MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
914 WEST PATAPSCO AVENUE ● BALTIMORE, MARYLAND 21230-3432 ● PHONE (410) 354-3300 ● FAX (410) 354-3313
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3162 BELICK STREET ● SANTA CLARA, CALIFORNIA 95054 ● PHONE (408 748-3585 ● FAX (510) 489-6372
13301 MCCALLEN PASS ● AUSTIN, TX 78753 ● PHONE (512) 287-2500 ● FAX (512) 287-2513

December 11, 2012

Murata Wireless
4441 Sigma Road
Dallas, TX 75244

Dear Bob Nelson,

Enclosed is the EMC Wireless test report for compliance testing of the Murata Wireless, DR-WLS1273L-102 as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Title 47 of the CFR, Part 15, Subpart B and ICES-003, Issue 4 February 2004for Unintentional Radiators and Part 15.407 and Industry Canada RSS-210, Annex 9, Issue 8, December 2010 for Intentional Radiators.

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

Sincerely yours,
MET LABORATORIES, INC.

Jennifer Warnell
Documentation Department

Reference: (\Murata Wireless\EMCS36587A-FCC407 Rev. 1 (UNII 1))

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Electromagnetic Compatibility Criteria
Test Report

for the

Murata Wireless
Model DR-WLS1273L-102

Tested under
the FCC Certification Rules
contained in
Title 47 of the CFR, Parts 15 Subpart B & ICES-003
for Class B Digital Devices
&
FCC Part 15.407 & RSS-210, Annex 9
for Intentional Radiators

MET Report: EMCS36587A-FCC407 Rev. 1 (UNII 1)

December 11, 2012

Prepared For:

Murata Wireless
4441 Sigma Road
Dallas, TX 75244

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

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Anderson Soungpanya, 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 and Industry Canada standards ICES-003, Issue 4 February 2004, RSS-210 Annex 9 under normal use and maintenance.

Dusmantha Tennakoon,
Wireless Manager, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	December 5, 2012	Initial Issue.
1	December 11, 2012	Revised to add section 15.205.

Table of Contents

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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

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Murata Wireless DR-WLS1273L-102, 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 DR-WLS1273L-102. Murata Wireless should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the DR-WLS1273L-102, 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 Murata Wireless, purchase order number 30835. All tests were conducted using measurement procedure ANSI C63.4-2003.

FCC Reference	Industry Canada Reference	Description	Results
§15.107	ICES-003 Issue 4 February 2004	Conducted Emissions	Compliant
§15.109	ICES-003 Issue 4 February 2004	Radiated Emissions	Compliant
§15.203	RSS-GEN 7.1.4	Antenna Requirements	Compliant
§15.207	RSS-GEN 7.2.2; RSS-210 2.2	AC Conducted Emissions 150KHz – 30MHz	Compliant
§15.403 (i)	A8.2	26dB Occupied Bandwidth	Compliant
§15.407 (a)(2)	A9.2(3)	Conducted Transmitter Output Power	Compliant
§15.407 (a)(2)	A9.2(3)	Power Spectral Density	Compliant
§15.407 (a)(6)	N/A	Peak Excursion	Compliant
§15.407 (b)(2), (3), (5), (6)	A9.3(4)	Undesirable Emissions (15.205/15.209 - General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Compliant
§15.407(f)	RSS-GEN	RF Exposure	Compliant
§15.407(g)	2.1	Frequency Stability	Compliant
N/A	RSS-Gen(4.8)	Receiver Spurious Emissions	Compliant

Table 1. Executive Summary of EMC Part 15.407 ComplianceTesting

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Murata Wireless to perform testing on the DR-WLS1273L-102, under Murata Wireless's purchase order number 30835.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Murata Wireless DR-WLS1273L-102.

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

Model(s) Tested:	DR-WLS1273L-102	
Model(s) Covered:	DR-WLS1273L-102	
EUT Specifications:	Primary Power: 5VDC (Supplied from USB Laptop)	
	FCC ID: TE6-DRWLS1273L IC: 10748A-DRWL1273L	
	Type of Modulations:	OFDM
	Equipment Code:	NII
	RF Output Power:	7.27dBm
	EUT Frequency Ranges:	5180-5240MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35º C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Anderson Soungpanya	
Report Date(s):	December 11, 2012	

Table 2. EUT Summary

B. References

CFR 47, Part 15, Subpart B	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
CFR 47, Part 15, Subpart E	Unlicensed National Information Infrastructure Devices (UNII)
RSS-210, Issue 8, Dec. 2010	Low-power Licence-exempt Radiocommunications Devices (All Frequency Bands): Category I Equipment
RSS-GEN, Issue 3, Dec. 2010	General Requirements and Information for the Certification of Radio Apparatus
ICES-003, Issue 4 February 2004	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
ANSI C63.4:2003	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ISO/IEC 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2009	American National Standard for Testing Unlicensed Wireless Devices

Table 3. References

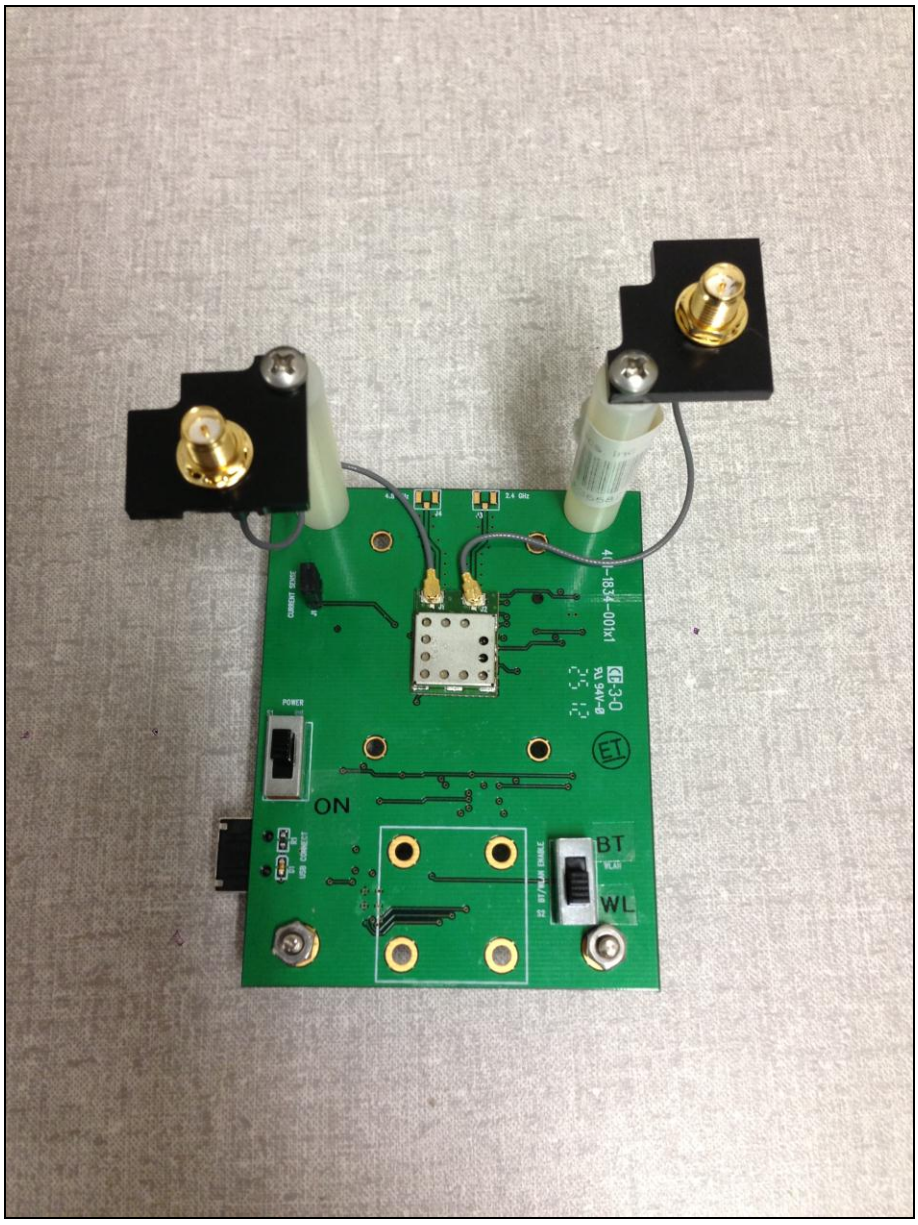
C. Test Site

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

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

D. Description of Test Sample

The Murata Wireless DR-WLS1273L-102, Equipment Under Test (EUT), is a WifFi Bluetooth combo module - WiFi 802.11a//b/g/n - Bluetooth core 4.0.



Photograph 1. Murata Wireless DR-WLS1273L-102

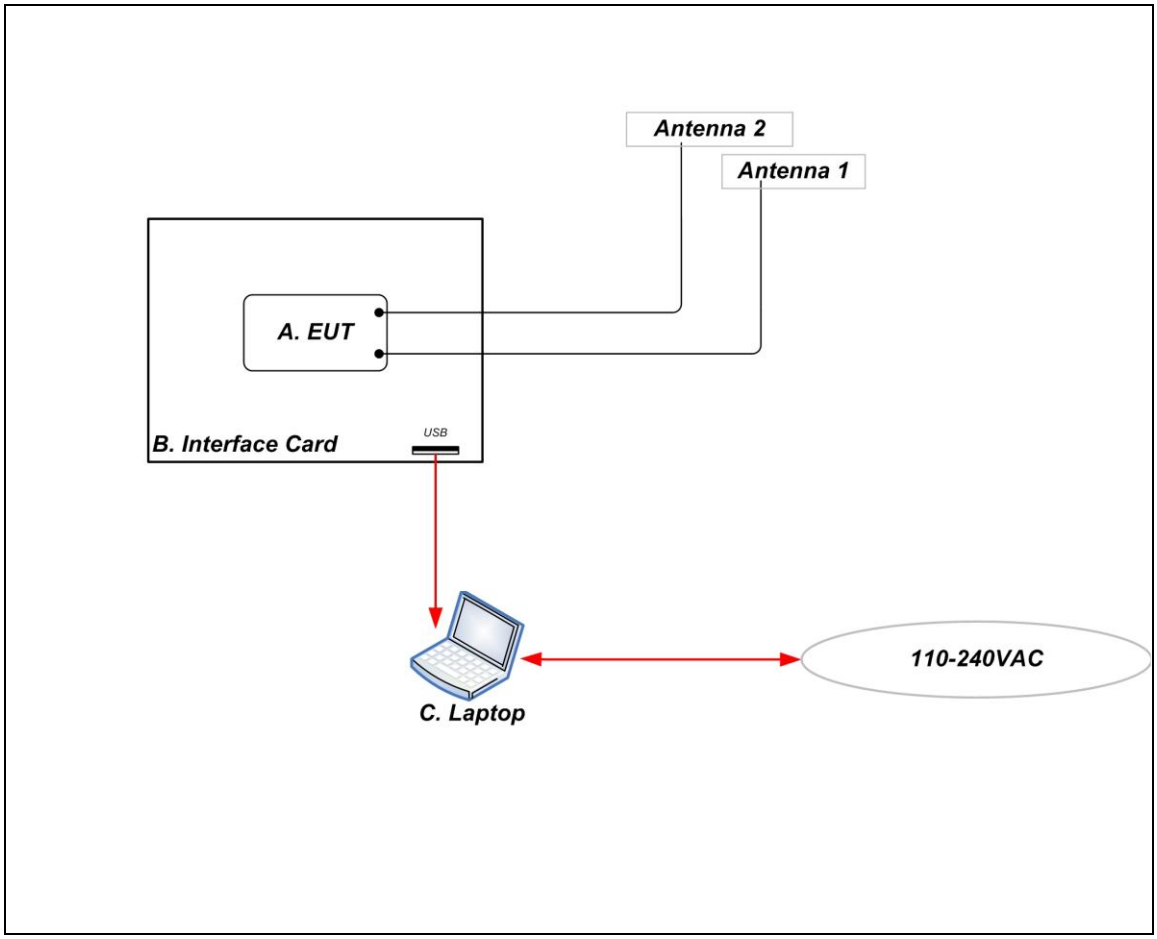


Figure 1. Block Diagram of Test Configuration

E. Equipment Configuration

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

Ref. ID	Name / Description	Model Number	Serial Number
B	802.11a/b/g/n & Bluetooth Module	1273	001

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
C	Laptop	Dell	Latitude D600

Table 5. Support Equipment

G. Ports and Cabling Information

Ref. ID	Port Name on EUT	Cable Description	Qty.	Length (m)	Shielded (Y/N)	Termination Point
1	USB	Com Port/Power Supply	1	1.5	Y	USB, Laptop

Table 6. Ports and Cabling Information

H. Mode of Operation

Both modules are a WiFi/Bluetooth combo module.
The WiFi I/O interface is 4 bit SDIO.
The Bluetooth I/O interface is Uart.
Module does not transmit WIFI and Bluetooth simultaneously. Also modules does no transmit in the 2.4 and 5GHz WIFI Band simultaneously. Only one modulation/Band can transmit at a time.

I. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

J. Disposition of EUT

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

III. Electromagnetic Compatibility Criteria for Unintentional Radiators

Electromagnetic Compatibility Criteria

§ 15.107 Conducted Emissions Limits

Test Requirement(s):

15.107 (a) Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in Table 7. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

15.107 (b) For a Class A digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in Table 7. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges.

Frequency range (MHz)	Class A Conducted Limits (dBµV)		*Class B Conducted Limits (dBµV)	
	Quasi-Peak	Average	Quasi-Peak	Average
* 0.15- 0.45	79	66	66 - 56	56 - 46
0.45 - 0.5	79	66	56	46
0.5 - 30	73	60	60	50
Note 1 — The lower limit shall apply at the transition frequencies. Note 2 — The limit decreases linearly with the logarithm if the frequency in the range 0.15 MHz to 0.5 MHz. * -- Limits per Subsection 15.207(a).				

Table 7. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(a) (b) and 15.207(a)

Test Procedures:

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

Test Results:

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

Test Engineer(s):

Jonathan Chao

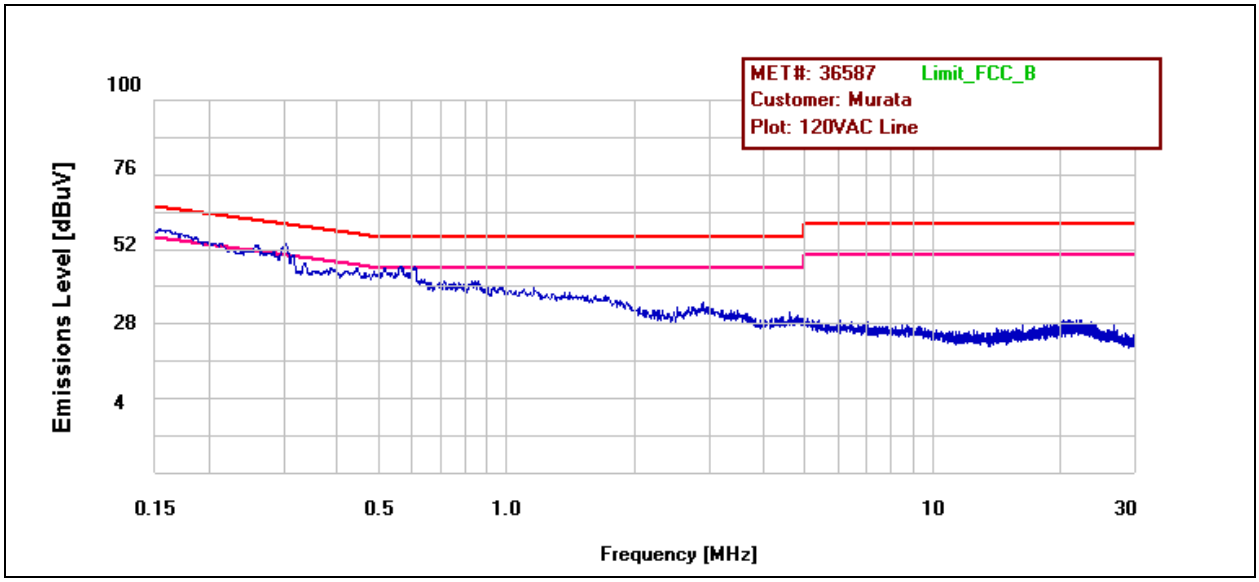
Test Date(s):

10/31/12

Conducted Emissions - Voltage, AC Power, Phase Line

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
120VAC Line	.155	51.66	65.728	-14.068	Pass	39.1	55.728	-16.628	Pass
120VAC Line	.284	43.65	60.713	-17.063	Pass	35.78	50.713	-14.933	Pass
120VAC Line	.412	38.8	57.631	-18.831	Pass	25.99	47.631	-21.641	Pass

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

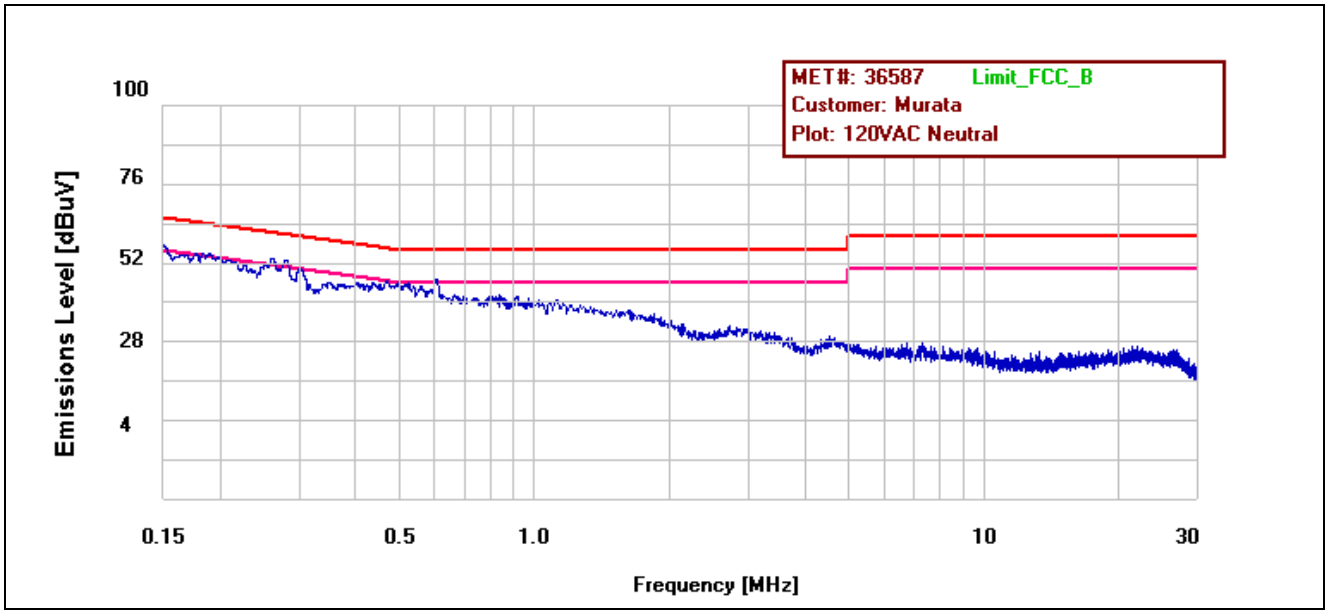


Plot 1. Conducted Emission, Phase Line Plot

Conducted Emissions - Voltage, AC Power, Neutral Line

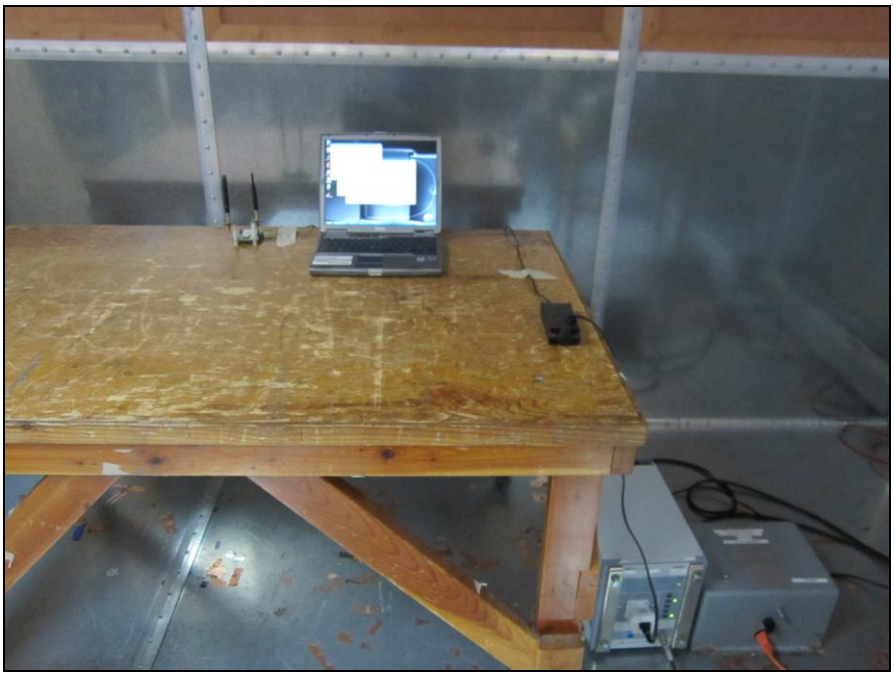
Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
120VAC Neutral	.15	51.33	66	-14.67	Pass	43.71	56	-12.29	Pass
120VAC Neutral	.258	46.99	61.508	-14.518	Pass	39.12	51.508	-12.388	Pass
120VAC Neutral	.439	38.99	57.105	-18.115	Pass	23.64	47.105	-23.465	Pass

Table 9. Conducted Emissions - Voltage, AC Power, Neutral Line



Plot 2. Conducted Emission, Neutral Line Plot

Conducted Emission Limits Test Setup



Photograph 2. Conducted Emissions, Test Setup

Photograph 3. Conducted Emissions, Test Setup, Side View

Radiated Emission Limits

§ 15.109 Radiated Emissions Limits

Test Requirement(s): **15.109 (a)** Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the Class B limits expressed in Table 10.

