



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

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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 1).

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 1 Rev. 4)

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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

MET Report: EMCA91224-FCC407 UNII 1 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

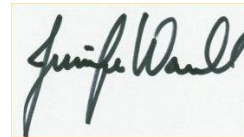
for the

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 Parts 15B, 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
Ø	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 test.

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List of Terms and Abbreviations

AC	Alternating Current
ACF	Antenna Correction Factor
Cal	Calibration
<i>d</i>	Measurement Distance
dB	Decibels
dBμA	Decibels above one microamp
dBμV	Decibels above one microvolt
dBμA/m	Decibels above one microamp per meter
dBμV/m	Decibels above one microvolt per meter
DC	Direct Current
E	Electric Field
DSL	Digital Subscriber Line
ESD	Electrostatic Discharge
EUT	Equipment Under Test
<i>f</i>	Frequency
FCC	Federal Communications Commission
GRP	Ground Reference Plane
H	Magnetic Field
HCP	Horizontal Coupling Plane
Hz	Hertz
IEC	International Electrotechnical Commission
kHz	Kilohertz
kPa	Kilopascal
kV	Kilovolt
LISN	Line Impedance Stabilization Network
MHz	Megahertz
μH	Microhenry
μ	Microfarad
μs	Microseconds
PRF	Pulse Repetition Frequency
RF	Radio Frequency
RMS	Root-Mean-Square
TWT	Traveling Wave Tube
V/m	Volts per meter
VCP	Vertical Coupling Plane

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

Table 1. Executive Summary of EMC Part 15.407 Compliance Testing

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.

Model(s) Tested:	Pano	
Model(s) Covered:	Pano	
EUT Specifications:	Primary Power: 48VDC [via AC/DC Adapter]	
	FCC ID: M72-PANO Using Pre-Approved Module FCC ID: VOB-P2180	
	Type of Modulations:	OFDM
	Equipment Code:	NII
	Max. RF Output Power:	17.21 dBm
	EUT Frequency Ranges:	5180 MHz – 5240 MHz
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:	Kristine Cabrera	
Report Date(s):	January 23, 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

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 μ H/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 (dB μ V)	
	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 μ H Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with ANSI C63.4-2014 "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 μ H LISN as the input transducer to an EMC/field intensity meter. For the purpose of this testing, the transmitter was turned on. Scans were performed with the transmitter on.

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

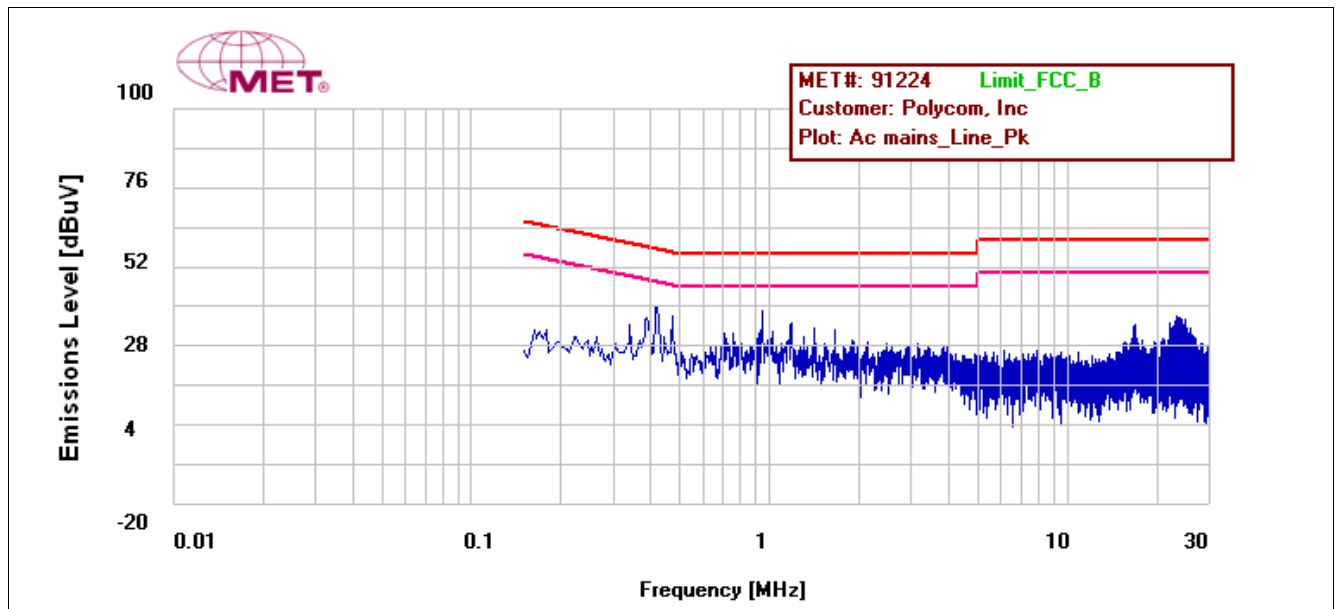
Test Engineer(s): Kamel Atia

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
0.390	35.13	58.085	-22.955	Pass	32.05	48.085	-16.035
0.422	39.26	57.432	-18.172	Pass	35.05	47.432	-12.382
0.474	35.62	56.456	-20.836	Pass	33.34	46.456	-13.116
0.950	37.88	56	-18.12	Pass	35.78	46	-10.22
1.18	36.18	56	-19.82	Pass	33.33	46	-12.67
23.47	36.52	60	-23.48	Pass	36.23	50	-13.77

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

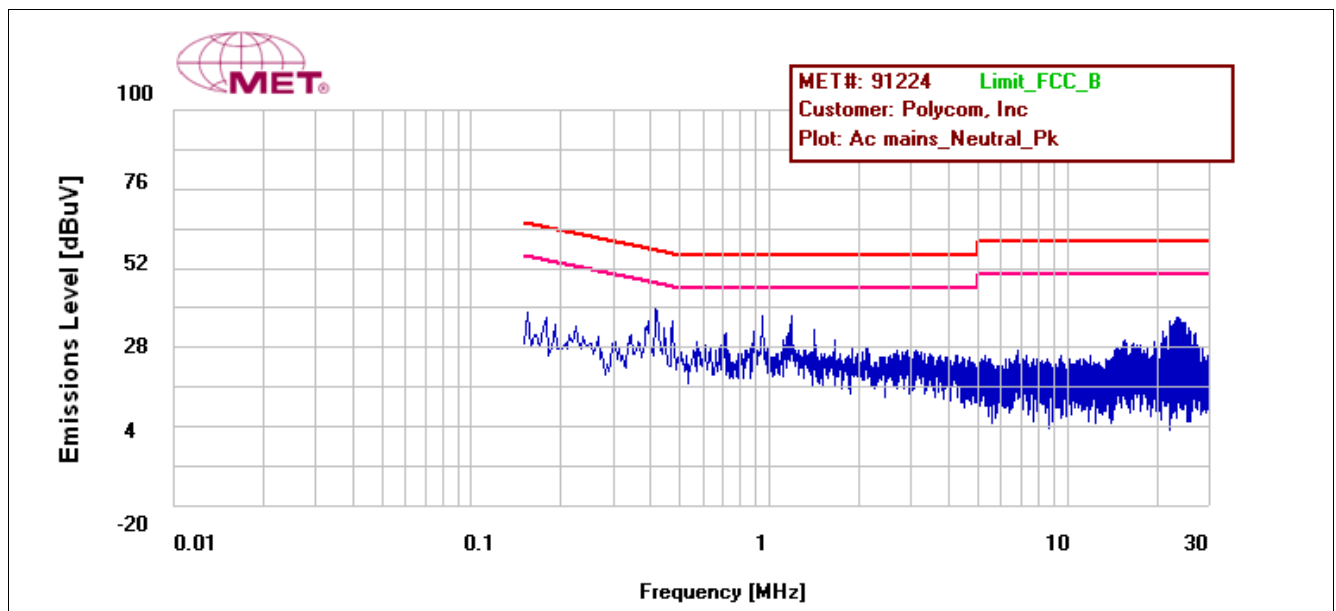


Plot 1. Conducted Emissions, 15.207(a), Phase Line

15.207(a) Conducted Emissions Test Results

Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta
0.154	35.01	65.782	-30.772	Pass	25.54	55.782	-30.242
0.178	32.03	64.582	-32.552	Pass	25.21	54.582	-29.372
0.418	40.21	57.511	-17.301	Pass	37.9	47.511	-9.611
0.950	37.45	56	-18.55	Pass	35.81	46	-10.19
1.18	35.75	56	-20.25	Pass	33.48	46	-12.52
23.71	36.31	60	-23.69	Pass	34.03	50	-15.97

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)(1) Maximum Conducted Output Power

Test Requirements:

§15.407(a)(1)(i): For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi.

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(a)(1)(ii): For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi.

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(a)(1)(iii): For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi.

