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

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May 26, 2017

ARRIS Group Inc.
3871 Lakefield Drive Suite 300
Suwanee, GA 30024

Dear Tony Figueiredo,

Enclosed is the EMC Wireless test report for compliance testing of the ARRIS Group Inc., SBG6950 as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Title 47 of the CFR, Part 15.407, Subpart E (UNII 2).

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

Sincerely yours,
MET LABORATORIES, INC.

Jennifer Warnell
Documentation Department

Reference: (\ARRIS Group Inc.\EMC89524A-FCC407 UNII 2 Rev. 1)

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Electromagnetic Compatibility Criteria
Test Report

for the

ARRIS Group Inc.
Model SBG6950

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

MET Report: EMC89524A-FCC407 UNII 2 Rev. 1

May 26, 2017

Prepared For:

ARRIS Group Inc.
3871 Lakefield Drive Suite 300
Suwanee, GA 30024

Prepared By:
MET Laboratories, Inc.
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Baltimore, MD 21230

Electromagnetic Compatibility Criteria
Test Report

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ARRIS Group Inc.
Model SBG6950

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

Hadid Jones, 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

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Report Status Sheet

Revision	Report Date	Reason for Revision
∅	May 5, 2017	Initial Issue.
1	May 26, 2017	Engineer corrections.

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List of Terms and Abbreviations

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

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I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the ARRIS Group Inc. SBG6950, 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 SBG6950. ARRIS Group Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the SBG6950, 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 ARRIS Group Inc., quote number 1ARR2103. All tests were conducted using measurement procedure ANSI C63.4-2014.

FCC Reference	Description	Results
§15.203	Antenna Requirement	Compliant
§15.403(i)	26 dB Occupied Bandwidth	Compliant
§15.407 (a)(2)	Maximum Conducted Output Power	Compliant
§15.407 (a)(2)	Maximum Power Spectral Density	Compliant
§15.407 (b)(2 – 3)& (6 - 7)	Undesirable Emissions	Compliant
§15.407(b)(6)	Conducted Emission	Compliant
§15.407(f)	RF Exposure	Compliant
§15.407(g)	Frequency Stability	Compliant

Table 1. Executive Summary of EMC Part 15.407 ComplianceTesting

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II. Equipment Configuration

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A. Overview

MET Laboratories, Inc. was contracted by ARRIS Group Inc. to perform testing on the SBG6950, under ARRIS Group Inc.'s quote number 1ARR2103.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the ARRIS Group Inc. SBG6950.

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

Model(s) Tested:	SBG6950	
Model(s) Covered:	SBG6950x ,TG1692x (where x can be any quantity of ASCII printable character, not affecting radio performance)	
EUT Specifications:	Primary Power: 12Vdc, 2.5A Via a 115V/60Hz Adapter	
	FCC ID: UIDSBG6950	
	Type of Modulations:	OFDM
	Equipment Code:	NII
	Peak RF Output Power:	UNII 2A: 18.56 dBm/ .072W UNII 2C: 18.47 dBm/ .070W
	EUT Frequency Ranges:	UNII 2A: 5260 – 5320 MHz UNII 2C: 5500 – 5700 MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35º C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Type of Filing:	Original	
Evaluated by:	Hadid Jones	
Report Date(s):	May 26, 2017	

Table 2. EUT Summary

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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 v01r03	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E
905462 DO2 UNII DFS Compliance Procedures New Rules v02	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., 914 W. Patapsco Ave., Baltimore, MD 21230. 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 3 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 ARRIS Group Inc. TG1692, is Telephony Gateway with 802.11ac Dual Band Wireless radios; 3x3 2.4GHz 802.11n and 3x3 5GHz 802.11ac Wave 2.

The SBG6950, Equipment Under Test (EUT), is identical to TG1692 except no telephony circuitry.

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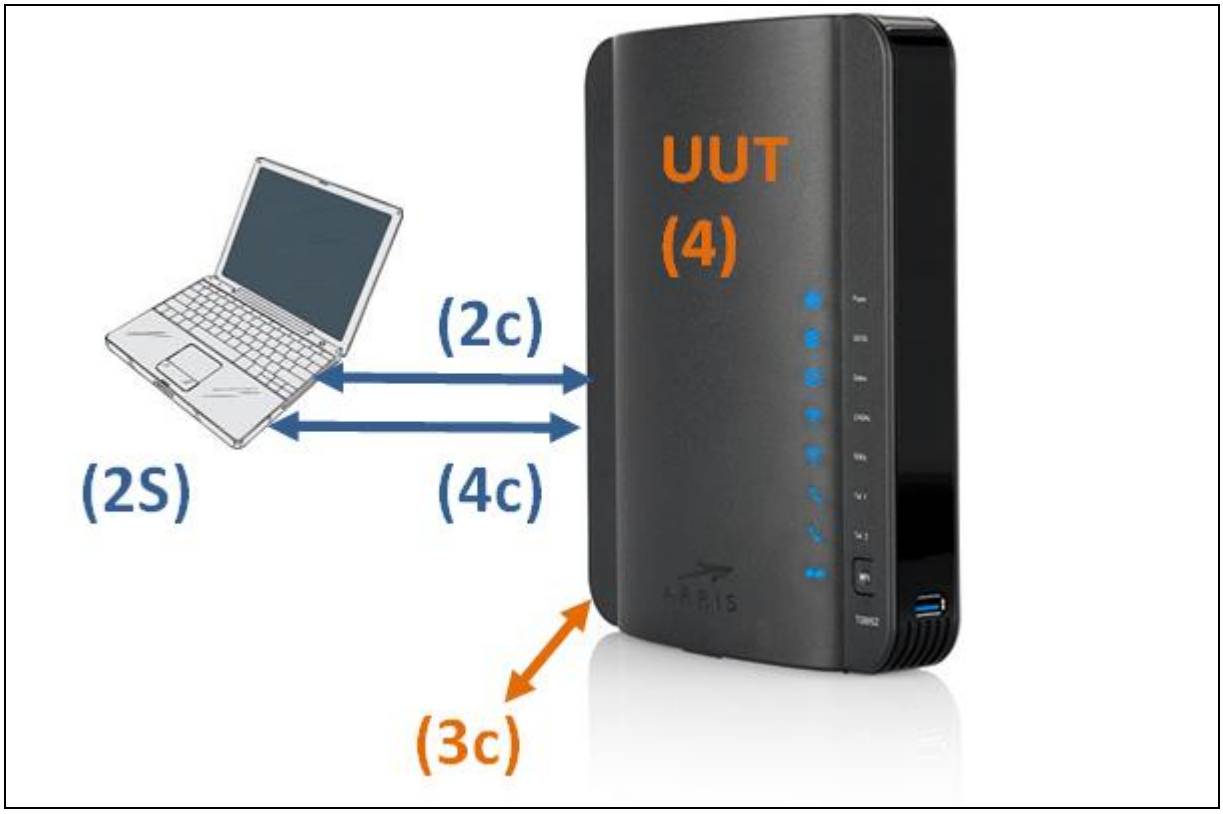

Figure 1. Block Diagram of Test Configuration

E. Equipment Configuration

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

Ref. ID	Name / Description	Model Number	Part Number	Serial Number	Revision
4	UUT	SBG6950	--	G7NBX7333345431	--

Table 4. Equipment Configuration

F. Support Equipment

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

Ref. ID	Name / Description	Manufacturer	Model Number
2s	Laptop	Assorted	N/A

Table 5. Support Equipment

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G. Ports and Cabling Information

Ref. ID	Port Name on EUT	Cable Description	Qty.	Length (m)	Shielded (Y/N)	Termination Point
2C	Ethernet	5e Modular 8 pin	1	1	No	--
3C	DC Input	2 conductor	1	2	No	--
4C	Serial	USB to 9 pin D-Sub	1	0.25	No	--

Table 6. Ports and Cabling Information

H. Mode of Operation

The provided instructions and software will configure the unit for operation at each required test mode. See Configuration.

I. Method of Monitoring EUT Operation

All indicator lights are active, both Wi-Fi 2.4G and 5 G passing traffic.

J. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

K. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to ARRIS Group Inc. upon completion of testing.

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III. Electromagnetic Compatibility Criteria for Intentional Radiators

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

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

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

a.) Antenna must be permanently attached to the unit.

b.) Antenna must use a unique type of connector to attach to the EUT.

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

Results: The EUT as tested is compliant the criteria of §15.203. The EUT has an integral antenna and measurement ports on the PCB for conducted testing.

Test Engineer(s): Hadid Jones

Test Date(s): 01/04/17

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15. 403(i) 26dB Bandwidth

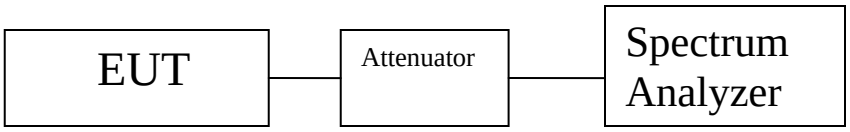
Test Requirements: **§ 15.403(i):** For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of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

Test Procedure: **The 26dB bandwidth was measured according to KDB789033 v01r03 Procedure C**
The EUT was connected to the spectrum analyzer through an attenuator. The spectrum analyzer was configured in the following manner. The RBW was set to approximately 1% of the emission bandwidth. The VBW was set to a value greater than or equal to the RBW. The detector was set to peak and trace to max hold. The EUT was operated at its maximum power level on the low, mid, and high test channels. The width of the emission that was 26dB down from the maximum emission was measured.

Test Results The 26 dB Bandwidth was compliant with the requirements of this section.

Test Engineer(s): Hadid Jones

Test Date(s): 03/14/17



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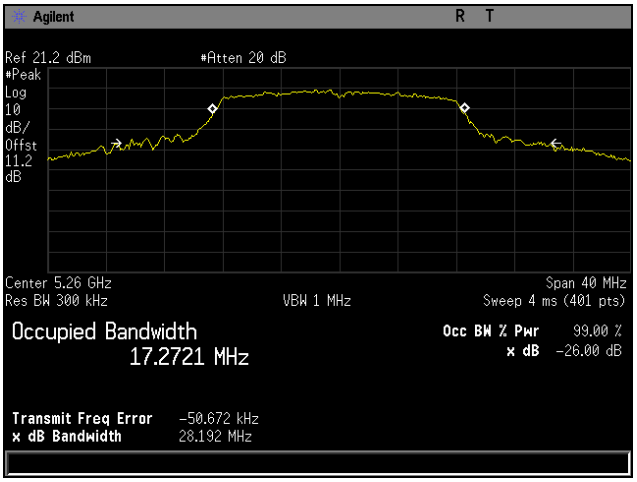
UNII2A Configuration	-26dB	99%
BW 20M_Ch 5260M_80211a MCS0 P3230	28.192	17.27
BW 20M_Ch 5260M_80211ac MCS24 P3230	20.93	17.73
BW 20M_Ch 5260M_80211n MCS24 P3230	20.865	17.68
BW 20M_Ch 5280M_80211a MCS0 P3230	29.214	17.31
BW 20M_Ch 5280M_80211ac MCS24 P3230	20.652	17.78
BW 20M_Ch 5280M_80211n MCS24 P3230	22.058	17.76
BW 20M_Ch 5320M_80211a MCS0 P3230	27.818	17.22
BW 20M_Ch 5320M_80211ac MCS24 P3230	21.22	17.72
BW 20M_Ch 5320M_80211n MCS24 P3230	20.481	17.7
BW 40M_Ch 5270M_80211ac MCS24 P3230	45.482	36.51
BW 40M_Ch 5270M_80211n MCS24 P3230	41.877	36.49
BW 40M_Ch 5310M_80211ac MCS24 P3230	44.84	36.5
BW 40M_Ch 5310M_80211n MCS24 P3230	41.813	36.35
BW 80M_Ch 5290M_80211ac MCS24 P3230	89.187	75.19

Table 7. Occupied Bandwidth, Test Results, Lower Bands

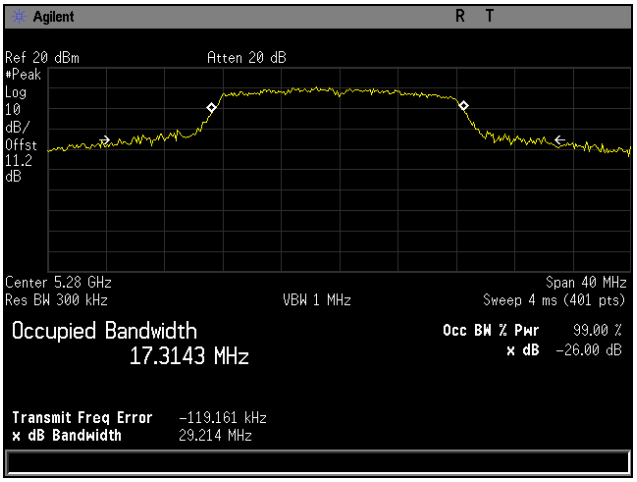
UNII2C Configuration	-26dB	99%
BW 20M_Ch 5500M_80211a MCS0 P3230	26.94	16.8213
BW 20M_Ch 5500M_80211ac MCS24 P3230	20.52	17.724
BW 20M_Ch 5500M_80211n MCS24 P3230	20.03	17.6498
BW 20M_Ch 5580M_80211a MCS0 P3230	28.44	17.2113
BW 20M_Ch 5580M_80211ac MCS24 P3230	20.3	17.6044
BW 20M_Ch 5580M_80211n MCS24 P3230	20.39	17.6141
BW 20M_Ch 5700M_80211a MCS0 P3230	28.01	17.1367
BW 20M_Ch 5700M_80211ac MCS24 P3230	20.44	17.7264
BW 20M_Ch 5700M_80211n MCS24 P3230	20.52	17.6822
BW 40M_Ch 5510M_80211ac MCS24 P3230	40.37	35.759
BW 40M_Ch 5510M_80211n MCS24 P3230	39.15	35.8984
BW 40M_Ch 5590M_80211ac MCS24 P3230	39.59	35.8788
BW 40M_Ch 5590M_80211n MCS24 P3230	39.55	35.807
BW 40M_Ch 5670M_80211ac MCS0 P3230	39.78	35.7948
BW 40M_Ch 5670M_80211n MCS24 P3230	40.46	35.8588
BW 80M_Ch 5530M_80211ac MCS24 P3230	80.1	75.0324
BW 80M_Ch 5610M_80211ac MCS24 P3230	81.81	75.2049

Table 8. Occupied Bandwidth, Test Results, Upper Bands

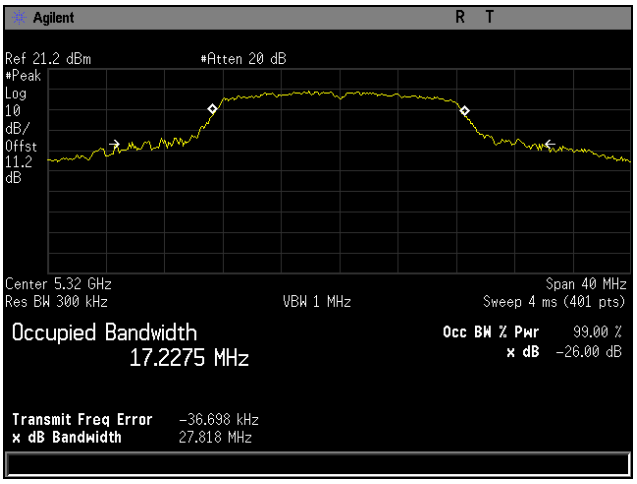
26 dB Occupied Bandwidth, 802.11a



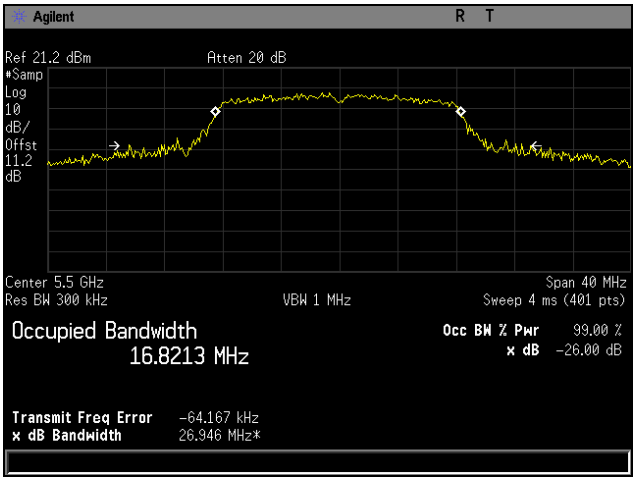
Plot 1. 26 dB Occupied Bandwidth, 5260 MHz, 802.11a



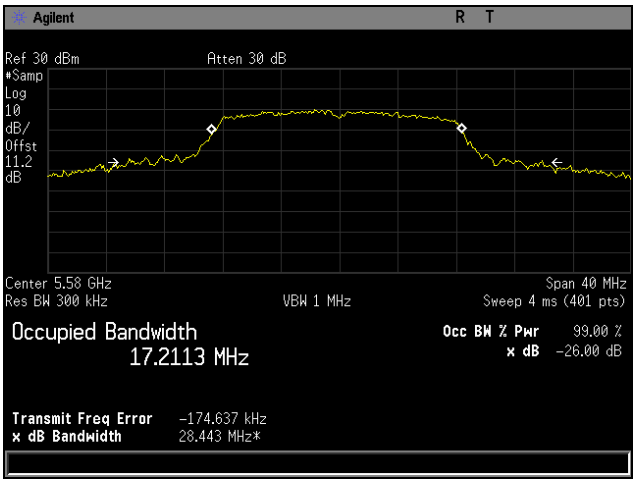
Plot 2. 26 dB Occupied Bandwidth, 5280 MHz, 802.11a



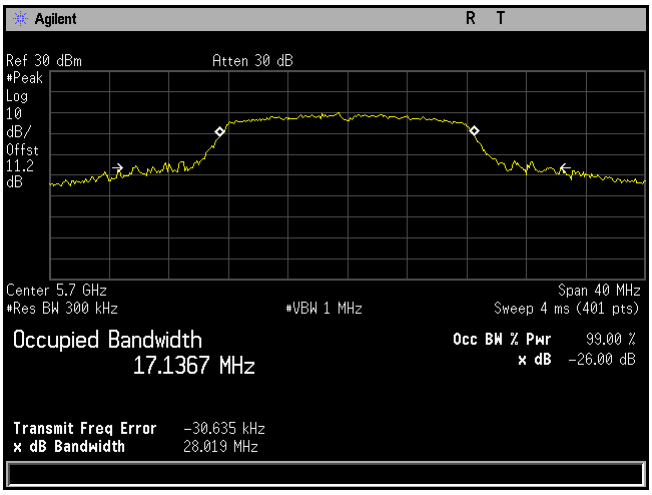
Plot 3. 26 dB Occupied Bandwidth, 5320 MHz, 802.11a



Plot 4. 26 dB Occupied Bandwidth, 5500 MHz, 802.11a

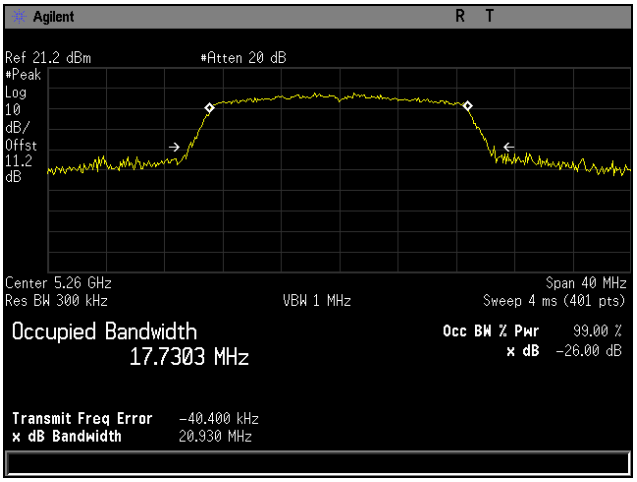


Plot 5. 26 dB Occupied Bandwidth, 5580 MHz, 802.11a

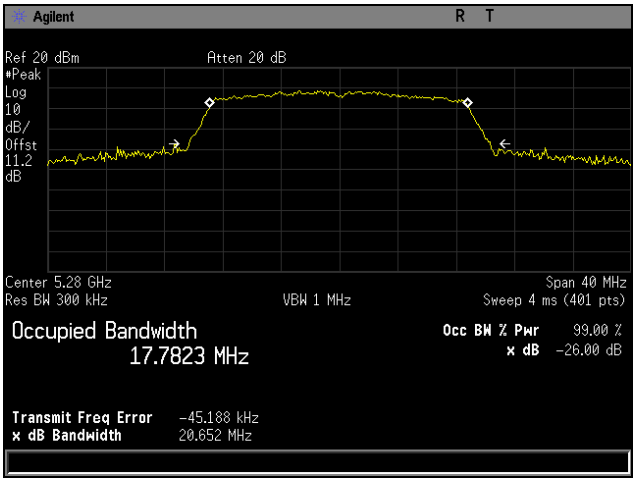


Plot 6. 26 dB Occupied Bandwidth, 5700 MHz, 802.11a

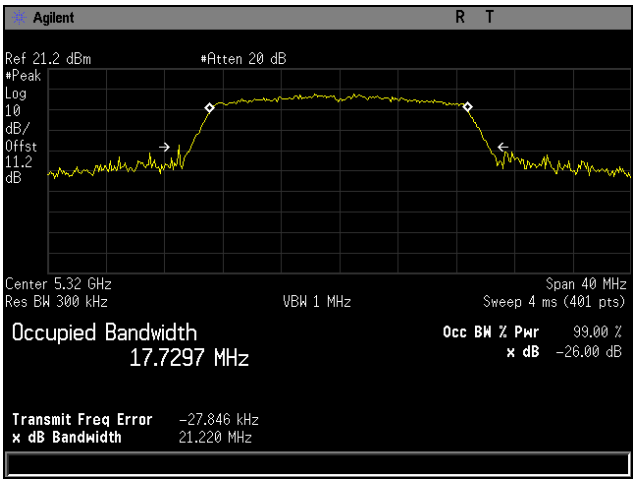
26 dB Occupied Bandwidth, 802.11ac 20 MHz



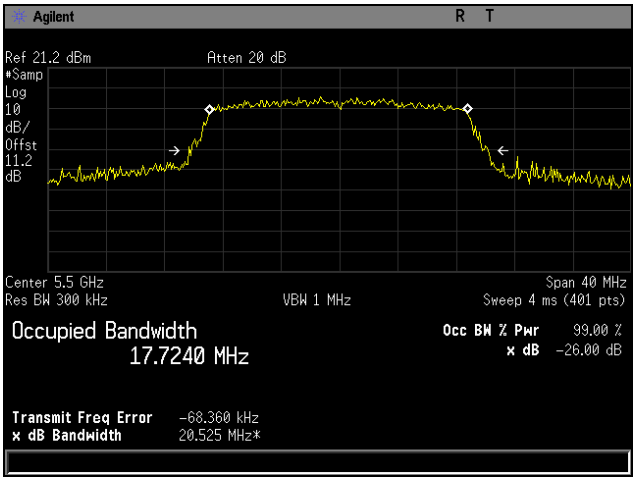
Plot 7. 26 dB Occupied Bandwidth, 5260 MHz, 802.11ac 20 MHz



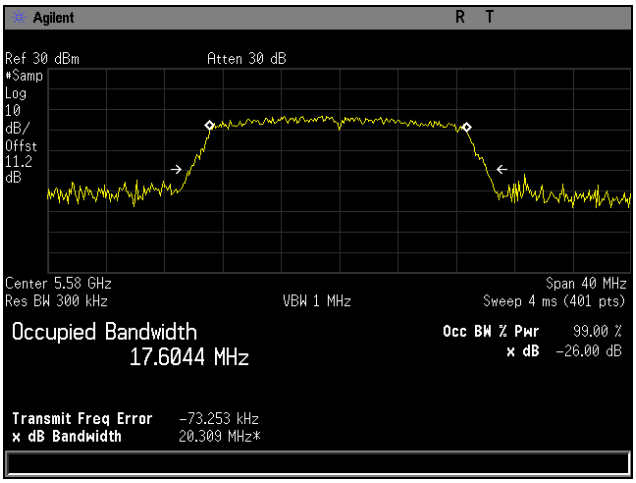
Plot 8. 26 dB Occupied Bandwidth, 5280 MHz, 802.11ac 20 MHz



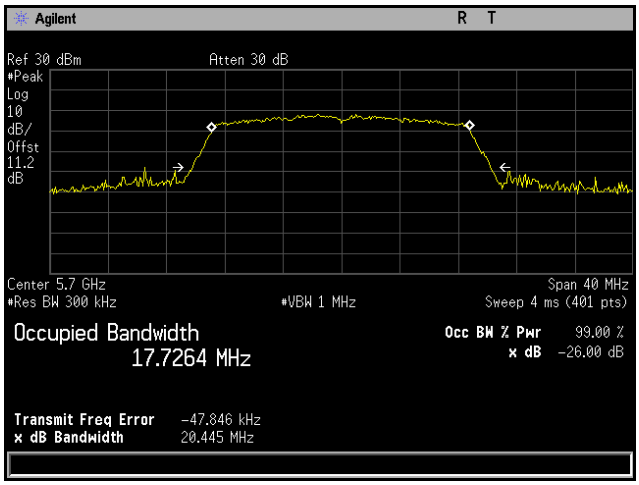
Plot 9. 26 dB Occupied Bandwidth, 5320 MHz, 802.11ac 20 MHz



Plot 10. 26 dB Occupied Bandwidth, 5500 MHz, 802.11ac 20 MHz

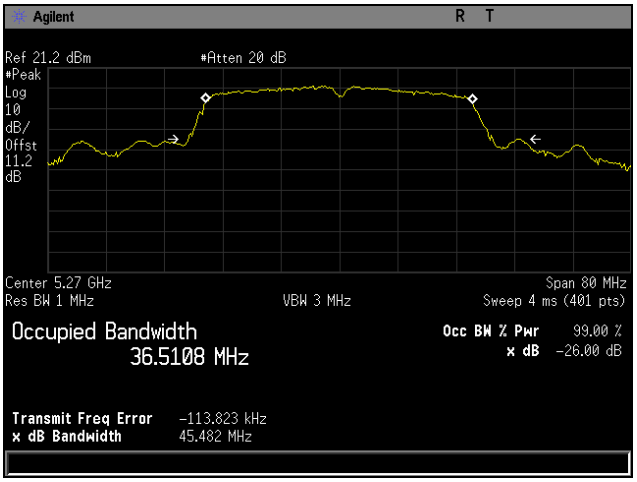


Plot 11. 26 dB Occupied Bandwidth, 5580 MHz, 802.11ac 20 MHz

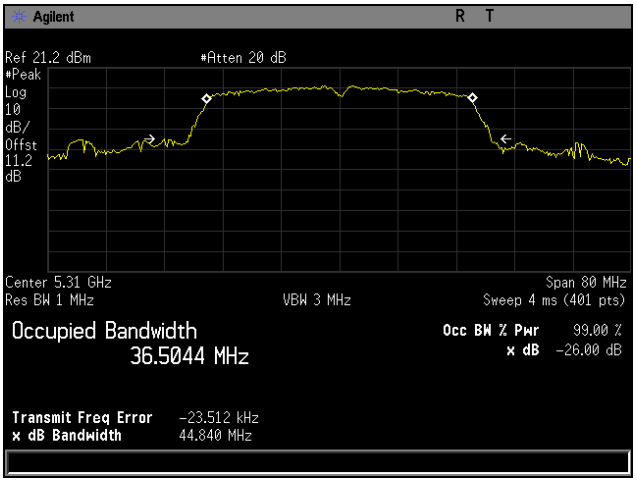


Plot 12. 26 dB Occupied Bandwidth, 5700 MHz, 802.11ac 20 MHz

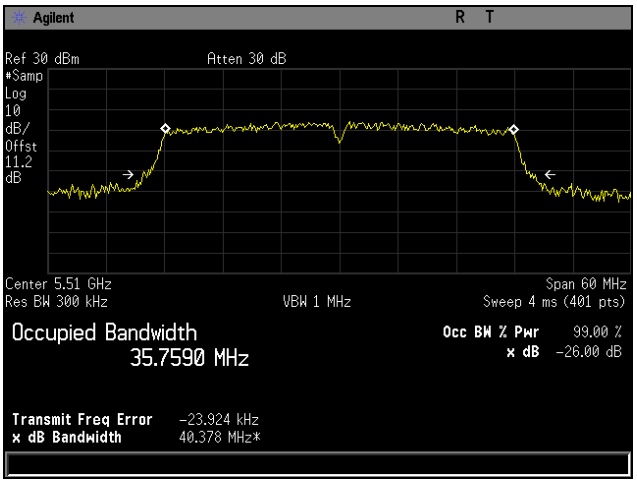
26 dB Occupied Bandwidth, 802.11ac 40 MHz



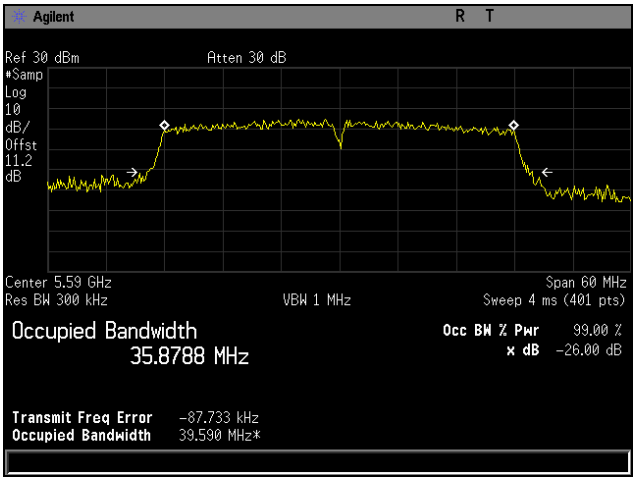
Plot 13. 26 dB Occupied Bandwidth, 5270 MHz, 802.11ac 40 MHz



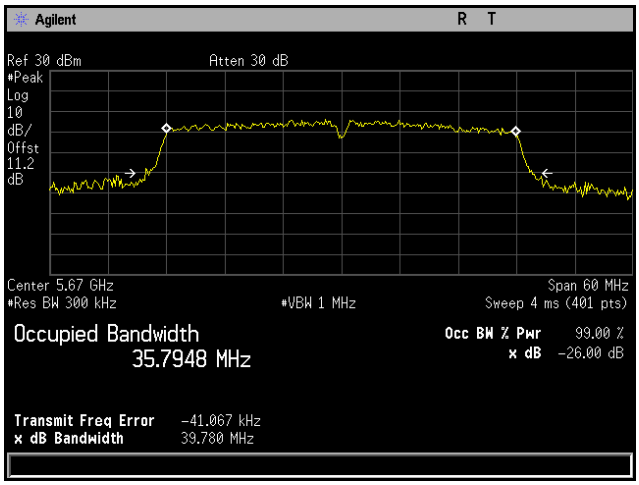
Plot 14. 26 dB Occupied Bandwidth, 5310 MHz, 802.11ac 40 MHz



Plot 15. 26 dB Occupied Bandwidth, 5510 MHz, 802.11ac 40 MHz

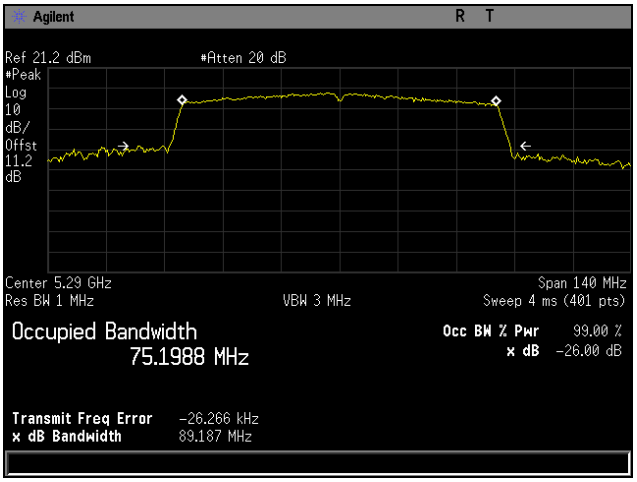


Plot 16. 26 dB Occupied Bandwidth, 5590 MHz, 802.11ac 40 MHz

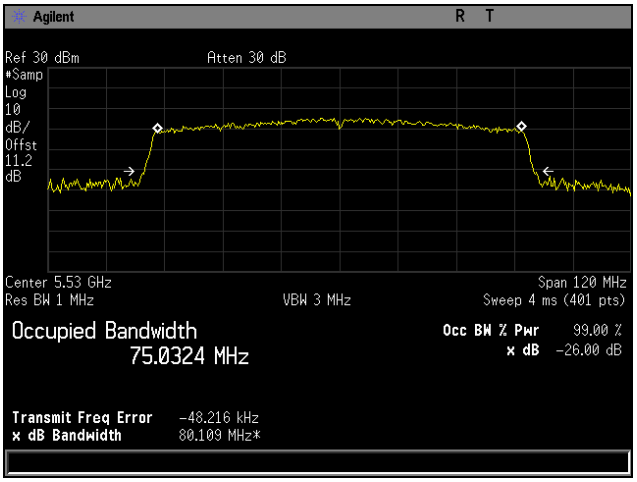


Plot 17. 26 dB Occupied Bandwidth, 5670 MHz, 802.11ac 40 MHz

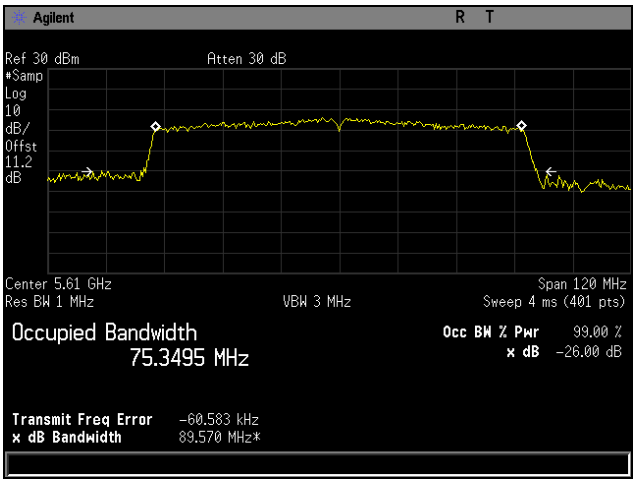
26 dB Occupied Bandwidth, 802.11ac 80 MHz



Plot 18. 26 dB Occupied Bandwidth, 5290 MHz, 802.11ac 80 MHz

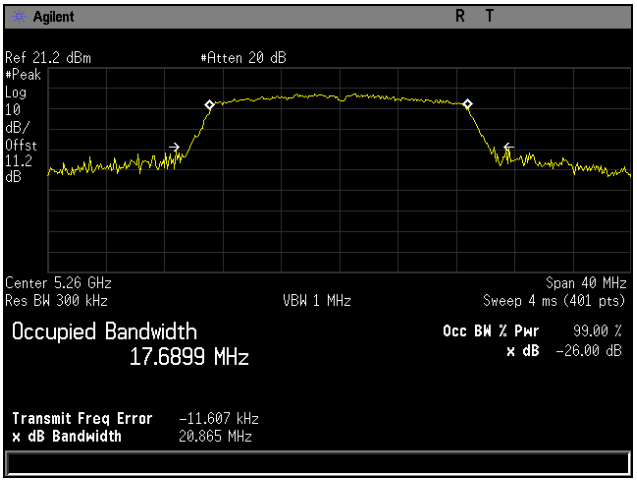


Plot 19. 26 dB Occupied Bandwidth, 5530 MHz, 802.11ac 80 MHz

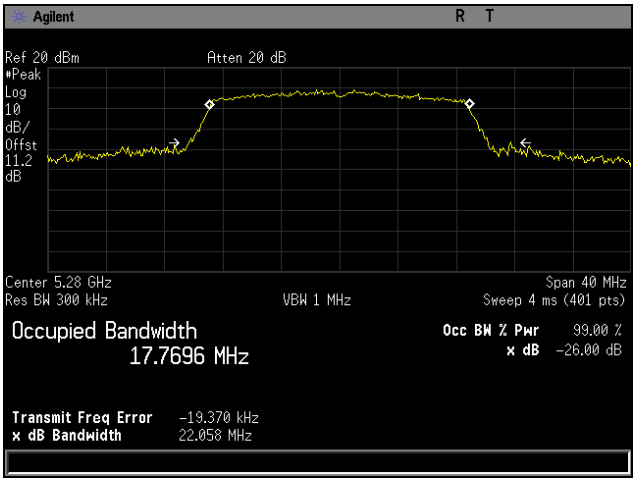


Plot 20. 26 dB Occupied Bandwidth, 5610 MHz, 802.11ac 80 MHz

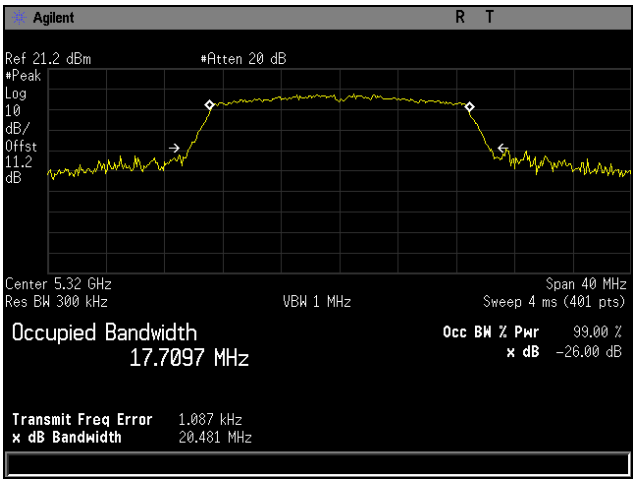
26 dB Occupied Bandwidth, 802.11n 20 MHz



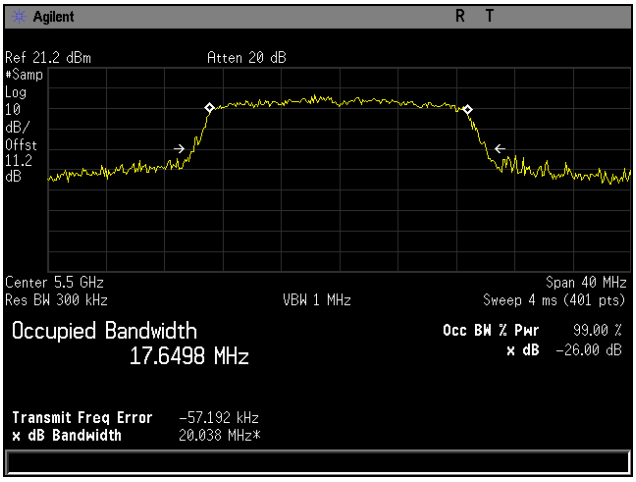
Plot 21. 26 dB Occupied Bandwidth, 5260 MHz, 802.11n 20 MHz



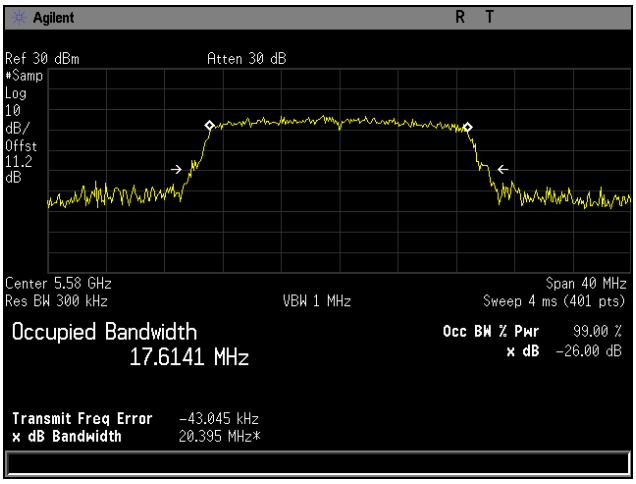
Plot 22. 26 dB Occupied Bandwidth, 5280 MHz, 802.11n 20 MHz



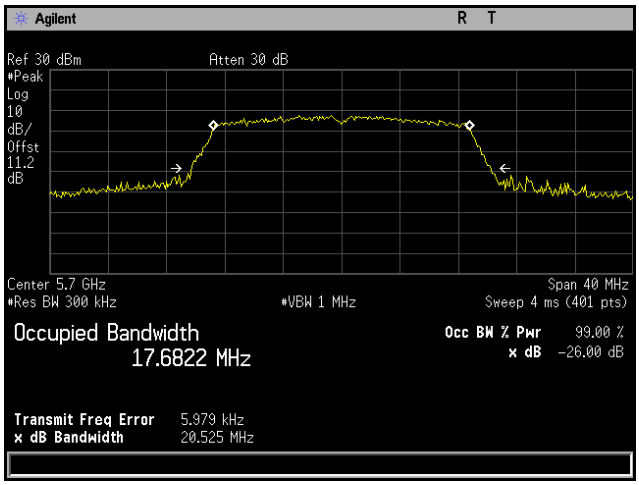
Plot 23. 26 dB Occupied Bandwidth, 5320 MHz, 802.11n 20 MHz



Plot 24. 26 dB Occupied Bandwidth, 5500 MHz, 802.11n 20 MHz

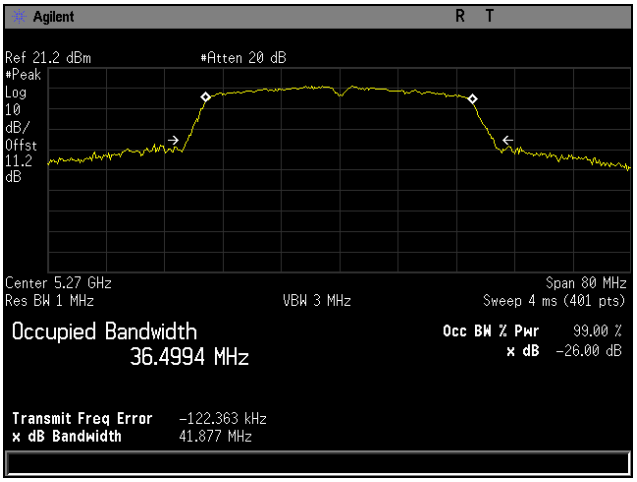


Plot 25. 26 dB Occupied Bandwidth, 5580 MHz, 802.11n 20 MHz

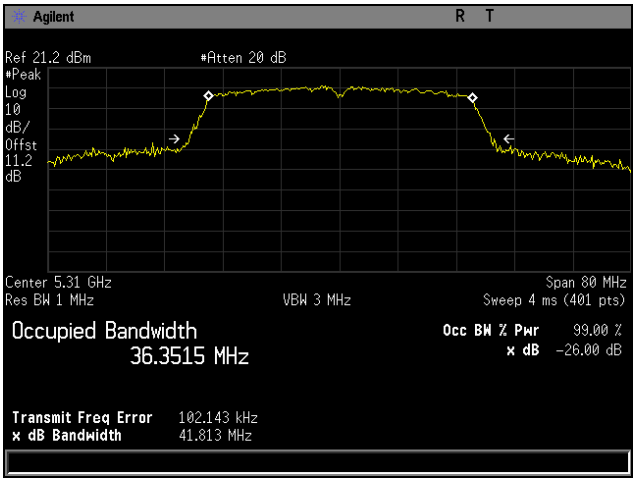


Plot 26. 26 dB Occupied Bandwidth, 5700 MHz, 802.11n 20 MHz

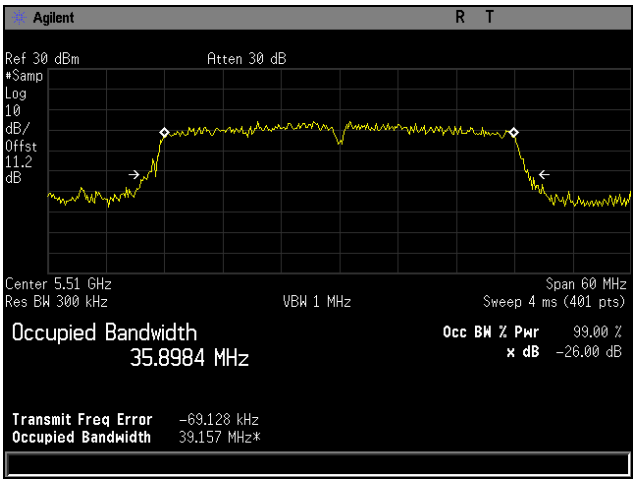
26 dB Occupied Bandwidth, 802.11n 40 MHz



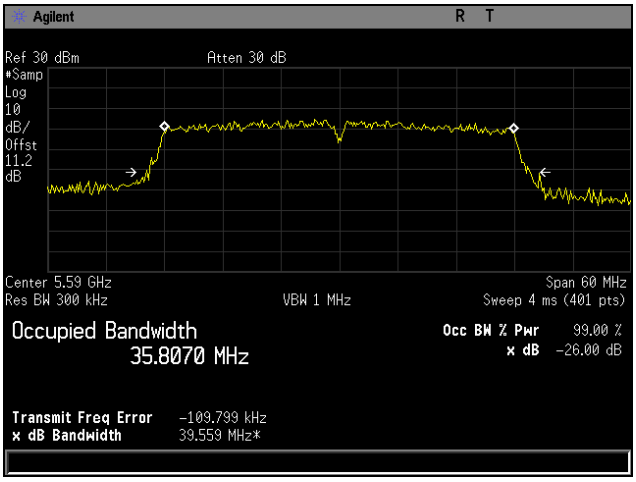
Plot 27. 26 dB Occupied Bandwidth, 5270 MHz, 802.11n 40 MHz



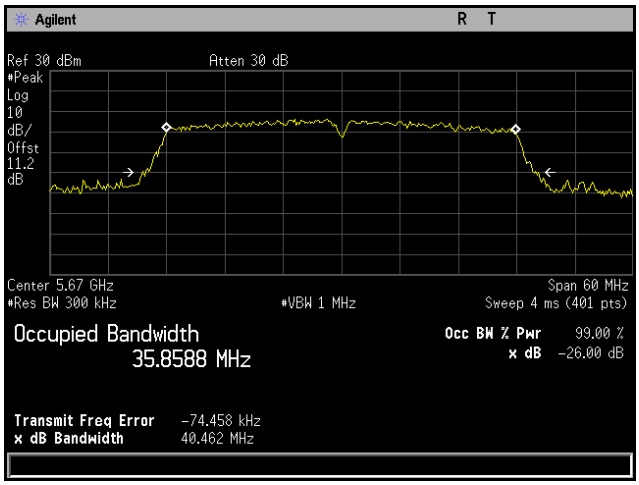
Plot 28. 26 dB Occupied Bandwidth, 5310 MHz, 802.11n 40 MHz



Plot 29. 26 dB Occupied Bandwidth, 5510 MHz, 802.11n 40 MHz



Plot 30. 26 dB Occupied Bandwidth, 5590 MHz, 802.11n 40 MHz



Plot 31. 26 dB Occupied Bandwidth, 56700 MHz, 802.11n 40 MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

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

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

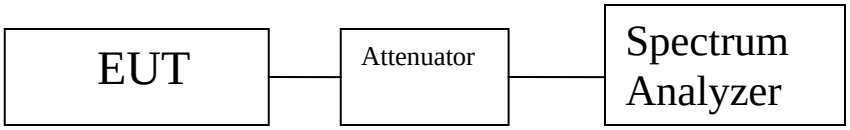
§15.407(h)(1): Transmit power control (TPC). U-NII devices operating in the 5.25-5.35 GHz band and the 5.47-5.725 GHz band shall employ a TPC mechanism. The U-NII device is required to have the capability to operate at least 6 dB below the mean EIRP value of 30 dBm. A TPC mechanism is not required for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

Test Procedure: The Maximum Conducted Output Power was measured according to KDB789033 v01r03 Method SA-1. The EUT was connected to the spectrum analyzer through an attenuator. The spectrum analyzer was configured in the following manner. The span was set to encompass the entire emission bandwidth of the signal. The RBW was set to 1MHz and the VBW was set to a value greater than or equal to 3x the RBW. An average detector was used with an auto sweep time. The trace was averaged over at least 100 traces. Power was computed by integrating the spectrum across the EBW of the signal using the instruments band power measurement function.