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

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

Table 10. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (b)

Test Procedures: The EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4 were used. An antenna was located 3 m from the EUT on an adjustable mast. A pre-scan was first performed in order to find prominent radiated emissions. For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. Unless otherwise specified, measurements were made using a quasi-peak detector with a 120 kHz bandwidth.

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

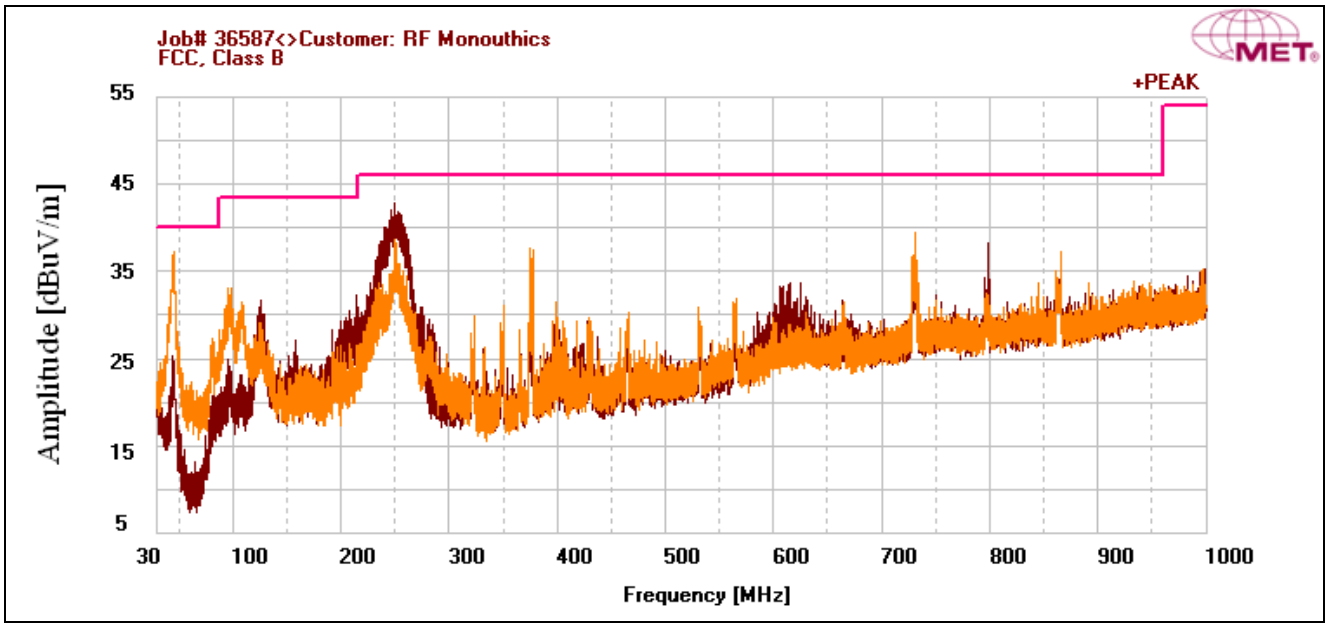
Test Engineer(s): Anderson Soungpanya

Test Date(s): 11/05/12

Radiated Emissions Limits Test Results, Class B

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
44.99	V	142	100	24.36	9.703	0	0.935	0	34.998	40	-5.002
250	H	112	100	27.63	12.9	0	2.39	0	42.92	46	-3.08
250	V	110	186	20.75	12.5	0	2.39	0	35.64	46	-10.36
377.22	V	145	100	15.97	15.644	0	2.9	0	34.514	46	-11.486
732.63	V	253	100	9.21	22.2	0	4.157	0	35.567	46	-10.433
799.09	H	124	100	8.22	22.3	0	4.395	0	34.915	46	-11.085

Table 11. Radiated Emissions Limits, Test Results, 30 MHz – 1 GHz, FCC Limits

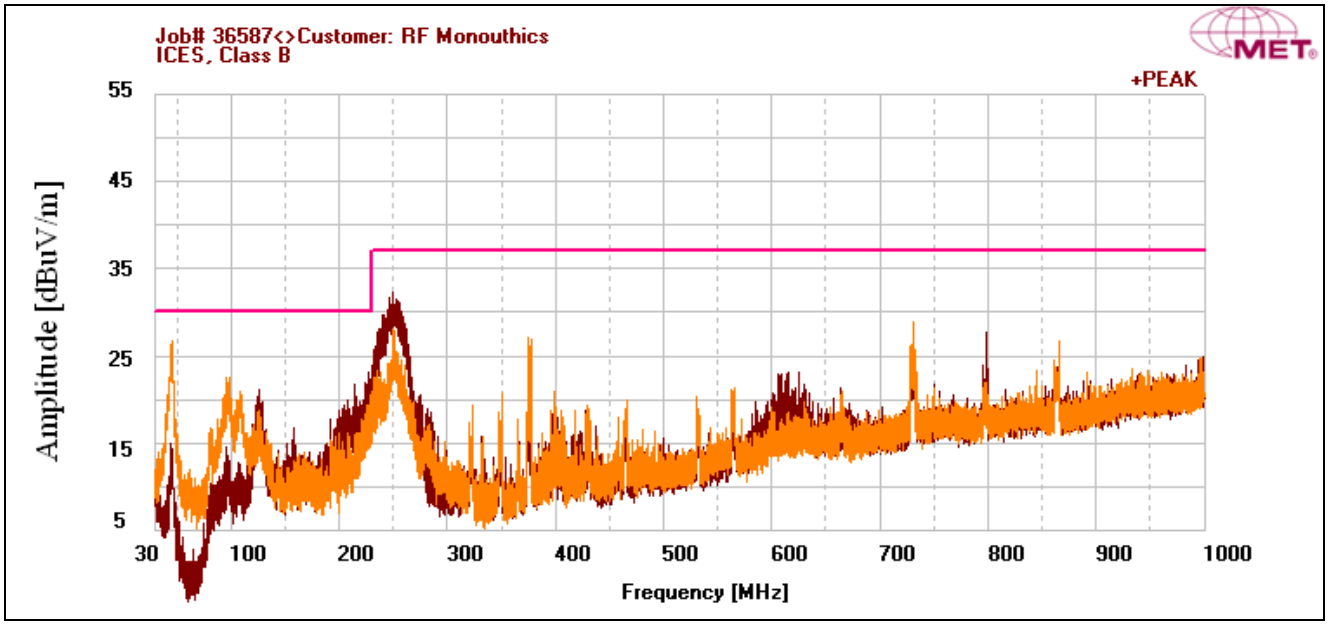


Plot 3. Radiated Emissions, 30 MHz - 1 GHz, FCC Limits

Radiated Emissions Limits Test Results, Class B

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
44.99	V	142	100	24.36	9.703	0	0.935	-10.46	24.538	30	-5.462
250	H	112	100	27.63	12.9	0	2.39	-10.46	32.46	37	-4.54
250	V	110	186	20.75	12.5	0	2.39	-10.46	25.18	37	-11.82
377.22	V	145	100	15.97	15.644	0	2.9	-10.46	24.054	37	-12.946
732.63	V	253	100	9.21	22.2	0	4.157	-10.46	25.107	37	-11.893
799.09	H	124	100	8.22	22.3	0	4.395	-10.46	24.455	37	-12.545

Table 12. Radiated Emissions Limits, Test Results, ICES-003 Limits



Plot 4. Radiated Emissions, ICES-003 Limits

Radiated Emissions Limits Test Setup

Photograph 4. Radiated Emissions, Test Setup

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

Photograph 6. Radiated Emissions, Test Setup, Rear View

IV. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

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

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

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

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

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

Results: The EUT as tested is compliant the criteria of §15.203. There is an U.FL connector on module which is a unique type of connector.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 10/23/12

Gain	Type
4dBi	Omni

Table 13. Antenna List

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207 Conducted Emissions Limits

Test Requirement(s): **§ 15.207 (a):** For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 Ω 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 14. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

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

Test Results: The EUT was compliant with this requirement. Measured emissions were below applicable limits.

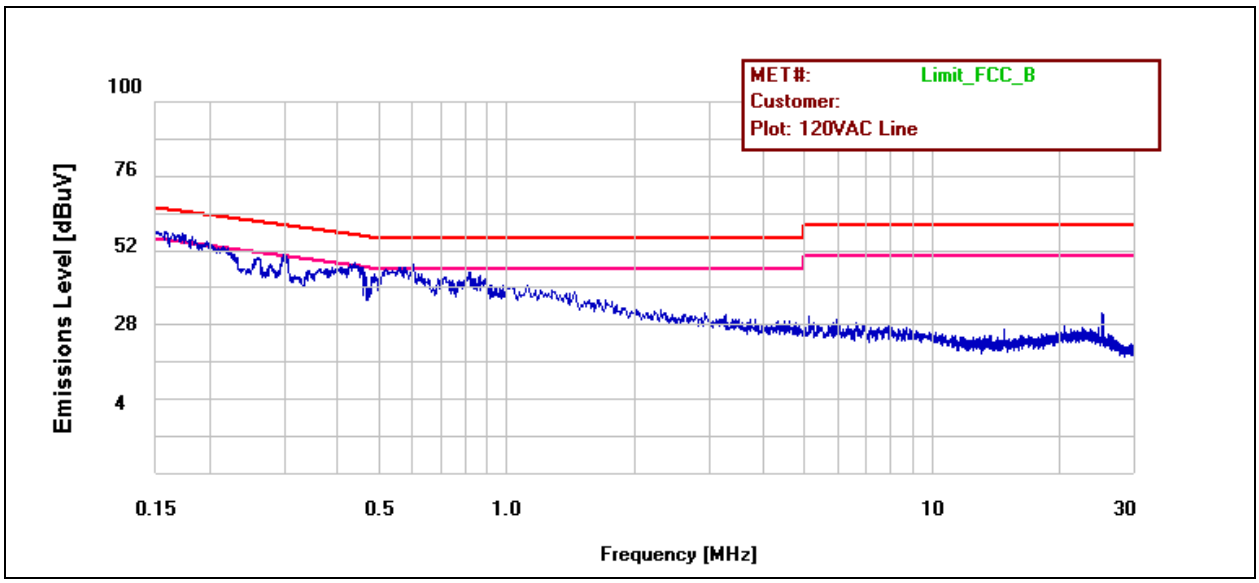
Test Engineer(s): Jonathan Chao

Test Date(s): 11/07/12

15.207(a) Conducted Emissions Test Results

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
120VAC Line	.153	53.6	65.836	-12.236	Pass	43.54	55.836	-12.296	Pass
120VAC Line	.301	48.28	60.231	-11.951	Pass	47.44	50.231	-2.791	Pass
120VAC Line	.406	42.84	57.752	-14.912	Pass	29.19	47.752	-18.562	Pass

Table 15. Conducted Emissions, 15.207(a), Phase Line, Test Results

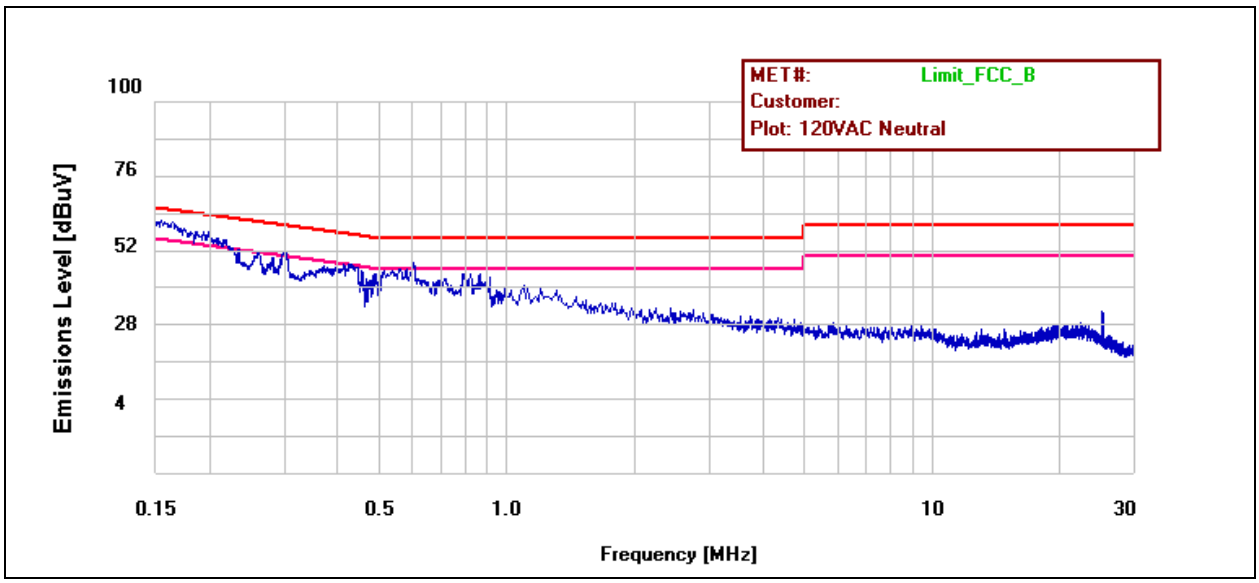


Plot 5. Conducted Emissions, 15.207(a), Phase Line

15.207(a) Conducted Emissions Test Results

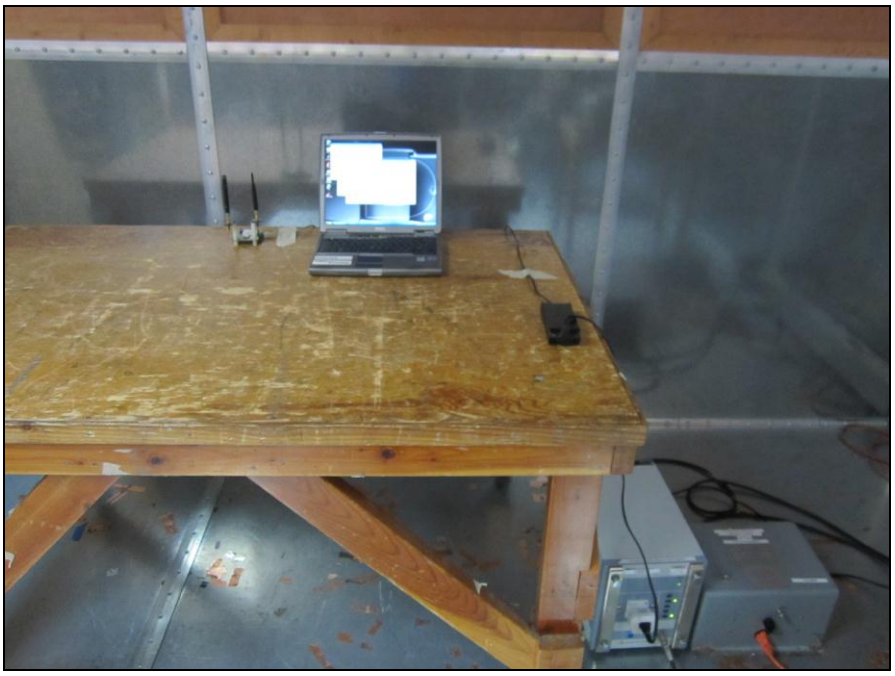
Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
120VAC Neutral	.155	57.89	65.728	-7.83799	Pass	44.85	55.728	-10.878	Pass
120VAC Neutral	.298	48.05	60.314	-12.264	Pass	47.29	50.314	-3.024	Pass
120VAC Neutral	.432	44.23	57.238	-13.008	Pass	28.7	47.238	-18.538	Pass

Table 16. Conducted Emissions, 15.207(a), Neutral Line, Test Results



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

15.207(a) Conducted Emissions Test Setup



Photograph 7. Conducted Emissions, 15.207(a), Test Setup

Photograph 8. Conducted Emissions, 15.207(a), Test Setup, Side View

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15. 403(c) 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 and was determined from the plots on the following pages.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 11/07/12

