



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

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March 29, 2012

Fortress Technologies
2 Technology Park Drive
Westford, MA 01886

Dear John Pacheco,

Enclosed is the EMC Wireless test report for compliance testing of the Fortress Technologies, Deployable Mesh Point Model: ES520 (with Ubiquiti Modular Approved Radio) as tested to the requirements of Title 47 of the CFR, Part 15, Subpart B and ICES-003, Issue 4 February 2004 for 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: (\Fortress Technologies\EMC33010B-FCC407 Rev. 1)

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Electromagnetic Compatibility Criteria Test Report

for the

Fortress Technologies

Model Deployable Mesh Point Model: ES520 (with Ubiquiti Modular Approved Radio)

Tested under

the FCC Certification Rules
contained in

Title 47 of the CFR, Parts 15 Subpart B & ICES-003
for Class A Digital Devices

&

FCC Part 15.407 & RSS-210, Annex 9
for Intentional Radiators

MET Report: EMC33010B-FCC407 Rev. 1

March 29, 2012

Prepared For:

**Fortress Technologies
2 Technology Park Drive
Westford, MA 01886**

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

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&
FCC Part 15.407 & RSS-210, Annex 9
for Intentional Radiators



Jeffrey Pratt, 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 407 and Industry Canada standards ICES-003, Issue 4 February 2004, RSS-210 Annex 9 under normal use and maintenance.



Shawn McMillen, Wireless Manager
Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	March 2, 2012	Initial Issue.
1	March 29, 2012	Revised to add Industry Canada references.

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List of Terms and Abbreviations

AC	Alternating Current
ACF	Antenna Correction Factor
Cal	Calibration
<i>d</i>	Measurement Distance
dB	Decibels
dBμA	Decibels above one microamp
dBμV	Decibels above one microvolt
dBμA/m	Decibels above one microamp per meter
dBμV/m	Decibels above one microvolt per meter
DC	Direct Current
E	Electric Field
DSL	Digital Subscriber Line
ESD	Electrostatic Discharge
EUT	Equipment Under Test
<i>f</i>	Frequency
FCC	Federal Communications Commission
GRP	Ground Reference Plane
H	Magnetic Field
HCP	Horizontal Coupling Plane
Hz	Hertz
IEC	International Electrotechnical Commission
kHz	kilohertz
kPa	kilopascal
kV	kilovolt
LISN	Line Impedance Stabilization Network
MHz	Megahertz
μH	microhenry
μ	microfarad
μs	microseconds
PRF	Pulse Repetition Frequency
RF	Radio Frequency
RMS	Root-Mean-Square
TWT	Traveling Wave Tube
V/m	Volts per meter
VCP	Vertical Coupling Plane

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Fortress Technologies Deployable Mesh Point Model: ES520 (with Ubiquiti Modular Approved Radio), 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 Deployable Mesh Point Model: ES520 (with Ubiquiti Modular Approved Radio). Fortress Technologies should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Deployable Mesh Point Model: ES520 (with Ubiquiti Modular Approved Radio), 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 Fortress Technologies, purchase order number 0003308. 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 Compliance Testing

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Fortress Technologies to perform testing on the Deployable Mesh Point Model: ES520 (with Ubiquiti Modular Approved Radio), under Fortress Technologies' purchase order number 0003308.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Fortress Technologies Deployable Mesh Point Model: ES520 (with Ubiquiti Modular Approved Radio).

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

Model(s) Tested:	Deployable Mesh Point Model: ES520 (with Ubiquiti Modular Approved Radio)	
Model(s) Covered:	Deployable Mesh Point Model: ES520 (with Ubiquiti Modular Approved Radio)	
EUT Specifications:	Primary Power: 120 VAC, 60 Hz	
	FCC ID: WYK-ES520 IC: 8190A-ES520	
	Type of Modulations:	OFDM
	Emission Designators:	D7D
	Equipment Code:	NII
	Peak RF Output Power:	14.76 dBm
	EUT Frequency Ranges:	5260 – 5320 MHz, 5500 – 5700 MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35° C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Jeff Pratt	
Report Date(s):	March 29, 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
ANSI/NCSL Z540-1-1994	Calibration Laboratories and Measuring and Test Equipment - General Requirements
ANSI/ISO/IEC 17025:2000	General Requirements for the Competence of Testing and Calibration Laboratories

Table 3. References

C. Test Site

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

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

D. Description of Test Sample

The Fortress Technologies Deployable Mesh Point Model: ES520 (with Ubiquiti Modular Approved Radio), Equipment Under Test (EUT), is a dual radio access point/bridge. It embeds two COTS high power radios and multiple Ethernet ports in a ruggedized enclosure. The radio operates in accordance to the 802.11a, 802.11b, and 802.11g standards. The frequency band 5600 MHz to 5650 MHz has been notched out and channels 116, 132, and 136 have been disabled on the test sample.

The ES520 is intended to provide outdoor mobile connectivity in a secure manner both wired and wirelessly.



Photograph 1. Fortress Technologies Deployable Mesh Point Model: ES520 (with Ubiquiti Modular Approved Radio)

E. Equipment Configuration

All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Ref. ID	Name / Description	Model Number	Serial Number
1	Fortress Deployable Mesh Point	ES520	108530006

Table 4. Equipment Configuration

F. Support Equipment

The EUT did not require any support equipment for operation or monitoring.

G. Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty.	Length (m)	Shielded? (Y/N)	Termination Box ID & Port ID
1	ANT 1, ANT 2	Antenna	2	--	--	--
2	12/24V 48V	Provides power	1	--	--	External AC Charger
3	1,2,3,4,5,6,7, or 8	Ethernet Port; Standard CAT5 Ethernet Cable	8	--	--	--
4	WAN	Ethernet Port; Standard CAT5 Ethernet Cable	1	--	--	--
5	Serial	Not Used	1	--	--	--
6	Console	Serial Console Port; Standard CAT5 Ethernet cable	1	--	--	--
6	USB	Not used	1	--	--	--

Table 5. Ports and Cabling Information

H. Mode of Operation

The ES520 can operate in 802.11a, 802.11b, and 802.11g modes. These modes may be configured using the UI of the product (either through the GUI or CLI).

I. Method of Monitoring EUT Operation

A Spectrum Analyzer and a Power Meter was use to monitor the EUT's transmitter channel and power output.

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 Fortress Technologies upon completion of testing.

III. Electromagnetic Compatibility Criteria for Unintentional Radiators

Electromagnetic Compatibility Criteria

§ 15.107 Conducted Emissions Limits

Test Requirement(s): **15.107 (a)** Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in Table 6. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

15.107 (b) For a Class A digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in Table 6. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges.

Frequency range (MHz)	Class A Conducted Limits (dB μ V)		*Class B Conducted Limits (dB μ V)	
	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 6. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(a) (b) and 15.207(a)

Test Results: The EUT was compliant with the Class A requirement(s) of this section.

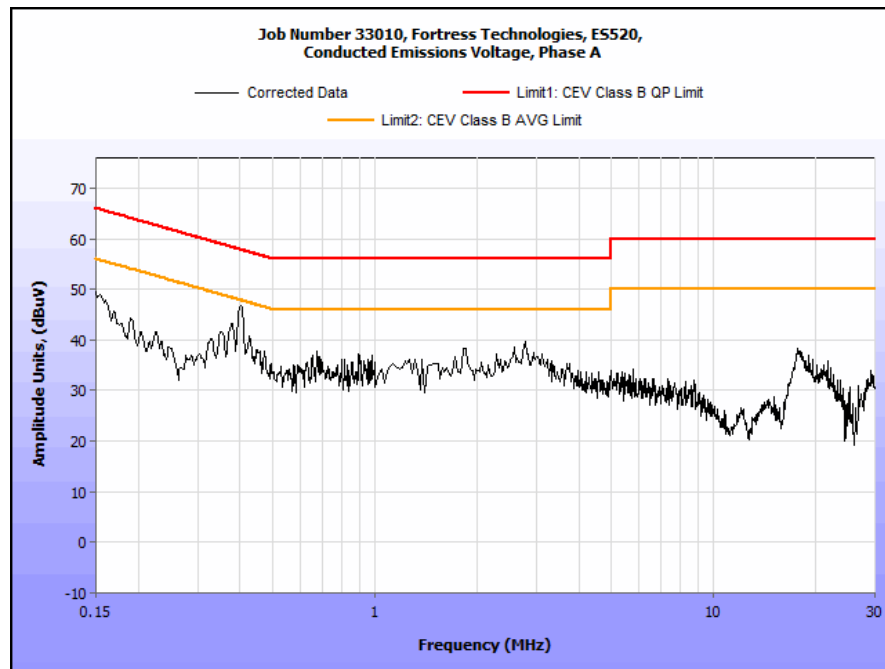
Test Engineer(s): Jeff Pratt

Test Date(s): 01/12/12 – 02/2/12

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

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) Avg.	Limit (dBuV) Avg.	Margin (dB) Avg.
0.241	38.75	0.02	38.77	79	-40.23	32.44	0.02	32.46	66	-33.54
0.401	37.07	0	37.07	79	-41.93	34.41	0	34.41	66	-31.59
0.48	36.01	0	36.01	79	-42.99	34.38	0	34.38	66	-31.62
8.068	32.26	0.11	32.37	73	-40.63	29.1	0.11	29.21	60	-30.79
15.15	49.54	0.12	49.66	73	-23.34	48.15	0.12	48.27	60	-11.73
23.05	17.71	0.18	17.89	73	-55.11	12.35	0.18	12.53	60	-47.47

Table 7. Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)

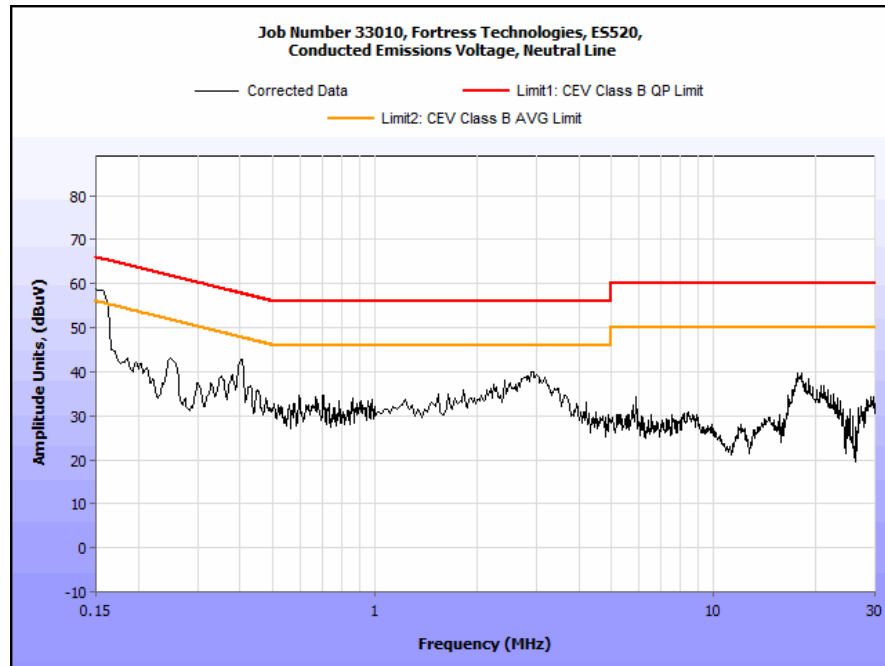


Plot 1. Conducted Emission, Phase Line Plot

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

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) Avg.	Limit (dBuV) Avg.	Margin (dB) Avg.
0.322	30.82	0.02	30.84	79	-48.16	25.91	0.02	25.93	66	-40.07
0.483	33.5	0	33.5	79	-45.5	30.99	0	30.99	66	-35.01
1.45	33.87	0	33.87	73	-39.13	33.52	0	33.52	60	-26.48
8.191	48.33	0.11	48.44	73	-24.56	47.07	0.11	47.18	60	-12.82
15.15	49.16	0.12	49.28	73	-23.72	47.34	0.12	47.46	60	-12.54
22.74	36.68	0.18	36.86	73	-36.14	34.76	0.18	34.94	60	-25.06

Table 8. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)



Plot 2. Conducted Emission, Neutral Line Plot

Conducted Emission Limits Test Setup



Photograph 2. Conducted Emissions, Test Setup

Radiated Emission Limits

§ 15.109 Radiated Emissions Limits

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

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

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

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

Test Procedures: The EUT was placed on a 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 A requirement(s) of this section.

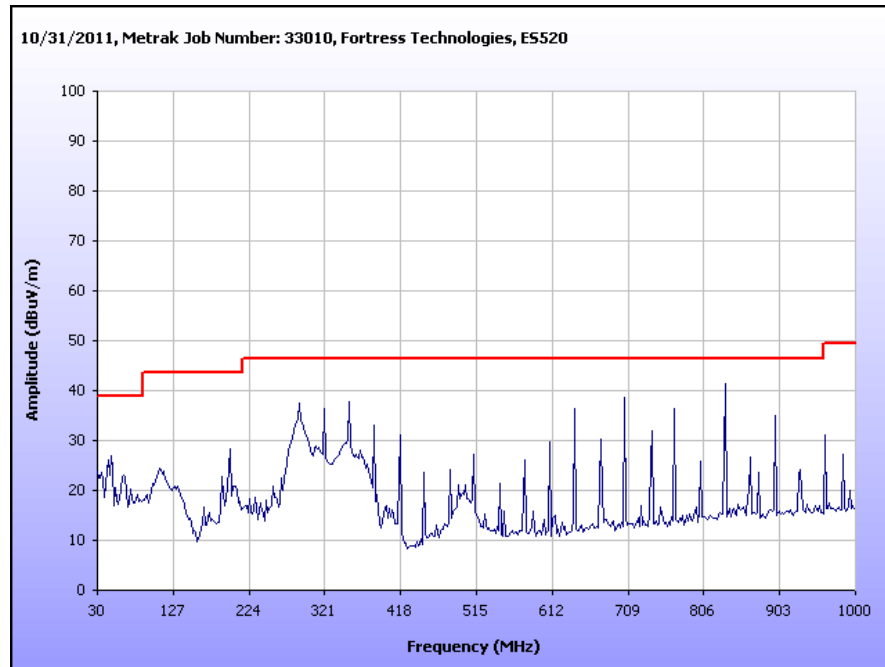
Test Engineer(s): Jeff Pratt

Test Date(s): 10/31/11

Radiated Emissions Limits Test Results, Class A

Frequency (MHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna HEIGHT (m)	Uncorrected Amplitude (dBuV)	Antenna Correction Factor (dB) (+)	Cable Loss (dB) (+)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
48.569639	296	H	3.57	13.65	9.03	0.23	10.46	12.45	39.00	-26.55
48.569639	21	V	1.01	25.73	9.03	0.23	10.46	24.53	39.00	-14.47
64.749499	300	H	1.90	12.18	7.80	0.23	10.46	9.75	39.00	-29.25
64.749499	10	V	1.07	23.65	7.80	0.23	10.46	21.22	39.00	-17.78
200.03507	312	H	1.01	21.52	12.99	0.23	10.46	24.28	43.50	-19.22
200.03507	283	V	1.01	21.21	12.99	0.23	10.46	23.97	43.50	-19.53
288.0511	270	H	1.05	32.06	13.86	0.75	10.46	36.21	46.40	-10.19
288.0511	171	V	1.01	20.23	13.86	0.75	10.46	24.38	46.40	-22.02
384.0506	66	H	1.01	25.80	15.70	0.83	10.46	31.87	46.40	-14.53
384.0506	208	V	1.01	24.19	15.70	0.83	10.46	30.26	46.40	-16.14
320.0263	63	H	1.00	32.02	14.50	0.83	10.46	36.89	46.40	-9.51
320.0263	282	V	1.35	21.06	14.50	0.83	10.46	25.93	46.40	-20.47

