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

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3162 BELICK STREET ● SANTA CLARA, CALIFORNIA 95054 ● PHONE (408) 748-3585 ● FAX (510) 489-6372
13501 MCCALLEN PASS ● AUSTIN, TX 78753 ● PHONE (512) 287-2500 ● FAX (512) 287-2513

August 5, 2016

Amimon
2 Maskit St Building D, 2nd Floor
Herzelia, Israel 46733

Dear Gabi Nocham,

Enclosed is the EMC Wireless test report for compliance testing of the Amimon, AMNCVRX01 as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Title 47 of the CFR, Part 15.407, Subpart E (UNII 1).

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

Sincerely yours,
MET LABORATORIES, INC.

Jennifer Warnell
Documentation Department

Reference: (\Amimon\ EMC89646B-FCC407 UNII 1 Rev. 1)

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Electromagnetic Compatibility Criteria
Test Report

for the

Amimon
Model AMNCVRX01

Tested under
The FCC Certification Rules
contained in
Title 47 of the CFR
15.407 Subpart E

MET Report: EMC89646B-FCC407 UNII 1 Rev. 1

August 5, 2016

Prepared For:

Amimon
2 Maskit St Building D, 2nd Floor
Herzelia, Israel 46733

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

Electromagnetic Compatibility Criteria
Test Report

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Amimon
Model AMNCVRX01

Tested under
The FCC Certification Rules
contained in
Title 47 of the CFR
15.407 Subpart E

Hadid Jones, Project Engineer
Electromagnetic Compatibility Lab

Jennifer Warnell
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Parts 15B, 15.407, of the FCC Rules under normal use and maintenance.

Asad Bajwa,
Director, Electromagnetic Compatibility Lab

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Report Status Sheet

Revision	Report Date	Reason for Revision
∅	June 29, 2016	Initial Issue.
1	August 5, 2016	Updated MPE.

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List of Terms and Abbreviations

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

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I. Executive Summary

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A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Amimon AMNCVRX01, with the requirements of Part 15, §15.407. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the AMNCVRX01. Amimon should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the AMNCVRX01, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.407, in accordance with Amimon, purchase order number 16000358. All tests were conducted using measurement procedure ANSI C63.4-2014.

FCC Reference	Description	Results
§15.203	Antenna Requirement	Compliant
§15.403(i)	26dB Occupied Bandwidth	Compliant
§15.407 (a)(1)	Maximum Conducted Output Power	Compliant
§15.407 (a)(1)	Maximum EIRP (Outdoor)	N/A*
§15.407 (a)(1)	Maximum Power Spectral Density	Compliant
§15.407 (b)(1)& (6 - 7)	Undesirable Emissions	Compliant
§15.407(b)(6)	Conducted Emission Limits	Compliant
§15.407(f)	RF Exposure	Compliant

Table 1. Executive Summary of EMC Part 15.407 ComplianceTesting

Note: *The EIRP was limited to 21 dBm.

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II. Equipment Configuration

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A. Overview

MET Laboratories, Inc. was contracted by Amimon to perform testing on the AMNCVRX01, under Amimon's purchase order number 16000358.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Amimon AMNCVRX01.

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

Model(s) Tested:	AMNCVRX01	
Model(s) Covered:	AMNCVRX01	
EUT Specifications:	Primary Power: 120 VAC, 60 Hz	
	FCC ID: VQSAMNCVRX01	
	Type of Modulations:	BPSK; OFDM
	Equipment Code:	NII
	Max. RF Output Power:	18.6 dBm
	EUT Frequency Ranges:	5150-5250 MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35º C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Type of Filing:	Original	
Evaluated by:	Hadid Jones	
Report Date(s):	August 5, 2016	

Table 2. EUT Summary

B. References

CFR 47, Part 15, Subpart E	Unlicensed National Information Infrastructure Devices (UNII)
ANSI C63.4:2014	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ISO/IEC 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
789033 D02 General UNII Test Procedures New Rules v01	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E

Table 3. References

C. Test Site

All testing was performed at MET Laboratories, Inc., 914 W. Patapsco Ave., Baltimore, MD 21230. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

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

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D. Description of Test Sample

The AMNCVRX01 video Sink module is designed to be at the receiver end of the WHDI downstream. The AMNCVRX01 receives wireless downstream transmission, demodulates it and regenerates the video, audio and control content transmitted by the WHDI source.

The receiver works in the 2.4GHz and 5GHz unlicensed bands.

The channel bandwidth can be operated at 40MHz, 20 MHz and 10MHz modes.

The AMNCVRX01 board has 5 receiving channels (Multiple-In), and single transmitting channel (Single-Out).

The AMNCVRX01 is a DFS Master device. It is equipped with all features and characteristics required to fully provide CAC and ISM requirements for Radar-Detection.

The AMNCVRX01 board is designed to be integrated with any custom-designed end-product, to form a complete product with standard video output and wireless capabilities.

The Petit-RX board is independent module, fully performing the wireless functionality of the WHDI video link.

The AMNCVRX01 has an approved BT module by muRata with FCC ID: VPYLBZY.

E. Equipment Configuration

Ref. ID	Name / Description	Model Number	Part Number	Serial Number	Revision
--	Camera Vision RX device	AMNCVRX01	--	--	--

Table 4. Equipment Configuration

F. Support Equipment

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

Ref. ID	Name / Description	Manufacturer	Model Number
1	PC Laptop	N/A	N/A
2	Debug Flat Cable	N/A	N/A
3	USB-to-Serial Converter (APP; MAGLAN)	ATEN	UC-232A
4	USB cable (optional)	N/A	N/A
5	Debug Board (APP; KITE)	Amimon	AMN043PCB
6	HDMI Cable	standard	standard
7	HDMI Pattern Generator	CYPRESS	CPHD-1
8	HDMI Monitor (not supplied)	Any	Any

Table 5. Support Equipment

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G. Ports and Cabling Information

Ref. ID	Port Name on EUT	Cable Description	Qty.	Shielded (Y/N)	Termination Point
1	RF connectors	N/A	3+5	N/A	J2, J3, J5, J4, J7, J8, J10, J11
2	DC Power	N/A	N/A	N/A	J14
3	USB	Telecommunication port	1	Yes	J15
4	UART	Telecommunication port	N/A	N/A	J16
5	debug	N/A	N/A	N/A	N/A
6	HDMI	I/O	N/A	N/A	J12

Table 6. Ports and Cabling Information

H. Mode of Operation

The AMNCVRX01 board can be set into Test mode, simulating continuous normal operating mode.

This mode is enabled by simple GUI provided by AMIMON's 'AppCom' Tool.

The tool enables setting the EUT to Transmit or Receive modes. It controls the center channel frequency, the operating channel bandwidth, and the TX channel power.

A complete description of operation is detailed in 'How to use AppCom Regulation control.doc' file.

I. Method of Monitoring EUT Operation

Slow blinking (on-off once during 1sec) blue LED indicates that board is functioning.

Fast blinking (on-off 3-4 times during 1sec) same LED, means that the board is out of calibration.

When this LED is not blinking this means that board has a certain problem.

Using the SW tool to configure the board, when configuration ended successfully a clear green indication appears, while a red bad indication appears when the desired configuration fails.

J. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

K. Disposition of EUT

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

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III. Electromagnetic Compatibility Criteria for Intentional Radiators

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

Test Requirement: **§ 15.203:** An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

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

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

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

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

Results: The EUT as tested is compliant the criteria of §15.203. The EUT has a unique reverse polarity antenna.

Test Engineer(s): Hadid Jones

Test Date(s): 01/12/16

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15. 403(i) 26dB Bandwidth

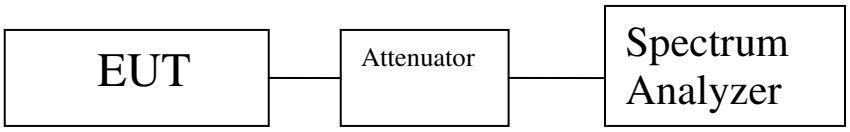
Test Requirements: **§ 15.403(i):** For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

Test Procedure: The transmitter was set to low, mid, and high operating frequencies at the highest output power and connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately equal to 1% of the total emission bandwidth, VBW > RBW. The 26 dB Bandwidth was measured and recorded.

Test Results The 26 dB Bandwidth was compliant with the requirements of this section.

Test Engineer(s): Hadid Jones

Test Date(s): 02/13/16



OBW 10MHz	
Frequency MHz	**-26dB**
5175	21.50
5215	20.96
5245	20.65
OBW 20MHz	
Frequency MHz	**-26dB**
5180	22.43
5220	20.94
5240	20.52
OBW 40MHz	
Frequency MHz	**-26dB**
5190	57.86
5230	58.6

Table 7. Occupied Bandwidth, Test Results

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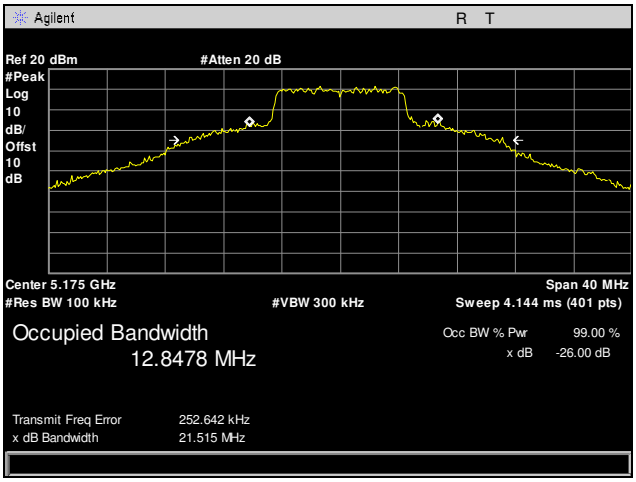
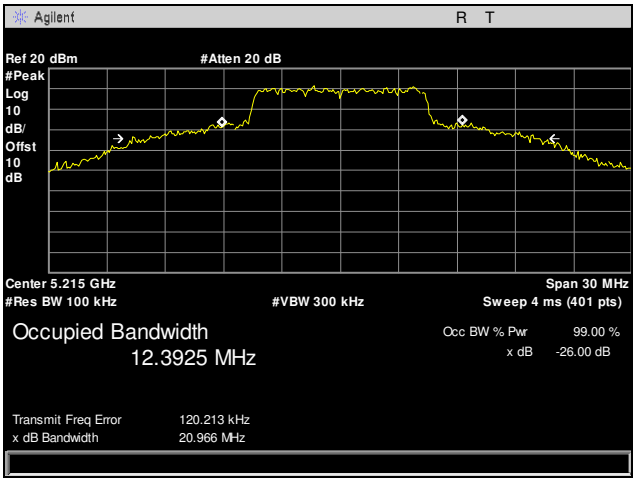
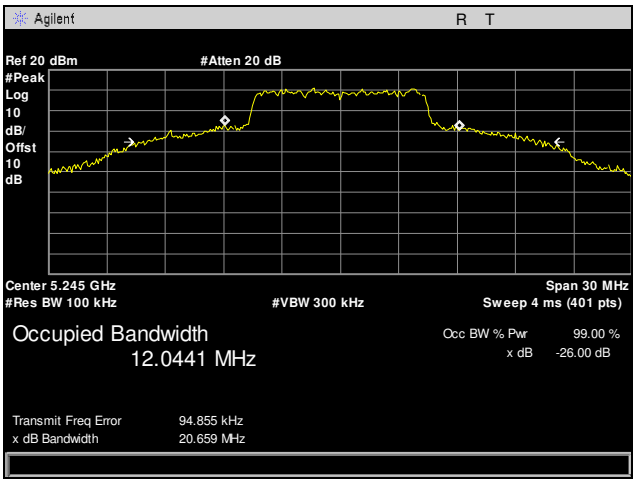
Occupied Bandwidth, 10 MHz