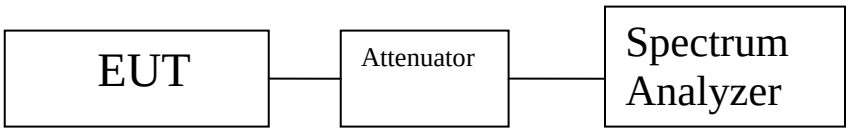


Figure 2. Occupied Bandwidth, Test Setup

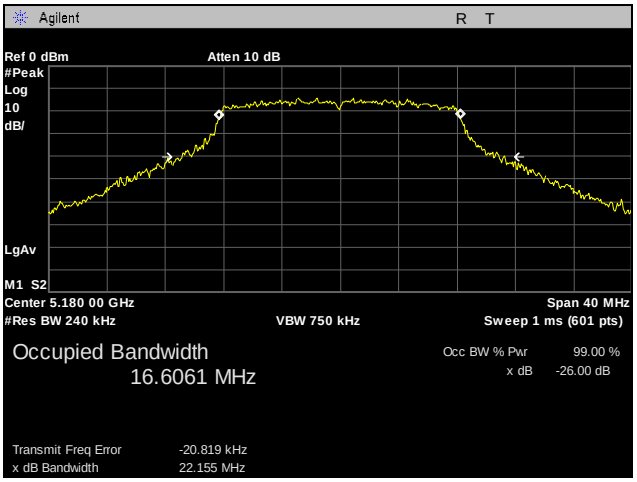
Mode	Channel	Frequency (MHz)	26dB Bandwidth (MHz)
802.11a	Low	5180	22.155
	Mid	5200	22.299
	High	5240	22.200
802.11n HT20	Low	5180	23.336
	Mid	5200	22.692
	High	5240	22.488

Table 17. 26 dB Occupied Bandwidth, Test Results

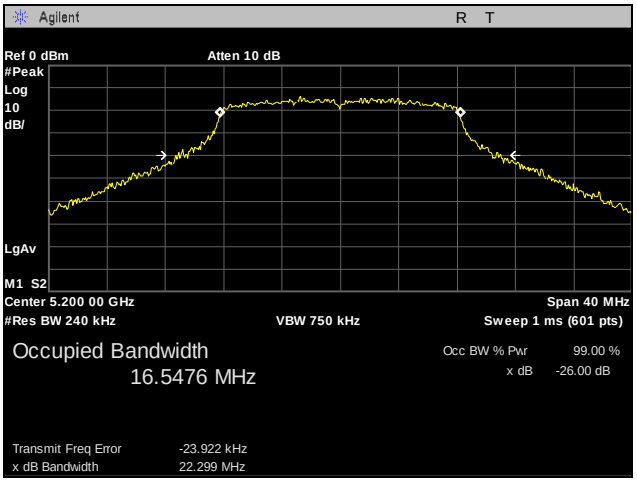
Mode	Channel	Frequency (MHz)	99% Bandwidth (MHz)
802.11a	Low	5180	16.4072
	Mid	5200	16.4004
	High	5240	16.4319
802.11n HT20	Low	5180	17.5238
	Mid	5200	17.5240
	High	5240	17.6039

Table 18. 99% Occupied Bandwidth, Test Results

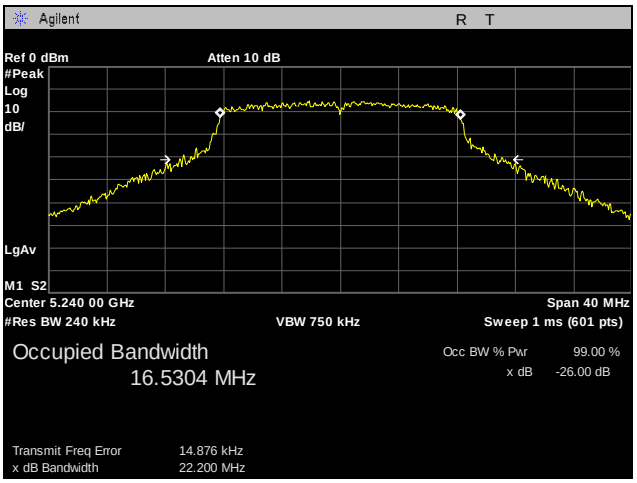
26 dB Occupied Bandwidth, 802.11a



Plot 7. 26 dB Occupied Bandwidth, Low Channel, 802.11a

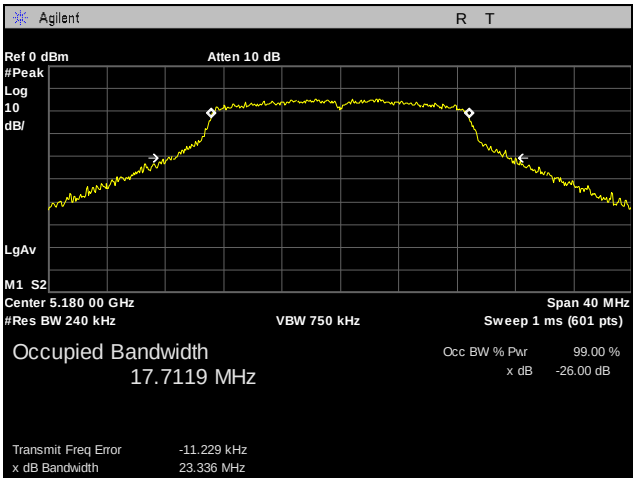


Plot 8. 26 dB Occupied Bandwidth, Mid Channel, 802.11a

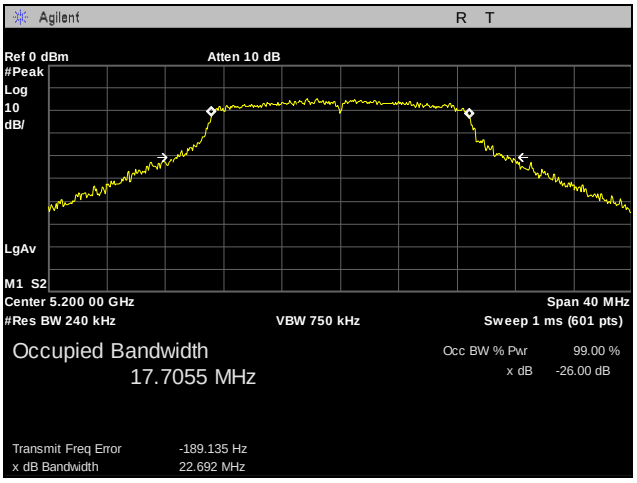


Plot 9. 26 dB Occupied Bandwidth, High Channel, 802.11a

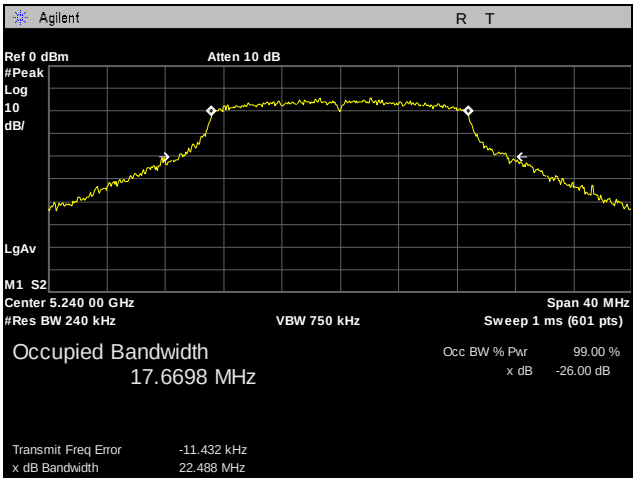
26 dB Occupied Bandwidth, 802.11n 20 MHz



Plot 10. 26 dB Occupied Bandwidth, Low Channel, 802.11n 20 MHz

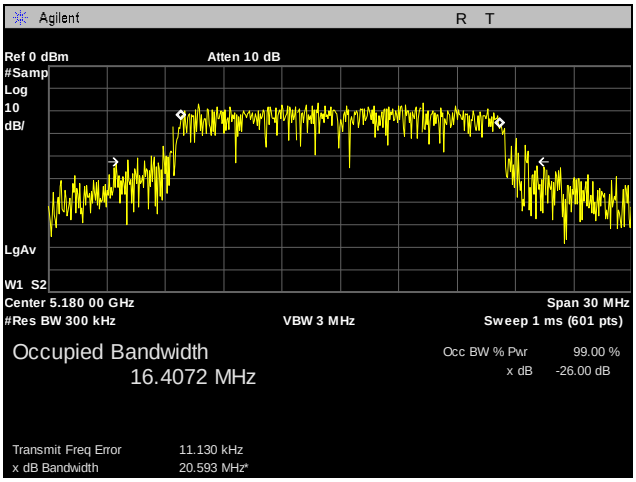


Plot 11. 26 dB Occupied Bandwidth, Mid Channel, 802.11n 20 MHz

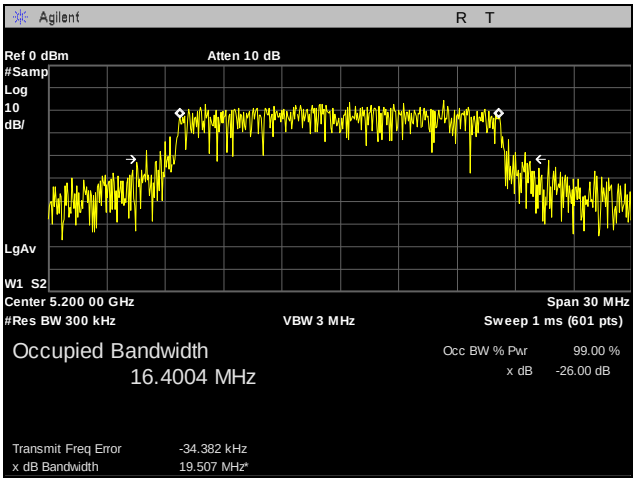


Plot 12. 26 dB Occupied Bandwidth, High Channel, 802.11n 20 MHz

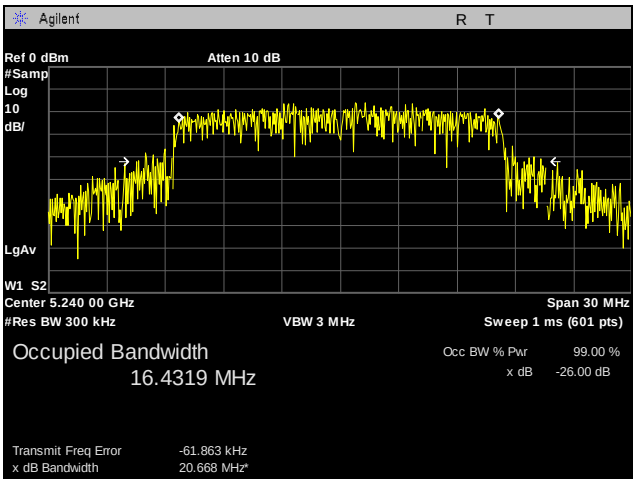
99% Occupied Bandwidth, 802.11a



Plot 13. 99% Occupied Bandwidth, Low Channel, 802.11a

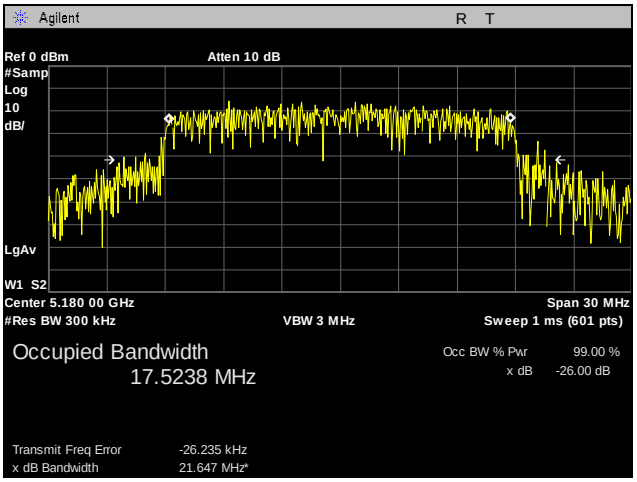


Plot 14. 99% Occupied Bandwidth, Mid Channel, 802.11a

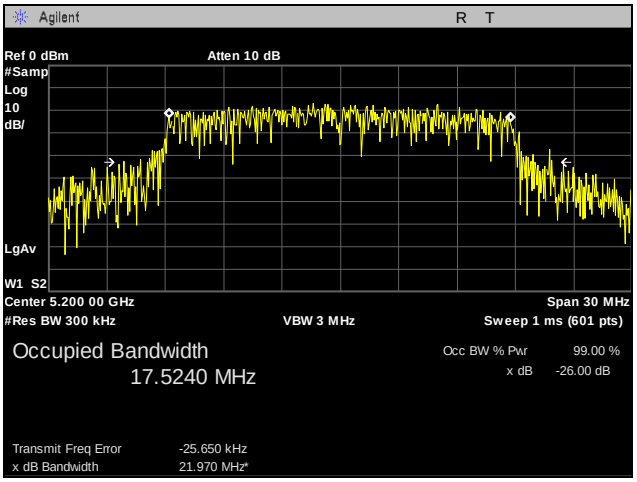


Plot 15. 99% Occupied Bandwidth, High Channel, 802.11a

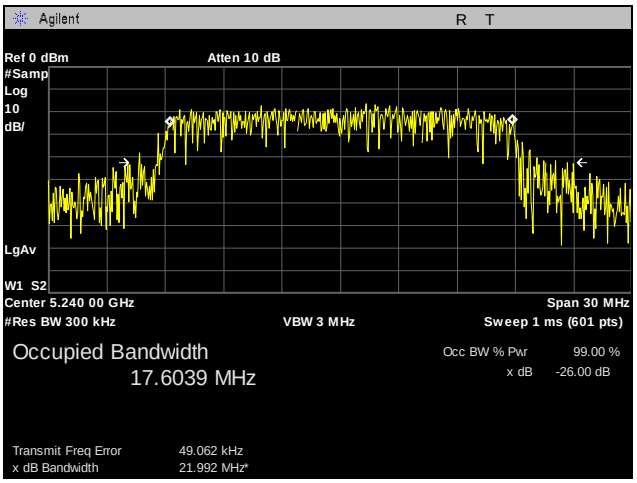
99% Occupied Bandwidth, 802.11n 20 MHz



Plot 16. 99% Occupied Bandwidth, Low Channel, 802.11n 20 MHz



Plot 17. 99% Occupied Bandwidth, Mid Channel, 802.11n 20 MHz



Plot 18. 99% Occupied Bandwidth, High Channel, 802.11n 20 MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15. 407(a)(1) RF Power Output

Test Requirements: **§15.407(a)(1):** For the band 5.15–5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or 4 dBm + 10 log B, where B is the 26–dB emission bandwidth in MHz.

Test Procedure: The EUT was connected to a spectrum analyzer and set to transmit continuously on the low, mid, and high channels. Its power was measured according to measurement method SA-1, as described in FCC publication number 789033.

Test Results: Equipment was compliant with the Peak Power Output limits of **§ 15.401(a)(1)**.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 11/07/12

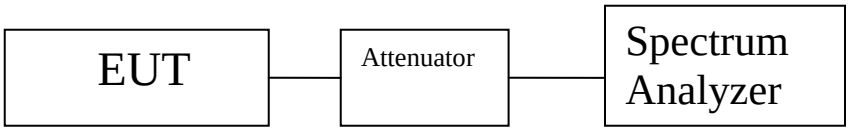
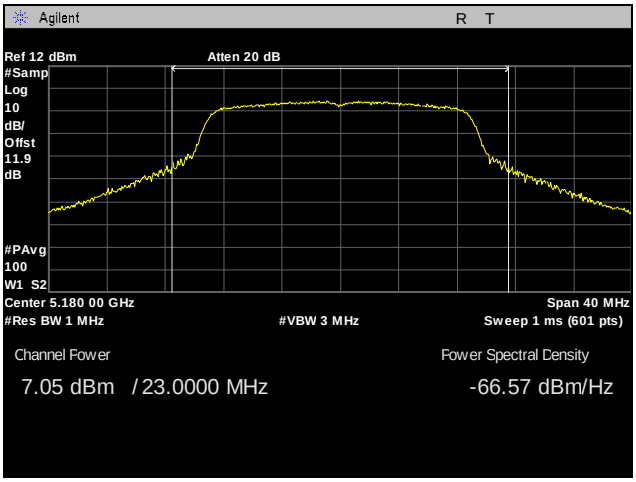


Figure 3. Power Output Test Setup

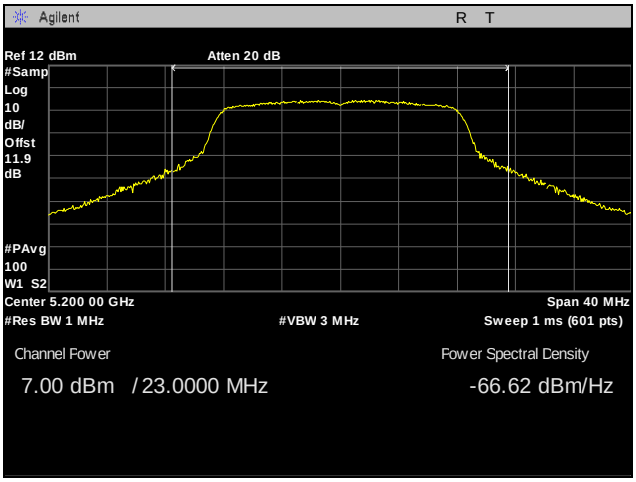
Mode	Channel	Frequency (MHz)	Output Power (dBm)
802.11a	Low	5180	7.05
	Mid	5200	7.00
	High	5240	6.65
802.11n HT20	Low	5180	7.27
	Mid	5200	6.88
	High	5240	6.74

Table 19. Output Power, Test Results

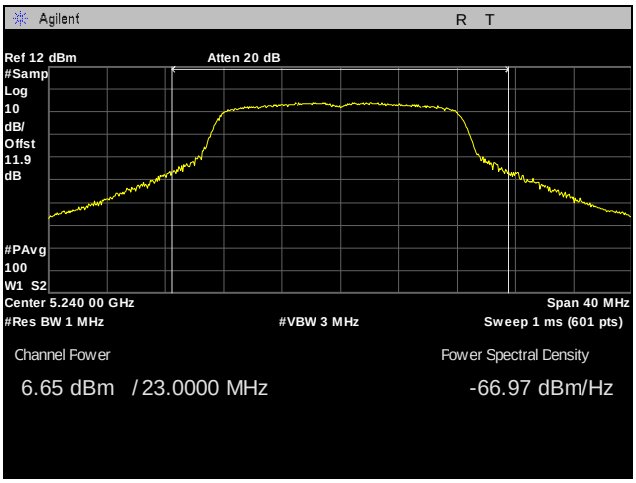
RF Power Output, 802.11a



Plot 19. RF Power Output, Low Channel, 802.11a

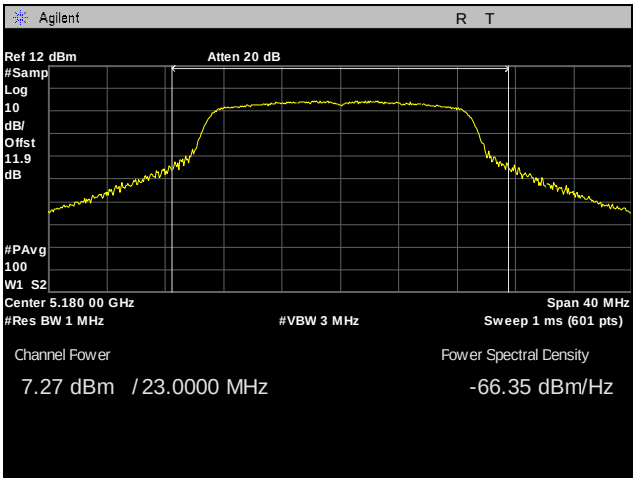


Plot 20. RF Power Output, Mid Channel, 802.11a

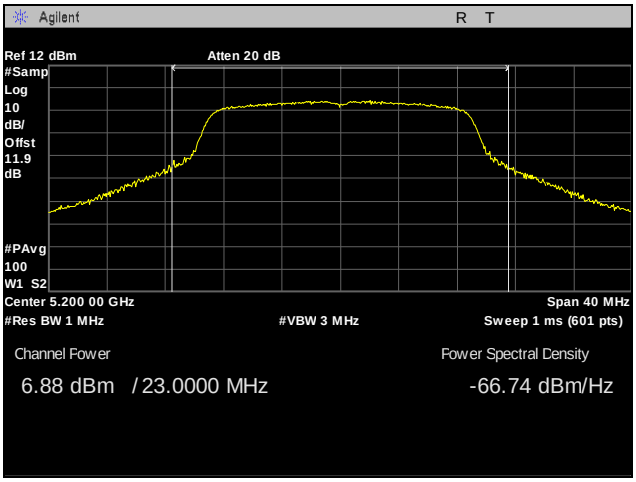


Plot 21. RF Power Output, High Channel, 802.11a

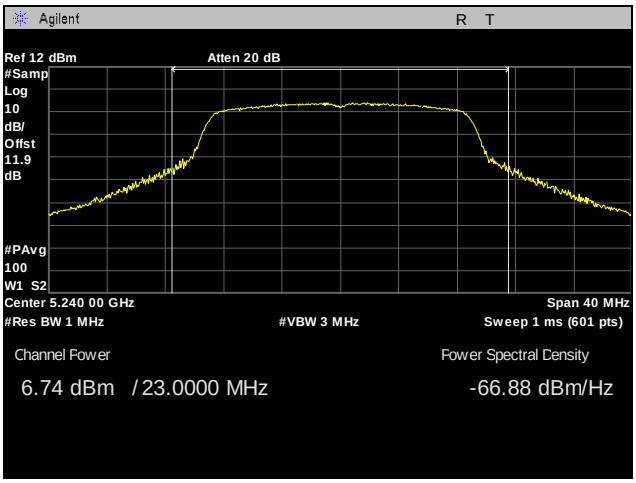
RF Power Output, 802.11n 20 MHz



Plot 22. RF Power Output, Low Channel, 802.11n 20 MHz



Plot 23. RF Power Output, Mid Channel, 802.11n 20 MHz



Plot 24. RF Power Output, High Channel, 802.11n 20 MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

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

Test Requirements: **§ 15.407(a)(1):** In addition, the peak power spectral density shall not exceed 4 dBm in any 1 megahertz band.

