MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
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September 19, 2013

Firetide, Inc.
2105 South Bascom Ave., Suite 220
Campbell, CA 95008

Dear Pramod Akkarachittor,

Enclosed is the EMC Wireless test report for compliance testing of the Firetide, Inc., HotPort 5020 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 5 August 2012 for Unintentional Radiators, and Part 15.407 Subpart E and RSS-210, Issue 8, Dec. 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.\EMCS38293A-FCC407 UNII 3 Rev. 2)

Electromagnetic Compatibility Criteria
Test Report

for the

Firetide, Inc.
Model HotPort 5020 Wireless Mesh Node

Tested under
the Certification Rules
contained in
Title 47 of the CFR, Part 15, Subpart B& ICES-003
for Unintentional Radiators
and
15.407 Subpart E & & RSS-210, Issue 8, Dec. 2010
for Intentional Radiators

MET Report: EMCS38293A-FCC407 UNII 3 Rev. 2

September 19, 2013

Prepared For:

Firetide, Inc.
2105 South Bascom Ave., Suite 220
Campbell, CA 95008

Prepared By:
MET Laboratories, Inc.
3162 Belick St.
Santa Clara, CA 95054

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for Intentional Radiators

Aaron Chang, Project Engineer
Electromagnetic Compatibility Lab

Jennifer Warnell
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of FCC Rules Parts 15B, 15.407 and Industry Canada standards ICES-003, Issue 5 August 2012, RSS-210, Issue 8, Dec. 2010 under normal use and maintenance.

Asad Bajwa,
Director, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	August 6, 2013	Initial Issue.
1	September 9, 2013	Revised to reflect customer corrections.
2	September 19, 2013	Revised to correct test setup photo.

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List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci**b**els
dBµA	**D**eci**b**els above one **micro**amp
dBµV	**D**eci**b**els above one **micro**volt
dBµA/m	**D**eci**b**els above one **micro**amp **per m**eter
dBµV/m	**D**eci**b**els above one **micro**volt **per m**eter
DC	**D**irect **C**urrent
E	**E**lectric Field
DSL	**D**igital **S**ubscriber **L**ine
ESD	**E**lectro**s**tatic **D**ischarge
EUT	**E**quipment **U**nder **T**est
f	**F**requency
FCC	**F**ederal **C**ommunications **C**ommission
GRP	**G**round **R**eference **P**lane
H	Magnetic Field
HCP	**H**orizontal **C**oupling **P**lane
Hz	**H**ert**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**ert**z**
kPa	**k**ilo**pa**scal
kV	**k**ilo**v**olt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**microh**enry
µ	**microf**arad
µs	**micros**econds
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
TWT	**T**raveling **W**ave **T**ube
V/m	**V**olts **per m**eter
VCP	**V**ertical **C**oupling **P**lane

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Firetide, Inc. HotPort 5020 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 HotPort 5020 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 HotPort 5020 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 3522. All tests were conducted using measurement procedure ANSI C63.4-2003.

FCC Reference	IC Reference RSS-210 Issue 8: 2010; RSS-GEN Issue 3: 2010	Description	Results
47 CFR Part 15.107 (a)	ICES-003 Issue 5 August 2012	Conducted Emission Limits for a Class A Digital Device	Compliant
47 CFR Part 15.109 (a)	ICES-003 Issue 5 August 2012	Radiated Emission Limits for a Class A Digital Device	Compliant
Title 47 of the CFR, Part 15 §15.203	N/A	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15 §15.207(a)	RSS-GEN (7.2.4)	Conducted Emission Limits	Compliant
Title 47 of the CFR, Part 15 §15.403 (i)	RSS-Gen (4.6)	26dB Occupied Bandwidth	Compliant
		99% Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15 §15.407 (a)(3)	RSS-210 (A9.2)	Conducted Transmitter Output Power	Compliant
Title 47 of the CFR, Part 15 §15.407 (a)(2)	RSS-210 (A8.2)	Power Spectral Density	Compliant
Title 47 of the CFR, Part 15 §15.407 (a)(6)	N/A	Peak Excursion	Compliant
Title 47 of the CFR, Part 15 §15.407 (b)(4), (5), (6)	RSS-210 (A9.2)	Undesirable Emissions (15.205/15.209 - General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Compliant
Title 47 of the CFR, Part 15 §15.407(f)	RSS-102 (4.1)	RF Exposure	Compliant

Table 1. Executive Summary of EMC Part 15.407 ComplianceTesting

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Firetide, Inc. to perform testing on the HotPort 5020 Wireless Mesh Node, under Firetide, Inc.'s purchase order number 3522.

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. HotPort 5020 Wireless Mesh Node.

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

Model(s) Tested:	HotPort 5020 Wireless Mesh Node		
Model(s) Covered:	HotPort 5020E, 5020ER, 5020LNK, 5020M		
EUT Specifications:	Primary Power: 120 VAC, 60 Hz		
	FCC ID: REP-5020-1 IC: 4988A-5020		
	Type of Modulations:	OFDM	
	Emission Designators:	D7D	
	Equipment Code:	NII	
	R.F. Power:	802.11n 20MHz:	21.86 dBm
		802.11n 40MHz:	22.78 dBm
	EUT Frequency Ranges:	5745 MHz – 5805MHz	
Analysis:	The results obtained relate only to the item(s) tested.		
Environmental Test Conditions:	Temperature: 15-35º C		
	Relative Humidity: 30-60%		
	Barometric Pressure: 860-1060 mbar		
Evaluated by:	Aaron Chang		
Report Date(s):	September 19, 2013		

Table 2. EUT Summary

B. References

CFR 47, Part 15, Subpart B	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
CFR 47, Part 15, Subpart E	Unlicensed National Information Infrastructure Devices (UNII)
RSS-210, Issue 8, Dec. 2010	Low-power Licence-exempt Radiocommunications Devices (All Frequency Bands): Category I Equipment
RSS-GEN, Issue 3, Dec. 2010	General Requirements and Information for the Certification of Radio Apparatus
ICES-003, Issue 5 August 2012	Information Technology Equipment (ITE) — Limits and methods of measurement
ANSI C63.4:2003	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ISO/IEC 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2009	American National Standard for Testing Unlicensed Wireless Devices

Table 3. References

C. Test Site

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

Radiated Emissions measurements were performed in a 10 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

D. Description of Test Sample

The Firetide, Inc. HotPort 5020 Wireless Mesh Node, Equipment Under Test (EUT), is a member of Firetide's HotPort family of wireless mesh nodes. Firetide mesh network gives you the convenience of a wired-Ethernet switch combined with the flexibility of wireless technology in the 2.4, 4.9 (public safety), and 5 GHz bands in MIMO environment ,satisfies the demands of high-bandwidth/low-latency applications, such as video, voice, and data. The EUT has two identical radios which are not co-located.

The HotPort 5020 powered using external AC-PoE power adapter which operates from 100~230V and provides 56 VDC output to the EUT. The EUT may alternatively be powered by an external AC-DC power adapter which operates from 100~230V and provides 15 VDC output to the EUT.

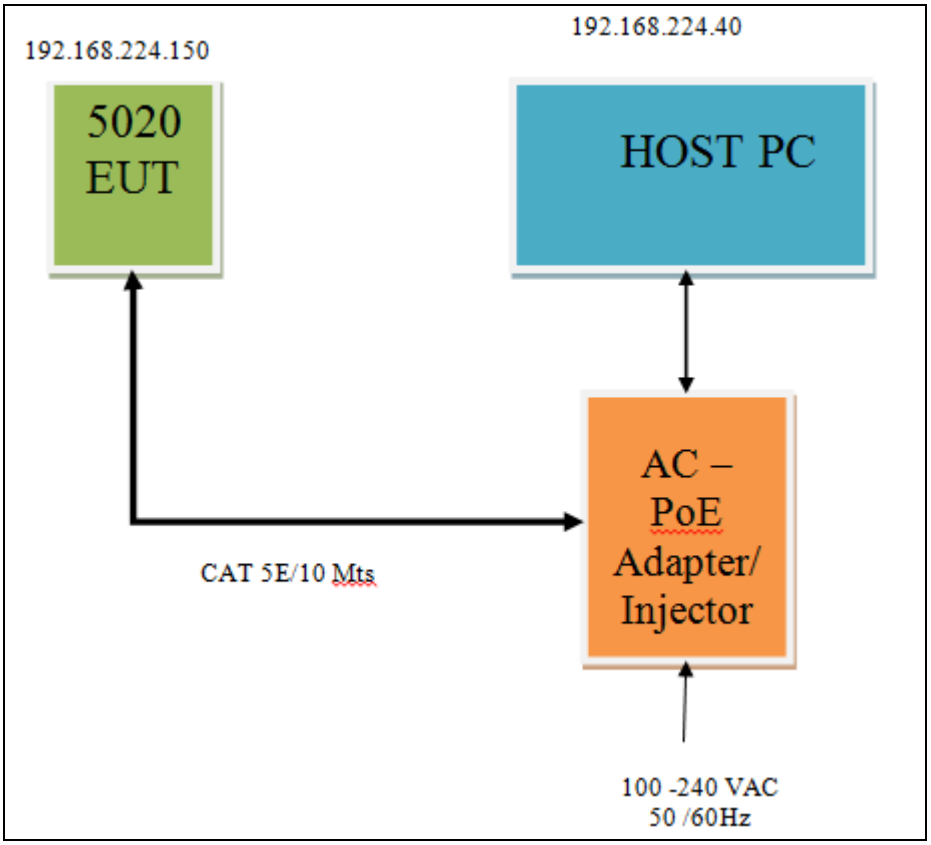


Figure 1. Block Diagram of Test Configuration, 1

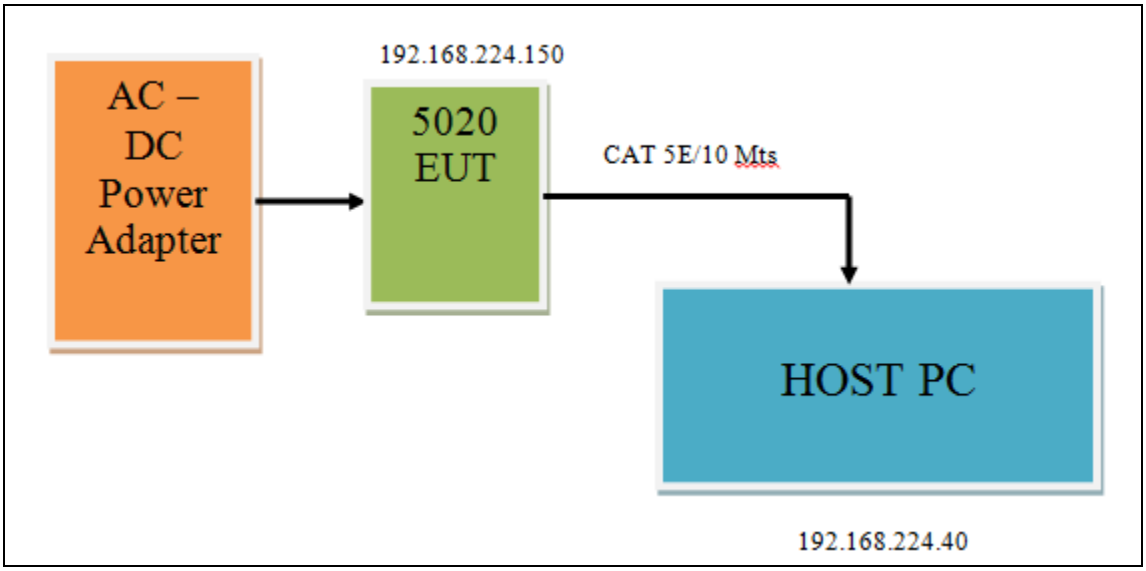


Figure 2. Block Diagram of Test Configuration, 2

E. Equipment Configuration

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

Ref. ID	Slot #	Name / Description	Model Number	Part Number	Serial Number	Rev. #
A	Chassis	Wireless Mesh Node	HotPort 5020	130-0094-001	WV6011235503291	1
B	N/A	External DC Adapter	HON-KWANG	HK-D532-A16	K0000003353	--
C	N/A	PoE Adapter	Phihong	POE30U-560(G)	P15000113D1	--

Table 4. Equipment Configuration

F. Support Equipment

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

Ref. ID	Name / Description	Manufacturer	Model Number	Customer Supplied Calibration Data
D	Laptop	Sony	N/A	N/A

Table 5. Support Equipment

G. Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty.	Length as tested (m)	Max Length (m)	Shielded (Y/N)	Termination Box ID & Port Name
E	Ethernet Port	RJ45	1	5	>100	N	RJ45 Port and Cable
F	DC Power Input Port	6-PIN DIN Cable	1	8	>100	Y	DC Power Source

Table 6. Ports and Cabling Information

H. Mode of Operation

Once the DC power is applied to the EUT, an 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. Both the radios will be disabled.

I. Method of Monitoring EUT Operation

HotPort5020 will be used for wireless mesh node application and all the 5020 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 (dBµV)		*Class B Conducted Limits (dBµV)	
	Quasi-Peak	Average	Quasi-Peak	Average
* 0.15- 0.45	79	66	66 - 56	56 - 46
0.45 - 0.5	79	66	56	46
0.5 - 30	73	60	60	50
Note 1 — The lower limit shall apply at the transition frequencies. Note 2 — The limit decreases linearly with the logarithm if the frequency in the range 0.15 MHz to 0.5 MHz.				

Table 7. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(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, test conditions, and test procedures of ANSI C63.4 were used. The EUT was powered through a 50Ω/50µH LISN. An EMI receiver, connected to the measurement port of the LISN, scanned the frequency range from 150 kHz to 30 MHz in order to find the peak conducted emissions. All peak emissions within 6 dB of the limit were re-measured using a quasi-peak and/or average detector as appropriate.

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

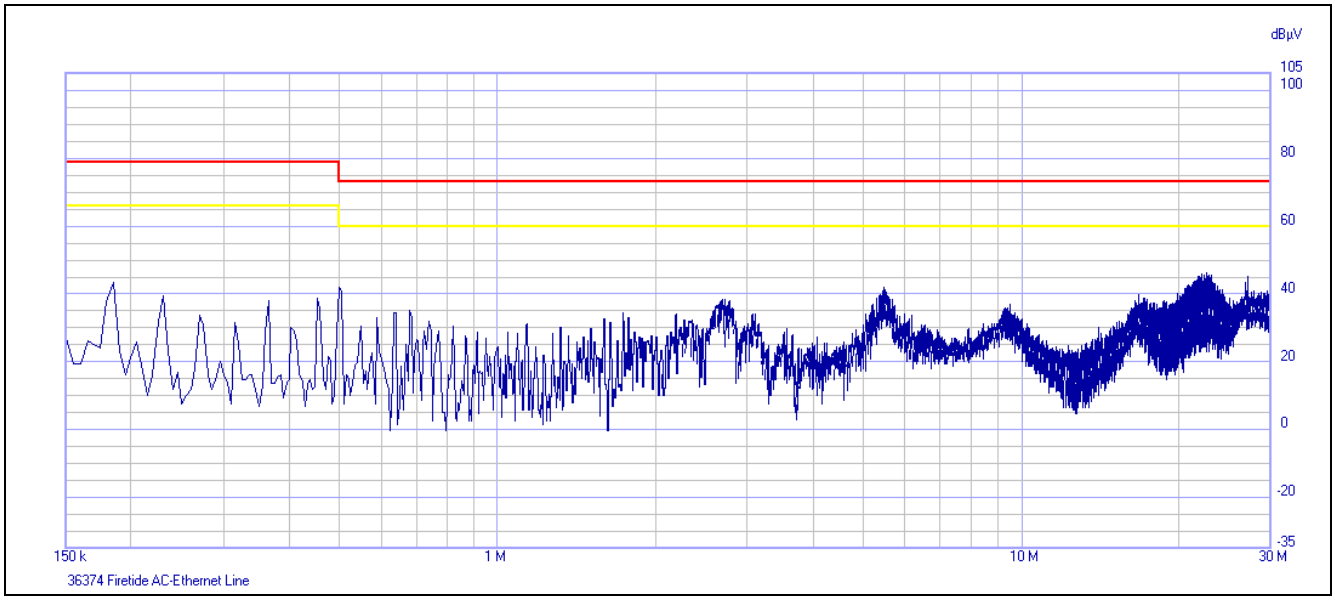
Test Engineer(s): Joseph Mendoza

Test Date(s): 10/5/2012 & 10/10/2012

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

Freq. (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
.185	42.47	79	-36.53	Pass	39.89	66	-26.11	Pass
.5	41.38	73	-31.62	Pass	39.78	60	-20.22	Pass
2.66	35.43	73	-37.57	Pass	29.83	60	-30.17	Pass
5.455	43.35	73	-29.65	Pass	24.52	60	-35.48	Pass
22.405	43	73	-30	Pass	37.97	60	-22.03	Pass
27	45.54	73	-27.46	Pass	42.68	60	-17.32	Pass

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

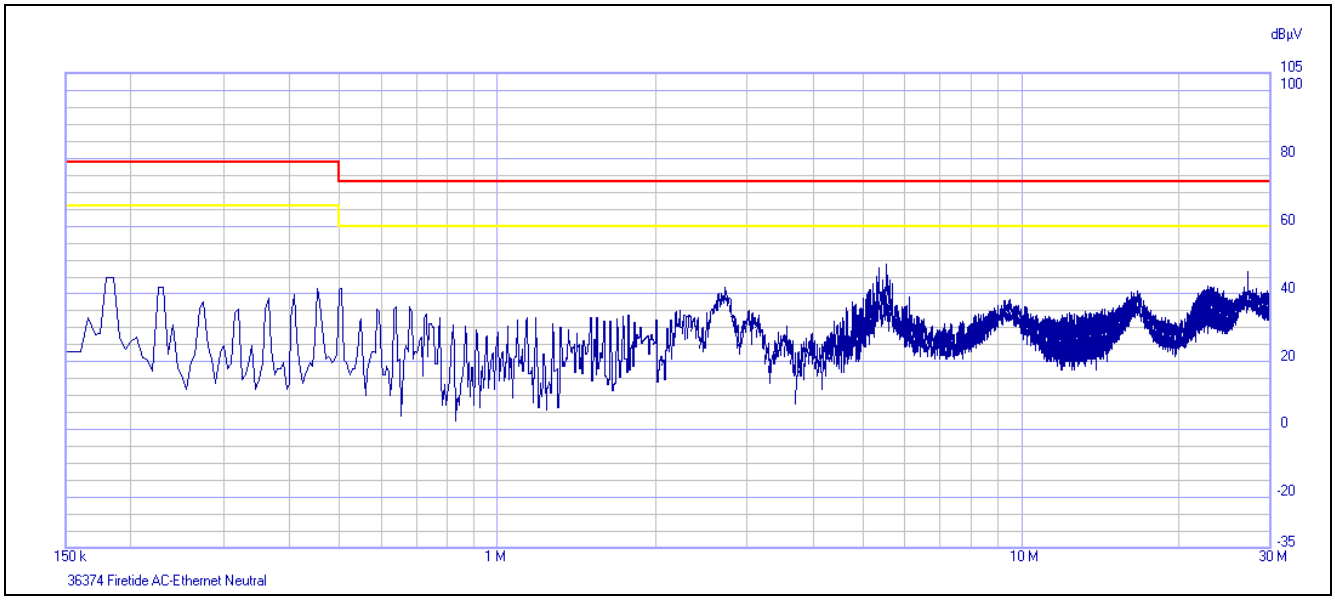


Plot 1. Conducted Emissions, Phase Line, PoE Adapter

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

Freq. (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
.18	43.49	79	-35.51	Pass	41.78	66	-24.22	Pass
.455	40.05	79	-38.95	Pass	38.81	66	-27.19	Pass
1.23	32.48	73	-40.52	Pass	30.37	60	-29.63	Pass
2.71	36.1	73	-36.9	Pass	30.34	60	-29.66	Pass
5.515	40.97	73	-32.03	Pass	34.75	60	-25.25	Pass
27	45.62	73	-27.38	Pass	43	60	-17	Pass

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

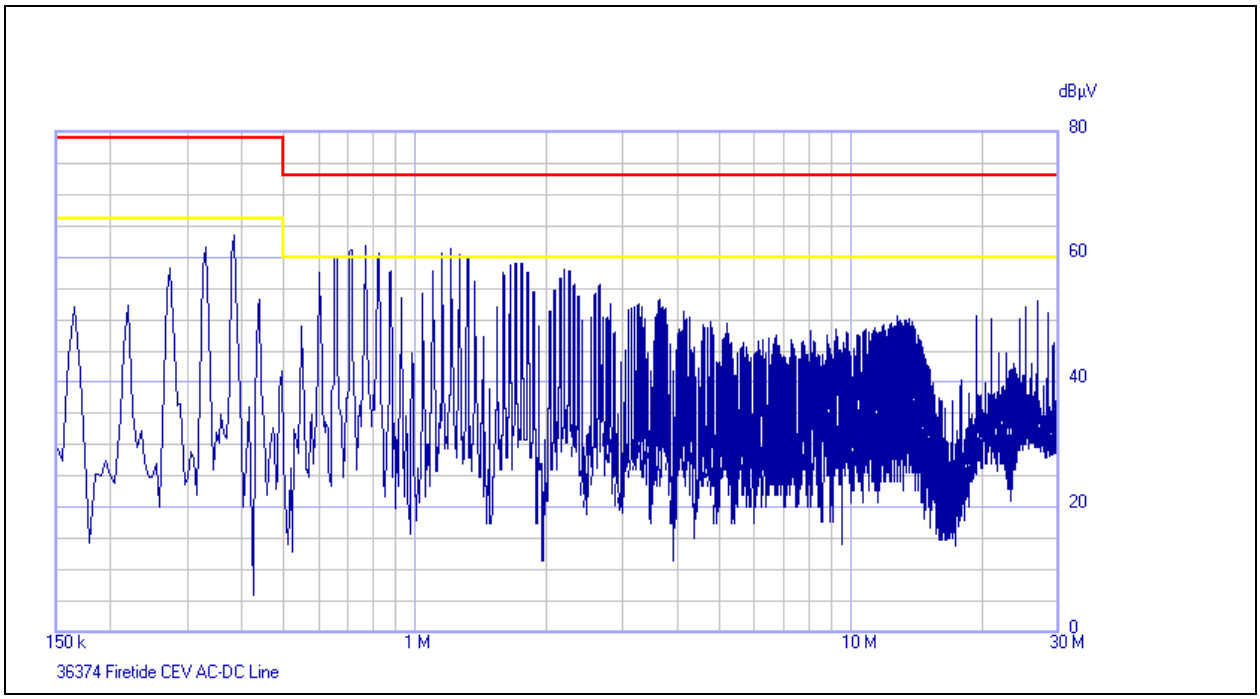


Plot 2. Conducted Emissions, Neutral Line, PoE Adapter

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

Freq. (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
.33	61.46	79	-17.54	Pass	58.64	66	-7.36	Pass
.385	62.88	79	-16.12	Pass	60.08	66	-5.92	Pass
.715	60.61	73	-12.39	Pass	57.39	60	-2.61	Pass
.77	61.16	73	-11.84	Pass	58.08	60	-1.92	Pass
.825	59.92	73	-13.08	Pass	56.94	60	-3.06	Pass
1.15	60.26	73	-12.74	Pass	57.14	60	-2.86	Pass
1.205	60.88	73	-12.12	Pass	57.86	60	-2.14	Pass
1.26	59.98	73	-13.02	Pass	56.97	60	-3.03	Pass

Table 10. Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz), DC Adapter

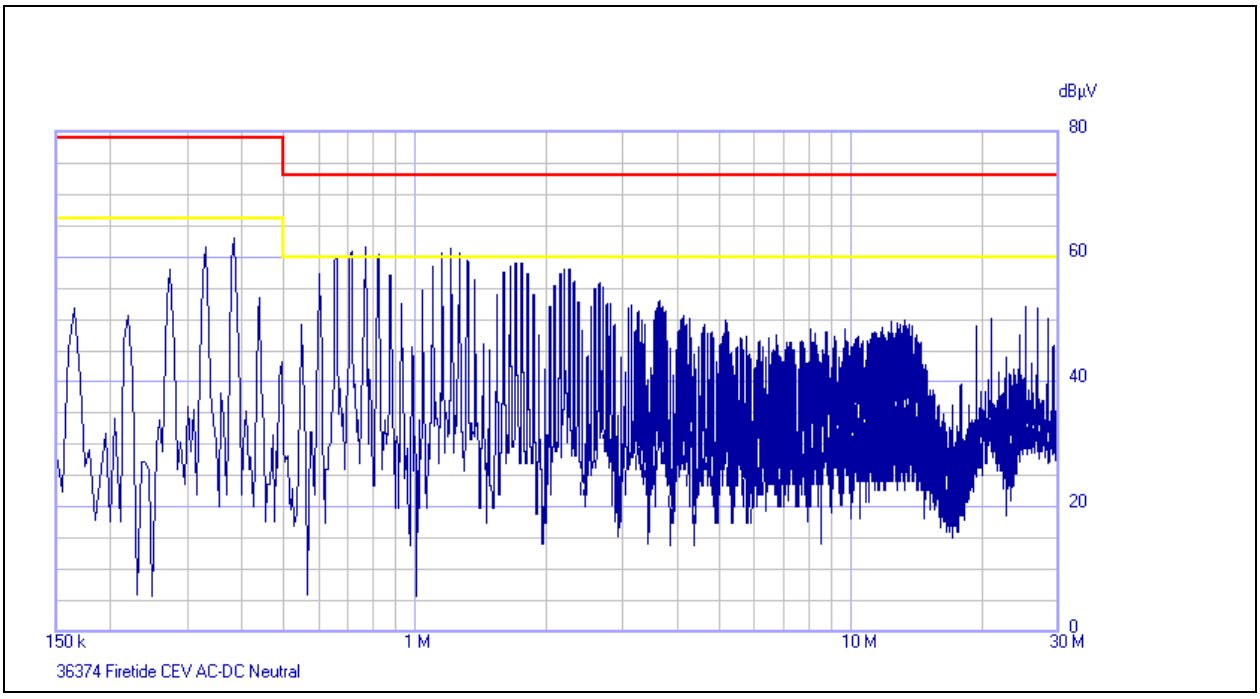


Plot 3. Conducted Emissions, Phase Line, DC Adapter

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

Freq. (MHz)	QP Amplitude	QP Limit	Delta	Results	Average Amplitude	Average Limit	Delta	Results
.33	61.4	79	-17.6	Pass	58.67	66	-7.33	Pass
.385	62.71	79	-16.29	Pass	59.93	66	-6.07	Pass
.715	60.55	73	-12.45	Pass	57.66	60	-2.34	Pass
.77	61.04	73	-11.96	Pass	58.02	60	-1.98	Pass
.825	60.55	73	-12.45	Pass	57.62	60	-2.38	Pass
1.15	60.41	73	-12.59	Pass	57.33	60	-2.67	Pass
1.205	60.74	73	-12.26	Pass	57.77	60	-2.23	Pass
1.26	59.75	73	-13.25	Pass	56.81	60	-3.19	Pass

Table 11. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz), PoE Adapter



Plot 4. Conducted Emissions, Neutral Line, DC Adapter

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 12.

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 12.

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

Table 12. 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.

Emissions measured at 3m were normalized using an inverse proportionality factor of 20dB per decade for comparison to the 10 m limit.

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

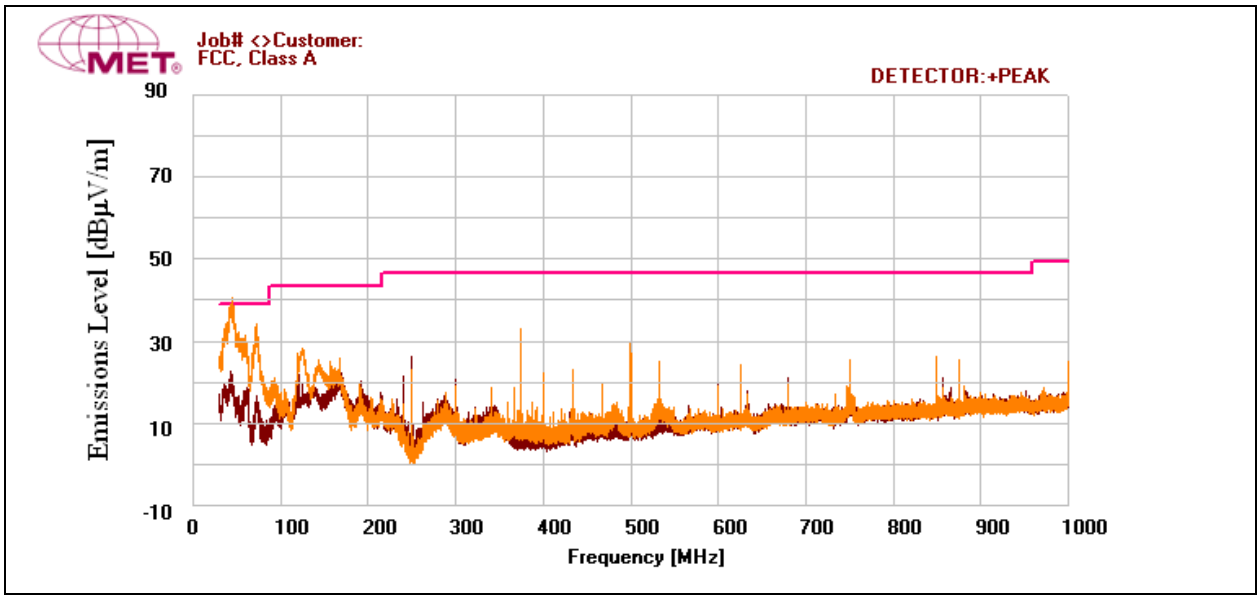
Test Engineer(s): Joseph Mendoza

Test Date(s): 10/5/2012 & 10/10/2012

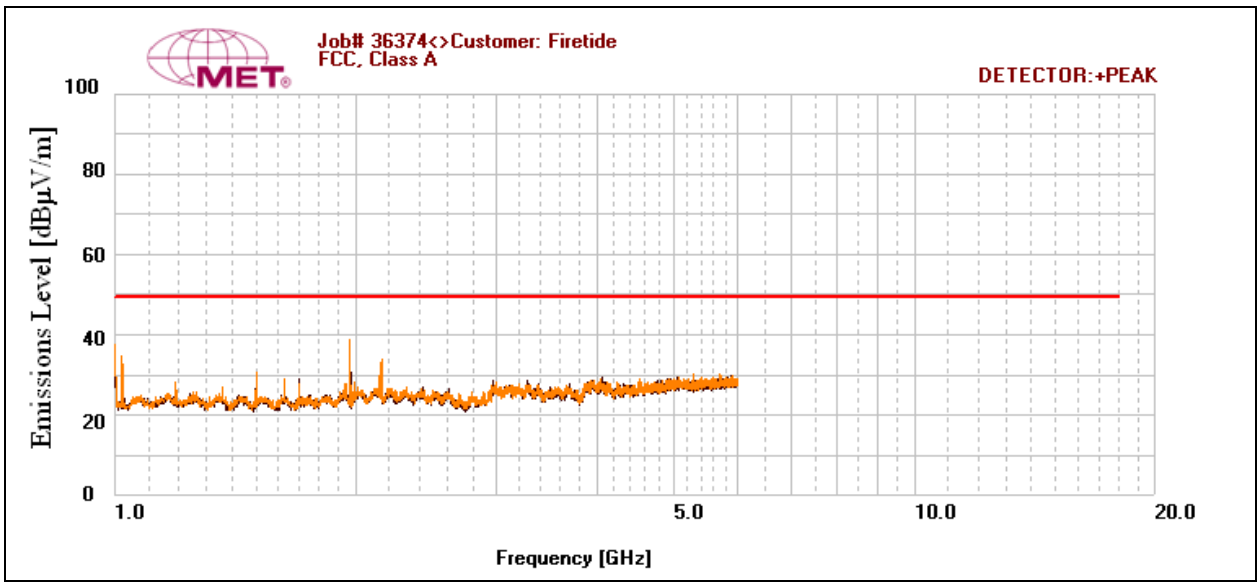
Radiated Emissions Limits Test Results, Class A

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBµV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
44.368	V	316	99	33.689	11.39	0	0.639	-10.46	35.258	39	-3.742
249.99	H	360	99	22.667	12.3	0	1.31	-10.46	25.817	46.4	-20.583
374.981	V	348	99	23.538	16.199	0	1.77	-10.46	31.047	46.4	-15.353
499.989	V	166	99	18.1	18.5	0	2.11	-10.46	28.25	46.4	-18.15
750.015	V	79	99	9.336	21.499	0	2.63	-10.46	23.005	46.4	-23.395
849.99	V	216	100	10.141	22.899	0	2.73	-10.46	25.31	46.4	-21.09
1000	V	205	100	74.74	22.075	56.682	4.513	-10.46	34.186	49.5	-15.314
1020	V	204	100	73.94	22.517	57.815	4.604	-10.46	32.786	49.5	-16.714
1962	V	267	100	74.48	27.906	62.194	7.888	-10.46	37.62	49.5	-11.88

Table 13. Radiated Emissions Limits, Test Results, 30 MHz – 6 GHz, FCC Limits, PoE Adapter



Plot 5. Radiated Emissions, 30 MHz - 1 GHz, FCC Limits, PoE Adapter



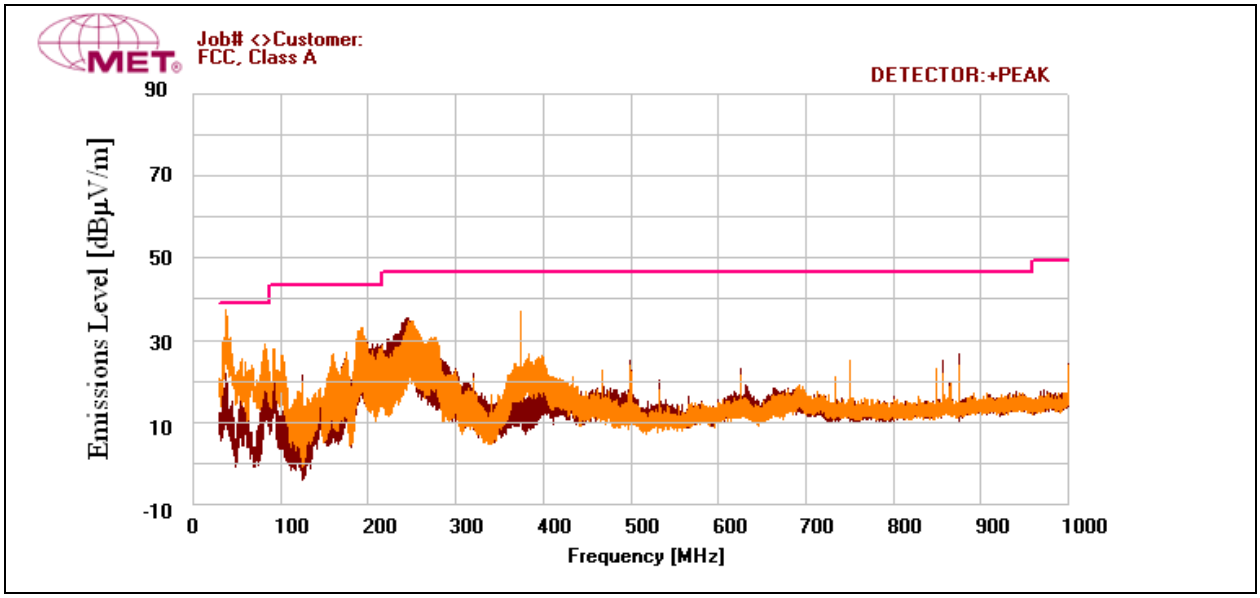
Plot 6. Radiated Emissions, Above 1 GHz, FCC Limits, PoE Adapter

Radiated Emissions Limits Test Results, Class A

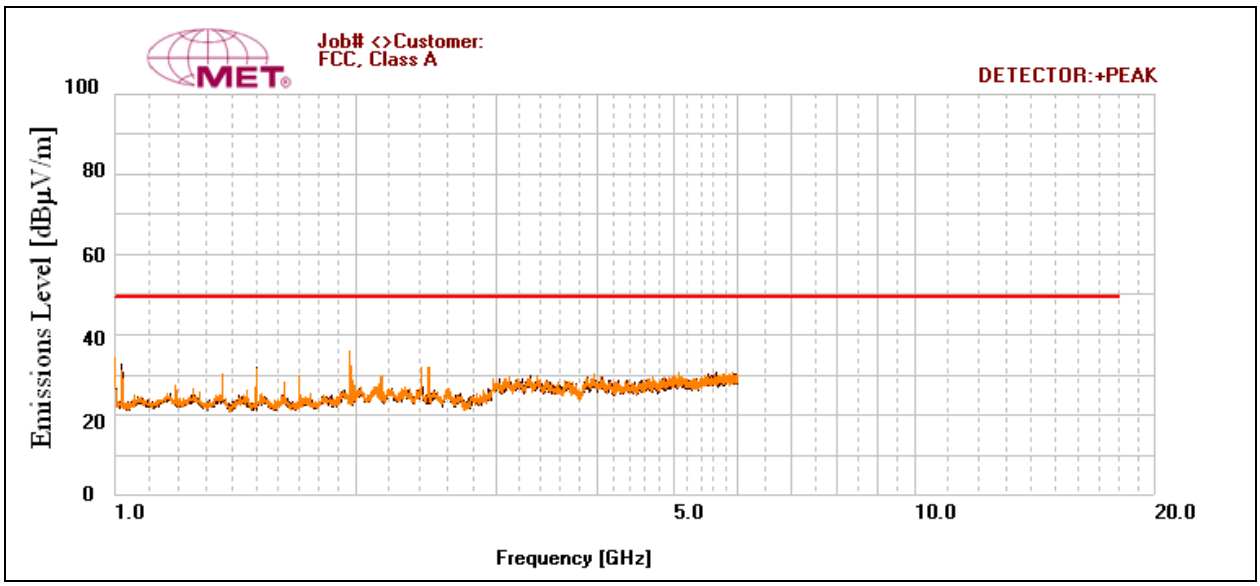
Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBµV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
*37.857	V	277	100	31.731	14.372	0	0.659	-10.46	36.302	39	-2.698
245.054	H	195	99	30.1	12.201	0	1.306	-10.46	33.147	46.4	-13.253
374.988	V	189	122	29.124	16.2	0	1.77	-10.46	36.634	46.4	-9.766
499.993	H	19	99	17.137	18.5	0	2.11	-10.46	27.287	46.4	-19.113
750.012	V	149	100	11.435	21.5	0	2.63	-10.46	25.105	46.4	-21.295
875.003	H	146	99	11.299	22.7	0	2.84	-10.46	26.379	46.4	-20.021
1000	V	143	187	71.18	22.075	56.682	4.513	-10.46	30.626	49.5	-18.874
1020	H	167	108	74.85	22.507	57.815	4.604	-10.46	33.686	49.5	-15.814
1962	V	343	187	71.95	27.906	62.194	7.888	-10.46	35.09	49.5	-14.41

Table 14. Radiated Emissions Limits, Test Results, 30 MHz – 6 GHz, FCC Limits, DC Adapter

Note: * - At this frequency, the measured electric-field strength exhibits a margin of compliance that is less than 3 dB below the specification limit. We recommend that every emission measured, have at least a 3 dB margin to allow for deviations in the emission characteristics that may occur during the production process.



