MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
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Electromagnetic Compatibility Criteria
Test Report

for the

Ubiquiti Networks
Model SR71

Tested under
the FCC Certification Rules
contained in
Title 47 of the CFR, Parts 15 Subpart B & ICES-003
for Class B Digital Devices
&
15.247 Subpart C & RSS-210, Issue 7, June 2007
for Intentional Radiators

MET Report: EMC80673-FCC247

April 24, 2008

Prepared For:

Ubiquiti Networks
495-499 Montague Expressway
Milpitas, CA 95035

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for Intentional Radiators

Minh Ly, 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 the FCC Rules Parts 15B, 15.247 and Industry Canada standards ICES-003, Issue 4 February 2004, RSS-210, Issue 7, June 2007 under normal use and maintenance.

Shawn McMillen, Manager
Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	April 24, 2008	Initial Issue.
1	June 23, 2008	Correct Power Meter to Spectrum Analyzer in Block Diagram 1

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List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci**b**els
dBµA	**D**eci**b**els above one **micro**amp
dBµV	**D**eci**b**els above one **micro**volt
dBµA/m	**D**eci**b**els above one **micro**amp **per m**eter
dBµV/m	**D**eci**b**els above one **micro**volt **per m**eter
DC	**D**irect **C**urrent µ
E	**E**lectric Field
DSL	**D**igital **S**ubscriber **L**ine
ESD	**E**lectro**s**tatic **D**ischarge
EUT	**E**quipment **U**nder **T**est
f	**F**requency
FCC	**F**ederal **C**ommunications **C**ommission
GR-1089-CORE	***(GR)*** **G**eneral **R**equirement(s) imposed by the NEBS standard, **(*CORE*) C**entral **O**ffice **R**ecovery **E**xpress (AT&T), ***(1089)*** specifies various parts of the General Requirements under Bellcore Technical Standard, Requirements for Electromagnetic Compatibility and Electrical Safety - Generic Criteria for Network Telecommunications Equipment
GRP	**G**round **R**eference **P**lane
H	Magnetic Field
HCP	**H**orizontal **C**oupling **P**lane
Hz	**H**ert**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**ert**z**
kPa	**k**ilo**pa**scal
kV	**k**ilovolt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**micro**henry
µ	**micro**farad
µs	**micros**econds
NEBS	**N**etwork **E**quipment-**B**uilding **S**ystem
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
TWT	**T**raveling **W**ave **T**ube
V/m	**V**olts **per m**eter
VCP	**V**ertical **C**oupling **P**lane

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Ubiquiti Networks SR71, with the requirements of Part 15, §15.247. 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 SR71. Ubiquiti Networks should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the SR71, 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, §15.247, in accordance with Ubiquiti Networks, purchase order number PO 803002. All tests were conducted using measurement procedure ANSI C63.4-2003.

FCC Reference	IC Reference	Description	Compliance
47 CFR Part 15.247:2005	RSS-210 Issue 7: 2007	Applicable Standard	Compliant
Title 47 of the CFR, Part 15 §15.203	N/A	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15 §15.205	RSS-210(A8.5)	Emissions at Restricted Band	Compliant
Title 47 of the CFR, Part 15 §15.207(a)	RSS-210(7.2.2)	Conducted Emission Voltage	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)	RSS-210(A8.1)	Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15 §15.247(b)	RSS-210(A8.4)	RF Output Power	Compliant
Title 47 of the CFR, Part 15 §15.209, §15.247(d)	RSS-210(A8.5)	Radiated and Conducted Spurious Emissions	Compliant
Title 47 of the CFR, Part 15; §15.247(e)	RSS-210(A8.3)	Power Spectral Density	Compliant
Title 47 of the CFR, Part 15 §15.247(i)	RSSGen(5.5)	Maximum Permissible Exposure	Compliant
N/A	RSSGen(4.8)	Receiver Spurious Emissions	Compliant

Table 1 Executive Summary of EMC Part 15.247 ComplianceTesting

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Ubiquiti Networks to perform testing on the SR71, under Ubiquiti Networks's purchase order number PO 803002.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Ubiquiti Networks, SR71.

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

Model(s) Tested:	SR71			
Model(s) Covered:	SR71			
EUT Specifications:	Primary Power: Power from Laptop			
	FCC ID: SWX-SR71			
	Type of Modulations:	DSSS (Direct Sequence Spread Spectrum) OFDM (Orthogonal Frequency Division multiplexing)		
	Emission Designators:		**20MHz**	**40MHz**
		802.11a:	16M6D7D	-
		802.11b:	11M0D7D	-
		802.11g:	16M2D7D	-
		802.11n:	17M5D7D	36M3D7D
	Equipment Code:	DTS		
	Peak RF Output Power:	**802.11a:**	24.75dBm	
		802.11b:	23.78dBm	
		802.11g:	21.94dBm	
		802.11n:	24.40dBm	
	EUT Frequency Ranges:	2412 – 2462MHz & 5745 – 5825MHz		
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:	Minh Ly			
Date(s):	April 24, 2008			

Table 2. EUT Summary Table

B. References

CFR 47, Part 15, Subpart C	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
RSS-210, Issue 7, June 2007	Low-power Licence-exempt Radiocommunications Devices (All Frequency Bands): Category I Equipment
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
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

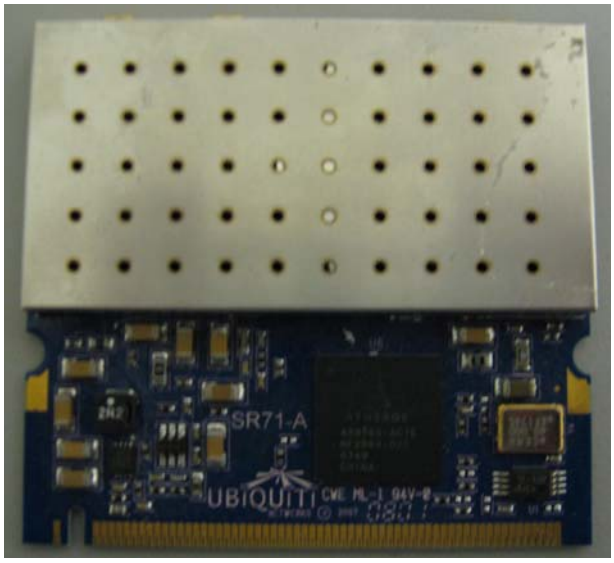
C. Test Site

All testing was performed at MET Laboratories, Inc., 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 Ubiquiti Networks SR71, is a 802.11a/b/g/n module.



Photograph 1. Ubiquiti Networks SR71

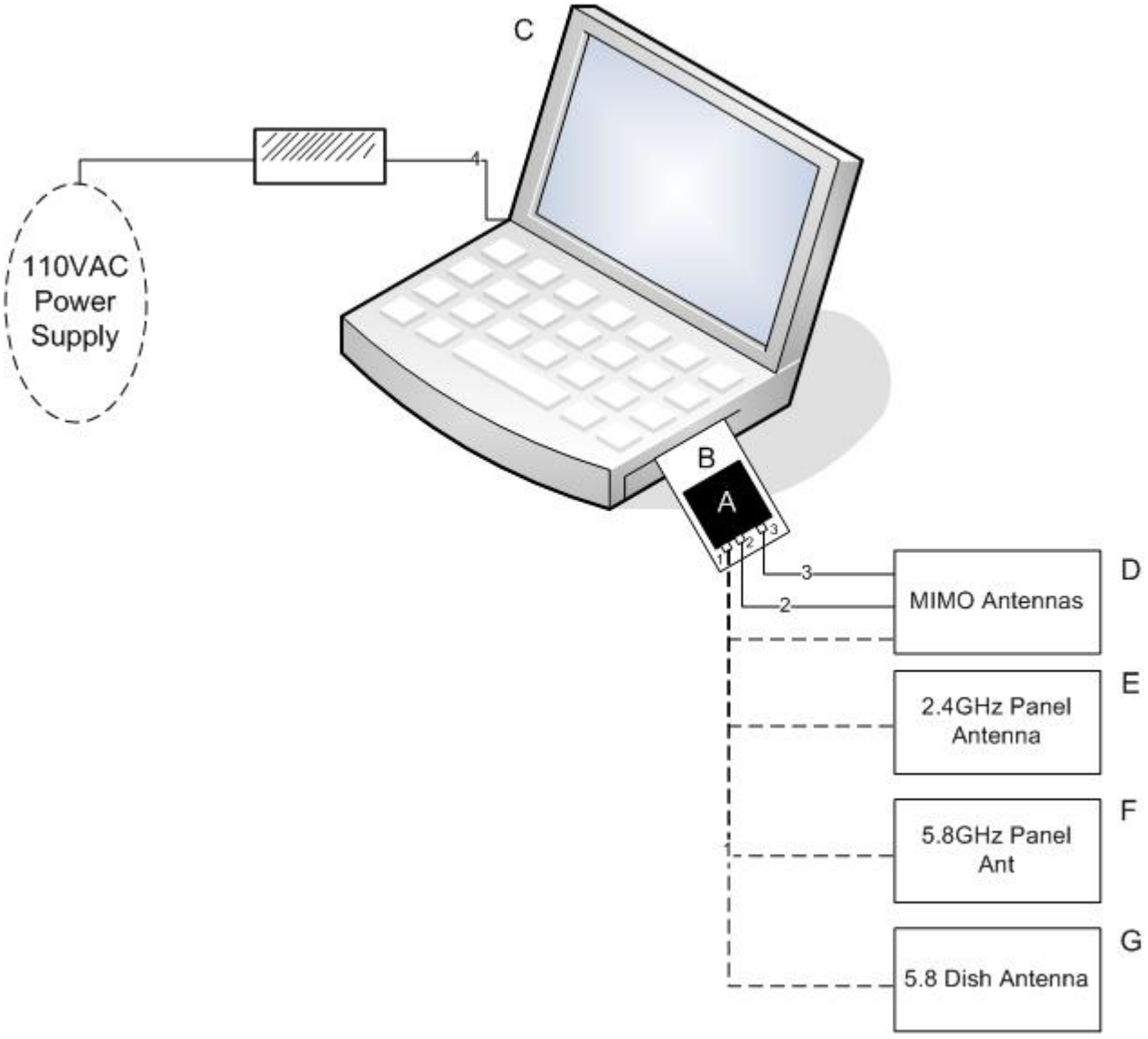


Figure 1. Block Diagram of Test Configuration (Radiated Emissions)

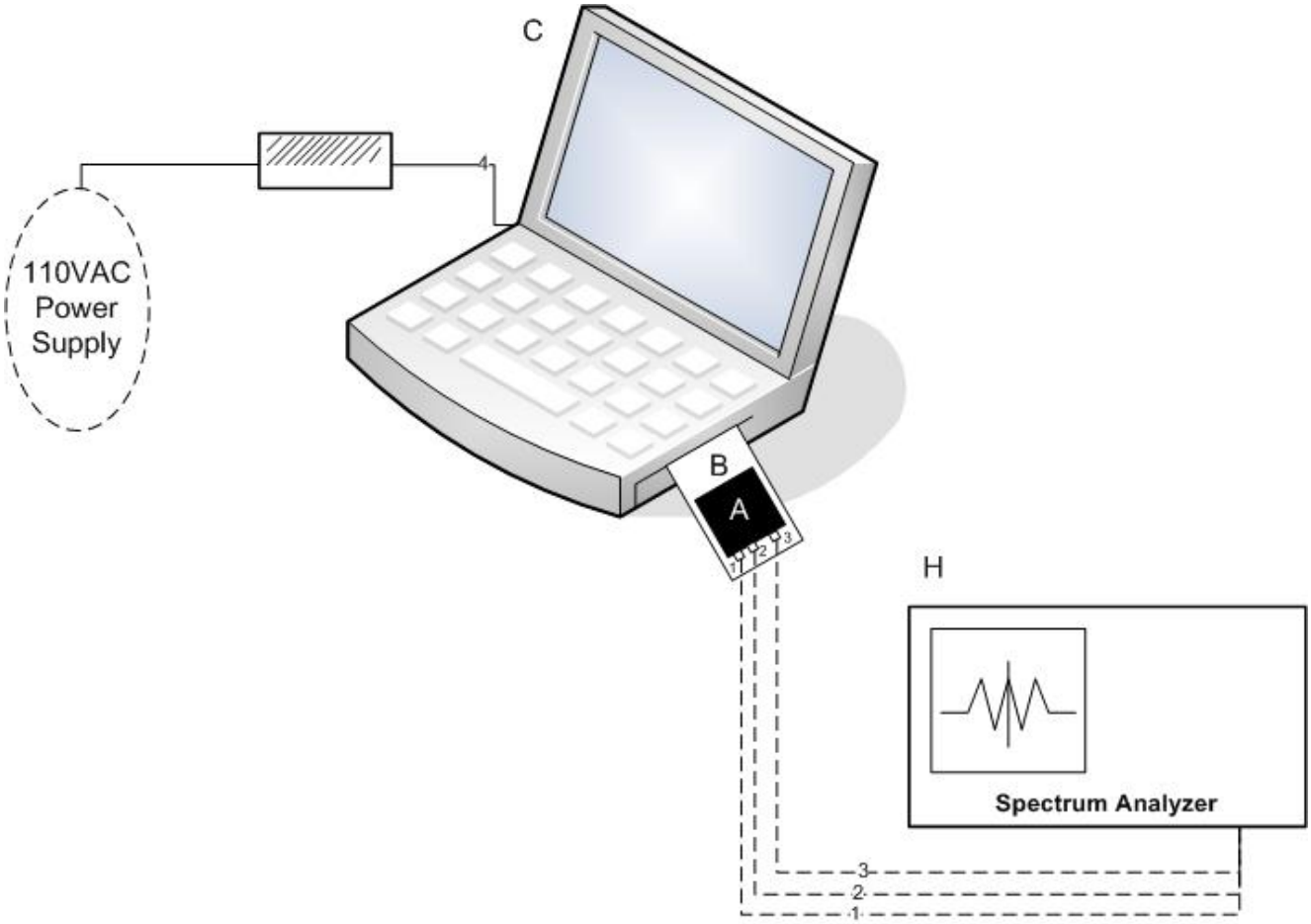


Figure 2. Block Diagram of Test Configuration (Conducted Measurement)

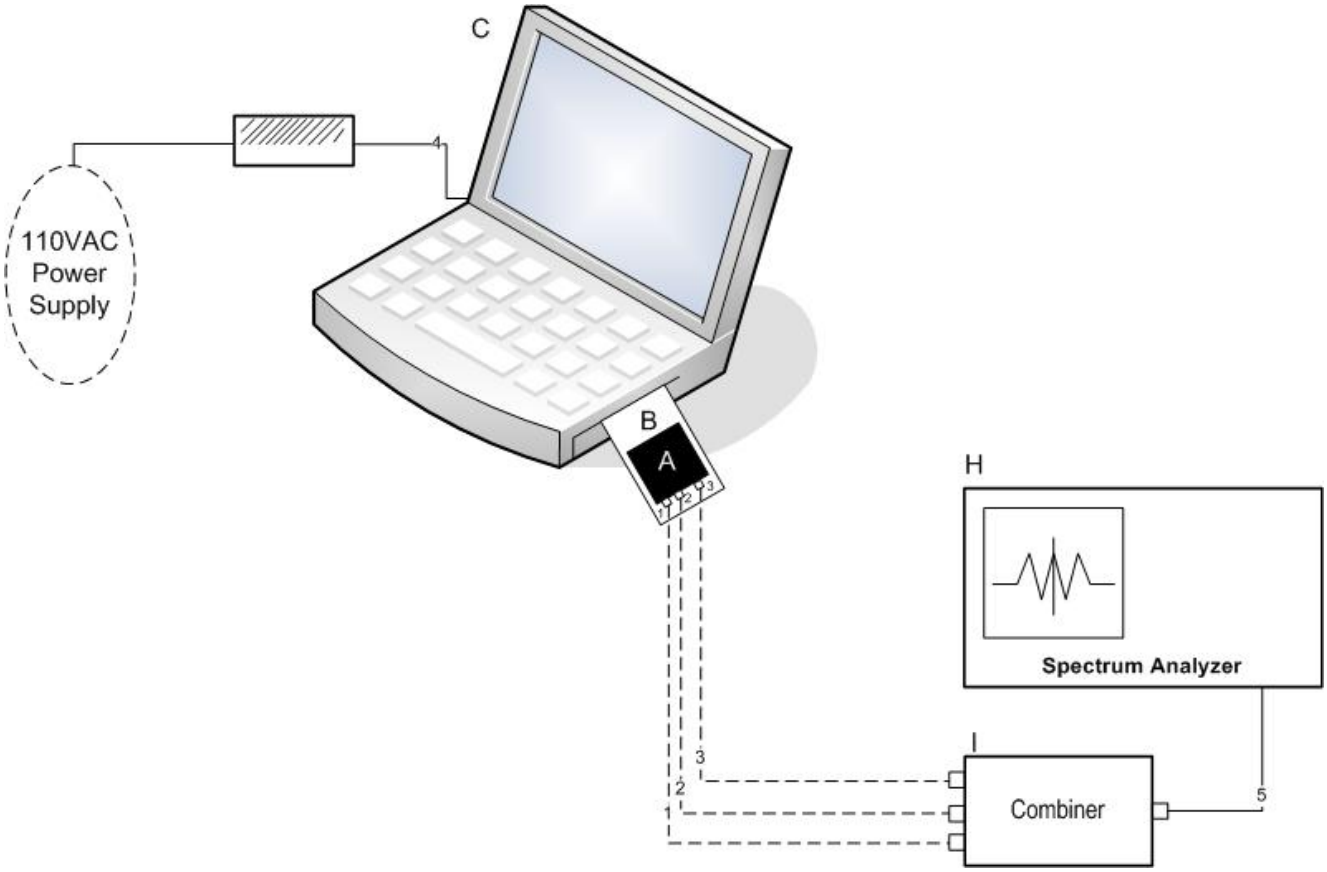


Figure 3. Block Diagram of Test Configuration (Combiner)

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	Rev. #
A	SR71 Radio Card	SR71	0801	

Table 4. Equipment Configuration

F. Support Equipment

Ubiquiti Networks supplied support equipment necessary for the operation and testing of the SR71. All support equipment supplied is listed in the following Support Equipment List.

Ref. ID	Name / Description	Manufacturer	Model Number	Serial Number
B	PCMIA Radio Card Adapter	VYTEK	STb601-RD07-01B	624
C	Laptop	IBM	Type 1844	LV-AMW16
D	3 MIMO Antennas	NA	NA	NA
E	2.4GHz Panel Antenna	Ubiquiti	NA	11-00027-05
F	5.8GHz Panel Antenna	Ubiquiti	NA	11-00064-02
G	5.8GHz Dish Antenna	LAIRD	DA58-29DISH	07400179
H	Spectrum Analyzer	Agilent	E4407B	MY45102898
I	Combiner	Mini Circuits	ZN4PD1-63-S+	SF103400728

Table 5. 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
Radiated Testing						
1	A, port 1	SMA	1	.5m	Yes	D or E or F or G
2	A, port 2	SMA	1	.5m	Yes	D
3	A, port 3	SMA	1	.5m	Yes	D
4	C, AC Power	Power Cord	1	2	No	110VAC Power Supply
Conducted Testing						
1	A, port 1	SMA	1	.5m	Yes	H
2	A, port 2	SMA	1	.5m	Yes	H
3	A, port 3	SMA	1	.5m	Yes	H
4	C, AC Power	Power Cord	1	2	No	110VAC Power Supply
Combiner Testing						
1	A, port 1	SMA	1	.5m	Yes	I
2	A, port 2	SMA	1	.5m	Yes	I
3	A, port 3	SMA	1	.5m	Yes	I
4	C, AC Power	Power Cord	1	2	No	110VAC Power Supply
5	I	SMA	1	1m	Yes	H

Table 6. Ports and Cabling Information

H. Mode of Operation

The EUT operates in OFDM & DSSS 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 Ubiquiti Networks upon completion of testing.

III. Electromagnetic Compatibility Criteria for Unintentional Radiators

Electromagnetic Compatibility Criteria

§ 15.107 Conducted Emissions Limits

Test Requirement(s):

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

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

15.207(a), Except as shown in paragraphs (b) and (c) of this section*, charging, AC adapters or battery eliminators 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 the Table 7, as measured using a 50 µH/50 ohms 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 frequencies ranges.

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

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

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

Test Engineer(s): Anderson Soungpanya

Test Date(s): April 25, 2008

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

Freq (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
.154	49.9	65.782	-15.882	Pass	20.81	55.782	-34.972	Pass
.466	39.62	56.602	-16.982	Pass	28.98	46.602	-17.622	Pass
.776	29.14	56	-26.86	Pass	22.97	46	-23.03	Pass

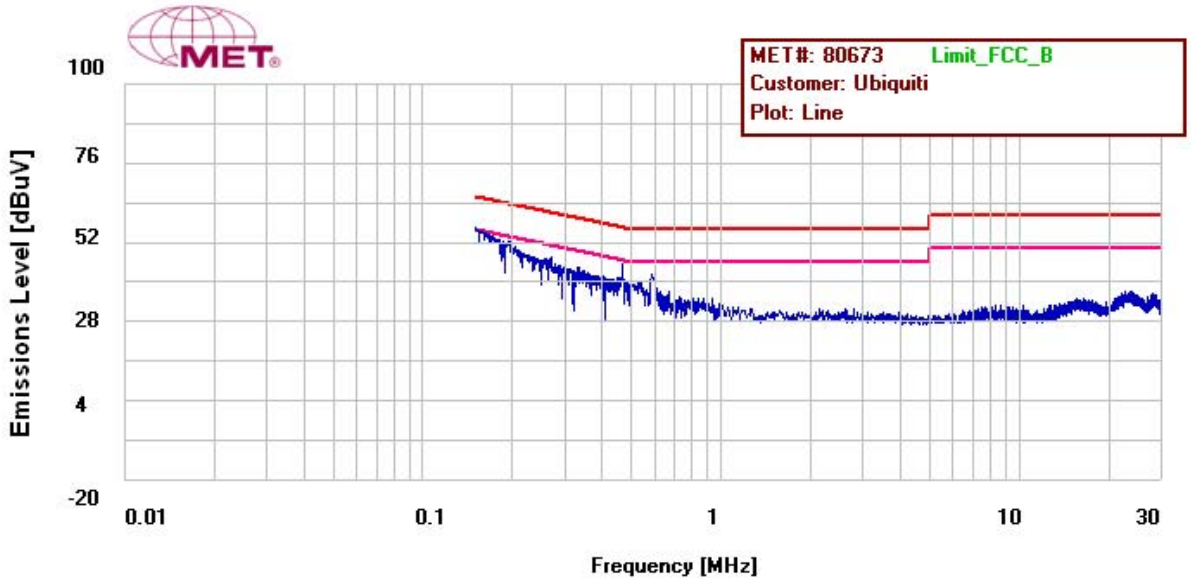
Table 8. Conducted Emissions - Voltage, AC Power, Phase Line (110 VAC, 60 Hz)

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

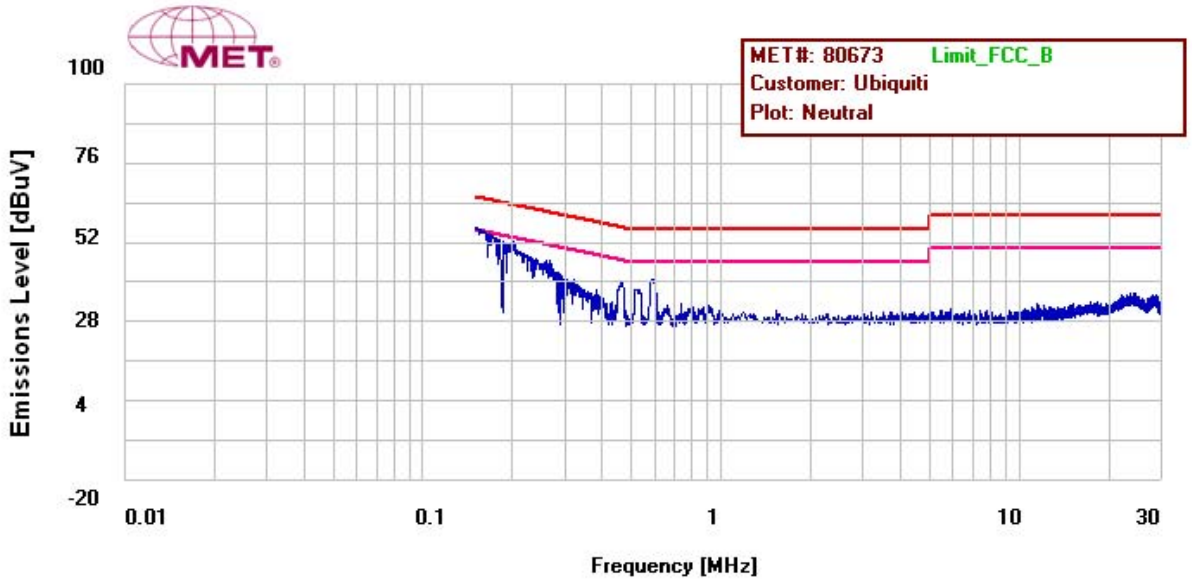
Freq (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
.150	50.7	66	-15.3	Pass	21.45	56	-34.55	Pass
.581	39.26	56	-16.74	Pass	33.12	46	-12.88	Pass
.466	37.83	56.602	-18.772	Pass	27.64	46.602	-18.962	Pass

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

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

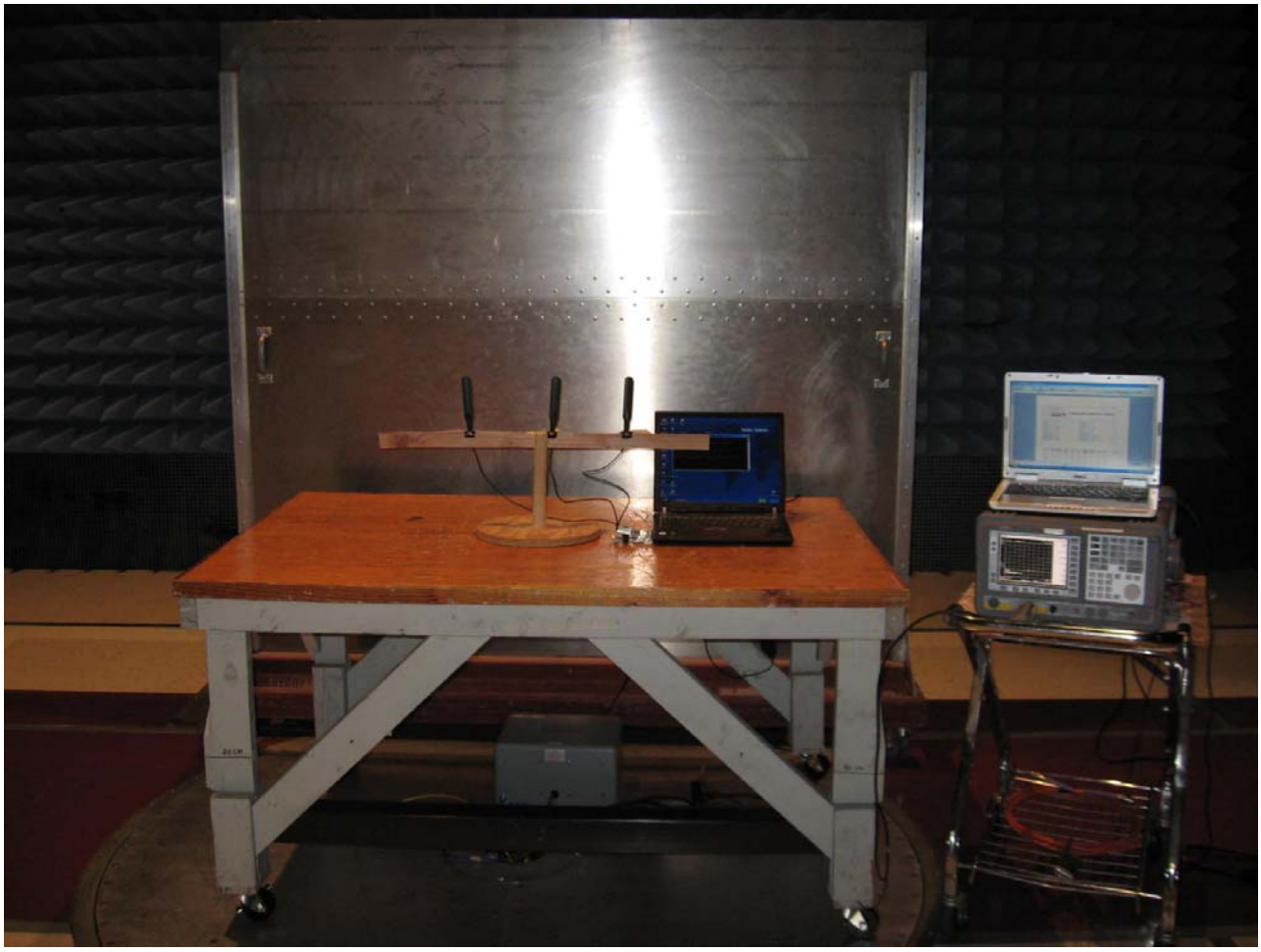


Conducted Emission, Phase Line Plots



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 10.

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

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

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

Test Procedures: The EUT was placed on a 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 to comply with the Class B requirement(s) of this section. Measured emissions were below applicable limits

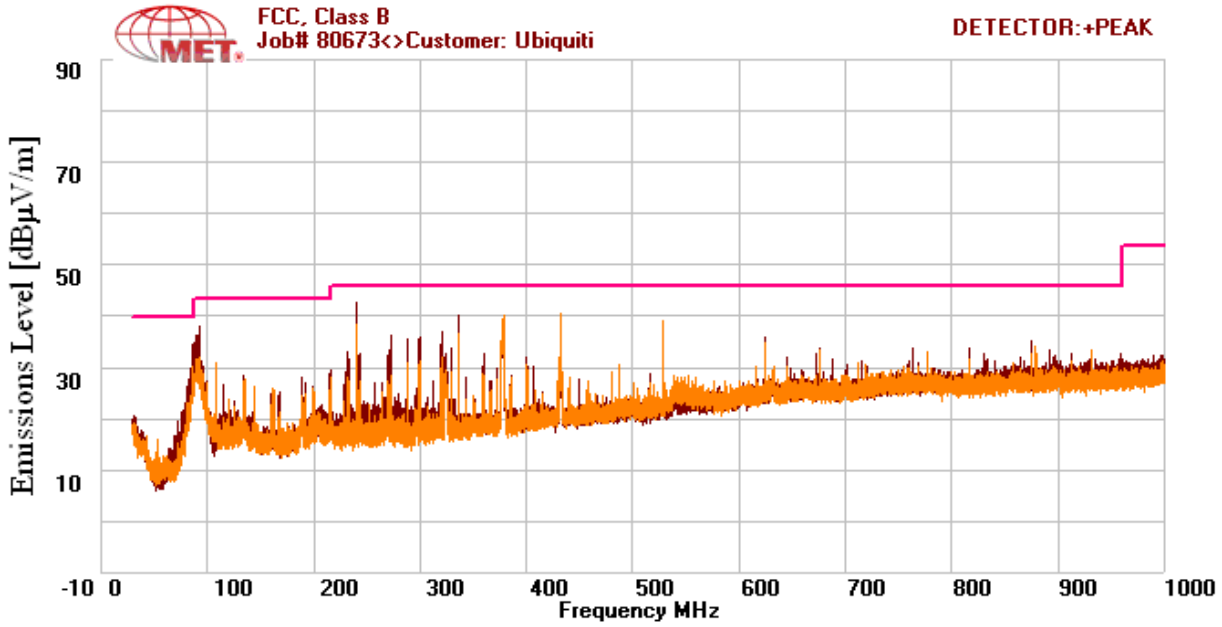
Test Engineer(s): Anderson Soungpanya

Test Date(s): April 25, 2008

Radiated Emissions Limits Test Results, Class B

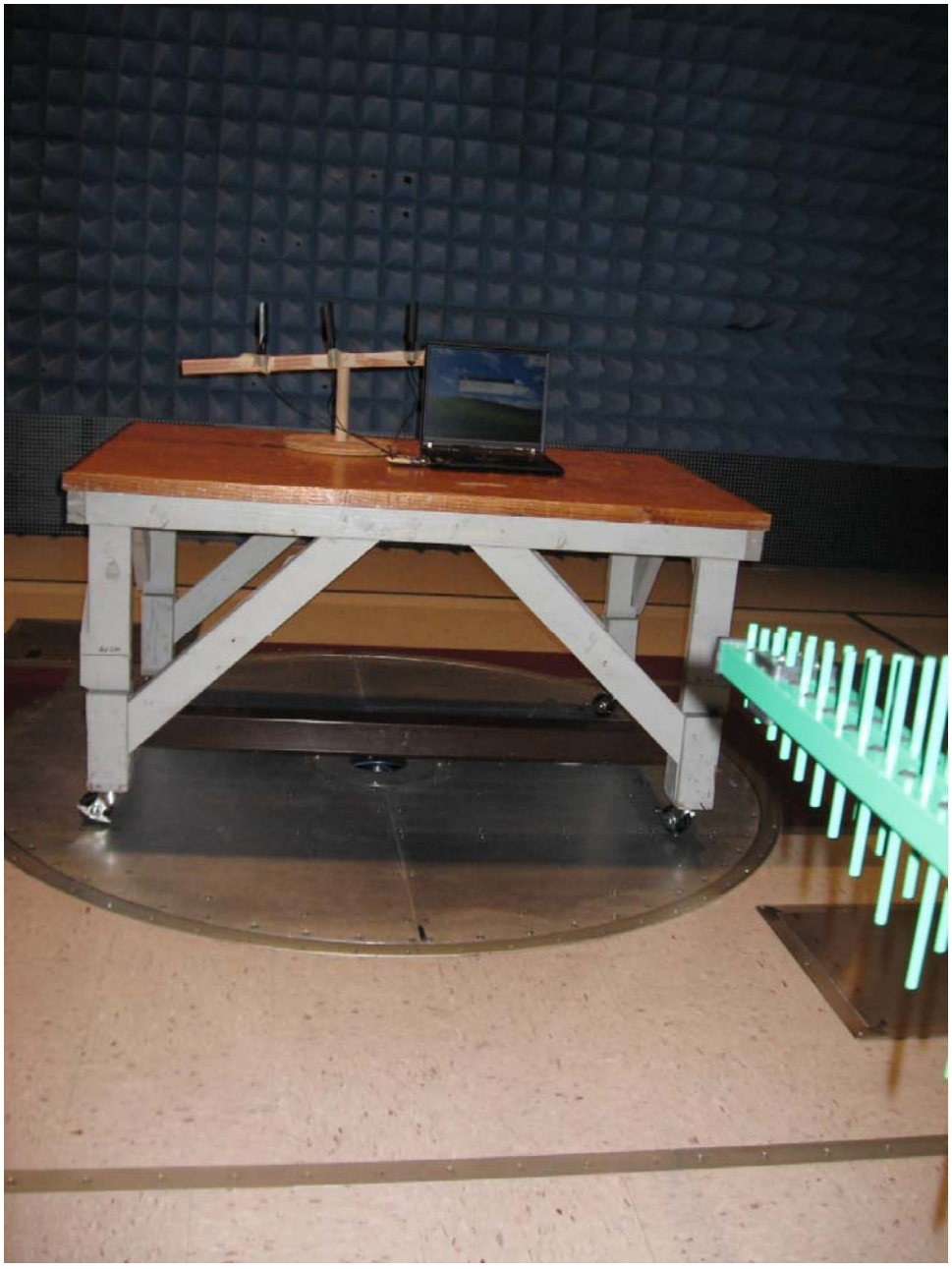
Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	CBL (dB)	Corrected Amplitude (dBuV)	Limit (dBuV)	Margin (dB)
89.722	H	164	366	27.766	9.056	1.226	38.048	43.5	-5.452
239.99	H	98	100	28.25	12.199	2.218	42.667	46	-3.333
335.99	H	170	100	24.32	14.7	2.737	41.757	46	-4.243
431.99	V	0	125	19.4	16.7	3.271	39.371	46	-6.629
379.25	V	47	100	21.42	15.615	2.946	39.981	46	-6.019
239.99	V	43	188	26.766	12.199	2.218	41.183	46	-4.817

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



Plot 1. Radiated Emissions Limits Test Results, 30 MHz – 1 GHz, Class B

Radiated Emission Limits Test Setup



Photograph 3. Radiated Emission Test Setup 30 MHz - 1 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 virtue of having professionally installed. The EUT is therefore compliant with §15.203.

Gain	Type	Model	Manufacturer
32dBi	Dish	HDDA5W-32	Pacific Wireless
5dBi	Omni	Omni24-5	Ubiquiti Networks
17dBi	Panel (2.4GHz)	Panel5-17	Ubiquiti Networks
20dBi	Panel (5.8GHz)	Panel5-20	Ubiquiti Networks

Test Engineer(s): Minh Ly

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207 Conducted Emissions Limits

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

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

Table 12. 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 μH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.4-1992 "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 μH LISN as the input transducer to an EMC/field intensity meter. The tests were conducted in a RF-shielded enclosure.

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

Test Engineer(s): Anderson Soungpanya

Test Date(s): April 25, 2008

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

Freq (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
.160	48.56	65.465	-16.905	Pass	20.33	55.465	-35.135	Pass
.333	36.36	59.394	-23.034	Pass	24.34	49.394	-25.054	Pass
.580	37.07	56	-18.93	Pass	30.41	46	-15.59	Pass

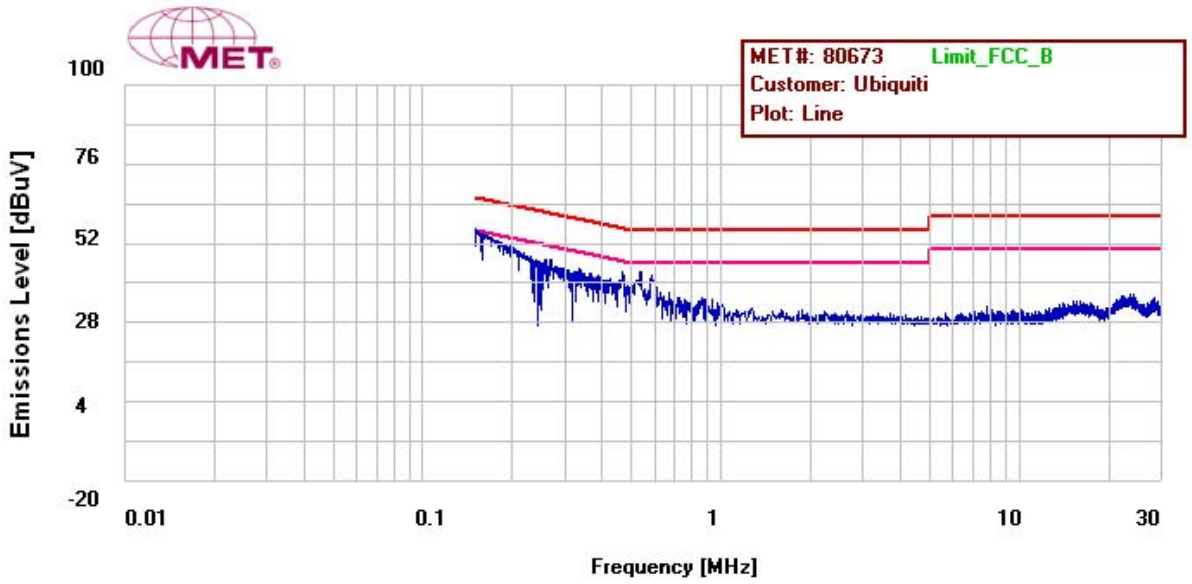
Table 13. Conducted Emissions - Voltage, AC Power, Phase Line (110 VAC, 60 Hz)

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

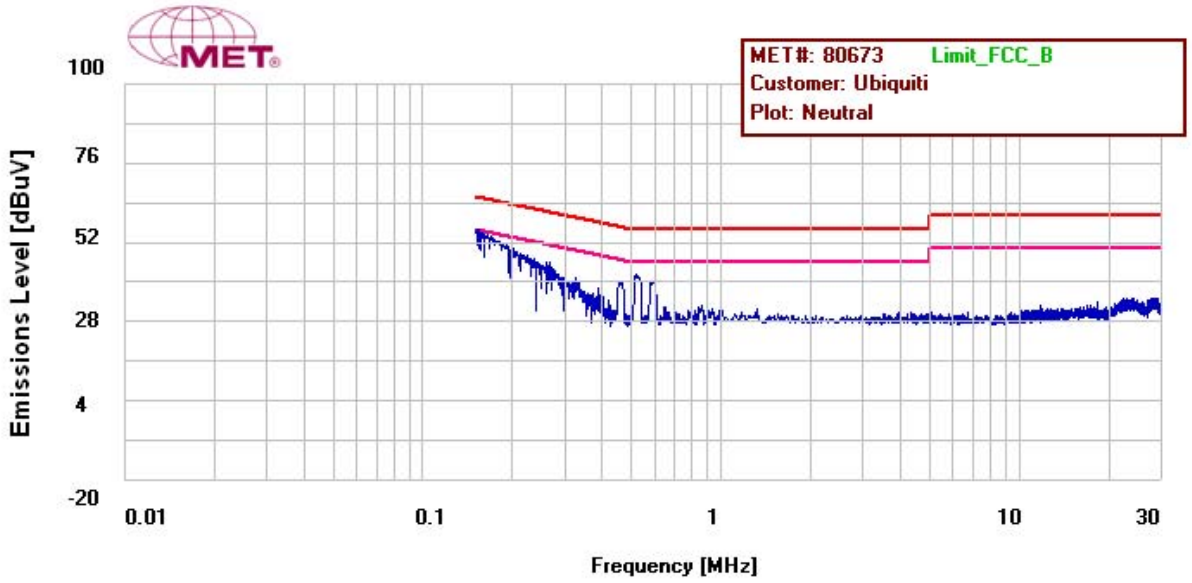
Freq (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
.150	49.84	66	-16.16	Pass	20.97	56	-35.03	Pass
.518	40.22	56	-15.78	Pass	34.04	46	-11.96	Pass
.467	35.15	56.583	-21.433	Pass	23.67	46.583	-22.913	Pass

Table 14. 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

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a) 6 dB and 99% Bandwidth

Test Requirements: **§ 15.247(a):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

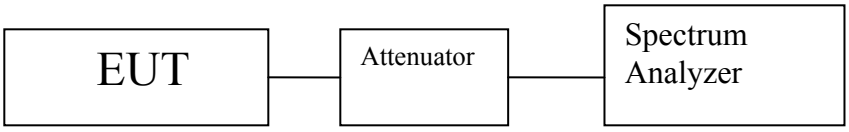
For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

Test Procedure: The transmitter was set to the mid channel at the highest output power and connected to the spectrum analyzer through an attenuator and a directional coupler. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately 1% of the total emission bandwidth, VBW > RBW. The 6 dB Bandwidth was measured and recorded. The measurements were repeated at the low and high channels.

Test Results Equipment complies with § 15.247 (a). The 6 dB and 99% Bandwidth was determined from the plots on the following pages.

Test Engineer(s): Minh Ly

Test Date(s): January 23, 25, 29 and April 25, 2008



Block Diagram 1. Occupied Bandwidth Test Setup

802.11a mode			
Carrier Channel	**Frequency (MHz)**	**Measured 6 dB Bandwidth (MHz)**	**Measured 99% Bandwidth (MHz)**
Low	5745	16.338	16.7336
Mid	5785	15.958	16.7435
High	5825	16.200	16.7163

Table 15. Occupied Bandwidth Summary Results for 802.11a mode (Port 1)

802.11b mode			
Carrier Channel	**Frequency (MHz)**	**Measured 6 dB Bandwidth (MHz)**	**Measured 99% Bandwidth (MHz)**
Low	2412	9.992	15.3524
Mid	2437	11.052	15.5074
High	2462	10.441	15.4148

Table 16. Occupied Bandwidth Summary Results for 802.11b mode (Port 1)

802.11g mode			
Carrier Channel	**Frequency (MHz)**	**Measured 6 dB Bandwidth (MHz)**	**Measured 99% Bandwidth (MHz)**
Low	2412	16.106	16.5201
Mid	2437	16.290	16.6638
High	2462	15.392	16.5915

Table 17. Occupied Bandwidth Summary Results for 802.11g mode (Port 1)

802.11n mode (20MHz)			
Carrier Channel	**Frequency (MHz)**	**Measured 6 dB Bandwidth (MHz)**	**Measured 99% Bandwidth (MHz)**
Low	2412	17.597	17.7934
Mid	2437	16.921	17.6880
High	2462	16.929	17.8242
802.11n mode (40MHz)			
Carrier Channel	**Frequency (MHz)**	**Measured 6 dB Bandwidth (MHz)**	**Measured 99% Bandwidth (MHz)**
Mid	2437	36.324	36.6478

Table 18. Occupied Bandwidth Summary Results for 802.11n mode (Port 1)

802.11n mode (20MHz)			
Carrier Channel	**Frequency (MHz)**	**Measured 6 dB Bandwidth (MHz)**	**Measured 99% Bandwidth (MHz)**
Low	2412	16.970	17.7345
Mid	2437	17.376	17.6949
High	2462	17.231	17.6916
802.11n mode (40MHz)			
Carrier Channel	**Frequency (MHz)**	**Measured 6 dB Bandwidth (MHz)**	**Measured 99% Bandwidth (MHz)**
Mid	2437	36.262	36.6432

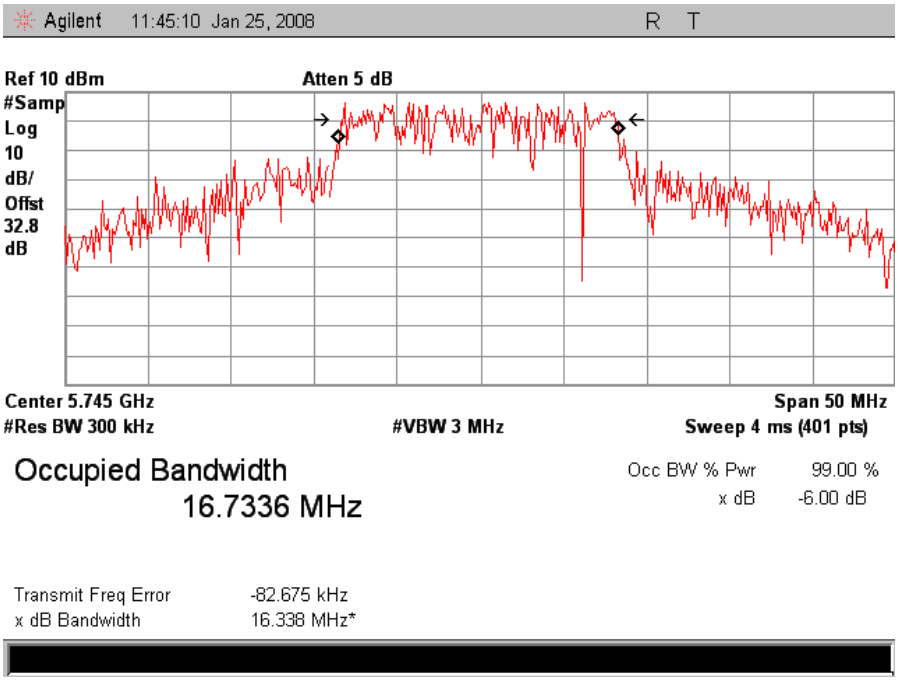
Table 19. Occupied Bandwidth Summary Results for 802.11n mode (Port 2)

802.11n mode (20MHz)			
Carrier Channel	**Frequency (MHz)**	**Measured 6 dB Bandwidth (MHz)**	**Measured 99% Bandwidth (MHz)**
Low	2412	17.029	17.7189
Mid	2437	17.362	17.7731
High	2462	15.210	17.7498
802.11n mode (40MHz)			
Carrier Channel	**Frequency (MHz)**	**Measured 6 dB Bandwidth (MHz)**	**Measured 99% Bandwidth (MHz)**
Mid	2437	36.123	36.5008

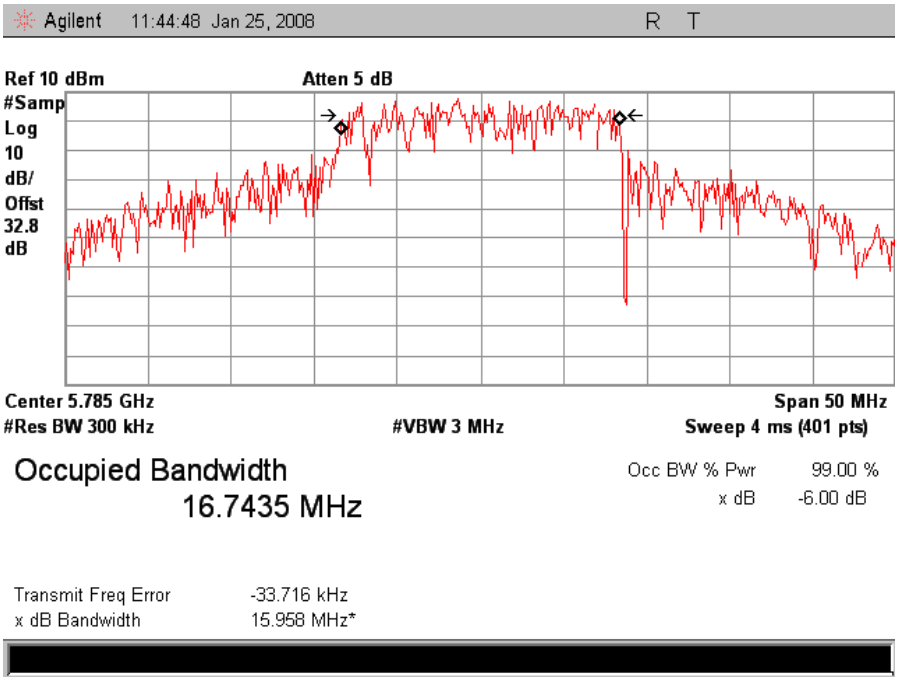
Table 20. Occupied Bandwidth Summary Results for 802.11n mode (Port 3)

Electromagnetic Compatibility Criteria for Intentional Radiators

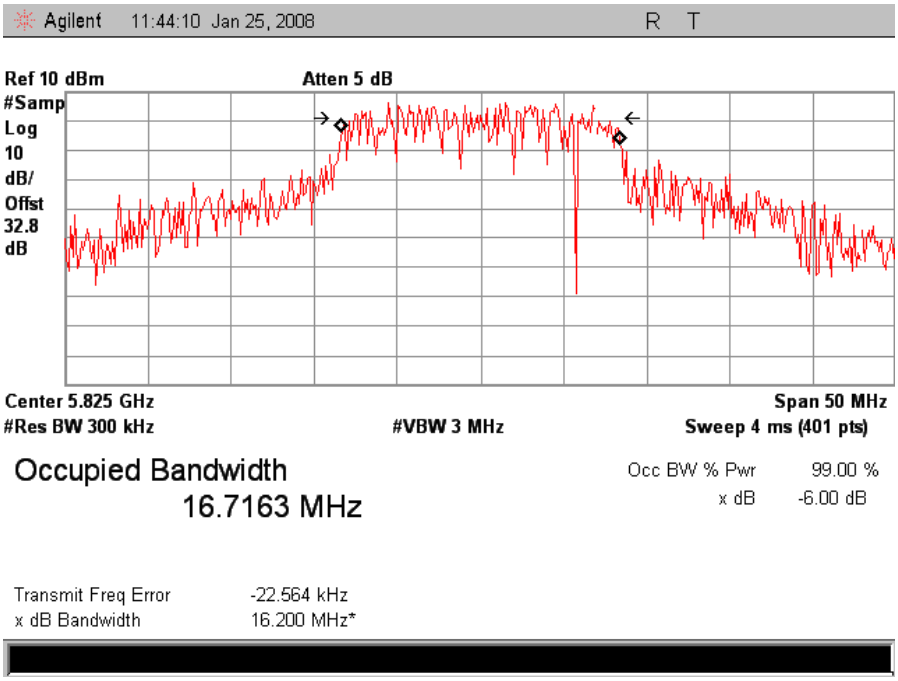
Occupied Bandwidth Test Plots – Port 1, 802.11a/b/g/n



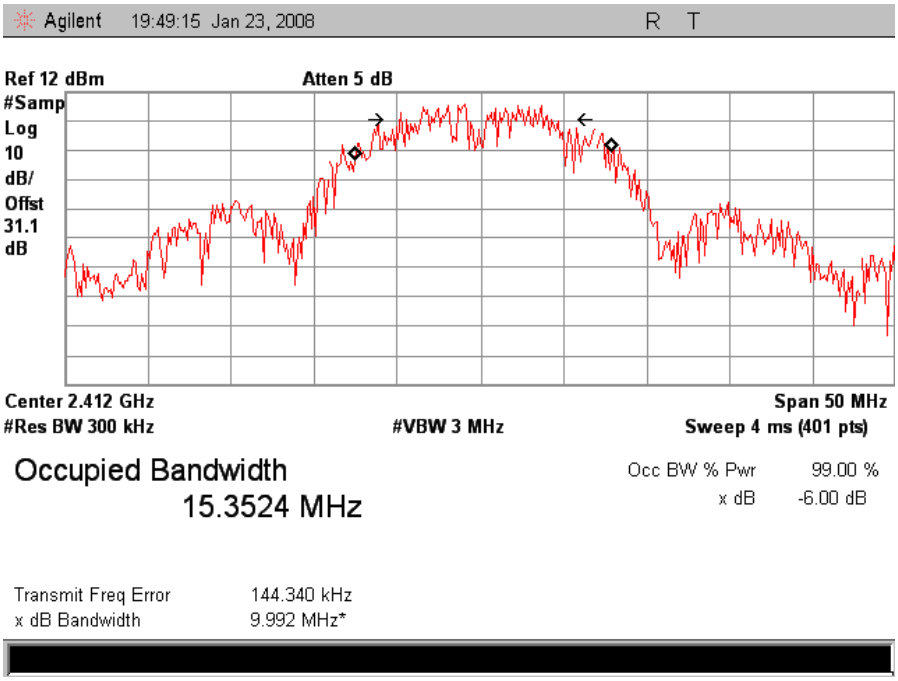
Plot 2. 802.11/a Low Ch Occupied Band Width.



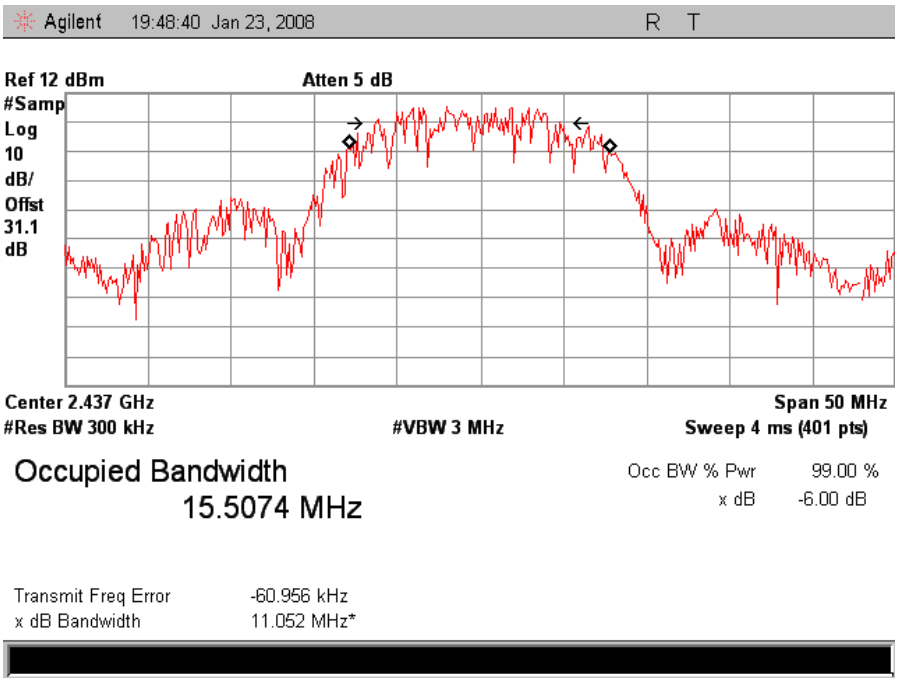
Plot 3. 802.11/a Mid Ch Occupied Band Width



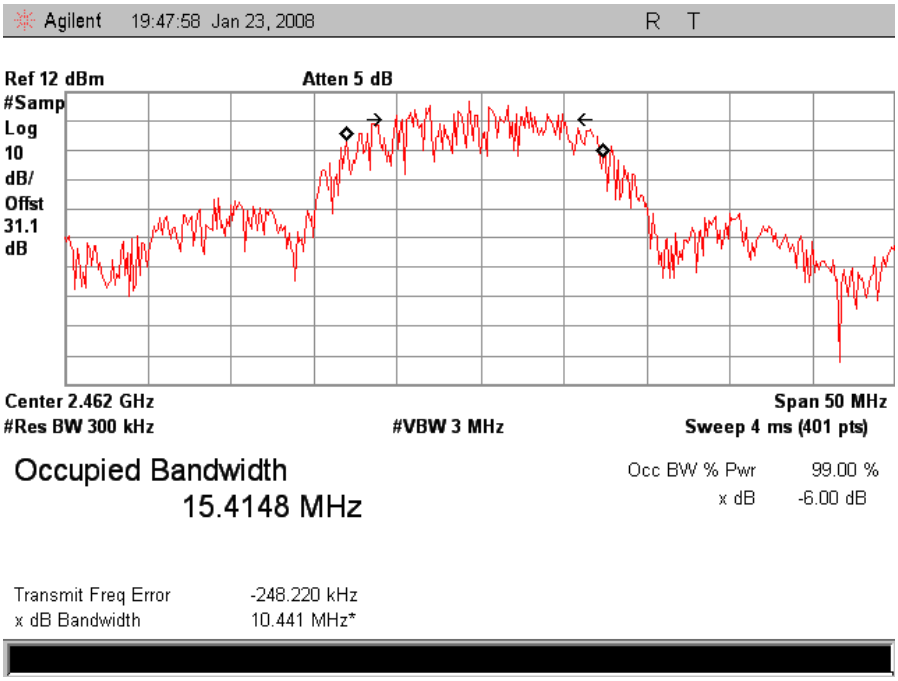
Plot 4. 802.11/a High Ch Occupied Band Width



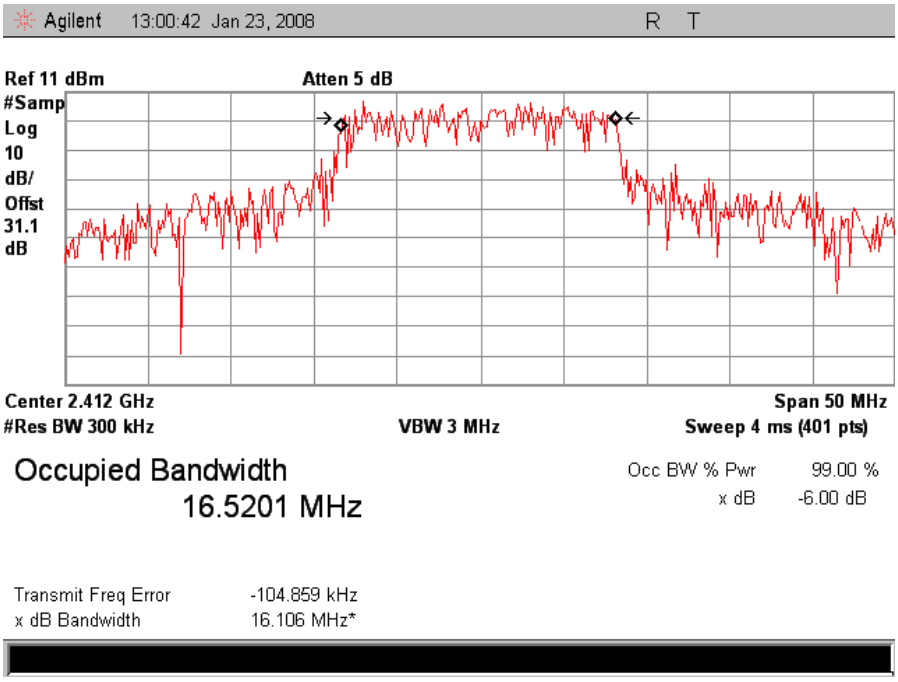
Plot 5. 802.11/b Low Ch Occupied Band Width.



