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
13301 MCCALLEN PASS ● AUSTIN, TX 78753 ● PHONE (512) 287-2500 ● FAX (512) 287-2513

January 23, 2017

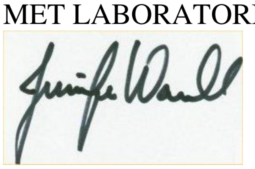
Polycom, Inc.
6001 America Center Drive
San Jose, CA 95002

Dear Tony Griffiths,

Enclosed is the EMC Wireless test report for compliance testing of the Polycom, Inc., Pano as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-6-16 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.



Jennifer Warnell
Documentation Department

Reference: (\Polycom, Inc.\EMCA91224-FCC407 UNII 2 Rev. 4)

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

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Electromagnetic Compatibility Criteria Test Report

for the

Polycom, Inc.
Pano

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

MET Report: EMCA91224-FCC407 UNII 2 Rev. 4

January 23, 2017

Prepared For:

Polycom, Inc.
6001 America Center Drive
San Jose, CA 95002

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

Electromagnetic Compatibility Criteria
Test Report

for the

Polycom, Inc.
Pano

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

Kristine Cabrera, Project Engineer
Electromagnetic Compatibility Lab

Jennifer Warnell
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of 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
∅	November 3, 2016	Initial Issue.
1	November 29, 2016	Editorial correction.
2	December 13, 2016	Engineer corrections.
3	January 16, 2017	Engineer corrections.
4	January 23, 2017	Added Conducted Emission Limits.

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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**lectrostatic **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	**Hertz**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**hertz**
kPa	**k**ilo**pa**scal
kV	**k**ilo**v**olt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
μH	**micro****h**enry
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 Polycom, Inc. Pano, 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 Pano. Polycom, Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Pano, 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 Polycom, Inc., purchase order number PO 6090001474. All tests were conducted using measurement procedure ANSI C63.4-2014.

FCC Reference	Description	Results
§15.203	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15 §15.207(a)	Conducted Emission Limits	Compliant
§15.403(i)	26 dB Occupied Bandwidth	Not Applicable
§15.407 (a)(2)	Maximum Conducted Output Power	Compliant
§15.407 (a)(2)	Maximum Power Spectral Density	Not Applicable
§15.407 (b)(2 – 3)& (6 - 7)	Undesirable Emissions	Compliant
§15.407(f)	RF Exposure	Compliant
§15.407(g)	Frequency Stability	Not Applicable
15.407(h)(2)(ii-iii)	In-Service Monitoring	Compliant

Table 1. Executive Summary of EMC Part 15.407 ComplianceTesting

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Polycom, Inc. to perform testing on the Pano, under Polycom, Inc.'s purchase order number PO 6090001474.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Polycom, Inc. Pano.

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

<table>
<tr><th>Model(s) Tested:</th><td colspan="2">Pano</td></tr>
<tr><th>Model(s) Covered:</th><td colspan="2">Pano</td></tr>
<tr><th rowspan="6">EUT Specifications:</th><td colspan="2">Primary Power: 48VDC [via AC/DC Adapter]</td></tr>
<tr><td colspan="2">FCC ID: M72-PANO
Using Pre-Approved Module FCC ID: VOB-P2180</td></tr>
<tr><td>Type of Modulations:</td><td>OFDM</td></tr>
<tr><td>Equipment Code:</td><td>NII</td></tr>
<tr><td>Peak RF Output Power:</td><td>18.67 dBm</td></tr>
<tr><td>EUT Frequency Ranges:</td><td>5260 MHz – 5320 MHz
5500 MHz – 5600 MHz
5650 MHz – 5725 MHz</td></tr>
<tr><th>Analysis:</th><td colspan="2">The results obtained relate only to the item(s) tested.</td></tr>
<tr><th rowspan="3">Environmental Test Conditions:</th><td colspan="2">Temperature: 15-35º C</td></tr>
<tr><td colspan="2">Relative Humidity: 30-60%</td></tr>
<tr><td colspan="2">Barometric Pressure: 860-1060 mbar</td></tr>
<tr><th>Type of Filing:</th><td colspan="2">Original</td></tr>
<tr><th>Evaluated by:</th><td colspan="2">Kristine Cabrera</td></tr>
<tr><th>Report Date(s):</th><td colspan="2">January 23, 2017</td></tr>
</table>

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., 13501 McCallen Pass, Austin, TX 78753. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

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

D. Description of Test Sample

The Polycom, Inc. Pano, Equipment Under Test (EUT), is a cloud connected visual collaboration device that democratizes content presentation and control.

- Wirelessly connect your personal device to share documents, music, movies and more from the comfort of your chair. Annotate and save with a simple touch to enable a seamless flow of information from anywhere.
- Unlike lesser-performing AV Pods, Pano allows up to 4 individuals to connect and share their own media into the same secure stream for maximum flexibility while in or out of a collaborative video session.

E. Equipment Configuration

Name / Description	Model Number	Part Number	Serial Number	Rev. #
Pano	Pano	2201-29400-001	821623464100DZ	01

Table 4. Equipment Configuration

F. Mode of Operation

The test software is DVT code that exercises all of the ports. The unit is set up and attached to a 4K monitor over HDMI. Then the unit is given a 4K video source as content input. This is provided over the HDMI input port from a 4K source (we used a NVIDIA shield box below the floor). The system is populated with a USB stick in the bottom port where files are written back and forth. The upper USB slot has a usb battery in it to charge. (This is a service port so the software doesn't write back and forth on this slot). The 3.5mm audio jack has a set of headphones plugged in to hear audio from the content in file. There are two LAN cables that are connected to a router outside the chamber that provides the IP addresses. Then a pc is also connected to the router and using Iperf we send data back and forth to both addresses.

G. Method of Monitoring EUT Operation

We monitor the video being displayed and the laptops Iperf window to see continuous operation during the testing.

H. 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.

I. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Polycom, 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 of §15.203. Both antennas (chain 0 and 1) are permanently attached.

Test Engineer(s): Kristine Cabrera

Test Date(s): 07/21/16

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207(a) Conducted Emissions Limits

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

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

Table 5. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was placed on a 0.8 m-high wooden table. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 μH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.4-2014 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz"*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω/50 μH LISN as the input transducer to an EMC/field intensity meter. For the purpose of this testing, the transmitter was turned on. Scans were performed with the transmitter on.

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

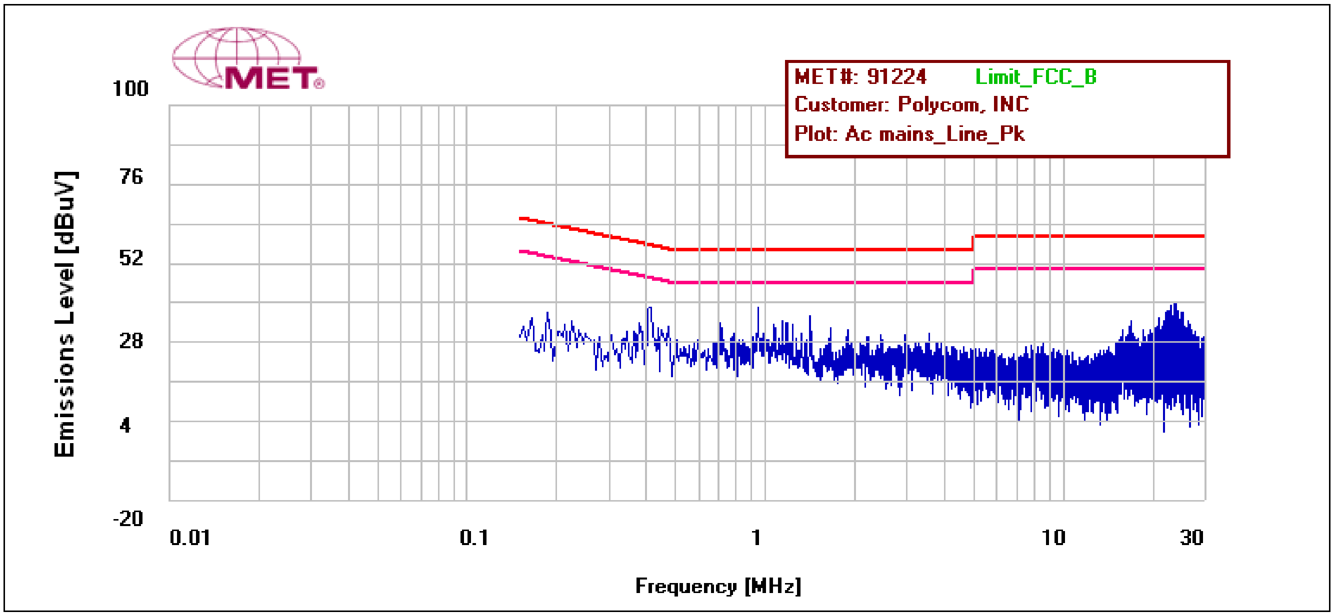
Test Engineer(s): Kamel Atia

Test Date(s): August 1, 2016

15.207(a) Conducted Emissions Test Results

Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta
0.166	36.23	65.16	-28.93	Pass	26.37	55.16	-28.79
0.186	33.39	64.218	-30.828	Pass	25.47	54.218	-28.748
0.414	41.97	57.591	-15.621	Pass	39.05	47.591	-8.541
0.950	36.85	56	-19.15	Pass	35.08	46	-10.92
1.42	36.5	56	-19.5	Pass	35.36	46	-10.64
0.166	36.23	65.16	-28.93	Pass	26.37	55.16	-28.79

Table 6. Conducted Emissions, 15.207(a), Phase Line

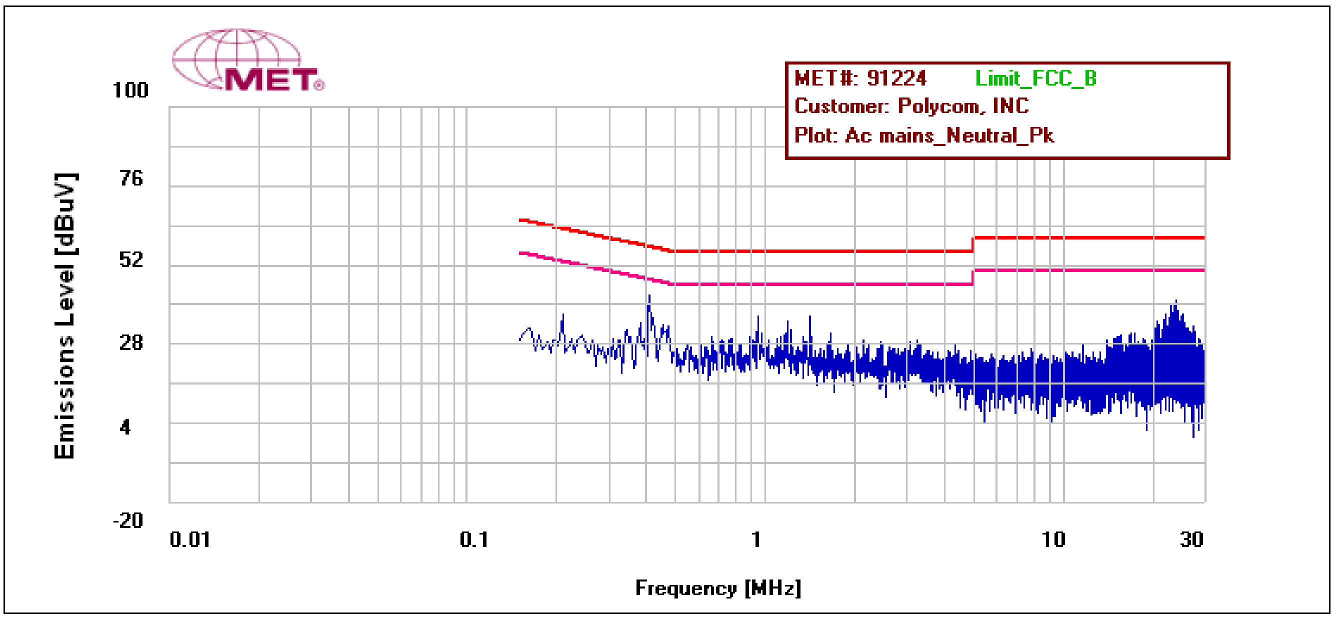


Plot 1. Conducted Emissions, 15.207(a), Phase Line

15.207(a) Conducted Emissions Test Results

Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta
0.190	31.59	64.042	-32.452	Pass	27.51	54.042	-26.532
0.210	31.36	63.213	-31.853	Pass	24.03	53.213	-29.183
0.410	42.34	57.671	-15.331	Pass	35.18	47.671	-12.491
0.950	36.53	56	-19.47	Pass	35.03	46	-10.97
1.42	36.46	56	-19.54	Pass	35.34	46	-10.66
23.95	40.04	60	-19.96	Pass	37.03	50	-12.97

Table 7. Conducted Emissions, 15.207(a), Neutral Line



Plot 2. Conducted Emissions, 15.207(a), Neutral Line

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.

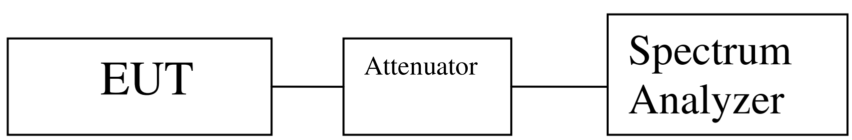
Test Procedure: The EUT was connected to a spectrum analyzer through a cable and attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels. Its power was measured according to measurement method SA-1, as described in 789033 D02 General UNII Test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

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.

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

Test Engineer(s): Kristine Cabrera

Test Date(s): 07/21/16



Peak Power Output Test Results

Limit (dBm)	Gain of One Antenna (dBi)	Total Gain (dBi)
24	3	6

Table 8. Total Gain of System

The total gain of both antennas is less than or equal to 6 dBi. Therefore, the final level for total power limit remains at 24 dBm.

Peak Conducted Output Power						
Carrier Channel	Frequency (MHz)	Measured PCOP (dBm) Port 1	Measured PCOP (dBm) Port 2	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5260	13.21	12.46	15.87	24	-8.13
Mid	5300	13.58	12.04	15.89	24	-8.11
High	5320	14.2	12.96	16.64	24	-7.36
Low	5500	15.78	14.2	18.08	24	-5.92
Mid	5580	15.82	14.2	18.1	24	-5.9
High	5700	14.06	12.04	16.18	24	-7.82

Table 9. Peak Conducted Output Power, 802.11 a Mode, Test Results

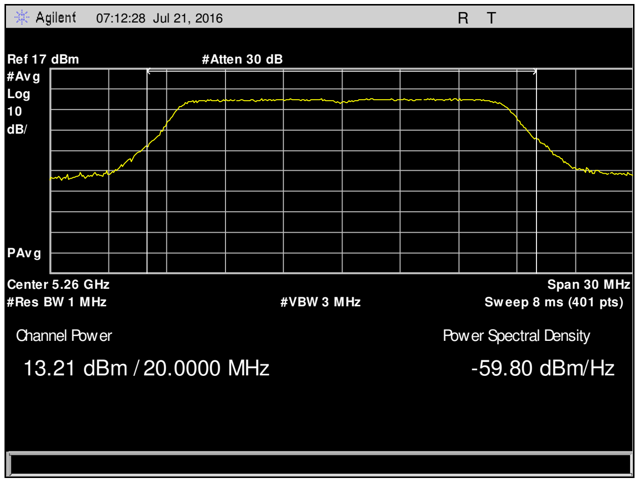
Peak Conducted Output Power						
Carrier Channel	Frequency (MHz)	Measured PCOP (dBm) Port 1	Measured PCOP (dBm) Port 2	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5260	14.54	13.89	17.24	24	-6.76
Mid	5300	12.86	11.9	15.42	24	-8.58
High	5320	12.85	11.77	15.36	24	-8.64
Low	5500	15.98	14.81	18.45	24	-5.55
Mid	5580	16.11	14.07	18.22	24	-5.78
High	5700	11.56	8.92	13.45	24	-10.55

Table 10. Peak Conducted Output Power, 802.11 n 20 MHz Mode, Test Results

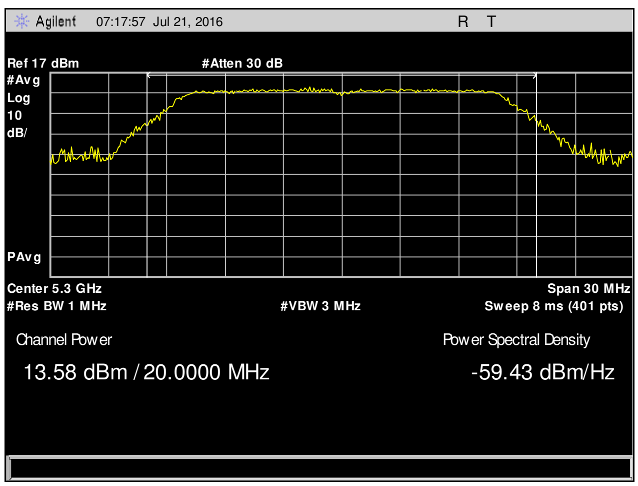
Peak Conducted Output Power						
Carrier Channel	Frequency (MHz)	Measured PCOP (dBm) Port 1	Measured PCOP (dBm) Port 2	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5270	16.21	15.01	18.67	24	-5.33
High	5310	7.87	6.67	10.33	24	-13.67
Low	5510	11.93	8.63	13.6	24	-10.4
High	5550	15.56	13.82	17.79	24	-6.21

Table 11. Peak Conducted Output Power, 802.11 n 40 MHz Mode, Test Results

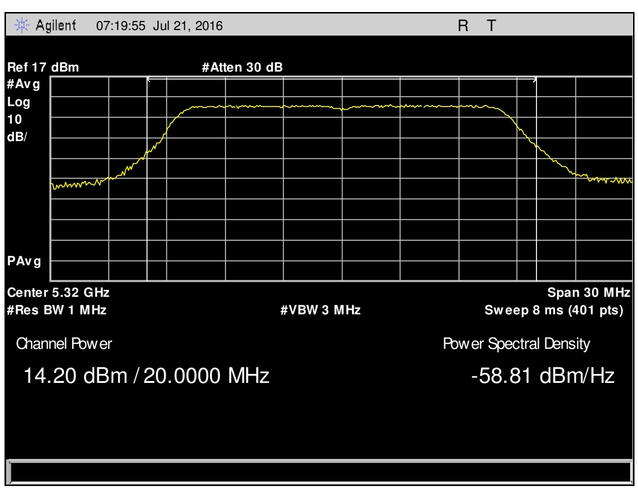
Conducted Output Power, 802.11a 20 MHz, Chain 0



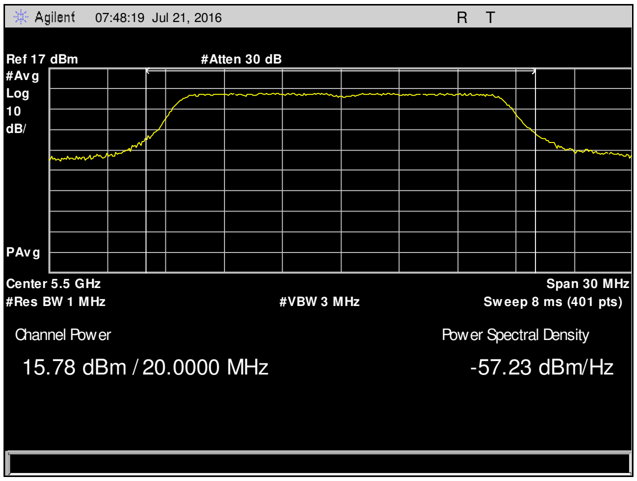
Plot 3. Conducted Output Power, 802.11a 20 MHz, 5260 MHz, Chain 0