Test Results: The EUT as is compliant with the requirements of this section. Graphical data is presented for chain 0. Tabular data is presented for all chains.

Test Engineer(s): Hadid Jones

Test Date(s): 03/14/17



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UNII2A Output Power									
EUT MODE & PWR Setting	**CH0 (dBm)**	**CH1 (dBm)**	**CH2 (dBm)**	**Duty Cycle CF (dB)**	**Σ (dBm)**	**Limit (dBm)**	**Gain (dBi)**	**Final Limit (dBm)**	**Margin (dB)**
BW 20M_Ch 5260M_80211a MCS0 P2018	10.07	9.19	8.22	1.02	**15.02**	24	10.52	19.48	**-4.46**
BW 20M_Ch 5260M_80211ac MCS24 P3230	13.4	10.45	11.61	1.08	**17.84**	24	4.5	24	**-6.16**
BW 20M_Ch 5260M_80211n MCS16 P3230	13.7	11.21	11.67	0.96	**18.06**	24	4.5	24	**-5.94**
BW 20M_Ch 5280M_80211a MCS0 P2018	10.39	9.11	9.04	1.02	**15.35**	24	10.52	19.48	**-4.13**
BW 20M_Ch 5280M_80211ac MCS24 P3230	13.69	11.69	12.51	1.08	**18.56**	24	4.5	24	**-5.44**
BW 20M_Ch 5280M_80211n MCS16 P3230	13.67	11.65	11.3	0.96	**18.07**	24	4.5	24	**-5.93**
BW 20M_Ch 5320M_80211a MCS0 P2018	10.59	7.4	9.89	1.02	**15.29**	24	10.52	19.48	**-4.19**
BW 20M_Ch 5320M_80211ac MCS24 P3230	13.43	10.71	12.09	1.08	**18.07**	24	4.5	24	**-5.93**
BW 20M_Ch 5320M_80211n MCS16 P3230	13.55	12.4	11.97	0.96	**18.42**	24	4.5	24	**-5.58**
BW 40M_Ch 5270M_80211ac MCS24 P3230	12.75	10.98	10.91	1.08	**17.48**	24	4.5	24	**-6.52**
BW 40M_Ch 5270M_80211n MCS16 P3230	12.46	10.88	10.72	0.96	**17.16**	24	4.5	24	**-6.84**
BW 40M_Ch 5310M_80211ac MCS24 P3230	12.59	12.19	11.26	1.08	**17.90**	24	4.5	24	**-6.10**
BW 40M_Ch 5310M_80211n MCS16 P3230	12.22	11.73	10.88	0.96	**17.38**	24	4.5	24	**-6.62**
BW 80M_Ch 5290M_80211ac MCS24 P3230	11.44	8.03	9.15	1.08	**15.63**	24	4.5	24	**-8.37**

Table 9. Conducted Output Power, Test Results, Lower Bands

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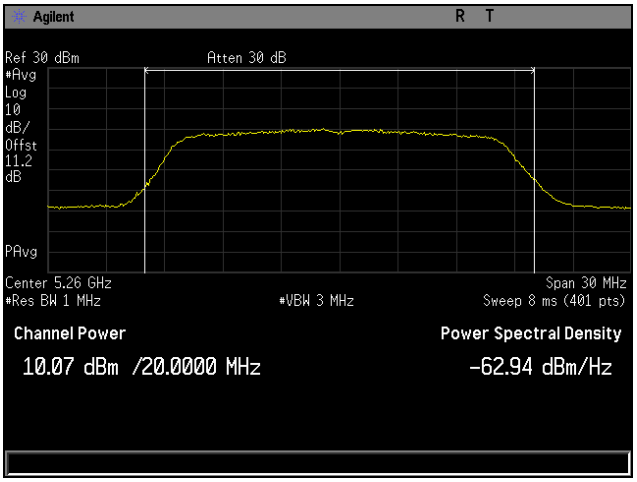
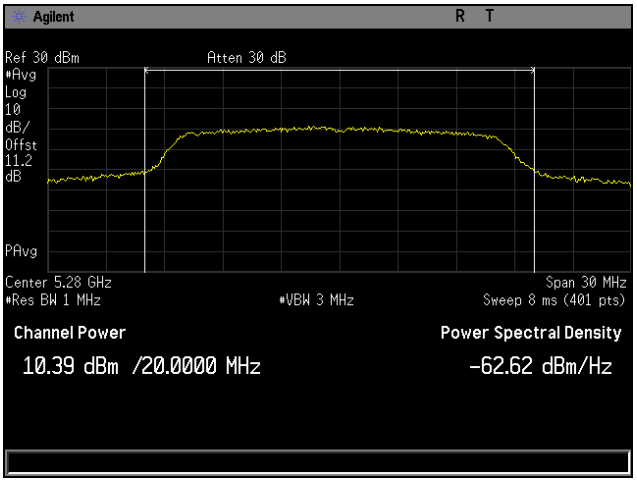
UNII2C Output Power									
EUT MODE & PWR Setting	**CH0 (dBm)**	**CH1 (dBm)**	**CH2 (dBm)**	**Duty Cycle CF (dB)**	**Σ (dBm)**	**Limit (dBm)**	**Gain (dBi)**	**Final Limit (dBm)**	**Margin (dB)**
BW 20M_Ch 5500M_80211a MSC0 P2018	9.72	8.89	10.03	1.02	**15.36**	24.00	10.52	19.48	**-4.12**
BW 20M_Ch 5500M_80211ac MCS24 P3230	12.27	12.35	12.68	1.08	**18.29**	24.00	4.50	24.00	**-5.71**
BW 20M_Ch 5500M_80211n MCS24 P3230	12.67	11.49	11.23	0.96	**17.57**	24.00	4.50	24.00	**-6.43**
BW 20M_Ch 5580M_80211a MSC0 P2018	10.50	9.05	10.02	1.02	**15.69**	24.00	10.52	19.48	**-3.79**
BW 20M_Ch 5580M_80211ac MCS24 P3230	13.17	12.41	12.23	1.08	**18.47**	24.00	4.50	24.00	**-5.53**
BW 20M_Ch 5580M_80211n MCS24 P3230	13.46	12.23	12.41	0.96	**18.47**	24.00	4.50	24.00	**-5.53**
BW 20M_Ch 5700M_80211a MSC0 P2018	8.92	8.71	7.23	1.02	**14.14**	24.00	10.52	19.48	**-5.34**
BW 20M_Ch 5700M_80211ac MCS24 P3230	10.65	10.25	10.31	1.08	**16.26**	24.00	4.50	24.00	**-7.74**
BW 20M_Ch 5700M_80211n MCS24 P3230	11.64	10.75	9.82	0.96	**16.53**	24.00	4.50	24.00	**-7.47**
BW 40M_Ch 5510M_80211ac MCS24 P3230	11.06	11.29	9.28	1.08	**16.48**	24.00	4.50	24.00	**-7.52**
BW 40M_Ch 5510M_80211n MCS24 P3230	11.72	10.43	10.69	0.96	**16.71**	24.00	4.50	24.00	**-7.29**
BW 40M_Ch 5590M_80211ac MCS24 P3230	12.50	11.39	10.74	1.08	**17.46**	24.00	4.50	24.00	**-6.54**
BW 40M_Ch 5590M_80211n MCS24 P3230	11.77	10.15	10.77	0.96	**16.68**	24.00	4.50	24.00	**-7.32**
BW 40M_Ch 5670M_80211ac MCS24 P3230	11.21	10.51	10.64	1.08	**16.65**	24.00	4.50	24.00	**-7.35**
BW 40M_Ch 5670M_80211n MCS24 P3230	12.41	11.30	11.36	0.96	**17.45**	24.00	4.50	24.00	**-6.55**
BW 80M_Ch 5530M_80211ac MCS24 P3230	10.68	9.98	9.27	1.08	**15.87**	24.00	4.50	24.00	**-8.13**
BW 80M_Ch 5610M_80211ac MCS24 P3230	10.05	9.34	8.92	1.08	**15.31**	24.00	4.50	24.00	**-8.69**
Data is uncorrelated for n and ac modes									

Table 10. Conducted Output Power, Test Results, Upper Bands

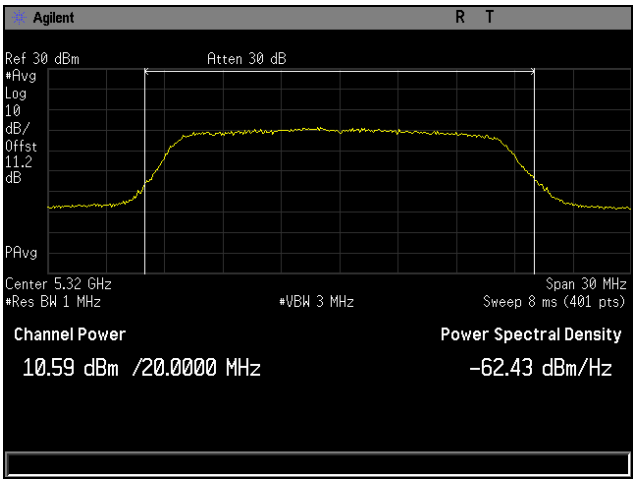
Conducted Output Power, 802.11a



Plot 32. Conducted Output Power, 5260 MHz, 802.11a



Plot 33. Conducted Output Power, 5280 MHz, 802.11a



Plot 34. Conducted Output Power, 5320 MHz, 802.11a

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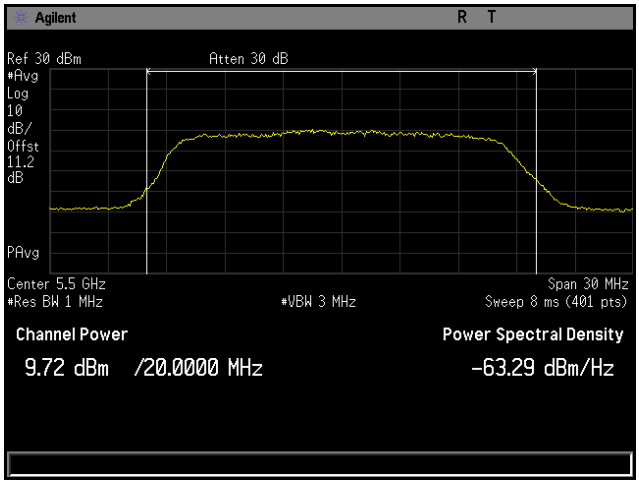
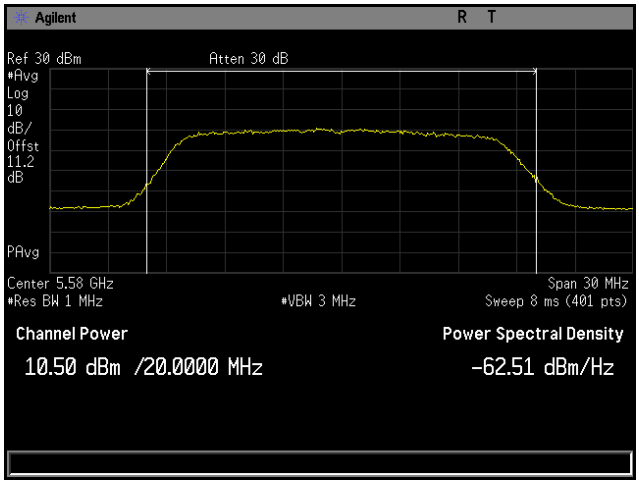
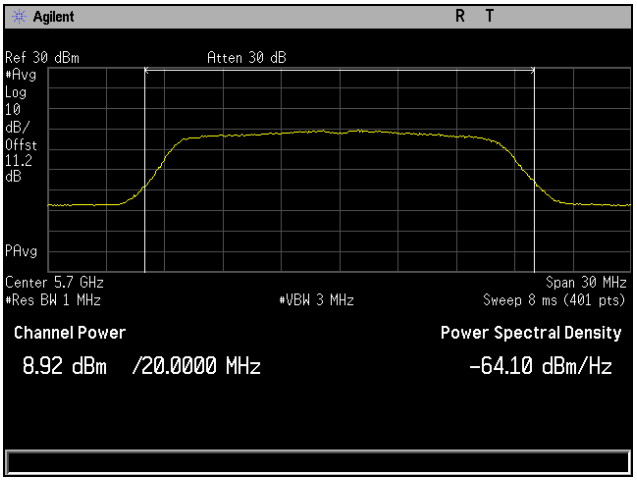


Plot 35. Conducted Output Power, 5500 MHz, 802.11a

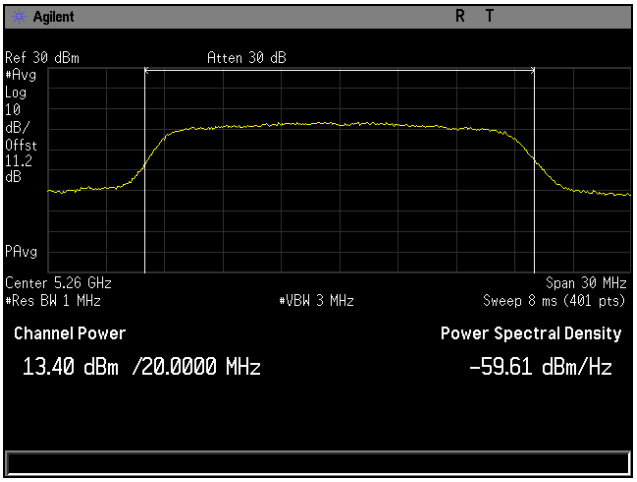


Plot 36. Conducted Output Power, 5580 MHz, 802.11a

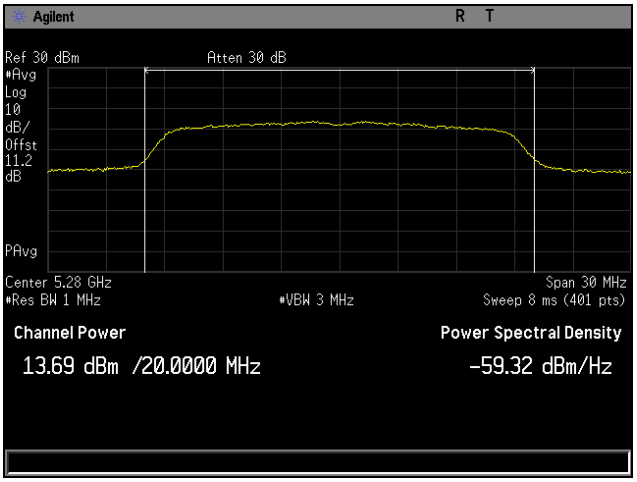


Plot 37. Conducted Output Power, 5700 MHz, 802.11a

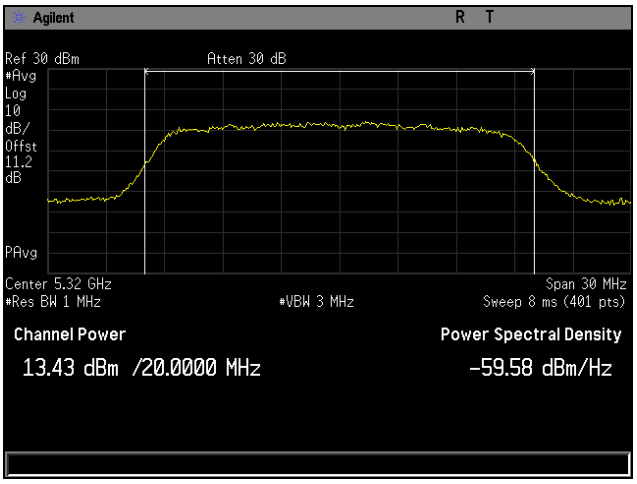
Conducted Output Power, 802.11ac 20 MHz



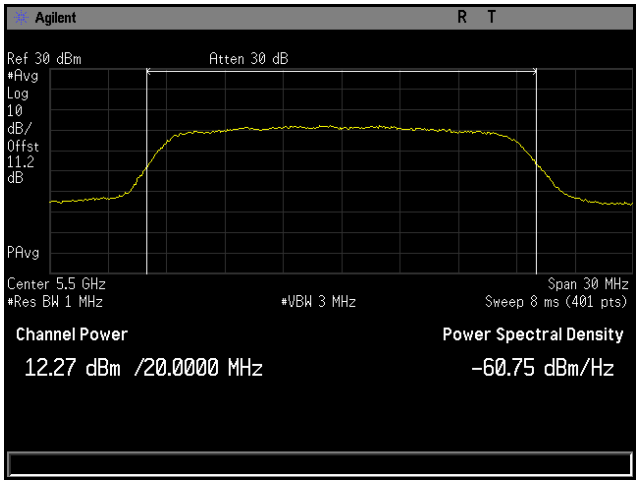
Plot 38. Conducted Output Power, 5260 MHz, 802.11ac 20 MHz



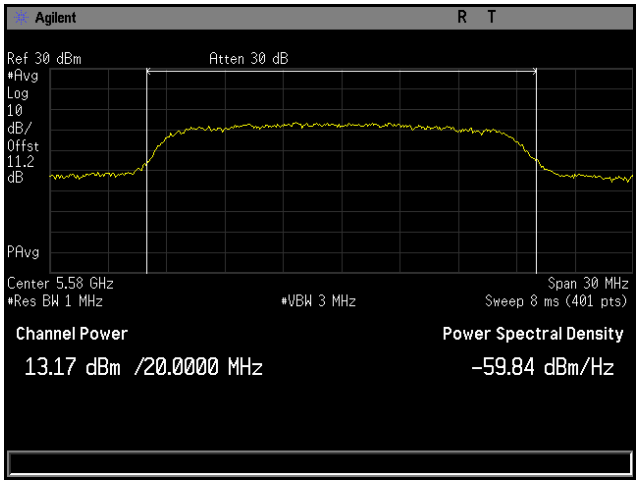
Plot 39. Conducted Output Power, 5280 MHz, 802.11ac 20 MHz



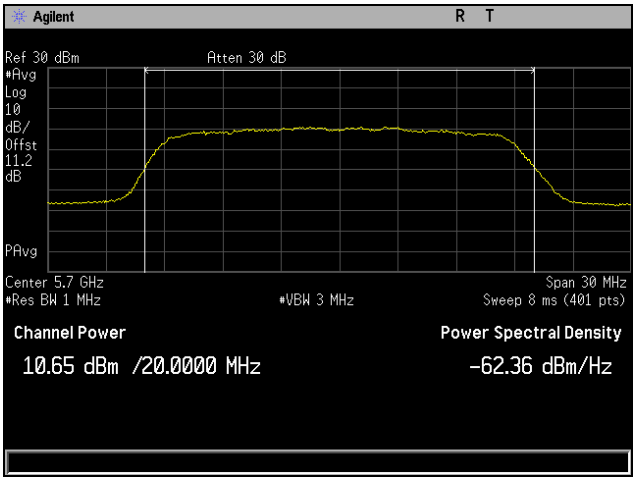
Plot 40. Conducted Output Power, 5320 MHz, 802.11ac 20 MHz



Plot 41. Conducted Output Power, 5500 MHz, 802.11ac 20 MHz

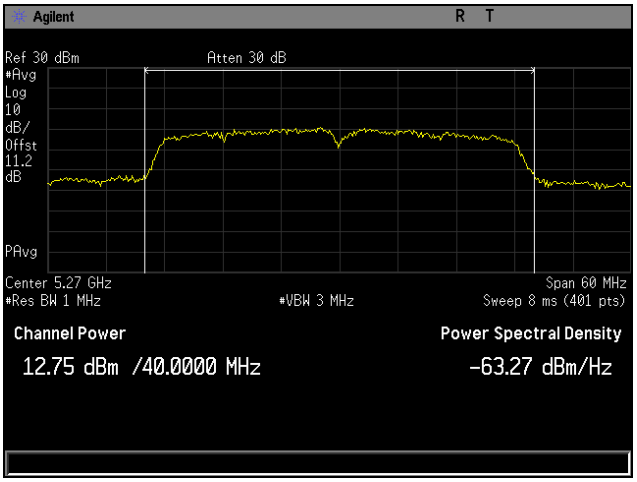


Plot 42. Conducted Output Power, 5580 MHz, 802.11ac 20 MHz

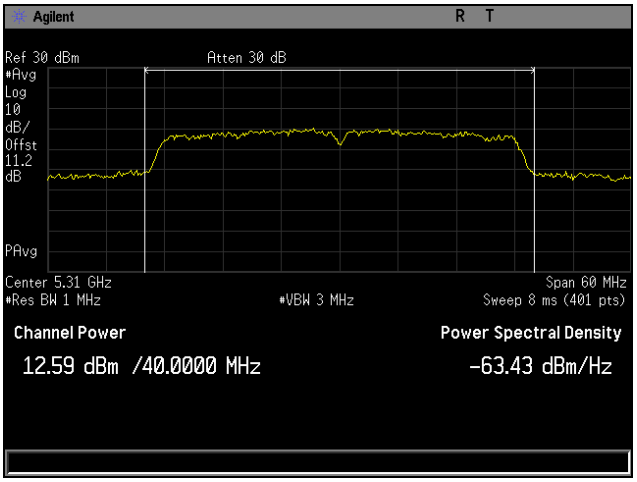


Plot 43. Conducted Output Power, 5700 MHz, 802.11ac 20 MHz

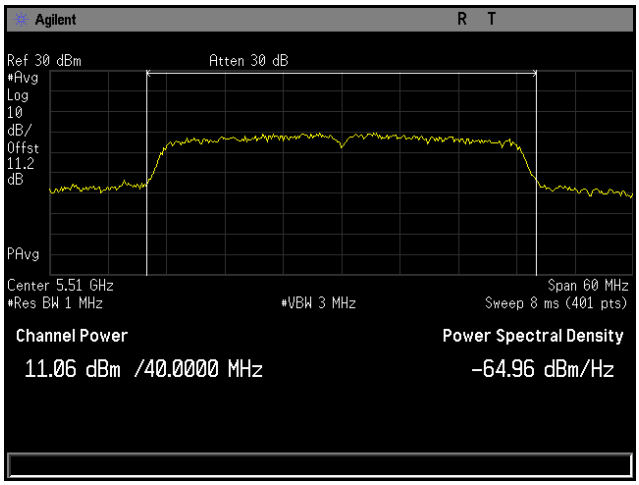
Conducted Output Power, 802.11ac 40 MHz



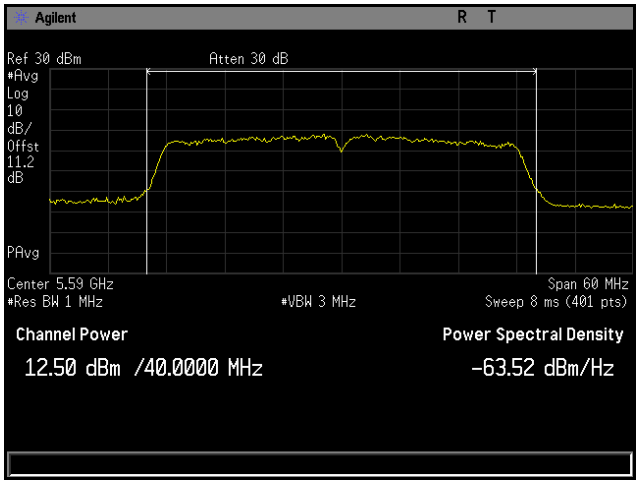
Plot 44. Conducted Output Power, 5270 MHz, 802.11ac 40 MHz



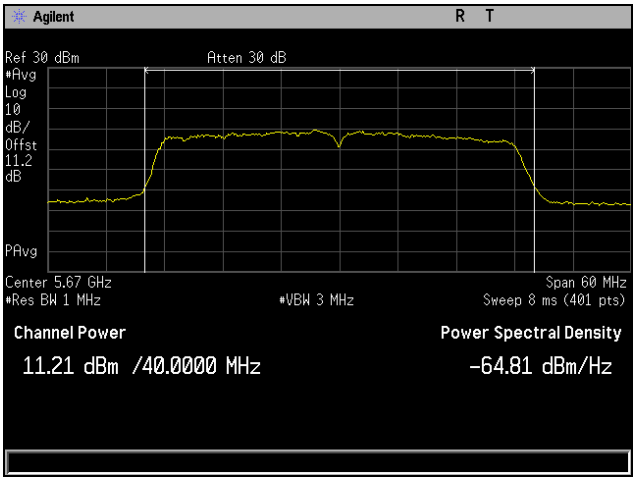
Plot 45. Conducted Output Power, 5310 MHz, 802.11ac 40 MHz



Plot 46. Conducted Output Power, 5510 MHz, 802.11ac 40 MHz

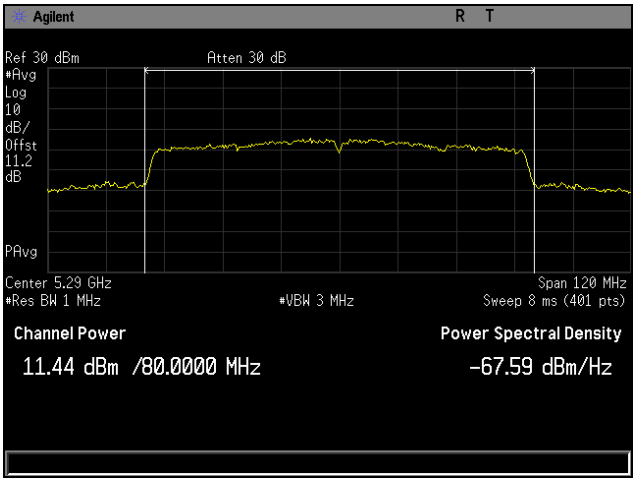


Plot 47. Conducted Output Power, 5590 MHz, 802.11ac 40 MHz

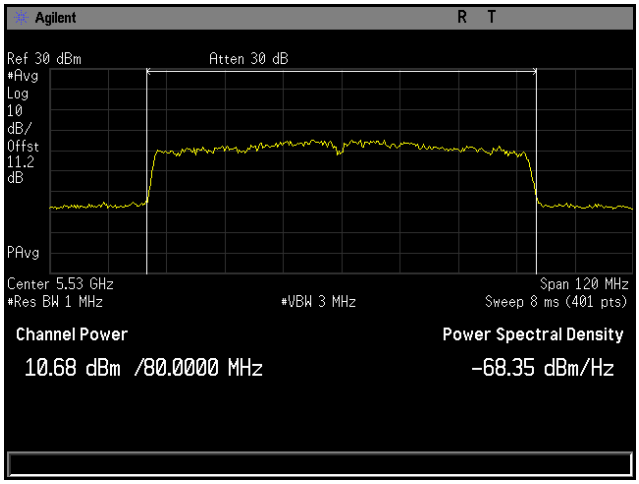


Plot 48. Conducted Output Power, 5670 MHz, 802.11ac 40 MHz

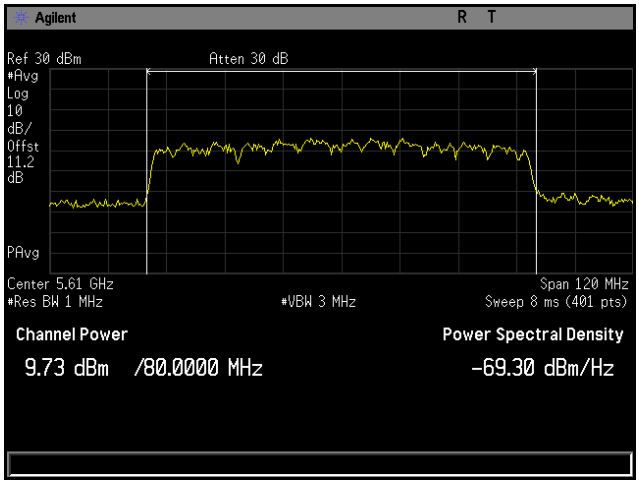
Conducted Output Power, 802.11ac 80 MHz



Plot 49. Conducted Output Power, 5290 MHz, 802.11ac 80 MHz

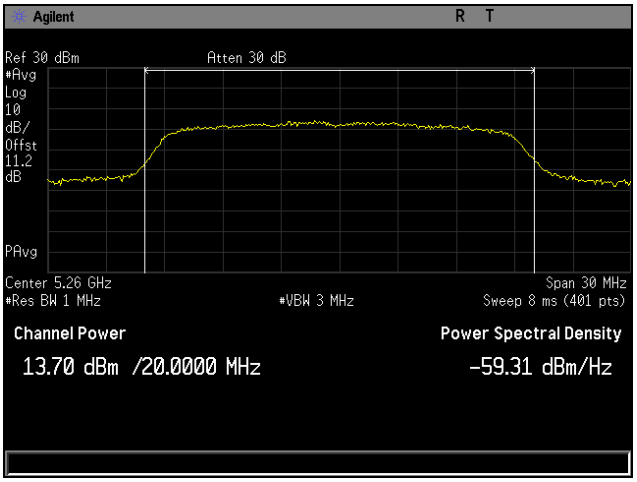


Plot 50. Conducted Output Power, 5530 MHz, 802.11ac 80 MHz

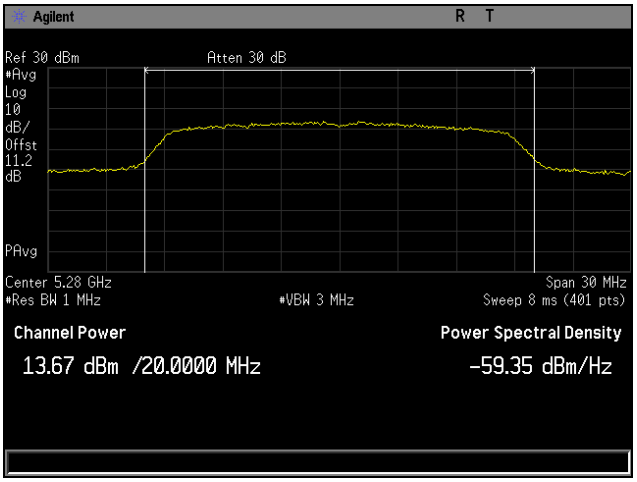


Plot 51. Conducted Output Power, 5610 MHz, 802.11ac 80 MHz

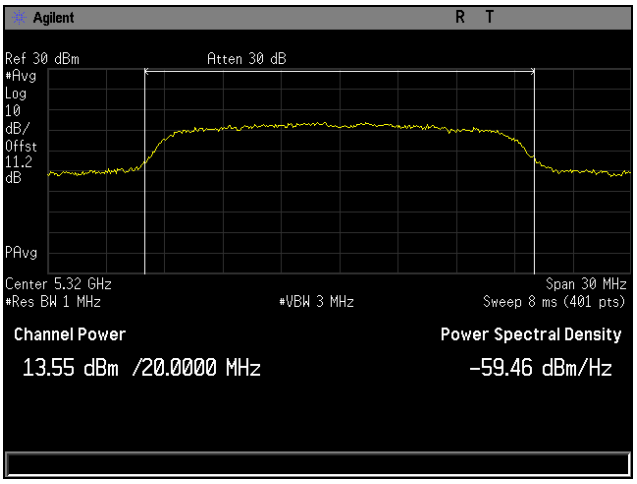
Conducted Output Power, 802.11n 20 MHz



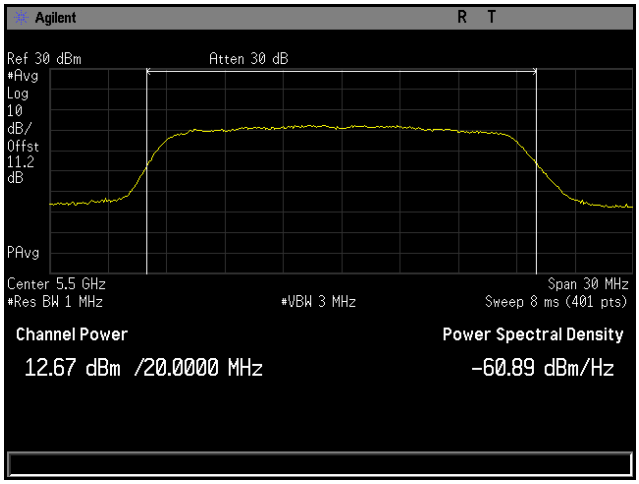
Plot 52. Conducted Output Power, 5260 MHz, 802.11n 20 MHz



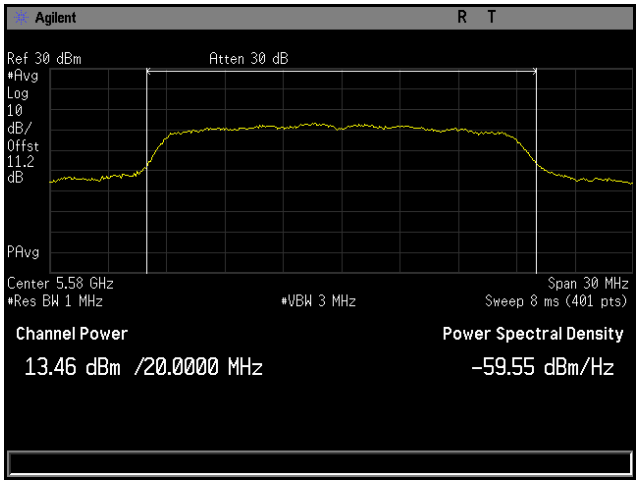
Plot 53. Conducted Output Power, 5280 MHz, 802.11n 20 MHz



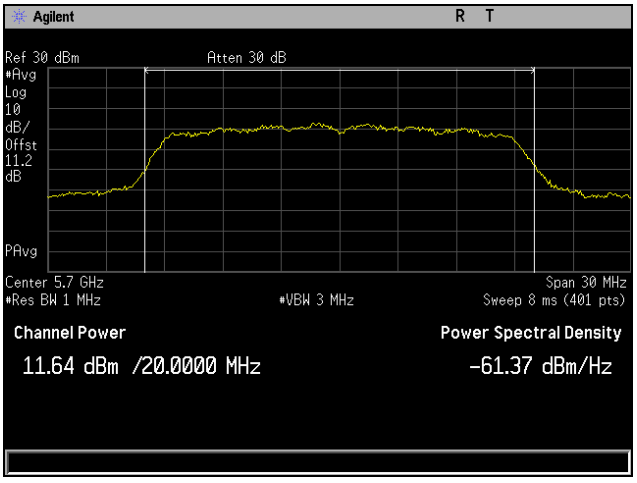
Plot 54. Conducted Output Power, 5320 MHz, 802.11n 20 MHz



Plot 55. Conducted Output Power, 5500 MHz, 802.11n 20 MHz

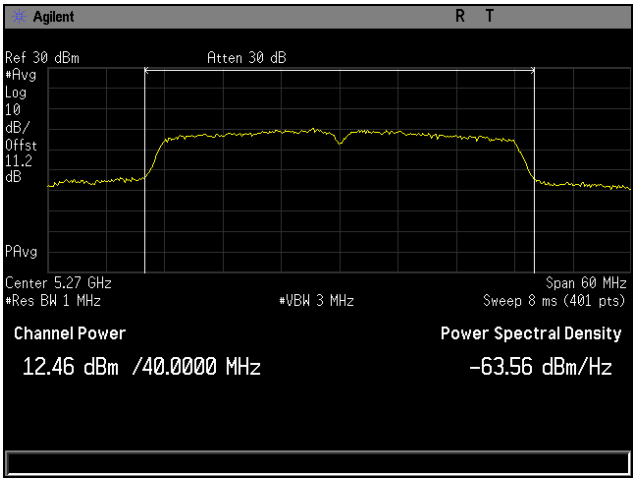


Plot 56. Conducted Output Power, 5580 MHz, 802.11n 20 MHz

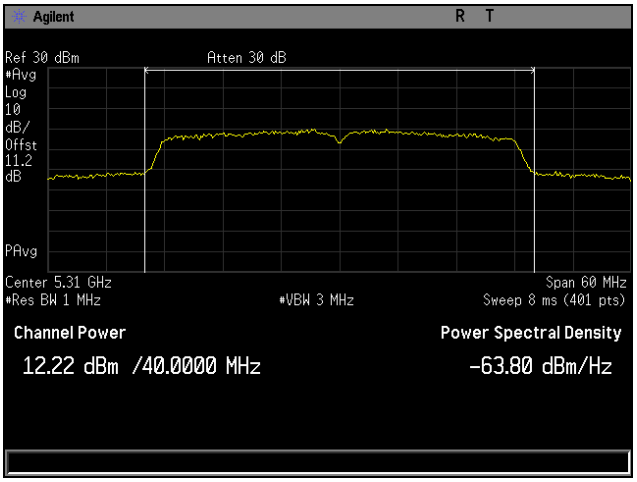


Plot 57. Conducted Output Power, 5700 MHz, 802.11n 20 MHz

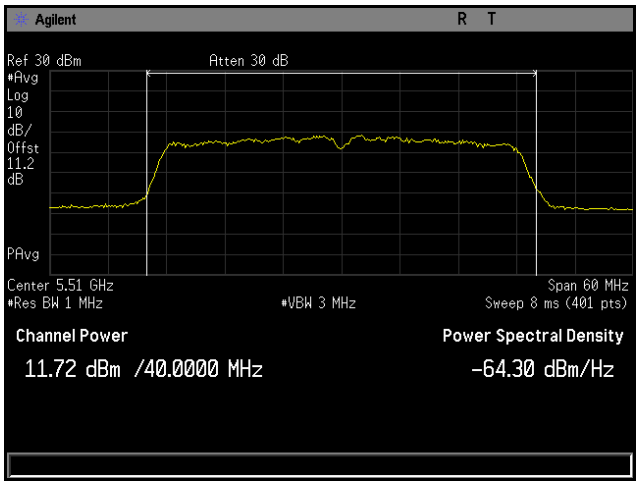
Conducted Output Power, 802.11n 40 MHz



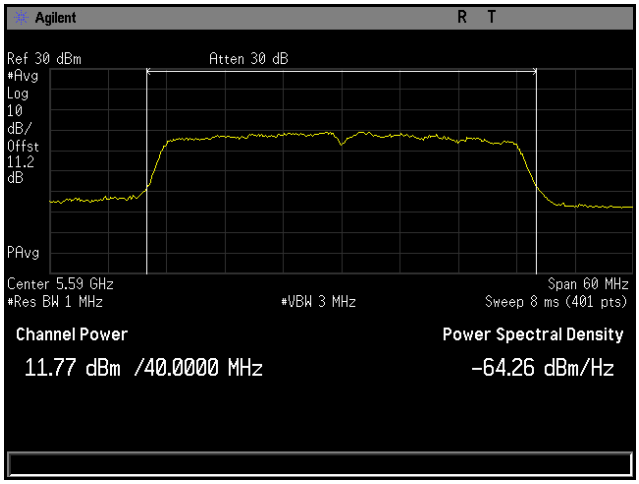
Plot 58. Conducted Output Power, 5270 MHz, 802.11n 40 MHz



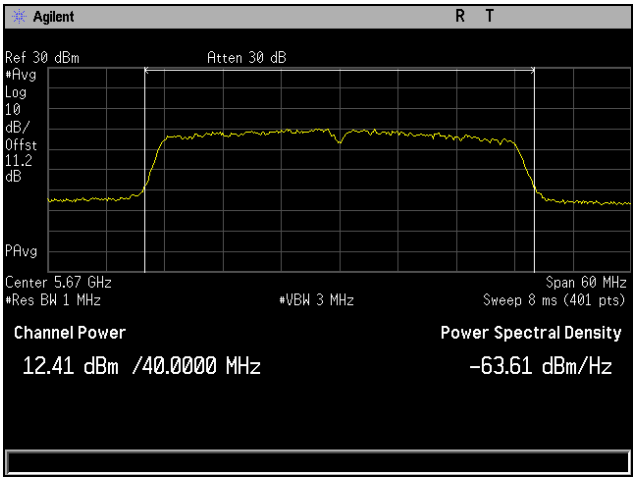
Plot 59. Conducted Output Power, 5310 MHz, 802.11n 40 MHz



Plot 60. Conducted Output Power, 5510 MHz, 802.11n 40 MHz



Plot 61. Conducted Output Power, 5590 MHz, 802.11n 40 MHz



Plot 62. Conducted Output Power, 5670 MHz, 802.11n 40 MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

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

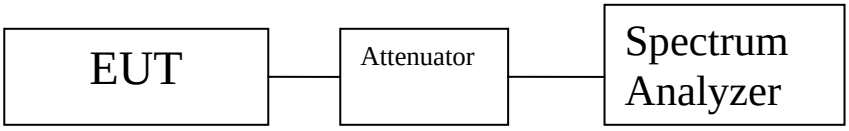
Test Requirements: **§15.407(a)(2):** In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced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

Test Procedure: The Maximum Power Spectral Density was measured according to KDB789033 v01r03 Procedure F. The EUT was connected to the spectrum analyzer through an attenuator. The spectrum analyzer was configured in the following manner. The span was set to encompass the entire emission bandwidth of the signal. The RBW was set to 1MHz and the VBW was set to a value greater than or equal to 3 times the RBW. An average detector was used with an auto sweep time. The trace was averaged over at least 100 traces. The peak search function was used to find the Maximum PSD over the 1MHz reference bandwidth.