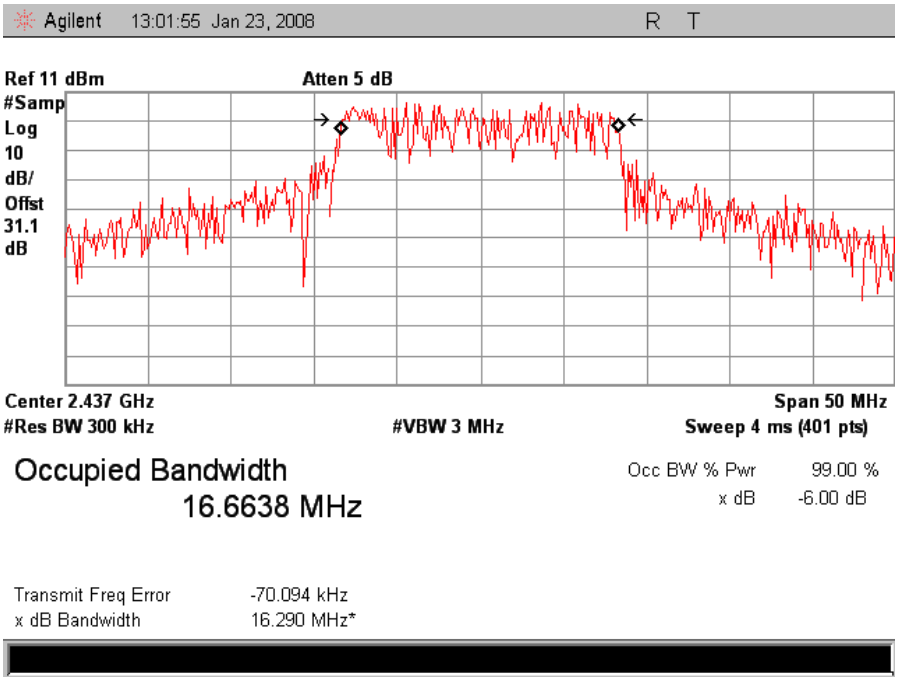
Plot 6. 802.11/b Mid Ch Occupied Band Width



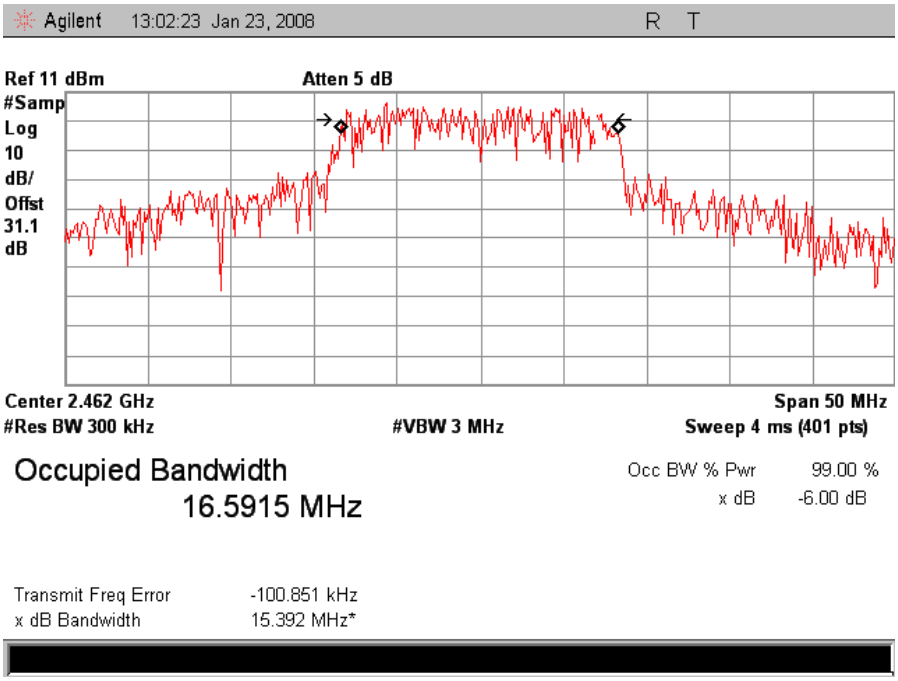
Plot 7. 802.11/b High Ch Occupied Band Width



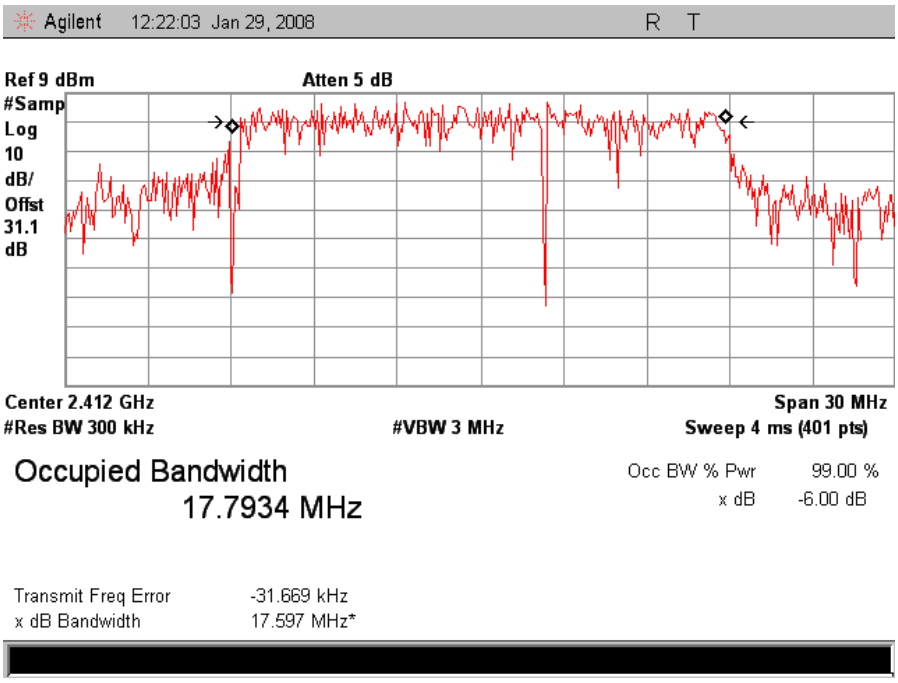
Plot 8. 802.11/g Low Ch Occupied Band Width



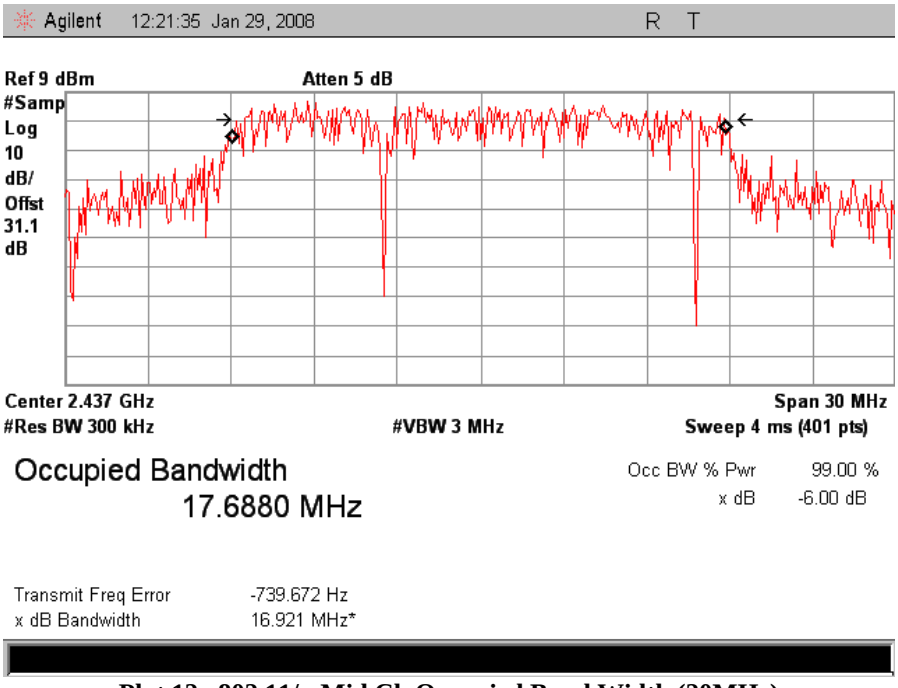
Plot 9. 802.11/g Mid Ch Occupied Band Width



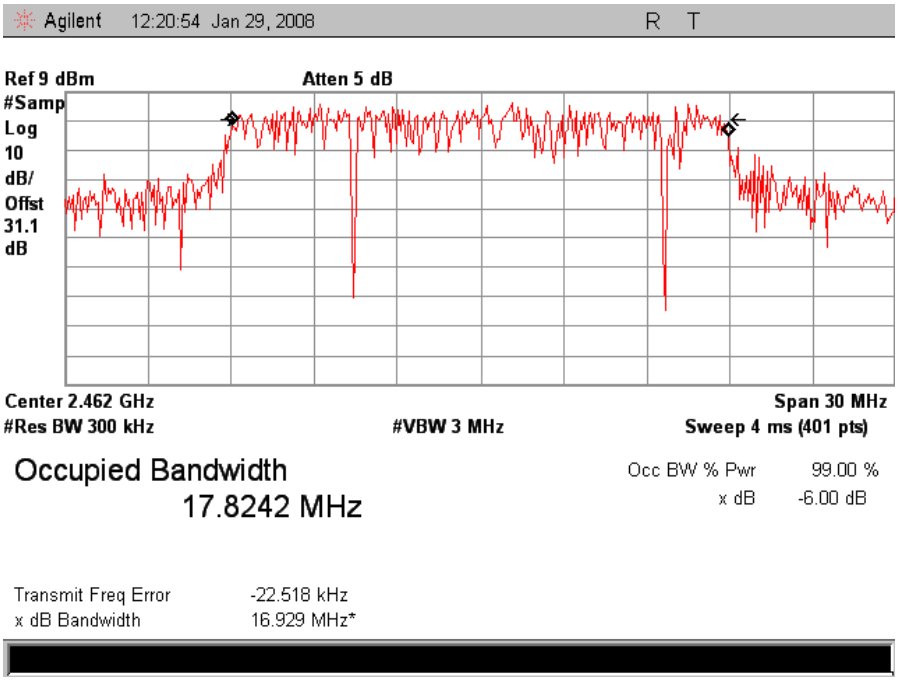
Plot 10. 802.11/g High Ch Occupied Band Width



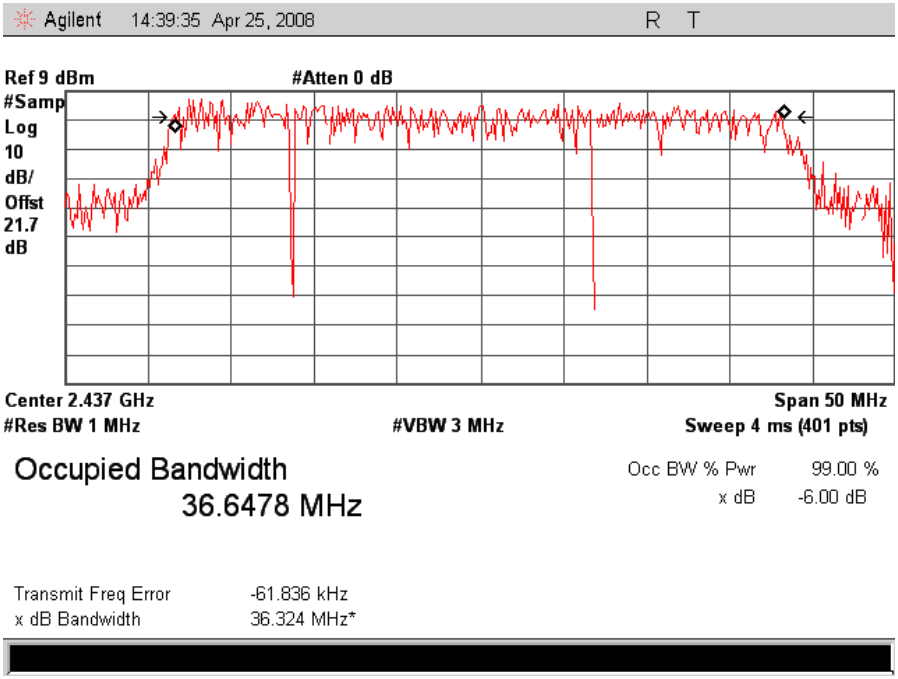
Plot 11. 802.11/n Low Ch Occupied Band Width.(20MHz)



Plot 12. 802.11/n Mid Ch Occupied Band Width (20MHz)

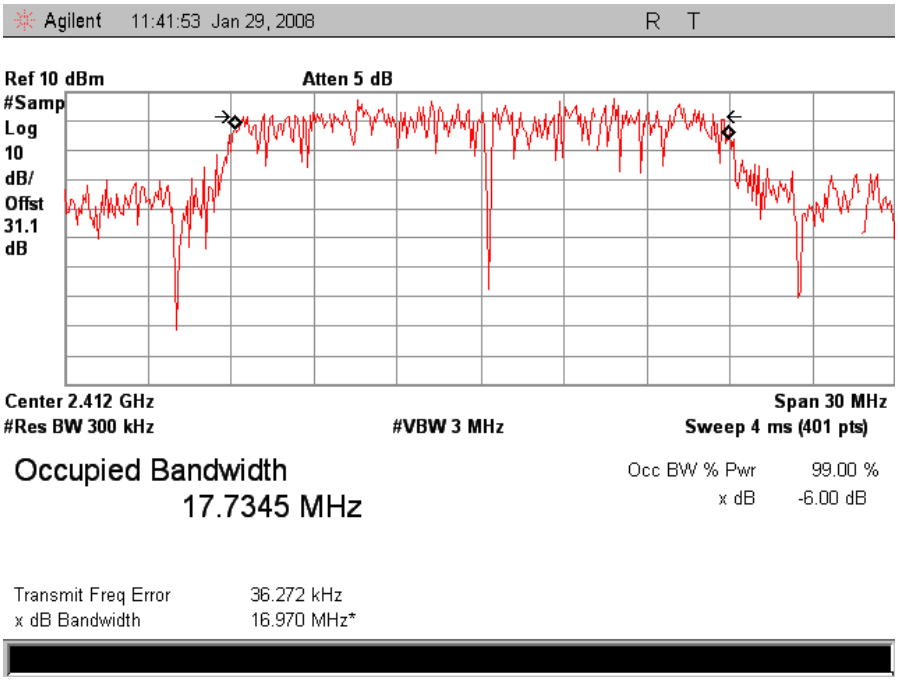


Plot 13. 802.11/n High Ch Occupied Band Width (20MHz)

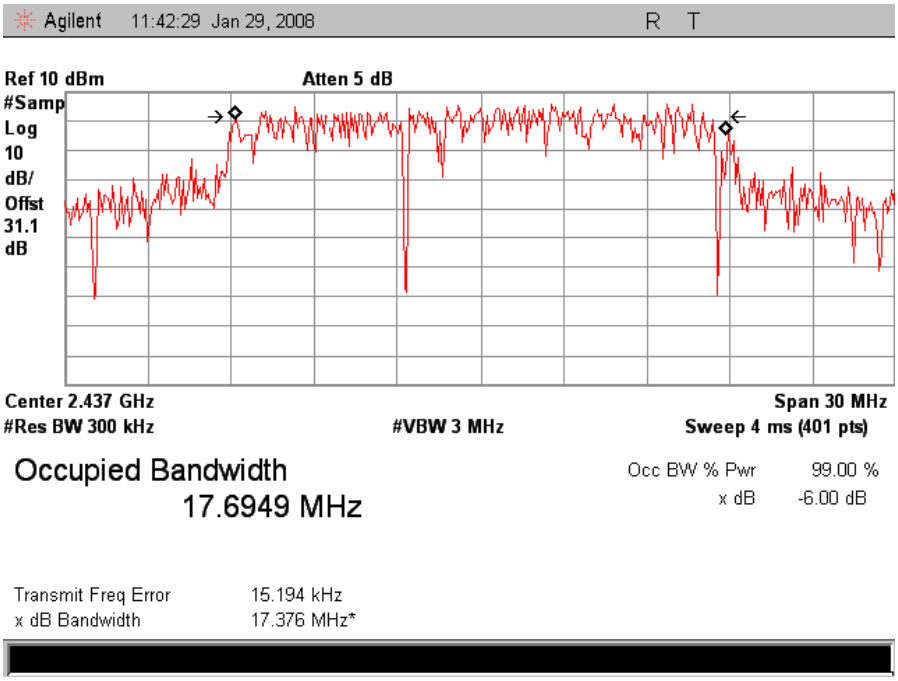


Plot 14. 802.11/n Mid Ch Occupied Band Width (40MHz)

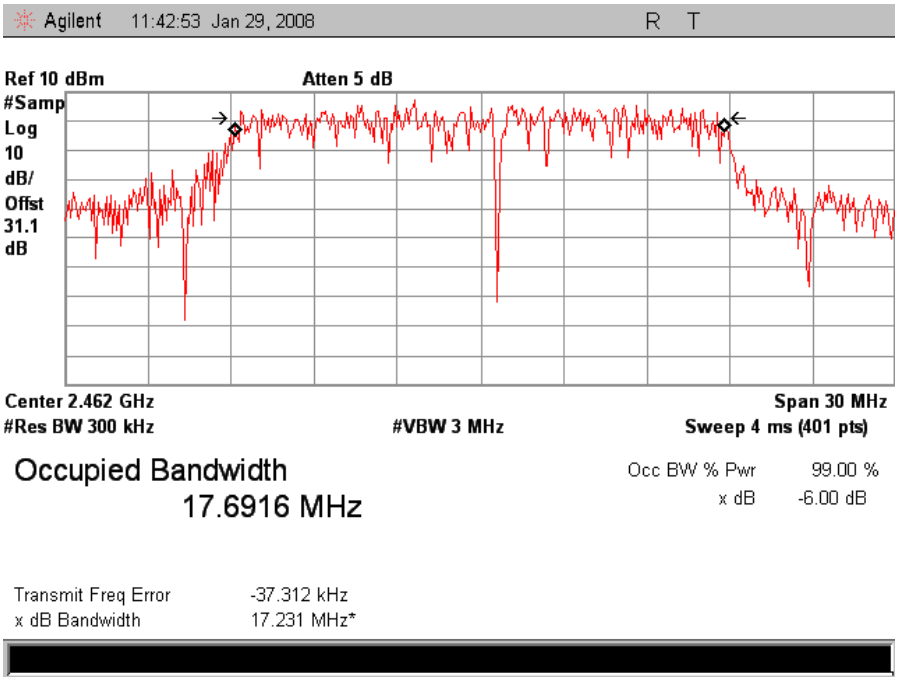
Occupied Bandwidth Test Plots – Port 2, 802.11n



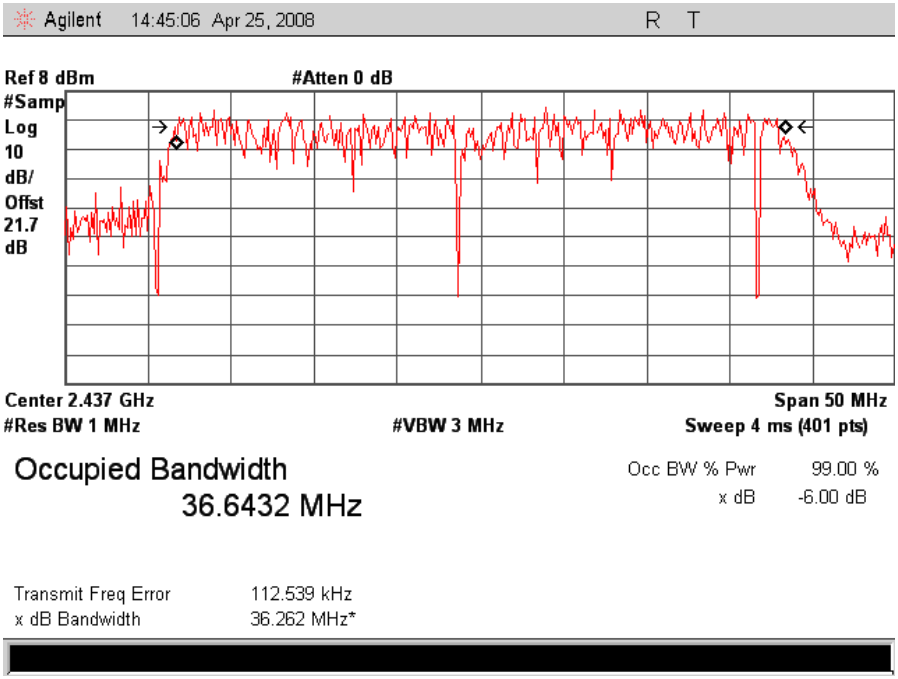
Plot 15. 802.11/n Low Ch Occupied Band Width.(20MHz)



Plot 16. 802.11/n Mid Ch Occupied Band Width (20MHz)

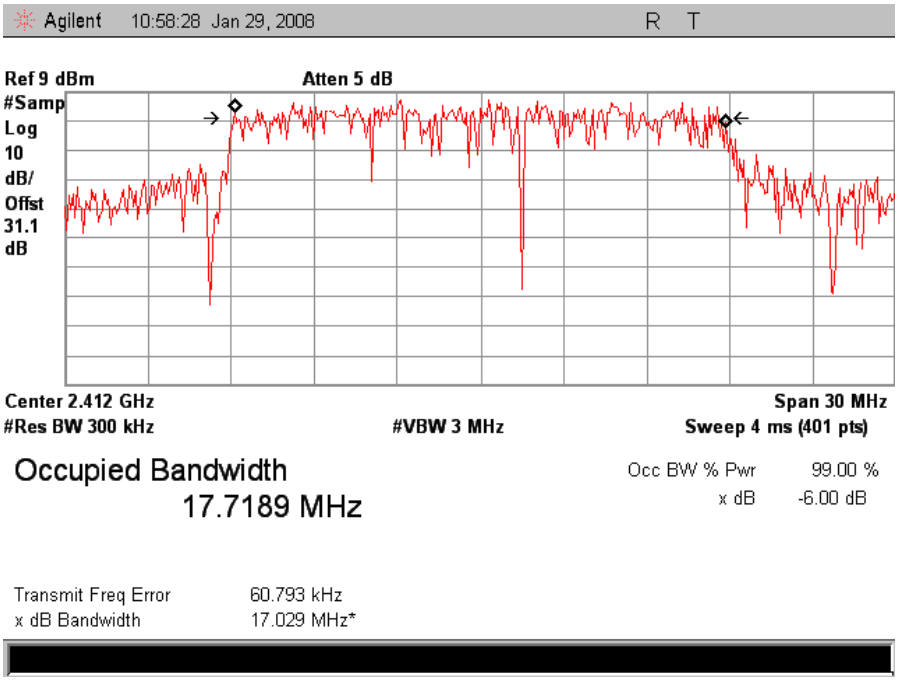


Plot 17. 802.11/n High Ch Occupied Band Width (20MHz)

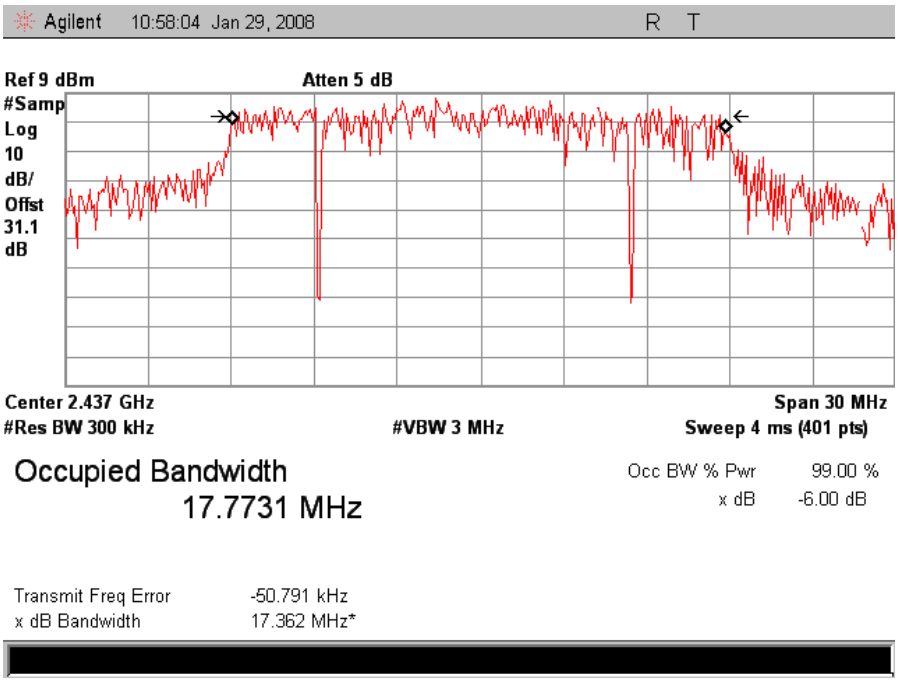


Plot 18. 802.11/n Mid Ch Occupied Band Width (40MHz)

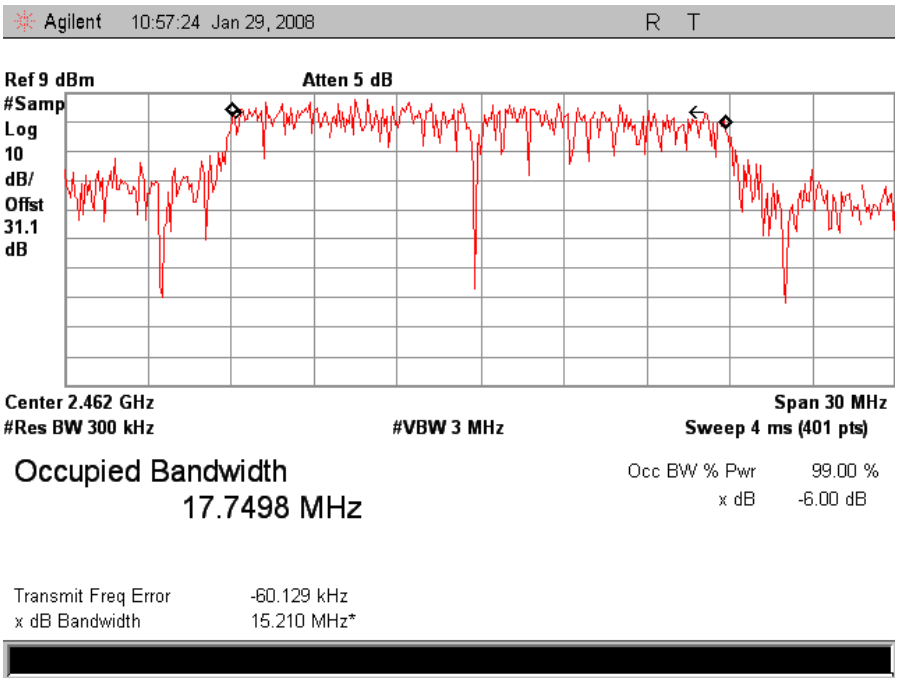
Occupied Bandwidth Test Plots – Port 3, 802.11n (20MHz)



Plot 19. 802.11/n Low Ch Occupied Band Width.

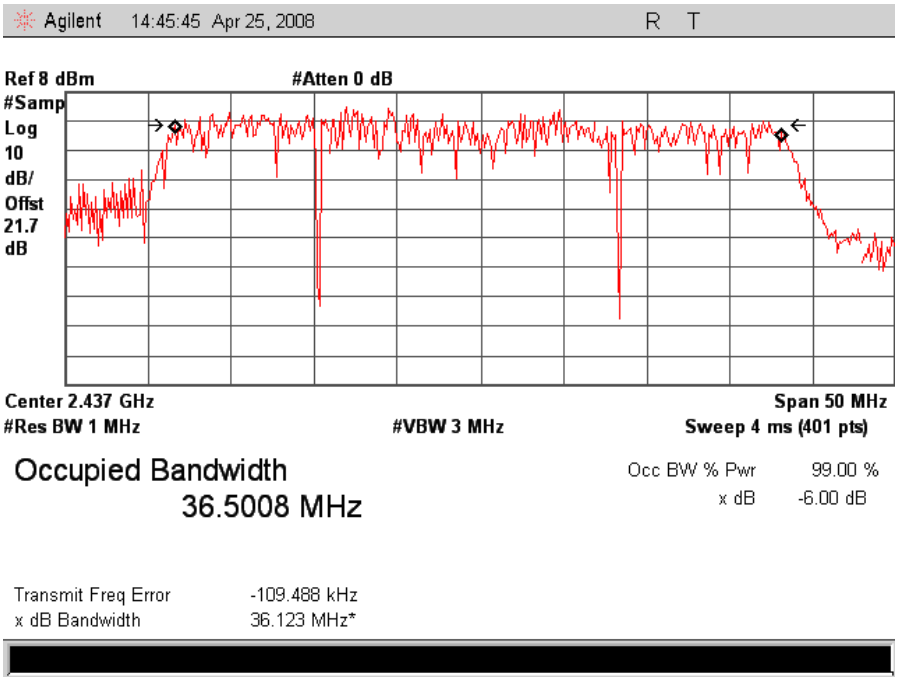


Plot 20. 802.11/n Mid Ch Occupied Band Width



Plot 21. 802.11/n High Ch Occupied Band Width

Occupied Bandwidth Test Plots – Port 3, 802.11n (40MHz)



Plot 22. 802.11/n Mid Ch Occupied Band Width

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output and RF Exposure

Test Requirements: **§15.247(b):** The maximum peak output power of the intentional radiator shall not exceed the following:

Digital Transmission Systems (MHz)	Output Limit (Watts)
902-928	1.000
2400–2483.5	1.000
5725– 5850	1.000

Table 21. Output Power Requirements from §15.247

§15.247(c): if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in the Table 21, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400 – 2483.5 MHz band may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

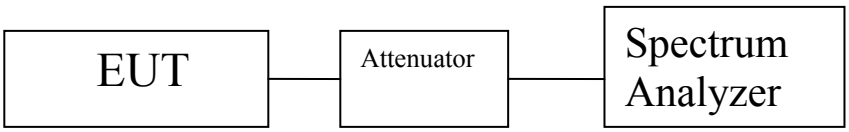
Fixed, point-to-point operation excludes the use of point-to-multipoint systems, omni-directional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

Test Procedure: The transmitter was connected to a calibrated Power Meter. The EUT was measured at the low, mid and high channels of each band at a data rate which gave the maximum power level.

Test Results: Equipment complies with the Peak Power Output limits of **§ 15.247(b)**.

Test Engineer(s): Minh Ly

Test Date(s): January 29, April 3 and 4 2008



Block Diagram 2. Peak Power Output Test Setup

RF Output Power Test Results –802.11a/b/g

802.11a mode		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm**
Low	5745	24.75
Mid	5785	24.63
High	5825	24.35

Table 22. RF Output Power Results – Port 1, 802.11a mode

802.11b mode		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm**
Low	2412	23.78
Mid	2437	23.68
High	2462	23.65

Table 23. RF Output Power Results – Port 1, 802.11b mode

802.11g mode		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm**
Low	2412	21.94
Mid	2437	21.82
High	2462	21.61

Table 24. RF Output Power Results – Port 1, 802.11g mode

RF Output Power Test Results – 802.11n

802.11n mode		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm**
Low	2412	19.79
Mid	2437	19.64
High	2462	19.50

Table 25. RF Output Power Results – Port 1, 802.11n mode (20MHz)

802.11n mode		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm**
Mid	2437	21.75

Table 26. RF Output Power Results – Port 1, 802.11n mode (40MHz)

802.11n mode		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm**
Low	2412	19.46
Mid	2437	19.49
High	2462	19.42

Table 27. RF Output Power Results – Port 2, 802.11n mode (20MHz)

802.11n mode		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm**
Mid	2437	22.35

Table 28. RF Output Power Results – Port 2, 802.11n mode (40MHz)

802.11n mode		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm**
Low	2412	19.96
Mid	2437	19.83
High	2462	19.78

Table 29. RF Output Power Results – Port 3, 802.11n mode (20MHz)

802.11n mode		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm**
Mid	2437	22.81

Table 30. RF Output Power Results – Port 3, 802.11n mode (40MHz)

802.11n mode						
Carrier Channel	**Frequency (MHz)**	**Port 1 (dBm)**	**Port 2 (dBm)**	**Port 3 (dBm)**	**Total (dBm)**	**Total (W)**
Low	2412	19.79	19.46	19.96	23.91	0.246
Mid	2437	19.64	19.49	19.83	24.40	0.275
High	2462	19.50	19.42	19.78	24.30	0.269

Table 31. RF Output Power Results – All Ports, 802.11n mode (20MHz)

Note: Total Output Power = Port 1 (10^(Output Power/10)/1000) + Port 2 (10^(Output Power/10)/1000) + Port 3 (10^(Output Power/10)/1000)

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output and RF Exposure

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

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

MPE Limit Calculation: EUT's operating frequencies @ 2412-2462 MHz; highest conducted power = **24.40dBm** (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

EUT maximum antenna gain **= 5 dBi Omni**

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

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

where, S = Power Density (mW/cm^2)
P = Power Input to antenna (275.4229mW)
G = Antenna Gain (3.16 numeric)

$S = (275.4*3.16/ 4*3.14*20.0^2) = (870.9636 / 5024)$ = **0.173 mW/cm^2**@ 20cm separation

MPE Limit Calculation: EUT's operating frequencies @ 2412-2462 MHz; highest conducted power = **24.40dBm** (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

EUT maximum antenna gain = **17 dBi Panel**

where, S = Power Density (mW/cm^2)
P = Power Input to antenna (275.4229mW)
G = Antenna Gain (50.11 numeric)

$R = (275.4*50.11/ 4*3.14*1.0)^{1/2} = (13803.84 / 12.56)^{1/2}$ = **33.15cm**

§ 15.247(b) Peak Power Output and RF Exposure

MPE Limit Calculation: EUT's operating frequencies @ 5745-5825 MHz; highest conducted power = **24.75dBm** (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

EUT maximum antenna gain = **20dBi Panel Antenna**

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

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

where, S = Power Density (mW/cm^2)
P = Power Input to antenna (298.5383mW)
G = Antenna Gain (100 numeric)

$R = (298.5*100/ 4*3.14*1.0)^{1/2} = (29853.83 / 12.56)^{1/2}$ = **48.75cm**

MPE Limit Calculation: EUT's operating frequencies @ 5745-5825 MHz; highest conducted power = **24.75dBm** (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

EUT maximum antenna gain = **32dBi Panel Antenna**

where, S = Power Density (mW/cm^2)
P = Power Input to antenna (298.5383mW)
G = Antenna Gain (1584.893 numeric)

$R = (298.5*1584.893/ 4*3.14*1.0)^{1/2} = (473151.3 / 12.56)^{1/2}$ = **194.09cm**

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Harmonic Emissions – Radiated and Conducted

Test Requirements: **§15.247(d)**; **§15.205, §15.209:** Emissions outside the frequency band.

§15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

§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 32. Restricted Bands of Operation

[1] Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.
[2] Above 38.6

Test Procedure:

The transmitter was set to the mid channel at the highest output power and placed on a 0.8 m high wooden table inside in a semi-anechoic chamber. Measurements were performed with the EUT rotated 360 degrees and varying the adjustable antenna mast with 1 m to 4 m height to determine worst case orientation for maximum emissions. Measurement were repeated the measurement at the low and highest channels.

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

For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

In accordance with §15.35(b) the limit on the radio frequency emissions as measured using instrumentation with a peak detector function shall be 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules.

EUT Field Strength Final Amplitude = Raw Amplitude – Preamp gain + Antenna Factor + Cable Loss – Distance Correction Factor (1 meter)

Test Results:

The EUT was found compliant with the Radiated Emission limits of **§15.247(d)**; **§15.205, §15.209** for Intentional Radiators. See following pages for detailed test results.

Test Engineer(s):

Anderson Soungpanya and Minh Ly

Test Date(s):

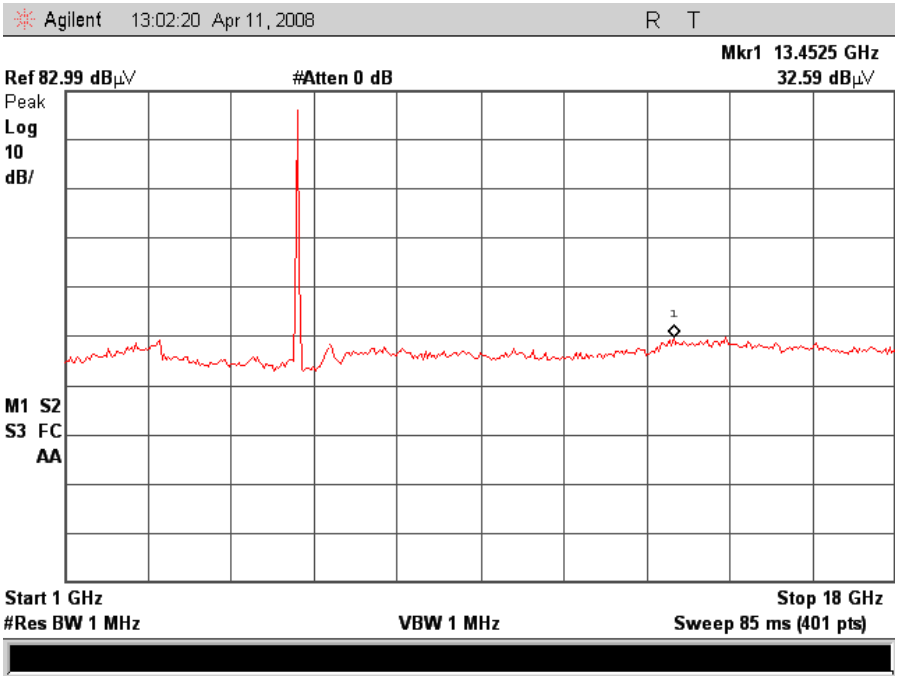
April 2, 11 and 21, 2008

Electromagnetic Compatibility Criteria for Intentional Radiators

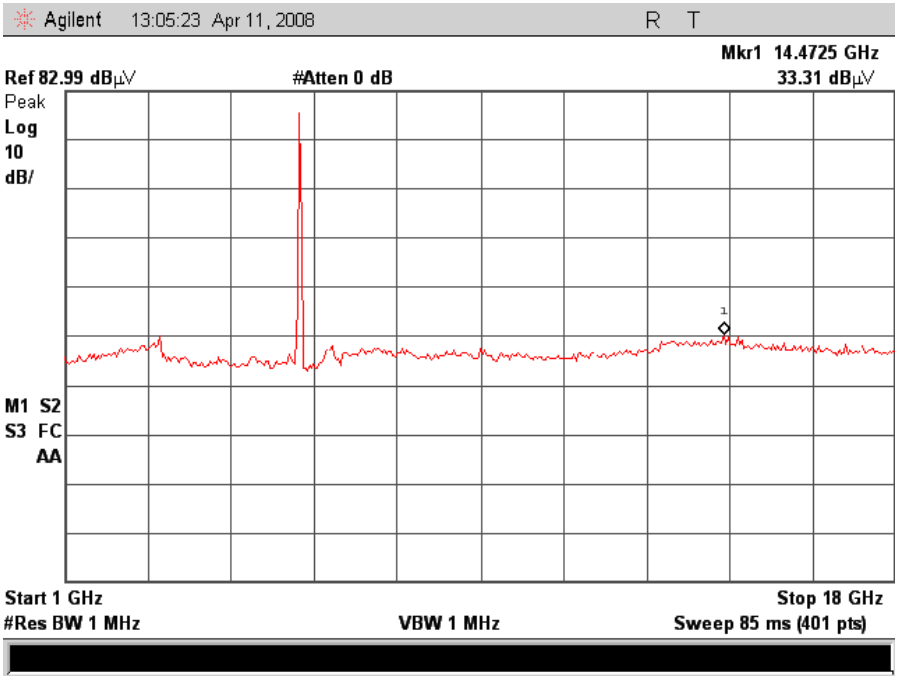
§ 15.247(d) Harmonic Emissions Requirements – Radiated (802.11a), Panel Antenna Horizontal

Frequency (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3m	P.Amp (dB)	Ant.Cor. Factor (dB)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dB)	Measurement Type
11490	H	45.8	34.35697	39.684467	8.6448844	59.8	74	-14.2	pk
11490	H	34.2	34.35697	39.684467	8.6448844	48.1	54	-5.9	avg
17235	H	37.7	33.3	42.475417	10.347403	57.2	74	-16.8	pk
Low Channel 5745MHz									
Frequency (GHz)	**Antenna Polarity (H/V)**	**Raw Amp. @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**EUT Field Strength Final Amp. (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
11570	H	50.9	34.4	39.799551	8.6874836	65.0	74	-9.0	pk
11570	H	35.7	34.4	39.799551	8.6874836	49.7	54	-4.3	avg
17355	H	37.9	33.3	42.93448	10.358976	57.9	74	-16.1	pk
Mid Channel 5785MHz									
Frequency (GHz)	**Antenna Polarity (H/V)**	**Raw Amp. @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**EUT Field Strength Final Amp. (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
11650	H	48.4	34.479473	39.8971	8.73325	62.5	74	-11.5	pk
11650	H	36.9	34.479473	39.8971	8.73325	51.1	54	-2.9	avg
17475	H	40.2	33.4	43.471131	10.37548	60.7	74	-13.3	pk
High Channel 5825MHz									

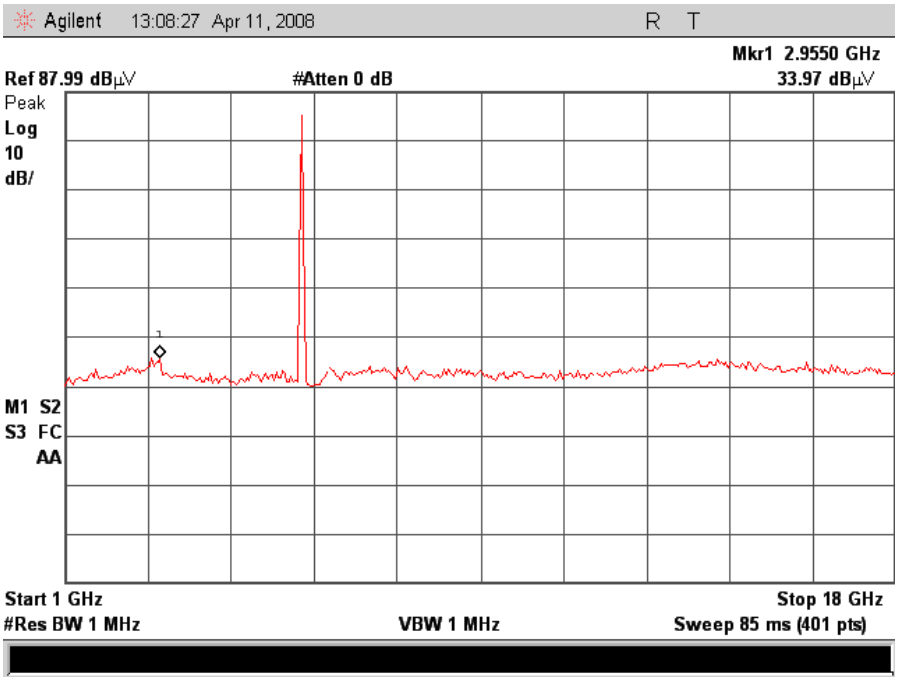
Note: All other emissions were measured at the noise floor of the spectrum analyzer



Plot 23. 802.11a Radiated Spurious, Low Channel, 1-18GHz (Panel Antenna Horizontal)



Plot 24. 802.11a Radiated Spurious, Mid Channel, 1-18GHz (Panel Antenna Horizontal)

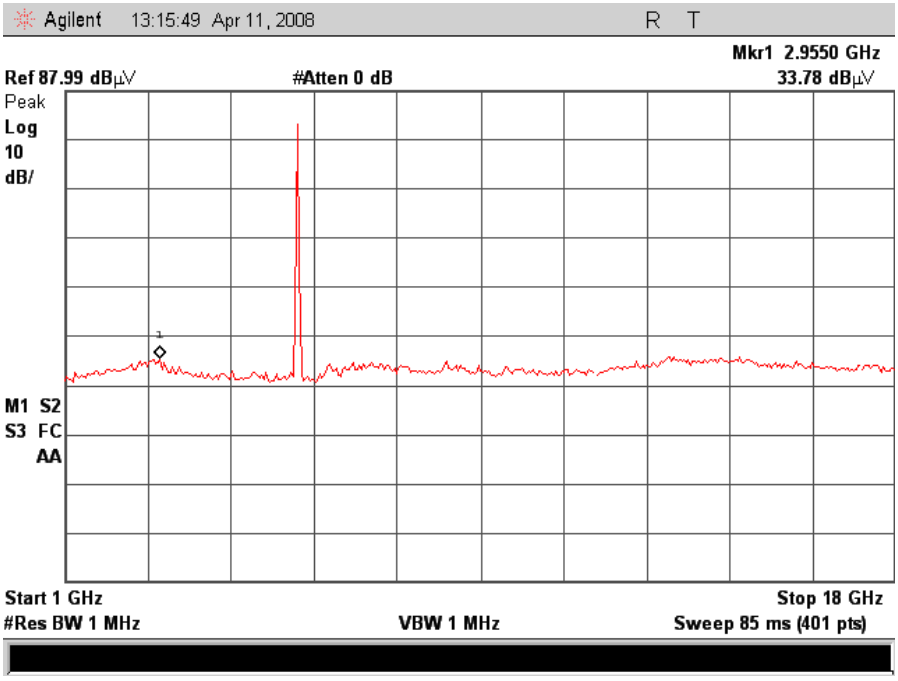


Plot 25. 802.11a Radiated Spurious, High Channel, 1-18GHz (Panel Antenna Horizontal)

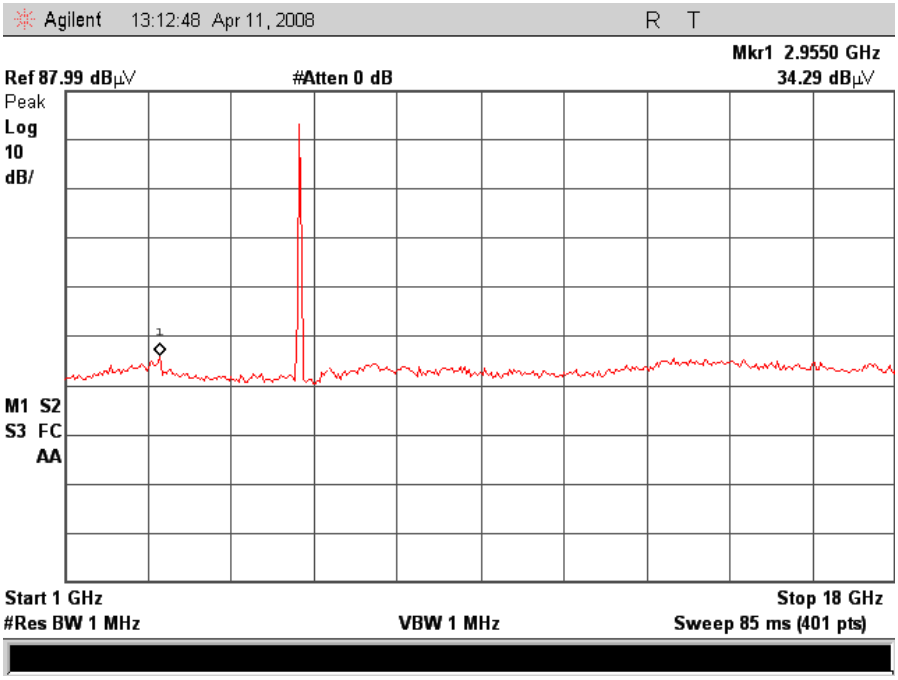
§ 15.247(d) Harmonic Emissions Requirements – Radiated (802.11a), Panel Antenna Vertical

Frequency (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3m	P.Amp (dB)	Ant.Cor. Factor (dB)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dB)	Measurement Type
11490	V	46.7	34.35697	39.684467	8.6448844	60.6	74	-13.4	pk
11490	V	34.2	34.35697	39.684467	8.6448844	48.1	54	-5.9	avg
17235	V	37.7	38.1	42.475417	10.347403	52.4	74	-21.6	pk
Low Channel 5745MHz									
Frequency (GHz)	**Antenna Polarity (H/V)**	**Raw Amp. @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**EUT Field Strength Final Amp. (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
11570	V	42.3	34.4	39.799551	8.6874836	56.4	74	-17.6	pk
11570	V	30.9	34.4	39.799551	8.6874836	44.9	54	-9.1	avg
17355	V	36.9	33.3	42.93448	10.358976	56.9	74	-17.1	pk
Mid Channel 5785MHz									
Frequency (GHz)	**Antenna Polarity (H/V)**	**Raw Amp. @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**EUT Field Strength Final Amp. (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
11650	V	41.6	34.479473	39.8971	8.73325	55.7	74	-18.3	pk
11650	V	32.7	34.479473	39.8971	8.73325	46.8	54	-7.2	avg
17475	V	37.4	33.4	43.471131	10.37548	57.9	74	-16.1	pk
High Channel 5825MHz									

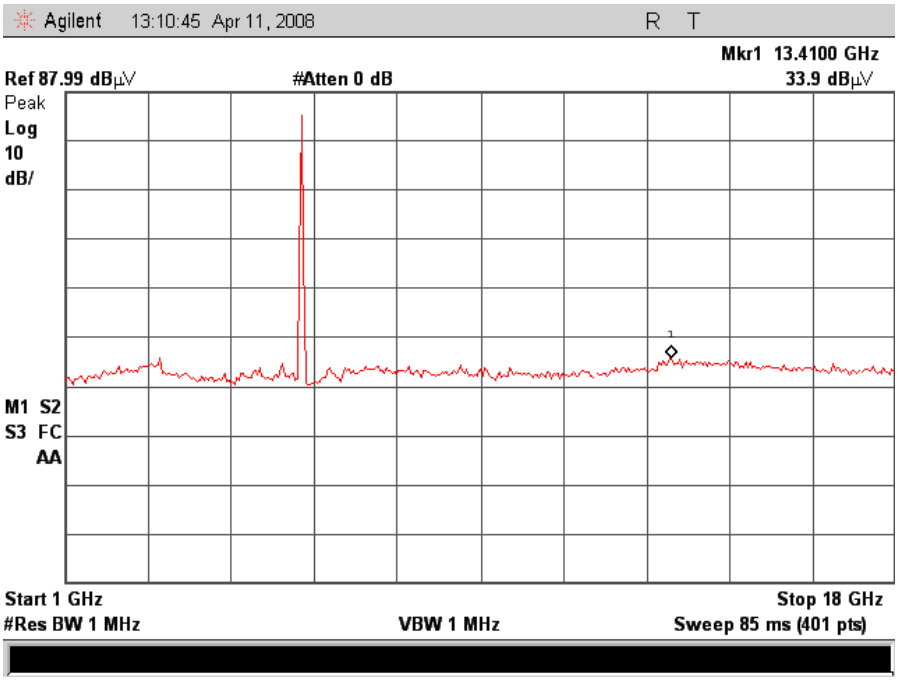
Note: All other emissions were measured at the noise floor of the spectrum analyzer



Plot 26. 802.11a Radiated Spurious, Low Channel, 1-18GHz (Panel Antenna Vertical)



Plot 27. 802.11a Radiated Spurious, Mid Channel, 1-18GHz (Panel Antenna Vertical)

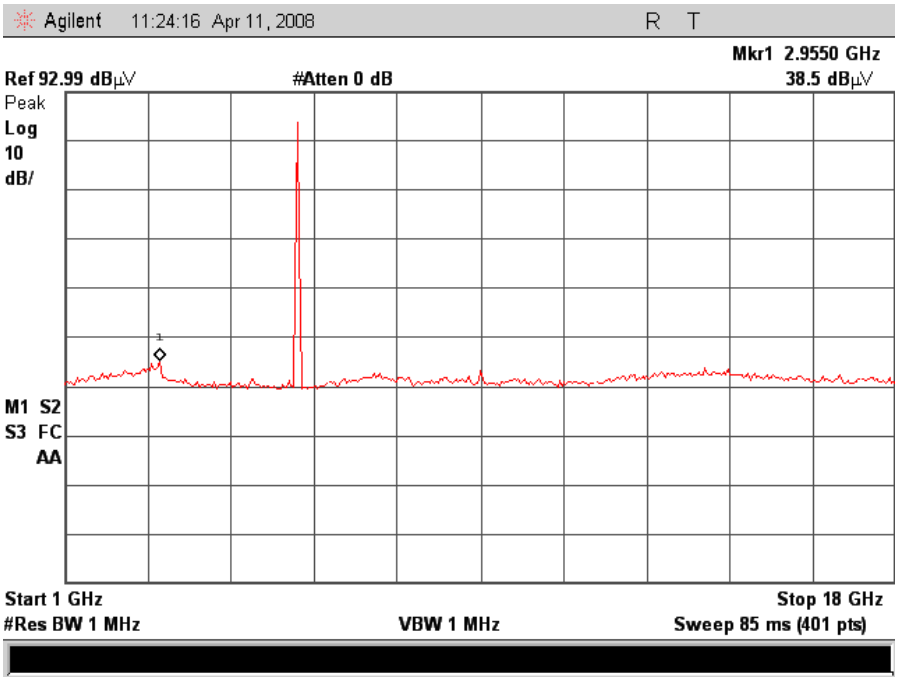


Plot 28. 802.11a Radiated Spurious, High Channel, 1-18GHz (Panel Antenna Vertical)

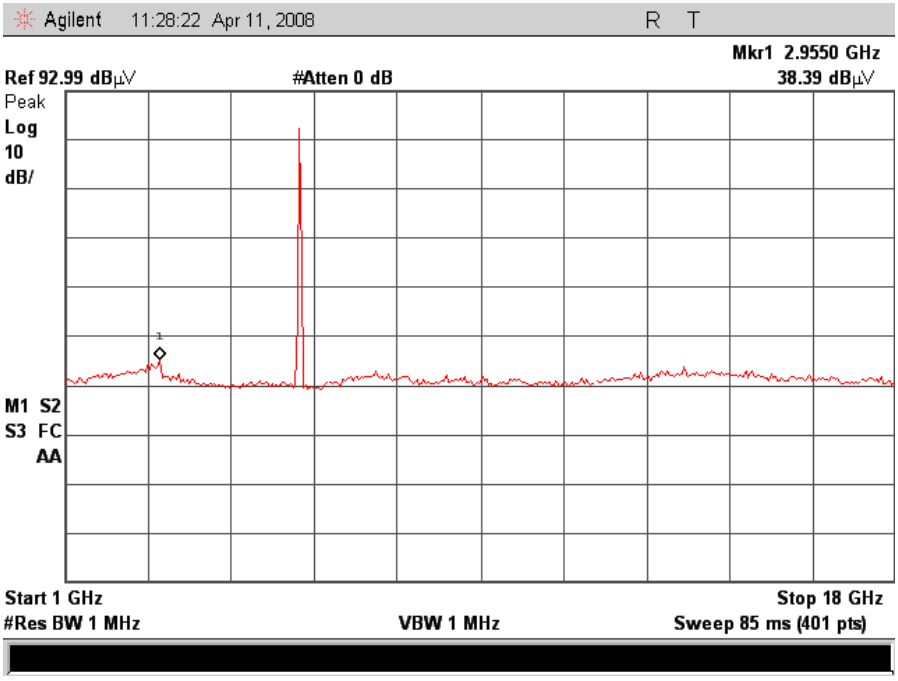
§ 15.247(d) Harmonic Emissions Requirements – Radiated (802.11a), Dish Antenna

Frequency (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3m	P.Amp (dB)	Ant.Cor. Factor (dB)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dB)	Measurement Type
11490	V	51.3	34.357	39.6845	8.64488	65.3	74	-8.7	pk
11490	V	36.4	34.357	39.6845	8.64488	50.4	54	-3.6	avg
17235	V	41.4	33.3	42.4754	10.3474	61.0	74	-13.0	pk
Low Channel 5745MHz									
Frequency (GHz)	**Antenna Polarity (H/V)**	**Raw Amp. @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**EUT Field Strength Final Amp. (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
11570	V	45.0	34.4	39.7996	8.68748	59.1	74	-14.9	pk
11570	V	31.8	34.4	39.7996	8.68748	45.9	54	-8.1	avg
17355	V	41.3	33.3	42.9345	10.359	61.3	74	-12.7	pk
Mid Channel 5785MHz									
Frequency (GHz)	**Antenna Polarity (H/V)**	**Raw Amp. @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**EUT Field Strength Final Amp. (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
11650	V	54.5	34.4795	39.8971	8.73325	68.7	74	-5.3	pk
11650	V	37.5	34.4795	39.8971	8.73325	51.7	54	-2.3	avg
17475	V	40.2	33.4	43.4711	10.3755	60.7	74	-13.3	pk
High Channel 5825MHz									

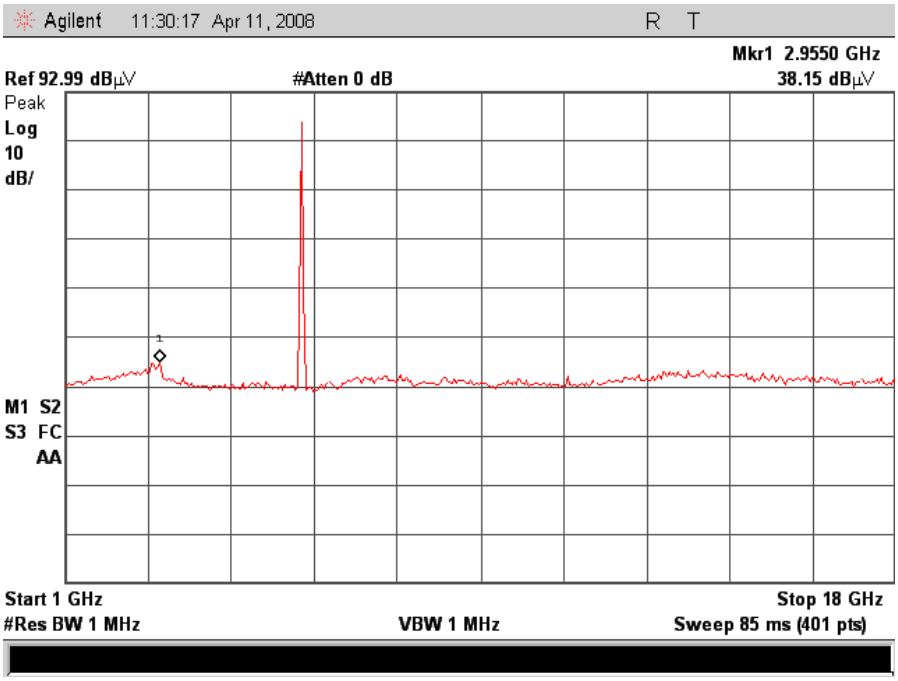
Note: All other emissions were measured at the noise floor of the spectrum analyzer



Plot 29. 802.11a Radiated Spurious, Low Channel, 1-18GHz (Dish Antenna)



Plot 30. 802.11a Radiated Spurious, Mid Channel, 1-18GHz (Dish Antenna)

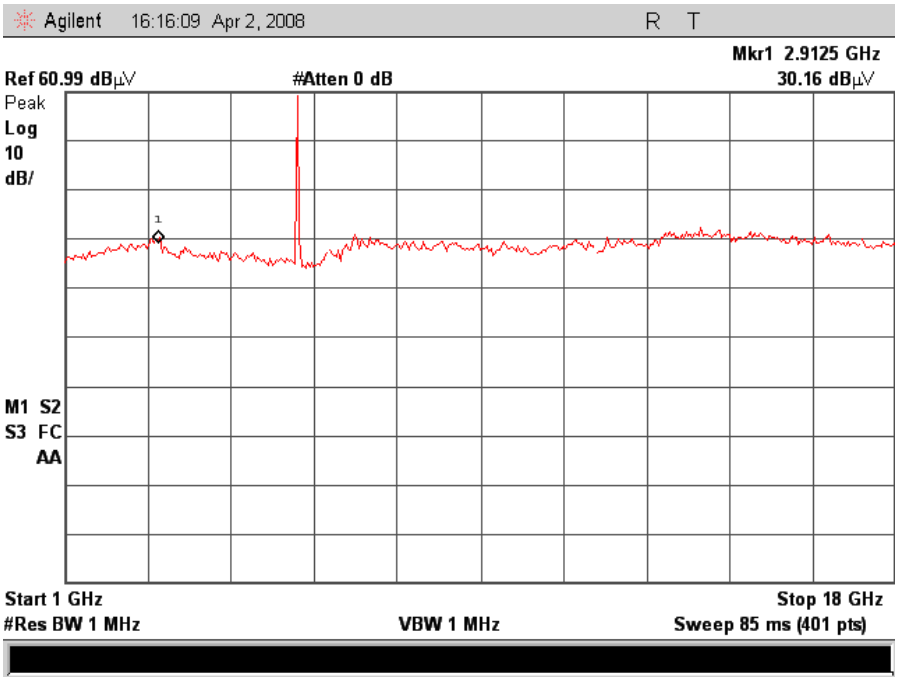


Plot 31. 802.11a Radiated Spurious, High Channel, 1-18GHz (Dish Antenna)

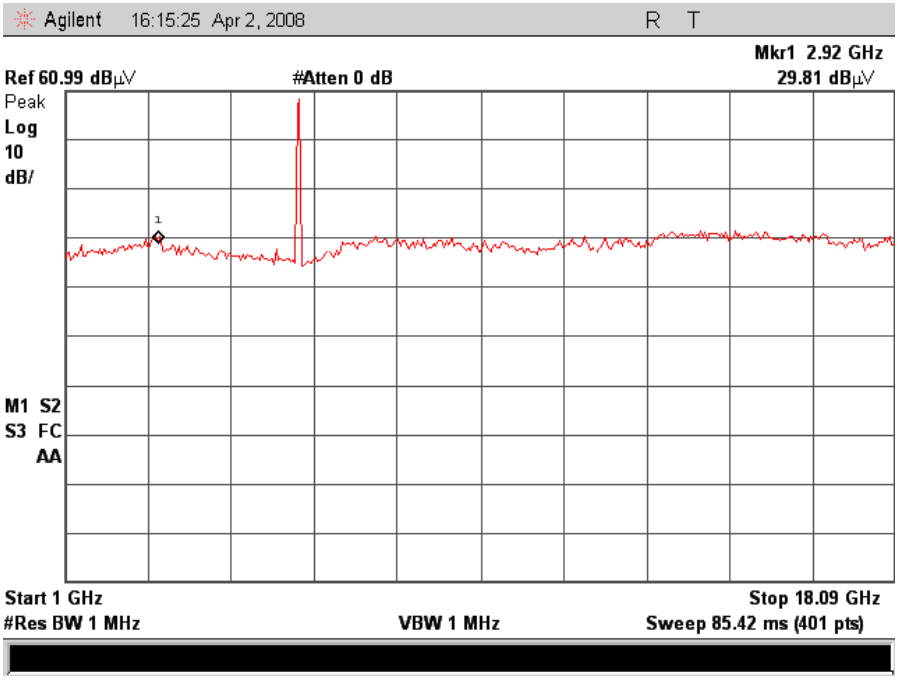
§ 15.247(d) Harmonic Emissions Requirements – Radiated (802.11a), MIMO Antenna