§15.407(a)(1)(iv): For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi.

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 to measurement method SA-1, as described in 789033 D02 General UNII Test Procedures v01.

Test Results:

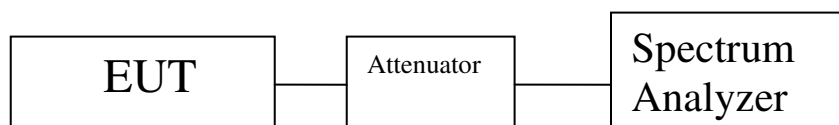
The EUT as tested is compliant with the requirements of this section.

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)
30	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 30 dBm.

Peak Conducted Output Power						
Carrier Channel	Frequency (MHz)	Measured PCOP (dBm) Chain 0	Measured PCOP (dBm) Chain 1	Total Power	Limit (dBm)	Margin (dB)
Low	5180	14.24	14.15	17.21	30	-12.79
Mid	5200	14.03	13.59	16.83	30	-13.17
High	5240	14.5	13.79	17.17	30	-12.83

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

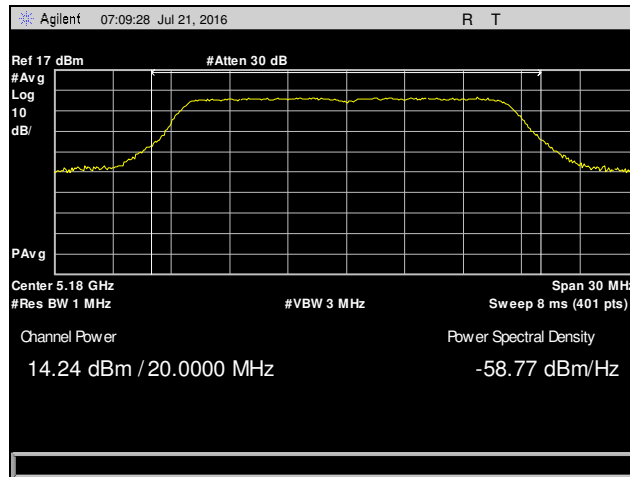
Peak Conducted Output Power						
Carrier Channel	Frequency (MHz)	Measured PCOP (dBm) Chain 0	Measured PCOP (dBm) Chain 1	Total Power	Limit (dBm)	Margin (dB)
Low	5180	8.67	7.86	11.3	30	-18.7
Mid	5200	9.07	8.05	11.61	30	-18.39
High	5240	9.05	7.62	11.41	30	-18.59

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

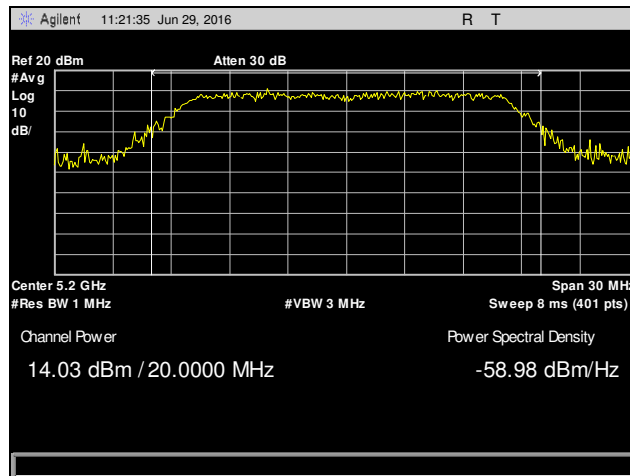
Peak Conducted Output Power						
Carrier Channel	Frequency (MHz)	Measured PCOP (dBm) Chain 0	Measured PCOP (dBm) Chain 1	Total Power	Limit (dBm)	Margin (dB)
Low	5190	5.18	4.58	7.91	30	-22.09
High	5230	11.11	10.25	13.72	30	-16.28

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

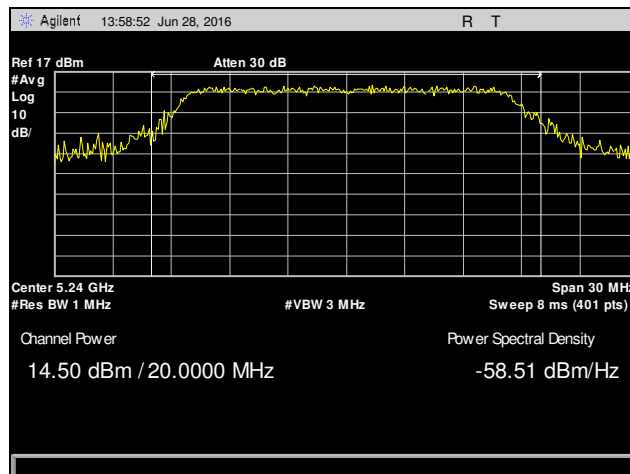
Conducted Output Power, 802.11a 20 MHz, Chain 0



Plot 3. Conducted Output Power, 802.11a 20 MHz, 5180 MHz, Chain 0

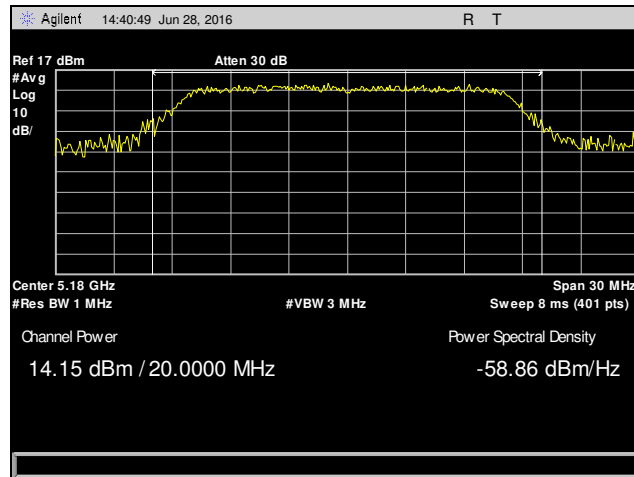


Plot 4. Conducted Output Power, 802.11a 20 MHz, 5200 MHz, Chain 0

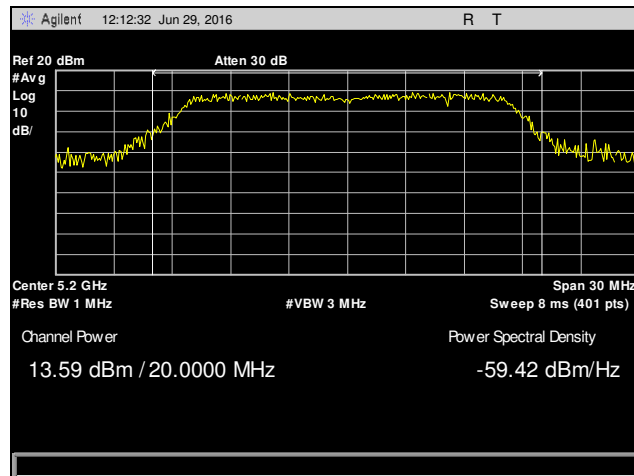


Plot 5. Conducted Output Power, 802.11a 20 MHz, 5240 MHz, Chain 0

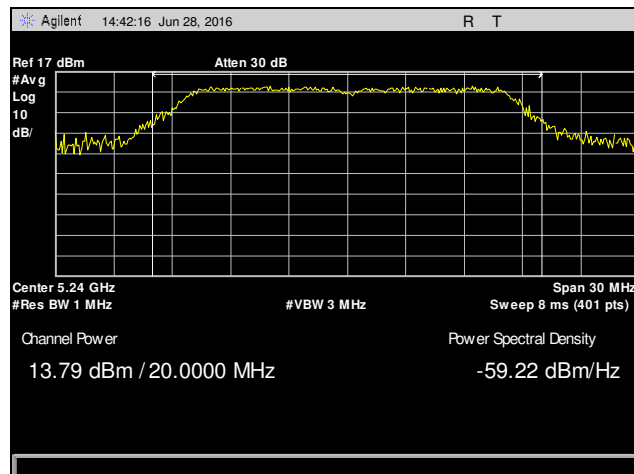
Conducted Output Power, 802.11a 20 MHz, Chain 1



