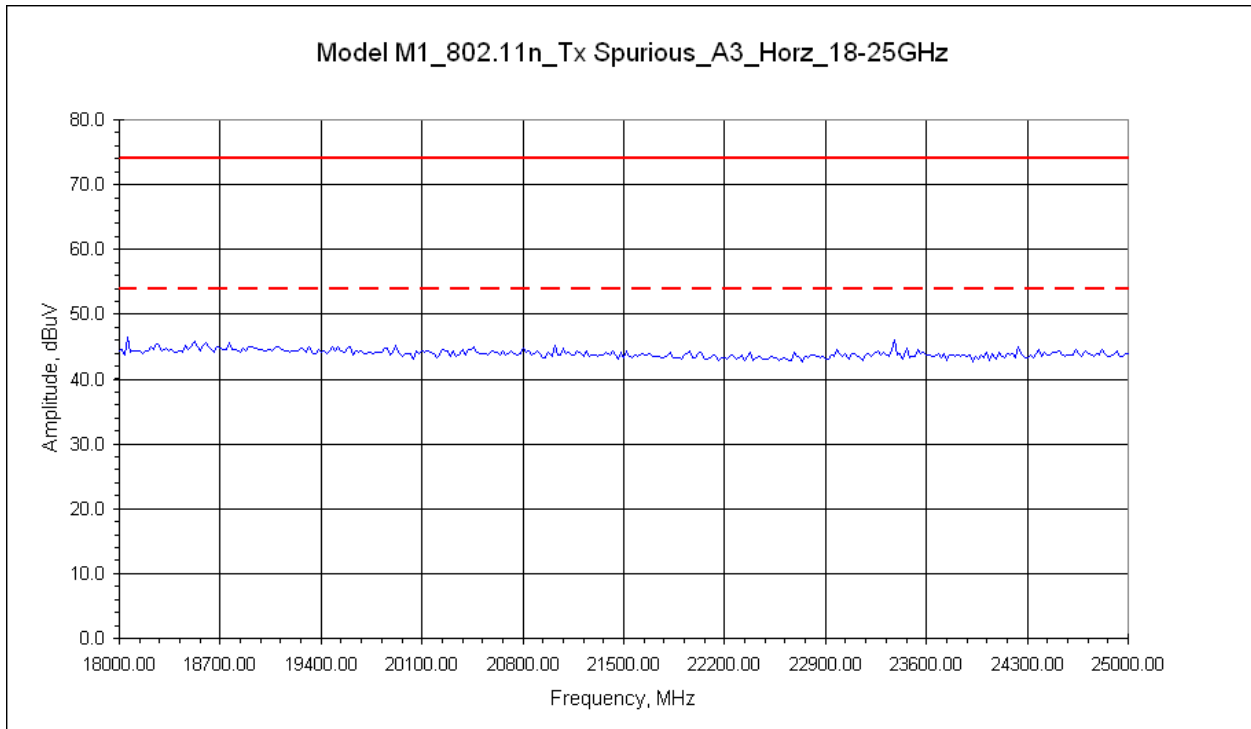
11.47 Plots: 802.11n HT20 Band

Vertical – Axis 3

18GHz to 25GHz



Horizontal – Axis 3



Intertek

Report Number: 101262612DEN-001B

Issued: 10/17/2013

11.48 Test Data: 802.11b Band

Tx Spurious Radiated Emissions – Including Restricted Band

Test Report #: G101262612	Test Area: CC1 Radiated	Temperature: <u>23.4</u> °C
Test Method: FCC 15.205/209	Test Date: <u>08/22/2013</u>	Relative Humidity: <u>33.5</u> %
EUT Model #: M1	EUT Power: <u>120V/ 60Hz</u>	Air Pressure: <u>82.7</u> kPa
EUT Serial #: FCC1		

Manufacturer: Revolv
 EUT Description: Revolv Hub – RF-enabled Home Automation wireless Hub
 Notes: Product transmitting continuously – WiFi Radio active – **802.11b**
 :
 Tx Spurious Radiated Emissions – including Restricted Band Harmonics

Level Key
Pk – Peak
Qp – Quasi Peak
Av - Average

Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Delta1	Delta2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.209 Qp	N/A	(MHz)
Measurements: Low Channel 30MHz to 1000MHz - Product Axis 1 (worst-case)													
68.5000	44.46	Qp	0.77	8.10	28.18	0.00	25.15	V	1.00	324.4	- 14.85	N/A	0.120
192.0000	48.42	Qp	0.92	11.60	27.59	0.00	33.35	V	1.00	149.0	- 10.17	N/A	0.120
192.0000	54.63	Qp	0.92	11.60	27.59	0.00	39.56	V	1.00	352.6	- 3.96	N/A	0.120
267.8564	34.83	Qp	1.11	13.21	27.31	0.00	21.85	V	1.19	337.0	- 24.17	N/A	0.120
286.8188	31.17	Qp	1.15	13.81	27.26	0.00	18.88	V	2.06	132.9	- 27.14	N/A	0.120
206.2500	46.97	Qp	0.96	11.17	27.53	0.00	31.57	V	1.09	336.8	- 11.95	N/A	0.120
797.8782	37.25	Qp	1.97	21.12	28.13	0.00	32.21	V	1.62	244.2	- 13.81	N/A	0.120
206.2500	45.20	Qp	0.96	11.17	27.53	0.00	29.80	V	1.62	244.2	- 13.72	N/A	0.120
206.2500	45.00	Qp	0.96	11.17	27.53	0.00	29.60	V	1.62	244.2	- 13.92	N/A	0.120
192.0000	45.24	Qp	0.92	11.60	27.59	0.00	30.17	H	2.28	63.9	- 13.35	N/A	0.120
Measurements: Mid Channel 30MHz to 1000MHz - Product Axis 1 (worst-case)													
68.7300	43.21	Qp	0.77	8.10	28.18	0.00	23.90	V	1.00	148.8	- 16.10	N/A	0.120
192.0000	50.73	Qp	0.92	11.60	27.59	0.00	35.66	V	1.00	35.1	- 7.86	N/A	0.120
206.2100	47.25	Qp	0.96	11.18	27.53	0.00	31.86	V	1.08	315.6	- 11.66	N/A	0.120
Measurements: High Channel 30MHz to 1000MHz - Product Axis 1 (worst-case)													
68.0000	41.11	Qp	0.77	8.10	28.18	0.00	21.80	V	1.00	254.8	- 18.20	N/A	0.120
192.0000	53.52	Qp	0.92	11.60	27.59	0.00	38.45	V	1.00	280.2	- 5.07	N/A	0.120
192.0000	53.16	Qp	0.92	11.60	27.59	0.00	38.09	V	1.00	103.2	- 5.43	N/A	0.120
206.2400	46.80	Qp	0.96	11.18	27.53	0.00	31.40	V	1.14	31.7	- 12.12	N/A	0.120

Intertek

Report Number: 101262612DEN-001B

Issued: 10/17/2013

Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Delta1	Delta2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.209 Average	FCC 15.35(b) Peak	(MHz)
Measurements: Mid Channel Above 1GHz - Product Axis 2 (worst-case)													
4874.0200	50.83	Pk	5.20	32.98	39.24	0.00	49.77	H	1.07	353.0	N/A	- 24.23	1.000
4874.0200	37.44	Av	5.20	32.98	39.24	0.00	36.38	H	1.07	353.0	- 17.62	NA	1.000
4874.0200	50.13	Pk	5.20	32.98	39.24	0.00	49.07	V	1.55	25.0	N/A	- 24.93	1.000
4874.0200	35.42	Av	5.20	32.98	39.24	0.00	34.36	V	1.55	25.0	- 19.64	NA	1.000
7311.0200	48.05	Pk	6.46	36.52	40.10	0.00	50.92	H	1.28	31.0	N/A	- 23.08	1.000
7311.0200	35.25	Av	6.46	36.52	40.10	0.00	38.12	H	1.28	31.0	- 15.88	NA	1.000

Intertek

Report Number: 101262612DEN-001B

Issued: 10/17/2013

11.49 Test Data: 802.11g Band

Tx Spurious Radiated Emissions – Including Restricted Band

Test Report #: G101262612	Test Area: CC1 Radiated	Temperature: <u>23.4</u> °C
Test Method: FCC 15.205/209	Test Date: <u>08/22/2013</u>	Relative Humidity: <u>33.5</u> %
EUT Model #: M1	EUT Power: <u>120V/ 60Hz</u>	Air Pressure: <u>82.7</u> kPa

EUT Serial #: FCC1

Manufacturer: Revolv

EUT Description: Revolv Hub – RF-enabled Home Automation wireless Hub

Notes: Product transmitting continuously – WiFi Radio active – **802.11g**

Tx Spurious Radiated Emissions – including Restricted Band Harmonics

Level Key

Pk – Peak

Qp – Quasi Peak

Av – Average

Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Delta1	Delta2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.209 Qp	N/A	(MHz)
Measurements: Mid Channel 30MHz to 1000MHz - Product Axis 1 (worst-case)													
45.0400	42.45	Qp	0.77	10.48	28.26	0.00	25.44	V	1.00	24.2	- 14.56	N/A	0.120
68.7479	42.98	Qp	0.77	8.10	28.18	0.00	23.67	V	1.00	344.7	- 16.33	N/A	0.120
192.0200	55.29	Qp	0.92	11.60	27.59	0.00	40.22	V	1.07	90.1	- 3.30	N/A	0.120
797.7564	36.17	Qp	1.97	21.11	28.13	0.00	31.12	V	1.76	252.8	- 14.90	N/A	0.120
797.7364	37.76	Qp	1.97	21.11	28.13	0.00	32.71	H	2.08	126.3	- 13.31	N/A	0.120
Measurements Above 1GHz: No significant signals found – refer to pre-scan plots													

Intertek

Report Number: 101262612DEN-001B

Issued: 10/17/2013

11.50 Test Data: 802.11n HT20 Band

Tx Spurious Radiated Emissions (Including Restricted Bands)

Test Report #: G101262612	Test Area: CC1 Radiated	Temperature: <u>23.4</u> °C
Test Method: FCC 15.205/209	Test Date: <u>08/22/2013</u>	Relative Humidity: <u>33.5</u> %
EUT Model #: M1	EUT Power: <u>120V/ 60Hz</u>	Air Pressure: <u>82.7</u> kPa
EUT Serial #: FCC1		

Manufacturer: Revolv

EUT Description: Revolv Hub – RF-enabled Home Automation wireless Hub

Notes: Product transmitting continuously – WiFi Radio active – **802.11n**

Tx Spurious Radiated Emissions – including Restricted Band Harmonics

Level Key

Pk – Peak
Qp – Quasi Peak
Av - Average

Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Delta1	Delta2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.209 Qp	N/A	(MHz)
Measurements: Low Channel 30MHz to 1000MHz - Product Axis 1 (worst-case)													
45.0421	43.47	Qp	0.77	10.48	28.26	0.00	26.46	V	1.00	341.2	- 13.54	N/A	0.120
68.3141	42.78	Qp	0.77	8.10	28.18	0.00	23.47	V	1.00	91.9	- 16.53	N/A	0.120
192.0277	52.79	Qp	0.92	11.60	27.59	0.00	37.72	V	1.00	206.2	- 5.80	N/A	0.120
795.2267	33.56	Qp	1.97	21.01	28.14	0.00	28.40	H	2.23	341.5	- 17.62	N/A	0.120
45.0421	43.47	Qp	0.77	10.48	28.26	0.00	26.46	V	1.00	341.2	- 13.54	N/A	0.120
Measurements Above 1GHz: No significant signals found – refer to pre-scan plots													

Example calculation:

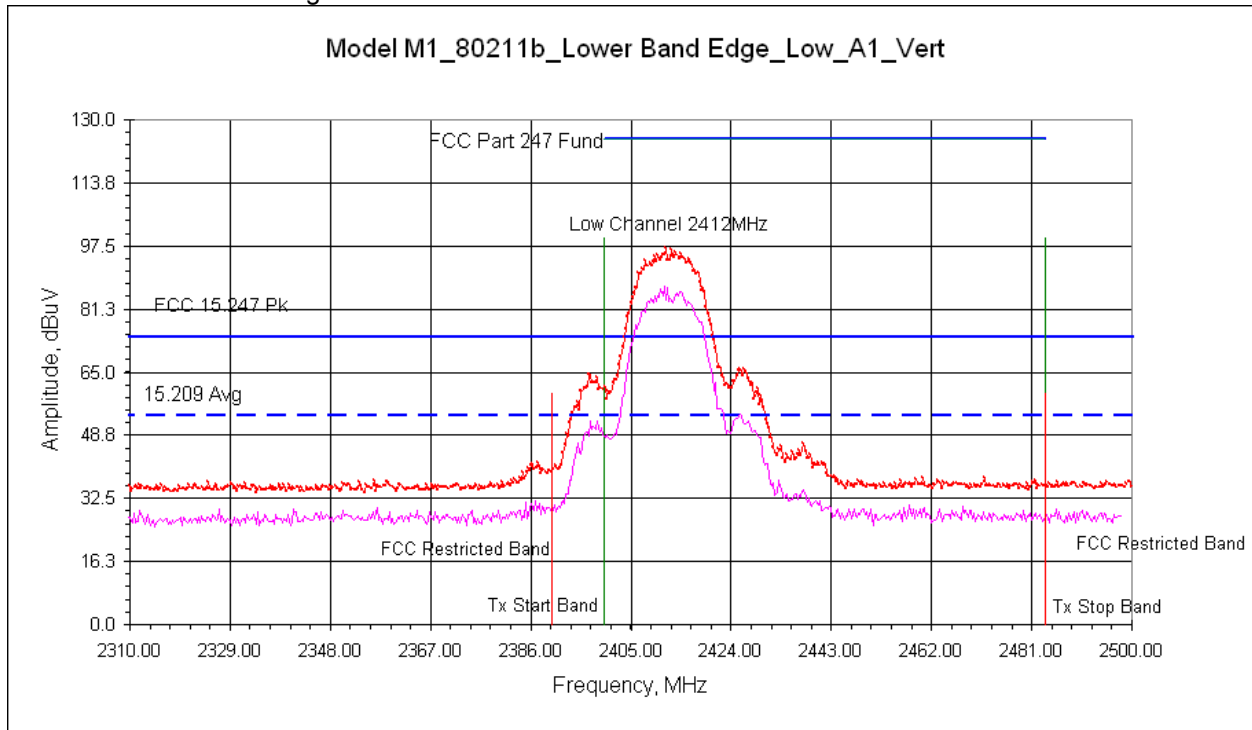
Measured Level	+	Transducer, Cable Loss & Amplifier corrections	=	Corrected Reading	Specification Limit	-	Corrected Reading	=	Delta Specification
(dBμV)		(dB)		(dBμV/m)	(dBμV/m)		(dBμV/m)		
14.0		14.9		28.9	40.0		28.9		-11.1

Notes: Only significant signals – as determined from plots – were measured.

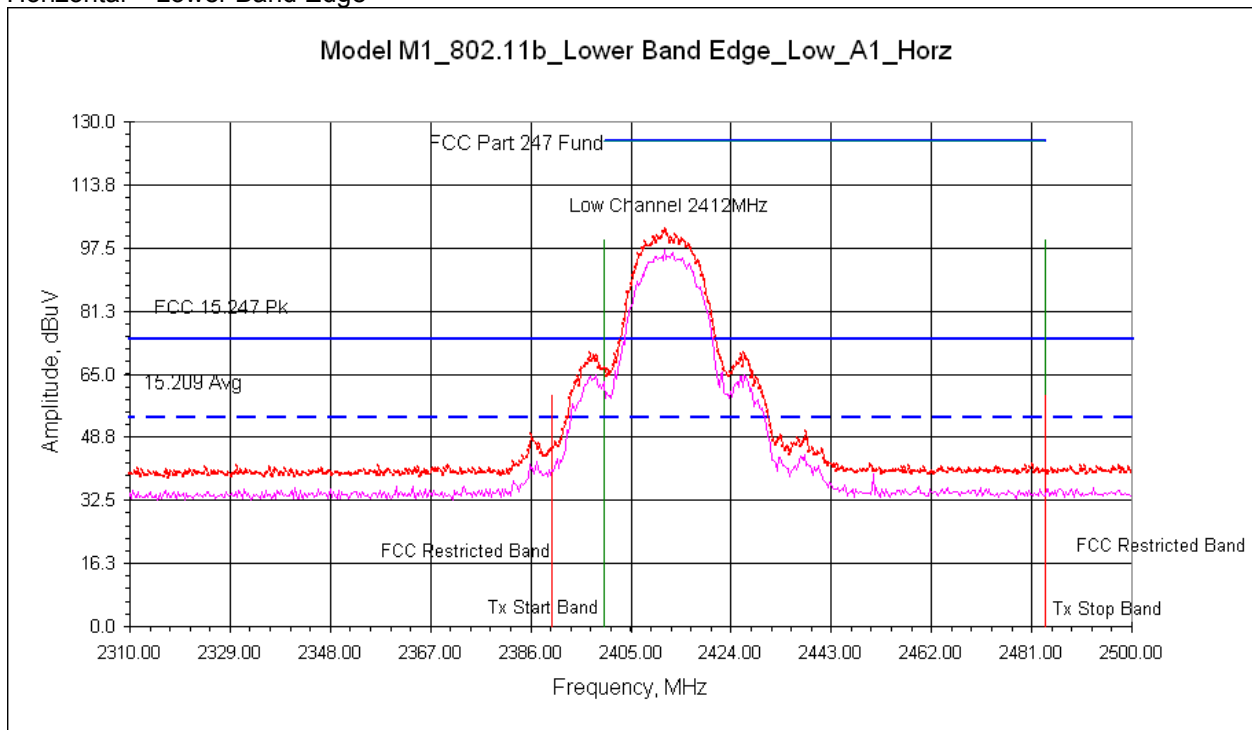
Deviations, Additions, or Exclusions: None

11.51 Band Edge Plots: 802.11b Band

Vertical – Lower Band Edge



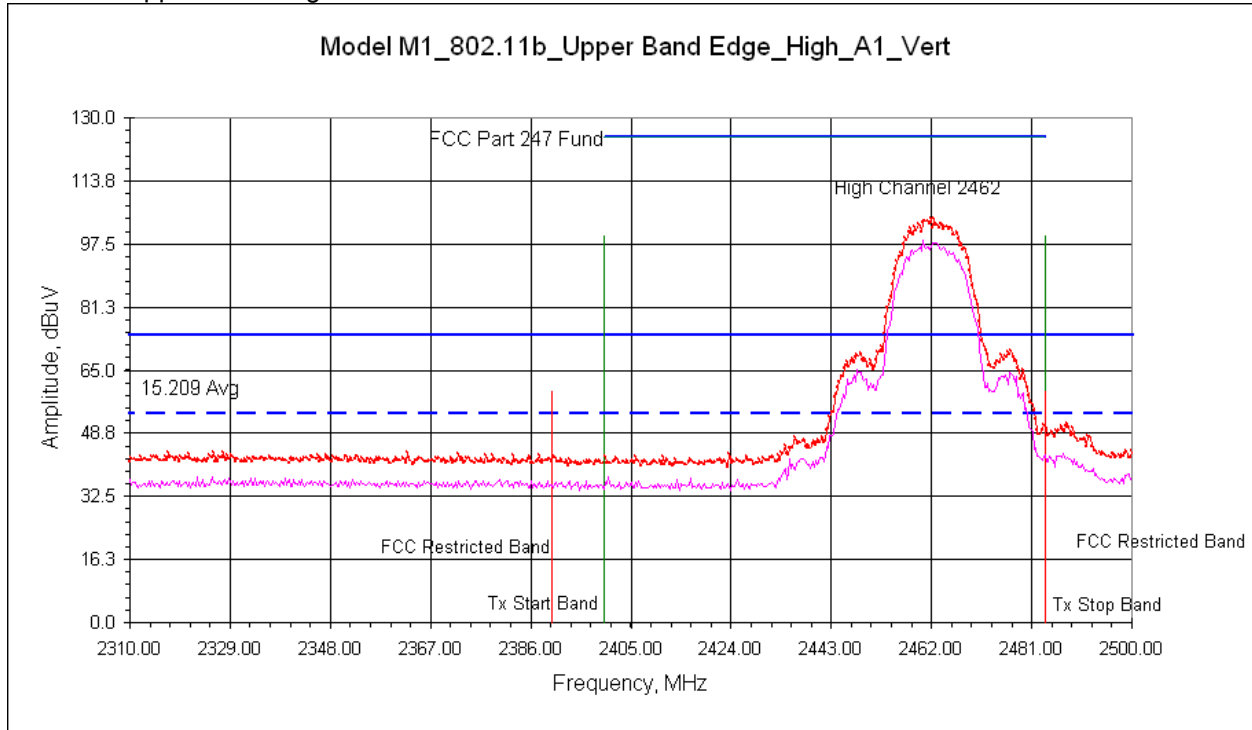
Horizontal – Lower Band Edge



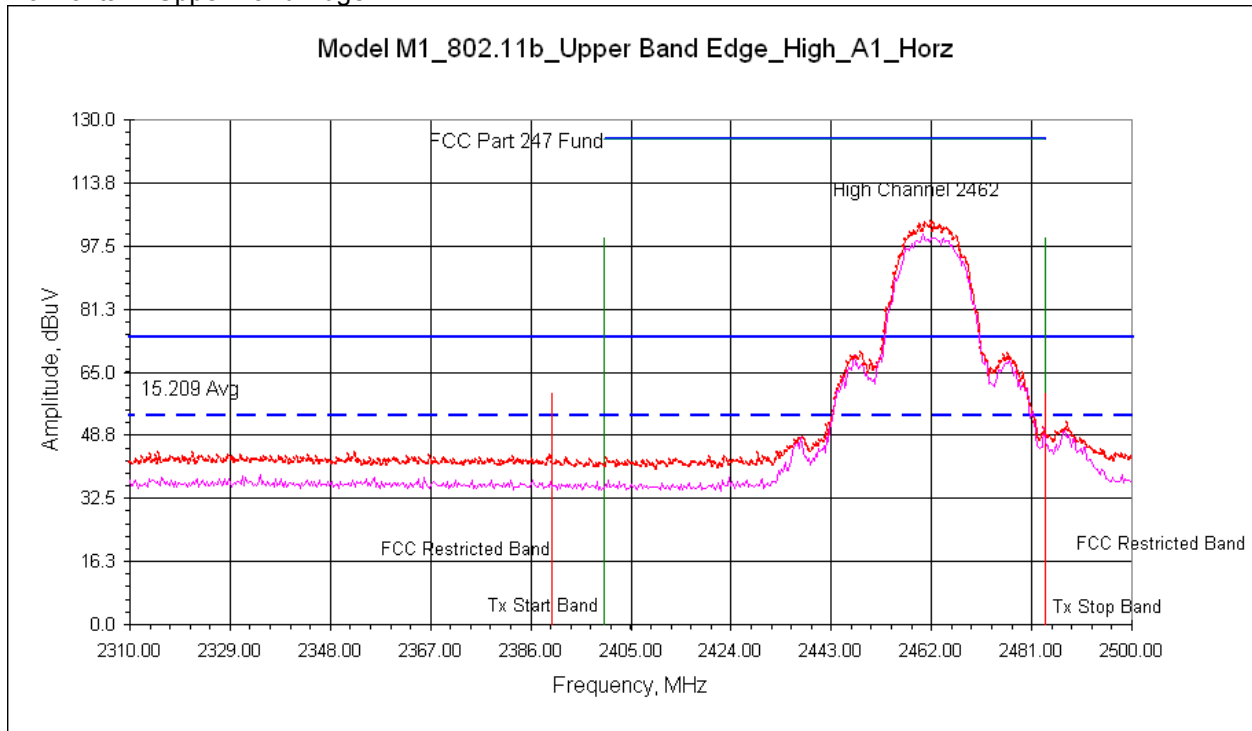
Legend: Green Vertical Lines (Tx allowable start/stop band)
 Red Vertical Lines (Restricted Band start/stop)
 Magenta Trace (Average trace line)
 Red Trace (Peak trace line)
 Blue Limit Lines (solid line = peak limit, dashed = average limit)

