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

914 WEST PATAPSCO AVENUE ● BALTIMORE, MARYLAND 21230-3432 ● PHONE (410) 354-3300 ● FAX (410) 354-3313
33439 WESTERN AVENUE ● UNION CITY, CALIFORNIA 94587 ● PHONE (510) 489-6300 ● FAX (510) 489-6372
3162 BELICK STREET ● SANTA CLARA, CALIFORNIA 95054 ● PHONE (408) 748-3585 ● FAX (510) 489-6372
13501 MCCALLEN PASS ● AUSTIN, TX 78753 ● PHONE (512) 287-2500 ● FAX (512) 287-2513

February 24, 2017

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

Dear Sudhir Hirudayaraj,

Enclosed is the EMC Wireless test report for compliance testing of the Firetide, Inc., 7010(W) as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Title 47 of the CFR, Part 15.407, Subpart E (UNII 2).

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.

Joel Huna
Documentation Department

Reference: (\Firetide, Inc.\EMCS92597-FCC407 UNII 2 Rev. 2)

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Electromagnetic Compatibility Criteria Test Report

for the

Firetide, Inc.
Model 7010(W)

Tested under
theFCC Certification Rules
contained in
Title 47 of the CFR
15.407 Subpart E

MET Report: EMCS92597-FCC407 UNII 2 Rev. 2

February 24, 2017

Prepared For:

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

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

Electromagnetic Compatibility Criteria
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Title 47 of the CFR
15.407 Subpart E

Jun Qi, Project Engineer
Electromagnetic Compatibility Lab

Joel Huna
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 15.407 of the FCC Rules under normal use and maintenance.

Asad Bajwa,
Director, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	January 30, 2017	Initial Issue.
1	February 20, 2017	Engineer corrections.
2	February 24, 2017	Editorial corrections.

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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**er**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**er**z**
kPa	**k**ilo**pa**scal
kV	**k**ilovolt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**micro**henry
µ	**micro**farad
µs	**micro**seconds
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. 7010(W), 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 7010(W). 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 7010(W), has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.407, in accordance with Firetide, Inc., purchase order number PO-3987. All tests were conducted using measurement procedure ANSI C63.4-2014.

FCC Reference	Description	Results
§15.203	Antenna Requirement	Compliant
§15.403(i)	26 dB Occupied Bandwidth	Compliant
§15.407 (a)(2)	Maximum Conducted Output Power	Compliant
§15.407 (a)(2)	Maximum Power Spectral Density	Compliant
§15.407 (b)(2 – 3)& (6 - 7)	Undesirable Emissions	Compliant
§15.407(b)(6)	Conducted Emission	Compliant
§15.407(f)	RF Exposure	Compliant
§15.407(g)	Frequency Stability	Not Applicable
15.40 (h)(2)	U-NII Detection Bandwidth	Compliant
15.407(h)(2)(ii)	Channel Availability Check Time	Compliant
15.407(h)(2)(ii-iii)	In-Service Monitoring	Compliant
15.407(h)(2)	Statistical Performance Check	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 7010(W), under Firetide, Inc.'s purchase order number PO-3987.

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. 7010(W).

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

Model(s) Tested:	7010(W)	
Model(s) Covered:	7010(W)	
EUT Specifications:	Primary Power: 115 VAC, 60 Hz	
	FCC ID: REP-7100-W	
	Type of Modulations:	OFDM
	Equipment Code:	NII
	Peak RF Output Power:	20.71 dBm @5310MHz
	EUT Frequency Ranges:	5260MHz – 5320MHz & 5500MHz – 5700MHz.
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35° C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Type of Filing:	Original	
Evaluated by:	Jun Qi	
Report Date(s):	February 24, 2017	

Table 2. EUT Summary

B. References

CFR 47, Part 15, Subpart E	Unlicensed National Information Infrastructure Devices (UNII)
ANSI C63.4:2014	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 C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
789033 D02 General UNII Test Procedures New Rules v01	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E
905462 DO2 UNII DFS Compliance Procedures New Rules v01r02	Compliance Measurement Procedures for Unlicensed-National Information Infrastructure Devices Operating in the 5250-5350 MHz and 5470-5725 MHz Bands Incorporating Dynamic Frequency Selection

Table 3. References

C. Test Site

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

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

D. Description of Test Sample

The Firetide, Inc. 7010(W), Equipment Under Test (EUT), is a Firetide Mesh Network, which is composed of two or more Mesh Nodes, gives you the convenience of a wired- Ethernet switch combined with the deployment flexibility of wireless technology. Each Mesh Node in the network can accept a wired Ethernet connection. That connection's Ethernet data is sent wirelessly to another Mesh Node. If the receiving Mesh Node is connected to the wired destination for the data packet, the Node routes that packet to its Ethernet connection. If it is not the final destination, the packet is forwarded wirelessly to the next Mesh Node and ultimately to its final destination.
Depending on the network topology, a Mesh Node can be set up to operate as a point to point device (in which directional antennas would be used) or as a point to multipoint device (in which a combination of omnidirectional and directional antennas would be used). The Radio technology incorporated into the Mesh Node is based on the 802.11a/b/g/n standard. The Radio can be configured to operate in standard 802.11g mode or 802.11n mode, referred to as MIMO.
The HotPort Node is housed in a weatherized, cast aluminum enclosure. External antennas connect to the four type N connectors (two per radio 2x2), two on each side of the enclosure.

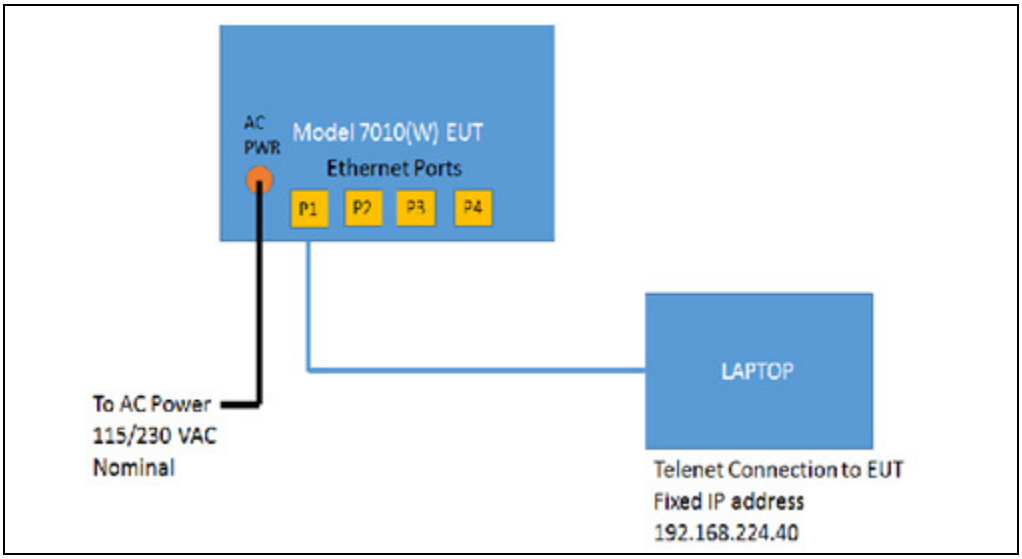


Figure 1. Block Diagram of Test Configuration

E. Equipment Configuration

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

Ref. ID	Name / Description	Model Number	Part Number	Serial Number	Revision
1	HOTPORT Out Door Mesh Node	7010(W)	7010(W)	--	1.0

Table 4. Equipment Configuration

F. Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

Ref. ID	Name / Description	Manufacturer	Model Number
1	5.125 to 6.1G,3xN,19dBi Panel Antenna	Firetide	AP-20-050-MIMO-19
2	4.9 to 6.1 GHZ3xN,16dBi Sector	Firetide	AS90-050-MIMO-16T
3	5.15 to 5.85G,3 Port,8dBi Omini	Firetide	AO-050-MIMO-9
4	2.3 to 2.7G,2xN,13dBi Panel	Firetide	AS90-024-MIMO-13
5	2.4 to 2.5G,3 Port,9dBi,Omini	Firetide	AO-024-MIMO-8
6	5G,5dBi Omini (used for DFS)	WHA Yu	C812510010-A
7	5G,5dBi Omini(used for DFS)	WHA Yu	C812510012-A

Table 5. Support Equipment

G. Ports and Cabling Information

Ref. ID	Port Name on EUT	Cable Description	Qty.	Length (m)	Shielded (Y/N)	Termination Point
1	Antenna Ports,Radio1: Ant1,Ant2 Radio2: Ant1,Ant2	CB-C-015-N(LMR400)	4	1.5Meter	Yes	Antenna Ports
2	Power Input Port: AC	Power cord, 3 conductor, 18 awg	1		Yes	AC: Power Input Port (230v/50hz)
3	Port1 … Port4 (P1...P4)	CAT 5E Ethernet cable	1	2 Meter	N	Port1 … Port4

Table 6. Ports and Cabling Information

H. Mode of Operation

HotPort 7010(W)
Once the AC power/POE Power is applied LED indicates to mention that the 7010(W) 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.

I. Method of Monitoring EUT Operation

HotPort 7010(W)
Mechanical Dimension: Dimensions: 13.4" X 9.3" X 4.7"Outdoor

Electrical Indication: Power and Status LED's on the front panel to verify whether the EUT is power ON, if the EUT is ON the Power LED will glow Green.
Status LED Glows when the firmware is up. When the unit meshes with another unit using single radio configuration Radio1 LED will glow and when the unit meshes with another unit with dual radio configuration both Radio 1 and Radio 2 LED will glow.
With the Ethernet cable connected to PC or Laptop Ping the EUT with the IP address 192.168.224.xxx (150) for 7010(W).

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 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 C of §15.203. The EUT has an outdoor unit that must be professionally installed.

Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

Test Engineer(s): Jun Qi

Test Date(s): November 30, 2016

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15. 403(i) 26dB Bandwidth

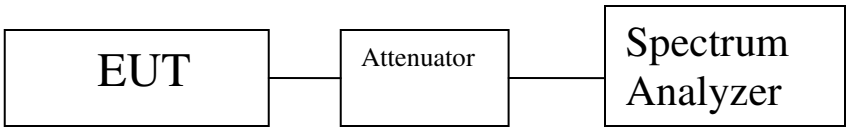
Test Requirements: **§ 15.403(i):** For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of 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 low, mid, and high 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.

Test Engineer(s): Saeed Kabirsalmani

Test Date(s): November 18, 2016



OBW			
	Channel	**Frequency (MHz)**	**26dB OBW (MHz)**
802.11a 20MHz Port R11	Low	5260	18.54
	Mid	5280	18.79
	High	5320	18.59
802.11n 20MHz Port R11	Low	5260	19.30
	Mid	5280	19.40
	High	5320	19.42

Table 7. Occupied Bandwidth, Test Results, 20 MHz, Lower Bands

OBW			
802.11n 40MHz Port R11	Low	5270	39.41
	High	5310	39.29

Table 8. Occupied Bandwidth, Test Results, 40 MHz, Lower Bands

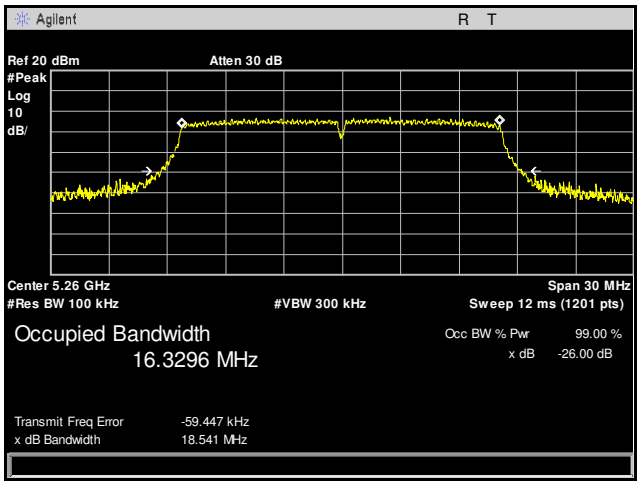
OBW			
	Channel	**Frequency (MHz)**	**26dB OBW (MHz)**
802.11a 20MHz Port R11	Low	5500	18.59
	Mid	5600	19.28
	High	5700	22.48
802.11n 20MHz Port R11	Low	5500	19.32
	Mid	5600	19.75
	High	5700	19.60

Table 9. Occupied Bandwidth, Test Results, 20 MHz, Upper Bands

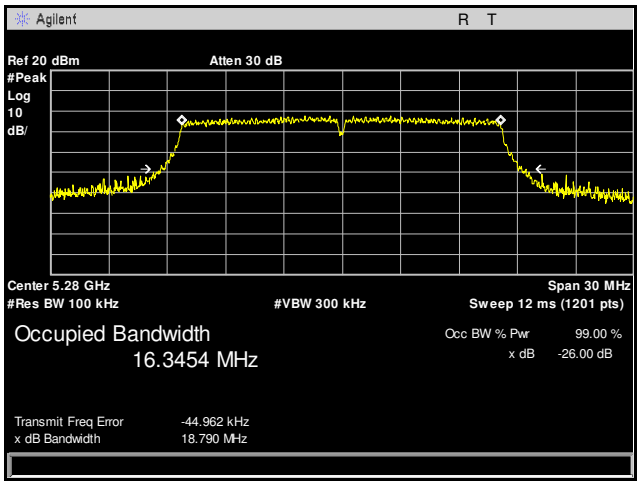
OBW			
802.11n 40MHz Port R11	Low	5510	38.98
	Mid	5590	39.17
	High	5670	39.17

Table 10. Occupied Bandwidth, Test Results, 40 MHz, Upper Bands

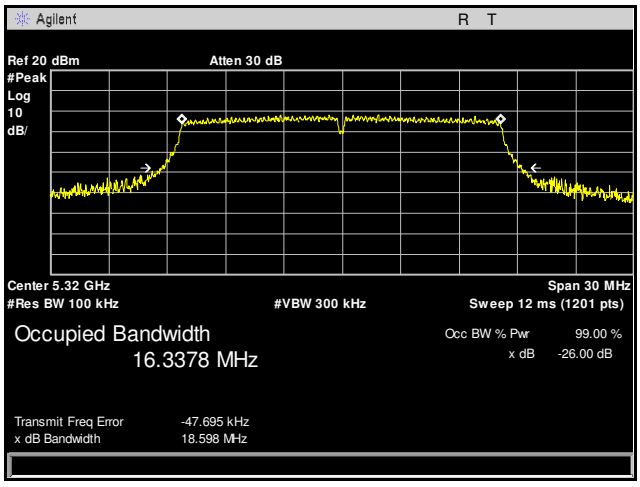
Occupied Bandwidth, 802.11a 20 MHz



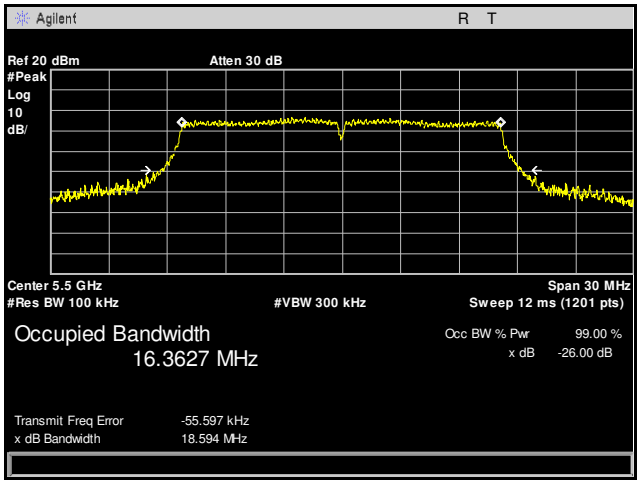
Plot 1. Occupied Bandwidth, 802.11a 20 MHz, 5260 MHz



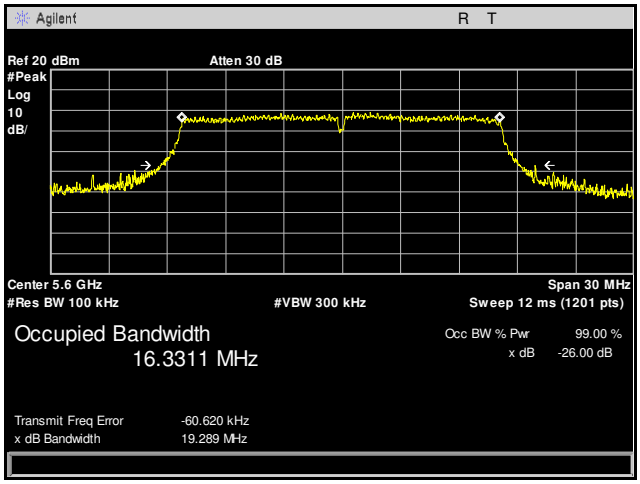
Plot 2. Occupied Bandwidth, 802.11a 20 MHz, 5280 MHz



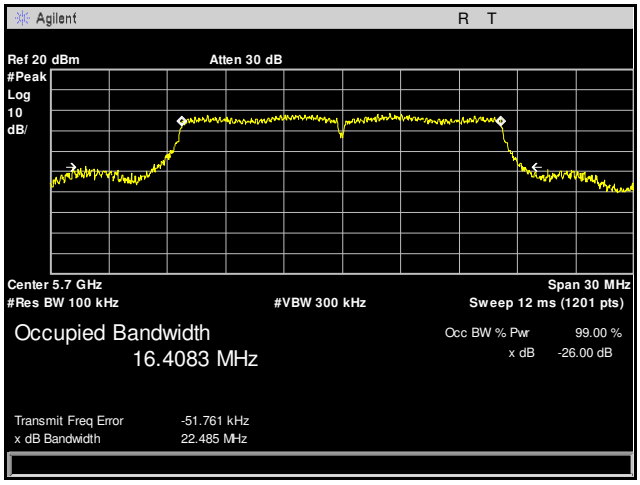
Plot 3. Occupied Bandwidth, 802.11a 20 MHz, 5320 MHz



Plot 4. Occupied Bandwidth, 802.11a 20 MHz, 5500 MHz

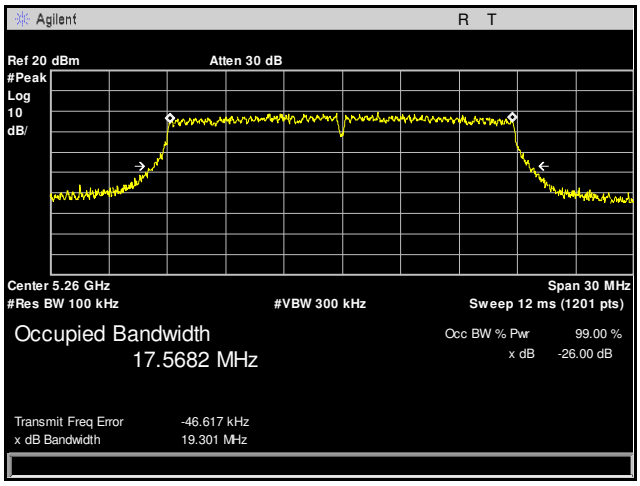


Plot 5. Occupied Bandwidth, 802.11a 20 MHz, 5600 MHz

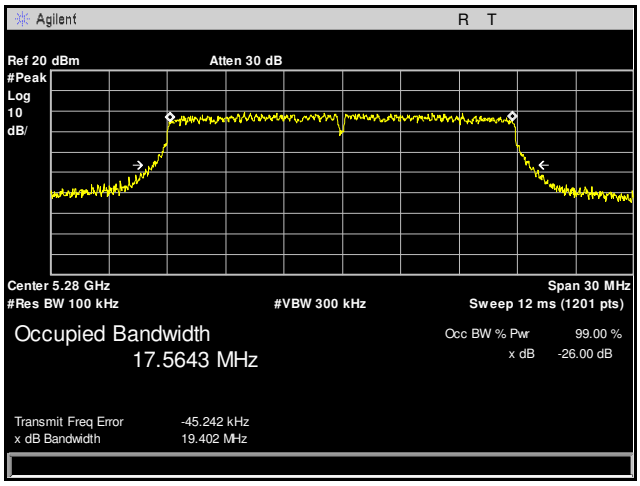


Plot 6. Occupied Bandwidth, 802.11a 20 MHz, 5700 MHz

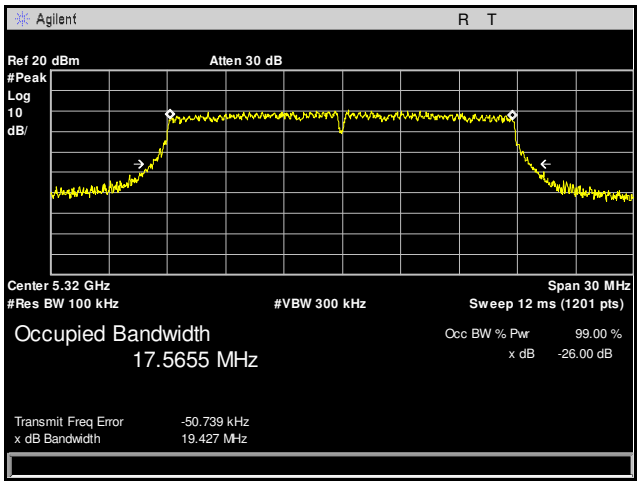
Occupied Bandwidth, 802.11n 20 MHz



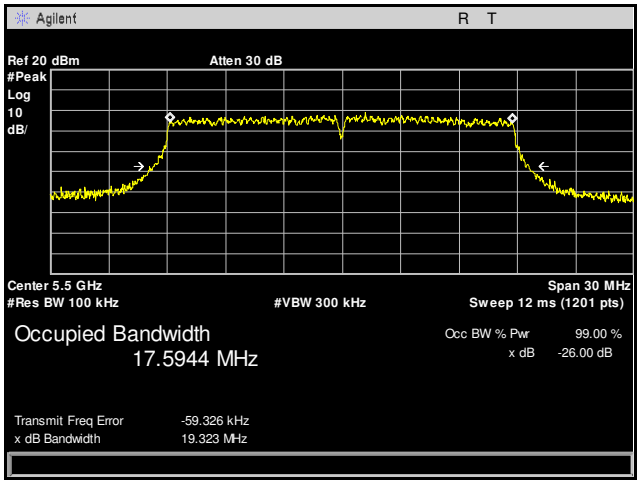
Plot 7. Occupied Bandwidth, 802.11n 20 MHz, 5260 MHz



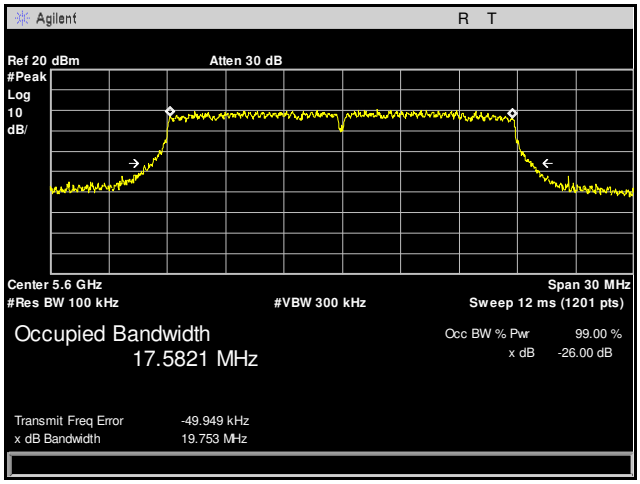
Plot 8. Occupied Bandwidth, 802.11n 20 MHz, 5280 MHz



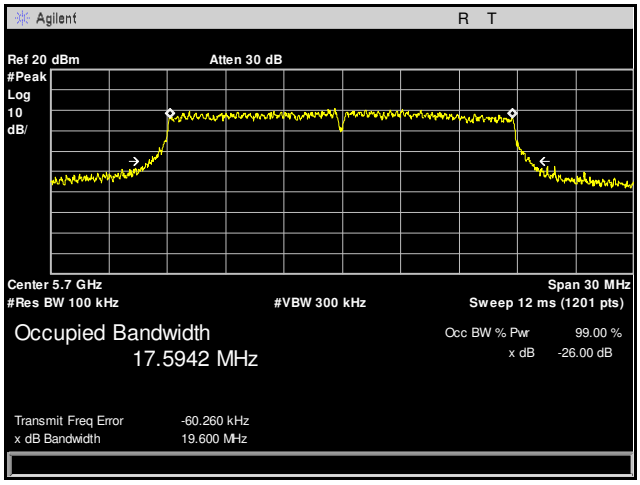
Plot 9. Occupied Bandwidth, 802.11n 20 MHz, 5320 MHz



Plot 10. Occupied Bandwidth, 802.11n 20 MHz, 5500 MHz

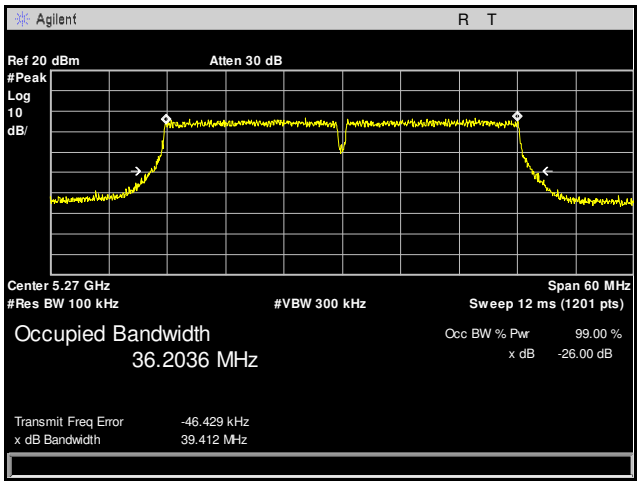


Plot 11. Occupied Bandwidth, 802.11n 20 MHz, 5600 MHz

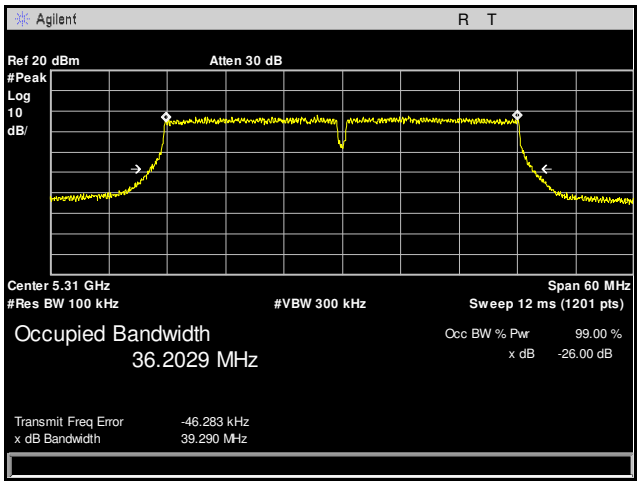


Plot 12. Occupied Bandwidth, 802.11n 20 MHz, 5700 MHz

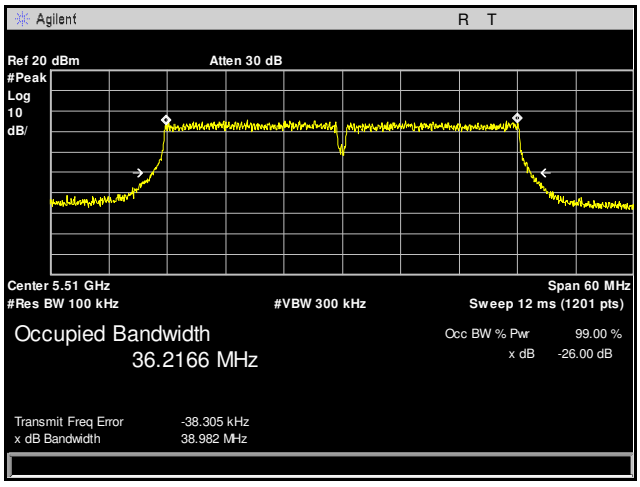
Occupied Bandwidth, 802.11n 40 MHz



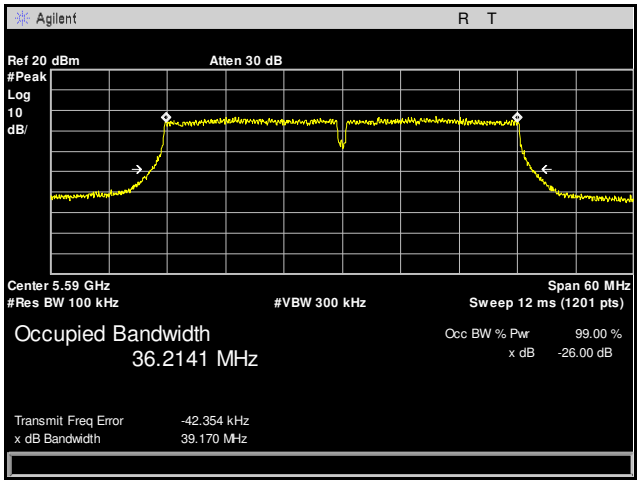
Plot 13. Occupied Bandwidth, 802.11n 40 MHz, 5270 MHz



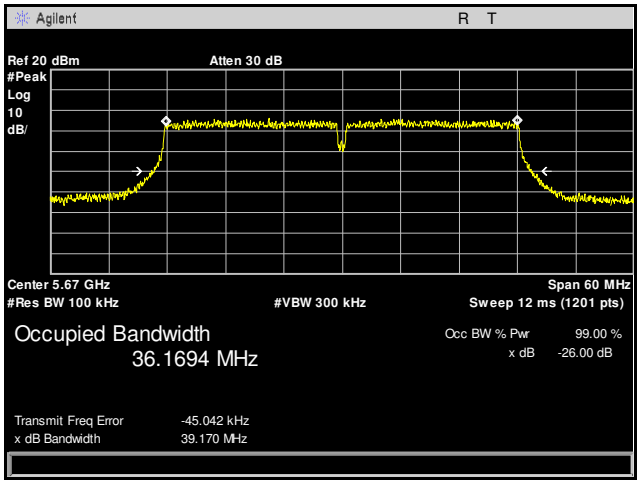
Plot 14. Occupied Bandwidth, 802.11n 40 MHz, 5310 MHz



Plot 15. Occupied Bandwidth, 802.11n 40 MHz, 5510 MHz



Plot 16. Occupied Bandwidth, 802.11n 40 MHz, 5590 MHz



Plot 17. Occupied Bandwidth, 802.11n 40 MHz, 5670 MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§15. 407(a)(2) Maximum Conducted Output Power

Test Requirements: **§15.407(a)(2):** For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz.
If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

§15.407(h)(1): Transmit power control (TPC). U-NII devices operating in the 5.25-5.35 GHz band and the 5.47-5.725 GHz band shall employ a TPC mechanism. The U-NII device is required to have the capability to operate at least 6 dB below the mean EIRP value of 30 dBm. A TPC mechanism is not required for systems with an e.i.r.p. of less than 500 mW.

Test Procedure: The EUT was connected to a spectrum analyzer through a cable and attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels. Its power was measured according to measurement method SA-1, as described in 789033 D02 General UNII Test Procedures v01 and KDB 662911 D01 Multiple Transmitter Output v02r01.

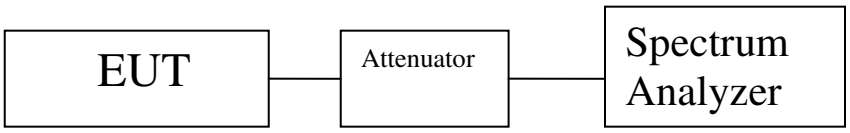
To verify the TPC requirement of the rule part, observations using the same measurement method were made with the EUT set to a lower power setting.

Limit calculation: limit = 24 – (Ga -6)
Limit Power19dBi = 24 – (19 – 6) = 11 dBm
Limit Power16dBi = 24 – (16 – 6) = 14 dBm
Limit Power9dBi = 24 – (9 – 6) = 21 dBm

Test Results: The EUT as tested is compliant with the requirements of this section.

Test Engineer(s): Saeed Kabirsalmani

Test Date(s): November 17, 2016



Peak Conducted Output Power					
	Channel	Frequency (MHz)	Measured Peak Power (dBm)		
Gain			19dBi	16dBi	9dBi
802.11a 20MHz Port R11	Low	5260	1.68	4.7	12.43
	Mid	5280	1.89	5.1	12.28
	High	5320	2.00	4.62	11.76
802.11a 20 MHz Port R12	Low	5260	1.81	2.8	11.73
	Mid	5280	2.08	4.44	13.01
	High	5320	1.76	4.71	11.98
802.11a 20MHz Port R21	Low	5260	2.22	5.11	13.34
	Mid	5280	2.55	4.51	12.18
	High	5320	2.99	4.42	11.53
802.11a 20 MHz Port R22	Low	5260	1.55	4.49	12.69
	Mid	5280	1.65	4.27	11.98
	High	5320	1.23	4.83	12.26
802.11n 20MHz Port R11	Low	5260	1.49	4.53	12.13
	Mid	5280	1.74	4.96	12.1
	High	5320	2.41	5.53	12.09
802.11n 20 MHz Port R12	Low	5260	1.85	4.54	12.16
	Mid	5280	1.53	4.8	12.48
	High	5320	1.82	5.07	12.72
802.11n 20MHz Port R21	Low	5260	2.15	5.36	14.13
	Mid	5280	2.63	5.31	12.08
	High	5320	2.36	4.93	11.72
802.11n 20 MHz Port R22	Low	5260	1.50	4.51	11.59
	Mid	5280	2.03	4.41	13.14
	High	5320	1.82	5.2	13.31

Table 11. Peak Conducted Output Power, Test Results, 20 MHz, Lower Bands

Summed Peak Conducted Output Power					
	Channel	Frequency (MHz)	Measured Peak Power (dBm)		
Gain			19dBi	16dBi	9dBi
802.11a 20 MHz Summed	Low	5260	7.84	10.38	18.61
	Mid	5280	8.08	10.61	18.40
	High	5320	8.06	10.67	17.91
802.11n 20 MHz Summed	Low	5260	7.78	10.77	18.64
	Mid	5280	8.02	10.90	18.49
	High	5320	8.13	11.21	18.52
Limit			11	14	21

Table 12. Summed Peak Conducted Output Power, 20 MHz, Lower Bands

Peak Conducted Output Power					
	Channel	Frequency (MHz)	Measured Peak Power (dBm)		
Gain			19dBi	16dBi	9dBi
802.11n 40MHz Port R11	Low	5270	4.72	7.91	14.54
	High	5310	4.40	7.5	14.92
802.11n 40 MHz Port R12	Low	5270	4.57	7.19	14.51
	High	5310	4.82	7.87	14.89
802.11n 40MHz Port R21	Low	5270	4.95	7.71	14.95
	High	5310	4.80	7.51	14.07
802.11n 40 MHz Port R22	Low	5270	4.81	7.41	14.02
	High	5310	4.65	7.72	14.81

Table 13. Peak Conducted Output Power, Test Results, 40 MHz, Lower Bands

Summed Peak Conducted Output Power					
	Channel	Frequency (MHz)	Measured Peak Power (dBm)		
Gain			19dBi	16dBi	9dBi
802.11n 40 MHz Summed	Low	5270	10.79	13.58	20.54
	High	5310	10.69	13.67	20.71
Limit			11	14	21

Table 14. Summed Peak Conducted Output Power, 40 MHz, Lower Bands

Peak Conducted Output Power					
	Channel	Frequency (MHz)	Measured Peak Power (dBm)		
Gain			19dBi	16dBi	9dBi
802.11a 20MHz Port R11	Low	5500	2.64	5.41	11.33
	Mid	5600	1.79	4.02	11.71
	High	5700	1.87	5.47	11.68
802.11a 20 MHz Port R12	Low	5500	1.92	4.49	12.03
	Mid	5600	1.66	4.75	12.05
	High	5700	1.74	4.46	11.4
802.11a 20MHz Port R21	Low	5500	2.72	5.89	12.38
	Mid	5600	3.33	5.52	11.93
	High	5700	2.72	5.83	11.74
802.11a 20 MHz Port R22	Low	5500	0.64	4.76	11.58
	Mid	5600	1.83	5.09	12.47
	High	5700	1.81	5.33	12.4
802.11n 20MHz Port R11	Low	5500	0.77	4.52	11.86
	Mid	5600	2.15	5.41	12.52
	High	5700	1.92	5.56	12.21
802.11n 20 MHz Port R12	Low	5500	2.75	5.72	12.48
	Mid	5600	2.55	4.84	12.16
	High	5700	2.60	5.76	12.21
802.11n 20MHz Port R21	Low	5500	1.65	5.33	11.91
	Mid	5600	2.23	5.94	11.59
	High	5700	2.58	4.79	11.46
802.11n 20 MHz Port R22	Low	5500	2.44	5.02	11.93
	Mid	5600	2.43	5.11	10.84
	High	5700	2.27	4.93	12.57

Table 15. Peak Conducted Output Power, Test Results, 20 MHz, Upper Bands

Summed Peak Conducted Output Power					
	Channel	Frequency (MHz)	Measured Peak Power (dBm)		
Gain			19dBi	16dBi	9dBi
802.11a 20 MHz Summed	Low	5500	8.08	11.19	17.87
	Mid	5600	8.23	10.90	18.07
	High	5700	8.07	11.32	17.84
802.11n 20 MHz Summed	Low	5500	7.99	11.19	18.07
	Mid	5600	8.36	11.37	17.84
	High	5700	8.37	11.30	18.15
Limit			11	14	21

Table 16. Summed Peak Conducted Output Power, 20 MHz, Upper Bands

Peak Conducted Output Power					
	Channel	Frequency (MHz)	Measured Peak Power (dBm)		
Gain			19dBi	16dBi	9dBi
802.11n 40MHz Port R11	Low	5510	4.77	6.91	14.01
	Mid	5590	4.71	7.28	14.35
	High	5670	4.82	7.44	14.51
802.11n 40 MHz Port R12	Low	5510	4.95	7.39	14.53
	Mid	5590	4.81	7.59	14.72
	High	5670	4.96	7.95	14.64
802.11n 40MHz Port R21	Low	5510	4.18	7.61	14.58
	Mid	5590	4.95	7.45	14.28
	High	5670	4.93	7.66	14.54
802.11n 40 MHz Port R22	Low	5510	4.70	7.39	14.86
	Mid	5590	4.58	7.32	14.92
	High	5670	4.95	7.95	14.56

Table 17. Peak Conducted Output Power, Test Results, 40 MHz, Upper Bands

Summed Peak Conducted Output Power					
	Channel	Frequency (MHz)	Measured Peak Power (dBm)		
Gain			19dBi	16dBi	9dBi
802.11n 40 MHz Summed	Low	5510	10.68	13.35	20.53
	Mid	5590	10.79	13.43	20.60
	High	5670	10.94	13.78	20.58
Limit			11	14	21

Table 18. Summed Peak Conducted Output Power, 40 MHz, Upper Bands

Electromagnetic Compatibility Criteria for Intentional Radiators

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

Test Requirements: **§15.407(a)(2):** In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

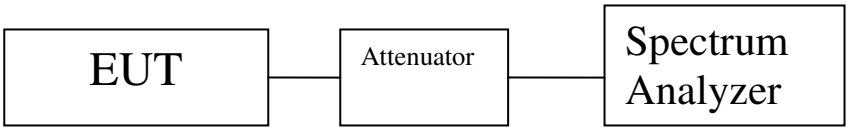
Test Procedure: The EUT was connected to a spectrum analyzer through a cable and attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels. Its power was measured according KDB 789033 D02 General UNII Test Procedures v01 and KDB 662911 D01 Multiple Transmitter Output v02r01.

Limit calculation: limit = 11 – (Ga -6)
Limit PSD19dBi = 11 – (19 – 6) = -2 dBm
Limit PSD16dBi = 11 – (16 – 6) = 1 dBm
Limit PSD9dBi = 11 – (9 – 6) = 8 dBm

Test Results: The EUT as tested is compliant with the requirements of this section.