Plot 6. Conducted Output Power, 802.11a 20 MHz, 5180 MHz, Chain 1

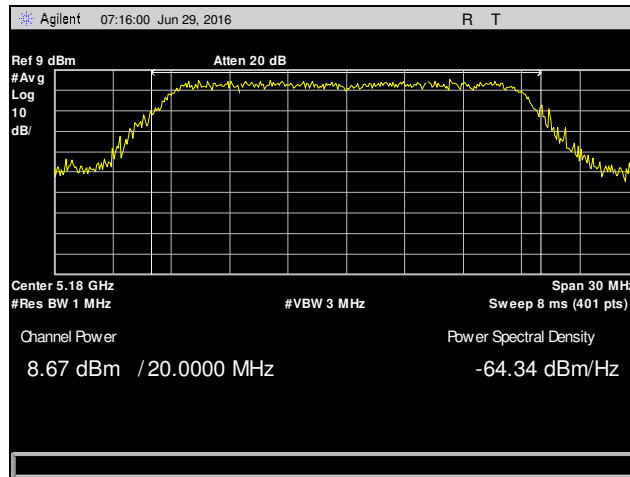


Plot 7. Conducted Output Power, 802.11a 20 MHz, 5200 MHz, Chain 1

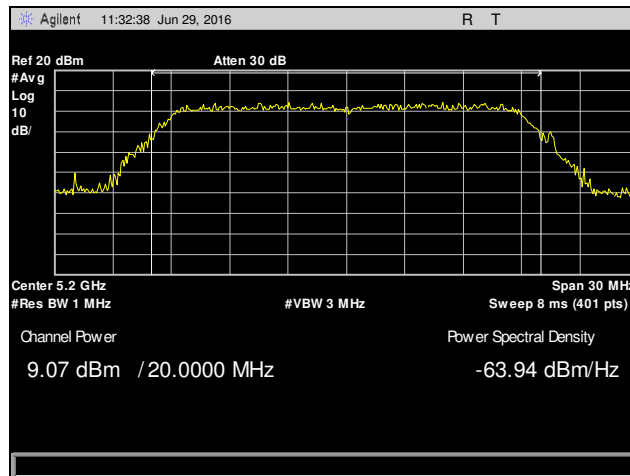


Plot 8. Conducted Output Power, 802.11a 20 MHz, 5240 MHz, Chain 1

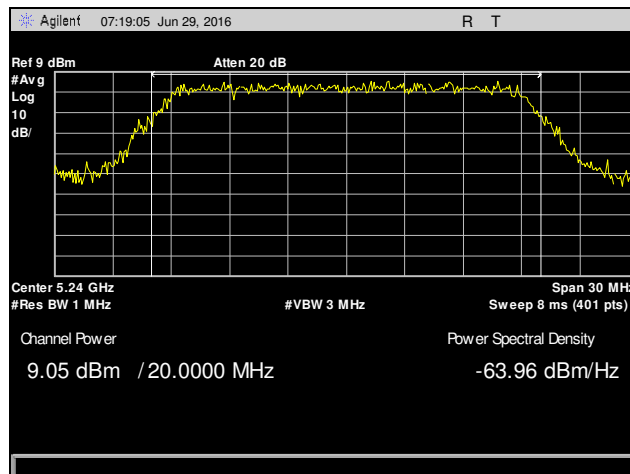
Conducted Output Power, 802.11n 20 MHz, Chain 0



Plot 9. Conducted Output Power, 802.11n 20 MHz, 5180 MHz, Chain 0

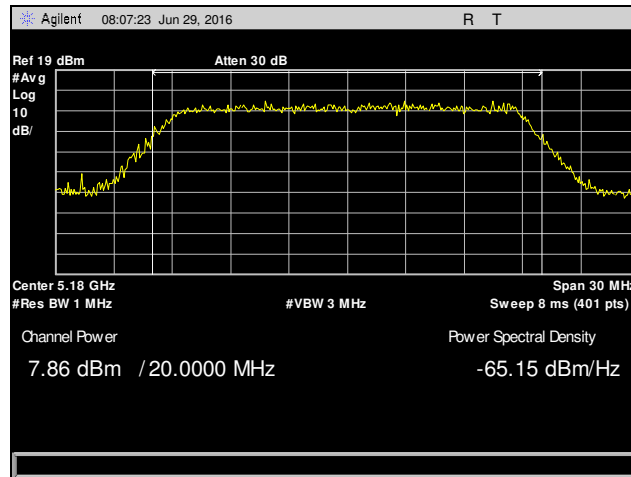


Plot 10. Conducted Output Power, 802.11n 20 MHz, 5200 MHz, Chain 0

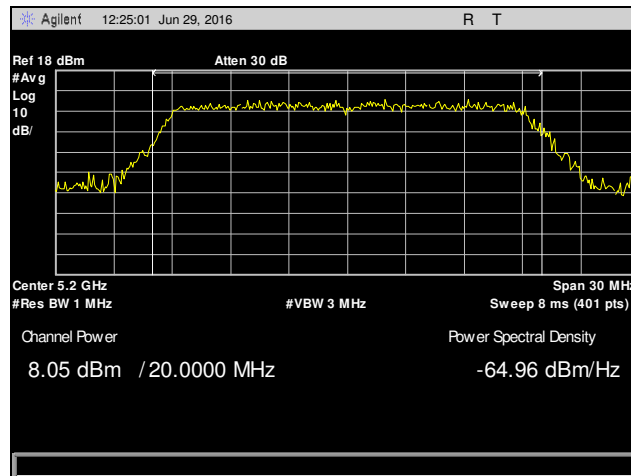


Plot 11. Conducted Output Power, 802.11n 20 MHz, 5240 MHz, Chain 0

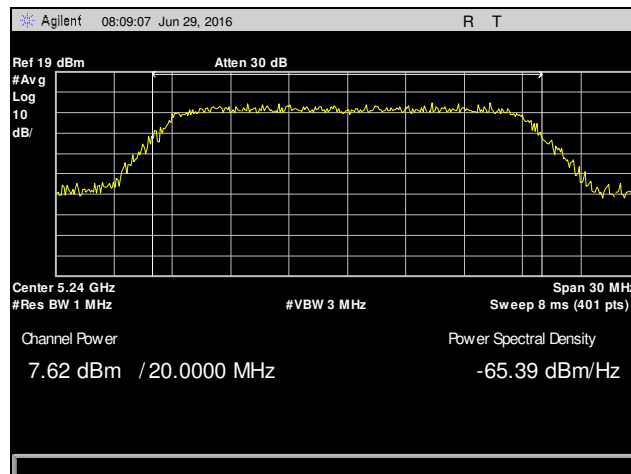
Conducted Output Power, 802.11n 20 MHz, Chain 1