Plot 7. Radiated Emissions, 30 MHz - 1 GHz, FCC Limits, DC Adapter



Plot 8. Radiated Emissions, Above 1 GHz, FCC Limits, DC Adapter

Radiated Emissions Limits Test Results, Class A

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBµV)	ACF (dB/m)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
44.368	V	316	1.00	33.69	11.39	0.64	10.46	35.26	40.00	-4.74
374.981	V	348	1.00	23.54	16.20	1.77	10.46	31.05	47.00	-15.95
249.99	H	360	1.00	22.67	12.30	1.31	10.46	25.82	47.00	-21.18
499.989	V	166	1.00	18.10	18.50	2.11	10.46	28.25	47.00	-18.75
750.015	V	79	1.00	9.34	21.50	2.63	10.46	23.01	47.00	-24.00
849.99	V	216	1.00	10.14	22.90	2.73	10.46	25.31	47.00	-21.69

Table 15. Radiated Emissions Limits, Test Results, ICES-003 Limits, PoE Adapter

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBµV)	ACF (dB/m)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
37.857	V	277	100.00	31.73	14.37	0.66	10.46	36.30	40.00	-3.70
245.054	H	195	99.00	30.10	12.20	1.31	10.46	33.15	47.00	-13.85
374.988	V	189	122.00	29.12	16.20	1.77	10.46	36.63	47.00	-10.37
499.993	H	19	99.00	17.14	18.50	2.11	10.46	27.29	47.00	-19.71
750.012	V	149	100.00	11.44	21.50	2.63	10.46	25.11	47.00	-21.90
875.003	H	146	99.00	11.30	22.70	2.84	10.46	26.38	47.00	-20.62

Table 16. Radiated Emissions Limits, Test Results, ICES-003 Limits, DC Adapter

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 unit will be professionally installed.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 12/17/09

Gain/Type	Model	Manufacturer
5dBi Omni (2.4GHz)	C812-510010-A	WHA YU INDUSTRIAL CO. LTD.
5dBi Omni (5GHz)	C812-510012-A	WHA YU INDUSTRIAL CO. LTD.
19dBi Panel (5GHz)	MA-WA55-MIMO	MARS ANTENNAS & RF Systems LTD

Table 17. Antenna List

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207 Conducted Emissions Limits

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

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

Table 18. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was placed on a 0.8 m-high wooden table inside a semi-anechoic chamber. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 μH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.4-1992 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz"*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω/50 μH LISN as the input transducer to an EMC/field intensity meter.

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

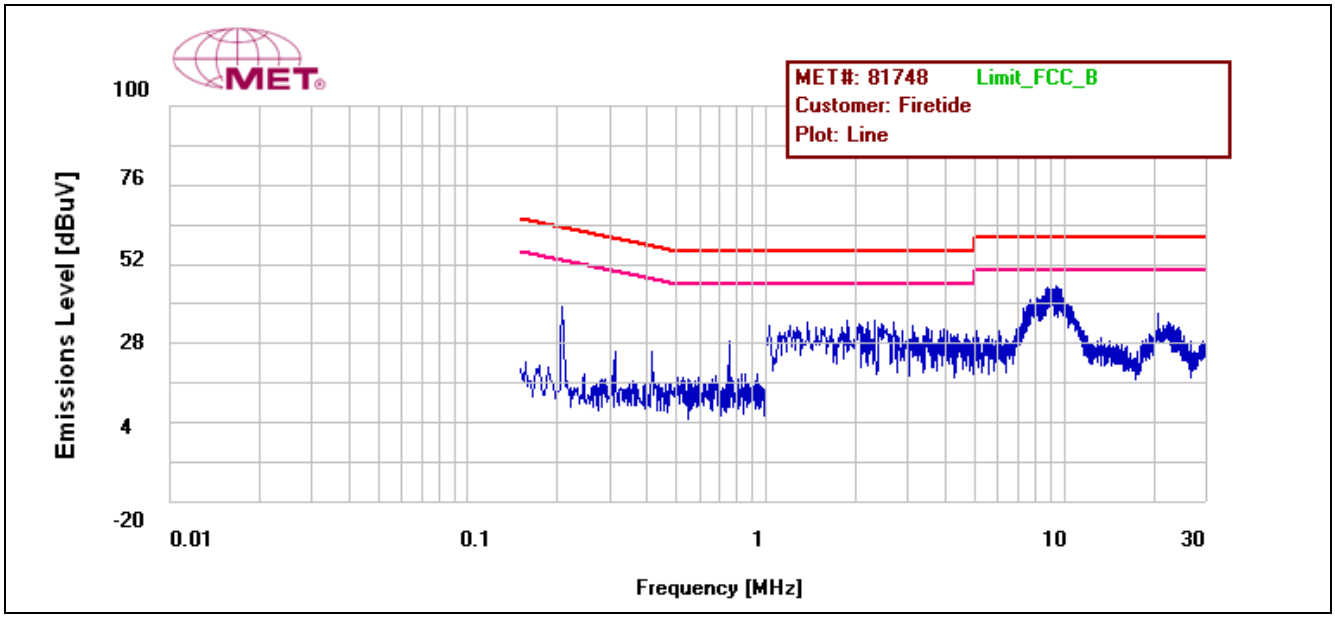
Test Engineer(s): Minh Ly

Test Date(s): 08/17/09

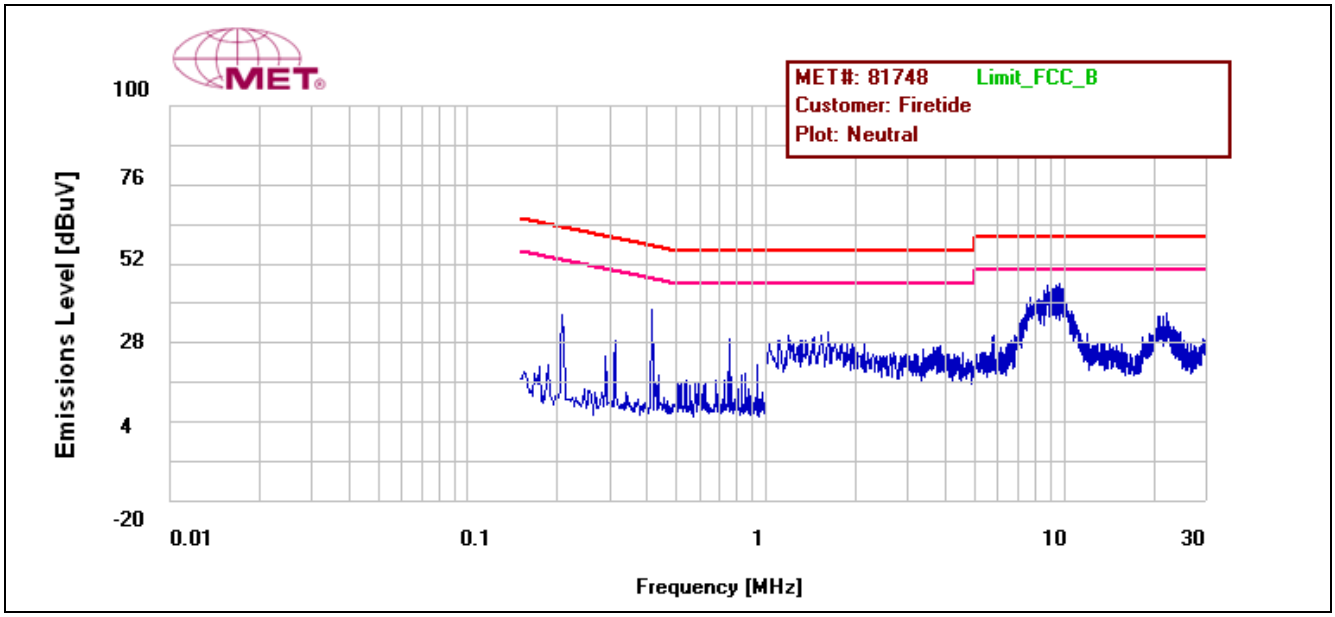
15.207(a) Conducted Emissions Test Results

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line	0.206	38.73	63.372	-24.642	Pass	33.83	53.372	-19.542	Pass
Line	0.76	21.03	56	-34.97	Pass	16.023	46	-29.977	Pass
Line	9.45	37.95	60	-22.05	Pass	31.47	50	-18.53	Pass
Neutral	0.207	36.5	63.332	-26.832	Pass	33.9	53.332	-19.432	Pass
Neutral	0.414	33.77	57.591	-23.821	Pass	32.7	47.591	-14.891	Pass
Neutral	9.117	38.87	60	-21.13	Pass	32.33	50	-17.67	Pass

Table 19. Conducted Emissions, 15.207(a), Test Results



Plot 9. Conducted Emissions, 15.207(a), Phase Line



Plot 10. Conducted Emissions, 15.207(a), Neutral Line

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): Aaron Chang

Test Date(s): 05/31/13

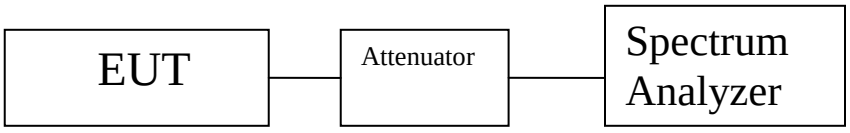


Figure 3. Occupied Bandwidth, Test Setup

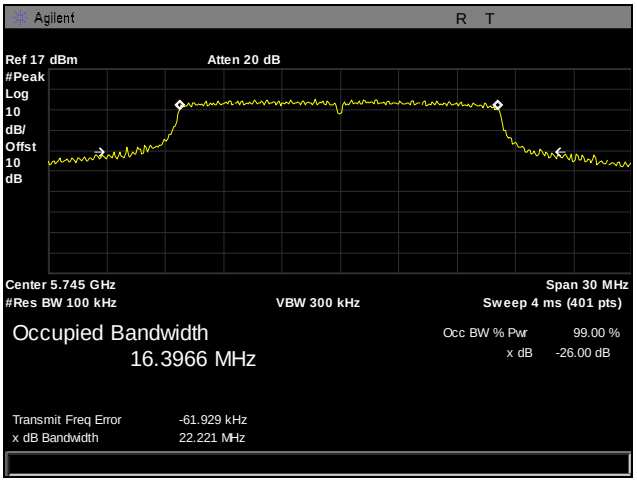
	Frequency (MHz)	26 dB Bandwidth (MHz)
802.11a Port 1	5745	22.221
	5785	20.064
	5805	23.770
802.11a Port 2	5745	21.908
	5785	20.435
	5805	20.718
802.11a Port 3	5745	19.487
	5785	19.014
	5805	19.859
802.11n 20 MHz Port 1	5745	19.419
	5785	19.515
	5805	19.281
802.11n 20 MHz Port 2	5745	20.038
	5785	19.953
	5805	20.550
802.11n 20 MHz Port 3	5745	19.879
	5785	19.649
	5805	19.682
802.11n 40 MHz Port 1	5755	39.367
	5795	40.333
802.11n 40 MHz Port 2	5755	41.090
	5795	40.530
802.11n 40 MHz Port 3	5755	39.175
	5795	39.016

Table 20. 26 dB Occupied Bandwidth, Test Results

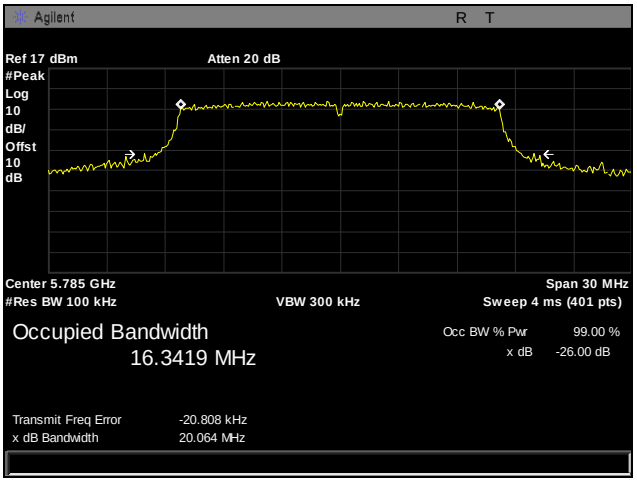
	Frequency (MHz)	99% Bandwidth (MHz)
802.11a Port 1	5745	19.6588
	5785	18.3126
	5805	17.7468
802.11a Port 2	5745	18.9779
	5785	17.6693
	5805	17.2007
802.11a Port 3	5745	18.2247
	5785	17.9575
	5805	16.9953
802.11n 20 MHz Port 1	5745	19.9465
	5785	20.9251
	5805	19.1777
802.11n 20 MHz Port 2	5745	19.7402
	5785	18.9406
	5805	18.2966
802.11n 20 MHz Port 3	5745	18.1751
	5785	17.9217
	5805	18.0406
802.11n 40 MHz Port 1	5755	36.4475
	5795	36.3047
802.11n 40 MHz Port 2	5755	36.2806
	5795	36.3927
802.11n 40 MHz Port 3	5755	36.4111
	5795	36.2046

Table 21. 99% Occupied Bandwidth, Test Results

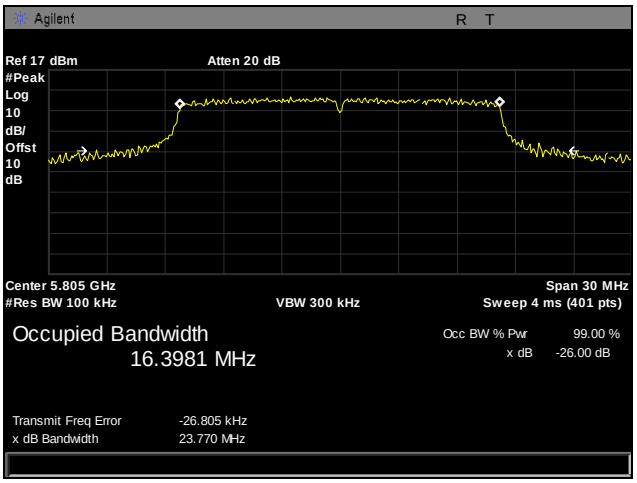
26 dB Occupied Bandwidth, 802.11a, Port 1



Plot 11. 26 dB Occupied Bandwidth, 802.11a, 5745 MHz, Port 1

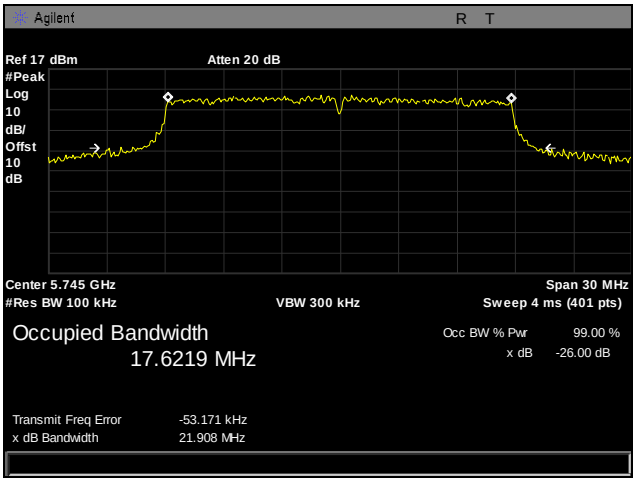


Plot 12. 26 dB Occupied Bandwidth, 802.11a, 5785 MHz, Port 1

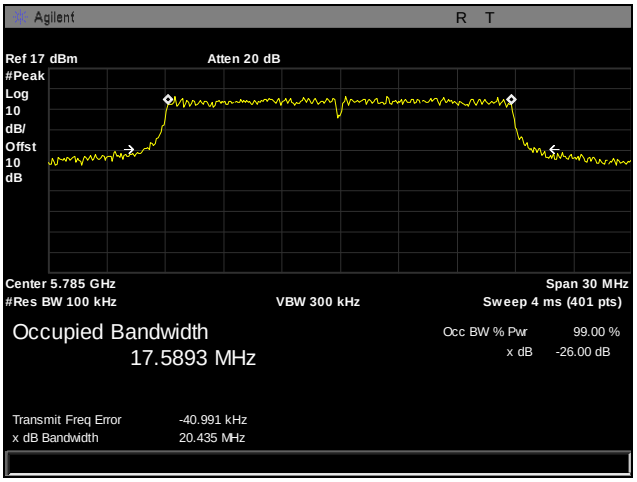


Plot 13. 26 dB Occupied Bandwidth, 802.11a, 5805 MHz, Port 1

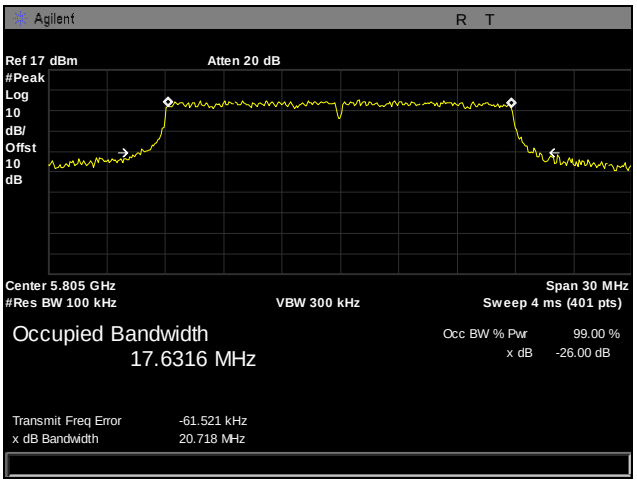
26 dB Occupied Bandwidth, 802.11a, Port 2



Plot 14. 26 dB Occupied Bandwidth, 802.11a, 5745 MHz, Port 2

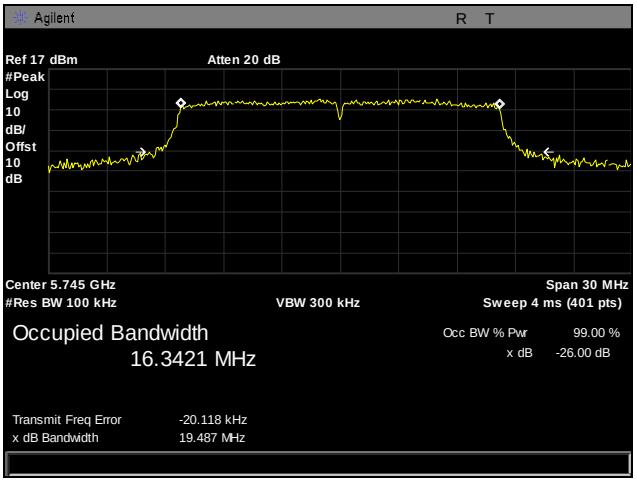


Plot 15. 26 dB Occupied Bandwidth, 802.11a, 5785 MHz, Port 2

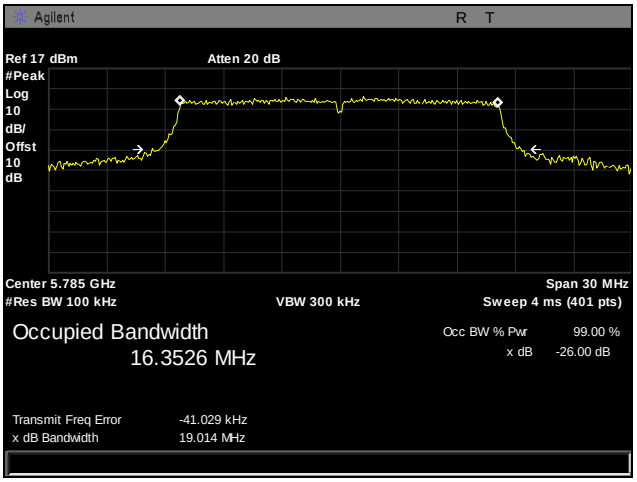


Plot 16. 26 dB Occupied Bandwidth, 802.11a, 5805 MHz, Port 2

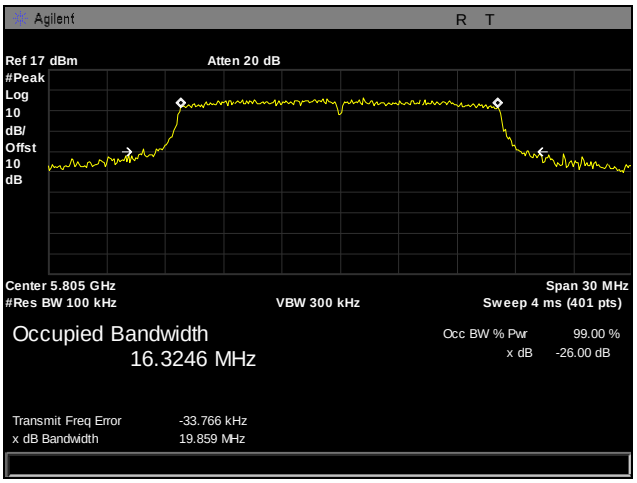
26 dB Occupied Bandwidth, 802.11a, Port 3



Plot 17. 26 dB Occupied Bandwidth, 802.11a, 5745 MHz, Port 3

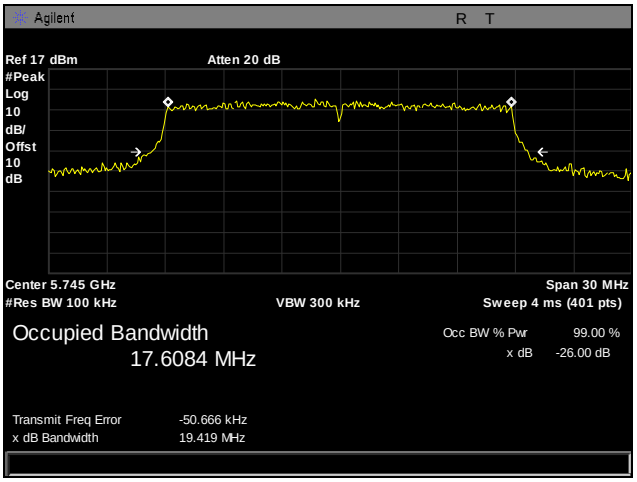


Plot 18. 26 dB Occupied Bandwidth, 802.11a, 5785 MHz, Port 3

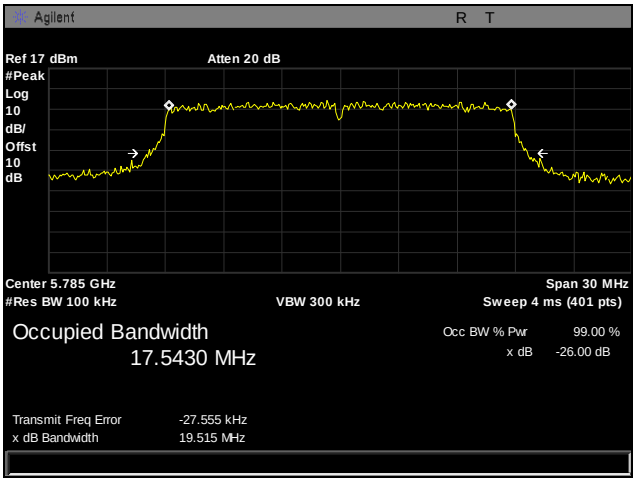


Plot 19. 26 dB Occupied Bandwidth, 802.11a, 5805 MHz, Port 3

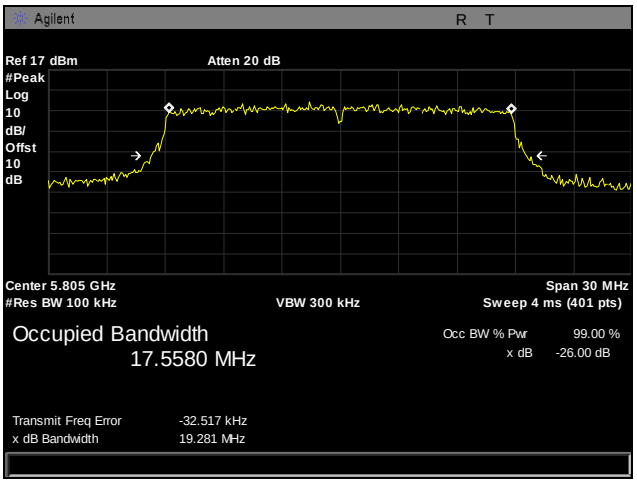
26 dB Occupied Bandwidth, 802.11n 20 MHz, Port 1



Plot 20. 26 dB Occupied Bandwidth, 802.11n 20 MHz, 5745 MHz, Port 1

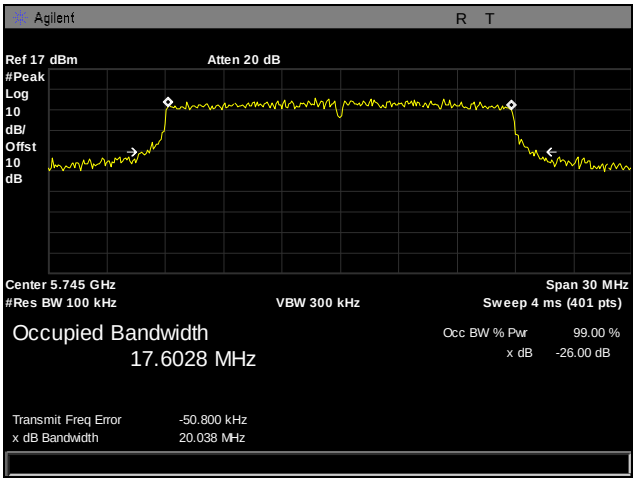


Plot 21. 26 dB Occupied Bandwidth, 802.11n 20 MHz, 5785 MHz, Port 1

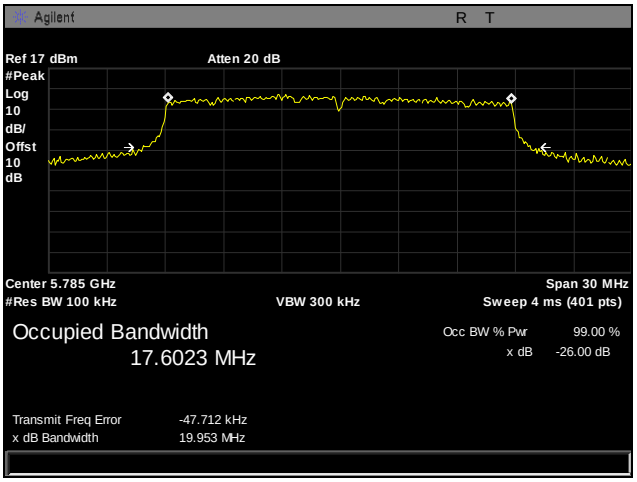


Plot 22. 26 dB Occupied Bandwidth, 802.11n 20 MHz, 5805 MHz, Port 1

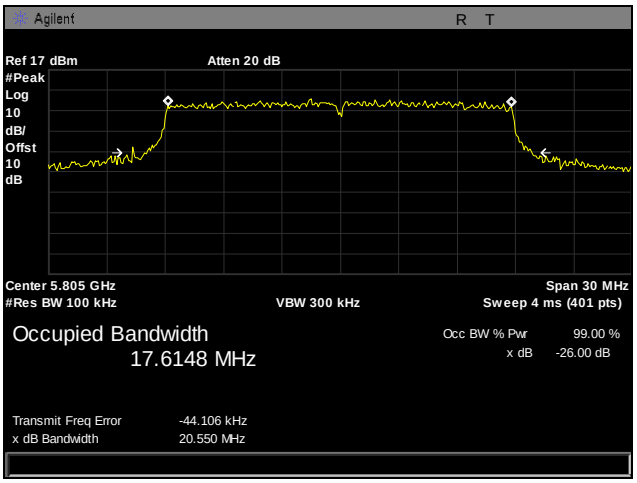
26 dB Occupied Bandwidth, 802.11n 20 MHz, Port 2



Plot 23. 26 dB Occupied Bandwidth, 802.11n 20 MHz, 5745 MHz, Port 2

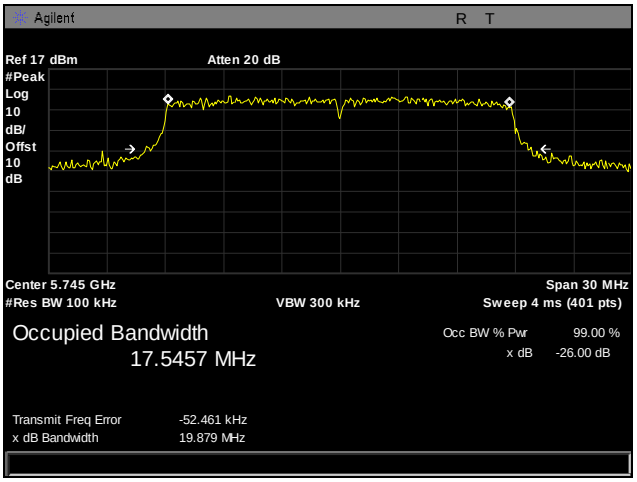


Plot 24. 26 dB Occupied Bandwidth, 802.11n 20 MHz, 5785 MHz, Port 2

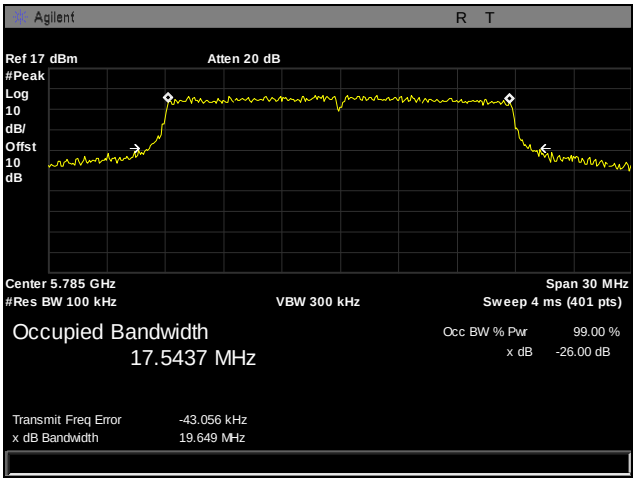


Plot 25. 26 dB Occupied Bandwidth, 802.11n 20 MHz, 5805 MHz, Port 2

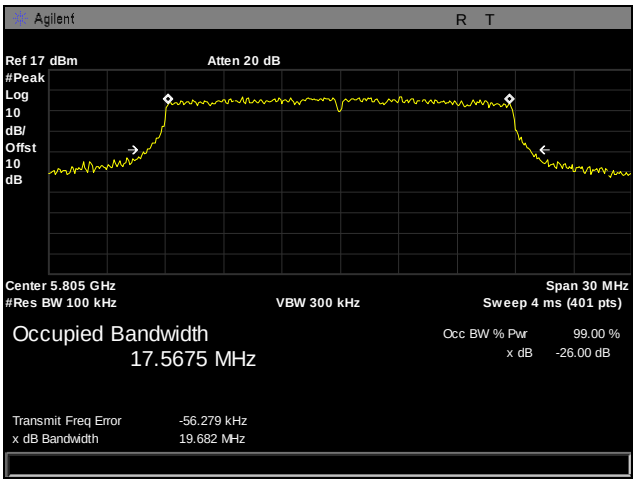
26 dB Occupied Bandwidth, 802.11n 20 MHz, Port 3