Test Engineer(s): Saeed Kabirsalmani

Test Date(s): November 17, 2016



PSD					
	Channel	Frequency (MHz)	Measured PSD(dBm)		
Gain			19dBi	16dBi	9dBi
802.11a 20MHz Port R11	Low	5260	-9.03	-5.31	1.88
	Mid	5280	-8.48	-5.1	1.28
	High	5320	-8.64	-5.24	1.37
802.11a 20 MHz Port R12	Low	5260	-8.81	-5.9	1.48
	Mid	5280	-8.73	-5.51	1.58
	High	5320	-9.39	-5.7	1.29
802.11a 20MHz Port R21	Low	5260	-8.37	-5.1	1.51
	Mid	5280	-8.30	-5.6	1.58
	High	5320	-8.18	-5.7	1.1
802.11a 20 MHz Port R22	Low	5260	-9.10	-5.31	1.61
	Mid	5280	-8.56	-5.9	1.83
	High	5320	-8.87	-5.12	1.96
802.11n 20MHz Port R11	Low	5260	-9.79	-5.5	1.88
	Mid	5280	-8.58	-5.2	1.24
	High	5320	-8.55	-5.1	1.81
802.11n 20 MHz Port R12	Low	5260	-8.39	-5.2	1.24
	Mid	5280	-9.12	-5.32	1.61
	High	5320	-9.80	-5.1	1.54
802.11n 20MHz Port R21	Low	5260	-9.40	-5.15	1.86
	Mid	5280	-8.85	-5.41	1.46
	High	5320	-8.25	-5.55	1.68
802.11n 20 MHz Port R22	Low	5260	-9.71	-5.3	1.64
	Mid	5280	-9.20	-5.73	1.93
	High	5320	-9.62	-5.11	1.96

Table 19. Peak Conducted Output Power, Test Results, 20 MHz, Lower Bands

Summed PSD					
	Channel	**Frequency (MHz)**	**Measured PSD (dBm)**		
Gain			**19dBi**	**16dBi**	**9dBi**
802.11a 20 MHz Summed	Low	5260	-2.80	0.63	7.64
	Mid	5280	-2.49	0.50	7.59
	High	5320	-2.73	0.59	7.46
802.11n 20 MHz Summed	Low	5260	-3.26	0.74	7.68
	Mid	5280	-2.91	0.61	7.59
	High	5320	-2.98	0.81	7.77
Limit			-2	1	8

Table 20. Summed Peak Conducted Output Power, 20 MHz, Lower Bands

PSD					
	Channel	**Frequency (MHz)**	**Measured PSD(dBm)**		
Gain			**19dBi**	**16dBi**	**9dBi**
802.11n 20MHz Port R11	Low	5270	-9.48	-7.58	-0.07
	High	5310	-10.43	-7.48	0.37
802.11n 20 MHz Port R12	Low	5270	-9.96	-7.97	0.53
	High	5310	-9.18	-6.47	0.74
802.11n 20MHz Port R21	Low	5270	-8.68	-6.67	0.58
	High	5310	-9.43	-7.2	0.27
802.11n 20 MHz Port R22	Low	5270	-10.45	-7.18	-0.24
	High	5310	-9.81	-7.06	-0.35

Table 21. Peak Conducted Output Power, Test Results, 40 MHz, Lower Bands

Summed PSD					
	Channel	**Frequency (MHz)**	**Measured PSD (dBm)**		
Gain			**19dBi**	**16dBi**	**9dBi**
802.11n 20 MHz Summed	Low	5270	-3.57	-1.30	6.24
	High	5310	-3.67	-1.02	6.30
Limit			-2	1	8

Table 22. Summed Peak Conducted Output Power, 40 MHz, Lower Bands

PSD					
	Channel	**Frequency (MHz)**	**Measured PSD(dBm)**		
Gain			**19dBi**	**16dBi**	**9dBi**
802.11a 20MHz Port R11	Low	5500	-8.21	-5.38	1.53
	Mid	5600	-8.27	-5.74	1.41
	High	5700	-8.39	-5.19	1.63
802.11a 20 MHz Port R12	Low	5500	-8.41	-5.22	1.92
	Mid	5600	-8.25	-5.78	1.81
	High	5700	-8.25	-5.45	1.28
802.11a 20MHz Port R21	Low	5500	-8.37	-5.12	1.71
	Mid	5600	-8.61	-5.14	1.14
	High	5700	-8.55	-5.27	1.11
802.11a 20 MHz Port R22	Low	5500	-8.41	-5.21	1.54
	Mid	5600	-8.89	-5.08	1.69
	High	5700	-8.13	-5.28	1.54
802.11n 20MHz Port R11	Low	5500	-8.03	-5.69	1.34
	Mid	5600	-8.28	-5.26	1.52
	High	5700	-8.59	-5.63	1.95
802.11n 20 MHz Port R12	Low	5500	-8.36	-5.54	1.93
	Mid	5600	-8.37	-5.79	1.39
	High	5700	-8.15	-5.08	1.63
802.11n 20MHz Port R21	Low	5500	-8.28	-5.15	1.09
	Mid	5600	-8.63	-5.19	1.31
	High	5700	-8.09	-5.78	1.35
802.11n 20 MHz Port R22	Low	5500	-8.52	-5.61	1.49
	Mid	5600	-8.37	-5.47	1.51
	High	5700	-8.50	-5.45	1.59

Table 23. Peak Conducted Output Power, Test Results, 20 MHz, Upper Bands

Summed PSD					
	Channel	**Frequency (MHz)**	**Measured PSD (dBm)**		
Gain			**19dBi**	**16dBi**	**9dBi**
802.11a 20 MHz Summed	Low	5500	-2.33	0.79	7.70
	Mid	5600	-2.48	0.60	7.54
	High	5700	-2.31	0.72	7.42
802.11n 20 MHz Summed	Low	5500	-2.27	0.53	7.49
	Mid	5600	-2.39	0.60	7.45
	High	5700	-2.31	0.54	7.66
Limit			-2	1	8

Table 24. Summed Peak Conducted Output Power, 20 MHz, Upper Bands

PSD					
	Channel	**Frequency (MHz)**	**Measured PSD(dBm)**		
Gain			**19dBi**	**16dBi**	**9dBi**
802.11n 20MHz Port R11	Low	5510	-9.80	-8.32	-2.34
	Mid	5590	-9.96	-7.56	-1.71
	High	5670	-10.35	-7.49	-0.92
802.11n 20 MHz Port R12	Low	5510	-9.90	-7.69	-0.21
	Mid	5590	-9.11	-7.21	-0.26
	High	5670	-9.08	-6.16	0.05
802.11n 20MHz Port R21	Low	5510	-10.53	-6.92	-2.01
	Mid	5590	-10.25	-8.67	-1.41
	High	5670	-9.65	-7.61	-1.92
802.11n 20 MHz Port R22	Low	5510	-9.37	-7.48	-0.81
	Mid	5590	-9.35	-7.82	-0.47
	High	5670	-9.83	-9.5	-1.41

Table 25. Peak Conducted Output Power, Test Results, 40 MHz, Upper Bands

Summed PSD					
	Channel	**Frequency (MHz)**	**Measured PSD (dBm)**		
Gain			**19dBi**	**16dBi**	**9dBi**
802.11n 20 MHz Summed	Low	5510	-3.86	-1.55	4.76
	Mid	5590	-3.62	-1.76	5.10
	High	5670	-3.68	-1.51	5.03
Limit			-2	1	8

Table 26. Summed Peak Conducted Output Power, 40 MHz, Upper Bands

Electromagnetic Compatibility Criteria for Intentional Radiators

§15.407(b)(2 – 3) & (6 – 7) Undesirable Emissions

Test Requirements:

§ 15.407(b)(2): For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

§ 15.407(b)(3): For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. 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 stand on a turntable in a chamber. To find the maximum emission the EUT was set to transmit on low, mid, and high channels. Additionally, the turntable was rotated 360 degrees, the EUT was oriented through its three orthogonal axes, and the receive antenna height was varied in order to maximize emissions.

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

Above 1 GHz, measurements were made pursuant the method described in FCC KDB 789033 D02 General UNII Test Procedure New Rules v01. The equation, **EIRP= E + 20 log D – 104.8** was used to convert field strength to EIRP (**E** = field strength (dBµV/m) and **D** = Reference measurement distance**).**

Above 1 GHz, notch filters (5250 MHz – 5350 MHz and 5470MHz – 5725MHz) are used for filter the fundamental signal.

The EUT was compliant with the Radiated Spurious Emission limits of **§ 15.407(b)**. The over-the-limit emissions in the range 30 MHz to 1000 MHz appear to be digital emissions since they still exist when the radio is off.

For emissions above 1 GHz and in restricted bands, measurements of the field strength were made with a peak detector and an average detector and compared with the limits of 15.209.

As an alternative, according to FCC KDB 789033 D02 General UNII Test Procedure New Rules v01, all emissions above 1 GHz that comply with the peak and average limits of 15.209 satisfy the requirements of unwanted emissions in 15.407.

Test Results:

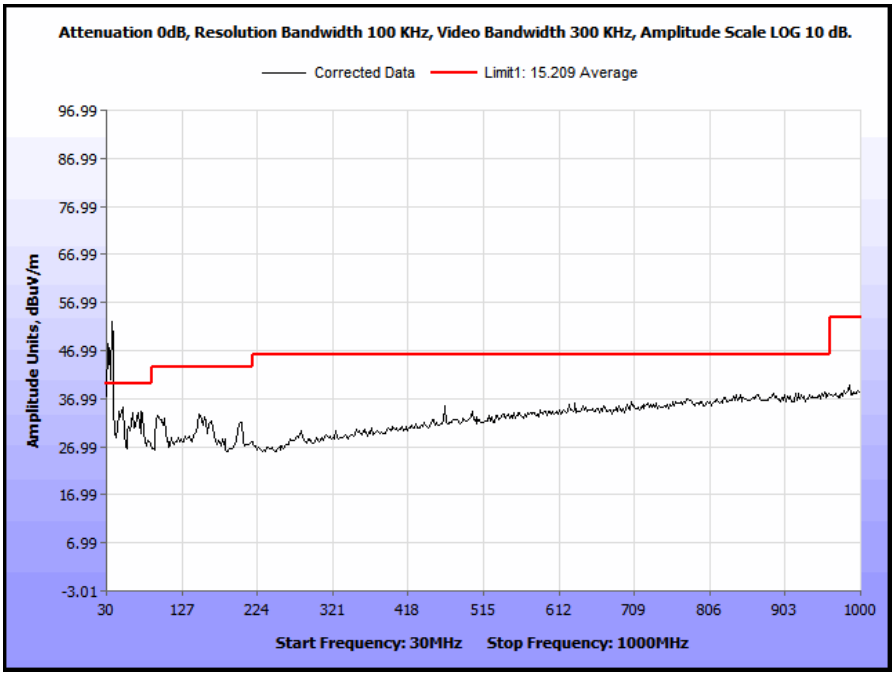
For below 1 GHz, the EUT was compliant with the requirements of this section.

For above 1 GHz, the EUT was compliant with the requirements of this section.

Only noise floor was observed above 18GHz.

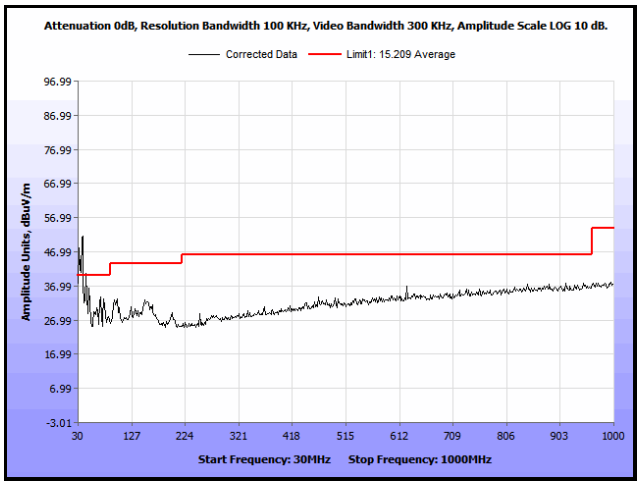
Test Engineer(s): Jun Qi

Test Date(s): November 30, 2016

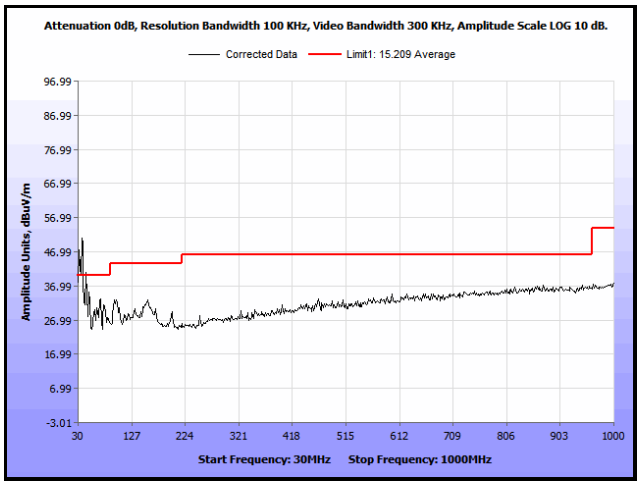


Plot 18. Radiated Spurious Emissions, No Radiate, Power on Only, 30 MHz – 1 GHz

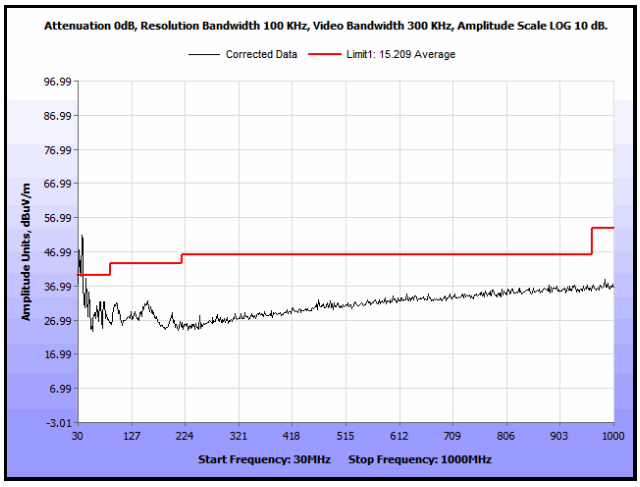
Radiated Spurious Emissions, Below 1 GHz, 802.11n 40 MHz, 9 dBi Antenna



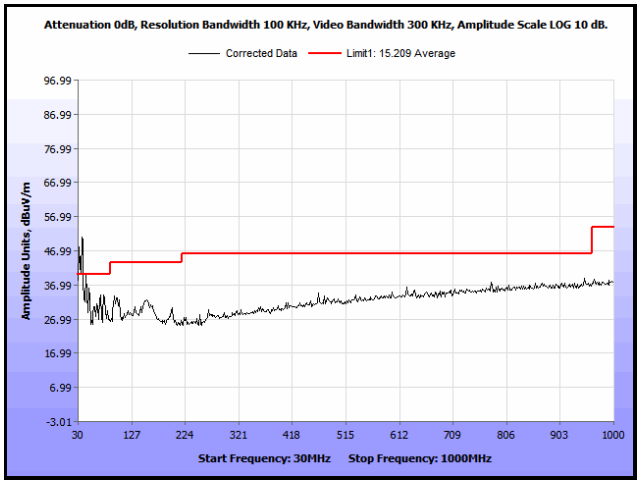
Plot 19. Radiated Spurious Emissions, 802.11n 40 MHz, 5270 MHz, 30 MHz – 1 GHz, Average, 9 dBi Antenna



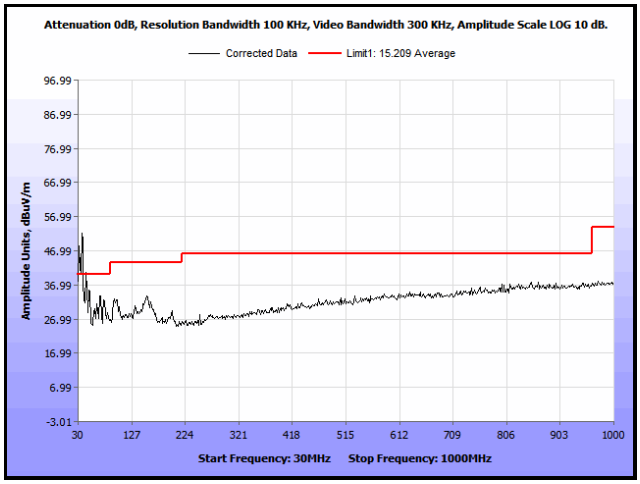
Plot 20. Radiated Spurious Emissions, 802.11n 40 MHz, 5310 MHz, 30 MHz – 1 GHz, Average, 9 dBi Antenna



Plot 21. Radiated Spurious Emissions, 802.11n 40 MHz, 5510 MHz, 30 MHz – 1 GHz, Average, 9 dBi Antenna

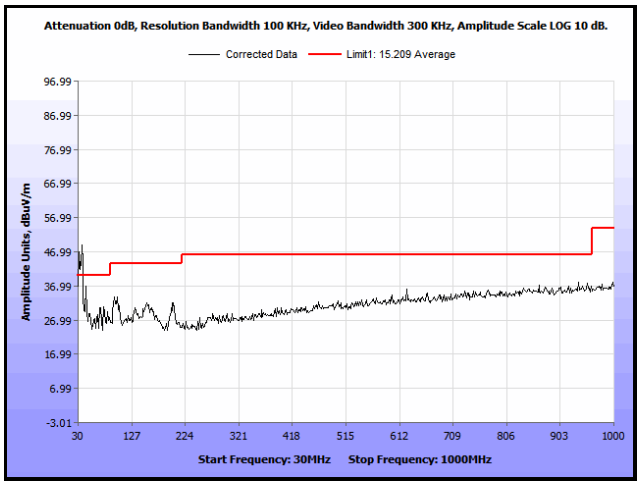


Plot 22. Radiated Spurious Emissions, 802.11n 40 MHz, 5590 MHz, 30 MHz – 1 GHz, Average, 9 dBi Antenna

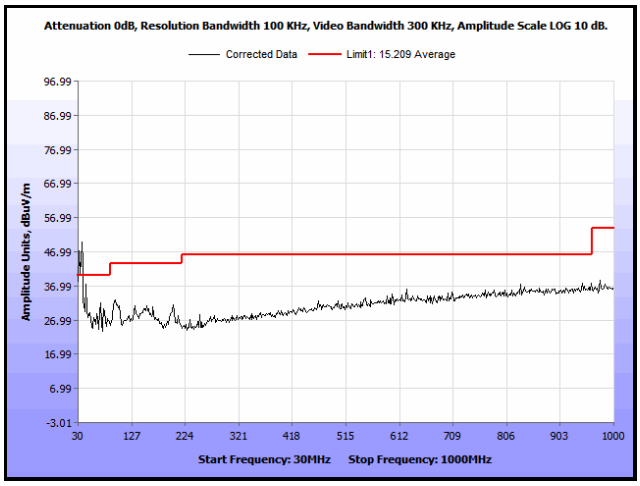


Plot 23. Radiated Spurious Emissions, 802.11n 40 MHz, 5670 MHz, 30 MHz – 1 GHz, Average, 9 dBi Antenna

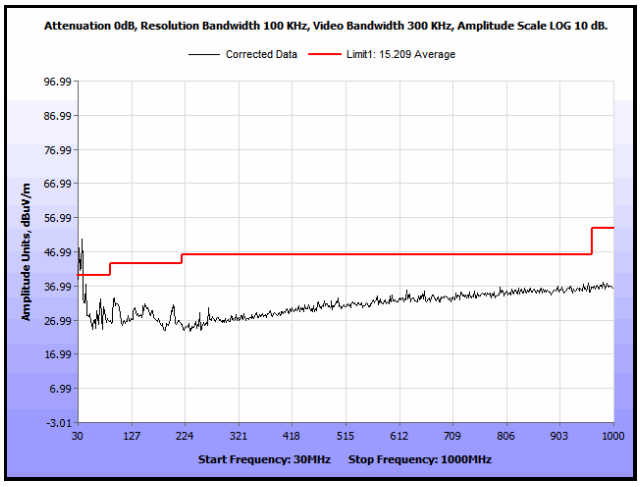
Radiated Spurious Emissions, Below 1 GHz, 802.11n 40 MHz, 16 dBi Antenna



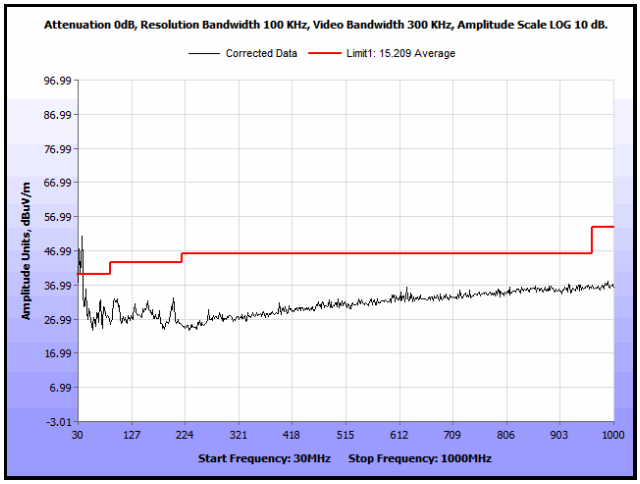
Plot 24. Radiated Spurious Emissions, 802.11n 40 MHz, 5270 MHz, 30 MHz – 1 GHz, Average, 16 dBi Antenna



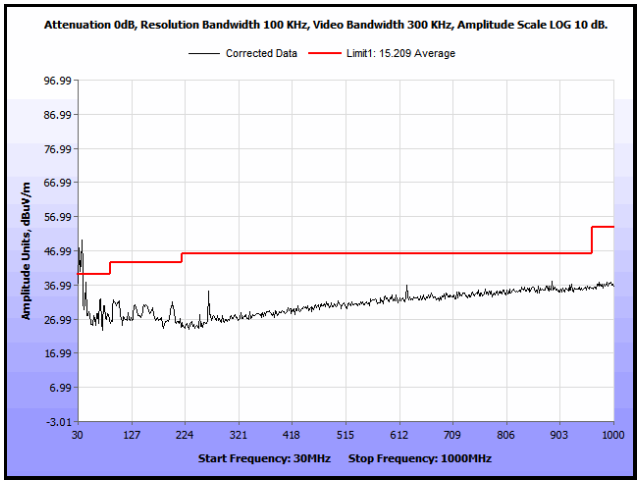
Plot 25. Radiated Spurious Emissions, 802.11n 40 MHz, 5310 MHz, 30 MHz – 1 GHz, Average, 16 dBi Antenna



Plot 26. Radiated Spurious Emissions, 802.11n 40 MHz, 5510 MHz, 30 MHz – 1 GHz, Average, 16 dBi Antenna

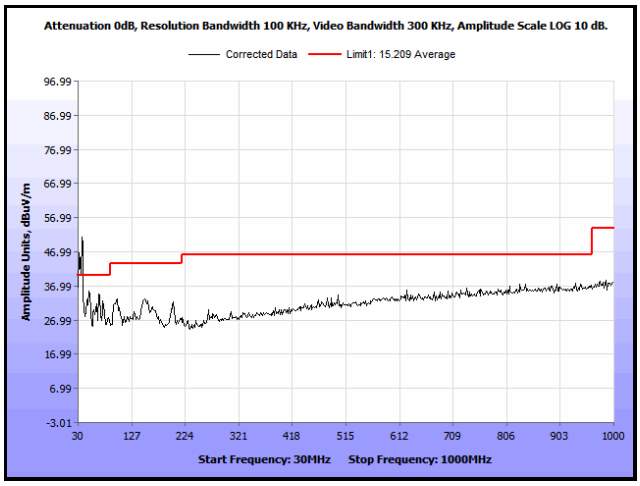


Plot 27. Radiated Spurious Emissions, 802.11n 40 MHz, 5590 MHz, 30 MHz – 1 GHz, Average, 16 dBi Antenna

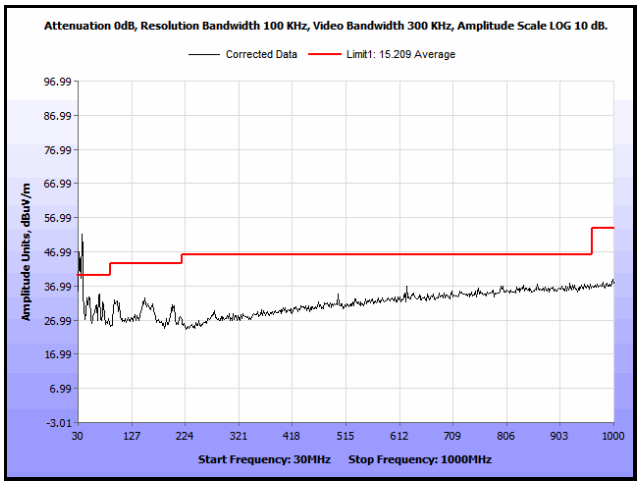


Plot 28. Radiated Spurious Emissions, 802.11n 40 MHz, 5670 MHz, 30 MHz – 1 GHz, Average, 16 dBi Antenna

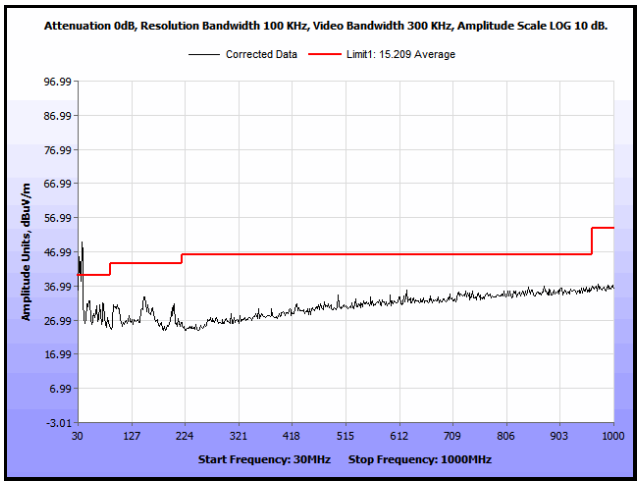
Radiated Spurious Emissions, Below 1 GHz, 802.11n 40 MHz, 19 dBi Antenna



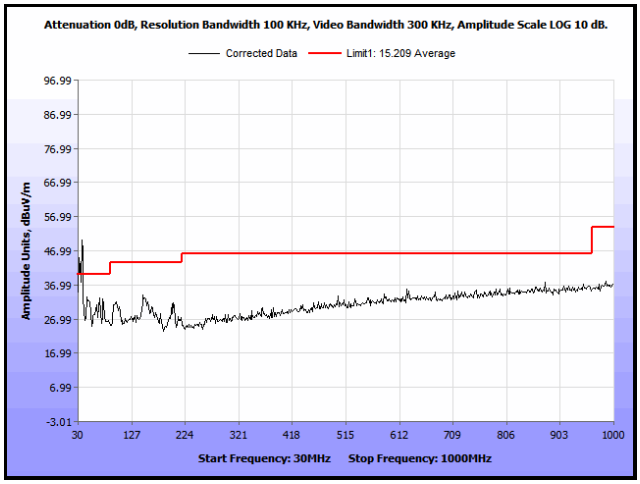
Plot 29. Radiated Spurious Emissions, 802.11n 40 MHz, 5270 MHz, 30 MHz – 1 GHz, Average, 19 dBi Antenna



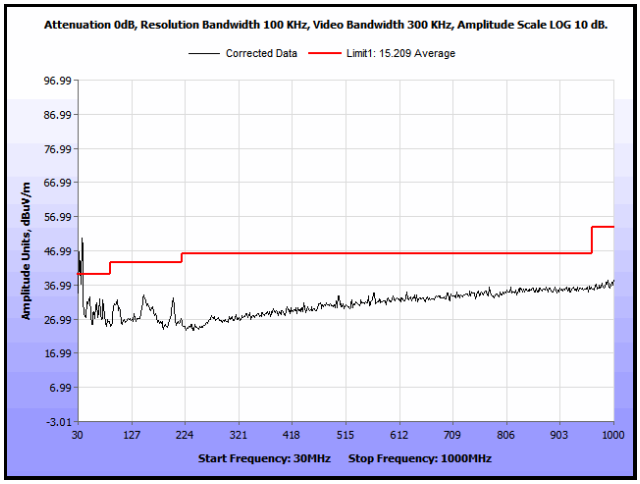
Plot 30. Radiated Spurious Emissions, 802.11n 40 MHz, 5310 MHz, 30 MHz – 1 GHz, Average, 19 dBi Antenna



Plot 31. Radiated Spurious Emissions, 802.11n 40 MHz, 5510 MHz, 30 MHz – 1 GHz, Average, 19 dBi Antenna

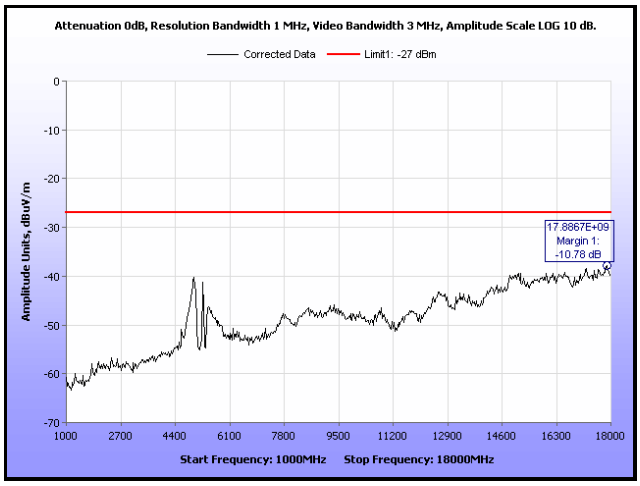


Plot 32. Radiated Spurious Emissions, 802.11n 40 MHz, 5590 MHz, 30 MHz – 1 GHz, Average, 19 dBi Antenna

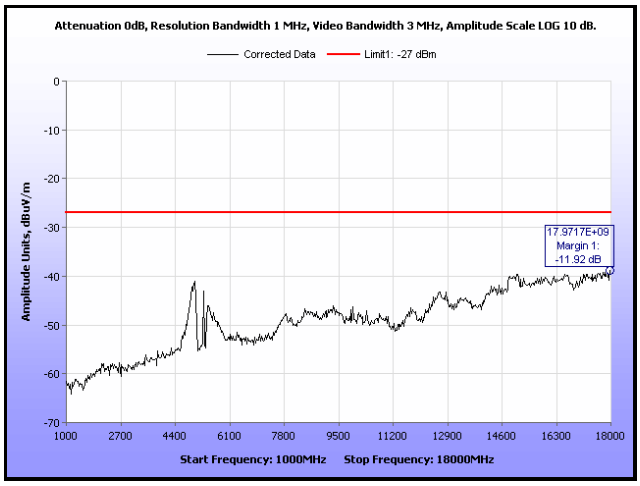


Plot 33. Radiated Spurious Emissions, 802.11n 40 MHz, 5670 MHz, 30 MHz – 1 GHz, Average, 19 dBi Antenna

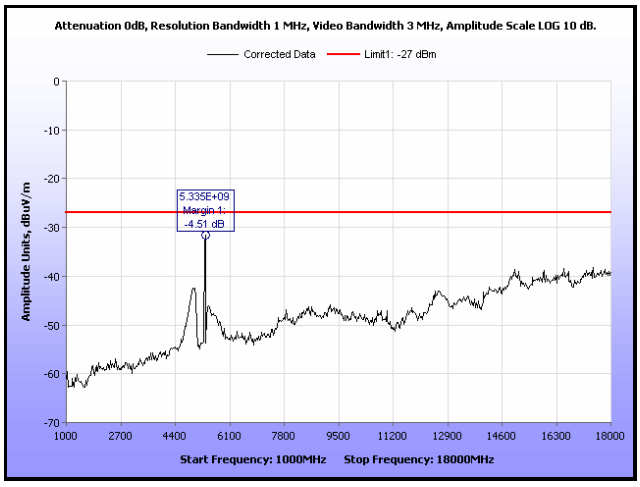
Radiated Spurious Emissions, 802.11a 20 MHz, 9 dBi Antenna



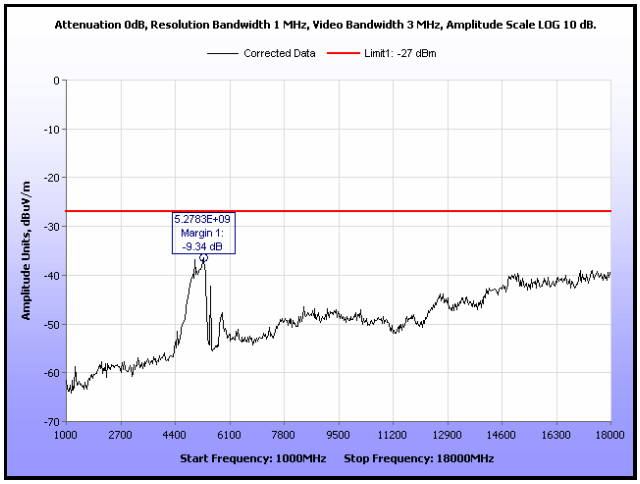
Plot 34. Radiated Spurious Emissions, 802.11a 20 MHz, 5260 MHz, 1 GHz – 18 GHz, 9 dBi Antenna



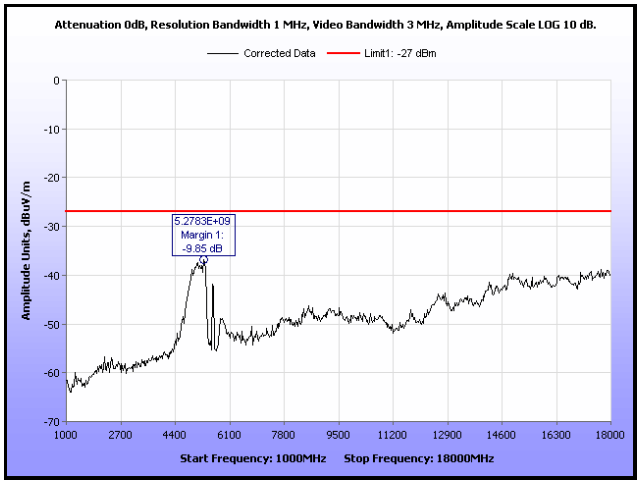
Plot 35. Radiated Spurious Emissions, 802.11a 20 MHz, 5280 MHz, 1 GHz – 18 GHz, 9 dBi Antenna



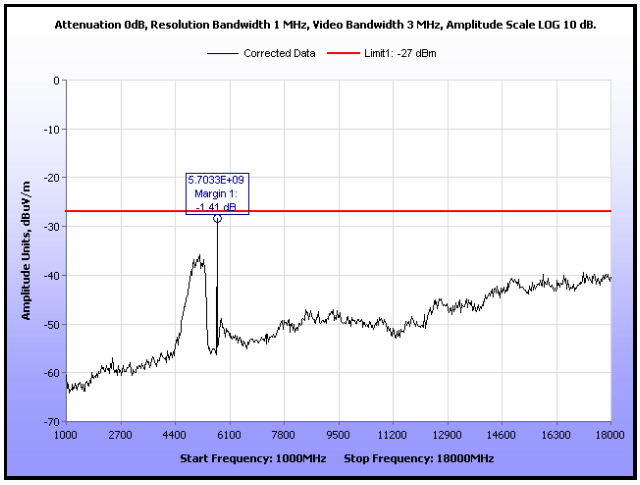
Plot 36. Radiated Spurious Emissions, 802.11a 20 MHz, 5320 MHz, 1 GHz – 18 GHz, 9 dBi Antenna



Plot 37. Radiated Spurious Emissions, 802.11a 20 MHz, 5500 MHz, 1 GHz – 18 GHz, 9 dBi Antenna

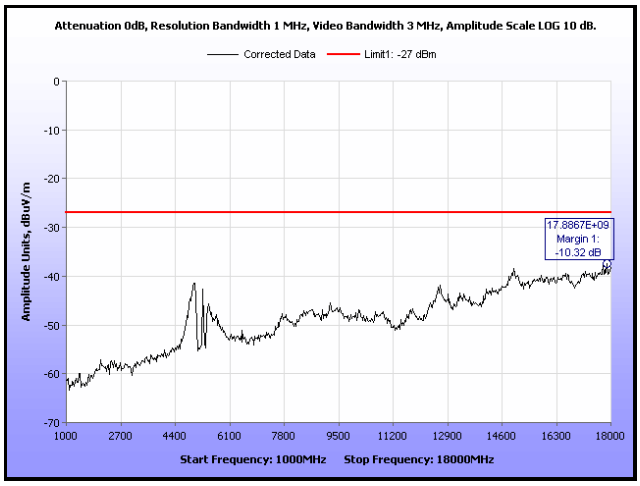


Plot 38. Radiated Spurious Emissions, 802.11a 20 MHz, 5580 MHz, 1 GHz – 18 GHz, 9 dBi Antenna

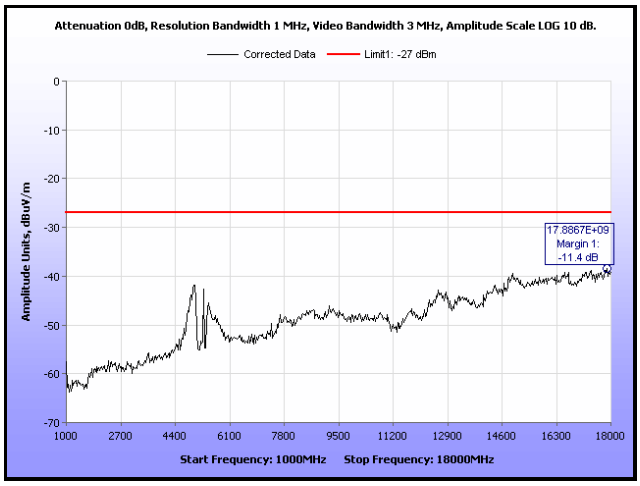


Plot 39. Radiated Spurious Emissions, 802.11a 20 MHz, 5700 MHz, 1 GHz – 18 GHz, 9 dBi Antenna

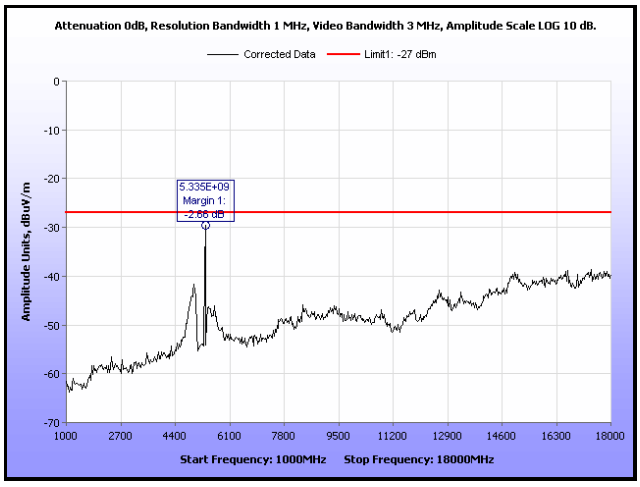
Radiated Spurious Emissions, 802.11n 20 MHz, 9 dBi Antenna



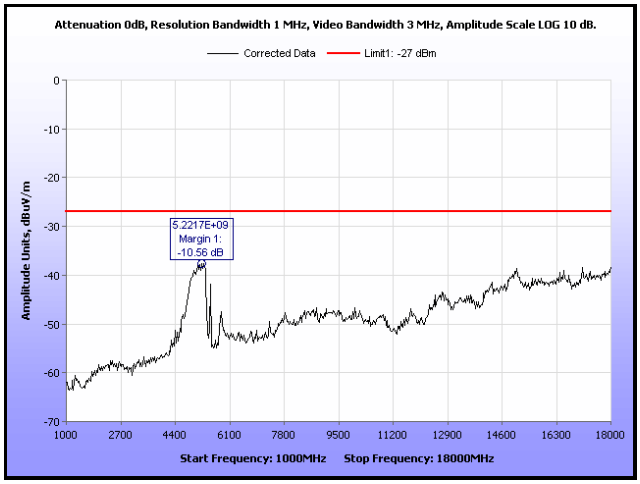
Plot 40. Radiated Spurious Emissions, 802.11n 20 MHz, 5260 MHz, 1 GHz – 18 GHz, 9 dBi Antenna



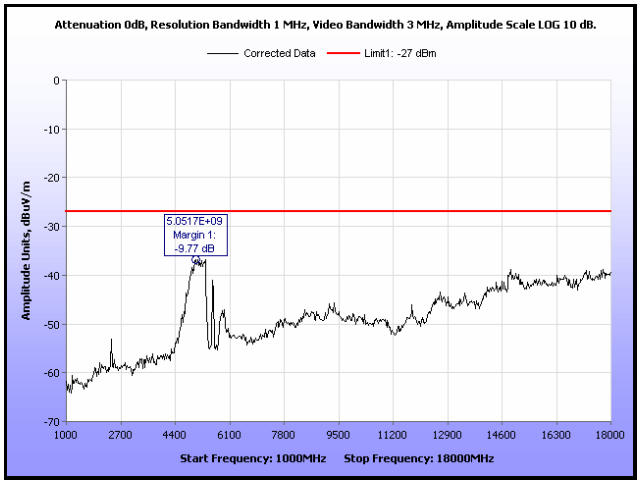
Plot 41. Radiated Spurious Emissions, 802.11n 20 MHz, 5280 MHz, 1 GHz – 18 GHz, 9 dBi Antenna



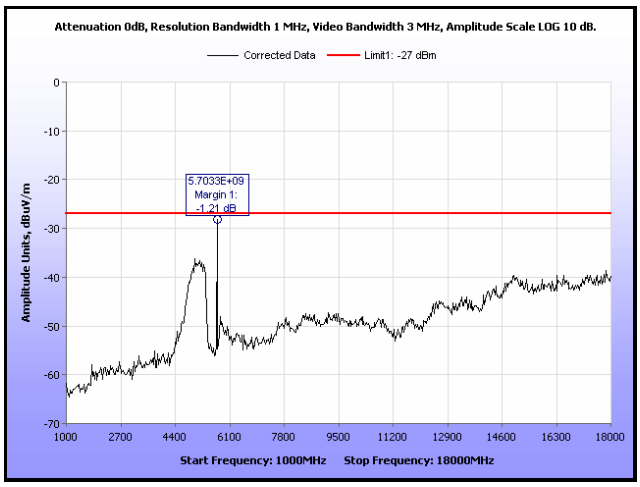
Plot 42. Radiated Spurious Emissions, 802.11n 20 MHz, 5320 MHz, 1 GHz – 18 GHz, 9 dBi Antenna