Table 10. Radiated Emissions Limits, Test Results, 30 MHz – 1 GHz, FCC Limits



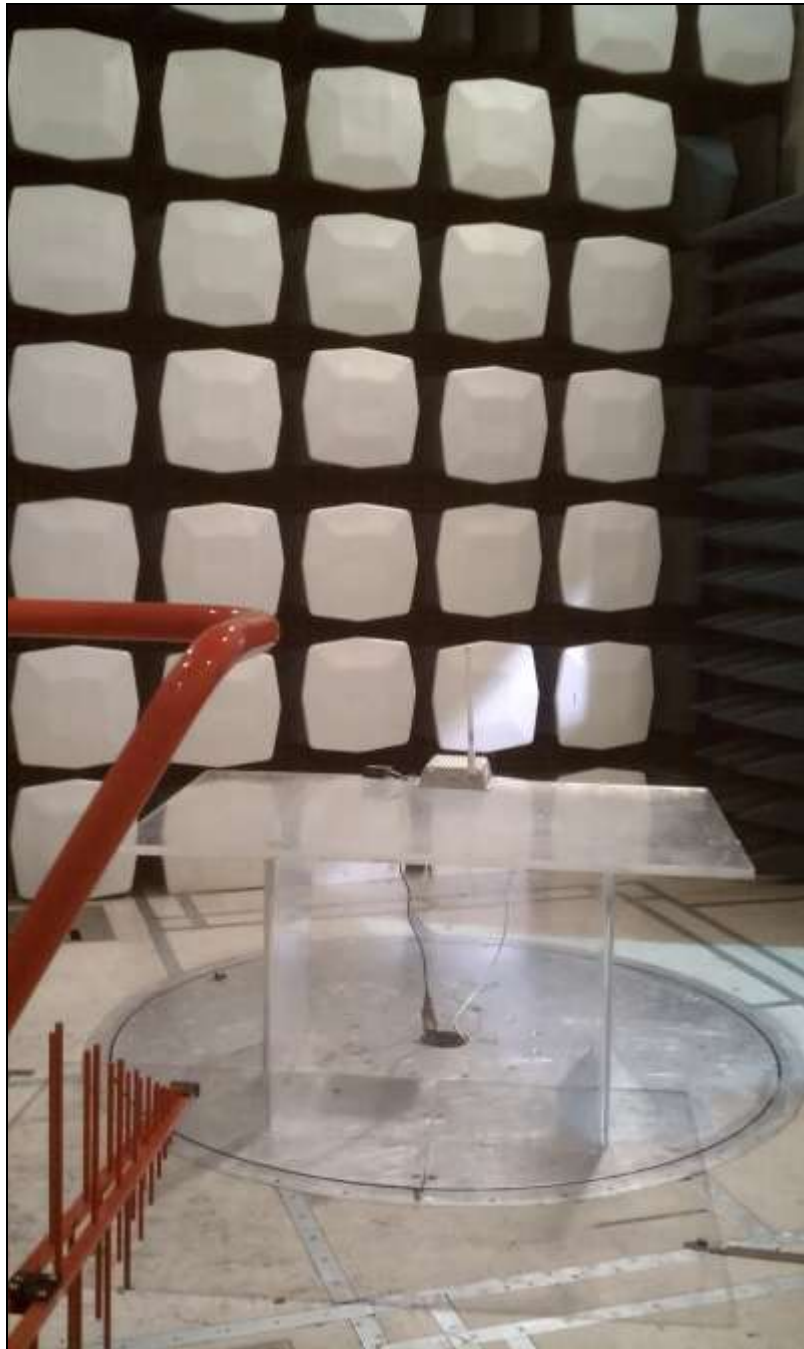
Plot 3. Radiated Emissions, 30 MHz - 1 GHz, FCC Limits, Omni Antenna

Radiated Emissions Limits Test Results, Class A

Frequency (MHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna HEIGHT (m)	Uncorrected Amplitude (dBuV)	Antenna Correction Factor (dB) (+)	Cable Loss (dB) (+)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
48.569639	296	H	3.57	13.65	9.03	0.23	10.46	12.45	40.00	-27.55
48.569639	21	V	1.01	25.73	9.03	0.23	10.46	24.53	40.00	-15.47
64.749499	300	H	1.90	12.18	7.80	0.23	10.46	9.75	40.00	-30.25
64.749499	10	V	1.07	23.65	7.80	0.23	10.46	21.22	40.00	-18.78
200.03507	312	H	1.01	21.52	12.99	0.23	10.46	24.28	40.00	-15.72
200.03507	283	V	1.01	21.21	12.99	0.23	10.46	23.97	40.00	-16.03
288.0511	270	H	1.05	32.06	13.86	0.75	10.46	36.21	47.00	-10.79
288.0511	171	V	1.01	20.23	13.86	0.75	10.46	24.38	47.00	-22.62
384.0506	66	H	1.01	25.80	15.70	0.83	10.46	31.87	47.00	-15.13
384.0506	208	V	1.01	24.19	15.70	0.83	10.46	30.26	47.00	-16.74
320.0263	63	H	1.00	32.02	14.50	0.83	10.46	36.89	47.00	-10.11
320.0263	282	V	1.35	21.06	14.50	0.83	10.46	25.93	47.00	-21.07

Table 11. Radiated Emissions Limits, Test Results, ICES-003 Limits

Radiated Emission Limits Test Setup



Photograph 3. Radiated Emission, Test Setup

IV. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

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

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

- a.) Antenna must be permanently attached to the unit.
- b.) Antenna must use a unique type of connector to attach to the EUT.
- c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

Results: The EUT as tested is compliant with the criteria of §15.203. The EUT is professional installed.

Test Engineer(s): Jeff Pratt

Test Date(s): 02/02/12

Gain	Type	Manufacturer	Model
9 dBi	Omni	Mobile Mark	EC09-5500

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 μ H/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 (dB μ V)	
	Quasi-Peak	Average
* 0.15- 0.45	66 - 56	56 - 46
0.45 - 0.5	56	46
0.5 - 30	60	50

Table 12. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber. 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 μ H 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 C63.4-1992 "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 μ H LISN as the input transducer to an EMC/field intensity meter.

Test Results: The EUT was compliant with the emissions limits of §15.207 (a).

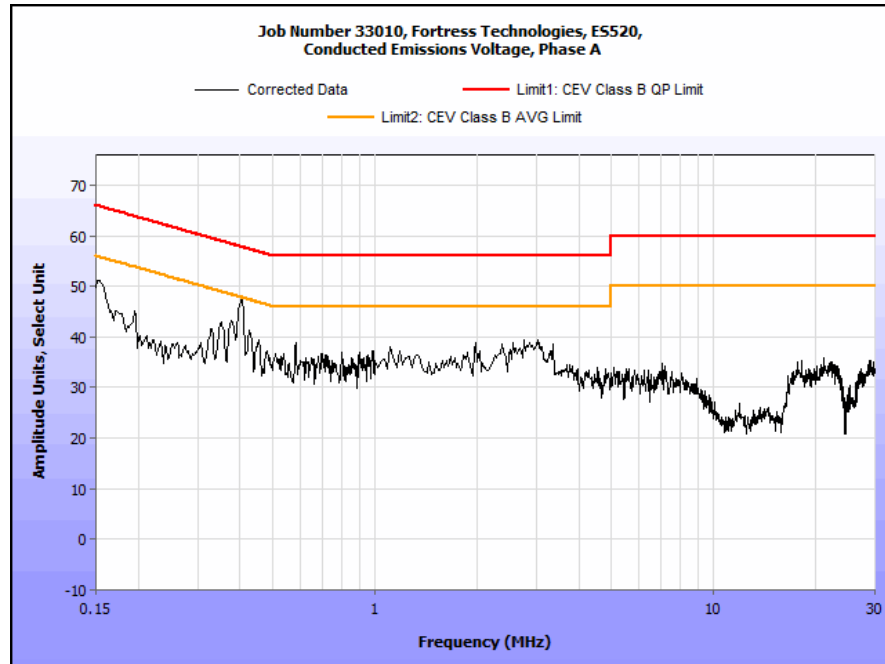
Test Engineer(s): Jeff Pratt

Test Date(s): 01/12/12

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

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) Avg.	Limit (dBuV) Avg.	Margin (dB) Avg.
0.401	43.45	0	43.45	57.83	-14.38	37.12	0	37.12	47.83	-10.71
2.861	31.74	0.01	31.75	56	-24.25	22.28	0.01	22.29	46	-23.71
18.24	30.82	0.15	30.97	60	-29.03	22.36	0.15	22.51	50	-27.49
29.33	28.49	0.21	28.7	60	-31.3	23.67	0.21	23.88	50	-26.12
0.379	39.52	0	39.52	58.3	-18.78	32.22	0	32.22	48.3	-16.08
0.354	38.45	0	38.45	58.87	-20.42	31.27	0	31.27	48.87	-17.6

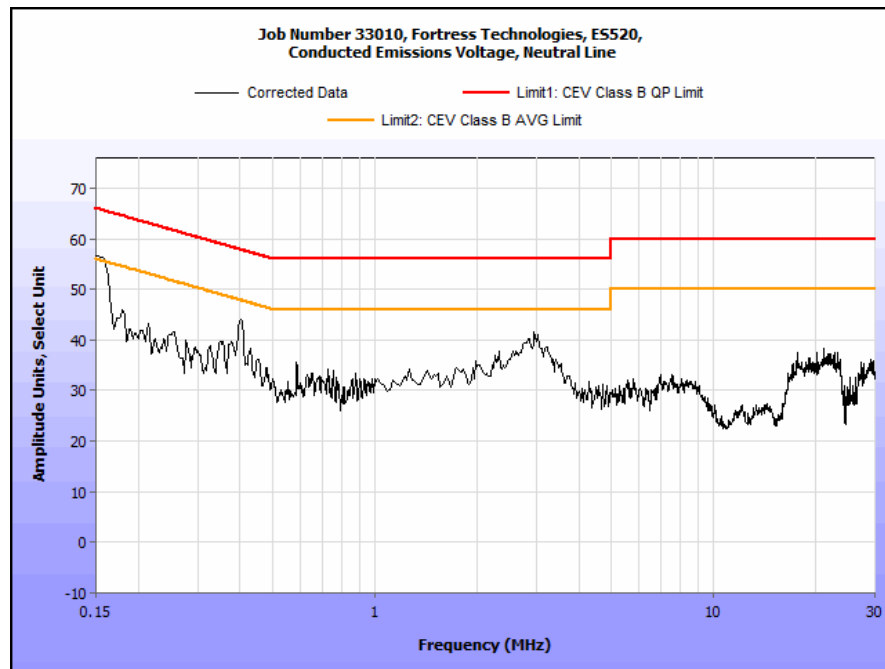
Table 13. Conducted Emissions - Voltage, AC Power, 15.207, Phase Line (120 VAC, 60 Hz)



Plot 4. Conducted Emissions, 15.207, Phase Line

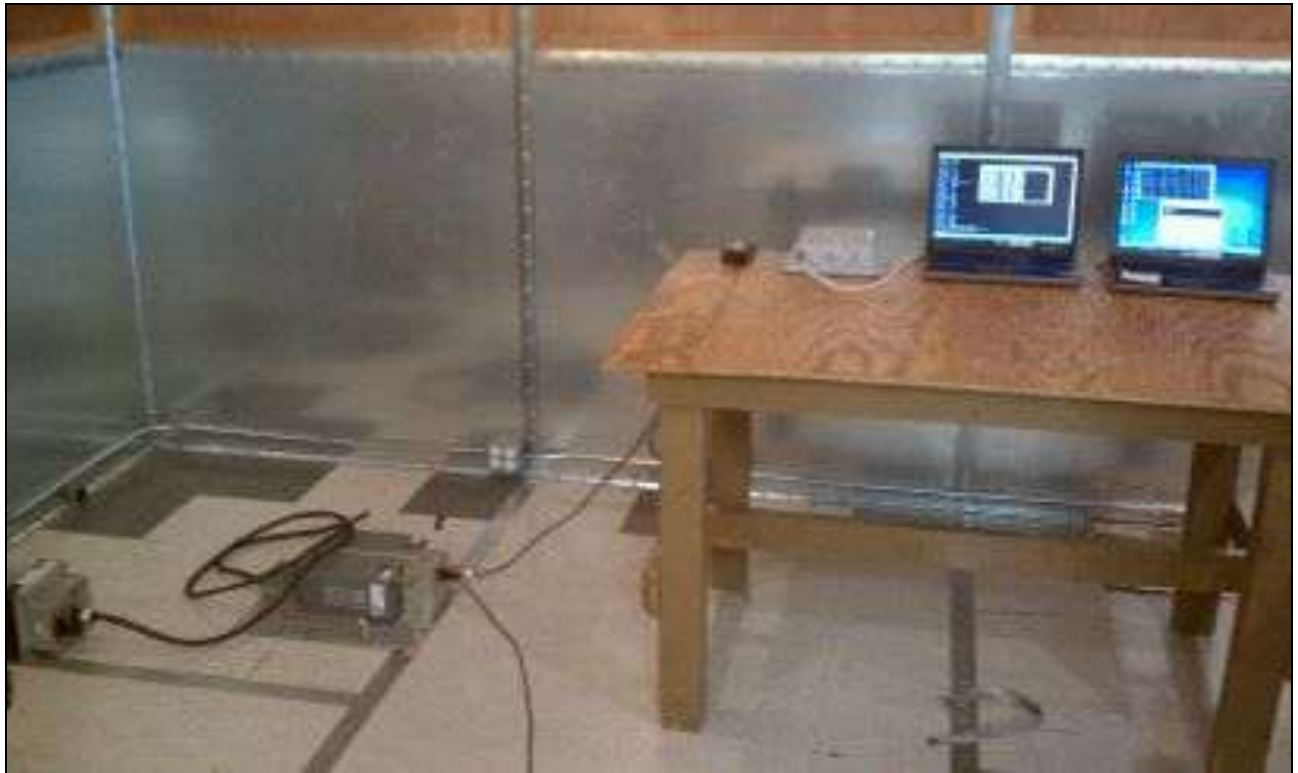
Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) Avg.	Limit (dBuV) Avg.	Margin (dB) Avg.
0.405	41.88	0	41.88	57.75	-15.87	41.61	0	41.61	47.75	-6.14
2.982	32.74	0.02	32.76	56	-23.24	29.35	0.02	29.37	46	-16.63
21.2	32.49	0.17	32.66	60	-27.34	27.97	0.17	28.14	50	-21.86
0.253	35.49	0.03	35.52	61.66	-26.14	28.11	0.03	28.14	51.66	-23.52
28.78	30.89	0.21	31.1	60	-28.9	26.31	0.21	26.52	50	-23.48
7.438	27.12	0.1	27.22	60	-32.78	22.6	0.1	22.7	50	-27.3

Table 14. Conducted Emissions - Voltage, AC Power, 15.207, Neutral Line (120 VAC, 60 Hz)



Plot 5. Conducted Emissions, 15.207, Phase Line

Conducted Emission Limits Test Setup



Photograph 4. Conducted Emissions, Test Setup

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 both 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): Jeff Pratt

Test Date(s): 11/15/11

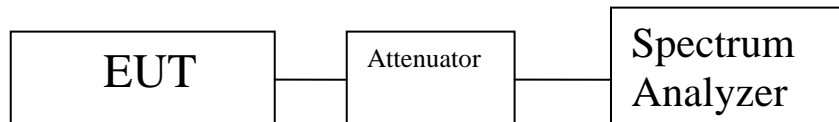
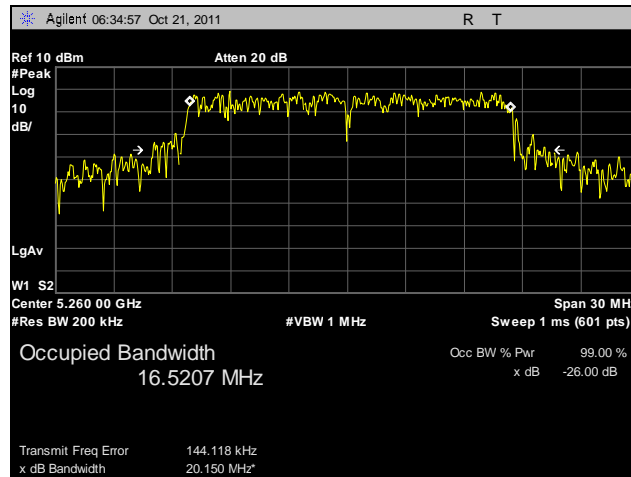


Figure 1. Occupied Bandwidth, Test Setup

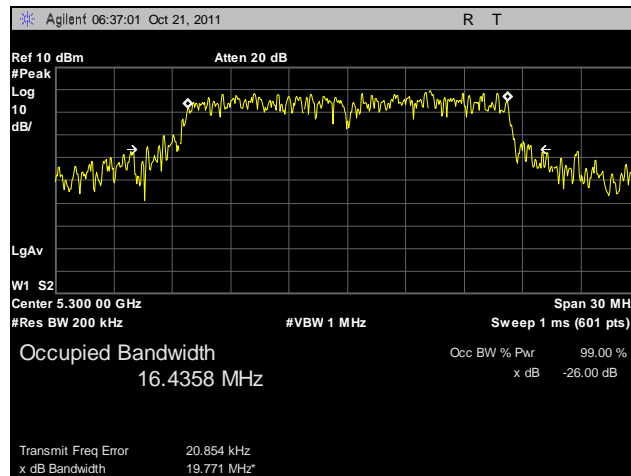
Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
5260	20.150	16.5861
5300	19.771	16.4941
5320	21.893	16.4950
5500	21.233	16.5307
5560	20.864	16.5076
5700	20.384	16.5183