11.52 Band Edge Plots: 802.11b Band

Vertical – Upper Band Edge



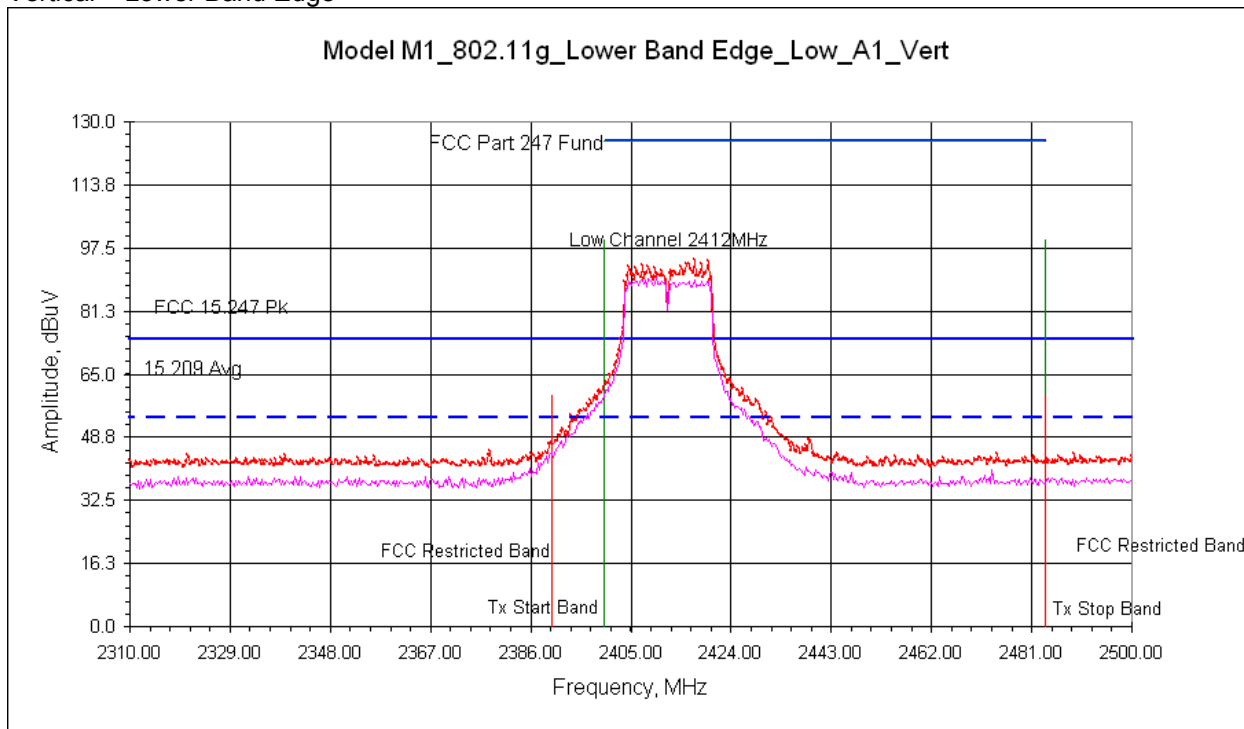
Horizontal – Upper Band Edge



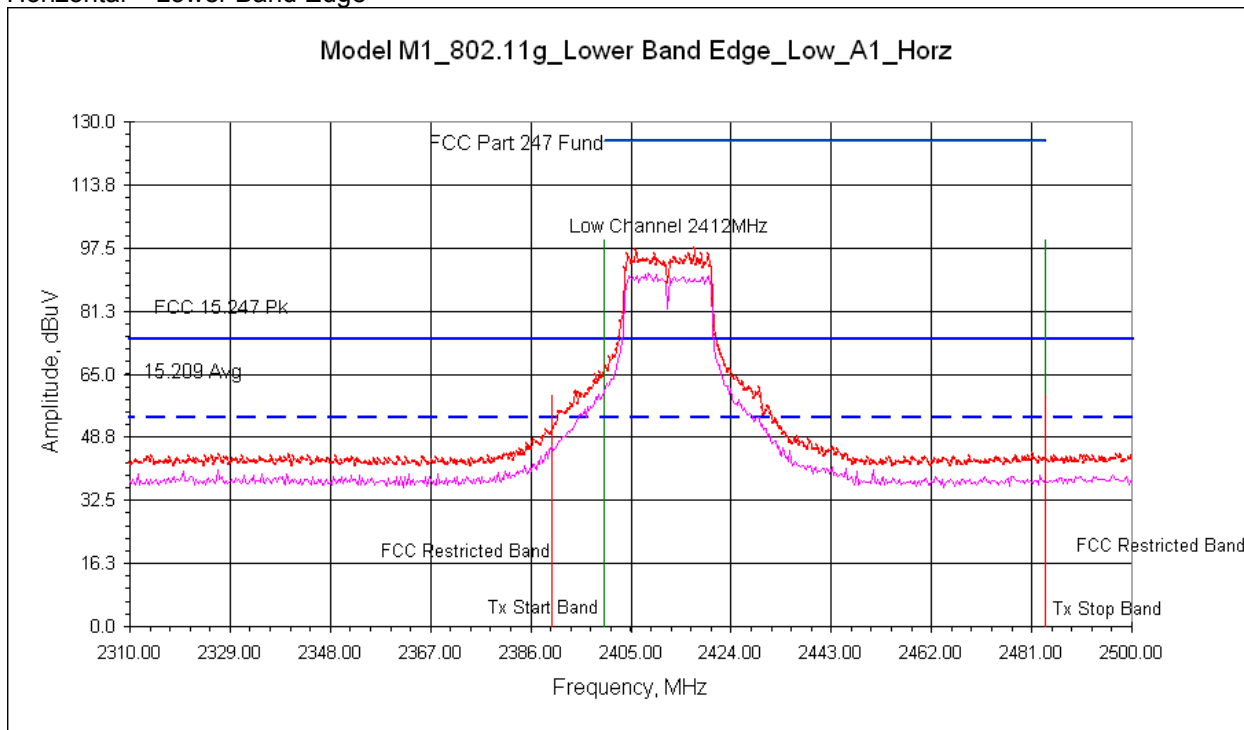
Legend: Green Vertical Lines (Tx allowable start/stop band)
Red Vertical Lines (Restricted Band start/stop)
Magenta Trace (Average trace line)
Red Trace (Peak trace line)
Blue Limit Lines (solid line = peak limit, dashed = average limit)

11.53 Band Edge Plots: 802.11g Band

Vertical – Lower Band Edge



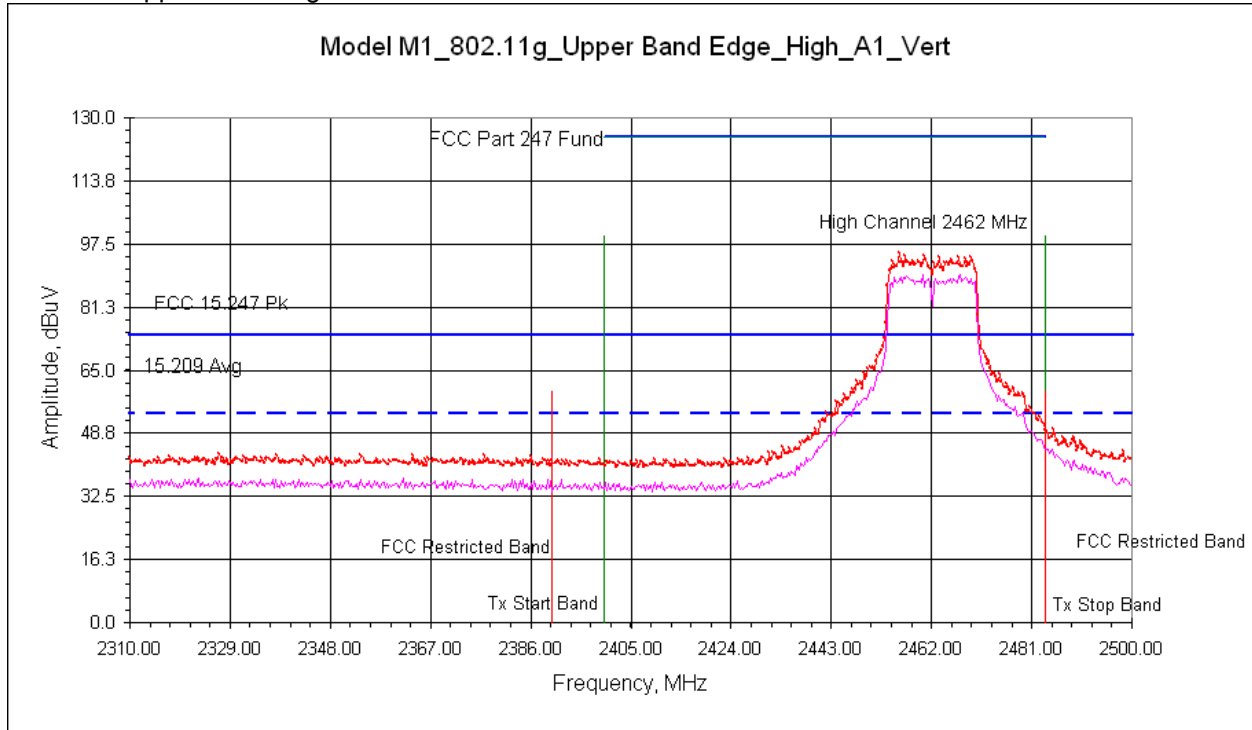
Horizontal – Lower Band Edge



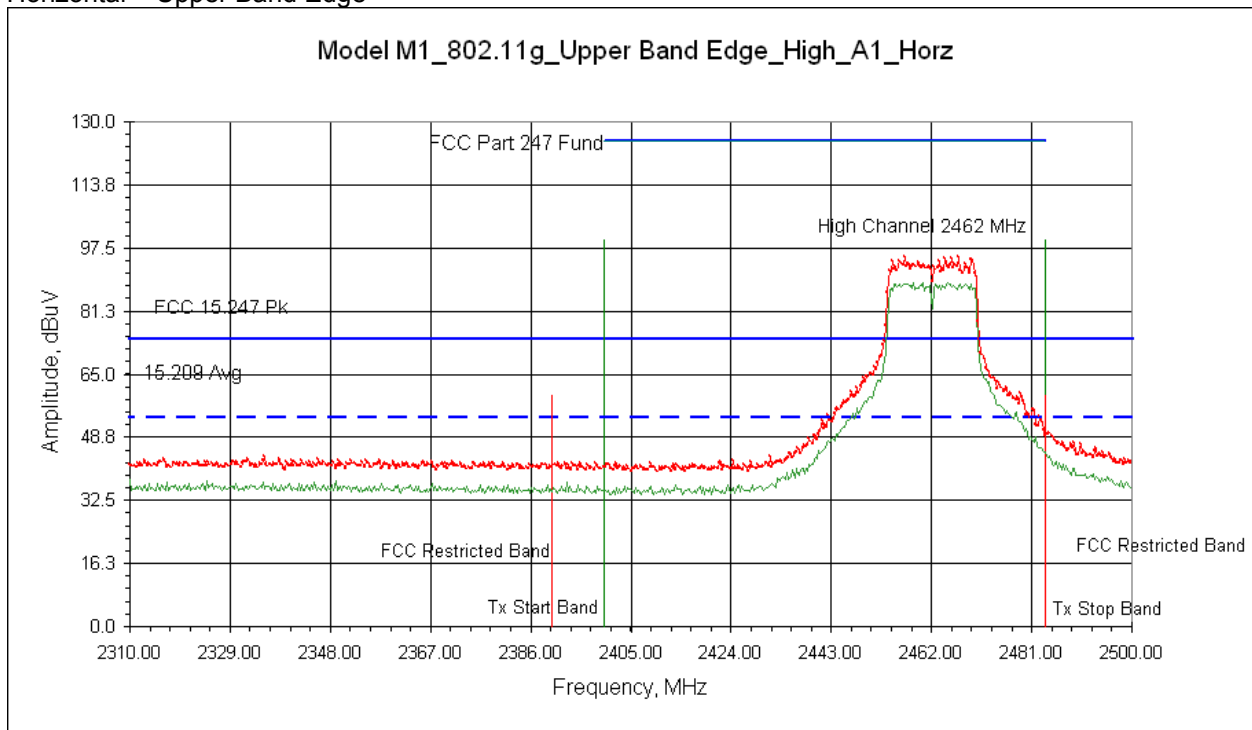
Legend: Green Vertical Lines (Tx allowable start/stop band)
 Red Vertical Lines (Restricted Band start/stop)
 Magenta Trace (Average trace line)
 Red Trace (Peak trace line)
 Blue Limit Lines (solid line = peak limit, dashed = average limit)

11.54 Band Edge Plots: 802.11g Band

Vertical – Upper Band Edge



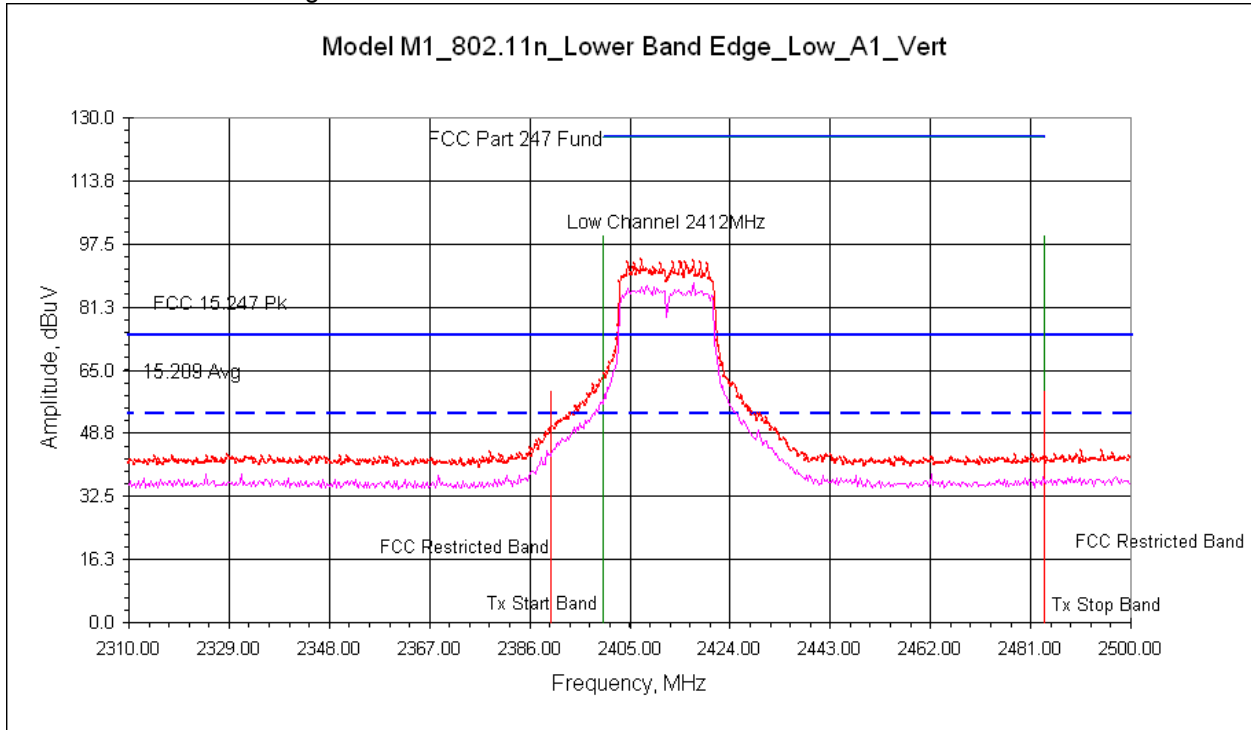
Horizontal – Upper Band Edge



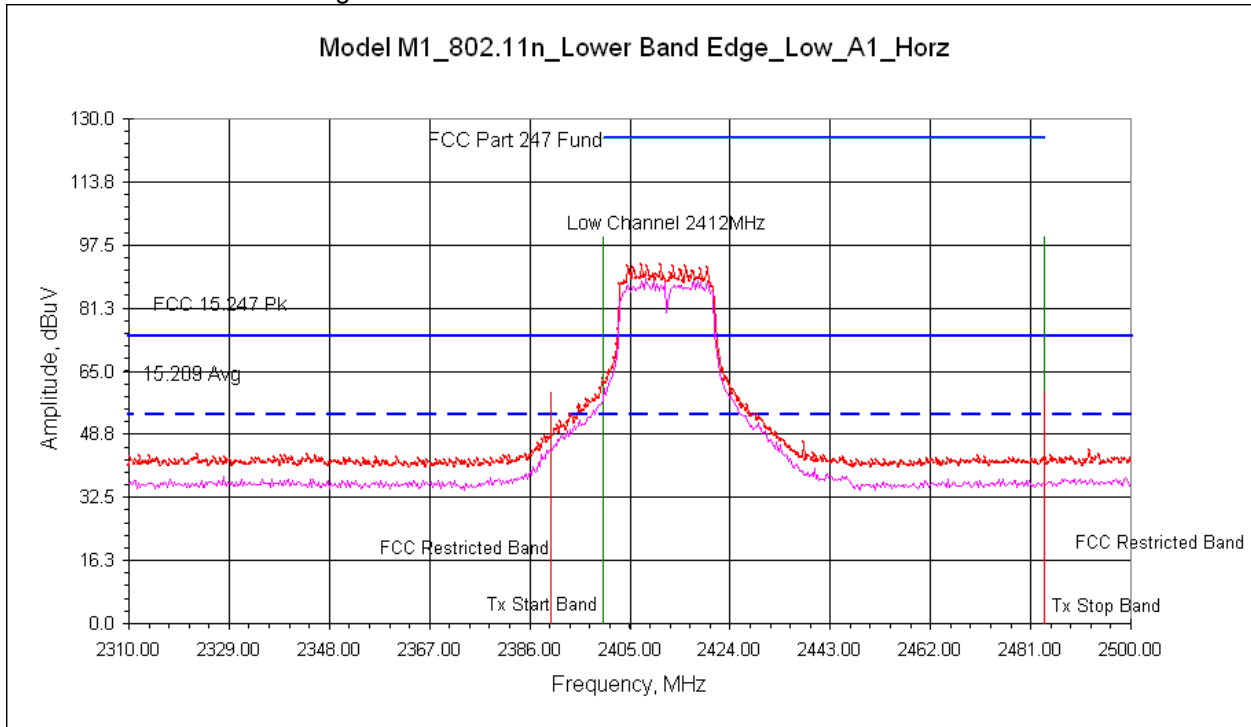
Legend: Green Vertical Lines (Tx allowable start/stop band)
 Red Vertical Lines (Restricted Band start/stop)
 Magenta Trace (Average trace line)
 Red Trace (Peak trace line)
 Blue Limit Lines (solid line = peak limit, dashed = average limit)