Plot 43. Radiated Spurious Emissions, 802.11n 20 MHz, 5500 MHz, 1 GHz – 18 GHz, 9 dBi Antenna

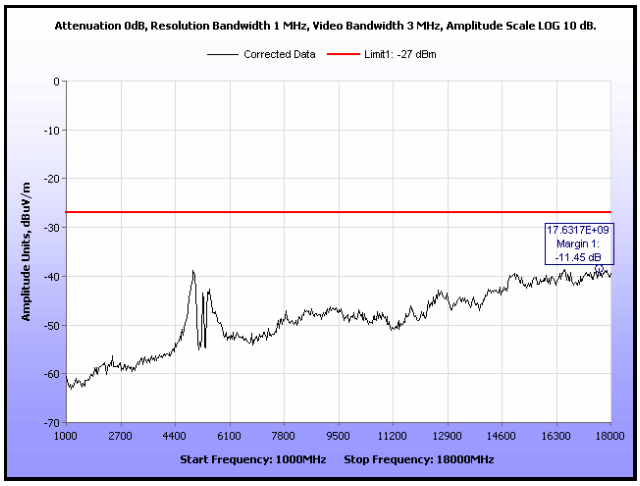


Plot 44. Radiated Spurious Emissions, 802.11n 20 MHz, 5580 MHz, 1 GHz – 18 GHz, 9 dBi Antenna

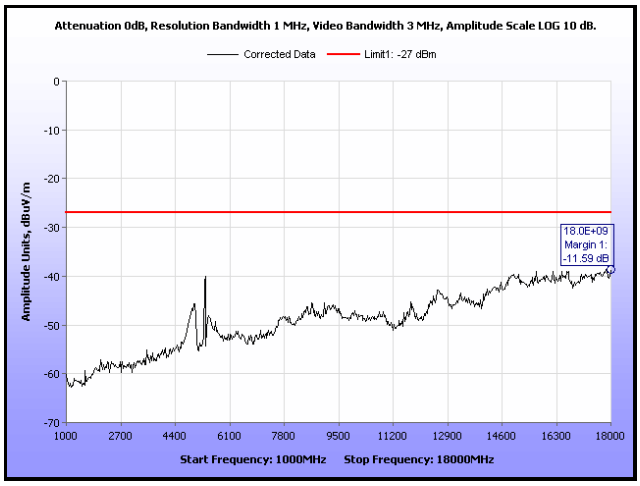


Plot 45. Radiated Spurious Emissions, 802.11n 20 MHz, 5700 MHz, 1 GHz – 18 GHz, 9 dBi Antenna

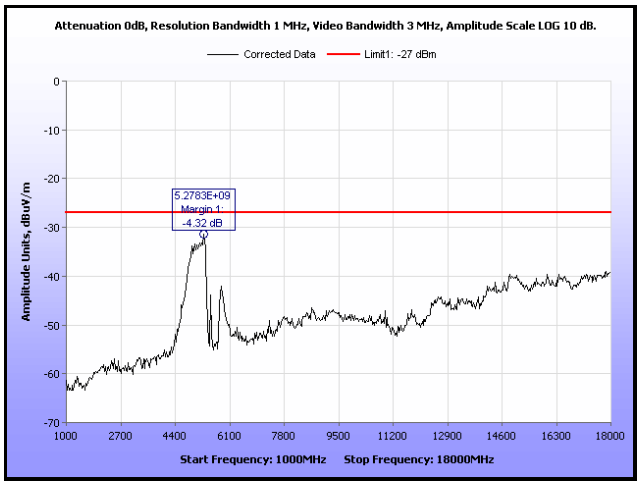
Radiated Spurious Emissions, 802.11n 40 MHz, 9 dBi Antenna



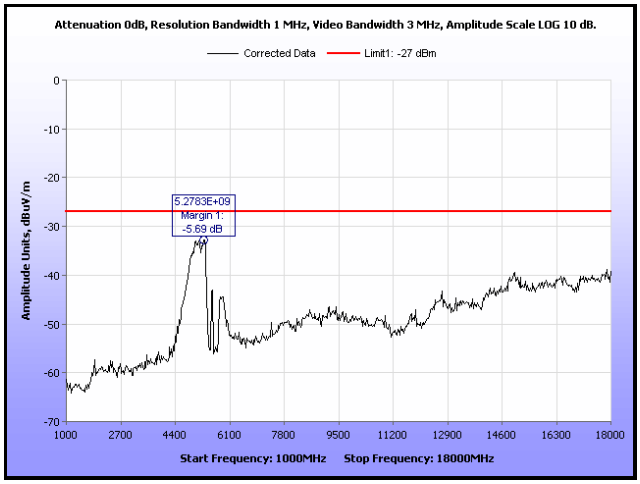
Plot 46. Radiated Spurious Emissions, 802.11n 40 MHz, 5270 MHz, 1 GHz – 18 GHz, 9 dBi Antenna



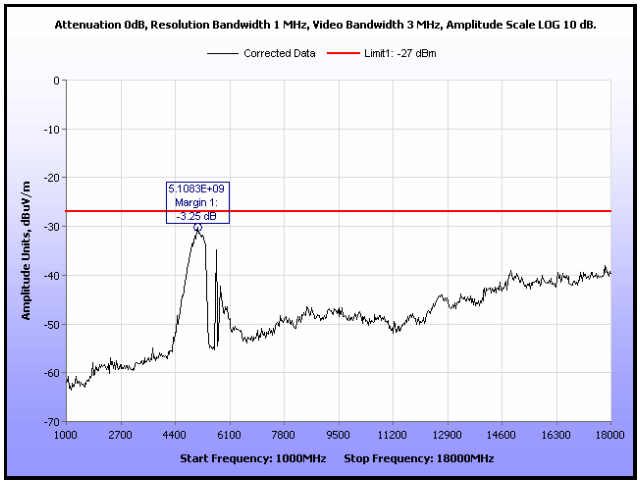
Plot 47. Radiated Spurious Emissions, 802.11n 40 MHz, 5310 MHz, 1 GHz – 18 GHz, 9 dBi Antenna



Plot 48. Radiated Spurious Emissions, 802.11n 40 MHz, 5510 MHz, 1 GHz – 18 GHz, 9 dBi Antenna

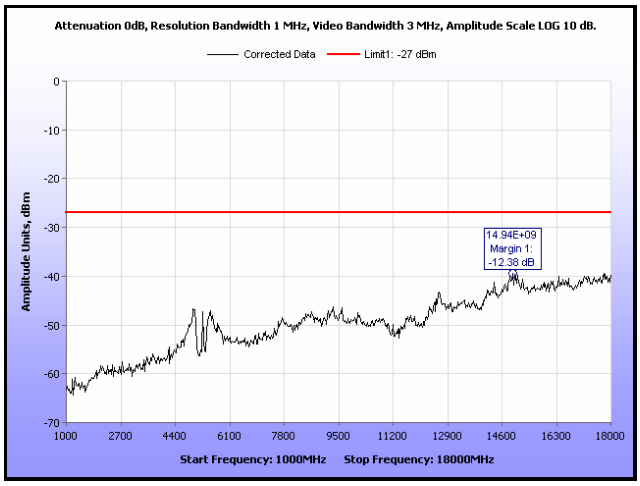


Plot 49. Radiated Spurious Emissions, 802.11n 40 MHz, 5550 MHz, 1 GHz – 18 GHz, 9 dBi Antenna

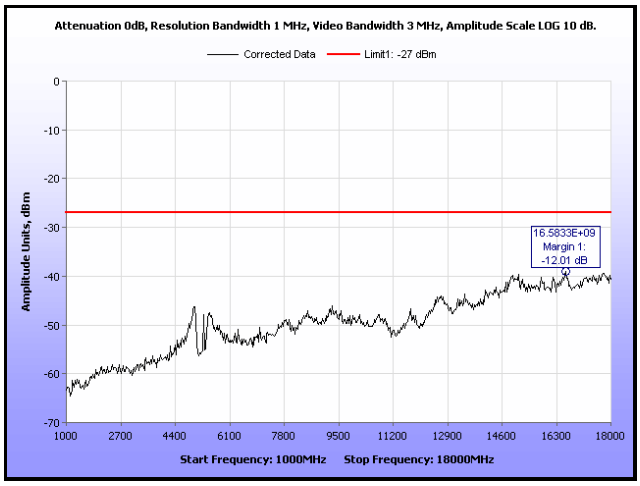


Plot 50. Radiated Spurious Emissions, 802.11n 40 MHz, 5670 MHz, 1 GHz – 18 GHz, 9 dBi Antenna

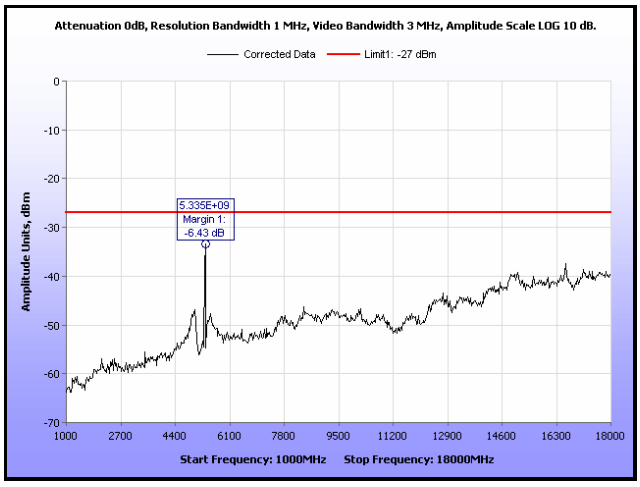
Radiated Spurious Emissions, 802.11a 20 MHz, 16 dBi Antenna



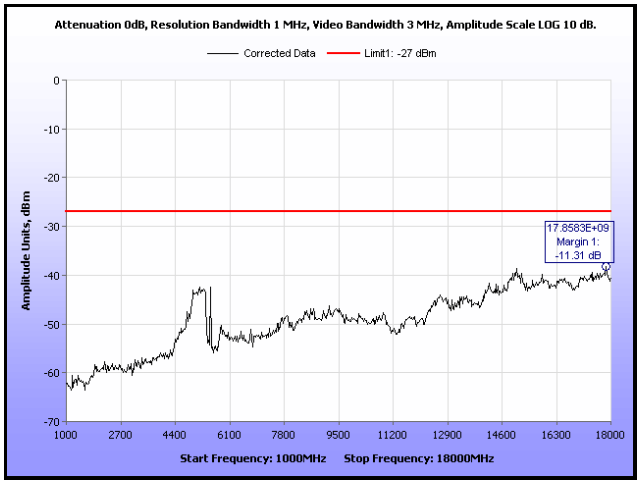
Plot 51. Radiated Spurious Emissions, 802.11a 20 MHz, 5260 MHz, 1 GHz – 18 GHz, 16 dBi Antenna



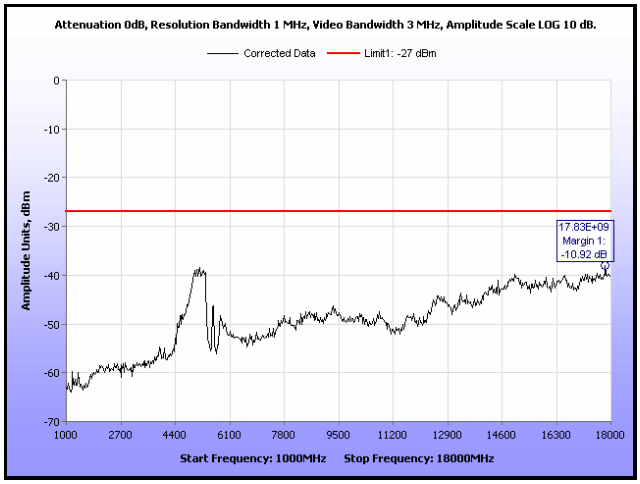
Plot 52. Radiated Spurious Emissions, 802.11a 20 MHz, 5280 MHz, 1 GHz – 18 GHz, 16 dBi Antenna



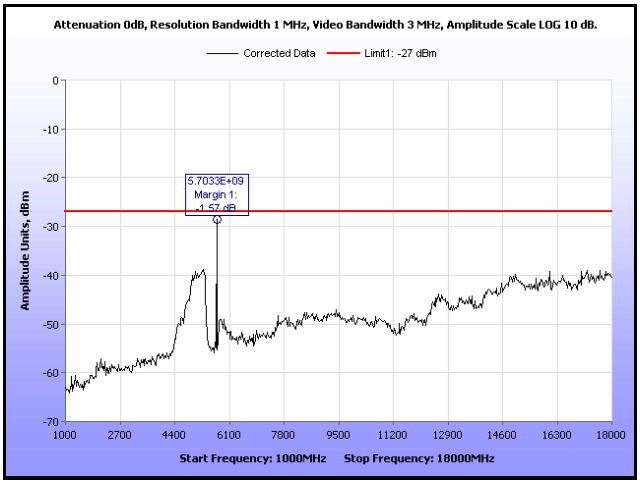
Plot 53. Radiated Spurious Emissions, 802.11a 20 MHz, 5320 MHz, 1 GHz – 18 GHz, 16 dBi Antenna



Plot 54. Radiated Spurious Emissions, 802.11a 20 MHz, 5500 MHz, 1 GHz – 18 GHz, 16 dBi Antenna

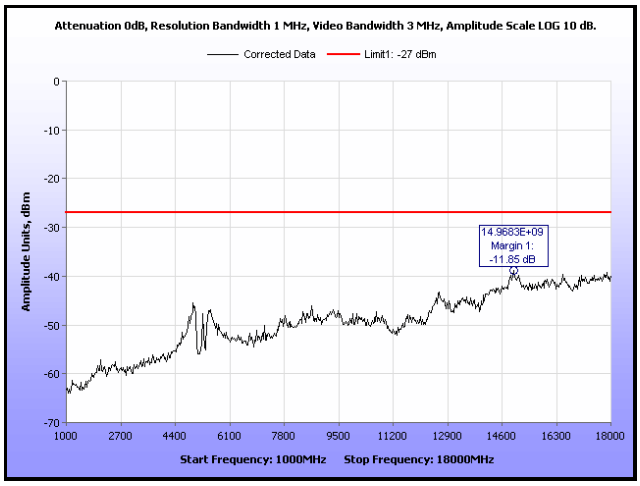


Plot 55. Radiated Spurious Emissions, 802.11a 20 MHz, 5580 MHz, 1 GHz – 18 GHz, 16 dBi Antenna

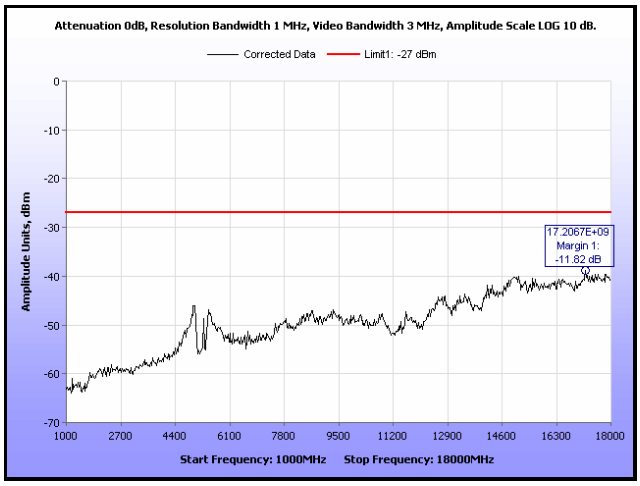


Plot 56. Radiated Spurious Emissions, 802.11a 20 MHz, 5700 MHz, 1 GHz – 18 GHz, 16 dBi Antenna

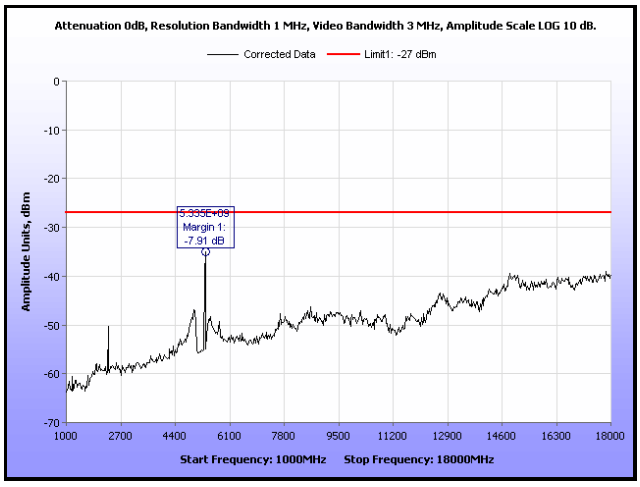
Radiated Spurious Emissions, 802.11n 20 MHz, 16 dBi Antenna



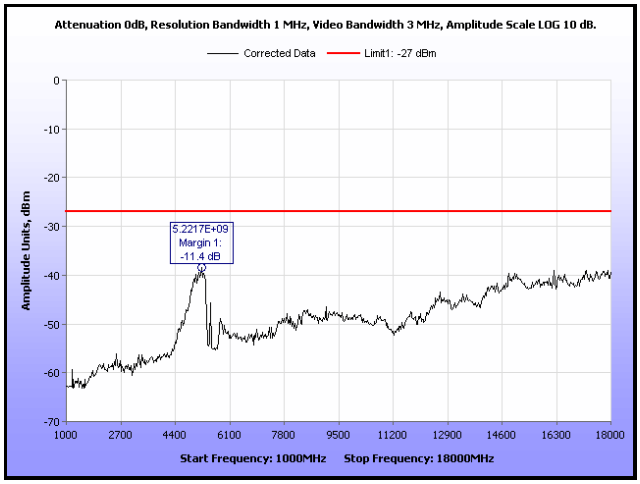
Plot 57. Radiated Spurious Emissions, 802.11n 20 MHz, 5260 MHz, 1 GHz – 18 GHz, 16 dBi Antenna



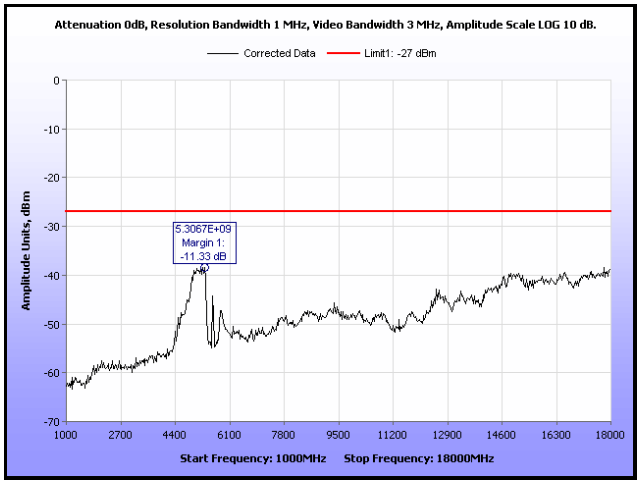
Plot 58. Radiated Spurious Emissions, 802.11n 20 MHz, 5280 MHz, 1 GHz – 18 GHz, 16 dBi Antenna



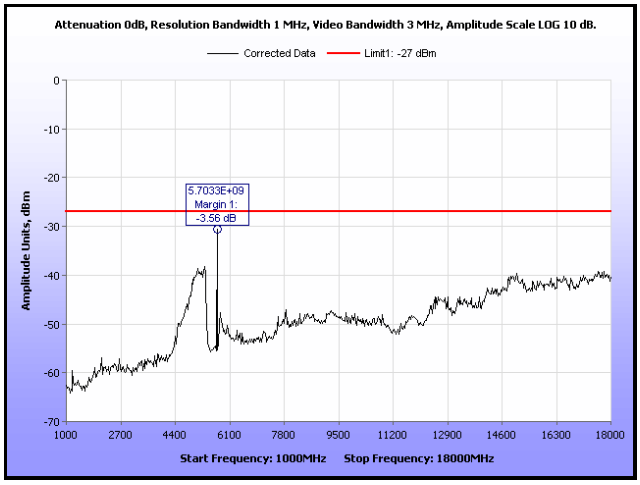
Plot 59. Radiated Spurious Emissions, 802.11n 20 MHz, 5320 MHz, 1 GHz – 18 GHz, 16 dBi Antenna



Plot 60. Radiated Spurious Emissions, 802.11n 20 MHz, 5500 MHz, 1 GHz – 18 GHz, 16 dBi Antenna

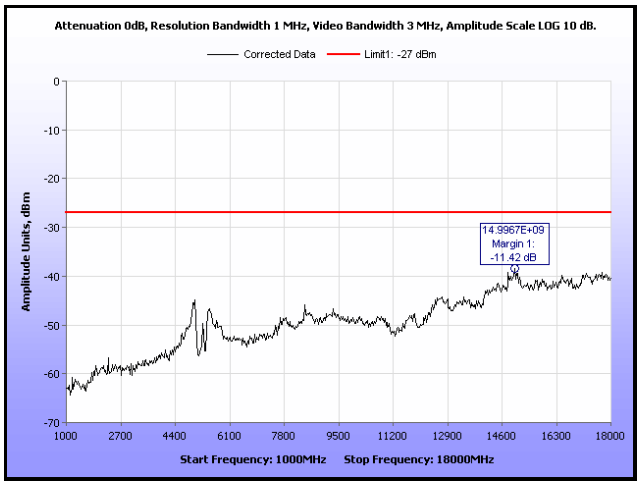


Plot 61. Radiated Spurious Emissions, 802.11n 20 MHz, 5580 MHz, 1 GHz – 18 GHz, 16 dBi Antenna

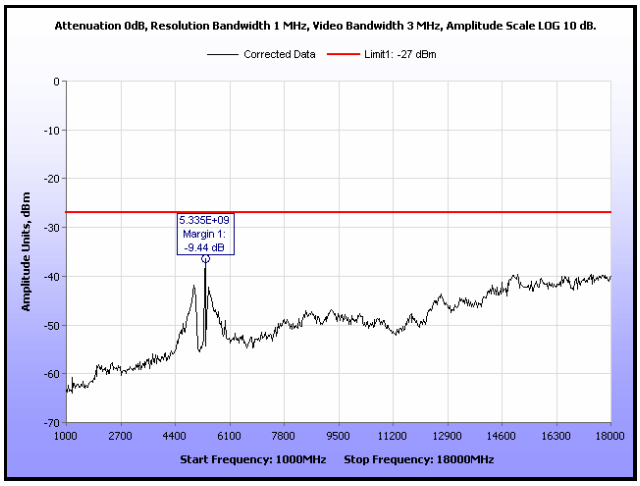


Plot 62. Radiated Spurious Emissions, 802.11n 20 MHz, 5700 MHz, 1 GHz – 18 GHz, 16 dBi Antenna

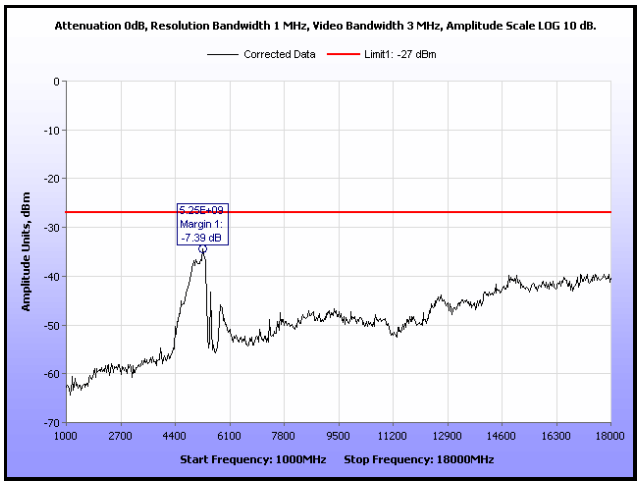
Radiated Spurious Emissions, 802.11n 40 MHz, 16 dBi Antenna



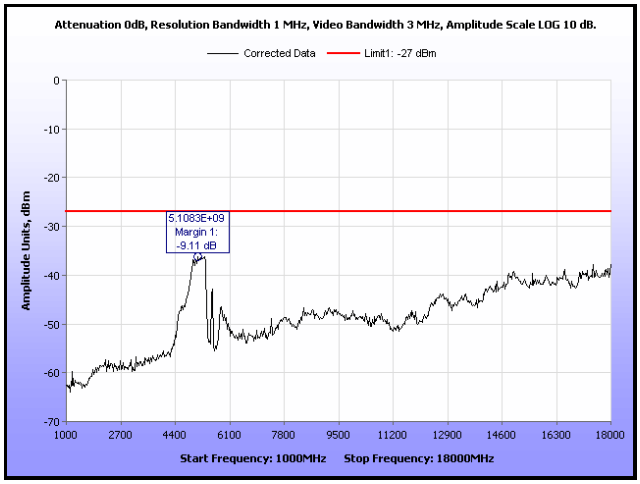
Plot 63. Radiated Spurious Emissions, 802.11n 40 MHz, 5270 MHz, 1 GHz – 18 GHz, 16 dBi Antenna



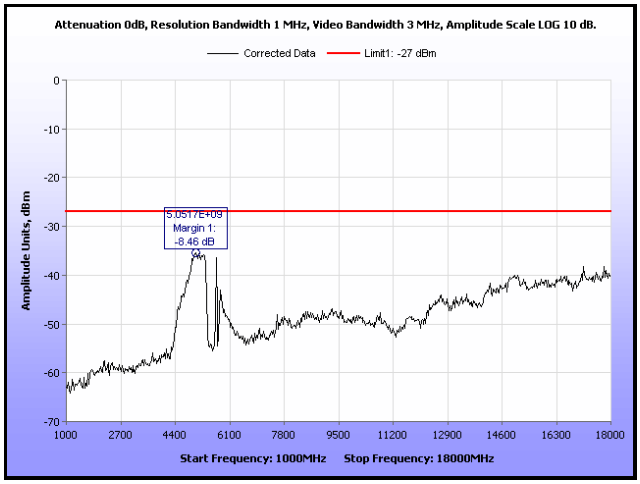
Plot 64. Radiated Spurious Emissions, 802.11n 40 MHz, 5310 MHz, 1 GHz – 18 GHz, 16 dBi Antenna



Plot 65. Radiated Spurious Emissions, 802.11n 40 MHz, 5510 MHz, 1 GHz – 18 GHz, 16 dBi Antenna

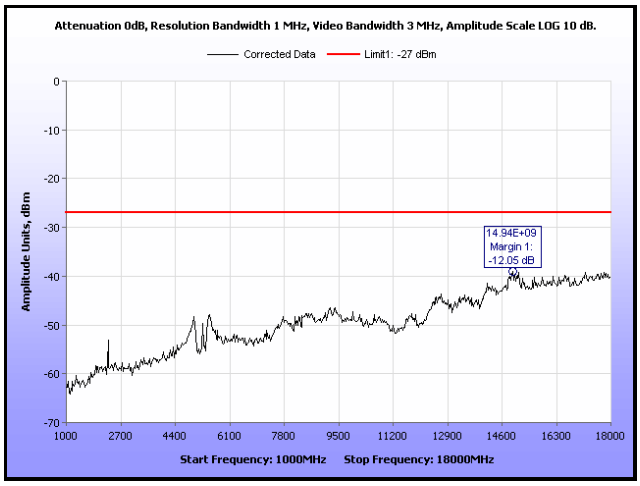


Plot 66. Radiated Spurious Emissions, 802.11n 40 MHz, 5550 MHz, 1 GHz – 18 GHz, 16 dBi Antenna

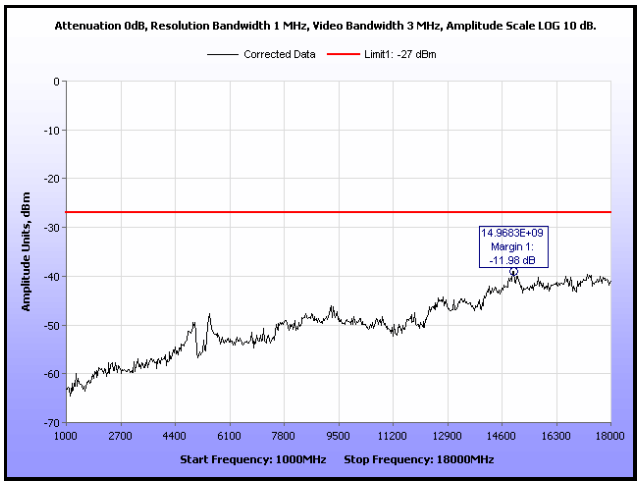


Plot 67. Radiated Spurious Emissions, 802.11n 40 MHz, 5670 MHz, 1 GHz – 18 GHz, 16 dBi Antenna

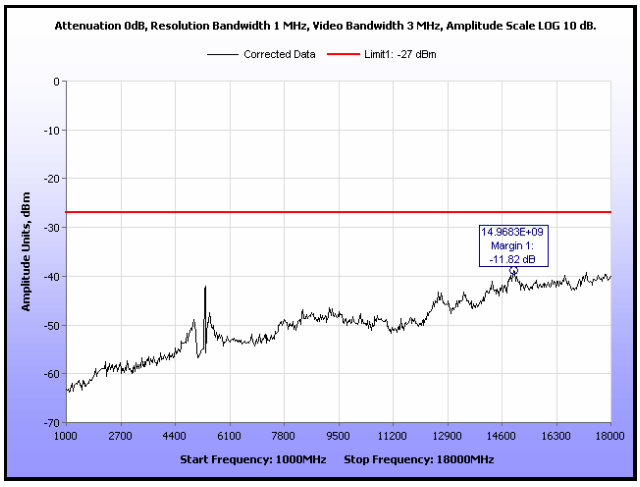
Radiated Spurious Emissions, 802.11a 20 MHz, 19 dBi Antenna



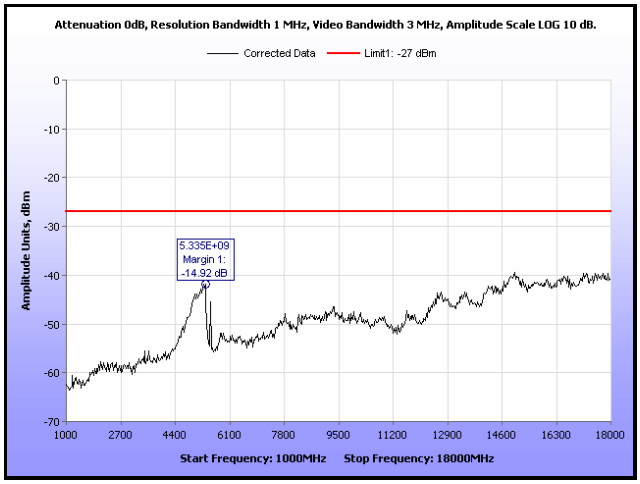
Plot 68. Radiated Spurious Emissions, 802.11a 20 MHz, 5260 MHz, 1 GHz – 18 GHz, 19 dBi Antenna



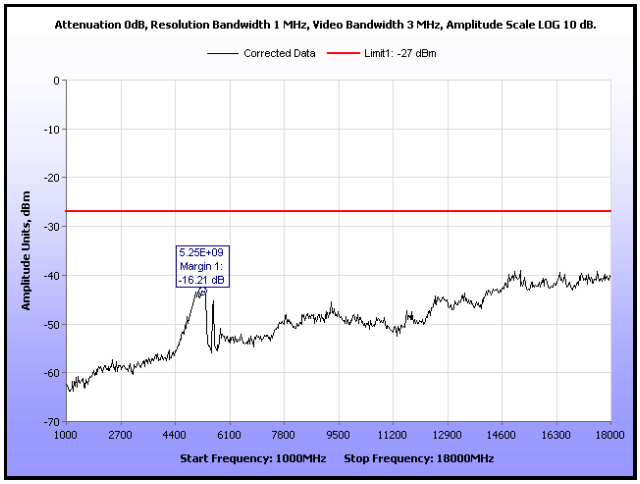
Plot 69. Radiated Spurious Emissions, 802.11a 20 MHz, 5280 MHz, 1 GHz – 18 GHz, 19 dBi Antenna



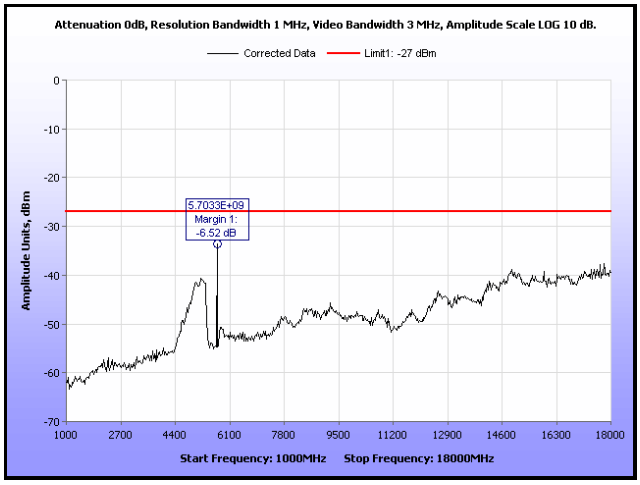
Plot 70. Radiated Spurious Emissions, 802.11a 20 MHz, 5320 MHz, 1 GHz – 18 GHz, 19 dBi Antenna



Plot 71. Radiated Spurious Emissions, 802.11a 20 MHz, 5500 MHz, 1 GHz – 18 GHz, 19 dBi Antenna

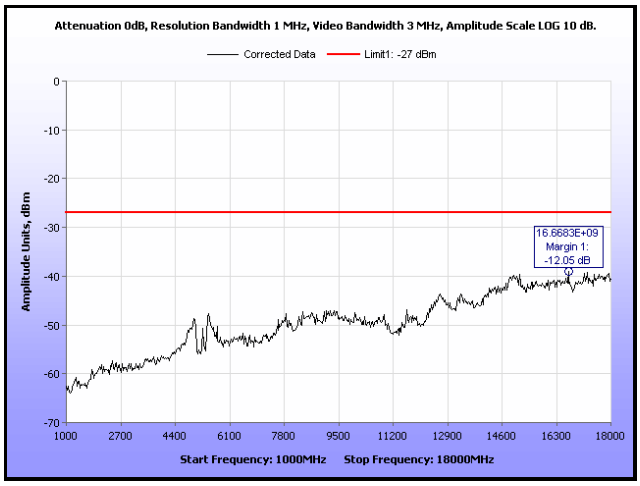


Plot 72. Radiated Spurious Emissions, 802.11a 20 MHz, 5580 MHz, 1 GHz – 18 GHz, 19 dBi Antenna

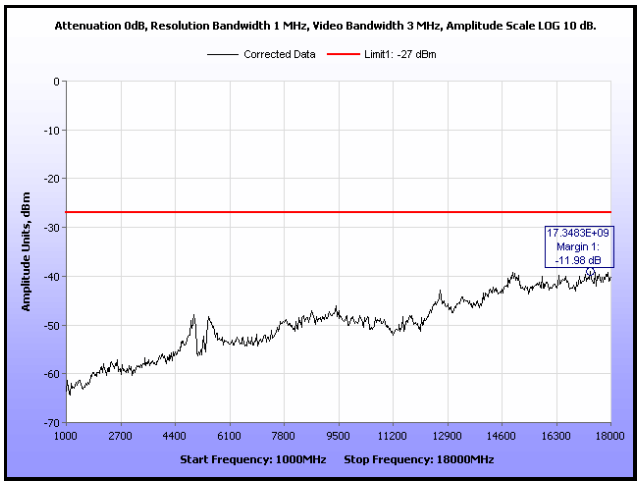


Plot 73. Radiated Spurious Emissions, 802.11a 20 MHz, 5700 MHz, 1 GHz – 18 GHz, 19 dBi Antenna

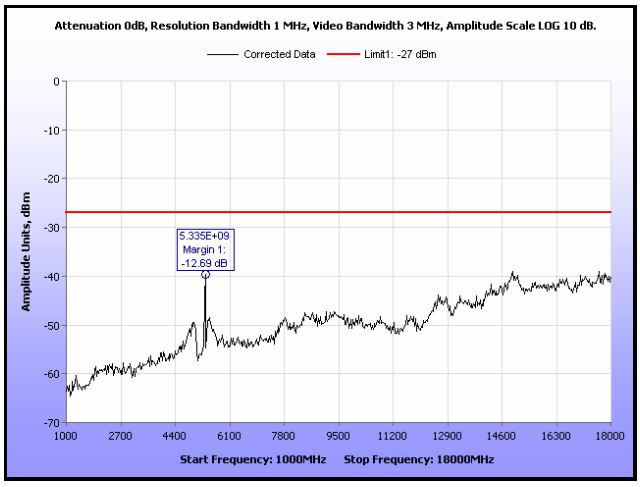
Radiated Spurious Emissions, 802.11n 20 MHz, 19 dBi Antenna



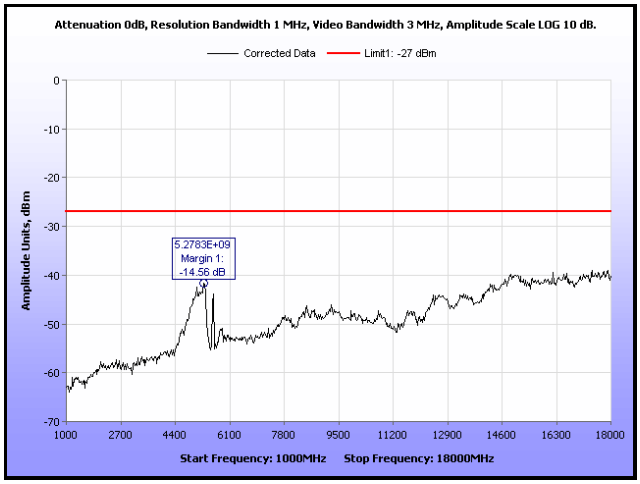
Plot 74. Radiated Spurious Emissions, 802.11n 20 MHz, 5260 MHz, 1 GHz – 18 GHz, 19 dBi Antenna



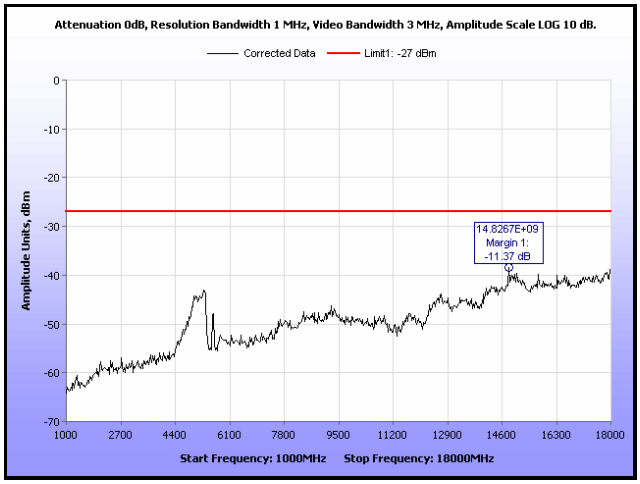
Plot 75. Radiated Spurious Emissions, 802.11n 20 MHz, 5280 MHz, 1 GHz – 18 GHz, 19 dBi Antenna



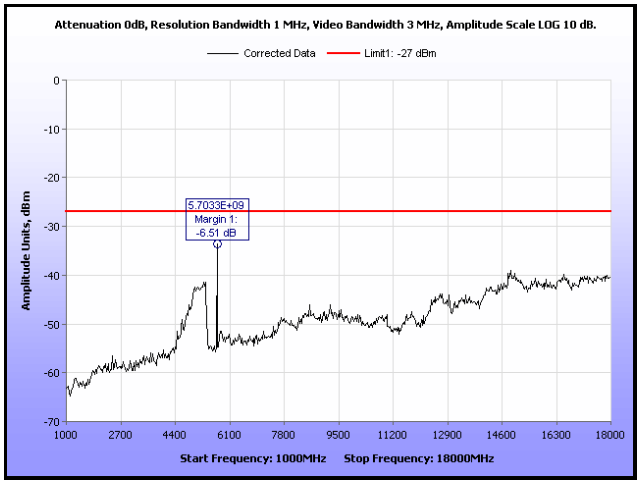
Plot 76. Radiated Spurious Emissions, 802.11n 20 MHz, 5320 MHz, 1 GHz – 18 GHz, 19 dBi Antenna



Plot 77. Radiated Spurious Emissions, 802.11n 20 MHz, 5500 MHz, 1 GHz – 18 GHz, 19 dBi Antenna

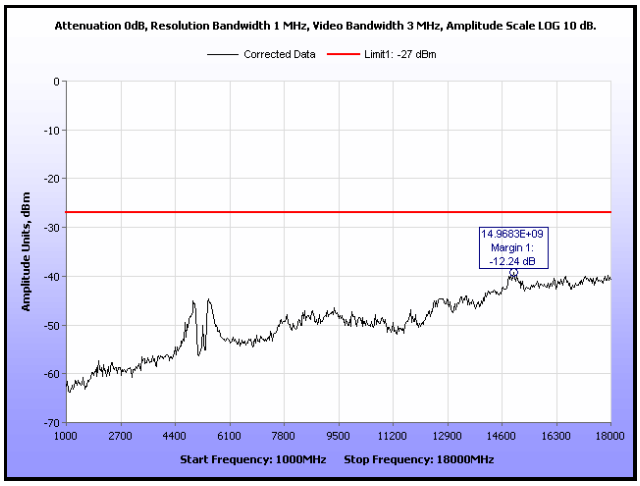


Plot 78. Radiated Spurious Emissions, 802.11n 20 MHz, 5580 MHz, 1 GHz – 18 GHz, 19 dBi Antenna

