



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

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February 10, 2012

Firetide, Inc.  
140 Knowles Drive  
Los Gatos, CA 95032

Dear Suresh Kumar,

Enclosed is the EMC Wireless test report for compliance testing of the Firetide, Inc., FT 5900 Wireless Mesh Node as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Title 47 of the CFR, Part 15, Subpart B and ICES-003, Issue 4 February 2004 for Unintentional Radiators and Part 15.407 and Industry Canada RSS-210, Annex 9, Issue 8, December 2010 for Intentional Radiators.

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

Sincerely yours,  
MET LABORATORIES, INC.

Jennifer Warnell  
Documentation Department

Reference: (\\Firetide, Inc.\\EMCS33266A-FCC407 Rev. 1)

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**Electromagnetic Compatibility Criteria  
Test Report**

for the

**Firetide, Inc.  
Model FT 5900 Wireless Mesh Node**

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

**MET Report: EMCS33266A-FCC407 Rev. 1**

February 10, 2012

**Prepared For:**

**Firetide, Inc.  
140 Knowles Drive  
Los Gatos, CA 95032**

**Prepared By:**  
**MET Laboratories, Inc.**  
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for Intentional Radiators



Anderson Soungpanya, Project Engineer  
Electromagnetic Compatibility Lab



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**Engineering Statement:** The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Parts 15B, 15.407, of the FCC Rules and 407 and Industry Canada standards ICES-003, Issue 4 February 2004, RSS-210 Annex 9 under normal use and maintenance.



Shawn McMillen,  
Wireless Manager, Electromagnetic Compatibility Lab

## Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	January 8, 2012	Initial Issue.
1	February 10, 2012	Revised to reflect engineer corrections.

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## List of Terms and Abbreviations

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

# I. Executive Summary

## A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Firetide, Inc. FT 5900 Wireless Mesh Node, with the requirements of Part 15, §15.407. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the FT 5900 Wireless Mesh Node. Firetide, Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the FT 5900 Wireless Mesh Node, has been **permanently** discontinued.

## B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.407, in accordance with Firetide, Inc., purchase order number PO-3077. All tests were conducted using measurement procedure ANSI C63.4-2003.

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

**Table 1. Executive Summary of EMC Part 15.407 Compliance Testing**

## II. Equipment Configuration

## A. Overview

MET Laboratories, Inc. was contracted by Firetide, Inc. to perform testing on the FT 5900 Wireless Mesh Node, under Firetide, Inc.'s purchase order number PO-3077.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Firetide, Inc. FT 5900 Wireless Mesh Node.

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

<b>Model(s) Tested:</b>	FT 5900 Wireless Mesh Node	
<b>Model(s) Covered:</b>	FT 5900 Wireless Mesh Node	
<b>EUT Specifications:</b>	Primary Power: 120 VAC, 60 Hz	
	FCC ID: REP-5900-1 IC: 4988A-5900	
	Type of Modulations:	OFDM
	Equipment Code:	NII
	Peak RF Output Power:	16.86dBm
	EUT Frequency Ranges:	5745 - 5805MHz
<b>Analysis:</b>	The results obtained relate only to the item(s) tested.	
<b>Environmental Test Conditions:</b>	Temperature: 15-35° C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
<b>Evaluated by:</b>	Anderson Soungpanya	
<b>Report Date(s):</b>	February 10, 2012	

**Table 2. EUT Summary**

## B. References

<b>CFR 47, Part 15, Subpart B</b>	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
<b>CFR 47, Part 15, Subpart E</b>	Unlicensed National Information Infrastructure Devices (UNII)
<b>ANSI C63.4:2003</b>	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
<b>ANSI/NCSL Z540-1-1994</b>	Calibration Laboratories and Measuring and Test Equipment - General Requirements
<b>ANSI/ISO/IEC 17025:2000</b>	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 St., Santa Clara, CA 95054. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

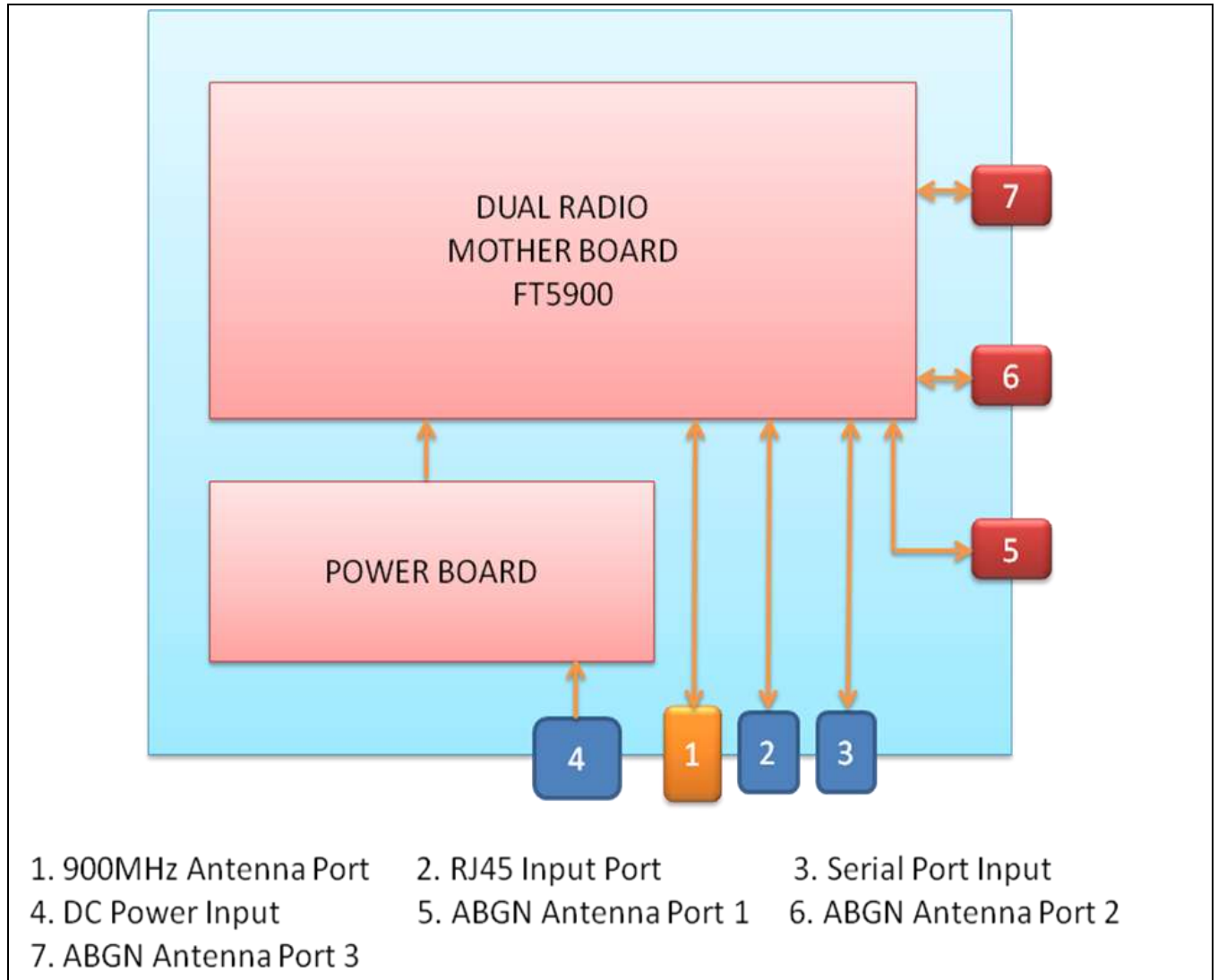
Radiated Emissions measurements were performed in a 5 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

#### D. Description of Test Sample

The Firetide, Inc. FT 5900 Wireless Mesh Node, Equipment Under Test (EUT), provide reliable Ethernet connectivity over a high performance, self-forming wireless mesh backbone. All nodes have an Ethernet port for connecting network devices or other networks to the wireless mesh. 5900 mesh features a dual radio solution with capability of operating in the 900 MHz spectrum on one radio while concurrently operating in the 2.4 GHz, 4.9 GHz (U.S. public safety licensed band) or 5 GHz frequency ranges on the other.



**Photograph 1. Firetide, Inc. FT 5900 Wireless Mesh Node**



**Figure 1. Block Diagram of Test Configuration**



## E. Equipment Configuration

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

Ref. ID	Name / Description	Model Number	Serial Number
1	Unit Enclosure	--	--
2	DC Power Board	GS260A12	EB14145528
3	Dual Radio Mother Board	FT5900	--
	9dBi Omni Antenna (5.8 GHz)	MA-WO55-MIMONHFT9	430
	15dBi Sector Antenna (5.8 GHz)	MA-WE55-MIMOFT15	327
	16dBi Panel Antenna (5.8 GHz)	MA-WD56-DSV16	623

Table 4. Equipment Configuration

## F. Support Equipment

Firetide, Inc. supplied support equipment necessary for the operation and testing of the FT 5900 Wireless Mesh Node. All support equipment supplied is listed in the following Support Equipment List.

Name / Description	Manufacturer	Model Number	Serial Number
External DC Adapter	Mean Well	GS60A12-P1J	NA
Laptop computer	Dell	vostro 1000	N/A
<del>RJ45 Cable</del>	--	--	--

Table 5. Support Equipment

## G. Ports and Cabling Information

Port name on EUT	Cable Description or reason for no cable	Qty.	Length (m)	Shielded? (Y/N)	Termination Box ID & Port ID
RJ45 Port	Ethernet Cable	1	--	N	Laptop
Serial Port	Serial Cable	1	--	Y	Laptop
DC Power Input Port	Power Cable	1	--	Y	DC Adapter

Table 6. Ports and Cabling Information

## H. Mode of Operation

Once the DC power is applied on board LED indicates to mention that the unit is powered on properly. . Proper IP address should be set in the PC prior to the Ethernet cable connection. The Ethernet connectivity needs to be made by connecting an Ethernet cable. Once the connection is established, you can verify this in the PC's LAN connectivity status. Proper IP address should be set in the PC prior to the Ethernet cable connection.

Dual radio mode, both the radios will be enabled.

## **I. Method of Monitoring EUT Operation**

FT5900 will be used for wireless mesh node application and all the FT5900 nodes connectivity will be monitored using a common server (PC or Laptop). The link connectivity can always be verified using the Firetide provided Software which will run on server PC or Laptop. If some connectivity is broken then we can verify this with Firetide software running on the server then we can take necessary action accordingly.

## **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 Firetide, Inc. upon completion of testing.

## **III. Electromagnetic Compatibility Criteria for Unintentional Radiators**

## Electromagnetic Compatibility Criteria

### § 15.107 Conducted Emissions Limits

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

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

Frequency range (MHz)	Class A Conducted Limits (dB $\mu$ V)		*Class B Conducted Limits (dB $\mu$ V)	
	Quasi-Peak	Average	Quasi-Peak	Average
* 0.15- 0.45	79	66	66 - 56	56 - 46
0.45 - 0.5	79	66	56	46
0.5 - 30	73	60	60	50

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

Note 2 — The limit decreases linearly with the logarithm if the frequency in the range 0.15 MHz to 0.5 MHz.

\* -- Limits per Subsection 15.207(a).

**Table 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 compliant with the Class A requirement(s) of this section. Measured emissions were below applicable limits.

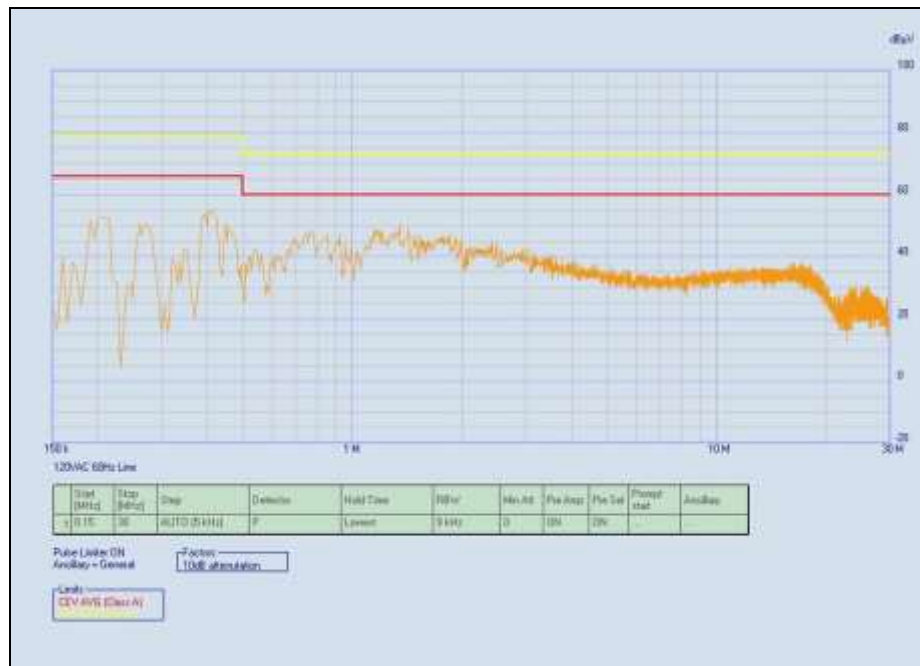
**Test Engineer(s):** Anderson Soungpanya

**Test Date(s):** 11/10/11

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

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
120VAC Line 60Hz	0.19	49.43	79	-29.57	Pass	32.49	66	-33.51	Pass
120VAC Line 60Hz	0.27	47.93	79	-31.07	Pass	35.37	66	-30.63	Pass
120VAC Line 60Hz	0.395	51.59	79	-27.41	Pass	35.38	66	-30.62	Pass
120VAC Line 60Hz	0.415	52.52	79	-26.48	Pass	36.21	66	-29.79	Pass
120VAC Line 60Hz	1.35	47.36	73	-25.64	Pass	34.56	60	-25.44	Pass

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

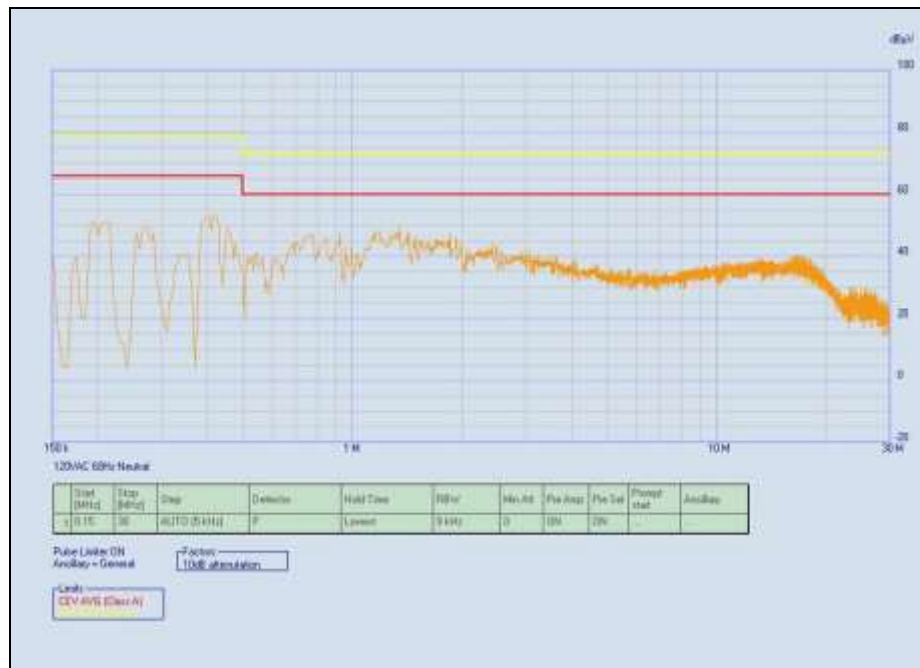


**Plot 1. Conducted Emission, Phase Line Plot**

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

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
120VAC Neutral 60Hz	0.195	39.87	79	-39.13	Pass	28.27	66	-37.73	Pass
120VAC Neutral 60Hz	0.27	46.89	79	-32.11	Pass	35.1	66	-30.9	Pass
120VAC Neutral 60Hz	0.405	51.45	79	-27.55	Pass	35.68	66	-30.32	Pass
120VAC Neutral 60Hz	0.42	51.42	79	-27.58	Pass	34.44	66	-31.56	Pass
120VAC Neutral 60Hz	0.455	46.93	79	-32.07	Pass	29.56	66	-36.44	Pass
120VAC Neutral 60Hz	1.35	44.87	73	-28.13	Pass	36.44	60	-23.56	Pass

**Table 9. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)**



**Plot 2. Conducted Emission, Neutral Line Plot**

## Conducted Emission Limits Test Setup



Photograph 2. Conducted Emissions, Test Setup

## Radiated Emission Limits

### § 15.109 Radiated Emissions Limits

**Test Requirement(s):** **15.109 (a)** Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the Class B limits expressed in Table 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 (dB $\mu$ V/m)	
	§15.109 (b), Class A Limit (dB $\mu$ V) @ 10m	§15.109 (a), Class B Limit (dB $\mu$ V) @ 3m
30 - 88	39.00	40.00
88 - 216	43.50	43.50
216 - 960	46.40	46.00
Above 960	49.50	54.00

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

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

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

**Test Engineer(s):** Lionel Gabrillo

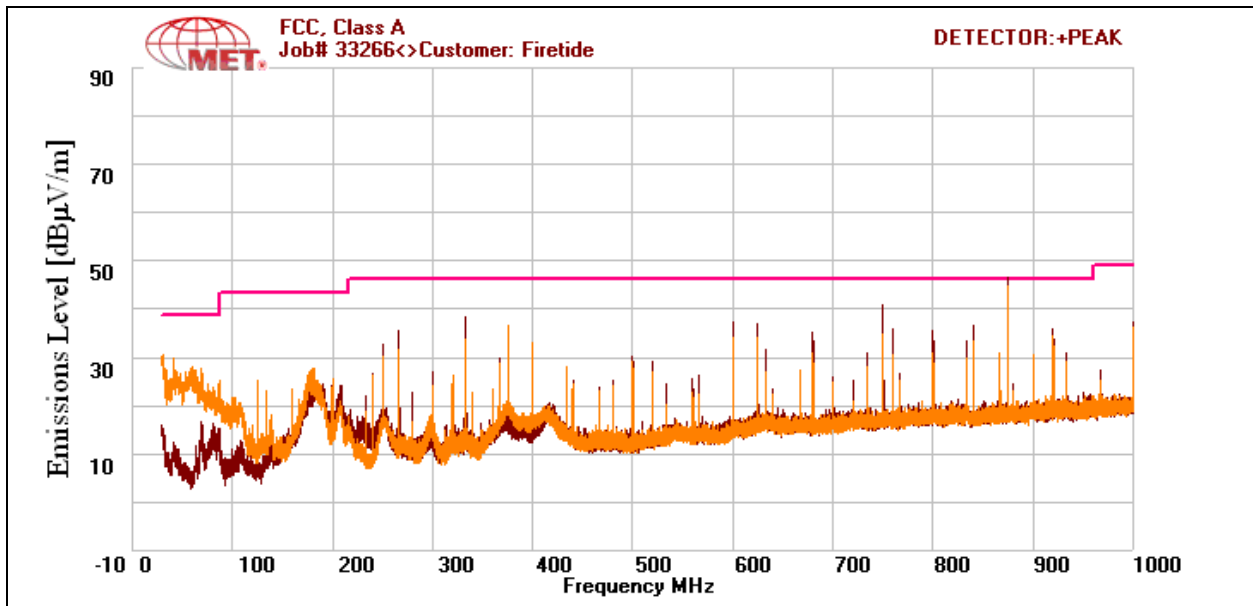
**Test Date(s):** 11/23/11



### Radiated Emissions Limits Test Results, Class A

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV)	Limit (dBuV)	Margin (dB)
875	V	203.0	108.23	28.46	20.1	0	6.455	-10.46	44.555	46.4	-1.845
875	H	33.0	120.41	29.32	20.1	0	6.455	-10.46	45.415	46.4	-0.984
750	H	6.0	158.29	27.54	19.3	0	5.985	-10.46	42.365	46.4	-4.035
333.32	H	209.0	100.76	31.44	13.766	0	3.763	-10.46	38.509	46.4	-7.891
625	H	186.0	171.94	23.46	19.2	0	5.32	-10.46	37.52	46.4	-8.88
45.28	V	266.0	100.0	13.07	10.132	0	1.685	-10.46	14.427	39	-24.573

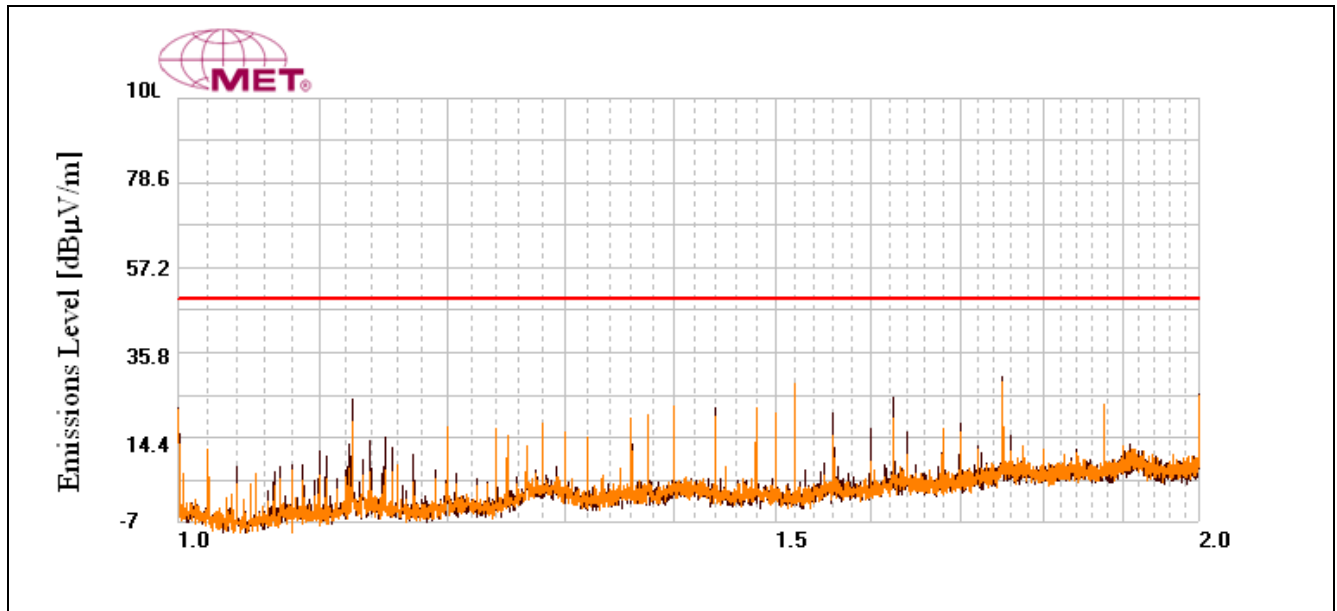
Table 11. Radiated Emissions Limits, Test Results, 30 MHz – 1 GHz, FCC Limits



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

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV)	Limit (dBuV)	Margin (dB)
1750	H	224.0	101.0	78.57	29.307	75.575	9.73	-10.46	31.572	49.5	-17.928
1520	V	257.0	102.94	86.14	28.396	75.856	9.086	-10.46	37.306	49.5	-12.194

Table 12. Radiated Emissions Limits, Test Results, 1 GHz – 2 GHz, FCC Limits

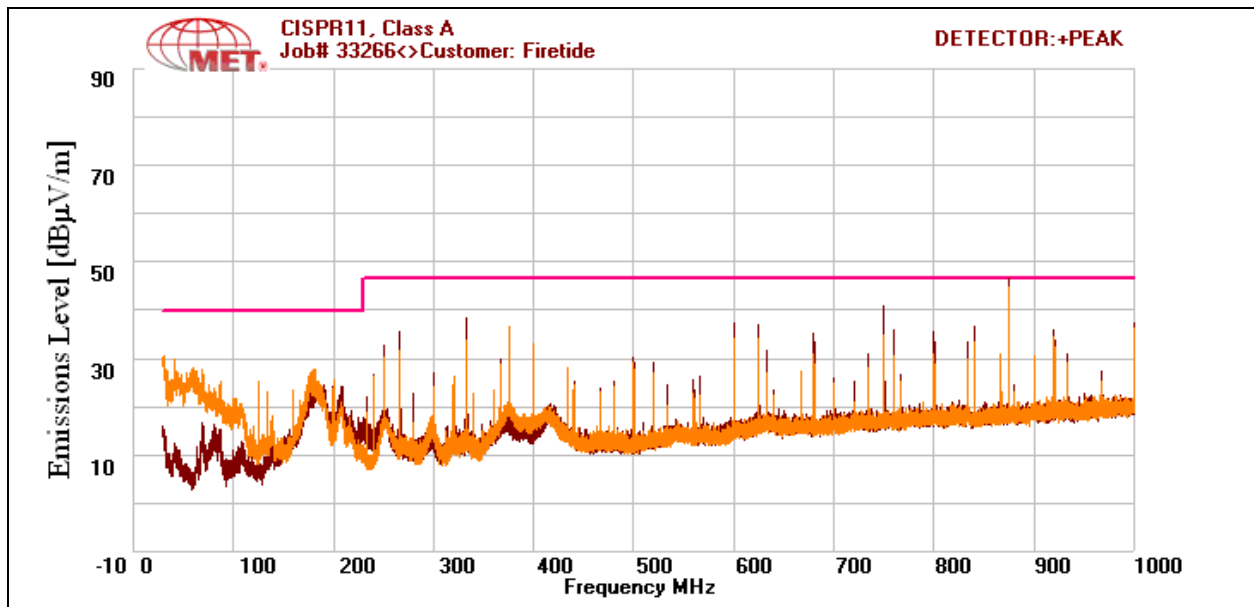


Plot 4. Radiated Emissions, 1 GHz - 2 GHz, FCC Limits

### Radiated Emissions Limits Test Results, Class A

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV)	Limit (dBuV)	Margin (dB)
875	V	203.0	108.23	28.46	20.1	0	6.455	-10.46	44.555	47	-2.445
875	H	33.0	120.41	29.32	20.1	0	6.455	-10.46	45.415	47	-1.585
750	H	6.0	158.29	27.54	19.3	0	5.985	-10.46	42.365	47	-4.635
333.32	H	209.0	100.76	31.44	13.766	0	3.763	-10.46	38.509	47	-8.491
625	H	186.0	171.94	23.46	19.2	0	5.32	-10.46	37.52	47	-9.48
45.28	V	266.0	100.0	13.07	10.132	0	1.685	-10.46	14.427	40	-25.573

Table 13. Radiated Emissions Limits, Test Results, ICES-003 Limits



Plot 5. Radiated Emissions, ICES-003 Limits

## Radiated Emission Limits Test Setup



Photograph 3. Radiated Emission, 30MHz – 1GHz, Test Setup



Photograph 4. Radiated Emission, 1GHz – 2GHz, Test Setup

## **IV. Electromagnetic Compatibility Criteria for Intentional Radiators**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.203 Antenna Requirement

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

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

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

**Results:** The EUT as tested is compliant the criteria of §15.203. The device is professionally installed.

**Test Engineer(s):** Anderson Soungpanya

**Test Date(s):** 11/07/11

Gain	Type	Model	Manufacturer
9dBi	Omni	MA-WO55-MIMONHFT9	Mars Antennas
15 dBi	Sector	MA-WE55-MIMOFT15	Mars Antennas
16 dBi	Panel	MA-WD56-DSV16	Mars Antennas

**Table 14. Antenna List**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207 Conducted Emissions Limits

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

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

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

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

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

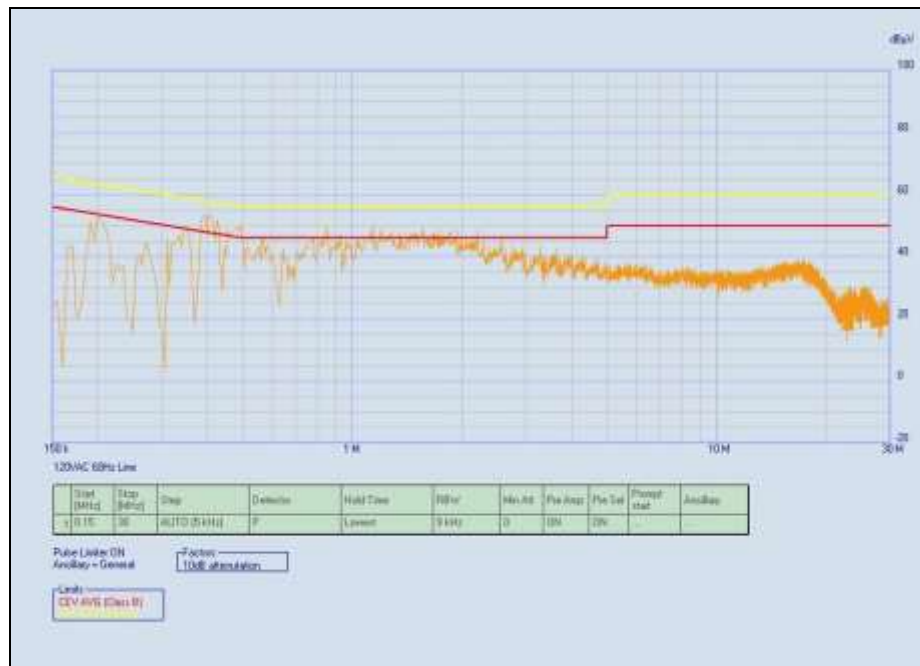
**Test Engineer(s):** Anderson Soungpanya

**Test Date(s):** 11/10/11

### 15.207(a) Conducted Emissions Test Results, 5.8 GHz

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
120VAC Line 60Hz	.200	49.89	63.617	-13.727	Pass	39.77	53.617	-13.847	Pass
120VAC Line 60Hz	.405	50.8	57.773	-6.973	Pass	35.55	47.773	-12.223	Pass
120VAC Line 60Hz	.495	47.14	56.086	-8.946	Pass	29.44	46.086	-16.646	Pass
120VAC Line 60Hz	.855	46.06	56	-9.94	Pass	29.65	46	-16.35	Pass
120VAC Line 60Hz	.925	43.88	56	-12.12	Pass	29.36	46	-16.64	Pass
120VAC Line 60Hz	1.14	46.4	56	-9.6	Pass	29.96	46	-16.04	Pass
120VAC Line 60Hz	1.20	43.73	56	-12.27	Pass	29.48	46	-16.52	Pass
120VAC Line 60Hz	1.57	46.42	56	-9.58	Pass	33.71	46	-12.29	Pass
120VAC Line 60Hz	2.21	44.22	56	-11.78	Pass	33.24	46	-12.76	Pass
120VAC Line 60Hz	2.56	42.54	56	-13.46	Pass	33.66	46	-12.34	Pass

Table 16. Conducted Emissions, 15.207(a), Phase Line, Test Results, 5.8 GHz



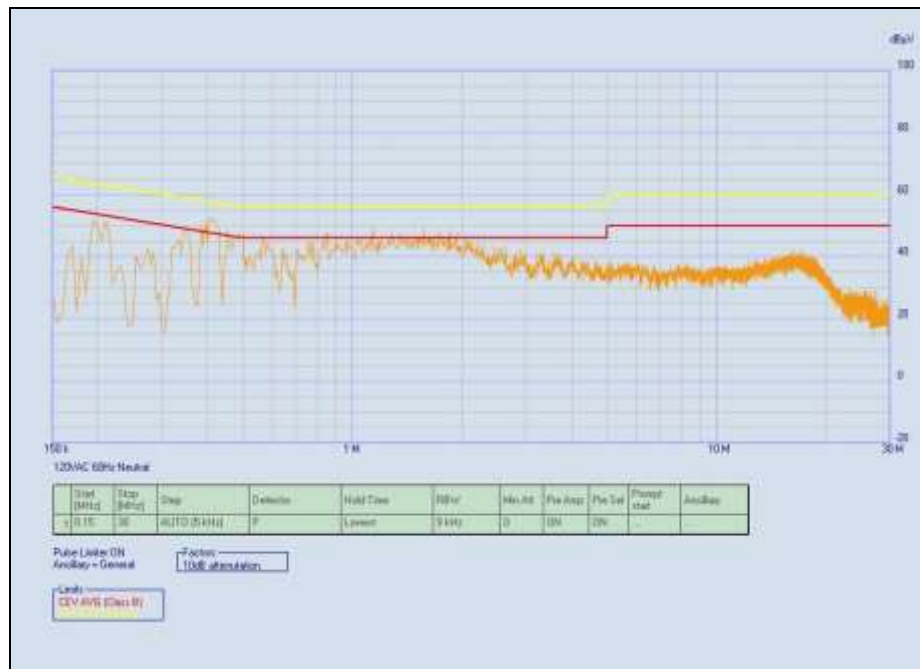
Plot 6. Conducted Emissions, 15.207(a), Phase Line, 5.8 GHz



### 15.207(a) Conducted Emissions Test Results, 5.8 GHz

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
120VAC Neutral 60Hz	.195	49.23	63.827	-14.597	Pass	35.66	53.827	-18.167	Pass
120VAC Neutral 60Hz	.210	48.59	63.213	-14.623	Pass	36.21	53.213	-17.003	Pass
120VAC Neutral 60Hz	.350	46.4	58.982	-12.582	Pass	30.12	48.982	-18.862	Pass
120VAC Neutral 60Hz	.410	49.66	57.671	-8.011	Pass	34.09	47.671	-13.581	Pass
120VAC Neutral 60Hz	.570	42.55	56	-13.45	Pass	23.56	46	-22.44	Pass
120VAC Neutral 60Hz	1.14	45.3	56	-10.7	Pass	28.61	46	-17.39	Pass
120VAC Neutral 60Hz	1.57	45.56	56	-10.44	Pass	32.12	46	-13.88	Pass
120VAC Neutral 60Hz	1.85	44.99	56	-11.01	Pass	34.67	46	-11.33	Pass

Table 17. Conducted Emissions, 15.207(a), Neutral Line, Test Results, 5.8 GHz



Plot 7. Conducted Emissions, 15.207(a), Neutral Line, 5.8 GHz

### 15.207(a) Conducted Emissions Test Setup



**Photograph 5. Conducted Emissions, 15.207(a), Test Setup**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.403(c) 26dB Bandwidth

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

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

**Test Results** The 26 dB Bandwidth was compliant with the requirements of this section and was determined from the plots on the following pages.