Plot 1. Occupied Bandwidth, Low Channel, 10 MHz



Plot 2. Occupied Bandwidth, Mid Channel, 10 MHz



Plot 3. Occupied Bandwidth, High Channel, 10 MHz

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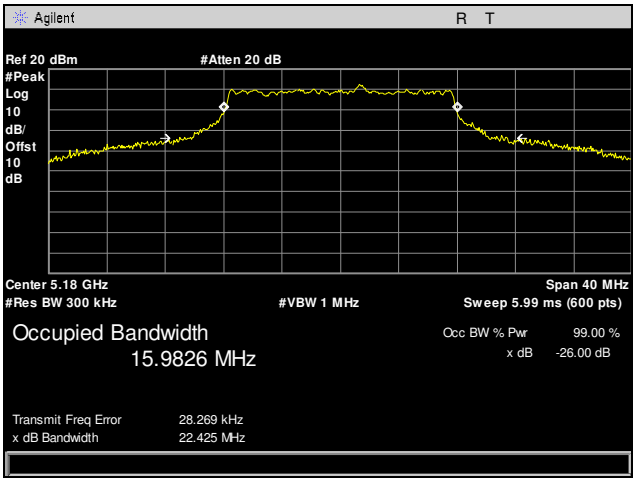
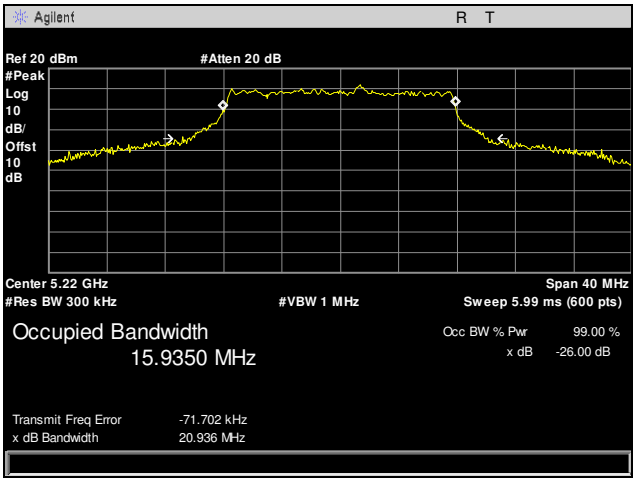
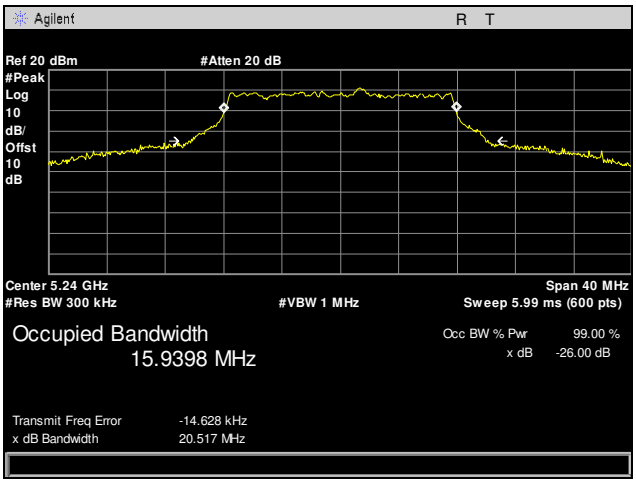
Occupied Bandwidth, 20 MHz



Plot 4. Occupied Bandwidth, Low Channel, 20 MHz



Plot 5. Occupied Bandwidth, Mid Channel, 20 MHz



Plot 6. Occupied Bandwidth, High Channel, 20 MHz

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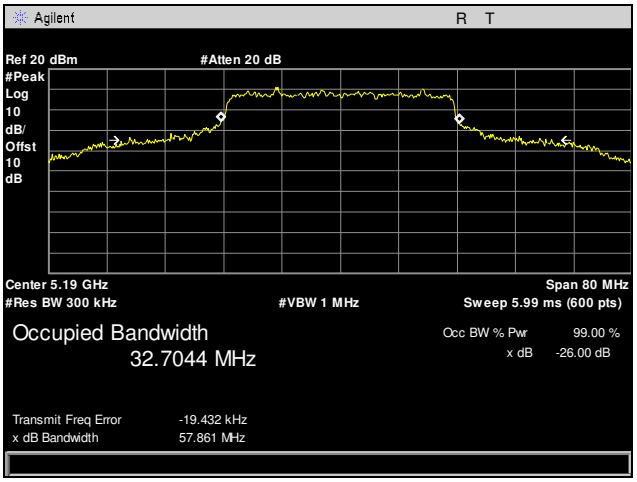
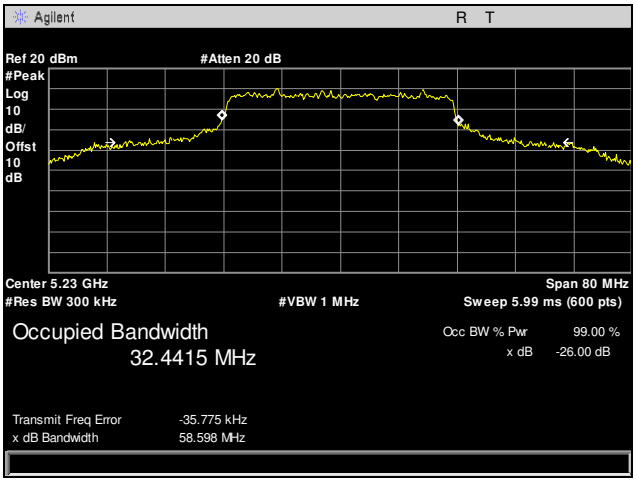
Occupied Bandwidth, 40 MHz



Plot 7. Occupied Bandwidth, Low Channel, 40 MHz



Plot 8. Occupied Bandwidth, High Channel, 40 MHz

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Electromagnetic Compatibility Criteria for Intentional Radiators

§15. 407(a)(1) Maximum Conducted Output Power

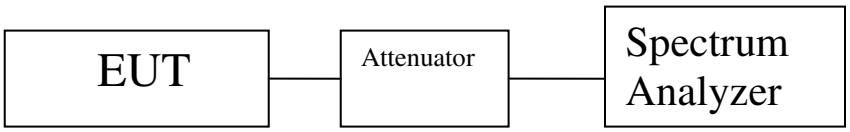
Test Requirements: **§15.407(a)(1)(i):** For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

Test Procedure: The EUT was connected to a spectrum analyzer through a cable and attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels. Its power was measured according to measurement method SA-1, as described in 789033 D02 General UNII Test Procedures v01.

Test Results: The EUT as tested is compliant with the requirements of this section.

Test Engineer(s): Hadid Jones

Test Date(s): 02/13/16



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Maximum Output Power 10MHz Band (FCC)								
	Frequency MHz	**Conducted Power (dBm)**	**Conducted Power limit (dBm)**	**Conducted Power Margin**	**Antenna Gain**	**EIRP**	**EIRP Limit (dBm)**	**EIPP Margin (dB)**
UNII 1	5175	18.3	19	**-0.7**	2	20.3	21	**-0.7**
	5215	18.4	19	**-0.6**	2	20.4	21	**-0.6**
	5245	17.9	19	**-1.1**	2	19.9	21	**-1.1**
Maximum Output Power 20MHz Band (FCC)								
	Frequency MHz	**Conducted Power (dBm)**	**Conducted Power limit (dBm)**	**Conducted Power Margin**	**Antenna Gain**	**EIRP**	**EIRP Limit (dBm)**	**EIPP Margin (dB)**
UNII 1	5180	18.5	19	**-0.5**	2	20.5	21	**-0.5**
	5220	18.6	19	**-0.4**	2	20.6	21	**-0.4**
	5240	18.1	19	**-0.9**	2	20.1	21	**-0.9**
Maximum Output Power 40MHz Band (FCC)								
	Frequency MHz	**Conducted Power (dBm)**	**Conducted Power limit (dBm)**	**Conducted Power Margin**	**Antenna Gain**	**EIRP**	**EIRP Limit (dBm)**	**EIPP Margin (dB)**
UNII 1	5190	17.1	19	**-1.9**	2	19.1	21	**-1.9**
	5230	18.5	19	**-0.5**	2	20.5	21	**-0.5**

Table 8. Output Power, Test Results

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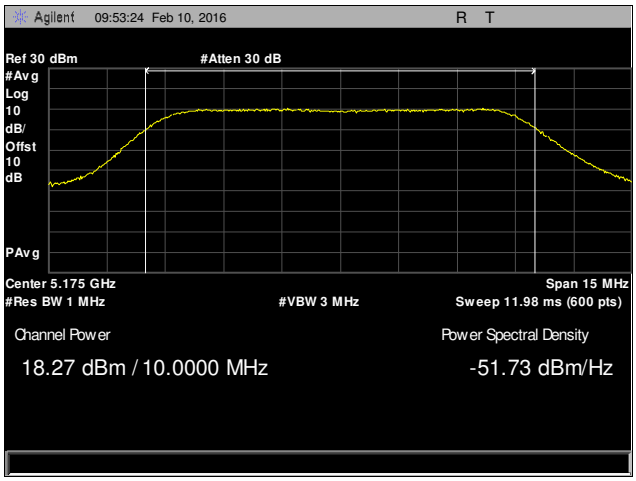
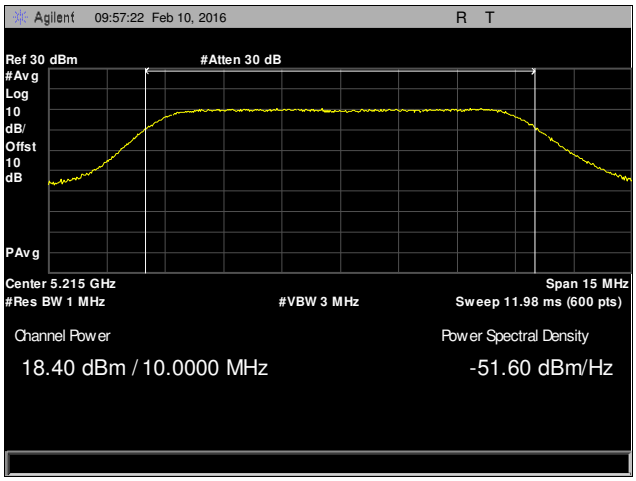
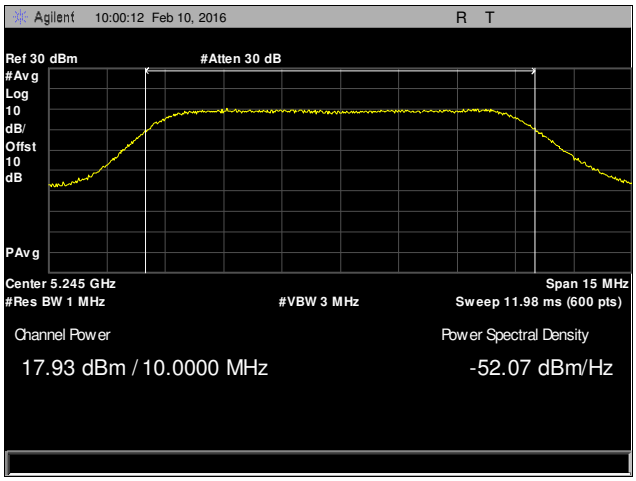
Output Power, 10 MHz