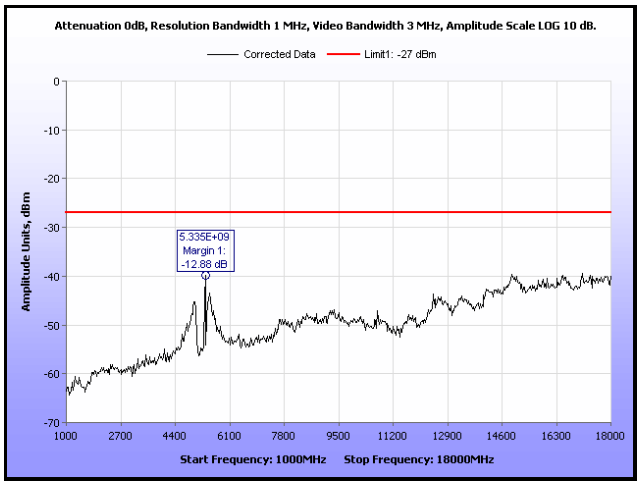


Plot 79. Radiated Spurious Emissions, 802.11n 20 MHz, 5700 MHz, 1 GHz – 18 GHz, 19 dBi Antenna

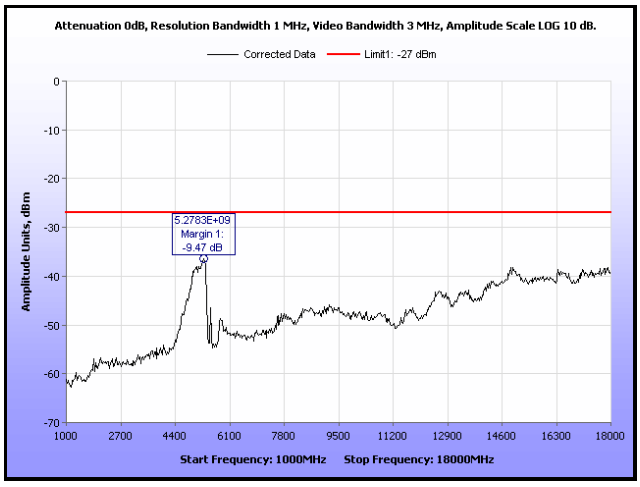
Radiated Spurious Emissions, 802.11n 40 MHz, 19 dBi Antenna



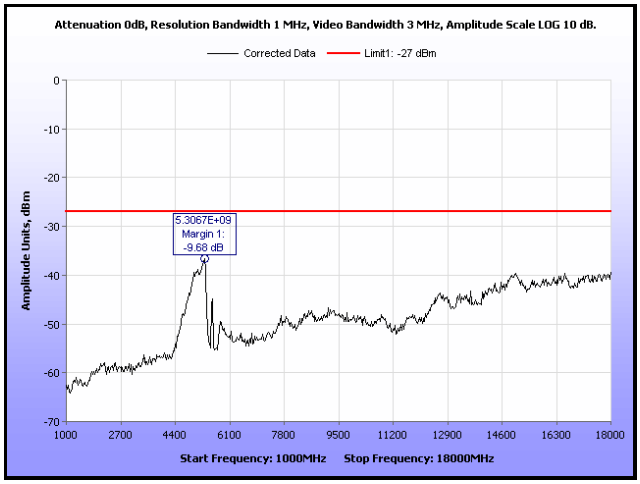
Plot 80. Radiated Spurious Emissions, 802.11n 40 MHz, 5270 MHz, 1 GHz – 18 GHz, 19 dBi Antenna



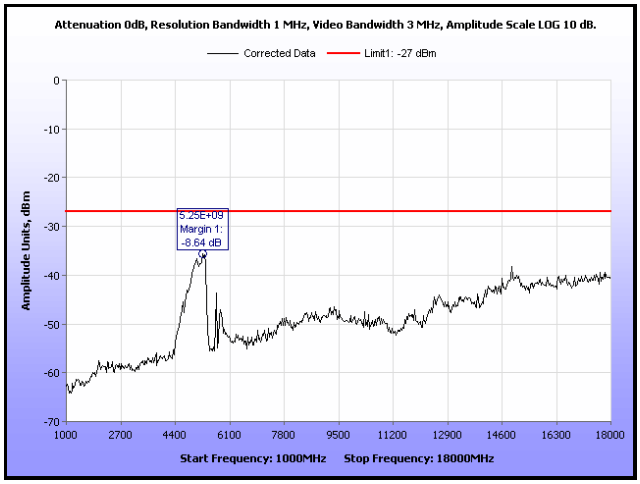
Plot 81. Radiated Spurious Emissions, 802.11n 40 MHz, 5310 MHz, 1 GHz – 18 GHz, 19 dBi Antenna



Plot 82. Radiated Spurious Emissions, 802.11n 40 MHz, 5510 MHz, 1 GHz – 18 GHz, 19 dBi Antenna

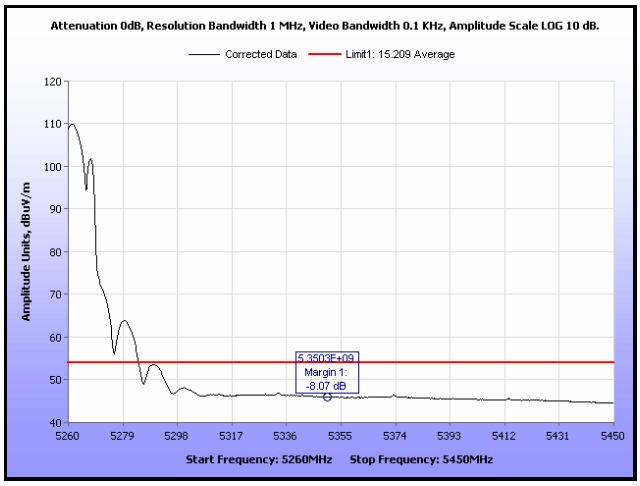


Plot 83. Radiated Spurious Emissions, 802.11n 40 MHz, 5550 MHz, 1 GHz – 18 GHz, 19 dBi Antenna

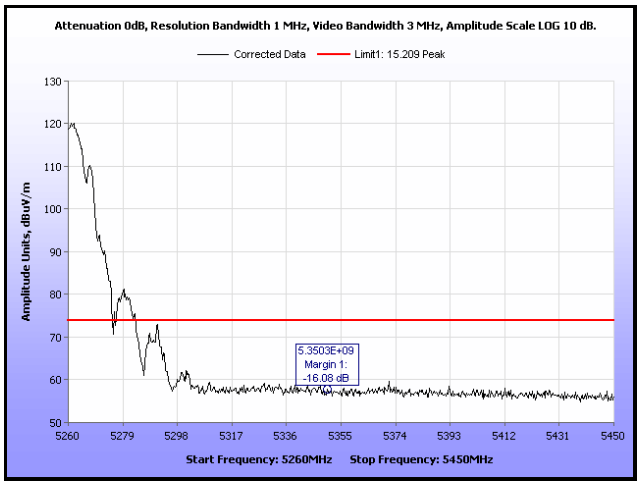


Plot 84. Radiated Spurious Emissions, 802.11n 40 MHz, 5670 MHz, 1 GHz – 18 GHz, 19 dBi Antenna

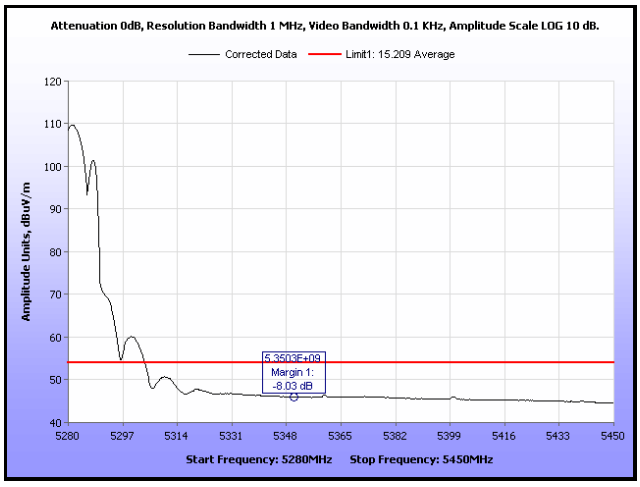
Restricted Band Edge, 802.11a 20 MHz, 9 dBi Antenna



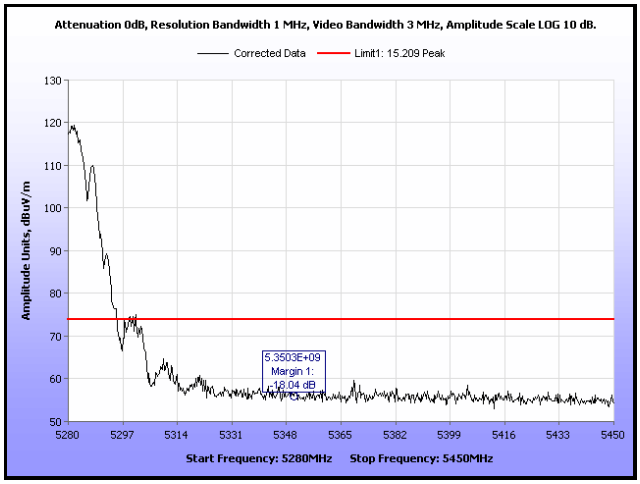
Plot 85. Restricted Band Edge, 802.11a 20 MHz, 5260 MHz, Average, 9 dBi Antenna



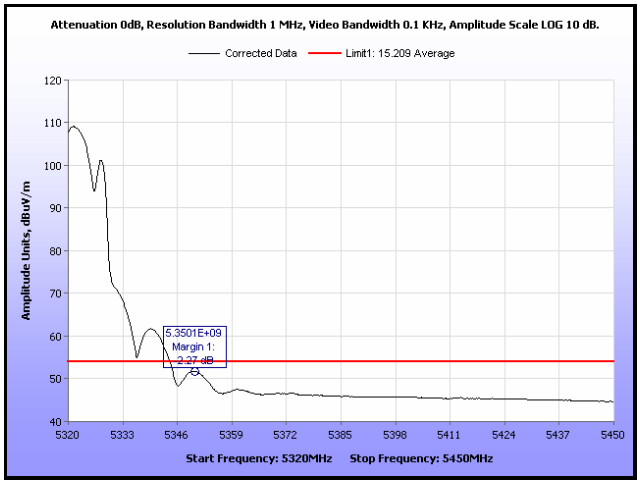
Plot 86. Restricted Band Edge, 802.11a 20 MHz, 5260 MHz, Peak, 9 dBi Antenna



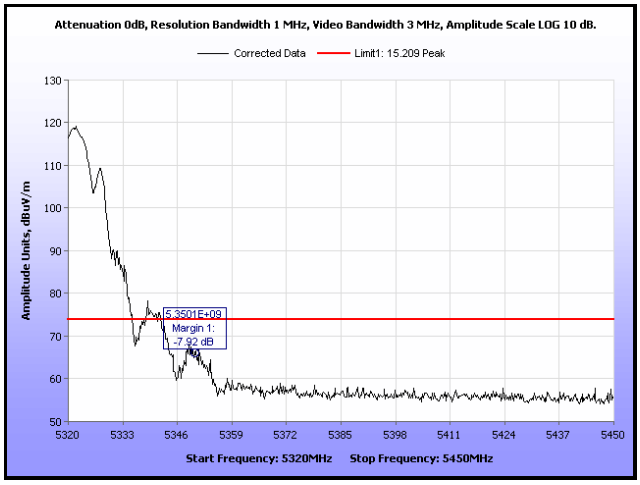
Plot 87. Restricted Band Edge, 802.11a 20 MHz, 5280 MHz, Average, 9 dBi Antenna



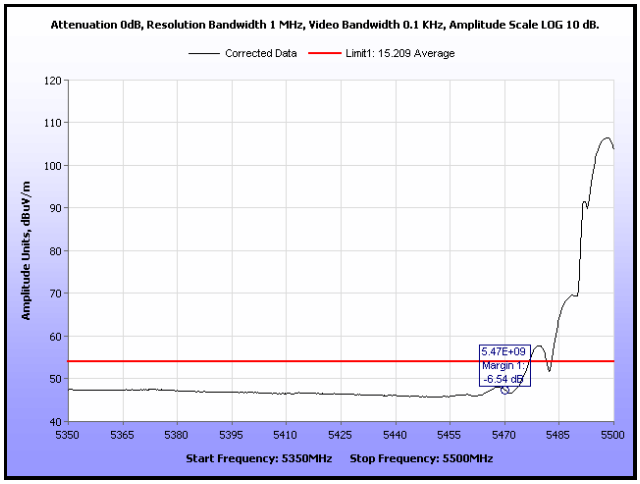
Plot 88. Restricted Band Edge, 802.11a 20 MHz, 5280 MHz, Peak, 9 dBi Antenna



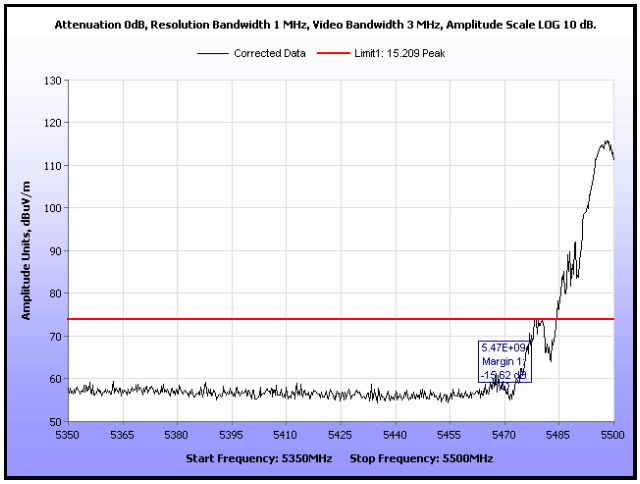
Plot 89. Restricted Band Edge, 802.11a 20 MHz, 5320 MHz, Average, 9 dBi Antenna



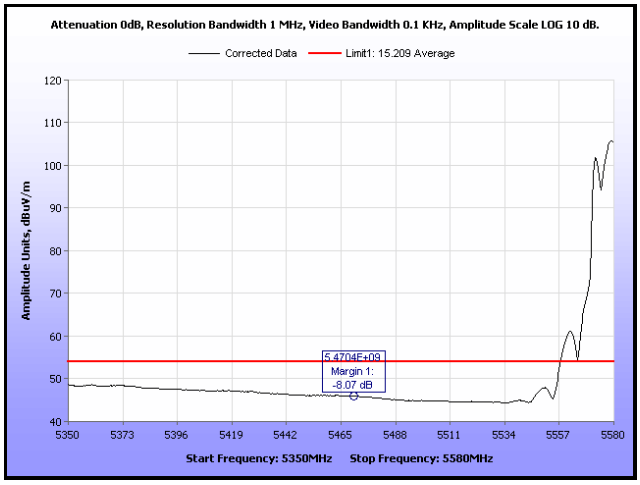
Plot 90. Restricted Band Edge, 802.11a 20 MHz, 5320 MHz, Peak, 9 dBi Antenna



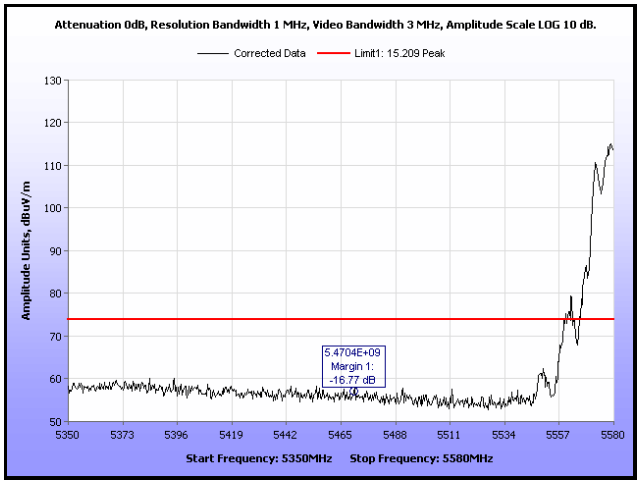
Plot 91. Restricted Band Edge, 802.11a 20 MHz, 5500 MHz, Average, 9 dBi Antenna



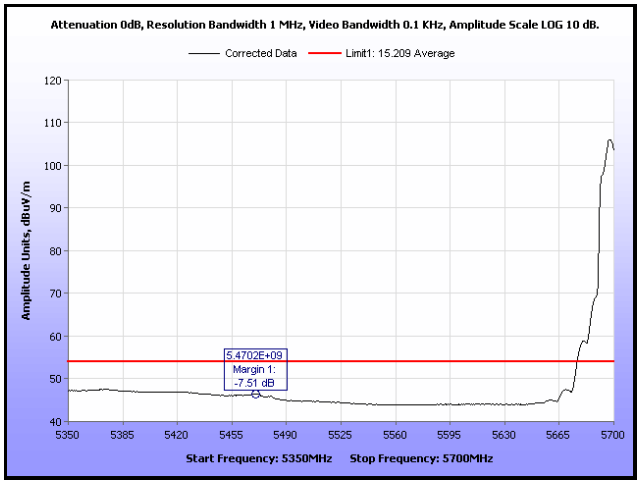
Plot 92. Restricted Band Edge, 802.11a 20 MHz, 5500 MHz, Peak, 9 dBi Antenna



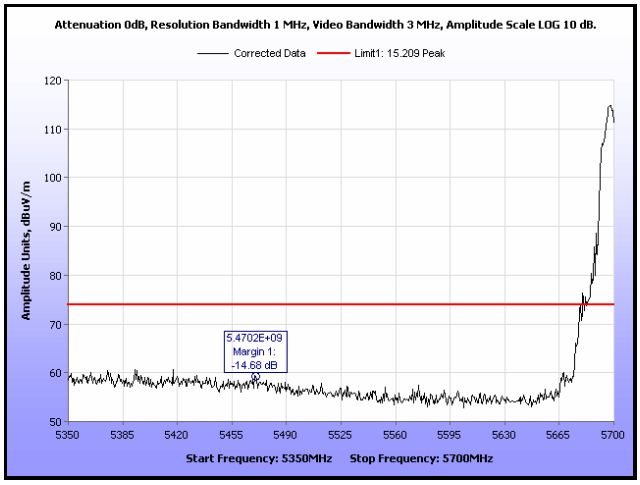
Plot 93. Restricted Band Edge, 802.11a 20 MHz, 5580 MHz, Average, 9 dBi Antenna



Plot 94. Restricted Band Edge, 802.11a 20 MHz, 5580 MHz, Peak, 9 dBi Antenna

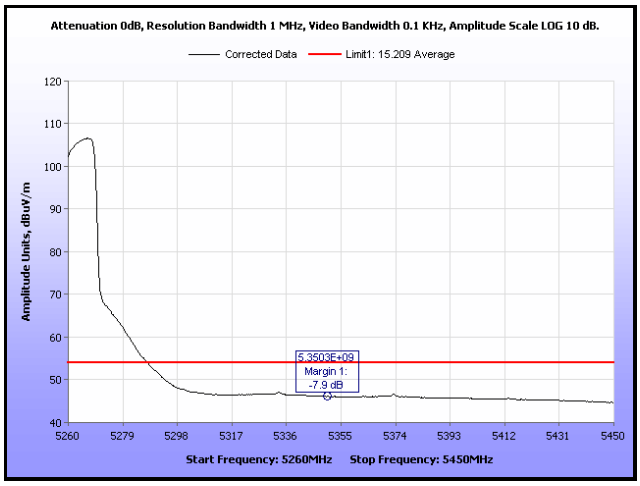


Plot 95. Restricted Band Edge, 802.11a 20 MHz, 5700 MHz, Average, 9 dBi Antenna

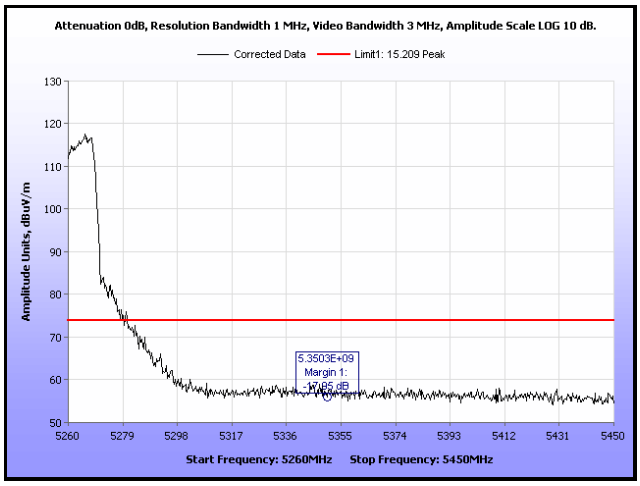


Plot 96. Restricted Band Edge, 802.11a 20 MHz, 5700 MHz, Peak, 9 dBi Antenna

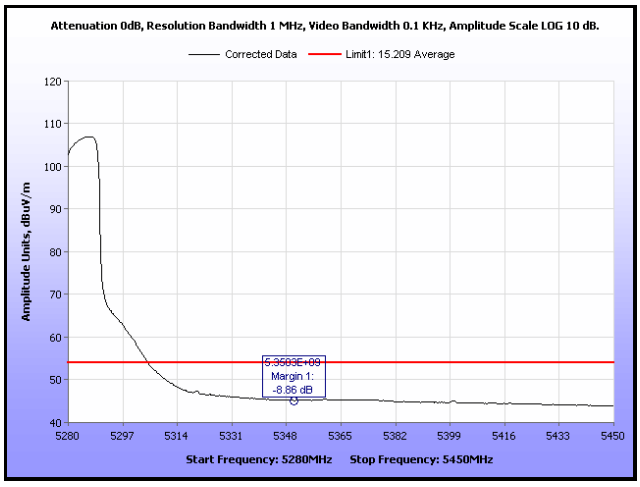
Restricted Band Edge, 802.11n 20 MHz, 9 dBi Antenna



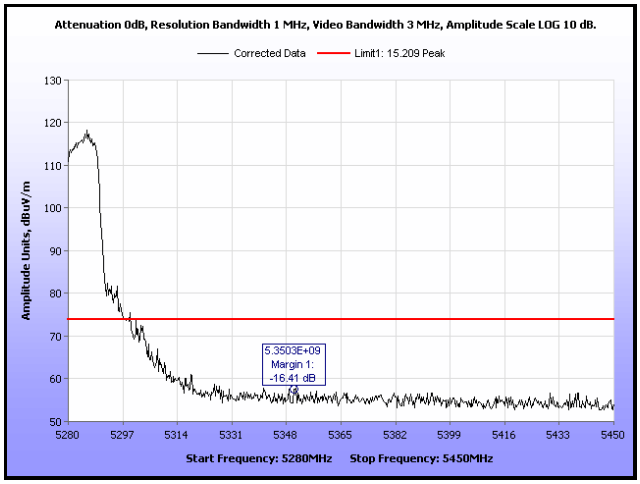
Plot 97. Restricted Band Edge, 802.11n 20 MHz, 5260 MHz, Average, 9 dBi Antenna



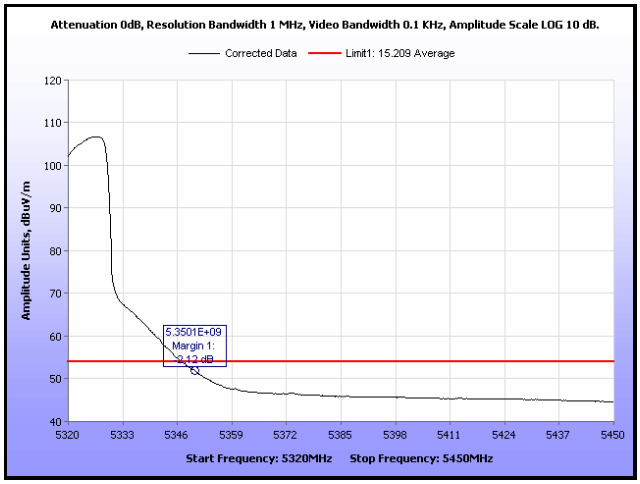
Plot 98. Restricted Band Edge, 802.11n 20 MHz, 5260 MHz, Peak, 9 dBi Antenna



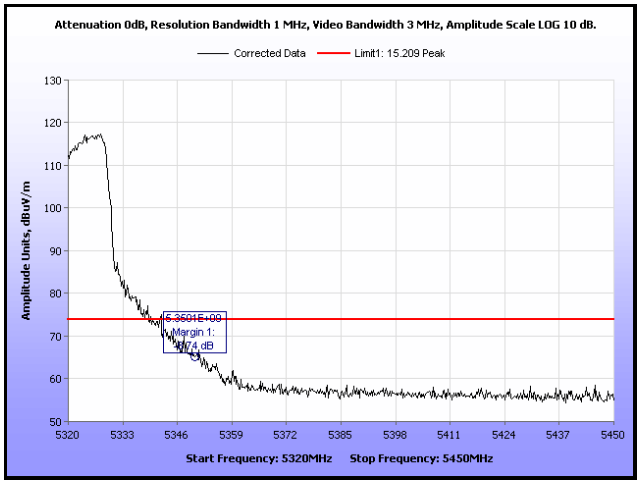
Plot 99. Restricted Band Edge, 802.11n 20 MHz, 5280 MHz, Average, 9 dBi Antenna



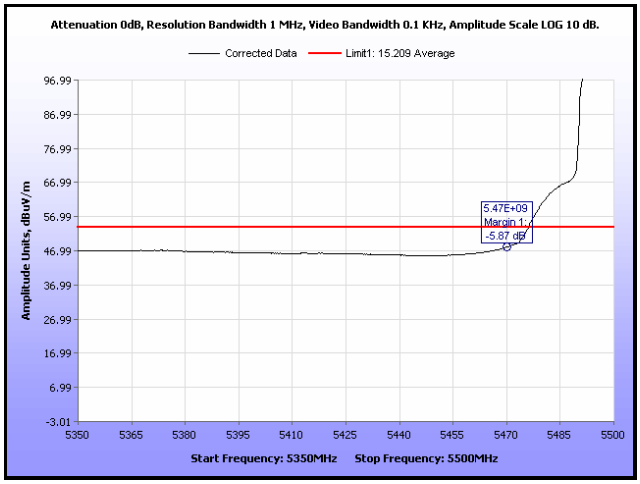
Plot 100. Restricted Band Edge, 802.11n 20 MHz, 5280 MHz, Peak, 9 dBi Antenna



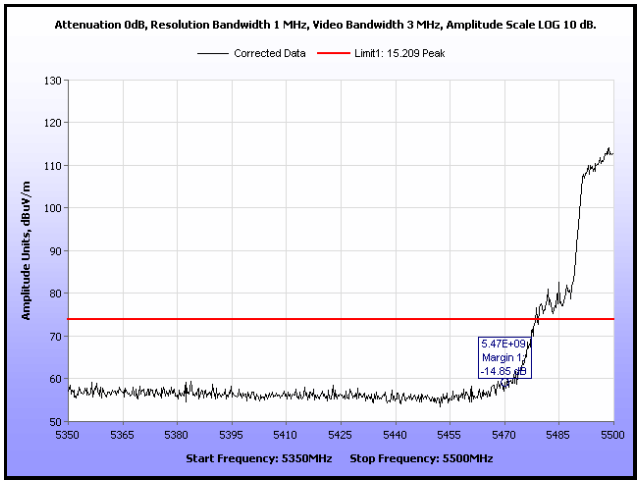
Plot 101. Restricted Band Edge, 802.11n 20 MHz, 5320 MHz, Average, 9 dBi Antenna



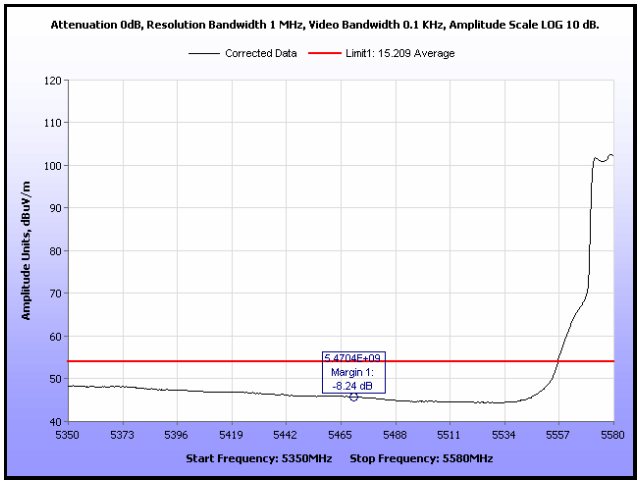
Plot 102. Restricted Band Edge, 802.11n 20 MHz, 5320 MHz, Peak, 9 dBi Antenna



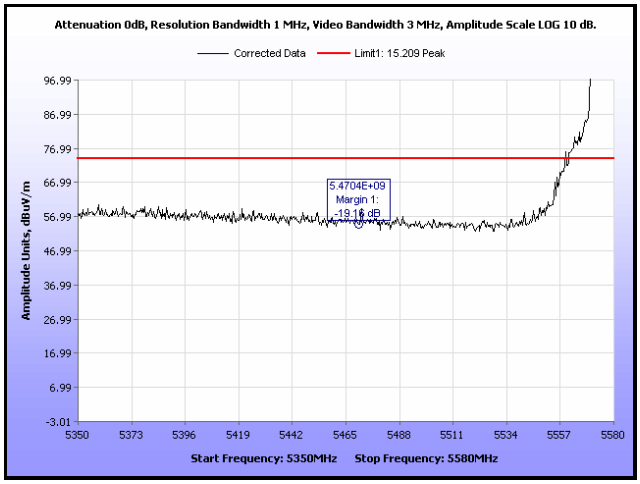
Plot 103. Restricted Band Edge, 802.11n 20 MHz, 5500 MHz, Average, 9 dBi Antenna



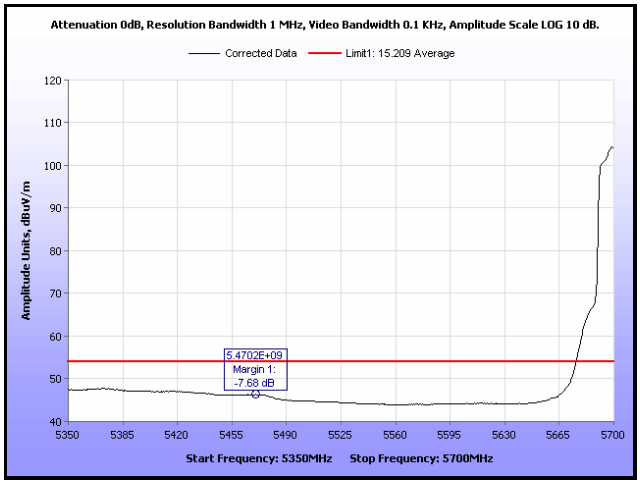
Plot 104. Restricted Band Edge, 802.11n 20 MHz, 5500 MHz, Peak, 9 dBi Antenna



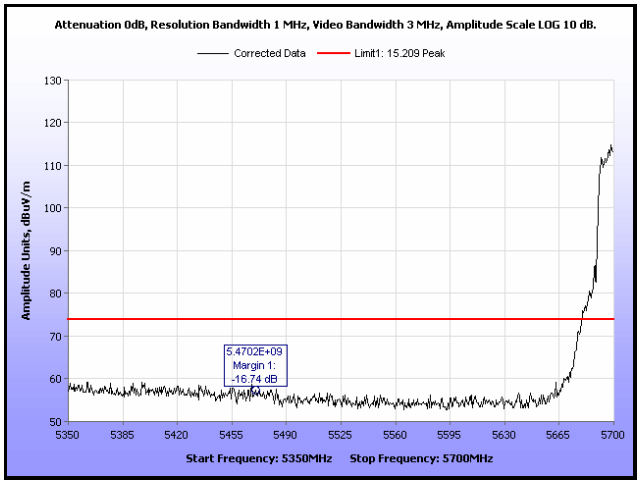
Plot 105. Restricted Band Edge, 802.11n 20 MHz, 5580 MHz, Average, 9 dBi Antenna



Plot 106. Restricted Band Edge, 802.11n 20 MHz, 5580 MHz, Peak, 9 dBi Antenna

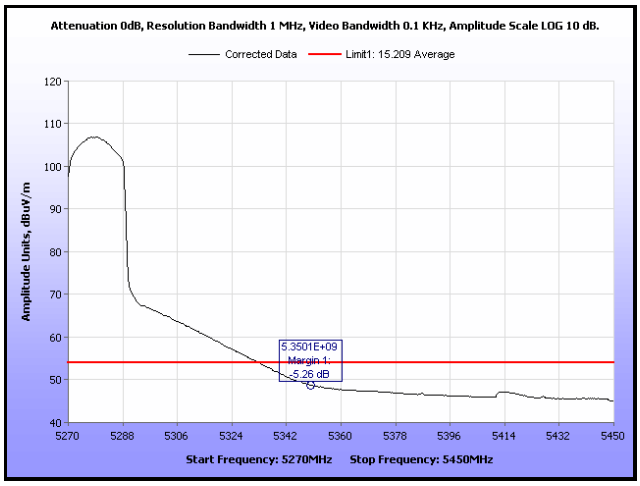


Plot 107. Restricted Band Edge, 802.11n 20 MHz, 5700 MHz, Average, 9 dBi Antenna

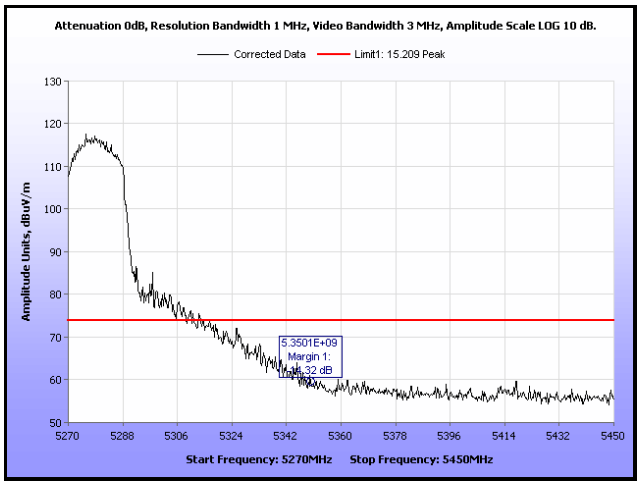


Plot 108. Restricted Band Edge, 802.11n 20 MHz, 5700 MHz, Peak, 9 dBi Antenna

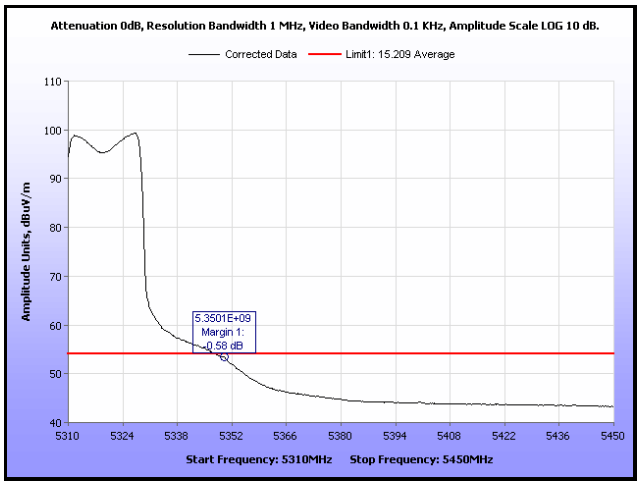
Restricted Band Edge, 802.11n 40 MHz, 9 dBi Antenna



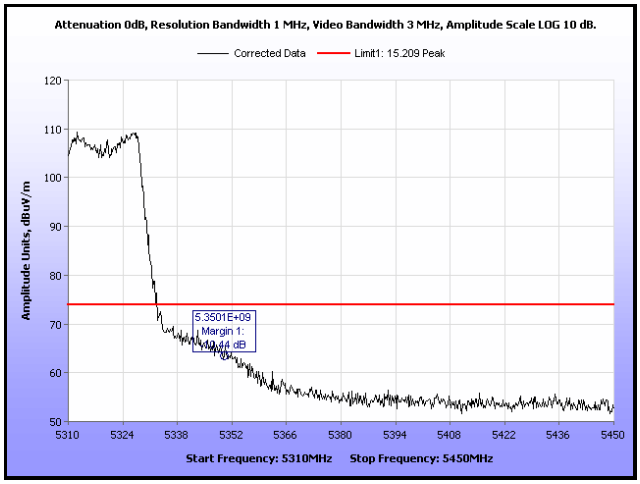
Plot 109. Restricted Band Edge, 802.11n 40 MHz, 5270 MHz, Average, 9 dBi Antenna



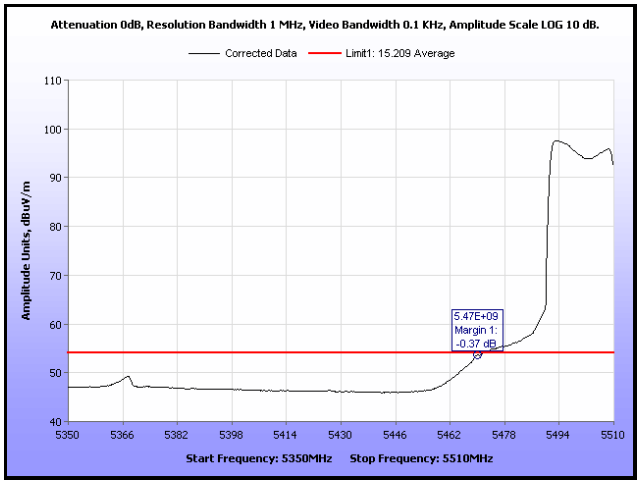
Plot 110. Restricted Band Edge, 802.11n 40 MHz, 5270 MHz, Peak, 9 dBi Antenna



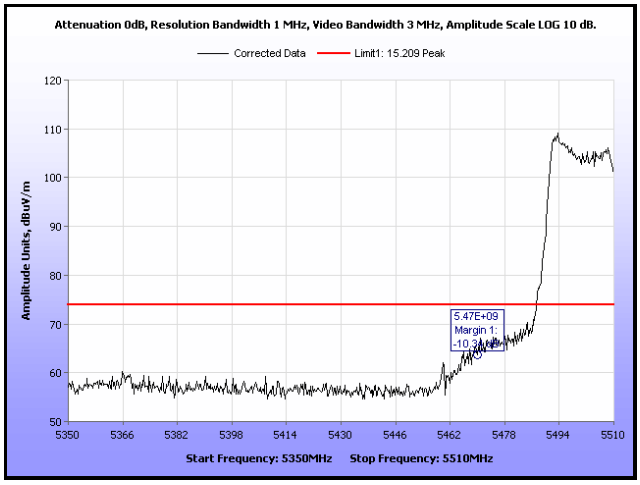
Plot 111. Restricted Band Edge, 802.11n 40 MHz, 5310 MHz, Average, 9 dBi Antenna



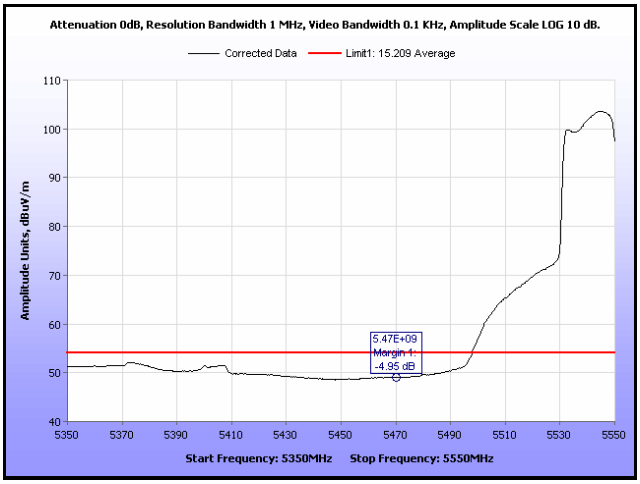
Plot 112. Restricted Band Edge, 802.11n 40 MHz, 5310 MHz, Peak, 9 dBi Antenna



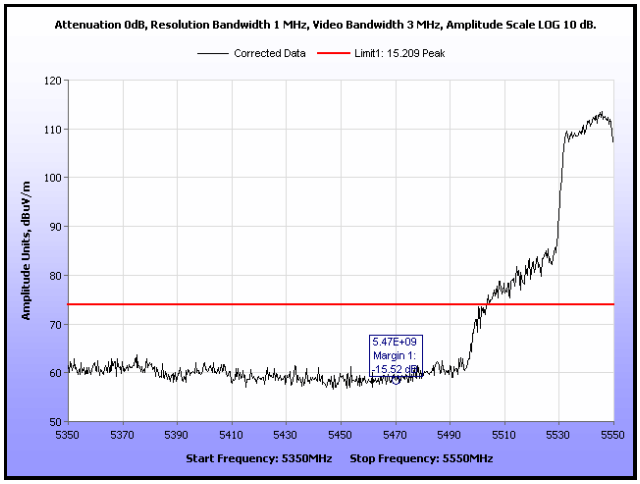
Plot 113. Restricted Band Edge, 802.11n 40 MHz, 5510 MHz, Average, 9 dBi Antenna