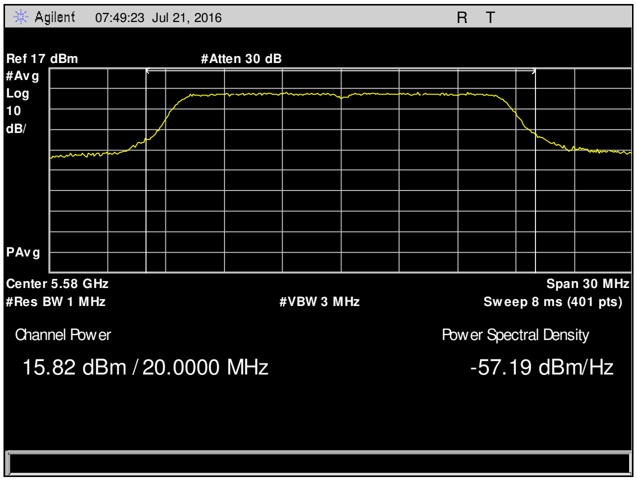
Plot 4. Conducted Output Power, 802.11a 20 MHz, 5300 MHz, Chain 0



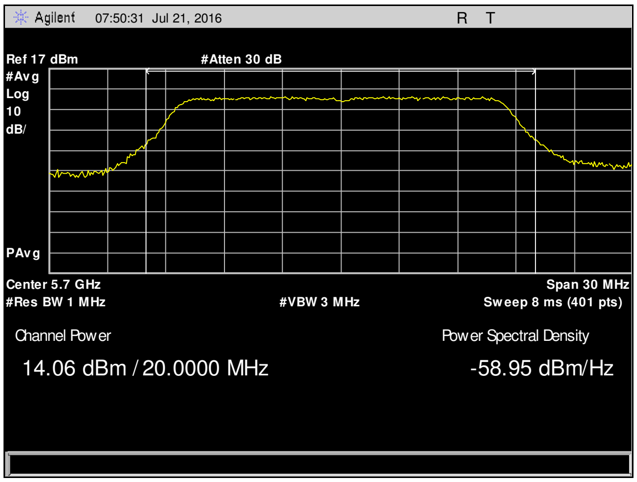
Plot 5. Conducted Output Power, 802.11a 20 MHz, 5320 MHz, Chain 0



Plot 6. Conducted Output Power, 802.11a 20 MHz, 5500 MHz, Chain 0

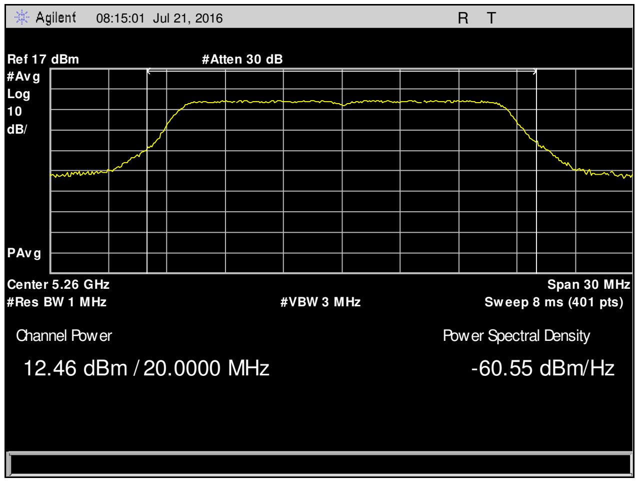


Plot 7. Conducted Output Power, 802.11a 20 MHz, 5580 MHz, Chain 0

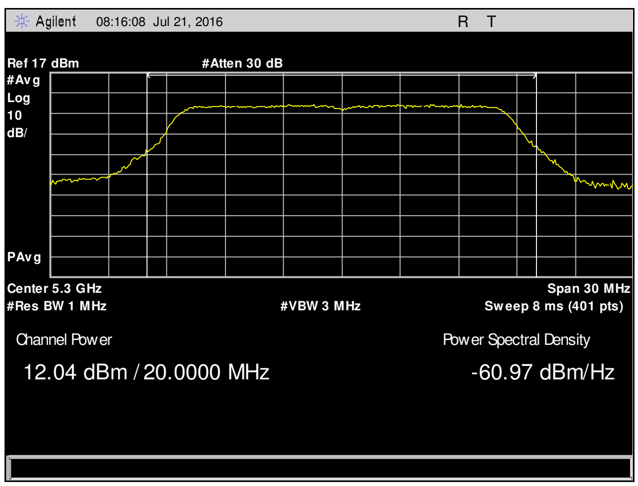


Plot 8. Conducted Output Power, 802.11a 20 MHz, 5700 MHz, Chain 0

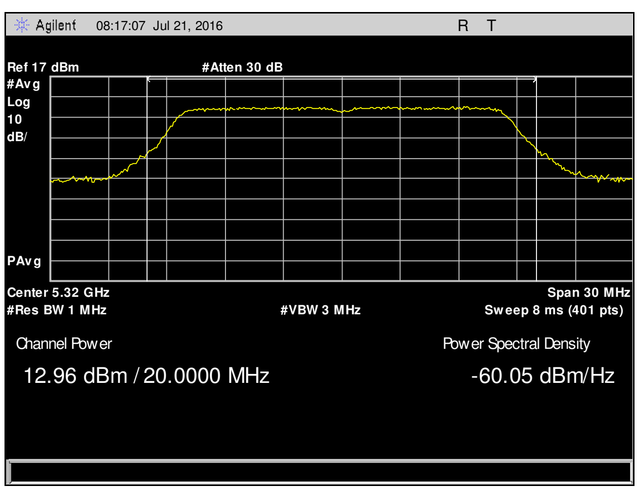
Conducted Output Power, 802.11a 20 MHz, Chain 1



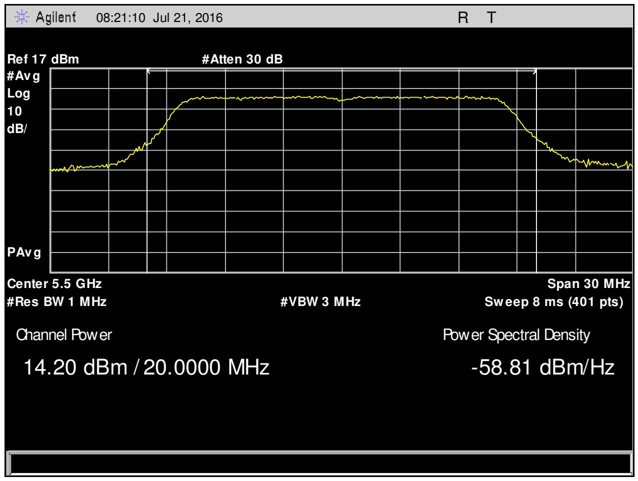
Plot 9. Conducted Output Power, 802.11a 20 MHz, 5260 MHz, Chain 1



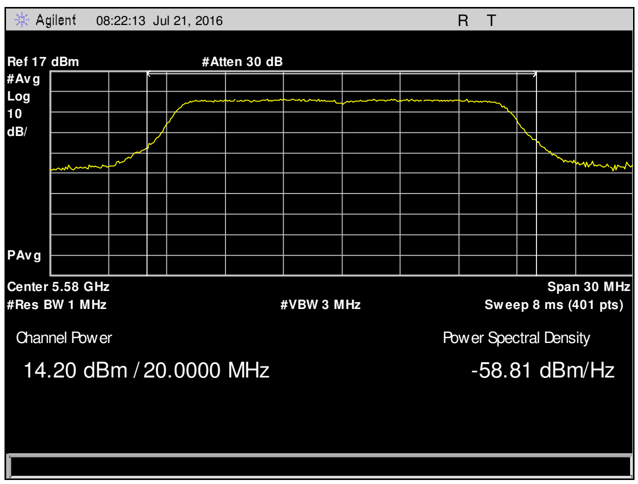
Plot 10. Conducted Output Power, 802.11a 20 MHz, 5300 MHz, Chain 1



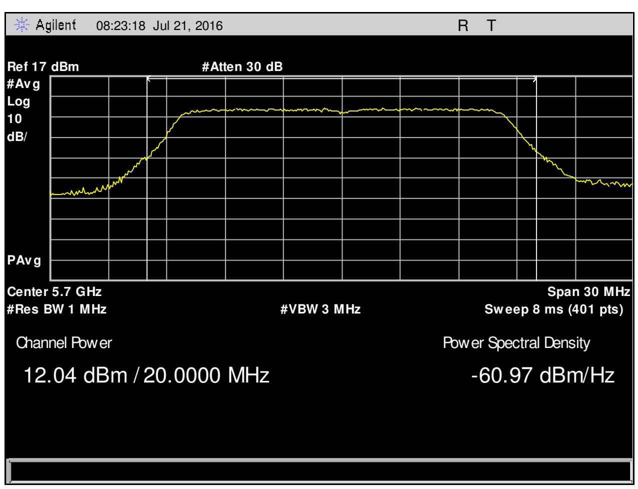
Plot 11. Conducted Output Power, 802.11a 20 MHz, 5320 MHz, Chain 1



Plot 12. Conducted Output Power, 802.11a 20 MHz, 5500 MHz, Chain 1

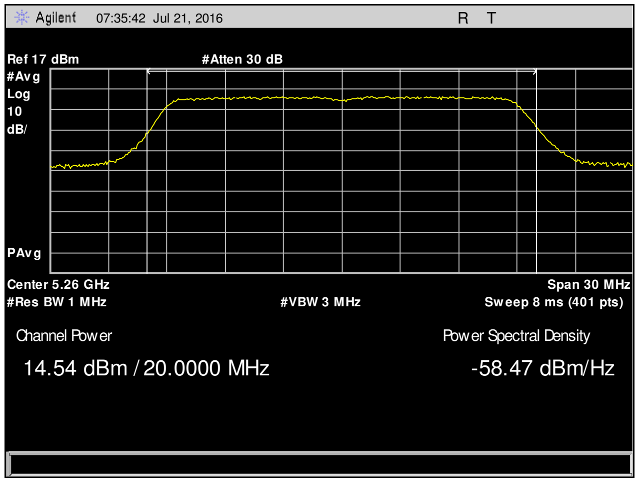


Plot 13. Conducted Output Power, 802.11a 20 MHz, 5580 MHz, Chain 1

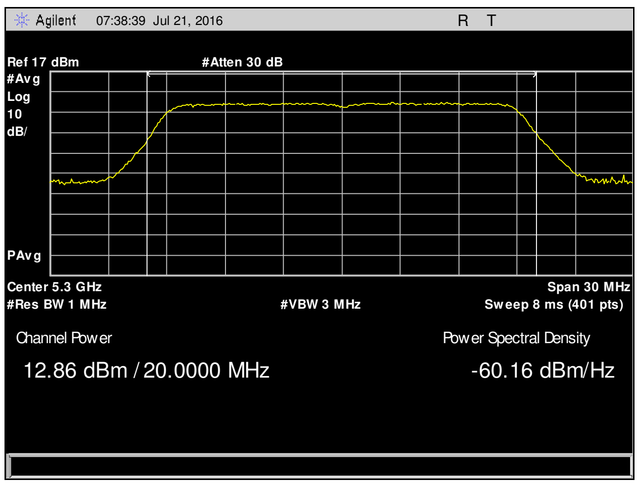


Plot 14. Conducted Output Power, 802.11a 20 MHz, 5700 MHz, Chain 1

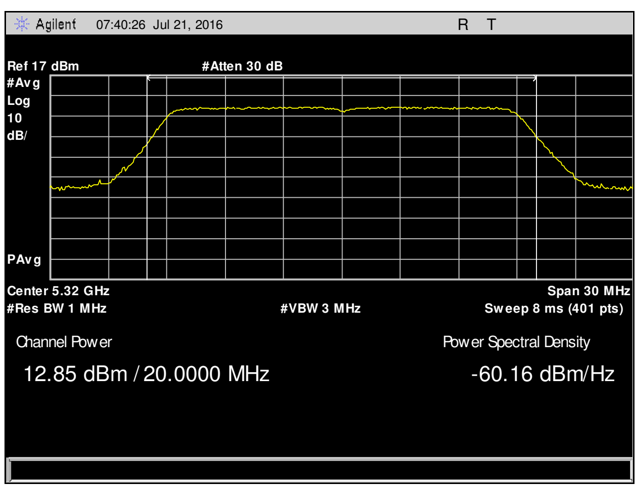
Conducted Output Power, 801.11n 20 MHz, Chain 0



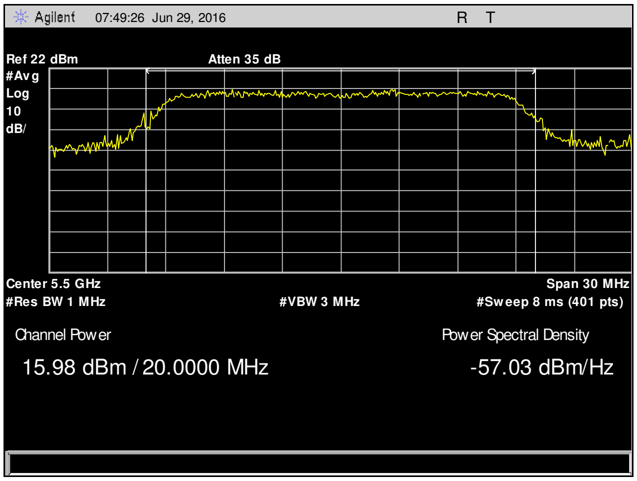
Plot 15. Conducted Output Power, 801.11n 20 MHz, 5260 MHz, Chain 0



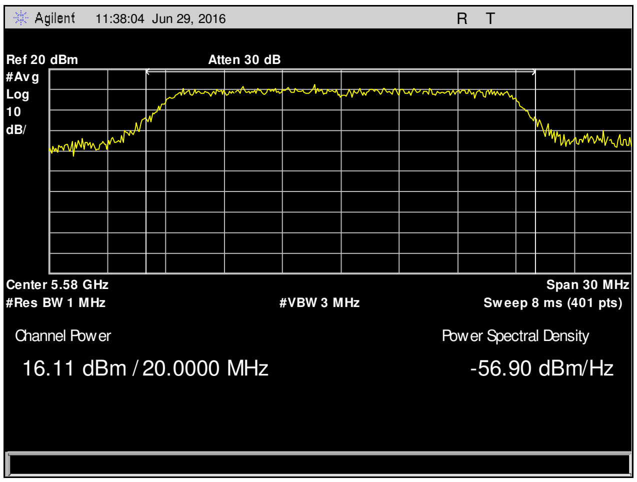
Plot 16. Conducted Output Power, 801.11n 20 MHz, 5300 MHz, Chain 0



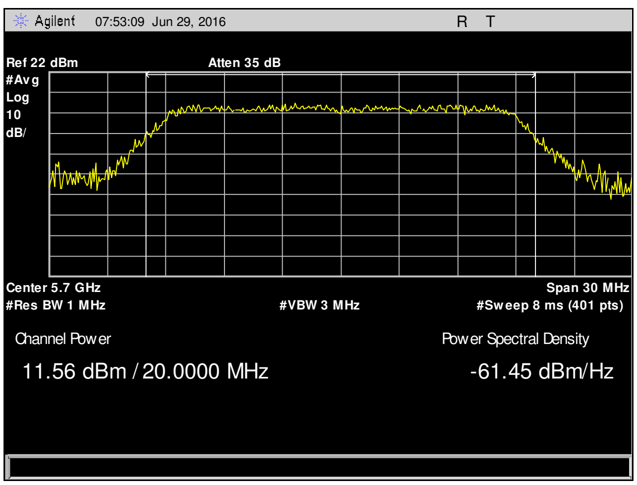
Plot 17. Conducted Output Power, 801.11n 20 MHz, 5320 MHz, Chain 0



Plot 18. Conducted Output Power, 801.11n 20 MHz, 5500 MHz, Chain 0

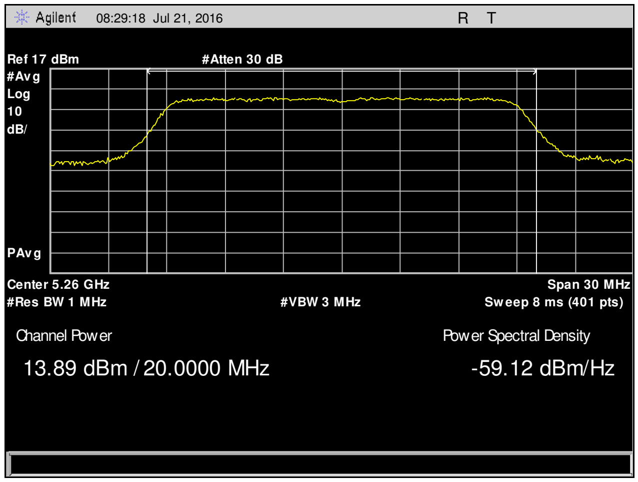


Plot 19. Conducted Output Power, 801.11n 20 MHz, 5580 MHz, Chain 0

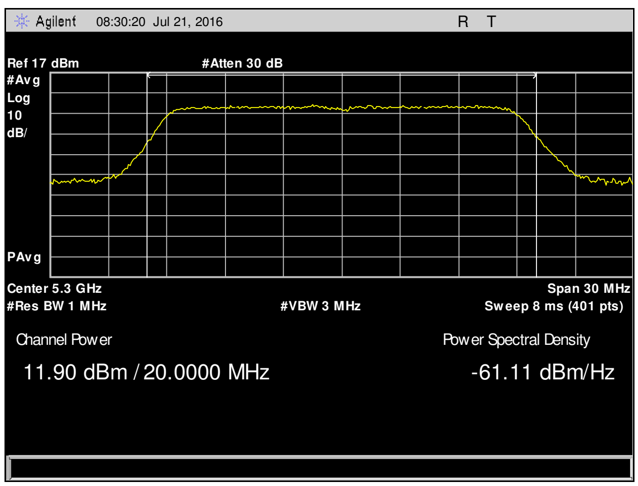


Plot 20. Conducted Output Power, 801.11n 20 MHz, 5700 MHz, Chain 0

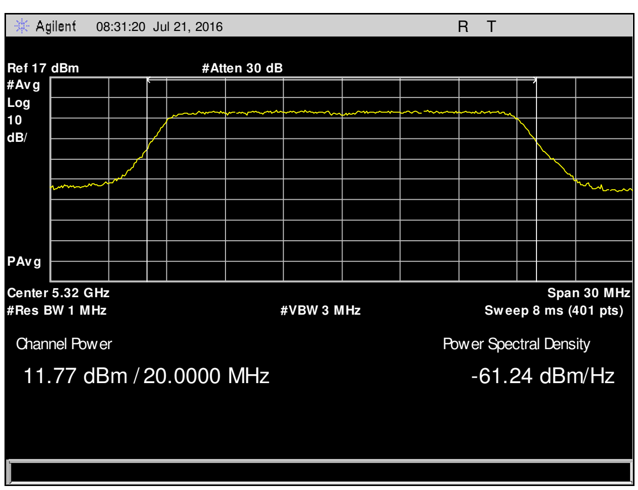
Conducted Output Power, 801.11n 20 MHz, Chain 1



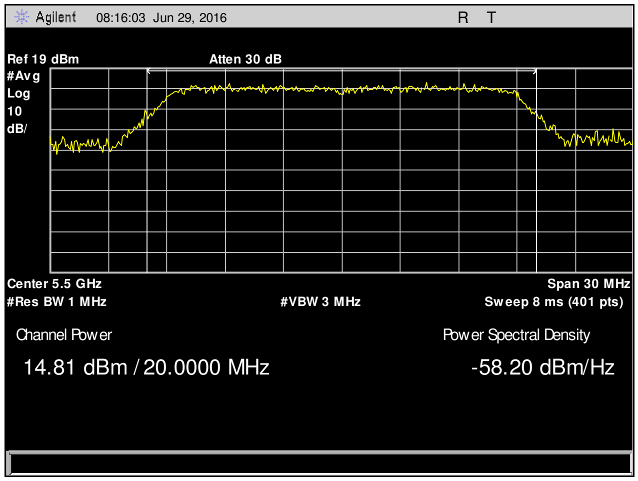
Plot 21. Conducted Output Power, 801.11n 20 MHz, 5260 MHz, Chain 1



