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Electromagnetic Compatibility Criteria Test Report

for the

**SkyPilot Networks
Model SkyConnector Mini**

Tested under

the FCC & Industry Canada Certification Rules
contained in
Title 47 of the CFR, Parts 15 Subpart B & ICES-003
for Class A Digital Devices
&
15.407 Subpart E & RSS-210, Issue 7, June 2007
for Intentional Radiators

MET Report: EMC81159-FCC407

October 15, 2008

Prepared For:

**SkyPilot Networks
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Prepared By:
MET Laboratories, Inc.
3162 Belick Street
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Anderson Soungpanya, Project Engineer
Electromagnetic Compatibility Lab

Jennifer Sanchez
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 Part 15 B & 15.407, ICES-003, Issue 4 February 2004 & RSS-210, Issue 7, June 2007 of the FCC & Industry Canada Rules under normal use and maintenance.

Shawn McMillen, Wireless Manager
Electromagnetic Compatibility Lab



Report Status Sheet

Revision	Report Date	Reason for Revision
∅	October 28, 2008	Initial Issue.
1	November 5, 2008	Final Issue.
2	November 12, 2008	Revision 1 (DFS Section, typos and Cal plot)



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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
dB μ A	Decibels above one microamp
dB μ V	Decibels above one microvolt
dB μ A/m	Decibels above one microamp per meter
dB μ V/m	Decibels above one microvolt per meter
DC	Direct Current μ
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
μ H	microhenry
μ	microfarad
μ s	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 SkyPilot Networks SkyConnector Mini, 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 SkyConnector Mini. SkyPilot Networks should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the SkyConnector Mini, 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 SkyPilot Networks, purchase order number 5841. All tests were conducted using measurement procedure ANSI C63.4-2003.

FCC Reference	RSS-210 Reference	Description	Results
§15.107	7.4	AC Power Line Conducted Emissions	Compliant
§15.109	7.3	Radiated Spurious Emissions	Compliant
§15.203	A8.4	Antenna Requirement	Compliant
§15.207	6.6	AC Power Line Conducted Emissions	Compliant
15.205/15.209	A8.5	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Compliant
15.403 (c)	A8.2	26dB Occupied Bandwidth	Compliant
15.407 (a)(1), (2), (3)	A9.2(3)	Conducted Transmitter Output Power	Compliant
15.407 (a)(1), (2), (3), (5)	A9.2(3)/RSS-102	Power Spectral Density	Compliant
15.407 (a)(6)		Peak Excursion	Compliant
15.407 (b)(1), (2), (5), (6)	A9.3(4)/7.2.2	Undesirable Emissions	Compliant

Table 1 Executive Summary of EMC Part 15.407 Compliance Testing

Reference	Description	Results
15.407 (h)(1)	Transmit Power Control (TPC)	Not Applicable
15.407 (h)(2)	Radar Detection Function of Dynamic Frequency Selection (DFS)	Not Applicable
15.407 (h)(2)(ii)	Channel Availability Check Time	Not Applicable
15.407 (h)(2)(iii)	Channel Move Time and Channel Closing Time	Compliant
15.407 (h)(2)(iv)	Non-Occupancy Period	Not Applicable

Table 2 Executive Summary of EMC Part 15.407 DFS Compliance Testing



II. Equipment Configuration



A. Overview

MET Laboratories, Inc. was contracted by SkyPilot Networks to perform testing on the SkyConnector Mini, under SkyPilot Networks's purchase order number 5841.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the SkyPilot Networks SkyConnector Mini.

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

Model(s) Tested:	SkyConnector Mini	
Model(s) Covered:	SkyConnector Mini	
EUT Specifications:	Primary Power: 120V/230V	
	FCC ID: RV7-SC5111	
	IC ID: 5550A-SC5111	
	Type of Modulations:	OFDM
	Emission Designators:	16M5D7D
	Equipment Code:	NII
	Peak RF Output Power:	17.16dBm (0.051W)
EUT Frequency Ranges:	5260 – 5320MHz, 5500-5700MHz	
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:	Anderson Soungpanya	
Date(s):	October 15, 2008	

Table 3. EUT Summary Table



B. References

CFR 47, Part 15, Subpart B	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
ICES-003, Issue 4 February 2004	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
CFR 47, Part 15, Subpart E	Unlicensed National Information Infrastructure Devices (UNII)
RSS-210, Issue 7, June 2007	Low-power Licence-exempt Radiocommunications Devices (All Frequency Bands): Category I Equipment
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 4. References

C. Test Site

All testing was performed at MET Laboratories, Inc., 3162 Belick Street, Santa Clara, California 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 10 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 SkyPilot Networks SkyConnector Mini, is a high performance 802.11 outdoor CPE device specifically designed for optimized performance at 5GHz



Photograph 1. SkyPilot Networks SkyConnector Mini

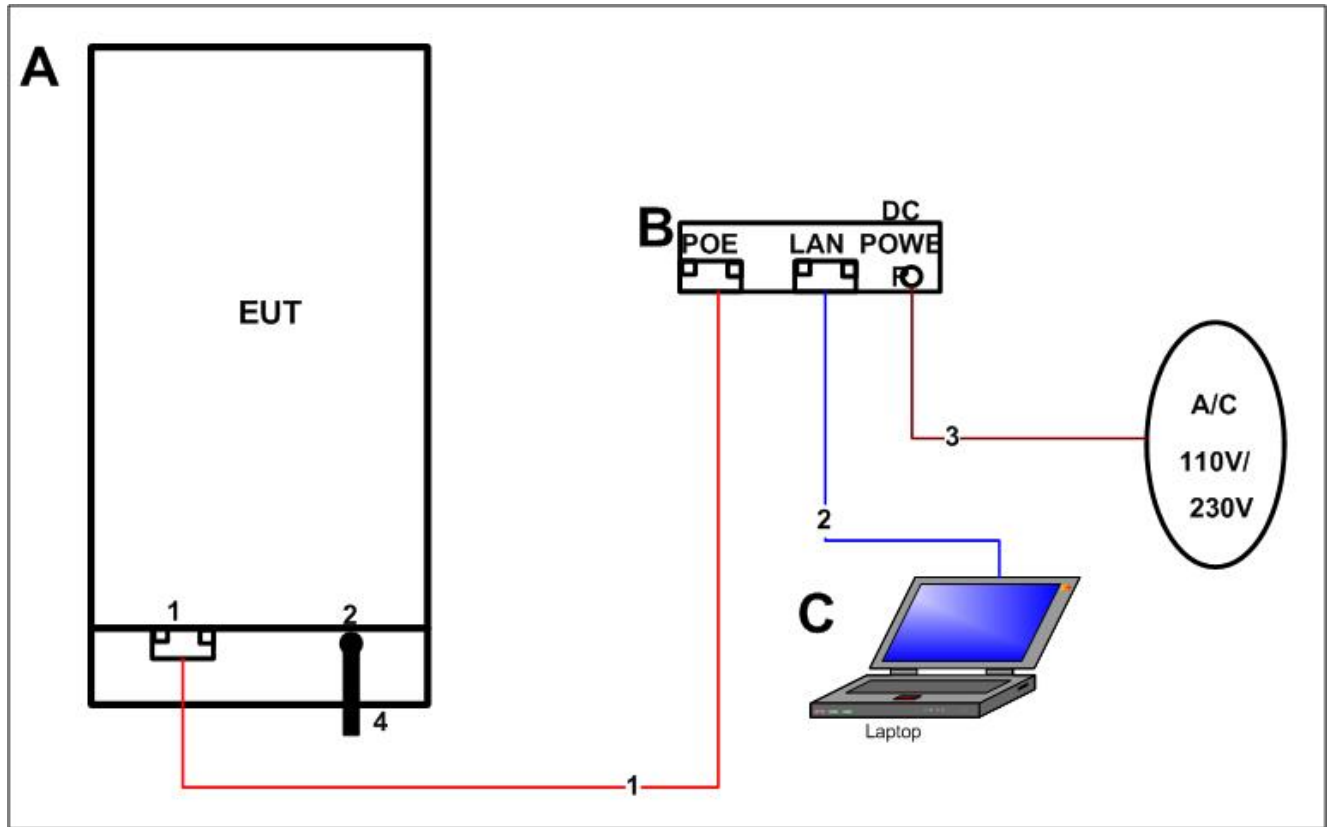


Figure 1. Block Diagram of Test Configuration



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
A	SkyConnector Mini	725-05020-01R	F50000001

Table 5. Equipment Configuration

F. Support Equipment

SkyConnector Mini supplied support equipment necessary for the operation and testing of the SkyConnector Mini. All support equipment supplied is listed in the following Support Equipment List.

Ref. ID	Name / Description	Manufacturer	Model Number
B	AC/DC Adaptor	GME Switching	GFP121U-1210B
C	Laptop	DELL	Inspiron-630m

Table 6. Support Equipment



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	A,1	Ethernet	1	2	Y	B, POE
2	B, LAN	Ethernet	1	2	Y	C, Laptop
3	B, DC POWER	Power Cable	1	2	N	230V/110V Power Supply

Table 7. Ports and Cabling Information

H. Mode of Operation

The EUT operates in OFDM mode.

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 SkyPilot Networks upon completion of testing.



III. Electromagnetic Compatibility Criteria for Unintentional Radiators



Electromagnetic Compatibility Emission Criteria

Limits for Conducted Disturbance at Mains Terminals

Test Method(s): FCC Part 15 Section 15.107(a) (b)

Test Requirement(s): FCC Part 15 Section 15.107(a) (b), ICES-003 Issue 4, February 2004,

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 8. 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.

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 8. 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 Limits (dBµV)		Class B Limits (dBµV)	
	Quasi-Peak	Average	Quasi-Peak	Average
0.15- 0.5	79	66	66 - 56	56 - 46
0.5 - 30	73	60	60	50

Note 1 — The lower limit shall apply at the transition frequencies.

Table 8. Conducted Emissions Limits from Section 4.1 of FCC 15B Section 15.107(a)(b), ICES-003 Issue 4, February 2004 Technical Requirements

Test Procedures: The EUT was placed on a 0.8m-high wooden table 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 measured using a quasi-peak and/or average detector as appropriate.

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

Test Engineer(s): Minh Ly

Test Date(s): November 10, 2007



Conducted Emissions - Voltage, AC Power, (110 VAC, 60 Hz)

FREQ. (MHz)	Corrected Amplitude (dBuV) QP	Limit (dBuV) QP	Results QP	Margin (dB) QP	Corrected Amplitude (dBuV) AVG	Limit (dBuV) AVG	Results AVG	Margin (dB) AVG
0.16	61.41	79	PASS	-17.59	34.98	66	PASS	-31.02
2.653	35.21	73	PASS	-37.79	15.97	60	PASS	-44.03
24.96	40.45	73	PASS	-32.55	35.85	60	PASS	-24.15

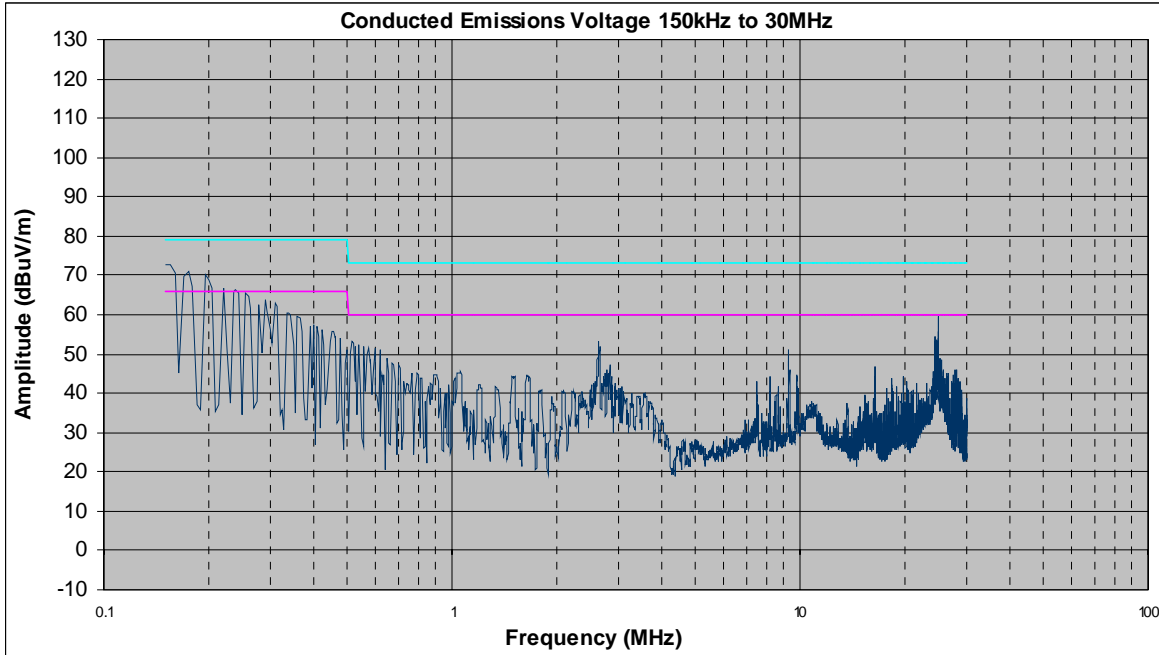
Table 9. Conducted Emissions - Voltage, AC Power, Phase Line (110 VAC, 60 Hz)

FREQ. (MHz)	Corrected Amplitude (dBuV) QP	Limit (dBuV) QP	Results QP	Margin (dB) QP	Corrected Amplitude (dBuV) AVG	Limit (dBuV) AVG	Results AVG	Margin (dB) AVG
0.161	62.37	79	PASS	-16.63	34.31	66	PASS	-31.69
2.576	30.53	73	PASS	-42.47	13.36	60	PASS	-46.64
25.58	34.13	73	PASS	-38.87	30.95	60	PASS	-29.05

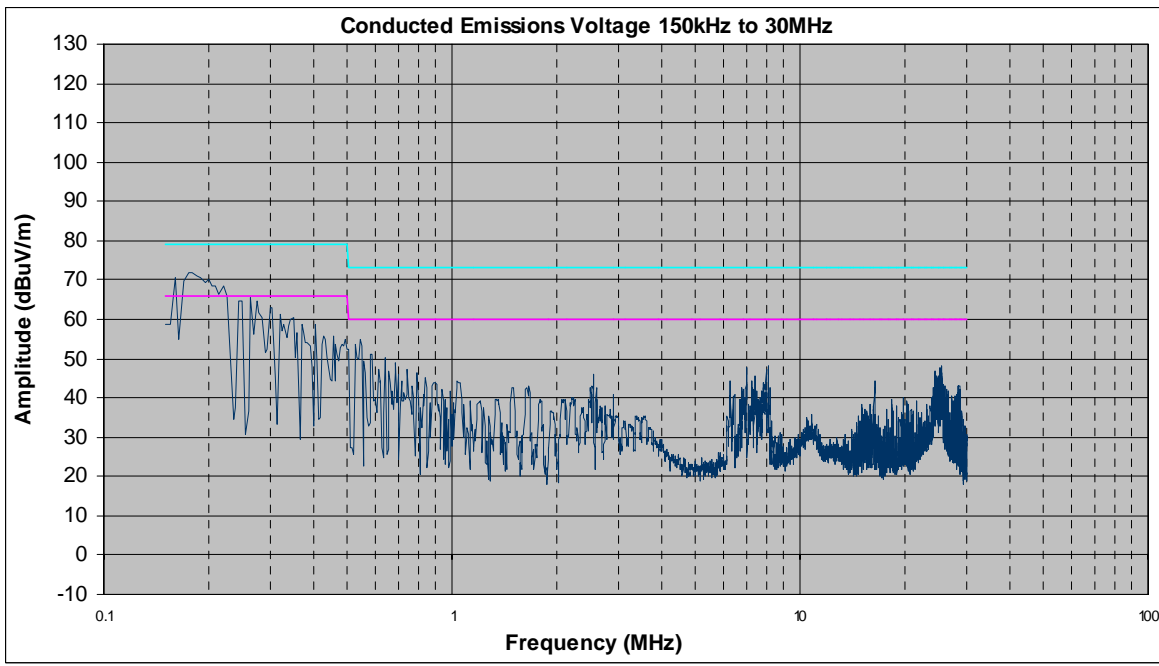
Table 10. Conducted Emissions - Voltage, AC Power, Neutral Line (110 VAC, 60 Hz)



Conducted Emissions - Voltage, Worst Case Emissions, AC Power, (110 VAC, 60 Hz)



Conducted Emission, Phase Line Plots



Conducted Emission, Neutral Line Plots

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 11.

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 11.

Frequency (MHz)	Field Strength (dB μ V/m)	
	§15.109 (b), Class A Limit (dB μ V) @ 10m	§15.109 (a), Class B Limit (dB μ V) @ 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 11. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (b)

Test Procedures: The EUT was placed on a 0.8m-high wooden table inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4 were used. An antenna was located 10 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 found Compliant with the Class A requirement(s) of this section. Measured emissions were below applicable limits

Test Engineer(s): Minh Ly

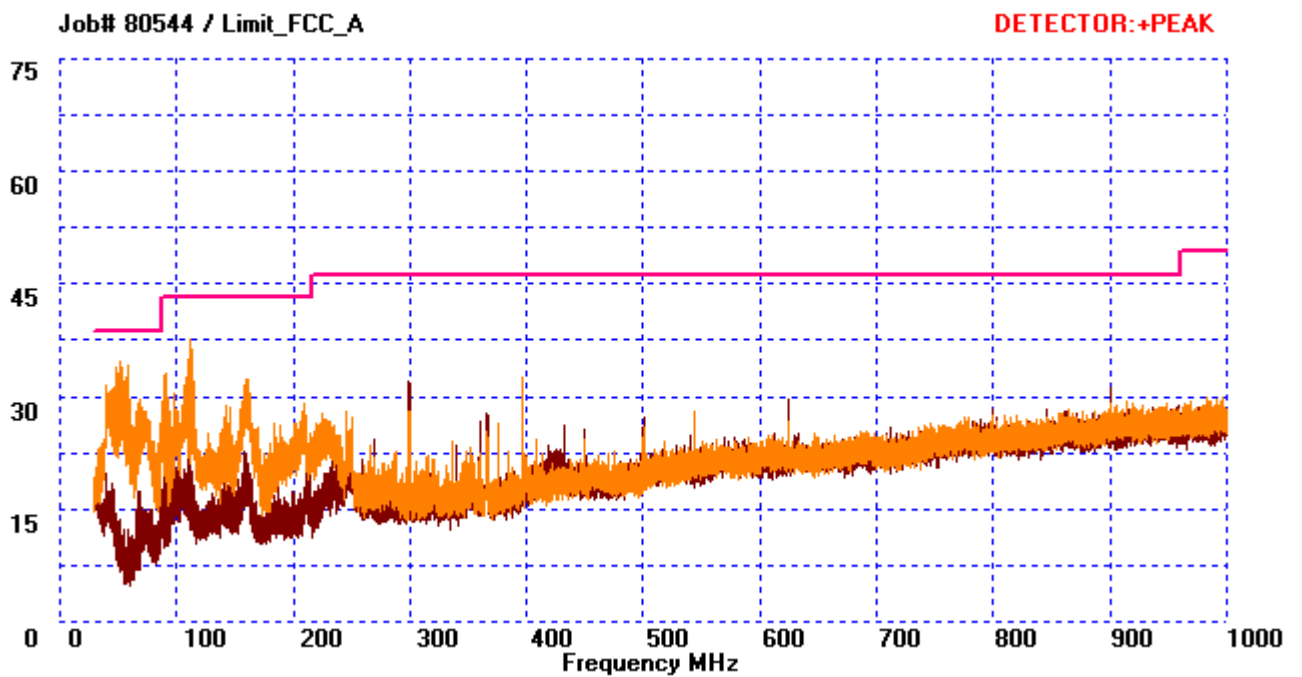
Test Date(s): November 10, 2007



Radiated Emissions Limits Test Results, Class A

Frequency (MHz)	Antenna Polarity (H/V)	EUT Azimuth (Degrees)	Antenna HEIGHT (m)	Uncorrected Amplitude QP Detector (dBuV)	Antenna Correction Factor (dB/m) (+)	Cable Loss (dB) (+)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
52.64	V	81	2.54	25.68	7.27	1.18	34.14	39.00	-4.86
58.72	V	271	2.87	24.50	6.54	1.26	32.30	39.00	-6.70
90.36	V	70	1.97	22.06	9.17	1.58	32.80	43.50	-10.70
111.6	V	99	1.1	23.00	11.70	1.86	36.55	43.50	-6.95
159.64	V	214	1.07	18.82	9.64	2.30	30.75	43.50	-12.75
298.64	H	67	3.2	16.79	13.23	2.92	32.94	46.40	-13.46

Table 12. Radiated Emissions Limits Test Results, 30 MHz – 1 GHz



Radiated Emissions Limits Test Results, 30 MHz – 1 GHz, Class A



Radiated Emissions Limits Test Results, Class A

Frequency (GHz)	Azimuth (Degrees)	Antenna Polarity (H/V)	Height (m)	Raw Amp.@ 3m(Avg)	P.Amp (dB)	Ant.Cor. Factor (dB/m)	Cable Loss (dB)	Dist.Cor Factor (dB)	EUT Field Strength Final Amp. (dBuV/m)	Limit per FCC pt 15 @ 3m (dBuV/m)	Delta (dB)
1.058	213	V	1.27	34.38	35.82	23.93	2.17	10.46	14.21	49.5	-35.29
1.063	77	H	1.29	42.67	35.80	24.11	2.18	10.46	22.69	49.5	-26.81
1.08	193	V	1.13	39.43	35.76	23.98	2.19	10.46	19.38	49.5	-30.12
1.26	202	H	1.22	49	35.35	24.52	2.32	10.46	30.03	49.5	-19.47
1.589	102	H	1.09	33	34.78	25.52	2.66	10.46	15.94	49.5	-33.56
1.596	209	V	1.21	33.6	34.77	25.56	2.67	10.46	16.60	49.5	-32.90

Table 13. Radiated Emissions from 1 GHz to 2 GHz

Note: When transmit mode or receive mode were activated, there are no differences to emissions. For above 1 GHz measurement up to 5th harmonic of the highest operating frequency, emissions are noise floor during receive mode.

Radiated Emission Limits Test Setup



Photograph 3. Radiated Emission Test Setup 30 MHz - 2 GHz



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 meets the criteria of this rule by being antenna being permanently attached and professionally installed. The EUT is compliant with §15.203.

Gain	Manufacturer
10dbi	SkyPilot Networks
14dBi	SkyPilot Networks

Test Engineer(s): Anderson Soungpanya



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 Σ line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency range (MHz)	§ 15.207(a), Conducted Limit (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 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 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 found compliant with the requirement(s) of this section. Measured emissions were below applicable limits.

