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

914 WEST PATAPSCO AVENUE ● BALTIMORE, MARYLAND 21230-3432 ● PHONE (410) 354-3300 ● FAX (410) 354-3313
33439 WESTERN AVENUE ● UNION CITY, CALIFORNIA 94587 ● PHONE (510) 489-6300 ● FAX (510) 489-6372
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February 2, 2017

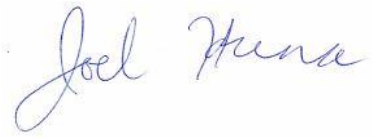
Vuzix Corporation
25 Hendrix Road
West Henrietta, NY 14586

Dear Devrin Talen,

Enclosed is the EMC Wireless test report for compliance testing of the Vuzix Corporation, M300 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 1).

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

Sincerely yours,
MET LABORATORIES, INC.



Joel Huna
Documentation Department

Reference: (\Vuzix Corporation\ EMC91667-FCC407 UNII 1Rev. 3)

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Electromagnetic Compatibility Criteria
Test Report

for the

Vuzix Corporation
Model M300

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

MET Report: EMC91667-FCC407 UNII 1 Rev. 3

February 2, 2017

Prepared For:

Vuzix Corporation
25 Hendrix Road
West Henrietta, NY 14586

Prepared By:
MET Laboratories, Inc.
914 West Patapsco Avenue,
Baltimore, MD 21230

Electromagnetic Compatibility Criteria
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Title 47 of the CFR
15.407 Subpart E

Arsalan Hasan, Project Engineer
Electromagnetic Compatibility Lab

Joel Huna
Documentation Department

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

Asad Bajwa,
Director, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	January 9, 2017	Initial Issue.
1	January 11, 2017	Addition of FCC ID
2	January 26, 2017	TCB Review Corrections
3	February 2, 2017	Engineer corrections.

Table of Contents

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List of Terms and Abbreviations

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

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Vuzix Corporation M300, 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 M300. Vuzix Corporation should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the M300, 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 Vuzix Corporation, purchase order number 507684. All tests were conducted using measurement procedure ANSI C63.4-2014.

FCC Reference	Description	Results
§15.203	Antenna Requirement	Compliant
§15.403(i)	26dB Occupied Bandwidth	Compliant
§15.407 (a)(1)	Maximum Conducted Output Power	Compliant
§15.407 (a)(1)	Maximum Power Spectral Density	Compliant
§15.407 (b)(1)& (6 - 7)	Undesirable Emissions	Compliant
§15.407(b)(6)	Conducted Emission Limits	Compliant
§15.407(c)	Automatic Discontinue of Transmitter	Compliant

Table 1. Executive Summary of EMC Part 15.407 ComplianceTesting

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Vuzix Corporation to perform testing on the M300, under Vuzix Corporation's purchase order number 507684.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Vuzix Corporation M300.

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

Model(s) Tested:	M300	
Model(s) Covered:	M300	
EUT Specifications:	Primary Power: 5VDC	
	FCC ID: 2AA9D-446	
	Type of Modulations:	OFDM
	Equipment Code:	NII
	Max. RF Output Power:	22.05
	EUT Frequency Ranges:	5180-5240MHz
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:	UNII1	
Evaluated by:	Arsalan Hasan	
Report Date(s):	February 2, 2017	

Table 2. EUT Summary

B. References

CFR 47, Part 15, Subpart E	Unlicensed National Information Infrastructure Devices (UNII)
ANSI C63.4:2014	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ISO/IEC 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
789033 D02 General UNII Test Procedures New Rules v01	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E

Table 3. References

C. Test Site

All testing was performed at MET Laboratories, Inc., 914 West Patapsco Avenue, 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 Vuzix Corporation M300, Equipment Under Test (EUT), is a smart glasses device that is worn on the head. The device includes a display, processor, camera, speaker, and wireless connectivity, and runs the Android operating system. The user runs applications on the device that assist them in their job or provide environmental information.
The M300 must always be connected to an external battery pack. The connection is a custom 8-pin cable designed by Vuzix that connects the M300 to custom battery packs. The default battery pack is an 860 mAh cell with onboard electronics to monitor state of charge and provide battery charging over USB.

E. Equipment Configuration

The EUT was set up as outlined in **Error! Reference source not found.**, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Ref. ID	Slot #	Name / Description	Model Number	Part Number	Serial Number	Rev. #
A		Smart Glasses	M300	446MA0101	TBD	3
B		Vuzix Power Cable		446CA0002	N/A	1
C		Glasses Battery Pack		446MA0116	TBD	2
D		Glasses Frames		446MA0123	N/A	1

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	*Customer Supplied Calibration Data
E	USB Cable			Not Applicable
F	Laptop	Lenovo		Not Applicable
The 'Customer Supplied Calibration Data' column will be marked as either not applicable, not available, or will contain the calibration date supplied by the customer.				

Table 5. Support Equipment

G. Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty	Length as tested (m)	Max Length (m)	Shielded? (Y/N)	Termination Box ID & Port Name
1	8-pin Connector	Vuzix 8-pin Cable	1	30"		Yes	8-pin Connector on Battery
2	USB Micro A/B	USB A to Micro-B	1	2	2	Yes	Laptop

Table 6. Ports and Cabling Information

H. Mode of Operation

Non-wireless test mode: The M300 will enable all peripherals, including the camera, flash, display, orientation sensors, proximity sensors, battery charging and communication with the battery pack. The M300 will stay in this mode until explicitly disabled.
Bluetooth test mode: The M300 will be configured to continuously transmit either in normal or hop mode via a test application.
WiFi test mode: The M300 will be configured to continuously transmit with modulation applied with the ability to change channels as well as changing between B, G, N, and AC modes via a test application.

I. Method of Monitoring EUT Operation

1: The unit will continue to display the camera feed and show the sensor readouts in the display.
2: Any other condition or sensor readout will say FAIL.

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 Vuzix Corporation upon completion of testing.

III. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

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

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

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

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

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

Results: The EUT as tested is compliant the criteria of §15.203. EUT has integral antennas..

Test Engineer(s): Arsalan Hasan

Test Date(s): December 23, 2016

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15. 403(i) 26dB Bandwidth

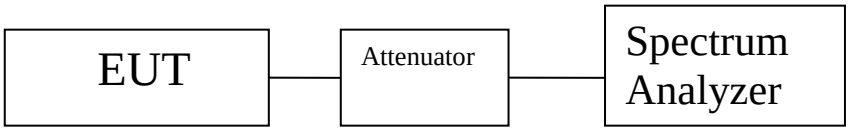
Test Requirements: **§ 15.403(i):** For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of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

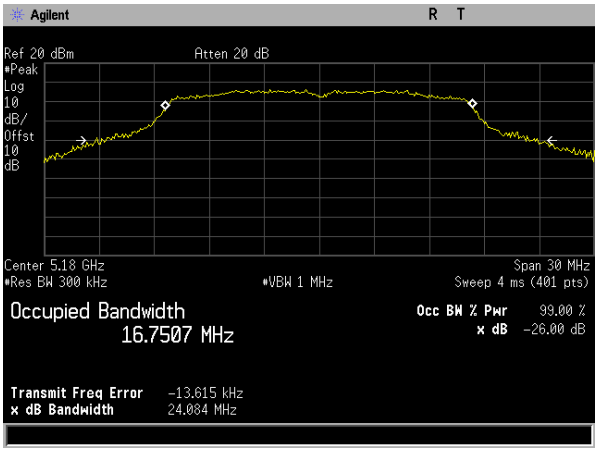
Test Procedure: The transmitter was set to low, mid, and high operating frequencies at the highest output power and connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately equal to 1% of the total emission bandwidth, VBW > RBW. The 26 dB Bandwidth was measured and recorded.

Test Results The 26 dB Bandwidth was compliant with the requirements of this section. No anomalies detected

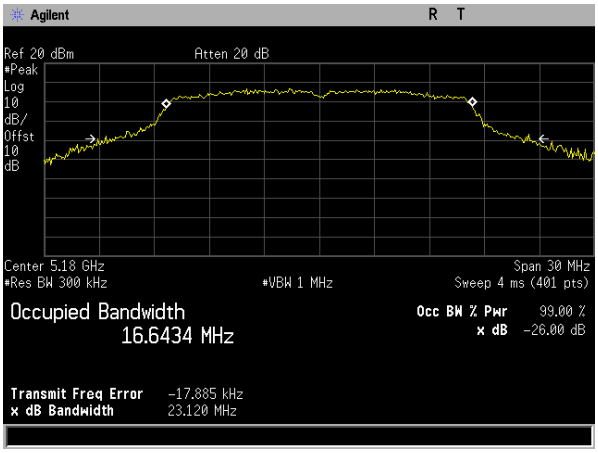
Test Engineer(s): Arsalan Hasan

Test Date(s): December 19, 2016

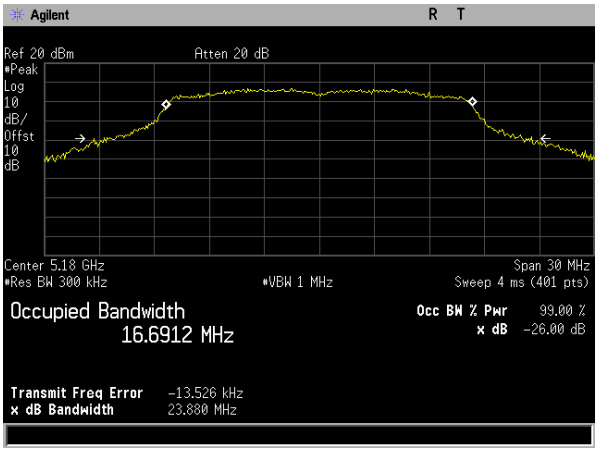




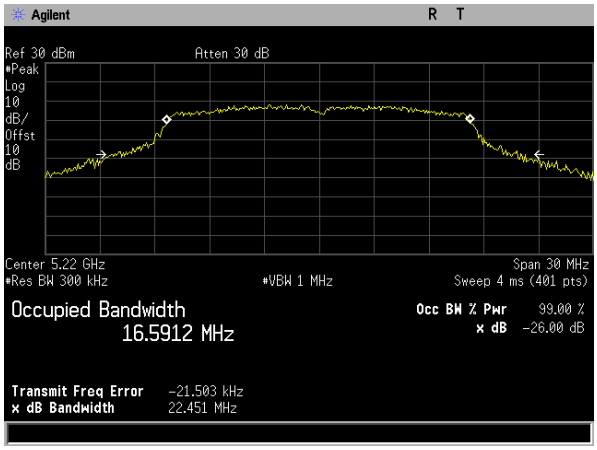
Plot 1. Occupied Bandwidth, 26dB, Bandwidth 20M, Ch. 5180M, a mode



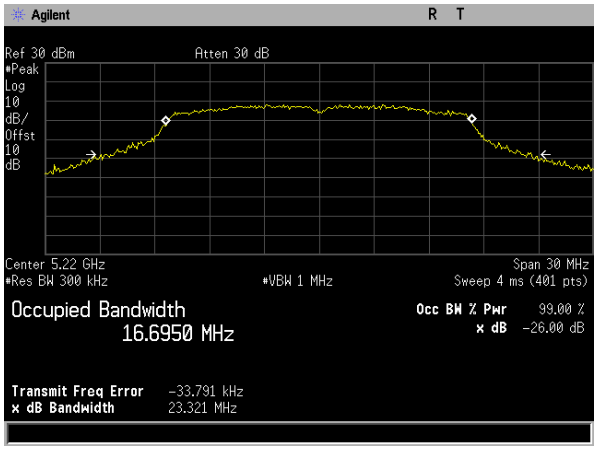
Plot 2. Occupied Bandwidth, 26dB, Bandwidth 20M, Ch. 5180M, ac mode



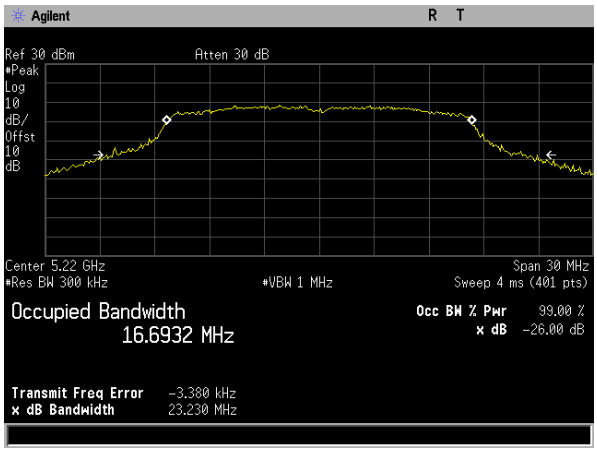
Plot 3. Occupied Bandwidth, 26dB, Bandwidth 20M, Ch. 5180M, n mode



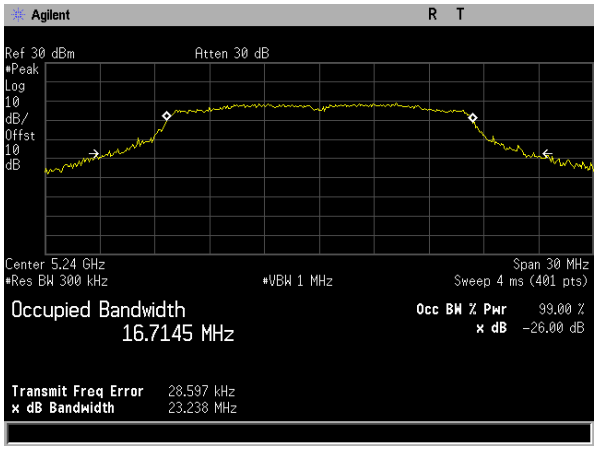
Plot 4. Occupied Bandwidth, 26dB, Bandwidth 20M, Ch. 5220M, a mode



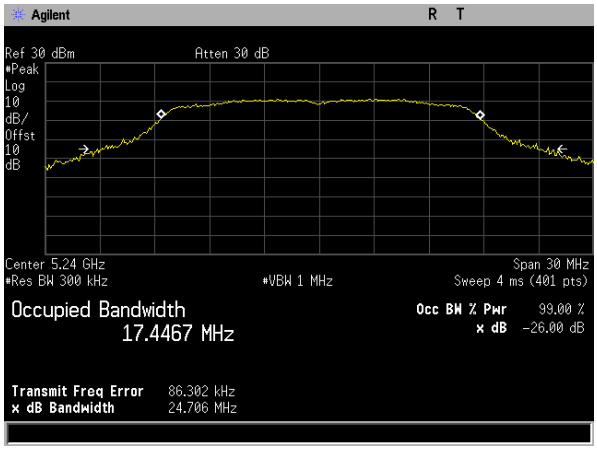
Plot 5. Occupied Bandwidth, 26dB, Bandwidth 20M, Ch. 5220M, ac mode



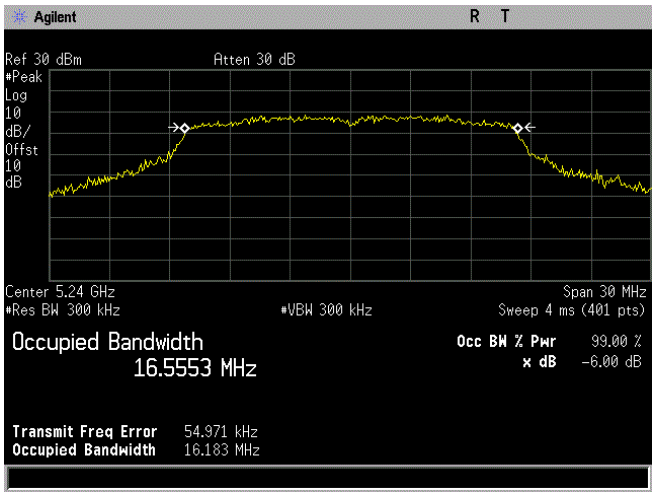
Plot 6. Occupied Bandwidth, 26dB, Bandwidth 20M, Ch. 5220M, n mode



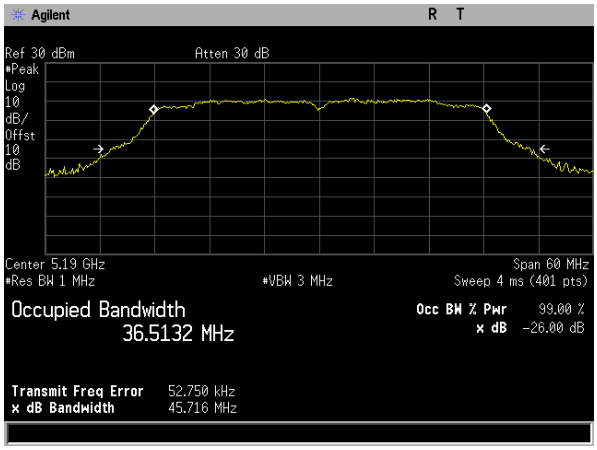
Plot 7. Occupied Bandwidth, 26dB, Bandwidth 20M, Ch. 5240M, a mode



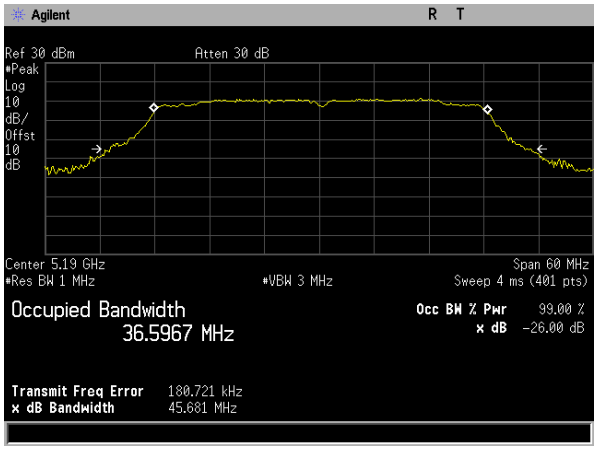
Plot 8. Occupied Bandwidth, 26dB, Bandwidth 20M, Ch. 5240M, ac mode



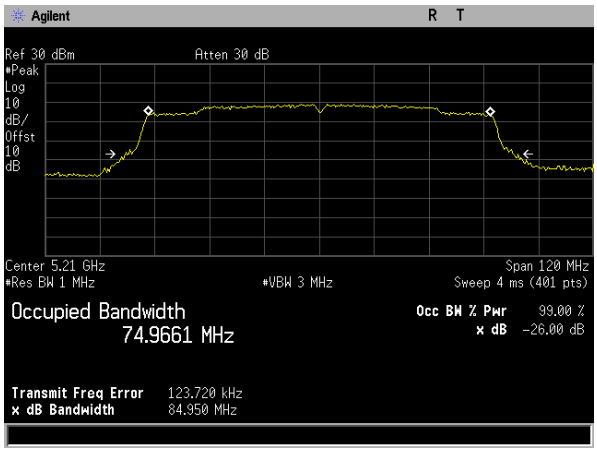
Plot 9. Occupied Bandwidth, 26dB, Bandwidth 20M, Ch. 5240M, n mode



Plot 10. Occupied Bandwidth, 26dB, Bandwidth 40M, Ch. 5190M, ac mode,



Plot 11. Occupied Bandwidth, 26dB, Bandwidth 40M, Ch. 5190M, n mode



Plot 12. Occupied Bandwidth, 26dB, Bandwidth 80M, Ch. 5120M, ac mode

Electromagnetic Compatibility Criteria for Intentional Radiators

§15. 407(a)(1) Maximum Conducted Output Power

Test Requirements:

§15.407(a)(1)(i): For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi.
If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

§15.407(a)(1)(ii): For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi.
If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

§15.407(a)(1)(iii): For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.
Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi.

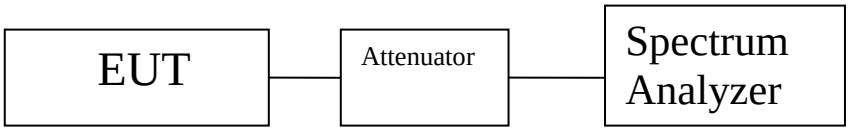
§15.407(a)(1)(iv): For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi.
If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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

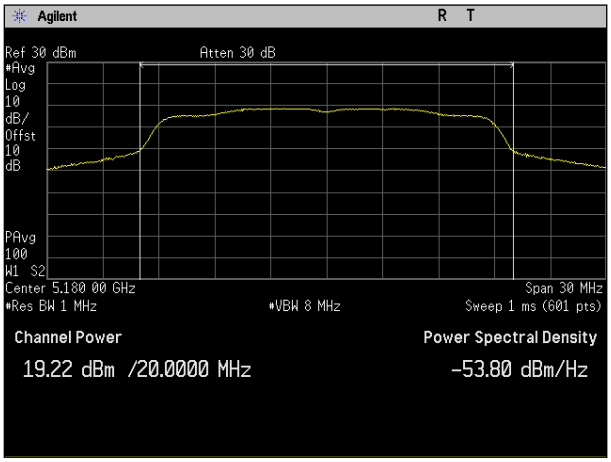
Test Results: The EUT as tested is compliant with the requirements of this section. No anomalies detected..

Test Engineer(s): Arsalan Hasan

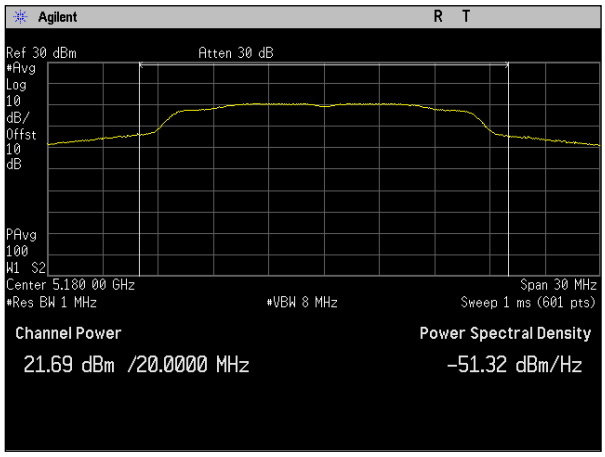
Test Date(s): December 19, 2016



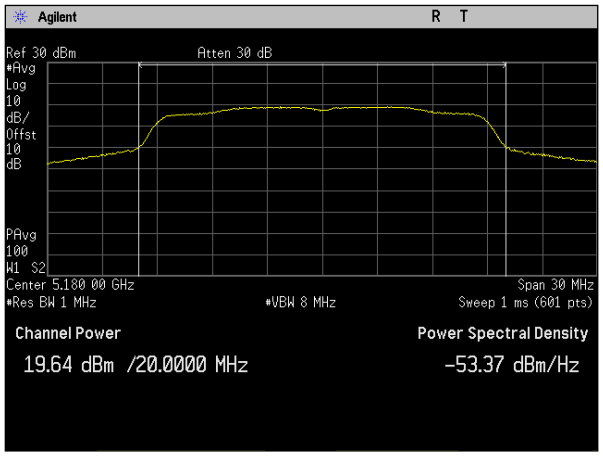
SISO



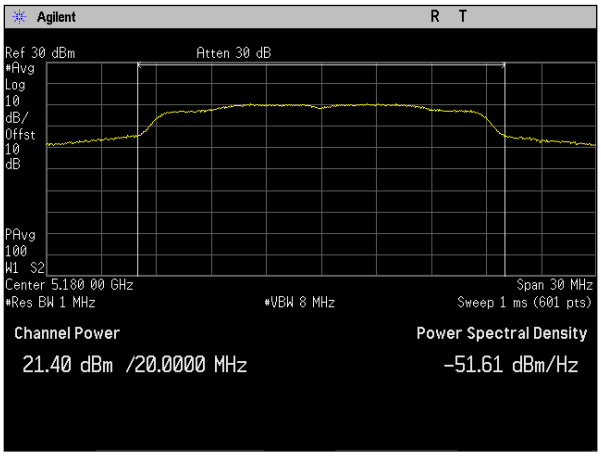
Plot 13. Conducted Transmitter Output Power, SISO, Bandwidth 20M, Ch. 5180M, a mode, Port b



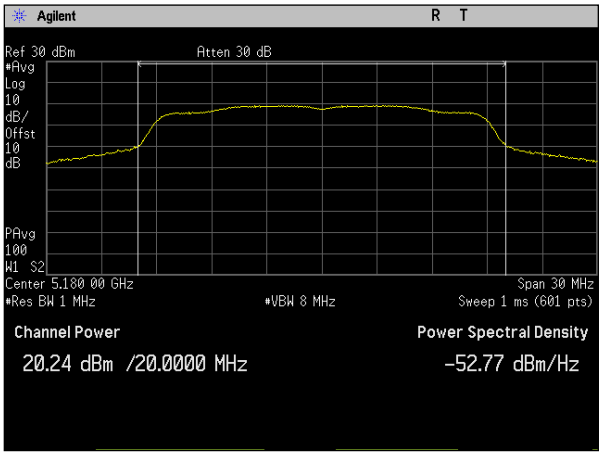
Plot 14. Conducted Transmitter Output Power, SISO, Bandwidth 20M, Ch. 5180M, a mode, Port a