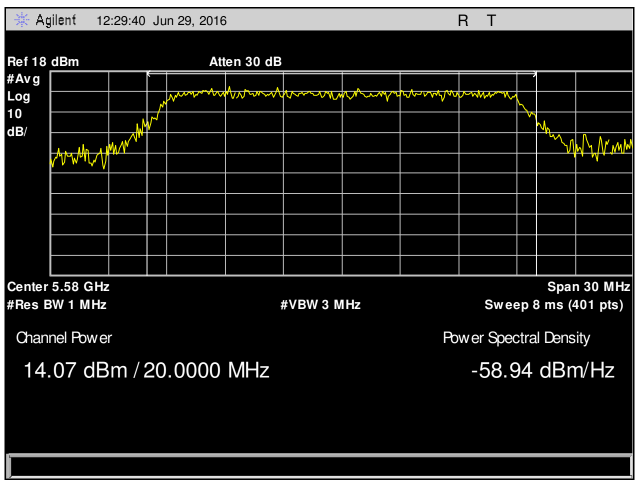
Plot 22. Conducted Output Power, 801.11n 20 MHz, 5300 MHz, Chain 1



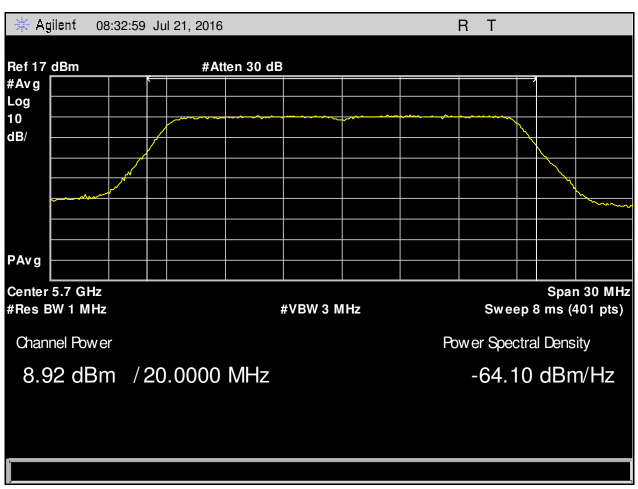
Plot 23. Conducted Output Power, 801.11n 20 MHz, 5320 MHz, Chain 1



Plot 24. Conducted Output Power, 801.11n 20 MHz, 5500 MHz, Chain 1

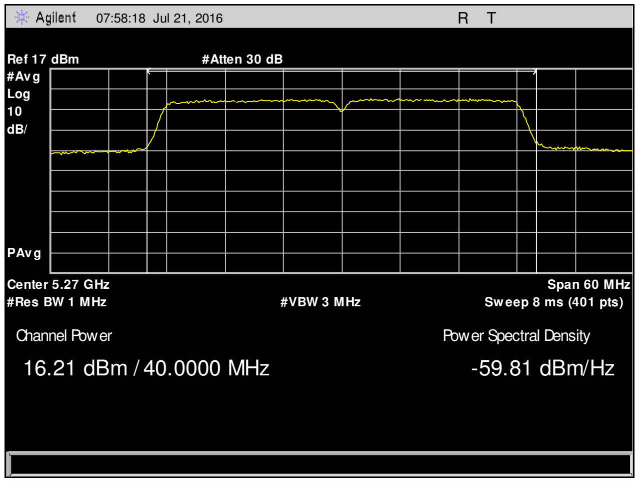


Plot 25. Conducted Output Power, 801.11n 20 MHz, 5580 MHz, Chain 1

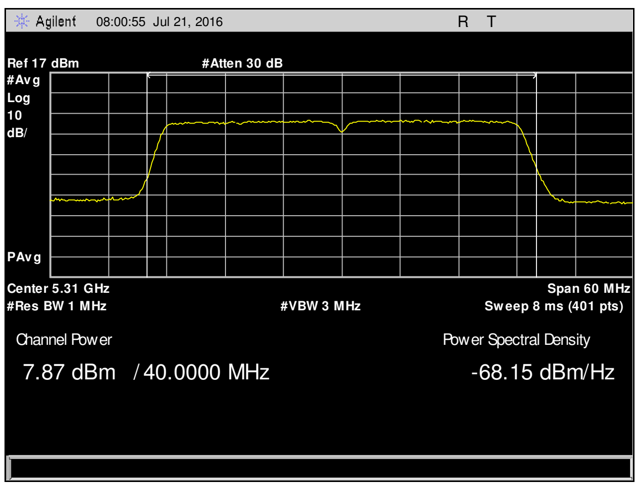


Plot 26. Conducted Output Power, 801.11n 20 MHz, 5700 MHz, Chain 1

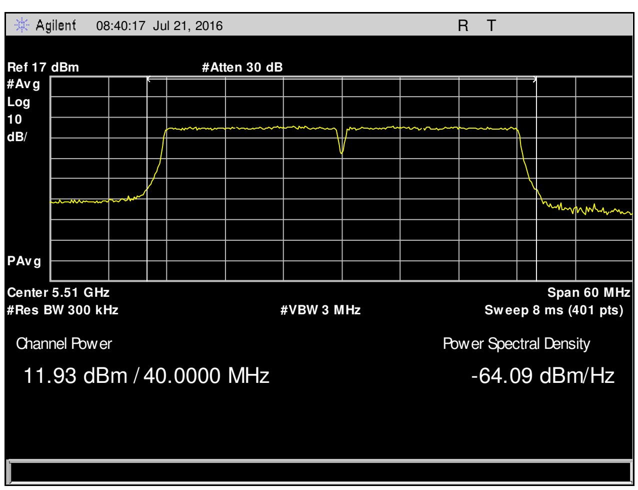
Conducted Output Power, 801.11n 40 MHz, Chain 0



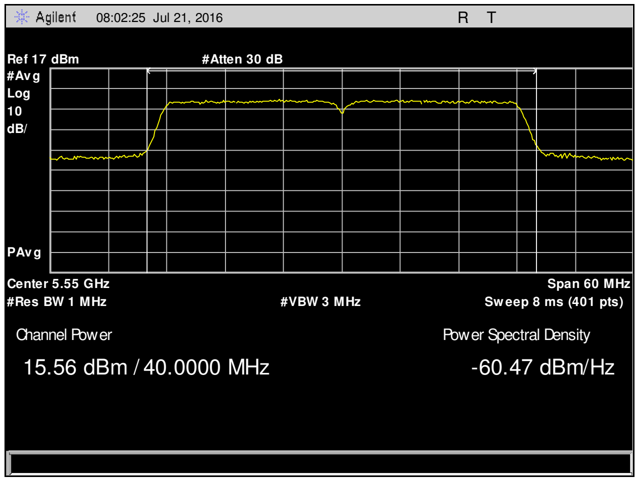
Plot 27. Conducted Output Power, 801.11n 40 MHz, 5270 MHz, Chain 0



Plot 28. Conducted Output Power, 801.11n 40 MHz, 5310 MHz, Chain 0

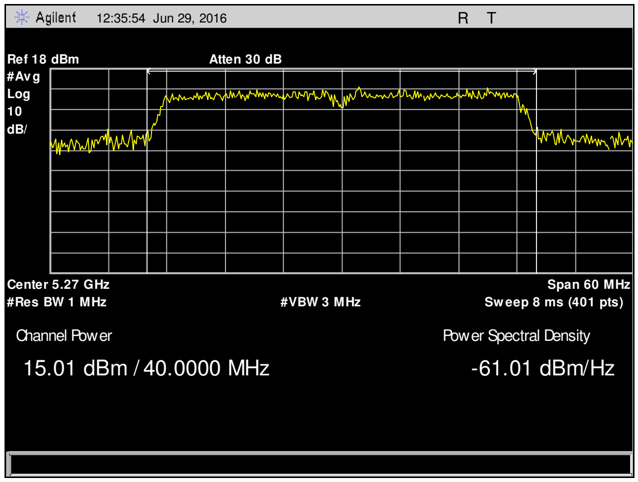


Plot 29. Conducted Output Power, 801.11n 40 MHz, 5510 MHz, Chain 0

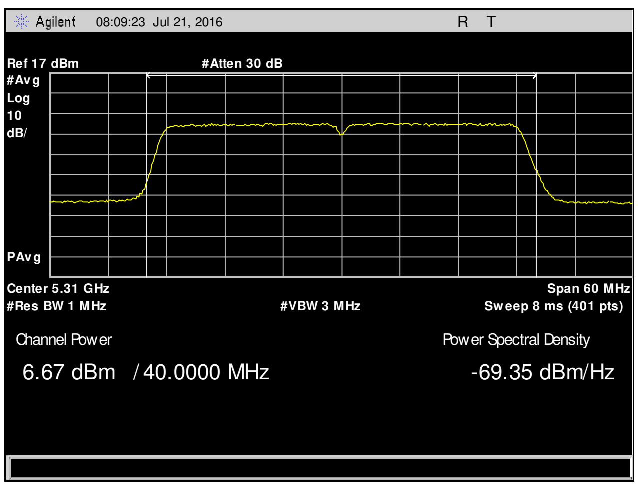


Plot 30. Conducted Output Power, 801.11n 40 MHz, 5550 MHz, Chain 0

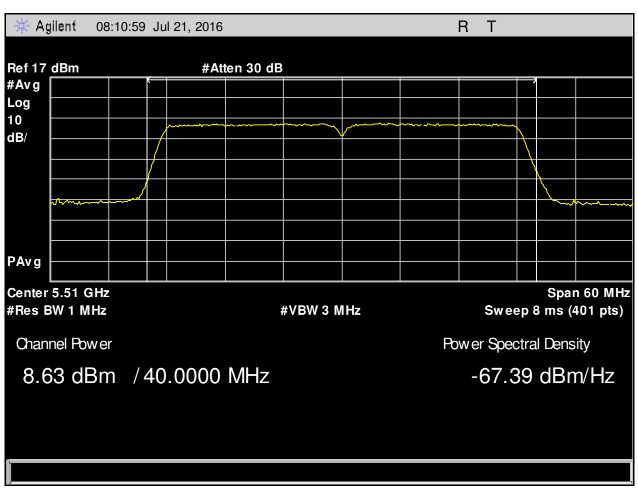
Conducted Output Power, 801.11n 40 MHz, Chain 1



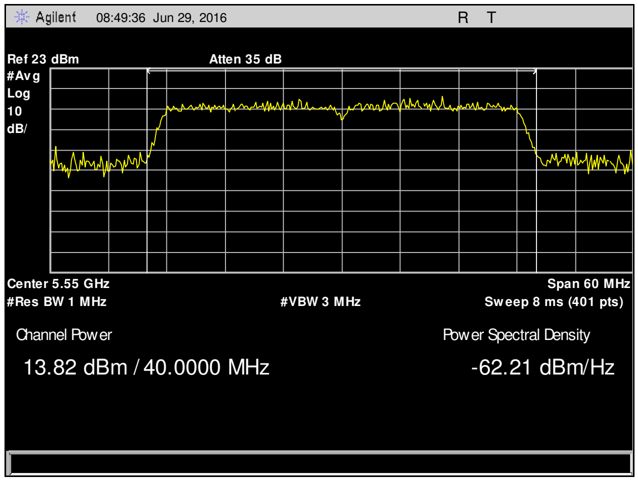
Plot 31. Conducted Output Power, 801.11n 40 MHz, 5270 MHz, Chain 1



Plot 32. Conducted Output Power, 801.11n 40 MHz, 5310 MHz, Chain 1



Plot 33. Conducted Output Power, 801.11n 40 MHz, 5510 MHz, Chain 1



Plot 34. Conducted Output Power, 801.11n 40 MHz, 5550 MHz, Chain 1

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. Both antenna chains were transmitting. 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).

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.

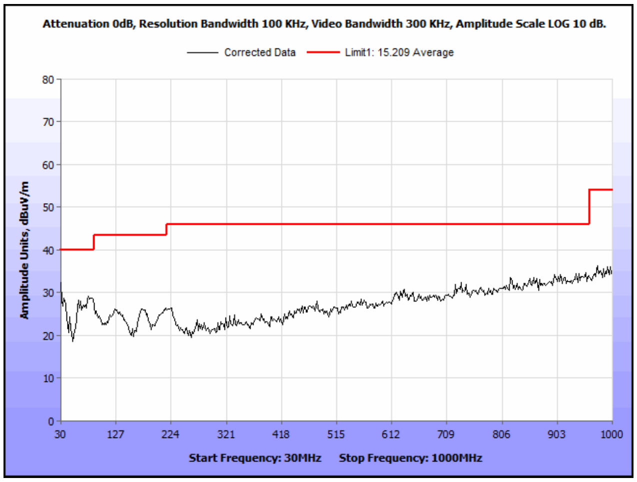
For above 1 GHz, the EUT was compliant with the requirements of this section.

NOTE: Only noise floor was measured above 18 GHz.

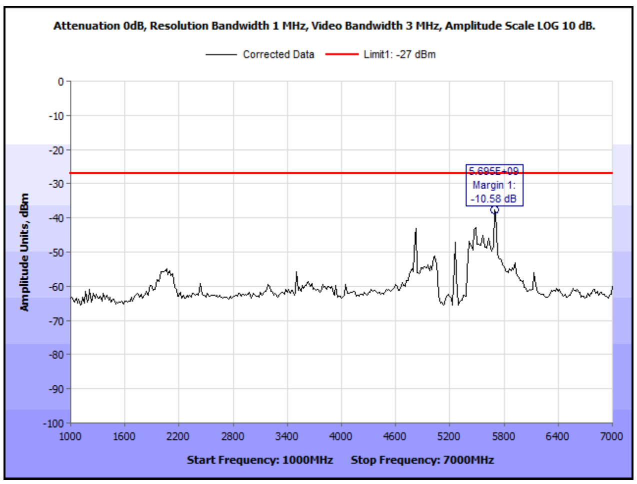
Test Engineer(s): Kristine Cabrera and Arsalan Hasan

Test Date(s): 08/03/16

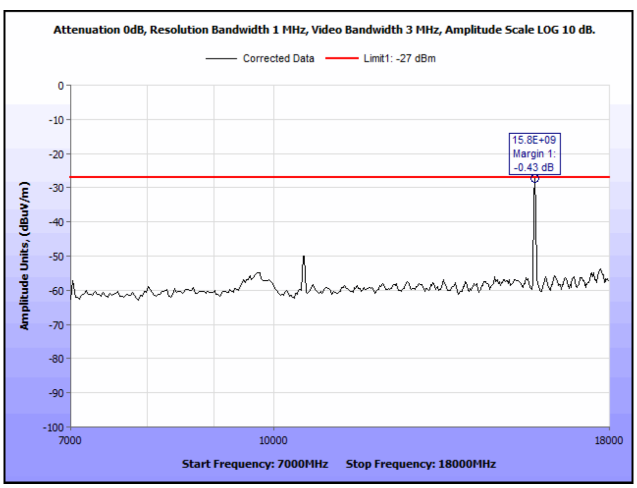
Radiated Spurious Emissions, 802.11a 20 MHz



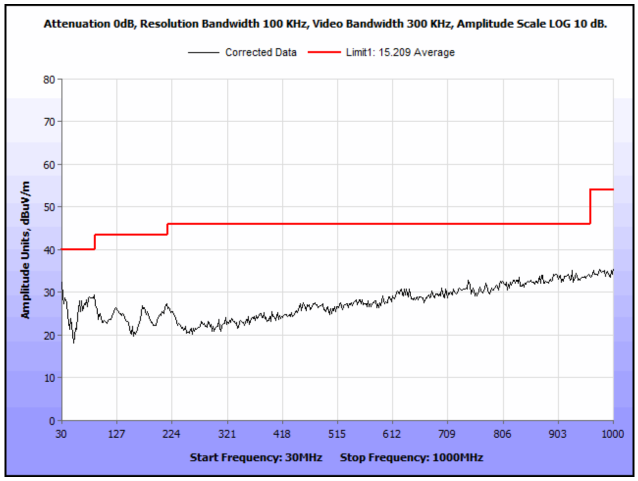
Plot 35. Radiated Spurious Emissions, 802.11a 20 MHz, 5260 MHz, Both Chains, 30 MHz – 1 GHz



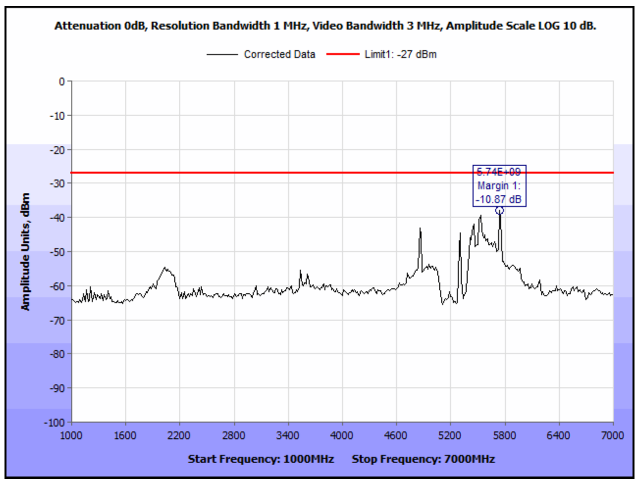
Plot 36. Radiated Spurious Emissions, 802.11a 20 MHz, 5260 MHz, Both Chains, 1 GHz – 7 GHz



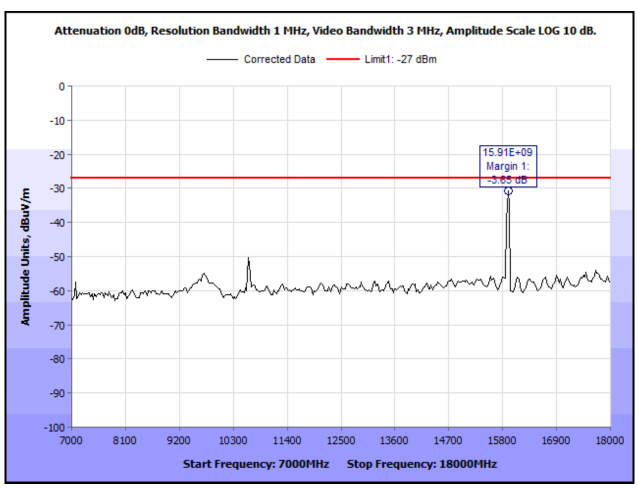
Plot 37. Radiated Spurious Emissions, 802.11a 20 MHz, 5260 MHz, Both Chains, 7 GHz – 18 GHz



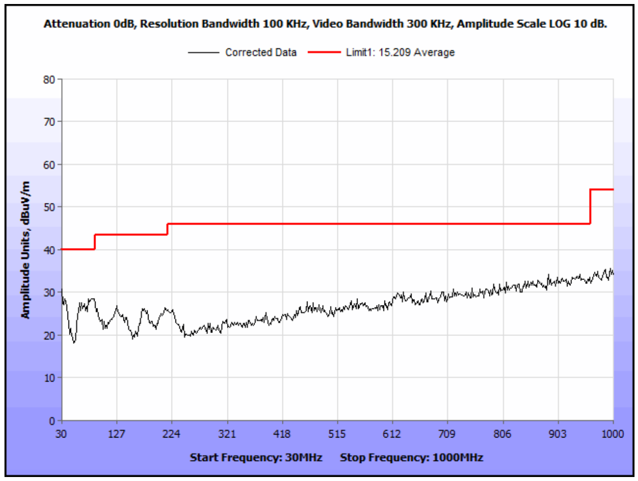
Plot 38. Radiated Spurious Emissions, 802.11a 20 MHz, 5300 MHz, Both Chains, 30 MHz – 1 GHz



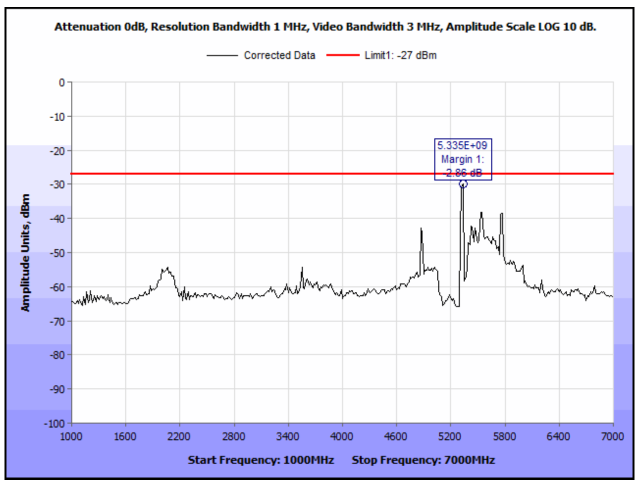
Plot 39. Radiated Spurious Emissions, 802.11a 20 MHz, 5300 MHz, Both Chains, 1 GHz – 7 GHz