Test Engineer(s): Minh Ly

Test Date(s): November 10, 2007



Conducted Emissions - Voltage, AC Power, (110 VAC, 60 Hz)

FREQ. (MHz)	Corrected Amplitude (dBuV) QP	Limit (dBuV) QP	Results QP	Margin (dB) QP	Corrected Amplitude (dBuV) AVG	Limit (dBuV) AVG	Results AVG	Margin (dB) AVG
0.165	60.43	79	PASS	-18.57	33.27	66	PASS	-32.73
3.89	31.16	73	PASS	-41.84	19.2	60	PASS	-40.8
29.236	44.64	73	PASS	-28.36	42.48	60	PASS	-17.52

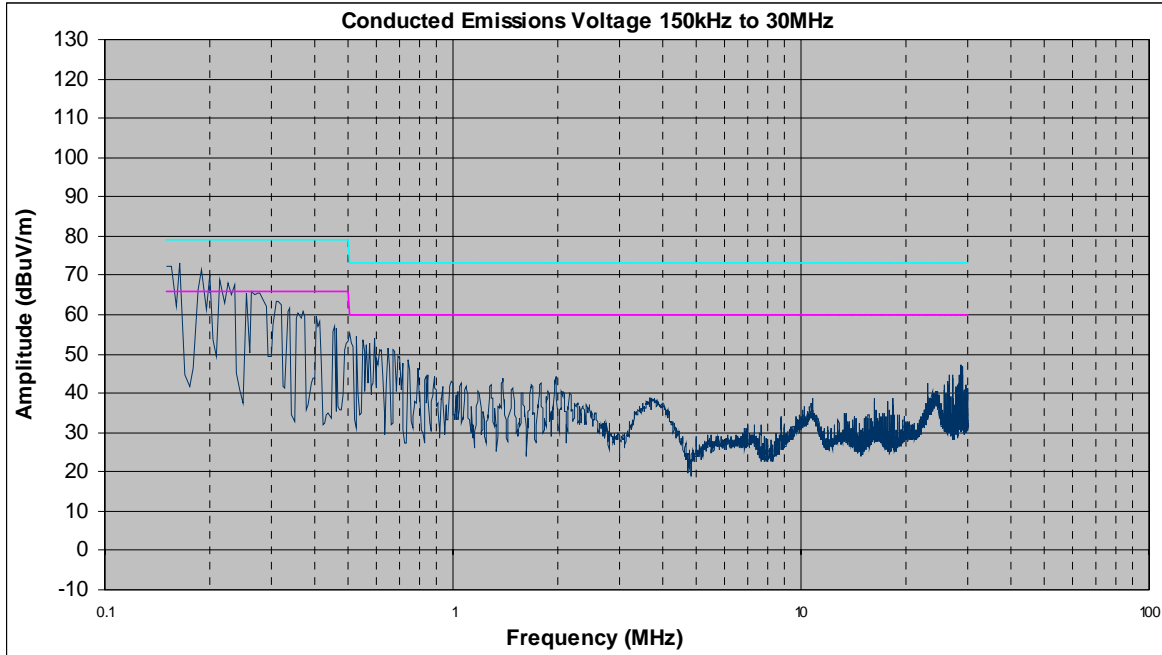
Table 15. Conducted Emissions Test Results, Phase Line

FREQ. (MHz)	Corrected Amplitude (dBuV) QP	Limit (dBuV) QP	Results QP	Margin (dB) QP	Corrected Amplitude (dBuV) AVG	Limit (dBuV) AVG	Results AVG	Margin (dB) AVG
0.221	57.81	79	PASS	-21.19	30.02	66	PASS	-35.98
3.734	28.73	73	PASS	-44.27	16.54	60	PASS	-43.46
29.236	43.31	73	PASS	-29.69	41.08	60	PASS	-18.92

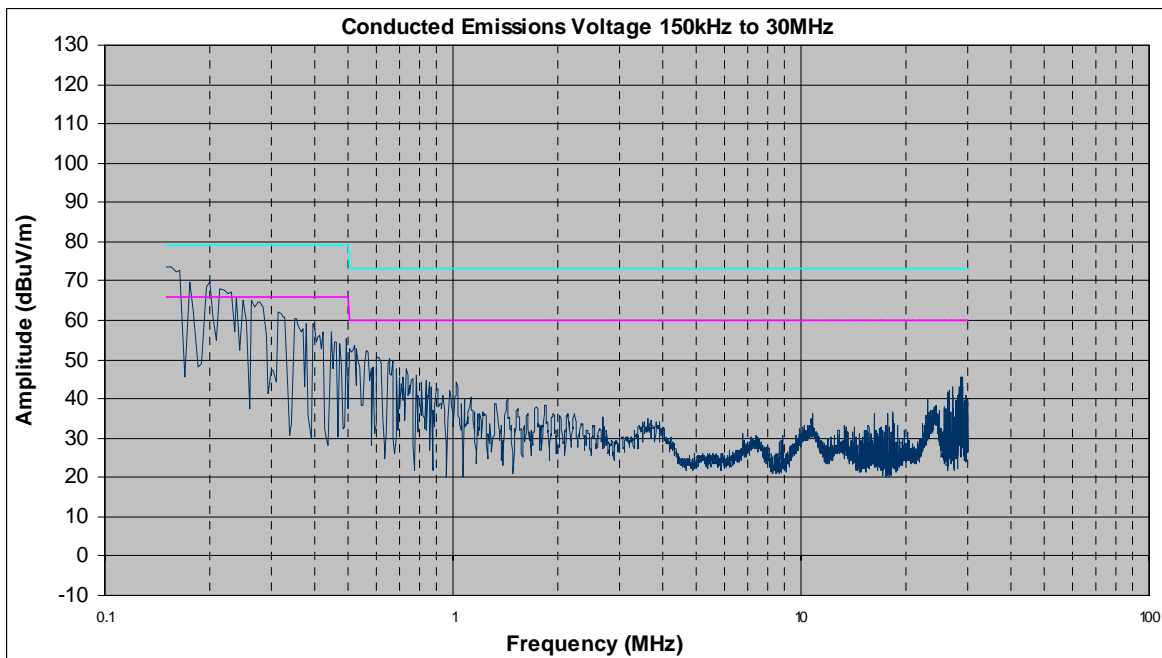
Table 16. Conducted Emissions Test Results, Neutral Line



Conducted Emissions - Voltage, AC Power, (110 VAC, 60 Hz)



Plot 1. Conducted Emissions, Phase Line Plot



Plot 2. Conducted Emissions, Neutral Line Plot

Conducted Emissions – Test Setup Photo



Photograph 4. Conducted Emissions Test Setup



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15. 403(c) 26dB Bandwidth

Test Requirements: § 15.403 (c): Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

Test Procedure: The transmitter was set to the mid channel 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. The measurements were repeated at the low and high channels.

Test Results Equipment complies with § 15.407 (c). The 26 dB Bandwidth was determined from the plots on the following pages.

802.11a mode UNII-2 Lower Band			
Carrier Channel	Frequency (MHz)	Measured 99% Bandwidth (MHz)	Measured 26 dB Bandwidth (MHz)
Low	5260	16.5267	21.730
High	5320	16.5542	21.587

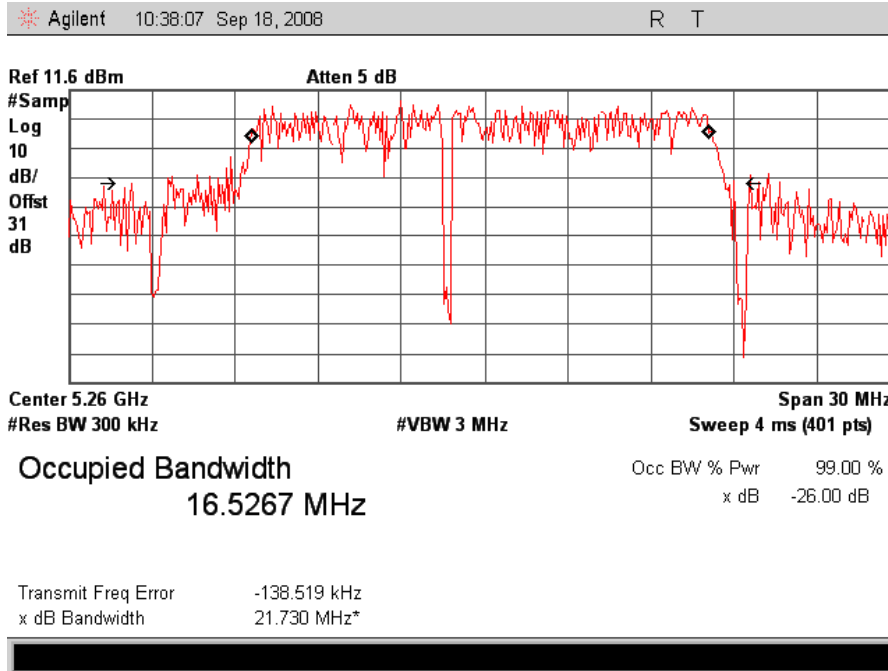
802.11a mode UNII-2 Upper Band			
Carrier Channel	Frequency (MHz)	Measured 99% Bandwidth (MHz)	Measured 26 dB Bandwidth (MHz)
Low	5500	16.5604	22.807
Mid	5600	16.4818	22.351
High	5700	16.5098	20.659

Test Engineer(s): Anderson Soungpanya

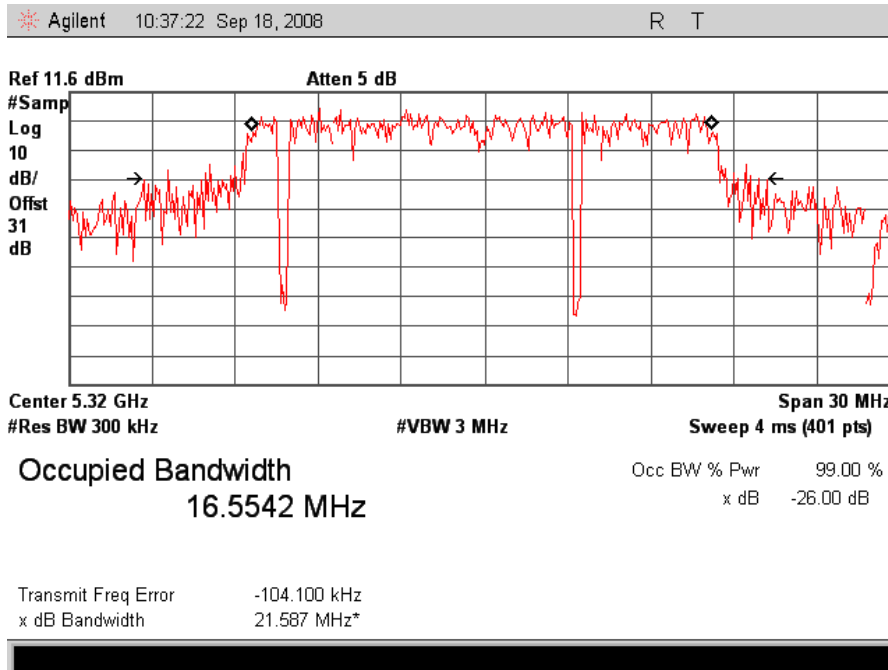
Test Date(s): September 18, 2008



Electromagnetic Compatibility Criteria for Intentional Radiators Occupied Bandwidth Results



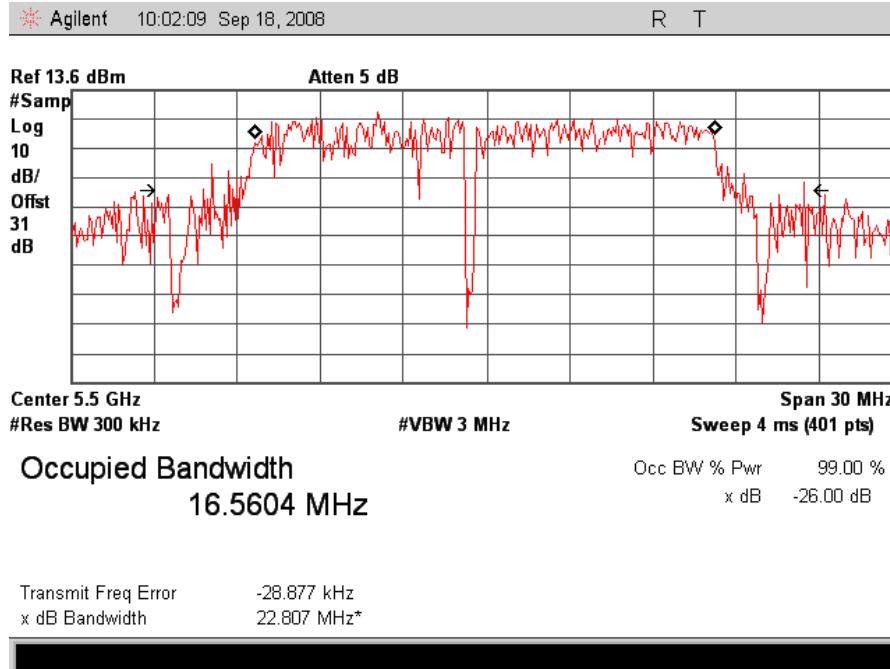
Plot 3. 802.11/a 5260MHz Occupied Band Width



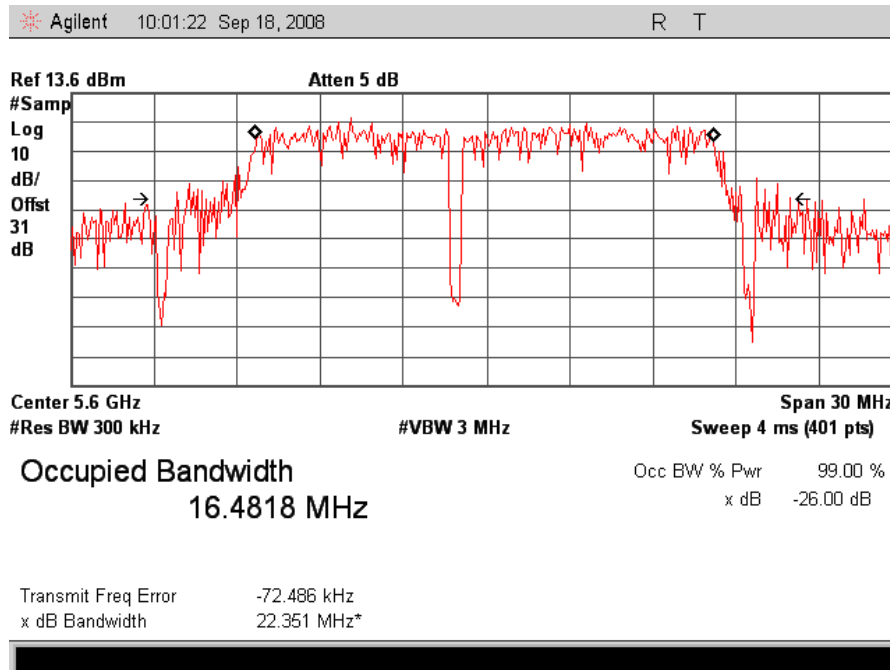
Plot 4. 802.11/a 5320MHz Occupied Band Width



Occupied Bandwidth Results



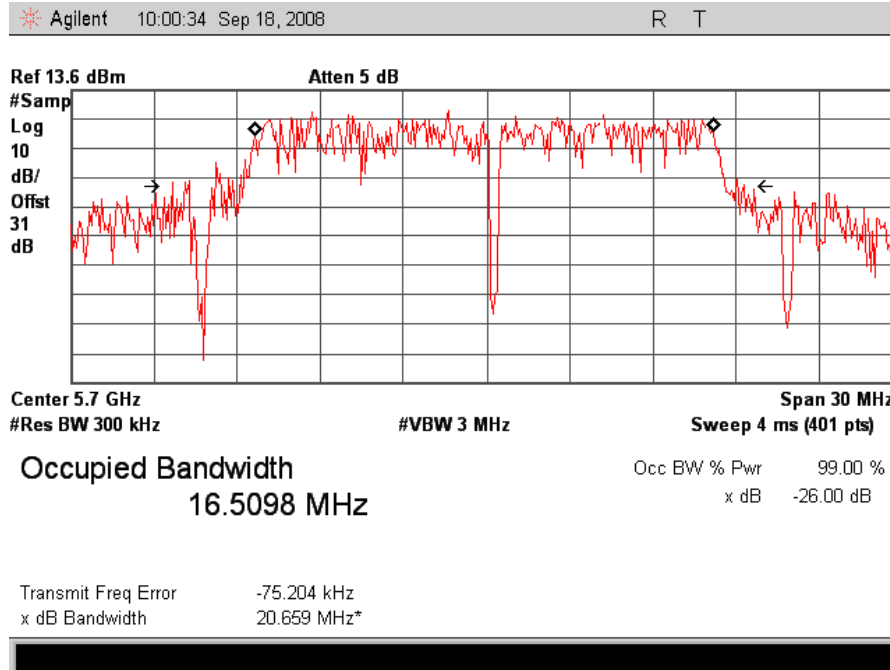
Plot 5. 802.11/a 5500MHz Occupied Band Width



Plot 6. 802.11/a 5600MHz Occupied Band Width



Occupied Bandwidth Results



Plot 7. 802.11/a 5700MHz Occupied Band Width



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15. 407(a) (1), (2) RF Power Output

Test Requirements: §15.407(a) (1), (2): The maximum output power of the intentional radiator shall not exceed the following:

Digital Transmission Systems (MHz)	Output Limit (mW)
5150-5250	50
5250-5350	250
5470-5725	250

Table 17. Output Power Requirements from §15.407

§15.407(a) (1): For the band 5.15-5.25 GHz the peak transmit power over the frequency band of operation shall not exceed the lesser 50mW or $4\text{dBm} + 10\log B$, where B is the 26-dB emission bandwidth in MHz.

§15.407(a) (2): For the band 5.25-5.35GHz & 5.470 – 5.725GHz the peak transmit power over the frequency band of operation shall not exceed the lesser of 250mW or $11\text{dBm} + 10\log B$, where B is the 26-dB emission bandwidth in MHz.

Test Procedure: The transmitter was connected to a calibrated Spectrum Analyzer. The EUT was measured at the low, mid and high channels of each band at all available data rates.

Test Results: Equipment complies with the Peak Power Output limits of § 15.401(a) (1) and § 15.401(a) (2).

802.11a mode UNII-2 Lower Band		
Carrier Channel	Frequency (MHz)	Measured Output Power dBm
Low	5260	17.16
High	5320	16.54

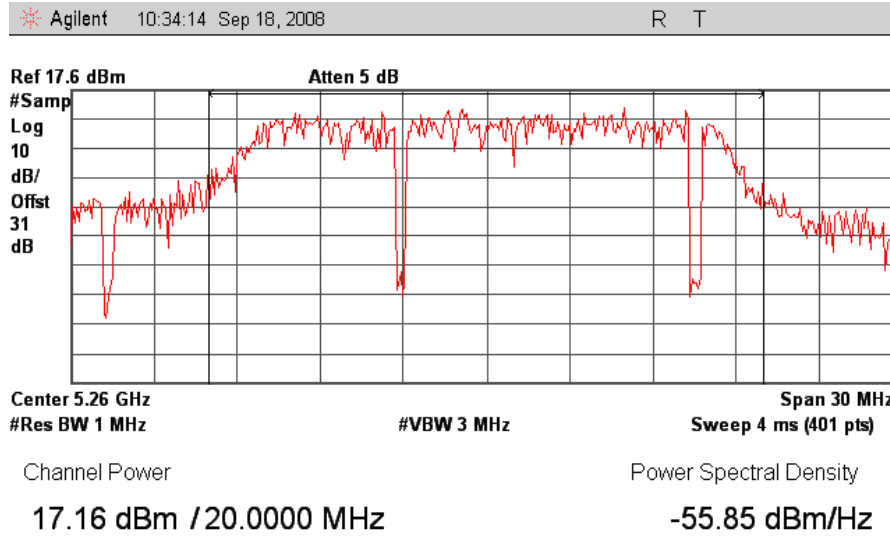
802.11a mode UNII-2 Upper Band		
Carrier Channel	Frequency (MHz)	Measured Output Power dBm
Low	5500	13.87
Mid	5600	12.72
High	5700	13.82

Test Engineer(s): Anderson Soungpanya

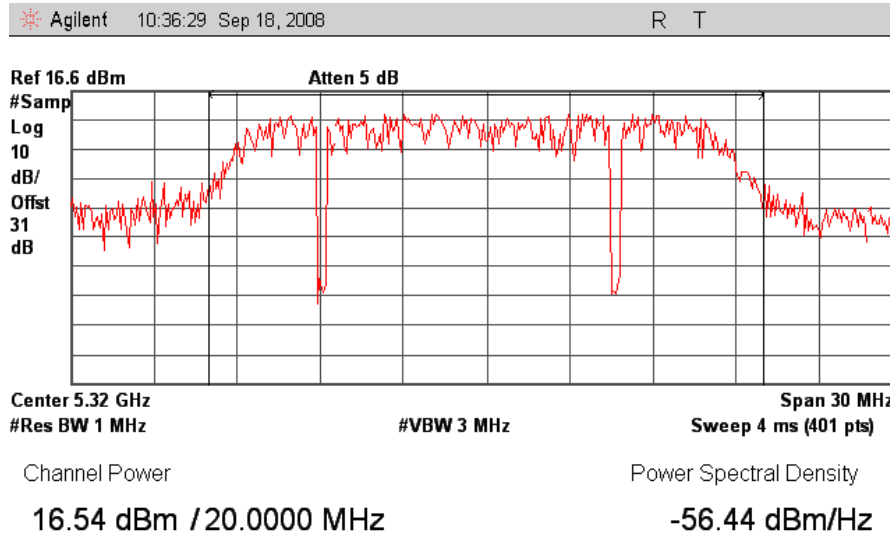
Test Date(s): September 18, 2008



RF Output Power Results



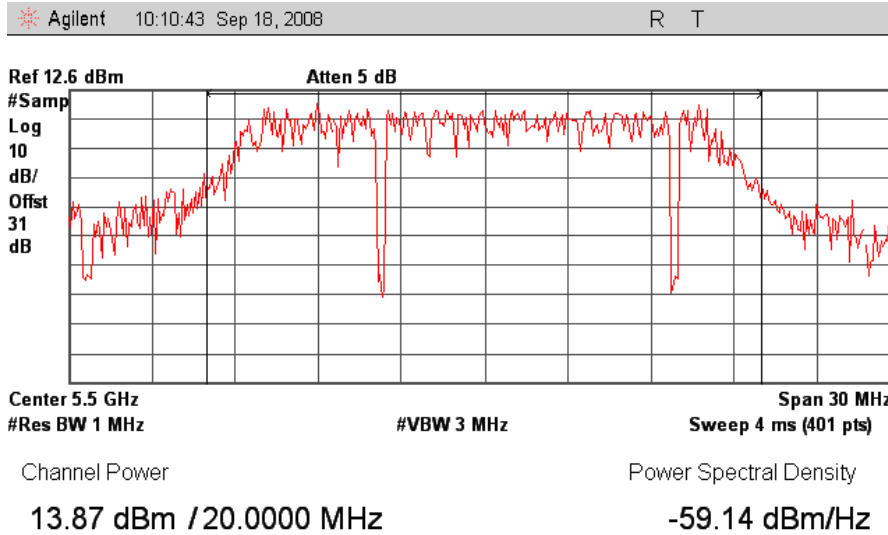
Plot 8. RF Output Power, 5260MHz



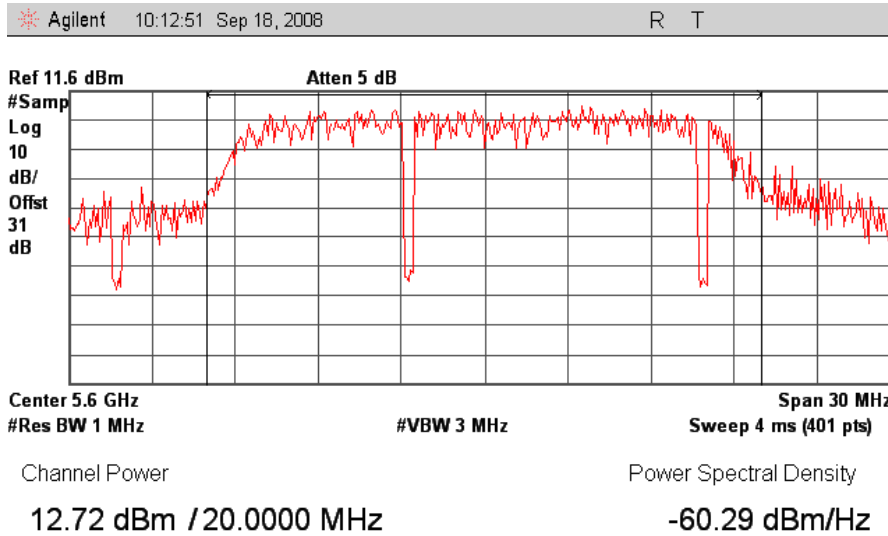
Plot 9. RF Output Power, 5320MHz



RF Output Power Results



Plot 10. RF Output Power, 5500MHz

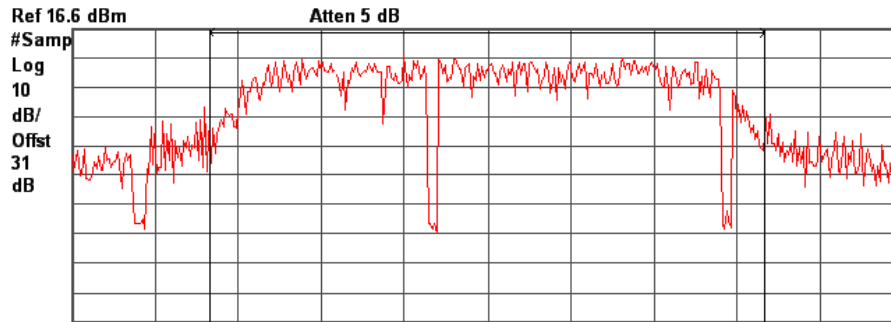


Plot 11. RF Output Power, 5600MHz



RF Output Power Results

Agilent 10:14:53 Sep 18, 2008 R T



Center 5.7 GHz Span 30 MHz
#Res BW 1 MHz #VBW 3 MHz Sweep 4 ms (401 pts)

Channel Power

13.82 dBm / 20.0000 MHz

Power Spectral Density

-59.19 dBm/Hz



Plot 12. RF Output Power, 5700MHz



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(a)(1), (a)(2) Peak Power Spectral Density

Test Requirements: § 15.407(a)(1), (a)(2): For digitally modulated systems, the conducted peak power spectral density from the intentional radiator to the antenna shall not be greater than 4dBm/MHz in the frequency band 5.15-5.25 GHz and 11dBm/MHz in the frequency band 5.25-5.35GHz and 5.47 – 5.725 GHz

Test Procedure: The transmitter was connected directly to a Spectrum Analyzer through a directional coupler. The power was monitored at the coupler port with a Power Meter capable of measuring peak and average RF power. 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 #2 from the FCC Public Notice CA 02-2138 was used.