**Test Engineer(s):** Lionel Gabrillo

**Test Date(s):** 11/02/11

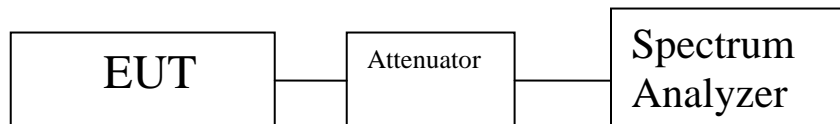


Figure 2. Occupied Bandwidth, Test Setup

Mode	Channel	Frequency	26 dB Bandwidth (MHz)
802.11a	Low	5745	18.866
	Mid	5785	19.131
	High	5805	19.135
802.11n 5 MHz Port 1	Low	5745	4.770
	Mid	5785	4.808
	High	5805	4.862
802.11n 5 MHz Port 2	Low	5745	4.788
	Mid	5785	5.689
	High	5805	4.859
802.11n 5 MHz Port 3	Low	5745	4.948
	Mid	5785	4.808
	High	5805	5.582
802.11n 10 MHz Port 1	Low	5745	9.598
	Mid	5785	9.623
	High	5805	9.657
802.11n 10 MHz Port 2	Low	5745	9.645
	Mid	5785	10.468
	High	5805	9.643
802.11n 10 MHz Port 3	Low	5745	9.860
	Mid	5785	9.777
	High	5805	9.852
802.11n 20 MHz Port 1	Low	5745	20.272
	Mid	5785	20.335
	High	5805	20.234
802.11n 20 MHz Port 2	Low	5745	24.475
	Mid	5785	23.147
	High	5805	20.225
802.11n 20 MHz Port 3	Low	5745	20.182
	Mid	5785	19.939
	High	5805	20.064
802.11n 40 MHz Port 1	Low	5755	42.485
	High	5795	42.198
802.11n 40 MHz Port 2	Low	5755	41.880
	High	5795	41.816
802.11n 40 MHz Port 3	Low	5755	41.611
	High	5795	41.594

**Table 18. 26 dB Occupied Bandwidth, Test Results**

Mode	Channel	Frequency	99% Bandwidth (MHz)
802.11a	Low	5745	16.3852
	Mid	5785	16.4171
	High	5805	16.3377
802.11n 5 MHz Port 1	Low	5745	4.1250
	Mid	5785	4.1258
	High	5805	4.1480
802.11n 5 MHz Port 2	Low	5745	4.1460
	Mid	5785	4.1377
	High	5805	4.1333
802.11n 5 MHz Port 3	Low	5745	4.1320
	Mid	5785	4.1390
	High	5805	4.1346
802.11n 10 MHz Port 1	Low	5745	8.2288
	Mid	5785	8.2083
	High	5805	8.2064
802.11n 10 MHz Port 2	Low	5745	8.2380
	Mid	5785	8.2321
	High	5805	8.2450
802.11n 10 MHz Port 3	Low	5745	8.2612
	Mid	5785	8.2061
	High	5805	8.2424
802.11n 20 MHz Port 1	Low	5745	17.6210
	Mid	5785	17.5993
	High	5805	17.6806
802.11n 20 MHz Port 2	Low	5745	17.6826
	Mid	5785	17.5574
	High	5805	17.6039
802.11n 20 MHz Port 3	Low	5745	17.5965
	Mid	5785	17.4794
	High	5805	17.6374
802.11n 40 MHz Port 1	Low	5755	36.3262
	High	5795	36.2227
802.11n 40 MHz Port 2	Low	5755	36.6902
	High	5795	36.5990
802.11n 40 MHz Port 3	Low	5755	36.5266
	High	5795	36.5303

**Table 19. 99% Occupied Bandwidth, Test Results**

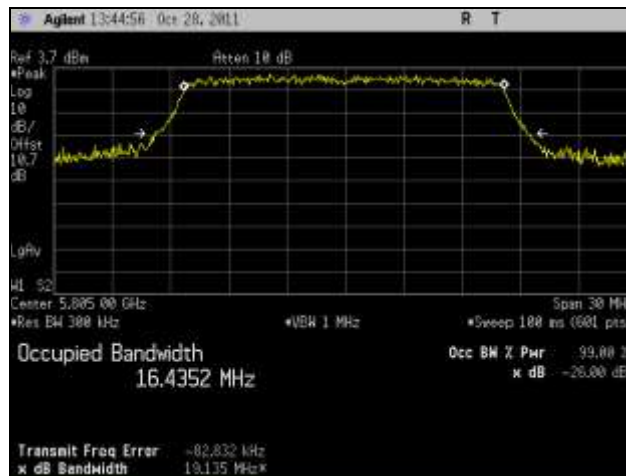
**26 dB Occupied Bandwidth, 802.11a**



**Plot 8. 26 dB Occupied Bandwidth, Low Channel, 802.11a**

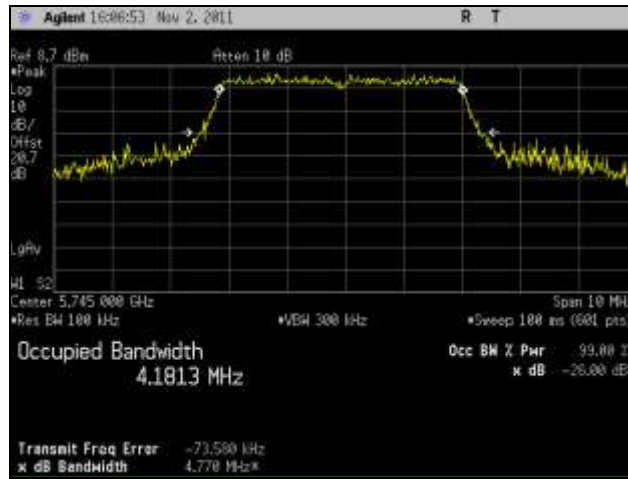


**Plot 9. 26 dB Occupied Bandwidth, Mid Channel, 802.11a**



**Plot 10. 26 dB Occupied Bandwidth, High Channel, 802.11a**

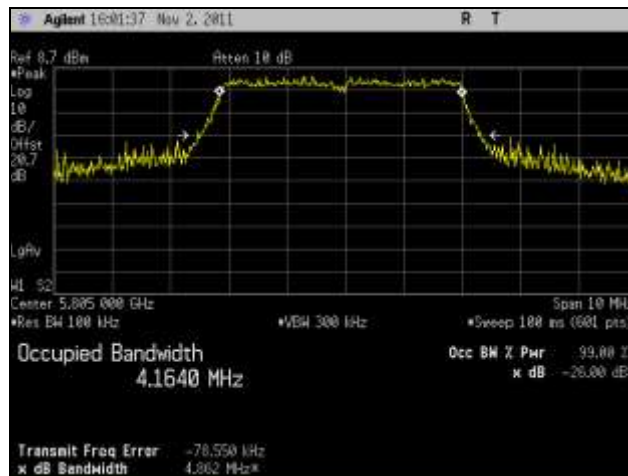
**26 dB Occupied Bandwidth, 802.11n 5 MHz, Port 1**



**Plot 11. 26 dB Occupied Bandwidth, Low Channel, 802.11n 5 MHz, Port 1**

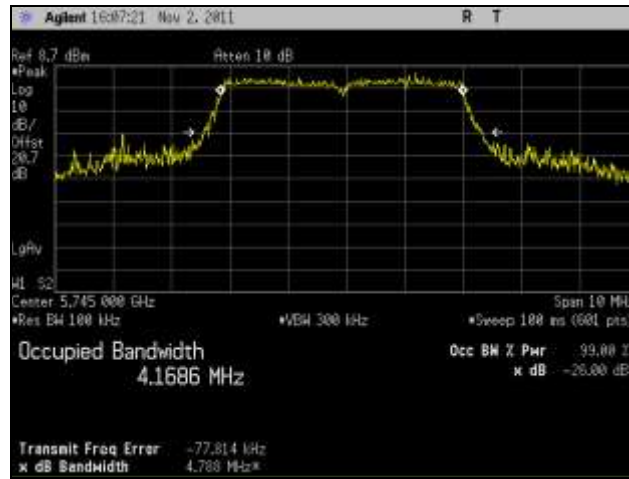


**Plot 12. 26 dB Occupied Bandwidth, Mid Channel, 802.11n 5 MHz, Port 1**

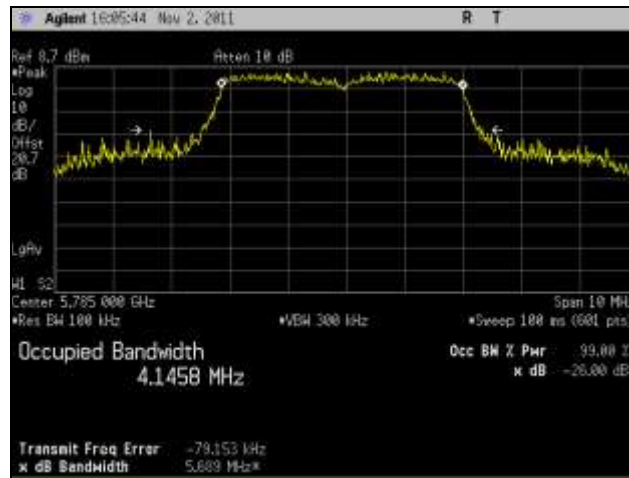


**Plot 13. 26 dB Occupied Bandwidth, High Channel, 802.11n 5 MHz, Port 1**

**26 dB Occupied Bandwidth, 802.11n 5 MHz, Port 2**



**Plot 14. 26 dB Occupied Bandwidth, Low Channel, 802.11n 5 MHz, Port 2**



**Plot 15. 26 dB Occupied Bandwidth, Mid Channel, 802.11n 5 MHz, Port 2**



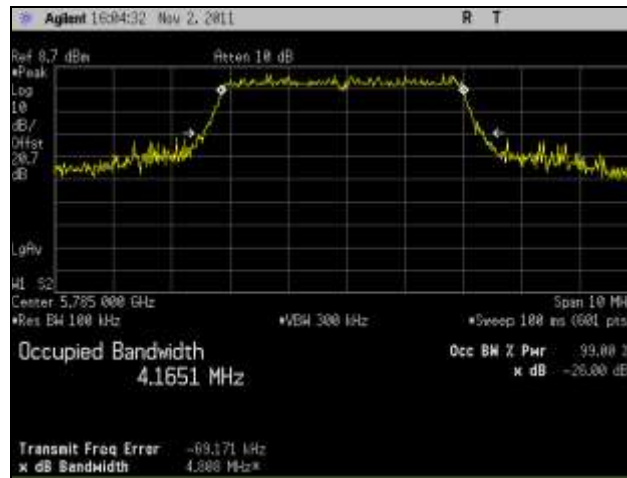
**Plot 16. 26 dB Occupied Bandwidth, High Channel, 802.11n 5 MHz, Port 2**



**26 dB Occupied Bandwidth, 802.11n 5 MHz, Port 3**



**Plot 17. 26 dB Occupied Bandwidth, Low Channel, 802.11n 5 MHz, Port 3**



**Plot 18. 26 dB Occupied Bandwidth, Mid Channel, 802.11n 5 MHz, Port 3**



**Plot 19. 26 dB Occupied Bandwidth, High Channel, 802.11n 5 MHz, Port 3**

**26 dB Occupied Bandwidth, 802.11n 10 MHz, Port 1**



**Plot 20. 26 dB Occupied Bandwidth, Low Channel, 802.11n 10 MHz, Port 1**



**Plot 21. 26 dB Occupied Bandwidth, Mid Channel, 802.11n 10 MHz, Port 1**



**Plot 22. 26 dB Occupied Bandwidth, High Channel, 802.11n 10 MHz, Port 1**

**26 dB Occupied Bandwidth, 802.11n 10 MHz, Port 2**



**Plot 23. 26 dB Occupied Bandwidth, Low Channel, 802.11n 10 MHz, Port 2**

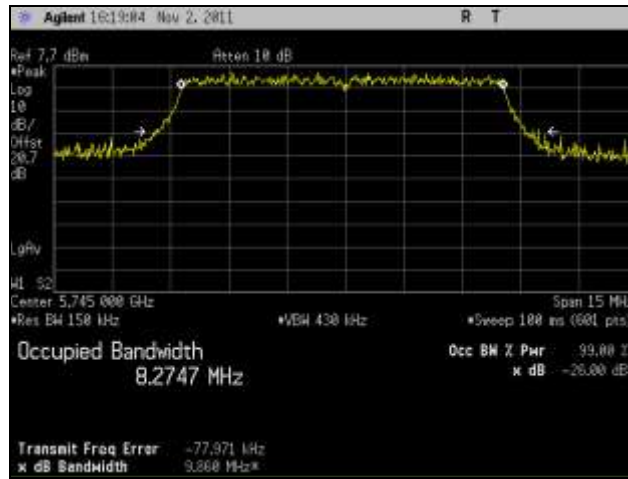


**Plot 24. 26 dB Occupied Bandwidth, Mid Channel, 802.11n 10 MHz, Port 2**

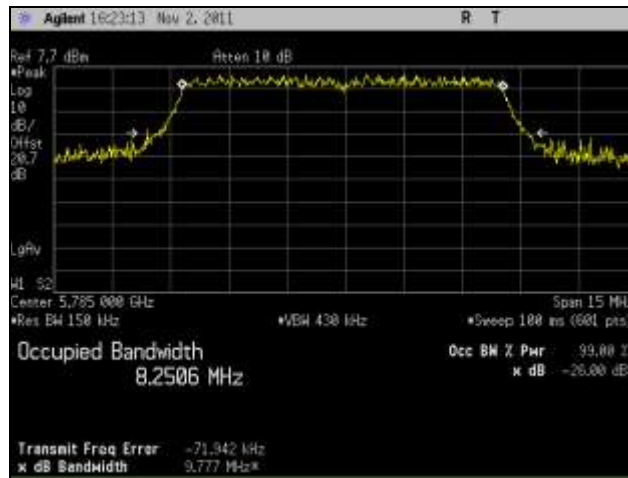


**Plot 25. 26 dB Occupied Bandwidth, High Channel, 802.11n 10 MHz, Port 2**

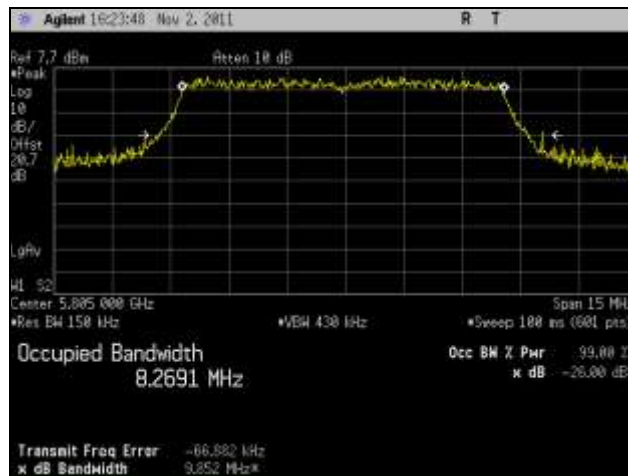
**26 dB Occupied Bandwidth, 802.11n 10 MHz, Port 3**



**Plot 26. 26 dB Occupied Bandwidth, Low Channel, 802.11n 10 MHz, Port 3**



**Plot 27. 26 dB Occupied Bandwidth, Mid Channel, 802.11n 10 MHz, Port 3**



**Plot 28. 26 dB Occupied Bandwidth, High Channel, 802.11n 10 MHz, Port 3**

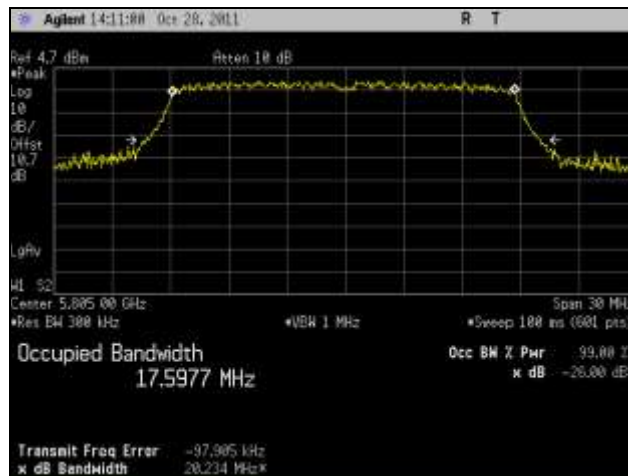
**26 dB Occupied Bandwidth, 802.11n 20 MHz, Port 1**



**Plot 29. 26 dB Occupied Bandwidth, Low Channel, 802.11n 20 MHz, Port 1**



**Plot 30. 26 dB Occupied Bandwidth, Mid Channel, 802.11n 20 MHz, Port 1**

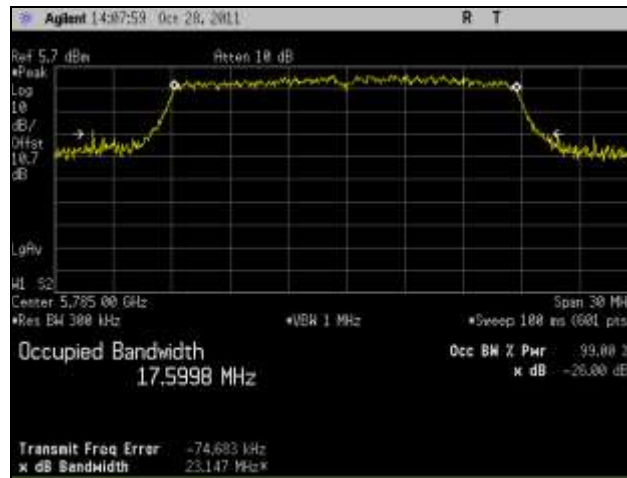


**Plot 31. 26 dB Occupied Bandwidth, High Channel, 802.11n 20 MHz, Port 1**

**26 dB Occupied Bandwidth, 802.11n 20 MHz, Port 2**



**Plot 32. 26 dB Occupied Bandwidth, Low Channel, 802.11n 20 MHz, Port 2**



**Plot 33. 26 dB Occupied Bandwidth, Mid Channel, 802.11n 20 MHz, Port 2**



**Plot 34. 26 dB Occupied Bandwidth, High Channel, 802.11n 20 MHz, Port 2**

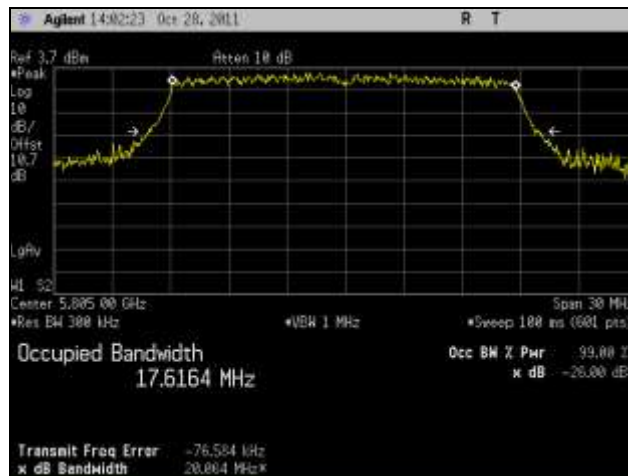
**26 dB Occupied Bandwidth, 802.11n 20 MHz, Port 3**



**Plot 35. 26 dB Occupied Bandwidth, Low Channel, 802.11n 20 MHz, Port 3**



**Plot 36. 26 dB Occupied Bandwidth, Mid Channel, 802.11n 20 MHz, Port 3**



**Plot 37. 26 dB Occupied Bandwidth, High Channel, 802.11n 20 MHz, Port 3**

**26 dB Occupied Bandwidth, 802.11n 40 MHz, Port 1**



**Plot 38. 26 dB Occupied Bandwidth, Low Channel, 802.11n 40 MHz, Port 1**



**Plot 39. 26 dB Occupied Bandwidth, High Channel, 802.11n 40 MHz, Port 1**



**26 dB Occupied Bandwidth, 802.11n 40 MHz, Port 2**



**Plot 40. 26 dB Occupied Bandwidth, Low Channel, 802.11n 40 MHz, Port 2**



**Plot 41. 26 dB Occupied Bandwidth, High Channel, 802.11n 40 MHz, Port 2**

**26 dB Occupied Bandwidth, 802.11n 40 MHz, Port 3**



**Plot 42. 26 dB Occupied Bandwidth, Low Channel, 802.11n 40 MHz, Port 3**

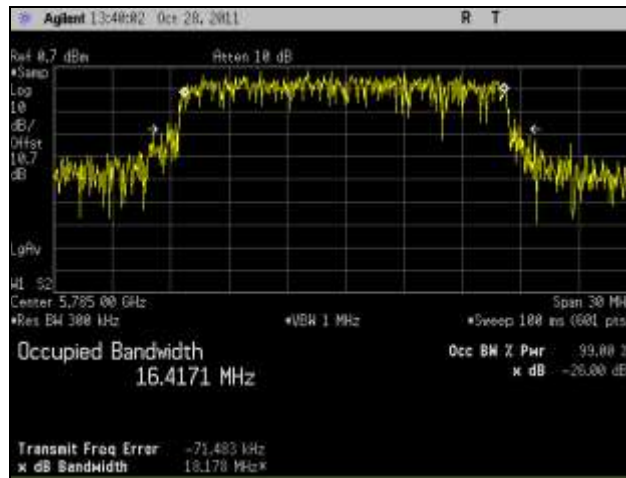


**Plot 43. 26 dB Occupied Bandwidth, High Channel, 802.11n 40 MHz, Port 3**

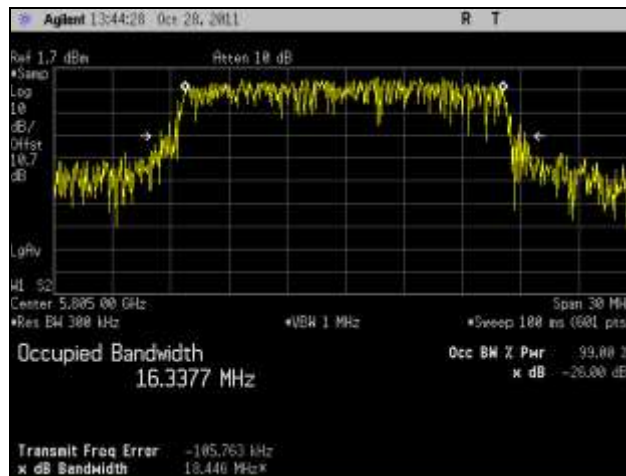
### 99% Occupied Bandwidth, 802.11a



Plot 44. 99% Occupied Bandwidth, Low Channel, 802.11a



Plot 45. 99% Occupied Bandwidth, Mid Channel, 802.11a

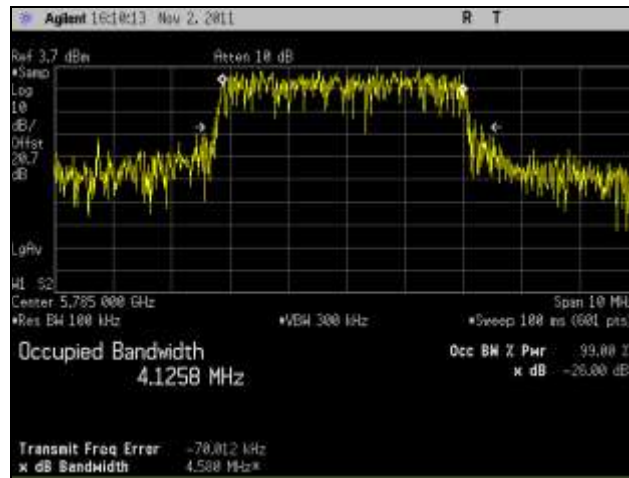


Plot 46. 99% Occupied Bandwidth, High Channel, 802.11a

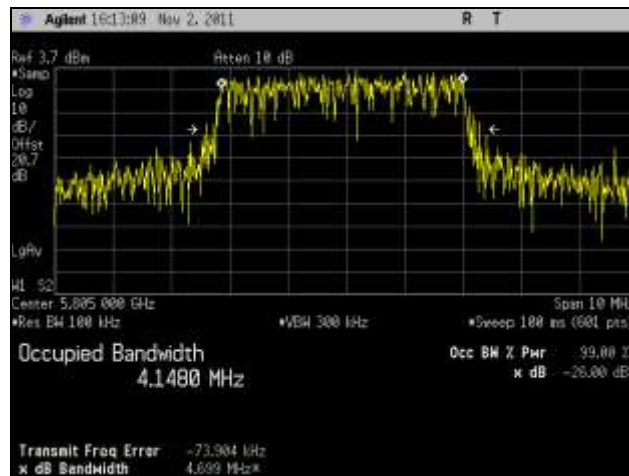
**99% Occupied Bandwidth, 802.11n 5 MHz, Port 1**



**Plot 47. 99% Occupied Bandwidth, Low Channel, 802.11n 5 MHz, Port 1**



**Plot 48. 99% Occupied Bandwidth, Mid Channel, 802.11n 5 MHz, Port 1**

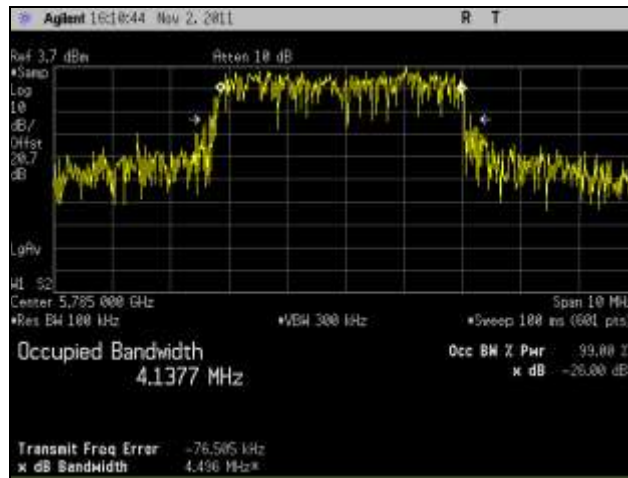


**Plot 49. 99% Occupied Bandwidth, High Channel, 802.11n 5 MHz, Port 1**

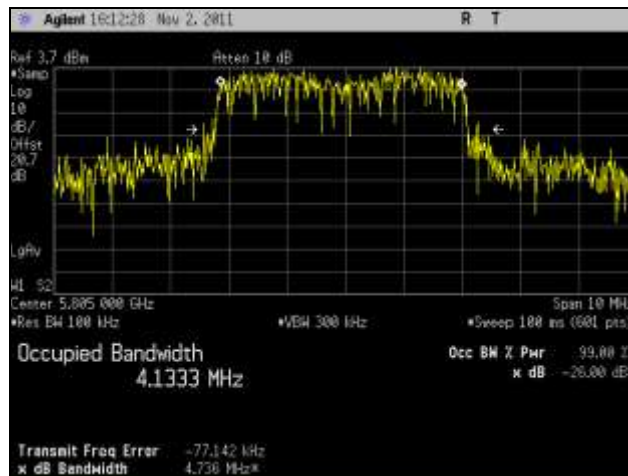
**99% Occupied Bandwidth, 802.11n 5 MHz, Port 2**