Plot 26. 26 dB Occupied Bandwidth, 802.11n 20 MHz, 5745 MHz, Port 3

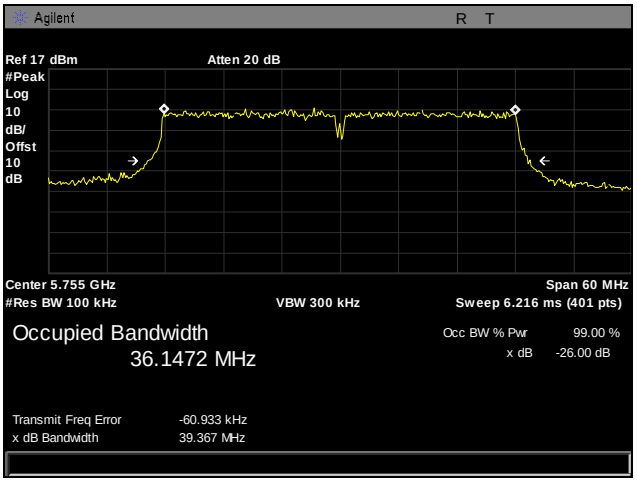


Plot 27. 26 dB Occupied Bandwidth, 802.11n 20 MHz, 5785 MHz, Port 3

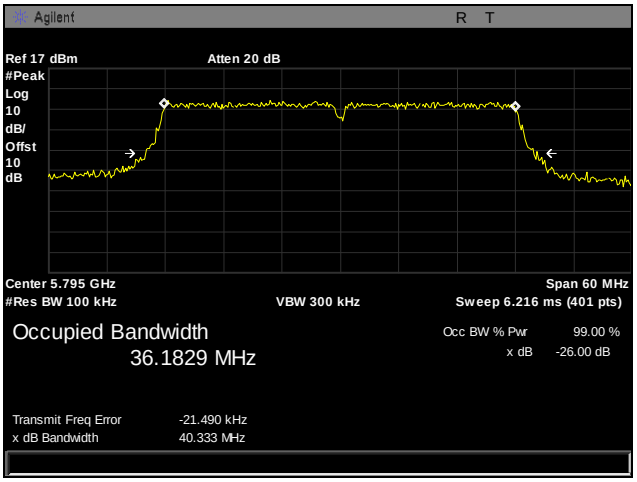


Plot 28. 26 dB Occupied Bandwidth, 802.11n 20 MHz, 5805 MHz, Port 3

26 dB Occupied Bandwidth, 802.11 40 MHz, Port 1

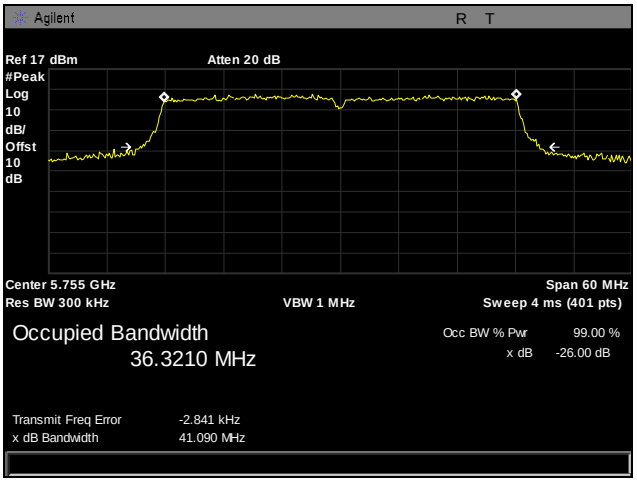


Plot 29. 26 dB Occupied Bandwidth, 802.11 40 MHz, 5755 MHz, Port 1

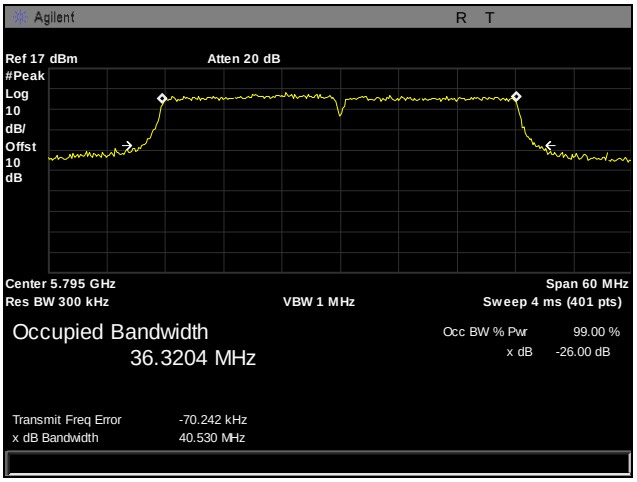


Plot 30. 26 dB Occupied Bandwidth, 802.11 40 MHz, 5795 MHz, Port 1

26 dB Occupied Bandwidth, 802.11 40 MHz, Port 2

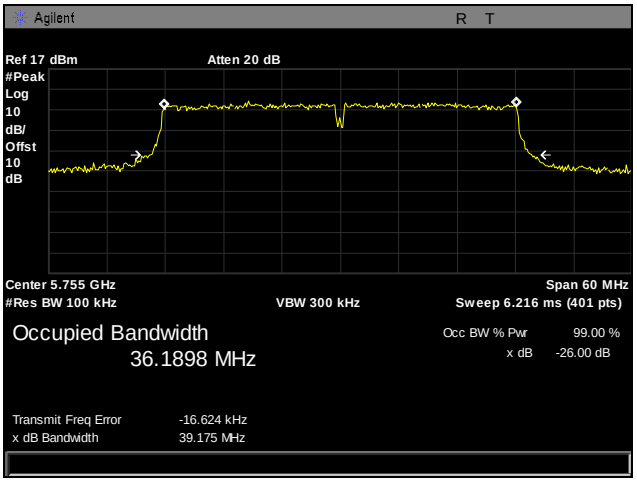


Plot 31. 26 dB Occupied Bandwidth, 802.11 40 MHz, 5755 MHz, Port 2

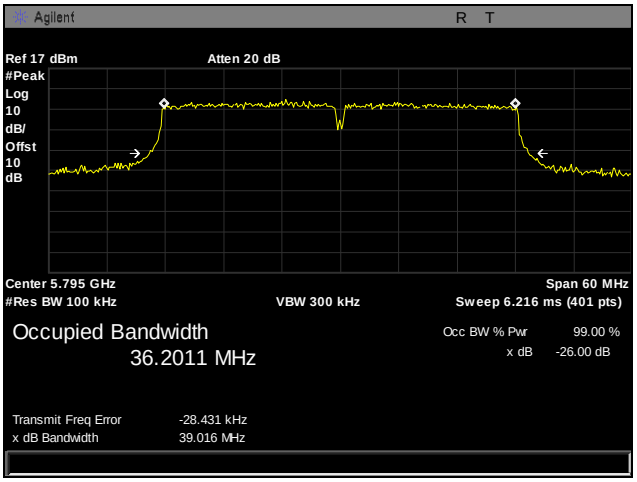


Plot 32. 26 dB Occupied Bandwidth, 802.11 40 MHz, 5795 MHz, Port 2

26 dB Occupied Bandwidth, 802.11 40 MHz, Port 3

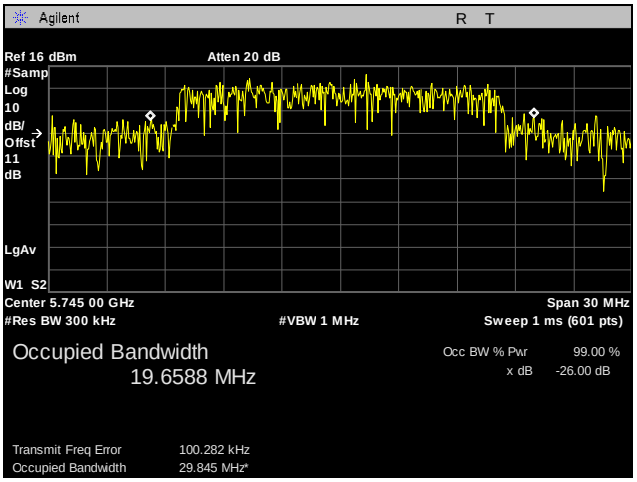


Plot 33. 26 dB Occupied Bandwidth, 802.11 40 MHz, 5755 MHz, Port 3

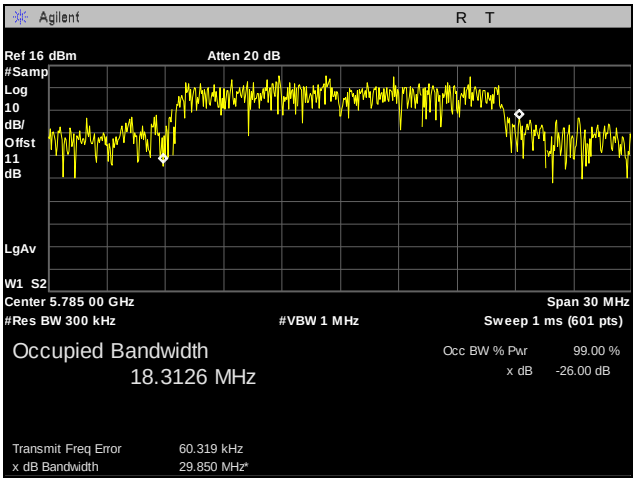


Plot 34. 26 dB Occupied Bandwidth, 802.11 40 MHz, 5795 MHz, Port 3

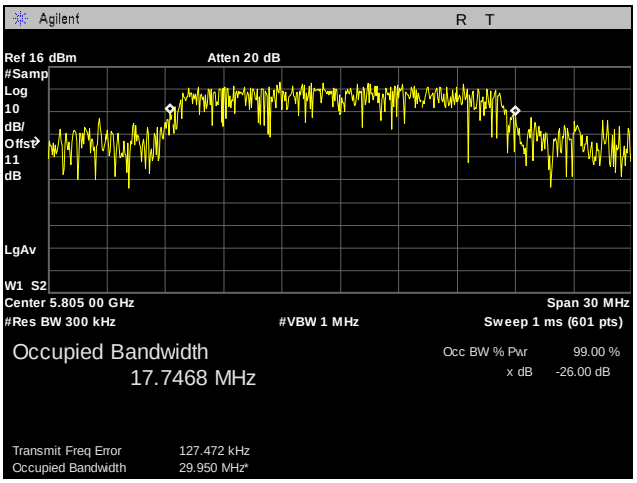
99% Occupied Bandwidth, 802.11a, Port 1



Plot 35. 99% Occupied Bandwidth, 802.11a, 5745 MHz, Port 1

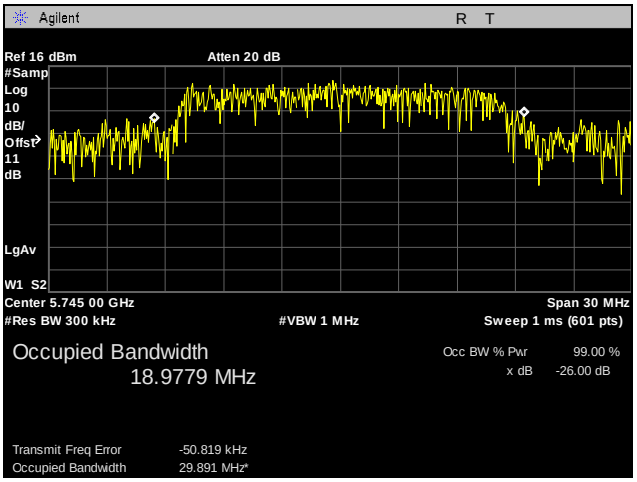


Plot 36. 99% Occupied Bandwidth, 802.11a, 5785 MHz, Port 1

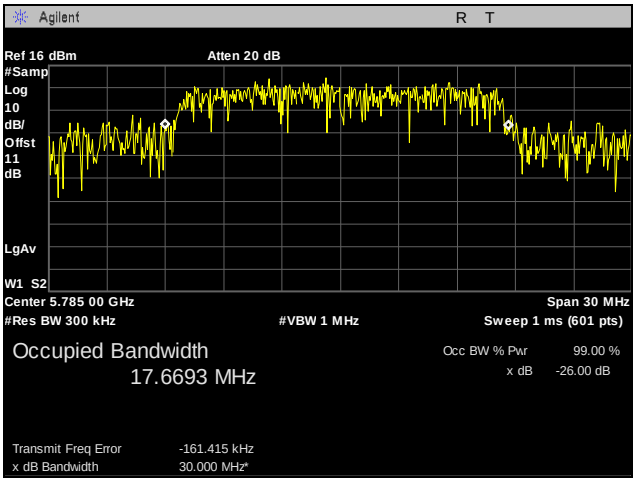


Plot 37. 99% Occupied Bandwidth, 802.11a, 5805 MHz, Port 1

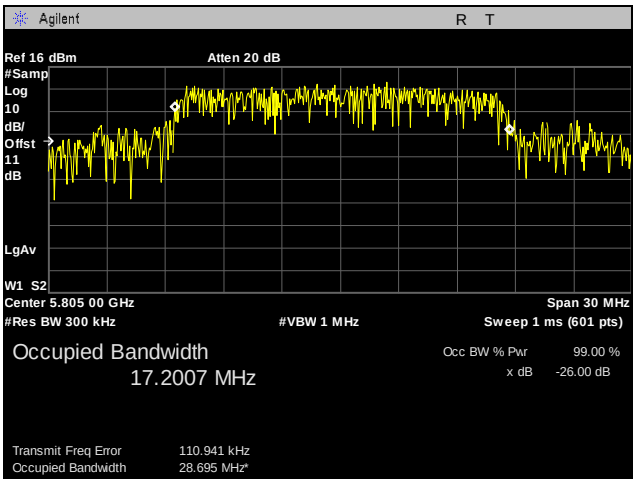
99% Occupied Bandwidth, 802.11a, Port 2



Plot 38. 99% Occupied Bandwidth, 802.11a, 5745 MHz, Port 2

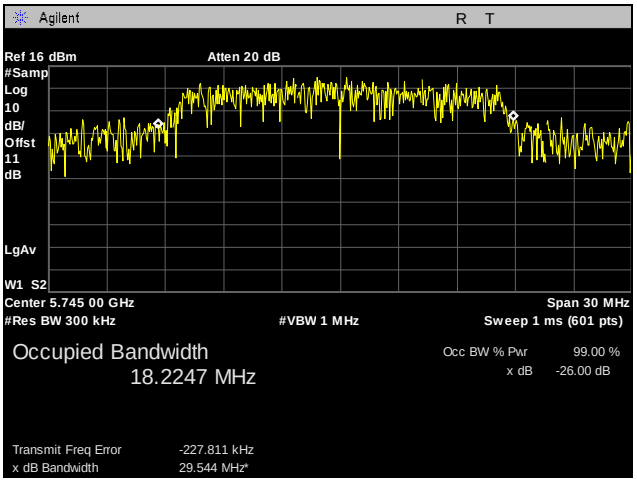


Plot 39. 99% Occupied Bandwidth, 802.11a, 5785 MHz, Port 2

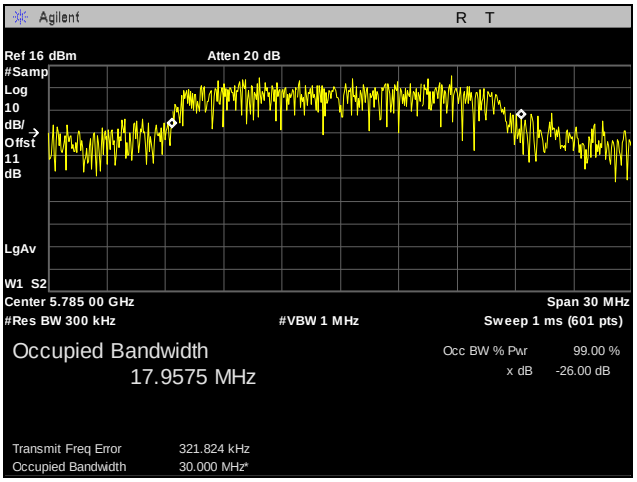


Plot 40. 99% Occupied Bandwidth, 802.11a, 5805 MHz, Port 2

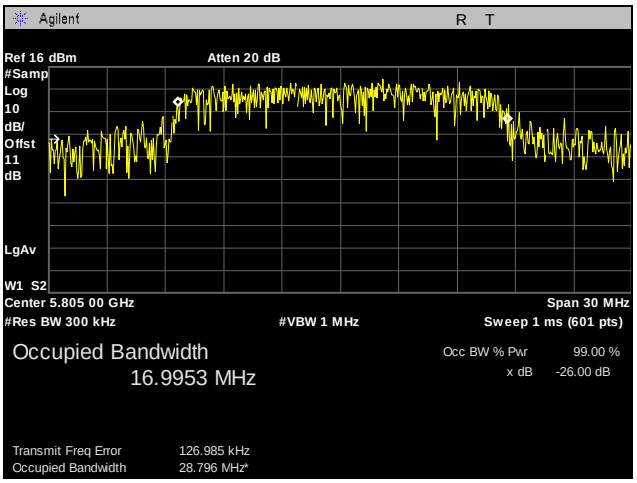
99% Occupied Bandwidth, 802.11a, Port 3



Plot 41. 99% Occupied Bandwidth, 802.11a, 5745 MHz, Port 3

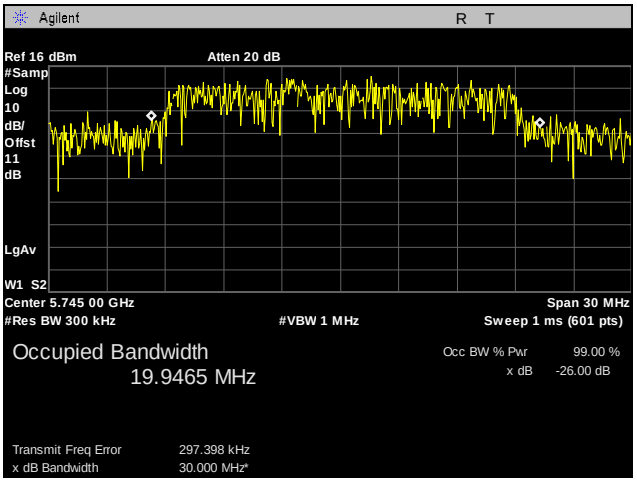


Plot 42. 99% Occupied Bandwidth, 802.11a, 5785 MHz, Port 3

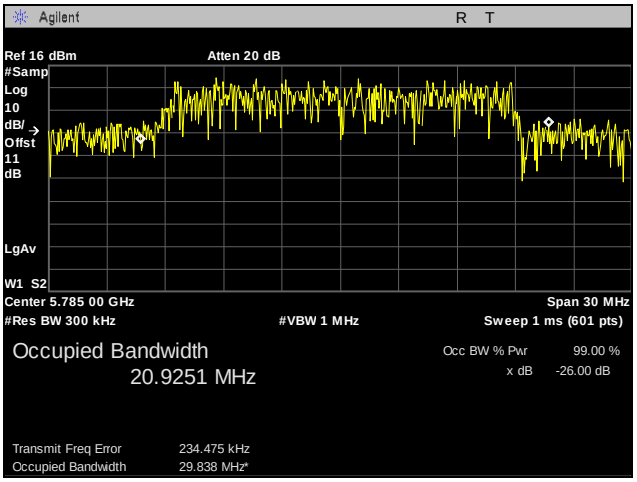


Plot 43. 99% Occupied Bandwidth, 802.11a, 5805 MHz, Port 3

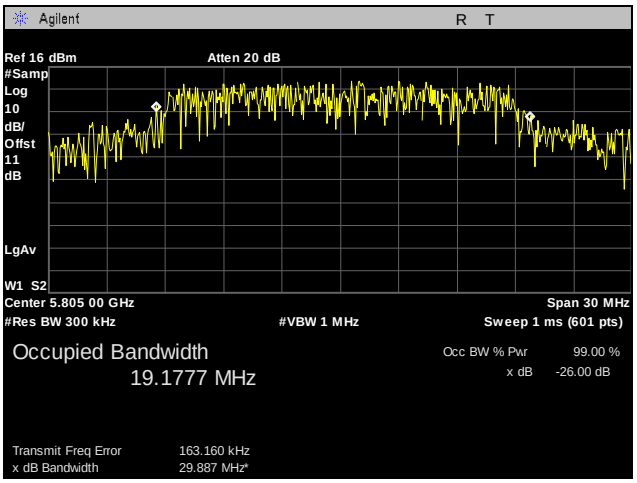
99% Occupied Bandwidth, 802.11n 20 MHz, Port 1



Plot 44. 99% Occupied Bandwidth, 802.11n 20 MHz, 5745 MHz, Port 1

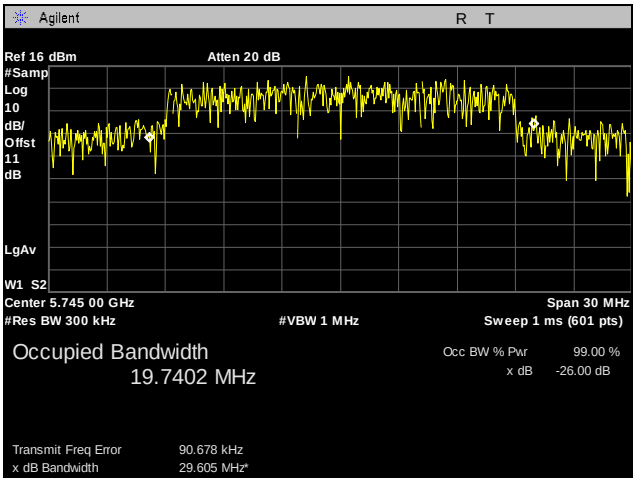


Plot 45. 99% Occupied Bandwidth, 802.11n 20 MHz, 5785 MHz, Port 1

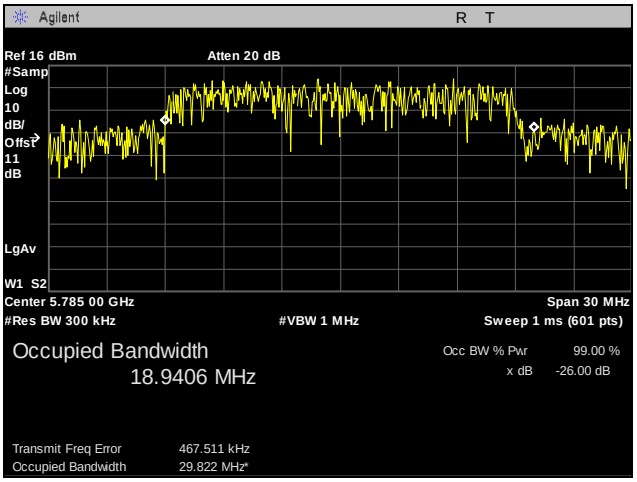


Plot 46. 99% Occupied Bandwidth, 802.11n 20 MHz, 5805 MHz, Port 1

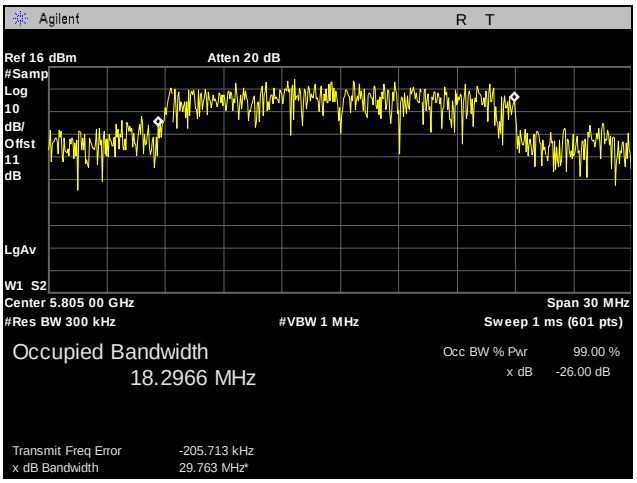
99% Occupied Bandwidth, 802.11n 20 MHz, Port 2



Plot 47. 99% Occupied Bandwidth, 802.11n 20 MHz, 5745 MHz, Port 2

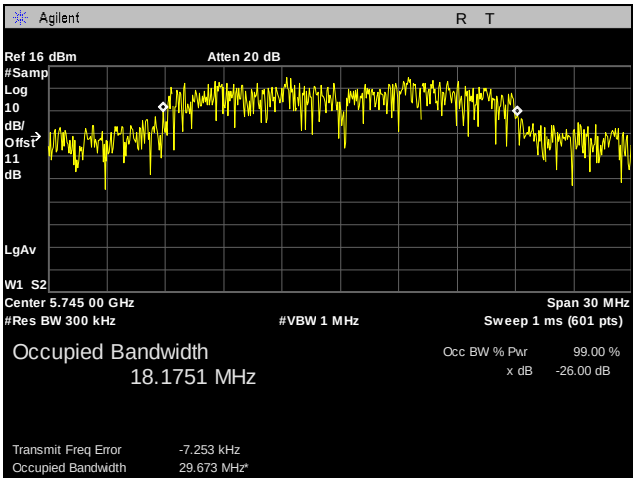


Plot 48. 99% Occupied Bandwidth, 802.11n 20 MHz, 5785 MHz, Port 2

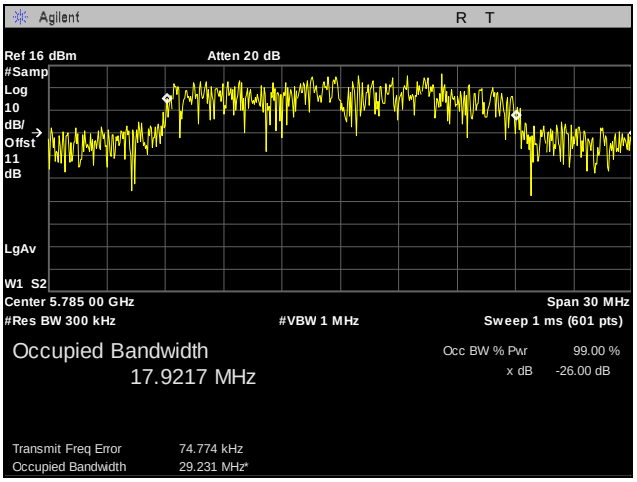


Plot 49. 99% Occupied Bandwidth, 802.11n 20 MHz, 5805 MHz, Port 2

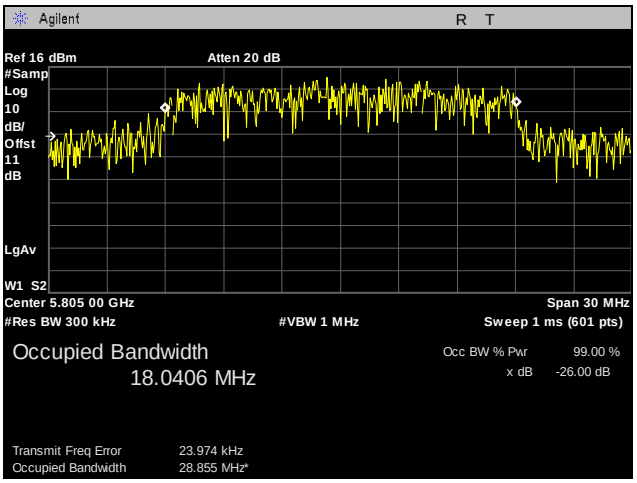
99% Occupied Bandwidth, 802.11n 20 MHz, Port 3



Plot 50. 99% Occupied Bandwidth, 802.11n 20 MHz, 5745 MHz, Port 3

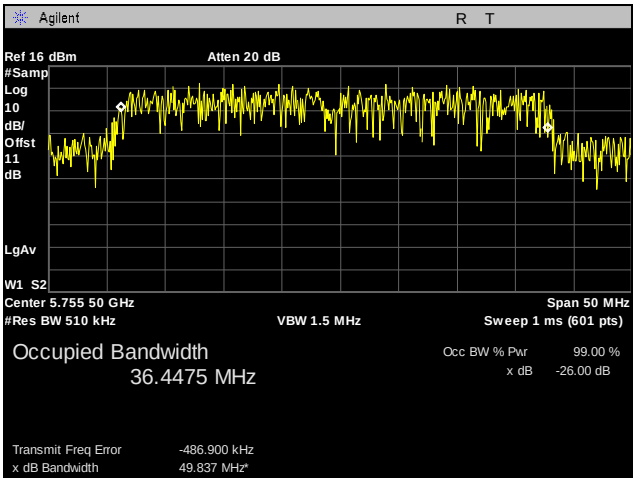


Plot 51. 99% Occupied Bandwidth, 802.11n 20 MHz, 5785 MHz, Port 3

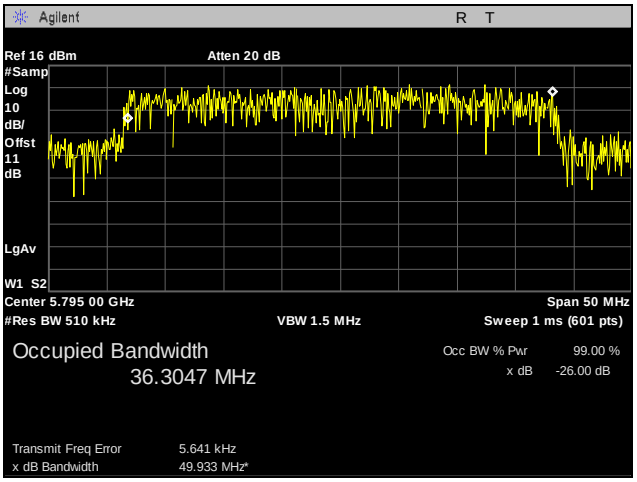


Plot 52. 99% Occupied Bandwidth, 802.11n 20 MHz, 5805 MHz, Port 3

99% Occupied Bandwidth, 802.11 40 MHz, Port 1

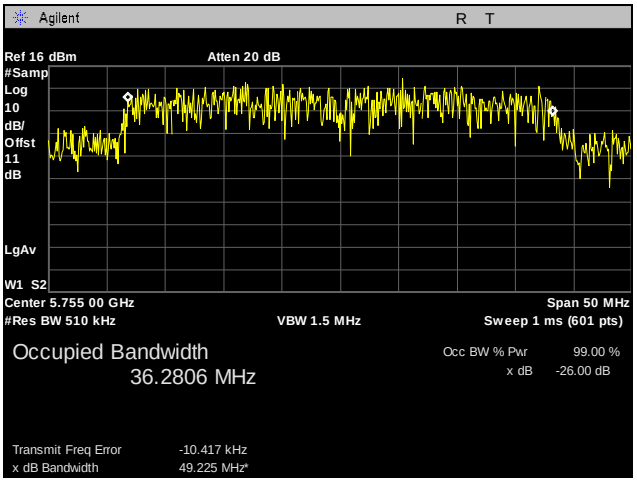


Plot 53. 99% Occupied Bandwidth, 802.11 40 MHz, 5755 MHz, Port 1

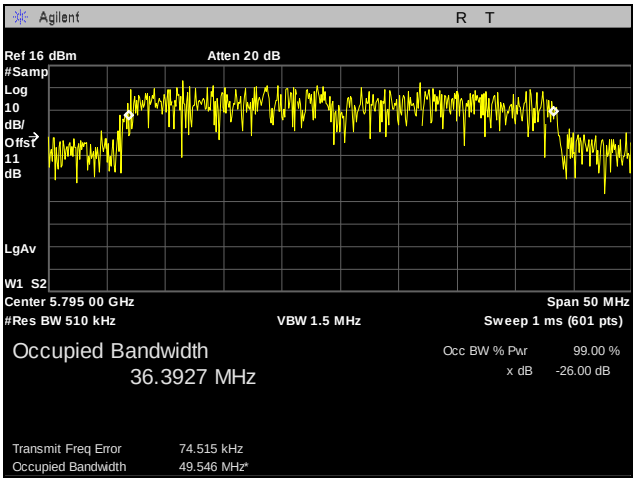


Plot 54. 99% Occupied Bandwidth, 802.11 40 MHz, 5795 MHz, Port 1

99% Occupied Bandwidth, 802.11 40 MHz, Port 2

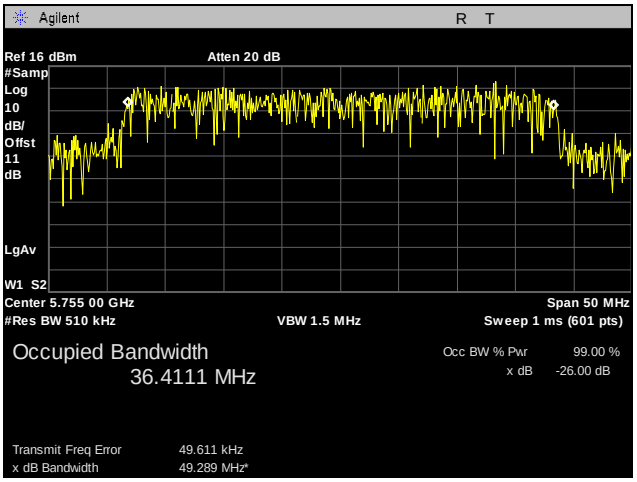


Plot 55. 99% Occupied Bandwidth, 802.11 40 MHz, 5755 MHz, Port 2

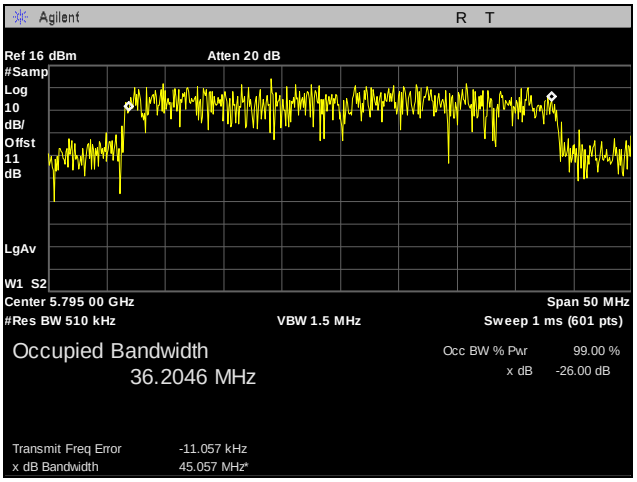


Plot 56. 99% Occupied Bandwidth, 802.11 40 MHz, 5795 MHz, Port 2

99% Occupied Bandwidth, 802.11 40 MHz, Port 3



Plot 57. 99% Occupied Bandwidth, 802.11 40 MHz, 5755 MHz, Port 3



Plot 58. 99% Occupied Bandwidth, 802.11 40 MHz, 5795 MHz, Port 3

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15. 407(a)(3) RF Power Output

Test Requirements: **§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.

Test Procedure: The EUT was connected to a spectrum analyzer through an RF cable and an attenuator. The EUT was set to transmit on low, mid, and high channels and the power was measured according to method SA-1 from FCC Publication Number 789033. Power across the antenna ports was summed.

Test Procedure: The transmitter was connected to a calibrated Spectrum analyzer. The EUT was measured at the low, mid and high channels of each band with the data rate that produced the highest output power.