Test Results: Equipment complies with the peak power spectral density limits of § 15.407(a)(1), (a)(2). The peak power spectral density was determined from plots on the following page(s).

The PPSD limit in the 5250-5350 MHz band is reduced to 7dBm based on a 10dBi antenna gain.

The PPSD limit in the 5470-5725MHz band is reduced to 3dBm based on a 14dBi antenna again.

802.11a UNII-2 Lower Band				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5260	5.738	7	1.262
High	5320	4.956	7	2.044

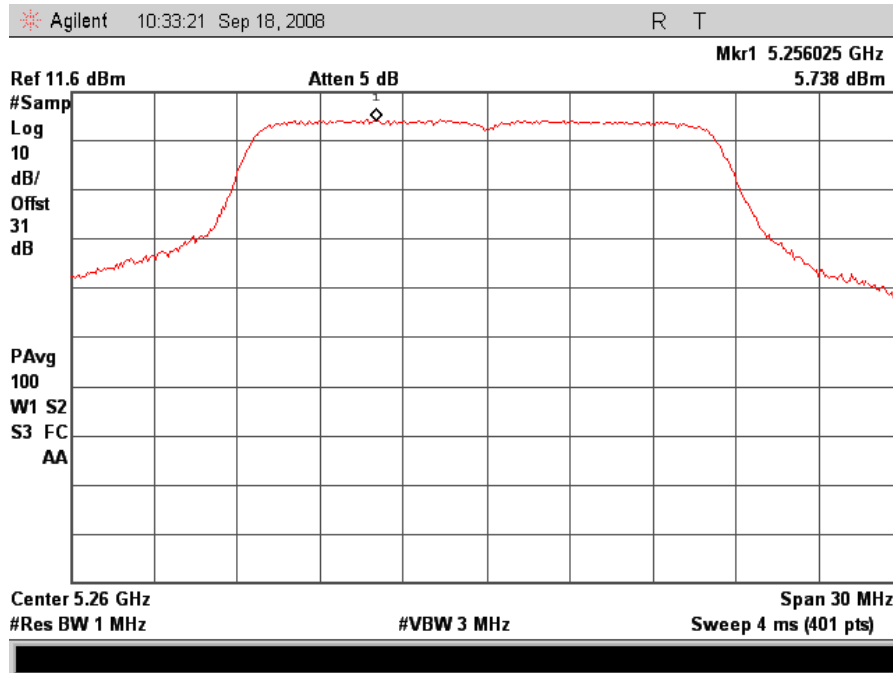
802.11a UNII-2 Upper Band				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5500	2.242	3	0.758
Mid	5600	1.937	3	1.063
High	5700	2.766	3	0.234

Test Engineer(s): Anderson Soungpanya

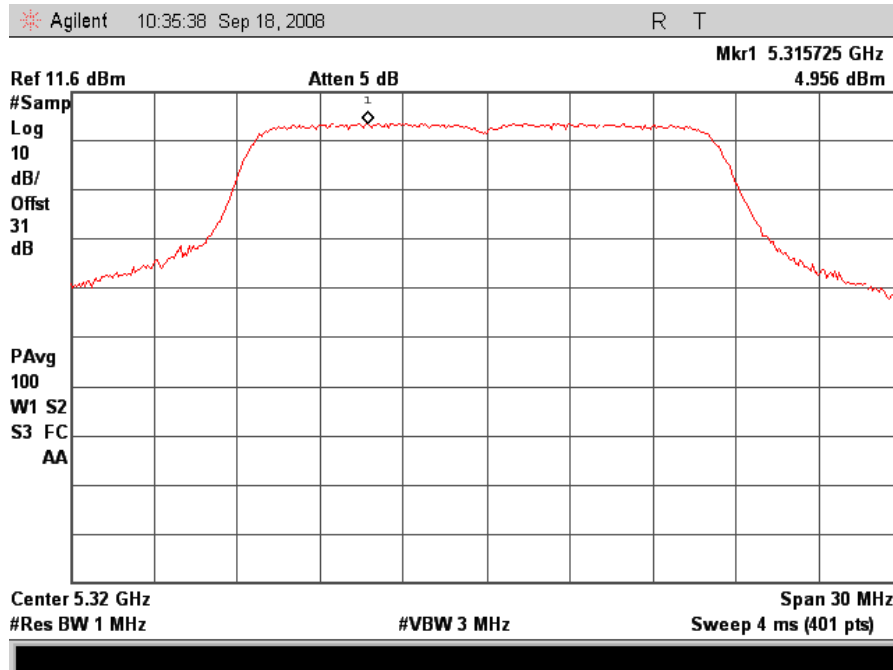
Test Date(s): September 18, 2008



Electromagnetic Compatibility Criteria for Intentional Radiators Peak Power Spectral Density Results



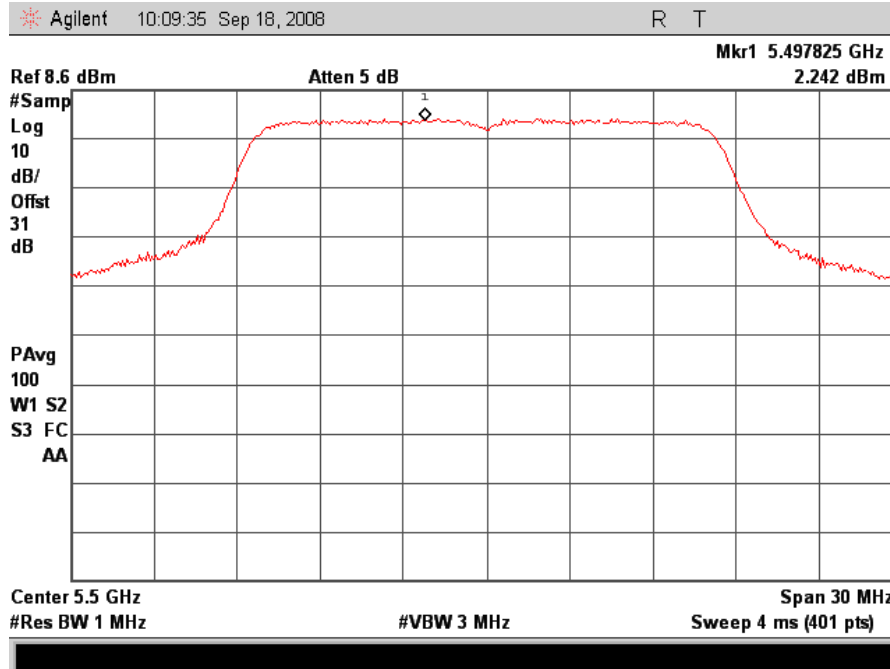
Plot 13. 802.11/a- 5260MHz Peak Power Spectral Density



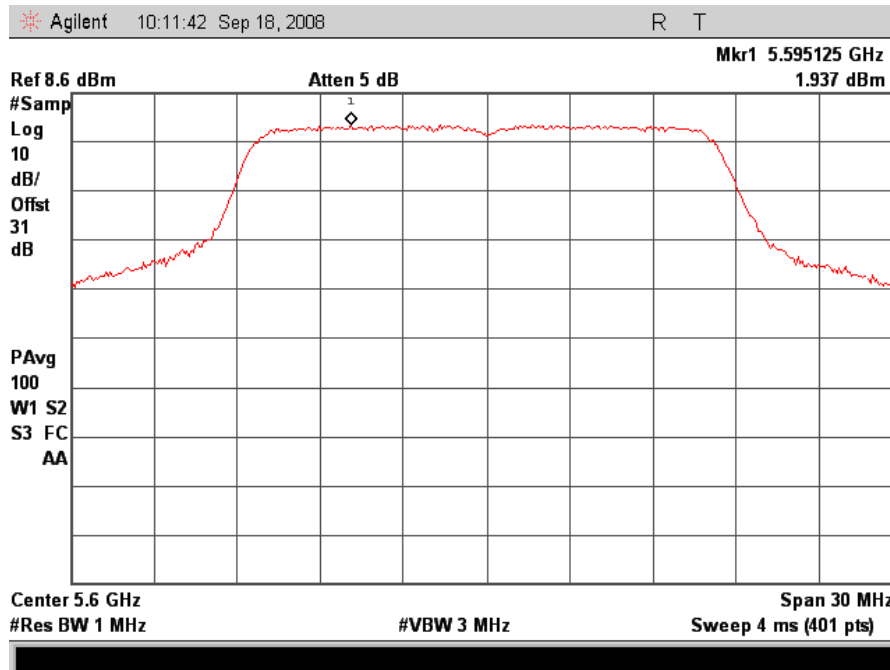
Plot 14. 802.11/a - 5320MHz Peak Power Spectral Density



Peak Power Spectral Density Results



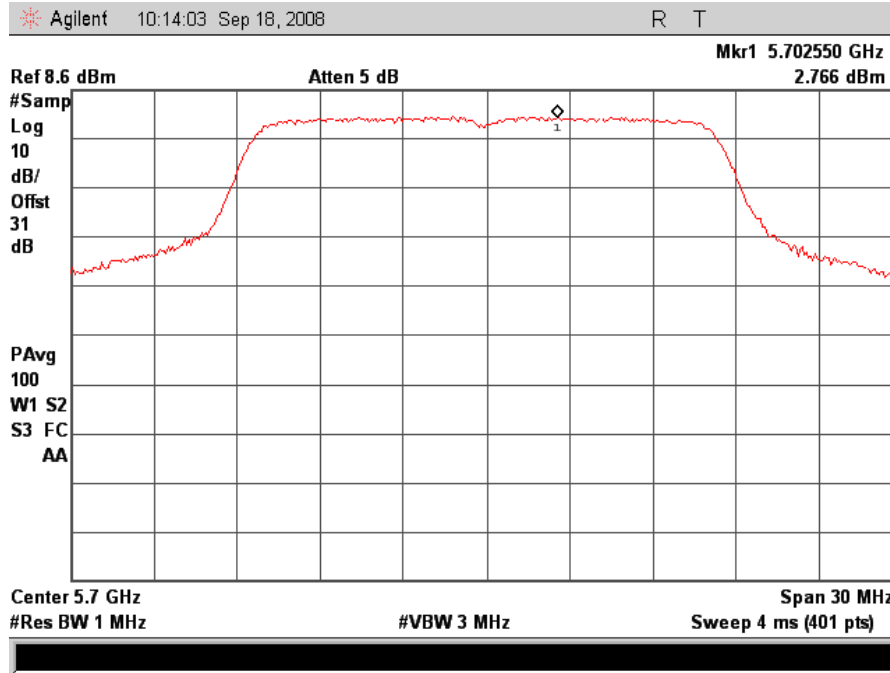
Plot 15. 802.11/a – 5500MHz Peak Power Spectral Density



Plot 16. 802.11/a – 5600MHz Peak Power Spectral Density



Peak Power Spectral Density Results



Plot 17. 802.11/a – 5700MHz Peak Power Spectral Density



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(a)(6) Peak Excursion Ratio

Test Requirements: § 15.407(a)(6): For digitally modulated systems, the peak excursion of the modulation envelope to the peak transmit power shall not exceed 13dB across any 1MHz bandwidth of the emission bandwidth whichever is less.

Test Procedure: The method of measurement #2 from the FCC Public Notice CA 02-2138 was used. 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. The peak detector mode was used and the trace max held. The 2nd trace on the spectrum analyzer was set to a RBW=1MHz, VBW=30 KHz. The detector mode was set to sample detector.

The Peak Excursion Ratio was determined from the difference between the maximum found in each trace.

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

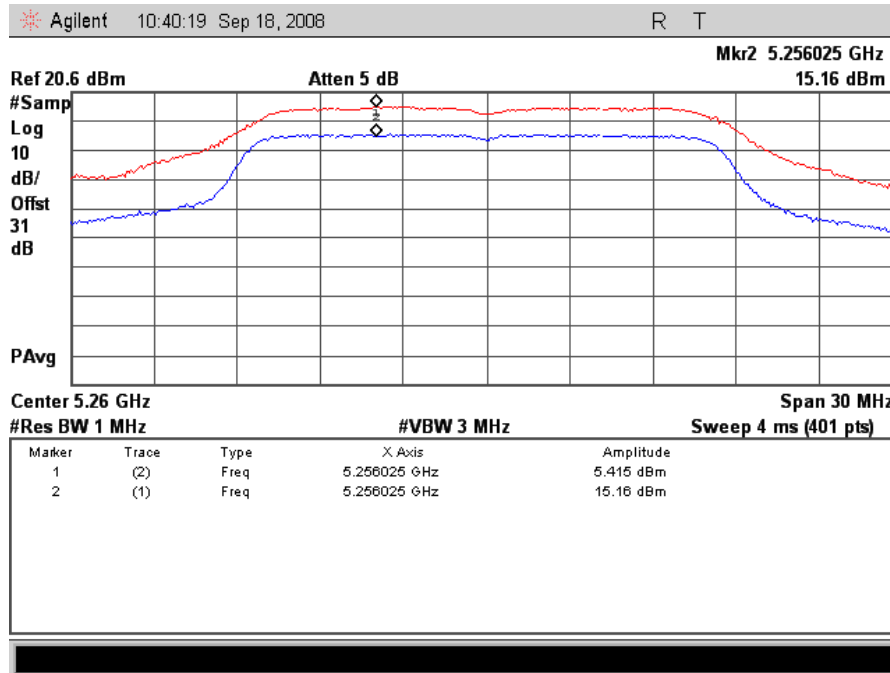
802.11a UNII-2 Lower Band				
Carrier Channel	Frequency (MHz)	Excursion Ratio (dBm)	Limit (dBm)	Margin (dB)
Low	5260	9.745	13	3.255
High	5320	9.59	13	3.41

802.11a UNII-2 Upper Band				
Carrier Channel	Frequency (MHz)	Excursion Ratio (dBm)	Limit (dBm)	Margin (dB)
Low	5500	8.428	13	4.572
Mid	5600	8.705	13	4.295
High	5700	9.357	13	3.643

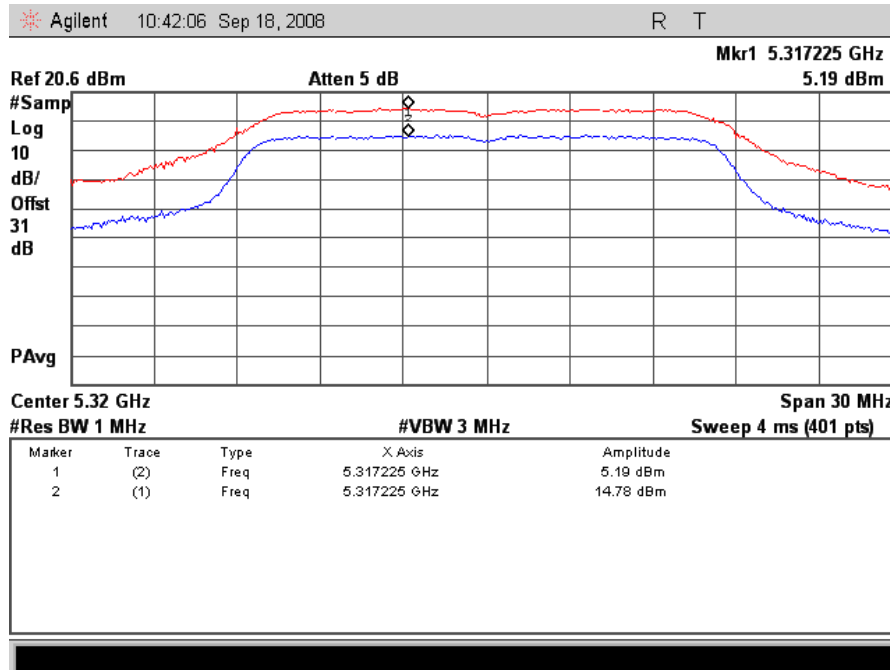
Test Engineer(s): Anderson Soungpanya

Test Date(s): September 18, 2008

Electromagnetic Compatibility Criteria for Intentional Radiators Peak Excursion Results



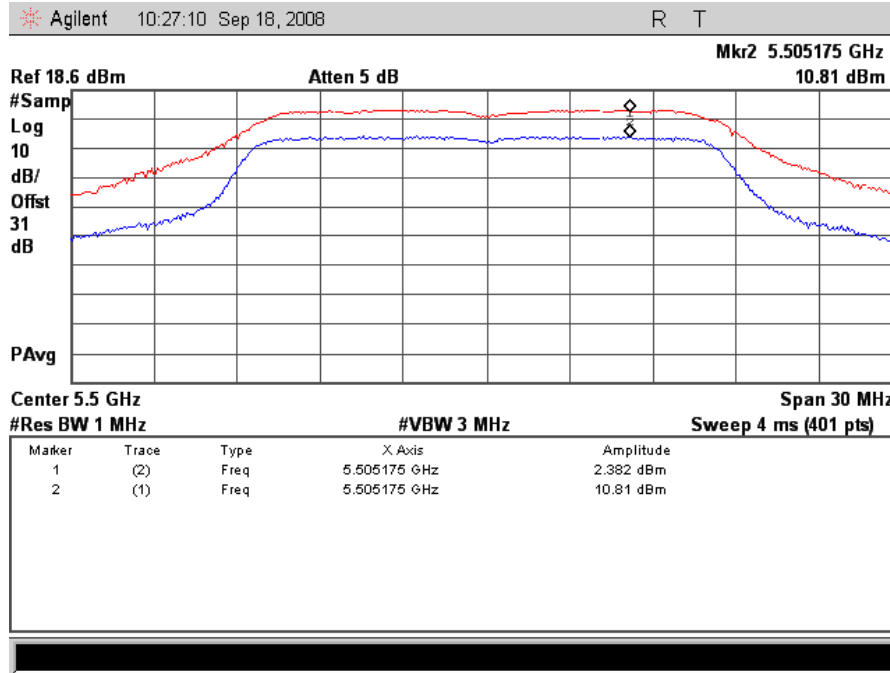
Plot 18. Peak Excursion Ratio for 5260MHz



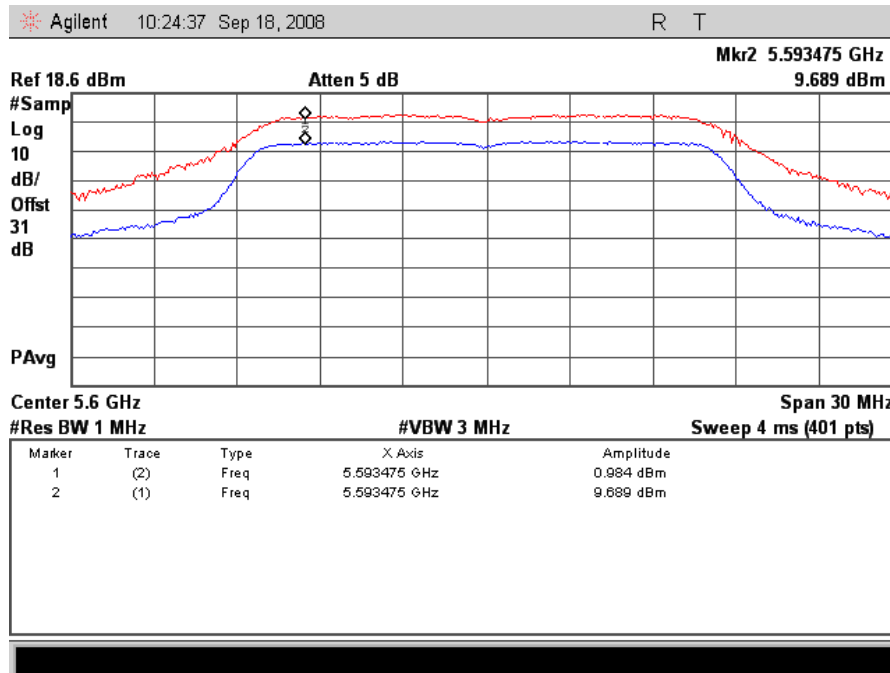
Plot 19. Peak Excursion Ratio for 5320MHz



Peak Excursion Results



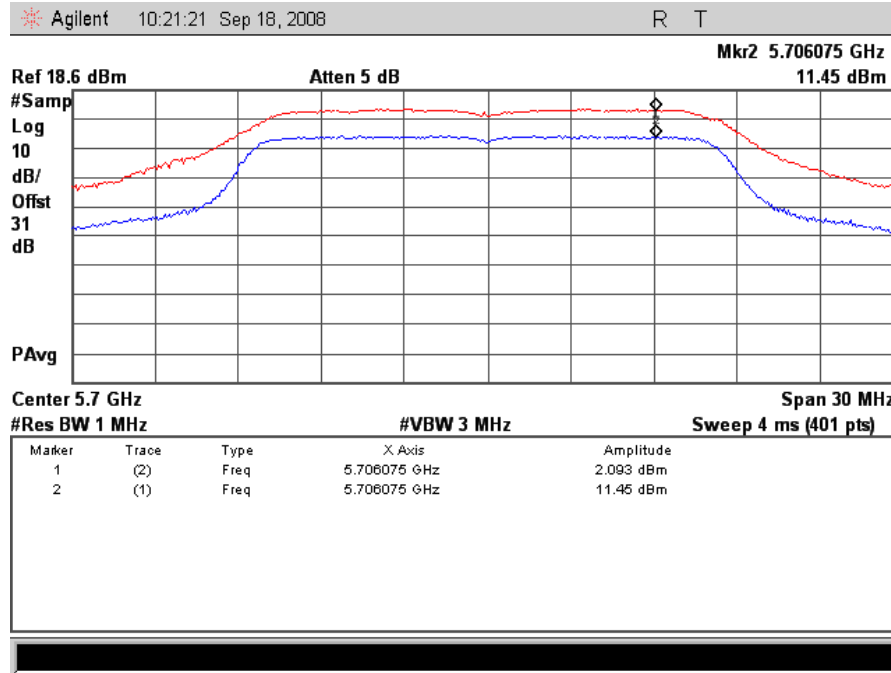
Plot 20. Peak Excursion Ratio for 5500MHz



Plot 21. Peak Excursion Ratio for 5600MHz



Peak Excursion Results



Plot 22. Peak Excursion Ratio for 5700MHz



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(b)(1),(2), (5), (6) Undesirable Emissions

Test Requirements: § 15.407(b)(1),(2), (5), (6); §15.205, §15.209(a): Emissions outside the frequency band.

§ 15.407(b)(1): In any 1MHz bandwidth outside the frequency band 5.15-5.25GHz in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power shall not exceed -27dBm.

§ 15.407(b)(2): In any 1MHz bandwidth outside the frequency band 5.25-5.35GHz in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power shall not exceed -27dBm.