Plot 50. 99% Occupied Bandwidth, Low Channel, 802.11n 5 MHz, Port 2

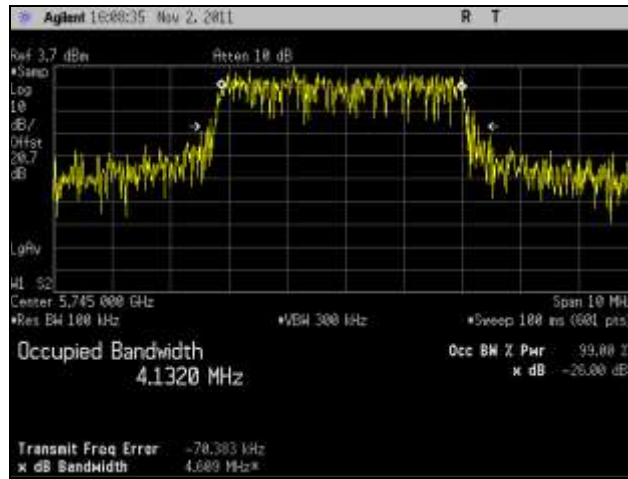


Plot 51. 99% Occupied Bandwidth, Mid Channel, 802.11n 5 MHz, Port 2

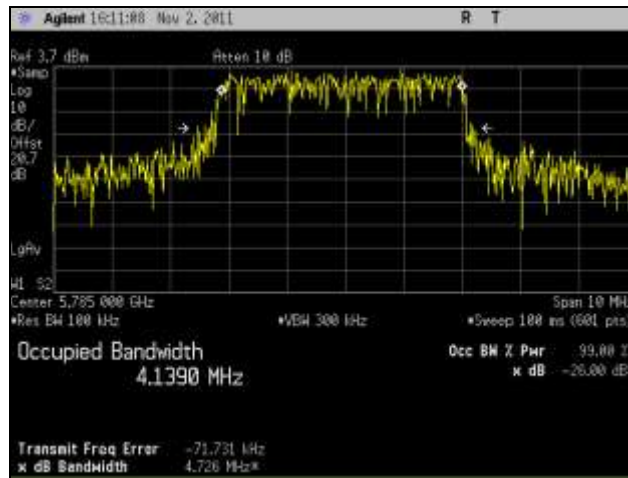


Plot 52. 99% Occupied Bandwidth, High Channel, 802.11n 5 MHz, Port 2

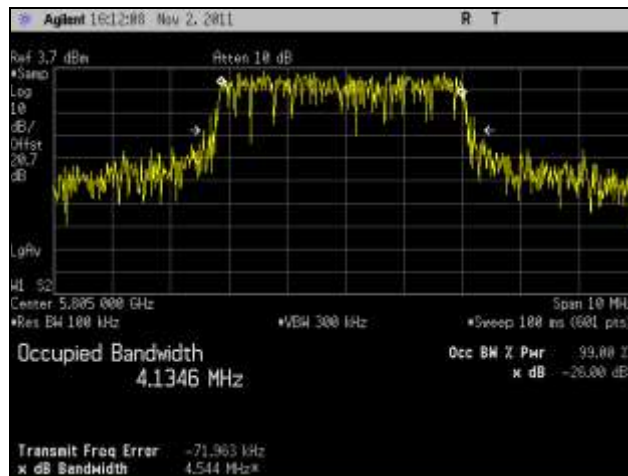
**99% Occupied Bandwidth, 802.11n 5 MHz, Port 3**



Plot 53. 99% Occupied Bandwidth, Low Channel, 802.11n 5 MHz, Port 3



Plot 54. 99% Occupied Bandwidth, Mid Channel, 802.11n 5 MHz, Port 3



Plot 55. 99% Occupied Bandwidth, High Channel, 802.11n 5 MHz, Port 3

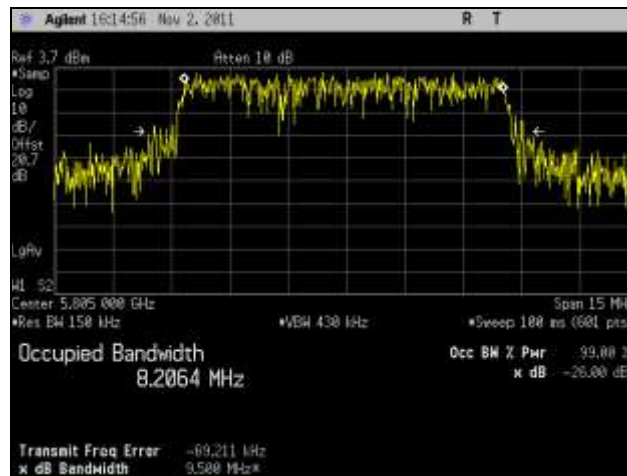
**99% Occupied Bandwidth, 802.11n 10 MHz, Port 1**



**Plot 56. 99% Occupied Bandwidth, Low Channel, 802.11n 10 MHz, Port 1**



**Plot 57. 99% Occupied Bandwidth, Mid Channel, 802.11n 10 MHz, Port 1**

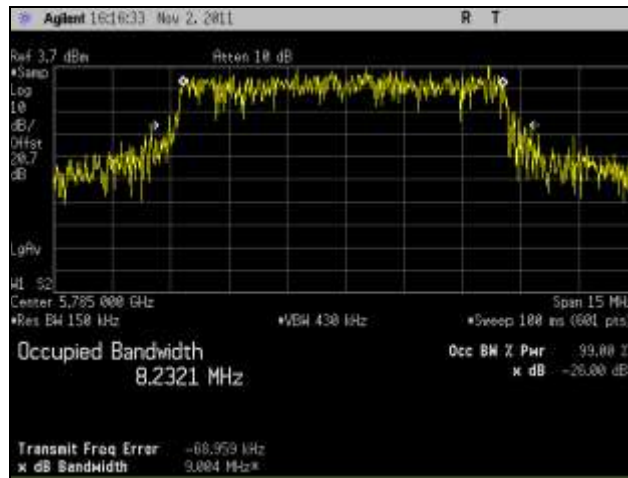


**Plot 58. 99% Occupied Bandwidth, High Channel, 802.11n 10 MHz, Port 1**

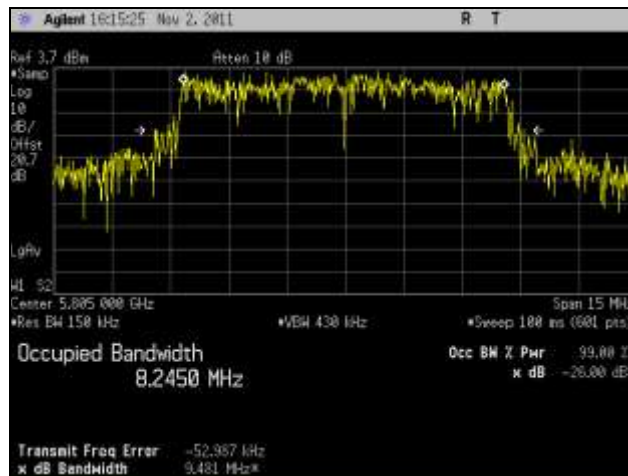
**99% Occupied Bandwidth, 802.11n 10 MHz, Port 2**



**Plot 59. 99% Occupied Bandwidth, Low Channel, 802.11n 10 MHz, Port 2**



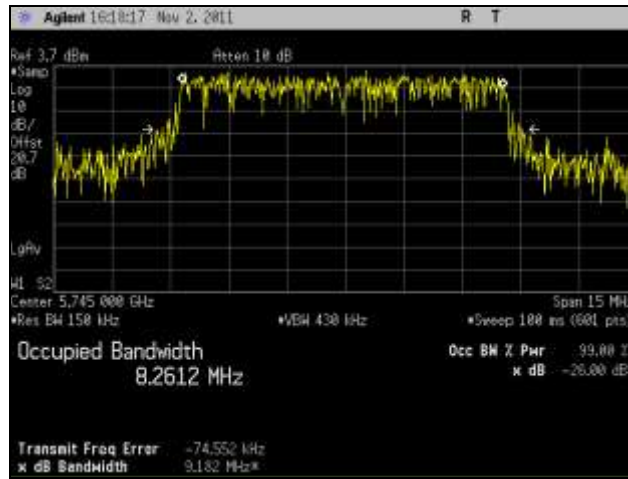
**Plot 60. 99% Occupied Bandwidth, Mid Channel, 802.11n 10 MHz, Port 2**



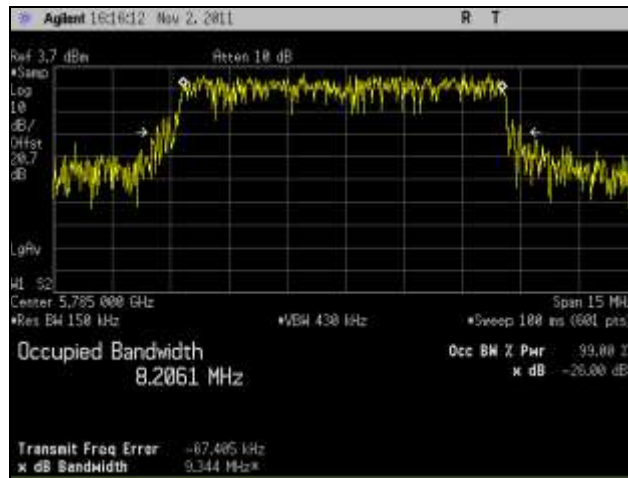
**Plot 61. 99% Occupied Bandwidth, High Channel, 802.11n 10 MHz, Port 2**



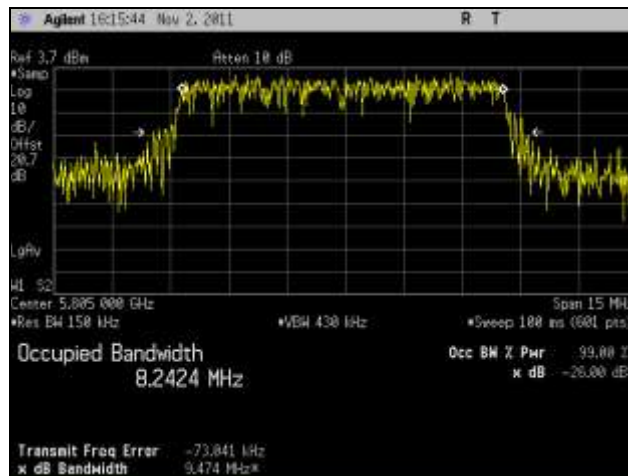
**99% Occupied Bandwidth, 802.11n 10 MHz, Port 3**



**Plot 62. 99% Occupied Bandwidth, Low Channel, 802.11n 10 MHz, Port 3**



**Plot 63. 99% Occupied Bandwidth, Mid Channel, 802.11n 10 MHz, Port 3**



**Plot 64. 99% Occupied Bandwidth, High Channel, 802.11n 10 MHz, Port 3**

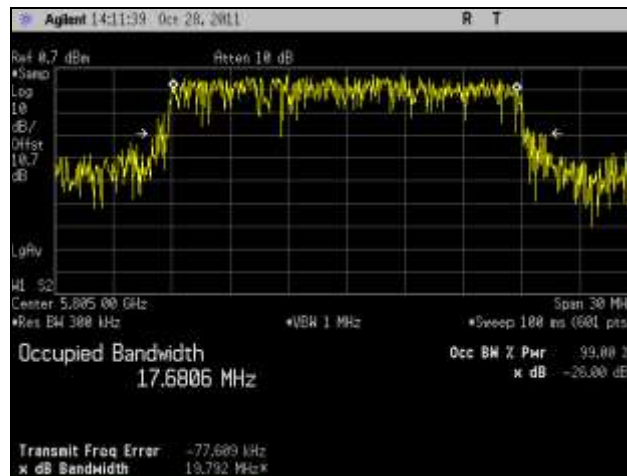
**99% Occupied Bandwidth, 802.11n 20 MHz, Port 1**



**Plot 65. 99% Occupied Bandwidth, Low Channel, 802.11n 20 MHz, Port 1**



**Plot 66. 99% Occupied Bandwidth, Mid Channel, 802.11n 20 MHz, Port 1**



**Plot 67. 99% Occupied Bandwidth, High Channel, 802.11n 20 MHz, Port 1**

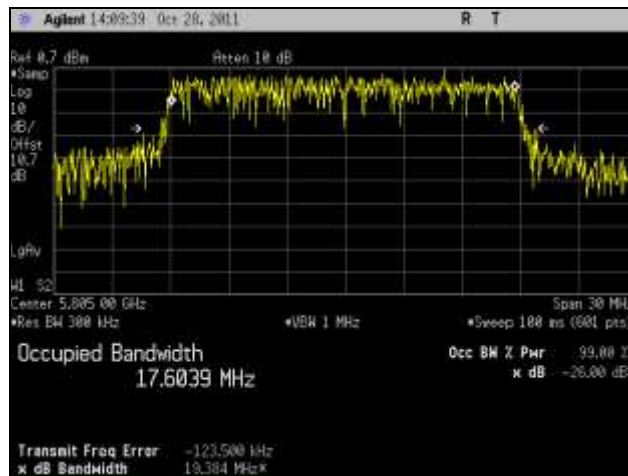
**99% Occupied Bandwidth, 802.11n 20 MHz, Port 2**



**Plot 68. 99% Occupied Bandwidth, Low Channel, 802.11n 20 MHz, Port 2**

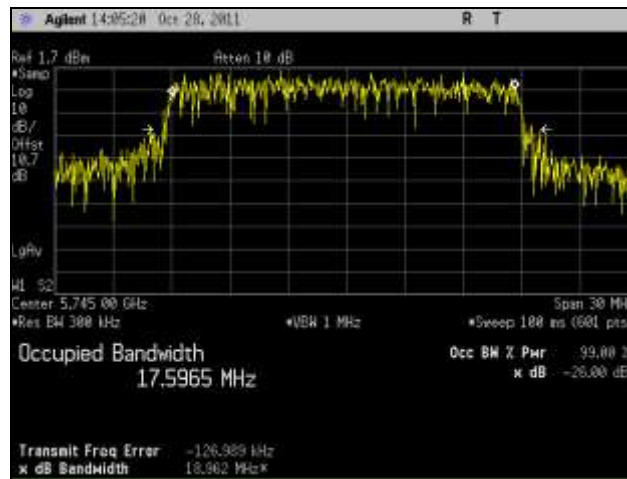


**Plot 69. 99% Occupied Bandwidth, Mid Channel, 802.11n 20 MHz, Port 2**

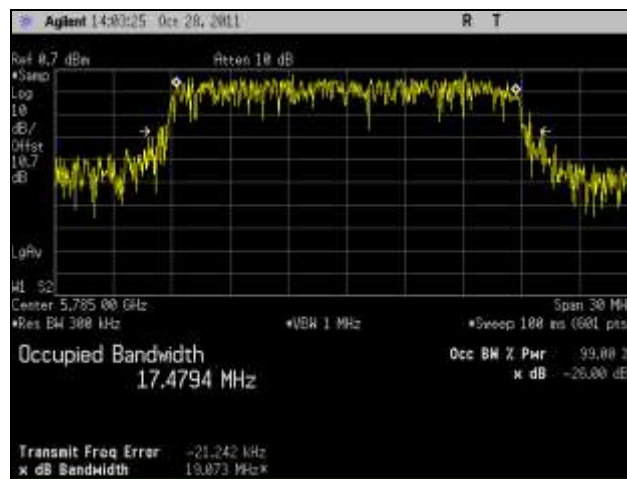


**Plot 70. 99% Occupied Bandwidth, High Channel, 802.11n 20 MHz, Port 2**

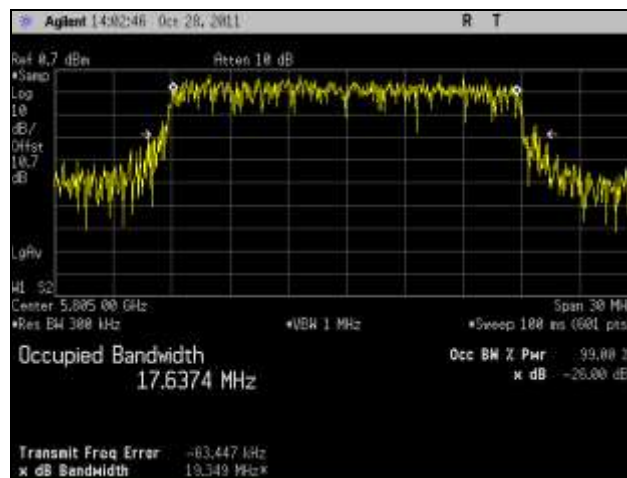
**99% Occupied Bandwidth, 802.11n 20 MHz, Port 3**



**Plot 71. 99% Occupied Bandwidth, Low Channel, 802.11n 20 MHz, Port 3**

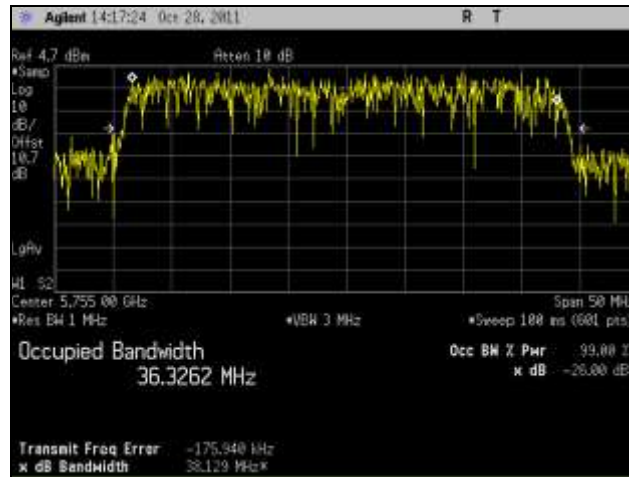


**Plot 72. 99% Occupied Bandwidth, Mid Channel, 802.11n 20 MHz, Port 3**

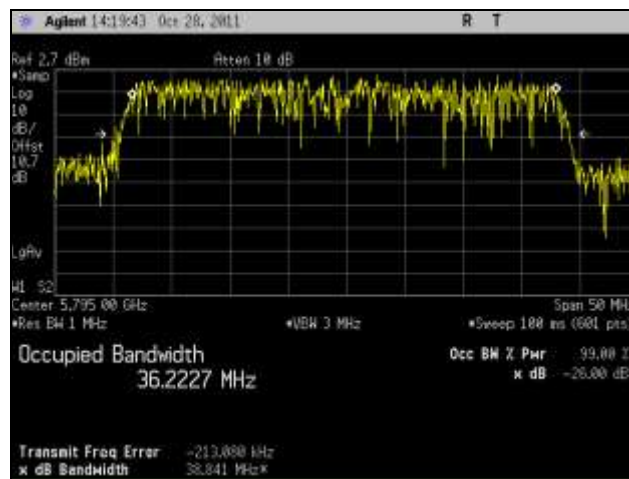


**Plot 73. 99% Occupied Bandwidth, High Channel, 802.11n 20 MHz, Port 3**

**99% Occupied Bandwidth, 802.11n 40 MHz, Port 1**

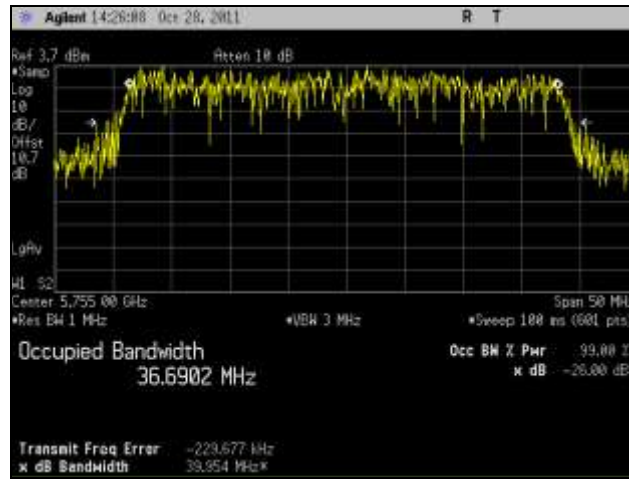


**Plot 74. 99% Occupied Bandwidth, Low Channel, 802.11n 40 MHz, Port 1**

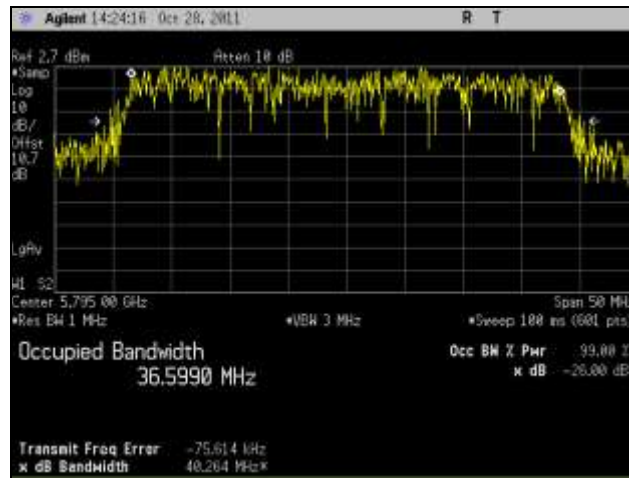


**Plot 75. 99% Occupied Bandwidth, High Channel, 802.11n 40 MHz, Port 1**

**99% Occupied Bandwidth, 802.11n 40 MHz, Port 2**

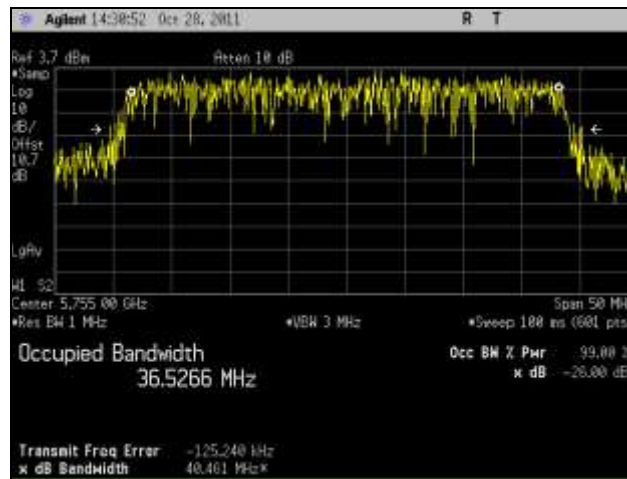


**Plot 76. 99% Occupied Bandwidth, Low Channel, 802.11n 40 MHz, Port 2**

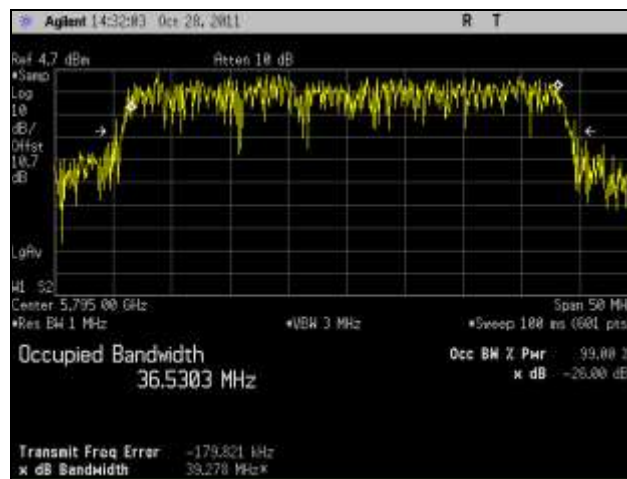


**Plot 77. 99% Occupied Bandwidth, High Channel, 802.11n 40 MHz, Port 2**

**99% Occupied Bandwidth, 802.11n 40 MHz, Port 3**



**Plot 78. 99% Occupied Bandwidth, Low Channel, 802.11n 40 MHz, Port 3**



**Plot 79. 99% Occupied Bandwidth, High Channel, 802.11n 40 MHz, Port 3**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15. 407(a)(2)(3) RF Power Output

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

§15.407(a) (2): For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10log B, where B is the 26 dB emission bandwidth in megahertz.

§15.407(a) (3): For the band 5.725-5.825 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 1 W or 17 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. In addition, the peak power spectral density shall not exceed 17 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain up to 23 dBi without an corresponding reduction in the transmitter peak output power or peak power spectral density. For fixed, point-to-point U-NII transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in peak transmitter power and peak power spectral density for each 1 dB of antenna gain in excess of 23 dBi would be required. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

Note to paragraph (a)(3): The Commission strongly recommends that parties employing U-NII devices to provide critical communications services should determine if there are any nearby Government radar systems that could affect their operation.

**Test Procedure:** The EUT was connected to a Spectrum Analyzer through a 20dB attenuator. The EUT was measured at the low, mid and high channels of each band at the maximum power level.

**Test Results:** Equipment was compliant with the Peak Power Output limits of § 15.401(a)(2).

**Test Engineer(s):** Lionel Gabrillo

**Test Date(s):** 12/19/11

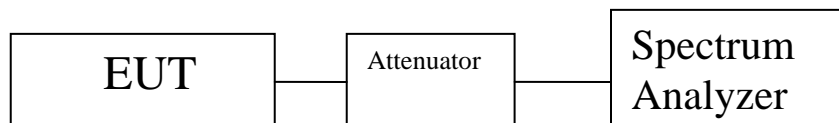


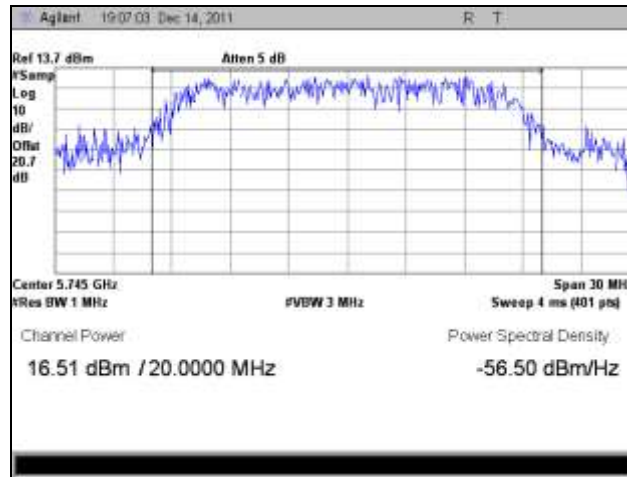
Figure 3. Power Output Test Setup



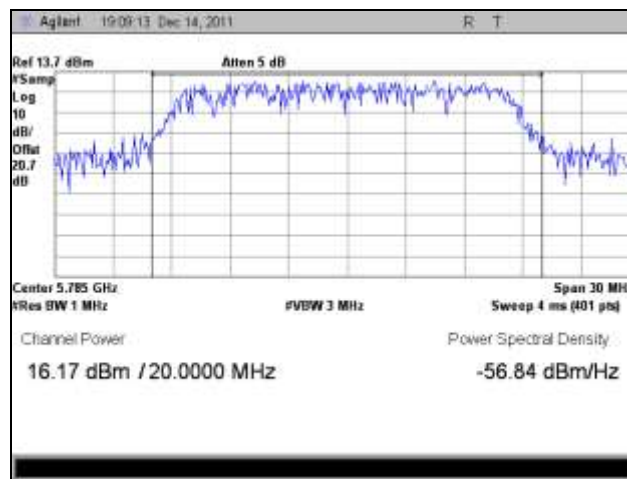
Mode	Channel	Frequency (MHz)	Conducted power (dBm) Port 1	Conducted power (dBm) Port 2	Conducted power (dBm) Port 3	Conducted power (dBm) Combined	Limit (dBm)
802.11a	Low	5745	16.51	--	--	--	26.82
	Mid	5785	16.17	--	--	--	26.82
	High	5805	15.97	--	--	--	26.82
802.11n 5 MHz	Low	5745	14.71	14.29	14.44	19.255	21.55
	Mid	5785	14.32	13.62	14.37	18.888	21.55
	High	5805	14.51	13.88	13.89	18.875	21.55
802.11n 10 MHz	Low	5745	10.97	13.37	12.81	17.270	24.20
	Mid	5785	11.55	13.73	10.38	16.885	24.20
	High	5805	10.13	13.61	12.17	16.968	24.20
802.11n 20 MHz	Low	5745	14.50	14.98	13.56	19.157	27.88
	Mid	5785	12.62	15.03	14.01	18.768	27.88
	High	5805	13.28	14.97	12.84	18.568	27.88
802.11n 40 MHz	Low	5755	14.25	16.86	14.75	20.211	30.00
	High	5795	13.52	15.94	13.07	19.140	30.00