Test Results: Equipment complies with the Peak Power Output limits of **§ 15.401(a) (3)**. Below tables are with the 5 dBi antenna. For 19 dBi antenna the output power will be reduced accordingly.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 12/17/09

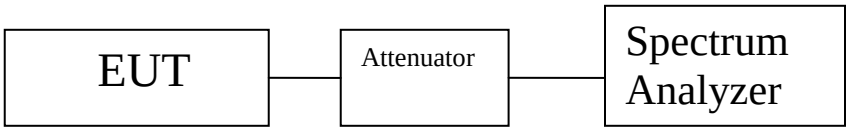


Figure 4. Power Output Test Setup

RF POWER OUTPUT, Port 1			
Mode	**Frequency (MHz)**		**Measured Output Power (dBm)**
802.11a	U-NII-3	5745	17.24
		5785	16.87
		5805	15.93
802.11n 20MHz	U-NII-3	5745	17.24
		5785	17.19
		5805	17.87
802.11n 40MHz	U-NII-3	5755	17.90
		5795	17.82

Table 22. RF Power Output, Test Results, Port 1

RF POWER OUTPUT, Port 2			
Mode	**Frequency (MHz)**		**Measured Output Power (dBm)**
802.11n 20MHz	U-NII-3	5745	15.49
		5785	16.67
		5805	14.80
802.11n 40MHz	U-NII-3	5755	18.14
		5795	17.50

Table 23. RF Power Output, Test Results, Port 2

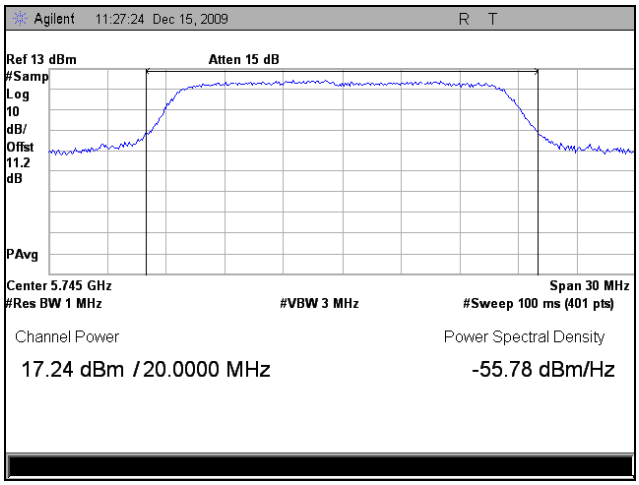
RF POWER OUTPUT, Port 3			
Mode	**Frequency (MHz)**		**Measured Output Power (dBm)**
802.11n 20MHz	U-NII-3	5745	17.24
		5785	17.40
		5805	15.15
802.11n 40MHz	U-NII-3	5755	17.99
		5795	17.51

Table 24. RF Power Output, Test Results, Port 3

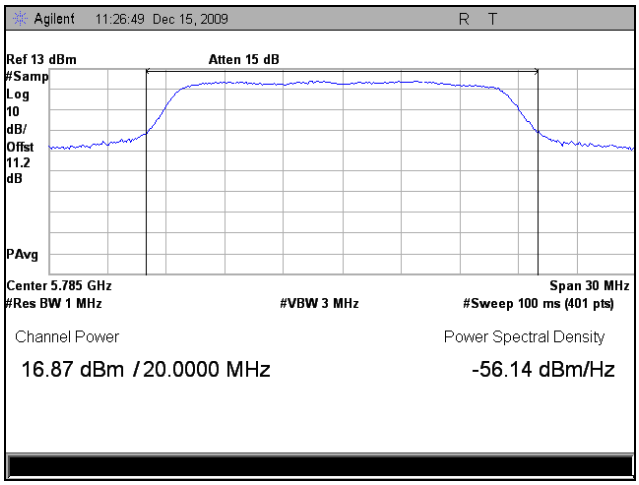
RF POWER OUTPUT, Summed Power						
Mode	**Frequency (MHz)**		**Port 1**	**Port 2**	**Port 3**	**Summed Power (dBm)**
802.11n 20MHz	U-NII-3	5745	17.24	15.49	17.24	21.50
		5785	17.19	16.67	17.40	21.86
		5805	17.87	14.80	15.15	20.94
802.11n 40MHz	U-NII-3	5755	17.90	18.14	17.99	22.78
		5795	17.82	17.50	17.51	22.38

Table 25. RF Power Output, Test Results, Summed Power

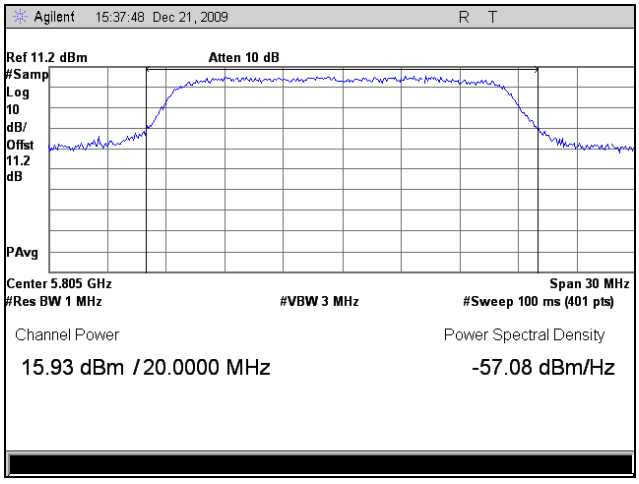
RF Power Output, Port 1 802.11a



Plot 59. RF Power Output, Port 1, 802.11a, 5745 MHz

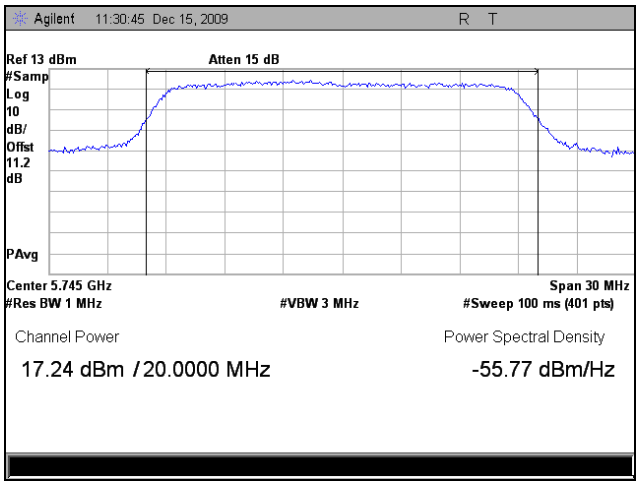


Plot 60. RF Power Output, Port 1, 802.11a, 5785 MHz

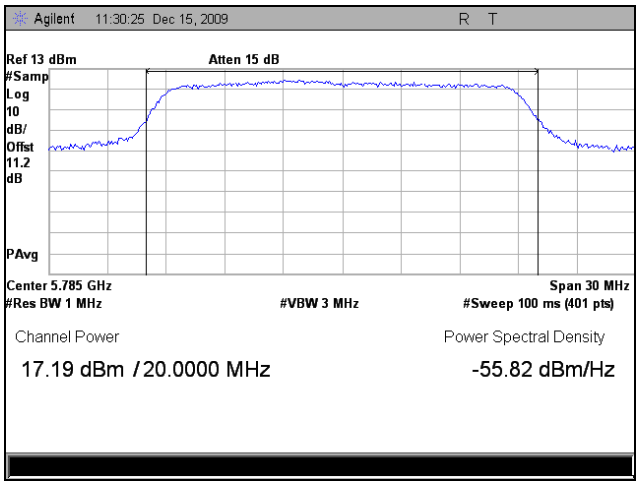


Plot 61. RF Power Output, Port 1, 802.11a, 5805 MHz

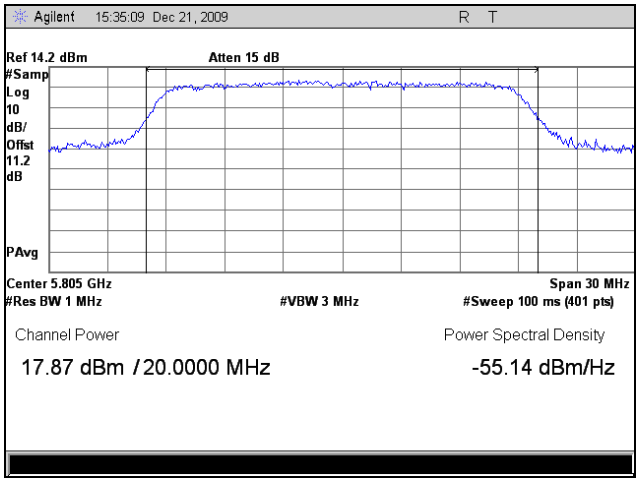
RF Power Output, Port 1, 802.11n 20MHz



Plot 62. RF Power Output, Port 1, 802.11n 20MHz, 5745 MHz

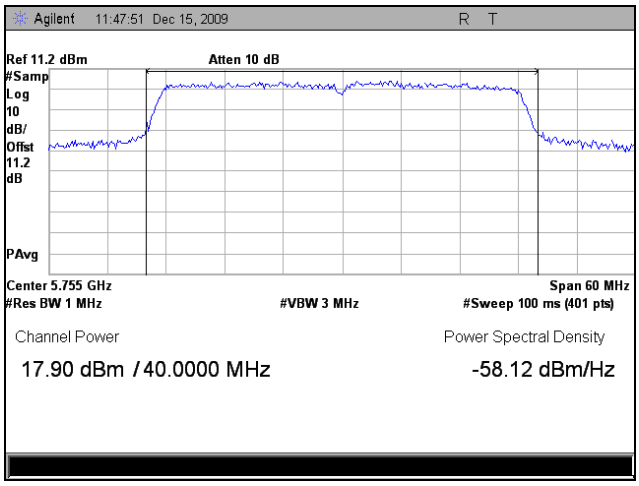


Plot 63. RF Power Output, Port 1, 802.11n 20MHz, 5785 MHz

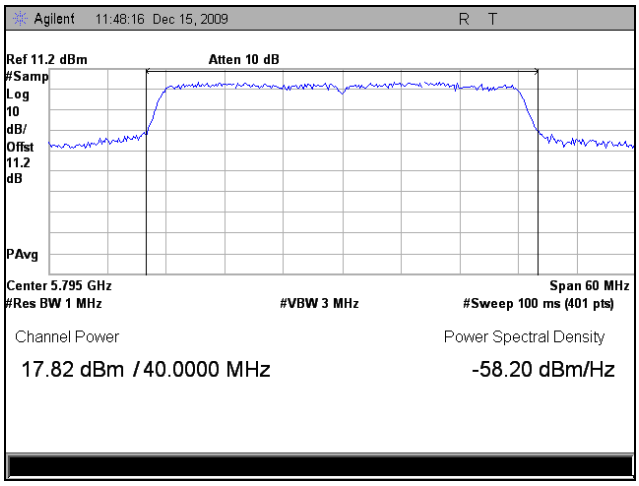


Plot 64. RF Power Output, Port 1, 802.11n 20MHz, 5805 MHz

RF Power Output, Port 1 802.11n 40MHz

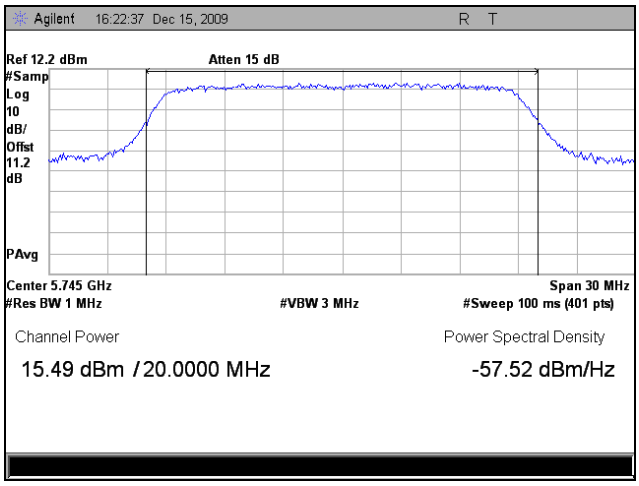


Plot 65. RF Power Output, Port 1, 802.11n 40MHz, 5755 MHz

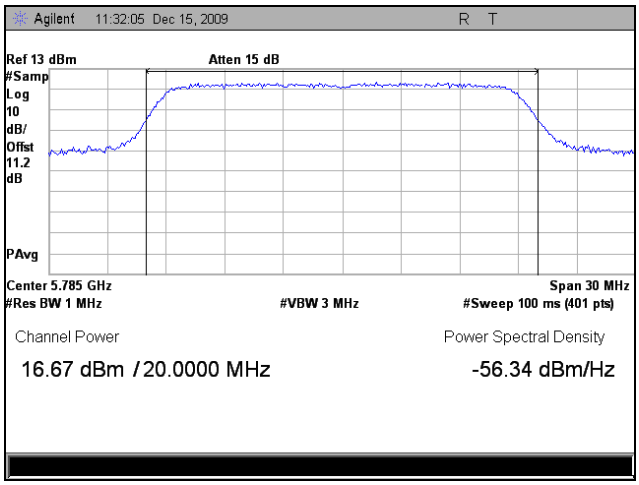


Plot 66. RF Power Output, Port 1, 802.11n 40MHz, 5795 MHz

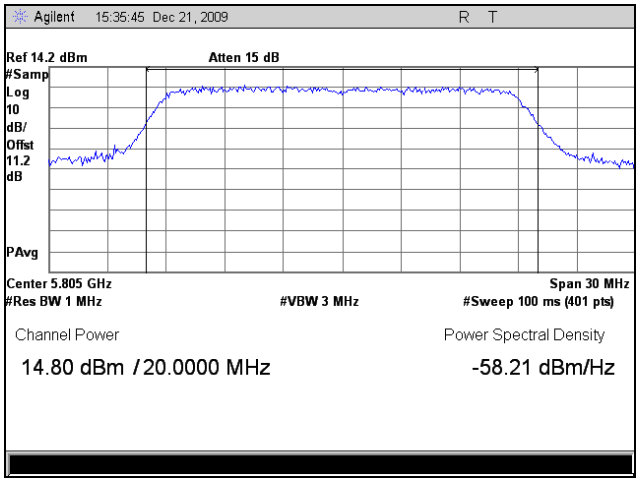
RF Power Output, Port 2, 802.11n 20MHz



Plot 67. RF Power Output, Port 2, 802.11n 20MHz, 5745 MHz

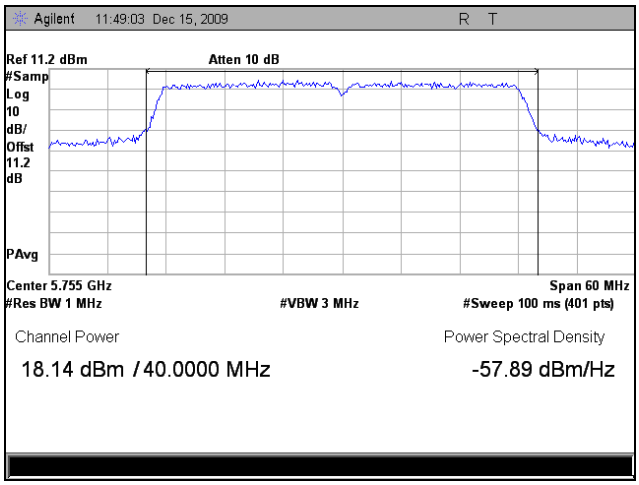


Plot 68. RF Power Output, Port 2, 802.11n 20MHz, 5785 MHz

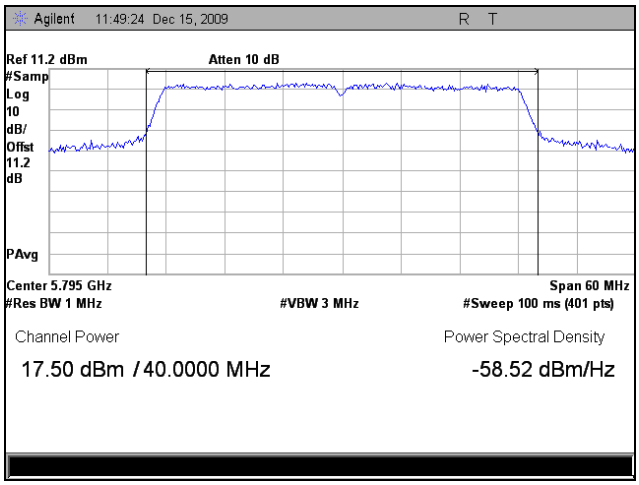


Plot 69. RF Power Output, Port 2, 802.11n 20MHz, 5805 MHz

RF Power Output, Port 2, 802.11n 40MHz

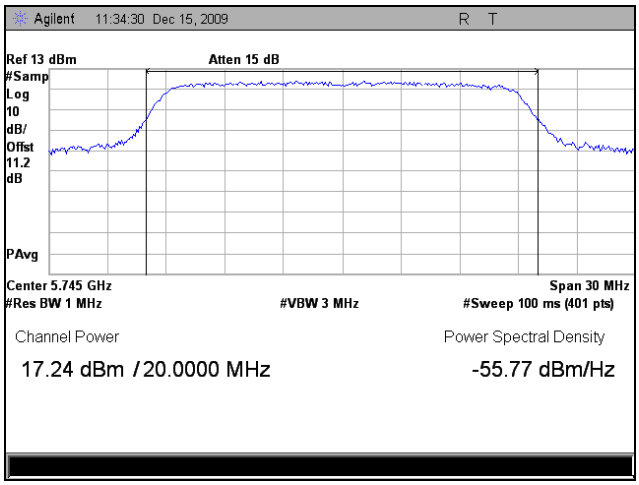


Plot 70. RF Power Output, Port 2, 802.11n 40MHz, 5755 MHz

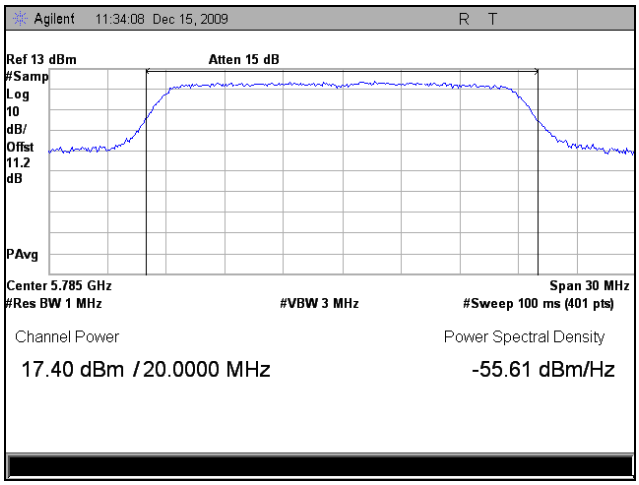


Plot 71. RF Power Output, Port 2, 802.11n 40MHz, 5795 MHz

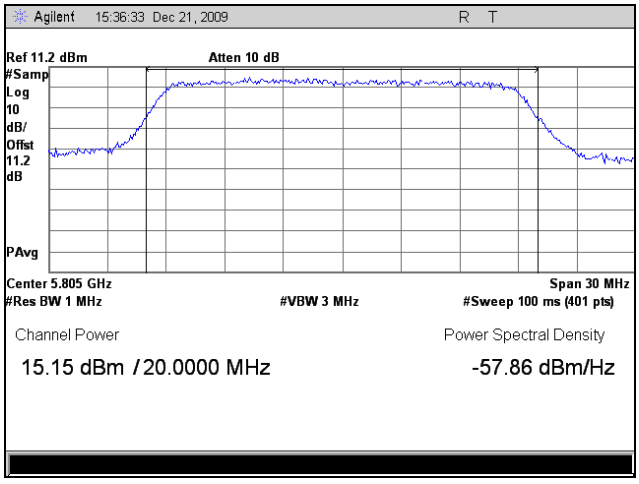
RF Power Output, Port 3, 802.11n 20MHz



Plot 72. RF Power Output, Port 3, 802.11n 20MHz, 5745 MHz

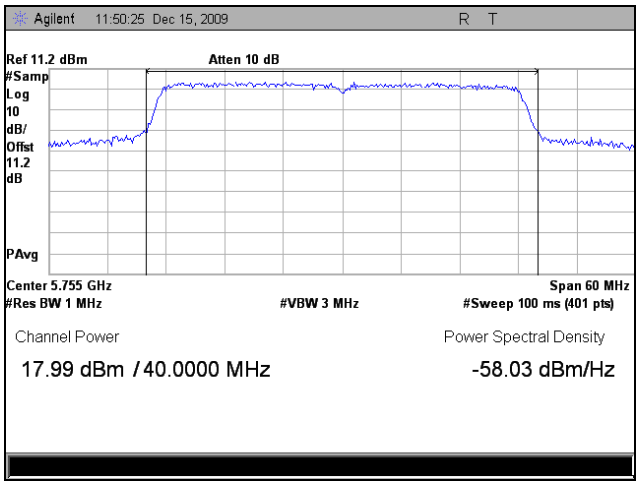


Plot 73. RF Power Output, Port 3, 802.11n 20MHz, 5785 MHz

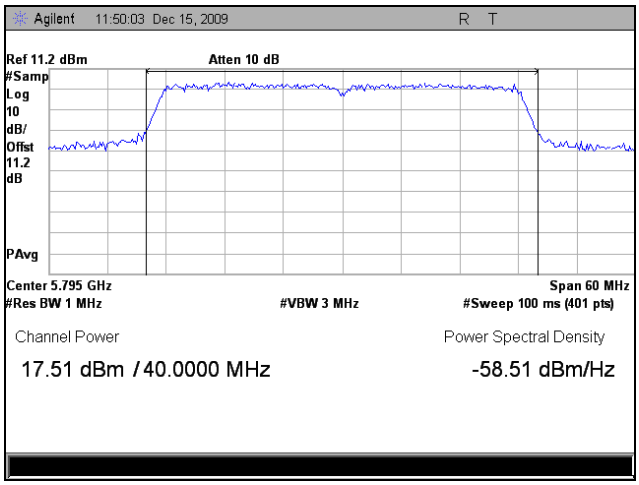


Plot 74. RF Power Output, Port 3, 802.11n 20MHz, 5805 MHz

RF Power Output, Port 3, 802.11n 40MHz



Plot 75. RF Power Output, Port 3, 802.11n 40MHz, 5755 MHz



Plot 76. RF Power Output, Port 3, 802.11n 40MHz, 5795 MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

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

Test Requirements: **§ 15.407(a)(2):** In addition, the peak power spectral density shall not exceed 17 dBm in any 1 megahertz band.

Test Procedure: The transmitter was connected directly to a Spectrum Analyzer through an attenuator. The power level was set to the maximum level on the EUT. The RBW was set to 1MHz and the VBW was set to 3MHz. The method of measurement #2 from the FCC Public Notice DA 02-2138 was used.

Test Results: Equipment complies with the peak power spectral density limits of **§ 15.407(a)(3).** The peak power spectral density was determined from plots on the following page(s). The following tables are for with the 5 dBi antenna.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 12/17/09

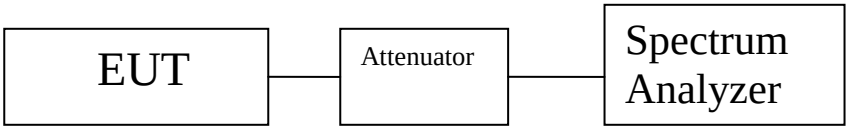


Figure 5. Power Spectral Density Test Setup

Peak Power Spectral Density, Port 1					
Mode	Frequency (MHz)		Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
802.11a	U-NII-3	5745	5.904	17	11.096
		5785	5.613	17	11.387
		5805	5.138	17	11.862
802.11n 20MHz	U-NII-3	5745	6.378	17	10.622
		5785	6.023	17	10.977
		5805	5.405	17	11.595
802.11n 40MHz	U-NII-3	5755	5.09	17	11.91
		5795	3.58	17	13.42

Table 26. Peak Power Spectral Density, Test Results, Port 1

Peak Power Spectral Density, Port 2					
Mode	Frequency (MHz)		Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
802.11n 20MHz	U-NII-3	5745	4.182	17	12.818
		5785	5.788	17	11.212
		5805	4.821	17	12.179
802.11n 40MHz	U-NII-3	5755	3.63	17	13.37
		5795	1.77	17	15.23

Table 27. Peak Power Spectral Density, Test Results, Port 2

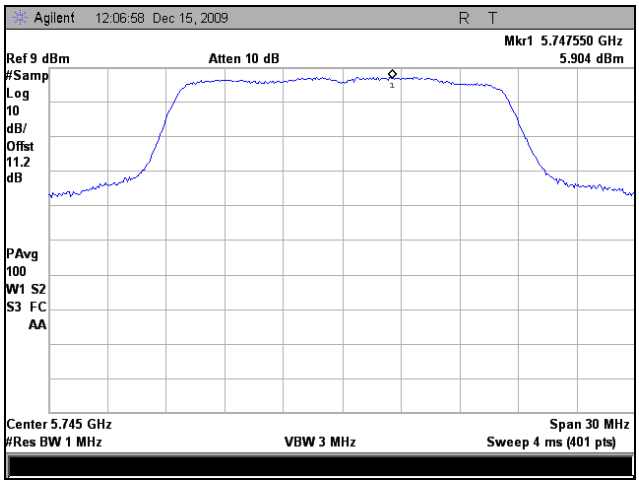
Peak Power Spectral Density, Port 3					
Mode	Frequency (MHz)		Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
802.11n 20MHz	U-NII-3	5745	6.131	17	10.869
		5785	5.768	17	11.232
		5805	5.342	17	11.658
802.11n 40MHz	U-NII-3	5755	2.16	17	14.84
		5795	3.02	17	13.98

Table 28. Peak Power Spectral Density, Test Results, Port 3

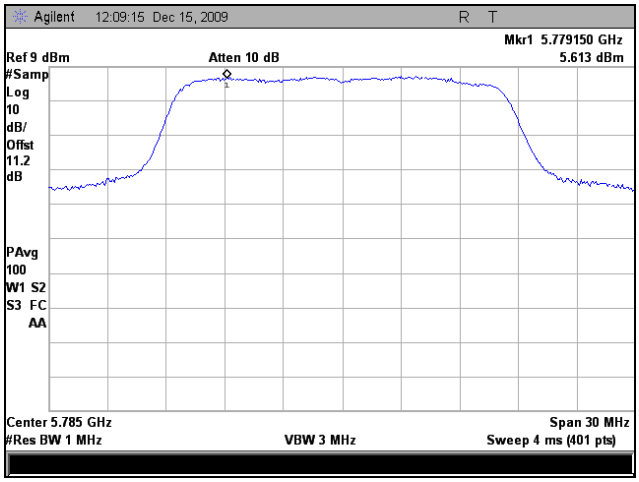
Peak Power Spectral Density, Combined Ports					
Mode	Frequency (MHz)		Measured PPSD (dBm)	Limit (dBm)	Margin (dB)
802.11n 20MHz	U-NII-3	5745	10.06	13.23	-3.17
		5785	9.89	13.23	-3.34
		5805	9.66	13.23	-3.57
802.11n 40MHz	U-NII-3	5755	9.26	13.23	-3.97
		5795	8.54	13.23	-4.69

Table 29. Peak Power Spectral Density, Test Results, Combined Ports

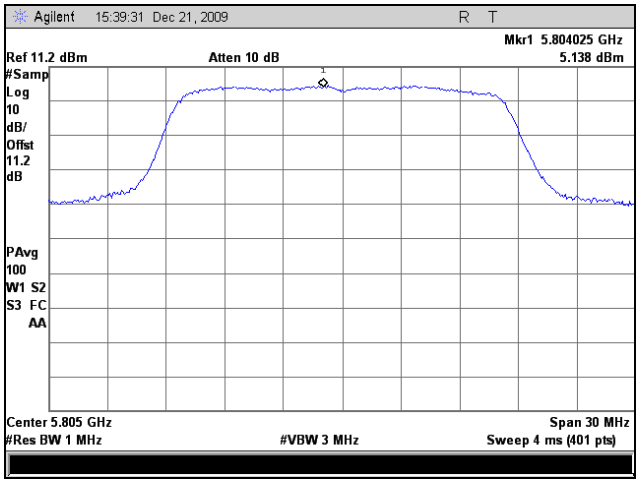
Peak Power Spectral Density, Port 1, 802.11a



Plot 77. PPSD, Port 1, 802.11a, 5745 MHz

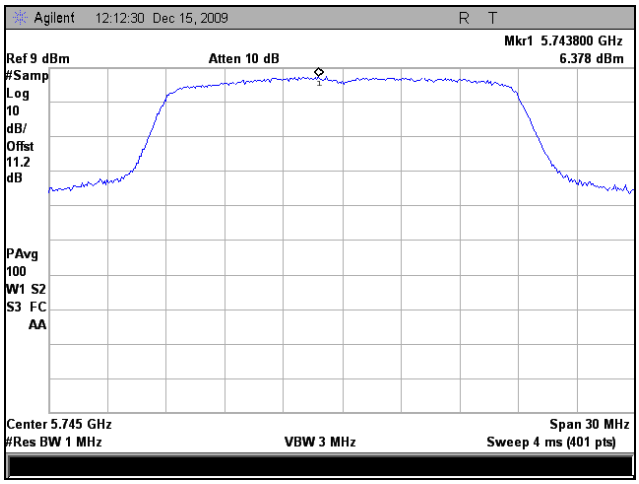


Plot 78. PPSD, Port 1, 802.11a 2, 5785 MHz

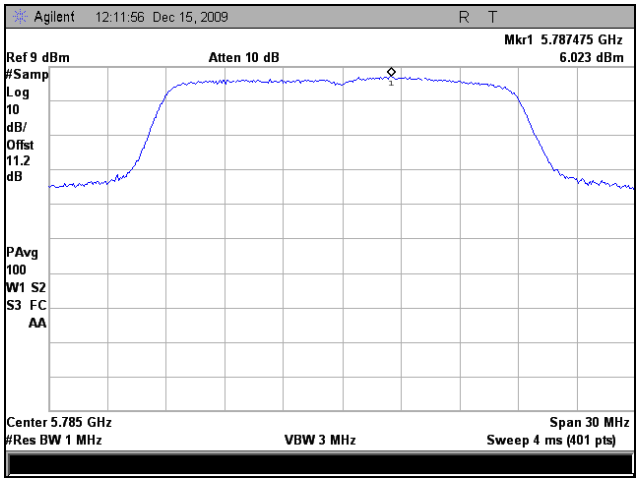


Plot 79. PPSD, Port 1, 802.11a, 5805 MHz

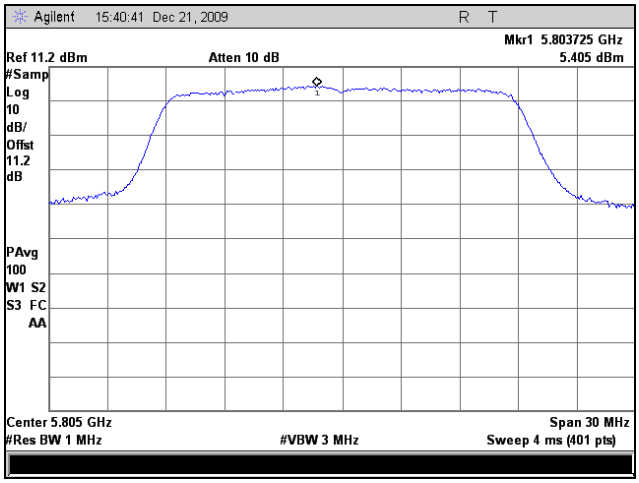
Peak Power Spectral Density, Port 1, 802.11n 20MHz



Plot 80. PPSD, \ Port 1, 802.11an 20MHz, 5745 MHz

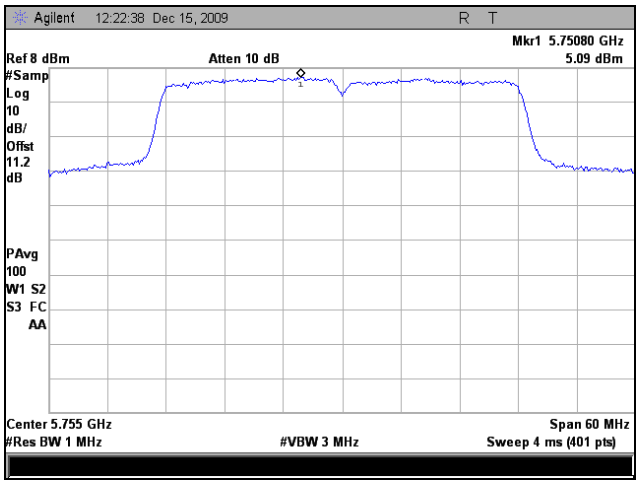


Plot 81. PPSD, Port 1, 802.11an 20MHz, 5785 MHz

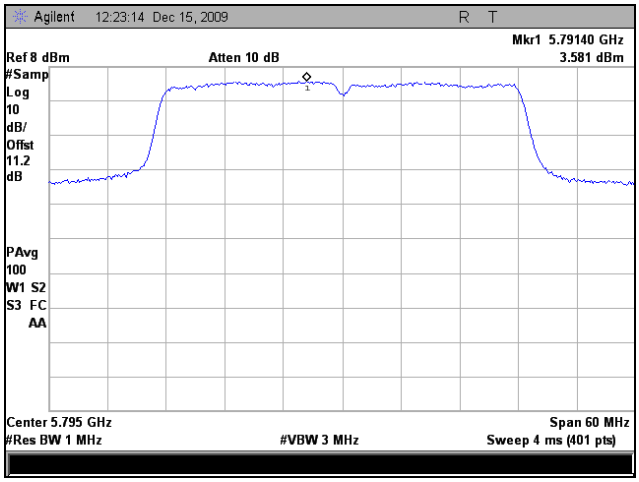


Plot 82. PPSD, Port 1, 802.11an 20MHz, 5805 MHz

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

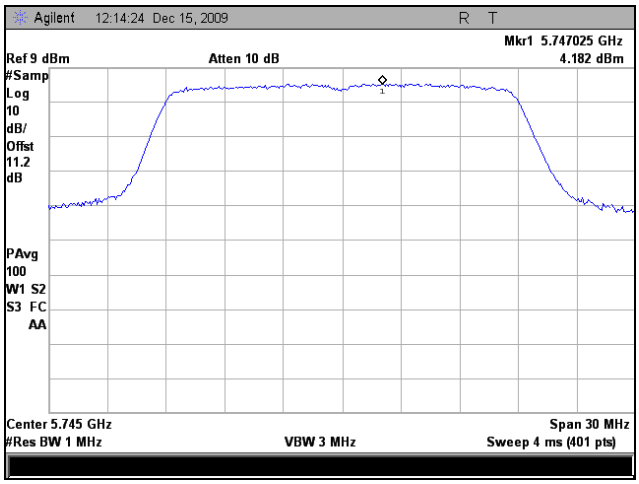


Plot 83. PPSD, Port 1, 802.11n 40MHz, 5755 MHz

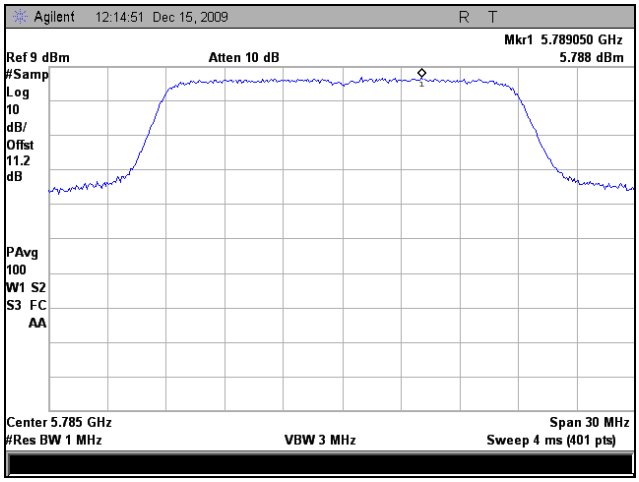


Plot 84. PPSD, Port 1, 802.11n 40MHz, 5795 MHz

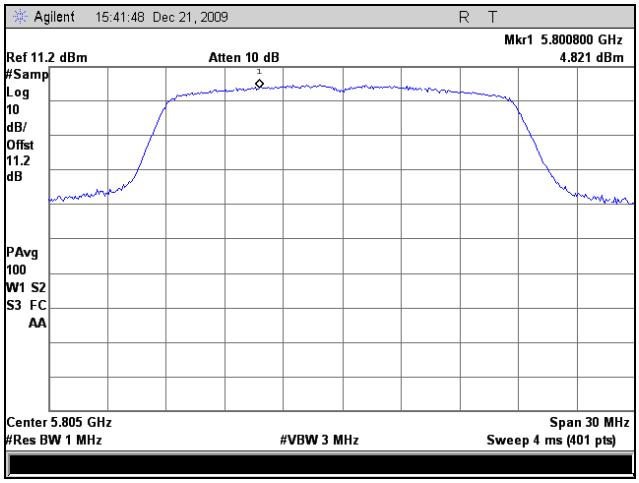
Peak Power Spectral Density, Port 2, 802.11n 20MHz



Plot 85. PPSD, Port 2, 802.11n 20MHz, 5745 MHz

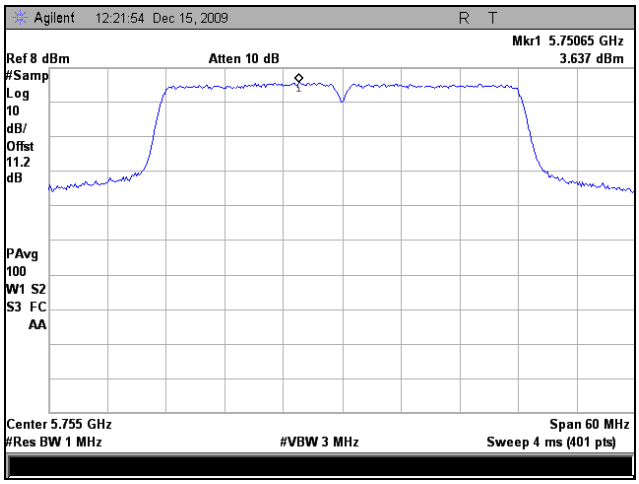


Plot 86. PPSD, Port 2, 802.11n 20MHz, 5785 MHz

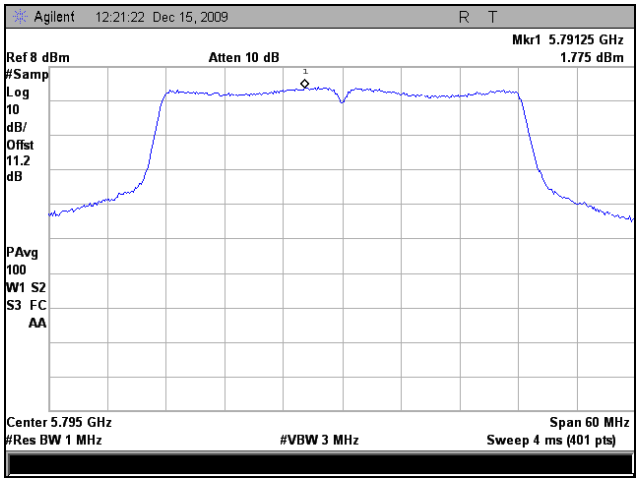


Plot 87. PPSD, Port 2, 802.11n 20MHz, 5805 MHz

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

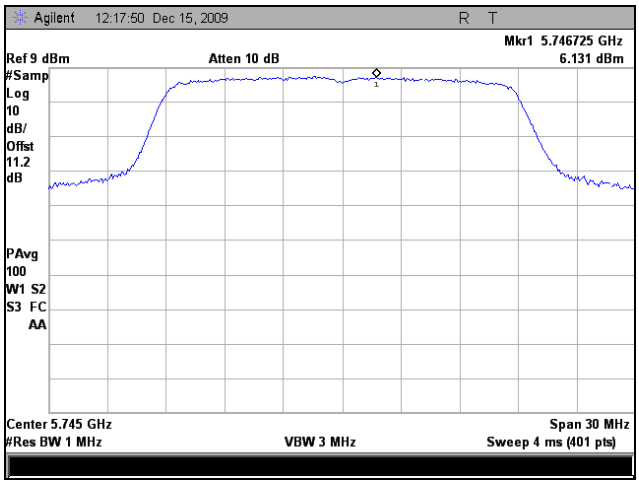


Plot 88. PPSD, Port 2, 802.11n 40MHz, 5755 MHz

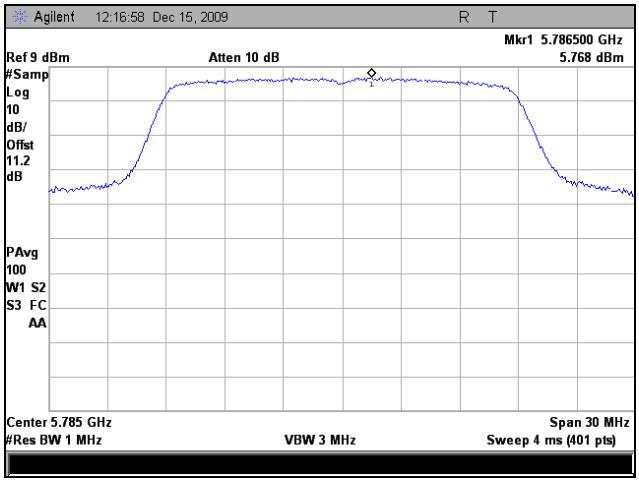


Plot 89. PPSD, Port 2, 802.11n 40MHz, 5795 MHz

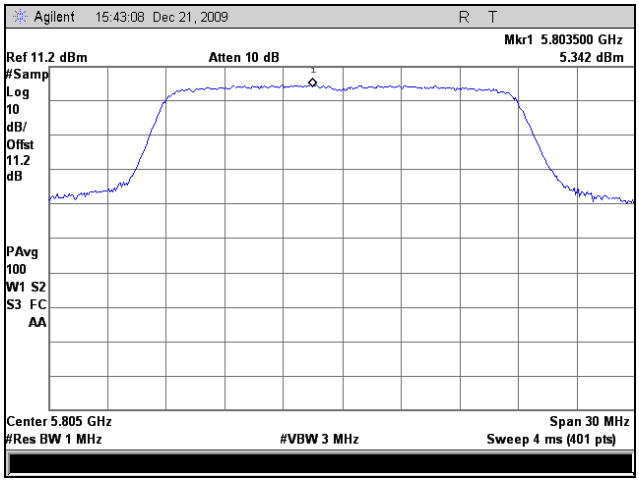
Peak Power Spectral Density, Port 3, 802.11n 20MHz