Table 15. Occupied Bandwidth, Test Results

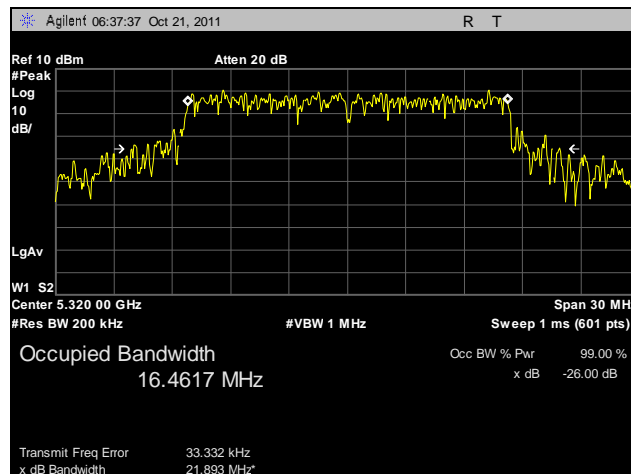
Electromagnetic Compatibility Criteria for Intentional Radiators



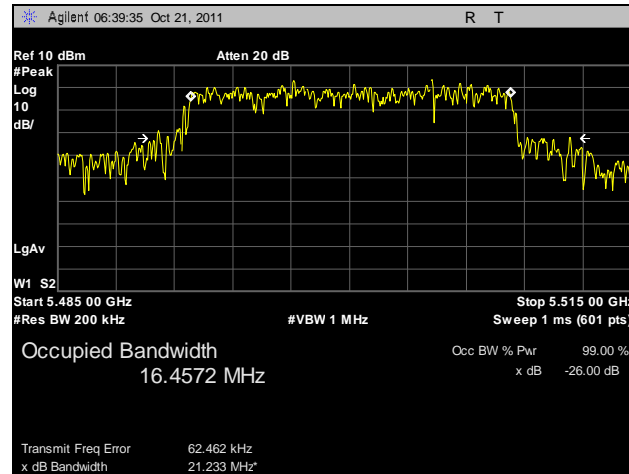
Plot 6. Occupied Bandwidth, 5260 MHz



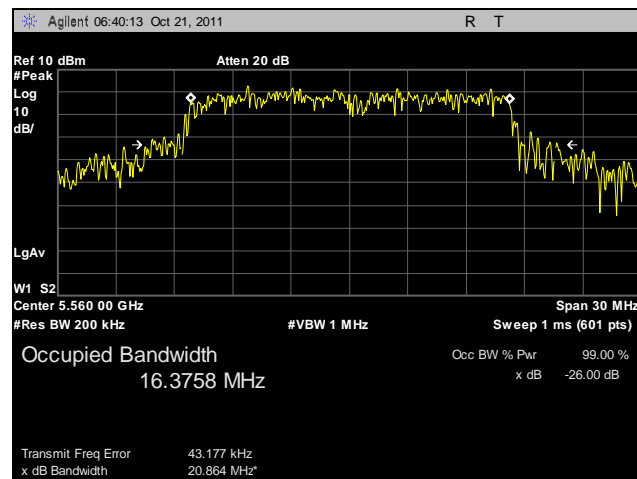
Plot 7. Occupied Bandwidth, 5300 MHz



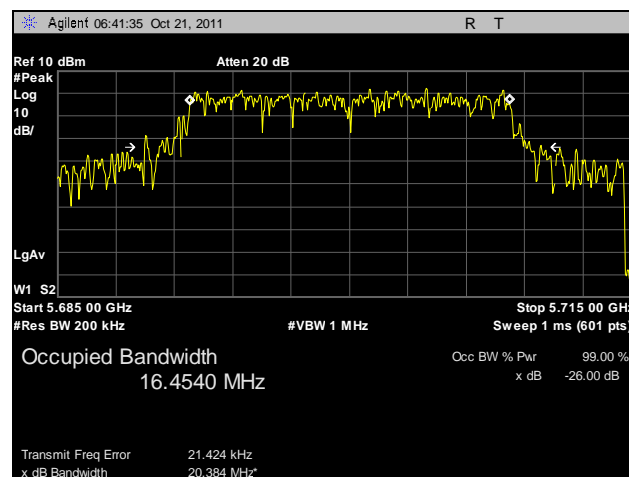
Plot 8. Occupied Bandwidth, 5320 MHz



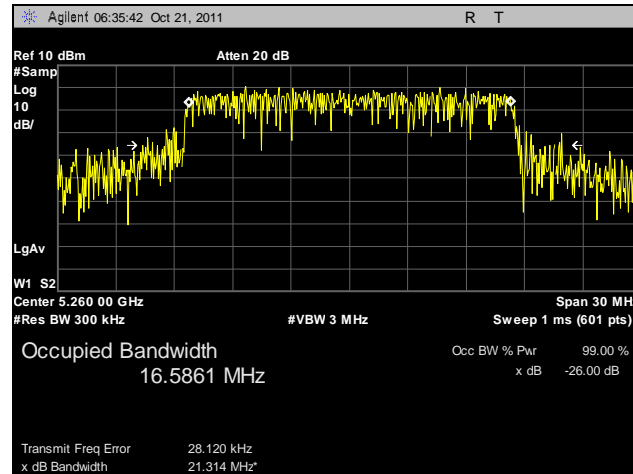
Plot 9. Occupied Bandwidth, 5500 MHz



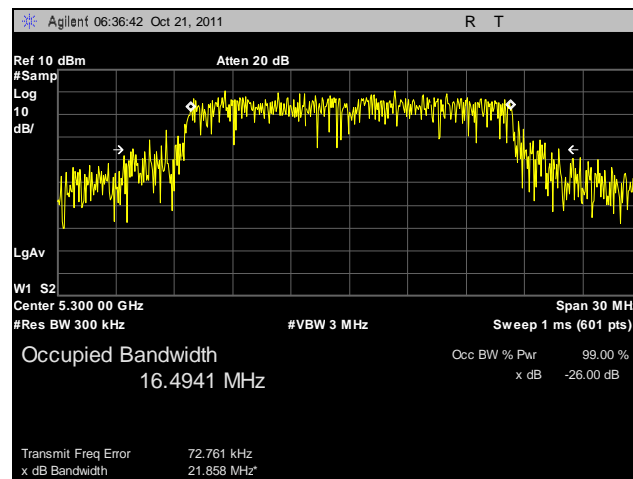
Plot 10. Occupied Bandwidth, 5560 MHz



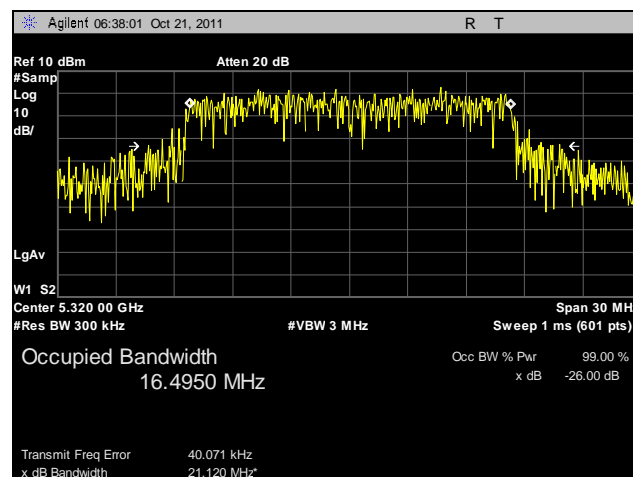
Plot 11. Occupied Bandwidth, 5700 MHz



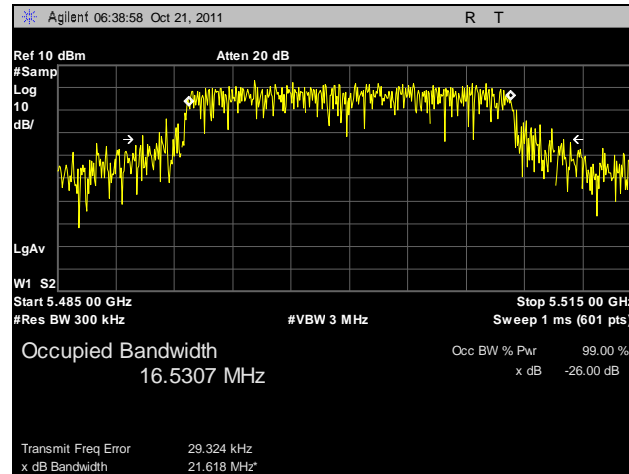
Plot 12. 99% Occupied Bandwidth, 5260 MHz



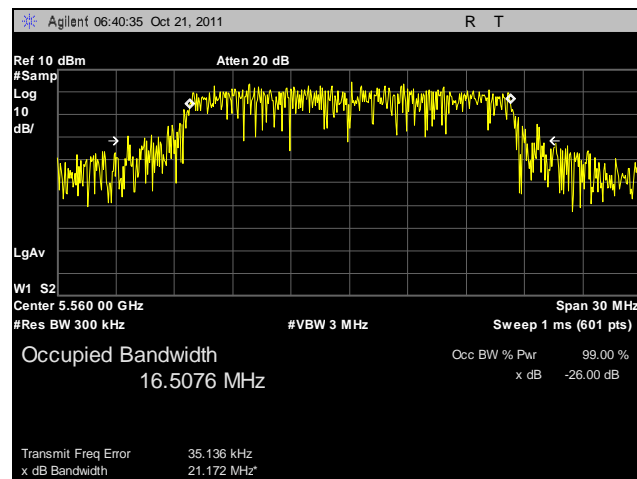
Plot 13. 99% Occupied Bandwidth, 5300 MHz



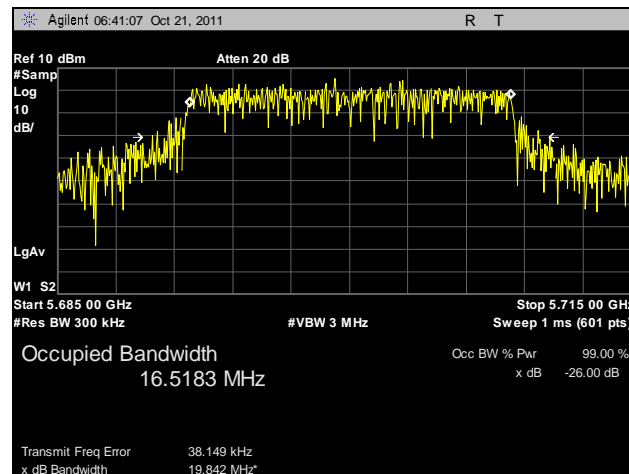
Plot 14. 99% Occupied Bandwidth, 5320 MHz



Plot 15. 99% Occupied Bandwidth, 5500 MHz



Plot 16. 99% Occupied Bandwidth, 5560 MHz



Plot 17. 99% Occupied Bandwidth, 5700 MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(a)(3) RF Power Output

Test Requirements: §15.407(a)(3): The maximum output power of the intentional radiator shall not exceed the following:

§15.407(a) (3): For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10log B, where B is the 26 dB emission bandwidth in megahertz.

Test Procedure: The EUT was connected to a Spectrum Analyzer. The power was measured on both channels.

Test Results: Equipment was compliant with the Peak Power Output limits of § 15.407(a)(2).

Test Engineer(s): Jeff Pratt

Test Date(s): 11/15/11

Frequency (MHz)	Conducted power (dBm)
5260	11.85
5300	11.87
5320	12.87
5500	14.76
5560	14.50
5700	13.90

Table 16. RF Power Output, Test Results

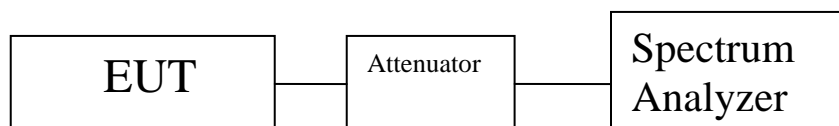
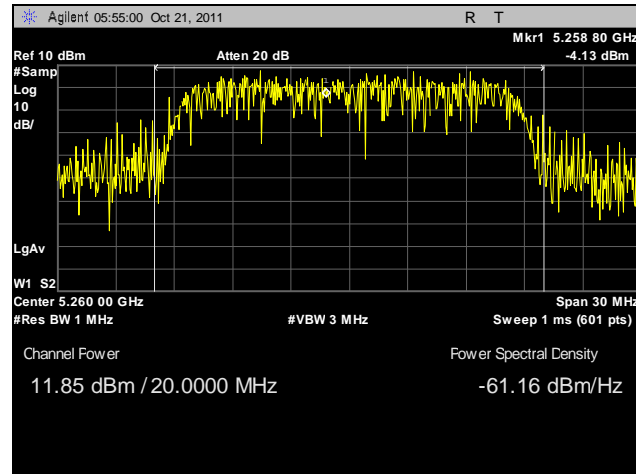
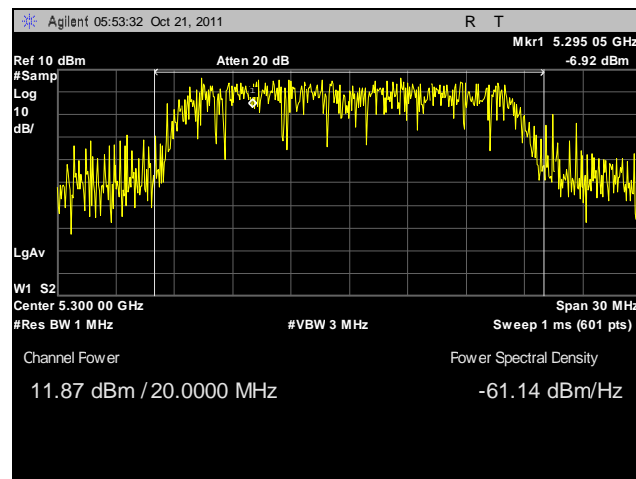


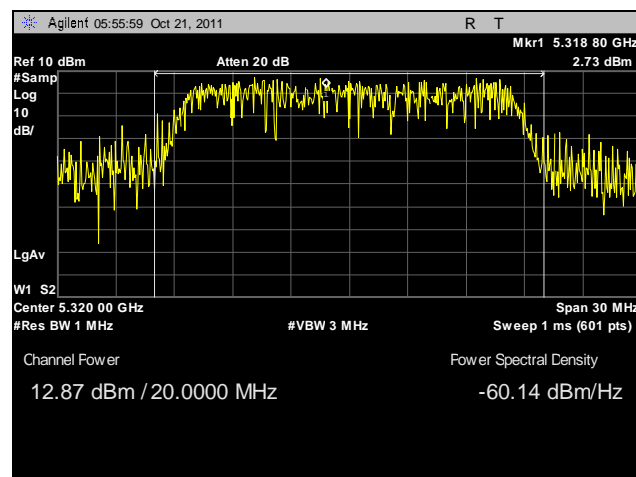
Figure 2. Power Output Test Setup



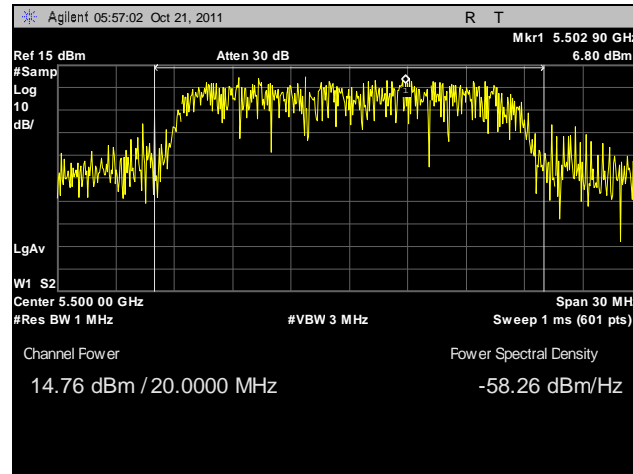
Plot 18. RF Power Output, 5260 MHz



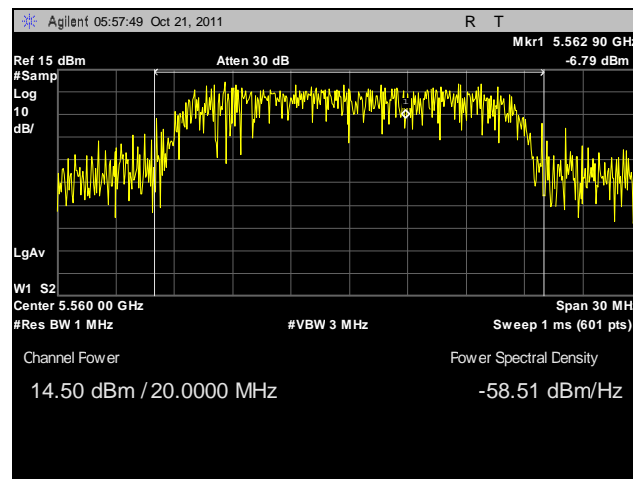
Plot 19. RF Power Output, 5300 MHz



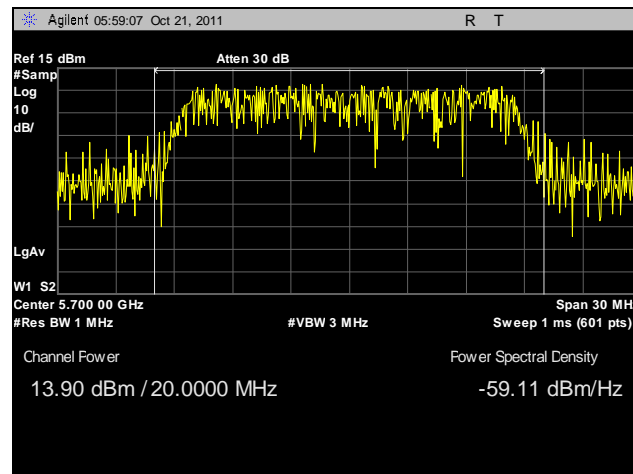
Plot 20. RF Power Output, 5320 MHz



Plot 21. RF Power Output, 5500 MHz



Plot 22. RF Power Output, 5560 MHz



Plot 23. RF Power Output, 5700 MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(a)(2) Peak Power Spectral Density

Test Requirements: § 15.407(a)(2): In addition, the peak power spectral density shall not exceed 11 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. A sample detector was used with power averaging over 100 sweeps. The method of measurement SA-1 from 789033 D01 General UNII Test Procedures v01 was used.