Test Results: The EUT as tested is compliant with the requirements of this section. Graphical data is presented for chain 0. Tabular data is presented for all chains.

Test Engineer(s): Hadid Jones

Test Date(s): 03/14/17



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PSD									
EUT MODE & PWR Setting	**CH0 (dBm)**	**CH1 (dBm)**	**CH2 (dBm)**	**Duty Cycle CF (dB)**	**Σ (dBm)**	**Limit (dBm)**	**Gain (dBi)**	**Final Limit (dBm)**	**Margin (dB)**
BW 20M_Ch 5260M_80211a MCS0 P2018	-0.467	-1.5	-1.113	1.02	4.79	11	10.52	6.48	-1.69
BW 20M_Ch 5260M_80211ac MCS24 P3230	3.47	0.778	2.305	1.08	8.17	11	4.5	11	-2.83
BW 20M_Ch 5260M_80211n MCS16 P3230	3.878	0.488	2.464	0.96	8.22	11	4.5	11	-2.78
BW 20M_Ch 5280M_80211a MCS0 P2018	-0.341	-1.15	-1.067	1.02	4.95	11	10.52	6.48	-1.53
BW 20M_Ch 5280M_80211ac MCS24 P3230	4.174	2.339	2.883	1.08	9.05	11	4.5	11	-1.95
BW 20M_Ch 5280M_80211n MCS16 P3230	3.56	1.813	2.037	0.96	8.27	11	4.5	11	-2.73
BW 20M_Ch 5320M_80211a MCS0 P2018	0.315	-0.15	-0.7	1.02	5.63	11	10.52	6.48	-0.85
BW 20M_Ch 5320M_80211ac MCS24 P3230	4.289	1.094	2.861	1.08	8.79	11	4.5	11	-2.21
BW 20M_Ch 5320M_80211n MCS16 P3230	3.575	3.015	3.319	0.96	9.04	11	4.5	11	-1.96
BW 40M_Ch 5270M_80211ac MCS24 P3230	0.389	-1.309	-2.464	1.08	4.88	11	4.5	11	-6.12
BW 40M_Ch 5270M_80211n MCS16 P3230	0.532	-1.848	-2.357	0.96	4.70	11	4.5	11	-6.30
BW 40M_Ch 5310M_80211ac MCS24 P3230	1.101	0.283	-0.896	1.08	6.09	11	4.5	11	-4.91
BW 40M_Ch 5310M_80211n MCS16 P3230	-1.184	-0.678	-2.36	0.96	4.38	11	4.5	11	-6.62
BW 80M_Ch 5290M_80211ac MCS24 P3230	-4.069	-5.454	-7.211	1.08	0.46	11	4.5	11	-10.54

Table 11. Power Spectral Density, Test Results, Lower Bands

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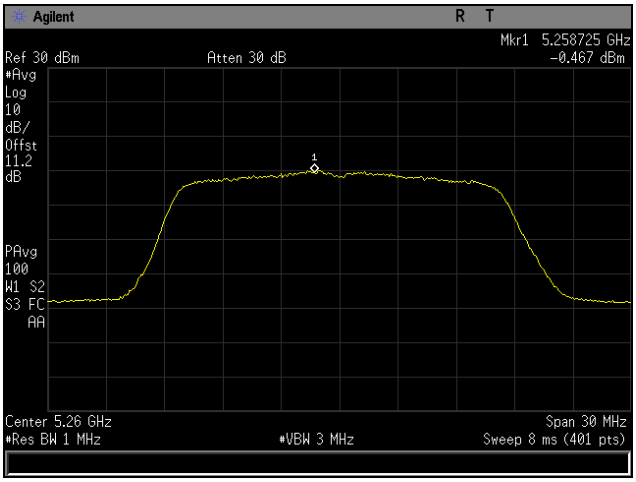
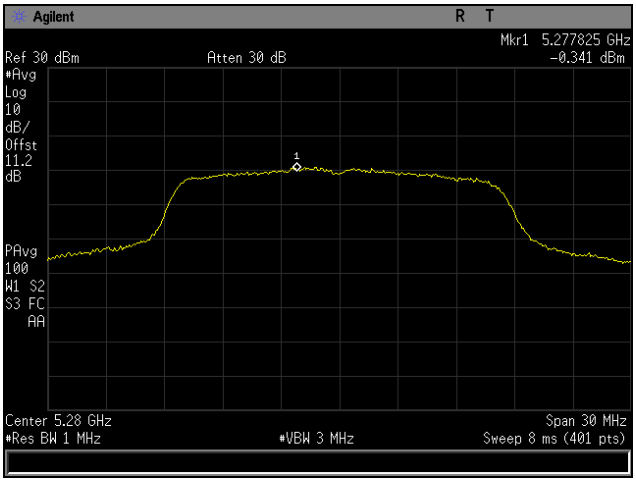
UNII2C Power Spectral Density									
EUT MODE & PWR Setting	**CH0 (dBm)**	**CH1 (dBm)**	**CH2 (dBm)**	**Duty Cycle CF (dB)**	**Σ (dBm)**	**Limit (dBm)**	**Gain (dBi)**	**Final Limit (dBm)**	**Margin (dB)**
BW 20M_Ch 5500M_80211a MSC0 P2018	-0.83	-1.17	-0.40	1.02	**5.00**	11.00	10.52	6.48	**-1.48**
BW 20M_Ch 5500M_80211ac MCS24 P3230	2.75	1.66	2.39	1.08	**8.14**	11.00	4.50	11.00	**-2.86**
BW 20M_Ch 5500M_80211n MCS24 P3230	2.92	2.49	1.61	0.96	**8.11**	11.00	4.50	11.00	**-2.89**
BW 20M_Ch 5580M_80211a MSC0 P2018	-0.03	-0.21	-0.88	1.02	**5.44**	11.00	10.52	6.48	**-1.04**
BW 20M_Ch 5580M_80211ac MCS24 P3230	3.62	3.02	2.10	1.08	**8.81**	11.00	4.50	11.00	**-2.19**
BW 20M_Ch 5580M_80211n MCS24 P3230	3.45	1.74	2.82	0.96	**8.46**	11.00	4.50	11.00	**-2.54**
BW 20M_Ch 5700M_80211a MSC0 P2018	-0.19	-1.69	-2.38	1.02	**4.47**	11.00	10.52	6.48	**-2.01**
BW 20M_Ch 5700M_80211ac MCS24 P3230	0.75	-0.20	0.44	1.08	**6.20**	11.00	4.50	11.00	**-4.80**
BW 20M_Ch 5700M_80211n MCS24 P3230	2.65	-0.40	0.34	0.96	**6.79**	11.00	4.50	11.00	**-4.21**
BW 40M_Ch 5510M_80211ac MCS24 P3230	-1.20	-1.20	-1.57	1.08	**4.53**	11.00	4.50	11.00	**-6.47**
BW 40M_Ch 5510M_80211n MCS24 P3230	-1.25	-2.28	-2.00	0.96	**3.91**	11.00	4.50	11.00	**-7.09**
BW 40M_Ch 5590M_80211ac MCS24 P3230	-0.38	-1.26	-1.36	1.08	**4.88**	11.00	4.50	11.00	**-6.12**
BW 40M_Ch 5590M_80211n MCS24 P3230	-0.99	-1.37	-0.35	0.96	**4.85**	11.00	4.50	11.00	**-6.15**
BW 40M_Ch 5670M_80211ac MCS24 P3230	-1.08	-1.34	-1.99	1.08	**4.40**	11.00	4.50	11.00	**-6.60**
BW 40M_Ch 5670M_80211n MCS24 P3230	-0.96	-1.99	-1.56	0.96	**4.25**	11.00	4.50	11.00	**-6.75**
BW 80M_Ch 5530M_80211ac MCS24 P3230	-3.92	-5.87	-4.52	1.08	**1.15**	11.00	4.50	11.00	**-9.85**
BW 80M_Ch 5610M_80211ac MCS24 P3230	-3.98	-5.14	-5.90	1.08	**0.92**	11.00	4.50	11.00	**-10.08**
Data is uncorrelated for n and ac modes									

Table 12. Power Spectral Density, Test Results, Upper Bands

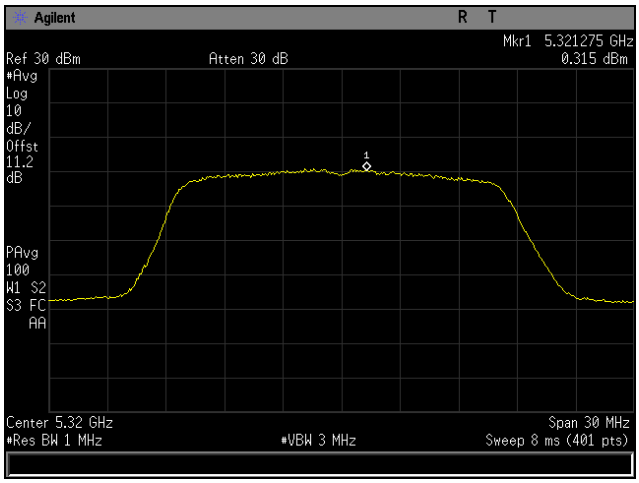
Power Spectral Density, 802.11a



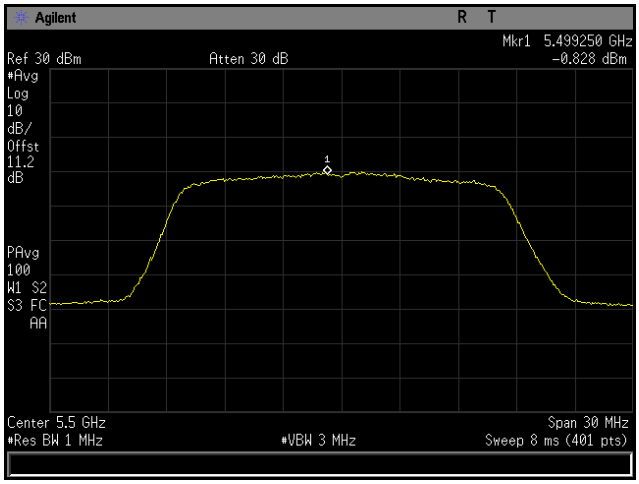
Plot 63. Power Spectral Density, 5260 MHz, 802.11a



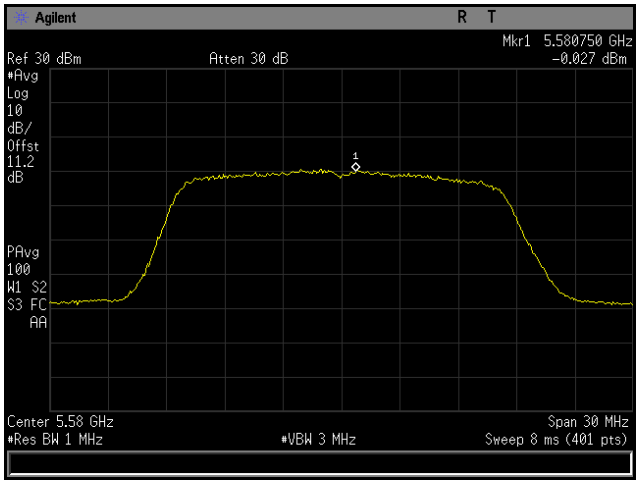
Plot 64. Power Spectral Density, 5280 MHz, 802.11a



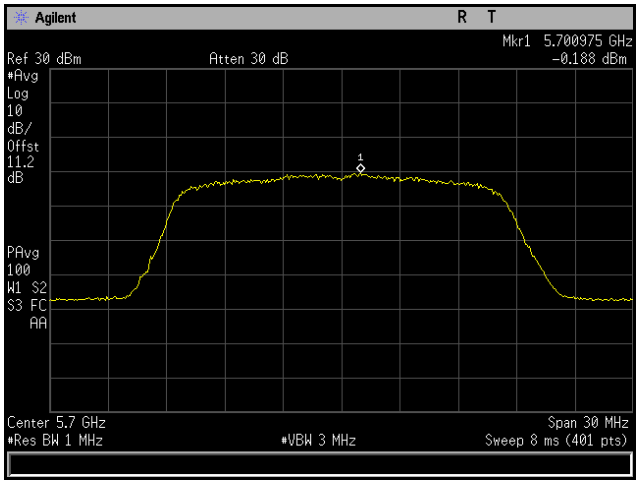
Plot 65. Power Spectral Density, 5320 MHz, 802.11a



Plot 66. Power Spectral Density, 5500 MHz, 802.11a

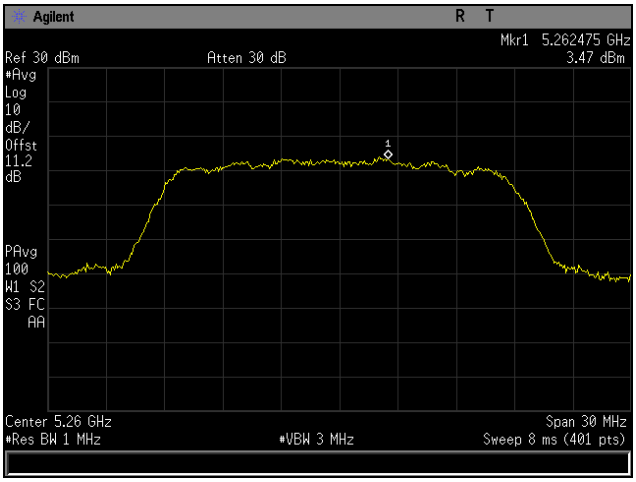


Plot 67. Power Spectral Density, 5580 MHz, 802.11a

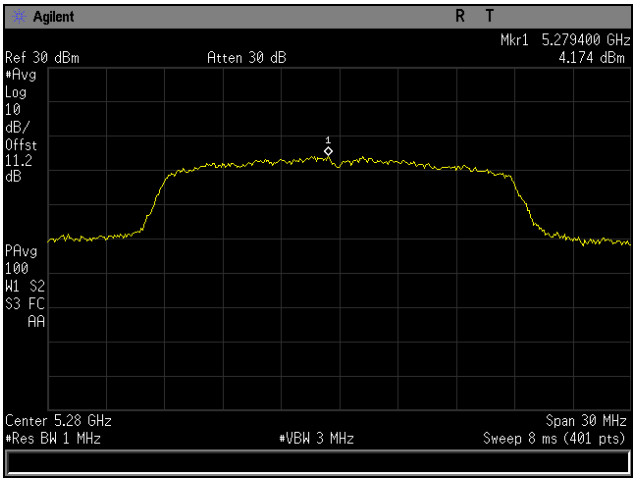


Plot 68. Power Spectral Density, 5700 MHz, 802.11a

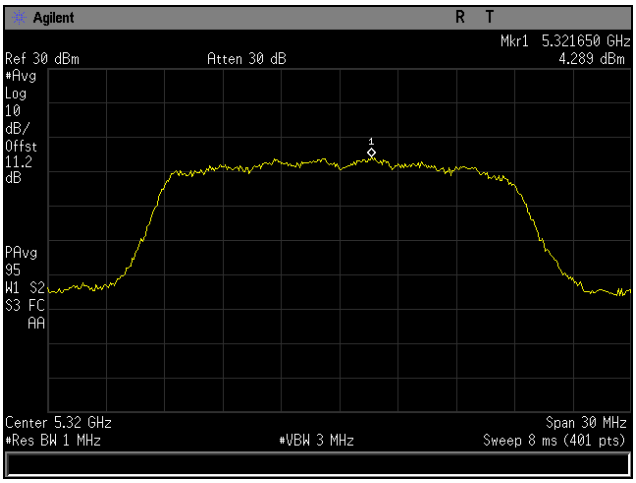
Power Spectral Density, 802.11ac 20 MHz



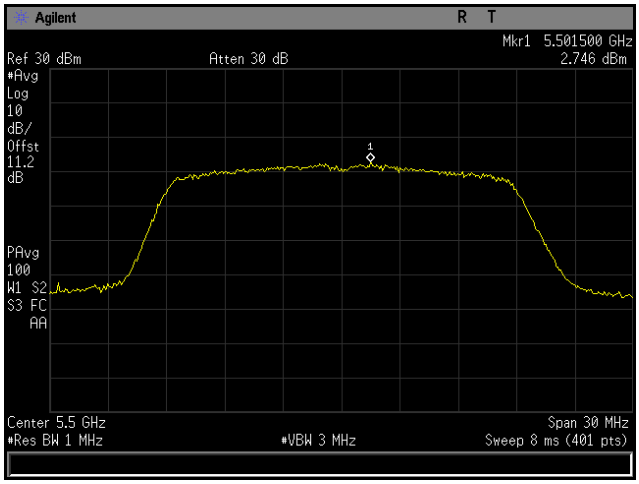
Plot 69. Power Spectral Density, 5260 MHz, 802.11ac 20 MHz



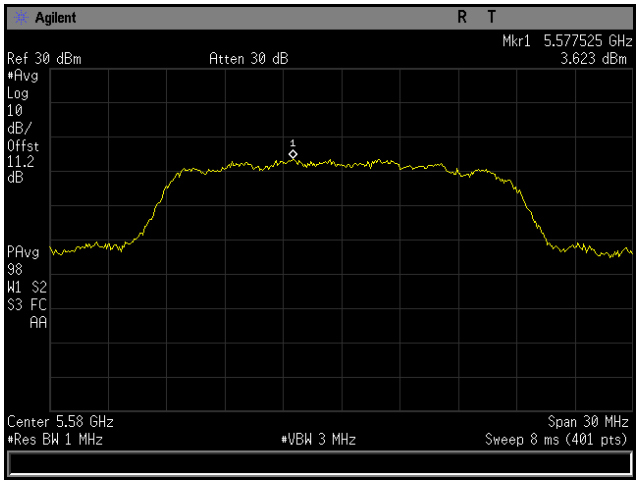
Plot 70. Power Spectral Density, 5280 MHz, 802.11ac 20 MHz



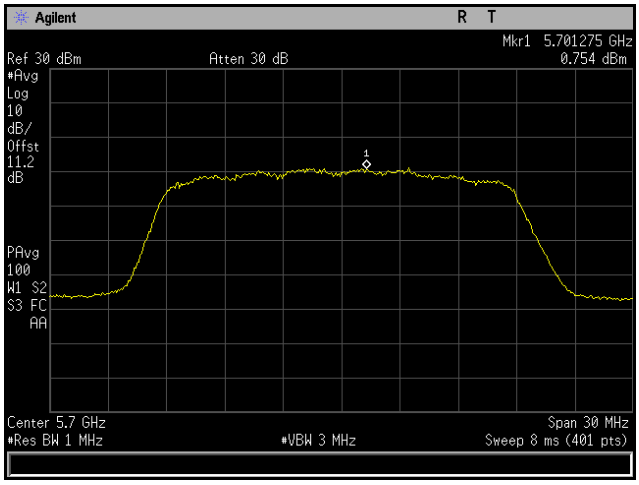
Plot 71. Power Spectral Density, 5320 MHz, 802.11ac 20 MHz



Plot 72. Power Spectral Density, 5500 MHz, 802.11ac 20 MHz

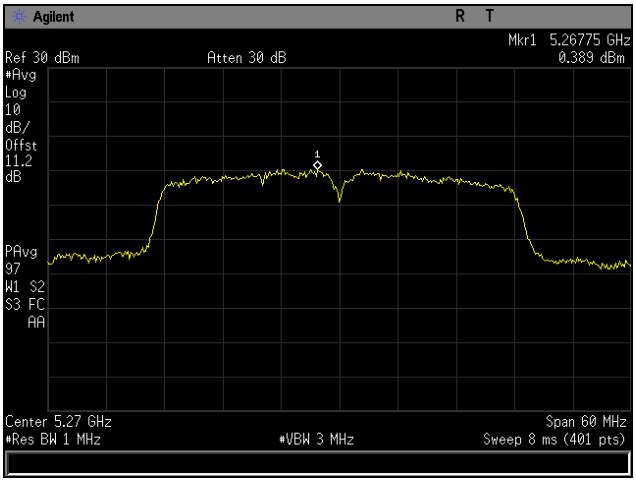


Plot 73. Power Spectral Density, 5580 MHz, 802.11ac 20 MHz

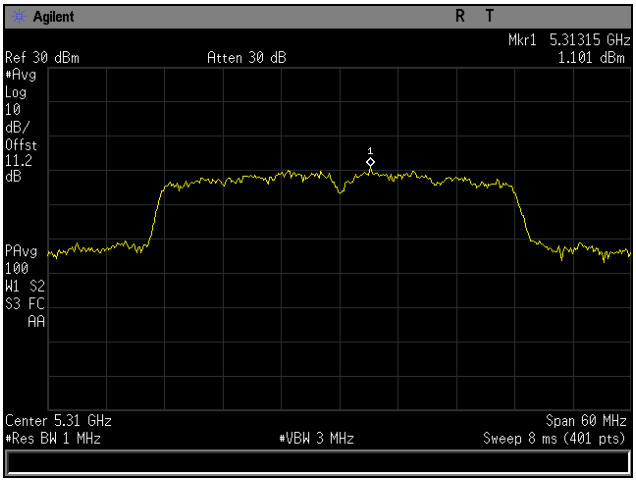


Plot 74. Power Spectral Density, 5700 MHz, 802.11ac 20 MHz

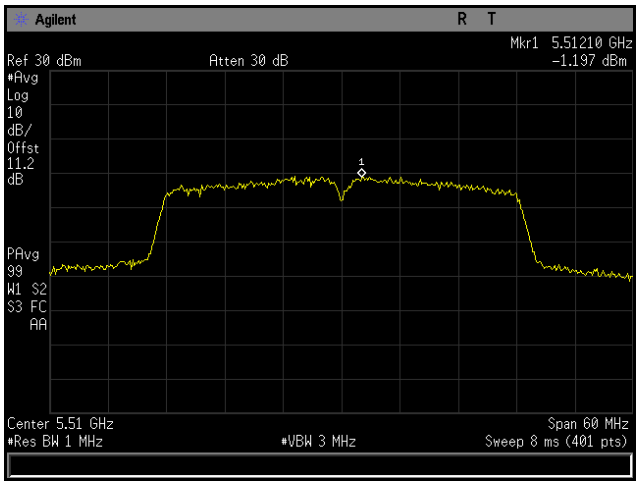
Power Spectral Density, 802.11ac 40 MHz



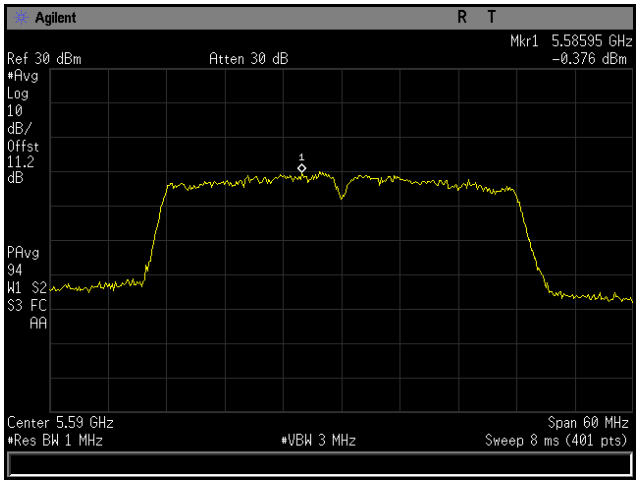
Plot 75. Power Spectral Density, 5270 MHz, 802.11ac 40 MHz



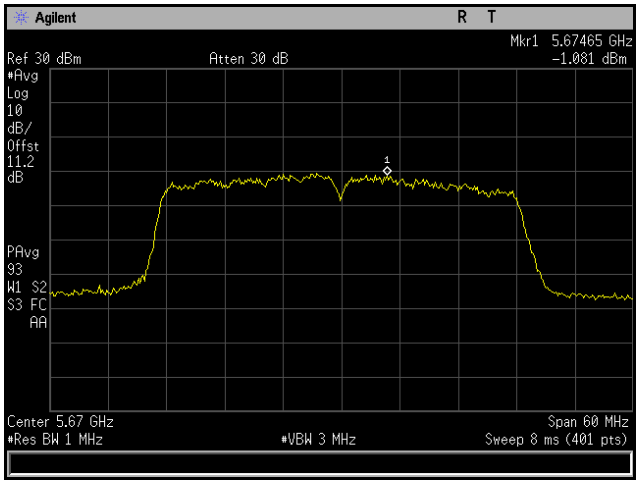
Plot 76. Power Spectral Density, 5310 MHz, 802.11ac 40 MHz



Plot 77. Power Spectral Density, 5510 MHz, 802.11ac 40 MHz

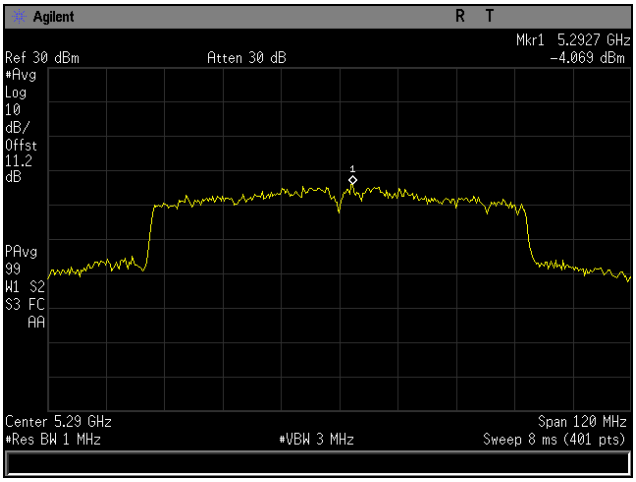


Plot 78. Power Spectral Density, 5590 MHz, 802.11ac 40 MHz

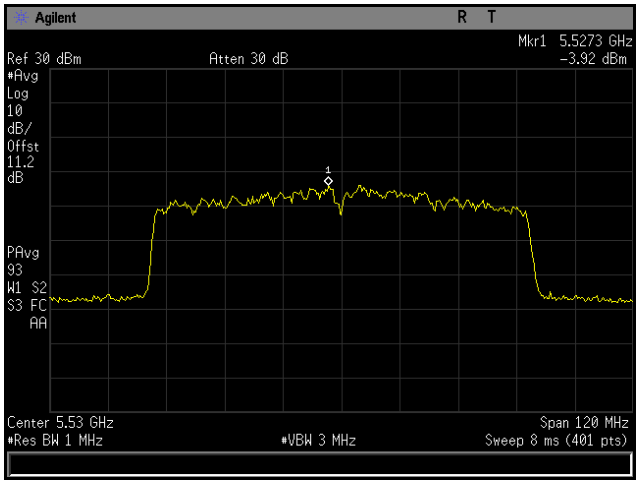


Plot 79. Power Spectral Density, 5670 MHz, 802.11ac 40 MHz

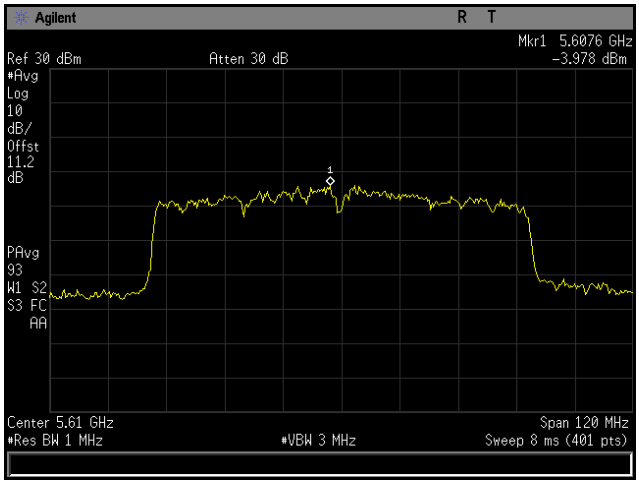
Power Spectral Density, 802.11ac 80 MHz



Plot 80. Power Spectral Density, 5290 MHz, 802.11ac 80 MHz



Plot 81. Power Spectral Density, 5530 MHz, 802.11ac 80 MHz



Plot 82. Power Spectral Density, 5610 MHz, 802.11ac 80 MHz

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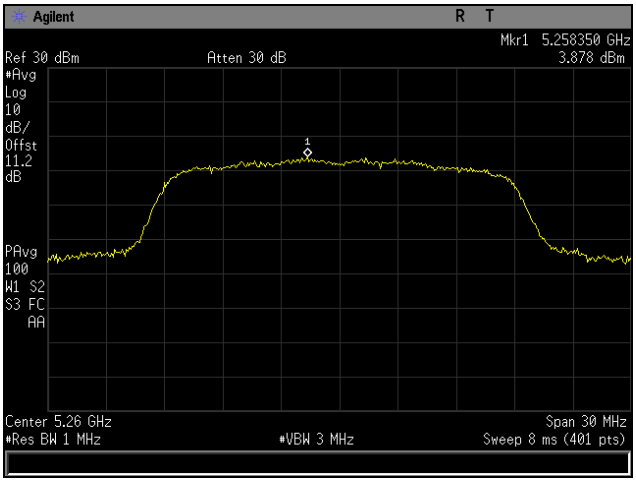
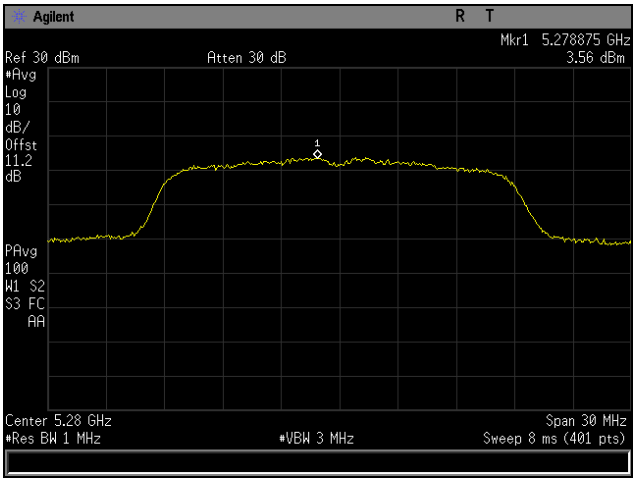
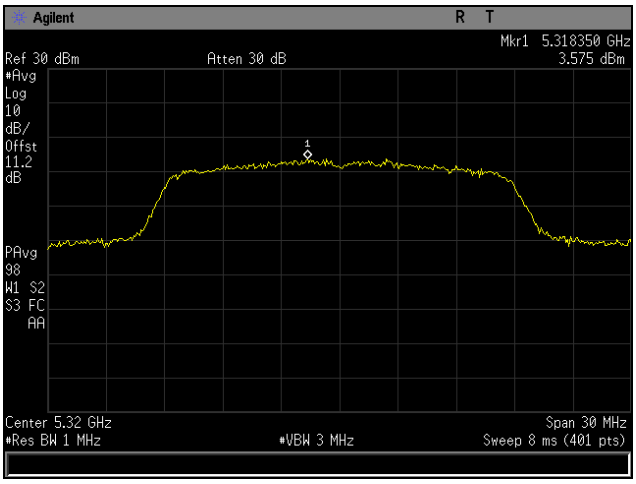
Power Spectral Density, 802.11n 20 MHz



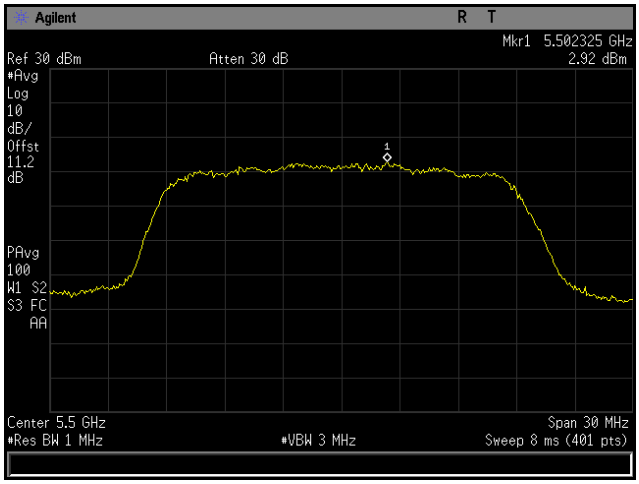
Plot 83. Power Spectral Density, 5260 MHz, 802.11n 20 MHz



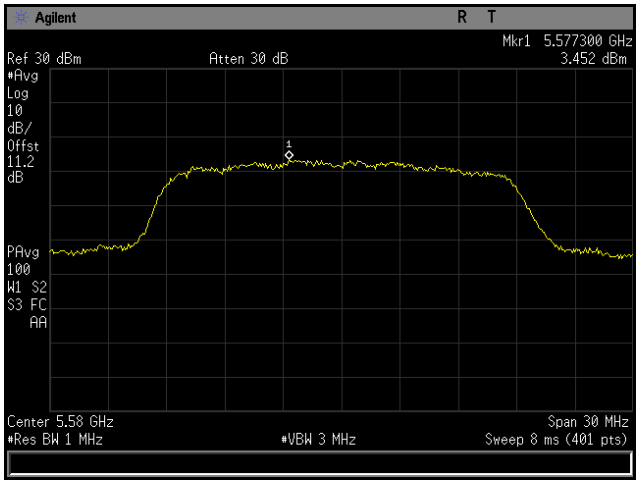
Plot 84. Power Spectral Density, 5280 MHz, 802.11n 20 MHz



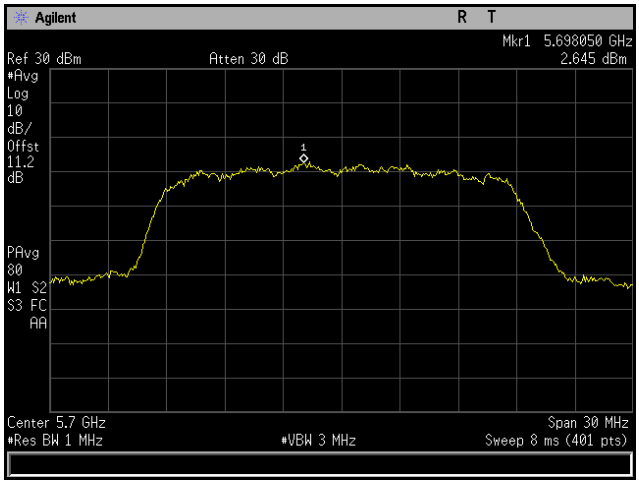
Plot 85. Power Spectral Density, 5320 MHz, 802.11n 20 MHz



Plot 86. Power Spectral Density, 5500 MHz, 802.11n 20 MHz

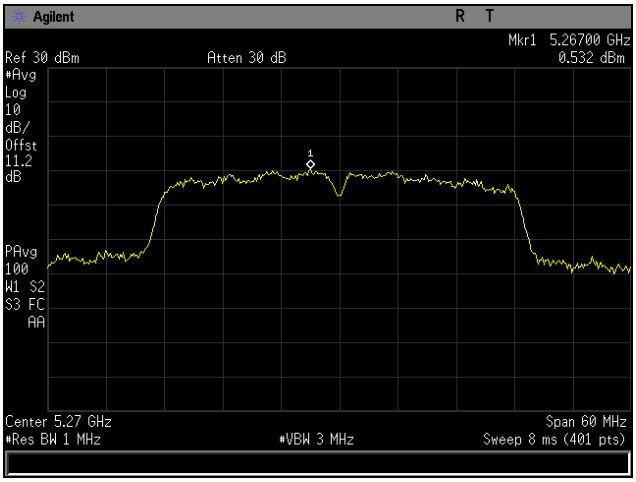


Plot 87. Power Spectral Density, 5580 MHz, 802.11n 20 MHz

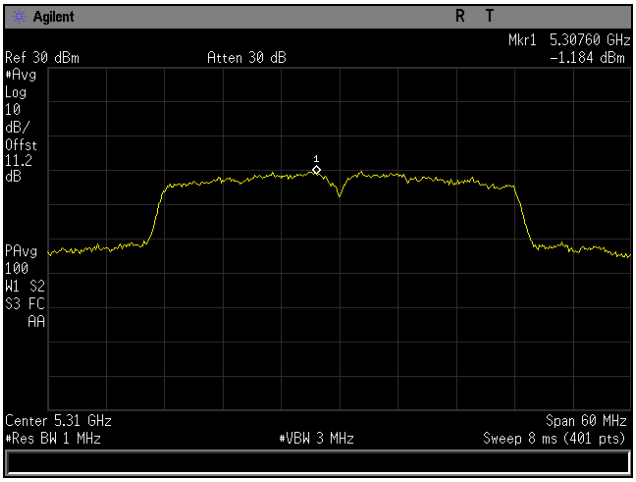


Plot 88. Power Spectral Density, 5700 MHz, 802.11n 20 MHz

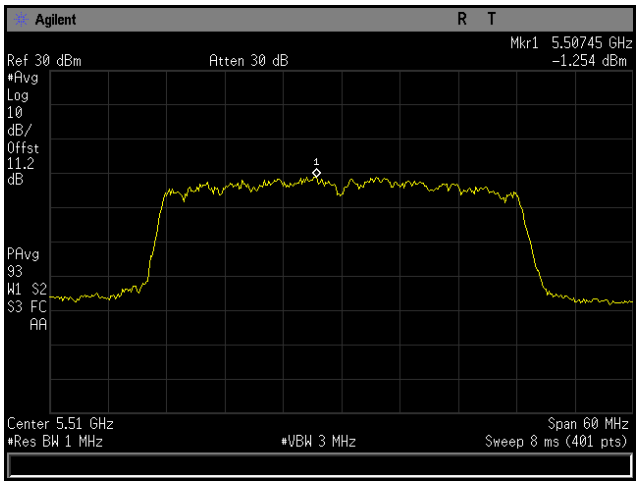
Power Spectral Density, 802.11n 40 MHz



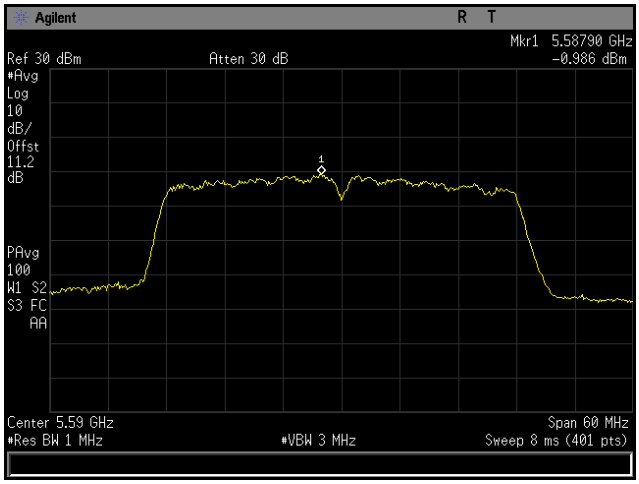
Plot 89. Power Spectral Density, 5270 MHz, 802.11n 40 MHz



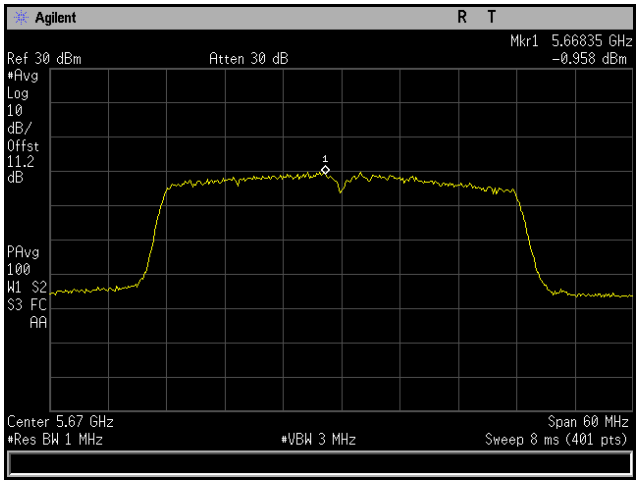
Plot 90. Power Spectral Density, 5310 MHz, 802.11n 40 MHz



Plot 91. Power Spectral Density, 5510 MHz, 802.11n 40 MHz



Plot 92. Power Spectral Density, 5590 MHz, 802.11n 40 MHz



Plot 93. Power Spectral Density, 5670 MHz, 802.11n 40 MHz

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:

Unwanted Emissions were measured according to KDB789033 v01r03 Procedure G. Measurements below 1GHz were made with the EUT on a non-conducting stand 80cm above the ground plane of a semi-anechoic chamber. To find the direction of maximum emissions, the EUT was oriented through its three orthogonal axes while rotating the turntable 360 degrees and varying the height of the receive antenna. Measurements were made with the EUT transmitting on the low and high channels of each configuration. Final measurements from 30MHz to 1GHz were made using a quasi-peak detector with a RBW of 120 kHz.