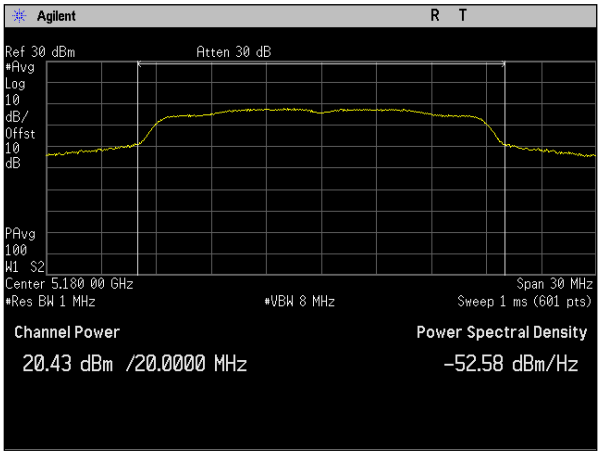
Plot 15. Conducted Transmitter Output Power, SISO, Bandwidth 20M, Ch. 5180M, ac mode, Port b



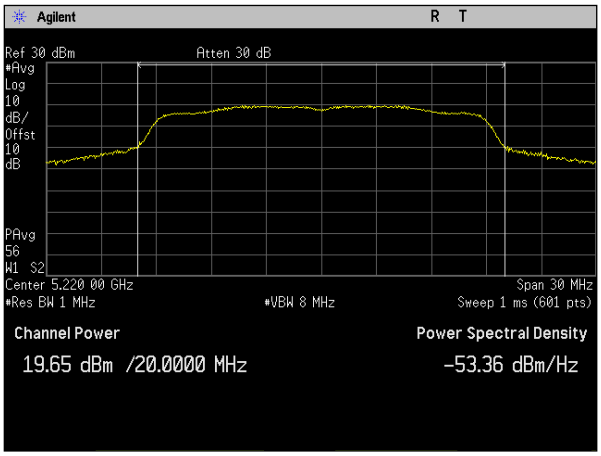
Plot 16. Conducted Transmitter Output Power, ,SISO, Bandwidth 20M, Ch. 5180M, ac mode, Port a



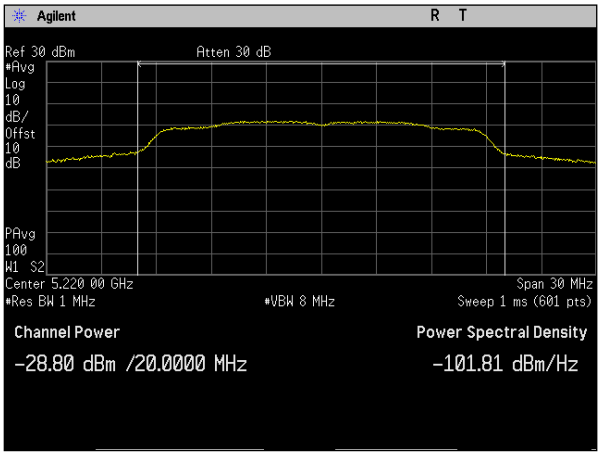
Plot 17. Conducted Transmitter Output Power, SISO, Bandwidth 20M, Ch. 5180M, n mode, Port b



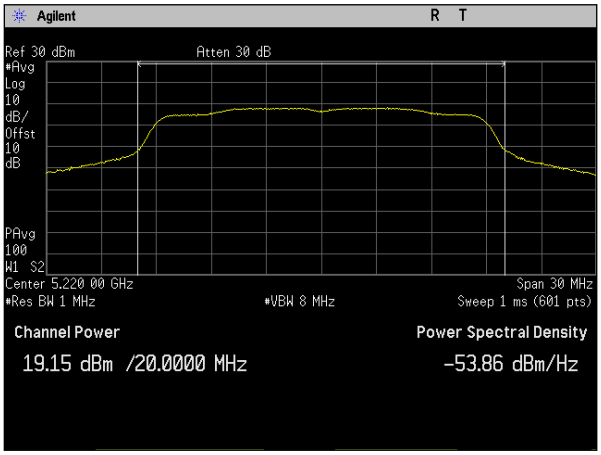
Plot 18. Conducted Transmitter Output Power, SISO, Bandwidth 20M, Ch. 5180M, n mode, Port a



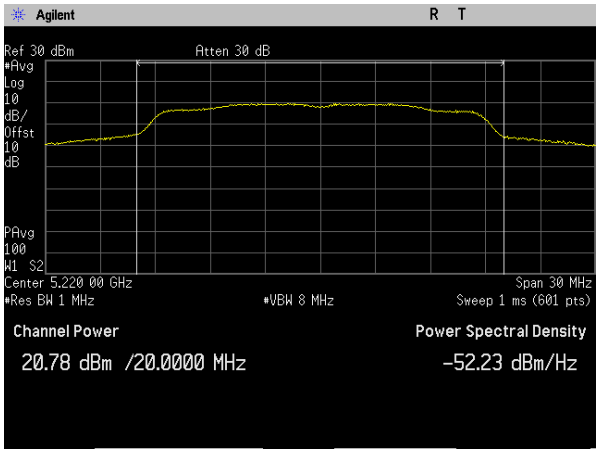
Plot 19. Conducted Transmitter Output Power, SISO, Bandwidth 20M, Ch. 5220M, a mode, Port b



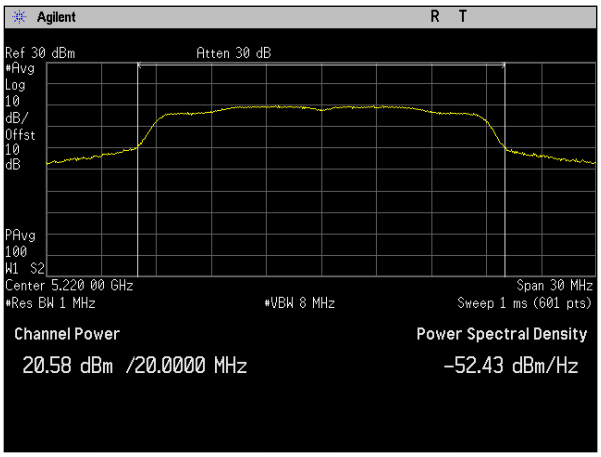
Plot 20. Conducted Transmitter Output Power, SISO, Bandwidth 20M, Ch. 5220M, a mode, Port a



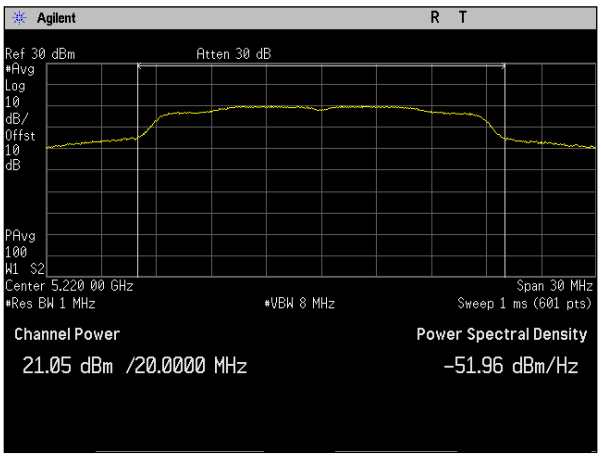
Plot 21. Conducted Transmitter Output Power, SISO, Bandwidth 20M, Ch. 5220M, ac mode, Port b



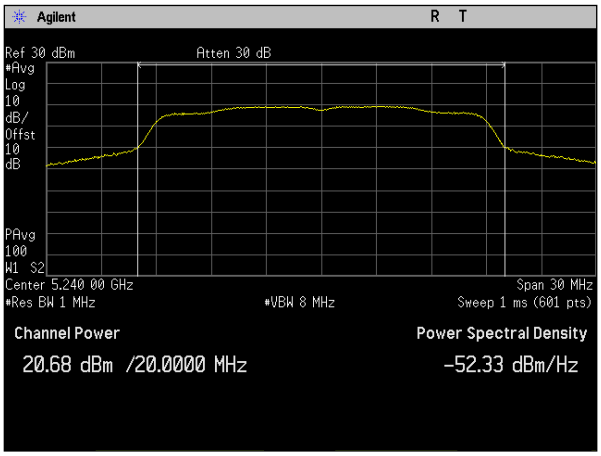
Plot 22. Conducted Transmitter Output Power, SISO, Bandwidth 20M, Ch. 5220M, ac mode, Port a



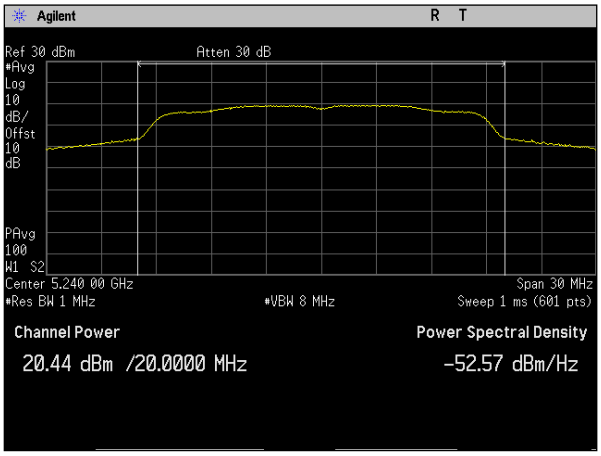
Plot 23. Conducted Transmitter Output Power, SISO, Bandwidth 20M, Ch. 5220M, n mode, Port b



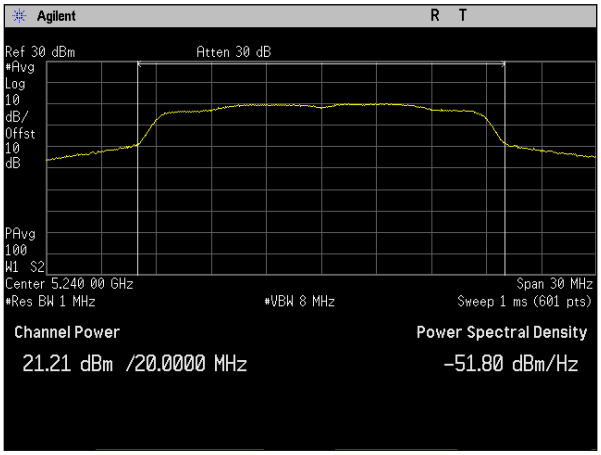
Plot 24. Conducted Transmitter Output Power, SISO, Bandwidth 20M, Ch. 5220M, n mode, Port a



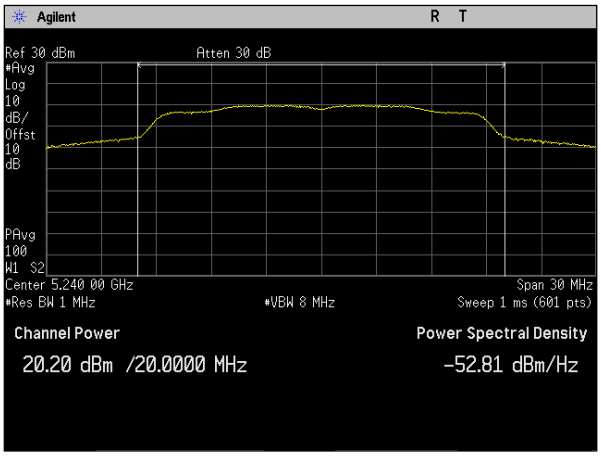
Plot 25. Conducted Transmitter Output Power, SISO, Bandwidth 20M, Ch. 5240M, a mode, Port b



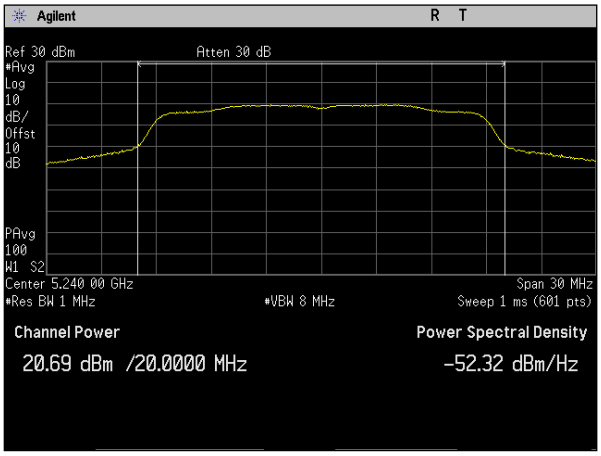
Plot 26. Conducted Transmitter Output Power, SISO, Bandwidth 20M, Ch. 5240M, a mode, Port a



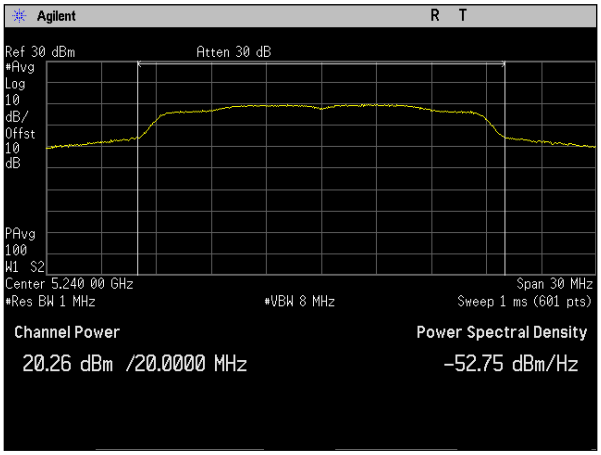
Plot 27. Conducted Transmitter Output Power, SISO, Bandwidth 20M, Ch. 5240M, ac mode, Port b



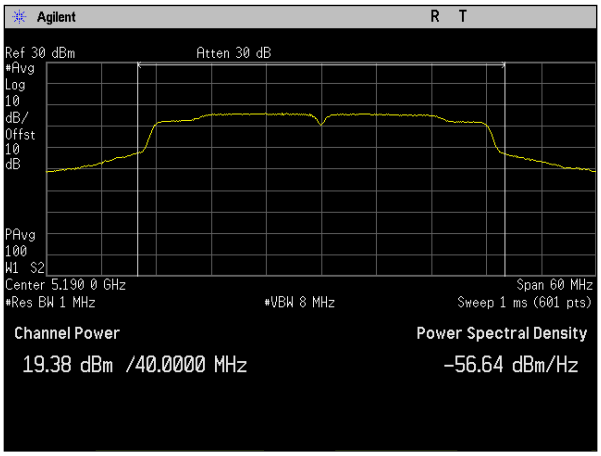
Plot 28. Conducted Transmitter Output Power, SISO, Bandwidth 20M, Ch. 5240M, ac mode, Port a



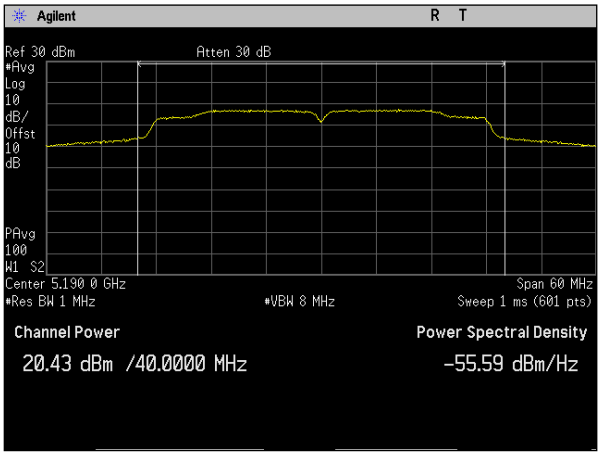
Plot 29. Conducted Transmitter Output Power, SISO, Bandwidth 20M, Ch. 5240M, n mode, Port b



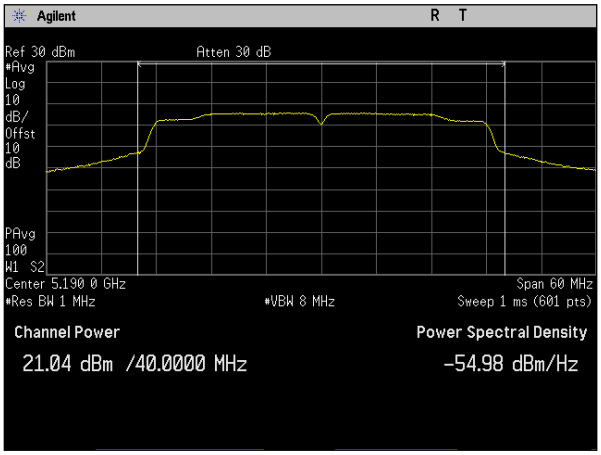
Plot 30. Conducted Transmitter Output Power, SISO, Bandwidth 20M, Ch. 5240M, n mode, Port a



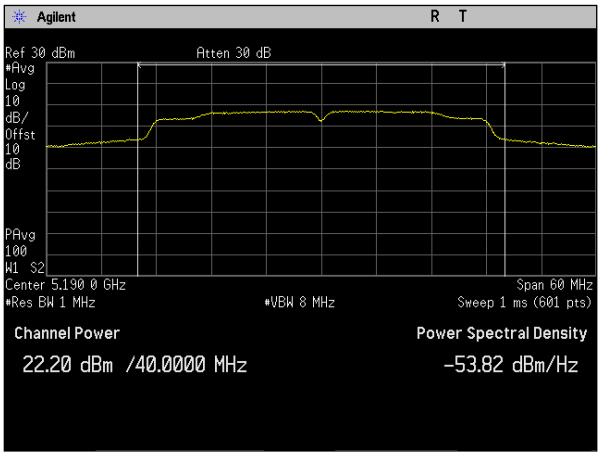
Plot 31. Conducted Transmitter Output Power, SISO, Bandwidth 40M, Ch. 5190M, ac mode, Port b



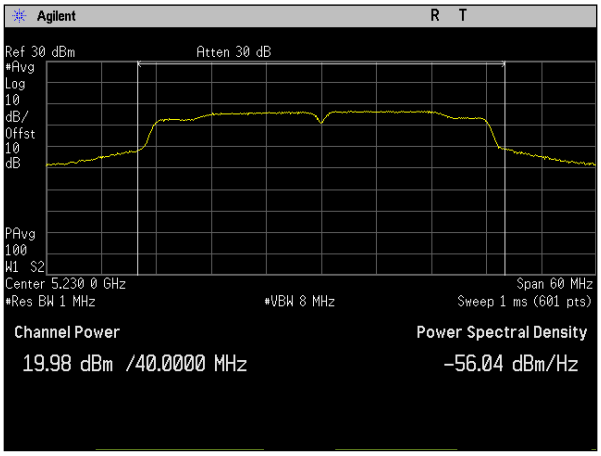
Plot 32. Conducted Transmitter Output Power, SISO, Bandwidth 40M, Ch. 5190M, ac mode, Port a



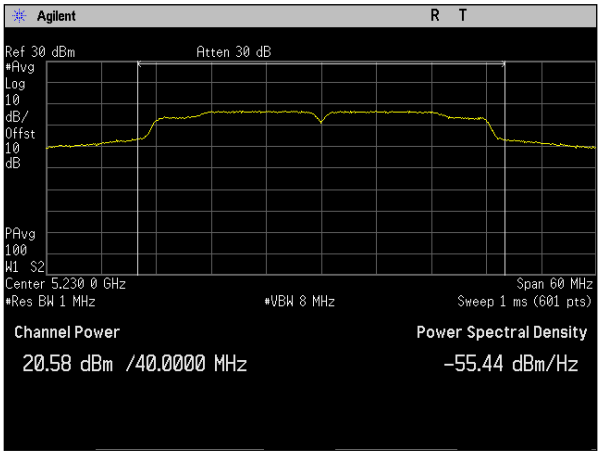
Plot 33. Conducted Transmitter Output Power, SISO, Bandwidth 40M, Ch. 5190M, n mode, Port b



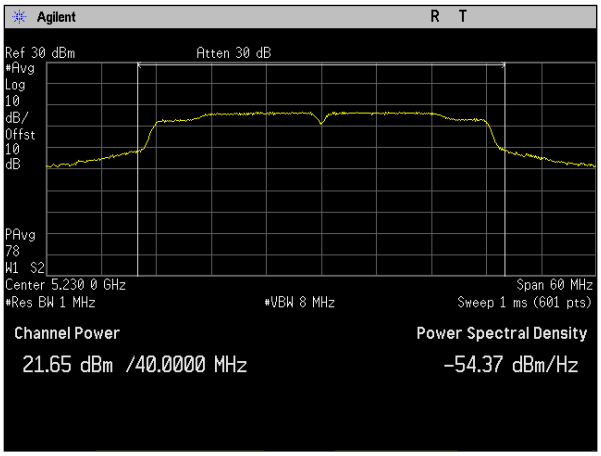
Plot 34. Conducted Transmitter Output Power, SISO, Bandwidth 40M, Ch. 5190M, n mode, Port a



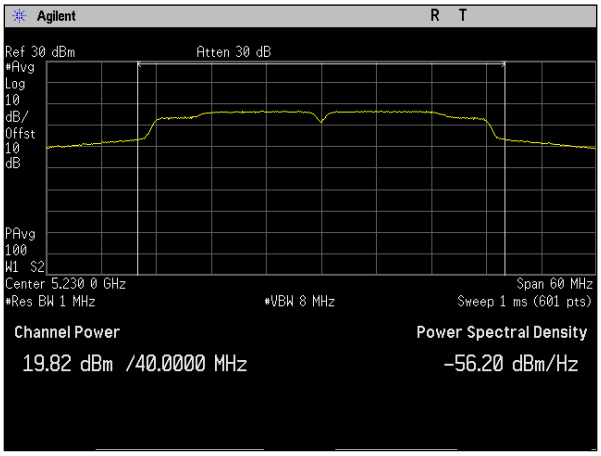
Plot 35. Conducted Transmitter Output Power, SISO, Bandwidth 40M, Ch. 5230M, ac mode, Port b



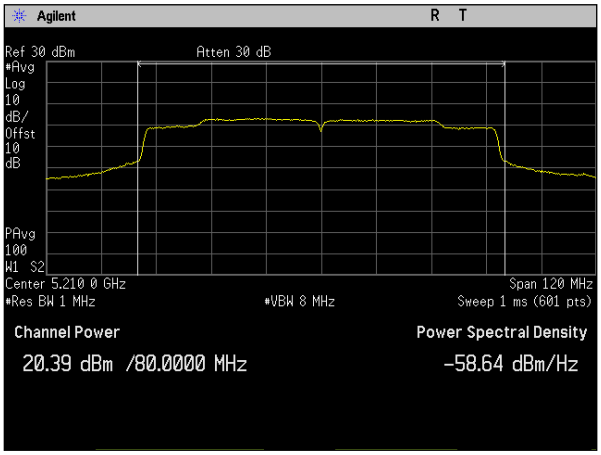
Plot 36. Conducted Transmitter Output Power, SISO, Bandwidth 40M, Ch. 5230M, ac mode, Port a



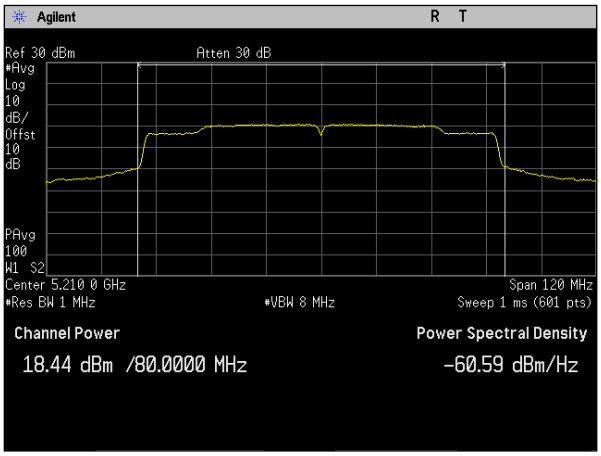
Plot 37. Conducted Transmitter Output Power, SISO, Bandwidth 40M, Ch. 5230M, n mode, Port b



Plot 38. Conducted Transmitter Output Power, SISO, Bandwidth 40M, Ch. 5230M, n mode, Port a

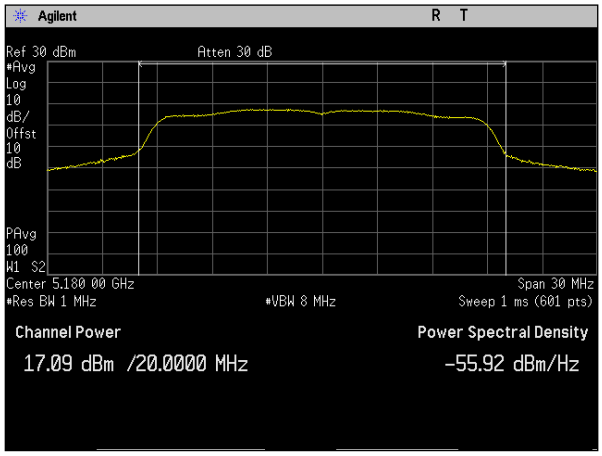


Plot 39. Conducted Transmitter Output Power, SISO, Bandwidth 80M, Ch. 5210M, ac mode, Port b