Test Results: Equipment was compliant with the peak power spectral density limits of § 15.407 (a)(2). The peak power spectral density was determined from plots on the following page(s).

Test Engineer(s): Jeff Pratt

Test Date(s): 11/15/11

Frequency (MHz)	PSD (dBm)
5260	1.006
5300	0.078
5320	2.334
5500	4.157
5560	4.484
5700	3.418

Table 17. Power Spectral Density, Test Results

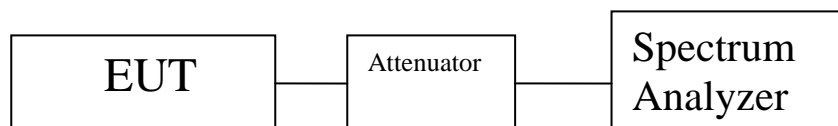
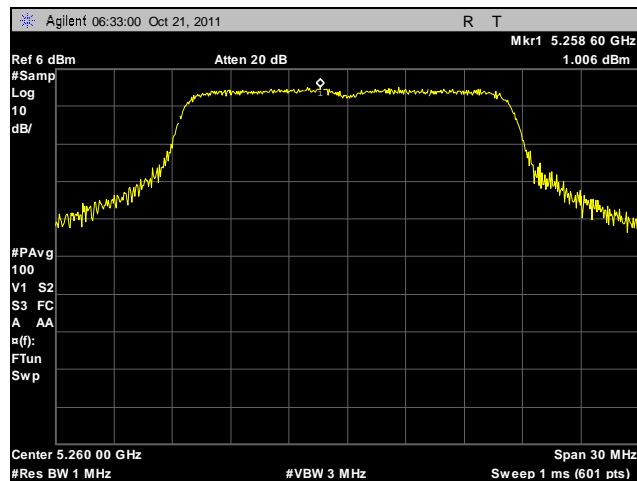
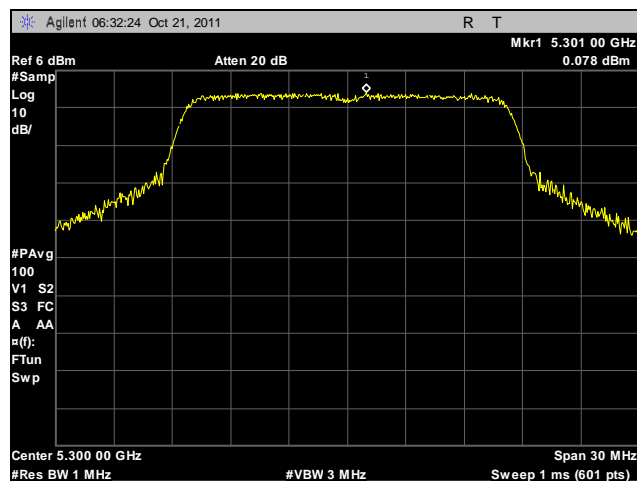


Figure 3. Power Spectral Density Test Setup

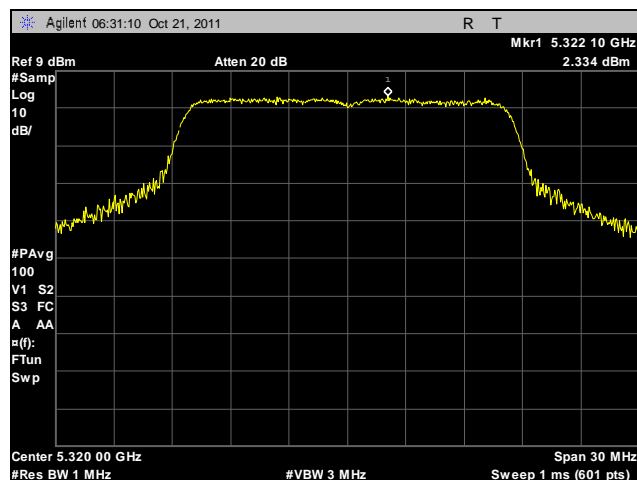
Electromagnetic Compatibility Criteria for Intentional Radiators



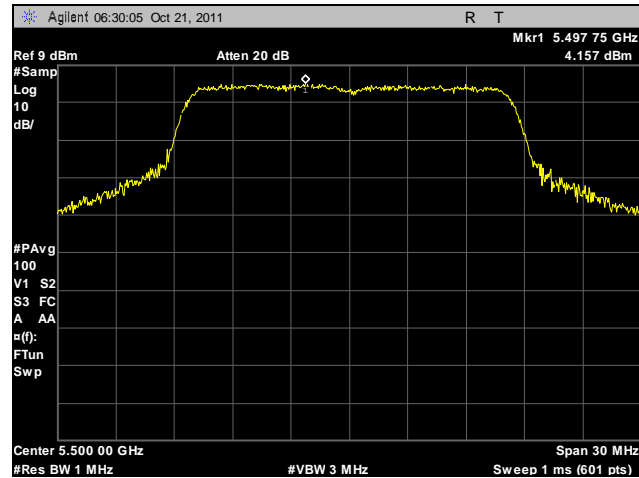
Plot 24. Power Spectral Density, 5260 MHz



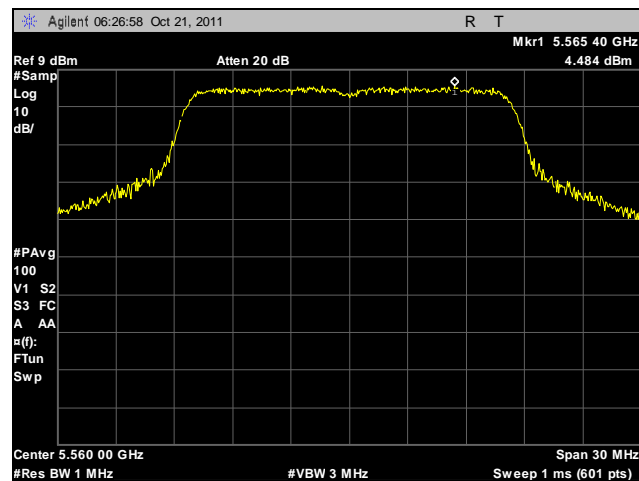
Plot 25. Power Spectral Density, 5300 MHz



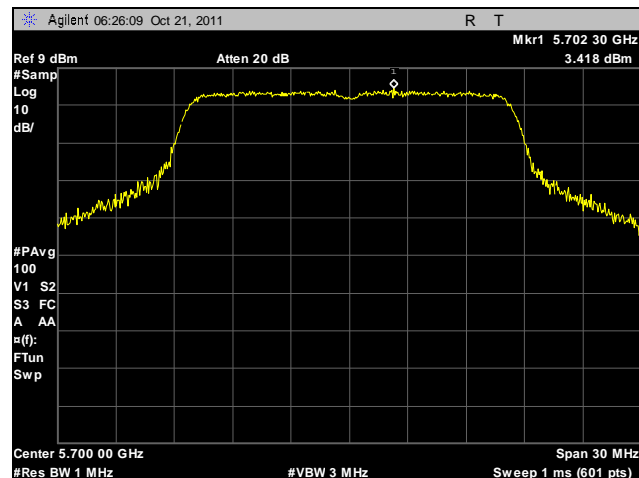
Plot 26. Power Spectral Density, 5320 MHz



Plot 27. Power Spectral Density, 5500 MHz



Plot 28. Power Spectral Density, 5560 MHz



Plot 29. Power Spectral Density, 5700 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 1 st trace on the spectrum analyzer was set to RBW=1MHz, VBW=3MHz. The peak detector mode was used and the trace max held. The 2 nd trace on the spectrum analyzer was set according to measurement method SA-1 from 789033 D01 General UNII Test Procedures v01.
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):	Jeff Pratt
Test Date(s):	11/15/11

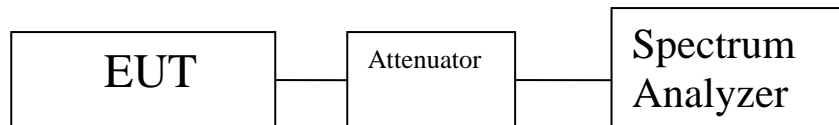
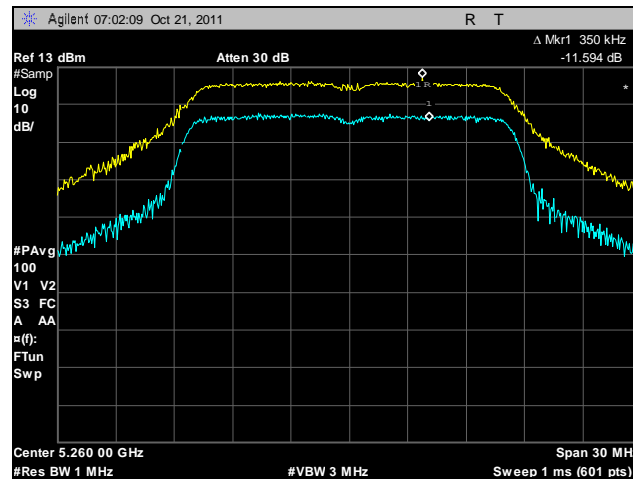
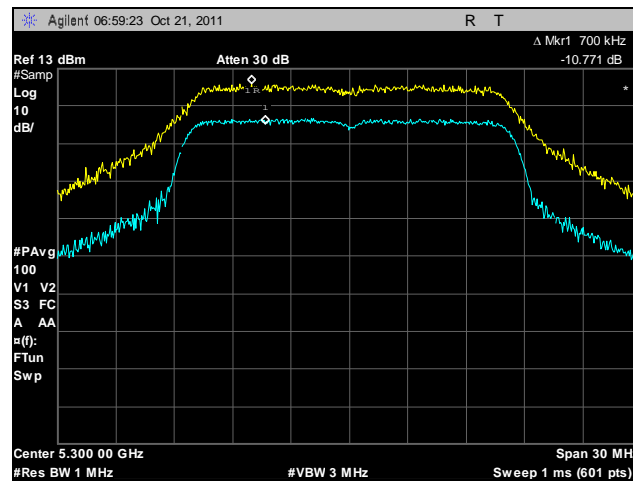


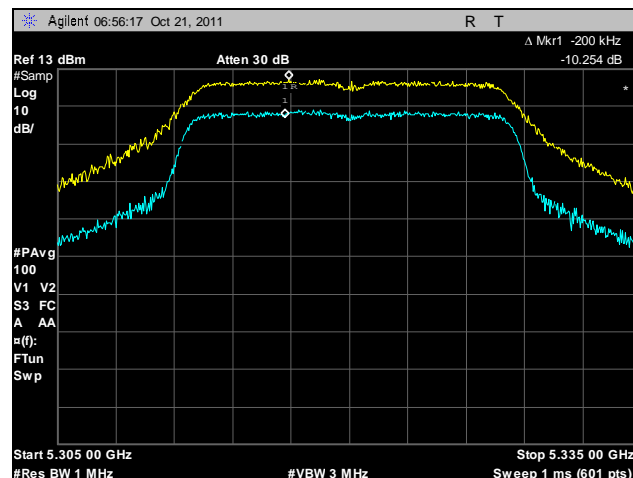
Figure 4. Peak Excursion Ration Test Setup



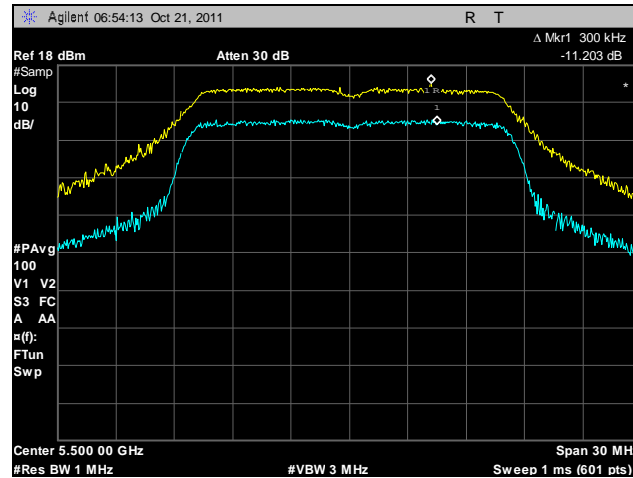
Plot 30. Peak Excursion Ratio, 52600 MHz



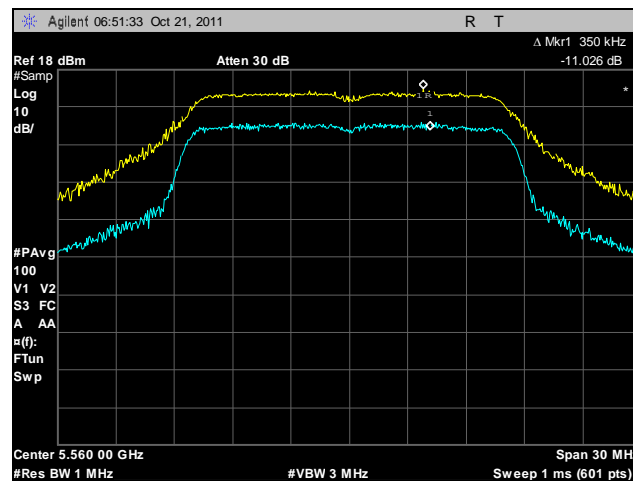
Plot 31. Peak Excursion Ratio, 5300 MHz



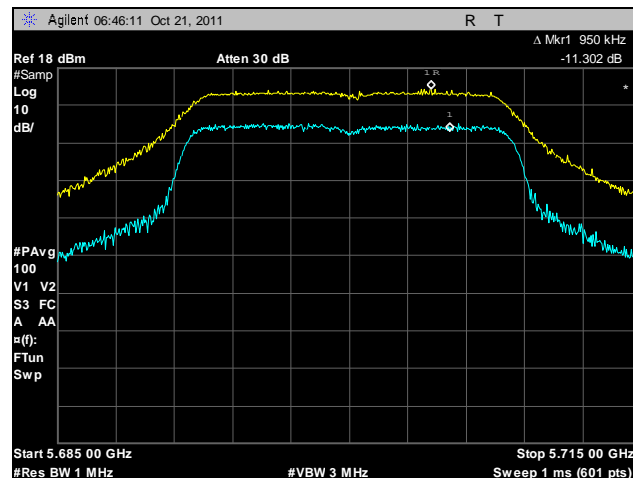
Plot 32. Peak Excursion Ratio, 5320 MHz



Plot 33. Peak Excursion Ratio, 5500 MHz



Plot 34. Peak Excursion Ratio, 5560 MHz



Plot 35. Peak Excursion Ratio, 5700 MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(b)(2), (3), (6), (7) Undesirable Emissions

Test Requirements: § 15.407(b)(2), (3), (6), (7); §15.205: Emissions outside the frequency band.

§ 15.407(b)(2): For transmitters operating in the 5.25-5.35 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz. Devices operating in the 5.25-5.35 GHz band that generate emissions in the 5.15-5.25 GHz band must meet all applicable technical requirements for operation in the 5.15-5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5.15-5.25 GHz band.