Plot 90. PPSD, Port 3, 802.11n 20MHz, 5745 MHz

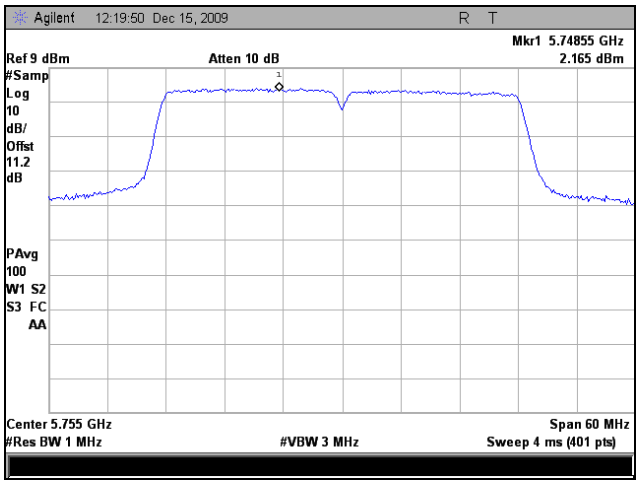


Plot 91. PPSD, Port 3, 802.11n 20MHz, 5785 MHz

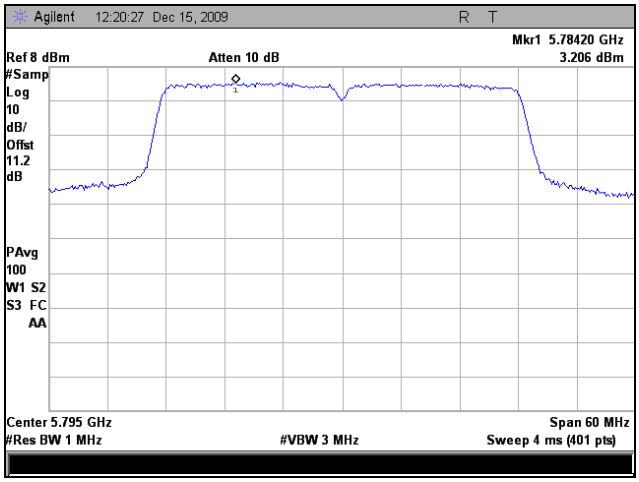


Plot 92. PPSD, Port 3, 802.11n 20MHz, 5805 MHz

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

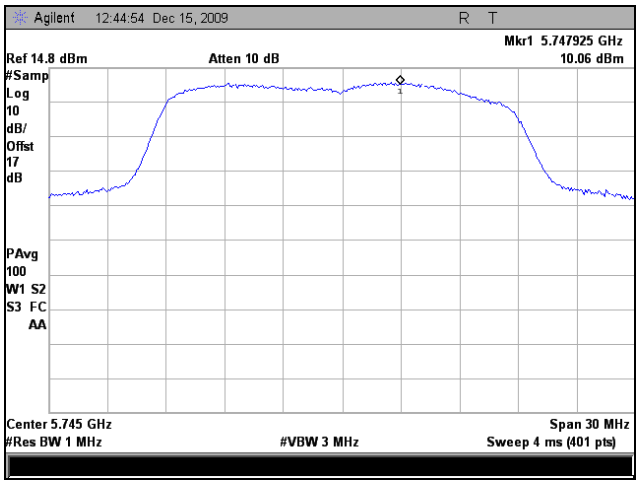


Plot 93. PPSD, Port 3, 802.11n 40MHz, 5755 MHz

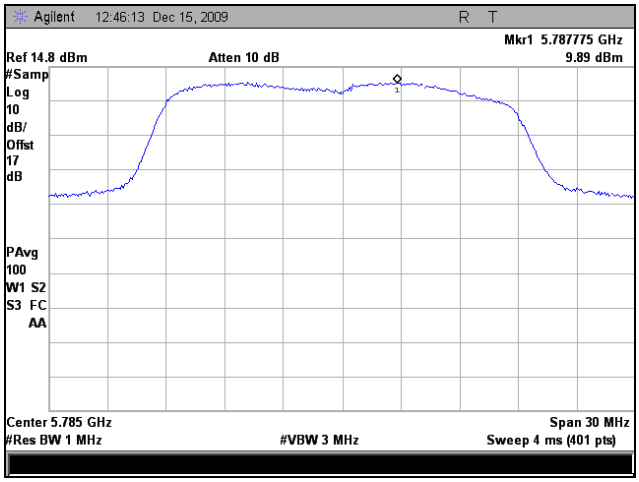


Plot 94. PPSD, Port 3, 802.11n 40MHz, 5795 MHz

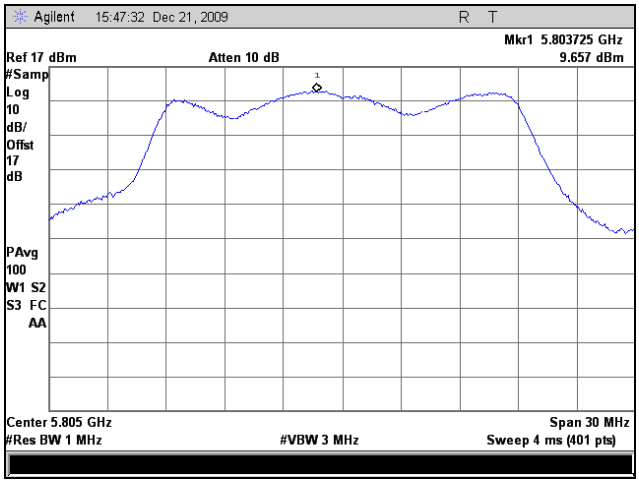
Peak Power Spectral Density, Combined Ports, 802.11n 20MHz



Plot 95. PPSD, Combined Ports, 802.11n 20MHz, 5745 MHz

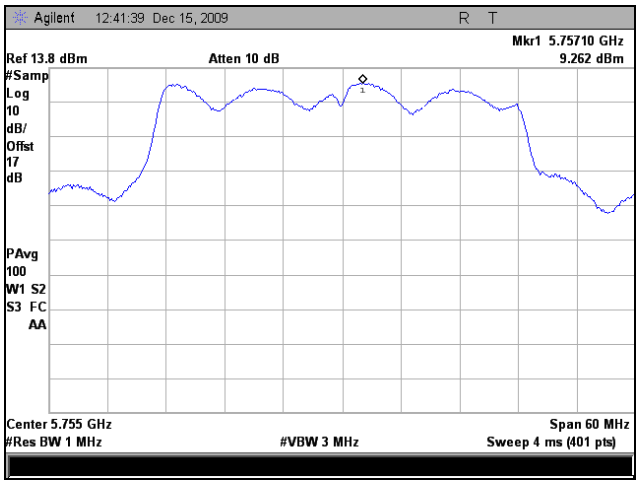


Plot 96. PPSD, Combined Ports, 802.11n 20MHz, 5785 MHz

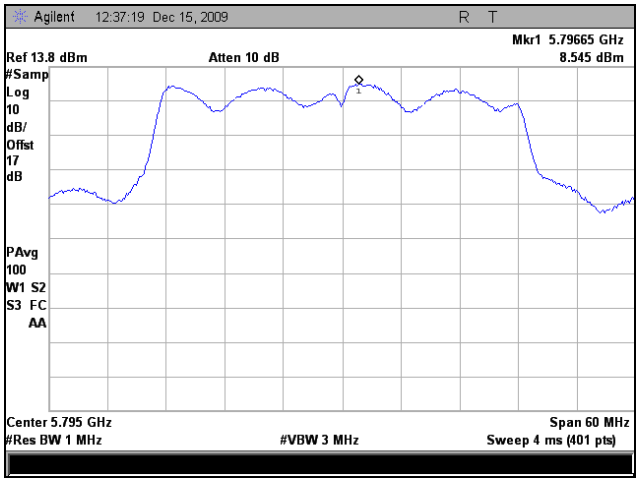


Plot 97. PPSD, Combined Ports, 802.11n 20MHz, 5805 MHz

Peak Power Spectral Density, Combined Ports, 802.11n 40MHz



Plot 98. PPSD, Combined Ports, 802.11n 40MHz, 5755 MHz



Plot 99. PPSD, Combined Ports, 802.11n 40MHz, 5795 MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(a)(6) Peak Excursion Ratio

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

Test Procedure: The method of measurement #2 from the FCC Public Notice CA 02-2138 was used. The EUT was connected directly to the spectrum analyzer through cabling and attenuation. The 1st trace on the spectrum analyzer was set to RBW=1MHz, VBW=3MHz. The peak detector mode was used and the trace max held. The 2nd trace on the spectrum analyzer was set to a RBW=1MHz, VBW=30 KHz. The detector mode was set to sample detector.

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

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

Test Engineer(s): Anderson Soungpanya

Test Date(s): 12/17/09

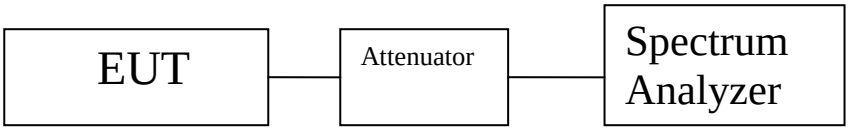


Figure 6. Peak Excursion Ration Test Setup

Peak Excursion Ratio, Port 1					
Mode	**Frequency (MHz)**		**Excursion Ratio (dBm)**	**Limit (dBm)**	**Margin (dB)**
802.11a	U-NII-3	5745	9.492	13	3.508
		5785	10.09	13	2.91
		5805	8.461	13	4.539
802.11n 20MHz	U-NII-3	5745	10.24	13	2.76
		5785	10.82	13	2.18
		5805	9.787	13	3.213
802.11n 40MHz	U-NII-3	5755	12.26	13	0.74
		5795	11.42	13	1.58

Table 30. Peak Excursion Ration, Test Results, Port 1

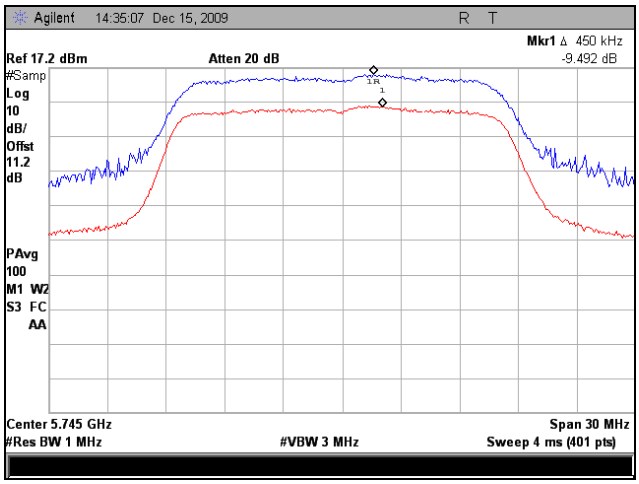
Peak Excursion Ratio, Port 2					
Mode	**Frequency (MHz)**		**Excursion Ratio (dBm)**	**Limit (dBm)**	**Margin (dB)**
802.11n 20MHz	U-NII-3	5745	11.14	13	1.86
		5785	9.76	13	3.24
		5805	10.67	13	2.33
802.11n 40MHz	U-NII-3	5755	11.23	13	1.77
		5795	12.02	13	0.98

Table 31. Peak Excursion Ration, Test Results, Port 2

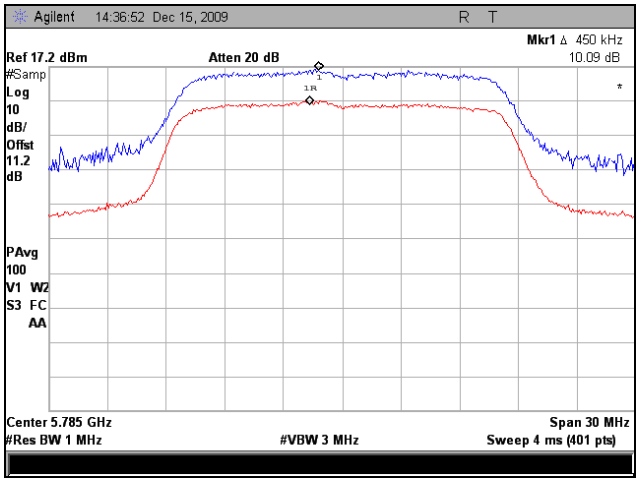
Peak Excursion Ratio, Port 3					
Mode	**Frequency (MHz)**		**Excursion Ratio (dBm)**	**Limit (dBm)**	**Margin (dB)**
802.11n 20MHz	U-NII-3	5745	10.48	13	2.52
		5785	10.59	13	2.41
		5805	10.7	13	2.3
802.11n 40MHz	U-NII-3	5755	12.64	13	0.36
		5795	12.4	13	0.6

Table 32. Peak Excursion Ration, Test Results, Port 3

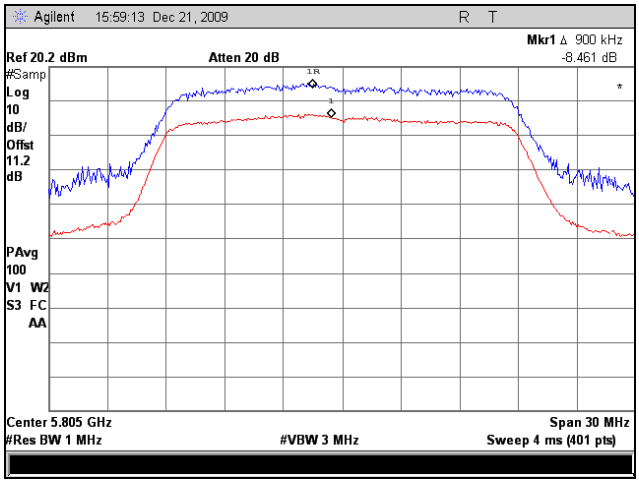
Peak Excursion Ratio, Port 1, 802.11a



Plot 100. Peak Excursion, Port 1, 802.11a, 5745 MHz

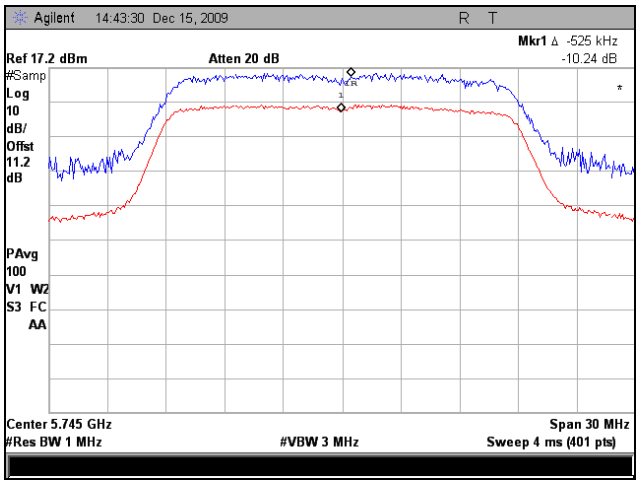


Plot 101. Peak Excursion, Port 1, 802.11a, 5785 MHz

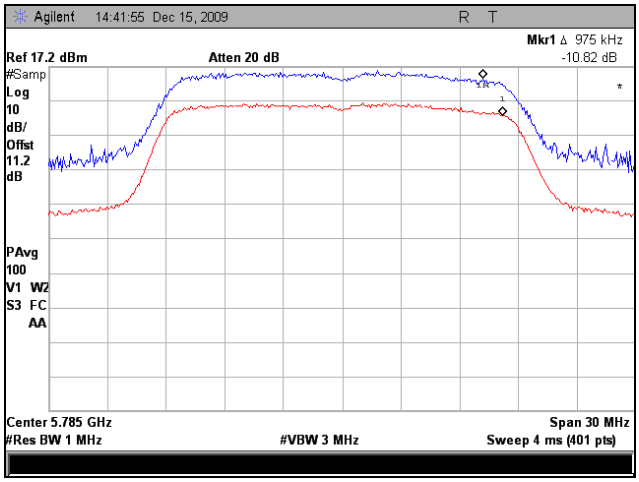


Plot 102. Peak Excursion, Port 1, 802.11a, 5805 MHz

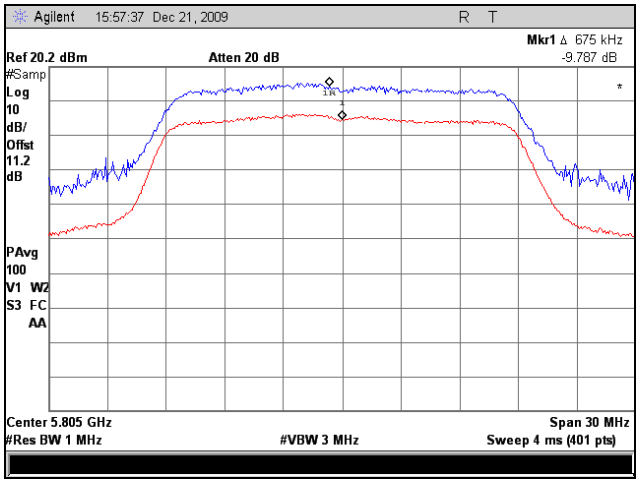
Peak Excursion Ratio, 5020 Outdoor, Port 1, 802.11n 20MHz



Plot 103. Peak Excursion, Port 1, 802.11n 20MHz, 5745 MHz

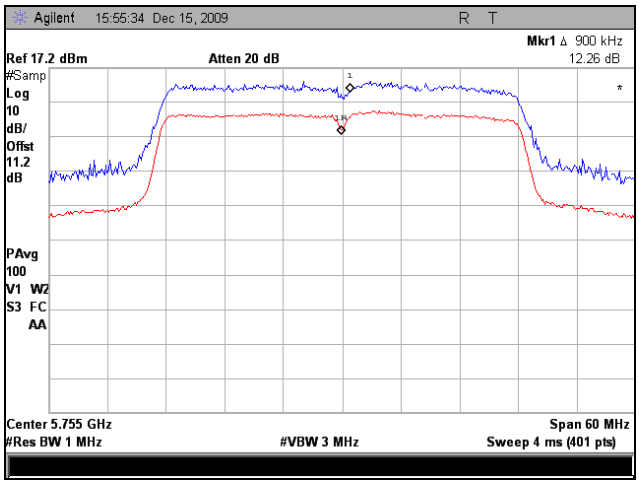


Plot 104. Peak Excursion, Port 1, 802.11n 20MHz, 5785 MHz

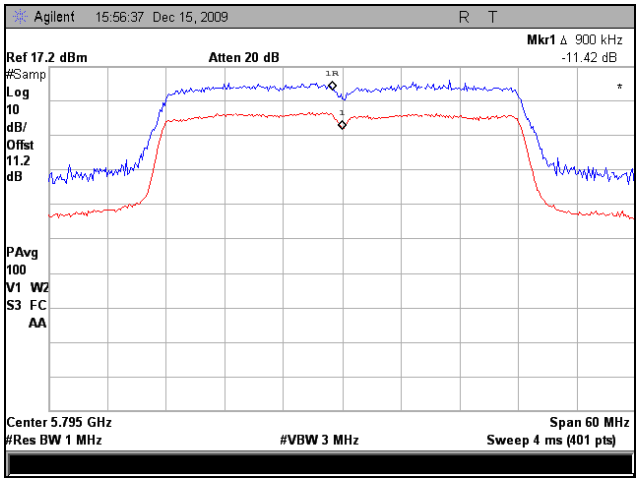


Plot 105. Peak Excursion, Port 1, 802.11n 20MHz, 5805 MHz

Peak Excursion Ratio, Port 1, 802.11n 40MHz

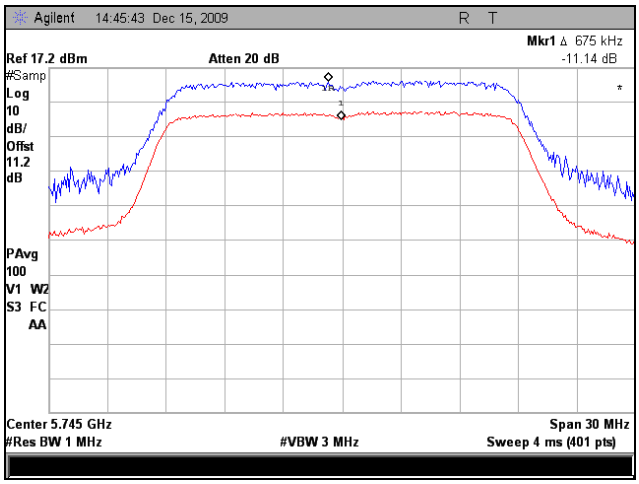


Plot 106. Peak Excursion, Port 1, 802.11n 40MHz, 5755 MHz

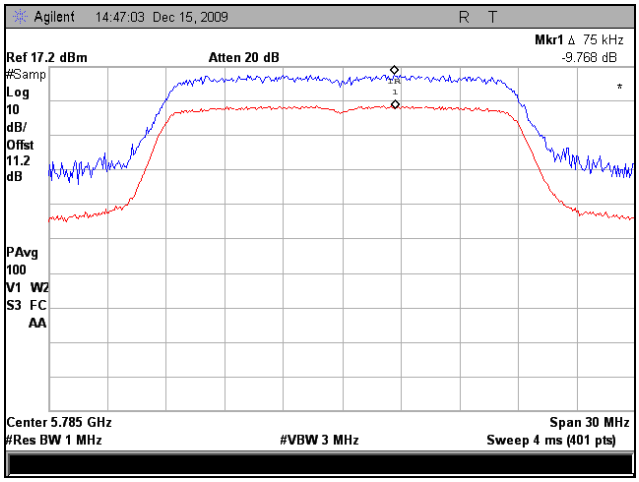


Plot 107. Peak Excursion, Port 1, 802.11n 40MHz, 5795 MHz

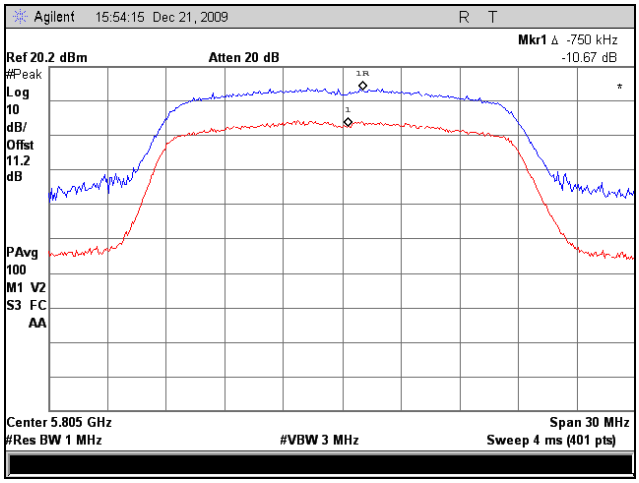
Peak Excursion Ratio, Port 2, 802.11n 20MHz



Plot 108. Peak Excursion, Port 2, 802.11n 20MHz, 5745 MHz

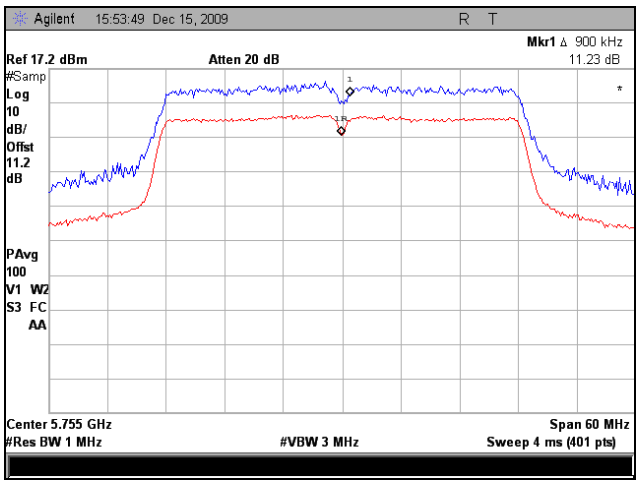


Plot 109. Peak Excursion, Port 2, 802.11n 20MHz, 5785 MHz

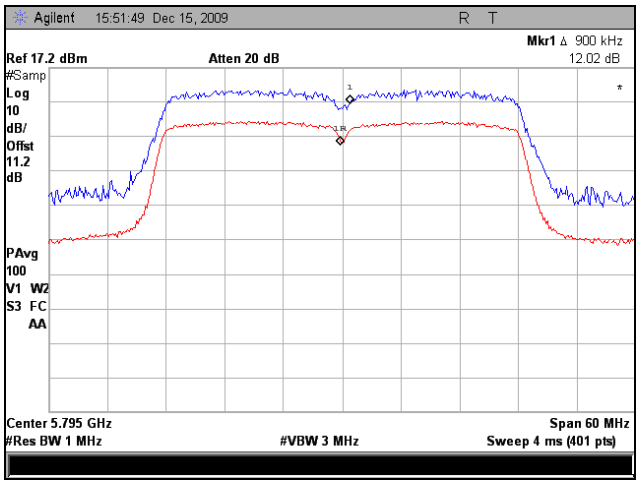


Plot 110. Peak Excursion, Port 2, 802.11n 20MHz, 5805 MHz

Peak Excursion Ratio, Port 2, 802.11n 40MHz

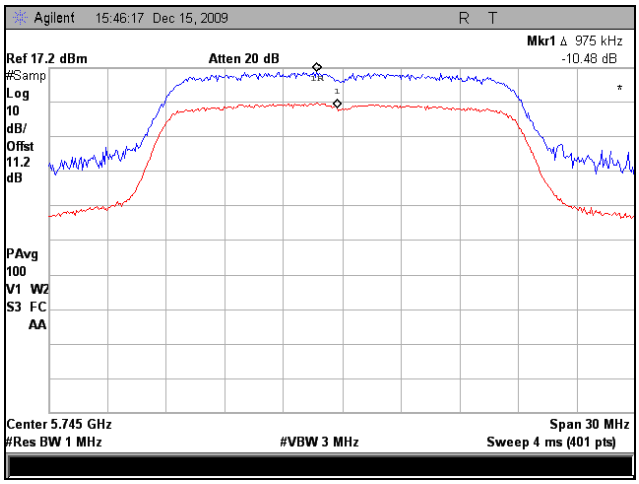


Plot 111. Peak Excursion, Port 2, 802.11n 40MHz, 5755 MHz

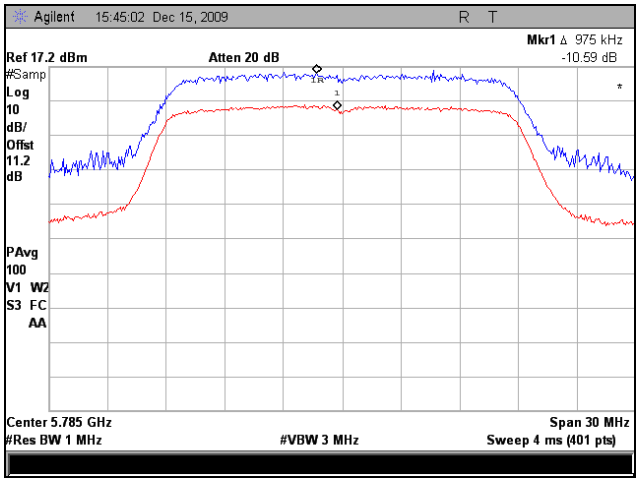


Plot 112. Peak Excursion, Port 2, 802.11n 40MHz, 5795 MHz

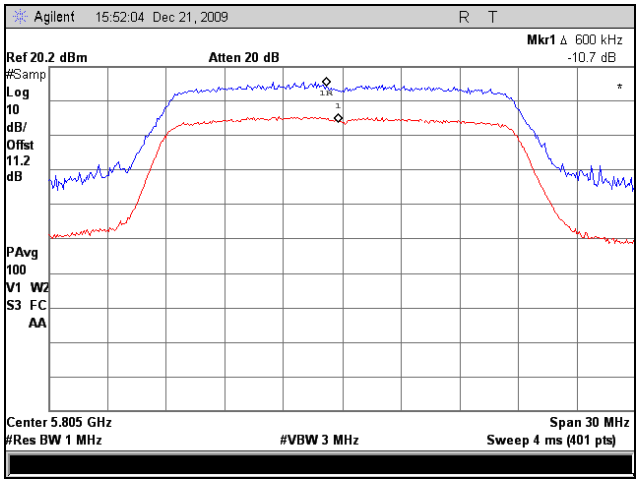
Peak Excursion Ratio, Port 3, 802.11n 20MHz



Plot 113. Peak Excursion, Port 3, 802.11n 20MHz, 5745 MHz

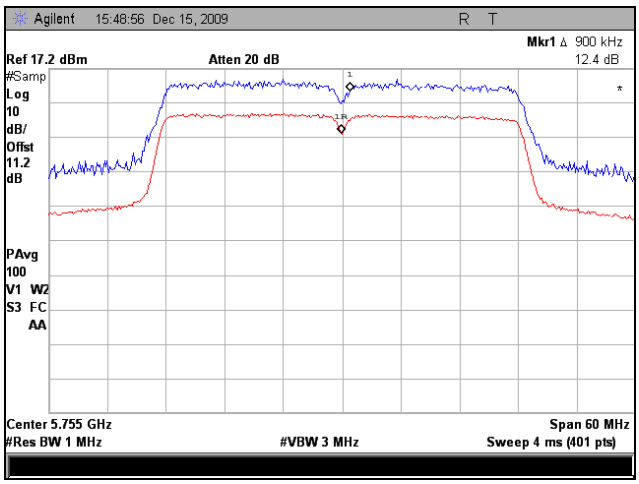


Plot 114. Peak Excursion, Port 3, 802.11n 20MHz, 5785 MHz

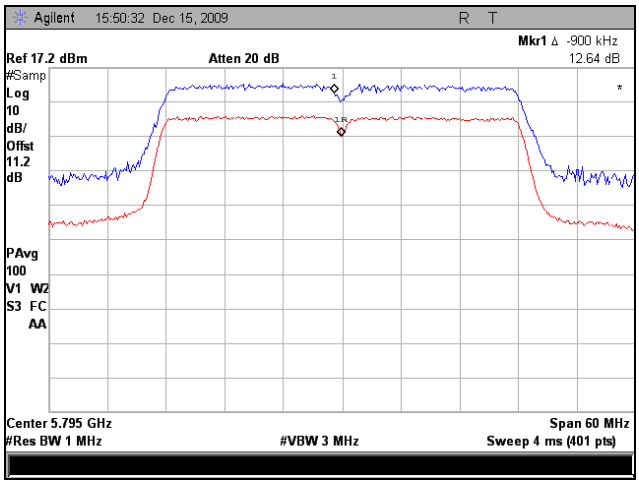


Plot 115. Peak Excursion, Port 3, 802.11n 20MHz, 5805 MHz

Peak Excursion Ratio, Port 3, 802.11n 40MHz



Plot 116. Peak Excursion, Port 3, 802.11n 40MHz, 5755 MHz



Plot 117. Peak Excursion, Port 3, 802.11n 40MHz, 5795 MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(b)(4), (6), (7) Undesirable Emissions

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

§ 15.407(b)(4): For transmitters operating in the 5.725-5.825 GHz band: all emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an EIRP of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions 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 EUT was placed on a non-conducting 0.8m high stand on a turntable in a semi-anechoic chamber. The EUT was set to transmit on low, mid, and high channels, while the turntable was rotated 360 degrees through three orthogonal axes and the receiving antenna height was varied to maximize emissions.

For frequencies from 30MHz to 1GHz, measurements were first made using a peak detector with a 100kHz resolution bandwidth. Emissions which exceeded the limits were re-measured using a quasi-peak detector with a 120kHz resolution bandwidth.