Frequency (GHz)	Antenna Polarity (H/V)	Raw Amp. @ 3m	P.Amp (dB)	Ant.Cor. Factor (dB)	Cable Loss (dB)	EUT Field Strength Final Amp. (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dB)	Measurement Type
11490	V	41.7	34.357	39.684	8.6449	55.7	74	-18.3	pk
11490	V	28.6	34.357	39.684	8.6449	42.6	54	-11.4	avg
17235	V	41.2	33.3	42.475	10.347	60.8	74	-13.2	pk
Low Channel 5745MHz									
Frequency (GHz)	**Antenna Polarity (H/V)**	**Raw Amp. @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**EUT Field Strength Final Amp. (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
11570	V	42.3	34.4	39.7996	8.68748	56.4	74	-17.6	pk
11570	V	30.2	34.4	39.7996	8.68748	44.3	54	-9.7	avg
17355	V	40.0	33.3	42.9345	10.359	59.9	74	-14.1	pk
Mid Channel 5785MHz									
Frequency (GHz)	**Antenna Polarity (H/V)**	**Raw Amp. @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**EUT Field Strength Final Amp. (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
11650	V	40.6	34.4795	39.8971	8.73325	54.8	74	-19.2	pk
11650	V	29.1	34.4795	39.8971	8.73325	43.2	54	-10.8	avg
17475	V	39.8	33.4	43.4711	10.3755	60.3	74	-13.7	pk
High Channel 5825MHz									

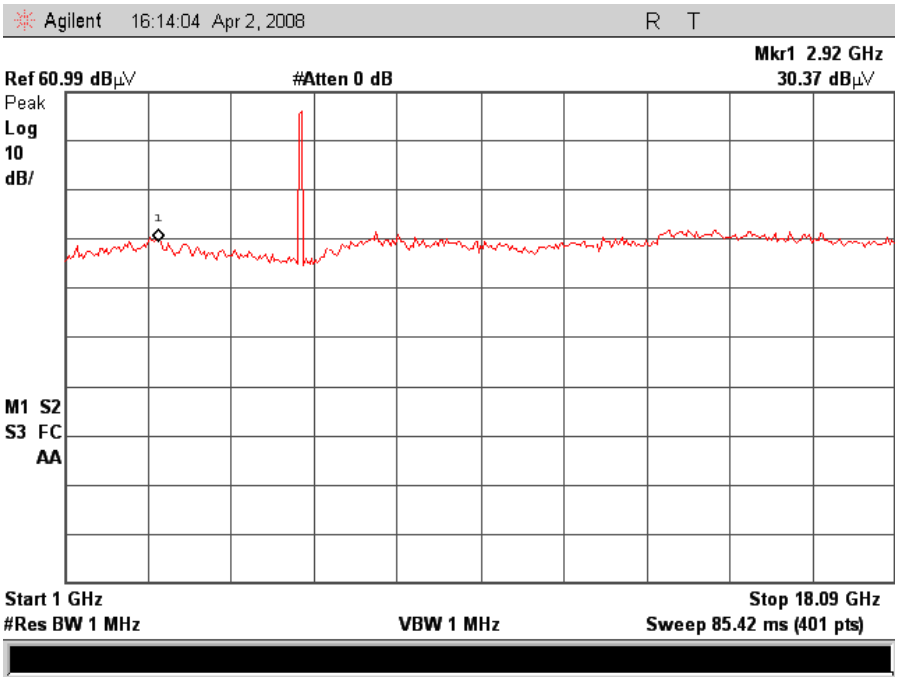
Note: All other emissions were measured at the noise floor of the spectrum analyzer



Plot 32. 802.11a Radiated Spurious, Low Channel, 1-18GHz (MIMO Antenna)



Plot 33. 802.11a Radiated Spurious, Mid Channel, 1-18GHz (MIMO Antenna)



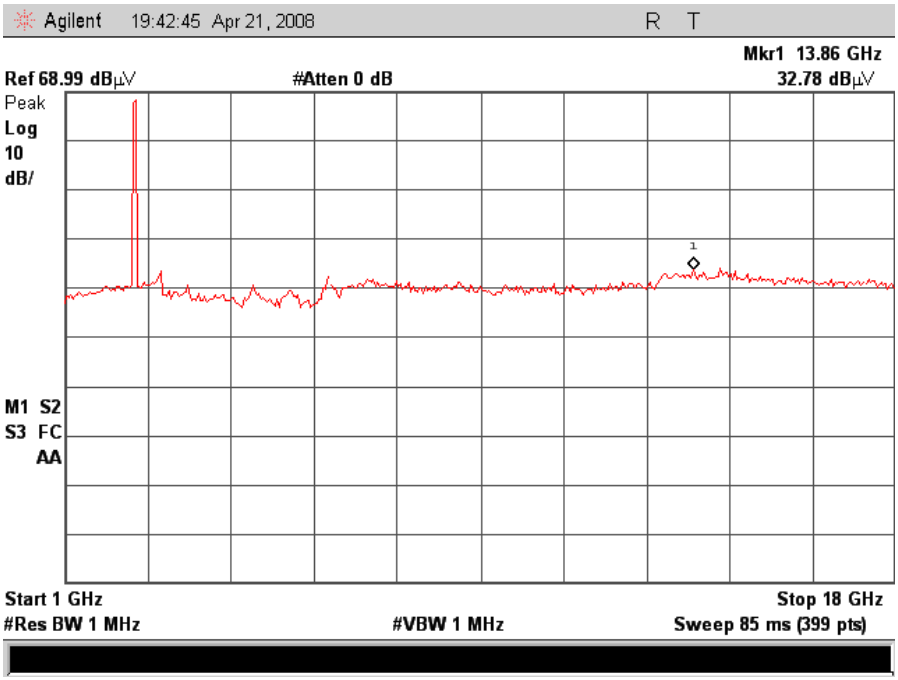
Plot 34. 802.11a Radiated Spurious, High Channel, 1-18GHz (MIMO Antenna)

Electromagnetic Compatibility Criteria for Intentional Radiators

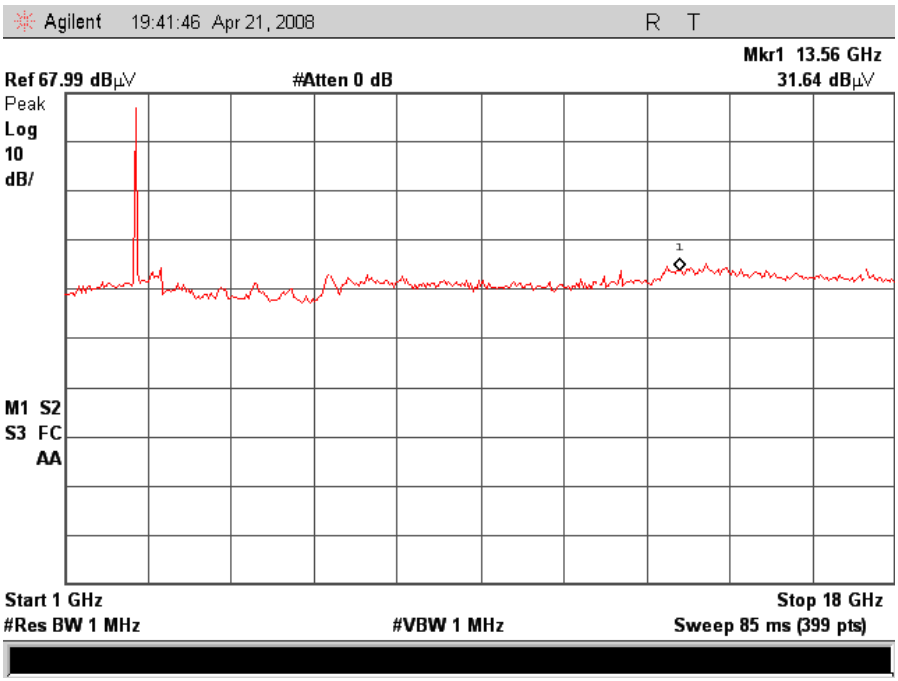
§ 15.247(d) Harmonic Emissions Requirements – Radiated (802.11b) Panel Antenna Horizontal

Frequency (GHz)	Receive Antenna Polarity (H/V)	Uncorrected Field Strength (dBµV) @ 3m	P.Amp (dB)	Ant.Cor. Factor (dB)	Cable Loss (dB)	Corrected Field Strength @3m (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dB)	Measurement Type
4824	H	43.14	34.8	33.2	5.2	46.8	74	27.2	pk
4824	H	31.16	34.8	33.2	5.2	34.8	54	19.2	avg
7236	H	43.33	35.0	35.7	6.5	50.5	74	23.5	pk
7236	H	30.8	35.0	35.7	6.5	38.0	54	16.0	avg
9648	H	40.45	35.0	37.7	7.8	50.9	74	23.1	pk
Low Channel 2412MHz									
Frequency (GHz)	**Receive Antenna Polarity (H/V)**	**Uncorrected Field Strength (dBµV) @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**Corrected Field Strength @3m (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
4874	H	44.04	34.8	33.5	5.2	48.0	74	26.0	pk
4874	H	30.85	34.8	33.5	5.2	34.8	54	19.3	avg
7311	H	43.33	35.0	36.0	6.5	50.8	74	23.2	pk
7311	H	30.22	35.0	36.0	6.5	37.7	54	16.3	avg
9748	H	43.47	35.6	38.0	7.8	53.7	74	20.3	pk
Mid Channel 2437MHz									
Frequency (GHz)	**Receive Antenna Polarity (H/V)**	**Uncorrected Field Strength (dBµV) @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**Corrected Field Strength @3m (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
4924	H	44.01	34.7	33.5	5.2	48.0	74	26.0	pk
4924	H	30.87	34.7	33.5	5.2	34.9	54	19.1	avg
7386	H	46.08	35.0	36.0	6.5	53.6	74	20.4	pk
7386	H	31.25	35.0	36.0	6.5	38.7	54	15.3	avg
9848	H	43.86	35.6	38.0	7.8	54.1	74	19.9	pk
High Channel 2462MHz									

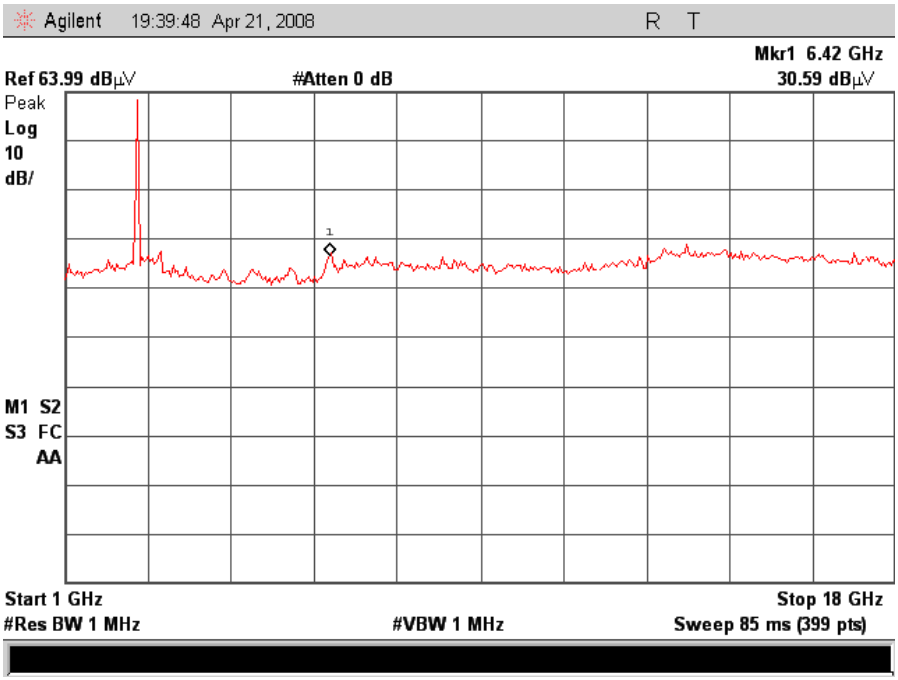
Note: All other emissions were measured at the noise floor of the spectrum analyzer



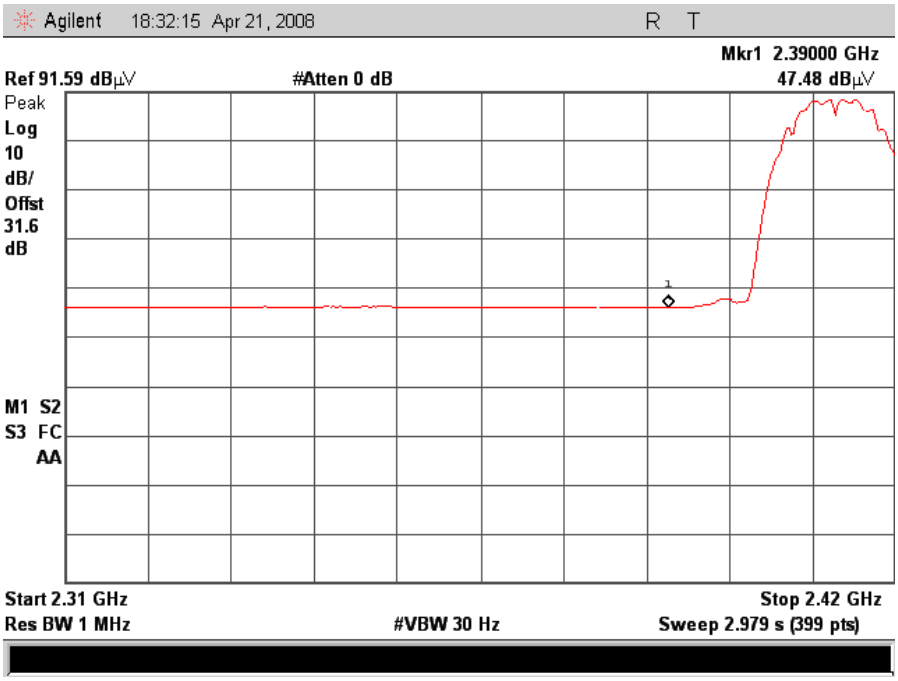
Plot 35. 802.11b Radiated Spurious, Low Channel, 1-18GHz (Panel Antenna Horizontal)



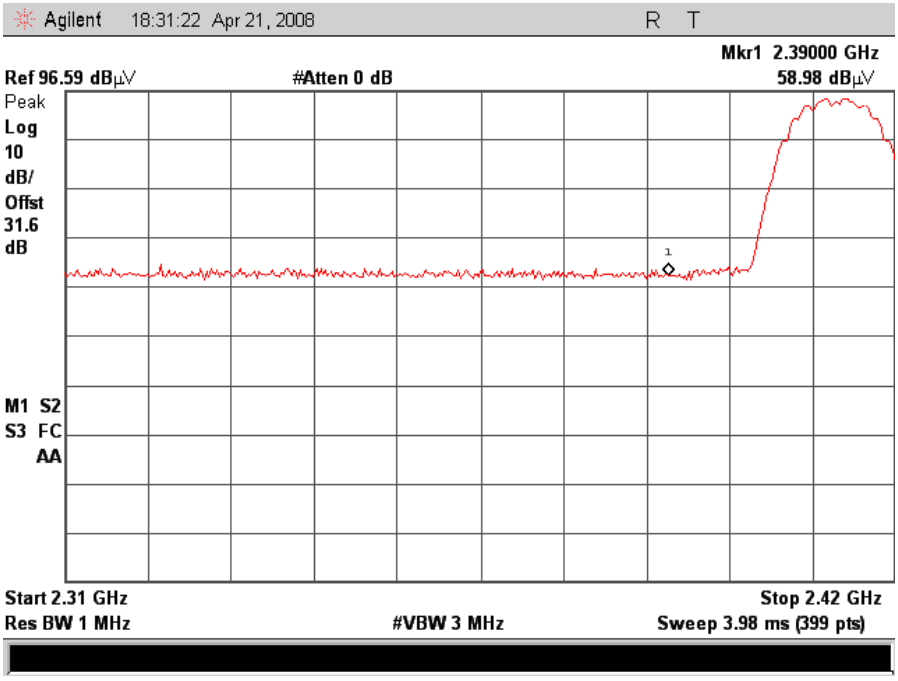
Plot 36. 802.11b Radiated Spurious, Mid Channel, 1-18GHz (Panel Antenna Horizontal)



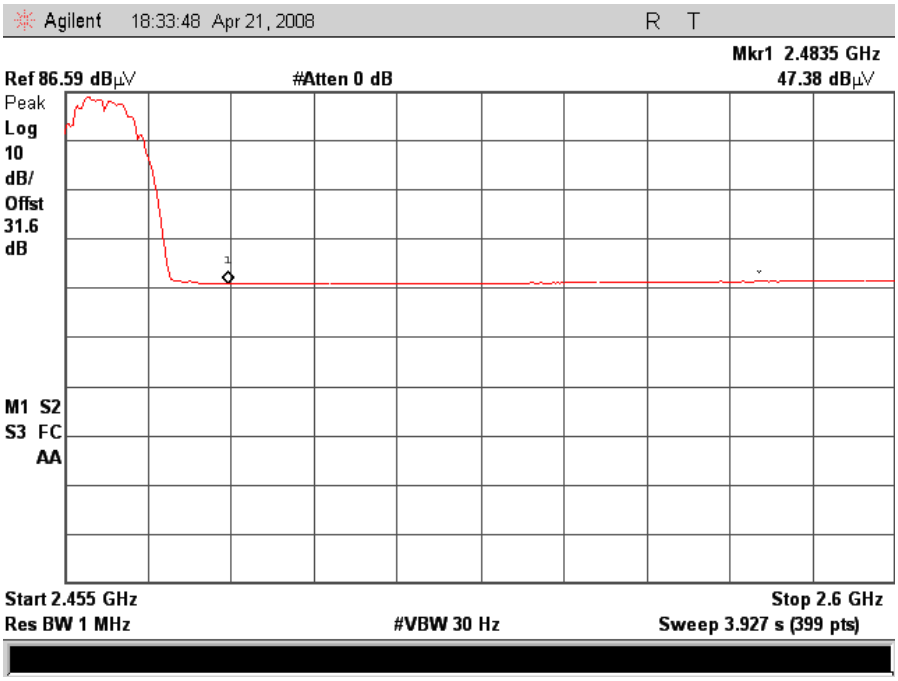
Plot 37. 802.11b Radiated Spurious, High Channel, 1-18GHz (Panel Antenna Horizontal)



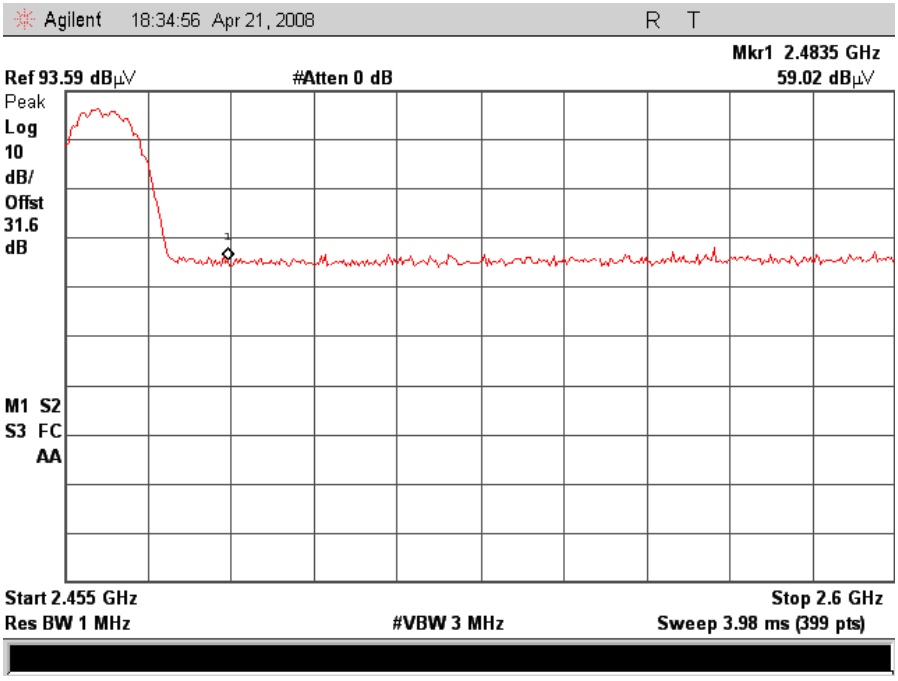
Plot 38. 802.11b Radiated Restricted Band, Low Channel, Avg (Panel Antenna Horizontal)



Plot 39. 802.11b Radiated Restricted Band, Low Channel, Peak (Panel Antenna Horizontal)



Plot 40. 802.11b Radiated Restricted Band, High Channel, Avg (Panel Antenna Horizontal)

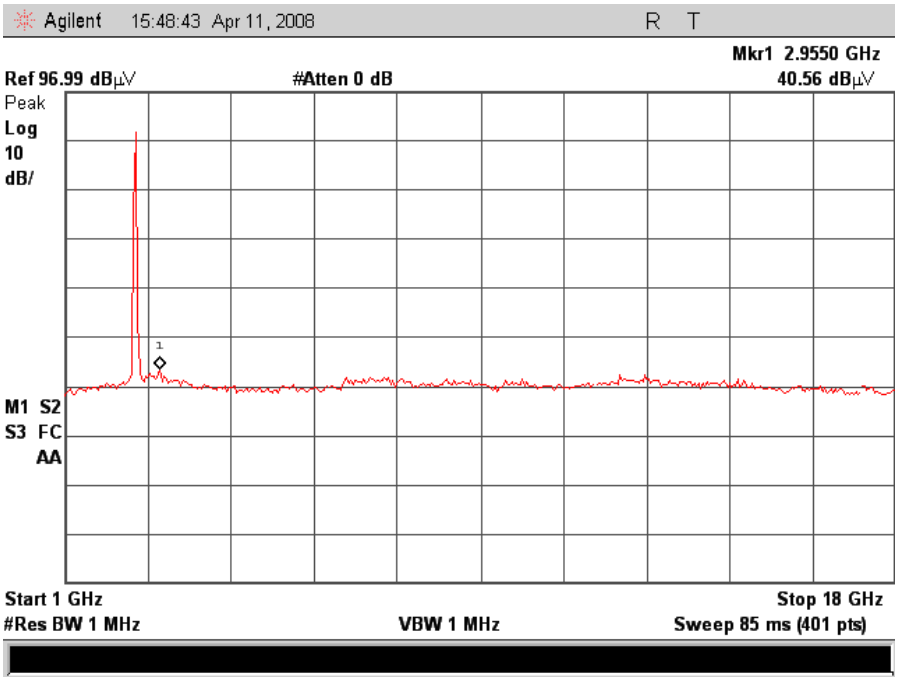


Plot 41. 802.11b Radiated Restricted Band, High Channel, Peak (Panel Antenna Horizontal)

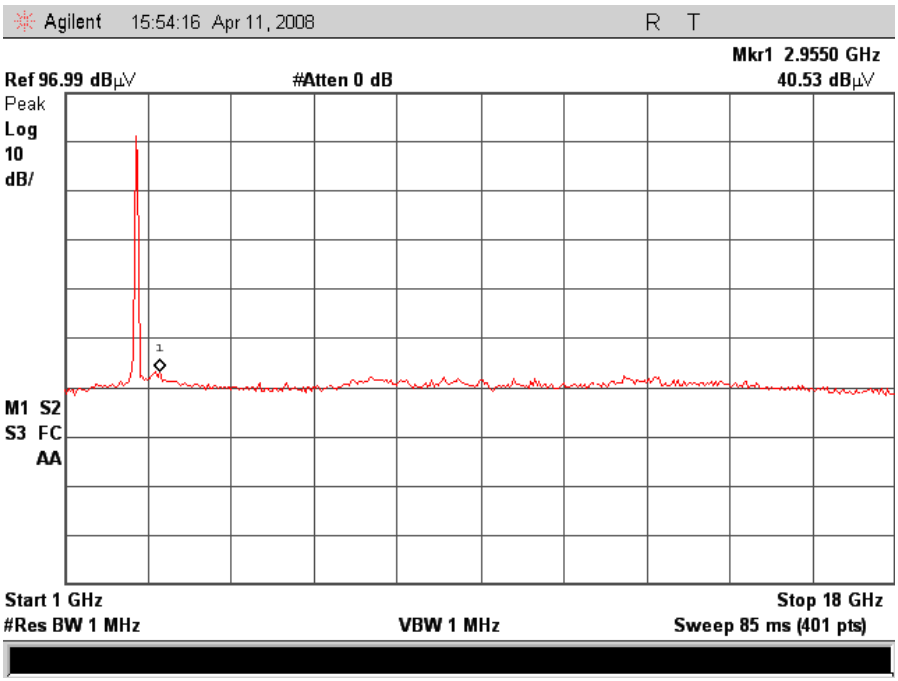
§ 15.247(d) Harmonic Emissions Requirements – Radiated (802.11b) Panel Antenna Vertical

Frequency (GHz)	Receive Antenna Polarity (H/V)	Uncorrected Field Strength (dBµV) @ 3m	P.Amp (dB)	Ant.Cor. Factor (dB)	Cable Loss (dB)	Corrected Field Strength @3m (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dB)	Measurement Type
4824	V	41.52	33.43	33.3	5.2	46.6	74	-27.4	pk
4824	V	31.27	33.43	33.3	5.2	36.4	54	-17.6	avg
7236	V	40.9	34.66	35.8	6.6	48.6	74	-25.4	pk
7236	V	31.28	34.66	35.8	6.6	39.0	54	-15.0	avg
9648	V	41.45	35.15	37.8	7.9	52.0	74	-22.0	pk
Low Channel 2412MHz									
Frequency (GHz)	**Receive Antenna Polarity (H/V)**	**Uncorrected Field Strength (dBµV) @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**Corrected Field Strength @3m (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
4874	V	40.68	34.4	33.4	5.3	45.0	74	-29.0	pk
4874	V	30.93	34.4	33.4	5.3	35.2	54	-18.8	avg
7311	V	40.86	34.7	36.0	6.6	48.8	74	-25.2	pk
7311	V	30.57	34.7	36.0	6.6	38.5	54	-15.5	avg
9748	V	39.57	35.1	38.0	8.0	50.4	74	-23.6	pk
Mid Channel 2437MHz									
Frequency (GHz)	**Receive Antenna Polarity (H/V)**	**Uncorrected Field Strength (dBµV) @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**Corrected Field Strength @3m (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
4924	V	41.53	34.4	33.5	5.3	46.0	74	-28.0	pk
4924	V	30.88	34.4	33.5	5.3	35.3	54	-18.7	avg
7386	V	41.92	34.7	36.2	6.7	50.1	74	-23.9	pk
7386	V	31.55	34.7	36.2	6.7	39.7	54	-14.3	avg
9848	V	40.31	35.1	38.1	8.1	51.4	74	-22.6	pk
High Channel 2462MHz									

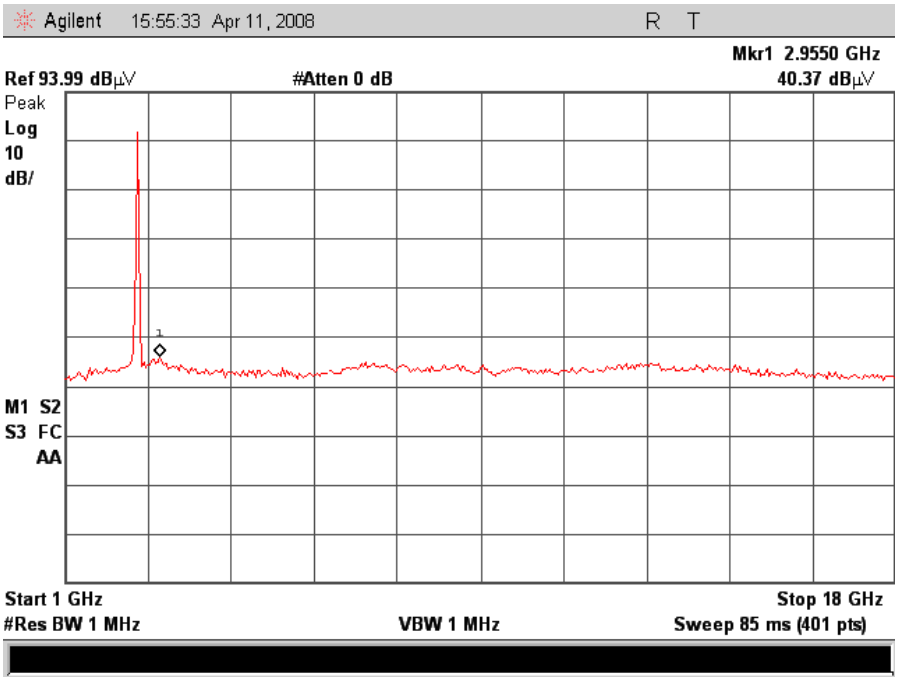
Note: All other emissions were measured at the noise floor of the spectrum analyzer



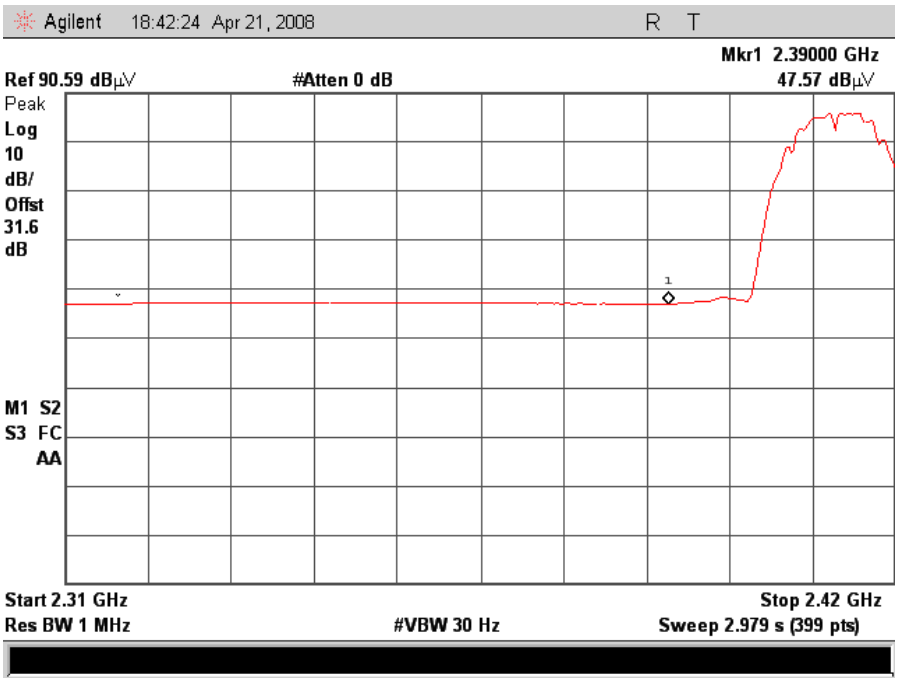
Plot 42. 802.11b Radiated Spurious, Low Channel, 1-18GHz (Panel Antenna Vertical)



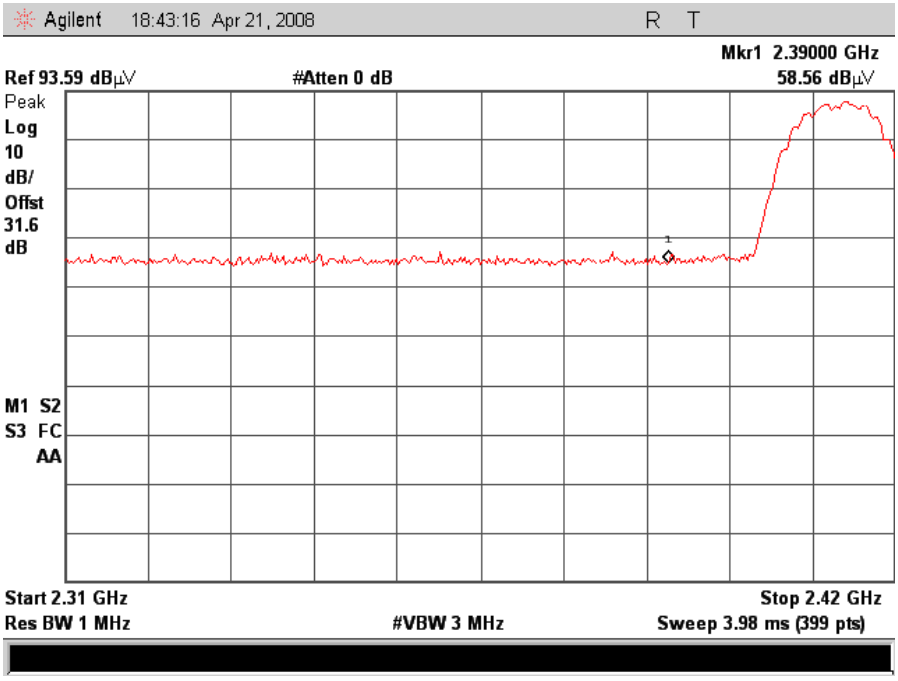
Plot 43. 802.11b Radiated Spurious, Mid Channel, 1-18GHz (Panel Antenna Vertical)



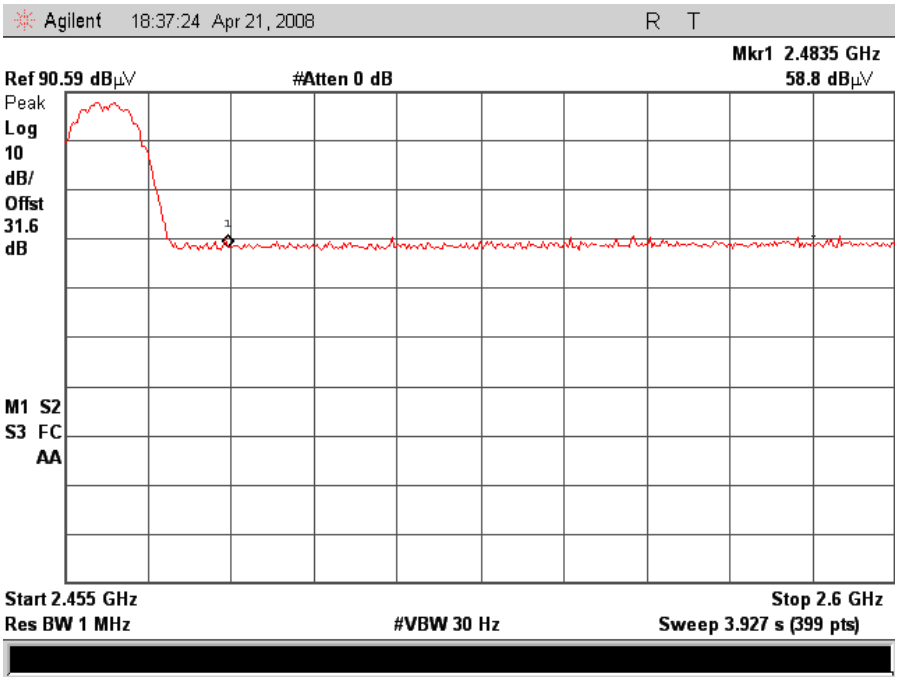
Plot 44. 802.11b Radiated Spurious, High Channel, 1-18GHz (Panel Antenna Vertical)



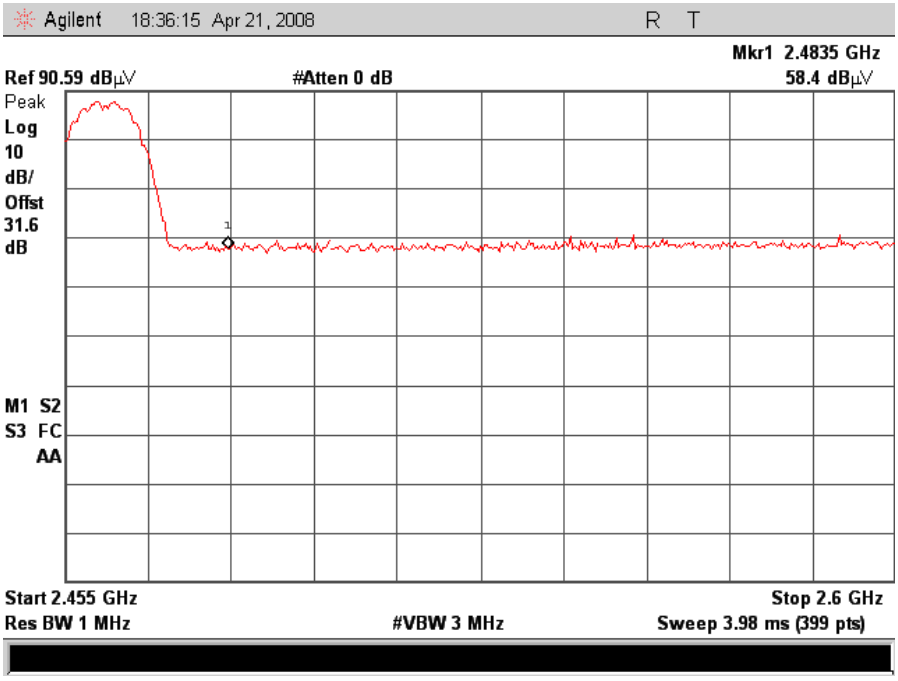
Plot 45. 802.11b Radiated Restricted Band, Low Channel, Avg (Panel Antenna Vertical)



Plot 46. 802.11b Radiated Restricted Band, Low Channel, Peak (Panel Antenna Vertical)



Plot 47. 802.11b Radiated Restricted Band, High Channel, Avg (Panel Antenna Vertical)

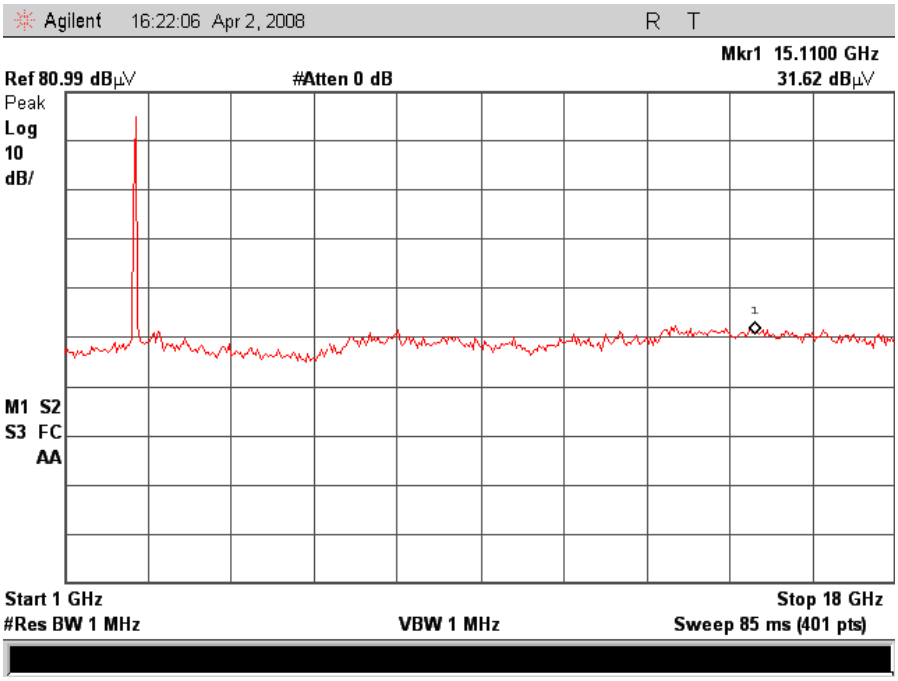


Plot 48. 802.11b Radiated Restricted Band, High Channel, Peak (Panel Antenna Vertical)

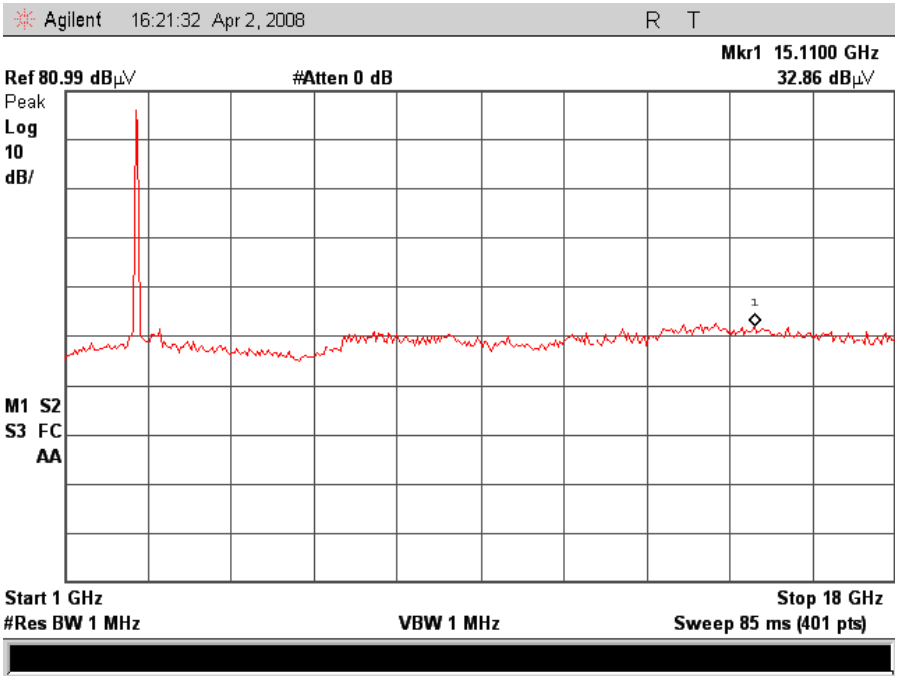
§ 15.247(d) Harmonic Emissions Requirements – Radiated (802.11b) MIMO Antenna

Frequency (GHz)	Receive Antenna Polarity (H/V)	Uncorrected Field Strength (dBµV) @ 3m	P.Amp (dB)	Ant.Cor. Factor (dB)	Cable Loss (dB)	Corrected Field Strength @3m (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dB)	Measurement Type
4824	V	43.34	33.43	33.3	5.2	48.5	74	-25.6	pk
4824	V	31.67	33.43	33.3	5.2	36.8	54	-17.2	avg
7236	V	43.09	34.66	35.8	6.6	50.8	74	-23.2	pk
7236	V	31.27	34.66	35.8	6.6	39.0	54	-15.0	avg
9648	V	45.12	35.15	37.8	7.9	55.7	74	-18.3	pk
Low Channel 2412MHz									
Frequency (GHz)	**Receive Antenna Polarity (H/V)**	**Uncorrected Field Strength (dBµV) @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**Corrected Field Strength @3m (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
4874	V	43.66	34.4	33.4	5.3	48.0	74	-26.0	pk
4874	V	30.95	34.4	33.4	5.3	35.2	54	-18.8	avg
7311	V	41.85	34.7	36.0	6.6	49.8	74	-24.2	pk
7311	V	30.57	34.7	36.0	6.6	38.5	54	-15.5	avg
9748	V	42.37	35.1	38.0	8.0	53.2	74	-20.8	pk
Mid Channel 2437MHz									
Frequency (GHz)	**Receive Antenna Polarity (H/V)**	**Uncorrected Field Strength (dBµV) @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**Corrected Field Strength @3m (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
4924	V	42.58	34.4	33.5	5.3	47.0	74	-27.0	pk
4924	V	30.97	34.4	33.5	5.3	35.4	54	-18.6	avg
7386	V	42.33	34.7	36.2	6.7	50.5	74	-23.5	pk
7386	V	31.27	34.7	36.2	6.7	39.4	54	-14.6	avg
9848	V	42.15	35.1	38.1	8.1	53.3	74	-20.7	pk
High Channel 2462MHz									

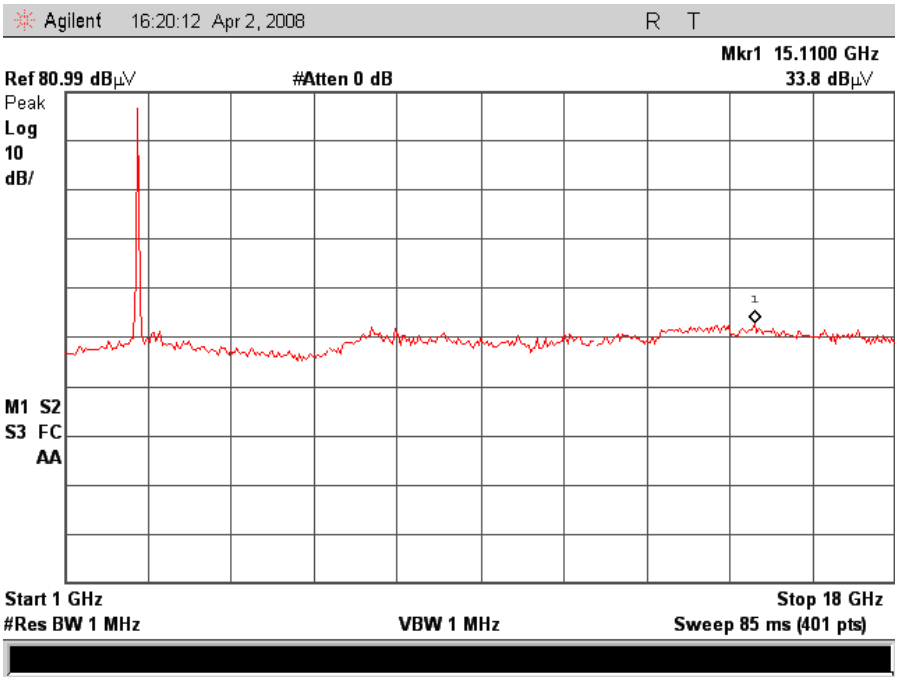
Note: All other emissions were measured at the noise floor of the spectrum analyzer



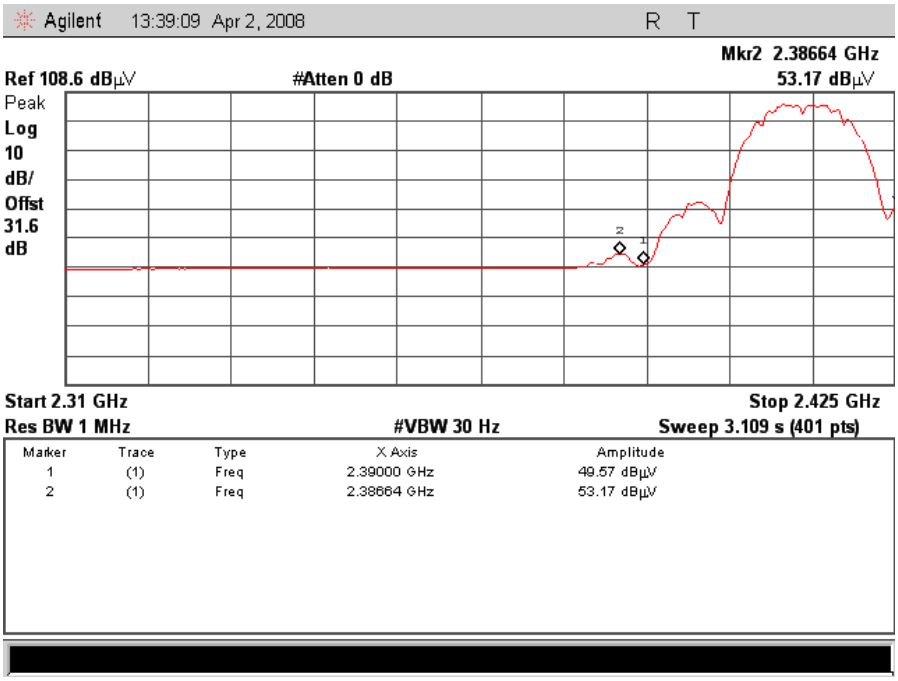
Plot 49. 802.11b Radiated Spurious, Low Channel, 1-18GHz (MIMO Antenna)



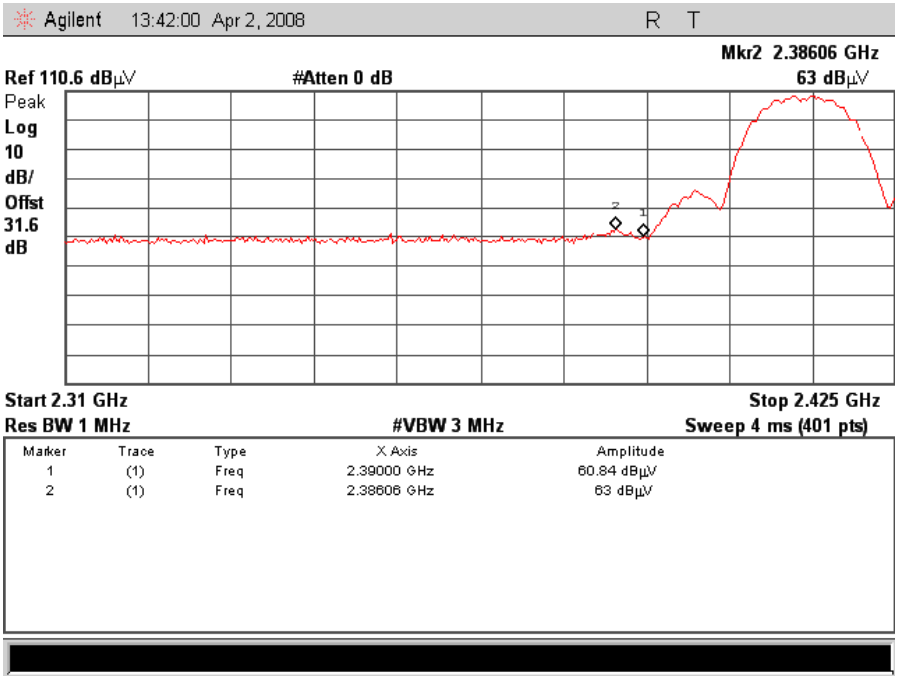
Plot 50. 802.11b Radiated Spurious, Mid Channel, 1-18GHz (MIMO Antenna)



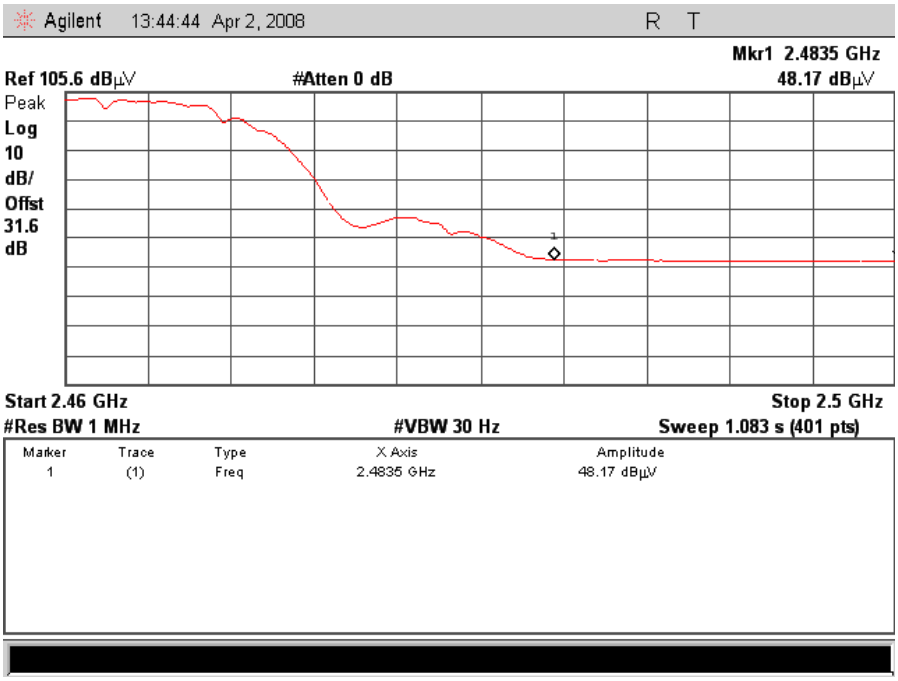
Plot 51. 802.11b Radiated Spurious, High Channel, 1-18GHz (MIMO Antenna)



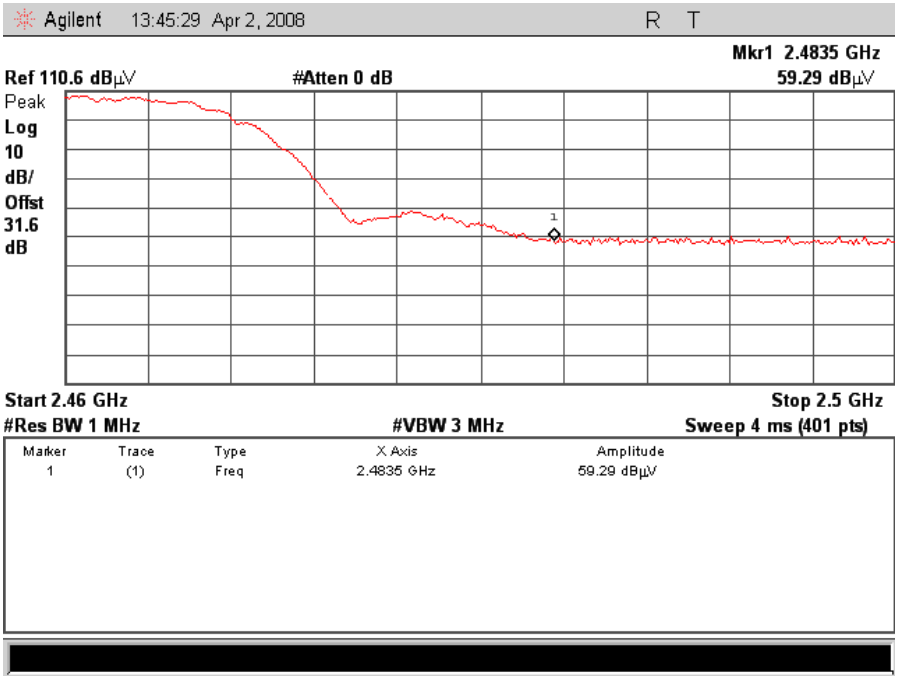
Plot 52. 802.11b Radiated Restricted Band, Low Channel, Avg (MIMO Antenna)



Plot 53. 802.11b Radiated Restricted Band, Low Channel, Peak (MIMO Antenna)



Plot 54. 802.11b Radiated Restricted Band, High Channel, Avg (MIMO Antenna)



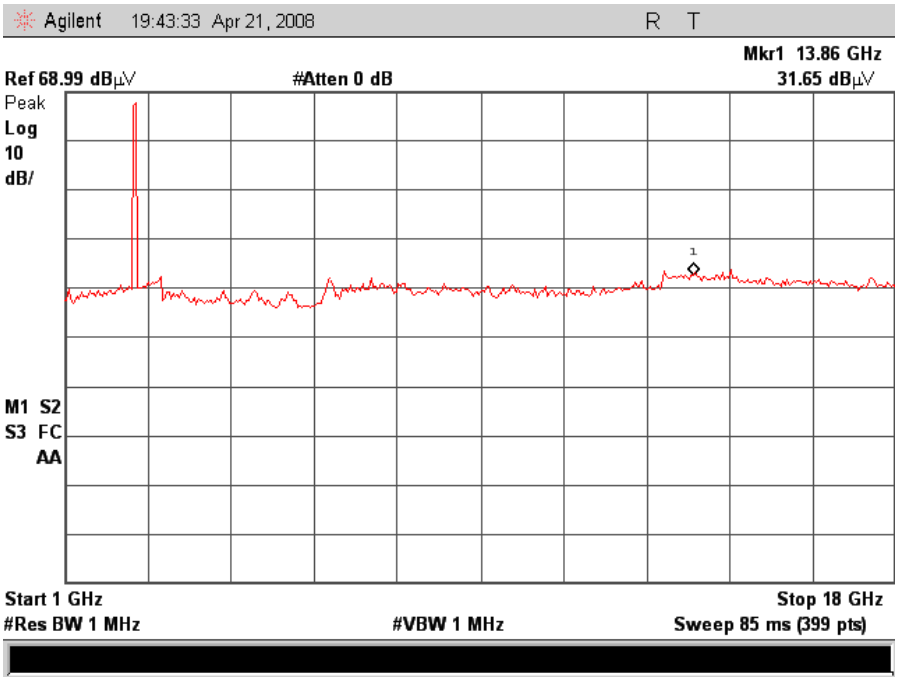
Plot 55. 802.11b Radiated Restricted Band, High Channel, Peak (MIMO Antenna)

Electromagnetic Compatibility Criteria for Intentional Radiators

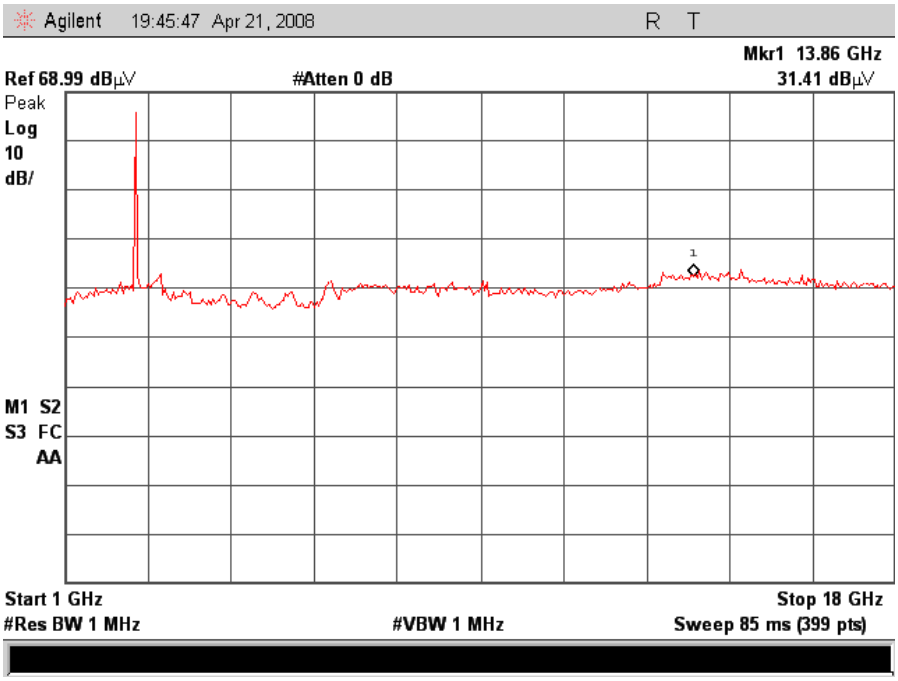
§ 15.247(d) Harmonic Emissions Requirements – Radiated (802.11g) Panel Antenna Horizontal

Frequency (GHz)	Receive Antenna Polarity (H/V)	Uncorrected Field Strength (dBµV) @ 3m	P.Amp (dB)	Ant.Cor. Factor (dB)	Cable Loss (dB)	Corrected Field Strength @3m (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dB)	Measurement Type
4824	H	43.96	34.8	33.2	5.2	47.6	74	26.4	pk
4824	H	30.33	34.8	33.2	5.2	33.9	54	20.1	avg
7236	H	44.41	35.0	35.7	6.5	51.6	74	22.4	pk
7236	H	31.02	35.0	35.7	6.5	38.2	54	15.8	avg
9648	H	42.06	35.0	37.7	7.8	52.6	74	21.5	pk
Low Channel 2412MHz									
Frequency (GHz)	**Receive Antenna Polarity (H/V)**	**Uncorrected Field Strength (dBµV) @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**Corrected Field Strength @3m (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
4874	H	44.58	34.8	33.5	5.2	48.5	74	25.5	pk
4874	H	30.33	34.8	33.5	5.2	34.2	54	19.8	avg
7311	H	42.62	35.0	36.0	6.5	50.1	74	23.9	pk
7311	H	31.25	35.0	36.0	6.5	38.8	54	15.3	avg
9748	H	42.29	35.6	38.0	7.8	52.5	74	21.5	pk
Mid Channel 2437MHz									
Frequency (GHz)	**Receive Antenna Polarity (H/V)**	**Uncorrected Field Strength (dBµV) @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**Corrected Field Strength @3m (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
4924	H	43.82	34.7	33.5	5.2	47.8	74	26.2	pk
4924	H	30.73	34.7	33.5	5.2	34.7	54	19.3	avg
7386	H	42.76	35.0	36.0	6.5	50.3	74	23.7	pk
7386	H	30.95	35.0	36.0	6.5	38.4	54	15.6	avg
9848	H	43.22	35.6	38.0	7.8	53.4	74	20.6	pk
High Channel 2462MHz									