Plot 12. Conducted Output Power, 802.11n 20 MHz, 5180 MHz, Chain 1

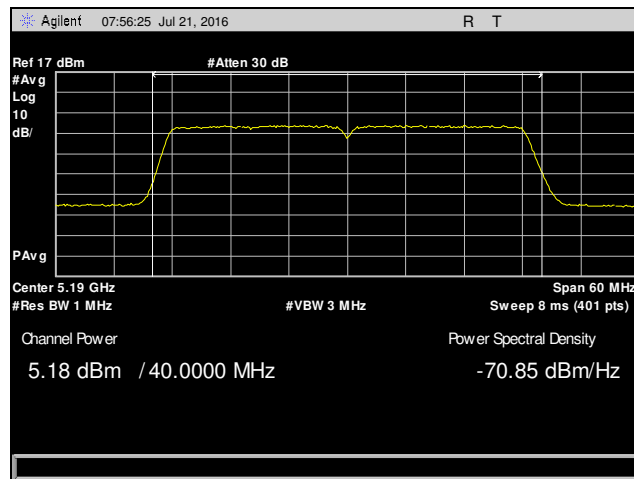


Plot 13. Conducted Output Power, 802.11n 20 MHz, 5200 MHz, Chain 1

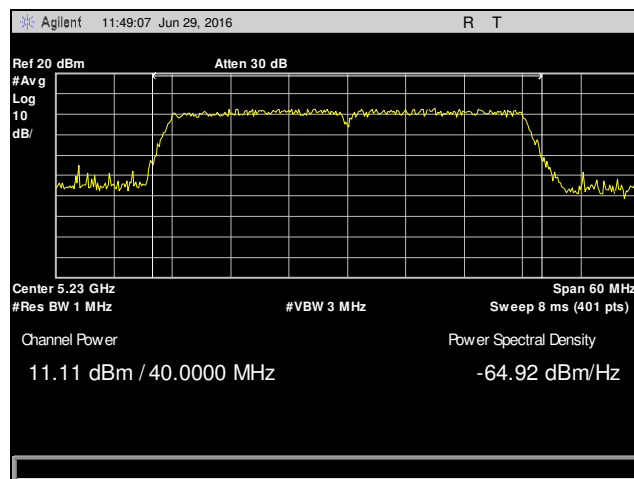


Plot 14. Conducted Output Power, 802.11n 20 MHz, 5240 MHz, Chain 1

Conducted Output Power, 802.11n 40 MHz, Chain 0

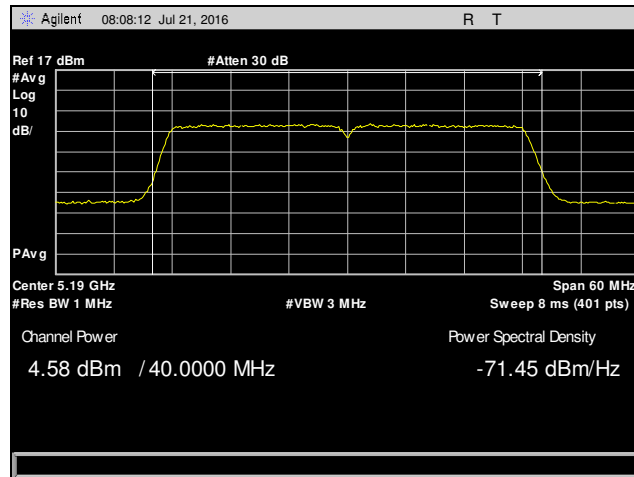


Plot 15. Conducted Output Power, 802.11n 40 MHz, 5190 MHz, Chain 0

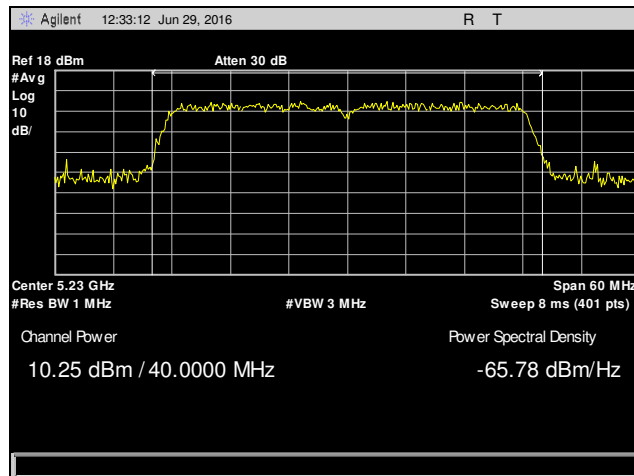


Plot 16. Conducted Output Power, 802.11n 40 MHz, 5230 MHz, Chain 0

Conducted Output Power, 802.11n 40 MHz, Chain 1



Plot 17. Conducted Output Power, 802.11n 40 MHz, 5190 MHz, Chain 1



Plot 18. Conducted Output Power, 802.11n 40 MHz, 5230 MHz, Chain 1

Electromagnetic Compatibility Criteria for Intentional Radiators

§15.407(b)(1) & (6 – 7) Undesirable Emissions

Test Requirements: § 15.407(b)(1): For transmitters operating in the 5.15-5.25 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz.

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

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

Test Procedure: The 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.

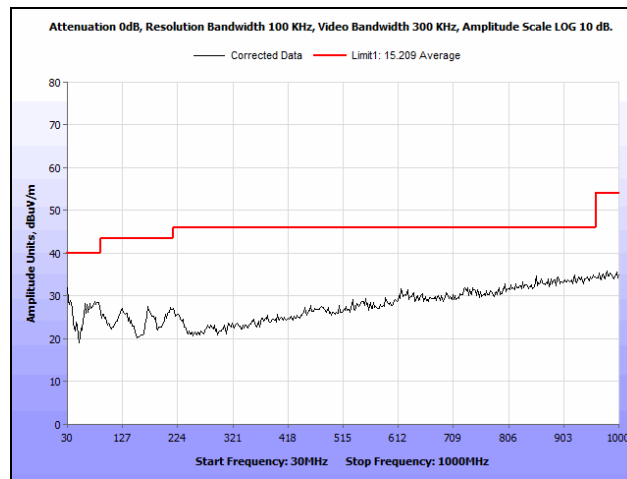
For above 1 GHz, the EUT was compliant with the requirements of this section.

NOTE: Only noise floor was measured above 18 GHz.

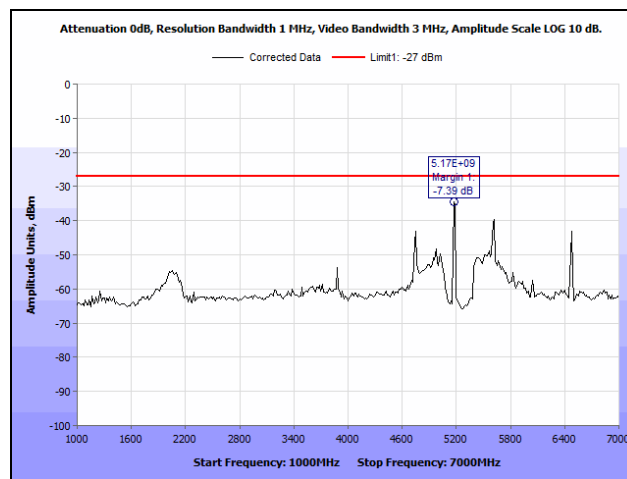
Test Engineer(s): Kristine Cabrera and Arsalan Hasan

Test Date(s): 08/03/16

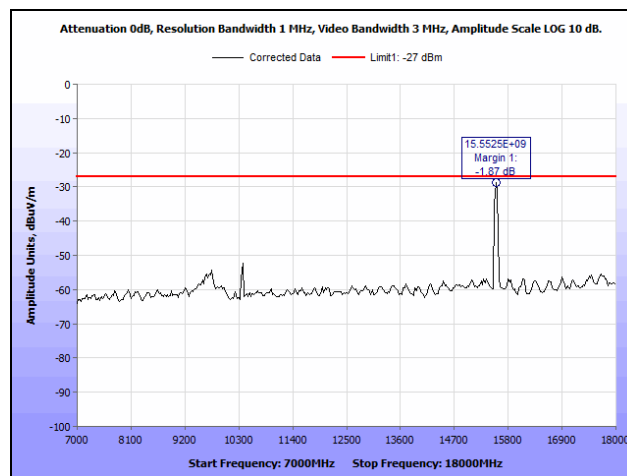
Radiated Spurious Emissions, 802.11a 20 MHz



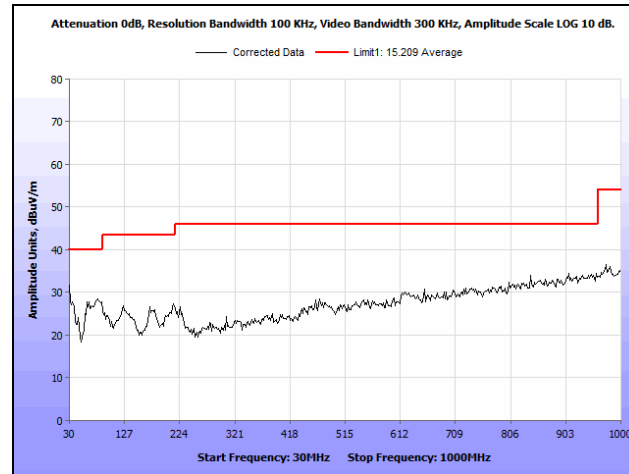
Plot 19. Radiated Spurious Emissions, 802.11a 20 MHz, 5180 MHz, Both Chains, 30 MHz – 1 GHz



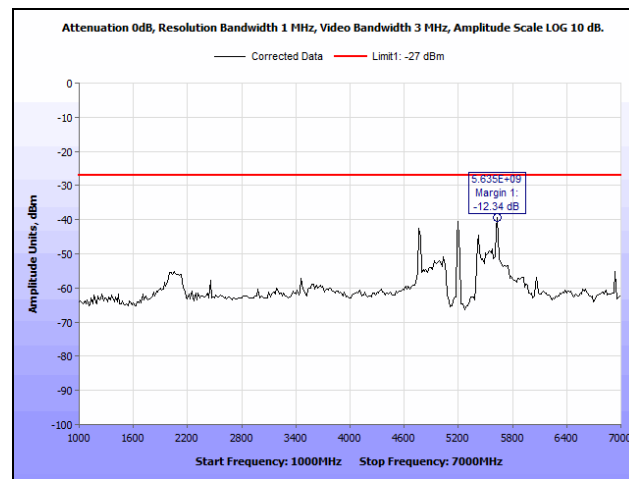
Plot 20. Radiated Spurious Emissions, 802.11a 20 MHz, 5180 MHz, Both Chains, 1 GHz – 7 GHz



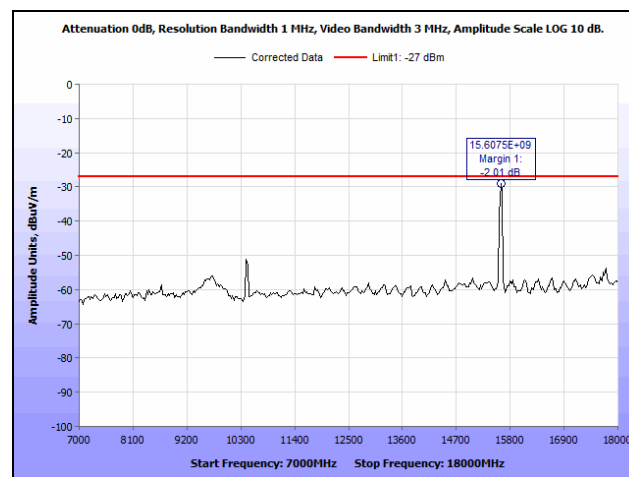
Plot 21. Radiated Spurious Emissions, 802.11a 20 MHz, 5180 MHz, Both Chains, 7 GHz – 18 GHz