11.55 Band Edge Plots: 802.11n HT20 Band

Vertical – Lower Band Edge



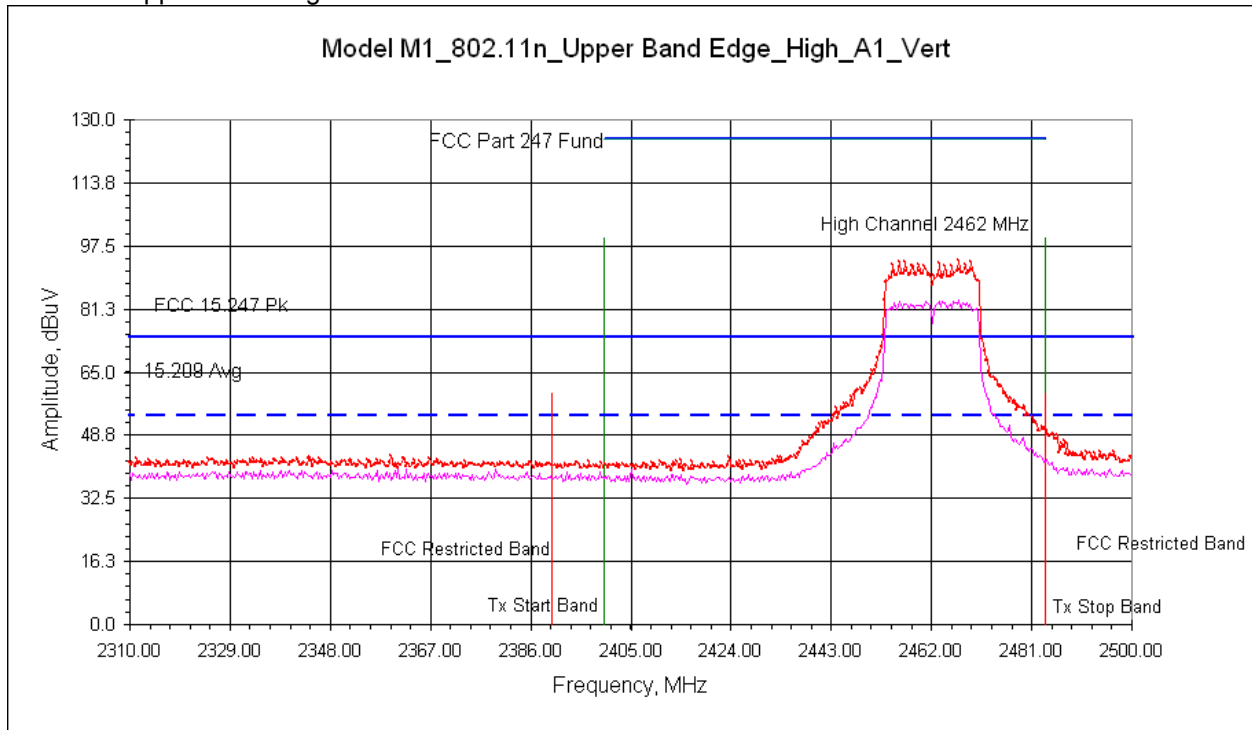
Horizontal – Lower Band Edge



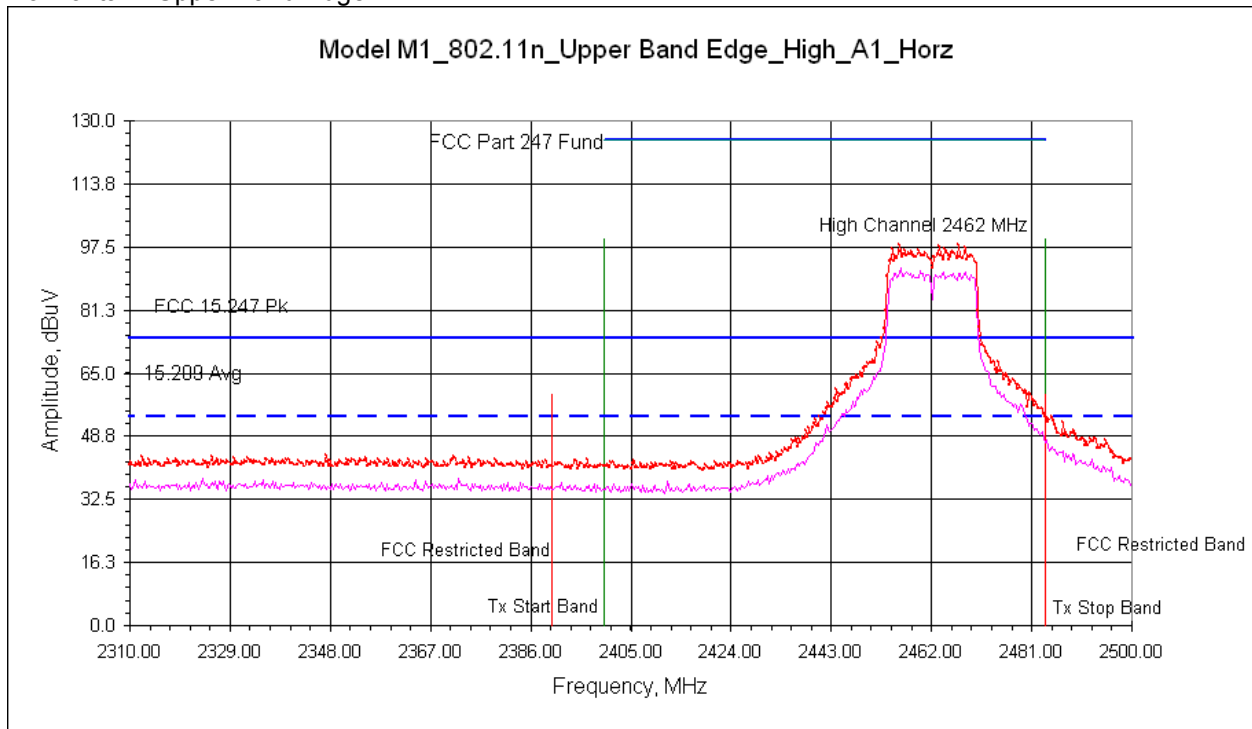
Legend: Green Vertical Lines (Tx allowable start/stop band)
 Red Vertical Lines (Restricted Band start/stop)
 Magenta Trace (Average trace line)
 Red Trace (Peak trace line)
 Blue Limit Lines (solid line = peak limit, dashed = average limit)

11.56 Band Edge Plots: 802.11n HT20 Band

Vertical – Upper Band Edge



Horizontal – Upper Band Edge



Legend: Green Vertical Lines (Tx allowable start/stop band)
Red Vertical Lines (Restricted Band start/stop)
Magenta Trace (Average trace line)
Red Trace (Peak trace line)
Blue Limit Lines (solid line = peak limit, dashed = average limit)

Intertek

Report Number: 101262612DEN-001B

Issued: 10/17/2013

11.57 Test Data: 802.11b/g/n

Tx Spurious Radiated Emissions (Band Edge/ Restricted Bands)

Test Report #: G101262612	Test Area: CC1 Radiated	Temperature: <u>23.4</u> °C
Test Method: FCC 15.205/209	Test Date: <u>08/22/2013</u>	Relative Humidity: <u>33.5</u> %
EUT Model #: M1	EUT Power: <u>120V/ 60Hz</u>	Air Pressure: <u>82.7</u> kPa
EUT Serial #: FCC1		

Manufacturer: Revolv

EUT Description: Revolv Hub – RF-enabled Home Automation wireless Hub

Notes: Product transmitting continuously – WiFi Radio active – **802.11b/g/n**

Band Edge Restricted Band Measurements

Level Key

Pk – Peak
Qp – Quasi Peak
Av - Average

802.11b

Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Delta1	Delta2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.209 Av	FCC 15.35(b) Peak	(MHz)
Measurements: Low Band Edge – Axis 1 (worst-case)													
2386.4263	55.38	Pk	3.50	28.49	37.56	9.55	59.36	H	1.05	10.0	N/A	- 14.64	1.000
2386.4263	43.40	Av	3.50	28.49	37.56	9.55	47.38	H	1.05	10.0	- 6.62	NA	1.000
2390.0000	57.23	Pk	3.50	28.51	37.57	9.48	61.16	H	1.00	31.0	N/A	- 12.84	1.000
2390.0000	45.93	Av	3.50	28.51	37.57	9.48	49.86	H	1.00	31.0	- 4.14	NA	1.000
2386.4260	57.70	Pk	3.50	28.49	37.56	9.55	61.68	H	1.04	30.0	N/A	- 12.32	1.000
2386.4260	46.43	Av	3.50	28.49	37.56	9.55	50.41	H	1.04	30.0	- 3.59	NA	1.000
2386.4260	57.01	Pk	3.50	28.49	37.56	9.55	60.99	V	2.54	110.0	N/A	- 13.01	1.000
2386.4260	45.34	Av	3.50	28.49	37.56	9.55	49.32	V	2.54	110.0	- 4.68	NA	1.000
2390.0000	56.07	Pk	3.50	28.51	37.57	9.48	60.00	V	2.54	119.0	N/A	- 14.00	1.000
2390.0000	44.79	Av	3.50	28.51	37.57	9.48	48.72	V	2.54	119.0	- 5.28	NA	1.000
Measurements: Upper Band Edge – Axis 1 (worst-case)													
2483.5000	56.84	Pk	3.58	28.69	37.67	10.11	61.55	H	1.04	22.0	N/A	- 12.45	1.000
2483.5000	46.11	Av	3.58	28.69	37.67	10.11	50.82	H	1.04	22.0	- 3.18	NA	1.000
2483.5000	55.33	Pk	3.58	28.69	37.67	10.11	60.04	V	2.39	129.0	N/A	- 13.96	1.000
2483.5000	44.00	Av	3.58	28.69	37.67	10.11	48.71	V	2.39	129.0	- 5.29	NA	1.000

Intertek

Report Number: 101262612DEN-001B

Issued: 10/17/2013

802.11g

Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Delta1	Delta2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.209 Av	FCC 15.35(b) Peak	(MHz)
Measurements: Low Band Edge – Axis 1 (worst-case)													
2390.0000	60.53	Pk	3.50	28.51	37.57	9.48	64.46	H	1.76	150.0	N/A	- 9.54	1.000
2390.0000	44.28	Av	3.50	28.51	37.57	9.48	48.21	H	1.76	150.0	- 5.79	NA	1.000
2390.0000	55.21	Pk	3.50	28.51	37.57	9.48	59.14	V	1.00	2.0	N/A	- 14.86	1.000
2390.0000	40.27	Av	3.50	28.51	37.57	9.48	44.20	V	1.00	2.0	- 9.80	NA	1.000
Measurements: Upper Band Edge – Axis 1 (worst-case)													
2483.5000	61.93	Pk	3.58	28.69	37.67	10.11	66.64	V	2.40	119.0	N/A	- 7.36	1.000
2483.5000	45.58	Av	3.58	28.69	37.67	10.11	50.29	V	2.40	119.0	- 3.71	NA	1.000
2483.5000	63.99	Pk	3.58	28.69	37.67	10.11	68.70	H	1.00	31.0	N/A	- 5.30	1.000
2483.5000	47.65	Av	3.58	28.69	37.67	10.11	52.36	H	1.00	31.0	- 1.64	NA	1.000

Intertek

Report Number: 101262612DEN-001B

Issued: 10/17/2013

802.11n HT20

Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Delta1	Delta2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.209 Av	FCC 15.35(b) Peak	(MHz)
Measurements: Low Band Edge – Axis 1 (worst-case)													
2390.0000	61.06	Pk	3.50	28.51	37.57	9.48	64.99	H	1.00	22.0	N/A	- 9.01	1.000
2390.0000	45.61	Av	3.50	28.51	37.57	9.48	49.54	H	1.00	22.0	- 4.46	NA	1.000
2390.0000	59.97	Pk	3.50	28.51	37.57	9.48	63.90	V	2.56	113.0	N/A	- 10.10	1.000
2390.0000	44.80	Av	3.50	28.51	37.57	9.48	48.73	V	2.56	113.0	- 5.27	NA	1.000
Measurements: Upper Band Edge – Axis 1 (worst-case)													
2483.5000	63.45	Pk	3.58	28.69	37.67	10.11	68.16	H	1.05	28.0	N/A	- 5.84	1.000
2483.5000	46.98	Av	3.58	28.69	37.67	10.11	51.69	H	1.05	28.0	- 2.31	NA	1.000
2483.5000	61.01	Pk	3.58	28.69	37.67	10.11	65.72	V	2.39	112.0	N/A	- 8.28	1.000
2483.5000	44.78	Av	3.58	28.69	37.67	10.11	49.49	V	2.39	112.0	- 4.51	NA	1.000

12 Power Spectral Density – PSD

12.1 Method

Unless otherwise stated no deviations were made from FCC Part 15.247..

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

12.2 Test Requirements/Specification:

For the band 2400 – 2483.5 GHz within digitally modulated systems (DTS) products, the power spectral density conducted from the intentional radiator to the antenna should not be greater than +8 dBm in any 3 kHz to 100kHz band during any time interval of continuous transmission.

Such specifications require that the same method as used to determine the conducted output power shall also be used to determine the power spectral density.

12.3 Test Equipment Used:

<u>Asset ID</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Serial</u>	<u>Cal Date</u>	<u>Cal Due</u>
DEN-073	EMI Receiver	RHODE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
E2 SW-6	RF Conducted Port Cable Software for Radiated and Conducted emissions.	----- Intertek	True Blue OATS vba	001 V. 3.0	09/12/2013 VBU	09/12/2014 VBU

12.4 Test Procedure:

The antenna port of the EUT was connected to the input port of a spectrum analyzer using an appropriate rf port cable to measure the Power Spectral Density (PSD). Use the peak marker function to determine the maximum amplitude level within the RBW. If the measured value exceeds the limit, reduce the RBW to no less than 3kHz and repeat.

The following procedures described in ANSI C63.10:2009 and FCC Publication 558074 (Guidelines for Compliance Measurements on DTS Operating Under 15.247), were used:

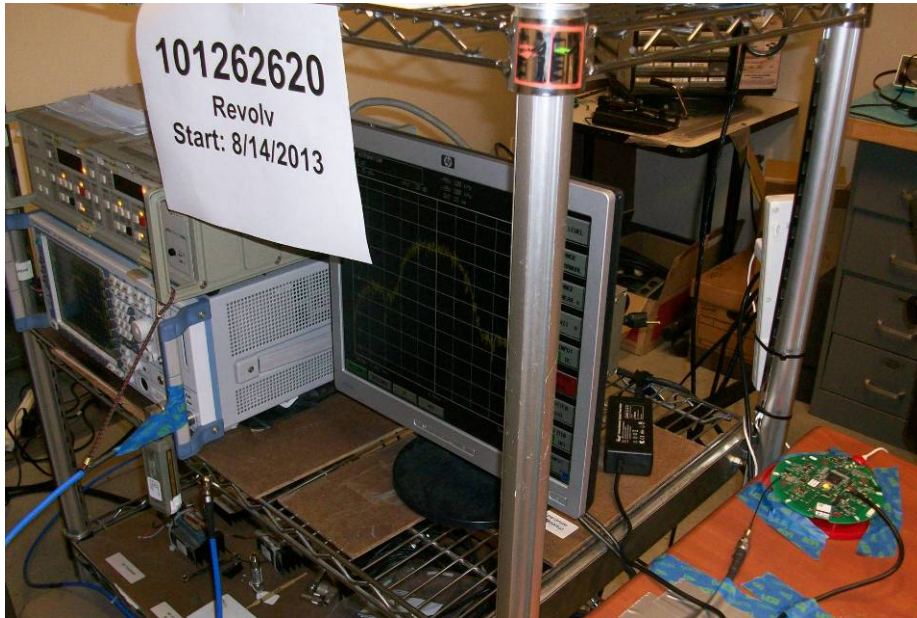
- 558074, Section 10.2
- ANSI C63.10: 2009 General Guidance

12.5 Test Results:

The sample tested was found to Comply.

12.6 Setup Photographs:

Power Spectral Density - Test setup



12.7 Test Data Summary: Power Spectral Density (PSD)

**Power Spectral Density 2400 – 2483.5 MHz
FCC Part 15.247(e)**

CHANNEL	FREQUENCY, MHZ	STANDARD/ DATA RATE	PSD (PEAK DBM)	PSD LIMIT (DBM)	PLOT
1	2412	802.11b, 5.5Mbps	-1.18	8.0	x
		802.11g, 54Mbps	-11.59	8.0	x
		802.11n HT20,	-12.07	8.0	x
6	2437	802.11b, 5.5Mbps	-0.67	8.0	x
		802.11g, 54Mbps	-3.80	8.0	x
		802.11n HT20,	-3.41	8.0	x
11	2462	802.11b, 5.5Mbps	-1.03	8.0	x
		802.11g, 54Mbps	-9.36	8.0	x
		802.11n HT20,	-9.75	8.0	x

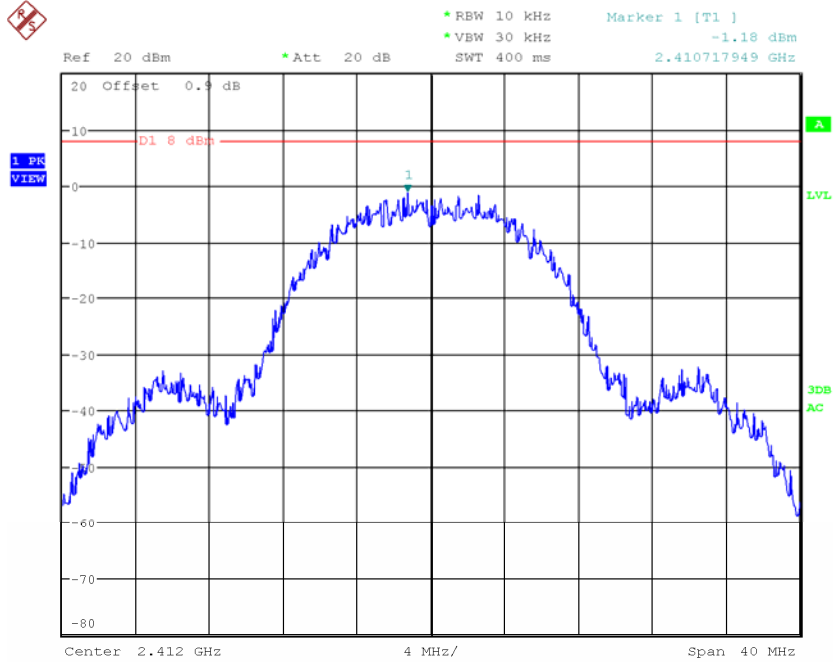
Note: The above represents the worst-case modulation and data rate.

12.8 Test Data/Plots: Power Spectral Density (PSD)

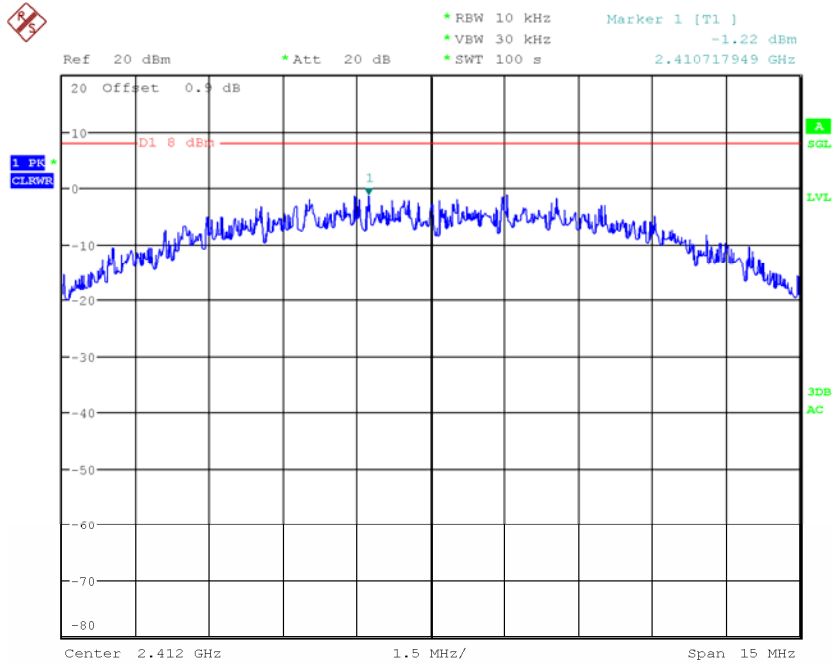
Power Spectral Density (PSD) - FCC Part 15.247(e)