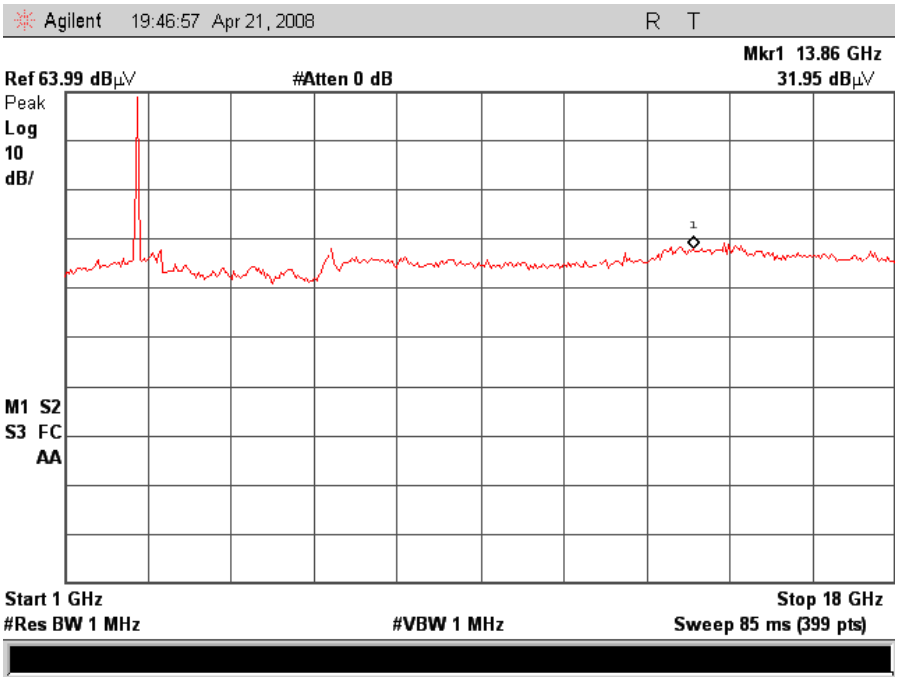
Note: All other emissions were measured at the noise floor of the spectrum analyzer



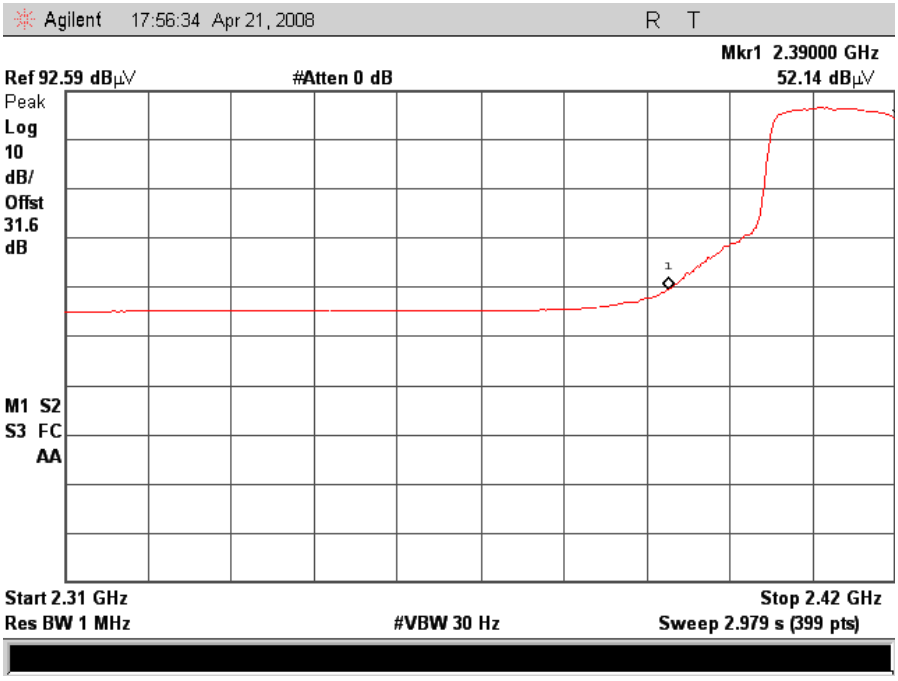
Plot 56. 802.11g Radiated Spurious, Low Channel, 1-18GHz (Panel Antenna Horizontal)



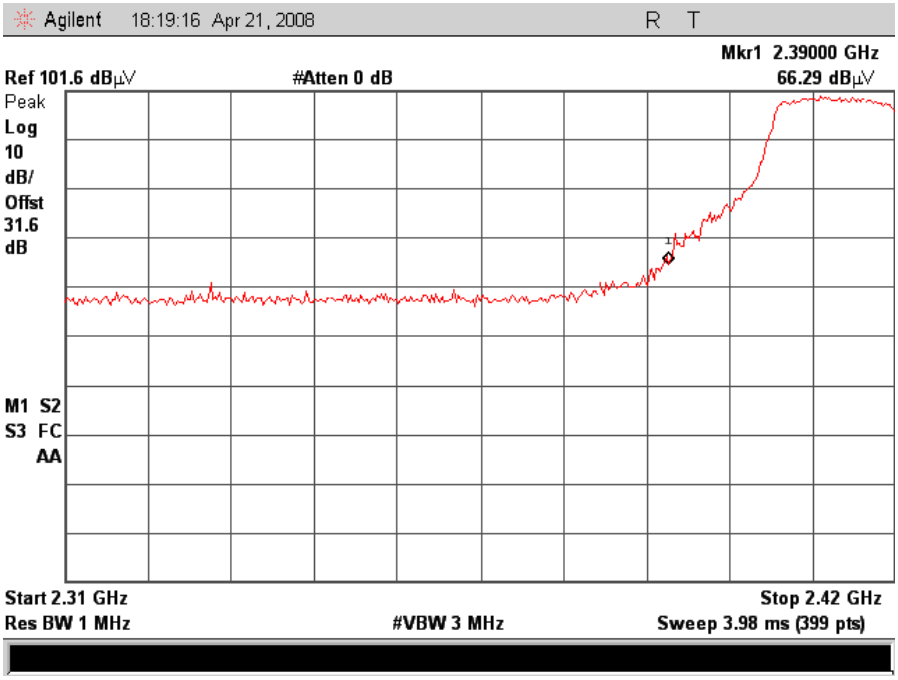
Plot 57. 802.11g Radiated Spurious, Mid Channel, 1-18GHz (Panel Antenna Horizontal)



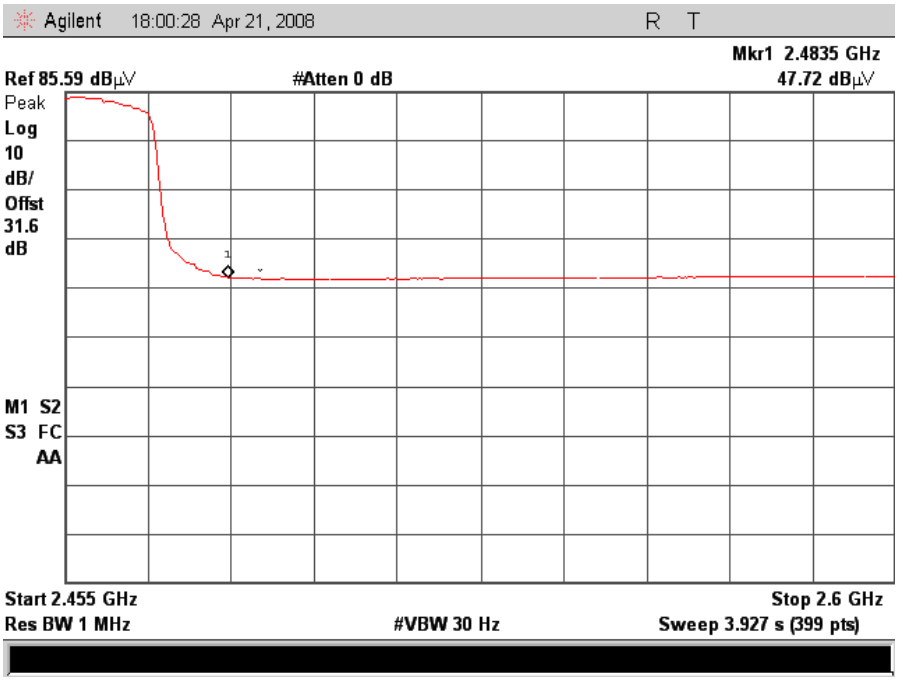
Plot 58. 802.11g Radiated Spurious, High Channel, 1-18GHz (Panel Antenna Horizontal)



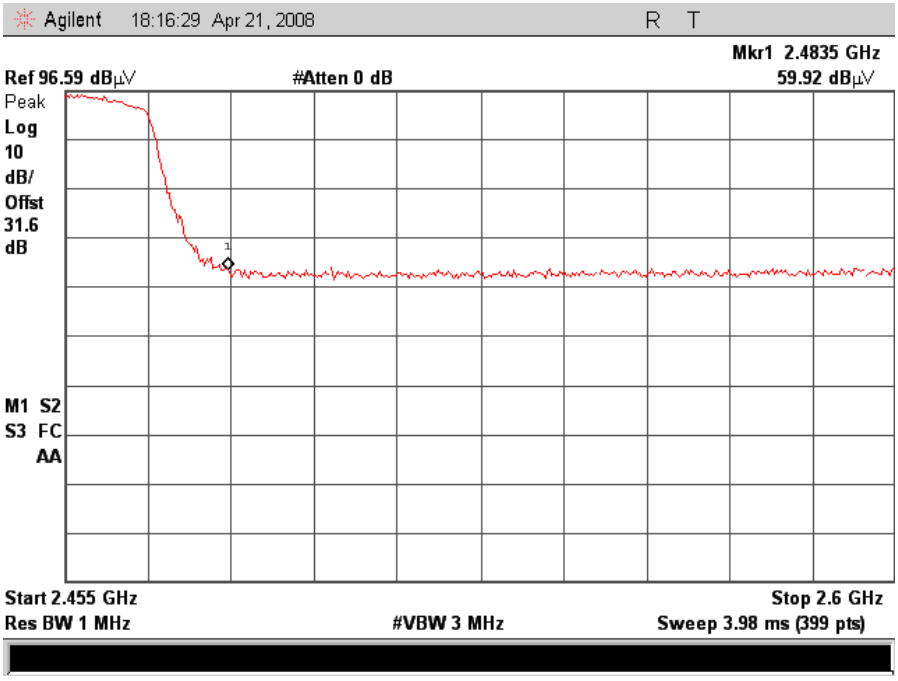
Plot 59. 802.11g Radiated Restricted Band, Low Channel, Avg (Panel Antenna Horizontal)



Plot 60. 802.11g Radiated Restricted Band, Low Channel, Peak (Panel Antenna Horizontal)



Plot 61. 802.11g Radiated Restricted Band, High Channel, Avg (Panel Antenna Horizontal)

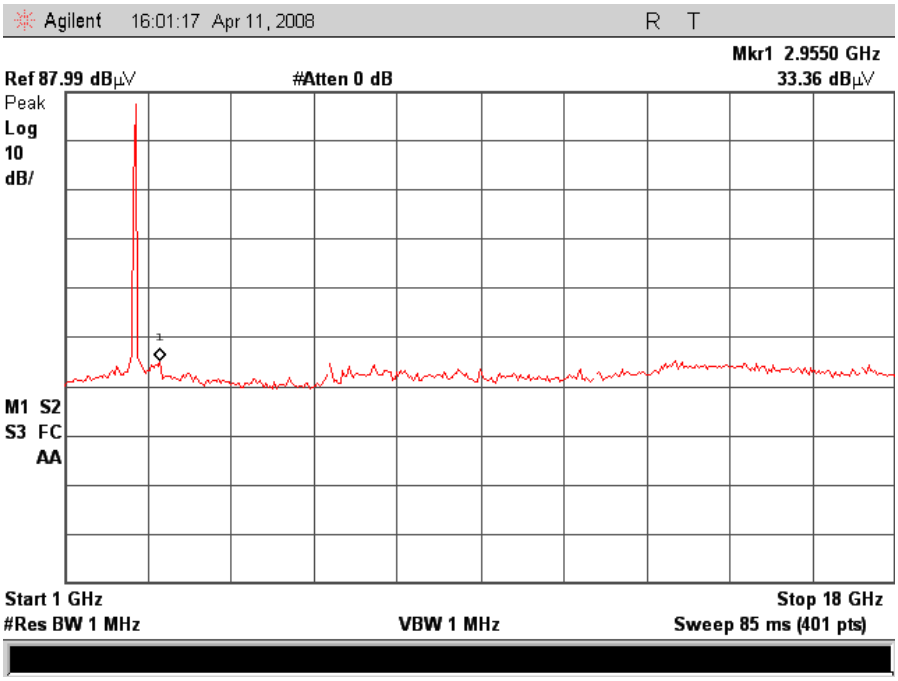


Plot 62. 802.11g Radiated Restricted Band, High Channel, Peak (Panel Antenna Horizontal)

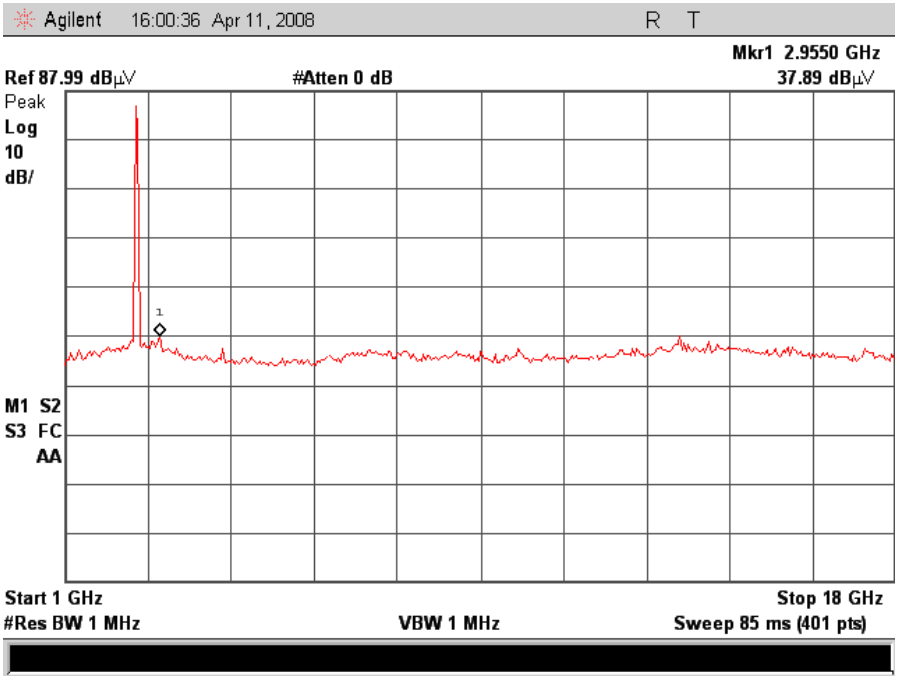
§ 15.247(d) Harmonic Emissions Requirements – Radiated (802.11g) Panel Antenna Vertical

Frequency (GHz)	Receive Antenna Polarity (H/V)	Uncorrected Field Strength (dBµV) @ 3m	P.Amp (dB)	Ant.Cor. Factor (dB)	Cable Loss (dB)	Corrected Field Strength @3m (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dB)	Measurement Type
4824	V	39.41	33.43	33.3	5.2	44.5	74	-29.5	pk
4824	V	31.05	33.43	33.3	5.2	36.2	54	-17.8	avg
7236	V	40.37	34.66	35.8	6.6	48.1	74	-25.9	pk
7236	V	31.15	34.66	35.8	6.6	38.9	54	-15.1	avg
9648	V	40.38	35.15	37.8	7.9	51.0	74	-23.1	pk
Low Channel 2412MHz									
Frequency (GHz)	**Receive Antenna Polarity (H/V)**	**Uncorrected Field Strength (dBµV) @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**Corrected Field Strength @3m (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
4874	V	40.1	34.4	33.4	5.3	44.4	74	-29.6	pk
4874	V	30.93	34.4	33.4	5.3	35.2	54	-18.8	avg
7311	V	40.21	34.7	36.0	6.6	48.2	74	-25.8	pk
7311	V	30.52	34.7	36.0	6.6	38.5	54	-15.5	avg
9748	V	40.74	35.1	38.0	8.0	51.6	74	-22.4	pk
Mid Channel 2437MHz									
Frequency (GHz)	**Receive Antenna Polarity (H/V)**	**Uncorrected Field Strength (dBµV) @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**Corrected Field Strength @3m (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
4924	V	41.7	34.4	33.5	5.3	46.1	74	-27.9	pk
4924	V	30.64	34.4	33.5	5.3	35.1	54	-18.9	avg
7386	V	41.6	34.7	36.2	6.7	49.8	74	-24.2	pk
7386	V	31.19	34.7	36.2	6.7	39.4	54	-14.6	avg
9848	V	40.84	35.1	38.1	8.1	52.0	74	-22.0	pk
High Channel 2462MHz									

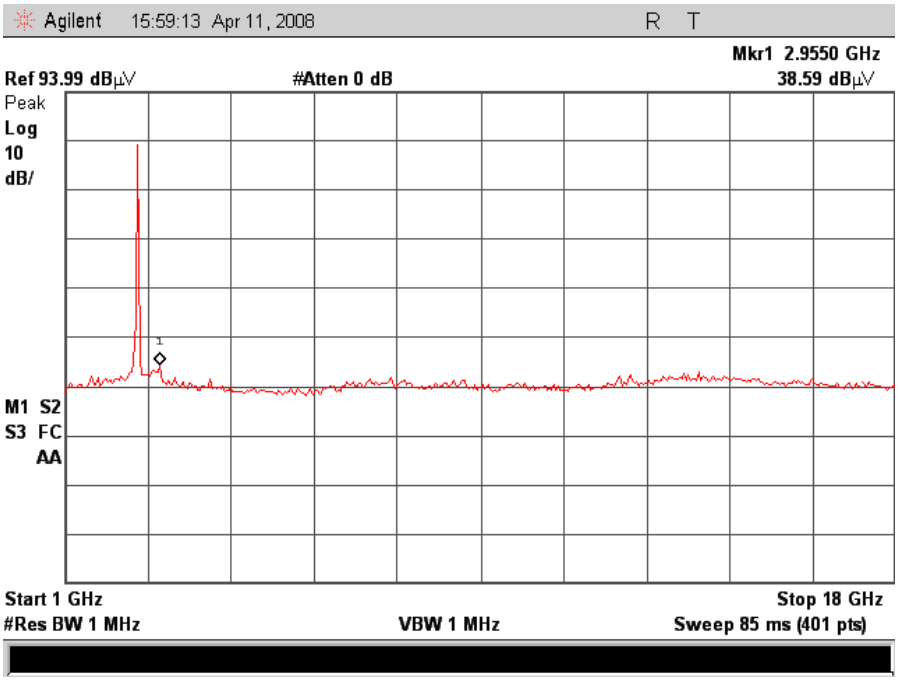
Note: All other emissions were measured at the noise floor of the spectrum analyzer



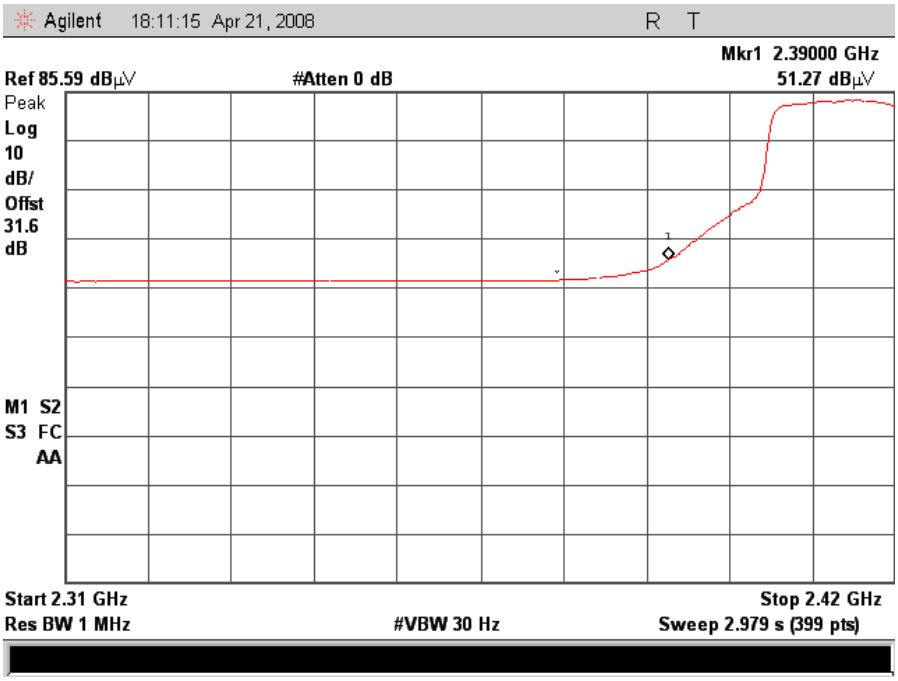
Plot 63. 802.11g Radiated Spurious, Low Channel, 1-18GHz (Panel Antenna Vertical)



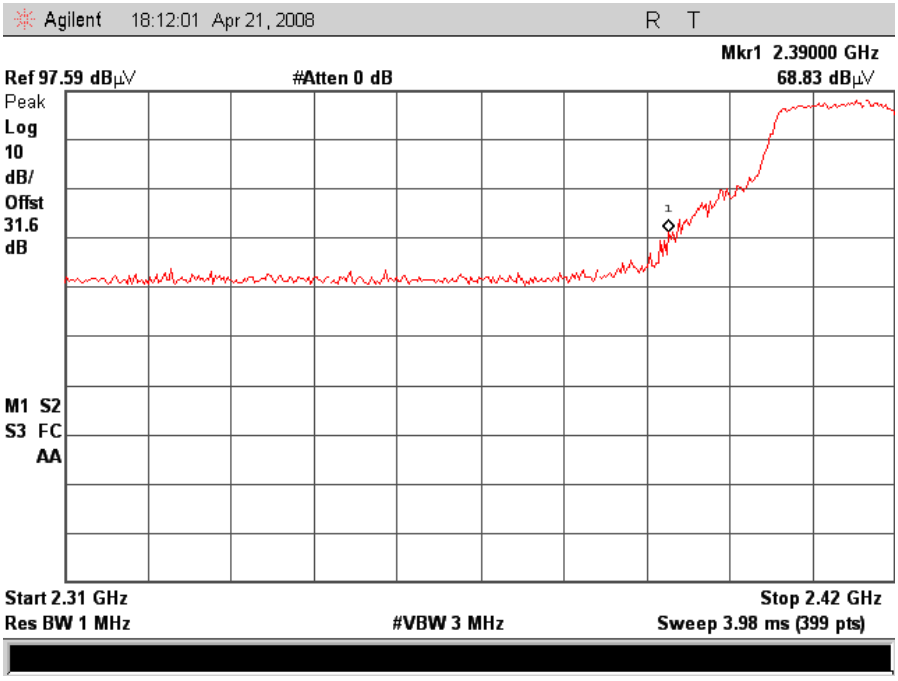
Plot 64. 802.11g Radiated Spurious, Mid Channel, 1-18GHz (Panel Antenna Vertical)



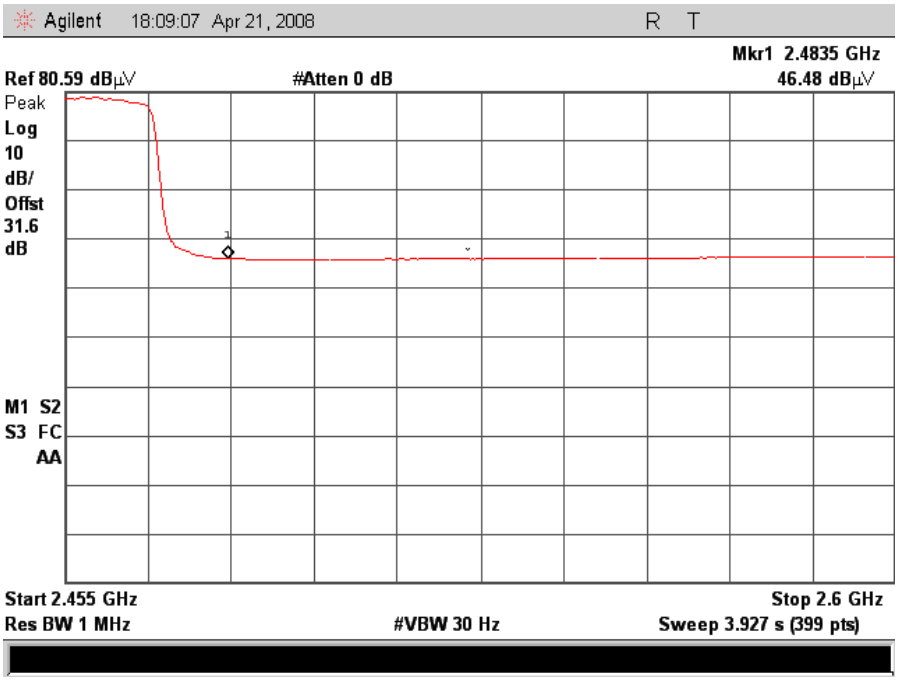
Plot 65. 802.11g Radiated Spurious, High Channel, 1-18GHz (Panel Antenna Vertical)



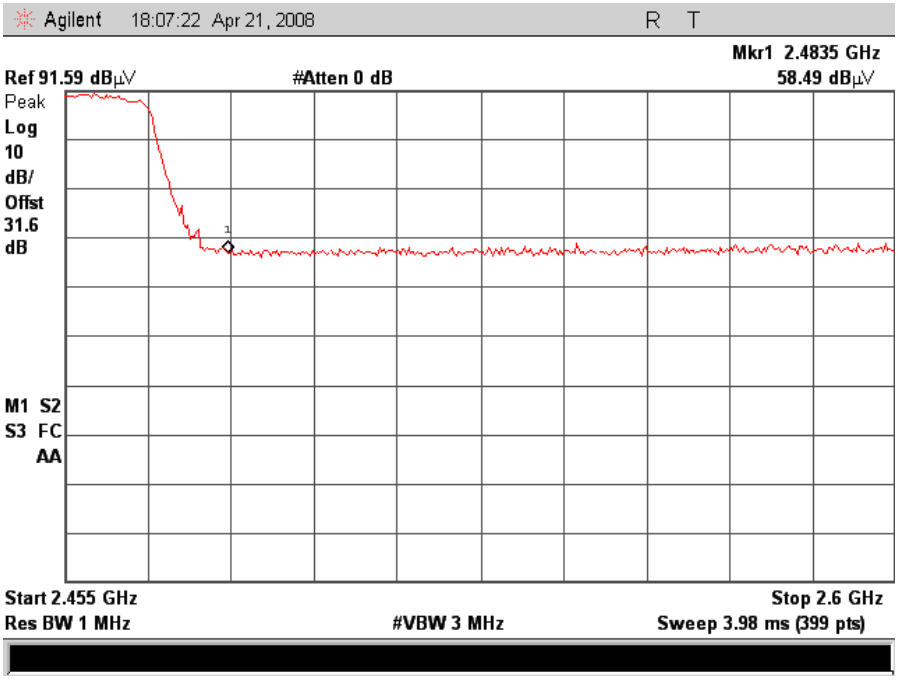
Plot 66. 802.11g Radiated Restricted Band, Low Channel, Avg (Panel Antenna Vertical)



Plot 67. 802.11g Radiated Restricted Band, Low Channel, Peak (Panel Antenna Vertical)



Plot 68. 802.11g Radiated Restricted Band, High Channel, Avg (Panel Antenna Vertical)

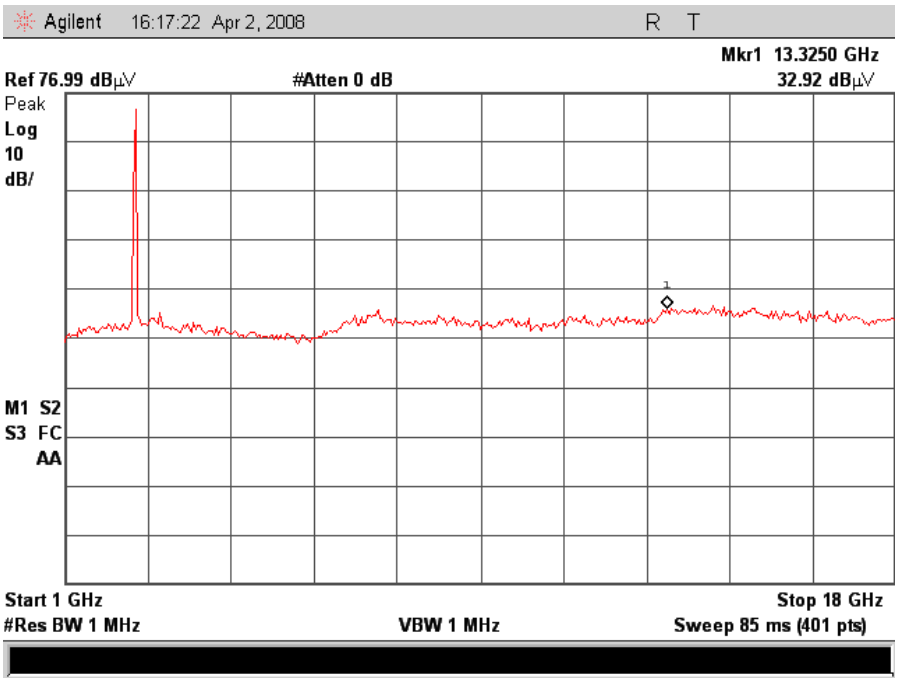


Plot 69. 802.11g Radiated Restricted Band, High Channel, Peak (Panel Antenna Vertical)

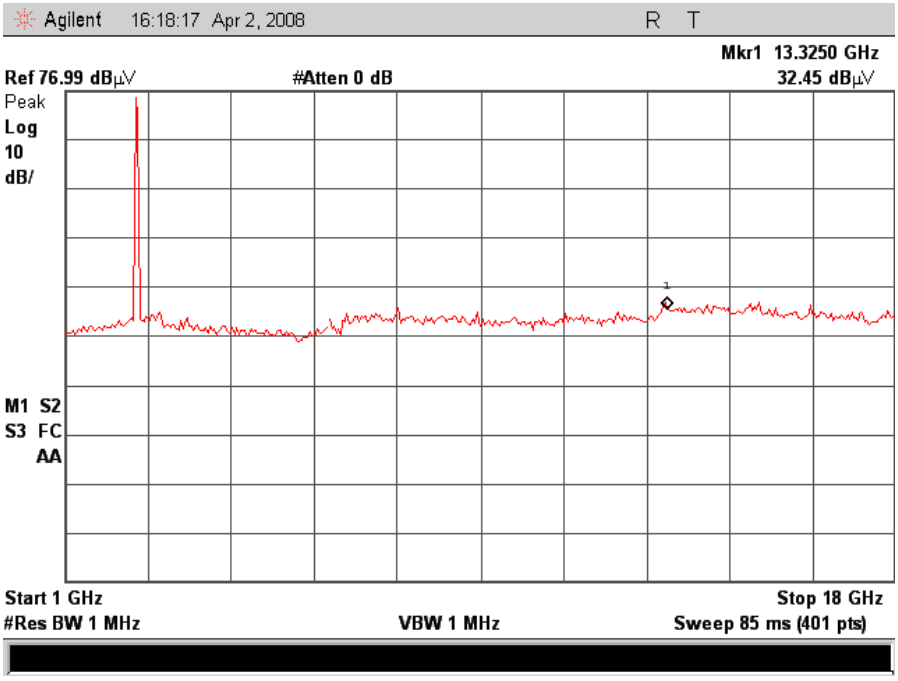
§ 15.247(d) Harmonic Emissions Requirements – Radiated (802.11g) MIMO Antenna l

Frequency (GHz)	Receive Antenna Polarity (H/V)	Uncorrected Field Strength (dBµV) @ 3m	P.Amp (dB)	Ant.Cor. Factor (dB)	Cable Loss (dB)	Corrected Field Strength @3m (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dB)	Measurement Type
4824	V	42.57	34.4	33.3	5.2	46.7	74	-27.3	pk
4824	V	31.26	34.4	33.3	5.2	35.4	54	-18.6	avg
7236	V	42.85	34.7	35.8	6.6	50.6	74	-23.4	pk
7236	V	31.5	34.7	35.8	6.6	39.2	54	-14.8	avg
9648	V	42.57	35.1	37.8	7.9	53.1	74	-20.9	pk
Low Channel 2412MHz									
Frequency (GHz)	**Receive Antenna Polarity (H/V)**	**Uncorrected Field Strength (dBµV) @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**Corrected Field Strength @3m (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
4874	V	42.73	34.4	33.4	5.3	47.0	74	-27.0	pk
4874	V	30.96	34.4	33.4	5.3	35.2	54	-18.8	avg
7311	V	42.24	34.7	36.0	6.6	50.2	74	-23.8	pk
7311	V	30.73	34.7	36.0	6.6	38.7	54	-15.3	avg
9748	V	41.72	35.1	38.0	8.0	52.6	74	-21.4	pk
Mid Channel 2437MHz									
Frequency (GHz)	**Receive Antenna Polarity (H/V)**	**Uncorrected Field Strength (dBµV) @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**Corrected Field Strength @3m (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
4924	V	43.12	34.4	33.5	5.3	47.6	74	-26.4	pk
4924	V	30.92	34.4	33.5	5.3	35.4	54	-18.6	avg
7386	V	42.91	34.7	36.2	6.7	51.1	74	-22.9	pk
7386	V	31.26	34.7	36.2	6.7	39.4	54	-14.6	avg
9848	V	42.26	35.1	38.1	8.1	53.4	74	-20.6	pk
High Channel 2462MHz									

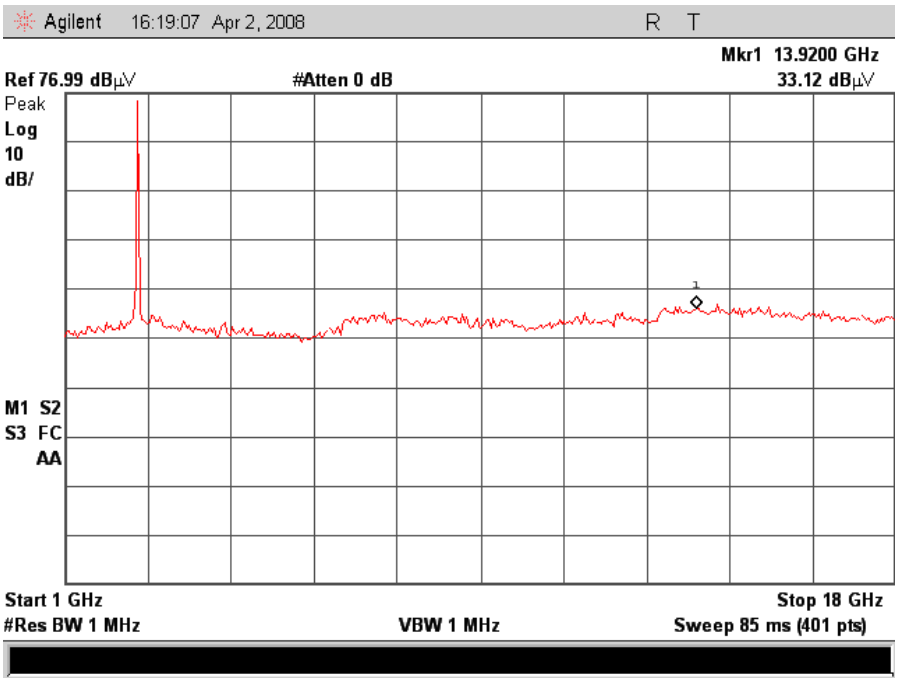
Note: All other emissions were measured at the noise floor of the spectrum analyzer



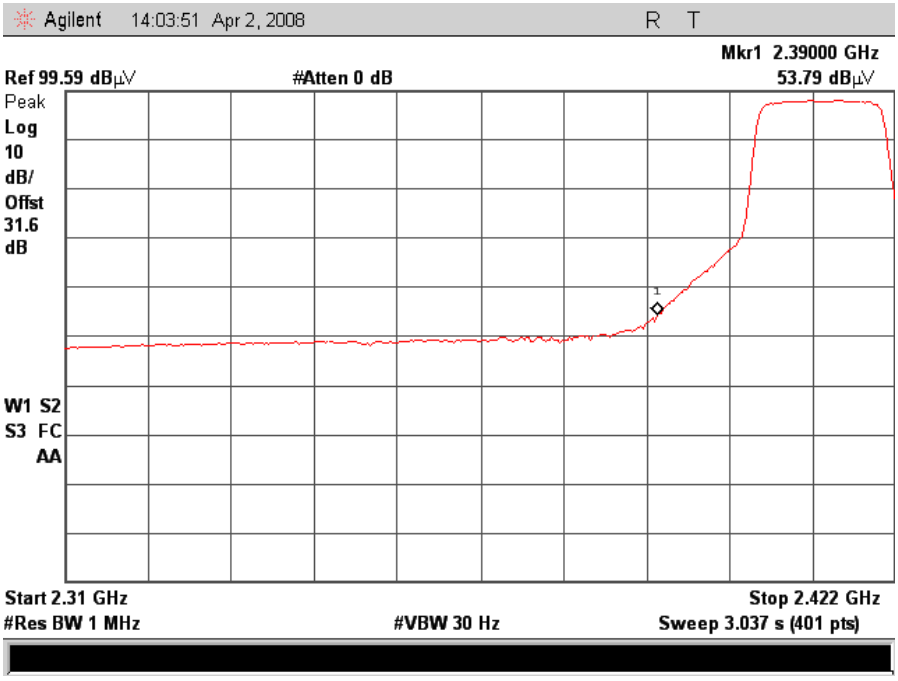
Plot 70. 802.11g Radiated Spurious, Low Channel, 1-18GHz (MIMO Antenna)



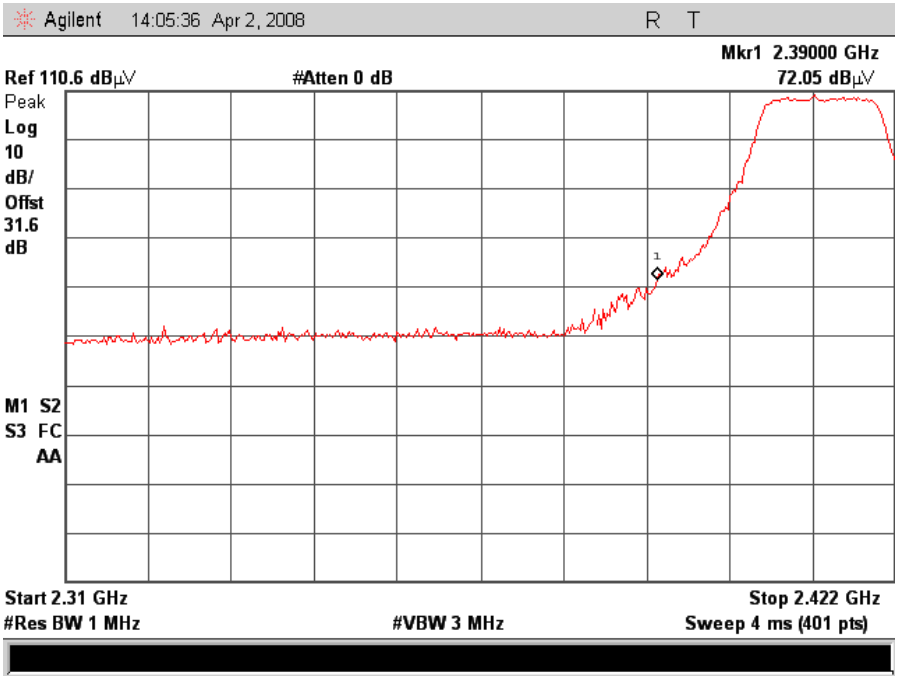
Plot 71. 802.11g Radiated Spurious, Mid Channel, 1-18GHz (MIMO Antenna)



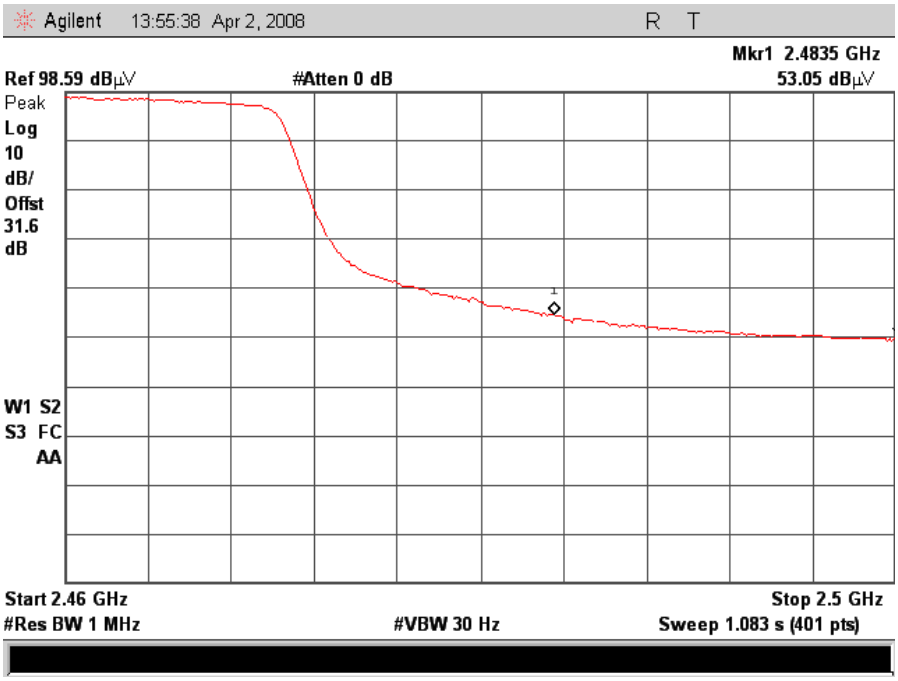
Plot 72. 802.11g Radiated Spurious, High Channel, 1-18GHz (MIMO Antenna)



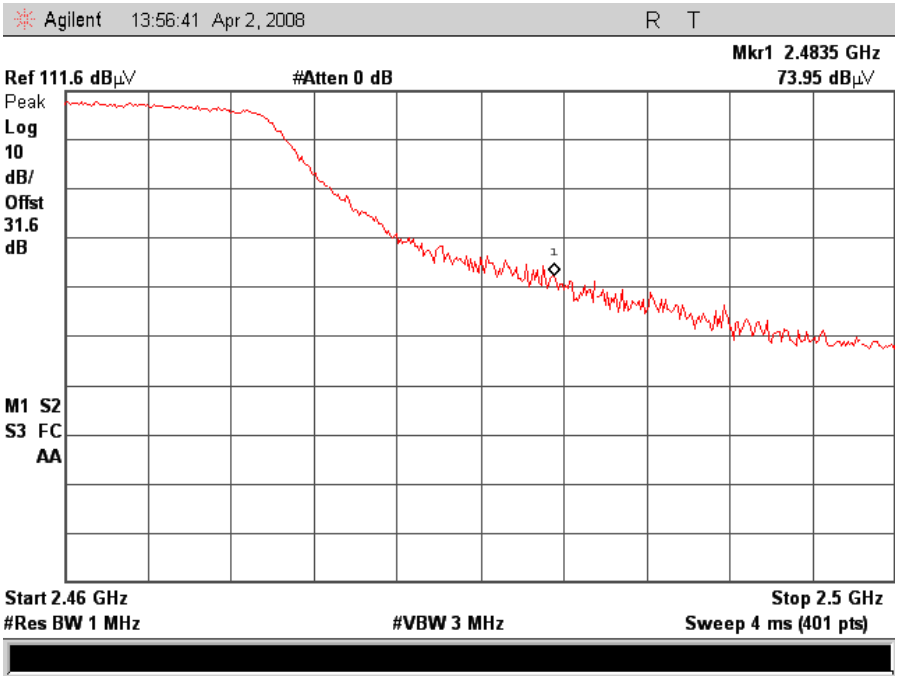
Plot 73. 802.11g Radiated Restricted Band, Low Channel, Avg (MIMO Antenna)



Plot 74. 802.11g Radiated Restricted Band, Low Channel, Peak (MIMO Antenna)



Plot 75. 802.11g Radiated Restricted Band, High Channel, Avg (MIMO Antenna)

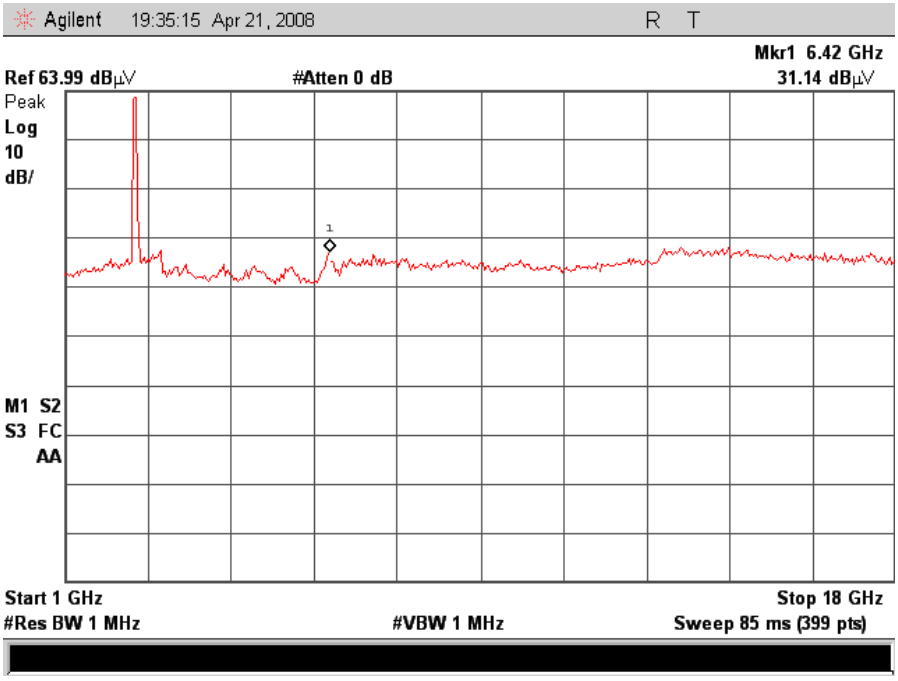


Plot 76. 802.11g Radiated Restricted Band, High Channel, Peak (MIMO Antenna)

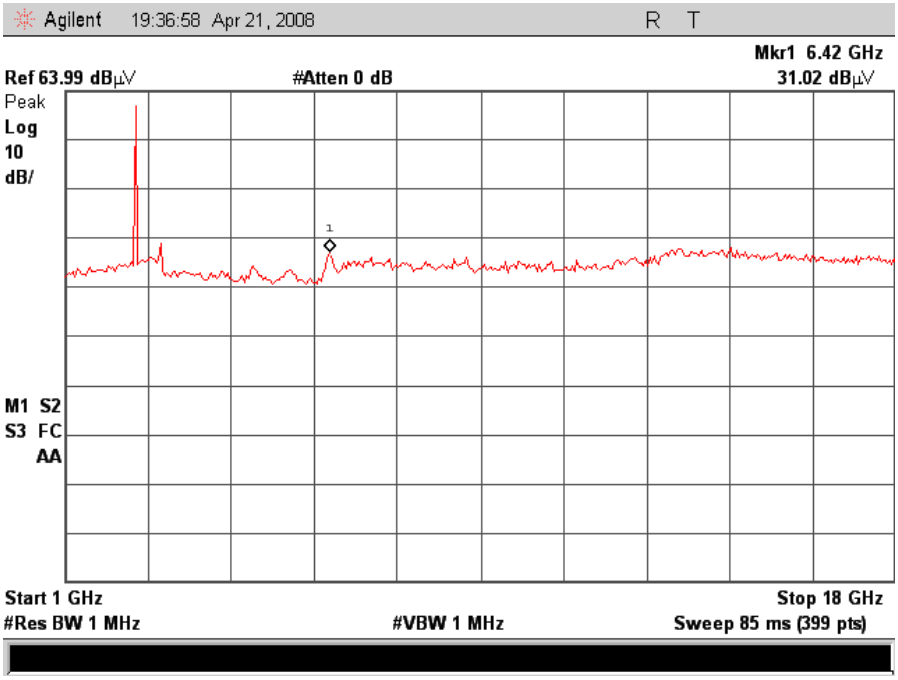
§ 15.247(d) Harmonic Emissions Requirements – Radiated (802.11n) Panel Antenna Horizontal (Port 1)

Frequency (GHz)	Receive Antenna Polarity (H/V)	Uncorrected Field Strength (dBµV) @ 3m	P.Amp (dB)	Ant.Cor. Factor (dB)	Cable Loss (dB)	Corrected Field Strength @3m (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dB)	Measurement Type
4824	H	43.15	34.8	33.2	5.2	46.8	74	27.2	pk
4824	H	31.16	34.8	33.2	5.2	34.8	54	19.2	avg
7236	H	43.02	35.0	35.7	6.5	50.2	74	23.8	pk
7236	H	30.13	35.0	35.7	6.5	37.3	54	16.7	avg
9648	H	42.16	35.0	37.7	7.8	52.7	74	21.4	pk
Low Channel 2412MHz									
Frequency (GHz)	**Receive Antenna Polarity (H/V)**	**Uncorrected Field Strength (dBµV) @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**Corrected Field Strength @3m (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
4874	H	44.28	34.8	33.5	5.2	48.2	74	25.8	pk
4874	H	30.43	34.8	33.5	5.2	34.3	54	19.7	avg
7311	H	43.77	35.0	36.0	6.5	51.2	74	22.8	pk
7311	H	30.45	35.0	36.0	6.5	38.0	54	16.1	avg
9748	H	42.96	35.6	38.0	7.8	53.2	74	20.8	pk
Mid Channel 2437MHz									
Frequency (GHz)	**Receive Antenna Polarity (H/V)**	**Uncorrected Field Strength (dBµV) @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**Corrected Field Strength @3m (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
4924	H	43.12	34.7	33.5	5.2	47.1	74	26.9	pk
4924	H	30.47	34.7	33.5	5.2	34.5	54	19.5	avg
7386	H	44.22	35.0	36.0	6.5	51.7	74	22.3	pk
7386	H	30.14	35.0	36.0	6.5	37.6	54	16.4	avg
9848	H	42.12	35.6	38.0	7.8	52.3	74	21.7	pk
High Channel 2462MHz									

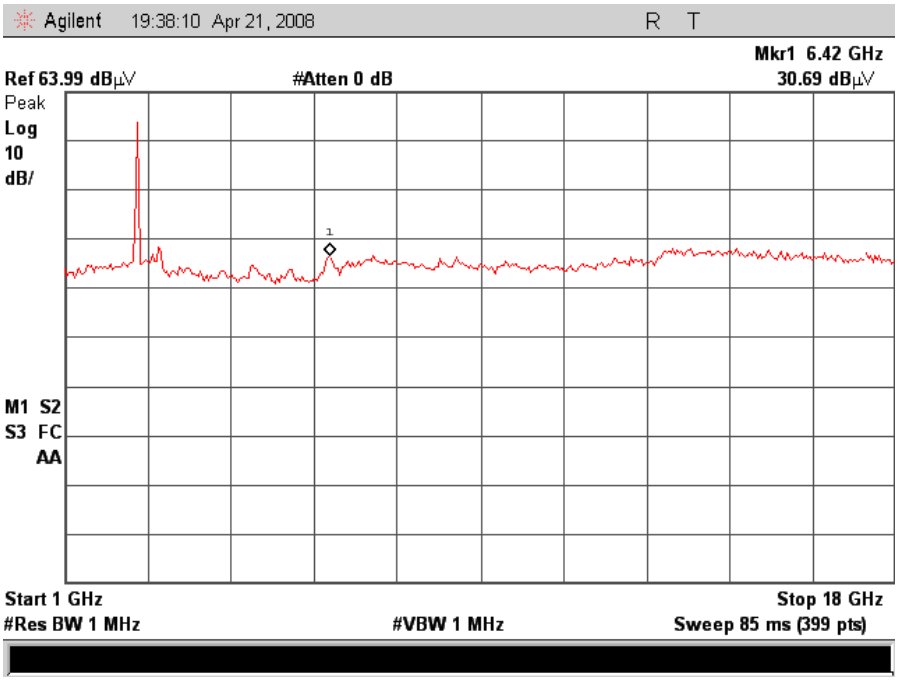
Note: All other emissions were measured at the noise floor of the spectrum analyzer



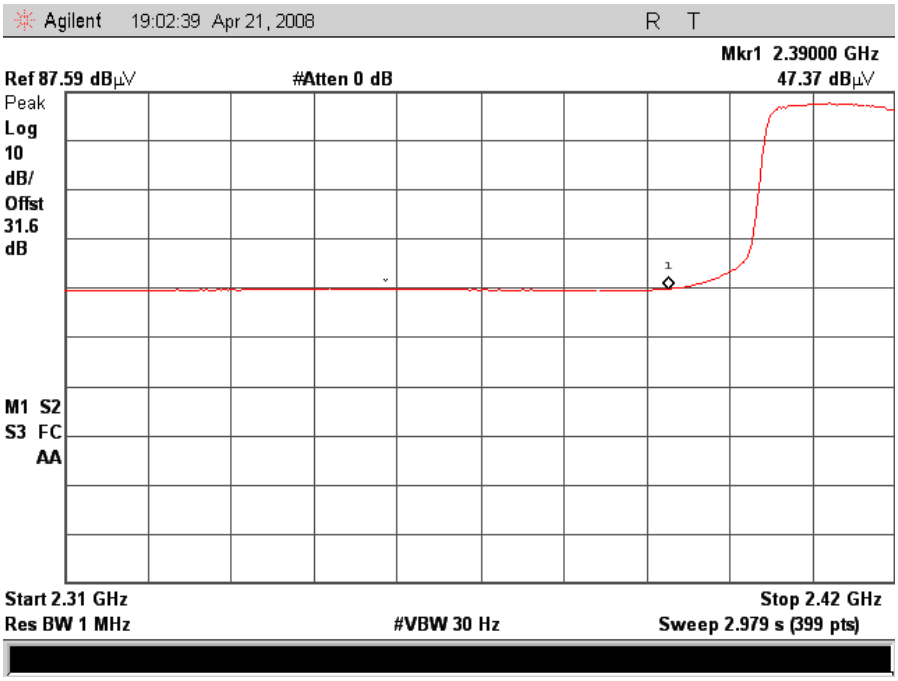
Plot 77. 802.11n Radiated Spurious, Low Channel, 1-18GHz (Panel Antenna Horizontal)



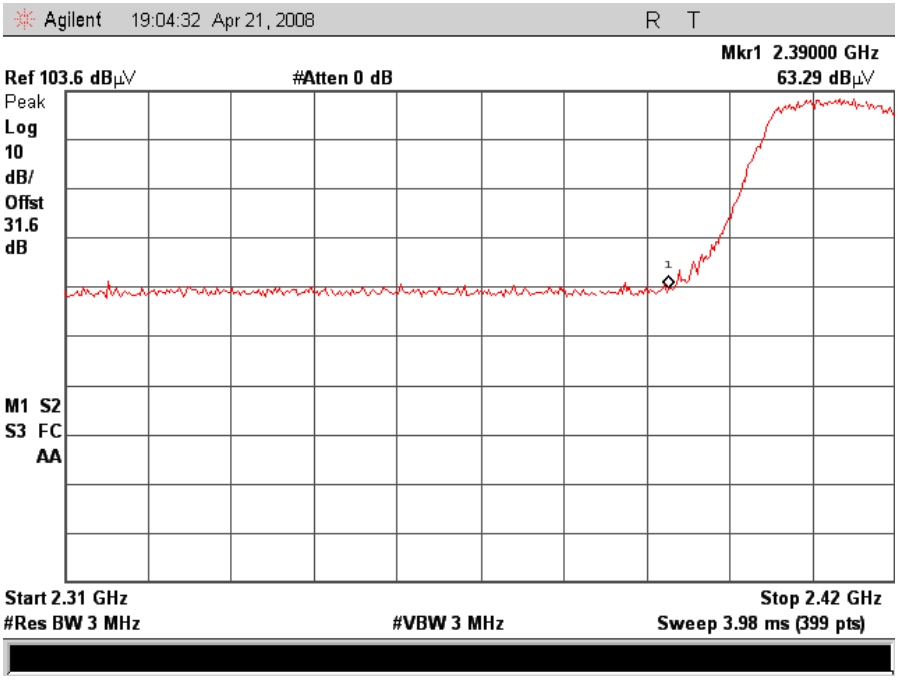
Plot 78. 802.11n Radiated Spurious, Mid Channel, 1-18GHz (Panel Antenna Horizontal)



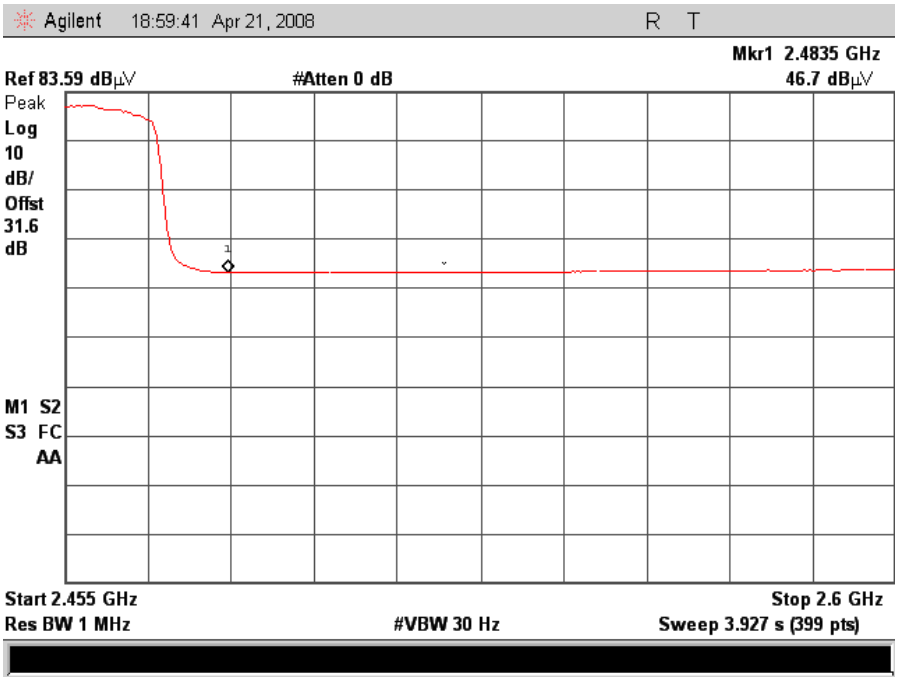
Plot 79. 802.11gnRadiated Spurious, High Channel, 1-18GHz (Panel Antenna Horizontal)



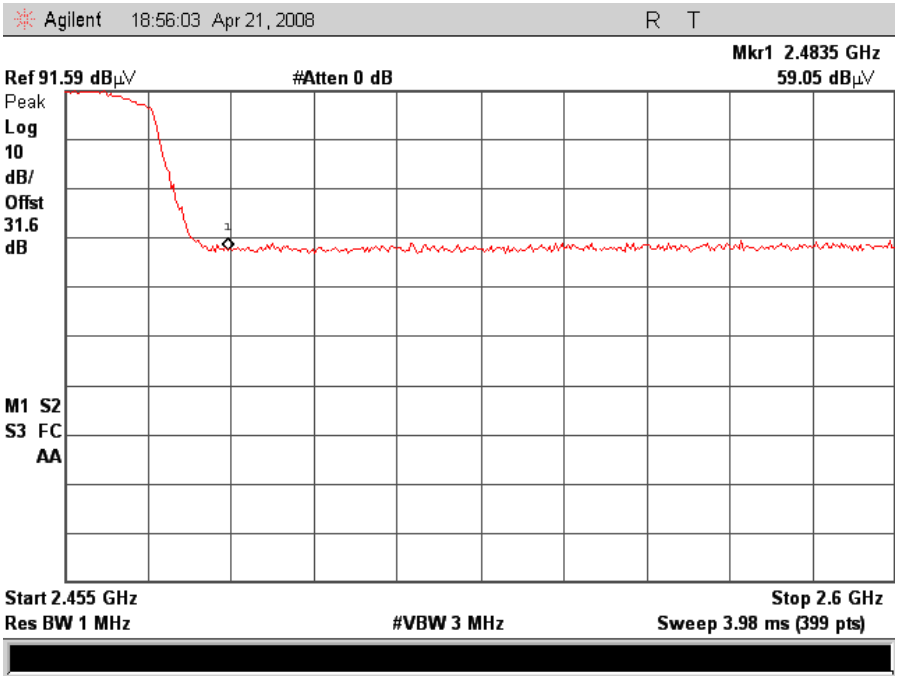
Plot 80. 802.11n Radiated Restricted Band, Low Channel, Avg (Panel Antenna Horizontal)



Plot 81. 802.11n Radiated Restricted Band, Low Channel, Peak (Panel Antenna Horizontal)



Plot 82. 802.11n Radiated Restricted Band, High Channel, Avg (Panel Antenna Horizontal)