Plot 9. Output Power, Low Channel, 10 MHz



Plot 10. Output Power, Mid Channel, 10 MHz



Plot 11. Output Power, High Channel, 10 MHz

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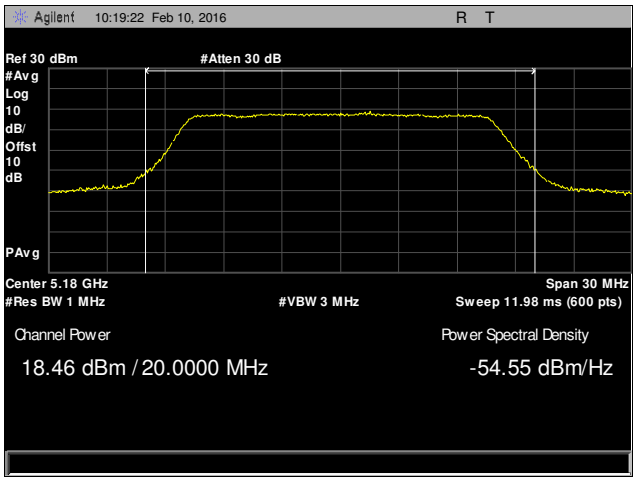
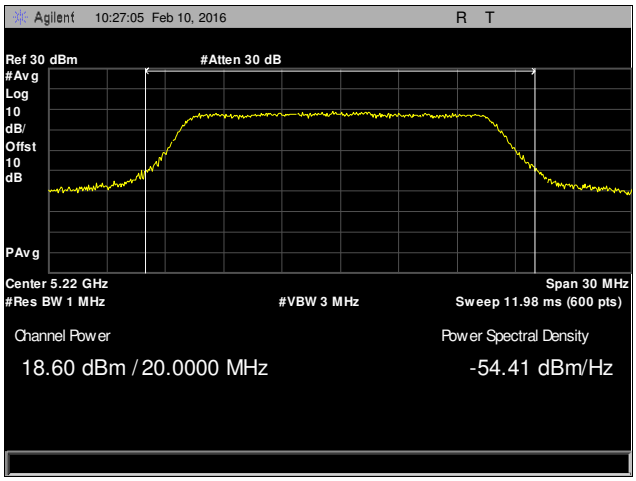
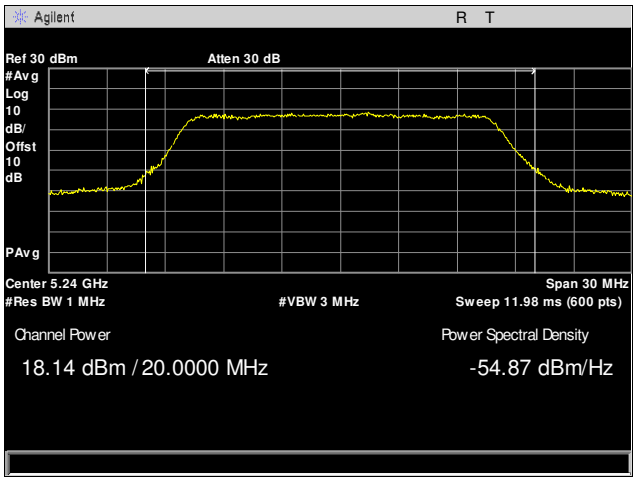
Output Power, 20 MHz



Plot 12. Output Power, Low Channel, 20 MHz



Plot 13. Output Power, Mid Channel, 20 MHz



Plot 14. Output Power, High Channel, 20 MHz

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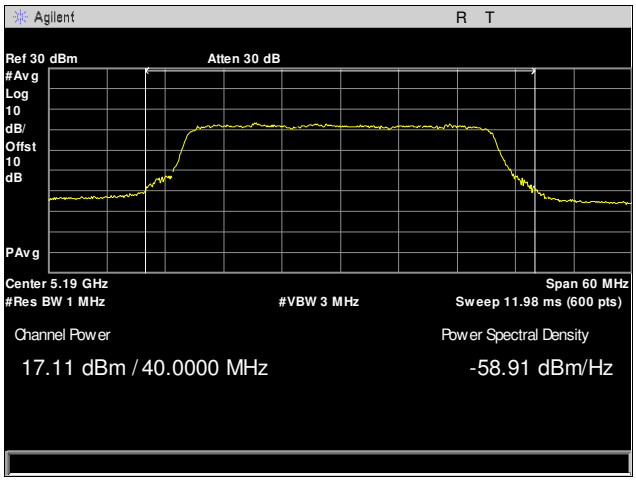
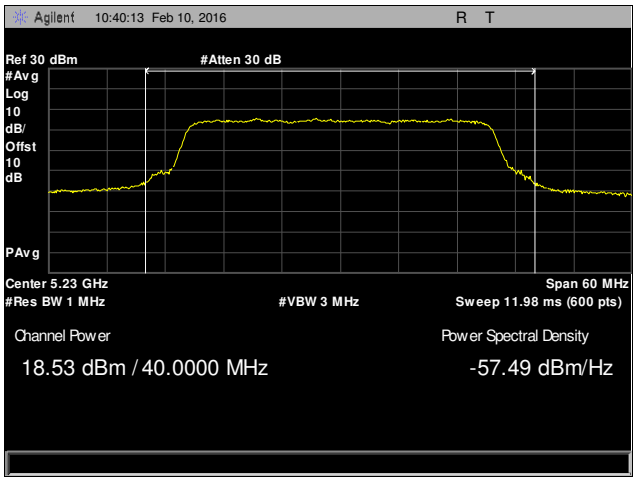
Output Power, 40 MHz



Plot 15. Output Power, Low Channel, 40 MHz



Plot 16. Output Power, High Channel, 40 MHz

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Electromagnetic Compatibility Criteria for Intentional Radiators

§15.407(a)(1) Maximum Power Spectral Density

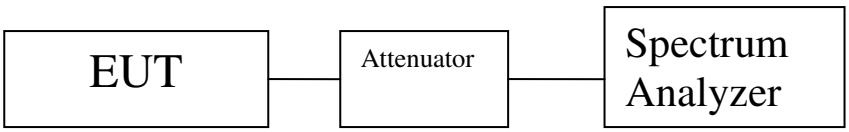
Test Requirements: **§15.407(a)(1)(i):** For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Test Procedure: The EUT was connected to a spectrum analyzer through a cable and attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels. Its power was measured according KDB 789033 D02 General UNII Test Procedures v01.

Test Results: The EUT as tested is compliant with the requirements of this section.

Test Engineer(s): Hadid Jones

Test Date(s): 02/14/16



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PSD 10MHz Band (FCC)					
	Frequency MHz	**PSD**	**PSD Limit (dBm)**	**PSD Margin**	**Antenna Gain**
UNII 1	5175	9.13	17	**-7.9**	2
	5215	9.8	17	**-7.2**	2
	5245	9.2	17	**-7.8**	2
PSD 20MHz Band (FCC)					
	Frequency MHz	**PSD**	**PSD Limit (dBm)**	**PSD Margin**	**Antenna Gain**
UNII 1	5180	7.97	17	**-9.03**	2
	5220	8.04	17	**-8.96**	2
	5240	7.34	17	**-9.66**	2
PSD 40MHz Band (FCC)					
	Frequency MHz	**PSD**	**PSD Limit (dBm)**	**PSD Margin**	**Antenna Gain**
UNII 1	5190	3.90	17	**-13.1**	2
	5230	4.9	17	**-12.1**	2

Table 9. Peak Spectral Power, Test Results

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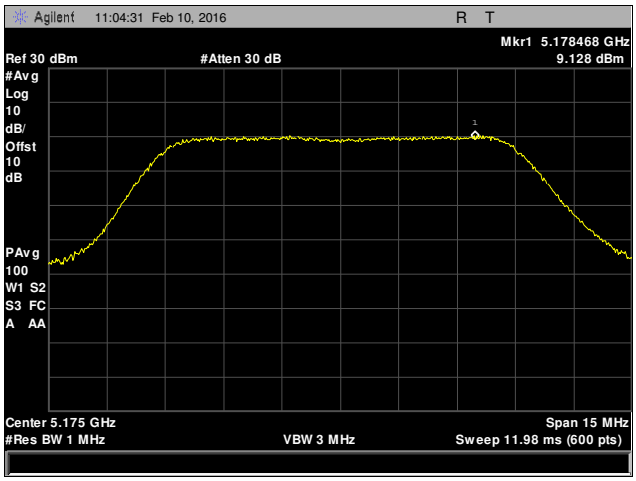
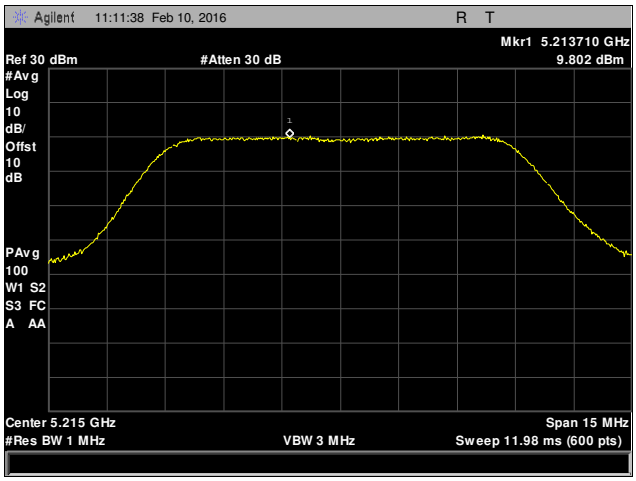
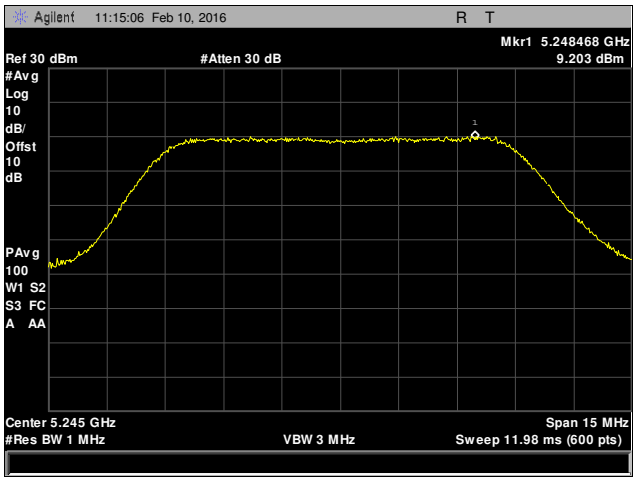
Peak Spectral Density, 10 MHz