802.11b – CCK Modulation Mode

Low Channel 1: 2412MHz



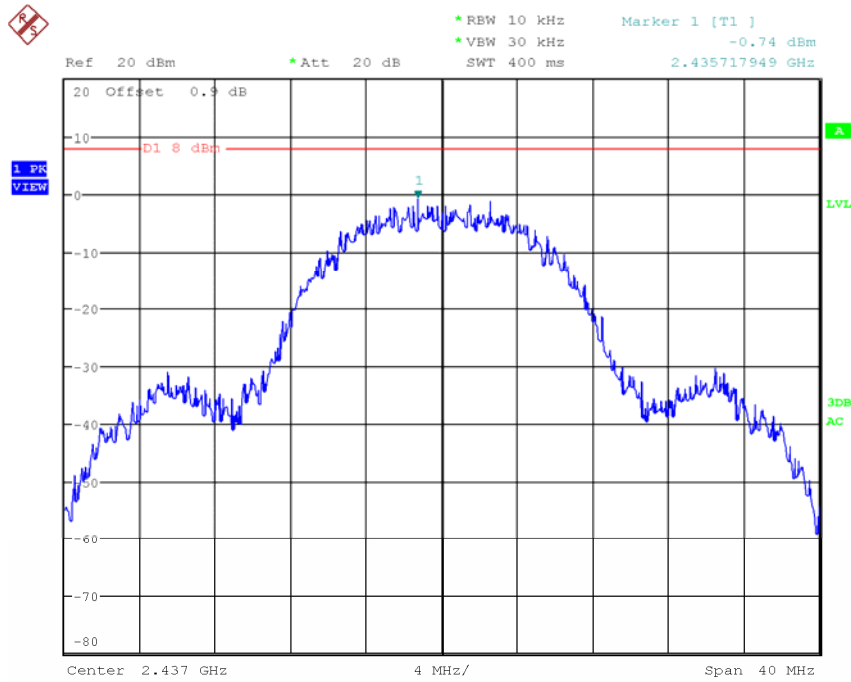
Date: 21.AUG.2013 10:29:05



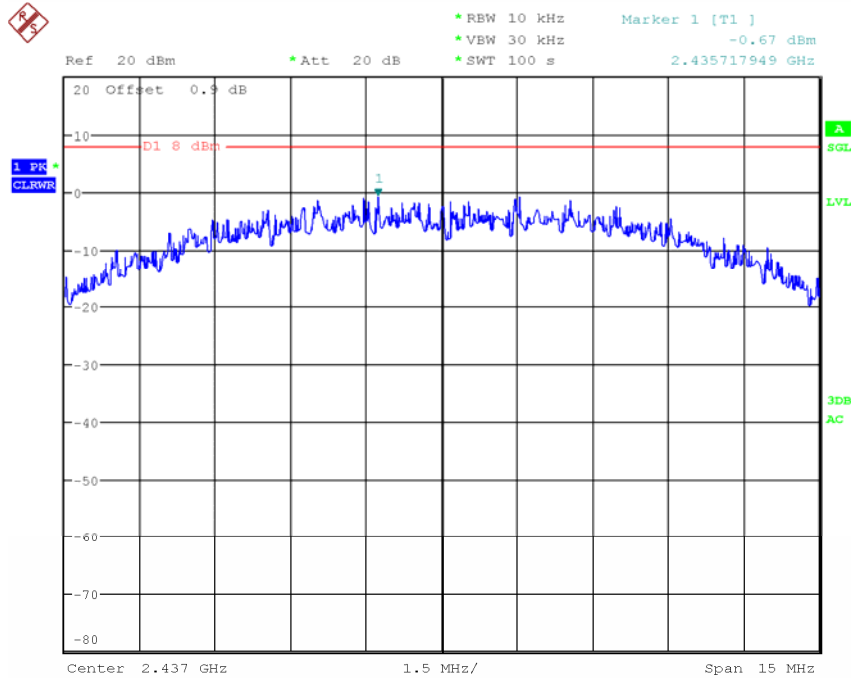
Date: 21.AUG.2013 10:34:58

802.11b – CCK Modulation Mode

Mid Channel 6: 2437MHz



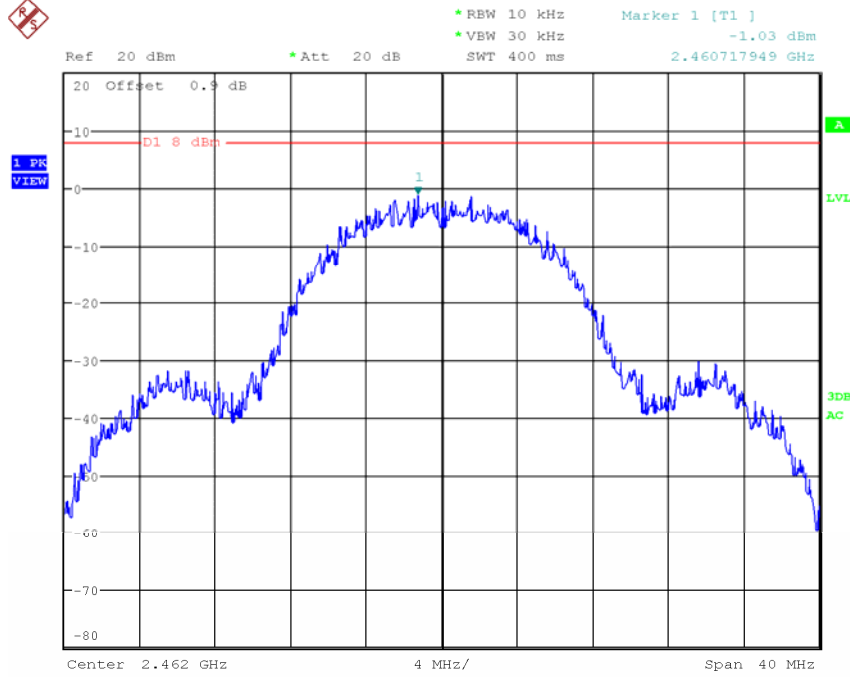
Date: 21.AUG.2013 10:36:24



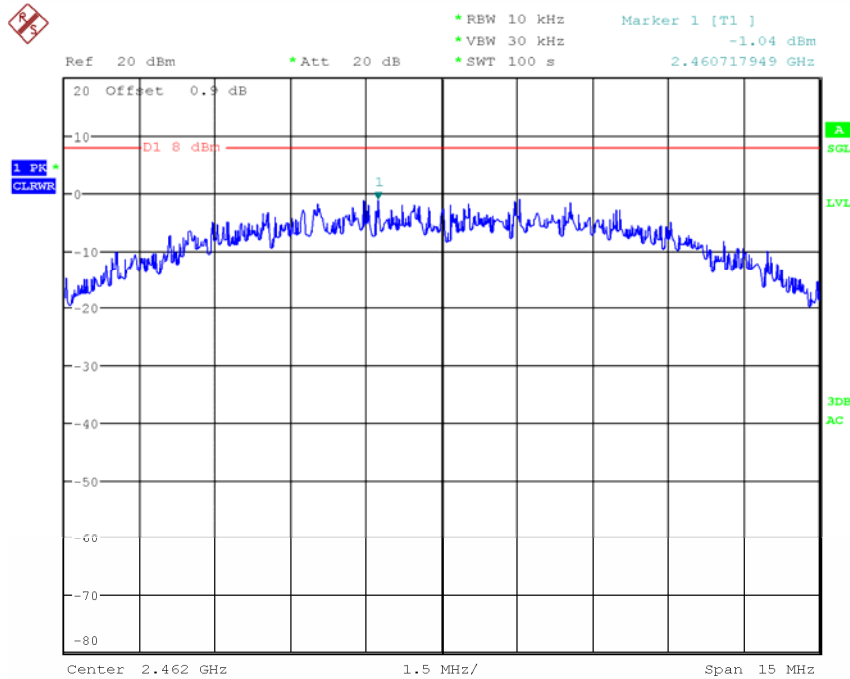
Date: 21.AUG.2013 10:39:27

802.11b – CCK Modulation Mode

High Channel 11: 2462MHz

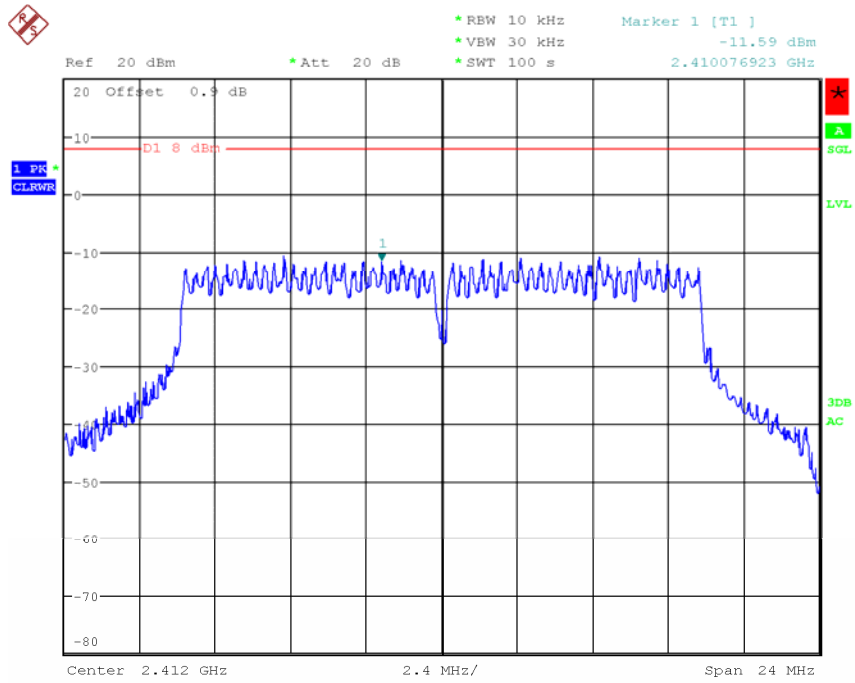


Date: 21.AUG.2013 10:40:38



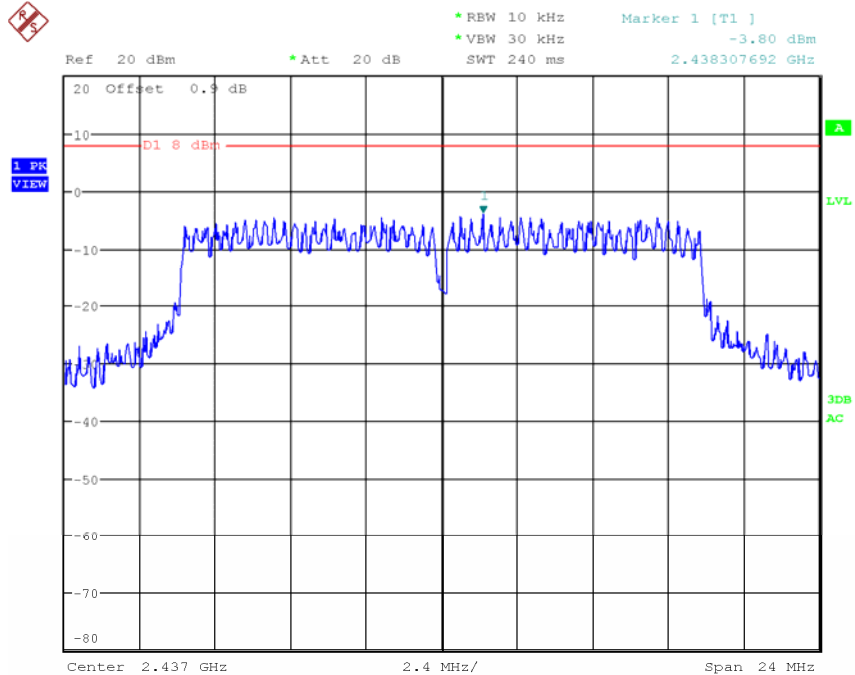
Date: 21.AUG.2013 10:42:55

802.11g – OFDM Modulation Mode
Low Channel 1: 2412MHz



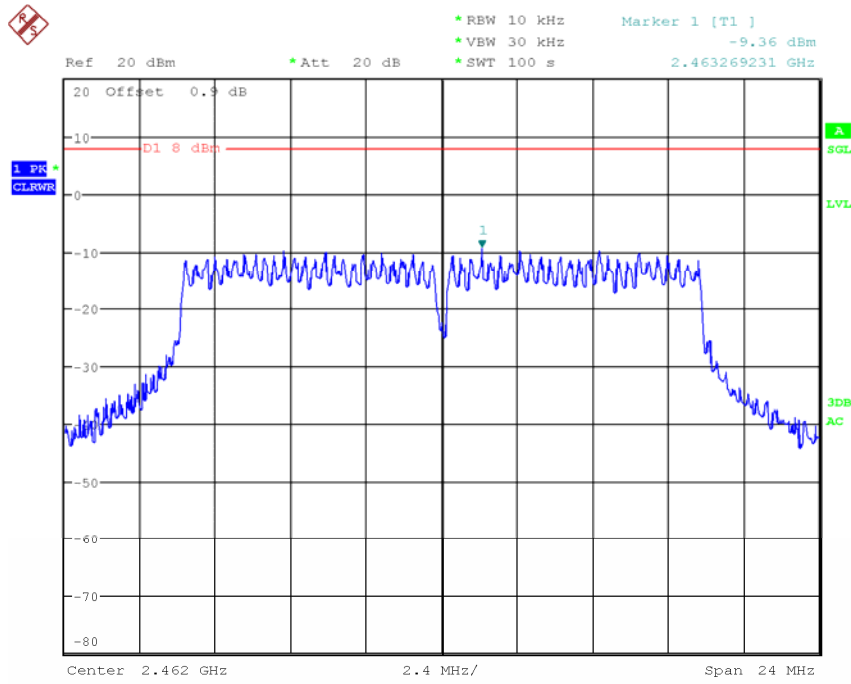
Date: 21.AUG.2013 10:49:20

802.11g – OFDM BPSK Modulation Mode
Mid Channel 6: 2437MHz



Date: 21.AUG.2013 10:51:19

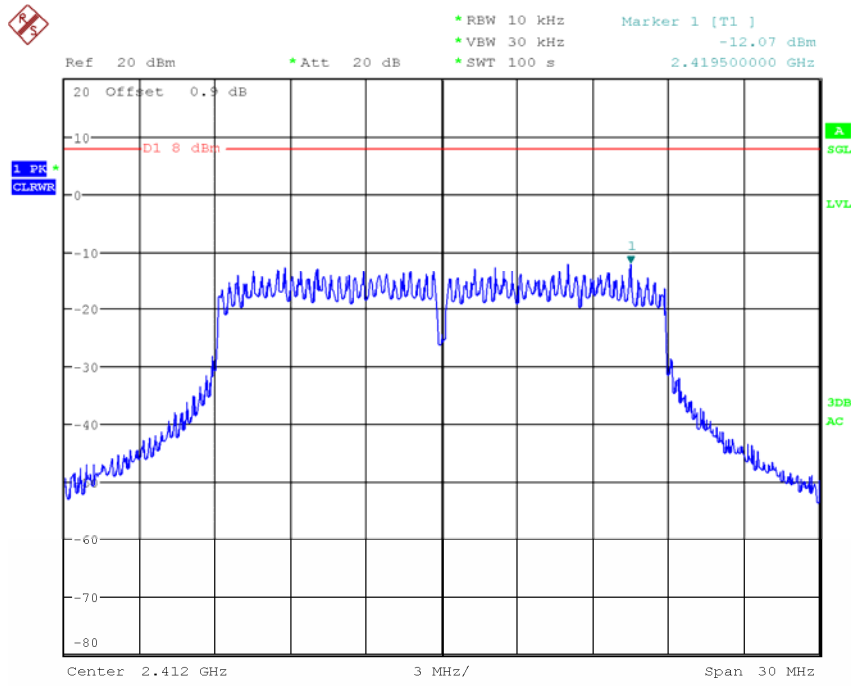
802.11g – OFDM Modulation Mode
High Channel 11: 2462MHz



Date: 21.AUG.2013 10:59:34

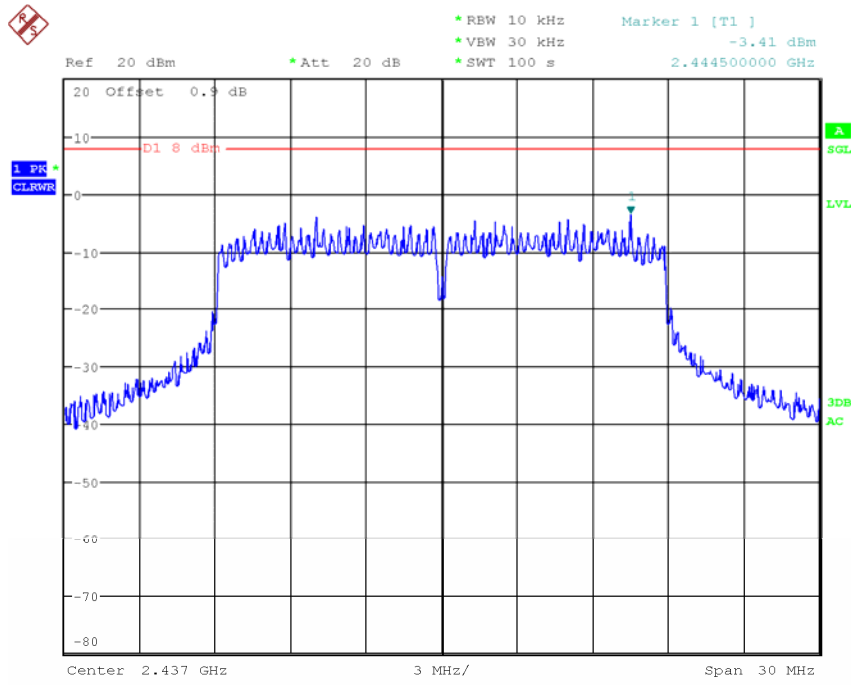
802.11n HT20 OFDM Modulation Mode

Low Channel 1: 2412MHz



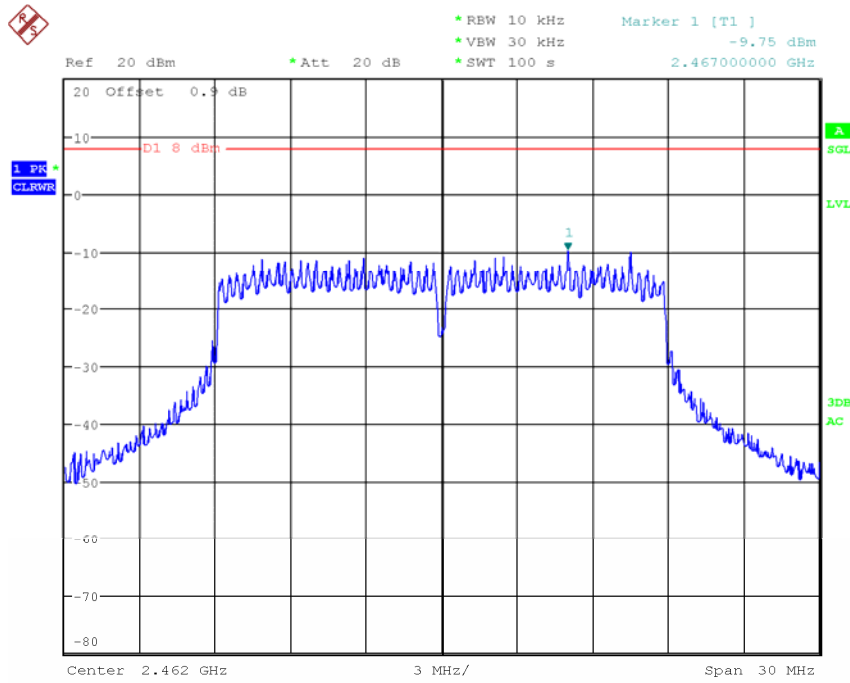
Date: 21.AUG.2013 11:05:35

802.11n HT20 OFDM Modulation Mode
Mid Channel 6: 2437MHz



Date: 21.AUG.2013 11:09:19

802.11n HT20 OFDM Modulation Mode
High Channel 11: 2462MHz



Date: 21.AUG.2013 11:14:29

FCC 15.247(e) PSD Limit: +8.00 dBm (3kHz to 100kHz band)

Worst-case measured PSD: -0.67dBm

- 802.11b Mid Channel 6, CCK Modulation Mode

13 Radiated Emissions (Digital Part of Receiver)**13.1 Method:**

Unless otherwise stated no deviations were made from FCC Part 15.109 – Class B.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

13.2 Test Equipment Used:

<u>Asset ID</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Serial</u>	<u>Cal Date</u>	<u>Cal Due</u>
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
18912	9 kHz- 1.3GHz Pre Amp	Hewlett-Packard	8447F	3113A05545	06/07/2013	06/07/2014
18906	RF Pre-Amp (1-4GHz)	Mini-Circuits Lab	ZHL-42	N052792-2	06/10/2013	06/10/2014
19936	Bilog Antenna 30MHz – 6GHz	Sunol Sciences	JB6	A050707-1	11/15/2012	11/15/2013
18887	Horn Antenna 1-18GHz	EMCO	3115	9205-3886	03/19/2013	03/19/2014
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBU	VBU

13.3 Test Requirement/ Specification:

Receive Mode - the product must pass Unintentional Radiated Emissions – Class B, per the limits specified in FCC 15.109(a). Unwanted emissions below 1GHz must comply with the general field strength limits defined in FCC Part 15.109, when measured with a quasi-peak detector. Unwanted emissions above 1GHz are measured with an average detector.

13.4 Test Procedure:

The Resolution Bandwidth is 120 kHz for frequencies 30 MHz -1000 MHz and 1 MHz for frequencies above 1000 MHz.

The EUT is placed on a plastic turntable that is 80 cm in height. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables are manipulated to produce worst-case emissions. The signal is maximized by rotating the turntable through a 360° rotation. The antenna height is varied from 1-4 meters. Both vertical and horizontal antenna configurations are utilized in the testing.

Radiated emissions are taken at 3-meter antenna-to-product test distance for all measurements.

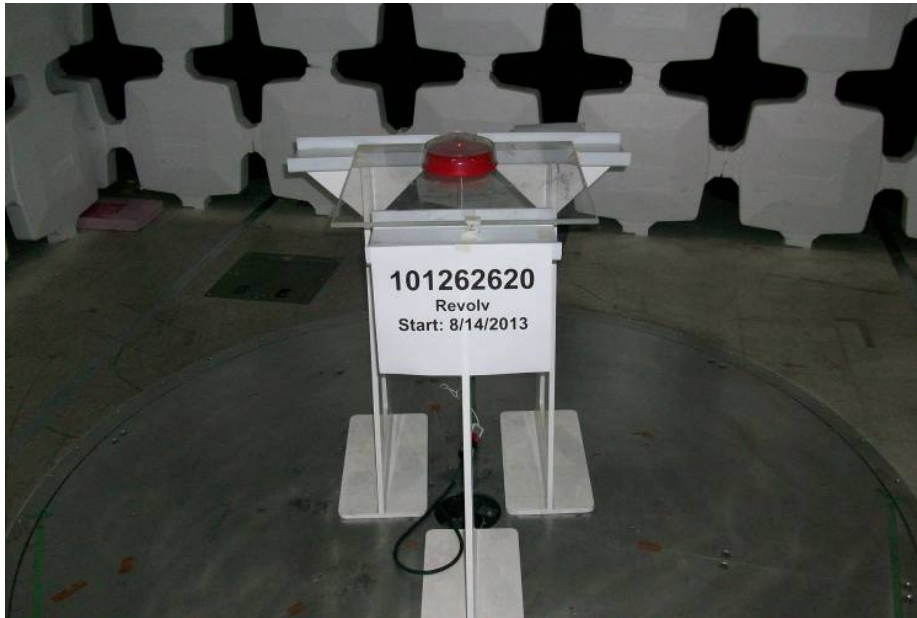
Data is included for the worst-case configuration - the configuration which resulted in the highest radiated emission levels.

13.5 Test Results:

The sample tested was found to Comply.