**Table 20. RF Power Output, Test Results**

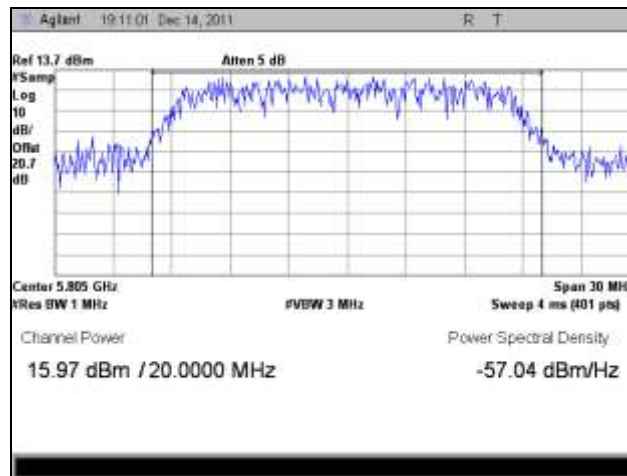
**RF Power Output, 802.11a**



**Plot 80. RF Power Output, Low Channel, 802.11a**

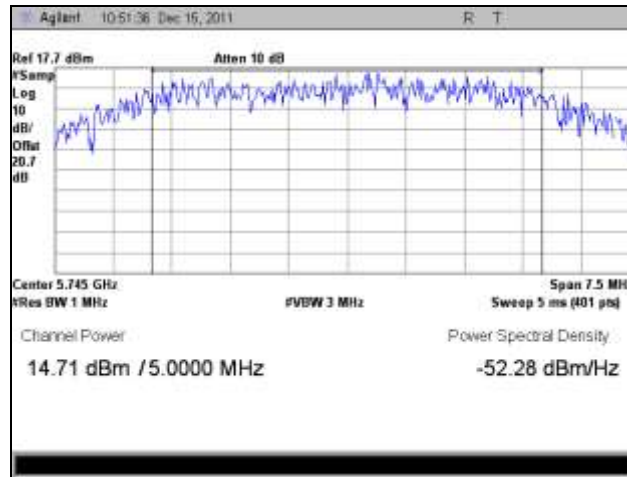


**Plot 81. RF Power Output, Mid Channel, 802.11a**

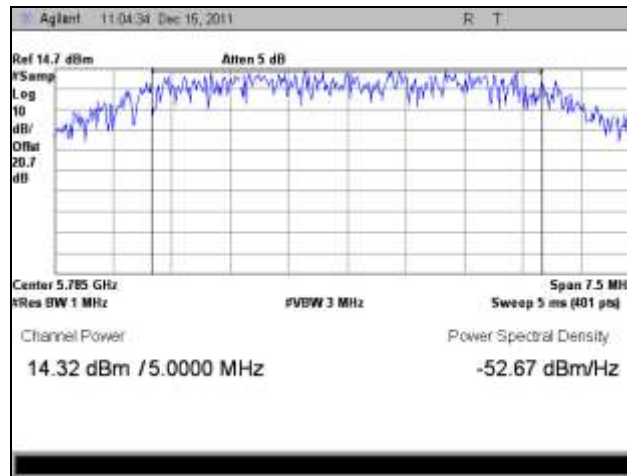


**Plot 82. RF Power Output, High Channel, 802.11a**

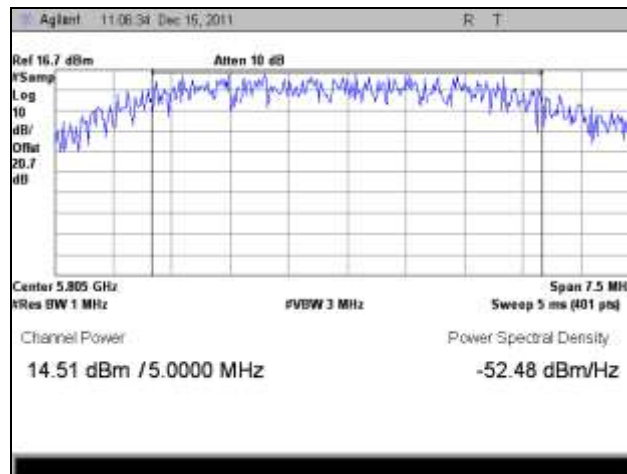
### RF Power Output, 802.11n 5 MHz Port 1



Plot 83. RF Power Output, Low Channel, 802.11n 5 MHz Port 1

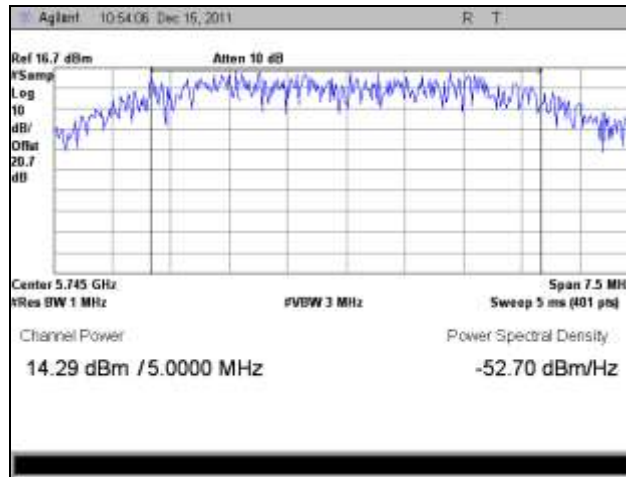


Plot 84. RF Power Output, Mid Channel, 802.11n 5 MHz Port 1

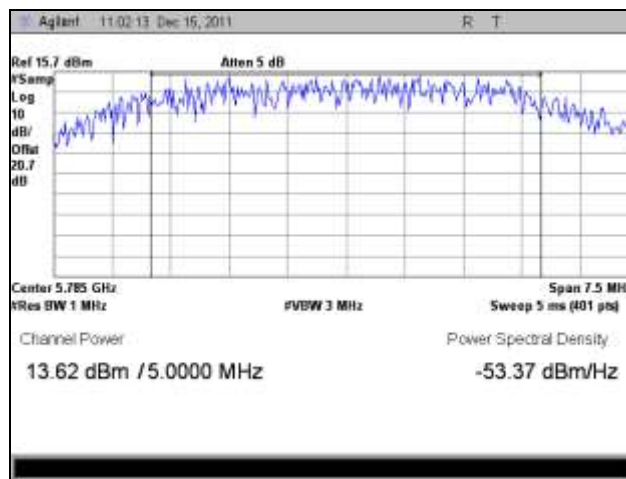


Plot 85. RF Power Output, High Channel, 802.11n 5 MHz Port 1

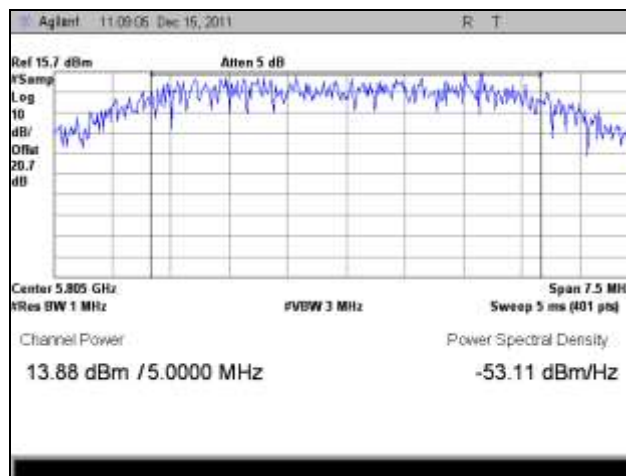
### RF Power Output, 802.11n 5 MHz Port 2



Plot 86. RF Power Output, Low Channel, 802.11n 5 MHz Port 2

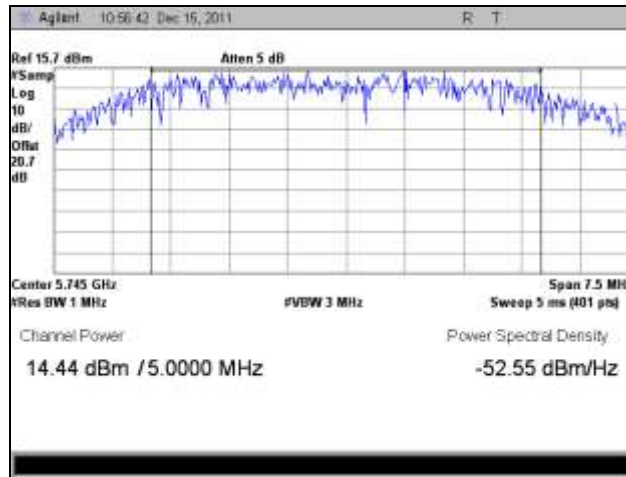


Plot 87. RF Power Output, Mid Channel, 802.11n 5 MHz Port 2

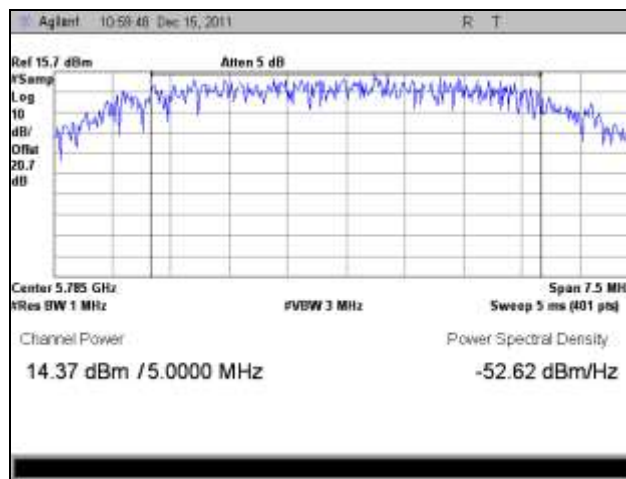


Plot 88. RF Power Output, High Channel, 802.11n 5 MHz Port 2

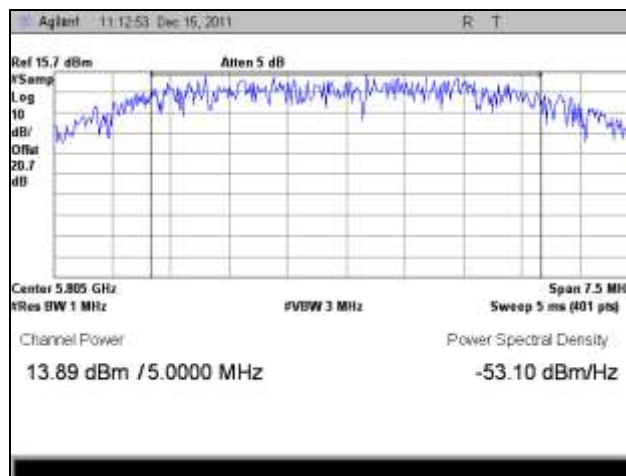
**RF Power Output, 802.11n 5 MHz Port 3**



**Plot 89. RF Power Output, Low Channel, 802.11n 5 MHz Port 3**

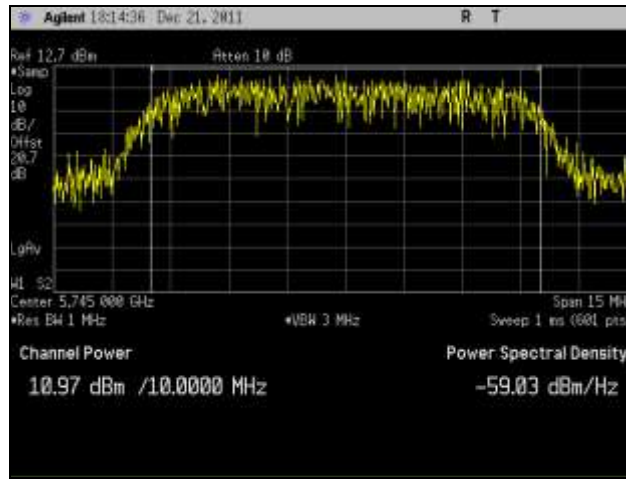


**Plot 90. RF Power Output, Mid Channel, 802.11n 5 MHz Port 3**



**Plot 91. RF Power Output, High Channel, 802.11n 5 MHz Port 3**

### RF Power Output, 802.11n 10 MHz Port 1



Plot 92. RF Power Output, Low Channel, 802.11n 10 MHz Port 1



Plot 93. RF Power Output, Mid Channel, 802.11n 10 MHz Port 1



Plot 94. RF Power Output, High Channel, 802.11n 10 MHz Port 1

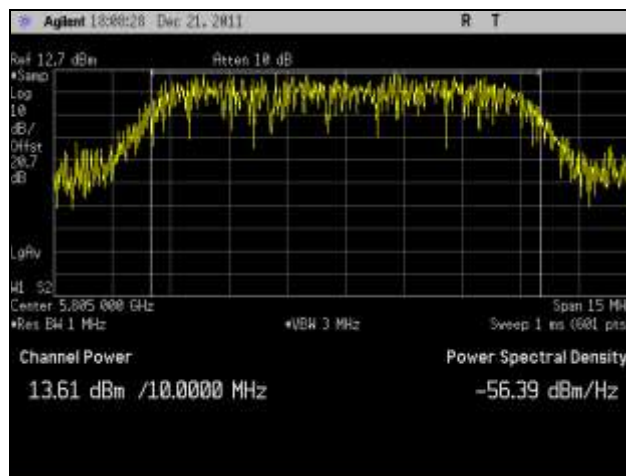
## RF Power Output, 802.11n 10 MHz Port 2



Plot 95. RF Power Output, Low Channel, 802.11n 10 MHz Port 2



Plot 96. RF Power Output, Mid Channel, 802.11n 10 MHz Port 2



Plot 97. RF Power Output, High Channel, 802.11n 10 MHz Port 2

### RF Power Output, 802.11n 10 MHz Port 3



Plot 98. RF Power Output, Low Channel, 802.11n 10 MHz Port 3



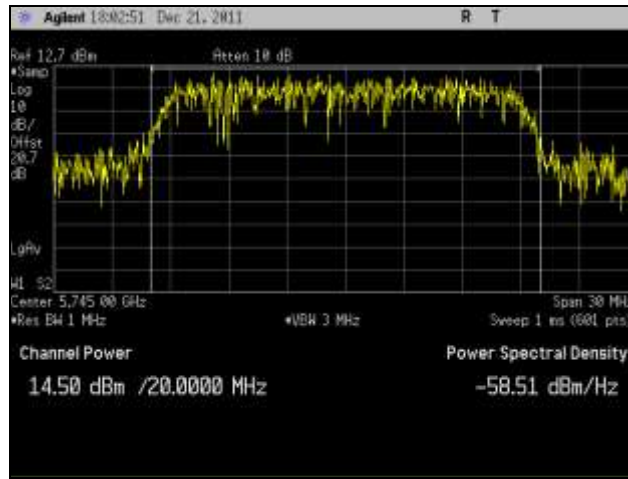
Plot 99. RF Power Output, Mid Channel, 802.11n 10 MHz Port 3



Plot 100. RF Power Output, High Channel, 802.11n 10 MHz Port 3



**RF Power Output, 802.11n 20 MHz Port 1**



**Plot 101. RF Power Output, Low Channel, 802.11n 20 MHz Port 1**

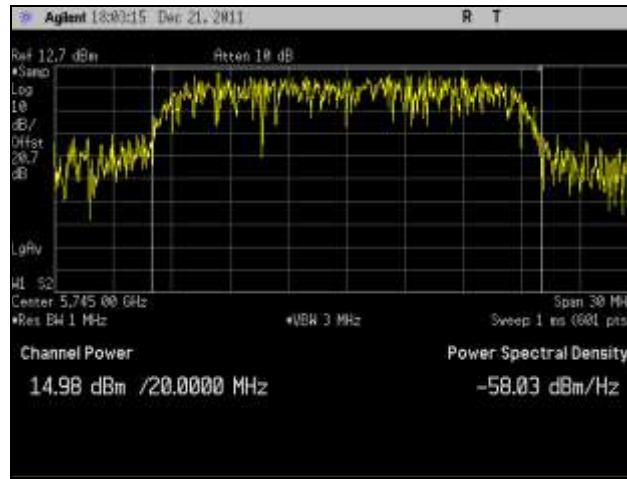


**Plot 102. RF Power Output, Mid Channel, 802.11n 20 MHz Port 1**



**Plot 103. RF Power Output, High Channel, 802.11n 20 MHz Port 1**

**RF Power Output, 802.11n 20 MHz Port 2**



**Plot 104. RF Power Output, Low Channel, 802.11n 20 MHz Port 2**



**Plot 105. RF Power Output, Mid Channel, 802.11n 20 MHz Port 2**



**Plot 106. RF Power Output, High Channel, 802.11n 20 MHz Port 2**

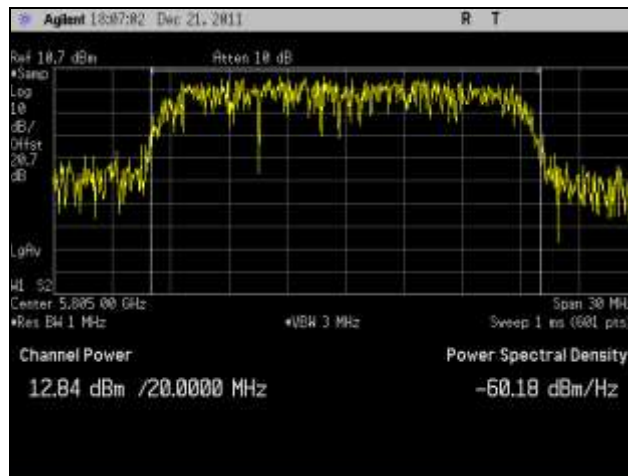
**RF Power Output, 802.11n 20 MHz Port 3**



**Plot 107. RF Power Output, Low Channel, 802.11n 20 MHz Port 3**

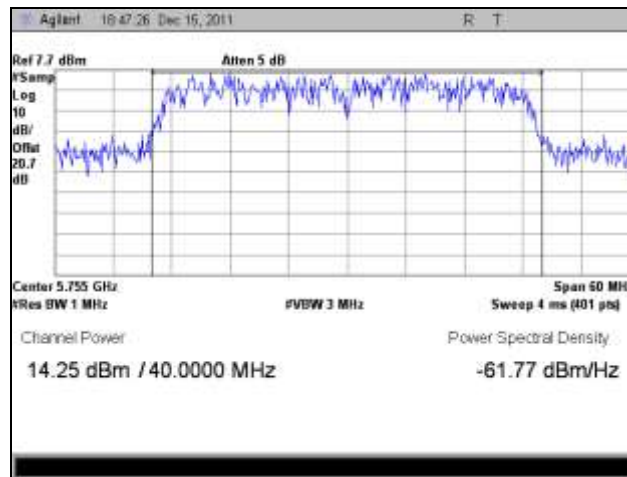


**Plot 108. RF Power Output, Mid Channel, 802.11n 20 MHz Port 3**

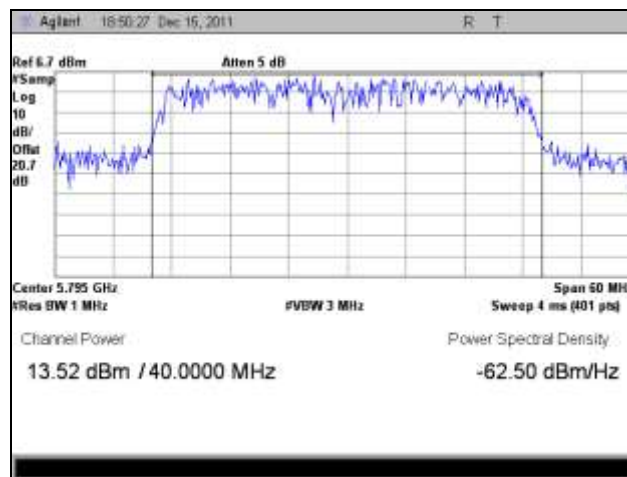


**Plot 109. RF Power Output, High Channel, 802.11n 20 MHz Port 3**

### RF Power Output, 802.11n 40 MHz Port 1

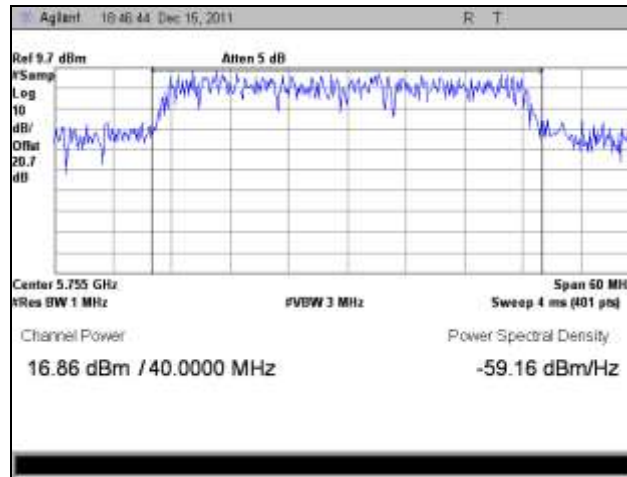


Plot 110. RF Power Output, Low Channel, 802.11n 40 MHz Port 1

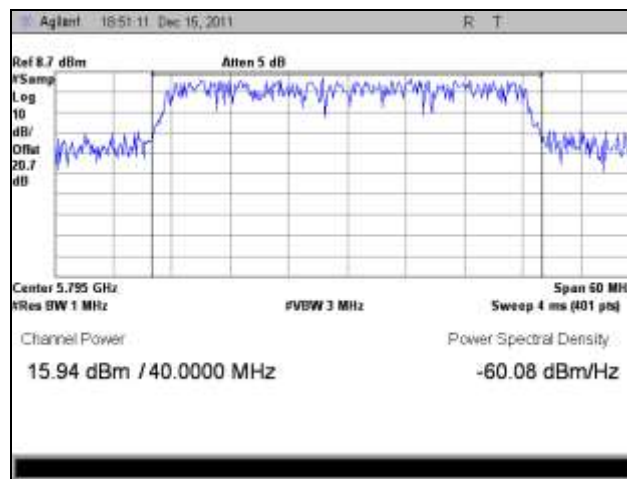


Plot 111. RF Power Output, High Channel, 802.11n 40 MHz Port 1

### RF Power Output, 802.11n 40 MHz Port 2

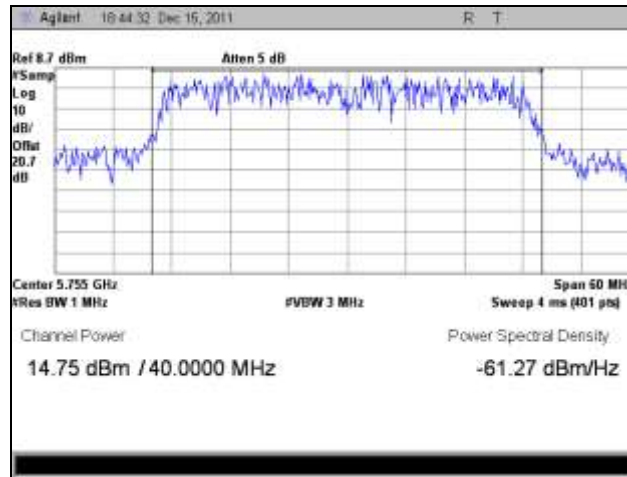


Plot 112. RF Power Output, Low Channel, 802.11n 40 MHz Port 2

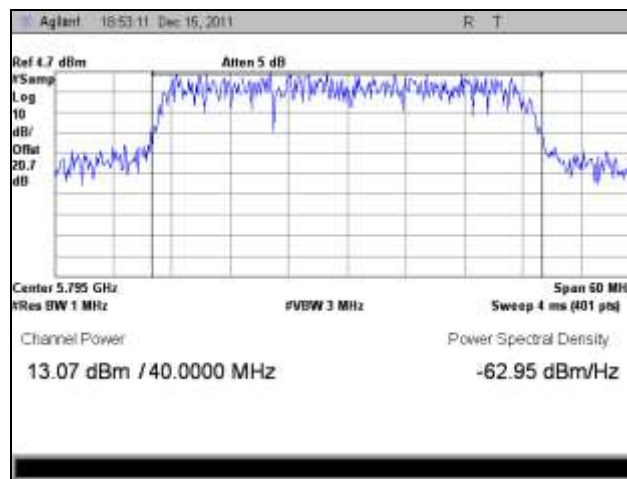


Plot 113. RF Power Output, High Channel, 802.11n 40 MHz Port 2

### RF Power Output, 802.11n 40 MHz Port 3



Plot 114. RF Power Output, Low Channel, 802.11n 40 MHz Port 3



Plot 115. RF Power Output, High Channel, 802.11n 40 MHz Port 3

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.407(a)(3) Peak Power Spectral Density

- Test Requirements:** § 15.407(a)(3): The peak power spectral density shall not exceed 17 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain up to 23dBi without any corresponding reduction in the transmitter peak output power or peak power spectral density. For fixed, point-to-point U-NII transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in peak transmitter power and peak power spectral density for each 1 dB of antenna gain in excess of 23 dBi would be required. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, Omni directional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.
- Test Procedure:** The transmitter was connected directly to a Spectrum Analyzer through an attenuator. The power level was set to the maximum level on the EUT. The RBW was set to 1MHz and the VBW was set to 3MHz. The method of measurement from the FCC Publication 789033 D01 UNII General Test Procedures v01 was used.
- Test Results:** Equipment was compliant with the peak power spectral density limits of § 15.407 (a)(2). The peak power spectral density was determined from plots on the following page(s).
- Test Engineer(s):** Lionel Gabrillo
- Test Date(s):** 12/19/11

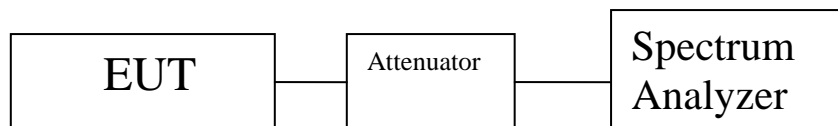


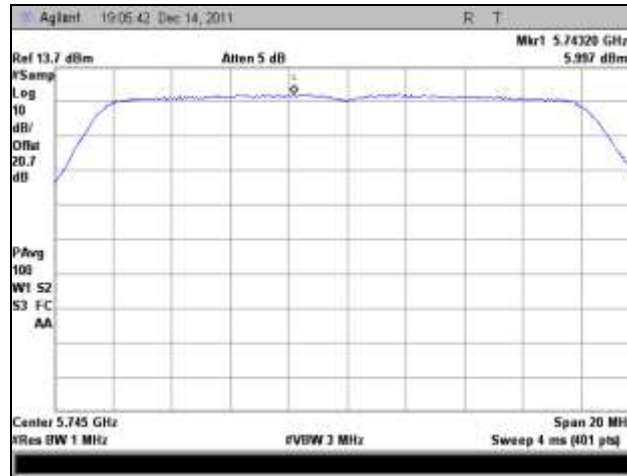
Figure 4. Power Spectral Density Test Setup

Mode	Frequency (MHz)	PSD (dBm) Port 1	PSD (dBm) Port 2	PSD (dBm) Port 3	Sum (mW)	Sum (dBm)	Limit (dBm)	Delta
802.11a	5745	5.997	-	-	-	-	14	-8.003
	5785	5.270	-	-	-	-	14	-8.730
	5805	5.154	-	-	-	-	14	-8.846
802.11n 5 MHz	5745	8.786	9.048	8.881	23.322	13.678	14	-0.322
	5785	8.921	8.482	8.888	22.591	13.539	14	-0.460
	5805	8.876	8.192	8.810	21.918	13.408	14	-0.592
802.11n 10MHz	5745	8.162	8.229	8.229	19.852	12.978	14	-1.022
	5785	7.515	8.421	8.421	19.547	12.911	14	-1.089
	5805	8.098	8.103	8.103	19.376	12.873	14	-1.127
802.11n 20MHz	5745	5.143	5.524	5.072	10.051	10.022	14	-3.978
	5785	6.757	8.938	8.684	19.956	13.001	14	-0.999
	5805	5.41	5.382	4.773	9.930	9.969	14	-4.031
802.11n 40MHz	5755	-0.043	2.679	0.308	3.917	5.929	14	-8.071
	5795	-0.692	1.727	-1.103	3.117	4.937	14	-9.063

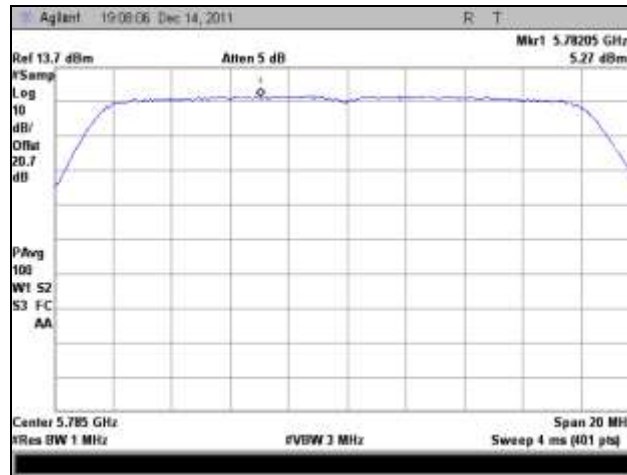
**Table 21. Power Spectral Density, Test Results**