Plot 17. Peak Spectral Density, Low Channel, 10 MHz



Plot 18. Peak Spectral Density, Mid Channel, 10 MHz



Plot 19. Peak Spectral Density, High Channel, 10 MHz

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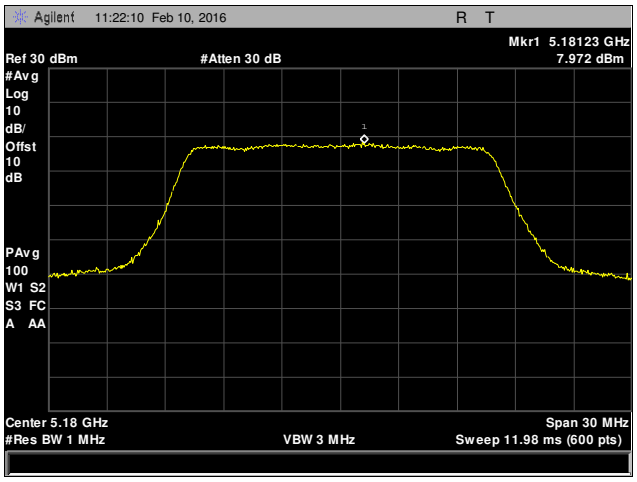
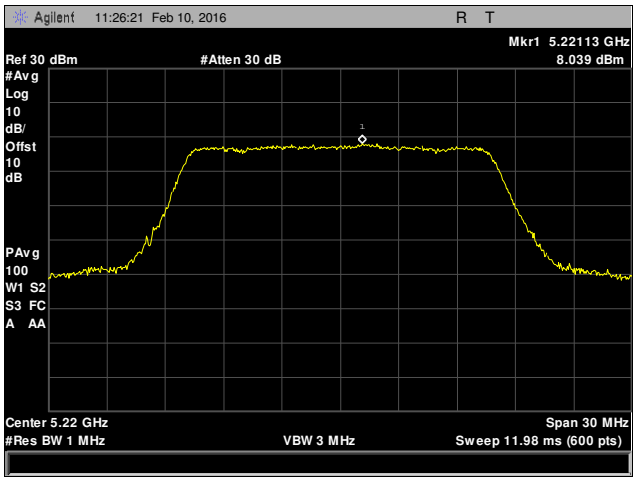
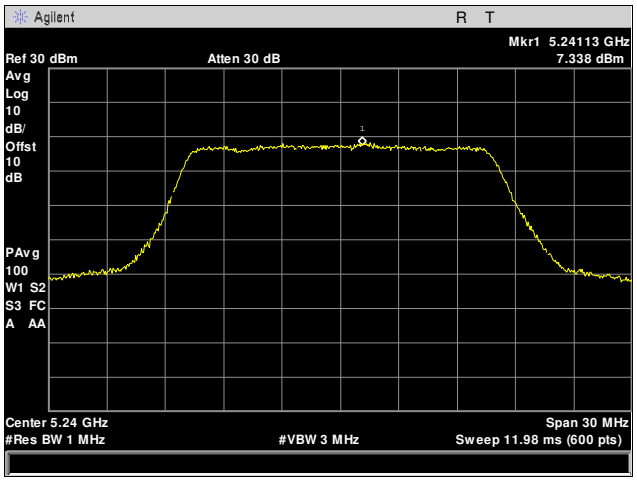
Peak Spectral Density, 20 MHz



Plot 20. Peak Spectral Density, Low Channel, 20 MHz



Plot 21. Peak Spectral Density, Mid Channel, 20 MHz



Plot 22. Peak Spectral Density, High Channel, 20 MHz

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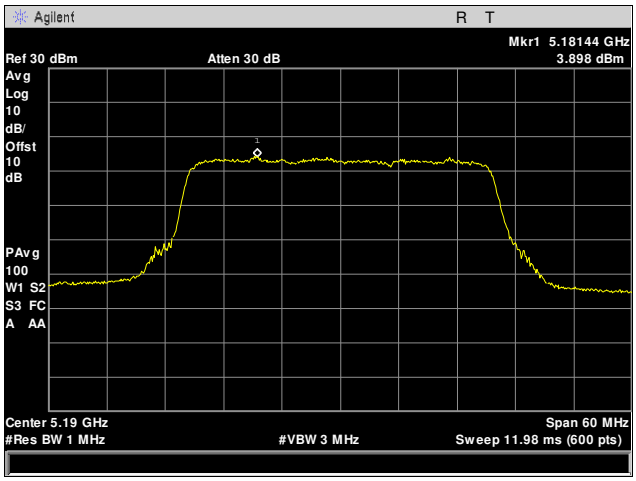
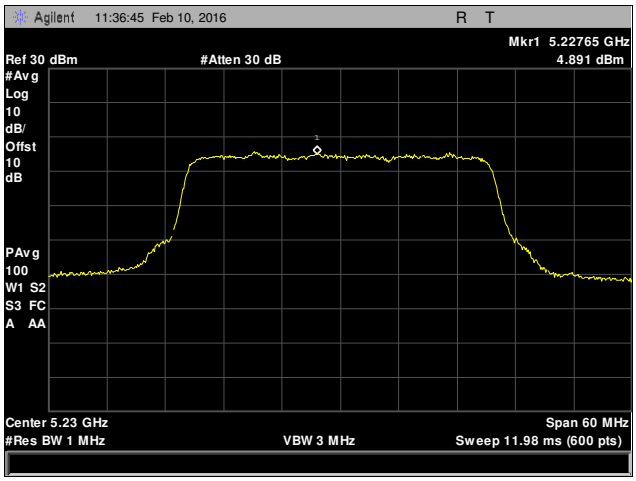
Peak Spectral Density, 40 MHz



Plot 23. Peak Spectral Density, Low Channel, 40 MHz



Plot 24. Peak Spectral Density, High Channel, 40 MHz

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Electromagnetic Compatibility Criteria for Intentional Radiators

§15.407(b)(1) & (6 – 7) Undesirable Emissions

Test Requirements:

§ 15.407(b)(1): For transmitters operating in the 5.15-5.25 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz.

§ 15.407(b)(6): Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in Section 15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in Section 15.207.

§ 15.407(b)(7): The provisions of Section 15.205 of this part apply to intentional radiators operating under this section.

Test Procedure:

The EUT was placed on a non-conducting stand on a turntable in a chamber. To find the maximum emission the EUT was set to transmit on low, mid, and high channels. Additionally, the turntable was rotated 360 degrees, the EUT was oriented through its three orthogonal axes, and the receive antenna height was varied in order to maximize emissions.

For frequencies from 30 MHz to 1 GHz, measurements were first made using a peak detector with a 100 kHz resolution bandwidth. Emissions which exceeded the limits were re-measured using a quasi-peak detector with a 120 kHz resolution bandwidth.

Above 1 GHz, measurements were made pursuant the method described in FCC KDB 789033 D02 General UNII Test Procedure New Rules v01. The equation, **EIRP= E + 20 log D – 104.8** was used to convert field strength to EIRP (**E** = field strength (dBµV/m) and **D** = Reference measurement distance**).**

For emissions above 1 GHz and in restricted bands, measurements of the field strength were made with a peak detector and an average detector and compared with the limits of 15.209.

As an alternative, according to FCC KDB 789033 D02 General UNII Test Procedure New Rules v01, all emissions above 1 GHz that comply with the peak and average limits of 15.209 satisfy the requirements of unwanted emissions in 15.407.

Test Results:

For below 1 GHz, the EUT was compliant with the requirements of this section.

For above 1 GHz, the EUT was compliant with the requirements of this section.

Note 1: From 30-1000MHz and 7-18GHz, the worst case configuration is reported, i.e. 40MHz BW.
Note 2: For the 15.209 average limit, the highest spurious emissions were found at the restricted band edge closest to the U-NII 1 band edge.

Test Engineer(s): Hadid Jones

Test Date(s): 06/14/16

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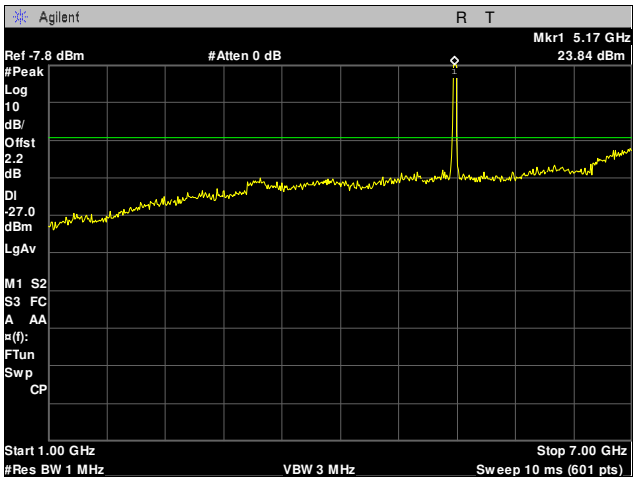
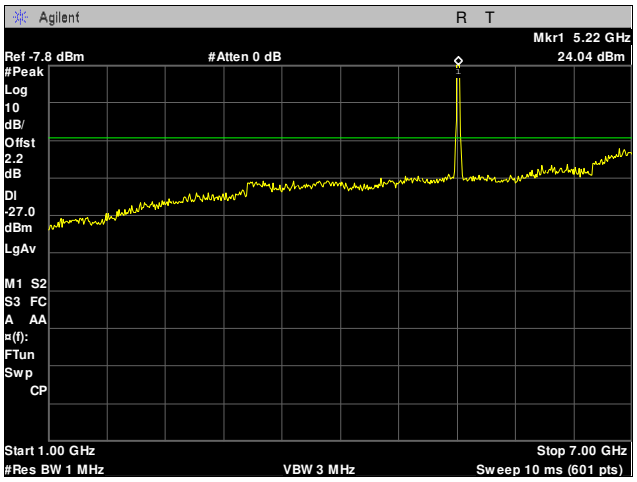
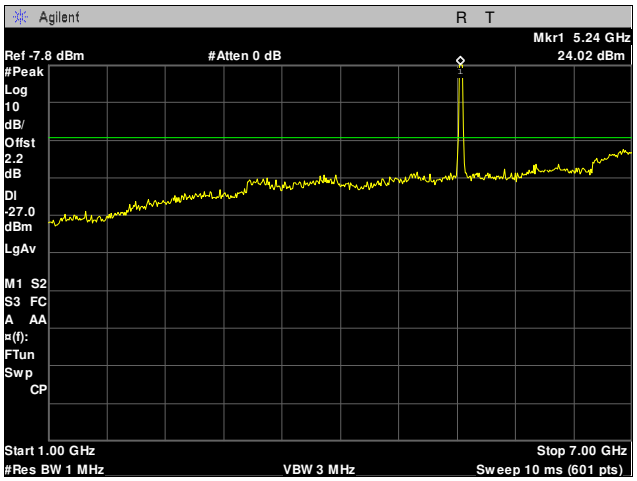
Radiated Spurious Emissions, 10 MHz