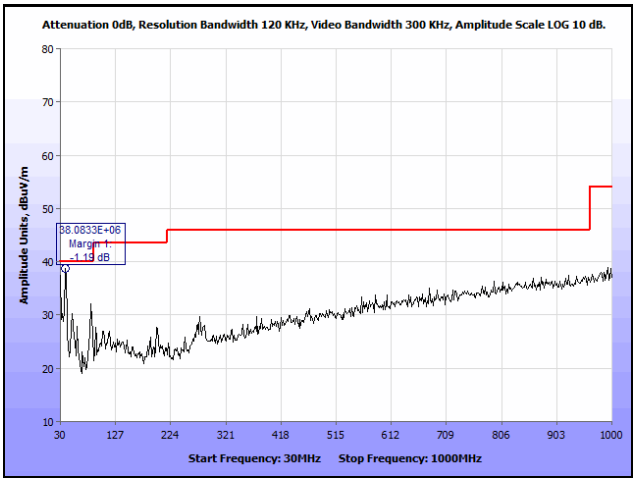
For measurements above 1 GHz, measurements were made with a Peak detector with 1 MHz resolution bandwidth. Where the spurious emissions fell into a restricted band, measurements were also made with an average detector to make sure they complied with 15.209 limits. Emissions were explored up to 40 GHz.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

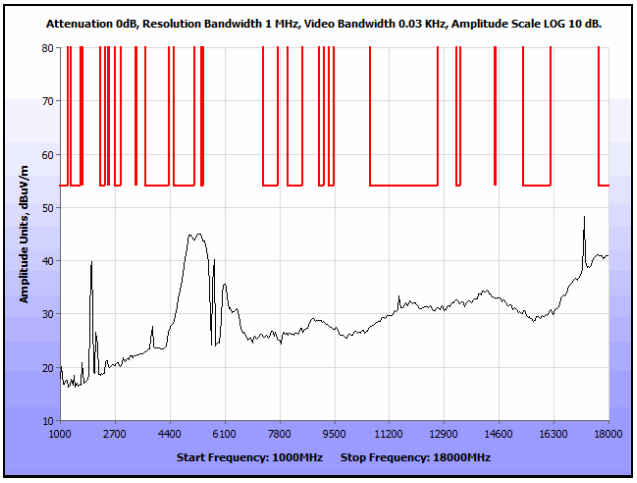
Test Engineer(s): Aaron Chang

Test Date(s): 06/24/13

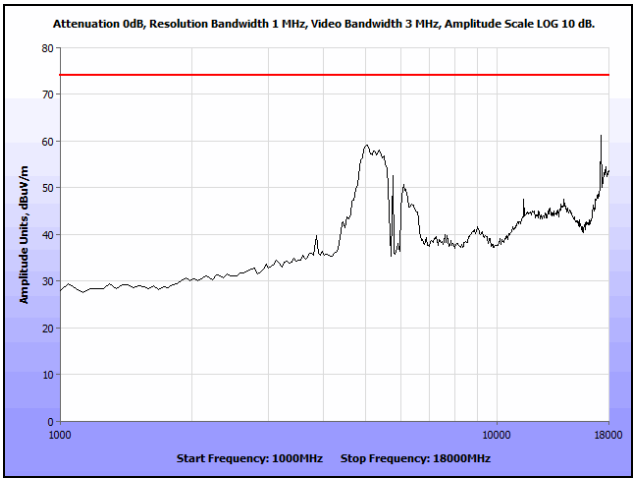
Radiated Spurious Emissions, 802.11a, 5 dBi Omni



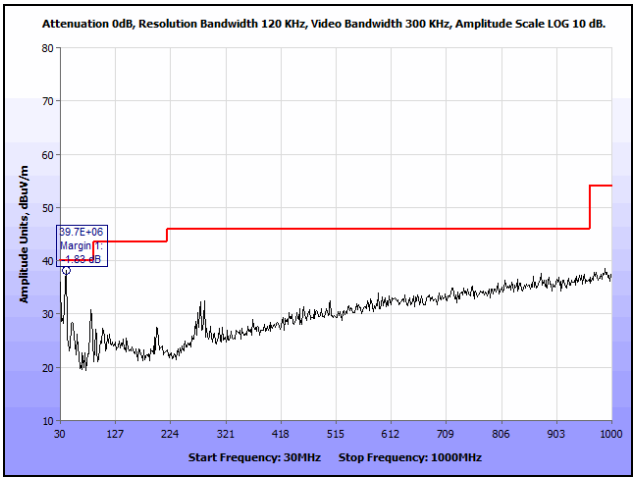
Plot 118. Radiated Spurious Emissions, 5 dBi Omni, 802.11a, 5745 MHz, 30 MHz – 1 GHz



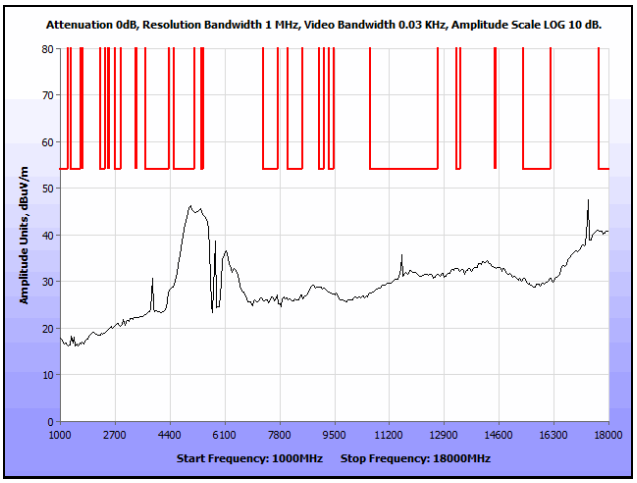
Plot 119. Radiated Spurious Emissions, 5 dBi Omni, 802.11a, 5745 MHz, 1 GHz – 18 GHz, Average



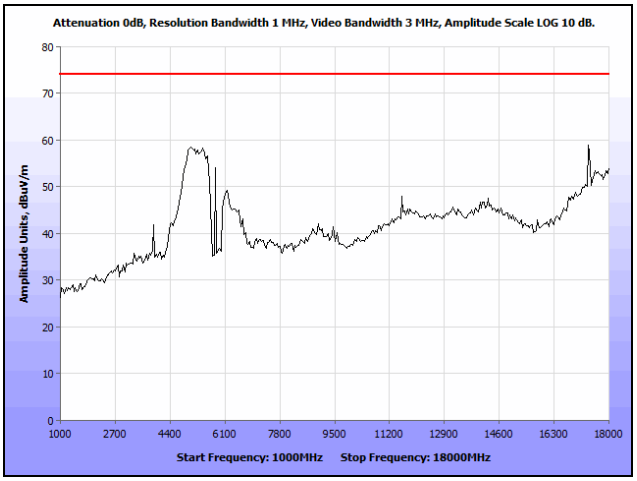
Plot 120. Radiated Spurious Emissions, 5 dBi Omni, 802.11a, 5745 MHz, 1 GHz – 18 GHz, Peak



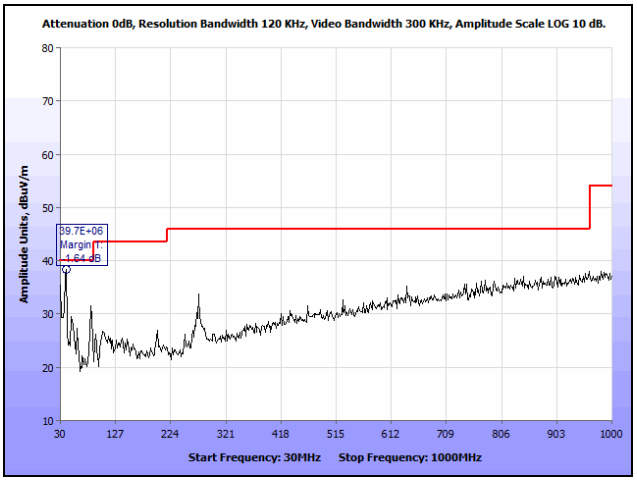
Plot 121. Radiated Spurious Emissions, 5 dBi Omni, 802.11a, 5785 MHz, 30 MHz – 1 GHz



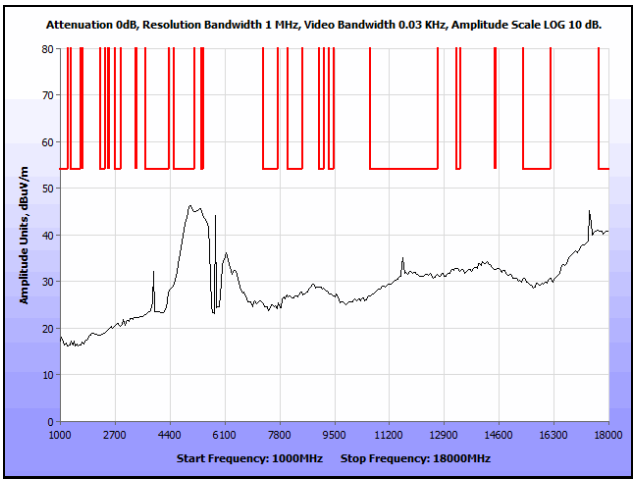
Plot 122. Radiated Spurious Emissions, 5 dBi Omni, 802.11a, 5785 MHz, 1 GHz – 18 GHz, Average



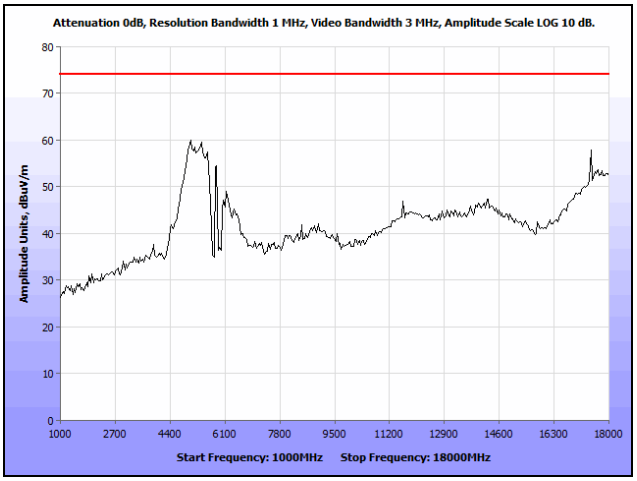
Plot 123. Radiated Spurious Emissions, 5 dBi Omni, 802.11a, 5785 MHz, 1 GHz – 18 GHz, Peak



Plot 124. Radiated Spurious Emissions, 5 dBi Omni, 802.11a, 5805 MHz, 30 MHz – 1 GHz

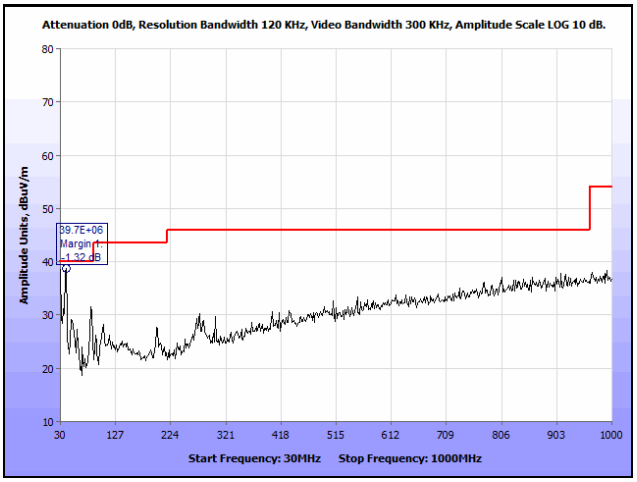


Plot 125. Radiated Spurious Emissions, 5 dBi Omni, 802.11a, 5805 MHz, 1 GHz – 18 GHz, Average

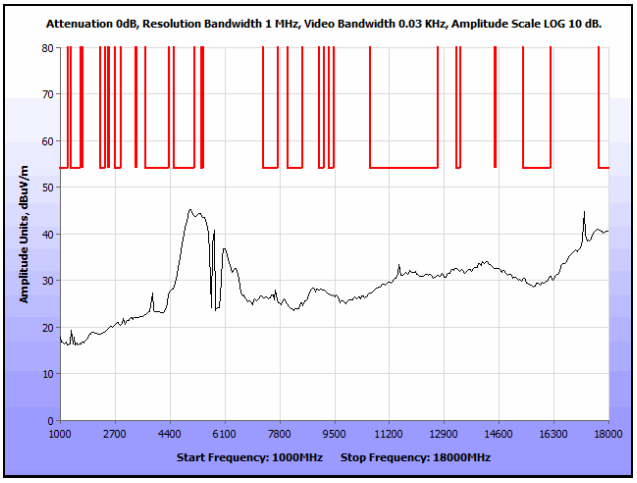


Plot 126. Radiated Spurious Emissions, 5 dBi Omni, 802.11a, 5805 MHz, 1 GHz – 18 GHz, Peak

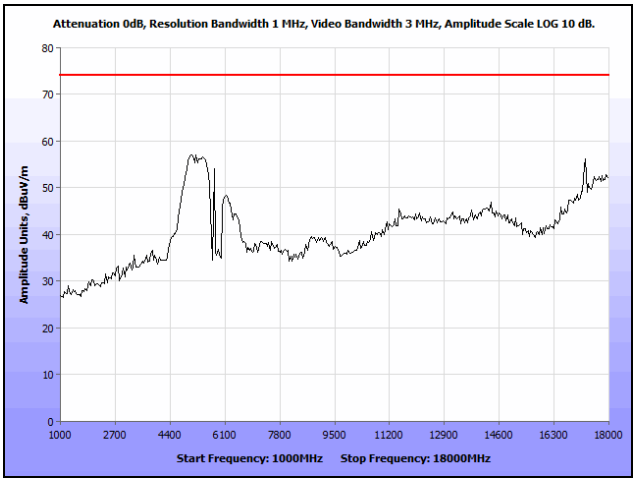
Radiated Spurious Emissions, 802.11n 20 MHz, 5 dBi Omni



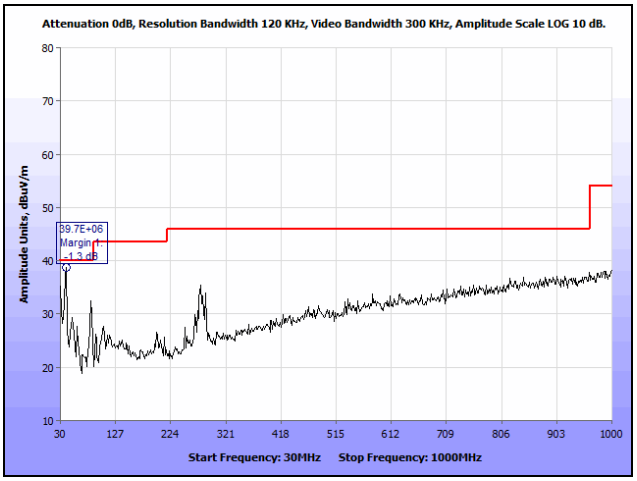
Plot 127. Radiated Spurious Emissions, 5 dBi Omni, 802.11n 20 MHz, 5745 MHz, 30 MHz – 1 GHz



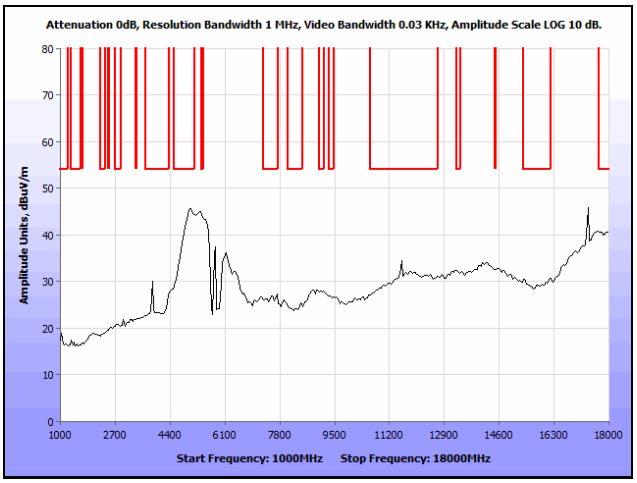
Plot 128. Radiated Spurious Emissions, 5 dBi Omni, 802.11n 20 MHz, 5745 MHz, 1 GHz – 18 GHz, Average



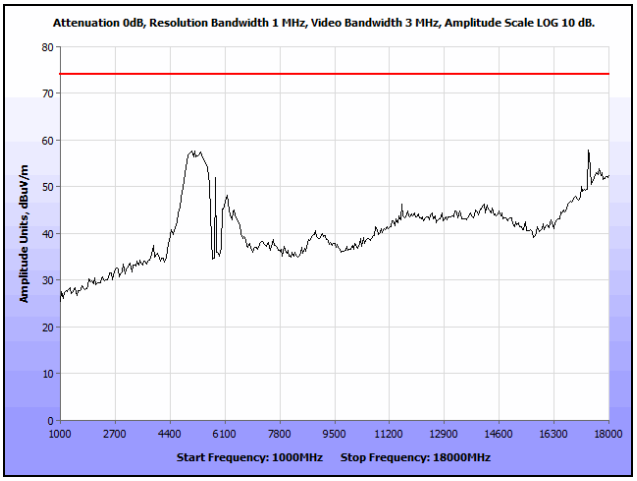
Plot 129. Radiated Spurious Emissions, 5 dBi Omni, 802.11n 20 MHz, 5745 MHz, 1 GHz – 18 GHz, Peak



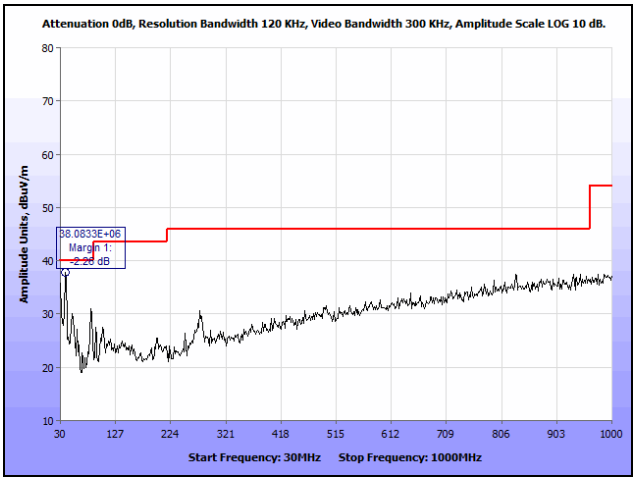
Plot 130. Radiated Spurious Emissions, 5 dBi Omni, 802.11n 20 MHz, 5785 MHz, 30 MHz – 1 GHz



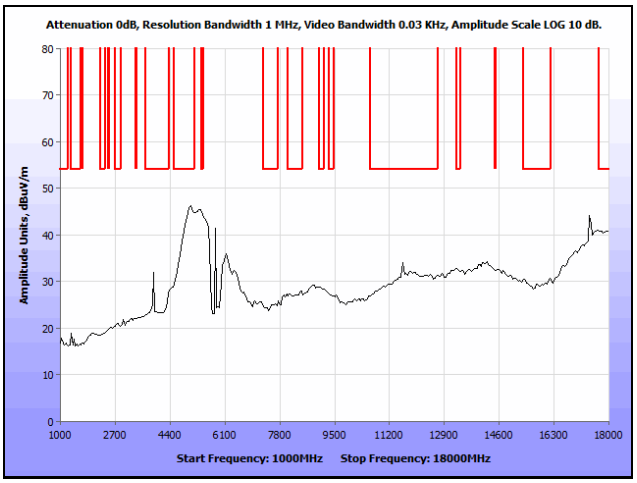
Plot 131. Radiated Spurious Emissions, 5 dBi Omni, 802.11n 20 MHz, 5785 MHz, 1 GHz – 18 GHz, Average



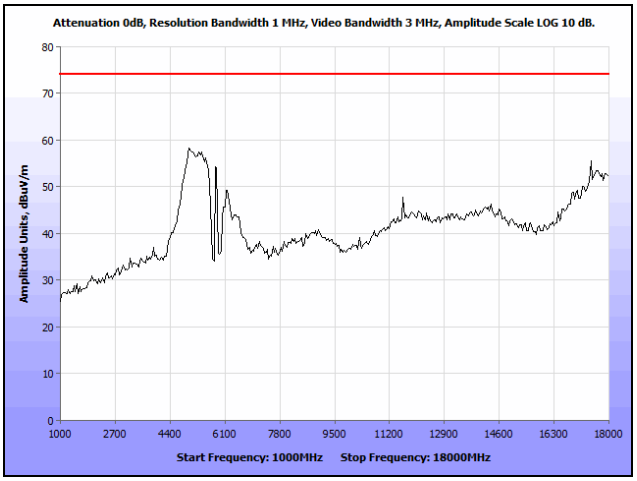
Plot 132. Radiated Spurious Emissions, 5 dBi Omni, 802.11n 20 MHz, 5785 MHz, 1 GHz – 18 GHz, Peak



Plot 133. Radiated Spurious Emissions, 5 dBi Omni, 802.11n 20 MHz, 5805 MHz, 30 MHz – 1 GHz

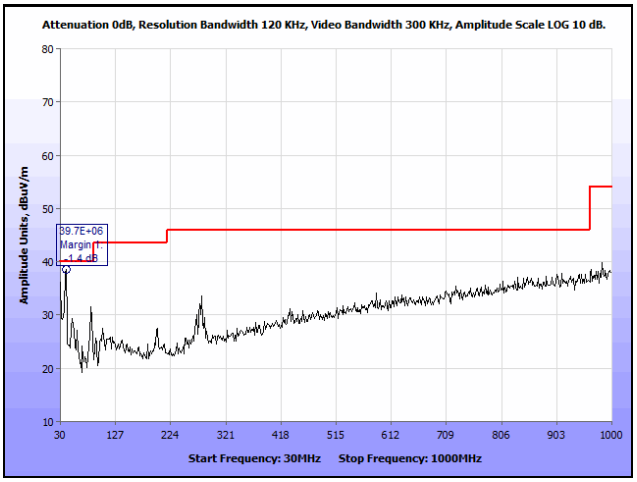


Plot 134. Radiated Spurious Emissions, 5 dBi Omni, 802.11n 20 MHz, 5805 MHz, 1 GHz – 18 GHz, Average

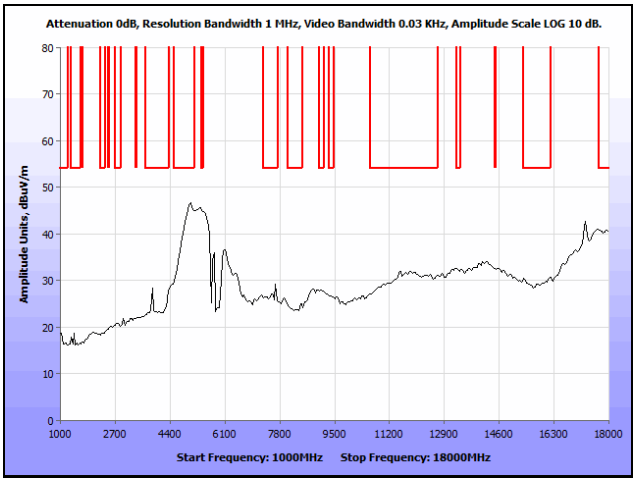


Plot 135. Radiated Spurious Emissions, 5 dBi Omni, 802.11n 20 MHz, 5805 MHz, 1 GHz – 18 GHz, Peak

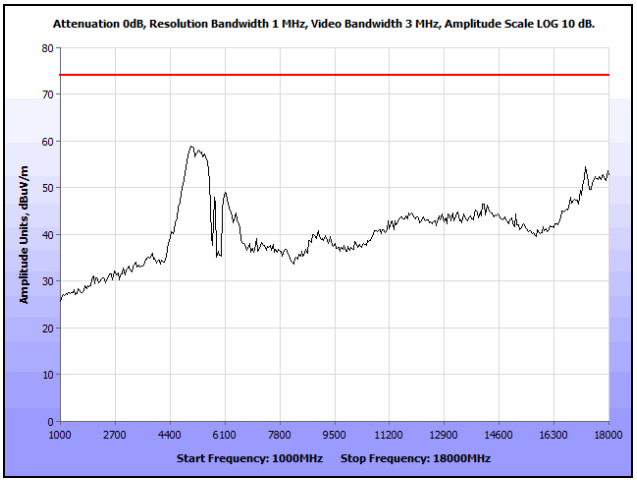
Radiated Spurious Emissions, 802.11n 40 MHz, 5 dBi Omni



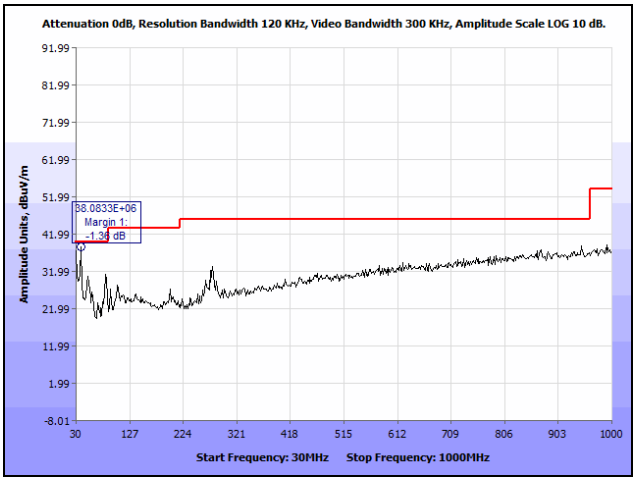
Plot 136. Radiated Spurious Emissions, 5 dBi Omni, 802.11n 40 MHz, 5755 MHz, 30 MHz – 1 GHz



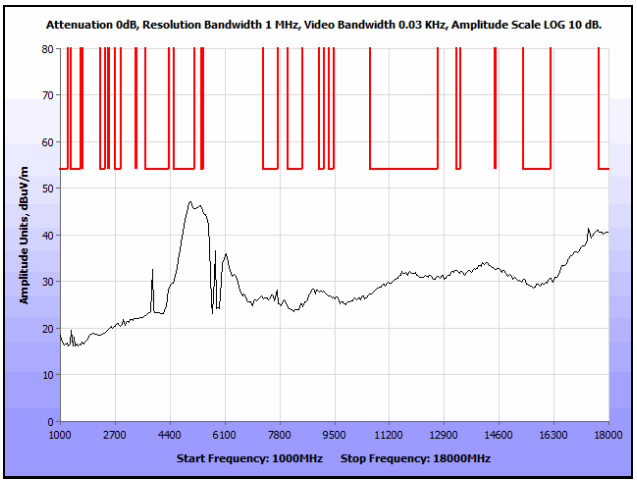
Plot 137. Radiated Spurious Emissions, 5 dBi Omni, 802.11n 40 MHz, 5755 MHz, 1 GHz – 18 GHz, Average



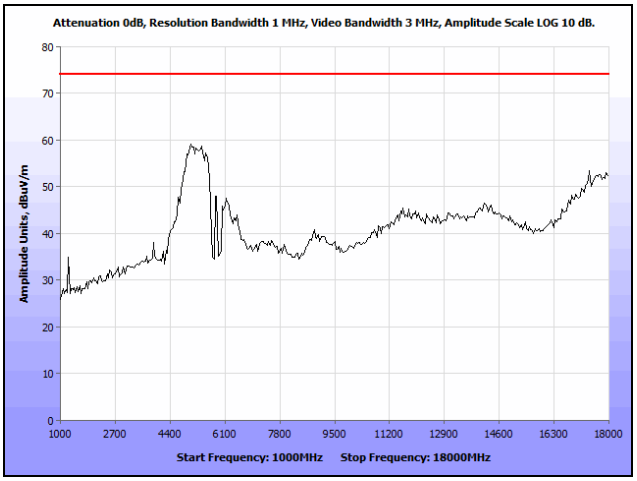
Plot 138. Radiated Spurious Emissions, 5 dBi Omni, 802.11n 40 MHz, 5755 MHz, 1 GHz – 18 GHz, Peak



Plot 139. Radiated Spurious Emissions, 5 dBi Omni, 802.11n 40 MHz, 5795 MHz, 30 MHz – 1 GHz

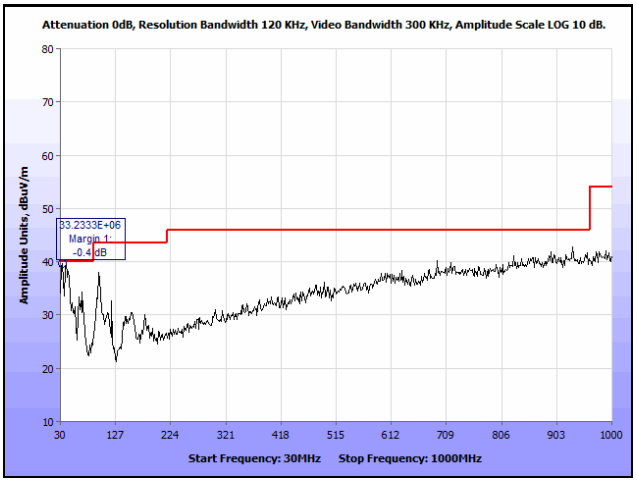


Plot 140. Radiated Spurious Emissions, 5 dBi Omni, 802.11n 40 MHz, 5795 MHz, 1 GHz – 18 GHz, Average

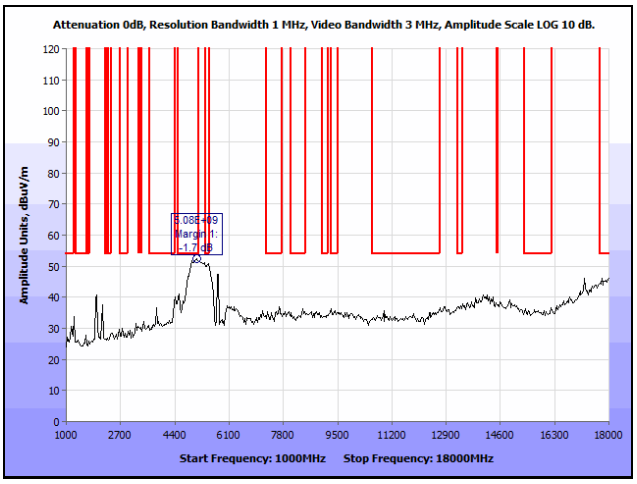


Plot 141. Radiated Spurious Emissions, 5 dBi Omni, 802.11n 40 MHz, 5795 MHz, 1 GHz – 18 GHz, Peak

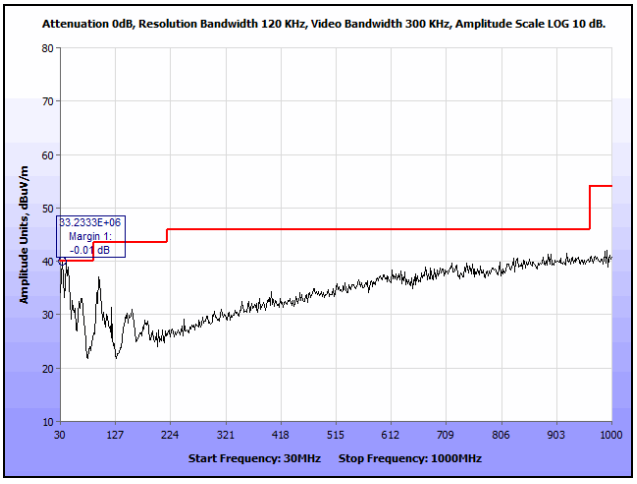
Radiated Spurious Emissions, 802.11a, 19 dBi Patch



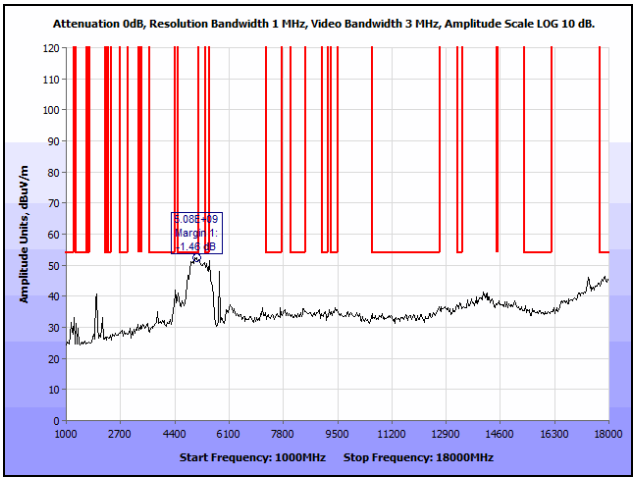
Plot 142. Radiated Spurious Emissions, 19 dBi Patch, 802.11a, 5745 MHz, 30 MHz – 1 GHz



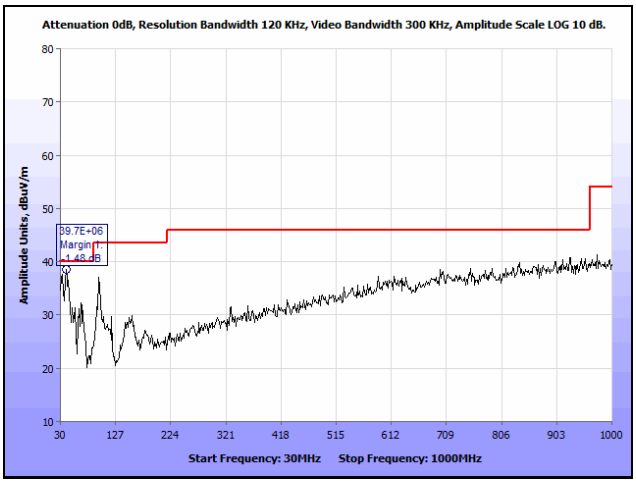
Plot 143. Radiated Spurious Emissions, 19 dBi Patch, 802.11a, 5745 MHz, 1 GHz – 18 GHz



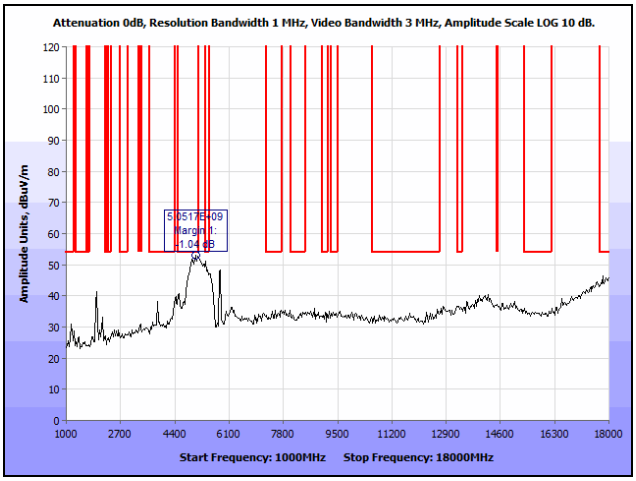
Plot 144. Radiated Spurious Emissions, 19 dBi Patch, 802.11a, 5785 MHz, 30 MHz – 1 GHz



Plot 145. Radiated Spurious Emissions, 19 dBi Patch, 802.11a, 5785 MHz, 1 GHz – 18 GHz

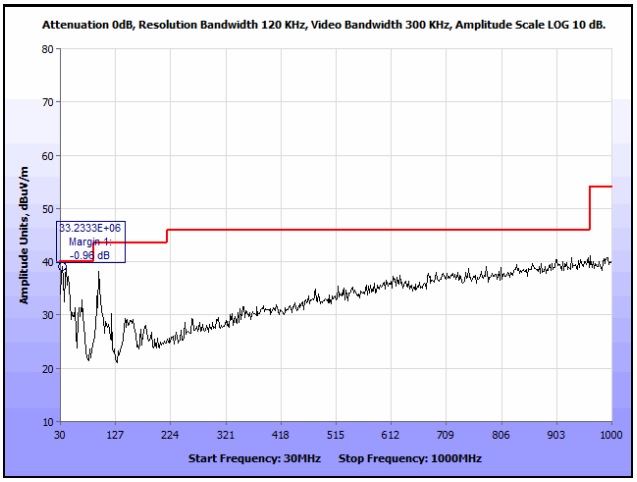


Plot 146. Radiated Spurious Emissions, 19 dBi Patch, 802.11a, 5805 MHz, 30 MHz – 1 GHz

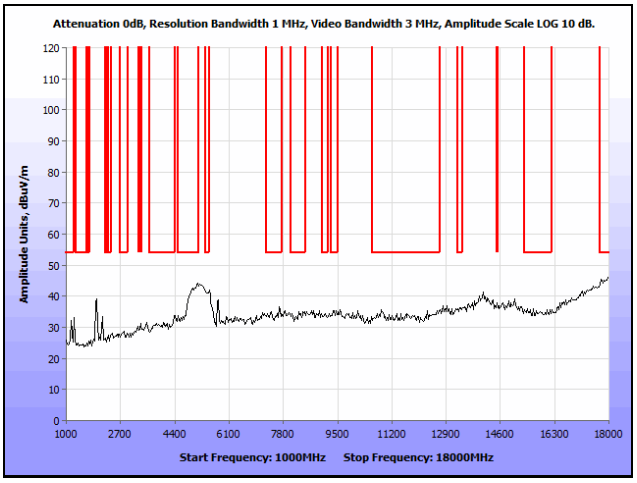


Plot 147. Radiated Spurious Emissions, 19 dBi Patch, 802.11a, 5805 MHz, 1 GHz – 18 GHz

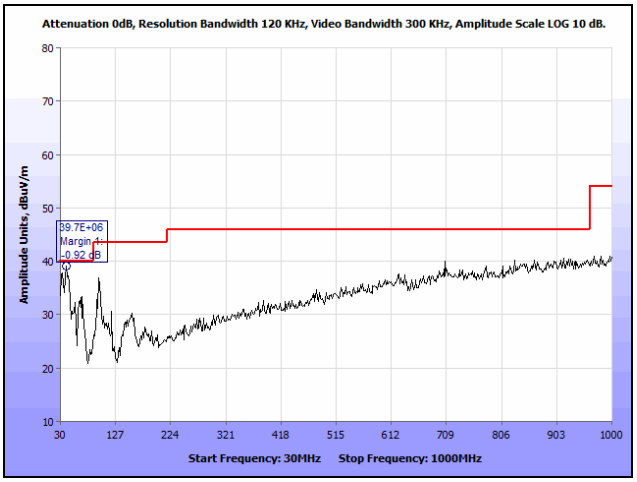
Radiated Spurious Emissions, 802.11n 20 MHz, 19 dBi Patch



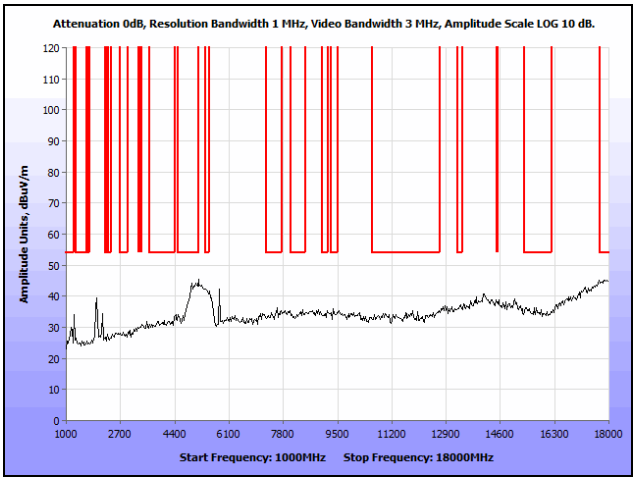
Plot 148. Radiated Spurious Emissions, 19 dBi Patch, 802.11n 20 MHz, 5745 MHz, 30 MHz – 1 GHz



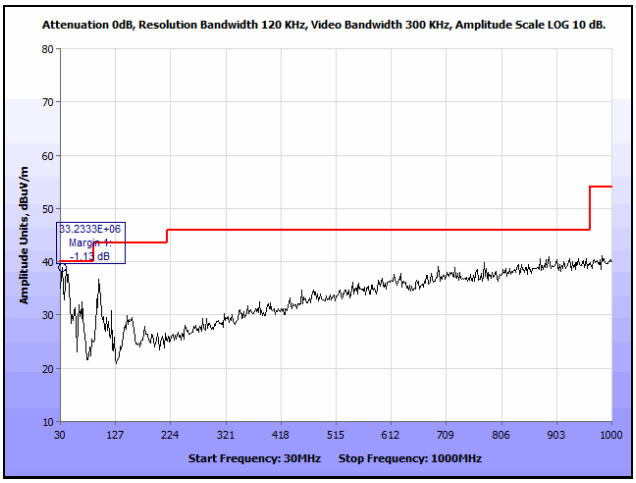
Plot 149. Radiated Spurious Emissions, 19 dBi Patch, 802.11n 20 MHz, 5745 MHz, 1 GHz – 18 GHz