§ 15.407(b)(6): Radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

§15.205(a): Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090–0.110-----	16.42–16.423	399.9–410	4.5–5.15
¹ 0.495–0.505-----	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905-----	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128-----	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775-----	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775-----	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218-----	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825-----	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225-----	123–138	2200–2300	14.47–14.5
8.291–8.294-----	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366-----	156.52475– 156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675-----	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475-----	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293-----	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025-----	240–285	3345.8–3358 36.	43–36.5
12.57675–12.57725-----	322–335.4	3600–4400	(²)

Table 18. Restricted Bands of Operation



Test Procedure: The EUT was installed placed on a 0.8m-high wooden table inside a semi-anechoic chamber. The harmonic frequencies the carriers were recorded for reference for final measurements. A receiving horn antenna was placed 3m away from the EUT. Unless otherwise specified, measurements were made using a with a 1MHz RBW & 1MHz VBW for peak measurements and 1MHz RBW & 10Hz VBW for average measurements on a spectrum analyzer.

For each harmonic of the carrier frequency, the turntable was rotated, the positions of the interface cables were varied, and the antenna height was varied between 1 m and 4 m, in order to find the maximum radiated emissions.

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

Test Engineer(s): Anderson Sounghanya

Test Date(s): September 18, 2008



Electromagnetic Compatibility Criteria for Intentional Radiators

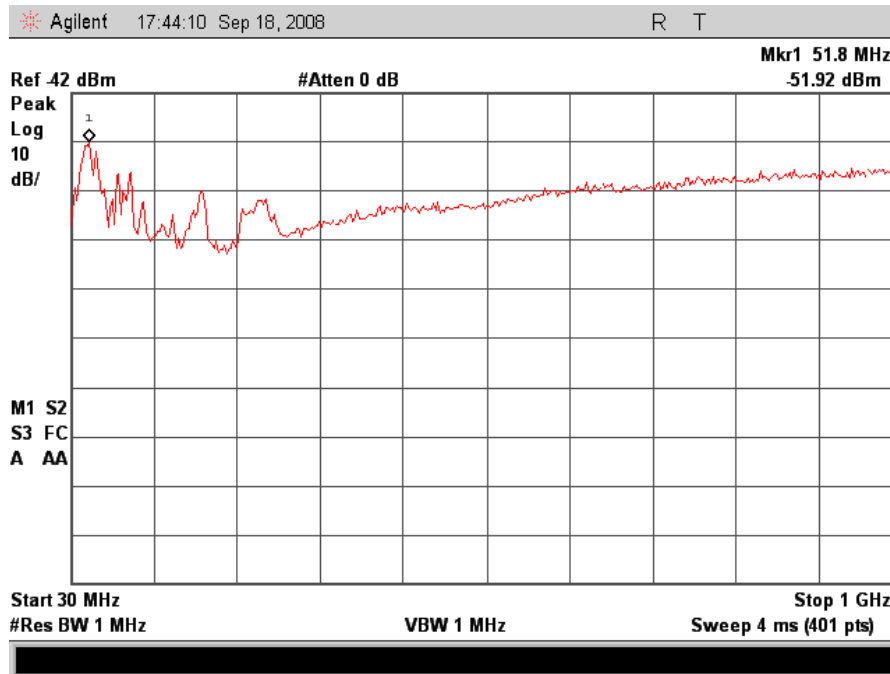
§ 15.407(b)(1): Harmonic Emissions Requirements – Radiated (802.11a)

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3 m (Peak) / (Avg)	P.Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Limit Detector Peak / Avg (Peak) / (Avg)	Limit @ 3 m (dBuV/m)	Delta (dB)
10.52	V	44.64	35.19	38.73	11.23	59.42	Peak	74	-14.58
10.52	V	32.01	35.19	38.73	11.23	46.79	Avg	54	-7.21
15.78	V	45.31	34.97	38.08	13.99	62.42	Peak	74	-11.58
15.78	V	33.55	34.97	38.08	13.99	50.66	Avg	54	-3.34
5260MHz									
Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3 m (Peak) / (Avg)	P.Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Limit Detector Peak / Avg (Peak) / (Avg)	Limit @ 3 m (dBuV/m)	Delta (dB)
10.64	V	45.04	35.03	38.99	11.12	60.12	Peak	74	-13.88
10.64	V	32.44	35.03	38.99	11.12	47.52	Avg	54	-6.48
15.96	V	44.65	35.09	38.64	13.97	62.17	Peak	74	-11.83
15.96	V	34.76	35.09	38.64	13.97	52.28	Avg	54	-1.72
5320MHz									

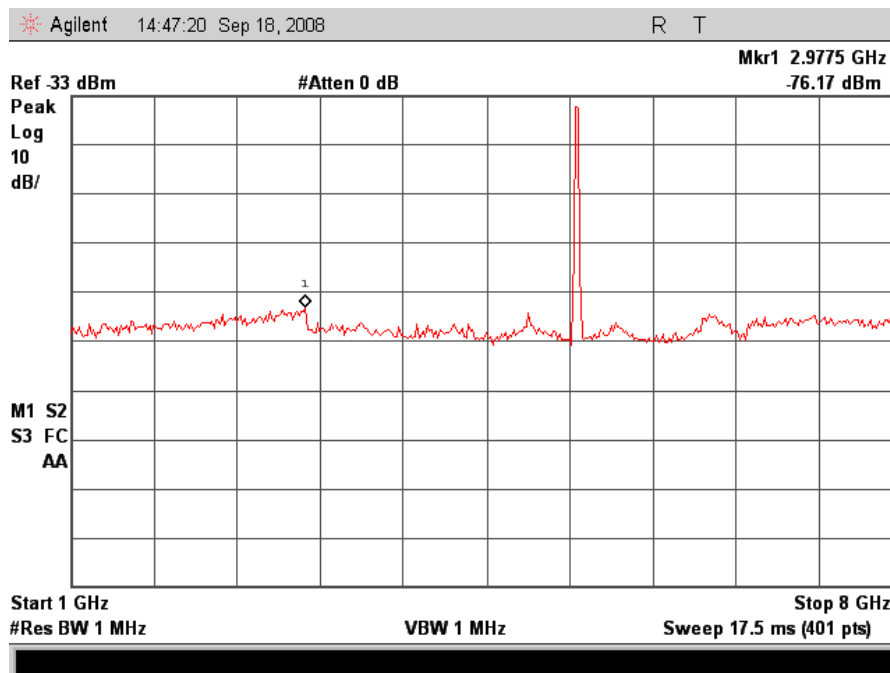
Note: All other emissions were measured at the noise floor of the spectrum analyzer



Electromagnetic Compatibility Criteria for Intentional Radiators § 15.407(b)(1): Harmonic Emissions Requirements



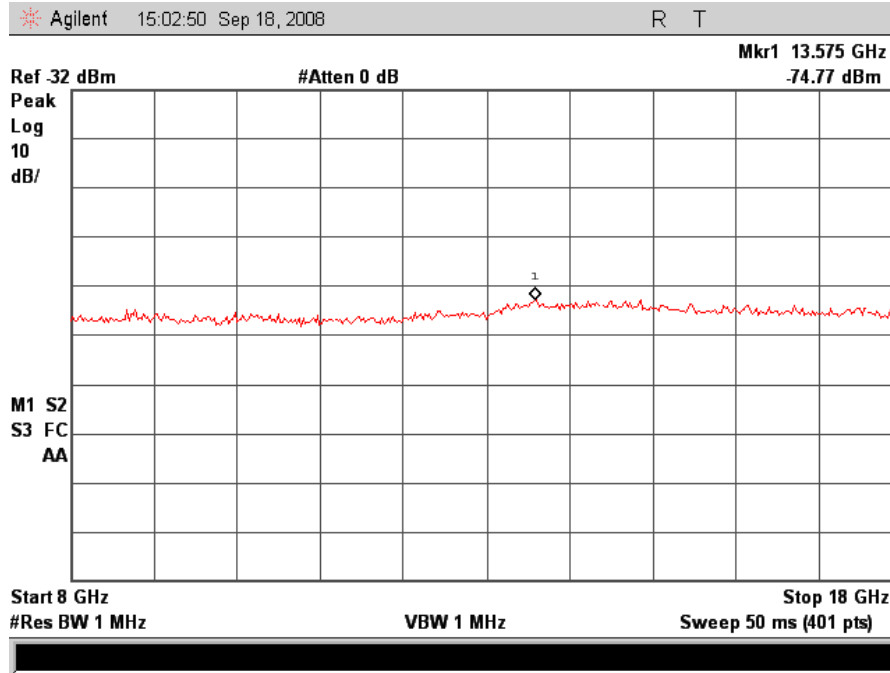
Plot 23. Radiated Spurious Emissions, 30MHz – 1GHz, 5260MHz



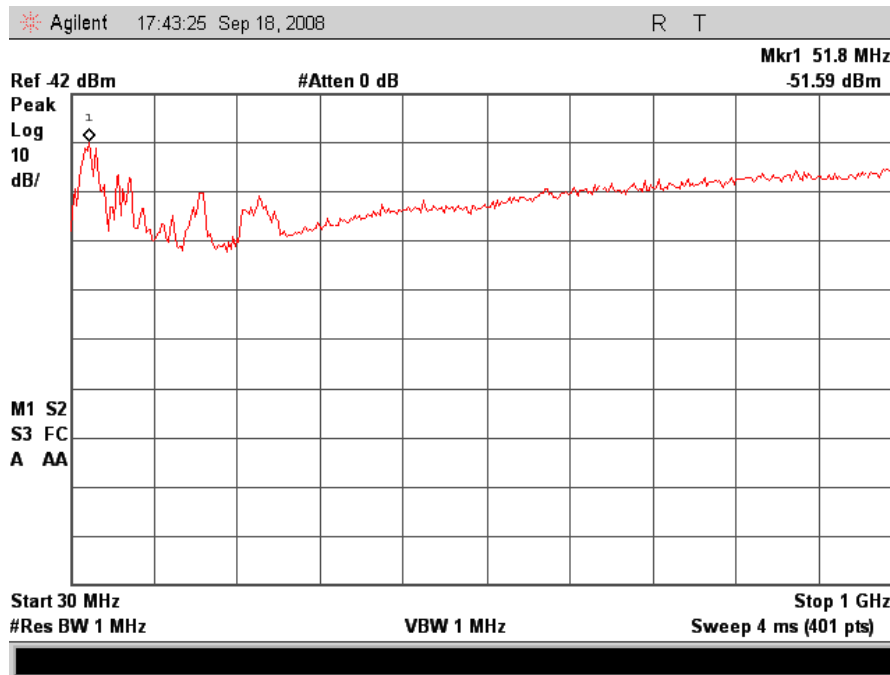
Plot 24. Radiated Spurious Emissions, 1GHz – 8GHz, 5260MHz



§ 15.407(b)(1): Harmonic Emissions Requirements



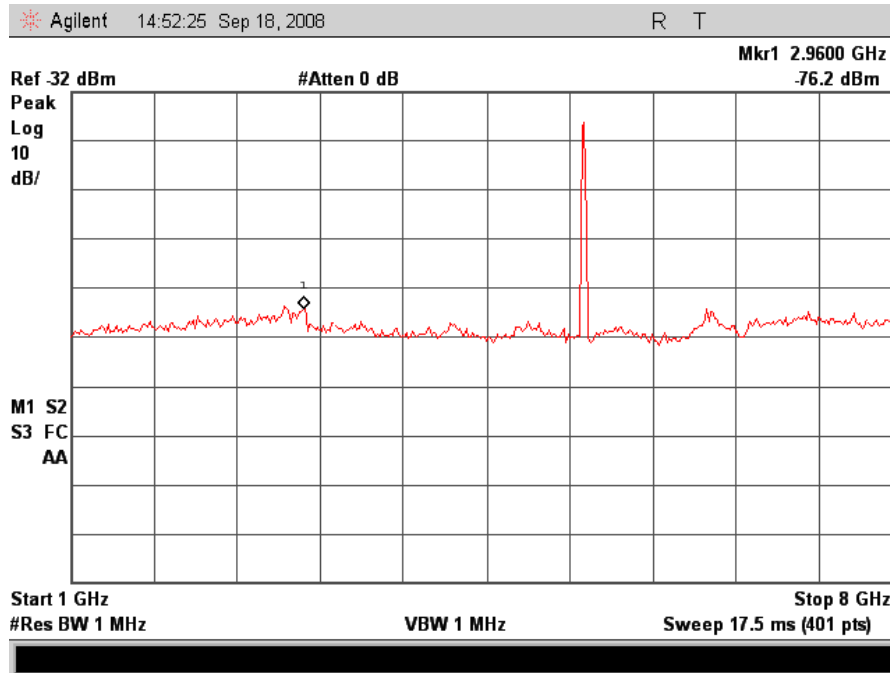
Plot 25. Radiated Spurious Emissions, 8GHz – 18GHz, 5260MHz



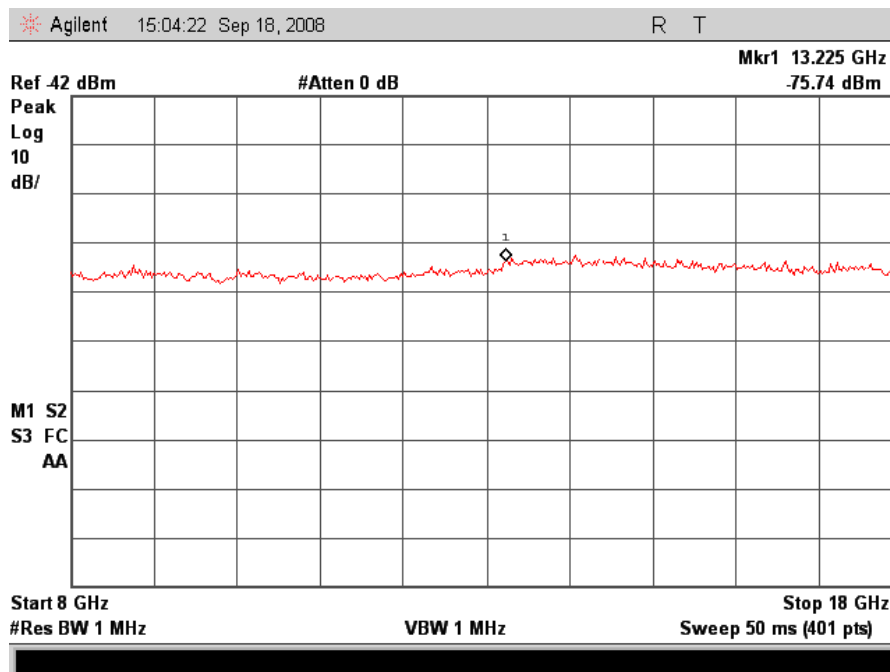
Plot 26. Radiated Spurious Emissions, 30MHz – 1GHz, 5320MHz



§ 15.407(b)(1): Harmonic Emissions Requirements



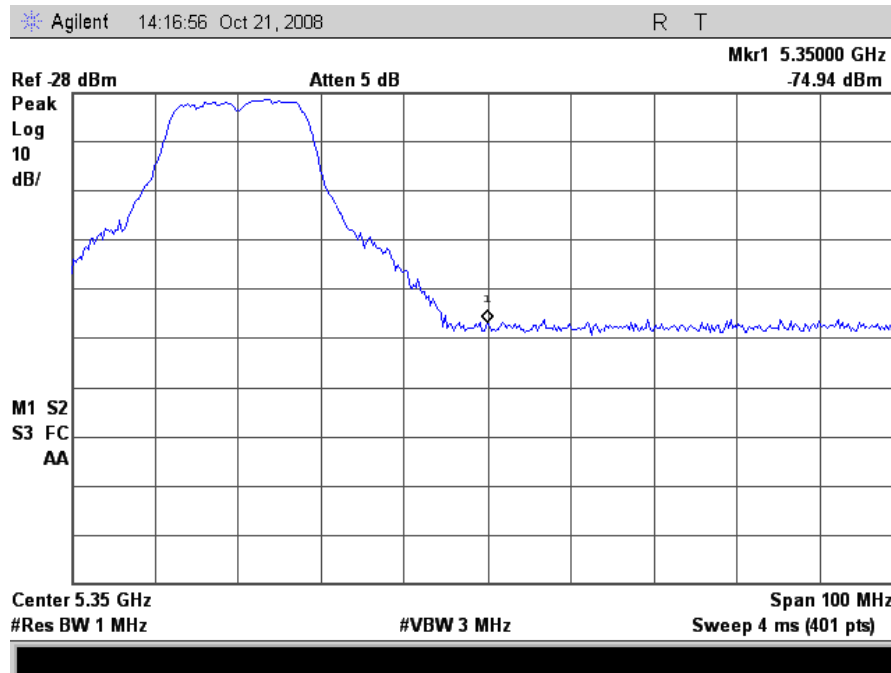
Plot 27. Radiated Spurious Emissions, 1GHz – 8GHz, 5320MHz



Plot 28. Radiated Spurious Emissions, 8GHz – 18GHz, 5320MHz



Restricted Band Results

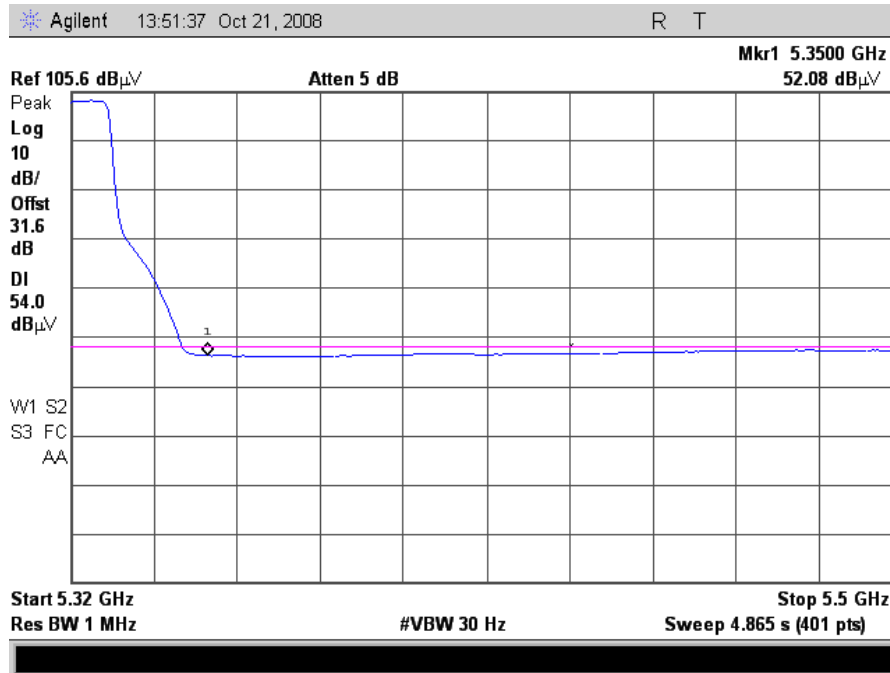


Plot 29. Restricted band 5350MHz

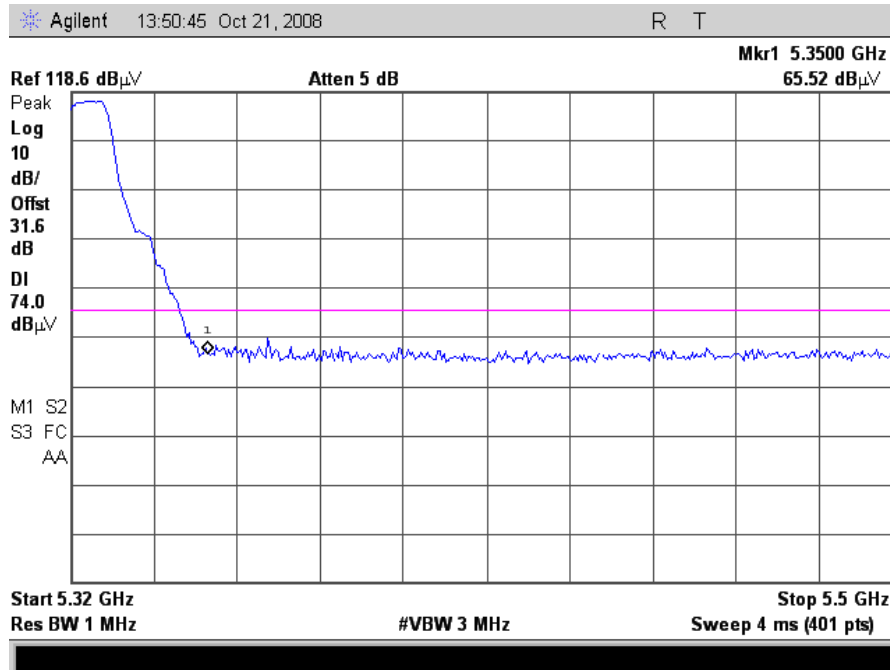
Signal Substitution				
Band Edge Frequency	Conducted Power (dBm)	Cable Lost (dB)	Antenna Gain (dBi)	EIRP (dBm)
5350	-42.9	1.03	10.8	-31.07



Electromagnetic Compatibility Criteria for Intentional Radiators Band-Edge Results



Plot 30. Band-Edge, 5350MHz Average



Plot 31. Band-Edge, 5350MHz Peak



Electromagnetic Compatibility Criteria for Intentional Radiators

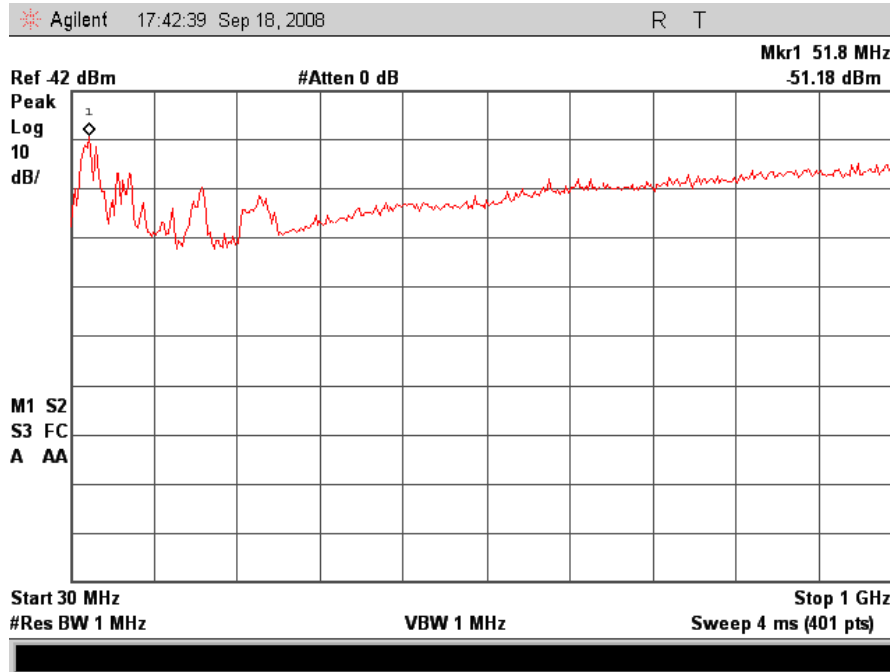
§ 15.407(b)(2): Harmonic Emissions Requirements – Radiated (802.11a)

Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3 m (Peak) / (Avg)	P.Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Limit Detector Peak / Avg (Peak) / (Avg)	Limit @ 3 m (dBuV/m)	Delta (dB)
11	V	44.18	34.81	39.80	10.90	60.07	Peak	74	-13.93
11	V	31.31	34.81	39.80	10.90	47.20	Avg	54	-6.80
16.5	V	44.85	34.60	42.00	13.90	66.15	Peak	74	-7.85
16.5	V	30.65	34.60	42.00	13.90	51.95	Avg	54	-2.05
5500MHz									
Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3 m (Peak) / (Avg)	P.Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Limit Detector Peak / Avg (Peak) / (Avg)	Limit @ 3 m (dBuV/m)	Delta (dB)
11.2	V	46.57	34.76	39.96	11.68	63.46	Peak	74	-10.54
11.2	V	34.22	34.76	39.96	11.68	51.11	Avg	54	-2.89
16.8	V	44.93	34.36	42.99	13.48	67.05	Peak	74	-6.95
16.8	V	30.29	34.36	42.99	13.48	52.41	Avg	54	-1.59
5600MHz									
Freq. (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3 m (Peak) / (Avg)	P.Amp (dB)	Ant. Cor. Factor (dB/m)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBuV/m)	Limit Detector Peak / Avg (Peak) / (Avg)	Limit @ 3 m (dBuV/m)	Delta (dB)
11.4	V	48.69	34.81	39.97	12.66	66.51	Peak	74	-7.49
11.4	V	35.31	34.81	39.97	12.66	53.13	Avg	54	-0.87
17.1	V	44.29	34.15	44.28	13.53	67.95	Peak	74	-6.05
17.1	V	30.74	34.15	44.28	13.53	54.40	Avg	54	0.40
5700MHz									