13.6 Setup Photographs: Product Axis 1 – Horizontal Position (Product Flat on Table)

Unintentional Radiated Emissions - Test setup (Front View)



13.7 Setup Photographs: Product Axis 1 – Horizontal Position (Product Flat on Table)

Unintentional Radiated Emissions - Test setup (Rear View)



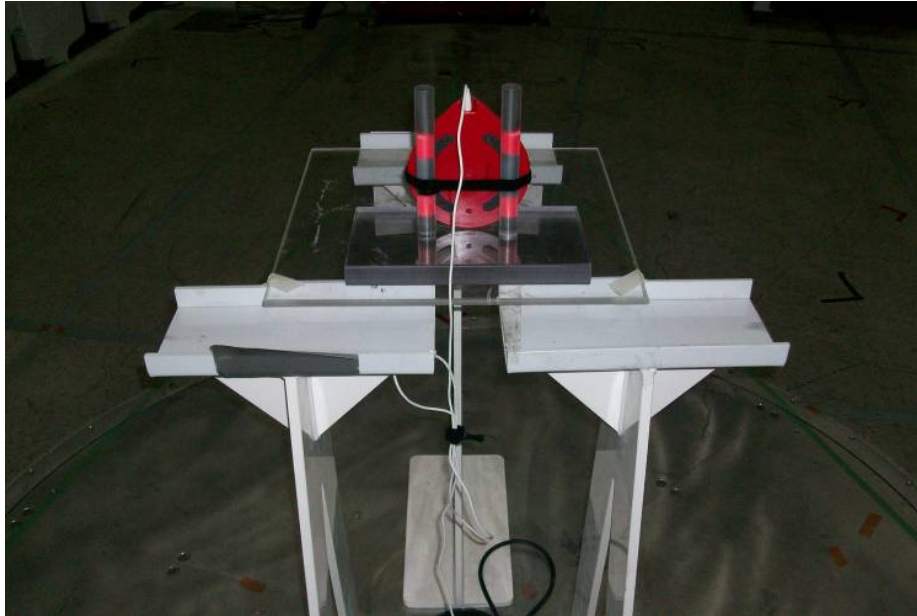
13.8 Setup Photographs: Product Axis 2 – Product Vertical on Table (Wall Mount)

Unintentional Radiated Emissions - Test setup (Front View)



13.9 Setup Photographs: Product Axis 2 – Product Vertical on Table (Wall Mount)

Unintentional Radiated Emissions - Test setup (Rear View)



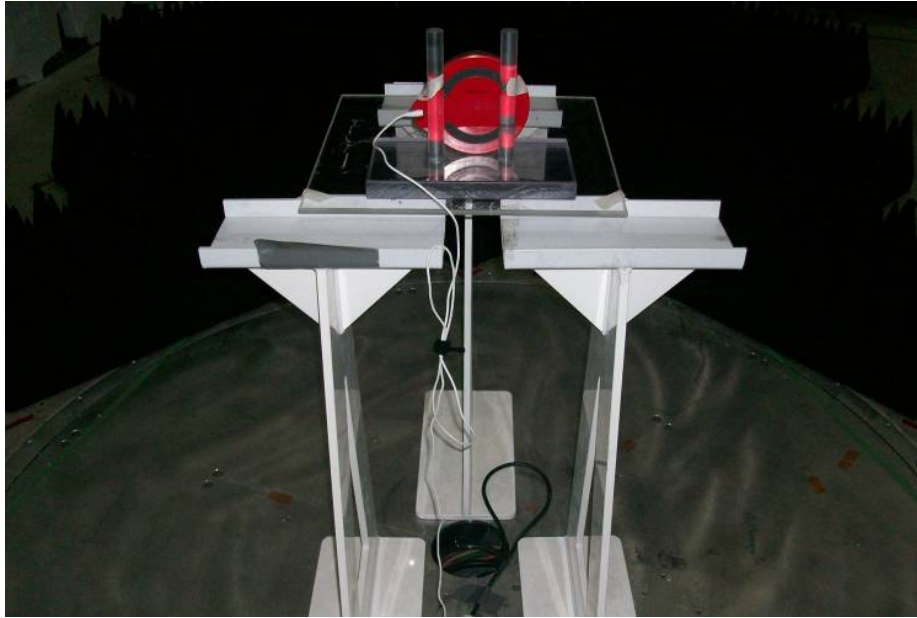
13.10 Setup Photographs: Product Axis 3 – Product Vertical & Rotated 90 Degrees

Unintentional Radiated Emissions - Test setup (Front View)



13.11 Setup Photographs: Product Axis 3 – Product Vertical & Rotated 90 Degrees

Unintentional Radiated Emissions - Test setup (Rear View)



13.12 Setup Photographs: Antennas

Antenna Setup – 30MHz to 1000MHz



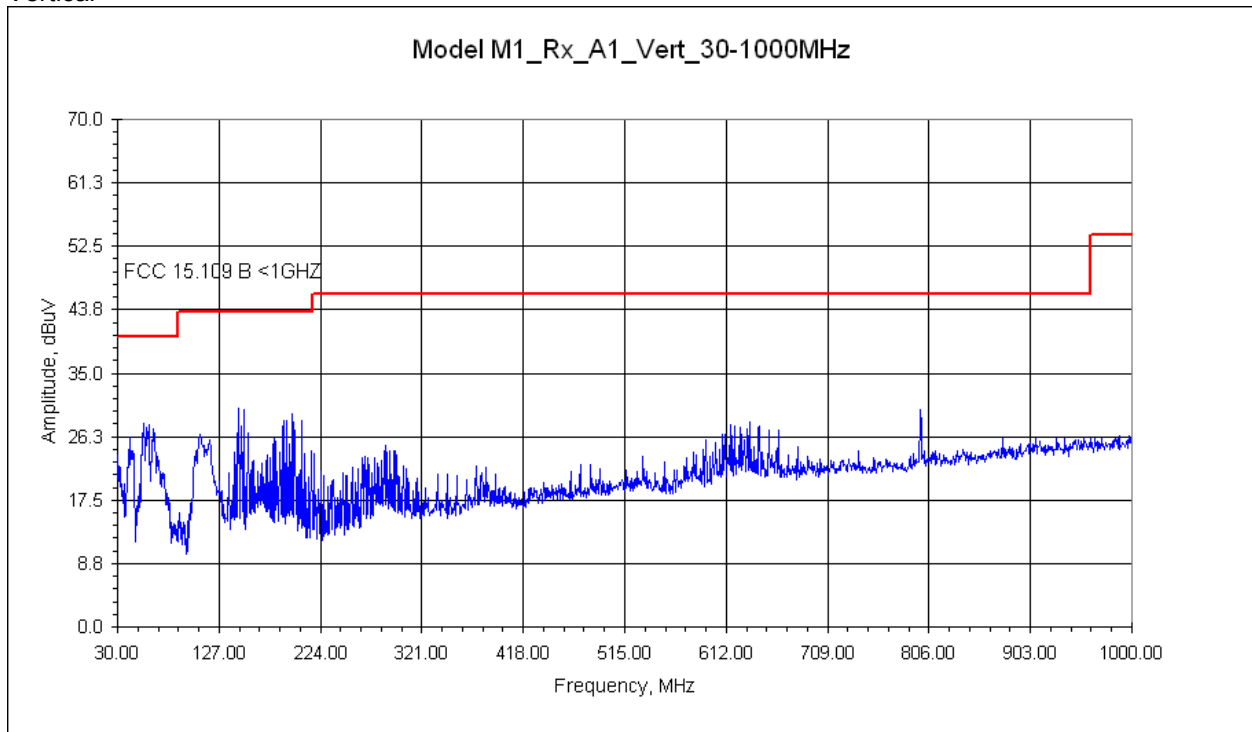
Antenna Setup – 1GHz to 2GHz



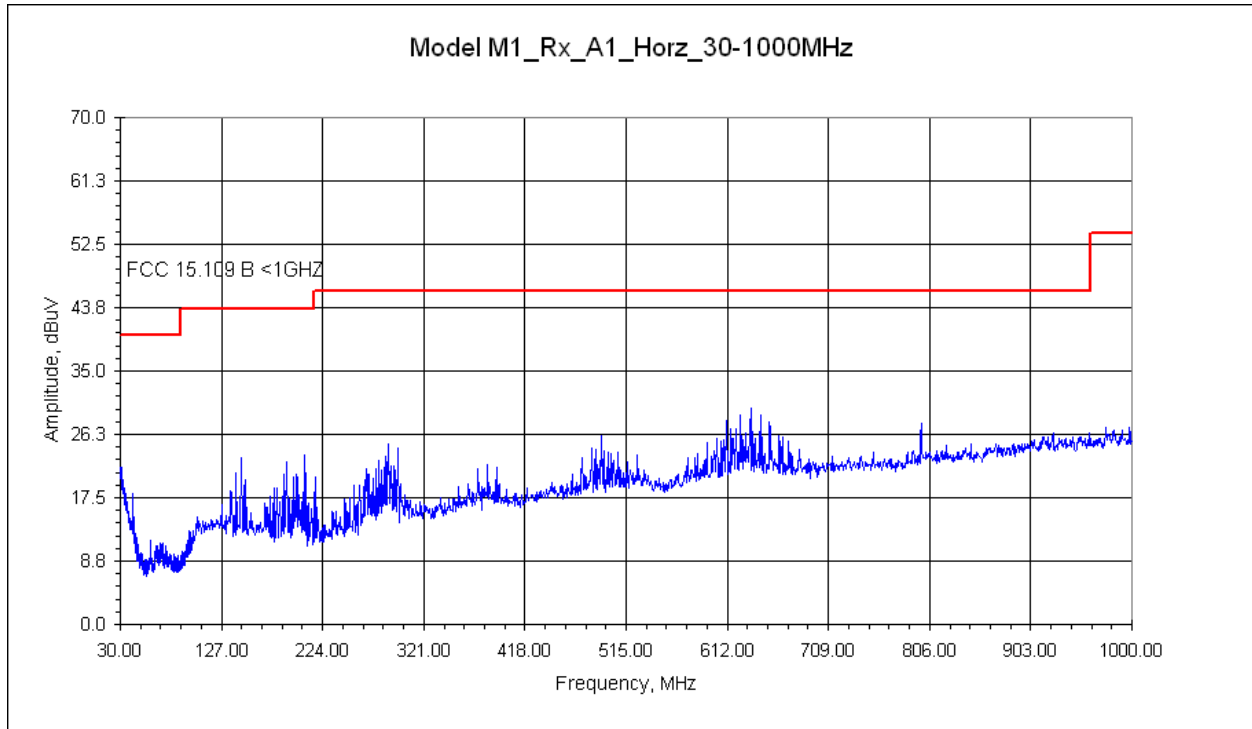
13.13 Pre-scan Plots: Radiated Emissions Product Axis 1 – Horizontal Position (Product Flat on Table)

30MHz to 1000MHz

Vertical



Horizontal

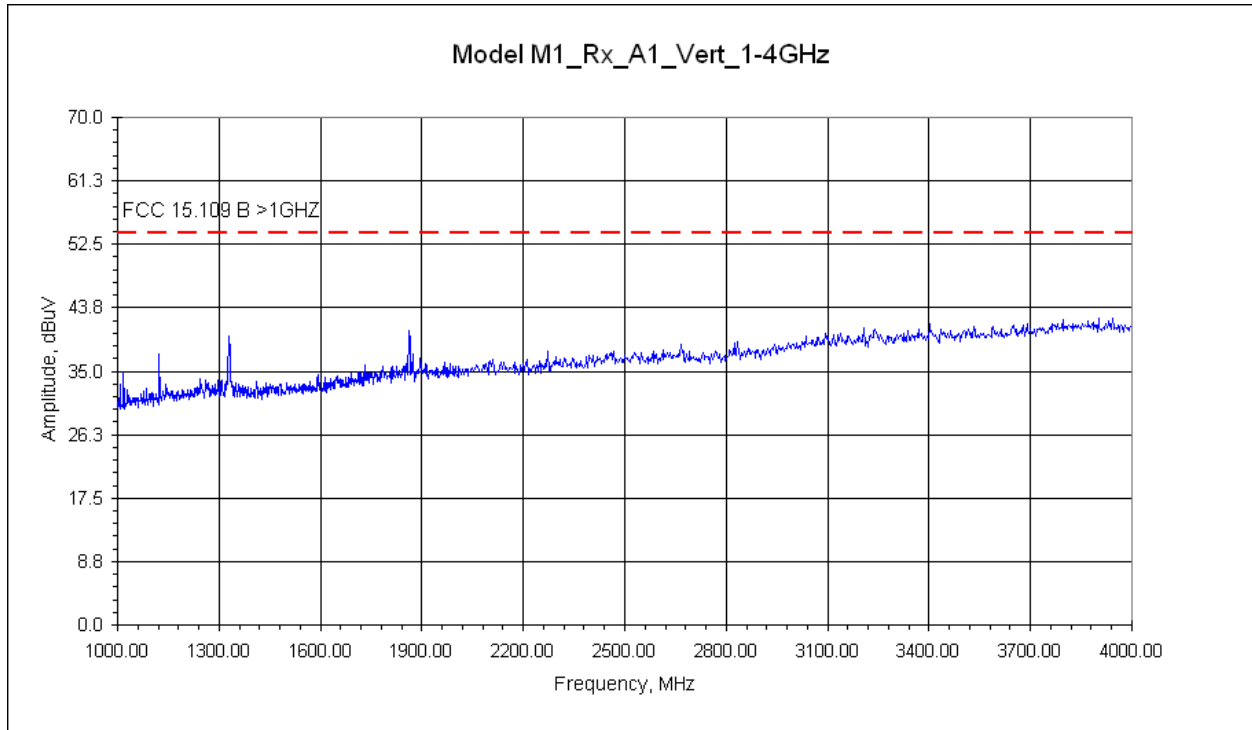


Reference only – to determine signals to be maximized

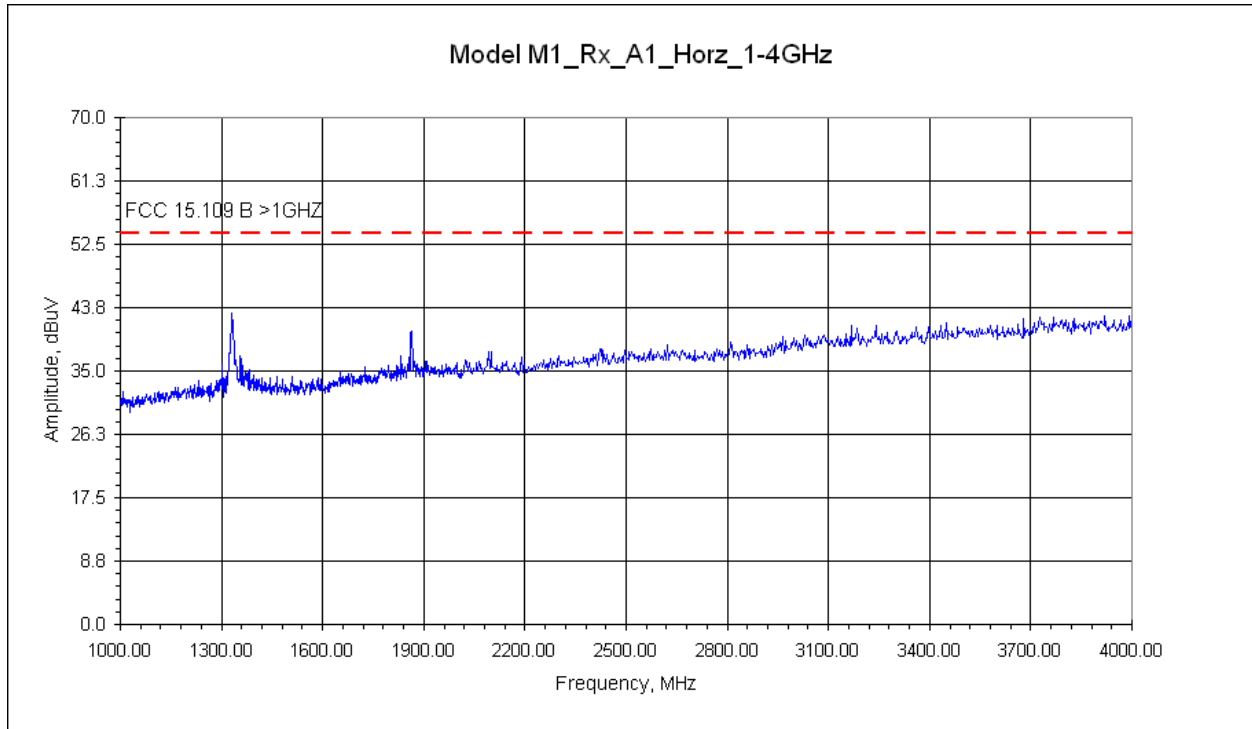
13.14 Pre-scan Plots: Radiated Emissions Product Axis 1 – Horizontal Position (Product Flat on Table)

1GHz to 4GHz

Vertical



Horizontal

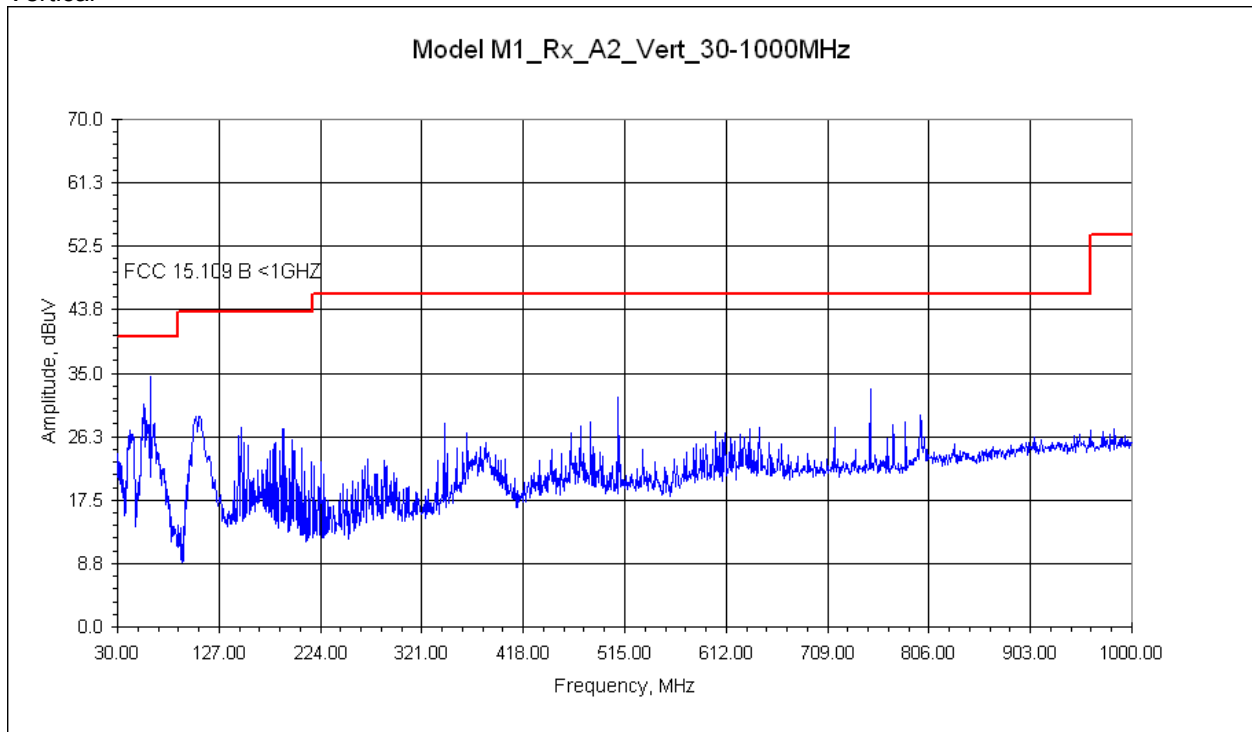


Reference only – to determine signals to be maximized

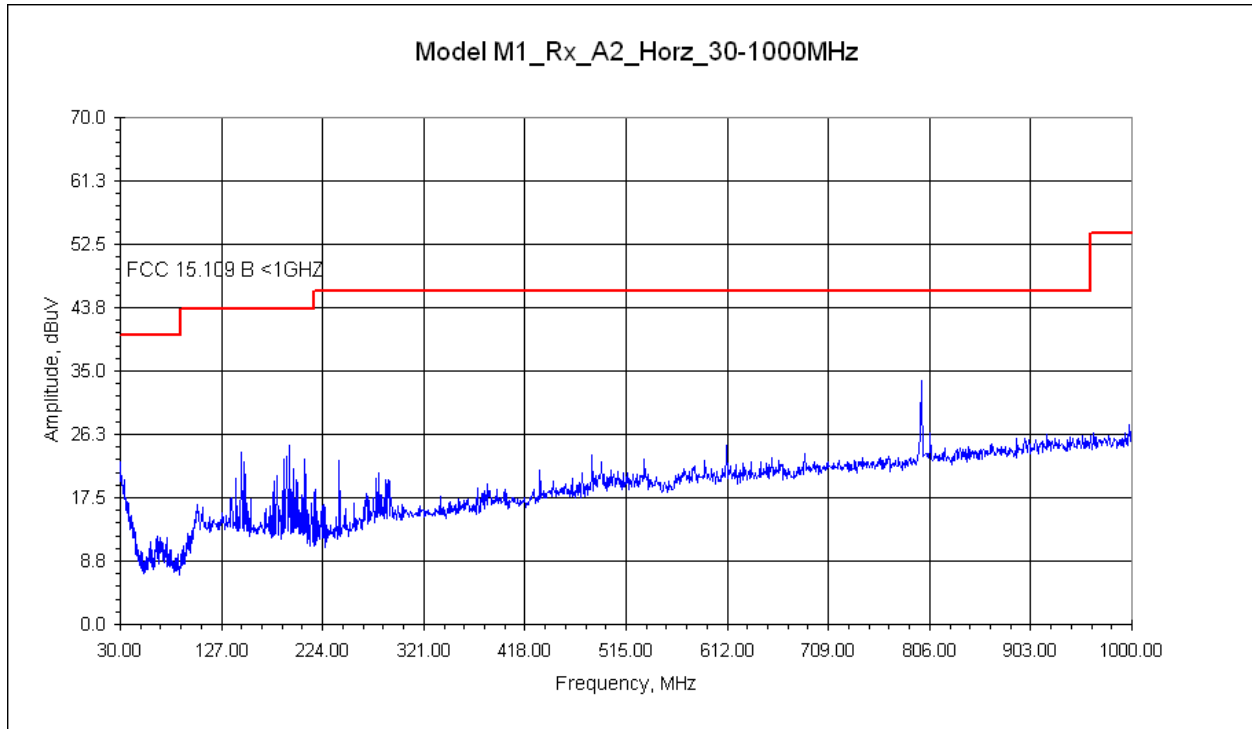
13.15 Pre-scan Plots: Radiated Emissions Product Axis 2 – Product Vertical on Table (Wall Mount)