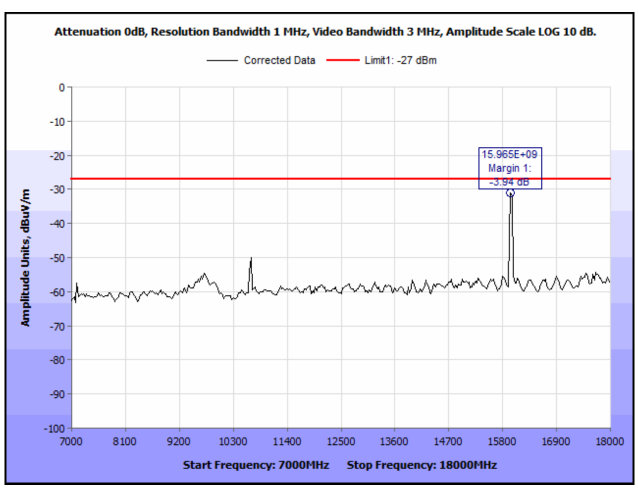
Plot 40. Radiated Spurious Emissions, 802.11a 20 MHz, 5300 MHz, Both Chains, 7 GHz – 18 GHz



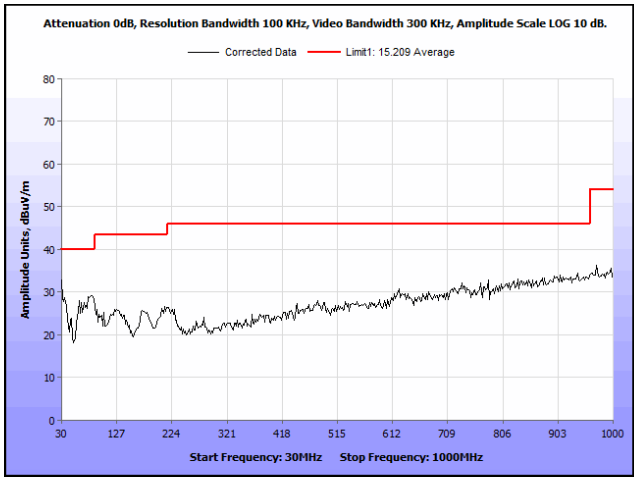
Plot 41. Radiated Spurious Emissions, 802.11a 20 MHz, 5320 MHz, Both Chains, 30 MHz – 1 GHz



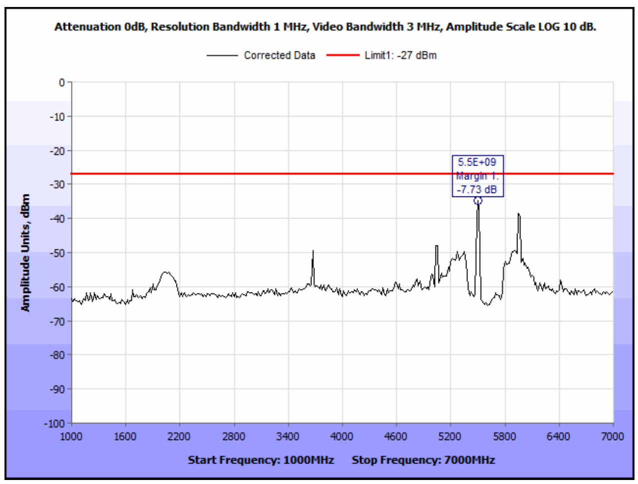
Plot 42. Radiated Spurious Emissions, 802.11a 20 MHz, 5320 MHz, Both Chains, 1 GHz – 7 GHz



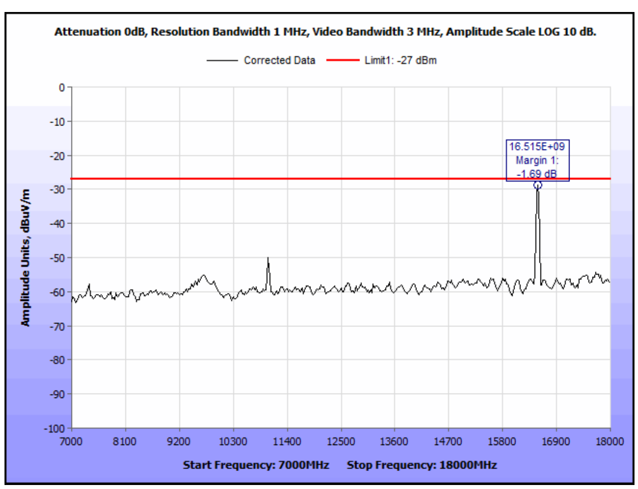
Plot 43. Radiated Spurious Emissions, 802.11a 20 MHz, 5320 MHz, Both Chains, 7 GHz – 18 GHz



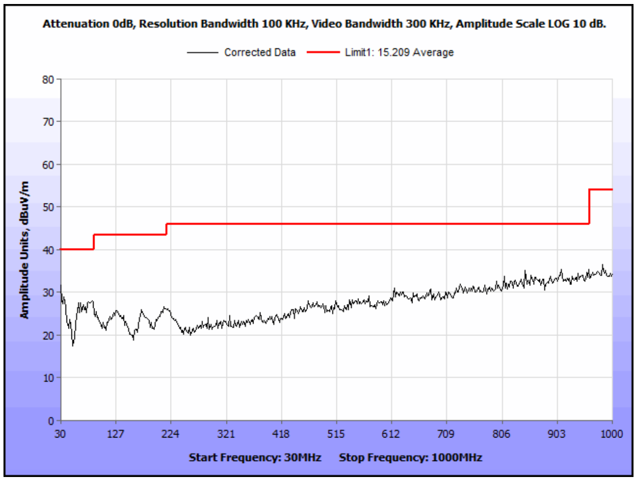
Plot 44. Radiated Spurious Emissions, 802.11a 20 MHz, 5500 MHz, Both Chains, 30 MHz – 1 GHz



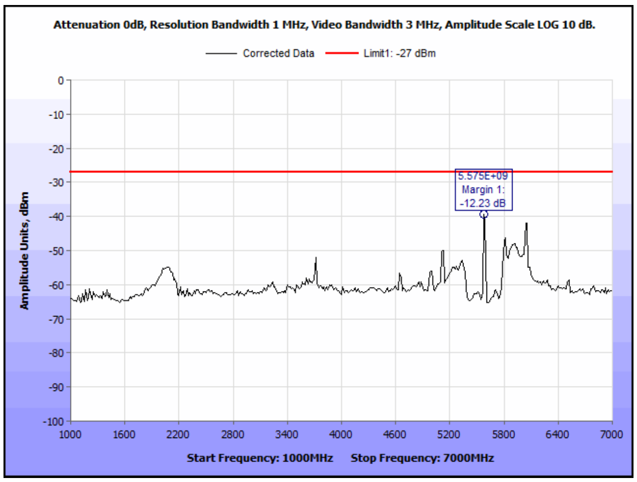
Plot 45. Radiated Spurious Emissions, 802.11a 20 MHz, 5500 MHz, Both Chains, 1 GHz – 7 GHz



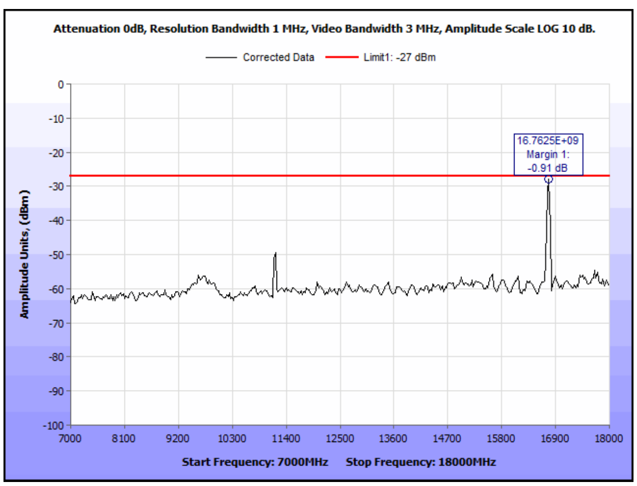
Plot 46. Radiated Spurious Emissions, 802.11a 20 MHz, 5500 MHz, Both Chains, 7 GHz – 18 GHz



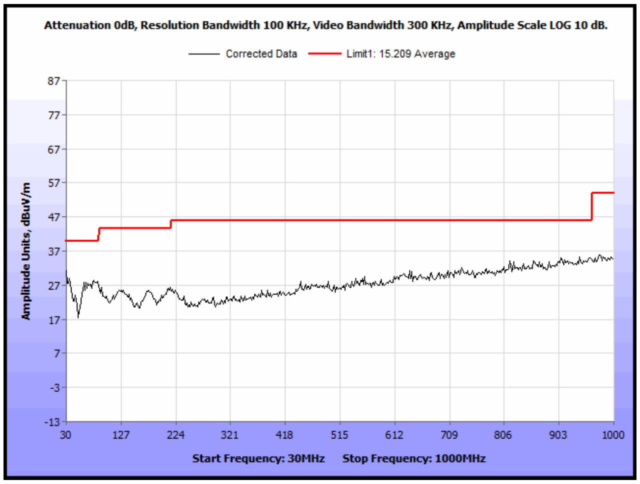
Plot 47. Radiated Spurious Emissions, 802.11a 20 MHz, 5580 MHz, Both Chains, 30 MHz – 1 GHz



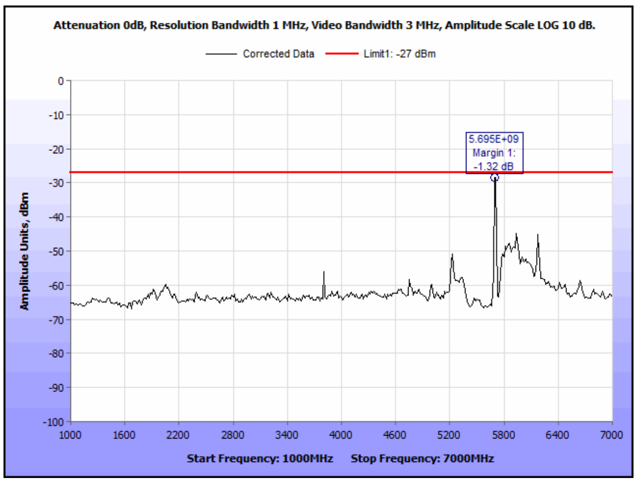
Plot 48. Radiated Spurious Emissions, 802.11a 20 MHz, 5580 MHz, Both Chains, 1 GHz – 7 GHz



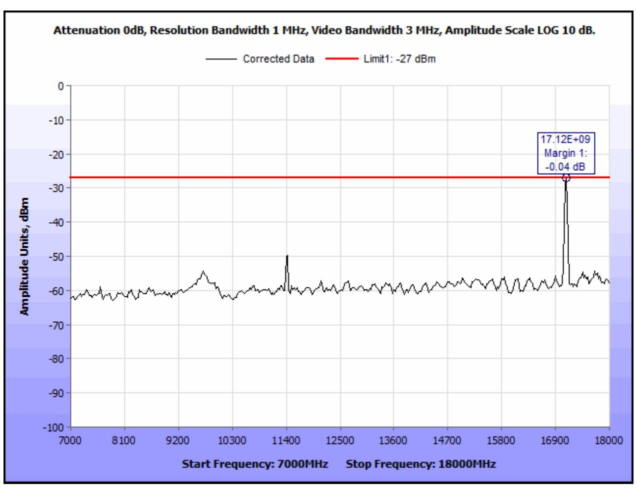
Plot 49. Radiated Spurious Emissions, 802.11a 20 MHz, 5580 MHz, Both Chains, 7 GHz – 18 GHz



Plot 50. Radiated Spurious Emissions, 802.11a 20 MHz, 5700 MHz, Both Chains, 30 MHz – 1 GHz

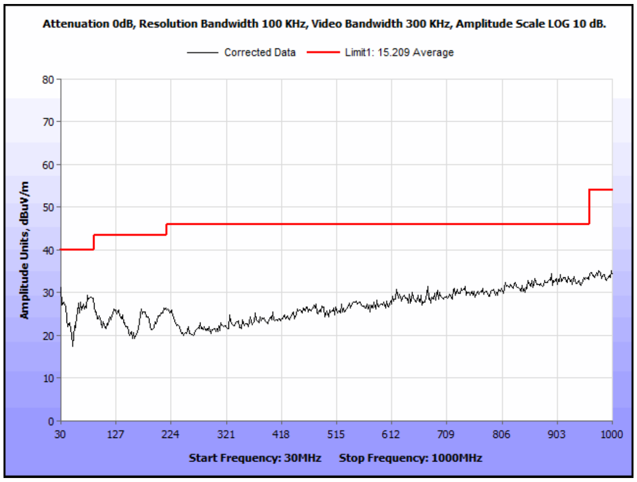


Plot 51. Radiated Spurious Emissions, 802.11a 20 MHz, 5700 MHz, Both Chains, 1 GHz – 7 GHz

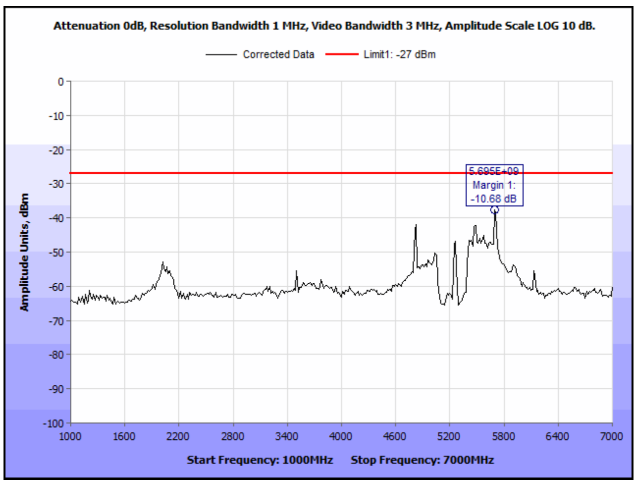


Plot 52. Radiated Spurious Emissions, 802.11a 20 MHz, 5700 MHz, Both Chains, 7 GHz – 18 GHz

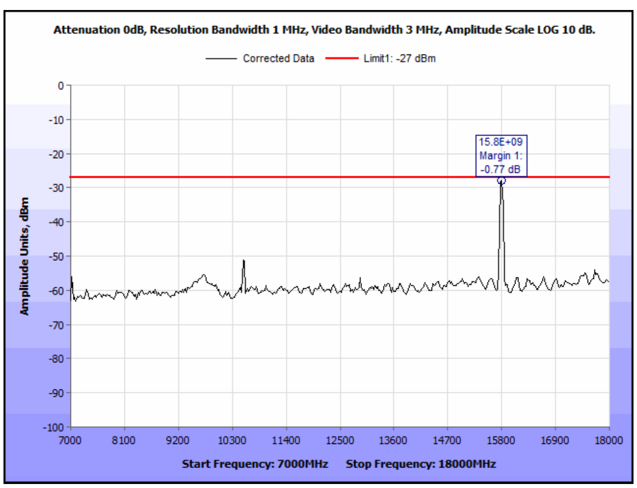
Radiated Spurious Emissions, 802.11n 20 MHz



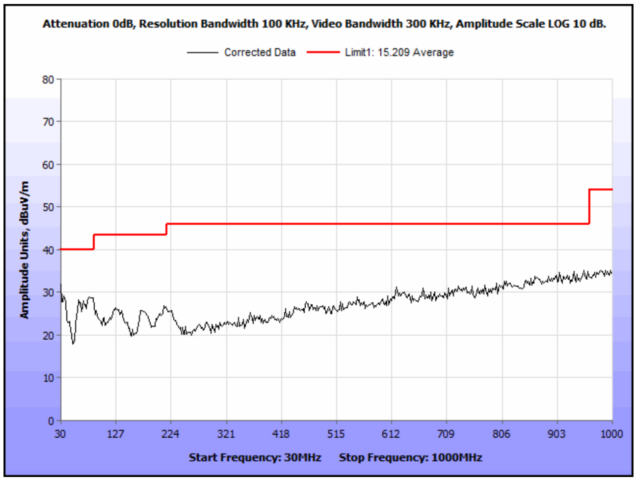
Plot 53. Radiated Spurious Emissions, 802.11n 20 MHz, 5260 MHz, Both Chains, 30 MHz – 1 GHz



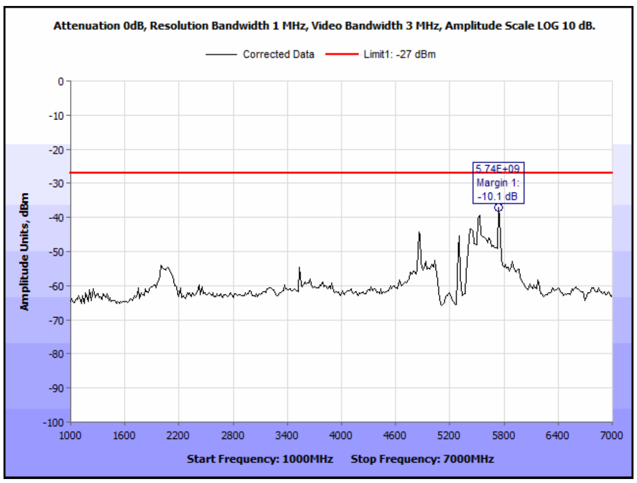
Plot 54. Radiated Spurious Emissions, 802.11n 20 MHz, 5260 MHz, Both Chains, 1 GHz – 7 GHz



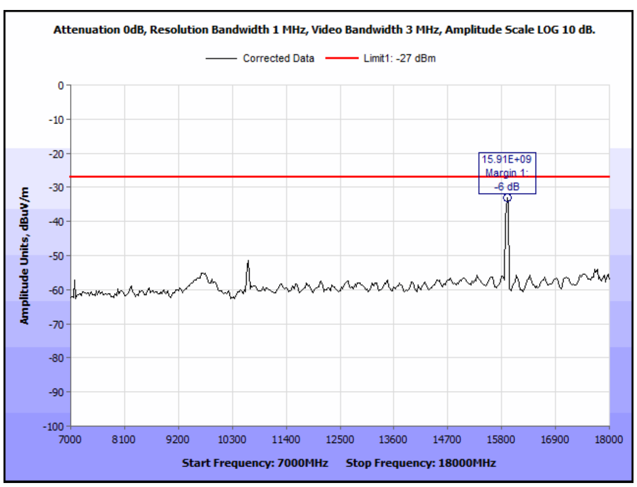
Plot 55. Radiated Spurious Emissions, 802.11n 20 MHz, 5260 MHz, Both Chains, 7 GHz – 18 GHz



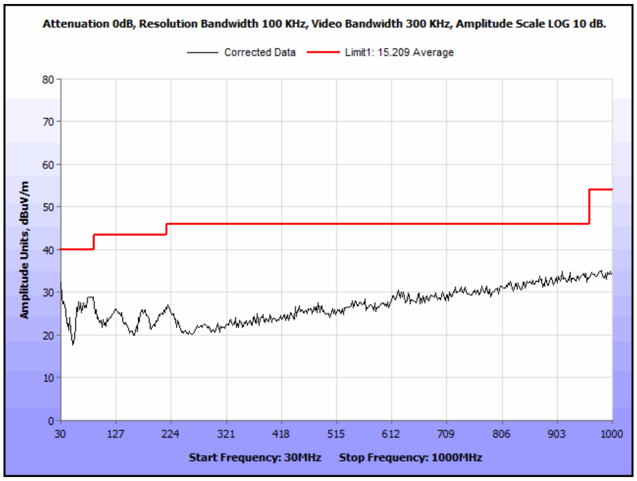
Plot 56. Radiated Spurious Emissions, 802.11n 20 MHz, 5300 MHz, Both Chains, 30 MHz – 1 GHz