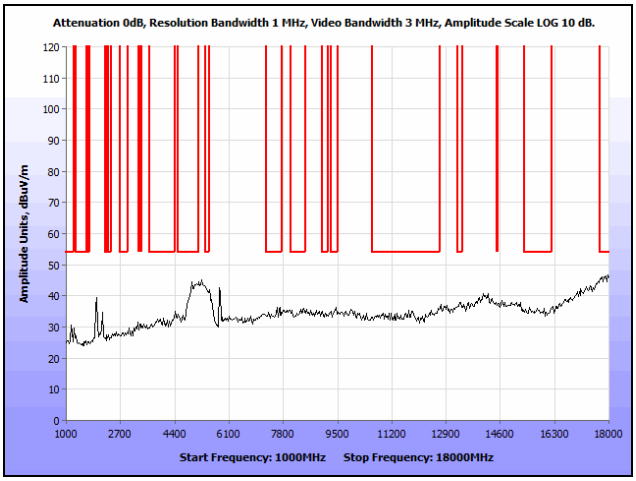
Plot 150. Radiated Spurious Emissions, 19 dBi Patch, 802.11n 20 MHz, 5785 MHz, 30 MHz – 1 GHz



Plot 151. Radiated Spurious Emissions, 19 dBi Patch, 802.11n 20 MHz, 5785 MHz, 1 GHz – 18 GHz

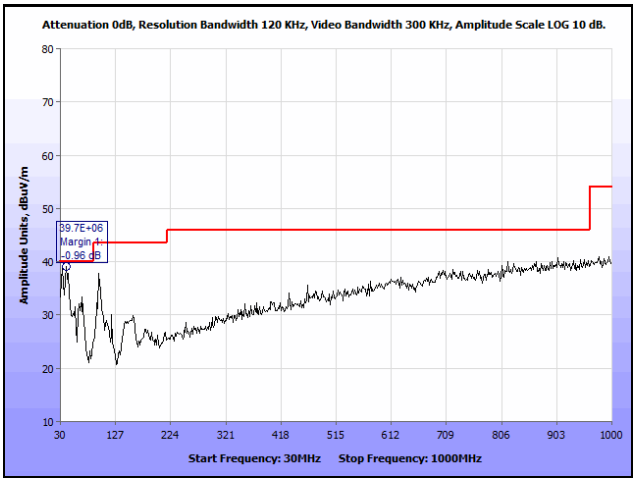


Plot 152. Radiated Spurious Emissions, 19 dBi Patch, 802.11n 20 MHz, 5805 MHz, 30 MHz – 1 GHz

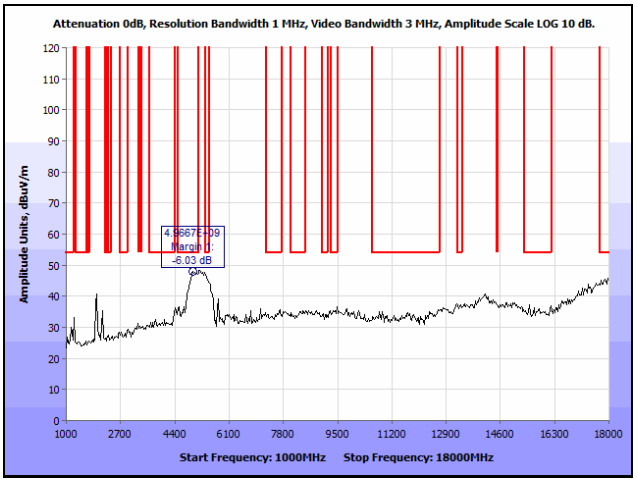


Plot 153. Radiated Spurious Emissions, 19 dBi Patch, 802.11n 20 MHz, 5805 MHz, 1 GHz – 18 GHz

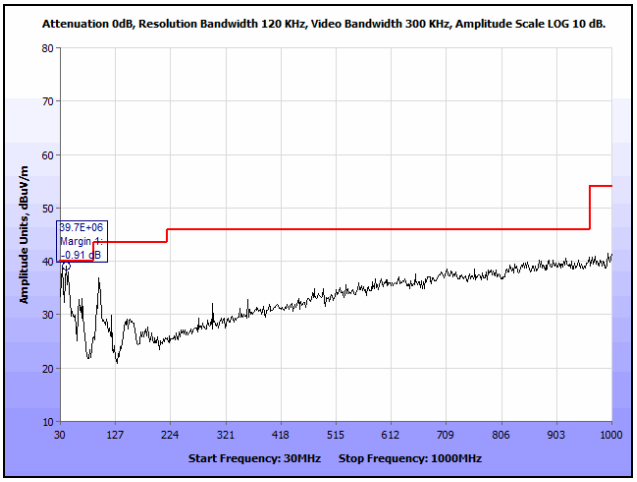
Radiated Spurious Emissions, 802.11n 40 MHz, 19 dBi Patch



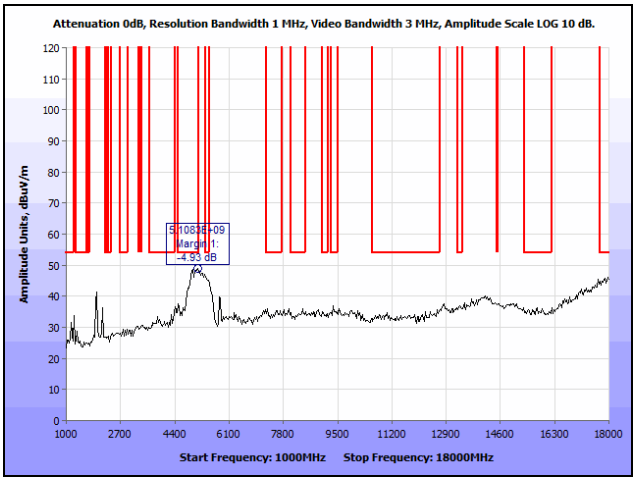
Plot 154. Radiated Spurious Emissions, 19 dBi Patch, 802.11n 40 MHz, 5755 MHz, 30 MHz – 1 GHz



Plot 155. Radiated Spurious Emissions, 19 dBi Patch, 802.11n 40 MHz, 5755 MHz, 1 GHz – 18 GHz



Plot 156. Radiated Spurious Emissions, 19 dBi Patch, 802.11n 40 MHz, 5795 MHz, 30 MHz – 1 GHz



Plot 157. Radiated Spurious Emissions, 19 dBi Patch, 802.11n 40 MHz, 5795 MHz, 1 GHz – 18 GHz

EIRP

5 dBi Omni Antenna								
a mode	**Frequency MHz**	**Uncorrected Peak (dBuV)**	**Cable Loss**	**ACF**	**DCF**	**Corrected**	**Limit (dBuV/m)**	**Margin**
	5745	40.62	7.51	35	9.54	73.59	78.26	-4.67
	5805	42.02	7.83	35	9.54	75.31	78.26	-2.95
HT 20	**Frequency MHz**	**Uncorrected Peak (dBuV)**	**Cable Loss**	**ACF**	**DCF**	**Corrected**	**Limit (dBuV/m)**	**Margin**
	5745	44.53	7.51	35	9.54	77.5	78.26	-0.76
	5805	44.01	7.83	35	9.54	77.3	78.26	-0.96
HT 40	**Frequency MHz**	**Uncorrected Peak (dBuV)**	**Cable Loss**	**ACF**	**DCF**	**Corrected**	**Limit (dBuV/m)**	**Margin**
	5755	39.7	7.51	35	9.54	72.67	78.26	-5.59
	5795	36.46	7.83	35	9.54	69.75	78.26	-8.51

Table 33. EIRP Calculation, 5 dBi Omni

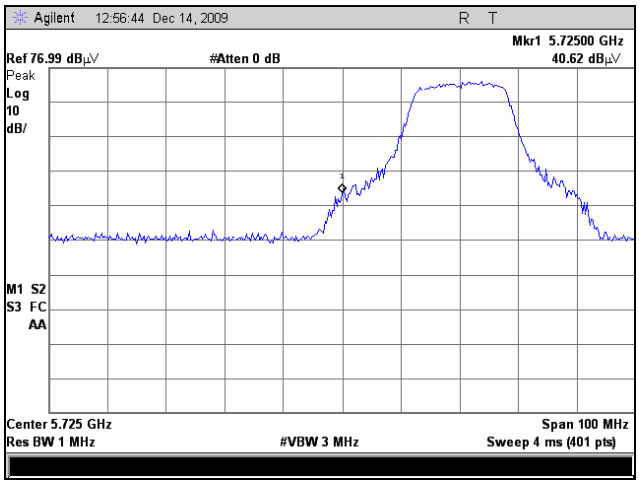
Note: EIRP Limit -17dBm/MHz = 78.26 dBuV/m

19dBi Panel Antenna								
a mode	**Frequency MHz**	**Uncorrected Peak (dBuV)**	**Cable Loss**	**ACF**	**DCF**	**Corrected**	**Limit (dBuV/m)**	**Margin**
	5745	34.42	7.51	35	9.54	67.39	78.26	-10.87
	5805	32.19	7.83	35	9.54	65.48	78.26	-12.78
HT 20	**Frequency MHz**	**Uncorrected Peak (dBuV)**	**Cable Loss**	**ACF**	**DCF**	**Corrected**	**Limit (dBuV/m)**	**Margin**
	5745	42.28	7.51	35	9.54	75.25	78.26	-3.01
	5805	41.37	7.83	35	9.54	74.66	78.26	-3.6
HT 40	**Frequency MHz**	**Uncorrected Peak (dBuV)**	**Cable Loss**	**ACF**	**DCF**	**Corrected**	**Limit (dBuV/m)**	**Margin**
	5755	43.8	7.51	35	9.54	76.77	78.26	-1.49
	5795	44.13	7.83	35	9.54	77.42	78.26	-0.84

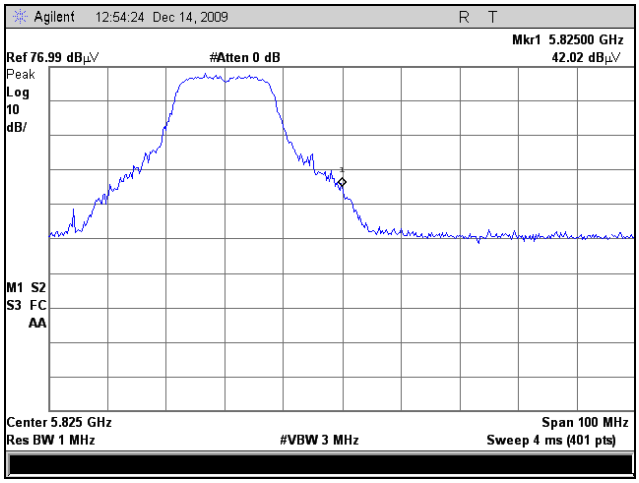
Table 34. EIRP Calculation, 19 dBi Panel

Note: EIRP Limit -17dBm/MHz = 78.26 dBuV/m

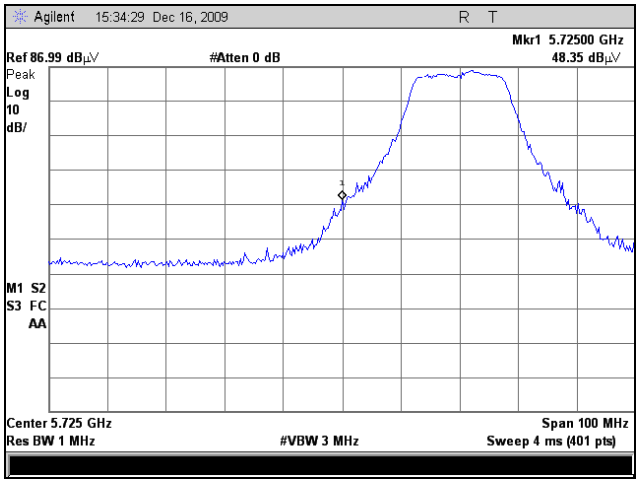
EIRP, Port 1, 802.11a



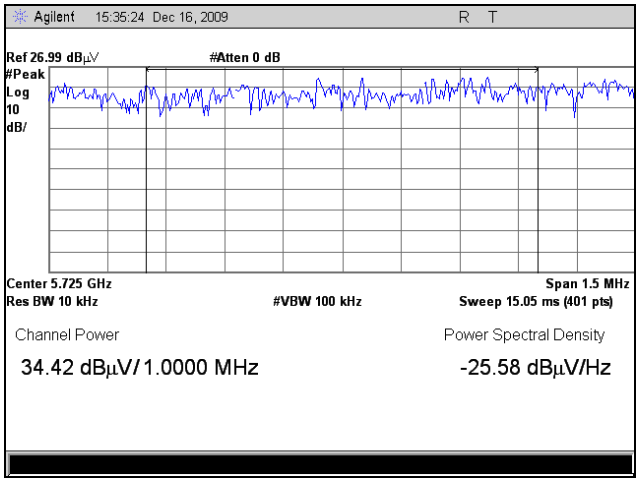
Plot 158. EIRP, 802.11a, Low Channel, 5745 MHz, 5 dBi Omni



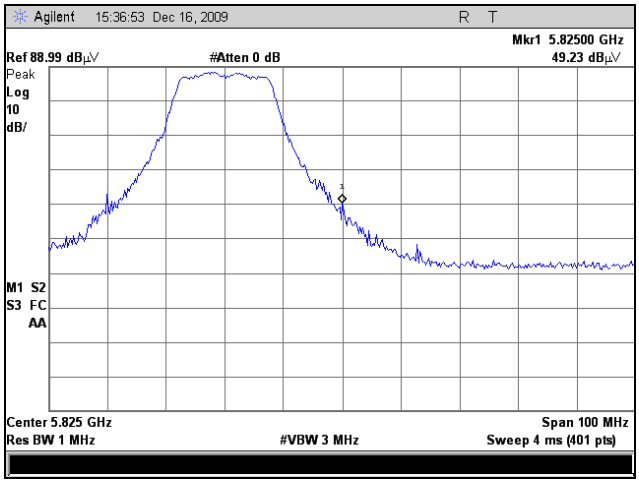
Plot 159. EIRP, 802.11a, High Channel, 5805 MHz, 5 dBi Omni



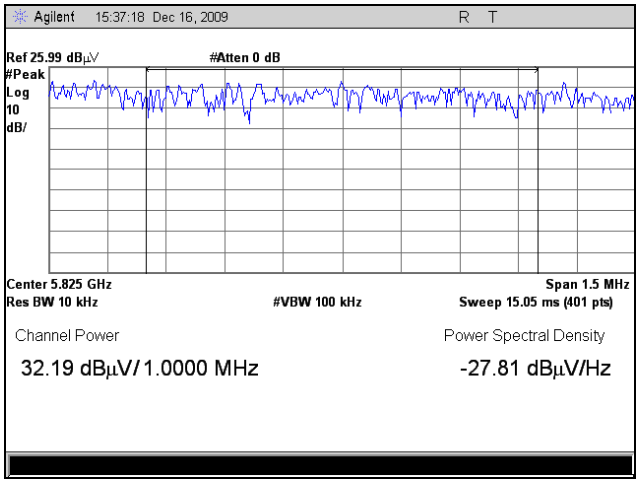
Plot 160. EIRP, 802.11a, Low Channel, 5745 MHz, 19 dBi Panel



Plot 161. EIRP, 802.11a, Low Channel, 5745 MHz Over 1 MHz, 19 dBi Panel

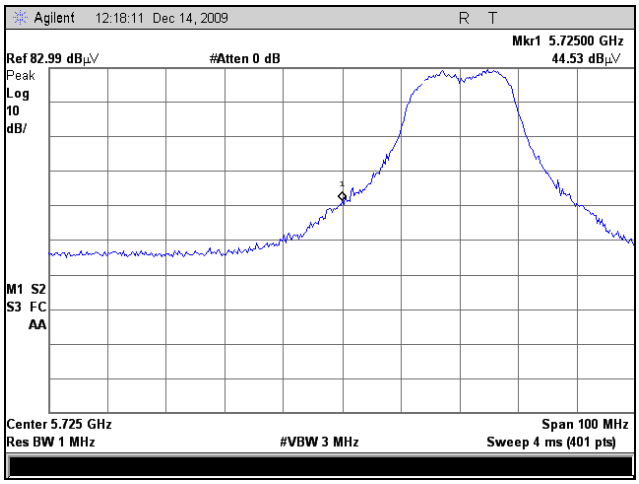


Plot 162. EIRP, 802.11a, High Channel, 5805 MHz, 19 dBi Panel

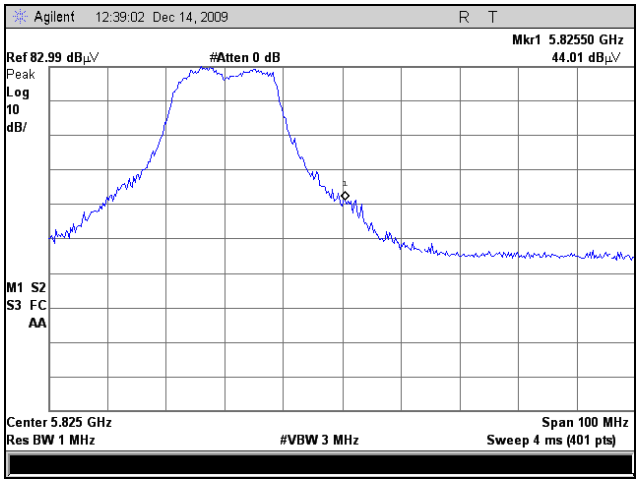


Plot 163. EIRP, 802.11a, High Channel, 5805 MHz Over 1 MHz, 19 dBi Panel

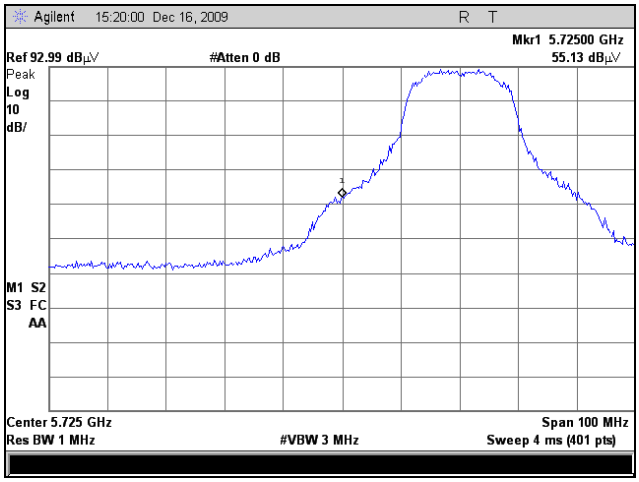
EIRP, 802.11n 20MHz



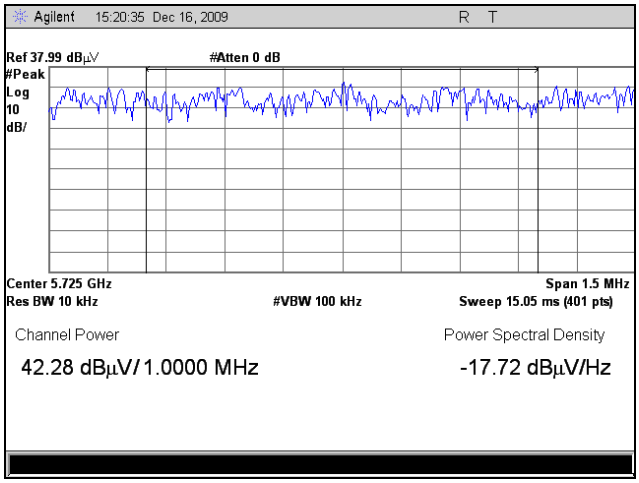
Plot 164. EIRP, 802.11n 20MHz, Low Channel, 5725 MHz, 5 dBi Omni



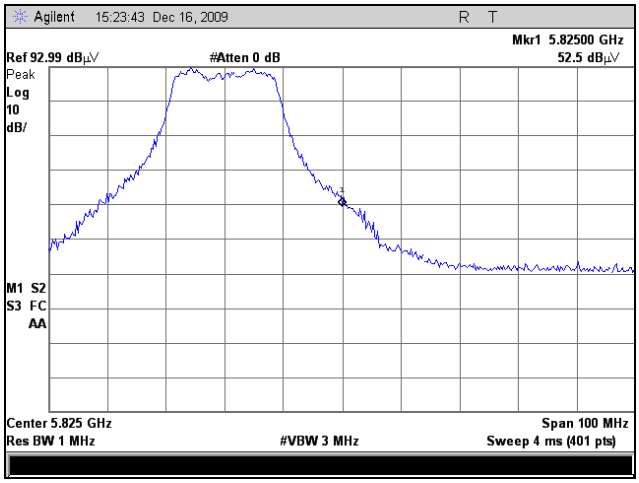
Plot 165. EIRP, 802.11n 20MHz, High Channel, 5080 MHz Over 1 MHz, 5 dBi Omni



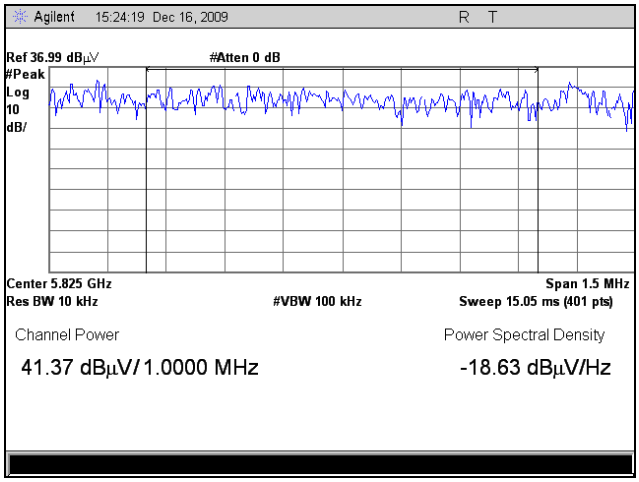
Plot 166. EIRP, 802.11n 20MHz, Low Channel, 5745 MHz, 19 dBi Panel



Plot 167. EIRP, 802.11n 20MHz, Low Channel, 5745 MHz Over 1 MHz, 19 dBi Panel

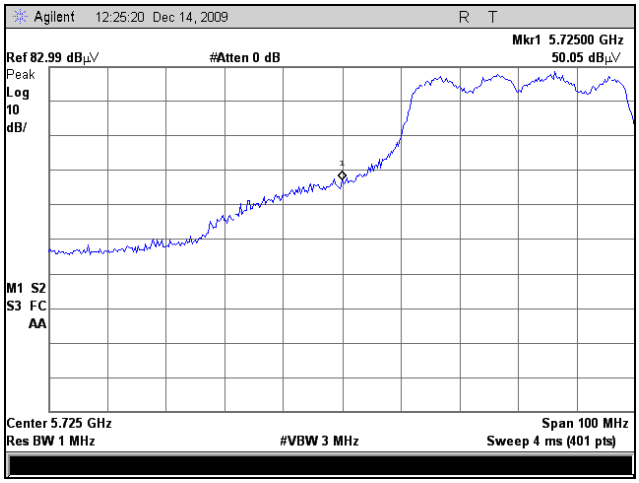


Plot 168. EIRP, 802.11n 20MHz, High Channel, 5805 MHz, 19 dBi Panel

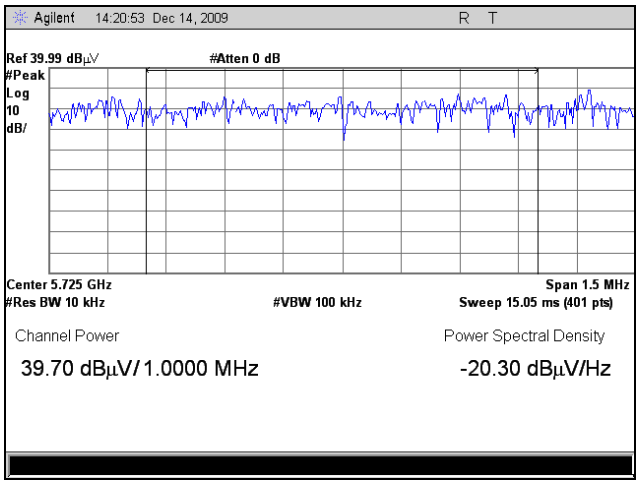


Plot 169. EIRP, 802.11n 20MHz, High Channel, 5805MHz Over 1 MHz, 19 dBi Panel

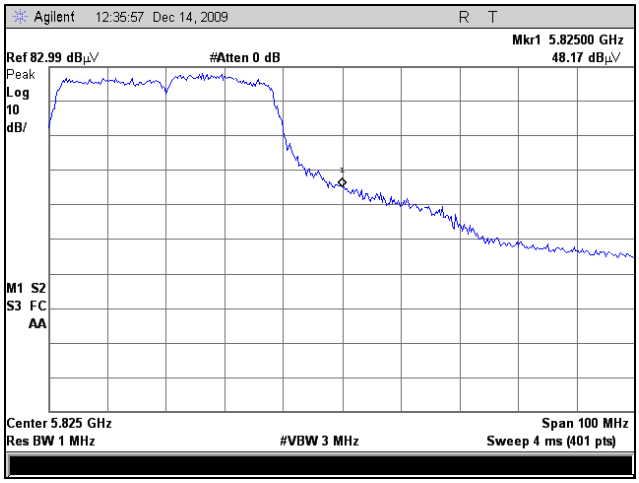
EIRP, 802.11n 40MHz



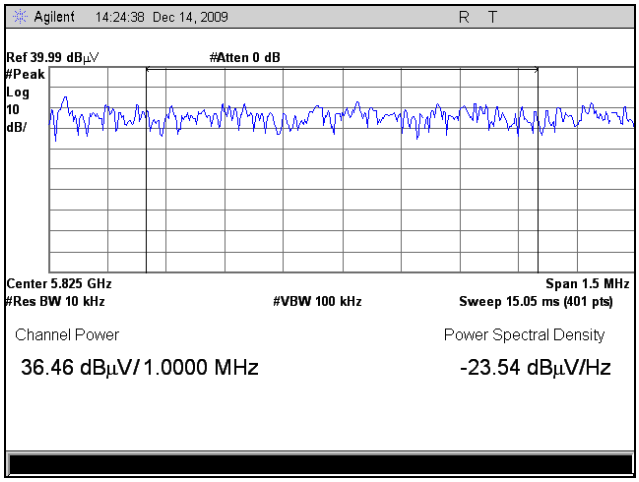
Plot 170. EIRP, 802.11n 40MHz, Low Channel, 5755 MHz, 5 dBi Omni



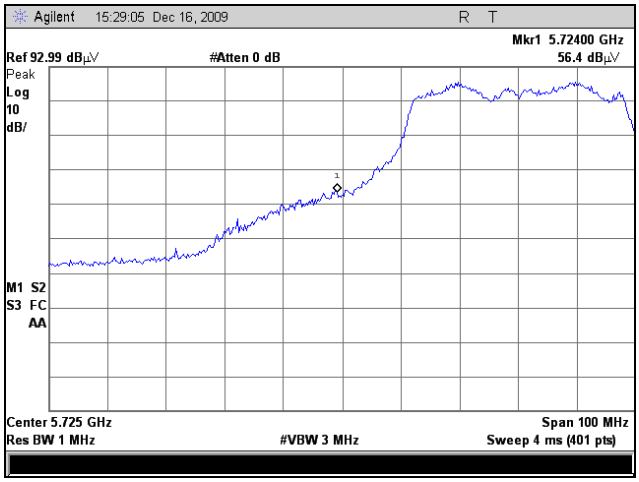
Plot 171. EIRP, 802.11n 40MHz, Low Channel, 5755 MHz Over 1 MHz, 5 dBi Omni



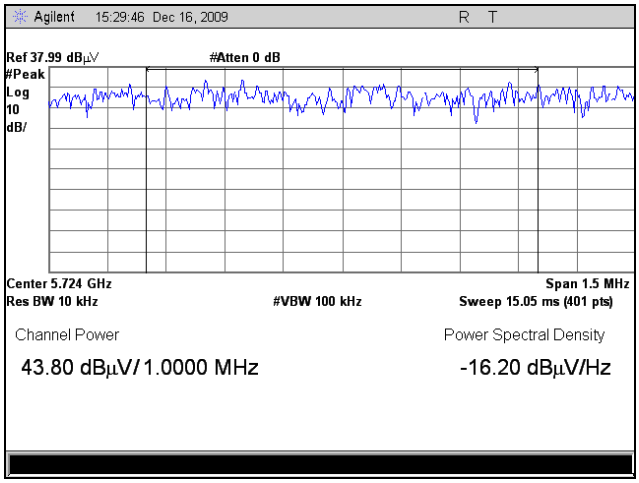
Plot 172. EIRP, 802.11n 40MHz, High Channel, 5795 MHz, 5 dBi Omni



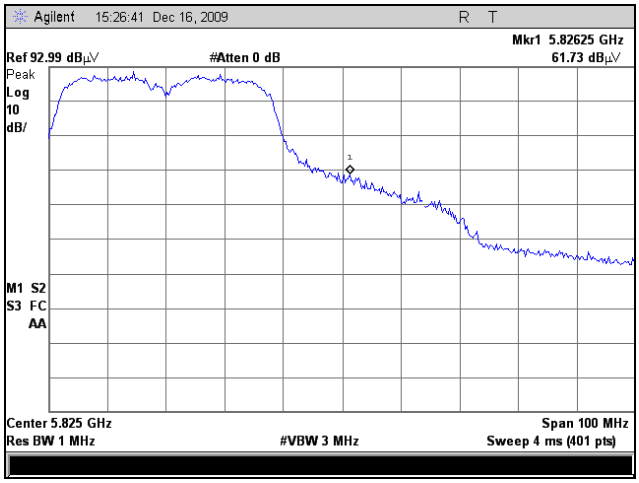
Plot 173. EIRP, 802.11n 40MHz, High Channel, 5895 MHz Over 1 MHz, 5 dBi Omni



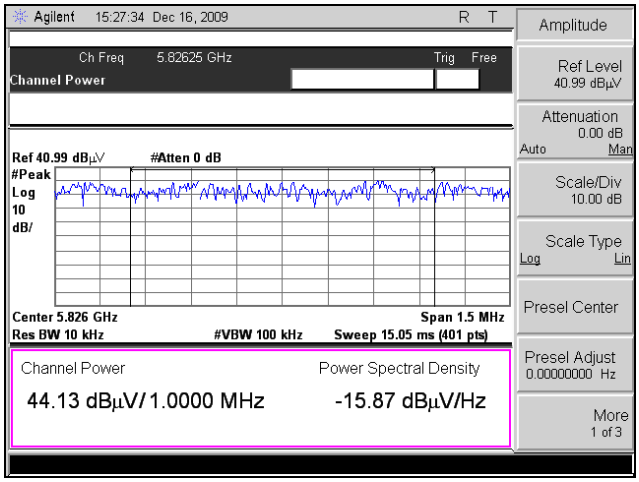
Plot 174. EIRP, 802.11n 40MHz, Low Channel, 5755 MHz, 19 dBi Panel



Plot 175. EIRP, 802.11n 40MHz, Low Channel, 5755 MHz Over 1 MHz, 19 dBi Panel

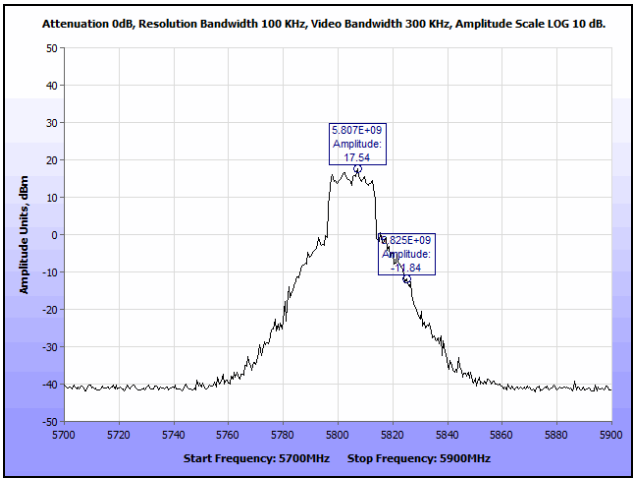


Plot 176. EIRP, 802.11n 40MHz, High Channel, 5795 MHz, 19 dBi Panel

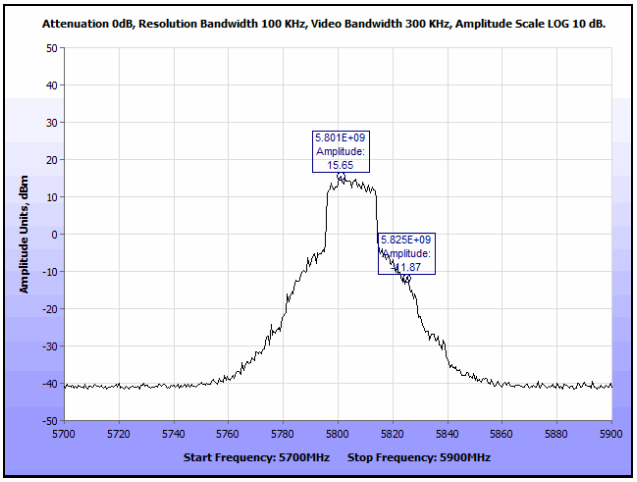


Plot 177. EIRP, 802.11n 40MHz, High Channel, 5795 MHz Over 1 MHz, 19 dBi Panel

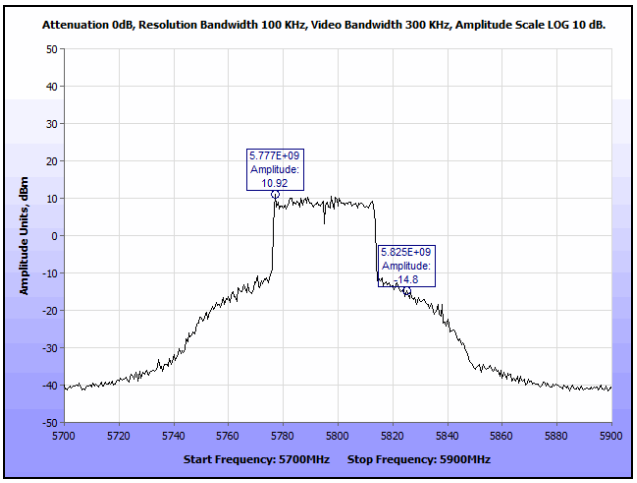
Restricted Band, 5 dBi Omni



Plot 178. Restricted Band Edge, 5 dBi Omni, 802.11a, 5805 MHz

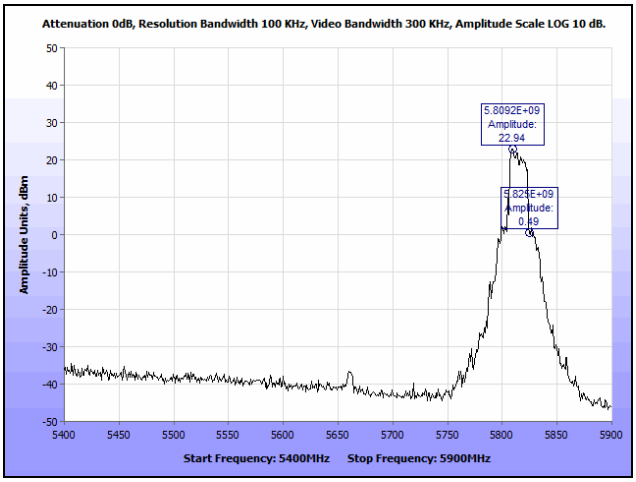


Plot 179. Restricted Band Edge, 5 dBi Omni, 802.11n 20 MHz, 5805 MHz

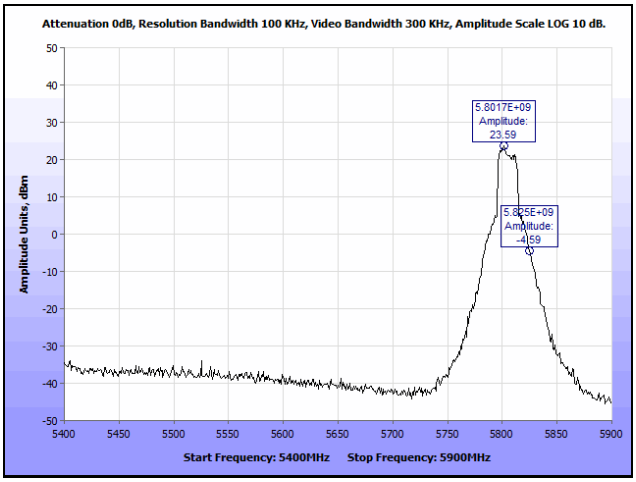


Plot 180. Restricted Band Edge, 5 dBi Omni, 802.11n 40 MHz, 5795 MHz

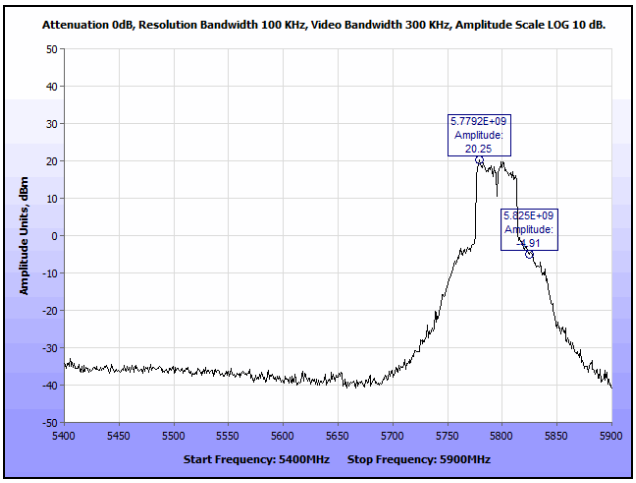
Restricted Band, 19 dBi Patch



Plot 181. Restricted Band Edge, 19 dBi Patch, 802.11a, 5805 MHz



Plot 182. Restricted Band Edge, 19 dBi Patch, 802.11n 20 MHz, 5805 MHz



Plot 183. Restricted Band Edge, 19 dBi Patch, 802.11n 40 MHz, 5795 MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(f) RF Exposure

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

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

MPE Limit Calculation: EUT's operating frequencies @ 5745-5805MHz; highest conducted power = 22.78dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

EUT maximum antenna gain = 9.77 dBi (3x5dBi Omni).