30MHz to 1000MHz

Vertical



Horizontal

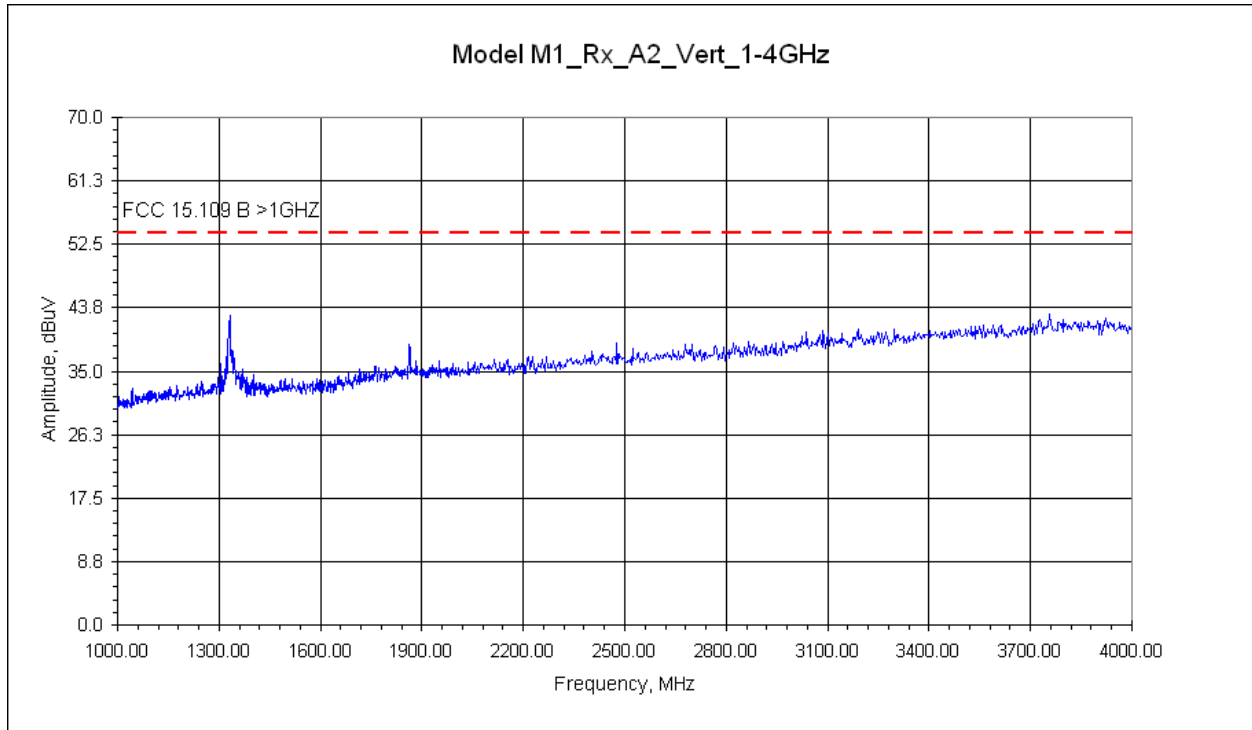


Reference only – to determine signals to be maximized

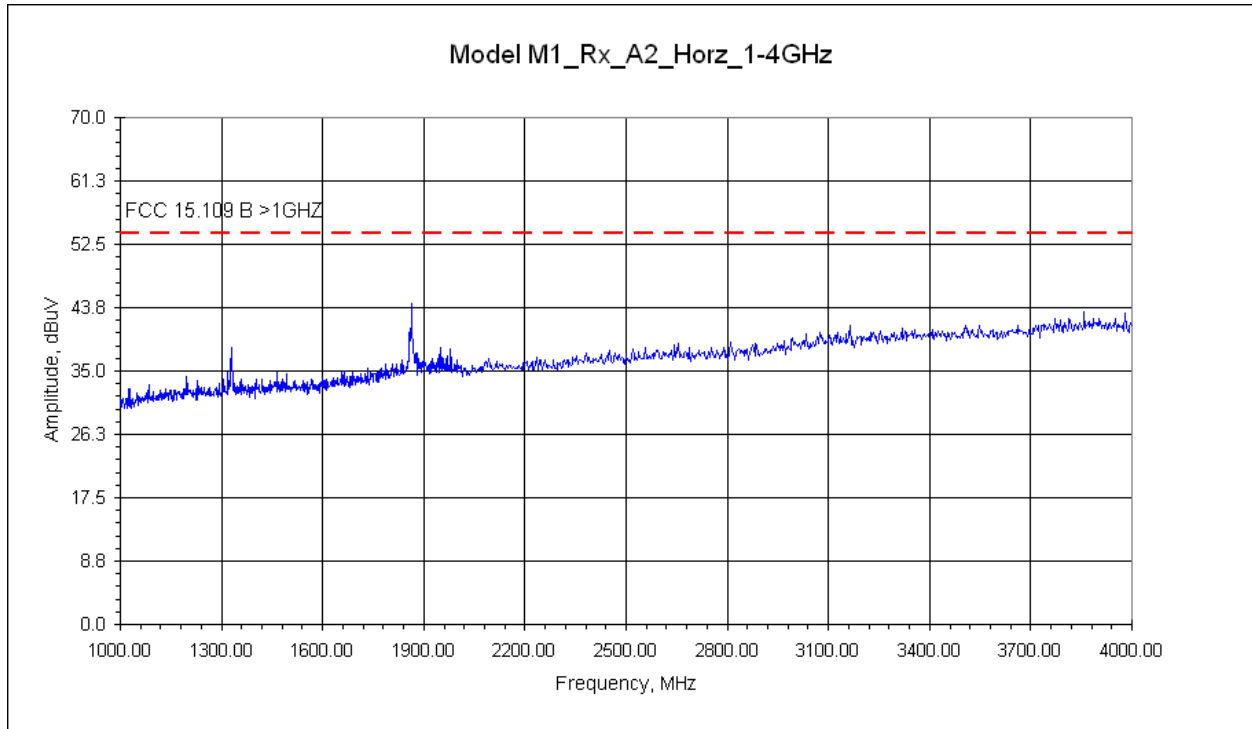
13.16 Pre-scan Plots: Radiated Emissions Product Axis 2 – Product Vertical on Table (Wall Mount)

1GHz to 4GHz

Vertical



Horizontal

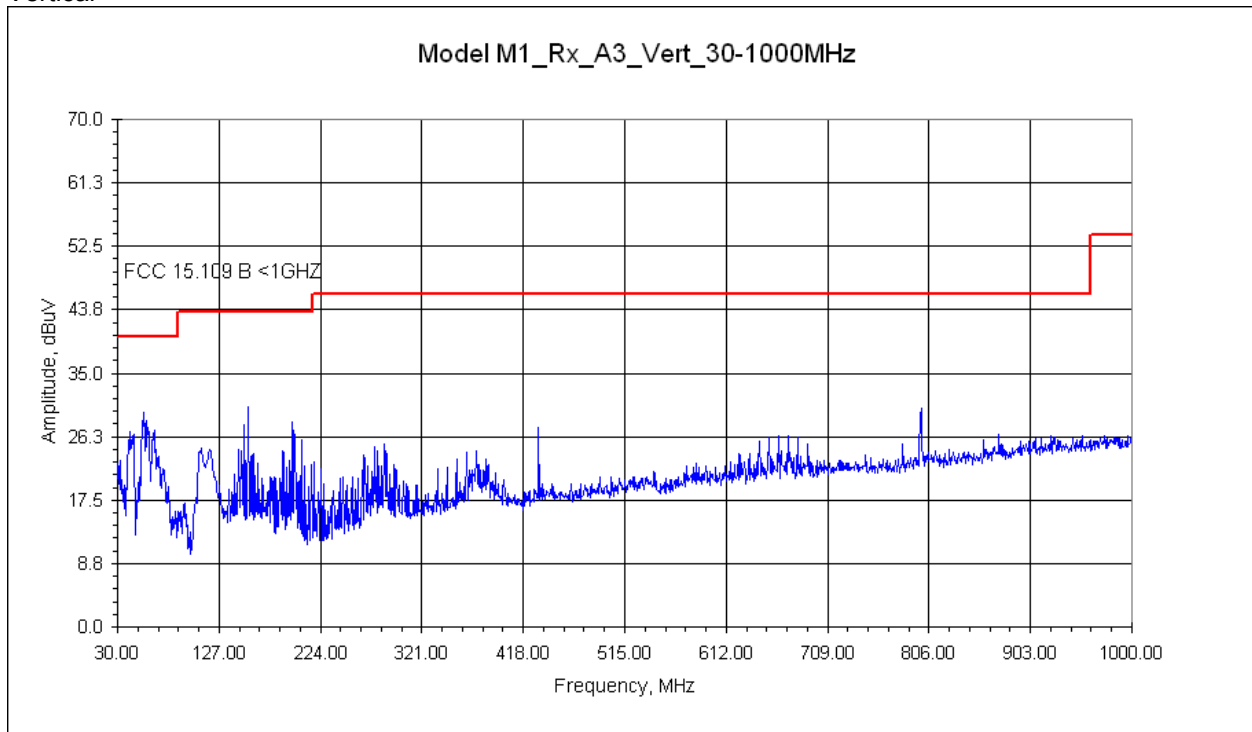


Reference only – to determine signals to be maximized

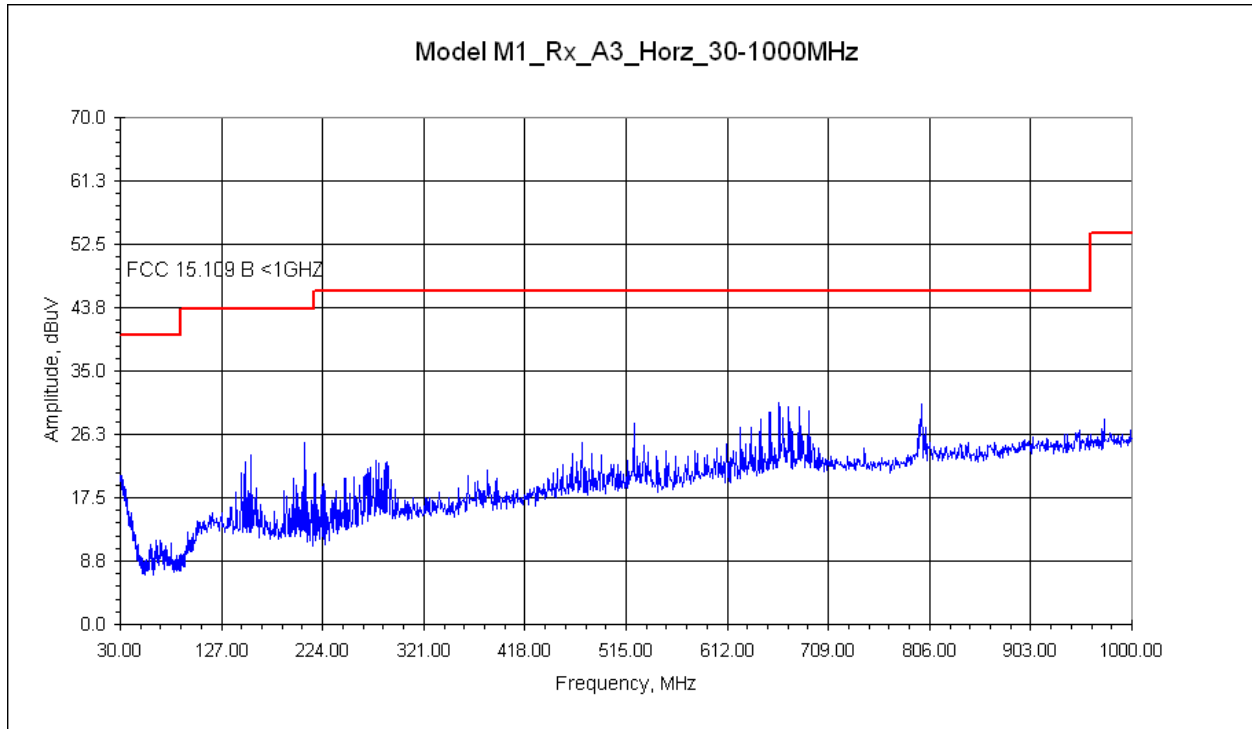
13.17 Pre-scan Plots: Radiated Emissions Product Axis 3 – Product Vertical & Rotated 90 Degrees

30MHz to 1000MHz

Vertical



Horizontal

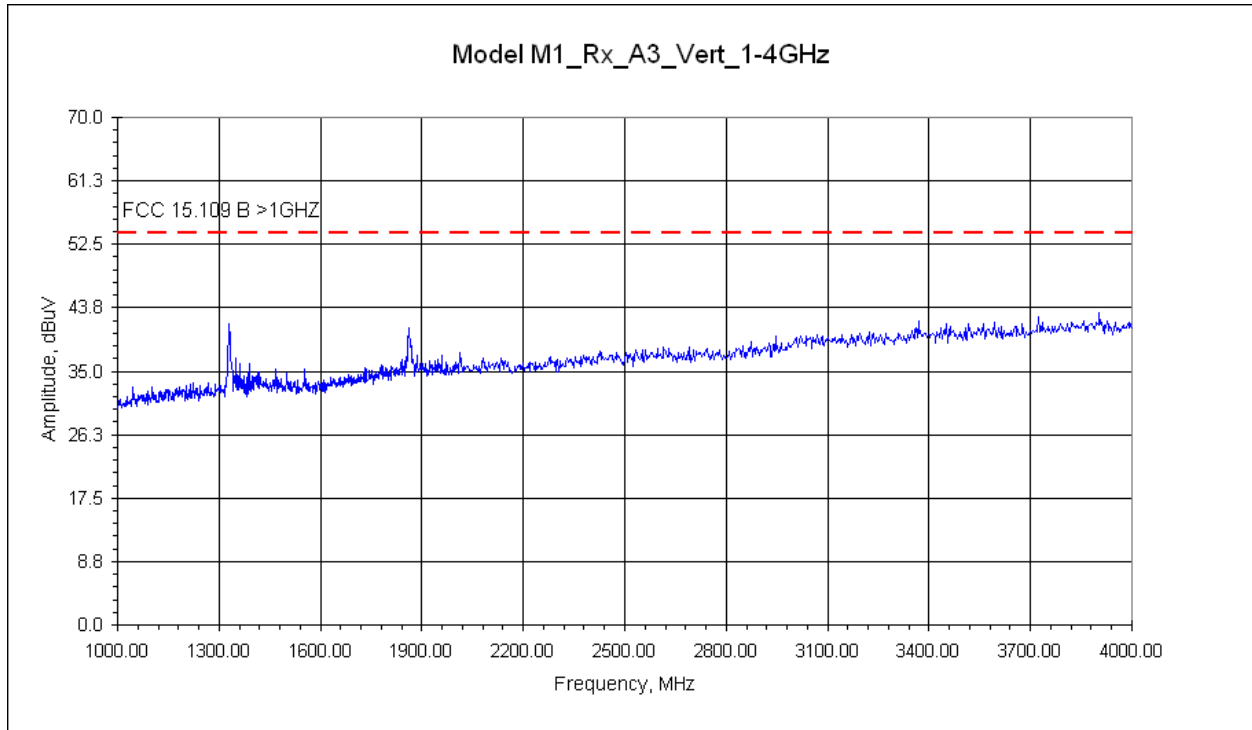


Reference only – to determine signals to be maximized

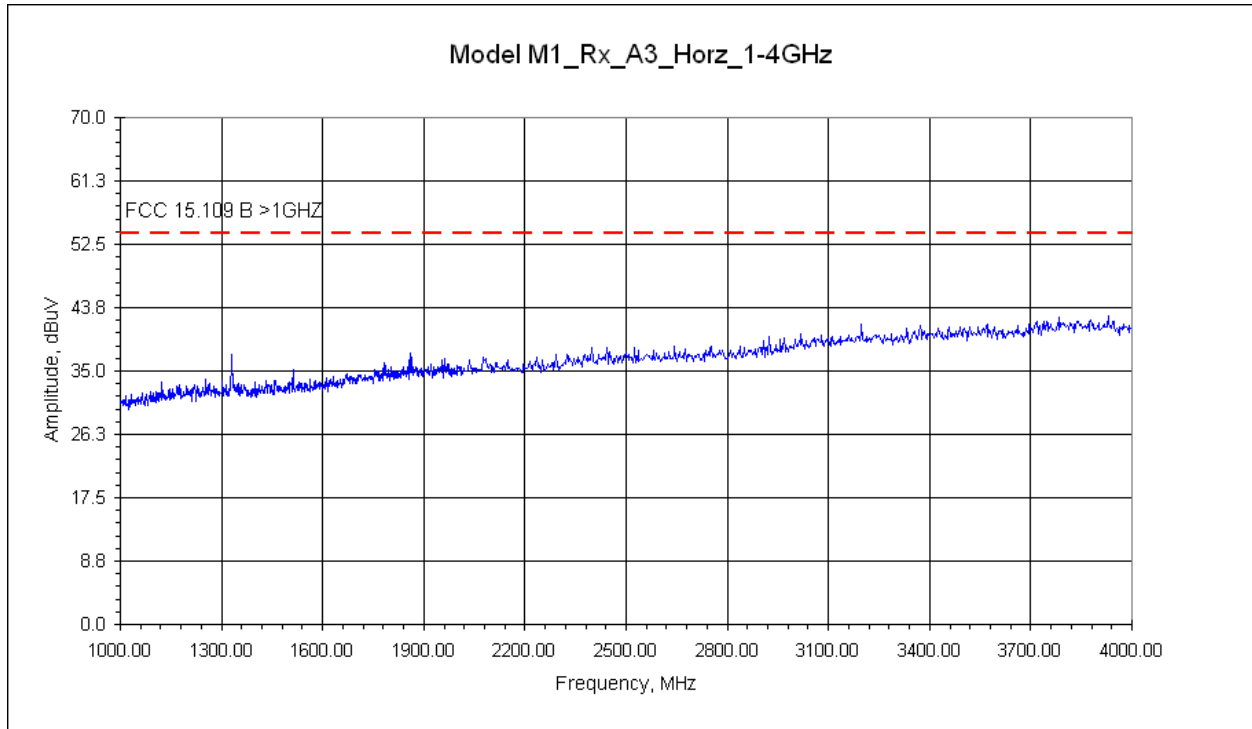
13.18 Pre-scan Plots: Radiated Emissions Product Axis 3 – Product Vertical & Rotated 90 Degrees

1GHz to 4GHz

Vertical



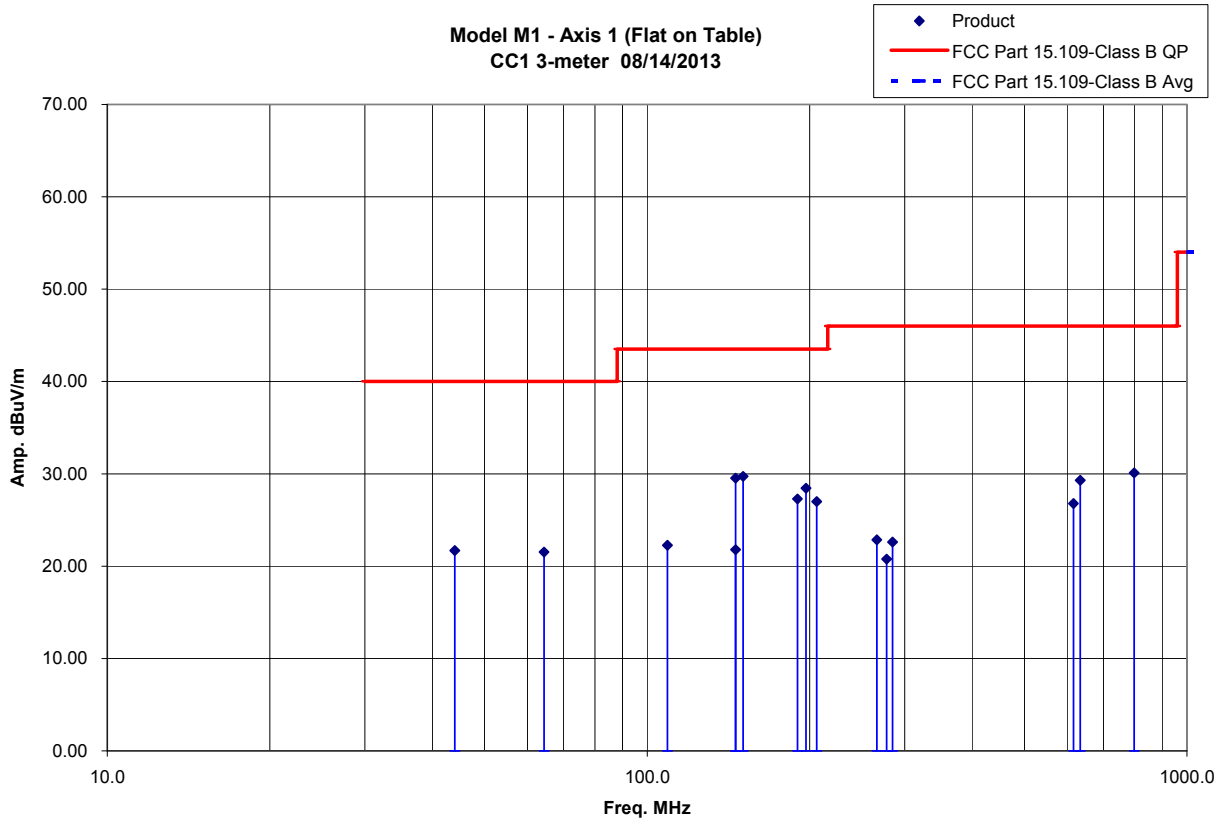
Horizontal



Reference only – to determine signals to be maximized

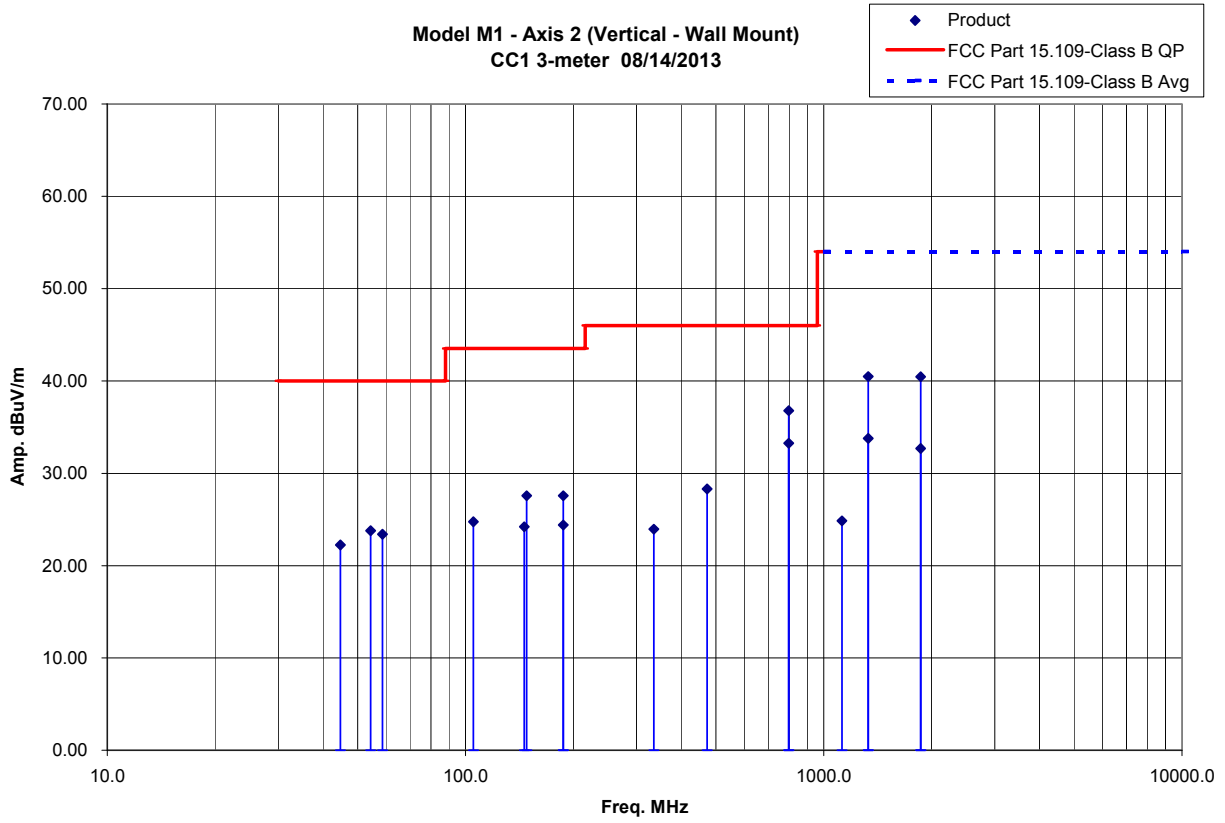
13.19 Final Plots: Radiated Emissions Product Axis 1 – Horizontal (Product Flat on Table)