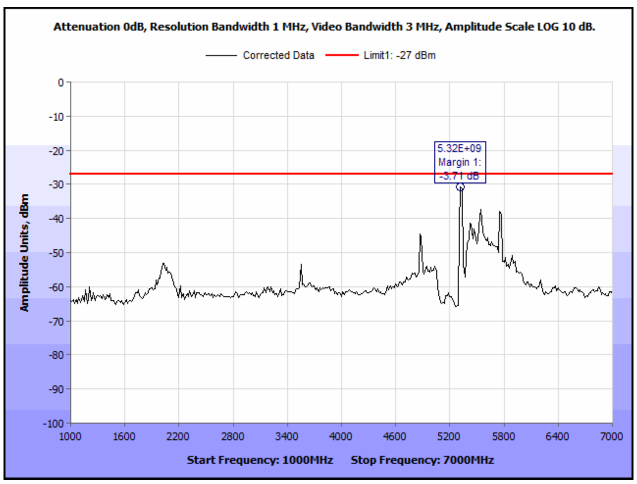
Plot 57. Radiated Spurious Emissions, 802.11n 20 MHz, 5300 MHz, Both Chains, 1 GHz – 7 GHz



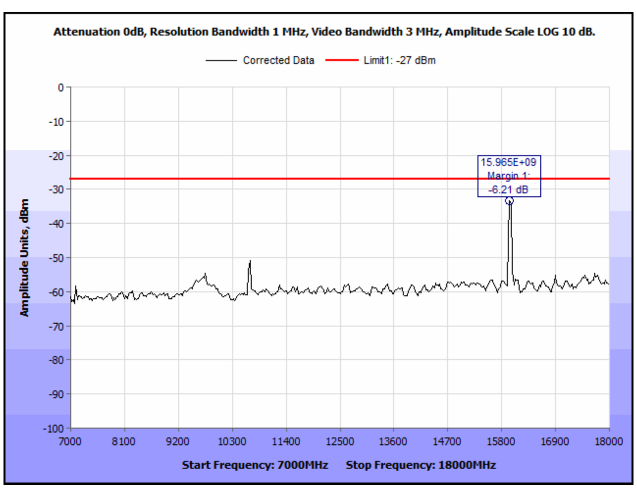
Plot 58. Radiated Spurious Emissions, 802.11n 20 MHz, 5300 MHz, Both Chains, 7 GHz – 18 GHz



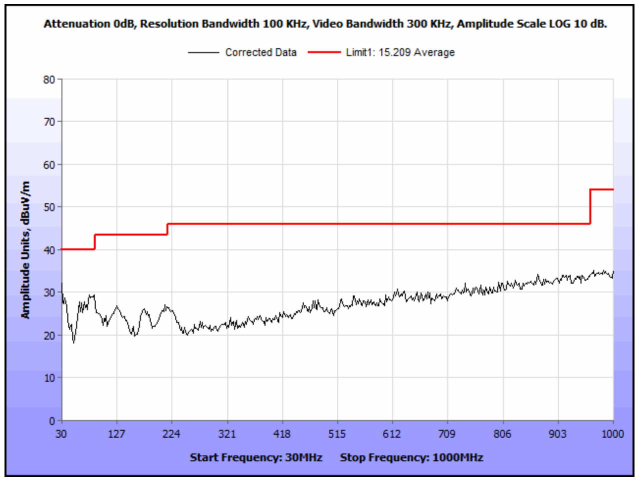
Plot 59. Radiated Spurious Emissions, 802.11n 20 MHz, 5320 MHz, Both Chains, 30 MHz – 1 GHz



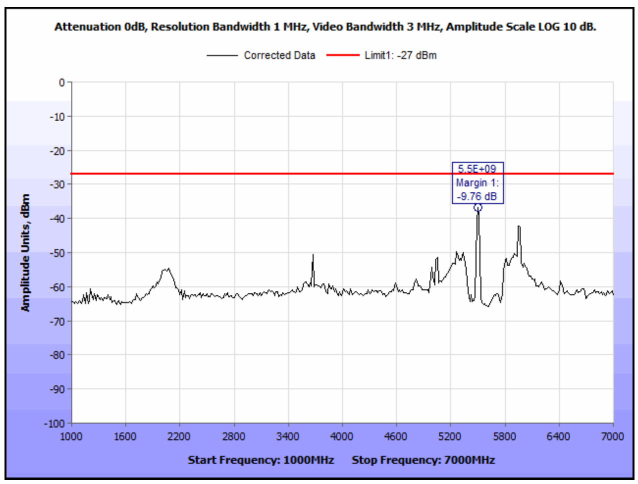
Plot 60. Radiated Spurious Emissions, 802.11n 20 MHz, 5320 MHz, Both Chains, 1 GHz – 7 GHz



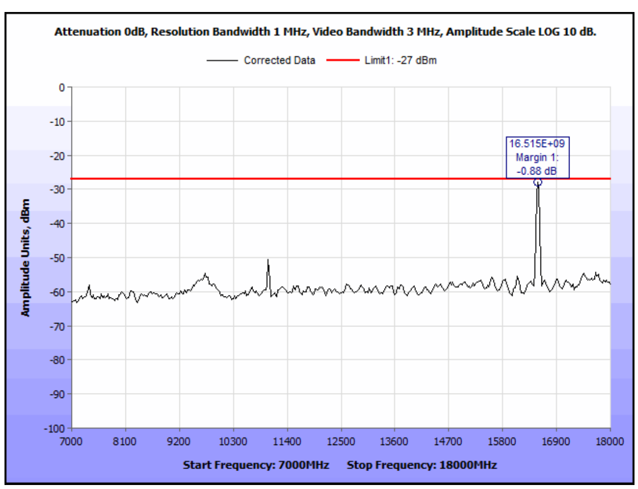
Plot 61. Radiated Spurious Emissions, 802.11n 20 MHz, 5320 MHz, Both Chains, 7 GHz – 18 GHz



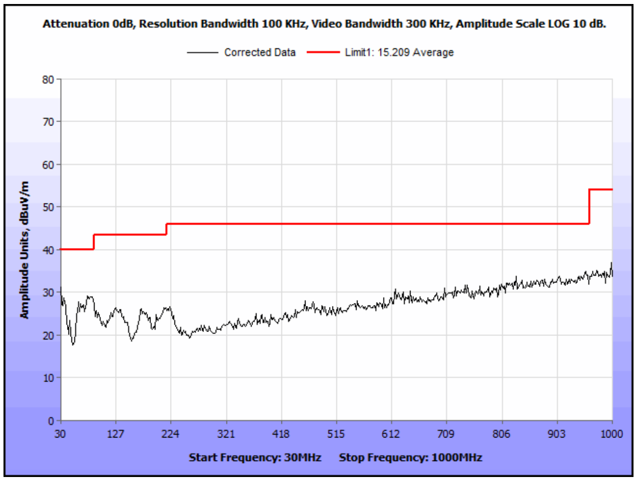
Plot 62. Radiated Spurious Emissions, 802.11n 20 MHz, 5500 MHz, Both Chains, 30 MHz – 1 GHz



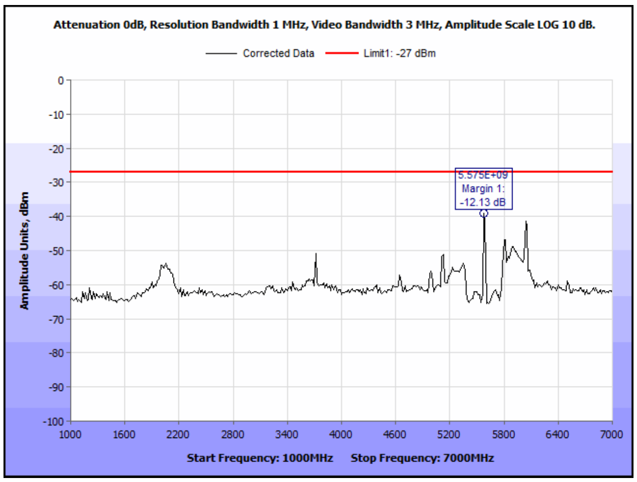
Plot 63. Radiated Spurious Emissions, 802.11n 20 MHz, 5500 MHz, Both Chains, 1 GHz – 7 GHz



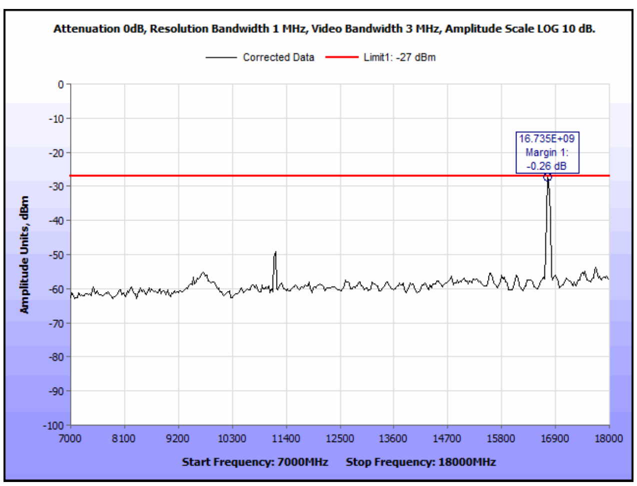
Plot 64. Radiated Spurious Emissions, 802.11n 20 MHz, 5500 MHz, Both Chains, 7 GHz – 18 GHz



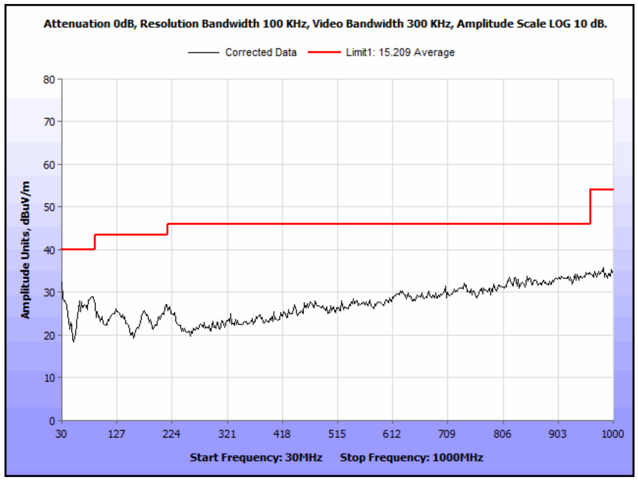
Plot 65. Radiated Spurious Emissions, 802.11n 20 MHz, 5580 MHz, Both Chains, 30 MHz – 1 GHz



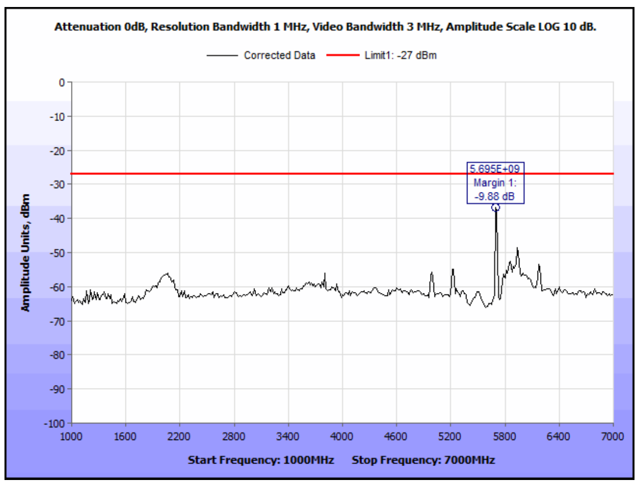
Plot 66. Radiated Spurious Emissions, 802.11n 20 MHz, 5580 MHz, Both Chains, 1 GHz – 7 GHz



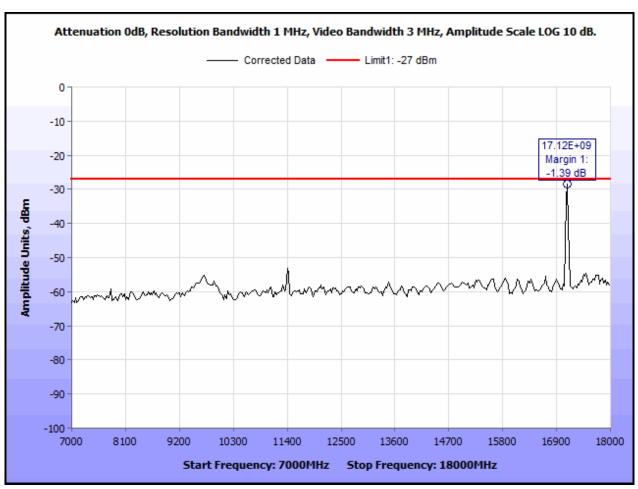
Plot 67. Radiated Spurious Emissions, 802.11n 20 MHz, 5580 MHz, Both Chains, 7 GHz – 18 GHz



Plot 68. Radiated Spurious Emissions, 802.11n 20 MHz, 5700 MHz, Both Chains, 30 MHz – 1 GHz

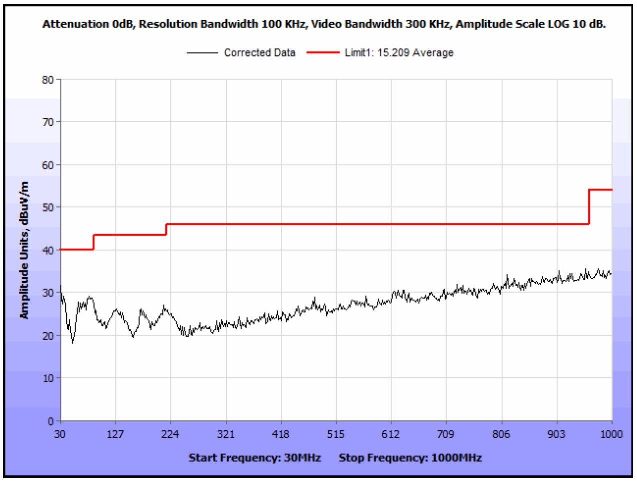


Plot 69. Radiated Spurious Emissions, 802.11n 20 MHz, 5700 MHz, Both Chains, 1 GHz – 7 GHz

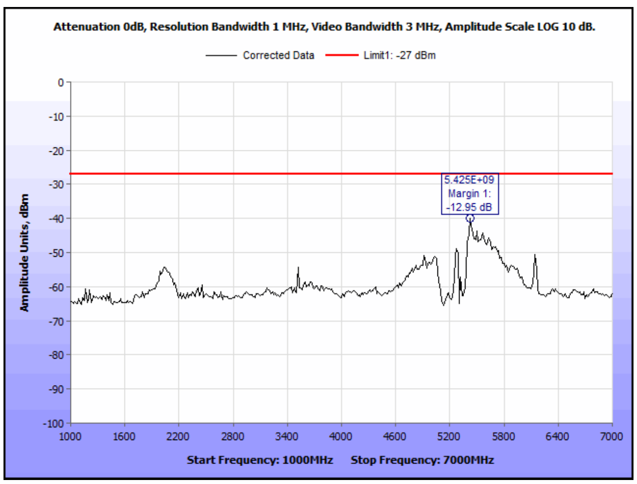


Plot 70. Radiated Spurious Emissions, 802.11n 20 MHz, 5700 MHz, Both Chains, 7 GHz – 18 GHz

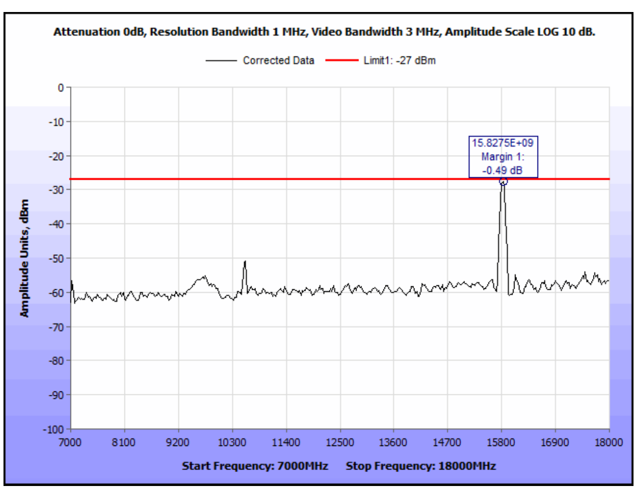
Radiated Spurious Emissions, 802.11n 40 MHz



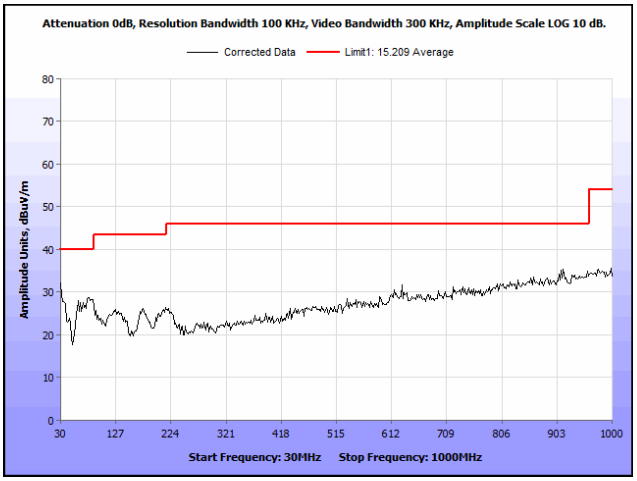
Plot 71. Radiated Spurious Emissions, 802.11n 40 MHz, 5270 MHz, Both Chains, 30 MHz – 1 GHz



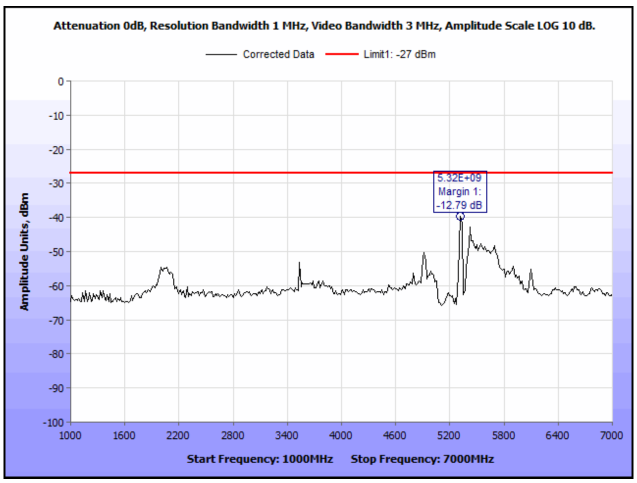
Plot 72. Radiated Spurious Emissions, 802.11n 40 MHz, 5270 MHz, Both Chains, 1 GHz – 7 GHz



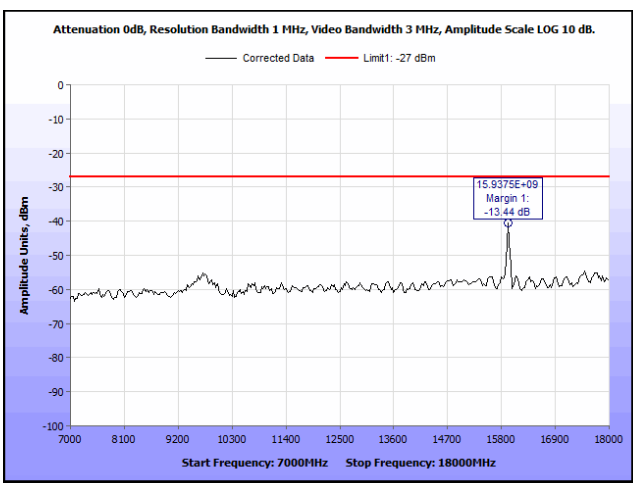
Plot 73. Radiated Spurious Emissions, 802.11n 40 MHz, 5270 MHz, Both Chains, 7 GHz – 18 GHz