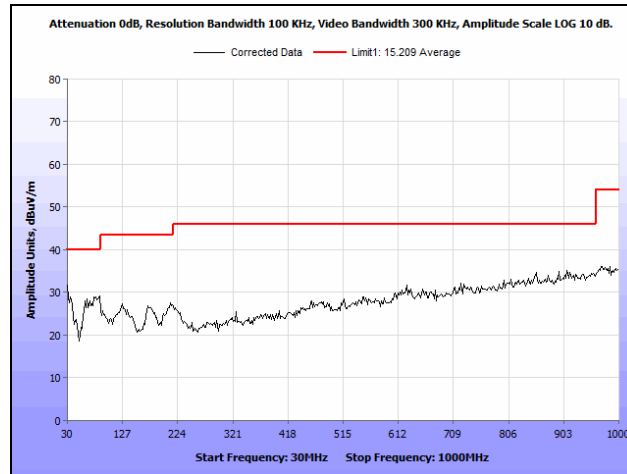
Plot 22. Radiated Spurious Emissions, 802.11a 20 MHz, 5200 MHz, Both Chains, 30 MHz – 1 GHz



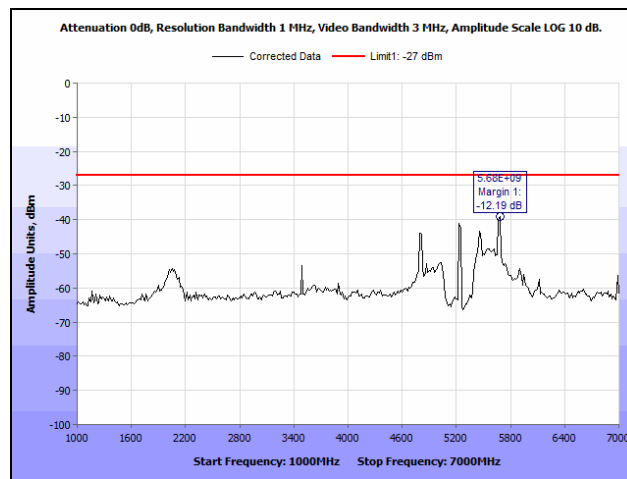
Plot 23. Radiated Spurious Emissions, 802.11a 20 MHz, 5200 MHz, Both Chains, 1 GHz – 7 GHz



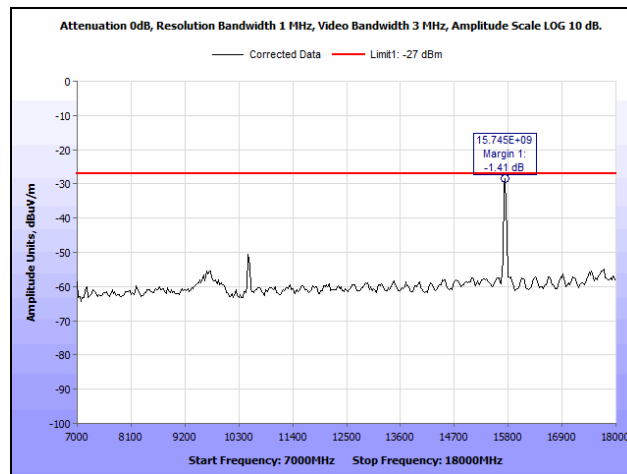
Plot 24. Radiated Spurious Emissions, 802.11a 20 MHz, 5200 MHz, Both Chains, 7 GHz – 18 GHz



Plot 25. Radiated Spurious Emissions, 802.11a 20 MHz, 5240 MHz, Both Chains, 30 MHz – 1 GHz

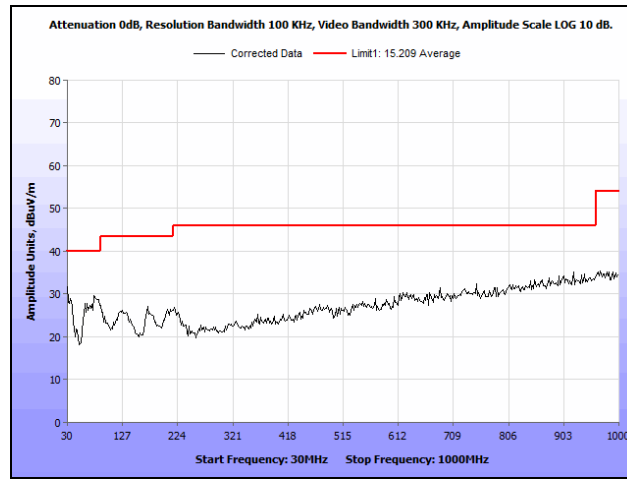


Plot 26. Radiated Spurious Emissions, 802.11a 20 MHz, 5240 MHz, Both Chains, 1 GHz – 7 GHz

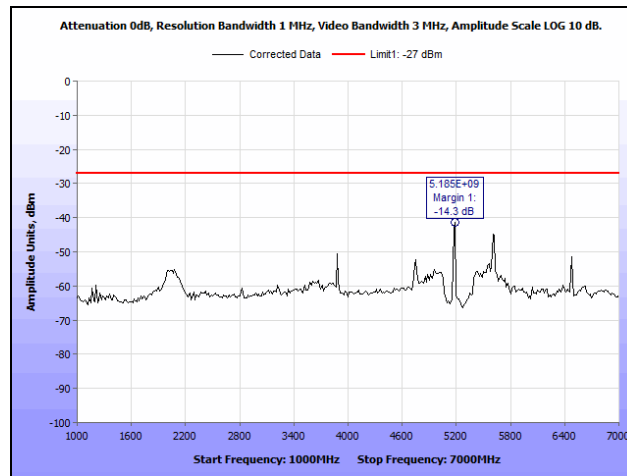


Plot 27. Radiated Spurious Emissions, 802.11a 20 MHz, 5240 MHz, Both Chains, 7 GHz – 18 GHz

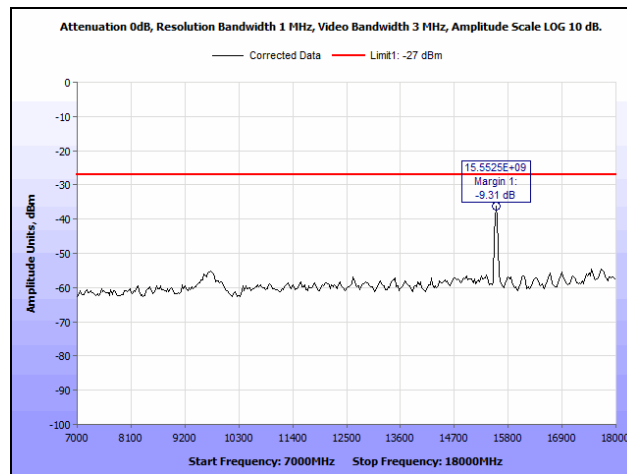
Radiated Spurious Emissions, 802.11n 20 MHz



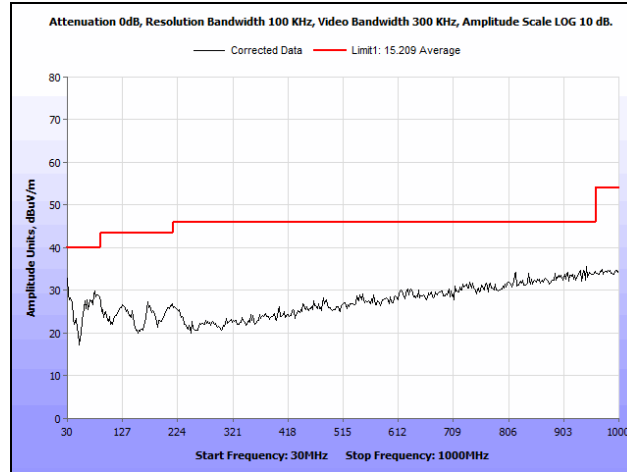
Plot 28. Radiated Spurious Emissions, 802.11n 20 MHz, 5180 MHz, Both Chains, 30 MHz – 1 GHz



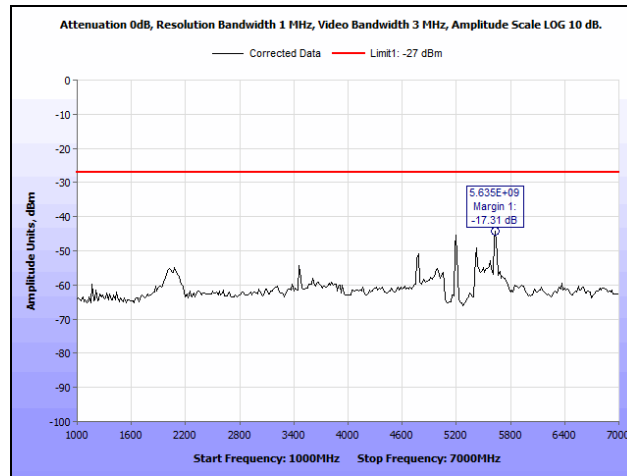
Plot 29. Radiated Spurious Emissions, 802.11n 20 MHz, 5180 MHz, Both Chains, 1 GHz – 7 GHz