Plot 25. Radiated Spurious Emissions, Low Channel, 10 MHz, 1 GHz – 7 GHz



Plot 26. Radiated Spurious Emissions, Mid Channel, 10 MHz, 1 GHz – 7 GHz



Plot 27. Radiated Spurious Emissions, High Channel, 10 MHz, 1 GHz – 7 GHz

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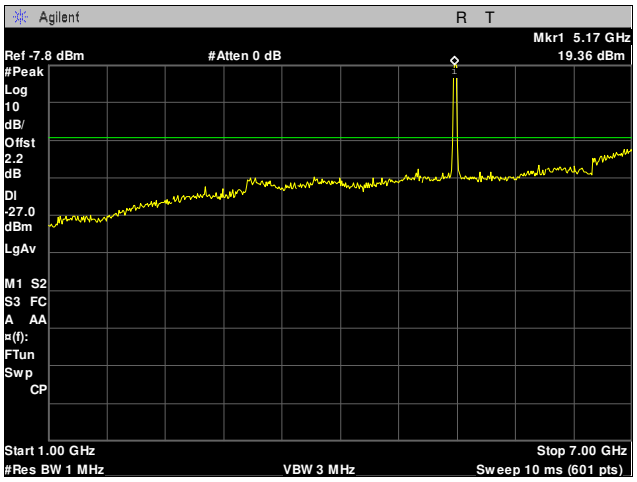
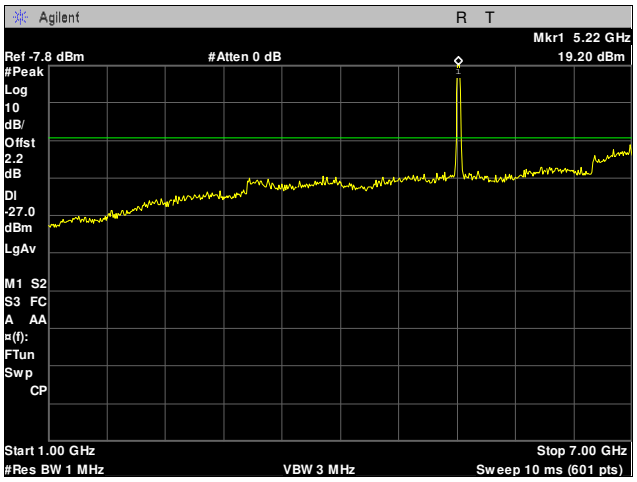
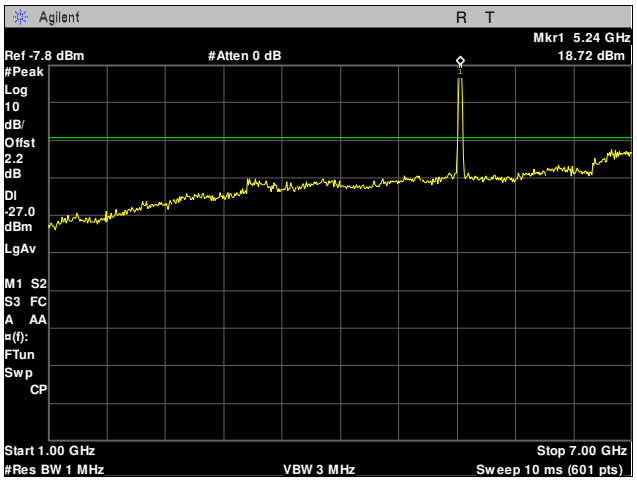
Radiated Spurious Emissions, 20 MHz



Plot 28. Radiated Spurious Emissions, Low Channel, 20 MHz, 1 GHz – 7 GHz



Plot 29. Radiated Spurious Emissions, Mid Channel, 20 MHz, 1 GHz – 7 GHz



Plot 30. Radiated Spurious Emissions, High Channel, 20 MHz, 1 GHz – 7 GHz

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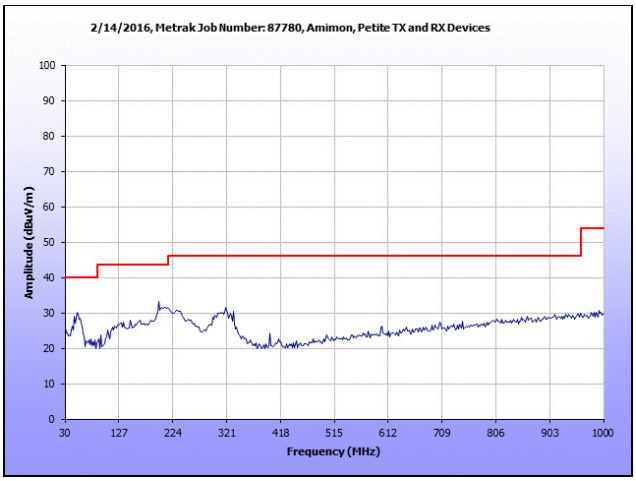
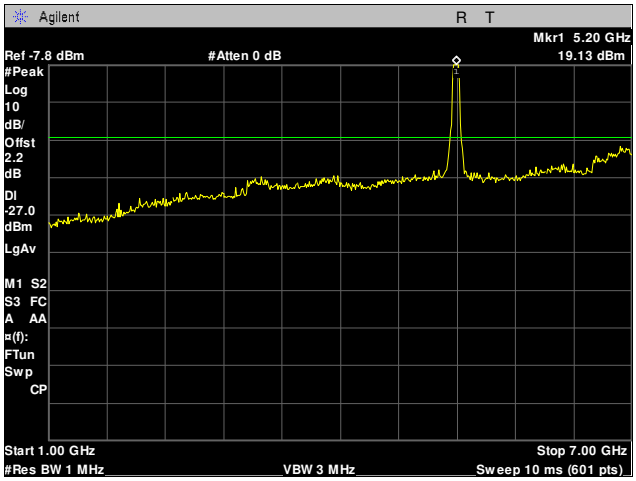
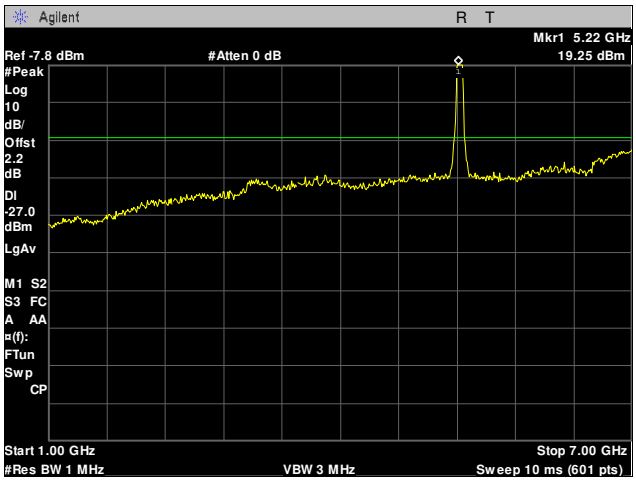
Radiated Spurious Emissions, 40 MHz



Plot 31. Radiated Spurious Emissions, Low Channel, 40 MHz, 30 MHz – 1 GHz



Plot 32. Radiated Spurious Emissions, Low Channel, 40 MHz, 1 GHz – 7 GHz



Plot 33. Radiated Spurious Emissions, High Channel, 40 MHz, 1 GHz – 7 GHz

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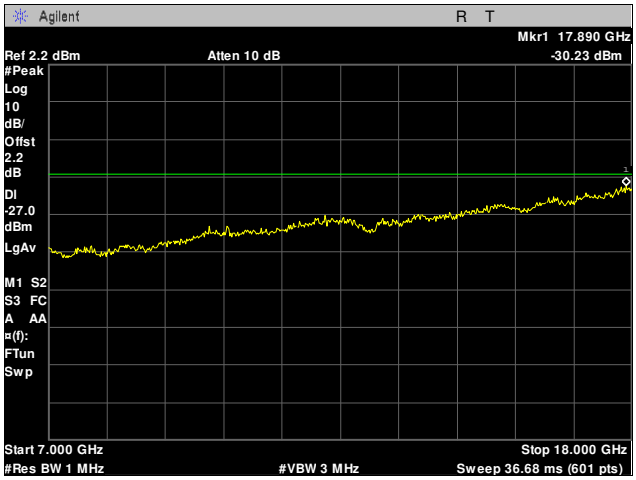

Plot 34. Radiated Spurious Emissions, Low Channel, 40 MHz, 7 GHz – 18 GHz

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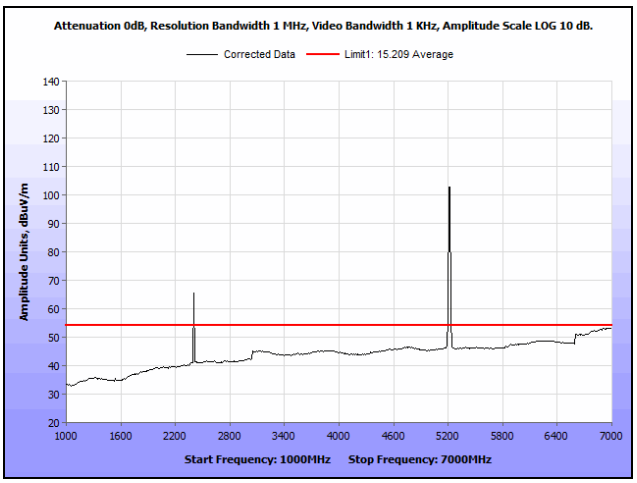
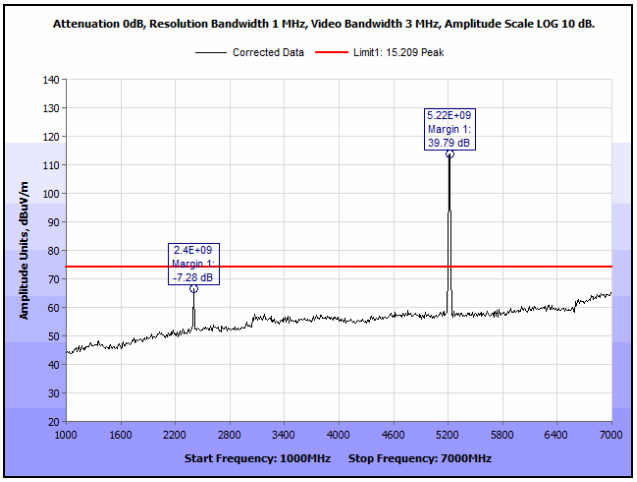
Radiated Spurious Emissions, Simultaneous Transmission

Bluetooth and WiFi radios activated for the channels with the maximum output power in each bandwidth.