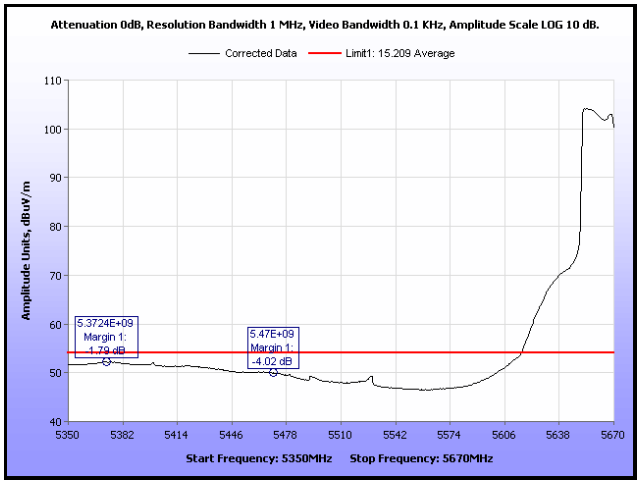
Plot 114. Restricted Band Edge, 802.11n 40 MHz, 5510 MHz, Peak, 9 dBi Antenna



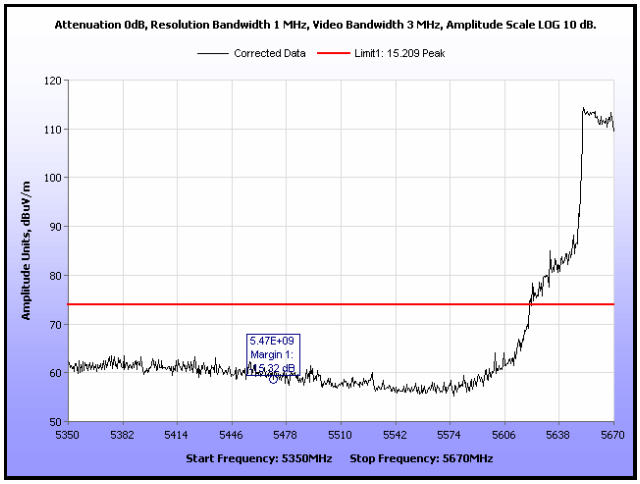
Plot 115. Restricted Band Edge, 802.11n 40 MHz, 5550 MHz, Average, 9 dBi Antenna



Plot 116. Restricted Band Edge, 802.11n 40 MHz, 5550 MHz, Peak, 9 dBi Antenna

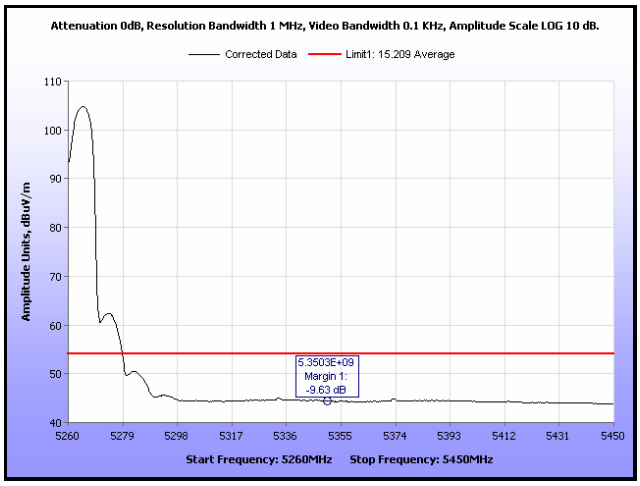


Plot 117. Restricted Band Edge, 802.11n 40 MHz, 5670 MHz, Average, 9 dBi Antenna

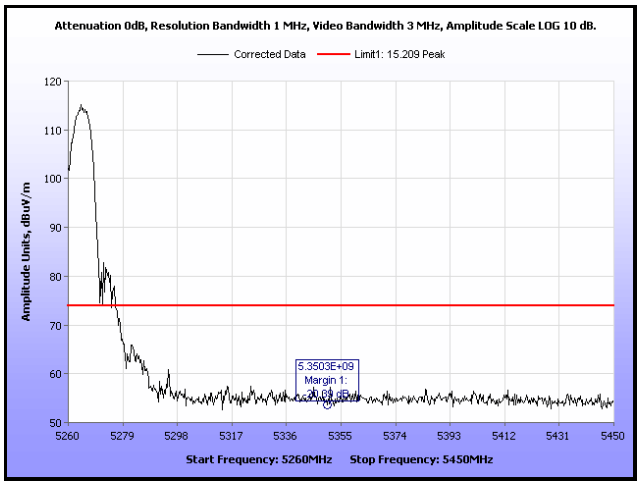


Plot 118. Restricted Band Edge, 802.11n 40 MHz, 5670 MHz, Peak, 9 dBi Antenna

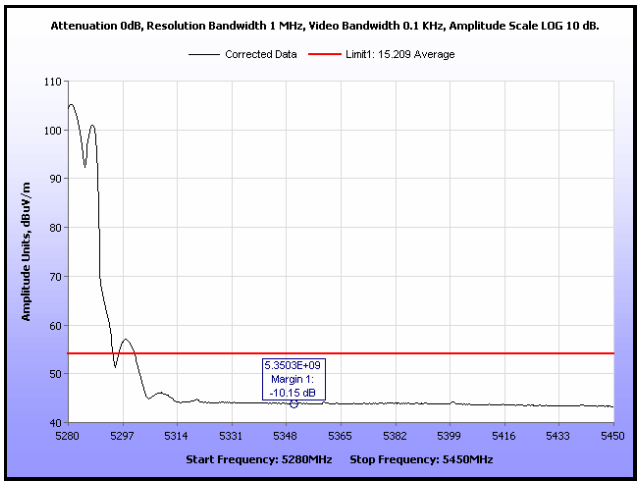
Restricted Band Edge, 802.11a 20 MHz, 16 dBi Antenna



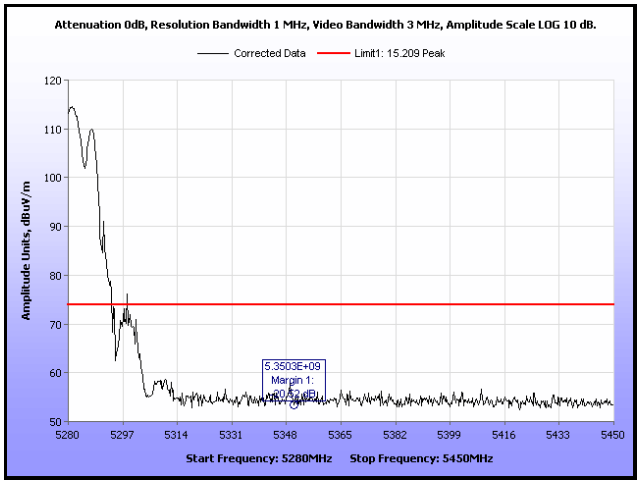
Plot 119. Restricted Band Edge, 802.11a 20 MHz, 5260 MHz, Average, 16 dBi Antenna



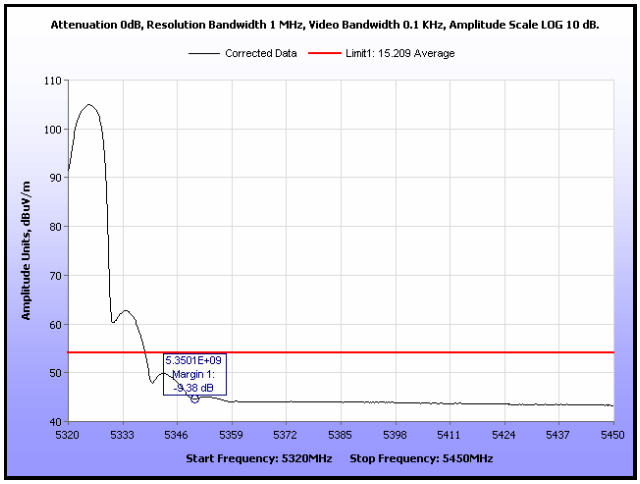
Plot 120. Restricted Band Edge, 802.11a 20 MHz, 5260 MHz, Peak, 16 dBi Antenna



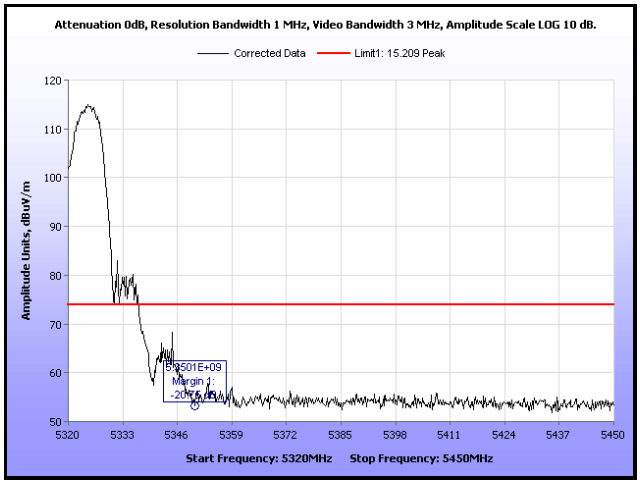
Plot 121. Restricted Band Edge, 802.11a 20 MHz, 5280 MHz, Average, 16 dBi Antenna



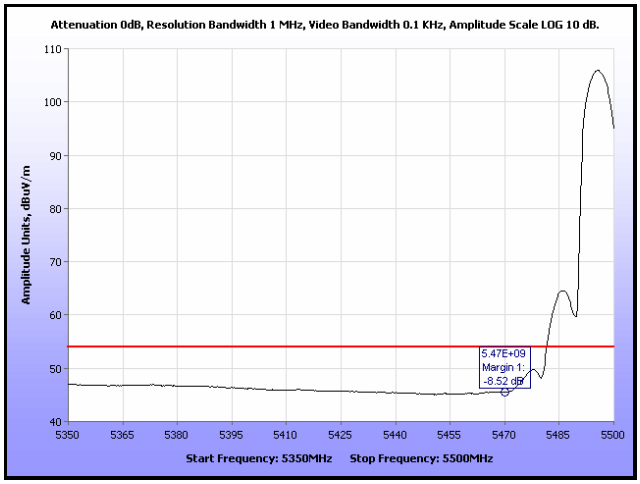
Plot 122. Restricted Band Edge, 802.11a 20 MHz, 5280 MHz, Peak, 16 dBi Antenna



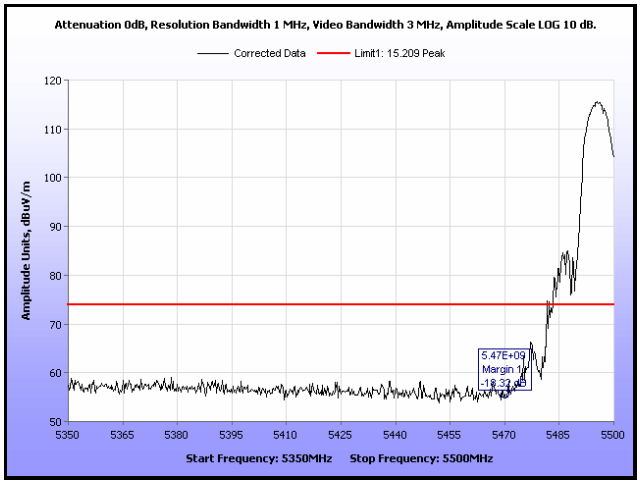
Plot 123. Restricted Band Edge, 802.11a 20 MHz, 5320 MHz, Average, 16 dBi Antenna



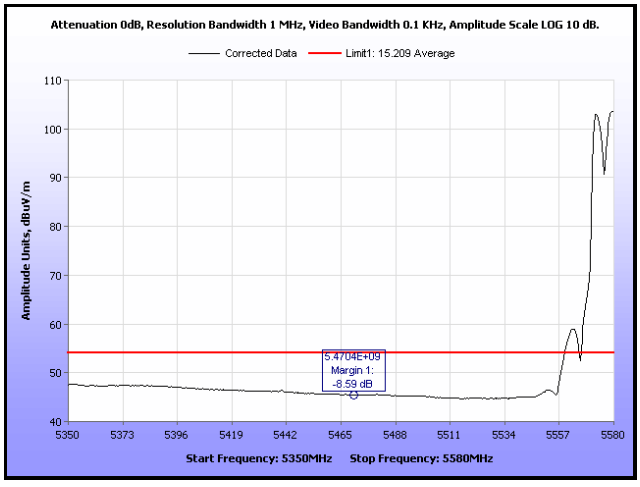
Plot 124. Restricted Band Edge, 802.11a 20 MHz, 5320 MHz, Peak, 16 dBi Antenna



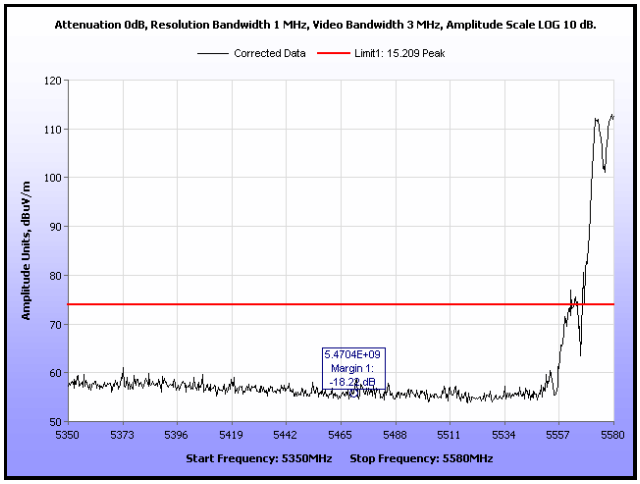
Plot 125. Restricted Band Edge, 802.11a 20 MHz, 5500 MHz, Average, 16 dBi Antenna



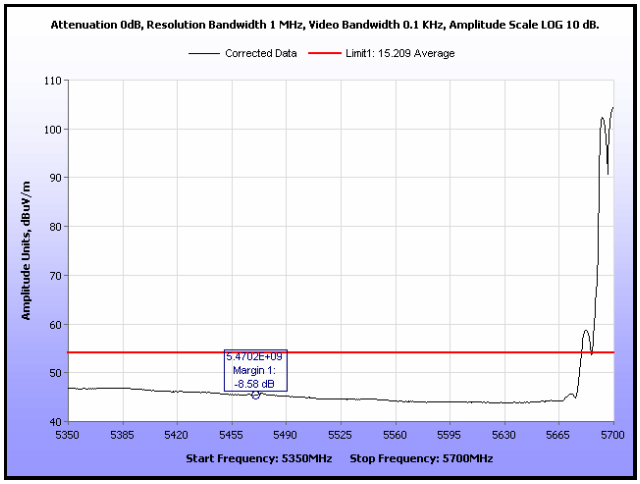
Plot 126. Restricted Band Edge, 802.11a 20 MHz, 5500 MHz, Peak, 16 dBi Antenna



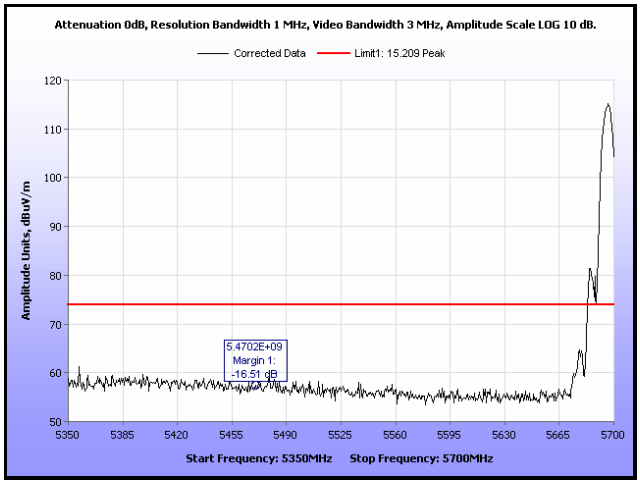
Plot 127. Restricted Band Edge, 802.11a 20 MHz, 5580 MHz, Average, 16 dBi Antenna



Plot 128. Restricted Band Edge, 802.11a 20 MHz, 5580 MHz, Peak, 16 dBi Antenna

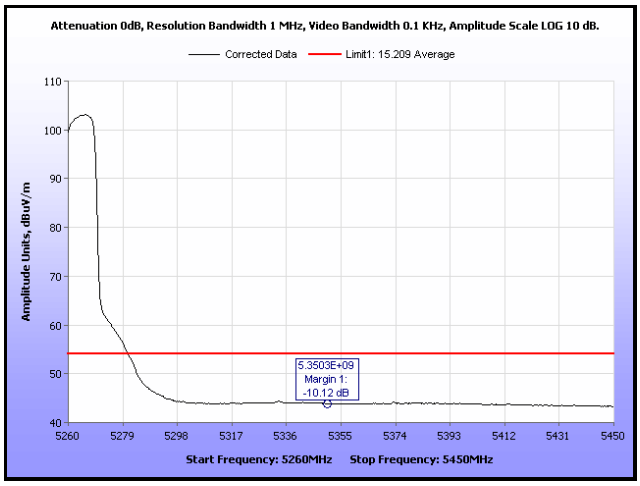


Plot 129. Restricted Band Edge, 802.11a 20 MHz, 5700 MHz, Average, 16 dBi Antenna

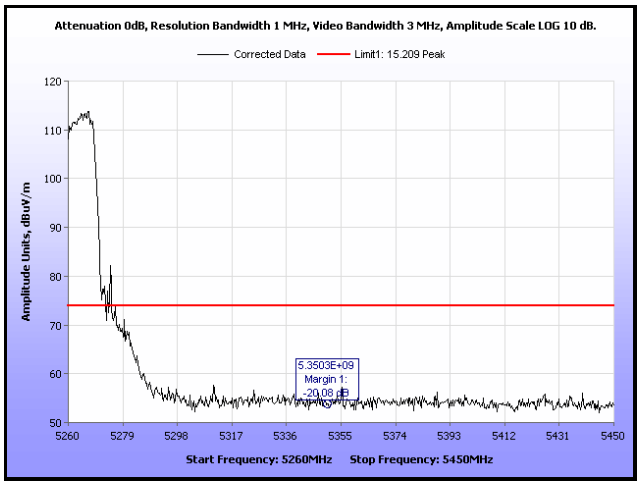


Plot 130. Restricted Band Edge, 802.11a 20 MHz, 5700 MHz, Peak, 16 dBi Antenna

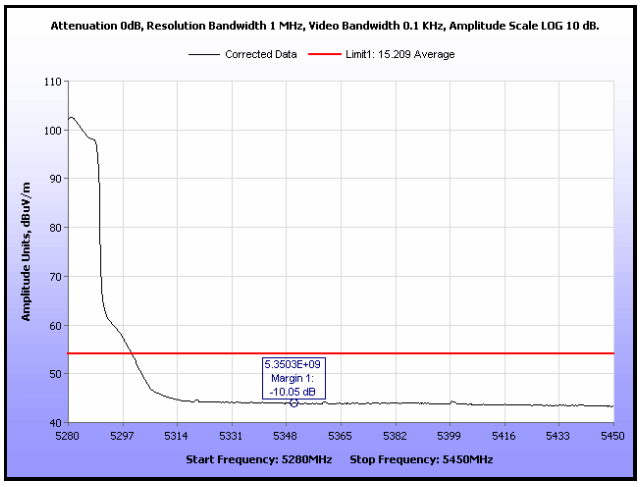
Restricted Band Edge, 802.11n 20 MHz, 16 dBi Antenna



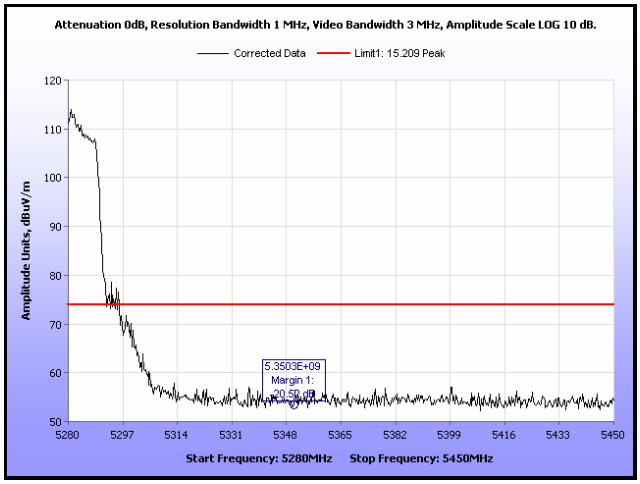
Plot 131. Restricted Band Edge, 802.11n 20 MHz, 5260 MHz, Average, 16 dBi Antenna



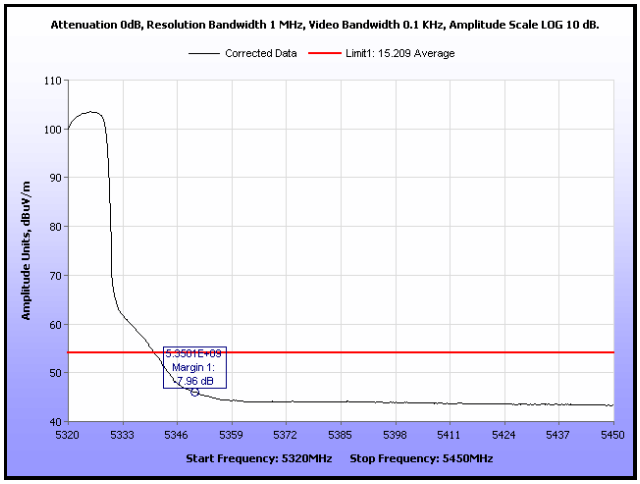
Plot 132. Restricted Band Edge, 802.11n 20 MHz, 5260 MHz, Peak, 16 dBi Antenna



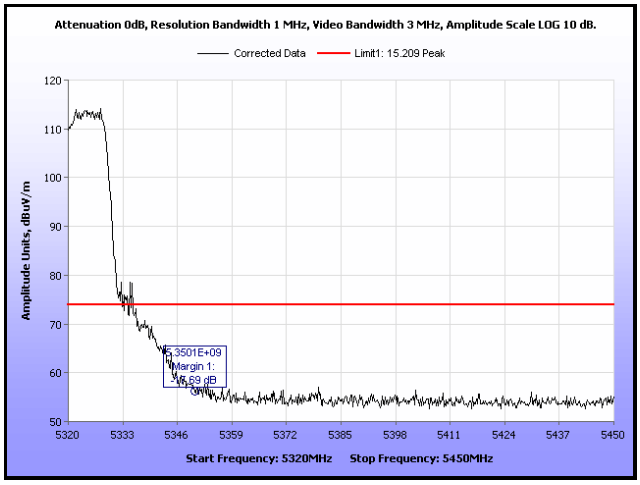
Plot 133. Restricted Band Edge, 802.11n 20 MHz, 5280 MHz, Average, 16 dBi Antenna



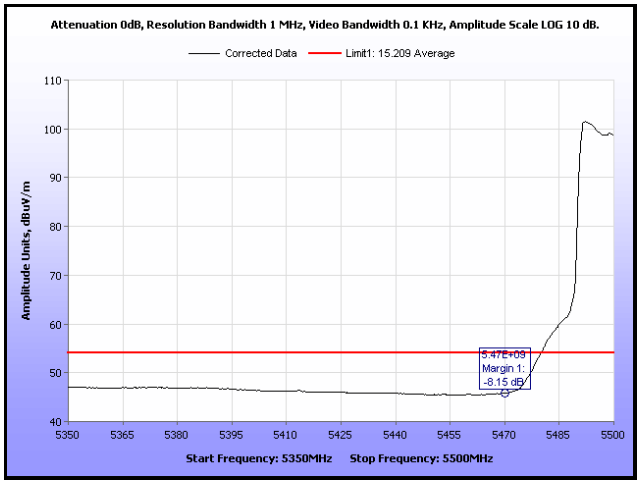
Plot 134. Restricted Band Edge, 802.11n 20 MHz, 5280 MHz, Peak, 16 dBi Antenna



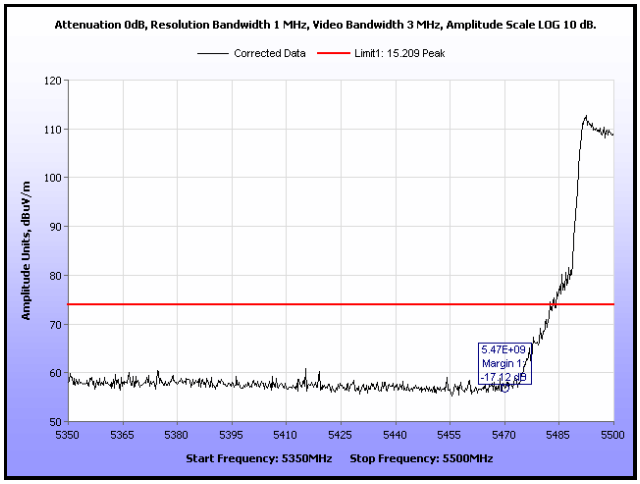
Plot 135. Restricted Band Edge, 802.11n 20 MHz, 5320 MHz, Average, 16 dBi Antenna



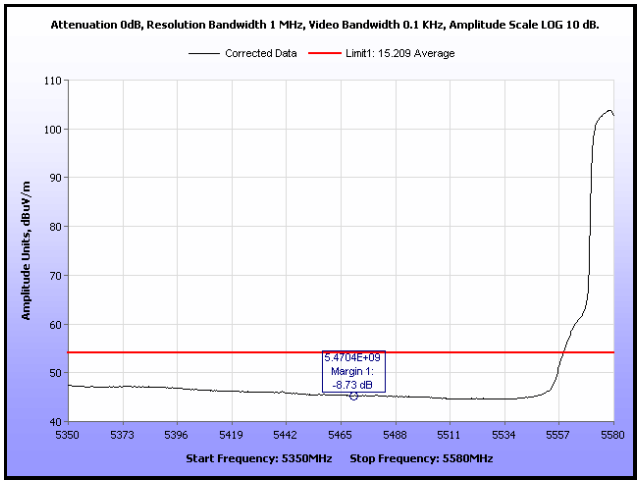
Plot 136. Restricted Band Edge, 802.11n 20 MHz, 5320 MHz, Peak, 16 dBi Antenna



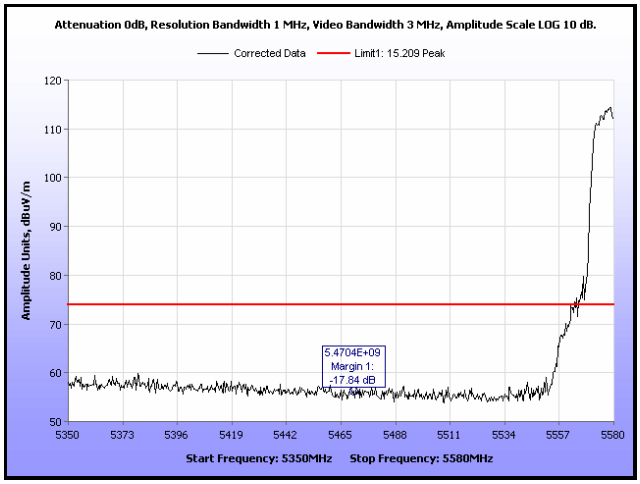
Plot 137. Restricted Band Edge, 802.11n 20 MHz, 5500 MHz, Average, 16 dBi Antenna



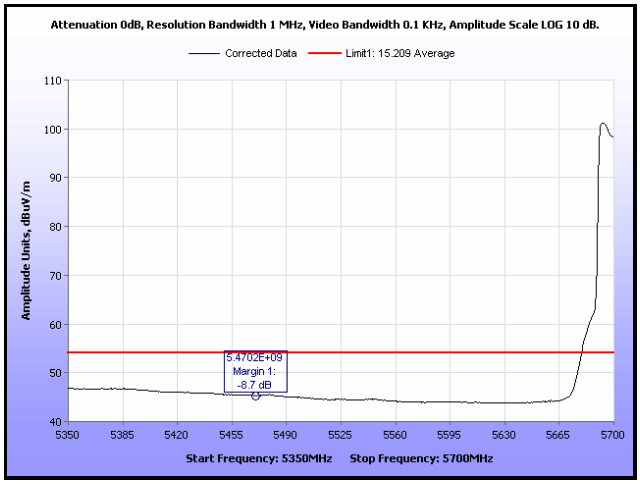
Plot 138. Restricted Band Edge, 802.11n 20 MHz, 5500 MHz, Peak, 16 dBi Antenna



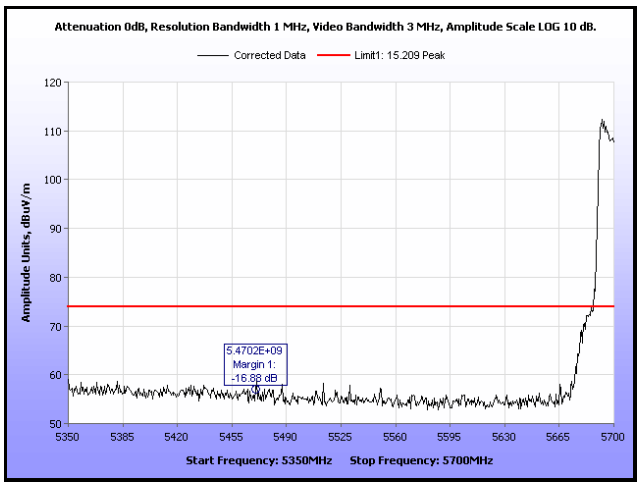
Plot 139. Restricted Band Edge, 802.11n 20 MHz, 5580 MHz, Average, 16 dBi Antenna



Plot 140. Restricted Band Edge, 802.11n 20 MHz, 5580 MHz, Peak, 16 dBi Antenna

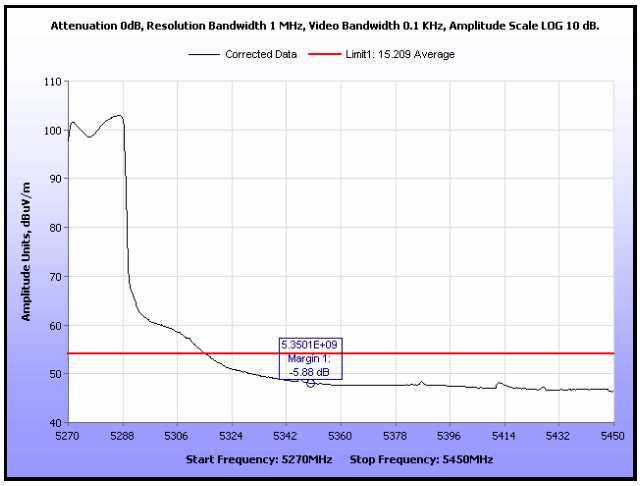


Plot 141. Restricted Band Edge, 802.11n 20 MHz, 5700 MHz, Average, 16 dBi Antenna

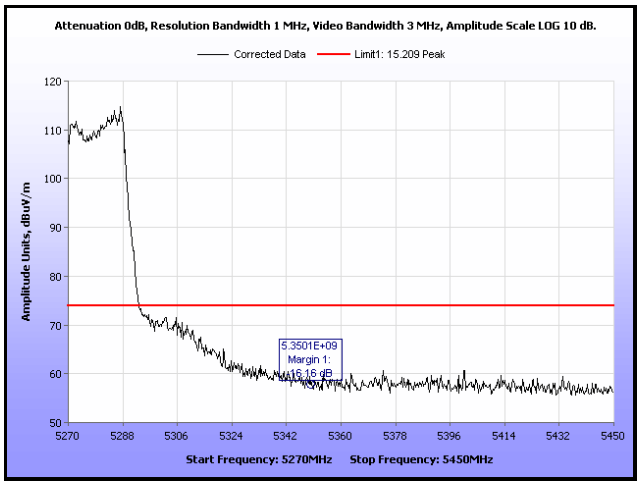


Plot 142. Restricted Band Edge, 802.11n 20 MHz, 5700 MHz, Peak, 16 dBi Antenna

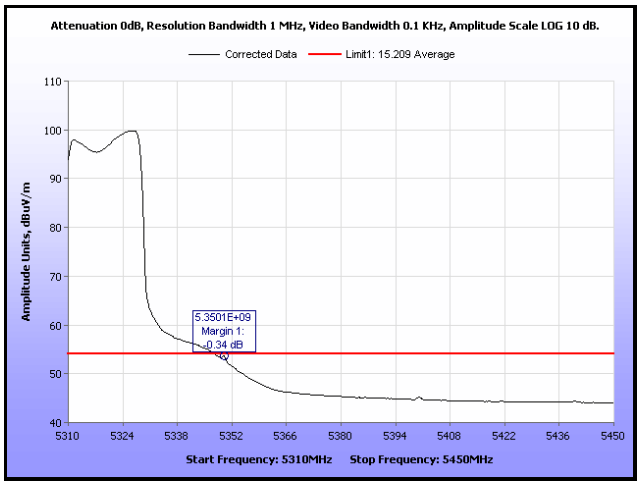
Restricted Band Edge, 802.11n 40 MHz, 16 dBi Antenna



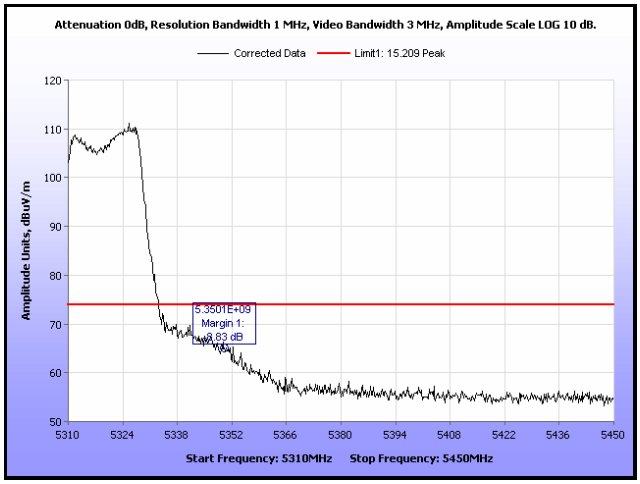
Plot 143. Restricted Band Edge, 802.11n 40 MHz, 5270 MHz, Average, 16 dBi Antenna



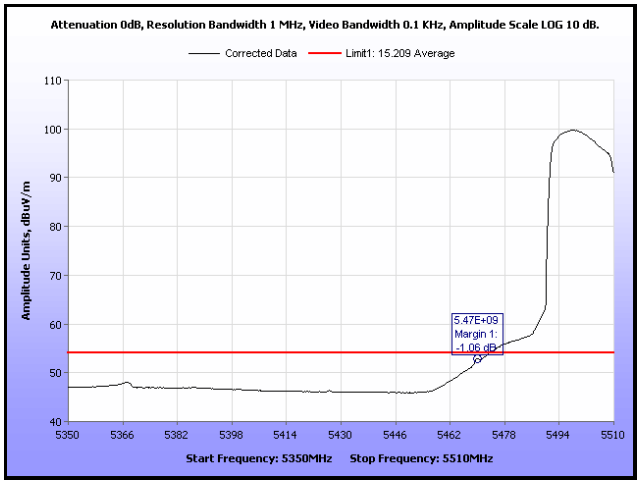
Plot 144. Restricted Band Edge, 802.11n 40 MHz, 5270 MHz, Peak, 16 dBi Antenna



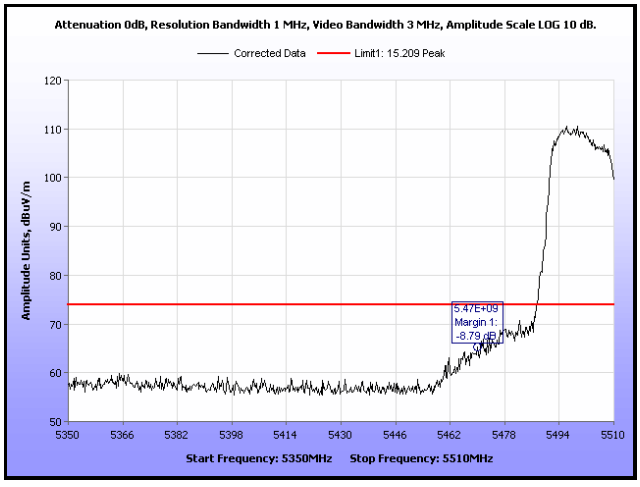
Plot 145. Restricted Band Edge, 802.11n 40 MHz, 5310 MHz, Average, 16 dBi Antenna



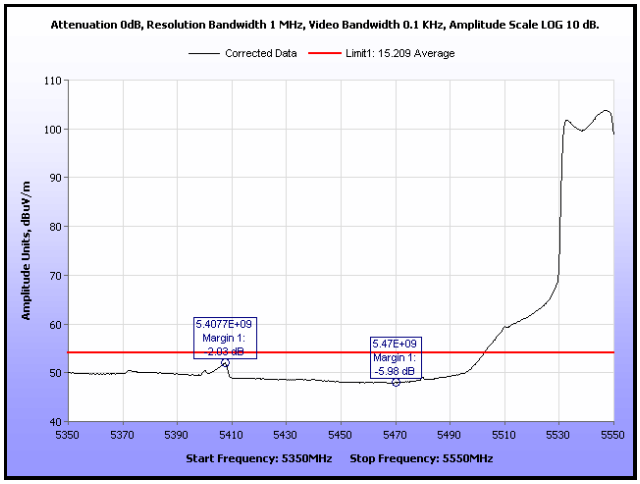
Plot 146. Restricted Band Edge, 802.11n 40 MHz, 5310 MHz, Peak, 16 dBi Antenna



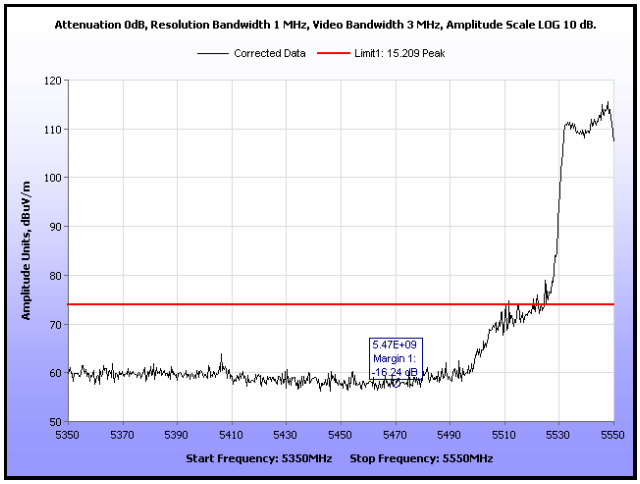
Plot 147. Restricted Band Edge, 802.11n 40 MHz, 5510 MHz, Average, 16 dBi Antenna



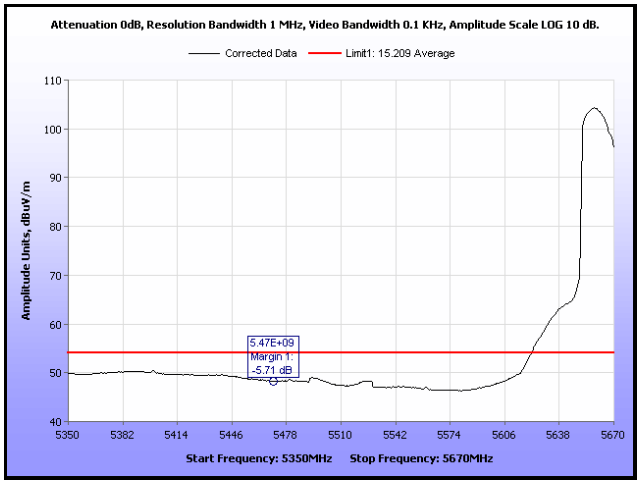
Plot 148. Restricted Band Edge, 802.11n 40 MHz, 5510 MHz, Peak, 16 dBi Antenna



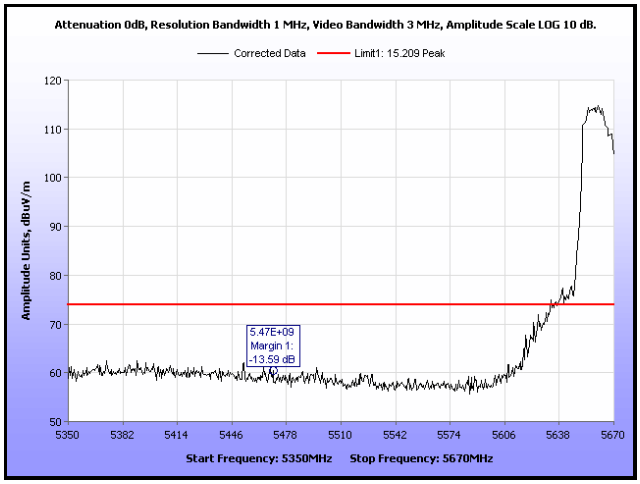
Plot 149. Restricted Band Edge, 802.11n 40 MHz, 5550 MHz, Average, 16 dBi Antenna