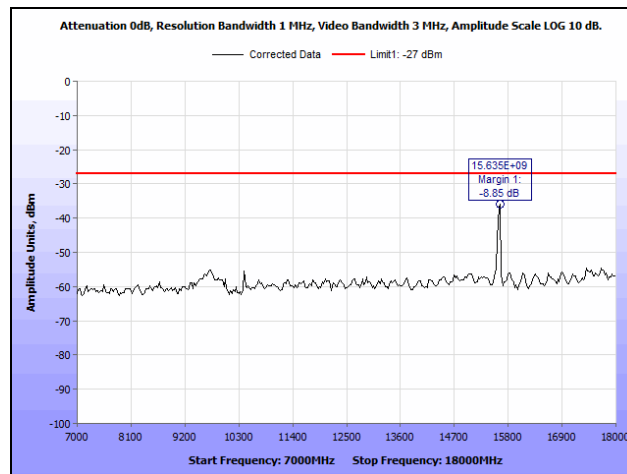
Plot 30. Radiated Spurious Emissions, 802.11n 20 MHz, 5180 MHz, Both Chains, 7 GHz – 18 GHz



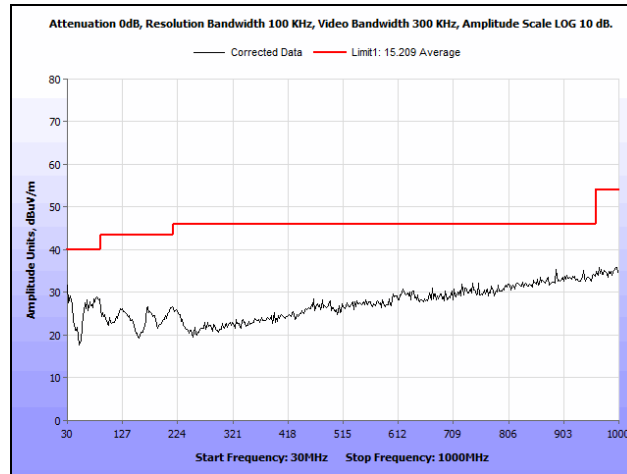
Plot 31. Radiated Spurious Emissions, 802.11n 20 MHz, 5200 MHz, Both Chains, 30 MHz – 1 GHz



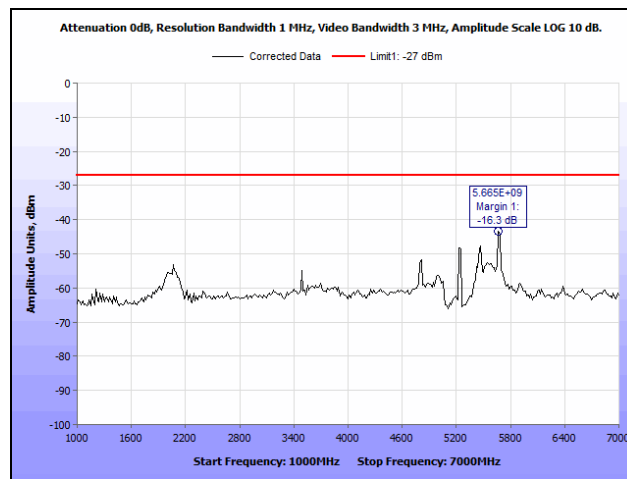
Plot 32. Radiated Spurious Emissions, 802.11n 20 MHz, 5200 MHz, Both Chains, 1 GHz – 7 GHz



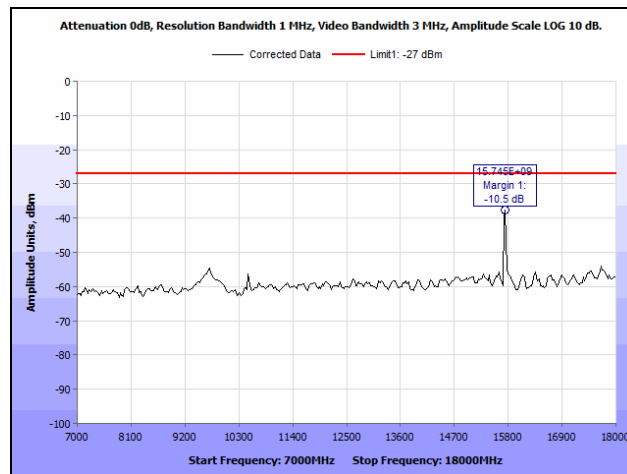
Plot 33. Radiated Spurious Emissions, 802.11n 20 MHz, 5200 MHz, Both Chains, 7 GHz – 18 GHz



Plot 34. Radiated Spurious Emissions, 802.11n 20 MHz, 5240 MHz, Both Chains, 30 MHz – 1 GHz

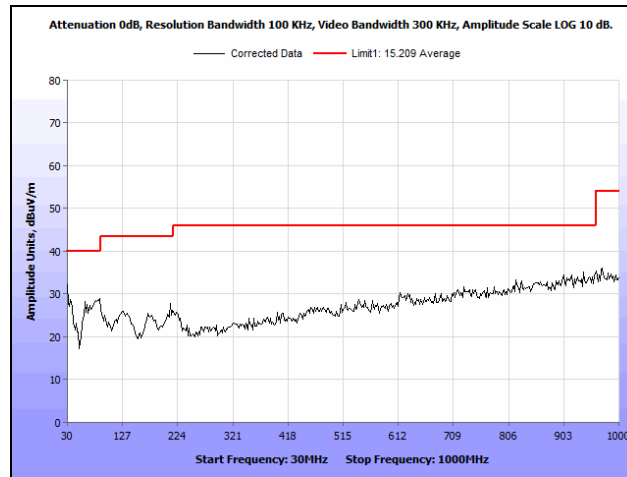


Plot 35. Radiated Spurious Emissions, 802.11n 20 MHz, 5240 MHz, Both Chains, 1 GHz – 7 GHz

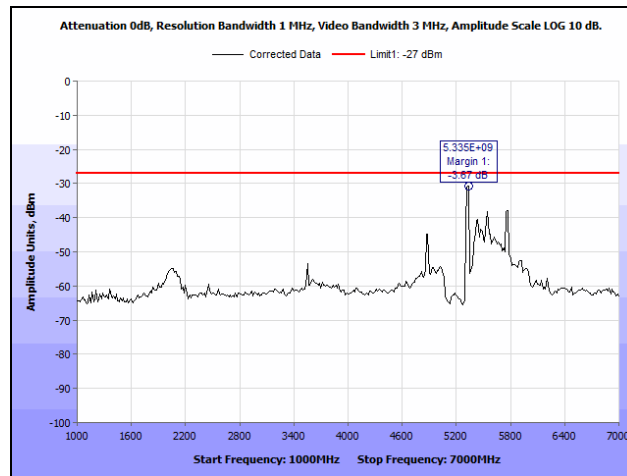


Plot 36. Radiated Spurious Emissions, 802.11n 20 MHz, 5240 MHz, Both Chains, 7 GHz – 18 GHz

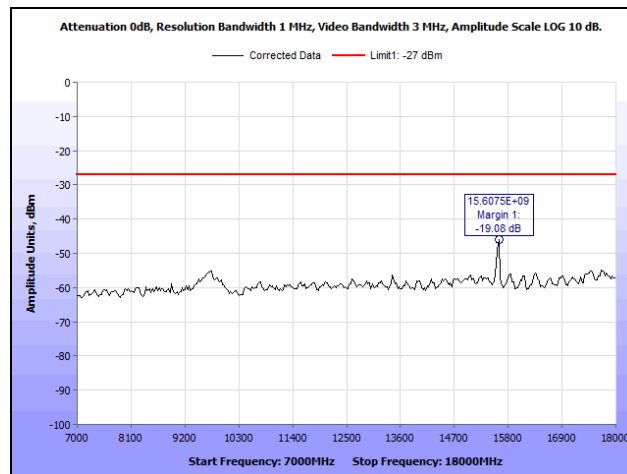
Radiated Spurious Emissions, 802.11n 40 MHz