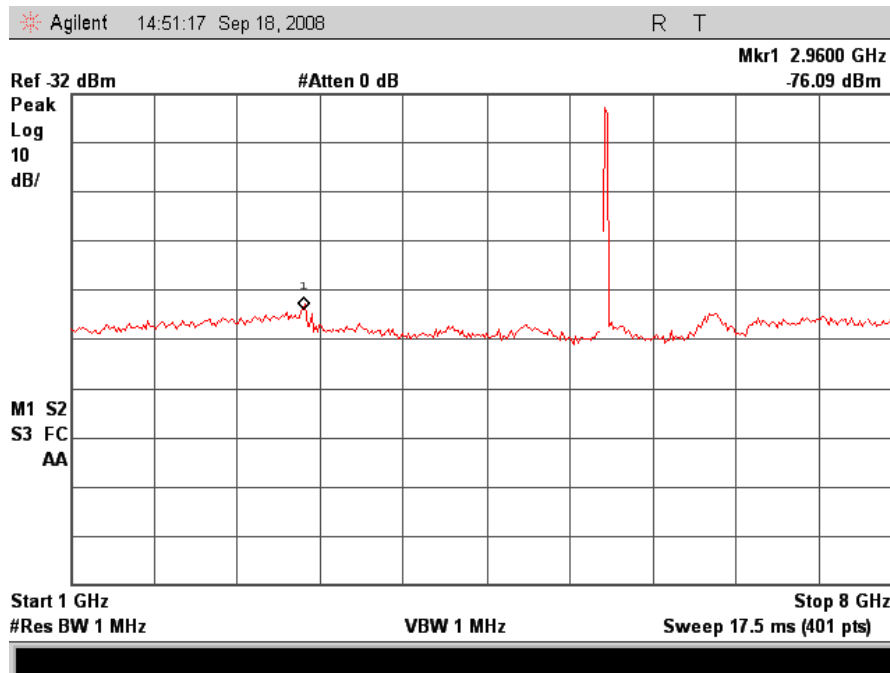
Note: All other emissions were measured at the noise floor of the spectrum analyzer



Electromagnetic Compatibility Criteria for Intentional Radiators § 15.407(b)(1): Harmonic Emissions Requirements



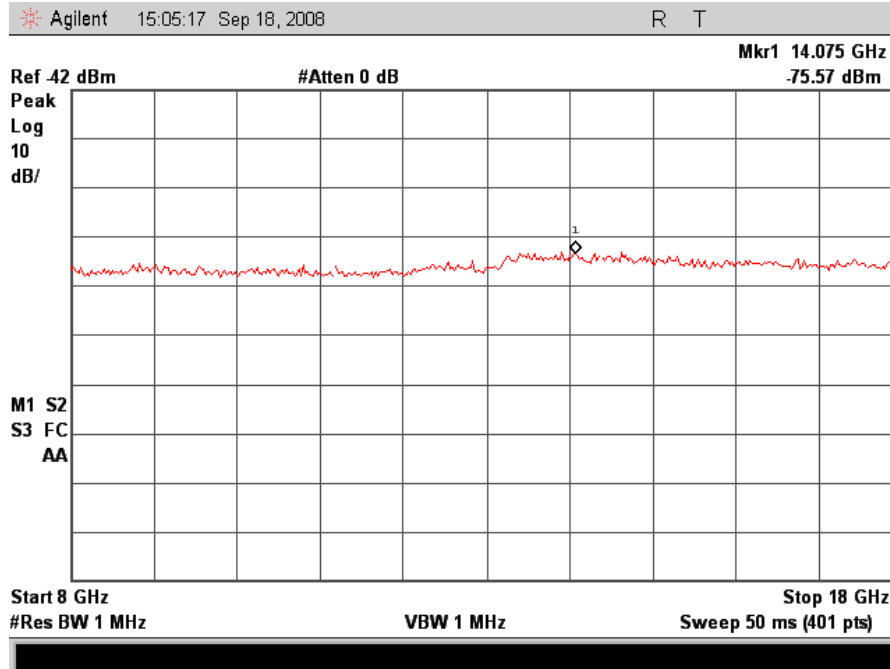
Plot 32. Radiated Spurious Emissions, 30MHz – 1GHz, 5500MHz



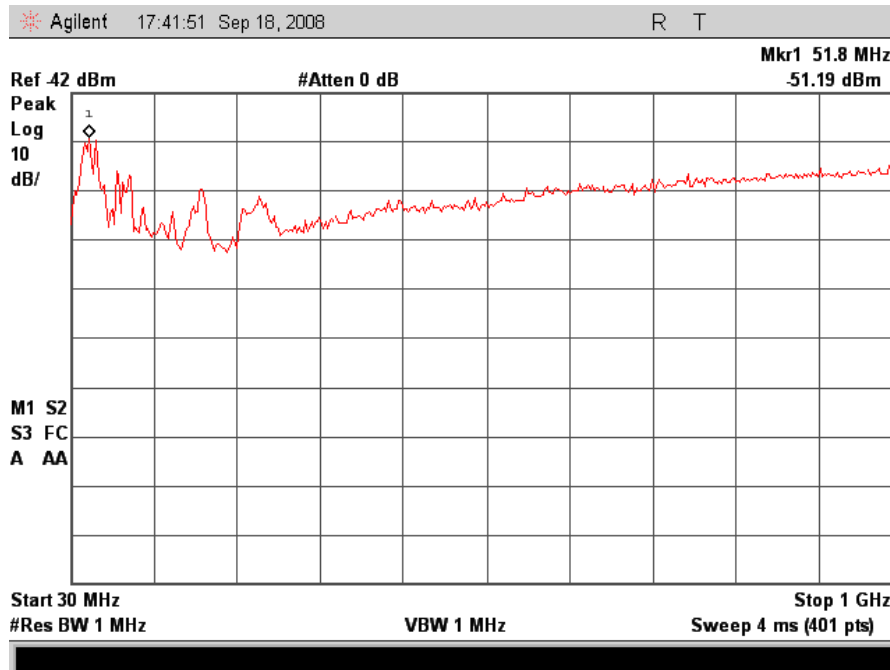
Plot 33. Radiated Spurious Emissions, 1GHz – 8GHz, 5500MHz



§ 15.407(b)(1): Harmonic Emissions Requirements



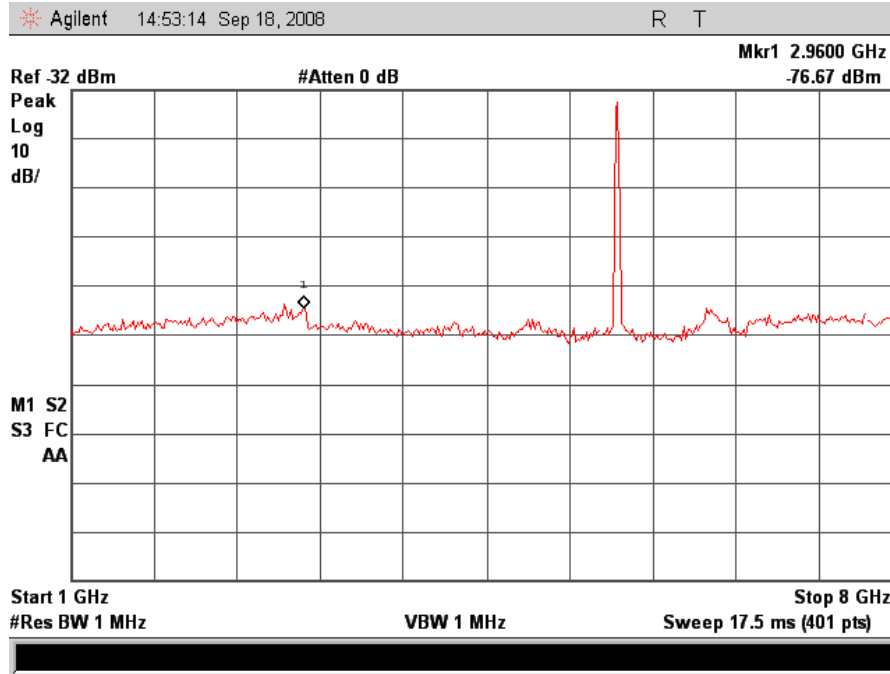
Plot 34. Radiated Spurious Emissions, 8GHz – 18GHz, 5500MHz



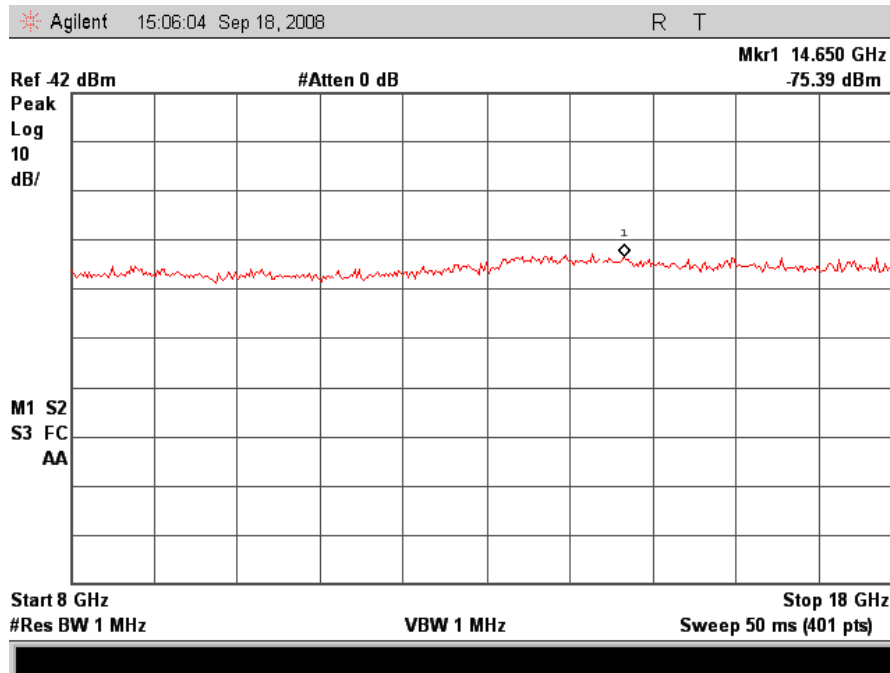
Plot 35. Radiated Spurious Emissions, 30MHz – 1GHz, 5600MHz



§ 15.407(b)(1): Harmonic Emissions Requirements



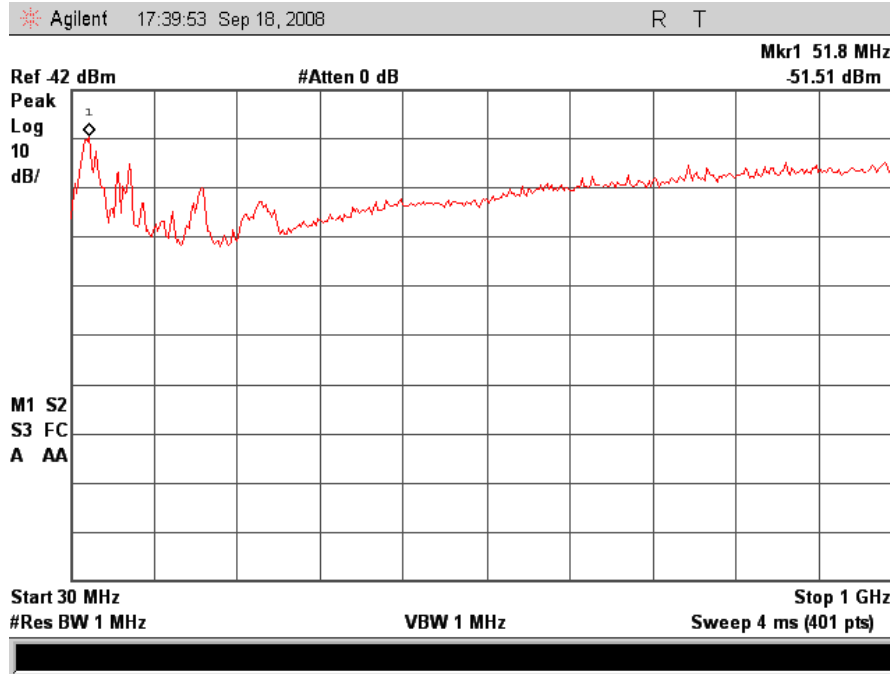
Plot 36. Radiated Spurious Emissions, 1GHz – 8GHz, 5600MHz



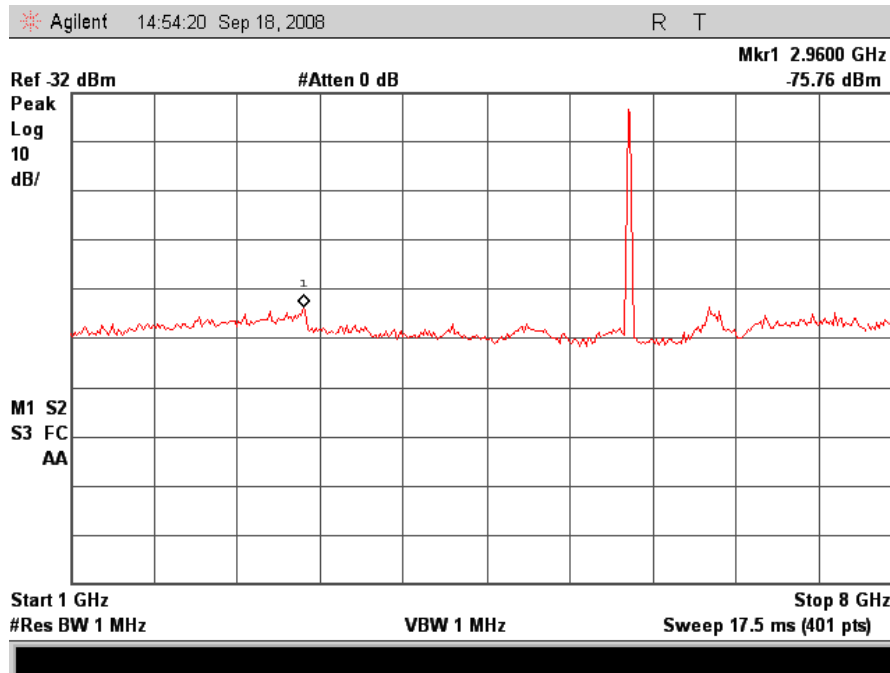
Plot 37. Radiated Spurious Emissions, 8GHz – 18GHz, 5600MHz



§ 15.407(b)(1): Harmonic Emissions Requirements



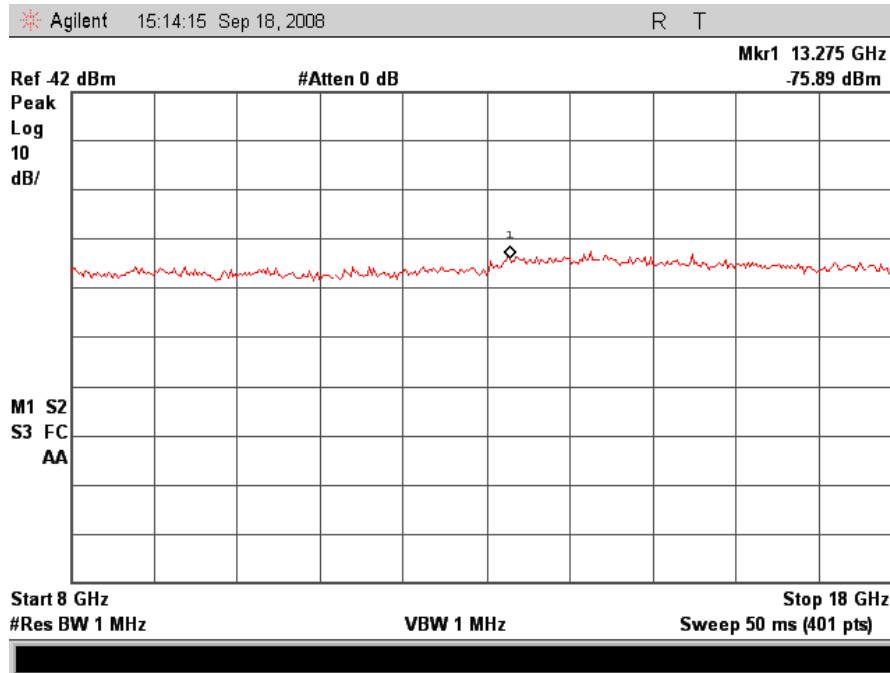
Plot 38. Radiated Spurious Emissions, 30MHz – 1GHz, 5700MHz



Plot 39. Radiated Spurious Emissions, 1GHz – 8GHz, 5700MHz



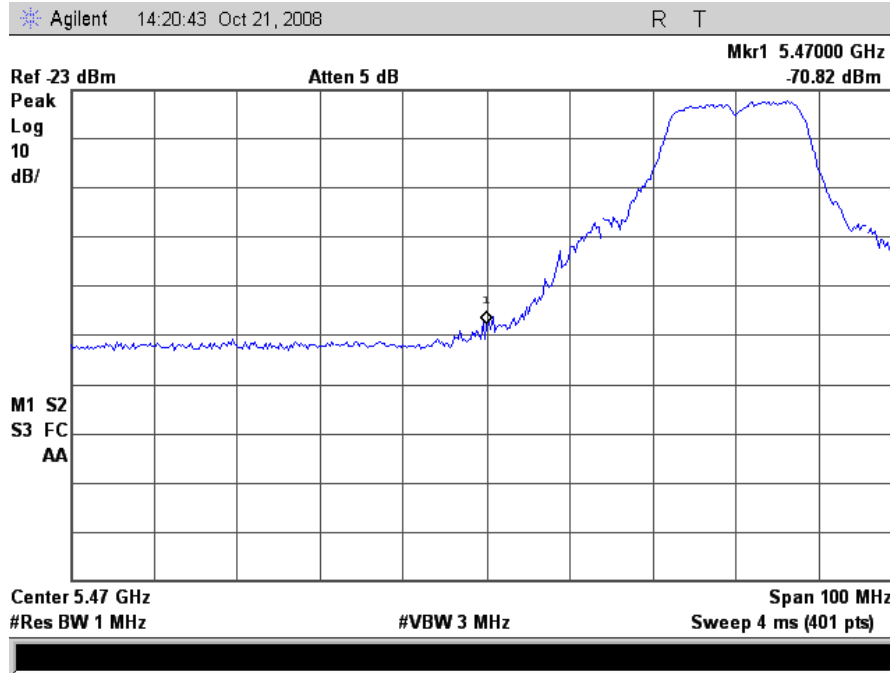
§ 15.407(b)(1): Harmonic Emissions Requirements



Plot 40. Radiated Spurious Emissions, 8GHz – 18GHz, 5700MHz



Electromagnetic Compatibility Criteria for Intentional Radiators Restricted Band Results

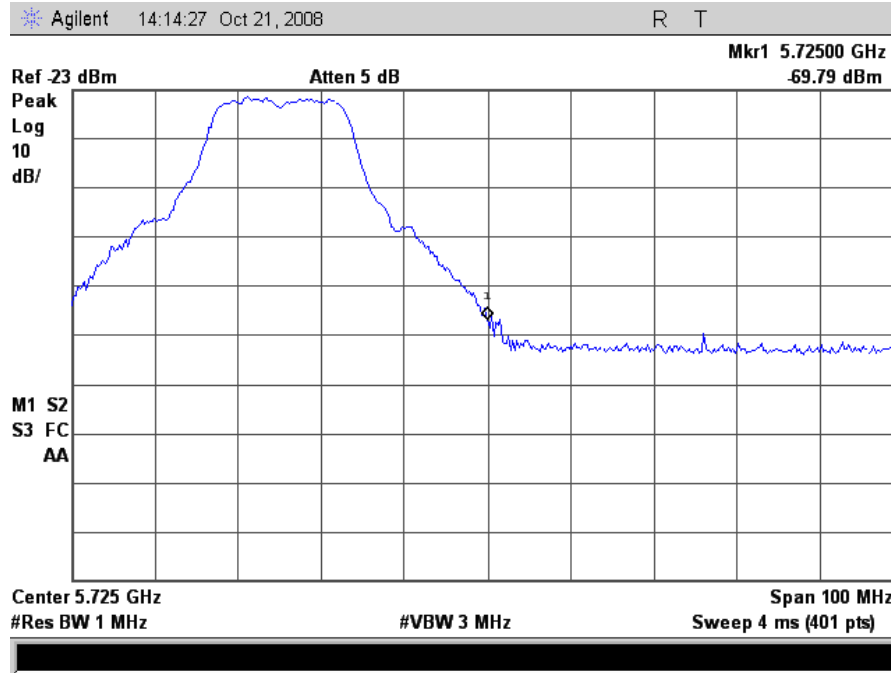


Plot 41. Restricted band 5470MHz

Signal Substitution				
Band Edge Frequency	Conducted Power (dBm)	Cable Lost (dB)	Antenna Gain (dBi)	EIRP (dBm)
5470	-41.02	1.15	10.8	-29.07



Electromagnetic Compatibility Criteria for Intentional Radiators Restricted Band Results

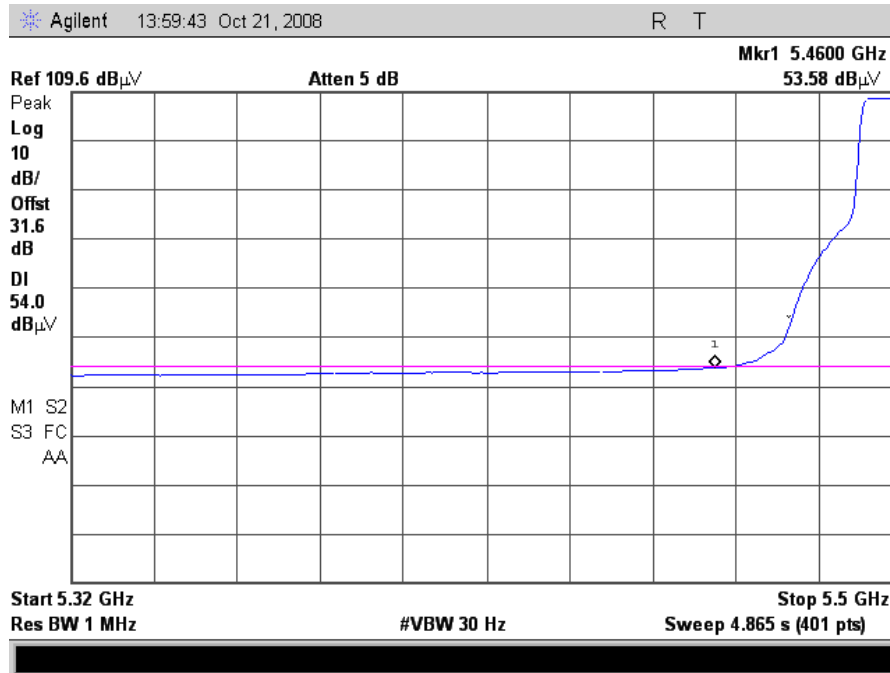


Plot 42. Restricted band 5725MHz

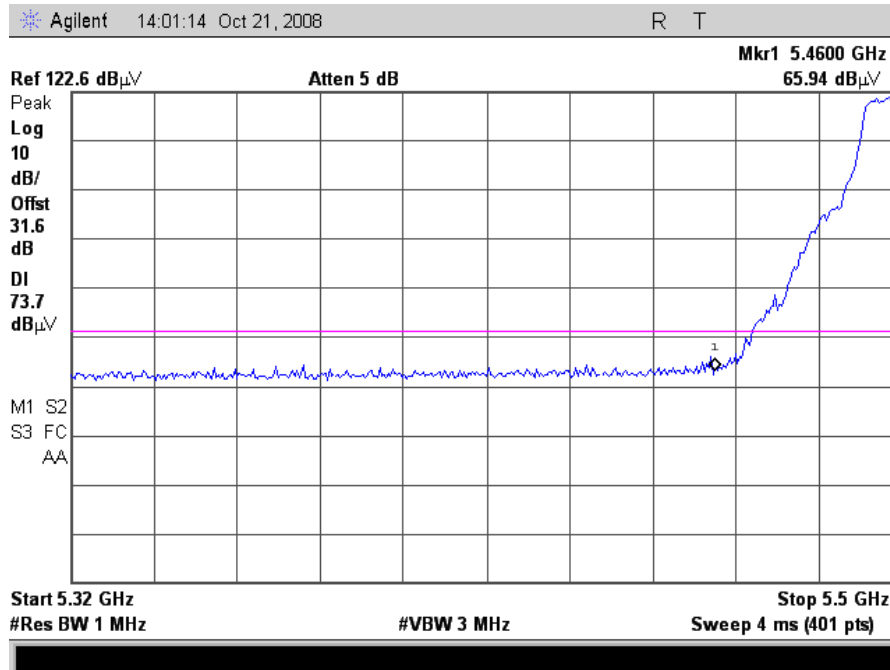
Signal Substitution				
Band Edge Frequency	Conducted Power (dBm)	Cable Lost (dB)	Antenna Gain (dBi)	EIRP (dBm)
5725	-39.33	1.19	10.8	-27.34



Electromagnetic Compatibility Criteria for Intentional Radiators Band-Edge Results



Plot 43. Band-Edge, 5500MHz Average



Plot 44. Band-Edge, 5500MHz Peak

Radiated Measurements Test Setup Photographs



Photograph 5. Test Equipment and setup for various Radiated Measurements



Electromagnetic Compatibility Criteria for Intentional Radiators

§2.1055 Frequency Stability over Temperature and Voltage Variations

Test Requirement(s): §2.1055(a)(1)

Test Procedures: As required by 47 CFR 2.1055, *Frequency Stability measurements* were made at the RF output terminals using a Directional Coupler through a Spectrum Analyzer and Power Meter.