Note 1: From 7-18GHz, the worst case configuration is reported, i.e. 40MHz BW.



Plot 35. Radiated Spurious Emissions, 5215 MHz, 10 MHz, 1 GHz – 7 GHz, Average



Plot 36. Radiated Spurious Emissions, 5215 MHz, 10 MHz, 1 GHz – 7 GHz, Peak

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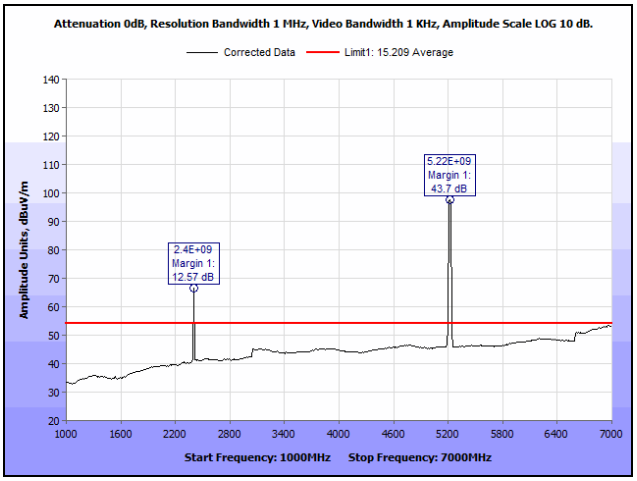
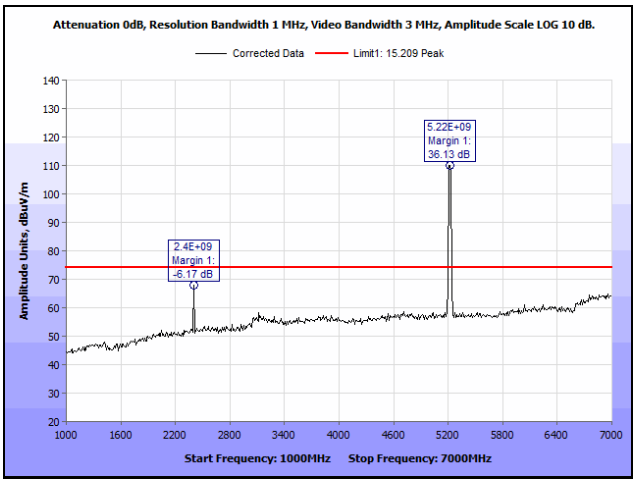
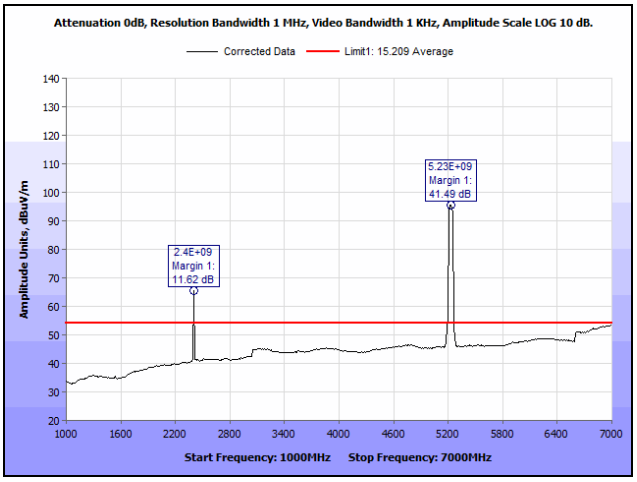


Plot 37. Radiated Spurious Emissions, 5220 MHz, 20 MHz, 1 GHz – 7 GHz, Average



Plot 38. Radiated Spurious Emissions, 5220 MHz, 20 MHz, 1 GHz – 7 GHz, Peak



Plot 39. Radiated Spurious Emissions, 5230 MHz, 40 MHz, 1 GHz – 7 GHz, Average

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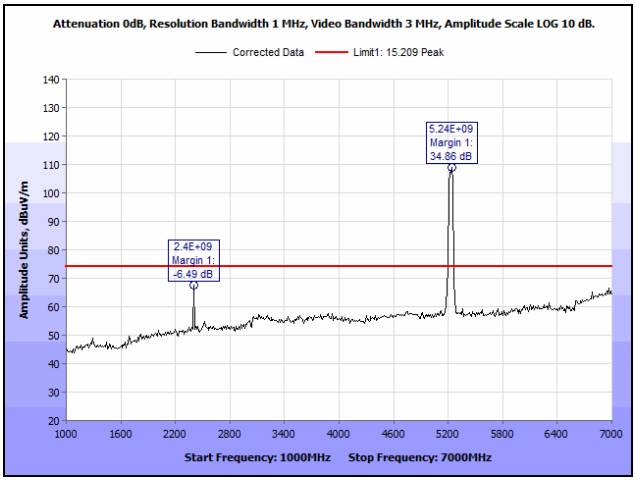
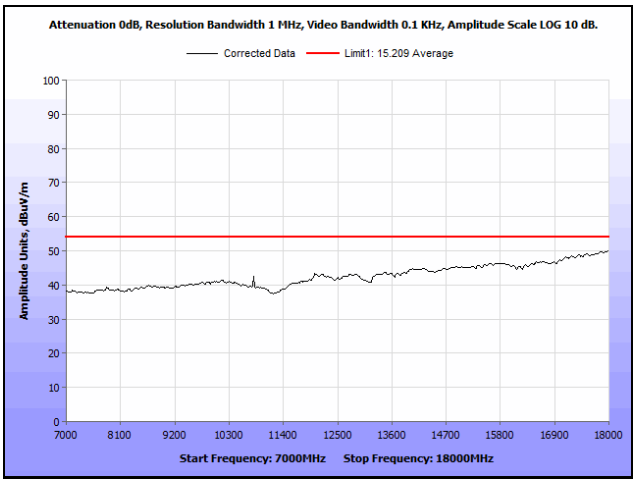
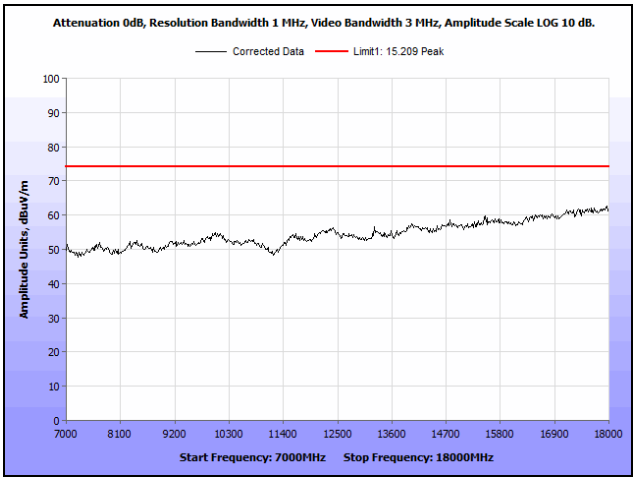


Plot 40. Radiated Spurious Emissions, 5230 MHz, 40 MHz, 1 GHz – 7 GHz, Peak



Plot 41. Radiated Spurious Emissions, 5230MHz, 40MHz, 7 GHz – 18 GHz, Average



Plot 42. Radiated Spurious Emissions, 5230MHz, 40MHz, 7 GHz – 18 GHz, Peak

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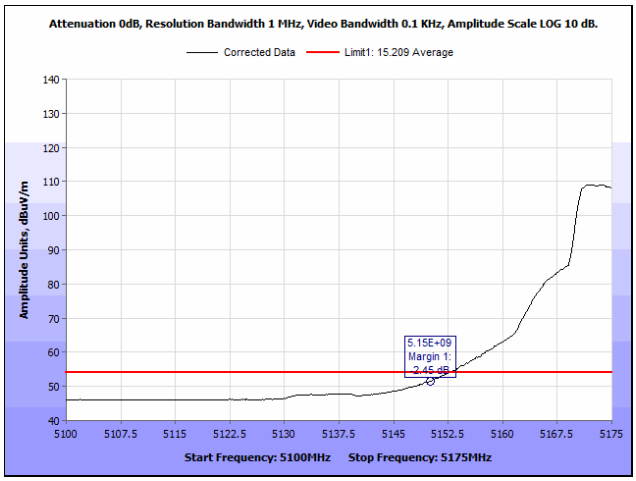
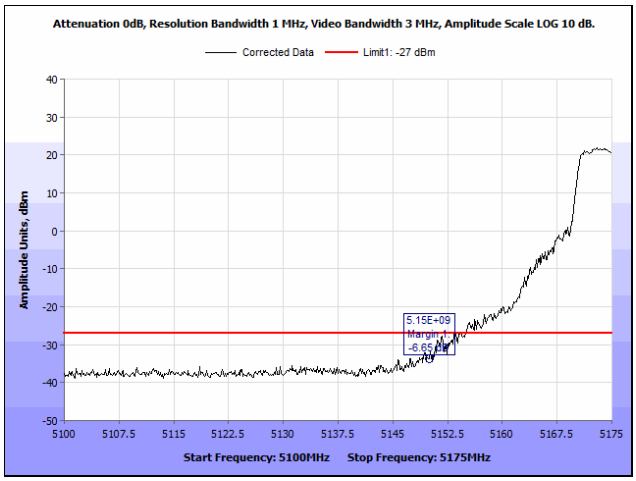
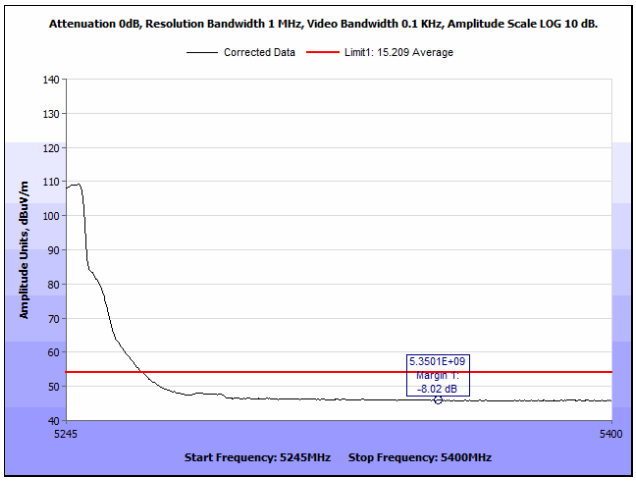
Radiated Band Edge, 10 MHz