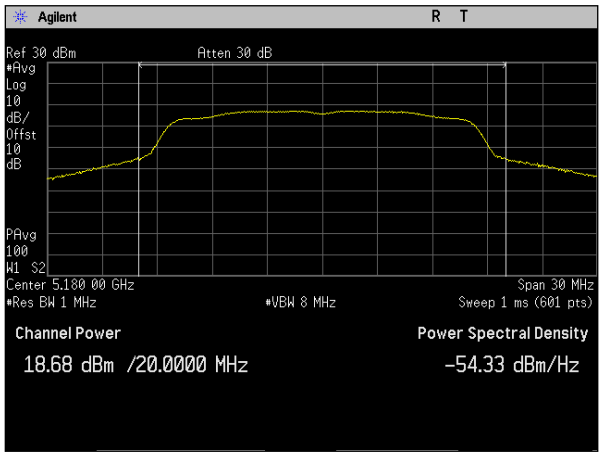


Plot 40. Conducted Transmitter Output Power, SISO, Bandwidth 80M, Ch. 5210M, ac mode, Port a

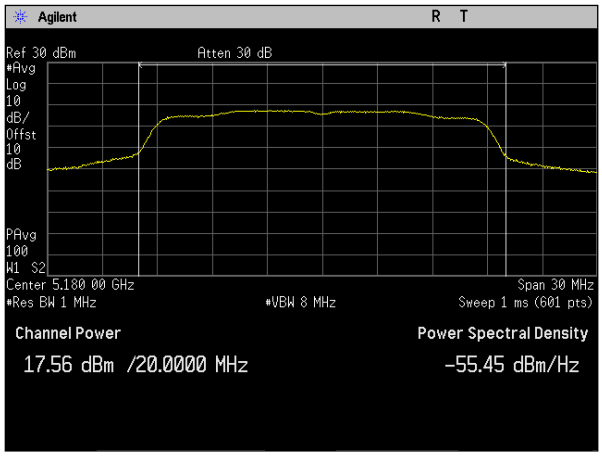
MIMO



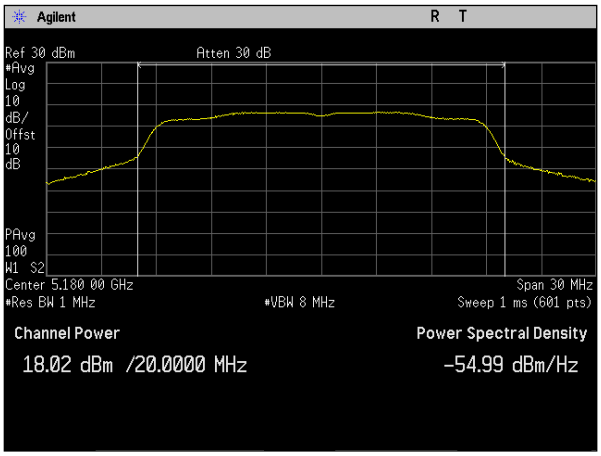
Plot 41. Conducted Transmitter Output Power, MIMO, Bandwidth 20M, Ch. 5180M, a mode, Port a



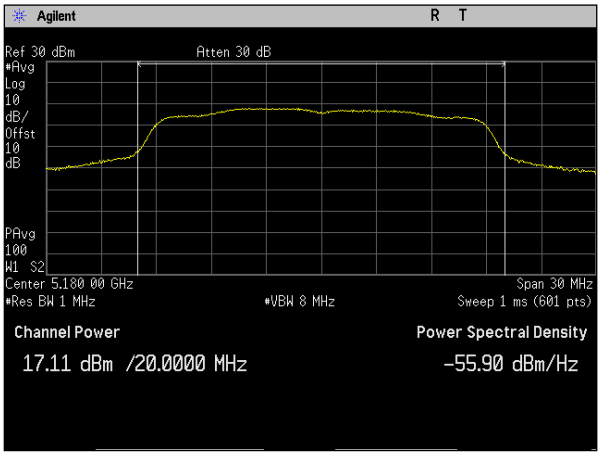
Plot 42. Conducted Transmitter Output Power, MIMO, Bandwidth 20M, Ch. 5180M, a mode, Port b



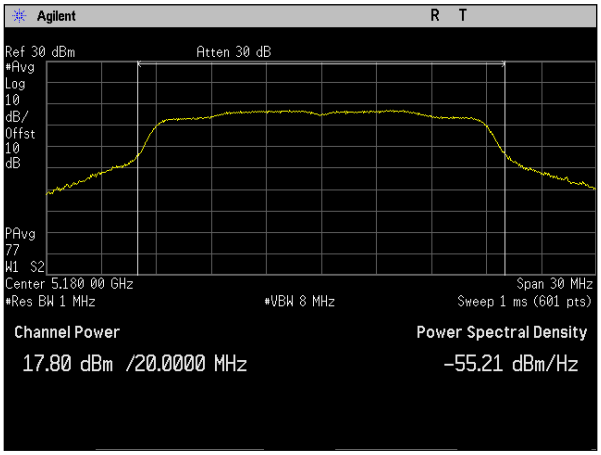
Plot 43. Conducted Transmitter Output Power, MIMO, Bandwidth 20M, Ch. 5180M, ac mode, Port a



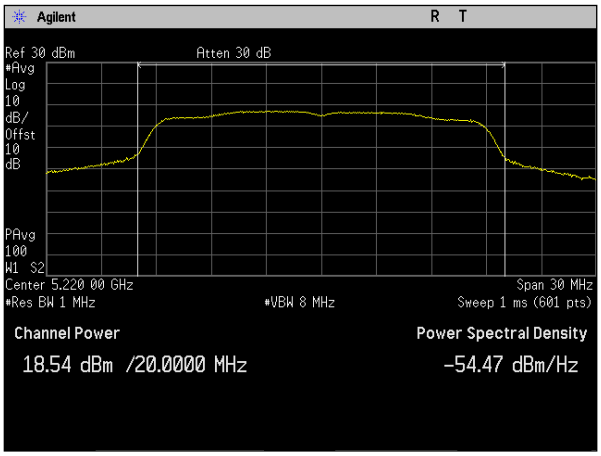
Plot 44. Conducted Transmitter Output Power, MIMO, Bandwidth 20M, Ch. 5180M, ac mode, Port b



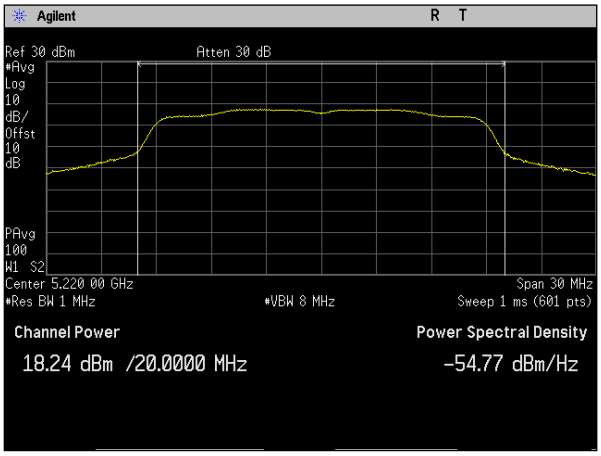
Plot 45. Conducted Transmitter Output Power, MIMO, Bandwidth 20M, Ch. 5180M, n mode, Port a



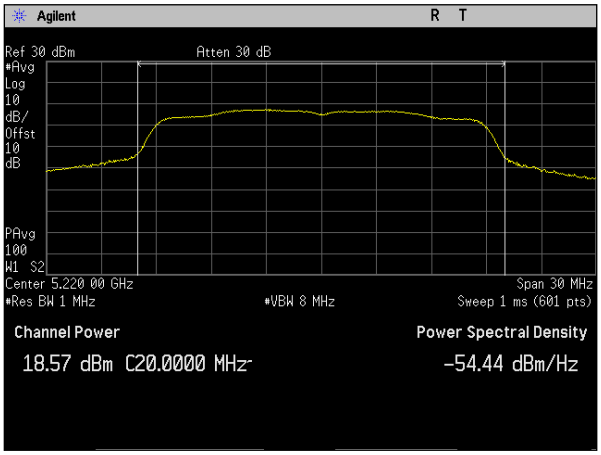
Plot 46. Conducted Transmitter Output Power, MIMO, Bandwidth 20M, Ch. 5180M, n mode, Port b



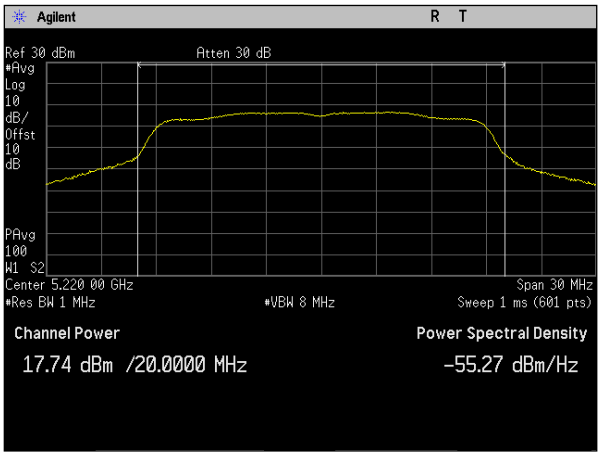
Plot 47. Conducted Transmitter Output Power, MIMO, Bandwidth 20M, Ch. 5220M, a mode, Port a



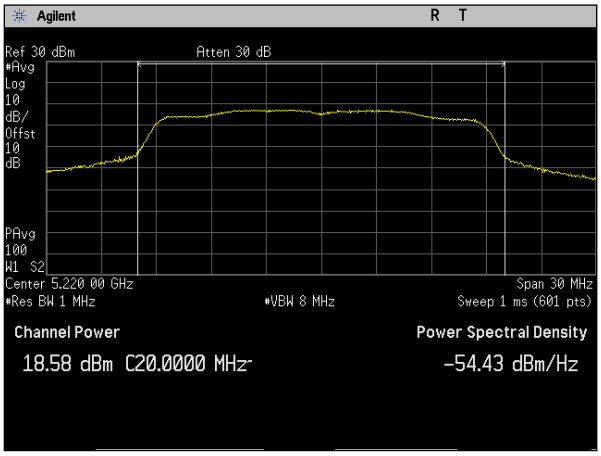
Plot 48. Conducted Transmitter Output Power, MIMO, Bandwidth 20M, Ch. 5220M, a mode, Port b



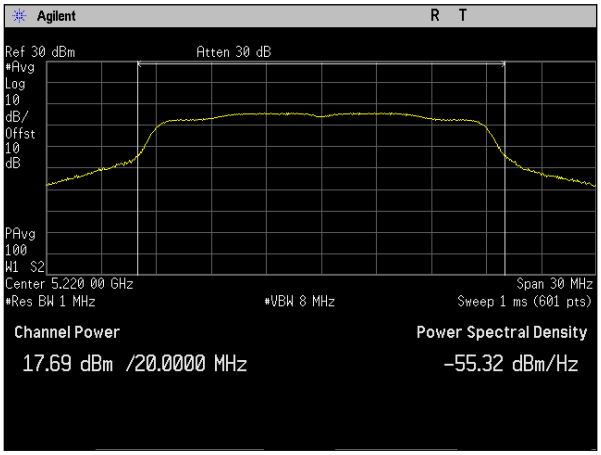
Plot 49. Conducted Transmitter Output Power, MIMO, Bandwidth 20M, Ch. 5220M, ac mode, Port a



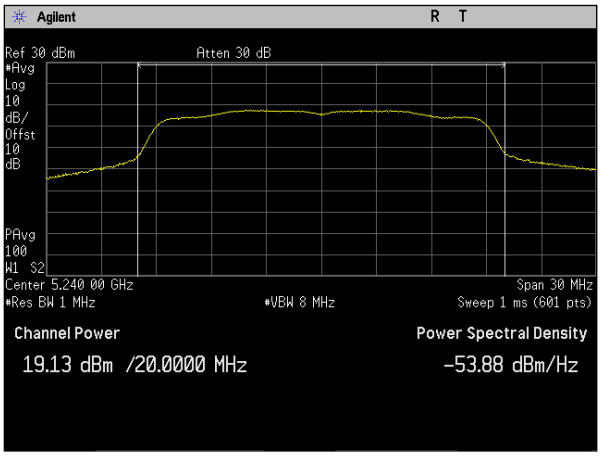
Plot 50. Conducted Transmitter Output Power, MIMO, Bandwidth 20M, Ch. 5220M, ac mode, Port b



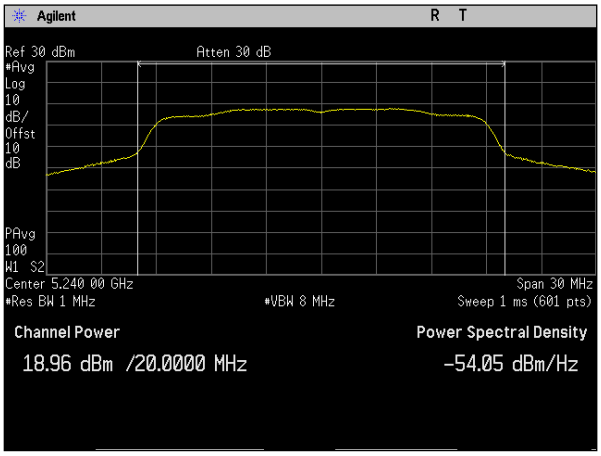
Plot 51. Conducted Transmitter Output Power, MIMO, Bandwidth 20M, Ch. 5220M, n mode, Port a



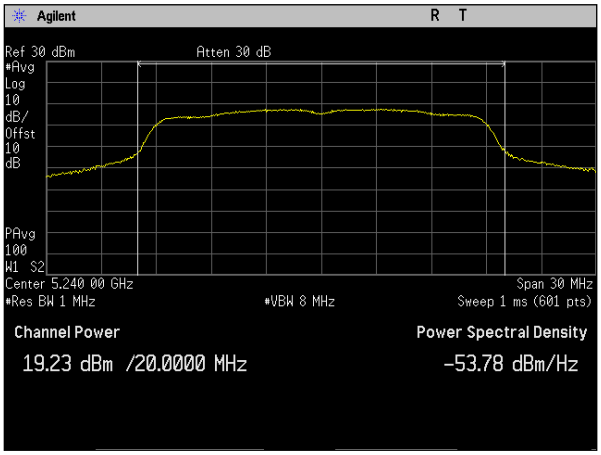
Plot 52. Conducted Transmitter Output Power, MIMO, Bandwidth 20M, Ch. 5220M, n mode, Port b



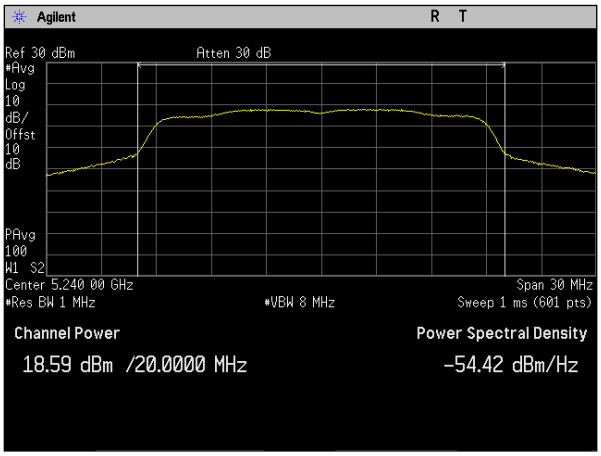
Plot 53. Conducted Transmitter Output Power, MIMO, Bandwidth 20M, Ch. 5240M, a mode, Port a



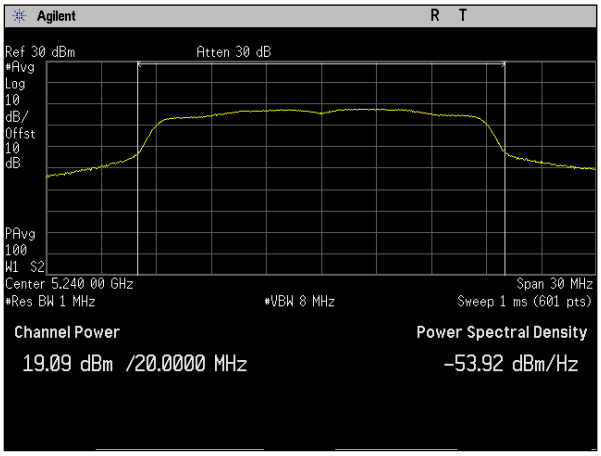
Plot 54. Conducted Transmitter Output Power, MIMO, Bandwidth 20M, Ch. 5240M, a mode, Port b



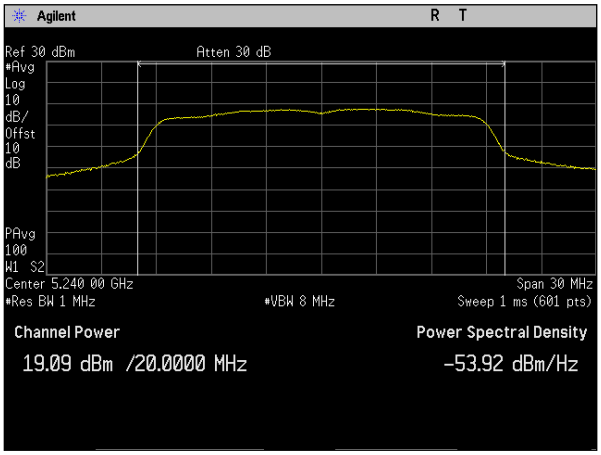
Plot 55. Conducted Transmitter Output Power, MIMO, Bandwidth 20M, Ch. 5240M, ac mode, Port a



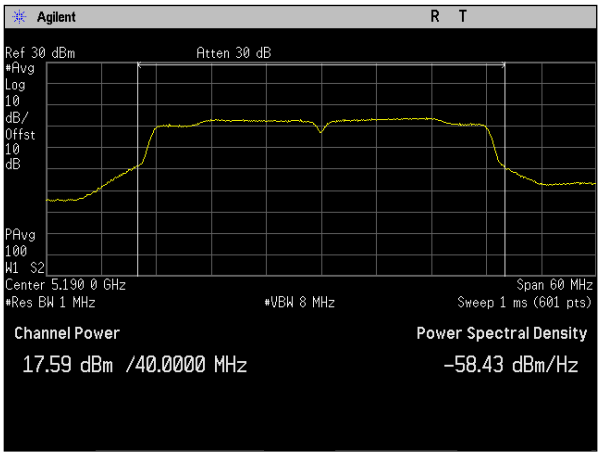
Plot 56. Conducted Transmitter Output Power, MIMO, Bandwidth 20M, Ch. 5240M, ac mode, Port b



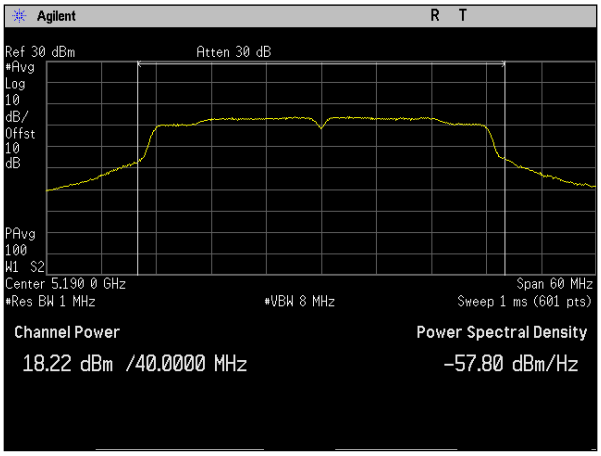
Plot 57. Conducted Transmitter Output Power, MIMO, Bandwidth 20M, Ch. 5240M, n mode, Port a



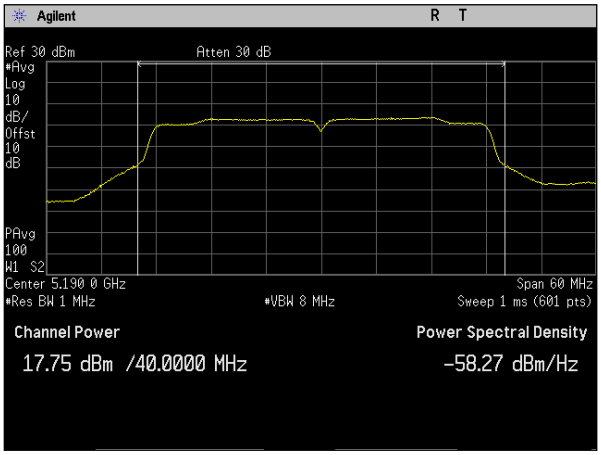
Plot 58. Conducted Transmitter Output Power, MIMO, Bandwidth 20M, Ch. 5240M, n mode, Port b



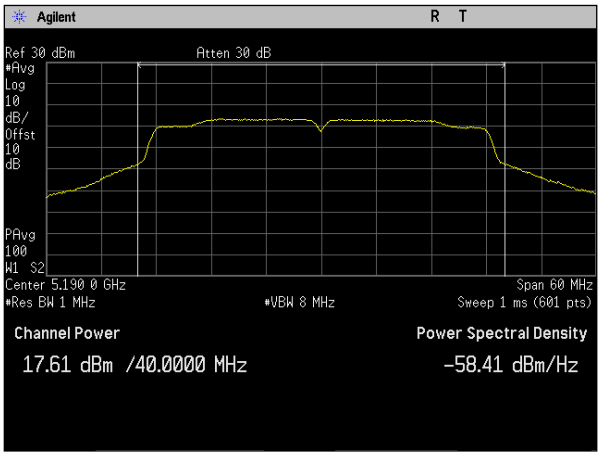
Plot 59. Conducted Transmitter Output Power, MIMO, Bandwidth 40M, Ch. 5190M, ac mode, Port a



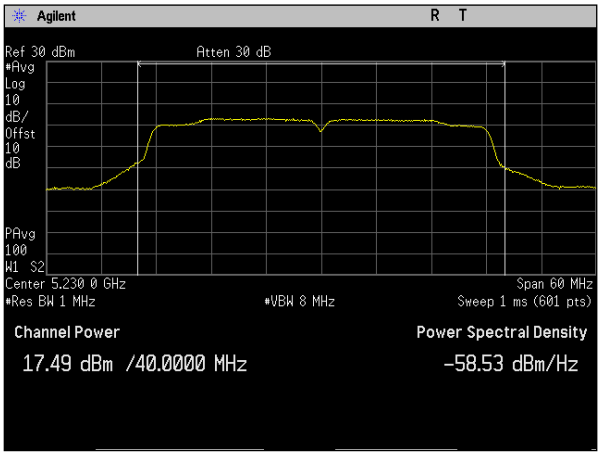
Plot 60. Conducted Transmitter Output Power, MIMO, Bandwidth 40M, Ch. 5190M, ac mode, Port b



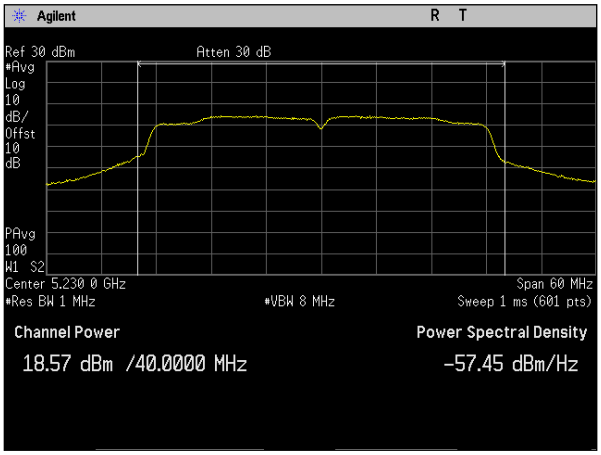
Plot 61. Conducted Transmitter Output Power, MIMO, Bandwidth 40M, Ch. 5190M, n mode, Port a



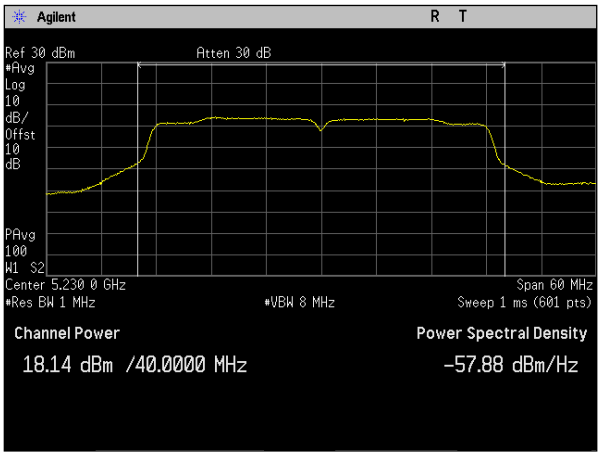
Plot 62. Conducted Transmitter Output Power, MIMO, Bandwidth 40M, Ch. 5190M, n mode, Port b