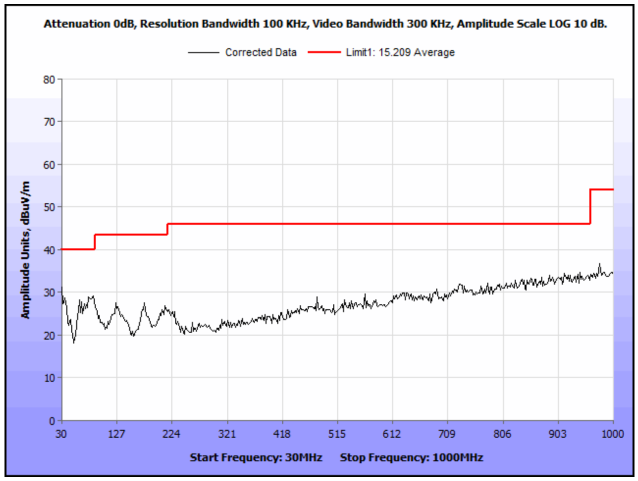
Plot 74. Radiated Spurious Emissions, 802.11n 40 MHz, 5310 MHz, Both Chains, 30 MHz – 1 GHz



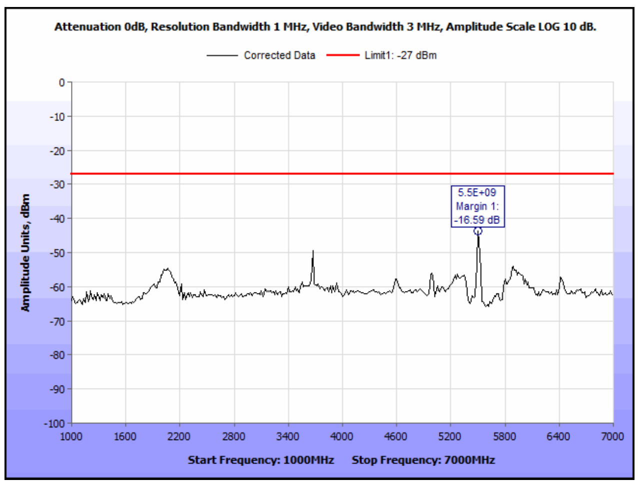
Plot 75. Radiated Spurious Emissions, 802.11n 40 MHz, 5310 MHz, Both Chains, 1 GHz – 7 GHz



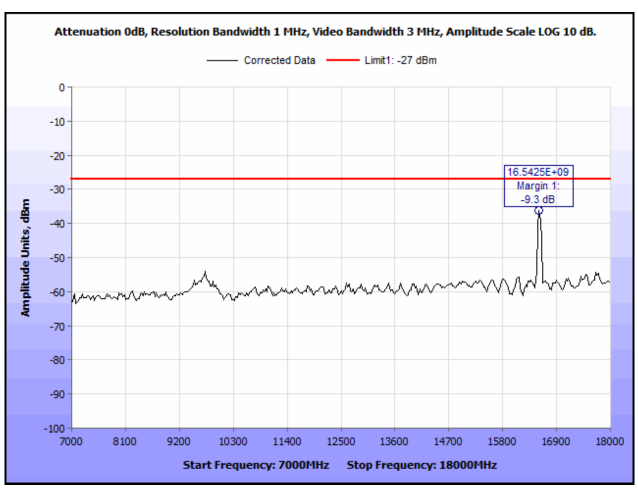
Plot 76. Radiated Spurious Emissions, 802.11n 40 MHz, 5310 MHz, Both Chains, 7 GHz – 18 GHz



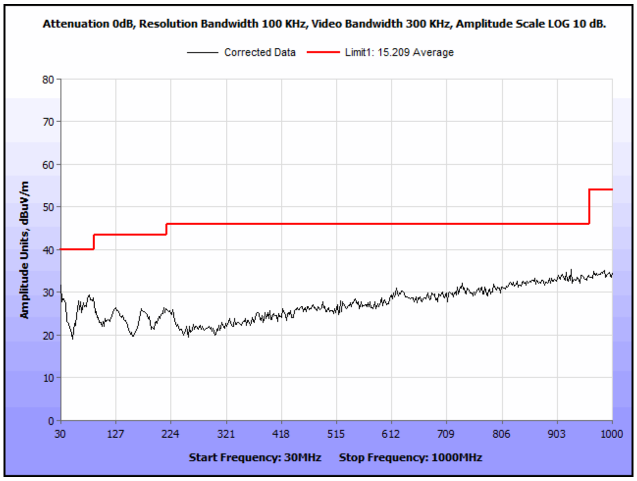
Plot 77. Radiated Spurious Emissions, 802.11n 40 MHz, 5510 MHz, Both Chains, 30 MHz – 1 GHz



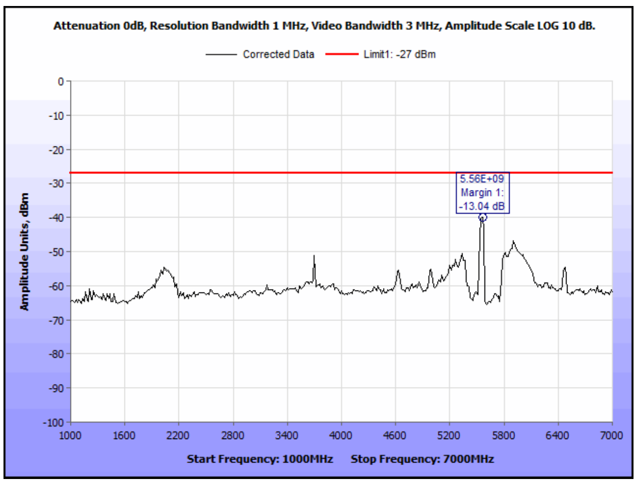
Plot 78. Radiated Spurious Emissions, 802.11n 40 MHz, 5510 MHz, Both Chains, 1 GHz – 7 GHz



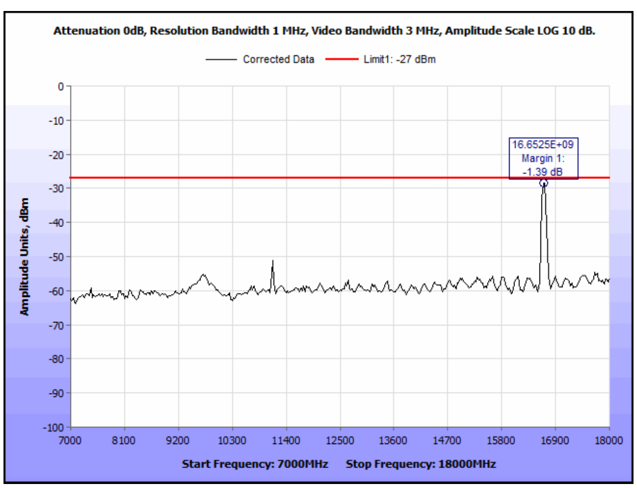
Plot 79. Radiated Spurious Emissions, 802.11n 40 MHz, 5510 MHz, Both Chains, 7 GHz – 18 GHz



Plot 80. Radiated Spurious Emissions, 802.11n 40 MHz, 5550 MHz, Both Chains, 30 MHz – 1 GHz

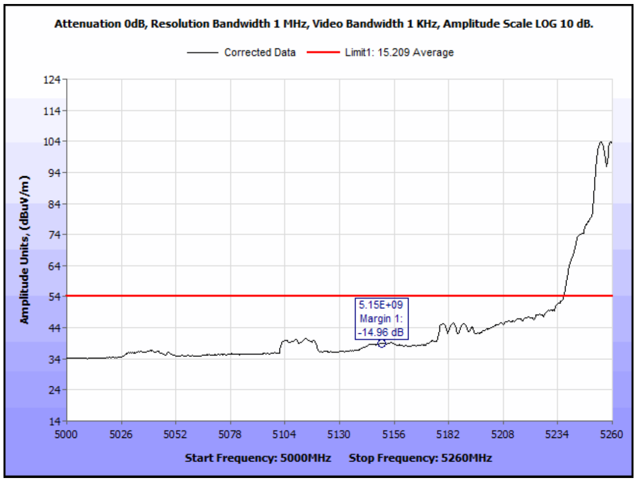


Plot 81. Radiated Spurious Emissions, 802.11n 40 MHz, 5550 MHz, Both Chains, 1 GHz – 7 GHz

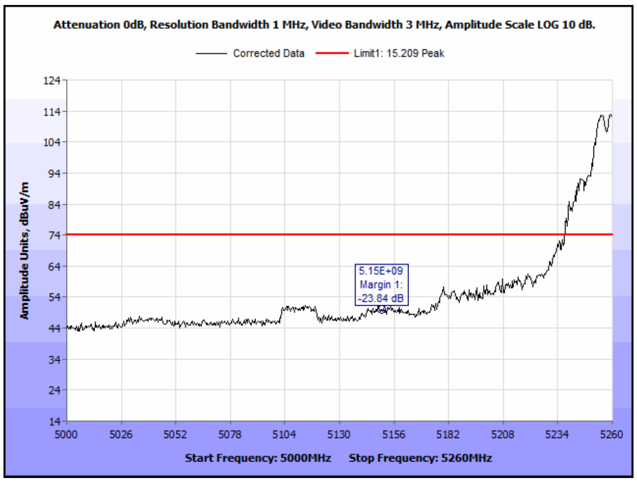


Plot 82. Radiated Spurious Emissions, 802.11n 40 MHz, 5550 MHz, Both Chains, 7 GHz – 18 GHz

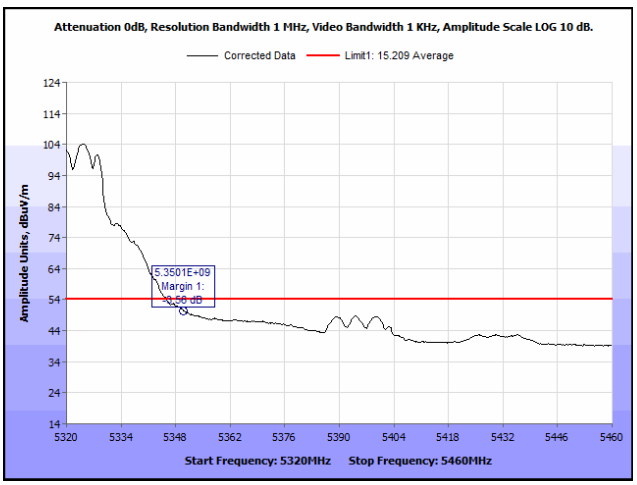
Radiated Band Edge, 802.11a 20 MHz



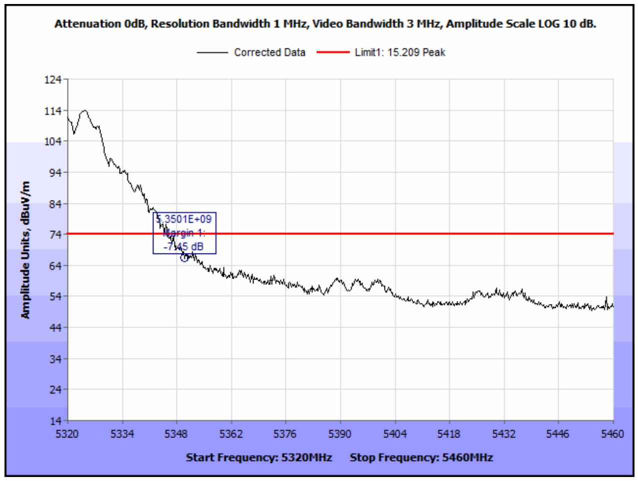
Plot 83. Radiated Band Edge, 802.11a 20 MHz, 5260 MHz, Both Chains, Average



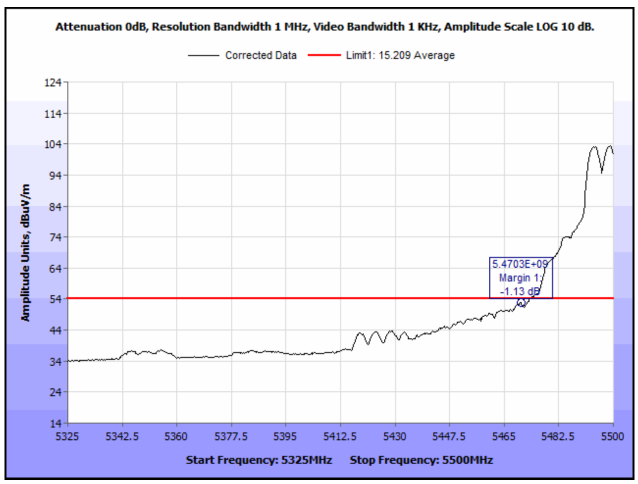
Plot 84. Radiated Band Edge, 802.11a 20 MHz, 5260 MHz, Both Chains, Peak



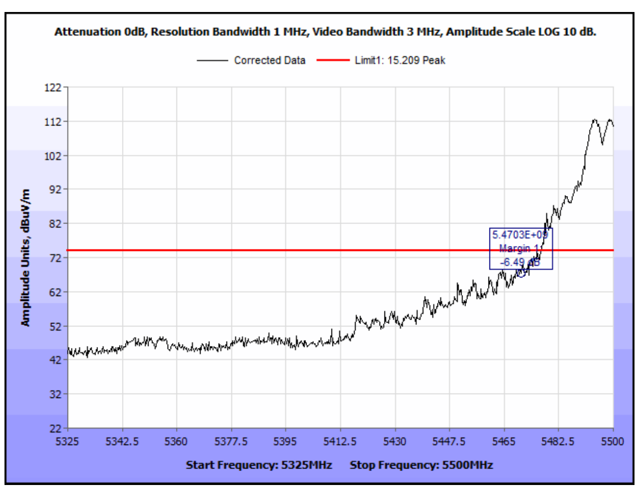
Plot 85. Radiated Band Edge, 802.11a 20 MHz, 5320 MHz, Both Chains, Average



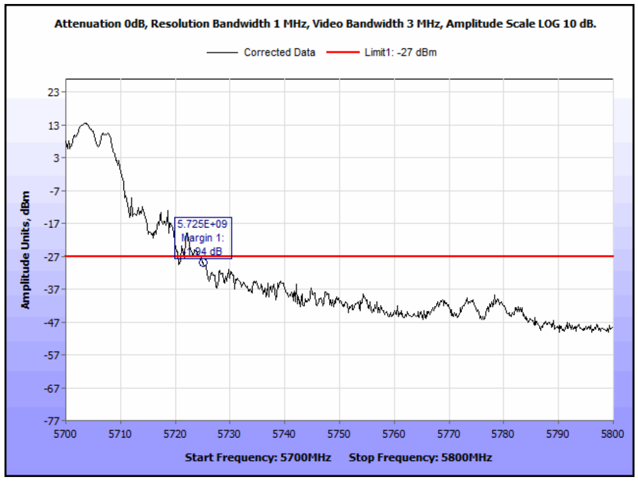
Plot 86. Radiated Band Edge, 802.11a 20 MHz, 5320 MHz, Both Chains, Peak



Plot 87. Radiated Band Edge, 802.11a 20 MHz, 5500 MHz, Both Chains, Average

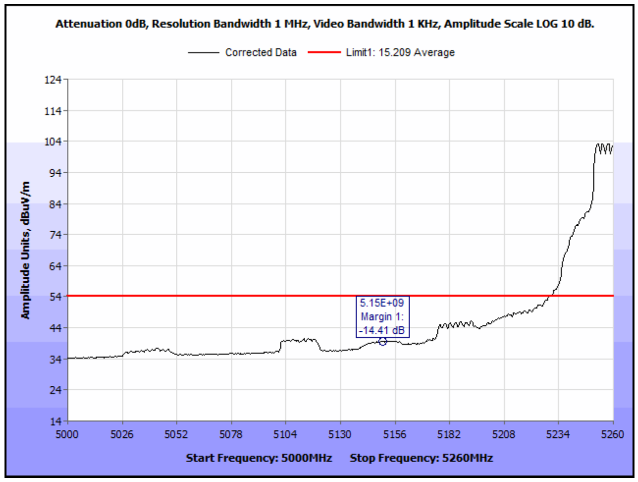


Plot 88. Radiated Band Edge, 802.11a 20 MHz, 5500 MHz, Both Chains, Peak

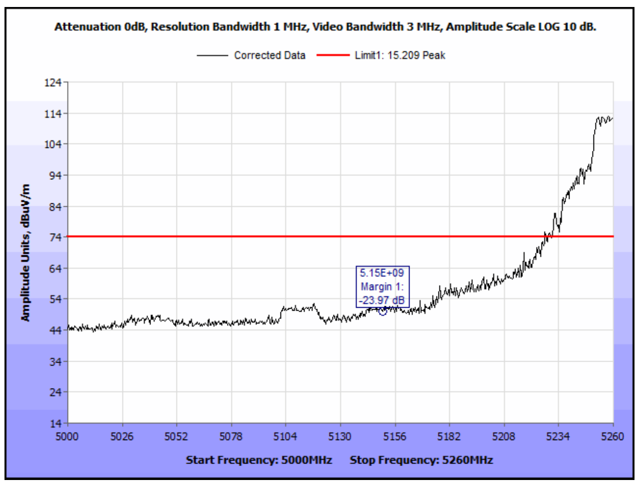


Plot 89. Radiated Band Edge, 802.11a 20 MHz, 5700 MHz, Both Chains

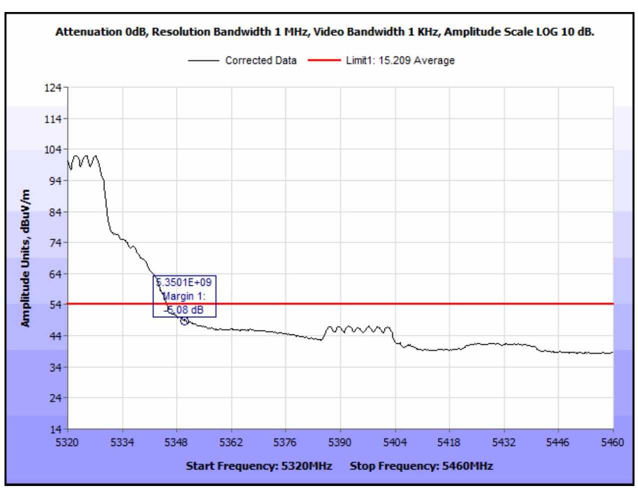
Radiated Band Edge, 802.11n 20 MHz



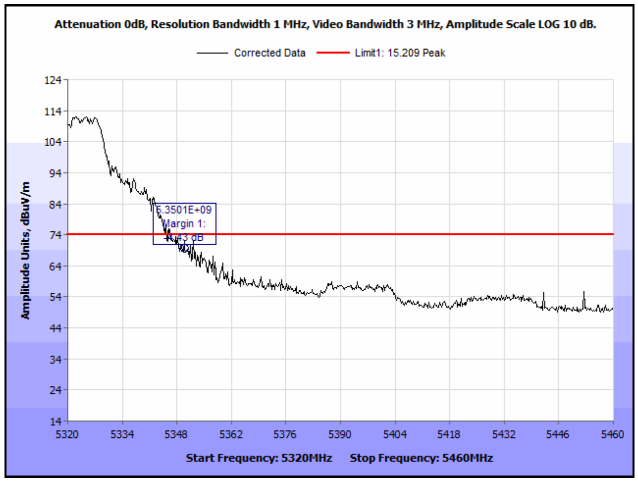
Plot 90. Radiated Band Edge, 802.11n 20 MHz, 5260 MHz, Both Chains, Average



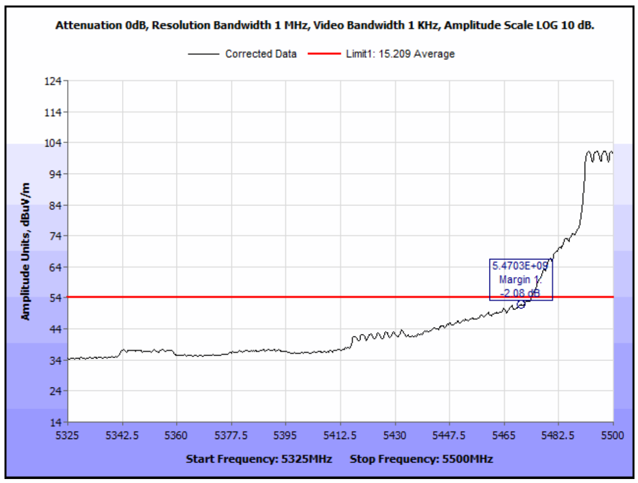
Plot 91. Radiated Band Edge, 802.11n 20 MHz, 5260 MHz, Both Chains, Peak