§ 15.407(b)(3): For transmitters operating in the 5.47-5.725 GHz band: all emissions outside of the 5.47-5.725 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 acrylic stand 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. Emissions were explored up to 40 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 (dBV/m)

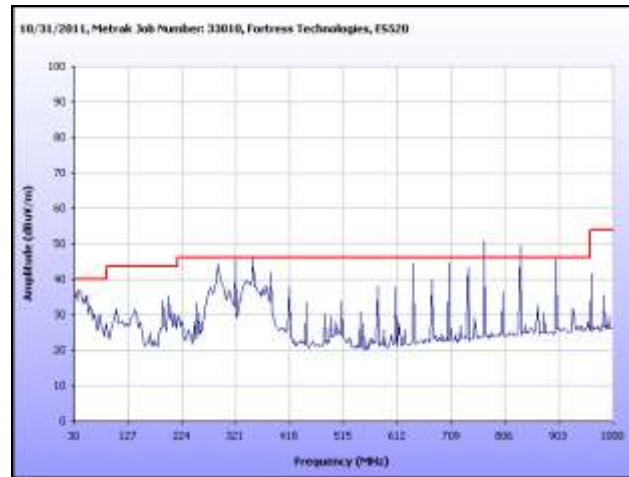
D = Reference measurement distance

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

Test Engineer(s): Jeff Pratt

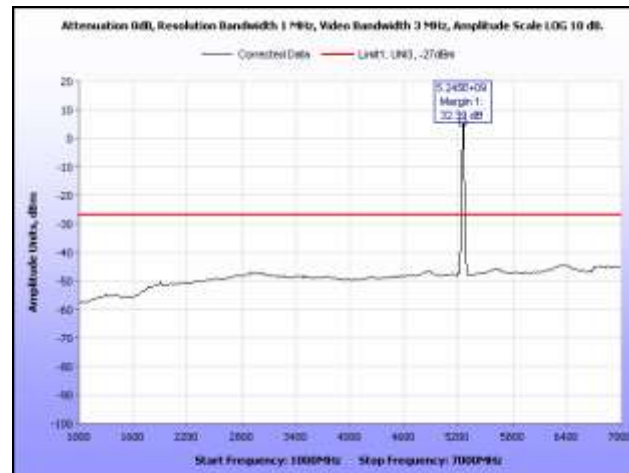
Test Date(s): 12/01/11

§ 15.209 Radiated Emissions Limits

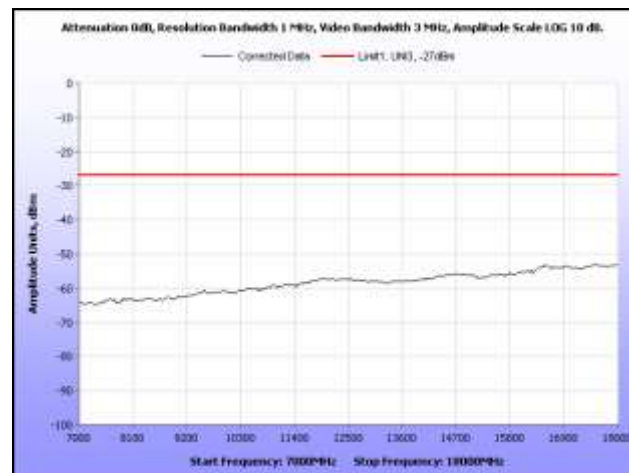


Plot 36. Radiated Spurious Emissions, 5260 MHz, 30 MHz – 1 GHz, Omni Antenna

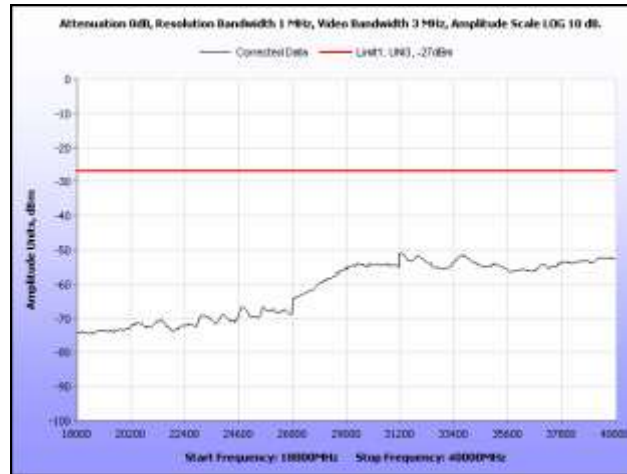
Note: Emissions which exceed the 15.209 limit are digital emissions which meet the Class A limits.



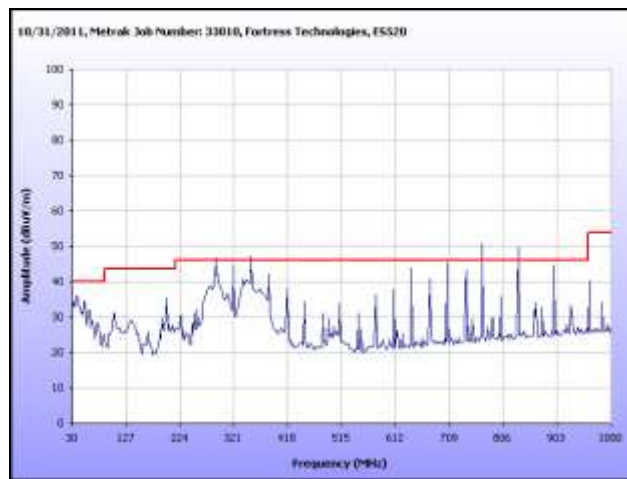
Plot 37. Radiated Spurious Emissions, 5260 MHz, 1 GHz – 7 GHz, Omni Antenna



Plot 38. Radiated Spurious Emissions, 5260 MHz, 7 GHz – 18 GHz, Omni Antenna



Plot 39. Radiated Spurious Emissions, 5260 MHz, 18 GHz – 40 GHz, Omni Antenna

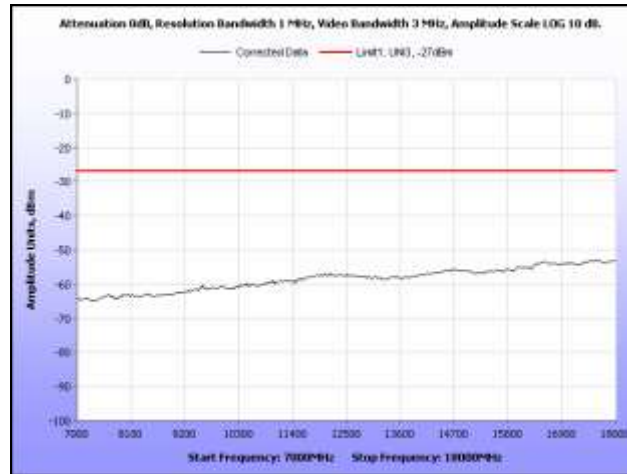


Plot 40. Radiated Spurious Emissions, 5300 MHz, 30 MHz – 1 GHz, Omni Antenna

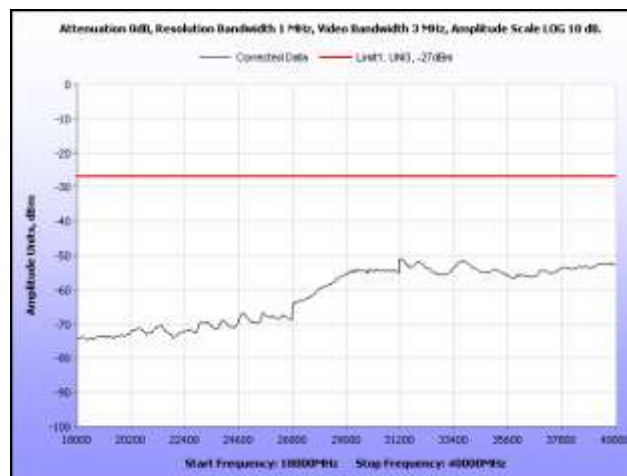
Note: Emissions which exceed the 15.209 limit are digital emissions which meet the Class A limits.



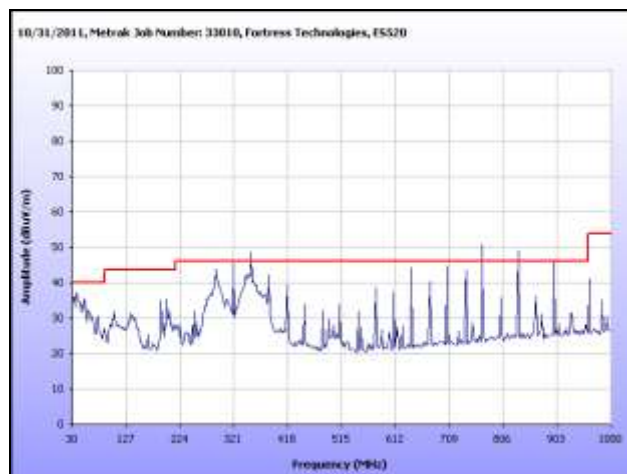
Plot 41. Radiated Spurious Emissions, 5300 MHz, 1 GHz – 7 GHz, Omni Antenna



Plot 42. Radiated Spurious Emissions, 5300 MHz, 7 GHz – 18 GHz, Omni Antenna

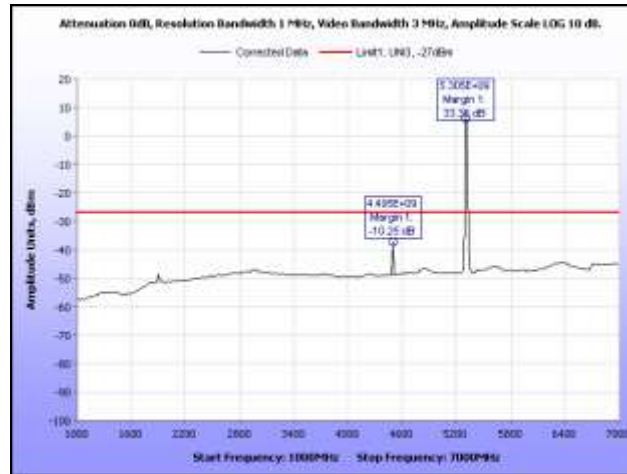


Plot 43. Radiated Spurious Emissions, 5300 MHz, 18 GHz – 40 GHz, Omni Antenna

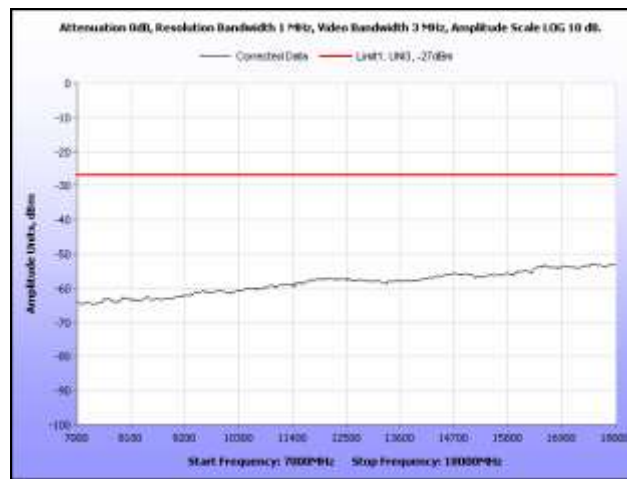


Plot 44. Radiated Spurious Emissions, 5320 MHz, 30 MHz – 1 GHz, Omni Antenna

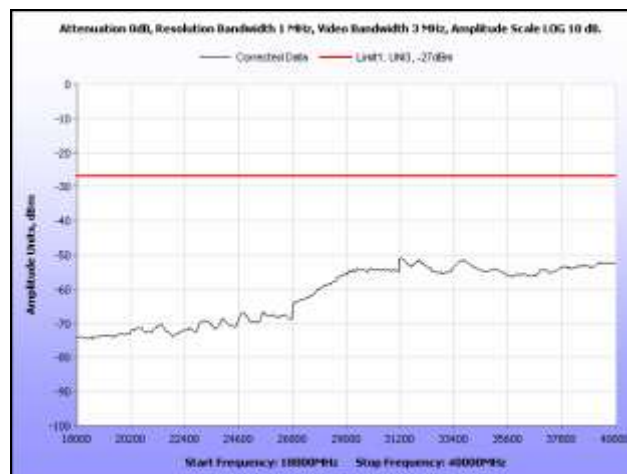
Note: Emissions which exceed the 15.209 limit are digital emissions which meet the Class A limits.



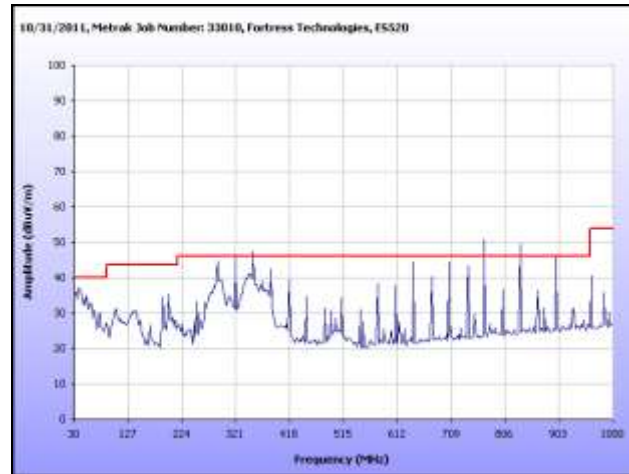
Plot 45. Radiated Spurious Emissions, 5320 MHz, 1 GHz – 7 GHz, Omni Antenna



Plot 46. Radiated Spurious Emissions, 5320 MHz, 7 GHz – 18 GHz, Omni Antenna

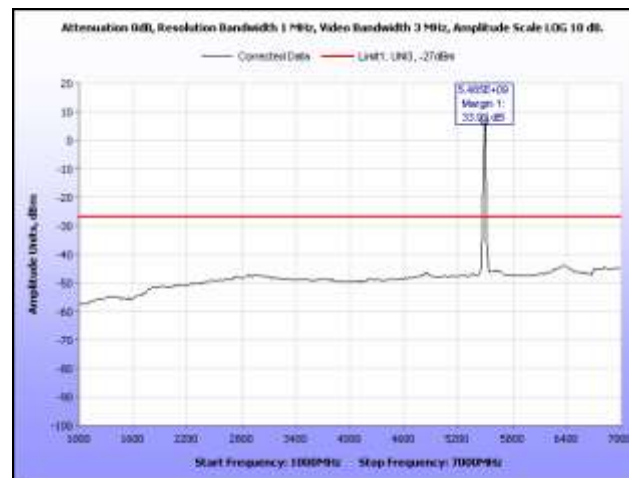


Plot 47. Radiated Spurious Emissions, 5320 MHz, 18 GHz – 40 GHz, Omni Antenna

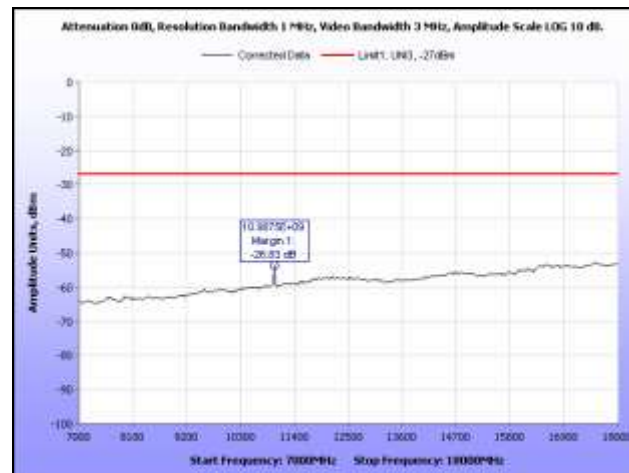


Plot 48. Radiated Spurious Emissions, 5500 MHz, 30 MHz – 1 GHz, Omni Antenna

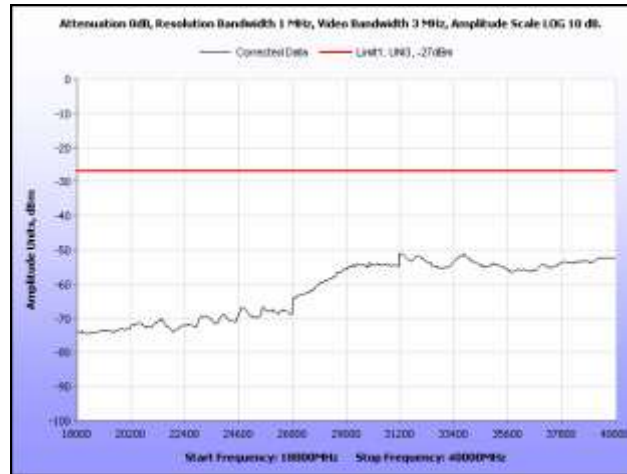
Note: Emissions which exceed the 15.209 limit are digital emissions which meet the Class A limits.