Measurements above 1GHz were made with the EUT on a non-conducting stand 1.5m above the ground plane of a fully-anechoic chamber. To find the direction of maximum emissions, the EUT was oriented through its three orthogonal axes while rotating the chamber's turntable 360 degrees and varying the height of the receive antenna. Measurements were made with the EUT transmitting on the low and high channels of each configuration. Final measurements were made using peak and average detectors. Average measurements were made using a RBW of 1MHz and VBW less than the RBW but not less than 10Hz. Peak Measurements were made with a RBW of 1MHz and a VBW greater than or equal to 3 times the RBW.

Emissions below 30MHz and above 18GHz that were greater than 20dB below the limit are not reported.

The worse-case configuration is reported below 1GHz and above 7GHz

Test Results:

The EUT was compliant with the Radiated Emission limits for Intentional Radiators. See following pages for detailed test results. The data presented is corrected field-strength.

Test Engineer(s): Hadid Jones

Test Date(s): 03/14/17

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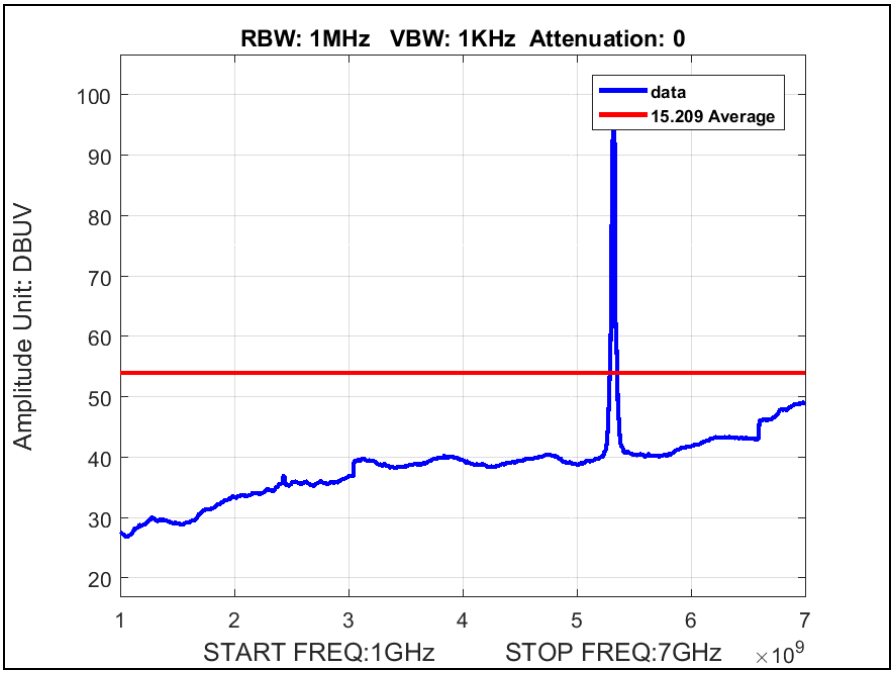
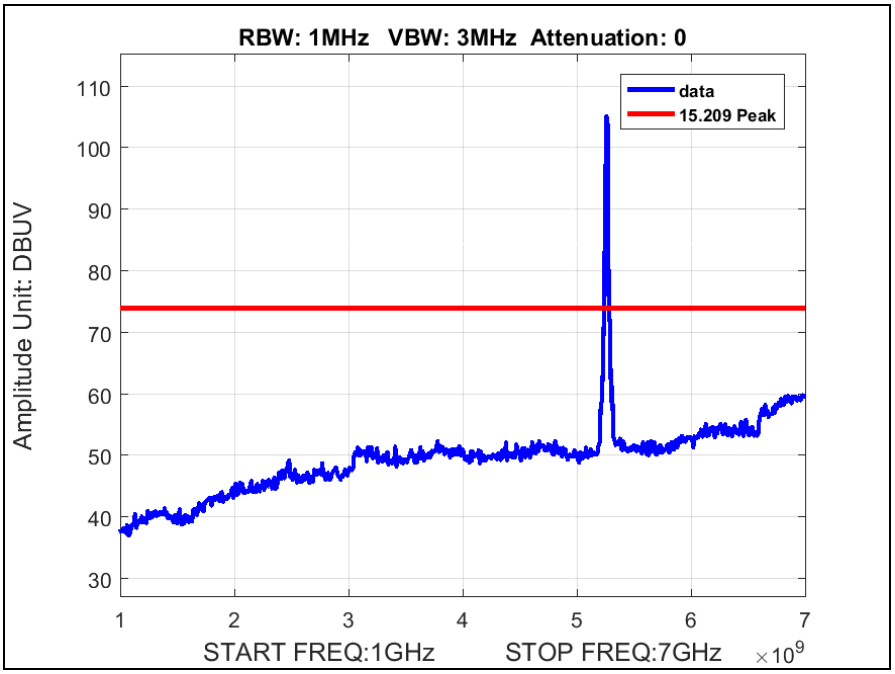
Radiated Spurious Emissions, 802.11a



Plot 94. Radiated Spurious Emissions, 5260 MHz, 802.11a, 1 GHz – 7 GHz, Average



Plot 95. Radiated Spurious Emissions, 5260 MHz, 802.11a, 1 GHz – 7 GHz, Peak

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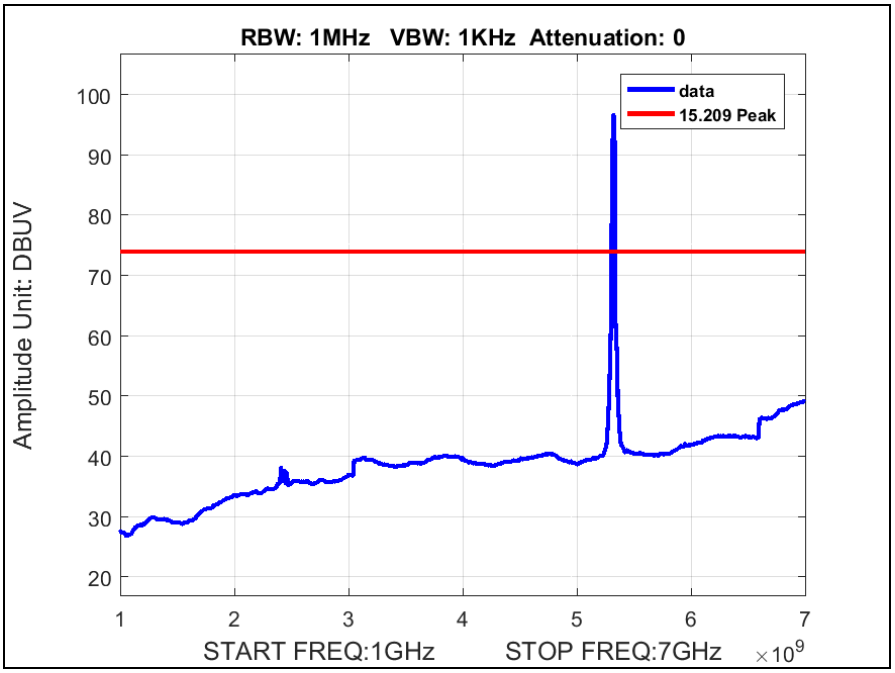
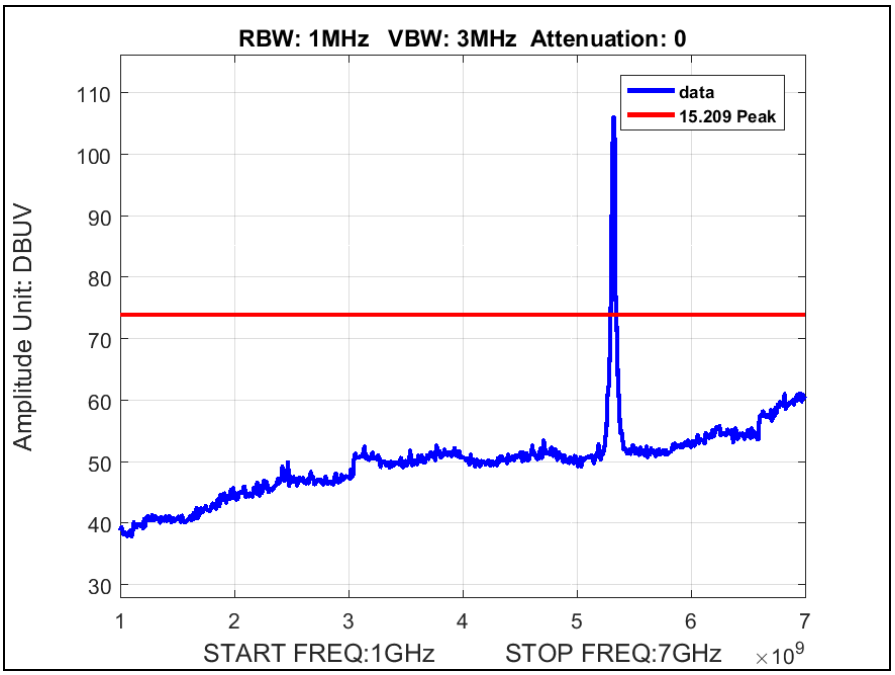
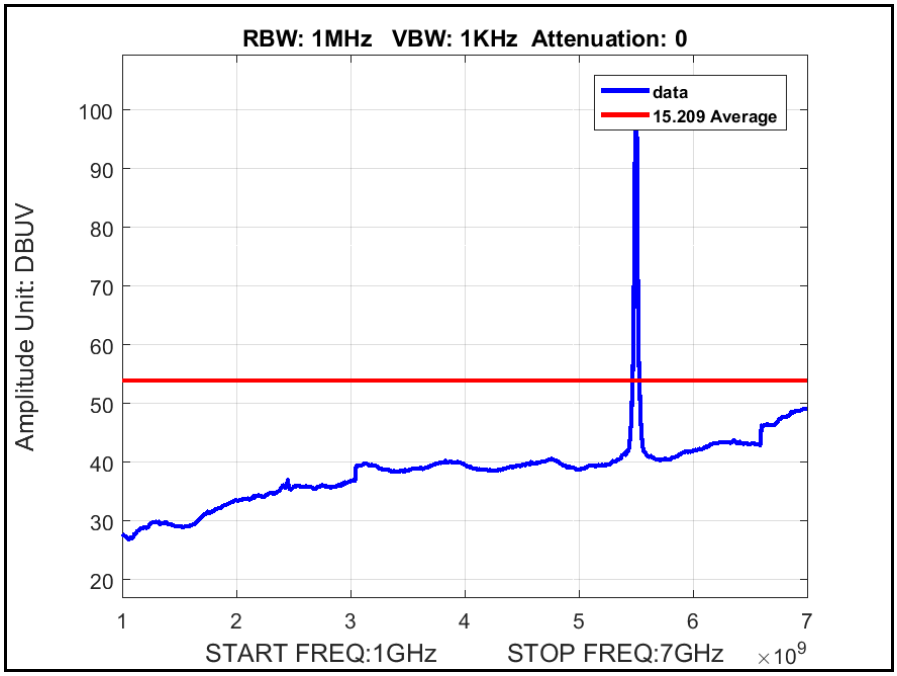


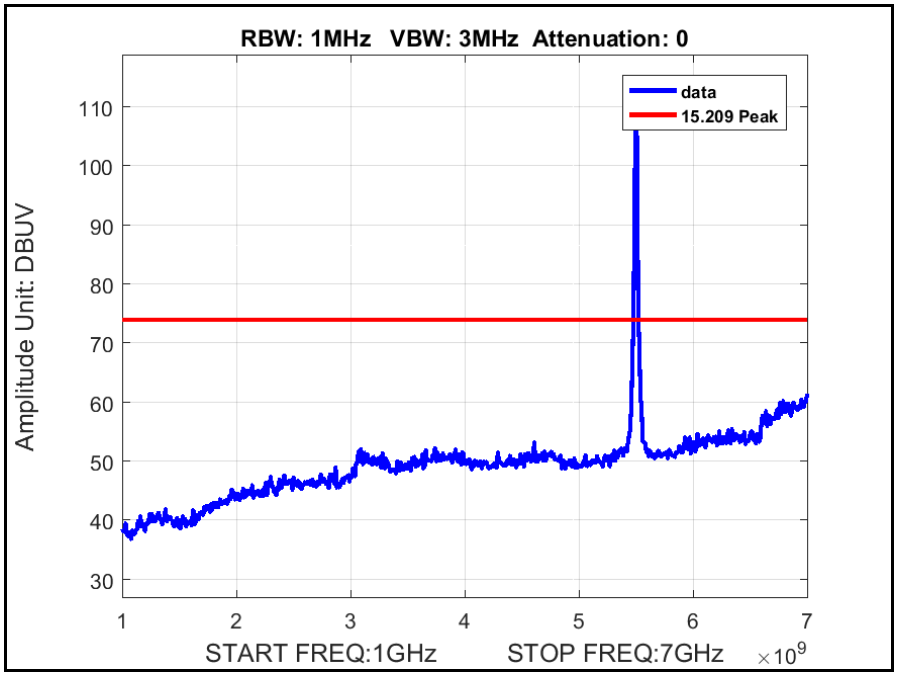
Plot 96. Radiated Spurious Emissions, 5320 MHz, 802.11a, 1 GHz – 7 GHz, Average



Plot 97. Radiated Spurious Emissions, 5320 MHz, 802.11a, 1 GHz – 7 GHz, Peak



Plot 98. Radiated Spurious Emissions, 5500 MHz, 802.11a, 1 GHz – 7 GHz, Average



Plot 99. Radiated Spurious Emissions, 5500 MHz, 802.11a, 1 GHz – 7 GHz, Peak

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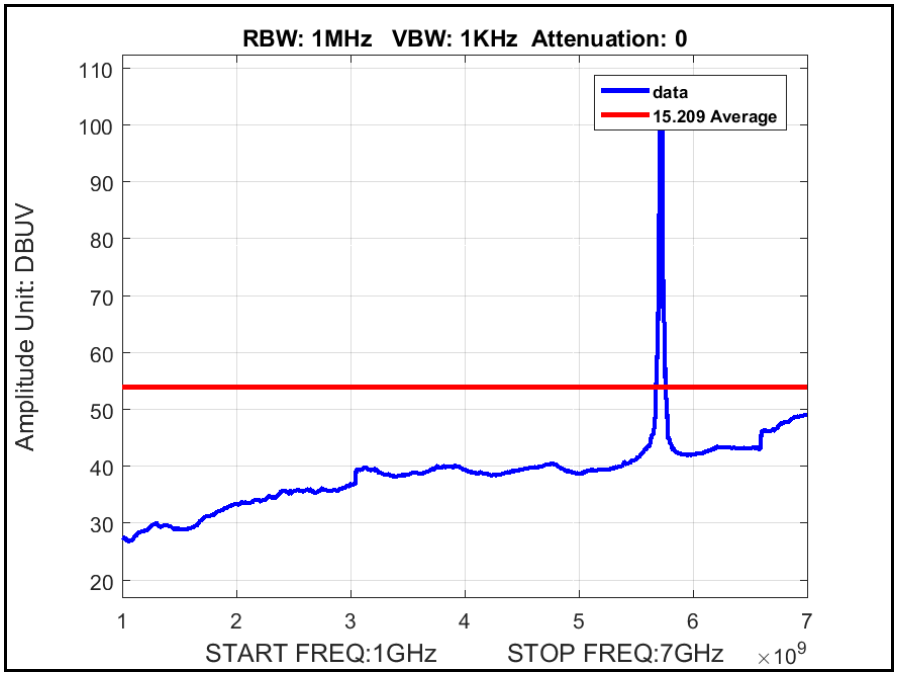
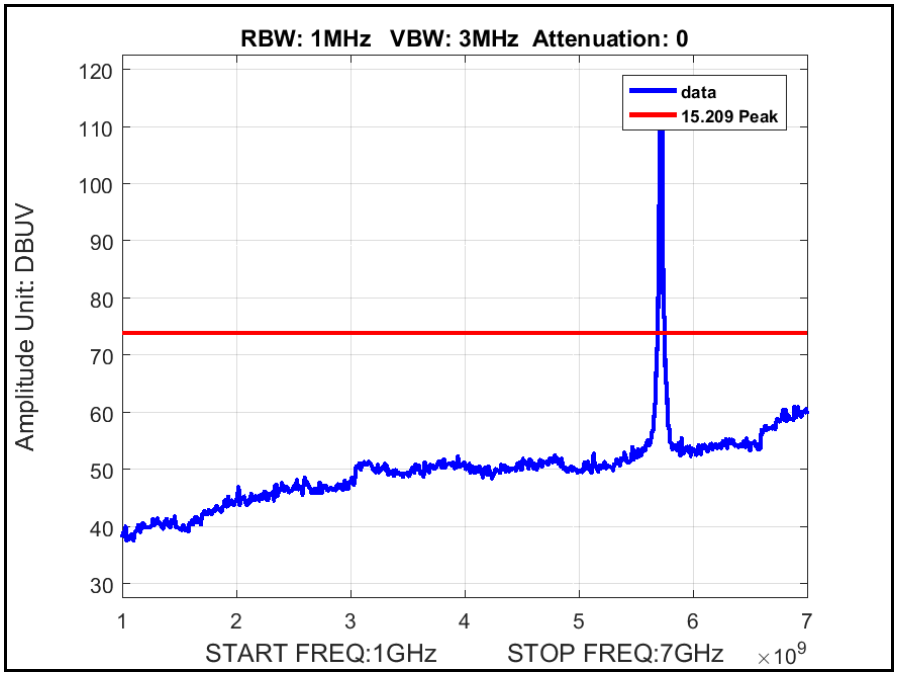


Plot 100. Radiated Spurious Emissions, 5700 MHz, 802.11a, 1 GHz – 7 GHz, Average



Plot 101. Radiated Spurious Emissions, 5700 MHz, 802.11a, 1 GHz – 7 GHz, Peak

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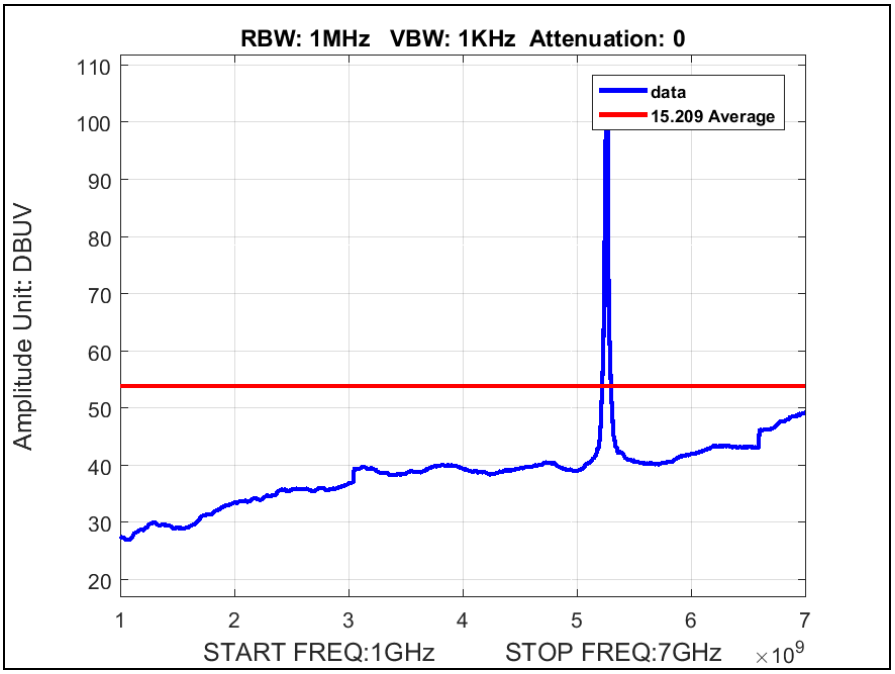
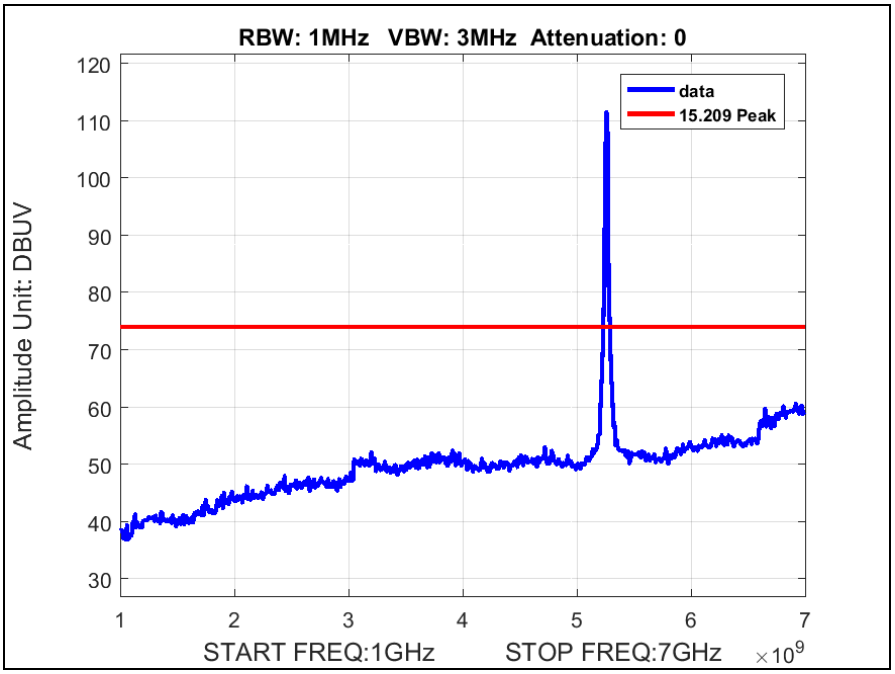
Radiated Spurious Emissions, 802.11ac 20 MHz



Plot 102. Radiated Spurious Emissions, 5260 MHz, 802.11ac 20 MHz, 1 GHz – 7 GHz, Average



Plot 103. Radiated Spurious Emissions, 5260 MHz, 802.11ac 20 MHz, 1 GHz – 7 GHz, Peak

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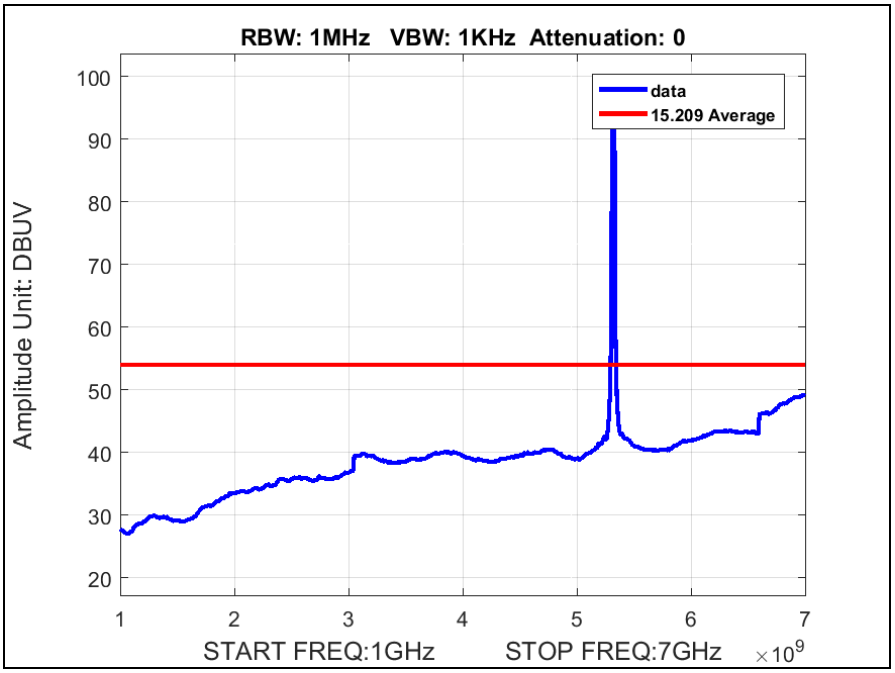
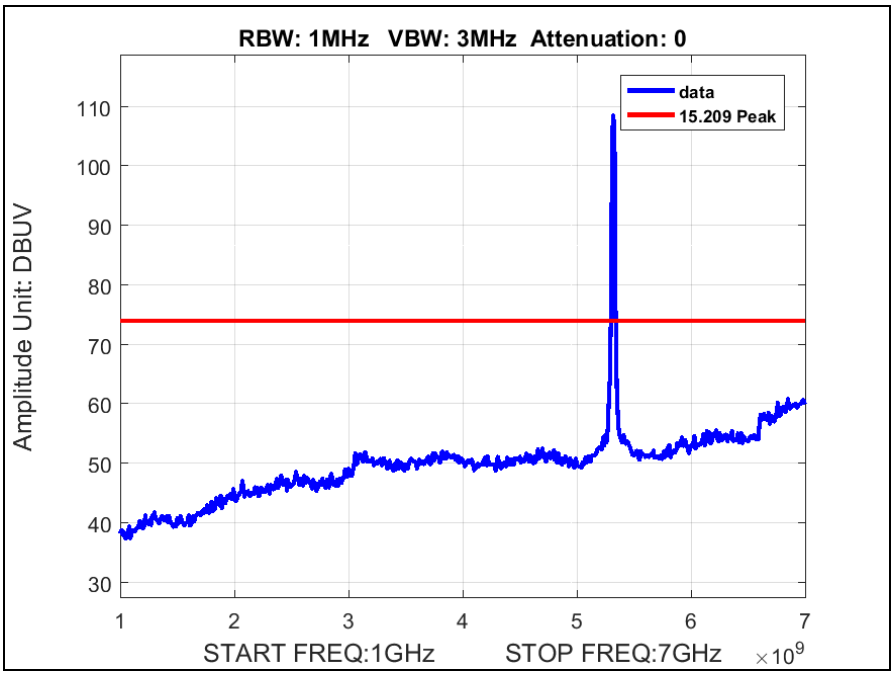
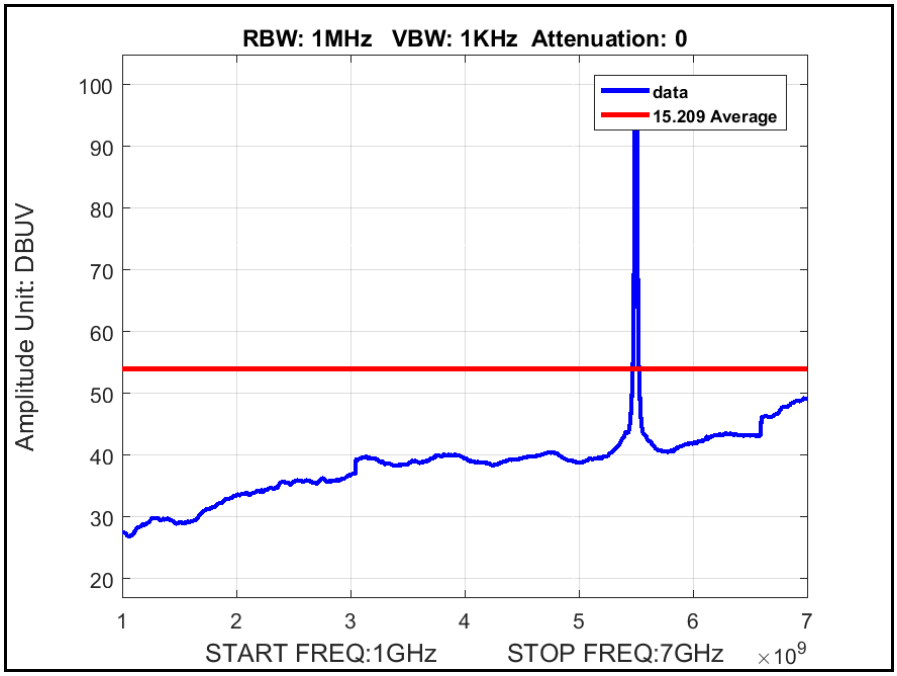


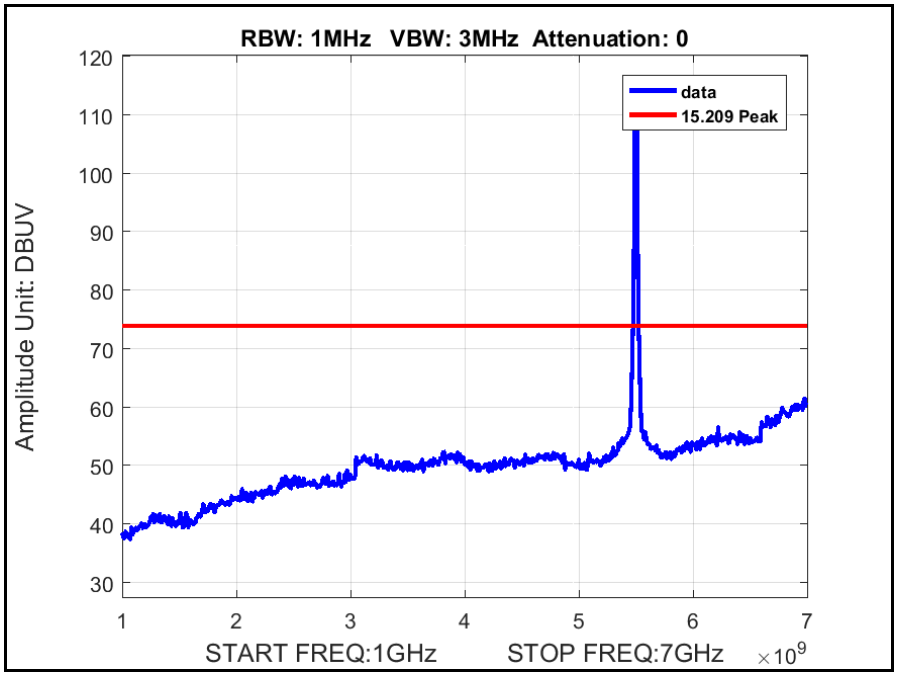
Plot 104. Radiated Spurious Emissions, 5320 MHz, 802.11ac 20 MHz, 1 GHz – 7 GHz, Average



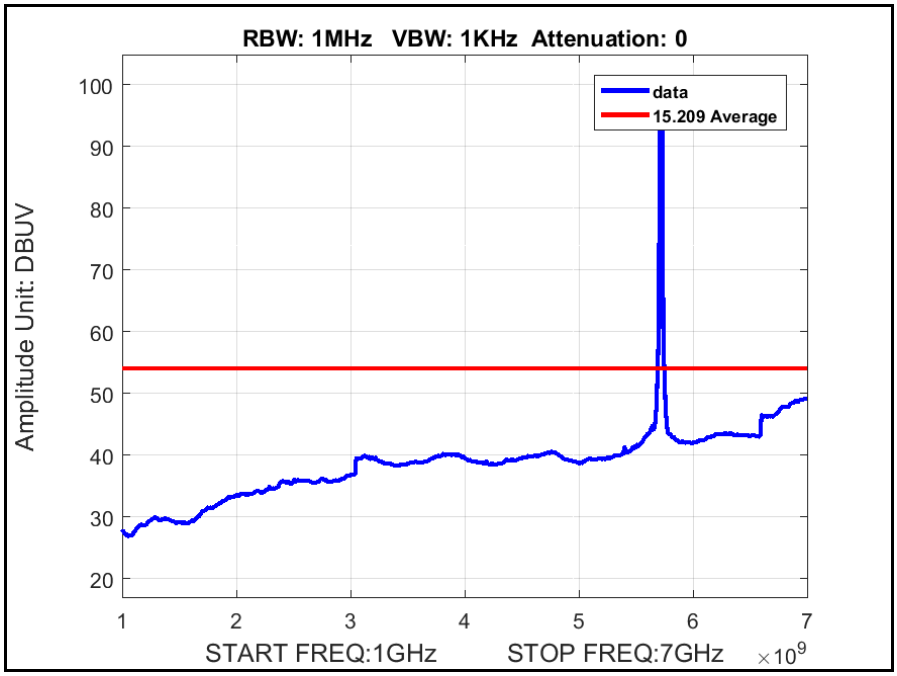
Plot 105. Radiated Spurious Emissions, 5320 MHz, 802.11ac 20 MHz, 1 GHz – 7 GHz, Peak



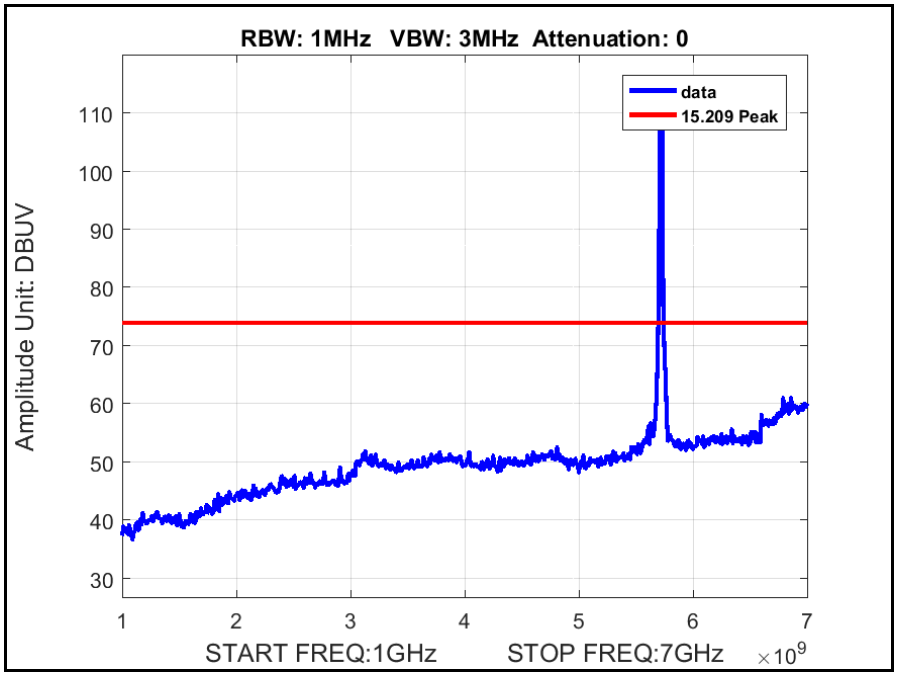
Plot 106. Radiated Spurious Emissions, 5500 MHz, 802.11ac 20 MHz, 1 GHz – 7 GHz, Average



Plot 107. Radiated Spurious Emissions, 5500 MHz, 802.11ac 20 MHz, 1 GHz – 7 GHz, Peak

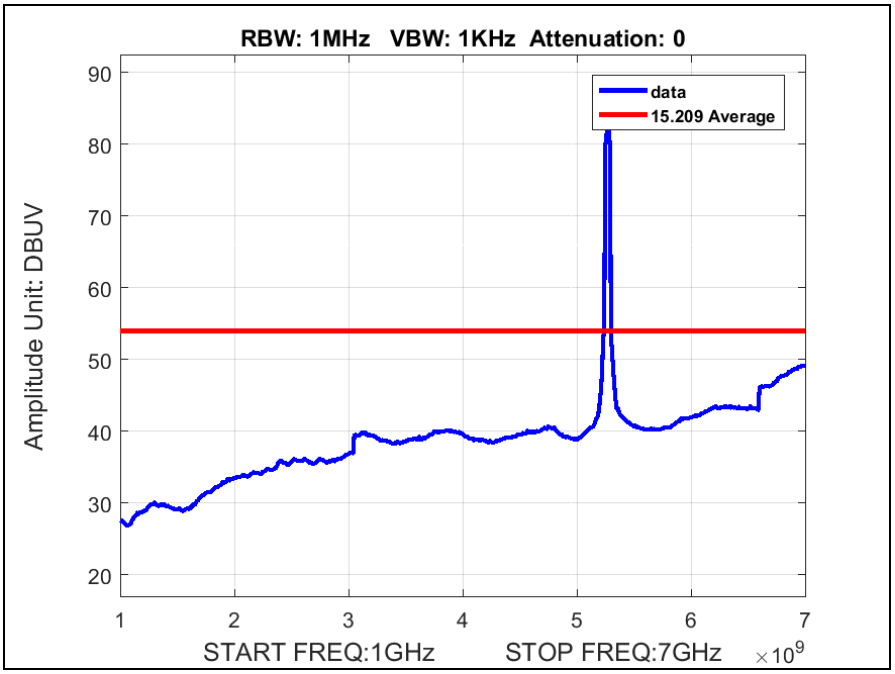


Plot 108. Radiated Spurious Emissions, 5700 MHz, 802.11ac 20 MHz, 1 GHz – 7 GHz, Average

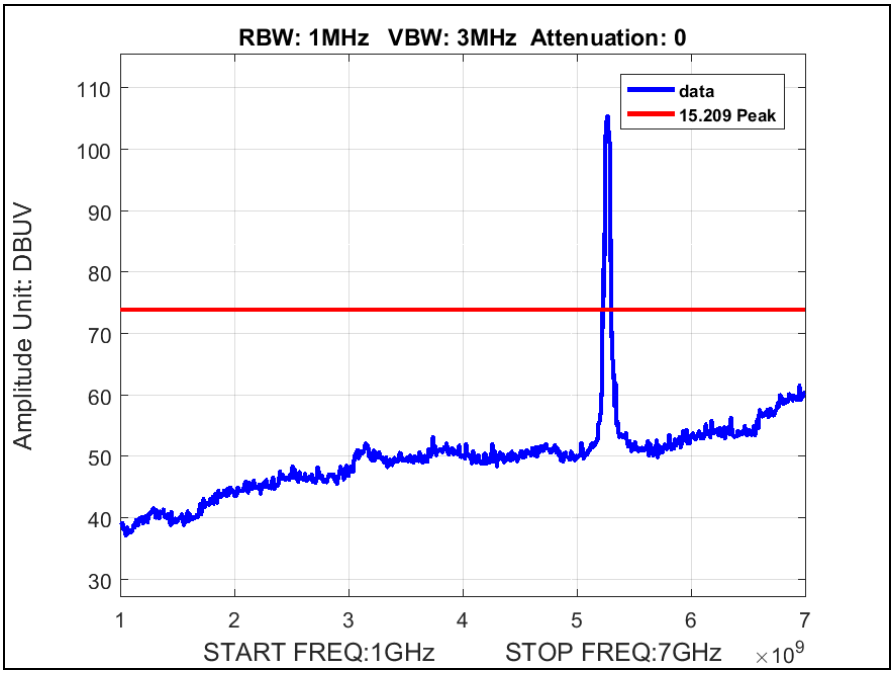


Plot 109. Radiated Spurious Emissions, 5700 MHz, 802.11ac 20 MHz, 1 GHz – 7 GHz, Peak

Radiated Spurious Emissions, 802.11ac 40 MHz



Plot 110. Radiated Spurious Emissions, 5270 MHz, 802.11ac 40 MHz, 1 GHz – 7 GHz, Average



Plot 111. Radiated Spurious Emissions, 5270 MHz, 802.11ac 40 MHz, 1 GHz – 7 GHz, Peak

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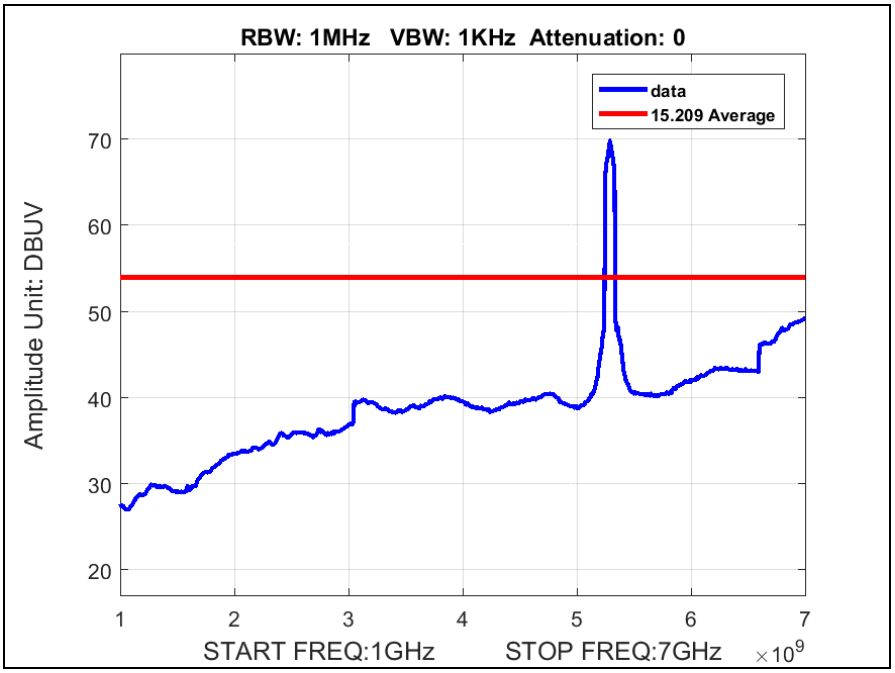
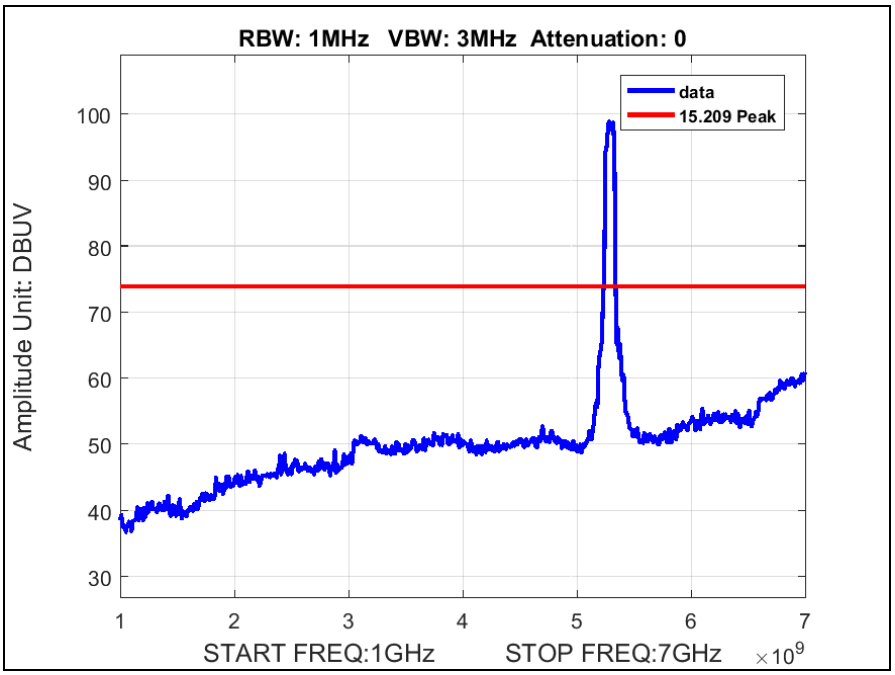
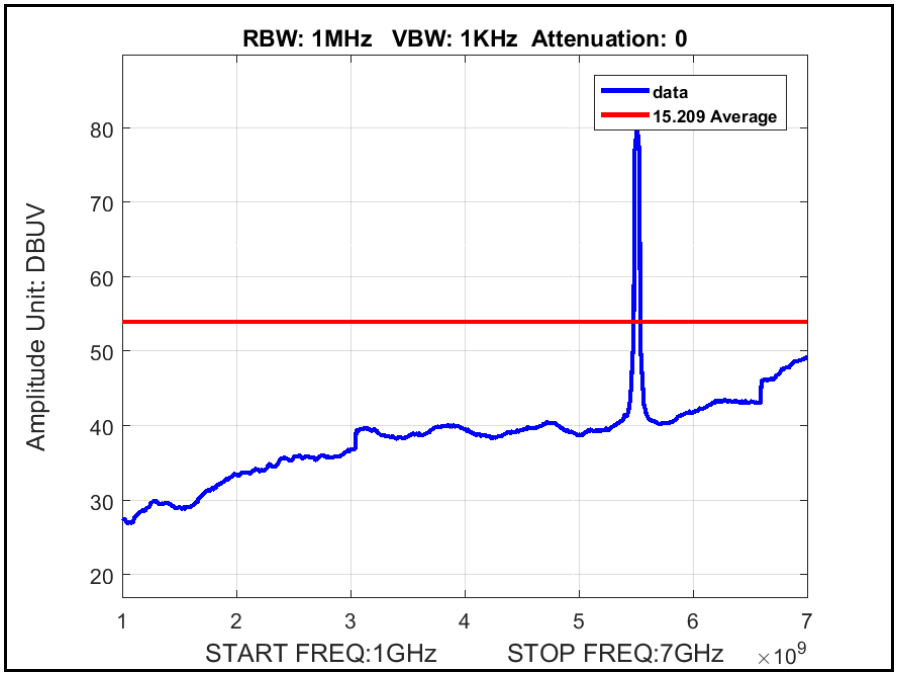