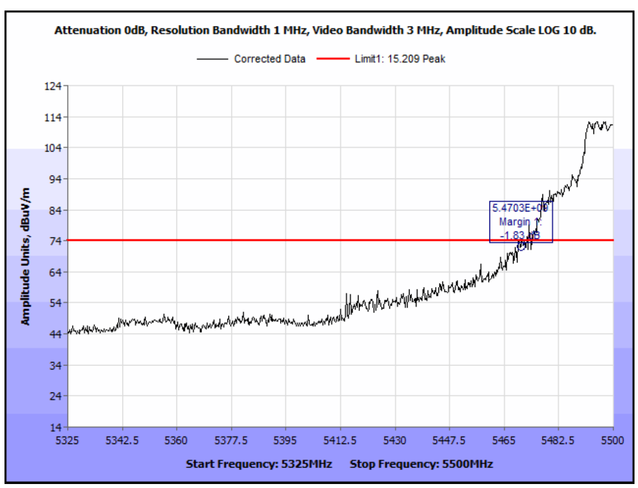
Plot 92. Radiated Band Edge, 802.11n 20 MHz, 5320 MHz, Both Chains, Average



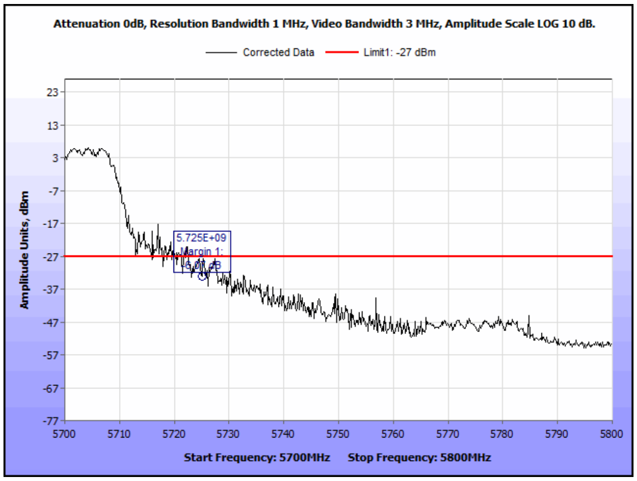
Plot 93. Radiated Band Edge, 802.11n 20 MHz, 5320 MHz, Both Chains, Peak



Plot 94. Radiated Band Edge, 802.11n 20 MHz, 5500 MHz, Both Chains, Average

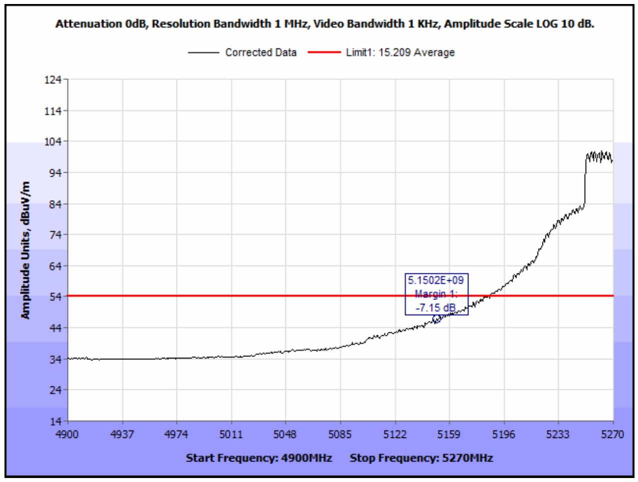


Plot 95. Radiated Band Edge, 802.11n 20 MHz, 5500 MHz, Both Chains, Peak

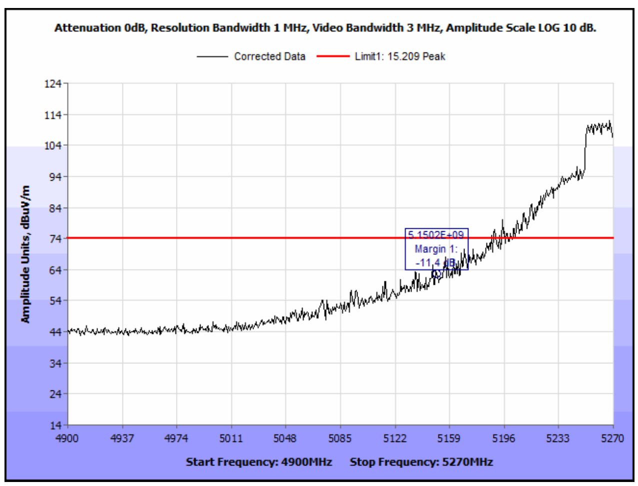


Plot 96. Radiated Band Edge, 802.11n 20 MHz, 5700 MHz, Both Chains

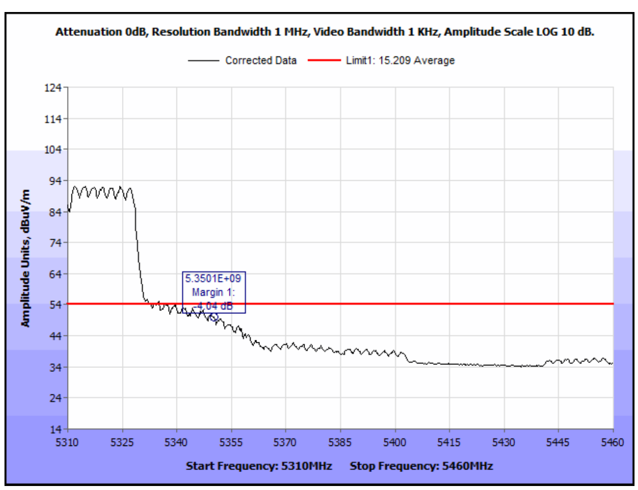
Radiated Band Edge, 802.11n 40 MHz



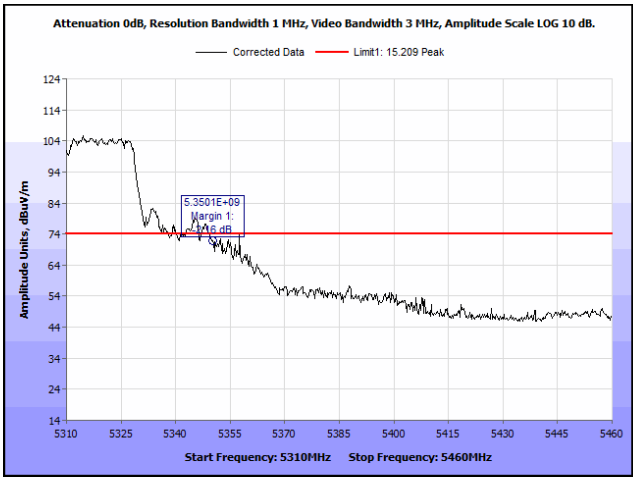
Plot 97. Radiated Band Edge, 802.11n 40 MHz, 5270 MHz, Both Chains, Average



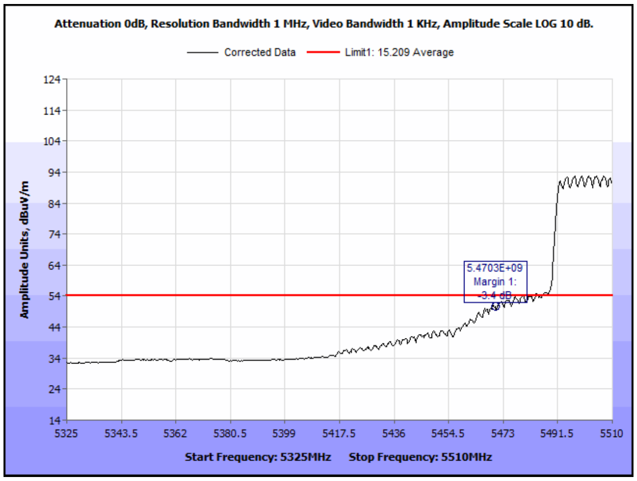
Plot 98. Radiated Band Edge, 802.11n 40 MHz, 5270 MHz, Both Chains, Peak



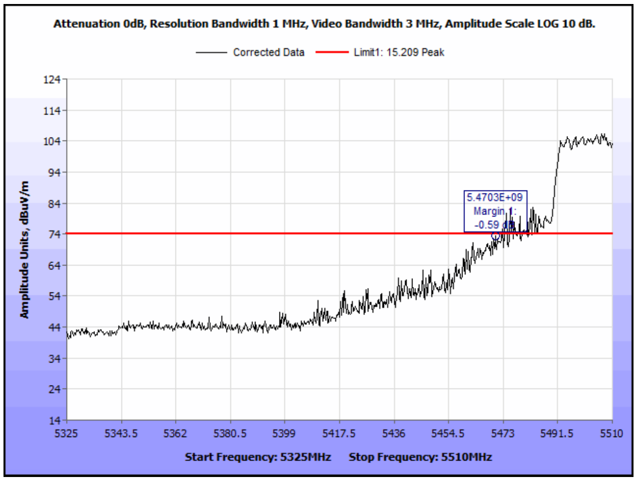
Plot 99. Radiated Band Edge, 802.11n 40 MHz, 5310 MHz, Both Chains, Average



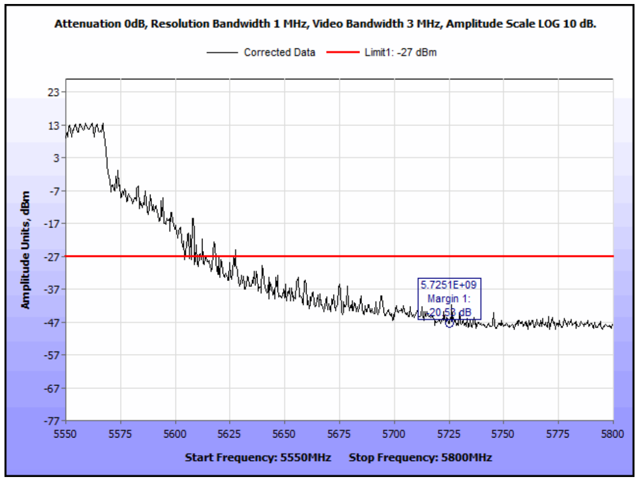
Plot 100. Radiated Band Edge, 802.11n 40 MHz, 5310 MHz, Both Chains, Peak



Plot 101. Radiated Band Edge, 802.11n 40 MHz, 5510 MHz, Both Chains, Average



Plot 102. Radiated Band Edge, 802.11n 40 MHz, 5510 MHz, Both Chains, Peak



Plot 103. Radiated Band Edge, 802.11n 40 MHz, 5550 MHz, Both Chains

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

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

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

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	18.67	73.621	6	3.981	0.05831	1	0.94169	20	Pass

Test Results:

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

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 12. 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 13. 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 14. 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 15. 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	$\text{Roundup}\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^{6}}{\text{PRI}_{\mu sec}}\right)\right\}$	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 16. 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).

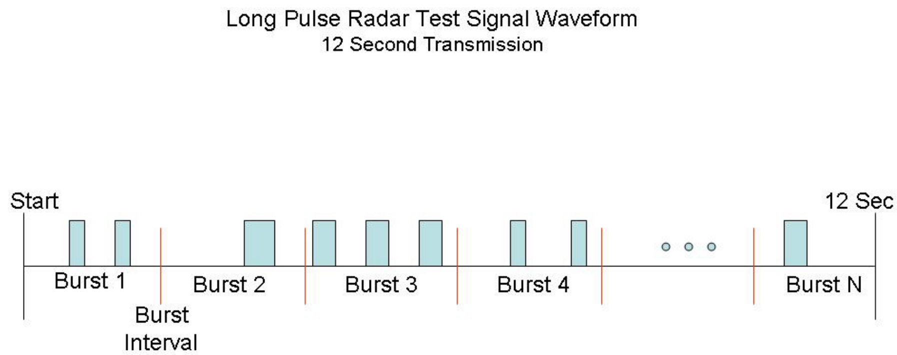


Figure 1. Long Pulse Radar Test Signal Waveform

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

Calibration of the DFS test was done using a radiated method. A signal generator capable of producing all radar pulse types (0-6) was connected to a transmitting antenna. A receive antenna, through an external pre-amp was connected to a spectrum analyzer. The spectrum analyzer was set to a zero span with a peak detector and an RBW and VBW of 3 MHz. The transmit and receive antennas were vertically polarized during this calibration.

With the signal generator and spectrum analyzer tuned to the test frequency, each radar pulse was triggered and observed on the spectrum analyzer. The DFS Detection Threshold was verified for each radar pulse type (0-6).

During this process there were no transmissions by either the Master or Client Device.

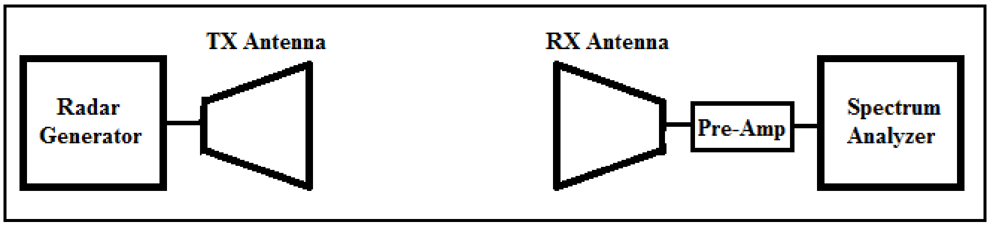
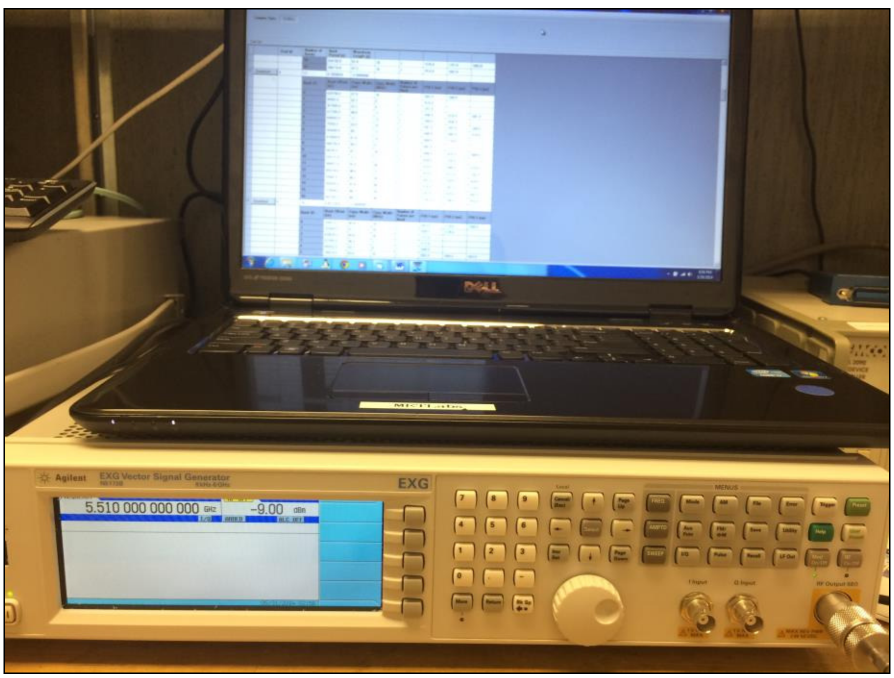
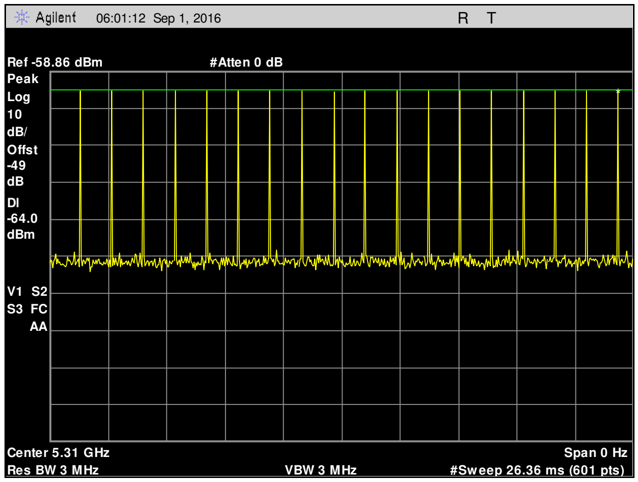


Figure 2. Radiated DFS Calibration Block Diagram

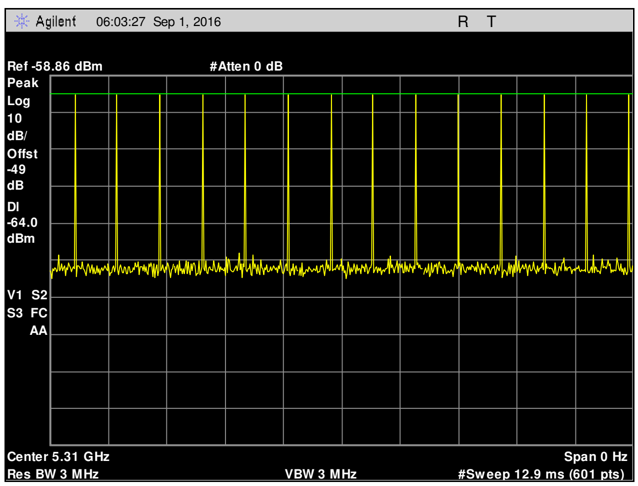


Photograph 1. DFS Radar Test Signal Generator

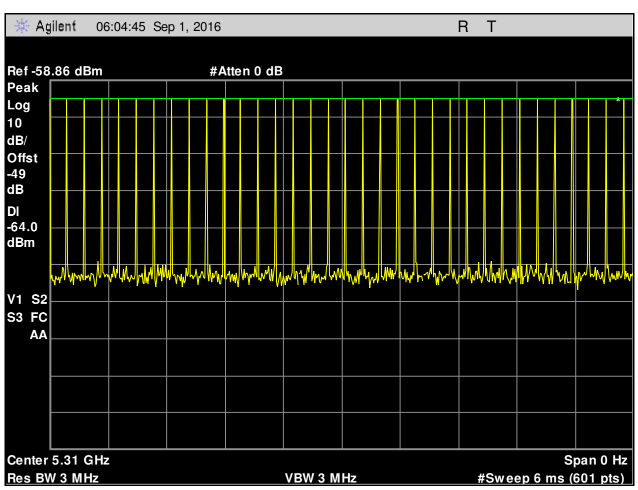
Radar Waveform Calibration, 40 MHz



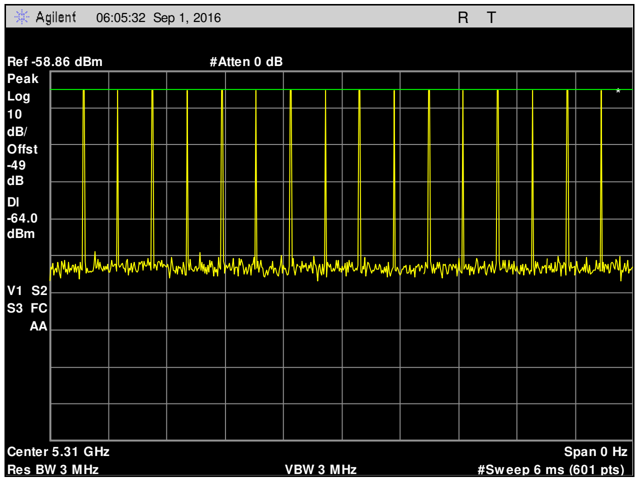
Plot 104. Radar Waveform Calibration, 5310 MHz, Type 0