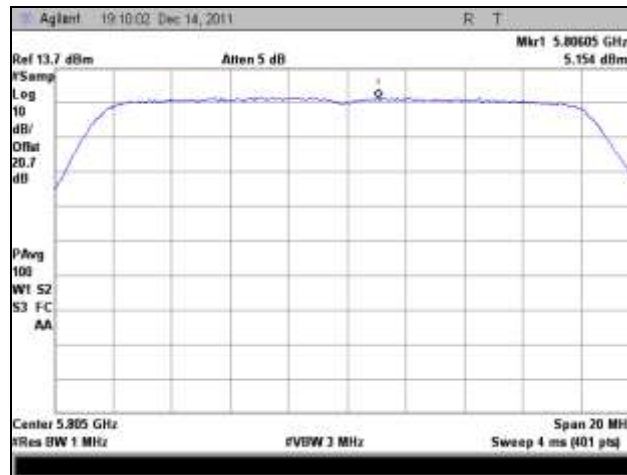
### Power Spectral Density, 802.11a



Plot 116. Power Spectral Density, Low Channel, 802.11a

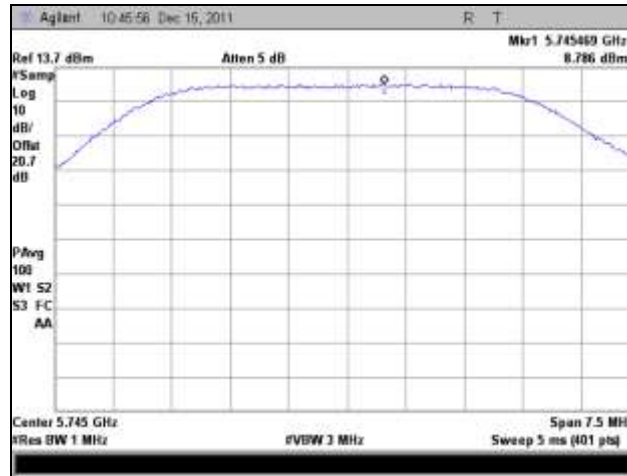


Plot 117. Power Spectral Density, Mid Channel, 802.11a

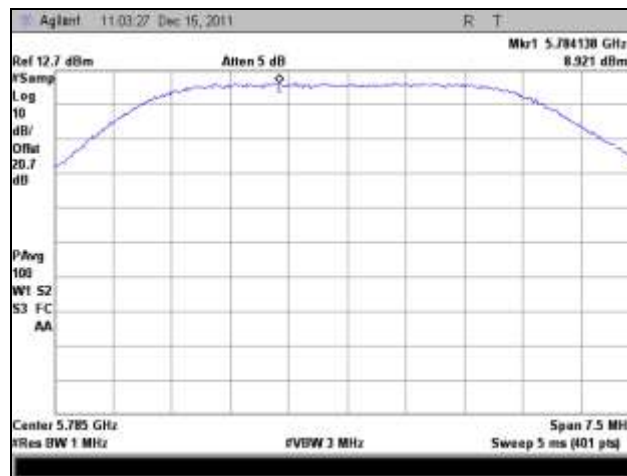


Plot 118. Power Spectral Density, High Channel, 802.11a

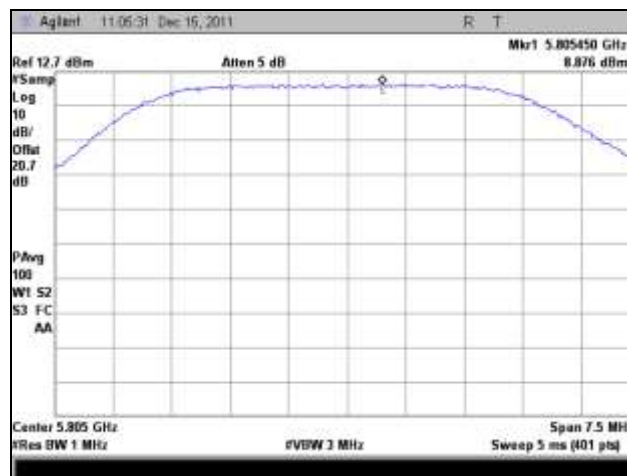
### Power Spectral Density, 802.11n 5 MHz, Port 1



Plot 119. Power Spectral Density, Low Channel, 802.11n 5 MHz, Port 1

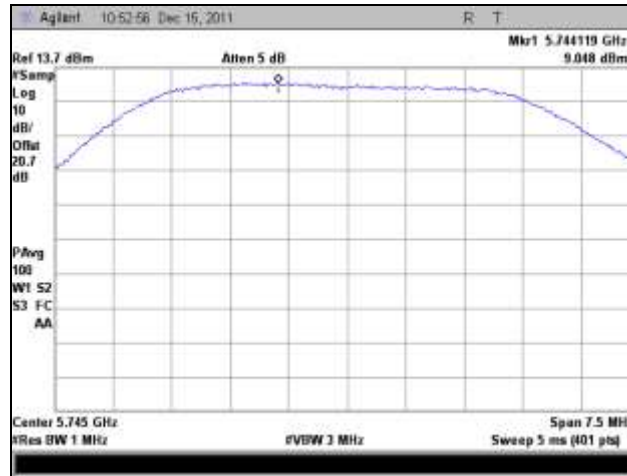


Plot 120. Power Spectral Density, Mid Channel, 802.11n 5 MHz, Port 1

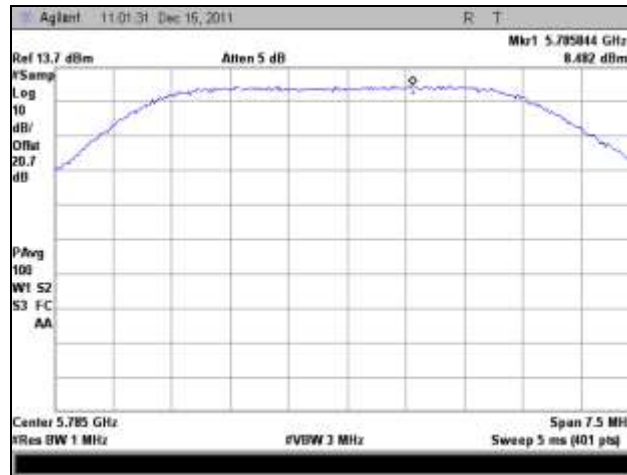


Plot 121. Power Spectral Density, High Channel, 802.11n 5 MHz, Port 1

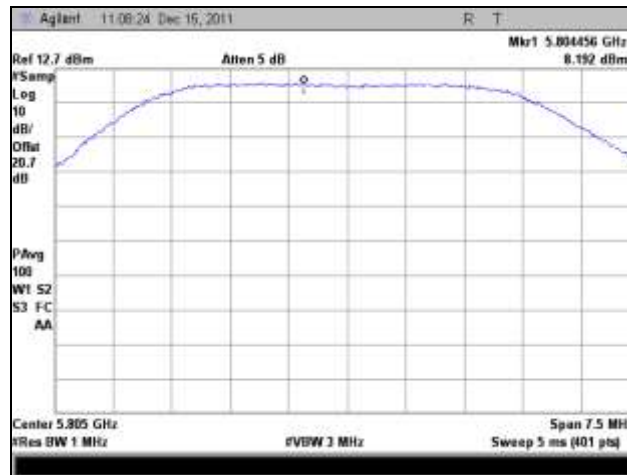
### Power Spectral Density, 802.11n 5 MHz, Port 2



Plot 122. Power Spectral Density, Low Channel, 802.11n 5 MHz, Port 2

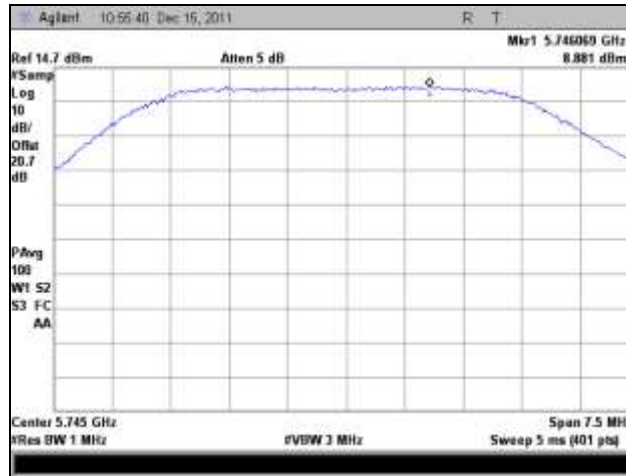


Plot 123. Power Spectral Density, Mid Channel, 802.11n 5 MHz, Port 2

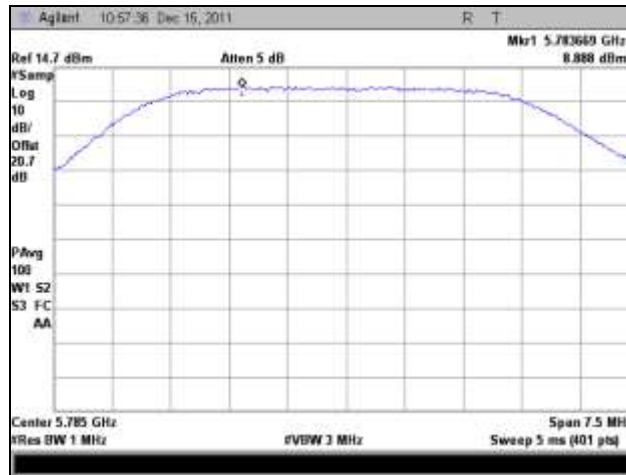


Plot 124. Power Spectral Density, High Channel, 802.11n 5 MHz, Port 2

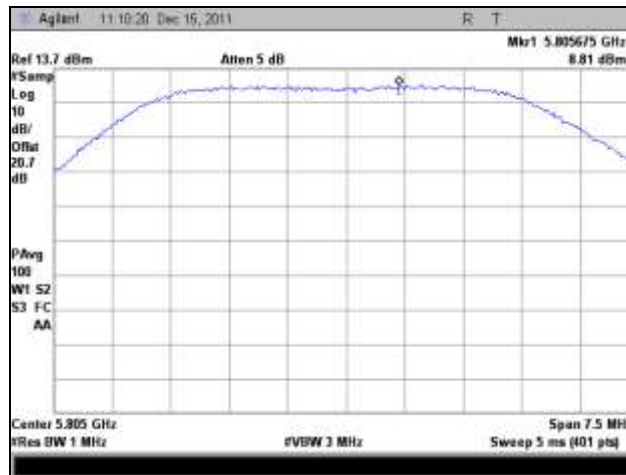
### Power Spectral Density, 802.11n 5 MHz, Port 3



Plot 125. Power Spectral Density, Low Channel, 802.11n 5 MHz, Port 3



Plot 126. Power Spectral Density, Mid Channel, 802.11n 5 MHz, Port 3

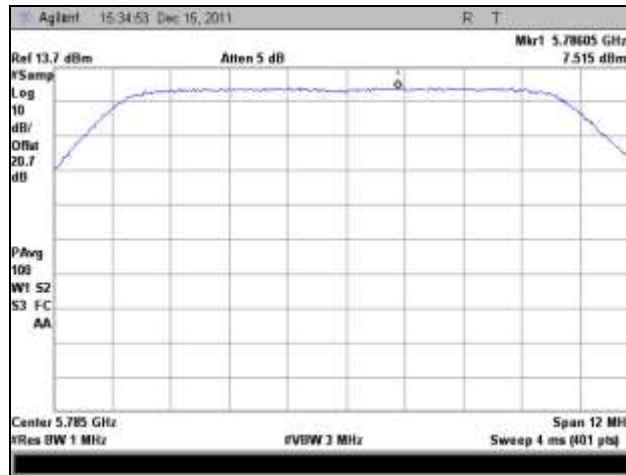


Plot 127. Power Spectral Density, High Channel, 802.11n 5 MHz, Port 3

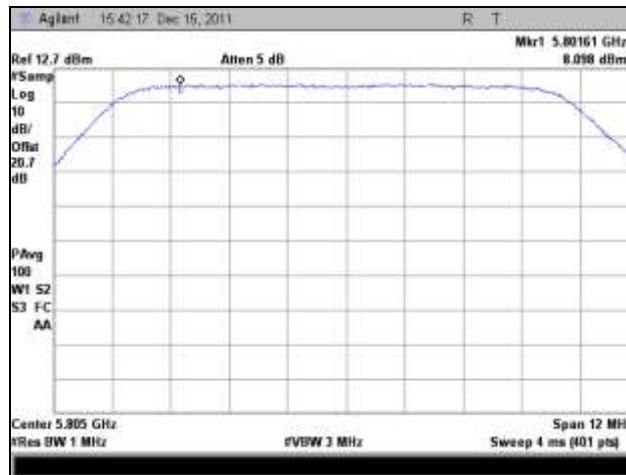
**Power Spectral Density, 802.11n 10 MHz, Port 1**



**Plot 128. Power Spectral Density, Low Channel, 802.11n 10 MHz, Port 1**

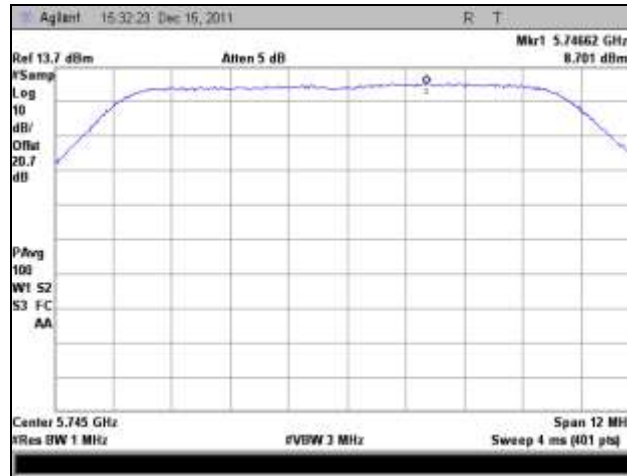


**Plot 129. Power Spectral Density, Mid Channel, 802.11n 10 MHz, Port 1**

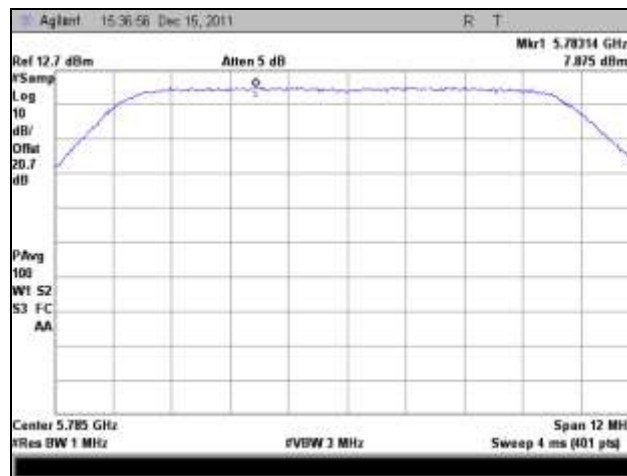


**Plot 130. Power Spectral Density, High Channel, 802.11n 10 MHz, Port 1**

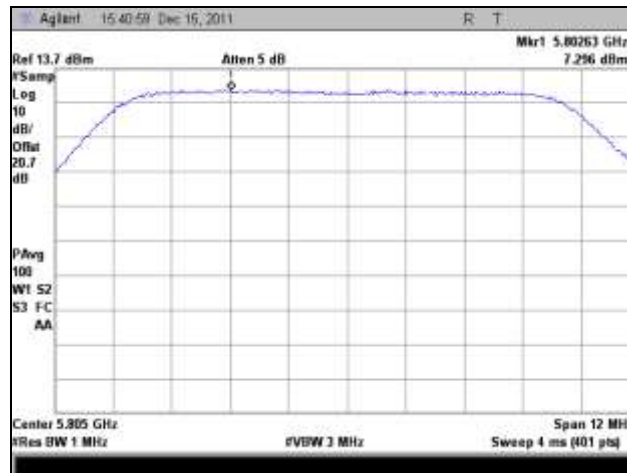
### Power Spectral Density, 802.11n 10 MHz, Port 2



Plot 131. Power Spectral Density, Low Channel, 802.11n 10 MHz, Port 2



Plot 132. Power Spectral Density, Mid Channel, 802.11n 10 MHz, Port 2

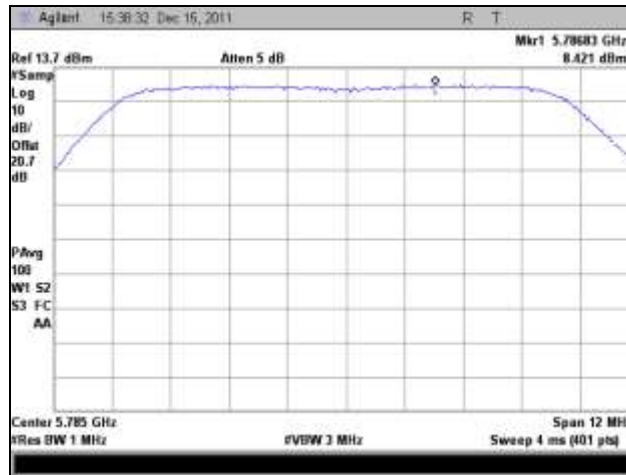


Plot 133. Power Spectral Density, High Channel, 802.11n 10 MHz, Port 2

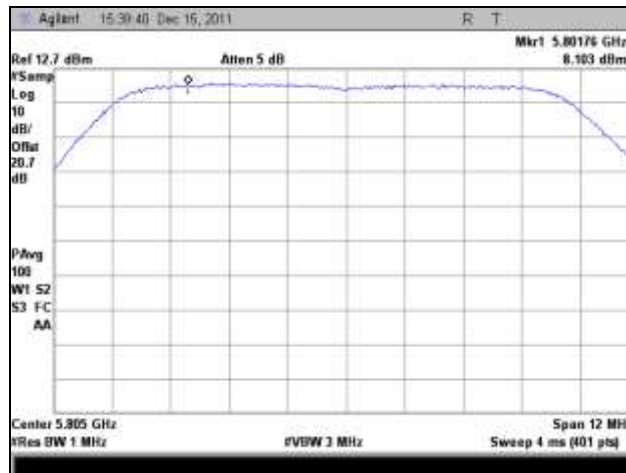
**Power Spectral Density, 802.11n 10 MHz, Port 3**



**Plot 134. Power Spectral Density, Low Channel, 802.11n 10 MHz, Port 3**

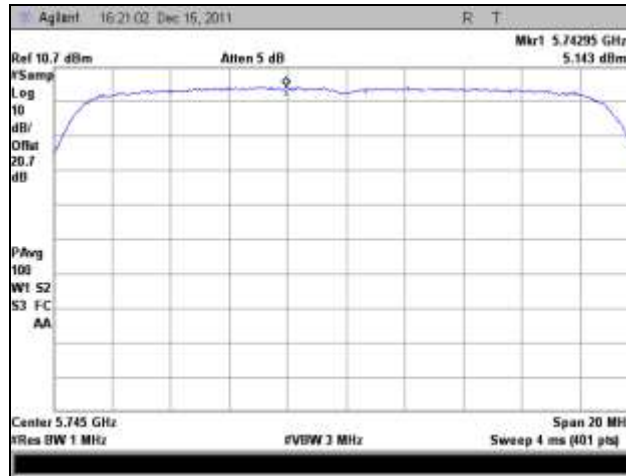


**Plot 135. Power Spectral Density, Mid Channel, 802.11n 10 MHz, Port 3**

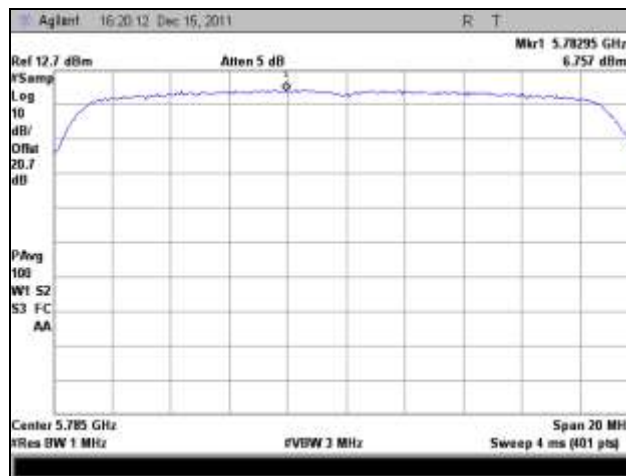


**Plot 136. Power Spectral Density, High Channel, 802.11n 10 MHz, Port 3**

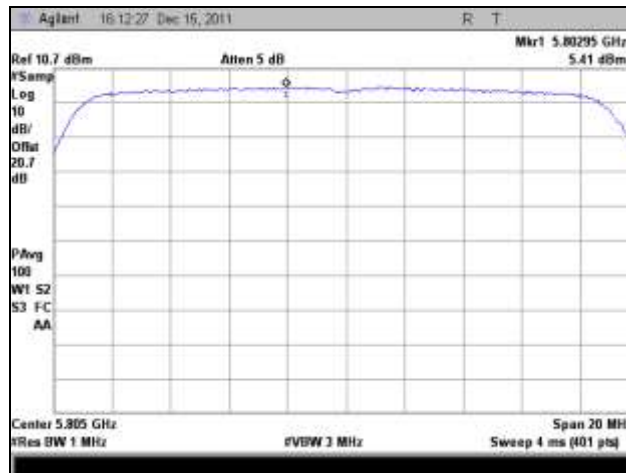
### Power Spectral Density, 802.11n 20 MHz, Port 1



Plot 137. Power Spectral Density, Low Channel, 802.11n 20 MHz, Port 1



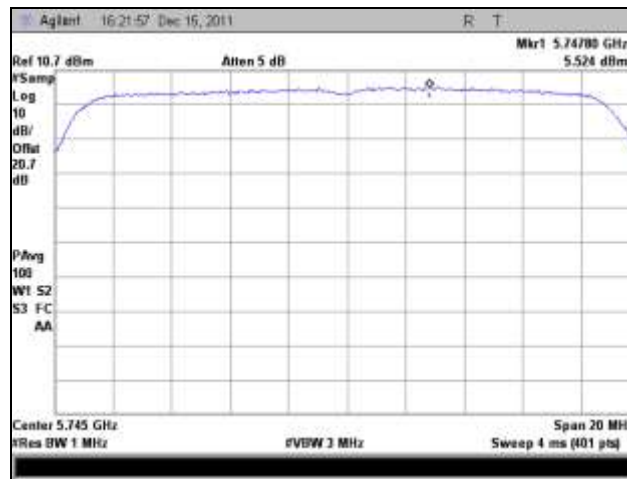
Plot 138. Power Spectral Density, Mid Channel, 802.11n 20 MHz, Port 1



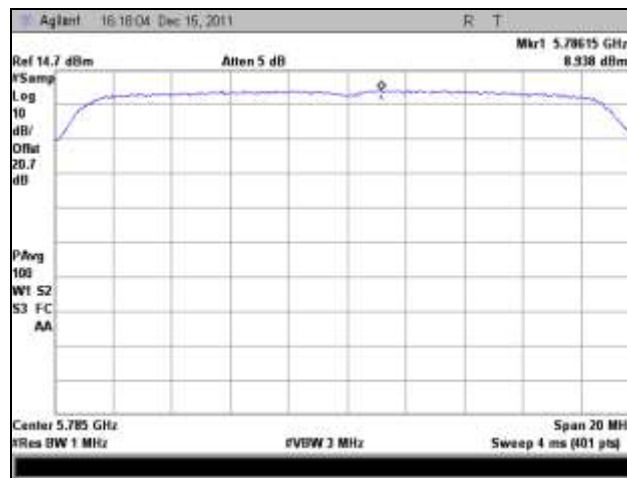
Plot 139. Power Spectral Density, High Channel, 802.11n 20 MHz, Port 1



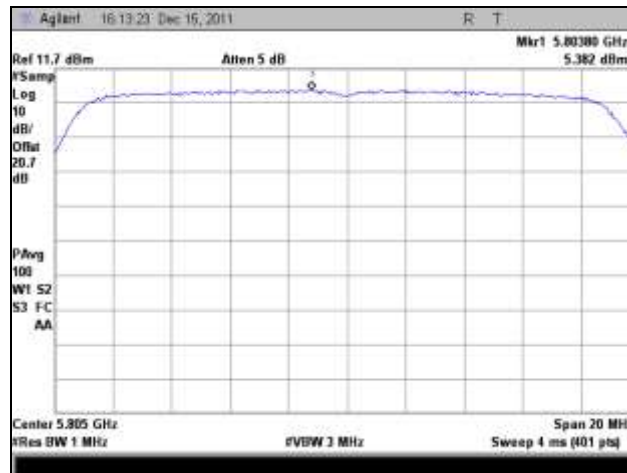
### Power Spectral Density, 802.11n 20 MHz, Port 2



Plot 140. Power Spectral Density, Low Channel, 802.11n 20 MHz, Port 2

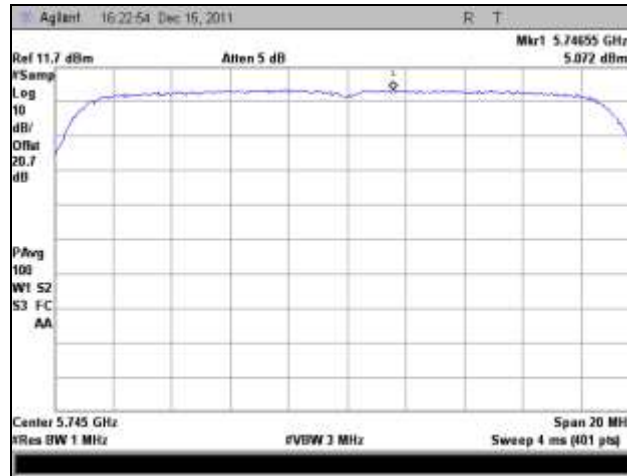


Plot 141. Power Spectral Density, Mid Channel, 802.11n 20 MHz, Port 2

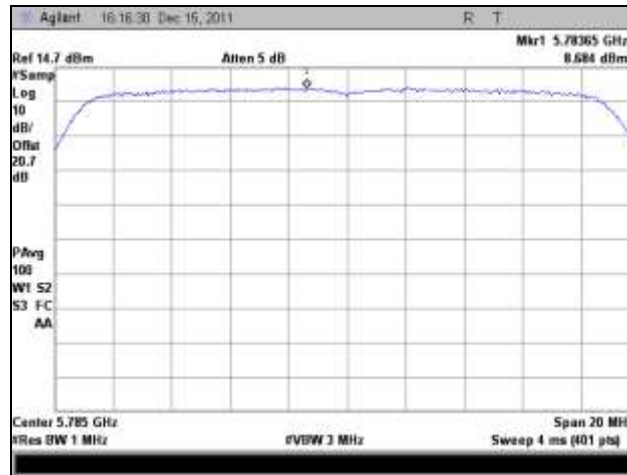


Plot 142. Power Spectral Density, High Channel, 802.11n 20 MHz, Port 2

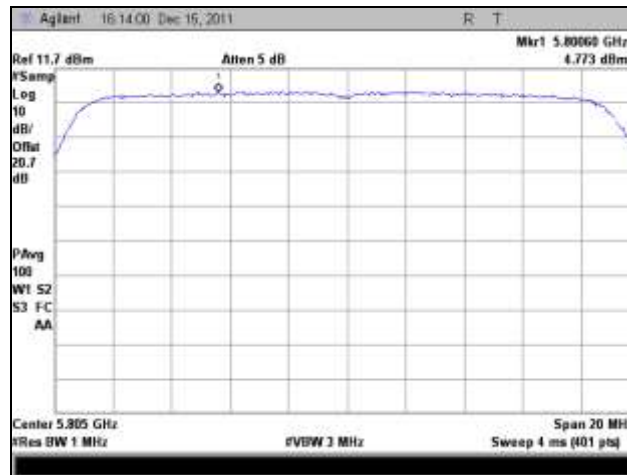
**Power Spectral Density, 802.11n 20 MHz, Port 3**



**Plot 143. Power Spectral Density, Low Channel, 802.11n 20 MHz, Port 3**

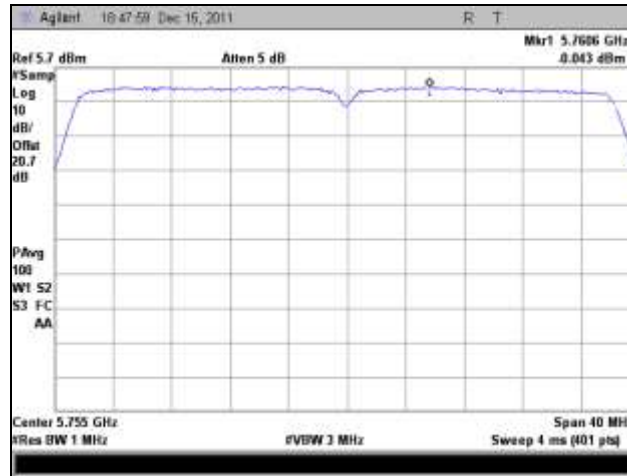


**Plot 144. Power Spectral Density, Mid Channel, 802.11n 20 MHz, Port 3**

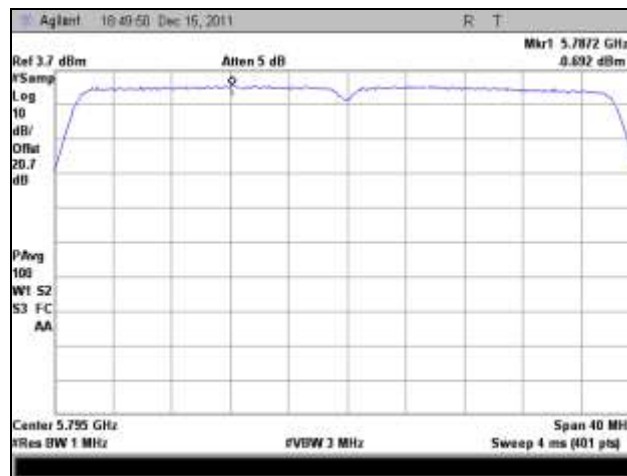


**Plot 145. Power Spectral Density, High Channel, 802.11n 20 MHz, Port 3**

### Power Spectral Density, 802.11n 40 MHz, Port 1

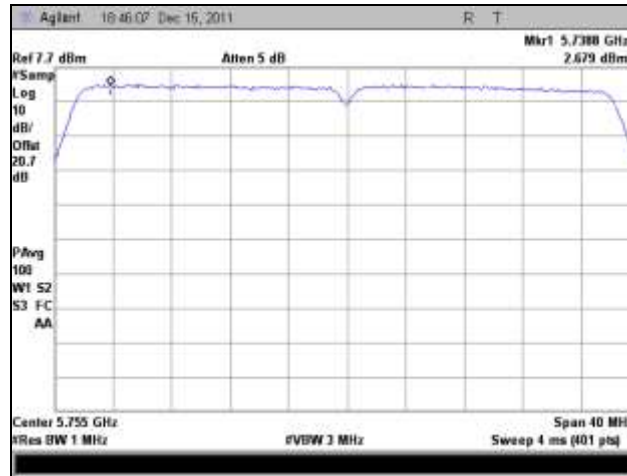


Plot 146. Power Spectral Density, Low Channel, 802.11n 40 MHz, Port 1

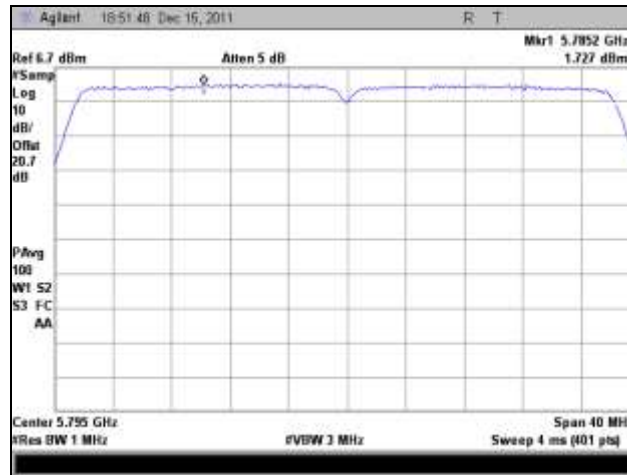


Plot 147. Power Spectral Density, High Channel, 802.11n 40 MHz, Port 1

**Power Spectral Density, 802.11n 40 MHz, Port 2**

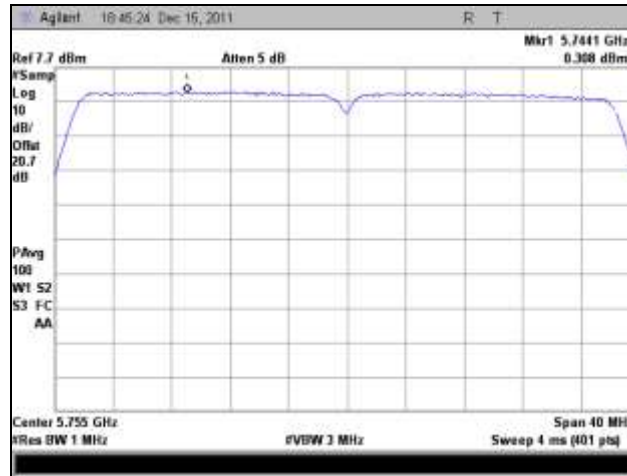


**Plot 148. Power Spectral Density, Low Channel, 802.11n 40 MHz, Port 2**

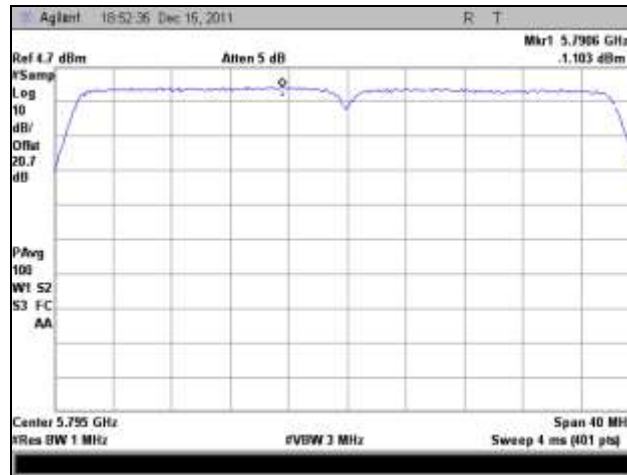


**Plot 149. Power Spectral Density, High Channel, 802.11n 40 MHz, Port 2**

**Power Spectral Density, 802.11n 40 MHz, Port 3**



**Plot 150. Power Spectral Density, Low Channel, 802.11n 40 MHz, Port 3**



**Plot 151. Power Spectral Density, High Channel, 802.11n 40 MHz, Port 3**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.407(a)(6) Peak Excursion Ratio