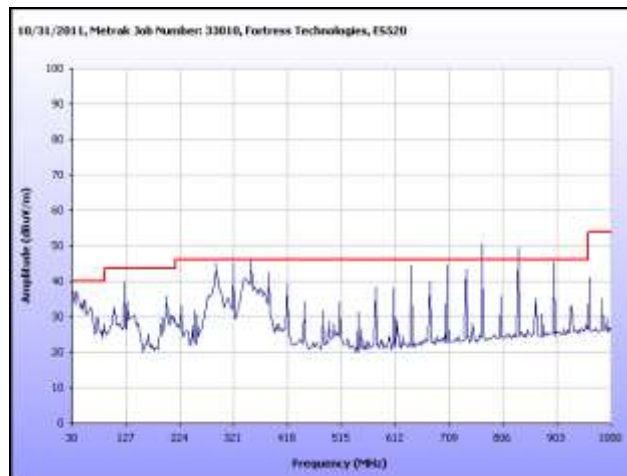
Plot 49. Radiated Spurious Emissions, 5500 MHz, 1 GHz – 7 GHz, Omni Antenna



Plot 50. Radiated Spurious Emissions, 5500 MHz, 7 GHz – 18 GHz, Omni Antenna



Plot 51. Radiated Spurious Emissions, 5500 MHz, 18 GHz – 40 GHz, Omni Antenna

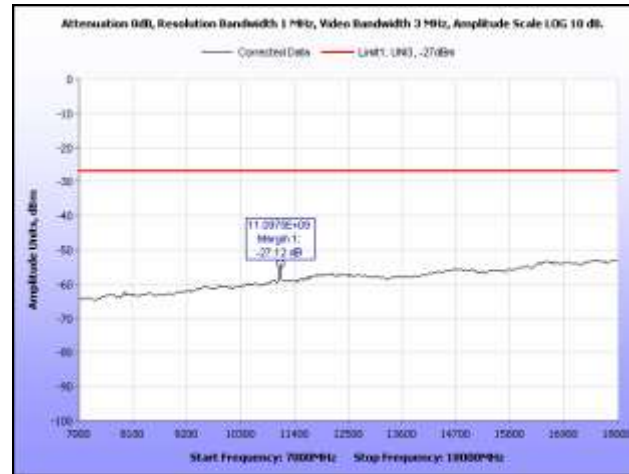


Plot 52. Radiated Spurious Emissions, 5560 MHz, 30 MHz – 1 GHz, Omni Antenna

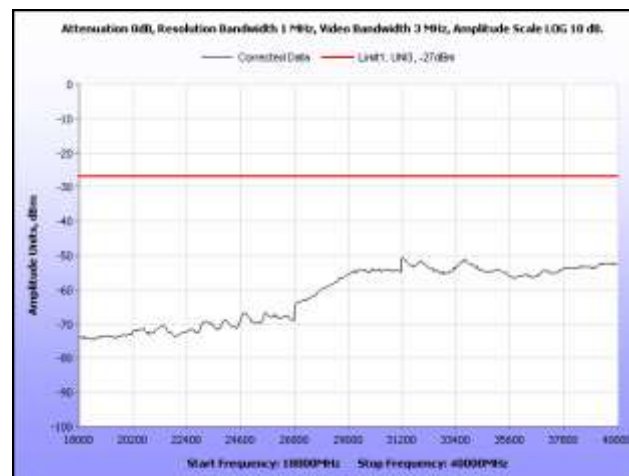
Note: Emissions which exceed the 15.209 limit are digital emissions which meet the Class A limits.



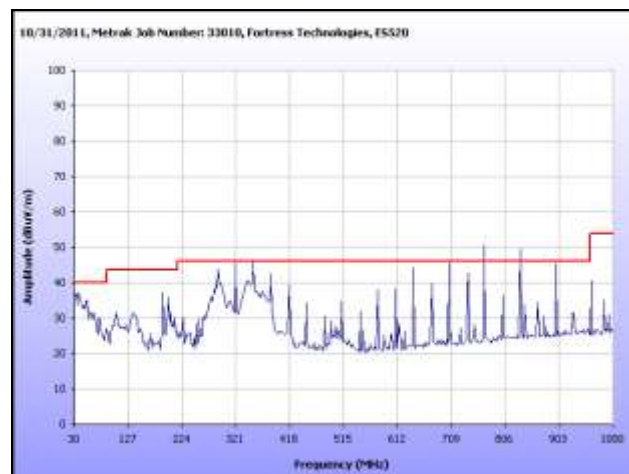
Plot 53. Radiated Spurious Emissions, 5560 MHz, 1 GHz – 7 GHz, Omni Antenna



Plot 54. Radiated Spurious Emissions, 5560 MHz, 7 GHz – 18 GHz, Omni Antenna

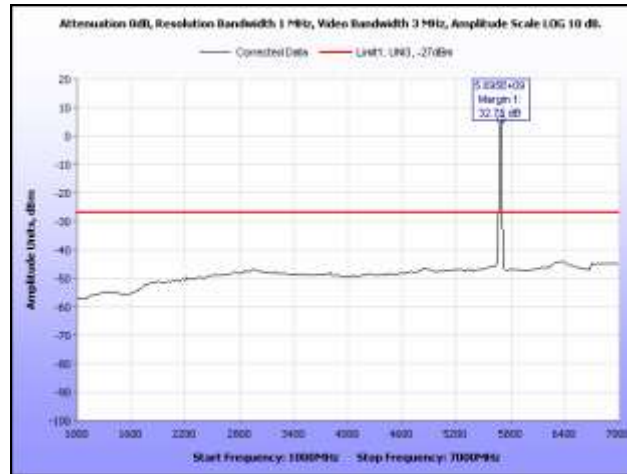


Plot 55. Radiated Spurious Emissions, 5560 MHz, 18 GHz – 40 GHz, Omni Antenna

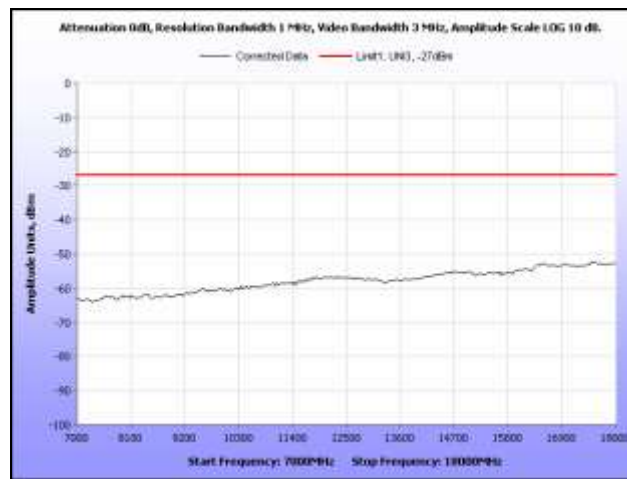


Plot 56. Radiated Spurious Emissions, 5700 MHz, 30 MHz – 1 GHz, Omni Antenna

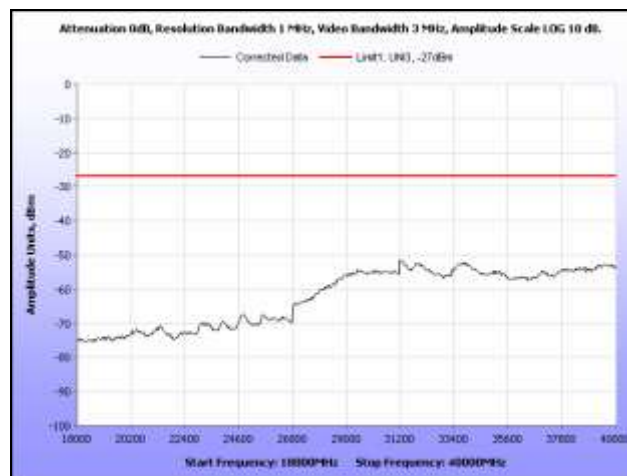
Note: Emissions which exceed the 15.209 limit are digital emissions which meet the Class A limits.



Plot 57. Radiated Spurious Emissions, 5700 MHz, 1 GHz – 7 GHz, Omni Antenna

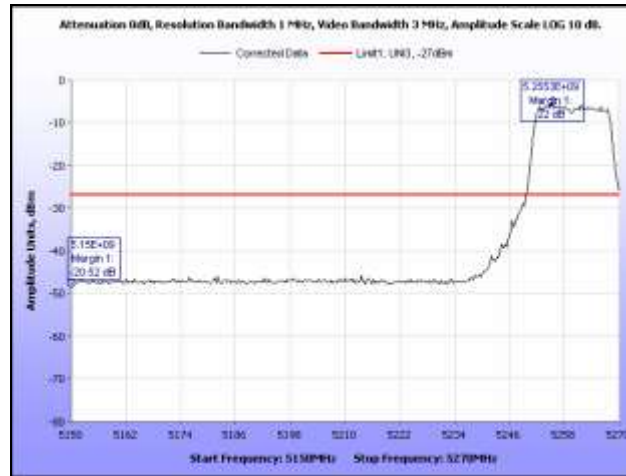


Plot 58. Radiated Spurious Emissions, 5700 MHz, 7 GHz – 18 GHz, Omni Antenna

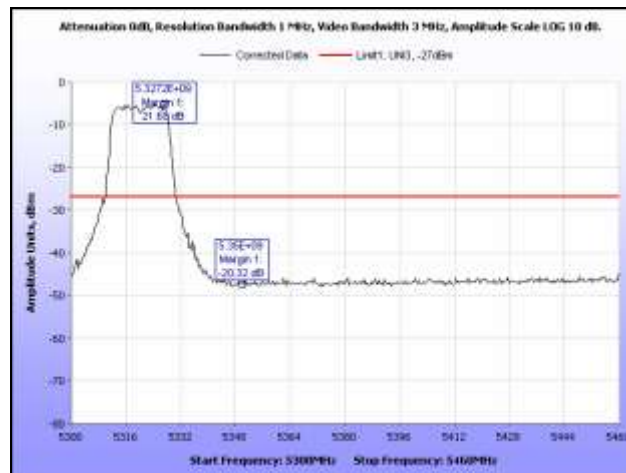


Plot 59. Radiated Spurious Emissions, 5700 MHz, 18 GHz – 40 GHz, Omni Antenna

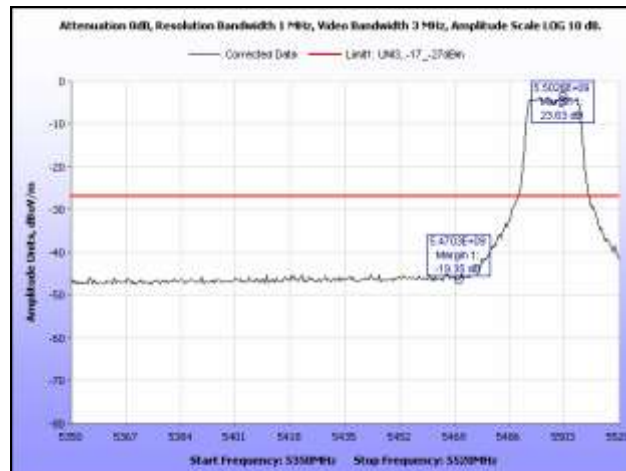
EIRP



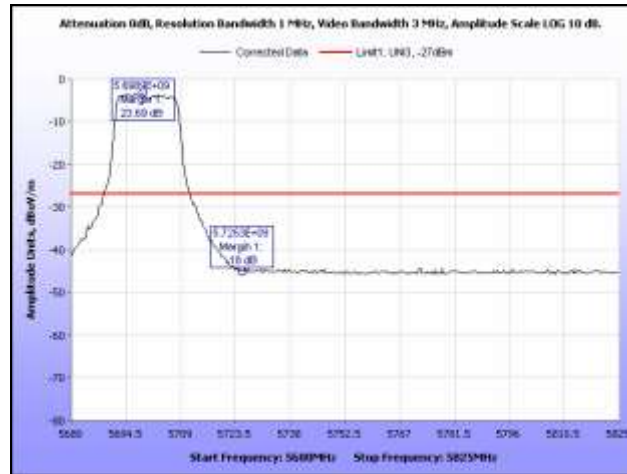
Plot 60. EIRP, 5260 MHz, Band Edge, Omni Antenna



Plot 61. EIRP, 5320 MHz, Band Edge, Omni Antenna

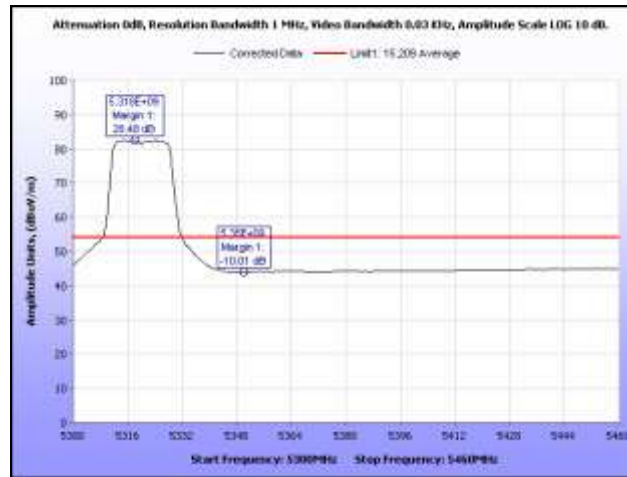


Plot 62. EIRP, 5500 MHz, Band Edge, Omni Antenna

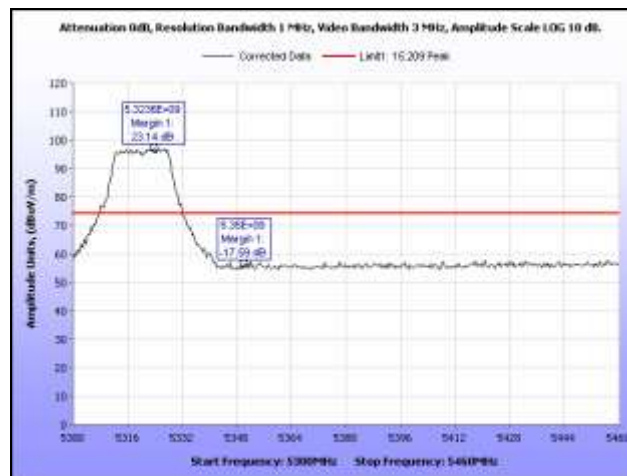


Plot 63. EIRP, 5700 MHz, Band Edge, Omni Antenna

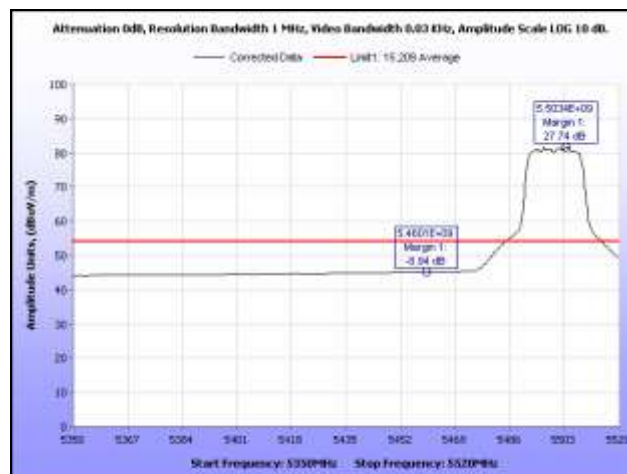
Restricted Band



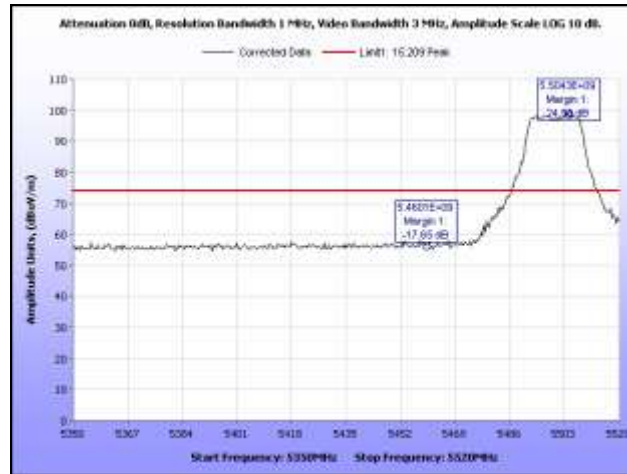
Plot 64. Radiated Restricted Band, 5320 MHz, Average



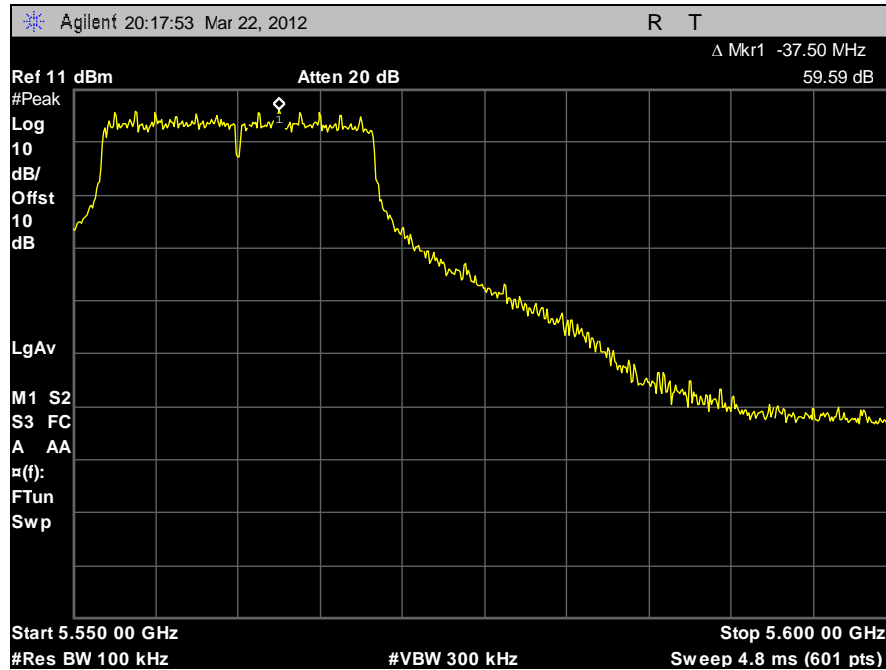
Plot 65. Radiated Restricted Band, 5320 MHz, Peak