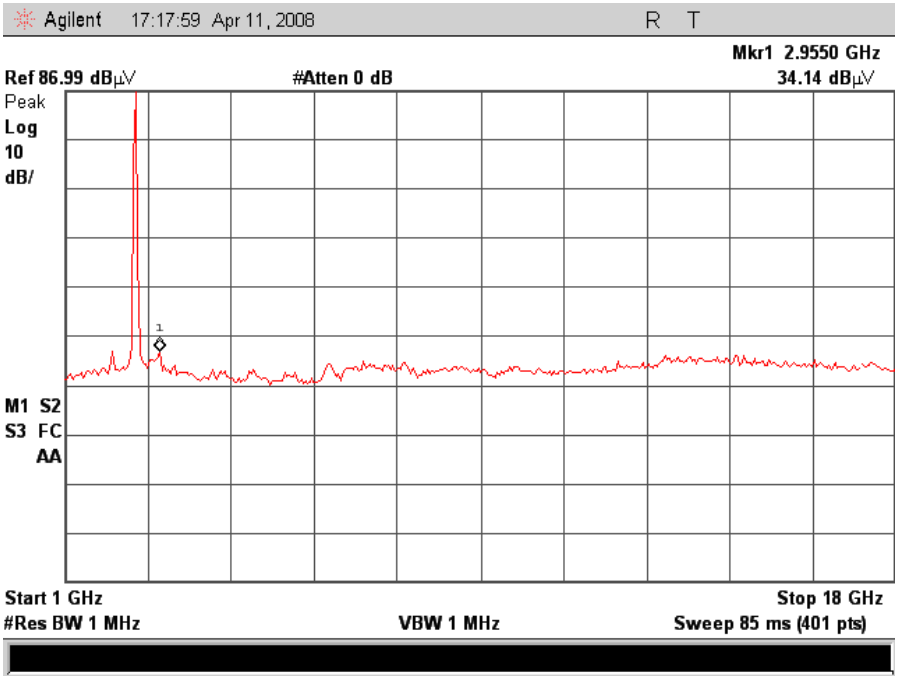


Plot 83. 802.11n Radiated Restricted Band, High Channel, Peak (Panel Antenna Horizontal)

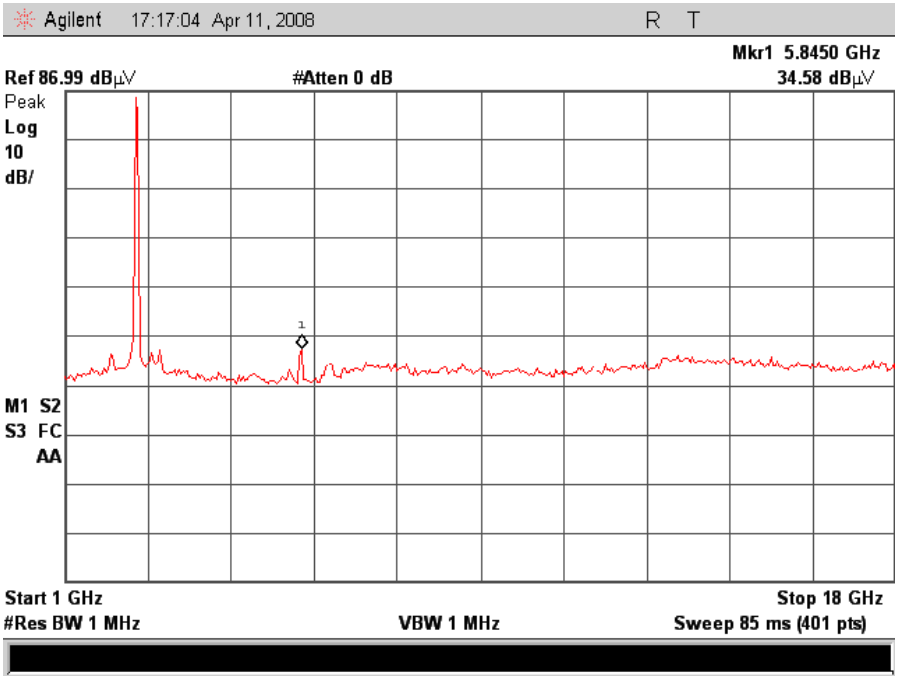
§ 15.247(d) Harmonic Emissions Requirements – Radiated (802.11n) Panel Antenna Vertical (Port 1)

Frequency (GHz)	Receive Antenna Polarity (H/V)	Uncorrected Field Strength (dBµV) @ 3m	P.Amp (dB)	Ant.Cor. Factor (dB)	Cable Loss (dB)	Corrected Field Strength @3m (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dB)	Measurement Type
4824	V	41.35	34.8	33.2	5.2	45.0	74	29.0	pk
4824	V	30.17	34.8	33.2	5.2	33.8	54	20.2	avg
7236	V	40.83	35.0	35.7	6.5	48.0	74	26.0	pk
7236	V	31.5	35.0	35.7	6.5	38.7	54	15.3	avg
9648	V	40.83	35.0	37.7	7.8	51.3	74	22.7	pk
Low Channel 2412MHz									
Frequency (GHz)	**Receive Antenna Polarity (H/V)**	**Uncorrected Field Strength (dBµV) @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**Corrected Field Strength @3m (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
4874	V	41.54	34.8	33.5	5.2	45.5	74	28.5	pk
4874	V	30.5	34.8	33.5	5.2	34.4	54	19.6	avg
7311	V	40.23	35.0	36.0	6.5	47.7	74	26.3	pk
7311	V	32.72	35.0	36.0	6.5	40.2	54	13.8	avg
9748	V	40.43	35.6	38.0	7.8	50.7	74	23.3	pk
Mid Channel 2437MHz									
Frequency (GHz)	**Receive Antenna Polarity (H/V)**	**Uncorrected Field Strength (dBµV) @ 3m**	**P.Amp (dB)**	**Ant.Cor. Factor (dB)**	**Cable Loss (dB)**	**Corrected Field Strength @3m (dBµV/m)**	**Limit @ 3m (dBµV/m)**	**Margin (dB)**	**Measurement Type**
4924	V	44.5	34.7	33.5	5.2	48.5	74	25.5	pk
4924	V	31.17	34.7	33.5	5.2	35.2	54	18.8	avg
7386	V	42.5	35.0	36.0	6.5	50.0	74	24.0	pk
7386	V	29.45	35.0	36.0	6.5	36.9	54	17.1	avg
9848	V	42.33	35.6	38.0	7.8	52.5	74	21.5	pk
High Channel 2462MHz									

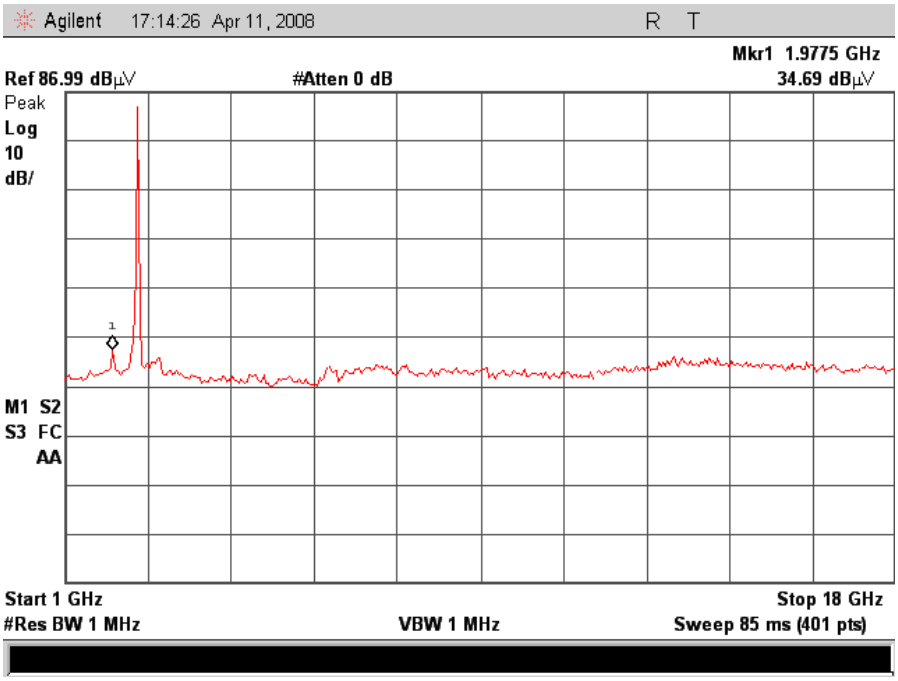
Note: All other emissions were measured at the noise floor of the spectrum analyzer



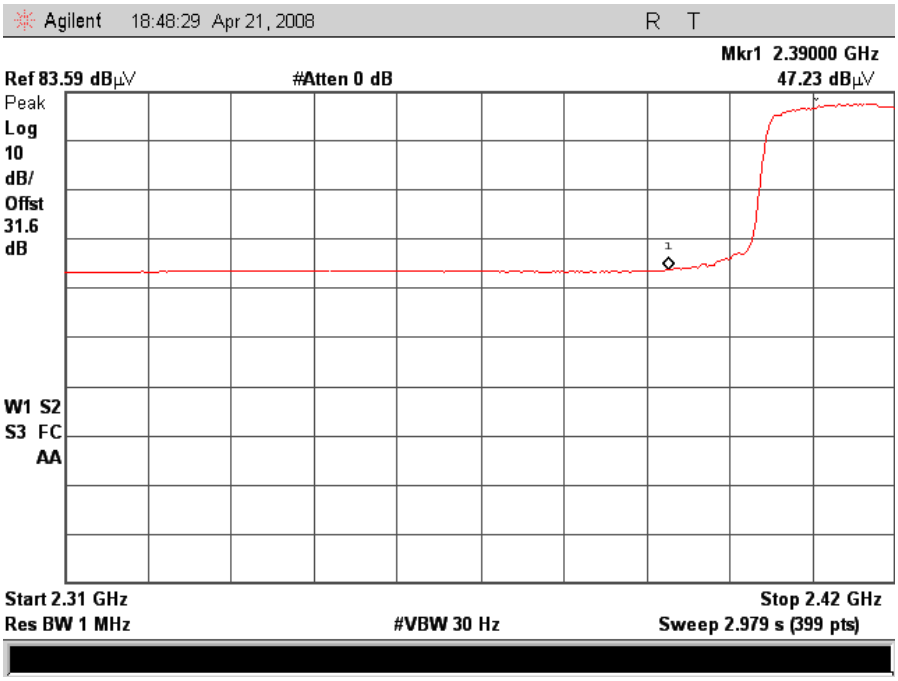
Plot 84. 802.11n Radiated Spurious, Low Channel, 1-18GHz (Panel Antenna Vertical)



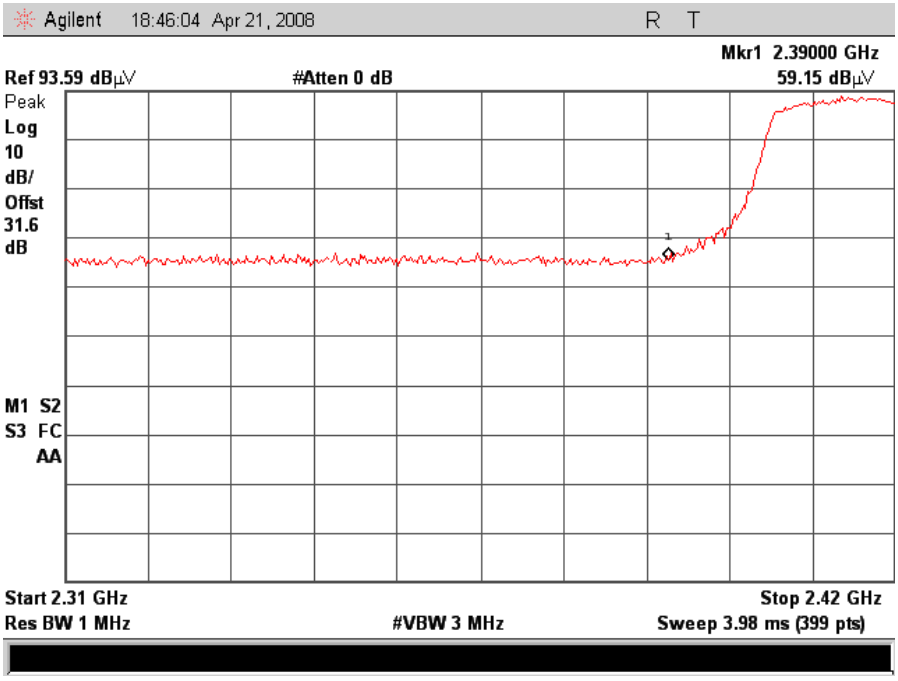
Plot 85. 802.11n Radiated Spurious, Mid Channel, 1-18GHz (Panel Antenna Vertical)



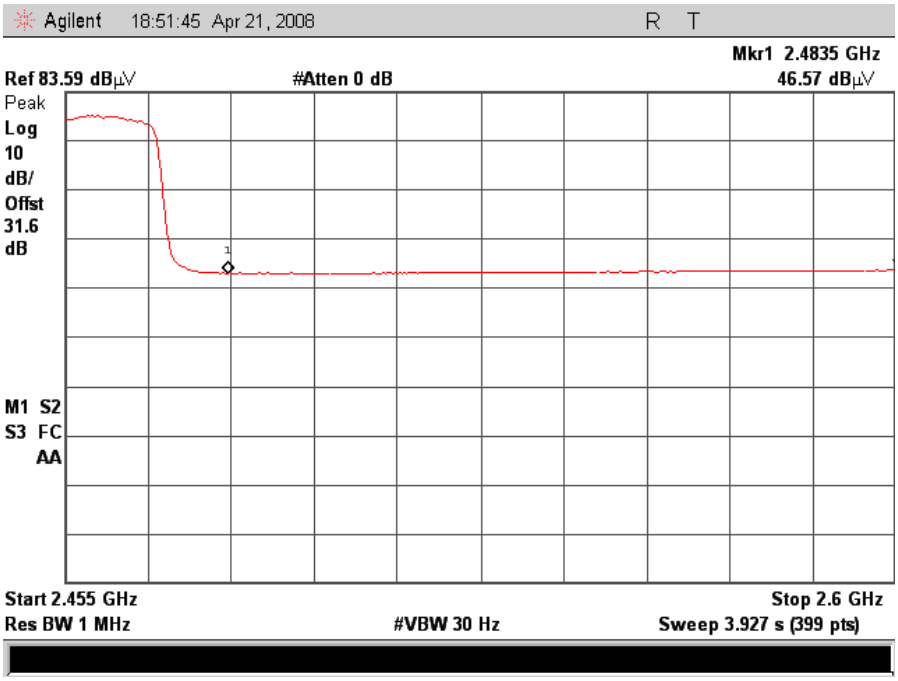
Plot 86. 802.11n Radiated Spurious, High Channel, 1-18GHz (Panel Antenna Vertical)



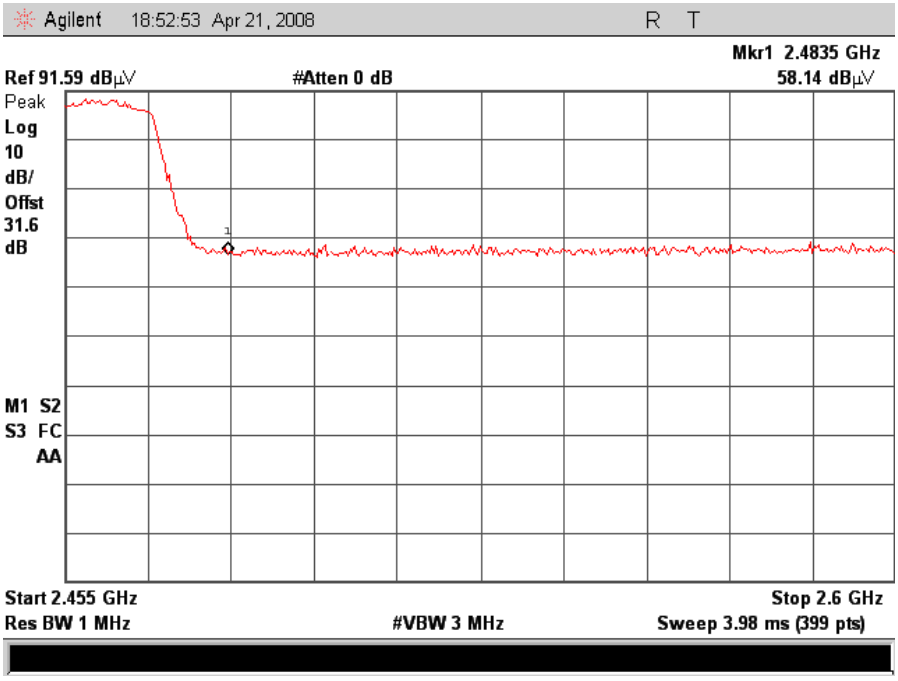
Plot 87. 802.11n Radiated Restricted Band, Low Channel, Avg (Panel Antenna Vertical)



Plot 88. 802.11n Radiated Restricted Band, Low Channel, Peak (Panel Antenna Vertical)



Plot 89. 802.11n Radiated Restricted Band, High Channel, Avg (Panel Antenna Vertical)



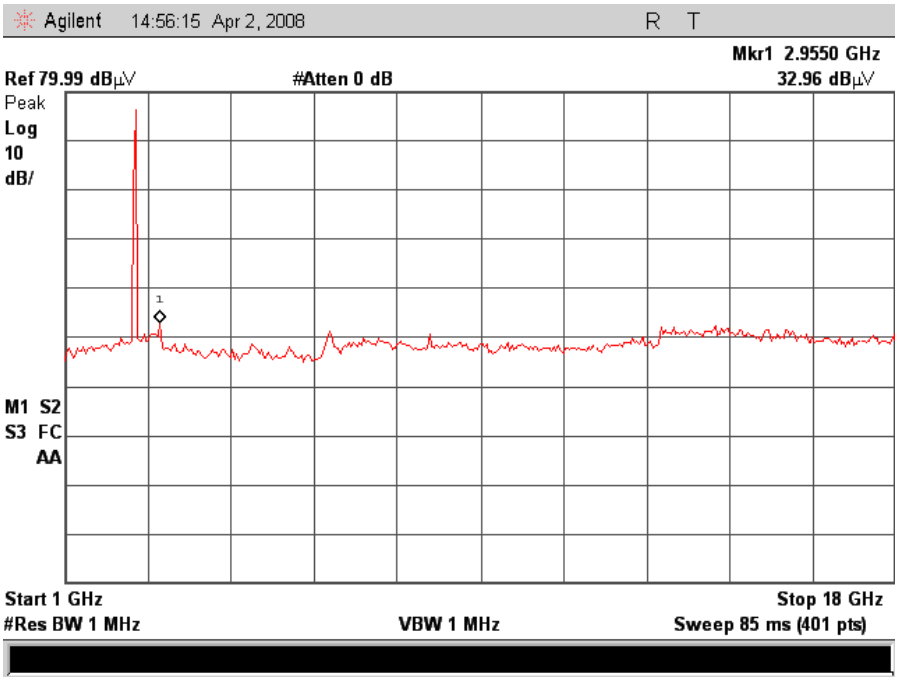
Plot 90. 802.11n Radiated Restricted Band, High Channel, Peak (Panel Antenna Vertical)

§ 15.247(d) Harmonic Emissions Requirements – Radiated (802.11n) Panel Antenna Vertical (All Ports) – 40MHz

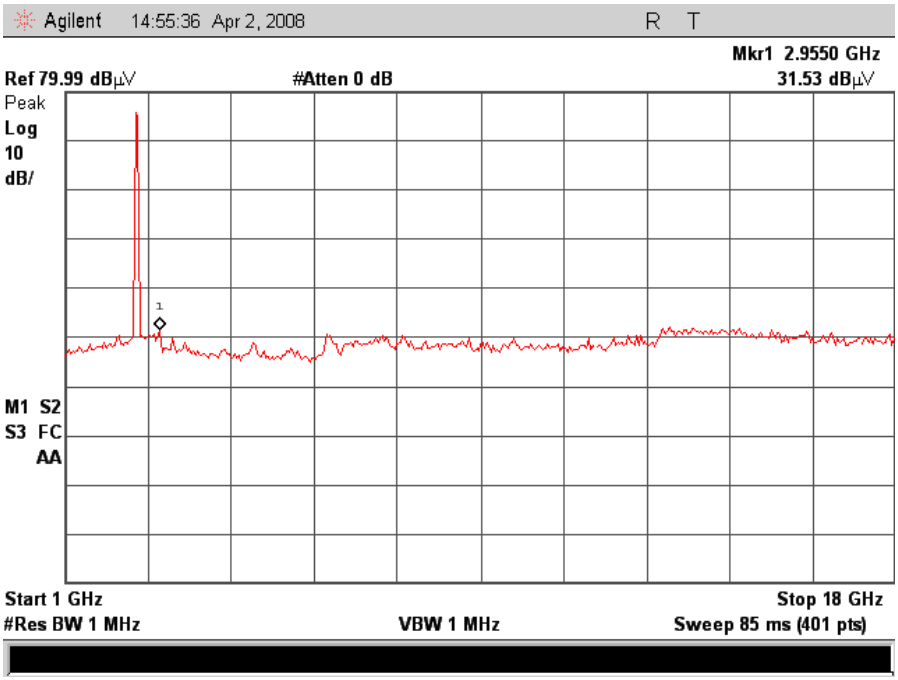
Frequency (GHz)	Receive Antenna Polarity (H/V)	Uncorrected Field Strength (dBµV) @ 3m	P.Amp (dB)	Ant.Cor. Factor (dB)	Cable Loss (dB)	Corrected Field Strength @3m (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dB)	Measurement Type
4874	V	43.83	34.4	33.4	5.3	48.1	74	-25.9	pk
4874	V	31.92	34.4	33.4	5.3	36.2	54	-17.8	avg
7311	V	43.25	34.7	35.9	6.6	51.1	74	-22.9	pk
7311	V	31.82	34.7	35.9	6.6	39.7	54	-14.3	avg
9748	V	45.04	35.1	38.0	8.0	55.9	74	-18.1	pk
Mid Channel 2437MHz									

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

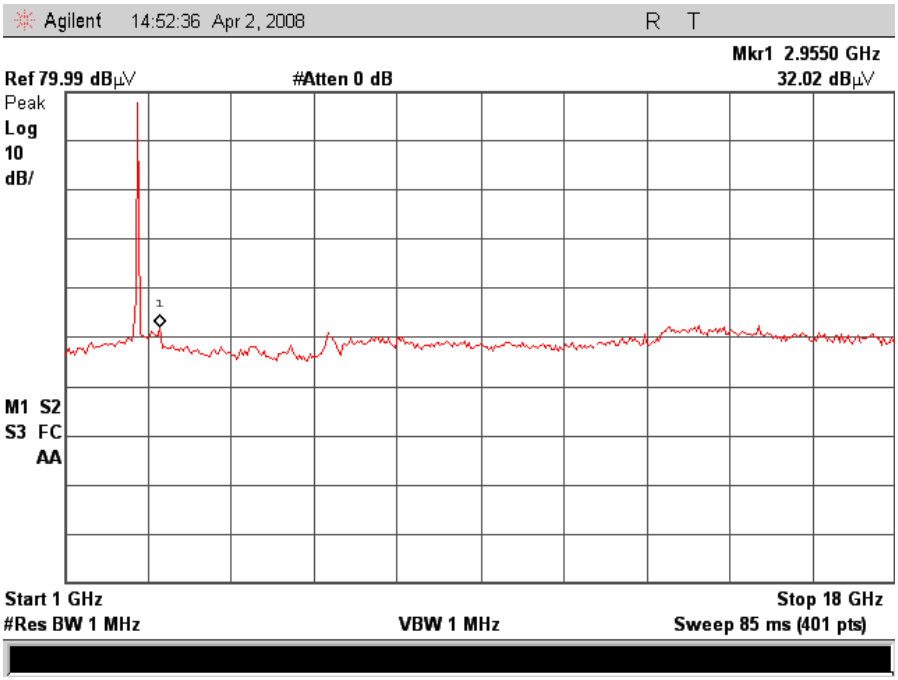
Radiated Spurious Emissions – 802.11n, All Ports, 20MHz



Plot 91. 802.11n Radiated Spurious, Low Channel, 1-18GHz (20MHz)

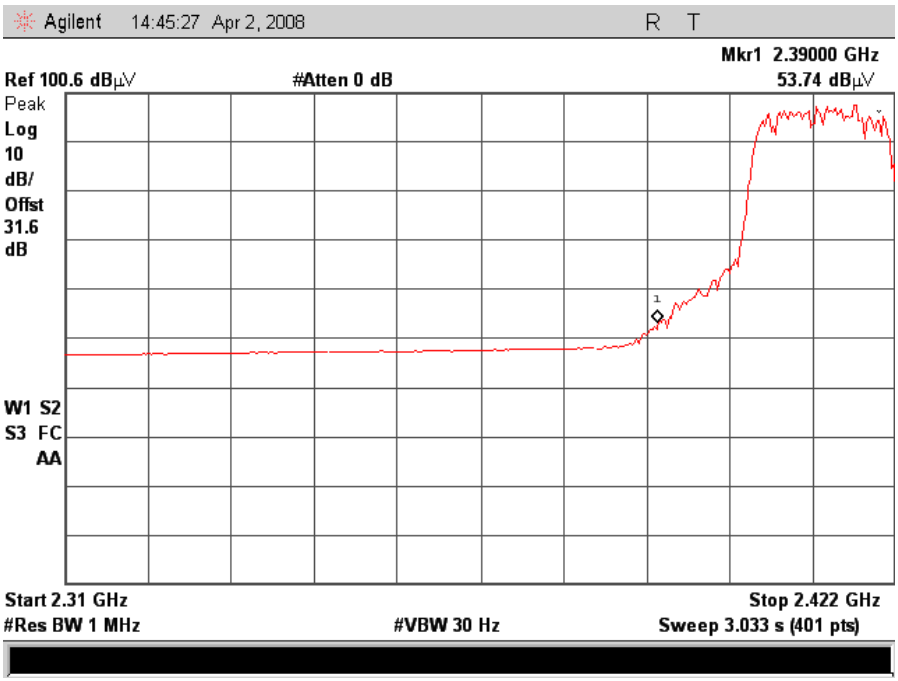


Plot 92. 802.11n Radiated Spurious, Mid Channel, 1-18GHz (20MHz)

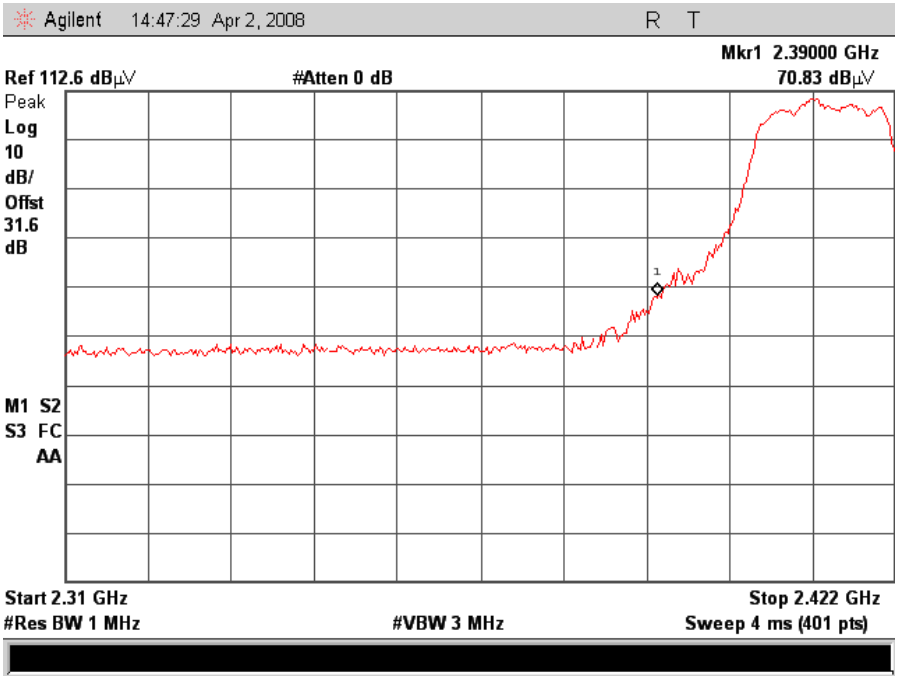


Plot 93. 802.11n Radiated Spurious, High Channel, 1-18GHz (20MHz)

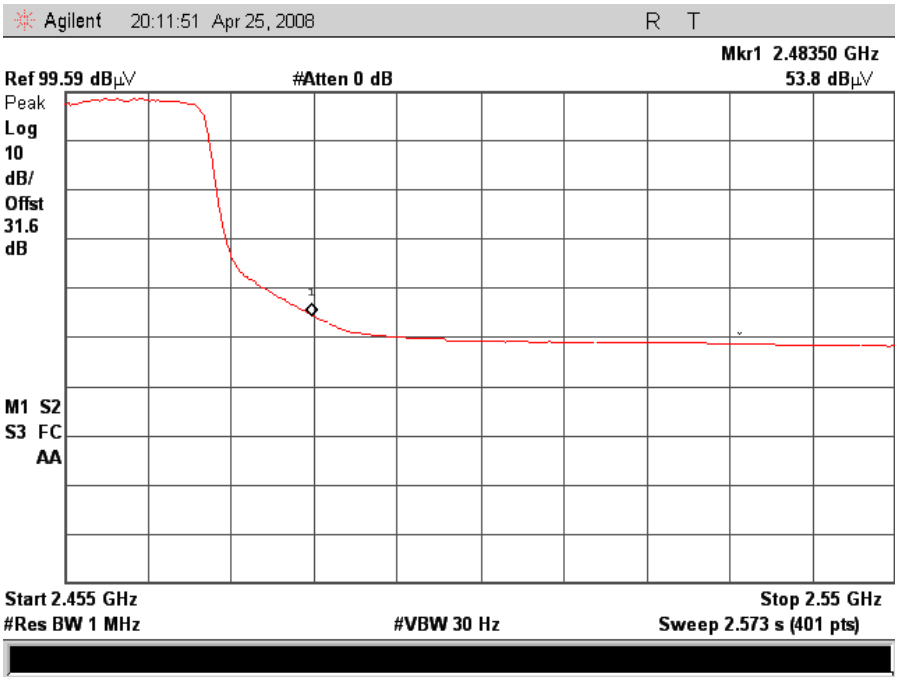
Radiated Restricted Band– 802.11n, All Ports, 20MHz



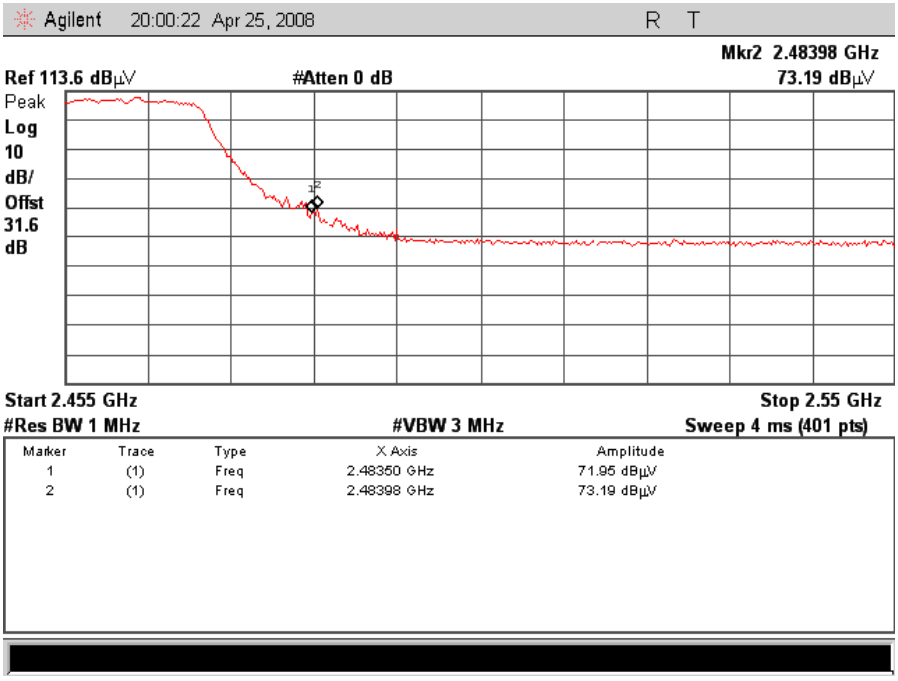
Plot 94. 802.11n Radiated Restricted Band, Low Channel, Avg (20MHz)



Plot 95. 802.11n Radiated Restricted Band, Low Channel, Peak (20MHz)

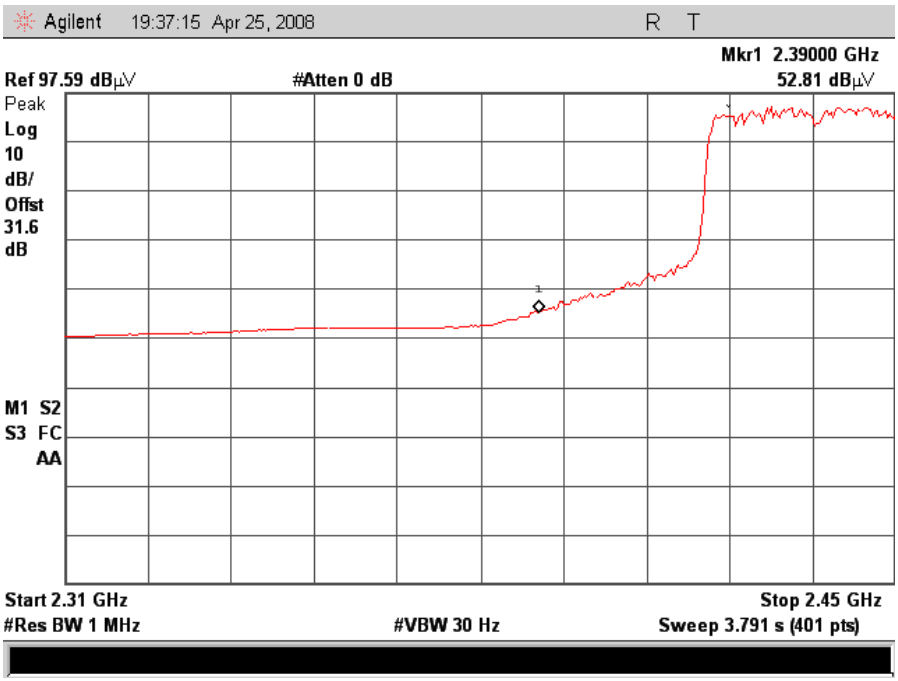


Plot 96. 802.11n Radiated Restricted Band, High Channel, Avg (20MHz)

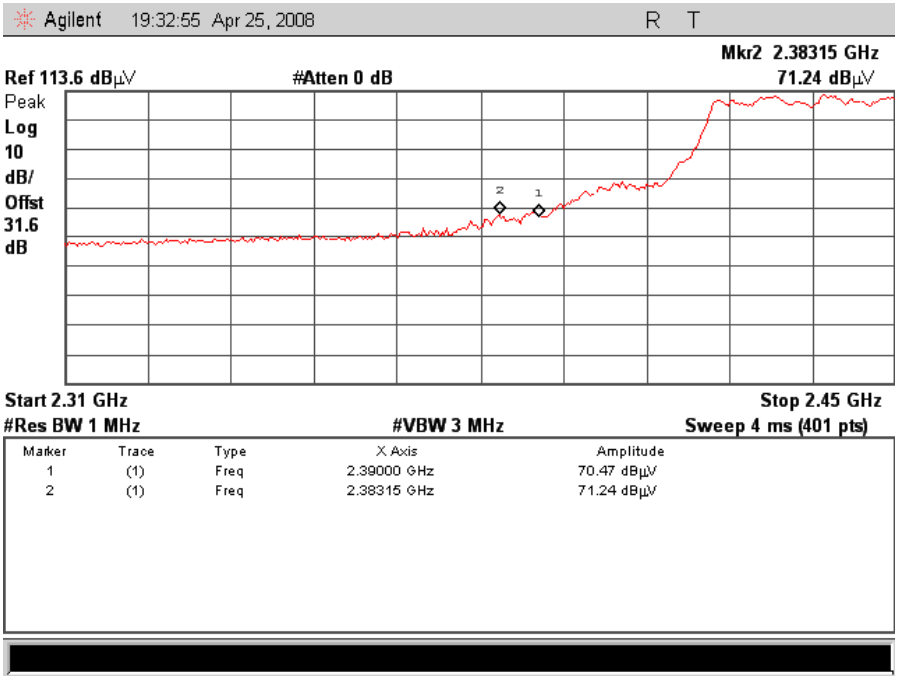


Plot 97. 802.11n Radiated Restricted Band, High Channel, Peak (20MHz)

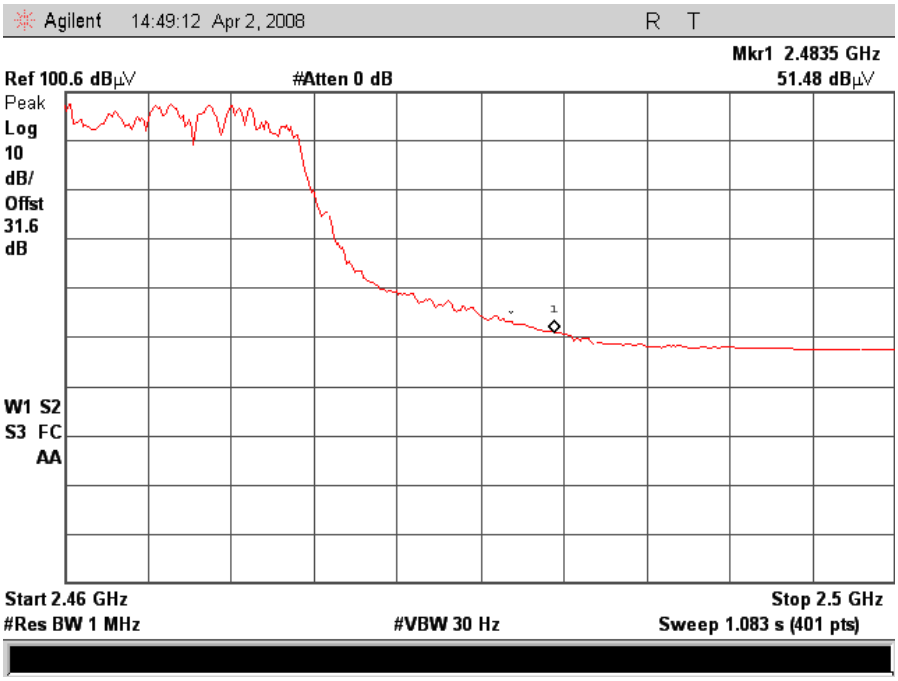
Radiated Restricted Band– 802.11n, All Ports, 40MHz



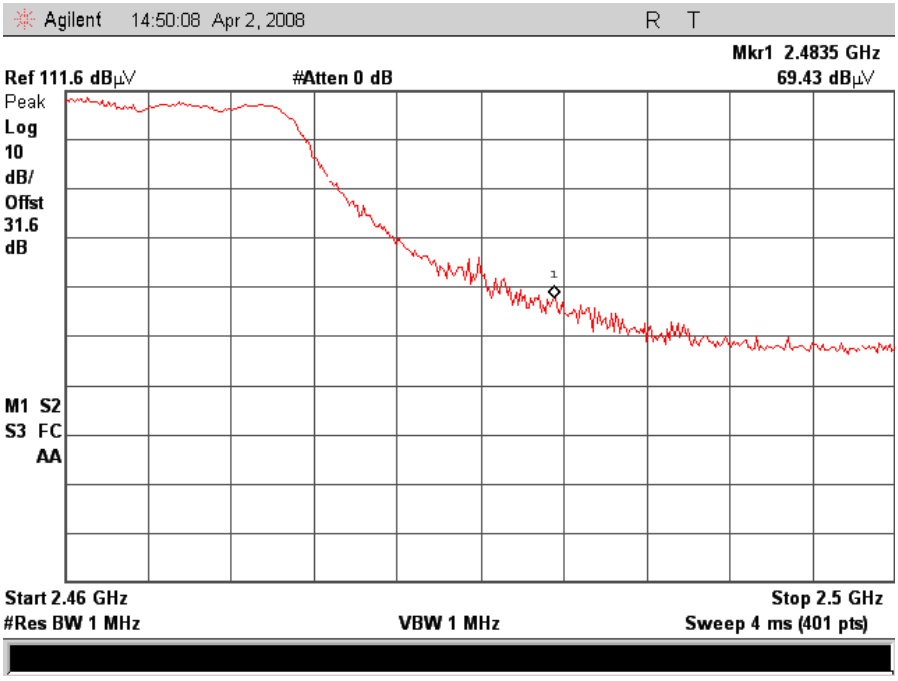
Plot 98. 802.11n Radiated Restricted Band, Low, Avg (40MHz)



Plot 99. 802.11n Radiated Restricted Band, Low, Peak (40MHz)

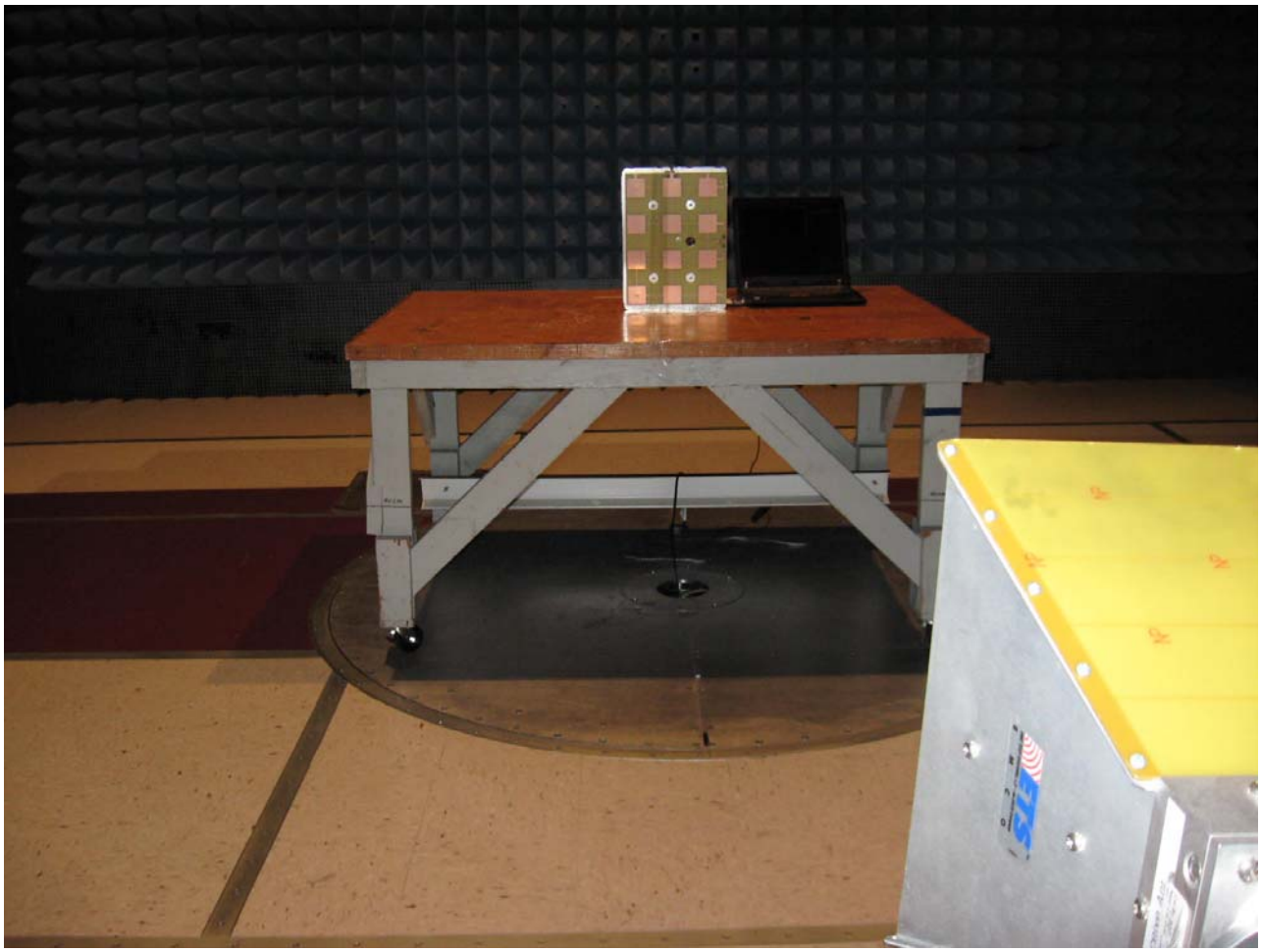


Plot 100. 802.11n Radiated Restricted Band, High, Avg (40MHz)

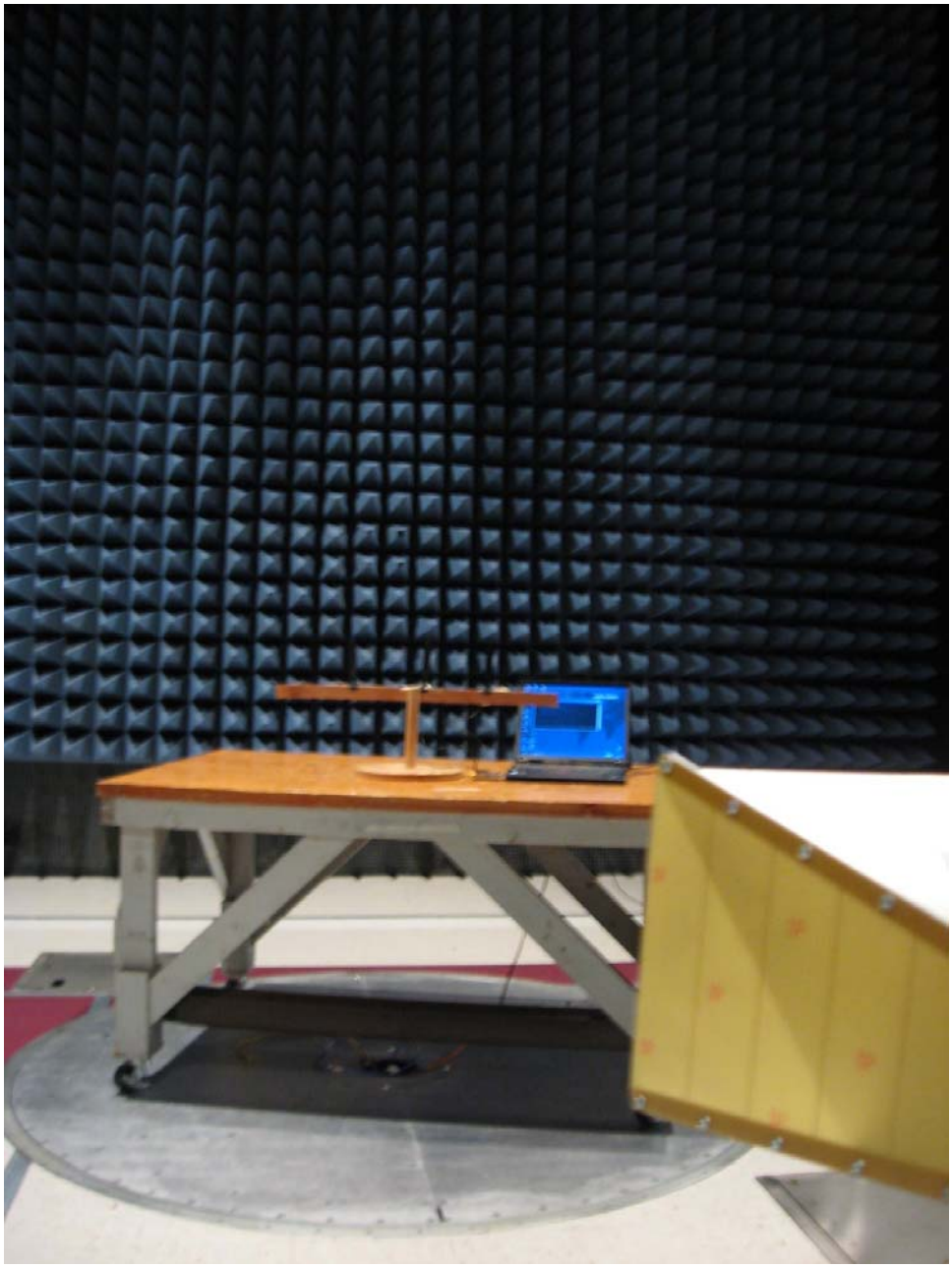


Plot 101. 802.11n Radiated Restricted Band, High, Peak (40MHz)

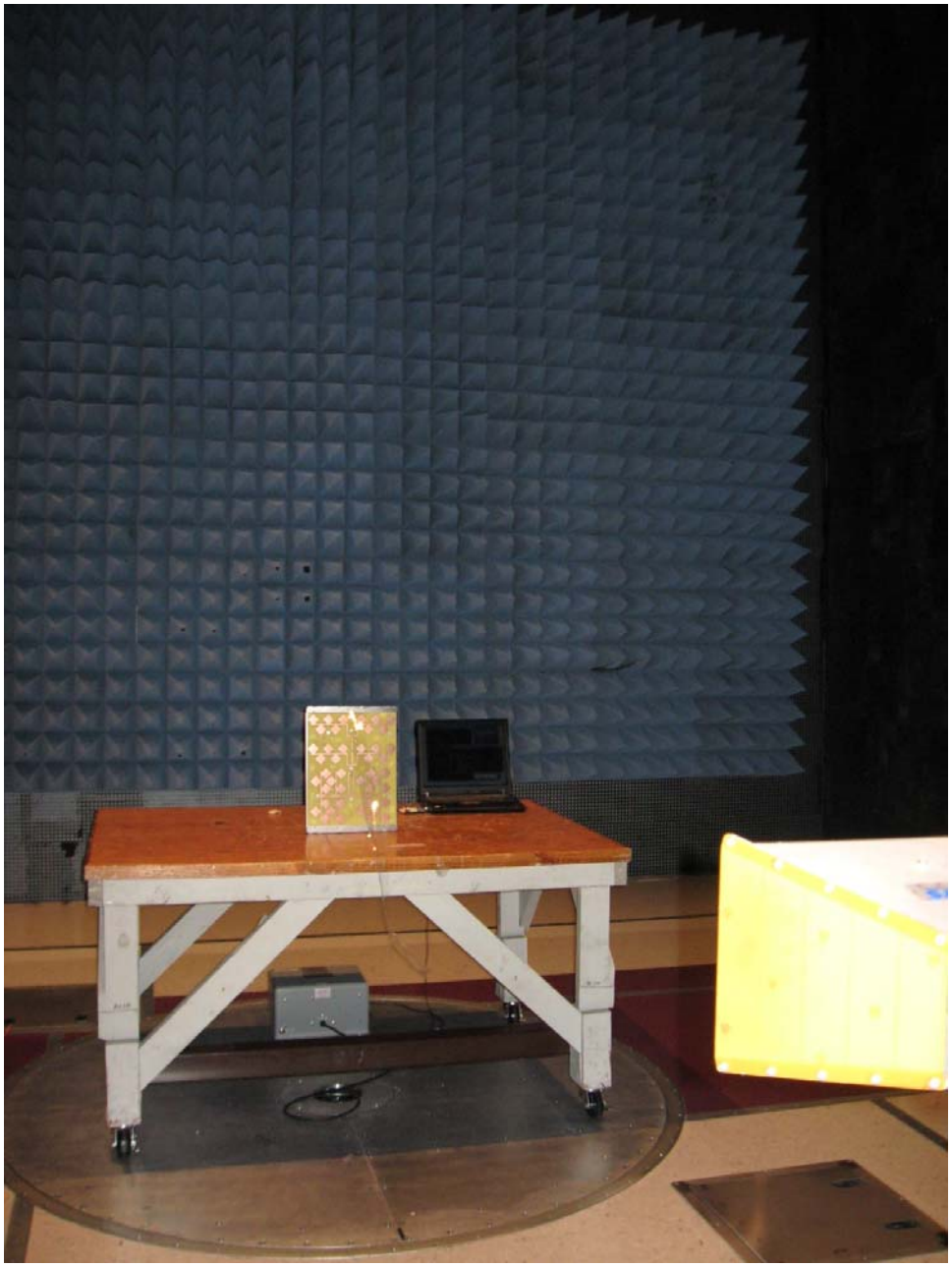
Electromagnetic Compatibility Criteria for Intentional Radiators



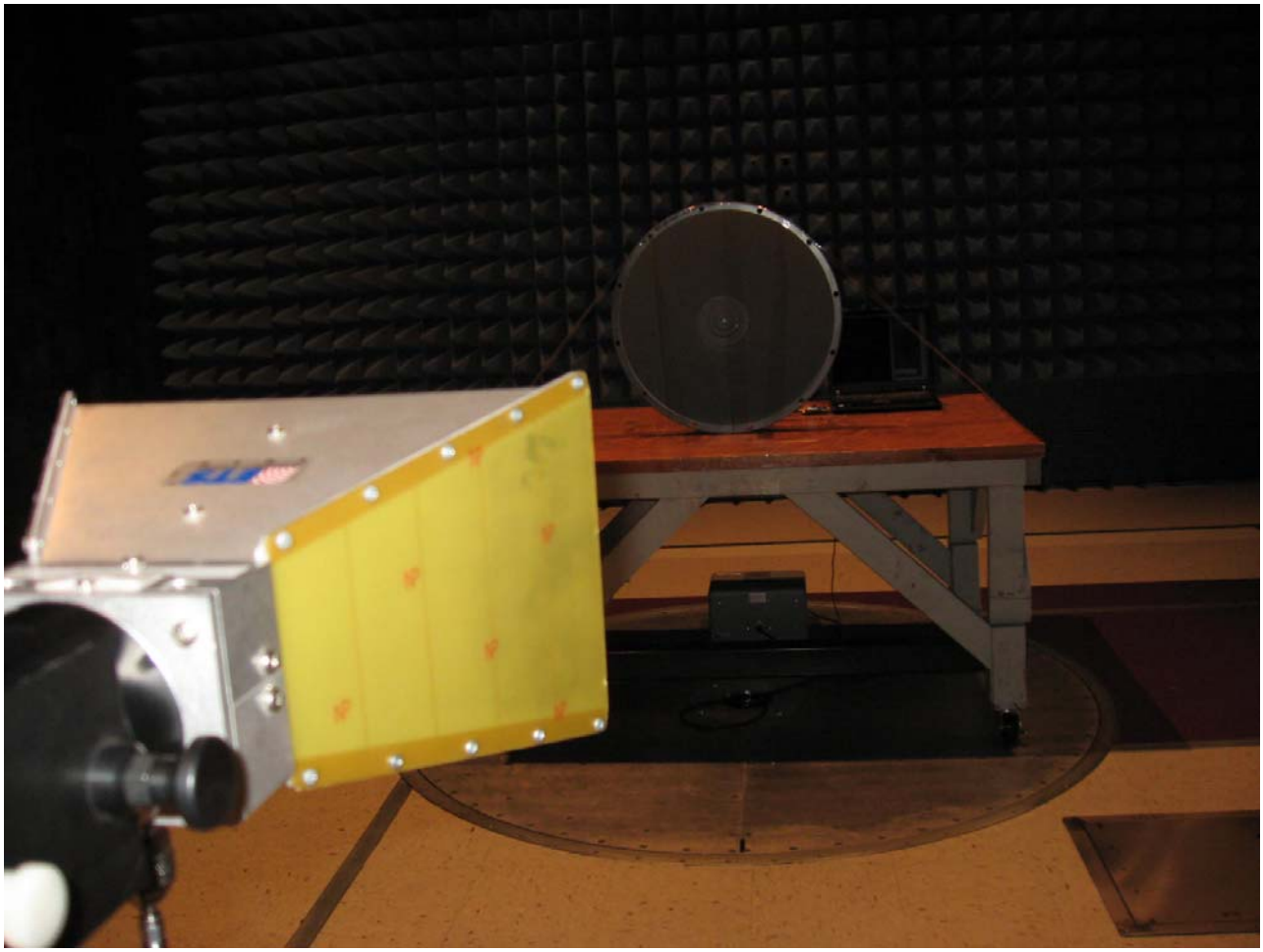
Photograph 4. Test Equipment and setup for various Radiated Measurements – 2.4GHz Panel Antenna



Photograph 5. Test Equipment and setup for various Radiated Measurements – MIMO Antenna



Photograph 6. Test Equipment and setup for various Radiated Measurements – 5.8GHz Panel Antenna



Photograph 7. Test Equipment and setup for various Radiated Measurements – Dish Antenna

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Spurious Emissions Requirements –RF Conducted

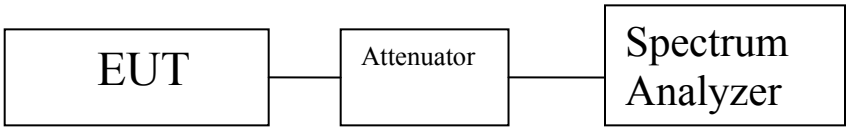
Test Procedure: For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

For frequencies 1-18GHz, measurements were made at coupler port of a 20dB directional coupler. The output of the coupler was terminated by a 50Ω load. For frequencies 18-40GHz a HP11970A and HP11970K harmonic mixer was used. Each harmonic mixer was fed with a SMA to wave guide adapter.

Test Results: Equipment complies with the Spurious Emissions Requirements – Radiated and RF Conducted limits of **§ 15.247 (d)**. For Radiated Emissions result, refer to section "§15.209: Radiated Emission Limits". See following pages for detailed test results with RF Conducted Spurious Emissions and §15.205.