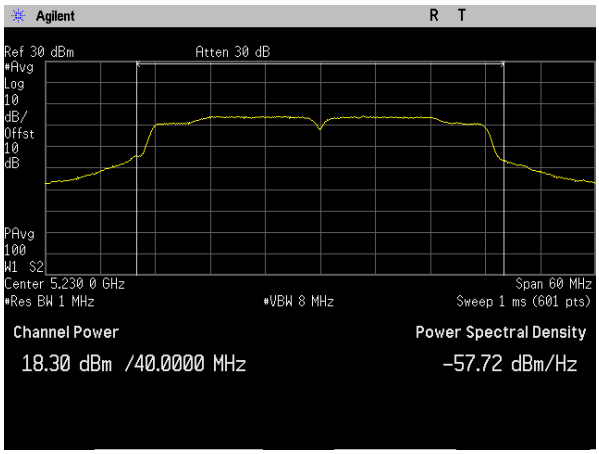
Plot 63. Conducted Transmitter Output Power, MIMO, Bandwidth 40M, Ch. 5230M, ac mode, Port a



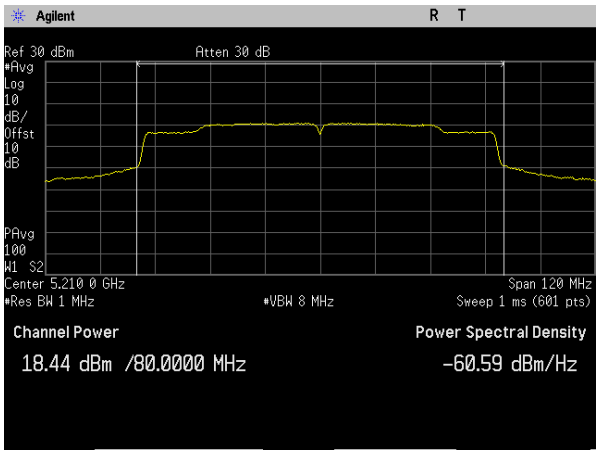
Plot 64. Conducted Transmitter Output Power, MIMO, Bandwidth 40M, Ch. 5230M, ac mode, Port b



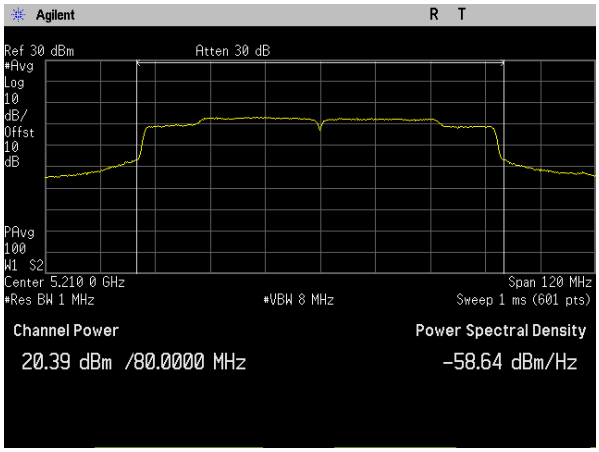
Plot 65. Conducted Transmitter Output Power, MIMO, Bandwidth 40M, Ch. 5230M, n mode, Port a



Plot 66. Conducted Transmitter Output Power, MIMO, Bandwidth 40M, Ch. 5230M, n mode, Port b



Plot 67. Conducted Transmitter Output Power, MIMO, Bandwidth 80M, Ch. 5290M, ac mode, Port a



Plot 68. Conducted Transmitter Output Power, MIMO, Bandwidth 80M, Ch. 5210M, ac mode, Port b

Channel	Power Port A (dBm)	Limit (dBm)	Margin
BW 20M Ch 5180M a Mode	19.22	24	4.78
BW 20M Ch 5180M n Mode	20.43	24	3.57
BW 20M Ch 5180M ac Mode	21.4	24	2.6
BW 20M Ch 5220M a Mode	18.8	24	5.2
BW 20M Ch 5220M n Mode	21.05	24	2.95
BW 20M Ch 5220M ac Mode	20.78	24	3.22
BW 20M Ch 5240M a Mode	20.44	24	3.56
BW 20M Ch 5240M n Mode	20.26	24	3.74
BW 20M Ch 5240M ac Mode	20.2	24	3.8
BW 40M Ch 5190M n Mode	22.2	24	1.8
BW 40M Ch 5190M ac Mode	20.43	24	3.57
BW 40M Ch 5230M n Mode	19.82	24	4.18
BW 40M Ch 5230M ac Mode	20.58	24	3.42
BW 80M Ch 5210M ac Mode	18.44	24	5.56

Table 7. Power Table, SISO, Port A

Channel	Power Port B (dBm)	Limit (dBm)	Margin
BW 20M Ch 5180M a Mode	19.22	24	4.78
BW 20M Ch 5180M n Mode	20.24	24	3.76
BW 20M Ch 5180M ac Mode	19.64	24	4.36
BW 20M Ch 5220M a Mode	19.65	24	4.35
BW 20M Ch 5220M n Mode	20.58	24	3.42
BW 20M Ch 5220M ac Mode	19.15	24	4.85
BW 20M Ch 5240M a Mode	20.68	24	3.32
BW 20M Ch 5240M n Mode	20.69	24	3.31
BW 20M Ch 5240M ac Mode	21.21	24	2.79
BW 40M Ch 5190M n Mode	21.04	24	2.96
BW 40M Ch 5190M ac Mode	19.38	24	4.62
BW 40M Ch 5230M n Mode	21.65	24	2.35
BW 40M Ch 5230M ac Mode	20.58	24	3.42
BW 80M Ch 5210M ac Mode	20.39	24	3.61

Table 8. Power Table, SISO, Port B

Channel	Port 1 (dBm)	Port 2 (dBm)	Sum (dBm)	Antenna Gain (dBi)	Limit (dBm)	Margin
BW 20M Ch 5180M a Mode	17.09	18.68	20.968	0	24	3.032
BW 20M Ch 5180M n Mode	17.11	17.8	20.479	0	24	3.521
BW 20M Ch 5180M ac Mode	17.56	18.02	20.806	0	24	3.194
BW 20M Ch 5220M a Mode	18.54	18.24	21.403	0	24	2.597
BW 20M Ch 5220M n Mode	18.58	17.69	21.168	0	24	2.832
BW 20M Ch 5220M ac Mode	18.57	17.74	21.185	0	24	2.815
BW 20M Ch 5240M a Mode	19.13	18.94	22.046	0	24	1.954
BW 20M Ch 5240M n Mode	19.09	18.89	22.001	0	24	1.999
BW 20M Ch 5240M ac Mode	19.23	18.59	21.932	0	24	2.068
BW 40M Ch 5190M n Mode	17.75	17.61	20.691	0	24	3.309
BW 40M Ch 5190M ac Mode	17.59	18.22	20.927	0	24	3.073
BW 40M Ch 5230M n Mode	18.18	18.3	21.251	0	24	2.749
BW 40M Ch 5230M ac Mode	17.49	18.57	21.074	0	24	2.926
BW 80M Ch 529010M ac Mode	18.28	17.92	21.114	0	24	2.886

Table 9. Power Table, MIMO

Electromagnetic Compatibility Criteria for Intentional Radiators

§15.407(a)(1) Maximum Power Spectral Density

Test Requirements:

§15.407(a)(1)(i): In addition, the maximum power spectral density shall not exceed 17 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.

§15.407(a)(1)(ii): In addition, the maximum power spectral density shall not exceed 17 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..

§15.407(a)(1)(iii): In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi.

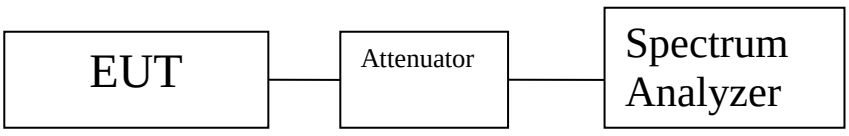
§15.407(a)(1)(iv): In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in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

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

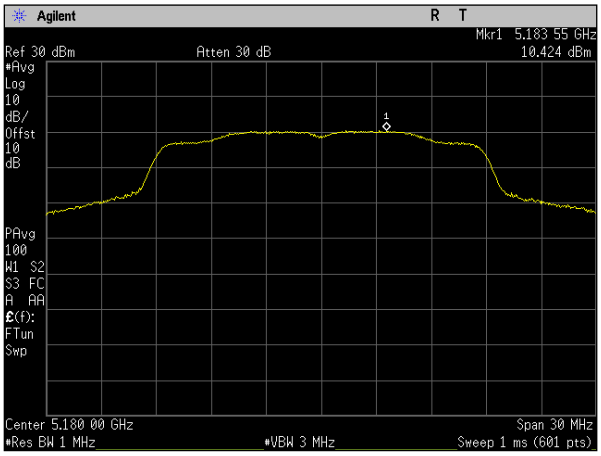
Test Results: The EUT as tested is compliant with the requirements of this section. No anomalies detected.

Test Engineer(s): Arsalan Hasan

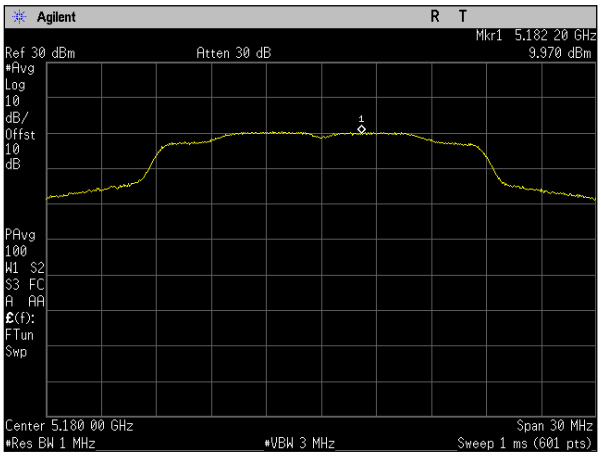
Test Date(s): December 19, 2016



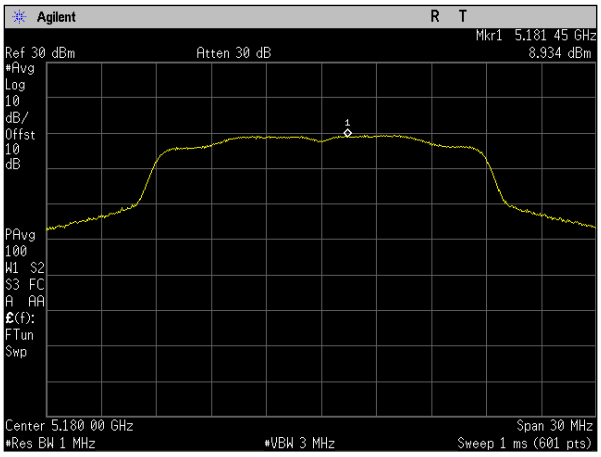
SISO



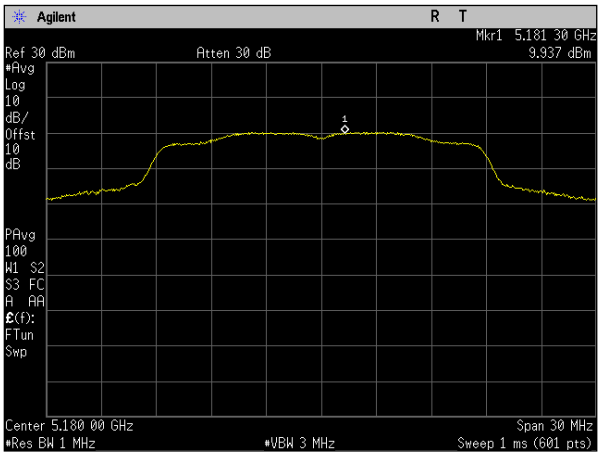
Plot 69. Power Spectral Density, SISO, Bandwidth 20M, Ch. 5180M, a mode, port b



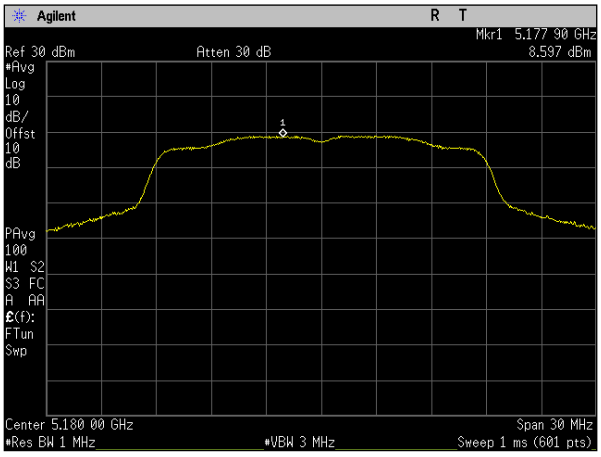
Plot 70. Power Spectral Density, SISO, Bandwidth 20M, Ch. 5180M, a mode, port a



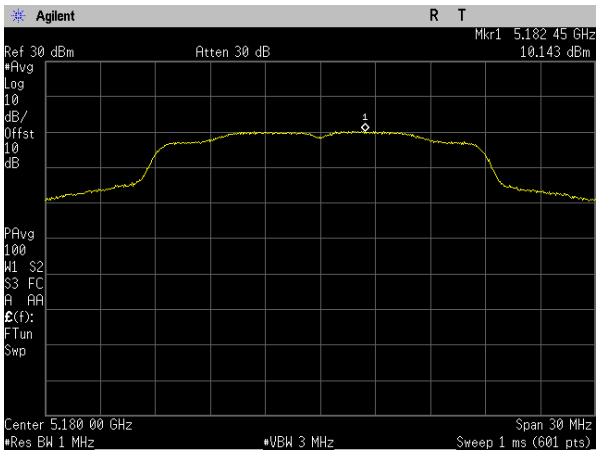
Plot 71. Power Spectral Density, SISO, Bandwidth 20M, Ch. 5180M, ac mode, port b



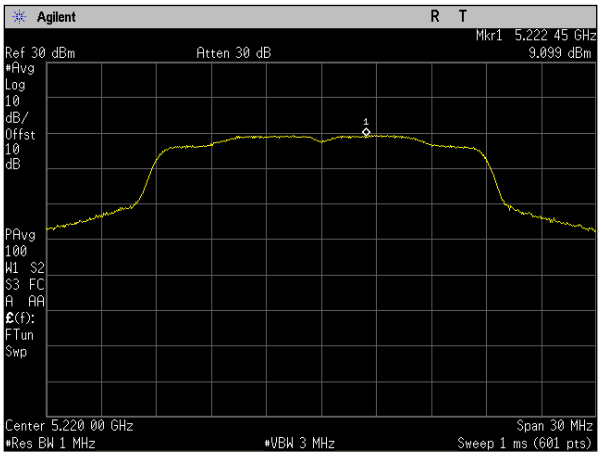
Plot 72. Power Spectral Density, SISO, Bandwidth 20M, Ch. 5180M, ac mode, port a



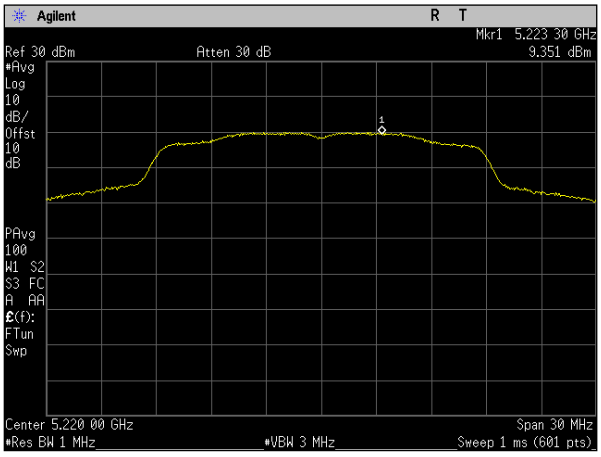
Plot 73. Power Spectral Density, SISO, Bandwidth 20M, Ch. 5180M, n mode, port b



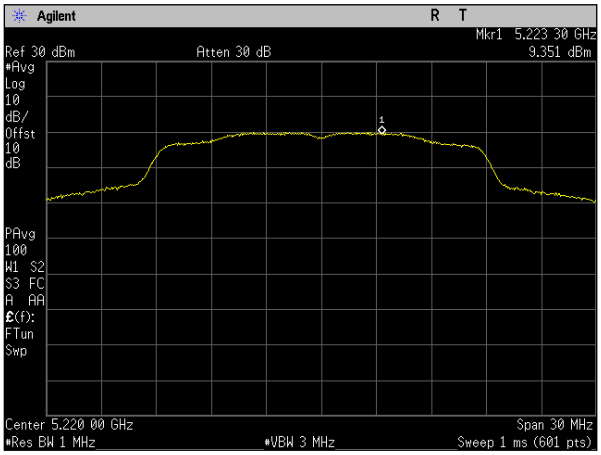
Plot 74. Power Spectral Density, SISO, Bandwidth 20M, Ch. 5180M, n mode, port a



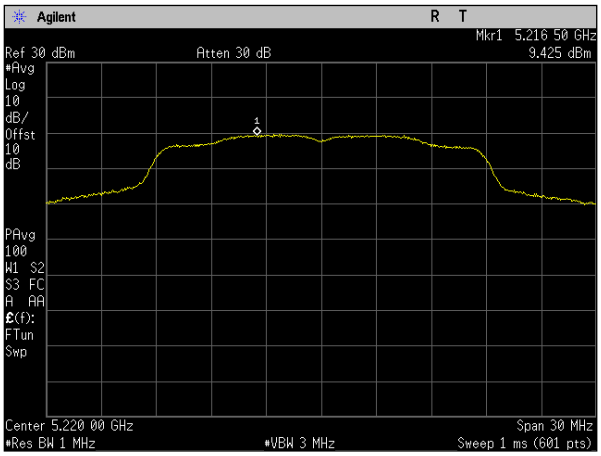
Plot 75. Power Spectral Density, SISO, Bandwidth 20M, Ch. 5220M, a mode, port b



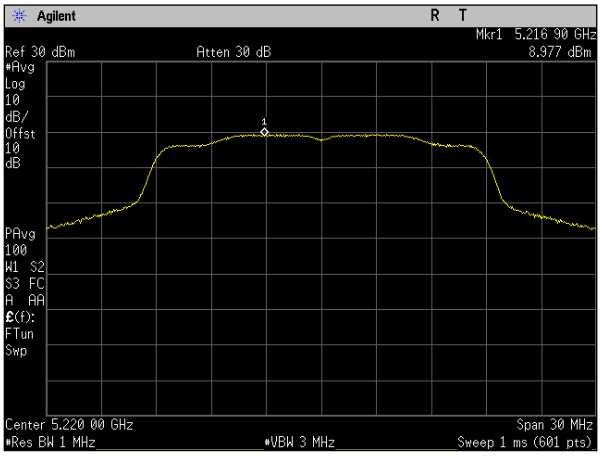
Plot 76. Power Spectral Density, SISO, Bandwidth 20M, Ch. 5220M, a mode, port a



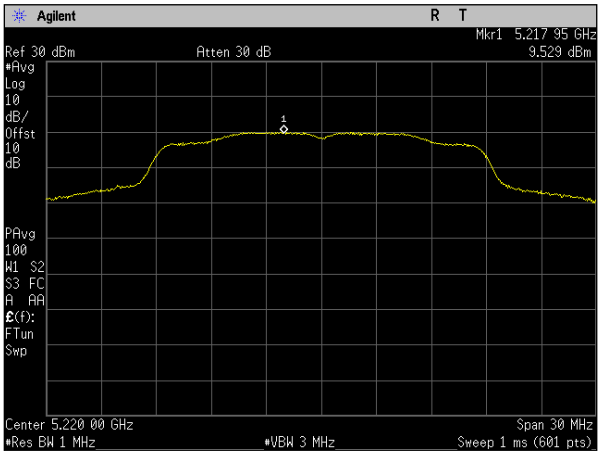
Plot 77. Power Spectral Density, SISO, Bandwidth 20M, Ch. 5220M, ac mode, port b



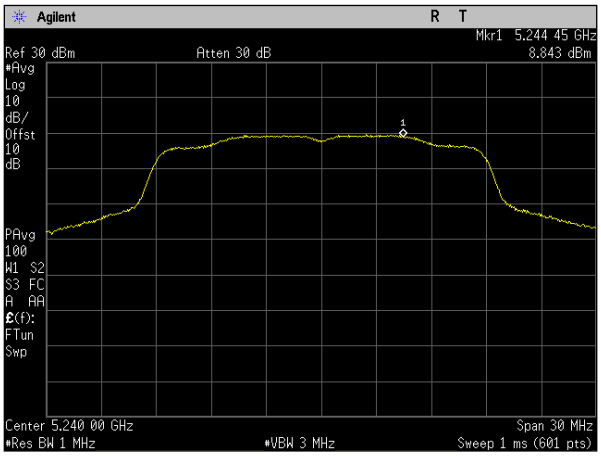
Plot 78. Power Spectral Density, SISO, Bandwidth 20M, Ch. 5220M, ac mode, port a



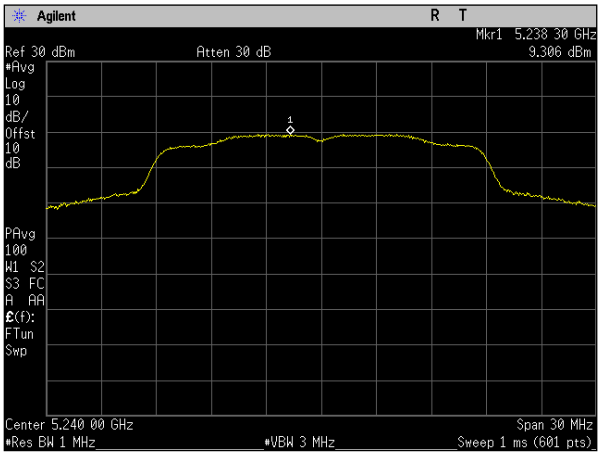
Plot 79. Power Spectral Density, SISO, Bandwidth 20M, Ch. 5220M, n mode, port b



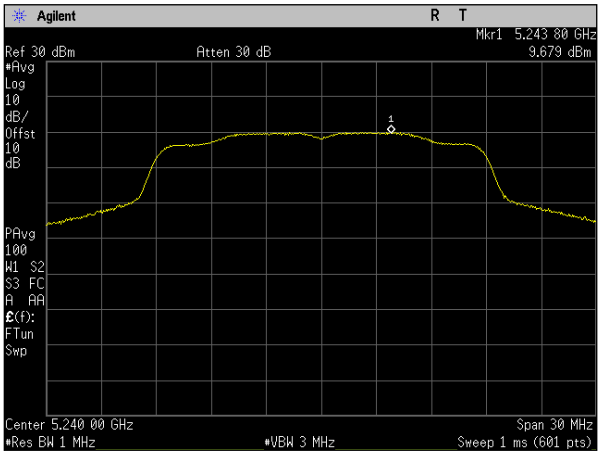
Plot 80. Power Spectral Density, SISO, Bandwidth 20M, Ch. 5220M, n mode, port a



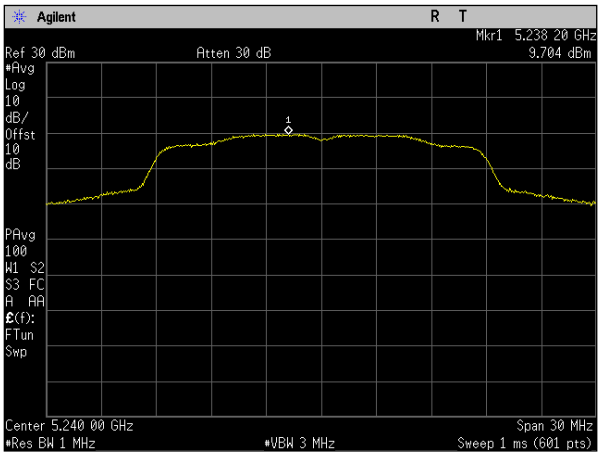
Plot 81. Power Spectral Density, SISO, Bandwidth 20M, Ch. 5240M, a mode, port b



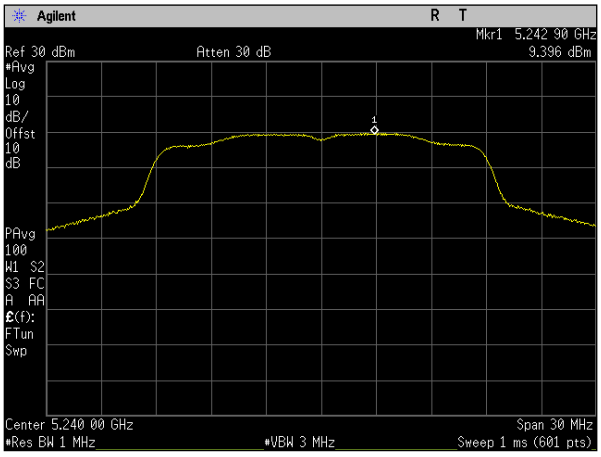
Plot 82. Power Spectral Density, SISO, Bandwidth 20M, Ch. 5240M, a mode, port a