Test Procedure: The transmitter was connected directly to a Spectrum Analyzer through an attenuator. The power level was set to the maximum level on the EUT. The RBW was set to 1MHz and the VBW was set to 3MHz. The method of measurement used was method SA-1 from FCC Publication Number 789033.

Test Results: Equipment was compliant with the peak power spectral density limits of **§ 15.407 (a)(1).** The peak power spectral density was determined from plots on the following page(s).

Test Engineer(s): Anderson Soungpanya

Test Date(s): 11/07/12

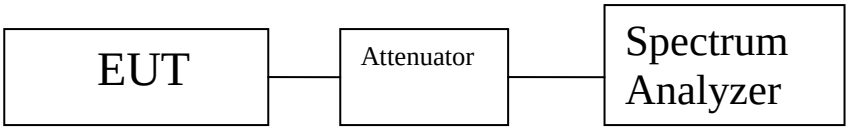
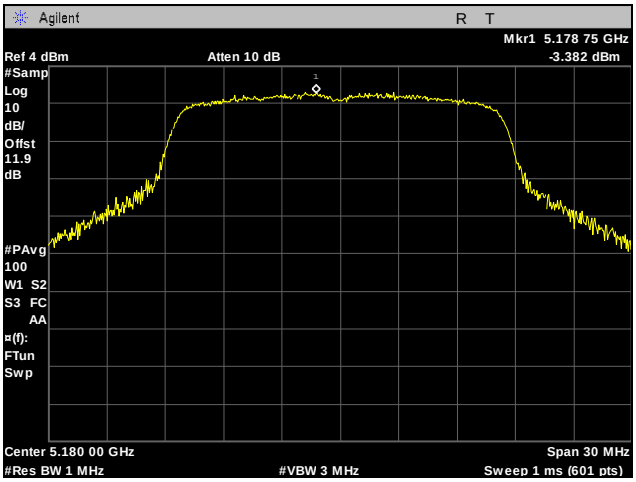


Figure 4. Power Spectral Density Test Setup

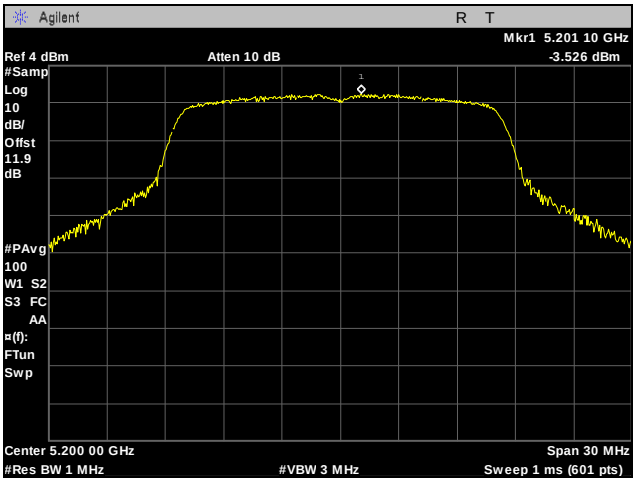
Mode	Channel	Frequency (MHz)	Peak Spectral Density (dBm)	Limit (dBm)
802.11a	Low	5180	-3.382	4
	Mid	5200	-3.526	4
	High	5240	-3.277	4
802.11n HT20	Low	5180	-3.488	4
	Mid	5200	-3.856	4
	High	5240	-4.178	4

Table 20. Peak Spectral Density, Test Results

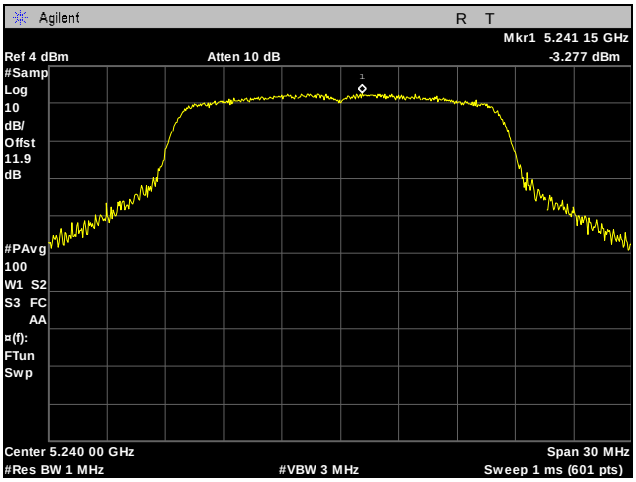
Power Spectral Density, 802.11a



Plot 25. Power Spectral Density, Low Channel, 802.11a

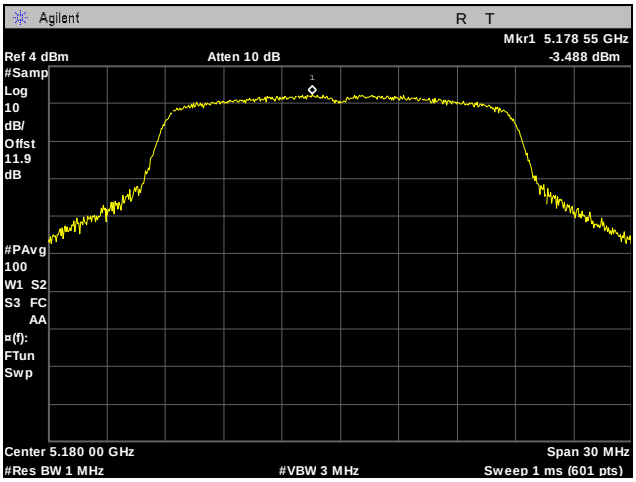


Plot 26. Power Spectral Density, Mid Channel, 802.11a

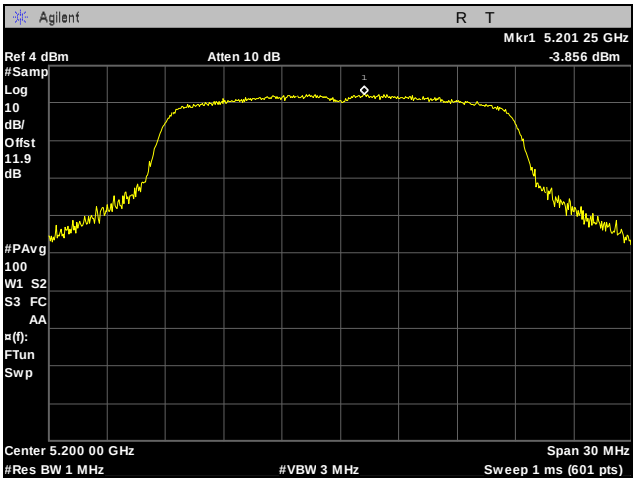


Plot 27. Power Spectral Density, High Channel, 802.11a

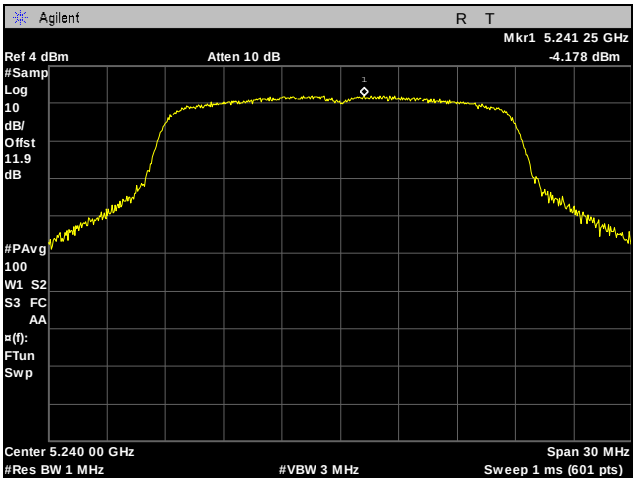
Power Spectral Density, 802.11n 20 MHz



Plot 28. Power Spectral Density, Low Channel, 802.11n 20 MHz



Plot 29. Power Spectral Density, Mid Channel, 802.11n 20 MHz



Plot 30. Power Spectral Density, High Channel, 802.11n 20 MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(a)(6) Peak Excursion Ratio

Test Requirements: **§ 15.407(a)(6):** The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

Test Procedure: The EUT was connected directly to the spectrum analyzer through cabling and attenuation. The 1st trace on the spectrum analyzer was set to RBW=1MHz, VBW=3MHz. A peak detector was used and the trace max held.. The 2nd trace on the spectrum analyzer was set according to measurement method SA-1 from the FCC Public Notice 789033 for making conducted power measurements.

Test Results: Equipment was compliant with the peak excursion ratio limits of **§ 15.407(a)(6).** The peak excursion ratio was determined from plots on the following page(s).

Test Engineer(s): Anderson Soungpanya

Test Date(s): 11/07/12

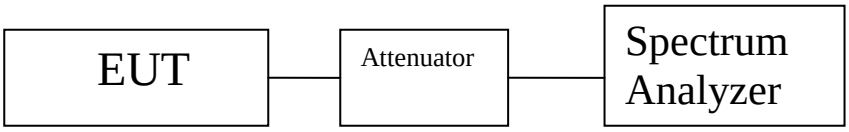
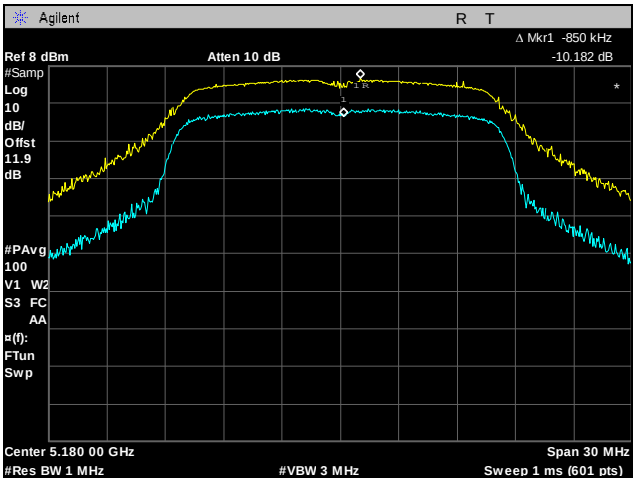


Figure 5. Peak Excursion Ratio Test Setup

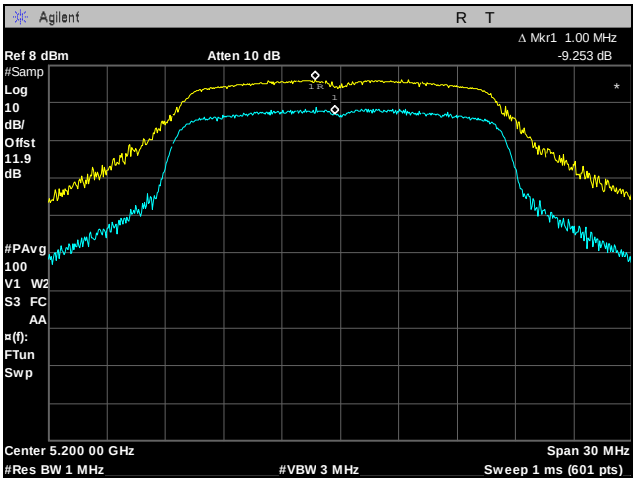
Mode	Channel	Frequency (MHz)	Peak Excursion Ratio (dBm)	Limit (dBm)
802.11a	Low	5180	10.182	13
	Mid	5200	9.253	13
	High	5240	9.280	13
802.11n HT20	Low	5180	9.488	13
	Mid	5200	9.483	13
	High	5240	9.138	13

Table 21. Peak Excursion Ratio, Test Results

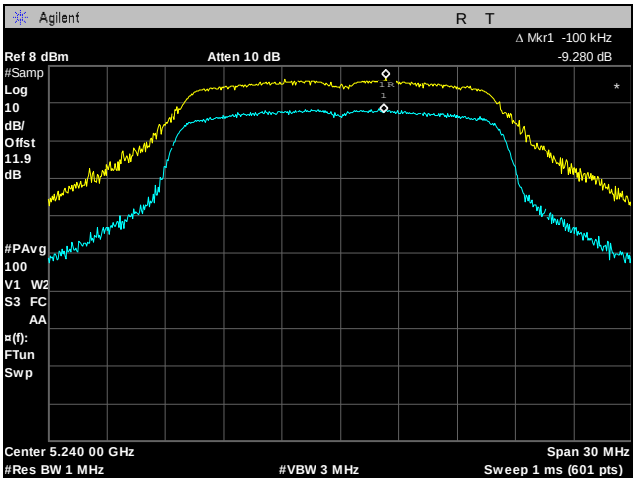
Peak Excursion Ratio, 802.11a



Plot 31. Peak Excursion Ratio, Low Channel, 802.11a

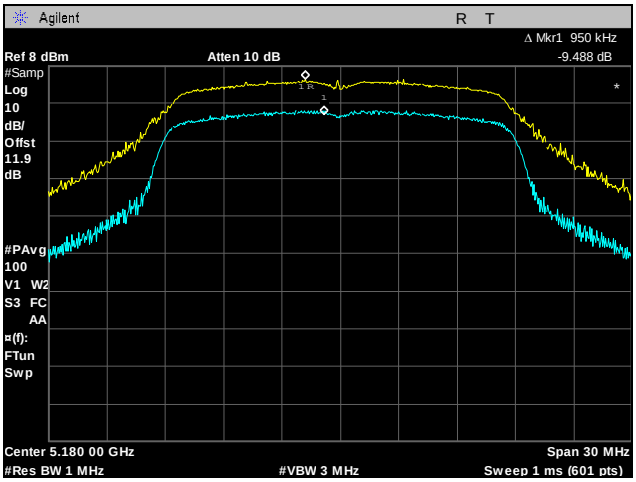


Plot 32. Peak Excursion Ratio, Mid Channel, 802.11a

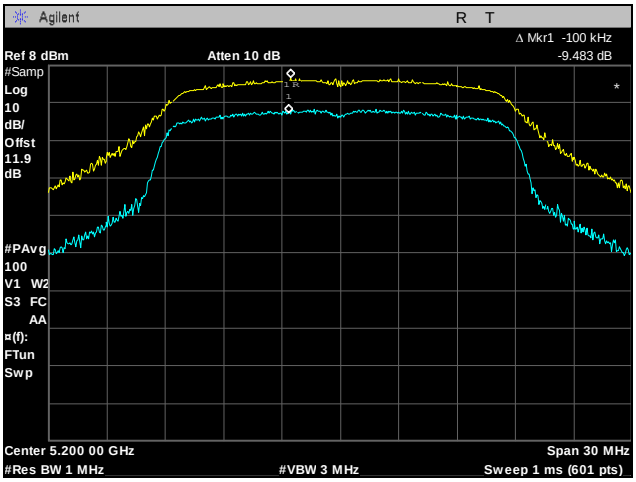


Plot 33. Peak Excursion Ratio, High Channel, 802.11a

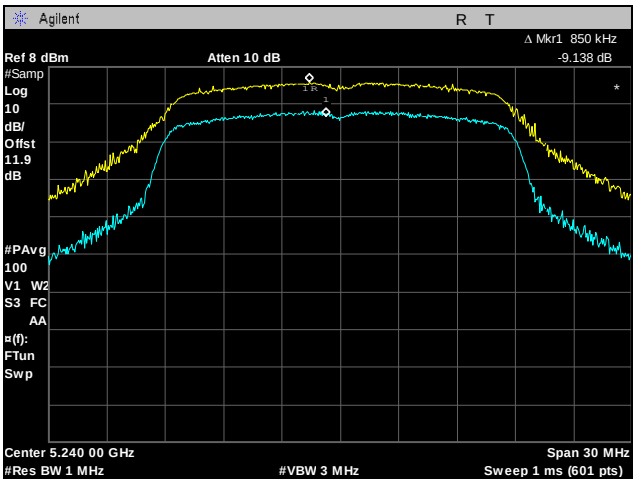
Peak Excursion Ratio, 802.11n 20 MHz



Plot 34. Peak Excursion Ratio, Low Channel, 802.11n 20 MHz



Plot 35. Peak Excursion Ratio, Mid Channel, 802.11n 20 MHz



Plot 36. Peak Excursion Ratio, High Channel, 802.11n 20 MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(b)(1), (6), (7) Undesirable Emissions

Test Requirements: **§ 15.407(b)(1), (6), (7)**; **§15.205:** Emissions outside the frequency band.

§ 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 transmitter was placed on an 80cm wooden table inside in a semi-anechoic chamber. Measurements were performed with the EUT rotated 360 degrees and varying the adjustable antenna mast height to determine worst case orientation for maximum emissions.

For frequencies from 30 MHz to 1 GHz, measurements were made using a quasi-peak detector with a 120 kHz bandwidth.