Plot 112. Radiated Spurious Emissions, 5310 MHz, 802.11ac 40 MHz, 1 GHz – 7 GHz, Average

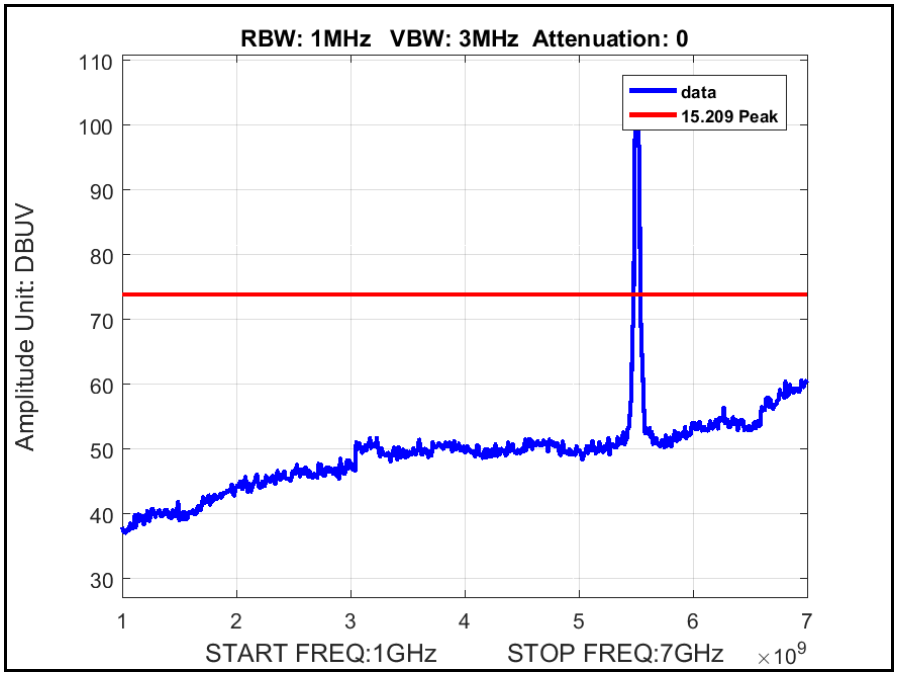


Plot 113. Radiated Spurious Emissions, 5310 MHz, 802.11ac 40 MHz, 1 GHz – 7 GHz, Peak

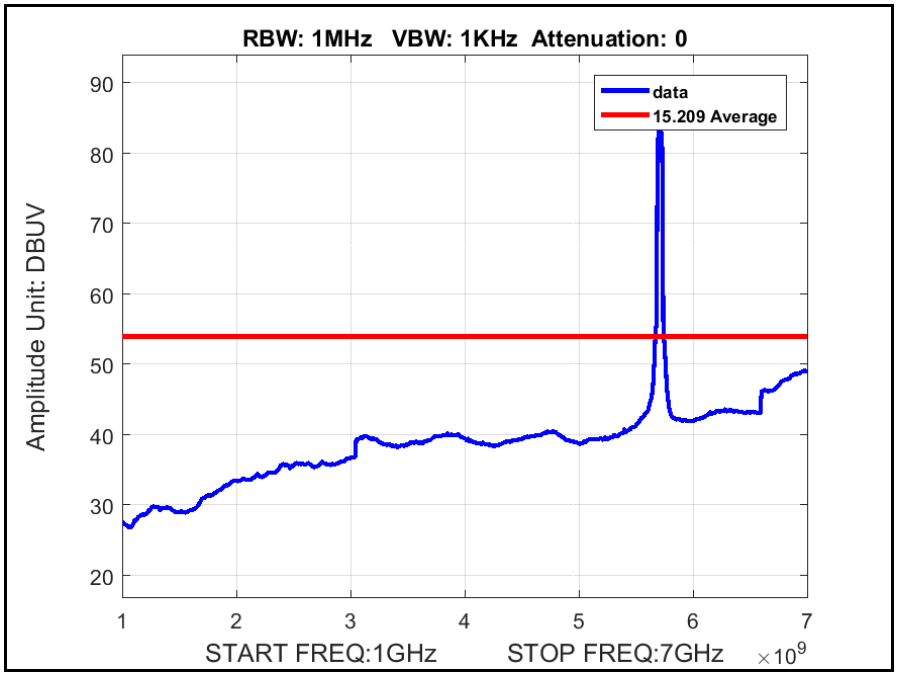
 © 2017, MET Laboratories, Inc.



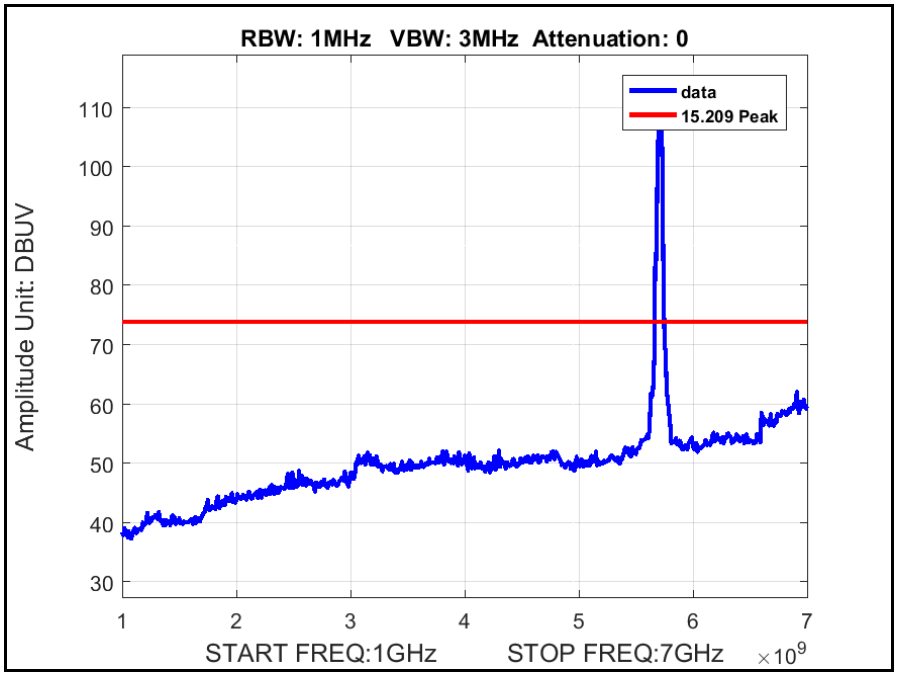
Plot 114. Radiated Spurious Emissions, 5510 MHz, 802.11ac 40 MHz, 1 GHz – 7 GHz, Average



Plot 115. Radiated Spurious Emissions, 5510 MHz, 802.11ac 40 MHz, 1 GHz – 7 GHz, Peak



Plot 116. Radiated Spurious Emissions, 5670 MHz, 802.11ac 40 MHz, 1 GHz – 7 GHz, Average



Plot 117. Radiated Spurious Emissions, 5670 MHz, 802.11ac 40 MHz, 1 GHz – 7 GHz, Peak

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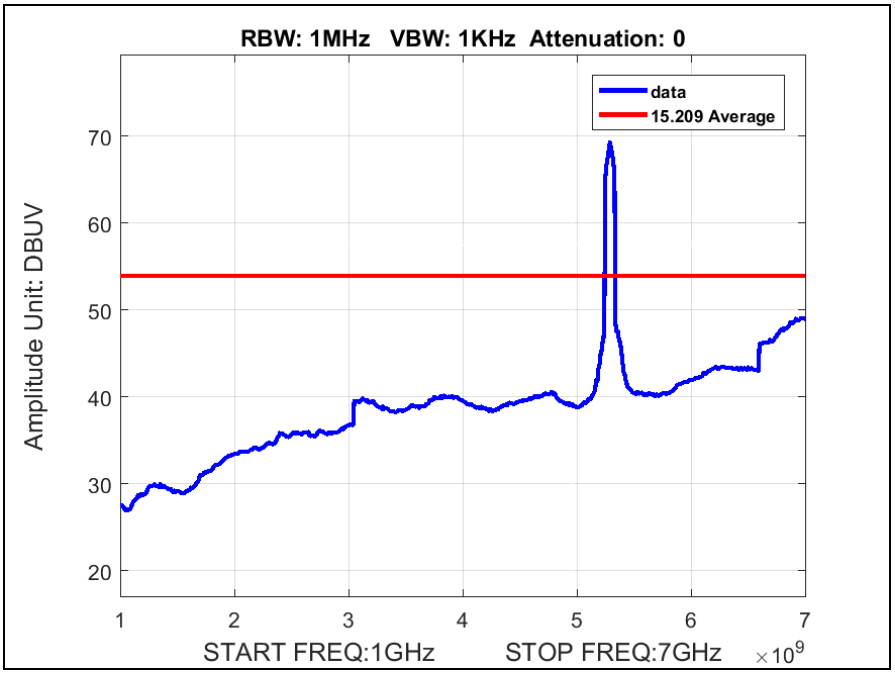
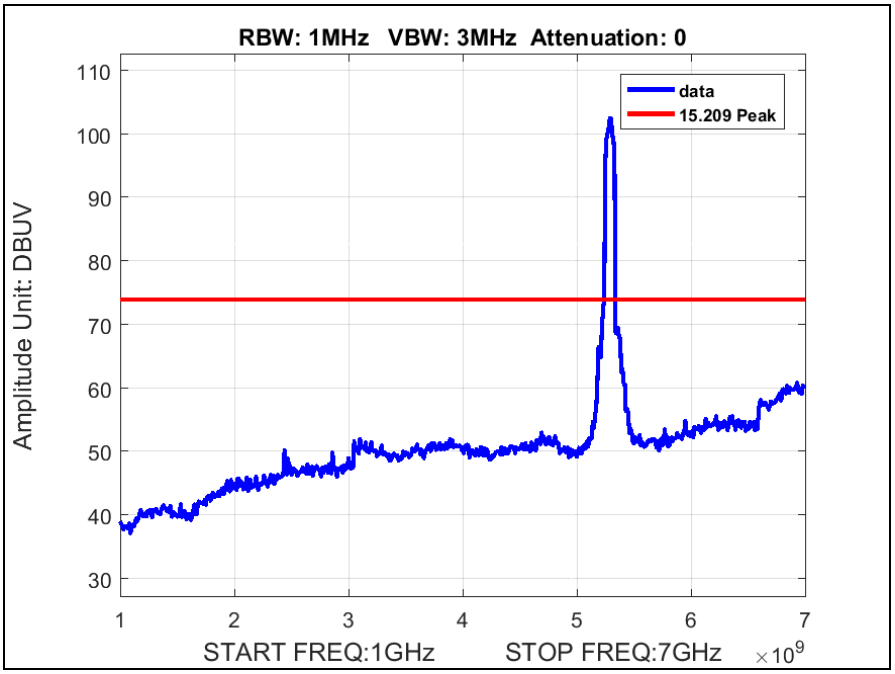
Radiated Spurious Emissions, 802.11ac 80 MHz



Plot 118. Radiated Spurious Emissions, 5290 MHz, 802.11ac 80 MHz, 1 GHz – 7 GHz, Average



Plot 119. Radiated Spurious Emissions, 5290 MHz, 802.11ac 80 MHz, 1 GHz – 7 GHz, Peak

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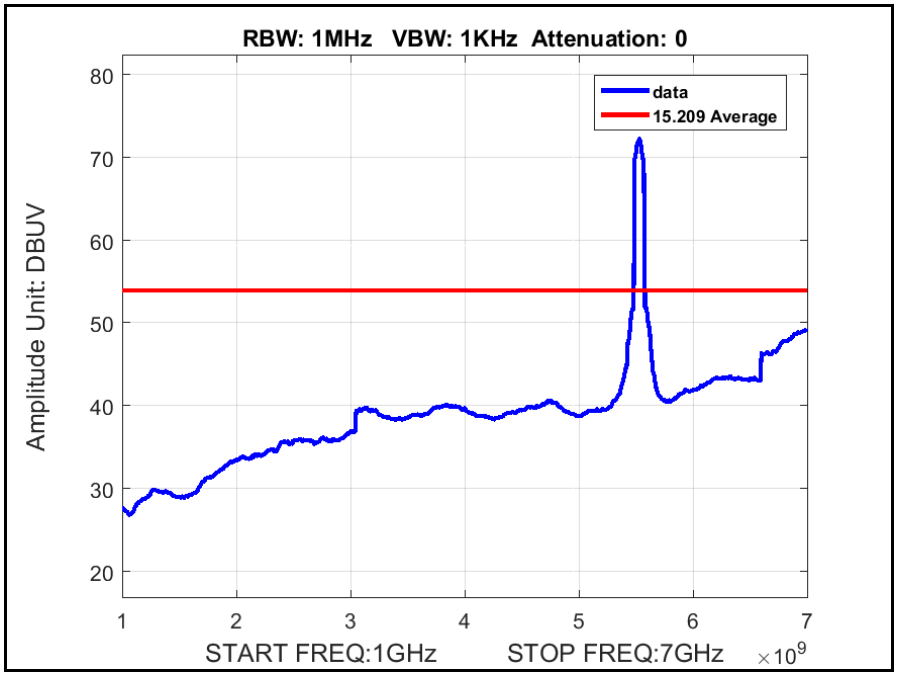
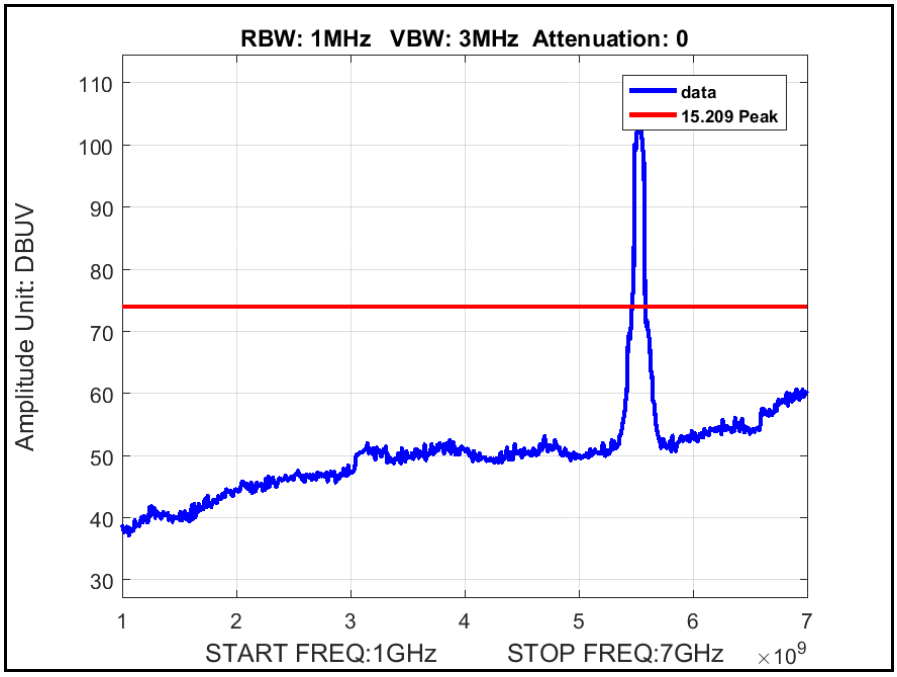


Plot 120. Radiated Spurious Emissions, 5530 MHz, 802.11ac 80 MHz, 1 GHz – 7 GHz, Average



Plot 121. Radiated Spurious Emissions, 5530 MHz, 802.11ac 80 MHz, 1 GHz – 7 GHz, Peak

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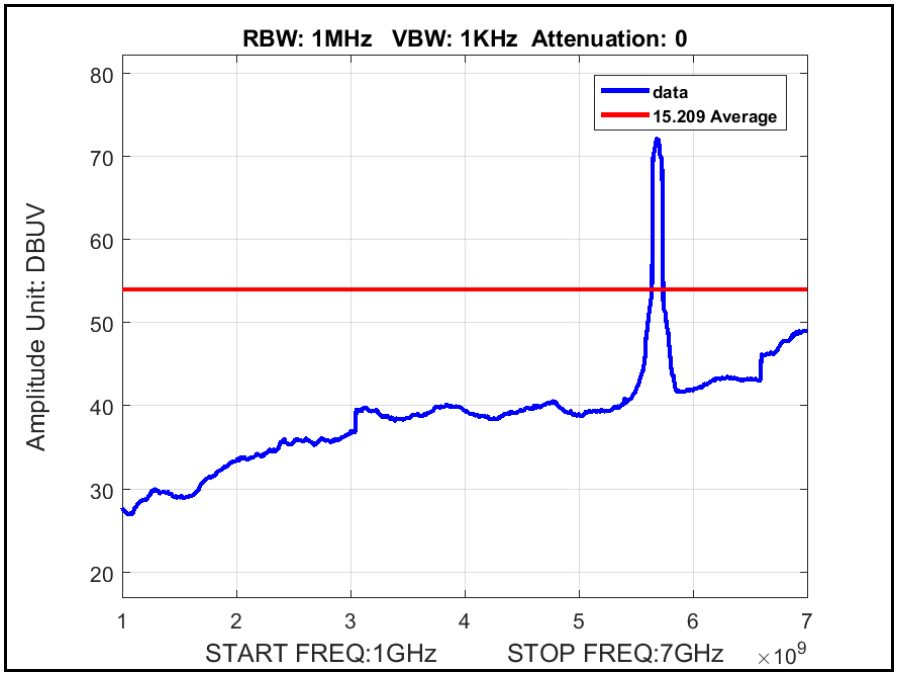
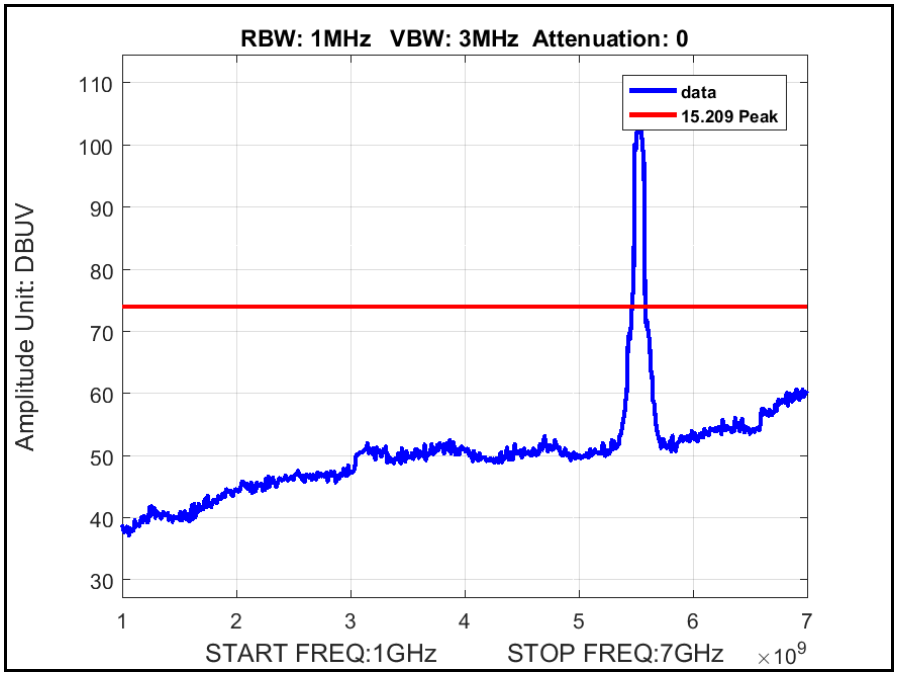


Plot 122. Radiated Spurious Emissions, 5610 MHz, 802.11ac 80 MHz, 1 GHz – 7 GHz, Average



Plot 123. Radiated Spurious Emissions, 5690 MHz, 802.11ac 80 MHz, 1 GHz – 7 GHz, Peak

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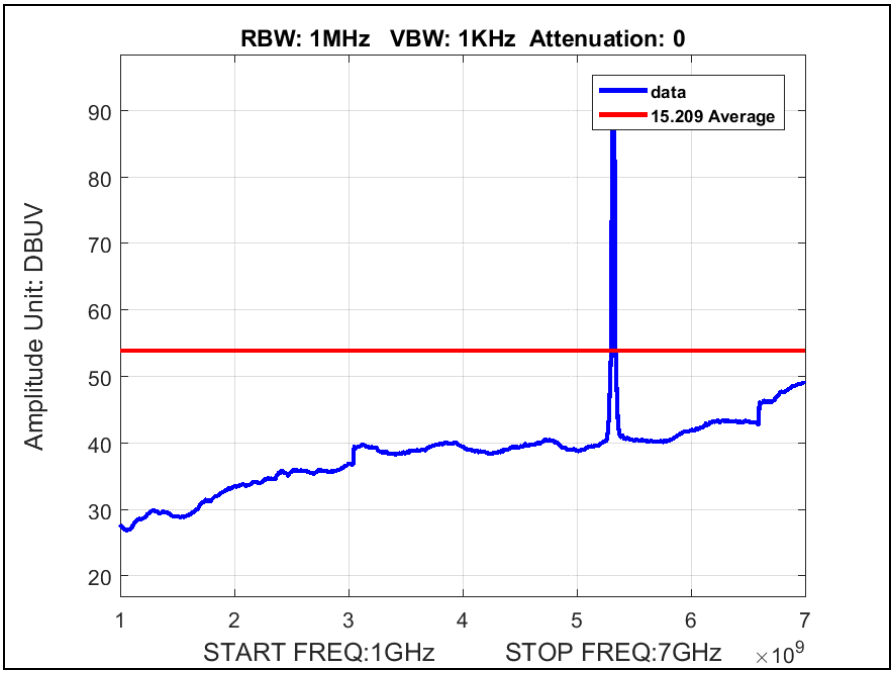
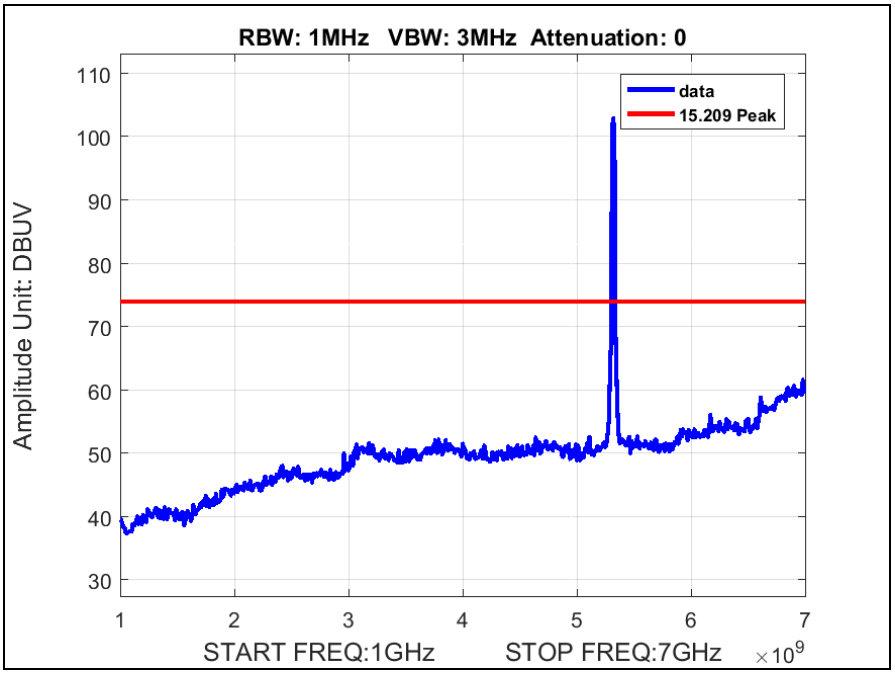
Radiated Spurious Emissions, 802.11n 20 MHz



Plot 124. Radiated Spurious Emissions, 5260 MHz, 802.11n 20 MHz, 1 GHz – 7 GHz, Average



Plot 125. Radiated Spurious Emissions, 5260 MHz, 802.11n 20 MHz, 1 GHz – 7 GHz, Peak

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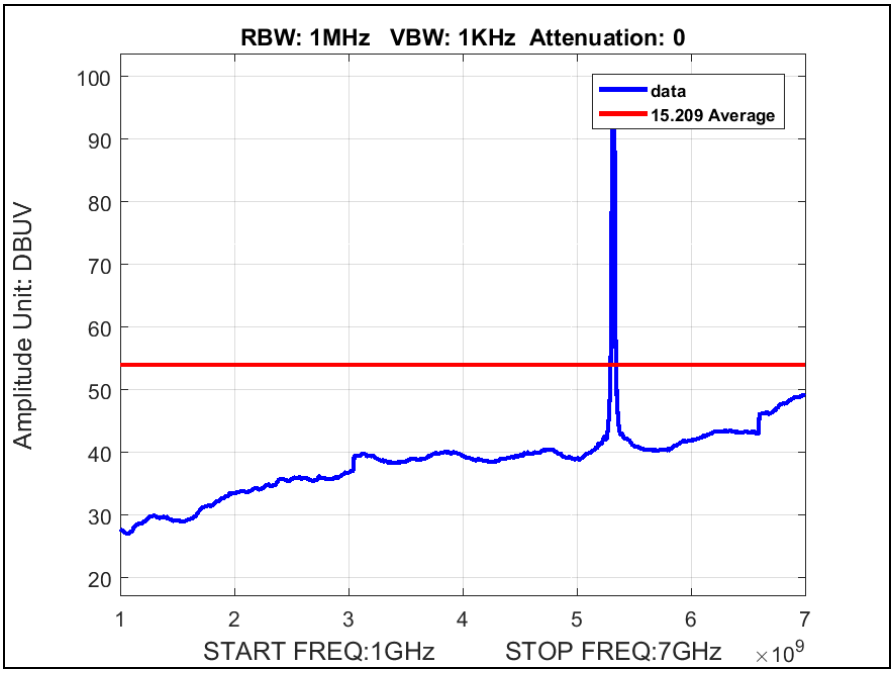
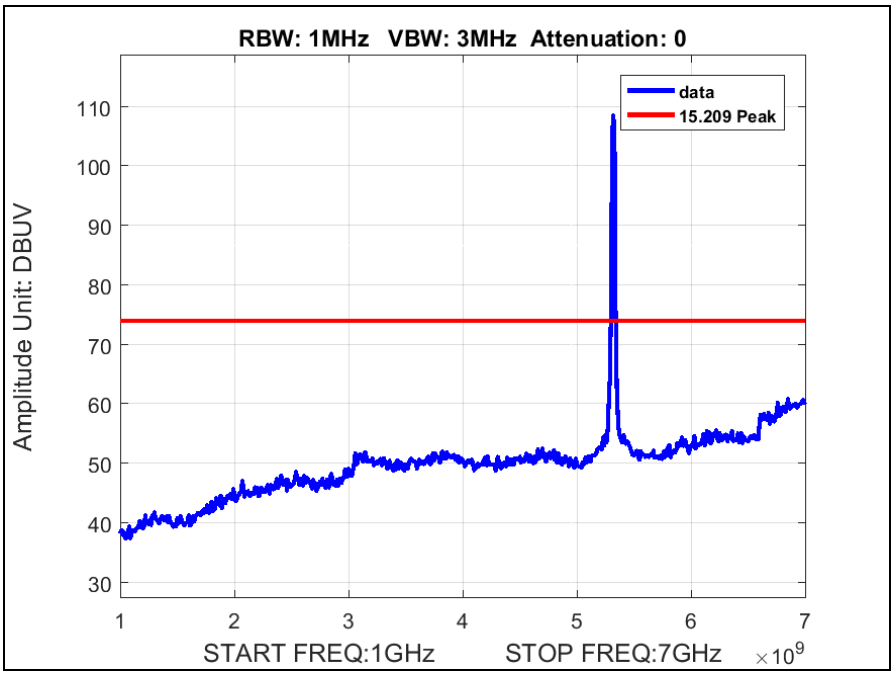
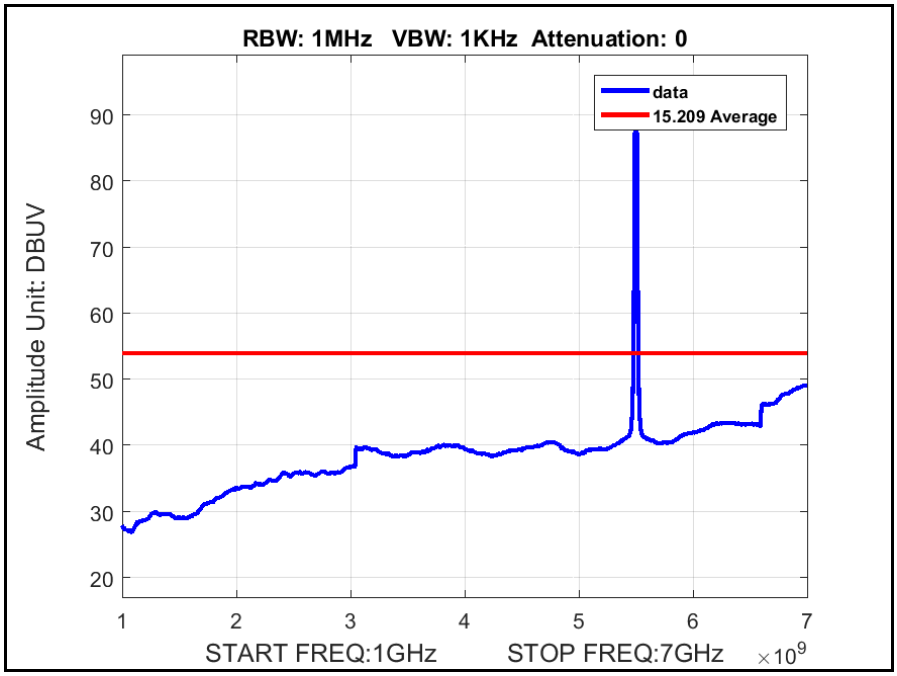


Plot 126. Radiated Spurious Emissions, 5320 MHz, 802.11n 20 MHz, 1 GHz – 7 GHz, Average

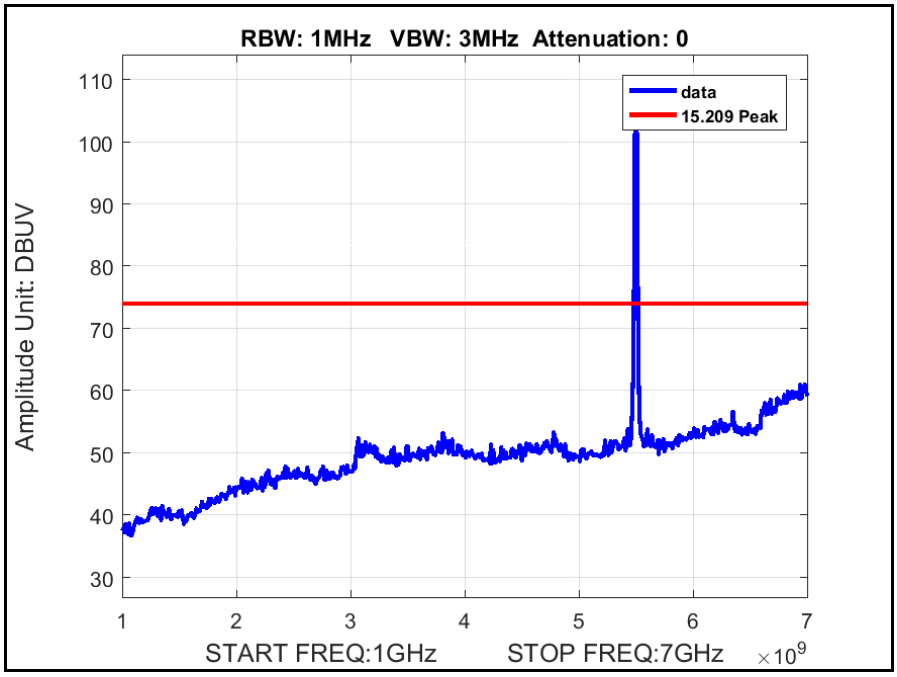


Plot 127. Radiated Spurious Emissions, 5320 MHz, 802.11n 20 MHz, 1 GHz – 7 GHz, Peak

 © 2017, MET Laboratories, Inc.



Plot 128. Radiated Spurious Emissions, 5500 MHz, 802.11n 20 MHz, 1 GHz – 7 GHz, Average



Plot 129. Radiated Spurious Emissions, 5500 MHz, 802.11n 20 MHz, 1 GHz – 7 GHz, Peak

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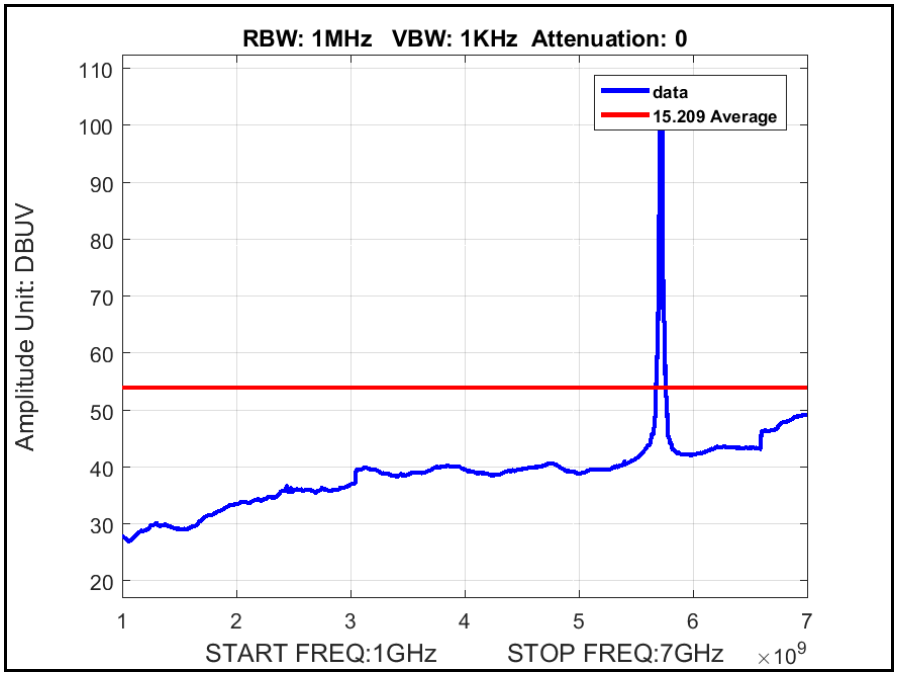
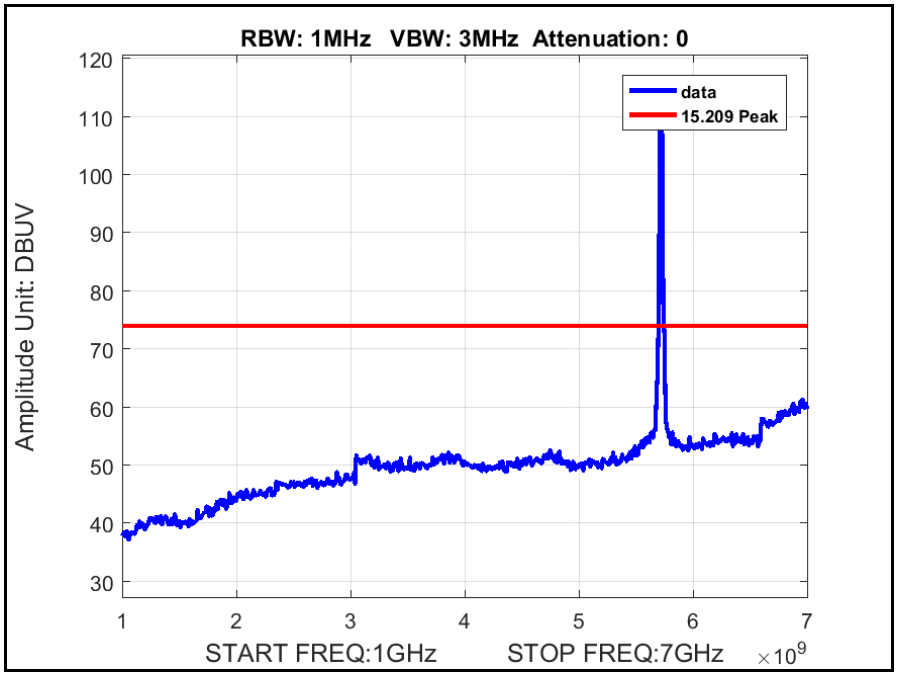


Plot 130. Radiated Spurious Emissions, 5700 MHz, 802.11n 20 MHz, 1 GHz – 7 GHz, Average



Plot 131. Radiated Spurious Emissions, 5700 MHz, 802.11n 20 MHz, 1 GHz – 7 GHz, Peak

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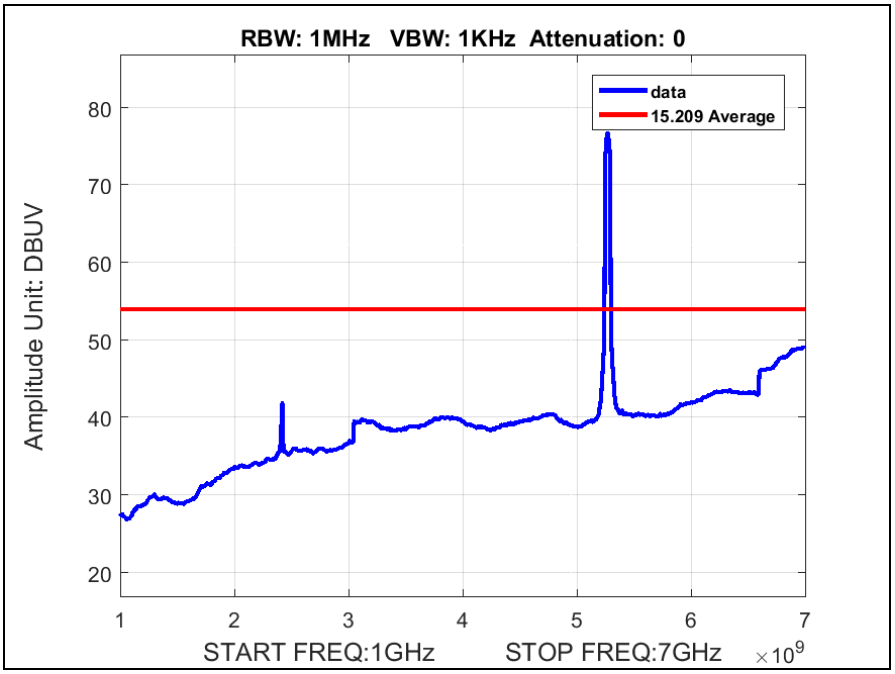
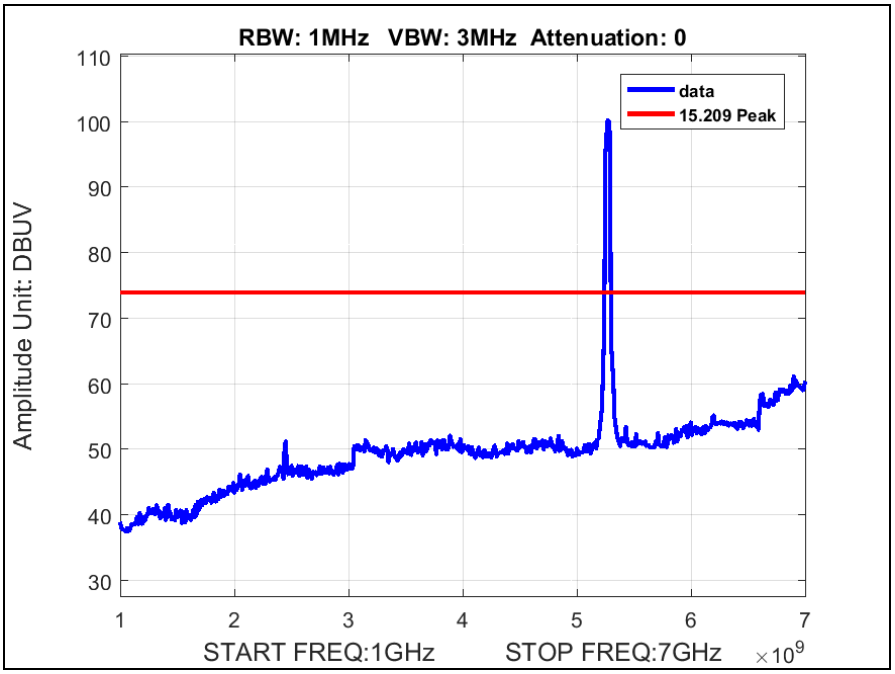
Radiated Spurious Emissions, 802.11n 40 MHz