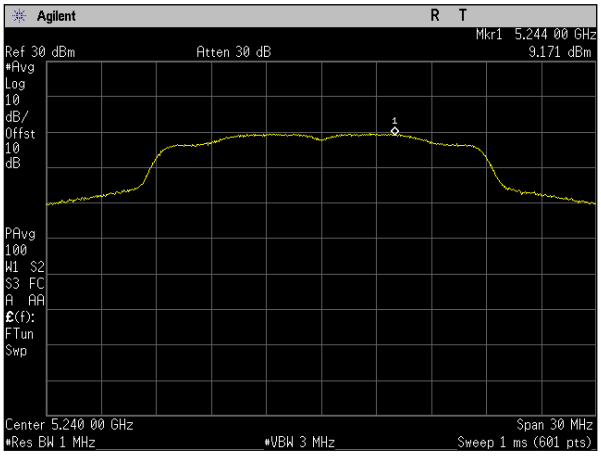
Plot 83. Power Spectral Density, SISO, Bandwidth 20M, Ch. 5240M, ac mode, port b



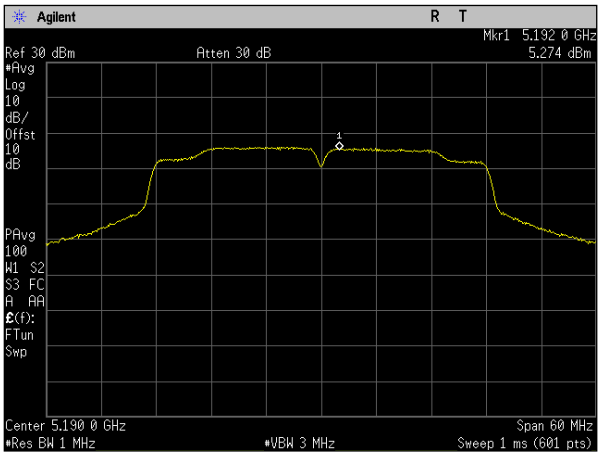
Plot 84. Power Spectral Density, SISO, Bandwidth 20M, Ch. 5240M, ac mode, port a



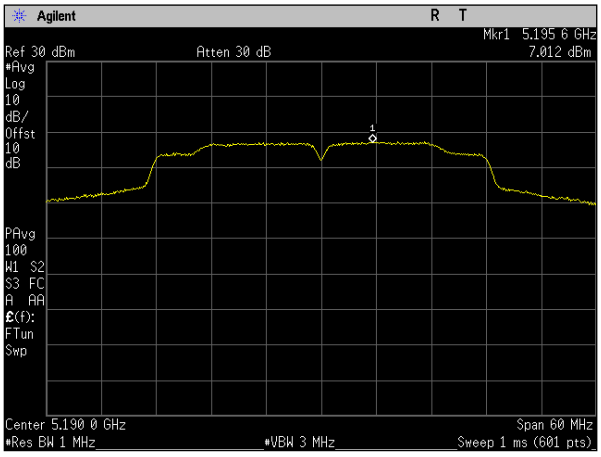
Plot 85. Power Spectral Density, SISO, Bandwidth 20M, Ch. 5240M, n mode, port b



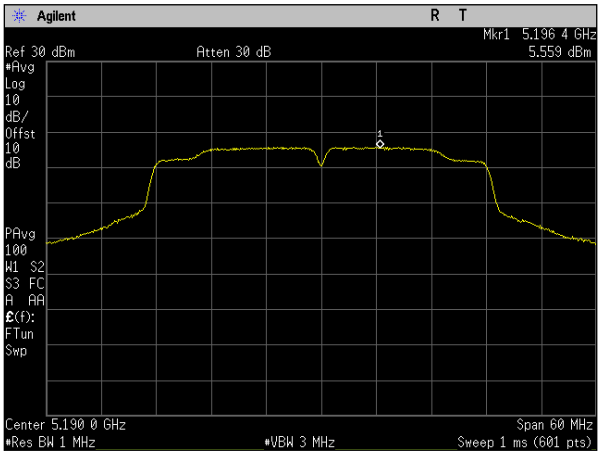
Plot 86. Power Spectral Density, SISO, Bandwidth 20M, Ch. 5240M, n mode, port a



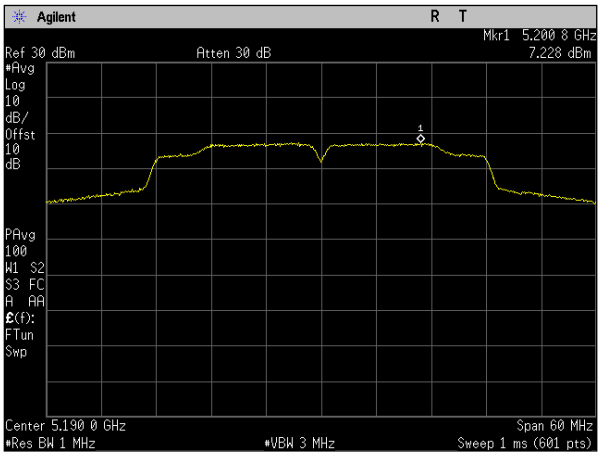
Plot 87. Power Spectral Density, SISO, Bandwidth 40M, Ch. 5190M, ac mode, port b



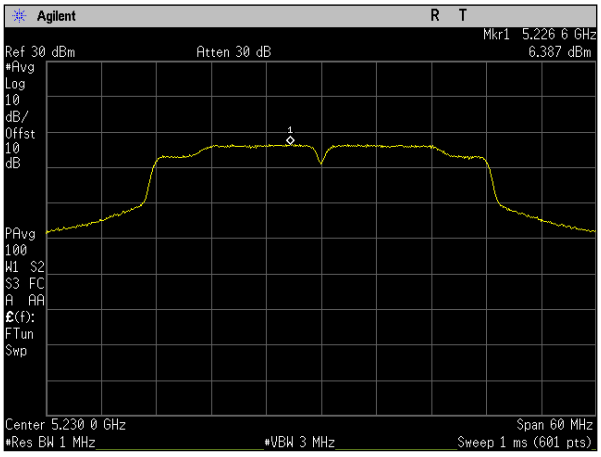
Plot 88. Power Spectral Density, SISO, Bandwidth 40M, Ch. 5190M, ac mode, port a



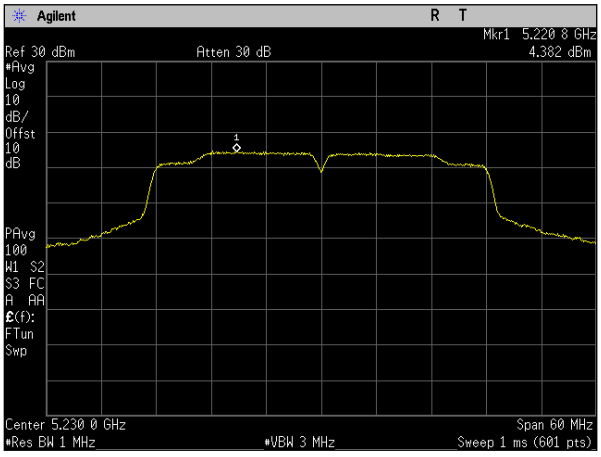
Plot 89. Power Spectral Density, SISO, Bandwidth 40M, Ch. 5190M, n mode, port b



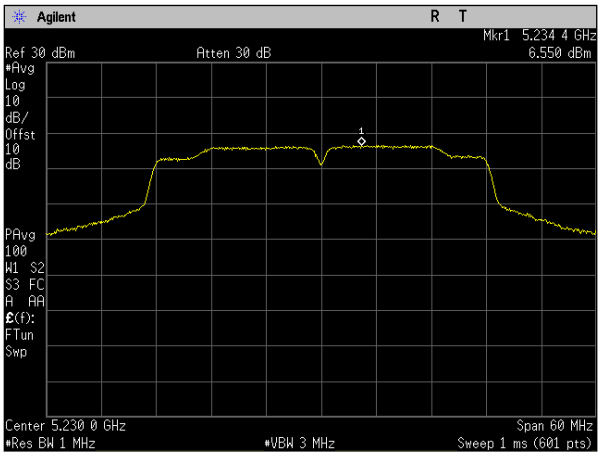
Plot 90. Power Spectral Density, SISO, Bandwidth 40M, Ch. 5190M, n mode, port a



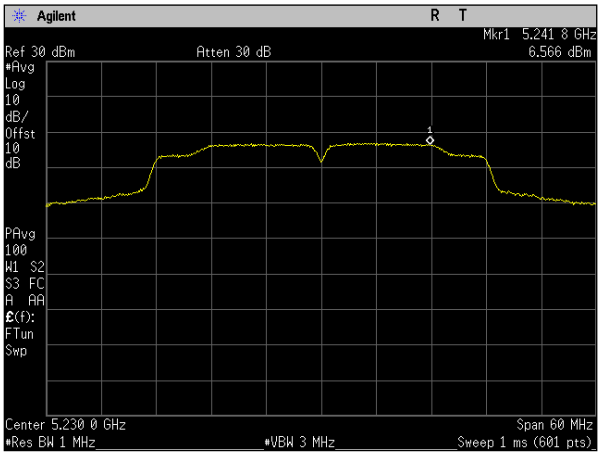
Plot 91. Power Spectral Density, SISO, Bandwidth 40M, Ch. 5230M, ac mode, port b



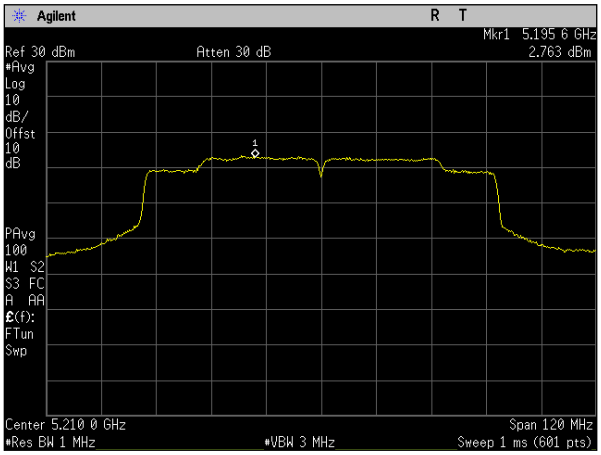
Plot 92. Power Spectral Density, SISO, Bandwidth 40M, Ch. 5230M, ac mode, port a



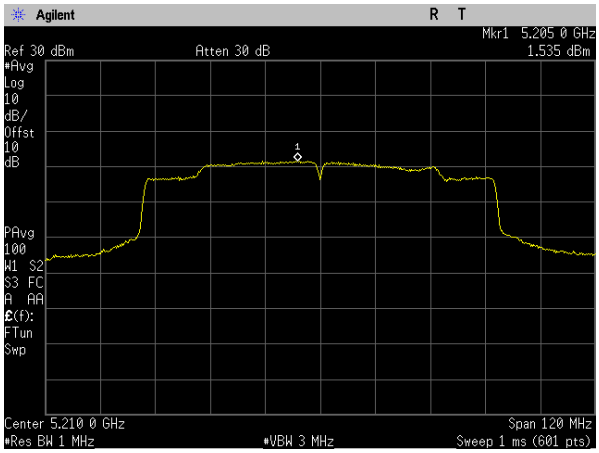
Plot 93. Power Spectral Density, SISO, Bandwidth 40M, Ch. 5230M, n mode, port b



Plot 94. Power Spectral Density, SISO, Bandwidth 40M, Ch. 5230M, n mode, port a

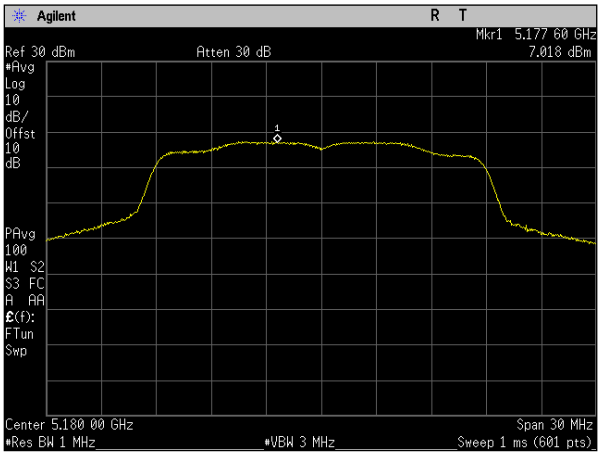


Plot 95. Power Spectral Density, SISO, Bandwidth 80M, Ch. 5210M, ac mode, port b

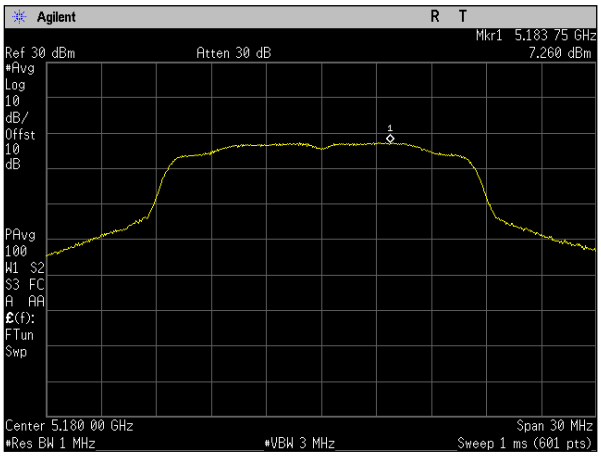


Plot 96. Power Spectral Density, SISO, Bandwidth 80M, Ch. 5210M, ac mode, port a

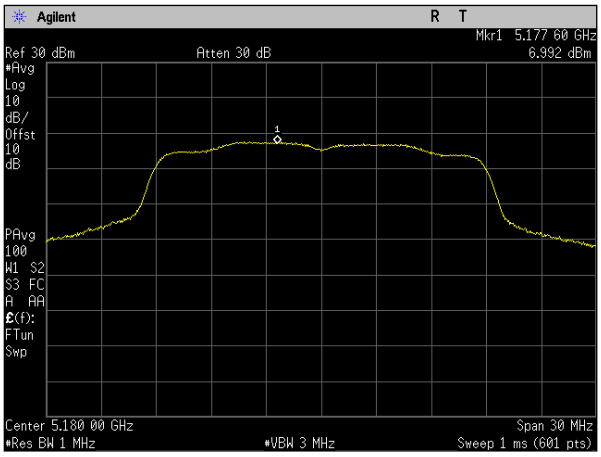
MIMO



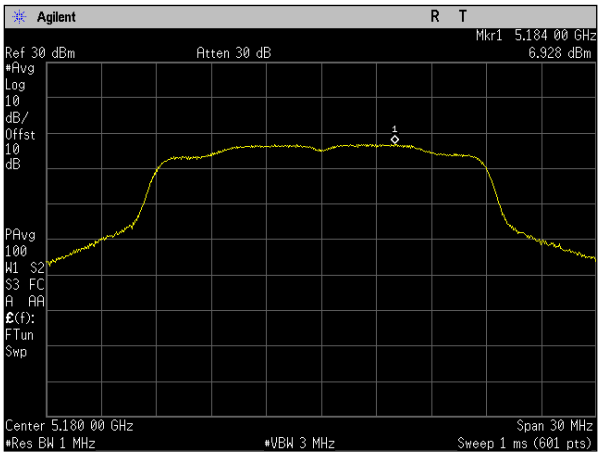
Plot 97. Power Spectral Density, MIMO, Bandwidth 20M, Ch. 5180M, a mode, port a



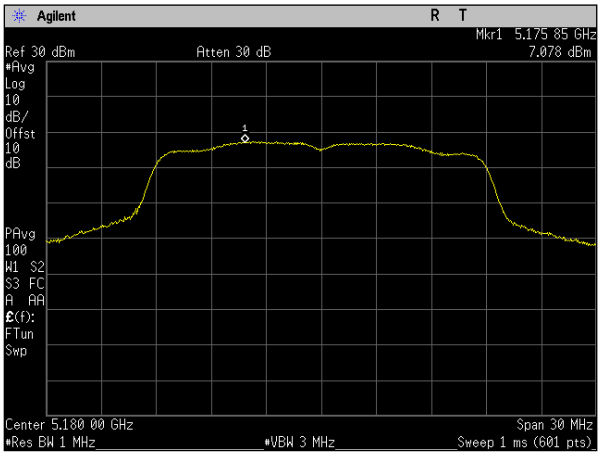
Plot 98. Power Spectral Density, MIMO, Bandwidth 20M, Ch. 5180M, a mode, port b



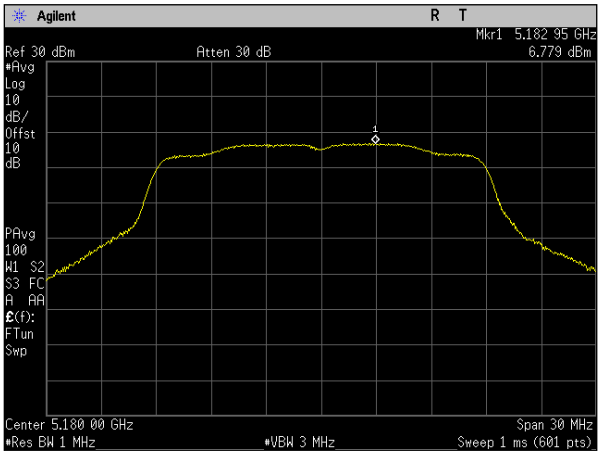
Plot 99. Power Spectral Density, MIMO, Bandwidth 20M, Ch. 5180M, ac mode, port a



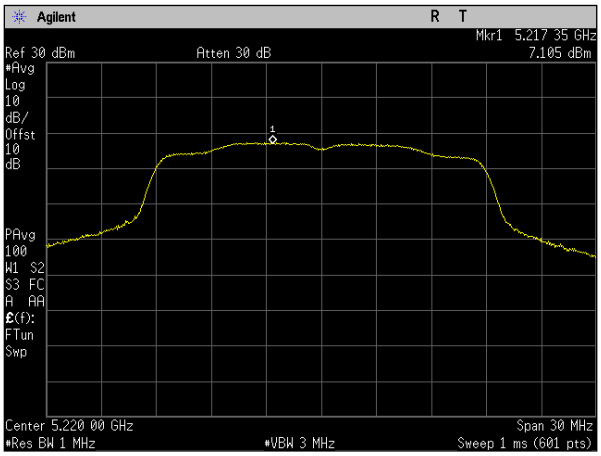
Plot 100. Power Spectral Density, MIMO, Bandwidth 20M, Ch. 5180M, ac mode, port b



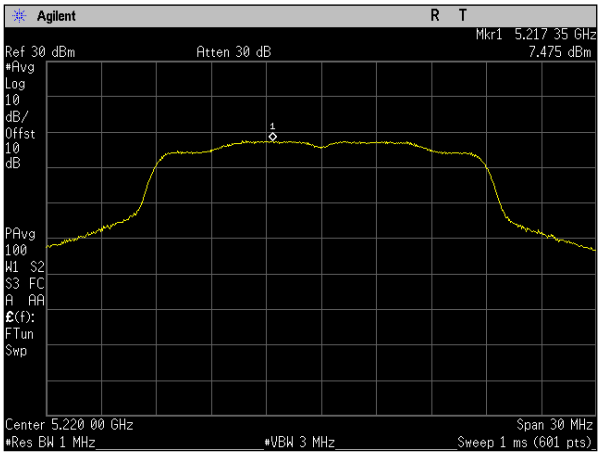
Plot 101. Power Spectral Density, MIMO, Bandwidth 20M, Ch. 5180M, n mode, port a



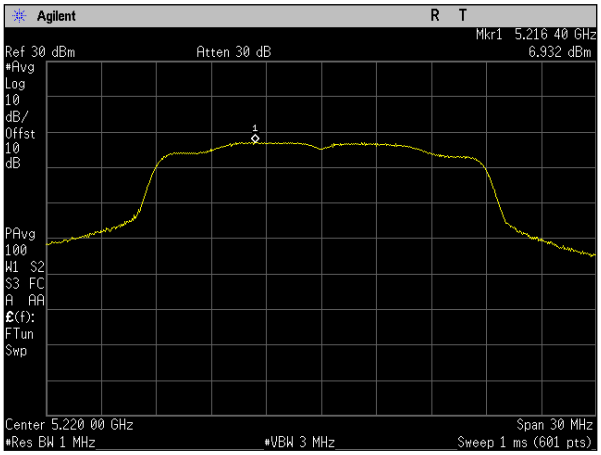
Plot 102. Power Spectral Density, MIMO, Bandwidth 20M, Ch. 5180M, n mode, port b



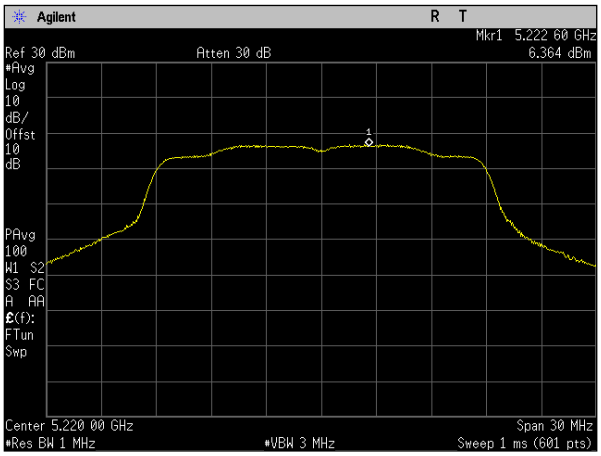
Plot 103. Power Spectral Density, MIMO, Bandwidth 20M, Ch. 5220M, a mode, port a



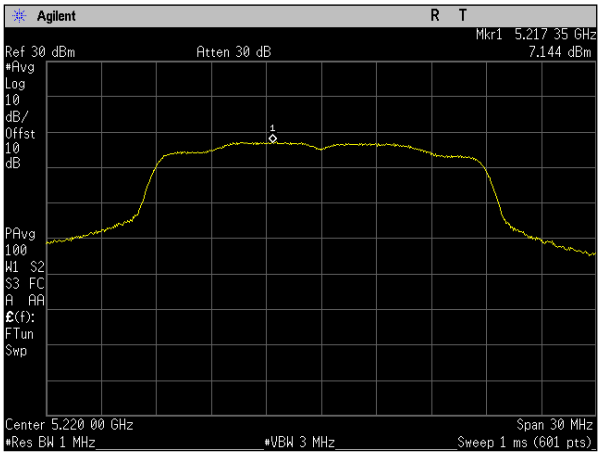
Plot 104. Power Spectral Density, MIMO, Bandwidth 20M, Ch. 5220M, a mode, port b



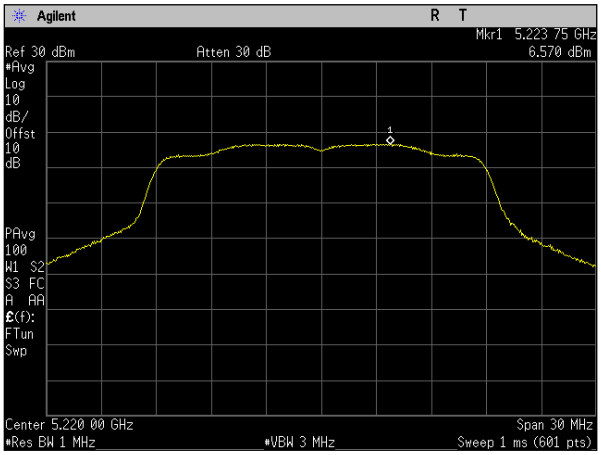
Plot 105. Power Spectral Density, MIMO, Bandwidth 20M, Ch. 5220M, ac mode, port a



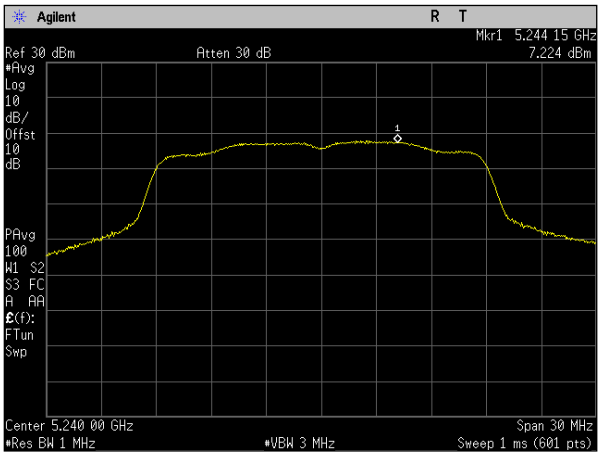
Plot 106. Power Spectral Density, MIMO, Bandwidth 20M, Ch. 5220M, ac mode, port b



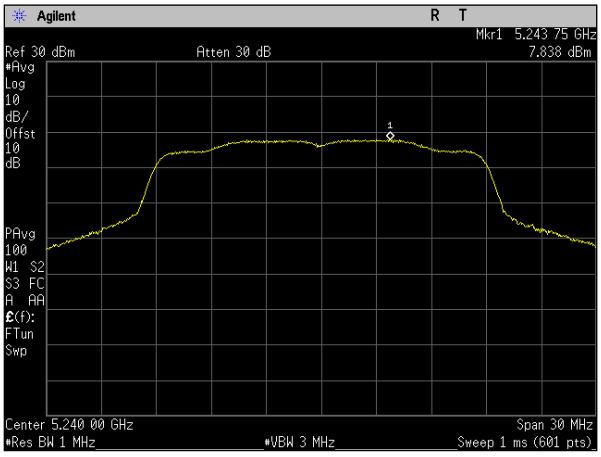
Plot 107. Power Spectral Density, MIMO, Bandwidth 20M, Ch. 5220M, n mode, port a