- Test Requirements:** § 15.407(a)(6): The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.
- Test Procedure:** The EUT was connected directly to the spectrum analyzer through cabling and attenuation. The 1<sup>st</sup> trace on the spectrum analyzer was set to RBW=1MHz, VBW=3MHz. The peak detector mode was used and the trace max held. The 2<sup>nd</sup> trace on the spectrum analyzer was set according to measurement method #SA-1 from the FCC Publication 789033 D01 UNII General Test Procedures v01 for making conducted power measurements.
- Test Results:** Equipment was compliant with the peak excursion ratio limits of § 15.407(a)(6). The peak excursion ratio was determined from plots on the following page(s).
- Test Engineer(s):** Lionel Gabrillo
- Test Date(s):** 11/02/11

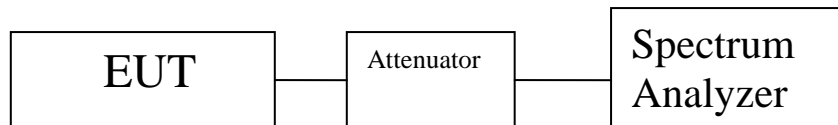
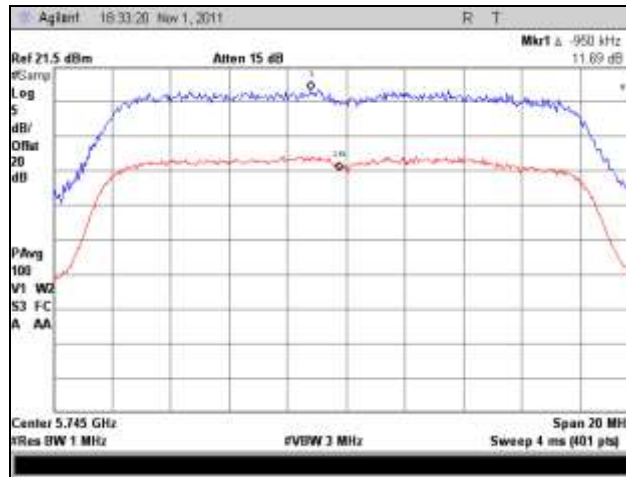
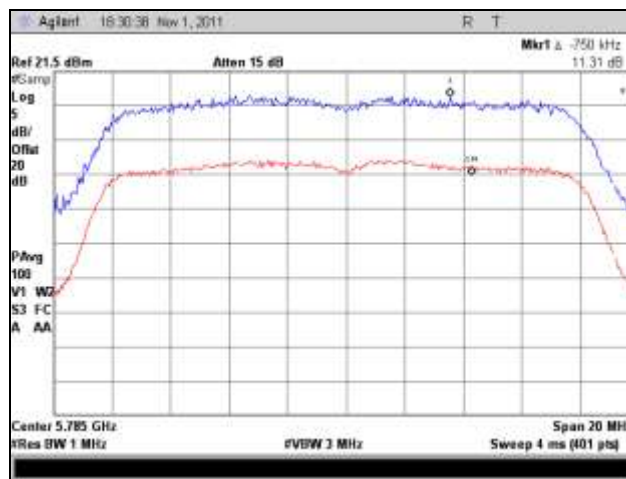


Figure 5. Peak Excursion Ration Test Setup

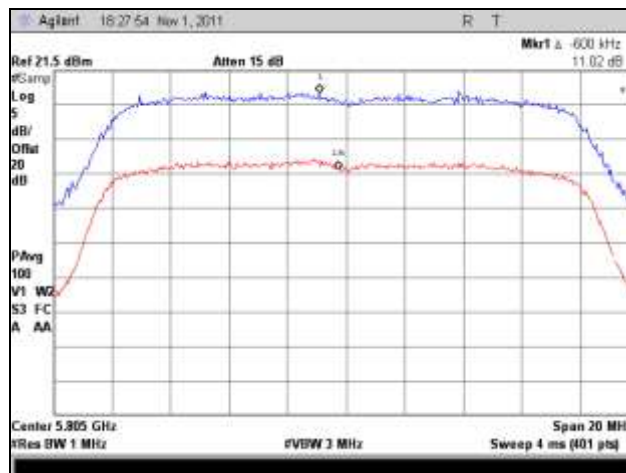
### Peak Excursion Ratio, 802.11a



Plot 152. Peak Excursion Ratio, Low Channel, 802.11a

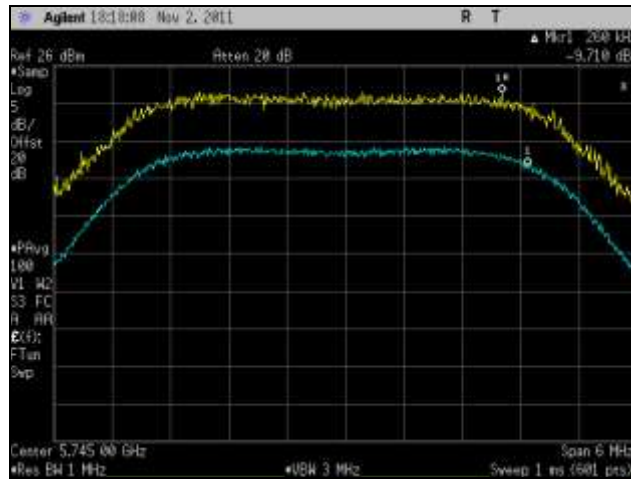


Plot 153. Peak Excursion Ratio, Mid Channel, 802.11a

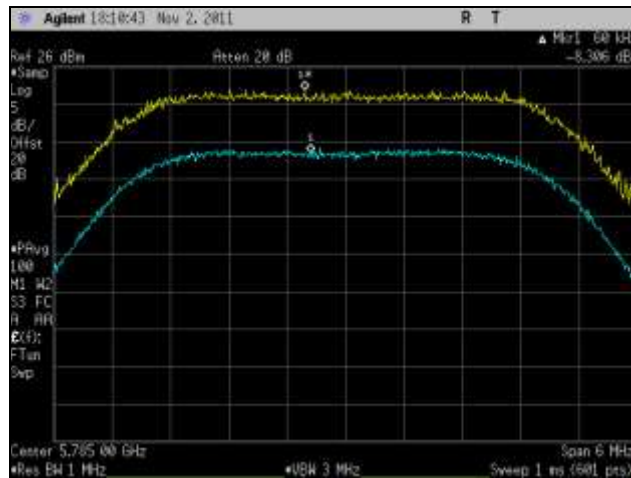


Plot 154. Peak Excursion Ratio, High Channel, 802.11a

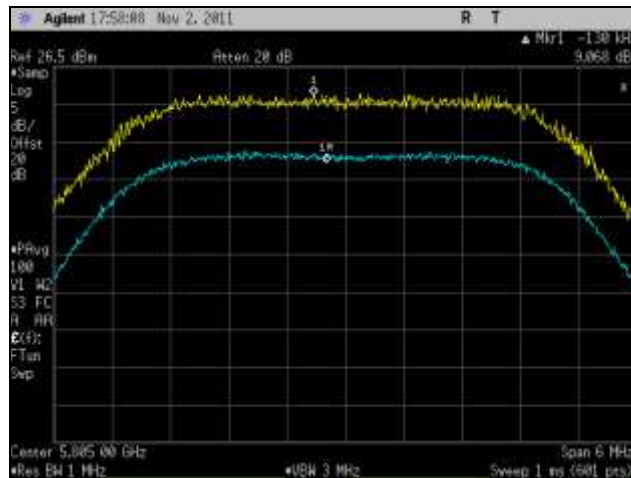
**Peak Excursion Ratio, 802.11n 5 MHz, Port 1**



**Plot 155. Peak Excursion Ratio, Low Channel, 802.11n 5 MHz, Port 1**



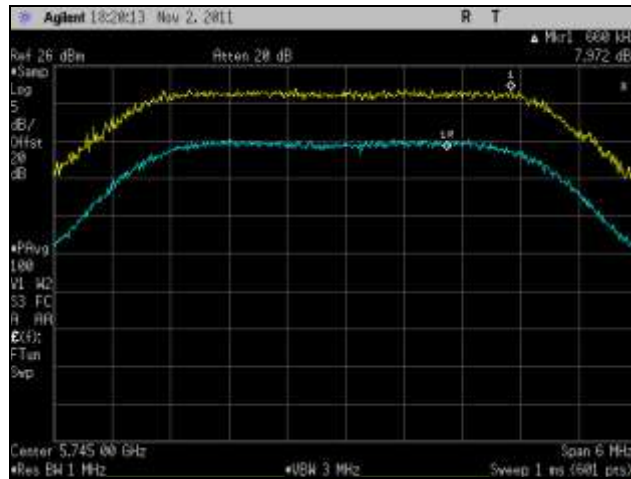
**Plot 156. Peak Excursion Ratio, Mid Channel, 802.11n 5 MHz, Port 1**



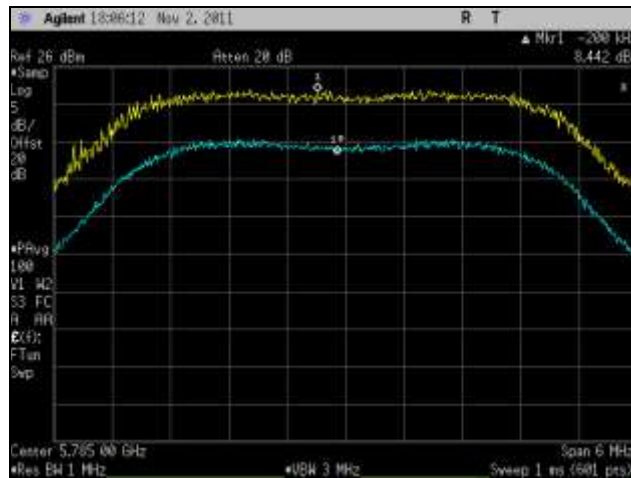
**Plot 157. Peak Excursion Ratio, High Channel, 802.11n 5 MHz, Port 1**



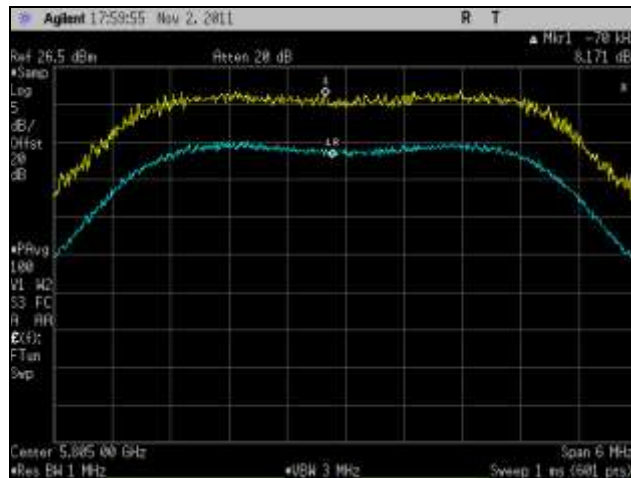
**Peak Excursion Ratio, 802.11n 5 MHz, Port 2**



**Plot 158. Peak Excursion Ratio, Low Channel, 802.11n 5 MHz, Port 2**

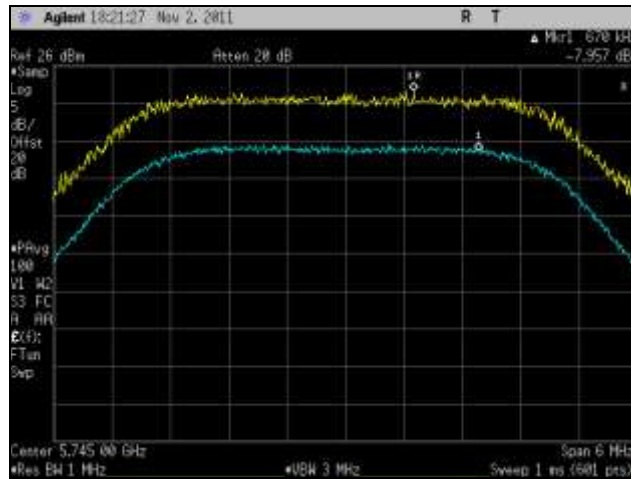


**Plot 159. Peak Excursion Ratio, Mid Channel, 802.11n 5 MHz, Port 2**

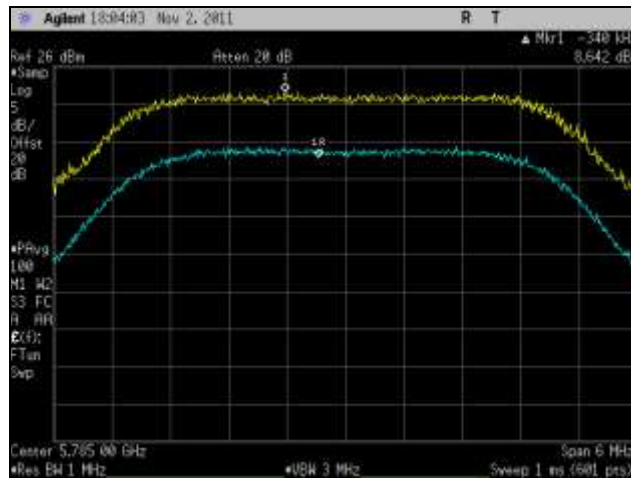


**Plot 160. Peak Excursion Ratio, High Channel, 802.11n 5 MHz, Port 2**

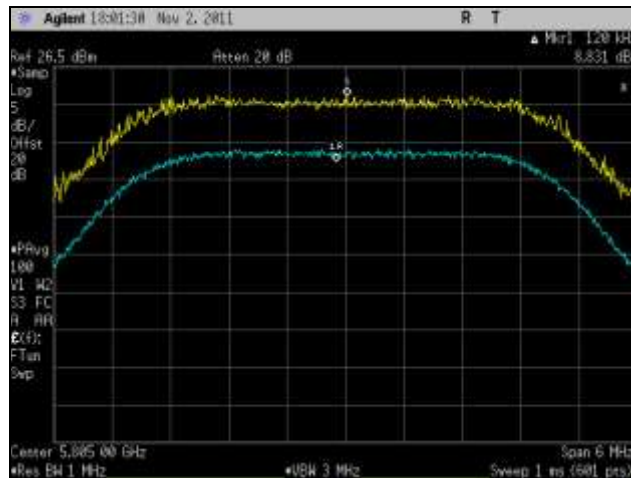
**Peak Excursion Ratio, 802.11n 5 MHz, Port 3**



**Plot 161. Peak Excursion Ratio, Low Channel, 802.11n 5 MHz, Port 3**

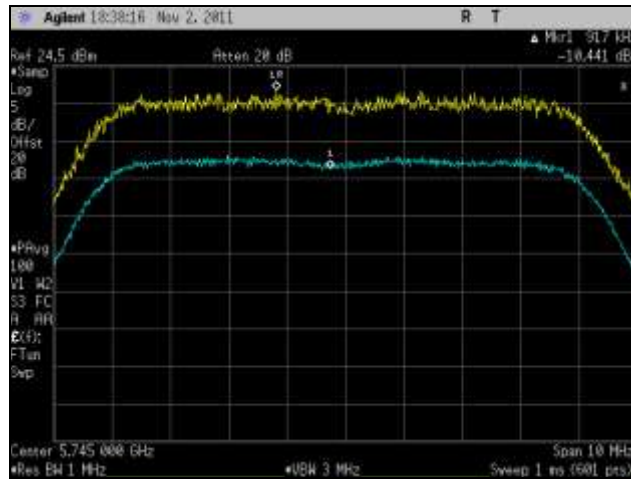


**Plot 162. Peak Excursion Ratio, Mid Channel, 802.11n 5 MHz, Port 3**

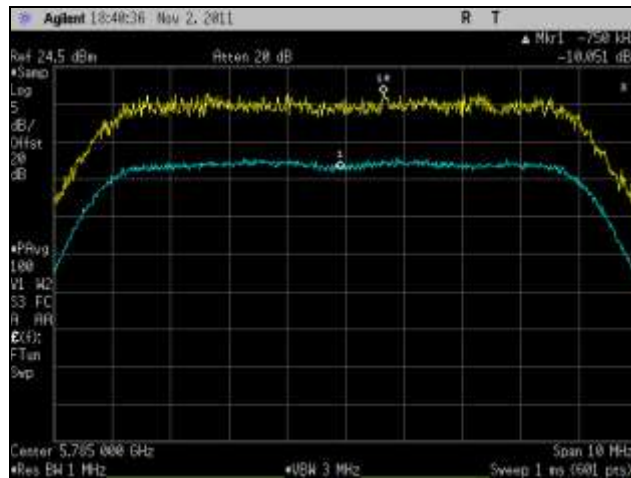


**Plot 163. Peak Excursion Ratio, High Channel, 802.11n 5 MHz, Port 3**

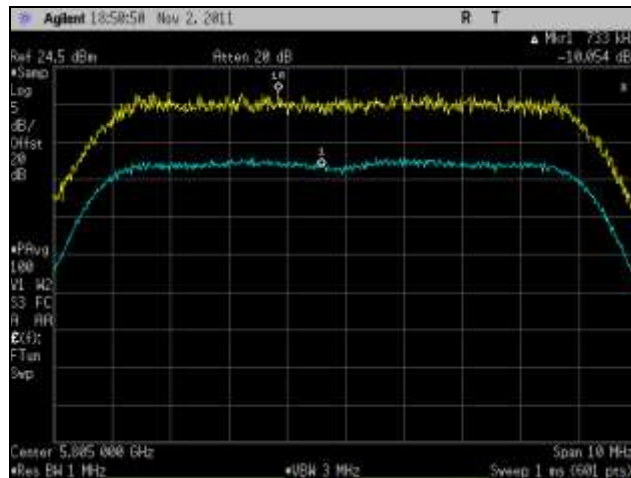
**Peak Excursion Ratio, 802.11n 10 MHz, Port 1**



**Plot 164. Peak Excursion Ratio, Low Channel, 802.11n 10 MHz, Port 1**

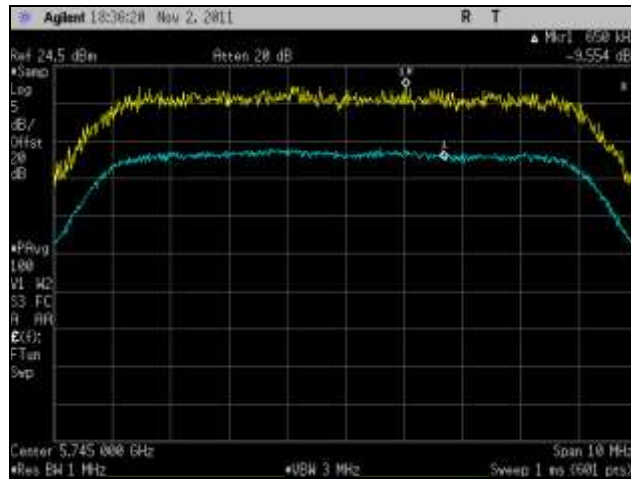


**Plot 165. Peak Excursion Ratio, Mid Channel, 802.11n 10 MHz, Port 1**

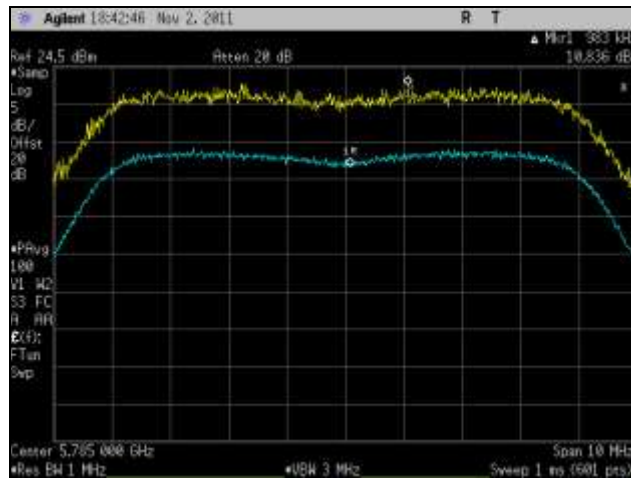


**Plot 166. Peak Excursion Ratio, High Channel, 802.11n 10 MHz, Port 1**

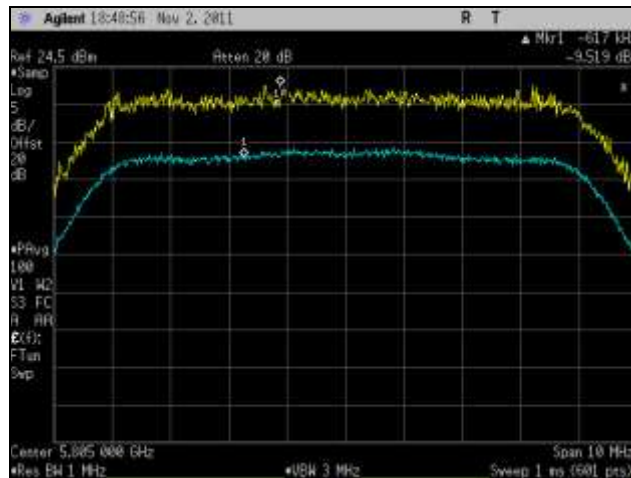
**Peak Excursion Ratio, 802.11n 10 MHz, Port 2**



**Plot 167. Peak Excursion Ratio, Low Channel, 802.11n 10 MHz, Port 2**

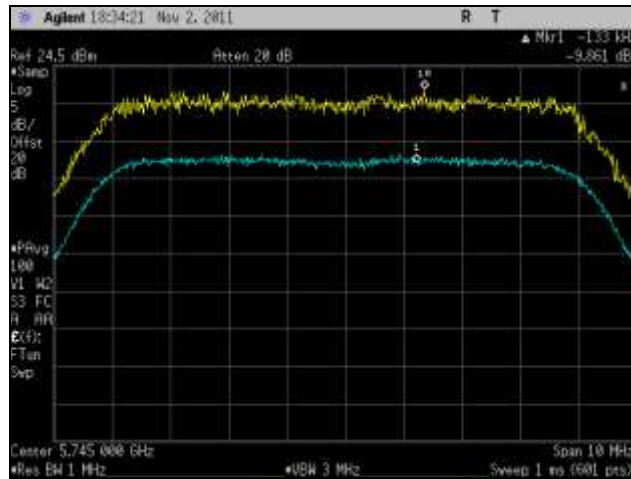


**Plot 168. Peak Excursion Ratio, Mid Channel, 802.11n 10 MHz, Port 2**

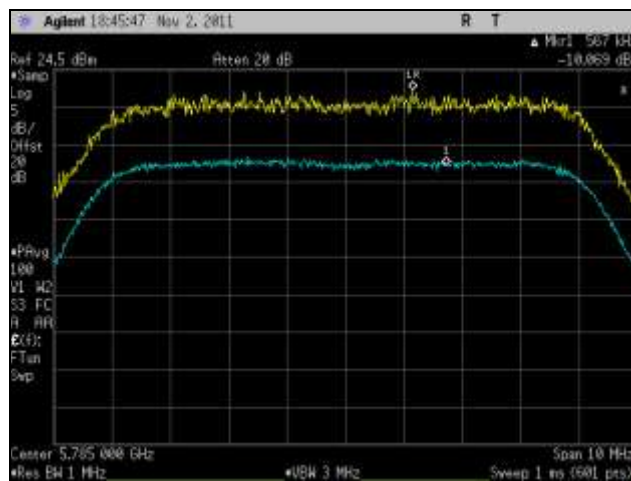


**Plot 169. Peak Excursion Ratio, High Channel, 802.11n 10 MHz, Port 2**

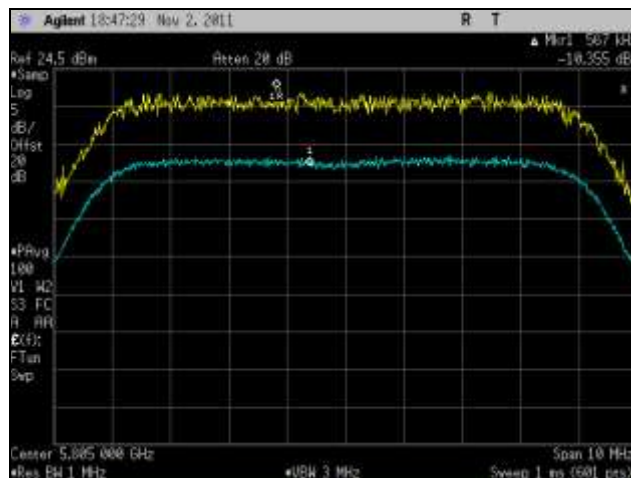
**Peak Excursion Ratio, 802.11n 10 MHz, Port 3**



**Plot 170. Peak Excursion Ratio, Low Channel, 802.11n 10 MHz, Port 3**

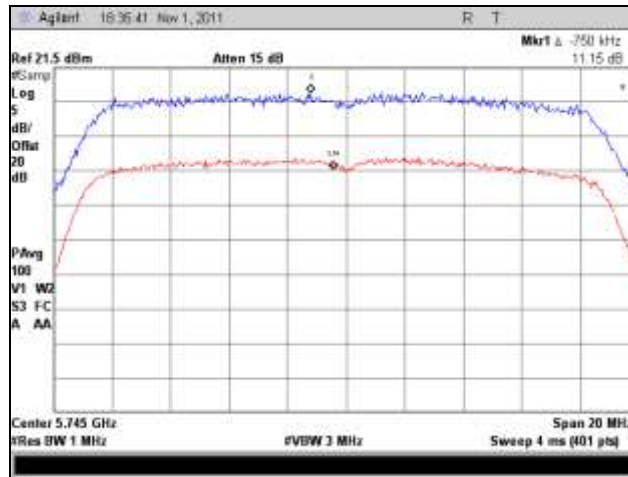


**Plot 171. Peak Excursion Ratio, Mid Channel, 802.11n 10 MHz, Port 3**



**Plot 172. Peak Excursion Ratio, High Channel, 802.11n 10 MHz, Port 3**

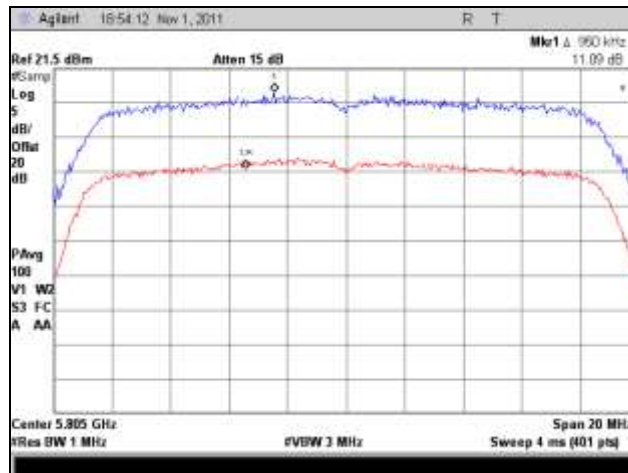
**Peak Excursion Ratio, 802.11n 20 MHz, Port 1**