The EUT was placed in the Environmental Chamber and support equipments are outside the chamber on a table. A CW signal was injected into the EUT at the appropriate RF level. The frequency counter option on the Spectrum Analyzer was used to measure frequency deviations. The frequency drift was investigated for every 10^C increment until the unit is stabilized then recorded the reading in tabular format with the temperature range of -30 to 50^C.

Voltage supplied to EUT is 120 VAC reference temperature was done at 20^C. The voltage was varied by ± 15 % of nominal

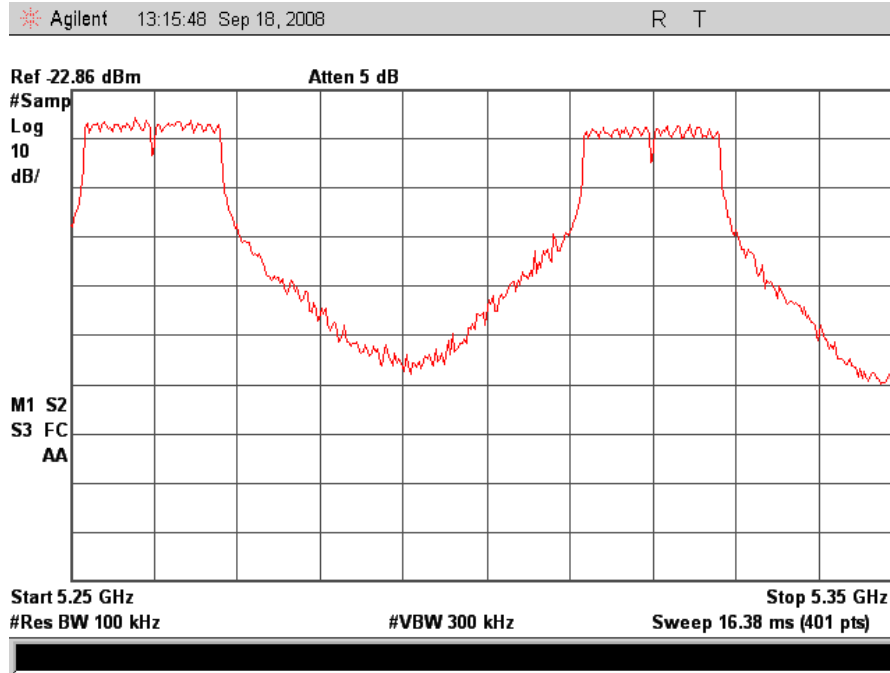
Test Results: Equipment complies with Section 2.1055

Test Engineer(s): Anderson Soungpanya

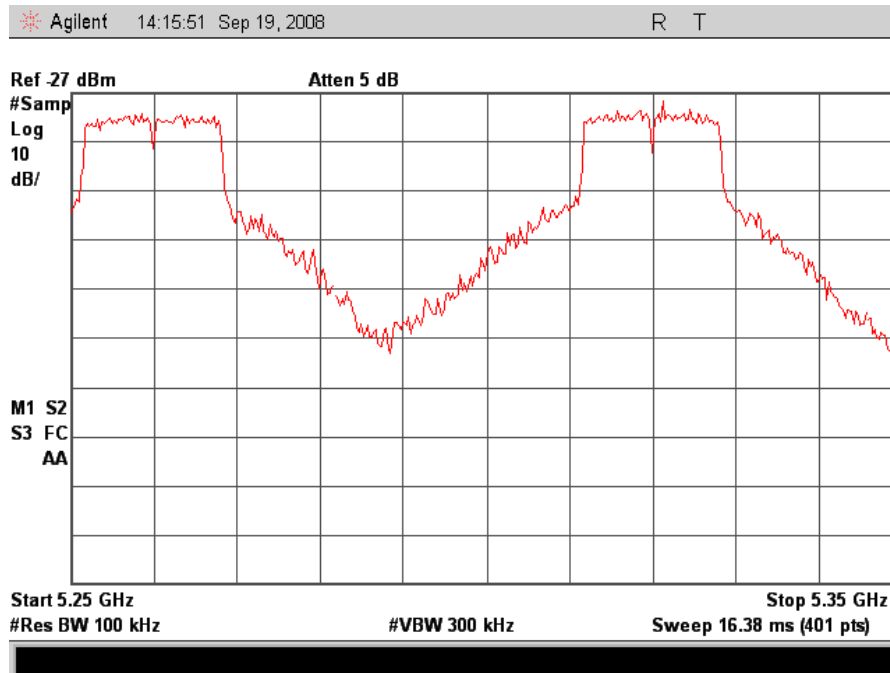
Test Date(s): September 19, 2008



Frequency Stability Test Results



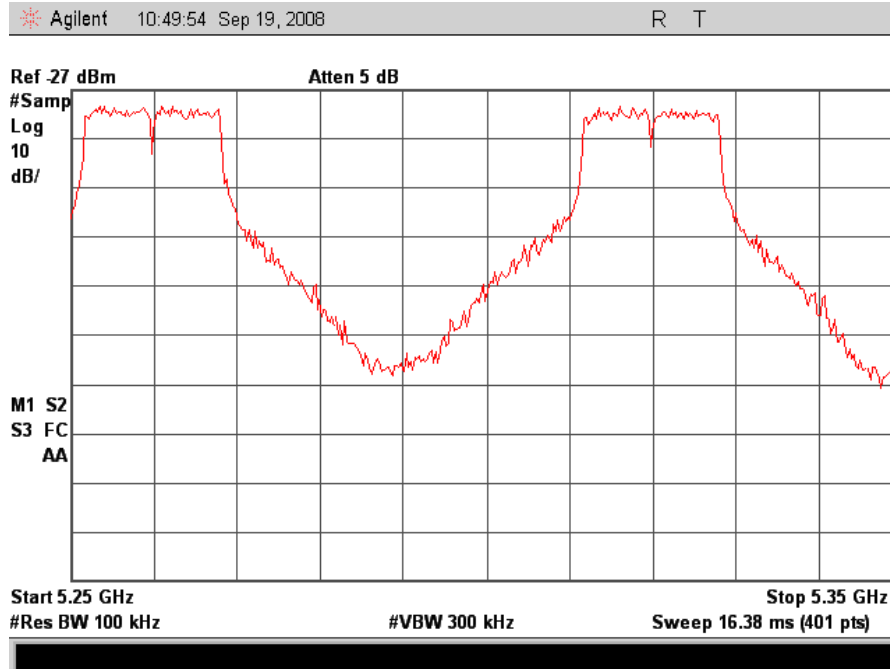
Plot 45. Nom Voltage, Low Temp – 5260/5320MHz



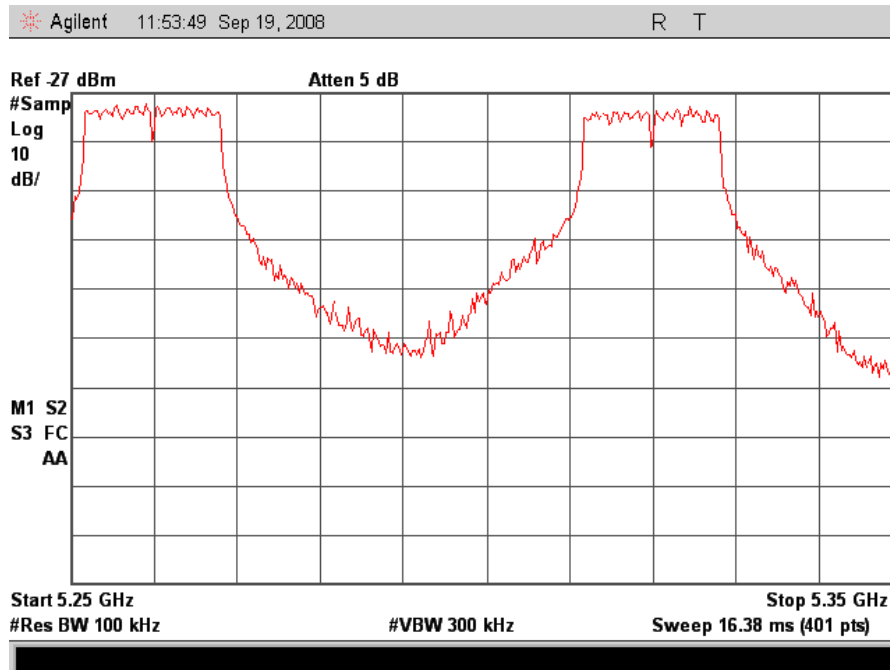
Plot 46. Nom Voltage, High Temp – 5260/5320MHz



Frequency Stability Test Results



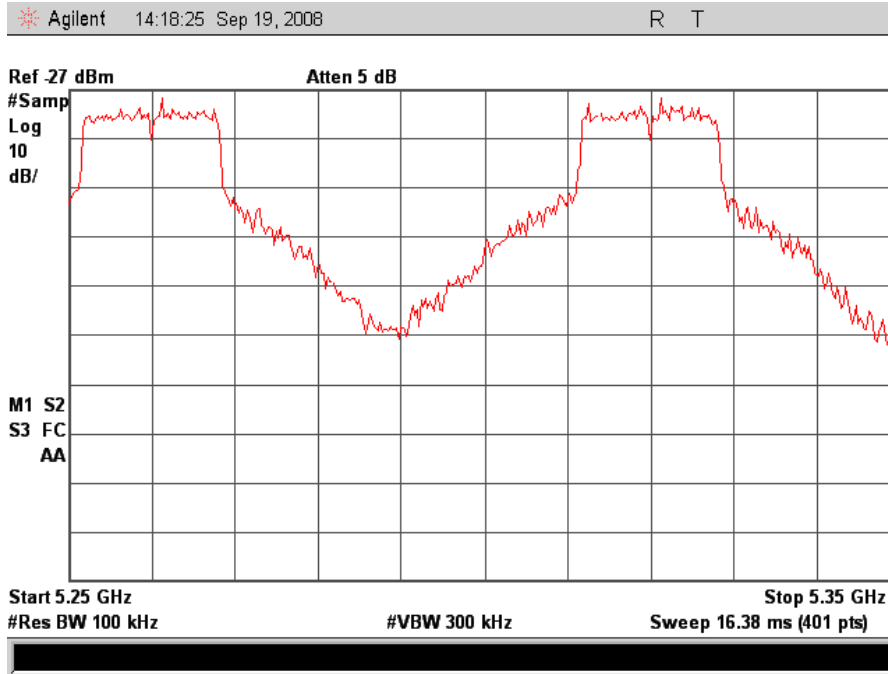
Plot 47. Nom Voltage, Nom Temp – 5260/5320MHz



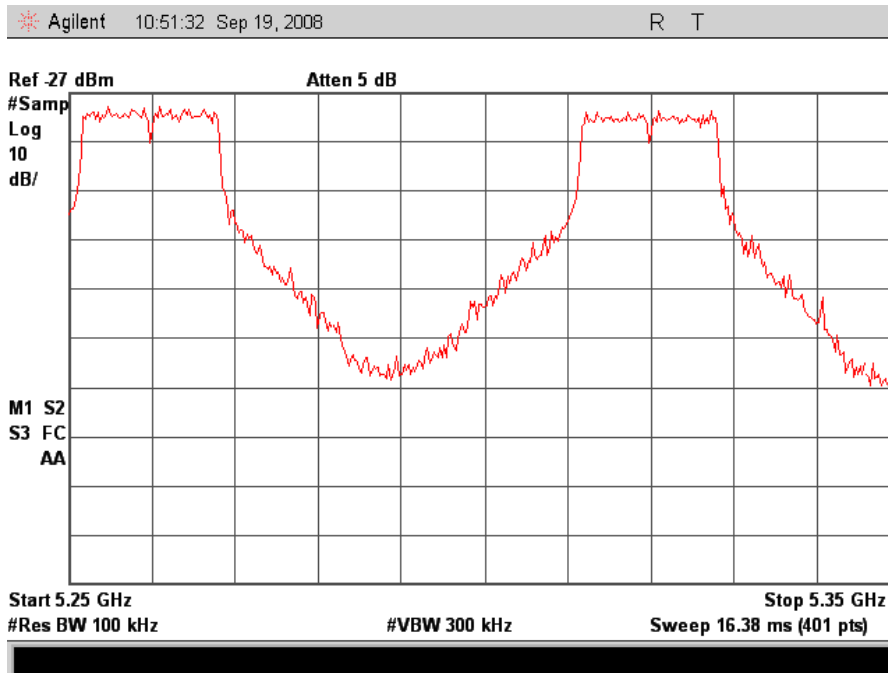
Plot 48. Low Voltage, Low Temp – 5260/5320MHz



Frequency Stability Test Results



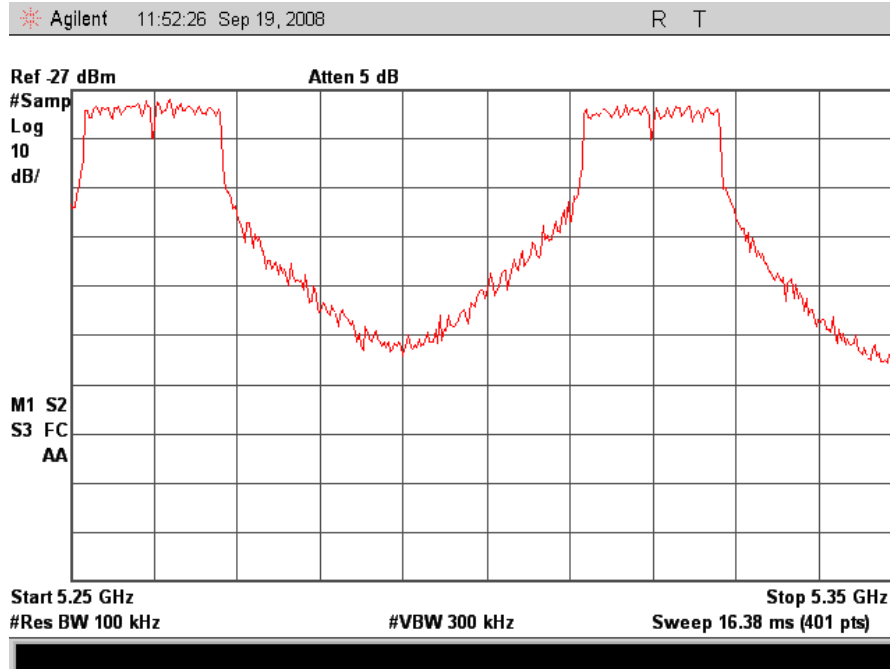
Plot 49. Low Voltage, High Temp – 5260/5320MHz



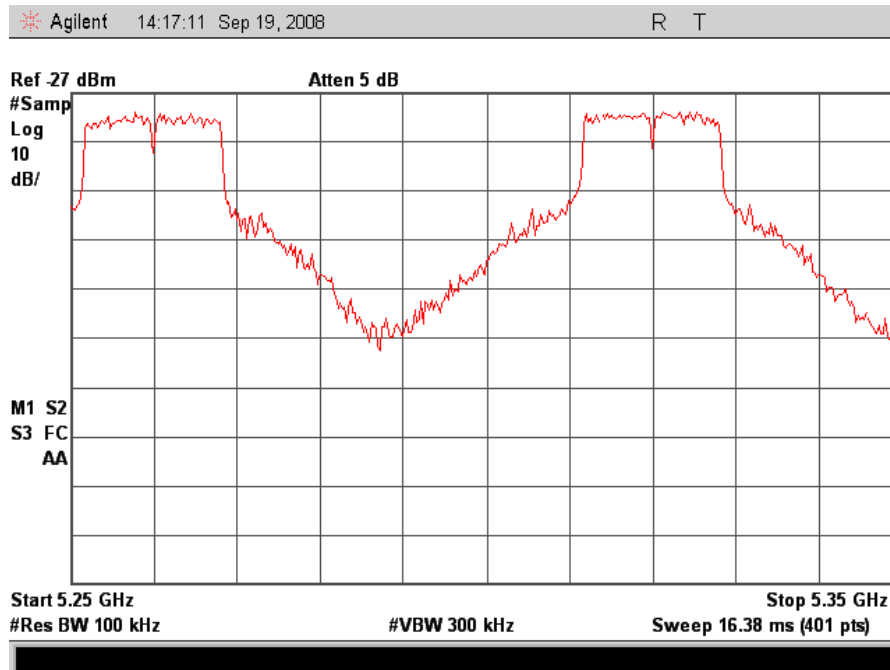
Plot 50. Low Voltage, Nom Temp – 5260/5320MHz



Frequency Stability Test Results



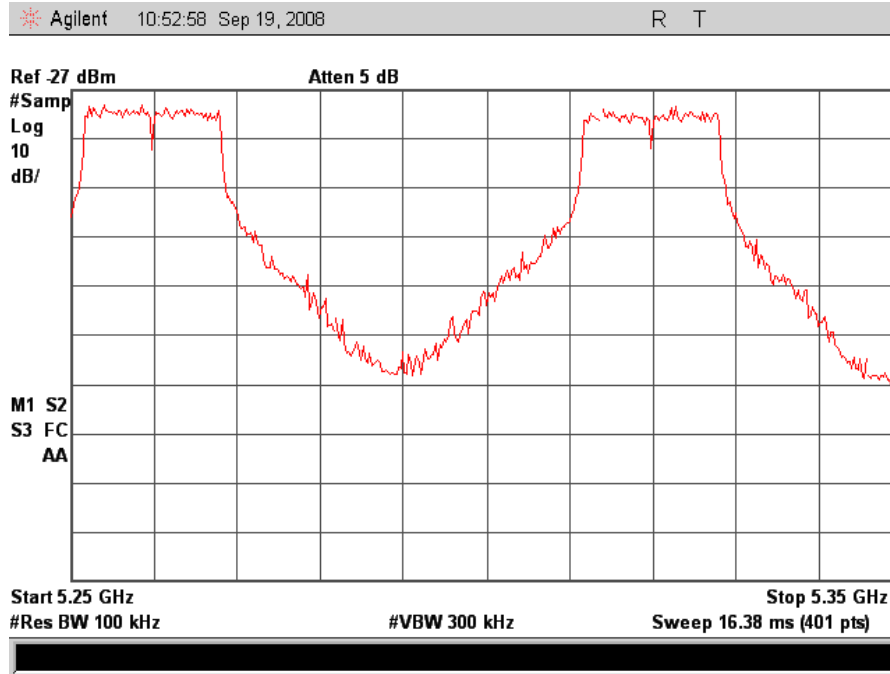
Plot 51. High Voltage, Low Temp – 5260/5320MHz



Plot 52. High Voltage, High Temp – 5260/5320MHz



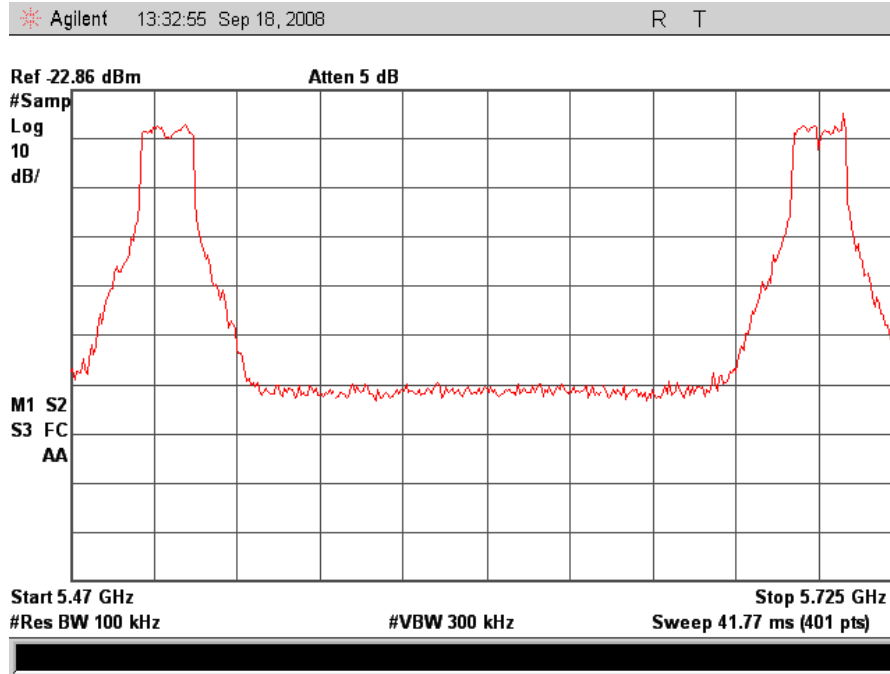
Frequency Stability Test Results



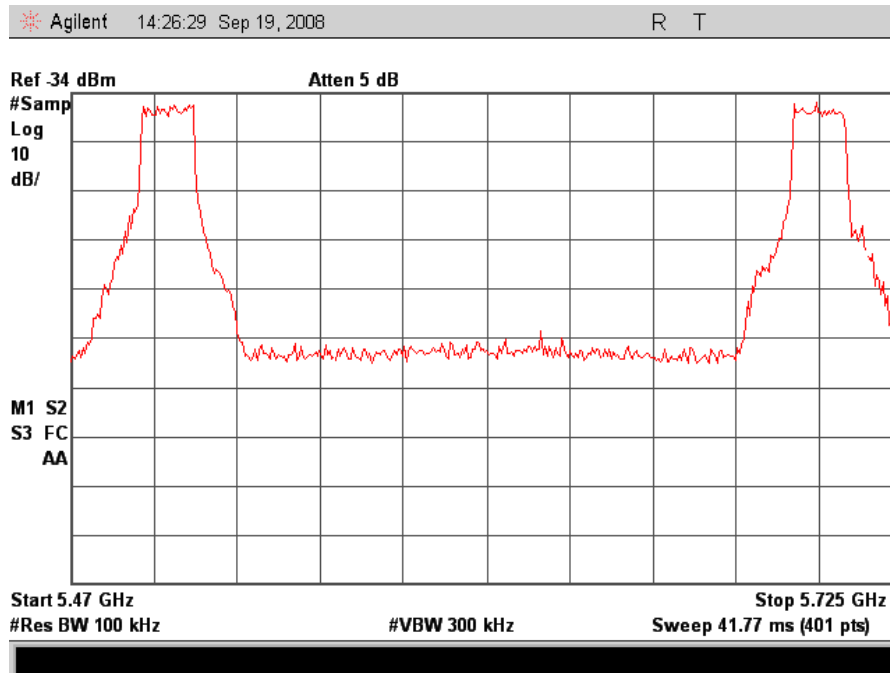
Plot 53. High Voltage, Nom Temp – 5260/5320MHz