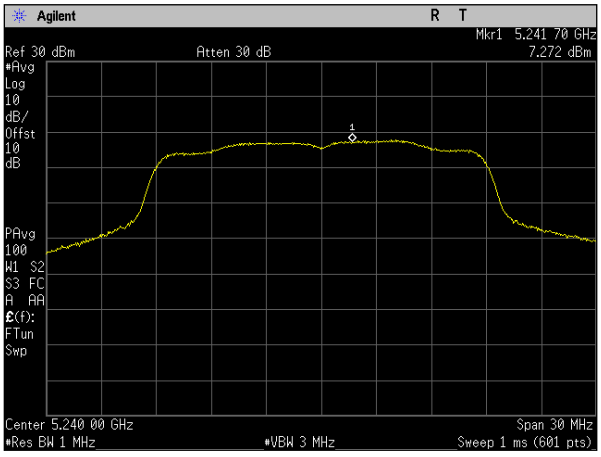
Plot 108. Power Spectral Density, MIMO, Bandwidth 20M, Ch. 5220M, n mode, port b



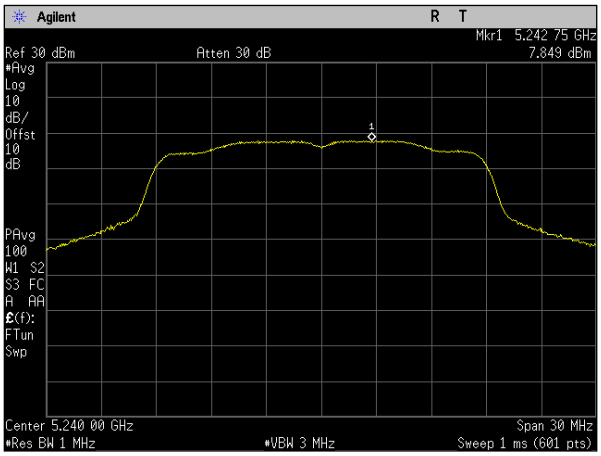
Plot 109. Power Spectral Density, MIMO, Bandwidth 20M, Ch. 5240M, a mode, port a



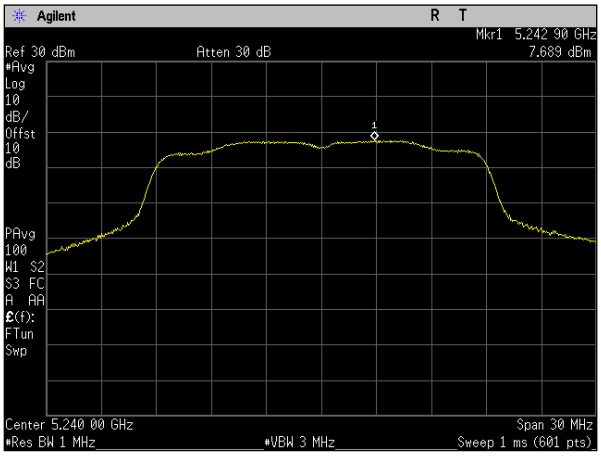
Plot 110. Power Spectral Density, MIMO, Bandwidth 20M, Ch. 5240M, a mode, port b



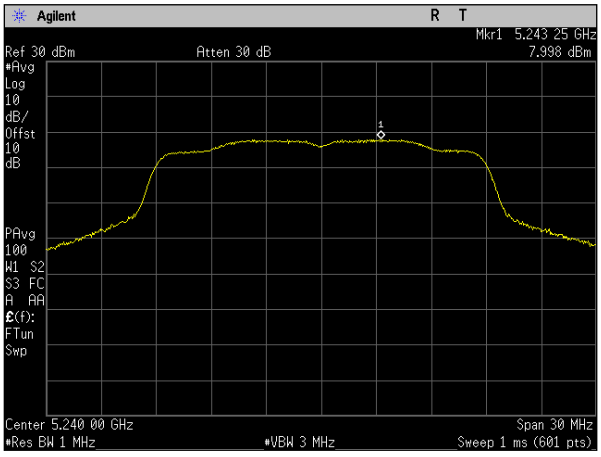
Plot 111. Power Spectral Density, MIMO, Bandwidth 20M, Ch. 5240M, ac mode, port a



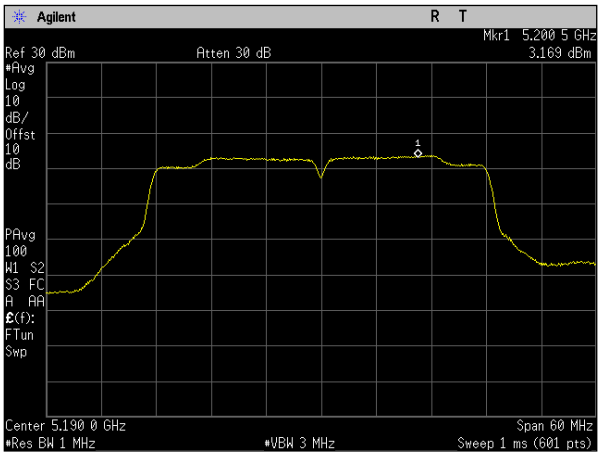
Plot 112. Power Spectral Density, MIMO, Bandwidth 20M, Ch. 5240M, ac mode, port b



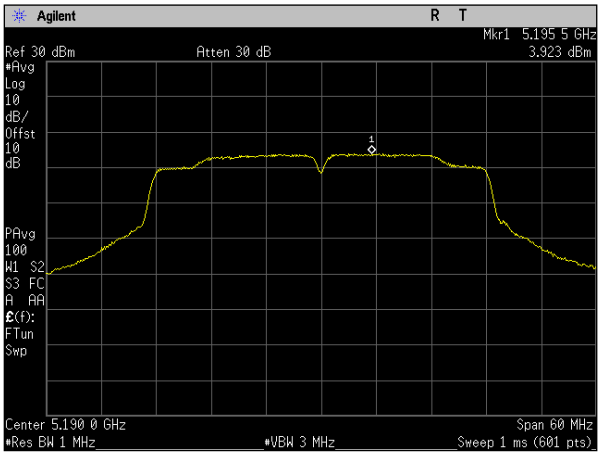
Plot 113. Power Spectral Density, MIMO, Bandwidth 20M, Ch. 5240M, n mode, port a



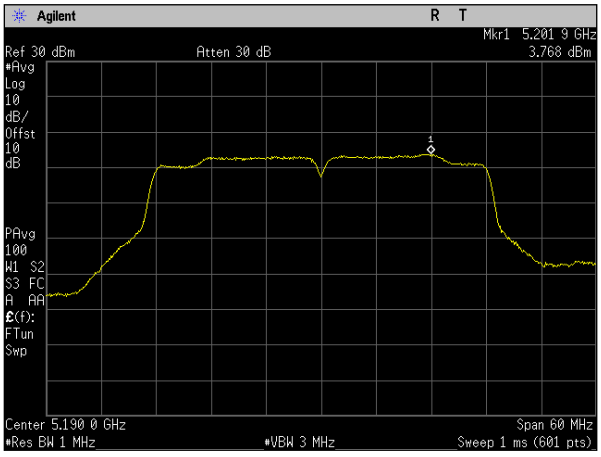
Plot 114. Power Spectral Density, MIMO, Bandwidth 20M, Ch. 5240M, n mode, port b



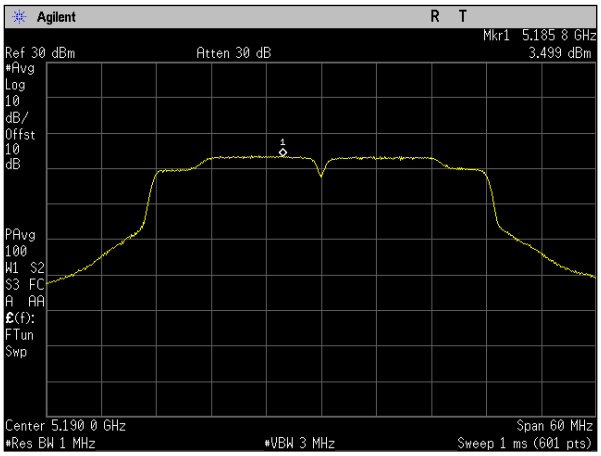
Plot 115. Power Spectral Density, MIMO, Bandwidth 40M, Ch. 5190M, ac mode, port a



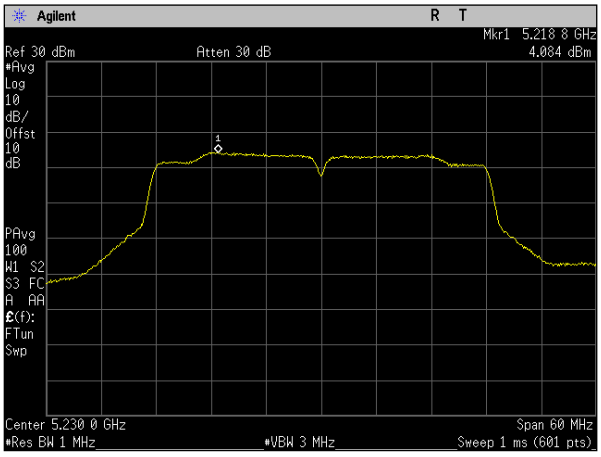
Plot 116. Power Spectral Density, MIMO, Bandwidth 40M, Ch. 5190M, ac mode, port b



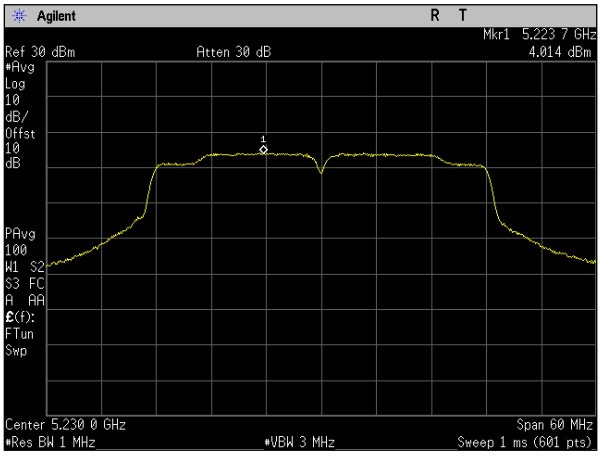
Plot 117. Power Spectral Density, MIMO, Bandwidth 40M, Ch. 5190M, n mode, port a



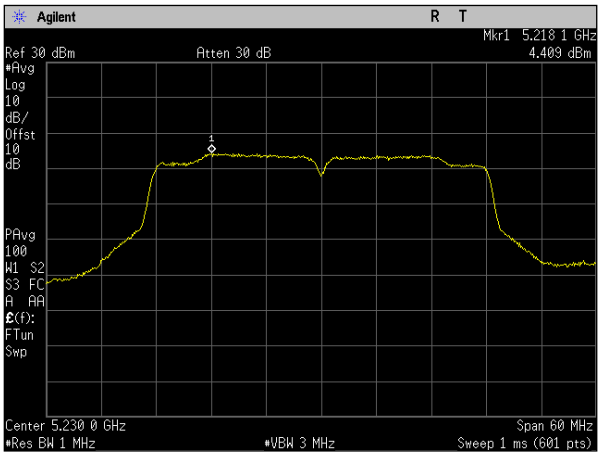
Plot 118. Power Spectral Density, MIMO, Bandwidth 40M, Ch. 5190M, n mode, port b



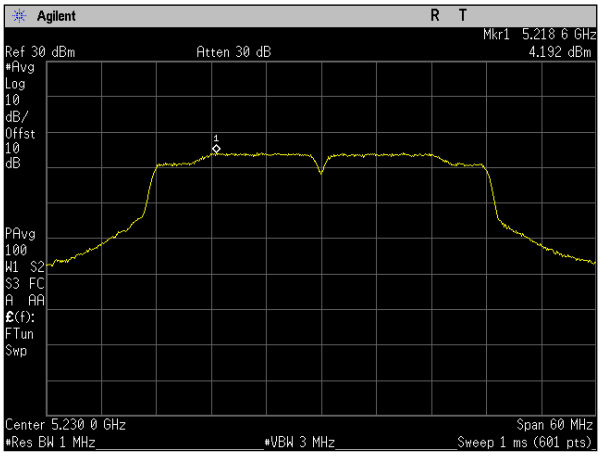
Plot 119. Power Spectral Density, MIMO, Bandwidth 40M, Ch. 5230M, ac mode, port a



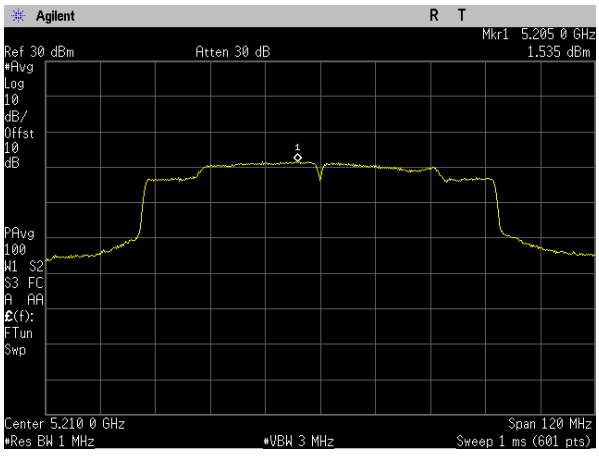
Plot 120. Power Spectral Density, MIMO, Bandwidth 40M, Ch. 5230M, ac mode, port b



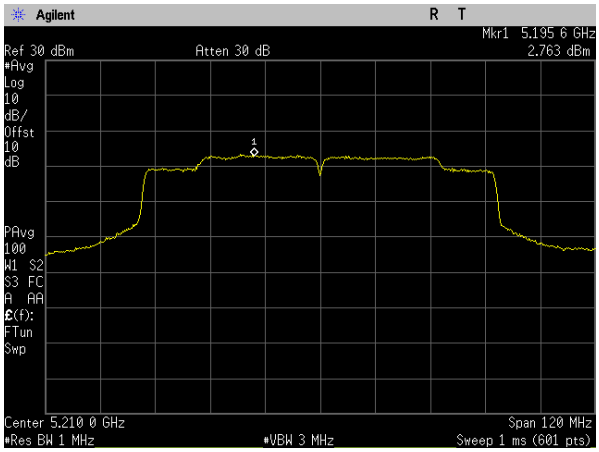
Plot 121. Power Spectral Density, MIMO, Bandwidth 40M, Ch. 5230M, n mode, port a



Plot 122. Power Spectral Density, MIMO, Bandwidth 40M, Ch. 5230M, n mode, port b



Plot 123. Power Spectral Density, MIMO, Bandwidth 80M, Ch. 5210M, ac mode, port a



Plot 124. Power Spectral Density, MIMO, Bandwidth 80M, Ch. 5210M, ac mode, port b

Channel	PSD Port A (dBm)	Limit (dBm)	Margin
BW 20M Ch 5180M a Mode	9.97	11	1.03
BW 20M Ch 5180M n Mode	10.143	11	0.857
BW 20M Ch 5180M ac Mode	9.937	11	1.063
BW 20M Ch 5220M a Mode	9.351	11	1.649
BW 20M Ch 5220M n Mode	8.977	11	0.857
BW 20M Ch 5220M ac Mode	9.425	11	1.575
BW 20M Ch 5240M a Mode	8.843	11	2.157
BW 20M Ch 5240M n Mode	9.171	11	1.829
BW 20M Ch 5240M ac Mode	9.704	11	1.296
BW 40M Ch 5190M n Mode	7.228	11	3.772
BW 40M Ch 5190M ac Mode	7.012	11	3.988
BW 40M Ch 5230M n Mode	6.566	11	4.434
BW 40M Ch 5230M ac Mode	4.382	11	4.434
BW 80M Ch 5210M ac Mode	1.535	11	9.465

Table 10. Power Spectral Denisty Table, SISO, Port A

Channel	PSD Port B (dBm)	Limit (dBm)	Margin
BW 20M Ch 5180M a Mode	10.424	11	0.576
BW 20M Ch 5180M n Mode	8.597	11	2.403
BW 20M Ch 5180M ac Mode	8.934	11	2.066
BW 20M Ch 5220M a Mode	9.099	11	1.901
BW 20M Ch 5220M n Mode	8.977	11	2.023
BW 20M Ch 5220M ac Mode	8.636	11	2.364
BW 20M Ch 5240M a Mode	8.843	11	2.157
BW 20M Ch 5240M n Mode	9.396	11	1.604
BW 20M Ch 5240M ac Mode	9.679	11	1.321
BW 40M Ch 5190M n Mode	5.559	11	5.441
BW 40M Ch 5190M ac Mode	5.274	11	5.726
BW 40M Ch 5230M n Mode	6.55	11	4.45
BW 40M Ch 5230M ac Mode	6.387	11	4.613
BW 80M Ch 5210M ac Mode	2.763	11	8.237

Table 11. Power Spectral Density Table, SISO, Port B

Channel	Port 1 (dBm)	Port 2 (dBm)	Sum (dBm)	Antenna Gain (dBi)	Limit (dBm)	Margin
BW 20M Ch 5180M a Mode	7.018	7.26	10.151	0	11	0.849
BW 20M Ch 5180M n Mode	7.078	6.779	9.941	0	11	1.059
BW 20M Ch 5180M ac Mode	6.992	6.928	9.97	0	11	1.03
BW 20M Ch 5220M a Mode	7.105	7.45	10.291	0	11	0.709
BW 20M Ch 5220M n Mode	7.144	6.75	9.962	0	11	1.038
BW 20M Ch 5220M ac Mode	6.932	6.634	9.796	0	11	1.204
BW 20M Ch 5240M a Mode	7.224	7.838	10.552	0	11	0.448
BW 20M Ch 5240M n Mode	7.689	7.998	10.857	0	11	0.143
BW 20M Ch 5240M ac Mode	7.272	7.849	10.58	0	11	0.42
BW 40M Ch 5190M n Mode	3.768	3.499	6.646	0	11	4.354
BW 40M Ch 5190M ac Mode	3.169	3.923	6.573	0	11	4.427
BW 40M Ch 5230M n Mode	4.409	4.192	7.312	0	11	3.688
BW 40M Ch 5230M ac Mode	4.048	4.014	7.041	0	11	3.959
BW 80M Ch 529010M ac Mode	1.783	0.941	4.393	0	11	6.607

Table 12. Power Spectral Density Table, MIMO

Electromagnetic Compatibility Criteria for Intentional Radiators

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

Test Requirements:

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

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

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

Test Procedure:

The EUT was placed on a non-conducting stand on a turntable in a chamber. To find the maximum emission the EUT was set to transmit on low, mid, and high channels. Additionally, the turntable was rotated 360 degrees, the EUT was oriented through its three orthogonal axes, and the receive antenna height was varied in order to maximize emissions.

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

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

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

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

Test Results:

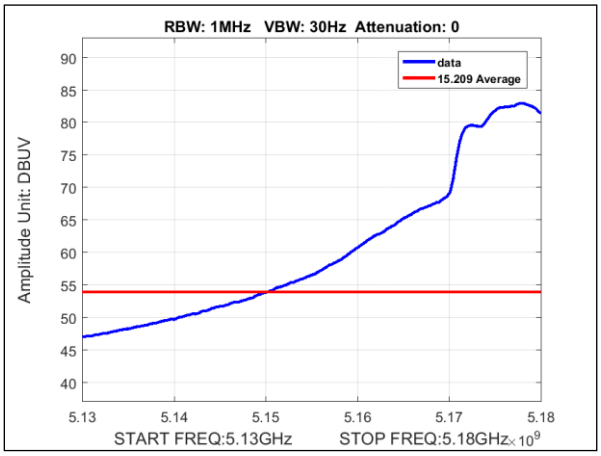
For below 1 GHz, the EUT was compliant with the requirements of this section. Emissions that appear to exceed the limits were evaluated with a QP detector and were below the required limits.

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

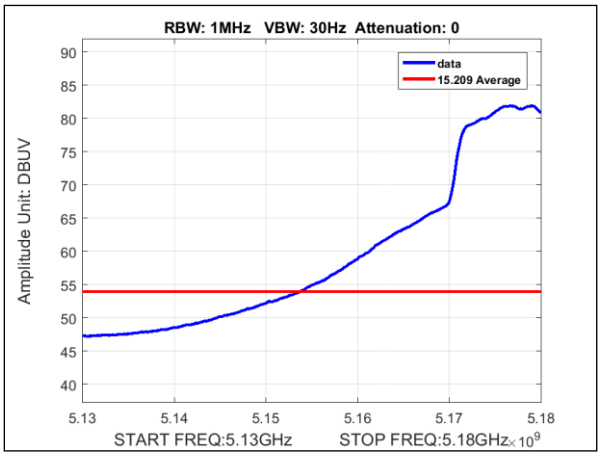
Test Engineer(s): Arsalan Hasan

Test Date(s): December 19, 2016

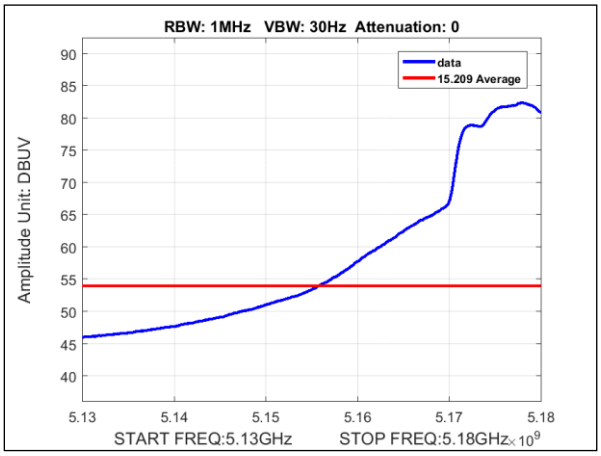
MIMO



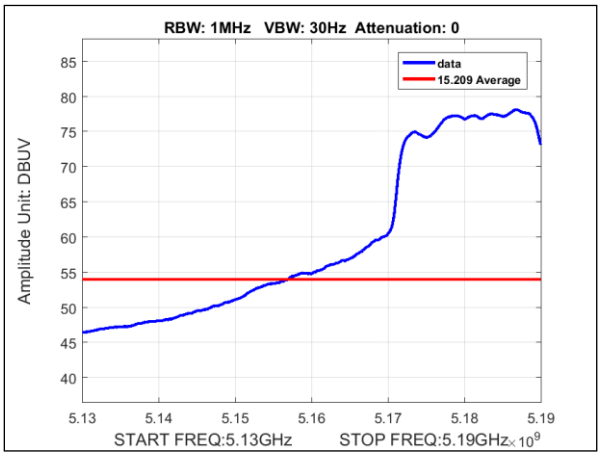
Plot 125. Undesirable Emissions, Average Band Edge Spurious, MIMO, Bandwidth 20M, Ch. 5180M, a mode setting 21



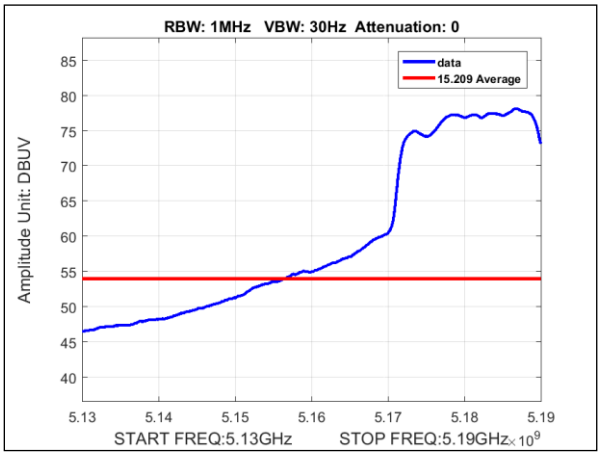
Plot 126. Undesirable Emissions, Average Band Edge Spurious, MIMO, Bandwidth 20M, Ch. 5180M, ac mode



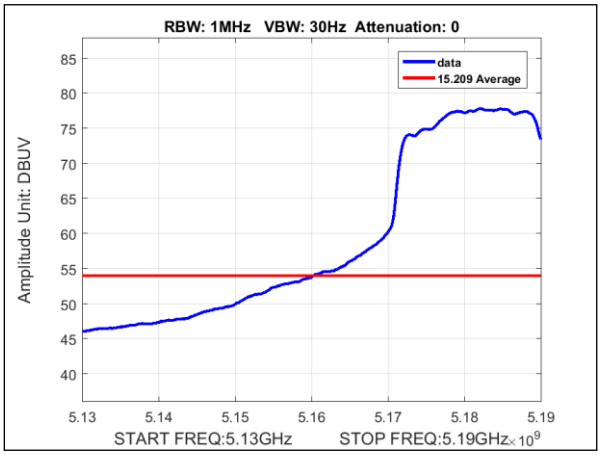
Plot 127. Undesirable Emissions, Average Band Edge Spurious, MIMO, Bandwidth 20M, Ch. 5180M, n mode