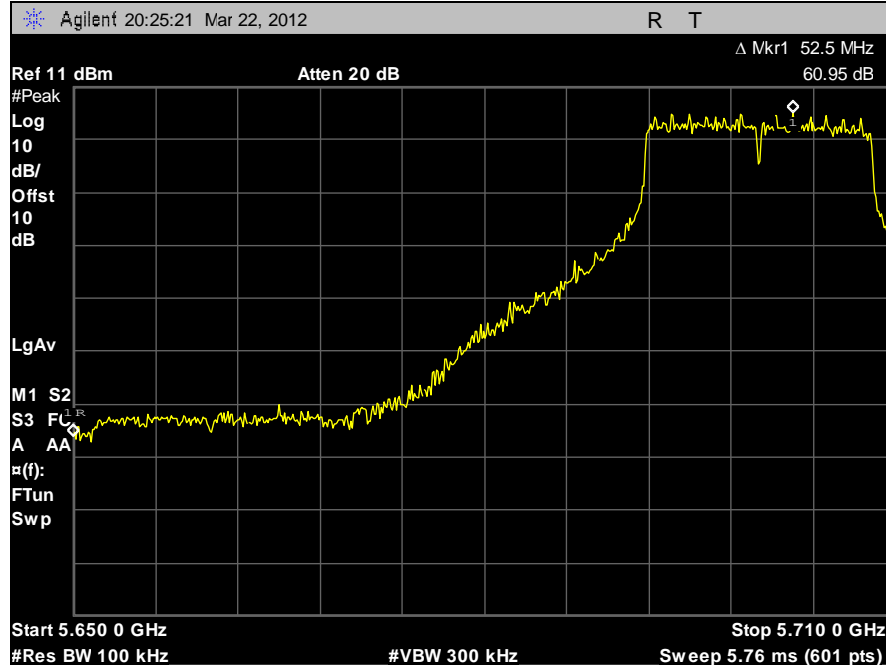
Plot 66. Radiated Restricted Band, 5500 MHz, Average



Plot 67. Radiated Restricted Band, 5500 MHz, Peak



Plot 68. 5560 MHz, 20 dB

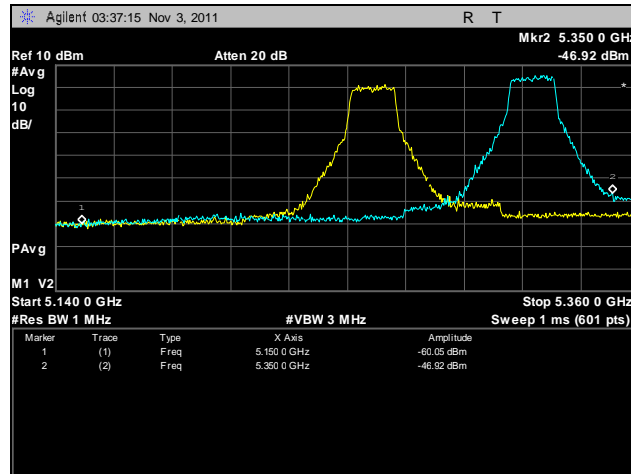


Plot 69. 5700 MHz, 20 dB

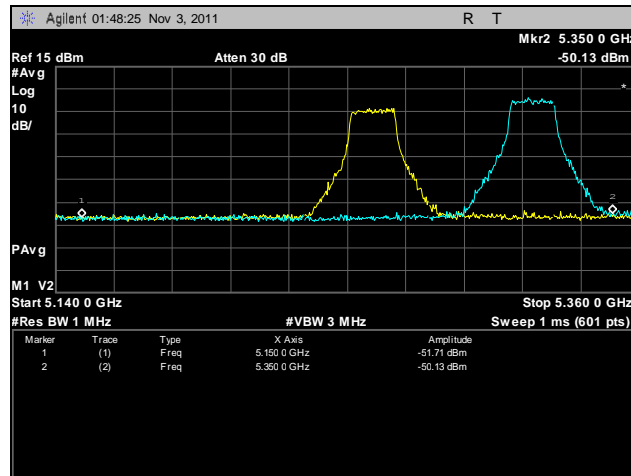
Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(g) Frequency Stability

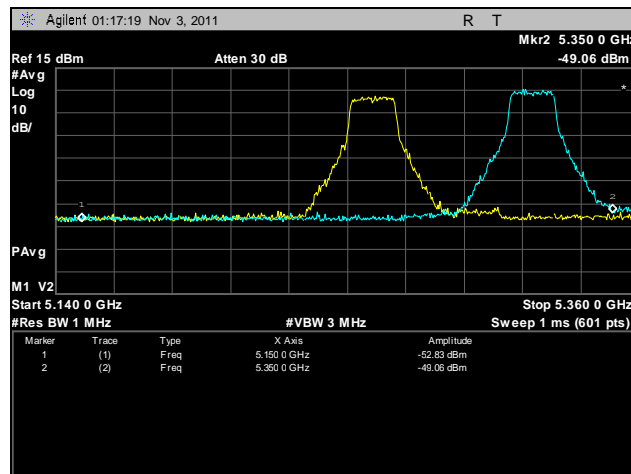
Test Requirements:	§ 15.407(g): Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.
Test Procedure:	The EUT was placed in a temperature chamber and connected directly to a spectrum analyzer through an attenuator. The resolution bandwidth was set to 1 MHz with an average detector and the span was set to encompass the complete frequency band. The transmitter was set to transmit on the low and high channels. Markers were used to measure the channels to ensure that the entire emission was contained within the frequency band. The temperature was varied between the minimum and maximum temperature (-20°C and +55°C) at increments of 10°C and the measurements were repeated. At ambient temperature (+20°C), the input voltage was varied between +/- 10% of the nominal input voltage and the measurements were repeated. Measurements were repeated for each frequency band.
Test Results:	The EUT was compliant with the requirements of §15.407(g).
Test Engineer(s):	Jeff Pratt
Test Date(s):	11/15/11



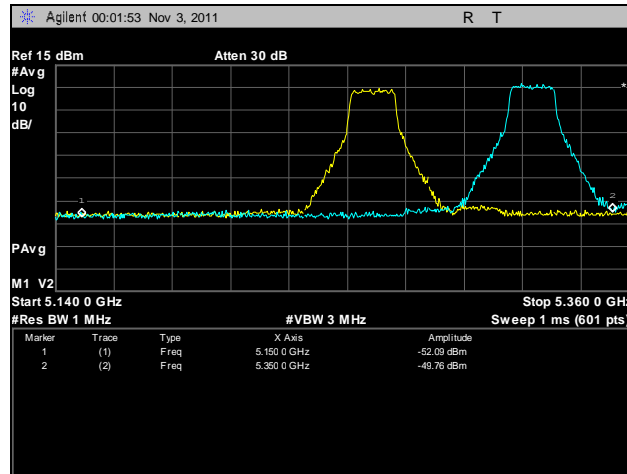
Plot 70. Frequency Stability, 5250 – 5350 MHz, -20°C, 120 V



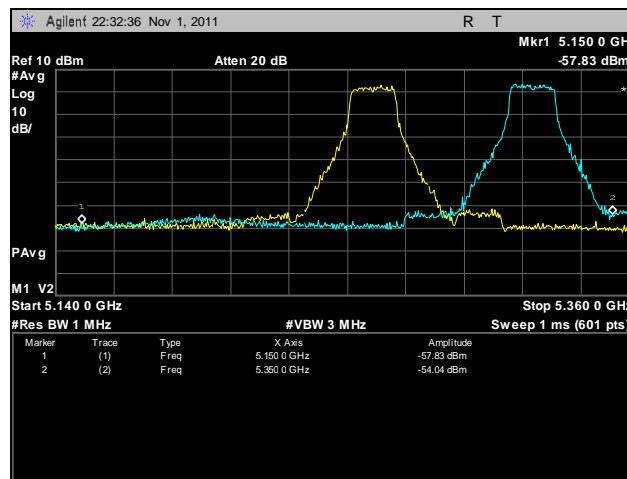
Plot 71. Frequency Stability, 5250 – 5350 MHz, -10°C, 120 V



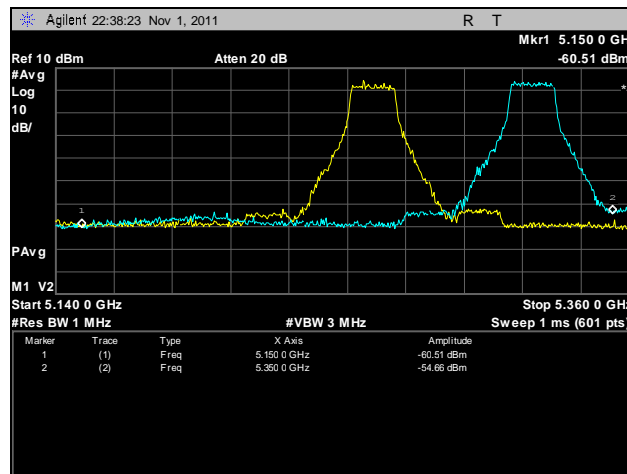
Plot 72. Frequency Stability, 5250 – 5350 MHz, 0°C, 120 V



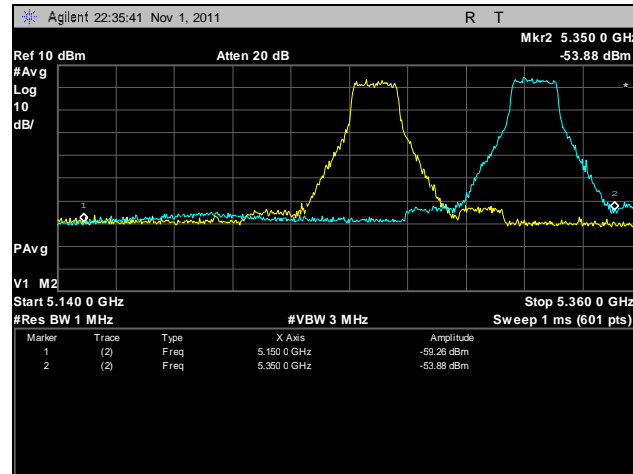
Plot 73. Frequency Stability, 5250 – 5350 MHz, 10°C, 120 V



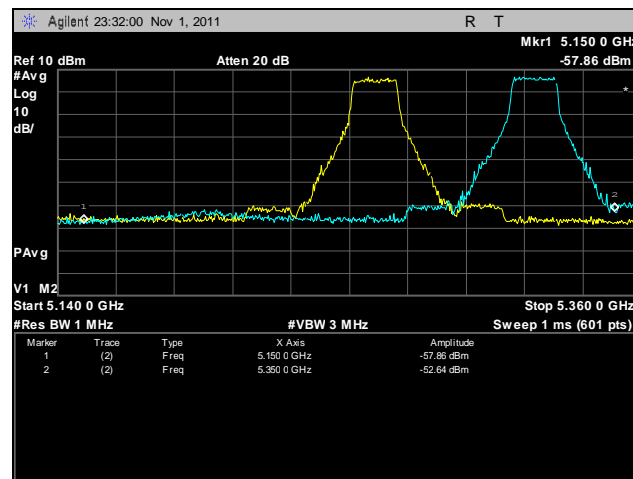
Plot 74. Frequency Stability, 5250 – 5350 MHz, 20°C, 108 V



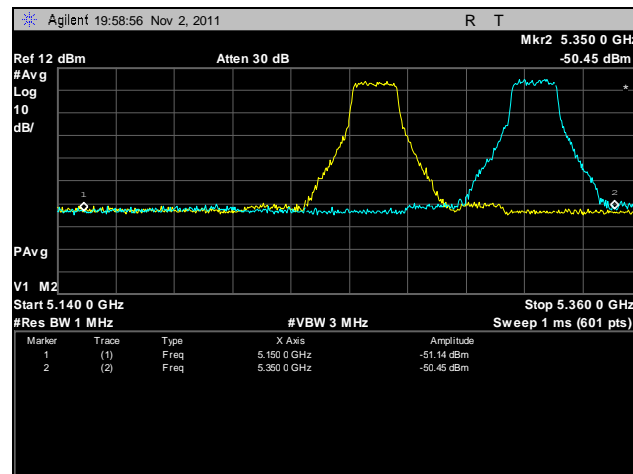
Plot 75. Frequency Stability, 5250 – 5350 MHz, 20°C, 120 V



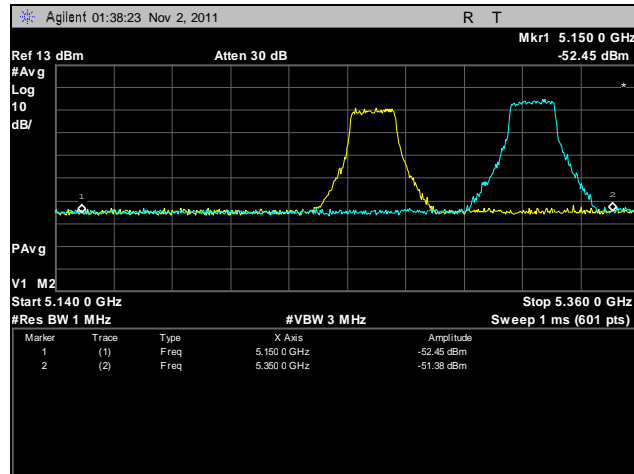
Plot 76. Frequency Stability, 5250 – 5350 MHz, 20°C, 132 V



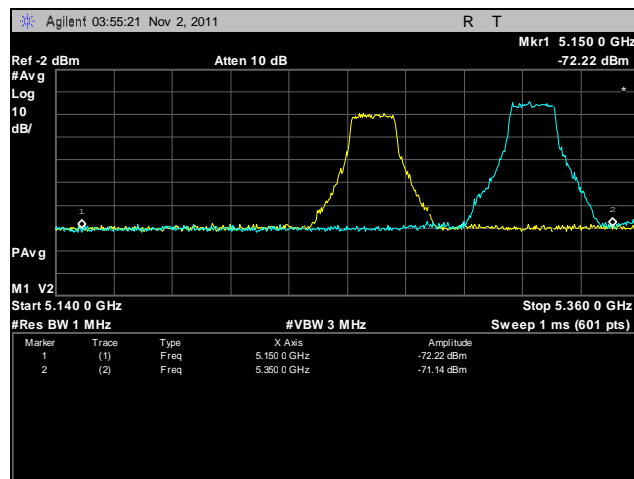
Plot 77. Frequency Stability, 5250 – 5350 MHz, 30°C, 120 V



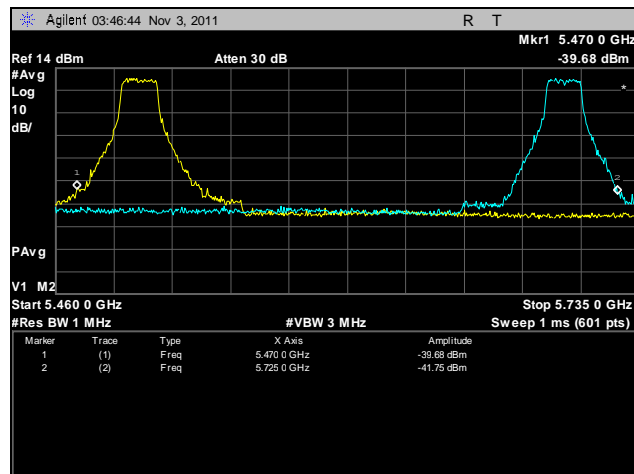
Plot 78. Frequency Stability, 5250 – 5350 MHz, 40°C, 120 V



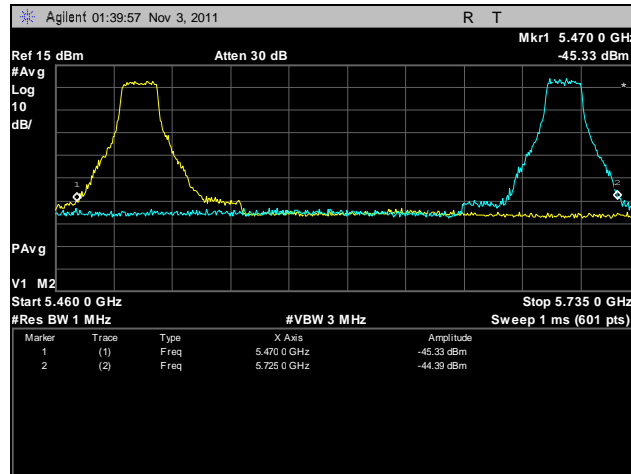
Plot 79. Frequency Stability, 5250 – 5350 MHz, 50°C, 120 V