Frequency Stability Test Results



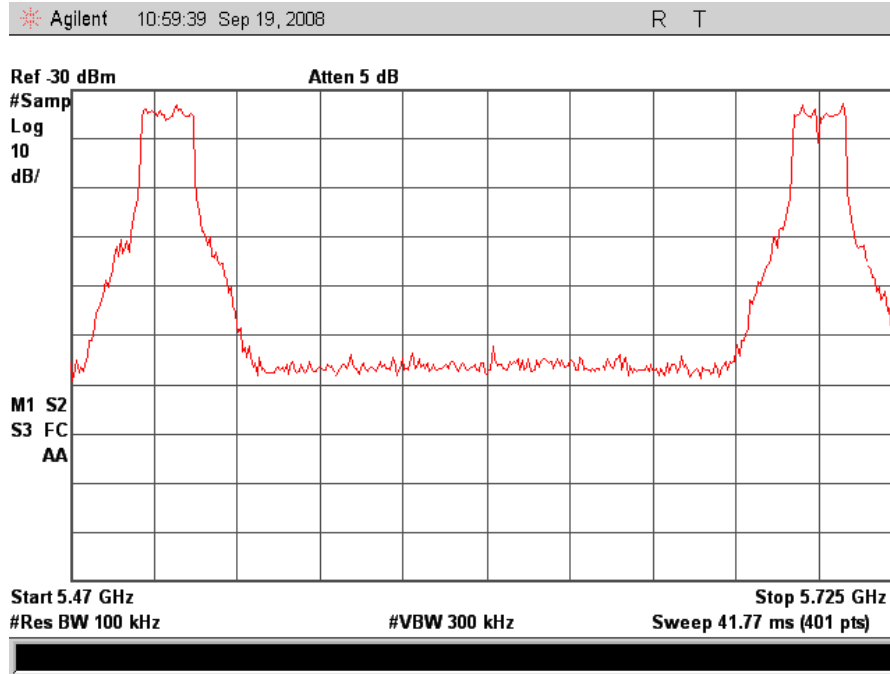
Plot 54. Nom Voltage, Low Temp – 5500/5700MHz



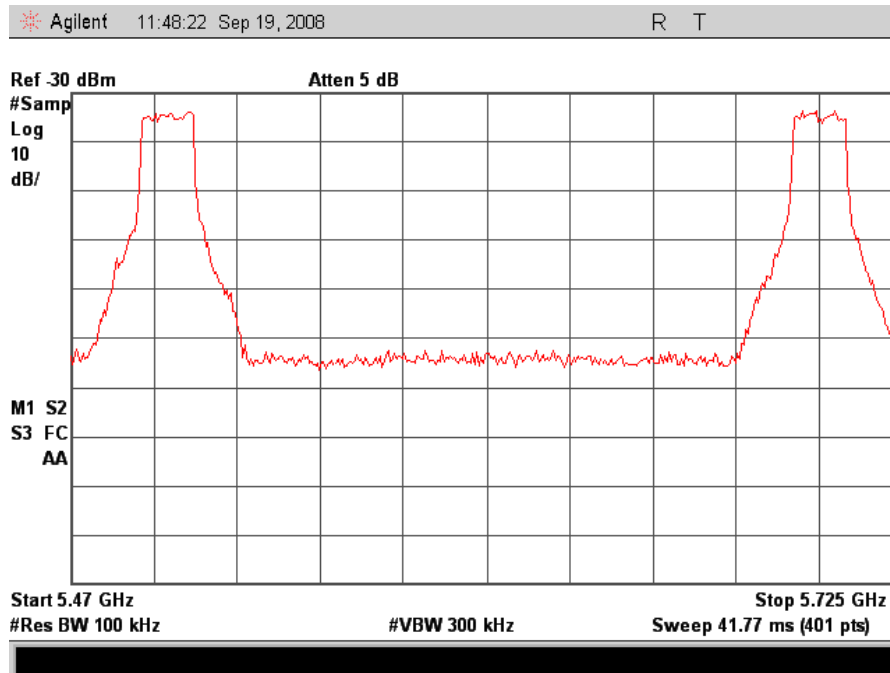
Plot 55. Nom Voltage, High Temp – 5500/5700MHz



Frequency Stability Test Results



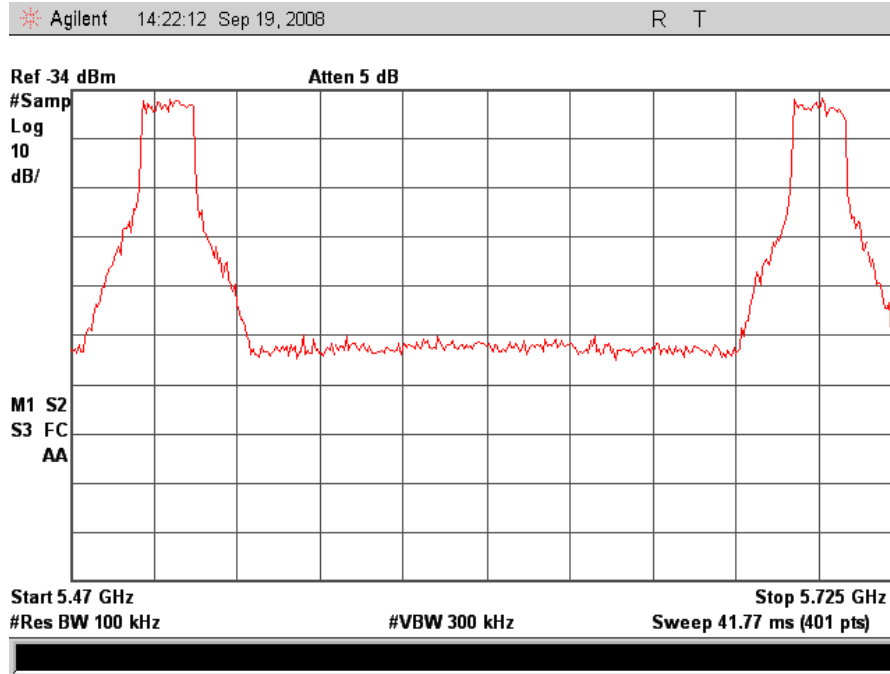
Plot 56. Nom Voltage, Nom Temp – 5500/5700MHz



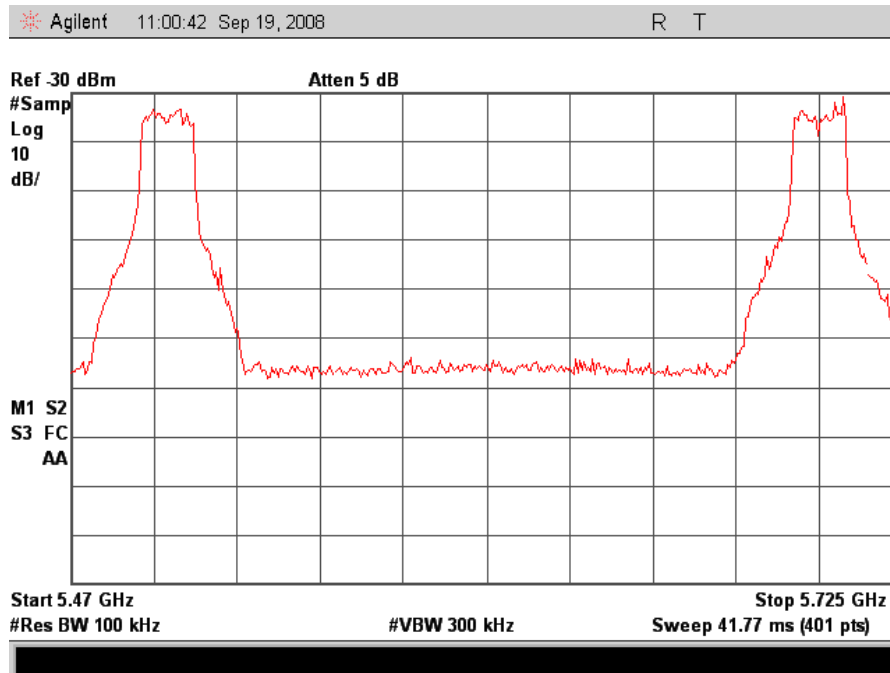
Plot 57. Low Voltage, Low Temp – 5500/5700MHz



Frequency Stability Test Results



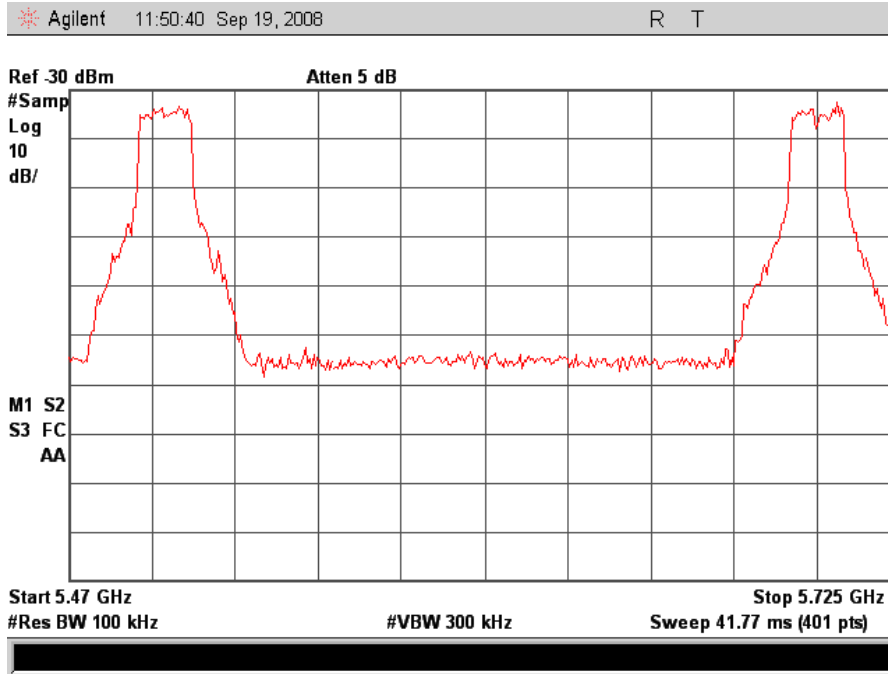
Plot 58. Low Voltage, High Temp – 5500/5700MHz



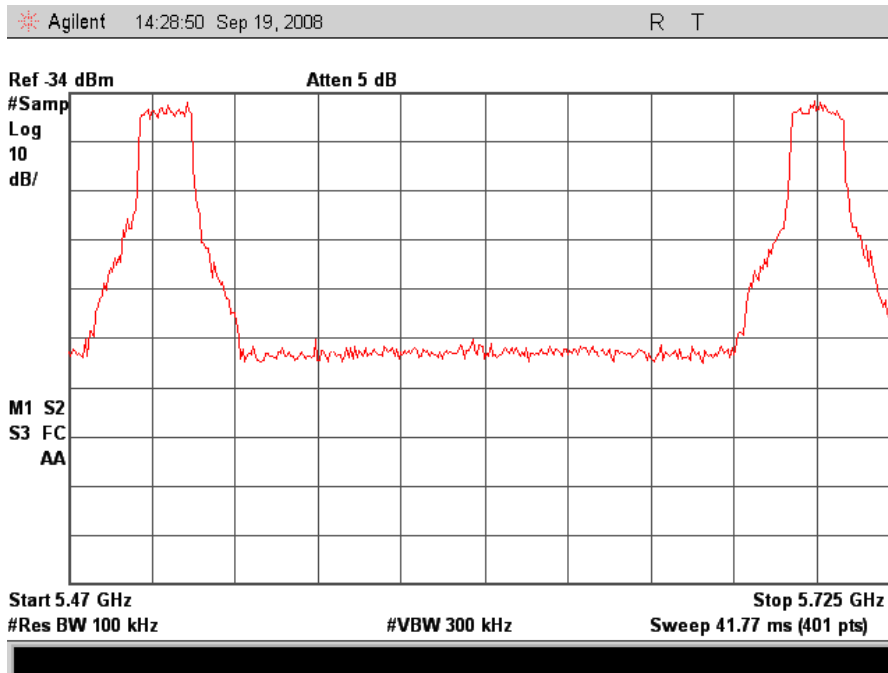
Plot 59. Low Voltage, Nom Temp – 5500/5700MHz



Frequency Stability Test Results



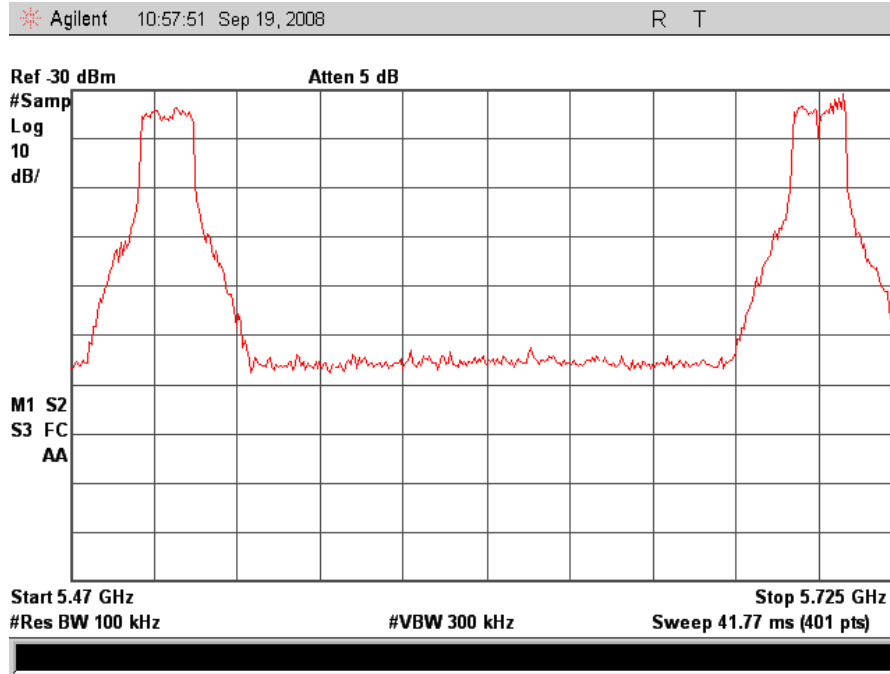
Plot 60. High Voltage, Low Temp – 5500/5700MHz



Plot 61. High Voltage, High Temp – 5500/5700MHz



Frequency Stability Test Results



Plot 62. High Voltage, Nom Temp – 5500/5700MHz



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
1S2421	EMI RECEIVER	ROHDE&SCHWARZ	ESIB 7	04/18/2008	04/18/2009
1S2484	BILOG ANTENNA	TESEQ	CBL6112D	1/21/2008	1/21/2009
1S2121	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	10/25/2007	10/25/2008
1S2198	ANTENNA, HORN	EMCO	3115	08/31/2008	08/31/2009
1S2208	ANTENNA, HORN	EMCO	3115	SEE NOTE	
1U0208	SIGNAL GENERATOR	ROHDE&SCHWARZ	SMR20	5/7/2007	5/7/2008
1S2202	ANTENNA, HORN, 1 METER	EMCO	3116	04/10/2007	04/10/2010
N/A	HIGH PASS FILTER	MICRO-TRONICS	HPM13146	SEE NOTE	
1S2482	SHIELDED TEST CHAMBER	ETS-Lindgren	DKE8X8DBL	12/26/2007	12/26/2008
1S2482	SHIELDED TEST CHAMBER	Panashield	5 Meter Semi-Anechoic Chamber	11/18/2007	11/18/2009
1S2041	COUPLER, BI DIRECTIONALCOAXIAL	NARDA	N/A	SEE NOTE	
1S2460	Analyzer, Spectrum 9 kHz-40GHz	Agilent	E4407B	03/24/2008	03/24/2009
1S2034	COUPLER, DIRECTIONAL 1-20 GHz	KRYTAR	101020020	SEE NOTE	
1S2041	COUPLER, BI DIRECTIONALCOAXIAL	NARDA	N/A	SEE NOTE	
1S2128	Harmonic Mixer	Hewlett Packard	11970A	10/26/2006	10/26/2008
1S2129	Harmonic Mixer	Hewlett Packard	11970K	10/26/2006	10/26/2008

Table 19. Test Equipment List

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



V. DFS Requirements



A. Description of Master Device

All testing was performed with an approved Master device, SkyPilot Networks, Model RV7-SD1085, FCC ID: RV7-SD1085.

B. Description of Client Device

1. The SkyPilot Networks, Model SkyConnector Mini operates in the following bands:
 - a) 5250-5350 MHz
 - b) 5500-5700 MHz
2. The maximum conducted power of the equipment in the 5GHz band is 17.16dBm, and the antenna gain is 10dBi.
3. Antennas used with SkyConnector Mini. For antenna gain patterns see additional FCC attachments for this filing.

Antennas		
Model No. / Gain	Frequency Band	Vendor
10dBi	5.25 – 5.35GHz	SkyPilot Networks
14dBi	5.470 – 5.725GHz	SkyPilot Networks

4. RF output power for SkyConnector Mini

802.11a mode UNII-2 Lower Band		
Carrier Channel	Frequency (MHz)	Measured Peak Output Power dBm
Low	5260	17.16
High	5320	16.54

802.11a mode UNII-2 Upper Band		
Carrier Channel	Frequency (MHz)	Measured Peak Output Power dBm
Low	5500	13.87
Mid	5600	12.72
High	5700	13.82

5. System testing was performed with the designated MPEG test file that streams full motion video at 30 frames per second from the Master to the Client IP based system.



VI. DFS Radar Waveform Description and Calibration



DFS Requirements

DFS Detection Thresholds

Interference Threshold values, Master or Client incorporating In-Service Monitoring

Maximum Transmit Power	Value
≥ 200 milliwatt	-64 dBm
< 200 milliwatt	-62 dBm

Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna
Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.

DFS Response requirement values

Parameter	Value
<i>Channel Move Time</i>	10 seconds
<i>Channel Closing Transmission Time</i>	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period.



Required Radar Test Waveforms

This section provides the parameters for required test waveforms, minimum percentage of successful detections, and the minimum number of trials that must be used for determining DFS conformance. Step intervals of 0.1 microsecond for Pulse Width, 1 microsecond for PRI, 1 MHz for chirp width and 1 for the number of pulses will be utilized for the random determination of specific test waveforms.

Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Trials
1	1	1428	18	60%	30

Radar Waveform Calibration

The following equipment setup was used to calibrate the conducted Radar Waveform. A spectrum analyzer was used to establish the test signal level for each radar type. During this process there were no transmissions by either the Master or Client Device. The spectrum analyzer was switched to the zero span (Time Domain) mode at the frequency of the Radar Waveform generator. Peak detection was utilized. The spectrum analyzer's resolution bandwidth (RBW) was set to 1MHz and the video bandwidth (VBW) was set to 3 MHz. See Figure 2.

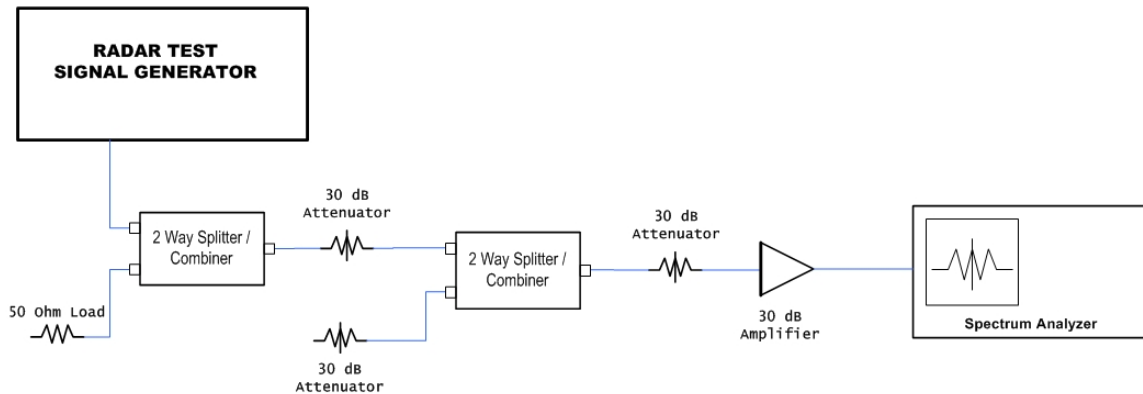
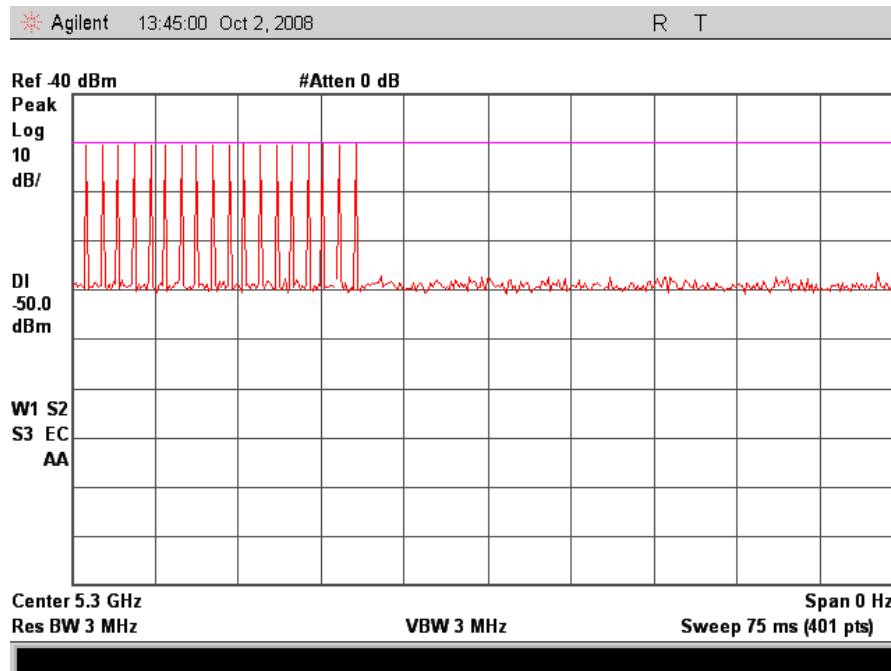
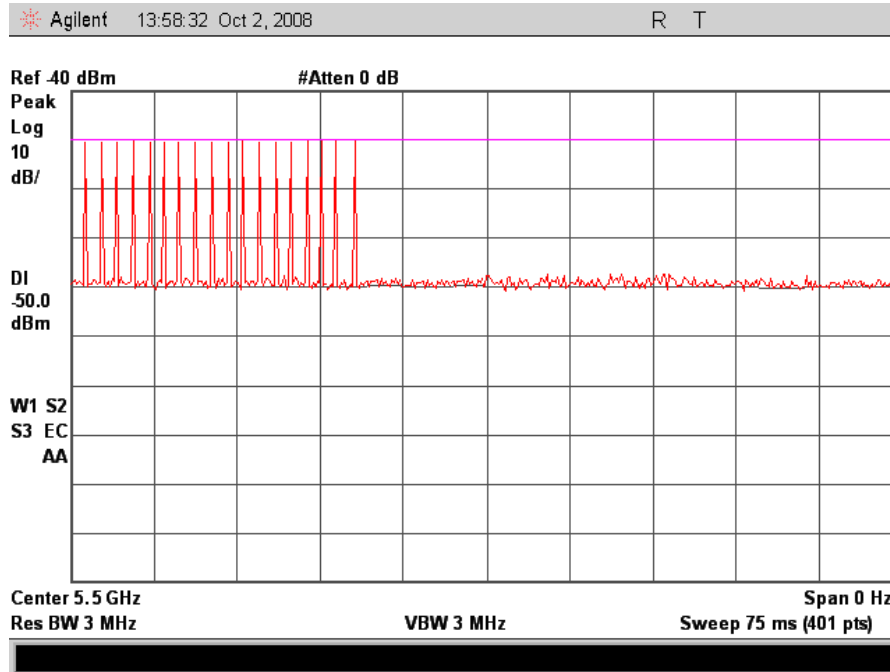


Figure 2. Radar Waveform Calibration Setup



Plot 63. Calibration Plot, 5300 MHz



Plot 64. Calibration Plot, 5500 MHz

Test Setup for EUT

1. A spectrum analyzer is used as a monitor to verify that the UUT has vacated the Channel within the (Channel Closing Transmission Time and Channel Move Time.
2. Figure 3 shows the test setup used to generate the Radar Waveforms.