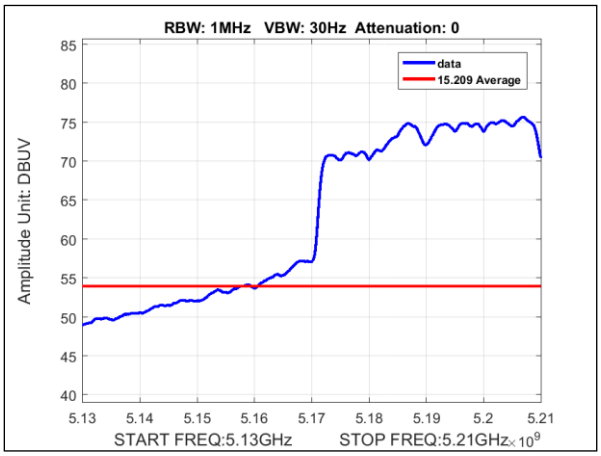
Plot 128. Undesirable Emissions, Average Band Edge Spurious, MIMO, Bandwidth 40M, Ch. 5190M, ac mode



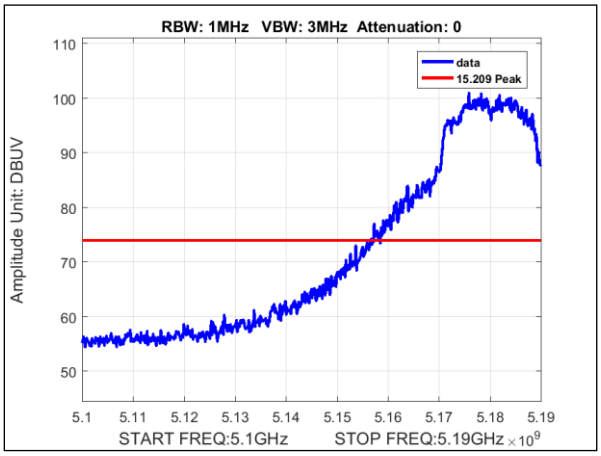
Plot 129. Undesirable Emissions, Average Band Edge Spurious, MIMO, Bandwidth 40M, Ch. 5190M, ac mode



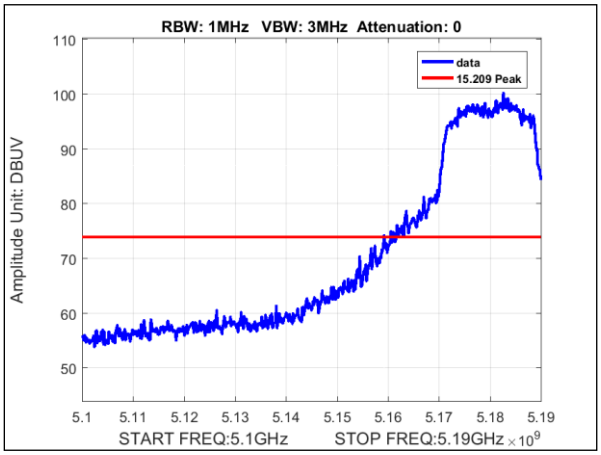
Plot 130. Undesirable Emissions, Average Band Edge Spurious, MIMO, Bandwidth 40M, Ch. 5190M, n mode



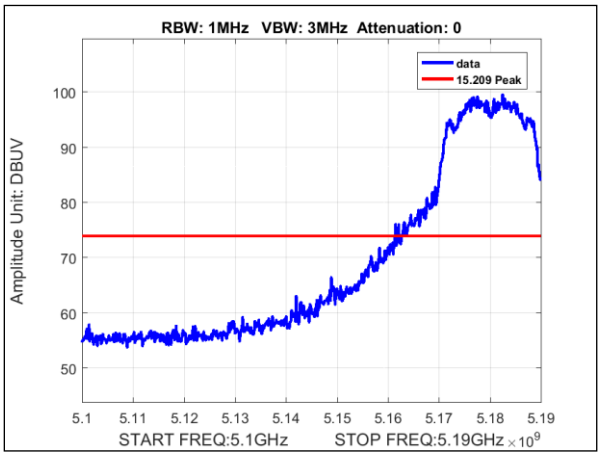
Plot 131. Undesirable Emissions, Average Band Edge Spurious, MIMO, Bandwidth 80M, Ch. 5210M, ac mode



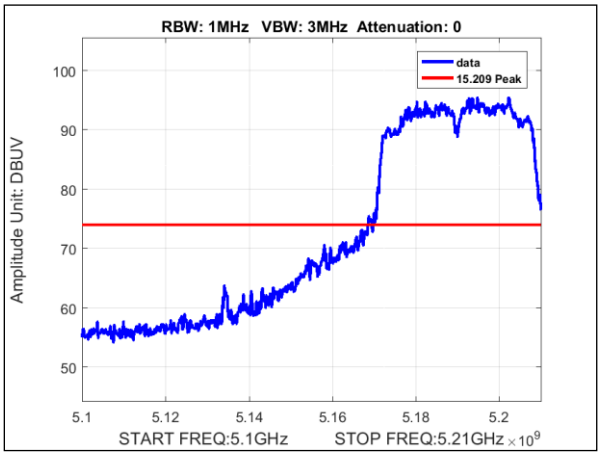
Plot 132. Undesirable Emissions, Peak Band Edge Spurious, MIMO, Bandwidth 20M, Ch. 5180M, a mode



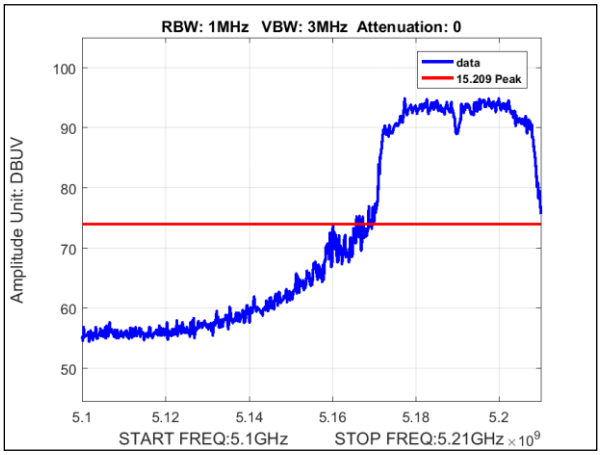
Plot 133. Undesirable Emissions, Peak Band Edge Spurious, MIMO, Bandwidth 20M, Ch. 5180M, ac mode



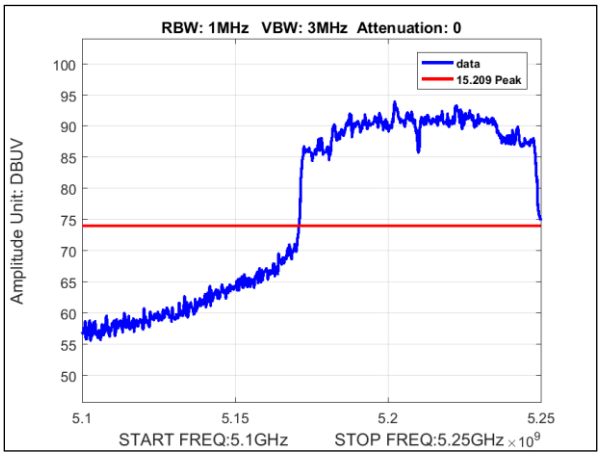
Plot 134. Undesirable Emissions, Peak Band Edge Spurious, MIMO, Bandwidth 20M, Ch. 5180M, n mode



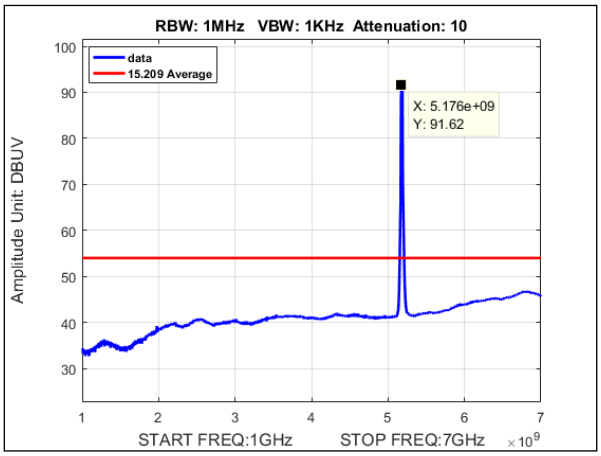
Plot 135. Undesirable Emissions, Peak Band Edge Spurious, MIMO, Bandwidth 40M, Ch. 5190M, ac mode



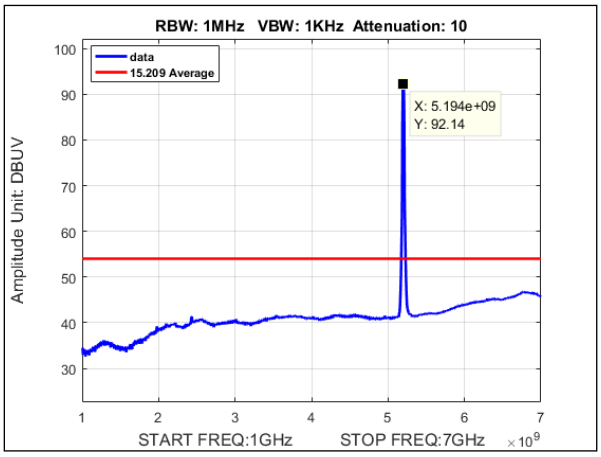
Plot 136. Undesirable Emissions, Peak Band Edge Spurious, MIMO, Bandwidth 40M, Ch. 5190M, n mode



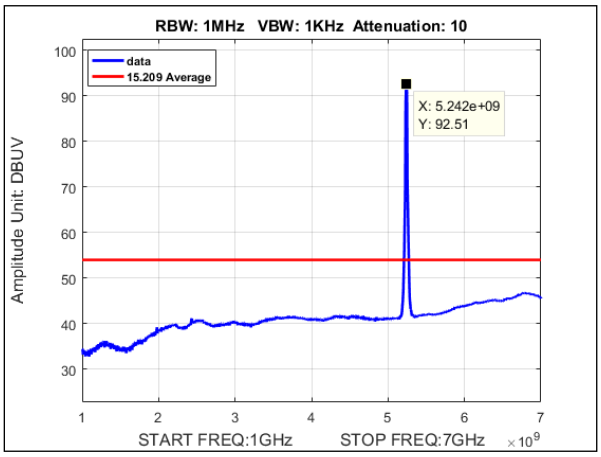
Plot 137. Undesirable Emissions, Peak Band Edge Spurious, MIMO, Bandwidth 80M, Ch. 5210M, ac mode



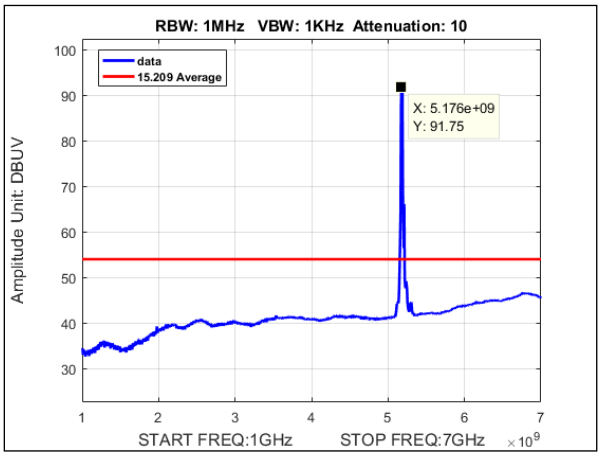
Plot 138. Undesirable Emissions, Average Spurious Radiated Emissions, MIMO, Bandwidth 20M, Ch. 5180M, 1-7 GHz, a mode



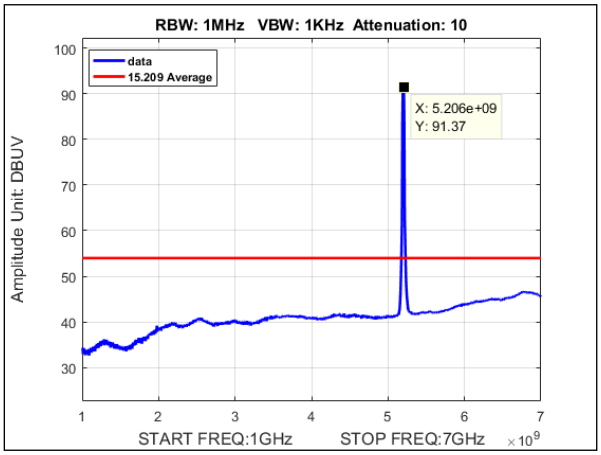
Plot 139. Undesirable Emissions, Average Spurious Radiated Emissions, MIMO, Bandwidth 20M, Ch. 5200M, 1-7 GHz, a mode



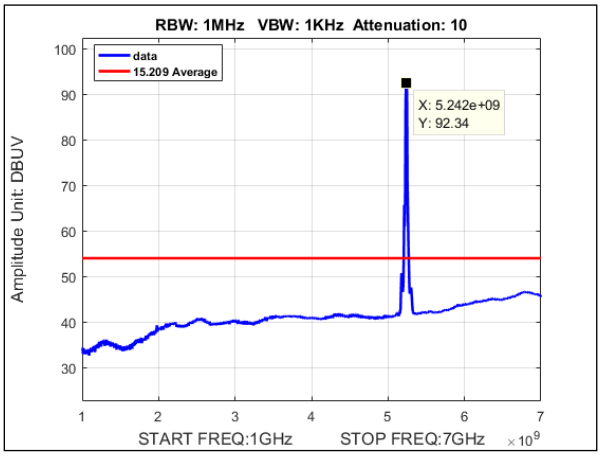
Plot 140. Undesirable Emissions, Average Spurious Radiated Emissions, MIMO, Bandwidth 20M, Ch. 5240M, 1-7 GHz, a mode



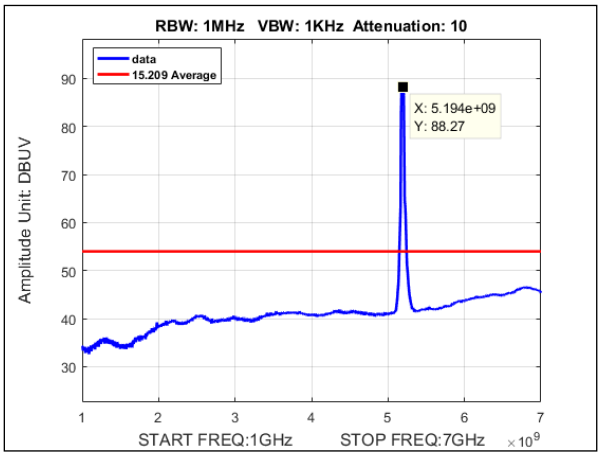
Plot 141. Undesirable Emissions, Average Spurious Radiated Emissions, MIMO, Bandwidth 20M, Ch. 5180M, 1-7 GHz, ac mode



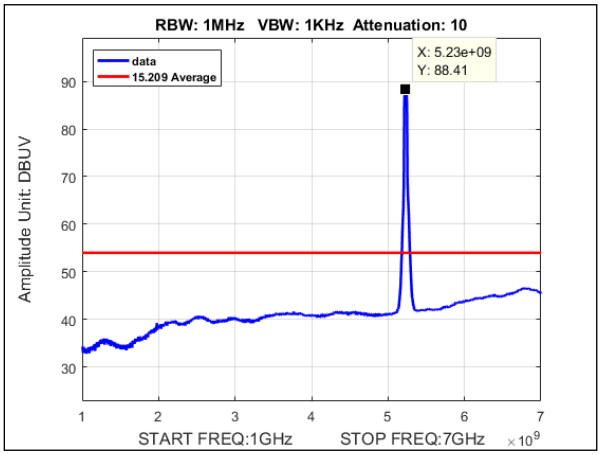
Plot 142. Undesirable Emissions, Average Spurious Radiated Emissions, MIMO, Bandwidth 20M, Ch. 5200M, 1-7 GHz, ac mode



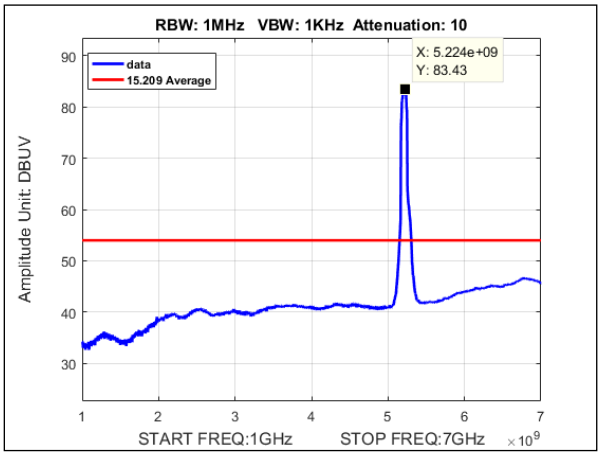
Plot 143. Undesirable Emissions, Average Spurious Radiated Emissions, MIMO, Bandwidth 20M, Ch. 5240M, 1-7 GHz, ac mode



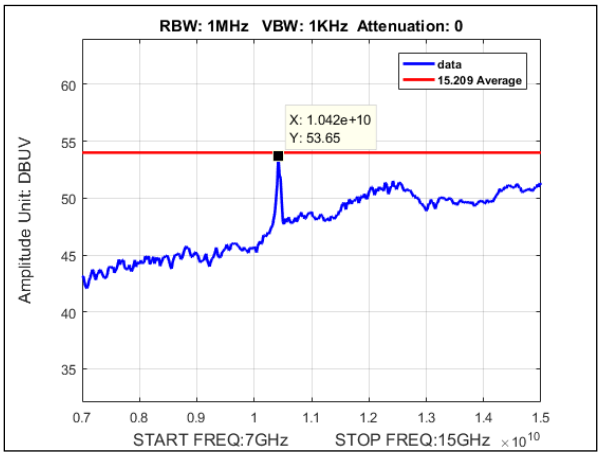
Plot 144. Undesirable Emissions, Average Spurious Radiated Emissions, MIMO, Bandwidth 40M, Ch. 5190M, 1-7 GHz, ac mode



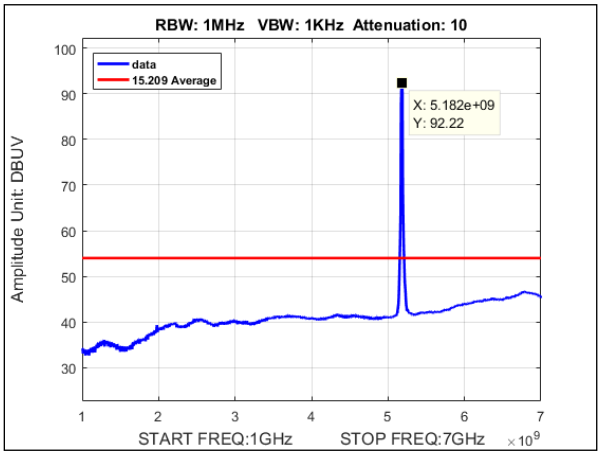
Plot 145. Undesirable Emissions, Average Spurious Radiated Emissions, MIMO, Bandwidth 40M, Ch. 5230M, 1-7 GHz, ac mode



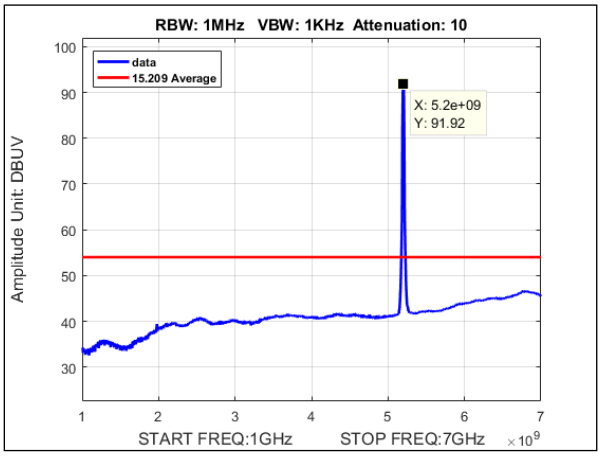
Plot 146. Undesirable Emissions, Average Spurious Radiated Emissions, MIMO, Bandwidth 80M, Ch. 5210M, 1-7 GHz, ac mode



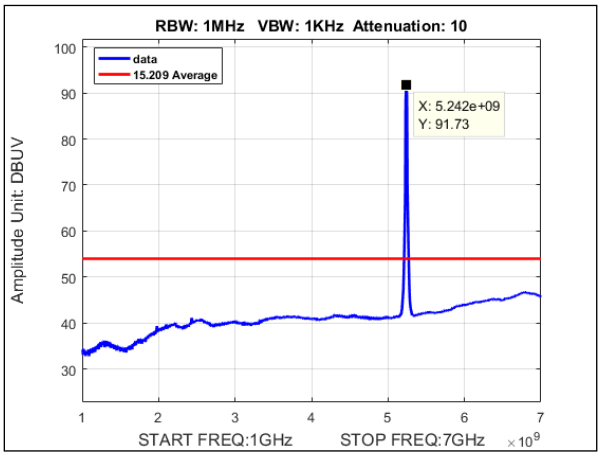
Plot 147. Undesirable Emissions, Average Spurious Radiated Emissions, MIMO, Bandwidth 80M, Ch. 5210M, 7-15 GHz at 17dBm, ac mode



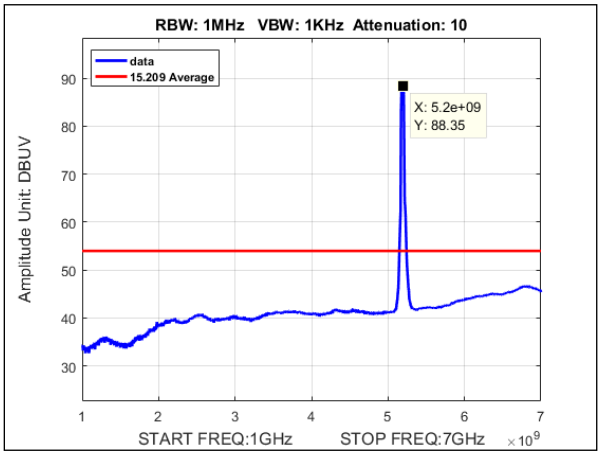
Plot 148. Undesirable Emissions, Average Spurious Radiated Emissions, MIMO, Bandwidth 20M, Ch. 5180M, 1-7 GHz, n mode



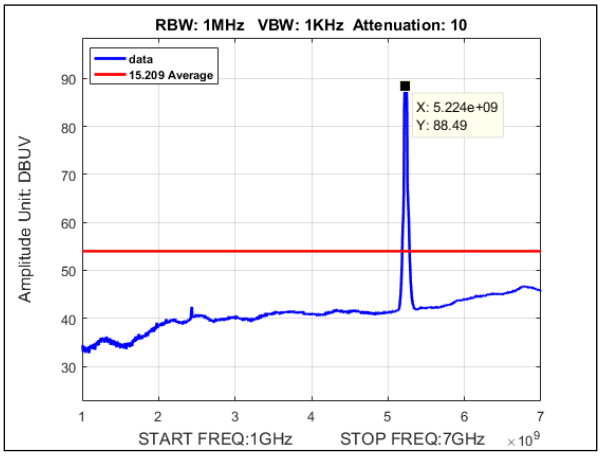
Plot 149. Undesirable Emissions, Average Spurious Radiated Emissions, MIMO, Bandwidth 20M, Ch. 5200M, 1-7 GHz, n mode



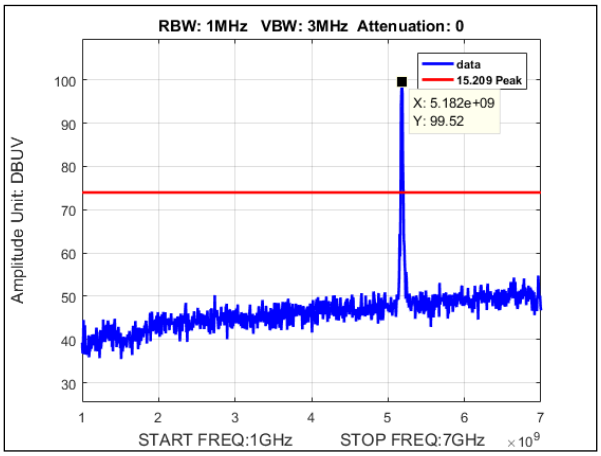
Plot 150. Undesirable Emissions, Average Spurious Radiated Emissions, MIMO, Bandwidth 20M, Ch. 5240M, 1-7 GHz, n mode



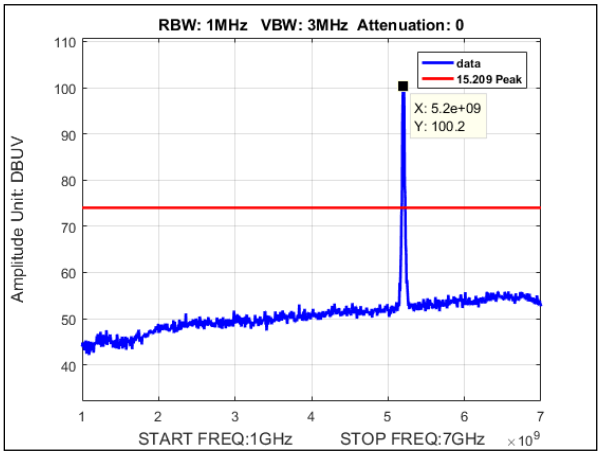
Plot 151. Undesirable Emissions, Average Spurious Radiated Emissions, MIMO, Bandwidth 40M, Ch. 5190M, 1-7 GHz, n mode