Plot 132. Radiated Spurious Emissions, 5270 MHz, 802.11n 40 MHz, 1 GHz – 7 GHz, Average



Plot 133. Radiated Spurious Emissions, 5270 MHz, 802.11n 40 MHz, 1 GHz – 7 GHz, Peak

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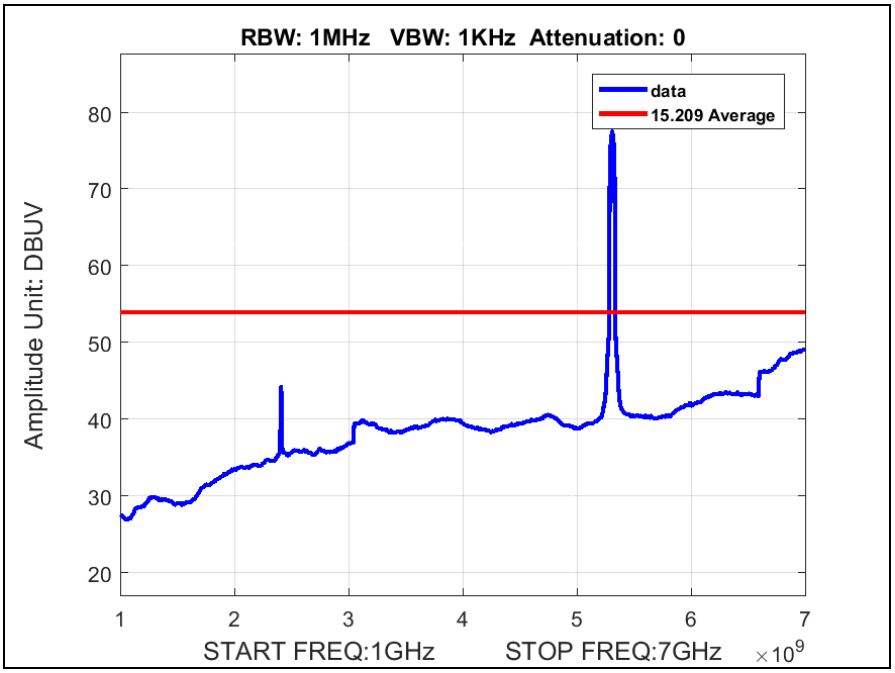
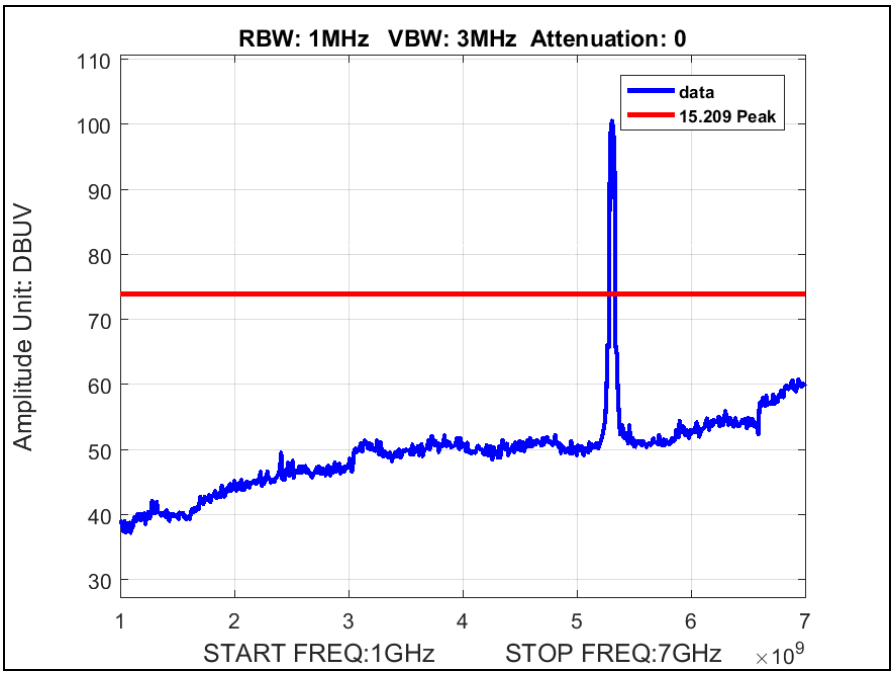
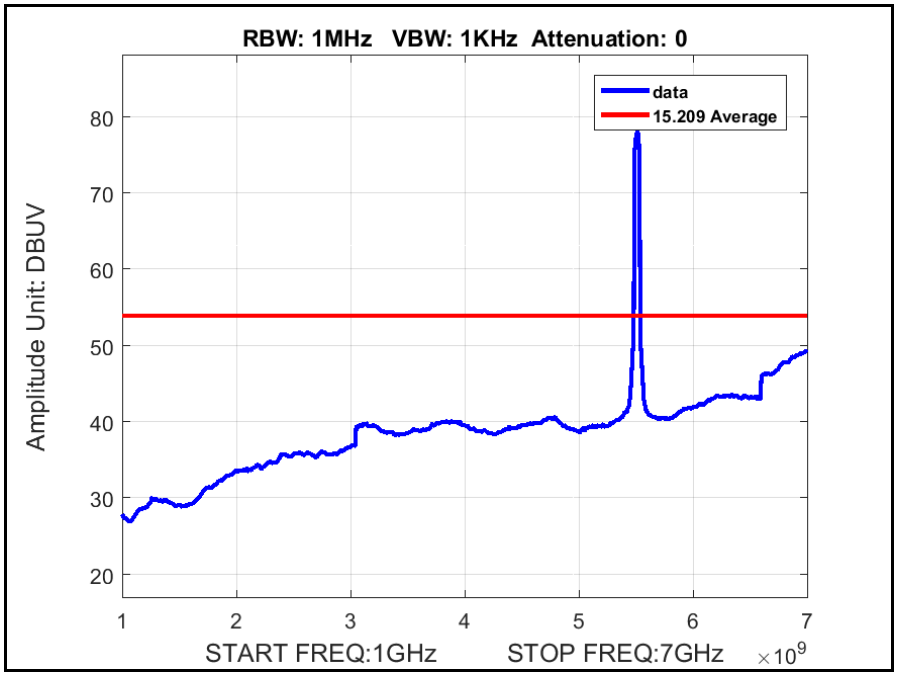


Plot 134. Radiated Spurious Emissions, 5310 MHz, 802.11n 40 MHz, 1 GHz – 7 GHz, Average

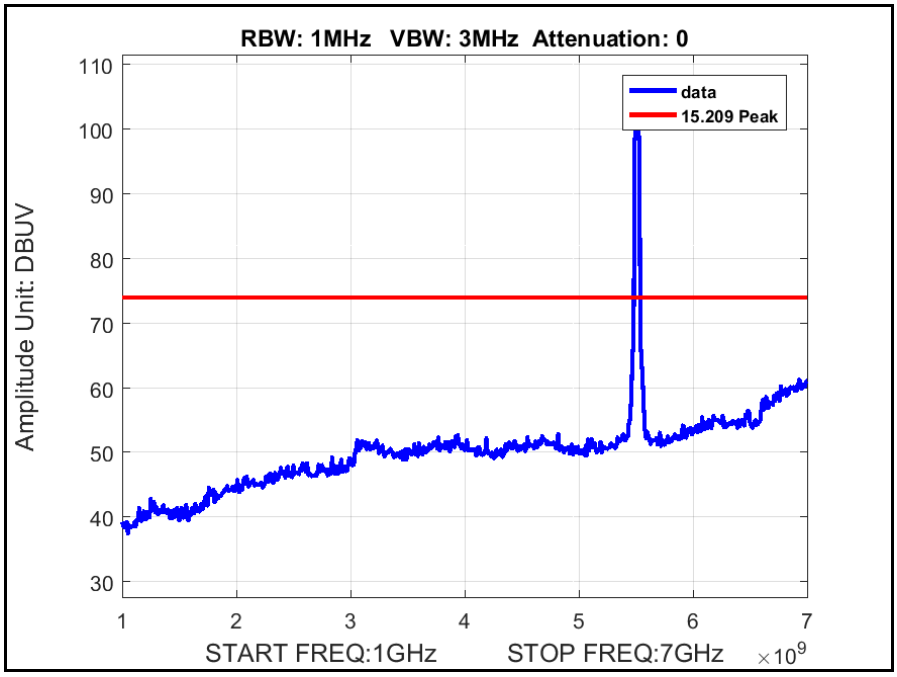


Plot 135. Radiated Spurious Emissions, 5310 MHz, 802.11n 40 MHz, 1 GHz – 7 GHz, Peak

 © 2017, MET Laboratories, Inc.



Plot 136. Radiated Spurious Emissions, 5510 MHz, 802.11n 40 MHz, 1 GHz – 7 GHz, Average



Plot 137. Radiated Spurious Emissions, 5510 MHz, 802.11n 40 MHz, 1 GHz – 7 GHz, Peak

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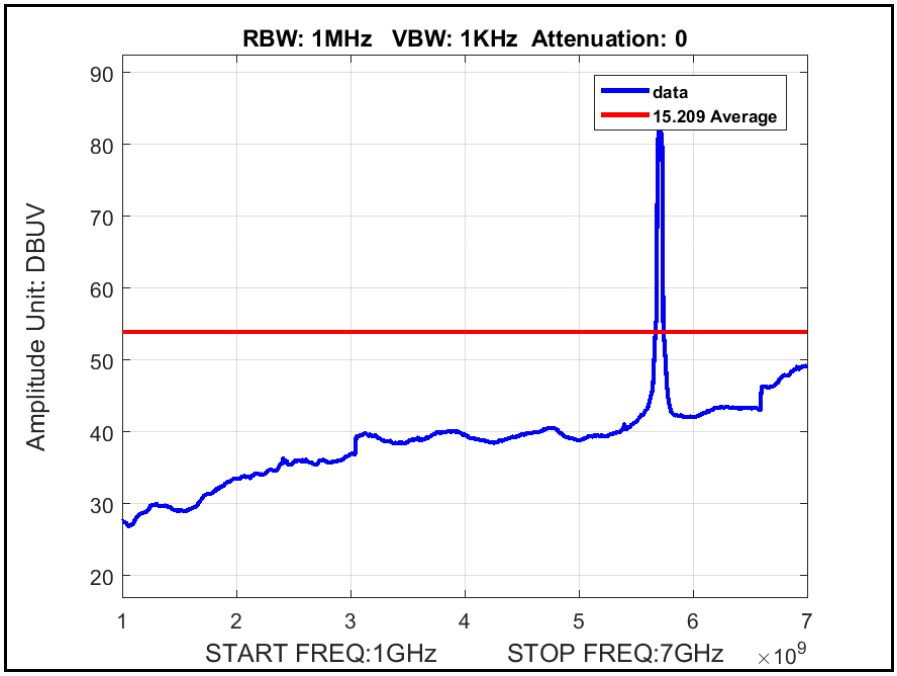
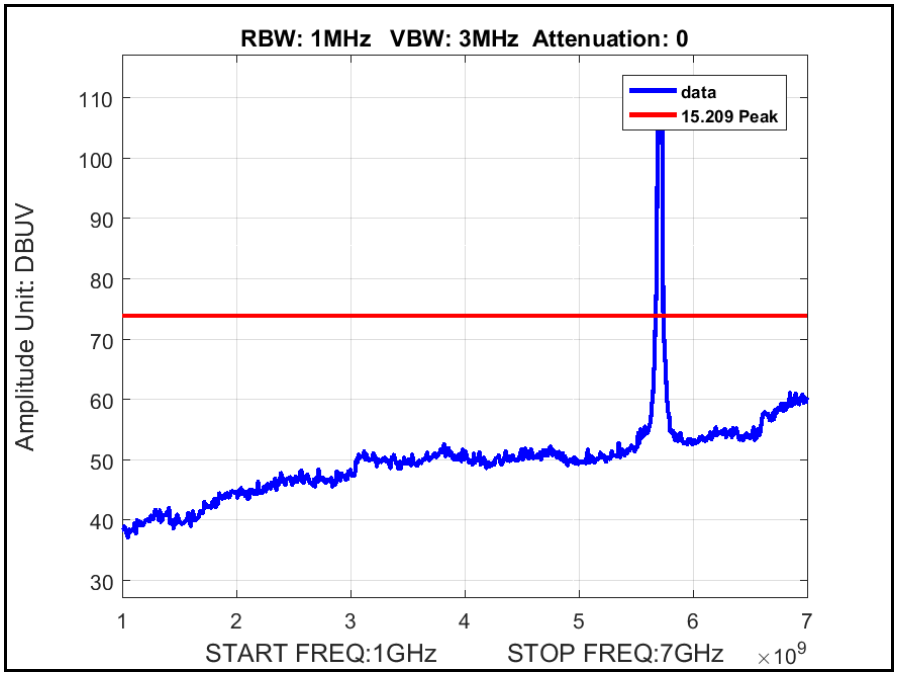


Plot 138. Radiated Spurious Emissions, 5670 MHz, 802.11n 40 MHz, 1 GHz – 7 GHz, Average



Plot 139. Radiated Spurious Emissions, 5670 MHz, 802.11n 40 MHz, 1 GHz – 7 GHz, Peak

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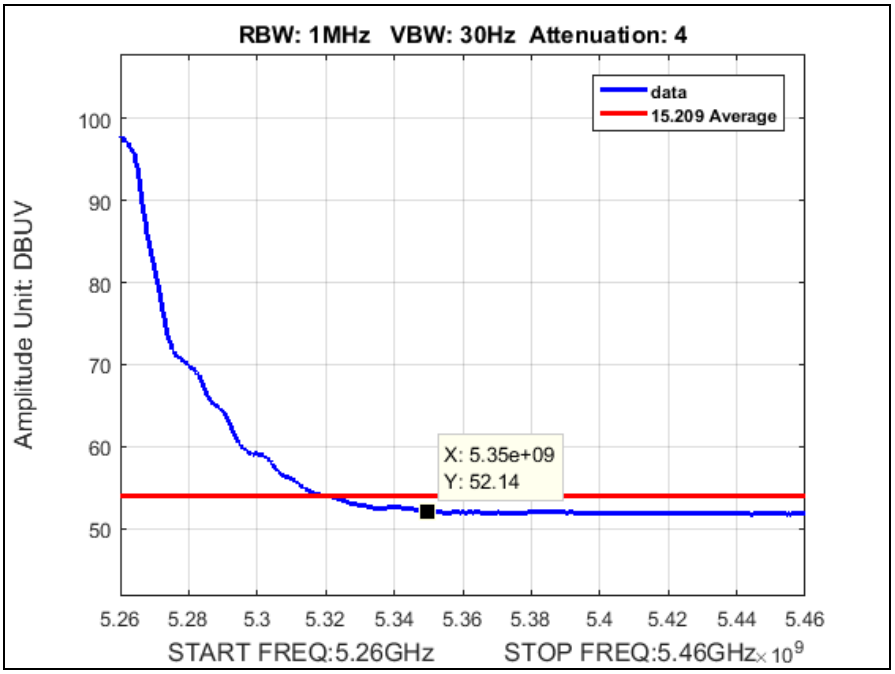
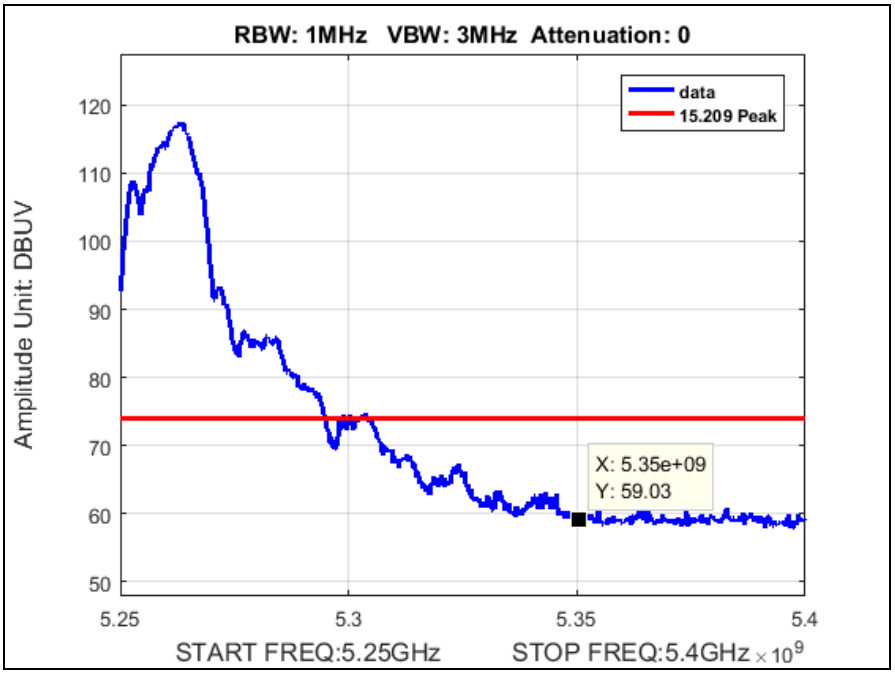
Radiated Band Edge, 802.11a



Plot 140. Radiated Band Edge, 5260 MHz, 802.11a, Average



Plot 141. Radiated Band Edge, 5260 MHz, 802.11a, Peak

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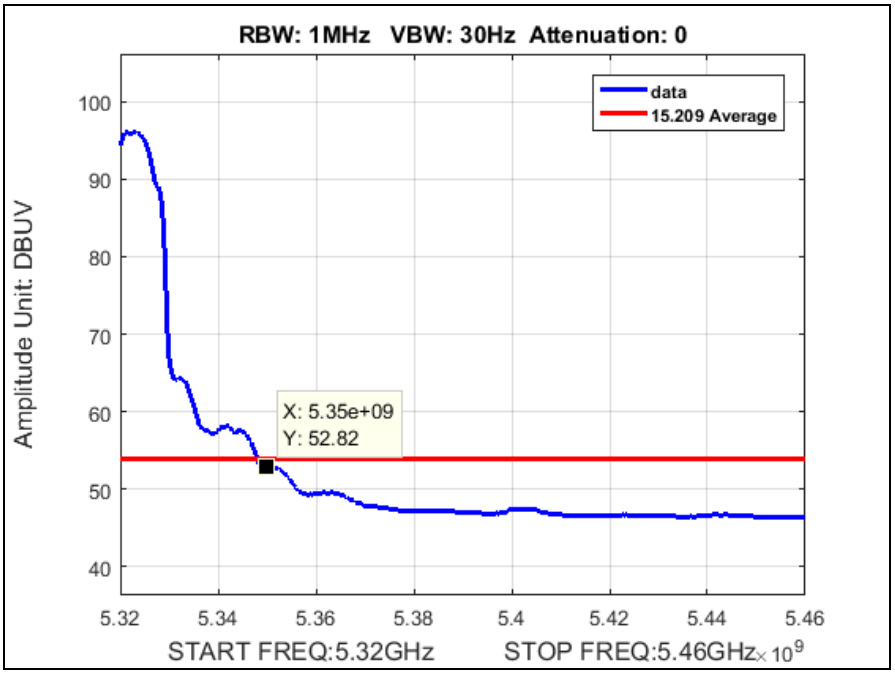
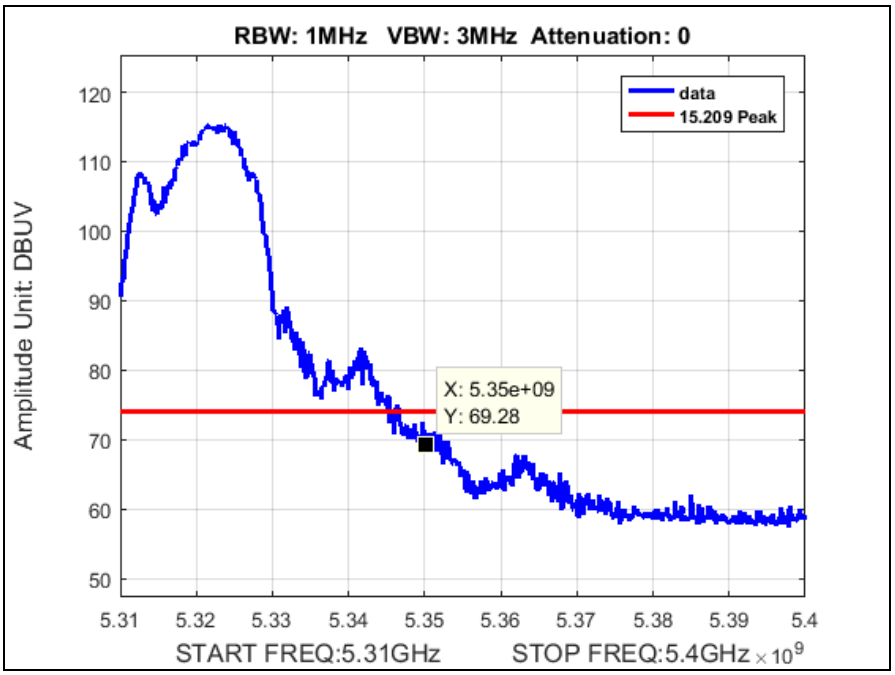
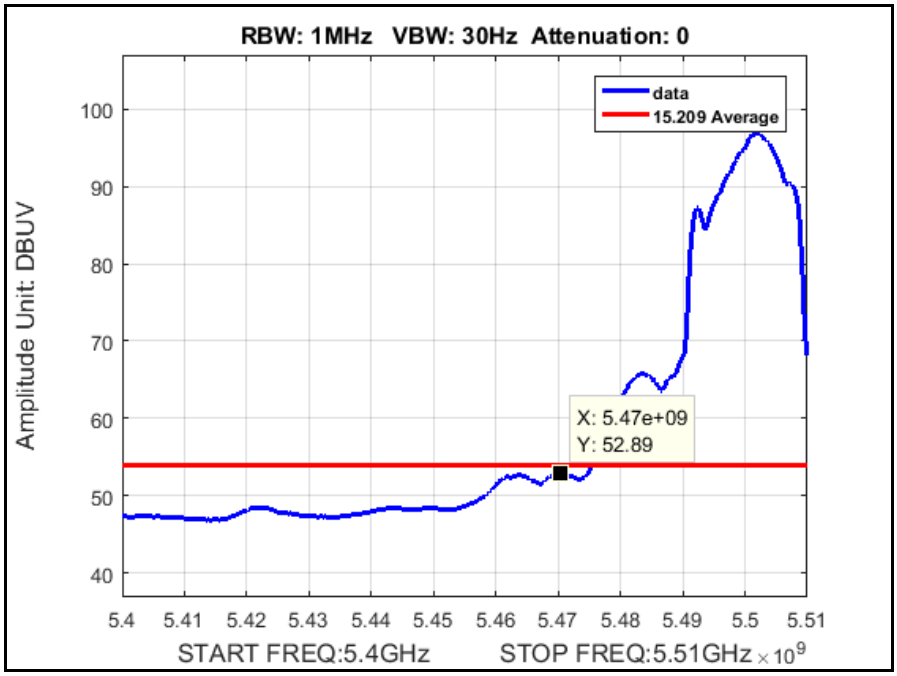


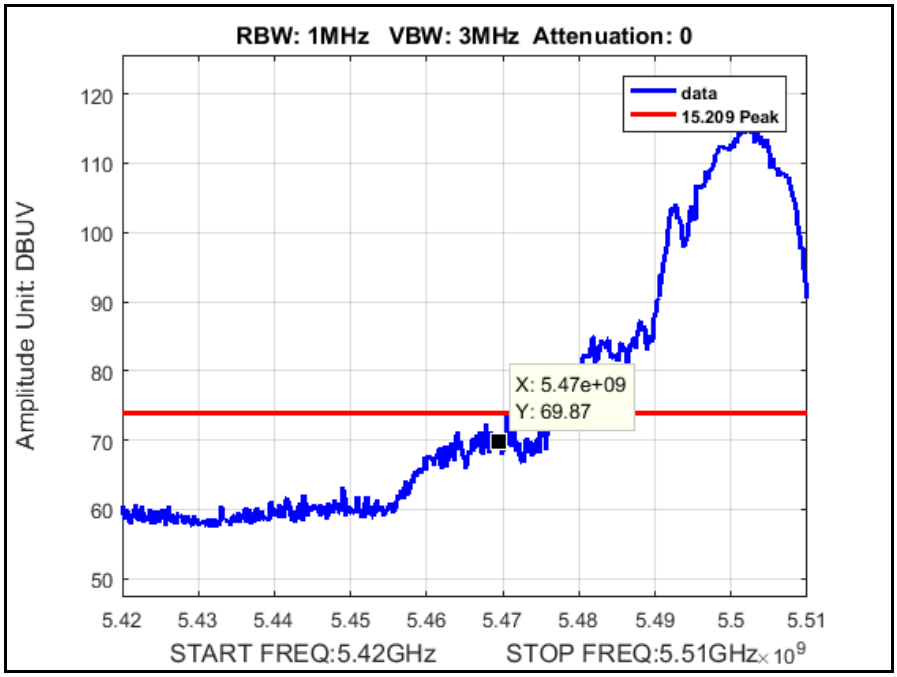
Plot 142. Radiated Band Edge, 5320 MHz, 802.11a, Average



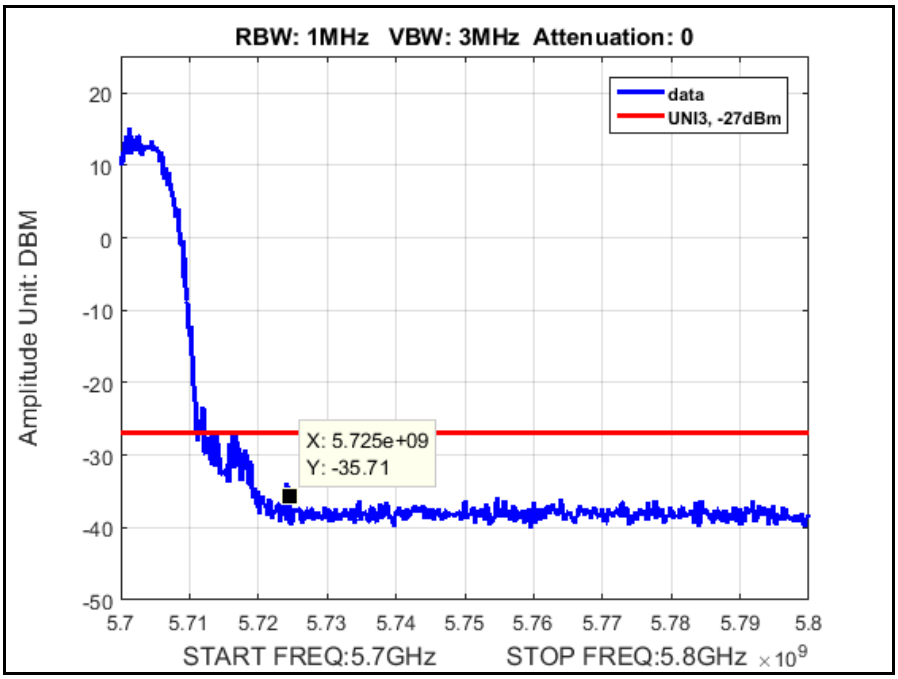
Plot 143. Radiated Band Edge, 5320 MHz, 802.11a, Peak



Plot 144. Radiated Band Edge, 5500 MHz, 802.11a, Average

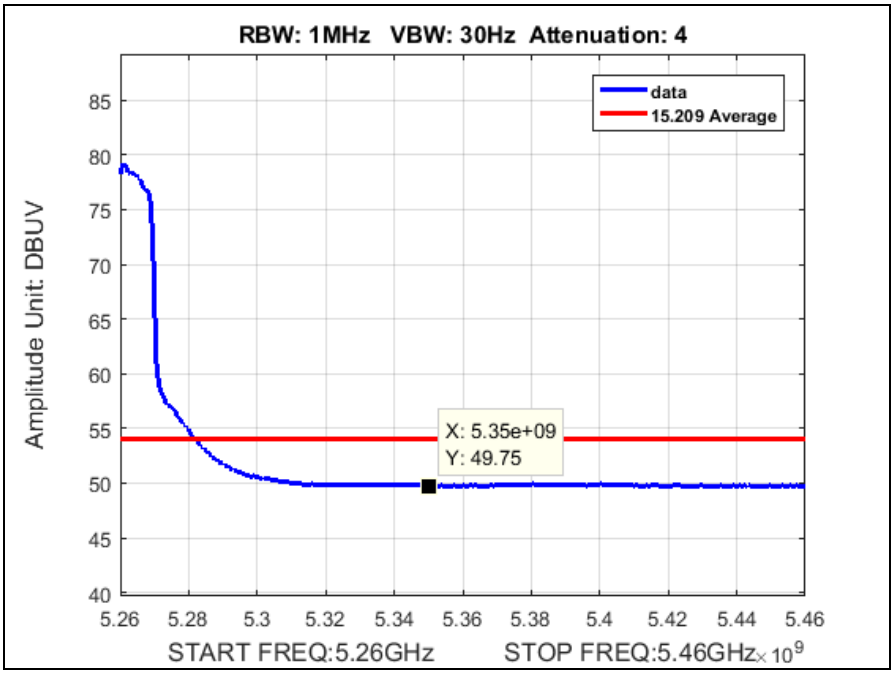


Plot 145. Radiated Band Edge, 5500 MHz, 802.11a, Peak

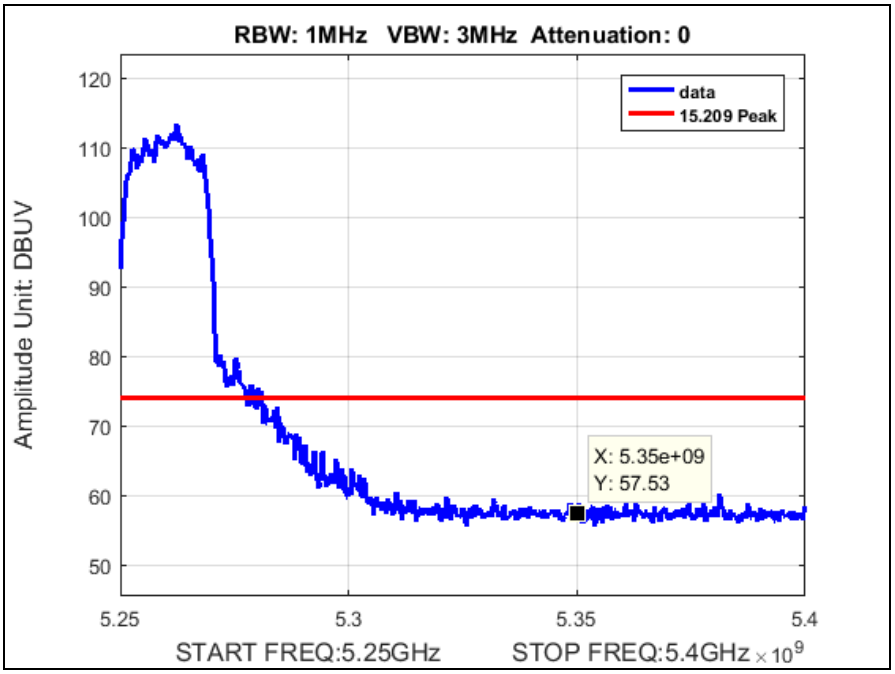


Plot 146. Radiated Band Edge, 5700 MHz, 802.11a, -27

Radiated Band Edge, 802.11ac 20 MHz

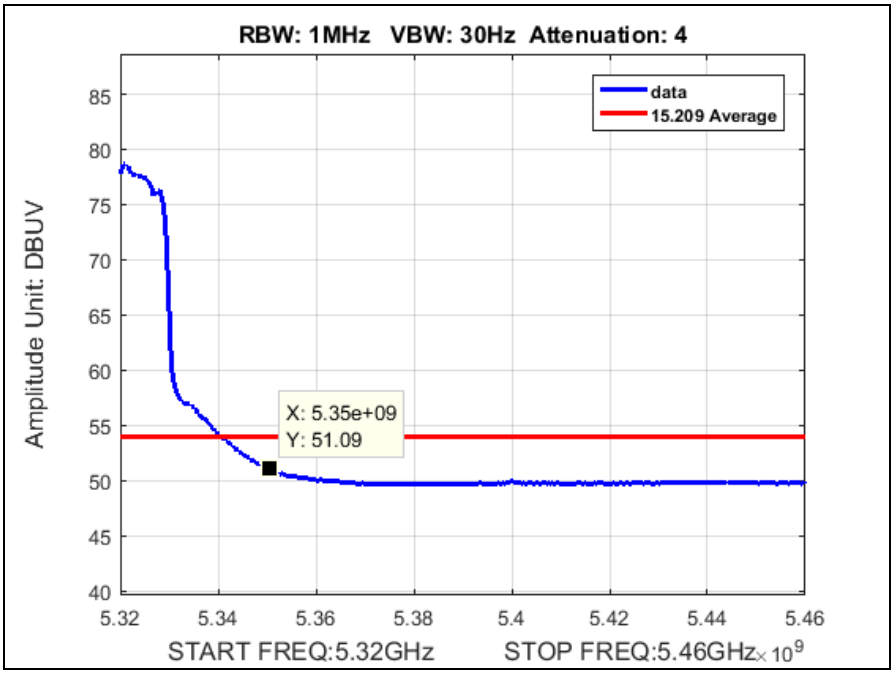


Plot 147. Radiated Band Edge, 5260 MHz, 802.11ac 20 MHz, Average

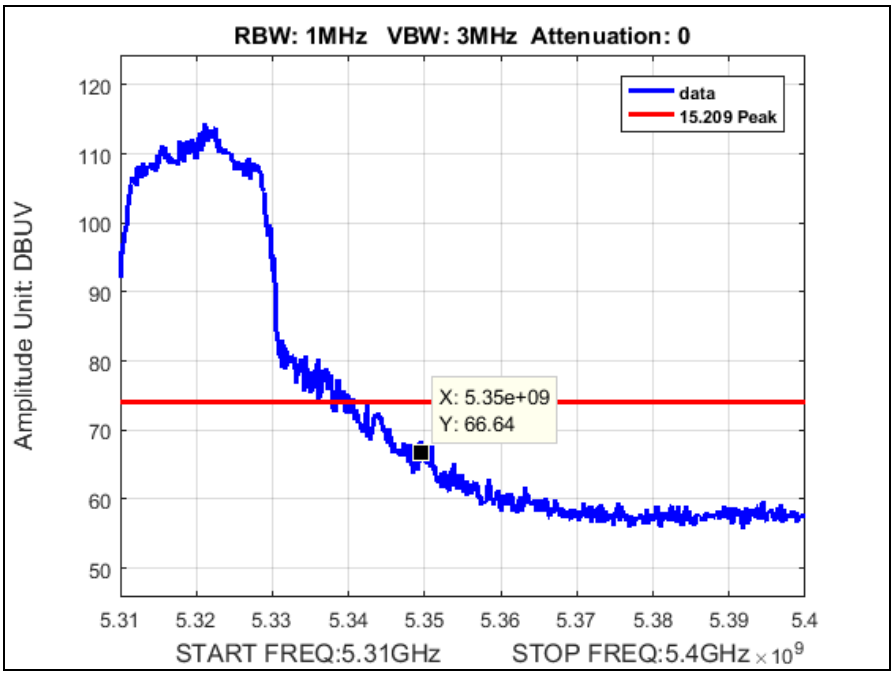


Plot 148. Radiated Band Edge, 5260 MHz, 802.11ac 20 MHz, Peak

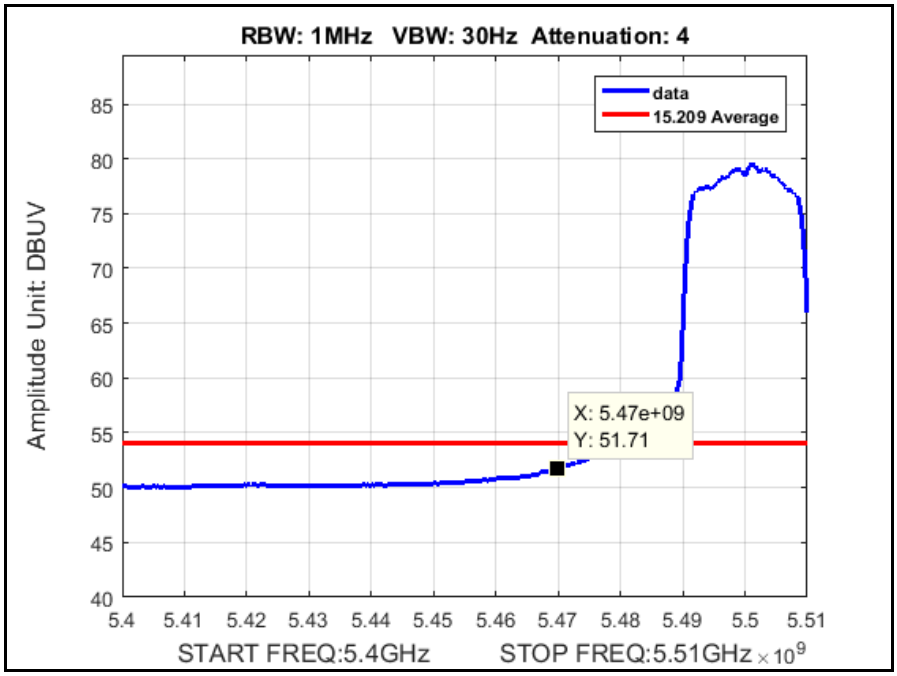
 © 2017, MET Laboratories, Inc.