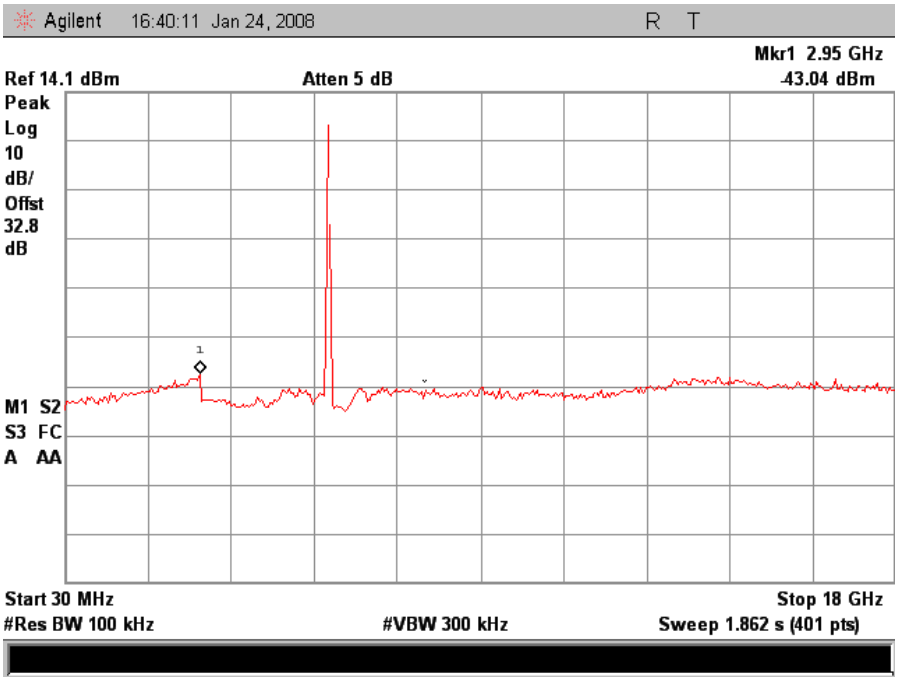
Test Engineer(s): Minh Ly

Test Date(s): January 23, 24, 25, 29 & April 4, 2008

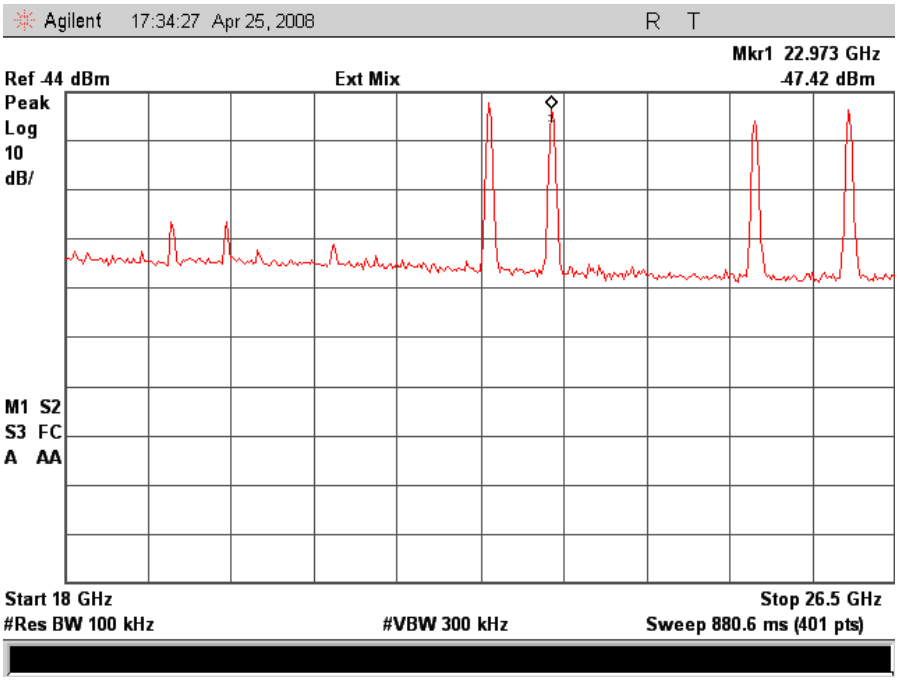


Block Diagram 3. Spurious Conducted Emissions Test Setup

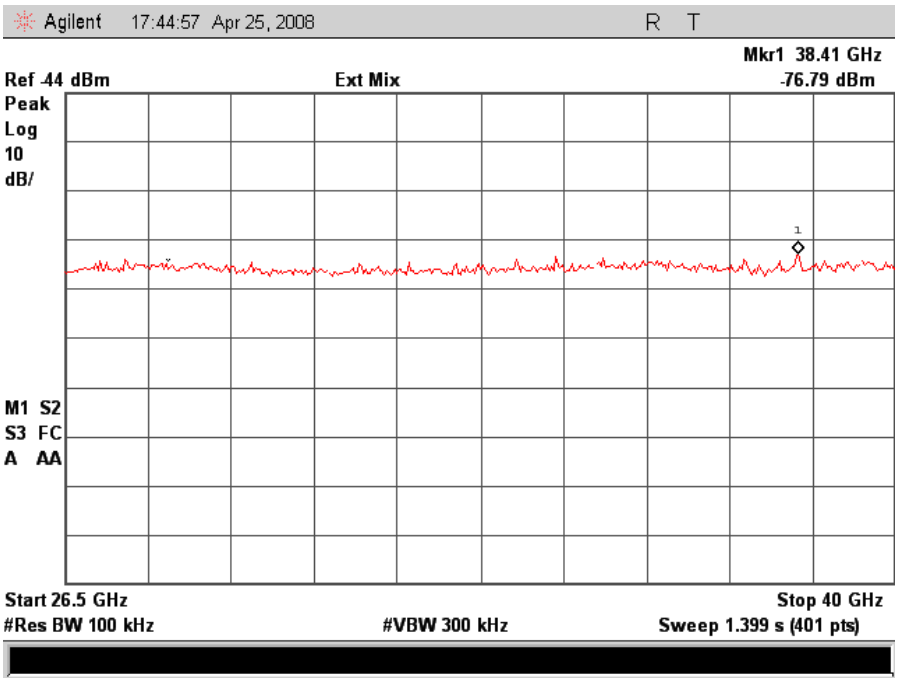
§ 15.247(d) Spurious Emissions Requirements –RF Conducted, 802.11a



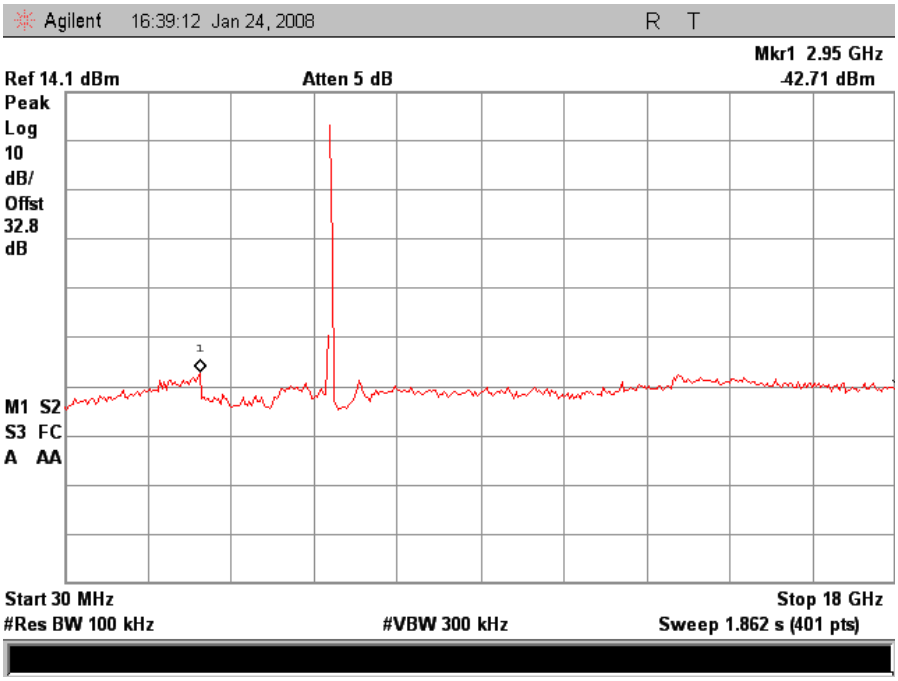
802.11/a – Low Channel Conducted Emissions 30MHz - 18GHz



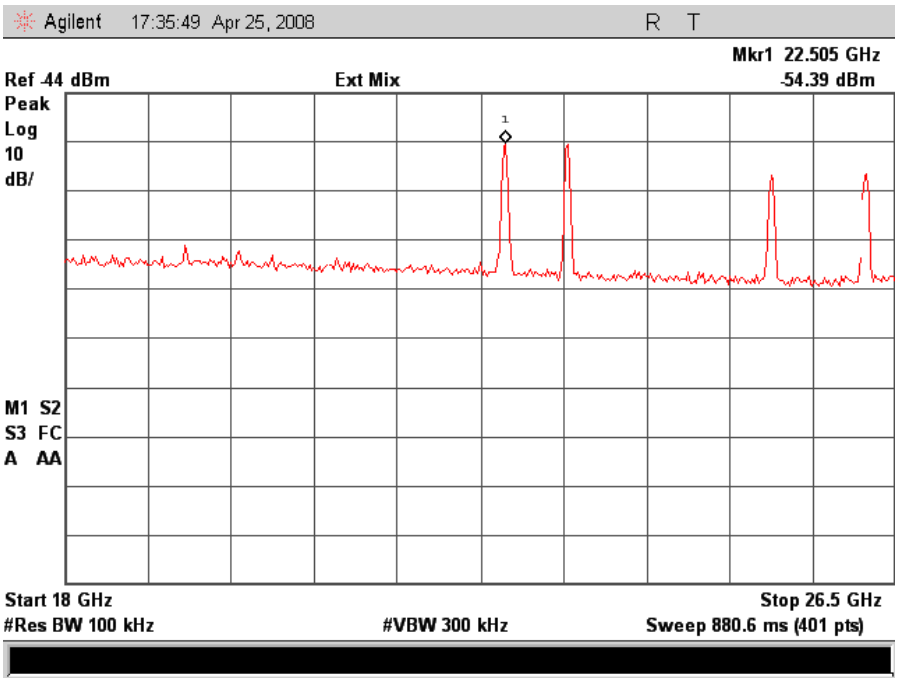
802.11/a – Low Channel Conducted Emissions 18GHz – 26.5GHz



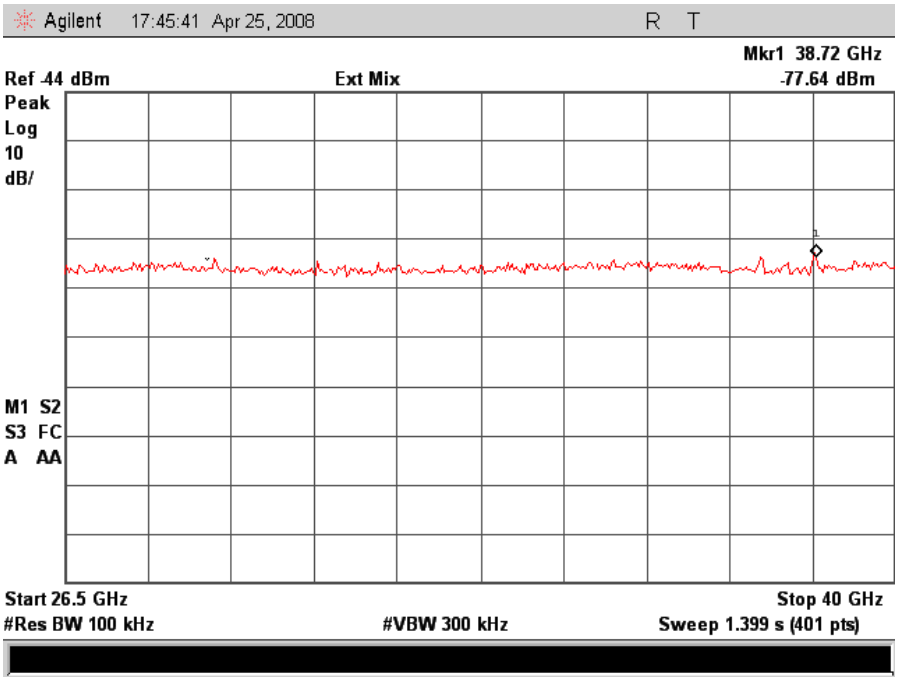
802.11/a – Low Channel Conducted Emissions 26.5GHz – 40GHz



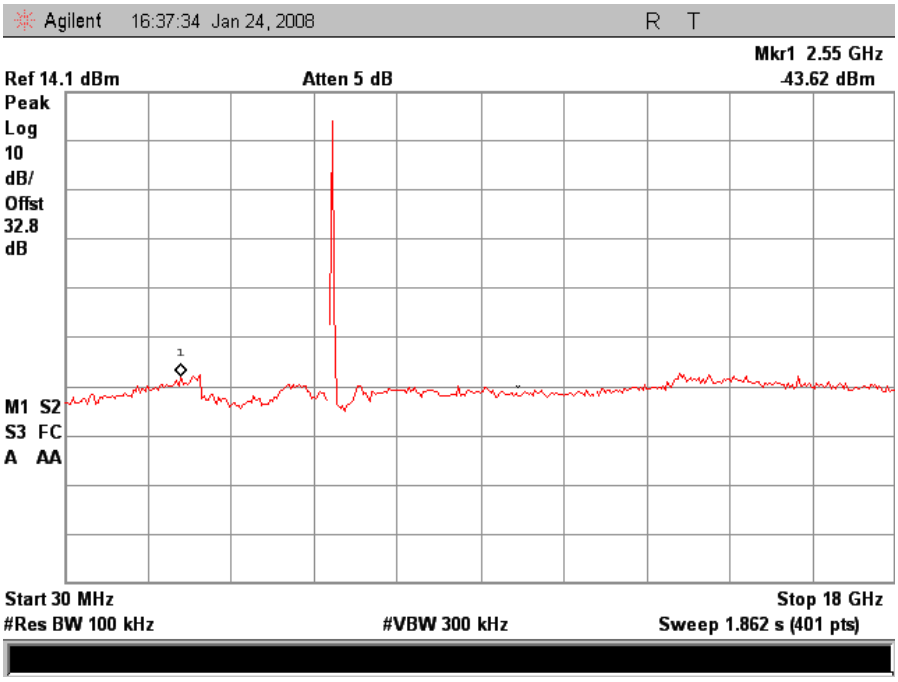
802.11/a – Mid Channel Conducted Emissions 30MHz – 18GHz



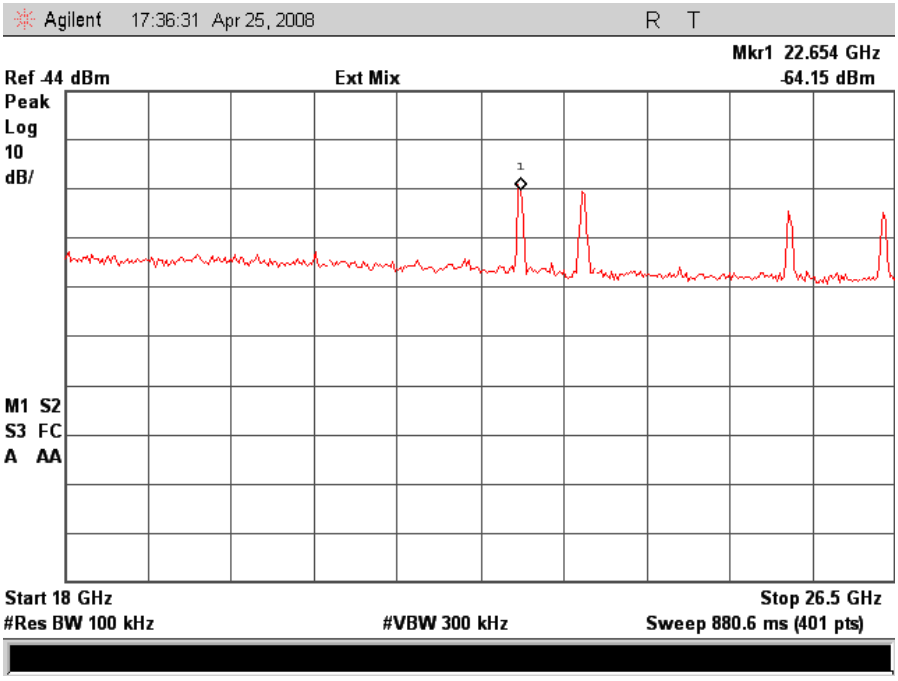
802.11/a – Mid Channel Conducted Emissions 18GHz – 26.5GHz



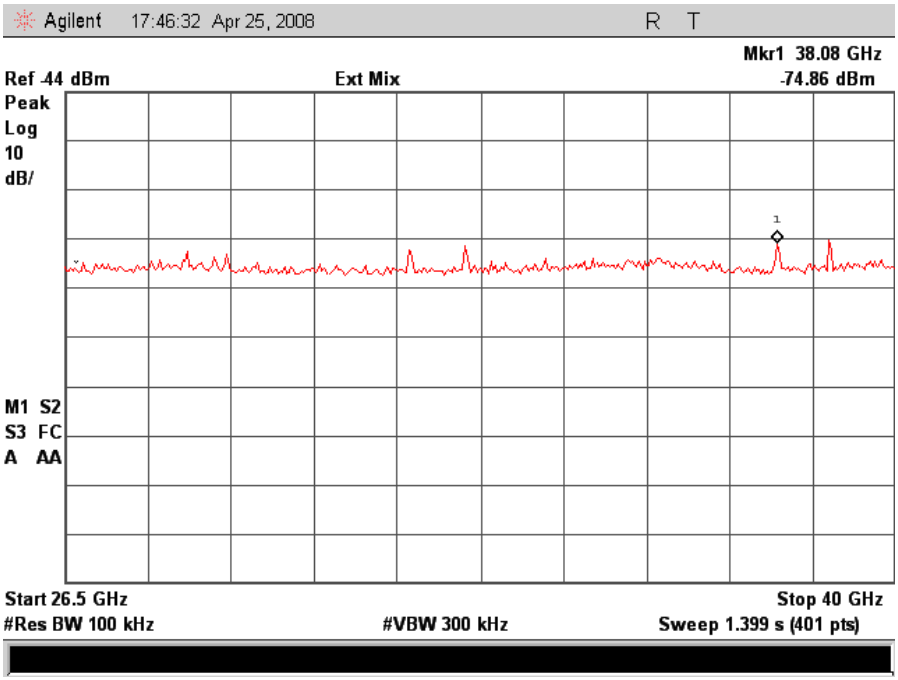
802.11/a – Mid Channel Conducted Emissions 26.5GHz – 40GHz



802.11/a – High Channel Conducted Emissions 30MHz- 18GHz

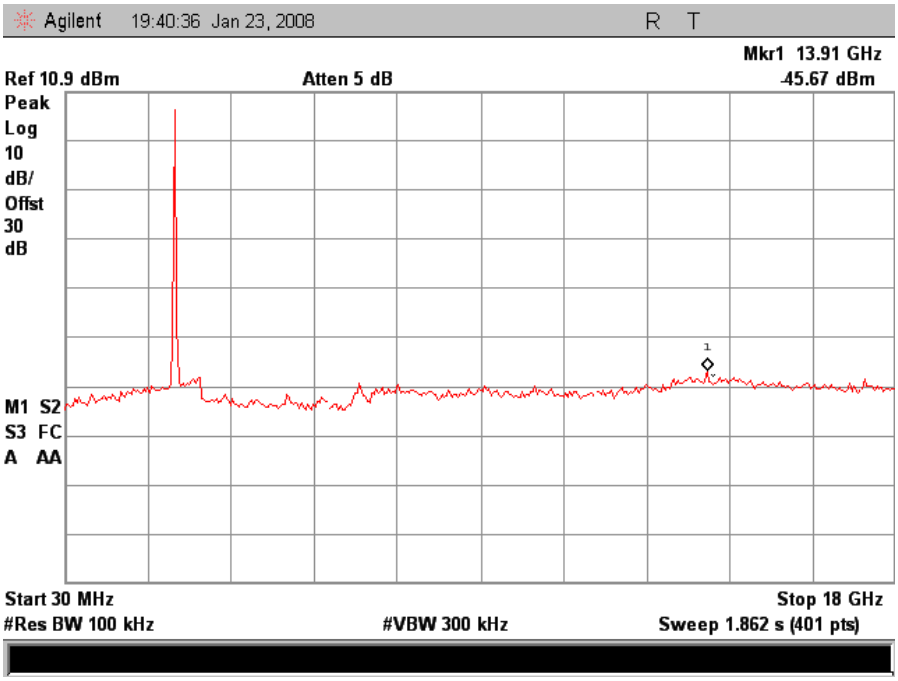


802.11/a – High Channel Conducted Emissions 18GHz- 26.5GHz

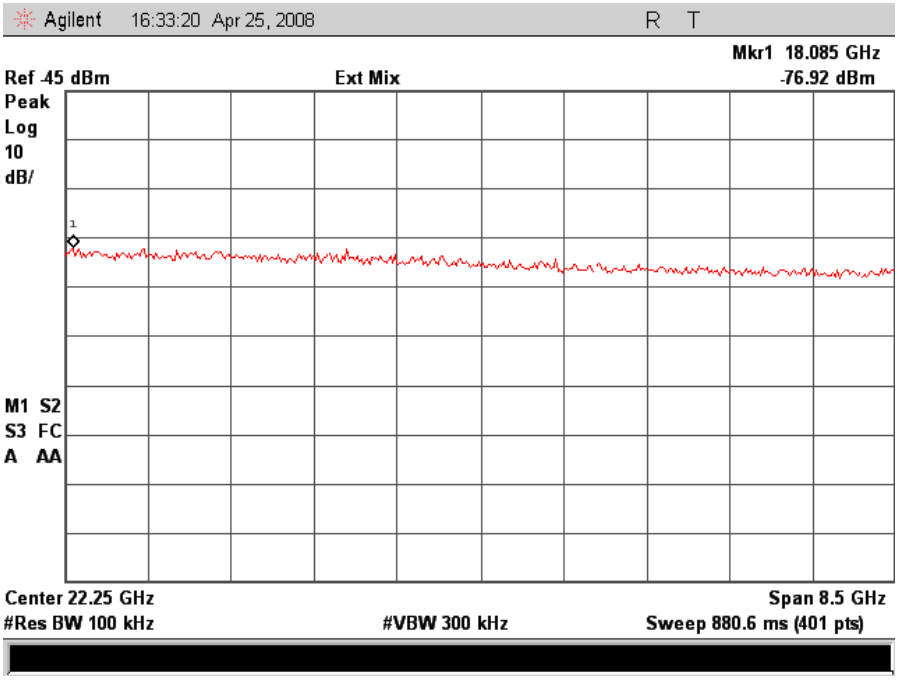


802.11/a – High Channel Conducted Emissions 26.5GHz- 40GHz

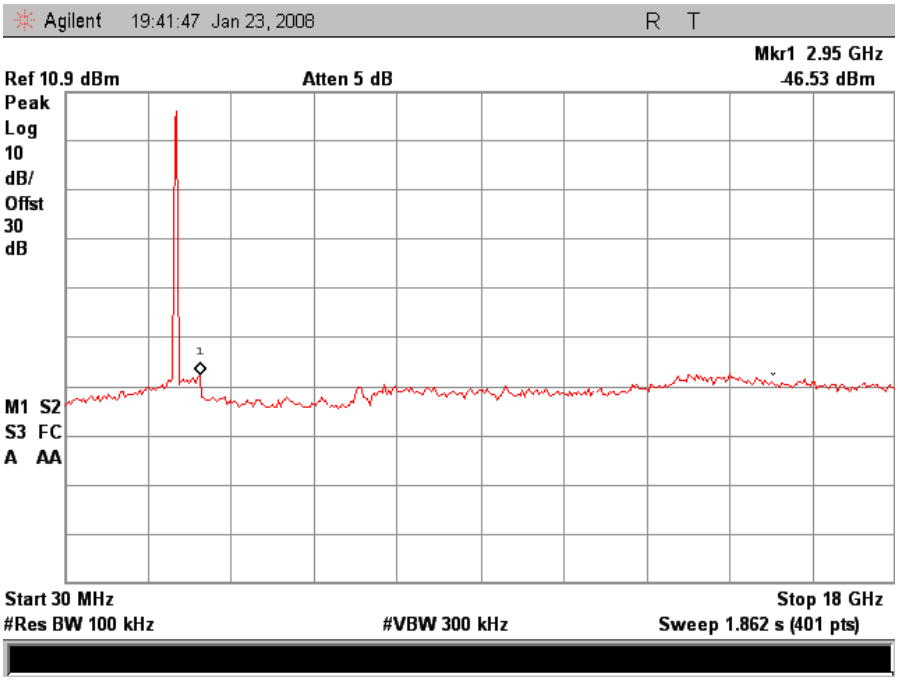
§ 15.247(d) Spurious Emissions Requirements –RF Conducted, 802.11b



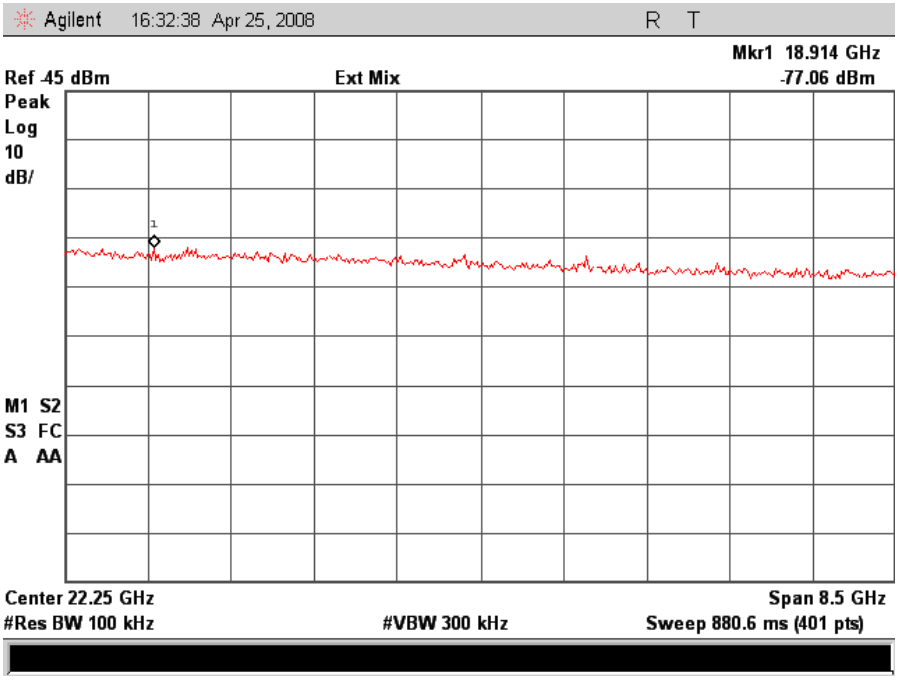
802.11/b – Low Channel Conducted Emissions 30MHz - 18GHz



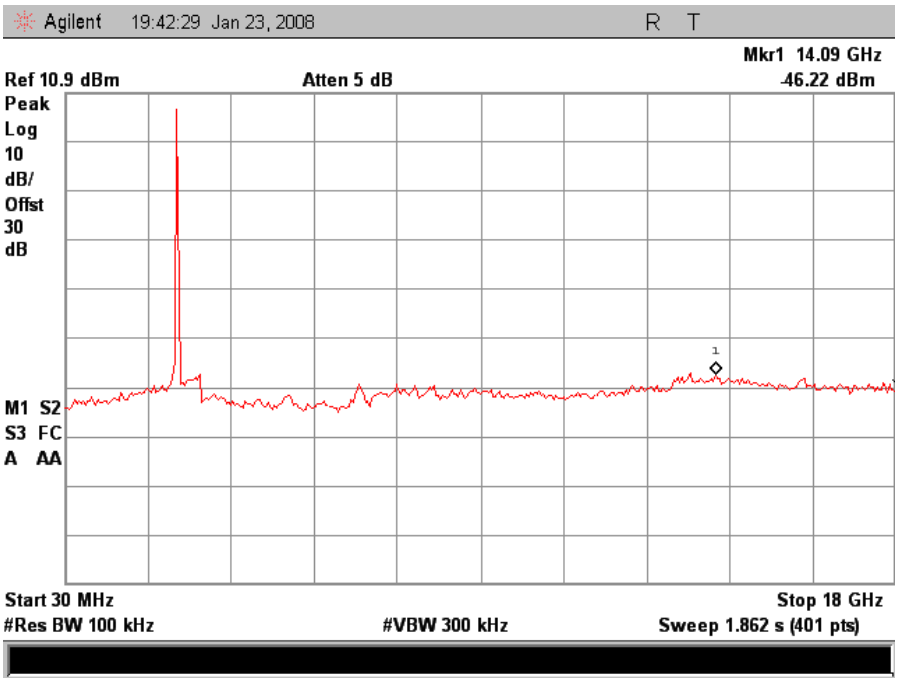
802.11/b – Low Channel Conducted Emissions 18GHz – 26.5GHz



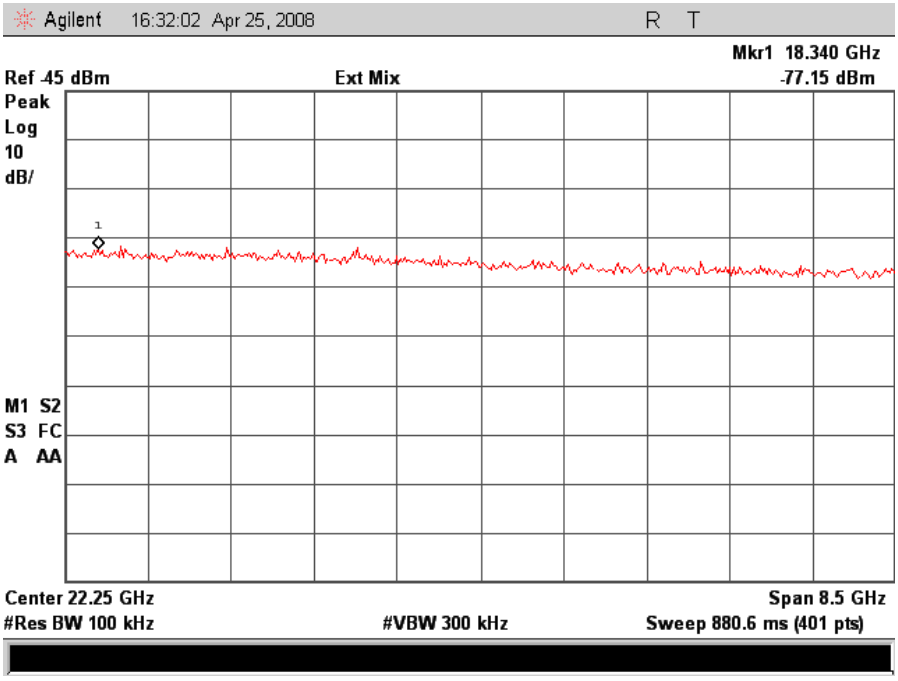
802.11/b – Mid Channel Conducted Emissions 30MHz – 18GHz



802.11/b – Mid Channel Conducted Emissions 18GHz – 26.5GHz

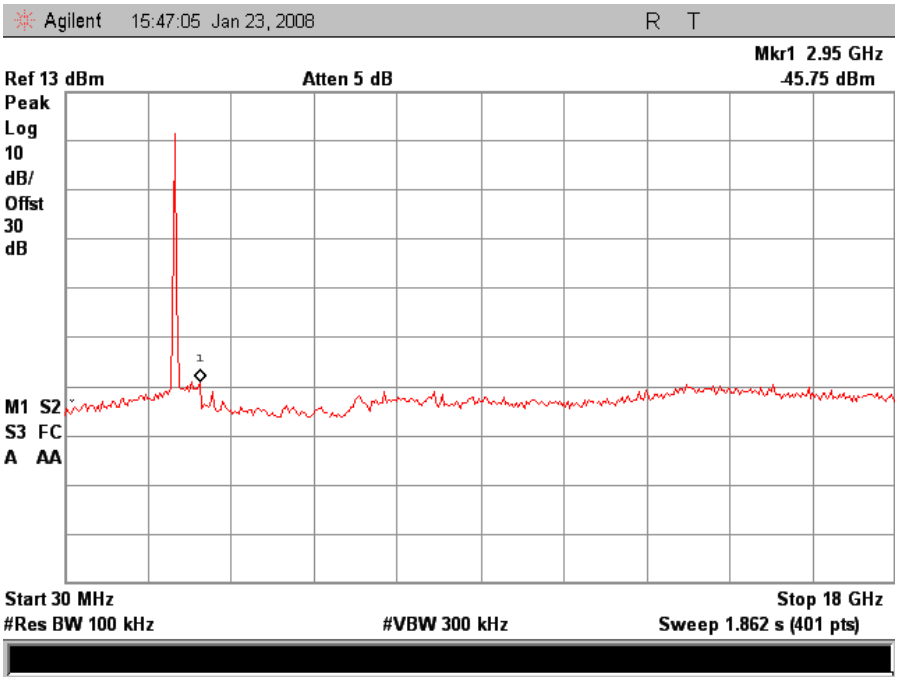


802.11/b – High Channel Conducted Emissions 30MHz- 18GHz

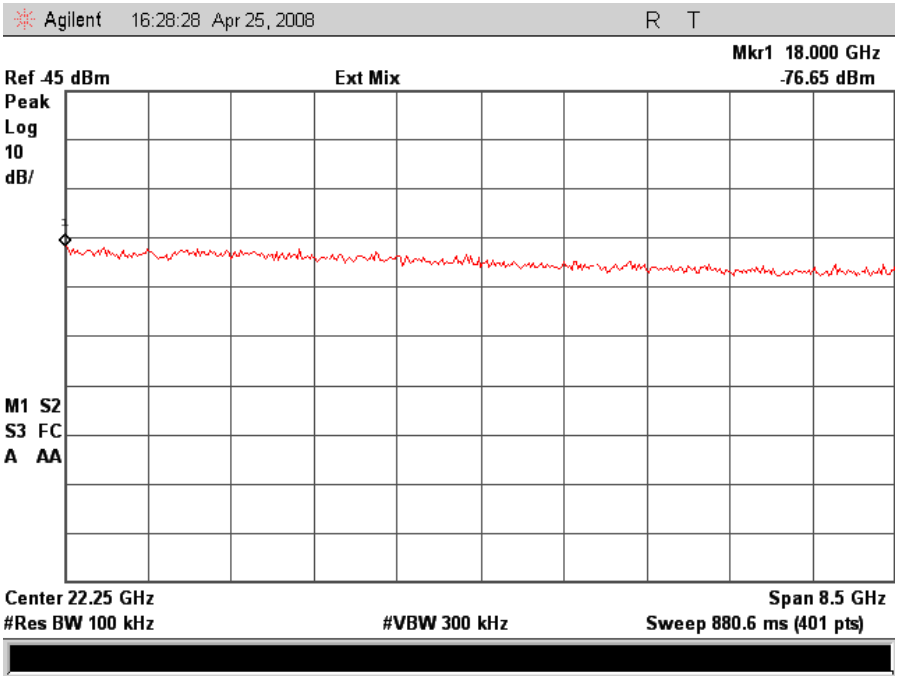


802.11/b – High Channel Conducted Emissions 18GHz – 26.5GHz

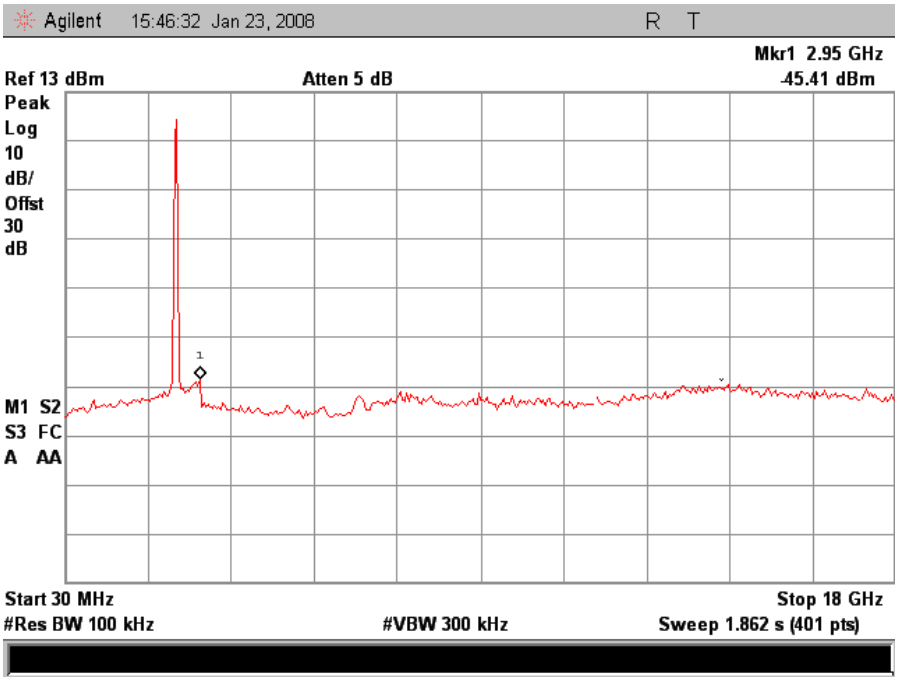
§ 15.247(d) Spurious Emissions Requirements –RF Conducted, 802.11g



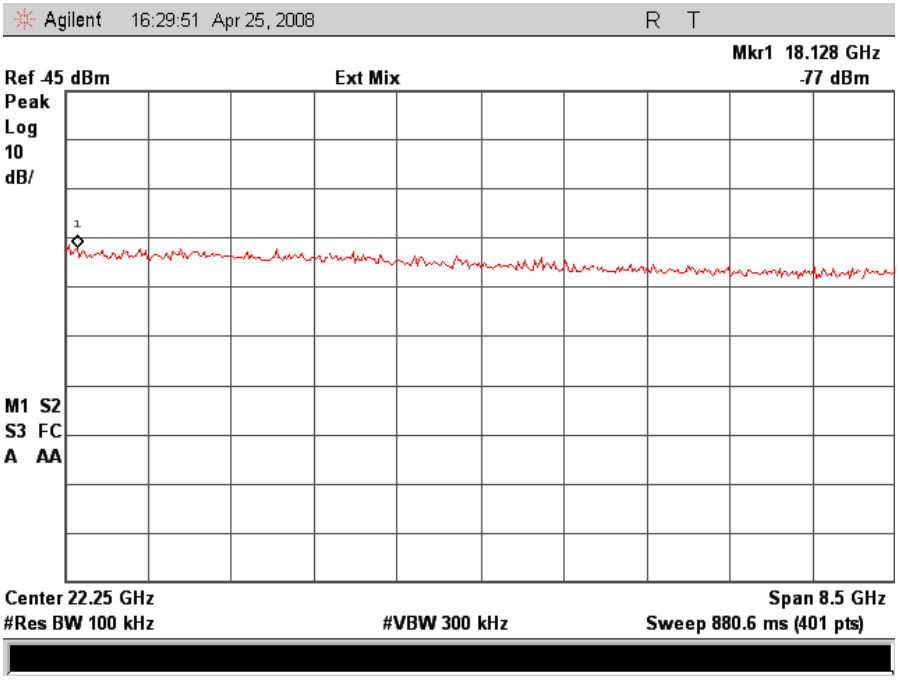
802.11/g – Low Channel Conducted Emissions 30MHz - 18GHz



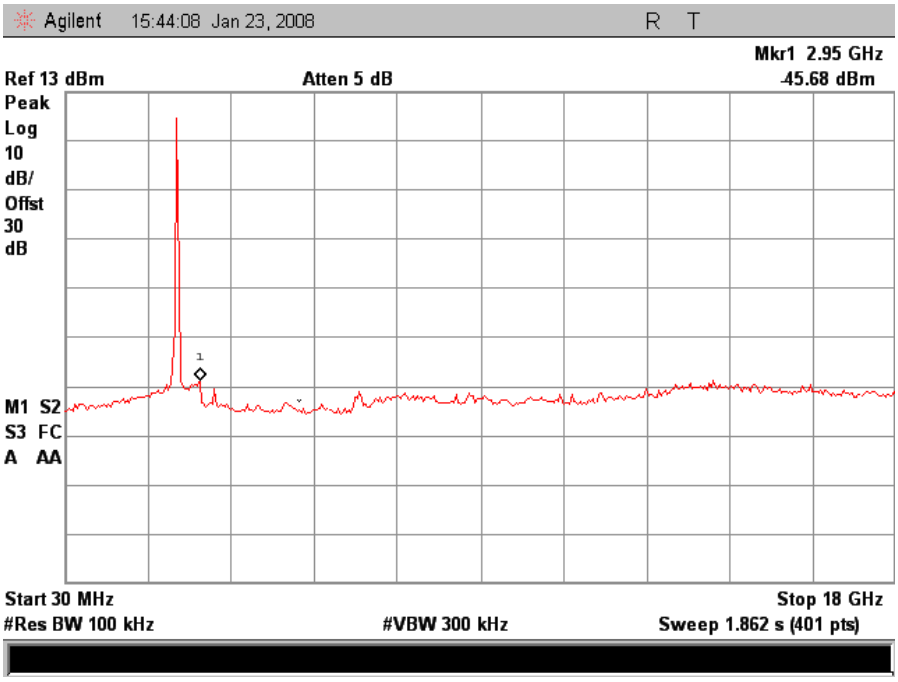
802.11/g – Low Channel Conducted Emissions 18GHz – 26.5GHz



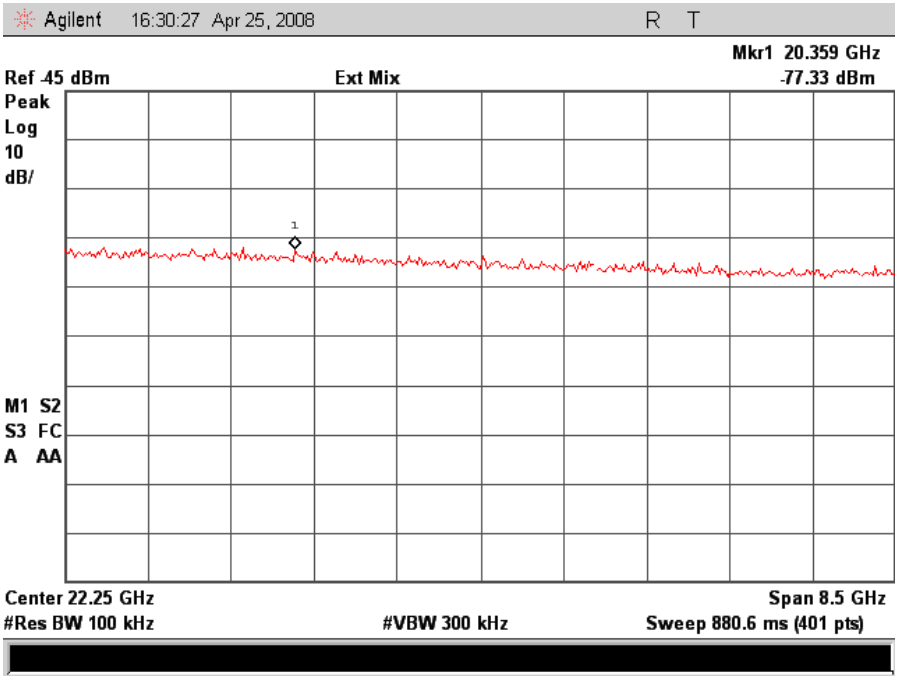
802.11/g – Mid Channel Conducted Emissions 30MHz – 18GHz



802.11/g – Mid Channel Conducted Emissions 18GHz – 26.5GHz

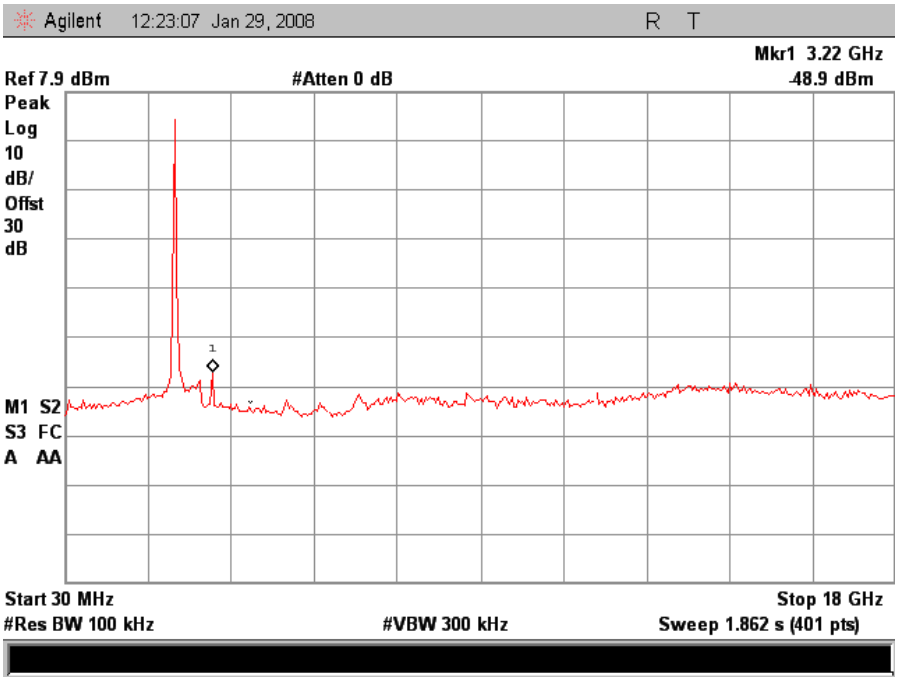


802.11/g – High Channel Conducted Emissions 30MHz- 18GHz

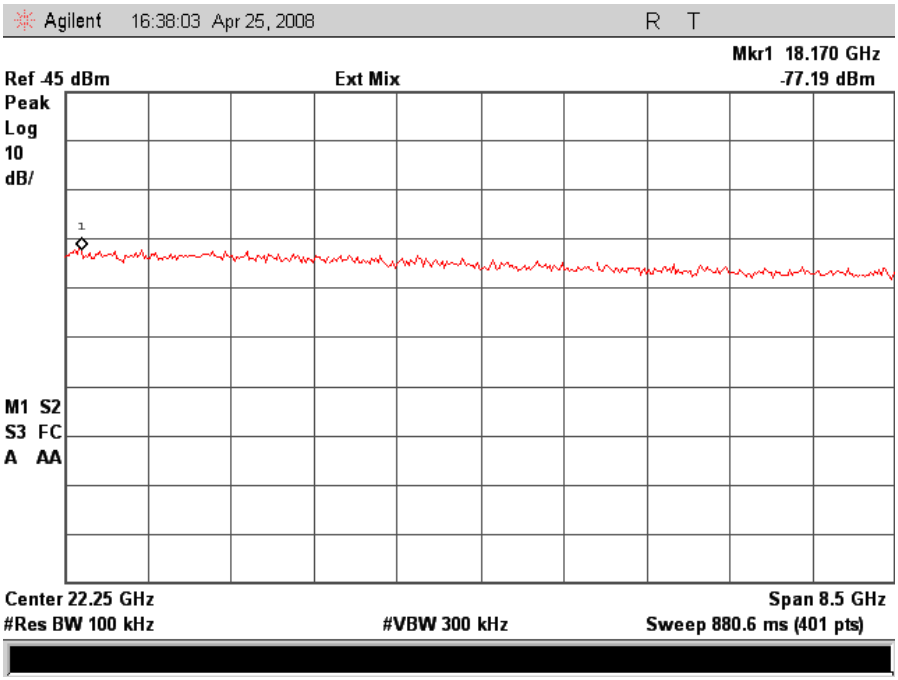


802.11/g – High Channel Conducted Emissions 18GHz – 26.5GHz

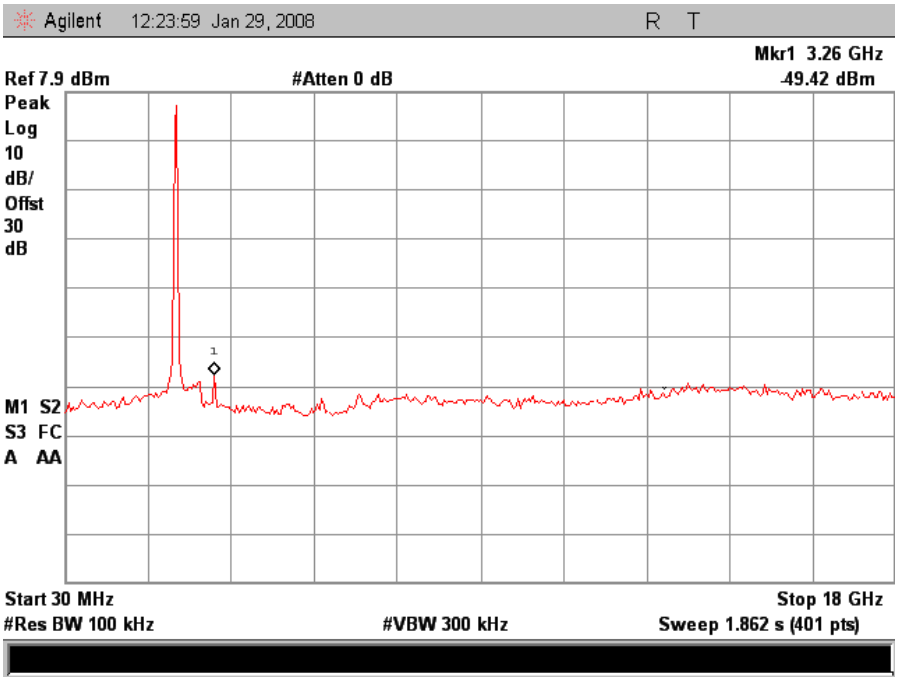
§ 15.247(d) Spurious Emissions Requirements –RF Conducted, 802.11n (Port 1, 20MHz)



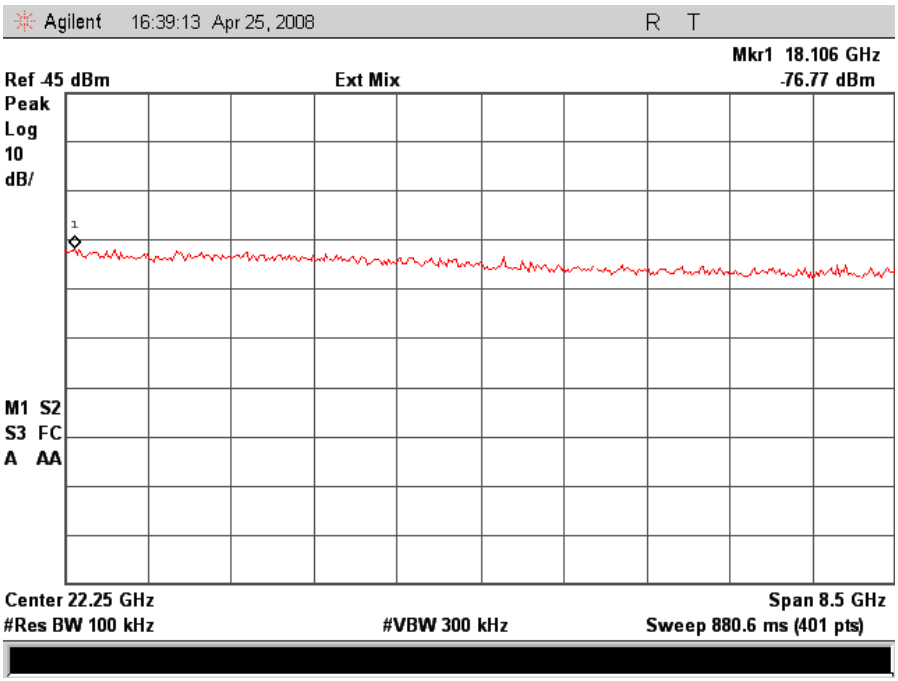
802.11/n – Low Channel Conducted Emissions 30MHz - 18GHz



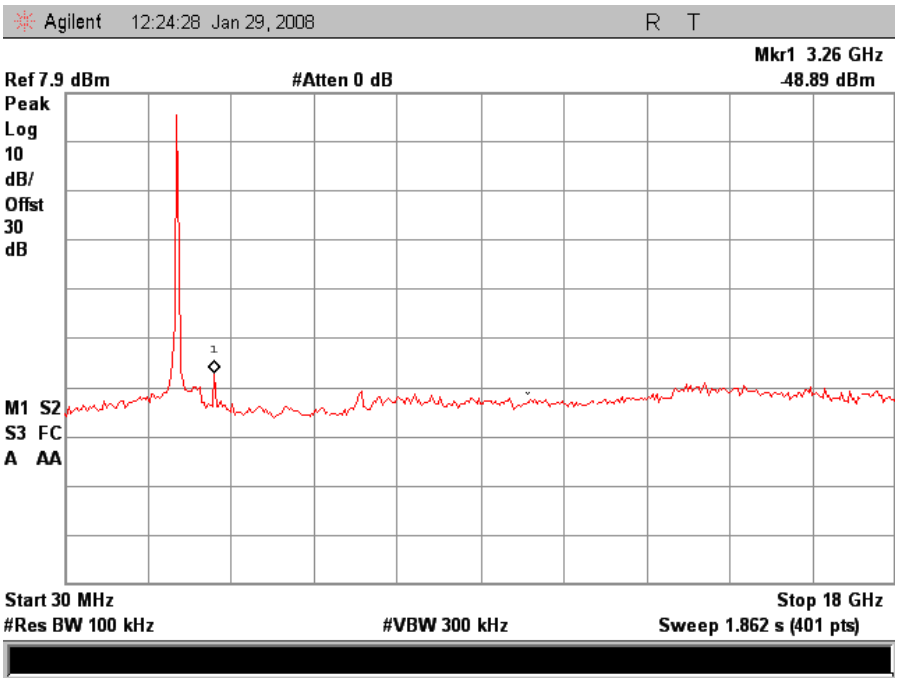
802.11/n – Low Channel Conducted Emissions 18GHz – 26.5GHz



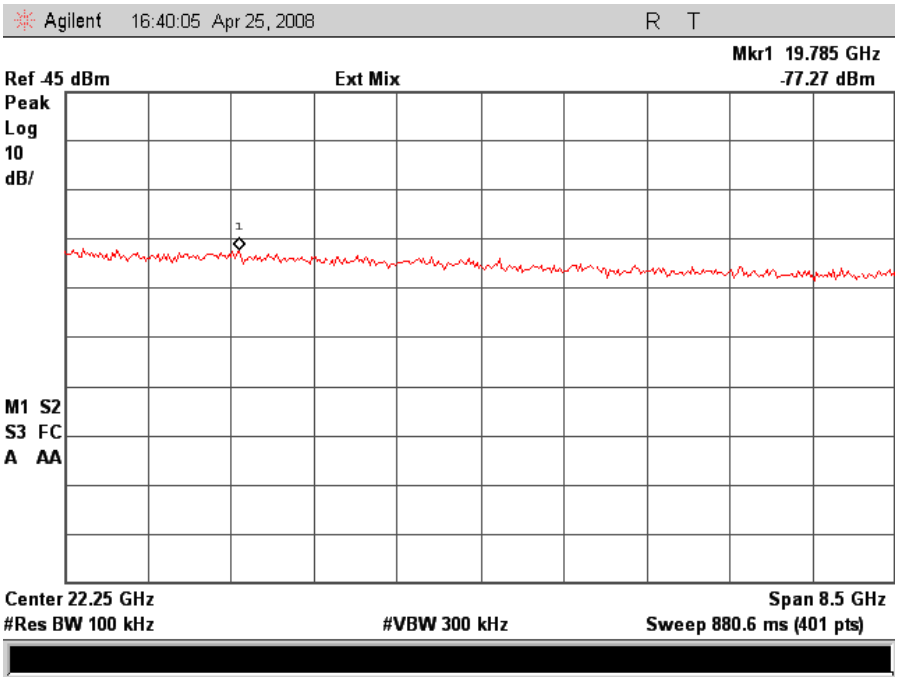
802.11/n – Mid Channel Conducted Emissions 30MHz – 18GHz



802.11/n – Mid Channel Conducted Emissions 18GHz – 26.5GHz

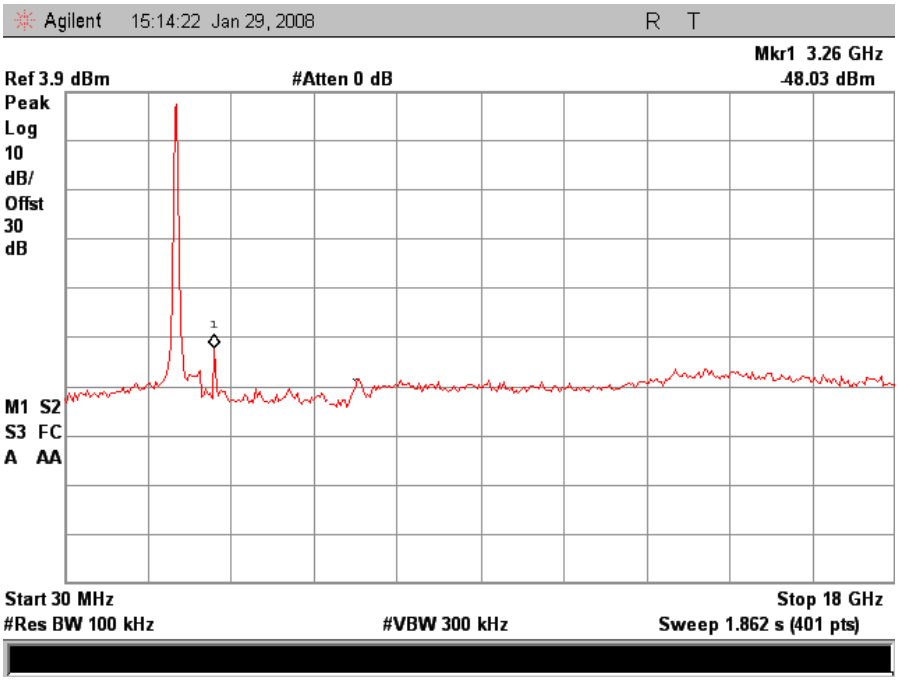


802.11/n – High Channel Conducted Emissions 30MHz- 18GHz

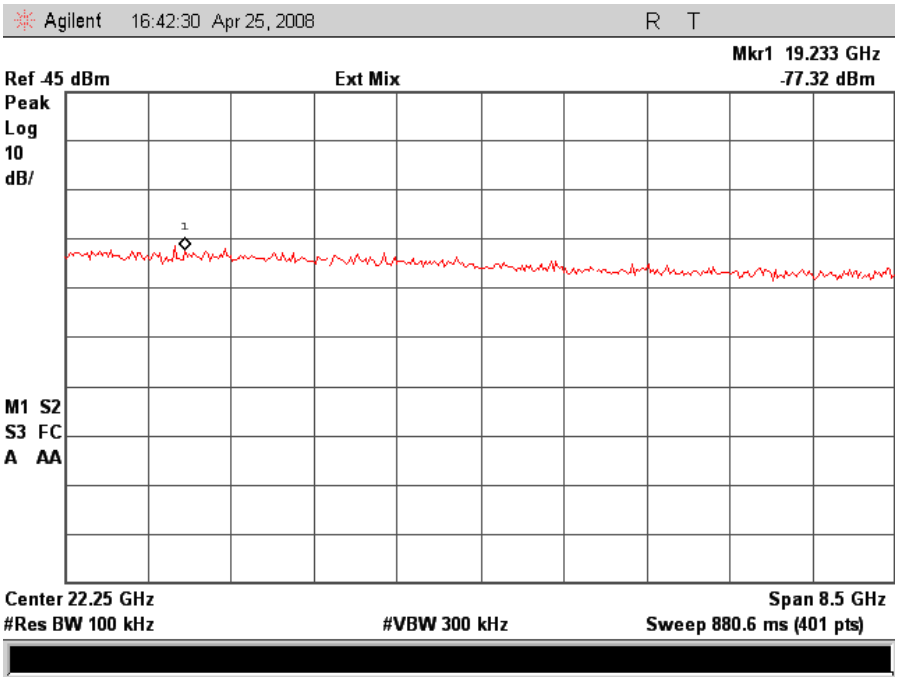


802.11/n – High Channel Conducted Emissions 18GHz – 26.5GHz

§ 15.247(d) Spurious Emissions Requirements –RF Conducted, 802.11n (Port 1, 40MHz)

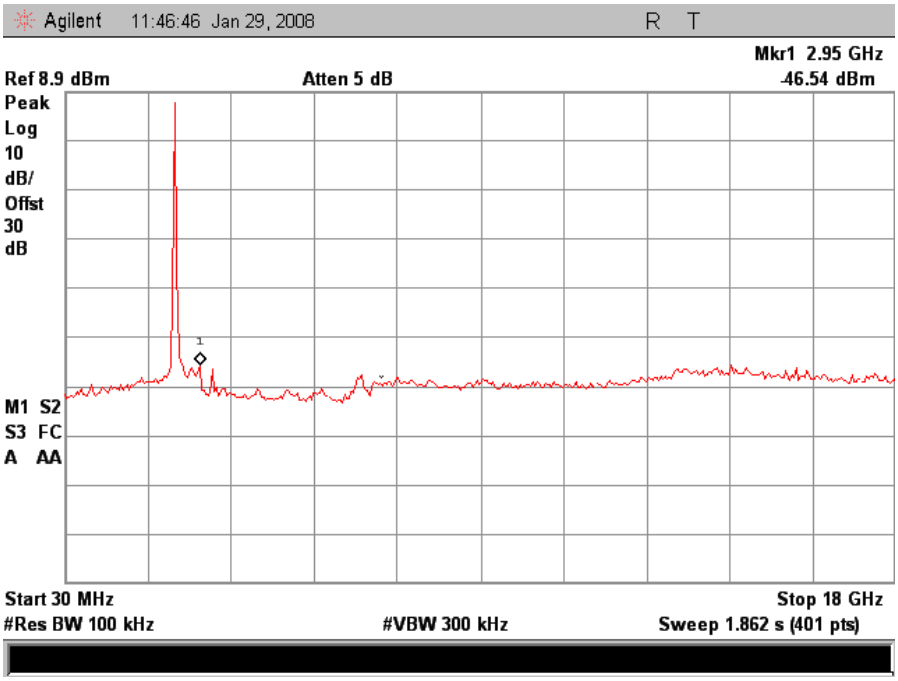


802.11/n – Mid Channel Conducted Emissions 30MHz – 18GHz

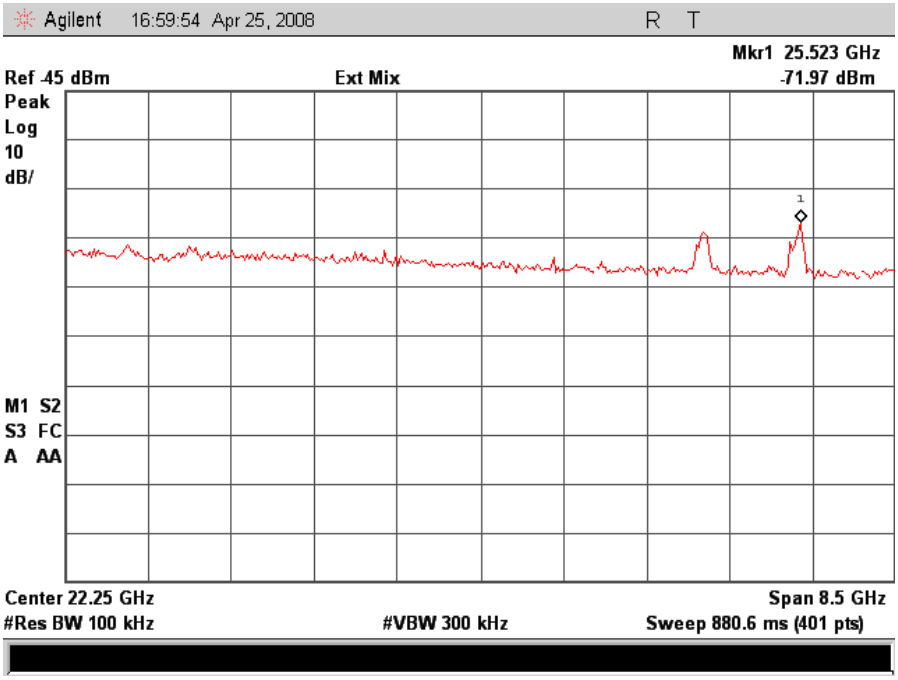


802.11/n – Mid Channel Conducted Emissions 18GHz – 26.5GHz

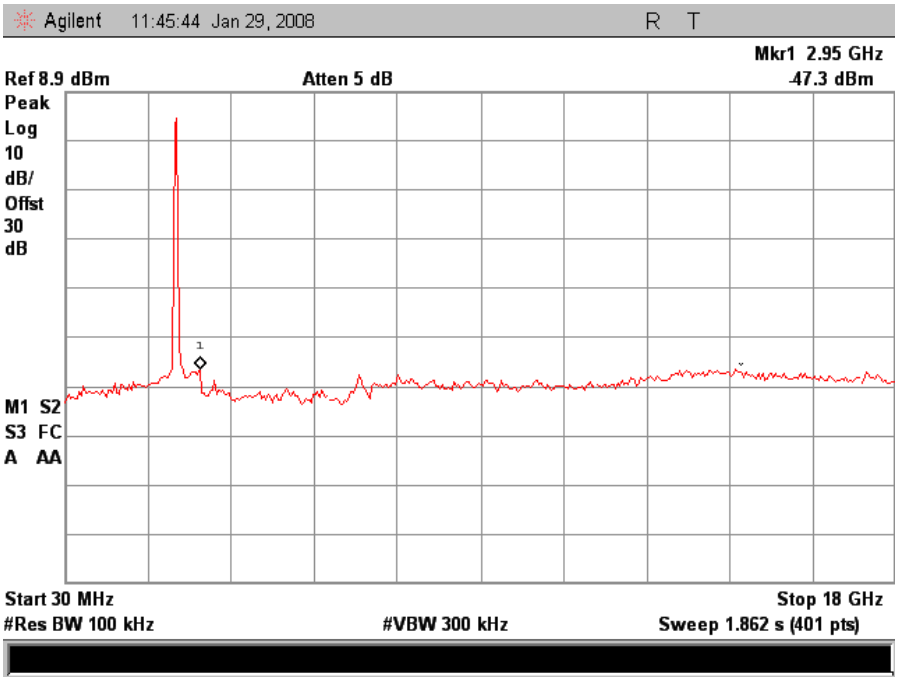
§ 15.247(d) Spurious Emissions Requirements –RF Conducted, 802.11n (Port 2, 20MHz)