Plot 43. Radiated Band Edge, Low Channel, 10 MHz, Average



Plot 44. Radiated Band Edge, Low Channel, 10 MHz, Peak



Plot 45. Radiated Band Edge, High Channel, 10 MHz, Average

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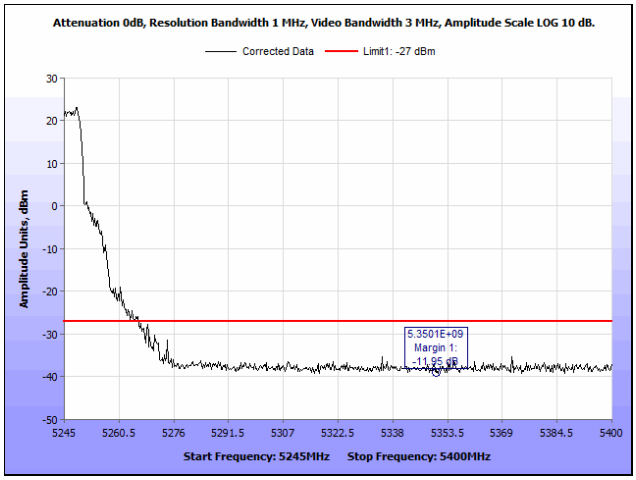

Plot 46. Radiated Band Edge, High Channel, 10 MHz, Peak

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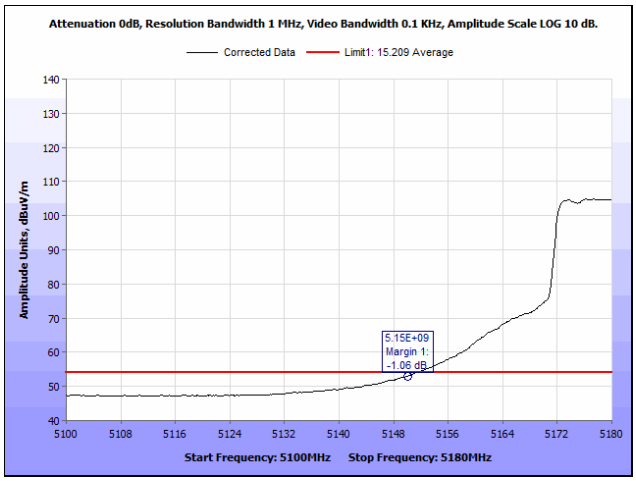
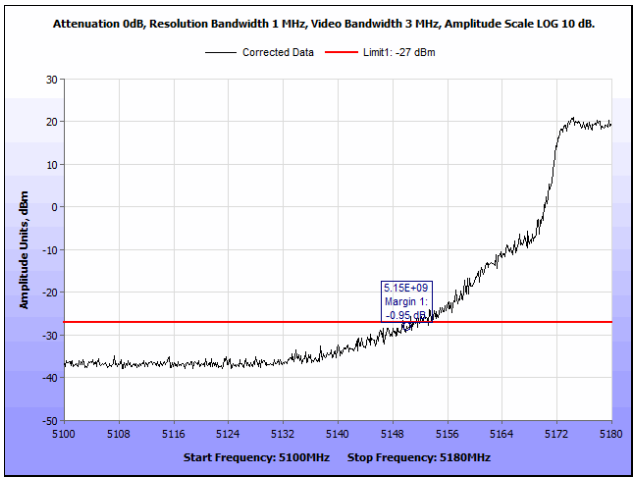
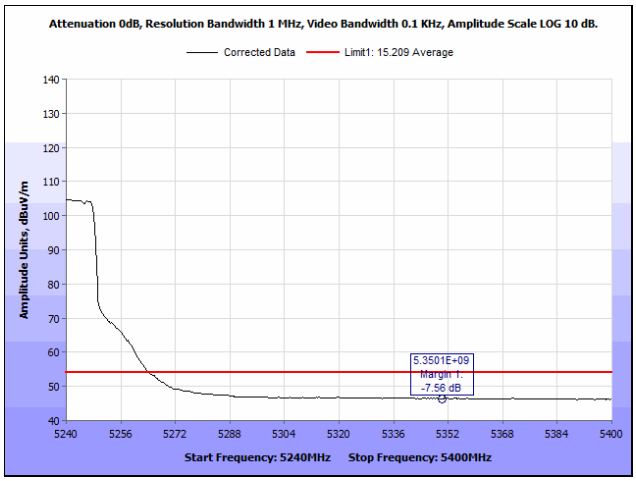
Radiated Band Edge, 20 MHz



Plot 47. Radiated Band Edge, Low Channel, 20 MHz, Average



Plot 48. Radiated Band Edge, Low Channel, 20 MHz, Peak



Plot 49. Radiated Band Edge, High Channel, 20 MHz, Average

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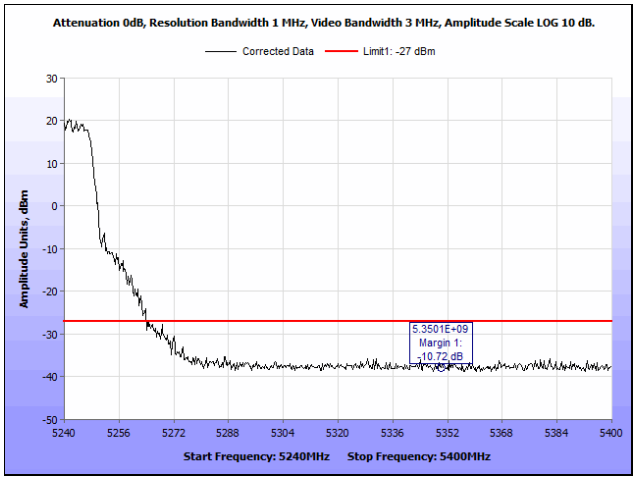

Plot 50. Radiated Band Edge, High Channel, 20 MHz, Peak

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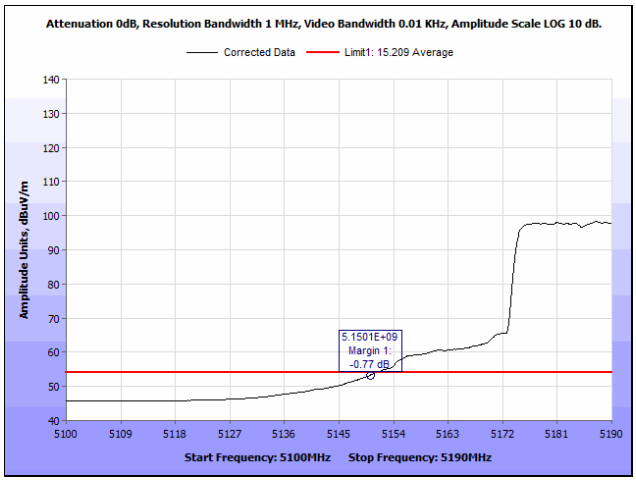
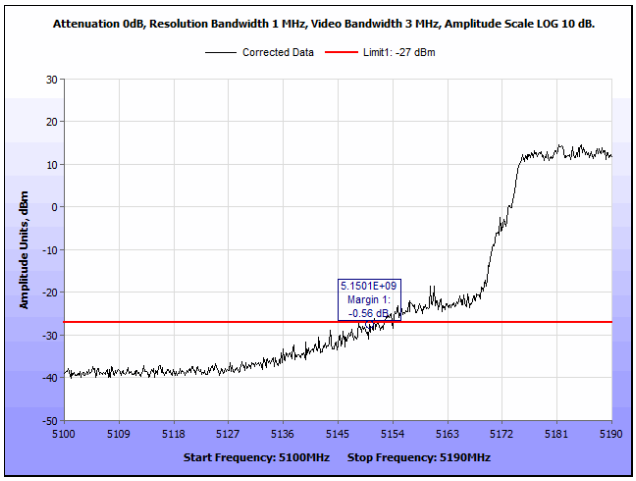
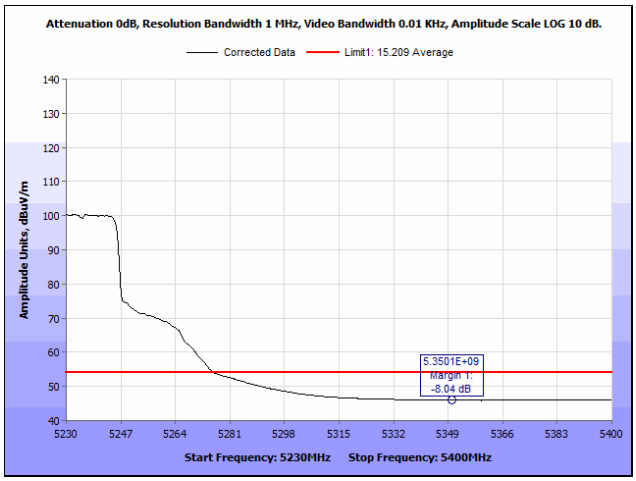
Radiated Band Edge, 40 MHz



Plot 51. Radiated Band Edge, Low Channel, 40 MHz, Average



Plot 52. Radiated Band Edge, Low Channel, 40 MHz, Peak



Plot 53. Radiated Band Edge, High Channel, 40 MHz, Average

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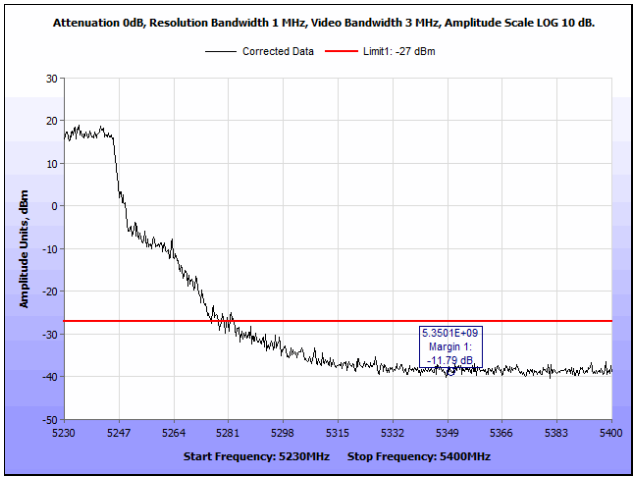

Plot 54. Radiated Band Edge, High Channel, 40 MHz, Peak

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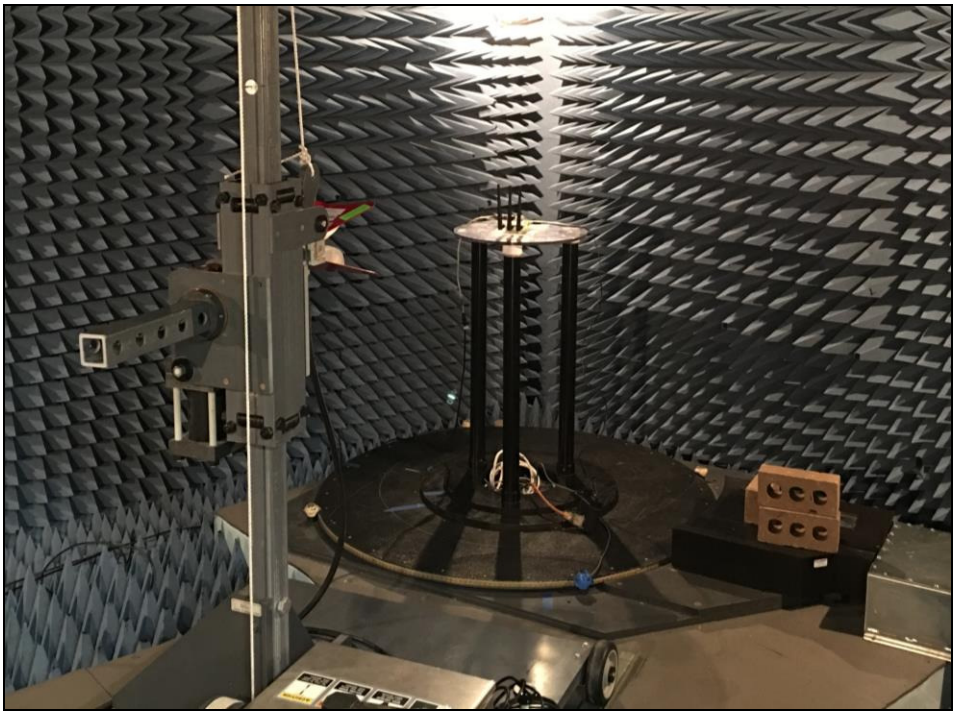

Photograph 1. Radiated Spurious Emissions, Test Setup

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(b)(6) Conducted Emissions

Test Requirement(s): **§ 15.407 (b)(6):** Any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

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

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

Table 10. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was placed on a non-metallic table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 µH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.4-2014 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz"*. Scans were performed with the transmitter on.