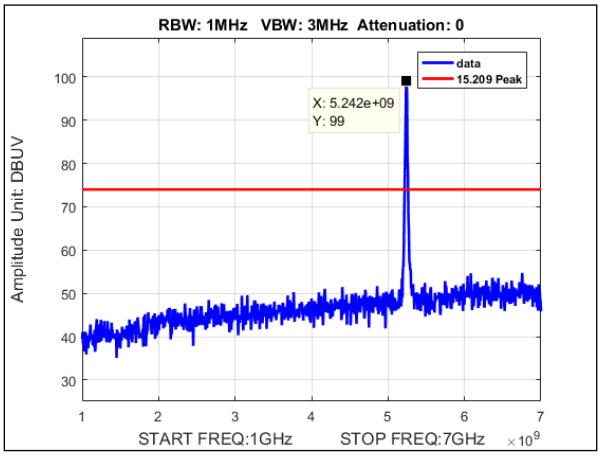
Plot 152. Undesirable Emissions, Average Spurious Radiated Emissions, MIMO, Bandwidth 40M, Ch. 5190M, 1-7 GHz, n mode



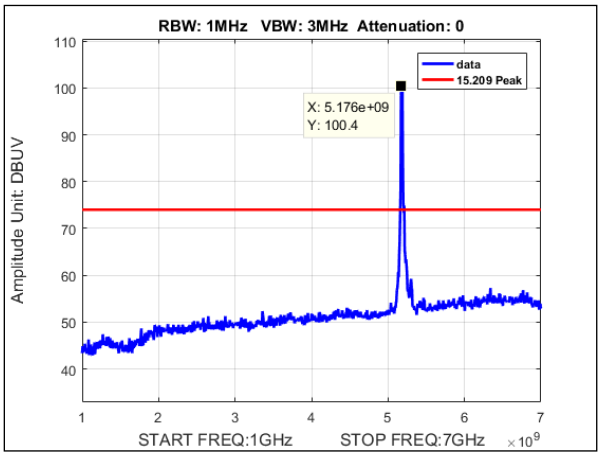
Plot 153. Undesirable Emissions, Peak Spurious Radiated Emissions, MIMO, Bandwidth 20M, Ch. 5180M,1-7 GHz, a mode



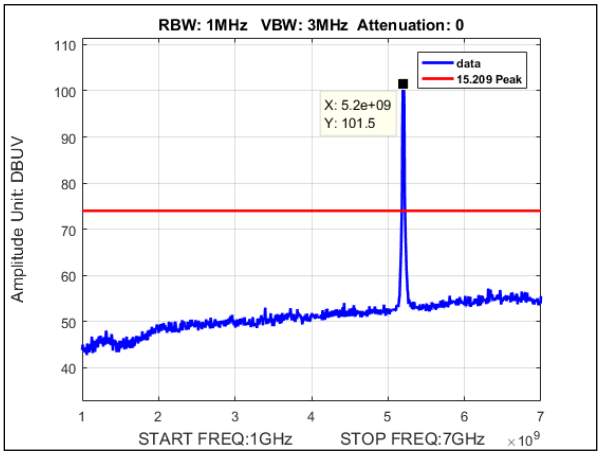
Plot 154. Undesirable Emissions, Peak Spurious Radiated Emissions, MIMO, Bandwidth 20M, Ch. 5200M, 1-7 GHz, a mode



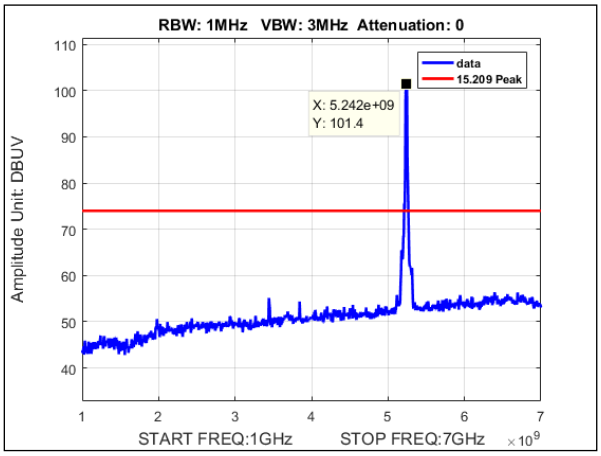
Plot 155. Undesirable Emissions, Peak Spurious Radiated Emissions, MIMO, Bandwidth 20M, Ch. 5240M, 1-7 GHz, a mode



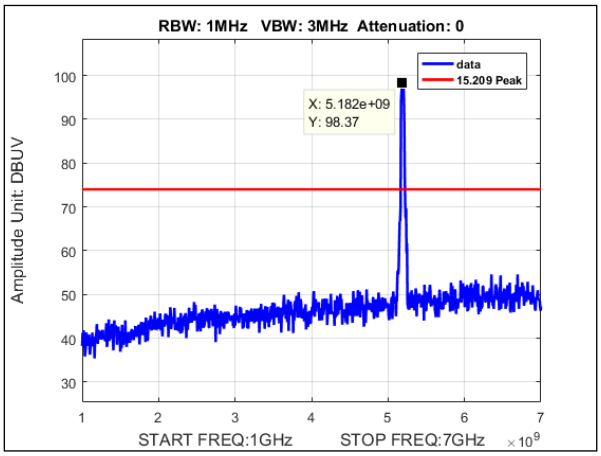
Plot 156. Undesirable Emissions, Peak Spurious Radiated Emissions, MIMO, Bandwidth 20M, Ch. 5180M,1-7 GHz, ac mode



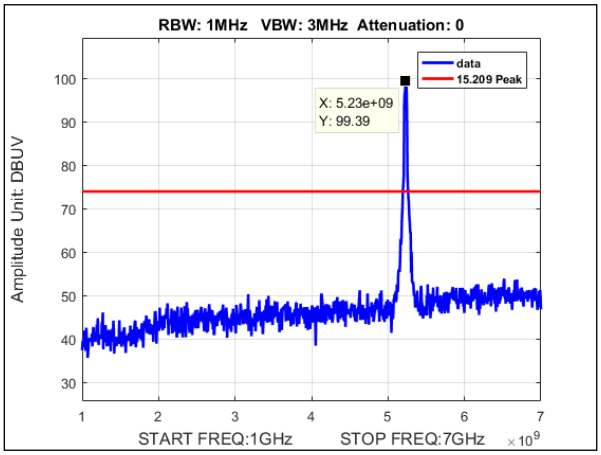
Plot 157. Undesirable Emissions, Peak Spurious Radiated Emissions, MIMO, Bandwidth 20M, Ch. 5200M,1-7 GHz, ac mode



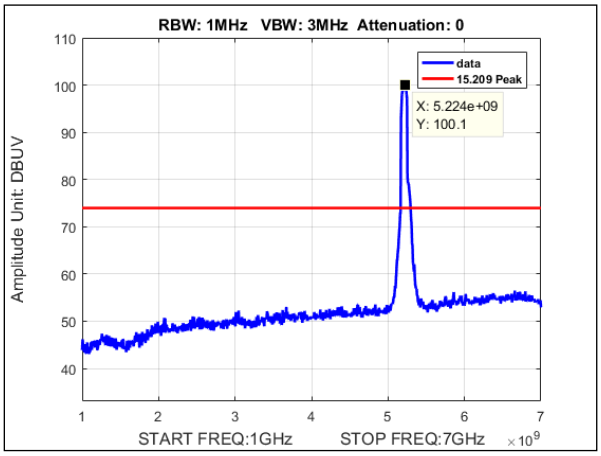
Plot 158. Undesirable Emissions, Peak Spurious Radiated Emissions, MIMO, Bandwidth 20M, Ch. 5240M,1-7 GHz, ac mode



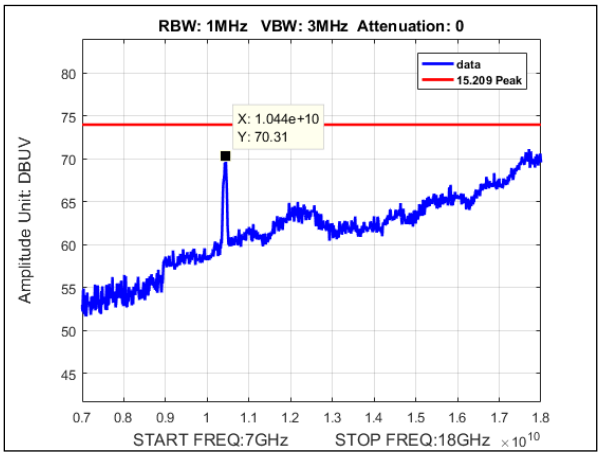
Plot 159. Undesirable Emissions, Peak Spurious Radiated Emissions, MIMO, Bandwidth 40M, Ch. 5190M,1-7 GHz, ac mode



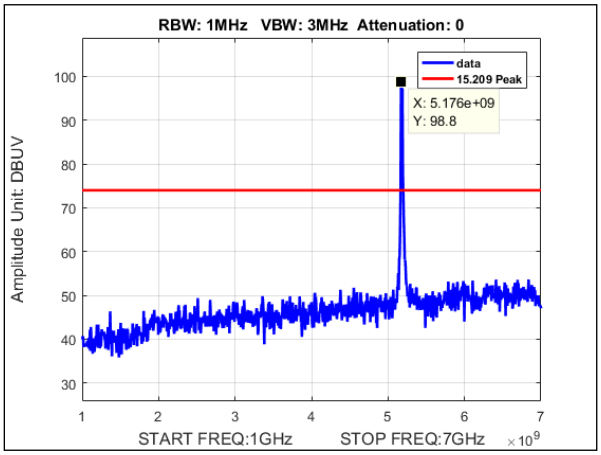
Plot 160. Undesirable Emissions, Peak Spurious Radiated Emissions, MIMO, Bandwidth 40M, Ch. 5230M,1-7 GHz, ac mode



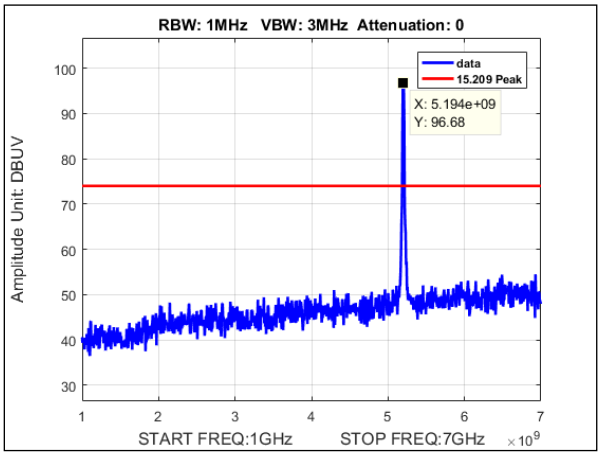
Plot 161. Undesirable Emissions, Peak Spurious Radiated Emissions, MIMO, Bandwidth 80M, Ch. 5210M,1-7 GHz, ac mode



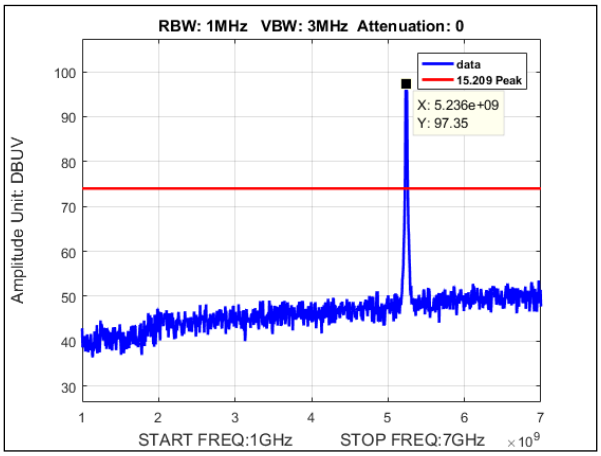
Plot 162. Undesirable Emissions, Peak Spurious Radiated Emissions, MIMO, Bandwidth 40M, Ch. 5210M, 7-18 GHz, ac mode



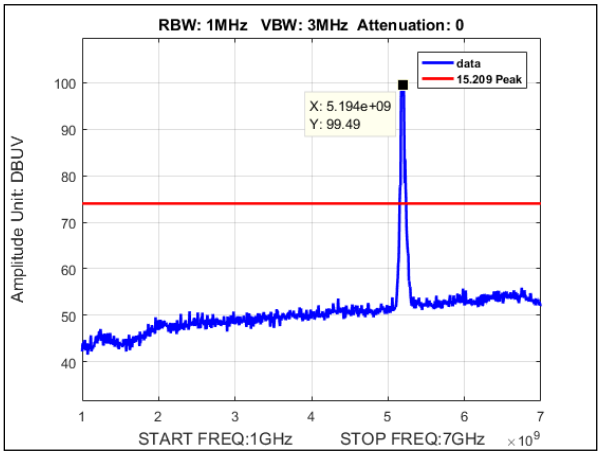
Plot 163. Undesirable Emissions, Peak Spurious Radiated Emissions, MIMO, Bandwidth 20M, Ch. 5180M,1-7 GHz, n mode



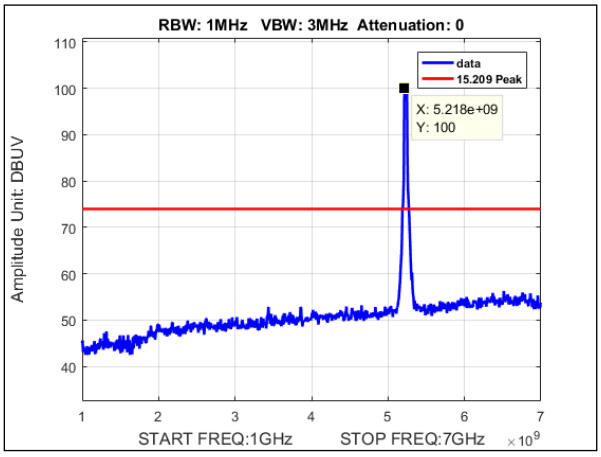
Plot 164. Undesirable Emissions, Peak Spurious Radiated Emissions, MIMO, Bandwidth 20M, Ch. 5200M,1-7 GHz, n mode



Plot 165. Undesirable Emissions, Peak Spurious Radiated Emissions, MIMO, Bandwidth 20M, Ch. 5240M,1-7 GHz, n mode



Plot 166. Undesirable Emissions, Peak Spurious Radiated Emissions, MIMO, Bandwidth 40M, Ch. 5190M,1-7 GHz n mode



Plot 167. Undesirable Emissions, Peak Spurious Radiated Emissions, MIMO, Bandwidth 40M, Ch. 5230M,1-7 GHz n mode

Undesirable Emissions, Test Setup

Plot 168.Undesirable Emissions, Below 1GHz

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

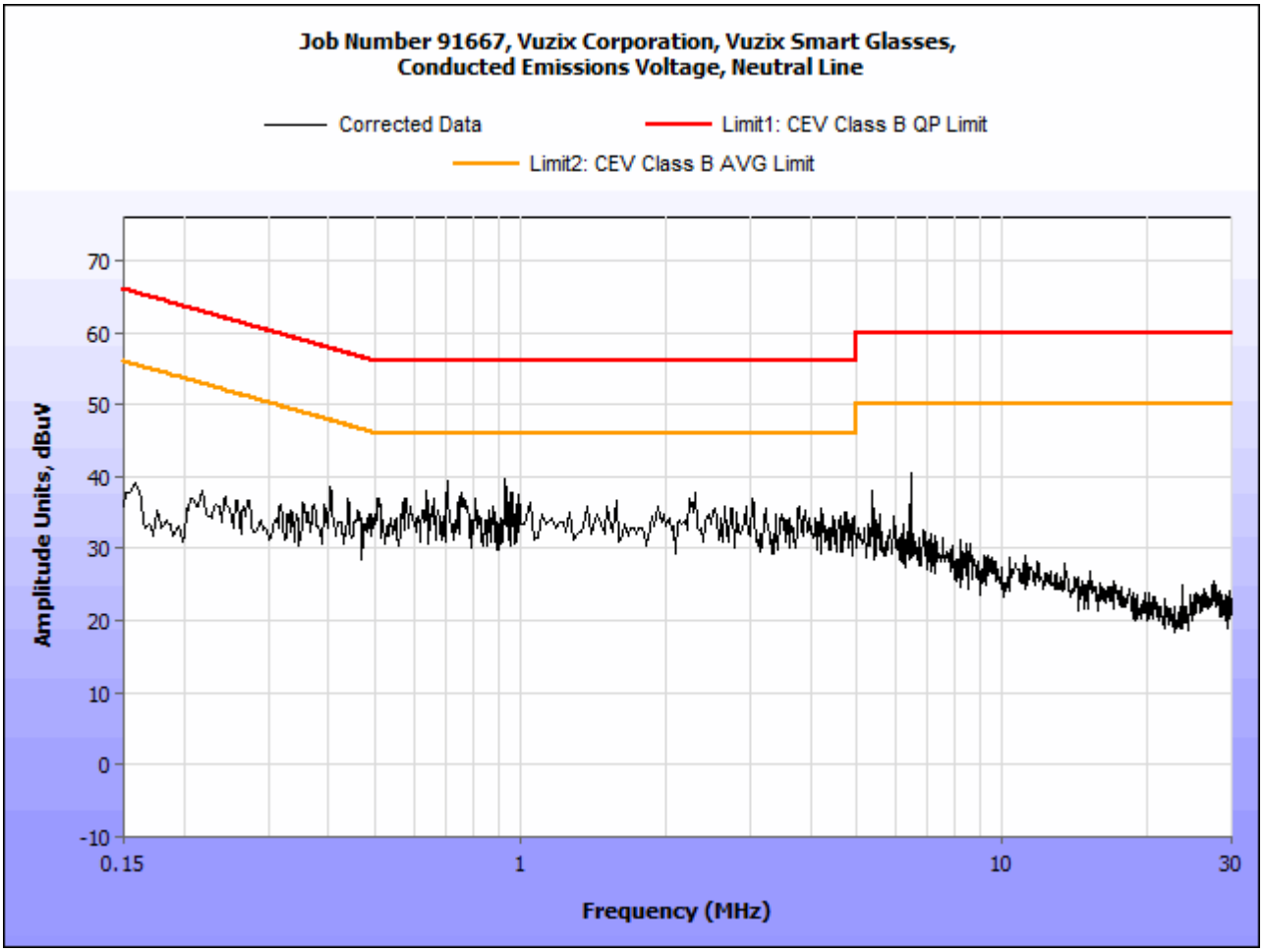
Table 13. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

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 requirements of this section. Measured emissions were within applicable limits.

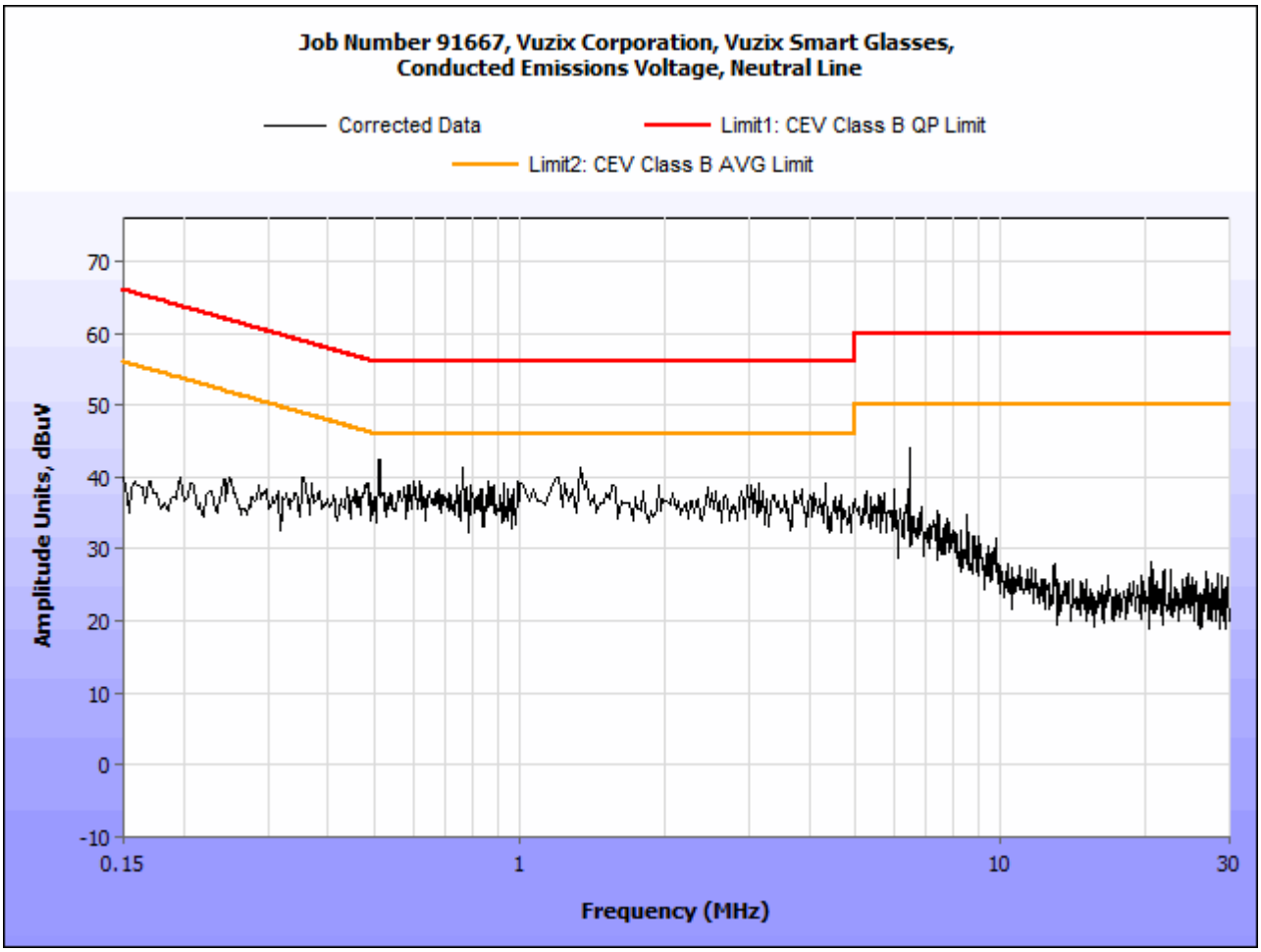
Test Engineer(s): Djed Mouada

Test Date(s): December 19, 2016



Plot 169. Conducted Emissions, 15.207(a), Phase Line

15.207(a) Conducted Emissions Test Results



Plot 170. Conducted Emissions, 15.207(a), Neutral Line

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(c) Automatic Discontinue of Transmission

Test Requirement(s): **§ 15.207 (c):** The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude the transmission of control or signaling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals.

Test Results: The EUT was compliant with the requirement of this section. The customer was made aware of this requirement.

Test Engineer(s): Djed Mouada

Test Date(s): December 19, 2016

IV. Test Equipment

Test Equipment

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

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1T6658	SPECTRUM ANALYZER	AGILENT	E4407B	12/09/2015	12/09/2016
1T4497	SIGNAL GENERATOR	AGILENT TECHNOLOGIES	E4432B	10/06/2014	04/06/2016
1T4483	ANTENNA; HORN	ETS-LINDGREN	3117	10/08/2015	04/08/2017
1T4771	PSA SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4446A	11/25/2014	05/25/2016
1T4300B	SEMI-ANECHOIC 3M CHAMBER # 1 D (2043A-1) (IC)	EMC TEST SYSTEMS	NONE	01/11/2015	01/11/2018
1T4409	EMI RECEIVER	ROHDE & SCHWARZ	ESIB7	10/29/2014	10/29/2016
1T4751	ANTENNA - BILOG	SUNOL SCIENCES	JB6	2/26/2016	8/26/2017
331T4442	PRE-AMPLIFIER, MICROWAVE	MITEQ	AFS42-01001800-30-10P	SEE NOTE	

Table 14. Test Equipment List

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

V. Certification & User's Manual Information

Certification & User's Manual Information

L. Certification Information

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

§ 2.801 Radio-frequency device defined.

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

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

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

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

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

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

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

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

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

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

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

(i) Compliance testing;

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

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

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

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

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

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

Certification & User's Manual Information

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

§ 2.901 Basis and Purpose

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

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

§ 2.907 Certification.

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

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

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

Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

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

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

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

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

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

Certification & User's Manual Information

Label and User's Manual Information

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

§ 15.19 Labeling requirements.

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

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

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

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

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

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

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

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

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

§ 15.21 Information to user.

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

Verification & User's Manual Information

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

§ 15.105 Information to the user.

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

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

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

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

– Reorient or relocate the receiving antenna.

– Increase the separation between the equipment and receiver.

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

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