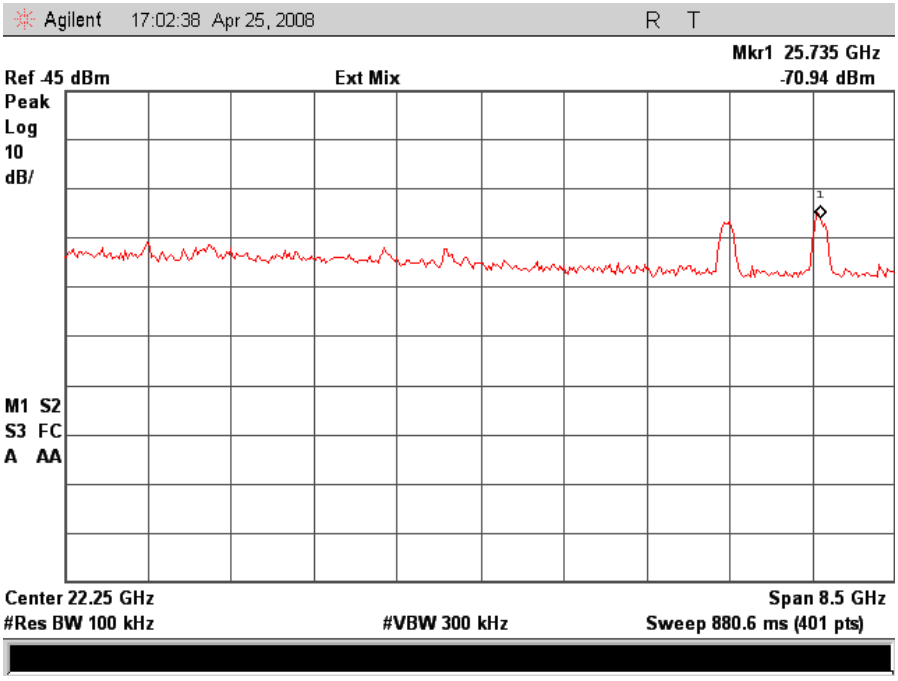
802.11/n – Low Channel Conducted Emissions 30MHz - 18GHz



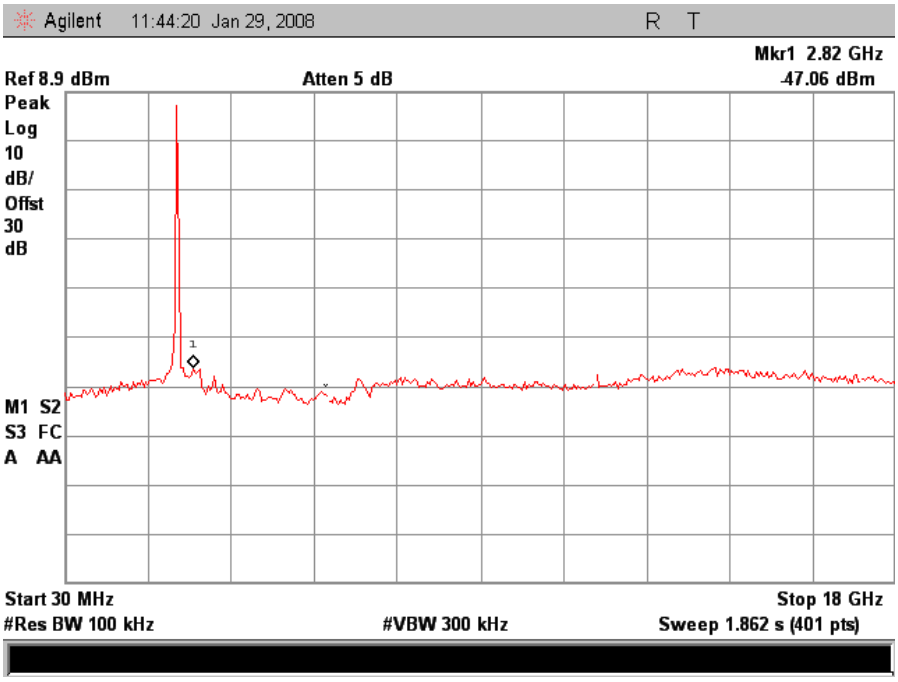
802.11/n – Low Channel Conducted Emissions 18GHz – 26.5GHz



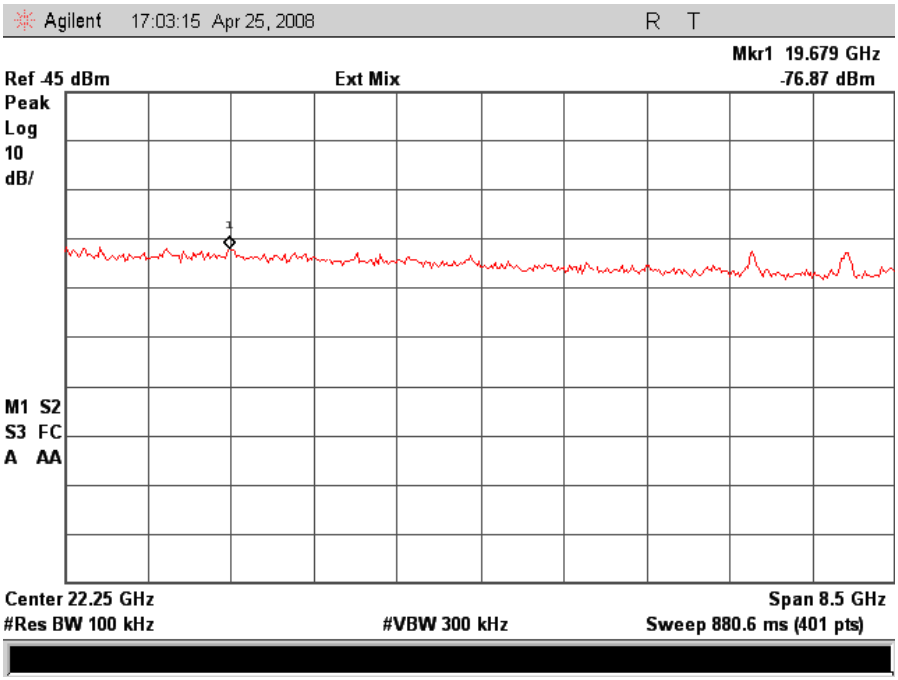
802.11/n – Mid Channel Conducted Emissions 30MHz – 18GHz



802.11/n – Mid Channel Conducted Emissions 18GHz – 26.5GHz

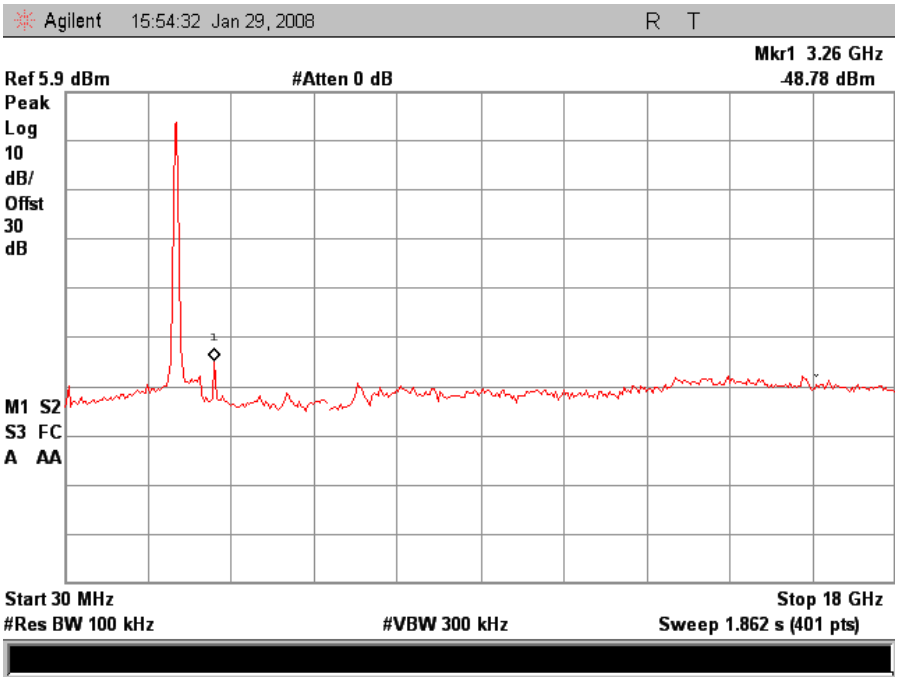


802.11/n – High Channel Conducted Emissions 30MHz- 18GHz

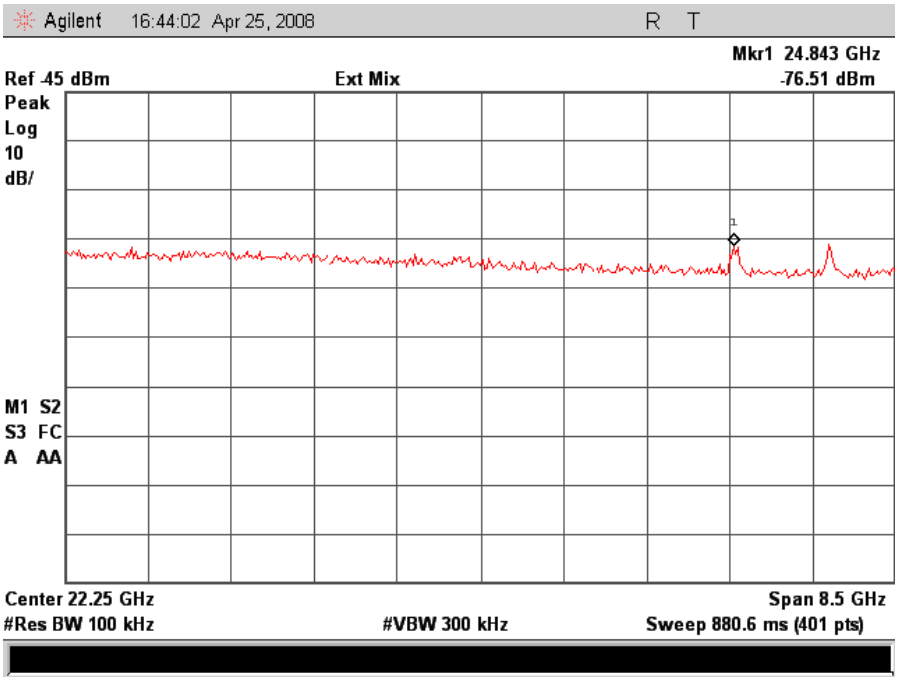


802.11/n – High Channel Conducted Emissions 18GHz – 26.5GHz

§ 15.247(d) Spurious Emissions Requirements –RF Conducted, 802.11n (Port 2, 40MHz)

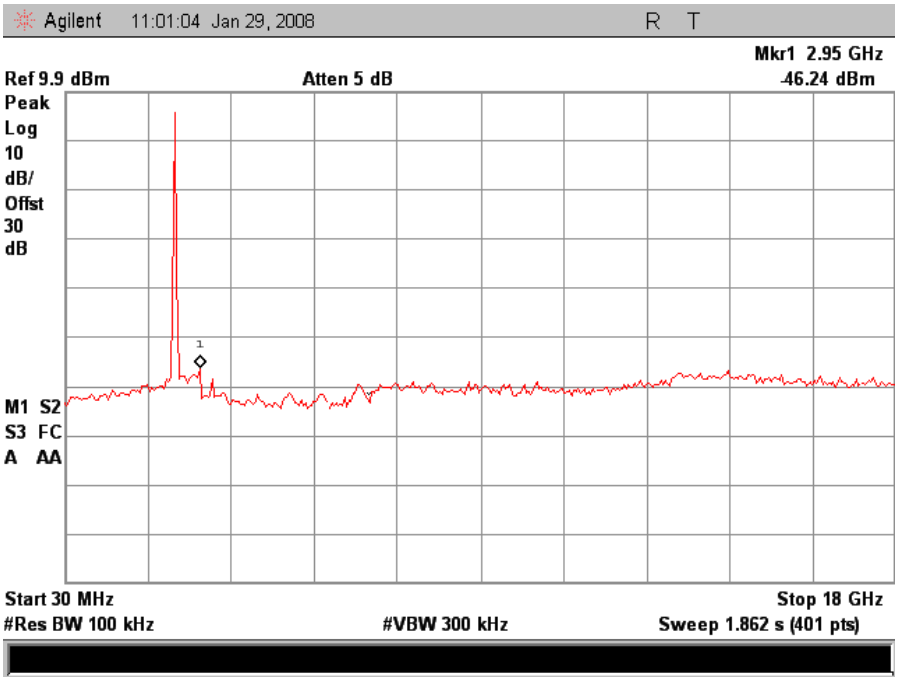


802.11/n – Mid Channel Conducted Emissions 30MHz – 18GHz

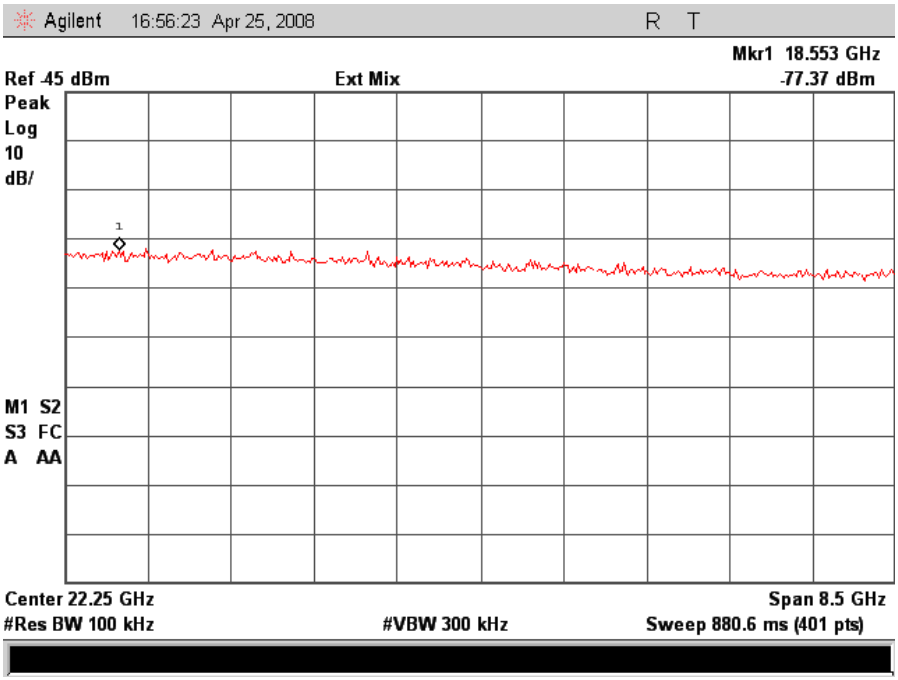


802.11/n – Mid Channel Conducted Emissions 18GHz – 26.5GHz

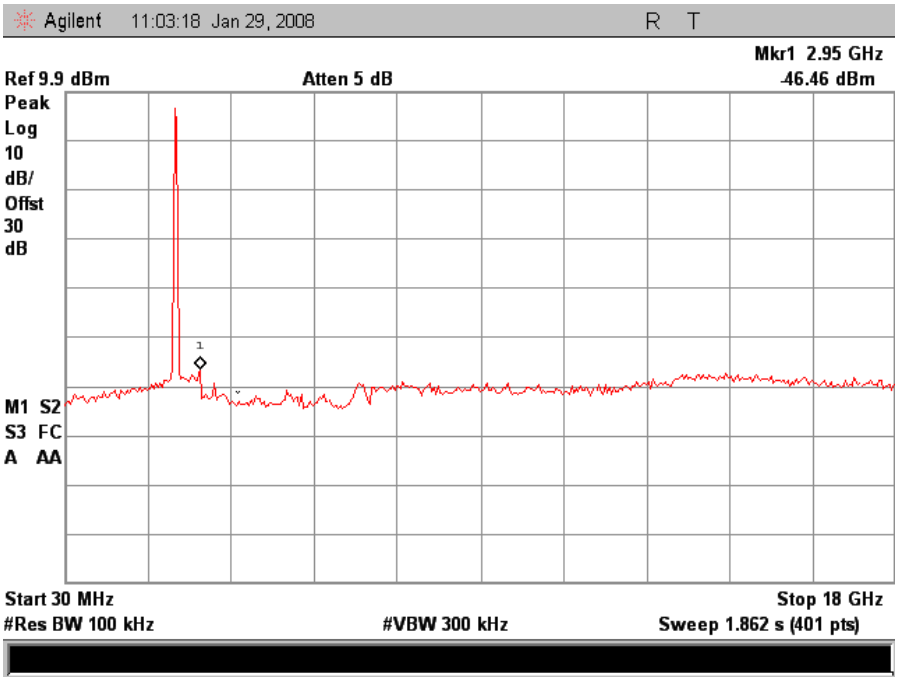
§ 15.247(d) Spurious Emissions Requirements –RF Conducted, 802.11n (Port 3, 20MHz)



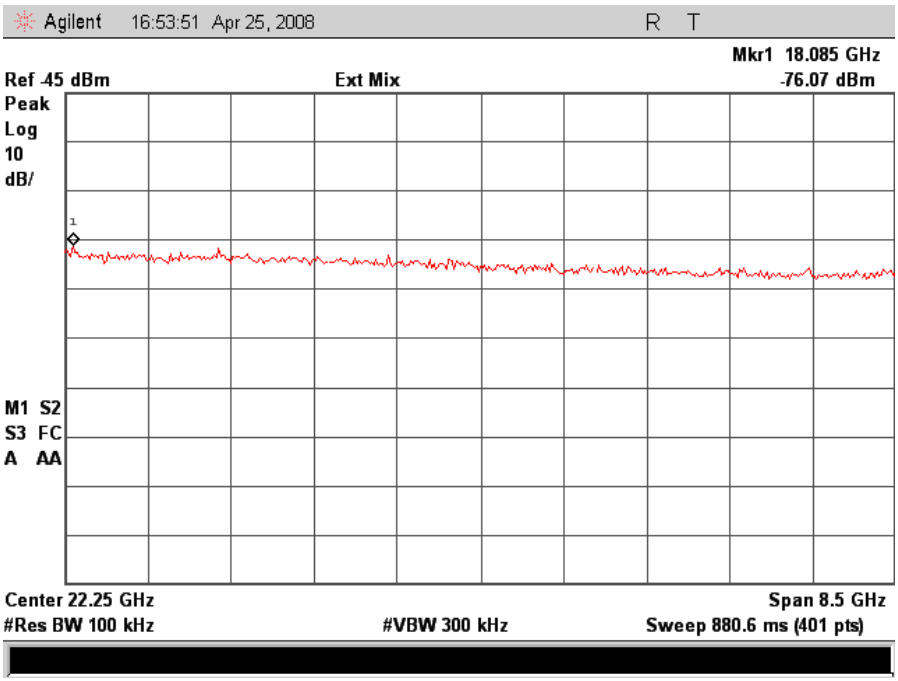
802.11/n – Low Channel Conducted Emissions 30MHz - 18GHz



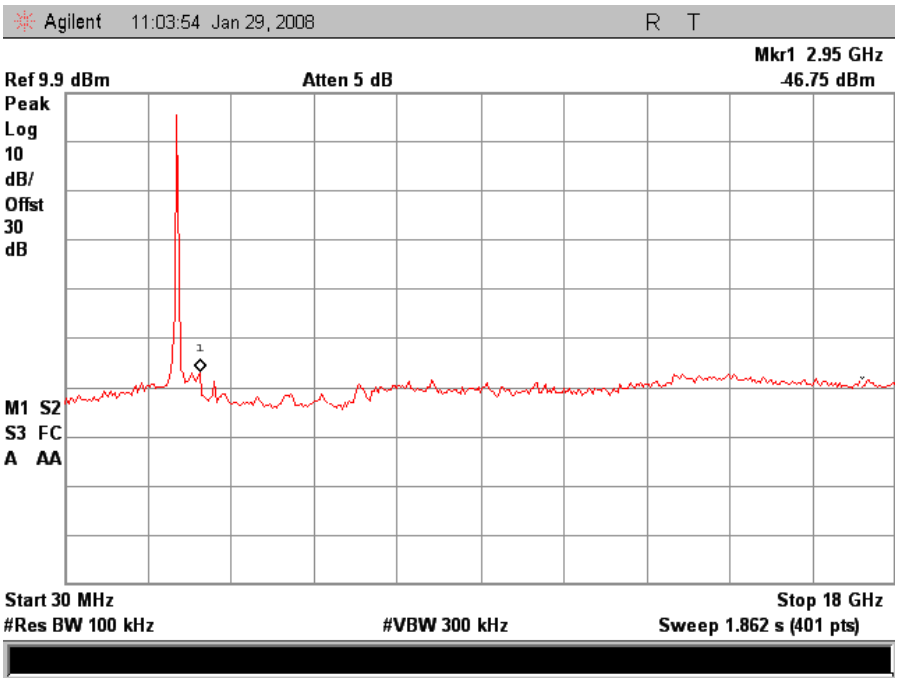
802.11/n – Low Channel Conducted Emissions 18GHz – 26.5GHz



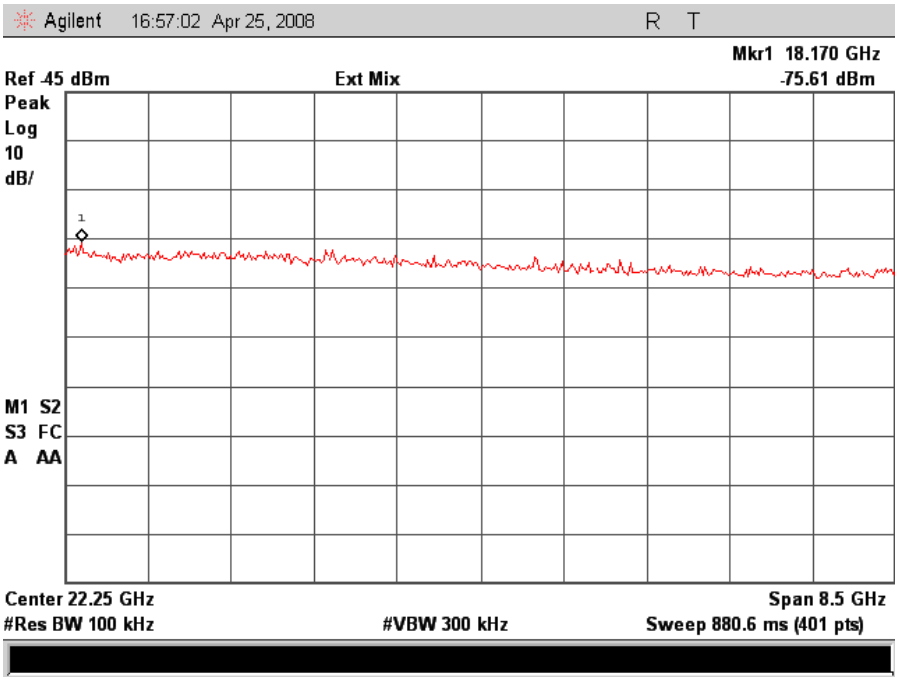
802.11/n – Mid Channel Conducted Emissions 30MHz – 18GHz



802.11/n – Mid Channel Conducted Emissions 18GHz – 26.5GHz

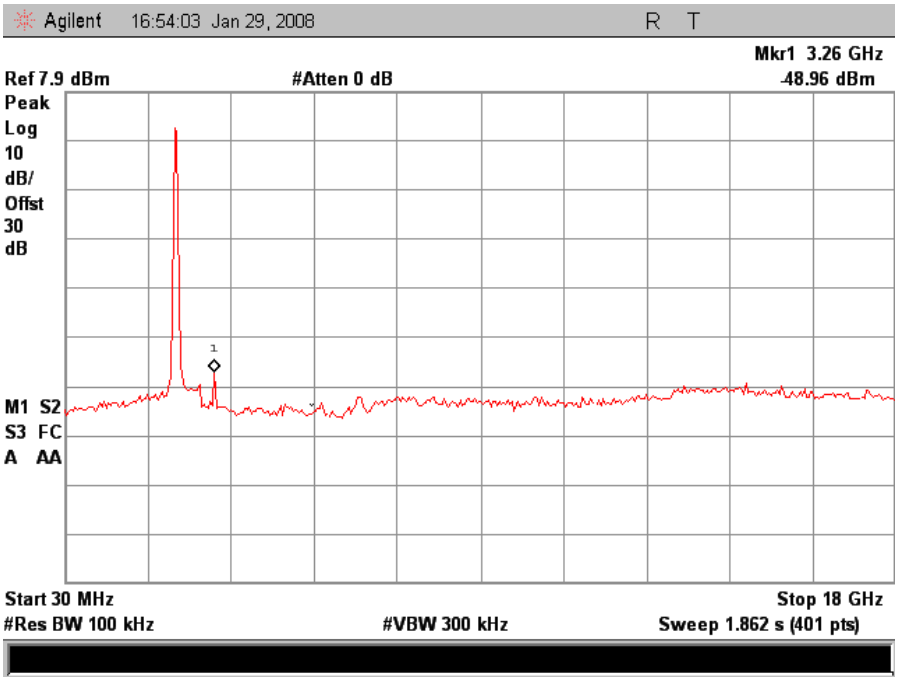


802.11/n – High Channel Conducted Emissions 30MHz- 18GHz

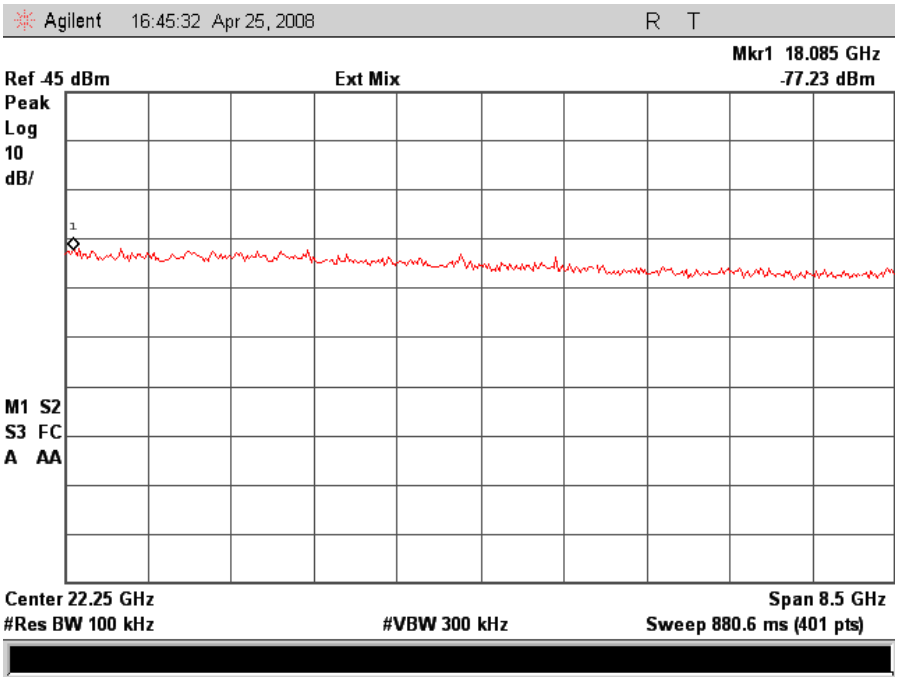


802.11/n – High Channel Conducted Emissions 18GHz – 26.5GHz

§ 15.247(d) Spurious Emissions Requirements –RF Conducted, 802.11n (Port 3, 40MHz)



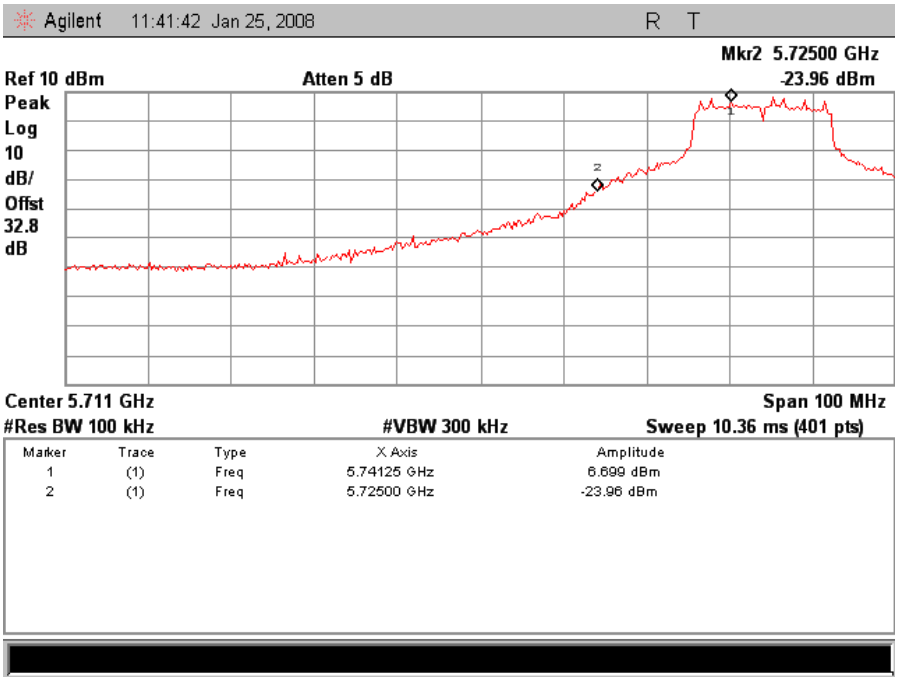
802.11/n – Mid Channel Conducted Emissions 30MHz – 18GHz



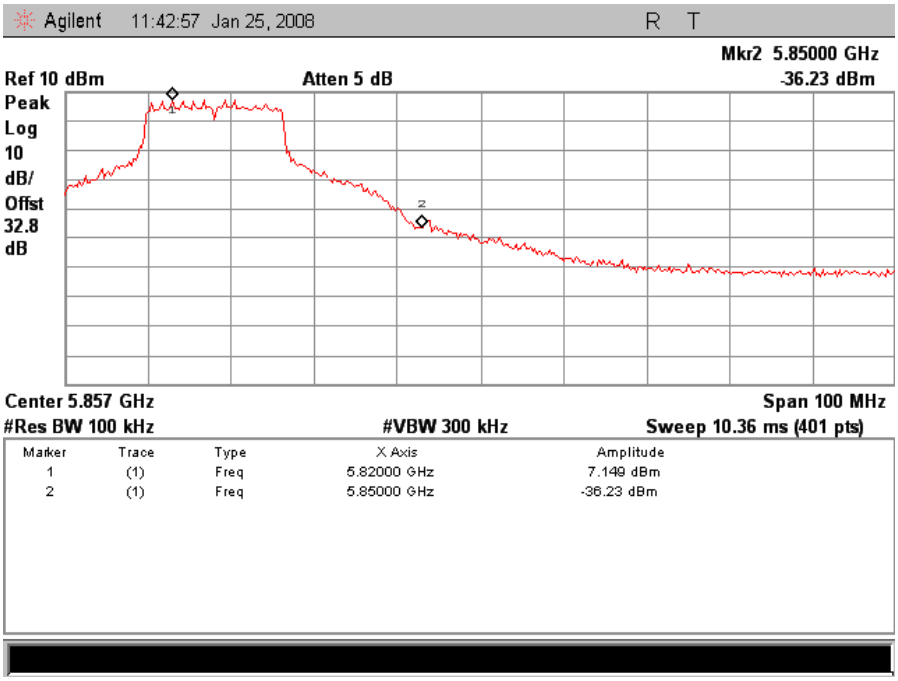
802.11/n – Mid Channel Conducted Emissions 18GHz – 26.5GHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247 Spurious Emissions Requirements –Band Edge (Conducted)

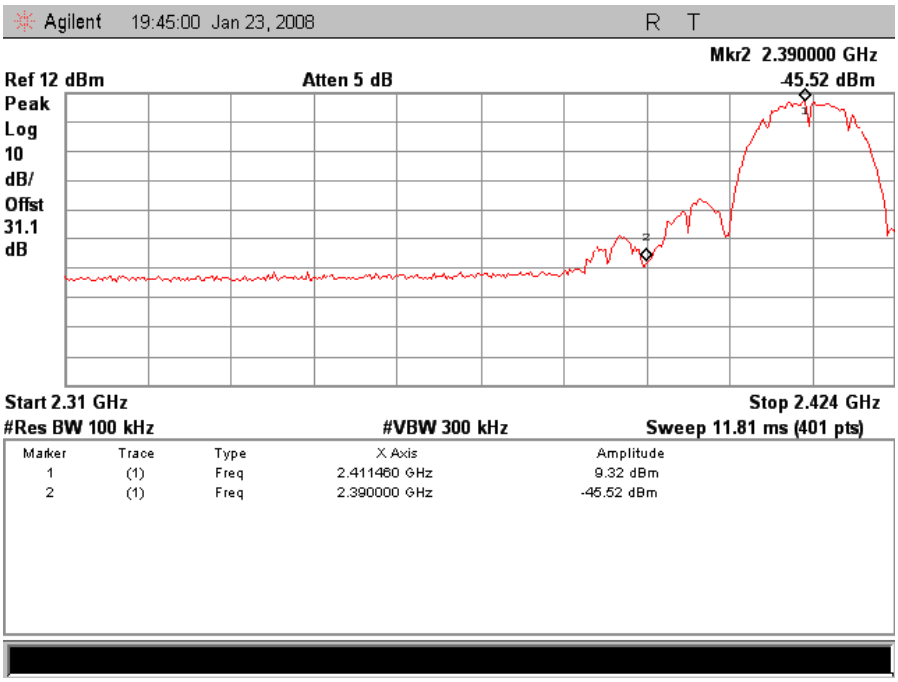


802.11/a – Lower Band Edge

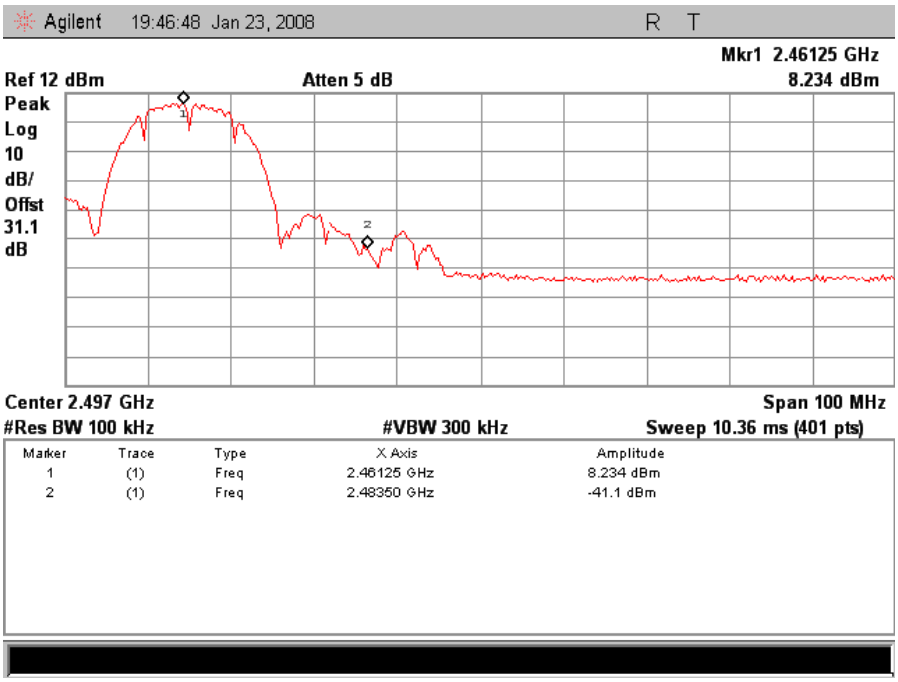


802.11/a –Upper Band Edge

§ 15.247 Spurious Emissions Requirements –Band Edge (Conducted)

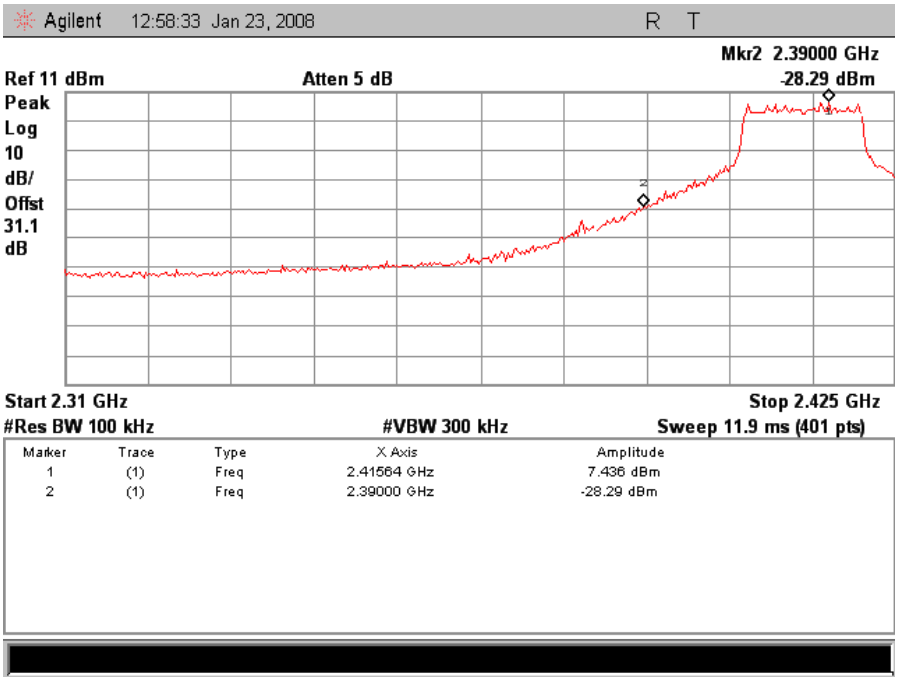


802.11/b – Lower Band Edge

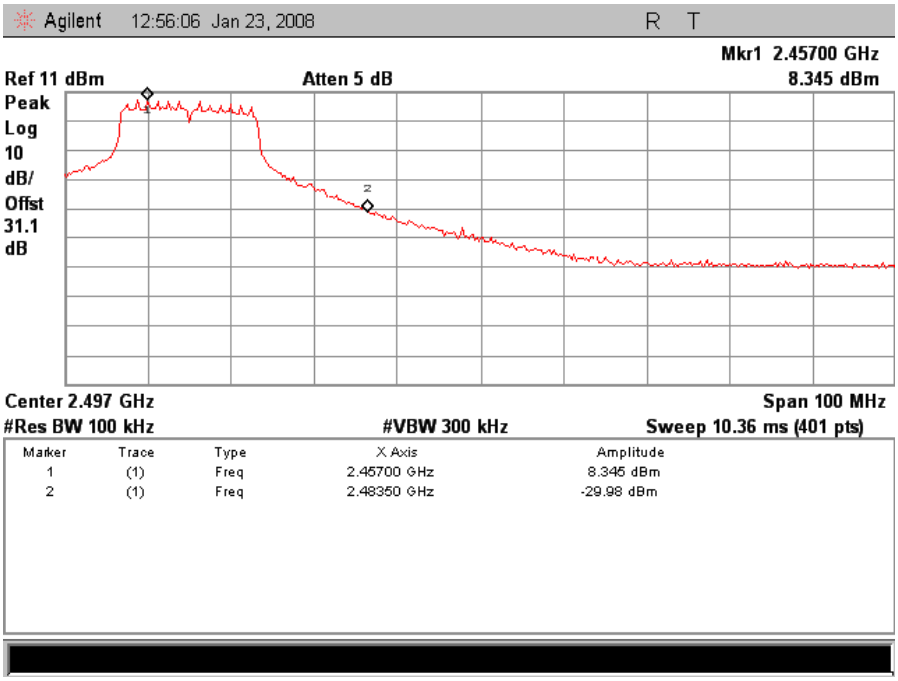


802.11/b –Upper Band Edge

§ 15.247 Spurious Emissions Requirements –Band Edge (Conducted)

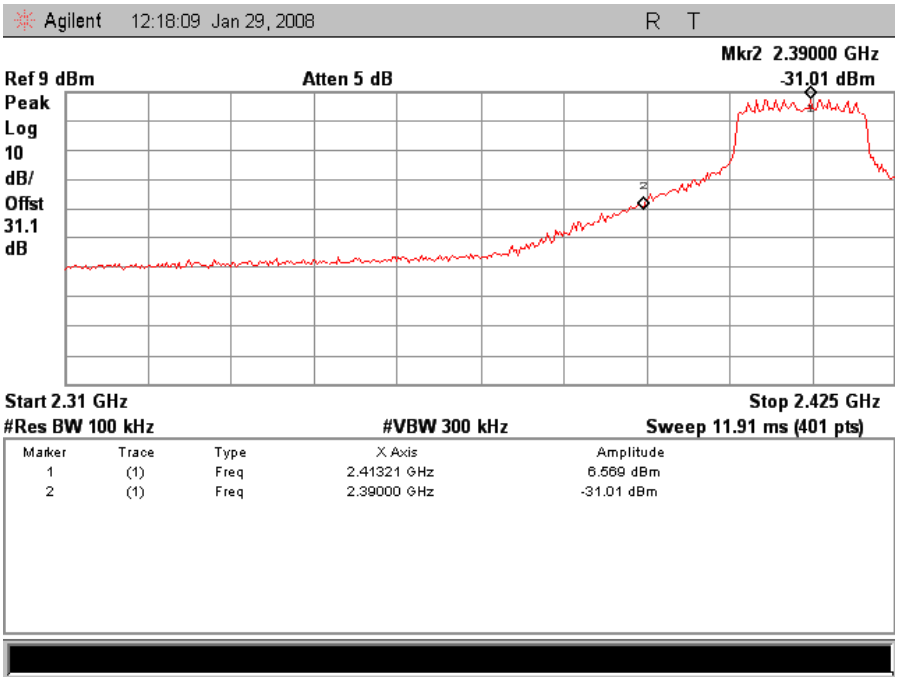


802.11/g – Lower Band Edge

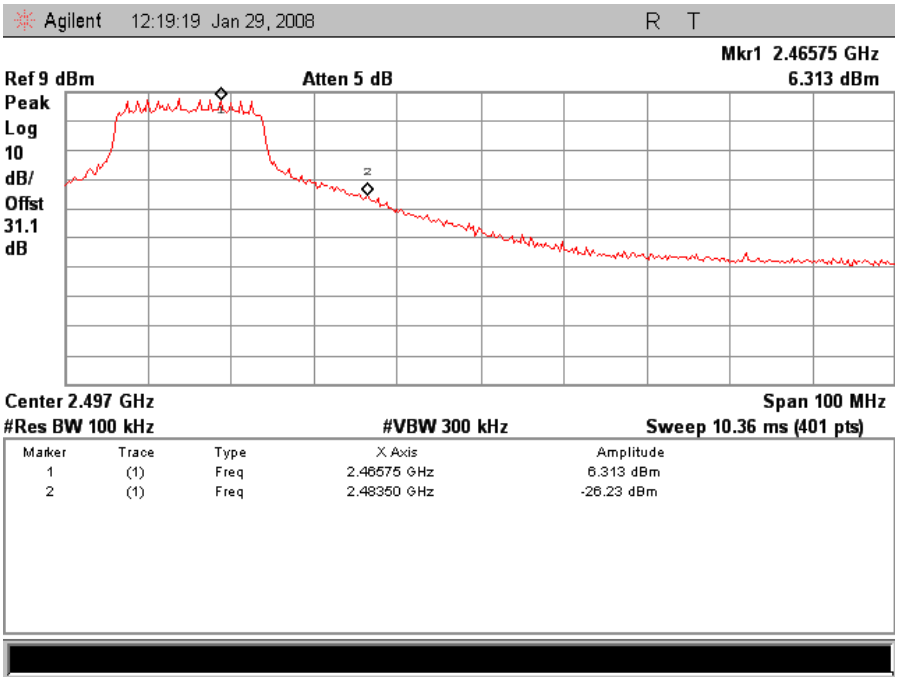


802.11/g – Upper Band Edge

§ 15.247 Spurious Emissions Requirements –Band Edge (Conducted) – Port 1, 20MHz

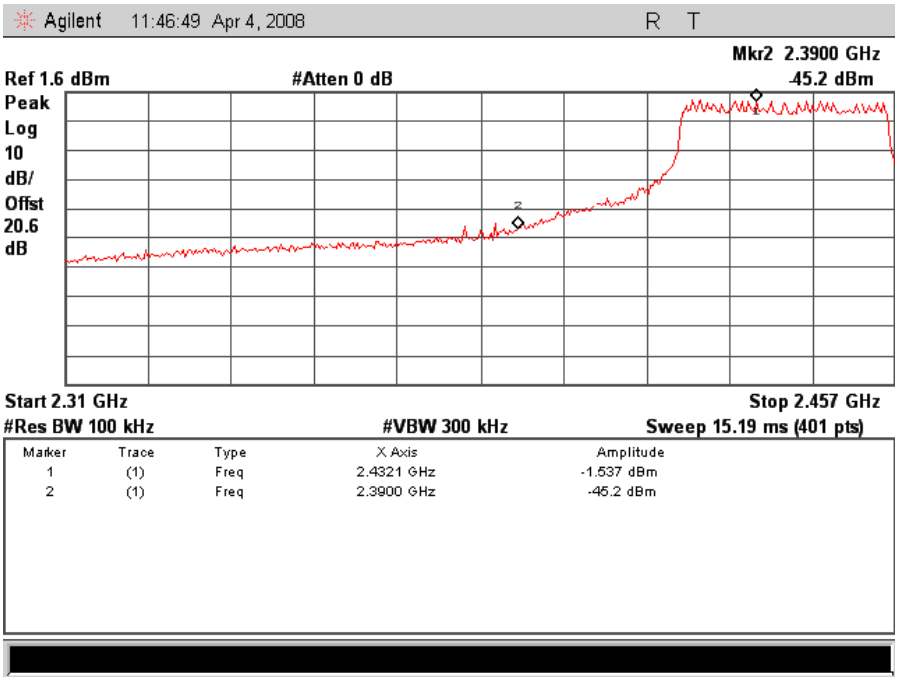


802.11/n – Lower Band Edge

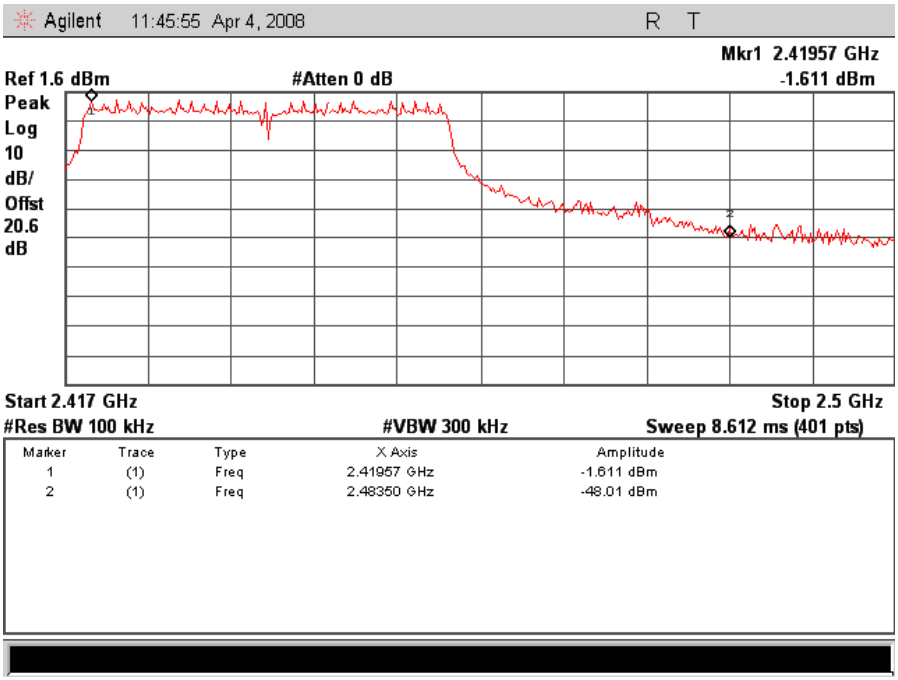


802.11/n – Upper Band Edge

§ 15.247 Spurious Emissions Requirements –Band Edge (Conducted) – Port 1, 40MHz

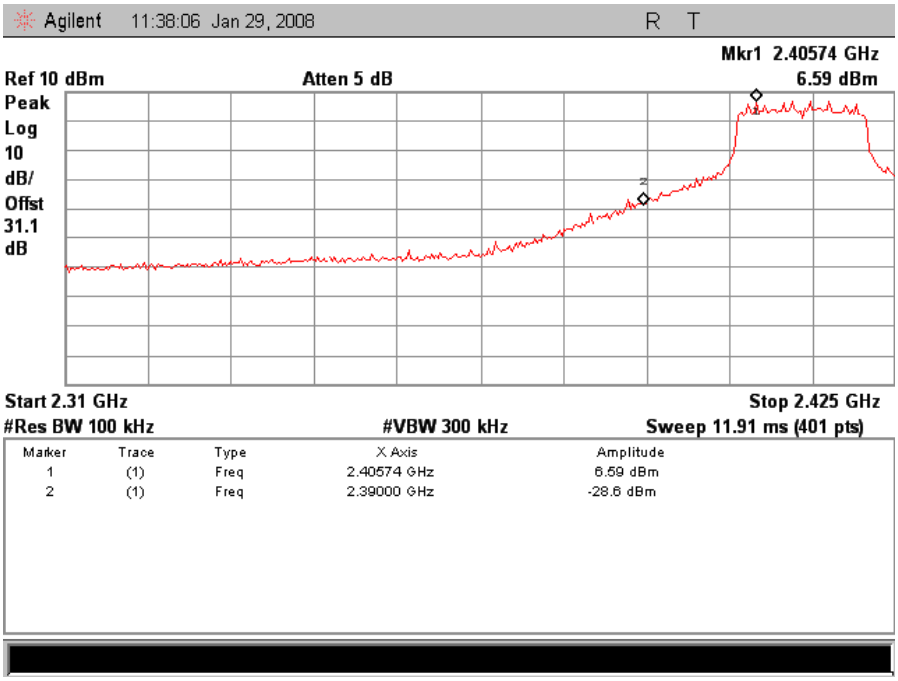


802.11/n – Lower Band Edge

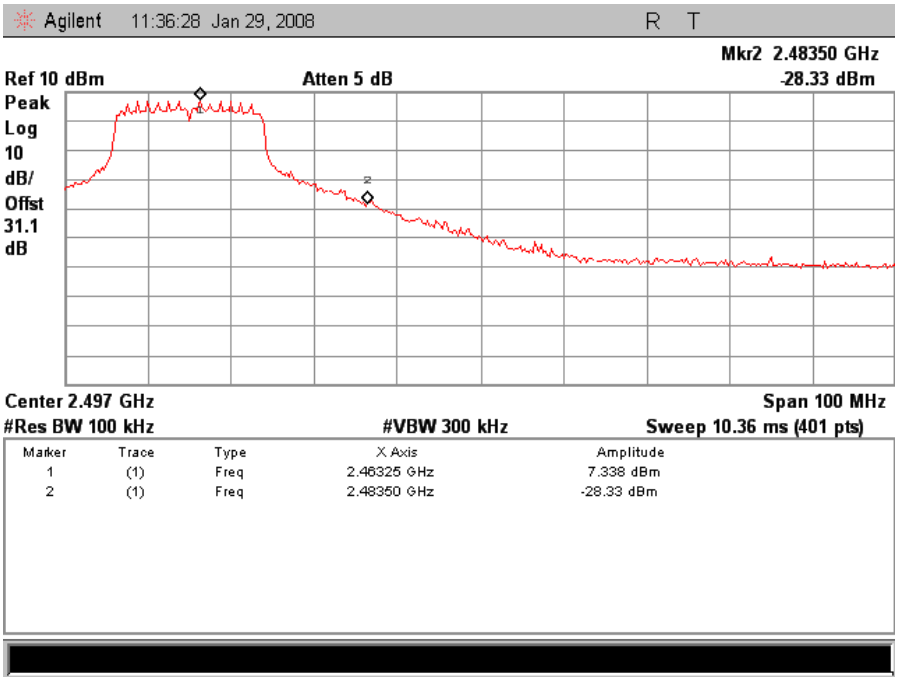


802.11/n – Upper Band Edge

§ 15.247 Spurious Emissions Requirements –Band Edge (Conducted) – Port 2, 20MHz

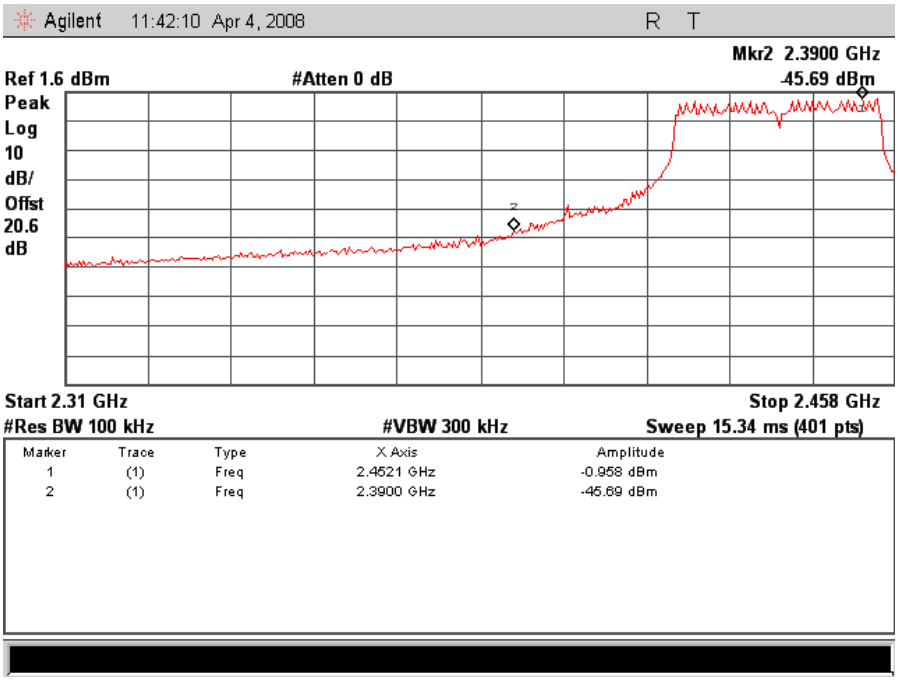


802.11/n – Lower Band Edge

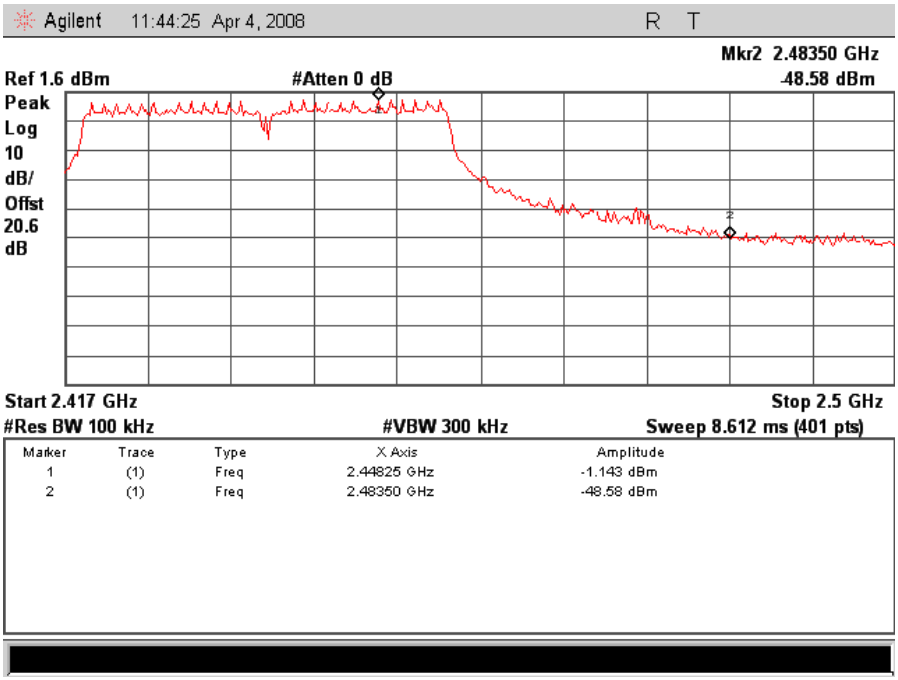


802.11/n – Upper Band Edge

§ 15.247 Spurious Emissions Requirements –Band Edge (Conducted) – Port 2, 40MHz

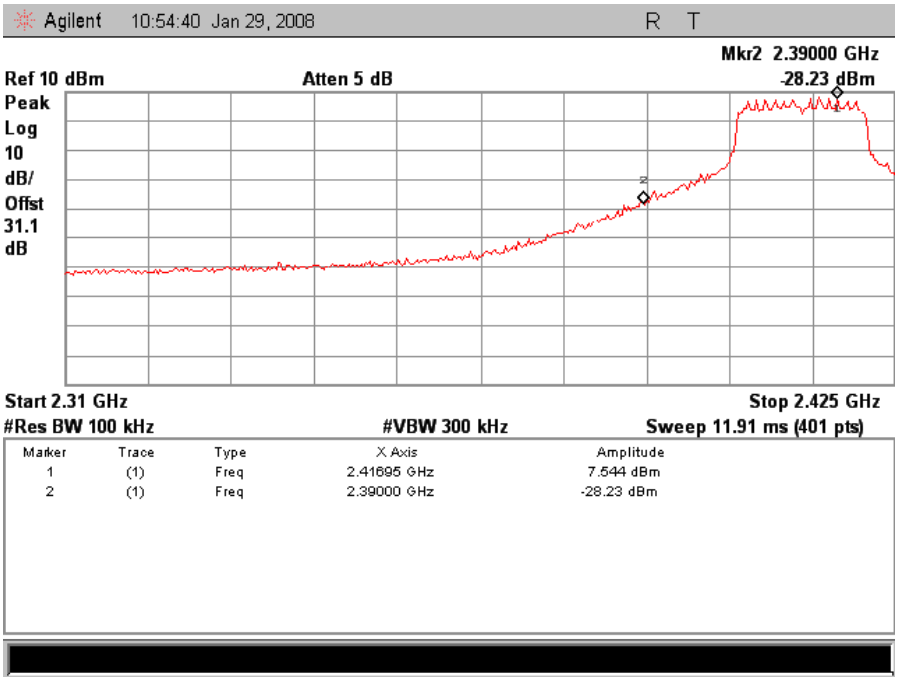


802.11/n – Lower Band Edge

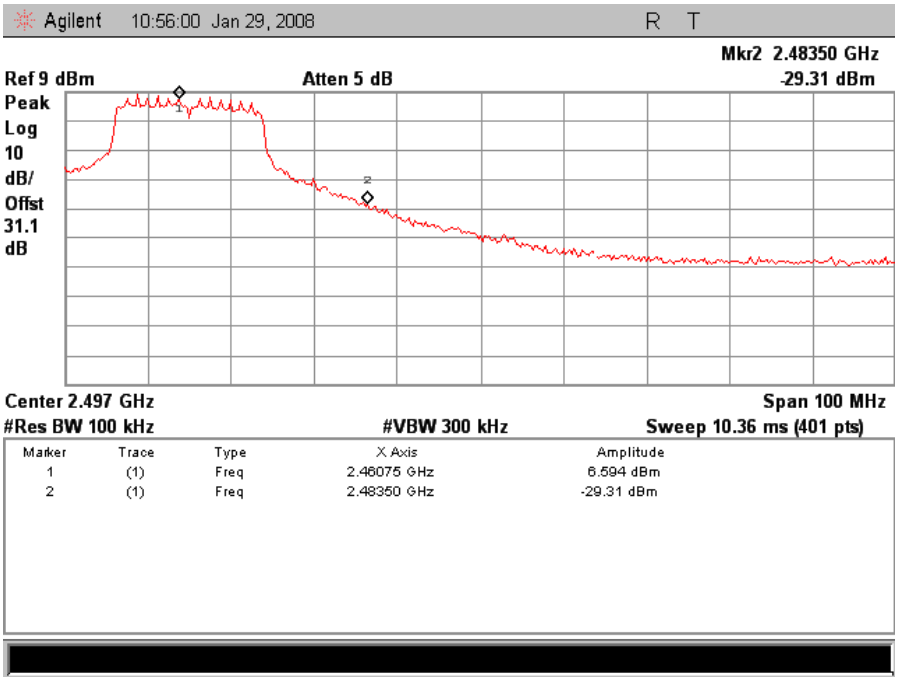


802.11/n – Upper Band Edge

§ 15.247 Spurious Emissions Requirements –Band Edge (Conducted) – Port 3, 20MHz

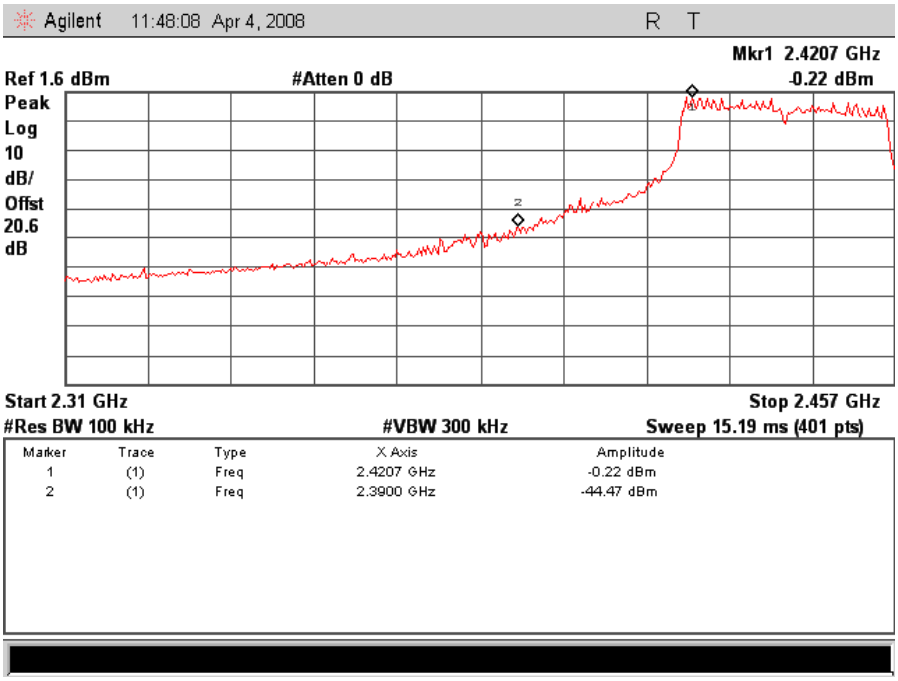


802.11/n – Lower Band Edge

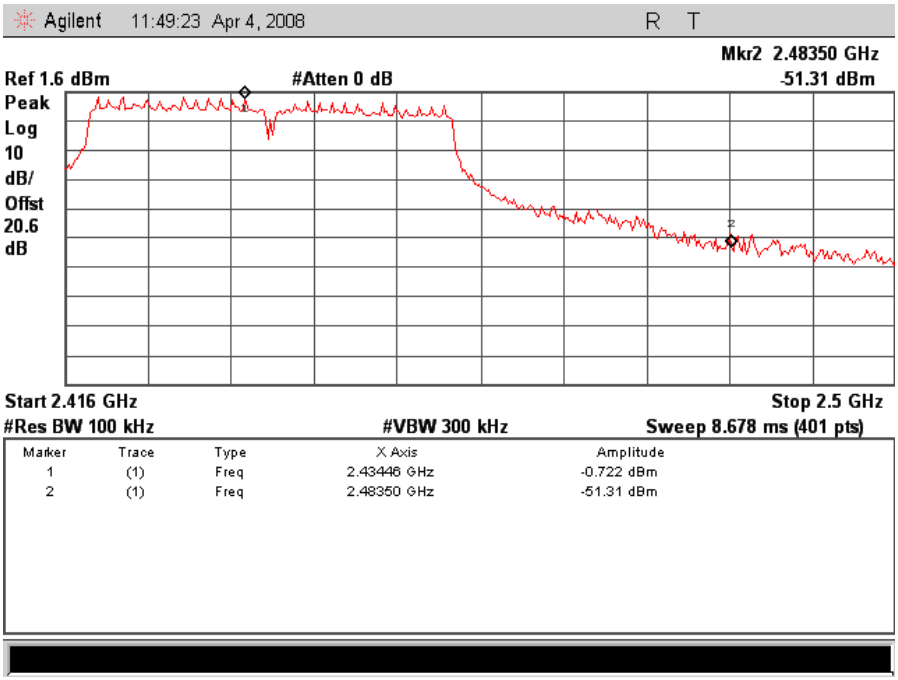


802.11/n – Upper Band Edge

§ 15.247 Spurious Emissions Requirements –Band Edge (Conducted) – Port 3, 40MHz



802.11/n – Lower Band Edge



802.11/n – Upper Band Edge

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(e) Peak Power Spectral Density

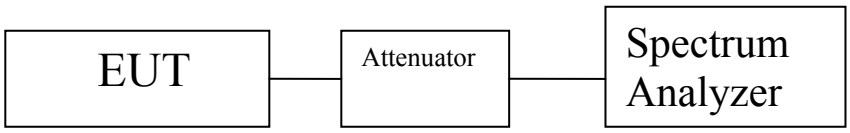
Test Requirements: **§15.247(e):** For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

Test Procedure: The transmitter was connected directly to a Spectrum Analyzer through a directional couple. The power was monitored at the coupler port with a Peak Power Meter. The power level was set to the maximum level. The RBW was set to 3 kHz with a VRB at 3*RBW. The spectrum analyzer was set to sweep over a 100 second interval. Measurements were carried out at the low, mid and high channels.