Plot 150. Restricted Band Edge, 802.11n 40 MHz, 5550 MHz, Peak, 16 dBi Antenna

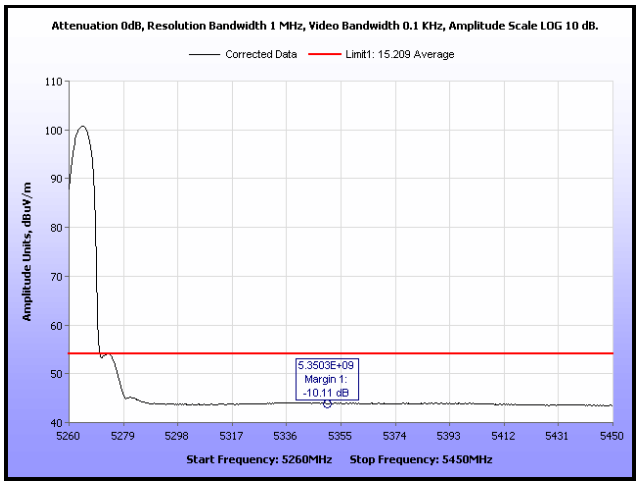


Plot 151. Restricted Band Edge, 802.11n 40 MHz, 5670 MHz, Average, 16 dBi Antenna

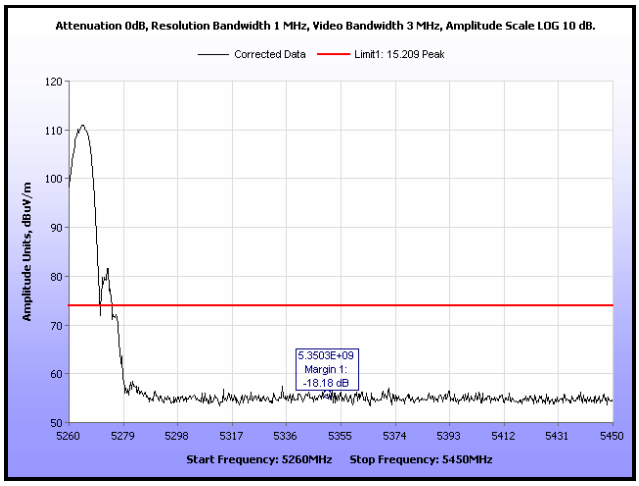


Plot 152. Restricted Band Edge, 802.11n 40 MHz, 5670 MHz, Peak, 16 dBi Antenna

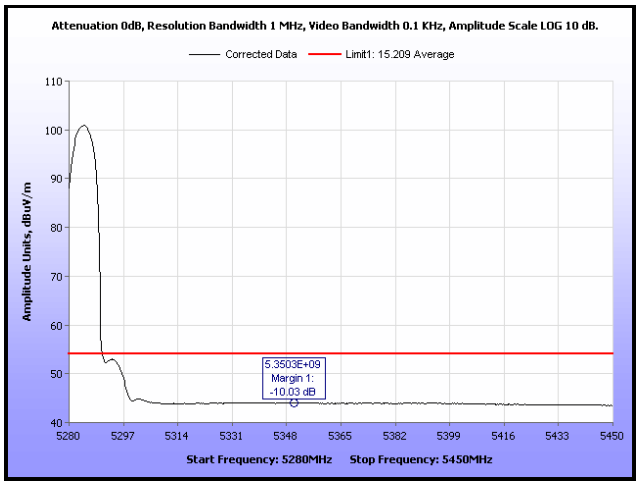
Restricted Band Edge, 802.11a 20 MHz, 19 dBi Antenna



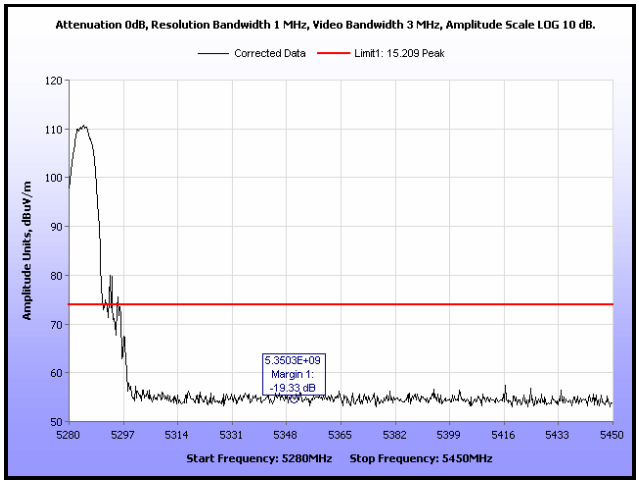
Plot 153. Restricted Band Edge, 802.11a 20 MHz, 5260 MHz, Average, 19 dBi Antenna



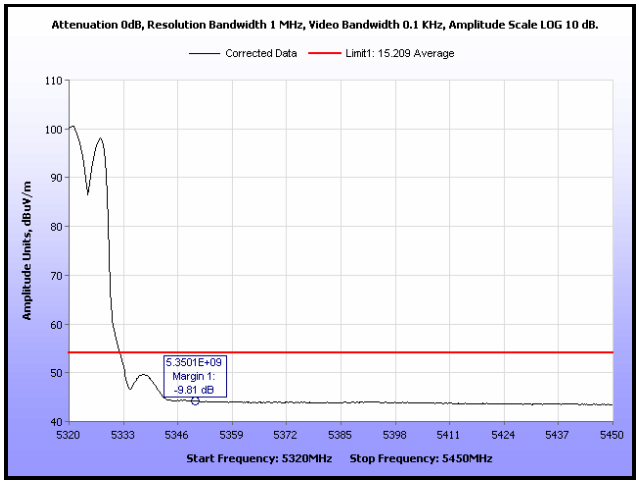
Plot 154. Restricted Band Edge, 802.11a 20 MHz, 5260 MHz, Peak, 19 dBi Antenna



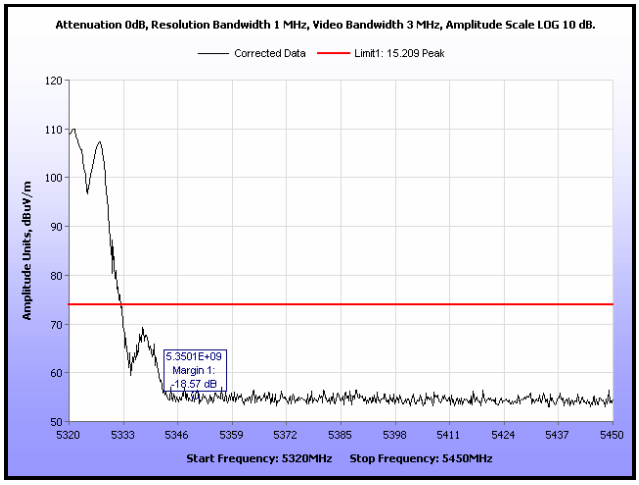
Plot 155. Restricted Band Edge, 802.11a 20 MHz, 5280 MHz, Average, 19 dBi Antenna



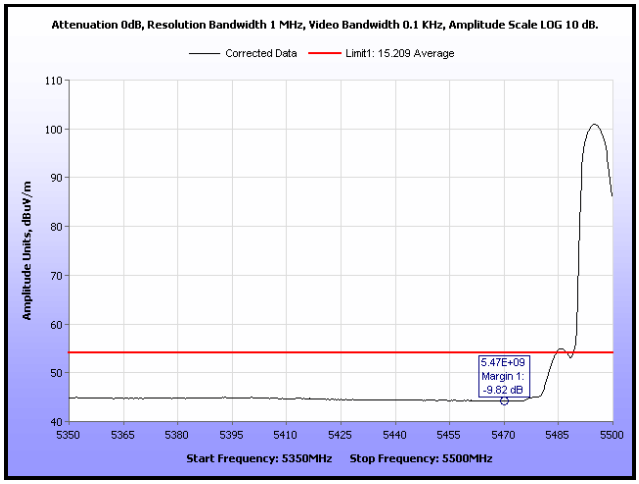
Plot 156. Restricted Band Edge, 802.11a 20 MHz, 5280 MHz, Peak, 19 dBi Antenna



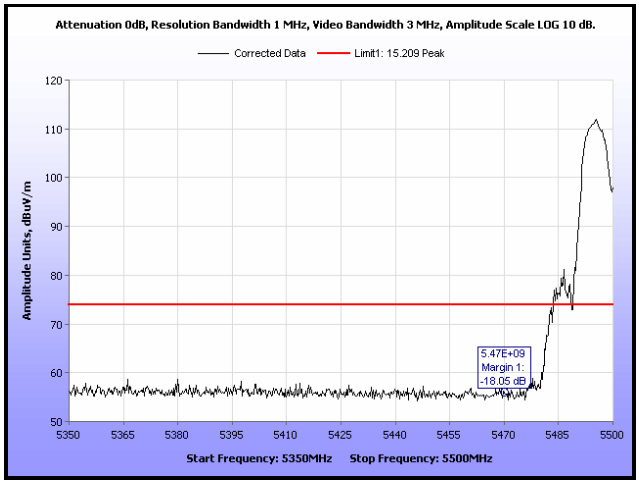
Plot 157. Restricted Band Edge, 802.11a 20 MHz, 5320 MHz, Average, 19 dBi Antenna



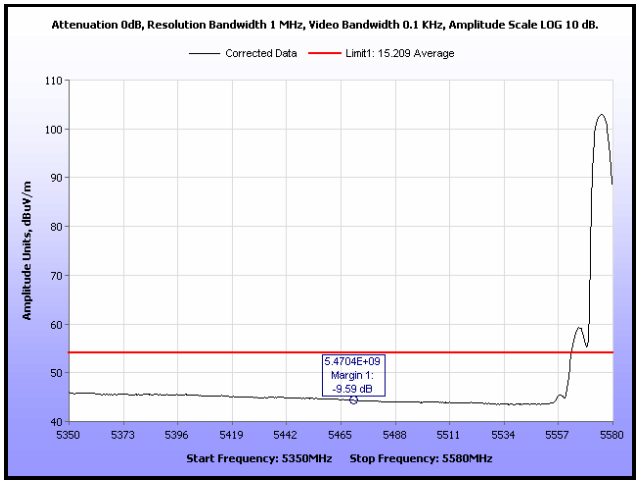
Plot 158. Restricted Band Edge, 802.11a 20 MHz, 5320 MHz, Peak, 19 dBi Antenna



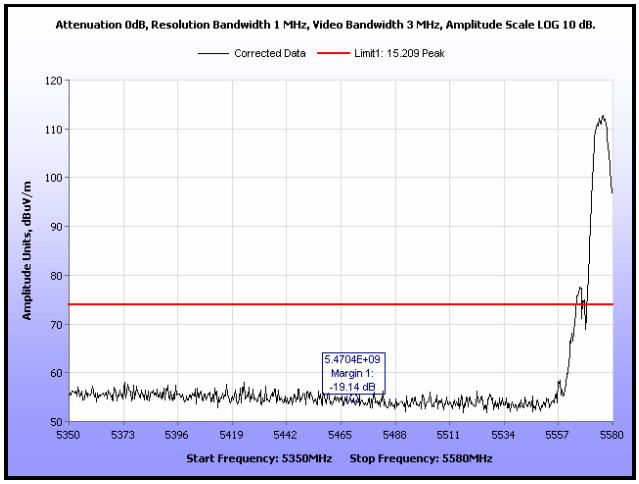
Plot 159. Restricted Band Edge, 802.11a 20 MHz, 5500 MHz, Average, 19 dBi Antenna



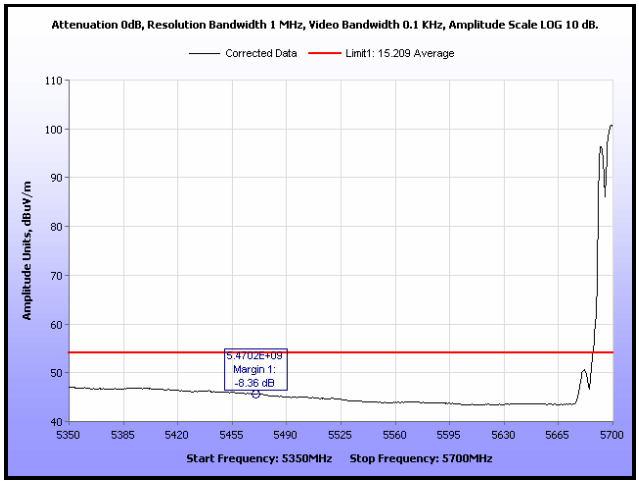
Plot 160. Restricted Band Edge, 802.11a 20 MHz, 5500 MHz, Peak, 19 dBi Antenna



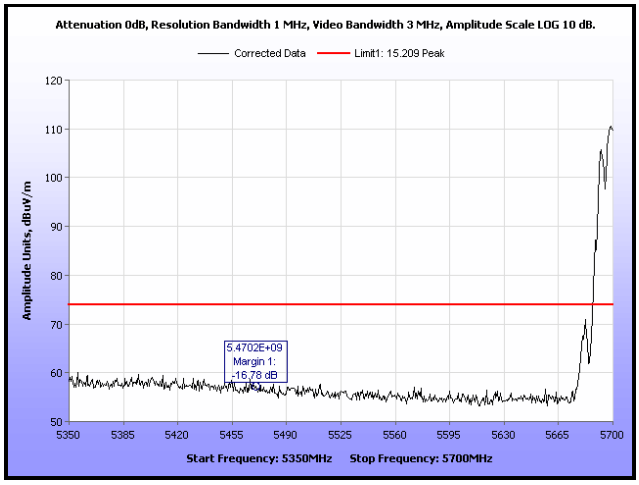
Plot 161. Restricted Band Edge, 802.11a 20 MHz, 5580 MHz, Average, 19 dBi Antenna



Plot 162. Restricted Band Edge, 802.11a 20 MHz, 5580 MHz, Peak, 19 dBi Antenna

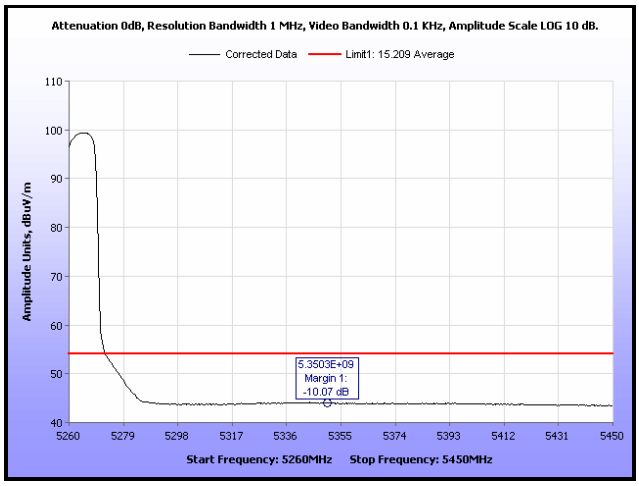


Plot 163. Restricted Band Edge, 802.11a 20 MHz, 5700 MHz, Average, 19 dBi Antenna

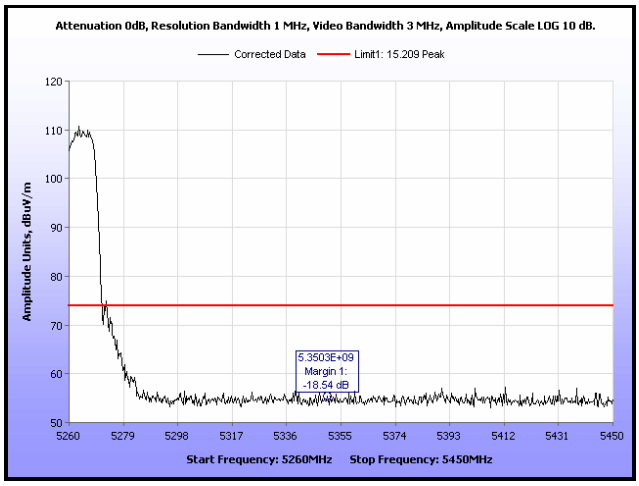


Plot 164. Restricted Band Edge, 802.11a 20 MHz, 5700 MHz, Peak, 19 dBi Antenna

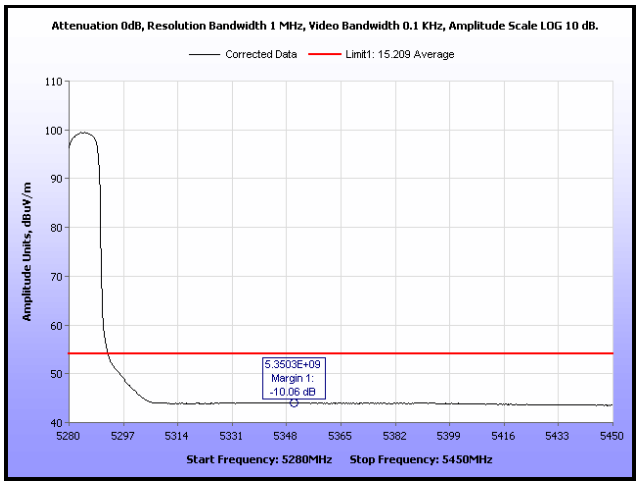
Restricted Band Edge, 802.11n 20 MHz, 19 dBi Antenna



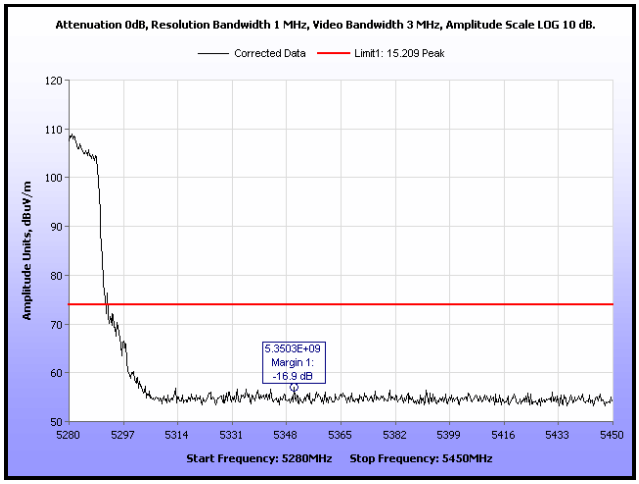
Plot 165. Restricted Band Edge, 802.11n 20 MHz, 5260 MHz, Average, 19 dBi Antenna



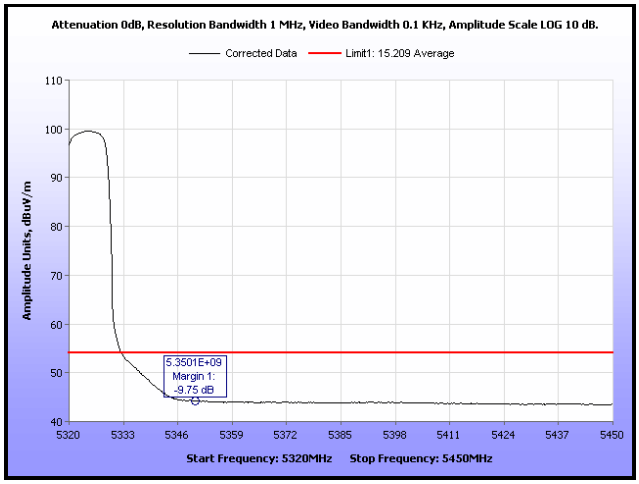
Plot 166. Restricted Band Edge, 802.11n 20 MHz, 5260 MHz, Peak, 19 dBi Antenna



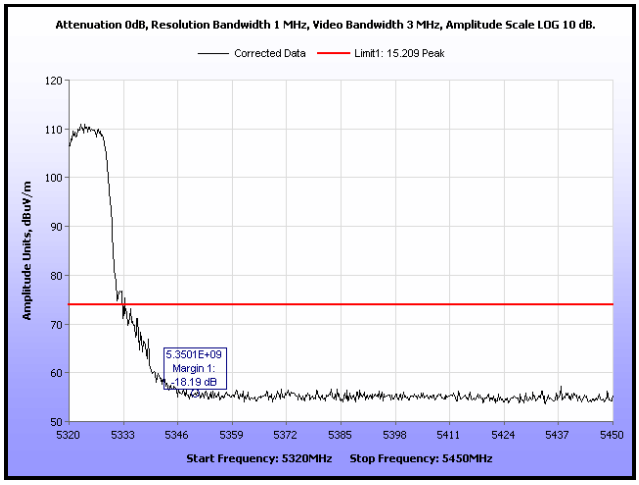
Plot 167. Restricted Band Edge, 802.11n 20 MHz, 5280 MHz, Average, 19 dBi Antenna



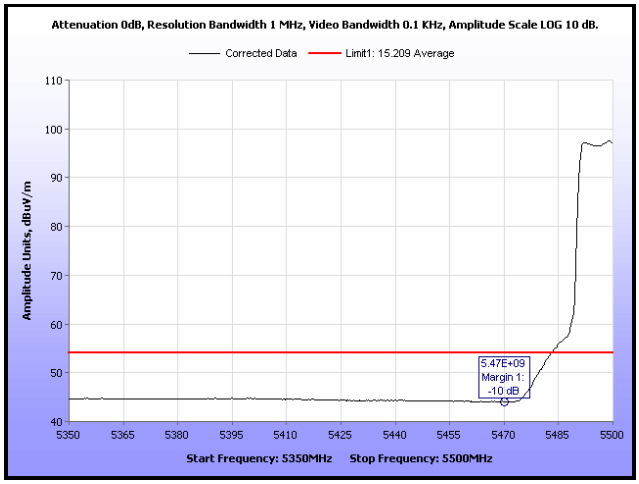
Plot 168. Restricted Band Edge, 802.11n 20 MHz, 5280 MHz, Peak, 19 dBi Antenna



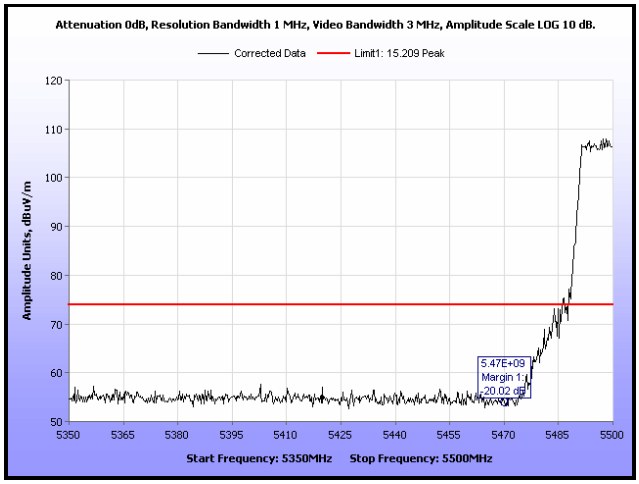
Plot 169. Restricted Band Edge, 802.11n 20 MHz, 5320 MHz, Average, 19 dBi Antenna



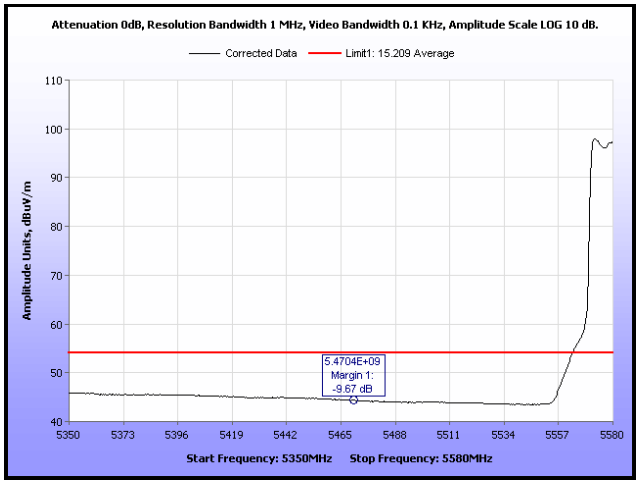
Plot 170. Restricted Band Edge, 802.11n 20 MHz, 5320 MHz, Peak, 19 dBi Antenna



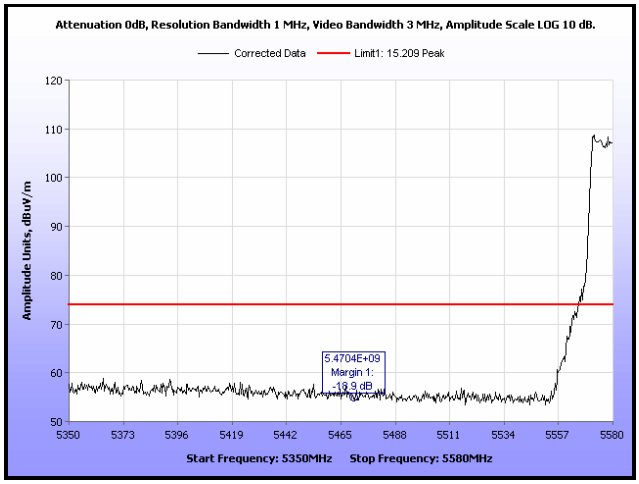
Plot 171. Restricted Band Edge, 802.11n 20 MHz, 5500 MHz, Average, 19 dBi Antenna



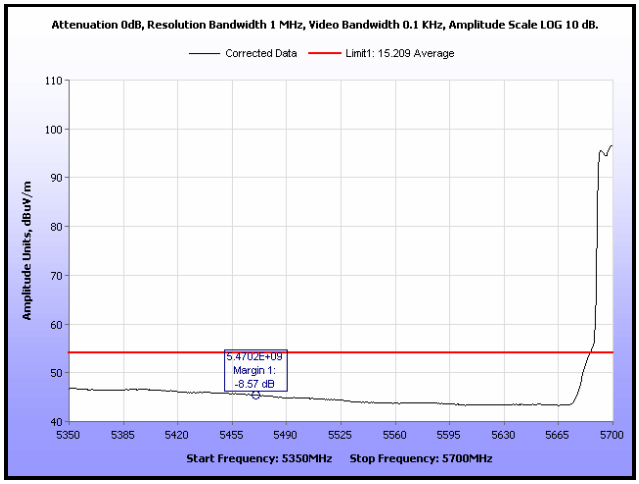
Plot 172. Restricted Band Edge, 802.11n 20 MHz, 5500 MHz, Peak, 19 dBi Antenna



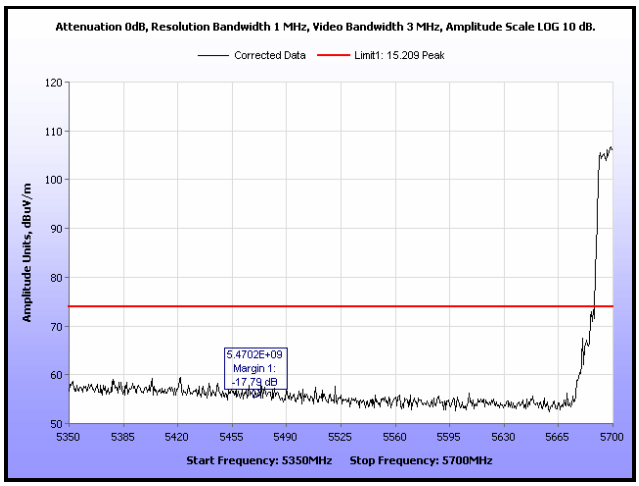
Plot 173. Restricted Band Edge, 802.11n 20 MHz, 5580 MHz, Average, 19 dBi Antenna



Plot 174. Restricted Band Edge, 802.11n 20 MHz, 5580 MHz, Peak, 19 dBi Antenna

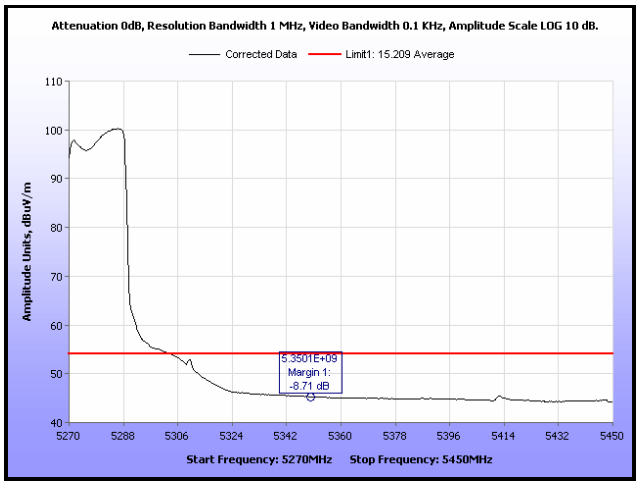


Plot 175. Restricted Band Edge, 802.11n 20 MHz, 5700 MHz, Average, 19 dBi Antenna

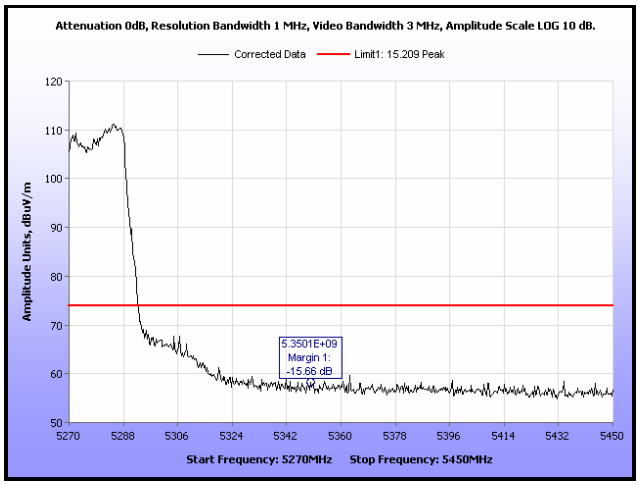


Plot 176. Restricted Band Edge, 802.11n 20 MHz, 5700 MHz, Peak, 19 dBi Antenna

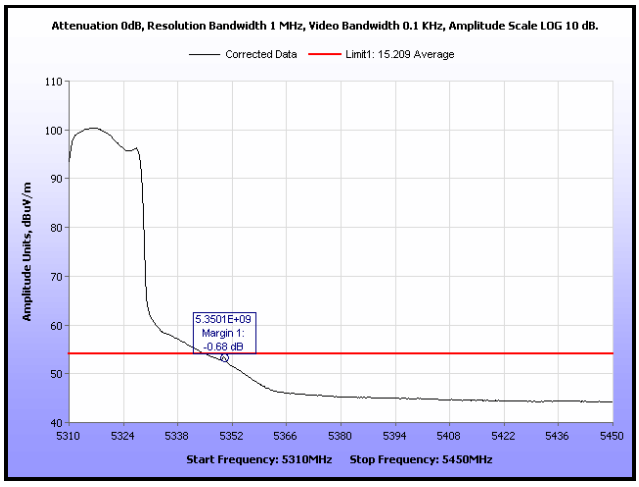
Restricted Band Edge, 802.11n 40 MHz, 19 dBi Antenna



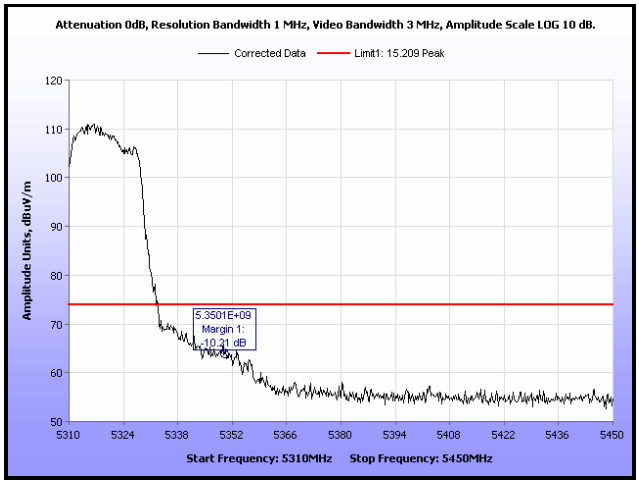
Plot 177. Restricted Band Edge, 802.11n 40 MHz, 5270 MHz, Average, 19 dBi Antenna



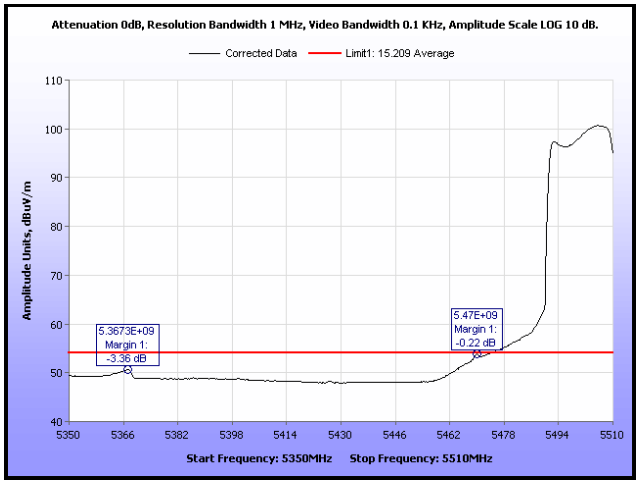
Plot 178. Restricted Band Edge, 802.11n 40 MHz, 5270 MHz, Peak, 19 dBi Antenna



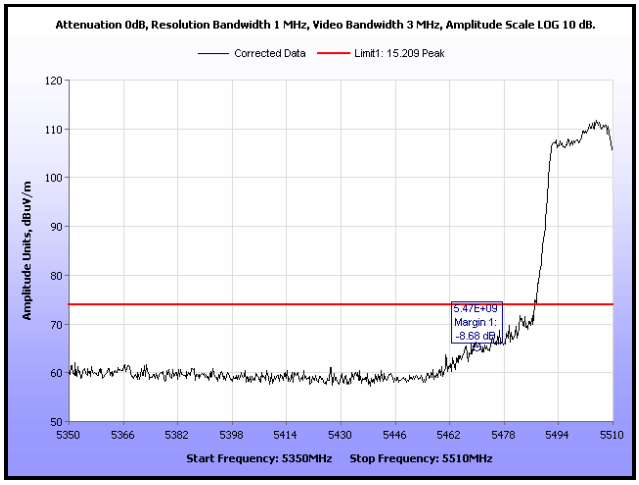
Plot 179. Restricted Band Edge, 802.11n 40 MHz, 5310 MHz, Average, 19 dBi Antenna



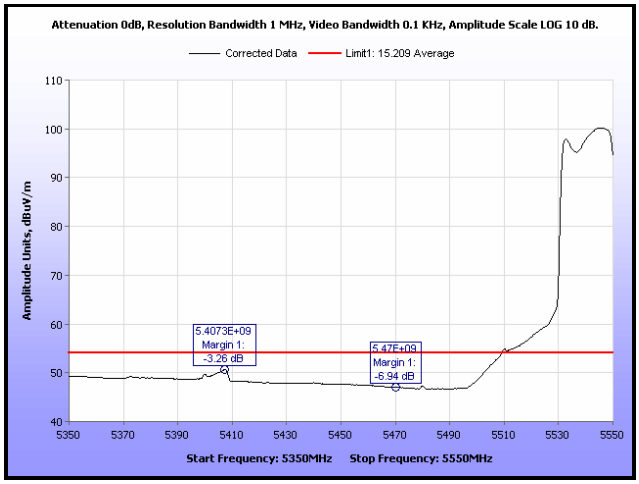
Plot 180. Restricted Band Edge, 802.11n 40 MHz, 5310 MHz, Peak, 19 dBi Antenna



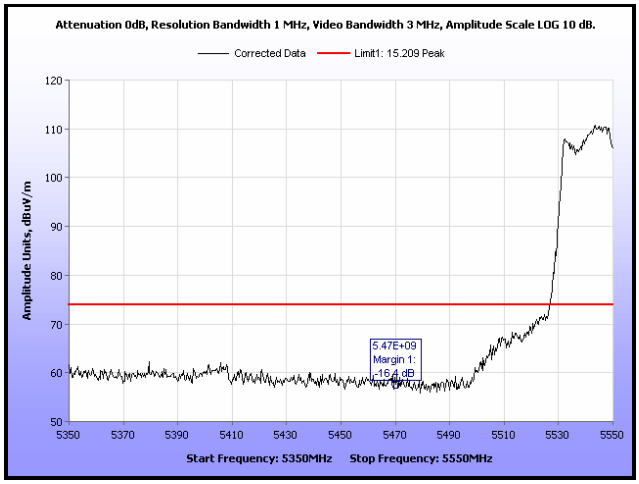
Plot 181. Restricted Band Edge, 802.11n 40 MHz, 5510 MHz, Average, 19 dBi Antenna



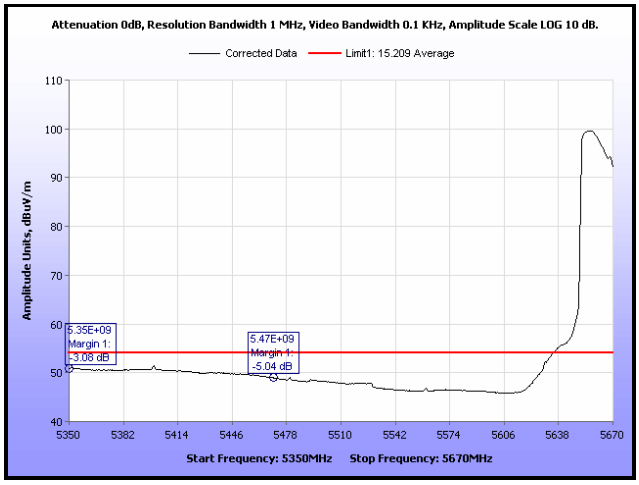
Plot 182. Restricted Band Edge, 802.11n 40 MHz, 5510 MHz, Peak, 19 dBi Antenna



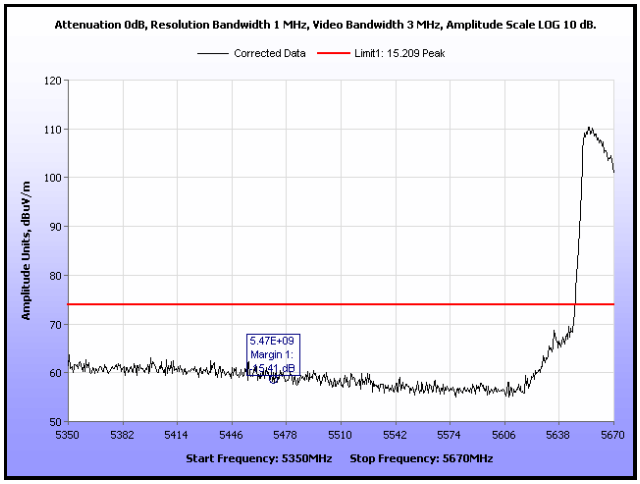
Plot 183. Restricted Band Edge, 802.11n 40 MHz, 5550 MHz, Average, 19 dBi Antenna



Plot 184. Restricted Band Edge, 802.11n 40 MHz, 5550 MHz, Peak, 19 dBi Antenna



Plot 185. Restricted Band Edge, 802.11n 40 MHz, 5670 MHz, Average, 19 dBi Antenna



Plot 186. Restricted Band Edge, 802.11n 40 MHz, 5670 MHz, Peak, 19 dBi Antenna

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(b)(6) Conducted Emissions

Test Requirement(s): **§ 15.407 (b)(6):** Any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

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

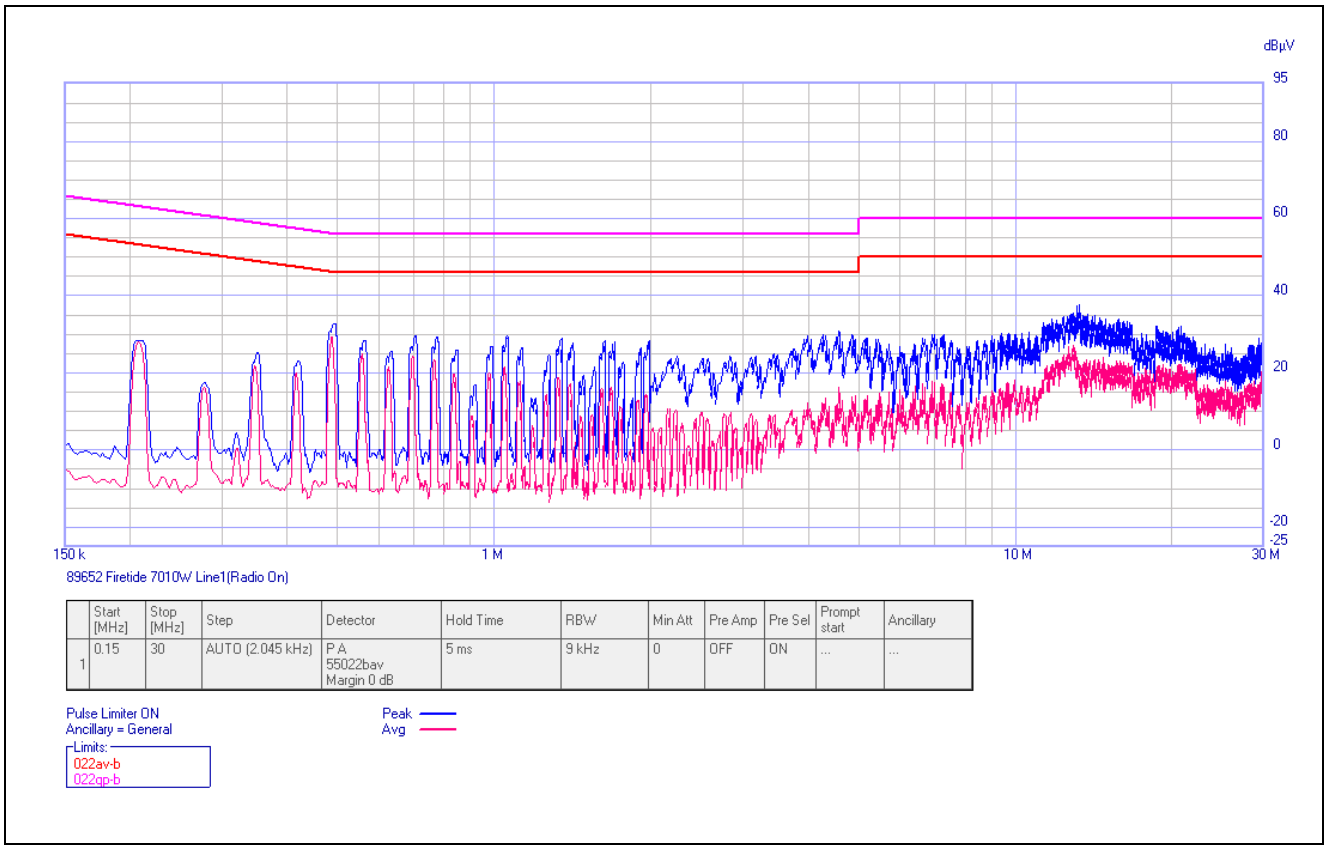
Test Results: The EUT was compliant with requirements of this section.