FCC 15.109-Class B (30MHz to 1000MHz)



13.20 Final Plots: Radiated Emissions Product Axis 2 – Product Vertical on Table (Wall Mount)

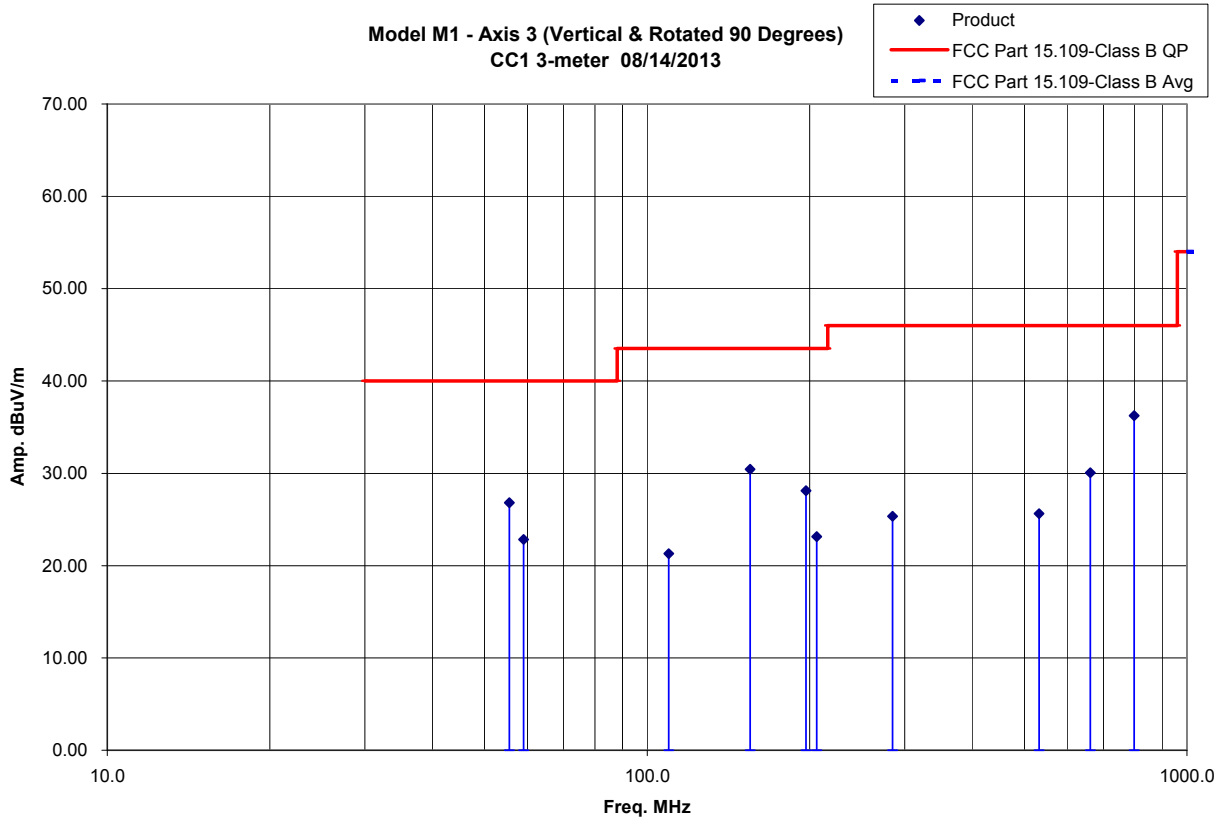
FCC 15.109-Class B (30MHz to 2GHz)



Note: Axis 2 was worst-case above 1GHz as determined from pre-scans

13.21 Final Plots: Radiated Emissions Product Axis 3 – Product Vertical & Rotated 90 Degrees

FCC 15.109-Class B (30MHz to 1000MHz)



Intertek

Report Number: 101262612DEN-001B

Issued: 10/17/2013

13.22 Test Data: Radiated Emissions Axis 1 – Horizontal (Product Flat on Table)

Radiated Electromagnetic Emissions

Test Report #: G101262620	Test Area: <u>CC1 Radiated</u>	Temperature: <u>23.4</u> °C
Test Method: <u>FCC 15.109 – Class B</u>	Test Date: <u>08/14/2013</u>	Relative Humidity: <u>33.5</u> %
EUT Model #: <u>M1</u>	EUT Power: <u>120V/ 60Hz</u>	Air Pressure: <u>82.7</u> kPa
EUT Serial #: <u>FCC1</u>		

Manufacturer: <u>Revolv</u> Description: <u>EUT Revolv Hub – RF-enabled Home Automation wireless hub</u> Notes: <u>AC Adapter: Unifive Model UN310-0520</u> <u>Product tested in normal idle/standby receive mode of operation</u>	Level Key Pk – Peak Qp – Quasi Peak Av - Average
---	---

Measurements: Axis 1 (Product flat on table – horizontal position)

Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Delta1	Delta2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.109 Class B	N/A	(MHz)
Measurements: 30MHz to 1000MHz - Product Axis 1 (Product flat on table – horizontal) – Vertical Antenna													
44.0000	38.02	Qp	0.77	11.10	28.20	0.00	21.69	V	1.00	250.7	- 18.31	NA	0.120
64.4000	40.99	Qp	0.77	7.90	28.13	0.00	21.53	V	1.00	184.5	- 18.47	NA	0.120
109.0000	36.81	Qp	0.77	12.60	27.92	0.00	22.26	V	1.00	246.2	- 21.24	NA	0.120
145.8665	43.84	Qp	0.81	12.61	27.74	0.00	29.53	V	1.00	168.7	- 13.97	NA	0.120
150.4965	43.98	Qp	0.82	12.65	27.72	0.00	29.74	V	1.00	198.4	- 13.76	NA	0.120
189.8565	42.40	Qp	0.92	11.49	27.53	0.00	27.28	V	1.00	319.7	- 16.22	NA	0.120
196.7965	42.96	Qp	0.94	12.06	27.50	0.00	28.46	V	1.00	311.5	- 15.04	NA	0.120
206.0665	42.30	Qp	0.96	11.21	27.45	0.00	27.01	V	1.10	14.6	- 16.49	NA	0.120
284.7865	34.91	Qp	1.15	13.69	27.12	0.00	22.63	V	1.34	205.5	- 23.37	NA	0.120
615.8487	34.53	Qp	1.72	18.88	28.34	0.00	26.79	V	1.27	61.7	- 19.21	NA	0.120
266.2500	35.77	Qp	1.10	13.15	27.16	0.00	22.86	V	1.00	358.2	- 23.14	NA	0.120
798.5000	34.97	Qp	1.97	21.14	27.97	0.00	30.12	V	1.80	239.0	- 15.88	NA	0.120
Measurements: 30MHz to 1000MHz Horizontal Antenna													
145.8700	36.10	Qp	0.81	12.61	27.74	0.00	21.79	H	2.42	96.0	- 21.71	NA	0.120
277.8635	33.23	Qp	1.13	13.51	27.11	0.00	20.77	H	1.70	285.0	- 25.23	NA	0.120
634.4100	36.86	Qp	1.75	19.01	28.33	0.00	29.30	H	1.56	99.7	- 16.70	NA	0.120

Intertek

Report Number: 101262612DEN-001B

Issued: 10/17/2013

13.23 Test Data: Radiated Emissions Axis 2 – Product Vertical on Table (Wall Mount)

Radiated Electromagnetic Emissions

Test Report #: G101262620	Test Area: <u>CC1 Radiated</u>	Temperature: <u>23.4</u> °C
Test Method: <u>FCC 15.109 – Class B</u>	Test Date: <u>08/14/2013</u>	Relative Humidity: <u>33.5</u> %
EUT Model #: <u>M1</u>	EUT Power: <u>120V/ 60Hz</u>	Air Pressure: <u>82.7</u> kPa
EUT Serial #: <u>FCC1</u>		

Manufacturer: <u>Revolv</u>	Level Key
EUT Description: <u>Revolv Hub – RF-enabled Home Automation wireless hub</u>	Pk – Peak
Notes: <u>AC Adapter: Unifive Model UN310-0520</u>	Qp – Quasi Peak
<u>Product tested in normal idle/standby mode of operation</u>	Av - Average

Measurements: Axis 2 (Product vertical – wall mount)

Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Delta1	Delta2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.109 Class B	N/A	(MHz)
Measurements: 30MHz to 1000MHz - Product Axis 2 (Product vertical – wall mount) – Vertical Antenna													
44.7000	39.00	Qp	0.77	10.68	28.20	0.00	22.25	V	1.00	334.6	- 17.75	NA	0.120
54.3000	43.66	Qp	0.77	7.53	28.18	0.00	23.78	V	1.00	90.0	- 16.22	NA	0.120
58.6333	43.24	Qp	0.77	7.56	28.16	0.00	23.41	V	1.00	282.3	- 16.59	NA	0.120
105.2679	39.96	Qp	0.77	11.95	27.94	0.00	24.75	V	1.00	37.1	- 18.75	NA	0.120
148.1879	41.87	Qp	0.82	12.62	27.73	0.00	27.58	V	1.00	165.1	- 15.92	NA	0.120
187.5562	42.85	Qp	0.91	11.36	27.54	0.00	27.58	V	1.00	229.1	- 15.92	NA	0.120
335.7262	35.58	Qp	1.26	14.41	27.31	0.00	23.95	V	1.65	159.4	- 22.05	NA	0.120
472.3447	37.97	Qp	1.49	17.05	28.21	0.00	28.30	V	1.00	168.6	- 17.70	NA	0.120
798.1000	41.67	Qp	1.97	21.12	27.97	0.00	36.80	V	1.30	104.0	- 9.20	NA	0.120
Measurements: 30MHz to 1000MHz Horizontal Antenna													
145.8600	38.51	Qp	0.81	12.61	27.74	0.00	24.20	H	1.70	99.8	- 19.30	NA	0.120
187.5327	39.67	Qp	0.91	11.35	27.54	0.00	24.40	H	2.12	263.4	- 19.10	NA	0.120
798.4000	38.11	Qp	1.97	21.14	27.97	0.00	33.25	H	1.87	187.8	- 12.75	NA	0.120

Radiated Electromagnetic Emissions

Test Report #: G101262620	Test Area: <u>CC1 Radiated</u>	Temperature: <u>23.4</u> °C
Test Method: <u>FCC 15.109 – Class B</u>	Test Date: <u>08/14/2013</u>	Relative Humidity: <u>33.5</u> %
EUT Model #: <u>M1</u>	EUT Power: <u>120V/ 60Hz</u>	Air Pressure: <u>82.7</u> kPa
EUT Serial #: <u>FCC1</u>		

Manufacturer: <u>Revolv</u>	Level Key
EUT Description: <u>Revolv Hub – RF-enabled Home Automation wireless hub</u>	Pk – Peak
Notes: <u>AC Adapter: Unifive Model UN310-0520</u>	Qp – Quasi Peak
<u>Product tested in normal idle/standby receive mode of operation</u>	Av - Average

Measurements: Axis 2 (Product vertical – wall mount) worst-case axis above 1GHz per pre-scans

Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Delta1	Delta2	RBW
<u>MHz</u>	<u>dBuV</u>	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.109 Class B Average	N/A	(MHz)
Measurements: 1GHz to 2GHz - Product Axis 2 (Product vertical – wall mount) – Vertical Antenna													
1123.9000	35.06	Av	2.36	24.62	37.19	0.00	24.85	V	1.59	176.5	- 29.15	N/A	1.000
1331.0000	42.89	Av	2.57	25.21	36.89	0.00	33.78	V	1.53	140.8	- 20.22	N/A	1.000
1863.1000	39.46	Av	3.07	27.14	36.97	0.00	32.70	V	1.53	140.8	- 21.30	N/A	1.000
Measurements: 1GHz to 2GHz - Horizontal Antenna													
1330.8000	49.60	Av	2.56	25.21	36.89	0.00	40.49	H	1.90	184.8	- 13.51	N/A	1.000
1863.0000	47.22	Av	3.07	27.14	36.97	0.00	40.46	H	1.90	137.5	- 13.54	N/A	1.000

13.24 Test Data: Radiated Emissions Axis 3 – Product Vertical & Rotated 90 Degrees

Radiated Electromagnetic Emissions

Test Report #: G101262620	Test Area: CC1 Radiated	Temperature: <u>23.4</u> °C
Test Method: FCC 15.109 – Class B	Test Date: <u>08/14/2013</u>	Relative Humidity: <u>33.5</u> %
EUT Model #: M1	EUT Power: <u>120V/ 60Hz</u>	Air Pressure: <u>82.7</u> kPa
EUT Serial #: FCC1		

Manufacturer: Revolv	Level Key Pk – Peak Qp – Quasi Peak Av - Average
EUT Description: Revolv Hub – RF-enabled Home Automation wireless hub	
Notes AC Adapter: Unifive Model UN310-0520	
Product tested in normal idle/standby receive mode of operation	

Measurements: Axis 3 (Product vertical & rotated 90 degrees – wall mount)

Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Delta1	Delta2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.109 Class B	N/A	(MHz)
Measurements: 30MHz to 1000MHz - Product Axis 3 (Product vertical & rotated 90 degrees) – Vertical Antenna													
55.5700	46.74	Qp	0.77	7.49	28.17	0.00	26.82	V	1.00	292.6	- 13.18	NA	0.120
59.0700	42.62	Qp	0.77	7.60	28.16	0.00	22.83	V	1.00	84.4	- 17.17	NA	0.120
109.6758	35.63	Qp	0.77	12.80	27.91	0.00	21.29	V	1.10	212.7	- 22.21	NA	0.120
155.1258	44.60	Qp	0.84	12.70	27.70	0.00	30.44	V	1.00	289.7	- 13.06	NA	0.120
196.7958	42.61	Qp	0.94	12.06	27.50	0.00	28.11	V	1.07	333.0	- 15.39	NA	0.120
284.7841	37.62	Qp	1.15	13.69	27.12	0.00	25.34	V	1.54	273.6	- 20.66	NA	0.120
798.3000	41.11	Qp	1.97	21.13	27.97	0.00	36.25	V	1.38	203.0	- 9.75	NA	0.120
Measurements: 30MHz to 1000MHz Horizontal Antenna													
206.0800	38.44	Qp	0.96	11.20	27.45	0.00	23.15	H	2.35	111.6	- 20.35	NA	0.120
532.0646	33.76	Qp	1.58	18.70	28.41	0.00	25.64	H	1.85	308.0	- 20.36	NA	0.120
662.1772	36.91	Qp	1.80	19.66	28.30	0.00	30.06	H	1.43	352.1	- 15.94	NA	0.120

Example calculation:

Measured Level	+	Cable Loss	+	Antenna Factor	-	Pre-Amp	+	Atten	=	Final Corrected Reading	-	Specification Limit	=	Delta Specification
(dBuV)		(dB)		(dB)		(dB)		(dB)		(dBuV/m)		(dBuV/m)		
20.0		3.0		5.0		10.0		0.0		18.0		40.0		- 22.0

Notes:

- 1) For due diligence, the product fully tested in (3) axes (product orientations).
- 2) The highest product clock was 266MHz – testing up to 2GHz required per standard.
- 3) Product tested in idle/standby receive mode of operation.

Intertek	
Report Number: 101262612DEN-001B	Issued: 10/17/2013

Deviations, Additions, or Exclusions: None

14 AC Mains Conducted Emissions - Transmitter**14.1 Method**

Unless otherwise stated no deviations were made from FCC Part 15.207.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

14.2 Test Equipment Used:

<u>Asset ID</u>	<u>Description</u>	<u>Manufacture</u>	<u>Model</u>	<u>Serial</u>	<u>Cal Date</u>	<u>Cal Due</u>
DEN-073	EMI Receiver	ROHDE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
18885	Transient Limiter	Hewlett-Packard	11947A	3107A00700	05/05/2013	05/05/2014
18914	Single Phase LISN	EMCO	3816/NM	9408-1003	04/11/2013	04/11/2014
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 1.0	VBU	VBU

14.3 Test Requirement/ Specification:

The product must pass the AC Conducted average and quasi-peak Class B Limits defined in FCC Part 15.207. The product is operated with all radios enabled and active.

14.4 Test Procedure:

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a defined impedance at all frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used.

The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.

The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

Equipment setup for conducted disturbance tests followed the guidelines of:

- ANSI C63.10: 2009, Section 6.2.

14.5 Test Results:

The sample tested was found to Comply.

14.6 Setup Photographs: AC Conducted Emissions - Transmitter

Test Setup – Conducted Emissions (Front View)

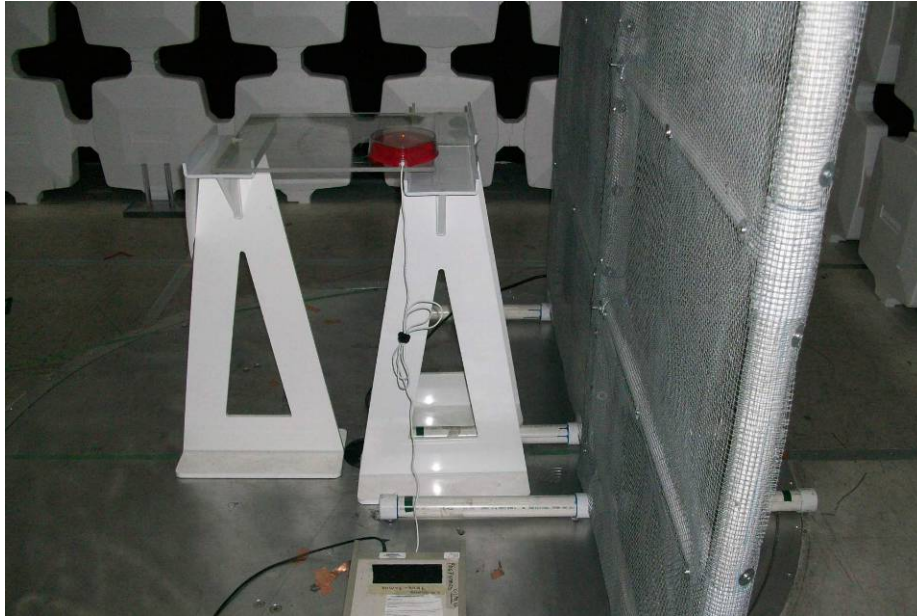


Test Setup – Conducted Emissions (Side View)



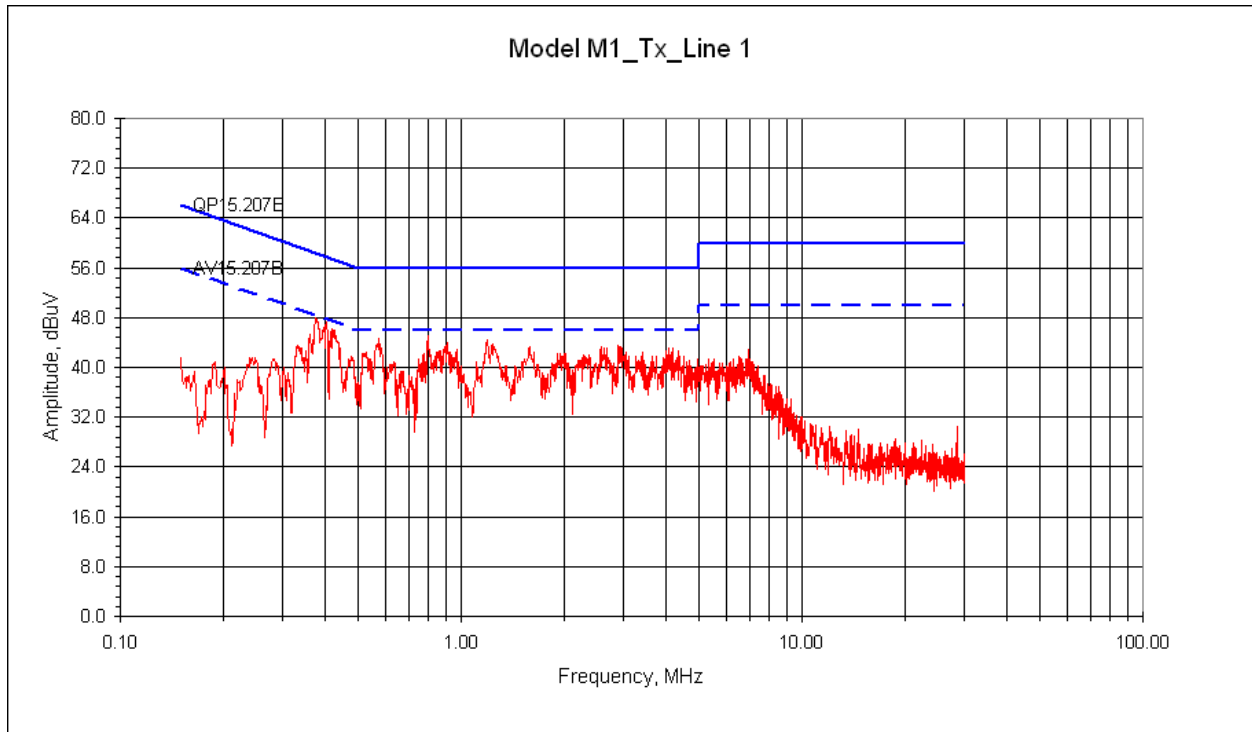
14.7 Set-up Photographs: AC Conducted Emissions - Transmitter