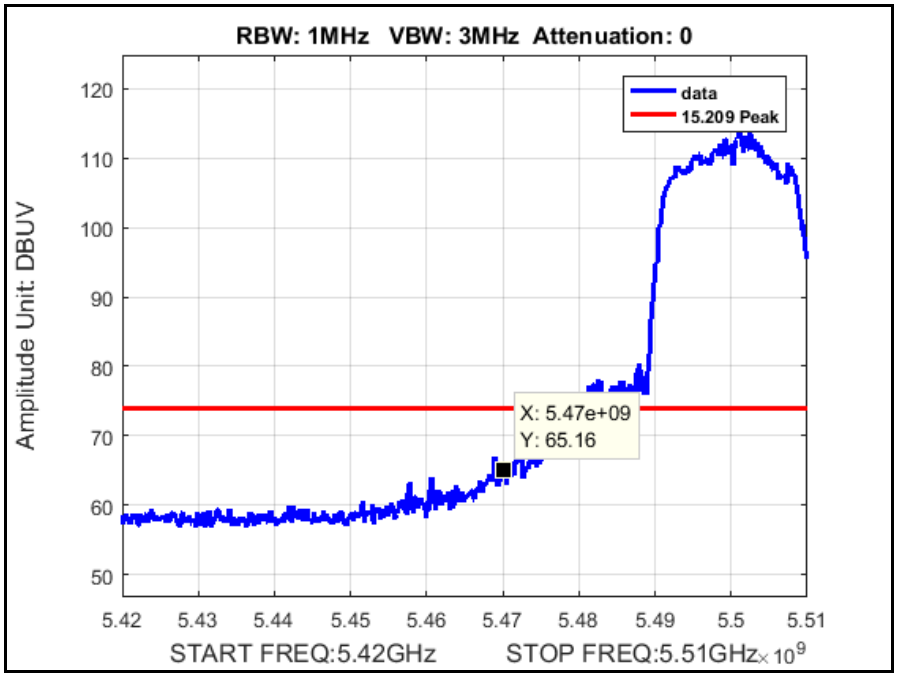
Plot 149. Radiated Band Edge, 5320 MHz, 802.11ac 20 MHz, Average



Plot 150. Radiated Band Edge, 5320 MHz, 802.11ac 20 MHz, Peak



Plot 151. Radiated Band Edge, 5500 MHz, 802.11ac 20 MHz, Average



Plot 152. Radiated Band Edge, 5500 MHz, 802.11ac 20 MHz, Peak

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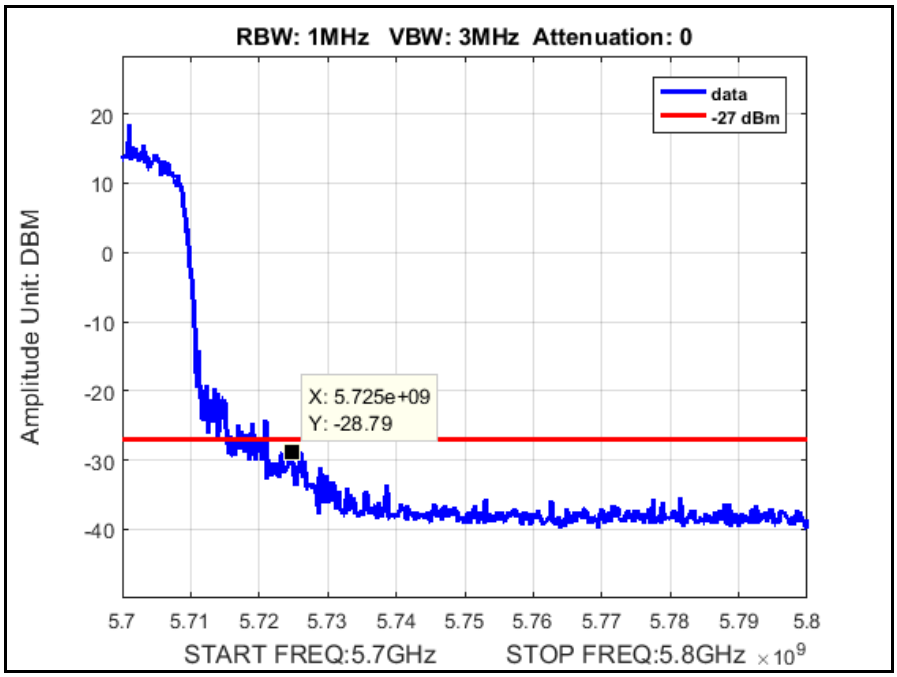
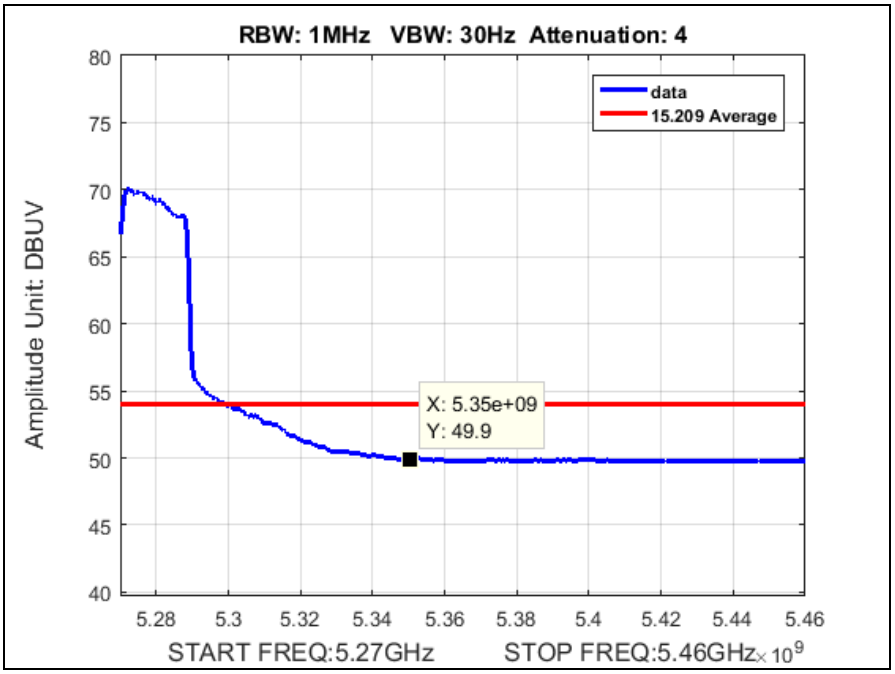
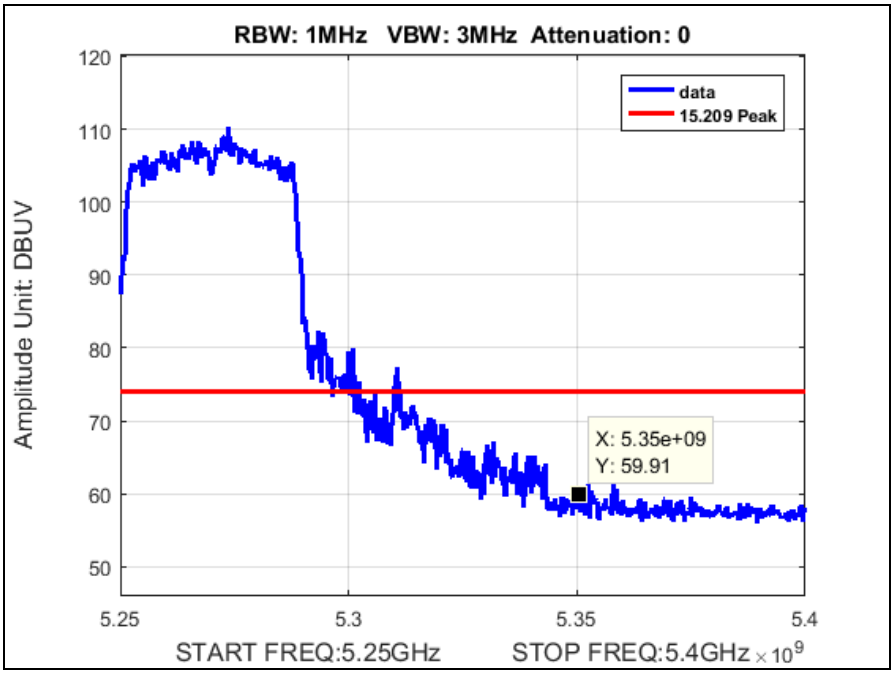


Plot 153. Radiated Band Edge, Integration, 5700 MHz, 802.11ac 20 MHz, -27

Radiated Band Edge, 802.11ac 40 MHz



Plot 154. Radiated Band Edge, 5270 MHz, 802.11ac 40 MHz, Average



Plot 155. Radiated Band Edge, 5270 MHz, 802.11ac 40 MHz, Peak

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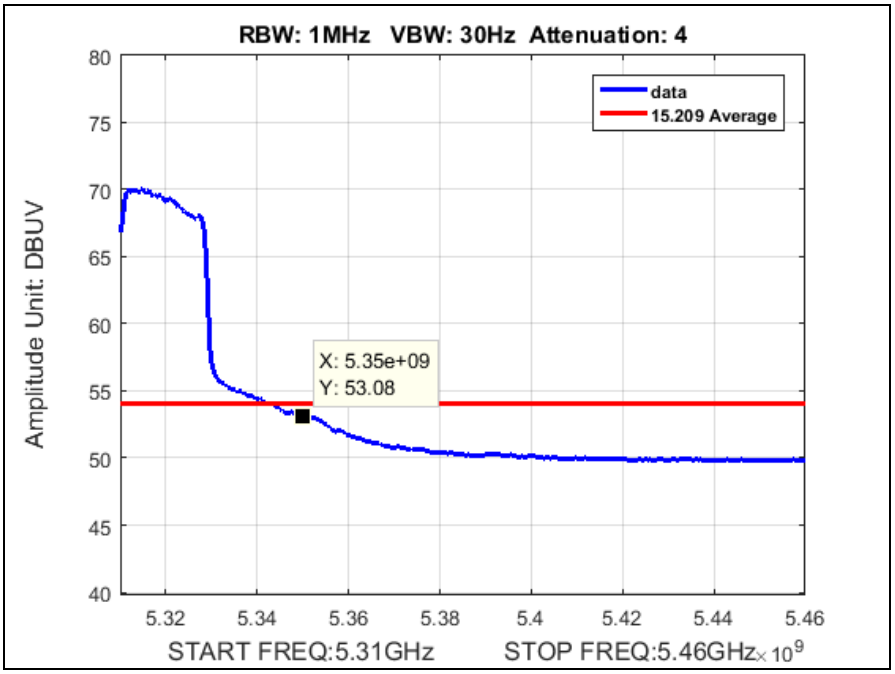
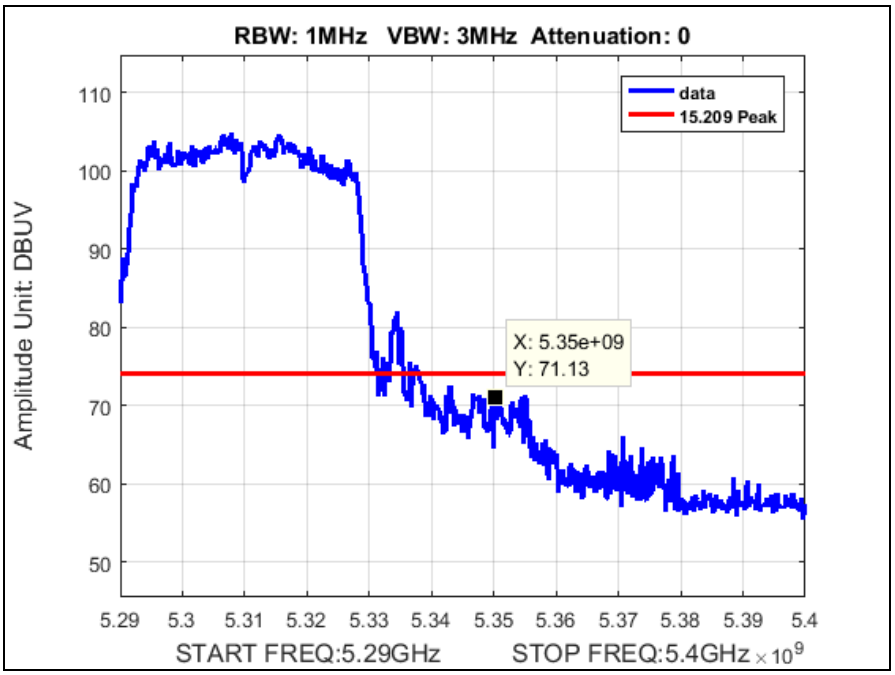


Plot 156. Radiated Band Edge, 5310 MHz, 802.11ac 40 MHz, Average



Plot 157. Radiated Band Edge, 5310 MHz, 802.11ac 40 MHz, Peak

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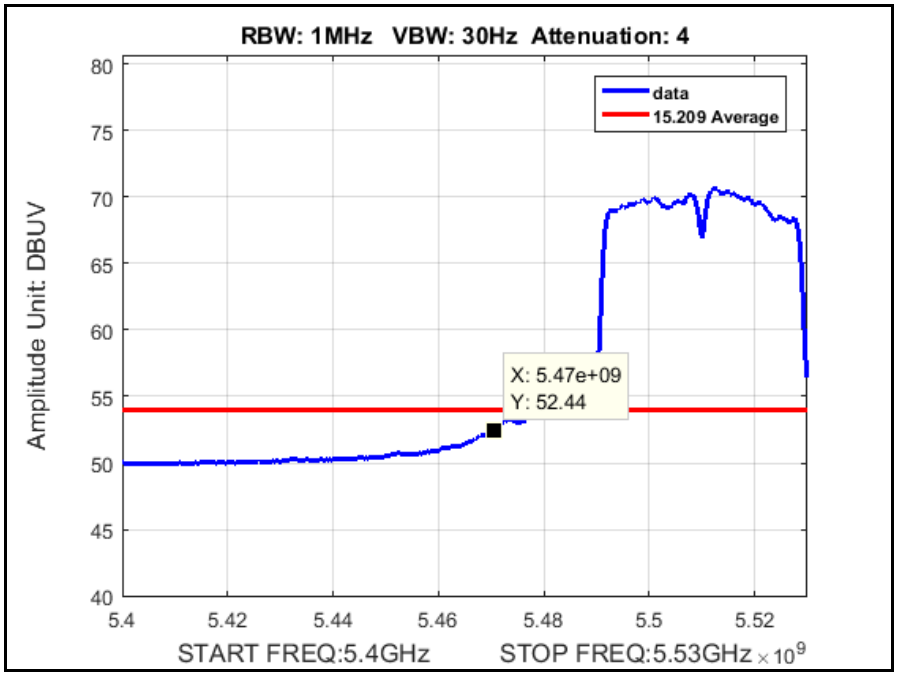
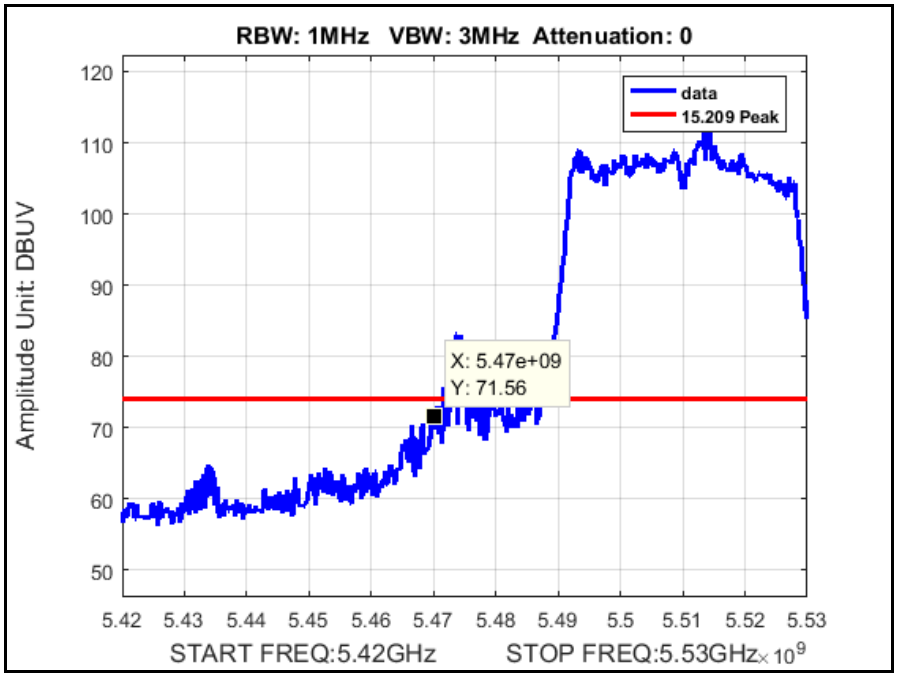
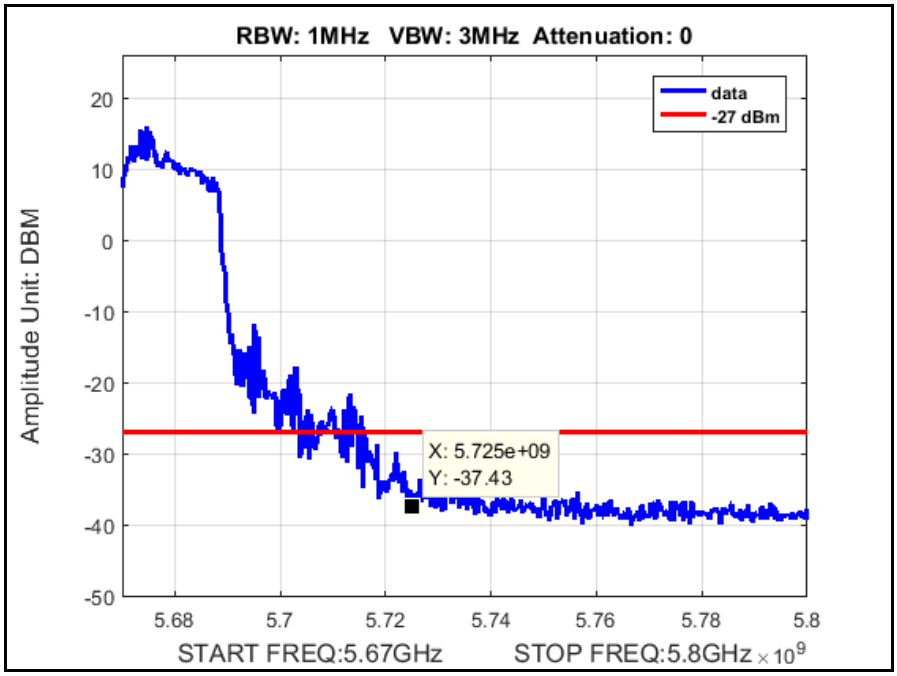


Plot 158. Radiated Band Edge, 5510 MHz, 802.11ac 40 MHz, Average

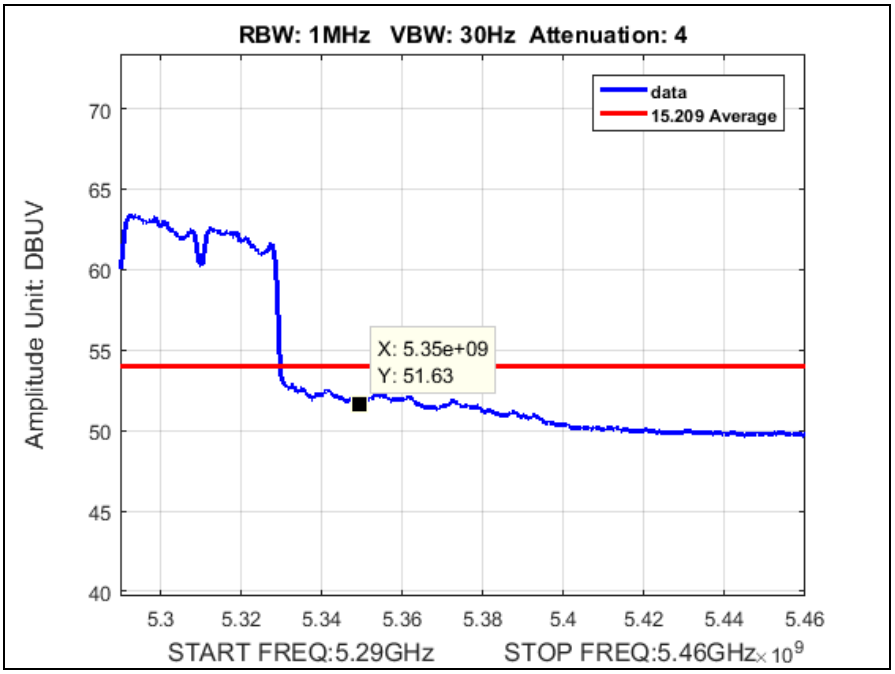


Plot 159. Radiated Band Edge, 5510 MHz, 802.11ac 40 MHz, Peak

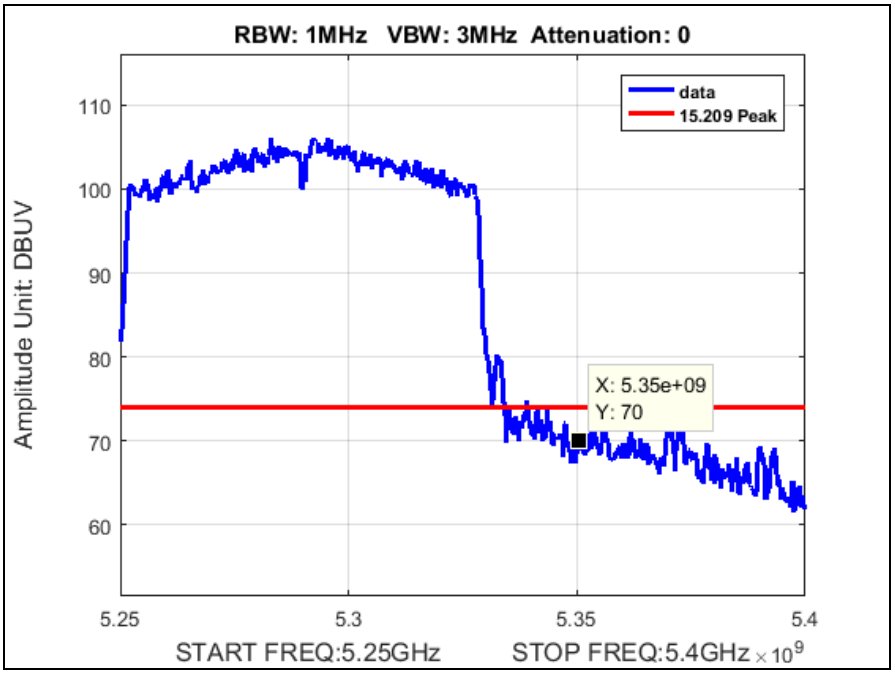


Plot 160. Radiated Band Edge, Integration, 5670 MHz, 802.11ac 40 MHz, -27

Radiated Band Edge, 802.11ac 80 MHz



Plot 161. Radiated Band Edge, 5290 MHz, 802.11ac 80 MHz, Average



Plot 162. Radiated Band Edge, 5290 MHz, 802.11ac 80 MHz, Peak

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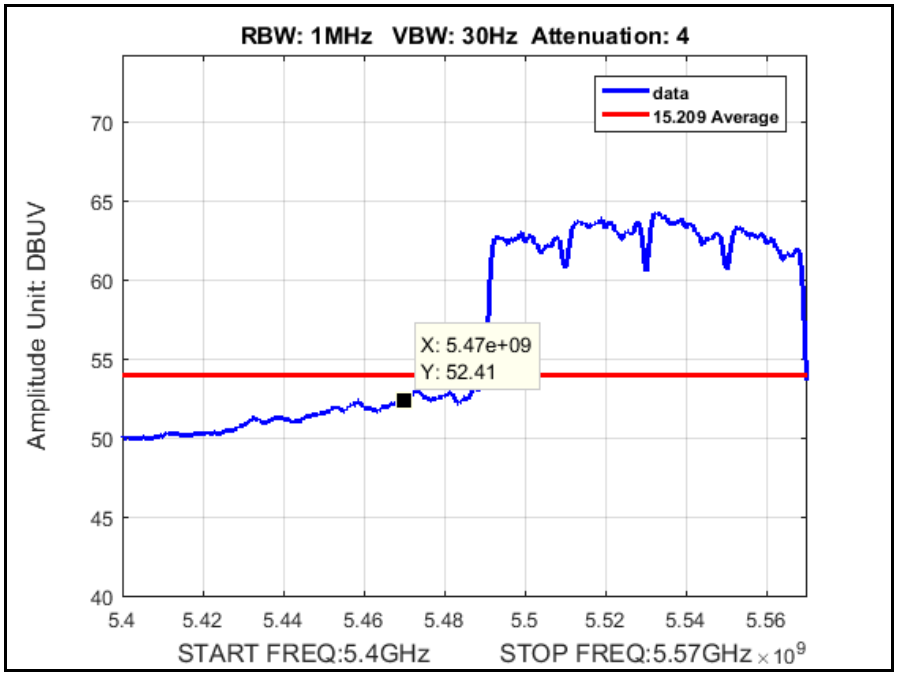
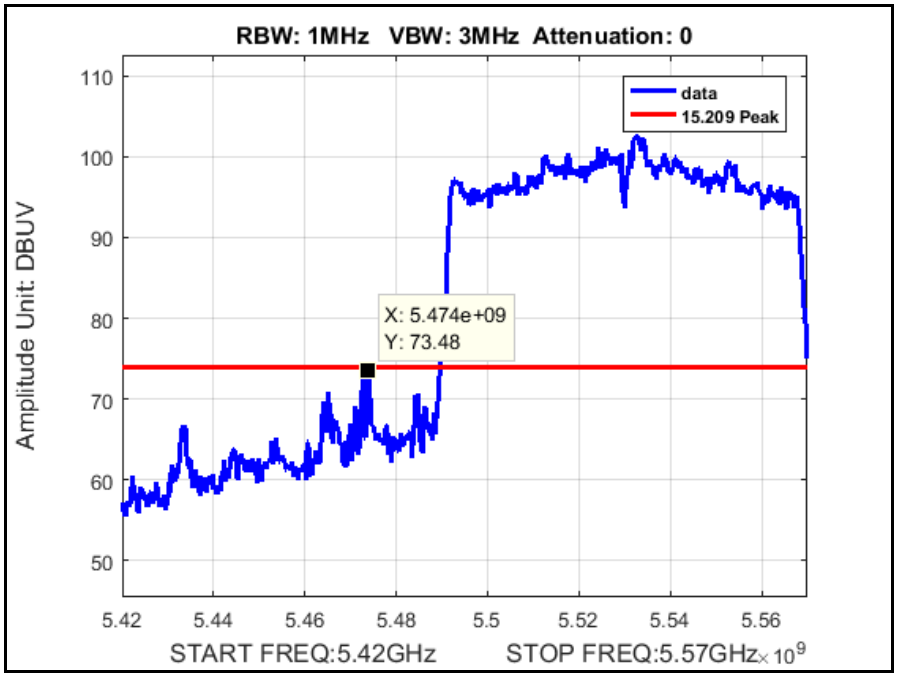


Plot 163. Radiated Band Edge, 5530 MHz, 802.11ac 80 MHz, Average



Plot 164. Radiated Band Edge, 5530 MHz, 802.11ac 80 MHz, Peak

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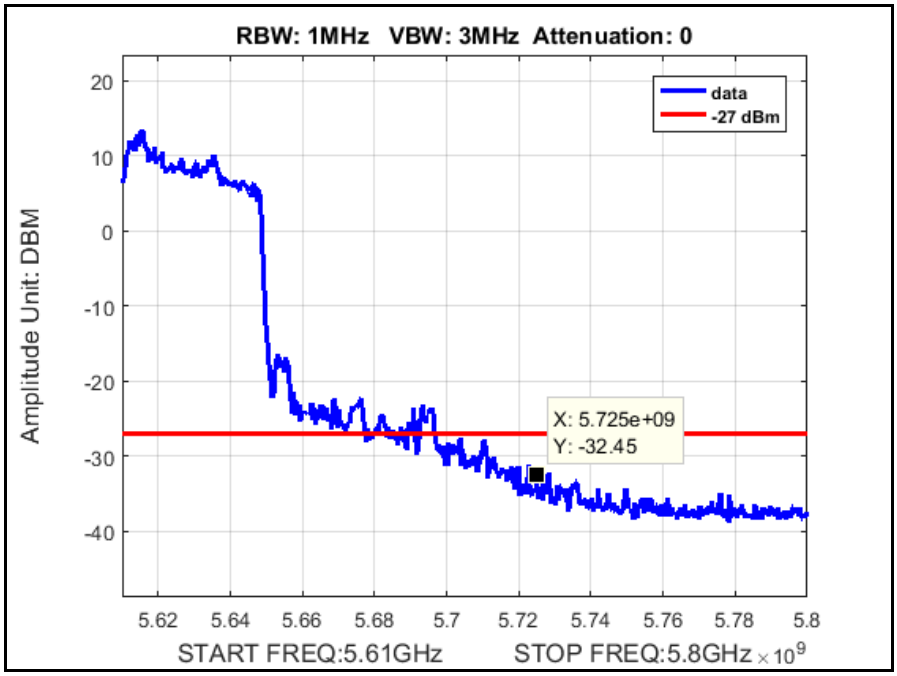
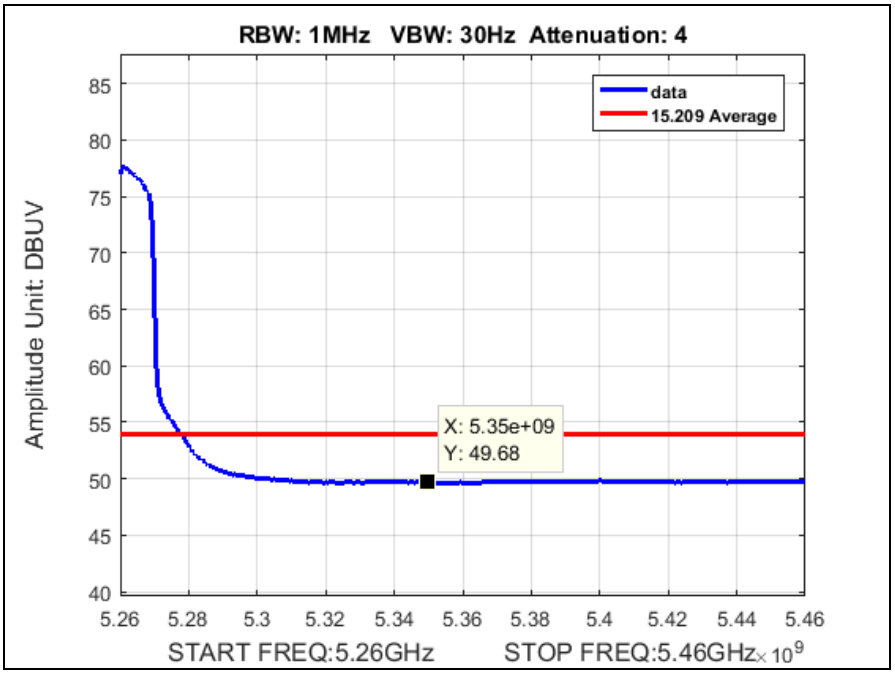
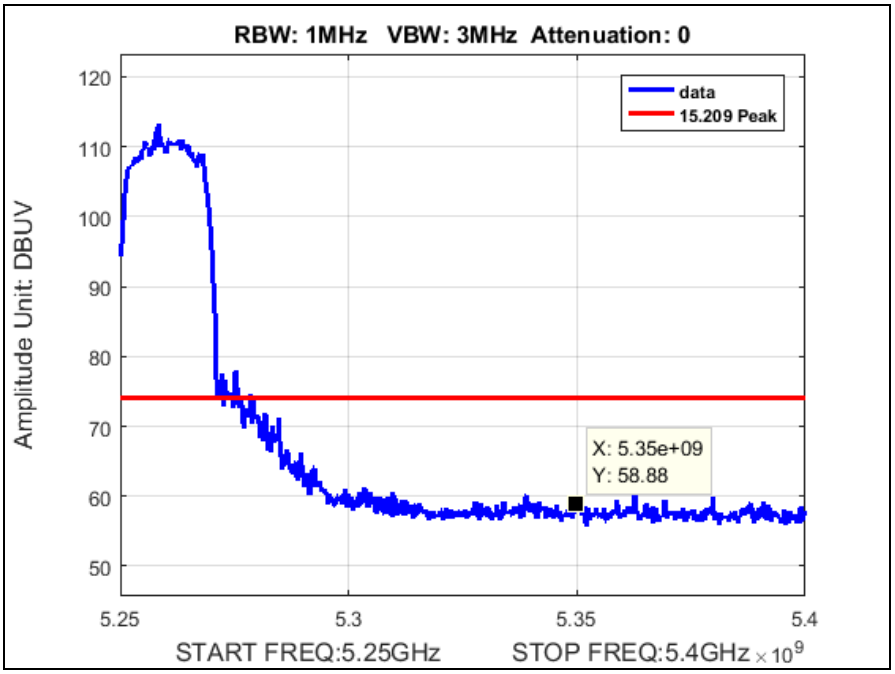


Plot 165. Radiated Band Edge, Integration, 5610 MHz, 802.11ac 80 MHz, -27

Radiated Band Edge, 802.11n 20 MHz



Plot 166. Radiated Band Edge, 5260 MHz, 802.11n 20 MHz, Average



Plot 167. Radiated Band Edge, 5260 MHz, 802.11n 20 MHz, Peak

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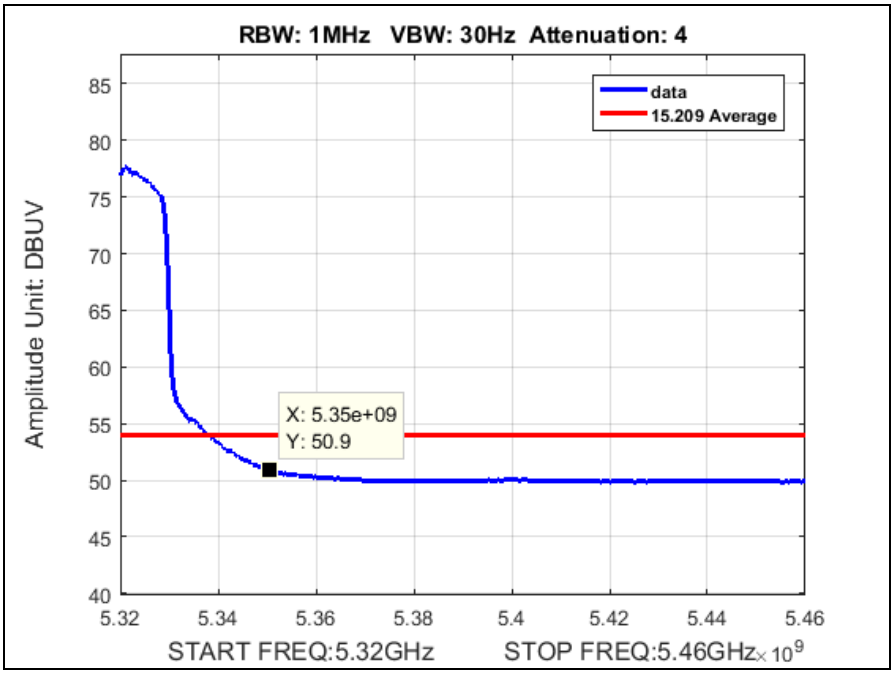
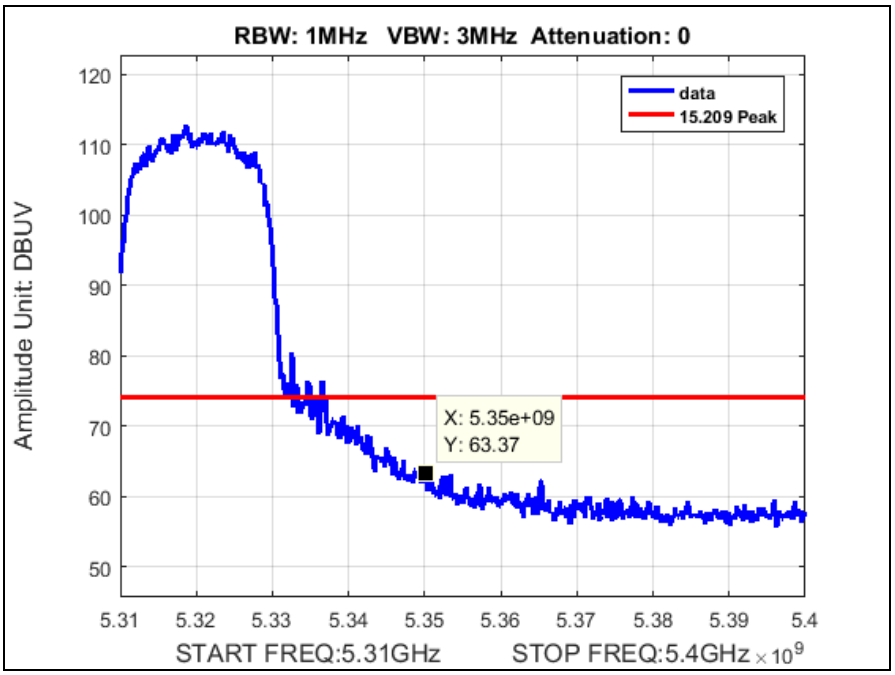
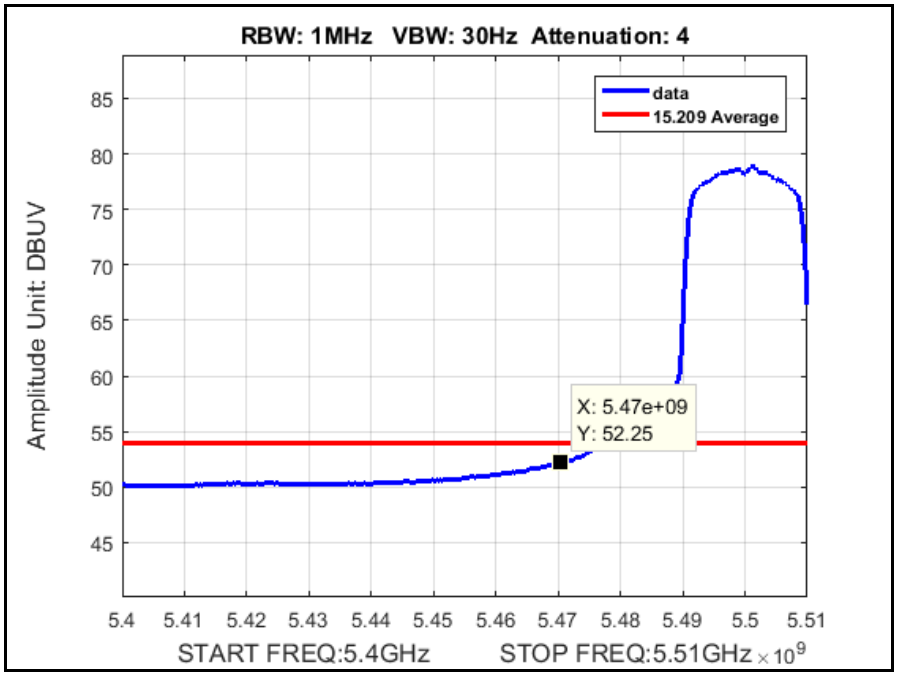


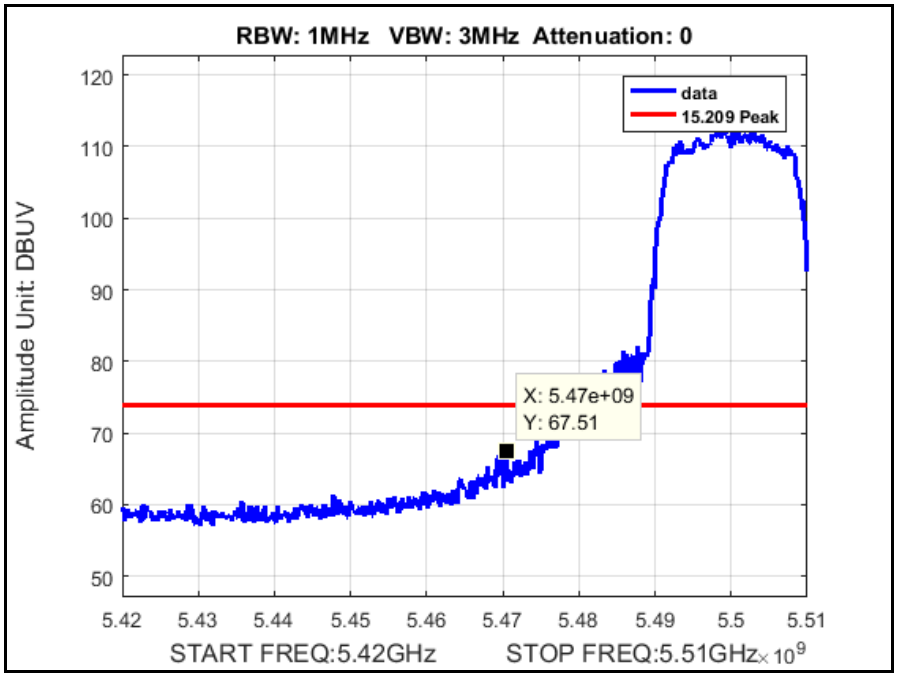
Plot 168. Radiated Band Edge, 5320 MHz, 802.11n 20 MHz, Average



Plot 169. Radiated Band Edge, 5320 MHz, 802.11n 20 MHz, Peak



Plot 170. Radiated Band Edge, 5500 MHz, 802.11n 20 MHz, Average



Plot 171. Radiated Band Edge, 5500 MHz, 802.11n 20 MHz, Peak

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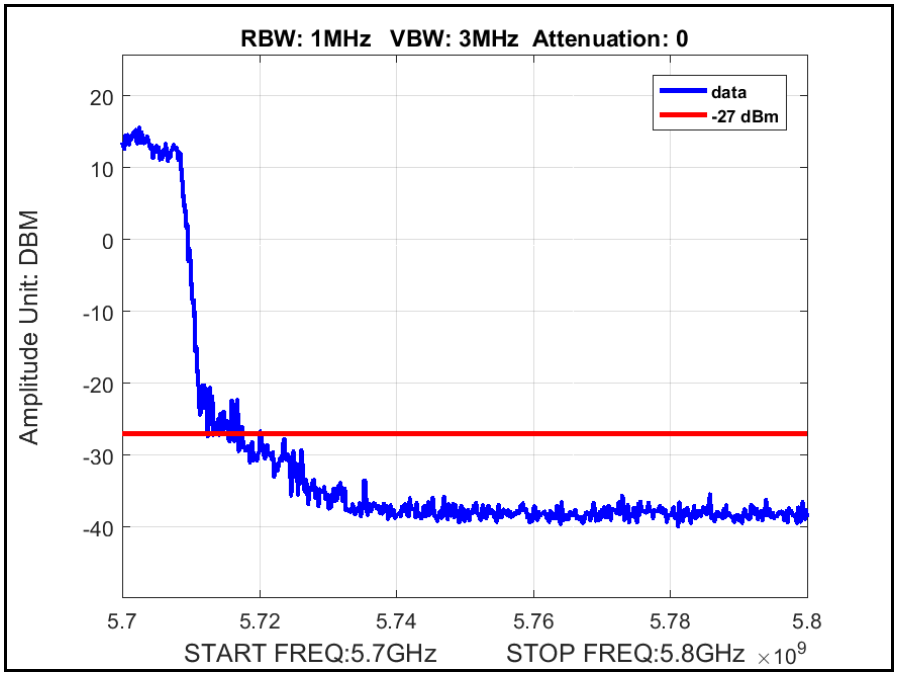
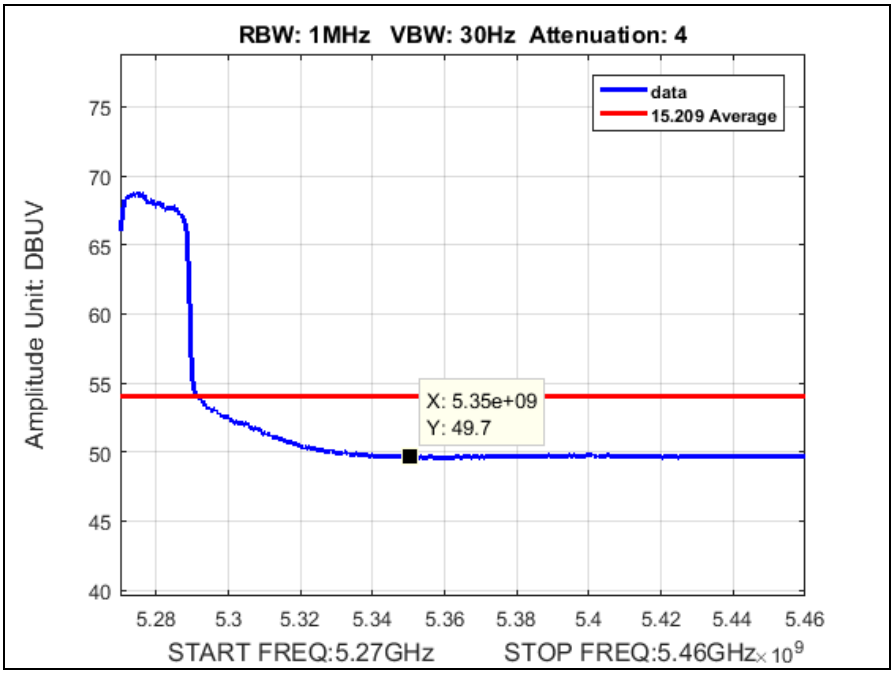
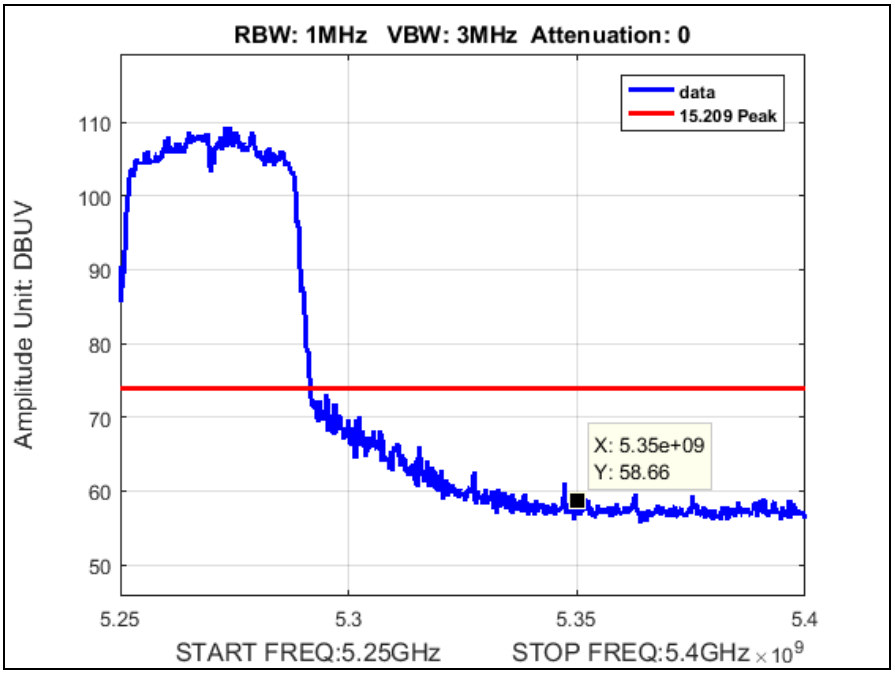