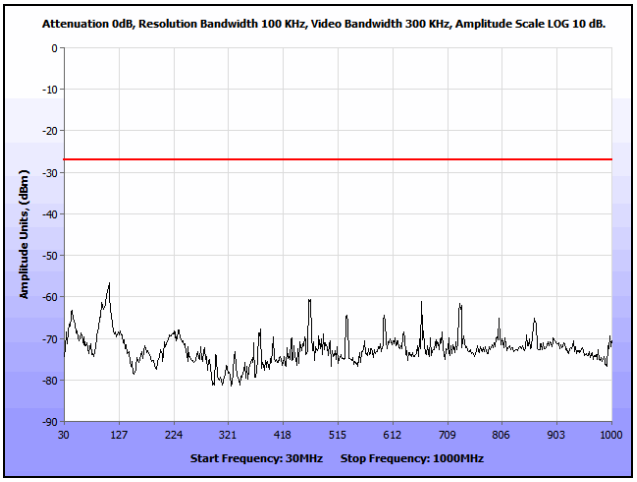
For measurements above 1 GHz, measurements were made with a Peak detector with 1 MHz resolution bandwidth. Where the spurious emissions fell into a restricted band, measurements were also made with an average detector to make sure they complied with 15.209 limits. Only noise floor was seen above 18 GHz.
The equation, **EIRP= E + 20 log D – 104.8** was used to convert an EIRP limit to a field strength limit.
E = field strength (dBUv/m)
D = Reference measurement distance

Test Results: The EUT was compliant with the Radiated Emission limits for Intentional Radiators. See following pages for detailed test results.

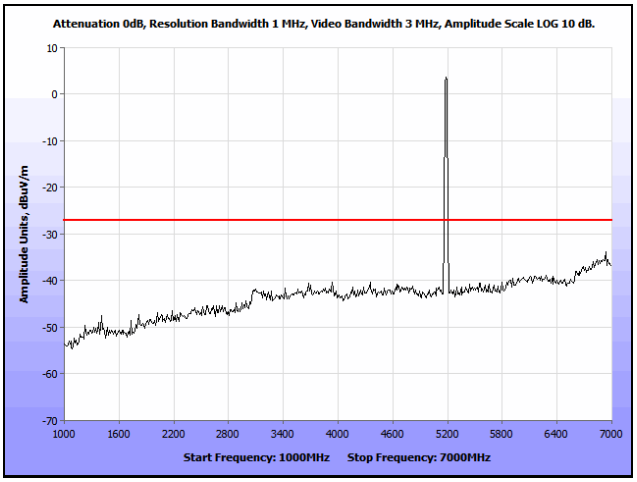
Test Engineer(s): Anderson Soungpanya

Test Date(s): 11/05/12 – 11/07/12

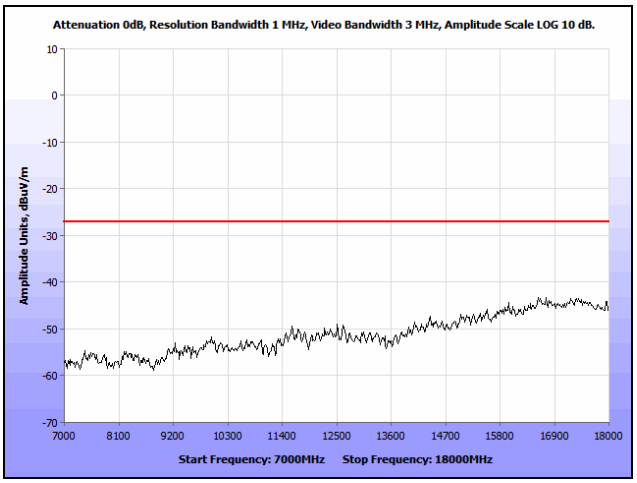
Radiated Spurious Emissions, 802.11a



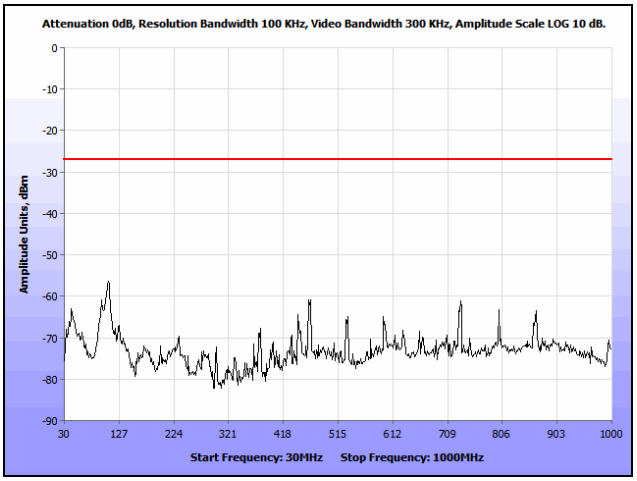
Plot 37. Radiated Spurious Emissions, 802.11a, Low Channel, 30 MHz – 1 GHz



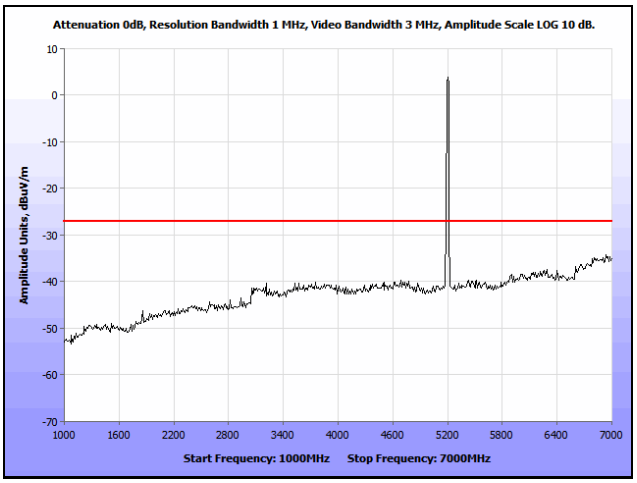
Plot 38. Radiated Spurious Emissions, 802.11a, Low Channel, 1 GHz – 7 GHz



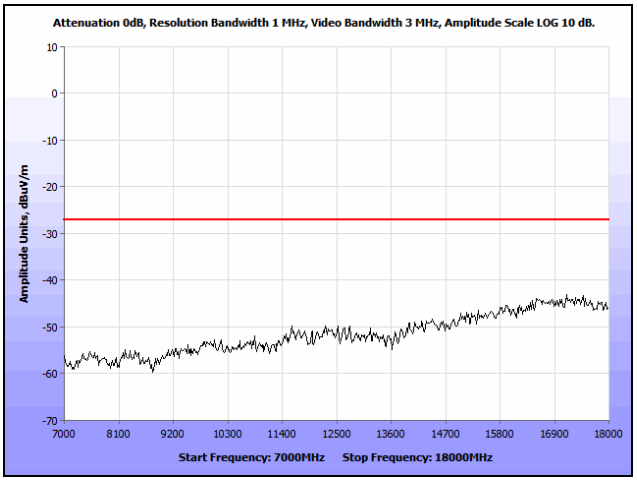
Plot 39. Radiated Spurious Emissions, 802.11a, Low Channel, 7 GHz – 18 GHz



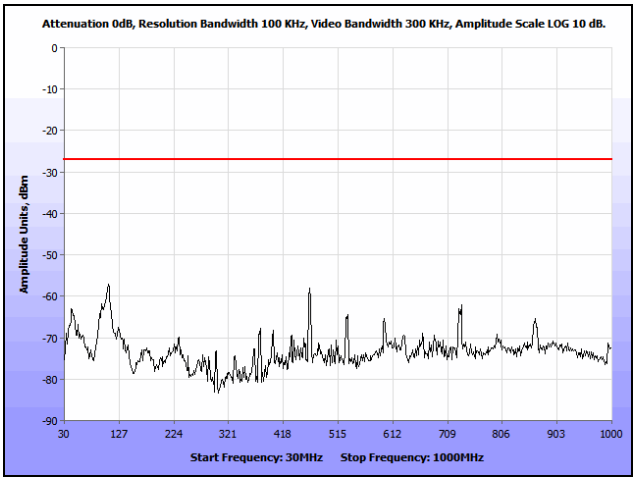
Plot 40. Radiated Spurious Emissions, 802.11a, Mid Channel, 30 MHz – 1 GHz



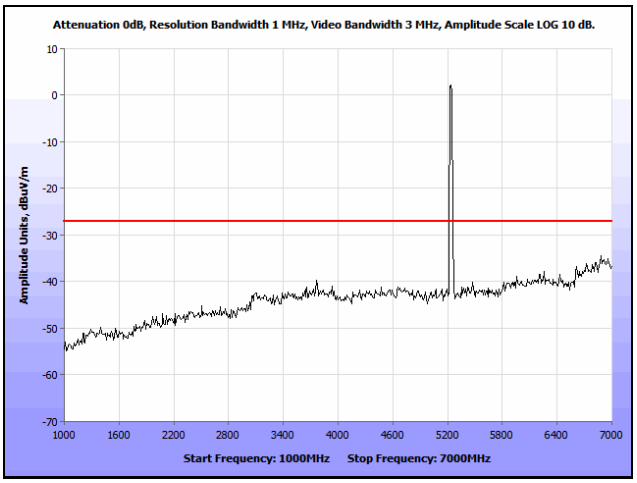
Plot 41. Radiated Spurious Emissions, 802.11a, Mid Channel, 1 GHz – 7 GHz



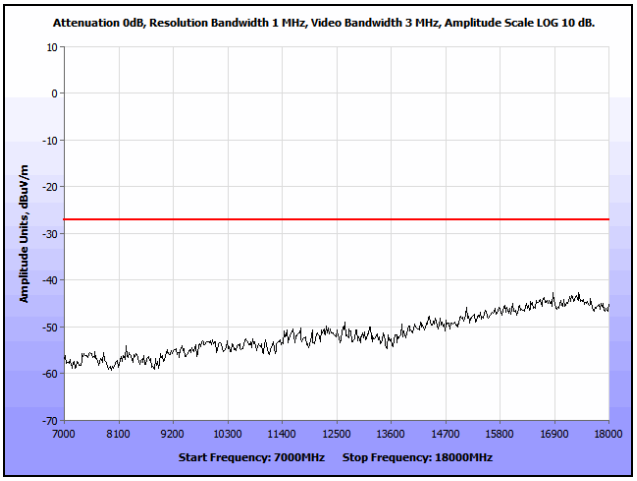
Plot 42. Radiated Spurious Emissions, 802.11a, Mid Channel, 7 GHz – 18 GHz



Plot 43. Radiated Spurious Emissions, 802.11a, High Channel, 30 MHz – 1 GHz

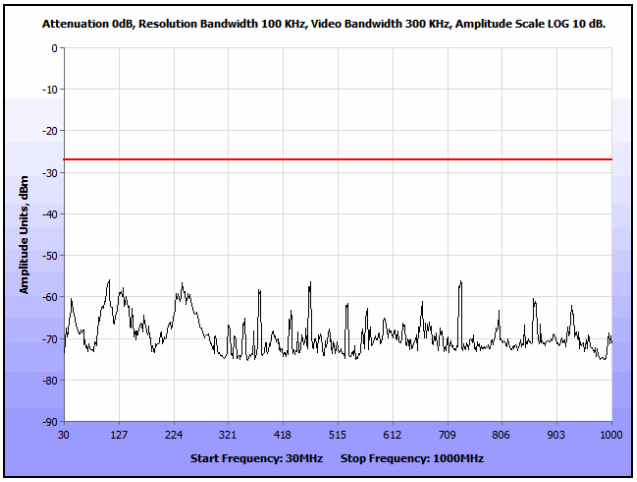


Plot 44. Radiated Spurious Emissions, 802.11a, High Channel, 1 GHz – 7 GHz

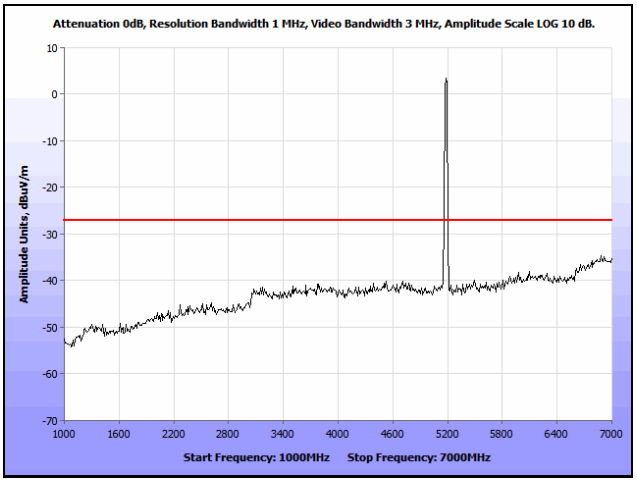


Plot 45. Radiated Spurious Emissions, 802.11a, High Channel, 7 GHz – 18 GHz

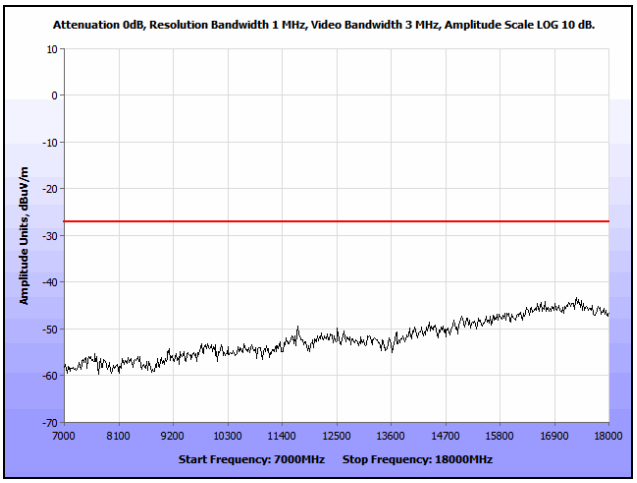
Radiated Spurious Emissions, 802.11n 20 MHz



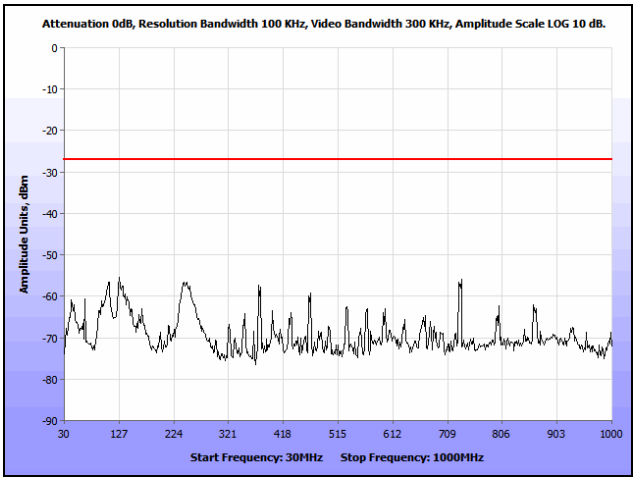
Plot 46. Radiated Spurious Emissions, 802.11n 20 MHz, Low Channel, 30 MHz – 1 GHz



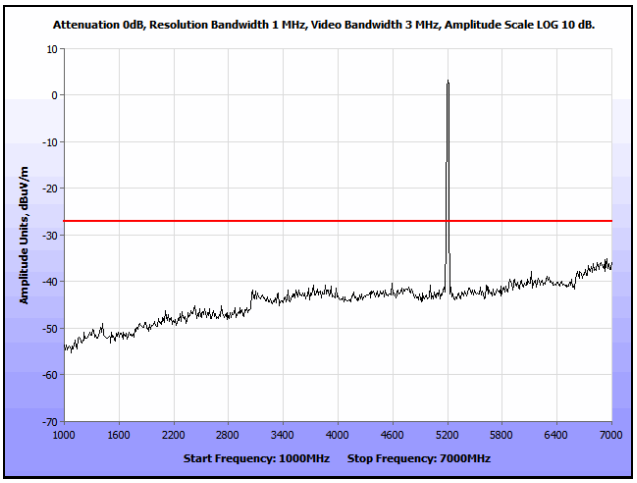
Plot 47. Radiated Spurious Emissions, 802.11n 20 MHz, Low Channel, 1 GHz – 7 GHz



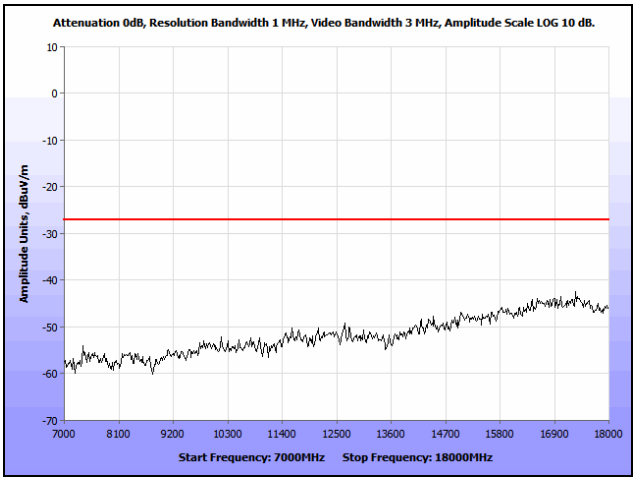
Plot 48. Radiated Spurious Emissions, 802.11n 20 MHz, Low Channel, 7 GHz – 18 GHz



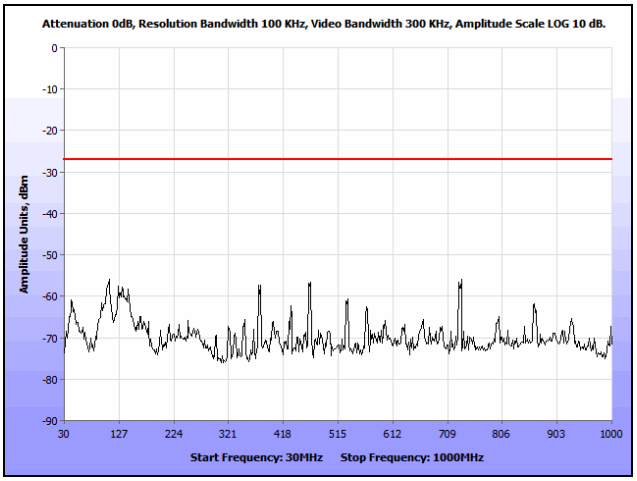
Plot 49. Radiated Spurious Emissions, 802.11n 20 MHz, Mid Channel, 30 MHz – 1 GHz



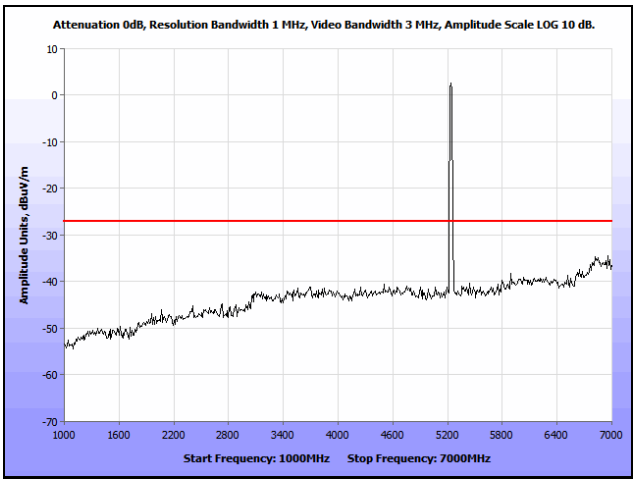
Plot 50. Radiated Spurious Emissions, 802.11n 20 MHz, Mid Channel, 1 GHz – 7 GHz