Test Results: Equipment complies with the peak power spectral density limits of **§ 15.247 (e)**. The peak power spectral density was determined from plots on the following page(s).

Test Engineer: Minh Ly

Test Date: January 29 & April 4, 2008



Block Diagram 4. Peak Power Spectral Density Test Setup

802.11a				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5745	-6.167	8	14.167
Mid	5785	-6.454	8	14.454
High	5825	-6.169	8	14.169

Table 33. Peak Power Spectral Density Test Results – 802.11a

802.11b				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-7.119	8	15.119
Mid	2437	-7.813	8	15.813
High	2462	-4.876	8	12.876

Table 34. Peak Power Spectral Density Test Results – 802.11b

802.11g				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-10.47	8	18.47
Mid	2437	-10.49	8	18.49
High	2462	-9.436	8	17.436

Table 35. Peak Power Spectral Density Test Results – 802.11g

802.11n (Port 1, 20MHz)				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-1.951	8	9.951
Mid	2437	-1.379	8	9.379
High	2462	-1.499	8	9.499

Table 36. Peak Power Spectral Density Test Results – 802.11n, 20MHz (Port 1)

802.11n (Port 1, 40MHz)				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Mid	2437	-15.750	8	23.75

Table 37. Peak Power Spectral Density Test Results – 802.11n, 40MHz (Port 1)

802.11n (Port 2, 20MHz)				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-4.457	8	12.457
Mid	2437	-5.372	8	13.372
High	2462	-5.815	8	13.815

Table 38. Peak Power Spectral Density Test Results – 802.11n, 20MHz (Port 2)

802.11n (Port 2, 40MHz)				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Mid	2437	-16.520	8	24.52

Table 39. Peak Power Spectral Density Test Results – 802.11n, 40MHz (Port 2)

802.11n (Port 3, 20MHz)				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-5.169	8	13.169
Mid	2437	-5.589	8	13.589
High	2462	-6.325	8	14.325

Table 40. Peak Power Spectral Density Test Results – 802.11n, 20MHz (Port 3)

802.11n (Port 3, 40MHz)				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Mid	2437	-15.480	8	23.48

Table 41. Peak Power Spectral Density Test Results – 802.11n, 40MHz (Port 3)

802.11n (All Ports, 20MHz with Combiner)				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-2.677	8	10.677
Mid	2437	-3.747	8	11.747
High	2462	-3.018	8	11.018

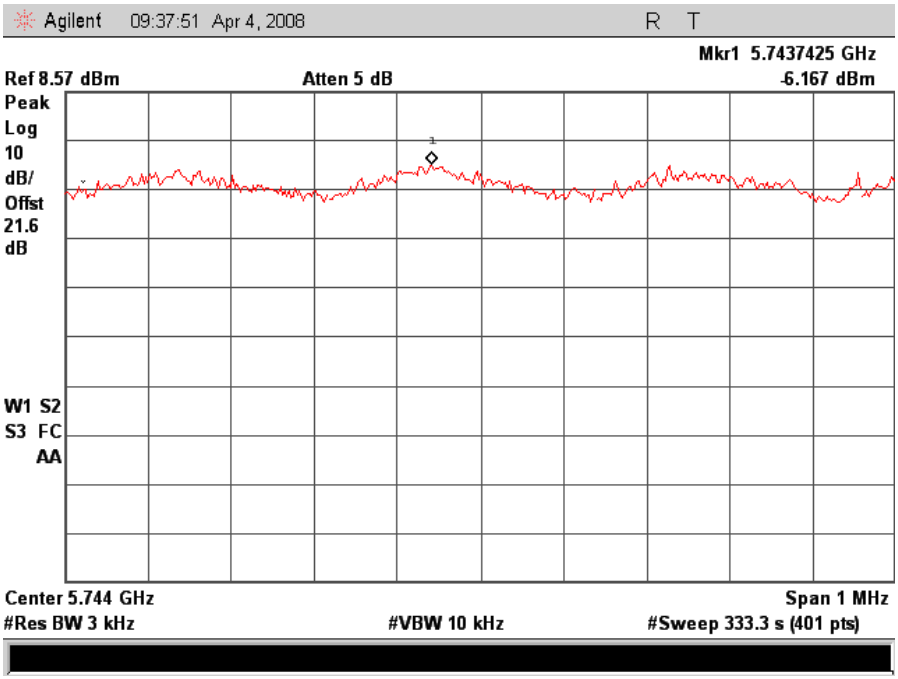
Table 42. Peak Power Spectral Density Test Results – 802.11n, 20MHz (All Ports)

802.11n (All Ports, 40MHz with Combiner)				
Carrier Channel	Frequency (MHz)	Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
Mid	2437	-14.190	8	22.19

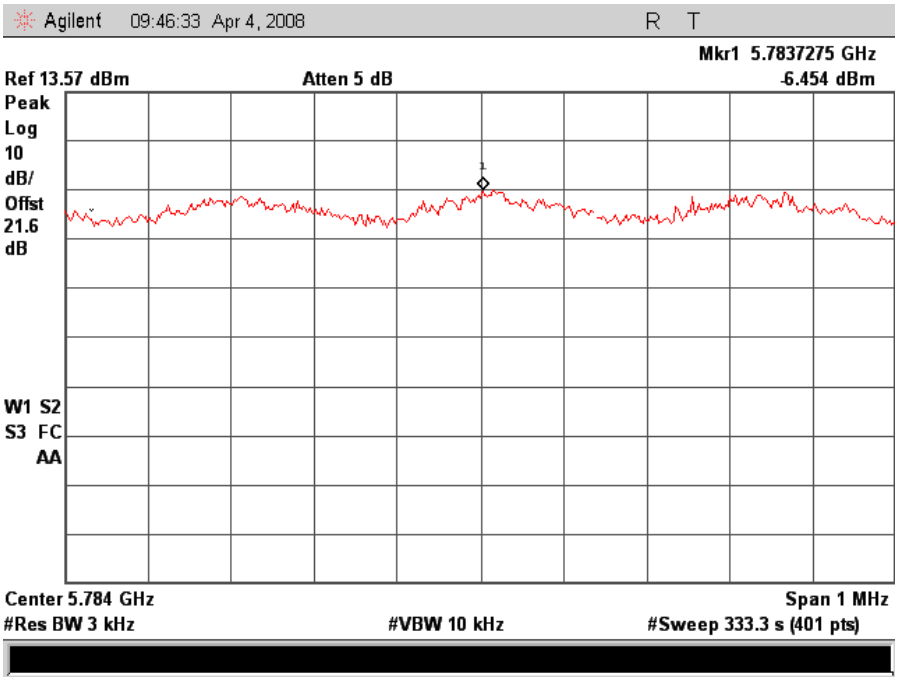
Table 43. Peak Power Spectral Density Test Results – 802.11n, 40MHz (All Ports)

Electromagnetic Compatibility Criteria for Intentional Radiators

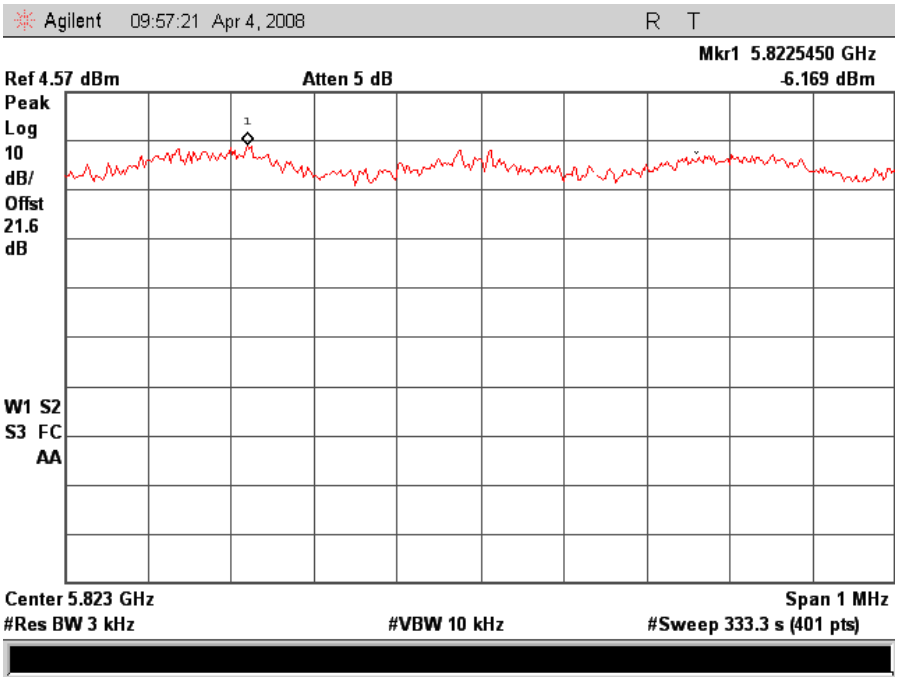
§ 15.247(e) Peak Power Spectral Density (802.11a)



802.11/a – Low Ch Peak Power Spectral Density

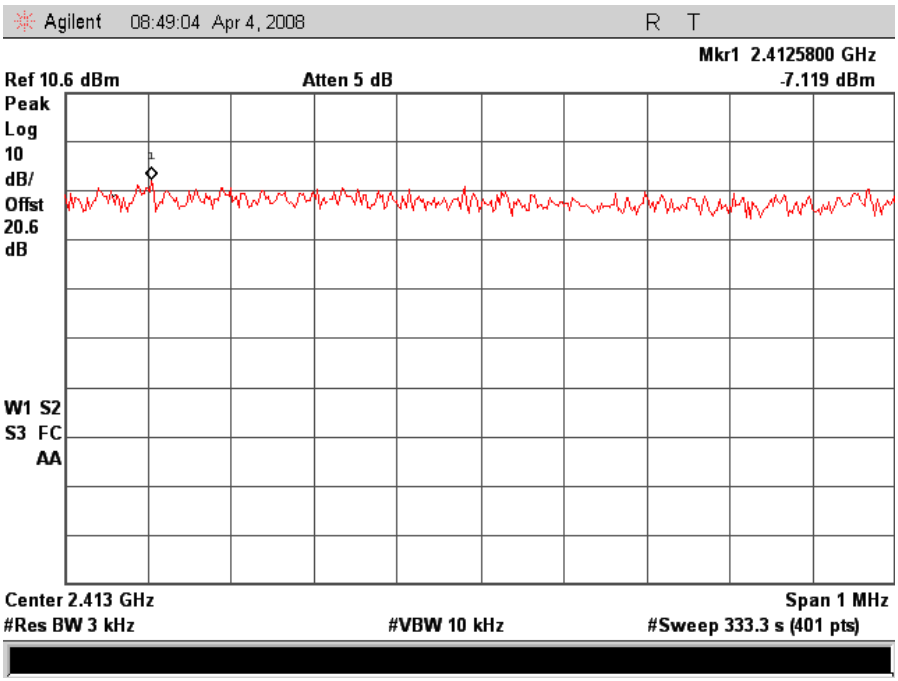


802.11/a – Mid Ch Peak Power Spectral Density

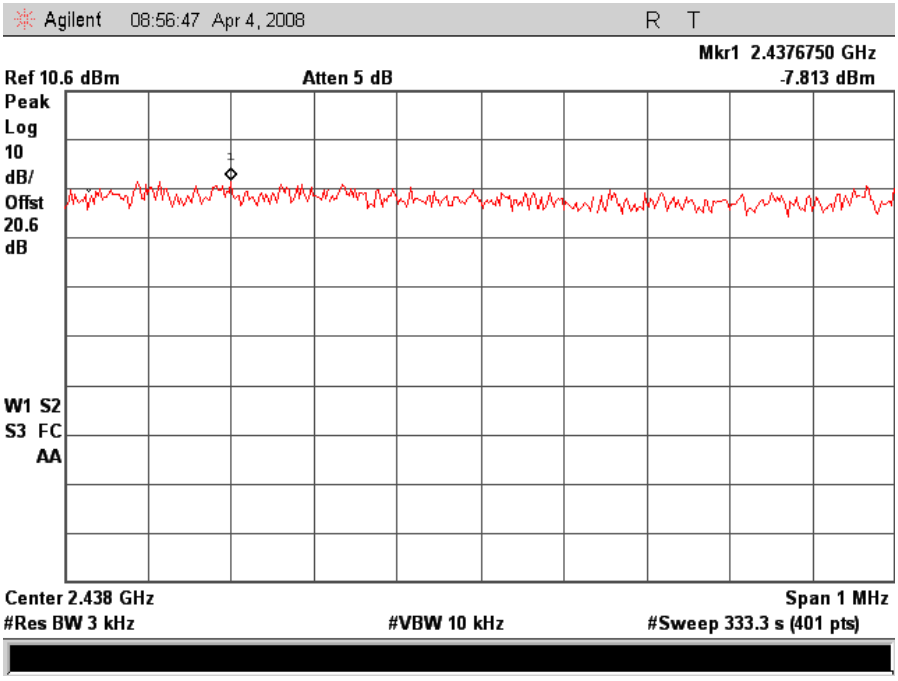


802.11/a – High Ch Peak Power Spectral Density

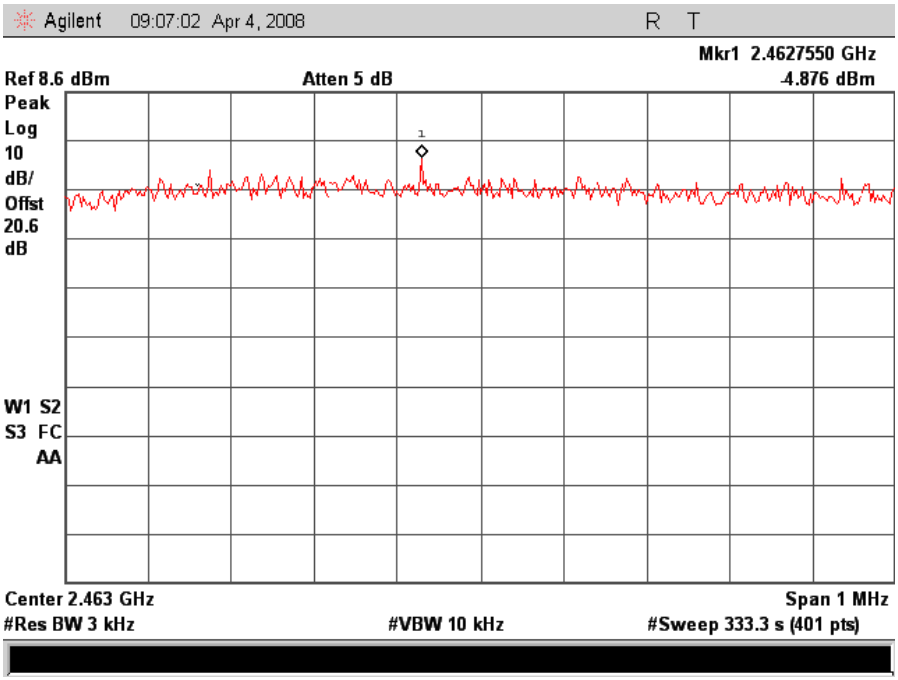
§ 15.247(e) Peak Power Spectral Density (802.11b)



802.11/b – Low Ch Peak Power Spectral Density

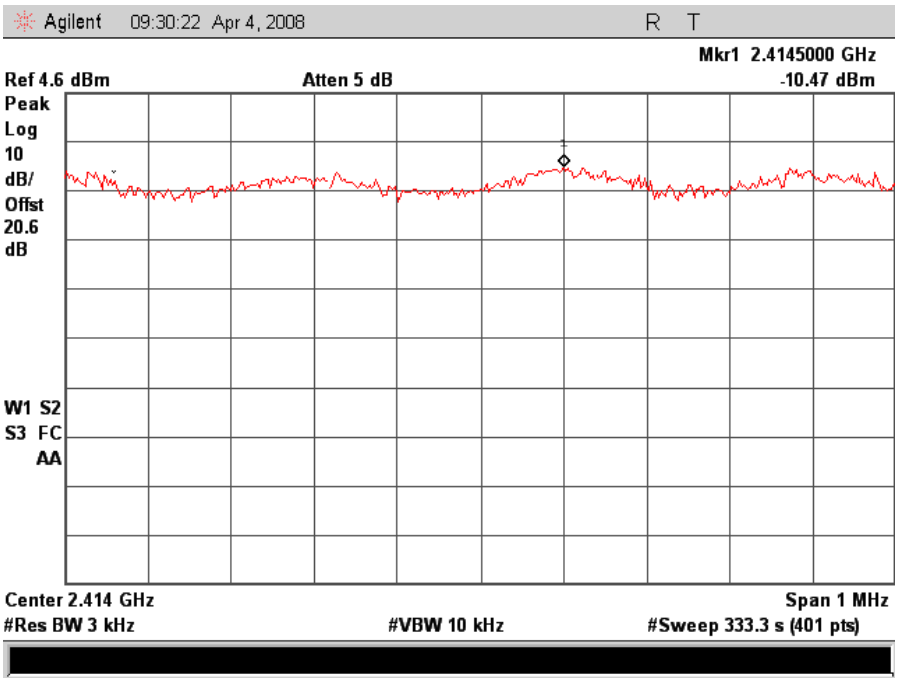


802.11/b – Mid Ch Peak Power Spectral Density

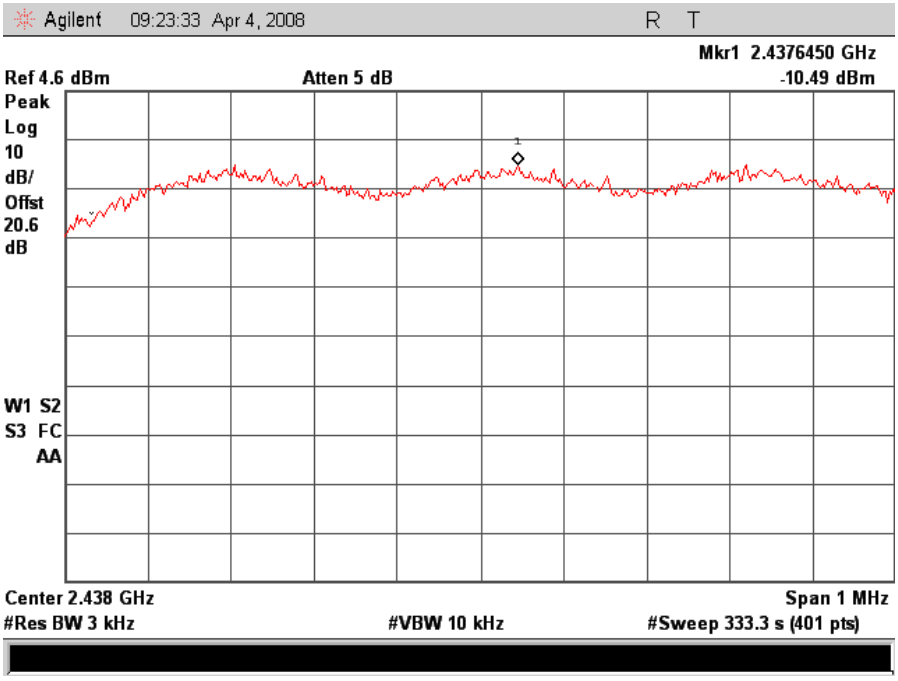


802.11/b – High Ch Peak Power Spectral Density

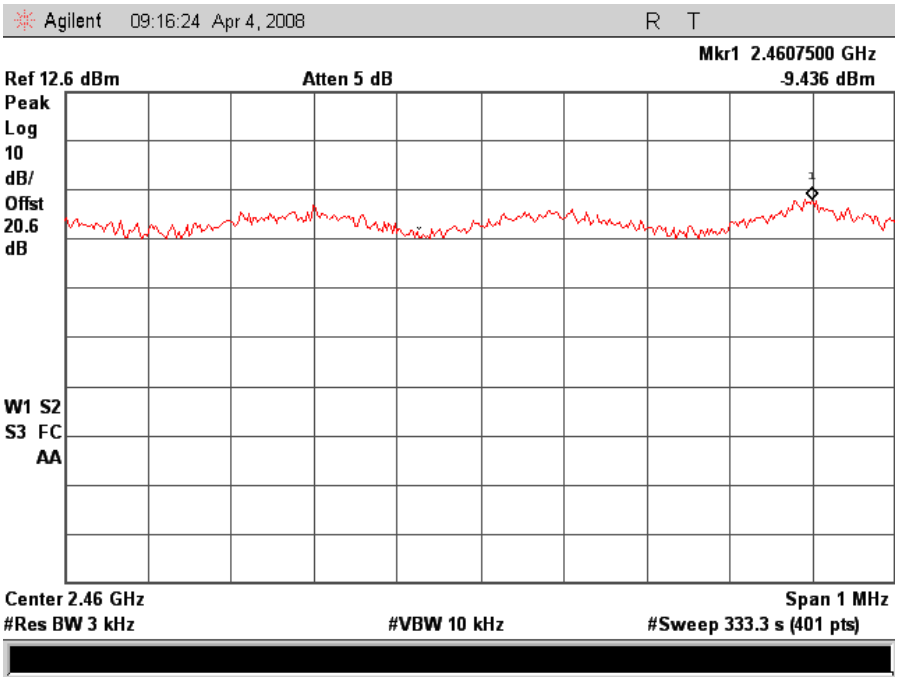
§ 15.247(e) Peak Power Spectral Density (802.11g)



802.11/g – Low Ch Peak Power Spectral Density

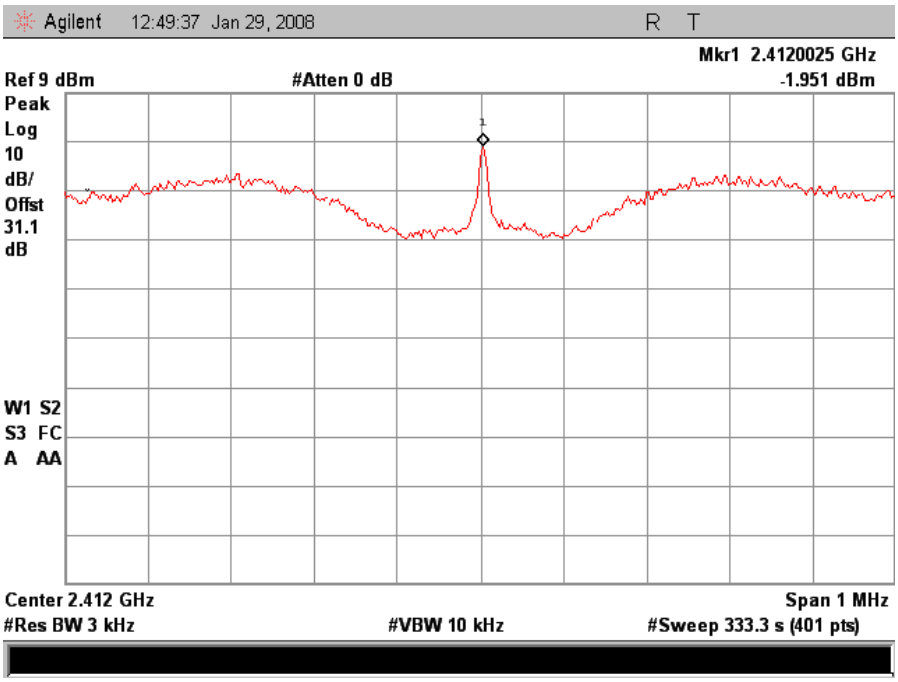


802.11/g – Mid Ch Peak Power Spectral Density

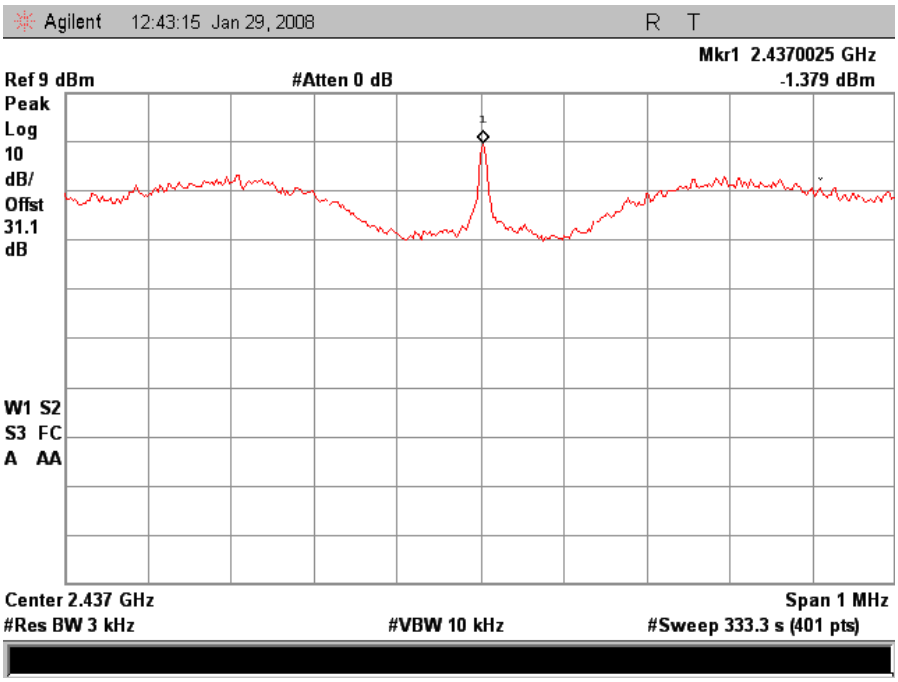


802.11/g – High Ch Peak Power Spectral Density

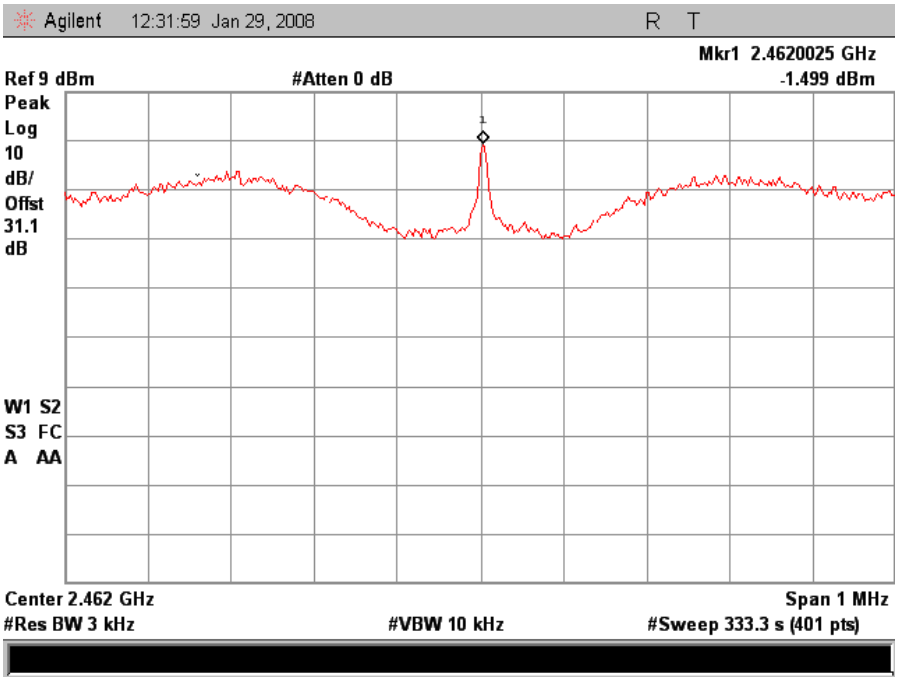
§ 15.247(e) Peak Power Spectral Density (802.11n) – Port 1, 20MHz



802.11/n – Low Ch Peak Power Spectral Density

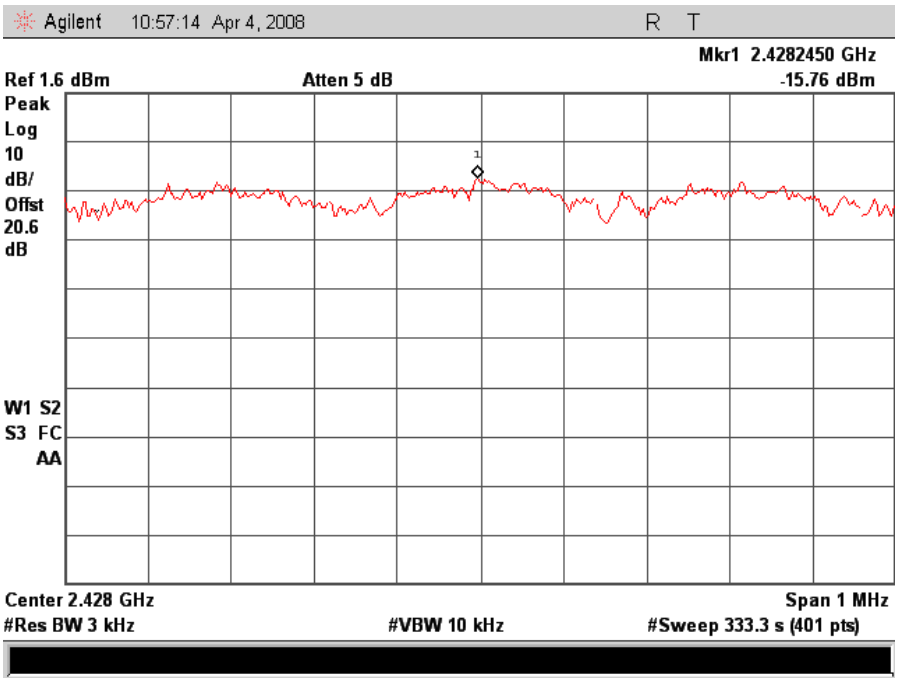


802.11/n – Mid Ch Peak Power Spectral Density



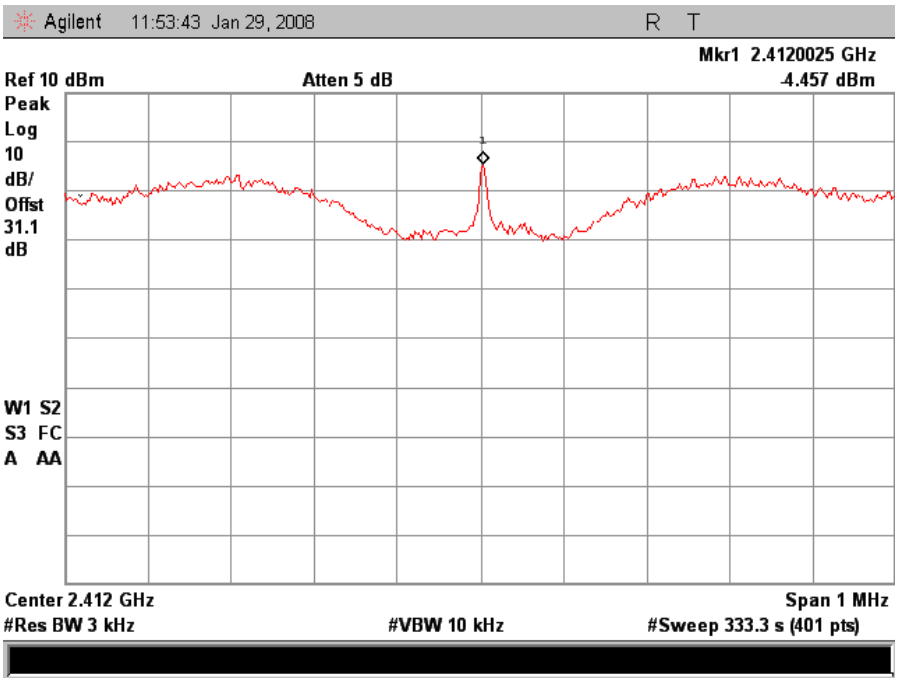
802.11/n – High Ch Peak Power Spectral Density

§ 15.247(e) Peak Power Spectral Density (802.11n) – Port 1, 40MHz

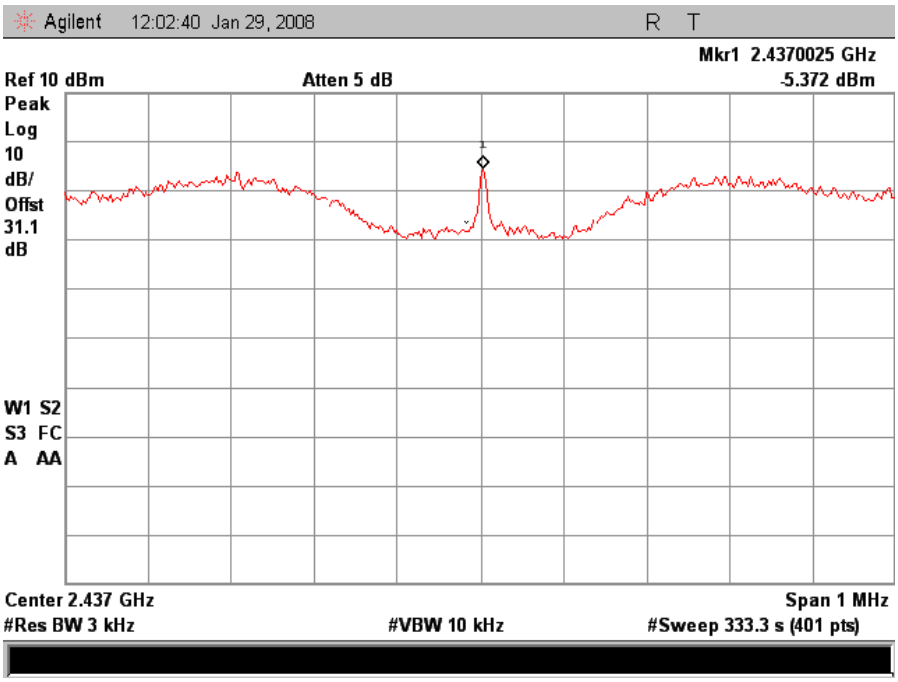


802.11/n – Mid Ch Peak Power Spectral Density

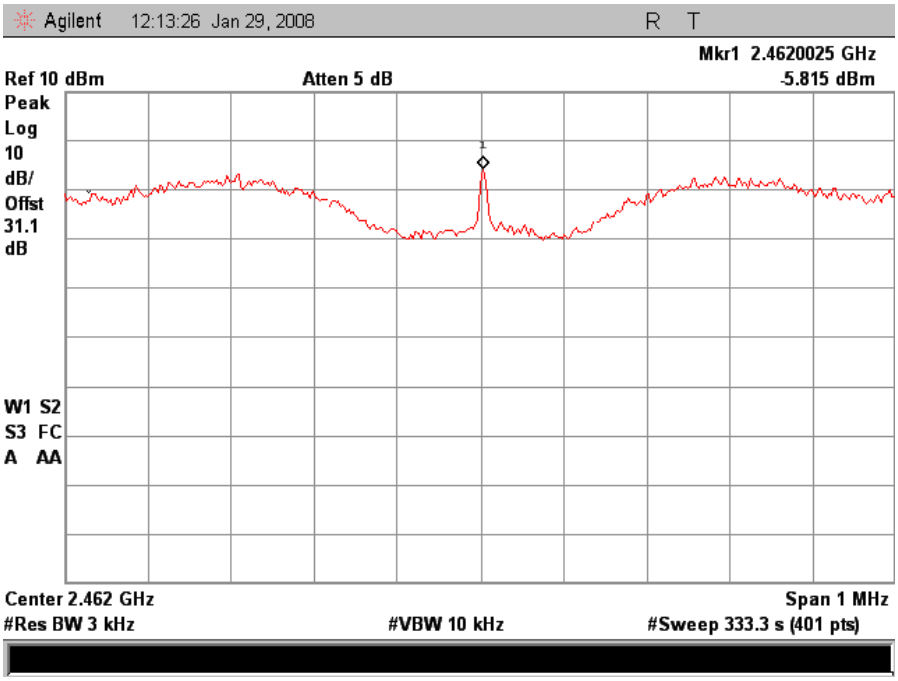
§ 15.247(e) Peak Power Spectral Density (802.11n) – Port 2, 20MHz



802.11/n – Low Ch Peak Power Spectral Density

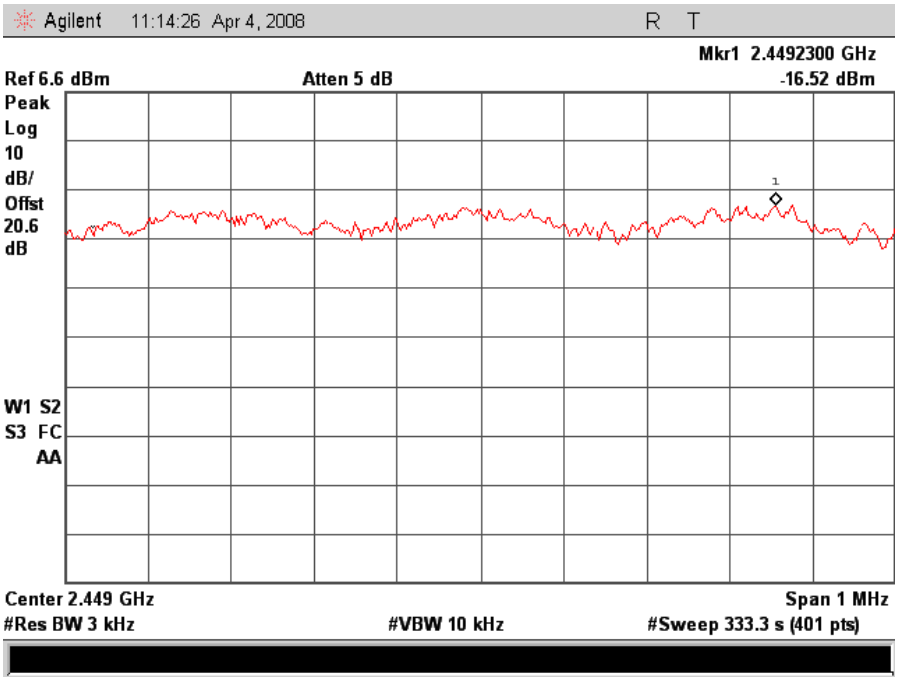


802.11/n – Mid Ch Peak Power Spectral Density



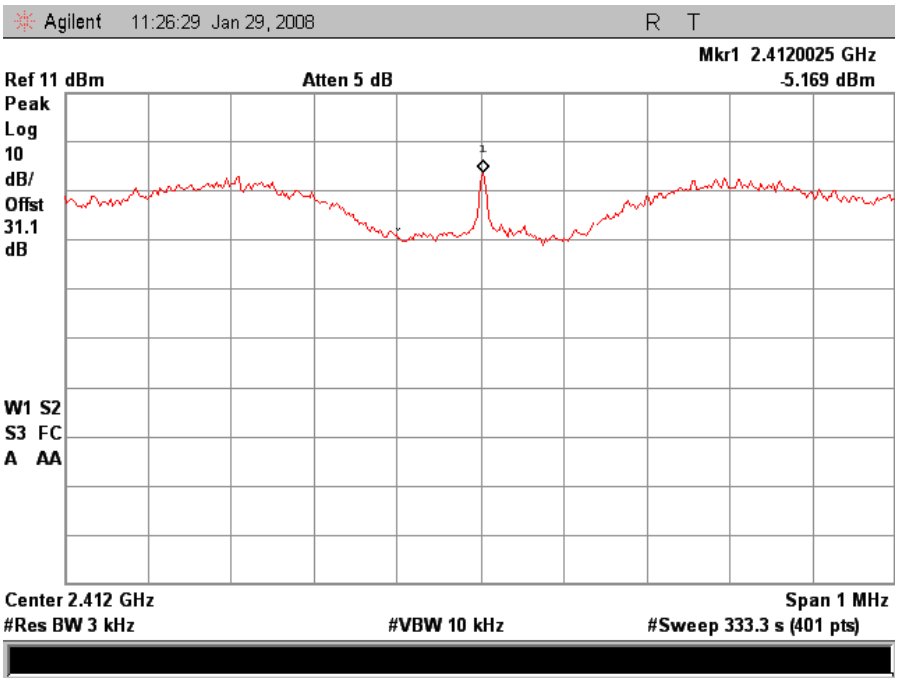
802.11/n – High Ch Peak Power Spectral Density

§ 15.247(e) Peak Power Spectral Density (802.11n) – Port 2, 40MHz

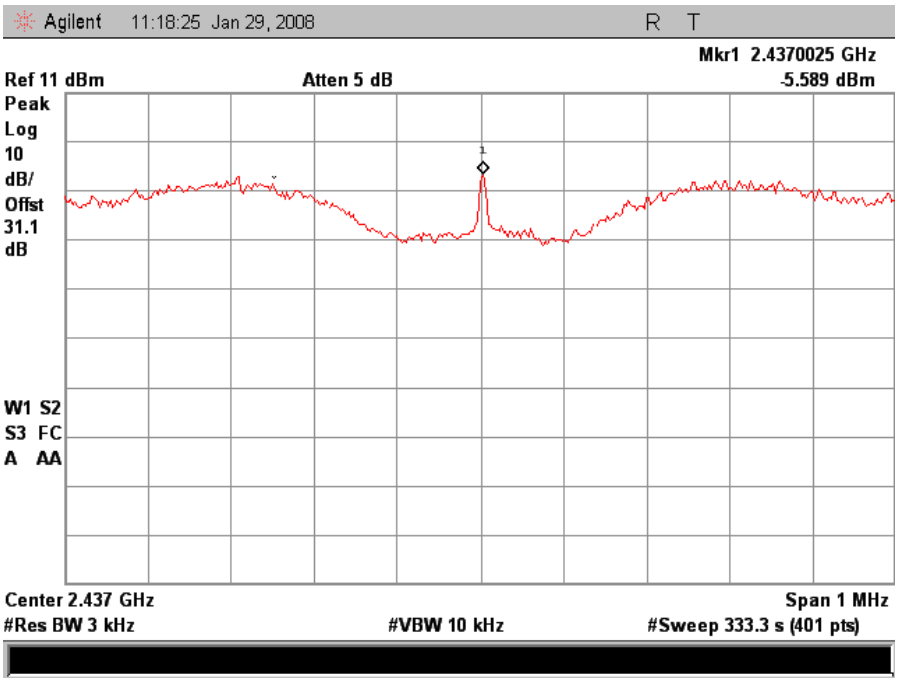


802.11/n – Mid Ch Peak Power Spectral Density

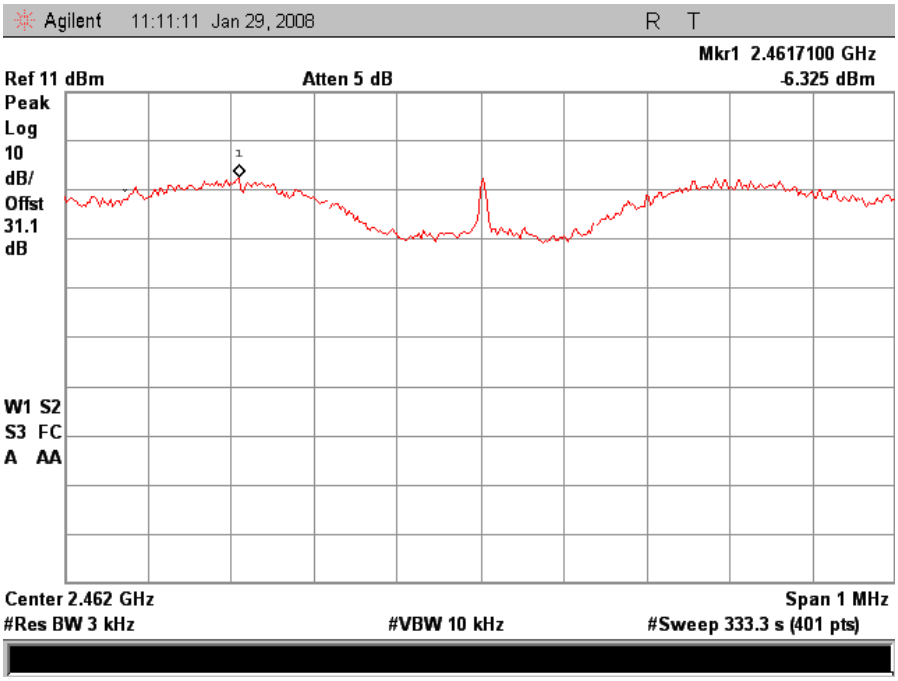
§ 15.247(e) Peak Power Spectral Density (802.11n) – Port 3, 20MHz



802.11/n – Low Ch Peak Power Spectral Density

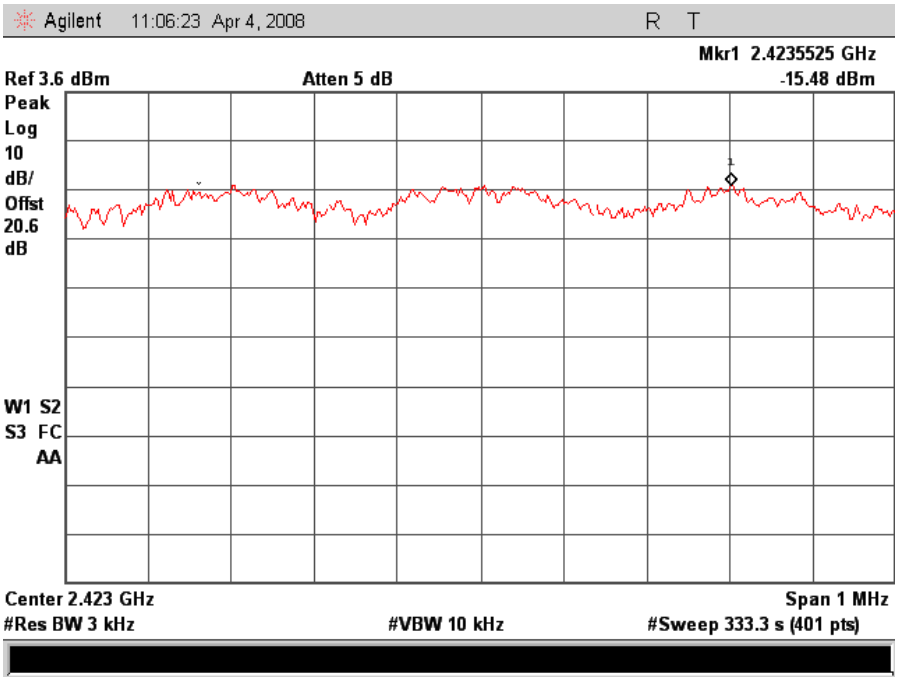


802.11/n – Mid Ch Peak Power Spectral Density



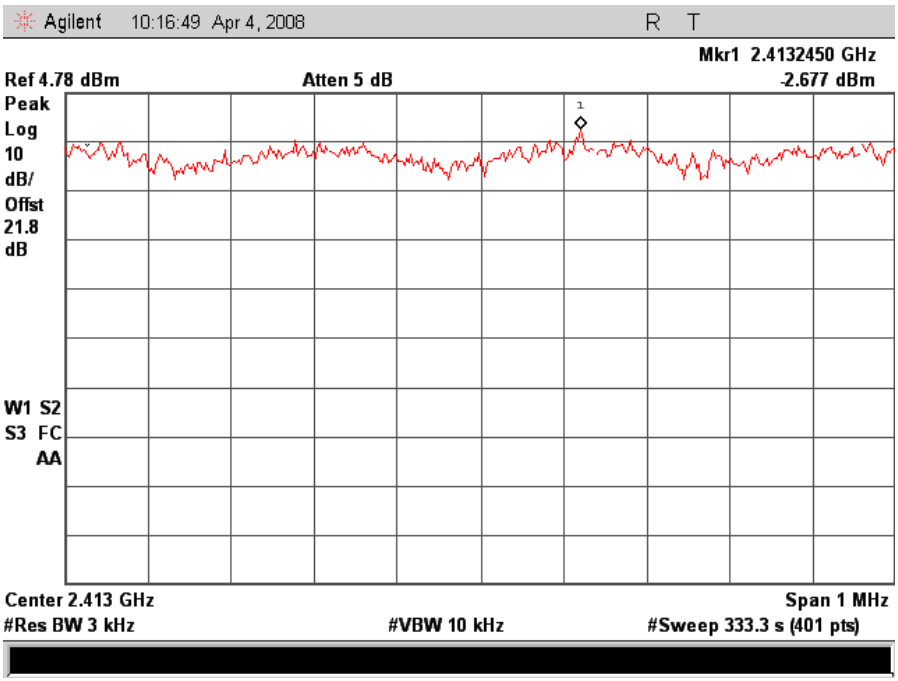
802.11/n – High Ch Peak Power Spectral Density

§ 15.247(e) Peak Power Spectral Density (802.11n) – Port 3, 40MHz

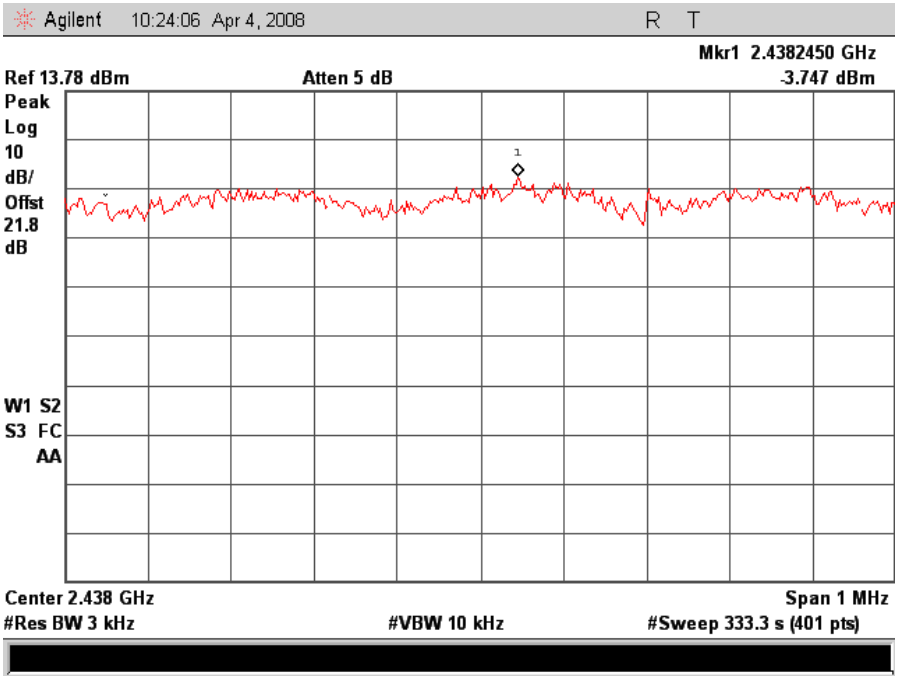


802.11/n – Mid Ch Peak Power Spectral Density

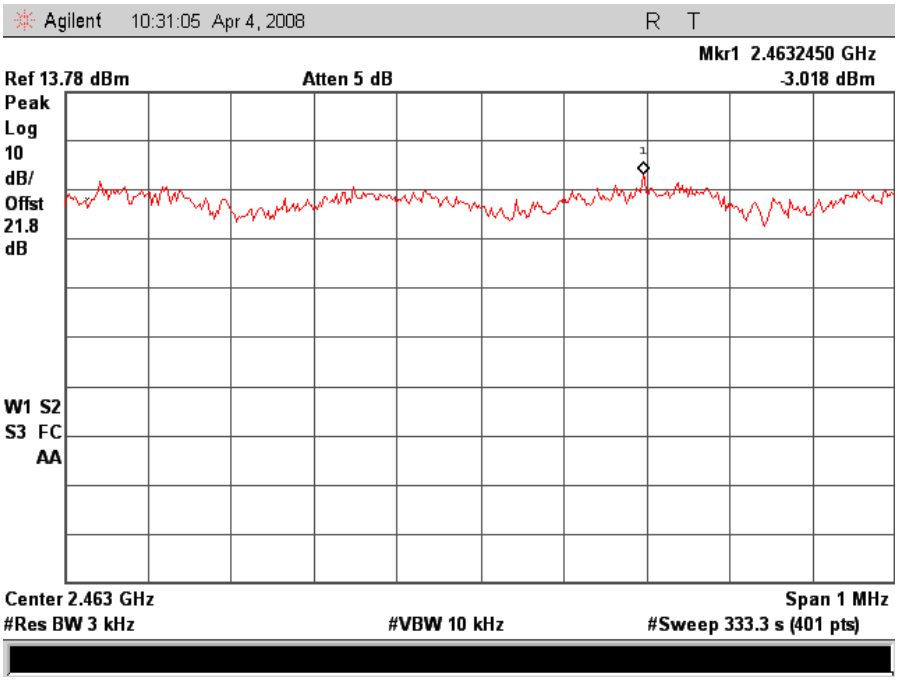
§ 15.247(e) Peak Power Spectral Density (802.11n) – All Ports, 20MHz



802.11/n – Low Ch Peak Power Spectral Density

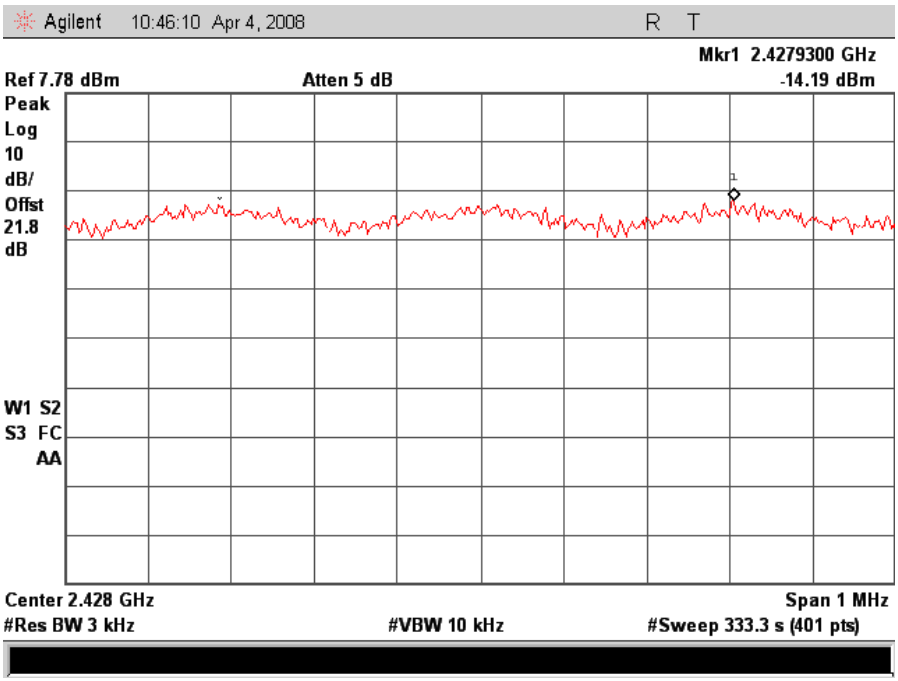


802.11/n – Mid Ch Peak Power Spectral Density



802.11/n – High Ch Peak Power Spectral Density

§ 15.247(e) Peak Power Spectral Density (802.11n) – All Ports, 40MHz



802.11/n – Mid Ch Peak Power Spectral Density

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	03/27/2007	03/27/2008
1S2184	BILOG ANTENNA	CHASE	CBL6112A	01/03/2007	01/03/2008
1S2121	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	11/28/2006	11/28/2007
1S2198	ANTENNA, HORN	EMCO	3115	08/17/2006	08/17/2007
1S2202	ANTENNA, HORN, 1 METER	EMCO	3116	04/10/2007	04/10/2010
N/A	HIGH PASS FILTER	MICRO-TRONICS	HPM13146	SEE NOTE	
1S2263	CHAMBER, 10 METER	RANTEC	N2-14	08/15/2007	08/15/2007
1S2041	COUPLER, BI DIRECTIONALCOAXIAL	NARDA	N/A	SEE NOTE	
1S2460	Analyzer, Spectrum 9 kHz-40GHz	Agilent	E4407B	07/06/2005	07/06/2008
1S2430	WIDEBAND POWER METER	ANRITSU COMPANY	ML2488A	03/12/2007	03/12/2008
1S2432	WIDEBAND POWER SENSOR	ANRITSU COMPANY	MA2491A	03/12/2007	03/12/2008
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

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

V. Certification & User's Manual Information

Certification & User's Manual Information

A. Certification Information

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

§ 2.801 Radio-frequency device defined.

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

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

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

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

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

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

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

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

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

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

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

(i) Compliance testing;

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

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

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

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

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

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

Certification & User's Manual Information

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

§ 2.901 Basis and Purpose

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

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

§ 2.907 Certification.

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

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

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

Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

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

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

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

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

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

Certification & User's Manual Information

Label and User's Manual Information

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

§ 15.19 Labeling requirements.

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

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

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

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

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

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

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

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

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

§ 15.21 Information to user.

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

Verification & User's Manual Information

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

§ 15.105 Information to the user.

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

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

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

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

– Reorient or relocate the receiving antenna.

– Increase the separation between the equipment and receiver.

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

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

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