Plot 172. Radiated Band Edge, Integration, 5700 MHz, 802.11n 20 MHz,-27

Radiated Band Edge, 802.11n 40 MHz



Plot 173. Radiated Band Edge, 5270 MHz, 802.11n 40 MHz, Average



Plot 174. Radiated Band Edge, 5270 MHz, 802.11n 40 MHz, Peak

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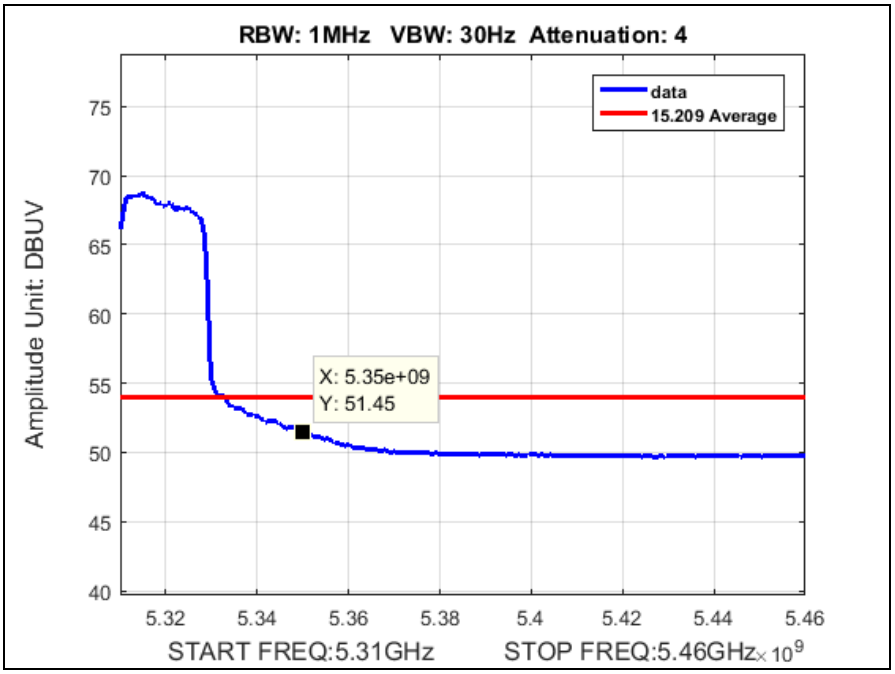
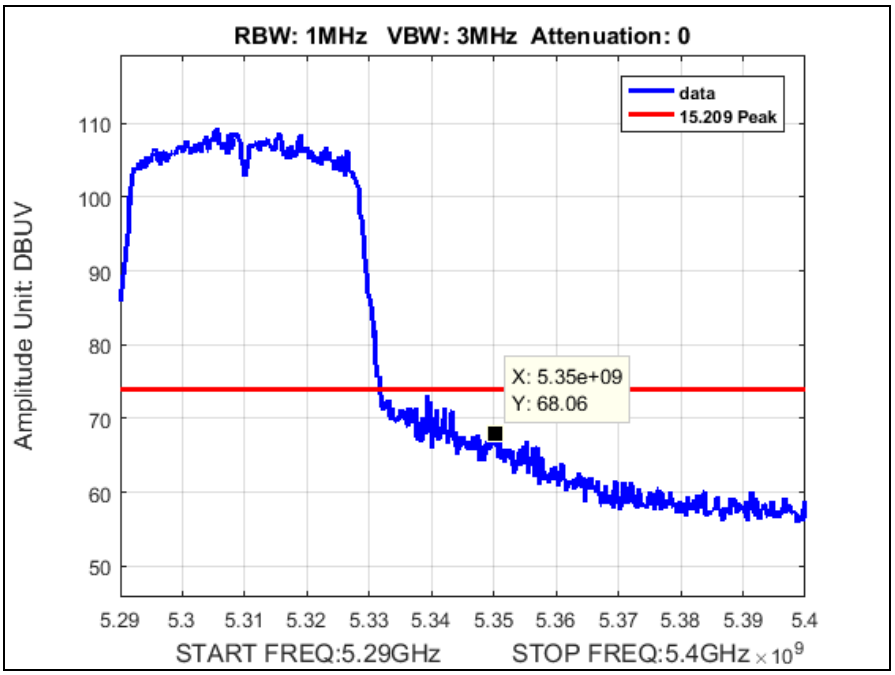
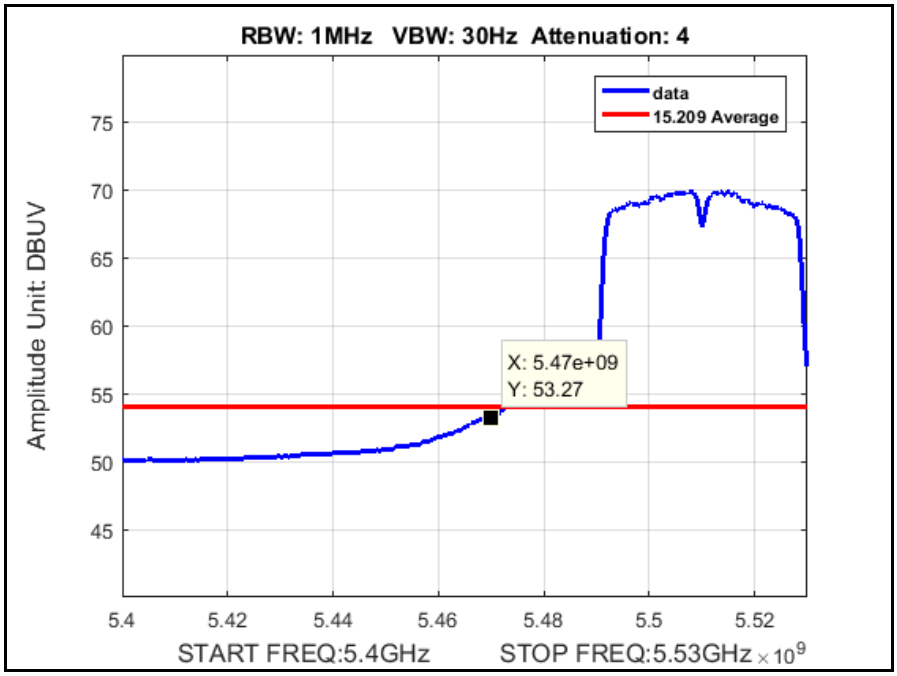


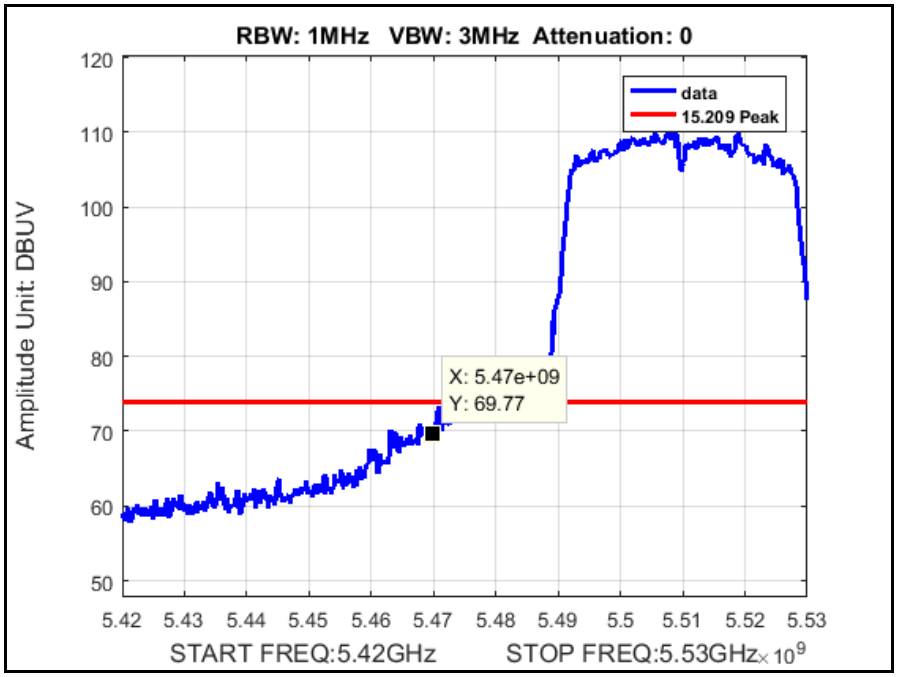
Plot 175. Radiated Band Edge, 5310 MHz, 802.11n 40 MHz, Average



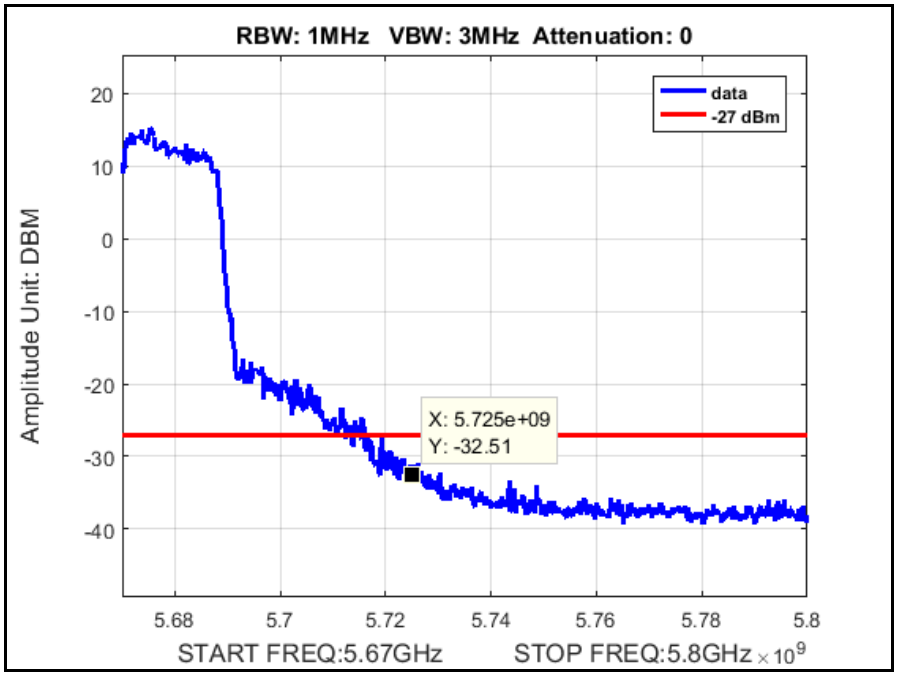
Plot 176. Radiated Band Edge, 5310 MHz, 802.11n 40 MHz, Peak



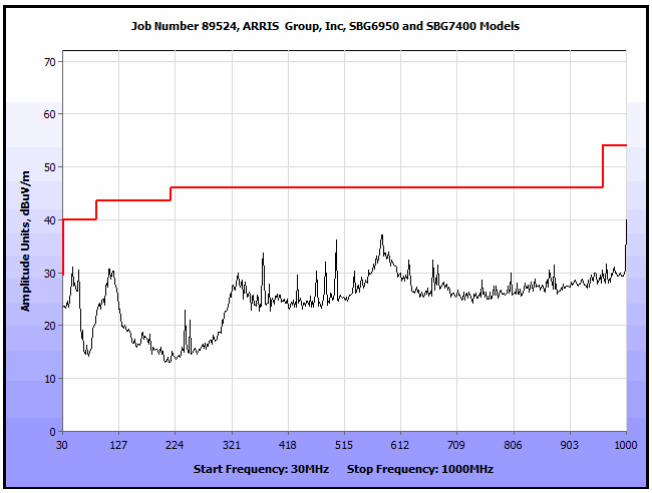
Plot 177. Radiated Band Edge, 5510 MHz, 802.11n 40 MHz, Average



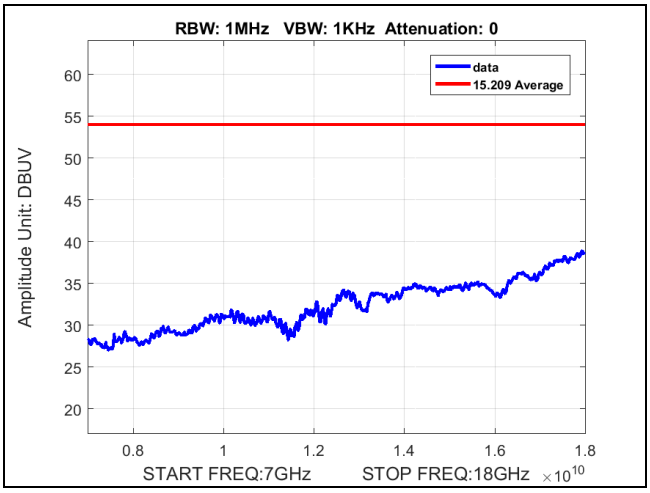
Plot 178. Radiated Band Edge, 5510 MHz, 802.11n 40 MHz, Peak



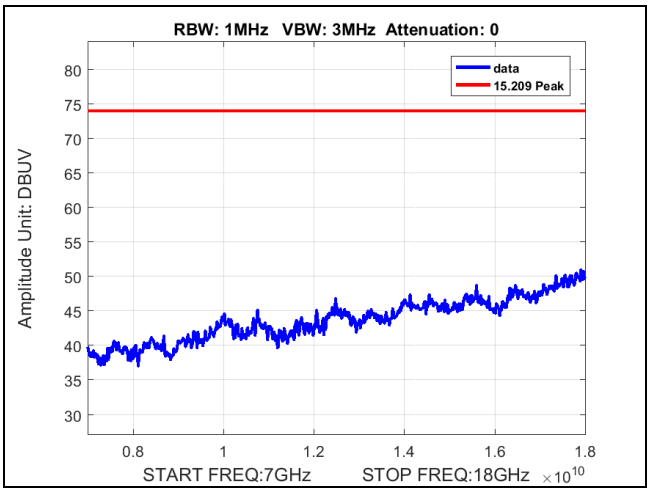
Plot 179. Radiated Band Edge, Integration, 5610 MHz, 802.11n 40 MHz, -27



Plot 180. Radiated Spurious Emissions802.11a, 30 MHz – 1 GHz



Plot 181. Average Radiated Spurious Emissions, 802.11ac, 7-18GHz



Plot 182. Peak Radiated Spurious Emissions, 802.11ac, 7-18GHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(b)(6) Conducted Emissions

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

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

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

Table 13. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was placed on a non-metallic table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 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"*. Scans were performed with the transmitter on.

Test Results: The EUT was compliant with this requirement. Measured emissions were more than 20dB below applicable limits in the worse-case configuration.

Test Engineer(s): Hadid Jones

Test Date(s): 01/04/17

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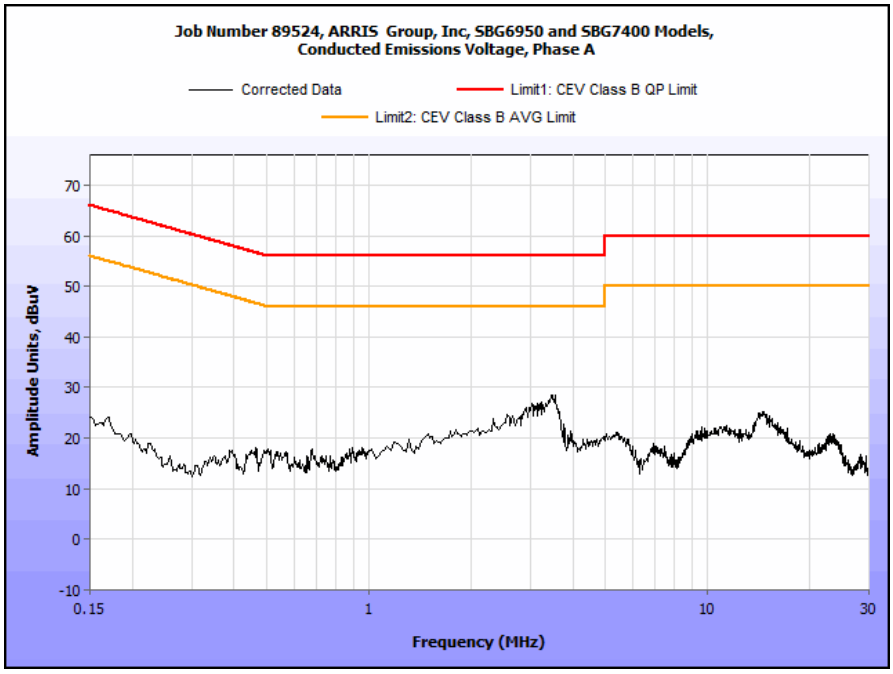
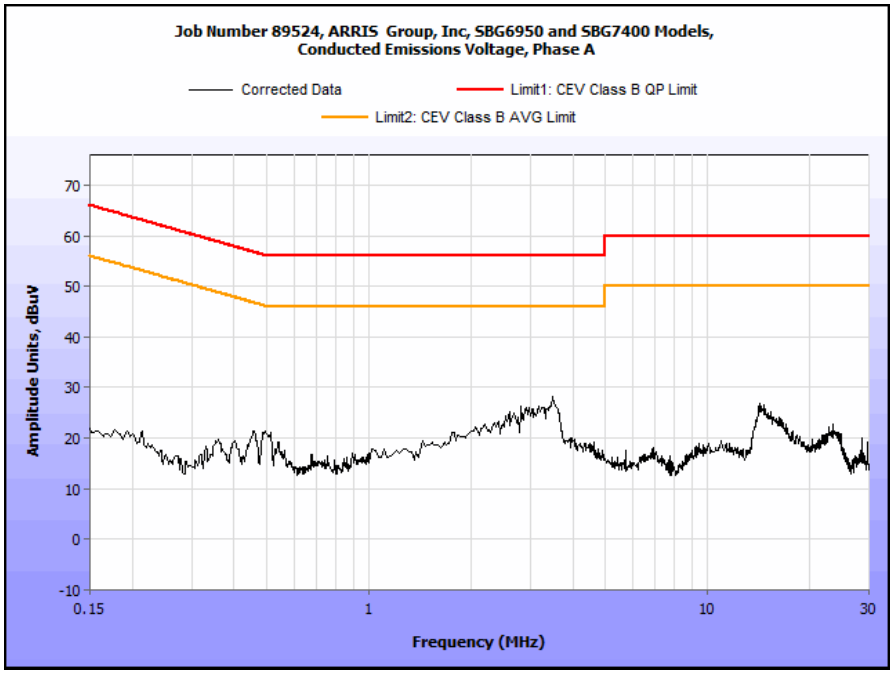
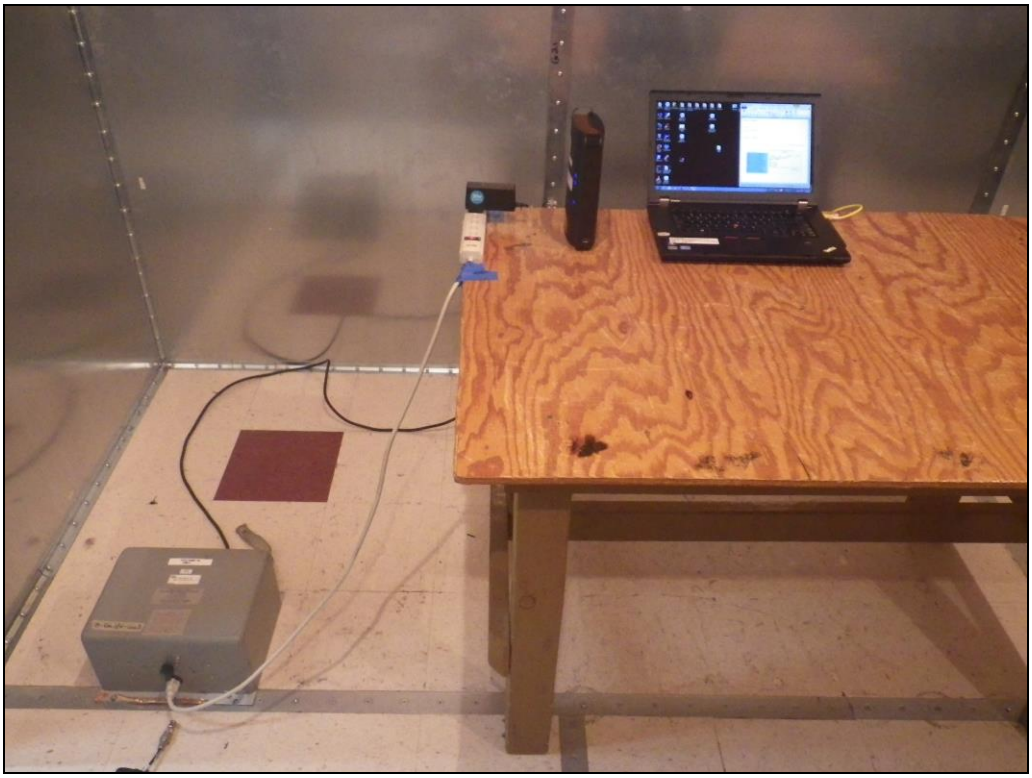


Plot 183. Conducted Emissions, 15.207(a), Phase Line



Plot 184. Conducted Emissions, 15.207(a), Neutral Line



Photograph 1. Conducted Emissions, 15.207(a), Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(f) Maximum Permissible Exposure

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

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

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

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

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

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

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

Test Results:

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**
2462	24.18	261.818	7.8	6.026	0.31386	1	0.68614	20	Pass
5280	18.56	71.779	4.5	2.818	0.04025	1	0.95975	20	Pass
MPE for co-location					0.35411			20	

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**
5200	21.73	148.936	4.5	2.818	0.08351	1	0.91649	20	Pass

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

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(g) Frequency Stability

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

Test Procedure: The EUT was placed in an environmental chamber and powered through a variable supply. The RF port was connected to a spectrum analyzer through an attenuator. The EUT was set to transmit at the low and high channels and evaluated using the marker delta method. For the low channel, marker 1 was placed at the lower band edge frequency and marker 2 at the channels peak amplitude. This was repeated for the high channel. The EUT is considered compliant if the amplitude difference between markers 1 and 2 is at least 26dB. The EUT was evaluated at its extreme operating voltages and temperature conditions in 10 degree C increments. Data is presented for normal and extreme conditions.

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

Test Engineer(s): Hadid Jones

Test Date(s): 03/14/17

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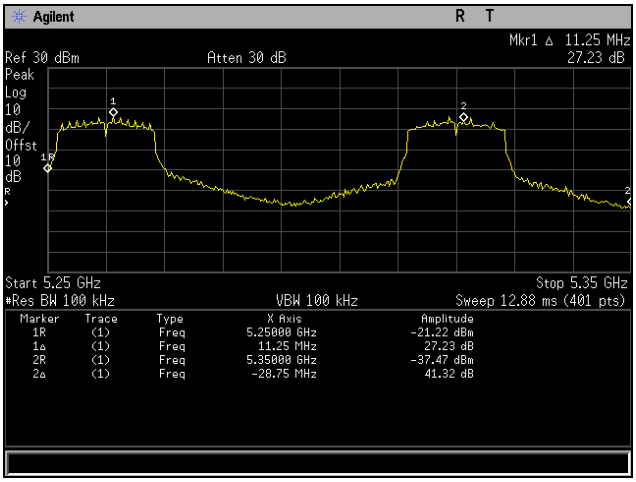
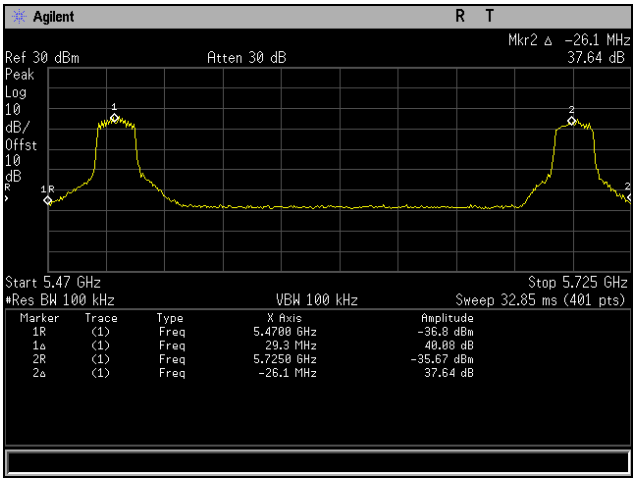
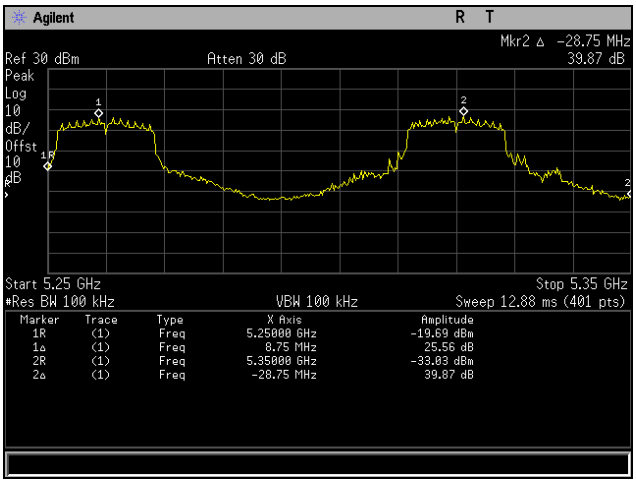
Frequency Stability, 802.11a



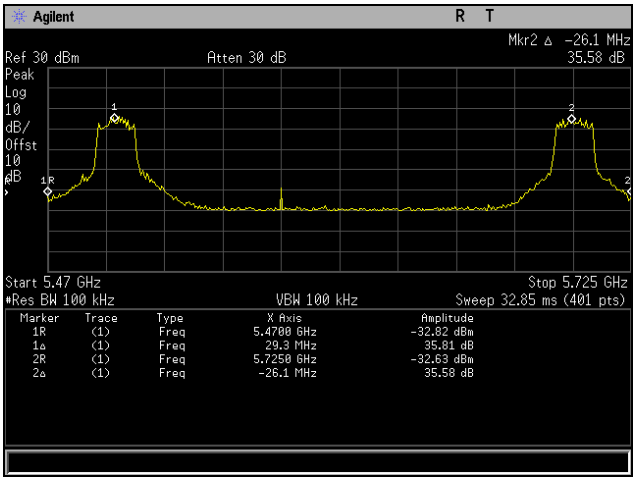
Plot 185. Frequency Stability, 802.11a, UNII2A, -20°C/97V



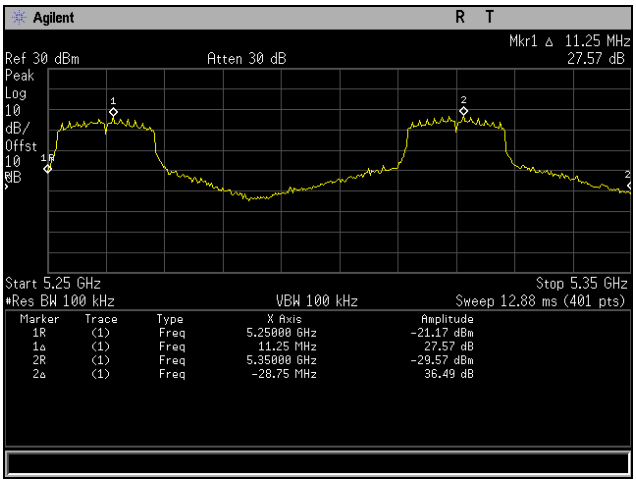
Plot 186. Frequency Stability, 802.11a, UNII2C, -20°C/97V



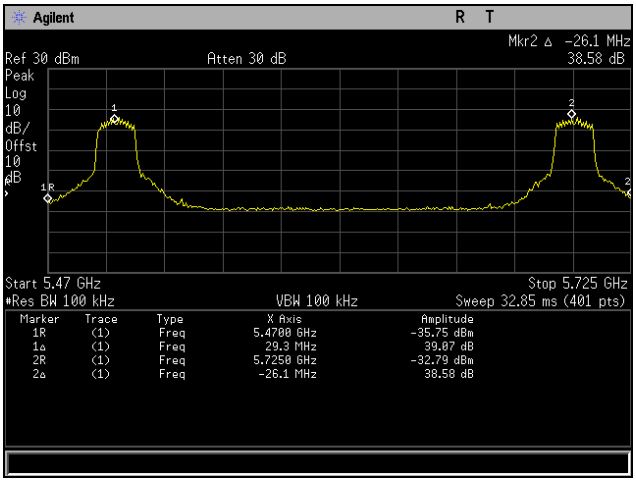
Plot 187. Frequency Stability, 802.11a, UNII2A, 20°C/115V



Plot 188. Frequency Stability, 802.11a, UNII2C, 20°C/115V

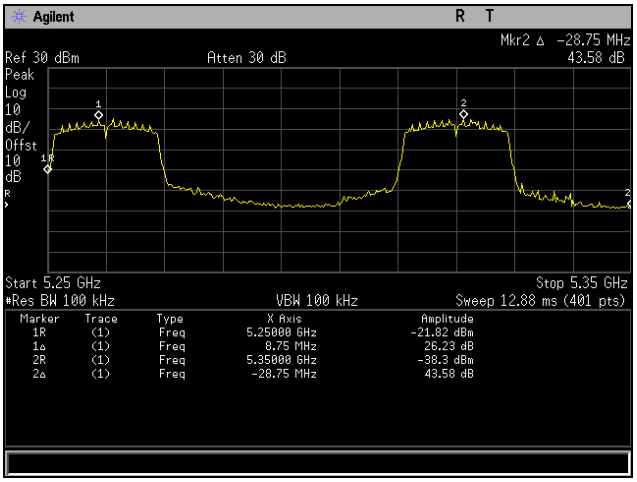


Plot 189. Frequency Stability, 802.11a, UNII2A, 40°C/133V

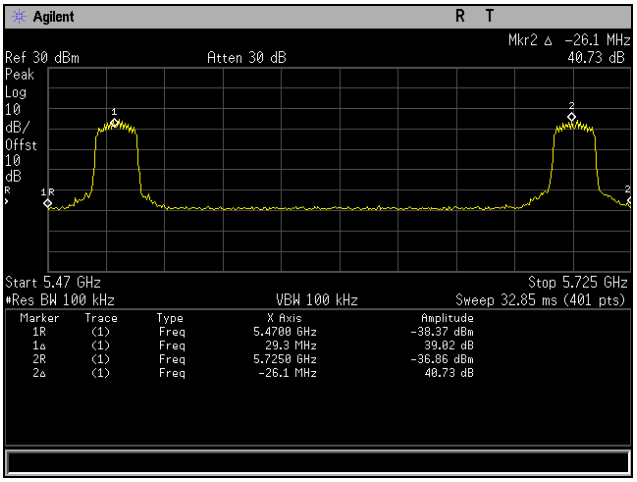


Plot 190. Frequency Stability, 802.11a, UNII2C, 40°C/133V

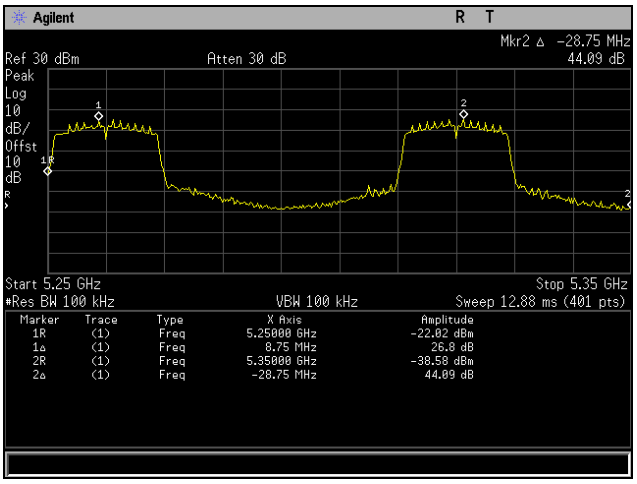
Frequency Stability, 802.11ac



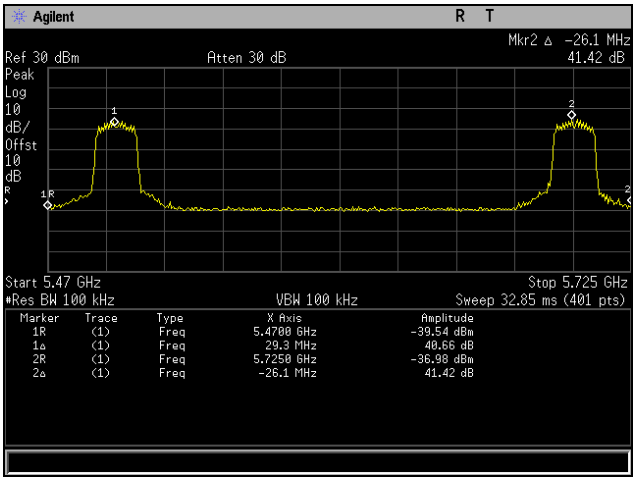
Plot 191. Frequency Stability, 802.11ac, UNII2A, -20°C/97V



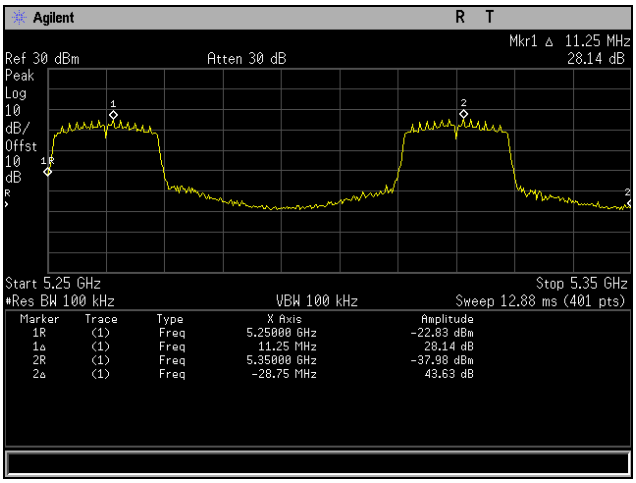
Plot 192. Frequency Stability, 802.11ac, UNII2C, -20°C/97V



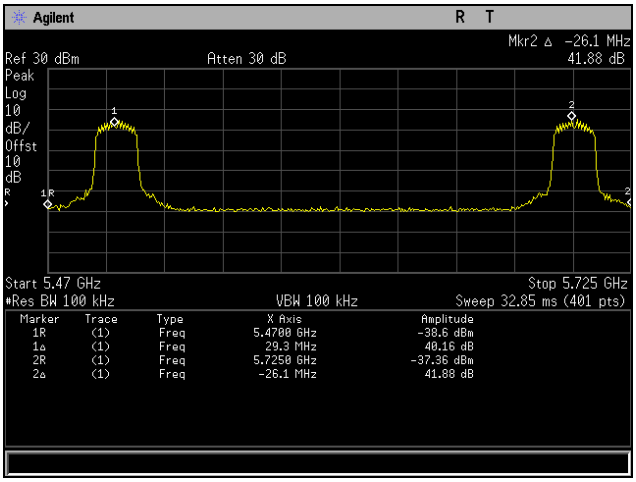
Plot 193. Frequency Stability, 802.11ac, UNII2A, 20°C/115V



Plot 194. Frequency Stability, 802.11ac, UNII2C, 20°C/115V

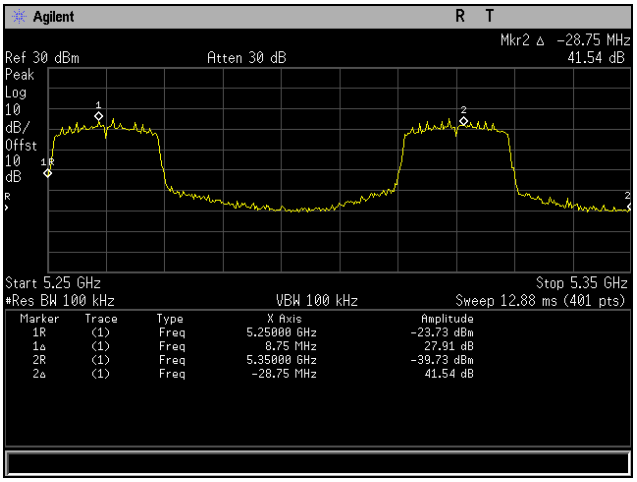


Plot 195. Frequency Stability, 802.11ac, UNII2A, 40°C/133V

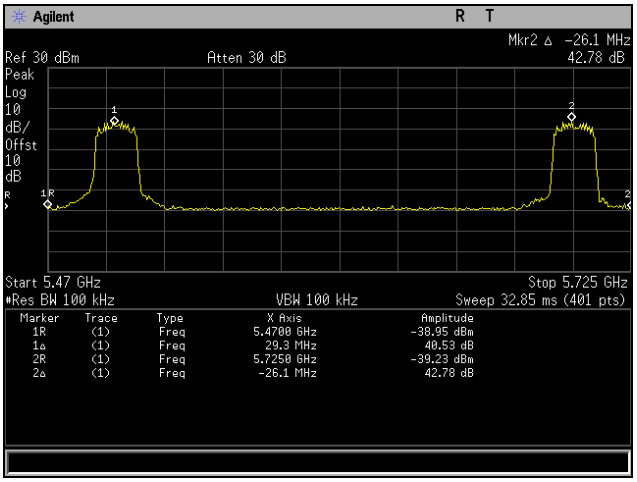


Plot 196. Frequency Stability, 802.11ac, UNII2C, 40°C/133V

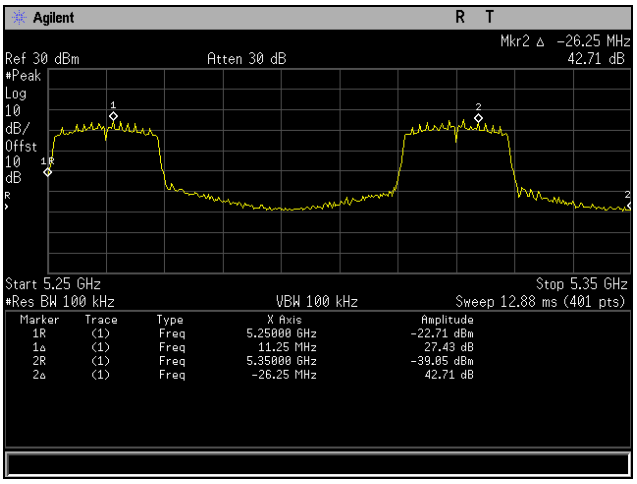
Frequency Stability, 802.11n



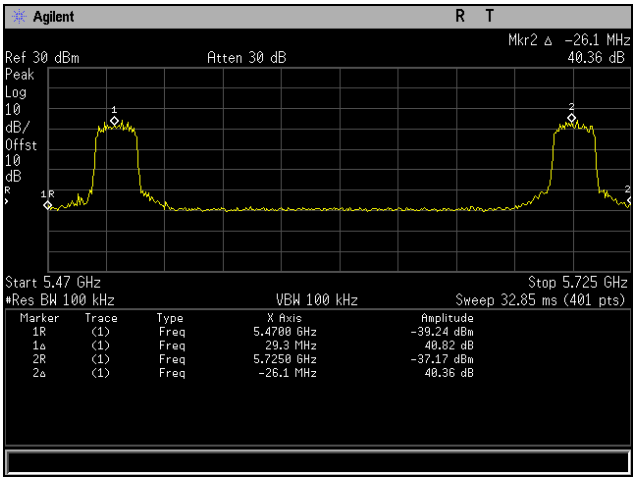
Plot 197. Frequency Stability, 802.11n, UNII2A, -20°C/97V



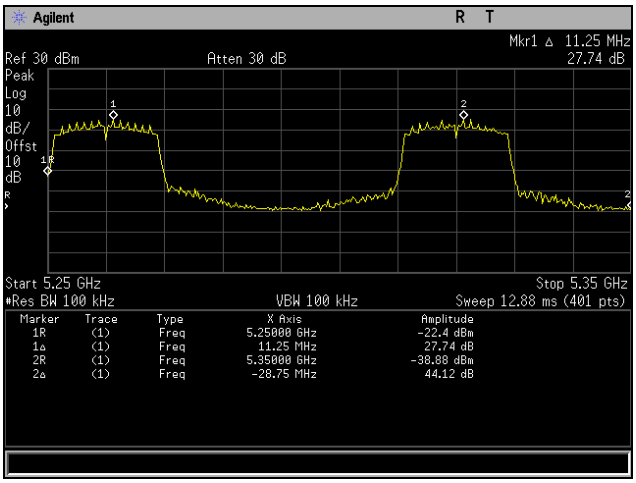
Plot 198. Frequency Stability, 802.11n, UNII2C, -20°C/97V



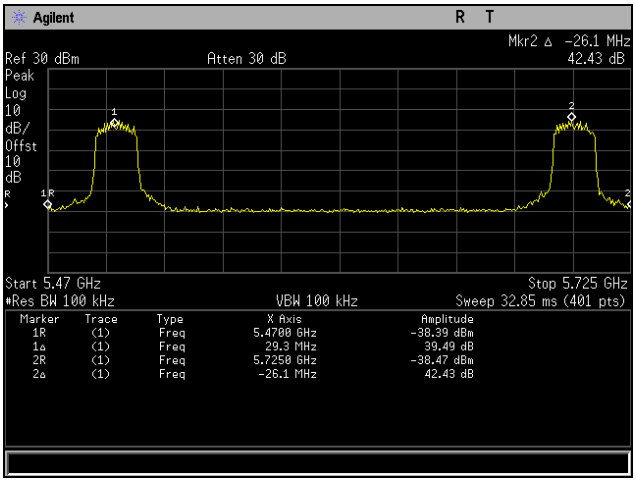
Plot 199. Frequency Stability, 802.11n, UNII2A, 20°C/115V



Plot 200. Frequency Stability, 802.11n, UNII2C, 20°C/115V



Plot 201. Frequency Stability, 802.11n, UNII2A, 40°C/133V



Plot 202. Frequency Stability, 802.11n, UNII2C, 40°C/133V

IV. Test Equipment

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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
1T4300A	SEMI-ANECHOIC CHAMBER # 1 (FCC)	EMC TEST SYSTEMS	NONE	1/31/2014	1/31/2017
1T4563	LISN (10 AMP)	SOLAR ELECTRONICS COMPANY	9322-50-R-10-BNC	8/27/2015	2/27/2017
1T4149	HIGH-FREQUENCY ANECHOIC CHAMBER	RAY PROOF	81	NOT REQUIRED	
1T4751	ANTENNA - BILOG	SUNOL SCIENCES	JB6	2/26/2016	8/26/2017
1T4483	ANTENNA; HORN	ETS-LINDGREN	3117	10/8/2015	4/8/2017
1T4745	ANTENNA, HORN	ETS-LINDGREN	3116	1/21/2017	7/21/2018
1T4612	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	9/1/2015	3/1/2017

Table 14. Test Equipment List

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

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V. Certification & User's Manual Information

Certification & User's Manual Information

L. Certification Information

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

§ 2.801 Radio-frequency device defined.

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

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

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

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

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

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

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

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

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

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

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(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.

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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.

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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.

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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.

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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.

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End of Report

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