**Plot 173. Peak Excursion Ratio, Low Channel, 802.11n 20 MHz, Port 1**

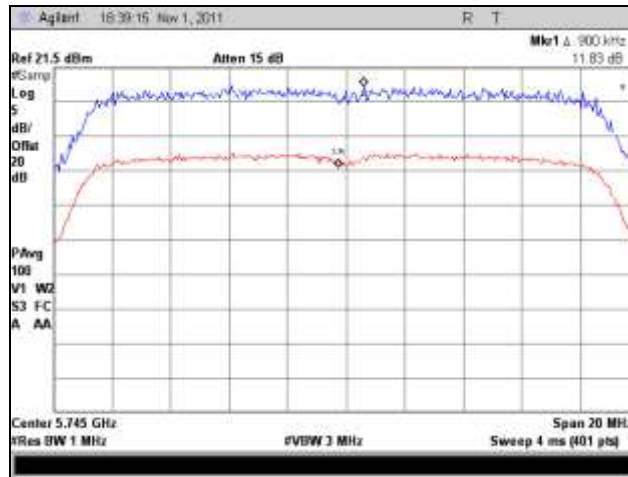


**Plot 174. Peak Excursion Ratio, Mid Channel, 802.11n 20 MHz, Port 1**

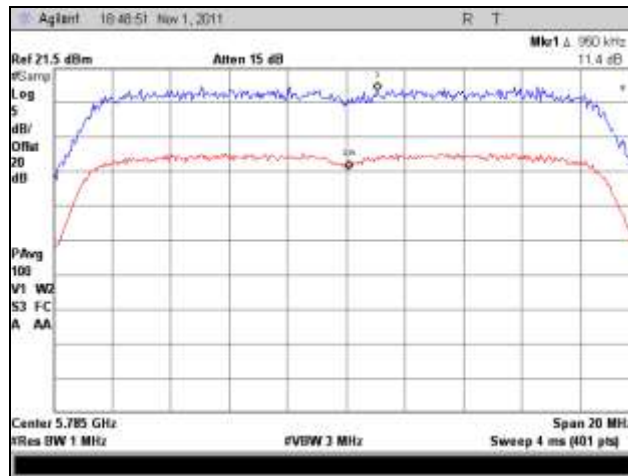


**Plot 175. Peak Excursion Ratio, High Channel, 802.11n 20 MHz, Port 1**

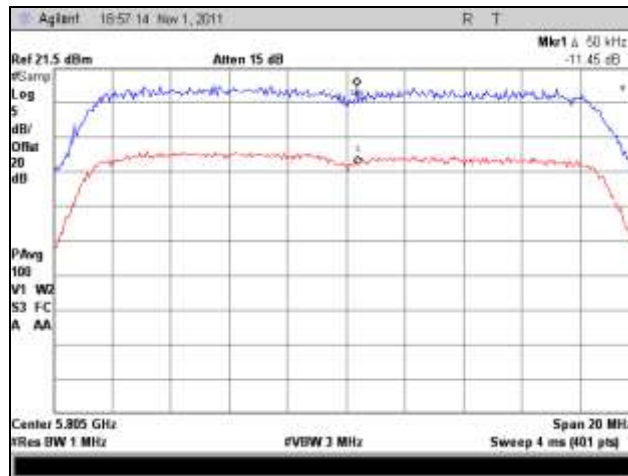
**Peak Excursion Ratio, 802.11n 20 MHz, Port 2**



**Plot 176. Peak Excursion Ratio, Low Channel, 802.11n 20 MHz, Port 2**

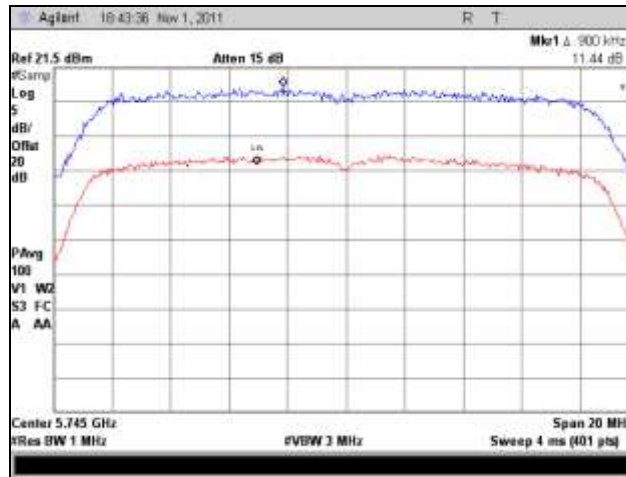


**Plot 177. Peak Excursion Ratio, Mid Channel, 802.11n 20 MHz, Port 2**

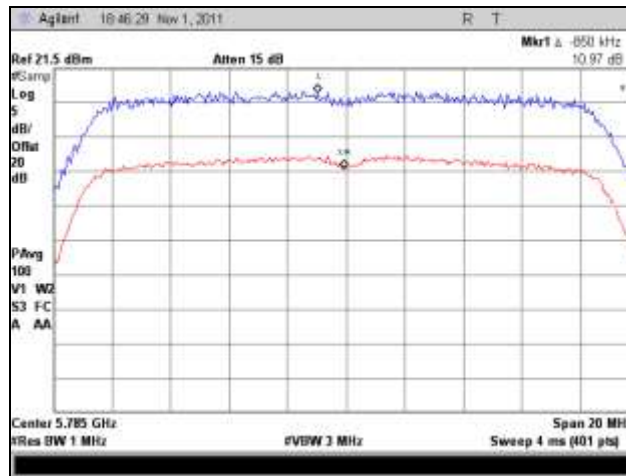


**Plot 178. Peak Excursion Ratio, High Channel, 802.11n 20 MHz, Port 2**

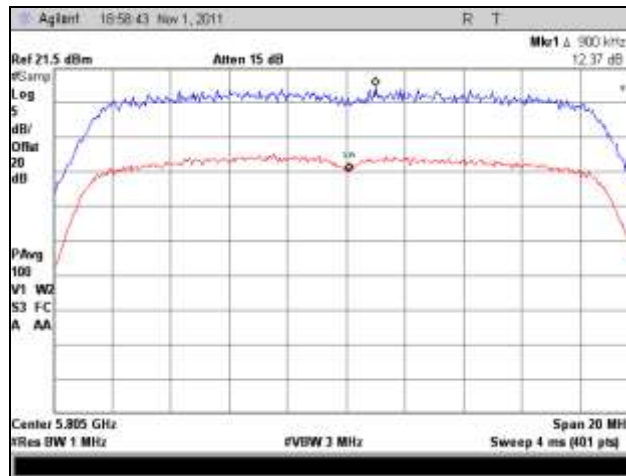
**Peak Excursion Ratio, 802.11n 20 MHz, Port 3**



**Plot 179. Peak Excursion Ratio, Low Channel, 802.11n 20 MHz, Port 3**



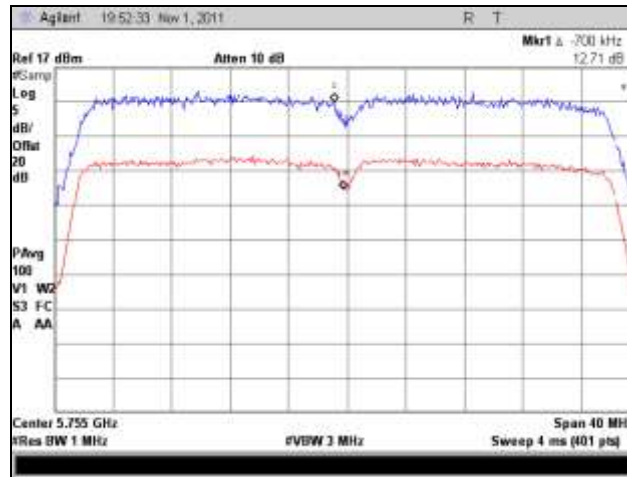
**Plot 180. Peak Excursion Ratio, Mid Channel, 802.11n 20 MHz, Port 3**



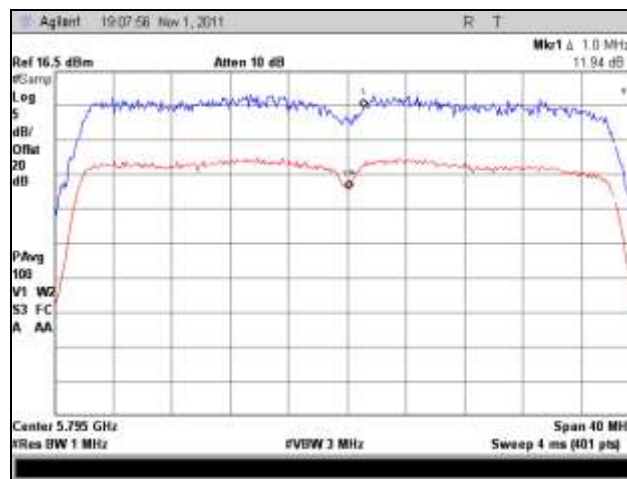
**Plot 181. Peak Excursion Ratio, High Channel, 802.11n 20 MHz, Port 3**



**Peak Excursion Ratio, 802.11n 40 MHz, Port 2**

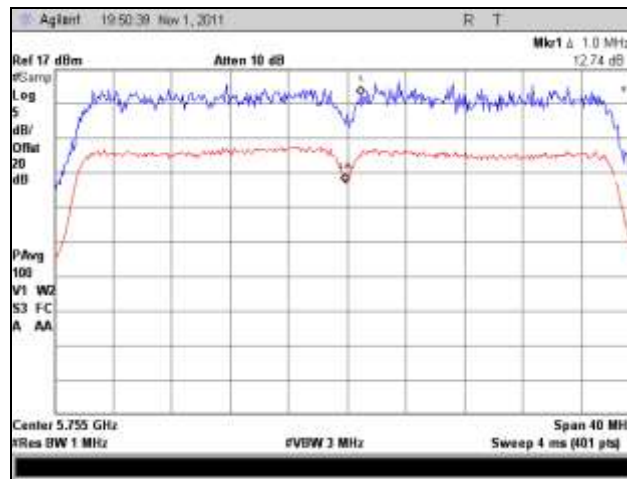


**Plot 182. Peak Excursion Ratio, Low Channel, 802.11n 40 MHz, Port 2**

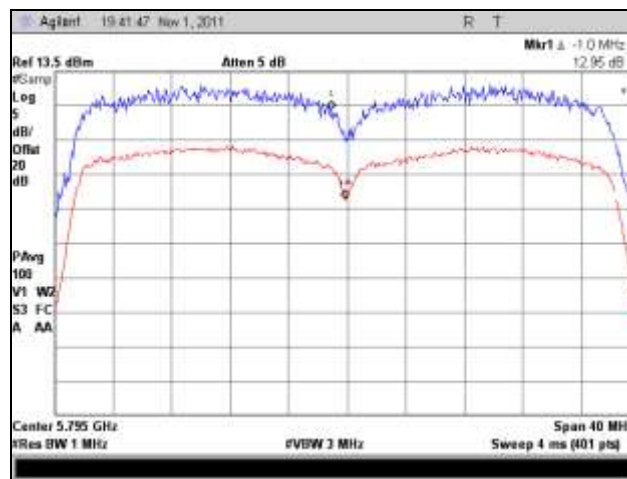


**Plot 183. Peak Excursion Ratio, High Channel, 802.11n 40 MHz, Port 2**

**Peak Excursion Ratio, 802.11n 40 MHz, Port 2**

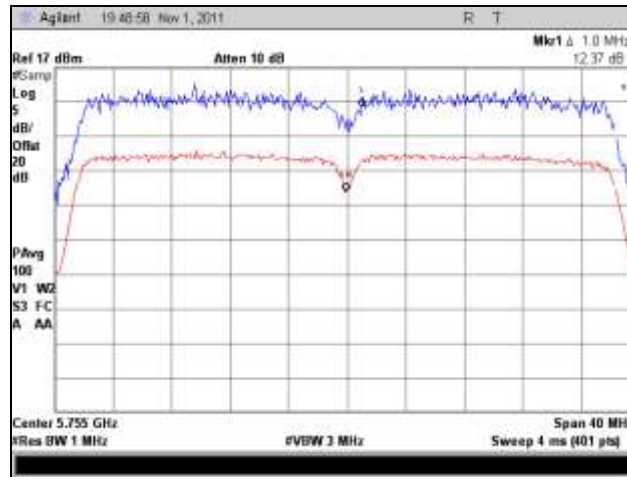


**Plot 184. Peak Excursion Ratio, Low Channel, 802.11n 40 MHz, Port 2**

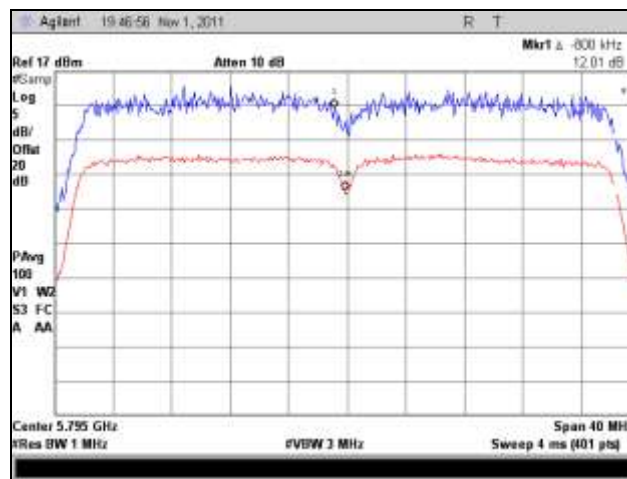


**Plot 185. Peak Excursion Ratio, High Channel, 802.11n 40 MHz, Port 2**

### Peak Excursion Ratio, 802.11n 40 MHz, Port 3



Plot 186. Peak Excursion Ratio, Low Channel, 802.11n 40 MHz, Port 3



Plot 187. Peak Excursion Ratio, High Channel, 802.11n 40 MHz, Port 3

## Electromagnetic Compatibility Criteria for Intentional Radiators

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

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

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

§ 15.407(b)(3): For transmitters operating in the 5.47-5.725 GHz band: all emissions outside of the 5.47-5.725 GHz band shall not exceed an EIRP of -27 dBm/MHz.

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

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

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

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

For measurements above 1 GHz, measurements were made with a Peak detector with 1 MHz resolution bandwidth. Where the spurious emissions fell into a restricted band, measurements were also made with an average detector to make sure they complied with 15.209 limits. Emissions were explored up to 40 GHz.

The equation,  $EIRP = E + 20 \log D - 104.8$  was used to convert an EIRP limit to a field strength limit.

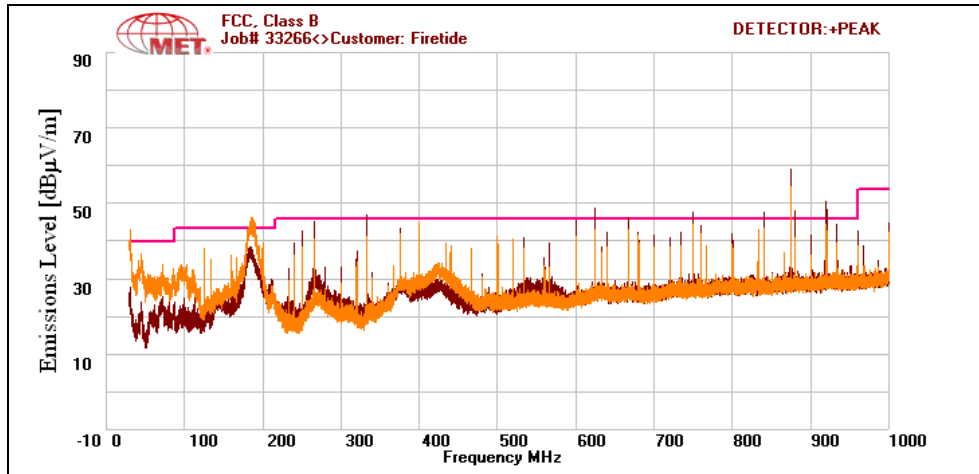
E = field strength (dBuV/m)

D = Reference measurement distance

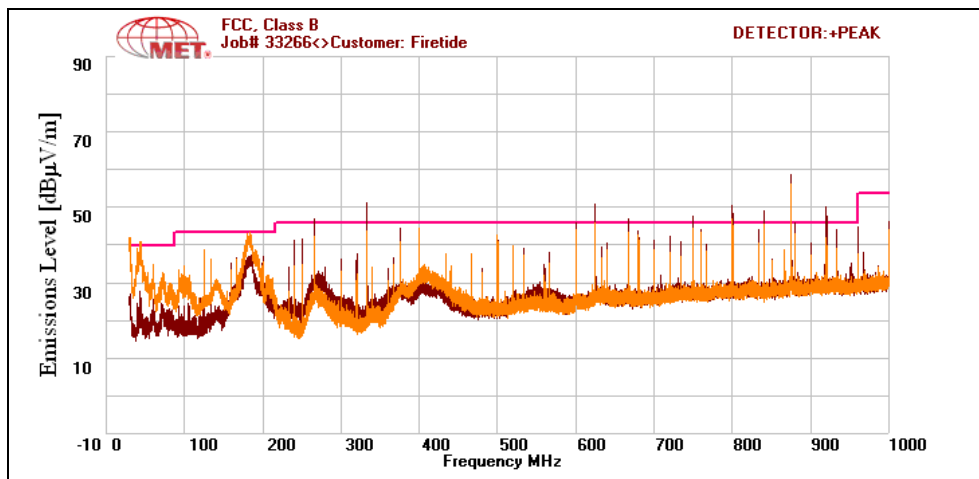
**Test Results:** The EUT was compliant with the Radiated Emission limits for Intentional Radiators. See following pages for detailed test results.

**Test Engineer(s):** Lionel Gabrillo

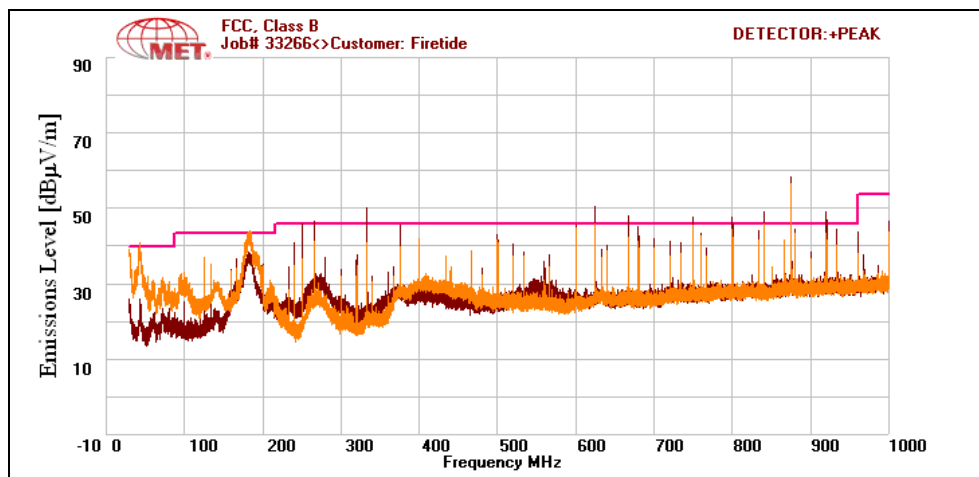
**Test Date(s):** 12/09/11



Plot 188. Radiated Spurs, 802.11a, Radio Off, 9 dBi Omni

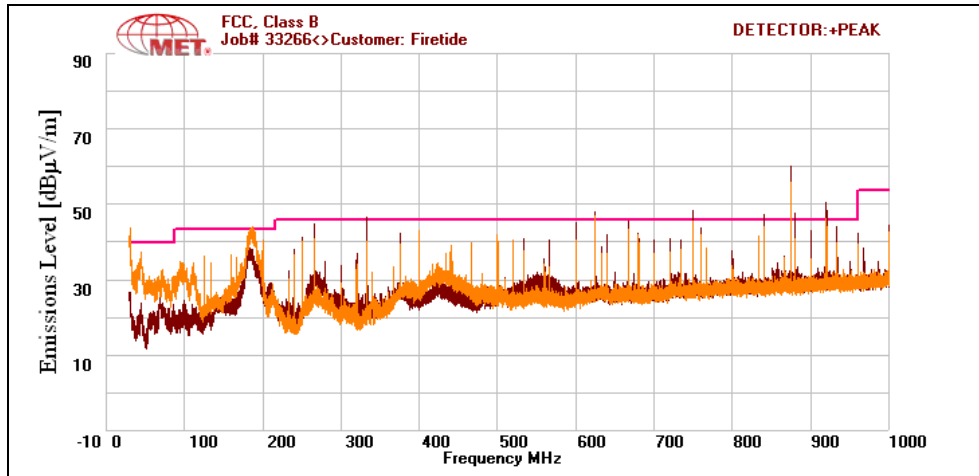


Plot 189. Radiated Spurs, 802.11a, Radio Off, 15 dBi Sector

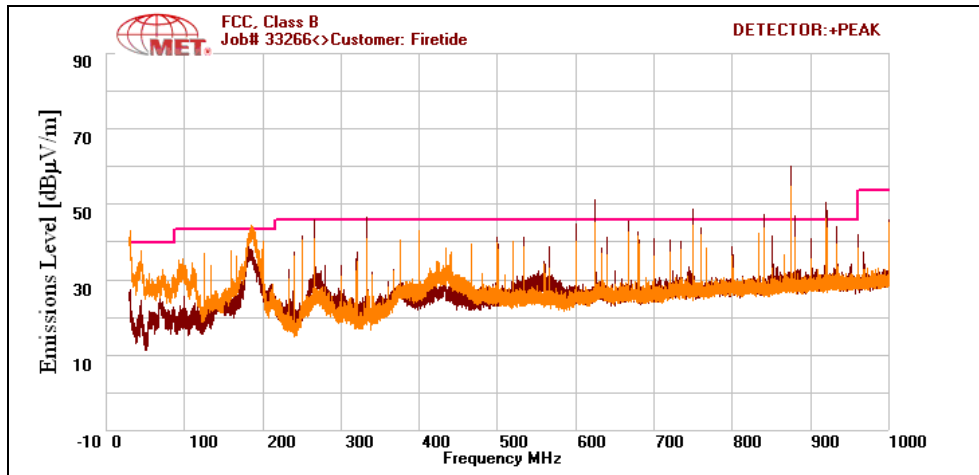


Plot 190. Radiated Spurs, 802.11a, Radio Off, 16 dBi Panel

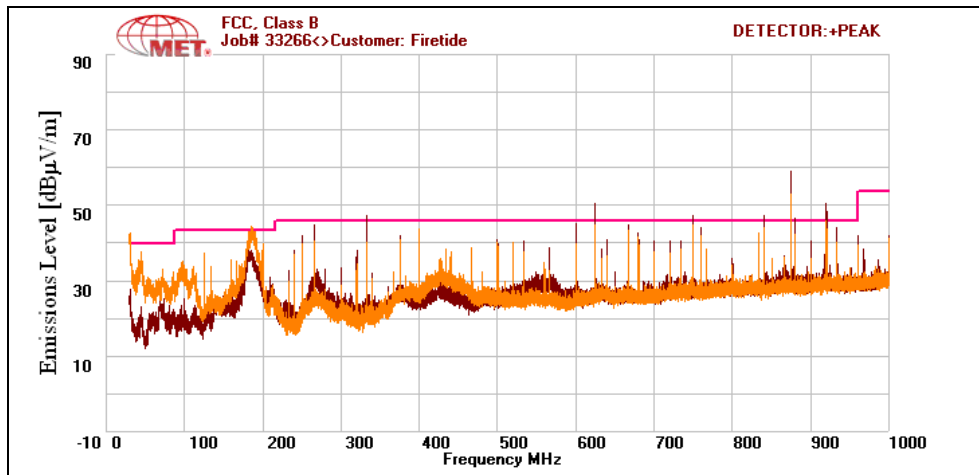
**Radiated Spurious Emissions, 802.11a, 9 dBi Omni**



**Plot 191. Radiated Spurs, Low Channel, 802.11a, 9 dBi Omni**

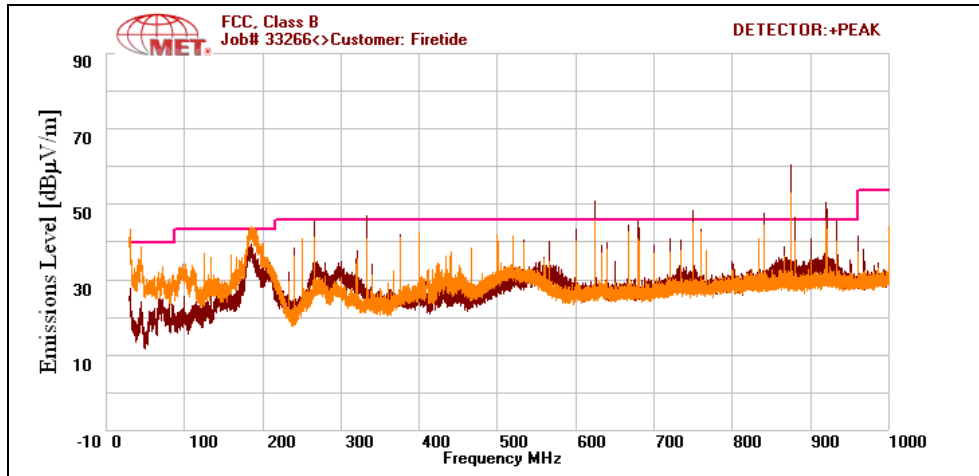


**Plot 192. Radiated Spurs, Mid Channel, 802.11a, 9 dBi Omni**

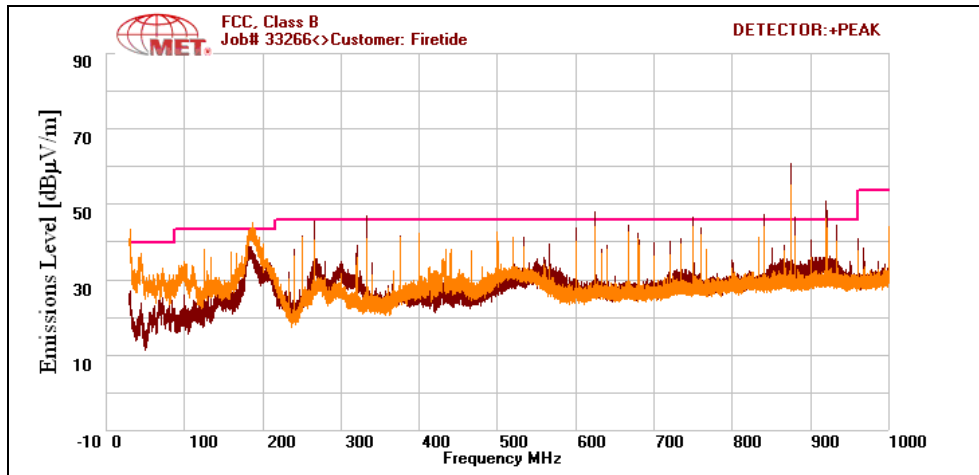


**Plot 193. Radiated Spurs, High Channel, 802.11a, 9 dBi Omni**

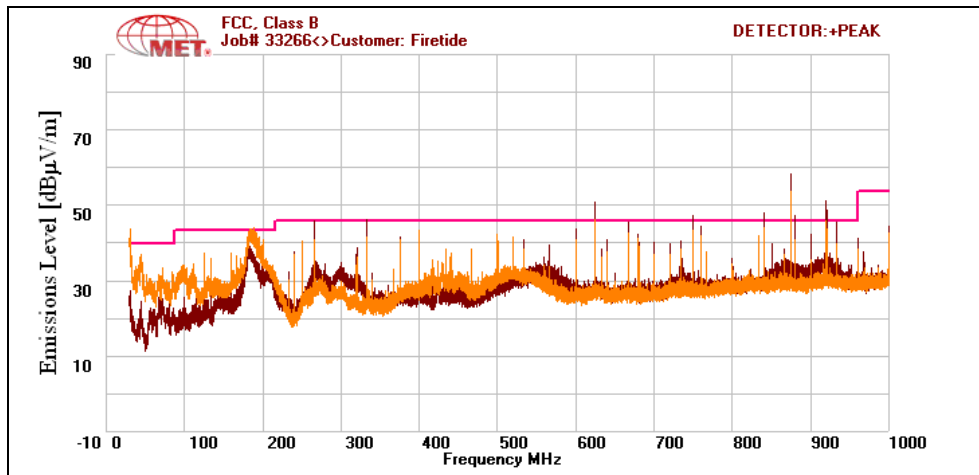
### Radiated Spurious Emissions, 802.11n 5 MHz, 9 dBi Omni



Plot 194. Radiated Spurs, Low Channel, 802.11n 5 MHz, 9 dBi Omni

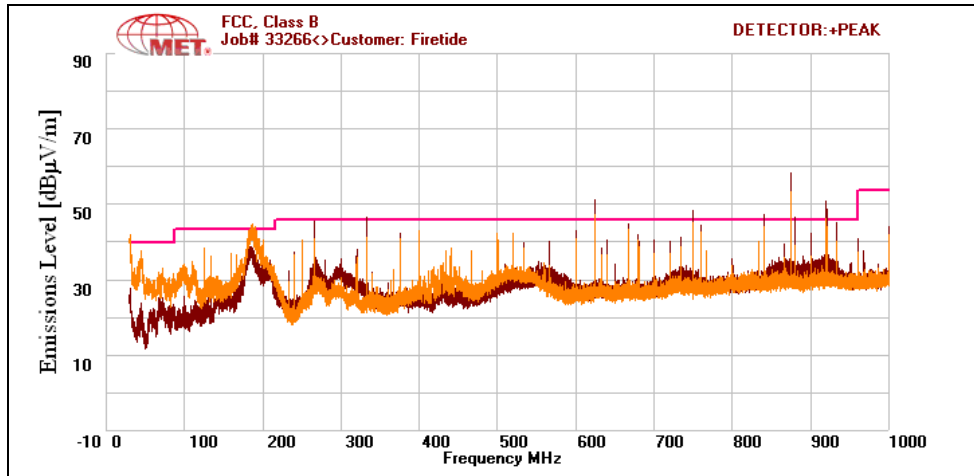


Plot 195. Radiated Spurs, Mid Channel, 802.11n 5 MHz, 9 dBi Omni

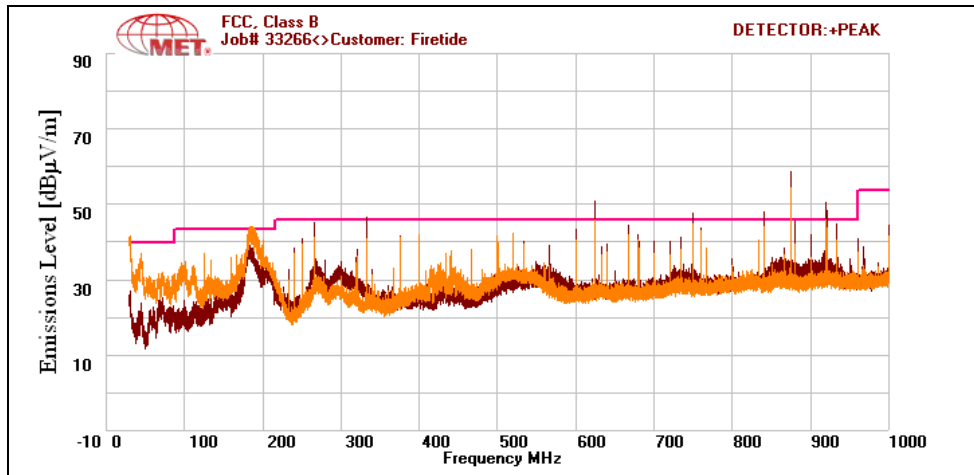


Plot 196. Radiated Spurs, High Channel, 802.11n 5 MHz, 9 dBi Omni

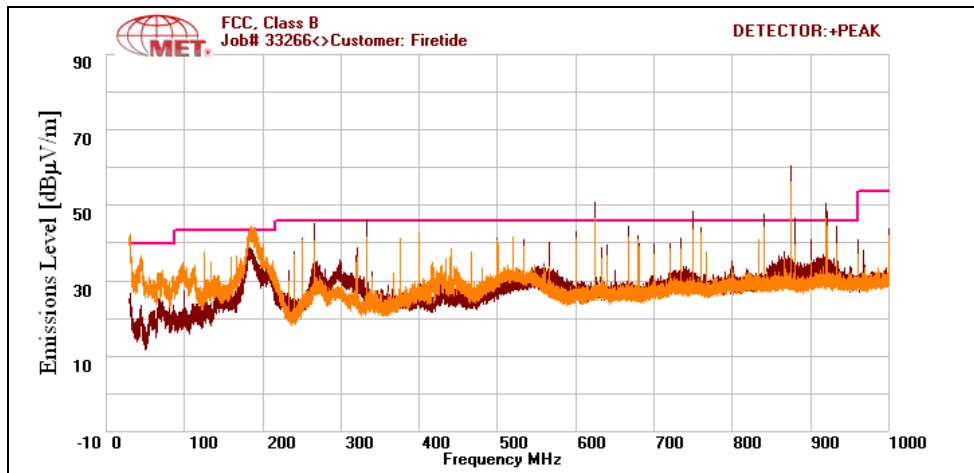
**Radiated Spurious Emissions, 802.11n 10 MHz, 9 dBi Omni**