Test Engineer(s): Jun Qi

Test Date(s): June 21, 2016

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line1	0.4956	37.23	56.076	-18.846	Pass	25.6	46.076	-20.476	Pass
Line1	4.5590	30.44	56	-25.56	Pass	22.46	46	-23.54	Pass
Line1	10.6204	31.66	60	-28.34	Pass	23.93	50	-26.07	Pass
Line1	11.7533	32.92	60	-27.08	Pass	25.39	50	-24.61	Pass
Line1	13.1868	32.7	60	-27.3	Pass	25.33	50	-24.67	Pass
Line1	18.5652	31.84	60	-28.16	Pass	25.55	50	-24.45	Pass

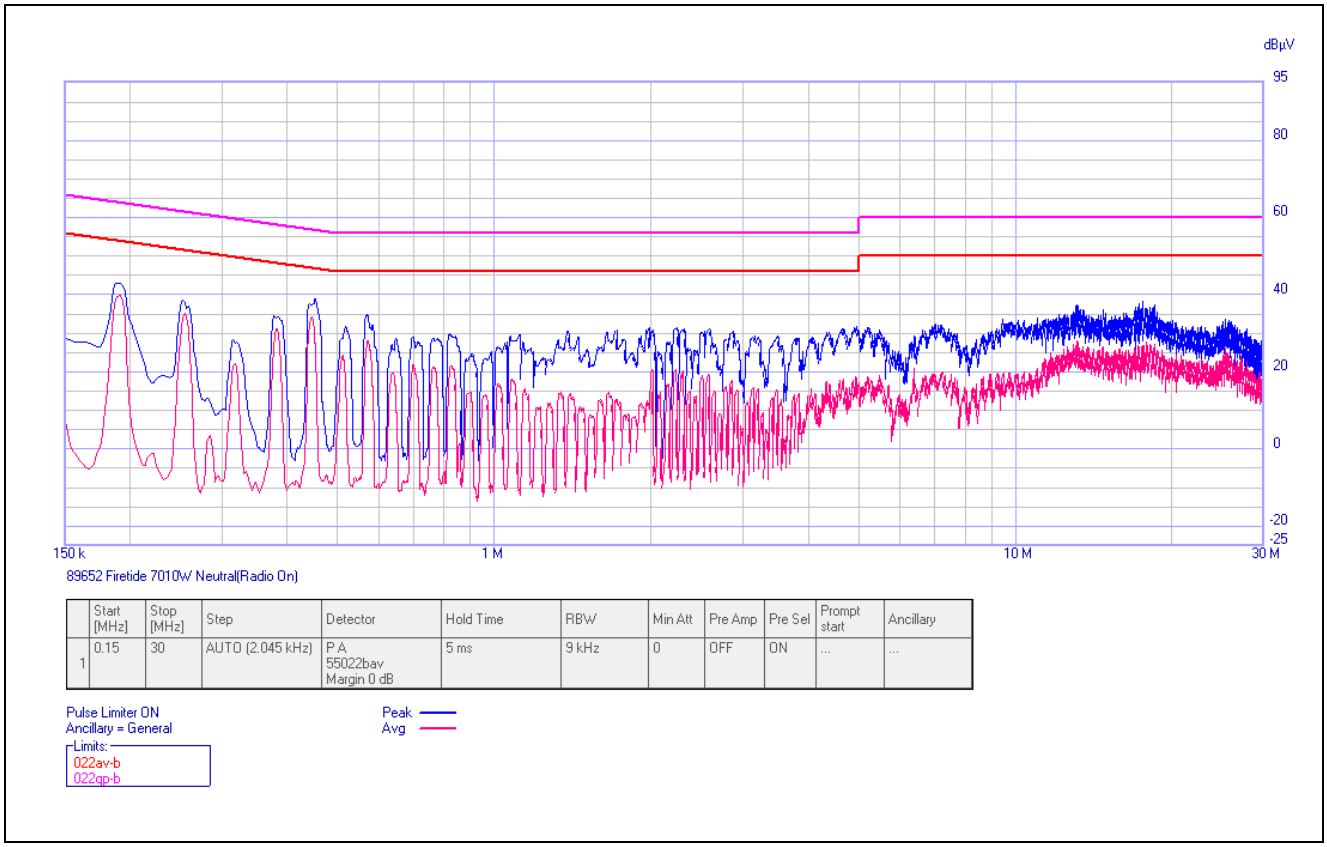
Table 28. Conducted Emissions, 15.207(a), Line 1, Test Results



Plot 187. Conducted Emissions, 15.207(a), Line 1

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Neutral	0.1909	47.97	64.003	-16.033	Pass	29.99	54.003	-24.013	Pass
Neutral	0.25225	37.27	61.695	-24.425	Pass	22.76	51.695	-28.935	Pass
Neutral	0.45266	36.84	56.85	-20.01	Pass	24.38	46.85	-22.47	Pass
Neutral	12.0928	32.27	60	-27.73	Pass	25.17	50	-24.83	Pass
Neutral	13.0253	32.85	60	-27.15	Pass	25.28	50	-24.72	Pass
Neutral	17.5222	32.45	60	-27.55	Pass	25.91	50	-24.09	Pass

Table 29. Conducted Emisisons, 15.207(a), Neutral, Test Results



Plot 188. Conducted Emissions, 15.207(a), Neutral Line

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(f) Maximum Permissible Exposure

Test Requirement(s): **§15.407(f):** U-NII devices are subject to the radio frequency radiation exposure requirements specified in §1.1307(b), §2.1091 and §2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a "general population/uncontrolled" environment.

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: EUT's operating frequencies @ 5250-5350 MHz and 5470 – 5725 MHz; **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

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

$$S = PG / 4\pi R^2 \quad \text{or} \quad R = \sqrt{(PG / 4\pi S)}$$

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

Test Results: The safe distance where Power Density is less than the MPE Limit listed above was found to be 20 cm.

FCC									
Frequency (MHz)	Con. Pwr. (dBm)	Con. Pwr. (mW)	Ant. Gain (dBi)	Ant. Gain numeric	Pwr. Density (mW/cm^2)	Limit (mW/cm^2)	Margin	Distance (cm)	Result
5310	20.71	117.761	9	7.943	0.18609	1	0.81391	20	Pass

Table 30. MPE, Lower Bands, 9 dBi Antenna

FCC									
Frequency (MHz)	Con. Pwr. (dBm)	Con. Pwr. (mW)	Ant. Gain (dBi)	Ant. Gain numeric	Pwr. Density (mW/cm^2)	Limit (mW/cm^2)	Margin	Distance (cm)	Result
5590	20.6	114.815	9	7.943	0.18144	1	0.81856	20	Pass

Table 31. MPE, Upper Bands, 9 dBi Antenna

FCC									
Frequency (MHz)	Con. Pwr. (dBm)	Con. Pwr. (mW)	Ant. Gain (dBi)	Ant. Gain numeric	Pwr. Density (mW/cm^2)	Limit (mW/cm^2)	Margin	Distance (cm)	Result
5310	13.67	23.281	16	39.811	0.18439	1	0.81561	20	Pass

Table 32. MPE, Lower Bands, 16 dBi Antenna

FCC									
Frequency (MHz)	Con. Pwr. (dBm)	Con. Pwr. (mW)	Ant. Gain (dBi)	Ant. Gain numeric	Pwr. Density (mW/cm^2)	Limit (mW/cm^2)	Margin	Distance (cm)	Result
5670	13.78	23.878	16	39.811	0.18912	1	0.81088	20	Pass

Table 33. MPE, Upper Bands, 16 dBi Antenna

FCC									
Frequency (MHz)	Con. Pwr. (dBm)	Con. Pwr. (mW)	Ant. Gain (dBi)	Ant. Gain numeric	Pwr. Density (mW/cm^2)	Limit (mW/cm^2)	Margin	Distance (cm)	Result
5270	10.79	11.995	19	79.433	0.18955	1	0.81045	20	Pass

Table 34. MPE, Lower Bands, 19 dBi Antenna

FCC									
Frequency (MHz)	Con. Pwr. (dBm)	Con. Pwr. (mW)	Ant. Gain (dBi)	Ant. Gain numeric	Pwr. Density (mW/cm^2)	Limit (mW/cm^2)	Margin	Distance (cm)	Result
5670	10.94	12.417	19	79.433	0.19621	1	0.80379	20	Pass

Table 35. MPE, Upper Bands, 19 dBi Antenna

IV. DFS Requirements and Radar Waveform Description & Calibration

A. DFS Requirements

Requirement	Operational Mode		
	Master	Client Without Radar Detection	Client With Radar Detection
Non-Occupancy Period	Yes	Not required	Yes
DFS Detection Threshold	Yes	Not required	Yes
Channel Availability Check Time	Yes	Not required	Not required
U-NII Detection Bandwidth	Yes	Not required	Yes

Table 36. Applicability of DFS Requirements Prior to Use of a Channel

Requirement	Operational Mode	
	Master Device or Client with Radar Detection	Client Without Radar Detection
DFS Detection Threshold	Yes	Not required
Channel Closing Transmission Time	Yes	Yes
Channel Move Time	Yes	Yes
U-NII Detection Bandwidth	Yes	Not required

Additional requirements for devices with multiple bandwidth modes	Master Device or Client with Radar Detection	Client Without Radar Detection
U-NII Detection Bandwidth and Statistical Performance Check	All BW modes must be tested	Not required
Channel Move Time and Channel Closing Transmission Time	Test using widest BW mode available	Test using the widest BW mode available for the link
All other tests	Any single BW mode	Not required
Note: Frequencies selected for statistical performance check (Section 7.8.4) should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in each of the bonded 20 MHz channels and the channel center frequency.		

Table 37. Applicability of DFS Requirements During Normal Operation

Maximum Transmit Power	Value (See Notes 1, 2, and 3)
EIRP ≥ 200 milliwatt	-64 dBm
EIRP < 200 milliwatt and power spectral density < 10 dBm/MHz	-62 dBm
EIRP < 200 milliwatt that do not meet the power spectral density requirement	-64 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna. **Note 2:** Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response. **Note3:** EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.	

Table 38. DFS Detection Thresholds for Master or Client Devices Incorporating DFS

Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds See Note 1.
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2.
U-NII Detection Bandwidth	Minimum 100% of the U-NII 99% transmission power bandwidth. See Note 3.
Note 1: *Channel Move Time* and the *Channel Closing Transmission Time* should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst. **Note 2:** The *Channel Closing Transmission Time* is comprised of 200 milliseconds starting at the beginning of the *Channel Move Time* plus any additional intermittent control signals required to facilitate a *Channel* move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions. **Note 3:** During the *U-NII Detection Bandwidth* detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.	

Table 39. DFS Response Requirement Values

B. Radar Test Waveforms

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

Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (µsec)	PRI (µsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a	Roundup $\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{PRI_{\mu sec}}\right)\right\}$	60%	30
		Test B: 15 unique PRI values randomly selected within the range of 518-3066 µsec, with a minimum increment of 1 µsec, excluding PRI values selected in Test A			
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120
Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.					

A minimum of 30 unique waveforms are required for each of the short pulse radar types 2 through 4. If more than 30 waveforms are used for short pulse radar types 2 through 4, then each additional waveform must also be unique and not repeated from the previous waveforms. If more than 30 waveforms are used for Short Pulse Radar Type1, then each additional waveform is generated with Test B and must also be unique and not repeated from the previous waveforms in Tests A or B.

Pulse Repetition Frequency Number	Pulse Repetition Frequency (Pulses Per Second)	Pulse Repetition Interval (Microseconds)
1	1930.5	518
2	1858.7	538
3	1792.1	558
4	1730.1	578
5	1672.2	598
6	1618.1	618
7	1567.4	638
8	1519.8	658
9	1474.9	678
10	1432.7	698
11	1392.8	718
12	1355	738
13	1319.3	758
14	1285.3	778
15	1253.1	798
16	1222.5	818
17	1193.3	838
18	1165.6	858
19	1139	878
20	1113.6	898
21	1089.3	918
22	1066.1	938
23	326.2	3066

Table 40. Pulse Repetition Intervals Values for Test A

Long Pulse Radar Test Waveform

Radar Type	Pulse Width (µsec)	Chirp Width (MHz)	PRI (µsec)	Number of Pulses per Bursts	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

The parameters for this waveform are randomly chosen. Thirty unique waveforms are required for the Long Pulse radar test signal. If more than 30 waveforms are used for the Long Pulse radar test signal, then each additional waveform must also be unique and not repeated from the previous waveforms.

Each waveform is defined as follows:

1) The transmission period for the Long Pulse Radar test signal is 12 seconds.
2) There are a total of 8 to 20 Bursts in the 12 second period, with the number of Bursts being randomly chosen. This number is Burst_Count.
3) Each Burst consists of 1 to 3 pulses, with the number of pulses being randomly chosen. Each Burst within the 12 second sequence may have a different number of pulses.
4) The pulse width is between 50 and 100 microseconds, with the pulse width being randomly chosen. Each pulse within a Burst will have the same pulse width. Pulses in different Bursts may have different pulse widths.
5) Each pulse has a linear FM chirp between 5 and 20 MHz, with the chirp width being randomly chosen. Each pulse within a Burst will have the same chirp width. Pulses in different Bursts may have different chirp widths. The chirp is centered on the pulse. For example, with radar frequency of 5300 MHz and a 20 MHz chirped signal, the chirp starts at 5290 MHz and ends at 5310 MHz.
6) If more than one pulse is present in a Burst, the time between the pulses will be between 1000 and 2000 microseconds, with the time being randomly chosen. If three pulses are present in a Burst, the time between the first and second pulses is chosen independently of the time between the second and third pulses.
7) The 12 second transmission period is divided into even intervals. The number of intervals is equal to Burst_Count. Each interval is of length (12,000,000 / Burst_Count) microseconds. Each interval contains one Burst. The start time for the Burst, relative to the beginning of the interval, is between 1 and [(12,000,000 / Burst_Count) – (Total Burst Length) + (One Random PRI Interval)] microseconds, with the start time being randomly chosen. The step interval for the start time is 1 microsecond. The start time for each Burst is chosen independently.

A representative example of a Long Pulse radar test waveform:

1) The total test signal length is 12 seconds.
2) 8 Bursts are randomly generated for the Burst_Count.
3) Burst 1 has 2 randomly generated pulses.
4) The pulse width (for both pulses) is randomly selected to be 75 microseconds.
5) The PRI is randomly selected to be at 1213 microseconds.
6) Bursts 2 through 8 are generated using steps 3 – 5.
7) Each Burst is contained in even intervals of 1,500,000 microseconds. The starting location for Pulse 1, Burst 1 is randomly generated (1 to 1,500,000 minus the total Burst 1 length + 1 random PRI interval) at the 325,001 microsecond step. Bursts 2 through 8 randomly fall in successive 1,500,000 microsecond intervals (i.e. Burst 2 falls in the 1,500,001 – 3,000,000 microsecond range).

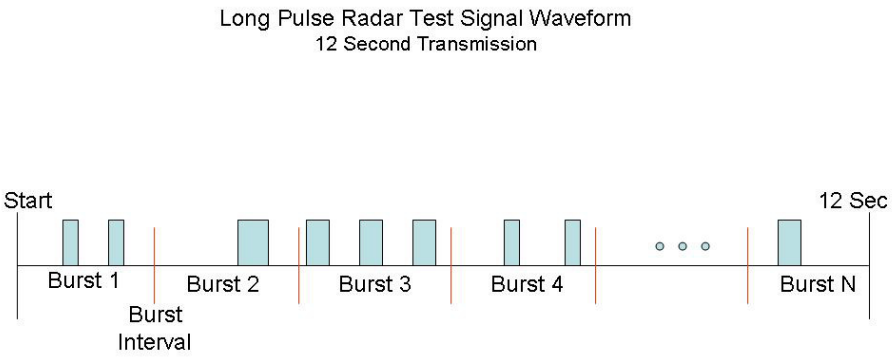


Figure 2. Long Pulse Radar Test Signal Waveform

Frequency Hopping Radar Test Waveform

Radar Type	Pulse Width (µsec)	PRI (µsec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Trials
6	1	333	9	.333	300	70%	30

For the Frequency Hopping Radar Type, the same *Burst* parameters are used for each waveform. The hopping sequence is different for each waveform and a 100-length segment is selected1 from the hopping sequence defined by the following algorithm:

The first frequency in a hopping sequence is selected randomly from the group of 475 integer frequencies from 5250 – 5724 MHz. Next, the frequency that was just chosen is removed from the group and a frequency is randomly selected from the remaining 474 frequencies in the group. This process continues until all 475 frequencies are chosen for the set. For selection of a random frequency, the frequencies remaining within the group are always treated as equally likely.

C. Radar Waveform Calibration

The following equipment setup was used to calibrate the radiated Radar Waveform. A signal generator capable of producing all radar pulse types (0-6) was used to generate the required signals. A spectrum analyzer was used to establish the test signal level for each radar type. During this process there were no transmissions by either the Master or Client Device. The spectrum analyzer was switched to the zero span (Time Domain) mode at the frequency of the Radar Waveform generator. Peak detection was utilized. The spectrum analyzer's resolution bandwidth (RBW) was set to 3 MHz and the video bandwidth (VBW) was set to 3 Mhz. The calibration setup is diagrammed in Figure 4, and the radar test signal generator is shown in Photograph 1. Because the device has 5dBi antennas, the radar signal power is increased from -64dbm to -59dbm.

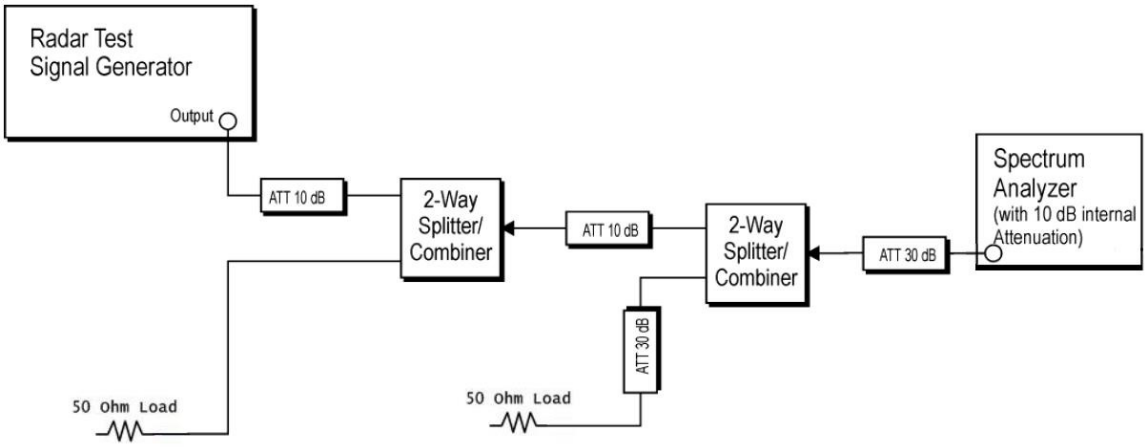
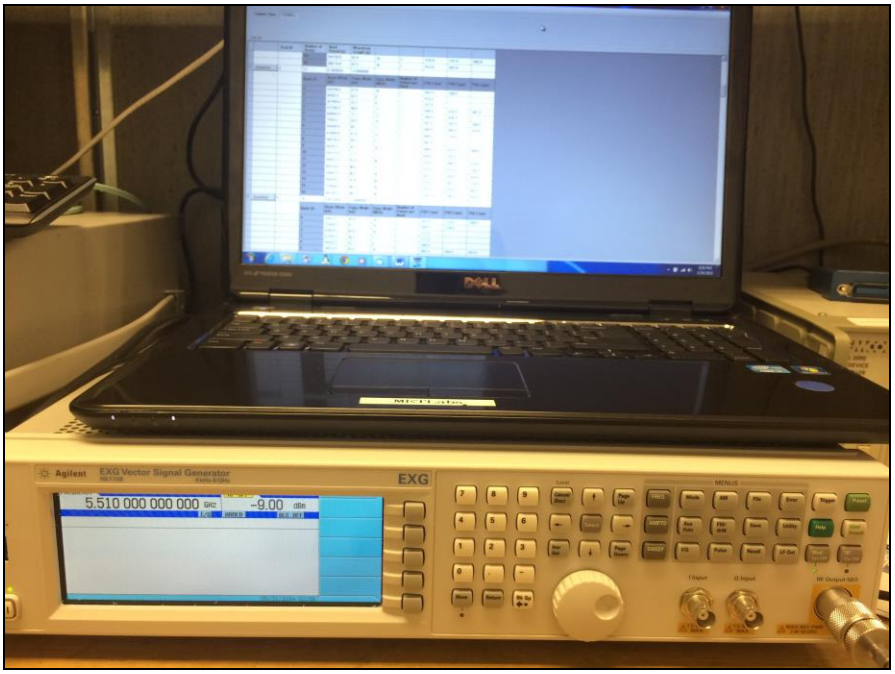
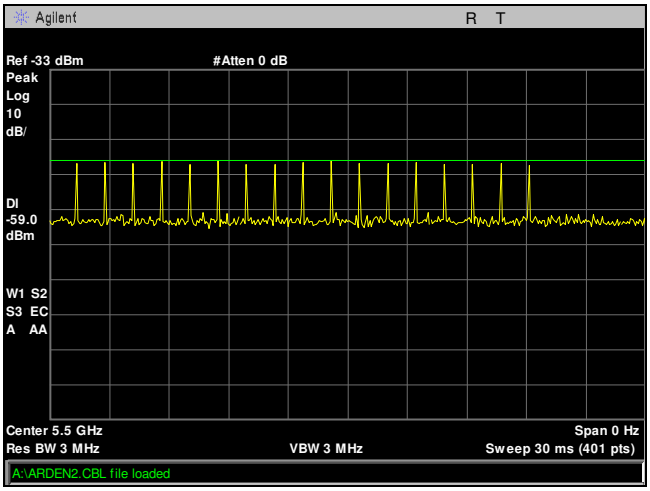


Figure 3. Radiated DFS Calibration Block Diagram

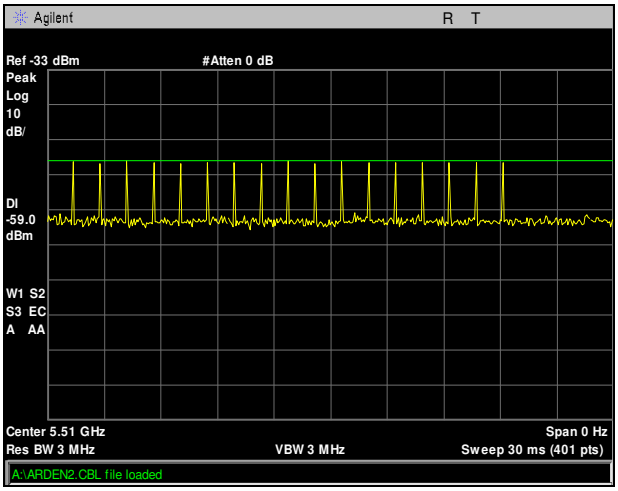


Photograph 1. DFS Radar Test Signal Generator

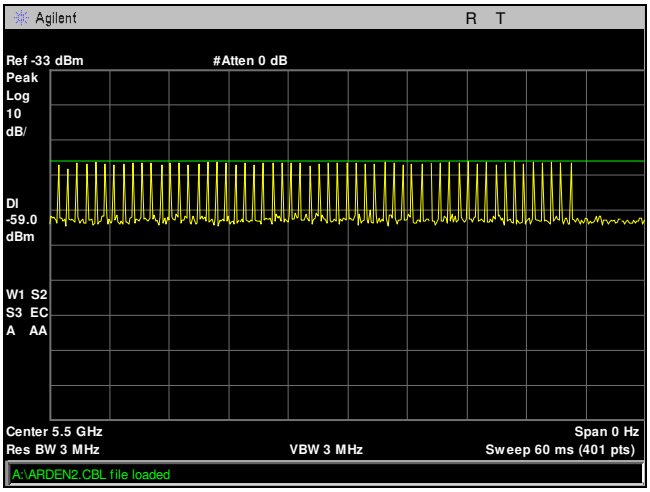
Radar Waveform Calibration



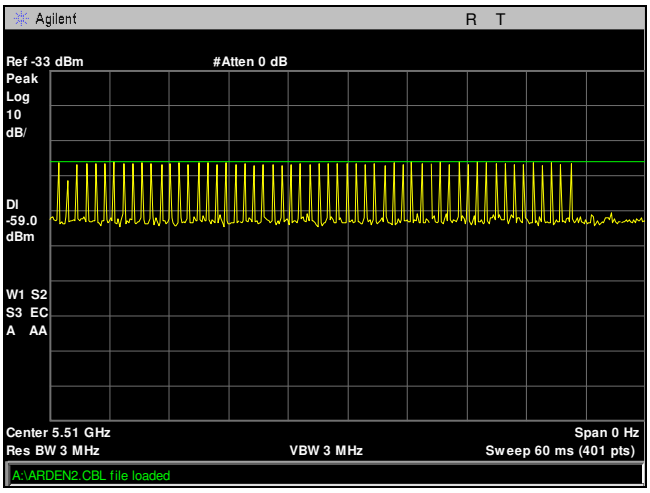
Plot 189. Radar Waveform Calibration, Radar Type 0, 5500 MHz, PS 15.5 dBm



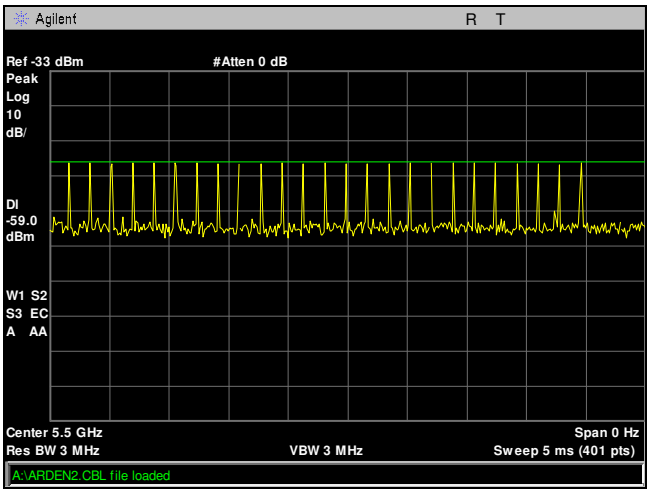
Plot 190. Radar Waveform Calibration, Radar Type 0, 5510 MHz, PS 15.8 dBm



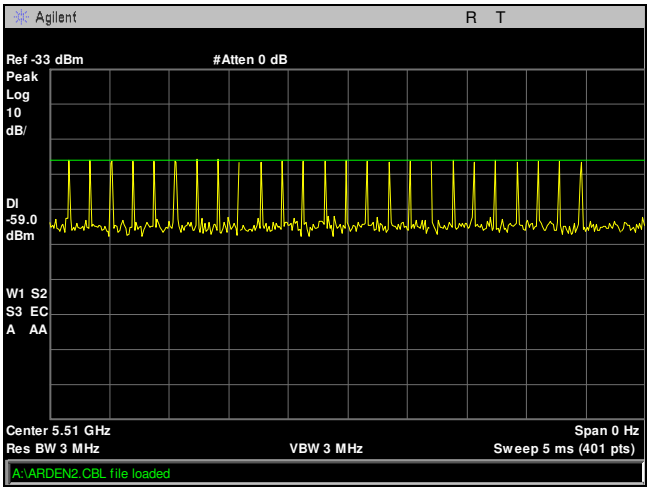
Plot 191. Radar Waveform Calibration, Radar Type 1, 5500 MHz, PS 15.5 dBm



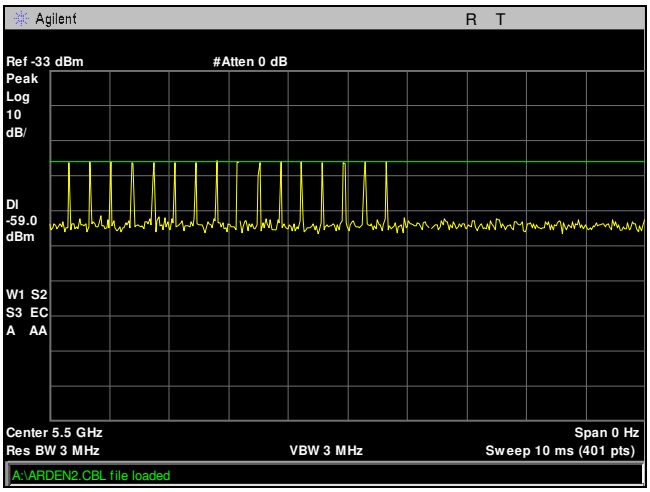
Plot 192. Radar Waveform Calibration, Radar Type 1, 5510 MHz, PS 15.8 dBm



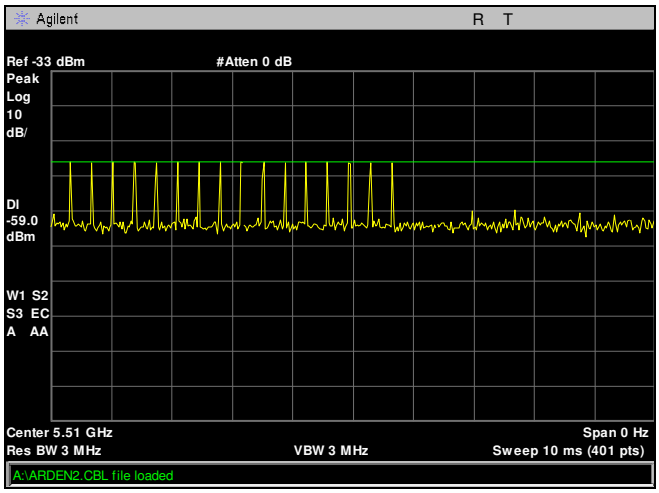
Plot 193. Radar Waveform Calibration, Radar Type 2, 5500 MHz, PS 15.5 dBm



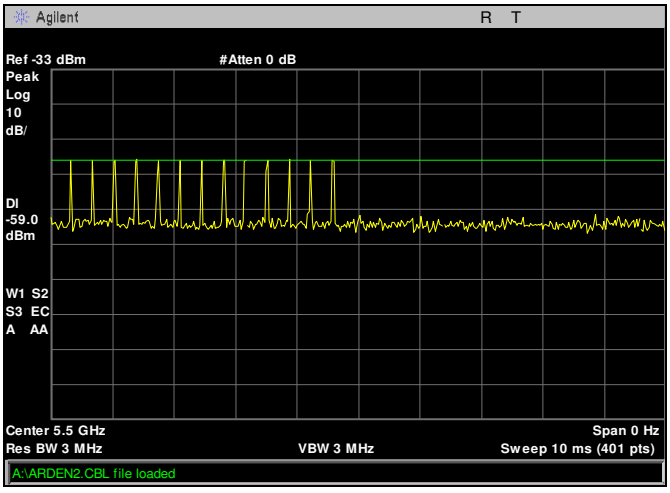
Plot 194. Radar Waveform Calibration, Radar Type 2. 5510MHz, PS15.8 dBm



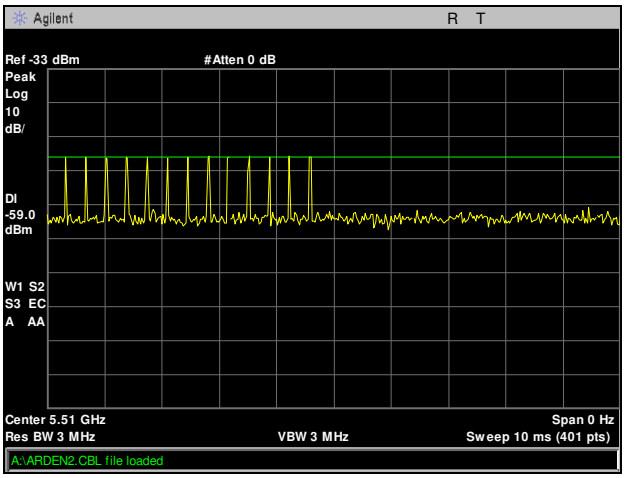
Plot 195. Radar Waveform Calibration, Radar Type 3, 5500 MHz, PS 15.5 dBm



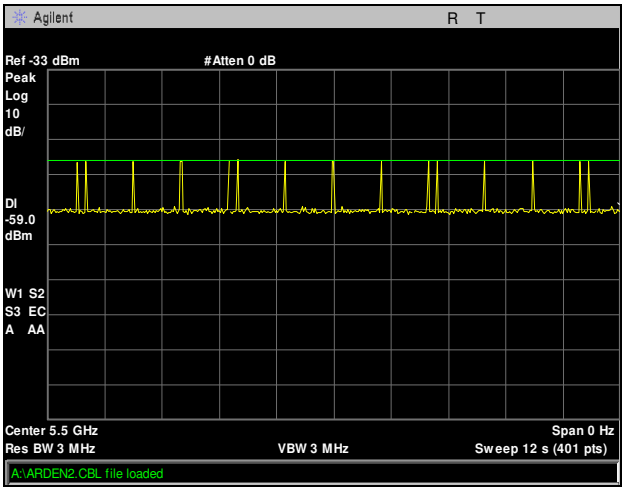
Plot 196. Radar Waveform Calibration, Radar Type 3, 5510 MHz, PS 15.8 dBm



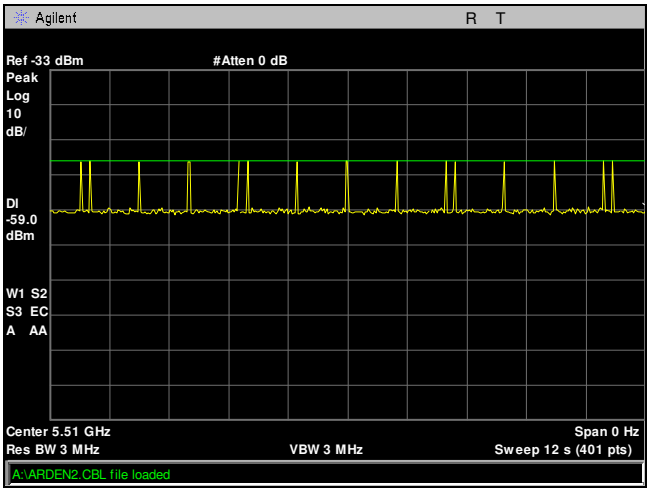
Plot 197. Radar Waveform Calibration, Radar Type 3, 5500 MHz, PS 15.5 dBm



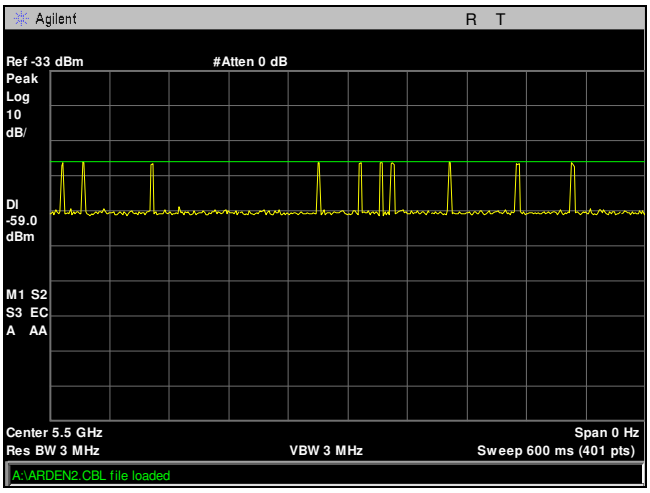
Plot 198. Radar Waveform Calibration, Radar Type 4, 5510 MHz, PS 15.8 dBm



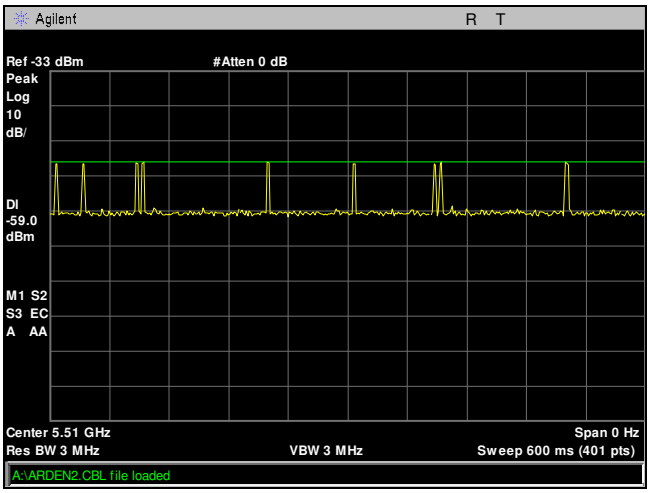
Plot 199. Radar Waveform Calibration, Radar Type 5, 5500 MHz, PS 15.5 dBm



Plot 200. Radar Waveform Calibration, Radar Type 5, 5510 MHz, PS 15.8 dBm



Plot 201. Radar Waveform Calibration, Radar Type 6. 5500 MHz, 15.5 dBm



Plot 202. Radar Waveform Calibration, Radar Type 6, 5510 MHz, PS 15.8 dBm

V. DFS Test Procedure and Test Results

A. DFS Test Setup

1. A spectrum analyzer is used as a monitor to verify that the Unit Under Test (EUT) has vacated the Channel within the Channel Closing Transmission Time and Channel Move Time, and does not transmit on a Channel during the Non-Occupancy Period after the detection and subsequent Channel move. It is also used to monitor EUT transmissions during the Channel Availability Check Time.
2. The test setup, which consists of test equipment and equipment under test (EUT), is diagrammed in Figure 4.

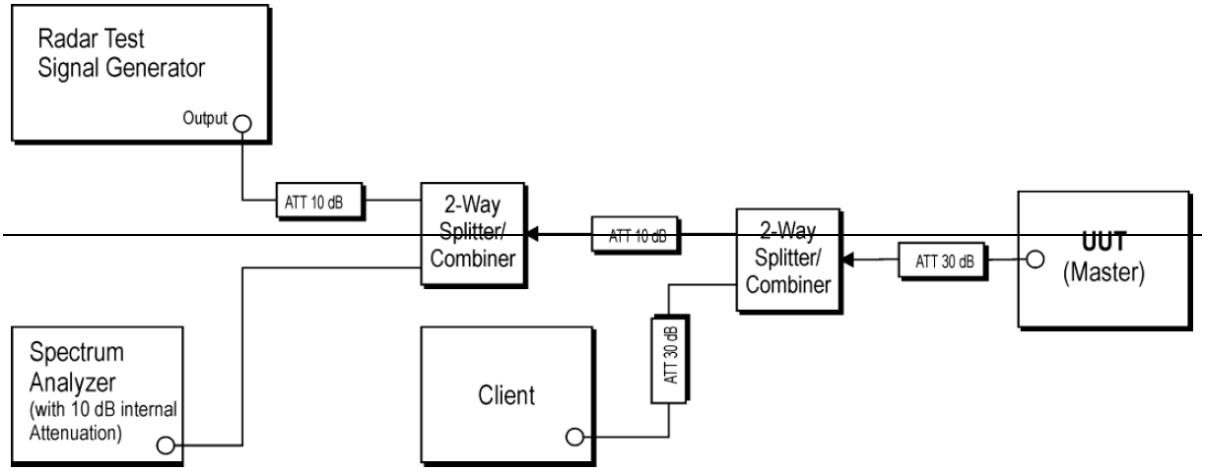


Figure 4. Test Setup Diagram

B. Description of Master Device

1. Operating Frequency Range: 5150 – 5850 MHz
2. Modes of Operation: OFDM
3. List all antennas and associated gains: 5 dBi Omni
4. List output power ranges: 7.78 dBm – 20.7 dBm
5. List antenna impedance: 50 Ohms
6. Antenna gain verification: Use antenna data sheet
7. State test file that is transmitted: FCC DFS Test. MP4
8. TCP description: EIRP less than 500 mW
9. Time for master to complete its power-on-cycle: 78 seconds
10. Describe EUT's uniform channel spreading: The device employs a 20MHz and 40MHz channel separation.

C. UNII Detection Bandwidth

Test Requirement(s): **KDB 905462 §5.1** All BW modes must be tested.