Test Results: The EUT was compliant with the Class B requirement(s) of this section. Measured emissions were below applicable limits

Test Engineer(s): Hadid Jones

Test Date(s): 12/19/15

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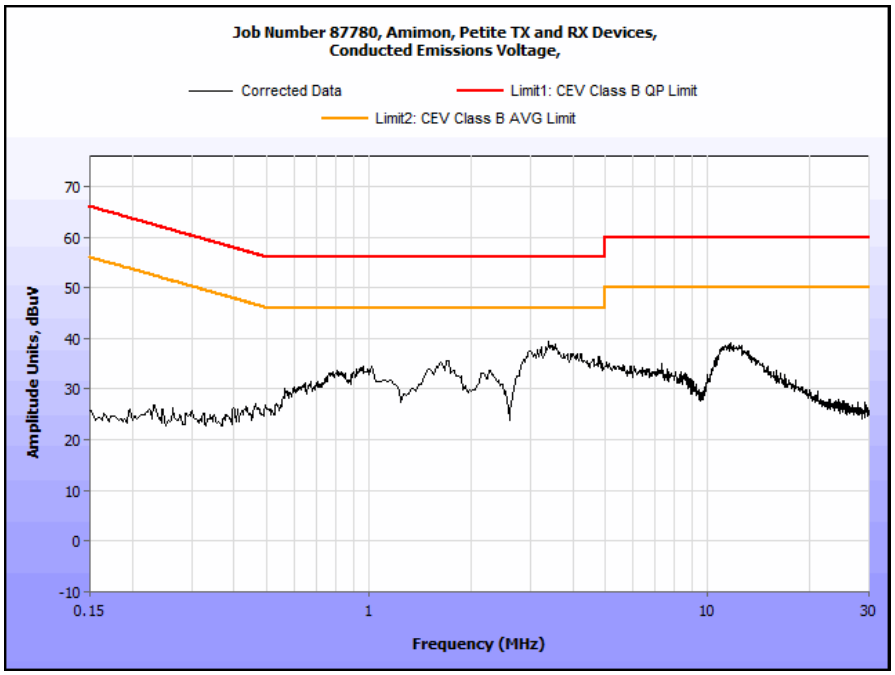
Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)

Frequency (MHz)	Uncorrected Meter Reading (dBµV) QP	Cable Loss (dB)	Corrected Measurement (dBµV) QP	Limit (dBµV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBµV) Avg.	Cable Loss (dB)	Corrected Measurement (dBµV) AVG	Limit (dBµV) AVG	Margin (dB) AVG
0.814	20.54	0	20.54	56	-35.46	11.16	0	11.16	46	-34.84
1.011	20.39	0	20.39	56	-35.61	11.51	0	11.51	46	-34.49
1.783	18.88	0	18.88	56	-37.12	10.23	0	10.23	46	-35.77
2.199	18.7	0	18.7	56	-37.3	9.3	0	9.3	46	-36.7
3.45	27.26	0	27.26	56	-28.74	14.49	0	14.49	46	-31.51
11.83	24.12	0	24.12	60	-35.88	17.37	0	17.37	50	-32.63

Table 11. Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)



Plot 55. Conducted Emission, Phase Line Plot

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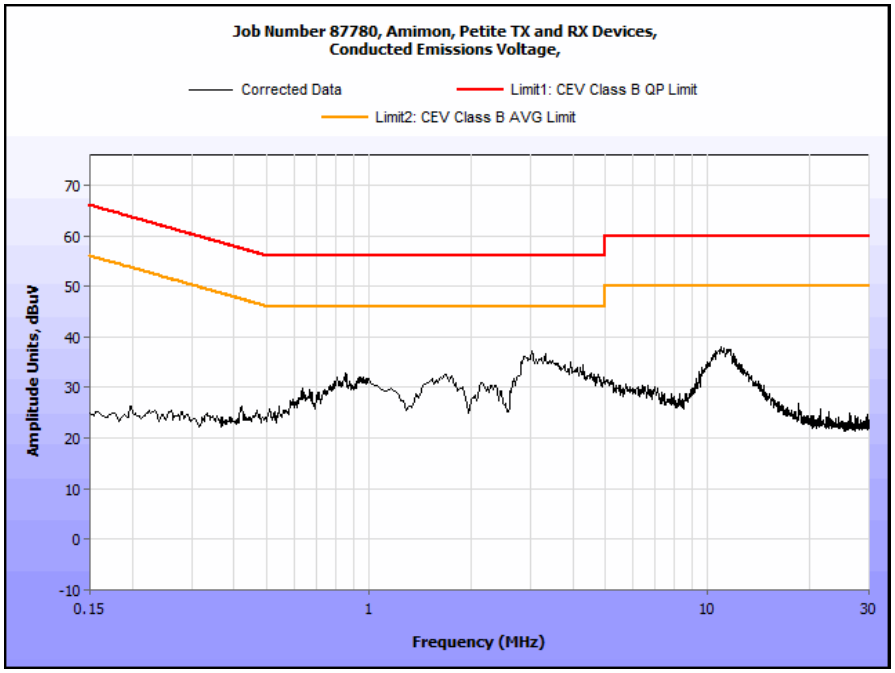
Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)

Frequency (MHz)	Uncorrected Meter Reading (dBµV) QP	Cable Loss (dB)	Corrected Measurement (dBµV) QP	Limit (dBµV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBµV) Avg.	Cable Loss (dB)	Corrected Measurement (dBµV) AVG	Limit (dBµV) AVG	Margin (dB) AVG
0.84	17.38	0	17.38	56	-38.62	7.8	0	7.8	46	-38.2
1.68	18.08	0	18.08	56	-37.92	8.6	0	8.6	46	-37.4
1.649	18.21	0	18.21	56	-37.79	9.45	0	9.45	46	-36.55
2.9	20.93	0	20.93	56	-35.07	10.1	0	10.1	46	-35.9
4.19	18.17	0	18.17	56	-37.83	10.17	0	10.17	46	-35.83
11.29	22.05	0	22.05	60	-37.95	15.34	0	15.34	50	-34.66

Table 12. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)



Plot 56. Conducted Emission, Neutral Line Plot

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(f) Maximum Permissible Exposure

Test Requirement(s): **§15.407(f):** U-NII devices are subject to the radio frequency radiation exposure requirements specified in §1.1307(b), §2.1091 and §2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a "general population/uncontrolled" environment.

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

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

MPE Limit: EUT's operating frequencies @ 5150-5250 MHz; **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

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

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

where, S = Power Density (mW/cm^2)
P = Power Input to antenna (mW)
G = Antenna Gain (numeric value)
R = Distance (cm)

Test Results:

This EUT is capable of simultaneous operation of its Bluetooth and 5GHz radios and therefore the individual contributions of both radios were summed to produce the combined power density listed in the table.

Combined Power Density (Bluetooth and WiFi)									
Frequency (MHz)	**Con. Pwr. (dBm)**	**Con. Pwr. (mW)**	**Ant. Gain (dBi)**	**Ant. Gain numeric**	**Pwr. Density (mW/cm^2)**	**Limit (mW/cm^2)**	**Margin**	**Distance (cm)**	**Result**
5230	20.2	104.713	2	1.585	0.03302	1	0.96698	20	Pass
2402	0.1	1.023	-0.6	0.871	0.00018	1	0.99982	20	Pass
combined power density					0.0332	1	0.9668	20	Pass

The safe distance where Power Density is less than the MPE Limit listed above was found to be 20 cm.

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IV. Test Equipment

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Test Equipment

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

MET ASSET #	EQUIPMENT	MANUFACTURER	MODEL	LAST CAL DATE	CAL DUE DATE
1T4612	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	09/01/2015	03/01/2017
1T4871	VECTOR SIGNAL GENERATOR	AGILENT TECHNOLOGIES	N5172B	02/03/2016	08/03/2017
1T8818	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	12/16/2015	12/16/2016
1T4300B	SEMI-ANECHOIC 3M CHAMBER # 1 D (2043A-1) (IC)	EMC TEST SYSTEMS	NONE	01/11/2015	01/11/2018
1T4409	EMI RECEIVER	ROHDE & SCHWARZ	ESIB7	10/29/2014	10/29/2016
1T4753	ANTENNA - BILOG	SUNOL SCIENCES	JB6	03/09/2015	09/09/2016
1T4483	ANTENNA; HORN	ETS-LINDGREN	3117	10/08/2015	04/08/2017
1T4771	PSA SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4446A	11/25/2014	05/25/2016
1T4564	LISN (24 AMP)	SOLAR ELECTRONICS COMPANY	9252-50-R-24-BNC	7/1/2015	7/1/2016
1T4504	SHIELDED ROOM	UNIVERSAL SHIELDING CORP	N/A	NOT REQUIRED	

Table 13. Test Equipment List

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V. Certification & User's Manual Information

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Certification & User's Manual Information

L. Certification Information

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

§ 2.801 Radio-frequency device defined.

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

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

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

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

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

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

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

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

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

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

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

(i) Compliance testing;

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

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

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

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

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

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

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Certification & User's Manual Information

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

§ 2.901 Basis and Purpose

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

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

§ 2.907 Certification.

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

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

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

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Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

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

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

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

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

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

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Certification & User's Manual Information

Label and User's Manual Information

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

§ 15.19 Labeling requirements.

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

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

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

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

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

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

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

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

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

§ 15.21 Information to user.

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

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Verification & User's Manual Information

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

§ 15.105 Information to the user.

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

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

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

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

– Reorient or relocate the receiving antenna.

– Increase the separation between the equipment and receiver.

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

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

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