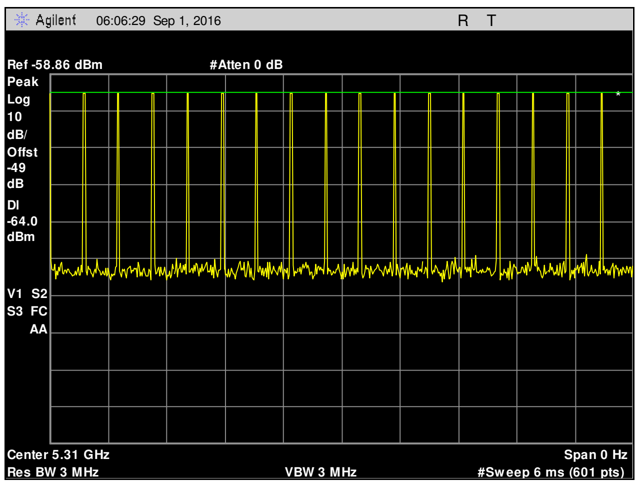
Plot 105. Radar Waveform Calibration, 5310 MHz, Type 1



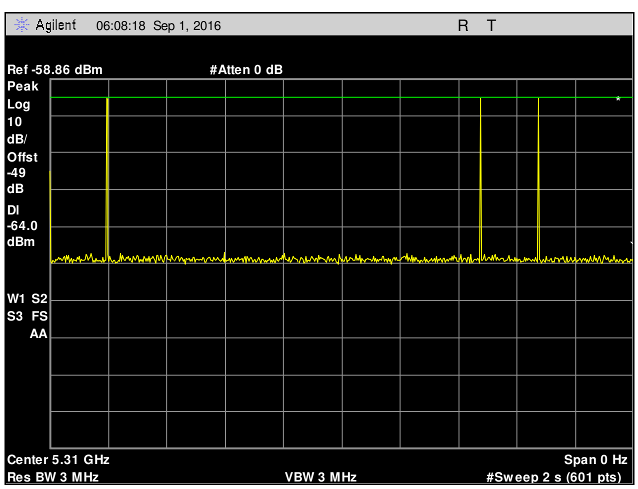
Plot 106. Radar Waveform Calibration, 5310 MHz, Type 2



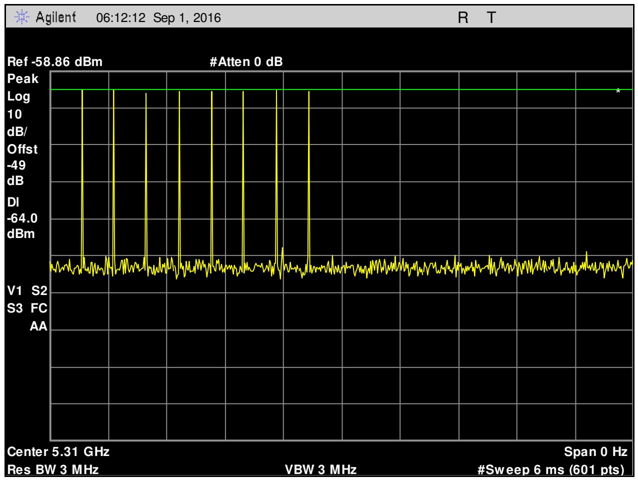
Plot 107. Radar Waveform Calibration, 5310 MHz, Type 3



Plot 108. Radar Waveform Calibration, 5310 MHz, Type 4

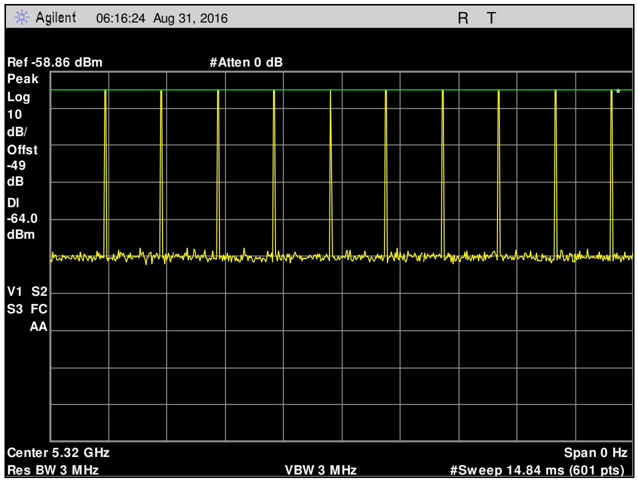


Plot 109. Radar Waveform Calibration, 5310 MHz, Type 5

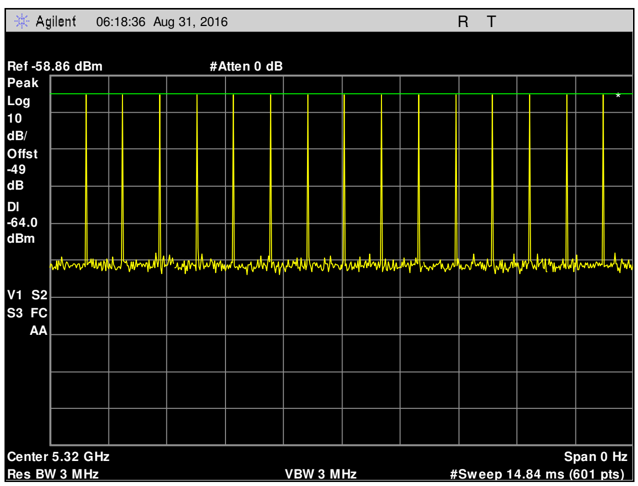


Plot 110. Radar Waveform Calibration, 5310 MHz, Type 6

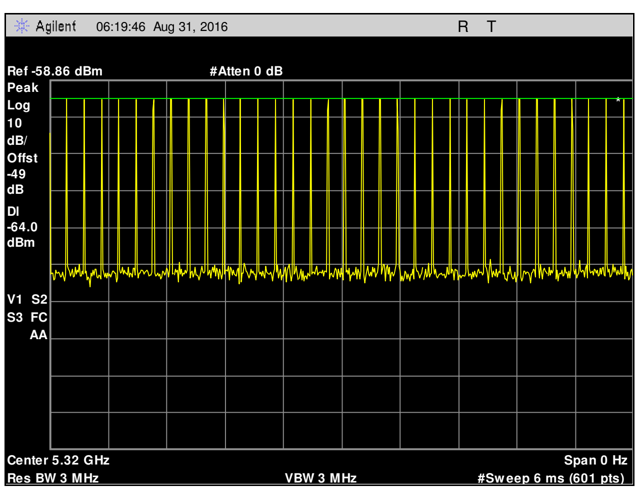
Radar Waveform Calibration, 20 MHz



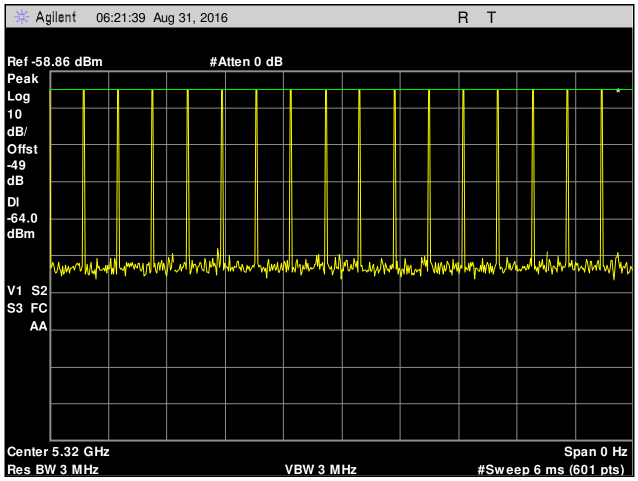
Plot 111. Radar Waveform Calibration, 5320 MHz, Type 0



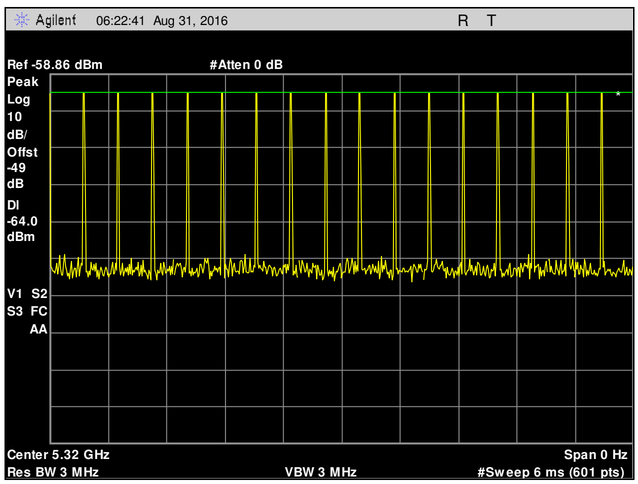
Plot 112. Radar Waveform Calibration, 5320 MHz, Type 1



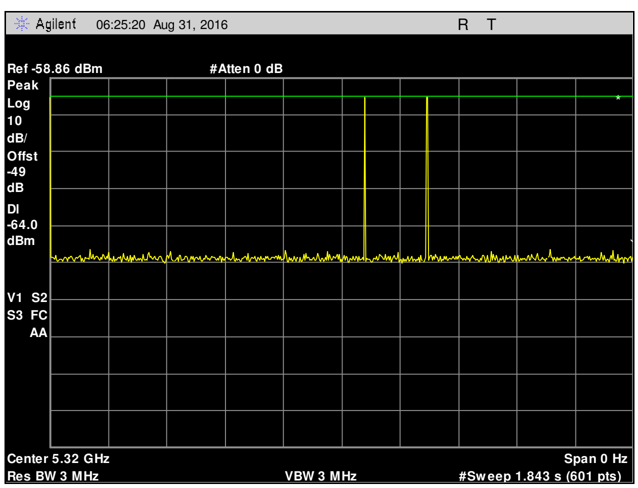
Plot 113. Radar Waveform Calibration, 5320 MHz, Type 2



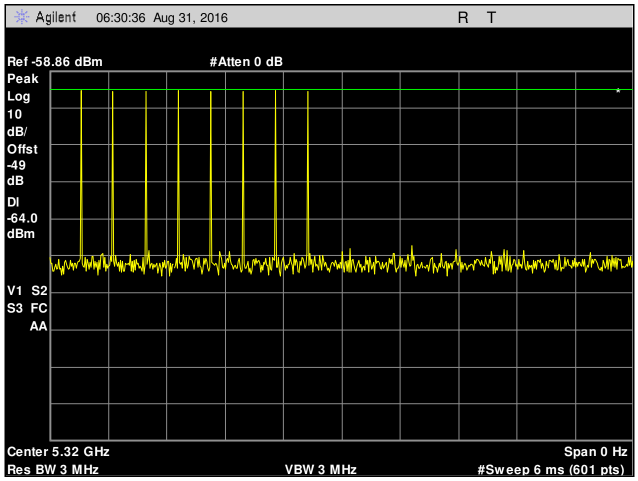
Plot 114. Radar Waveform Calibration, 5320 MHz, Type 3



Plot 115. Radar Waveform Calibration, 5320 MHz, Type 4



Plot 116. Radar Waveform Calibration, 5320 MHz, Type 5



Plot 117. Radar Waveform Calibration, 5320 MHz, Type 6

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 3.

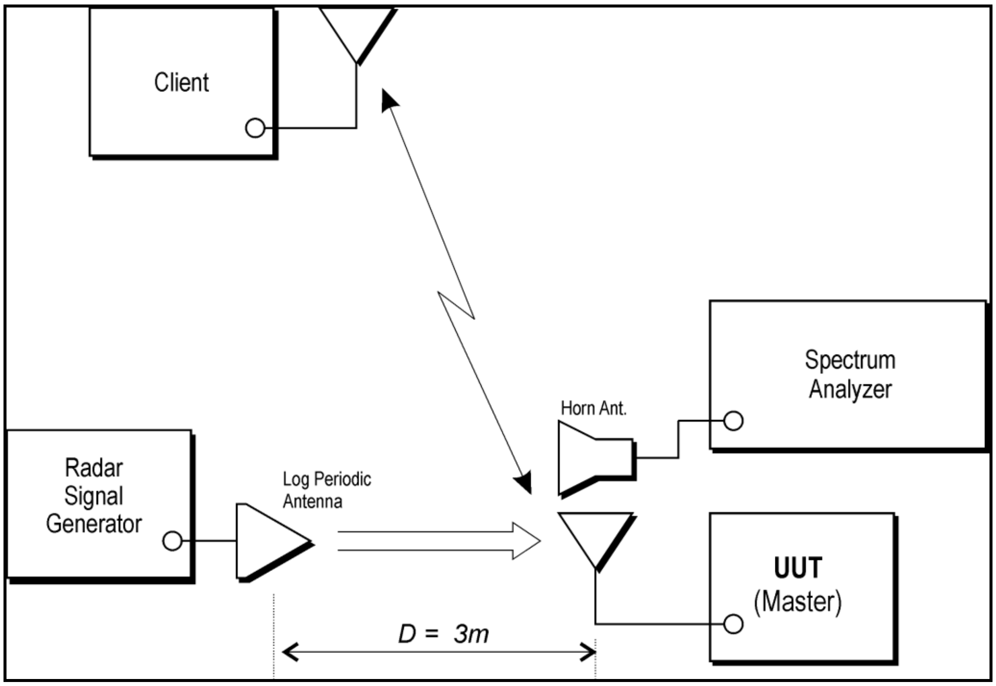


Figure 3. Test Setup Diagram

B. 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.

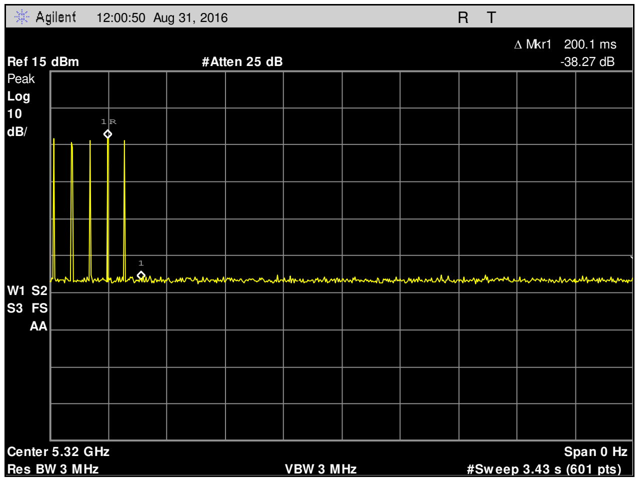
Test Procedure: The EUT was setup as a Client device and associated with a Master device. A test file was streamed from the Master device to the Client device for the entire period of the test. A Radar Burst of type 0 with a level equal to the DFS Detection Threshold + 1 dB was used.

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.

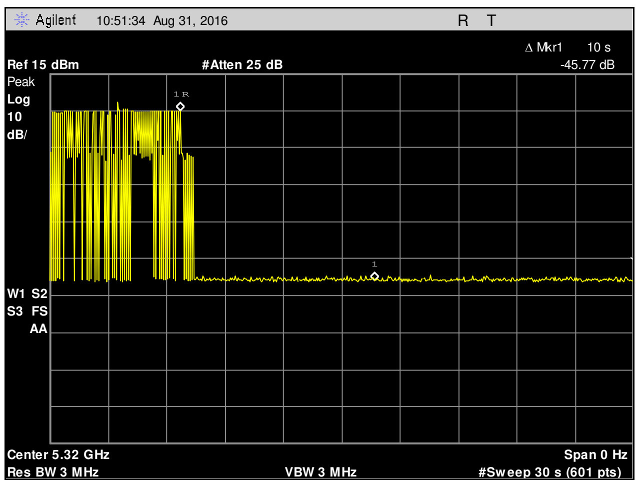
Test Results: The EUT was compliant with the requirements of this section.

Test Engineer(s): Kristine Cabrera

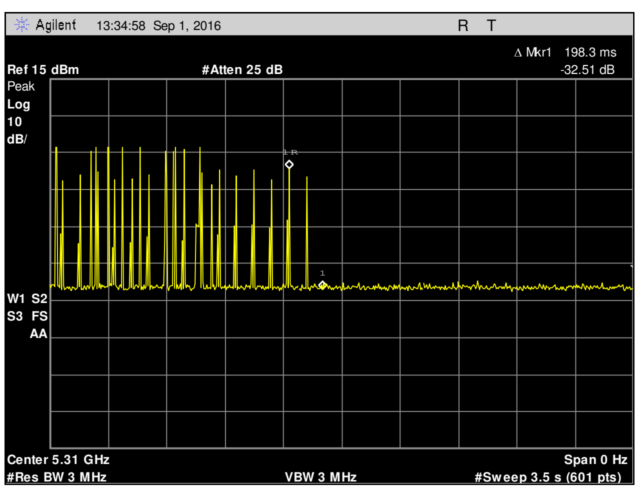
Test Date(s): 09/01/16



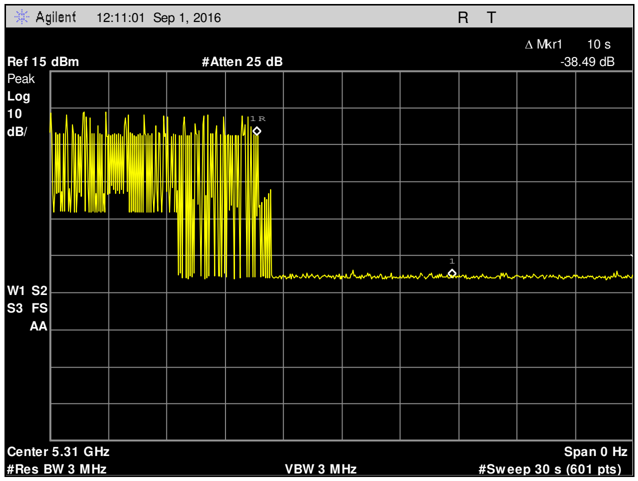
Plot 118. Channel Close Transmission, 20 MHz, 5320 MHz



Plot 119. Channel Move Time, 20 MHz, 5320 MHz



Plot 120. Channel Close Transmission, 40 MHz, 5310 MHz



Plot 121. Channel Move Time, 40 MHz, 5310 MHz

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
1A1044	GENERATOR	COM-POWER CORP	CG-520	SEE NOTE	
1A1047	HORN ANTENNA	ETS	3117	08/03/2015	02/03/2017
1A1063	SIGNAL GENERATOR	IFR SYSTEMS	2032	04/25/2016	10/25/2017
1A1073	MULTI DEVICE CONTROLLER	ETS EMCO	2090	SEE NOTE	
1A1074	SYSTEM CONTROLLER	PANASONIC	WV-CU101	SEE NOTE	
1A1075	SYSTEM CONTROLLER	PANASONIC	WV-CU101	SEE NOTE	
1A1080	MULTI DEVICE CONTROLLER	ETS EMCO	2090	SEE NOTE	
1A1083	TEST RECEIVER	ROHDE & SCHWARZ	ESU40	08/02/2016	08/02/2017
1A1088	PRE-AMP	RHODE & SCHWARZ	TS-PR1	SEE NOTE	
1A1099	GENERATOR	COM-POWER CORP	CGO-51000	SEE NOTE	
1A1106A	10M CHAMBER (FCC)	ETS	SEMI-ANECHOIC	03/31/2015	03/31/2017
1A1141	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	03/31/2016	03/31/2017
1A1147	BILOG ANTENNA (30MHZ TO 1GHZ)	SUNOL SCIENCES CORP	JB3	08/14/2015	02/14/2017
1A1180	PRE-AMP	MITEQ	AMF-7D-01001800-22-10P	SEE NOTE	
1A1183	HORN ANTENNA	ETS-LINDGREN	3117	11/23/2015	05/23/2017
1A1184	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	02/03/2016	02/03/2017
1S2523	PRE-AMP	AGILENT TECHNOLOGIES	8449B	SEE NOTE	
1S3905	VECTOR SIGNAL GENERATOR	KEYSIGHT TECHNOLOGIES	N5172B	03/30/2015	03/30/2017
1A1065	EMI RECEIVER	ROHDE & SCHWARZ	ESCI	03/24/2016	03/4/2017
1A1079	CONDUCTED COMB GENERATOR	COM-POWER CORP	CGC-255	SEE NOTE	
1A1177	PULSE LIMITER	ROHDE & SCHWARZ	ESH3Z2	06/30/2015	12/30/2016
1A1119	TEST AREA	CUSTOM MADE	N/A	08/14/2015	08/14/2017
1A1122	LISN	TESEQ	NNB 51	05/26/2016	05/26/2017

Table 17. 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

J. 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.

End of Report