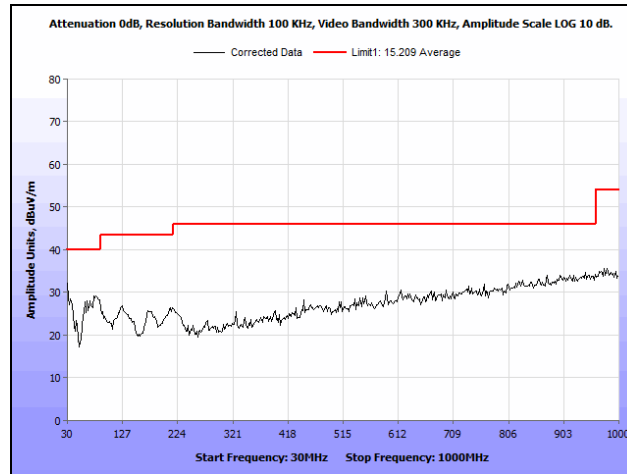
Plot 37. Radiated Spurious Emissions, 802.11n 40 MHz, 5190 MHz, Both Chains, 30 MHz – 1 GHz



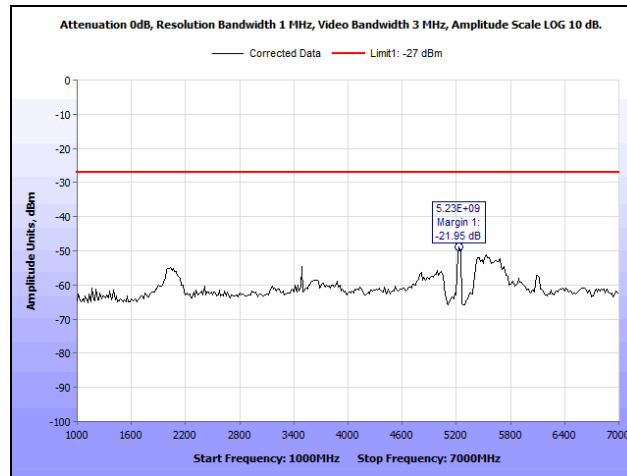
Plot 38. Radiated Spurious Emissions, 802.11n 40 MHz, 5190 MHz, Both Chains, 1 GHz – 7 GHz



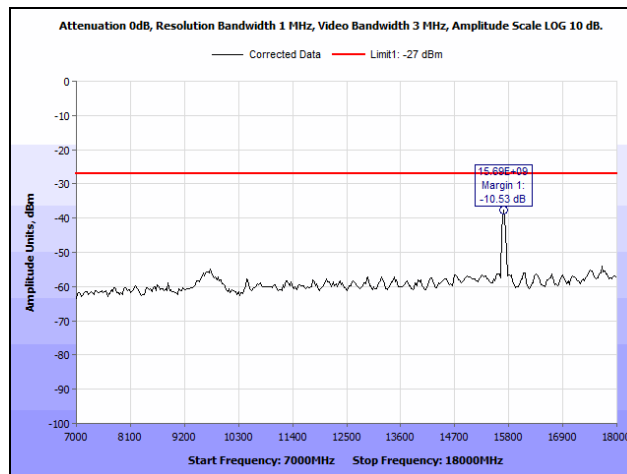
Plot 39. Radiated Spurious Emissions, 802.11n 40 MHz, 5190 MHz, Both Chains, 7 GHz – 18 GHz



Plot 40. Radiated Spurious Emissions, 802.11n 40 MHz, 5230 MHz, Both Chains, 30 MHz – 1 GHz

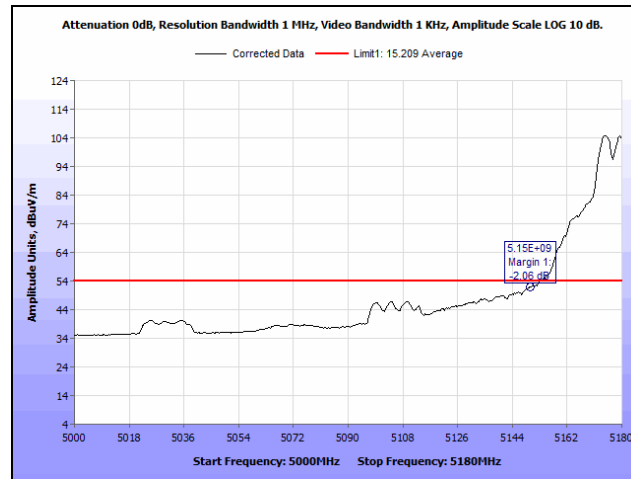


Plot 41. Radiated Spurious Emissions, 802.11n 40 MHz, 5230 MHz, Both Chains, 1 GHz – 7 GHz

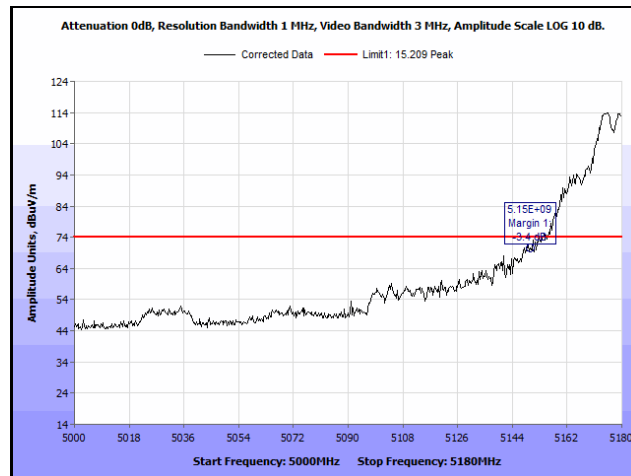


Plot 42. Radiated Spurious Emissions, 802.11n 40 MHz, 5230 MHz, Both Chains, 7 GHz – 18 GHz

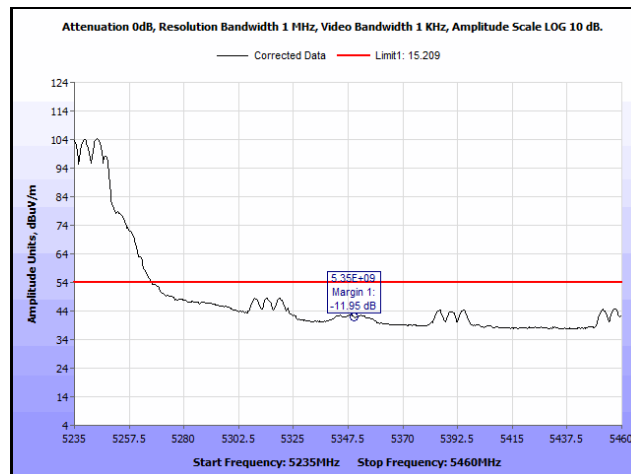
Radiated Band Edge, 802.11a 20 MHz



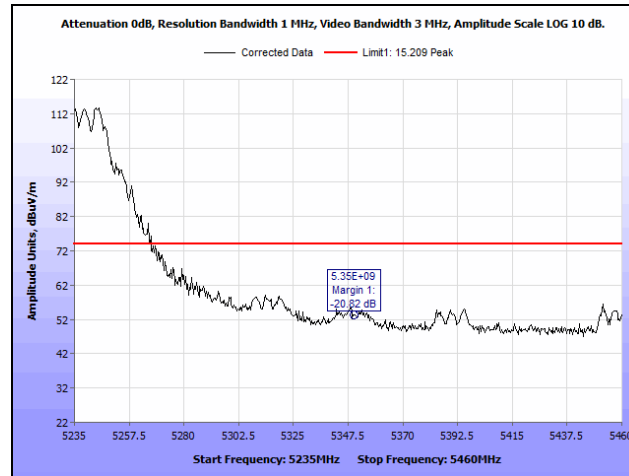
Plot 43. Radiated Band Edge, 802.11a 20 MHz, 5180 MHz, Both Chains, Average