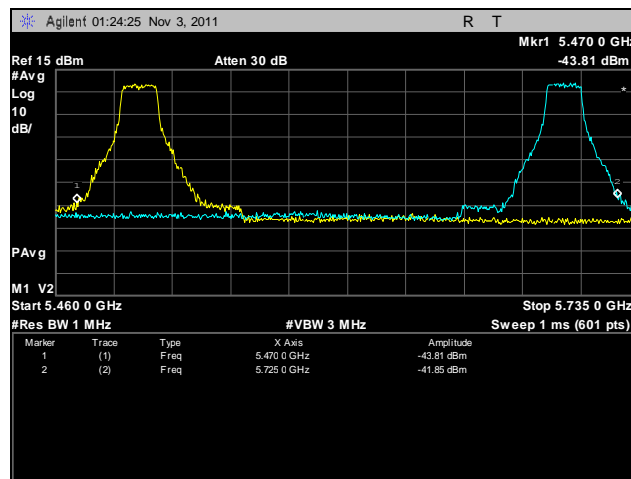
Plot 80. Frequency Stability, 5250 – 5350 MHz, 55°C, 120 V



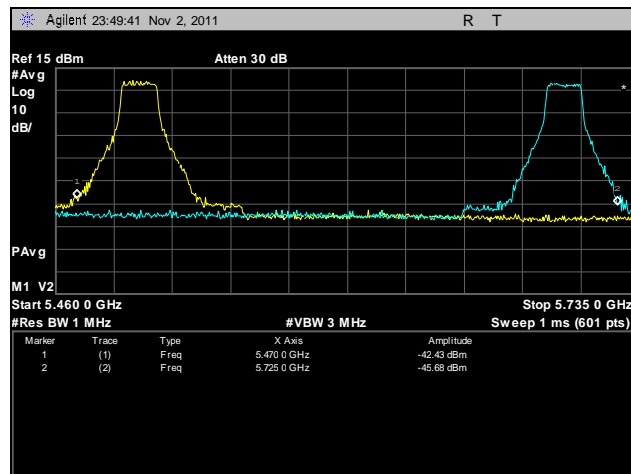
Plot 81. Frequency Stability, 5470 – 5725 MHz, -20°C, 120 V



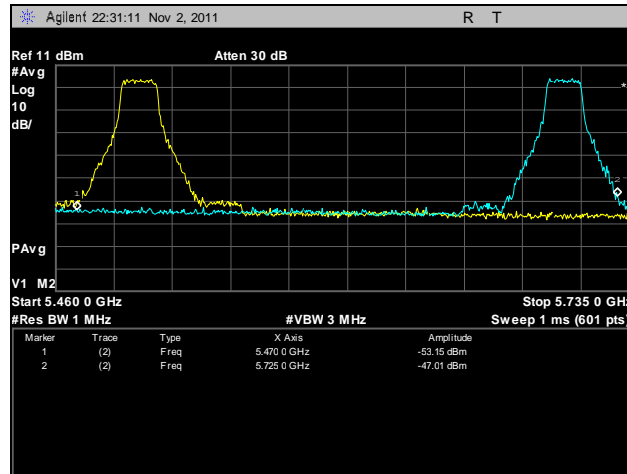
Plot 82. Frequency Stability, 5470 – 5725 MHz, -10°C, 120 V



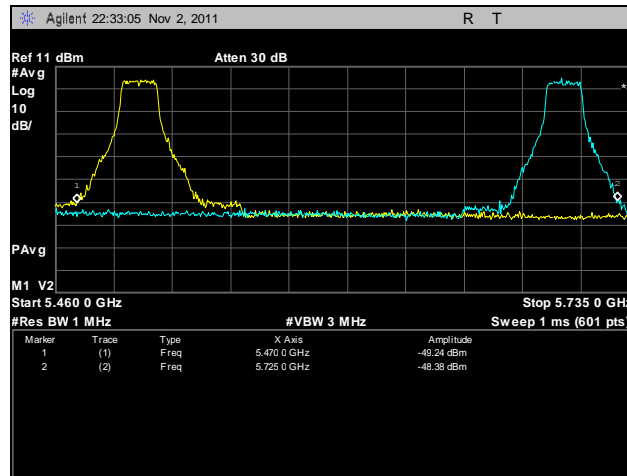
Plot 83. Frequency Stability, 5470 – 5725 MHz, 0°C, 120 V



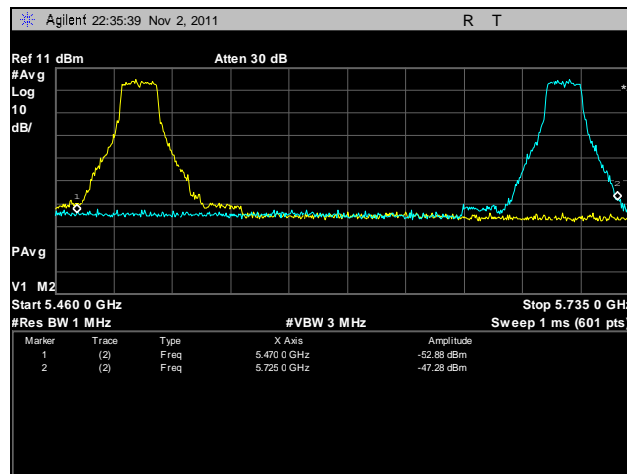
Plot 84. Frequency Stability, 5470 – 5725 MHz, 10°C, 120 V



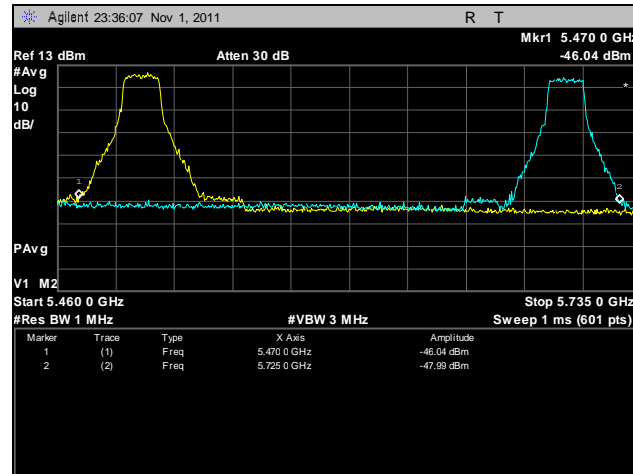
Plot 85. Frequency Stability, 5470 – 5725 MHz, 20°C, 108 V



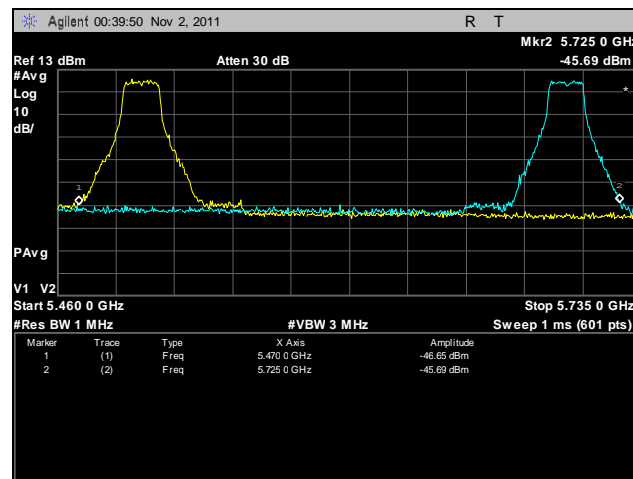
Plot 86. Frequency Stability, 5470 – 5725 MHz, 20°C, 120 V



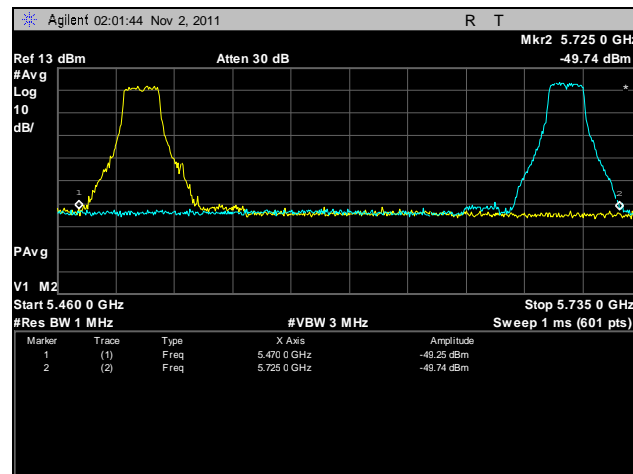
Plot 87. Frequency Stability, 5470 – 5725 MHz, 20°C, 132 V



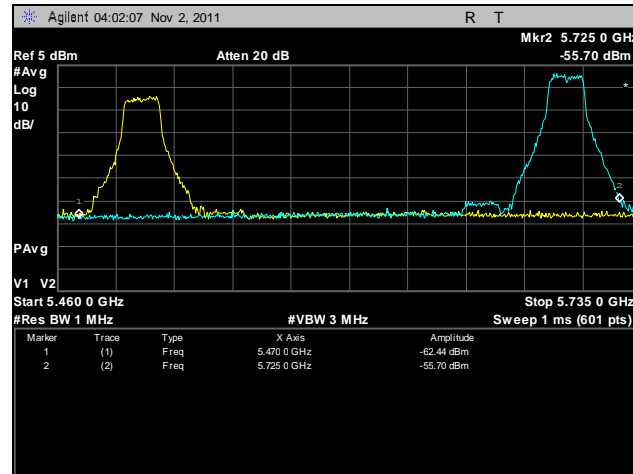
Plot 88. Frequency Stability, 5470 – 5725 MHz, 30°C, 120 V



Plot 89. Frequency Stability, 5470 – 5725 MHz, 40°C, 120 V



Plot 90. Frequency Stability, 5470 – 5725 MHz, 50°C, 120 V



Plot 91. Frequency Stability, 5470 – 5725 MHz, 55°C, 120 V



Photograph 5. Frequency Stability, Test Setup

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 18.

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

Table 18. 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 300 kHz 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): Jeff Pratt

Test Date(s): 03/19/12

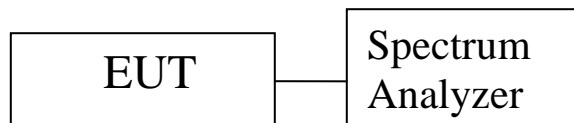
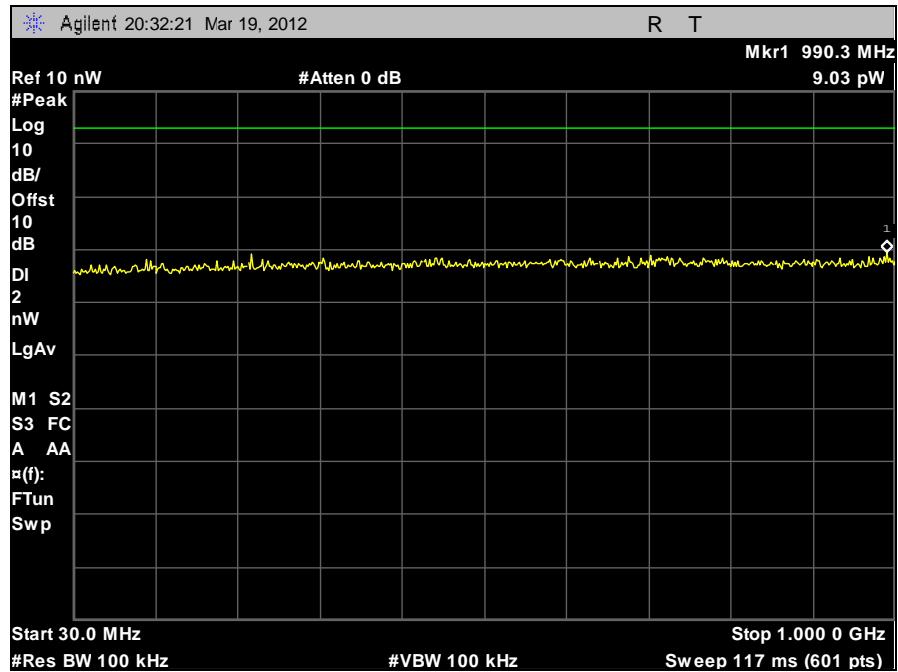
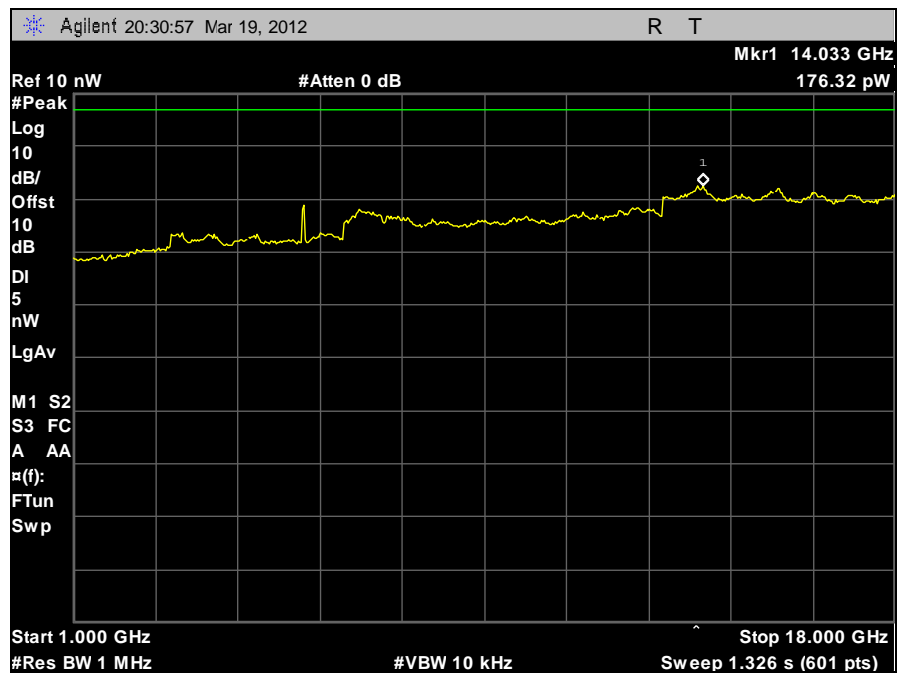


Figure 5. Block Diagram, Conducted Receiver Spurious Emissions Test Setup

Conducted Receiver Spurious Emissions



Plot 92. Receiver Spurious Emission, 30 MHz – 1 GHz



Plot 93. 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 ANSI/NCSL Z540-1-1994 and ANSI/ISO/IEC 17025:2000.

MET ASSET #	EQUIPMENT	MANUFACTURER	MODEL	LAST CAL DATE	CAL DUE DATE
1T4214	SHIELD ROOM #4	UNIVERSAL SHIELD INC	N/A	SEE NOTE	
1T4621	ESA-E SERIES SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4402B	5/31/2011	5/31/2012
1T4565	LISN (10 AMP)	SOLAR ELECTRONICS	9252-50-R-24-BNC	12/15/2011	12/15/2012
1T4758	THERMO/HYGROMETER	CONTROL COMPANY	4040	5/21/2010	5/21/2012
1T4300	SEMI-ANECHOIC CHAMBER # 1	EMC TEST SYSTEMS	NONE	8/23/2010	8/23/2013
1T4751	ANTENNA; BILOG	SUNOL SCIENCES	JB6	12/7/2011	12/7/2012
1T4409	EMI RECEIVER	ROHDE & SCHWARZ	ESIB7	6/14/2011	6/14/2012
1T4634	THERMO/HYGROMETER	CONTROL COMPANY	02-401	3/11/2010	3/11/2012
1T4505	TEMPERATURE CHAMBER	TEST EQUITY	115	11/30/2011	11/30/2012
1T4728	PROGRAMMABLE AC POWER SOURCE	QUADTECH	31010	SEE NOTE	
1T4612	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	12/15/2010	6/15/2012
1T4483	ANTENNA; HORN	ETS-LINDGREN	3117	7/19/2011	7/19/2012
1T4745	ANTENNA; HORN	ETS-LINDGREN	3116	10/4/2011	10/4/2012
1T4442	PRE-AMPLIFIER, MICROWAVE	MITEQ	AFS42-01001800-30-10P	SEE NOTE	
1T4752	PRE-AMPLIFIER	MITEQ	JS44-18004000-35-8P	SEE NOTE	
1T4771	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4446A	6/25/2011	6/25/2012
1T4502	COMB GENERATOR	COM-POWER	CGC-255	11/3/2011	11/3/2012
1T4568	RADIATING NOISE SOURCE	MET LABORATORIES	N/A	SEE NOTE	
1T4149	HIGH-FREQUENCY ANECHOIC CHAMBER	RAY-PROOF	81	CAL NOT REQUIRED	
1T4246	DIRECTIONAL COUPLER	HP	11691D	SEE NOTE	

Table 19. Test Equipment List

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



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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.



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