AC Conducted Emissions – Test Setup (Side View)

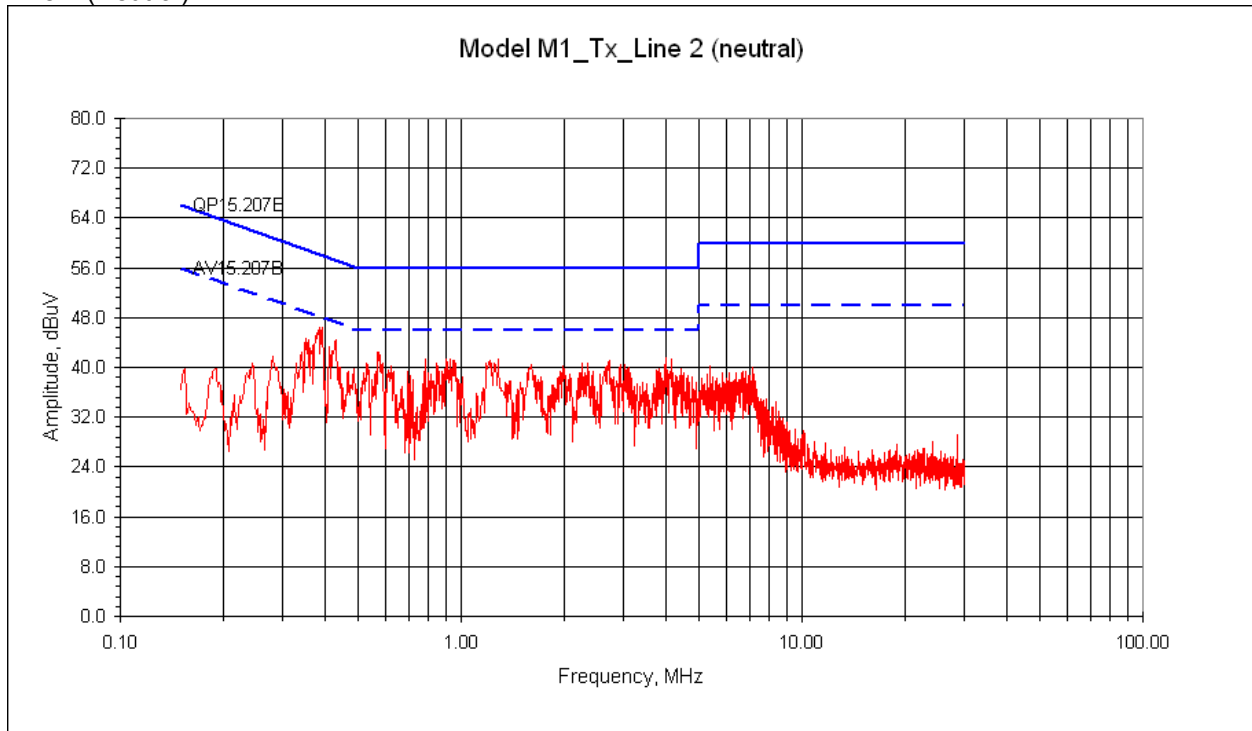


14.8 Plots: AC Mains Conducted Emissions - Transmitter

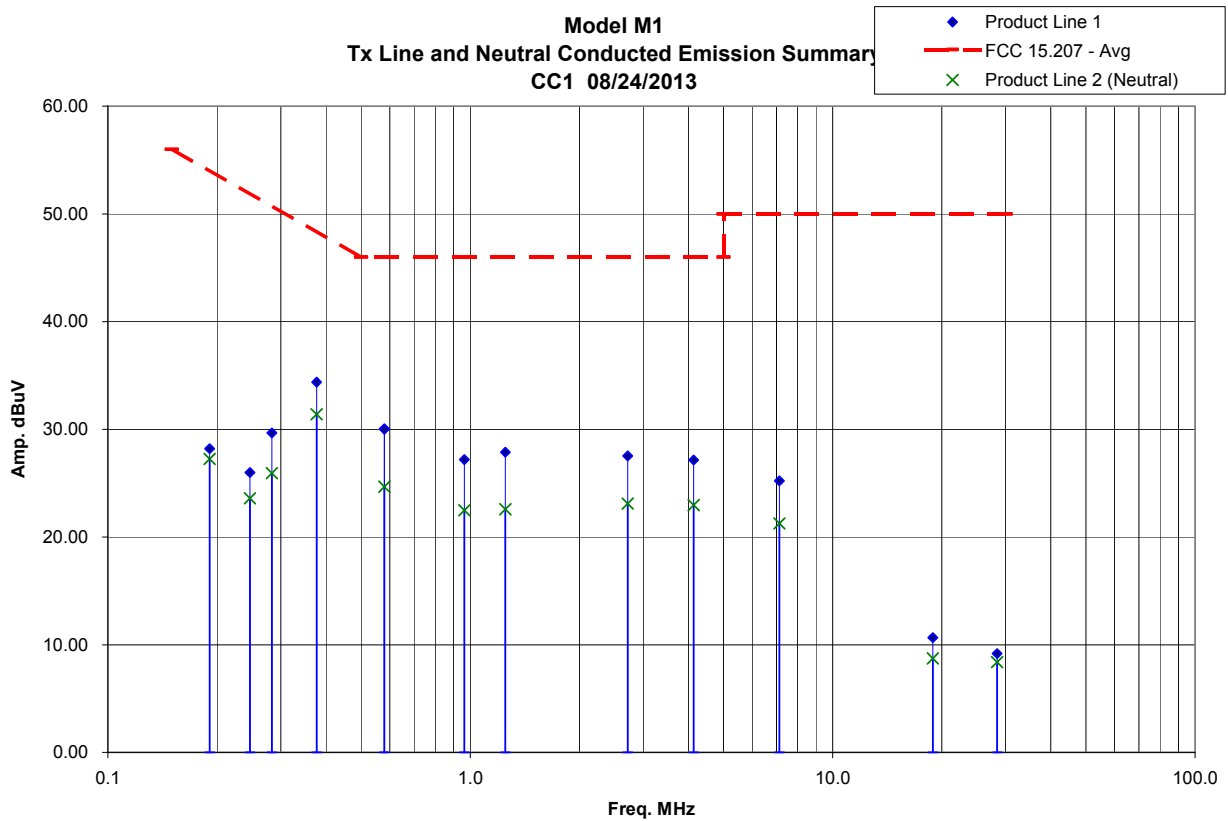
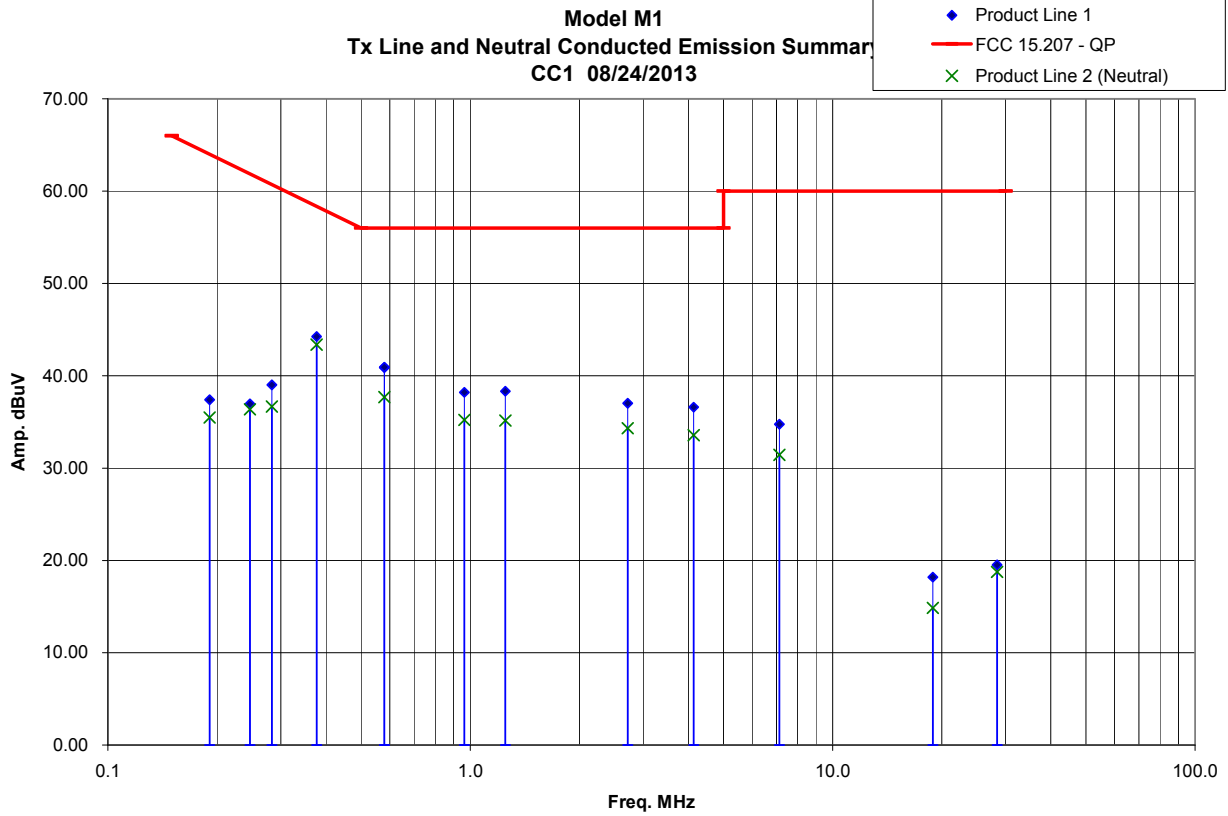
Line 1



Line 2 (Neutral)



14.9 Final Plots: AC Mains Conducted Emissions – Transmitter



Intertek

Report Number: 101262612DEN-001B

Issued: 10/17/2013

14.10 Test Data: AC Mains Conducted Emissions – Transmitter

Tx AC Conducted Electromagnetic Emissions

Test Report #:	G101262620	Test Area:	CC1 Conducted	Temperature:	23.5	C
Test Method:	FCC 15.207	Test Date:	24-Aug-2013	Relative Humidity:	22.8	%
EUT Model #:	M1	EUT Power:	120V/ 60Hz	Air Pressure:	82.8	kPa
EUT Serial #:	FCC1					
Manufacturer:	Revolv	Level Key				
EUT Description:	Revolv Hub – RF-enabled Home Automation	Pk - Peak	Nb - Narrow Band			
Notes:	AC Adapter: Model UN310-0520	Qp - QuasiPeak	Bb - Broad Band			
	Product tested in Tx mode of operation – all radios active	Av - Average				

FREQ	LEVEL	DET	CABLE	LISN	PREAMP	ATTEN	FINAL	TEST POINT	DELTA1	DELTA2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	Line 1 Line2 (Neutral)	FCC 15.107 Class B Average	FCC 15.107 Class B Qp	(MHz)
Line 1 Data – 150kHz to 30MHz											
0.191	18.11	Av	0.10	0.03	0.00	9.96	28.21	Line 1	- 25.79	NA	0.009
0.191	27.31	Qp	0.10	0.03	0.00	9.96	37.41	Line 1	NA	- 26.59	0.009
0.247	15.91	Av	0.10	0.03	0.00	9.96	26.00	Line 1	- 25.86	NA	0.009
0.247	26.87	Qp	0.10	0.03	0.00	9.96	36.96	Line 1	NA	- 24.90	0.009
0.283	19.57	Av	0.10	0.03	0.00	9.97	29.66	Line 1	- 21.05	NA	0.009
0.283	28.92	Qp	0.10	0.03	0.00	9.97	39.01	Line 1	NA	- 21.70	0.009
0.377	24.27	Av	0.10	0.03	0.00	9.97	34.37	Line 1	- 13.99	NA	0.009
0.377	34.15	Qp	0.10	0.03	0.00	9.97	44.25	Line 1	NA	- 14.11	0.009
0.579	19.95	Av	0.10	0.02	0.00	9.97	30.05	Line 1	- 15.95	NA	0.009
0.579	19.92	Av	0.10	0.02	0.00	9.97	30.02	Line 1	- 15.98	NA	0.009
0.579	30.78	Qp	0.10	0.02	0.00	9.97	40.88	Line 1	NA	- 15.12	0.009
0.579	30.83	Qp	0.10	0.02	0.00	9.97	40.93	Line 1	NA	- 15.07	0.009
0.963	16.99	Av	0.20	0.03	0.00	9.98	27.19	Line 1	- 18.81	NA	0.009
0.963	28.02	Qp	0.20	0.03	0.00	9.98	38.22	Line 1	NA	- 17.78	0.009
1.250	17.67	Av	0.20	0.03	0.00	9.98	27.88	Line 1	- 18.12	NA	0.009
1.250	28.11	Qp	0.20	0.03	0.00	9.98	38.32	Line 1	NA	- 17.68	0.009
2.718	17.31	Av	0.20	0.03	0.00	9.98	27.53	Line 1	- 18.47	NA	0.009
2.718	26.80	Qp	0.20	0.03	0.00	9.98	37.02	Line 1	NA	- 18.98	0.009
4.135	16.83	Av	0.30	0.04	0.00	9.98	27.15	Line 1	- 18.85	NA	0.009
4.135	26.29	Qp	0.30	0.04	0.00	9.98	36.61	Line 1	NA	- 19.39	0.009
7.131	14.75	Av	0.40	0.07	0.00	9.99	25.21	Line 1	- 24.79	NA	0.009
7.131	24.28	Qp	0.40	0.07	0.00	9.99	34.74	Line 1	NA	- 25.26	0.009
18.910	- 0.67	Av	1.10	0.20	0.00	10.02	10.65	Line 1	- 39.35	NA	0.009
18.910	6.88	Qp	1.10	0.20	0.00	10.02	18.20	Line 1	NA	- 41.80	0.009
28.429	- 2.29	Av	1.31	0.12	0.00	10.04	9.18	Line 1	- 40.82	NA	0.009
28.429	8.06	Qp	1.31	0.12	0.00	10.04	19.53	Line 1	NA	- 40.47	0.009
Line 2 (Neutral) Data – 150kHz to 30MHz											
0.191	17.15	Av	0.10	0.03	0.00	9.96	27.25	Line 2	- 26.75	NA	0.009

Intertek

Report Number: 101262612DEN-001B

Issued: 10/17/2013

0.191	25.38	Qp	0.10	0.03	0.00	9.96	35.48	Line 2	NA	- 28.52	0.009
0.247	13.50	Av	0.10	0.03	0.00	9.96	23.59	Line 2	- 28.28	NA	0.009
0.247	26.28	Qp	0.10	0.03	0.00	9.96	36.37	Line 2	NA	- 25.50	0.009
0.283	15.83	Av	0.10	0.03	0.00	9.97	25.92	Line 2	- 24.79	NA	0.009
0.283	26.57	Qp	0.10	0.03	0.00	9.97	36.66	Line 2	NA	- 24.05	0.009
0.377	21.31	Av	0.10	0.02	0.00	9.97	31.40	Line 2	- 16.95	NA	0.009
0.377	33.28	Qp	0.10	0.02	0.00	9.97	43.37	Line 2	NA	- 14.98	0.009
0.579	14.57	Av	0.10	0.02	0.00	9.97	24.67	Line 2	- 21.33	NA	0.009
0.579	27.59	Qp	0.10	0.02	0.00	9.97	37.69	Line 2	NA	- 18.31	0.009
0.963	12.27	Av	0.20	0.02	0.00	9.98	22.47	Line 2	- 23.53	NA	0.009
0.963	25.03	Qp	0.20	0.02	0.00	9.98	35.23	Line 2	NA	- 20.77	0.009
1.250	12.37	Av	0.20	0.03	0.00	9.98	22.58	Line 2	- 23.42	NA	0.009
1.250	24.95	Qp	0.20	0.03	0.00	9.98	35.16	Line 2	NA	- 20.84	0.009
2.718	12.89	Av	0.20	0.03	0.00	9.98	23.10	Line 2	- 22.90	NA	0.009
2.718	24.11	Qp	0.20	0.03	0.00	9.98	34.32	Line 2	NA	- 21.68	0.009
4.135	12.65	Av	0.30	0.03	0.00	9.98	22.97	Line 2	- 23.03	NA	0.009
4.135	23.24	Qp	0.30	0.03	0.00	9.98	33.56	Line 2	NA	- 22.44	0.009
7.131	10.79	Av	0.40	0.07	0.00	9.99	21.25	Line 2	- 28.75	NA	0.009
7.131	20.98	Qp	0.40	0.07	0.00	9.99	31.44	Line 2	NA	- 28.56	0.009
18.910	- 2.59	Av	1.10	0.20	0.00	10.02	8.73	Line 2	- 41.27	NA	0.009
18.910	3.53	Qp	1.10	0.20	0.00	10.02	14.85	Line 2	NA	- 45.15	0.009
28.429	- 3.17	Av	1.31	0.20	0.00	10.04	8.38	Line 2	- 41.62	NA	0.009
28.429	7.20	Qp	1.31	0.20	0.00	10.04	18.75	Line 2	NA	- 41.25	0.009

Example calculation:

Measured Level	+	Transducer, Cable Loss & Amplifier corrections	=	Corrected Reading	Specification Limit	-	Corrected Reading	=	Delta Specification
(dB μ V)		(dB)		(dB μ V/m)	(dB μ V/m)		(dB μ V/m)		
14.0		14.9		28.9	40.0		28.9		-11.1

Notes: All radios active during testing.

Deviations, Additions, or Exclusions: None

15 RF Exposure Requirement**15.1 Method**

Unless otherwise stated no deviations were made from FCC Part 2.1091.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

15.2 Test Requirement/ Specification:

- Power Density Limit for Frequency Range: 1500 to 100,000 MHz = 1.0mW/cm²

15.3 Test Results:

The sample tested was found to comply.

15.4 Test Data:

RF Exposure Requirements - MPE

Project #:	G101262612	Test Area:	Intertek Louisville
Test Method:	FCC CFR47 Part 1.1310	Test Date:	10/14/2013
EUT Model #:	M1		
EUT Serial #:	FCC1		
Manufacturer:	Revolv, Inc.		
EUT Description:	Wireless RF-enabled Home Automation Hub		
Notes:	WiFi Radio: 802.11b/g/n HT20 Bands		

The following limit is from table 1 (B) Limits for General Population/Uncontrolled Exposure in FCC part 1.1310:

Power Density Limit for Frequency Range: 1500 to 100,000 MHz = 1.0mW//cm²

The following calculation was used to determine compliance to the above limit. The calculation is from FCC OET bulletin 65.

$$\text{Power Density(S)} = PG/4\pi R^2 \text{ or } S = \text{EIRP}/4\pi R^2$$

Where:

S = power density (in appropriate units, e.g. mW/cm²)

P = power input to the antenna (mW).

G = numeric power gain of the antenna in the direction of interest relative to an isotropic radiator.

R = distance to the center of radiation of the antenna (cm)

In this case, 20cm will be used.

=====

WiFi 802.11b/g/n HT20 (2.4GHz) Band Radio

Maximum measured rf conducted port power input to antenna = 25.91dBm = 389.94mW

Maximum typical gain declared by the manufacture = +2.0 dBi = 1.58 (numeric gain)

Power Density

Power (mW)	Gain (dbi)	Gain numeric	Distance (cm)	Power Density (mW/cm ²)
389.94	+2.0	1.58	20	0.12255

Therefore: Power Density Margin (Δ Limit) = 0.12255 – 1.0 = - 0.87745 mW/cm²

To determine what minimum distance the product can satisfy the Power Density Limit:

$$R(\text{cm}) = \text{SQRT}[(P*G)/(4*\pi*S)] = 7.002 \text{ cm}$$

Therefore: Distance Margin (Δ Limit) = 7.002 cm – 20 cm = -12.998 cm

=====

Reference Conversion Equations:

1. Gain numeric = $10^{(\text{dBi}/10)}$
2. Gain (dBi) = $10 \log(\text{Gain numeric})$
3. dBm = dBuV/m – 107 (50 ohm system)
4. dBm to Watts (W) = $10^{((\text{dBm} - 30)/10)}$

16 Duty Cycle/ Duty Cycle Correction Factor

No duty cycle correction factor was utilized during this testing – therefore, product duty cycle verification was not applicable.

16.1 Method:

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC CFR47 15.35(c).

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

16.2 Test Requirement/Specification:

Unless otherwise specified, e.g. §15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

Determine the period of the pulse train, T, in mSec and record the results. T is defined as the time from the beginning of one pulse train to the beginning of the next pulse train.
Count the number of different types of pulses, N and record the results.
For each of the different types of pulses, count the number of occurrences within one pulse train.
Use the Duty Cycle Correction Factor, DCCF, from the results table and use it to adjust the field strength measurements recorded for radiated emissions.

- FCC 15.35(c)

16.3 Test Equipment Used:

16.4 Results:

Not applicable

16.5 Test Method:

- ANSI C63.10: 2009, Clause 7.5

16.6 Test Summary:

Duty Cycle Measurements	

16.7 Plots:

16.8 Test Data:

17 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements.

The measurement uncertainty figures were calculated and correspond to a coverage factor of $k = 2$, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Measurement uncertainty Table

Parameter	Uncertainty \pm	Notes
Radiated emissions, 10kHz to 30 MHz	3.4 dB	
Radiated emissions, 30 to 200 MHz HP	2.2 dB	
Radiated emissions, 30 to 200 MHz VP	3.8 dB	
Radiated emissions, 200 to 1000 MHz HP	2.8 dB	
Radiated emissions, 200 to 1000 MHz VP	2.7 dB	
Radiated emissions, 1 to 18 GHz	5.2 dB	
Conducted port emissions 10kHz to 1000 MHz	1.0 dB	
Conducted port emissions 1GHz to 26.5GHz	1.6 dB	
AC mains Conducted emissions, 9kHz to 30 MHz	3.14 dB	

18 Revision History

Revision Level	Date	Report Number	Notes
0	10/17/2013	101262612DEN-001B	Original Issue