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

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

where, S = Power Density (1 mW/cm^2)
P = Power Input to antenna (190 mW)
G = Antenna Gain (9.48 numeric)

$S = (190*9.48 / 4*3.14*20.0^2) = (1506.607 / 5024) =$ **0.358 mW/cm^2**@ 20cm separation

EUT maximum antenna gain = 19dBi Panel.
Power = 9.78 dBm
Equation from page 18 of OET 65, Edition 97-01

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

where, S = Power Density (1 mW/cm^2)
P = Power Input to antenna (9.5 mW)
G = Antenna Gain (79.43 numeric)

$R = (190*79.432 / 4*3.14*1.0)^{1/2} =$ **34.6 cm**

Therefore, the uncontrolled exposure limit is satisfied at 34.6 cm.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(g) Frequency Stability

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

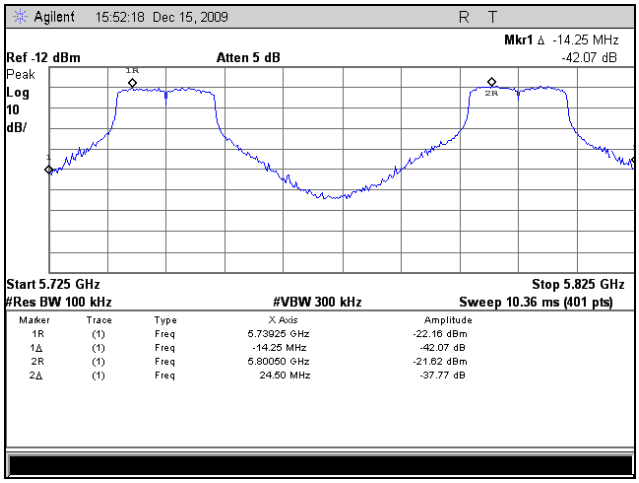
Test Procedure: The EUT was placed in an environmental chamber and the RF port was connected directly to a spectrum analyzer through an attenuator. Depending on which band was being investigated, the EUT was set to transmit at the low, mid, and high with the appropriate power level. If the EUT was capable of transmitting a CW carrier then the spectrum analyzer's frequency counting function was used to measure the actual frequency. If only a modulated carrier was available then the frequency relative to -10dBc above and below the carrier was measured and the carrier frequency was determined using (f1+f2)/2. The frequency of the carrier was measured at normal and extreme conditions with the temperature range of -40°C to +60°C .

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

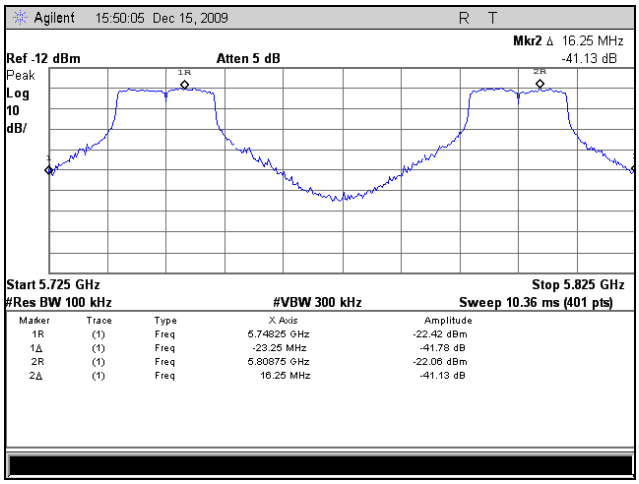
Test Engineer(s): 12/17/09

Test Date(s): Anderson Soungpanya

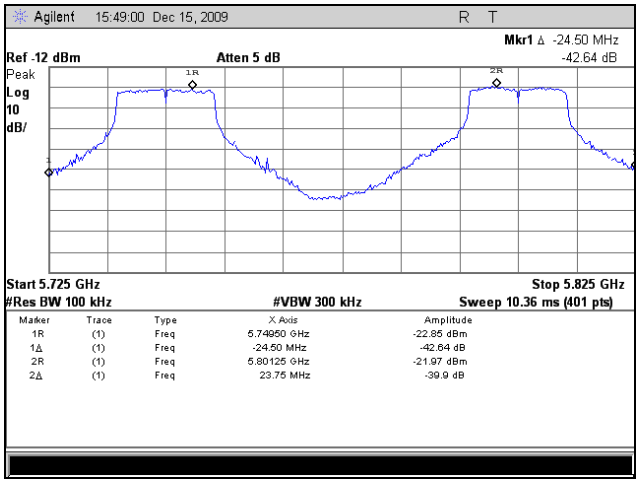
Frequency Stability, 802.11a



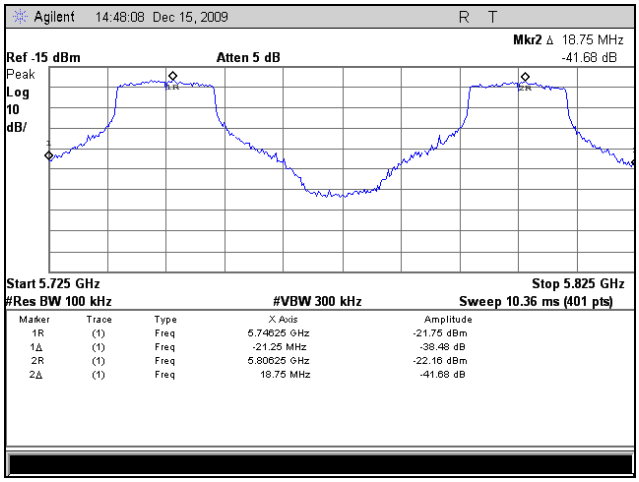
Plot 184. Frequency Stability, 802.11a 20MHz Bandwidth, -40°C, 108 VAC



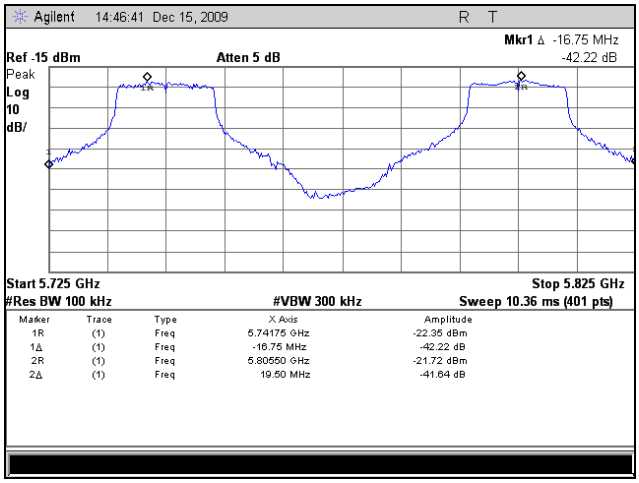
Plot 185. Frequency Stability, 802.11a 20MHz Bandwidth, -40°C, 120 VAC



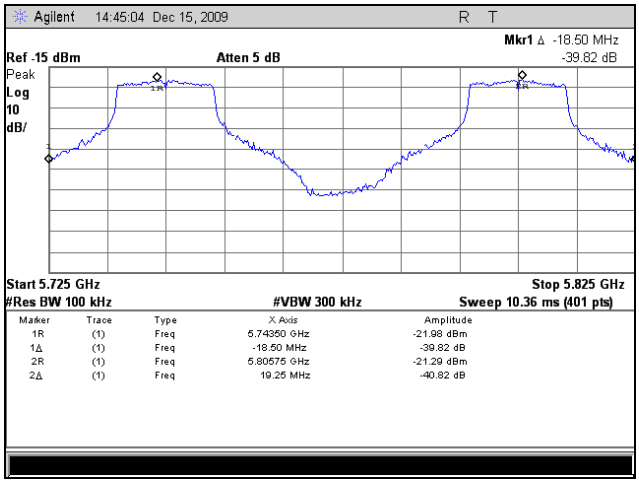
Plot 186. Frequency Stability, 802.11a 20MHz Bandwidth, -40°C, 132 VAC



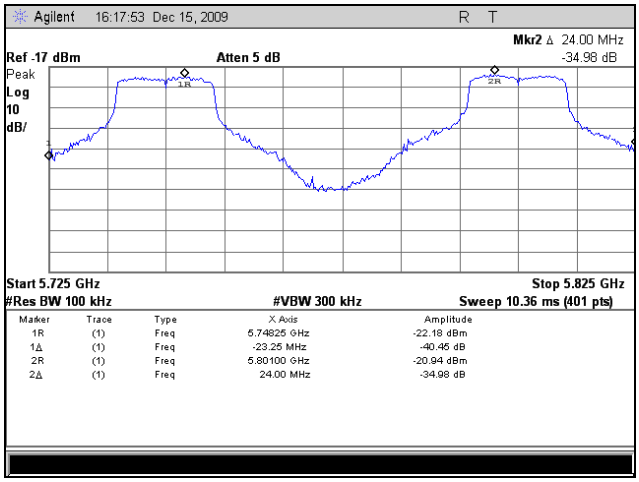
Plot 187. Frequency Stability, 802.11a 20MHz Bandwidth, 20°C, 108 VAC



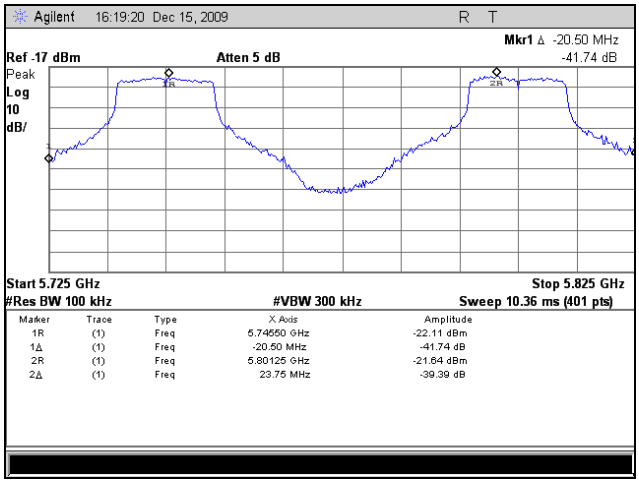
Plot 188. Frequency Stability, 802.11a 20MHz Bandwidth, 20°C, 120 VAC



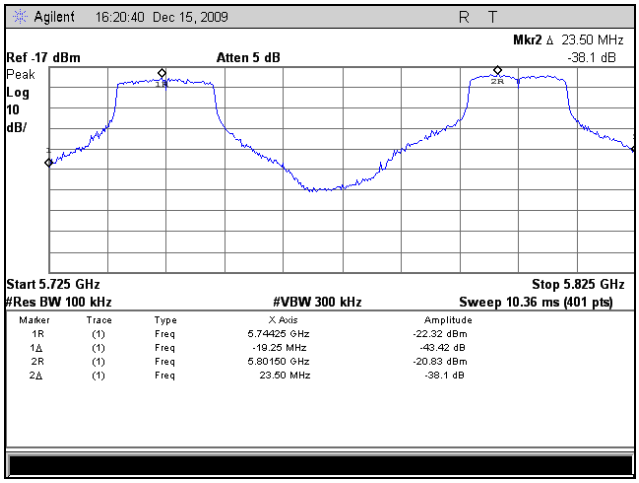
Plot 189. Frequency Stability, 802.11a 20MHz Bandwidth, 20°C, 132 VAC



Plot 190. Frequency Stability, 802.11a 20MHz Bandwidth, 60°C, 108 VAC

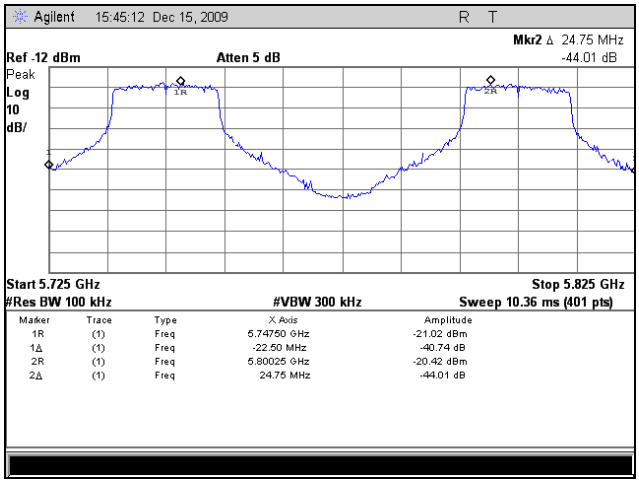


Plot 191. Frequency Stability, 802.11a 20MHz Bandwidth, 60°C, 120 VAC

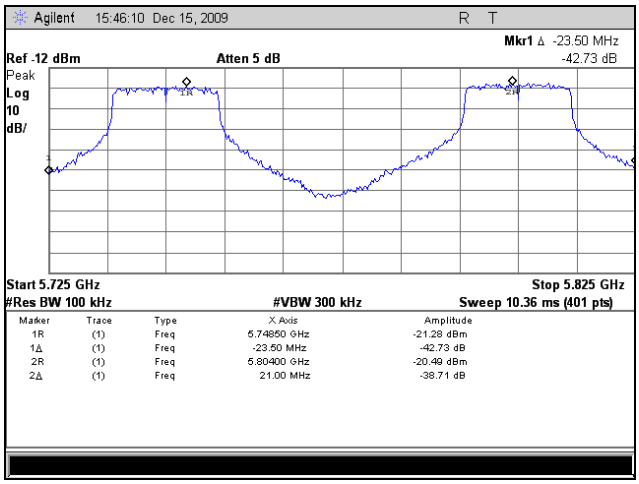


Plot 192. Frequency Stability, 802.11a 20MHz Bandwidth, 60°C, 132 VAC

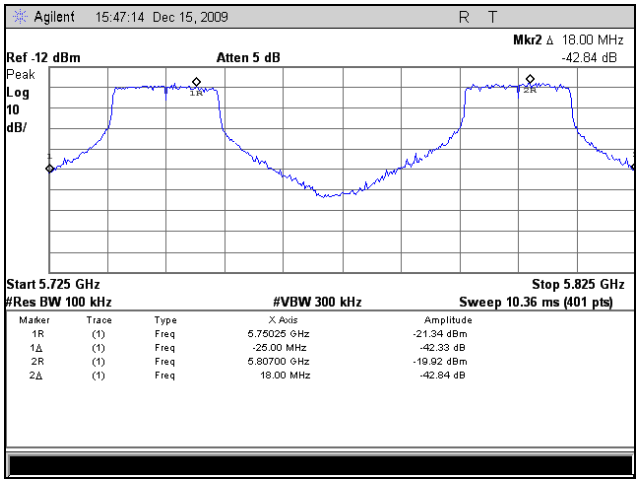
Frequency Stability, 802.11n 20 MHz



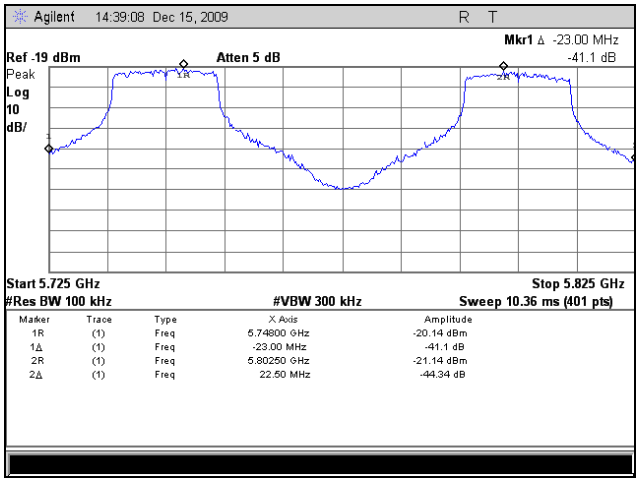
Plot 193. Frequency Stability, 802.11n 20MHz Bandwidth, -40°C, 108 VAC



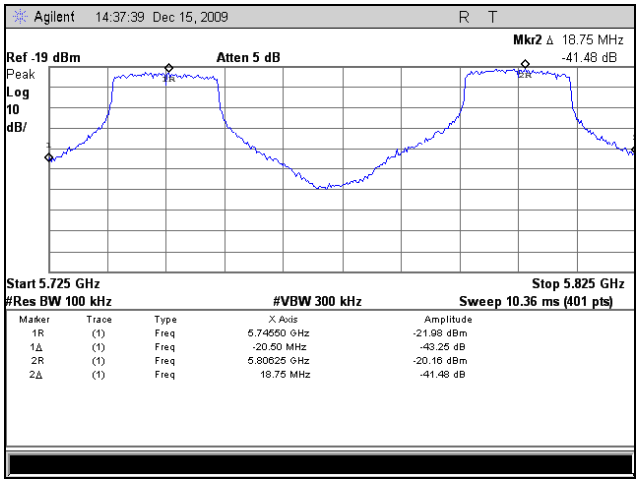
Plot 194. Frequency Stability, 802.11n 20MHz Bandwidth, -40°C, 120 VAC



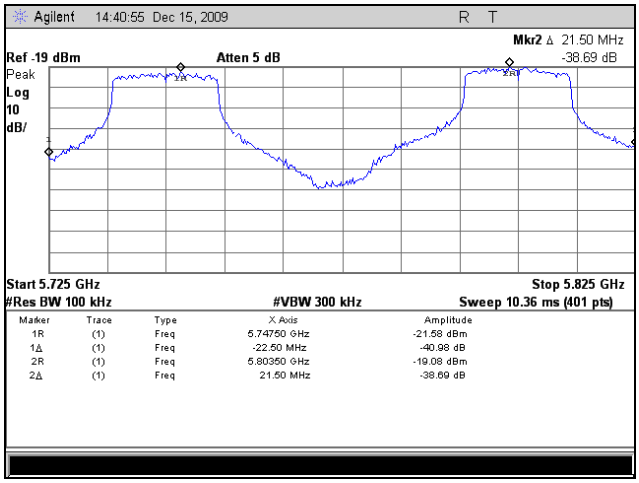
Plot 195. Frequency Stability, 802.11n 20MHz Bandwidth, -40°C, 132 VAC



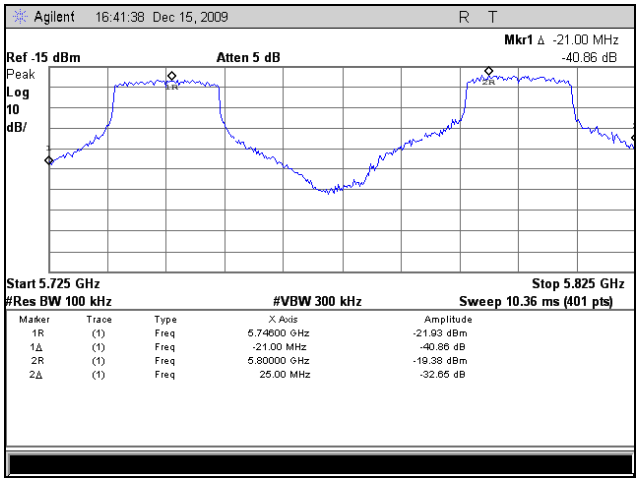
Plot 196. Frequency Stability, 802.11n 20MHz Bandwidth, 20°C, 108 VAC



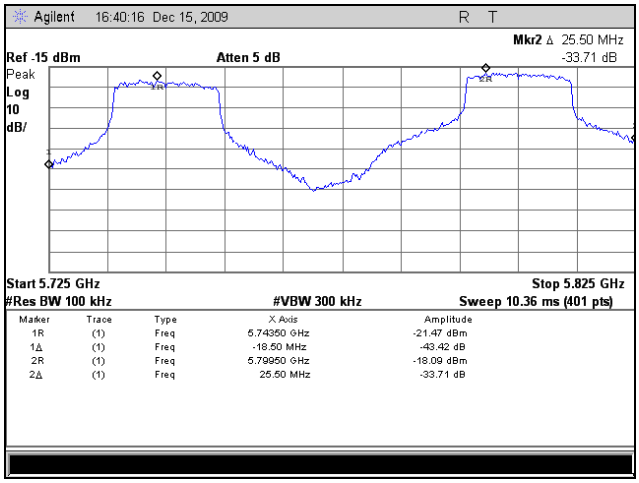
Plot 197. Frequency Stability, 802.11n 20MHz Bandwidth, 20°C, 120 VAC



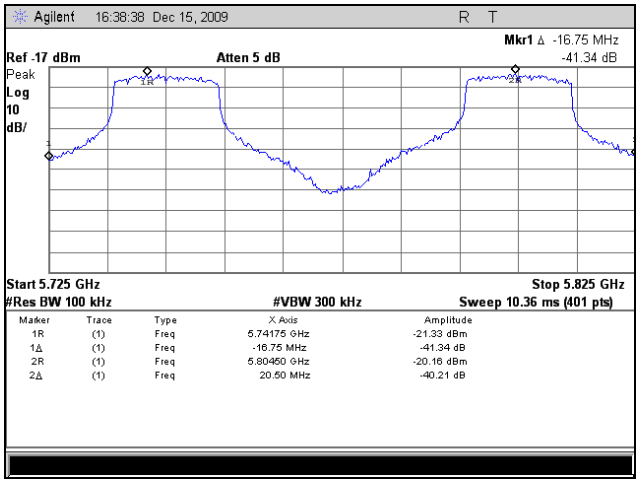
Plot 198. Frequency Stability, 802.11n 20MHz Bandwidth, 20°C, 132 VAC



Plot 199. Frequency Stability, 802.11n 20MHz Bandwidth, 60°C, 108 VAC

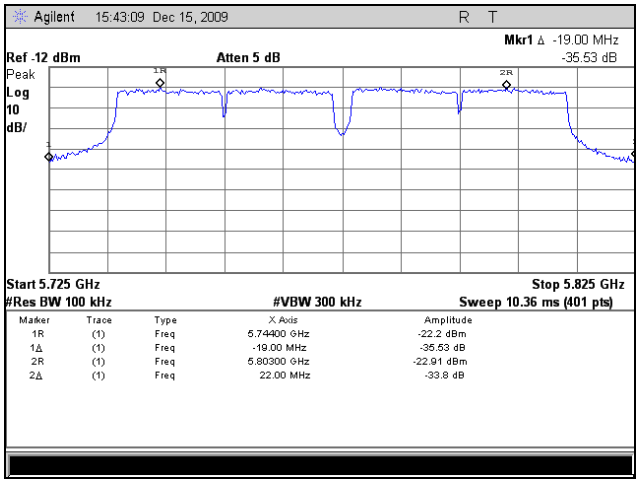


Plot 200. Frequency Stability, 802.11n 20MHz Bandwidth, 60°C, 120 VAC

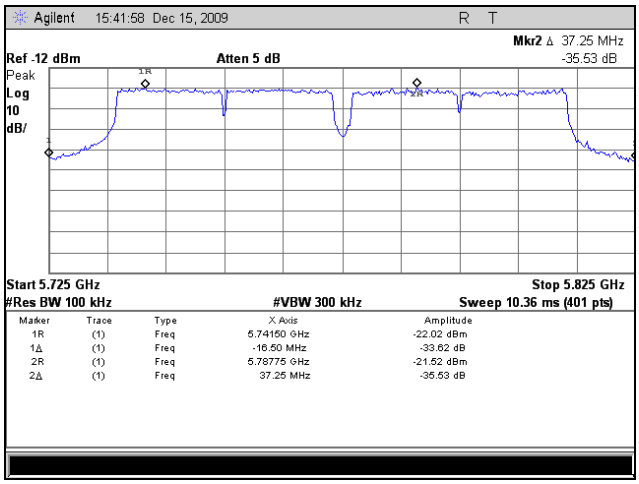


Plot 201. Frequency Stability, 802.11n 20MHz Bandwidth, 60°C, 132 VAC

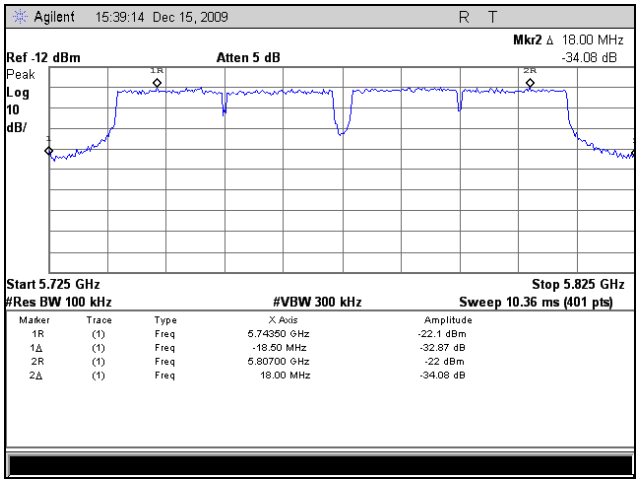
Frequency Stability, 802.11n 40MHz



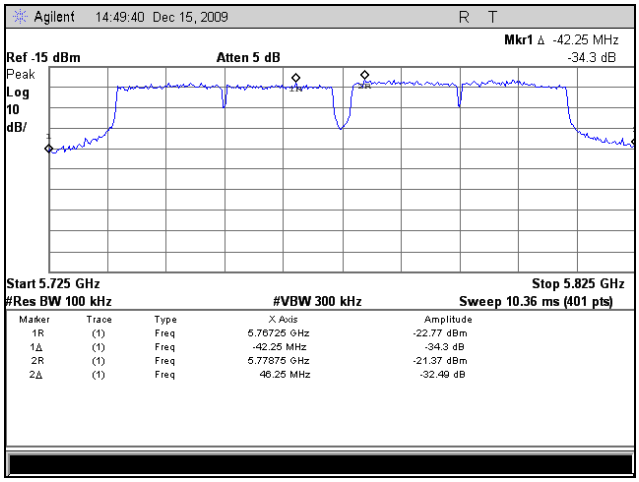
Plot 202. Frequency Stability, 802.11n 40MHz Bandwidth, -40°C, 108 VAC



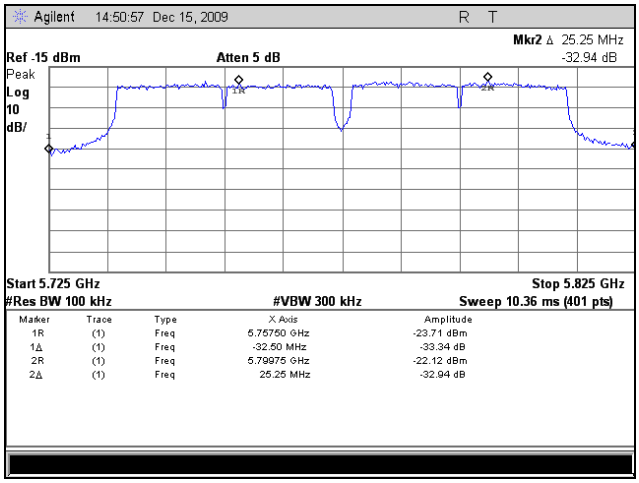
Plot 203. Frequency Stability, 802.11n 40MHz Bandwidth, -40°C, 120 VAC



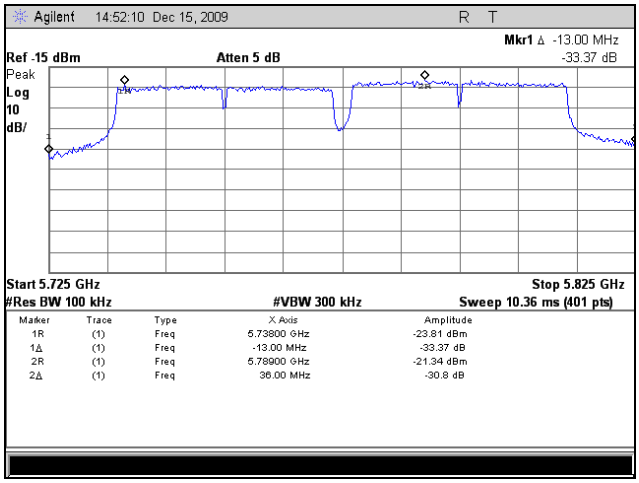
Plot 204. Frequency Stability, 802.11n 40MHz Bandwidth, -40°C, 132 VAC



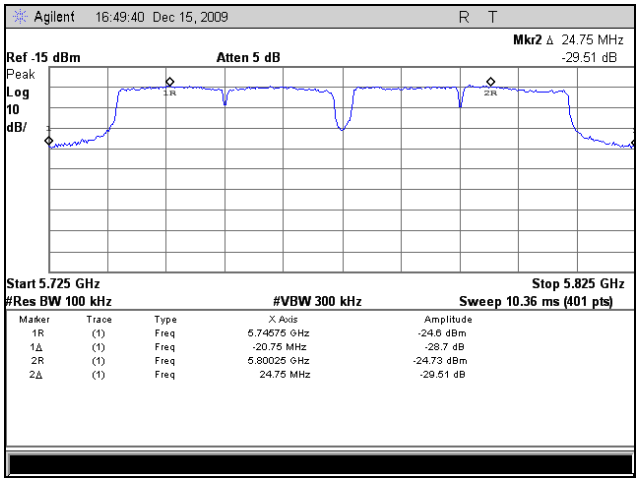
Plot 205. Frequency Stability, 802.11n 40MHz Bandwidth, 20°C, 108 VAC



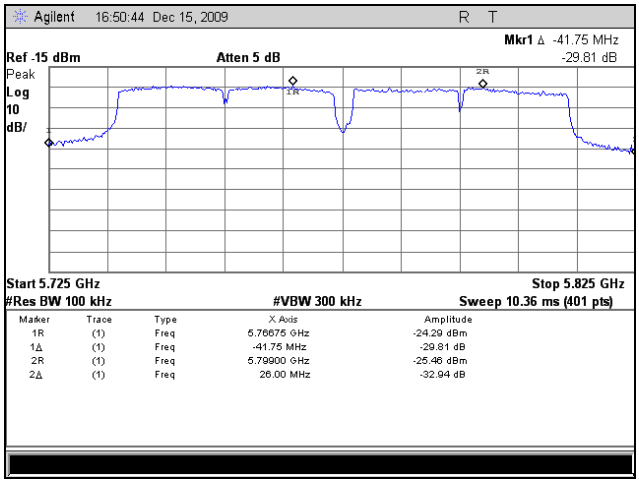
Plot 206. Frequency Stability, 802.11n 40MHz Bandwidth, 20°C, 120 VAC



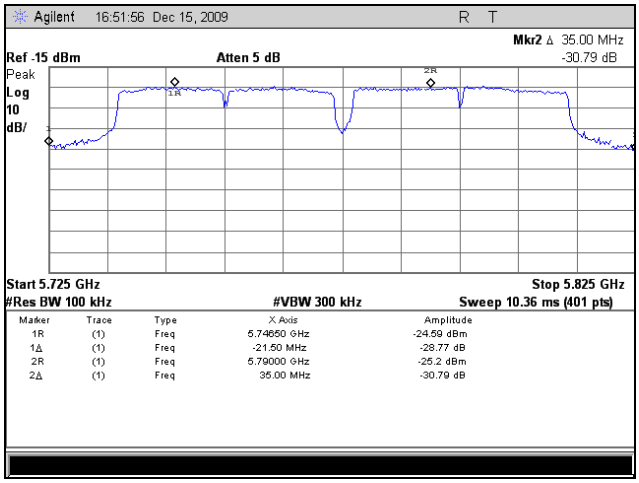
Plot 207. Frequency Stability, 802.11n 40MHz Bandwidth, 20°C, 132 VAC



Plot 208. Frequency Stability, 802.11n 40MHz Bandwidth, 60°C, 108 VAC



Plot 209. Frequency Stability, 802.11n 40MHz Bandwidth, 60°C, 120 VAC



Plot 210. Frequency Stability, 802.11n 40MHz Bandwidth, 60°C, 132 VAC

IV. Test Equipment

Test Equipment

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

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2421	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB7	8/20/2012	8/20/2013
1S2121	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	SEE NOTE	
1S2198	HORN ANTENNA	EMCO	3115	10/18/2012	4/18/2014
1S2202	HORN ANTENNA (1 METER)	EMCO	3116	4/26/2013	4/26/2016
N/A	HIGH PASS FILTER	MICRO-TRONICS	HPM13146	SEE NOTE	
1S2481	10 METER CHAMBER (NSA)	ETS-LINGREN	DKE- 8X8 DBL	6/24/2013	12/24/2014
1S2041	COUPLER, BI DIRECTIONALCOAXIAL	NARDA	N/A	SEE NOTE	
1S2460	1-26GHZ SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	7/27/2012	1/27/2014
1S2034	COUPLER, DIRECTIONAL 1-20 GHZ	KRYTAR	101020020	SEE NOTE	
1S2508	LISN	SOLAR ELECTRONICS	9252-50--R-24-BNC	10/23/2012	4/23/2014
1S2512	TRANSIENT LIMITER	AGILENT	11947A	SEE NOTE	
1S2520	DIGITAL THERMO/HYGROMETER	CONTROL COMPANY	11-661-7D	11/18/2010	11/18/2011
1S2482	5 METER CHAMBER (NSA)	PANASHIELD	5 METER SEMI-ANECHOIC CHAMBER	12/22/2011	6/22/2013
1S2108	RECIEVER, EMI, RF FILTER SECTION	HEWLETT PACKARD	85460A	9/12/2012	9/12/2013
1S2399	TURNTABLE CONTROLLER	SUNOL SCIENCE	SC99V	SEE NOTE	
1S2485	BILOG ANTENNA	TESEQ	CBL6112D	5/17/2011	5/17/2012
N/A	2-6GHZ COMBINER	MINI CIRCUITS	ZN4PD-1-63-S+	SEE NOTE	
1S2109	RECIEVER, EMI, RECIEVER SECTION	HEWLETT PACKARD	85462A	9/12/2012	9/12/2013
1S2041	COUPLER, BI DIRECTIONALCOAXIAL	NARDA	N/A	SEE NOTE	
1S2128	HARMONIC MIXER	HEWLETT PACKARD	11970A	7/12/2012	1/12/2014
1S2129	HARMONIC MIXER	HEWLETT PACKARD	11970K	7/12/2012	1/12/2014

Table 35. Test Equipment List

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

V. Certification & User's Manual Information

Certification & User's Manual Information

A. Certification Information

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

§ 2.801 Radio-frequency device defined.

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

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

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

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

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

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

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

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

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

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

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

(i) Compliance testing;

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

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

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

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

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

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

Certification & User's Manual Information

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

§ 2.901 Basis and Purpose

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

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

§ 2.907 Certification.

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

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

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

Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

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

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

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

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

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

Certification & User's Manual Information

Label and User's Manual Information

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

§ 15.19 Labeling requirements.

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

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

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

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

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

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

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

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

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

§ 15.21 Information to user.

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

Verification & User's Manual Information

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

§ 15.105 Information to the user.

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

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

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

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

– Reorient or relocate the receiving antenna.

– Increase the separation between the equipment and receiver.

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

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

ICES-003 Procedural & Labeling Requirements

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

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

Procedural Requirements:

According to Industry Canada's Interference Causing Equipment Standard for Digital Apparatus ICES-003 Issue 5 August 2012:

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

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

Labeling Requirements:

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

> This Class [2] digital apparatus complies with Canadian ICES-003.
>
> Cet appareil numérique de la classe [1] est conforme à la norme NMB-003 du Canada.

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

End of Report