Setup for Client with injection at the Master

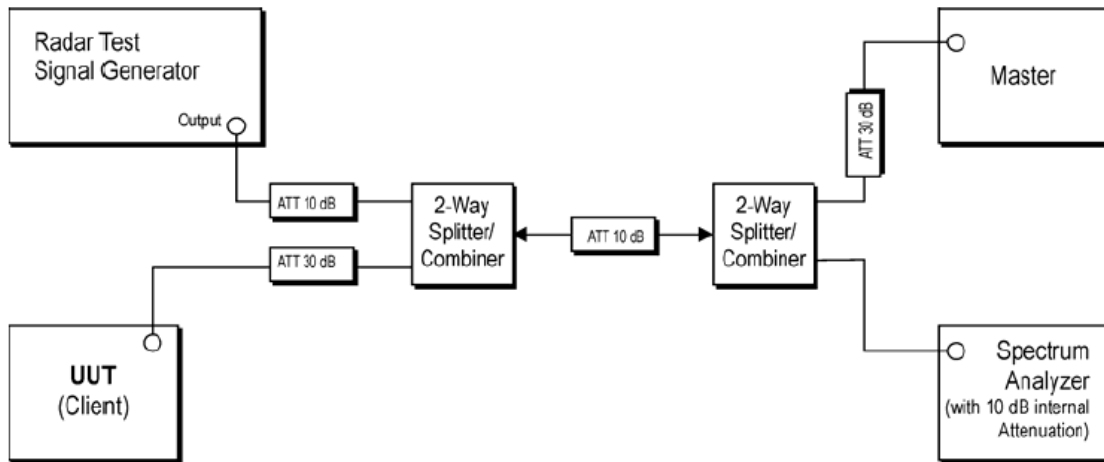
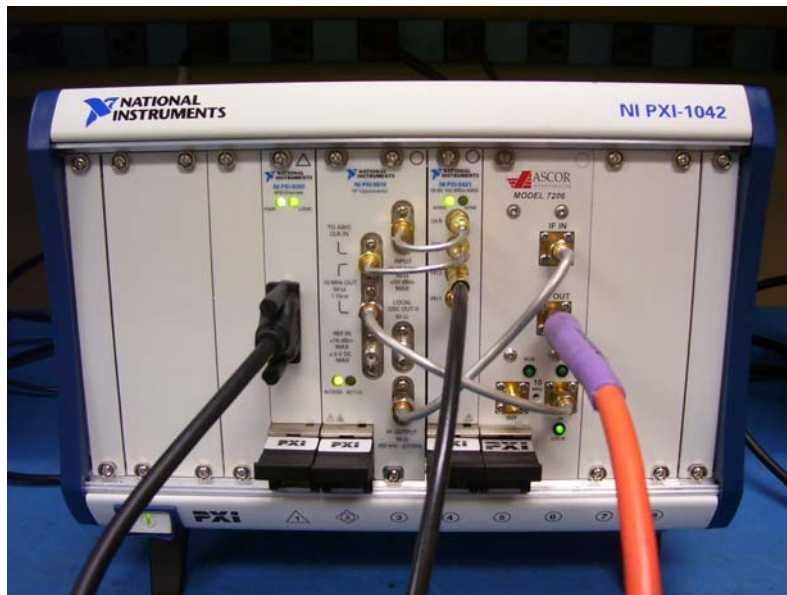
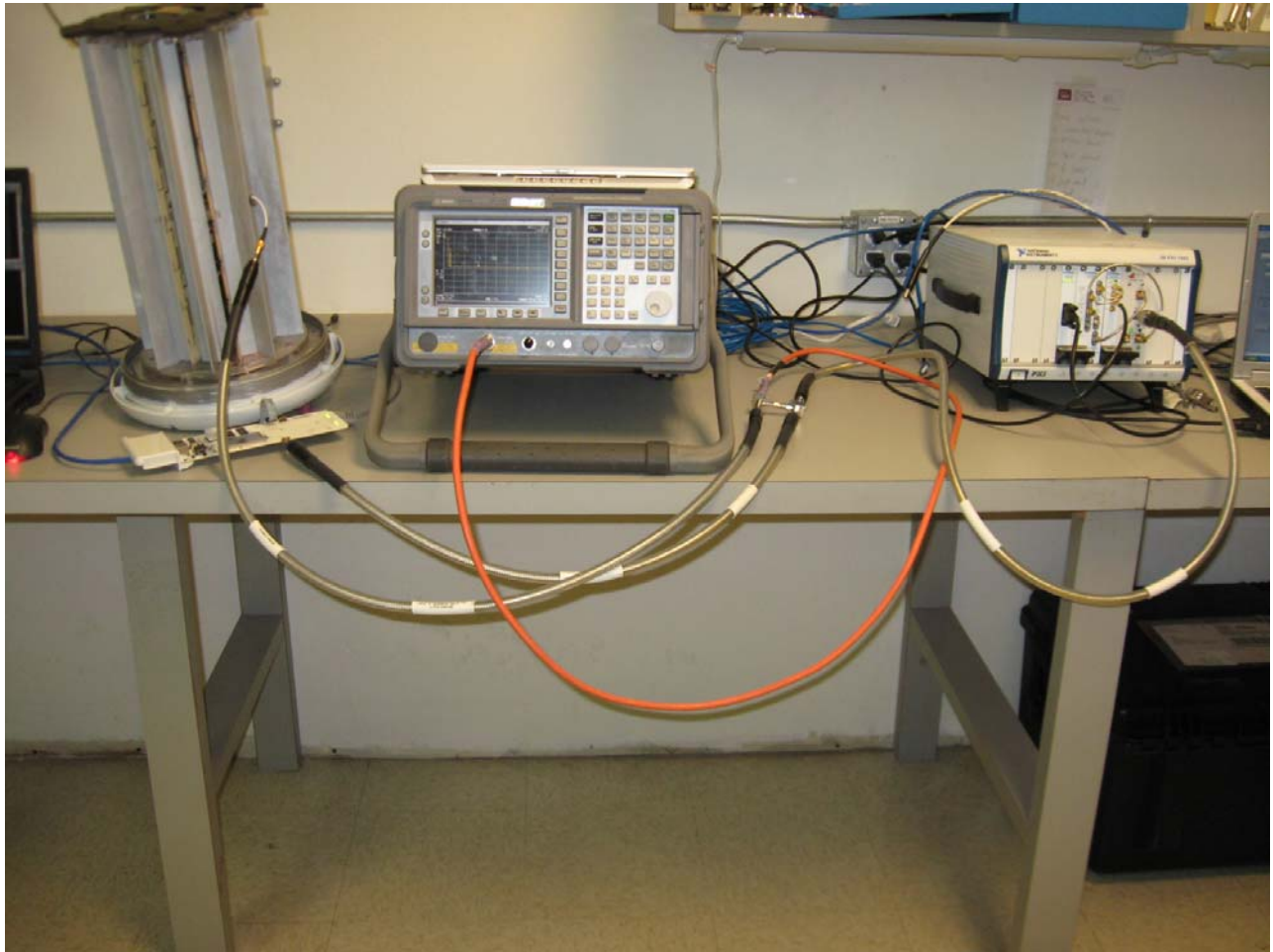


Figure 3. Test Setup for Client Device



Photograph 6. Radar Test Signal Generator

DFS Test Setup Photograph



Photograph 7. EUT Test Setup Photograph



VII. DFS Procedures and Test Results



Channel Closing Transmission Time and Channel Move Time

Test Requirements: § 15.407

Test Procedure: These tests define how the following DFS parameters are verified during Channel Closing Transmission Time and Channel Move Time

The steps below define the procedure to determine the above mentioned parameters when a radar Burst with a level equal to the DFS Detection Threshold + 1dB (-63dBm) is generated on the Operating Channel of the U-NII device.

A U-NII device operating as a Client Device will associate with the UUT (Master) at 5300 MHz and 5500MHz. Stream the MPEG test file from the Master Device to the Client Device on the selected Channel for the entire period of the test.

Observe the transmissions of the UUT at the end of the radar Burst on the Operating Channel for duration greater than 10 seconds. Measure and record the transmissions from the UUT during the observation time (Channel Move Time). Compare the Channel Move Time and Channel Closing Transmission Time results to the limits defined in the *DFS Response requirement values table*.

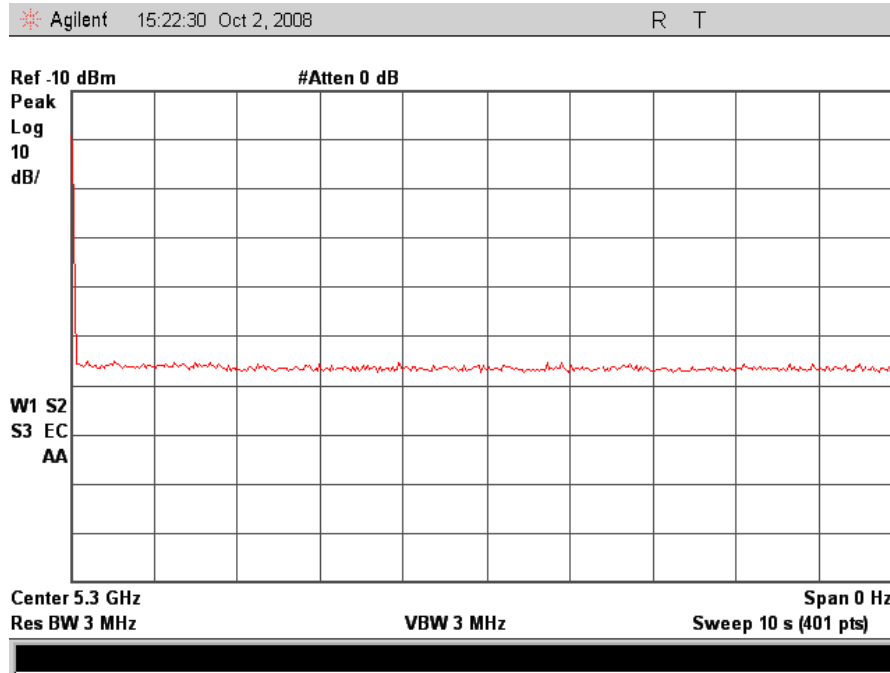
Test Results: The equipment complies with § 15.407 Channel Move Time and Channel Closing Transmission Time.

Test Engineer: Anderson Soungpanya

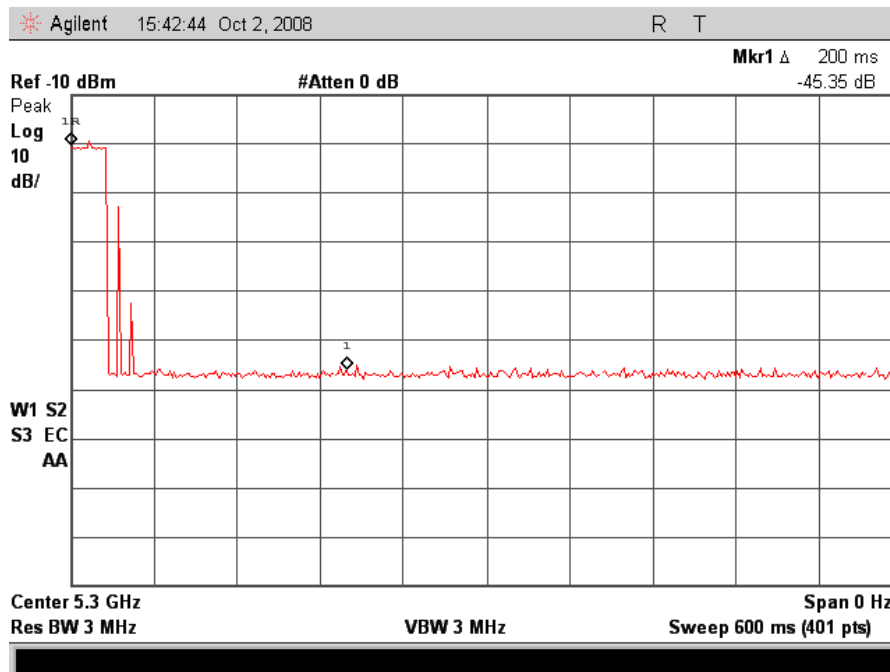
Test Date: October 2, 2008



Channel Closing Transmission Time Plots, 5300MHz

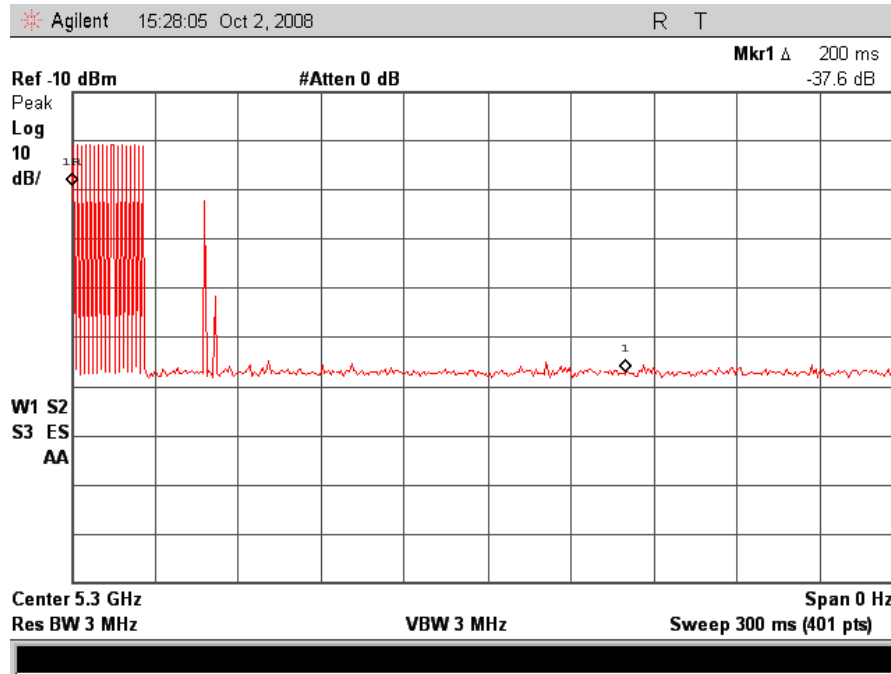


Plot 65. 10 Sec Move Time (5300MHz)



Plot 66. Channel Closing 600sec Window (5300MHz)

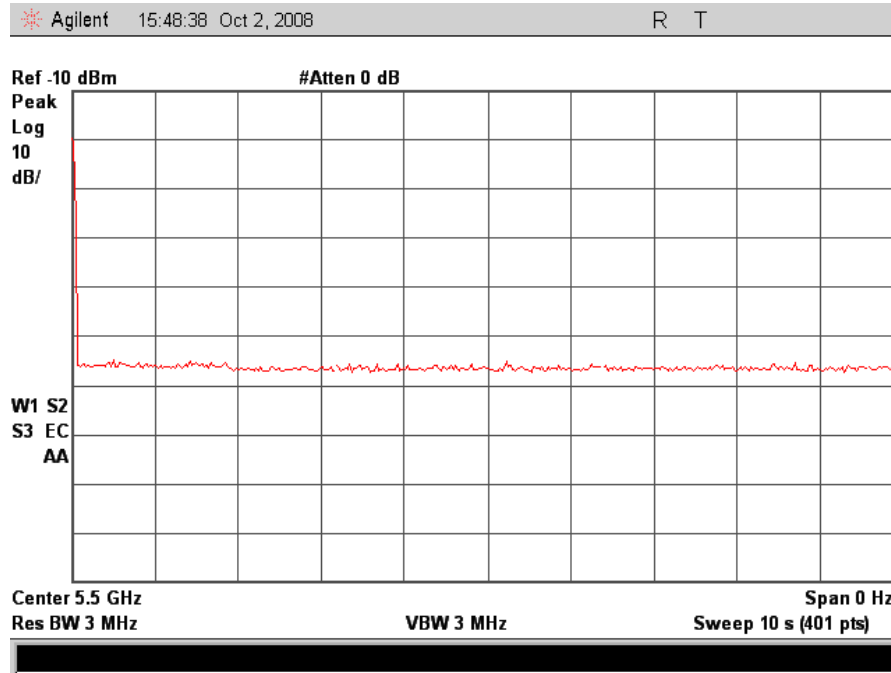
Channel Closing Transmission Time Plots



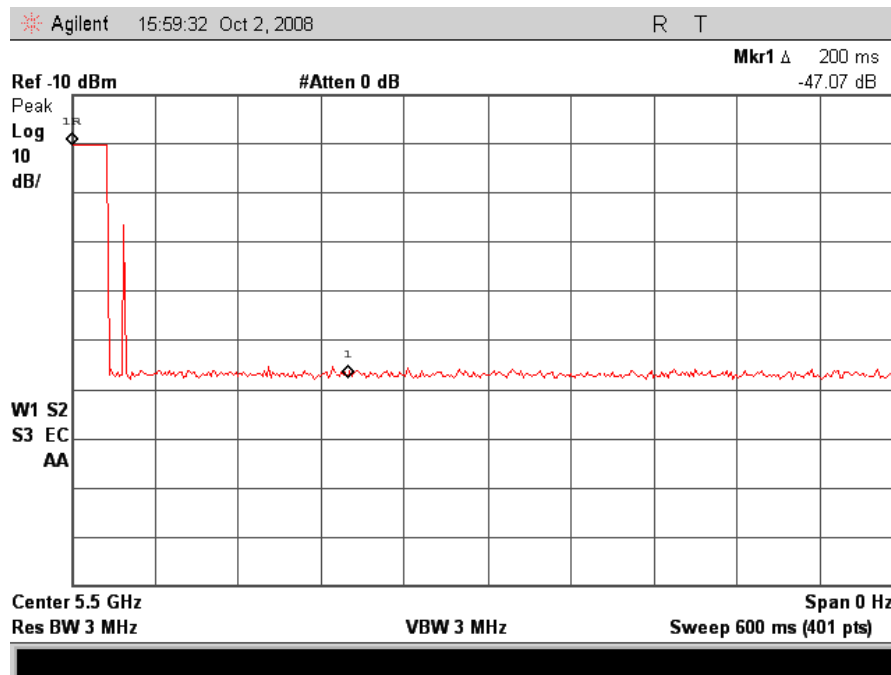
Plot 67. Channel Closing 200sec Window (5300MHz)



Channel Closing Transmission Time Plots, 5500MHz



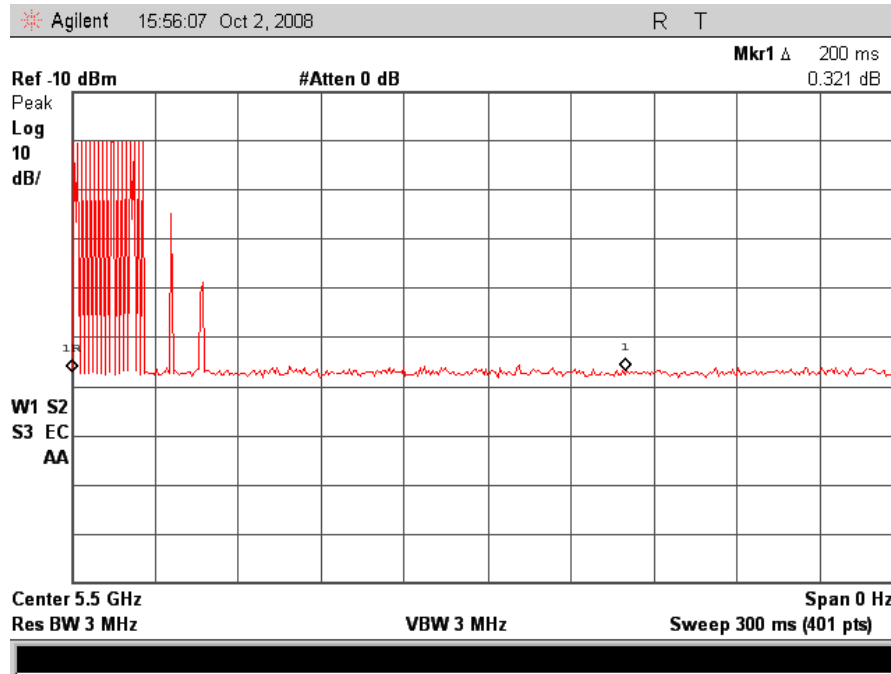
Plot 68. 10 Sec Move Time (5700MHz)



Plot 69. Channel Closing 600msec Window (5500MHz)



Channel Closing Transmission Time Plots



Plot 70. Channel Closing 200msec Window (5500MHz)



V. DFS 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.

Description	Manufacturer	Model	Serial No.	Cal date	Cal due
Laptop computer	Dell	Inspiron 630m	4WVH891	See Note	
MXI-Express controller	National Instruments	PXI-8360	-	See Note	
Arbitrary Waveform Generator 16-Bit 100 MS/s	National Instruments	PXI-5421	-	See Note	
RF Upconverter 250 kHz to 2.7 GHz	National Instruments	PXI-5610	-	See Note	
RF Upconverter 4.9 to 6 GHz	ASCOR	7206	-	See Note	
Spectrum Analyzer 3 Hz to 50 GHz	Agilent	E4448A	MY46180580	2/2/2008	2/2/2009
Pre-amplifier 30 dB 1 to 26.5 GHz	Hewlett-Packard	8449B	3008A01235	11/28/2007	11/28/2008
Power Splitter 2.95 to 7.1 GHz	Mini-Circuits	ZX10-2-71	-	See Note	
Attenuator 10 dB DC to 18 GHz	Pasternack Enterprises	PE7005-10	-	See Note	
Attenuator 30 dB DC to 18 GHz	Pasternack Enterprises	PE7005-30	-	See Note	

Table 20. Test Equipment List – DFS Testing

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



VI. 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.



ICES-003 Procedural & Labeling Requirements

From the Industry Canada Electromagnetic Compatibility Advisory Bulletin entitled, "Implementation and Interpretation of the Interference-Causing Equipment Standard for Digital Apparatus, ICES-003" (EMCAB-3, Issue 2, July 1995):

"At present, CISPR 22: 2002 and ICES technical requirements are essentially equivalent. Therefore, if you have CISPR 22: 2002 approval by meeting CISPR Publication 22, the only additional requirements are: to attach a note to the report of the test results for compliance, indicating that these results are deemed satisfactory evidence of compliance with ICES-003 of the Canadian Interference-Causing Equipment Regulations; to maintain these records on file for the requisite five year period; and to provide the device with a notice of compliance in accordance with ICES-003."

Procedural Requirements:

According to Industry Canada's Interference Causing Equipment Standard for Digital Apparatus ICES-003 Issue 4, February 2004:

Section 6.1: A record of the measurements and results, showing the date that the measurements were completed, shall be retained by the manufacturer or importer for a period of at least five years from the date shown in the record and made available for examination on the request of the Minister.

Section 6.2: A written notice indicating compliance must accompany each unit of digital apparatus to the end user. The notice shall be in the form of a label that is affixed to the apparatus. Where because of insufficient space or other constraints it is not feasible to affix a label to the apparatus, the notice may be in the form of a statement in the user's manual.

Labeling Requirements:

The suggested text for the notice, in English and in French, is provided below, from the Annex of ICES-003:

This Class [²] digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe [¹] est conforme à la norme NMB-003 du Canada.

² Insert either A or B but not both as appropriate for the equipment requirements.



End of Report