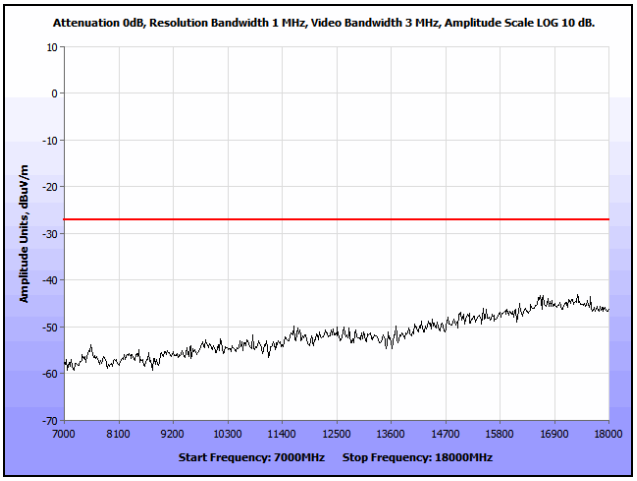
Plot 51. Radiated Spurious Emissions, 802.11n 20 MHz, Mid Channel, 7 GHz – 18 GHz



Plot 52. Radiated Spurious Emissions, 802.11n 20 MHz, High Channel, 30 MHz – 1 GHz

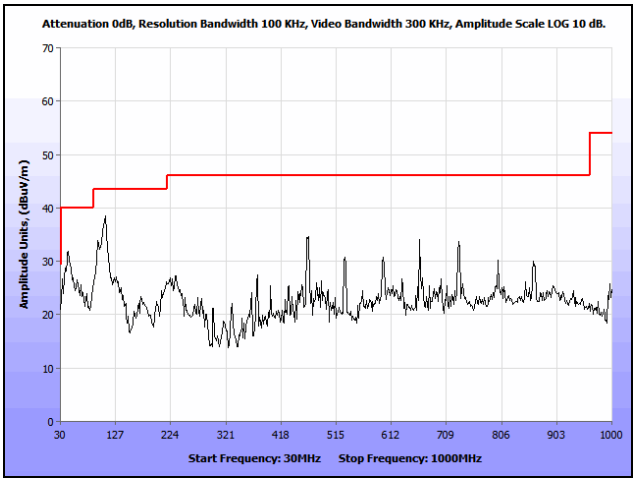


Plot 53. Radiated Spurious Emissions, 802.11n 20 MHz, High Channel, 1 GHz – 7 GHz

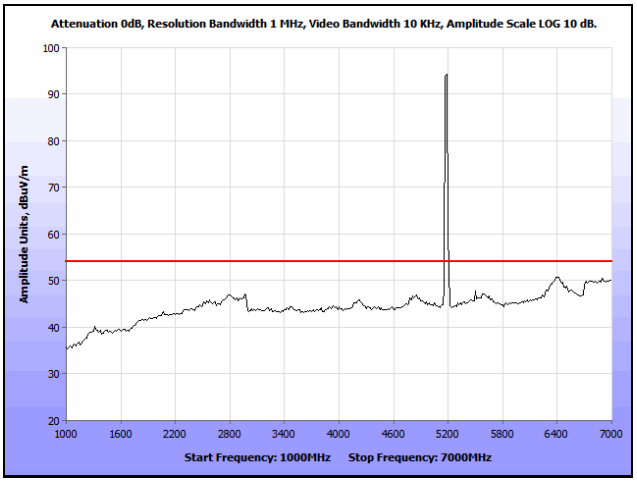


Plot 54. Radiated Spurious Emissions, 802.11n 20 MHz, High Channel, 7 GHz – 18 GHz

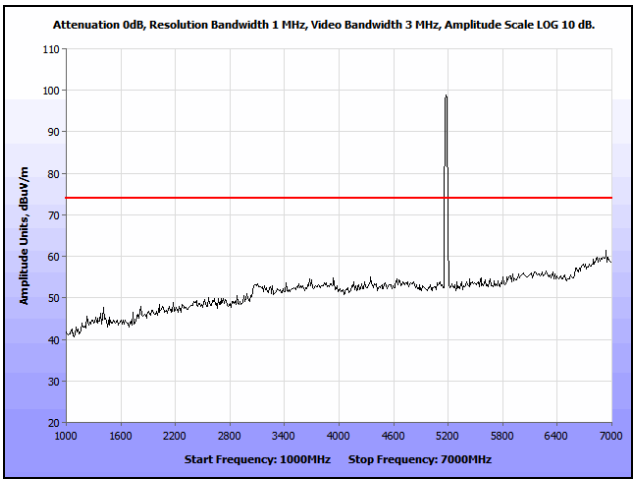
§15.205 Radiated Spurious Emissions, 802.11a



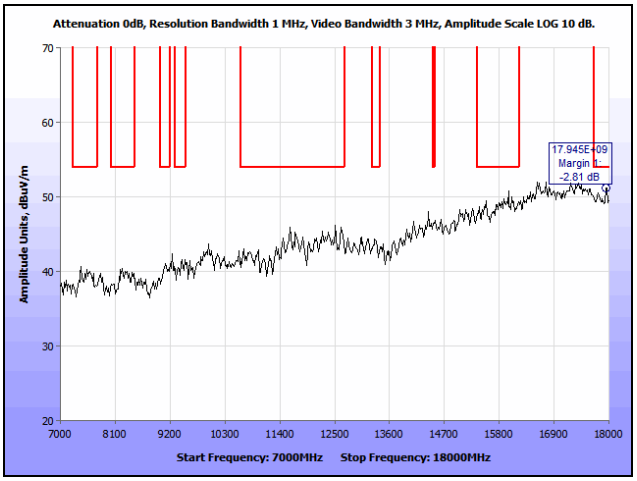
Plot 55. §15.205, Radiated Spurious Emissions, 802.11a, Low Channel, 30 MHz – 1 GHz



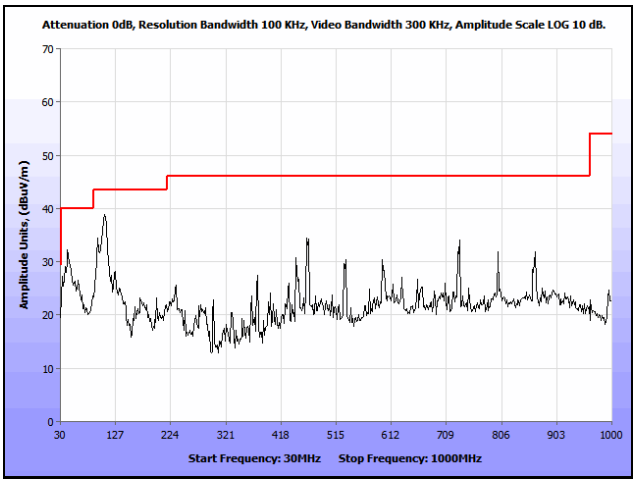
Plot 56. §15.205, Radiated Spurious Emissions, 802.11a, Low Channel, 1 GHz – 7 GHz, Average



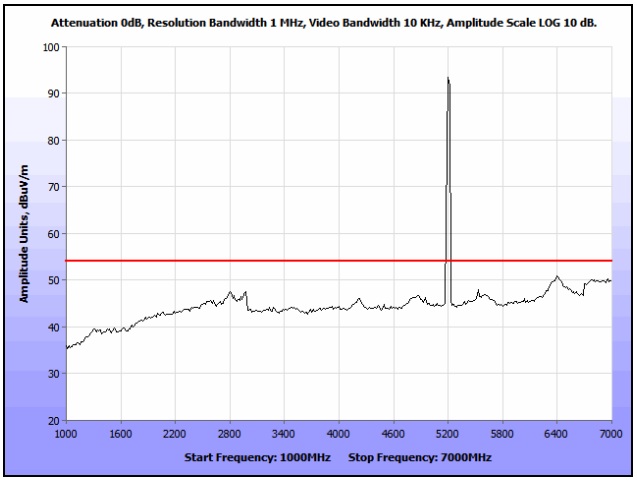
Plot 57. §15.205, Radiated Spurious Emissions, 802.11a, Low Channel, 1 GHz – 7 GHz, Peak



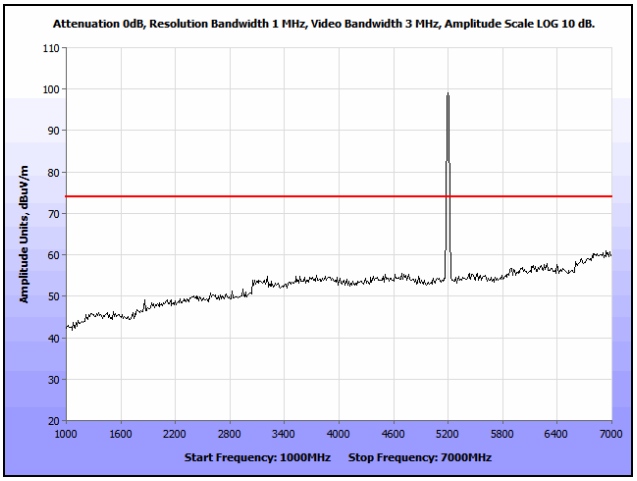
Plot 58. §15.205, Radiated Spurious Emissions, 802.11a, Low Channel, 7 GHz – 18 GHz



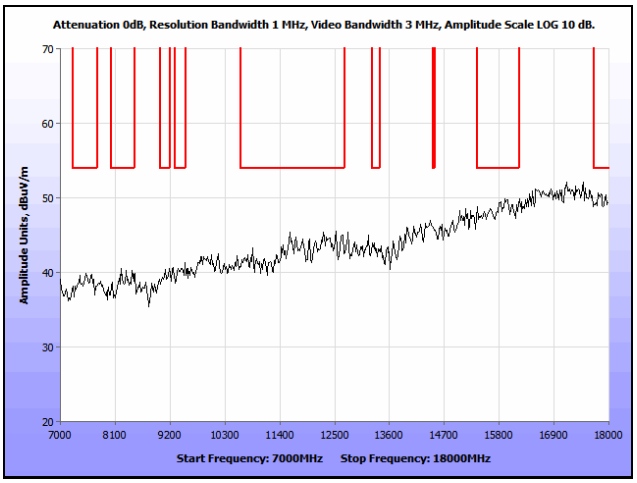
Plot 59. §15.205, Radiated Spurious Emissions, 802.11a, Mid Channel, 30 MHz – 1 GHz



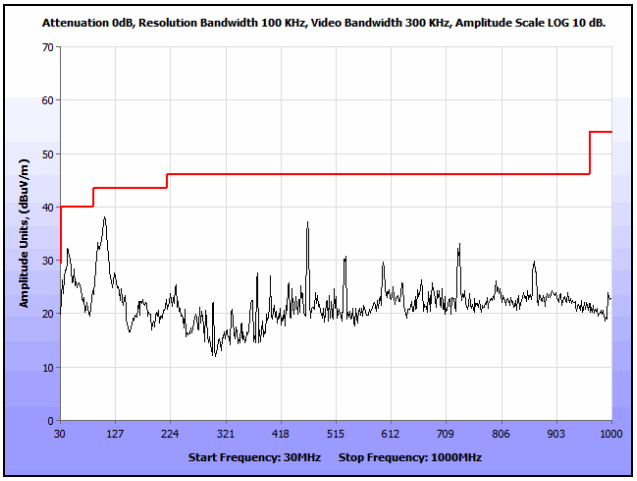
Plot 60. §15.205, Radiated Spurious Emissions, 802.11a, Mid Channel, 1 GHz – 7 GHz, Average



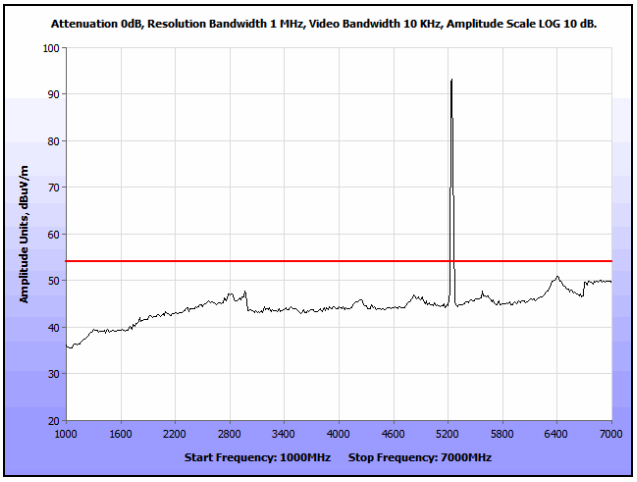
Plot 61. §15.205, Radiated Spurious Emissions, 802.11a, Mid Channel, 1 GHz – 7 GHz, Peak



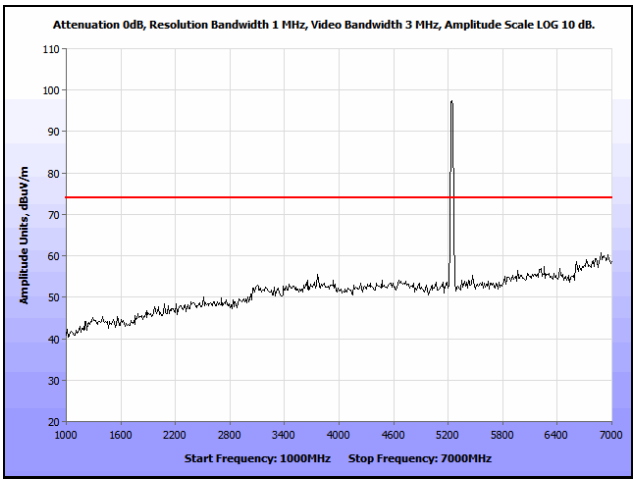
Plot 62. §15.205, Radiated Spurious Emissions, 802.11a, Mid Channel, 7 GHz – 18 GHz



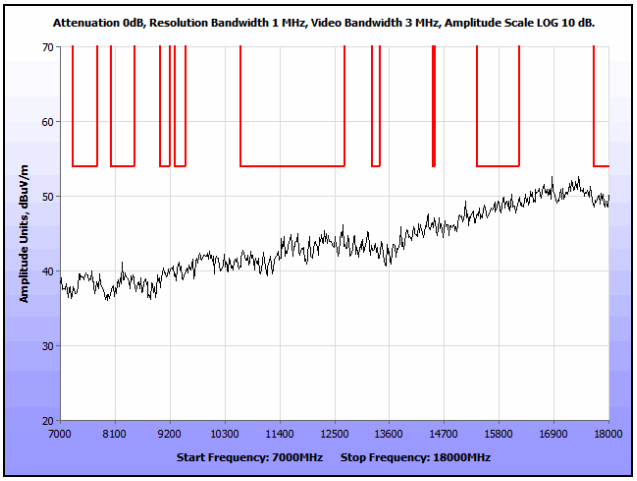
Plot 63. §15.205, Radiated Spurious Emissions, 802.11a, High Channel, 30 MHz – 1 GHz



Plot 64. §15.205, Radiated Spurious Emissions, 802.11a, High Channel, 1 GHz – 7 GHz, Average

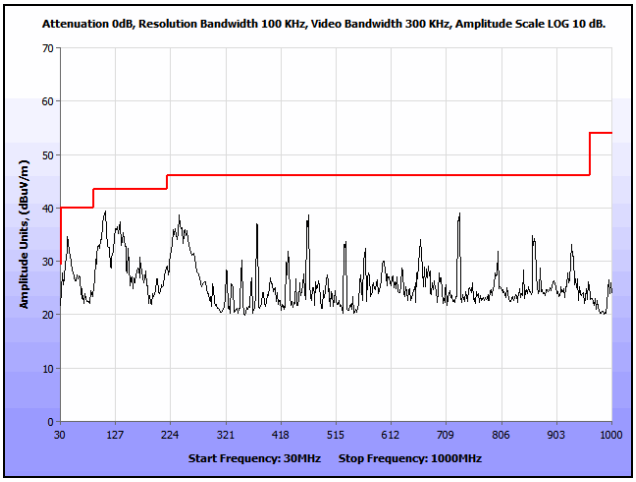


Plot 65. §15.205, Radiated Spurious Emissions, 802.11a, High Channel, 1 GHz – 7 GHz, Peak

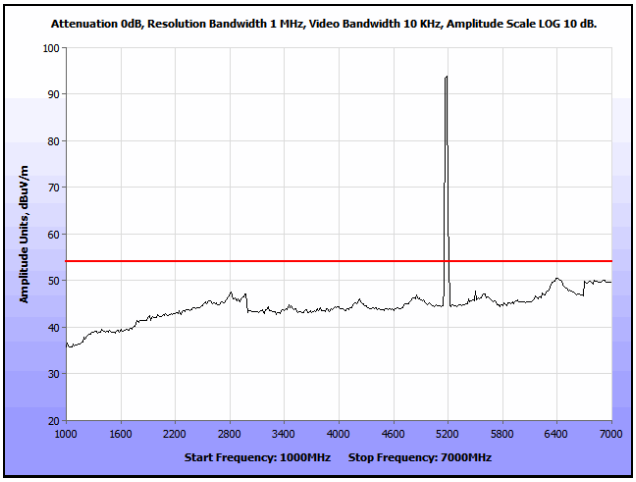


Plot 66. §15.205, Radiated Spurious Emissions, 802.11a, High Channel, 7 GHz – 18 GHz

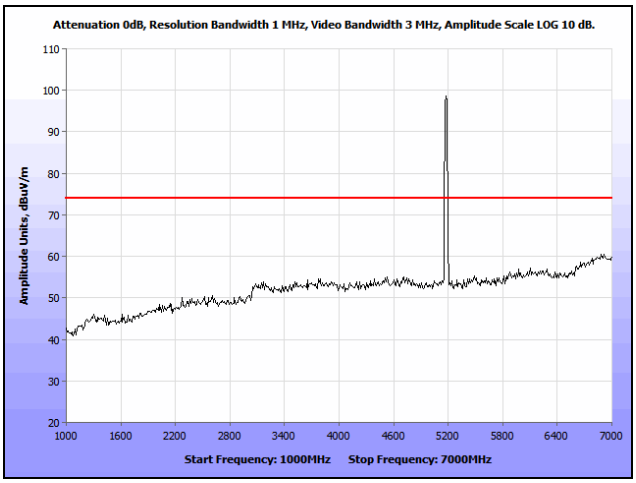
§15.205, Radiated Spurious Emissions, 802.11n 20 MHz



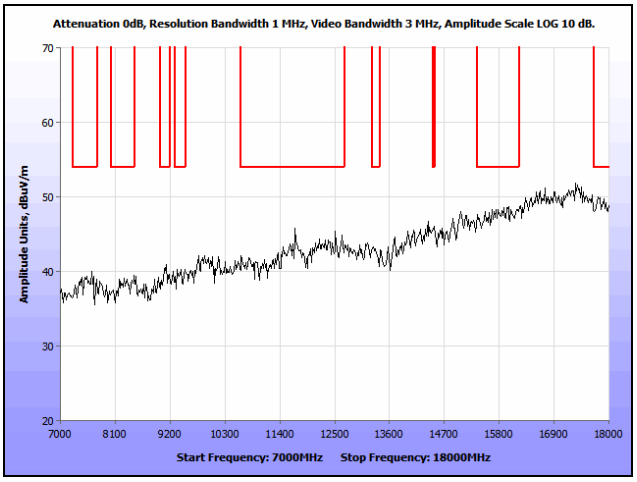
Plot 67. §15.205, Radiated Spurious Emissions, 802.11n 20 MHz, Low Channel, 30 MHz – 1 GHz