**Plot 197. Radiated Spurs, Low Channel, 802.11n 10 MHz, 9 dBi Omni**



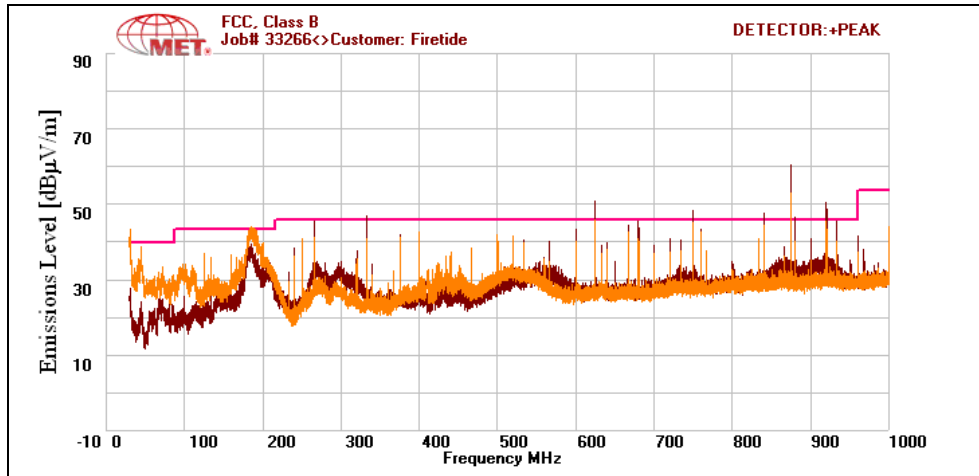
**Plot 198. Radiated Spurs, Mid Channel, 802.11n 10 MHz, 9 dBi Omni**



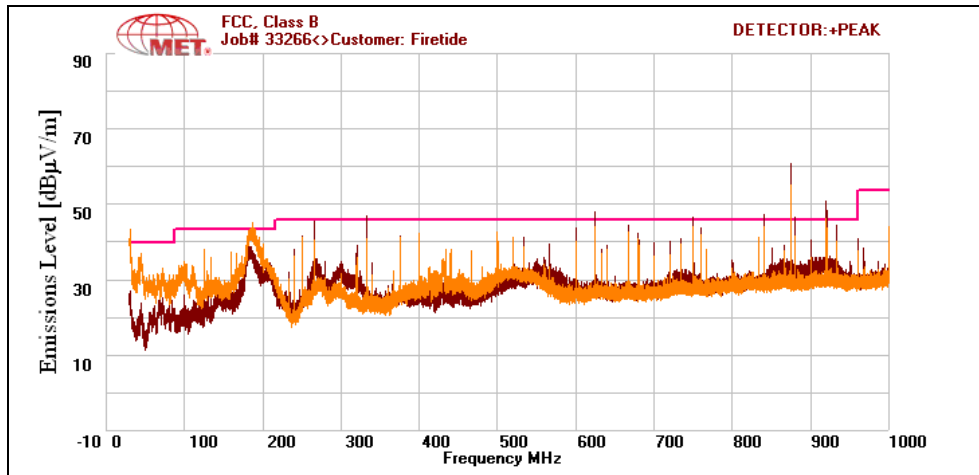
**Plot 199. Radiated Spurs, High Channel, 802.11n 10 MHz, 9 dBi Omni**



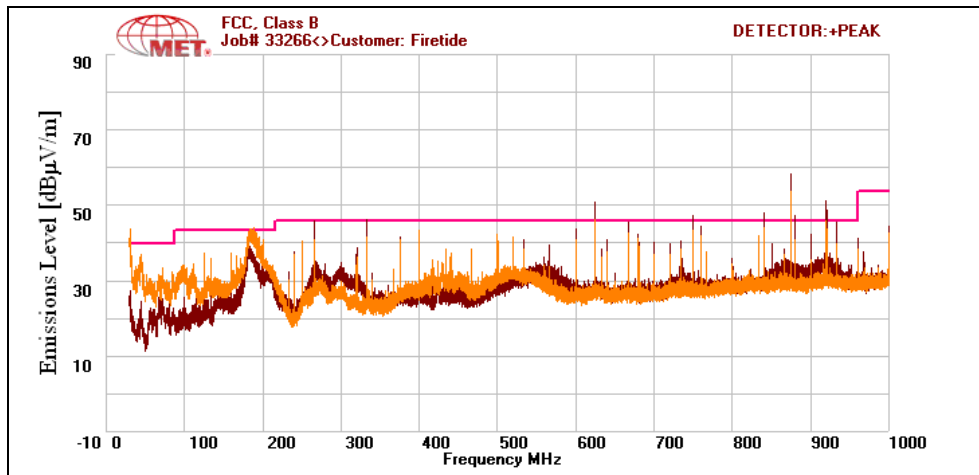
**Radiated Spurious Emissions, 802.11n 20 MHz, 9 dBi Omni**



**Plot 200. Radiated Spurs, Low Channel, 802.11n 20 MHz, 9 dBi Omni**

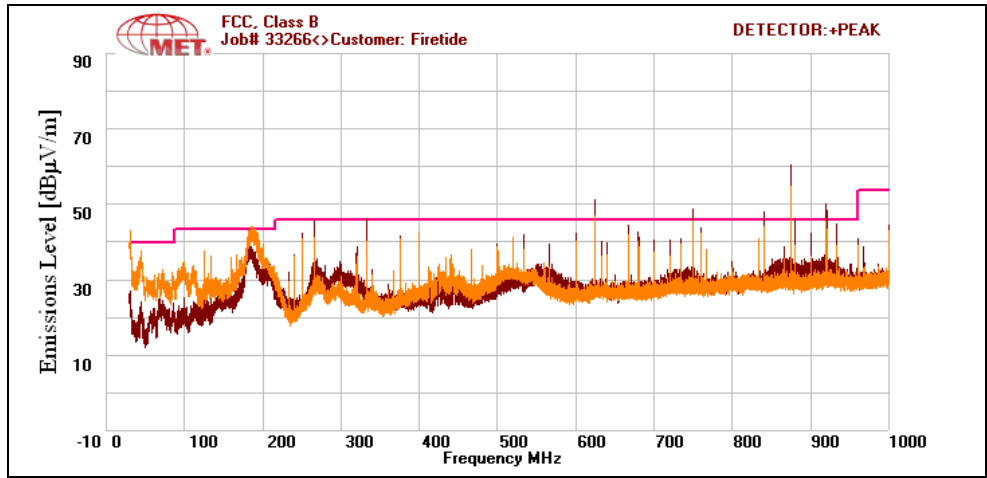


**Plot 201. Radiated Spurs, Mid Channel, 802.11n 20 MHz, 9 dBi Omni**

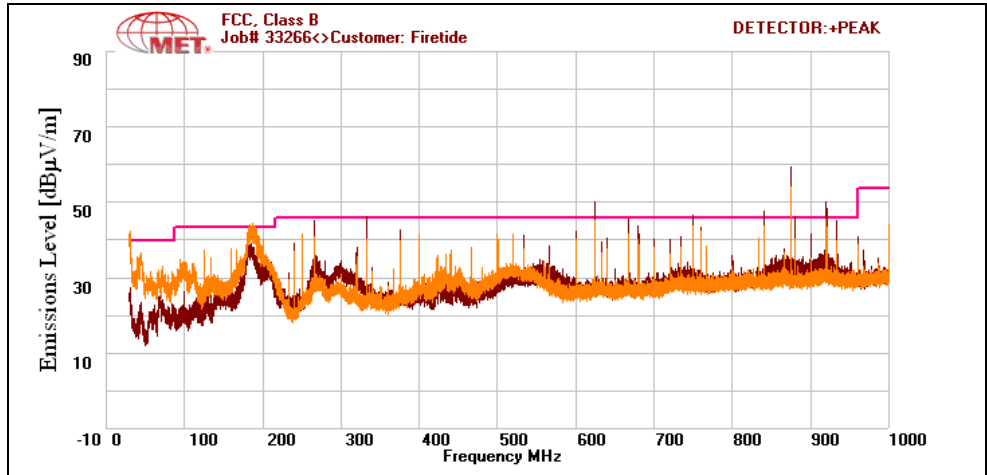


**Plot 202. Radiated Spurs, High Channel, 802.11n 20 MHz, 9 dBi Omni**

**Radiated Spurious Emissions, 802.11n 40 MHz, 9 dBi Omni**

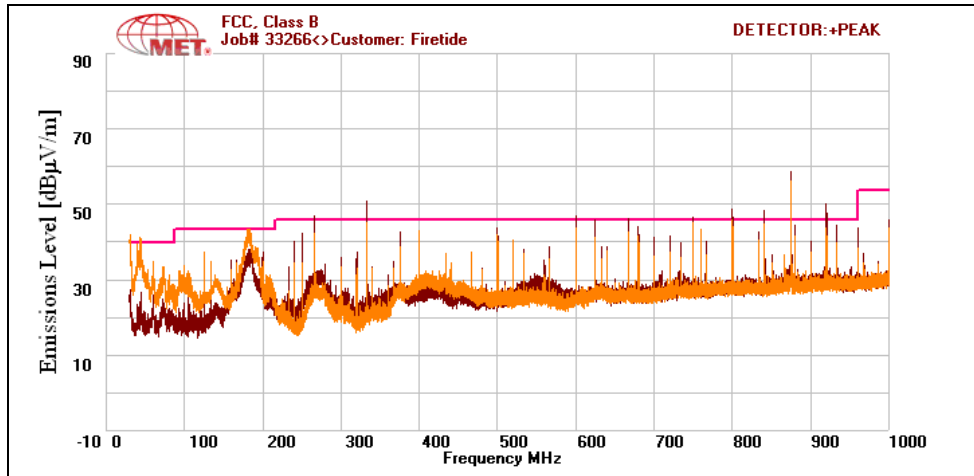


**Plot 203. Radiated Spurs, Low Channel, 802.11n 40 MHz, 9 dBi Omni**

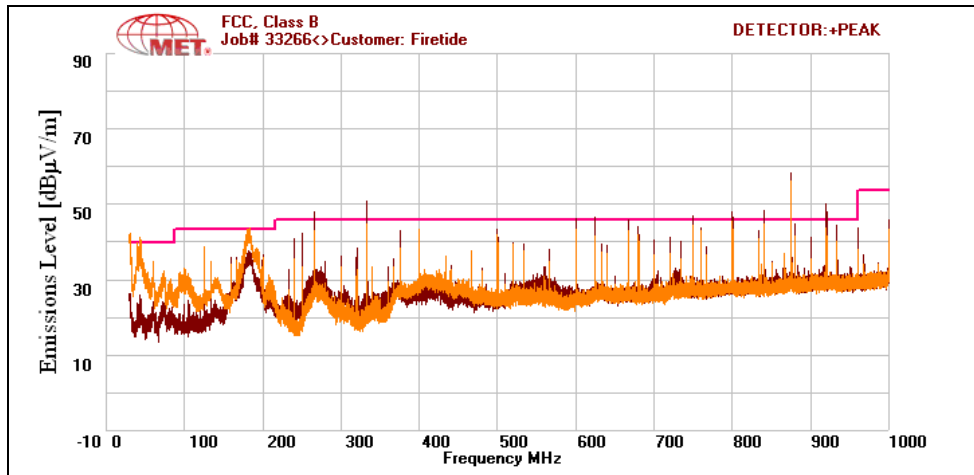


**Plot 204. Radiated Spurs, High Channel, 802.11n 40 MHz, 9 dBi Omni**

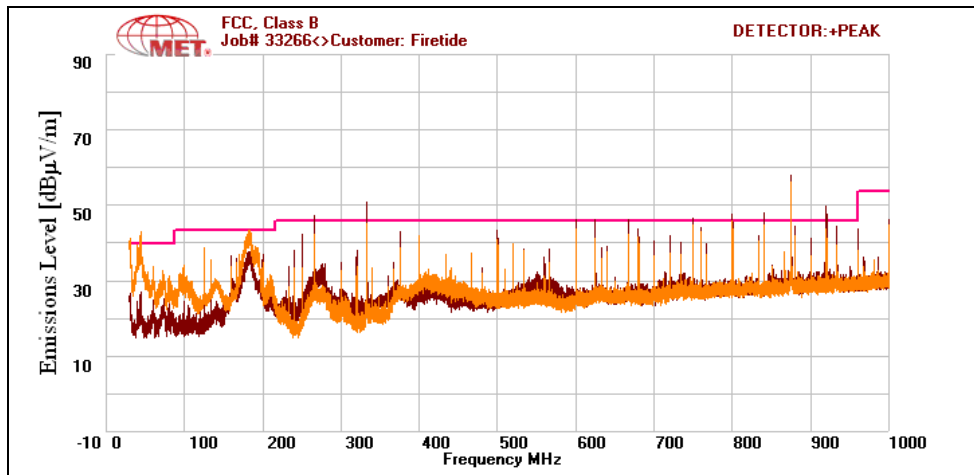
### Radiated Spurious Emissions, 802.11a, 15 dBi Sector



Plot 205. Radiated Spurs, Low Channel, 802.11a, 15 dBi Sector

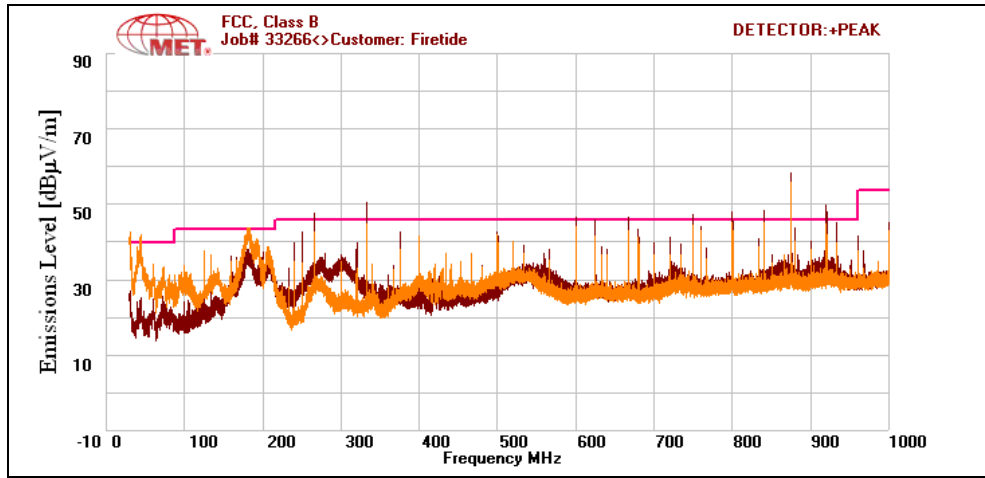


Plot 206. Radiated Spurs, Mid Channel, 802.11a, 15 dBi Sector

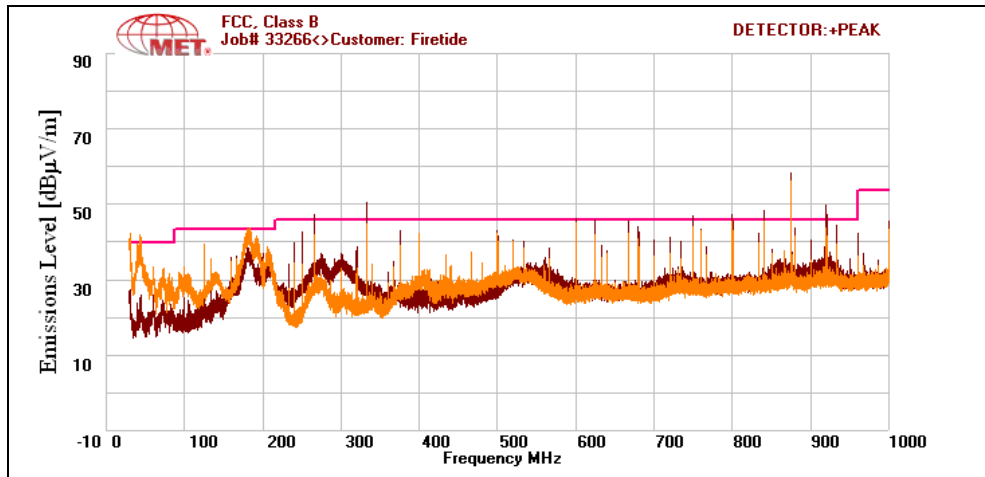


Plot 207. Radiated Spurs, High Channel, 802.11a, 15 dBi Sector

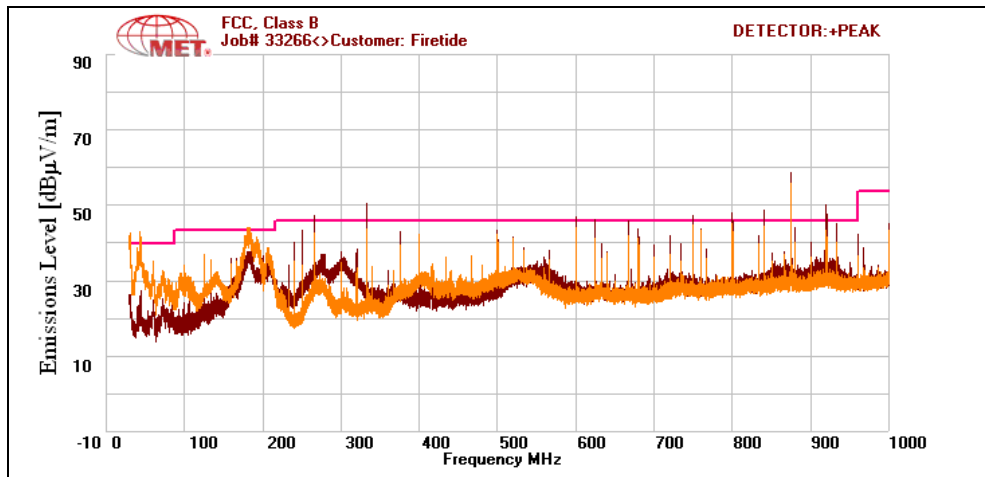
### Radiated Spurious Emissions, 802.11n 5 MHz, 15 dBi Sector



Plot 208. Radiated Spurs, Low Channel, 802.11n 5 MHz, 15 dBi Sector

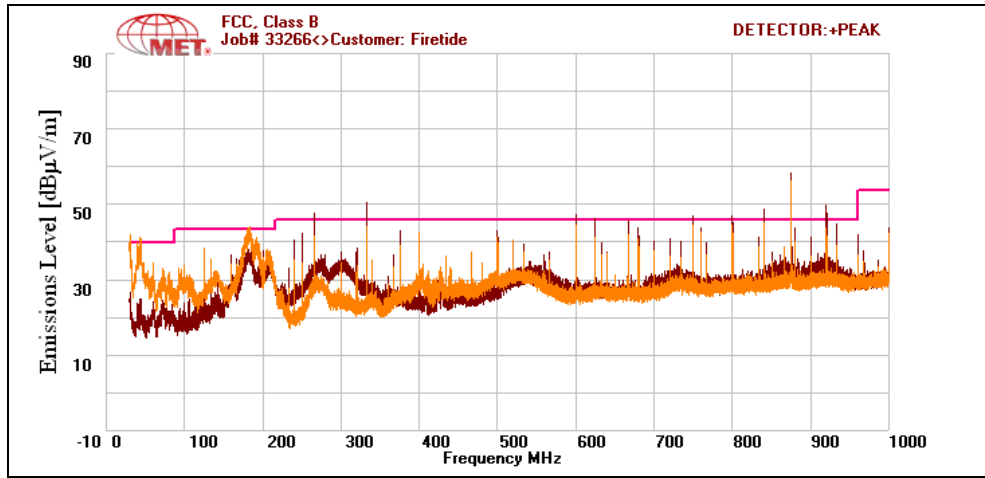


Plot 209. Radiated Spurs, Mid Channel, 802.11n 5 MHz, 15 dBi Sector

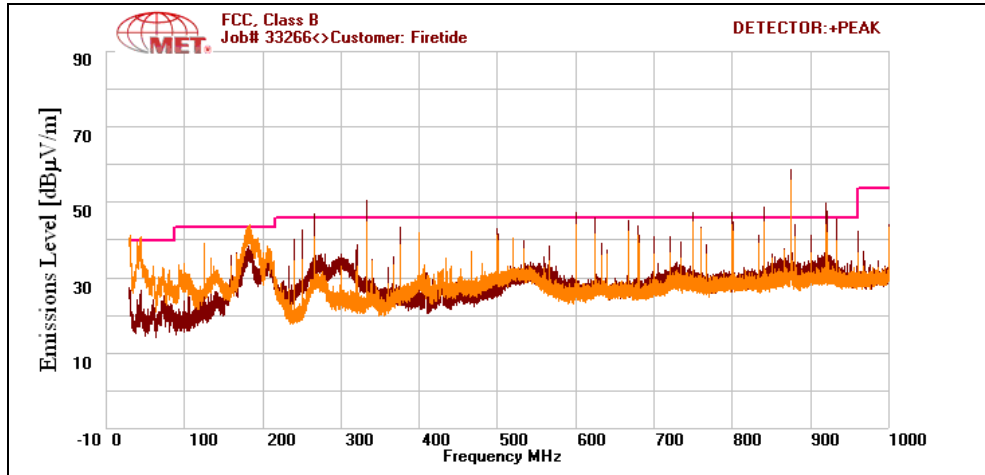


Plot 210. Radiated Spurs, High Channel, 802.11n 5 MHz, 15 dBi Sector

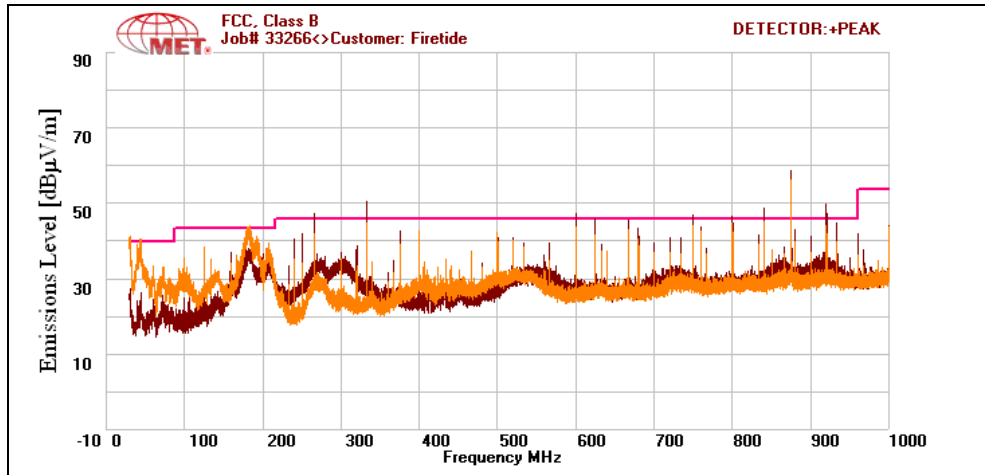
### Radiated Spurious Emissions, 802.11n 10 MHz, 15 dBi Sector



Plot 211. Radiated Spurs, Low Channel, 802.11n 10 MHz, 15 dBi Sector

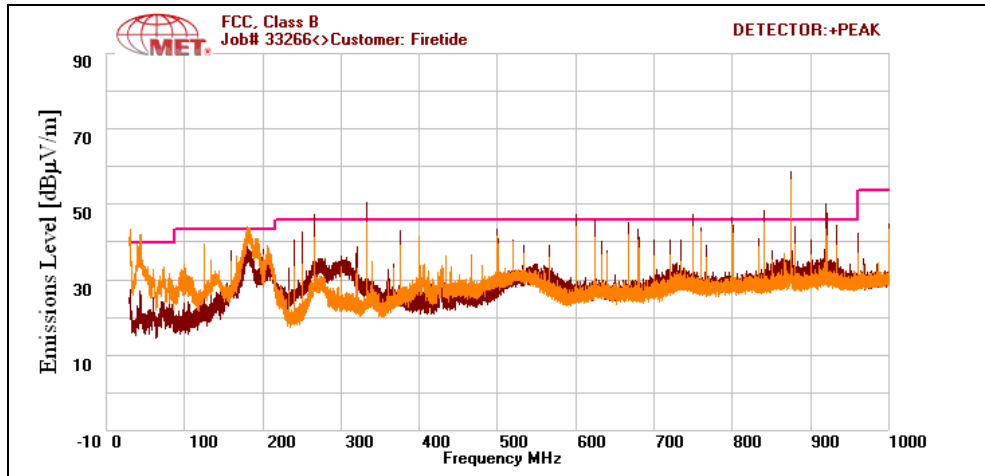


Plot 212. Radiated Spurs, Mid Channel, 802.11n 10 MHz, 15 dBi Sector

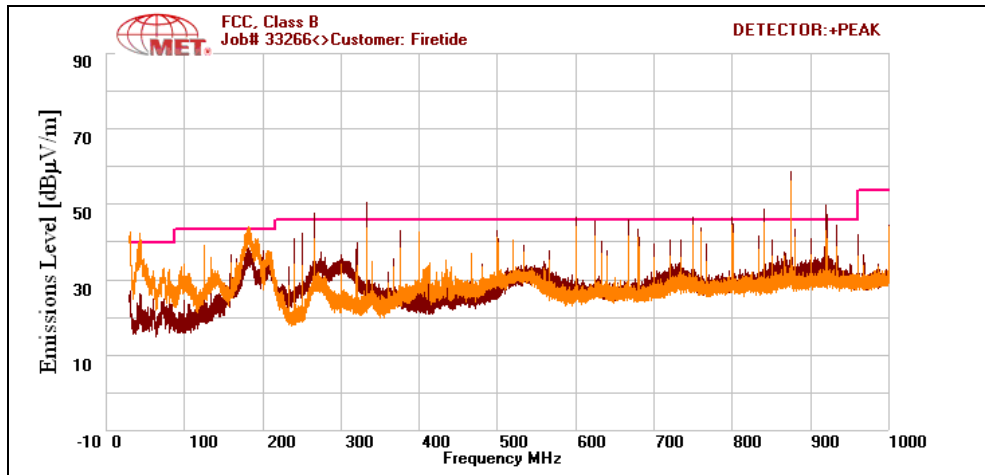


Plot 213. Radiated Spurs, High Channel, 802.11n 10 MHz, 15 dBi Sector

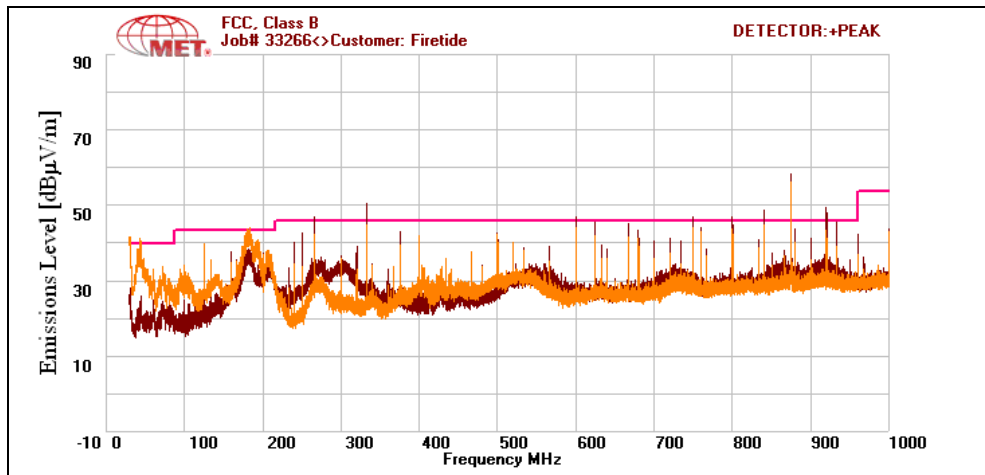
**Radiated Spurious Emissions, 802.11n 20 MHz, 15 dBi Sector**



**Plot 214. Radiated Spurs, Low Channel, 802.11n 20 MHz, 15 dBi Sector**



**Plot 215. Radiated Spurs, Mid Channel, 802.11n 20 MHz, 15 dBi Sector**



**Plot 216. Radiated Spurs, High Channel, 802.11n 20 MHz, 15 dBi Sector**