Plot 44. Radiated Band Edge, 802.11a 20 MHz, 5180 MHz, Both Chains, Peak

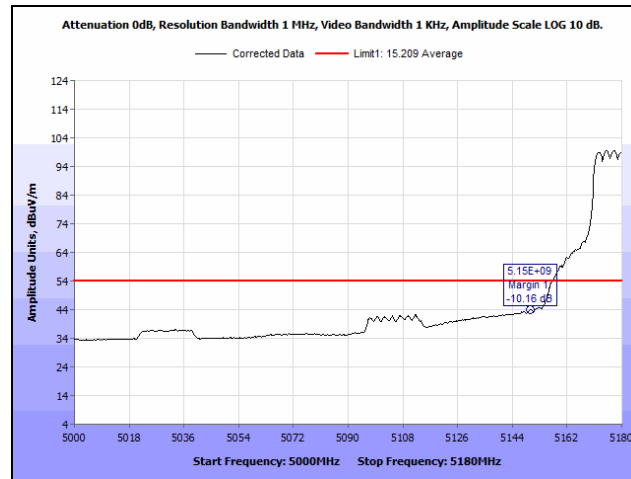


Plot 45. Radiated Band Edge, 802.11a 20 MHz, 5240 MHz, Both Chains, Average

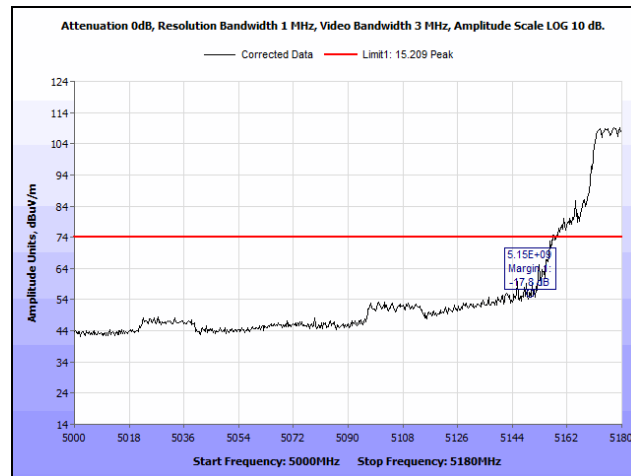


Plot 46. Radiated Band Edge, 802.11a 20 MHz, 5240 MHz, Both Chains, Peak

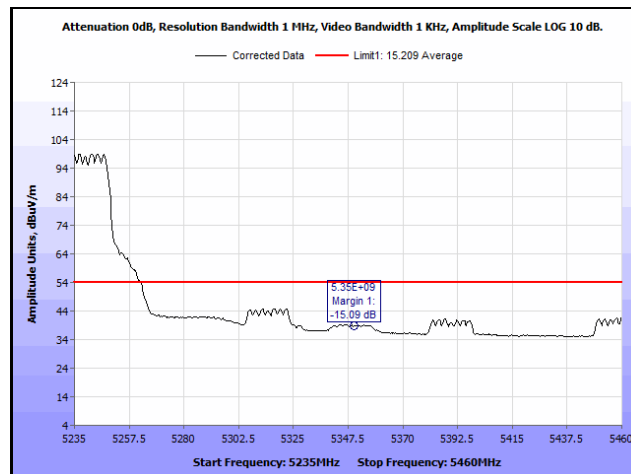
Radiated Band Edge, 802.11n 20 MHz



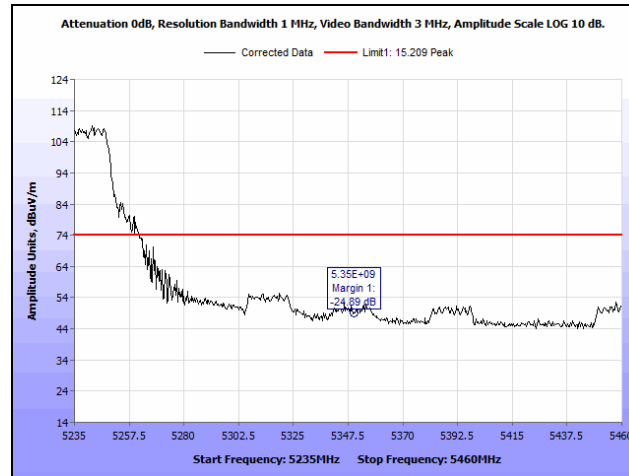
Plot 47. Radiated Band Edge, 802.11n 20 MHz, 5180 MHz, Both Chains, Average



Plot 48. Radiated Band Edge, 802.11n 20 MHz, 5180 MHz, Both Chains, Peak

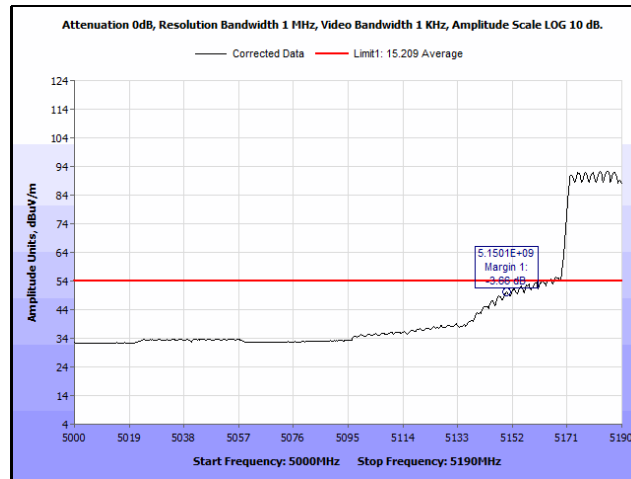


Plot 49. Radiated Band Edge, 802.11n 20 MHz, 5240 MHz, Both Chains, Average

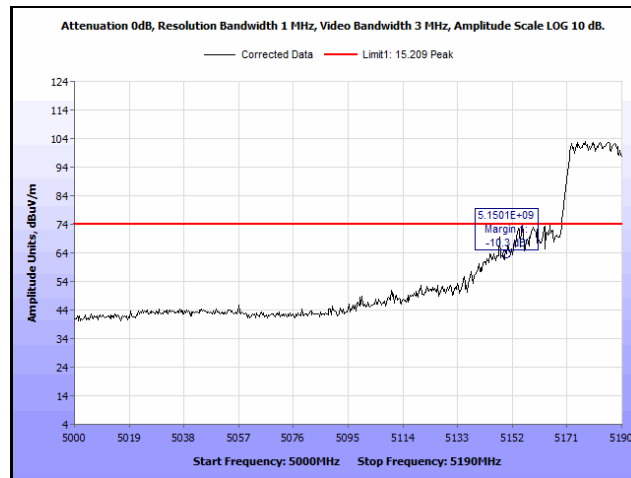


Plot 50. Radiated Band Edge, 802.11n 20 MHz, 5240 MHz, Both Chains, Peak

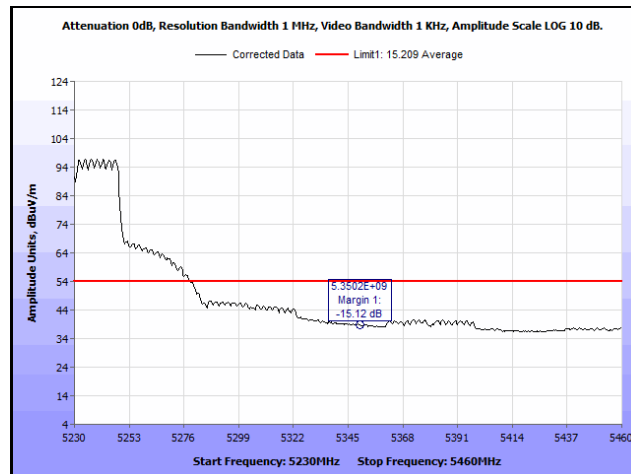
Radiated Band Edge, 802.11n 40 MHz



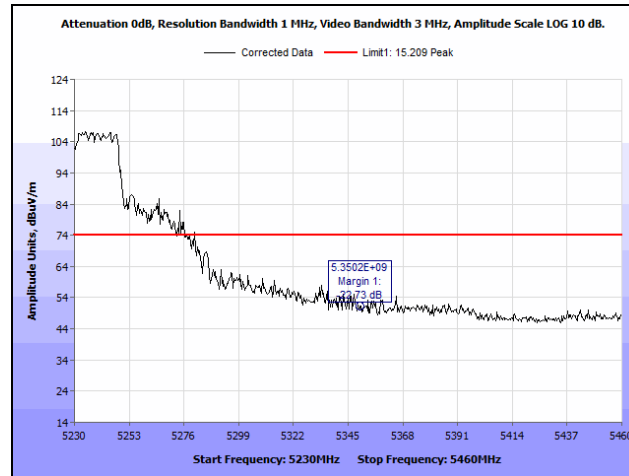
Plot 51. Radiated Band Edge, 802.11n 40 MHz, 5190 MHz, Both Chains, Average



Plot 52. Radiated Band Edge, 802.11n 40 MHz, 5190 MHz, Both Chains, Peak



Plot 53. Radiated Band Edge, 802.11n 40 MHz, 5230 MHz, Both Chains, Average



Plot 54. Radiated Band Edge, 802.11n 40 MHz, 5230 MHz, Both Chains, Peak

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 @ 5150-5250 MHz; **Limit for Uncontrolled exposure: 1 mW/cm² or 10 W/m²**

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/cm²)
P = Power Input to antenna (mW)
G = Antenna Gain (numeric value)
R = Distance (cm)

Test Results:

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
5180	17.21	52.602	6	3.981	0.04166	1	0.95834	20	Pass

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

IV. Test Equipment

Test Equipment

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

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1A1044	GENERATOR	COM-POWER CORP	CG-520	SEE NOTE	
1A1047	HORN ANTENNA	ETS	3117	08/03/2015	02/03/2017
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	
1A1184	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	02/03/2016	02/03/2017
1S2523	PRE-AMP	AGILENT TECHNOLOGIES	8449B	SEE NOTE	
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 12. Test Equipment List

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

V. Certification & User's Manual Information

Certification & User's Manual Information

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.