§5.3 A minimum 100% detection rate is required across a EUT's 99% bandwidth.

Test Procedure: The EUT was set up as a standalone device (no associated Client or Master, as appropriate) and no traffic.

A single radar burst of type 0 and the center frequency was generated and the response of the EUT was noted. This was repeated for a minimum of 10 trials. The minimum percentage of detection was 90%, as per the KDB 905462.

Starting at the center frequency of the EUT operating Channel, the radar frequency was increased in 5 MHz steps, repeating the minimum of 10 trials, until the detection rate fell below the U-NII Detection Bandwidth criterion (90%). The measurement was repeated in 1MHz steps at frequencies 5 MHz below where the detection rate began to fall. The highest frequency (denoted as F_H) at which detection was greater or equal than the U-NII Detection Bandwidth criterion (90%) was recorded.

Starting at the center frequency of the EUT operating Channel, the radar frequency was decreased in 5 MHz steps, repeating the minimum of 10 trials, until the detection rate fell below the U-NII Detection Bandwidth criterion (90%). The measurement was repeated in 1MHz steps at frequencies 5 MHz below where the detection rate began to fall. The lowest frequency (denoted as F_L) at which detection was greater or equal than the U-NII Detection Bandwidth criterion (90%) was recorded.

The U-NII Detection Bandwidth was calculated as follow:

U-NII Detection Bandwidth = FH – FL

Test Results: The EUT was compliant with the requirements of this section.

No anomalies detected

Test Engineer(s): Jun Qi

Test Date(s): November 28, 2016

EUT Frequency- 5500MHz											
	DFS Detection Trials (1=Detection, 0= No Detection)										
Radar Frequency (MHz)	1	2	3	4	5	6	7	8	9	10	Detection Rate (%)
5489(FL)	1	1	1	1	1	1	1	1	1	1	100
5490	1	1	1	1	1	1	1	1	1	1	100
5491	1	1	1	1	1	1	1	1	1	1	100
5492	1	1	1	1	1	1	1	1	1	1	100
5493	1	1	1	1	1	1	1	1	1	1	100
5494	1	1	1	1	1	1	1	1	1	1	100
5495	1	1	1	1	1	1	1	1	1	1	100
5496	1	1	1	1	1	1	1	1	1	1	100
5497	1	1	1	1	1	1	1	1	1	1	100
5498	1	1	1	1	1	1	1	1	1	1	100
5499	1	1	1	1	1	1	1	1	1	1	100
5500	1	1	1	1	1	1	1	1	1	1	100
5501	1	1	1	1	1	1	1	1	1	1	100
5502	1	1	1	1	1	1	1	1	1	1	100
5503	1	1	1	1	1	1	1	1	1	1	100
5504	1	1	1	1	1	1	1	1	1	1	100
5505	1	1	1	1	1	1	1	1	1	1	100
5506	1	1	1	1	1	1	1	1	1	1	100
5507	1	1	1	1	1	1	1	1	1	1	100
5508	1	1	1	1	1	1	1	1	1	1	100
5509	1	1	1	1	1	1	1	1	1	1	100
5510(FH)	1	1	1	1	1	1	1	1	1	1	100
Overall Detection Percentage											100%
Detection Bandwidth = f_h - f_l = 5510MHz-5489MHz = 21MHz											
EUT 99% Bandwidth = 16.4904MHz											
OBW* 100% = 16.4904MHz											

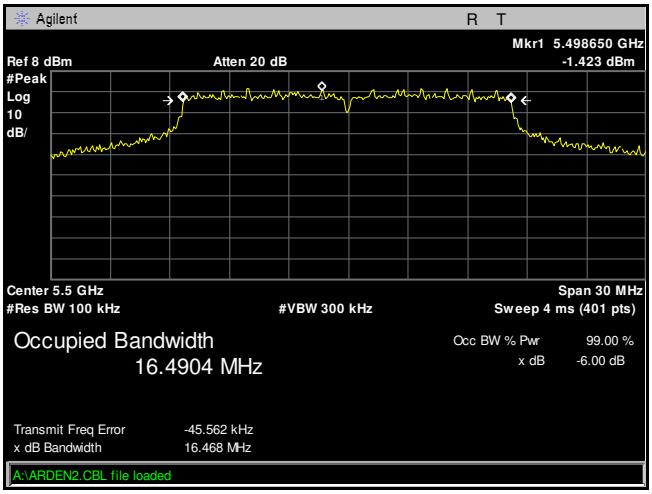
Table 41. UNII Detection Bandwidth, 5500 MHz, 11a, 20 MHz Bandwidth

EUT Frequency- 5500MHz											
	DFS Detection Trials (1=Detection, 0= No Detection)										
Radar Frequency (MHz)	1	2	3	4	5	6	7	8	9	10	Detection Rate (%)
5489(FL)	1	1	1	1	1	1	1	1	1	1	100
5490	1	1	1	1	1	1	1	1	1	1	100
5491	1	1	1	1	1	1	1	1	1	1	100
5492	1	1	1	1	1	1	1	1	1	1	100
5493	1	1	1	1	1	1	1	1	1	1	100
5494	1	1	1	1	1	1	1	1	1	1	100
5495	1	1	1	1	1	1	1	1	1	1	100
5496	1	1	1	1	1	1	1	1	1	1	100
5497	1	1	1	1	1	1	1	1	1	1	100
5498	1	1	1	1	1	1	1	1	1	1	100
5499	1	1	1	1	1	1	1	1	1	1	100
5500	1	1	1	1	1	1	1	1	1	1	100
5501	1	1	1	1	1	1	1	1	1	1	100
5502	1	1	1	1	1	1	1	1	1	1	100
5503	1	1	1	1	1	1	1	1	1	1	100
5504	1	1	1	1	1	1	1	1	1	1	100
5505	1	1	1	1	1	1	1	1	1	1	100
5506	1	1	1	1	1	1	1	1	1	1	100
5507	1	1	1	1	1	1	1	1	1	1	100
5508	1	1	1	1	1	1	1	1	1	1	100
5509	1	1	1	1	1	1	1	1	1	1	100
5510(FH)	1	1	1	1	1	1	1	1	1	1	100
Overall Detection Percentage											100%
Detection Bandwidth = f_h - f_l = 5510MHz-5489MHz = 21MHz											
EUT 99% Bandwidth = 17.7572MHz											
OBW* 100% = 17.7572MHz											

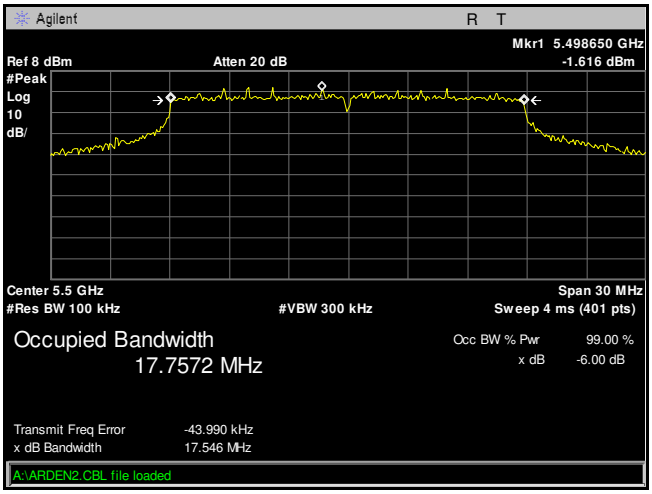
Table 42. UNII Detection Bandwidth, 5500 MHz, 11n, 20 MHz Bandwidth

EUT Frequency- 5510MHz											
	DFS Detection Trials (1=Detection, 0= No Detection)										
Radar Frequency (MHz)	1	2	3	4	5	6	7	8	9	10	Detection Rate (%)
5490(FL)	1	1	1	1	1	1	1	1	1	1	100
5491	1	1	1	1	1	1	1	1	1	1	100
5492	1	1	1	1	1	1	1	1	1	1	100
5493	1	1	1	1	1	1	1	1	1	1	100
5494	1	1	1	1	1	1	1	1	1	1	100
5495	1	1	1	1	1	1	1	1	1	1	100
5496	1	1	1	1	1	1	1	1	1	1	100
5497	1	1	1	1	1	1	1	1	1	1	100
5498	1	1	1	1	1	1	1	1	1	1	100
5499	1	1	1	1	1	1	1	1	1	1	100
5500	1	1	1	1	1	1	1	1	1	1	100
5501	1	1	1	1	1	1	1	1	1	1	100
5502	1	1	1	1	1	1	1	1	1	1	100
5503	1	1	1	1	1	1	1	1	1	1	100
5504	1	1	1	1	1	1	1	1	1	1	100
5505	1	1	1	1	1	1	1	1	1	1	100
5506	1	1	1	1	1	1	1	1	1	1	100
5507	1	1	1	1	1	1	1	1	1	1	100
5508	1	1	1	1	1	1	1	1	1	1	100
5509	1	1	1	1	1	1	1	1	1	1	100
5510	1	1	1	1	1	1	1	1	1	1	100
5511	1	1	1	1	1	1	1	1	1	1	100
5512	1	1	1	1	1	1	1	1	1	1	100
5513	1	1	1	1	1	1	1	1	1	1	100
5514	1	1	1	1	1	1	1	1	1	1	100
5515	1	1	1	1	1	1	1	1	1	1	100
5516	1	1	1	1	1	1	1	1	1	1	100
5517	1	1	1	1	1	1	1	1	1	1	100
5518	1	1	1	1	1	1	1	1	1	1	100
5519	1	1	1	1	1	1	1	1	1	1	100
5520	1	1	1	1	1	1	1	1	1	1	100
5521	1	1	1	1	1	1	1	1	1	1	100
5522	1	1	1	1	1	1	1	1	1	1	100
5523	1	1	1	1	1	1	1	1	1	1	100
5524	1	1	1	1	1	1	1	1	1	1	100
5525	1	1	1	1	1	1	1	1	1	1	100
5526	1	1	1	1	1	1	1	1	1	1	100
5527	1	1	1	1	1	1	1	1	1	1	100
5528	1	1	1	1	1	1	1	1	1	1	100
5529(FH)	1	1	1	1	1	1	1	1	1	1	100
Overall Detection Percentage											100%
Detection Bandwidth = f_h - f_l = 5529MHz-5490MHz = 39MHz											
EUT 99% Bandwidth = 36.2790MHz											
OBW* 100% = 36.2790MHz											

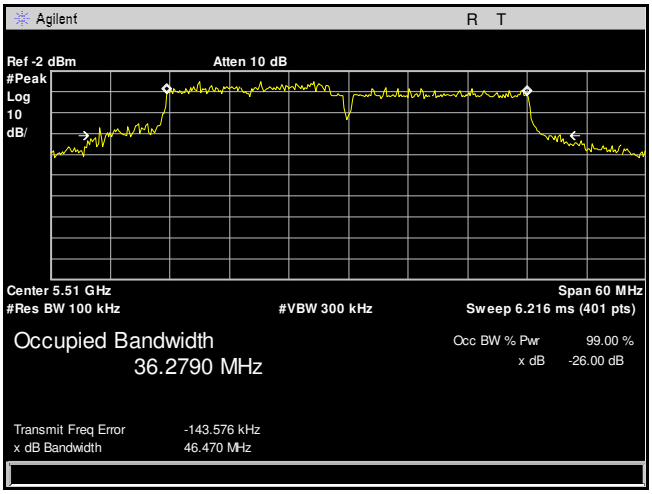
Table 43. UNII Detection Bandwidth, 5510 MHz, 11n, 40 MHz Bandwidth



Plot 203. UNII Detection Bandwidth, Occupied Bandwidth, 11a, 20 MHz, Channel 100, 5500 MHz



Plot 204. UNII Detection Bandwidth, Occupied Bandwidth, 11n, 20 MHz, Channel 100, 5500 MHz



Plot 205. UNII Detection Bandwidth, Occupied Bandwidth, 11n, 40 MHz, Channel 102, 5510 MHz

D. Channel Availability Check Time

Test Requirements: **§15.407(h)(2)(ii)** A U-NII device shall check if there is a radar system already operating on the channel before it can initiate a transmission on a channel and when it has to move to a new channel. The U-NII device may start using the channel if no radar signal with a power level greater than the interference threshold values listed in paragraph (h)(2) of this section, is detected within 60 seconds.

Test Procedure: The spectrum analyzer was set to a zero span mode with a 3 MHz RBW and 3 MHz VBW on the test channel with a 2.5 minute sweep time. The spectrum analyzer's sweep was started at the same time power was applied to the U-NII device.

For the initial Channel Availability Check Time no radar burst was generated and the EUT was monitored for how long after startup transmission started.

For radar burst at the beginning of the Channel Availability Check Time a short pulse radar type (0-4) with a level equal to the DFS Detection Threshold + 1 dB was generated within the first 6 seconds of the EUT's channel availability check. The EUT was monitored to ensure that it did not start transmitting on the channel.

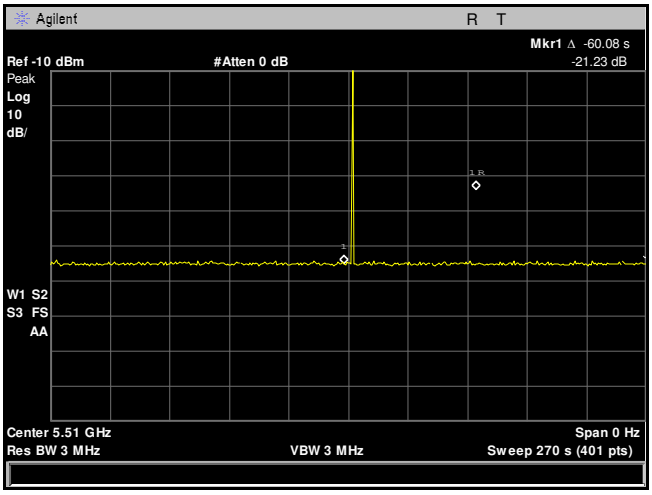
For radar burst at the end of the Channel Availability Check Time a short pulse radar type (0-4) with a level equal to the DFS Detection Threshold + 1 dB was generated within the last 6 seconds of the EUT's channel availability check. The EUT was monitored to ensure that it did not start transmitting on the channel.

Test Results: The EUT was compliant with the requirements of this section.

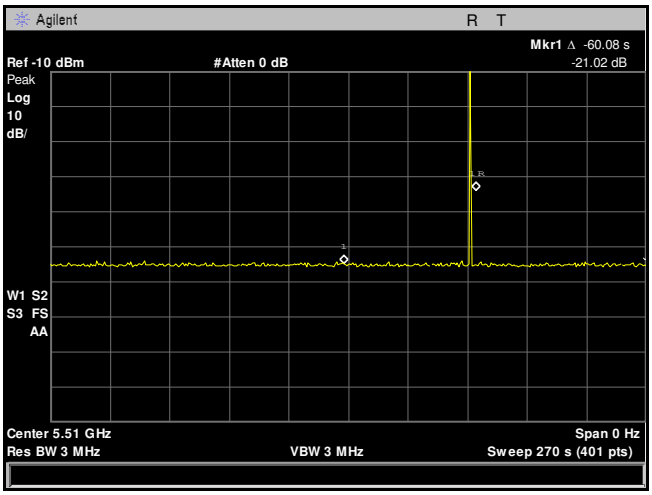
No anomalies detected.

Test Engineer(s): Jun Qi

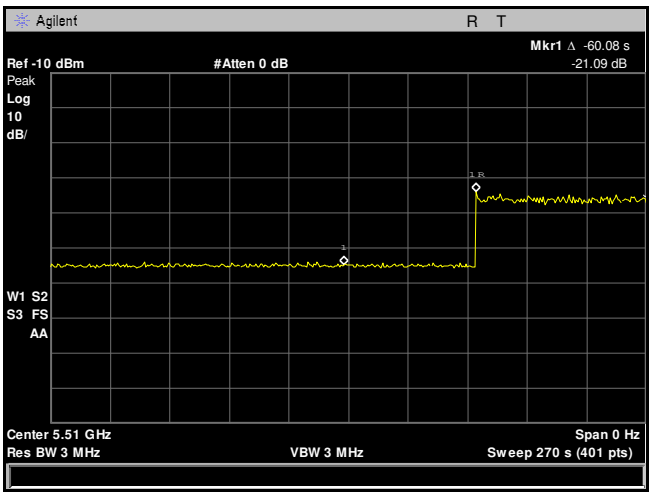
Test Date(s): November 28, 2016



Plot 206. Channel Availability Check Time, 2s after start, CACT, 11n, 40 MHz, Channel 102



Plot 207. Channel Availability Check Time, 2s before end, CACT, 11n, 40 MHz, Channel 102



Plot 208. Channel Availability Check Time, No radar, CACT, 11n, 40 MHz, Channel 102

E. In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time, and Non-Occupancy Period

Test Requirements: **§15.407(h)(2)(iii)** Channel Move Time. After a radar's presence is detected, all transmissions shall cease on the operating channel within 10 seconds. Transmissions during this period shall consist of normal traffic for a maximum of 200 ms after detection of the radar signal. In addition, intermittent management and control signals can be sent during the remaining time to facilitate vacating the operating channel.

§15.407(h)(2)(iv) Non-occupancy Period. A channel that has been flagged as containing a radar system, either by a channel availability check or in-service monitoring, is subject to a non-occupancy period of at least 30 minutes. The non-occupancy period starts at the time when the radar system is detected.

KDB 905462 §5.1 Test using widest BW mode available.

Test Procedure: The EUT was setup as a Master device and associated with a Client device. A test file was streamed from the Master device to the Client device for the entire period of the test. A Radar Burst of type 0 with a level equal to the DFS Detection Threshold + 1 dB was used.

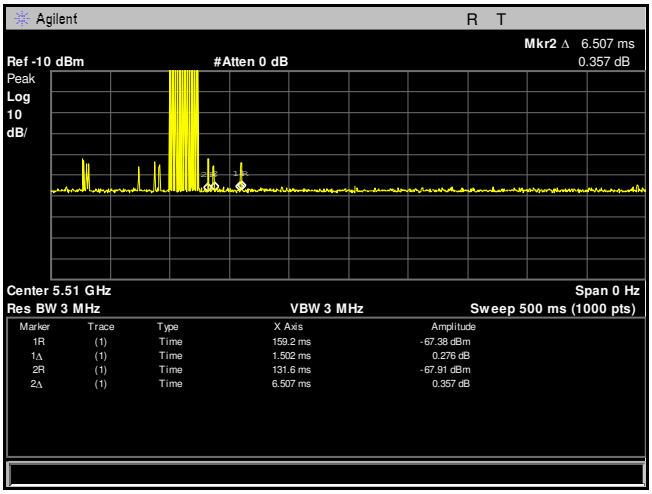
A radar pulse was generated while the EUT was transmitting. A spectrum analyzer set to a zero span was used to observe the transmission of the EUT at the end of the burst.

Test Results: The EUT was compliant with the requirements of this section.

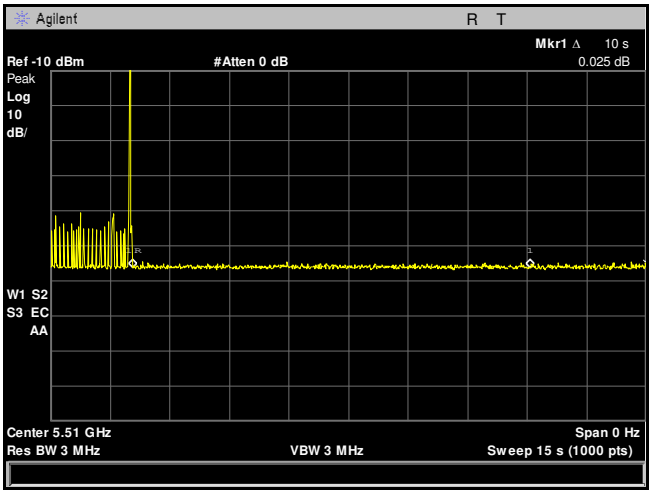
No anomalies detected.

Test Engineer(s): Jun Qi

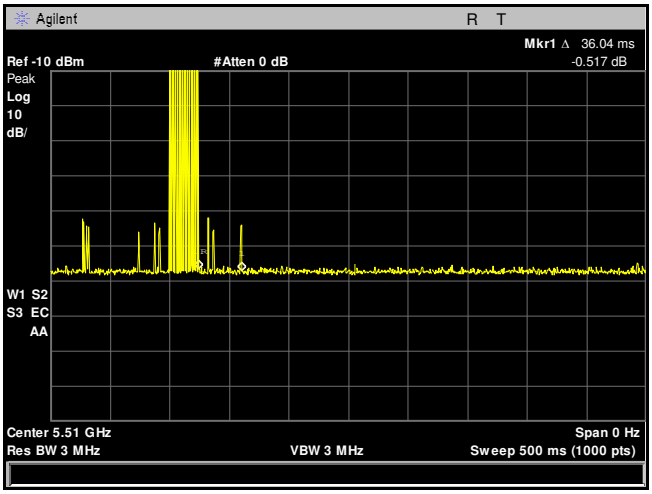
Test Date(s): November 28, 2016



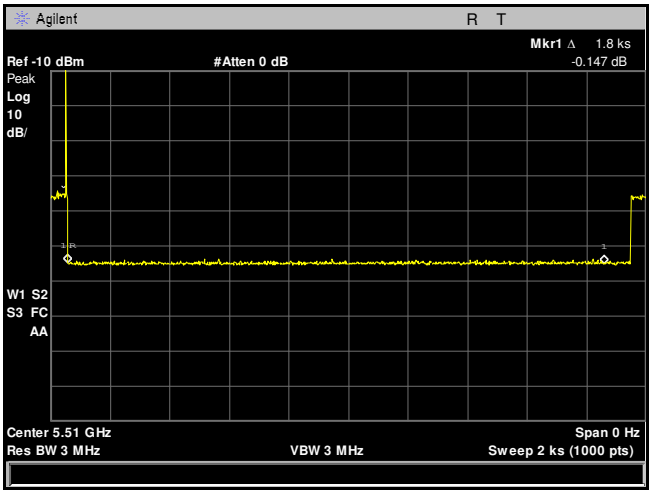
Plot 209. In-Service Monitoring, Channel Closing Transmission Time Aggregate, 11n, Bandwidth 40, Channel 102



Plot 210. In-Service Monitoring, Channel Closing Transmission 15s, 11n, Bandwidth 40, Channel 102



Plot 211. In-Service Monitoring, Channel Closing Transmission 500ms, 11n, Bandwidth 40, Channel 102



Plot 212. In-Service Monitoring, Non-Occupancy Period, 11n, 40 MHz

F. Statistical Performance Check

Test Requirements: **KDB 905462 §5.1** All BW modes must be tested.

KDB 905462: Each of the Radar Pulse types requires a minimum percentage of detections while the EUT is transmitting and listening for potential radar systems operating within the DFS Detection Bandwidth.
For Short Pulse Radar types the aggregate minimum percentage of detections is 80 percent.
Fort the Long Pulse Radar types the minimum percentage of detections is 80 percent.
For the Frequency Hopping Radar type the minimum percentage of detections is 70 percent.

Test Procedure: The EUT was setup as a Master device and associated with a Client device. A test file was streamed from the Master device to the Client device for the entire period of the test. The EUT was also set to a test mode as to demonstrate when the detection occurred without reseting the device between trials.
A Radar Burst of each type (1-6) with a level equal to the DFS Detection Threshold + 1 dB was used. The frequencies selected for the radar burst included several frequencies within the DFS Detection Bandwidth and frequencies near the edge of the bandwidth.
For Short Pulse Radar types, an observation of the EUT's transmission was made for duration greater than 10 seconds after the burst to ensure detection occurred.
For Long Pulse Radar types, an observation of the EUT's transmission was made for duration greater than 10 seconds after the burst to ensure detection occurred. Also, center frequencies for the 30 trials were randomly selected within 80% of the Occupied Bandwidth.
Once the performance check was completed, statistical data was gathered as to determine the ability of the EUT to detect radar waveforms. An aggregate total for the Short Pulse Radar detections was calculated.

Test Results: The EUT was compliant with the requirements of this section.

No anomalies detected.

Test Engineer(s): Jun Qi

Test Date(s): November 28, 2016

Test Channel	Bandwidth	Mode
5500MHz	20MHz	11a
5510MHz	40MHz	11n

Table 44. Channel Tested

Radar Type	Trial #	Pulses per Burst	Pulse Width (µsec)	PRI (µsec)	Detection
					1 = Yes, 0 = No
1	1	57	1	938	1
	2	76	1	698	1
	3	86	1	618	1
	4	99	1	538	1
	5	61	1	878	1
	6	18	1	3066	1
	7	83	1	638	1
	8	58	1	918	1
	9	63	1	838	1
	10	62	1	858	1
	11	67	1	798	1
	12	74	1	718	1
	13	92	1	578	1
	14	89	1	598	1
	15	95	1	558	1
	16	21	1	2536	1
	17	55	1	966	1
	18	64	1	827	1
	19	22	1	2501	1
	20	21	1	2595	1
	21	48	1	1114	1
	22	41	1	1302	1
	23	18	1	3045	1
	24	33	1	1624	1
	25	19	1	2878	1
	26	52	1	1027	1
	27	22	1	2485	1
	28	33	1	1600	1
	29	46	1	1172	1
	30	45	1	1177	1
	Detection Percentage				**100% (> 60%)**

Table 45. Statistical Performance Check, FCC DFS Statistical Performance Check Datasheet, 11a, 20 MHz, Channel 100, 5500 MHz, Type 1

Radar Type	Trial #	Pulse Width 1 to 5 µsec	PRI 150 to 230 µsec	Pulses per Burst 23 to 29	Detection 1 = Yes, 0 = No
2	1	3.2	179	26	1
	2	1.1	207	23	1
	3	2.1	230	24	1
	4	4.8	200	29	1
	5	3.9	214	28	1
	6	2.9	222	26	1
	7	3.2	204	26	1
	8	2.5	192	25	1
	9	3.1	164	26	1
	10	1.2	156	23	1
	11	3.9	210	27	1
	12	4.6	201	29	1
	13	3.2	162	26	1
	14	2.2	197	25	1
	15	4.5	163	29	1
	16	3	203	26	1
	17	5	168	29	1
	18	2.4	217	25	1
	19	2.9	191	26	1
	20	2.3	166	25	1
	21	3.7	150	27	1
	22	2.2	176	25	1
	23	4.9	195	29	1
	24	2.9	202	26	1
	25	2.5	178	25	1
	26	1.1	206	23	1
	27	3.8	155	27	1
	28	4.7	157	29	1
	29	2.4	224	25	1
	30	4.2	159	28	1
	Detection Percentage				100% (> 60%)

Table 46. Statistical Performance Check, FCC DFS Statistical Performance Check Datasheet, 11a, 20 MHz, Channel 100, 5500 MHz, Type 2

Radar Type	Trial #	Pulse Width 6 to 10 µsec	PRI 200 to 500 µsec	Pulses per Burst 16 to 18	Detection 1 = Yes, 0 = No
3	1	8.2	355	17	1
	2	6.1	487	16	1
	3	7.1	344	16	1
	4	9.8	288	18	1
	5	8.9	230	18	1
	6	7.9	432	17	1
	7	8.2	207	17	1
	8	7.5	443	17	1
	9	8.1	439	17	1
	10	6.2	223	16	1
	11	8.9	208	18	1
	12	9.6	463	18	1
	13	8.2	441	17	1
	14	7.2	323	16	1
	15	9.5	297	18	1
	16	8	412	17	1
	17	10	324	18	1
	18	7.4	271	17	1
	19	7.9	349	17	1
	20	7.3	409	16	1
	21	8.7	373	18	1
	22	7.2	254	16	1
	23	9.9	274	18	1
	24	7.9	278	17	1
	25	7.5	317	17	1
	26	6.1	260	16	1
	27	8.8	211	18	1
	28	9.7	272	18	1
	29	7.4	264	17	1
	30	9.2	284	18	1
	Detection Percentage				100% (> 60%)

Table 47. Statistical Performance Check, FCC DFS Statistical Performance Check Datasheet, 11a, 20 MHz, Channel 100, 5500 MHz, Type 3

Trial #	Pulse Width 11 to 20 µsec	PRI 200 to 500 µsec	Pulses per Burst 12 to 16	Detection 1 = Yes, 0 = No
1	16	355	14	1
2	11.3	487	12	1
3	13.5	344	13	1
4	19.4	288	16	1
5	17.5	230	15	1
6	15.3	432	14	1
7	15.9	207	14	1
8	14.3	443	13	1
9	15.8	439	14	1
10	11.5	223	12	1
11	17.4	208	15	1
12	19	463	16	0
13	16	441	14	1
14	13.8	323	13	1
15	18.9	297	16	1
16	15.5	412	14	1
17	19.9	324	16	1
18	14.1	271	13	1
19	15.2	349	14	1
20	13.8	409	13	1
21	17.1	373	15	1
22	13.8	254	13	1
23	19.8	274	16	1
24	15.3	278	14	1
25	14.5	317	13	1
26	11.3	260	12	1
27	17.3	211	15	1
28	19.2	272	16	1
29	14.2	264	13	1
30	18.2	284	15	1
Detection Percentage				**96% (> 60%)**

Table 48. Statistical Performance Check, FCC DFS Statistical Performance Check Datasheet, 11a, 20 MHz, Channel 100, 5500 MHz, Type 4

Radar Type	Trial #	Frequency (MHz)	Filename*	Detection
				1 = Yes, 0 = No
5	1	5500	bin5-trial 1	1
	2	5500	bin5-trial 2	1
	3	5500	bin5-trial 3	1
	4	5500	bin5-trial 4	1
	5	5500	bin5-trial 5	1
	6	5500	bin5-trial 6	1
	7	5500	bin5-trial 7	1
	8	5500	bin5-trial 8	1
	9	5500	bin5-trial 9	1
	10	5500	bin5-trial 10	1
	11	5492.4	bin5-trial 11	1
	12	5496.8	bin5-trial 12	1
	13	5495.2	bin5-trial 13	1
	14	5496.4	bin5-trial 14	1
	15	5495.6	bin5-trial 15	1
	16	5493.6	bin5-trial 16	1
	17	5496	bin5-trial 17	1
	18	5494.8	bin5-trial 18	1
	19	5492.8	bin5-trial 19	1
	20	5497.2	bin5-trial 20	1
	21	5502	bin5-trial 21	1
	22	5507.6	bin5-trial 22	1
	23	5505.6	bin5-trial 23	1
	24	5502.4	bin5-trial 24	1
	25	5507.2	bin5-trial 25	1
	26	5508	bin5-trial 26	1
	27	5503.6	bin5-trial 27	1
	28	5503.2	bin5-trial 28	1
	29	5506.8	bin5-trial 29	1
	30	5506	bin5-trial 30	1
	Detection Percentage			100% (> 80%)

Table 49. Statistical Performance Check, FCC DFS Statistical Performance Check Datasheet, 11a, 20 MHz, Channel 100, 5500 MHz, Type 5

Radar Type	Trial #	Pulses/Hop	Pulse Width (µsec)	PRI (µsec)	Detection
					1 = Yes, 0 = No
6	1	9	1	333	1
	2	9	1	333	1
	3	9	1	333	1
	4	9	1	333	1
	5	9	1	333	1
	6	9	1	333	1
	7	9	1	333	1
	8	9	1	333	1
	9	9	1	333	1
	10	9	1	333	1
	11	9	1	333	1
	12	9	1	333	1
	13	9	1	333	1
	14	9	1	333	1
	15	9	1	333	1
	16	9	1	333	1
	17	9	1	333	1
	18	9	1	333	1
	19	9	1	333	1
	20	9	1	333	1
	21	9	1	333	1
	22	9	1	333	1
	23	9	1	333	1
	24	9	1	333	1
	25	9	1	333	1
	26	9	1	333	1
	27	9	1	333	1
	28	9	1	333	1
	29	9	1	333	1
	30	9	1	333	1
	Detection Percentage				100% (> 60%)

Table 50. Statistical Performance Check, FCC DFS Statistical Performance Check Datasheet, 11a, 20 MHz, Channel 100, 5500 MHz, Type 6

Radar Type	Trial #	Pulses per Burst	Pulse Width (µsec)	PRI (µsec)	Detection
					1 = Yes, 0 = No
1	1	57	1	938	1
	2	76	1	698	1
	3	86	1	618	1
	4	99	1	538	1
	5	61	1	878	1
	6	18	1	3066	1
	7	83	1	638	1
	8	58	1	918	1
	9	63	1	838	1
	10	62	1	858	1
	11	67	1	798	1
	12	74	1	718	1
	13	92	1	578	1
	14	89	1	598	1
	15	95	1	558	1
	16	21	1	2536	1
	17	55	1	966	1
	18	64	1	827	1
	19	22	1	2501	1
	20	21	1	2595	1
	21	48	1	1114	1
	22	41	1	1302	1
	23	18	1	3045	1
	24	33	1	1624	1
	25	19	1	2878	1
	26	52	1	1027	1
	27	22	1	2485	1
	28	33	1	1600	1
	29	46	1	1172	1
	30	45	1	1177	1
	Detection Percentage				100% (> 60%)

Table 51. Statistical Performance Check, FCC DFS Statistical Performance Check Datasheet, 11n, 40 MHz, Channel 102, 5510 MHz, Type 1

Radar Type	Trial #	Pulse Width 1 to 5 µsec	PRI 150 to 230 µsec	Pulses per Burst 23 to 29	Detection 1 = Yes, 0 = No
2	1	3.2	179	26	1
	2	1.1	207	23	1
	3	2.1	230	24	1
	4	4.8	200	29	1
	5	3.9	214	28	1
	6	2.9	222	26	0
	7	3.2	204	26	1
	8	2.5	192	25	1
	9	3.1	164	26	1
	10	1.2	156	23	1
	11	3.9	210	27	1
	12	4.6	201	29	1
	13	3.2	162	26	1
	14	2.2	197	25	1
	15	4.5	163	29	1
	16	3	203	26	1
	17	5	168	29	1
	18	2.4	217	25	1
	19	2.9	191	26	1
	20	2.3	166	25	1
	21	3.7	150	27	1
	22	2.2	176	25	1
	23	4.9	195	29	1
	24	2.9	202	26	0
	25	2.5	178	25	1
	26	1.1	206	23	1
	27	3.8	155	27	1
	28	4.7	157	29	1
	29	2.4	224	25	1
	30	4.2	159	28	1
	Detection Percentage				93% (> 60%)

Table 52Statistical Performance Check, FCC DFS Statistical Performance Check Datasheet, 11n, 40 MHz, Channel 102, 5510 MHz, Type 2

Radar Type	Trial #	Pulse Width 6 to 10 µsec	PRI 200 to 500 µsec	Pulses per Burst 16 to 18	Detection 1 = Yes, 0 = No
3	1	8.2	355	17	1
	2	6.1	487	16	1
	3	7.1	344	16	1
	4	9.8	288	18	1
	5	8.9	230	18	1
	6	7.9	432	17	1
	7	8.2	207	17	1
	8	7.5	443	17	1
	9	8.1	439	17	1
	10	6.2	223	16	1
	11	8.9	208	18	1
	12	9.6	463	18	1
	13	8.2	441	17	1
	14	7.2	323	16	1
	15	9.5	297	18	1
	16	8	412	17	1
	17	10	324	18	1
	18	7.4	271	17	1
	19	7.9	349	17	1
	20	7.3	409	16	1
	21	8.7	373	18	1
	22	7.2	254	16	1
	23	9.9	274	18	1
	24	7.9	278	17	1
	25	7.5	317	17	1
	26	6.1	260	16	1
	27	8.8	211	18	1
	28	9.7	272	18	1
	29	7.4	264	17	1
	30	9.2	284	18	1
	Detection Percentage				100% (> 60%)

Table 53. Statistical Performance Check, FCC DFS Statistical Performance Check Datasheet, 11n, 40 MHz, Channel 102, 5510 MHz, Type 3

Radar Type	Trial #	Pulse Width 11 to 20 µsec	PRI 200 to 500 µsec	Pulses per Burst 12 to 16	Detection 1 = Yes, 0 = No
4	1	16	355	14	1
	2	11.3	487	12	1
	3	13.5	344	13	1
	4	19.4	288	16	1
	5	17.5	230	15	1
	6	15.3	432	14	1
	7	15.9	207	14	1
	8	14.3	443	13	1
	9	15.8	439	14	1
	10	11.5	223	12	1
	11	17.4	208	15	1
	12	19	463	16	0
	13	16	441	14	1
	14	13.8	323	13	1
	15	18.9	297	16	1
	16	15.5	412	14	1
	17	19.9	324	16	1
	18	14.1	271	13	1
	19	15.2	349	14	1
	20	13.8	409	13	1
	21	17.1	373	15	1
	22	13.8	254	13	1
	23	19.8	274	16	1
	24	15.3	278	14	1
	25	14.5	317	13	1
	26	11.3	260	12	1
	27	17.3	211	15	1
	28	19.2	272	16	1
	29	14.2	264	13	1
	30	18.2	284	15	1
	Detection Percentage				96% (> 60%)

Table 54. Statistical Performance Check, FCC DFS Statistical Performance Check Datasheet, 11n, 40 MHz, Channel 102, 5510 MHz, Type 4

Radar Type	Trial #	Frequency (MHz)	Filename*	Detection
				1 = Yes, 0 = No
5	1	5510	bin5-trial 1	1
	2	5510	bin5-trial 2	1
	3	5510	bin5-trial 3	1
	4	5510	bin5-trial 4	1
	5	5510	bin5-trial 5	1
	6	5510	bin5-trial 6	1
	7	5510	bin5-trial 7	1
	8	5510	bin5-trial 8	1
	9	5510	bin5-trial 9	1
	10	5510	bin5-trial 10	1
	11	5492.4	bin5-trial 11	1
	12	5496.8	bin5-trial 12	1
	13	5495.2	bin5-trial 13	1
	14	5496.4	bin5-trial 14	1
	15	5495.6	bin5-trial 15	1
	16	5493.6	bin5-trial 16	0
	17	5496	bin5-trial 17	1
	18	5494.8	bin5-trial 18	1
	19	5492.8	bin5-trial 19	1
	20	5497.2	bin5-trial 20	1
	21	5522	bin5-trial 21	0
	22	5527.6	bin5-trial 22	0
	23	5525.6	bin5-trial 23	1
	24	5522.4	bin5-trial 24	1
	25	5527.2	bin5-trial 25	1
	26	5528	bin5-trial 26	1
	27	5523.6	bin5-trial 27	1
	28	5523.2	bin5-trial 28	1
	29	5526.8	bin5-trial 29	1
	30	5526	bin5-trial 30	1
	Detection Percentage			**90% (> 80%)**

Table 55. Statistical Performance Check, FCC DFS Statistical Performance Check Datasheet, 11n, 40 MHz, Channel 102, 5510 MHz, Type 5

Radar Type	Trial #	Pulses/Hop	Pulse Width (µsec)	PRI (µsec)	Detection
					1 = Yes, 0 = No
6	1	9	1	333	1
	2	9	1	333	1
	3	9	1	333	1
	4	9	1	333	1
	5	9	1	333	1
	6	9	1	333	1
	7	9	1	333	1
	8	9	1	333	1
	9	9	1	333	1
	10	9	1	333	1
	11	9	1	333	1
	12	9	1	333	1
	13	9	1	333	1
	14	9	1	333	1
	15	9	1	333	1
	16	9	1	333	1
	17	9	1	333	1
	18	9	1	333	1
	19	9	1	333	1
	20	9	1	333	1
	21	9	1	333	1
	22	9	1	333	1
	23	9	1	333	1
	24	9	1	333	1
	25	9	1	333	1
	26	9	1	333	1
	27	9	1	333	1
	28	9	1	333	1
	29	9	1	333	1
	30	9	1	333	1
	Detection Percentage				100% (> 60%)

Table 56. Statistical Performance Check, FCC DFS Statistical Performance Check Datasheet, 11n, 40 MHz, Channel 102, 5510 MHz, Type 6

VI. 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
1S3914	SPIKEGUARD	FCC	FCC-450B-2.4-N	SEE NOTE	
1S3809	EMI CISPR RECEIVER	NARDA SAFETY TEST SOLUTIONS	PMM 9010F	2/1/2016	2/1/2017
1U0337	AC LISN	COM POWER	LI-215A	5/31/2016	5/31/2017
1S2657	SCREEN ROOM	ETS LINDGREN	14W-2/2-0	NOT REQUIRED	
1S2746	BILOG ANTENNA	SUNOL SCIENCE	JB3	9/29/2015	3/29/2017
1S2482	5 METER CHAMBER (NSA)	PANASHIELD	5 METER SEMI-ANECHOIC CHAMBER	SEE NOTE	
1S2603	DOUBLE RIDGED WAVEGUIDE HORN	ETS-LINDGREN	3117	08/09/2016	08/09/18
1S3962	SPECTRUM ANALYZER (PSA)	KEYSIGHT/AGILENT	E4448A	02/26/16	02/26/2018
1S2121	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	SEE NOTE	
1U0258	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	2/2/2016	2/2/2017
1S3905	VECTOR SIGNAL GENERATOR	KEYSIGHT TECHNOLOGIES	N5172B	3/30/2015	3/30/2017

Table 57. Test Equipment List

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

VII. Certification & User's Manual Information

Certification & User's Manual Information

L. 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.