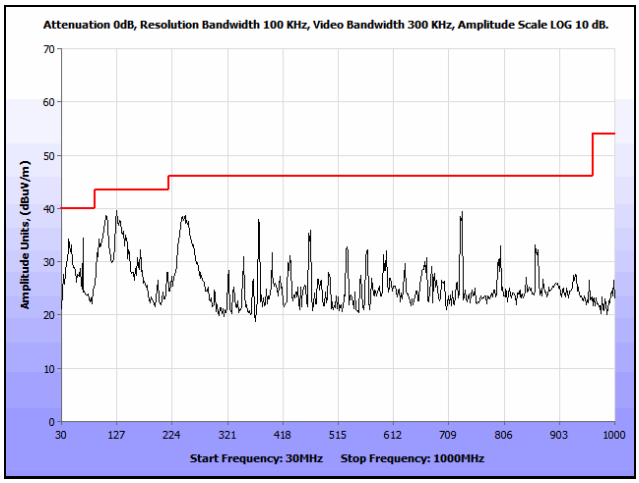
Plot 68. §15.205, Radiated Spurious Emissions, 802.11n 20 MHz, Low Channel, 1 GHz – 7 GHz, Average



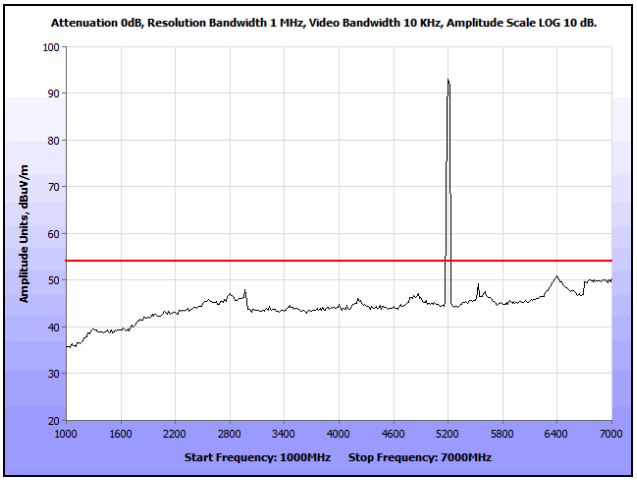
Plot 69. §15.205, Radiated Spurious Emissions, 802.11n 20 MHz, Low Channel, 1 GHz – 7 GHz, Peak



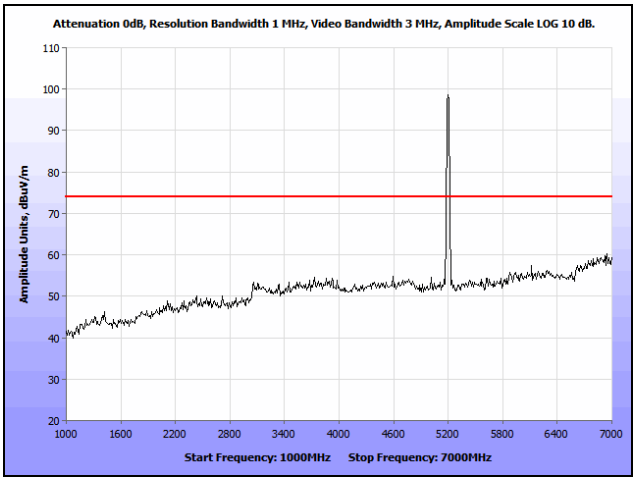
Plot 70. §15.205, Radiated Spurious Emissions, 802.11n 20 MHz, Low Channel, 7 GHz – 18 GHz



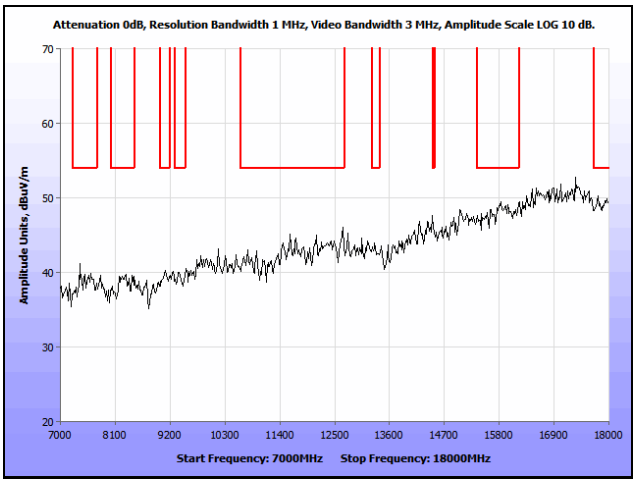
Plot 71. §15.205, Radiated Spurious Emissions, 802.11n 20 MHz, Mid Channel, 30 MHz – 1 GHz



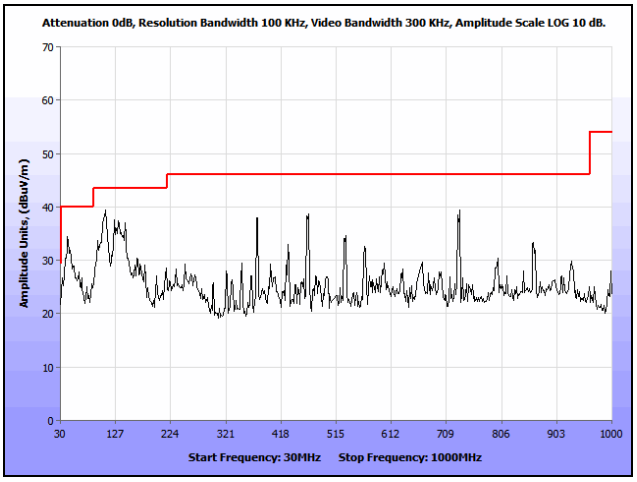
Plot 72. §15.205, Radiated Spurious Emissions, 802.11n 20 MHz, Mid Channel, 1 GHz – 7 GHz, Average



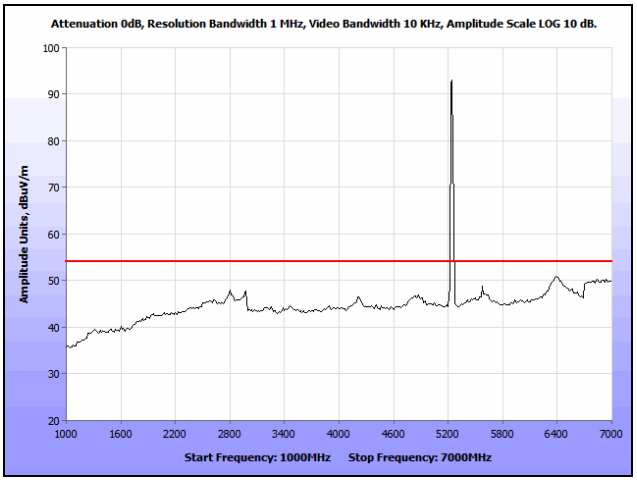
Plot 73. §15.205, Radiated Spurious Emissions, 802.11n 20 MHz, Mid Channel, 1 GHz – 7 GHz, Peak



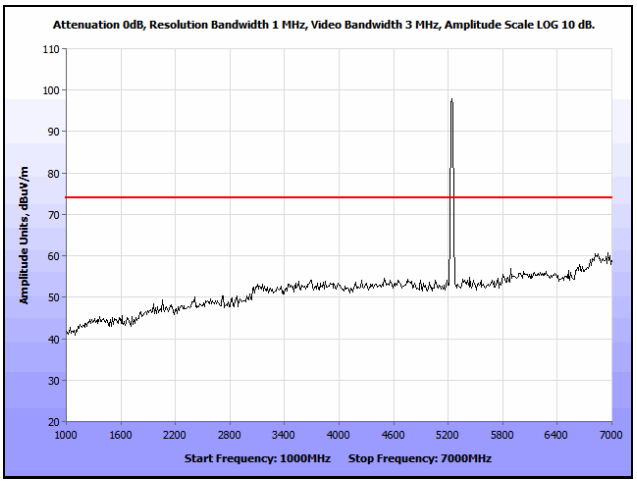
Plot 74. §15.205, Radiated Spurious Emissions, 802.11n 20 MHz, Mid Channel, 7 GHz – 18 GHz



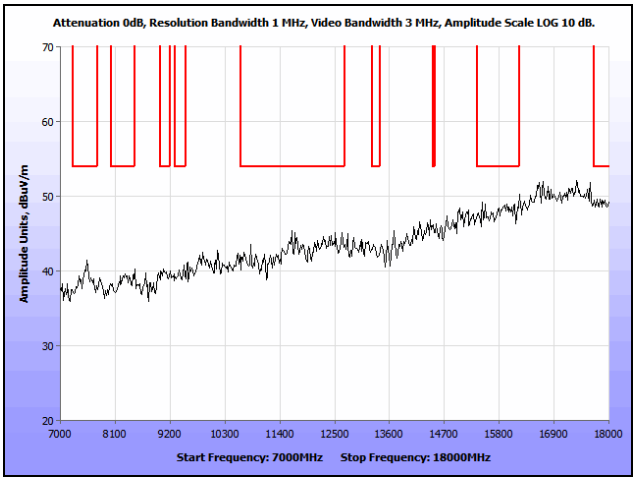
Plot 75. §15.205, Radiated Spurious Emissions, 802.11n 20 MHz, High Channel, 30 MHz – 1 GHz



Plot 76. §15.205, Radiated Spurious Emissions, 802.11n 20 MHz, High Channel, 1 GHz – 7 GHz, Average

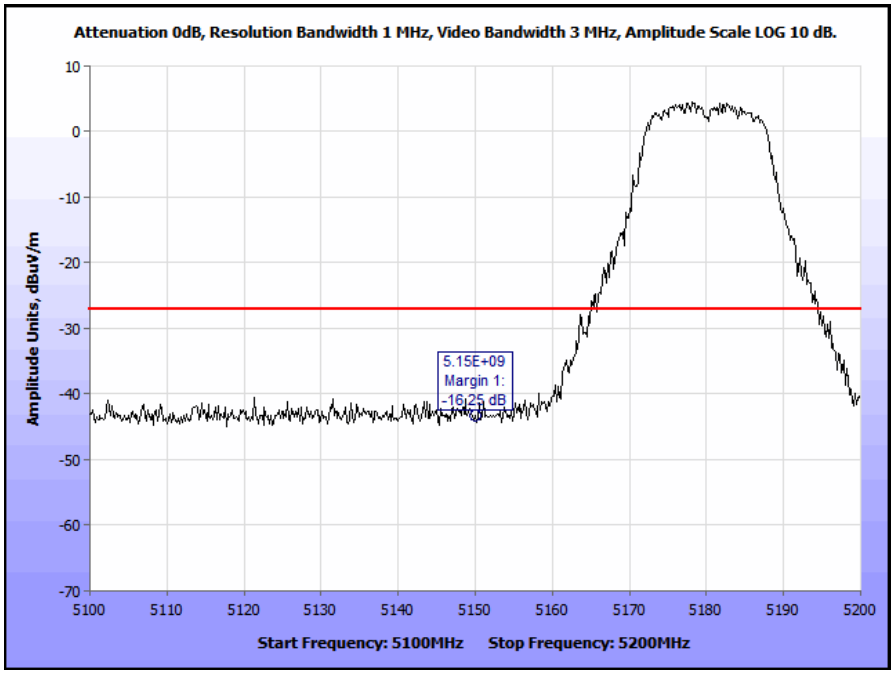


Plot 77. §15.205, Radiated Spurious Emissions, 802.11n 20 MHz, High Channel, 1 GHz – 7 GHz, Peak

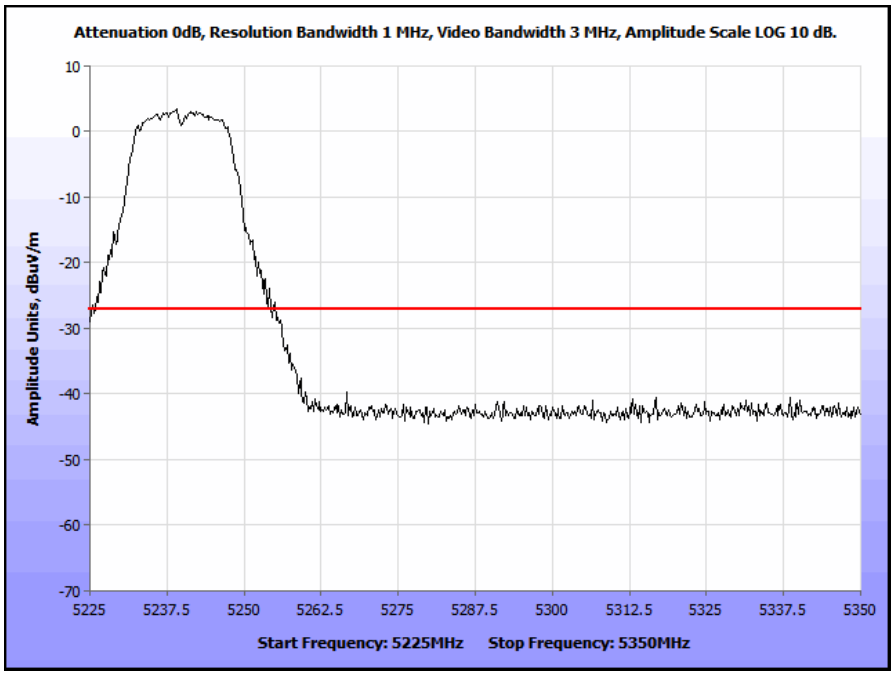


Plot 78. §15.205, Radiated Spurious Emissions, 802.11n 20 MHz, High Channel, 7 GHz – 18 GHz

Radiated Band Edge, 802.11a

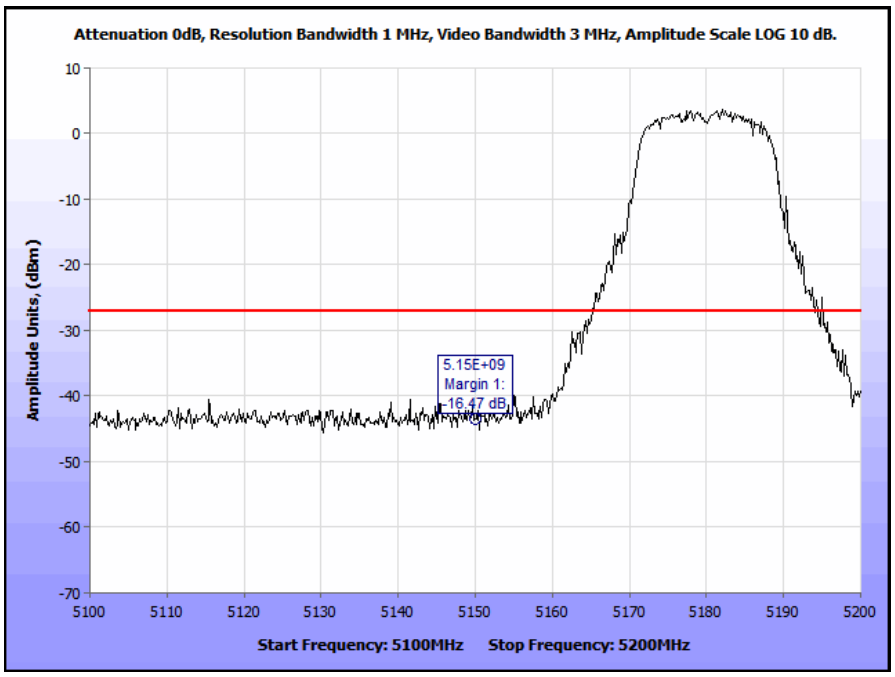


Plot 79. Radiated Band Edge, 802.11a, Low Channel

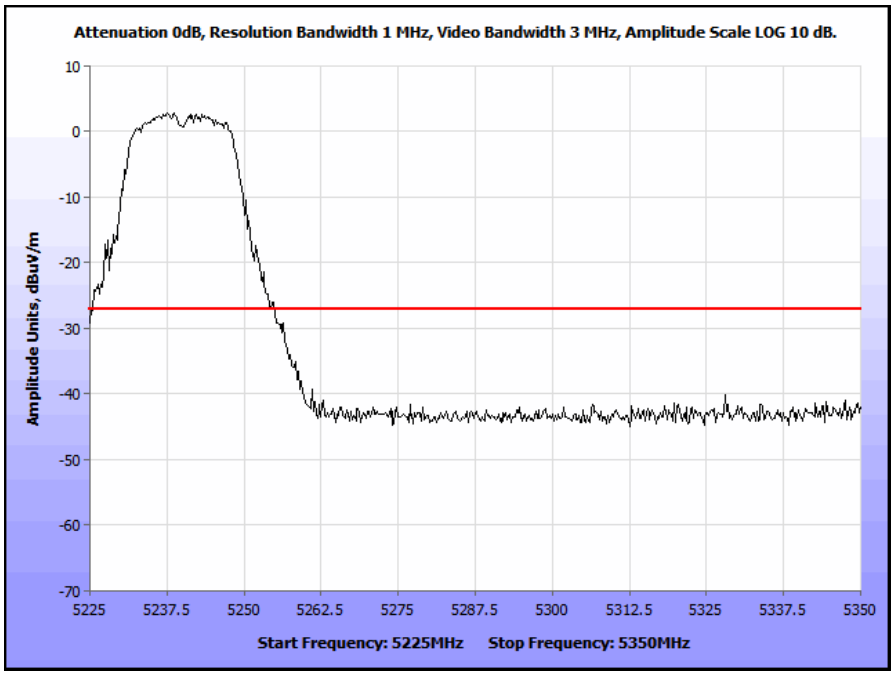


Plot 80. Radiated Band Edge, 802.11a, High Channel

Radiated Band Edge, 802.11n 20 MHz

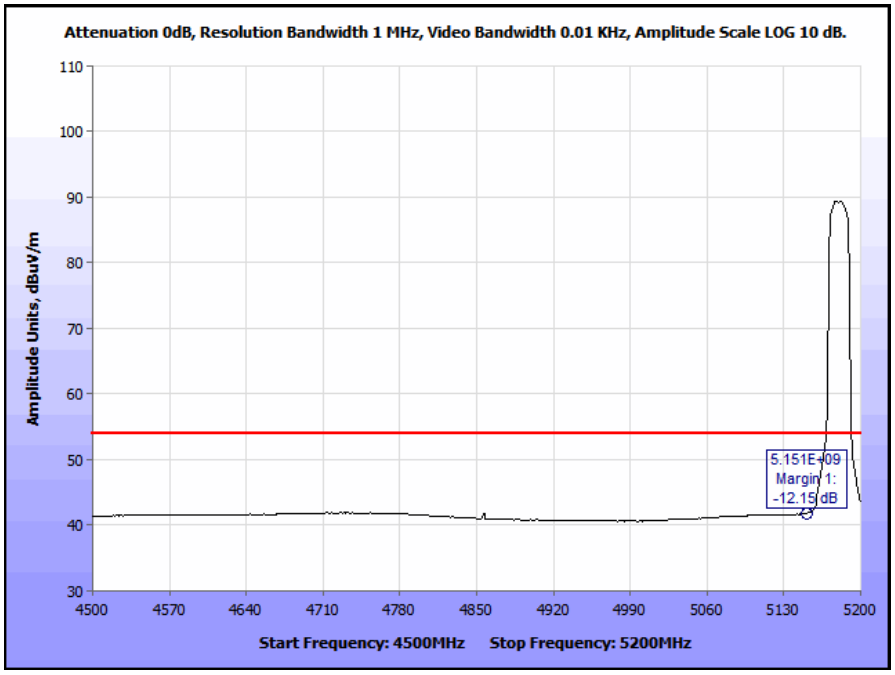


Plot 81. Radiated Band Edge, 802.11n 20 MHz, Low Channel

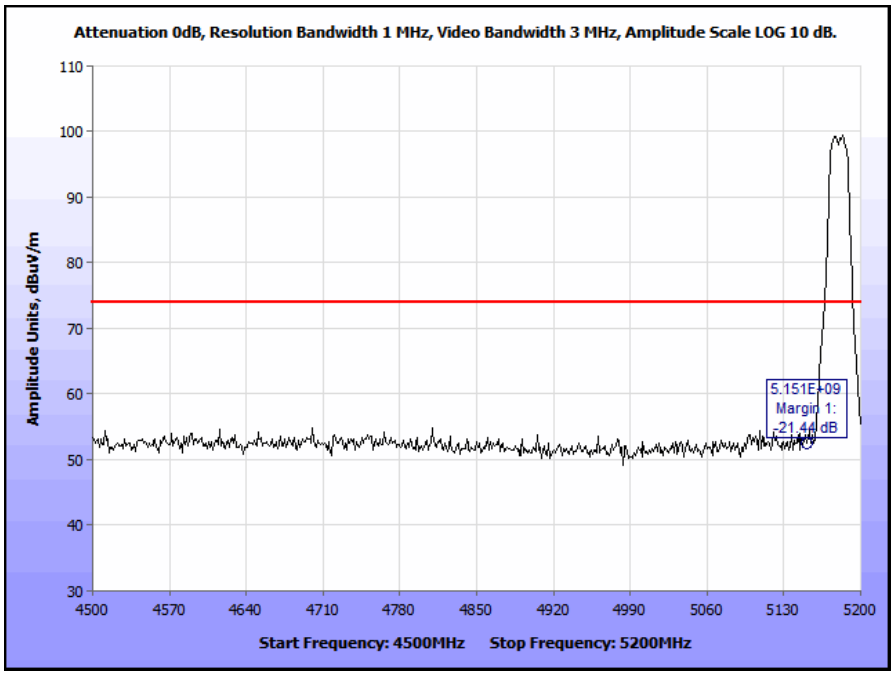


Plot 82. Radiated Band Edge, 802.11n 20 MHz, High Channel

Restricted Band, 802.11a

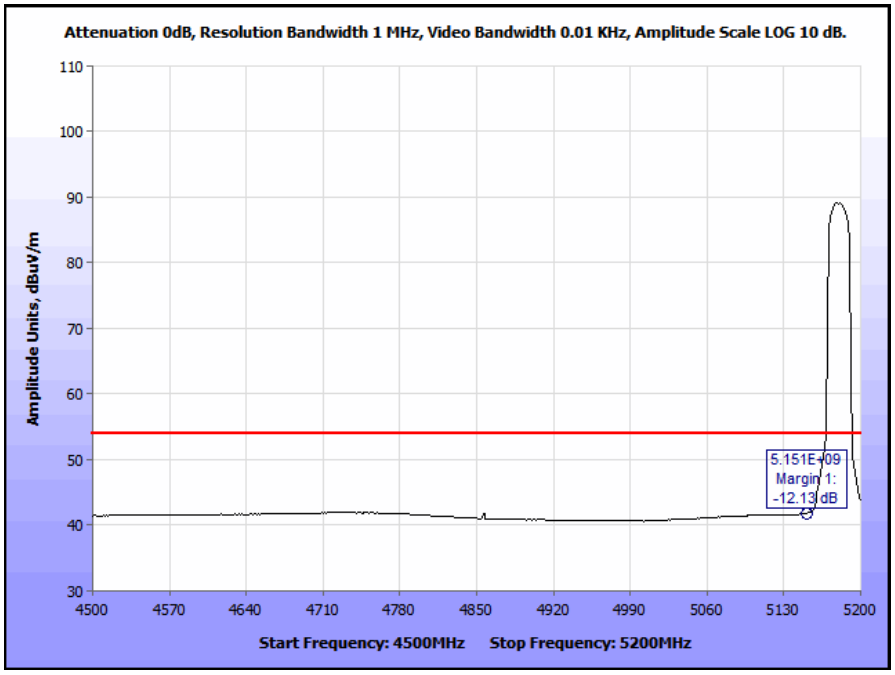


Plot 83. Restricted Band Edge, 802.11a, Low Channel, Average

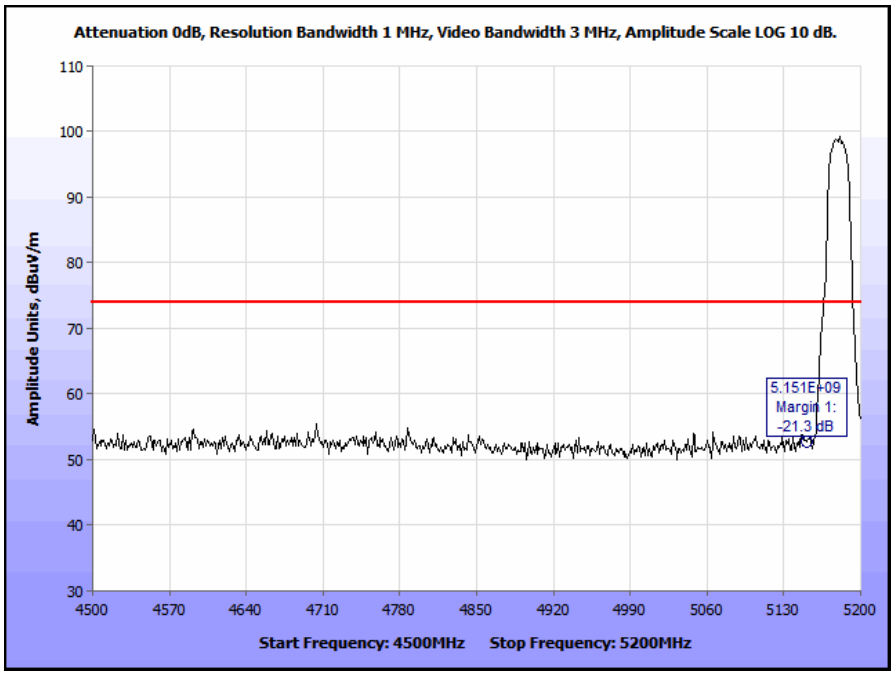


Plot 84. Restricted Band Edge, 802.11a, Low Channel, Peak

Restricted Band, 802.11n 20 MHz

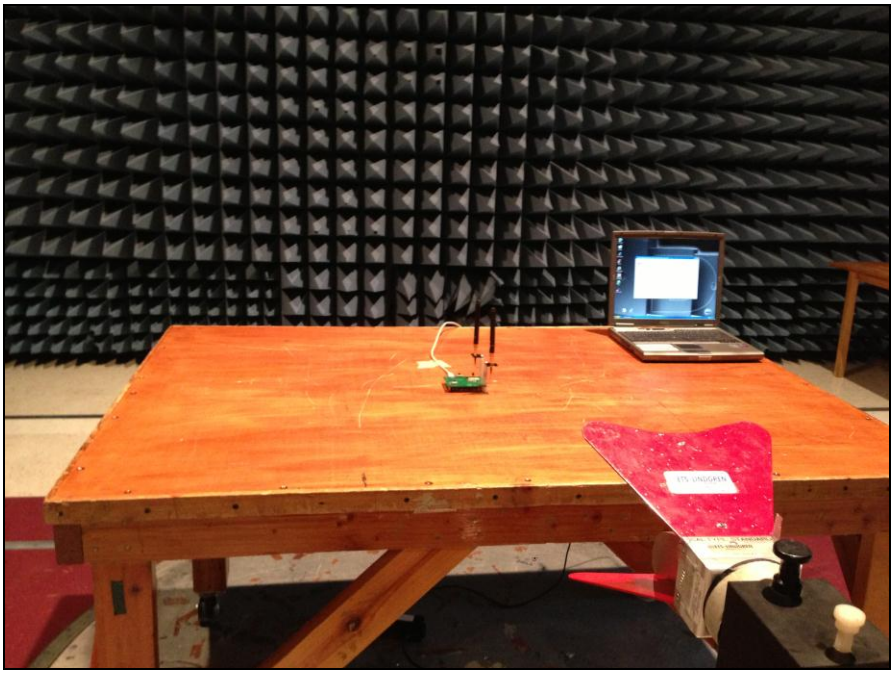


Plot 85. Restricted Band Edge, 802.11n 20 MHz, Low Channel, Average



Plot 86. Restricted Band Edge, 802.11n 20 MHz, Low Channel, Peak

Radiated Spurious Emissions Test Setup



Photograph 9. Radiated Spurious Emissions, Test Setup, 1 m

Photograph 10. Radiated Spurious Emissions, Test Setup, 3 m

Photograph 11. Radiated Spurious Emissions, Test Setup, 30 MHz – 1 GHz

Photograph 12. Radiated Spurious Emissions, Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(f) RF Exposure

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

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

MPE Limit Calculation: EUT's operating frequencies @ 5150-5250 MHz; highest conducted power = 7.27 dBm (Sample) therefore, **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

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

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

where, S = Power Density (1 mW/cm^2)
P = Power Input to antenna (5.33mW)
G = Highest Antenna Gain (2.51 numeric)
R = Minimum Distance between User and Antenna (20 cm)

$S = (5.33 * 2.51)/(4 * 3.14 * 20^2) = 12.40/5024 = 0.0027$ mW/cm^2

Since $S < 1$ mW/cm^2, the minimum distance (R) is 20cm

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(g) Frequency Stability

Test Requirements: **§ 15.407(g):** Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

Test Procedure: The EUT was set to transmit a continuous wave. The EUT was connected directly to a spectrum analyzer through an attenuator. The frequency counter function of the spectrum analyzer was utilized to measure frequency drift.

Test Results: The EUT was compliant with the requirements of **§15.407(g)**.

EUT has utilizes a low drop-out regulator (LDO) that cannot be disabled for extreme voltage variation testing.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 11/01/12 – 11/05/12

Frequency Stability

5180 MHz (Low Channel)			
	Temperature (C)	**Frequency (MHz)**	**PPM**
Reference @ 20C	60	5179.977763	0.079
	50	5179.977601	0.047
	40	5179.977738	0.074
	30	5179.977382	0.005
	20	5179.977356	0.000
5179.977356	10	5179.977384	0.005
	0	5179.977645	0.056
	-10	5179.978488	0.219
	-20	5179.978642	0.248
	-30	5179.979914	0.494
	-40	5179.979371	0.389
5200 MHz (Mid Channel)			
	Temperature (C)	**Frequency (MHz)**	**PPM**
Reference @ 20C	60	5199.977635	0.054
	50	5199.977542	0.037
	40	5199.977637	0.055
	30	5199.977542	0.037
	20	5199.977352	0.000
5199.977352	10	5199.977388	0.007
	0	5199.977654	0.058
	-10	5199.978566	0.233
	-20	5199.978812	0.281
	-30	5199.977992	0.123
	-40	5199.979908	0.492
5240 MHz (High Channel)			
	Temperature (C)	**Frequency (MHz)**	**PPM**
Reference @ 20C	60	5239.977768	0.058
	50	5239.977523	0.012
	40	5239.977677	0.041
	30	5239.977922	0.088
	20	5239.977462	0.000
5239.977462	10	5239.973910	0.678
	0	5239.977566	0.020
	-10	5239.978569	0.211
	-20	5239.977902	0.084
	-30	5239.978290	0.158
	-40	5239.979908	0.467

Table 22. Frequency Stability, Test Results

Electromagnetic Compatibility Criteria for Intentional Radiators

RSS-GEN Receiver Spurious Emissions Requirements

Test Requirements: The following receiver spurious emission limits shall be complied with:

(a) If a radiated measurement is made, all spurious emissions shall comply with the limits of Table 23.

Spurious Frequency (MHz)	Field Strength (microvolt/m at 3 metres)
30 – 88	100
88 – 216	150
216 – 960	200
Above 960	500

Table 23. Spurious Emission Limits for Receivers

(b) If a conducted measurement is made, no spurious output signals appearing at the antenna terminals shall exceed 2 nanowatts per any 4 kHz spurious frequency in the band 30-1000 MHz, or 5 nanowatts above 1 GHz.

Test Procedures: The EUT was programmed for receive mode only. Conducted measurements were taken at the antenna port of the EUT. 100 kHz resolution bandwidth was used from 30 MHz - 1 GHz and 1 MHz resolution was used for measurements done above 1 GHz. All plots are corrected for cable loss.

Test Results: Equipment is compliant with the Receiver Spurious Emissions Requirements of RSS-GEN.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 11/07/12

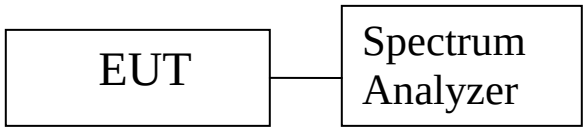
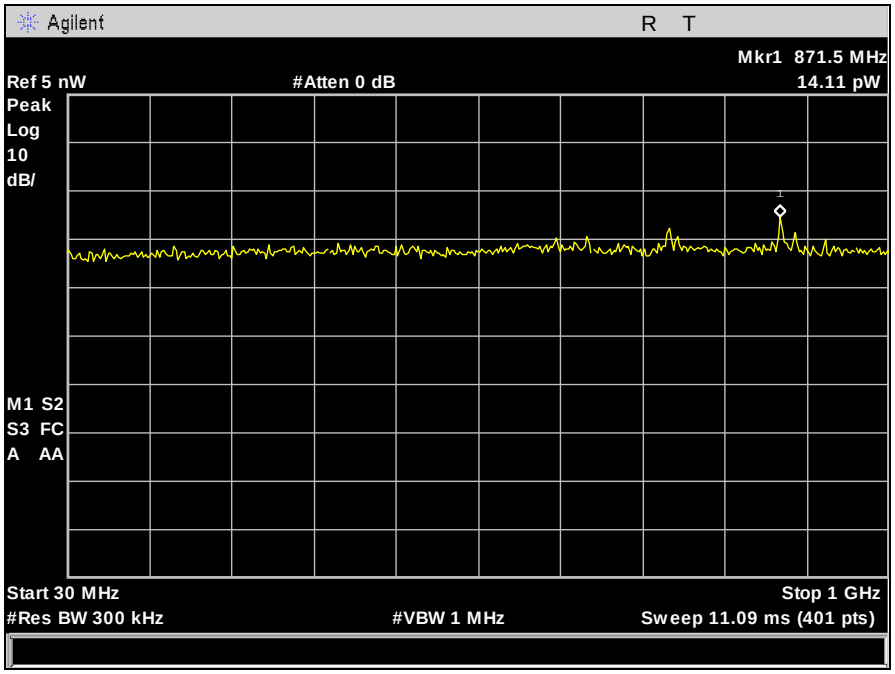
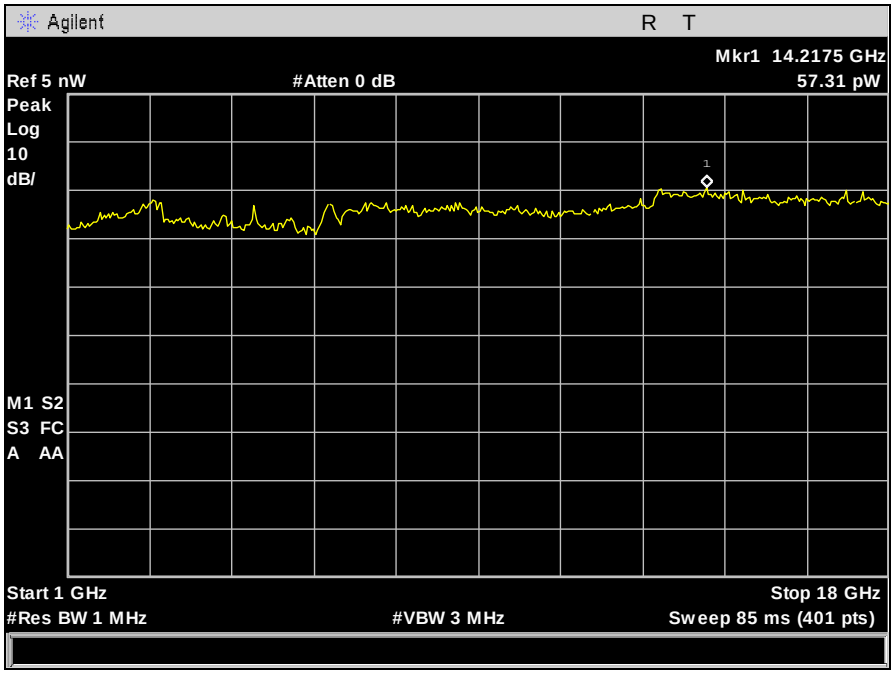


Figure 6. Block Diagram, Conducted Receiver Spurious Emissions Test Setup

Conducted Receiver Spurious Emissions



Plot 87. Receiver Spurious Emission, 30 MHz – 1 GHz



Plot 88. Receiver Spurious Emission, 1 GHz – 18 GHz

IV. Test Equipment

Test Equipment

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

Asset	Equipment	Manufacturer	Model	Calibration Date	Calibration Due Date
1S2600	BILOG ANTENNA	TESEQ	CBL6112D	4/14/2010	4/14/2013
1S2482	5 METER CHAMBER (NSA)	PANASHIELD	5 METER SEMI-ANECHOIC CHAMBER	11/22/2011	5/22/2013
1S2583	SPECTRUM ANALYZER	AGILENT/HP	E4447A	3/27/2012	9/27/2013
1S2460	1-26GHZ SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	7/27/2012	1/27/2014
1S2202	HORN ANTENNA (1 METER)	EMCO	3116	4/23/2010	4/23/2013
1S2523	PREAMPLIFIER	AGILENT TECHNOLOGIES	8449B	SEE NOTE	
1S2603	DOUBLE RIDGED WAVEGUIDE HORN	ETS-LINDGREN	3117	4/15/2011	4/15/2013
1S2729	SONOMA AMPLIFIER	SONOMA INSTRUMENT	310N	4/18/2012	10/18/2013
1S2229	TEMPERATURE CHAMBER	TENNY ENGINEERING	T63C	2/18/2012	8/18/2013
1S2710	DRG HORN ANTENNA	AH SYSTEMS, INC	SAS-574	11/30/2011	11/30/2012
NA	HIGH PASS FILTER	MICRO-TRONICS	HPM13147	SEE NOTE	

Table 24. Test Equipment List

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

V. Certification & User's Manual Information

Certification & User's Manual Information

A. Certification Information

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

§ 2.801 Radio-frequency device defined.

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

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

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

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

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

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

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

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

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

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

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

(i) Compliance testing;

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

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

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

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

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

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

Certification & User's Manual Information

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

§ 2.901 Basis and Purpose

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

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

§ 2.907 Certification.

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

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

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

Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

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

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

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

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

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

Certification & User's Manual Information

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.

Verification & User's Manual Information

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

§ 15.105 Information to the user.

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

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

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

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

– Reorient or relocate the receiving antenna.

– Increase the separation between the equipment and receiver.

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

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

End of Report